EPA-4724

Reid Rosnick/DC/USEPA/US		To	Susan Stahle
07/03/2012 10:43 AM		cc	
		bcc	
		Subject	Subpart W Stakeholders Conference Call

Meeting

Date	07/05/2012
Time	11:00:00 AM to 12:00:00 PM
Chair	Reid Rosnick
Invitees	
Required	Susan Stahle
Optional	
FYI	
Location	Call-in number - 866-299-3188 Conference Code 2023439563

EPA-308

Reid Rosnick/DC/USEPA/US
07/05/2012 07:56 AM

To Angelique Diaz
cc
bcc
Subject Today's Subpart W Conference Call

Hi Angelique,

Hope your holiday was good. If you are on the call this morning would you mind taking some minutes?
Thanks

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-5102

Angelique Diaz/R8/USEPA/US
07/05/2012 09:37 AM

To Reid Rosnick
cc
bcc
Subject Re: Today's Subpart W Conference Call

Hey. Reid. I did have a good holiday, I hope you did too. I'm not going to be able to be on today's call. I'm meeting with the UIC folks to talk about Dewey Burdock and their ponds. I could probably take some minutes before the call though, using my crystal ball.

Let me know if there is any new discussion.

-Angelique

Angelique D. Diaz, Ph.D.
Environmental Engineer
Air Program, USEPA/Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
Office: 303.312.6344
Fax: 303.312.6064
diaz.angelique@epa.gov

Reid Rosnick Hi Angelique, Hope your holiday was g... 07/05/2012 05:56:23 AM

From: Reid Rosnick/DC/USEPA/US
To: Angelique Diaz/R8/USEPA/US@EPA
Date: 07/05/2012 05:56 AM
Subject: Today's Subpart W Conference Call

Hi Angelique,

Hope your holiday was good. If you are on the call this morning would you mind taking some minutes?
Thanks

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-505

Reid Rosnick/DC/USEPA/US
07/05/2012 09:55 AM

To Angelique Diaz
cc
bcc
Subject Re: Today's Subpart W Conference Call

Ha! I wager you could provide minutes, and they wouldn't need too much correction ;)

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-4783

Susan Stahle/DC/USEPA/US
07/05/2012 11:11 AM

To Emily Atkinson
cc Reid Rosnick
bcc
Subject subpart W call - I don't think Reid can hear us

Emily - we're all on the call but it doesn't sound like Reid can hear us. Could you find Reid and let him know that? Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-4983

Mike Flynn/DC/USEPA/US

07/13/2012 05:41 PM

To Gina McCarthy

cc Betsy Shaw, Janet McCabe, Jonathan Edwards, Alan Perrin, Anna Duncan

bcc

Subject PAGs etc

Gina,
FYI we have a meeting with Dom and staff at OMB next Thursday on the PAGs manual. Debbie D will be joining us. We'll see how it goes - thanks for paving the way.

As you know, we have two rad rules "in the cue" to go to OMB. Not sure there's much we can do to push these along, but NRC and others seem to be supportive of us moving forward (see my attached note). Let me know if there's anything more we can do to help move these forward.

Thanks, Mike
to -----------------\Sent by EPA Wireless E-Mail Services.
Mike Flynn

----- Original Message -----
From: Mike Flynn
Sent: 06/27/2012 06:41 PM EDT
To: Gina McCarthy
Cc: Janet McCabe; Betsy Shaw; Jonathan Edwards; Alan Perrin
Subject: Radiation rules

Gina,

As mentioned at the OAR Priorities meeting yesterday, we have two radiation rules in OP awaiting submission to OMB - (1) the NPRM on NESHAP Amendments for Uranium Mill Tailings and (2) the ANPRM on Revised Standards for Nuclear Power Operations (40 CFR 190).

We're not aware of any outstanding issues/concerns with the Uranium Mill package. With regard to the ANPRM on Nuclear Power Operations, there was some discussion at the briefing we did for Bob on this back in May about where NRC and OSTP stood on this package. FYI, we've talked to NRC and OSTP, and the folks we spoke with were supportive of moving forward with this package. Following up on some earlier staff level EPA/NRC discussions, I met with my counterpart at NRC (Cathy Haney, Director, Office of Nuclear Material Safety and Safeguards) in late May. We briefed her on the notice and, while she couldn't speak for the Commissioners, she didn't have any major concerns. Staff also spoke with OSTP (Steve Fetter), provided him an overview of the ANPRM and answered several questions that he had. He also had no significant objections to sending the ANPRM to OMB.

I wanted you to be aware of this follow-up in case you wanted to pass onto Bob.

Thanks, Mike

Mike Flynn, Director
Office of Radiation and Indoor Air
U.S. Environmental Protection Agency
Phone: (202) 343-9356

EPA-419

Reid Rosnick/DC/USEPA/US
07/17/2012 01:48 PM

To Beth Miller
cc
bcc
Subject Re: Subpart W website changes

Hey Beth,

As much as I am looking forward to your generous offer it will have to wait till Thursday. I have Dr. appointments tomorrow and will be working from home.

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Beth Miller HI ReidO. I have been out on sick leav... 07/17/2012 01:43:50 PM

From: Beth Miller/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 07/17/2012 01:43 PM
Subject: Re: Subpart W website changes

HI ReidO.

I have been out on sick leave I will back in the office tomorrow and I am all yours.

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Reid Rosnick Hi Beth, Finally (!) I'm ready to work on... 07/16/2012 07:51:16 AM

From: Reid Rosnick/DC/USEPA/US
To: Beth Miller/DC/USEPA/US@EPA
Date: 07/16/2012 07:51 AM
Subject: Subpart W website changes

Hi Beth,

Finally (!) I'm ready to work on the website stuff. Please let me know when you're ready.

[attachment "7_5_12 Subpart W Stakeholder Conference Call (ss 071312).pdf" deleted by Beth Miller/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)

U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-5278

Wendy Blake/DC/USEPA/US	To	Susan Stahle
07/25/2012 02:04 PM	cc	
	bcc	
	Subject	Re: Subpart W - what was submitted to OP

do you have any idea if this will move in the next 2 weeks?

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle	You had asked that I send this to you -...	07/25/2012 01:50:27 PM

From: Susan Stahle/DC/USEPA/US
To: Wendy Blake/DC/USEPA/US@EPA
Date: 07/25/2012 01:50 PM
Subject: Subpart W - what was submitted to OP

You had asked that I send this to you - here is the proposal package that is sitting at OP:

[attachment "FR Proposal for Revision of Subpart W Final.docx" deleted by Wendy Blake/DC/USEPA/US]

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-4745

Susan Stahle/DC/USEPA/US
07/25/2012 02:10 PM

To Wendy Blake
cc
bcc
Subject Re: Subpart W - what was submitted to OP

Last I heard the tentative schedule was for OP to send the package to OMB around august 3 for their 90 day review period. I can find out if that is still on or if it has changed.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Wendy Blake do you have any idea if this will move i... 07/25/2012 02:04:02 PM

From: Wendy Blake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Date: 07/25/2012 02:04 PM
Subject: Re: Subpart W - what was submitted to OP

---

do you have any idea if this will move in the next 2 weeks?

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle You had asked that I send this to you -... 07/25/2012 01:50:27 PM

From: Susan Stahle/DC/USEPA/US
To: Wendy Blake/DC/USEPA/US@EPA
Date: 07/25/2012 01:50 PM
Subject: Subpart W - what was submitted to OP

You had asked that I send this to you - here is the proposal package that is sitting at OP:

[attachment "FR Proposal for Revision of Subpart W Final.docx" deleted by Wendy Blake/DC/USEPA/US]

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)

Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-292

Susan Stahle/DC/USEPA/US	To	Reid Rosnick
07/25/2012 02:12 PM	cc	Tom Peake
	bcc	
	Subject	question on subpart W package - any updates on when it will go to OMB?

Hi - last we talked I think you mentioned that the plan was for OP to send the package to OMB around August 3 - correct? If so, is that still the plan or has anything changed? We're asking because Wendy will be out on vacation for two weeks starting on Friday and she's trying to give those covering for her an idea of what might happen while she is gone. Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-4725

Susan Stahle/DC/USEPA/US

07/25/2012 02:12 PM

To	Reid Rosnick
cc	Tom Peake
bcc	
Subject	question on subpart W package - any updates on when it will go to OMB?

Hi - last we talked I think you mentioned that the plan was for OP to send the package to OMB around August 3 - correct? If so, is that still the plan or has anything changed? We're asking because Wendy will be out on vacation for two weeks starting on Friday and she's trying to give those covering for her an idea of what might happen while she is gone. Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-5292

Wendy Blake/DC/USEPA/US		To	Susan Stahle
07/25/2012 02:54 PM		cc	
		bcc	
		Subject	Re: Subpart W - what was submitted to OP

pls do - thanks

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle	Last I heard the tentative schedule was...	07/25/2012 02:10:41 PM

From: Susan Stahle/DC/USEPA/US
To: Wendy Blake/DC/USEPA/US@EPA
Date: 07/25/2012 02:10 PM
Subject: Re: Subpart W - what was submitted to OP

Last I heard the tentative schedule was for OP to send the package to OMB around august 3 for their 90 day review period. I can find out if that is still on or if it has changed.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Wendy Blake	do you have any idea if this will move i...	07/25/2012 02:04:02 PM

From: Wendy Blake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Date: 07/25/2012 02:04 PM
Subject: Re: Subpart W - what was submitted to OP

---

do you have any idea if this will move in the next 2 weeks?

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle You had asked that I send this to you -... 07/25/2012 01:50:27 PM

From: Susan Stahle/DC/USEPA/US
To: Wendy Blake/DC/USEPA/US@EPA
Date: 07/25/2012 01:50 PM
Subject: Subpart W - what was submitted to OP

You had asked that I send this to you - here is the proposal package that is sitting at OP:

[attachment "FR Proposal for Revision of Subpart W Final.docx" deleted by Wendy Blake/DC/USEPA/US]

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-774

Tom Peake/DC/USEPA/US	To	Susan Stahle
07/25/2012 02:58 PM	cc	Reid Rosnick, Lee.Raymond, Daniel Schultheisz
	bcc	
	Subject	Re: question on subpart W package - any updates on when it will go to OMB?

Sue,
We have no idea when the package will go to OMB other than not soon. Based on info Ray has learned everything is being delayed, and there is a good chance it won't go to OMB until after the election. Even simple things already at OMB probably will just sit. Glenn Paulson (the new science advisor) said he would recommend to Bob P that 190 go forward, but I doubt that OMB will release it even if we send to them. So, I doubt Subpart W will go to OMB during her vacation--unless its a really long vacation!

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Susan Stahle	Hi - last we talked I think you mentione...	07/25/2012 02:12:11 PM

From: Susan Stahle/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 07/25/2012 02:12 PM
Subject: question on subpart W package - any updates on when it will go to OMB?

Hi - last we talked I think you mentioned that the plan was for OP to send the package to OMB around August 3 - correct? If so, is that still the plan or has anything changed? We're asking because Wendy will be out on vacation for two weeks starting on Friday and she's trying to give those covering for her an idea of what might happen while she is gone. Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-4776

Susan Stahle/DC/USEPA/US	To	Wendy Blake
07/25/2012 02:58 PM	cc	
	bcc	
	Subject	Re: Subpart W - what was submitted to OP

I sent a note to the staff person but he is apparently out until 8/7. I cc'ed his manager so if Tom gets back to me, I'll pass it on to you.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Wendy Blake	pls do - thanks Wendy L. Blake U.S. En...	07/25/2012 02:53:59 PM

From: Wendy Blake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Date: 07/25/2012 02:53 PM
Subject: Re: Subpart W - what was submitted to OP

pls do - thanks

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle	Last I heard the tentative schedule was...	07/25/2012 02:10:41 PM

From: Susan Stahle/DC/USEPA/US
To: Wendy Blake/DC/USEPA/US@EPA
Date: 07/25/2012 02:10 PM
Subject: Re: Subpart W - what was submitted to OP

Last I heard the tentative schedule was for OP to send the package to OMB around august 3 for their 90 day review period. I can find out if that is still on or if it has changed.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272

fax: (202) 564-5603
stahle.susan@epa.gov

Wendy Blake do you have any idea if this will move i... 07/25/2012 02:04:02 PM

From: Wendy Blake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Date: 07/25/2012 02:04 PM
Subject: Re: Subpart W - what was submitted to OP

---

do you have any idea if this will move in the next 2 weeks?

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle You had asked that I send this to you -... 07/25/2012 01:50:27 PM

From: Susan Stahle/DC/USEPA/US
To: Wendy Blake/DC/USEPA/US@EPA
Date: 07/25/2012 01:50 PM
Subject: Subpart W - what was submitted to OP

You had asked that I send this to you - here is the proposal package that is sitting at OP:

[attachment "FR Proposal for Revision of Subpart W Final.docx" deleted by Wendy Blake/DC/USEPA/US]

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-4764

Susan Stahle/DC/USEPA/US		To	Wendy Blake
07/25/2012 02:59 PM		cc	
		bcc	
		Subject	Fw: question on subpart W package - any updates on when it will go to OMB?

FYI

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov
----- Forwarded by Susan Stahle/DC/USEPA/US on 07/25/2012 02:59 PM -----

From: Tom Peake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Reid Rosnick/DC/USEPA/US@EPA, Lee.Raymond@epamail.epa.gov, Daniel Schultheisz/DC/USEPA/US@EPA
Date: 07/25/2012 02:58 PM
Subject: Re: question on subpart W package - any updates on when it will go to OMB?

Sue,
We have no idea when the package will go to OMB other than not soon. Based on info Ray has learned everything is being delayed, and there is a good chance it won't go to OMB until after the election. Even simple things already at OMB probably will just sit. Glenn Paulson (the new science advisor) said he would recommend to Bob P that 190 go forward, but I doubt that OMB will release it even if we send to them. So, I doubt Subpart W will go to OMB during her vacation--unless its a really long vacation!

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Susan Stahle	Hi - last we talked I think you mentione...	07/25/2012 02:12:11 PM

From: Susan Stahle/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA

Date: 07/25/2012 02:12 PM
Subject: question on subpart W package - any updates on when it will go to OMB?

Hi - last we talked I think you mentioned that the plan was for OP to send the package to OMB around August 3 - correct? If so, is that still the plan or has anything changed? We're asking because Wendy will be out on vacation for two weeks starting on Friday and she's trying to give those covering for her an idea of what might happen while she is gone. Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-184

Susan Stahle/DC/USEPA/US	To	Tom Peake
07/25/2012 03:02 PM	cc	Reid Rosnick, Lee.Raymond, Daniel Schultheisz
	bcc	
	Subject	Re: question on subpart W package - any updates on when it will go to OMB?

Thanks Tom. Well, we'll just wait and see what happens. Not much else we can do.

Enjoy your own vacation - sounds like a nice choice, that great Pacific Northwest area. Hope you get to enjoy all it has to offer.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Tom Peake   Sue, We have no idea when the packa...   07/25/2012 02:58:12 PM

From: Tom Peake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Reid Rosnick/DC/USEPA/US@EPA, Lee.Raymond@epamail.epa.gov, Daniel Schultheisz/DC/USEPA/US@EPA
Date: 07/25/2012 02:58 PM
Subject: Re: question on subpart W package - any updates on when it will go to OMB?

Sue,
We have no idea when the package will go to OMB other than not soon. Based on info Ray has learned everything is being delayed, and there is a good chance it won't go to OMB until after the election. Even simple things already at OMB probably will just sit. Glenn Paulson (the new science advisor) said he would recommend to Bob P that 190 go forward, but I doubt that OMB will release it even if we send to them. So, I doubt Subpart W will go to OMB during her vacation--unless its a really long vacation!

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Susan Stahle Hi - last we talked I think you mentione... 07/25/2012 02:12:11 PM

From: Susan Stahle/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 07/25/2012 02:12 PM
Subject: question on subpart W package - any updates on when it will go to OMB?

Hi - last we talked I think you mentioned that the plan was for OP to send the package to OMB around August 3 - correct? If so, is that still the plan or has anything changed? We're asking because Wendy will be out on vacation for two weeks starting on Friday and she's trying to give those covering for her an idea of what might happen while she is gone. Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-4787

Susan Stahle/DC/USEPA/US	To	Tom Peake
07/25/2012 03:02 PM	cc	Reid Rosnick, Lee.Raymond, Daniel Schultheisz
	bcc	
	Subject	Re: question on subpart W package - any updates on when it will go to OMB?

Thanks Tom. Well, we'll just wait and see what happens. Not much else we can do.

Enjoy your own vacation - sounds like a nice choice, that great Pacific Northwest area. Hope you get to enjoy all it has to offer.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Tom Peake   Sue, We have no idea when the packa...   07/25/2012 02:58:12 PM

From: Tom Peake/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Reid Rosnick/DC/USEPA/US@EPA, Lee.Raymond@epamail.epa.gov, Daniel Schultheisz/DC/USEPA/US@EPA
Date: 07/25/2012 02:58 PM
Subject: Re: question on subpart W package - any updates on when it will go to OMB?

Sue,
We have no idea when the package will go to OMB other than not soon. Based on info Ray has learned everything is being delayed, and there is a good chance it won't go to OMB until after the election. Even simple things already at OMB probably will just sit. Glenn Paulson (the new science advisor) said he would recommend to Bob P that 190 go forward, but I doubt that OMB will release it even if we send to them. So, I doubt Subpart W will go to OMB during her vacation--unless its a really long vacation!

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Susan Stahle Hi - last we talked I think you mentione... 07/25/2012 02:12:11 PM

From: Susan Stahle/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 07/25/2012 02:12 PM
Subject: question on subpart W package - any updates on when it will go to OMB?

Hi - last we talked I think you mentioned that the plan was for OP to send the package to OMB around August 3 - correct? If so, is that still the plan or has anything changed? We're asking because Wendy will be out on vacation for two weeks starting on Friday and she's trying to give those covering for her an idea of what might happen while she is gone. Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

EPA-3442

Philip Egidi/DC/USEPA/US		To	Tom Peake, Daniel Schultheisz, Reid Rosnick, Andrea Cherepy
08/02/2012 02:25 PM		cc	
		bcc	
		Subject	Call from NMA to meet

I got a call this afternoon from Katie Sweeney, who would like to set up a meeting with us the week of 8/13.
She, Tony Thompson and Chris Pugsley would like to discuss "trends in aquifer exemptions."
I told her that Tom is out this week, and that we would need to include someone from the UIC program and to expect a call back from Tom early next week.

She also asked if it would be possible for us to give a short presentation here in DC to the NMA Environmental Committee meeting on 10/17 to update them on Subpart W and 192.
Told her that Tom is out this week, and he will get back with her on this, also.

PVE

Philip Egidi
Environmental Scientist
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Radiation Protection Division
Center for Waste Management and Regulations
Washington, DC

phone: 202-343-9186
email: egidi.philip@epa.gov
cell: 970-209-2885

EPA-637

Reid Rosnick/DC/USEPA/US	To	Beth Miller
08/07/2012 12:21 PM	cc	
	bcc	
	Subject	Re: Fw: Radon Presentation

Beth,

Get off this website and enjoy your vacation! And thanks for the birthday wishes.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Beth Miller	Hey Reido	08/07/2012 12:14:04 PM

From:	Beth Miller/DC/USEPA/US
To:	Reid Rosnick/DC/USEPA/US@EPA
Cc:	Marisa Savoy/DC/USEPA/US@EPA
Date:	08/07/2012 12:14 PM
Subject:	Re: Fw: Radon Presentation

Hey Reido

I am on vacation I will be back on the 13th can it wait till then if not please ask Marisa..

Ps happy belated bday

Beth Miller
202-343-9223

-----Reid Rosnick/DC/USEPA/US@EPA wrote: -----

=======================
To: Beth Miller/DC/USEPA/US@EPA
From: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/07/2012 09:40AM
Subject: Fw: Radon Presentation
=======================

Hi Beth,

Another presentation for the Subpart W Website. Let me know when you want to do this and I'll come over.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 08/07/2012 09:39 AM -----

From: "Sweeney,Katie" <KSweeney@nma.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/02/2012 01:30 PM
Subject: Radon Presentation

Reid,

Please add this presentation to the Subpart W webpage http://www.epa.gov/rpdweb00/neshaps/subpartw/rulemaking-activity.html as a National Mining Association comment. Thanks.

Katie

Katie Sweeney
General Counsel
National Mining Association
101 Constitution Avenue, Suite 500 East
Washington, DC 20001

ksweeney@nma.org
202/463-2627

[attachment(s) Paulson Presentation.pdf removed by Beth Miller/DC/USEPA/US]

Tom Peake/DC/USEPA/US
08/07/2012 12:52 PM

To Ronald Bergman
cc Daniel Schultheisz, Philip Egidi, Andrea Cherepy, Reid Rosnick
bcc
Subject Fw: Call from NMA to meet next week--Who from the UIC program should be involved?

Hello,
Katie Sweeney from the National Mining Association (with some other of her lawyers) would like to meet with us next week, and it appears the "us" probably should include somebody from your office who deals with UIC/aquifer exemption policy issues. Who would you recommend be part of a meeting, and what day(s) would work best for you/them next week?

Thanks.

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

----- Forwarded by Tom Peake/DC/USEPA/US on 08/07/2012 12:46 PM -----

From: Philip Egidi/DC/USEPA/US
To: Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA, Reid Rosnick/DC/USEPA/US@EPA, Andrea Cherepy/DC/USEPA/US@EPA
Date: 08/02/2012 02:25 PM
Subject: Call from NMA to meet

I got a call this afternoon from Katie Sweeney, who would like to set up a meeting with us the week of 8/13.
She, Tony Thompson and Chris Pugsley would like to discuss "trends in aquifer exemptions."
I told her that Tom is out this week, and that we would need to include someone from the UIC program and to expect a call back from Tom early next week.

She also asked if it would be possible for us to give a short presentation here in DC to the NMA Environmental Committee meeting on 10/17 to update them on Subpart W and 192.
Told her that Tom is out this week, and he will get back with her on this, also.

PVE

Philip Egidi
Environmental Scientist
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Radiation Protection Division

Center for Waste Management and Regulations
Washington, DC

phone: 202-343-9186
email: egidi.philip@epa.gov
cell: 970-209-2885

EPA-3404

Tom Peake/DC/USEPA/US
08/07/2012 03:37 PM

To Ronald Bergman
cc Susan Stahle, Reid Rosnick, Philip Egidi, Daniel Schultheisz, Andrea Cherepy
bcc
Subject Re: Call from NMA to meet next week--Who from the UIC program should be involved?

Ron,
Great! Just so you know, we are inviting our own legal counsel since they will have at least 3 lawyers.

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Ronald Bergman Hi Tom, I'm probably the guy. Wedne... 08/07/2012 03:30:56 PM

From: Ronald Bergman/DC/USEPA/US
To: Tom Peake/DC/USEPA/US@EPA
Date: 08/07/2012 03:30 PM
Subject: Re: Call from NMA to meet next week--Who from the UIC program should be involved?

Hi Tom,

I'm probably the guy. Wednesday and Thursday are wide open for me. I'm in from 7:00 to 4:30.

Tom Peake

----- Original Message -----
From: Tom Peake
Sent: 08/07/2012 12:52 PM EDT
To: Ronald Bergman
Cc: Daniel Schultheisz; Philip Egidi; Andrea Cherepy; Reid Rosnick
Subject: Fw: Call from NMA to meet next week--Who from the UIC program should be involved?

Hello,
Katie Sweeney from the National Mining Association (with some other of her lawyers) would like to meet with us next week, and it appears the "us" probably should include somebody from your office who deals with UIC/aquifer exemption policy issues. Who would you recommend be part of a meeting, and what day(s) would work best for you/them next week?

Thanks.

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

----- Forwarded by Tom Peake/DC/USEPA/US on 08/07/2012 12:46 PM -----

From:	Philip Egidi/DC/USEPA/US
To:	Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA, Reid Rosnick/DC/USEPA/US@EPA, Andrea Cherepy/DC/USEPA/US@EPA
Date:	08/02/2012 02:25 PM
Subject:	Call from NMA to meet

I got a call this afternoon from Katie Sweeney, who would like to set up a meeting with us the week of 8/13.
She, Tony Thompson and Chris Pugsley would like to discuss "trends in aquifer exemptions."
I told her that Tom is out this week, and that we would need to include someone from the UIC program and to expect a call back from Tom early next week.

She also asked if it would be possible for us to give a short presentation here in DC to the NMA Environmental Committee meeting on 10/17 to update them on Subpart W and 192.
Told her that Tom is out this week, and he will get back with her on this, also.

PVE

Philip Egidi
Environmental Scientist
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Radiation Protection Division
Center for Waste Management and Regulations
Washington, DC

phone: 202-343-9186
email: egidi.philip@epa.gov
cell: 970-209-2885

EPA-3406

Susan Stahle/DC/USEPA/US	To	Tom Peake
08/07/2012 03:58 PM	cc	Ronald Bergman, Reid Rosnick, Philip Egidi, Daniel Schultheisz, Andrea Cherepy, Leslie Darman
	bcc	
	Subject	Re: Call from NMA to meet next week--Who from the UIC program should be involved?

Hi Tom --

I'd be happy to join on this meeting. Leslie Darman (cc'ed above) is the WLO attorney to invite for UIC purposes. For both of us, Wednesday of next week works best.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Tom Peake Ron, Great! Just so you know, we are i... 08/07/2012 03:37:31 PM

From: Tom Peake/DC/USEPA/US
To: Ronald Bergman/DC/USEPA/US@EPA
Cc: Susan Stahle/DC/USEPA/US@EPA, Reid Rosnick/DC/USEPA/US@EPA, Philip Egidi/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA, Andrea Cherepy/DC/USEPA/US@EPA
Date: 08/07/2012 03:37 PM
Subject: Re: Call from NMA to meet next week--Who from the UIC program should be involved?

Ron,
Great! Just so you know, we are inviting our own legal counsel since they will have at least 3 lawyers.

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Ronald Bergman Hi Tom, I'm probably the guy. Wedne... 08/07/2012 03:30:56 PM

From: Ronald Bergman/DC/USEPA/US
To: Tom Peake/DC/USEPA/US@EPA

Date: 08/07/2012 03:30 PM
Subject: Re: Call from NMA to meet next week--Who from the UIC program should be involved?

Hi Tom,

I'm probably the guy. Wednesday and Thursday are wide open for me. I'm in from 7:00 to 4:30.

Tom Peake

----- Original Message -----
From: Tom Peake
Sent: 08/07/2012 12:52 PM EDT
To: Ronald Bergman
Cc: Daniel Schultheisz; Philip Egidi; Andrea Cherepy; Reid Rosnick
Subject: Fw: Call from NMA to meet next week--Who from the UIC program should be involved?

Hello,
Katie Sweeney from the National Mining Association (with some other of her lawyers) would like to meet with us next week, and it appears the "us" probably should include somebody from your office who deals with UIC/aquifer exemption policy issues. Who would you recommend be part of a meeting, and what day(s) would work best for you/them next week?

Thanks.

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

----- Forwarded by Tom Peake/DC/USEPA/US on 08/07/2012 12:46 PM -----

From: Philip Egidi/DC/USEPA/US
To: Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA, Reid Rosnick/DC/USEPA/US@EPA, Andrea Cherepy/DC/USEPA/US@EPA
Date: 08/02/2012 02:25 PM
Subject: Call from NMA to meet

I got a call this afternoon from Katie Sweeney, who would like to set up a meeting with us the week of 8/13.
She, Tony Thompson and Chris Pugsley would like to discuss "trends in aquifer exemptions."
I told her that Tom is out this week, and that we would need to include someone from the UIC program and to expect a call back from Tom early next week.

She also asked if it would be possible for us to give a short presentation here in DC to the NMA Environmental Committee meeting on 10/17 to update them on Subpart W and 192.
Told her that Tom is out this week, and he will get back with her on this, also.

PVE

Philip Egidi
Environmental Scientist
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Radiation Protection Division
Center for Waste Management and Regulations
Washington, DC

phone: 202-343-9186
email: egidi.philip@epa.gov
cell: 970-209-2885

EPA-338

Reid Rosnick/DC/USEPA/US
08/13/2012 09:02 AM

To Beth Miller
cc
bcc
Subject Re: Fw: Radon Presentation

k, gimme 5...

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Beth Miller ready when you are. Please consider t... 08/13/2012 09:00:03 AM

From: Beth Miller/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/13/2012 09:00 AM
Subject: Re: Fw: Radon Presentation

ready when you are.

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Reid Rosnick Hi Beth, Another presentation for the S... 08/07/2012 09:40:36 AM

From: Reid Rosnick/DC/USEPA/US
To: Beth Miller/DC/USEPA/US@EPA
Date: 08/07/2012 09:40 AM
Subject: Fw: Radon Presentation

Hi Beth,

Another presentation for the Subpart W Website. Let me know when you want to do this and I'll come over.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 08/07/2012 09:39 AM -----

From: "Sweeney,Katie" <KSweeney@nma.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/02/2012 01:30 PM
Subject: Radon Presentation

Reid,

Please add this presentation to the Subpart W webpage http://www.epa.gov/rpdweb00/neshaps/subpartw/rulemaking-activity.html as a National Mining Association comment. Thanks.

Katie

Katie Sweeney
General Counsel
National Mining Association
101 Constitution Avenue, Suite 500 East
Washington, DC 20001

ksweeney@nma.org
202/463-2627

[attachment "Paulson Presentation.pdf" deleted by Beth Miller/DC/USEPA/US]

EPA-5040

Angelique Diaz/R8/USEPA/US		To	"Yilma, Haimanot"
08/20/2012 05:25 PM		cc	
		bcc	
		Subject	Subpart W Rulemaking Website

Let me know if you have any questions. Sending you this link was one of my action items from our 8/14 meeting.

http://www.epa.gov/radiation/neshaps/subpartw/rulemaking-activity.html

Angelique D. Diaz, Ph.D.
Environmental Engineer
Air Program, USEPA/Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
Office: 303.312.6344
Fax: 303.312.6064
diaz.angelique@epa.gov

"Yilma, Haimanot"
<Haimanot.Yilma@nrc.gov>
08/20/2012 06:40 PM

To Angelique Diaz
cc
bcc
Subject RE: Subpart W Rulemaking Website

Thanks Angelique.

Haimanot

From: Angelique Diaz [mailto:Diaz.Angelique@epamail.epa.gov]
Sent: Monday, August 20, 2012 5:25 PM
To: Yilma, Haimanot
Subject: Subpart W Rulemaking Website

Let me know if you have any questions. Sending you this link was one of my action items from our 8/14 meeting.

http://www.epa.gov/radiation/neshaps/subpartw/rulemaking-activity.html

Angelique D. Diaz, Ph.D.
Environmental Engineer
Air Program, USEPA/Region 8
1595 Wynkoop Street (8P-AR)
Denver, CO 80202-1129
Office: 303.312.6344
Fax: 303.312.6064
diaz.angelique@epa.gov

EPA-461

Reid Rosnick/DC/USEPA/US
08/21/2012 10:42 AM

To	Angelique Diaz
cc	
bcc	
Subject	DFO

Hi Angelique,

We're looking at travel budgets for FY 13, and a question came up regarding a public hearing for the proposed Subpart W. A Designated Federal Official (hearing officer) must oversee the public hearing. Does Regio 8 have anyone who fits that description? I assume you do, but I need to make sure so that we don't have to add in travel for someone. Thanks

Reid

PS, Cool looking cupcakes from your meeting!

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-333

Reid Rosnick/DC/USEPA/US

08/24/2012 10:33 AM

To	Albion Carlson, Andrea Cherepy, Angelique Diaz, Barry Elman, CharlesA Hooper, Charlie Garlow, Davis Zhen, George Brozowski, Kenneth Distler, Marilyn Ginsberg, Robert Duraski, Robert Dye, Stephen Hoffman, Stuart Walker, Susan Stahle, Tim Benner, Tom Peake, Valentine Anoma
cc	
bcc	
Subject	Status Update

Hello all,

I hope you are enjoying your summer. I realized that it had been some time since we had communicated regarding the status of the Subpart W proposed rule. Here is a brief update. After the FAR meeting on April 19 there were a few outstanding issues that were resolved and the package went to the Office of Policy on May 10. According to the most recent OAR Reg Tracker the proposal is scheduled to be transmitted to OMB on or about September 7. The date of transmission has been pushed back several times, and I am uncertain if the September 7 date will be met, but when the package does make its way to OMB I will send a note to the workgroup. As always, thank you for your efforts in drafting this proposal and getting us to this point.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-339

Reid Rosnick/DC/USEPA/US
08/27/2012 08:36 AM

To Beth Miller
cc
bcc
Subject Re: Are you working today? (eom)

On the Subpart W web site, in the section titled "Tentative Completion Estimate," It currently states "EPA plans to propose a decision on Subpart W in September of 2012. After allowing for public comment and or hearings we plan to have a final decision in the summer of 2013." Could you please change it to read..." EPA plans to propose a decision on Subpart W in **February 2013**. After allowing for public comment and or hearings we plan to have a final decision in **late** 2013 **or early 2014**. Thanks

----

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Beth Miller From: Beth Miller/DC/USEPA/US To: R... 08/27/2012 08:31:16 AM

From: Beth Miller/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/27/2012 08:31 AM
Subject: Re: Are you working today? (eom)

From home want can I do for you.

Beth Miller
202-343-9223

-----Reid Rosnick/DC/USEPA/US@EPA wrote: -----

=======================

To: Beth Miller/DC/USEPA/US@EPA
From: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/27/2012 08:29AM
Subject: Are you working today? (eom)

=======================

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

202.343.9563
rosnick.reid@epa.gov

EPA-772

Reid Rosnick/DC/USEPA/US
08/27/2012 10:50 AM

To Marisa Savoy
cc Beth Miller
bcc
Subject Re: Are you working today? (eom)

Thanks!

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Marisa Savoy done - http://epa.gov/radiation/neshaps... 08/27/2012 10:49:27 AM

From: Marisa Savoy/DC/USEPA/US
To: Beth Miller/DC/USEPA/US@EPA
Cc: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/27/2012 10:49 AM
Subject: Re: Are you working today? (eom)

done - http://epa.gov/radiation/neshaps/subpartw/rulemaking-activity.html#tce

Marisa D. Savoy | Center for Radiation and Information Outreach | U.S. EPA | Tel. 202.343.9237 | Fax: 202.343.2305 | savoy.marisa @epa.

Beth Miller From: Beth Miller/DC/USEPA/US To: R... 08/27/2012 10:15:33 AM

From: Beth Miller/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Marisa Savoy/DC/USEPA/US@EPA
Date: 08/27/2012 10:15 AM
Subject: Re: Are you working today? (eom)

Hi Reid

I made the changes..

Marisa can you please ck it and post for me. Thanks

Beth Miller
202-343-9223

-----Reid Rosnick/DC/USEPA/US@EPA wrote: -----

=======================
To: Beth Miller/DC/USEPA/US@EPA
From: Reid Rosnick/DC/USEPA/US@EPA

Date: 08/27/2012 08:36AM
Subject: Re: Are you working today? (eom)
=======================

On the Subpart W web site, in the section titled "Tentative Completion Estimate," It currently states "EPA plans to propose a decision on Subpart W in September of 2012. After allowing for public comment and or hearings we plan to have a final decision in the summer of 2013." Could you please change it to read..." EPA plans to propose a decision on Subpart W in February 2013. After allowing for public comment and or hearings we plan to have a final decision in late 2013 or early 2014. Thanks

----

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

From: Beth Miller/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/27/2012 08:31 AM
Subject: Re: Are you working today? (eom)

From home want can I do for you.

Beth Miller
202-343-9223

-----Reid Rosnick/DC/USEPA/US@EPA wrote: -----

=======================
To: Beth Miller/DC/USEPA/US@EPA
From: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/27/2012 08:29AM
Subject: Are you working today? (eom)
=======================

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-493

Reid Rosnick/DC/USEPA/US	To	Beth Miller
09/05/2012 08:39 AM	cc	
	bcc	
	Subject	Fw: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

----
Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:39 AM -----

From: Reid Rosnick/DC/USEPA/US
To: pdcarestia@aol.com
Cc: Sharyn Cunningham <Sharyn@bresnan.net>
Date: 10/22/2009 02:28 PM
Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Paul,

Thanks for all of the information. As I wrote to Sharyn, I was out of the office all last week on work unrelated to Subpart W, so this is the first chance I have had to respond. I probably won't get a chance to review the information until some time this weekend, but I'll respond when I have something to report. Thanks again.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

pdcarestia	Reid, Sharyn Cunningham asked me to...	10/14/2009 03:56:47 PM

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: sharyn@bresnan.net
Date: 10/14/2009 03:56 PM
Subject: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Reid,
Sharyn Cunningham asked me to send to you the document produced by MFG Inc, a firm hired by Cotter Corporation, which proposed the use of an Effective Effluent Limit (EEL) to gauge whether radon concentrations at the Cotter Mill perimeter were "safely within limits".
It is my understanding that you asked to see this document as a result of some discussion at the Rapid

City WMAN Conference in October.

Attached is that document in .pdf form. Unfortunately it was scanned upside down, so you will have to use "View" on Adobe Reader's toolbar to rotate the document so it can be read on your computer screen. I have read this document numerous times and as an engineer with a master's degree in electrical engineering and as an MBA with a fair number of statistics courses behind me, I have a number of issues with the approach proposed and accepted by the Colorado Department of Health in this matter with Cotter. I have raised these issues with the Department of Health and the EPA in Region 8 to no avail. I am hoping that someone with the right expertise on your staff in Washington, D. C. will take a detailed, critical look at what is written here and will truly evaluate the science as appropriate and adequate. Region 8 of the EPA never responded to my documented concerns and Colorado Department of Health responses were obfuscating at best. I'll be happy to make their responses available to you as well if you wish. I have basically given up on getting anything reasonable from those folks, who are obviously stakeholders in this approach having given approval for its use.

The issues I have with the approach are as follows.

1. The sample sizes being used to calculate reliable, realistic means and standard deviations for background radon concentrations and perimeter radon concentrations are simply too small. Statistical theory shows that in order to have reliability in the calculation of the mean and standard deviation of a sample distribution, one needs a sample size somewhere between 30 and 50 samples. Four samples are used for perimeter radon concentrations (1 per quarter) and 4 samples are used from each of three background radon locations (1 per quarter), for a total of 12 background radon samples. These sample sizes are simply insufficient, especially when the resulting mean and standard deviation for background are used to predominantly set the upper limit for radon concentrations at the mill perimeter. I view this as highly unreliable for such an important metric of concern to public health and welfare.
2. The average background radon measurement and resulting background standard deviation are then used in the Effective Effluent Limit equation:

EEL Alternative Effluent Limit + Average Background + 2 times the standard deviation of Average Background

Alternate Effluent Limit is defined in the MFG document and is basically a constant number dependent upon distance of perimeter station from the tailings impoundment.

This EEL sets the upper limit against which mill perimeter average radon concentrations are compared. It is my contention that using such an approach will make it highly unlikely, if not impossible for the EEL to ever be exceeded. I think this approach is highly suspect, meaningless, and biased to give a result that will always say radon concentrations at the perimeter are "safely within limits".

You may recall in my presentation to you at the June 30 EPA meeting in Canon City I pointed out that while radon flux from the Cotter Primary Impoundment increased by 230% over a 3 year period, radon concentrations at the mill perimeter decreased by 30% over the same 3 year period. This makes absolutely no sense to me. Colorado Department of Health showed no interest in this concern, and for that matter neither did EPA in Region 8. Colorado Department of Health simply indicated that radon concentrations at the mill perimeter were "within EEL limits", so radon flux readings weren't really of relevance to them. They said they look at and count on radon concentrations at the perimeter. EEL as it is used in this case is being given an extremely high credence. I strongly question this.

3. All measurements in this approach, background as well as perimeter, are made using the same measurement technology, Laundauer's DRNF. I would assume then that all measurements are subject to the same random and real variation, not just background. The MFG document calls specific attention to this variation as it relates to background radon measurements and applies the 2 sigma 95% confidence interval for background to account for it. Yet the MFG document does nothing to take this variation into consideration for any of the perimeter measurements. I would argue that the appropriate 2 sigma for perimeter average measurements be added to those measurements to insure a 95% confidence in them as well. The approach as currently implemented is not an apples to apples approach.

I would appreciate very much having an EPA expert in Washington, D. C. study this document and the resulting approach. I respectfully request that this be undertaken and that the expert who does the review get back with me on their finding. I need corroboration from an expert, or I need to be shown where I am mistaken. Either outcome will suffice.
Thanks for your willingness to look into this matter. I appreciate it.

Paul Carestia
[attachment "MFG Document.pdf" deleted by Reid Rosnick/DC/USEPA/US]

EPA-476

Reid Rosnick/DC/USEPA/US
09/05/2012 08:39 AM

To Beth Miller
cc
bcc
Subject Fw: Response to your e-mail of 10/14/09

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:39 AM -----

From: Reid Rosnick/DC/USEPA/US
To: pdcarestia@aol.com
Cc: Sharyn Cunningham <Sharyn@bresnan.net>, Angelique Diaz/R8/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA
Date: 10/30/2009 10:31 AM
Subject: Response to your e-mail of 10/14/09

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m^2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-3356

Reid Rosnick/DC/USEPA/US
09/05/2012 08:40 AM

To Beth Miller
cc
bcc
Subject Fw: EPA to Cotter 2-24-09

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:40 AM -----

From: Reid Rosnick/DC/USEPA/US
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Date: 11/24/2009 06:51 AM
Subject: Re: EPA to Cotter 2-24-09

Hi Sharyn,

I'm glad that you saw the website. Our IT folks put it up because I needed to see it on my home computer to make sure that it "looked" the same as on the computers here at EPA. At the same time, I was making sure that all of the links work, and to make sure that everything was complete. In addition to the Cotter letter, I also found two broken links. Those will be repaired this morning, and I will be sending an e-mail today to everyone who wanted to be notified that the web site is officially launched. Please note that some of the documents are very large, up to 25 MB, and they take some time to download.

As for correspondence with Cotter, I am not aware of any further communication since May. I'll check with Angelique Diaz in Denver to see if she has anything.

Thanks for the photos, you are correct that Dr. Diaz is the person to talk with, and I'm sure that she is communicating with CDPHE as well.

For the conference call on 12/3, do you have any agenda items that you would care to see?

I'll be out of the office for the rest of the week, so have a very Happy Thanksgiving, and I'll talk to you next week.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

"Sharyn Cunningham" Hi Reid, I see that the website is... 11/23/2009 04:43:59 PM

From: "Sharyn Cunningham" <Sharyn@bresnan.net>

To: Reid Rosnick/DC/USEPA/US@EPA
Date: 11/23/2009 04:43 PM
Subject: EPA to Cotter 2-24-09

Hi Reid,

I see that the website is up and we are really appreciative of your efforts. Just looking at correspondence between EPA & Cotter and see that the Feb 24, 2009, letter has even numbered pages of the document missing.

1. Could you please get the pages added and the letter reposted?

Also, there are no further letters after May 2009, either from Cotter or any EPA responses. If any further communication has gone on between EPA and Cotter since May 2009.

2. Would you please post correspondence since May 2009, as well?

One other thing - the aerial photos provided by Cotter in the information sent in May 2009 seem to be rather old. Attached are Nov 1, 2009, photos where it is very evident that tailings are now exposed in the Secondary Impoundment. In case you're unaware, Cotter made an inventory of Impoundment contents for EPA in 2003 (see attached) with details for the Primary. Other sources indicate that the Secondary does contain waste from the Manhattan project. We're really concerned about how radon is being controlled as Cotter is dewatering the Secondary Impoundment. This may be out of your jurisdiction, but I'm not as up on this, so am at least making you aware of the situation. We recently sent an email to Ms. Diaz about this, but thought you might like to see the photos in light of Cotter's response to request for information.

Thanks very much,

Sharyn Cunningham
CCAT Co-Chair
1614 Grand Ave
Canon City, CO 81212
(719)275-3432

[attachment "Cotter Secondary Impoundment Photos 11-1-09.pdf" deleted by Reid Rosnick/DC/USEPA/US] [attachment "Cotter Inventory Impmt Ponds 3-3-03.PDF" deleted by Reid Rosnick/DC/USEPA/US]

EPA-857

Reid Rosnick/DC/USEPA/US
09/05/2012 08:41 AM

To Beth Miller
cc
bcc
Subject Fw: EPA to Cotter 2-24-09

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:40 AM -----

From:	Reid Rosnick/DC/USEPA/US
To:	"Sharyn Cunningham" <sharyn@bresnan.net>
Date:	12/01/2009 07:43 AM
Subject:	Re: EPA to Cotter 2-24-09

Hello Sharyn,

Thanks for the agenda items. I will incorporate them into an agenda, and I hope to have it posted on the web site later today. I have taken all of your suggestions, and I hope to give a brief update on all of the activities you requested. I want to make sure, however, that there is also sufficient time for questions from anyone on the call. My thinking at this point is that whatever I don't cover on this call can be picked up on the call in January.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

"Sharyn Cunningham" Dear Reid, Thanks for the effort... 11/30/2009 12:46:02 PM

From:	"Sharyn Cunningham" <sharyn@bresnan.net>
To:	Reid Rosnick/DC/USEPA/US@EPA
Date:	11/30/2009 12:46 PM
Subject:	Re: EPA to Cotter 2-24-09

Dear Reid,

Thanks for the effort put forth on the website and the upcoming teleconference. Everyone is looking forward to this update. After conferring with interested parties, our group and others, here are some agenda items we'd like to see covered on Dec. 3rd:

1. EPA Activity since previous meeting
    a. Website
    b. Accumulation of data from previous rulemaking
    c. EPA response to request for additional meeting near Gallup/Grants in conjunction with White Mesa meeting in Blanding
    d. Any further correspondence between EPA and industry regarding information requests?

2. Technical Issues
    a. Describe EPA review teams by subject matter
    b. Review issues raised by public or industry to date
    c. 1989 Risk Assessment - status of current historical research?
    d. Existing Technologies - status of current survey?
    e. Method 115 - status of current research?
    f. Status of Part 192 review as it applies to Subpart W regulations

3. EPA Activity before next call.
    a. Interim reports?
    b. Bids for contractors?

4. Define agenda items for next quarterly call, scheduled for January 5, 2010.

Sincerely,

Sharyn Cunningham
CCAT Co-Chair
1614 Grand Ave
Canon City, CO 81212

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Sent: Tuesday, November 24, 2009 4:51 AM
Subject: Re: EPA to Cotter 2-24-09

> Hi Sharyn,
>
> I'm glad that you saw the website. Our IT folks put it up because I needed to see it on my home computer to make sure that it "looked" the same as on the computers here at EPA. At the same time, I was making sure that all of the links work, and to make sure that everything was complete. In addition to the Cotter letter, I also found two broken links. Those will be repaired this morning, and I will be sending an e-mail today to everyone who wanted to be notified that the web site is officially launched. Please note that some of the documents are very large, up to 25 MB, and they take some time to download.
>
> As for correspondence with Cotter, I am not aware of any further communication since May. I'll check with Angelique Diaz in Denver to see if she has anything.
>
> Thanks for the photos, you are correct that Dr. Diaz is the person to talk with, and I'm sure that she is communicating with CDPHE as well.
>
> For the conference call on 12/3, do you have any agenda items that you would care to see?

>
> I'll be out of the office for the rest of the week, so have a very Happy
> Thanksgiving, and I'll talk to you next week.
>
> Reid
>

>
> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov
>

EPA-365

Reid Rosnick/DC/USEPA/US

09/05/2012 08:41 AM

To Beth Miller

cc

bcc

Subject Fw: Need Help

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:41 AM -----

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 12/21/2009 11:50 AM
Subject: Need Help

Reid,

I appreciate your time in reviewing this documentation that I sent you some time ago. I understand your position on these issues and realized up front that this was not a Subpart W issue. So thank you for the time you took to read over the MFG Inc. document that I sent you and for your advice on how I should move forward.

Colorado is an agreement state. The Colorado Department of Health and Environment have done little to assist me here and in fact have been reluctant and defensive, arguing with me about my understanding of the issue.

Today I made two attempts to contact the Nuclear Regulatory Commission, asking for the names of experts in the NRC who understand the science of radon emissions from mill tailings. The contacts were via e-mail to their Human Resources Office and their Office of Public Affairs. I don't feel really confident that either will be able to provide what I am looking for.

I am asking for your help here because you are inside the government and have some understanding of what it is that I need. Can you help me find an NRC expert who could possibly provide the knowledgeable, hopefully unbiased review of this approach to monitoring and safeguarding the public health and welfare? Or can you by way of introduction put me in contact with someone who can and will help me find the expertise I am looking for?

As a formally trained engineer with a Masters Degree who spent 32 years working for America's premiere research company, Bell Laboratories, I cannot accept without scientifically justified explanation the fact that radon flux from Cotter's Primary Impoundment increased 230% over a three year period while the radon concentration measurements at the perimeter of the mill property decreased by 30% over the same three year period. This is illogical, counter intuitive, and highly suspect. That additional radon went somewhere and to my way of thinking should have been evident in increased radon concentrations at the mill perimeter as a minimum.

We the people of Lincoln Park and greater Canon City cannot control the air we breathe and to a lesser degree, the ground water we drink or irrigate with. I need resolution to my concern and I need expert help to do that. Colorado Department of Health and Environment is not that resource. They are too close, too vested, too seemingly uninterested or unwilling to partnering with me to address this concern.

I believe you to be a reasonable, honest, concerned individual.

Please help me resolve this radon concern by directing me to someone in my government who can help me.

Thank you.

Happy Holidays!

Paul Carestia

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment.

-----Original Message-----
From: Rosnick.Reid@epamail.epa.gov
To: pdcarestia@aol.com
Cc: Sharyn Cunningham <Sharyn@bresnan.net>; Diaz.Angelique@epamail.epa.gov; Peake.Tom@epamail.epa.gov
Sent: Fri, Oct 30, 2009 8:31 am
Subject: Response to your e-mail of 10/14/09

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Reid Rosnick/DC/USEPA/US

09/05/2012 08:41 AM

To Beth Miller

cc

bcc

Subject Fw: Need Help

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:41 AM -----

From: Reid Rosnick/DC/USEPA/US
To: pdcarestia@aol.com
Date: 12/22/2009 11:35 AM
Subject: Re: Need Help

H i Paul,

I have sent your request for someone knowledgeable in radon emissions from mill tailings to one of my contacts at NRC. I'll let you know when I hear something. This is a difficult time of year, because people are in and out of their offices. In fact, after today I'll be out of the office until January 4, 2010.

Happy Holidays to you, Paul.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

pdcarestia	Reid, I appreciate your time in reviewin...	12/21/2009 11:50:18 AM

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 12/21/2009 11:50 AM
Subject: Need Help

Reid,

I appreciate your time in reviewing this documentation that I sent you some time ago. I understand your position on these issues and realized up front that this was not a Subpart W issue. So thank you for the time you took to read over the MFG Inc. document that I sent you and for your advice on how I should move forward.

Colorado is an agreement state. The Colorado Department of Health and Environment have done little to assist me here and in fact have been reluctant and defensive, arguing with me about my understanding of the issue.

Today I made two attempts to contact the Nuclear Regulatory Commission, asking for the names of experts in the NRC who understand the science of radon emissions from mill tailings. The contacts were via e-mail to their Human Resources Office and their Office of Public Affairs. I don't feel really confident that either will be able to provide what I am looking for.

I am asking for your help here because you are inside the government and have some understanding of what it is that I need. Can you help me find an NRC expert who could possibly provide the knowledgeable, hopefully unbiased review of this approach to monitoring and safeguarding the public health and welfare? Or can you by way of introduction put me in contact with someone who can and will help me find the expertise I am looking for?

As a formally trained engineer with a Masters Degree who spent 32 years working for America's premiere research company, Bell Laboratories, I cannot accept without scientifically justified explanation the fact that radon flux from Cotter's Primary Impoundment increased 230% over a three year period while the radon concentration measurements at the perimeter of the mill property decreased by 30% over the same three year period. This is illogical, counter intuitive, and highly suspect. That additional radon went somewhere and to my way of thinking should have been evident in increased radon concentrations at the mill perimeter as a minimum.

We the people of Lincoln Park and greater Canon City cannot control the air we breathe and to a lesser degree, the ground water we drink or irrigate with. I need resolution to my concern and I need expert help to do that. Colorado Department of Health and Environment is not that resource. They are too close, too vested, too seemingly uninterested or unwilling to partnering with me to address this concern.

I believe you to be a reasonable, honest, concerned individual.

Please help me resolve this radon concern by directing me to someone in my government who can help me.

Thank you.

Happy Holidays!

Paul Carestia

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and

adding 2 standard deviations to create average background

3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment.

-----Original Message-----
From: Rosnick.Reid@epamail.epa.gov
To: pdcarestia@aol.com
Cc: Sharyn Cunningham <Sharyn@bresnan.net>; Diaz.Angelique@epamail.epa.gov; Peake.Tom@epamail.epa.gov
Sent: Fri, Oct 30, 2009 8:31 am
Subject: Response to your e-mail of 10/14/09

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon

Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-823

Reid Rosnick/DC/USEPA/US

09/05/2012 08:42 AM

To Beth Miller

cc

bcc

Subject Fw: Need Help

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:42 AM -----

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 12/22/2009 01:41 PM
Subject: Re: Need Help

Reid,

Thanks much for your willingness to help me here. I truly appreciate it.

Paul

-----Original Message-----
From: Rosnick.Reid@epamail.epa.gov
To: pdcarestia@aol.com
Sent: Tue, Dec 22, 2009 9:35 am
Subject: Re: Need Help

Hi Paul,

I have sent your request for someone knowledgeable in radon emissions from mill tailings to one of my contacts at NRC. I'll let you know when I hear something. This is a difficult time of year, because people are in and out of their offices. In fact, after today I'll be out of the office until January 4, 2010.

Happy Holidays to you, Paul.

Reid

Reid J. Rosnick

Radiation Protection Division (6608J)

U.S. Environmental Protection Agency

1200 Pennsylvania Ave., NW

Washington, DC 20460

202.343.9563

rosnick.reid@epa.gov

From: pdcarestia@aol.com

To: Reid Rosnick/DC/USEPA/US@EPA

Date: 12/21/2009 11:50 AM

Subject: Need Help

Reid,

I appreciate your time in reviewing this documentation that I sent you some time ago. I understand your position on these issues and realized up front that this was not a Subpart W issue. So thank you for the time you took to read over the MFG Inc. document that I sent you and for your advice on how I should move forward.

Colorado is an agreement state. The Colorado Department of Health and Environment have done little to assist me here and in fact have been reluctant and defensive, arguing with me about my understanding of the issue.

Today I made two attempts to contact the Nuclear Regulatory Commission, asking for the names of experts in the NRC who understand the science of radon emissions from mill tailings. The contacts were via e-mail to their Human Resources Office and their Office of Public Affairs. I don't feel really confident that either will be able to provide what I am looking for.

I am asking for your help here because you are inside the government and have some understanding of what it is that I need. Can you help me find an NRC expert who could possibly provide the knowledgeable, hopefully unbiased review of this approach to monitoring and safeguarding the public health and welfare? Or can you by way of introduction put me in contact with someone who can and will help me find the expertise I am looking for?

As a formally trained engineer with a Masters Degree who spent 32 years working for America's premiere research company, Bell Laboratories, I cannot accept without scientifically justified explanation the fact that radon flux from Cotter's Primary Impoundment increased 230% over a three year period while the radon concentration measurements at the perimeter of the mill property decreased by 30% over the same three year period. This is illogical, counter intuitive, and highly suspect. That additional radon went somewhere and to my way of thinking should have been evident in increased radon concentrations at the mill perimeter as a minimum.

We the people of Lincoln Park and greater Canon City cannot control the air we breathe and to a lesser degree, the ground water we drink or irrigate with. I need resolution to my concern and I need expert help to do that. Colorado Department of Health and Environment is not that resource. They are too close, too vested, too seemingly uninterested or unwilling to partnering with me to address this concern.

I believe you to be a reasonable, honest, concerned individual.

Please help me resolve this radon concern by directing me to someone in my government who can help me.

Thank you.

Happy Holidays!

Paul Carestia

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility’s operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would

need to examine considerably more documentation before I could determine

the usefulness of this proposed sampling program, and frankly, since it

is not related to Subpart W, I do not have the time to explore it for

further follow-up. I suggest that you continue to raise this issue with

the Colorado Department of Public Health and Environment.

-----Original Message-----

From: Rosnick.Reid@epamail.epa.gov

To: pdcarestia@aol.com

Cc: Sharyn Cunningham <Sharyn@bresnan.net>;

Diaz.Angelique@epamail.epa.gov; Peake.Tom@epamail.epa.gov

Sent: Fri, Oct 30, 2009 8:31 am

Subject: Response to your e-mail of 10/14/09

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to

Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements

Loose and dry top surfaces – 100 flux measurements

Sides – 100 flux measurements, unless soil is used in dam construction

Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with

Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

Reid J. Rosnick

Radiation Protection Division (6608J)

U.S. Environmental Protection Agency

1200 Pennsylvania Ave., NW

Washington, DC 20460

202.343.9563

rosnick.reid@epa.gov

EPA-525

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 08:43 AM		cc	
		bcc	
		Subject	Fw: NRC Contact

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:43 AM -----

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 01/04/2010 02:35 PM
Subject: Re: NRC Contact

Reid,

Thank you very much. I truly appreciate your help here more than you will ever realize.

Paul

-----Original Message-----
From: Rosnick.Reid@epamail.epa.gov
To: pdcarestia@aol.com
Sent: Mon, Jan 4, 2010 8:10 am
Subject: Re: NRC Contact

Hi Paul,

Yes, I spoke with Ron and his supervisor to make sure that he is the right person. I copied him on my original note to you, so he is expecting to hear from you. If he cannot address your radon questions, he promised that he would find someone who could.

Reid

Reid J. Rosnick

Radiation Protection Division (6608J)

U.S. Environmental Protection Agency

1200 Pennsylvania Ave., NW

Washington, DC 20460

202.343.9563

rosnick.reid@epa.gov

From: pdcarestia@aol.com

To: Reid Rosnick/DC/USEPA/US@EPA

Date: 01/04/2010 09:55 AM

Subject: Re: NRC Contact

Reid,

Thank you for the fast response.

Will Mr. Burrows be aware that I am contacting him based upon your referral? Will he know who I am when he sees an e-mail from me? I just want to make sure my contact with him is not ignored.

If I understood correctly, you know Mr. Burrows. Just trying to grease the skids a little.

I hope you and your family had a nice Holiday.

Paul Carestia

-----Original Message-----

From: Rosnick.Reid@epamail.epa.gov

To: pdcarestia@aol.com

Cc: ronald.burrows@nrc.gov

Sent: Mon, Jan 4, 2010 6:39 am

Subject: NRC Contact

Good Morning Paul,

Here is a contact at NRC for questions related to radon.

Ronald A. Burrows CHP, RRPT

U.S. Nuclear Regulatory Commission

Federal and State Materials and Environmental

Management Programs

Uranium Recovery Licensing Branch

301.415.6443

E-mail: Ronald.Burrows@nrc.gov

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 08:44 AM		cc	
		bcc	
		Subject	Fw: Status of Request for NRC Help and Guidance

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:44 AM -----

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: ronald.burrows@nrc.gov
Date: 01/27/2010 07:54 PM
Subject: Fwd: Status of Request for NRC Help and Guidance

Reid,

Need you to see this one too.................I need to know just what is the "nature of my request"?

You need to know something.............I am the first son of a coal miner who had no more than a 6th grade education before my father made him quit school and go to work in the coal mines. I am the first grandchild in my family to get a college education. I have degrees from Colorado State University, Northwestern University, and the University of Chicago. I got there through hard work, scholastic achievement, determination, and never giving up............and I will not be giving up on the issues I've brought to you as part of the Subpart W/Method 115 review............or the issues I've asked and you have kindly agreed to help get resolved with the NRC.........and I am asking you and the NRC, not the state of Colorado, to address my concerns.

Both my mother and my father were diagnosed with cancer.........my mother died at the young age of 58 from brain cancer (glioblastoma multiforma, a word that has never left my mind since first hearing it. I got to watch her die a very slow, debilitating death.) and my father had prostate cancer, had surgery, was later again diagnosed with it returning as inoperable and terminal. Had he not tragically died in a car accident, cancer would have taken his life as well. I try not to think of what's in store for me, having lived all of my childhood life within 1 mile of the Cotter uranium mill during its operating heyday...........breathing in the stench from that mill on hot summer nights with my bedroom windows open............and having no idea what I was exposed to during my waking hours. There was no history of cancer in my family on my father or mother's sides. What would you think Reid if this were your situation? How would you feel? This mill or any uranium mill should not be in close proximity to people and communities in which they live and breathe! And I find the methodology used to monitor the radon emanating from this mill to be highly irregular, suspect, and without merit. And so do radiation scientists with a lot more knowledge and expertise than me.

This is visceral to me...........visceral!.......please appreciate that. If I have to go to senators in Colorado and Washington D.C., I will..........right now I am pissed off..............very upset, very disappointed...........and 1000% more determined to get action from those who are accountable to me as a tax payer in the country.

Senator Mark Udall will be visiting the Canon City and the Cotter Mill site in the not too distant future. I intend to be there when he does and I intend that he become involved in all of this............and I won't give up until he does.

I respectfully ask that my issues get addressed and answered. I think you'd all would rather be doing this at my request rather than his.

Thank you.

Paul Carestia

-----Original Message-----
From: pdcarestia@aol.com
To: Ronald.Burrows@nrc.gov
Sent: Wed, Jan 27, 2010 5:27 pm
Subject: Re: Status of Request for NRC Help and Guidance

> As such, due to the nature of your request I have forwarded it to the State of Colorado Radiation Program Manager. His contact details are as follows:

Ron,

I'd appreciate you expounding on the "nature of my request". Just what in your eyes IS the nature of my request?

Thanks.

Paul Carestia

-----Original Message-----
From: Burrows, Ronald <Ronald.Burrows@nrc.gov>
To: pdcarestia@aol.com <pdcarestia@aol.com>
Cc: steve.tarlton@state.co.us <steve.tarlton@state.co.us>
Sent: Wed, Jan 27, 2010 1:39 pm
Subject: Status of Request for NRC Help and Guidance

Good afternoon, Paul.
We have had a chance to review the details of your request. As you may know, Colorado is an Agreement State. As such, due to the nature of your request I have forwarded it to the State of Colorado Radiation Program Manager. His contact details are as follows:

Steve Tarlton, Manager
Radiation Program
CO Department of Public Health & Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1560
Telephone: 303-692-3423
Email: steve.tarlton@state.co.us

Regards,

Ronald A. Burrows

Ronald A. Burrows CHP, RRPT
U.S. Nuclear Regulatory Commission
Federal and State Materials and Environmental
Management Programs
Uranium Recovery Licensing Branch
301.415.6443

EPA-451

Reid Rosnick/DC/USEPA/US
09/05/2012 08:46 AM

To Beth Miller
cc
bcc
Subject Fw: Logistics for June 30 Subpart W Meeting

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:46 AM -----

From: "Carol Dunn" <rcdunn@bresnan.net>
To: "'Sharyn Cunningham'" <Sharyn@bresnan.net>, Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA, Angelique Diaz/R8/USEPA/US@EPA, "'Jeremy Nichols'" <jnichols@wildearthguardians.org>
Date: 06/12/2009 05:18 PM
Subject: RE: Logistics for June 30 Subpart W Meeting

Hi all,

I have booked the Quality Inn here in Canon City, Hwy. 50 and Dozier, 719-275-8676. They have a meeting room for 30-50 people. We will have it from 6:00 to 9:00 p.m. on June 30. I will check with the Events Coordinator the week before to make sure they have the set up for PowerPoint, etc. By that time I will have input on how many people are coming and be able to decide what sort of seating/table arrangement will best suit. If any presenter has has any special needs along those lines let me know as soon as possible. Look forward to seeing you in Canon City.

Carol Dunn
CCAT Co-Chair
719-275-2822 (work, preferred number)
719-275-7618 home

-----Original Message-----
From: Sharyn Cunningham [mailto:Sharyn@bresnan.net]
Sent: Thursday, June 11, 2009 8:54 AM
To: Rosnick.Reid@epamail.epa.gov
Cc: Peake.Tom@epamail.epa.gov; Diaz.Angelique@epamail.epa.gov; Carol Dunn; Jeremy Nichols
Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair
(719)275-3432

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Cc: <Peake.Tom@epamail.epa.gov>; <Diaz.Angelique@epamail.epa.gov>
Sent: Tuesday, June 09, 2009 8:07 AM
Subject: Re: Logistics for June 30 Subpart W Meeting

> Hi Sharyn,
>
> Thanks for your response. I have a couple of ideas I'd like to share for

```
> our meeting on the 30th. If it's OK with you, I could give a
> presentation on the basics of Subpart W, an update of what the workgroup
> has been doing, and an update of our status of other items that are part
> of the settlement agreement. After that, perhaps we could open it up for
> a question and answer period, where I can get a sense of issues that are
> of concern to you. My hope is that we can keep this meeting as informal
> as possible, I think that way we can have an open dialogue, with sharing
> of ideas that will be beneficial to both of us. Do you have an estimate
> of how many people would attend the meeting, and how much time would be
> needed? I'm just trying to get a feel on how to tailor my presentation.
>
> Regarding when we can speak by phone, I'll leave that to you as your
> schedule dictates. Just let me know when you are available, and I'll be
> happy to contact you.
>
> I look forward to meeting you in a couple of weeks.
>
> Reid
>
----------------------------------------------------------------------------
----------------------------------
>
> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov
>
>
> |------------>
> | From:      |
> |------------>
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
>  |"Sharyn Cunningham" <Sharyn@bresnan.net>
> |
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | To:        |
> |------------>
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
>  |Reid Rosnick/DC/USEPA/US@EPA
> |
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | Cc:        |
> |------------>
```

```
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
>  |Tom Peake/DC/USEPA/US@EPA
> |
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | Date:      |
> |------------>
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
>  |06/08/2009 05:24 PM
> |
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | Subject:   |
> |------------>
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
>  |Re: Logistics for June 30 Subpart W Meeting
> |
>
>
>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>
>
>
>
> Hello Reid,
>
> Thanks for your message.  Our group has already begun looking at
> potential
> sites for the June 30th meeting in Canon City.  We'll take steps to help
>
> confirm a location after we've had a chance to discuss the best time for
> the
> meeting, if you would like.  We would be happy to discuss the format and
>
> info desired, as well.  Let me know when you would like to speak by
> telephone.
>
> Sharyn Cunningham
> CCAT Co-Chair
> 1614 Grand Ave
> Canon City, CO 81212
> (719) 275-3432
>
```

>
> ----- Original Message -----
> From: <Rosnick.Reid@epamail.epa.gov>
> To: <sharyn@bresnan.net>
> Cc: <Peake.Tom@epamail.epa.gov>
> Sent: Friday, June 05, 2009 6:16 AM
> Subject: Logistics for June 30 Subpart W Meeting
>
>
>>
>> Hi Sharyn,
>>
>> I either misplaced your phone number, or I might not have gotten it
> when
>> we last spoke in February. If you would kindly send it to me, I'll
> give
>> you a call and we can discuss some of the logistics (time/place) for
> the
>> Subpart W meeting on June 30. We can also discuss the format of the
>> meeting, and get a sense of what you would like me to talk about, and
>> any issues you would like me to address. Thanks
>>
>> Reid
>>
>

>
>>
>> Reid J. Rosnick
>> Radiation Protection Division (6608J)
>> U.S. Environmental Protection Agency
>> 1200 Pennsylvania Ave., NW
>> Washington, DC 20460
>> 202.343.9563
>> rosnick.reid@epa.gov
>>
>
>
>
>

EPA-722

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 08:53 AM		cc	
		bcc	
		Subject	Fw: Colorado Uranium

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:53 AM -----

From: hilary@sheepmountainalliance.org
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 01/16/2010 05:19 PM
Subject: Colorado Uranium

Hello Reid,

Kate Winston from the EPA Insider gave me your name. She had seen your powerpoint presentation on the EPA's review of its toxic air standards for uranium mill tailings.

Sheep Mountain Alliance is an environmental organization in Southwest Colorado and we are working to stop the Piñon Ridge Uranium Mill proposed by Energy Fuels, Inc. in the Paradox Valley.

I would like to get a better understanding of the potential for EPA oversight of the permit process.

I will be in DC next week and my week is filling rapidly with meetings, but I wanted to try to speak with you even if briefly.

If you feel there would be someone more appropriate for me to talk with please let me know.

Thanks for your time.

Hilary White
Director
Sheep Mountain Alliance
PO Box 389
Telluride, CO 81435
970-729-2321

EPA-3392

Reid Rosnick/DC/USEPA/US
09/05/2012 08:54 AM

To Beth Miller
cc
bcc
Subject Fw: Today's teleconference

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:54 AM -----

From:	khawklee@aol.com
To:	Reid Rosnick/DC/USEPA/US@EPA
Date:	01/05/2010 03:36 PM
Subject:	Today's teleconference

Hi Reid,
Kay Hawklee from Canon City here.
I just wanted you to know that I was late... but on the phone call.
So, please include me on the "list of attendees."

I got there for the fireworks from Phil Egidi. Proof that I was truly on the call.

And, just FYI, yesterday I did a "google earth" distance from Paul Carestia's home to the Primary Impoundment... 1.66 miles is how close he is to this impoundment. Other CCAT members are even closer.
Maybe that could explain the great concern! (Plus, his mother died of brain cancer. His family was party to the lawsuit.)

Thanks again,
Will either see you in Blanding or "hear" you later,
Kay Hawklee

EPA-610

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 08:57 AM		cc	
		bcc	
		Subject	Fw: Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:57 AM -----

From: "Paulson, Oscar (CCC)" <Oscar.Paulson@riotinto.com>
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA, "Sweeney,Katie" <KSweeney@nma.org>, "Anthony J. Thompson" <ajthompson@athompsonlaw.com>, "Chris Pugsley" <cpugsley@athompsonlaw.com>
Date: 09/21/2010 04:44 PM
Subject: RE: Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Reid Rosnick:

Thank you for your reply. Kennecott Uranium Company believes that the Agency for Toxic Substances and Disease Registry (ATSDR) draft Public Health Assessment applies directly to Subpart W regulation for the following reasons:

- 40 CFR Part 61 Subpart W regulates radon emissions from tailings impoundments via either the twenty (20) picocurie per meter squared second standard for existing impoundments or the work practices for new impoundments constructed after December 15, 1989. The goal of this regulation is to reduce exposures and doses to the general public from radon and its decay products from uranium mill tailings impoundments.
- The draft Public Health Assessment specifically addresses public dose from and exposure to radon and its decay products from a uranium mill tailings impoundment namely Cotter Corporation's Canon City Mill impoundment.
- The draft Public Health Assessment states:
  On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.
- This conclusion has direct bearing on the current effectiveness of 40 CFR part 61 Subpart W, specifically that as it now stands the doses from radon and its decay products from a tailings impoundment (Cotter Corporation's Canon City impoundment) regulated under 40 CFR Part 61 Subpart W do not represent a health threat.
- This conclusion goes directly to statements made in the lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and

> Rocky Mountain Clean Air Action specifically the request to *“Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air…”*

The above reasons are why Kennecott Uranium Company is requesting that this draft Public Health Assessment be on the agenda for discussion on the Wednesday, October 6, 2010 conference call.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project
P.O. Box 1500
42 Miles Northwest of Rawlins
Rawlins, Wyoming 82301-1500

Telephone: (307)-324-4924
Fax: (307)-324-4925
Cellular: (307)-320-8758

E-mail: oscar.paulson@riotinto.com

-----Original Message-----
From: Rosnick.Reid@epamail.epa.gov [mailto:Rosnick.Reid@epamail.epa.gov]
Sent: Tuesday, September 21, 2010 1:45 PM
To: Paulson, Oscar (CCC)
Cc: Peake.Tom@epamail.epa.gov
Subject: Re: Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Hi Oscar,

Sorry not to respond earlier, but I've been out of the office on travel.

Thanks for sending the ATSDR document. I'm thinking about your request to discuss this on the next conference call, but I need to make sure I keep the focus of any discussions specifically on issues related to the national Subpart W regulation, and not on the topic of the document, namely the public health assessment for Lincoln Park/Cotter. I'm also not certain that we aren't talking apples and oranges, since Subpart W does not regulate ambient air emissions, the topic of the assessment.

I'd be interested in your thoughts about this. Thanks

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

```
|------------>
| From:      |
|------------>

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
  |"Paulson, Oscar (CCC)"
<Oscar.Paulson@riotinto.com>
                                   |

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
|------------>
| To:        |
|------------>

>-----------------------------------------------------------------------------
-----------------------------------------------------------|

|<Rosnick.Reid@epamail.epa.gov>
                                                           |

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
|------------>
| Cc:        |
|------------>

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
  |"Sweeney,Katie"
<KSweeney@nma.org>
                                          |

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
|------------>
| Date:      |
|------------>

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
  |09/13/2010 12:45 PM

                 |

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
|------------>
| Subject:   |
|------------>

>-----------------------------------------------------------------------------
-----------------------------------------------------------|
  |Public Health Assessment for  LINCOLN PARK/COTTER URANIUM MILL  CAÑON CITY,
FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 -  |
  |SEPTEMBER 9,
2010
                                             |
```

>---|

Reid Rosnick:

The following:

> Attached please find the Adobe Acrobat Portable Document format (*.pdf) file LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf that contains the U.S. Public Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.
> Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
> This study concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.
> The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
>
>> Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.
>
> This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases from the Canon City Mill. The filing states, "Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado."
> The filing continues by requesting that the Environmental Protection Agency (EPA), "Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid."

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project
P.O. Box 1500
42 Miles Northwest of Rawlins
Rawlins, Wyoming 82301-1500

Telephone: (307)-324-4924
Fax: (307)-324-4925
Cellular: (307)-320-8758

E-mail: oscar.paulson@riotinto.com

[attachment "LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf" deleted by Reid Rosnick/DC/USEPA/US]

EPA-826

Reid Rosnick/DC/USEPA/US
09/05/2012 08:58 AM

To	Beth Miller
cc	
bcc	
Subject	Fw: Sweetwater Data

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:58 AM -----

From:	"Paulson, Oscar (CCC)" <Oscar.Paulson@riotinto.com>
To:	"Steve Marschke" <smarschke@scainc.com>
Cc:	Reid Rosnick/DC/USEPA/US@EPA, "Rose Gogliotti" <rgogliotti@scainc.com>, Brian Littleton/DC/USEPA/US@EPA, "Abe Zeitoun" <azeitoun@scainc.com>
Date:	02/16/2011 11:30 PM
Subject:	RE: Sweetwater Data

Dear Mr. Marschke:

The required environmental data to perform a radon risk assessment for the Sweetwater Uranium Project is either already in the possession of the Environmental Protection Agency (EPA) or publically available. The following applies to the required data:

- Radon flux testing data for the Sweetwater Uranium Project tailings impoundment for calendar years 1990 to 2010 has been submitted to the Agency as required by 40 CFR Part 61 Subpart W. and is already available to Agency staff.
- Meteorological data in the Revised Environmental Report dated August 1994, represents a good long term summary of site's meteorological conditions and as such is representative and suitable for use. This document is available on the Nuclear Regulatory Commission's (NRC's) web site at the link below:
- http://pbadupws.nrc.gov/docs/ML0810/ML081010327.pdf
- The meteorological data provided in this document including, I believe, joint frequency distributions, is site specific data.
- Upwind and downwind radon activity data for ambient air collected using Landauer, Inc.'s TrakEtch devices has been submitted semiannually to the Nuclear Regulatory Commission (NRC) as part of the facility's semiannual 40.65 Reports and is publically available in the Commission's online ADAMS system.
- In addition, I believe that upwind and downwind radon activity data for ambient air was summarized in a submittal to the Commission in either the first half of 1998 or 1999 so that the submittal plus any 40.65 Reports submitted from its date forward, provide a complete set of upwind and downwind radon activity data for the site. In any event, upwind and downwind radon activity data is submitted semiannually in the required 40.65 Reports and is available in the ADAMS system. I can check on the 1998 summary report when I return to the office and probably provide a link to it on the Nuclear Regulatory Commission's (NRC's) web site.

I am traveling this week and will return to the site on Tuesday, February 21, 2011. I would like to work with you upon my return to ensure that the risk assessment completed for the Sweetwater Uranium Project is based upon actual site conditions and measurements. Should you have any questions please call me at that time.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project
P.O. Box 1500
42 Miles Northwest of Rawlins
Rawlins, Wyoming 82301-1500

Telephone: (307)-324-4924
Fax: (307)-324-4925
Cellular: (307)-320-8758

E-mail: oscar.paulson@riotinto.com

From: Steve Marschke [mailto:smarschke@scainc.com]
Sent: Monday, February 14, 2011 3:46 PM
To: Paulson, Oscar (CCC)
Cc: Rosnick.Reid@epamail.epa.gov; Rose Gogliotti; Brian Littleton; Abe Zeitoun
Subject: Sweetwater Data

Dear Mr Paulson,

I'm working with Reid Rosnick and Brian Littleton of the EPA on the radon risk assessment from uranium recovery facilities. As you know, we performed the draft assessment for the Sweetwater site using CAP88, meteorological data that was obtained from the CAP88 library for Rock Spring WY, and radon release estimates based on data from the 1994 Revised Environmental and from the 2004 license renewal request.

Reid asked me to contact you to see if you wanted to provide us with any updated meteorological, radon release, or other data that we could use as we finalize the risk assessment.

Thanks for your help,
Steve

Reid Rosnick/DC/USEPA/US
09/05/2012 09:01 AM

To Beth Miller
cc
bcc
Subject Fw: Subpart W Rulemaking Historical Documents

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:01 AM -----

From: Sarah Fields <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 03/29/2011 06:33 PM
Subject: Subpart W Rulemaking Historical Documents

Dear Mr. Rosnick,

I note that the Subpart W review documents on the Subpart W Rulemaking Activity Website in the Historical Rulemakings section includes the Draft EIS for the Proposed Radionuclides rulemaking, dated February 1989. However, this is only Volume 1 of a 3-volume draft EIS.

I request that the all 3 volumes of the Final EIS, September 1989, be placed with the Historical Rulemakings documents.

Sarah Fields
Uranium Watch

EPA-855

Reid Rosnick/DC/USEPA/US	To	Beth Miller
09/05/2012 09:01 AM	cc	
	bcc	
	Subject	Fw: Subpart W Letter to Cotter

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:01 AM -----

From: Sarah Fields <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 01/07/2011 11:51 AM
Subject: Re: Subpart W Letter to Cotter

Reid,

The BLM/USFS Meeting on the expansion of the La Sal Mine is on January 13. I will not be there. I had already made plans to go to Denver for the NRC uranium recovery workshop long before the BLM announced the scoping meeting in La Sal.

There are a number of outstanding issues related to the La Sal Mines, including Subpart B compliance.

Sarah

On Jan 7, 2011, at 6:28 AM, Rosnick.Reid@epamail.epa.gov wrote:

> Hello Sarah,
>
> You are correct that Cotter was sent a letter in 2009. That letter was an information request from our enforcement office, and asked for a number of items that are related to our discussion from Wednesday. However, the debate on Wednesday was focused on whether our contractor, in preparing the risk assessment draft document within the last 2 months, contacted Cotter for real-time radon flux data, as well as meteorological data specific to the Canon City area. As we discussed on Wednesday, most of that data is available on-line at NRC's ADAMS website. I am waiting for confirmation from the contractor on exactly how they obtained the Cotter data.
>
> Separately, I saw that there was a BLM/USFS public meeting last night regarding the plan of operations amendment for the expansion of the LaSal mine. I would be interested in your take on the meeting. Thank you.
>
> Reid
>
> --
> Reid J. Rosnick

Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

From: Sarah Fields <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Travis Stills <emlc@frontier.net>, Sharyn Cunningham <sharyn@bresnan.net>
Date: 01/05/2011 02:22 PM
Subject: Subpart W Letter to Cotter

Hello Reid,

During this morning's conference call re the Subpart W review, Cotter stated that they had not received any request for information from the EPA.

Cotter was sent a letter in 2009 asking them for information; at least a letter that is addressed to them is on the Subpart W Review website:

http://www.epa.gov/radiation/docs/neshaps/subpart-w/uranium%20cotter%20test.pdf

Sarah Fields
Uranium Watch

EPA-654

Reid Rosnick/DC/USEPA/US
09/05/2012 09:02 AM

To Beth Miller
cc
bcc
Subject Fw: Cotter and Heap Leach Processing

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:02 AM -----

From: "Sharyn Cunningham" <sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 07/07/2011 01:15 AM
Subject: Cotter and Heap Leach Processing

Dear Reid,

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist
~~~~~~

EPA-3343

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 09:03 AM		cc	
		bcc	
		Subject	Fw: Location for Utah Public Meeting

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:02 AM -----

From: "Sharyn Cunningham" <sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 02/05/2010 04:35 PM
Subject: Re: Location for Utah Public Meeting

Hello Reid,

Thanks for your message. After consulting with our group, we would choose the White Mesa Ute community meeting place, as it may be more accessible to people closest to the Mill, and Blanding residents could get there easily. A few people from Canon City will be making the trip, so a few miles one way or the other won't make a difference to us. May 24th seems quite a ways off, and we think would happen after our next scheduled conference call, which is unfortunate. The consensus here is that a date sooner than May 24th should be scheduled. Other than that, thanks for your efforts and asking for our opinion.

Sharyn

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Sent: Thursday, February 04, 2010 8:31 AM
Subject: Location for Utah Public Meeting

Hi Sharyn,

I hope you are well. I wanted to touch base with you regarding the possible time and location for the Utah public meeting. I have been corresponding with Sarah Fields, who gave me some good information on where we could locate the meeting. She has given me two locations: The first one is the White Mesa Ute community, about 5 miles south of Blanding, which is the community closest to the White Mesa Mill. They have a gym where the DOE held scoping and draft EIS hearings related to the disposition of the Moab Mill Tailings. The second location is the Blanding Arts and Events Center at the College of Eastern Utah.

They apparently have a large meeting room. Either one of these locations would be fine with me, although I am leaning toward the White Mesa Ute facility, since it is closest to the mill. I welcome any input you have on the issue.

The second issue is the date of the meeting. I am currently looking at Monday, May 24th, at approximately 6 PM. I believe that Dr. Diaz will be accompanying me on the trip.

Please let me know if this works for you, so I can go ahead with the reservations for the room, etc. Thanks a lot.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-133

Reid Rosnick/DC/USEPA/US
09/05/2012 09:04 AM

To Beth Miller
cc
bcc
Subject Fw: SD SPW Meeting - Attendee List

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:03 AM -----

From: "Sharyn Cunningham" <Sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 11/09/2009 05:56 PM
Subject: Re: SD SPW Meeting - Attendee List

Hi Reid,

I've spoken with Travis Stills and he sees no problem with going a few days past the 30-day deadline under the circumstances. Travis suggested that you might contact Susan Stahle for any input on your end:
Stahle.Susan@epamail.epa.gov

Thanks for the attendee list, and we're looking forward to the first teleconference. Any update on the development of the website?

Thanks, Sharyn

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Sent: Monday, November 09, 2009 8:55 AM
Subject: Re: SD SPW Meeting - Attendee List

> Hi Sharyn,
>
> Sorry for the delay in responding, I was in Gallup, New Mexico last week
> for a Navajo uranium stakeholders conference.
>
> Thanks for scheduling the time for the conference call. December 8 at 1
> PM MST is fine with me except for just one issue. The settlement
> agreement became effective on November 3, and one of the issues we
> agreed to was that the conference calls would begin within 30 days of
> the agreement becoming final. The conference call date is 5 days beyond
> the 30 day stipulation. If you are OK with that, then so am I, but I
> need to make sure that we don't violate any terms of the agreement,
> which would force the call to happen on or before December 3. Please let

> me know if you're still willing to go with December 8. Thanks
>
> I've also attached the sign-in sheet you requested for the meeting we
> had in Rapid City. Have a good day.
>
> Reid
>
> (See attached file: October 1 sign in.pdf)
>

EPA-186

Reid Rosnick/DC/USEPA/US
09/05/2012 09:14 AM

To Beth Miller
cc
bcc
Subject Fw: Web Posting

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:14 AM -----

From: "Sharyn Cunningham" <Sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 06/18/2009 01:34 PM
Subject: Re: Web Posting

Reid,

Thanks very much, and yes the announcement language was very good.

Sharyn

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Cc: <Peake.Tom@epamail.epa.gov>
Sent: Thursday, June 18, 2009 4:58 AM
Subject: Re: Web Posting

> Hi Sharyn,
>
> I trust that the language I used in the announcement is acceptable. I know that Jeremy Nichols is no longer representing Rocky Mountain Clean Air Action, but I felt obliged to mention them, since they are co-plaintiffs with your organization. The Region is continuing to work on determining placement of the announcements, and I reckon that we will have a resolution soon.
>
> I will be sending 50 copies of the presentation tomorrow. That number is based on the 30-40 number of attendees you had estimated, plus 10 more for good measure. You should probably receive it on Monday or Tuesday. I'll also be sending the electronic versions of the presentation and the 2008 NMA presentation tomorrow afternoon. I'll also bring a CD with my presentation to use at the meeting, and you are welcome to keep that if you wish.
>
> Thanks again for all your help.
>

```
> Reid
>
------------------------------------------------------------------------------
--------------------------------
>
> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov
>
>
> |------------>
> | From:      |
> |------------>
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
>  |"Sharyn Cunningham" <Sharyn@bresnan.net>
> |
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | To:        |
> |------------>
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
>  |Reid Rosnick/DC/USEPA/US@EPA
> |
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | Date:      |
> |------------>
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
>  |06/17/2009 04:18 PM
> |
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
> |------------>
> | Subject:   |
> |------------>
>
>
>-----------------------------------------------------------------------------
-----------------------------------------------------------|
```

> |Re: Web Posting
> |
>
>
>---
---|
>
>
>
>
>
> Reid,
>
> Thanks and I saw that the announcement was up last night after receiving
>
> your last message. Only those informed on this particular issue will
> know
> to check that site. An effort to notify the public of this meeting and
> it's
> purpose really should be included at the Lincoln Park Superfund website
> on
> EPA, and at the Cotter Mill & Superfund site website on the CDPHE
> website.
> Hopefully that will happen, as those are sites that the general public
> accesses periodically, people who may not be aware of the review of
> Subpart
> W. We will appreciate your continued effort to see that happens.
>
> I'll be looking for your package of materials, the PPTs by email, and
> will
> hopefully be getting back to you soon about our issues of concern.
>
> Thanks again,
> Sharyn
>
>
>
>
> ----- Original Message -----
> From: <Rosnick.Reid@epamail.epa.gov>
> To: "Sharyn Cunningham" <Sharyn@bresnan.net>
> Sent: Wednesday, June 17, 2009 12:57 PM
> Subject: Web Posting
>
>
>>
>> Hi Sharyn,
>>
>> I have managed to get an announcement about the June 30 meeting on our
>> Subpart W web page. The link is:
>>
>> http://www.epa.gov/radiation/neshaps/subpartw/index.html
>>
>> The Region is still looking into the possibility of getting an
>> announcement on the Lincoln Park Superfund site, the CDPHE websites,
> and
>> the Canon City Daily Record. I'll keep you posted.
>>
>> Reid
>>

>

>
>>
>> Reid J. Rosnick
>> Radiation Protection Division (6608J)
>> U.S. Environmental Protection Agency
>> 1200 Pennsylvania Ave., NW
>> Washington, DC 20460
>> 202.343.9563
>> rosnick.reid@epa.gov
>>
>
>
>
>

EPA-779

Reid Rosnick/DC/USEPA/US	To Beth Miller
09/05/2012 09:14 AM	cc
	bcc
	Subject Fw: Logistics for June 30 Subpart W Meeting

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:14 AM -----

From:	"Sharyn Cunningham" <Sharyn@bresnan.net>
To:	Reid Rosnick/DC/USEPA/US@EPA
Cc:	Angelique Diaz/R8/USEPA/US@EPA, "Jeremy Nichols" <jnichols@wildearthguardians.org>, "Carol Dunn" <rcdunn@bresnan.net>, Susan Stahle/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA, Glenna Shields/DC/USEPA/US@EPA, Helen Burnett/DC/USEPA/US@EPA
Date:	06/17/2009 04:29 PM
Subject:	Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

Thank you for putting a notice of the June 30th meeting on the Subpart W website at the EPA. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, the Cotter Uranium Mill & Superfund site on the CDPHE website, and the CDPHE Powertech website where ISL uranium mining is being proposed. Hopefully that will happen, as those are sites that the general public access periodically, people who may not be aware of the review of Subpart W. An ad in our local newspaper seems only appropriate for this meeting on a historical effort by EPA that will have a direct impact on our community. We will appreciate your continued effort, and efforts by others at EPA and CDPHE, to see that proper notification is offered to the public.

I'll be looking for your package of materials, the electronic versions of presentations on the subject to NMA and for this meeting by email, and will hopefully be getting back to you soon about our issues of concern.

Sharyn Cunningham
CCAT Co-Chair
(719)275-3432

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Cc: <Diaz.Angelique@epamail.epa.gov>; "Jeremy Nichols" <jnichols@wildearthguardians.org>; "Carol Dunn" <rcdunn@bresnan.net>; <Stahle.Susan@epamail.epa.gov>; <Peake.Tom@epamail.epa.gov>; <Shields.Glenna@epamail.epa.gov>; <Burnett.Helen@epamail.epa.gov>

Sent: Tuesday, June 16, 2009 9:39 AM
Subject: Re: Logistics for June 30 Subpart W Meeting

> Hi Sharyn,
>
> Thanks to you and Carol Dunn for making all the arrangements and logistics for the meeting location. I will Fed-Ex the box of presentations to you on Friday. Additionally, I'll send you an electronic version and a copy of the presentation I made to NMA last year.
>
> Regarding advertising for the meeting, I am in the process of placing a notice of a public meeting on EPA's Subpart W web page. It may take a day or two to get through our Product Review section. Angelique Diaz will make a request of the Regional Superfund group on whether they will update their web site. She will also see if CDPHE will allow for placement of an announcement on their web sites. For the Canon City Daily Record she will speak with the public affairs people to see if any funding is available for the advertisement. I'll update you as I hear about the success of the requests.
>
> Thanks again, and as always, don't hesitate to contact me if you have questions or comments.
>
> Reid
>

> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov
>
>
> |------------>
> | From: |
> |------------>
>
>
>---|
> |"Sharyn Cunningham" <Sharyn@bresnan.net>
> |
>
>
>---|
> |------------>
> | To: |
> |------------>
>
>
>---|
> |Reid Rosnick/DC/USEPA/US@EPA

```
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
> |------------>
> | Cc:        |
> |------------>
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>  |Angelique Diaz/R8/USEPA/US@EPA, "Jeremy Nichols"
> <jnichols@wildearthguardians.org>, "Carol Dunn" <rcdunn@bresnan.net>, Tom
> |
>  |Peake/DC/USEPA/US@EPA, Susan Stahle/DC/USEPA/US@EPA
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
> |------------>
> | Date:      |
> |------------>
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>  |06/12/2009 07:22 PM
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
> |------------>
> | Subject:   |
> |------------>
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>  |Re: Logistics for June 30 Subpart W Meeting
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>
>
>
>
>
> Dear Reid,
>
> We understand that the meeting will need to end at 9pm, and we greatly
> appreciate having this opportunity to participate in the Subpart W
> review
> and potential rulemaking.  In response to your comments (using the same
> numbering system):
>
```

> 1.) In regard to citizen presentations at the meeting, I assumed that
> "this
> issue" would be understood as referring to the review of Subpart W, not
> water or any other concerns at this site. We will make every effort to
> provide information to you on citizen issues/questions prior to the
> meeting,
> or at least within one week of the meeting. We agree, it will be
> advantageous for all if you can think about these points before hand.
>
> 2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate
> receiving the PPT and NMA materials by email. You can mail your
> handouts
> for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO
> 81212.
>
> 4.) We will make sure that a screen and projection system will be
> available
> for computers. Carol Dunn sent an email earlier today with the location
>
> name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon
> City,
> CO (719-275-8676).
>
> Can EPA place an ad for the meeting in our local newspaper, The Canon
> City
> Daily Record? Aside from that, we would appreciate it if EPA would put
> an
> announcement for this meeting, with links to Subpart W and a brief
> explanation of the purpose of the meeting, on these websites:
>
> USEPA Lincoln Park Superfund website:
> http://www.epa.gov/region08/superfund/co/lincolnpark/
> CDPHE website for Cotter (OU1 of the Superfund Site):
> http://www.cdphe.state.co.us/hm/cotter/index.htm
> CDPHE website for Powertech (ISL Uranium Mining in Colorado):
> http://www.cdphe.state.co.us/hm/rad/rml/powertech/
>
> We'll look forward to an answer regarding an ad and announcements on the
>
> websites. If there's anything else we can do to make this a productive
> and
> educational meeting, please email or call. We look forward to hearing
> from
> you again, and seeing you and Dr. Diaz on June 30th.
>
> Sharyn Cunningham
> CCAT Co-Chair
> 1614 Grand Ave
> Canon City, CO 81212
> (719)275-3432
>
> ----- Original Message -----
> From: <Rosnick.Reid@epamail.epa.gov>
> To: "Sharyn Cunningham" <Sharyn@bresnan.net>
> Cc: <Diaz.Angelique@epamail.epa.gov>; "Jeremy Nichols"
> <jnichols@wildearthguardians.org>; "Carol Dunn" <rcdunn@bresnan.net>;
> <Peake.Tom@epamail.epa.gov>; <Stahle.Susan@epamail.epa.gov>
> Sent: Friday, June 12, 2009 6:19 AM
> Subject: Re: Logistics for June 30 Subpart W Meeting
>

>
>> Hi Sharyn,
>>
>> The meeting time you chose is fine with me. I know people work during
>> the day, and it's difficult to schedule meetings during the week. I
>> would ask that we go no later than 9 PM, as I have to drive back to
>> Denver that night. I think the meeting format is good, and I want to
>> allow as much time as possible for questions. If there are only 30-40
>> people in the room, perhaps we can make it more of a roundtable, and
>> questions can be asked anywhere throughout my presentation.
>>
>> I'm going to address each of your numbered items in order, so I don't
>> forget anything.
>>
>> 1   I welcome the period for citizen presentations. If you know of
>> specific citizen issues or concerns, please let me know beforehand, so
> I
>> can attempt to address them in my presentation. Please remember that
> the
>> focus of my work is limited to the radon emission standards of Subpart
>> W, and the associated review and possible revision of those standards.
>> If you have information or studies related to the protectiveness of
> the
>> radon standard of 20 pCi/m2, I would be very interested in obtaining
>> them.
>>
>> While I am generally aware of issues with Cotter in other topic areas
>> like ground water and drinking water, and though you may wish to
> discuss
>> those types of issues, they are beyond the scope of my work, and I am
>> not the technical person who could answer questions of this nature. I
>> raise this point so that you know what you can expect me to address
> at
>> the meeting. For questions outside of the scope of my Subpart W focus
> I
>> will try to relay the questions to Region 8 staff.
>>
>> 2.   As I write this, assume there will be two EPA folks attending
> the
>> meeting, myself and Dr. Angelique Diaz from our Regional office in
>> Denver. As I get more information on any other participants, I'll let
>> you know immediately. I'm still in the process of putting my PPT
>> presentation together, and I hope to e-mail it to you by no later than
>> next Friday, June 19.
>>
>> 3.   On June 19 I'll also e-mail you a copy of the presentation my
>> colleague Loren Setlow and I made to NMA last year. Based on what I'm
>> currently putting together, you'll find that a lot of the information
>> is redundant. There are no other documents or correspondence that has
>> been shared with NMA to my knowledge. Also, if you would kindly give
> me
>> an address, I can ship out at least 50 copies of my presentation at
> the
>> same time so that you have them prior to the meeting, and I'm not
>> carrying a big box through airport security.
>>
>> 4.   I am not aware of any other announcements or advertisements that
>> EPA is planning for this meeting. I am turning to you to announce the
>> meeting to the interested individuals. I assure you that once our web
>> site is up and running we will announce future meetings. I also

```
>> appreciate your securing a meeting room. I would appreciate it if the
>> room had a projection system and screen. That way I can bring a flash
>> drive with the presentation on it, and we can project it for all to
> see.
>>
>> I believe I touched all the bases from your note. Thanks for your
>> cooperation, Sharyn, and please don't hesitate to call or e-mail me if
>> you have other questions or issues. Thanks, have a great weekend.
>>
>> Reid
>>
>>
>>
>
------------------------------------------------------------------------------
--------------------------------
>
>>
>> Reid J. Rosnick
>> Radiation Protection Division (6608J)
>> U.S. Environmental Protection Agency
>> 1200 Pennsylvania Ave., NW
>> Washington, DC 20460
>> 202.343.9563
>> rosnick.reid@epa.gov
>>
>>
>> |------------>
>> | From:      |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |"Sharyn Cunningham" <Sharyn@bresnan.net>
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | To:        |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |Reid Rosnick/DC/USEPA/US@EPA
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | Cc:        |
>> |------------>
```

```
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |Tom Peake/DC/USEPA/US@EPA, Angelique Diaz/R8/USEPA/US@EPA, "Carol
> Dunn"
>> <rcdunn@bresnan.net>, "Jeremy Nichols"                        |
>>  |<jnichols@wildearthguardians.org>
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | Date:      |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |06/11/2009 10:54 AM
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | Subject:   |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |Re: Logistics for June 30 Subpart W Meeting
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>
>>
>>
>>
>>
>> Dear Reid,
>>
>> Sorry for the delay in responding as we had to put our heads together
>> regarding what we believe we will need for this meeting.  I've added
> to
>> the
>> cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action,
> and
>>
>> CCAT's other Co-Chair, Carol Dunn, as they are involved in the
```

>> Settlement,
>> and in coordination of this meeting. Your suggestions for the
>> presentation,
>> the basics of Subpart W, an explanation of the workgroup and update on
>> its
>> progress, and the status of items that are part of the settlement,
> would
>> be
>> very helpful. Q&A works best, in our opinion, if it follows each
>> presentation. At the same time, keeping the meeting informal and open
>> for
>> dialogue is very desirable.
>>
>> It's been difficult in deciding when to hold the meeting. A number of
>> key
>> people, like yourselves, will be traveling here, and a number of key
>> people
>> in the community work during the day. Therefore, we're suggesting
> that
>> the
>> meeting be held in the evening from around 6-9pm, with a break planned
>> mid-way through the evening. Here are some suggestions of items or
>> actions
>> we would like to see:
>>
>> 1. We would like for and hour and a half to be made available for a
> few
>>
>> citizen presentations on specific concerns surrounding this issue.
> I'm
>> not
>> certain we would need the whole 1.5 hrs, but would like for it to be
>> available, to best convey information to EPA.
>>
>> 2. Please let us know who will be attending from the EPA and their
> area
>> and
>> level of expertise on this issue. We would also appreciate, if
>> possible, an
>> electronic copy emailed with any presentation materials that will be
>> used by
>> you or EPA staff (e.g. PPT slides, informational documents, etc.). It
>> would
>> also be helpful if printouts of these materials were available as
>> handouts
>> to the audience or participants.
>>
>> 3. We would appreciate receiving copies of the presentation EPA used
>> for
>> the NMA on this topic last year, as well as any other documents or
>> correspondence shared with the NMA on this topic.
>>
>> 4. Is EPA planning any sort of announcement or advertising for this
>> meeting? If so, please let us know, so that we don't duplicate our
>> efforts.
>>
>> We are uncertain as to the size of the audience. We just had a
>> Superfund
>> meeting on Monday with about 165 people in attendence. However, we
>> don't

>> anticipate that size of a crowd. Our best guess is that we will have
>> anywhere from 30-40 in attendance, and believe that people north of
> our
>> area, and other interested parties may travel here for the meeting.
> We
>> have
>> at least two possible locations, and would be happy to secure
> something
>> appropriate. One location, if it's available, has the capability of
>> expanding the room if needed.
>>
>> Our group looks forward to hearing from you.
>>
>> Sharyn Cunningham
>> CCAT Co-Chair
>> (719)275-3432
>>
>>
>>
>> ----- Original Message -----
>> From: <Rosnick.Reid@epamail.epa.gov>
>> To: "Sharyn Cunningham" <Sharyn@bresnan.net>
>> Cc: <Peake.Tom@epamail.epa.gov>; <Diaz.Angelique@epamail.epa.gov>
>> Sent: Tuesday, June 09, 2009 8:07 AM
>> Subject: Re: Logistics for June 30 Subpart W Meeting
>>
>>
>>> Hi Sharyn,
>>>
>>> Thanks for your response. I have a couple of ideas I'd like to share
>> for
>>> our meeting on the 30th. If it's OK with you, I could give a
>>> presentation on the basics of Subpart W, an update of what the
>> workgroup
>>> has been doing, and an update of our status of other items that are
>> part
>>> of the settlement agreement. After that, perhaps we could open it up
>> for
>>> a question and answer period, where I can get a sense of issues that
>> are
>>> of concern to you. My hope is that we can keep this meeting as
>> informal
>>> as possible, I think that way we can have an open dialogue, with
>> sharing
>>> of ideas that will be beneficial to both of us. Do you have an
>> estimate
>>> of how many people would attend the meeting, and how much time would
>> be
>>> needed? I'm just trying to get a feel on how to tailor my
>> presentation.
>>>
>>> Regarding when we can speak by phone, I'll leave that to you as your
>>> schedule dictates. Just let me know when you are available, and I'll
>> be
>>> happy to contact you.
>>>
>>> I look forward to meeting you in a couple of weeks.
>>>
>>> Reid
>>>

```
>>
>
------------------------------------------------------------------------------
--------------------------------
>
>>
>>>
>>> Reid J. Rosnick
>>> Radiation Protection Division (6608J)
>>> U.S. Environmental Protection Agency
>>> 1200 Pennsylvania Ave., NW
>>> Washington, DC 20460
>>> 202.343.9563
>>> rosnick.reid@epa.gov
>>>
>>>
>>> |------------>
>>> | From:      |
>>> |------------>
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>>  |"Sharyn Cunningham" <Sharyn@bresnan.net>
>>> |
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>> |------------>
>>> | To:        |
>>> |------------>
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>>  |Reid Rosnick/DC/USEPA/US@EPA
>>> |
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>> |------------>
>>> | Cc:        |
>>> |------------>
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>>  |Tom Peake/DC/USEPA/US@EPA
```

```
>>> |
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>> |------------>
>>> | Date:      |
>>> |------------>
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>>  |06/08/2009 05:24 PM
>>> |
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>> |------------>
>>> | Subject:   |
>>> |------------>
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>>  |Re: Logistics for June 30 Subpart W Meeting
>>> |
>>>
>>>
>>>---------------------------------------------------------------------------
-----------------------------------------------------------|
>
>>
>>>
>>>
>>>
>>>
>>>
>>> Hello Reid,
>>>
>>> Thanks for your message.  Our group has already begun looking at
>>> potential
>>> sites for the June 30th meeting in Canon City.  We'll take steps to
>> help
>>>
>>> confirm a location after we've had a chance to discuss the best time
>> for
>>> the
>>> meeting, if you would like.  We would be happy to discuss the format
>> and
>>>
>>> info desired, as well.  Let me know when you would like to speak by
```

>>> telephone.
>>>
>>> Sharyn Cunningham
>>> CCAT Co-Chair
>>> 1614 Grand Ave
>>> Canon City, CO 81212
>>> (719) 275-3432
>>>
>>>
>>> ----- Original Message -----
>>> From: <Rosnick.Reid@epamail.epa.gov>
>>> To: <sharyn@bresnan.net>
>>> Cc: <Peake.Tom@epamail.epa.gov>
>>> Sent: Friday, June 05, 2009 6:16 AM
>>> Subject: Logistics for June 30 Subpart W Meeting
>>>
>>>
>>>>
>>>> Hi Sharyn,
>>>>
>>>> I either misplaced your phone number, or I might not have gotten it
>>> when
>>>> we last spoke in February. If you would kindly send it to me, I'll
>>> give
>>>> you a call and we can discuss some of the logistics (time/place) for
>>> the
>>>> Subpart W meeting on June 30. We can also discuss the format of the
>>>> meeting, and get a sense of what you would like me to talk about,
> and
>>>> any issues you would like me to address. Thanks
>>>>
>>>> Reid
>>>>
>>>
>>
>

>
>>
>>>
>>>>
>>>> Reid J. Rosnick
>>>> Radiation Protection Division (6608J)
>>>> U.S. Environmental Protection Agency
>>>> 1200 Pennsylvania Ave., NW
>>>> Washington, DC 20460
>>>> 202.343.9563
>>>> rosnick.reid@epa.gov
>>>>
>>>
>>>
>>>
>>>
>>
>>
>>
>>
>
>

>
>

EPA-306

Reid Rosnick/DC/USEPA/US
09/05/2012 09:15 AM

To Beth Miller
cc
bcc
Subject Fw: Web Posting

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:14 AM -----

From:	"Sharyn Cunningham" <Sharyn@bresnan.net>
To:	Reid Rosnick/DC/USEPA/US@EPA
Date:	06/17/2009 04:18 PM
Subject:	Re: Web Posting

Reid,

Thanks and I saw that the announcement was up last night after receiving your last message. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, and at the Cotter Mill & Superfund site website on the CDPHE website. Hopefully that will happen, as those are sites that the general public accesses periodically, people who may not be aware of the review of Subpart W. We will appreciate your continued effort to see that happens.

I'll be looking for your package of materials, the PPTs by email, and will hopefully be getting back to you soon about our issues of concern.

Thanks again,
Sharyn

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Sent: Wednesday, June 17, 2009 12:57 PM
Subject: Web Posting

>
> Hi Sharyn,
>
> I have managed to get an announcement about the June 30 meeting on our
> Subpart W web page. The link is:
>

> http://www.epa.gov/radiation/neshaps/subpartw/index.html
>
> The Region is still looking into the possibility of getting an
> announcement on the Lincoln Park Superfund site, the CDPHE websites, and
> the Canon City Daily Record. I'll keep you posted.
>
> Reid
>

>
> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov
>

EPA-494

Reid Rosnick/DC/USEPA/US
09/05/2012 09:15 AM

To Beth Miller
cc
bcc
Subject Fw: Logistics for June 30 Subpart W Meeting

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:15 AM -----

From: "Sharyn Cunningham" <Sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Angelique Diaz/R8/USEPA/US@EPA, "Jeremy Nichols" <jnichols@wildearthguardians.org>, "Carol Dunn" <rcdunn@bresnan.net>, Tom Peake/DC/USEPA/US@EPA, Susan Stahle/DC/USEPA/US@EPA
Date: 06/12/2009 07:22 PM
Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/

CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair
1614 Grand Ave
Canon City, CO 81212
(719)275-3432

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: "Sharyn Cunningham" <Sharyn@bresnan.net>
Cc: <Diaz.Angelique@epamail.epa.gov>; "Jeremy Nichols" <jnichols@wildearthguardians.org>; "Carol Dunn" <rcdunn@bresnan.net>; <Peake.Tom@epamail.epa.gov>; <Stahle.Susan@epamail.epa.gov>
Sent: Friday, June 12, 2009 6:19 AM
Subject: Re: Logistics for June 30 Subpart W Meeting

> Hi Sharyn,
>
> The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.
>
> I'm going to address each of your numbered items in order, so I don't forget anything.
>
> 1   I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.
>
> While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.
>
> 2.   As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT

> presentation together, and I hope to e-mail it to you by no later than
> next Friday, June 19.
>
> 3.   On June 19 I'll also e-mail you a copy of the presentation my
> colleague Loren Setlow and I made to NMA last year. Based on what I'm
> currently putting together, you'll find that a lot of the information
> is redundant. There are no other documents or correspondence that has
> been shared with NMA to my knowledge. Also, if you would kindly give me
> an address, I can ship out at least 50 copies of my presentation at the
> same time so that you have them prior to the meeting, and I'm not
> carrying a big box through airport security.
>
> 4.   I am not aware of any other announcements or advertisements that
> EPA is planning for this meeting. I am turning to you to announce the
> meeting to the interested individuals. I assure you that once our web
> site is up and running we will announce future meetings. I also
> appreciate your securing a meeting room. I would appreciate it if the
> room had a projection system and screen. That way I can bring a flash
> drive with the presentation on it, and we can project it for all to see.
>
> I believe I touched all the bases from your note. Thanks for your
> cooperation, Sharyn, and please don't hesitate to call or e-mail me if
> you have other questions or issues. Thanks, have a great weekend.
>
> Reid
>
>
>

>
> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov
>
>
> |------------>
> | From: |
> |------------>
>
>
>---
---|
> |"Sharyn Cunningham" <Sharyn@bresnan.net>
> |
>
>
>---
---|
> |------------>
> | To: |
> |------------>
>
>
>---
---|

```
>  |Reid Rosnick/DC/USEPA/US@EPA
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
> |------------>
> | Cc:        |
> |------------>
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>  |Tom Peake/DC/USEPA/US@EPA, Angelique Diaz/R8/USEPA/US@EPA, "Carol Dunn"
> <rcdunn@bresnan.net>, "Jeremy Nichols"                        |
>  |<jnichols@wildearthguardians.org>
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
> |------------>
> | Date:      |
> |------------>
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>  |06/11/2009 10:54 AM
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
> |------------>
> | Subject:   |
> |------------>
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>  |Re: Logistics for June 30 Subpart W Meeting
> |
>
>
>-----------------------------------------------------------------------------
---------------------------------------------------------|
>
>
>
>
>
> Dear Reid,
>
> Sorry for the delay in responding as we had to put our heads together
> regarding what we believe we will need for this meeting.  I've added to
> the
> cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and
>
> CCAT's other Co-Chair, Carol Dunn, as they are involved in the
```

> Settlement,
> and in coordination of this meeting. Your suggestions for the
> presentation,
> the basics of Subpart W, an explanation of the workgroup and update on
> its
> progress, and the status of items that are part of the settlement, would
> be
> very helpful. Q&A works best, in our opinion, if it follows each
> presentation. At the same time, keeping the meeting informal and open
> for
> dialogue is very desirable.
>
> It's been difficult in deciding when to hold the meeting. A number of
> key
> people, like yourselves, will be traveling here, and a number of key
> people
> in the community work during the day. Therefore, we're suggesting that
> the
> meeting be held in the evening from around 6-9pm, with a break planned
> mid-way through the evening. Here are some suggestions of items or
> actions
> we would like to see:
>
> 1. We would like for and hour and a half to be made available for a few
>
> citizen presentations on specific concerns surrounding this issue. I'm
> not
> certain we would need the whole 1.5 hrs, but would like for it to be
> available, to best convey information to EPA.
>
> 2. Please let us know who will be attending from the EPA and their area
> and
> level of expertise on this issue. We would also appreciate, if
> possible, an
> electronic copy emailed with any presentation materials that will be
> used by
> you or EPA staff (e.g. PPT slides, informational documents, etc.). It
> would
> also be helpful if printouts of these materials were available as
> handouts
> to the audience or participants.
>
> 3. We would appreciate receiving copies of the presentation EPA used
> for
> the NMA on this topic last year, as well as any other documents or
> correspondence shared with the NMA on this topic.
>
> 4. Is EPA planning any sort of announcement or advertising for this
> meeting? If so, please let us know, so that we don't duplicate our
> efforts.
>
> We are uncertain as to the size of the audience. We just had a
> Superfund
> meeting on Monday with about 165 people in attendence. However, we
> don't
> anticipate that size of a crowd. Our best guess is that we will have
> anywhere from 30-40 in attendance, and believe that people north of our
> area, and other interested parties may travel here for the meeting. We
> have
> at least two possible locations, and would be happy to secure something

> appropriate. One location, if it's available, has the capability of
> expanding the room if needed.
>
> Our group looks forward to hearing from you.
>
> Sharyn Cunningham
> CCAT Co-Chair
> (719)275-3432
>
>
>
> ----- Original Message -----
> From: <Rosnick.Reid@epamail.epa.gov>
> To: "Sharyn Cunningham" <Sharyn@bresnan.net>
> Cc: <Peake.Tom@epamail.epa.gov>; <Diaz.Angelique@epamail.epa.gov>
> Sent: Tuesday, June 09, 2009 8:07 AM
> Subject: Re: Logistics for June 30 Subpart W Meeting
>
>
>> Hi Sharyn,
>>
>> Thanks for your response. I have a couple of ideas I'd like to share
> for
>> our meeting on the 30th. If it's OK with you, I could give a
>> presentation on the basics of Subpart W, an update of what the
> workgroup
>> has been doing, and an update of our status of other items that are
> part
>> of the settlement agreement. After that, perhaps we could open it up
> for
>> a question and answer period, where I can get a sense of issues that
> are
>> of concern to you. My hope is that we can keep this meeting as
> informal
>> as possible, I think that way we can have an open dialogue, with
> sharing
>> of ideas that will be beneficial to both of us. Do you have an
> estimate
>> of how many people would attend the meeting, and how much time would
> be
>> needed? I'm just trying to get a feel on how to tailor my
> presentation.
>>
>> Regarding when we can speak by phone, I'll leave that to you as your
>> schedule dictates. Just let me know when you are available, and I'll
> be
>> happy to contact you.
>>
>> I look forward to meeting you in a couple of weeks.
>>
>> Reid
>>
>

>
>>
>> Reid J. Rosnick
>> Radiation Protection Division (6608J)
>> U.S. Environmental Protection Agency

```
>> 1200 Pennsylvania Ave., NW
>> Washington, DC 20460
>> 202.343.9563
>> rosnick.reid@epa.gov
>>
>>
>> |------------>
>> | From:      |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |"Sharyn Cunningham" <Sharyn@bresnan.net>
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | To:        |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |Reid Rosnick/DC/USEPA/US@EPA
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | Cc:        |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |Tom Peake/DC/USEPA/US@EPA
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | Date:      |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |06/08/2009 05:24 PM
```

```
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>> |------------>
>> | Subject:   |
>> |------------>
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>  |Re: Logistics for June 30 Subpart W Meeting
>> |
>>
>>
>>----------------------------------------------------------------------------
----------------------------------------------------------|
>
>>
>>
>>
>>
>>
>> Hello Reid,
>>
>> Thanks for your message.  Our group has already begun looking at
>> potential
>> sites for the June 30th meeting in Canon City.  We'll take steps to
> help
>>
>> confirm a location after we've had a chance to discuss the best time
> for
>> the
>> meeting, if you would like.  We would be happy to discuss the format
> and
>>
>> info desired, as well.  Let me know when you would like to speak by
>> telephone.
>>
>> Sharyn Cunningham
>> CCAT Co-Chair
>> 1614 Grand Ave
>> Canon City, CO 81212
>> (719) 275-3432
>>
>>
>> ----- Original Message -----
>> From: <Rosnick.Reid@epamail.epa.gov>
>> To: <sharyn@bresnan.net>
>> Cc: <Peake.Tom@epamail.epa.gov>
>> Sent: Friday, June 05, 2009 6:16 AM
>> Subject: Logistics for June 30 Subpart W Meeting
>>
>>
>>>
>>> Hi Sharyn,
>>>
```

>>> I either misplaced your phone number, or I might not have gotten it
>> when
>>> we last spoke in February. If you would kindly send it to me, I'll
>> give
>>> you a call and we can discuss some of the logistics (time/place) for
>> the
>>> Subpart W meeting on June 30. We can also discuss the format of the
>>> meeting, and get a sense of what you would like me to talk about, and
>>> any issues you would like me to address. Thanks
>>>
>>> Reid
>>>
>>
>

>
>>
>>>
>>> Reid J. Rosnick
>>> Radiation Protection Division (6608J)
>>> U.S. Environmental Protection Agency
>>> 1200 Pennsylvania Ave., NW
>>> Washington, DC 20460
>>> 202.343.9563
>>> rosnick.reid@epa.gov
>>>
>>
>>
>>
>>
>
>
>
>

EPA-756

Reid Rosnick/DC/USEPA/US

09/05/2012 09:15 AM

To Beth Miller

cc

bcc

Subject Fw: Method 115

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:15 AM -----

From: "Sharyn Cunningham" <sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 02/04/2009 02:30 PM
Subject: Re: Method 115

Reid,

We also appreciated the opportunity to speak with all of you this morning. Thanks for the document on Method 115. I'm encouraged that we've begun opening channels of communication on this important issue. I look forward to speaking with you in the future.

Sharyn Cunningham, Co-Chair
Colorado Citizens Against ToxicWaste, Inc.
P.O. Box 964
Canon City, CO 81215
(719)275-3432

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov>
To: <sharyn@bresnan.net>
Sent: Wednesday, February 04, 2009 11:35 AM
Subject: Method 115

>
> Hi Sharyn,
>
> I enjoyed speaking with you and Jeremy this morning. Please let me know
> if you have any other questions I can answer. In the meantime, attached
> is the copy of Method 115 I promised. This is the required test method
> for radon flux from Subpart W units.
>
> Reid
>
> (See attached file: Method 115.pdf)
>

>
> Reid J. Rosnick
> Radiation Protection Division (6608J)
> U.S. Environmental Protection Agency
> 1200 Pennsylvania Ave., NW
> Washington, DC 20460
> 202.343.9563
> rosnick.reid@epa.gov

EPA-4727

Wendy Blake/DC/USEPA/US

09/10/2012 09:22 AM

To Eric Ginsburg, Reid Rosnick, Susan Stahle

cc Marguerite McLamb, Tom Peake

bcc

Subject quick follow-up on Subpart W; call-in number below

Meeting

Date 09/11/2012
Time 01:30:00 PM to 02:00:00 PM
Chair Wendy Blake
Invitees
Required Eric Ginsburg; Reid Rosnick; Susan Stahle
Optional Marguerite McLamb; Tom Peake
FYI
Location

Follow-up on Eric's comments on the Subpart W package.

1-866-299-3188; 202-564-1821

EPA-5269

Wendy Blake/DC/USEPA/US

09/10/2012 09:22 AM

To

cc

bcc

Subject quick follow-up on Subpart W; call-in number below

Meeting

Date 09/11/2012
Time 01:30:00 PM to 02:00:00 PM
Chair Wendy Blake
Invitees
Required Eric Ginsburg; Reid Rosnick; Susan Stahle
Optional Marguerite McLamb; Tom Peake
FYI
Location

Follow-up on Eric's comments on the Subpart W package.

1-866-299-3188; 202-564-1821

EPA-5293

Reid Rosnick/DC/USEPA/US	To	Wendy Blake
09/10/2012 09:23 AM	cc	
	bcc	
	Subject	Accepted: quick follow-up on Subpart W; call-in number below

EPA-5287

Susan Stahle/DC/USEPA/US		To	Wendy Blake
09/10/2012 10:10 AM		cc	
		bcc	
		Subject	Accepted: quick follow-up on Subpart W; call-in number below

EPA-5294

Eric Ginsburg/RTP/USEPA/US

09/11/2012 10:45 AM

To	Wendy Blake
cc	
bcc	
Subject	Accepted: quick follow-up on Subpart W; call-in number below

EPA-4786

Susan Stahle/DC/USEPA/US	To	Reid Rosnick
09/13/2012 04:21 PM	cc	Tom Peake
	bcc	
	Subject	Re: Emails for Subpart W Website

These look fine to post.

As much as you can, please try and capture any other emails you have that we can post, and let's post them to the website. I appreciate that this is time-consuming, but it is what we agreed to do under the settlement agreement.

Once you catch up (it looks like you may be there), maybe the best strategy would be to take some time each week and post whatever emails you have from that week. That way you'll stay on top of it and will hopefully make it a little easier to keep the website current with the appropriate documents.

Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Reid Rosnick   Hi Sue, I got your voice mail earlier, I'll...   09/12/2012 09:36:07 AM

From: Reid Rosnick/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 09/12/2012 09:36 AM
Subject: Emails for Subpart W Website

Hi Sue,

I got your voice mail earlier, I'll be on the lookout for the language and I'll also scrub as you suggested.

Attached are emails that Sharyn Cunningham mentioned during the last Subpart W Stakeholders call. I have scrubbed these of phone numbers, email addresses, etc. I'm sure I haven't captured all of them, but it is time consuming, and I have other items on the plate. If you wish to look at them to determine if any should be deleted due to deliberative or confusing information, please feel free. Please let me know if you have questions or comments. Thanks

[attachment "Subpart W emails.docx" deleted by Susan Stahle/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-614

Susan Stahle/DC/USEPA/US

09/13/2012 04:21 PM

To Reid Rosnick
cc Tom Peake
bcc
Subject Re: Emails for Subpart W Website

These look fine to post.

As much as you can, please try and capture any other emails you have that we can post, and let's post them to the website. I appreciate that this is time-consuming, but it is what we agreed to do under the settlement agreement.

Once you catch up (it looks like you may be there), maybe the best strategy would be to take some time each week and post whatever emails you have from that week. That way you'll stay on top of it and will hopefully make it a little easier to keep the website current with the appropriate documents.

Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Reid Rosnick Hi Sue, I got your voice mail earlier, I'll... 09/12/2012 09:36:07 AM

From: Reid Rosnick/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 09/12/2012 09:36 AM
Subject: Emails for Subpart W Website

Hi Sue,

I got your voice mail earlier, I'll be on the lookout for the language and I'll also scrub as you suggested.

Attached are emails that Sharyn Cunningham mentioned during the last Subpart W Stakeholders call. I have scrubbed these of phone numbers, email addresses, etc. I'm sure I haven't captured all of them, but it is time consuming, and I have other items on the plate. If you wish to look at them to determine if any should be deleted due to deliberative or confusing information, please feel free. Please let me know if you have questions or comments. Thanks

[attachment "Subpart W emails.docx" deleted by Susan Stahle/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-615

Reid Rosnick/DC/USEPA/US	To	Susan Stahle
09/14/2012 08:34 AM	cc	Tom Peake
	bcc	
	Subject	Re: Emails for Subpart W Website

Thanks Sue,

Yes, I think I'm caught up, it's possible that I just overlooked some emails, and I'm sure that will be pointed out. As for posting recent emails, that's been a lot easier sine we dedicated an email address, so we're pretty much caught up.

On another note, I don't believe that I'm going to get any management comments on the Subpart W preamble, I recommended that we go with the changes. Once I hear back from Tom, I'll clean up the package and send it to you.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Susan Stahle	These look fine to post. As much as y...	09/13/2012 04:21:26 PM

From: Susan Stahle/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 09/13/2012 04:21 PM
Subject: Re: Emails for Subpart W Website

These look fine to post.

As much as you can, please try and capture any other emails you have that we can post, and let's post them to the website. I appreciate that this is time-consuming, but it is what we agreed to do under the settlement agreement.

Once you catch up (it looks like you may be there), maybe the best strategy would be to take some time each week and post whatever emails you have from that week. That way you'll stay on top of it and will hopefully make it a little easier to keep the website current with the appropriate documents.

Thanks.

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Reid Rosnick Hi Sue, I got your voice mail earlier, I'll... 09/12/2012 09:36:07 AM

From: Reid Rosnick/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Tom Peake/DC/USEPA/US@EPA
Date: 09/12/2012 09:36 AM
Subject: Emails for Subpart W Website

Hi Sue,

I got your voice mail earlier, I'll be on the lookout for the language and I'll also scrub as you suggested.

Attached are emails that Sharyn Cunningham mentioned during the last Subpart W Stakeholders call. I have scrubbed these of phone numbers, email addresses, etc. I'm sure I haven't captured all of them, but it is time consuming, and I have other items on the plate. If you wish to look at them to determine if any should be deleted due to deliberative or confusing information, please feel free. Please let me know if you have questions or comments. Thanks

[attachment "Subpart W emails.docx" deleted by Susan Stahle/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-5544

Tom Peake/DC/USEPA/US	To	Reid Rosnick
09/14/2012 08:59 AM	cc	
	bcc	
	Subject	Re: Fw: Revised Subpart W Preamble

I have no changes but I do have a comment. It seems a little weird that we are emphasizing so often that the risk assessment is not required. But what the lawyers want.....

Also, I still think deleting the 10 year sentence is an overreaction though not materially affecting anything. But what the lawyers want....

Lastly, at what point can we fill in the docket reference? Does the docket number get assigned right before the FR is finalized or is it at the Agency's discretion?

Tom Peake
Director
Center for Waste Management and Regulations
US EPA (6608J)
1200 Pennsylvania Ave, NW
Washington, DC 20460
phone: 202-343-9765

Physical Location and for deliveries:
Room 529
1310 L St, NW
Washington, DC 20005

Reid Rosnick	I have looked through the revisions and...	09/14/2012 07:33:44 AM

From: Reid Rosnick/DC/USEPA/US
To: Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA
Cc: Jonathan Edwards/DC/USEPA/US@EPA, Alan Perrin/DC/USEPA/US@EPA
Date: 09/14/2012 07:33 AM
Subject: Fw: Revised Subpart W Preamble

I have looked through the revisions and I have no comments. With your consent I'll clean up the package and send it off to Sue/Wendy.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/14/2012 07:32 AM -----

From: Susan Stahle/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA

Cc: Alan Perrin/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA, Jonathan Edwards/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA
Date: 09/13/2012 01:52 PM
Subject: Re: Revised Subpart W Preamble

Thanks Reid. I made some additional edits to your input on pg 48, see what you think. I did this just so we can beat it over everyone's heads that our updated risk assessment has nothing to do with our GACT analysis.

Once ORIA is ok with these new additions, please send me a clean version of the package and I'll send it to Wendy so she can read it over the weekend. Thanks.

[attachment "FR Proposal for Revision of Subpart W Final (ss 091312).docx" deleted by Reid Rosnick/DC/USEPA/US]

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov

Reid Rosnick All, After RPD and OGC spoke with Eri... 09/12/2012 01:02:38 PM

From: Reid Rosnick/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA
Cc: Jonathan Edwards/DC/USEPA/US@EPA, Alan Perrin/DC/USEPA/US@EPA
Date: 09/12/2012 01:02 PM
Subject: Revised Subpart W Preamble

All,

After RPD and OGC spoke with Eric Ginsburg of OAQPS yesterday we made a few minor changes to the preamble to the Subpart W rule (attached).

- (page 11) We removed the reference from our discussion of CAA Section 112 (q) to the 10 year requirement to review/revise NESHAP rule promulgated before 1990.
- (page 31) We removed the discussion of the risk assessment from the section on what information we gathered for the rulemaking. We then placed it in its own section and added a sentence or two about why we performed the risk assessment. (page 42). OAQPS wanted us to emphasize that we were under no obligation to perform a risk assessment in terms of setting a GACT standard, and that it was for public informational purposes only.
- Replaced the work "risk" in some sentences (where possible) to further downplay that we were not basing our GACT standards on risk.

After your review we'll send it back to OGC, and Wendy Blake would like to look over the package again before we send it to OAQPS to make sure we have addressed their issues. Please let me know if you have any comments or questions. Thanks.

[attachment "FR Proposal for Revision of Subpart W Final (ss 091212__rjr).docx" deleted by Susan Stahle/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-5280

Wendy Blake/DC/USEPA/US	To	Susan Stahle
09/19/2012 09:18 AM	cc	
	bcc	
	Subject	Re: Fw: Subpart W Package

thanks

Wendy L. Blake
U.S. Environmental Protection Agency
Office of General Counsel
phone: (202) 564-1821
fax: (202) 564-5603

Susan Stahle Hi Eric -- Below is a revised version of t... 09/19/2012 09:16:23 AM

From: Susan Stahle/DC/USEPA/US
To: Eric Ginsburg/RTP/USEPA/US@EPA
Cc: Reid Rosnick/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA, Wendy Blake/DC/USEPA/US@EPA
Date: 09/19/2012 09:16 AM
Subject: Fw: Subpart W Package

Hi Eric --

Below is a revised version of the subpart W package that includes changes to reflect the discussion we had last week.

Wendy indicated to me that she will review this package once she clears her plate of other section 112 packages with immediate deadlines.

Please let Reid or me know if you have any questions on any aspect of the package.

Thanks,

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov
----- Forwarded by Susan Stahle/DC/USEPA/US on 09/19/2012 09:13 AM -----

From: Reid Rosnick/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Jonathan Edwards/DC/USEPA/US@EPA, Alan Perrin/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA
Date: 09/14/2012 10:18 AM

Subject: Subpart W Package

Sue,

Attached is the clean copy of the package, along with the marked up version in case you want it. Please let me know if you have any questions. Thanks. Have a great weekend.

Reid

[attachment "FR Proposal for Revision of Subpart W Final (9_14_12).docx" deleted by Wendy Blake/DC/USEPA/US] [attachment "FR Proposal for Revision of Subpart W Final (ss 091312 rjr).docx" deleted by Wendy Blake/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Eric Ginsburg/RTP/USEPA/US

09/19/2012 11:14 AM

To Susan Stahle
cc Reid Rosnick, Tom Peake, Wendy Blake
bcc
Subject Re: Fw: Subpart W Package

Thank you, Sue, I will review it this afternoon and coordinate with the right folks in my division. So folks know, Marguerite McLamb is a policy advisor in our front office, and Keith Barnett is the group leader for our Minerals and Manufacturing Group that has responsibility for those NESHAP most closely related to the Subpart W rule, so I've share the package with them and with Lisa Conner, group leader for our Policies and Strategies Group, who is responsible for ensuring policy consistency across the section 112 rules.

****

Eric O. Ginsburg
Senior Program Advisor
Sector Policies and Programs Division (D205-01)
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Ph: (919) 541-0877
Fax: (919) 541-4991

Please Note: I work a part-time schedule and am in the office on Tuesdays and Thursdays, available by email or voice mail on Wednesday afternoons. If you attempt to contact me at other times, I will reply to your message as soon as I am able.

-----Susan Stahle/DC/USEPA/US wrote: -----
To: Eric Ginsburg/RTP/USEPA/US@EPA
From: Susan Stahle/DC/USEPA/US
Date: 09/19/2012 09:16AM
Cc: Reid Rosnick/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA, Wendy Blake/DC/USEPA/US@EPA
Subject: Fw: Subpart W Package

Hi Eric --

Below is a revised version of the subpart W package that includes changes to reflect the discussion we had last week.

Wendy indicated to me that she will review this package once she clears her plate of other section 112 packages with immediate deadlines.

Please let Reid or me know if you have any questions on any aspect of the package.

Thanks,

Susan Stahle
Air and Radiation Law Office (Rm 7502B)
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (ARN: MC 2344A)
Washington, D.C. 20460
ph: (202) 564-1272
fax: (202) 564-5603
stahle.susan@epa.gov
----- Forwarded by Susan Stahle/DC/USEPA/US on 09/19/2012 09:13 AM -----

From: Reid Rosnick/DC/USEPA/US
To: Susan Stahle/DC/USEPA/US@EPA
Cc: Jonathan Edwards/DC/USEPA/US@EPA, Alan Perrin/DC/USEPA/US@EPA, Tom Peake/DC/USEPA/US@EPA, Daniel Schultheisz/DC/USEPA/US@EPA
Date: 09/14/2012 10:18 AM
Subject: Subpart W Package

Sue,

Attached is the clean copy of the package, along with the marked up version in case you want it. Please let me know if you have any questions. Thanks. Have a great weekend.

Reid

(See attached file: FR Proposal for Revision of Subpart W Final (9_14_12).docx)(See attached file: FR Proposal for Revision of Subpart W Final (ss 091312 rjr).docx)

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

[attachment "FR Proposal for Revision of Subpart W Final (9_14_12).docx" removed by Eric Ginsburg/RTP/USEPA/US]
[attachment "FR Proposal for Revision of Subpart W Final (ss 091312 rjr).docx" removed by Eric Ginsburg/RTP/USEPA/US]

EPA-4390

Reid Rosnick/DC/USEPA/US

09/24/2012 10:00 AM

To

cc Daniel Schultheisz, Susan Stahle, Tom Peake

bcc

Subject Invitation: Subpart W Stakeholders Conference Call (Oct 4 11:00 AM EDT in 1310L Room 502/DC-1310L-OAR@EPA)

EPA-425

Reid Rosnick/DC/USEPA/US
09/25/2012 08:11 AM

To Beth Miller
cc
bcc
Subject Re:

Hi Beth,

Since each email has its own subject I assume you want to know how it should be posted on the web site. I think we should call it "Archived Emails." What do you think?

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

-----Beth Miller/DC/USEPA/US wrote: -----
To: Reid Rosnick/DC/USEPA/US@EPA
From: Beth Miller/DC/USEPA/US
Date: 09/25/2012 07:57AM
Subject: Re:

Hi Reid

Hate to bother you but what would you like the subject to be for all these compiled emails. If you feel like calling me you may do so 301-752-3045. Thanks

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Inactive hide details for Reid Rosnick---09/20/2012 08:48:01 AM--Reid Rosnick---09/20/2012 08:48:01 AM--

From: Reid Rosnick/DC/USEPA/US
To: Beth Miller/DC/USEPA/US@EPA
Date: 09/20/2012 08:48 AM

Subject:

[attachment "Subpart W emails.docx" deleted by Beth Miller/DC/USEPA/US]

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-798

Reid Rosnick/DC/USEPA/US
09/26/2012 08:48 AM

To Beth Miller
cc
bcc
Subject Method 115

Hi Beth,

How did your surgery go? I hope you're not in too much pain.

You called me yesterday about an attachment for Method 115. Recall that we talked about this last week, and it's already on the Subpart W website. You were just going to link to it from the email in question. Call me if you have any questions. Thanks!

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-559

Beth Miller/DC/USEPA/US
09/27/2012 12:23 PM

To Reid Rosnick
cc
bcc
Subject help this is not going to the correct thing you may call me on 3017523045

7/7/2011

Reid,

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223
~~~~~~

Reid Rosnick/DC/USEPA/US
09/27/2012 01:38 PM

To Beth Miller
cc
bcc
Subject Re: help this is not going to the correct thing you may call me on 3017523045

Well, while I support breast feeding as much as the next guy, it appears that the link to this letter has been broken. I suggest we just say that the link to the letter has been broken.

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

-----Beth Miller/DC/USEPA/US wrote: -----
To: Reid Rosnick/DC/USEPA/US@EPA
From: Beth Miller/DC/USEPA/US
Date: 09/27/2012 12:23PM
Subject: help this is not going to the correct thing you may call me on 3017523045

7/7/2011

Reid,

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

Please consider the environment before printing this e-mail.
~~~~~~

Beth Miller
202-343-9223

EPA-78

Sarah Fields
<sarah@uraniumwatch.org>
09/17/2012 02:32 PM

To Reid Rosnick
cc
bcc
Subject Subpart W Review and Rulemaking

2 attachments

TAC Ltr to NRC - UBHM & Ablation July 2012.pdf
NRC Response 8-8-12 to UBHM.Ablation Ltr.pdf

Dear Reid,

I wish to bring to you attention an in situ uranium recovery technology that the Environmental Protection Agency (EPA) must address in its Subpart W review and rulemaking. The process of underground borehole mining (UBHM) has been proposed in Colorado.

For your information, I am sending you a copy of a recent letter from the Nuclear Regulatory Commission (NRC) to the Tallehassee Area Community regarding whether Colorado, as an NRC Agreement State, has regulatory jurisdiction for this kind of uranium recovery technology. The NRC letter states that uranium recovery operations using this technology would be regulated by the Colorado Dept. of Public Health and Environment. Therefore, The EPA must address the aspects of this process that would be subject to 40 CFR Part 61, Subpart W. For the surface facilities associated with this technology that fall under Atomic Energy Act and NRC/Agreement State authority, the EPA must determine how the radionuclide emissions would be regulated under Subpart W.

I am also enclosing the Tallehassee letter to the NRC.

Sincerely,

Sarah Fields
Uranium Watch
PO Box 344
Moab, Utah 84532
435-259-9450

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 8, 2012

Lee J. Alter, Chairman
Government Affairs Committee
Tallahassee Area Community, Inc.
0489 Fremont County Road 21A
Cañon City, Colorado 81212

SUBJECT: INQUIRY REGARDING UNDERGROUND BORE HOLE MINING AND ABLATION TECHNOLOGIES FOR URANIUM RECOVERY

Dear Mr. Alter:

The U.S. Nuclear Regulatory Commission (NRC) is in receipt of your letter dated July 12, 2012, addressed to Bill Von Till and myself, regarding your concerns about the emerging technologies in uranium recovery including ablation technologies in the State of Colorado. After reviewing the issues related to Underground Bore Hole Mining and Impact Ablation, the NRC staff determined that the Colorado Department of Public Health and the Environment (CDPHE) is the regulatory authority with jurisdiction on these matters within the State of Colorado.

It is our understanding that although there have not yet been any applications submitted to CDPHE for licenses or permits requesting use of this technology in the State of Colorado; there are companies in Colorado investigating the possibility of doing so in the near future. The NRC will defer to the CDPHE to communicate with their potential licensees in this area to better understand the process that will be utilized in implementing this new technology. CDPHE may request technical assistance from the NRC to address this new technology for uranium recovery. Until then, the NRC will continue to monitor the state of the technology in order to consider what regulatory changes will be necessary should companies request NRC authority to utilize such technology for uranium recovery.

If you have any further questions or concerns regarding ablation technologies and their implementation in the State of Colorado, we suggest that you direct them to Steve Tarlton, Program Manager, at (303) 692-3423 or steve.tarlton@state.co.us.

Sincerely,

Duncan White, Branch Chief
Agreement State Programs Branch
Division of Materials Safety and State Agreements
Office of Federal and State Materials
and Environmental Management Programs

cc:
Steve Tarlton, Program Manager

Tallahassee Area Community, Inc.
Fremont County, Colorado

Board of Directors
P.O .Box 343
Cañon City, Colorado 81212
(www.taccolorado.com)

July 12, 2012

U.S Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attention:
Mr. Duncan White, Branch Chief, Agreement State Programs;
Division of Materials Safety and State Agreements
Mr. Randolph (Bill) Von Till, Branch Chief, Uranium Recovery ;
Division of Waste Management and Environmental Protection

Federal and State Materials and Environmental Management Programs

Via email attachment (Duncan.White@nrc.gov; RWV@nrc.gov)

Dear Mr. White and Mr. Von Till:

This letter is related to the reference to Emerging Technologies in Uranium Recovery at the recent April 17, 2012 IMPEP review meeting with the Radiation Management Unit of the Colorado Department of Public Health and Environment (CDPHE). Black Range Minerals, Ltd. (ASX:BLR) has made numerous recent announcements regarding their expected utilization of both Underground Bore Hole Mining (UBHM) and Ablation technologies for uranium recovery at their Hansen/Taylor Ranch Uranium Project. Please see: www.blackrangeminerals.com, Investor Relations, ASX Announcements.

The Tallahassee Area Community, Inc. (TAC) is a Colorado not-for-profit organization consisting of residents and property owners in the Tallahassee area of northwest Fremont County, Colorado who are concerned about the potential adverse human health and environmental impacts of large scale uranium exploitation in the immediate vicinity. Please see: www.taccolorado.com.

Both UBHM and Ablation for uranium recovery are acknowledged experimental technologies. To the best of our knowledge, neither have ever been used commercially nor have been specifically considered in NRC or Agreement State regulations or guidance.

TAC believes that their regulatory status is unclear and that there appears to be a conflict between NRC and Colorado definitions and possible interpretations with respect to the question of whether either or both of these technologies should require the issuance of Colorado Radioactive Materials Licenses.

A. **Underground Bore Hole Mining**

1. Black Range, and its consultant Kinley Exploration, LLC, describes the process as the injection of high pressure water, without added chemicals, into large bore holes drilled to the depth of the targeted uranium ore body which then, by use of an "under reamer", excavates a "cavern" by fragmenting the uranium containing rock and returning those fragments to the surface as a water slurry. http://www.blackrangeminerals.com/content/wpcontent/uploads/2012/05/New/BlackRangeSelectsDevelopmentApproachForHansenDeposit26Apr12.pdf

2. The company has not disclosed many details about the process ,however, TAC research has revealed that up to 50,000 gallons per hour of water pressurized to 1000 - 1500 psi or greater would be required to fragment the sandstone-embedded uranium ore body.

3. The water recovered from the slurry would be reused -- supplemented with make-up water, re pressurized and re injected into the bore hole -- until the cavern is exhausted of the targeted material.

4. It is, at present, unknown what concentration of atmospheric oxygen would be dissolved in the water injected into the bore hole. It would surely be greater than for water at standard temperature and pressure conditions. Oxidation of insoluble uranium oxide to the soluble state, depending on the pH and other conditions in the cavern, would be enhanced. It is expected that as the water is reused, the concentration of uranium, other radioactive constituents , and heavy metals would increase.

5. Some portion of this high pressure water would inevitably be forced out of the cavern into the surrounding sandstone aquifer and threaten the quality of the groundwater and local domestic water wells. Ultimately, the remaining water would be impounded on the surface and presumably left to evaporate away.

6. While UBHM poses many of the same environmental issues as does In-Situ Leach Uranium Recovery, it does not meet the current definition since only the fragmented ore pieces are processed for its uranium content; the "leachate" is not processed for recovery of uranium but rather would be treated as waste.

7. The Colorado Hard Rock Mining Rules distinguish between In-Situ Leach Uranium Mining, which it regulates concurrently with CDPHE, and In-Situ Mining. However, the point at which uranium mining ends and uranium processing begins appears to be defined by conflicting definitions of CDPHE and NRC. The difference is: precisely when does "ore" becomes "source material". CDPHE regulations specify that uranium ore prior to chemical processing is not source material but rather the product of mining. The NRC Office of General Counsel has ruled to the contrary.

8. OGC has said that the line between "mining" and "processing" is drawn at the point of "unrefined and unprocessed ore" in its "natural form" and when "its gross appearance...has not been altered from the point of mining". http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos184.html.

TAC believes that it is reasonable and prudent, in view of health & safety and environmental considerations of the UBHM technique, that the fragmenting of ore in the underground cavern be considered as a uranium processing activity requiring (in Colorado) a Radioactive Material License.

B. Ablation

1. The name of the technology should properly be "Impact Ablation" to distinguish this uranium concentration process from Laser Ablation, which is used to identify minerals and in other applications.

2. Black Range and Ablation Technologies, LLC, its consultant and recently announced Joint Venture partner, describes the process as follows: " In ablation, the slurry from UBHM is ejected from two opposing injection nozzles to create a high energy impact zone. This high energy impact separates the mineralized patina of uranium from the underlying grain. The uranium bearing particles are found in the fine fractions separated in a subsequent screening process. As tested on material from Hansen, ablation allows approximately 90% of barren material to be separated from mineralized material prior to milling, greatly reducing the total OPEX and CAPEX costs to process mineralized material. The final product is an "ablated concentrate" which consists of approximately 10% of the original mineralized material, which will be processed with conventional milling techniques." http://www.blackrangeminerals.com/content/wp-content/uploads/2012/07/07-06-2012-BLR-Secures-Rights-to-Ablation-Technology.pdf. (Emphasis added).

3. Clearly, the company does not consider that this process is "milling" and subject to licensing by CDPHE. It appears to be relying on the Colorado Radiation Control Regulations definition of "ore" as a product of mining and before it becomes "source material". ""Ore" means naturally occurring uranium-bearing, thorium-bearing, or radium-bearing material in its natural form, to be processed for its uranium or thorium content, prior to chemical processing including but not limited to roasting, beneficiating, or refining, and specifically includes material that has been physically processed, such as by crushing, grinding, screening, or sorting." 6 CCR 1007-1 Part 1.2 Definitions. (Emphasis included in the recent PowerPoint presentation by the Black Range Vice President of Regulatory Affairs to the National Mining Association in Denver). http://www.nma.org/pdf/urw_2012/grebb.pdf

4. Regardless of the determined status of the UBHM fragmented ore in the cavern, the material undergoing impact ablation is being subjected to source material processing and the resultant waste, both the "barren" rock and process water, is 11e.(2) byproduct material. The high energy impact which separates the uranium grains from the "barren" rock is the functional equivalent of crushing or grinding. The grains are then separated and sized by a screening and elutriation process to isolate the "ablated concentrate" which is then transported off-site to a conventional mill for final processing into yellowcake.

5. As stated in 40 CFR 261.4(b)(7) the beneficiation of ore (including uranium ore) includes every one of those steps. The fact that they would be done at other than a conventional mill does not change the fact that impact ablation is a milling activity subject to a Radioactive Materials License.

6. In the 2002 Office of General Counsel document entitled *Uranium Milling Activities at Sequoyah Fuels Corporation* , the question of "What Constitutes Uranium Milling" was considered: "A fundamental,

plain-language, working definition of uranium milling can be constructed from the somewhat circular references contained in the ... regulatory definitions (in 10 CFR 40.4, of uranium milling, byproduct material and source material): Uranium milling is an activity or series of processes that extracts or concentrates uranium or thorium from any ore primarily for its source material content, and the resulting tailings or waste are 11e.(2) byproduct material." http//www.nrc.gov/reading-rm/doc-collections/commission/secys/2002/secy2002-0095/attachment5.pdf.

7. The OGC document further discussed non-conventional milling and milling at multiple locations. It stated: " Non-conventional processing ... comprise other technologies.... The distinction among non-conventional milling activities is that these activities often occur at locations other than a uranium mill.... Uranium milling entails many processing steps , which ... are not required to occur at a single location, but often do."

We respectfully request that you consider the regulatory status of both UBHM and Impact Ablation uranium recovery technologies as promptly as possible since Black Range is expected to finalize their intentions for the Hansen/Taylor Ranch Uranium Project by the end of 2012.

Thank you for your attention. I look forward to your response.

Respectfully submitted,

Lee J Alter
Chairman, Government Affairs Committee
Tallahassee Area Community, Inc.

0489 Fremont County Road 21A
Cañon City, Colorado 81212
719.276.0864
AlterConsult@Starband.net

EPA-88

"Sweeney,Katie"
<KSweeney@nma.org>
08/02/2012 01:31 PM

To Reid Rosnick
cc
bcc
Subject Radon Presentation

1 attachment

Paulson Presentation.pdf

Reid,

Please add this presentation to the Subpart W webpage http://www.epa.gov/rpdweb00/neshaps/subpartw/rulemaking-activity.html as a National Mining Association comment. Thanks.

Katie

Katie Sweeney
General Counsel
National Mining Association
101 Constitution Avenue, Suite 500 East
Washington, DC 20001

ksweeney@nma.org
202/463-2627

National Mining Association

Experimental Determination of Radon Fluxes over Water

NMA™
THE AMERICAN RESOURCE

Introduction

- This presentation will:
  - Discuss prior information regarding radon fluxes from water surfaces
  - Discuss laboratory research funded by the National Mining Association (NMA) regarding radon fluxes from water surfaces.
  - Compare the results of the research with previously reported data.
  - Show that radon fluxes from most water surfaces at uranium recovery operations are insignificant and approximate background soil fluxes for most areas.

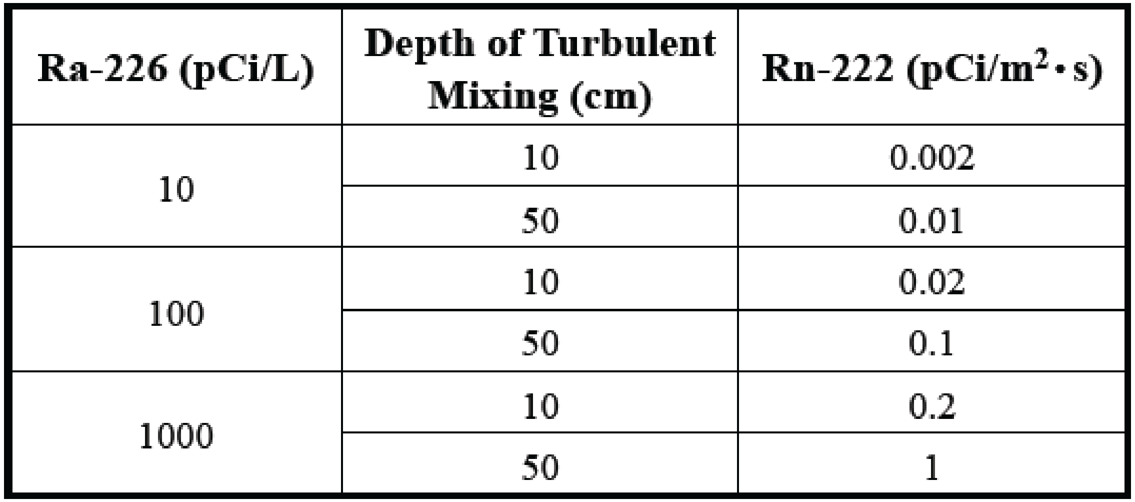
NMA™
THE AMERICAN RESOURCE

Prior Work

- Information regarding radon fluxes from water surfaces has been presented on the following two (2) occasions:
  - *Radon Emissions From Tailings Ponds* - Dr. Douglas B. Chambers - July 2, 2009
  - *Radon Flux from Evaporation Ponds* – Dr. Kenneth R. Baker, Ph.D. Environmental Restoration Group, Inc and Alan D. Cox - Homestake Mining Company of California

Prior Work - *continued*

- *Radon Emissions From Tailings Ponds* - Dr. Douglas B. Chambers - July 2, 2009
  - Discussed Rn-222 gas exchange via diffusion from the surface of a small lake (Experimental lakes, Ontario)
  - Concluded that Radon-222 releases were low as shown in the table below:



Ra-226 (pCi/L)	Depth of Turbulent Mixing (cm)	Rn-222 ($pCi/m^2 \cdot s$)
10	10	0.002
	50	0.01
100	10	0.02
	50	0.1
1000	10	0.2
	50	1

Prior Work - *continued*

- *Radon Flux from Evaporation Ponds* – Dr. Kenneth R. Baker, Ph.D. Environmental Restoration Group, Inc and Alan D. Cox - Homestake Mining Company of California
  - Measured radon flux from an evaporation pond using modified floating Large Area Activated Charcoal Canisters (LAACCs)
  - Concluded that radon fluxes obeyed the Stagnant Film Model (SFM) and that flux rates in picoCuries per meter2-second were approximately 0.01 times the Radium-226 activity of the water. The Radon-222 activity of the water was not measured in this experiment and was assumed to be in equilibrium with the dissolved Radium-226.
  - A picture of the floating Large Area Activated Charcoal Canister (LAACC) used is shown below:

Discussion of Prior Work

- Both prior experiments were performed in outdoor environments specifically in experimental lakes or evaporation ponds under non-laboratory conditions.
- No specific data regarding actual Radon-222 activity of the water was provided for either experiment.

Purpose of this Research

- This current research was performed to determine Radon-222 flux at the surface of water containing Radium-226 and Radon-222 under controlled laboratory conditions using an accepted method of determining Radon – 222 flux, specifically using Large Area Activated Charcoal Canisters (LAACCs) as described in *Radon Flux Measurements on Gardiner and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida* since this is the currently accepted method of determining radon flux in Method 115 referenced in 40 CFR Part 61.253 *Determining compliance*.
- In this way, data gathered in the course of this study can be effectively compared with other data collected in prior compliance monitoring work using Large Area Activated Charcoal Canisters (LAACCs) since the measurement method is the same.

NMA™
THE AMERICAN RESOURCE

Testing Protocol

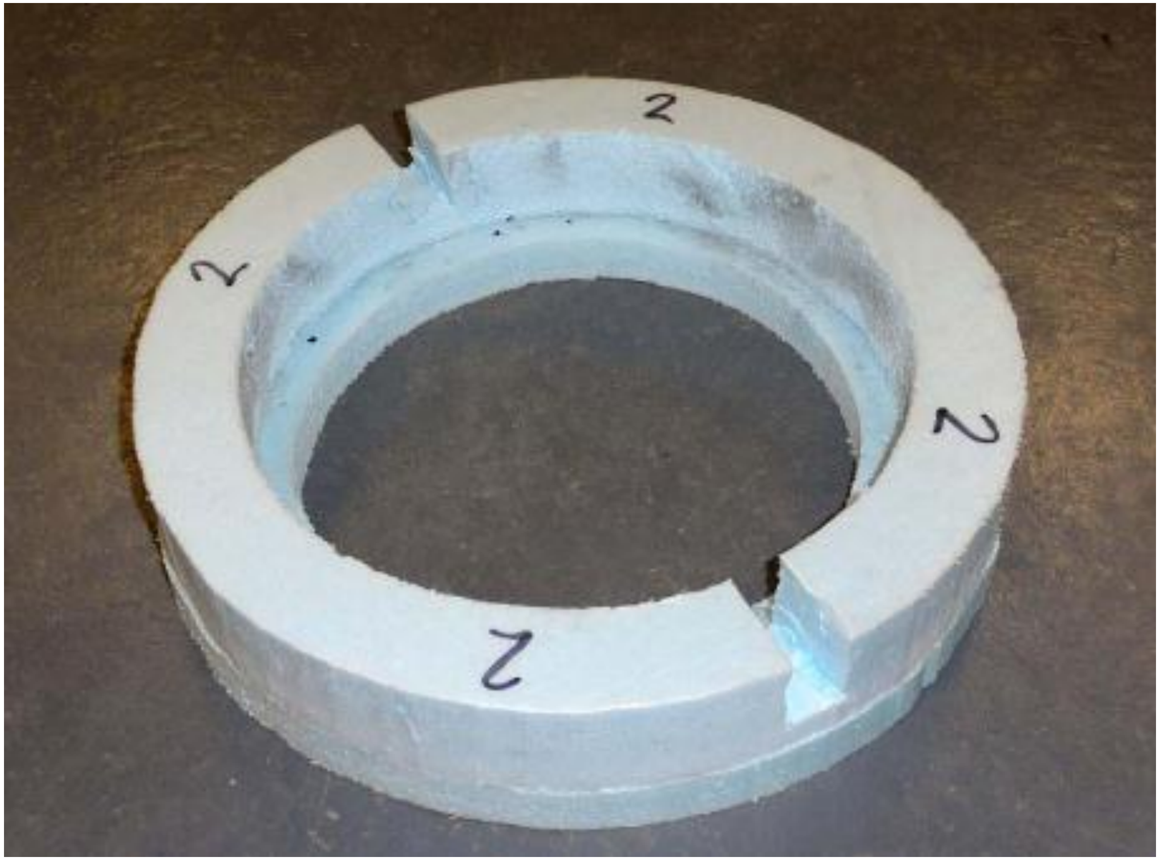
- Five (5) barrels containing deionized water with the following Radium-226 activities were created using a traceable Radium-226 standard:
  - 0 picoCuries per liter (water with no added Radium-226)
  - 5,000 picoCuries per liter
  - 10,000 picoCuries per liter
  - 15,000 picoCuries per liter
  - 20,000 picoCuries per liter

The solutions were placed in barrels as shown below:

The Radium – 226 in the solutions in the barrels was allowed to attain radiometric equilibrium with the Radon-222 by being allowed to sit covered for forty (40) days (slightly over ten (10) half lives for Radon-222).

Testing Protocol *continued*

- Styrofoam floats were created to float the Large Area Activated Charcoal Canisters (LAACCs) over the water in the barrels as shown below:



Testing Protocol *continued*

- The Large Area Activated Charcoal Canisters (LAACCs) were installed in the floats as shown below:

The Large Area Activated Charcoal Canisters (LAACCs) fit snugly in the float to create a seal.
They are similar in appearance to the ones used by Dr. Kenneth R. Baker.

Testing Protocol continued

- The Large Area Activated Charcoal Canisters (LAACCs) were floated on top of the Radium-226/Radon-222 bearing water in the barrels as shown below:

The weight of the Large Area Activated Charcoal Canister (LAACC) unit presses the float into the water creating a seal between the water and the float.

Testing Protocol *continued*

- Barrels of Radium-226 solution were prepared.
- The analysis results for the barrels were as follows:

Barrel Number	**Prepared Radium-226 Activity**	**Measured Radium-226 Activity**	**Measured Radon-222 Activity**
	pCi/L	**pCi/L**	**pCi/L**
1	0.0	-0.5	32. 4
2	5,000.	4,580.	5500.
3	10,000.	9,450.	11000.
4	15,000.	13,900.	16600.
5	20,000.	19,200.	21500.

•The barrels were allowed to attain radiometric equilibrium for forty (40) days (slightly over ten (10) half lives for Radon-222).
•A very high Radium-226 activity (higher than would be encountered in operations) was used to test relationships under extreme conditions.
•Data reported to the number of significant figures provided in final report.

Testing Results

Test Summary

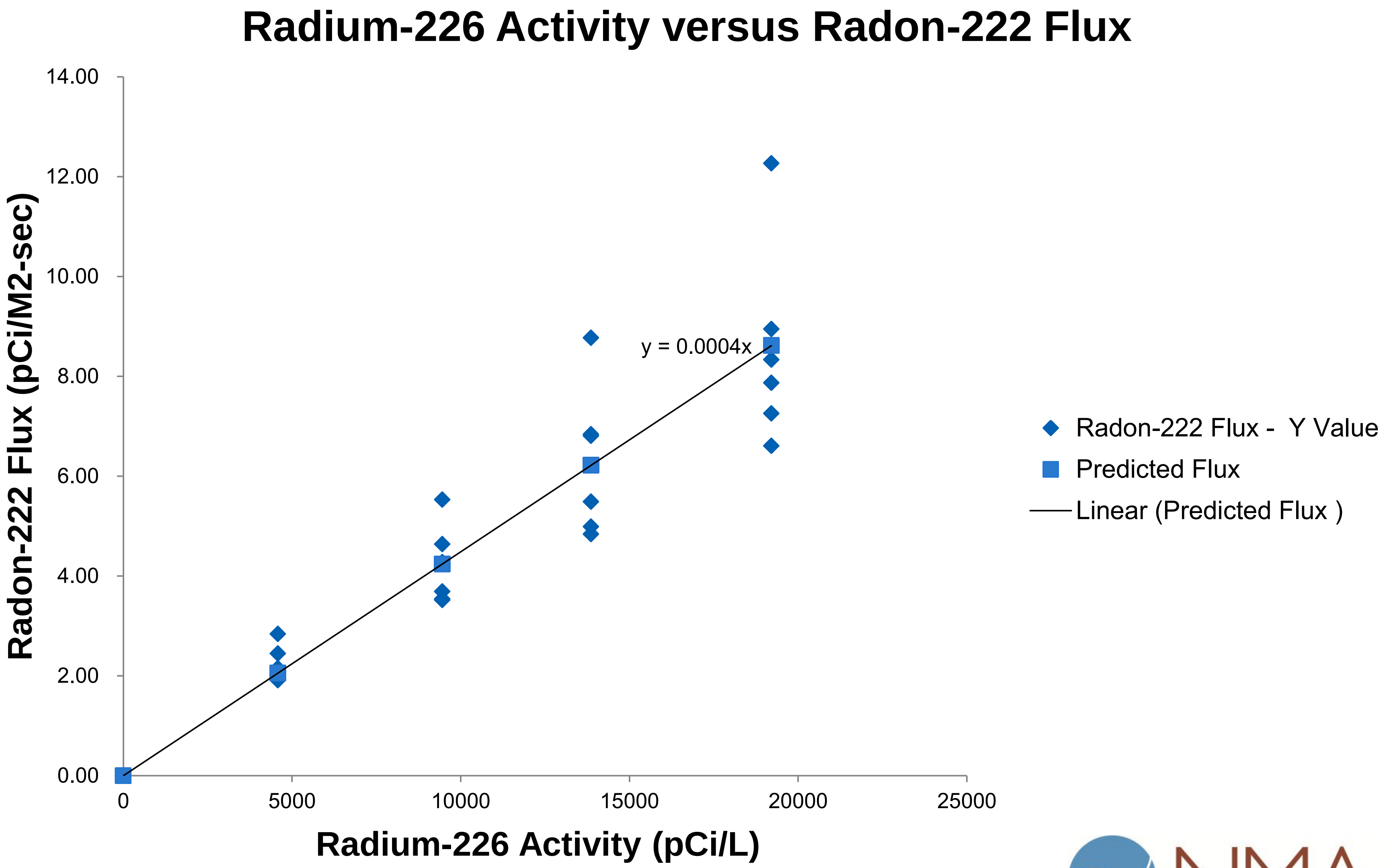
	Date Canister Set	Date Canister Removed	Radium-226 Activity Reported	Radium-226 Activity Used	Radon-222 Activity	Reported Flux Rate	Flux rate Used
			pCi/L	pCi/L	pCi/L	pCi/M2-sec	pCi/M2-sec
Day 1	7/31/11	8/1/11	-0.5	0.0	32. 4	<0.5	0.0
Day 1	7/31/11	8/1/11	4,580.	4,580.	5500.	2.8	2.8
Day 1	7/31/11	8/1/11	9,450.	9,450.	11000.	5.6	5.6
Day 1	7/31/11	8/1/11	13,900.	13,900.	16600.	8.8	8.8
Day 1	7/31/11	8/1/11	19,200.	19,200.	21500.	12.	12.
Day 2	8/1/11	8/2/11	-0.5	0.0	32. 4	<0.5	0.0
Day 2	8/1/11	8/2/11	4,580.	4,580.	5500.	2.4	2.4
Day 2	8/1/11	8/2/11	9,450.	9,450.	11000.	4.3	4.3
Day 2	8/1/11	8/2/11	13,900.	13,900.	16600.	6.8	6.8
Day 2	8/1/11	8/2/11	19,200.	19,200.	21500.	8.3	8.3
Day 3	8/2/11	8/3/11	-0.5	0.0	32. 4	<0.5	0.0
Day 3	8/2/11	8/3/11	4,580.	4,580.	5500.	2.2	2.2
Day 3	8/2/11	8/3/11	9,450.	9,450.	11000.	4.6	4.6
Day 3	8/2/11	8/3/11	13,900.	13,900.	16600.	6.8	6.8
Day 3	8/2/11	8/3/11	19,200.	19,200.	21500.	8.9	8.9
Day 4	8/3/11	8/4/11	-0.5	0.0	32. 4	<0.5	0.0
Day 4	8/3/11	8/4/11	4,580.	4,580.	5500.	1.9	1.9
Day 4	8/3/11	8/4/11	9,450.	9,450.	11000.	3.7	3.7
Day 4	8/3/11	8/4/11	13,900.	13,900.	16600.	5.5	5.5
Day 4	8/3/11	8/4/11	19,200.	19,200.	21500.	7.3	7.3
Day 5	8/4/11	8/5/11	-0.5	0.0	32. 4	<0.5	0.0
Day 5	8/4/11	8/5/11	4,580.	4,580.	5500.	2.0	2.0
Day 5	8/4/11	8/5/11	9,450.	9,450.	11000.	3.5	3.5
Day 5	8/4/11	8/5/11	13,900.	13,900.	16600.	4.8	4.8
Day 5	8/4/11	8/5/11	19,200.	19,200.	21500.	7.9	7.9
Day 6	8/5/11	8/6/11	-0.5	0.0	32. 4	<0.5	0.0
Day 6	8/5/11	8/6/11	4,580.	4,580.	5500.	2.0	2.0
Day 6	8/5/11	8/6/11	9,450.	9,450.	11000.	3.5	3.5
Day 6	8/5/11	8/6/11	13,900.	13,900.	16600.	5.0	5.0
Day 6	8/5/11	8/6/11	19,200.	19,200.	21500.	6.6	6.6

Notes:

- Reported Radium-226 activity of -0.51 set to zero for calculation purposes.
- Reported Radon-222 flux of <0.5 set to zero for calculation purposes
- Data reported to the number of significant figures provided in final report.

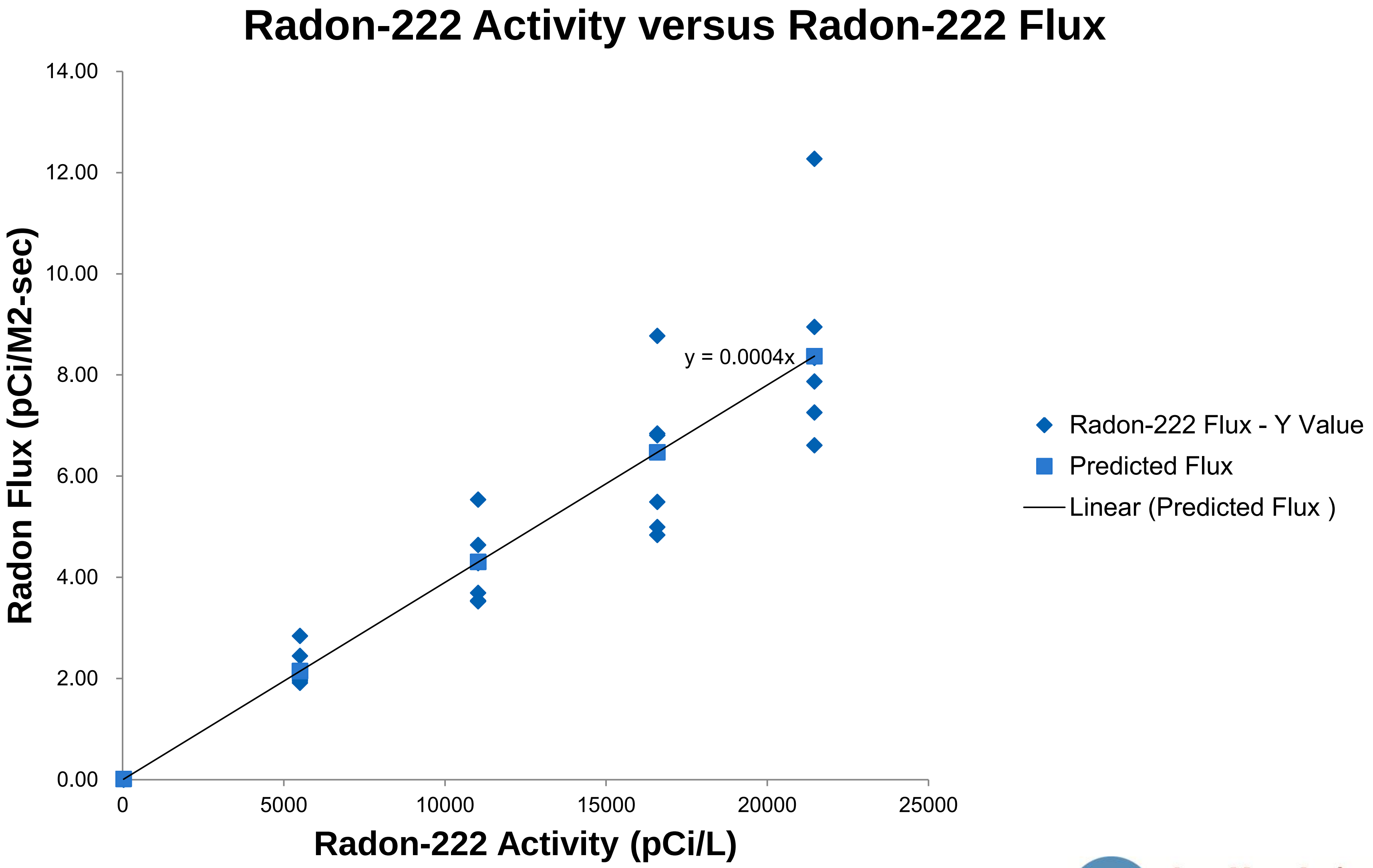
NMA™
THE AMERICAN RESOURCE

Radium-226 Activity versus Radon-222 Flux Rate



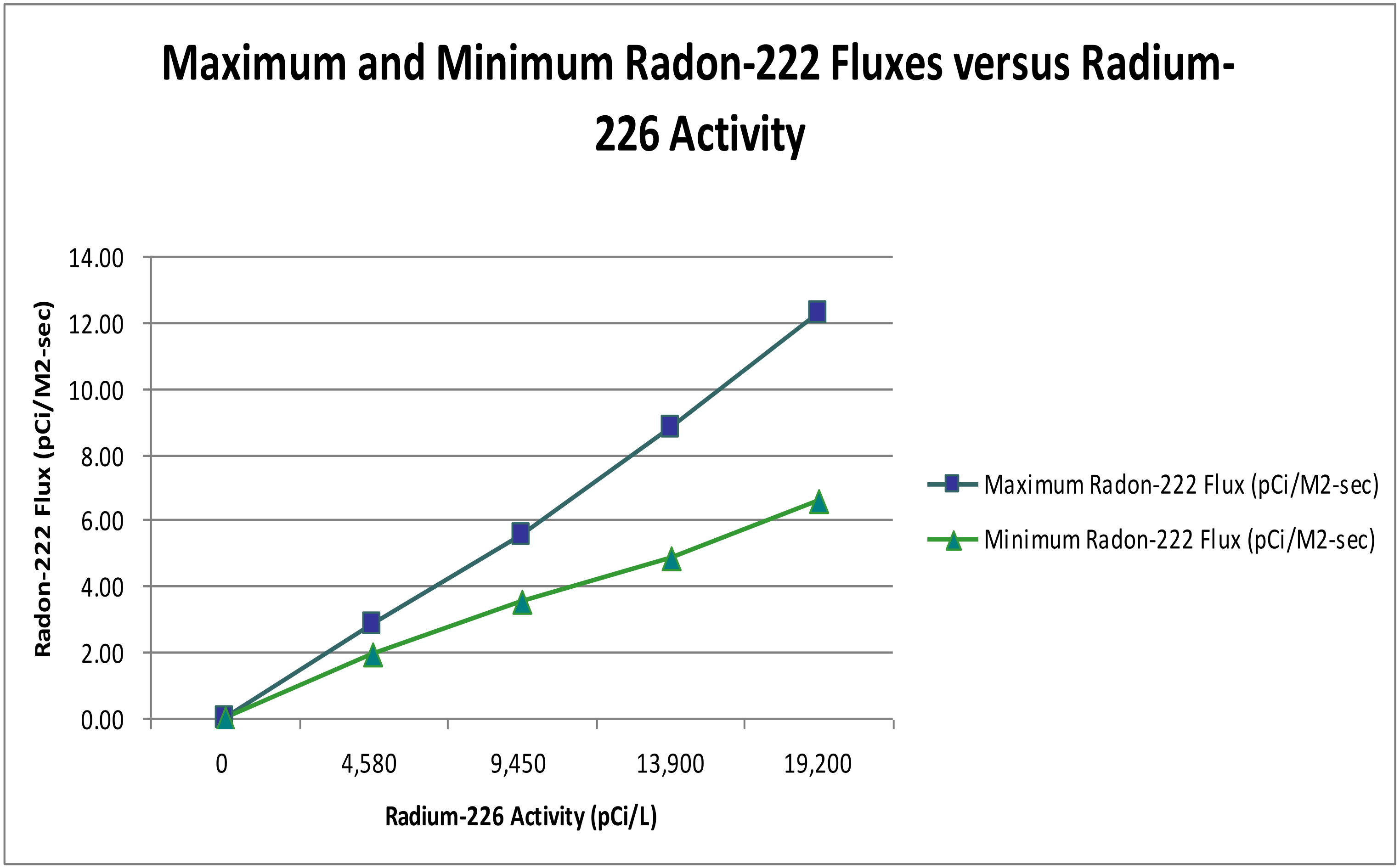
Note: The R^2 (correlation coefficient squared) value is 0.96, showing good linear correlation.

Radon-222 Activity versus Radon-222 Flux Rate



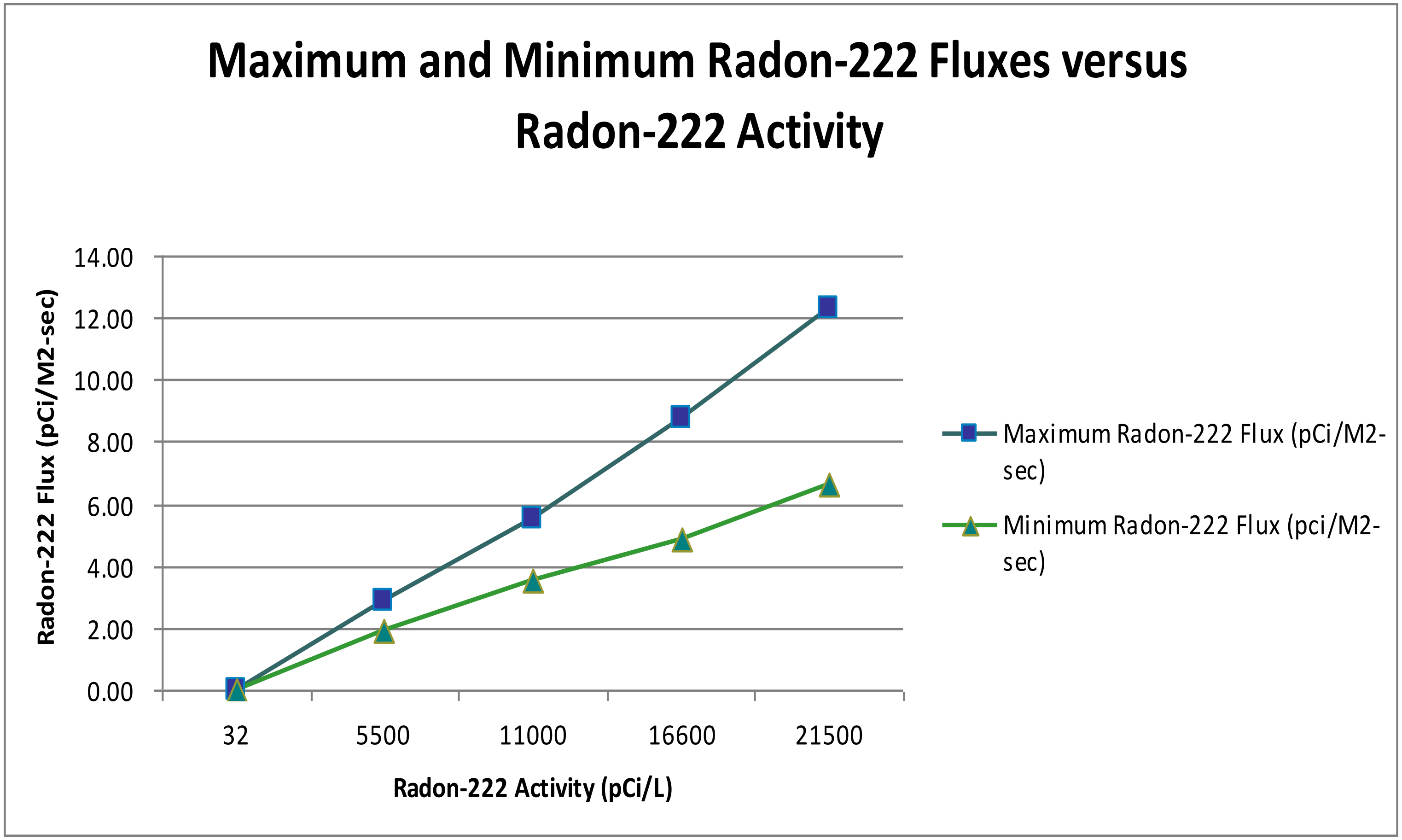
Note: The R^2 (correlation coefficient squared) value is 0.96, showing good linear correlation.

Maximum and Minimum Radon-222 Fluxes versus Radium-226 Activity of the Water



Maximum Slope = 0.00064
Minimum Slope = 0.00034
Average Slope = 0.0004 (previous slide)

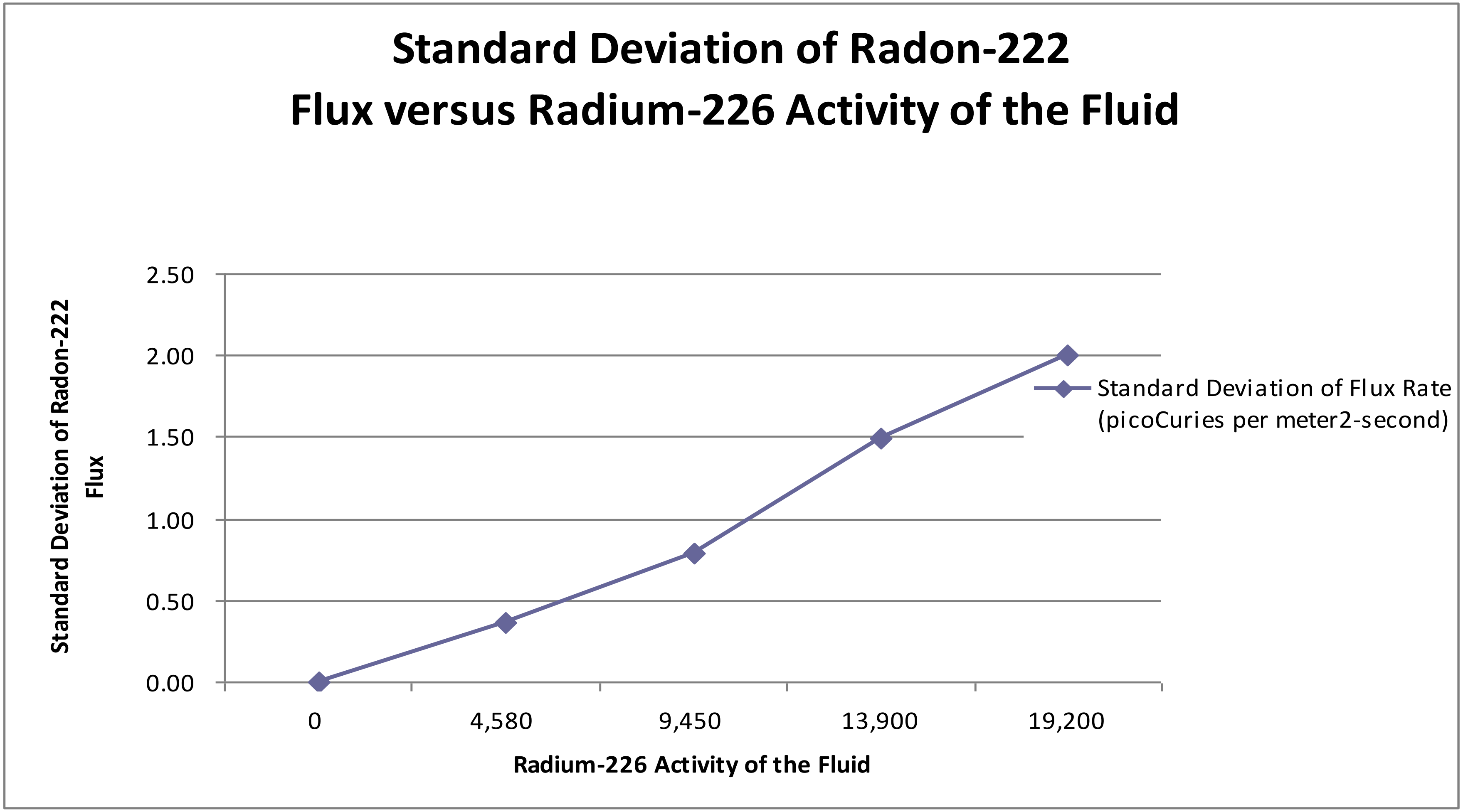
Maximum and Minimum Radon-222 Fluxes versus Radon-222 Activity of the Water



Maximum Slope = 0. 00057
Minimum Slope = 0.00031
Average Slope = 0.0004 (previous slide)

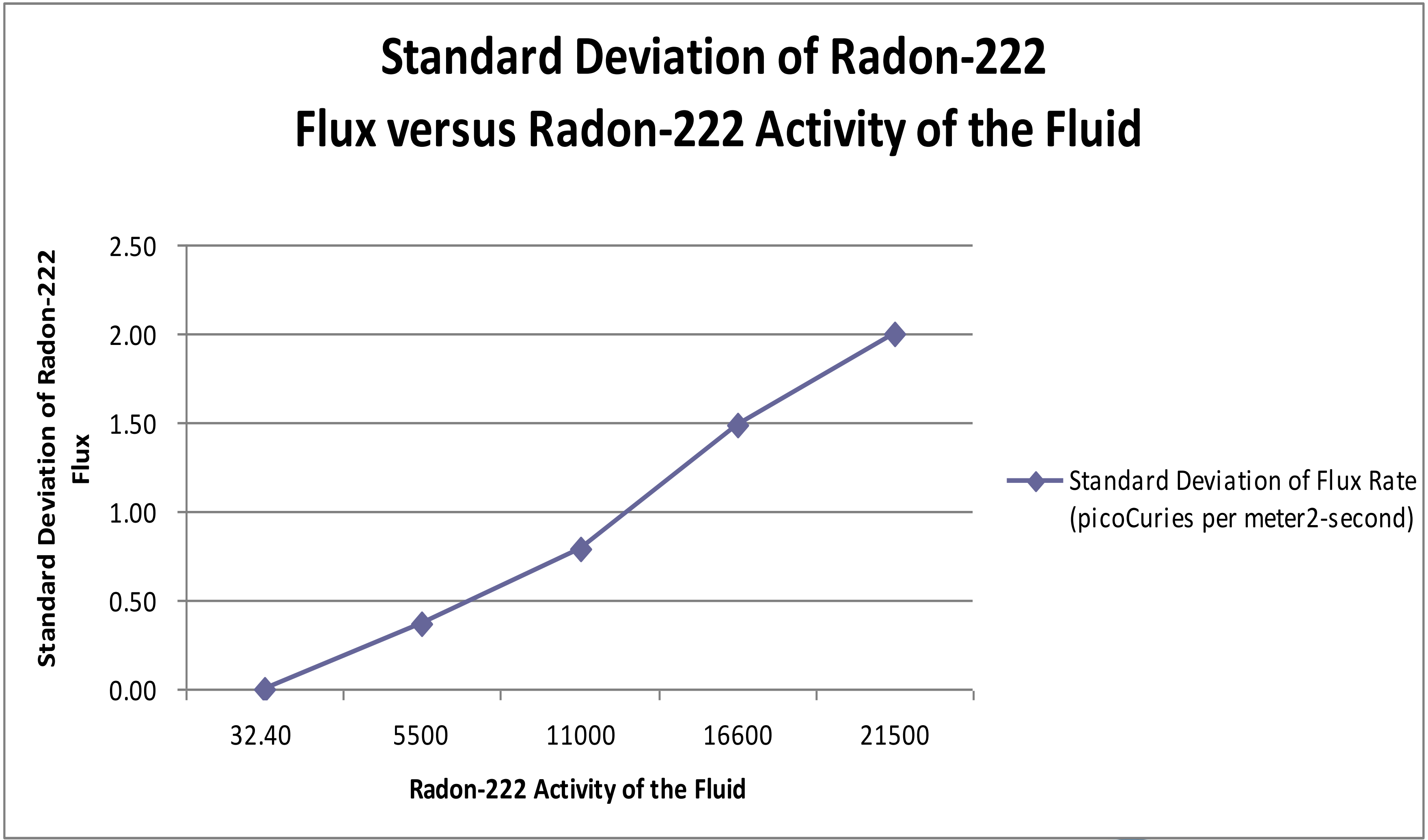
NMA™
THE AMERICAN RESOURCE

Standard Deviation of Radon-222 Flux versus Radium-226 Activity of the Water



Standard deviation of the Radon-222 flux equals approximately 0.0001 times the Radium-226 activity of the fluid.

Standard Deviation of Radon-222 Flux versus Radon-222 Activity of the Water



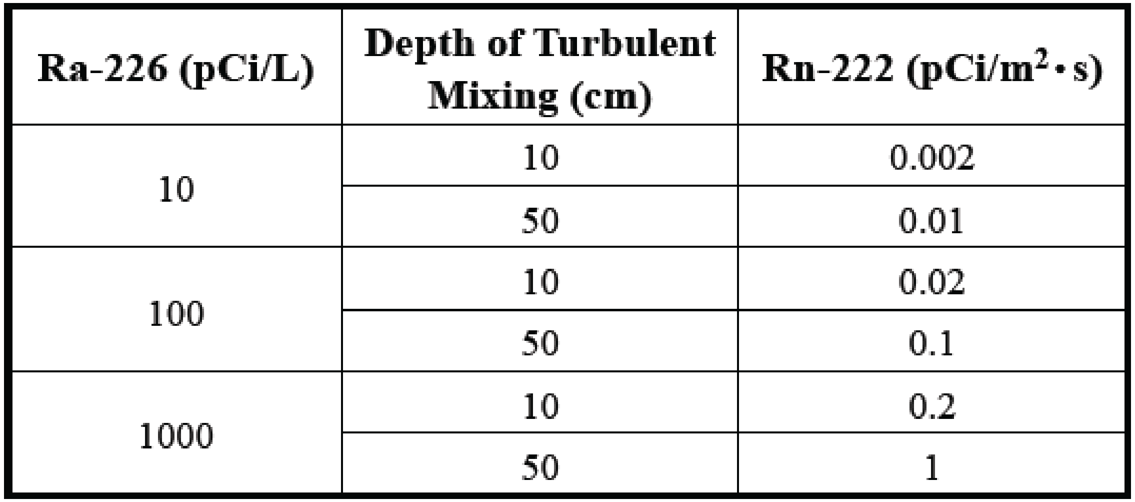
Standard deviation of the Radon-222 flux equals approximately 0.0001 times the Radon-222 activity of the fluid.

Conclusions

- Radon-222 flux is linearly dependent upon Radon-222 activity of the fluid even at high fluid Radon-222 activities.
- Standard deviation of the flux rate is also linearly dependent upon the Radon-222 activity of the fluid approximating 0.0001 times the Radon-222 activity.
- In a normal distribution, 95.4% of the measurements will lie within two (2) standard deviations from the mean.
- The mean of the flux rate is related linearly to the Radon-222 activity of the fluid approximating 0.0004 times the Radon-222 activity.
- For the measured Radon-222 activities of the fluid in the barrels, 95.4% of the measured flux rates at the fluid surface can be calculated by the following equation:
  - Radon-222 Flux = 0.0004*(Radon-222 Activity) +/- 2*(0.0001)*(Radon-222 Activity) which simplifies to:
  - Radon-222 Flux = 0.0004*(Radon-222 Activity) +/-0.0002(Radon-222 Activity)
- This equates well with the relationship between the maximum flux rates and Radon-222 activity of 0.00057*(Radon-222 Activity)

Conclusions *continued*

- This experimental data does not correlate well with fluxes derived from application of the Stagnant Film Model (SFM). The Stagnant Film Model (SFM) appears to be too conservative, over estimating fluxes by at least an order of magnitude.
- This data however correlates fairly well with data presented by Dr. Douglas Chambers regarding the experimental lake, shown again below:



Ra-226 (pCi/L)	Depth of Turbulent Mixing (cm)	Rn-222 (pCi/m^2·s)
10	10	0.002
	50	0.01
100	10	0.02
	50	0.1
1000	10	0.2
	50	1

The experimental data lies between the Radon-222 fluxes from turbulent mixing depths of 10 and 50 centimeters.

Conclusions *continued*

- The above discussed experimental data fits well with the Radon-222 flux data obtained by another uranium recovery licensee in tests conducted in its tailings impoundment in August 2010 that was recently submitted to the Environmental Protection Agency (EPA).
- Radon-222 fluxes from water surfaces even in the case of high Radium-226 and Radon-222 activities are minimal and in the case of fluid Radium-226 activities up to 5,000 pCi/L are within the range and variability of natural background assuming a *typical planet wide background flux of 1 - 2 pCi/m2 - sec* (Steven H Brown, CHP, SENES Consultants Limited – November 7, 2010).
- Construction of a fluid retention impoundment and filling it with water containing up to 5,000 pCi/L Radium-226 would just displace normal background surface flux in most areas.

Subpart W Stakeholder Conference Call

July 5, 2012

Attendees

EPA: Reid Rosnick, Phil Egidi, ORIA, Susan Stahle, OGC
ENVIRONMENTAL GROUPS: Sharyn Cunningham, Carol Dunn, Paul Carestia (CCAT), Sarah Fields (Uranium Watch), Jennifer Thurston (Information Network for Responsible Mining)
INDUSTRY: Oscar Paulson (Kennecott Uranium), Jim Cain (Cotter), Joann Tischler (Denison), Dawn Volkman (Uranerz), Mike Thomas (?), Wayne Heile (URS), Scott Sherman (Uranium 1), John Schwenk (Cameco), Mike Newman (Neutron Energy), Frank Filas (Energy Fuels)
OTHER: Katie Sweeney (National Mining Association), Janet Johnson (TetraTech), Chris Johnston (Intermountain Labs)

Reid - Status of Rulemaking – We held our final Agency review on April 19, 2012. There were several loose ends that need to be cleared up and the entire package was sent to our Office of Policy on May 10. Office of Policy submits all EPA regulations to the Office of Management and Budget (OMB). EPA has a lot of regulations, and the Office of Policy prioritizes which rules and when go to OMB. The Subpart W package has been placed in the pipeline and is scheduled to be submitted on August 3 for OMB 90 day review. Also, given that we are nearing an election, OMB's limited staff is looking more closely at all regulations. So, many regulatory packages are being delayed due to the OMB bottleneck. We hope that it can get to and through OMB soon, but we cannot at this point say when it will actually get published in the Federal Register.

Questions/Comments from the group?

Oscar Paulson: Thanks for placing my comments on the website so quickly. At the NRC/NMA meeting several months ago there was a presentation with data on radon flux from fluids. It should also be placed on the website.

Reid: I know there is a link on the NMA website that we can link to on the Subpart W website.

Paul Carestia: When are you going to respond or post responses to my questions?

Reid: I know that I have responded to some of your questions in the past via email. I have not maliciously withheld them from the website, I frankly just forgot.

Katie Sweeney: Regarding the OMB review, they many times take longer than the official 90 day review. In many cases, rules may stay at OMB for significantly long periods of time.

Jennifer Thurston: Expressed disappointment with EPA failure to get the process started earlier, not meeting deadlines, etc. The Pinon Ridge mill should have been permitted under the provisions of a new Subpart W rule, not the existing requirements. These delays are very frustrating.

Sarah Fields: Please tell me the difference between Subpart W and the 40 CFR 192 rule. Also, please give an update on the progress of this rule.

Reid: The differences are: Subpart W is a regulation authorized by the Clean Air Act. It specifically regulates radon emissions from uranium recovery facilities. 40 CFR 192 is a regulation authorized by the Uranium Mill Tailings Radiation Control Act (UMTRCA), and authorizes the NRC to implement regulations written by EPA to provide for the disposal, long-term stabilization, and control of these mill tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public. 40 CFR 192 is currently being revised. It is estimated that the proposed rule will be issued early next year.

Unknown: Does EPA do independent radon monitoring at uranium recovery facilities? If not, why not? It doesn't seem like a company's test results should be believed without independent verification.

Reid: EPA does not perform independent radon monitoring at these facilities. The monitoring procedures are specifically outlined in the regulations, and there are quality control methods in place to assure that the laboratories are properly analyzing the samples the company collects.

Scott Sherman: Also, our company notifies (in this case) the State of Utah, and they always send representative to observe how are samples are collected and sent to the lab.

Sharyn Cunningham: In January I sent comments to EPA regarding issues I had with the risk assessment document that had been posted on the website. How did you address those comments in any revised risk assessment, and why are my comments not posted on the website?

Reid: I did review your comments with our contractor. We decided that at this point, in order to move the project forward we would keep the document as it is and refer back to your comments later during the proposal period.

Sharyn: It is frustrating that you ask for our comments, and you neither post them nor use them when they could be of value to the project. We're frustrated that the process is not transparent and open. When will you be posting communication that we have with you, such as emails?

Susan Stahle: We need to think about how or if we can do that. There are several issues we need to consider. It is possible that some or all of the information you request to be posted could be privileged, and therefore we may choose not to post it. For example, currently the proposal (preamble and rule language) and the Background Information Document are internal Agency documents that we are not yet releasing to the public. Also, there may be some past emails between you and Reid that, if now posted on the website, could be confusing to the public, especially before the proposed rule is released for public comment. We were clear in the Settlement Agreement that we would not post privileged documents on the website. However, we have made an effort to post anything that could be released. We will find any responses we have made to you and review them to determine if they can be posted on the website.

Reid: There may be some inadvertent emails or responses that I have not posted, but it was not out of malice, I just forgot to post them. Suggested to Sharyn that some of the information she requests may already be in the thousands of emails we released as a result of a Freedom of Information Act request. Sharyn stated that she looked through most of the emails, and didn't see the responses.

Next call is October 4, 2012 at 11 am east coast time.

EPA-874

Reid Rosnick/DC/USEPA/US
07/16/2012 07:51 AM

To Beth Miller
cc
bcc
Subject Subpart W website changes

Hi Beth,

Finally (!) I'm ready to work on the website stuff. Please let me know when you're ready.

7_5_12 Subpart W Stakeholder Conference Call (ss 071312).pdf

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

EPA-88

"Sweeney,Katie"
<KSweeney@nma.org>
08/02/2012 01:31 PM

To	Reid Rosnick
cc	
bcc	
Subject	Radon Presentation

1 attachment

Paulson Presentation.pdf

Reid,

Please add this presentation to the Subpart W webpage http://www.epa.gov/rpdweb00/neshaps/subpartw/rulemaking-activity.html as a National Mining Association comment. Thanks.

Katie

Katie Sweeney
General Counsel
National Mining Association
101 Constitution Avenue, Suite 500 East
Washington, DC 20001

ksweeney@nma.org
202/463-2627

National Mining Association

Experimental Determination of Radon Fluxes over Water

NMA
THE AMERICAN RESOURCE

Introduction

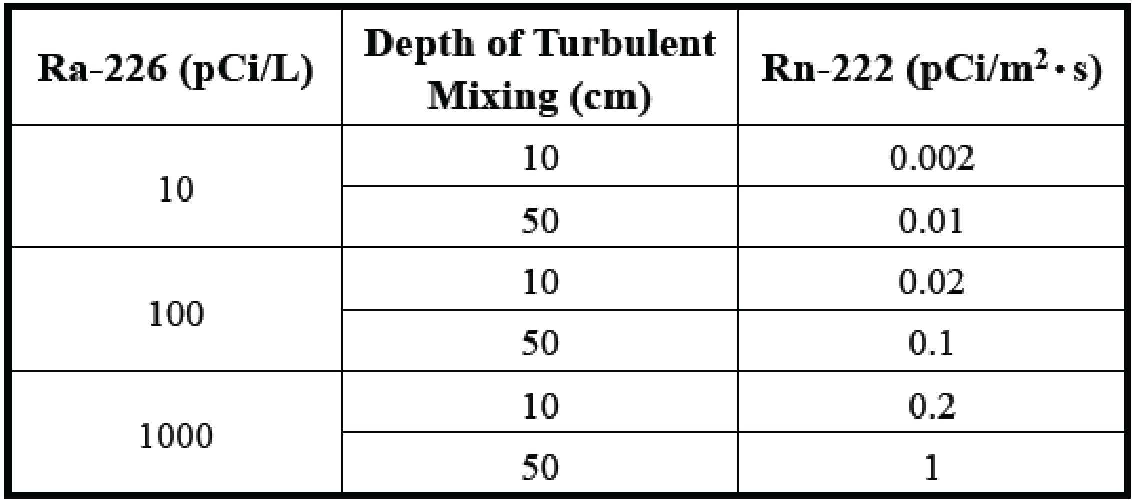
- This presentation will:
  - Discuss prior information regarding radon fluxes from water surfaces
  - Discuss laboratory research funded by the National Mining Association (NMA) regarding radon fluxes from water surfaces.
  - Compare the results of the research with previously reported data.
  - Show that radon fluxes from most water surfaces at uranium recovery operations are insignificant and approximate background soil fluxes for most areas.

Prior Work

- Information regarding radon fluxes from water surfaces has been presented on the following two (2) occasions:
  - *Radon Emissions From Tailings Ponds* - Dr. Douglas B. Chambers - July 2, 2009
  - *Radon Flux from Evaporation Ponds* – Dr. Kenneth R. Baker, Ph.D. Environmental Restoration Group, Inc and Alan D. Cox - Homestake Mining Company of California

Prior Work - *continued*

- *Radon Emissions From Tailings Ponds* - Dr. Douglas B. Chambers - July 2, 2009
  - Discussed Rn-222 gas exchange via diffusion from the surface of a small lake (Experimental lakes, Ontario)
  - Concluded that Radon-222 releases were low as shown in the table below:



Ra-226 (pCi/L)	Depth of Turbulent Mixing (cm)	Rn-222 (pCi/$m^2 \cdot s$)
10	10	0.002
	50	0.01
100	10	0.02
	50	0.1
1000	10	0.2
	50	1

NMA THE AMERICAN RESOURCE

Prior Work - *continued*

- *Radon Flux from Evaporation Ponds* – Dr. Kenneth R. Baker, Ph.D. Environmental Restoration Group, Inc and Alan D. Cox - Homestake Mining Company of California
  - Measured radon flux from an evaporation pond using modified floating Large Area Activated Charcoal Canisters (LAACCs)
  - Concluded that radon fluxes obeyed the Stagnant Film Model (SFM) and that flux rates in picoCuries per meter2-second were approximately 0.01 times the Radium-226 activity of the water. The Radon-222 activity of the water was not measured in this experiment and was assumed to be in equilibrium with the dissolved Radium-226.
  - A picture of the floating Large Area Activated Charcoal Canister (LAACC) used is shown below:

Discussion of Prior Work

- Both prior experiments were performed in outdoor environments specifically in experimental lakes or evaporation ponds under non-laboratory conditions.
- No specific data regarding actual Radon-222 activity of the water was provided for either experiment.

Purpose of this Research

- This current research was performed to determine Radon-222 flux at the surface of water containing Radium-226 and Radon-222 under controlled laboratory conditions using an accepted method of determining Radon – 222 flux, specifically using Large Area Activated Charcoal Canisters (LAACCs) as described in *Radon Flux Measurements on Gardiner and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida* since this is the currently accepted method of determining radon flux in Method 115 referenced in 40 CFR Part 61.253 *Determining compliance*.
- In this way, data gathered in the course of this study can be effectively compared with other data collected in prior compliance monitoring work using Large Area Activated Charcoal Canisters (LAACCs) since the measurement method is the same.

NMA™
THE AMERICAN RESOURCE

Testing Protocol

- Five (5) barrels containing deionized water with the following Radium-226 activities were created using a traceable Radium-226 standard:
  - 0 picoCuries per liter (water with no added Radium-226)
  - 5,000 picoCuries per liter
  - 10,000 picoCuries per liter
  - 15,000 picoCuries per liter
  - 20,000 picoCuries per liter

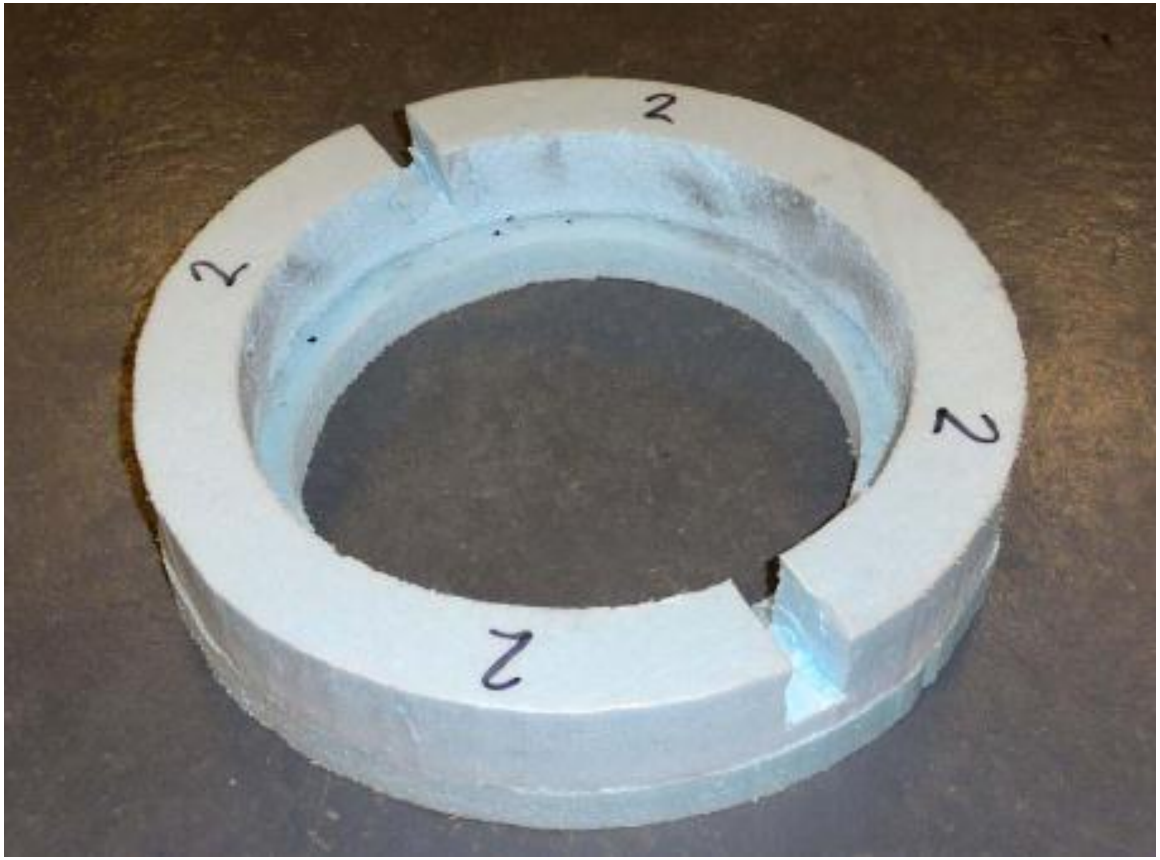
The solutions were placed in barrels as shown below:

The Radium – 226 in the solutions in the barrels was allowed to attain radiometric equilibrium with the Radon-222 by being allowed to sit covered for forty (40) days (slightly over ten (10) half lives for Radon-222).

NMA™
THE AMERICAN RESOURCE

Testing Protocol *continued*

- Styrofoam floats were created to float the Large Area Activated Charcoal Canisters (LAACCs) over the water in the barrels as shown below:



Testing Protocol *continued*

- The Large Area Activated Charcoal Canisters (LAACCs) were installed in the floats as shown below:

The Large Area Activated Charcoal Canisters (LAACCs) fit snugly in the float to create a seal.
They are similar in appearance to the ones used by Dr. Kenneth R. Baker.

Testing Protocol continued

- The Large Area Activated Charcoal Canisters (LAACCs) were floated on top of the Radium-226/Radon-222 bearing water in the barrels as shown below:

The weight of the Large Area Activated Charcoal Canister (LAACC) unit presses the float into the water creating a seal between the water and the float.

Testing Protocol *continued*

- Barrels of Radium-226 solution were prepared.
- The analysis results for the barrels were as follows:

Barrel Number	**Prepared Radium-226 Activity**	**Measured Radium-226 Activity**	**Measured Radon-222 Activity**
	pCi/L	**pCi/L**	**pCi/L**
1	0.0	-0.5	32. 4
2	5,000.	4,580.	5500.
3	10,000.	9,450.	11000.
4	15,000.	13,900.	16600.
5	20,000.	19,200.	21500.

•The barrels were allowed to attain radiometric equilibrium for forty (40) days (slightly over ten (10) half lives for Radon-222).
•A very high Radium-226 activity (higher than would be encountered in operations) was used to test relationships under extreme conditions.
•Data reported to the number of significant figures provided in final report.

NMA™
THE AMERICAN RESOURCE

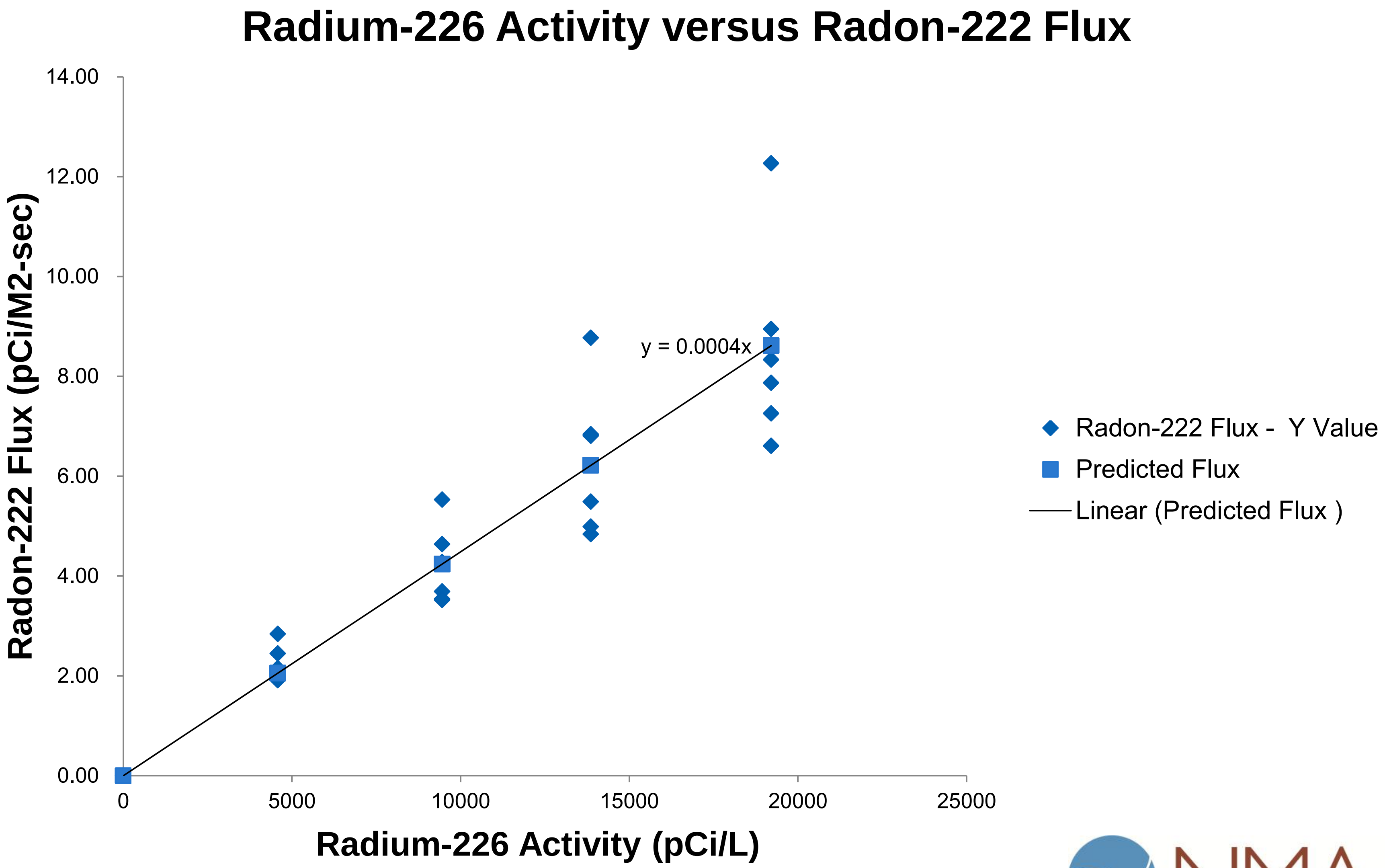
Testing Results

	Test Summary						
	Date Canister Set	Date Canister Removed	Radium-226 Activity Reported	Radium-226 Activity Used	Radon-222 Activity	Reported Flux Rate	Flux rate Used
			pCi/L	pCi/L	pCi/L	pCi/M2-sec	pCi/M2-sec
Day 1	7/31/11	8/1/11	-0.5	0.0	32. 4	<0.5	0.0
Day 1	7/31/11	8/1/11	4,580.	4,580.	5500.	2.8	2.8
Day 1	7/31/11	8/1/11	9,450.	9,450.	11000.	5.6	5.6
Day 1	7/31/11	8/1/11	13,900.	13,900.	16600.	8.8	8.8
Day 1	7/31/11	8/1/11	19,200.	19,200.	21500.	12.	12.
Day 2	8/1/11	8/2/11	-0.5	0.0	32. 4	<0.5	0.0
Day 2	8/1/11	8/2/11	4,580.	4,580.	5500.	2.4	2.4
Day 2	8/1/11	8/2/11	9,450.	9,450.	11000.	4.3	4.3
Day 2	8/1/11	8/2/11	13,900.	13,900.	16600.	6.8	6.8
Day 2	8/1/11	8/2/11	19,200.	19,200.	21500.	8.3	8.3
Day 3	8/2/11	8/3/11	-0.5	0.0	32. 4	<0.5	0.0
Day 3	8/2/11	8/3/11	4,580.	4,580.	5500.	2.2	2.2
Day 3	8/2/11	8/3/11	9,450.	9,450.	11000.	4.6	4.6
Day 3	8/2/11	8/3/11	13,900.	13,900.	16600.	6.8	6.8
Day 3	8/2/11	8/3/11	19,200.	19,200.	21500.	8.9	8.9
Day 4	8/3/11	8/4/11	-0.5	0.0	32. 4	<0.5	0.0
Day 4	8/3/11	8/4/11	4,580.	4,580.	5500.	1.9	1.9
Day 4	8/3/11	8/4/11	9,450.	9,450.	11000.	3.7	3.7
Day 4	8/3/11	8/4/11	13,900.	13,900.	16600.	5.5	5.5
Day 4	8/3/11	8/4/11	19,200.	19,200.	21500.	7.3	7.3
Day 5	8/4/11	8/5/11	-0.5	0.0	32. 4	<0.5	0.0
Day 5	8/4/11	8/5/11	4,580.	4,580.	5500.	2.0	2.0
Day 5	8/4/11	8/5/11	9,450.	9,450.	11000.	3.5	3.5
Day 5	8/4/11	8/5/11	13,900.	13,900.	16600.	4.8	4.8
Day 5	8/4/11	8/5/11	19,200.	19,200.	21500.	7.9	7.9
Day 6	8/5/11	8/6/11	-0.5	0.0	32. 4	<0.5	0.0
Day 6	8/5/11	8/6/11	4,580.	4,580.	5500.	2.0	2.0
Day 6	8/5/11	8/6/11	9,450.	9,450.	11000.	3.5	3.5
Day 6	8/5/11	8/6/11	13,900.	13,900.	16600.	5.0	5.0
Day 6	8/5/11	8/6/11	19,200.	19,200.	21500.	6.6	6.6

Notes:
- Reported Radium-226 activity of -0.51 set to zero for calculation purposes.
- Reported Radon-222 flux of <0.5 set to zero for calculation purposes
- Data reported to the number of significant figures provided in final report.

NMA™
THE AMERICAN RESOURCE

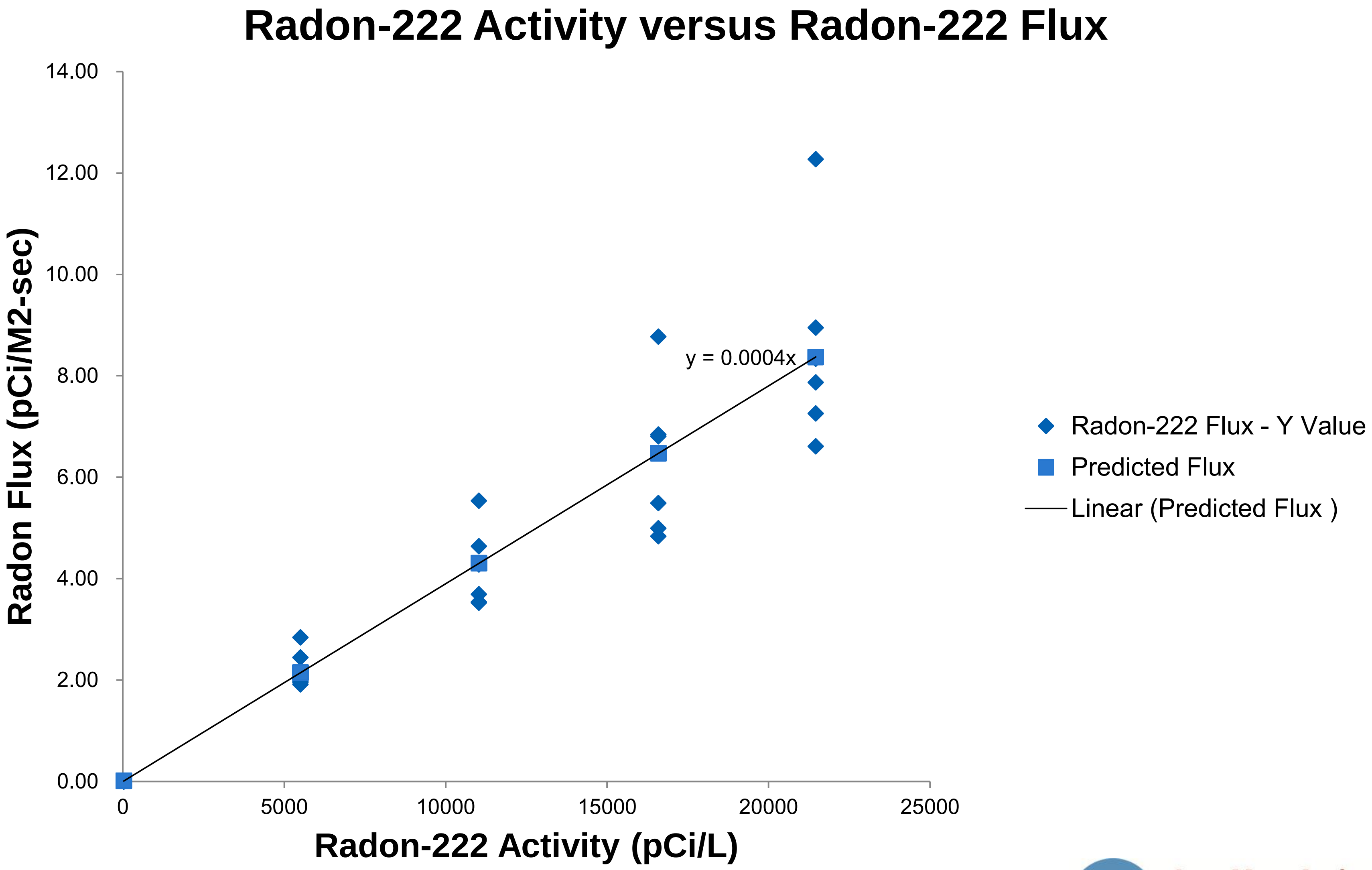
Radium-226 Activity versus Radon-222 Flux Rate



Note: The R² (correlation coefficient squared) value is 0.96, showing good linear correlation.

NMA
THE AMERICAN RESOURCE

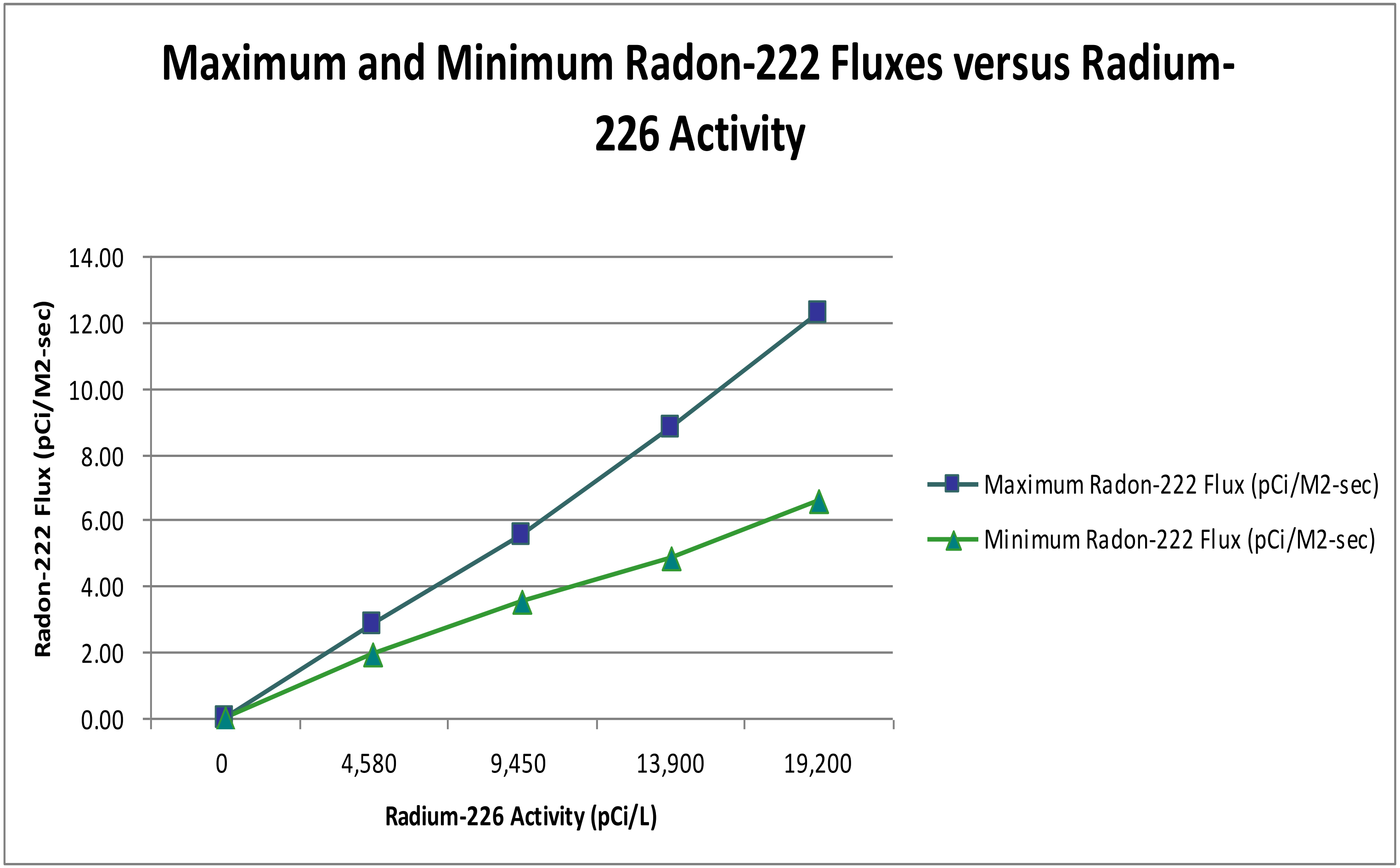
Radon-222 Activity versus Radon-222 Flux Rate



Note: The R^2 (correlation coefficient squared) value is 0.96, showing good linear correlation.

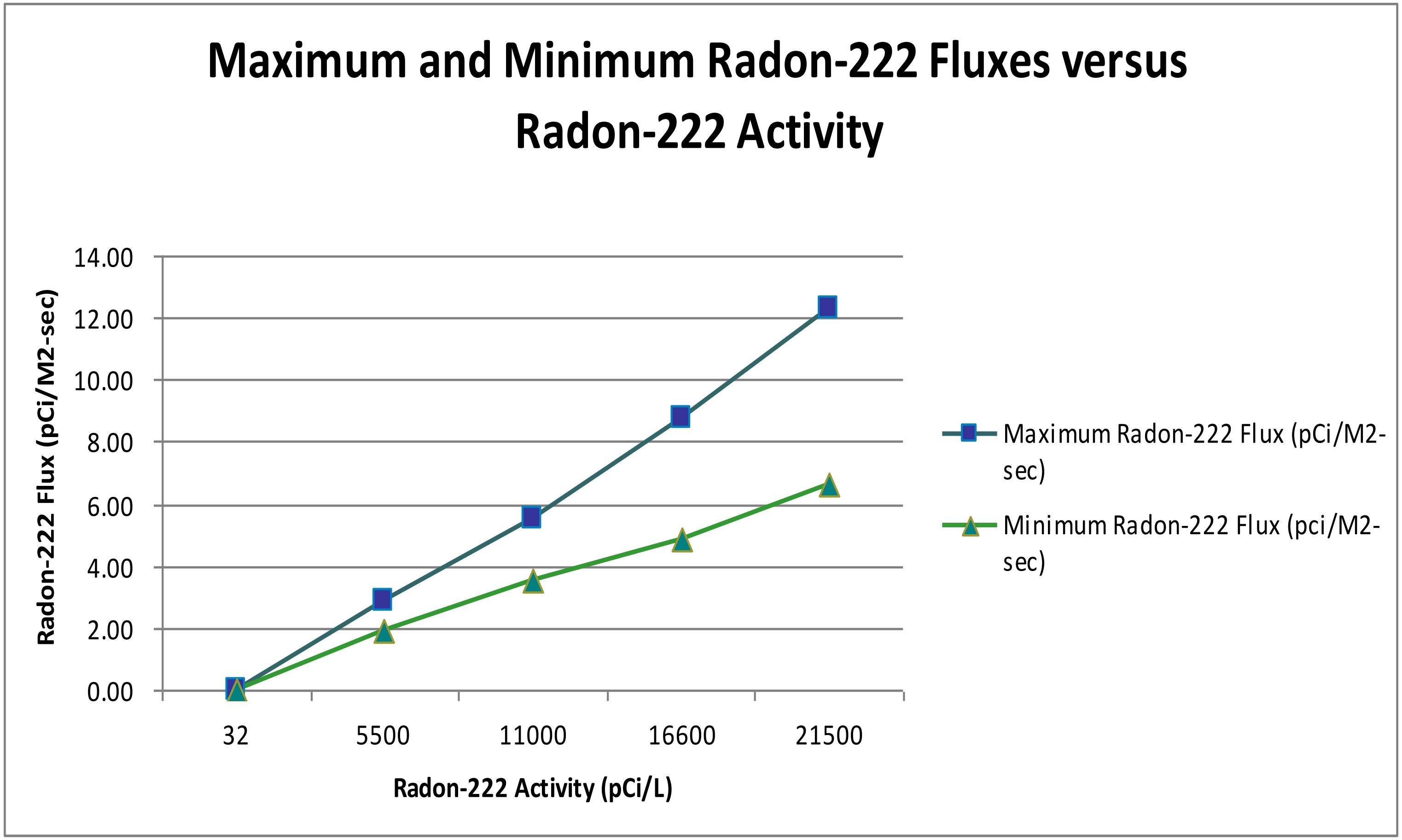
NMA THE AMERICAN RESOURCE

Maximum and Minimum Radon-222 Fluxes versus Radium-226 Activity of the Water



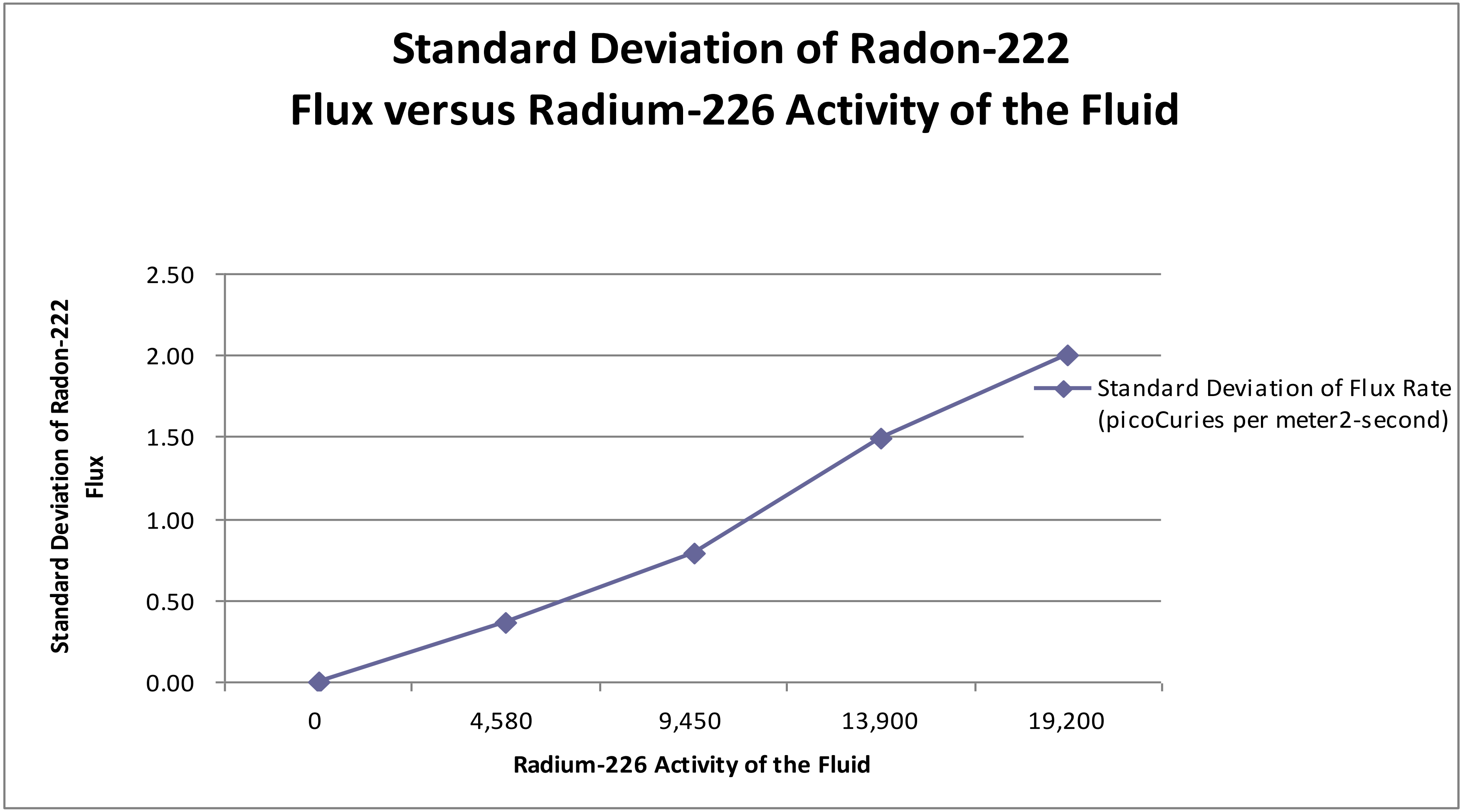
Maximum Slope = 0.00064
Minimum Slope = 0.00034
Average Slope = 0.0004 (previous slide)

Maximum and Minimum Radon-222 Fluxes versus Radon-222 Activity of the Water



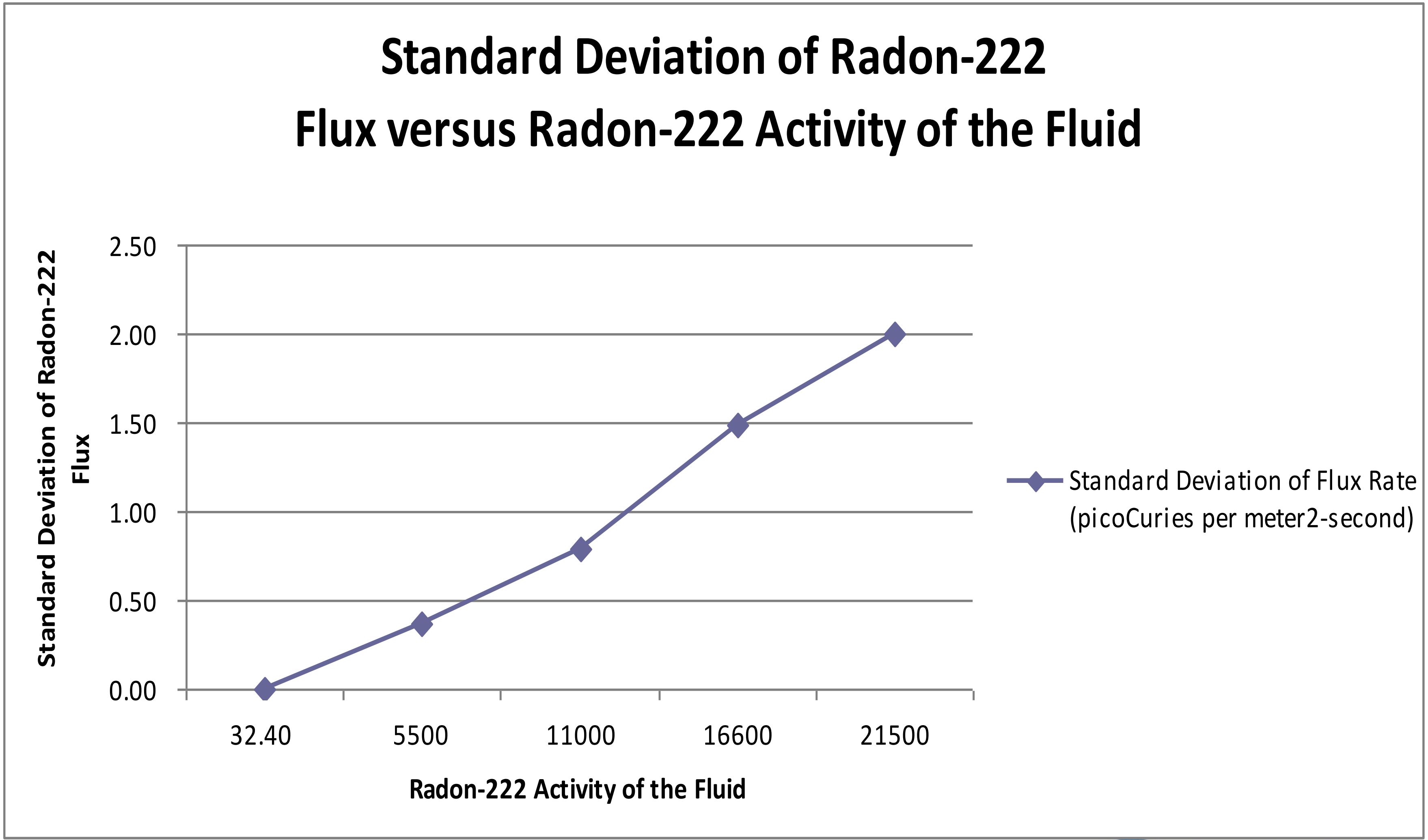
Maximum Slope = 0. 00057
Minimum Slope = 0.00031
Average Slope = 0.0004 (previous slide)

Standard Deviation of Radon-222 Flux versus Radium-226 Activity of the Water



Standard deviation of the Radon-222 flux equals approximately 0.0001 times the Radium-226 activity of the fluid.

Standard Deviation of Radon-222 Flux versus Radon-222 Activity of the Water



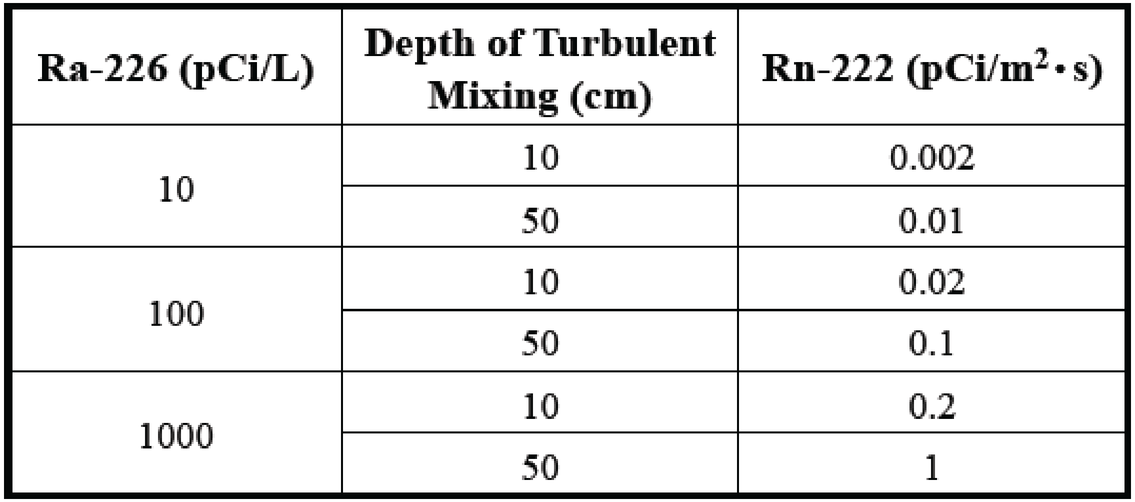
Standard deviation of the Radon-222 flux equals approximately 0.0001 times the Radon-222 activity of the fluid.

Conclusions

- Radon-222 flux is linearly dependent upon Radon-222 activity of the fluid even at high fluid Radon-222 activities.
- Standard deviation of the flux rate is also linearly dependent upon the Radon-222 activity of the fluid approximating 0.0001 times the Radon-222 activity.
- In a normal distribution, 95.4% of the measurements will lie within two (2) standard deviations from the mean.
- The mean of the flux rate is related linearly to the Radon-222 activity of the fluid approximating 0.0004 times the Radon-222 activity.
- For the measured Radon-222 activities of the fluid in the barrels, 95.4% of the measured flux rates at the fluid surface can be calculated by the following equation:
  - Radon-222 Flux = 0.0004*(Radon-222 Activity) +/- 2*(0.0001)*(Radon-222 Activity) which simplifies to:
  - Radon-222 Flux = 0.0004*(Radon-222 Activity) +/-0.0002(Radon-222 Activity)
- This equates well with the relationship between the maximum flux rates and Radon-222 activity of 0.00057*(Radon-222 Activity)

Conclusions *continued*

- This experimental data does not correlate well with fluxes derived from application of the Stagnant Film Model (SFM). The Stagnant Film Model (SFM) appears to be too conservative, over estimating fluxes by at least an order of magnitude.
- This data however correlates fairly well with data presented by Dr. Douglas Chambers regarding the experimental lake, shown again below:



Ra-226 (pCi/L)	Depth of Turbulent Mixing (cm)	Rn-222 (pCi/m$^2\cdot$s)
10	10	0.002
	50	0.01
100	10	0.02
	50	0.1
1000	10	0.2
	50	1

The experimental data lies between the Radon-222 fluxes from turbulent mixing depths of 10 and 50 centimeters.

Conclusions *continued*

- The above discussed experimental data fits well with the Radon-222 flux data obtained by another uranium recovery licensee in tests conducted in its tailings impoundment in August 2010 that was recently submitted to the Environmental Protection Agency (EPA).
- Radon-222 fluxes from water surfaces even in the case of high Radium-226 and Radon-222 activities are minimal and in the case of fluid Radium-226 activities up to 5,000 pCi/L are within the range and variability of natural background assuming a *typical planet wide background flux of 1 - 2 pCi/m2 - sec* (Steven H Brown, CHP, SENES Consultants Limited – November 7, 2010).
- Construction of a fluid retention impoundment and filling it with water containing up to 5,000 pCi/L Radium-226 would just displace normal background surface flux in most areas.

EPA-455

Reid Rosnick/DC/USEPA/US
08/07/2012 09:40 AM

To Beth Miller
cc
bcc
Subject Fw: Radon Presentation

Hi Beth,

Another presentation for the Subpart W Website. Let me know when you want to do this and I'll come over.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 08/07/2012 09:39 AM -----

From: "Sweeney,Katie" <KSweeney@nma.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 08/02/2012 01:30 PM
Subject: Radon Presentation

Reid,

Please add this presentation to the Subpart W webpage http://www.epa.gov/rpdweb00/neshaps/subpartw/rulemaking-activity.html as a National Mining Association comment. Thanks.

Katie

Katie Sweeney
General Counsel
National Mining Association
101 Constitution Avenue, Suite 500 East
Washington, DC 20001

ksweeney@nma.org
202/463-2627

Paulson Presentation.pdf

National Mining Association

Experimental Determination of Radon Fluxes over Water

NMA™

THE AMERICAN RESOURCE

Introduction

- This presentation will:
  - Discuss prior information regarding radon fluxes from water surfaces
  - Discuss laboratory research funded by the National Mining Association (NMA) regarding radon fluxes from water surfaces.
  - Compare the results of the research with previously reported data.
  - Show that radon fluxes from most water surfaces at uranium recovery operations are insignificant and approximate background soil fluxes for most areas.

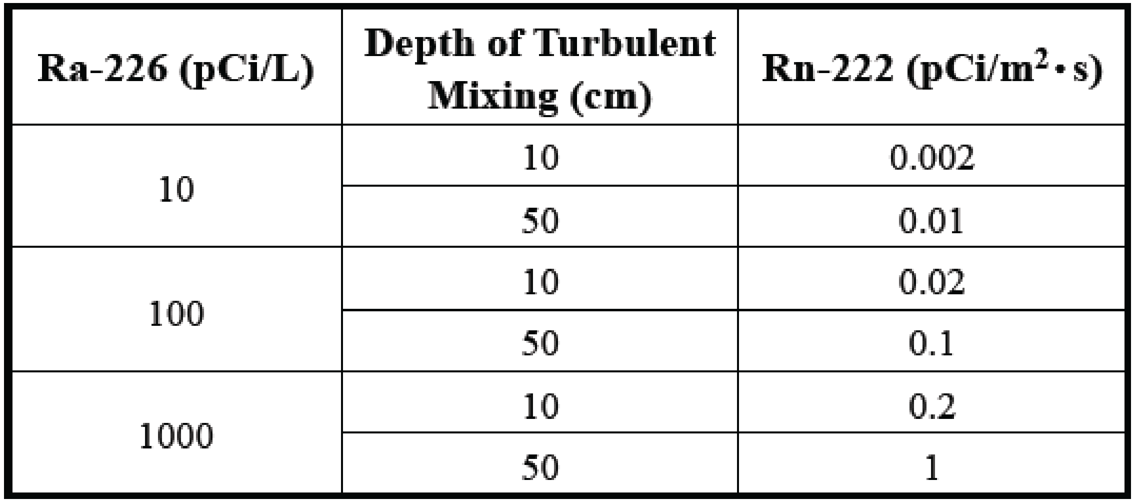
NMA™
THE AMERICAN RESOURCE

Prior Work

- Information regarding radon fluxes from water surfaces has been presented on the following two (2) occasions:
  - *Radon Emissions From Tailings Ponds* - Dr. Douglas B. Chambers - July 2, 2009
  - *Radon Flux from Evaporation Ponds* – Dr. Kenneth R. Baker, Ph.D. Environmental Restoration Group, Inc and Alan D. Cox - Homestake Mining Company of California

Prior Work - *continued*

- *Radon Emissions From Tailings Ponds* - Dr. Douglas B. Chambers - July 2, 2009
  - Discussed Rn-222 gas exchange via diffusion from the surface of a small lake (Experimental lakes, Ontario)
  - Concluded that Radon-222 releases were low as shown in the table below:



Ra-226 (pCi/L)	Depth of Turbulent Mixing (cm)	Rn-222 ($pCi/m^2 \cdot s$)
10	10	0.002
	50	0.01
100	10	0.02
	50	0.1
1000	10	0.2
	50	1

Prior Work - *continued*

- *Radon Flux from Evaporation Ponds* – Dr. Kenneth R. Baker, Ph.D. Environmental Restoration Group, Inc and Alan D. Cox - Homestake Mining Company of California
  - Measured radon flux from an evaporation pond using modified floating Large Area Activated Charcoal Canisters (LAACCs)
  - Concluded that radon fluxes obeyed the Stagnant Film Model (SFM) and that flux rates in picoCuries per meter2-second were approximately 0.01 times the Radium-226 activity of the water. The Radon-222 activity of the water was not measured in this experiment and was assumed to be in equilibrium with the dissolved Radium-226.
  - A picture of the floating Large Area Activated Charcoal Canister (LAACC) used is shown below:

Discussion of Prior Work

- Both prior experiments were performed in outdoor environments specifically in experimental lakes or evaporation ponds under non-laboratory conditions.
- No specific data regarding actual Radon-222 activity of the water was provided for either experiment.

Purpose of this Research

- This current research was performed to determine Radon-222 flux at the surface of water containing Radium-226 and Radon-222 under controlled laboratory conditions using an accepted method of determining Radon – 222 flux, specifically using Large Area Activated Charcoal Canisters (LAACCs) as described in *Radon Flux Measurements on Gardiner and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida* since this is the currently accepted method of determining radon flux in Method 115 referenced in 40 CFR Part 61.253 *Determining compliance*.
- In this way, data gathered in the course of this study can be effectively compared with other data collected in prior compliance monitoring work using Large Area Activated Charcoal Canisters (LAACCs) since the measurement method is the same.

Testing Protocol

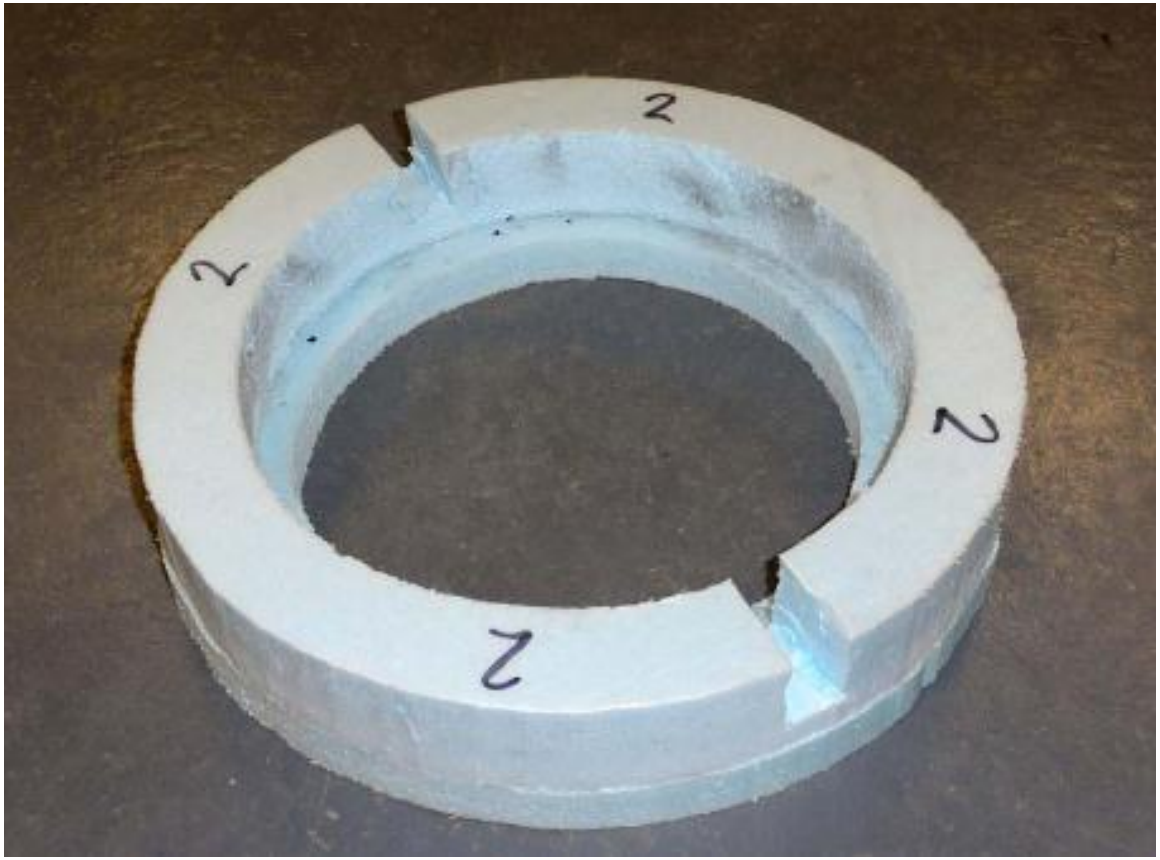
- Five (5) barrels containing deionized water with the following Radium-226 activities were created using a traceable Radium-226 standard:
  - 0 picoCuries per liter (water with no added Radium-226)
  - 5,000 picoCuries per liter
  - 10,000 picoCuries per liter
  - 15,000 picoCuries per liter
  - 20,000 picoCuries per liter

The solutions were placed in barrels as shown below:

The Radium – 226 in the solutions in the barrels was allowed to attain radiometric equilibrium with the Radon-222 by being allowed to sit covered for forty (40) days (slightly over ten (10) half lives for Radon-222).

Testing Protocol *continued*

- Styrofoam floats were created to float the Large Area Activated Charcoal Canisters (LAACCs) over the water in the barrels as shown below:



Testing Protocol *continued*

- The Large Area Activated Charcoal Canisters (LAACCs) were installed in the floats as shown below:

The Large Area Activated Charcoal Canisters (LAACCs) fit snugly in the float to create a seal.
They are similar in appearance to the ones used by Dr. Kenneth R. Baker.

Testing Protocol continued

- The Large Area Activated Charcoal Canisters (LAACCs) were floated on top of the Radium-226/Radon-222 bearing water in the barrels as shown below:

The weight of the Large Area Activated Charcoal Canister (LAACC) unit presses the float into the water creating a seal between the water and the float.

Testing Protocol *continued*

- Barrels of Radium-226 solution were prepared.
- The analysis results for the barrels were as follows:

Barrel Number	**Prepared Radium-226 Activity**	**Measured Radium-226 Activity**	**Measured Radon-222 Activity**
	pCi/L	**pCi/L**	**pCi/L**
1	0.0	-0.5	32. 4
2	5,000.	4,580.	5500.
3	10,000.	9,450.	11000.
4	15,000.	13,900.	16600.
5	20,000.	19,200.	21500.

•The barrels were allowed to attain radiometric equilibrium for forty (40) days (slightly over ten (10) half lives for Radon-222).
•A very high Radium-226 activity (higher than would be encountered in operations) was used to test relationships under extreme conditions.
•Data reported to the number of significant figures provided in final report.

Testing Results

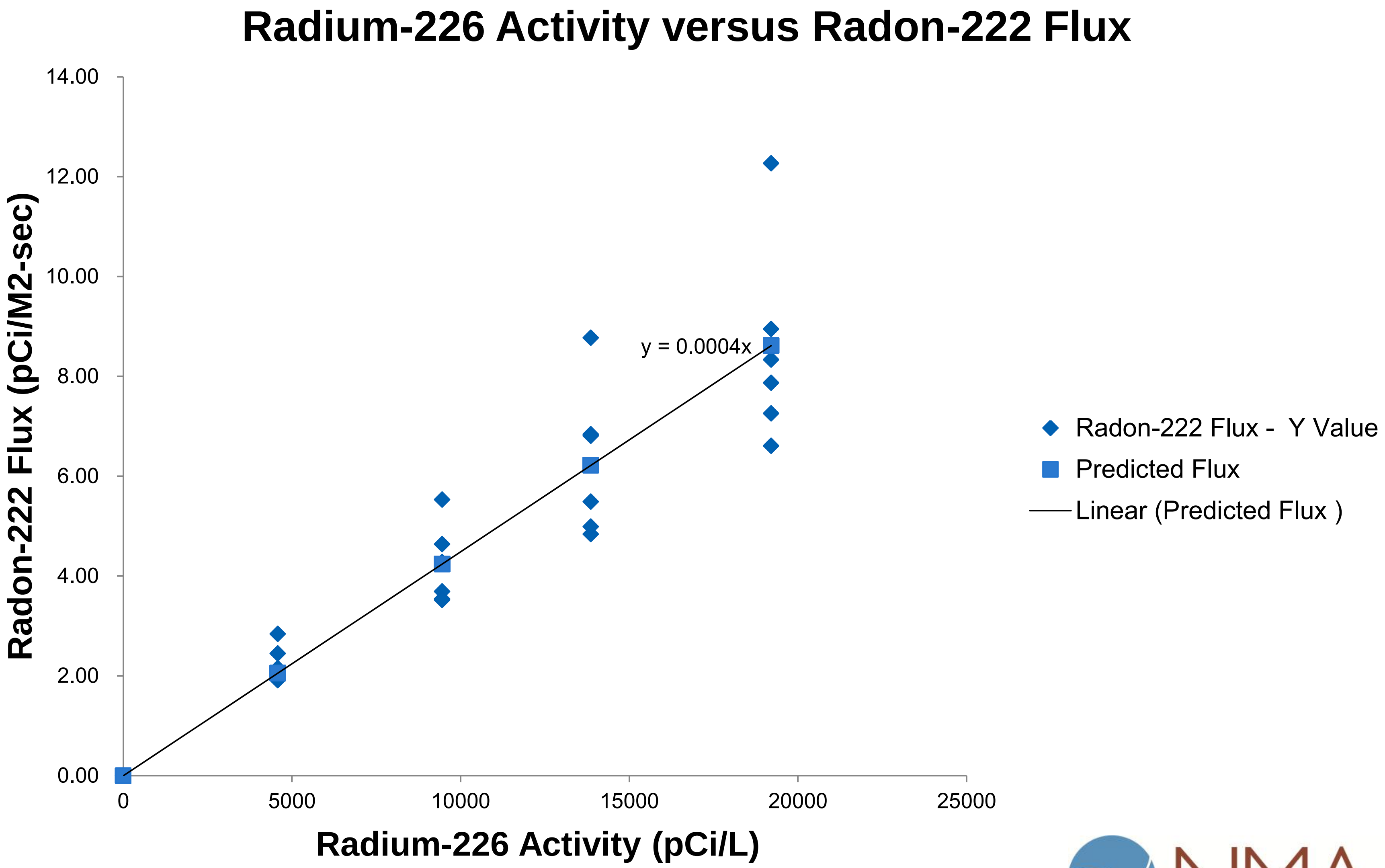
	Test Summary						
	Date Canister Set	**Date Canister Removed**	**Radium-226 Activity Reported**	**Radium-226 Activity Used**	**Radon-222 Activity**	**Reported Flux Rate**	**Flux rate Used**
			pCi/L	**pCi/L**	**pCi/L**	**pCi/M2-sec**	**pCi/M2-sec**
Day 1	7/31/11	8/1/11	-0.5	0.0	32. 4	<0.5	0.0
Day 1	7/31/11	8/1/11	4,580.	4,580.	5500.	2.8	2.8
Day 1	7/31/11	8/1/11	9,450.	9,450.	11000.	5.6	5.6
Day 1	7/31/11	8/1/11	13,900.	13,900.	16600.	8.8	8.8
Day 1	7/31/11	8/1/11	19,200.	19,200.	21500.	12.	12.
Day 2	8/1/11	8/2/11	-0.5	0.0	32. 4	<0.5	0.0
Day 2	8/1/11	8/2/11	4,580.	4,580.	5500.	2.4	2.4
Day 2	8/1/11	8/2/11	9,450.	9,450.	11000.	4.3	4.3
Day 2	8/1/11	8/2/11	13,900.	13,900.	16600.	6.8	6.8
Day 2	8/1/11	8/2/11	19,200.	19,200.	21500.	8.3	8.3
Day 3	8/2/11	8/3/11	-0.5	0.0	32. 4	<0.5	0.0
Day 3	8/2/11	8/3/11	4,580.	4,580.	5500.	2.2	2.2
Day 3	8/2/11	8/3/11	9,450.	9,450.	11000.	4.6	4.6
Day 3	8/2/11	8/3/11	13,900.	13,900.	16600.	6.8	6.8
Day 3	8/2/11	8/3/11	19,200.	19,200.	21500.	8.9	8.9
Day 4	8/3/11	8/4/11	-0.5	0.0	32. 4	<0.5	0.0
Day 4	8/3/11	8/4/11	4,580.	4,580.	5500.	1.9	1.9
Day 4	8/3/11	8/4/11	9,450.	9,450.	11000.	3.7	3.7
Day 4	8/3/11	8/4/11	13,900.	13,900.	16600.	5.5	5.5
Day 4	8/3/11	8/4/11	19,200.	19,200.	21500.	7.3	7.3
Day 5	8/4/11	8/5/11	-0.5	0.0	32. 4	<0.5	0.0
Day 5	8/4/11	8/5/11	4,580.	4,580.	5500.	2.0	2.0
Day 5	8/4/11	8/5/11	9,450.	9,450.	11000.	3.5	3.5
Day 5	8/4/11	8/5/11	13,900.	13,900.	16600.	4.8	4.8
Day 5	8/4/11	8/5/11	19,200.	19,200.	21500.	7.9	7.9
Day 6	8/5/11	8/6/11	-0.5	0.0	32. 4	<0.5	0.0
Day 6	8/5/11	8/6/11	4,580.	4,580.	5500.	2.0	2.0
Day 6	8/5/11	8/6/11	9,450.	9,450.	11000.	3.5	3.5
Day 6	8/5/11	8/6/11	13,900.	13,900.	16600.	5.0	5.0
Day 6	8/5/11	8/6/11	19,200.	19,200.	21500.	6.6	6.6

Notes:

- Reported Radium-226 activity of -0.51 set to zero for calculation purposes.
- Reported Radon-222 flux of <0.5 set to zero for calculation purposes
- Data reported to the number of significant figures provided in final report.

NMA™
THE AMERICAN RESOURCE

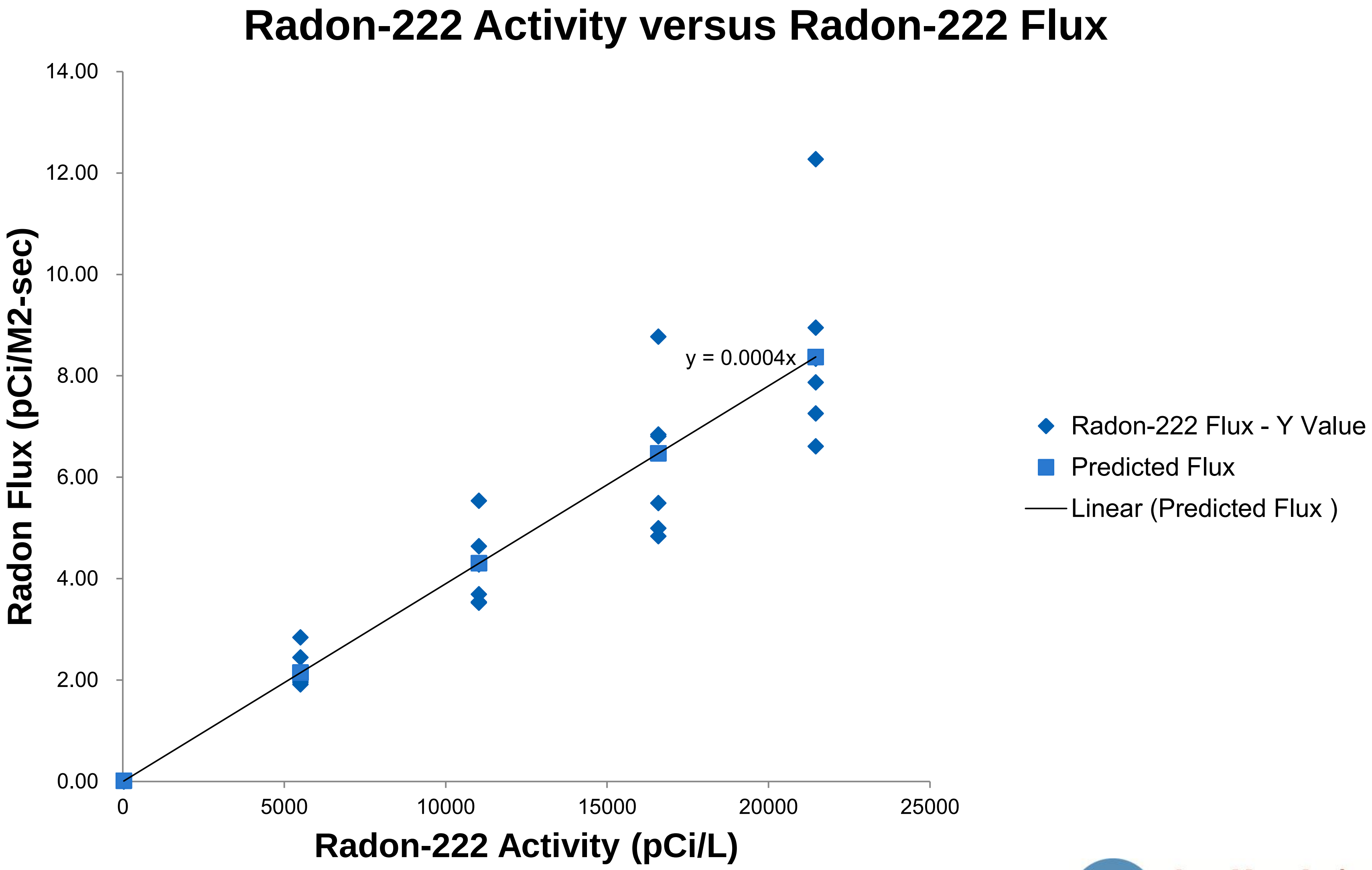
Radium-226 Activity versus Radon-222 Flux Rate



Note: The R^2 (correlation coefficient squared) value is 0.96, showing good linear correlation.

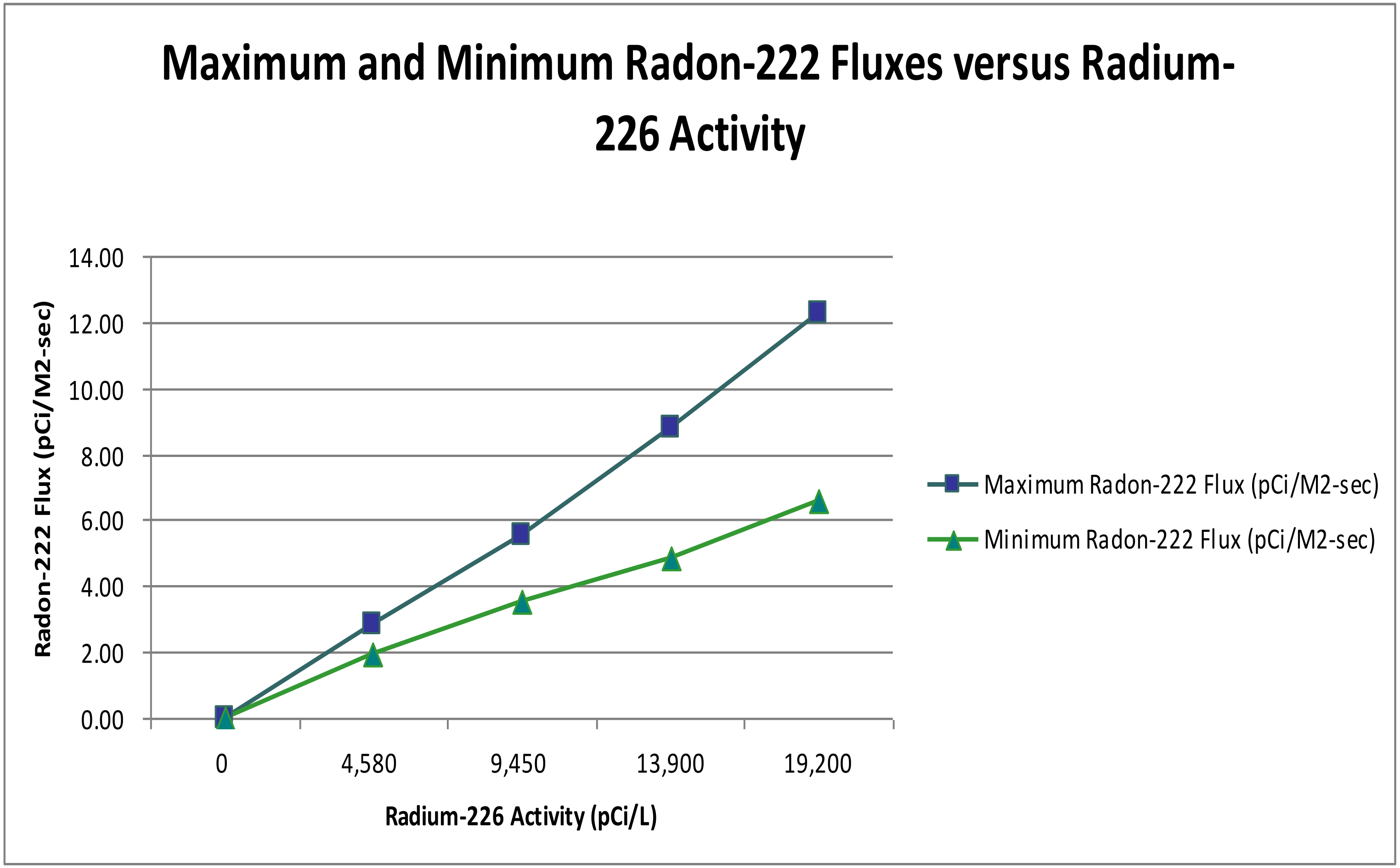
NMA
THE AMERICAN RESOURCE

Radon-222 Activity versus Radon-222 Flux Rate



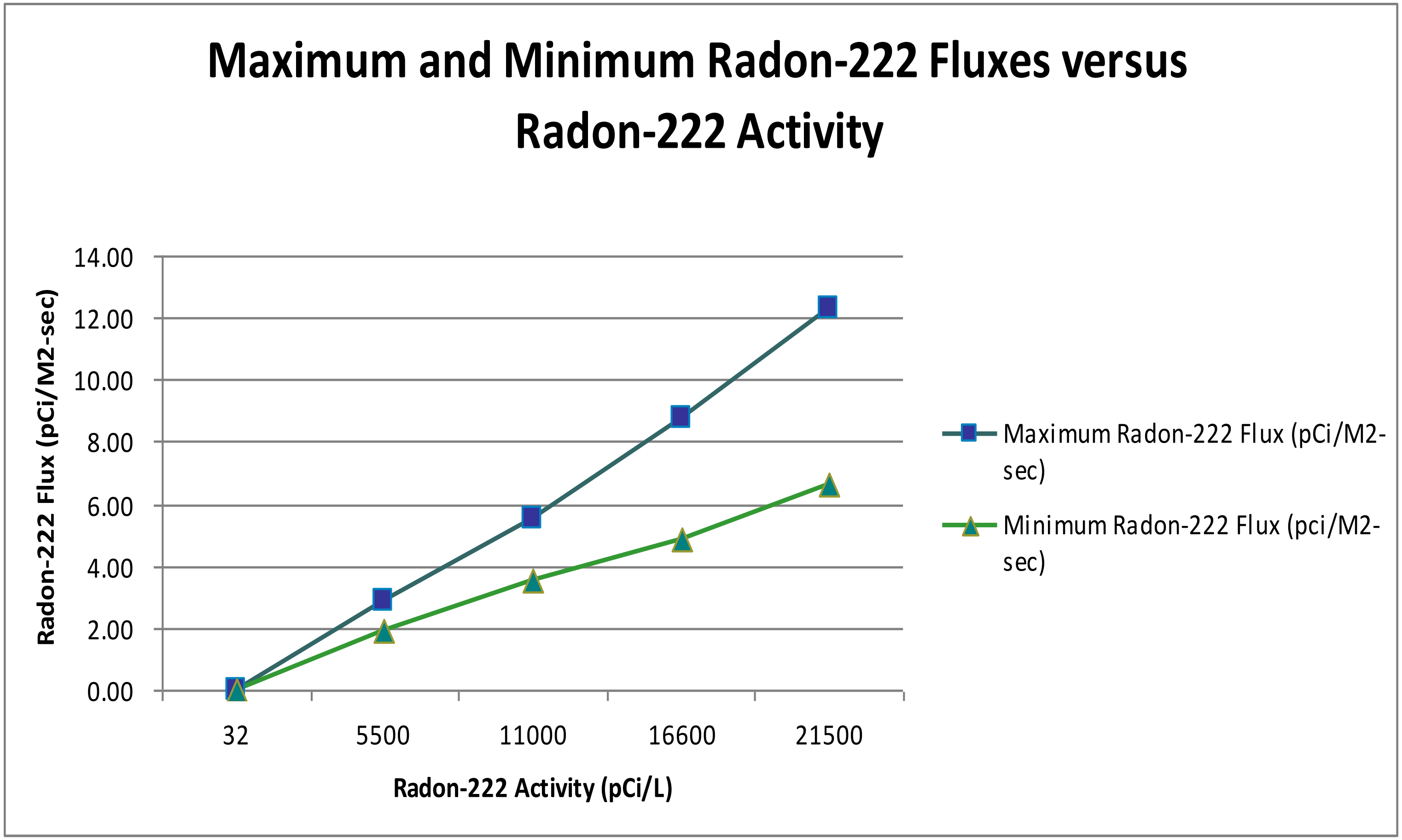
Note: The R^2 (correlation coefficient squared) value is 0.96, showing good linear correlation.

Maximum and Minimum Radon-222 Fluxes versus Radium-226 Activity of the Water



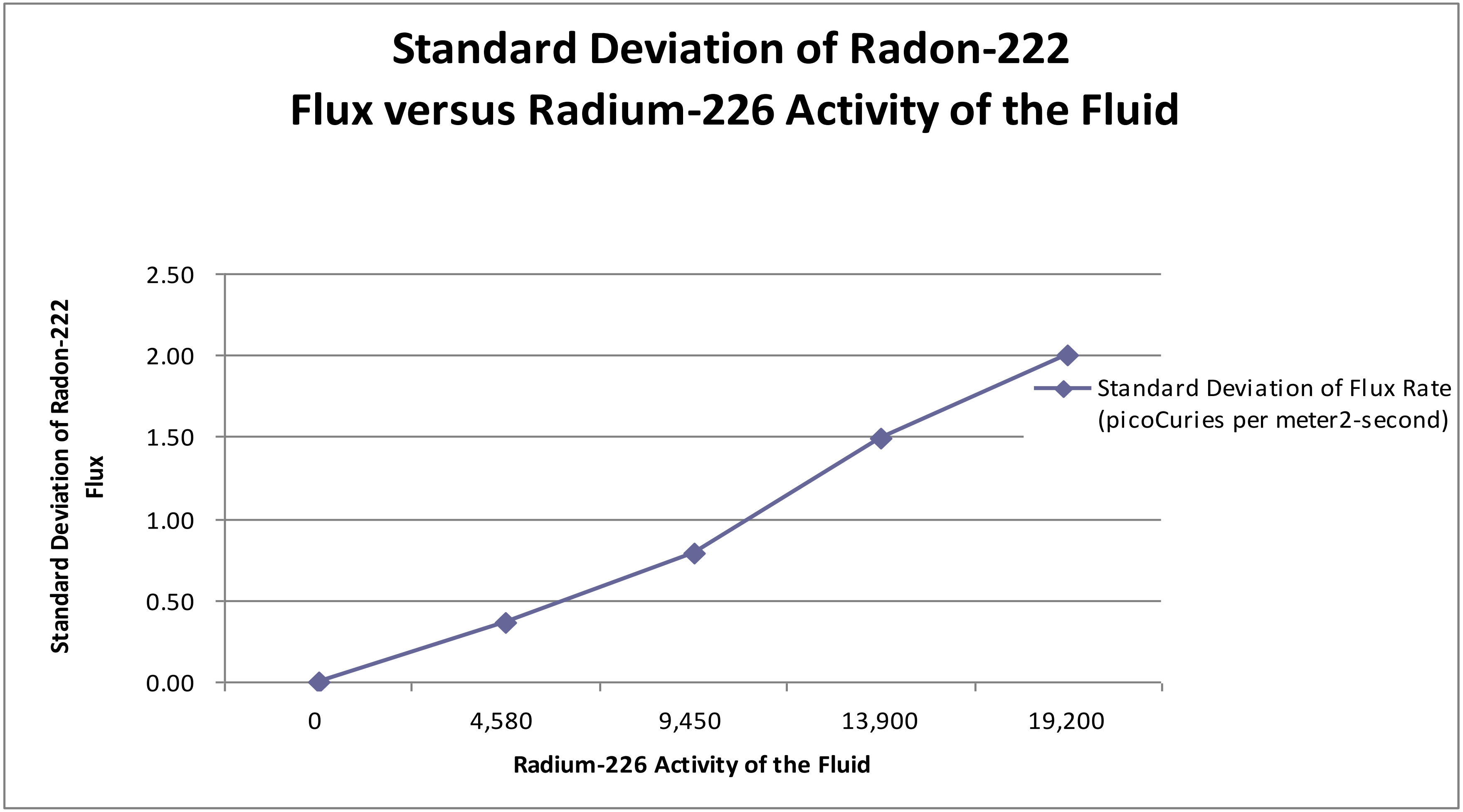
Maximum Slope = 0.00064
Minimum Slope = 0.00034
Average Slope = 0.0004 (previous slide)

Maximum and Minimum Radon-222 Fluxes versus Radon-222 Activity of the Water



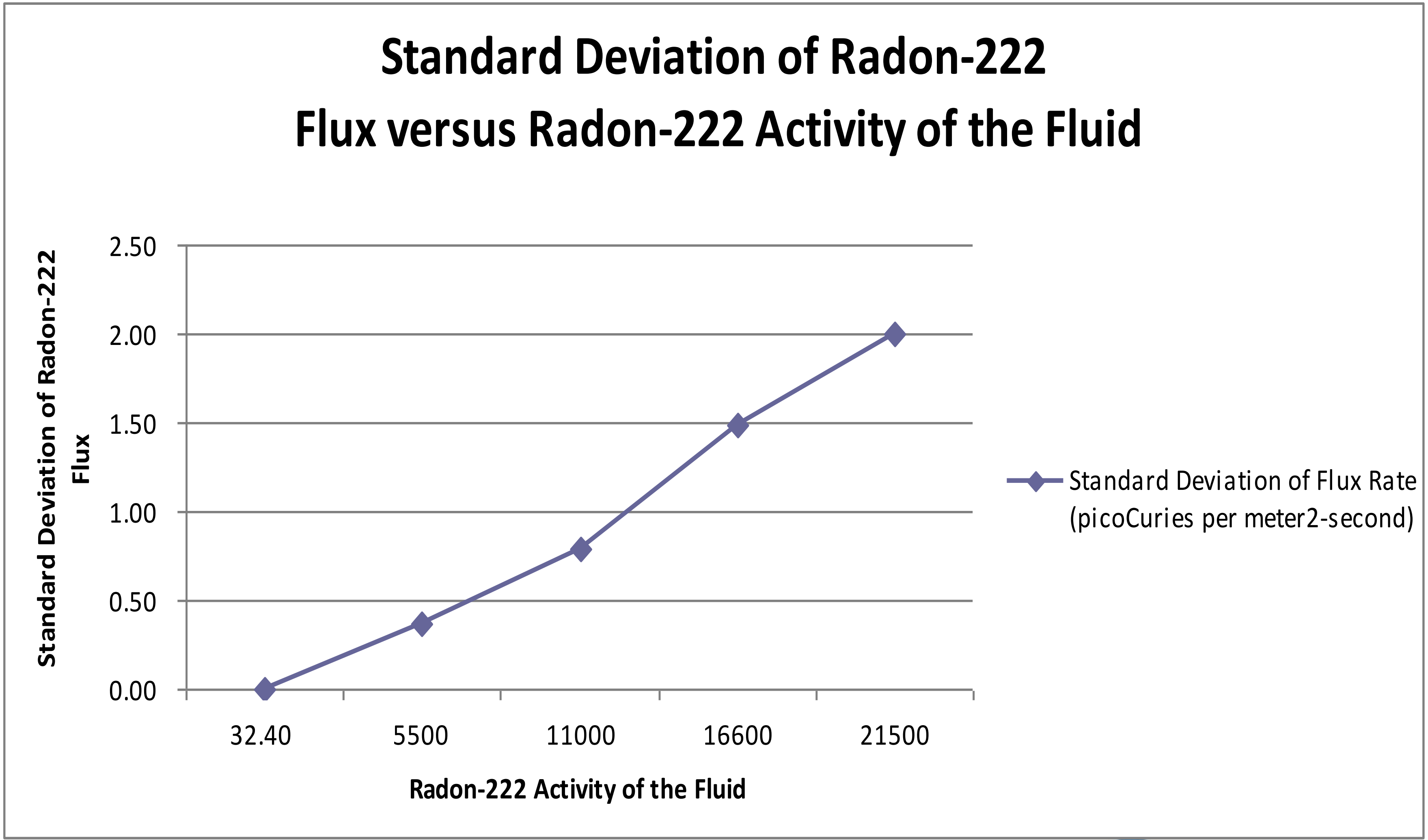
Maximum Slope = 0. 00057
Minimum Slope = 0.00031
Average Slope = 0.0004 (previous slide)

Standard Deviation of Radon-222 Flux versus Radium-226 Activity of the Water



Standard deviation of the Radon-222 flux equals approximately 0.0001 times the Radium-226 activity of the fluid.

Standard Deviation of Radon-222 Flux versus Radon-222 Activity of the Water



Standard deviation of the Radon-222 flux equals approximately 0.0001 times the Radon-222 activity of the fluid.

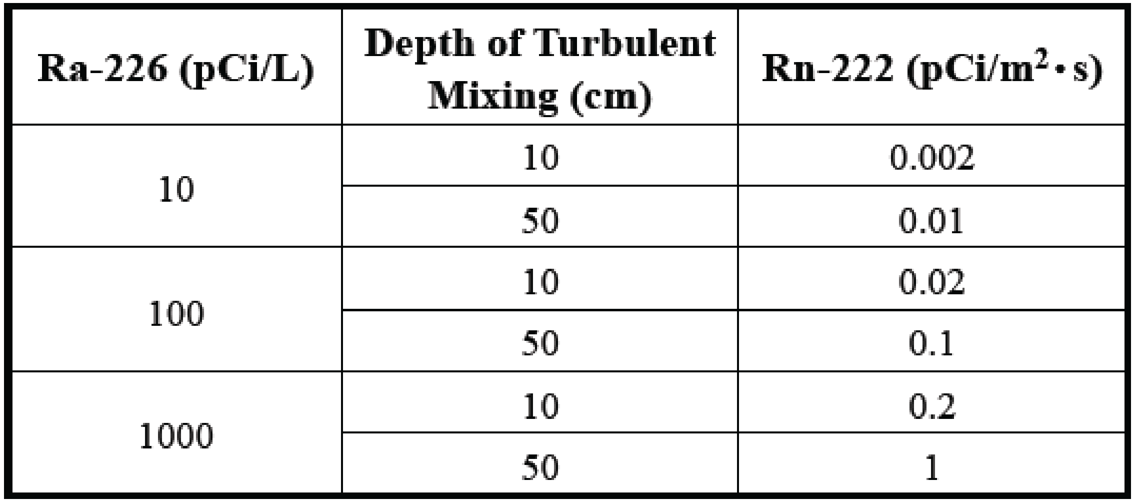
Conclusions

- Radon-222 flux is linearly dependent upon Radon-222 activity of the fluid even at high fluid Radon-222 activities.
- Standard deviation of the flux rate is also linearly dependent upon the Radon-222 activity of the fluid approximating 0.0001 times the Radon-222 activity.
- In a normal distribution, 95.4% of the measurements will lie within two (2) standard deviations from the mean.
- The mean of the flux rate is related linearly to the Radon-222 activity of the fluid approximating 0.0004 times the Radon-222 activity.
- For the measured Radon-222 activities of the fluid in the barrels, 95.4% of the measured flux rates at the fluid surface can be calculated by the following equation:
  - Radon-222 Flux = 0.0004*(Radon-222 Activity) +/- 2*(0.0001)*(Radon-222 Activity) which simplifies to:
  - Radon-222 Flux = 0.0004*(Radon-222 Activity) +/-0.0002(Radon-222 Activity)
- This equates well with the relationship between the maximum flux rates and Radon-222 activity of 0.00057*(Radon-222 Activity)

Conclusions *continued*

•This experimental data does not correlate well with fluxes derived from application of the Stagnant Film Model (SFM). The Stagnant Film Model (SFM) appears to be too conservative, over estimating fluxes by at least an order of magnitude.

•This data however correlates fairly well with data presented by Dr. Douglas Chambers regarding the experimental lake, shown again below:



Ra-226 (pCi/L)	Depth of Turbulent Mixing (cm)	Rn-222 ($pCi/m^2 \cdot s$)
10	10	0.002
	50	0.01
100	10	0.02
	50	0.1
1000	10	0.2
	50	1

The experimental data lies between the Radon-222 fluxes from turbulent mixing depths of 10 and 50 centimeters.

Conclusions *continued*

- The above discussed experimental data fits well with the Radon-222 flux data obtained by another uranium recovery licensee in tests conducted in its tailings impoundment in August 2010 that was recently submitted to the Environmental Protection Agency (EPA).
- Radon-222 fluxes from water surfaces even in the case of high Radium-226 and Radon-222 activities are minimal and in the case of fluid Radium-226 activities up to 5,000 pCi/L are within the range and variability of natural background assuming a *typical planet wide background flux of 1 - 2 pCi/m2 - sec* (Steven H Brown, CHP, SENES Consultants Limited – November 7, 2010).
- Construction of a fluid retention impoundment and filling it with water containing up to 5,000 pCi/L Radium-226 would just displace normal background surface flux in most areas.

NMA™
THE AMERICAN RESOURCE

EPA-3380

Reid Rosnick/DC/USEPA/US	To	Beth Miller
09/05/2012 08:38 AM	cc	
	bcc	
	Subject	Fw: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

----

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:38 AM -----

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: sharyn@bresnan.net
Date: 10/14/2009 03:56 PM
Subject: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Reid,
Sharyn Cunningham asked me to send to you the document produced by MFG Inc, a firm hired by Cotter Corporation, which proposed the use of an Effective Effluent Limit (EEL) to gauge whether radon concentrations at the Cotter Mill perimeter were "safely within limits".
It is my understanding that you asked to see this document as a result of some discussion at the Rapid City WMAN Conference in October.
Attached is that document in .pdf form. Unfortunately it was scanned upside down, so you will have to use "View" on Adobe Reader's toolbar to rotate the document so it can be read on your computer screen.
I have read this document numerous times and as an engineer with a master's degree in electrical engineering and as an MBA with a fair number of statistics courses behind me, I have a number of issues with the approach proposed and accepted by the Colorado Department of Health in this matter with Cotter. I have raised these issues with the Department of Health and the EPA in Region 8 to no avail. I am hoping that someone with the right expertise on your staff in Washington, D. C. will take a detailed, critical look at what is written here and will truly evaluate the science as appropriate and adequate.
Region 8 of the EPA never responded to my documented concerns and Colorado Department of Health responses were obfuscating at best. I'll be happy to make their responses available to you as well if you wish. I have basically given up on getting anything reasonable from those folks, who are obviously stakeholders in this approach having given approval for its use.
The issues I have with the approach are as follows.

1. The sample sizes being used to calculate reliable, realistic means and standard deviations for background radon concentrations and perimeter radon concentrations are simply too small. Statistical theory shows that in order to have reliability in the calculation of the mean and standard deviation of a sample distribution, one needs a sample size somewhere between 30 and 50 samples. Four samples are used for perimeter radon concentrations (1 per quarter) and 4 samples are used from each of three background radon locations (1 per quarter), for a total of 12 background radon samples. These sample sizes are simply insufficient, especially when the resulting mean and standard deviation for background are used to predominantly set the upper limit for radon concentrations at the mill perimeter. I view this as highly unreliable for such an

important metric of concern to public health and welfare.

2. The average background radon measurement and resulting background standard deviation are then used in the Effective Effluent Limit equation:

EEL Alternative Effluent Limit + Average Background + 2 times the standard deviation of Average Background

Alternate Effluent Limit is defined in the MFG document and is basically a constant number dependent upon distance of perimeter station from the tailings impoundment.

This EEL sets the upper limit against which mill perimeter average radon concentrations are compared. It is my contention that using such an approach will make it highly unlikely, if not impossible for the EEL to ever be exceeded. I think this approach is highly suspect, meaningless, and biased to give a result that will always say radon concentrations at the perimeter are "safely within limits".

You may recall in my presentation to you at the June 30 EPA meeting in Canon City I pointed out that while radon flux from the Cotter Primary Impoundment increased by 230% over a 3 year period, radon concentrations at the mill perimeter decreased by 30% over the same 3 year period. This makes absolutely no sense to me. Colorado Department of Health showed no interest in this concern, and for that matter neither did EPA in Region 8. Colorado Department of Health simply indicated that radon concentrations at the mill perimeter were "within EEL limits", so radon flux readings weren't really of relevance to them. They said they look at and count on radon concentrations at the perimeter. EEL as it is used in this case is being given an extremely high credence. I strongly question this.

3. All measurements in this approach, background as well as perimeter, are made using the same measurement technology, Laundauer's DRNF. I would assume then that all measurements are subject to the same random and real variation, not just background. The MFG document calls specific attention to this variation as it relates to background radon measurements and applies the 2 sigma 95% confidence interval for background to account for it. Yet the MFG document does nothing to take this variation into consideration for any of the perimeter measurements. I would argue that the appropriate 2 sigma for perimeter average measurements be added to those measurements to insure a 95% confidence in them as well. The approach as currently implemented is not an apples to apples approach.

I would appreciate very much having an EPA expert in Washington, D. C. study this document and the resulting approach. I respectfully request that this be undertaken and that the expert who does the review get back with me on their finding. I need corroboration from an expert, or I need to be shown where I am mistaken. Either outcome will suffice.

Thanks for your willingness to look into this matter. I appreciate it.

Paul Carestia

MFG Document.pdf

WORKING COPY

consulting
scientists and
engineers

MEMORANDUM

MFG PROJECT: 181077

TO: Steve Landau
Jim Cain
Cotter Corporation

CC: Craig Little, Ph.D., MFG, Inc.

FROM: Jan Johnson, Ph.D., MFG, Inc.

DATE: May 20, 2004

SUBJECT: Proposed Sampler Specific Radon Concentrations

This Technical Memorandum is in response to the concerns expressed by the Colorado Department of Public Health and Environment (CDPHE) in our meeting on April 5, 2004. The specific issues to be addressed are as follows:

- Specific method for calculating the applicable background radon concentration
- Proposal for sampler-specific effluent limits based on the average equilibrium factor for the location.
- Justification for a single effluent limit for Rn-222 plus Rn-220

Cotter Corporation measures radon gas concentrations at seven boundary locations around its Canon City facility and three area background locations using alpha track detectors supplied by Landauer Inc. The boundary locations have previously been approved by CDPHE. In general, they represent the four compass directions, one location between the site and the nearest resident, and two additional locations:

- AS-202 East Boundary
- AS-203 South Boundary
- AS-204 West Boundary
- AS- 206 North Boundary
- AS-209 Mill Entrance Road
- AS-210 Shadow Hills Estates
- AS-212 Nearest Resident (The monitoring station is located between the site boundary and the nearest residence.)

Background radon concentrations are measured at the following locations:

- Canon City
- Oro Verde
- Lincoln Park

The radon detectors currently in use are the Landauer's DRNF detectors that measure both Rn-220 and Rn-222.

Specific Method for Calculating the Applicable Background Radon Concentration

The effluent radon concentration attributable to the Cotter mill is the measured radon concentration at the sampling stations minus the background concentration. As noted above, Cotter Corporation measures radon concentrations at three background locations. The measured radon gas concentrations at these locations will be averaged on an annual basis to obtain a background for that particular year. Since average background levels may fluctuate from year to year due to atmospheric conditions, it is important to use a year-specific background radon level for comparison to the annual average levels at the other air sampling stations.

The background radon measurement is subject to both random variation and real variation among background locations. Therefore, the background value to be used for comparison with the concentrations at the other air sampling stations is the mean of the annual averages for the three locations plus two standard deviations of the mean. Use of the upper 95% confidence limit on the mean is a standard method for establishing background levels that ensures that the mean background will only be underestimated less than 2.5% of the time.

The annual average background radon concentrations for 2001 - 2003 are given in Table 1:

Table 1: Average Annual Radon Background Concentrations

Year	Mean Background (pCi/m^3)	Std. Dev. of Mean (pCi/m^3)	Mean + 2 Std. Dev. (pCi/m^3)
2001	242	25	293
2002	724	77	878
2003	581	123	826

The upper 95% confidence limit on the mean annual background will be added to the allowable effluent radon gas concentration, based on the effluent limit of 100 pCi/m^3 for radon in equilibrium with its decay products and the estimated equilibrium factor for each specific air sampler location.

Detailed background calculations are given in Attachment A, Table A-1.

Proposal for Sampler-Specific Effluent Limits

The Colorado Radiation Control Regulations specify different effluent concentration limits for radon with and without decay products of 100 pCi/m^3 and 10,000 pCi/m^3 respectively. However, it is rare for either of the extreme cases to exist. The regulations allow adjustment of the effluent limits based on equilibrium considerations. This is especially important when setting an effluent limit for radon since the risk from radon gas is very small compared to the risk from its short-lived decay products.

The average annual decay product concentration at the site boundary cannot be measured without specialized continuous working level measurement systems. Grab samples or short term samples are not adequate to characterize the annual average concentrations since weather conditions have a significant influence on the measurements. Continuous working level measurement systems employing electrets (E-RPSIU) are commercially available but are used primarily for indoor radon measurements and for research purposes. Such measurements would reflect the ambient working levels but would not be representative of the radon decay product concentrations attributable to the regulated emissions from the Cotter facility. Therefore, equilibrium fractions for comparison of mill effluent to the effluent limits for radon must be calculated.

The equilibrium fraction depends on the age of the air from a specific source of radon gas. The environmental outdoor equilibrium factors quoted in the literature reflect equilibrium of global radon and are not applicable to specific sources. The MILDOS code used to calculate doses to receptors from mill effluents also calculates the annual average working level (WL) and thus, by inference, equilibrium fraction for the receptor locations. The MILDOS calculated equilibrium fractions for the 2001-2003 MILDOS runs, previously submitted to CDPHE, for each boundary air monitoring station and source were used to calculate a mean equilibrium factor for each station. The mean equilibrium factor for each air sampling station is given in Table 2. All point and area sources were included in the equilibrium analysis. It should be noted that the point sources contributed very little to the radon at the boundary stations as would be expected.

Detailed calculations are provided in Attachment A, Tables A-2, A-3, and A-4 and summarized in Table A-5. (Excel spreadsheets).

Table 2: Calculated Mean Equilibrium Fraction

Location	Average Equilibrium Fraction	Equilibrium-adjusted Effluent Limit (pCi/m^3)
AS 202	0.214	467
AS 203	0.278	360
AS 204	0.180	556
AS 206	0.400	250
AS 209	0.139	719
AS 210	0.330	303
AS 212	0.254	394

The calculated equilibrium fractions ranged from 0.14 at station AS 209, the Mill Entrance Road, to 0.40 at station AS 206, the North boundary. These equilibrium fractions are within the range that would be expected for the site. Station AS 209 is directly to the north of the ore storage areas thus the travel time for the radon emanating from ore would be relatively short resulting in a small fraction of ingrowth of the short-lived decay products. Station 206 is at the north end of the site by the dam, the furthest monitoring station from the radon sources. Therefore, an equilibrium fraction of 0.40 is reasonable. The stations with the lowest potential for radon concentrations attributable to the site are generally at the greatest distances from the radon sources and show the highest equilibrium fractions as would be expected. Due to their dependence primarily on distance from the site, the equilibrium fractions would not be expected to change significantly from year to year; therefore, use of an overall average is reasonable.

The equilibrium-adjusted concentration limits above background were calculated by dividing the effluent limit with decay products present at equilibrium by the equilibrium factor determined based on the MILDOS analysis. These values are also given in Table 2. The effective radon concentration limit at each air monitoring station is the year-specific background concentration (95% upper confidence level) plus the sampler-specific equilibrium-adjusted effluent limit. The effective radon concentration limits and the measured annual average concentrations for each monitoring station are given in Table 3.

Table 3: Comparison of Effective Radon Concentration Limit to Measured Concentration

Location	Year	Bkg (pCi/m^3)	Effluent Limit (pCi/m^3)	Effective Conc. Limit (pCi/m^3)	Measured Ave. Conc. (pCi/m^3)	In compliance?
AS 202	2001	293	467	760	192	Yes
	2002	878	467	1345	543	Yes
	2003	826	467	1293	700	Yes
AS 203	2001	293	360	653	375	Yes
	2002	878	360	1238	975	Yes
	2003	826	360	1186	825	Yes
AS 204	2001	293	556	849	325	Yes
	2002	878	556	1434	1125	Yes
	2003	826	556	1186	775	Yes
AS 206	2001	293	250	543	160	Yes
	2002	878	250	1128	693	Yes
	2003	826	250	1076	900	Yes
AS 209	2001	293	719	1012	350	Yes
	2002	878	719	1597	1475	Yes
	2003	826	719	1545	625	Yes
AS 210	2001	293	303	596	218	Yes
	2002	878	303	1181	700	Yes
	2003	826	303	1129	675	Yes
AS 212	2001	293	394	687	192	Yes
	2002	878	394	1272	698	Yes
	2003	826	394	1220	700	Yes

The measured radon concentration at each air sampling station was below the effective radon concentration limit for all stations and all three years.

Justification for a Single Effluent Concentration Limit for Rn-222 plus Rn-220

Cotter Corporation co-located Landauer DRNF monitors that measure Rn-220 plus Rn-222 with DRNM monitors that do not allow Rn-220 to diffuse into the sensitive volume of the detector, for two quarters during 2002. The variability in the radon concentration measurements made it impossible to determine the contribution from Rn-220 by subtraction. There are no practical options for environmental monitoring of radon isotopes other than determining Rn-220 by difference.

Cotter will continue to monitor radon concentrations using the DRNF detectors or other detectors that measure both Rn-220 and Rn-222. The use of such monitors for measurement of radon is conservative in that the potential alpha energy, thus dose, from ^{220}Rn is much less than the potential alpha energy from

^{222}Rn at the same concentration in air as the attached calculation demonstrates (Attachment B previously provided to CDPHE). Therefore, the intent of the effluent limit, i.e., ensuring that the dose to a member of the public would not exceed 50 mrem per year, is met by detecting both radon isotopes and assuming that all of the radon is ^{222}Rn.

ATTACHMENT A

EXCEL SPREADSHEETS

Table A-1: Calculation of Sampler-specific Effluent Concentration Limits.

Year	Background Concentrations					
	CC	LP	OV3	Mean	Std dev. of mean	UCL Bkg Mean + 2 s
2001	192	268	267	242	25	293
2002	875	673	625	724	77	878
2003	375	800	567	581	123	826

Year	Sampler	Eq. Frac.	Eff. Limit	Eff.Limit + UCL Bkg	Ave. Rn	> Eff. Lim?
2001	AS 202	0.214	467	760	192	no
	AS 203	0.278	360	653	375	no
	AS 204	0.180	556	849	325	no
	AS 206	0.400	250	543	160	no
	AS 209	0.139	719	1012	350	no
	AS 210	0.330	303	596	218	no
	AS 212	0.254	394	687	192	no
2002	AS 202	0.214	467	1345	543	no
	AS 203	0.278	360	1238	975	no
	AS 204	0.180	556	1434	1125	no
	AS 206	0.400	250	1128	693	no
	AS 209	0.139	719	1597	1475	no
	AS 210	0.330	303	1181	700	no
	AS 212	0.254	394	1272	698	no
2003	AS 202	0.214	467	1293	700	no
	AS 203	0.278	360	1186	825	no
	AS 204	0.180	556	1382	775	no
	AS 206	0.400	250	1076	900	no
	AS 209	0.139	719	1545	625	no
	AS 210	0.330	303	1129	675	no
	AS 212	0.254	394	1220	700	no

Table A-2: Calculation of Average Equilibrium Fraction for Years 2001-2003

(Based on MILDOS results for listed years)

Location	2001	2002	2003	Average	Std Dev.	CV	
AS 202	2.64E-01	1.59E-01	2.17E-01	2.14E-01	0.052664	2.47E-01	
AS 203	3.22E-01	2.28E-01	2.83E-01	2.78E-01	0.047195	1.70E-01	
AS 204	1.27E-01	1.72E-01	2.40E-01	1.80E-01	0.057046	3.17E-01	
AS 206	3.63E-01	4.28E-01	4.09E-01	4.00E-01	0.033605	8.40E-02	
AS 209	1.32E-01	1.67E-01	1.19E-01	1.39E-01	0.024848	1.79E-01	
AS 210	3.37E-01	3.48E-01	3.06E-01	3.30E-01	0.021831	6.61E-02	
AS 212	2.47E-01	2.78E-01	2.36E-01	2.54E-01	0.021736	8.57E-02	

ATTACHMENT B

COMPARISON OF ^{220}RN SHORT-LIVED DAUGHTER POTENTIAL ALPHA ENERGY TO ^{222}RN DAUGHTER POTENTIAL ALPHA ENERGY

Comparison of ^{220}Rn Short-Lived Daughter Potential Alpha Energy to ^{222}Rn Daughter Potential Alpha Energy

The total potential alpha energy from ^{220}Rn short-lived decay products is much less than the potential alpha energy from ^{222}Rn short-lived decay products at the same activity concentration because the specific activity of ^{220}Rn is much greater than the specific activity of ^{222}Rn. Therefore, the number of atoms of ^{220}Rn present at a given activity concentration is much smaller than the number of atoms of ^{222}Rn at the same activity concentration. While the decay products of ^{222}Rn can build in to equilibrium, or significant fractions thereof, the decay products of ^{220}Rn cannot (unless supported by its parent ^{224}Ra) because of the short half-life of the parent (55 s) compared to the half-life of its decay product ^{212}Pb (10.6 hours).

Assume:
^{220}Rn concentration = 100 pCi/L
^{222}Rn concentration = 100 pCi/L
Equilibrium fraction for ^{222}Rn = 0.20
All ^{220}Rn decays to ^{208}Pb

^{220}Rn potential alpha energy

Total number of atoms at 100 pCi/L:

$A = (0.693/T_{1/2})(N)$
$N = AT_{1/2}/0.693$
$T_{1/2} = 55$ seconds

N = (100 pCi/L)(0.037 d/s-pCi)(55 s)/0.693 = 295 atoms

Potential alpha energy of all of the decay products assuming 295 atoms of ^{220}Rn decay to ^{208}Pb:

^{216}Po - 6.78 MeV
^{212}Bi - 6.07 MeV x 0.36
^{212}Po - 8.79 MeV x 0.64

Total alpha energy = 14.6 MeV

Total potential alpha decay product energy at 100 pCi/L ^{220}Rn:
Energy = 14.6 MeV/atom x 295 atoms = 4.31×10^3 MeV

^{222}Rn potential alpha energy:

Assume 20% of equilibrium
At 100% of equilibrium, 100 pCi/L ^{222}Rn = 1.0 Working Level
Potential alpha energy of ^{222}Rn short-lived decay products at 1.0 WL = 1.3×10^5 MeV

Potential alpha energy at 20% of equilibrium = $0.2 \times 1.3 \times 10^5$ MeV = 2.6×10^4 MeV

Ratio of potential alpha energy for ^{222}Rn decay products to ^{220}Rn decay products:

$$\text{Ratio} = 2.6 \times 10^4 \text{Mev}/4.3 \times 10^3 \text{ MeV} = 6$$

Conclusion

Assuming all radon detected at the monitoring stations is ^{222}Rn overestimates the potential dose from ^{220}Rn by a factor of 6. Therefore, use of the DRNF radon detectors is conservative and meets the intent of determining compliance with the effluent limit. It is neither necessary nor practical to measure ^{220}Rn and ^{222}Rn individually.

Colorado Department
of Public Health
and Environment

Radiation Management Program
Hazardous Materials and
Waste Management Division

To: Jill Cooper, APCD
From: Phil Egidi, RMP, x-3447
Subject: Cotter Mill Radon Flux Report
Cc: Ken Weaver, Gene Potter
Date: June 16, 2003

MEMORANDUM

I have been docketed to review the *2002 NESHAPs Radon Flux Measurement Program, Canon City Millsite, Canon City, Colorado* prepared by Tellco Environmental, LLC of Grand Junction. The report is required by 40 CFR 61, Subpart W, National Emissions Standards for Radon Emissions from Operating Mill Tailings, and was submitted to you on March 31, 2003. This is the due date per 40CFR61.254.

The measurement protocol follows the methods prescribed in 40CFR61.253, found in 40CFR61, Appendix B, Method 115. In addition, *Guidance on Implementing the Radionuclide NESHAPS* (EPA 1991) was used in the review of the report. http://www.epa.gov/radiation/docs/neshaps/nesh_implement_07_91.pdf

The report indicates that the radon flux from the impoundment was 18.7 picocuries per square meter per second (pCi/m^2 – s) for the reporting period.
The standard is 20 pCi/m^2 – s.

The Guidance document states (p 62):

> "In addition, a facility that can demonstrate compliance but is very close to the limit should examine its operations and monitoring results to see whether it is exceeding the standard for part of a calendar year and operating well beneath it at other times. Such a pattern may be due to the nature of the firm's operation, or it may indicate that sound practices should be more rigorously enforced. The records required to be kept at the facility for five years will reflect the situation."

Since the standard is 20 pCi/m^2 - s and the reported value was 18.7 pCi/m^2 - s, Radiation Management staff is concerned that one-time sampling may not have been sufficient for last year. This is due to the drought conditions encountered the last few years resulting in lower water levels and more exposed beaches, sample spacing, and uncertainty inherent in measurements, which appear to be approximately +/- 10% (Appendix C of the report). It should be noted that the laboratory QA process shows greater accuracy than the individual uncertainty reported for individual measurements (~ 3.6%).

Cotter has also received and disposed off-site tailings materials with a range of radium content (up to an average of 10,000 pCi/g ^{226}Ra). They are proposing to continue to receive off-site materials as part of their ongoing operations in their current license renewal application. Varying concentrations of radium in those materials may be encountered. A question may be "Does this constitute a "modification" as defined in the Guidance"?

Cotter collected 200 measurements (plus QA/QC samples). The area averaging for the flux calculation was carried out over 6 areas. The distribution of the 200 samples is split between the beaches area (100 samples) and four other areas that split the remaining 100 samples. The distribution of these samples over the three areas is stratified, not uniform. For example, the evaporation ponds area, which covers about 25% of the surface area, is represented by only seven samples. Another example is the dirt-covered area, which only had ten samples, and a very high radon flux average. When the flux is averaged over the distinct areas: beaches (100 samples), and soil-covered areas (100 samples), the calculation appears to change to an average flux of 20.8 $\text{pCi/m}^2 - \text{s}$.

Since the reported, calculated values are at or near the standard, and sample collection in some areas may be unrepresentative due to safety, spacing, or accessibility, the conclusion that the site was in compliance is difficult to validate.

Cotter performs this sampling according to USEPA procedures. Cotter does not have a standard operating procedure for this activity in its Radiological Health and Safety Procedures Manual. License Condition 22.1 states: "The licensee shall control emissions to air according to procedures approved by the Division and according to applicable permits of the Air Pollution Control Division (APCD) of the Department."

During a routine inspection the week of June 9, 2003, it was noted that Cotter has increased the amount of area covered by water substantially, and that much of previously exposed areas now are under water. If you believe there should be additional requirements that specify ALARA or more frequent monitoring due to changing conditions, consult with me on language, and it can be considered in the current license renewal effort.

Reviews of the previous five years reports should be undertaken to determine if 2002 was an anomalous situation.

The attached checklist contains my review of the report based on the standard. If you have any questions, feel free to contact me at x-3447.

EPA-751

Reid Rosnick/DC/USEPA/US	To	Beth Miller
09/05/2012 08:39 AM	cc	
	bcc	
	Subject	Fw: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

---

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:39 AM -----

From: "Sharyn Cunningham" <Sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: "Paul Carestia" <pdcarestia@aol.com>
Date: 10/14/2009 07:55 PM
Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Reid,

I'm sending additional information to include with Paul Carestia's email sent earlier today. Attached is a series of letters exchanged between Cotter and the CDPHE in 2004 concerning radon. The MFG, Inc. paper was part of this process. These letters may shed additional light on the matter. Paul had not seen them, and he is reviewing them now and will send you his notes and thoughts on them later.

Though there may be other reasons that radon came up in 2004, one may be that leadership staff at the CDPHE radiation division changed in 2003 bringing a new approach to Cotter. Also, radon flux in 2002 was18.7 pCi/m2-sec, probably due to the Primary Impoundment drying out during a period of extended drought. A third contributing event, as seen in the February 12th Memorandum from Jan Johnson to Steven Landau, was soil sampling done in 2003 where high levels of stable lead were found in a private residence attic and barn, and some other locations near Cotter. It appears that CDPHE was questioning whether radon from Cotter's impoundment and facility was contributing to this contamination. I've also attached a CDPHE letter from 6-16-2003 regarding the 2002 radon flux that was sent to CDPHE Air Pollution Division.

Thank you, and we'll look forward to hearing from you.

Sharyn Cunningham

(719)275-3432 Cotter CDPHE Radon Correspondence 2004.pdf 2003-6-16 CDPHE Review Radon Flux 2002.pdf

STATE OF COLORADO

Bill Owens, Governor
Douglas H. Benevento, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

January 13, 2004

Attention: Jim Cain, Radiation Safety Officer
Cotter Corporation, Canon City Mill
P.O. Box 1750
Canon City, Colorado 81215-1750

Re: Cotter's Reported Radon Effluent Levels In 2002
Radioactive Materials License Number Colo. 369-01

This letter is in response to data provided in Cotter's Environmental and Occupational Performance Report and ALARA Review dated June 30, 2003. The Department would like to obtain additional data regarding your environmental monitoring program.

1. Please provide the specific results from all ^{222}Rn and ^{220}Rn measurements at the facility and offsite which were used to generate the average environmental values provided in Section 4 of the June 30, 2003 annual report. The results for ^{222}Rn and ^{220}Rn measurements must be listed separately. Please provide the actual lower limits of detection for measurements of each radionuclide.

2. Effluent limits for emission of radionuclides are specified in the Regulations in Part 4, Appendix B, Table II, Column I. Two effluent limits are listed for ^{222}Rn and two effluent limits for ^{220}Rn. The Cotter effluent limit listed in Figures 4-12 and 4-13 corresponds to 1E-8 μCi/ml which is appropriate if the radioactive daughters of ^{222}Rn are not present. The Part 4 effluent limits for ^{222}Rn and ^{220}Rn with daughters present are 1E-10 μCi/ml and 3E-11 μCi/ml respectively. These lower effluent limits (with daughters present) are applicable to outdoor radon and equate to a values of 0.1 pCi/l and 0.03 pCi/l. The Cotter reported average concentration of ^{222}Rn at the site boundary is 0.962 pCi/l and the average concentration of ^{222}Rn offsite was reported as 0.714 pCi/l. *The difference between these values is 0.248 pCi/l.* In addition, the ^{222}Rn values reported for air monitoring stations AS-204 and AS-209 were 1.125 pCi/l and 1.475 pCi/l respectively. *The difference between the values at these two sampling stations and the average offsite concentration are 0.411 and 0.761 pCi/l.* Air concentrations for ^{220}Rn were not provided. The Department requests that Cotter provide a detailed assessment of ^{222}Rn and ^{220}Rn effluent levels at the facility. *An explanation of the difference between the reported site boundary concentrations and the average concentration offsite is of particular importance.*

Please provide your written response within thirty (30) days. If you have any questions concerning this notice, please contact Mr. Tom Pentecost of this Division at (303) 692-3458.

Tim G. Bonzer, Lead of Compliance
Radioactive Management Program

TGB:TP

Prepared by:______ Reviewed by:______ Reviewed by:______ Mailed by:______
Date:____________ Date:_____________ Date:____________ Date Mailed:______________

COTTER

February 12, 2004

Mr. Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

RECEIVED
FEB 12 2004
HAZARDOUS MATERIALS
AND WASTE MANAGEMENT

Re: Unit Letter Dated January 13, 2004-Radon Effluent Concentration Limit

As stated in our January 8, 2004 meeting, the appropriate radon limit for the Northern boundary of the Canon City Milling facility has been studied previously and reported to the Department. As an element of the previous license renewal process Cotter provided to the Department a report entitled *Pathway Assessment Of Radionuclide Exposures To Residents Living Near Cotter Corporation's Canon City Uranium Mill, December,* 1995. In addition to this effluent concentration limit evaluation, Radon-222 has been a component of previous dose and risk assessments relative to the site and was reported for select receptor locations. With regard to Radon-220, this has also been studied previously within the context of receptor dose. The previous Radon-220 assessment was included as an element of the *Human Health Screening Level Risk Assessment Uranium/Zirconium Project, November, 2000.*

In order to supplement the record, accounting for current conditions and the questions expressed the Units letter of January 13, 2004, Radon-222 and Radon-220 have been reviewed again. The result of that evaluation is attached for the Units review (Attachment A). The current condition review indicates that Cotter remains well within the Radon-222 and Radon-220 effluent concentration limits, with and without daughters present.

In addition to this work, and because there has been undue and unanswered concern as to whether the decay of radon emanating from the site could account for elevated stable lead soil concentrations in the community, site radon releases and their contribution to stable lead in soil has been evaluated as well. The result of that evaluation is attached for the Unit's consideration (Attachment B).

If you should have any questions regarding this information, please contact me.

Sincerely,

Steven D. Landau
Manager, Environmental Affairs

Attachment A

Response to CDPHE Letter re: Cotter's Reported Radon Effluent Levels in 2002

The Colorado Department of Public Health and Environment's (CDPHE's) letter dated January 13,2004 requested additional information regarding radon concentrations at the Canon City mill boundaries. The following are Cotter's responses to the questions posed by CDPHE:
Question 1: *Provide specific results…*

The results of radon monitoring at boundary air monitoring stations for the past 24 years are provided in the attached Excel spreadsheet, Table A-l, and have been included in Annual Reports. The 2003 data are not yet complete.

Question 2: *Explain the difference between the reported site boundary concentrations and the average concentration off-site.*

Cotter has included the radon monitoring results in its Annual Reports and has used the data in risk assessments submitted to the CDPHE over the past eight years. However, the specific explanation relevant to boundary effluent concentration limits is reiterated here.

Historical Perspective

The appropriate limit for the Northern boundary of the Canon City Milling facility has been studied previously and reported to the Department. More specifically (as an element of the previous license renewal process) Cotter provided to the Department a report entitled *Pathway Assessment Of Radionuclide Exposures To Residents Living Near Cotter Corporation's Canon City Uranium Mill, December*, 1995. This report was prepared by a team of Health Physicists from Colorado State University, Keystone Scientific Corporation and the Shepard-Miller Corporation. Within the report the team evaluated the applicable effluent concentration limits for Radon-222 at the North Boundary of the Mi11ing Facility, The findings in this regard are found at pages 29 and 30 of the report under the heading Comparison of Radon Concentrations to the CDPHE Effluent Limit. The referenced text stated the following:

> "The mean measured radon concentrations at the North Boundary, attributable to the mill, for the period 1981-1986 and the mill access road for 1994, are given in Table 20.
>
> These concentrations were compared to the effluent limits from the Colorado Department of Public health and Environment Radiation Protection Regulations, Part 4, Standards for Protection against Radiation, Appendix B, Table 2.
>
> Two values are given in Appendix B, Tab]e 2 for the effluent limit for radon depending on the equilibrium state: 1 E-8 uCi/ml (lE4 pCi/m^3) "with daughters removed"; and 1 E-10 uCi/ml (lE2 pCi/m^3) "with daughters present". The limit "with daughters present" is based on 100 % of equilibrium as indicated by the Appendix B, Table 1 values (occupational limits). Therefore, the effective effluent limit in areas close to the source of radon gas, where equilibrium fractions may be as low as 0.1, should be adjusted to account for the degree of equilibrium.
>
> If it is assumed that the mean distance from the source to the site boundary is 1000 meters and that the mean wind speed is 4.5 m/s (as assumed in the

> EPA diffuse NORM document), the mean travel time from the source to the receptor is 222 seconds or 3.7 minutes. The ingrowth of ^{222}Rn daughters in 3.7 minutes is approximately 0.08, i.e. 1.0 WL is equal to 1250 pCi/L (Schiager 74). To be consistent with the basis for the Appendix B, Table 2 effluent limits, the radon limit should be adjusted for the degree of equilibrium reached at the boundary receptor location. Therefore, the effluent limit under these conditions should be approximately 1 E-9 uCi/ml (1000 pCi/m3*)*.
>
> The radon concentration attributable to the mill at the point of highest measured concentration are shown in Table 20. These concentrations exceed the stated limit in part 4, Appendix B, Table 2. but are within the limit adjusted for degree of equilibrium."

Current Evaluation of Compliance

The existing effluent limits for Rn-220 and Rn-222, given in Part 4, Appendix B, Table II, are 2 E-8 uCi/ml (20 pCi/l) and 1 E-8 uCi/ml (10 pCi/l), respectively, with no daughters present. The limits with daughters present are 3 E-l1 uCi/ml (0.03 pCi/l) and 1 E-10 uCi/ml (0.1 pCi/l), respectively. The introduction to Appendix B notes that the effluent air concentration limits are derived from the occupational Derived Air Concentrations, adjusted by a factor of 50 to account for the difference between the maximum allowable occupational radiation dose and the allowable radiation dose to a member of the public (5 rem/y vs 0.1 rem/y); a factor of 3 to account for the difference in exposure time; and a factor of 2 to allow for exposure to different age groups. The occupational DACs for Rn220 and Rn-222 are dependent on the degree of equilibrium. Part 4 allows for the adjustment of the effluent limits for radioactive equilibrium status (4.15.3). The applicable Rn-222 effluent limits for individual monitoring stations at the Cotter site vary depending on the expected degree of equilibrium at each location.

Estimated Radon Decay Product Equilibrium Fraction at the Boundary Air Monitors

As noted above, the CDPHE Radiation Protection Rules allow for adjustment of the effluent limit based on " actual physical and chemical characteristics of the effluents, such as, aerosol size distribution, solubility, density, radioactive decay equilibrium, and chemical form." (4.15.3). The following analysis explains the derivation of monitor-specific radon effluent limits based on equilibrium status at each air monitoring station:

The equilibrium fraction at the boundary air monitors was estimated by calculating the average travel time for the air from the primary tailings impoundment to each boundary monitoring station. The annual average wind speed in each app1icable compass direction was calculated using the STAR file from the MILDOS output. The distance was calculated assuming the radon all emanated from the center of the impoundment. The average age of the air was calculated by dividing the distance by the average wind speed as shown in the attached Excel spreadsheets.

The equilibrium fraction for radon emanating from the tailings impoundment at the air monitoring station was estimated from the graph of ingrowth rate of radon progeny from radon-222 in Schiager, 1974. The ingrowth rate shown in the graph was calculated based on solutions to the Bateman equations.

The equilibrium-adjusted effluent limit concentration for Rn-222 was calculated based on the Appendix B, Table II effluent limit for Rn-222 with progeny present. As noted above, the CDPHE Radiation Protection Rules allow for adjustment of the effluent limit based on radioactive decay equilibrium. That adjustment results in the effluent limits for Rn-222 given in Table 1.

Table 1: Monitor-Specific Estimated Equilibrium Fractions:

Station	Location	Average Wind speed	Distance	Average Age of air (m)	Estimated Equilibrium Fraction	Calc. Eq.-Adj. Eff. Lim (pCi/l)
AS 202	E of tailings	8.03	1560 feet	2.2	0.05	2.0
AS 203	SSW of Tailings	7.18	1920 feet	3.0	0.06	1.7
AS 204	W of tailings	8.06	3000 feet	4.2	0.08	1.3
AS 206	North of tailings	7.76	6000 feet	8.8	0.16	0.63
AS 209	NW of tailings	7.61	3600 feet	5.4	0.10	1.0

As noted above, the effluent concentration limit is a secondary limit based on adjustment of the occupational DAC. The following example demonstrates that the equilibrium adjusted effluent limit meets the primary criterion of 50 mrem per year.

> The dose from Rn-222 gas is almost entirely due to the presence of the short-lived decay products. If one assumes, based on the occupational annual limit of intake expressed as 4 Working Level Months per year. i.e., a committed effective dose equiva1ent (CEDE) of 1.25 mrem per Working Level Month (WLM) and an occupancy adjustment factor of 3, the annual dose from Rn222, at the equilibrium adjusted Rn-222 concentration for AS 209, can be calculated as follows: .
>
> Annual average activity Rn-222 concentration = 0.63 pCi/1
> Equilibrium factor = 0.16
>
> CEDE = [(0.63 pCi/1)(0.16)/100pCi/I-WL][3][12 m/y][(1250 mrem/WLM)]
>
> CEDE = 45 mrem/y

The difference between the annual average Rn-222 concentration at the site boundary and the background or off-site concentration at each site boundary monitoring station for 2003 was below the equilibrium-adjusted effluent limit for that station. The Colorado Department of Public Health and Environment (CDPHE) accepted the use of the equilibrium adjusted Rn-222 concentration in the 1995 risk assessment prepared by Colorado State University.

Comparisons of the annual average Rn-222 concentrations at the site boundary averaged over the past 24 years; averaged over the past 5 years, and for 2002 alone are provided in the attached Excel spreadsheets and in Table 2 below. All of boundary Rn-222 concentrations are less than the monitor-specific equilibrium adjusted effluent limits.

Table 2: Comparison of Incremental Rn-222 Concentrations with Eq. Adj. Limit

Sampler ID	Ave. Cone. (pCi/m3)	Background Cone. (pCilm3)			Incremental Cone. (pCi/m3) (for specific background location)			Eq. Adj. Cone. Lim. (p/Ci/m3)
2002		CC	LP	QV	CC	LP	QV	
AS 202	543	875	673	625	-332	-130	-82	**2000**
AS 203	975	875	673	625	100	302	350	**1700**
AS 204	1125	875	673	625	250	452	500	**1300**
AS 206	693	875	673	625	-182	20	68	**630**
AS 209	1475	875	673	625	600	802	850	**1000**
1998-02								
AS 202	629	708	599	522	-79	30	107	**2000**
AS 203	715	708	599	522	7	116	193	**1700**
AS 204	781	708	599	522	73	182	259	**1300**
AS 206	556	708	599	522	-152	43	34	**630**
AS 209	1061	708	599	522	353	462	539	**1000**
All yrs								
AS 202	643	605	557	518	38	86	125	**2000**
AS 203	657	605	557	518	52	100	139	**1700**
AS 204	758	605	557	518	153	201	240	**1300**
AS 206	683	605	557	518	78	126	165	**630**
AS 209	977	605	557	518	372	420	459	**1000**

Radon-220 Concentrations at the Site Boundary

The Rn-220 concentration at the site boundary cannot be measured with the appropriate degree of accuracy due to the limitations of the measurement techniques. The inherent error in the measurement is at least an order of magnitude greater than the effluent limit of 0.03 pCi/l with daughters present. Due to the fact that the half-life of Rn-220 is very short compared to the half-life of the decay product, equilibrium cannot be reached in an open environment. The 0.03 pCi/l is not applicable to dose to members of the public from the Cotter facility. Therefore, the dose from Rn-220 decay produces at a receptor location must be modeled based on reasonable assumptions with regard to site emissions. The dose can then be compared to the implicit dose limit for members of the public from inhalation or airborne particulate matter, 50 mrem per year (Part 4, Appendix B).

The potential dose due to Rn-220 projected to be released from the Cotter site for processing of caldasite ore was calculated and reported in the Screening Level Risk Assessment for the Uranium/Zirconium Project (SMI 2002). The estimated dose due to Rn-220 decay products was 0.05 mrem per year assuming all of the Rn-220 decayed to Pb-212 before dispersion. This calculated dose is three orders of magnitude below the dose limit, therefore, Rn-220 is not a concern for dose to members of the public.

References:

Colorado State University (CSU). 1995. Pathway Assessment of Radionuc1ide Exposures to Residents Living Near Cotter Corporation's Canon City Uranium Mill. December.

Shepherd Mil1er, Inc. (SMI). 2000. Screening Level Risk Assessment, Uranium/Zirconium Project. November 6.

Table A-1: Radon Concentrations at Boundary Air Monitoring Stations

	Location								
Year	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	CC	LP	OV-3
1979	420	460	785					707		
1980	330	250	240					310	293	
1961	380	378	520	970				260	260	395
1982	470	579	1360	923				657	1040	576
1983	916	705	875	1190				419	492	648
1984	610	720	650	850				414	544	895
1985	660	690	820	830				560	470	572
1986	1940	1510	1440	1090				1250	1370	1050
1987	775	675	800	875				775	400	475
1988	525	900	975	775				833	550	450
1989	725	1030	950	525				850	500	500
1990	500	375	500	325				325	375	158
1991	400	450	475	475				475	325	293
1992	725	750	650	500				500	575	475
1993	375	325	375	350				275	250	120
1994	590	580	650	690	980			560	500	540
1995	500	450	580	500	680			450	450	380
1996	680	650	900	780	1030	880		660	700	700
1997	820	720	750	600	800	720		690	720	560
1998	560	500	520	550	920	600		450	430	520
1999	750	725	700	550	1025	850	733	975	725	450
2000	1050	1000	1233	825	1533	1267	1250	1050	900	750
2001	192	375	325	160	350	218	192	192	268	267
2002	543	975	1125	693	1475	700	698	875	673	625
Mean	643	657	758	683	977	748	718	605	557	518
Stdev	340	283	312	256	367	317	432	272	269	218
# obs	24	24	24	22	9	7	4	24	23	22
Stdev mean	69	58	64	55	122	120	216	56	56	46
Last 5 years										
Mean	619	715	781	556	1061	727	718	708	599	522
Stdev	314	279	389	249	480	382	432	370	250	182
# obs	5	5	5	5	5	5	4	5	5	5
Stdev mean	140	125	174	111	215	171	216	166	112	81

Table A-2: COMPARISON OF BOUNDARY MONITORING STATION RADON-222 CONCENTRATION WITH BACKGROUND											
Canon Citv Background											
Station	Average conc.	Std dev	5-year ave	Std dev	CC Ave. Conc.	Std dev	5-year Ave.	Std. Dev.	Ave. Inc.	5-year Inc.	Eq. Adj. Eff. Limit
AS 202	643	69	629	140	605	56	708	166	38	-79	2000
AS 203	657	58	715	125	605	56	708	166	52	7	1700
AS 204	758	64	781	174	605	56	708	166	153	73	1300
AS 206	683	55	556	111	605	56	708	166	78	-152	630
AS 209	977	122	1061	215	605	56	708	166	372	353	1000
Lincoln Park Background:											
Station	Average conc.	Std dev	5-year ave	Std dev	LP Ave. Conc.	Std dev	5-year ave.	Std. Dev.	Ave. Inc.	5-year Inc.	Eq. Adj. Eff. Limit
AS 202	656	69	629	140	557	56	599	112	99	30	2000
AS 203	657	58	715	125	557	56	599	112	100	116	1700
AS 204	758	64	781	174	557	56	599	112	201	182	1300
AS 206	683	55	556	111	557	56	599	112	126	-43	630
AS 209	977	122	1061	215	557	56	599	112	420	462	1000
Oro Verde – 3 Background											
Station	Average conc.	Std dev	5-year ave	Std dev	OV-3 Ave. Conc.	Std dev	5-year Ave.	Std. Dev.	Ave. Inc.	5-year Inc.	Eq. Adj. Eff. Limit
AS 202	656	69	629	140	518	46	522	81	138	107	2000
AS 203	657	58	715	125	518	46	522	81	139	193	1700
AS 204	758	64	781	174	518	46	522	81	240	259	1300
AS 206	683	55	556	111	518	46	522	81	165	34	630
AS 209	977	122	1061	215	518	46	522	81	459	539	1000
2002 Rn-222 Concentrations											
Station	2002 Conc.	2002 CC	2002 LP	2002 OV	Net-CC bkg	Net-LP bkg	Net-Ovbkg				Eq. Adj. Eff. Limit
AS 202	543	875	673	625	-332	-130	-82				2000
AS 203	975	875	673	625	100	302	350				1700
AS 204	1125	875	673	625	250	452	500				1300
AS 206	693	875	673	625	-182	20	68				630
AS 209	1475	875	673	625	600	802	850				1000

Attachment B

MEMORANDUM

MFG PROJECT: 181077

TO: Steve Landau
Jim Cain

FROM: Jan Johnson, Ph.D.
Craig A. Little, Ph.D.

DATE: February 12, 2004

SUBJECT: Calculation of Stable Lead Buildup in Canon City Soils Following Decay of 221Rn

---

Concern has been expressed that the decay products of ^{222}Rn released from the Cotter Canon City Milling Facility have accumulated in soils surrounding the facility resulting in an increase in stable lead concentrations. That concern in absolutely unfounded. The following very conservative calculations demonstrate that stable lead resulting from the decay of Rn-222 attributable to the mill operations and storage of waste materials (tailings) could account for approximately one-millionth of a percent of the stable lead in soil.

Radon-222 is released from the decay of Ra-226 in the uranium ore and tailings at the site. There are two sources of Rn-222: Rn-222 released during processing of the ore and Rn-222 released from the stored tailings and ore. The total amount of Rn-222 released during the history of the Canon City mill is calculated in the following sections:

Rn-222 Release from Ore Processing

The activity concentration of Rn-222 in ore is equal to the activity concentration of Ra-226 since Rn-222 is in equilibrium. Assuming that all of the Rn-222 is released during processing either in handling or crushing, the total activity of Rn-222 released during the mill's history would be equal to the total activity of Ra-226 processed through the mill. The current inventory of Ra-226 stored on the site is a reasonable estimate of the total Ra-226 activity in material processed. Cotter records show an inventory of approximately 4200 Ci. Therefore, it can be assumed that 4200 Ci of Rn-222 have been released during milling activities.

Rn-222 Release from Stored Tailings and Ore

The total Rn-222 release from tailings, ore, and other solid wastes stored on site in 2002 was estimated using the MILDOS computer code to be approximately 2800 Ci. The mill has been in existence at the Canon City site for 40 years. The configuration of the tailings and ore storage has not changed significantly for the past 25 years. Therefore, the release rate of 2800 Ci per year can be applied for 25

MFG,lnc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525
Phone: 970-223-9600 *Fax: 970-223-7171*

years. The release rate for the years prior to 1979 was lower since the footprint of the tailings storage area and ore storage would have covered a smaller area. Assuming that the average release rate for the years prior to 1984 was 75 percent of the 2002 release rate, the total Rn-222 release for the history of the mill would be as follows:

Rn-222 release from area sources = [(25 y)(2800 Ci/y) + (15 y)(0.75)(2800 Ci/y)] = 101,500 Ci

The total Rn-222 release *for* the history of the mill would then be as follows:

Total Rn-222 release = 101,500 Ci + 4,200 Ci = 105,700 Ci

Calculation of Equivalent Mass of Pb-206 Released

The total number of Rn-222 atoms that would produce an activity of 105,700 Ci can be calculated as follows:

Activity = (decay constant)(number of atoms)

A = (105,700 Ci)(37,000,000,000 d/s-Ci) = 3.9×10^{15} d/s

The number of atoms that would produce 3.9×10^{15} d/s is as follows:

N =3.9×10^{15} d/s/decay constant for Rn-222

The decay constant for Rn-222 = 2.1×10^{-6} (based on a half-life of 3.83 days)

Therefore, the total number of Rn-222 atoms would be as follows:

N = $3.9 \text{ X } 10^{15}$ d/s/ $2.1 \text{ X } 10^{-6}$ /s = $1.9 \text{ X } 10^{21}$ atoms

Assuming all of the Rn-222 atoms decayed to stable lead (Pb-206) and were deposited within 1 km of the Cotter mill, the total mass of stable lead dispersed over that area would be as follows:

Mass of stable lead = (1.9×10^{21} atoms)(206 g/mole Pb-206)/(6.023×10^{23} atoms/mole) = 0.64 grams

The concentration of stable lead in soil in the vicinity of Canon City due to the decay of Rn-222 derived from Cotter mill operations would be as follows:

Concentration = 0.64 g/mass of soil within 1 km of the mill

The total mass of soil can be calculated as follows:

Area = 3.14 km^2 = $3.14 \text{ X } 10^{10}$ cm^2

Assuming an average mixing depth of 15 cm and a soil density of 1.6 g/cm^3, the concentration of mill-derived Pb-206 in soil would be as follows:

Mass of soil = 3.14×10^{10} cm^2 x 15 cm x 1.6 g/cm^3 = 4.71×10^{11} g

Concentration of Pb-206 from Rn-222 decay = 0.64 g/4.71×10^{11} g = $1.4 \text{ X } 10^{-12}$ g Pb-206/g soil

This is equivalent to 1.4 x 10^{-6} ppm. The estimated background concentration of stable lead in soil in the vicinity of the Canon City Milling Facility is approximately 120 ppm or a factor of 86 million greater than the calculated Pb-206 concentration from mill-derived Rn-222 decay.

To raise the Pb content of the top 15 cm of soil to as high as 1 % from Cotter ^{222}Rn releases would take millions of years.

References

MFG, Inc. 2003. Estimates of Radiation Doses to Members of the Public From Cotter 2002 Operations. Appendix B to Cotter Annual ALARA report. June, 2003.

STATE OF COLORADO

Bill Owens, Governor
Douglas H. Benevento, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

February 25, 2004

Attention: Steve Landau
Cotter Corporation
7800 East Dorado Place, Suite 210
Englewood, Colorado 80111

Re: Cotter's Letter Dated February 12, 2004 Regarding Radon Effluent Levels In 2002
Radioactive Materials License Number Colo. 369-01

This letter is in response to data provided in Cotter's Environmental and Occupational Performance Report and ALARA Review dated June 30, 2003 and Cotter's correspondence dated February 12, 2004.

In correspondence dated January 13, 2004 the Department requested additional data regarding your environmental monitoring program. Specifically:

1. The Department requested that Cotter provide the specific results from all ^{222}Rn and ^{220}Rn measurements at the facility and offsite which were used to generate the average environmental values provided in Section 4 of the June 30, 2003 annual report.

   Cotter has not provided the specific results from all ^{222}Rn and ^{220}Rn measurements at the facility and offsite which were used to generate the average environmental values in the 2003 Annual Report.

   Please provide the Department with the information requested in Item 1 above. The Department would like to have a copy of the specific quarterly results provided by the processor of the radon monitors.

2. The Department requested that the results for ^{222}Rn and ^{220}Rn measurements must be listed separately.

   Cotter has not provided individual measurement results for ^{222}Rn and ^{220}Rn. In your correspondence dated February 12, 2004 it states that the ^{220}Rn concentrations at the site boundary cannot be measured with the appropriate degree accuracy due to limitations in the measurement techniques.

   Please provide the Department with a description of the specific measurement techniques implemented in 2002/2003 by Cotter for the assessment of ^{220}Rn effluent levels and describe how Cotter will alter its monitoring program to verify compliance with effluent levels for ^{220}Rn.

3. The Department requested that Cotter provide the actual lower limits of detection for measurements of each radionuclide.

   Cotter has not provided documentation of the actual lower limits of detection for measurements of ^{222}Rn and ^{220}Rn.

   Please provide the Department with the specific lower limits of detection for the measurement techniques used in 2002 for ^{222}Rn and ^{220}Rn . If these lower limits of detection do not meet the requirements of the license, provide a description of alternative measurement techniques that can be implemented to achieve the necessary level of detection.

4. The Department requested that Cotter provide a detailed assessment of ^{222}Rn and ^{220}Rn effluent levels at the facility. The Department also stressed the importance of explaining the difference between the reported site boundary concentrations and the average concentration offsite.

   Cotter's response provided arguments for use of an alternate effluent limit based on the level of equilibrium between ^{222}Rn and its short lived decay products, citing estimated equilibrium fractions ranging between 0.05 and 0.16 for the specific sampling locations.

   Please provide the Department with the measured levels of the short lived decay products of ^{222}Rn at the sampling locations and calculations of the actual equilibrium factors for 2002.

Note: The scientific literature indicates actual outdoor equilibrium factors may be significantly higher than the estimates cited by Cotter. Also note that only the impoundment was specifically discussed in the February 12, 2004 correspondence and that the ore pads and fine ore bins are of additional concern.

Please provide your written response to this letter within ten (10) days. Following the Department's review of your response, we will contact you to arrange a working group meeting to resolve programmatic issues. If you have any questions concerning this letter, please contact Mr. Tom Pentecost of this Division at (303) 692-3458.

Tim G. Bonzer, Lead of Compliance
Radioactive Management Program

TGB:TP

March 8, 2004

Mr. Tim G. Bonzer, Lead of Compliance
Radiation Management Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

Re: Response to CDPHE letter of February 25, 2004 to Cotter's Response of February 12, 2004 to CDPHE RFI of January 13, 2004, regarding Radon Effluent Levels reported in Cotter's Environmental and Occupational Performance Report and ALARA Review dated June 30, 2003.

Our responses follow your text and requests and are underlined for clarity.

1. The Department requested that Cotter provide the specific results from all ^{222}Rn and ^{220}Rn measurements at the facility and offsite which were used to generate the average environmental values provided in Section 4 of the June 30, 2003 annual report.

   Cotter has not provided the specific results from all ^{222}Rn and ^{220}Rn measurements at the facility and offsite which were used to generate the average environmental values in the 2003 Annual Report.

   Please provide the Department with the information requested in Item 1 above. The Department would like to have a copy of the specific quarterly results provided by the processor of the radon monitors.

Response: Please find enclosed the vendor reports for your consideration (Attachment A). As you will note, we co-located DRNM (^{222}Rn) and DRNF (^{222}Rn + ^{220}Rn) monitors during the second and third quarters in 2003. Average levels were calculated using the DRNF results except for the first quarter 2003.

2. The Department requested that the results for ^{222}Rn and ^{220}Rn measurements must be listed separately.

   Cotter has not provided individual measurement results for ^{222}Rn and ^{220}Rn. In your correspondence dated February 12, 2004 it states that the ^{220}Rn concentrations at the site boundary cannot be measured with the appropriate degree accuracy due to limitations in the measurement techniques.

   Please provide the Department with a description of the specific measurement techniques implemented in 2002/2003 by Cotter for the assessment of ^{220}Rn effluent levels and describe how Cotter will alter its monitoring program to verify compliance with effluent levels for ^{220}Rn.

Response: As noted above, we co-located monitors for two quarters. As can be seen from the reports, based on the variability of the results and background for both ^{222}Rn and ^{220}Rn, one cannot estimate any contribution from ^{220}Rn by subtraction. We plan to continue monitoring for combined ^{222}Rn and ^{220}Rn using the DRNF monitors.

The use of the DRNF monitors for measurement of radon is conservative in that the potential alpha energy, thus dose, from ^{220}Rn is much less than the potential alpha energy from ^{222}Rn at the same concentration in air as the attached calculation demonstrates (Attachment C). Therefore, the intent of the effluent limit, i.e., ensuring that the dose to a member of the public would not exceed 50 mrem per year, is met by detecting both radon isotopes and assuming that all of the radon is ^{222}Rn.

3. The Department requested that Cotter provide the actual lower limits of detection for measurements of each radionuclide.

   Cotter has not provided documentation of the actual lower limits of detection for measurements of ^{222}Rn and ^{220}Rn.

   Please provide the Department with the specific lower limits of detection for the measurement techniques used in 2002 for ^{222}Rn and ^{220}Rn. If these lower limits of detection do not meet the requirements of the license, provide a description of alternative measurement techniques that can be implemented to achieve the necessary level of detection.

Response: The lower limit of detection for both the DRNF and DRNM monitors is 70 pCi/m^3 versus the license requirement of 200 pCi/m^3.

4. The Department requested that Cotter provide a detailed assessment of ^{222}Rn and ^{220}Rn effluent levels at the facility. The Department also stressed the importance of explaining the difference between the reported site boundary concentrations and the average concentration offsite.

   Cotter's response provided arguments for use of an alternate effluent limit based on the level of equilibrium between ^{222}Rn and its short lived decay products, citing estimated equilibrium fractions ranging between 0.05 and 0.16 for the specific sampling locations.

   Please provide the Department with the measured levels of the short lived decay products of at the sampling locations and calculations of the actual equilibrium factors for 2002.

   Note: The scientific literature indicates actual outdoor equilibrium factors may be significantly higher than the estimates cited by Cotter. Also note that only the impoundment was specifically discussed in the February 12, 2004 correspondence and that the ore pads and fine ore bins are of additional concern.

The average annual decay product concentration at the site boundary cannot be measured without specialized continuous working level measurement systems. Grab samples or short-term samples are not adequate to characterize the annual average concentrations since weather conditions have a significant influence on the measurements. Continuous working level measurement systems employing electrets (E-RPSIU) are commercially available but are used primarily for indoor radon measurements and for research purposes. Such measurements would reflect the ambient working levels but would not be representative of the radon decay product concentrations attributable to the regulated emissions from the Cotter facility. Therefore, equilibrium fraction for comparison of mill effluent to the effluent limits for radon must be calculated.

The equilibrium fraction depends on the age of the air from a specific source of radon gas. The environmental outdoor equilibrium factors quoted in the literature reflect equilibrium of global radon and are not applicable to specific sources. The MILDOS code used to calculate doses to receptors from mill effluents calculates the annual average working level (WL) and thus, by inference, equilibrium fraction for the receptor locations. The MILDOS calculated equilibrium fractions for the 2002 MILDOS runs, previously submitted to CDPHE, for each boundary air monitoring station and source are given in the attached Excel Spreadsheet. The mean equilibrium factor for each of the boundary air monitoring stations is given in Table 1.

The calculated equilibrium fractions ranged from 0.16 at station AS 202 to 0.43 at station AS 206. These equilibrium fractions are within the range that would be expected for the site although somewhat higher than those calculated from the Schiager paper (Schiager 1974). Station AS 202 is directly to the east of the tailings impoundment thus the travel time for the radon emanating from tailings would be relatively short resulting in a small fraction of ingrowth of the short-lived decay products. Station 206 is at the north end of the site by the dam, the furthest monitoring station from the radon sources. Therefore, an equilibrium fraction of 0.43 is reasonable. The stations with the lowest potential for radon concentrations attributable to the site are generally at the greatest distances from the radon sources and show the highest equilibrium fractions as would be expected. Due to their dependence on distance from the site, the equilibrium fractions would not be expected to change significantly from year to year.

The equilibrium-adjusted concentration limits above background based on the MILDOS analysis are also given in Table 2. The incremental concentrations for radon are at or below the equilibrium adjusted concentration limit for all boundary stations when compared to the Canon City background station. Station 209 shows incremental concentrations above the equilibrium-adjusted concentration limit for 2002 when compared to the Lincoln Park and Oro Verde background stations. However the differences are well within the uncertainty in the measurements. It should be noted that the point sources, including the fine ore bins contribute very little to the radon concentrations at the monitoring stations compared to the area sources.

If you have any questions please contact me.

Sincerely,

Jim Cain

cc: Mr. Steve Tarlton
Mr. Tom Pentecost
Mr. Pat Mutz
Mr. Steve Landau

Attachments

Attachment A

Response to CDPHE Letter re: Cotter's Reported Radon Effluent Levels in 2002

The Colorado Department of Public Health and Environment's (CDPHE's) letter dated January 13, 2004 requested additional information regarding radon concentrations at the Canon City mill boundaries. The following are Cotter's responses to the questions posed by CDPHE:

Question 1: Provide specific results…

The results of radon monitoring at boundary air monitoring stations for the past 24 years are provided in the attached Excel spreadsheet, Table A-1, and have been included in Annual Reports. The 2003 data are not yet complete.

Table A-1: Radon Concentrations at Boundary Air Monitoring Stations										
	Location									
Year	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	CC	LP	OV-3
1979	420	460	785					707		
1980	330	250	240					310	293	
1981	380	378	520	970				260	260	395
1982	470	579	1360	923				657	1040	576
1983	916	705	875	1190				419	492	648
1984	610	720	650	850				414	544	895
1985	660	690	820	830				560	470	572
1986	1940	1510	1440	1090				1250	1370	1050
1987	775	675	800	875				775	400	475
1988	525	900	975	775				833	550	450
1989	725	1030	950	525				850	500	500
1990	500	375	500	325				325	375	158
1991	400	450	475	475				475	325	293
1992	725	750	650	500				500	575	475
1993	375	325	375	350				275	250	120
1994	590	580	650	690	980			560	500	540
1995	500	450	580	500	680			450	450	380
1996	680	650	900	780	1030	880		660	700	700
1997	820	720	750	600	800	720		690	720	560
1998	560	500	520	550	920	600		450	430	520
1999	750	725	700	550	1025	850	733	975	725	450
2000	1050	1000	1233	825	1533	1267	1250	1050	900	750
2001	192	375	325	160	350	218	192	192	268	267
2002	543	975	1125	693	1475	700	698	875	673	625
Mean	643	657	758	683	977	748	718	605	557	518
Stdev	340	283	312	256	367	317	432	272	269	218
# obs	24	24	24	22	9	7	4	24	23	22
Stdev mean	69	58	64	55	122	120	216	56	56	46
Last 5 years										
Mean	619	715	781	556	1061	727	718	708	599	522
Stdev	314	279	389	249	480	382	432	370	250	182
# obs	5	5	5	5	5	5	4	5	5	5
Stdev mean	140	125	174	111	215	171	216	166	112	81

Table A-2: COMPARISON OF BOUNDARY MONITORING STATION RADON-222 CONCENTRATION WITH BACKGROUND

Canon City Background

Station	Average conc.	Std dev	5-year ave	Std dev	CC Ave. Conc.	Std dev	5-year Ave.	Std. dev.	Ave. Inc.	5-year Inc.	Eq. Adj. Eff. Limit
AS 202	643	69	629	140	605	56	708	166	38	-79	2000
AS 203	657	58	715	125	605	56	708	166	52	7	1700
AS 204	758	64	781	174	605	56	708	166	153	73	1300
AS 206	683	55	556	111	605	56	708	166	78	-152	630
AS 209	977	122	1061	215	605	56	708	166	372	353	1000

Lincoln Park Background

Station	Average conc.	Std dev	5-year ave	Std dev	LP Ave. Conc.	Std dev	5-year Ave.	Std. dev.	Ave. Inc.	5-year Inc.	Eq. Adj. Eff. Limit
AS 202	656	69	629	140	557	56	599	112	99	30	2000
AS 203	657	58	715	125	557	56	599	112	100	116	1700
AS 204	758	64	781	174	557	56	599	112	201	182	1300
AS 206	683	55	556	111	557	56	599	112	126	-43	630
AS 209	977	122	1061	215	557	56	599	112	420	462	1000

Oro Verde - 3 Background

Station	Average conc.	Std dev	5-year ave	Std dev	OV-3 Ave. Conc.	Std dev	5-year Ave.	Std. dev.	Ave. Inc.	5-year Inc.	Eq. Adj. Eff. Limit
AS 202	656	69	629	140	518	46	522	81	138	107	2000
AS 203	657	58	715	125	518	46	522	81	139	193	1700

AS 204	758	64	781	174	518	46	522	81	240	259	1300
AS 206	683	55	556	111	518	46	522	81	165	34	630
AS 209	977	122	1061	215	518	46	522	81	459	539	1000

2002 Rn-222 Concentrations

Station	2002 Conc.	2002 CC	2002 LP	2002 OV	Net-CC bkg	Net-LP bkg	Net OV bkg	Eq. Adj. Eff. Limit
AS 202	543	875	673	625	-332	-130	-82	2000
AS 203	975	875	673	625	100	302	350	1700
AS 204	1125	875	673	625	250	452	500	1300
AS 206	693	875	673	625	-182	20	68	630
AS 209	1475	875	673	625	600	802	850	1000

Question 2: Explain the difference between the reported site boundary concentrations and the average concentration off-site.

Cotter has included the radon monitoring results in its Annual Reports and has used the data in risk assessments submitted to the CDPHE over the past eight years. However, the specific explanation relevant to boundary effluent concentration limits is reiterated here.

Historical Perspective

The appropriate limit for the Northern boundary of the Canon City Milling facility has been studied previously and reported to the Department. More specifically (as an element of the previous license renewal process) Cotter provided to the Department a report entitled *Pathway Assessment Of Radionuclide Exposures To Residents Living Near Cotter Corporation's Cañon City Uranium Mill, December, 1995.* This report was prepared by a team of Health Physicists from Colorado State University, Keystone Scientific Corporation and the Shepard-Miller Corporation. Within the report the team evaluated the applicable effluent concentration limits for Radon-222 at the North Boundary of the Milling Facility. The findings in this regard are found at pages 29 and 30 of the report under the heading **Comparison of Radon Concentrations to the CDPHE Effluent Limit**. The referenced text stated the following:

> "The mean measured radon concentrations at the North Boundary, attributable to the mill, for the period 1981-1986 and the mill access road for 1994, are given in Table 20.
>
> These concentrations were compared to the effluent limits from the Colorado Department of Public health and Environment Radiation Protection Regulations, Part 4, Standards for Protection against Radiation, Appendix B, Table 2.
>
> Two values are given in Appendix B, Table 2 for the effluent limit for radon depending on the equilibrium state: 1 E-8 uCi/ml (1E4 pCi/m^3) "with daughters removed"; and 1 E-10 uCi/ml (1E2 pCi/m^3) "with daughters present". The limit "with daughters present" is based on 100% of equilibrium as indicated by the Appendix B, Table 1 values (occupational limits). Therefore, the effective effluent limit in areas close to the source of radon gas, where equilibrium fractions may be as low as 0.1, should be adjusted to account for the degree of equilibrium.
>
> If it is assumed that the mean distance from the source to the site boundary is 1000 meters and that the mean wind speed is 4.5 m/s (as assumed in the EPA diffuse NORM document), the mean travel time from the source to the receptor is 222 seconds or 3.7 minutes. The ingrowth of ^{222}Rn daughters in 3.7 minutes is approximately 0.08, i.e. 1.0 WL is equal to 1250 pCi/L (Schiager 74). To be consistent with the basis for the Appendix B, Table 2 effluent limits, the radon limit should be adjusted for the degree of equilibrium reached at the boundary receptor location. Therefore, the effluent limit under these conditions should be approximately 1 E-9 uCi/ml (1000 pCi/m3).
>
> The radon concentration attributable to the mill at the point of highest measured concentration are shown in Table 20. These concentrations exceed the stated limit in part 4, Appendix B, Table 2, but are within the limit adjusted for degree of equilibrium."

Current Evaluation of Compliance

The existing effluent limits for Rn-220 and Rn-222, given in Part 4, Appendix B, Table II, are 2 E-8 µCi/ml (20 pCi/l) and 1 E-8 µCi/ml (10 pCi/l), respectively, with no daughters present. The limits with daughters present are 3 E-11 µCi/ml (0.03 pCi/l) and 1 E-10 µCi/ml (0.1 pCi/l), respectively. The introduction to Appendix B notes that the effluent air concentration limits are derived from the occupational Derived Air Concentrations, adjusted by a factor of 50 to account for the difference between the maximum allowable occupational radiation dose and the allowable radiation dose to a member of the public (5 rem/y vs 0.1 rem/y); a factor of 3 to account for the difference in exposure time; and a factor of 2 to allow for exposure to different age groups. The occupational DACs for Rn-220 and Rn-222 are dependent on the degree of equilibrium. Part 4 allows for the adjustment of the effluent limits for radioactive equilibrium status (4.15.3). The applicable Rn-222 effluent limits for individual monitoring stations at the Cotter site vary depending on the expected degree of equilibrium at each location.

Estimated Radon Decay Product Equilibrium Fraction at the Boundary Air Monitors

As noted above, the CDPHE Radiation Protection Rules allow for adjustment of the effluent limit based on " actual physical and chemical characteristics of the effluents, such as, aerosol size distribution, solubility, density, radioactive decay equilibrium, and chemical form." (4.15.3). The following analysis explains the derivation of monitor-specific radon effluent limits based on equilibrium status at each air monitoring station:

The equilibrium fraction at the boundary air monitors was estimated by calculating the average travel time for the air from the primary tailings impoundment to each boundary monitoring station. The annual average wind speed in each applicable compass direction was calculated using the STAR file from the MILDOS output. The distance was calculated assuming the radon all emanated from the center of the impoundment. The average age of the air was calculated by dividing the distance by the average wind speed as shown in the attached Excel spreadsheets.

The equilibrium fraction for radon emanating from the tailings impoundment at the air monitoring station was estimated from the graph of ingrowth rate of radon progeny from radon-222 in Schiager, 1974. The ingrowth rate shown in the graph was calculated based on solutions to the Bateman equations.

The equilibrium-adjusted effluent limit concentration for Rn-222 was calculated based on the Appendix B, Table II effluent limit for Rn-222 with progeny present. As noted above, the CDPHE Radiation Protection Rules allow for adjustment of the effluent limit based on radioactive decay equilibrium. That adjustment results in the effluent limits for Rn-222 given in Table 1.

Table 1: Monitor-Specific Estimated Equilibrium Fractions

Station	Location	Average Wind speed	Distance	Average Age of air (m)	Estimated Equilibrium Fraction	Calc. Eq.-Adj. Eff. Lim (pCi/l)
AS 202	E of tailings	8.03	1560 feet	2.2	0.05	2.0
AS 203	SSW of tailings	7.18	1920 feet	3.0	0.06	1.7

AS 204	W of tailings	8.06	3000 feet	4.2	0.08	1.3
AS 206	North of tailings	7.76	6000 feet	8.8	0.16	0.63
AS 209	NW of tailings	7.61	3600 feet	5.4	0.10	1.0

As noted above, the effluent concentration limit is a secondary limit based on adjustment of the occupational DAC. The following example demonstrates that the equilibrium adjusted effluent limit meets the primary criterion of 50 mrem per year.

The dose from Rn-222 gas is almost entirely due to the presence of the short-lived decay products. If one assumes, based on the occupational annual limit of intake expressed as 4 Working Level Months per year, i.e., a committed effective dose equivalent (CEDE) of 1.25 mrem per Working Level Month (WLM) and an occupancy adjustment factor of 3, the annual dose from Rn-222, at the equilibrium adjusted Rn-222 concentration for AS 209, can be calculated as follows:

Annual average activity Rn-222 concentration = 0.63 pCi/l
Equilibrium factor = 0.16

CEDE = [(0.63 pCi/l)(0.16)/100 pCi/l-WL][3][12 m/y][(1250 mrem/WLM)]

CEDE = 45 mrem/y

The difference between the annual average Rn-222 concentration at the site boundary and the background or off-site concentration at each site boundary monitoring station for 2003 was below the equilibrium-adjusted effluent limit for that station. The Colorado Department of Public Health and Environment (CDPHE) accepted the use of the equilibrium adjusted Rn-222 concentration in the 1995 risk assessment prepared by Colorado State University.

Comparisons of the annual average Rn-222 concentrations at the site boundary averaged over the past 24 years; averaged over the past 5 years, and for 2002 alone are provided in the attached Excel spreadsheets and in Table 2 below. All of boundary Rn-222 concentrations are less than the monitor-specific equilibrium adjusted effluent limits.

Table 2: Comparison of Incremental Rn-222 Concentrations with Eq. Adj. Limit

Sampler ID	Ave. Conc. (pCi/m^3)	Background Conc. (pCi/m^3)			Incremental Conc. (pCi/m^3) (for specific background location)			Eq. Adj. Conc. Lim. (p/Ci/m^3)
2002		CC	LP	OV	CC	LP	OV	
AS 202	543	875	673	625	-332	-130	-82	**2000**
AS 203	975	875	673	625	100	302	350	**1700**
AS 204	1125	875	673	625	250	452	500	**1300**
AS 206	693	875	673	625	-182	20	68	**630**
AS 209	1475	875	673	625	600	802	850	**1000**
1998-02								
AS 202	629	708	599	522	-79	30	107	**2000**
AS 203	715	708	599	522	7	116	193	**1700**
AS 204	781	708	599	522	73	182	259	**1300**
AS 206	556	708	599	522	-152	-43	34	**630**
AS 209	1061	708	599	522	353	462	539	**1000**
All yrs								
AS 202	643	605	557	518	38	86	125	**2000**
AS 203	657	605	557	518	52	100	139	**1700**
AS 204	758	605	557	518	153	201	240	**1300**
AS 206	683	605	557	518	78	126	165	**630**
AS 209	977	605	557	518	372	420	459	**1000**

Radon-220 Concentrations at the Site Boundary

The Rn-220 concentration at the site boundary cannot be measured with the appropriate degree of accuracy due to the limitations of the measurement techniques. The inherent error in the measurement is at least an order of magnitude greater than the effluent limit of 0.03 pCi/l with daughters present. Due to the fact that the half-life of Rn-220 is very short compared to the half-life of the decay product, equilibrium cannot be reached in an open environment. The 0.03 pCi/l is not applicable to dose to members of the public from the Cotter facility. Therefore, the dose from Rn-220 decay products at a receptor location must be modeled based on reasonable assumptions with regard to site emissions. The dose can then be compared to the implicit dose limit for members of the public from inhalation or airborne particulate matter, 50 mrem per year (Part 4, Appendix B).

The potential dose due to Rn-220 projected to be released from the Cotter site for processing of caldasite ore was calculated and reported in the Screening Level Risk Assessment for the Uranium/Zirconium Project (SMI 2002). The estimated dose due to Rn-220 decay products was 0.05 mrem per year assuming all of the Rn-220 decayed to Pb-212 before dispersion. This calculated dose is three orders of magnitude below the dose limit, therefore, Rn-220 is not a concern for dose to members of the public.

References:

Colorado State University (CSU). 1995. Pathway Assessment of Radionuclide Exposures to Residents Living Near Cotter Corporation's Canon City Uranium Mill. December.

Shepherd Miller, Inc. (SMI). 2000. Screening Level Risk Assessment, Uranium/Zirconium Project. November 6.

STATE OF COLORADO

Bill Owens, Governor
Douglas H. Benevento, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department
of Public Health
and Environment

March 29, 2004

Attention: Steve Landau
Cotter Corporation
7800 East Dorado Place, Suite 210
Englewood, Colorado 80111

**Re: Cotter's Letter Dated March 8, 2004 regarding Radon Effluent Levels In 2002
Radioactive Materials License Number Colo. 369-01**

This letter is in response to data provided in Cotter's Environmental and Occupational Performance Report and ALARA Review dated June 30, 2003 and Cotter's correspondence dated February 12, 2004 and March 8, 2004. This letter is also to frame key issues for our meeting scheduled for April 5, 2004.

The Department is concerned with the information presented in the annual report regarding radon. Specifically, the annual report incorrectly used the ^{222}Rn effluent limit (100 pCi/l) based on the assumption that no radon daughters are present in outdoor air. The Department agrees that the degree of equilibrium is not likely to be 100 % and that site-wide alternate effluent limits (other than the 0.1 pCi/l and 0.03 pCi/l listed in Part 4 for ^{222}Rn and ^{220}Rn) should be established in the license.

The discussion and reporting of radon levels in the annual report does not identify the unexpected results between the two different radon monitors used to assess ^{222}Rn and ^{220}Rn levels. The report did not identify or explain how the monitoring results from the different types of monitors and QA samples were compiled to give the reported averages. The Department desires to clarify how Cotter compiles, interprets, and reports data in the annual report.

The license establishes a lower limit of detection of 2×10^{-10} µCi/ml (0.2 pCi/l) for measurements of ^{222}Rn. Cotter's response to Item 3 in their March 8, 2004 letter indicates a lower limit of detection of 70 pCi/m^3 (0.07 pCi/l) for measurements of radon using the Landauer supplied DRNF and DRNM monitors. ***However, information supplied directly from Landauer indicates that the lower limit of detection for these monitors is only 0.33 pCi/l when the monitors are used for a sampling period of 90 days. A lower limit of detection of 0.33 pCi/l does not meet the requirement established in the license.***

The Department is currently reviewing the procedures for measuring environmental radon levels submitted as part of the license renewal application. Given the unresolved issues raised during the review of the annual report, and the need to establish adequate procedures during the license renewal, we would like to closely examine:

a. the number and locations of radon monitors used at the facility;
b. the type and capabilities of the radon monitors available and in use;
c. the appropriate license requirements for lower limits of detection for ^{222}Rn and ^{220}Rn:
d. the appropriate site specific effluent limits for ^{222}Rn and ^{220}Rn;
e. the determination of a "background" radon level for assessing compliance with effluent limits and public doses;
f. use of computer codes MILDOS and COMPLY; and
g. how Cotter compiles, interprets, and reports data in annual reports.

My staff and I look forward to meeting with you and your staff in our offices on April 5, 2004 to discuss these issues in detail. If you have any questions concerning this notice, please contact Mr. Tom Pentecost of this Division at (303) 692-3458.

Sincerely,

Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division

ST:TP

March 30, 2004

Mr. Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

Re: CDPHE Correspondence of March 29, 2004-Canon City Milling Facility
Radon Effluent Levels

Dear Mr. Tarlton,

This is written to correct erroneous information contained in paragraph four of the above-captioned letter. Specifically, the Unit reports a vendor (Landauer) lower limit of detection for radon monitors of 0.33 pCi/l, as opposed to the limit of 0.07 pCi/l reported by Cotter relative to the Landauer-supplied monitors. The reason the Unit was given the higher detection limit has to do with the sensitivity of the detector readout requested by the client. The standard sensitivity reading only provides a 0.33 pCi/l detection limit, whereas the high-sensitivity reading (the one requested by Cotter) provides a sensitivity of 0.07 pCi/l. The 0.07 pCi/l detection limit reported by Cotter came directly from the manufacturer specification supplied by Landauer for high-sensitivity readout. This was verified today with Mr. Mark Salasky a Health Physicist at the Landauer facility.

Cotter requests that the Unit post this letter on the Unit website in order to correct the apparently inadvertent misrepresentation of facts surrounding the detection limit issue.

Sincerely,

Steven D. Landau
Manager, Environmental Affairs

STATE OF COLORADO

Bill Owens, Governor
Douglas H. Benevento, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department
of Public Health
and Environment

JUN 24 2004

Cotter Corporation
7800 E. Dorado Place, Suite 210
Englewood, CO 80111

<u>Subject: Determining Compliance with Radon Effluent Levels</u>

Dear Mr. Landau:

This letter acknowledges receipt of a technical memorandum dated May 20, 2004 that provided data to support alternate effluent levels for Radon from those found in Table 1 of Part 4 of the State of Colorado *Rules and Regulations Pertaining to Radiation Control,* and a method for establishing a background concentration for Radon in outdoor air. The following alternate criteria are approved in accordance with the provisions of RH 4.15.3 and will be incorporated into the license during the current license renewal.

1. A background level of Radon for comparison with effluent levels will be determined annually by taking the mean of 12 samples from three sampling locations (Canon City, Lincoln Park, and Oro Verde) and adding two standard deviations of the mean. One sample is collected at each location per calendar quarter (3 samples x 4 quarters = 12 samples).

2. Alternate effluents levels for Radon are based on two assumed equilibrium fractions. An equilibrium fraction of 0.4 shall be used for sample locations 206, 210, and 212 and any subsequent Radon samplers at a comparable distance from the center of the mill. An equilibrium fraction of 0.2 shall be used for sample locations 202, 203, 204, and 209 and any subsequent Radon samplers at a comparable distance from the center of the mill. The corresponding effluent limits are 0.25 pCi/l and 0.5 pCi/l respectively.

The alternate effluent levels and the Radon background level shall be inclusive of Rn-220 and Rn-222. If you have any questions regarding this letter, please contact Tom Pentecost at 303-692-3458.

Sincerely,

Steve Tarlton

Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division

Prepared by: TP Reviewed by: AE Reviewed by: Mailed by:
Date: 23 June 04 Date: 6/23/04 Date: Date Mailed: JUN 24 2004

EPA-3364

Reid Rosnick/DC/USEPA/US
09/05/2012 08:40 AM

To Beth Miller
cc
bcc
Subject Fw: EPA to Cotter 2-24-09

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:40 AM -----

From: "Sharyn Cunningham" <Sharyn@bresnan.net>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 11/23/2009 04:43 PM
Subject: EPA to Cotter 2-24-09

Hi Reid,

I see that the website is up and we are really appreciative of your efforts. Just looking at correspondence between EPA & Cotter and see that the Feb 24, 2009, letter has even numbered pages of the document missing.

1. Could you please get the pages added and the letter reposted?

Also, there are no further letters after May 2009, either from Cotter or any EPA responses. If any further communication has gone on between EPA and Cotter since May 2009.

2. Would you please post correspondence since May 2009, as well?

One other thing - the aerial photos provided by Cotter in the information sent in May 2009 seem to be rather old. Attached are Nov 1, 2009, photos where it is very evident that tailings are now exposed in the Secondary Impoundment. In case you're unaware, Cotter made an inventory of Impoundment contents for EPA in 2003 (see attached) with details for the Primary. Other sources indicate that the Secondary does contain waste from the Manhattan project. We're really concerned about how radon is being controlled as Cotter is dewatering the Secondary Impoundment. This may be out of your jurisdiction, but I'm not as up on this, so am at least making you aware of the situation. We recently sent an email to Ms. Diaz about this, but thought you might like to see the photos in light of Cotter's response to request for information.

Thanks very much,

Sharyn Cunningham
CCAT Co-Chair
1614 Grand Ave
Canon City, CO 81212
(719)275-3432

Cotter Secondary Impoundment Photos 11-1-09.pdf

Cotter Inventory Impmt Ponds 3-3-03.PDF


11-01-2009


11-01-2009


11-01-2009

11-01-2009

Impoundment Inventory (March 3, 2003)

Material/Source Information			Mass/Volume		Feedstock Information		Progeny[1] & Th-232 Activity (pCi/g)				Activity To Primary Impoundment (Ci)					
Material Category/Location	Origin	Date(s)	Tons	Yd^3	%U_3O_8	U^{nat} (pCi/g)	Th-230	Ra-226	Pb-210	Th-232	U-nat[2]	Th-230	Ra-226	Pb-210	Th-232	Total
Primary Impoundment-Processed Ores																
White Water Ores	Colorado Mines	1979-84	218,177	160,424	0.18	1033.37	516.69	516.69	516.69	20	20.47	102.36	102.36	102.36	3.96	331.51
Thornburg Mine Ores	Utah Mine	1979-84	39,612	29,126	0.25	1435.24	717.62	717.62	717.62	20	5.16	25.81	25.81	25.81	0.72	83.31
Schwartzwalder Ore	Colorado Mine	1984-2001	570,551	419,523	0.5	2870.48	1435.24	1435.24	1435.24	20	148.71	743.54	743.54	743.54	10.36	2389.69
Sweeney Ore	Colorado Mines	1977-84	253	186	15	86114.40	43057.20	43057.20	43057.20	20	1.98	9.89	9.89	9.89	0.00	31.65
Hartzel Ore	Colorado Mine	1979	1,247	917	0.25	1435.24	717.62	717.62	717.62	20	0.16	0.81	0.81	0.81	0.02	2.61
Martin Trost Ore	Colorado Mine	1979-80	4,831	3,552	0.25	1435.24	717.62	717.62	717.62	20	0.63	3.15	3.15	3.15	0.09	10.17
G.E. Seven Mile Ore	Utah Mine	1979-84	40,849	30,036	0.25	1435.24	717.62	717.62	717.62	20	5.32	26.62	26.62	26.62	0.74	85.92
Colorado Raffinate	Missouri Residue	1985	439	323	0.17	975.96	17000.00	800.00	800.00	20	0.04	6.78	0.32	0.32	0.01	7.47
USGS Material	Various, US	2000	25	18	0.1	574.1	287.05	287.05	287.05	20	0.00	0.01	0.01	0.01	0.00	0.03
Cyprus Amax	Colorado Mill	2000	653	481	0.12	688.92	344.46	344.46	344.46	20	0.04	0.2	0.2	0.2	0.01	0.65
Sequoyah Concentrates	Oklahoma-Gore Facility	2002	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	0	0	0	0	0	0
Schwartzwalder Eluate	Colorado Mine	1982-2002	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	0	0	0	0	0	0
Recycled Tailings Uranium Recovery	Primary Impoundment	1996	NA	NA	100	NA	NA	NA	NA	NA	-13.03	0	0	0	0	-13.03
Primary Impoundment-Direct Disposal																
Colorado Raffinate	Missouri Residue	1996	9,600	7,529	0.17	975.96	17000.00	800.00	800.00	20	8.51	148.19	6.97	6.97	0.17	170.81
Old Mill Disposed Volume	Colorado-CC Mill	2001	NA	15,276	NA	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	0	0	0	0	0	0
Depot Cleanup	Colorado-CC Rail Loadout	1994	20,000	15,686	NA	50.00	100.00	50.00	50.00	20	0.91	1.82	0.91	0.91	0.36	4.91
Sand Creek Cleanup	Colorado-CC RAP	1999	14,400	11,294	NA	10.00	50.00	25.00	25.00	20	0.13	0.65	0.33	0.33	0.26	1.7
Nonac Site Cleanup	Colorado-CC Rail Loadout	1999	96,000	75,294	NA	50.00	100.00	50.00	50.00	20	4.36	8.72	4.36	4.36	1.74	23.54
Team Track Cleanup	Colorado-CC Rail Loadout	1999	40,000	31,373	NA	50.00	100.00	50.00	50.00	20	1.82	3.63	1.82	1.82	0.73	9.82
Old Pond Soils RAP	Colorado-CC RAP	1989	230,400	180,706	NA	25.00	50.00	25.00	25.00	20	5.23	10.46	5.23	5.23	4.18	30.33
Evap. Cell Material																
• Old Mill Soils	Colorado-CC Mill	2001	5,440	4,267	NA	25.00	50.00	50.00	50.00	20	0.12	0.25	0.25	0.25	0.10	0.97
• CF Cells	Colorado-CC Mill	2001	50,560	39,655	NA	50.00	25.00	25.00	25.00	20	2.30	1.15	1.15	1.15	0.92	6.67
• OPA Soils	Colorado-CC Mill	2001	78,496	61,565	NA	25.00	50.00	50.00	50.00	20	1.78	3.56	3.56	3.56	1.43	13.89
SCS Barrier Soils	Colorado-CC RAP	1989	65,120	51,074	NA	5.00	20.00	10.00	10.00	20	0.30	1.18	0.59	0.59	1.18	3.84
CSMRI Soils	Colorado-Table Mtn. Site	2000	839	658	NA	2.00	2.00	100.00	100.00	20	0.00	0.00	0.08	0.08	0.02	0.18
CSMRI Yttrium	Colorado-Table Mtn. Site	2000	9,016	7,071	NA	30.00	200.00	10000.00	10000.00	20	0.25	1.64	81.87	81.87	0.16	165.79
PD Tailings	Colorado-Amax R&D	1999-2001	24,430	19,160	NA	15.00	15.00	150.00	150.00	20	0.33	0.33	3.33	3.33	0.44	7.76

---

[1] Major progeny nuclides generally considered relative to uranium decay chain evaluations.

[2] Assumed uranium recovery is at 90% for all Primary Impoundment processed materials.

[3] These materials were uranium slurry concentrates and the discarded solutions did not contribute appreciably to the tailings repository.

[4] Disposed "Old Mill" materials were surface contaminated objects (SCO) only and do not contribute appreciable activity to the tailings repository.

PD Affected Soils	Colorado-Amax R&D	1999-2001	4,034	3,164	NA	15.00	15.00	150.00	150.00	20	0.05	0.05	0.55	0.55	0.07	1.27
PD OYT Soils	Colorado-Amax R&D	1999-2001	5,113	4,010	NA	15.00	15.00	150.00	150.00	20	0.07	0.07	0.70	0.70	0.09	1.63
Schwartz Soils	Colorado-RML Cleanup	1983-2002	29,037	22,774	NA	100.00	50.00	50.00	50.00	20	2.64	1.32	1.32	1.32	0.53	11.09
Schwartz Sludge	Colorado-RML Treatment Plant	1983-2002	1,080	847	NA	800.00	400.00	400.00	400.00	20	0.78	0.39	0.39	0.39	0.02	3.14
Total-Primary Impoundment			1,560,202	1,195,989							199.06	1102.58	1026.12	1026.12	28.31	3387.32
Secondary Impoundment																
Transferred Tailings From Old Pond Area	Old Mill-Produced Tailings	1958-1979	2,800,231	2,154,024	NA	135	2009	1229	1229	20	343.25	5,108.10	3124.87	3124.87	50.85	11,751.94
Grand Total			4,360,433	3,350,013							542.31	6,210.68	4150.99	4150.99	79.16	15,139.26

EPA-781

Reid Rosnick/DC/USEPA/US	To	Beth Miller
09/05/2012 08:54 AM	cc	
	bcc	
	Subject	Fw: 2010 Uranium Contamination Stakeholder Workshop - Sept. 14-16, 2010

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:54 AM -----

From: Lilia Dignan/R9/USEPA/US
To: Lilia Dignan/R9/USEPA/US@EPA
Date: 08/06/2010 06:43 PM
Subject: 2010 Uranium Contamination Stakeholder Workshop - Sept. 14-16, 2010

Attached is the Flier and Registration Form for the 2010 Uranium Contamination Stakeholder Workshop September 14-16, 2010. The conference will be held at the Moenkopi Legacy Inn & Suites at Tuba City, AZ. A summary of main topics and their respective dates is included on the registration form. A more detailed agenda will follow. Please contact Lilia Dignan at (415) 972-3779 or Alejandro Diaz at (415) 972-3242 or e-mail uranium_conf@epa.gov for more information. Hope to see you at the conference!

Lilia

Lilia Dignan
U.S. EPA, Superfund Div.
75 Hawthorne Street (SFD-6)
San Francisco, CA 94105
Phone: 415 972-3779
Fax: 415 947-3520

Email: dignan.lilia@epa.gov NUCSW Flyer 2010.pdf 10 NAUM Conference Registration Form.docx

Uranium **Contamination** Stakeholders **Workshop**

September 14-16, 2010

Moenkopi Legacy Inn & Suites
P.O. Box 2260
Tuba City, AZ
Ph. (928) 283.4500 Fx. (928) 283.4499

Sessions will Include:
Uranium Mills
Mine Cleanup
Data Management
Health Research & Outreach
Tuba City Open Dump
Contaminated Structures
Community Involvement
Abandoned Uranium Mines
Uranium Permits and Licensing
Contaminated Water Sources
Capacity Building in Affected Communities
and a tour of nearby uranium projects,
including Tuba City Open Dump

> “*To collaborate with co-implementers and stakeholders of the multi-agency Five-Year Plan to find practical and effective solutions to uranium contamination on the Navajo Nation.S*”

Keynote Address to Begin Promptly
at 8:30am, September 14th

A more detailed agenda will follow

Please RSVP with registration
materials by August 23rd to:
uranium_conf@epa.gov

For more information contact Lilia Dignan (415) 972-3779

For more information about the multi-agency Five-Year Plan:
http://www.epa.gov/region9/superfund/navajo-nation

Speakers and sessions may be video-taped and/or photographed

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

Navajo Uranium Contamination Stakeholder Workshop

September 14th, 15th & 16th 2010

Registration Form

Instructions

Email registration to:

uranium_conf@epa.gov

Or Fax**: 415-947-3528**

Complete **one** form per person.
Phone registrations accepted;

Please register no later than
August 23rd, 2010

If you have any questions,
please contact:
Lilia Dignan at
Dignan.lilia@epa.gov
415-972-3779 (phone)
- or -
Alejandro Díaz at
diaz.alejandro@epa.gov
415-972-3242 (phone)

Conference Hotel:

Moenkopi Legacy Inn & Suites
P.O. Box 2260
Tuba City, AZ 86045
Phone: 928-283-4500

____
Name

____
Agency/Company/Organization

____
Email Address

____
Mailing Address

____
City State Zip

Please indicate the Day(s) you would like to attend:

Day 1: Tues, Sept 14 _______
Plenary Session
Keynote Address
Plenary Session – 5 Year Plan Update
Contaminated Structures
Uranium Permits and Licensing
Uranium Mills
Community Involvement

Day 2: Wed, Sept 15 _______
Plenary Session – Health Research & Outreach
Tuba City Open Dump
Contaminated Water Sources
Mine Cleanup
Data Management
Capacity Building in Affected Communities
Abandoned Uranium Mines

Day 3: Thurs, Sept 16 _______
Tour of nearby Uranium Projects, including Tuba City Open Dump

EPA-849

Reid Rosnick/DC/USEPA/US
09/05/2012 08:56 AM

To Beth Miller
cc
bcc
Subject Fw: Conference Call re Subpart W

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:56 AM -----

From: "Marion Loomis" <loomis@vcn.com>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 10/01/2010 11:49 AM
Subject: Conference Call re Subpart W

Mr. Rosnick

The Wyoming Mining Association (WMA) is very concerned about claims that uranium mining and processing may contribute to health impairment from the release of radon from uranium processing facilities. WMA would like to draw your attention to the attached report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010. In summary the study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.* The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded that outdoor concentration of radon contributed zero dust to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay.
I understand that there will be a conference call on October 6 to discuss 40 CFR Part 61 Subpart W which deals with this issue. WMA requests that this study be on the agenda for discussion during that conference call.

Thank you.

Marion Loomis Public Health Assessment for Cotter Corp.pdf

Public Health Assessment for

LINCOLN PARK/COTTER URANIUM MILL
CAÑON CITY, FREMONT COUNTY, COLORADO
EPA FACILITY ID: COD042167585
SEPTEMBER 9, 2010

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

NOVEMBER 9, 2010

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Agency for Toxic Substances and Disease Registry....................................Thomas R. Frieden, M.D., M.P.H., Administrator
Christopher J. Portier, Ph.D., Director

Division of Health Assessment and Consultation…………………………………….William Cibulas, Jr., Ph.D., Director
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Health Promotion and Community Involvement Branch………………………………Hilda Shepeard, Ph.D., M.B.A., Chief

Exposure Investigations and Consultation Branch……………………..……………………..Susan M. Moore, M.S., Chief

Federal Facilities Assessment Branch…………………………………………………….....Sandra G. Isaacs, B.S., Chief

Superfund and Program Assessment Branch .... Richard E. Gillig, M.C.P., Chief

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
Attn: Records Center
1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

You May Contact ATSDR Toll Free at
1-800-CDC-INFO or
Visit our Home Page at: http://www.atsdr.cdc.gov

PUBLIC HEALTH ASSESSMENT

LINCOLN PARK/COTTER URANIUM MILL

CAÑON CITY, FREMONT COUNTY, COLORADO

EPA FACILITY ID: COD042167585

Prepared by:

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Site and Radiological Assessment Branch

This information is distributed by the Agency for Toxic Substances and Disease Registry for public comment under applicable information quality guidelines. It does not represent and should not be construed to represent final agency conclusions or recommendations.

Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund law. This law set up a fund to identify and clean up hazardous waste sites. The Environmental Protection Agency (EPA) and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high-risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate possible the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the public comments that related to the document are addressed in the final version of the report.

Conclusions: The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Rolanda Morrison
ATSDR Records Center (MS F-09)
4770 Buford Hwy, NE
Building 106, Room 2108
Atlanta, GA 30341

Table of Contents

APPENDIX C - ATSDR'S EVALUATION PROCESS AND EXPOSURE DOSE CALCULATIONS

Acronyms and Abbeviations

CCAT	Colorado Citizens Against Toxic Waste
CDPHE	Colorado Department of Public Health and Environment
CREG	cancer risk evaluation guide
CV	comparison value
D	dissolved
EMEG	environmental media evaluation guide
EPA	US Environmental Protection Agency
LPWUS	Lincoln Park Water Use Survey
LTHA	lifetime health advisory for drinking water
MCL	maximum contaminant level
mg/L	milligrams per liter
µR/hr	microroentgen per hour
N	not defined in the CDPHE database
NA	not available
ND	not detected
NPL	National Priorities List
OU	operable units
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppm	parts per million
RAP	Remedial Action Plan
RBC	risk based concentration
RMEG	reference dose media evaluation guide
S	suspended
SCS	Soil Conservation Service
SSL	soil screening level
T	total
UMTRCA	1978 Uranium Mill Tailings Radiation Control Act
USGS	United States Geological Survey

I. SUMMARY

Introduction

ATSDR’s top priority is to ensure that the community of Lincoln Park and surrounding communities have the best information possible to safeguard their health.

The purpose of this public health assessment (PHA) is to evaluate available data and information on the release of hazardous substances from the Cotter Uranium Mill to determine if people could be harmed by coming into contact with those substances. This PHA will also list actions, as needed, to be taken to protect the public’s health.

Background

The Cotter Uranium Mill (Cotter) is located approximately two miles south of downtown Cañon City in Fremont County, Colorado. The community of Lincoln Park borders the site to the north and the housing developments of Dawson Ranch, Wolf Park, and Eagle Heights are located along Cotter’s western boundary. The nearest residence is about 0.25 miles from the mill (Galant et al. 2007).

The 2,500-acre site includes two inactive mills, ore stockpile areas, a partially reclaimed tailings pond disposal area (i.e., the old ponds area), and a current tailings pond disposal area (i.e., the lined “main impoundment area”). A large portion of the site is used to store waste products in the impoundment area. The former mill area is fenced and is known as the “restricted area”.

The Cotter Mill began operations in 1958, extracting uranium ore using an alkaline leach process. In 1979, the facility switched to an acid leach process for extracting uranium. Cotter suspended primary operations in 1987, and only limited and intermittent processing occurred until the facility resumed operations in 1999 with a modified alkaline-leaching capability until 2001. Cotter refabricated the mill circuits between 2002 and 2005 to operate using an acid process when it went into stand down in March 2006. Cotter is currently evaluating whether to re-engineer the mill for future operation.

Wastes containing metals and radionuclides were released from Cotter and entered the nearby environment. People could potentially be exposed to these wastes if they come into contact with them in drinking water, soil, sediment, biota (fruits and vegetables) or ambient air.

Conclusions

After evaluating the available data, ATSDR reached four important conclusions in this public health assessment:

Conclusion 1	ATSDR concludes that drinking water from contaminated private wells could harm people’s health. This is a public health hazard.
Basis for Conclusion	Private well sampling data collected from 1984 to 2007 revealed the presence of molybdenum at levels that could harm people’s health. A water use survey conducted in Lincoln Park in 1989 revealed that at least seven people used groundwater (from their private wells) for personal consumption. These and other residents whose private wells were affected by the highest molybdenum contamination may be at increased risk for health effects such as gout-like conditions. Individuals who do not take in enough dietary copper or who cannot process it correctly will be affected the most. The lack of consistent monitoring over the years and the unknown usage of wells before the installation of the public water supply makes these past exposures difficult to accurately assess. Most town residents are now connected to the public water supply and have thus eliminated their exposure to contaminated water. However, some residents are reported to have refused public water supply connections, and many may still have operational private wells. Additionally, no formal institutional controls exist to control groundwater use in Lincoln Park. Therefore, current and future uses of private wells for domestic purposes are still possible.
Conclusion 2	ATSDR concludes that accidentally eating or touching soil and sediment near the Cotter Mill property or in Lincoln Park will not harm people’s health. However, ATSDR cannot make conclusions about whether lead in soils near Cotter Mill could harm people’s health in the future.
Basis for Conclusion	Currently, the property near the Cotter Mill property is restricted access, vacant or used for industrial purposes; therefore, contact with soils near the property should be minimal. The soil sampling conducted at the site does not allow ATSDR to accurately assess potential exposures if the area is ever developed for residential, commercial or recreational uses. Therefore, a conclusion regarding future exposures cannot be made because not enough information is available about future development of this area.
	ATSDR recommends that lead contamination in soil be re-evaluated if

Next Steps

the area is considered for development for residential or non-industrial uses.

Conclusion 3

ATSDR concludes that eating locally-grown fruits and vegetables irrigated with private well water will not harm most people's health. However, a person eating above-average amounts of fruits and vegetables (4 times the average consumer) might have a low increased risk for developing cancer over a lifetime. As a precaution, residents should limit their use of contaminated well water to irrigate their crops. In all cases, the crops should be thoroughly cleaned prior to eating.

Basis for Conclusion

Sampled locally-grown fruits and vegetables did not indicate the presence of contaminants at levels that would cause non-cancer health effects. The increased cancer risk is based on a person consuming more fruits and vegetables (95th percentile range) than a typical consumer. The cancer estimate is conservative because it assumes that a person would grow and eat fruits and vegetables that contain arsenic every day for 30 years. The amount of fruits and vegetables eaten will likely be much less than estimated, mainly because the growing season is not year-round.

The amount of a contaminant ingested would depend upon the type of crop eaten, the likelihood of the crop bioaccumulating any of the contaminants, how often the crop is eaten, if contaminated well water is used to irrigate the crop, and if the crop is thoroughly cleaned prior to eating them.

Conclusion 4

ATSDR concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.

Basis for Conclusion

With the exception of thorium-230 levels observed in 1981 and 1982, associated with excavation of contaminated tailings, every radionuclide monitored has been more than a factor of ten below annual dose based health limits to the public. The excavation releases appear to have only exposed on-site workers, but still below occupational limits at that time.

ATSDR is taking the following follow-up actions at this site:

Next Steps

ATSDR's Health Promotion and Community Involvement Branch (HPCIB) will conduct health-related educational activities in the community, as necessary.

ATSDR's HPCIB will coordinate community outreach and community involvement activities for the site.

ATSDR will continue to work with appropriate state and federal agencies and review additional relevant environmental data (including the water use survey) as it becomes available.

ATSDR will update the action plan for this site as needed. New environmental, toxicological, health outcome data, or implementing the above proposed actions may necessitate the need for additional or alternative actions at this site.

For More Information

If you have concerns about your health, you should contact you health care provider. You can also call ATSDR at 1-800-CDC-INFO for more information on the Lincoln Park/Cotter Uranium Mill site.

II. BACKGROUND

A. Site description and operational history

The Cotter Mill is located approximately two miles south of downtown Cañon City in Fremont County, Colorado (see Figure 1) [Galant et al. 2007]. The community of Lincoln Park borders the site to the north and the housing developments of Dawson Ranch, Wolf Park, and Eagle Heights are located along Cotter's western boundary. The nearest residence is about 0.25 miles from the mill [Galant et al. 2007].

The 2,500-acre site includes two inactive mills, ore stockpile areas, a partially reclaimed tailings pond disposal area (i.e., the old ponds area), and a current tailings pond disposal area (i.e., the lined "main impoundment area"). A large portion of the site is used to store waste products in the impoundment area. The former mill area is fenced and is known as the "restricted area" [Galant et al. 2007].

The Cotter Mill began operations in 1958, extracting uranium ore using an alkaline leach process. In 1979, the facility switched to an acid leach process for extracting uranium. Cotter suspended primary operations in 1987 [Weston 1998], and only limited and intermittent processing occurred until the facility resumed operations in 1999 with a modified alkaline-leaching capability until 2001 [EPA 2002]. Cotter refabricated the mill circuits between 2002 and 2005 to operate using an acid process when it went into stand down in March 2006 [Cotter 2007]. Cotter is currently evaluating whether to re-engineer the mill for future operation [CDPHE 2008].

Additional information about the history and licensing of the Cotter Mill can be found on the Colorado Department of Public Health and Environment's (CDPHE) and the US Environmental Protection Agency's (EPA) Web sites at http://www.cdphe.state.co.us/hm/cotter/sitedescript.htm and http://www.epa.gov/region8/superfund/co/lincolnpark/.

B. Remedial and regulatory history

Originally, mill tailings (i.e., solid ore processing waste), raffinate (liquid waste that remains after extraction), and other liquids from the alkaline leach process were stored in ten on-site unlined ponds. In 1978, lined impoundments were built on site to store process waste products. The main impoundment contained two cells to segregate acid-leach tailings and liquids in the primary impoundment cell from alkaline-leach tailings in the secondary impoundment cell (EPA 2002). By 1983, more than 2.5 million cubic yards of waste products from historic operations were transferred from the original unlined ponds to the secondary impoundment. All new process wastes are stored in the lined primary impoundment [Galant et al. 2007].

Because Cotter Mill operations released radionuclides and metals into the environment, soil around the mill and groundwater in the nearby Lincoln Park community became contaminated, primarily with molybdenum and uranium [CDPHE 2008]. In 1984, the Lincoln Park/Cotter Mill Site was added to the Superfund National Priorities List (NPL) [EPA 2008]. EPA divided the site into two operable

According to a signed Memorandum of Understanding, CDPHE is the lead regulatory agency overseeing cleanup at the Cotter Mill.

units (OUs)—OU1 consists of the on-site contamination and OU2 is the neighborhood of Lincoln Park (i.e., the off-site impacted area) [CDPHE 2008; EPA 2007]. Together, the Lincoln Park/Cotter Mill Superfund Site encompasses about 7.8 square miles (5,000 acres) [EPA 2004].

In 1988, the Cotter Corporation and CDPHE signed a Consent Decree and Remedial Action Plan (RAP) [Galant et al. 2007]. The purpose of the court-ordered action was to assess and mitigate human and environmental impacts from the Cotter Mill. As part of the settlement, Cotter agreed to clean up the site at the corporation's expense [EPA 2008]. The cleanup was estimated to take 16 years and cost $11 million [Galant et al. 2007]. EPA and the US Department of Energy have also contributed to cleanup costs [DOE 2003]. Remedial activities have focused on eliminating the sources of contamination at the Cotter Mill and eliminating exposures to Lincoln Park residents [CDPHE 2008]. Many of the activities outlined in the 1988 RAP have been completed, including the following:

- Connecting Lincoln Park residents to city water;
- Constructing a groundwater barrier at the Soil Conservation Service (SCS) Flood Control Dam to minimize migration of contaminated groundwater into Lincoln Park;
- Moving tailings and contaminated soils into a lined impoundment to eliminate them as a source of contamination; and
- Excavating contaminated stream sediments in Sand Creek.

The old ponds area was undergoing reclamation in late 2008 [Pat Smith, EPA Region 8, personal communication, August 2008]. Remaining activities include groundwater remediation and final site cleanup [CDPHE 2008; Galant et al. 2007]. Groundwater remediation activities have shown some positive results. However, the balance of the remedial activities listed in the Consent Decree have not been successful enough in mitigating the plume, and most have been discontinued (e.g., barrier wall, dam to ditch flushing, calcium-polysulfide fix/flush, and permeable reactive treatment wall). Table 1 below lists a timeline of process events, remedial activities, and government actions for the Lincoln Park/Cotter Mill Superfund Site.

Table 1. Lincoln Park/Cotter Mill Superfund Site Activity Timeline

Date	Type of Event[1]	Event[2]
July 1958	Process	Cotter Corporation began alkali leach process operations (licensing by the Atomic Energy Commission)
June 1965	Event	Flood that caused the unlined tailings ponds at the Cotter Mill to overflow into Lincoln Park
1971	Remediation	SCS Dam completed; dam pumps impounded surface water back to the main impoundment (groundwater barrier completed at a later date after 1988 RAP)
July 1972	Remediation	Pond 2 lined
June 1976	Remediation	Pond 10 lined
1978–1979	Remediation	A new lined impoundment consisting of two cells (primary and secondary) constructed adjacent to the old ponds area for management of wastes from the new mill (alkali process)
1979	Remediation	The old mill was demolished and new mill construction began
1979–present	Remediation	Impounded water at the SCS Dam pumped back to the main impoundment
1979–1998	Process	Operations switched from an alkali leach process to an acid leach mill; continuing operations intermittently
1980	Remediation	Old upstream method tailings ponds replaced by a full-height compacted earth embankment
1980	Remediation	Construction of Well 333 just north of Cotter; well removes contaminated water flowing from the old ponds area
June 1981	Remediation	Pond 3 lined
1981–1983	Remediation	Tailings from the unlined old ponds area (~2.5 million cubic yards) removed and placed in the new impoundment
December 9, 1983	Government Action	State of Colorado files a complaint against Cotter under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
September 21, 1984	Government Action	Cotter (OU1) and Lincoln Park (OU2) added to the NPL
1985–1986	Investigation	Remedial Investigation and Feasibility Study (GeoTrans 1986)
April 1986	Government Action	Memorandum of Agreement between EPA and the state of Colorado
April 8, 1988	Government Action	Consent decree signed, including a RAP that required cleanup activities
1988	Remediation	An additional 2 feet of soil was removed from the old ponds area and placed in the lined primary impoundment
1988	Remediation	Lined water distribution/surge pond constructed over Pond 7
1988	Remediation	Installation of a hydrologic clay barrier upgradient from the SCS Dam
1989	Remediation	The secondary impoundment cell was covered with liquid for dust control and to create evaporative capacity; additional contaminated soils were removed from the old ponds area and placed in the primary impoundment cell

Date	Type of Event[1]	Event[2]
1989–2000	Remediation	Installation of two hydraulic barriers (injection/withdrawal systems) to control groundwater flow from the old ponds area; discontinued in 2000 because the system was unproductive
1990–1996	Remediation	SCS Dam to DeWeese ditch flushing project
1990–1998	Remediation	Four pilot tests to evaluate the effectiveness of active flushing of vadose zone and aquifer for contaminant removal in OU1
October 29, 1991	Report	Health Risk Assessment of the Cotter Uranium Mill Site: Phase I (HRAP 1991)
January 7, 1993	Report	RAP final report, Willow Lakes (Cotter)
1993–1999	Remediation	Sand Creek Soil Cleanup Action identified and removed approximately 9,000 cubic yards of tailings, soil, and sediment from Sand Creek (Cotter 2000)
1995	Licensing	Cotter filed a license amendment with the state for alkaline leach processing of uranium ore (approved 2/97)
November 19, 1996	Report	Supplemental Human Health Risk Assessment: Phase II Final Report (Weston 1996)
1996–1998	Remediation	Flush/fixation process using Calcium Polysulfide in surface infiltration cells
February 1997	Government Action	Radioactive materials license amendment became effective
1998	Process	Mill reconverted to an alkaline leach process
September 29, 1998	Report	Ecological Risk Assessment, Lincoln Park Superfund Site (Stoller Corporation and Schafer & Associates)
1998	Report	Supplemental Human Health Risk Assessment, Phase III Final Report (Weston 1998)
1999	Remediation	Old ponds area surface soils (~100,000 cubic yards) were removed and placed in the lined primary impoundment
May 1999	Process	Cotter resumed operations (which had been intermittent since 1979) with modified alkaline-leaching capability
September 30, 1999	Investigation	Final Focused Feasibility Study, Lincoln Park
June 2000	Remediation	Installation of a permeable reactive treatment wall across Sand Creek channel, north of SCS Dam in DeWeese Dye Ditch flush (to fulfill EPA requirement to address contaminated groundwater that was bypassing the SCS Dam barrier)
2000–2005	Process	Cotter proposes modifications to the circuit to process zircon ore. Process was not successful and discontinued by 2005.
January 2002	Government Action	EPA issued a Record of Decision for Lincoln Park requiring “No Further Action” for surface soils within Lincoln Park (EPA 2002)
April 2002	Government Action	The governor of Colorado passed an emergency bill requiring an Environmental Assessment be conducted before shipping out-of-state radioactive waste to Cotter
July 9, 2002	Government Action	CDPHE denied Cotter’s license amendment request, preventing receipt of shipments for direct disposal

Date	Type of Event[1]	Event[2]
September 13, 2002	Government Action	State of Colorado allowed Cotter to receive limited amounts of waste material as a test of its handling/storage capability
2002/2003	Investigation	Sampling for plutonium, uranium, lead and molybdenum in the Canon City vicinity (CDPHE 2003)
January 3, 2003	Government Action	EPA issued a notice of unacceptability under the Off-Site Rule regarding the five Proposed Units and impoundments previously found acceptable
2003	Remediation	Permeable reactive treatment wall not functioning as designed
September 9, 2004	Investigation	Cotter submits Feasibility Study for Old Ponds Area with six alternatives
December 15, 2004	Government Action	State health officials approved a 5-year extension of Cotter's uranium-processing license but denied requests to become a disposal facility for off-site radioactive materials
February 1, 2005	Government Action	Cotter filed a request for a hearing regarding the conditions of the license renewal
October 2005	Investigation	Survey of lead in indoor dust, soils, and blood in Lincoln Park to investigate potential impacts of historic smelters (ATSDR 2006a, 2006b, 2006c, 2006d)
April 2006	Government Action	A judge recommended in CDPHE's favor and Cotter filed an exception on the direct disposal issue only
2006	Remediation	To replace the permeable reactive treatment wall, water building up behind barrier is pumped back to the impoundments
January 2007	Government Action	CDPHE signed a Final Agency Decision, affirming the judge's Decision on the license. Cotter filed an appeal to be able to dispose of out-of-state soils in its primary impoundment.
2008	Process	Cotter decides not to take the case to the Court of Appeals, effectively ending the licensing issues from the 2004 renewal.

[1] Describes the general nature of events/actions relating to the Lincoln Park/Cotter Mill Superfund Site.

[2] Includes events/actions most pertinent to ATSDR's evaluation of exposures and potential health effects. Not all site-related events and reports are included.

C. Demographics

ATSDR examines demographic data to identify sensitive populations, such as young children, the elderly, and women of childbearing age, and to determine whether these sensitive populations are exposed to any potential health risks. Demographics also provide details on population mobility and residential history in a particular area. This information helps ATSDR evaluate how long residents might have been exposed to contaminants. According to the 2000 census, 1,170 people live within one mile of the Cotter Mill property—90 of whom are age 6 or younger, 190 are women of childbearing age (15–44 years), and 243 are age 65 or older. Figure 2 in Appendix B shows the demographics within one mile of the mill.

Cañon City is the largest population center in Fremont County with 15,760 residents (see Table 2 below). The Cañon City Metro area includes Cañon City, North Cañon, Lincoln Park, Brookside, Prospect Heights, Four Mile Ranch, Shadow Hills, Dawson Ranch, and the Colorado State Correctional Facilities. Florence is the second largest community in the area with a population of 3,816. The unincorporated portions of Fremont County represent 55% of the population and include Lincoln Park, Prospect Heights, and Shadow Hills [Cotter 2007].

Table 2. Population of communities near the Cotter Mill

Community	2000 Census Population	2006 Population Estimate
Brookside	219	218
Cañon City	15,431	15,760
Coal Creek	303	380
Florence	3,653	3,816
Lincoln Park	3,904	Not available
Rockvale	426	432
Williamsburg	714	700
Fremont County	46,145	47,727

Source: Cotter 2007; Galant et al. 2007

The unincorporated community of Lincoln Park is located in the greater Cañon City area, south of the Arkansas River and north of the Cotter Mill (see Figure 1). The community consists of single and multi-family homes, trailer parks, and rural single family homes. Many of the residents are retired and own their homes. The Lincoln Park area is currently experiencing growth [Galant et al. 2007].

The largest employers in Fremont County are the Colorado Department of Corrections and the Federal Bureau of Prisons. Tourism is the second largest employer in the Cañon City area [Cotter 2007; Galant et al. 2007]. Additional industry and manufacturing employers in Fremont County include Portec, Inc.; Holcim, Inc.; Thermal Ceramics; and Cañon Industrial Ceramics [Cotter 2007]. The health care and school systems also employ a substantial number of people in the county [CCAT, personal communication, August 2008].

D. Land use and natural resources

The Cotter Mill is located within an industrial zone. All abutting lands are zoned for agriculture-forestry. The semi-rural community of Lincoln Park is comprised predominantly of residential developments, agricultural plots and orchards, and small grazing parcels. The Shadow Hills Golf Course is located to the north of the Cotter Mill complex. The land to the south and east of the site is largely undeveloped. Recently, several high end homes have been built near the golf course and in the Wolf Park and Dawson Ranch areas. The distance from Cotter Mill's restricted area to the nearest home is about 0.25 mile [Galant et al. 2007].

Fremont County contains a large amount of public land managed by the US Department of the Interior Bureau of Land Management and the US Department of Agriculture Forest Service. Some of these areas are leased for livestock grazing, aggregate mining, and firewood removal. Visiting the many scenic attractions in Colorado's High Country (e.g., the Royal Gorge Bridge) and rafting in the Arkansas River are popular recreational activities [Cotter 2007].

1. Hydrogeology

In the vicinity of the Cotter Mill, contaminated groundwater primarily migrates along the near surface alluvium and fractured, weathered bedrock immediately underlying the alluvium (<100 feet deep) [USGS 1999a]. Groundwater migration is generally in northerly directions from the mill area, along the Sand Creek drainage area, through a gap in Raton Ridge, and into Lincoln Park. However, groundwater contamination has also been found in the vicinity of the Shadow Hills Golf Course, which is west of the Sand Creek drainage [EPA 2007]. The hydrogeology of the Lincoln Park/Cotter Mill Superfund Site can be conceptually divided into two areas: the upgradient area near the mill and the downgradient area to the north-northeast in Lincoln Park [USGS 1999a].

- In the upgradient area near the mill, the rate of groundwater flow is limited by small hydraulic conductivities [USGS 1999a]. However, cracks in the bedrock, fractures, and weathering enhance water transmission and allow groundwater to travel at considerable rates. Monitoring wells in the upgradient area, specifically in the Poison Canyon Formation, yield small amounts of water.

- The downgradient area in Lincoln Park is characterized by an "alluvial aquifer" comprised of alluvium and terrace alluvium, to a depth of 0–60 feet, and the underlying weathered and/or fractured bedrock below the alluvium. In this area, groundwater can be transmitted at substantial rates. The mix of gravel, sand, silt, and clay in this aquifer yields 10 to 400 gallons per minute to wells in Lincoln Park. The aquifer discharges to Sand Creek, as well as to multiple springs and seeps as far downgradient as the Arkansas River, approximately 2.5 miles downgradient from the Cotter site.

2. Geology

The Cotter Mill is located in a topographic depression resulting from an underlying structure called the Chandler syncline. The core of the syncline is the Poison Canyon formation, which is the uppermost bedrock unit beneath the site. Soils near the mill are shallow and well drained.

The top layer consists of brown loam. The subsoil is a pale brown loam, grading into a yellowish brown sandy loam. Areas north of the mill are covered with Quaternary alluvium consisting of gravel, cobble, boulders, and sand [EPA 2002].

3. *Hydrology*

The Cotter Mill lies within the Sand Creek watershed [HRAP 1991]. The main hydrologic feature of the Lincoln Park/Cotter Mill Superfund Site is Sand Creek, a primarily ephemeral creek [EPA 2007]. The creek originates at Dawson Mountain (south of the Cotter Mill), travels north through the Cotter Mill, intersects the DeWeese Dye Ditch, and runs north-northeast through Lincoln Park. It becomes perennial for the last 0.25–0.5 mile before its confluence with the Arkansas River. The DeWeese Dye Ditch is one irrigation ditch that flows between the Cotter Mill and Lincoln Park.

An ephemeral creek has flowing water only during, and for a short duration after, precipitation. A perennial creek has flowing water year-round.

Alluvial material (sediment deposited by flowing water) associated with Sand Creek is the predominant migration pathway for mill-derived contaminants in groundwater. Sand Creek carved a channel into the Vermejo formation at the Raton outcrop in the vicinity of the SCS Dam, which filled with permeable sediments, creating a preferential pathway for alluvial groundwater into Lincoln Park. The alluvial aquifer in Lincoln Park receives recharge from the DeWeese Dye Ditch, Crooked Ditch, Pump Ditch, ditch laterals, and ponds filled by the DeWeese Dye Ditch [EPA 2007].

4. *Prevailing Wind Patterns*

Cotter's monitoring network includes an on-site meteorological station that continuously measures a standard set of meteorological parameters (e.g., wind speed, wind direction, temperature, and relative humidity). The wind rose in Figure 3 in Appendix B depicts the statistical distribution of measured wind speeds and wind directions. During 2008, wind patterns at the station were principally westerly (i.e., winds out of the southwest to northwest) and accounted for 55% of the total winds [Cotter 2008b]. Easterly winds (i.e., winds out of the southeast to northeast) accounted for a smaller, but still significant, portion (26%) of the observed wind directions. Southerly and northerly winds were much less common. A nearly identical profile was observed in 2007. Other average parameters measured in 2008 follow: air temperature of 53.4 °F; relative humidity of 41%; and rainfall of 5.18 inches.

The prevailing westerly and easterly wind patterns are reasonably consistent with trends in the observed concentrations. Ambient air concentrations of selected site-related pollutants were highest at the perimeter monitoring stations directly east and west of the primary operations. There is a hilly ridge that straddles the western border of the site, blocking much east/west wind flow. However, it should be noted that prevailing wind patterns measured at Cotter Mill may not be representative of surface winds throughout the area, especially considering the proximity of nearby terrain features.

E. Past ATSDR involvement

ATSDR has been involved with the Lincoln Park site in the past. In October 1983, ATSDR completed a Public Health Assessment for the site. After reviewing available groundwater data, ATSDR concluded that the potential long term health effects from consumption of the contaminated water were:

- cancer and kidney damage, from uranium;
- gout-like symptoms, from molybdenum; and
- possibly a group of physiological and psychological symptoms, from selenium.

None of the potential health effects were definitive.

Numerous questions and concerns have been voiced by residents of Lincoln Park regarding the historical sites of numerous milling and smelting facilities in the Cañon City area. Among the various concerns were specific concerns about residual lead contamination from these milling and smelting operations. In response to these concerns, and after a specific request by the EPA, ATSDR evaluated the health risks associated with lead contamination in the area. ATSDR focused on two primary issues: 1) the blood lead level of children living in the area and 2) lead contaminated dust in homes in the Lincoln Park area.

In September and October 2005, ATSDR conducted an Exposure Investigation (EI) to answer the questions presented by the community and EPA. Previously, ATSDR concluded that lead levels in house dust and lead exposures to children represented an indeterminate health hazard because of a lack of available data. ATSDR conducted the EI to gather data on blood lead levels in the children, and soil and indoor dust level from homes.

The activities of the EI included:

- Collecting 44 indoor dust samples from 21 homes in Lincoln Park
- Collecting 80 composite soil samples from 22 properties (sampling conducted by EPA)
- Obtaining 45 blood samples from 21 households (42 blood samples were analyzed)

After evaluating the data obtained during the EI, ATSDR concluded that blood lead levels in adults and children, lead levels in dust in homes, and lead levels in soil did not represent a public health harard. ATSDR recommended no further actions related to lead in dust in homes, but did recommend routine monitoring of children's blood lead levels in the Lincoln Park area.

In September 2005, ATSDR conducted a blood lead testing program as a service to the community of Lincoln Park. A total of 115 children from a local school were tested for blood lead. None of the children tested had elevated blood lead levels. Therefore, ATSDR concluded that the children tested did not have unusual exposures to lead at the time of testing. ATSDR recommended that local and state agencies continue routine monitoring of lead levels in area children.

Full reports discussed above may be obtained by contacting any of the contacts listed at the end of this report, by visiting our website at www.atsdr.cdc.gov or by calling our toll-free hotline at 800-232-4636.

III. EVALUATION OF EXPOSURE PATHWAYS

A. What is meant by exposure?

An exposure pathway has five elements: (1) a source of contamination, (2) an environmental media, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. The *source* is the place where the chemical or radioactive material was released. The *environmental media* (such as groundwater, soil, surface water, or air) transport the contaminants. The *point of exposure* is the place where people come into contact with the contaminated media. The *route of exposure* (for example, ingestion, inhalation, or dermal contact) is the way the contaminant enters the body. The people actually exposed are the *receptor population*.

ATSDR's public health assessments are driven by exposure to, or contact with, environmental contaminants. Contaminants released into the environment have the potential to cause harmful health effects. Nevertheless, *a release does not always result in exposure*. People can only be exposed to a contaminant if they come in contact with that contaminant—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant. If no one comes in contact with a contaminant, then no exposure occurs, and thus no health effects could occur. Often the general public does not have access to the source area of contamination or areas where contaminants are moving through the environment. This lack of access to these areas becomes important in determining whether people could come in contact with the contaminants.

The route of a contaminant's movement is the *pathway*. ATSDR identifies and evaluates exposure pathways by considering how people might come in contact with a contaminant. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. Exposure can occur by breathing, eating, drinking, or by skin contact with a substance containing the chemical contaminant. ATSDR identifies an exposure pathway as completed or potential, or eliminates the pathway from further evaluation.

- *Completed exposure pathways* exist for a past, current, or future exposure if contaminant sources can be linked to a receptor population. All five elements of the exposure pathway must be present. In other words, people have or are likely to come in contact with site-related contamination at a particular exposure point via an identified exposure route. As stated above, a release of a chemical or radioactive material into the environment does not always result in human exposure. For an exposure to occur, a completed exposure pathway must exist.

- *Potential exposure pathways* indicate that exposure to a contaminant could have occurred in the past, could be occurring currently, or could occur in the future. It exists when one or more of the elements are missing but available information indicates possible human exposure. A potential exposure pathway is one which ATSDR cannot rule out, even though not all of the five elements are identifiable.

- An *eliminated exposure pathway* exists when one or more of the elements are missing. Exposure pathways can be ruled out if the site characteristics make past, current, and future human exposures extremely unlikely. If people do not have access to contaminated areas, the pathway is eliminated from further evaluation. Also, an exposure pathway is eliminated if site monitoring reveals that media in accessible areas are not contaminated.

Contact with contamination at the Cotter Mill is an eliminated exposure pathway.

Because the mill site itself is fenced and access is restricted, exposure to on-site contamination by the public at the Cotter Mill is limited. Further, remediation efforts have removed some of the on-site soil contamination, including moving millions of cubic yards of tailings and contaminated soils from unlined ponds to lined impoundments (EPA 2002). In some areas, contaminated soil was removed down to bedrock. In addition, various process changes reduced the release of contaminated materials (EPA 2002). Any potential exposure by the occasional trespasser to remaining impacted soils at the Cotter Mill would be too infrequent to present a health hazard.

B. How does ATSDR determine which exposure situations to evaluate?

ATSDR scientists evaluate site conditions to determine if people could have been, are, or could be exposed (i.e., exposed in a past scenario, a current scenario, or a future scenario) to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, sediment, water, air, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

If exposure was, is, or could be possible, ATSDR scientists consider whether contamination is present at levels that might affect public health. ATSDR scientists select contaminants for further evaluation by comparing them to health-based comparison values. These are developed by ATSDR from available scientific literature related to exposure and health effects. Comparison values are derived for each of the different media and reflect an estimated contaminant concentration that is *not likely* to cause adverse health effects for a given chemical, assuming a standard daily contact rate (e.g., an amount of water or soil consumed or an amount of air breathed) and body weight.

Comparison values are not thresholds for adverse health effects. ATSDR comparison values establish contaminant concentrations many times lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. If contaminant concentrations are above comparison values, ATSDR further analyzes exposure variables (for example, duration and frequency of exposure), the toxicology of the contaminant, other epidemiology studies, and the weight of evidence for health effects.

Some of the comparison values used by ATSDR scientists include ATSDR's environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs) and EPA's maximum contaminant levels (MCLs). EMEGs, RMEGs, and CREGs are non-enforceable, health-based comparison values developed by ATSDR for screening environmental contamination for further evaluation. MCLs are enforceable drinking water regulations developed to protect public health. Effective May 2008, Colorado established state groundwater standards for uranium and molybdenum.

You can find out more about the ATSDR evaluation process by calling ATSDR's toll-free telephone number, 1-800-CDC-INFO (1-800-232-4636) or reading ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/PHAManual/.

C. If someone is exposed, will they get sick?

Exposure does not always result in harmful health effects. The type and severity of health effects a person can experience because of contact with a contaminant depend on the exposure concentration (how much), the frequency (how often) and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of contaminants). Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status of the exposed individual influence how the individual absorbs, distributes, metabolizes, and excretes the contaminant. Together, these factors and characteristics determine the health effects that may occur.

In almost any situation, there is considerable uncertainty about the true level of exposure to environmental contamination. To account for this uncertainty and to be protective of public health, ATSDR scientists typically use worst-case exposure level estimates as the basis for determining whether adverse health effects are possible. These estimated exposure levels usually are much higher than the levels that people are really exposed to. If the exposure levels indicate that adverse health effects are possible, ATSDR performs more detailed reviews of exposure and consults the toxicologic and epidemiologic literature for scientific information about the health effects from exposure to hazardous substances.

D. What exposure situations were evaluated for residents living near the Cotter Mill?

ATSDR obtained information to support the exposure pathway analysis for the Lincoln Park/Cotter Mill Superfund Site from multiple site investigation reports; state, local, and facility documentation; and communication with local and state officials. The analysis also draws from available environmental and exposure data for groundwater, soil, surface water and sediment, and biota. Throughout this process, ATSDR examined concerns expressed by the community to ensure exposures of special concern are adequately addressed. ATSDR identified the following exposure pathways for further evaluation:

1. Exposure to site-related contaminants in groundwater in Lincoln Park.

2. Contact with site-related contaminants in soil adjacent to the Cotter Mill and in Lincoln Park.

3. Contact with site-related contaminants in surface water downstream from the Cotter Mill.

4. Exposure from eating produce locally grown in Lincoln Park.

5. Exposure from site-related soil contaminants in windborne dust.

6. Exposure from air emission sources (stacks and uncontrolled fugitive dust)

This exposure pathway analysis focuses on past, current, and future exposures for residents living near the Cotter Mill, with a focus on the community of Lincoln Park. Some attention is also paid to exposures at the Shadow Hills Golf Course and along the county road. Table 3 below provides a summary of exposure pathways evaluated in this public health assessment.

1. *Exposure to groundwater in Lincoln Park*

In the past, a number of residences used wells[1] on their property (GeoTrans 1986; IMS 1989). Based on a 1989 water use survey in Lincoln Park, 60 out of 104 wells, springs, and cisterns were used to obtain water for domestic purposes, including consumption and irrigation (IMS 1989). See Table 14 in Appendix A for the reported groundwater uses in the Lincoln Park area. Seven survey respondents indicated that they used groundwater for domestic consumption, accounting for 5 to 100% of their total water consumption. Based on the survey, five residents had private wells that were affected by contaminated groundwater; these residents were connected to the municipal water supply between 1989 and 1993 [EPA 2002]. The 1988 RAP requires Cotter to connect eligible affected users with legal water rights for a well to the town water supply [CDPHE 2005]. Cotter checks the State of Colorado's Engineer's Office database for new water permits and reports their findings in their annual ALARA reports [Pat Smith, EPA Region 8, personal communication, August 2008].

The use of private groundwater wells in the past was a completed exposure pathway. Most residences are now connected to the public water supply. The current and future use of these wells is a potential exposure pathway because the extent to which these wells are used is not well documented.

While the majority of town residents are now connected to the public water supply [Galant et al. 2007], several residences also have operational private wells. A 2005 summary of the RAP status reports that some residents have refused public water supply connections [CDPHE 2005]. Additionally, no formal institutional controls exist to control groundwater use in Lincoln Park [EPA 2007]. The United States Geological Survey (USGS) reports that existing private wells are used primarily for stock watering and irrigation [USGS 1999a]. However, a newspaper article reports that at least one residence, located on Grand Avenue in Lincoln Park, used private well water for consumption as recently as 2002 [Plasket 2002]. Based on a 2007 review of Colorado State well permits for residences in the plume configuration, at least one well is permitted for irrigation and domestic use, but no details of actual use are documented [EA 2007]. On properties that continue to use private wells, new purchasers are offered connection to the town's municipal water system [Galant et al. 2007]. In late 2008, EPA conducted another water use survey to verify whether groundwater is being utilized by residences in Lincoln Park. Well water samples were also collected and analyzed. Once available, ATSDR will review the information and will revise the public health assessment, if needed.

2. *Contact with soil adjacent to the Cotter Mill and in Lincoln Park*

People (especially children) might accidentally ingest soil or exposed sediment, and dust generated from these materials, during normal activities. Everyone ingests some soil or dust every day. Small children (especially those of preschool age) tend to swallow more soil or dust than any other age group because children of this age tend to have more contact with soil through play activities and have a tendency for more hand-to-mouth activity. Children in elementary school, teenagers, and adults swallow much smaller amounts of soil or dust. The amount of grass

---

[1] The term "well" is used to represent all groundwater sources, and includes both wells and springs.

cover in an area, the amount of time spent outdoors, and weather conditions also influence how much contact people have with soil.

a) Contact with soil near the Cotter Mill

Soils adjacent to the Cotter Mill have been contaminated by wind-blown particulates [CDPHE 2005]. Elevated levels are primarily detected in soils directly east and west of the facility [Weston 1998]. This distribution of contaminated soils is consistent with wind patterns in the area, which blow mainly from west to east with occasional flows from east to west. The primarily vacant areas directly east and west of the facility are referred to as a "buffer zone" between the Cotter Mill and residential developments [EPA 2002]. Therefore, limited opportunities for exposure to impacted site-adjacent soils exist—people are not expected to be in this area on a daily basis and for an extended period of time. One exception may be at the Shadow Hills Golf Course, located immediately north of the Cotter mill complex. Exposure to potentially impacted soil at this public golf course is unlikely due to grass cover.

Contact with contaminated soil near the Cotter Mill (i.e., in the buffer zone) is a past, current, and future potential exposure pathway.

For nearly 50 years, Cotter has intermittently hauled materials by truck, possibly losing some materials along the county road leading to the facility and along the access road entering the mill site [MFG 2005]. The public could be exposed to potentially impacted soils along the county road. However, there is limited potential for exposure to contaminants along the access road, since access to the Cotter Mill is restricted and Cotter remediated soil adjacent to the access road in 2007 and 2008.

b) Contact with soil and sediment in the community of Lincoln Park

The community of Lincoln Park is located approximately 1.5 miles north-northeast of the restricted area of the Cotter Mill. Contaminated materials from the Cotter Mill may have contributed to soil contamination in Lincoln Park in two ways:

1. Dust from soil or tailings associated with site operations could be transported by wind to Lincoln Park. However, wind patterns in the area suggest that wind-blown contamination is not likely a considerable source of soil contamination in Lincoln Park (Weston 1998). Additionally, on-site remediation at the Cotter Mill substantially reduced the sources of soil contamination.

2. Potentially impacted groundwater used for irrigation could lead to the accumulation of chemicals in town soils [Weston 1998].

Further, in the past, contaminated surface water runoff from the Cotter Mill entered Sand Creek, where it was transported downstream toward Lincoln Park [EPA 2002]. However, Sand Creek is not believed to be used for recreational activities—the creek is ephemeral and on private land until it goes under the river walk and enters the Arkansas River [Phil Stoffey, CDPHE, personal communication, June 2007].

Contact with contaminated sediment in Sand Creek was a past potential exposure pathway. Due to the remediation of Sand Creek, current and future contact is an eliminated exposure pathway.

Contact with contaminated soil in Lincoln Park was a past completed exposure pathway. Cotter has performed all required off-site soil cleanup activities, as outlined in the RAP [EPA 2002]. CDPHE reports that the Cotter Mill poses no risk to the residents of Lincoln Park by exposure to soil [Weston 1998], and EPA and CDPHE have advised “No Further Action” in regards to Lincoln Park soils [EPA 2002]. EPA’s Record of Decision states that surface-soil cleanup activities have eliminated or reduced risks to “acceptable” levels [EPA 2002, 2007]. Therefore, current and future contact with soil and sediment is an eliminated exposure pathway.

3. *Contact with surface water downstream from the Cotter Mill*

In the past, people could have come in contact with contamination in surface water during recreational activities. The Arkansas River is used primarily for fishing and boating or rafting, as well as some swimming [Phil Stoffey, CDPHE, personal communication, June 2007]. Sand Creek is on private land until it goes under the river walk and enters the Arkansas River, and is generally not used for recreational activities [Phil Stoffey, CDPHE, personal communication, June 2007]. Many Lincoln Park residents use water from the DeWeese Dye Ditch to irrigate their orchards and gardens [Galant et al. 2007].

Contact with contaminated surface water near the Cotter Mill was a past potential exposure pathway. Due to the construction of the SCS Dam and the remediation of Sand Creek, current and future contact is an eliminated exposure pathway.

4. *Exposure from eating locally grown produce*

Many Lincoln Park residents have orchards and gardens. Water from the DeWeese Dye Ditch is primarily used to irrigate the orchards and gardens, however, some residents use water from their groundwater wells [Galant 2007; IMS 1989]. If fruits and vegetables are grown in contaminated soil and/or irrigated with contaminated water, the people who eat this produce could be exposed to contamination.

5. *Exposure from breathing windborne dust*

Many Lincoln Park residents are concerned about the arid environment and the risks of breathing in contaminated dust from the site. The profile of air emission sources at Cotter Mill has changed considerably over the years. These sources include both releases through stacks and uncontrolled (or fugitive) dust emissions. Stack emissions occurred during times of active processing at Cotter Mill; however, the magnitude of these stack emissions has varied, depending on production rates and effectiveness of air pollution controls. The sources of fugitive dust emissions have also changed. In the past, the site had many uncontrolled sources of wind-blown dust, which would cause particulate matter (along with any chemical and radiological constituents) to be emitted into the air. Examples of these sources include ore handling operations, stockpiles, and the previous unlined holding ponds. Many of these sources of wind-blown dust have since been controlled or eliminated, causing facility-wide fugitive dust emissions to decrease considerably over the years, though some fugitive dust emissions (e.g., from unpaved roads) continue to occur.

Table 3. Exposure pathways for residents living near the Cotter Mill

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Groundwater							
Completed Exposure Pathway							
Private groundwater wells	Tailings and other wastes from the Cotter Mill (heavy metals and radionuclides)	Migration of groundwater into the Lincoln Park area	Residential tap water drawn from private wells	Residents, including children, who are not connected to the public water supply and rely on private wells	Ingestion, Dermal contact	Past	Past consumption of groundwater from private wells has been documented and was, therefore, a completed exposure pathway.
Potential Exposure Pathway							
Private groundwater wells	Tailings and other wastes from the Cotter Mill (heavy metals and radionuclides)	Migration of groundwater into the Lincoln Park area	Residential tap water drawn from private wells	Residents, including children, who are not connected to the public water supply and rely on private wells	Ingestion, Dermal contact	Current Future	The extent to which private wells are currently used in Lincoln Park is uncertain. Although most residents are supplied with town water, documents indicate that residents have been drinking private well water as recently as 2002, and are permitted to use wells for unspecified domestic purposes. However, it is believed that water from wells is used primarily for irrigation and other non-drinking purposes. Therefore, current and future use of water from private wells is a potential exposure pathway.

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Soil and Sediment							
Completed Exposure Pathway							
Surface soil and dust in Lincoln Park	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust; soil irrigated by contaminated groundwater	Residences and public areas	Residents, including children	Dermal contact, Incidental ingestion, Inhalation	Past	Prior to remediation, contaminants were detected in soil from residential lawns and gardens. Therefore, contact with contaminated soil in Lincoln Park was a past completed exposure pathway.
Potential Exposure Pathways							
Surface soil near the Cotter Mill	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust	The Shadow Hills Golf Course west of the Cotter Mill; along the county road leading to the Cotter Mill	Golfers at the public golf course; people on the county road	Dermal contact, Incidental ingestion, Inhalation	Past Current Future	Soils adjacent to the Cotter Mill have been contaminated by wind-blown particulates. Therefore, contact with soil near the Cotter Mill, especially at the public golf course and along the county road, is a past, current, and future potential exposure pathway.
Sediment in Sand Creek	Tailings, dusts, and other wastes from the Cotter Mill	Tailings carried in surface water runoff	Along Sand Creek	Recreational users; children playing along Sand Creek	Dermal contact, Incidental ingestion	Past	There were limited opportunities for exposure since Sand Creek was not used for recreational purposes. Therefore, exposure to sediments prior to the Sand Creek Cleanup project was a past potential exposure pathway.
Eliminated Exposure Pathways							
Surface soil at the Cotter Mill	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust; surface water runoff	Unauthorized access is not allowed	None	None	Past Current Future	Because the mill site itself is fenced and access is restricted, contact with on-site contamination is an eliminated exposure pathway. Further, remediation efforts have removed some impacted soils.

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Surface soil and dust in Lincoln Park	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust; soil irrigated with contaminated groundwater	Cleanup activities have eliminated or reduced risks to acceptable levels	None	None	Current Future	Due to the sampling and remediation in Lincoln Park, current and future contact with soil and dust is an eliminated exposure pathway.
Sediment in Sand Creek	Tailings, dusts, and other wastes from the Cotter Mill	Tailings carried in surface water runoff	Contaminated sediment was removed from Sand Creek	None	None	Current Future	Sediment in Sand Creek is no longer a hazard since the completion of the Sand Creek Cleanup project. Therefore, current and future contact with sediment in Sand Creek is an eliminated exposure pathway.
Surface Water							
Potential Exposure Pathway							
Surface water near the Cotter Mill	Tailings and other waste from the Cotter Mill	Surface water runoff; transport from Sand Creek to the Arkansas River	Along Sand Creek between the Cotter Mill and the Arkansas River; the DeWeese Dye Ditch; the Arkansas River	Recreational users (mostly in the Arkansas River, limited recreational use in Sand Creek); people irrigating with water from the DeWeese Dye Ditch	Incidental ingestion, Dermal contact	Past	In the past, surface water in Sand Creek was found to contain elevated levels of metals and radionuclides. Therefore, past contact with contaminated surface water near the Cotter Mill was a potential exposure pathway.
Eliminated Exposure Pathway							
Surface water near the Cotter Mill	Tailings and other waste from the Cotter Mill	Surface-water runoff; transport from Sand Creek to the Arkansas River	Contamination was removed from Sand Creek	None	None	Current Future	Due to the construction of the SCS Dam and the remediation of Sand Creek, current and future contact with contaminated surface water is an eliminated exposure pathway.

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Locally Grown Produce							
Potential Exposure Pathway							
Produce grown in Lincoln Park	Tailings, dusts, and other wastes from the Cotter Mill	Produce grown in contaminated soil or irrigated with contaminated water	Orchards and gardens in Lincoln Park	People who eat locally grown produce	Ingestion	Past Current Future	Because many Lincoln Park residents have orchards and gardens, eating locally grown produce is a past, current, and future potential exposure pathway.
Air Emissions							
Completed Exposure Pathway							
Ambient air near the Cotter Mill facility	Ground-level fugitive emissions (e.g., wind-blown dust) and elevated point sources (e.g., stacks)	Windblown dust; stack emissions into the air and transport to off-site locations	Off-site or down-wind locations	People who live in the vicinity of Cotter Mill or downwind of the stacks	Inhalation	Past Future Present	Cotter's air monitoring network monitors air concentrations at off-site locations. With the facility currently in "stand down" status, facility emissions are now predominantly fugitive; air quality impacts should be characterized by perimeter monitoring stations.

IV. EVALUATION OF ENVIRONMENTAL CONTAMINATION

A. Groundwater

Prior to 1980, Cotter disposed of waste in unlined ponds, which allowed contaminated liquids to leach into the groundwater [EPA 2002]. Groundwater was shown to be contaminated as far away as the Arkansas River, which is approximately 2.5 miles downgradient from the mill [EPA 2002]. Results from the 1984–1985 Remedial Investigation found that despite attempts at remediation, the new, lined impoundments were leaking and the old ponds area was a continuing source of groundwater contamination [GeoTrans 1986]. This study also found that a gap in the ridge at the SCS Dam, built in 1971 across Sand Creek on the Cotter property, was allowing shallow groundwater to move downgradient towards Lincoln Park, resulting in concentrations of molybdenum and uranium that were 2,000 times above background levels at that time.

Groundwater concentrations of molybdenum and uranium have decreased in recent years, but concentrations have not yet returned to background levels in some wells [Weston 1998]. Figures 4 and 5 show the extent of the molybdenum and uranium concentrations, respectively, above water quality standards (0.035 milligrams per liter [mg/L] for molybdenum and 0.03 mg/L for uranium). The highest levels in Lincoln Park were detected nearest to the Cotter property in the vicinity of the DeWeese Dye Ditch [Weston 1998]. Additionally, despite remediation efforts, the physical and chemical groundwater data suggest minor leakage from the primary impoundment at the Cotter site [CDPHE 2007a; EPA 2002; USGS 1999b].

1. Remedial actions for controlling groundwater contamination

Since the early- to mid-1980s, remedial actions aimed at controlling groundwater contamination and the spread of the resulting plume have taken place. Remediation has targeted the area along the primary surface groundwater migration pathway, which runs parallel to Sand Creek [USGS 1999a]. Remediation has included the following:

- In the early 1980s, contaminated materials were moved into lined impoundments [EPA 2002].

- In 1988, a hydrologic clay barrier was installed on the Cotter property to help contain the contaminated groundwater plume associated with the Cotter Mill.

- In 1989, a network of injection and withdrawal wells were constructed downgradient of the lined impoundment to reverse the hydraulic gradient and prevent the northward migration of contaminated groundwater. This system was discontinued in 2000, because the system had little or no discernable effect on groundwater conditions [CDPHE 2005].

- Dam to ditch flushing began in 1990. However, this effort was discontinued in 1996 due to citizens' concerns about contaminant concentrations rising in groundwater wells as the plume was being flushed [CDPHE 2005].

- In 2000, a permeable reactive treatment wall was constructed across Sand Creek channel in the DeWeese Dye Ditch flush, downstream of the SCS Dam [EPA 2002]. Although the permeable reactive treatment wall has not performed as anticipated, it is acting as a barrier to additional groundwater flowing into Lincoln Park [Phil Egidi, CDPHE, personal communication, July 2008].

These efforts have reduced groundwater contamination downgradient of the Cotter Mill [CDPHE 2008; EPA 2002; USGS 1999a], although the rate at which groundwater quality is being restored is slower than anticipated [EPA 2007]. Cotter and CDPHE continue to explore options for cleaning the groundwater. Until a solution is reached, contaminated groundwater is captured at the SCS Dam and pumped back to the on-site lined impoundments [CDPHE 2008].

2. Nature and extent of groundwater contamination in Lincoln Park

CDPHE maintains a database containing environmental sampling data from various sources dating back to 1961. The most recent data entered into the database are from September 2007. To evaluate exposures to residents of Lincoln Park, ATSDR identified data within the CDPHE database for the wells reported to be in use during the 1989 water use survey (see Table 14 in Appendix A). After discussions with a CDPHE representative, the following assumptions were made while summarizing the data within the database.

- For chemicals, samples that were designated “Y” in the detect flag column and contained a zero in the result value column, but no value in the reporting detection limit column were excluded from the summary statistics. For radionuclides, however, these samples were included in the summary statistics since zero is considered a valid result.
- Samples that were designated “N” in the detect flag column and had the same value in the result value column as the reporting detection limit column were included in the summary statistics as ½ the reporting detection limit.
- Negative result values for manganese and iron were assumed to be not detected and were included in the summary statistics as ½ the reporting detection limit.
- Negative values[2] for radionuclides were included in the summary statistics.

a) Wells used for personal consumption

When this document was written, data from EPA’s 2008 water use survey were not yet available. ATSDR will update well use information when the data are available.

The 1989 *Lincoln Park Water Use Survey* identified seven wells used for personal consumption (IMS 1989). Data for six of the wells are available in the CDPHE database (see Table 14). The seventh well had a broken pump at the time of the survey [IMS 1989]; no data for this well appear to be in the database. The data for wells reportedly used for personal consumption in 1989 are summarized in Table 15. Samples were collected intermittently from 1984 to 2007. The locations of these wells are shown in Figure 6. With the exception of molybdenum and uranium, the data are limited (e.g., only two wells were sampled for the majority of the chemicals and none were sampled for radionuclides).

---

[2] Negative values for radionuclides occur when samples are not much different from background, since standard protocol is to subtract background radioactivity from the sample count.

However, all six wells were repeatedly tested for molybdenum and uranium, which were the only chemicals detected above comparison values (see Table 15). Of the personal consumption wells, Well 189 contains the highest molybdenum and uranium concentrations. Well 189 is the only well with levels of uranium consistently detected above the comparison value (see Figure 6).

It is difficult to evaluate the molybdenum and uranium data over time, because of the limited sampling data for these wells and the inconsistency of sampling the same wells over time. The molybdenum and uranium concentrations in the personal consumption wells over time are graphically shown in Figure 7 and Figure 8 in Appendix B, respectively. Well 168 (house well on Grand Avenue)[3] and Well 189 (house well on Hickory)[4] were sampled the most frequently. No clear pattern of decreasing concentrations from 1984 to 2007 exists.

The USGS identified Well 10 (So. 12th St.) and Well 114 (Pine) as representative of background for the Lincoln Park area [Weston 1998]. The data available in the CDPHE database for these two wells are summarized in Table 16.[5] The average concentration of molybdenum in the wells used for personal consumption (0.082 mg/L; see Table 15) is higher than the average concentration found in the background wells (0.023 mg/L; see Table 16). The average uranium concentration in the wells used for personal consumption (0.028 mg/L; see Table 15) is only slightly higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

(1) Grand Avenue Well

In a 2002 newspaper article, a resident on Grand Avenue reported drinking water from their well [Plasket 2002]. Limited data (1 to 20 samples) are available in the CDPHE database for this location (see Figure 6). Samples were collected and analyzed for most chemicals in 1984, and then from either 2004 or 2005 to 2007. Samples from this well were also tested for molybdenum and uranium from 1988 to1991. The water from this well was tested for several chemicals, but not for radionuclides. None of the samples detected chemicals above comparison values (see Table 17).

b) Wells used to irrigate fruit and vegetable gardens

When this document was written, data from EPA’s 2008 water use survey were not yet available. ATSDR will update well use information when the data are available.

The 1989 *Lincoln Park Water Use Survey* identified 22 wells used to irrigate fruit and 21 wells used to irrigate vegetable gardens [IMS 1989].[6] Data for 28 of these wells are available in the CDPHE database (see Table 14). Samples were sporadically collected from these wells and analyzed for various chemicals between 1962 and 2007. Samples were collected and analyzed for radionuclides from

---

[3] There are five non-detected molybdenum values for Well 168. Four of them are most likely due to the detection limit being too high for the level of molybdenum in that well. The detection limits were 0.01 mg/L for three of the samples and 0.05 mg/L for one of the samples. The concentrations in that well hover around 0.01 mg/L.

[4] One of the non-detected molybdenum concentrations in Well 189 is unexplainable. The detection limit (0.01 mg/L) is low enough to have detected the level of molybdenum typically found in the well. The detection limit (0.5 mg/L) for the other non-detected concentration is too high for the level of molybdenum typically found in the well.

[5] Groundwater samples from the background wells were not tested for radionuclides.

[6] Some wells were used for both purposes.

1995 to 2000. The data for wells reportedly used to irrigate fruit and vegetable gardens in 1989 are summarized in Table 18 (chemicals) and Table 19 (radionuclides). The locations of these wells are shown in Figure 9. The data for these wells are much more robust than the data available for the wells used for personal consumption, in part due to the increased number of wells. Molybdenum and uranium were sampled in all 28 wells used for irrigation. Five wells were tested for radionuclides.

The maximum concentrations in the wells used to irrigate fruit and vegetable gardens exceeded the comparison values for molybdenum, selenium, sulfate, total dissolved solids, and uranium. The average concentrations exceeded comparison values only for molybdenum, total dissolved solids, and uranium. Looking at data from 2000 to 2007, only the average molybdenum concentration (0.1 mg/L) continued to exceed the comparison value.

The average concentration of molybdenum in the wells used to irrigate fruit and vegetable gardens (0.99 mg/L; see Table 18) is higher than the average concentration found in the wells that USGS identified as background for Lincoln Park (0.023 mg/L; see Table 16). Similarly, the average uranium concentration in the wells used to irrigate fruit and vegetable gardens (0.13 mg/L; see Table 13) is higher than the average concentration in the background wells (0.021 mg/L; see Table 16). The average concentration for total dissolved solids in the wells used to irrigate fruit and vegetable gardens (550 mg/L; see Table 18) is also higher than the average concentration found in the background wells (429 mg/L; see Table 16).

c) Wells used to water livestock

When this document was written, data from EPA's 2008 water use survey were not yet available. ATSDR will update well use information when the data are available

The 1989 *Lincoln Park Water Use Survey* identified 22 wells used to water livestock [IMS 1989]. Data for 19 of these wells are available in the CDPHE database (see Table 14). Samples were sporadically collected from these wells and analyzed for various chemicals between 1962 and 2007. Samples were collected and analyzed for radionuclides from 1995 and 1996. The data for wells reportedly used to water livestock in 1989 are summarized in Table 20 (chemicals) and Table 21 (radionuclides). The locations of these wells are shown in Figure 10. Only one to four wells were sampled for the majority of the chemicals, however, molybdenum and uranium were sampled in all 19 wells used to water livestock. Two wells were tested for radionuclides.

The maximum concentrations exceeded the comparison values for molybdenum, sulfate, total dissolved solids, and uranium. The average concentrations only exceeded comparison values for molybdenum and uranium. Looking at data from 2000 to 2007, only the average molybdenum concentration (0.08 mg/L) continued to exceed the comparison value.

The average concentration of molybdenum in the wells used to water livestock (0.212 mg/L; see Table 20) is an order of magnitude higher than the average concentration found in the wells that USGS identified as background for Lincoln Park (0.023 mg/L; see Table 16). The average uranium concentration in the wells used to water livestock (0.034 mg/L; see Table 20) is higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

d) *Wells used to water lawns*

When this document was written, data from EPA's 2008 water use survey were not yet available. ATSDR will update well use information when the data are available.

The 1989 *Lincoln Park Water Use Survey* identified 42 wells used to water lawns [IMS 1989]. Data for all 42 wells are available in the CDPHE database (see Table 14). Samples were sporadically collected from these wells and analyzed for various chemicals between 1962 and 2007. Samples were collected and analyzed for radionuclides from 1995 to 2000. The data for wells reportedly used to water lawns in 1989 are summarized in Table 22 (chemicals) and Table 23 (radionuclides). The locations of these wells are shown in Figure 11. Several wells were sampled for each chemical, and molybdenum and uranium were tested in all 42 wells used to water lawns. Seven wells were sampled for radionuclides.

The maximum concentrations exceeded the comparison values for chloride, molybdenum, selenium, sulfate, total dissolved solids, and uranium. The average concentrations exceeded comparison values for molybdenum, sulfate, total dissolved solids, and uranium. Looking at data from 2000 to 2007, only the average molybdenum concentration (0.1 mg/L) continued to exceed the comparison value from 2000 to 2007, while the average uranium concentration (0.03 mg/L) was at the comparison value.

The average concentration of molybdenum in wells used to water lawns (2.2 mg/L; see Table 22) is two orders of magnitude higher than the average concentration found in the wells that USGS identified as background for Lincoln Park (0.023 mg/L; see Table 16). The average sulfate concentration in wells used to water lawns (351 mg/L; see Table 22) is almost six times higher than the average concentration in the background wells (61 mg/L; see Table 16). The average concentration for total dissolved solids in wells used to water lawns (746 mg/L; see Table 22) is higher than the average concentration found in the background wells (429 mg/L; see Table 16). The average dissolved uranium concentration in wells used to water lawns (0.233 mg/L; see Table 22) is an order of magnitude higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

(1) Well 138

Well 138 (field well on Cedar Street; see Figure 11) was identified during the *1998 Supplemental Human Health Risk Assessment* as the maximally impacted off-site well [Weston 1998]. In 1989, Well 138 was used only to water the lawn [IMS 1989]. Adequate data for this well are available in the CDPHE database. Samples were collected from Well 138 and analyzed for various chemicals between 1968 and 2000. Samples were collected and analyzed for radionuclides from 1995 to 2000. The data for Well 138 are summarized in Table 24 (chemicals) and Table 25 (radionuclides).

The maximum concentrations exceeded the comparison values for chloride, molybdenum, selenium, sulfate, total dissolved solids, and uranium. The average concentrations also exceeded comparison values for molybdenum, sulfate, total dissolved solids, and uranium. A clear decrease in concentrations occurred over time for molybdenum (see Figure 12), selenium (see Figure 13), and uranium (see Figure 14).

Well 138 has higher levels of contamination than the wells that USGS identified as background for Lincoln Park. The average concentration of molybdenum in Well 138 (8.0 mg/L; see Table 244) is hundreds of times higher than the average concentration found in the background wells (0.023 mg/L; see Table 16). The average sulfate concentration in Well 138 (1,059 mg/L; see Table 24) is considerably higher than the average concentration in the background wells (61 mg/L; see Table 16). The average concentration for total dissolved solids in Well 138 (1,530 mg/L; see Table 24) is three times higher than the average concentration found in the background wells (429 mg/L; see Table 16). The average dissolved uranium concentration in Well 138 (0.73 mg/L; see Table 24) is more than an order of magnitude higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

e) Groundwater trends over time

To evaluate the levels of molybdenum, selenium, and uranium in groundwater over time, ATSDR combined and graphed all the groundwater data for the wells used for personal consumption, irrigating fruit and vegetables, watering livestock, and watering lawns (Figures 15 through 17 in Appendix B). Figure 15 shows a pattern of decreasing concentrations of molybdenum in groundwater over time. The concentrations of selenium seem to hold steady, but do decrease slightly over time (see Figure 16). The concentrations of uranium also clearly decrease over time (see Figure 17).

B. Soil and sediment

1. Background levels

Cotter was required by the 1988 RAP to establish background levels of certain elements in soils and sediments. Twenty soil samples were collected from five sub-basins considered free from mill-related contamination to represent natural background typical of the area near the mill [HRAP 1991]. Table 4 below presents the results of that study, which were further supported by additional sampling [CDPHE 2005].

Table 4. Background soil and sediment levels

	Soil		Sediment	
	Average	**Upper Confidence Limit**	**Average**	**Upper Confidence Limit**
Molybdenum	2.4 ppm	4.6 ppm	2.3 ppm	4.7 ppm
Uranium	2.1 ppm	2.9 ppm	2.0 ppm	3.4 ppm
Radium-226	1.3 pCi/g	1.9 pCi/g	1.1 pCi/g	1.7 pCi/g
Thorium-230	1.8 pCi/g	3.2 pCi/g	1.5 pCi/g	3.1 pCi/g
Gamma Exposure Rates	9.4 µR/hr	--	--	--

Source: CDPHE 2005; HRAP 1991

pCi/g – picocuries per gram

ppm – parts per million

µR/hr – microroentgen per hour

2. *Off-site soil contamination and remediation*

As part of the 1988 RAP, Cotter was required to survey soils outside the restricted area (the fenced active mill site) and to remediate contaminated soils with levels of radium and molybdenum that are above the established background [CDPHE 2005].

As part of the *1998 Supplemental Human Health Risk Assessment* [Weston 1998], Weston (a contractor for Cotter) collected surface soil samples (0-2 inches) from eight zones around the mill property (see Figure 18 in Appendix B). Each zone was divided into 8 to 12 grids. Four samples were collected near the center of each grid and were composited (i.e., combined and homogenized) to form a single representative sample [Weston 1998]. The results of this sampling are shown in Table 26 (chemicals) and Table 27 (radionuclides). The maximum concentrations exceeded the comparison values for arsenic[7] in all eight zones, for cadmium in all zones except one (D), for lead in three zones (F, G, and H), and for radium-226 in four zones (A, B, C, and E). The average concentrations also exceeded comparison values for arsenic[7] in all eight zones, for cadmium in one zone (F), for lead in one zone (H), and for radium-226 in two zones (A and B). The average radium-226 and thorium-230 concentrations were higher than the established average background levels in all eight zones (see 4 for background).

Cotter has occasionally hauled ore and other materials by truck to the site for processing at their facility. To assess the potential that material has been lost alongside the county road leading to the mill and the access road entering the mill site, MFG (a contractor to Cotter) scanned the county road (assuming CR 143) from the road leading to the Shadow Hills Golf Course to the Cotter Mill access road for gamma radiation (see Figure 19). They also collected soil samples to establish a correlation between the gamma exposure rate and the concentration of gamma emitters in the soil. A total of 16 locations were sampled—five along the county road, five along the mill's access road, and six from background locations. The locations were not chosen to estimate an average concentration, but rather to provide data for a range of gamma exposure rates. Each sample was a composite of 10 aliquots within a 100 x 100 meter area [MFG 2005]. The results of this sampling are shown in Table 28. The maximum and average radium-226 and natural uranium concentrations exceeded the comparison values for samples taken along the mill's access road. The maximum and average radium-226 concentrations also exceeded the comparison value for samples taken along the county road. Average concentrations of all radionuclides sampled were higher along the county road and the mill's access road than from those areas designated as background (see Table 28).

There is limited potential for exposure to contaminants along the access road since access to the Cotter Mill is restricted and soils along the access road were remediated in 2007 and 2008.

To address public concerns about the impact of the Cotter Mill on the health of Cañon City residents, CDPHE collected 21 soil samples in January 2003 [CDPHE 2003]. Each sample was a composite of 30–40 scrape samples[8] from each location. Seven samples from Lincoln Park were

---

[7] The *1998 Supplemental Human Health Risk Assessment* found no discernible spatial pattern for arsenic around the Cotter Mill, indicating that arsenic levels have not been measurably altered by airborne releases from the mill (Weston 1998).

[8] Surface soil samples were collected using a method developed specifically to look for airborne contamination that settled to the ground (CDPHE 2003).

collected, including one sample of suspected flood sediment (Pine Street near Elm Avenue), two samples of dust (one from a barn loft and one from a residential attic), and four samples of surface soil (one from the McKinley Elementary School playground). Seven samples were collected from areas east of the mill, including the Brookside Head Start School. Six samples were collected from areas west of the mill, including a private residence. One sample was collected from the extreme northern part of Cañon City to represent the regional background (corner of Orchard Avenue and High Street). The sampling event was intentionally biased toward finding the highest amounts of contamination possible [CDPHE 2003]. Sample locations are shown in Figure 20. The data from this sampling event are summarized in Table 29 (chemicals) and Table 30 (radionuclides). The maximum concentrations for lead and radium-226 exceeded the comparison values. The average concentration for lead also exceeded the comparison value. The average concentration for radium-226 did not exceed the comparison value.

Since 1994, Cotter has been annually collecting surface soil samples (0–6 inches) at 10 environmental air monitoring stations that are located along the facility's boundary and in residential areas (see Figure 21). From 1979 to 1993, soils were collected every 9 months. The data from this effort are summarized in Table 31. The maximum concentration for radium-226 exceeded the comparison value; however, the average concentration of samples over the timeframe did not.

a) The nearest resident

The nearest resident is located 0.25 mile from the restricted area [Galant et al. 2007]. One of the air monitoring stations annually monitored by Cotter was established as "the nearest resident" (AS-212). This location is between the Cotter Mill and an actual residence [Cotter 2007]. The limited data for this location are shown in Table 32 (chemicals) and Table 33 (radionuclides). The maximum concentration for radium-226 exceeded the comparison value; however, the average concentration did not.

b) Lincoln Park

As part of the 1988 RAP, Cotter was required to conduct a gamma scintillometer survey in Lincoln Park to evaluate whether soils had been contaminated by windblown and waterborne contaminants from the facility. In December 1988, 127 scintillometer readings were taken near intersections in Lincoln Park. The average external gamma radiation for Lincoln Park was 9.8 microroentgen per hour (µR/hr), which is considered to show "no elevated gamma in Lincoln Park" [CDPHE 2005; HRAP 1991].

EPA determined that sediment and soil in Lincoln Park are no longer an issue since the completion of the Sand Creek Cleanup project in 1998 [EPA 2002, 2007].

As part of the *1996 Supplemental Human Health Risk Assessment* [Weston 1996], Weston compiled data from several past soil studies, including the following:

- Samples collected at the air monitoring location in Lincoln Park in 1987 and 1988

- Samples collected from yards of 10 participants in the Lincoln Park water use survey in 1989
- Samples collected from residential gardens in Lincoln Park in 1990
- Samples collected from lawns and gardens in Lincoln Park in 1996

The data from these studies are collectively summarized in Table 34 (chemicals) and Table 35 (radionuclides). Only the maximum and average concentrations for arsenic exceeded the comparison value.

The soil samples collected from yards of the participants in the 1989 *Lincoln Park water use survey* were also analyzed for molybdenum and uranium. The average molybdenum concentration was 2.0 ppm and the average uranium concentration was 2.8 ppm [HRAP 1991]. The samples collected as part of the 1990 residential garden soil survey were also analyzed for molybdenum. The average concentration was 0.13 ppm [HRAP 1991]. These concentrations are well below the comparison values for molybdenum (300 ppm) and uranium (100 ppm).[9]

As part of the *1998 Supplemental Human Health Risk Assessment* [Weston 1998], 73 surface soil samples were collected from lawns (0–2 inches) and gardens (0–6 inches) in Lincoln Park. For sampling purposes, Lincoln Park was divided into seven areas and 6–16 samples were taken from each area [Weston 1998]. The results of this sampling are shown in Table 26 (chemicals) and Table 27 (radionuclides). Only the maximum and average arsenic concentrations exceeded the comparison value.

The effect of irrigation with contaminated well water on the levels in the soil was also examined during the *1998 Supplemental Human Health Risk Assessment* [Weston 1998]. The soil samples from Lincoln Park were divided into two categories—those irrigated with well water that had been impacted by mill releases and those not believed to have been irrigated with contaminated well water. These data are shown in Table 36 (chemicals) and Table 37 (radionuclides). The concentrations of arsenic, molybdenum, and uranium were statistically higher in soil samples irrigated with impacted well water [Weston 1998].

(1) Lead in Lincoln Park

Residents of Lincoln Park expressed concerns about lead contamination in soil and dust due to historical and current mining and milling operations in the area. Six potential sources of lead are located near the community of Lincoln Park—the Cotter Mill, the Empire Zinc Smelter (also known as New Jersey Zinc and the College of the Cañons), the US Smelter Facility, the Cañon City Copper Smelter, the Ohio Zinc Company, and the Royal Gorge Smelter [EPA 2004]. The Lincoln Park neighborhood is located generally east-southeast of these facilities and the general wind direction is west to east.

To address the residents' concerns, EPA requested that ATSDR assess the health risk associated with lead contamination in Lincoln Park. After a site visit and discussions with the community,

---

[9] The data for molybdenum and uranium are not summarized in Table because the raw data for these two chemicals are not presented in the *1996 Supplemental Human Health Risk Assessment* (Weston 1996).

ATSDR focused assessments on two primary issues—1) blood lead levels in children living in Lincoln Park and 2) lead contaminated dust in homes in Lincoln Park.

ATSDR reviewed the available data on blood lead levels in children and concluded that the rate of elevated blood lead levels for Fremont County is below the state average. However, it was not possible to evaluate whether area children, including "high risk" children, were being adequately screened for blood lead levels [ATSDR 2006a]. To further assess blood lead levels, ATSDR tested the blood level of 115 "at risk" school children in 2005. None of the children had elevated blood lead levels [ATSDR 2006b].

EPA's report documenting the residential soils sampling project can be accessed at the following site: http://www.epa.gov/region8/superfund/co/lincolnpark/.

ATSDR reviewed the available data on lead levels in household dust and found the data to be sparse and/or lacking. ATSDR conducted a screening level evaluation of the available dust samples and concluded that the data were not sufficient to determine the magnitude or extent of the potential hazard associated with levels of lead in household dust [ATSDR 2006c]. To further assess the health impacts in Lincoln Park, ATSDR, in collaboration with the Colorado Citizens Against Toxic Waste (CCAT) and EPA, collected and analyzed 44 indoor dust samples, 80 surface soil samples (0–2 inches or 0–6 inches) from 22 properties, and 45 blood samples. The results of this exposure investigation did not indicate the presence of unusual levels of lead in residential indoor dust samples, the soil at those homes, or in the blood of occupants of those homes [ATSDR 2006d].

c) Sand Creek

Sand Creek is primarily an ephemeral creek that passes through the Cotter Mill and runs north-northeast through Lincoln Park. It becomes perennial for the last 0.25–0.5 mile before its confluence with the Arkansas River. Prior to the construction of the SCS Dam north of the Cotter Mill in 1971, surface water and sediment from the facility flowed down the Sand Creek drainage into Lincoln Park [CDPHE 2005; GeoTrans 1986]. Mill tailings in the Old Tailings Pond Area are the source of the mill-derived contaminants (primarily radium-226 and thorium-230) in Sand Creek [Cotter 2000].

During the *1986 Remedial Investigation* [GeoTrans 1986], sediment samples were collected from the following locations in Sand Creek to evaluate present (i.e., 1985) and historical loadings from the Cotter Mill.

- SD01 – mouth near the Arkansas River
- SD02 – near spring where flow begins (reflects migration of contaminants in the groundwater)
- SD04 – below the SCS Dam in
  (1) an abandoned stock watering pond (formed by diversion of runoff water into a depression adjacent to Sand Creek)
  (2) in drainage (reflects historical picture of uncontrolled emissions)
  (3) in drainage above #2 (reflects historical picture of uncontrolled emissions)

- SD05 – above the SCS Dam adjacent to the west property edge

The results of this sampling are presented in Table 38 and Table 39. Only the concentrations for arsenic and radium-226 exceeded ATSDR's comparison values.

As part of the 1988 RAP, Cotter was required to evaluate the mill's potential impacts to Sand Creek and remove sediments that exceeded the radium-226 cleanup goal of 4.0 picocuries per gram (pCi/g), which allows unrestricted use of the creek [Cotter 2000]. A total of 721 samples were systematically collected along the 1.25 mile stretch from just north of the Cotter Mill to where Sand Creek becomes perennial (see Figure 22). Surveying and cleanup began in the spring of 1993 and continued until remediation was completed in December 1998. Approximately 9,000 cubic yards of soil were removed from Sand Creek and disposed of on Cotter property [Cotter 2000]. The excavated areas were backfilled with clean soil [CDPHE 2005]. Thirty confirmatory samples established that the average site-wide radium-226 concentration was 1.5 pCi/g (below the cleanup goal of 4.0 pCi/g) and the average site-wide thorium-230 concentration was 3.9 pCi/g after remediation [Cotter 2000]. In addition to the sampling and remediation for radium-226, seven of the confirmation samples were analyzed for 10 chemicals in 1998 [Cotter 2000]. These results are presented in Table 40. Only the maximum and average concentrations for arsenic exceeded ATSDR's comparison value.

At the time of mill closure, Cotter was required by the 1988 RAP to survey molybdenum and radium-226 in sediments in the perennial stream segments of Sand Creek and Willow (Plum) Creek to determine whether these areas have been impacted by the mill. If necessary, sediments above background will be removed and properly disposed of (CDPHE 2005).

d) The Fremont Ditch

The Fremont Ditch system is downstream of Sand Creek. It diverts water from near the confluence of Sand Creek and the Arkansas River downgradient toward Florence. The ditch receives substantial amounts of water from Sand Creek during low flows in the Arkansas River. During these periods, any contaminants moving down Sand Creek would likely be transported to Fremont Ditch [GeoTrans 1986].

As part of the 1988 RAP, Cotter was also required to conduct a gamma survey of the dry beds of the Fremont Ditch. Cotter sampled sediment in Fremont Ditch from its head gate near Sand Creek to about a quarter mile downstream. The average radium-226 level was 1.86 pCi/g, which was below the cleanup standard of 4 pCi/g. The state agreed with Cotter that the Fremont Ditch did not require remediation because the concentrations of gross alpha (3.8 pCi/g), uranium (6.6 ppm), and molybdenum (2.2 ppm) were also low [CDPHE 2005].

C. Surface water

1. Nature and extent of contamination

The Cotter Mill is a non-discharge facility, meaning that Cotter does not release wastewater to the surface water system. All remediation water is pumped to on-site impoundments for evaporation or recycling. However, prior to construction of the SCS Dam in 1971, storm events carried contaminated surface water and sediments from the facility down the Sand Creek drainage [CDPHE 2005]. One event in particular, a flood in June 1965, caused the unlined tailings ponds at the Cotter Mill to overflow into Lincoln Park. Sediment in the Lincoln Park portion of Sand Creek was contaminated with tailings that were carried in surface water runoff from the mill [EPA 2007].

The SCS Dam was built to prevent surface water and sediment from flowing into Lincoln Park during storm-generated floods. Since the construction of the dam, Lincoln Park no longer receives runoff from the Cotter Mill. Additionally, since 1979, impounded water collected at the dam has been pumped back to the lined impoundment on site [EPA 2002; GeoTrans 1986; HRAP 1991].

CDPHE maintains a database containing surface water monitoring data dating back to 1962. The most recent data entered into the database are from September 2007. To evaluate exposures to people living near the Cotter Mill, ATSDR extracted surface water data collected from Sand Creek, the DeWeese Dye Ditch, and the Arkansas River. After discussions with a CDPHE representative, the following assumptions were made while summarizing data within the database.

- Samples that were designated “N” in the detect flag column and had the same value in the result value column as the reporting detection limit column were included in the summary statistics as ½ the reporting detection limit.
- Negative result values for manganese and iron were assumed to be not detected and were included in the summary statistics as ½ the reporting detection limit.
- Negative values[10] for radionuclides were included in the summary statistics.

a) Sand Creek

From 1993 to 1998, Cotter conducted the Sand Creek Cleanup project to identify and remove mill tailings that had moved into the creek bed as the result of surface water runoff from the Cotter Mill prior to the construction of the SCS Dam. Sediments above the radium-226 cleanup goal of 4.0 pCi/g were removed, which allows unrestricted use of the creek [Cotter 2000; EPA 2002].

Two locations in Sand Creek—one at Ash Street (008) and one at the confluence with the Arkansas River (506)—are sampled as part of the surface water monitoring program (Cotter 2007). The CDPHE database contains surface water monitoring data from these two locations, which are summarized in Table 41 (chemicals) and Table 42 (radionuclides). The maximum concentrations for manganese, molybdenum, sulfate, and total dissolved solids exceeded the comparison values. However, for all four of these chemicals, only the maximum concentrations exceeded comparison values—the second highest detected concentrations were below comparison values. None of the average concentrations exceeded comparison values.

---

[10] Negative values for radionuclides occur when samples are not much different from background, since standard protocol is to subtract background radioactivity from the sample count.

As part of the *1991 Health Risk Assessment of the Cotter Uranium Mill Site* [HRAP 1991], the Health Risk Assessment Panel (HRAP) reviewed over 18,000 samples collected from 1976–1989, from 55 different surface water locations. More than 95% of the surface water data were collected from 10 main locations. The location in Sand Creek at Ash Street (008, formerly known as 555) was one of these locations. The average molybdenum (0.009 mg/L) and uranium (0.016 mg/L) concentrations from this location were well below the comparison values (molybdenum: 0.035 mg/L; uranium: 0.03 mg/L).[11]

b) DeWeese Dye Ditch

The DeWeese Dye Ditch is an irrigation ditch that flows between the Cotter Mill and Lincoln Park. The ditch diverts water from Grape Creek to irrigate about 1,200 acres during the summer growing period [GeoTrans 1986]. The ditch crosses Sand Creek downstream from the SCS Dam, but does not join it. Seepage from the ditch recharges groundwater within the Sand Creek drainage. This process dilutes and flushes the contaminated groundwater under Lincoln Park [EPA 2002].

The CDPHE database contains surface water monitoring data from two locations in the DeWeese Dye Ditch—one upstream of the confluence with Forked Gulch (520) and one at Cedar Avenue (526). The location at Cedar Avenue is sampled as part of the surface water monitoring program [Cotter 2007]. The data for both locations are summarized in Table 43 (chemicals) and Table 44 (radionuclides). The maximum concentrations exceeded the comparison values for iron, manganese, total dissolved solids, and dissolved uranium. However, for iron and manganese, only the maximum concentrations exceeded comparison values—the second highest detected concentrations were below comparison values. Only three of the total dissolved solids samples and three of the dissolved uranium samples were detected above comparison values. None of the average concentrations exceeded comparison values.

Molybdenum and uranium data from 1984 to 1989, from the same two locations in the DeWeese Dye Ditch (520 and 526), are summarized in the *1991 Health Risk Assessment of the Cotter Uranium Mill Site* (HRAP 1991). The average molybdenum and uranium concentrations were well below the comparison values (see Table 5 below).

Table 5. Average molybdenum and uranium concentrations in the DeWeese Dye Ditch

Chemical	Average concentration at Location 520 (mg/L)	Average concentration at Location 526 (mg/L)	Comparison Value (mg/L)
Molybdenum	0.003	0.003	0.035
Uranium	0.002	0.0019	0.03

Source: HRAP 1991

Molybdenum data that were several orders of magnitude greater than any other observed sample (i.e., outliers) were not used to calculate the average concentrations (HRAP 1991).

It was not possible to determine whether these data are included in the CDPHE database.

c) Arkansas River

---

[11] It was not possible to determine whether these data are included in the CDPHE database.

From April 1989 to June 1990, Cotter and their consultant, Western Environmental Analysts, conducted bi-weekly sampling in the Arkansas River at the following five locations:

The Arkansas River sampling plan was approved by the CDPHE Water Quality Control Division [CDPHE 2005].

1. Parkdale (background)
2. Grape Creek
3. 1st Street (upstream of where Sand Creek enters the Arkansas River)
4. Mackenzie Avenue Bridge (downstream from where Sand Creek enters the Arkansas River)
5. Where Highway 67 to Florence crosses the river

Water, sediment, autotrophs (algae), primary consumers/detrivores (tadpoles, macroinvertebrates), and carnivores (fish) were collected and tested for molybdenum, uranium, radium-226, and thorium-230. Extremely low concentrations were detected, which indicated no statistical evidence of an increase in contamination downstream on the Arkansas River [CDPHE 2005].

In addition, four synoptic sampling events (i.e., sampling of water in-flows) were conducted between Canyon Mouth and Highway 67. The purpose of the synoptic sampling was to determine whether tributary flows reflect unusual sources of uranium or molybdenum. The sampling showed that other sources such as Fourmile Creek, as well as Sand Creek and Plum Creek, contribute to increases in the Arkansas River [CDPHE 2005].

Two locations in the Arkansas River—one upstream of Sand Creek at 1st Street (907) and one downstream of Sand Creek at Mackenzie Avenue (904)—are sampled as part of the surface water monitoring program [Cotter 2007]. The CDPHE database contains surface water monitoring data from these two locations, which are summarized in Table 45 (chemicals) and Table 46 (radionuclides). At both locations, the maximum concentrations exceeded the comparison value for sulfate. The maximum concentration for total dissolved solids exceeded the comparison value for the upstream location, but not the downstream location. In all three instances, these maximum concentrations appear to be outliers and are the only concentrations that exceeded comparison values—the second highest detected concentrations were below comparison values. The maximum concentration for molybdenum also exceeded the Colorado state groundwater standard for the upstream location, but not the downstream location. None of the average concentrations exceeded comparison values.

Data from 1984 to 1989, from two locations in the Arkansas River—one upstream of Sand Creek near Grape Creek (502) and one downstream of Sand Creek near Fourmile Bridge (504)—are summarized in the *1991 Health Risk Assessment of the Cotter Uranium Mill Site* [HRAP 1991]. The average molybdenum and uranium concentrations were well below the comparison values (see Table 6 below).

Table 6. Average molybdenum and uranium concentrations in the Arkansas River

Chemical	Average concentration upstream of Sand Creek near Grape Creek (502) (mg/L)	Average concentration downstream of Sand Creek near Fourmile Bridge (504) (mg/L)	Comparison Value (mg/L)
Molybdenum	0.00391	0.0056	0.035
Uranium	0.00532	0.00574	0.03

Source: HRAP 1991

Molybdenum data that were several orders of magnitude greater than any other observed sample (i.e., outliers) were not used to calculate the average concentrations (HRAP 1991).

d) Willow Lakes

The Willow Lakes are comprised of several small ponds near the Arkansas River in the Willow Creek watershed, which lies directly to the east of the Sand Creek watershed. The Willow Lakes receive water from shallow groundwater and surface runoff [HRAP 1991].

Cotter was required by the 1988 RAP to evaluate whether the Willow Lakes had been contaminated by the mill. Water, sediment, autotrophs (algae), primary consumers/detrivores (tadpoles, macroinvertebrates), and carnivores (fish) from the Willow Lakes and three comparison lakes were collected and tested for molybdenum, uranium, and radium. The information showed that the Willow Lakes had not been contaminated by the Cotter Mill [CDPHE 2005].

D. Locally grown produce

1. Nature and extent of contamination

As part of the *1996 Supplemental Human Health Risk Assessment* (Weston 1996), Weston compiled available food data from several past studies. Samples included chicken meat, fruit (apples, cherries, grapes), and vegetables (asparagus, carrots, lettuce, tomatoes, turnips). The local samples were compared to food collected from supermarkets. The data are presented in Table 47 and Table 48 in Appendix A. The limited sample data suggest that the chemicals and radionuclides found in the foods are probably natural in origin, however, it was not possible to exclude the possibility that some food types may be influenced by mill-related contaminants [Weston 1996].

To further evaluate exposures to residents who eat locally grown fruits and vegetables, a sampling program was initiated in Lincoln Park during the *1998 Supplemental Human Health Risk Assessment* [Weston 1998]. People were asked to donate locally grown produce samples for analysis. The fruits and vegetables sampled are presented in the table below. The samples were tested for heavy metals and radionuclides. The analytical results of the sampling program are summarized in Table 49 and Table 50 in Appendix A.

Fruits Sampled

Apples
Cantaloupe
Grapes
Honey dew melon
Plums
Watermelon

Vegetables Sampled

Acorn squash
Beets
Carrots
Celery
Corn
Cucumbers
Green Beans
Green Onions
Kohlrabi
Patty pan squash
Peppers
Pumpkin
Rhubarb
Squash
Tomatoes
Turnip Greens
Turnips
Winter squash

The samples were divided into two categories—(1) produce that was grown in soil known to have been irrigated with contaminated well water (fruits n = 16; vegetables n = 43) and (2) produce that was grown in soil not believed to have been irrigated with contaminated well water (fruits n = 1; vegetables n = 6). A statistical comparison of the data for the two categories of vegetables indicated that irrigation with contaminated well water did not cause a significant increase in contaminant levels (Weston 1998). The following trends were also noted:

- The concentrations of most metals were higher in root vegetables than other types of vegetables and fruit.
- Concentrations were much lower in peeled turnips than in whole turnips, suggesting that most of the contamination was on or in the surface layer.
- There was high variability both within and between the different types of produce.
- Concentration values were below the limit of detection for many of the samples.

E. Ambient Air

ATSDR reviewed ambient air monitoring data and air sampling data collected from the following two sources:

- Cotter Mill has operated an ambient air monitoring program to characterize air quality impacts of radioactive particulates and radon for more than 20 years. ATSDR accessed summaries of the monitoring data from Cotter Mill's annual Environmental and Occupational Performance Reports, which are posted to the CDPHE's web site; and
- The state of Colorado operated three particulate monitoring stations in Fremont County, one each in Lincoln Park, Cañon City, and Florence. The station in Cañon City continues to operate today. ATSDR downloaded measured concentrations of particulate matter, and some chemical constituents of particulate matter, from EPA's Air Quality System (AQS) database—a publicly accessible online clearinghouse of ambient air monitoring data. Some of the measurements collected by these monitors date back 40 years.

Historically, Cotter Mill had two general types of air emission sources: ground-level fugitive emissions (e.g., wind-blown dust) that would be expected to have greatest air quality impacts nearest the source; and elevated point sources (e.g., stacks) that have the potential for having peak ground-level impacts at downwind locations. With the facility currently in "stand down" status, facility emissions are now predominantly fugitive and their air quality impacts should be adequately characterized by the perimeter monitoring stations.

1. Nature and extent of air contamination

ATSDR compiled and evaluated ambient air monitoring data to assess potential air quality impacts from Cotter Mill's past and ongoing operations. As will be discussed later, ambient air concentrations of some substances changed considerably from one year to the next—in some cases, annual average concentrations vary by more than a factor of 250 over the period of record. These substantial changes in measured air contamination levels can sometimes be traced back to site-specific activities.

To provide background information and context for the air quality trends documented later in this report, the following list identifies key milestones over the history of Cotter Mill's operations. The timeline is not intended to be a comprehensive listing of site-specific events, but rather focuses on events and activities expected to be *associated with notable changes in the facility's air emissions*.

- 1958: Cotter Corporation begins its uranium milling operations at the Cotter Mill site
- 1979: Continuous operations cease, but intermittent operations continue
- 1981-1983: Cotter excavates 2,500,000 cubic yards of contaminated tailings from unlined holding ponds and places the material in a newly constructed, lined surface impoundment
- 1987: Cotter suspends its primary milling operations and only limited and intermittent ore processing occurs for the next 12 years
- 1993-1999: Cotter excavates 9,000 cubic yards of contaminated tailings, soil, and sediment from 1.25 miles of Sand Creek near the facility
- 1999: Cotter excavates 100,000 cubic yards of contaminated soil in "near surface soils" from the on-site Old Pond Area and places this material into the lined, surface impoundment
- 1999: Milling operations using a different production process begin
- 2005: Cotter ceases its routine operations and enters "stand down" status; site remediation activities continue; stack emissions from most sources continue into 2006, after which the main operational stack is for the laboratory baghouse
- 2009: Cotter submits letter to CDPHE announcing its intent to refurbish the mill, rather than decommission it

The following sections summarize the data and air quality trends for particulate matter, selected particle-bound radionuclides, radon gas and gamma radiation.

a) Ambient Air Monitoring for Radioactive Substances

The Cotter Mill monitoring network is operated by Cotter Mill in accordance with guidelines and requirements set forth by the U.S. Nuclear Regulatory Commission (USNRC 1980) and the Radioactive Materials License established between Cotter Mill and the state of Colorado [CDPHE 2009]. The purpose of the network is to characterize the extent to which Cotter Mill's operations affect off-site air quality.

Cotter Mill's ambient air monitoring network has been operating from 1979 to the present, but the number of monitoring stations included in the network has changed over time. In 1979, four stations were fully operational; this increased to seven by 1981 and to ten by 1999. These ten monitoring stations continue to operate today. Each station is equipped with the same monitoring equipment: an environmental air sampler used to collect particulates for analysis of particle-bound radionuclides; a radon track etch measurement device; and an environmental thermoluminescent dosimeter (TLD) for measuring gamma exposure. The height of the sampling inlet probes was not specified in the reports that ATSDR reviewed to prepare this health assessment. Table 51 in Appendix A identifies the monitoring stations and their periods of operation. Figure 23 in Appendix B shows the approximate locations of the monitoring stations. For purposes of this evaluation, ATSDR has classified the ten monitoring stations as being either "perimeter" or "off-site." The five "perimeter" monitoring stations are located along or just within Cotter Mill's property line; and the five "off-site" monitoring stations are located off-site, anywhere from 0.5 mile to 4 miles from the Cotter Mill property line.

(1) Particulate Matter

At each of the 10 monitoring stations described above, Cotter Mill operates a high-volume total suspended particulate (TSP) sampling device. For each sampling period, the devices are loaded with glass fiber filters that collect airborne particulates as ambient air passes through the sampling apparatus. The TSP sampling devices collect 1-week integrated samples; when the sampling period ends, field personnel remove filters, record observations on chain-of-custody forms, and store filters for subsequent laboratory analysis.

Cotter prepares annual summary reports for its environmental monitoring network, and those reports document monthly average TSP concentrations measured at each station. ATSDR had access to the summary reports for 2006, 2007, and 2008. TSP data from earlier years can be accessed through data reports that CDPHE has on compact disk. Over the last three years, annual average TSP concentrations were consistently higher in the more populated areas (Lincoln Park and Cañon City) than at the perimeter monitoring stations. In 2008, for instance, the annual average TSP levels at Lincoln Park and Cañon City were 29.9 $\mu g/m^3$ and 26.5 $\mu g/m^3$, respectively; in contrast, annual average concentrations at the five perimeter monitoring stations ranged from 15.5 $\mu g/m^3$ to 21.4 $\mu g/m^3$.

Although quantitative quality control information was not available when summarizing Cotter's TSP data, these measurements can be compared to CDPHE's PM_{10} monitoring results in Cañon City during the same time frame. From 2006 to 2008, the annual average TSP levels measured by Cotter Mill in Cañon City were 26.6 $\mu g/m^3$, 26.3 $\mu g/m^3$, and 26.5 $\mu g/m^3$, respectively; the annual average PM_{10} levels measured by CDPHE in Cañon City during these same years were

16.5 µg/m^3, 16.4 µg/m^3, and 15.0 µg/m^3. The difference between the TSP and PM$_{10}$ annual average concentrations in Cañon City are within the expected range and direction (i.e., TSP levels exceeding PM$_{10}$ levels), which gives some assurance in the quality of the underlying data sets.

(2) Particle-Bound Radionuclides

Weekly particulate filters collected at the 10 stations mentioned in the previous section are not only weighed for mass loading but are also analyzed at Cotter Mill's analytical laboratory for concentrations of five radionuclides, identified below. All laboratory analyses are conducted according to methodologies approved by CDPHE.

Field sampling and laboratory analyses for particle-bound radionuclides are conducted according to specifications outlined in Cotter Mill's Quality Assurance Program Plan (QAPP). This document is revised periodically and submitted to CDPHE for review. The QAPP outlines many quality control and quality assurance procedures implemented to ensure that the network's measurements are of a known and high quality. Examples of specific procedures followed include: routine collection and analysis of blank samples to ensure sampling media and laboratory equipment are not contaminated; quarterly calibration of flow rates for the "high volume" samplers; audit of sampler flow rates using special equipment; collection of duplicate samples that are analyzed in replicate to quantify measurement precision; and participation in a "laboratory exchange program" through which a subset of environmental samples (mostly water samples, by all appearances) are split and sent to Cotter Mill's laboratory and two commercial laboratories for analyses. While these and other quality control procedures give some assurance that samples are collected and analyzed with fine attention to data quality, the reports available to ATSDR during this review generally did not present the actual data quality metrics (e.g., the relative percent difference in duplicate samples or for inter-laboratory audits, contamination levels found in blanks) for the particle-bound radionuclides.

The key findings from the monitoring program for the five radionuclides measured are below. For each substance, a section compares the measured concentrations to regulatory limits or health-based comparison values, comments on temporal and spatial variations, and then presents a brief summary.

- **Natural uranium (^{nat}U).** Table 52 in Appendix A presents the history of annual average ^{nat}U concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.
    - *Screening.* Cotter Mill compares measured concentrations of ^{nat}U to an "effluent concentration" (9.0 x 10^{-14} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 52 exceed this derived concentration guide. The highest annual average concentration over the period of record (2.5 x 10^{-14} µCi/ml at a perimeter monitoring station in 1982) is 3.6 times below this screening value. The highest annual average in 2008 (4.4 x 10^{-16} µCi/ml at a

  perimeter monitoring station) was approximately 200 times below the screening value, and larger margins are observed for the off-site monitoring stations.

  - *Spatial and temporal variations.* Generally, the highest annual average concentrations of ^{nat}U were observed at perimeter monitoring stations, with lower levels observed at the off-site stations. During most years, the annual average values did not vary considerably (by more than an order of magnitude) across all of the stations. As an exception, the 1982 annual average ^{nat}U concentration observed at the west boundary monitoring station was roughly 50 times greater than the annual averages observed at the other monitoring stations during the same year; this “spike” at one station during one year was most likely caused by air emissions associated with an on-site tailings excavation project. As another exception, in several years between 1998 and 2006, annual average ^{nat}U concentrations at the mill entrance road monitoring station were more than an order of magnitude higher than those recorded at all other stations, which most likely reflects contributions from clean-up of the site entry road and delivery of ores (which mostly ended in 2006). As noted above, the highest annual average concentration of ^{nat}U was observed in 1982, and more recent (2004-2008) annual average levels are considerably lower.

  - *Summary.* Every annual average concentration of ^{nat}U recorded to date has been lower than Cotter Mill’s health-based regulatory limit. In the last five years, the annual average concentrations at every station have been at least 20 times below this limit. It seems unlikely that air emissions from the mill would lead to an off-site “hot spot” of ^{nat}U concentrations that could be considerably higher than the levels measured by the monitoring network.

- **Thorium-230 (^{230}Th).** Table 53 in Appendix A presents the history of annual average ^{230}Th concentrations measured in Cotter Mill’s monitoring network. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{230}Th to an “effluent concentration” (2.0×10^{-14} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. The annual average concentration at the west boundary monitoring station exceeded this value in 1981 and 1982, as did the annual average concentration in 1981 at the east boundary monitoring station. The highest annual average concentration recorded by this network (9.0×10^{-14} µCi/ml at the west boundary in 1982) was 4.5 times higher than the derived concentration guide. Concentrations decreased over the years, and the highest annual average in 2008 (7.2×10^{-16} µCi/ml at a perimeter monitoring station) was a factor of 28 times lower than the screening value, and larger margins are observed for the off-site monitoring stations.

  - *Spatial and temporal variations.* Without exception, the highest annual average concentrations of ^{230}Th were observed at perimeter monitoring stations, with considerably lower levels observed at the off-site stations—a spatial trend suggesting that Cotter Mill's emissions very likely account for a considerable portion of the measured levels. As with natural uranium, the ^{230}Th concentrations exhibited a notable "spike" in 1981-1982, when 2.5 million cubic yards of on-site tailings were excavated from the unlined ponds. As an illustration of this effect, the highest annual average concentration in 1981 (3.0×10^{-14} µCi/ml at a perimeter monitoring station) was nearly 370 times higher than the annual average concentration measured in Cañon City. Moreover, the highest concentrations were observed at the monitoring station closest to, and downwind from, the excavation activity. Average concentrations of ^{230}Th decreased markedly after the 1981-1982 peak: the most recent (2004-2008) annual average concentrations at perimeter stations are all at least 20 times lower than the highest levels from 1981-1982.

  - *Summary.* In 1981 and 1982, annual average concentrations of ^{230}Th at two perimeter monitoring stations exceeded Cotter Mill's health-based regulatory limit; however, for every other calendar year, every station's annual average concentration was lower than this limit. In the last five years, the annual average concentrations at every station were between six and 30 times below this limit. For the off-site monitoring stations, however, all annual average concentrations during this 5-year time frame were at least a factor of 40 below Cotter Mill's health-based regulatory limit.

- **Thorium-232 (^{232}Th).** Table 54 in Appendix A presents the history of annual average ^{232}Th concentrations measured in Cotter Mill's monitoring network. Laboratory analyses for this radionuclide first began in 2001. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{232}Th to an "effluent concentration" (4.0×10^{-15} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 54 exceed this derived concentration guide. In 2008, the highest annual average concentration (3.1×10^{-17} µCi/ml in Lincoln Park) was a factor of 128 lower than the screening value.

  - *Spatial and temporal variations.* Unlike ^{nat}U and ^{230}Th, for which measured concentrations were consistently (if not always) highest at perimeter monitoring stations, the highest annual average concentrations of ^{232}Th have always been observed at off-site monitoring stations, most commonly at the Lincoln Park monitoring station. Moreover, of all the radionuclides measured, annual average concentrations of ^{232}Th exhibited the least variability from station to station. For any given year between 2001 and 2008, annual average concentrations at the ten monitoring stations fell within a factor of three of each other. The annual average concentrations did not exhibit considerable variability from one year to the next.

  - *Summary.* Over the last five years, annual average concentrations of ^{232}Th at every monitoring station were more than 60 times lower than Cotter Mill's health-based regulatory limit. The spatial variations in ^{232}Th concentrations have been limited, suggesting that air emissions from Cotter Mill may be relatively insignificant for this radionuclide.

- **Radium-226 (^{226}Ra).** Table 55 in Appendix A presents the history of annual average ^{226}Ra concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{226}Ra to an "effluent concentration" (9.0 x 10^{-13} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 55 exceed this derived concentration guide. In 2008, the highest annual average concentration (7.9 x 10^{-16} µCi/ml at a perimeter monitoring station) was three orders of magnitude lower than the screening value.

  - *Spatial and temporal variations.* In almost every year between 1979 and 2008, the highest annual average concentrations of ^{226}Ra were measured at perimeter monitoring stations, and primarily at the west boundary and mill entrance road locations. For most years, the highest annual average value at the facility's perimeter was usually between one and two orders of magnitude greater than the lowest annual average concentration at off-site locations—a pattern that points to facility emissions as a likely source for contributing to at least part of the measured concentrations. At the four perimeter stations with the longest period of record, the highest annual average concentrations occurred prior to 1985, and the current (2008) levels at these stations are between 10 and 100 times lower than those peaks.

  - *Summary.* The spatial variations in ^{226}Ra concentrations suggest that Cotter Mill's emissions contribute to the measured levels. However, over the last five years, annual average concentrations of ^{226}Ra at every monitoring station were more than 390 times lower than Cotter Mill's health-based regulatory limit.

- **Lead-210 (^{210}Pb).** Table 56 in Appendix A presents the history of annual average ^{210}Pb concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{210}Pb to an "effluent concentration" (6.0 x 10^{-13} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 56 exceed this derived concentration guide. In 2008, the highest annual average concentration (1.9 x 10^{-14} µCi/ml at a perimeter monitoring station) was more than a factor of 30 lower than the screening value.

- *Spatial and temporal variations.* The main distinguishing feature of the ^{210}Pb monitoring data (when compared to data for the other radionuclides) is the low variability, both spatially and temporally. Since 1983, annual average concentrations across the ten monitoring stations tended to fall within a factor of two; and year-to-year variability was of a comparable magnitude. This lack of variability points to a "background effect" (i.e., the measured concentrations likely are not the result of Cotter Mill's emissions, but reflect typical atmospheric levels for this part of the country). In 1981-1982, annual average concentrations at a perimeter monitoring station were slightly higher than what was routinely measured at all other locations and years; and these slightly elevated levels likely reflected air quality impacts from the excavation of the unlined holding ponds.

- *Summary.* Of all the radionuclides considered, ^{210}Pb showed the least variability in annual average concentrations, suggesting that the monitoring data characterize background levels and not a site-specific contribution. From 1983 to the present, annual average concentrations during every year and at every station were generally at least 20 times below Cotter Mill's health-based regulatory limit.

With one exception, the five radioactive substances measured by Cotter Mill's network were below their corresponding health-based regulatory limits at all 10 monitoring stations and for the entire 30 years of record. As the exception, annual average ^{230}Th concentrations exceeded health-based regulatory limits during a tailing pond excavation project, but this was limited to a short time frame (1981-1982) and the immediate proximity of the facility (two fenceline monitoring locations). The spike in measured concentrations during this time frame was far less pronounced (if not completely imperceptible) at monitoring stations in Lincoln Park or Cañon City. Another spatial variation linked to site activities is the relatively elevated readings (e.g., for ^{nat}U) observed at the "mill entrance road" monitoring station between roughly 1997 and 2006.

Over the last five years, annual average concentrations of every radionuclide were at least 20 times lower than health-based screening limits at the five off-site monitoring stations. This large margin provides some assurance that the monitoring network has adequate coverage in terms of monitors—it is quite possible that annual average ambient air concentrations of radionuclides at some un-monitored off-site locations exceed what has been measured to date, but it is far less likely that the network is failing to capture a "hot spot" with concentrations more than 20 times higher than the levels that are currently measured.

b) *Radon Gas*

Cotter measures radon gas concentrations at the same ten monitoring stations where particle-bound radionuclides are sampled. The annual environmental monitoring reports provide very limited information on the sampling methodology, other than noting that the detectors are apparently exposed to ambient air for a calendar quarter and then retrieved for laboratory analysis. Recent data summary reports suggest that a new sampling and analytical method was implemented in the second quarter of 2002. This new method outputs combined ^{220}Rn (from natural thorium) and ^{222}Rn (from natural uranium). However, the report does not describe what the previous sampling and analytical method measured.

According to Cotter's radon sampling procedures (Cotter 2004b), the sampling devices are "Landauer Type DRNF Radon Detectors." The reports provided to ATSDR suggest that various quality control measures have been implemented for this sampling (e.g., collection and analysis of duplicate samples to characterize precision), but they do not document quantitative data quality metrics. The method detection limit for the combined ^{220}Rn/^{222}Rn measurement is 70 pCi/m^3 (Cotter 2004b). This appears to offer adequate measurement sensitivity, because most quarterly average concentrations measured since this method was implemented are at least an order of magnitude greater than the detection limit.

Table 57 presents the annual average ^{220}Rn/^{222}Rn concentrations that Cotter has measured from 2002 to the present. Data are not presented for earlier years (1979 to 2001), as they may not be directly comparable due to the use of different measurement technologies. Cotter has recently concluded that its radon monitoring data "demonstrate slightly elevated readings at boundary locations [when compared to] readings in residential areas at background levels" (Cotter 2008b). This statement seems to be supported, in a general sense, by the monitoring results, though the difference between the perimeter and the off-site concentrations is much lower in certain years, particularly in 2008.

The approach used for screening the ^{220}Rn/^{222}Rn concentrations differs from that used for other radionuclides. Cotter screens the ^{220}Rn/^{222}Rn using an approach approved by CDPHE. In this approach, Cotter derives an "effective effluent limit" based on a baseline regulatory limit, an equilibration factor for the measurements, and average background concentrations that are calculated semi-annually. The details of this derivation are documented in a letter that CDPHE sent to Cotter in June, 2004. The net effect of this calculation approach is that the "effective effluent limit" (i.e., the concentration used for screening purposes) can vary across the monitoring stations and years. To illustrate this point, between 2006 and 2008, the "effective effluent limit" of ^{220}Rn/^{222}Rn concentrations ranged from 1,290 to 1,981 pCi/m^3, depending on the magnitude of the background concentrations at the time. During this time frame, measured concentrations at perimeter monitoring stations reached as high as 85% of the "effective effluent limit."

c) *Gamma Radiation*

Cotter measures gamma radiation levels at the same ten monitoring stations where particle-bound radionuclides are sampled. Measurements are made using thermoluminescent dosimeters (TLDs) that are exposed for 3-month periods before being sent off-site for analysis. Every calendar quarter, an additional duplicate TLD is deployed to at least one monitoring station to assess measurement precision, and a control TLD is placed in a lead-shielded box at another location to serve as a "blank" sample. However, the site reports provided to ATSDR did not contain any quantitative metrics of data quality (e.g., relative percent difference in co-located samples).

Table 58 presents annual average gamma radiation exposure rates between 1979 and 2008, by monitoring station; these annual averages were calculated from the quarterly TLD measurements from each calendar year. For every year on record, the highest annual average exposure rate was observed at one of the perimeter monitoring stations. Since Cotter installed the monitoring station at the mill's entrance road in 1994, this station has recorded the highest annual average exposure rates every year through the present. The relatively high readings at this location are believed to result primarily from past spillage or incoming materials entering the facility (Cotter 2008b). Under oversight from CDPHE, Cotter removed contamination alongside the entrance road in 2006 and 2007, with exposure rates decreasing thereafter.

Cotter's monitoring reports do not include health-based screening evaluations for these measurements, but they do acknowledge that the exposure rates near the facility perimeter (and particularly along the entrance road) exceed background levels. Specifically, the reports assume that the Cañon City station's measurements reflect "background" contributions from all external sources. The report indicates that the reported background level at this station (10.2 µR/hr) is equivalent to a dose of 89 mrem/year.

d) Ambient Air Monitoring for non-Radioactive Substances

To prepare this summary, ATSDR accessed all ambient air monitoring data that the state of Colorado collected in Fremont County and reported to EPA's Air Quality System (AQS), an online clearinghouse of monitoring data that states collect to assess compliance with federal air quality standards. The AQS database included monitoring results for three locations in Fremont County: one in Cañon City, one in Lincoln Park, and one in Florence. This section summarizes only those data collected in Cañon City and in Lincoln Park given their closer proximity to Cotter Mill. However, the monitoring summarized in this section was not conducted to characterize air quality impacts associated with Cotter Mill's emissions; the measured concentrations at these locations likely reflect contributions from many different local emission sources (e.g., mobile sources, wind-blown dust, wood-burning stoves). The AQS database does not specify quality control parameters for the monitoring results; however, state agencies that submit data to AQS are supposed to thoroughly validate measured concentrations before entering them into the database.

(1) Particulate Matter (TSP, PM_{10}, and $PM_{2.5}$)

The state-operated Cañon City and Lincoln Park monitoring stations measured three different size fractions of particulate matter between 1969 and the present. Following standard practice, all three size fractions were measured in 24-hour average integrated samples that were typically collected once every 6 days, though more frequent monitoring occurred during some years. Measurements were collected using either standard technologies (e.g., high-volume samplers for TSP and PM_{10}) or EPA-approved Federal Reference Method devices. A brief summary of the measurements follows:

- **TSP measurements.** From 1969 through 1987, high-volume sampling devices were used to measure TSP. Table 59 in Appendix A presents the maximum and annual average TSP concentrations measured by the two monitoring stations over the period of record. Annual average TSP in Cañon City did not change considerably from 1969-1987. In Lincoln Park, only two calendar years have complete data sets; the annual average concentration in 1982 was below the range of annual averages observed at Cañon City.

The fact that TSP levels were lower in Lincoln Park than in Cañon City suggests that Cotter Mill's emissions are not the primary contribution to TSP levels in the area.

- **PM_{10} measurements.** The state of Colorado began monitoring PM_{10} in Cañon City in 1987 and continues this monitoring today. The monitoring station was originally located at the courthouse in Cañon City, but the state moved the monitoring equipment in 1987 to a less obstructed site at city hall. Annual average PM_{10} concentrations throughout the period of record range from 15 to 23 $\mu g/m^3$, well below EPA's former National Ambient Air Quality Standard for annual average levels (50 $\mu g/m^3$). Between 1987 and 2009, only one measured 24-hour average concentration exceeded EPA's current health-based standard; that occurred in 1988 and likely reflected contributions from many different local sources and should not be attributed solely to Cotter Mill's emissions.

- **$PM_{2.5}$ measurements.** In 1991 and 1992, the state conducted $PM_{2.5}$ monitoring at its Cañon City station. All measured 24-hour average concentrations and both annual average concentrations were lower than the health-based standards that EPA would develop later in the 1990s. This monitoring occurred before EPA designated Federal Reference Methods for $PM_{2.5}$ measurement devices.

(2) Constituents of Particulate Matter

Between 1978 and 1987, the state of Colorado analyzed some of the TSP filters collected in Cañon City and Lincoln Park for chemical constituents. This included analyses for metals (iron, lead, manganese, and zinc) and ions (nitrate and sulfate). Table 60 summarizes these measurements by presenting the highest 24-hour average concentration and the highest annual average concentration for the period of record.

V. PUBLIC HEALTH EVALUATION

A. Introduction

This section of the public health assessment evaluates the health effects that could possibly result from exposures to site-related contaminants at or near the Cotter Mill site. For a public health hazard to exist, people must contact contamination at levels high enough and for long enough time to affect their health. The environmental data and conditions at the site revealed five completed exposure pathways:

1. Exposure to site-related contaminants in groundwater in Lincoln Park.
2. Contact with site-related contaminants in soil adjacent to the Cotter Mill and in Lincoln Park.
3. Contact with site-related contaminants in surface water downstream from the Cotter Mill.
4. Exposure from eating produce locally grown in Lincoln Park
5. Exposure to ambient air near the Cotter Mill facility

B. How Health Effects are Evaluated

The potential health effects associated with completed exposure pathways (listed above) will be evaluated in this section. For chemicals found to exceed comparison values, ATSDR calculated exposure doses and estimated non-cancer and cancer risks, where applicable. The calculations estimate the amount of the chemical to which a person may have been exposed. Calculated exposure doses are then compared to the available health guidelines to determine whether the potential exists for adverse non-cancer health effects. In the event that calculated exposure doses exceed established health guidelines (e.g., ATSDR's Minimal Risk Levels or EPA's Reference Doses), an in-depth toxicological evaluation is necessary to determine the likelihood of harmful health effects. ATSDR also may compare the estimated amount of exposure directly to human and animal studies, which are reported in ATSDR's chemical-specific toxicological profiles. Not only do the toxicological profiles provide health information, they also provide information about environmental transport, human exposure, and regulatory status.

ATSDR's **Minimal Risk Level (MRL),** which is derived from human and animal studies, is an estimate of daily exposure to a contaminant below which non-cancer health effects are unlikely to occur.

EPA's **Reference Dose** An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's noncancer health assessments.

A detailed explanation of ATSDR's evaluation process for determining cancer and non-cancer health effects is contained in Appendix C of this document. The equations to calculate exposure doses, the exposure scenarios, and the exposure assumptions used to estimate exposures at this site are also in Appendix C.

C. Groundwater Pathway: Private wells used for personal consumption

As discussed above, the data from the 1989 *Lincoln Park Water Use Survey* survey indicated approximately 7 wells are used for personal consumption; sampling data for 6 of the 7 wells were available to ATSDR for evaluation. Samples were collected intermittently from 1984 to 2007.

Although most residents in Lincoln Park currently use municipal water for drinking purposes, the survey reveals that residents at 7 locations still use their private wells for drinking purposes. It is not verified whether residents who reported using their well water for personal consumption also use their well water for other household purposes, such as bathing and showering. Some residents report that they and others used their private wells for personal consumption and other household uses in the past (before the installation of the municipal water line). Therefore, it is reasonable to assume that many more people obtained their drinking water from private wells in the past, and that some people are continuing to use their private wells for drinking, and possibly, household purposes.

Very little quantitative information is known about what levels of contamination residents may have been exposed to in the past. However, ATSDR attempted to address this issue by assuming that the average resident would have been exposed to the average chemical concentration (i.e., temporal average per well) detected in the 6 private wells for which we have sampling data. There is some uncertainty in using this estimate because some people may have been exposed to more, and some to less, than the estimated amount. To capture the resident who may have been more highly exposed (or a worst case scenario), ATSDR used the average chemical concentration from the single private well that consistently contained the highest chemical concentrations (Well 189). ATSDR assumed that adults and children drank the water from this well for 350 days per year for 30 years (adults) and 6 years (children), respectively.

Molybdenum was the only chemical in private wells that had an average detected level (0.082 mg/L) that exceeded its comparison value (0.05 mg/L). The average level of molybdenum in Well 189 (0.16 mg/L) also exceeded the comparison value for molybdenum in drinking water. Therefore, molybdenum was retained as a chemical of concern and evaluated for possible adverse health effects. The maximum detected level of uranium (0.067 mg/L), but not the average detected level (0.028 mg/L), also exceeded the comparison value of 0.03 mg/L for uranium. Additionally, the average detected level of uranium in Well 189 (0.048 mg/L) exceeded the comparison value for uranium. Therefore, ATSDR evaluated uranium more closely for potential adverse health effects. Table 7 below summarizes the estimated child and adult doses for molybdenum and uranium that guide the health discussion below. (See Table C1 in Appendix C for a detailed discussion of how these values were derived.)

Table 7. Estimated Child and Adult Doses for Molybdenum and Uranium in Drinking Water

Chemical	Exposure Group	Adult Estimated Dose (mg/kg/day)	Child Estimated Dose (mg/kg/day)	Health Guideline (mg/kg/day)
Molybdenum	Well 189 (high exposures)	0.004	**0.010**	0.005 Chronic Oral RfD
	All wells (average exposures)	0.002	0.005	
Uranium	Well 189 (high exposures)	0.001	**0.003**	0.002 Intermediate Oral MRL
	All Wells (average exposures)	0.0008	0.002	

1. *Molybdenum*

Molybdenum is a naturally occurring element found in various ores. Molybdenum is also considered an essential dietary nutrient in humans and animals. Foods such as legumes, leafy vegetables, nuts and cereals tend to be higher in molybdenum than meats, fruits, and root and stem vegetables [WHO 2003]. The Food and Nutrition Board (FNB) of the Institute of Medicine has determined the Tolerable Upper Intake Level[12] (UL) for molybdenum in children and adults [FNB 2001] as follows:

- children 1 to 3 years of age - 0.3 mg/kg/day;
- children 4 to 8 years of age - 0.6 mg/kg/day;
- children 9 to 13 years of age - 1.1 mg/kg/day;
- adolescents 14 to 18 years of age - 1.7 mg/kg/day; and
- adults - 2.0 mg/kg/day.

a) *Health Evaluation of Molybdenum*

Drinking water from a private well contaminated with molybdenum would result in an estimated dose of 0.002 mg/kg/day for an average adult and 0.005 mg/kg/day for an average child. The adult dose is lower than the oral RfD of 0.005 mg/kg/day for molybdenum. The estimated child dose is equal to the oral RfD (0.005 mg/kg/day) for molybdenum. Therefore, adverse health

---

[12] UL = maximum level of daily nutrient intake that is likely to pose no risk of adverse health effects in all individuals. The UL represents the total intake from food, water, and supplements.

effects are not expected for the average adult or child who drank from a private well contaminated with molybdenum.

Adults who may have had high exposures, such as those similar to Well 189, have an estimated dose of 0.004 mg/kg/day, and children who may have had high exposures have an estimated dose of 0.010 mg/kg/day. The adult high dose is less than the oral RfD for molybdenum. However, the estimated child high exposure dose is 2 times greater than the oral RfD of 0.005 mg/kg/day for molybdenum. Because the estimated exposure dose for children exceeds the long-term health guidelines for molybdenum, the possibility of health consequences from this exposure was evaluated further.

To further evaluate the possibility of adverse health effects, ATSDR divides the lowest observed adverse effect level (LOAEL) and/or the no observed adverse effect level (NOAEL) by the site-specific exposure doses. Interpretation of the resulting value is subjective and depends on a host of toxicological factors. Further evaluation consists of a careful comparison of site-specific exposure doses and circumstances with the epidemiologic and experimental data on the chemical. The purpose of the comparison is to evaluate how close the estimated exposure doses are to doses that cause health effects in humans or animals.

The oral RfD for molybdenum is based on a human epidemiological study that found a LOAEL of 0.14 mg/kg/day for increased serum uric acid levels and prevalence of gout-like condition in Armenian villagers [Koval'skiy 1961]. A higher incidence (18-31%) of a gout-like disease was associated with high intake of molybdenum (10-15 mg/day) from soil and plants. The gout-like condition was characterized by pain, swelling, inflammation and deformities of the joints, and, in all cases, an increase in the uric acid content of the blood. In a number of cases, illnesses of the GI tract, liver, and kidneys accompanied the condition [EPA IRIS]. In deriving the oral RfD, an uncertainty factor of 3 was used for protection of sensitive human populations and a factor of 10 was used for the use of a LOAEL instead of a NOAEL for a long-term study in a human population. The estimated child high dose (0.010 mg/kg/day) for molybdenum at the Cotter Mill/Lincoln Park site is 14 times lower than the LOAEL from this study. There was no NOAEL determination for molybdenum from this study.

Molybdenum is known to interfere with copper metabolism in ruminant animals (grazing animals that "chew their cud," such as sheep or cows); the resulting copper deficiency is reported to cause the animal's hair/wool to turn white [FNB 2001]. This is a problem with ruminant animals in particular because high dietary molybdenum reacts with moderate to high dietary sulfur in the rumen (the first stomach) to form thiomolybdates. These compounds greatly reduce copper absorption, and certain thiomolybdate species can be absorbed and interfere systemically with copper metabolism [Spear 2003]. This interaction between thiomolybdates and copper is not expected to occur to a significant degree in humans [Turnlund 2002]. Although the exact effect of molybdenum intake on copper status in humans remains to be clearly established, individuals who do not take in enough dietary copper or cannot process it correctly could be at increased risk of molybdenum toxicity [FNB 2001].

In conclusion, children who drink water containing high concentrations of molybdenum could be at increased risk of adverse health effects such as gout-like symptoms. However, molybdenum is not stored at high levels in the body, so it is unlikely that children will suffer long-term health effects once the exposure is stopped [FNB 2001]. In healthy people, excess molybdenum is not associated with adverse health outcomes. However, individuals who do not take in enough dietary copper or cannot process it correctly could be at increased risk for adverse health effects. The actual risk of adverse health effects occurring depends on the concentration of molybdenum in the water and how much water is drunk. Therefore, private wells known to be contaminated with molybdenum should not be used for drinking purposes.

b) Additional Comments about Molybdenum in Drinking Water

- ATSDR did not evaluate potential exposures to molybdenum that could occur if well water is used for other household purposes such as showering or bathing. If it is confirmed that residents are using their wells for other potable purposes, then exposure levels would increase, as well as the likelihood of adverse health effects. However, exposure to airborne and/or dermal molybdenum is not likely to be a major exposure pathway because of the physicochemical properties of molybdenum.

- The estimated dose for children and adults at this site did not exceed the Tolerable Upper Intake Level (UL) for molybdenum established by the Institute of Medicine. However, ATSDR's evaluation did not consider molybdenum intake from other sources, including food and supplements, which would increase total intake.

- Molybdenum is often found naturally in the geology of this region. The wells identified and sampled as background for the Lincoln Park area contained an average molybdenum concentration of 0.023 mg/L. This concentration is lower than the average of 0.082 mg/L found in private wells used for personal consumption. The maximum concentration of molybdenum in a background well (0.3 mg/L) was about the same as that in a private well (0.28 mg/L) used for personal consumption.

- Overall molybdenum levels in groundwater decreased over time. Molybdenum levels measured from 1968 to 2000 show a clear pattern of decrease in molybdenum concentrations. Therefore, exposures to molybdenum in groundwater were likely higher in the past, and may continue to decrease in the future.

People who currently own private wells are not prevented from using their private wells for any purpose. New residents who move to the area may install new wells in the contaminated zone and use their well for any purpose. Therefore, this exposure pathway will continue to exist as a potential exposure pathway in the future.

2. Uranium

Throughout the world uranium is a natural and common radioactive element. Uranium is a silver-white, extremely dense, and weakly radioactive metal. It is typically extracted from ores containing less than 1% natural uranium. Natural uranium is a mixture of three isotopes: 238U (99.2739%), 235U (0.7204%), and 234U (0.0057%). It usually occurs as an inorganic compound with oxygen, chlorine, or other elements [NHANES 2005]. Rocks, soil, surface and ground water, air, plants, and animals all contain varying amounts of uranium. Colorado ranks third, behind Wyoming and New Mexico, tied with Arizona and Utah, as the state with the most uranium reserves in the United States [EIA 2001].

a) Health Evaluation of Uranium

Natural uranium is radioactive but poses little radioactive danger—it releases only small amounts of radiation that cannot travel far from its source. Moreover, unlike other types of radiation, alpha radiation released by natural uranium cannot pass through solid objects, such as paper or human skin. You have to eat, drink, or breathe natural uranium in order to be exposed to the alpha radiation; however, no adverse effects from natural uranium's radiation properties have been observed in humans. The National Academy of Sciences determined that bone sarcoma is the most likely cancer from oral exposure to uranium; its report noted, however, that this cancer has not been observed in exposed humans and concluded that exposure to natural uranium may have no measurable effect [BEIR IV].

Scientists have seen chemical effects in people who have ingested large amounts of uranium. Kidney disease has been reported in both humans and animals that were exposed to large amounts of uranium; however, the available data on soluble (more bioavailable) and insoluble uranium compounds are sufficient to conclude that uranium has a low order of metallotoxicity in humans [Eisenbud and Quigley 1955].

When uranium is ingested most of it leaves the body through the feces and a small portion (approximately 2% for an adult) will be absorbed into the blood stream through the gastrointestinal (GI) tract. Most of the uranium in the blood is excreted from the body through urine excretion within a few days; however, a small amount will be retained in the kidneys, bone, and soft tissue for as long as several years. The percentage of the uranium retained in the kidneys over time is different for acute and chronic ingestion of uranium (as long as the individual continues to drink the water). When an individual discontinues drinking the uranium contaminated water, the percentage of retention in the kidney decreases similar to an acute exposure. In the case of chronic ingestion of drinking water containing uranium, the kidney retention (or kidney burden) increases rapidly in the first two weeks. After approximately 100 days, the amount present in the kidney is approximately 5% of the daily intake for an infant and approximately 3% for all other ages. After 25 years of chronic ingestion, the uranium kidney burden reaches equilibrium for all age groups at approximately 6.6% of the daily intake [Chen et al 2004].

Nephrotoxicity (kidney toxicity) occurs when the body is exposed to a drug or toxin such as uranium that causes temporary or permanent damage to the kidneys. When kidney damage occurs, blood electrolytes (such as potassium and magnesium) and chemical wastes in the blood (such as creatinine) become elevated indicating either a temporary condition or the development of kidney failure. Creatinine is a chemical waste molecule that is generated from muscle metabolism. The kidneys maintain the blood creatinine in the normal range. Creatinine is a fairly reliable indicator of kidney function. As the kidneys are impaired, the creatinine level in the blood will rise because of the poor clearance by the kidney. If detected early, permanent kidney problems may be avoided.

Several mechanisms for uranium-induced kidney toxicity have been proposed. In one of these, uranium accumulates in specialized (epithelial) cells that enclose the renal tubule, where it reacts chemically with ion groups on the inner surface of the tubule. This interferes with ion and chemical transport across the tubular cells, causing cell damage or cell death. Cell division and regeneration occur in response to cell damage and death, resulting in enlargement and decreased kidney function. Heavy metal ions, such as uranyl ions, may also delay or block the cell division process, thereby magnifying the effects of cell damage [Leggett 1989, 1994; ATSDR 1999].

Animal and human studies conducted in 1940s and 1950s provide evidence that humans can tolerate certain levels of uranium, suffering only minor effects on the kidney [Leggett 1989]. Most of these studies involved inhalation exposures to uranium; however, the kidney is the target organ for inhaled as well as ingested uranium. On the basis of this tolerance, the International Council on Radiologic Protection (ICRP) adopted a maximal permissible concentration of 3 μg of uranium per gram of kidney tissue for occupational exposure in 1959 [Spoor and Hursh 1973]. This level has often been interpreted as a threshold for chemical toxicity.

More recent papers have been published on effects of uranium at levels below 3 μg/g, and those papers have discussed possible mechanisms of uranium toxicity [Diamond 1989; Leggett 1989, 1994; Zhao and Zhao 1990; Morris and Meinhold 1995]. It is thought that the kidney may develop an acquired tolerance to uranium after repeated doses; however, this tolerance involves detectable histological (structural) and biochemical changes in the kidney that may result in chronic damage. Cells of the inner surface of the tubule that are regenerated in response to uranium damage are flattened, with fewer energy-producing organelles (mitochondria). Transport of ions and chemicals across the tubule is also altered in the tubule cells [Leggett 1989, 1994; McDonald-Taylor et al. 1997]. These effects may account for the decreased rate of filtration through the kidney and loss of concentrating capacity by the kidney following uranium exposure. Biochemical changes include diminished activity of important enzymes (such as alkaline phosphatase), which can persist for several months after exposure has ended. Therefore, acquired tolerance to uranium may not prevent chronic damage, because the kidney that has developed tolerance is not normal [Leggett 1989]. Acting on the basis of this recent information for uranium, researchers have suggested that exposure limits be reduced to protect against these chronic effects on the kidney.

Renal damage appears to be definite at concentrations of uranium per gram of kidney tissue above 3 μg/g for a number of different animal species, but mild kidney injury can occur at uranium concentrations as low as 0.1 to 0.4 μg/g in dogs, rabbits, guinea pigs, and rats after they inhale uranium hexafluoride or uranium tetrachloride over several months [Maynard and Hodge 1949; Hodge 1953; Stokinger et al. 1953; Diamond 1989]. Zhao and Zhao proposed a limit of uranium to the kidney of 0.26 μg/g based on renal effects in a man who was exposed to high concentrations of uranyl tetrafluoride dust for 5 minutes in a closed room [Zhao and Zhao 1990]. The man showed signs of kidney toxicity, including increased protein content in the urine (proteinuria) and nonprotein nitrogen. These signs persisted for 4.6 years, gradually returning to normal values. The kidney content 1 day after the accident was estimated to be 2.6 μg/g.

A study conducted in Finland and published in 2002 observed 325 people that had used their drilled wells for drinking water over a period of 13 years on average (range 1 – 34 years) [Kurttio et. al 2002]. The median uranium concentration in the water was 28 ppb (range 0.001 –

1,920 ppb). The study showed an association between increased uranium exposure through drinking water and tubular function, but not between uranium exposure and indicators of glomerular injury. The primary target is the proximal convoluted tubule of the kidney which is where most of the sodium, water, glucose, and other filtered substances are reabsorbed and returned to the blood. The authors of the study indicated that tubular dysfunction may merely represent a manifestation of subclinical toxicity, and it is unclear if it carries a risk of development into kidney failure or overt illness. This study concluded that "The public health implications of these findings remain uncertain, but suggest that the safe concentration of uranium in drinking water may be close to the guideline values proposed by the WHO and the U.S.EPA." However, this study found that altered tubular function was statistically significant at water uranium concentrations exceeding 300 μg/L [Kurttio et. al 2002], or 0.3 mg/L, which is an order of magnitude higher than EPA's guideline (0.035 mg/l) and the highest average concentration at the Lincoln Park site (0.048 mg/L). At 300 μg/L and assuming ingestion of two liters of water per day, the kidney burden after 25 years of chronic ingestion would be 39.6 μg of uranium with a uranium concentration per gram of kidney tissue of 0.13 μg/g.

A review of studies of uranium effects on the kidney [Morris and Meinhold 1995] suggests a probability distribution of threshold values for kidney toxicity ranging from 0.1 to 1 μg/g, with a peak at about 0.7 μg/g. The researchers proposed that the severity of effects increases with increasing dose to the kidney with probably no effects below 0.1 to 0.2 μg/g, possible effects on the kidney at 0.5 μg/g, more probable effects at 1 μg/g, and more severe effects at 3 μg/g and above [Morris and Meinhold 1995; Killough et al. 1998b].

If an adult in Lincoln Park drank 2 liters (L) of uranium-contaminated water per day (at the highest average exposure concentration of 0.048 mg/L, or 48 μg/L) for 25 years or longer, then the maximum daily ingestion would be 96 μg of uranium, resulting in a uranium kidney burden of 6.3 μg (96 μg × 0.066). The weight of both kidneys in adults is about 300 g [Madsden et al 2007]. Thus, the uranium concentration per gram of kidney tissue for an adult would be 0.02 μg/g. If a child drank 1 L of uranium-contaminated water per day (at the highest average exposure concentration of 0.048 mg/L, or 48 μg/L) for 100 days to 25 years, then the maximum daily ingestion would be 48 μg of uranium, resulting in a uranium kidney burden of 1.4 μg (48 μg x 0.03). The weight of both kidneys in a child is about 100 g; therefore, the uranium concentration per gram of kidney tissue to be 0.01 μg/g. The calculated kidney uranium concentration for adults and children is below the level found to cause harm in published studies.

ATSDR's health-based guidelines for ingested (and inhaled) uranium are lower than the lower limit threshold for kidney toxicity proposed by Morris and Meinhold (1995). ATSDR's guidelines are derived by use of levels of toxicity observed in animal studies, and those guidelines incorporate safety factors to account for uncertainty in extrapolating from animals to humans and to protect the most sensitive human individuals [ATSDR 1999].

Note that urinalysis has limitations as a test for kidney toxicity. First, the presence of substances in urine may indicate that kidney damage has occurred, but it cannot be used to determine whether the damage was caused by uranium. Second, most uranium leaves the body within a few days of exposure, so that urine tests can be used only to determine whether exposure has occurred in the past week or two. Finally, the tests may be used to detect mild effects on the kidney, but such effects are generally transient in nature and may not result in permanent damage. More severe effects involve greater damage to the kidney that is likely to be clinically manifest and longer lasting. The kidney has incredible reserve capacity and can recover even after showing pronounced clinical symptoms of damage; however, biochemical and functional changes can persist in a kidney that appears to have recovered structurally [Leggett 1989, 1994; CDC 1998].

The maximum average uranium concentration detected in a private well was 0.048 mg/L, or 48 µg/L. The residence where this concentration was detected is not connected to the municipal water supply and is noted to use a private well for personal consumption. Drinking water from this private well containing uranium would result in an estimated dose of 0.001 mg/kg/day for an adult and 0.003 mg/kg/day for a child. The adult dose is lower than the intermediate oral MRL. The estimated child dose slightly exceeds the MRL of 0.002 mg/kg/day for an intermediate-duration oral exposure. The MRL level for intermediate-duration oral exposure is also protective for chronic-duration oral exposure because the renal toxicity of uranium exposure is more dependent on the dose than on the duration of the exposure. The MRL is based on a LOAEL of 0.05 mg U/kg/day for renal effects in rabbits. The estimated child dose is an order of magnitude lower than the LOAEL; therefore, adverse health effects are not likely.

Although older evaluations suggested carcinogenicity of uranium among smokers, the U.S. EPA has withdrawn its classification for carcinogenicity for uranium; the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) have no ratings [NHANES 2005].

D. Soil Pathway: Surface Soil near Cotter Mill and Lincoln Park

As discussed above, surface soil samples were collected from areas around the Cotter Mill property, from property access roads and in the Lincoln Park area. Surface soil sampling data were available from eight designated zoned areas around Cotter Mill and in Lincoln Park. People who live or recreate in these areas could accidentally ingest some contaminated soil or get it on their skin. ATSDR evaluated these potential exposure scenarios to determine if concentrations of chemicals and radionuclides in soil are high enough to cause adverse health effects.

ATSDR assumed that the average adult would accidentally ingest 100 milligrams of soil per day and would also contact the contaminated soil with their skin (dermal). Small children were not assumed to access the soil around Cotter Mill because these areas are primarily industrial or vacant. The vacant area has been designated as a “buffer zone” between the Cotter Mill property and the residential areas. Therefore, it is unlikely that small children would access the area. A residential exposure scenario was used to evaluate potential exposures in Lincoln Park. For Lincoln Park, we assumed that a small child would ingest 200 mg of soil per day, and an adult would ingest 100 mg/day, for 350 days per year.

Concentrations of arsenic, cadmium and lead exceeded their comparison values in soil taken from the area surrounding Cotter Mill. The concentration of radium-226 was the only radionuclide to exceed its comparison value in soil near Cotter Mill. Arsenic was the only chemical to exceed its comparison value in soil in Lincoln Park. The highest zonal average concentration of arsenic, cadmium, lead and radium-226 was used to estimate exposure doses. If the highest zonal average concentration of a chemical would not result in adverse health effects, it follows that lower concentrations of the chemical would not as well.

1. *Soil Near Cotter Mill*

a) Arsenic

Arsenic is a naturally occurring element that is widely distributed throughout the earth's crust and may be found in air, water, and soil [ATSDR 2000]. Arsenic in soil exists as inorganic and organic arsenic. Generally, organic arsenic is less toxic than inorganic arsenic, with some forms of organic arsenic being virtually non-toxic. Inorganic arsenic occurs naturally in soil, and children may be exposed to arsenic by eating soil or by direct skin contact with soil containing arsenic [ATSDR 2007].

The estimated dose of arsenic for adolescents and adults at this site is 0.00002 mg/kg/day. This dose is lower than the Minimal Risk Level (MRL) of 0.0003 mg/kg/day for arsenic; therefore, non-cancer health effects are not likely from being exposed to arsenic in surface soil near Cotter Mill (Zones A through H). The chronic oral MRL of 0.0003 mg/kg/day for inorganic arsenic was derived by dividing the identified chronic No Observable Adverse Effect Levels (NOAEL) of 0.0008 mg/kg/day (obtained from human epidemiologic studies) by an uncertainty factor of three to account for the lack of data on reproductive toxicity and to account for some uncertainty as to whether the NOAEL accounts for all sensitive individuals [ATSDR 2007]. The Lowest Observed Adverse Effect Level (LOAEL) associated with these epidemiologic studies was 0.014 mg/kg/day, where exposure to arsenic above this level resulted in hyperpigmentation of the skin, keratosis (patches of hardened skin), and possible vascular complications [ATSDR 2007].

The U.S. Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) classify arsenic as a human carcinogen. The EPA has developed an oral cancer slope factor to estimate the excess lifetime risk for developing cancer. Using EPA's cancer slope factor for arsenic, and based on a 30 year exposure scenario, ATSDR calculated a lifetime estimated cancer risk level of 1×10^{-5} for exposure to arsenic in soil near Cotter Mill. Qualitatively, we interpret this as a very low increased lifetime risk of developing cancer.

b) Cadmium

The estimated dose for adolescents and adults for cadmium is 0.00002 mg/kg/day, which is lower than the MRL of 0.0001 mg/kg/day for cadmium; therefore, non-cancer adverse health effects are not likely. The U.S. Department of Health and Human Services (DHHS), IARC, and EPA have determined that cadmium is carcinogenic to humans. Although cadmium can be carcinogenic when inhaled, human or animal studies have not provided sufficient evidence to show that cadmium is a carcinogen by oral routes of exposure (ATSDR 1999b). Therefore, a cancer evaluation for cadmium was not done as part of this assessment.

c) Lead

The highest average concentration of lead detected in any of the zones (Zone H) is 445 ppm, which is only slightly higher than the soil screening value of 400 ppm for lead. A value of 400 ppm is commonly used to evaluate lead in soil in residential properties. The property near the Cotter Mill site is currently restricted, vacant or used for industrial purposes; therefore contact with these soils should be minimal. Adverse health effects are not expected to occur from these limited exposures to soils near the site. Exposures to lead, however, should be re-evaluated should the area ever be considered for residential or other non-industrial use.

Maximum lead concentrations in zones F, G and H are 800 ppm, 450 ppm, and 1,400 ppm, respectively. To protect children from exposure to lead, it is important to know the average lead level in a yard or other frequent play area. The *1998 Supplemental Human Health Risk Assessment* provides the only characterization of surface soils adjacent to the Cotter Mill property (See Figure 17, Zones A through H). The soil sample results in this report were generated by collecting four samples from the center of a grid and compositing the samples to form a single representative sample. The size of each sampled grids, however, appears to be larger than 100 x 100 feet, which is the size that triggers additional sampling for lead (EPA 1995). Although the sampling in the *1998 Supplemental Human Health Risk Assessment* measured contamination in soils at several properties near Cotter Mill, it does not allow ATSDR to evaluate contamination in individual exposure units (yards, playgrounds, etc), as would be required to accurately assess exposures in a residential setting, commercial or recreational setting. The sample design is sufficient for making general public health decisions about exposure to lead in soil based on current use patterns. However, any future public health decision regarding the soil near the Cotter Mill property must be made with the limitations of the current sampling design in mind.

The Centers for Disease Control and Prevention (CDC) has established a level of concern for case management of 10 micrograms lead per deciliter of blood (µg/dL). This means that when blood lead levels in children exceed 10 µg/dL, CDC recommends that steps be taken to lower their blood lead levels. However, some agencies and public health officials have mistakenly used this level in blood as a safe level of exposure or as a no effect level. Recent scientific research has shown that blood lead levels below 10 µg/dL cause serious harmful effects in young children, including neurological, behavioral, immunological, and development effects. Specifically, lead causes or is associated with decreases in intelligent quotient (IQ), attention deficit hyperactivity disorder (ADHD), deficits in reaction time, visual-motor integration, fine motor skills, withdrawn behavior, lack of concentration, sociability, deceased height, and delays in puberty, such as breast and pubic hair development, and delays in menarche [CDC].

d) Radium-226

The average concentrations of radium-226 detected in Zones A and B are higher than allowed by the Uranium Mill Tailing Act (UMTRA). That standard does not apply in this case, since the Cotter Mill is still considered active.

The highest average soil concentration of 9.2 pCi/g in surface soil would result in a dose from radium's decay gammas of 58 mrem per year above background, assuming that residents spend 12 hours per day 365 days per year sitting or lying on the highest measured radium concentration of 9.2 pCi/g on the haul road. Since Zones A and B are buffer areas (actually haul roads), the time spent in these areas would be much lower (less than 2 hours per day) and the resulting dose would be roughly 10 mrem per year above background, to a maximally exposed individual.

2. *Soil in Lincoln Park*

a) Arsenic

The estimated arsenic dose for an adult in Lincoln Park is 0.00003 mg/kg/day, which is an order of magnitude lower than the MRL of 0.0003 mg/kg/day for arsenic. The estimated arsenic dose for a child in Lincoln Park is 0.0003 mg/kg/day, which is equal to the MRL of 0.0003 mg/kg/day for arsenic. Children are estimated to have higher arsenic doses than adults because they tend to engage in activities that increase their soil ingestion exposure, and because they weigh less than adults. Neither children nor adults should experience adverse health effects from exposure to arsenic in soil in Lincoln Park.

Arsenic is a naturally occurring element in soil. Arsenic has also historically been used in a variety of industrial applications, including bronze plating, electronics manufacturing, preserving animal hides, purifying industrial gases, and mining, milling and smelting activities. Studies of background levels of arsenic in soils have revealed that background concentrations range from 1 ppm to 40 ppm, with average values around 5 ppm [ATSDR 2007]. The average arsenic concentration detected in Lincoln Park was 31 ppm, a concentration within the observed background range but higher than the average background concentration. The maximum concentration of arsenic detected in Lincoln Park was 50 ppm.

Although the maximum arsenic concentration is higher than the observed background concentration, this fact alone does not definitely point to an anthropogenic source for the arsenic found in soil in Lincoln Park. Uncertainty exists regarding whether the arsenic levels detected are a natural occurrence or from past milling operations in the area.

Several factors contribute to whether people have contact with contaminated soil, including:

- grass cover, which is likely to reduce contact with contaminated soil when grass cover is thick but increase contact with soil when grass cover is sparse or bare ground is present,
- weather conditions, which is likely to reduce contact with outside soil during cold months because people tend to stay indoors more often,
- the amount of time someone spends outside playing or gardening, and
- people's personal habits when outside, for instance, children whose play activities involve playing in the dirt are likely to have greater exposure than other children

Using EPA’s cancer slope factor for arsenic, and based on a 30 year exposure scenario, ATSDR calculated a lifetime estimated cancer risk level of 5×10^{-5} for exposure to arsenic in Lincoln Park. Qualitatively, we interpret this as no apparent increased lifetime risk of developing cancer.

E. Surface Water: Sand Creek, DeWeese Dye Ditch, and the Arkansas River

People who swim or wade in the surface waters of Sand Creek, the DeWeese Dye Ditch, or the Arkansas River will get surface water on their skin and they might also accidentally ingest some of the surface water. To estimate exposures to adults and children who may have come into contact with contaminated surface water, ATSDR assumed that adults and children will swallow 50 mL of water per hour while swimming or wading, for 104 days per year for 30 and 6 years, respectively. Molybdenum exceeded its comparison value in Sand Creek and the Arkansas River. Manganese exceeded its comparison value in Sand Creek and the DeWeese Dye Ditch. ATSDR conservatively selected the maximum concentration for each chemical to estimate exposures.

1. Manganese

The estimated exposure dose for manganese is 0.0007 mg/kg/day for adults and 0.0006 mg/kg/day for children. Both adult and child doses are considerably lower than the reference dose of 0.05 mg/kg/day for manganese. Therefore, no adverse health effects are expected to occur as a result of exposure to manganese in surface waters.

2. Molybdenum

The estimated exposure dose for molybdenum is 0.00002 mg/kg/day for adults and 0.00006 mg/kg/day for children. Both adult and child doses are below the chronic oral reference dose (RfD) of 0.005 mg/kg/day for molybdenum. Therefore, no adverse health effects are expected to occur as a result of exposure to molybdenum in surface waters.

F. Homegrown Fruits and Vegetables

Ingestion of contaminated foods is a potential exposure pathway for this site. Residents may have been exposed to contaminants when they ate homegrown fruits and vegetables after using contaminated groundwater (either surface water or private well water) to irrigate their crops, or after growing their crops in contaminated soil. The soil may become contaminated from contaminated water or from tailings, dusts and other wastes deposited in the soil in the past.

Eating fruits, vegetables, herbs, or other produce grown in gardens with contaminated soil can cause exposure. This type of exposure occurs because some plants slowly absorb small amounts of the chemicals found in soil into their plant tissue or because contaminated soil can adhere to the exterior surface of produce, particularly low-growing leafy produce or produce where the underground portion is eaten. Some of these absorbed chemicals are essential nutrients and are actually good for humans to eat, but other chemicals can present health hazards if they are found at high enough levels and are consumed on a regular basis.

Generally, there is not a strong relationship between levels of heavy metals in soils and plants [Vousta 1996]. The uptake of heavy metal concentration depends on speciation of metal, soil characteristics, the type of plant species and other characteristics [Laizu 2007]. Table 8 below developed by Sauerbeck (1988) provides a qualitative guide for assessing heavy metal uptake into a number of plants.

Table 8. Plant Uptake of Heavy Metals

High	Moderate	Low	Very Low
Lettuce	Onion	Corn	Beans
Spinach	Mustard	Cauliflower	Peas
Carrot	Potato	Asparagus	Melons
Endive	Radish	Celery	Tomatoes
Crest		Berries	Fruit
Beet			
Beet leaves			
Source: USEPA (1991), Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors."			

To address the concern regarding contaminated crops, residents contributed locally grown produce for sampling analysis. ATSDR used the sampling results to estimate an exposure dose for each contaminant using typical consumption rates for the average and above-average (95th percentile) consumer in the Western United States. Child and infant consumption rates were also used to assess exposures to these vulnerable populations. Table 9 below provides the consumption rates used by ATSDR for homegrown fruits and vegetables.

Table 9. Homegrown Fruit and Vegetable Consumption Rates for the Western United States

Food	Consumer Type†	Intake Rate (g/kg/day)	Standard Error
Homegrown fruits	Average consumer	2.62	0.3
	Above-average consumer	10.9	
	Child	4.1	NA
	Infant (1 to 2 years)	8.7	
Homegrown vegetables	Average consumer	1.81	0.1
	Above-average consumer	6.21	
	Child	2.5	NA
	Infant (1 to 2 years)	5.2	

Sources: EPA Exposure Factors Handbook, Volume II, 1997; Child-Specific Exposure Factors Handbook, 2008
g/kg/day: grams per kilogram per day
NA = not applicable
†An average consumer is represented here as a person who eats fruits and vegetables in the typical range (mean intake). An above average consumer is a person who eats more fruits and vegetables than is typical, represented here by the 95th percentile intake.

All of the estimated fruit and vegetable doses were below health guideline values except for those for arsenic (See Table C4 in Appendix C). The estimated doses for fruits for the above-average consumer (95th percentile intake rate) and for infants exceed the chronic health guideline for arsenic. The above-average consumer and infant doses for fruit are 0.0006 mg/kg/day and 0.0004 mg/kg/day, respectively. Also, the estimated doses for vegetables for the above-average consumer (95th percentile intake rate) and for infants exceed the chronic health guideline for arsenic. The vegetable doses are 0.0005 mg/kg/day for an above-average consumer and 0.0004 mg/kg/day for an infant. These doses exceed the chronic oral MRL of 0.0003 mg/kg/day for arsenic.

Next, ATSDR assumed that a person will eat both fruits and vegetables daily. To do this, we added the calculated doses for fruits and vegetables to derive a single dose. The estimated fruit and vegetable doses for the above-average consumer, child and infant exceed the health guideline of 0.0003 mg/kg/day for arsenic. The above-average consumer dose is 0.001 mg/kg/day; the child dose is 0.0004 mg/kg/day; and the infant dose is 0.0008 mg/day/day.

The chronic oral MRL of 0.0003 mg/kg/day for inorganic arsenic was derived by dividing the chronic No Observable Adverse Effect Level (NOAEL) of 0.0008 mg/kg/day (obtained from human epidemiologic studies) by an uncertainty factor of 3 to account for the lack of data on reproductive toxicity and to account for some uncertainty as to whether the NOAEL accounts for all sensitive individuals [ATSDR 2007]. The Lowest Observed Adverse Effect Level (LOAEL) associated with these epidemiologic studies was 0.014 mg/kg/day, where exposure to arsenic above this level resulted in hyperpigmentation of the skin, keratosis (patches of hardened skin), and possible vascular complications [ATSDR 2007]. The child and infant doses are below or equal to the NOAEL, and the above-average consumer dose is 14 times lower than the dose that caused adverse health effects in epidemiologic studies. Therefore, adverse health effects are not expected in infants, children or the above-average consumer.

Using EPA’s cancer slope factor for arsenic and the above consumer exposure dose, and based on a 30 year exposure scenario, ATSDR calculated a lifetime estimated cancer risk level of 6×10^{-4} for exposure to arsenic in fruits and vegetables. Qualitatively, we interpret this as a low to moderate increased risk of developing cancer over a lifetime.

ATSDR conservatively assumed that every consumer ate homegrown fruits and vegetables every day for 30 years. In reality, it is likely that most people only eat homegrown fruits and vegetables during a defined season, usually a 3 to 4 month period during the summer/fall growing season. Therefore, the true risk to consumers is likely overestimated.

ATSDR also noted that the highest arsenic level detected in lawns and gardens in Lincoln Park was 50 ppm. This level is near what is typically observed as background arsenic levels (1 ppm to 40 ppm) in soil. This suggests that the contaminated well water used to irrigate crops is not contributing significantly to arsenic soil levels, or other soil additives may have been added that dilute soil contamination [ODEQ 2003]. The highest arsenic level detected in soil at the site was 86 ppm. There were no sampling data for arsenic in drinking or irrigation water. ATSDR is unsure if the arsenic found in soil at this site is a natural occurrence or from an anthropogenic (man-made) source.

Plants vary in the amount of arsenic they absorb from the soil and where they store arsenic. Some plants move arsenic from the roots to the leaves, while others absorb and store it in the roots only [Peryea 1999]. The best method of reducing exposure to external arsenic from homegrown vegetables is to soak and wash residual soil from produce before bringing it into the home and washing the produce again thoroughly indoors before eating [ATSDR 2007]. It is always a good health practice to wash all fruits and vegetables thoroughly before eating, whether they are bought or homegrown.

Molybdenum was the only other contaminant to approach a health guideline when calculating a single dose for fruits and vegetables. The above-average consumer and infant doses are 0.005mg/kg/day, which is equal to the chronic health guideline of 0.005mg/kg/day for molybdenum.

G. Air Pathway

ATSDR looked at all the air data collected from 1979 to present. Concentrations of radionuclides in air from direct release or re-suspension of radioactive contaminants in soil were less than a tenth of ATSDR's health based comparison value (100 millirem per year) at all off-site sampling locations (CC-1/2, LP-2, AS-210, AS-212, OV-3). ATSDR evaluated doses to all age groups and found that adults would have received the highest doses, because of their higher breathing rate. Infants only received one quarter the dose of an adult.

Table 10 below breaks down the dose estimates by age group and by the highest annual concentration measured for each radionuclide and by the highest location. The two highest doses were both in 1982, during the excavation of the unlined settling ponds and were measured at the on-site sampling location AS-204, that was directly adjacent to the dewatered ponds. Neither of those doses would have been to the public. The combined dose to a worker near AS-204 would have been less than a third of the sum in the table since the worker was there less than 8 hours per day for 5 days a week, or 70 mrem of inhalation dose for the year 1982, while the numbers in Table 10 reflect 24/7 exposure through the year. Doses listed in Table 10 did not result in any elevated exposures to the public.

Table 10. Annual Effective Doses by Highest Concentration, Location and Age Group

Radionuclide	Highest Year	Highest Location	Concentration (µCi/ml)	Dose to Infant (mrem/yr)	Annual Dose to Adult	Notes
Natural Uranium (µCi/ml)	1979	AS-204	2.48E-14	2.72	5.97	
Thorium-230 (µCi/ml)	1982	AS-204	8.95E-14	71.57	272.68	
Thorium-232 (µCi/ml)	2001	CC#2	8.33E-17	0.07	0.27	
Radium-226 (µCi/ml)	1985	AS-202	9.63E-15	1.25	2.75	
Lead-210 (µCi/ml)	1982	AS-204	9.95E-14	7.01	16.77	Dose from Radon Progeny
Radon-220/222 (pCi/l)	2004	AS-202	1.50E+00	NA	NA	No dose from Radon

Most of the calculated inhalation dose was from the isotope Thorium-230 (Th-230). Table 11 below lists just the dose from Th-230 for the highest annual average concentration at each sampling station. Again it can be seen that the on-site concentrations are consistently orders of magnitude higher than at off-site locations in Cañon City, Lincoln Park and west of the site boundary.

Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.

Table 11. Annual Doses from Thorium-230 by Location and Year

Year	Highest Location	Concentration (µCi/ml)	Annual Dose to Infant (mrem/yr)	Annual Dose to Adult(mrem/yr)
1982	AS-204	8.95E-14	71.57	272.68
1982	AS-202	2.12E-14	16.95	64.59
1983	AS-203	9.79E-15	7.83	29.83
1982	AS-206	1.26E-14	10.08	38.39
2000	AS-209	4.16E-15	3.33	12.67
2005	AS-210	4.85E-16	0.39	1.48
2000	AS-212	6.69E-16	0.53	2.04
1982	LP-1/2	7.49E-16	0.60	2.28
1982	CC-1/2	9.18E-16	0.73	2.80
1982	OV-3	3.15E-15	2.52	9.60

VI. COMMUNITY HEALTH CONCERNS

Responding to community health concerns is an essential part of ATSDR's overall mission and commitment to public health. The community associated with a site is both an important resource for and a key audience in the public health assessment process. Community members can often provide information that will contribute to the quality of the health assessment. Therefore, during site visits and telephone conversations with community members, ATSDR obtained information from the community regarding their specific health concerns related to the site.

In some cases, ATSDR was unable to address a community health concern because 1) adequate scientific information on the particular health effect is not available or is limited or 2) the available scientific data are insufficient to assess whether the specific health effect is related to exposure to a particular chemical. Where feasible, ATSDR addressed the health concerns identified by the community. Below is a summary of the community concerns and ATSDR's response to those concerns.

1. How did the 1965 flood event affect my health?

In June 1965, prior to the construction of the SCS Dam in 1971, a flood caused the unlined tailings ponds at the Cotter Mill to overflow into Lincoln Park. According to the residents, the waters flowed north through the gap in the ridge, down Pine Street, and ultimately down 12th Street (Sharyn Cunningham, CCAT, personal communication, February 2008). There is concern that this flood event contaminated groundwater wells and that dust from soil or tailings may have been resuspended by wind and distributed in Lincoln Park. Community members are very concerned that current illnesses may be a result of this tailings pond flood event.

> There is documentation that ponds at the Cotter Mill historically overflowed, which led to the construction of the SCS Dam. Aerial photography from October 1970 indicates that one of the evaporation ponds overflowed into an alluvial channel tributary to Sand Creek (Wilder et al. 1983). A chronology compiled by CDPHE states that in October 1970 and January 1971, an evaporation pond overflowed with high levels of total dissolved solids, sodium, molybdenum, sulfate, and high radiation (CDPHE 1975).However, since the construction of the SCS Dam, there are no recorded surface water discharges past the dam (GeoTrans 1986).

ATSDR tried to locate data to evaluate the potential health effects resulting from this flood event. No data from 1965 or 1966 exist in the CDPHE database. The *1986 Remedial Investigation* (GeoTrans 1986) states that off-site groundwater contamination in the Lincoln Park areas was first identified in 1968; therefore, any data prior to 1968 are unlikely to exist. The only data ATSDR found related to this flood event were from a sediment sample collected in January 2003 (CDPHE 2003). To address community concerns, CDPHE collected a sample of suspected flood sediment from Pine Street near Elm Avenue. This area was identified by a property owner who was present during the flood. The sample was collected from two locations. About 250 grams of soil were collected from each location to a depth of approximately 18 inches. No obvious soil horizons were identified, and no significant differences in gamma radiation were noted between shallow and deep soils. The results are presented in Table 12 below. All concentrations from this one sample are below comparison values.

The results of the sediment sample from the flood did not exceed any comparison values. If this sample was representative of the material moved by the floodwaters, it would not cause any adverse health effects.

Table 12. Concentrations found in a suspected flood sediment sample, January 2003

Chemical	**Concentration (ppm)**	**Comparison Value (ppm)**
Lead	87	400
Molybdenum	Not detected	300
Uranium	1.6	100
Radionuclide	**Concentration (pCi/g)**	**Comparison Value (pCi/g)**
Cesium-137	0.12	Not available
Lead-210	2.2	Not available
Plutonium-239, 240	Not detected	Not available
Potassium-40	22.5	Not available
Radium-226	2.2	15
Radium-228	1.3	15

Source: CDPHE 2003

2. Were an adequate number of soil samples collected during the *1998 Supplemental Human Health Risk Assessment*?

The community expressed concern that not enough samples were collected during the *1998 Supplemental Human Health Risk Assessment*. Weston, a contractor for Cotter, collected surface soil samples (0-2 inches) from eight zones around the mill property (see Figure). Each zone was divided into 8 to 12 grids. Four samples were collected near the center of each grid and were composited (i.e., combined and homogenized) to form a single representative sample (Weston 1998). The dates the samples were collected were not specified in the report; however, it is assumed to be in the 1994–1996 timeframe. In 1995, EPA released guidance for obtaining representative soil samples at Superfund sites (EPA 1995). The systematic grid sampling approach used by Weston conforms with EPA's guidance for delineating the extent of contamination. The number of samples taken from each grid for compositing, however, is not entirely consistent with EPA's guidance. For grids larger than 100 x 100 feet, which it appears that the grids established by Weston are, EPA recommends collecting nine aliquots from each grid. Compositing four aliquots from each grid is recommended for grids smaller than 100 x 100 feet (EPA 1995). Because the timeframe of the sampling is unclear, it is not known whether EPA's 1995 guidance was available during Weston's sampling effort.

3. Are there high levels of thorium near the Black Bridge?

The community expressed concern that high thorium levels were detected in surface water near the Black Bridge. This bridge is located where a railroad spur crosses the Arkansas River between the 4th Street and 9th Street bridges. The closest sampling location in the Arkansas River is upstream at 1st Street (907). Thorium-230 was sampled at this location as part of the surface water monitoring program between 1995 and 2007. These data are summarized below in Table 13. The highest thorium-230 concentration detected was 2.5 picocuries per liter (pCi/L) (suspended sample) in August 2007. This concentration is below levels known to cause adverse health effects. It should also be noted that the Black Bridge is located upstream of the confluence with Sand Creek.

Table 13. Thorium-230 data upstream of the Black Bridge

Chemical	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)
Thorium-230 (D)	121/127	-0.1	0.1	1
Thorium-230 (S)	115/120	0	0.2	2.5
Thorium-230 (T)	7/7	0.1	0.3	0.7

Source: CDPHE 2007b
Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
Thorium-230 “D” and “S” samples were collected between 1995 and 2007. Thorium-230 “T” samples were only collected in 1995.

D – dissolved
pCi/L – picocuries per liter
S – suspended
T – total

4. I grew up near the Cotter plant. Does this increase my risk of getting cancer?

Soil sampling data from the nearest residence to the Cotter plant did not indicate the presence of chemicals at levels above established guidelines. Soil sampling data from the Lincoln Park community did not reveal the presence of contaminants at levels associated with adverse health effects, including cancer. Air data do not indicate the presence of chemicals at levels associated with adverse health effects, including cancer. If you drank water from a contaminated private well, you might be at increased risk for gout-like conditions, such as pain, swelling, inflammation and deformities of the joints. However, once exposure is stopped, the risk of adverse health effects goes down.

5. I used water from my private well or surface water to irrigate my crops and garden vegetables. Am I going to get sick?

According to our evaluation, people who ate fruits or vegetables irrigated with contaminated well water are not at increased risk for non-cancer health effects. However, people who eat more than the average amount of fruits and vegetables (95th percentile consumers) might be at increased risk for developing cancer over a lifetime. This conclusion is based on a person eating approximately 4 times more fruits and vegetables than the average person every day for 30 years.

People who grew fruits and vegetables at their home and used their well water to irrigate their crops submitted crop samples for analysis. The analysis revealed that vegetables irrigated with well water did not cause a significant increase in contaminant levels (Weston 1998). As a precaution, however, we recommend washing all homegrown fruits and vegetables before eating them.

6. **I have lived in Lincoln Park since the 1960s. I know of many neighbors and family members who are sick. Is uranium from the mill making us sick?**

Uranium primarily acts as a heavy metal toxin. Renal toxicity is the hallmark effect of uranium exposure, specifically to the proximal tubules of the kidney. We looked at CDC's Compressed Mortality Database "WONDER" looking specifically at specific modes of kidney failure that could be associated with uranium toxicity. Fremont County in Colorado had an age adjusted rate for renal failure as the cause of death of 7.1 per 100,000, for the years 1999-2006. The state average during that same period was 12.1 per 100,000[13]. From the available health outcome data, it does not appear that residents in the area have elevated rates of kidney disease, which could be associated with uranium exposure.

7. **My husband worked at the plant. Was I possibly exposed when he brought his dirty work clothes home?**

Workers in industrial settings have the potential to expose their household members to work-related chemicals if residues attach to the worker's clothing, skin, shoes, or in their vehicles and is inadvertently brought into the home. Whether and to what magnitude these take-home exposures actually occur depends on a number of factors, including the nature of the job held by the worker, the occupational practices of the industrial facility (e.g., providing workers with disposable gowns and gloves), and the precautions/practices of the worker and other family members. ATSDR did not evaluate potential exposures to workers' families because the data needed to quantitatively or qualitatively make a determination on potential health effects were not available.

8. **I used contaminated water from my private well water for many years as a potable source of water for my family. Are we now at risk for adverse health effects?**

The levels of molybdenum were high enough in some wells to cause adverse health effects in individuals who were exposed for many years. Once exposure is stopped, the risk of adverse health effects goes down. Residents, particularly individuals who do not take in enough dietary copper or cannot process copper correctly, might be at increased risk for gout-like conditions. The levels of other contaminants are too low to cause adverse health effects.

9. **CCAT conducted a health survey and submitted it to ATSDR. Why didn't ATSDR use the results of this survey to determine if people are experiencing adverse health effects in the community?**

The community organization CCAT conducted a health survey in 2004–2005. The survey included responses from 239 individuals in the Lincoln Park area. Volunteers went door-to-door in Lincoln Park and the surrounding areas to administer the health surveys. Each person filled out a survey and submitted it to a volunteer. A tabulation of self-reported illnesses reported by respondents included occurrences of cancer; lung, health, skin, central nervous system, kidney, and thyroid problems; reproductive issues, including chromosomal and congenital defects;

---

[13] Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed Mortality File 1999-2006. CDC WONDER On-line Database, compiled from Compressed Mortality File 1999-2006 Series 20 No. 2L, 2009. Accessed at http://wonder.cdc.gov/cmf-icd10.html on Sep 30, 2009 10:42:05 AM

autoimmune disease, psychological disorders, and gout. Although ATSDR could not use the survey to make conclusions about disease associations, we did use the survey results to focus our attention and pursue a more in-depth scientific analysis of the health conditions identified by the community.

While the CCAT health survey was a good effort by the community to examine the frequency of their various health concerns, there are many issues that make it of limited use in determining the prevalence of adverse health effects present in the entire community and their potential associations with exposure to environmental contaminants. Some of these issues include the use of a relatively small convenience sample, the lack of medical verification of self-reported health outcomes, and the need for individual-level exposure data. Convenient samples are typically not representative of the entire population, so results cannot be extrapolated to the community. People who participate in nonrandomized surveys such as this may provide biased information because of perceived relationships between environmental contamination or other risk factors and their health. Many of the self-reported health outcomes measured in the survey are present in most populations and are related to several different potential causes beyond environmental exposures, such as lifestyle or genetics. Therefore, without any assessment of exposure, it is not possible to link the occurrence of disease to environmental concerns.

10. **CDPHE previously ordered Cotter to have all environmental samples analyzed by an external laboratory until Cotter could demonstrate that its laboratory had addressed various deficiencies. Why was this done and how did it affect the data used by ATSDR?**

Cotter’s license requires the company to collect and report a wide range of environmental measurements. Cotter’s own analytical laboratory conducted most of the measurements between the late 1970s and the present. The main exception is that an external analytical laboratory measured contamination levels in most of the samples collected in 2005 and 2006.

For many years, Cotter has participated in so-called “round robin” inter-laboratory performance evaluations. As part of these evaluations, selected environmental samples are split every calendar quarter and simultaneously sent to Cotter’s laboratory and to three external analytical laboratories for analysis. The measurement results are then compared to assess the performance of Cotter’s laboratory. CDPHE’s website presents data from these inter-laboratory comparisons from 2007 to the present. Earlier comparisons are not readily available, mostly because Cotter’s laboratory was not analyzing samples throughout much of 2005 and 2006 and data from earlier years have since been archived from CDPHE’s website.

In September 2008, Cotter submitted a letter to CDPHE documenting five quarters of inter-laboratory comparisons for groundwater samples [Cotter 2008]. These comparisons presented “round robin” data for more than two dozen substances or indicators, including uranium, molybdenum, selenium, nitrate, and selected radionuclides. In some cases, Cotter’s laboratory tended to measure higher concentrations than the other participating laboratories; but in other cases, the opposite was observed. With one exception, the differences between the measurements made by the various laboratories fell within the range typically observed or expected.

The exception is for molybdenum, for which Cotter's laboratory did not meet pre-established comparability limits for the "round robin" sampling. Specifically, in two out of the five quarters of samples that were collected, Cotter's laboratory did not meet the acceptable limits.[14] In contrast, the three external laboratories' molybdenum measurements met the pre-established comparability limits for all five quarters considered in this report. The table below presents the specific concentration measurements for the two quarters of interest, and these measurements show that (in these two instances) the molybdenum levels measured by Cotter were less than 50 percent of the average concentrations calculated from the three external laboratories' measurements.

After CDPHE requested that Cotter investigate the issue further, Cotter prepared a written response to the issue [Cotter 2009]. The response suggests that the poor performance on these samples resulted from the analytical method used. Cotter uses atomic adsorption to measure molybdenum levels in groundwater samples, and the external laboratories used a different method (inductively coupled plasma with mass spectrometry). When molybdenum concentrations are below roughly 0.5 mg/L, Cotter measures molybdenum by atomic adsorption *graphite furnace* analysis; but at higher concentrations, analysis is by atomic adsorption *flame* analysis. The two quarters with the poor comparisons both had concentration levels below 0.5 mg/L, leading Cotter to infer that the underreporting was associated with the graphite furnace analyses. In January 2009, Cotter proposed several measures that were believed to cause the graphite furnace analyses to perform better, and CDPHE approved of the proposed remedy.

Overall, the "round robin" studies have demonstrated that Cotter's analytical laboratory met pre-specified performance criteria for almost every one of the substances considered. Only for molybdenum was a performance issue noted, and it appears that Cotter's laboratory previously used a method that would understate molybdenum concentrations, but typically only when those concentrations were less than approximately 0.5 mg/L. This issue was observed for samples collected between January 2007 and March 2008, but it likely also affected earlier samples that Cotter's laboratory analyzed; and this negative bias should be considered in any uses of these data. Measurements collected since this timeframe likely do not exhibit the same negative bias, given the changes that Cotter proposed to its analytical methods.

Inter-Laboratory Comparison Results for Molybdenum: First Quarter 2007 & First Quarter 2008

Parameter	Analytical Laboratory			
	Cotter	Laboratory #1	Laboratory #2	Laboratory #3
Inter-Laboratory Comparison for First Quarter 2007				
Measurement 1 (mg/L)	0.012	0.0263	0.027	0.024
Measurement 2 (mg/L)	0.012	0.025	0.027	0.0232
Average (mg/L)	0.012	0.0257	0.027	0.0236
Avg across three comparison laboratories (mg/L)		0.025		
Inter-Laboratory Comparison for First Quarter 2008				
Measurement 1 (mg/L)	0.01	0.0281	0.029	0.0267
Measurement 2 (mg/L)	0.011	0.0274	0.029	0.0274
Average (mg/L)	0.011	0.0278	0.029	0.0271
Avg across three comparison laboratories (mg/L)		0.028		

Note: Every laboratory was supposed to analyze each sample twice, thus providing data allowing for intra-laboratory and inter-laboratory comparisons.

---

[14] CDPHE actually voiced concern about three quarters of Cotter's molybdenum data, even though only two of these three quarters did not meet the pre-established comparability limits.

VII. CONCLUSIONS

ATSDR reached four important conclusions in this public health assessment:

1. ATSDR concludes that drinking water for many years from contaminated private wells could harm people's health. This is a public health hazard.

   Private well sampling data collected from 1984 to 2007 revealed the presence of molybdenum at levels that could harm people's health. A water use survey conducted in Lincoln Park in 1989 revealed that at least seven people used groundwater (from their private wells) for personal consumption. These and other residents whose private wells were affected by the highest molybdenum contamination may be at increased risk for health effects such as gout-like conditions, particularly individuals who do not take in enough dietary copper or cannot process copper correctly.

   The lack of consistent monitoring over the years and the unknown usage of wells before the installation of the public water supply make these past exposures difficult to accurately assess.

   Most town residents are now connected to the public water supply and have eliminated their exposure to the contaminated well water. However, some residents are reported to have refused public water supply connections, and many may still have operational private wells. Additionally, no formal institutional controls exist to control groundwater use in Lincoln Park. Therefore, current and future uses of private wells for domestic purposes are still possible.

2. ATSDR concludes that accidentally eating or touching soil and sediment near the Cotter Mill property or in Lincoln Park will not harm people's health. However, ATSDR cannot make conclusions about soils near Cotter Mill if the properties closest to the facility are developed for residential or other non-industrial uses in the future.

3. ATSDR concludes that eating locally-grown fruits and vegetables irrigated with private well water will not harm most people's health. However, a person eating above-average amounts of fruits and vegetables (4 times the average consumer) might have a low increased risk for developing cancer over a lifetime. As a precaution, residents should limit their use of contaminated well water to irrigate their crops. In all cases, the crops should be thoroughly cleaned prior to eating.

4. ATSDR concludes that ambient air emissions of particle bound radionuclides have not resulted in completed exposures to the public at levels that could cause adverse health outcomes. With the exception of thorium-230 levels observed in 1981 and 1982, associated with excavation of contaminated tailings, every radionuclide monitored has been more than a factor of ten below annual dose based health limits to the public. The excavation releases appear to have only exposed on-site workers, but still below occupational limits at that time.

VIII. RECOMMENDATIONS

Based upon ATSDR's review of the environmental data and the concerns expressed by community members, the following recommendations are appropriate and protective of the health of residents in and around the Lincoln Park area.

- Residents should be informed about the health risks associated with contaminated private wells and advised to connect to the public water supply if possible. Local officials should advise new residents who move to the area of the groundwater contamination and that they should have their water supply tested before using groundwater for household purposes.

- Residents should discontinue of use of any impacted private wells for household purposes, including watering livestock and crops.

- CDPHE should continue to monitor the groundwater contaminant plume to assess whether additional wells may be impacted in the future.

- CDPHE should conduct a water use survey in the affected area to determine how groundwater is being utilized by residents in Lincoln Park.

- CDPHE should evaluate the need for further analysis of lead in soil should the areas adjacent to the Cotter Mill property change current use patterns.

- ATSDR in the short-term, and CDPHE in the long-term, should advise residents who have fruit and vegetable gardens to wash the crops thoroughly before eating them. This measure is just a precaution to remove soil adhering to the surface of the crop.

IX. PUBLIC HEALTH ACTION PLAN

The public health action plan for the site contains a description of actions that have been taken or will be taken by ATSDR or other government agencies at the site. The purpose of the public health action plan is to ensure that this document both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from exposure to the hazardous substances at this site.

Public health actions COMPLETED:

- ATSDR conducted site visits to gather community health concerns, to communicate to identified stakeholders, and to gather relevant site-related data;
- ATSDR's Exposure Investigations and Site Assessment Branch (EISB) performed two Exposure Investigations to 1) evaluate blood lead levels in children living in the Lincoln Park area and 2) evaluate lead in dust in homes in the Lincoln Park area. (These documents are available on our website at www.atsdr.cdc.gov.)

Public health actions PLANNED:

- ATSDR's Health Promotion and Community Involvement Branch (HPCIB) will conduct health-related educational activities in the community, as necessary.
- ATSDR's HPCIB will coordinate community outreach and community involvement activities for the site.
- ATSDR will continue to work with appropriate state and federal agencies and review, if requested, additional relevant environmental data (including the water use survey) as it becomes available.
- ATSDR will re-evaluate and revise the public health action plan if needed. New environmental, toxicological, health outcome data, or implementing the above proposed actions may necessitate the need for additional or alternative actions at this site.

X. SITE TEAM

Teresa Foster, MPH
Environmental Health Scientist
Division of Health Assessment and Consultation
Site and Radiological Assessment Branch

Michael Brooks, CHP
Health Physicist
Division of Health Assessment and Consultation
Site and Radiological Assessment Branch

Debra Joseph, MHA
Community Involvement Specialist
Division of Health Assessment and Consultation
Health Promotion and Community Involvement Branch

Carla Galindo,* MPH
Health Education Specialist
Division of Health Assessment and Consultation
Health Promotion and Community Involvement Branch

Dawn Arlotta, MPH, CHES
Health Education Specialist
Division of Health Assessment and Consultation
Health Promotion and Community Involvement Branch

ATSDR Regional Representatives:

Chris Poulet
Environmental Health Scientist
Division of Regional Operations

David Dorian
Environmental Health Scientist
Division of Regional Operations

Epidemiological Review:

Candis Mayweather Hunter, MSPH
Epidemiologist
Division of Health Studies

*Carla Galindo provided health education input until 2009. Carla is no longer employed at ATSDR.

XI. REFERENCES

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006a. Health Consultation, Blood Lead Levels in Children in the Lincoln Park Neighborhood, Cañon City, Fremont County, Colorado. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/LincolnParkBloodLeadLevels/LincolnPark-BloodLeadLevelsChildrenHC11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006b. Health Consultation, Blood Levels in the Cañon City Vicinity, Fremont County, Colorado. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/CanonCityBloodLevels/BloodLevels-CanonCityEI11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006c. Health Consultation, Lead in Dust in Homes in the Lincoln Park Neighborhood, Cañon City, Fremont County, Colorado. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/LincolnParkDustinLeadinHomes/LincolnPark-LeadinDustHC11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006d. Health Consultation, Exposure Investigation Report: Lead in Indoor Dust, Outdoor Soil, and Blood of Lincoln Park Neighborhood Residents. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/LincolnParkLeadinIndoo%20Dust/LincolnPark-LeadEI11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2007. Toxicological profile for arsenic (update). Atlanta: US Department of Health and Human Services. 2007.

[ATSDR] Agency for Toxic Substances and Disease Registry, 1999. Toxicological profile for uranium (update). Atlanta: US Department of Health and Human Services. September 1999.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2006e. ToxFACTS Chemical Agent Briefing Sheet - Arsenic. Atlanta: US Department of Health and Human Services. January 2006.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2004. Interaction Profile for: arsenic, cadmium, chromium, and lead. Atlanta: US Department of Health and Human Services. May 2004.

[BEIR IV]. Committee on the Biological Effects of Ionizing Radiations, National Research Council. 1988. Health risks of radon and other internally deposited alpha-emitters. Washington DC: National Academy Press.

[CCAT] Colorado Citizens Against Toxic Waste. 2004-2005 Lincoln Park Health Survey, Cañon City, Colorado 81212.

[CDC] Centers for Disease Control and Prevention. 1998. Estimation of the impact of the former Feed Materials Production Center (FMPC) on lung cancer mortality in the surrounding community. Atlanta: US Department of Health and Human Services Public Health Service; 1998 Dec.

[CDPHE 1975] Colorado Department of Public Health and Environment. 1975. Letter to Fred Matter, Cotter Corporation, from Joe Virgona, CDPHE, concerning the chronological report on Cotter Corporation. July 1975.

[CDPHE 2003] Colorado Department of Public Health and Environment, Laboratory Services Division. 2003. Results of Sampling for Plutonium, Uranium, Lead and Molybdenum in the Cañon City Vicinity. July 2003.

[CDPHE 2005] Colorado Department of Public Health and Environment. 2005. Cotter Cañon City Uranium Mill 1988 Remedial Action Plan, Summary and Status – August 2005. Available at: http://www.cdphe.state.co.us/hm/cotter/rapsummary050826.pdf.

[CDPHE 2007a] Colorado Department of Public Health and Environment. 2007a. Letter to Mr. John Hamrick, Cotter Corporation, from Steve Tarlton, CDPHE, concerning the Cotter Corporation Cañon City Mill Impoundments evaluation. June 14, 2007.

[CDPHE 2007b] Colorado Department of Public Health and Environment. 2007b. Cotter Mill Site Monitoring Database: data through September 25, 2007.

[CDPHE 2008] Colorado Department of Public Health and Environment. 2008. Cotter Corporation Uranium Mill Site Description. Available at: http://www.cdphe.state.co.us/hm/cotter/sitedescript.htm.

[CDPHE 2001] Colorado Department of Public Health and the Environment. 2001. 6 CCR 1007-1, Part 18, State Board of Health Licensing Requirements for Uranium and Thorium Processing. Hazardous Materials and Waste Management Division, Radiation Control, November 2001.

[CDPHE 2005b] Colorado Department of Public Health and the Environment. 2005. Cotter Cañon City Uranium Mill 1988 Remedial Action Plan Summary and Status – August 2005b.

[CDPHE 2005c] Colorado Department of Public Health and the Environment. 2005. 6 CCR 1007-1, Part 3, Licensing of Radioactive Material. Hazardous Materials and Waste Management Division, State Board of Health Rules and Regulations Pertaining to Radiation Control, July 2005.

[CDPHE 2009] Colorado Department of Public Health and the Environment. 2009. Radioactive Materials License 369-01, Amendment 50, February 2009.

Chen J, Meyerhof DP, Tracy BL. 2004. Model results of kidney burdens from uranium intakes. Health Phys 86(1):3-11 (2004).

Cotter. 2000. Sand Creek Project Cleanup Report. June 2000.

[Cotter 2007] Environmental and occupational performance report, ALARA review and annual report on remedial action plan activities. Calendar year 2006. Cañon City Milling Facility. June 29, 2007. Available at: http://www.cdphe.state.co.us/hm/cotter/LetterFromCotter/2006perfrpt/.

Cotter. 2008. Operational unit 2 (OU2) Lincoln Park water use survey. April 7, 2008. Available at: http://www.cdphe.state.co.us/hm/cotter/08cotterdocs.htm.

[Cotter 2004a] Cotter Corporation, Cañon City Milling Facility. 2004. Procedure: Environmental Air Particulate Sampling, #EV-020, Revision 5. July 2004.

[Cotter 2004b] Cotter Corporation, Cañon City Milling Facility. 2004. Procedure: Radon-222/220 Air Surveys, #EV-030, Revision 2. July 2004.

[Cotter 2008b] Cotter Corporation, Cañon City Milling Facility. 2008. Environmental and Occupational Performance Report, ALARA Review, and Annual Report on Remedial Action Plan Activities for Calendar Year 2008.

[Cotter 2009b] Cotter Corporation, Cañon City Milling Facility. 2009. Quality Assurance Program Plan for Environmental and Occupational Sampling and Monitoring Studies for the Cotter Corporation, Cañon City Milling Facility and Lincoln Park, Colorado Superfund Site. Prepared by Environmental Alternatives, Inc., May 2009.

Diamond GL. 1989. Biological consequences of exposure to soluble forms of natural uranium. Rad Protect Dosim 26: 23-33.

[DOE] United States Department of Energy. 2003. Fiscal year 2003 status report, Reimbursements to licensees of active uranium and thorium processing sites. Title X of the Energy Policy Act of 1992. September 2003.

[DOE 1993] U.S. Department of Energy. 1993. Order 5400.5 Change 2. Radiation Protection of the Public and the Environment. Office of Environment, Safety, and Health, January, 1993.

[EA] Environmental Alternatives, Inc. 2007. Report on Semi-Annual Review of Well Permits. March 20, 2007. Available at: http://www.cdphe.state.co.us/hm/cotter/LetterFromCotter/wellpermitreview070329.pdf.

[EIA] Energy Information Administration, 2001, Web site: U.S. Department of Energy, http://www.eia.doe.gov/.

Eisenbud M, Quigley JA. 1955. Industrial hygiene of uranium processing. AMA Archives of Industrial Health. p. 12–22.

[EPA] Environmental Protection Agency, Environmental Response Team. 1995. Superfund Program, Representative Sampling Guidance, Volume 1: Soil. Interim Final. Available at: http://www.clu-in.org/download/char/SF_Rep_Samp_Guid_soil.pdf.

[EPA] Environmental Protection Agency. 2002. Record of Decision: Lincoln Park Study Area Surface Soils, Lincoln Park Superfund Site, Cañon City, Colorado. Available at: http://www.epa.gov/region08/superfund/co/lincolnpark/LincolnPkROD.pdf.

[EPA] Environmental Protection Agency, Superfund Technical Assessment and Response Team 2 - Region 8. 2004. Cañon City Lead Data Compilation Report, Cañon City, Fremont County, Colorado. March 24, 2004. Available at: http://www.epa.gov/region8/superfund/co/lincolnpark/.

[EPA] Environmental Protection Agency, Region 8. 2007. Final First 5-year review report for Lincoln Park Superfund site, Operable Unit 2. September 2007. Available at: http://www.epa.gov/region08/superfund/co/lincolnpark/LincolnPark5YrRvw07.pdf.

[EPA] Environmental Protection Agency, Region 8. 2008. Superfund Program: Lincoln Park. Available at: http://www.epa.gov/region8/superfund/co/lincolnpark/.

[EPA] Environmental Protection Agency, Integrated Risk Information System (IRIS). Cincinnati, OH: Office of Health and Environmental Assessment, Environmental Criteria and Assessment. Accessed June 16, 2009 at http://www.epa.gov/ncea/iris/subst/0425.htm.

[FNB] Food and Nutrition Board, Institute of Medicine. 2001. Molybdenum. In: Dietary reference intakes for vitamin A, vitamin K, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington, D.C.: National Academy Press. p. 420–41.

[FDA] US Food and Drug Administration. 2008. Total Diet Study - Summary of Toxic and Nutritional Elements Found in TDS Foods. Accessed August 4, 2009 at . http://www.fda.gov/downloads/Food/FoodSafety/FoodContaminantsAdulteration/TotalDietStudy/UCM184301.pdf.

Galant, M.M., Linnert, T., and J. Dalton. 2007. Community involvement plan: Lincoln Park Superfund site and associated activities at the Cotter Corporation uranium mill. March 2007. Available at: http://www.cdphe.state.co.us/hm/cotter/lincolnparkcottercip.pdf.

[GeoTrans] GeoTrans, Inc. 1986. Remedial Investigation: Cotter Corporation Uranium Mill Site. February 1986.

[HRAP] Health Risk Assessment Panel, Cotter Uranium Mill Site. 1991. Health Risk Assessment of the Cotter Uranium Mill Site, Cañon City, Colorado. Prepared with the assistance of ENVIRON Corporation, Radiation Surveillance Associates, Radiant Energy Management, and Western Radiation Consultants. October 29, 1991.

Hodge HC. 1953. Resume of chapters 18 to 28. In: Voegtlin C and Hodge HC, eds. Pharmacology and toxicology of uranium compounds. National Nuclear Energy Series, Division VI, Vol 1, Part IV. New York: McGraw-Hill.

[IMS] IMS Inc. 1989. Lincoln Park Water Use Survey. Submitted to Cotter Corporation, Lakewood, Colorado. June 28, 1989.

[IPCS] International Programme on Chemical Safety. 2001.Environmental Health Criteria for Arsenic and Arsenic compounds. EHC 224, Chapter 1: Summary, section 4.

Juhasz, Albert L., Euan Smith, John Weber, Matthew Rees, Allan Rofe, Tim Kuchel, Lloyd Sansom, Ravi Naidu, Application of an In Vivo Swine Model for the Determination of Arsenic Bioavailability in Contaminated Vegetables. Chemosphere. Feb 7, 2008.

Killough GG, Case MJ, Meyer KR, et al. 1998. Fernald Dosimetry Reconstruction Project, Task 6—radiation doses and risk to residents from FMPC Operations from 1951-1988. Vol I and II (final report). Radiological Assessments Corporation Report No. CDC-1. Neeses, SC: 1998 Sep

[Koval'skiy] Koval'skiy, V.V., G.A. Yarovaya and D.M. Shmavonyan. 1961. Changes of purine metabolism in man and animals under conditions of molybdenum biogeochemical provinces. Zh. Obshch. Biol. 22: 179-191.

[Kurttio et al] Päivi Kurttio, Anssi Auvinen, Laina Salonen, Heikki Saha, Juha Pekkanen, Ilona Mäkeläinen, Sari B. Väisänen, Ilkka M. Penttilä, and Hannu Komulainen. Renal Effects of Uranium in Drinking Water. Environmental Health Perspectives Volume 110, Number 4, April 2002.

Laizu Jahanara. 2007. Speciation of arsenic in vegetables and their correlation with inorganic phosphate level. Bangladesh J Pharmacol 2007; 2:88-94.

Leggett RW. 1989. The behavior and chemical toxicity of U in the kidney: a reassessment. Health Phys 57(3): 365-383.

Leggett RW. 1994. Basis for ICRP's age-specific biokinetic model for uranium. Health Phys 67: 589-601.

[MFG] MFG, Inc. 2005. Assessment of potential dose to members of the public from materials along roads near the Cotter Corporation, Cañon City Milling Facility. May 2005. Available at: http://www.cdphe.state.co.us/hm/cotter/potentialdoseassessment.pdf.

Madsden KM, Nielsen S, Tisher CC. 2007. Chapter 2 – Anatomy of the Kidney from Brenner: Brenner and Rector's The Kidney, 8th ed. Oxford: Elsevier Science Ltd.

Maynard EA, Hodge HC. 1949. Studies of the toxicity of various uranium compounds when fed to experimental animals. In: Voegtlin IC, Hodge HC, eds. Pharmacology and toxicology of uranium compounds. National Nuclear Energy Series (VI). New York: McGraw-Hill; 309-376.

McDonald-Taylor CK, Singh A, Gilman A. 1997. Uranyl nitrate-induced tubule alterations in rabbits: a quantitative analysis. Toxicol Pathol 25(4): 381-389.

Morris SC, Meinhold AF. 1995. Probabilistic risk assessment of nephrotoxic effect of uranium in drinking water. Health Phys 69: 897-908.

[ODEQ] State of Oregon Department of Environmental Quality. 2003. Memorandum, Red Rock Road Project File, Evaluation Potential for Arsenic and Mercury Uptake into Garden Vegetables. September 22, 2003.

[NHANES] National Health and Nutrition Examination Survey. Third National Report on Human Exposure to Environmental Chemicals, Dept of Health and Human Services, Centers for Disease Control and Prevention. Atlanta, GA. July 2005.

Plasket, BJ. 2002. Cotter at the Crossroads: On the Hot Seat. The Daily Record News Group. Available at: http://www.timescall.com/cotter/cotter24.htm.

Spear JW. Trace mineral bioavailability in ruminants. J. Nutr. 2003; 133: 1506S—1509S.

Spoor NL, Hursh JB. 1973. Protection criteria. In: Hodge HC, Stannard JN, Hursh JB, eds. Handbook of experimental pharmacology. Berlin: Springer-Verlag; 241-270.

Stokinger HE, Baxter RC, Dygent HP, et al. 1953. In: Voegtlin C, Hodge HC, eds. Toxicity following inhalation for 1 and 2 years. National Nuclear Energy Series: Manhattan Project Technical Section, Div VI, Vol 1. New York: McGraw-Hill.

Turnlund JR. Molybdenum metabolism and requirements in humans. Met. Ions Bio. Syst. 2002; 39:727—739.

[USGS] United States Geological Survey. 1999a. Migration and Geochemical Evolution of Ground Water Affected by Uranium-Mill Effluent near Cañon City, Colorado. Water-Resources Investigations Report 98-4228. DT Chafin and ER Banta.

[USGS] United States Geological Survey. 1999b. Ground-Water Hydrology and Simulation of Five Remediation Alternatives for an Area Affected by Uranium-Mill Effluent near Cañon City, Colorado. ER Banta and DT Chafin.

[USNRC 1980] U.S. Nuclear Regulatory Commission. 1980. Regulatory Guide 4.14 Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1. Office of Standards Development, April 1980.

[USNRC 1996] U.S. Nuclear Regulatory Commission. 1996. Regulatory Guide 4.20 Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees other than Power Reactors. Office of Nuclear Regulatory Research, December 1996.

Vousta D, Grimanis A, Samara C. 1996. Trace elements in vegetables grown in an industrial area in relation to soil and air particulate matter. Environ Pollution 94(3):325–35.

[Weston] Roy F. Weston, Inc. 1996. Supplemental Human Health Risk Assessment. Lincoln Park Superfund Site. Cañon City, Colorado. Phase II Evaluation. Baseline Human Health Risks in 1988. Final Report. Prepared for CDPHE. November 19, 1996.

[Weston] Roy F. Weston, Inc. 1998. Supplemental Human Health Risk Assessment, Lincoln Park Superfund Site, Cañon City, Colorado: Phase III Evaluation, Baseline Human Health Risks in 1994-1996. January 1998.

Wilder, RJ, DJ Goode, P Huidobro, MO Kozik, DR Cogley, NH Krusell, ME Connolly, EJ Limberakis, and AW Levin. 1983. Assessment of data concerning ground water contamination in the Lincoln Park section of Cañon City, Colorado. Final report prepared for EPA by GCA Corporation. May 1983.

[WHO] World Health Organization. 2003. Molydbenum in Drinking water: Background document for development of WHO *Guidelines for Drinking-water Quality*.

Zhao LS, Zhao SF. 1990. Nephrotoxic limit and annual limit on intake for natural U. Health Phys 58: 619-623.

Appendix A - Tables

[Page intentionally left blank]

Table 14. Well Use in Lincoln Park, 1989

Well Number	Description	Reported Well Use				
		Personal Consumption	Irrigating Fruit	Irrigating Vegetable Gardens	Watering Livestock	Watering Lawns
117	Logan (LPWUS)		✓			✓
119	Birch (LPWUS)			✓		✓
122	Elm (LPWUS)					✓
123	Cedar (LPWUS)					✓
124	Elm (LPWUS)			✓		✓
129	Elm (LPWUS)		✓	✓		✓
130	Poplar (LPWUS)		✓			✓
138	Field well, Cedar (LPWUS)					✓
139	House well, Cedar (LPWUS)					✓
140	C. R. Ransom house well, Cedar (LPWUS)		✓	✓		✓
144	Cedar (LPWUS)		✓	✓	✓	✓
165	Spring, Elm (LPWUS)	✓		✓		✓
166	Willow (LPWUS)				✓	✓
168	Grand (house well) (LPWUS)	✓			✓	✓
173	Beulah (LPWUS)		✓			✓
174	Chestnut (LPWUS)		✓		✓	✓
189	Hickory (LPWUS)	✓				
198	Grand (LPWUS)	✓	✓	✓	✓	✓
206	Grand (field well) (LPWUS)				✓	
212	Cedar (LPWUS)		✓	✓		✓
219	Locust (LPWUS)	✓				
221	Elm (LPWUS)					✓
222	Elm (LPWUS)					✓

Well Number	Description	Reported Well Use				
		Personal Consumption	Irrigating Fruit	Irrigating Vegetable Gardens	Watering Livestock	Watering Lawns
223	Elm (LPWUS)				✓	
224	Elm (LPWUS)		✓			✓
226	Chestnut (LPWUS)					✓
229	Grand (LPWUS)				✓	✓
230	Birch (LPWUS)		✓			✓
231	Birch (LPWUS)		✓	✓		
235	Elm (LPWUS)				✓	
237	Elm (LPWUS)				✓	
239	Grand (LPWUS)		✓	✓	✓	✓
241	Grand (LPWUS)				✓	
243	Chestnut (LPWUS)					✓
245	Elm (LPWUS)				✓	
246	Elm (LPWUS)		✓			✓
252	Poplar (cistern* in barn) (LPWUS)					✓
255	Riley Dr. (LPWUS)	✓	✓			✓
261	Elm (LPWUS)		✓	✓		✓
262	Cedar (LPWUS)		✓	✓		✓
263	Willow (LPWUS)					✓
264	Chestnut (LPWUS)		✓	✓		✓
266	Willow (LPWUS)		✓	✓		✓
267	Willow (spring) (LPWUS)		✓	✓	✓	✓
269	Birch			✓		✓
273	Willow (cistern #1) (LPWUS)			✓		✓
274	Grand (LPWUS)		✓	✓		✓
278	Cedar (LPWUS)					✓

Well Number	Description	Reported Well Use				
		Personal Consumption	Irrigating Fruit	Irrigating Vegetable Gardens	Watering Livestock	Watering Lawns
280	Grand (LPWUS)				✓	
284	Spring - Grand St. (LPWUS)				✓	
285	Grand (LPWUS)				✓	
286	Willow (cistern #2) (LPWUS)				✓	
287	Willow (LPWUS)			✓		✓
288	Poplar (cistern* on porch)					✓
293	Cedar (LPWUS)		✓	✓	✓	✓
	Totals	6	22	20	19	42

Source: IMS 1989

*Modified from the original spelling: "cystern"
Street numbers have been excluded for privacy reasons.

LPWUS – Lincoln Park Water Use Survey

Table 15. Groundwater sampling data (chemicals) from wells used for personal consumption

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Chloride	N/T*	11/11	4.5	8.8	14	Spring, Elm [165]	13-Mar-84	250 (Secondary MCL)	165, 168	1984, 2005–2007
Iron	D	2/12	0.04	0.06	0.1	Grand (house well) [168]	19-Aug-05	26 (RBC)	165, 168	1984, 2004–2007
Manganese	D	2/12	0.002	0.008	0.01	Grand (house well) [168]	13-Dec-04	0.5 (RMEG, child)	165, 168	1984, 2004–2007
Molybdenum	D	52/59	0.007	**0.082**	**0.28**	Hickory [189]	19-Jan-89	0.035 (SS); 0.05 (RMEG, child)	165, 168, 189, 198, 219, 255	1984, 1988–1991, 1995, 2000–2007
Nitrate	T	8/8	0.5	2.9	7.7	Grand (house well) [168]	19-Mar-07	10 (MCL)	168	2005–2007
Selenium	D	0/2	ND	ND	ND	--	--	0.05 (c-EMEG, child)	165, 168	1984
Sulfate	N/T*	11/11	15	62	214	Grand (house well) [168]	19-Aug-05	250 (Secondary MCL)	165, 168	1984, 2005–2007
Total Dissolved Solids	N/T*	11/11	240	330	410	Spring, Elm [165]	13-Mar-84	500 (Secondary MCL)	165, 168	1984, 2005–2007
Uranium	D	56/57	0.001	0.028	**0.067**	Hickory [189]	15-Dec-06	0.03 (MCL)	165, 168, 189, 198, 219, 255	1984, 1988–1991, 1995, 2001–2007

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The source of water used for personal consumption at 1935 Elm [165] was a spring.

* For chloride, sulfate, and total dissolved solids, 1984 data were designated “N” and 2005–2007 data were designated “T”.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
SS – Colorado state groundwater standard
T – total

Table 16. Groundwater sampling data (chemicals) from background wells

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	0/25	ND	ND	ND	--	10 (c-EMEG, child)	1981, 1988–1994
Ammonia	N	3/45	0.02	0.4	4.2	26-Jan-90	30 (LTHA)	1988–1994
Ammonium	T	0/3	ND	ND	ND	--	NA	1995
Chloride	N/T*	168/168	3	12	110.3	07-Jan-80	250 (Secondary MCL)	1975, 1976, 1978–2007
Iron	D	24/79	0.02	0.03	0.3	16-May-89	26 (RBC)	1981–2007
Manganese	D	13/79	0.005	0.007	0.05	16-Mar-99	0.5 (RMEG, child)	1981–2007
Molybdenum	D	116/193	0.005	0.023	**0.3**	09-Nov-82, 09-Jun-76	0.035 (SS); 0.05 (RMEG, child)	1975, 1976, 1979–2007
Nitrate	N/T*	70/79	0.4	2.5	**50.4****	10-Feb-89	10 (MCL)	1988–2007
Selenium	D	10/103	0.001	0.003	0.015	15-Apr-80	0.05 (c-EMEG, child)	1975, 1977–1988, 1996–2000
Sulfate	N/T*	171/171	10	61	**434§**	18-Aug-80	250 (Secondary MCL)	1975–2007
Total Dissolved Solids	N/T*	171/171	286	429	**1,580†**	18-Aug-80	500 (Secondary MCL)	1980–2007
Uranium	D	155/193	0.004	0.021	**0.29**	07-Aug-79	0.03 (MCL)	1975–1977, 1979–2007

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The USGS identified Well 10 (1220 So. 12th St.) and Well 114 (1408 Pine) as representative of background for the Lincoln Park area (Weston 1998).

* For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated "N" and post-1995 data were designated "T".
** Only two of 79 samples were above the CV.

[§] Only one of 171 samples was above the CV.
[†] The maximum concentration appears to be an outlier. The next highest concentration is 590 mg/L.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
SS – Colorado state groundwater standard
T – total

Table 17. Groundwater sampling data (chemicals) from the Grand Avenue Well

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Chloride	N/T*	10/10	4.5	8.250	11	20-Jun-84, 20-Jun-05	250 (Secondary MCL)	1984, 2005–2007
Iron	D	2/11	0.04	0.06	0.1	19-Aug-05	26 (RBC)	1984, 2004–2007
Manganese	D	2/11	0.002	0.009	0.01	13-Dec-04	0.5 (RMEG, child)	1984, 2004–2007
Molybdenum	D	15/20	0.008	0.01	0.015	21-Jun-04	0.035 (SS); 0.05 (RMEG, child)	1984, 1988–1991, 2004–2007
Nitrate	T	8/8	0.5	2.9	7.7	19-Mar-07	10 (MCL)	2005–2007
Selenium	D	0/1	ND	ND	ND	--	0.05 (c-EMEG, child)	1984
Sulfate	N/T*	10/10	15	58	214	19-Aug-05	250 (Secondary MCL)	1984, 2005–2007
Total Dissolved Solids	N/T*	10/10	240	322	402	19-Mar-07	500 (Secondary MCL)	1984, 2005–2007
Uranium	D	20/20	0.001	0.013	0.0218	28-Mar-05	0.03 (MCL)	1984, 1988–1991, 2004–2007

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
* For chloride, sulfate, and total dissolved solids, 1984 data were designated “N” and 2005–2007 data were designated “T”.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
SS – Colorado state groundwater standard
T – total

Table 18. Groundwater sampling data (chemicals) from wells used to irrigate fruit and vegetable gardens

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Aluminum	D	3/120	0.01	0.186*	0.02	Elm [124] & Elm [129]	15-Mar-95	10 (c-EMEG, child)	117, 119, 124, 129, 130, 140, 144	1981, 1988–1995
Ammonia	N	10/53	0.01	0.3	0.6	house well, Cedar [140]	23-Aug-88	30 (LTHA)	119, 124, 129, 130, 140, 144	1988–1995
Ammonium	T	0/3	ND	ND	ND	--	--	NA	119, 140, 144	1995
Cadmium	D	0/3	ND	ND	ND	--	--	0.002 (c-EMEG, child)	119, 140, 144	1995
Chloride	N/T**	784/793	2.5	19.6	232	house well, Cedar [140]	05-Apr-79	250 (Secondary MCL)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1975, 1976, 1978–2007
Copper	D	0/3	ND	ND	ND	--	--	0.1 (i-EMEG, child)	119, 140, 144	1995
Iron	D	114/398	0.011	0.029	0.31	Elm [129]	21-Apr-03	26 (RBC)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1981–2007
Manganese	D	69/397	0.0007	0.008	0.13	house well, Cedar [140]	09-Sep-94	0.5 (RMEG, child)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1981–2007
Molybdenum	D	1,052/1,077	0.004	0.99	42	house well, Cedar [140]	12-May-73	0.035 (SS); 0.05 (RMEG, child)	All 28 wells (see Table 14)	1968–2007
Nickel	D	0/3	ND	ND	ND	--	--	0.2 (RMEG, child)	119, 140, 144	1995

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Nitrate	N/T**	159/185	0.1	1.7	9.8	Cedar [144]	14-May-70	10 (MCL)	119, 124, 129, 130, 140, 144, 174, 224	1970, 1988–2007
Selenium	D	115/626	0.001	0.003	**0.082**[†]	house well, Cedar [140]	21-Apr-78	0.05 (c-EMEG, child)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224, 264	1974–1988, 1995–2000
Sulfate	N/T**	798/800	8	214	**25,460**[‡]	house well, Cedar [140]	07-May-79	250 (Secondary MCL)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1975–2007
Total Dissolved Solids	N/T**	767/767	31	**550**	**3,438**	house well, Cedar [140]	20-Apr-81	500 (Secondary MCL)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1980–2007
Uranium	D	1,048/1,088	0.0003	**0.13**	**2.54**	house well, Cedar [140]	05-Jan-79	0.03 (MCL)	All 28 wells (see Table 14)	1962–1964, 1967, 1968, 1971, 1974–2007
	S	1/20	0.081	0.005[§]	**0.081**	house well, Cedar [140]	27-May-97		140, 174, 224	1995–2000
Vanadium	D	0/3	ND	ND	ND	--	--	0.03 (i-EMEG, child)	119, 140, 144	1995
Zinc	D	2/3	0.005	0.01	0.022	Birch [119]	25-Aug-95	3 (c-EMEG, child)	119, 140, 144	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The source of water used to water fruits and vegetable gardens at 1935 Elm [165] was a spring.

* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
[†] Only two of 626 samples were above the CV.
[‡] The maximum concentration appears to be an outlier. The next highest concentration is 1,948 mg/L from the same well [140] in 1981.
[§] The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 19. Groundwater sampling data (radionuclides) from wells used to irrigate fruit and vegetable gardens

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Location of Maximum	Date of Maximum	CV (pCi/L)	Wells Sampled	Years Sampled
Lead-210	D	29/29	-0.2	0.22	1.5	Birch [119]	21-Jun-95	NA	119, 140, 144, 174, 224	1995–2000
	S	20/20	-0.1	0.15	0.6	house well, Cedar [140]	22-Feb-96, 05-May-99		140, 174, 224	1995–2000
Polonium-210	D	29/29	-0.1	0.13	0.6	Cedar [144]	08-Mar-95, 21-Jun-95,	NA	119, 140, 144, 174, 224	1995–2000
	S	20/20	0	0.12	0.6	house well, Cedar [140]	22-Feb-96, 05-Dec-96		140, 174, 224	1995–2000
Radium-226	D	29/29	0	0.12	0.5	house well, Cedar [140]	12-May-95	5 (MCL radium-226/228)	119, 140, 144, 174, 224	1995–2000
	S	19/19*	0	0	0	--	--		140, 174, 224	1995–2000
Thorium-230	D	28/28	-0.1	0.08	0.3	Birch [119] house well, Cedar [140]	25-Aug-95 21-Feb-95	NA	119, 140, 144, 174, 224	1995–2000
	S	17/17	0	0.08	0.3	house well, Cedar [140]	05-May-99		140, 174, 224	1995–2000

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
*The detect flag is “Y” for all 19 samples, however, the result value is zero for all 19 samples.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended

Table 20. Groundwater sampling data (chemicals) from wells used to water livestock

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Aluminum	D	0/19	ND	ND	ND	--	--	10 (c-EMEG, child)	144	1981, 1988–1995
Ammonia	N	0/10	ND	ND	ND	--	--	30 (LTHA)	144	1988–1995
Ammonium	T	0/1	ND	ND	ND	--	--	NA	144	1995
Cadmium	D	0/1	ND	ND	ND	--	--	0.002 (c-EMEG, child)	144	1995
Chloride	N/T*	160/160	2.5	14	185	Cedar [144]	24-Aug-83	250 (Secondary MCL)	144, 166, 168, 174	1970, 1975, 1976, 1979–1989, 1991–2007
Copper	D	0/1	ND	ND	ND	--	--	0.1 (i-EMEG, child)	144	1995
Iron	D	27/97	0.03	0.04	0.19	Cedar [144]	18-Oct-01	26 (RBC)	144, 166, 168, 174	1970, 1981–2007
Manganese	D	14/96	0.0007	0.007	0.02	Cedar [144]	13-Jul-81, 13-Sep-83, 17-May-01, 06-Jun-02, 23-Oct-03	0.5 (RMEG, child)	144, 166, 168, 174	1981–2007
Molybdenum	D	271/286	0.006	0.212	1	Cedar [144]	12-May-71	0.035 (SS); 0.05 (RMEG, child)	All 19 wells (see Table 14)	1968–1971, 1975–1977, 1979–2007
Nickel	D	0/1	ND	ND	ND	--	--	0.2 (RMEG, child)	144	1995

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Nitrate	N/T*	55/58	0.1	1.8	9.8	Cedar [144]	14-May-70	10 (MCL)	144, 168, 174	1970, 1988–2007
Selenium	D	10/119	0.001	0.003	0.011	Cedar [144]	19-Mar-80	0.05 (c-EMEG, child)	144, 166, 168, 174	1975–1977, 1979–1988, 1995–2000
Sulfate	N/T*	162/162	10	95	**1,650****	Cedar [144]	18-Aug-80	250 (Secondary MCL)	144, 166, 168, 174	1970, 1975–1977, 1979–1989, 1991–2007
Total Dissolved Solids	N/T*	162/162	195	465	**860**	Cedar [144]	18-Aug-80	500 (Secondary MCL)	144, 166, 168, 174	1970, 1980–2007
Uranium	D	283/302	0.001	**0.034**	**0.46**	Cedar [144]	28-Jun-68	0.03 (MCL)	All 19 wells (see Table 14)	1962–1964, 1967, 1968, 1971, 1975–1977, 1979–2007
	S	0/1	ND	ND	ND	--	--		174	1996
Vanadium	D	0/1	ND	ND	ND	--	--	0.03 (i-EMEG, child)	144	1995
Zinc	D	0/1	ND	ND	ND	--	--	3 (c-EMEG, child)	144	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
** The maximum concentration appears to be an outlier. The next highest concentration is 340 mg/L from the same well [144] in 1984.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 21. Groundwater sampling data (radionuclides) from wells used to water livestock

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Location of Maximum	Date of Maximum	CV (pCi/L)	Wells Sampled	Years Sampled
Lead-210	D	4/4	-0.1	0.1	0.3	Cedar [144]	08-Mar-95	NA	144, 174	1995, 1996
	S	1/1	0.2	0.2	0.2	Chestnut [174]	19-Sep-96		174	1996
Polonium-210	D	4/4	-0.1	0.3	0.6	Cedar [144]	08-Mar-95, 21-Jun-95	NA	144, 174	1995, 1996
	S	1/1*	0	0	0	Chestnut [174]	19-Sep-96		174	1996
Radium-226	D	4/4	0.1	0.1	0.1	--**	--**	5 (MCL radium-226/228)	144, 174	1995, 1996
	S	1/1*	0	0	0	Chestnut [174]	19-Sep-96		174	1996
Thorium-230	D	4/4	0	0.05	0.1	Cedar [144] Chestnut [174]	20-Sep-95 19-Sep-96	NA	144, 174	1995, 1996
	S	1/1*	0	0	0	Chestnut [174]	19-Sep-96		174	1996

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
* The detect flag is “Y” for the one sample, however, the result value is zero.
** All four result values were 0.1 pCi/L.

CV – comparison value
D – dissolved
MCL – maximum contaminant level

NA – not available
pCi/L – picocuries per liter
S – suspended

Table 22. Groundwater sampling data (chemicals) from wells used to water lawns

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Aluminum	D	11/239	0.01	0.19*	0.13	Field well, Cedar [138]	18-Dec-90	10 (c-EMEG, child)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144	1981, 1988–1995
Ammonia	N	21/112	0.01	0.3	0.9	Field well, Cedar [138]	23-Aug-88	30 (LTHA)	119, 122, 123, 124, 129, 130, 138, 139, 140, 144	1988–1995
Ammonium	T	0/5	ND	ND	ND	--	--	NA	119, 138, 139, 140, 144	1995
Cadmium	D	0/5	ND	ND	ND	--	--	0.002 (c-EMEG, child)	119, 138, 139, 140, 144	1995
Chloride	N/T**	1,362/1,372	2.5	30	450	Field well, Cedar [138]	12-Aug-80	250 (Secondary MCL)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1975, 1976, 1978–2007
Copper	D	0/5	ND	ND	ND	--	--	0.1 (i-EMEG, child)	119, 138, 139, 140, 144	1995
Iron	D	205/683	0.005	0.031	0.31	Field well, Cedar [138] Elm [129]	09-Mar-95 21-Apr-03	26 (RBC)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1981–2007

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Manganese	D	134/683	0.0005	0.008	0.13	house well, Cedar [140]	09-Sep-94	0.5 (RMEG, child)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1979, 1981–2007
Molybdenum	D	1,755/1,790	0.004	2.2	56.7	Field well, Cedar [138]	11-Aug-72	0.035 (SS); 0.05 (RMEG, child)	All 42 wells (see Table 14)	1968–2007
Nickel	D	0/5	ND	ND	ND	--	--	0.2 (RMEG, child)	119, 138, 139, 140, 144	1995
Nitrate	N/T**	277/314	0.1	1.8	9.8	Cedar [144]	14-May-70	10 (MCL)	119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 168, 174, 224	1970, 1988–2007
Selenium	D	320/1,105	0.001	0.005	0.134	Field well, Cedar [138]	13-Jul-81	0.05 (c-EMEG, child)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224, 264	1974–1976, 1978–1988, 1995–2000
Sulfate	N/T**	1,382/1,384	8	351	25,460†	house well, Cedar [140]	07-May-79	250 (Secondary MCL)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1975–2007

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Total Dissolved Solids	N/T**	1,311/1,311	31	**746**	**4,373**	Field well, Cedar [138]	06-Mar-81	500 (Secondary MCL)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1980–2007
Uranium	D	1,733/1,789	0.0003	**0.233**	**5.161**	Field well, Cedar [138]	01-Aug-68	0.03 (MCL)	All 42 wells (see Table 14)	1962–1964, 1967, 1968, 1971, 1974–2007
	S	4/38	0.0067	0.010	**0.26**	Field well, Cedar [138]	27-May-97		138, 140, 174, 224	1995–2000
Vanadium	D	0/5	ND	ND	ND	--	--	0.03 (i-EMEG, child)	119, 138, 139, 140, 144	1995
Zinc	D	3/5	0.005	0.007	0.022	Birch [119]	25-Aug-95	3 (c-EMEG, child)	119, 138, 139, 140, 144	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
† The maximum concentration and the second highest concentration (23,200 mg/L from Well 138 in 1978) appear to be outliers. The third highest concentration is 3,360 mg/L from Well 138 in 1979.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 23. Groundwater sampling data (radionuclides) from wells used to water lawns

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Location of Maximum	Date of Maximum	CV (pCi/L)	Wells Sampled	Years Sampled
Lead-210	D	53/53	-0.2	0.2	1.5	Birch [119]	21-Jun-95	NA	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	38/38	-0.1	0.1	0.6	house well, Cedar [140]	22-Feb-96, 05-May-99		138, 140, 174, 224	1995–2000
	T	1/1*	0	0	0	Field well, Cedar [138]	06-Sep-96		138	1996
Polonium-210	D	53/53	-0.1	0.2	0.9	Field well, Cedar [138]	04-May-99	NA	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	38/38	0	0.1	0.6	house well, Cedar [140]	22-Feb-96, 05-Dec-96		138, 140, 174, 224	1995–2000
	T	1/1	0.5	0.5	0.5	Field well, Cedar [138]	06-Sep-96		138	1996
Radium-226	D	51/51	0	0.1	0.5	house well, Cedar [140]	12-May-95	5 (MCL radium-226/228)	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	37/37**	0	0.003	0.1	Field well, Cedar [138]	30-Oct-95		138, 140, 174, 224	1995–2000
	T	2/2	0	0.05	0.1	Field well, Cedar [138]	06-Sep-96		138	1995–1996
Thorium-230	D	51/51	-0.1	0.08	0.4	Field well, Cedar [138]	06-Aug-98	NA	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	34/34	0	0.06	0.3	house well, Cedar [140]	05-May-99		138, 140, 174, 224	1995–2000
	T	1/1	0.1	0.1	0.1	Field well, Cedar [138]	06-Sep-96		138	1996

Source: CDPHE 2007b
Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
* The detect flag is "Y" for the one sample, however, the result value is zero.
** For all but one sample, the result value is zero.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended
T – total

Table 24. Groundwater sampling data (chemicals) from Well 138

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	8/57	0.05	0.23*	0.13	18-Dec-90	10 (c-EMEG, child)	1981, 1988–1995
Ammonia	N	10/42	0.02	0.29	0.9	23-Aug-88	30 (LTHA)	1988–1995
Ammonium	T	0/1	ND	ND	ND	--	NA	1995
Cadmium	D	0/1	ND	ND	ND	--	0.002 (c-EMEG, child)	1995
Chloride	N/T**	199/199	5.5	70	**450**	12-Aug-80	250 (Secondary MCL)	1975, 1976, 1978–2000
Copper	D	0/1	ND	ND	ND	--	0.1 (i-EMEG, child)	1995
Iron	D	21/106	0.01	0.025	0.31	09-Mar-95	26 (RBC)	1981–2000
Manganese	D	21/107	0.01	0.008[§]	0.06	11-Jun-91	0.5 (RMEG, child)	1979, 1981–2000
Molybdenum	D	253/253	**1.1**	**8.0**	**56.7**	11-Aug-72	0.035 (SS); 0.05 (RMEG, child)	1968–1973, 1975, 1976, 1978–2000
Nickel	D	0/1	ND	ND	ND	--	0.2 (RMEG, child)	1995
Nitrate	N/T**	59/62	0.7	2.3	4.1	11-Jun-91	10 (MCL)	1988–2000
Selenium	D	102/151	0.001	0.011	**0.134**[†]	13-Jul-81	0.05 (c-EMEG, child)	1974–1976, 1978–1988, 1995–2000
Sulfate	N/T**	200/200	71	**1,059**	**23,200**[‡]	01-Nov-78	250 (Secondary MCL)	1975, 1976, 1978–2000
Total Dissolved Solids	N/T**	202/202	290	**1,530**	**4,373**	06-Mar-81	500 (Secondary MCL)	1980–2000

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Uranium	D	253/253	0.0005	**0.73**	**5.161**	01-Aug-68	0.03 (MCL)	1968, 1974–1976, 1978–2000
	S	3/18	0.007	0.016	**0.26**	27-May-97		1995–2000
Vanadium	D	0/1	ND	ND	ND	--	0.03 (i-EMEG, child)	1995
Zinc	D	0/1	ND	ND	ND	--	3 (c-EMEG, child)	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
§ The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
† Only three of 151 samples were above the CV.
‡ The maximum concentration appears to be an outlier. The next highest concentration is 3,360 mg/L in 1979.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 25. Groundwater sampling data (radionuclides) from Well 138

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Date of Maximum	CV (pCi/L)	Years Sampled
Lead-210	D	21/21	-0.2	0.22	1.1	03-Aug-95	NA	1995–2000
	S	18/18	0	0.08	0.2	27-May-97, 06-Feb-98, 29-Jul-99, 19-Oct-99		1995–2000
	T	1/1*	0	0	0	06-Sep-96		1996
Polonium-210	D	21/21	0	0.28	0.9	04-May-99	NA	1995–2000
	S	18/18	0	0.11	0.4	28-Aug-00		1995–2000
	T	1/1	0.5	0.5	0.5	06-Sep-96		1996
Radium-226	D	19/19	0	0.13	0.4	21-Mar-96	5 (MCL radium-226/228)	1995–2000
	S	18/18	0	0.006	0.1	30-Oct-95		1995–2000
	T	2/2	0	0.05	0.1	06-Sep-96		1995, 1996
Thorium-230	D	20/20	0	0.07	0.4	06-Aug-98	NA	1995–2000
	S	17/17	0	0.04	0.2	04-May-99, 29-Jul-99		1995–2000
	T	1/1	0.1	0.1	0.1	06-Sep-96		1996

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
*The detect flag is “Y” even though the result value is zero.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended
T – total

Table 26. Surface soil sampling data (chemicals) from eight zones around the Cotter Mill and from Lincoln Park

Chemical		Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Lincoln Park	CV (ppm)
Arsenic	Range (ppm)	**33–69**	**19–39**	**14–42**	**10–40**	**16–38**	**17–60**	**17–33**	**19–86**	**13–50**	0.5 (CREG), 20 (c-EMEG, child)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (ppm)	**45**	**30**	**25**	**26**	**28**	**35**	**26**	**42**	**31**	
Beryllium	Range (ppm)	0.5–1.6	0.5–0.9	0.6–1	0.5–1.2	0.6–1.7	0.5–0.7	0.6–0.7	0.5–0.9	0.5–1.7	100 (c-EMEG, child)
	Frequency of Detection	9/10	11/12	9/12	10/10	6/8	8/8	4/4	7/8	72/73	
	Average (ppm)	0.8	0.7	0.7	0.6	0.7	0.6	0.7	0.6	0.7	
Cadmium	Range (ppm)	**1.2–15**	**2.1–13**	**2.2–16**	2.5–6.8	**5.3–18**	**8.9–110**	**1.6–20**	**4.4–51**	0.5–5	10 (c-EMEG, child)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	68/73	
	Average (ppm)	6.9	6.4	6.4	4.1	9.8	**36.5**	7.9	**21.1**	1.4	
Lead	Range (ppm)	43–270	45–240	46–260	47–130	100–280	**68–800**	**37–450**	**61–1,400**	17–270	400 (SSL)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (ppm)	132	104	113	74	173	380	201	**445**	120	
Manganese	Range (ppm)	180–480	320–630	200–500	110–750	150–420	140–400	200–370	210–770	290–640	3,000 (RMEG , child)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (ppm)	336	422	356	391	298	268	290	439	424	
Selenium	Range (ppm)	5–7	39	7–16	5	ND	ND	ND	7	5–44	300 (c-EMEG, child)
	Frequency of Detection	5/10	1/12	2/12	1/10	0/8	0/8	0/4	1/8	7/73	
	Average (ppm)	4.2*	5.5*	4*	2.8*	ND	ND	ND	3.1*	3.5*	

Source: Weston 1998

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.

Each sample is a composite of four subsamples collected from the corners of a 10x10 square established near the center of the grid.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.
See Figure for a map of the sampling zones.

* The calculated averages are lower than the minimum detected concentrations due to including ½ the detection limit in the calculation.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
ND – not detected
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 27. Surface soil sampling data (radionuclides) from eight zones around the Cotter Mill and from Lincoln Park

Radionuclide		Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Lincoln Park	CV (pCi/g)
Lead-210	Range (pCi/g)	1.6–9.7	3.0–14.4	2.5–6.0	2.3–4.5	2.6–6.1	2.7–4.9	1.2–4.4	1.5–4.7	0.7–4.2	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	58/58	
	Average (pCi/g)	6.3	8.2	4.1	3.4	4.4	3.9	2.9	2.6	2.1	
Radium-226	Range (pCi/g)	2.4–10.7	3.6–16.5	1.3–5.7	1.4–2.3	2.5–5.6	1.9–3.0	1.4–1.9	1.2–2.2	1.1–2.2	5 (UMTRCA, surface)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	58/58	
	Average (pCi/g)	6.6	9.2	2.6	1.8	3.9	2.5	1.7	1.5	1.5	
Thorium-230	Range (pCi/g)	3.6–35.3	5.8–40.1	1.6–21.7	1.8–4.4	4.3–12.1	3.6–8.3	1.7–2.8	1.6–11.9	1.0–4.2	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	58/58	
	Average (pCi/g)	17.7	20.9	5.9	2.5	7.7	5.2	2.4	3.3	1.7	
Uranium, natural	Range (pCi/g)	0.871–4.288	1.541–5.427	0.737–5.628	0.737–1.64	1.005–2.412	0.6432–1.943	0.5561–1.005	0.536–1.206	0.6566–3.417	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (pCi/g)	2.45	3.29	1.98	1.17	1.52	1.21	0.83	0.73	1.215	
Uranium-234	Range (pCi/g)	0.436–2.14	0.771–2.71	0.369–2.81	0.369–0.82	0.503–1.21	0.322–0.972	0.278–0.503	0.268–0.603	0.328–1.709	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (pCi/g)	1.23	1.65	0.991	0.584	0.758	0.606	0.413	0.366	0.607	

Radionuclide		**Zone A**	**Zone B**	**Zone C**	**Zone D**	**Zone E**	**Zone F**	**Zone G**	**Zone H**	**Lincoln Park**	**CV (pCi/g)**
Uranium-238	Range (pCi/g)	0.436–2.14	0.771–2.71	0.369–2.81	0.369–0.82	0.503–1.21	0.322–0.972	0.278–0.503	0.268–0.603	0.328–1.709	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (pCi/g)	1.23	1.65	0.991	0.584	0.758	0.606	0.413	0.366	0.607	

Source: Weston 1998

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that radionuclide.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.
Each sample is a composite of four subsamples collected from the corners of a 10x10 square established near the center of the grid.
See Figure for a map of the sampling zones.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 28. Surface soil sampling data (radionuclides) from the county road and the Cotter Uranium Mill access road

Radionuclide		Samples from background areas	Samples along the county road	Samples along the access road*	CV
Radium-226	Range (pCi/g)	0.8–2.1	3.8–14	2.7–**351**	5 pCi/g (UMTRCA, surface)
	Frequency of Detection	5/5	5/5	6/6	
	Average (pCi/g)	1.42	7.7	**65**	
Thorium-230	Range (pCi/g)	0.2–2.4	9.7–25	10–395	NA
	Frequency of Detection	3/5	5/5	6/6	
	Average (pCi/g)	1.53	20	87	
Uranium, natural	Range (ppm)	1.18–3.05	5.28–29.2	4.31–922	100 ppm (i-EMEG, child for highly soluble salts)
	Frequency of Detection	5/5	5/5	6/6	
	Average (ppm)	1.87	13.6	**161**	
Uranium-238**	Range (pCi/g)	0.39–1.01	1.74–9.64	1.42–304	NA
	Frequency of Detection	5/5	5/5	6/6	
	Average (pCi/g)	0.62	4.5	53	
Gamma Exposure Rates	Range (µR/hr)	NA	13.8–55.3	18.6–893	NA
	Frequency of Detection	NA	NA	NA	
	Average (µR/hr)	15.7	25.8	73.7	

Source: MFG 2005

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value.
Each sample consists of 10 aliquots taken from 0–6 inches within a 100 m^2 area.
See Figure for a map of the sampling locations.

*There is limited potential for exposure to contaminants along the access road since access to the Cotter Mill is restricted and soils along the access road were remediated in 2007 and 2008.
**Uranium-238 concentrations were calculated by multiplying the natural uranium concentrations by 0.33.

CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
µR/hr – microroentgen per hour
NA – not available
pCi/g – picocuries per gram
ppm – parts per million
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 29. Soil data (chemicals) from samples taken by CDPHE, January 2003

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Location of Maximum	CV (ppm)
Lead	20/20	23	410	3,651*	Private barn in Lincoln Park (dust sample)	400 (SSL)
Molybdenum	0/20	ND**	ND**	ND**	--	300 (RMEG , child)
Uranium	20/20	1.2	6.0	31	Mill Entrance Road	100 (i-EMEG, child for highly soluble salts)

Source: CDPHE 2003, 2007b

Concentrations from the Background Location§

Lead	36 ppm
Molybdenum	ND
Uranium	1.3 ppm

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
See Figure for a map of the sampling locations.
The sampling event was intentionally biased toward finding the highest amounts of contamination possible (CDPHE 2003).

*The second highest lead concentration is 908 ppm from a location northwest of the Cotter Mill.
**The molybdenum detection limit was 25 ppm.
§ Concentrations from the background location on the corner of Orchard Avenue and High Street were not included in the table.

CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ND – not detected
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA's soil screening level for residential areas

Table 30. Soil data (radionuclides) from samples taken by CDPHE, January 2003

Radionuclide	Frequency of Detection	Minimum (pCi/g)	Average (pCi/g)	Maximum (pCi/g)	Location of Maximum	CV (pCi/g)
Cesium-137	20/20	0	0.64	1.33	Private residence in Lincoln Park (dust sample)	NA
Lead-210	20/20	1.9	9.7	22.8	East of the Cotter Mill	NA
Plutonium-239, 240	9/20	0.03	0.03*	0.06	East of the Cotter Mill & a private residence in Lincoln Park (dust sample)	NA
Potassium-40	20/20	17.6	22.6	31.9	East of the Cotter Mill	NA
Radium-226	20/20	1.4	7.8	21.2	East of the Cotter Mill	15 (UMTRCA, subsurface)
Radium-228	20/20	0.6	1.0	1.3	Private barn in Lincoln Park (dust sample), private residence in Lincoln Park (dust sample), Pine St near Elm Ave in Lincoln Park (sediment sample), Northwest of the Cotter Mill	15 (UMTRCA, subsurface)

Source: CDPHE 2003, 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that radionuclide.
Averages were calculated using ½ the reporting detection limit for non-detects.
See Figure for a map of the sampling locations.
The sampling event was intentionally biased toward finding the highest amounts of contamination possible (CDPHE 2003).

* The calculated average is the same as the minimum detected concentration due to including ½ the detection limit in the calculation.
** Concentrations from the background location on the corner of Orchard Avenue and High Street were not included in the table.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Concentrations from the Background Location**

Cesium-137	0.2 pCi/g
Lead-210	3.2 pCi/g
Plutonium-239, 240	ND
Potassium-40	19.5 pCi/g
Radium-226	1.9 pCi/g
Radium-228	1.0 pCi/g

Table 31. Surface soil sampling data from 10 air monitoring locations

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Location of Maximum	Date of Maximum	Years Sampled	CV (ppm)
Molybdenum	106/134	0.6	15.1	251.3	AS-204 (West Boundary)	2002	1992–2006*	300 (RMEG, child)
Radionuclide	**Frequency of Detection**	**Minimum (pCi/g)**	**Average (pCi/g)**	**Maximum (pCi/g)**	**Location of Maximum**	**Date of Maximum**	**Years Sampled**	**CV (pCi/g)**
Radium-224**	10/10	-5.7	-2.9	0.3	Lincoln Park	2006	2006	5 (UMTRCA, surface)
Radium-226	246/251	<0.5	3.9	**53.5**	AS-209 (Mill Entrance Road)	2002	1979–2006[†]	5 (UMTRCA, surface)
Thorium-230	107/107	0.4	22.2	354	AS-209 (Mill Entrance Road)	2002	1996–2006	NA
Thorium-232	60/60	0.5	1.4	7.9	AS-209 (Mill Entrance Road)	2002	2001–2006	NA
Uranium	258/262	<0.001	4.6	73.6	AS-209 (Mill Entrance Road)	2002	1979–2006	NA

Source: Cotter 2007; GeoTrans 1986

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value.
Uranium and radium-226 were also tested in soil from two additional off-site locations (Oro Verde #1 and Oro Verde #2) in 1983 and 1984.
See Figure for a map of the air monitoring locations.

*Data from 2006 are unavailable.
**Data are blank corrected.
[†] Results from 2005 were not reported based on quality assurance analysis (Cotter 2007).

CV – comparison value
NA – not available
pCi/g – picocuries per gram
ppm – parts per million
RMEG – reference dose media evaluation guide
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 32. Soil sampling data (chemicals) from location AS-212 (the Nearest Resident)

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Date of Maximum	Years Sampled	CV (ppm)
Lead	1/1	199	199	199	15-Jan-03	2003	400 (SSL)
Molybdenum	7/8	1.6	11.3	42.4	2005	1999–2005	300 (RMEG , child)
Uranium	1/1	4.9	4.9	4.9	15-Jan-03	2003	100 (i-EMEG, child for highly soluble salts)

Source: CDPHE 2007b, Cotter 2007

Averages were calculated using ½ the reporting detection limit for non-detects.
See Figure for the location of AS-212, the nearest resident.

CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 33. Soil sampling data (radionuclides) from location AS-212 (the Nearest Resident)

Radionuclide	Frequency of Detection	Minimum (pCi/g)	Average (pCi/g)	Maximum (pCi/g)	Date of Maximum	Years Sampled	CV (pCi/g)
Cesium-137	1/1	0.61	0.61	0.61	15-Jan-03	2003	NA
Lead-210	1/1	8	8	8	15-Jan-03	2003	NA
Plutonium-239, 240	1/1	0.03	0.03	0.03	15-Jan-03	2003	NA
Potassium-40	1/1	17.7	17.7	17.7	15-Jan-03	2003	NA
Radium-224*	1/1	-3.6	-3.6	-3.6	2006	2006	5 (UMTRCA, surface)
Radium-226	8/8	1.4	3.3	7.5	2004	1999–2004, 2006	5 (UMTRCA, surface)
Radium-228	1/1	0.9	0.9	0.9	15-Jan-03	2003	5 (UMTRCA, surface)
Thorium-230	8/8	3.3	10.1	20	2004	1999–2006	NA
Thorium-232	6/6	0.7	1.0	1.1	2001, 2002	2001–2006	NA
Uranium	8/8	2.0	5.2	13	2004	1999–2006	NA

Source: CDPHE 2007b, Cotter 2007

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that radionuclide.
See Figure for the location of AS-212, the nearest resident.

*Data are blank corrected.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 34. Surface soil sampling data (chemicals) from lawns and gardens in Lincoln Park

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Location of Maximum	Years Sampled	CV (ppm)
Arsenic	15/15	31	44	50	garden soil	1996	0.5 (CREG), 20 (c-EMEG, child)
Beryllium	14/15	0.5	0.7	1.1	lawn soil	1996	100 (c-EMEG, child)
Cadmium	14/15	0.5	1.2	1.9	lawn soil	1996	10 (c-EMEG, child)
Manganese	15/15	290	428	640	lawn soil	1996	3,000 (RMEG , child)
Selenium	1/32	18	1.7*	18	garden soil	1990, 1996	300 (c-EMEG, child)

Source: Weston 1996 (some or all of these data may also be included in Table)

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.

* The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
ppm – parts per million
RMEG – reference dose media evaluation guide

Table 35. Surface soil sampling data (radionuclides) from yards, gardens, and air monitoring locations in Lincoln Park

Radionuclide	Frequency of Detection	Minimum (pCi/g)	Average (pCi/g)	Maximum (pCi/g)	Source of Maximum	Years Sampled	CV (pCi/g)
Lead-210	17/17	0.4	1.6	2.5	0–2” garden sample	1990	NA
Polonium-210	17/17	1.1	1.7	2.6	0–2” garden sample	1990	NA
Radium-226	19/19	0.8	1.5	2.0	0–2” garden sample	1987, 1988, 1990	5 (UMTRCA, surface)
Thorium-228	17/17	1.0	1.4	1.8	0–2” garden sample	1990	NA
Thorium-230	17/17	1.0	1.5	2.3	0–2” garden sample	1990	NA
Uranium-234	29/29	0.355	1.23	1.95	Soil from the yard of a participant in the LPWUS	1987–1990	NA
Uranium-235	0/17	ND*	ND*	ND*	--	1990	NA
Uranium-238	29/29	0.355	1.21	1.95	Soil from the yard of a participant in the LPWUS	1987–1990	NA

Source: Weston 1996

*The uranium-235 detection limit was 0.2 pCi/g.

CV – comparison value
LPWUS – Lincoln Park Water Use Survey
NA – not available
ND – not detected
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 36. Surface soil data (chemicals) from lawns and gardens in Lincoln Park

Chemical		Samples from locations irrigated with contaminated well water	Samples from locations not irrigated with contaminated well water	CV (ppm)
Arsenic	Range (ppm)	14–50	13–38	0.5 (CREG), 20 (c-EMEG, child)
	Frequency of Detection	26/26	47/47	
	Average (ppm)	36*	28*	
Beryllium	Range (ppm)	0.5–1.1	0.6–1.7	100 (c-EMEG, child)
	Frequency of Detection	25/26	47/47	
	Average (ppm)	0.7	0.8	
Cadmium	Range (ppm)	0.6–1.9	0.5–5	10 (c-EMEG, child)
	Frequency of Detection	23/26	45/47	
	Average (ppm)	1.2	1.5**	
Lead	Range (ppm)	17–270†		400 (SSL)
	Frequency of Detection	73/73†		
	Average (ppm)	122	121	
Manganese	Range (ppm)	290–640	320–580	3,000 (RMEG , child)
	Frequency of Detection	26/26	47/47	
	Average (ppm)	430	421**	
Molybdenum	Range (ppm)	*Data not available*§	*Data not available*§	300 (RMEG , child)
	Frequency of Detection	*Data not available*§	*Data not available*§	
	Average (ppm)	1.7*	0.5*	
Selenium	Range (ppm)	18	5–44	300 (c-EMEG, child)
	Frequency of Detection	1/26	6/47	
	Average (ppm)	3.1	3.8	
Uranium	Range (ppm)	*Data not available*§	*Data not available*§	100 (i-EMEG, child for highly soluble salts)
	Frequency of Detection	*Data not available*§	*Data not available*§	
	Average (ppm)	2.3*	1.6*	

Source: Weston 1998

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.

*The concentrations were statistically higher in irrigated soil samples.
**The calculated averages for cadmium and manganese differ slightly from the reported mean concentrations in Table 3-3.
†The raw data for lead are not presented by whether the samples were taken from locations irrigated with contaminated well water. However, Table 3-3 presents the mean concentrations by manner of irrigation.
§The raw data for molybdenum and uranium are not presented in the report. Therefore, the range and frequency of detection could not be determined. Table 3-3 presents the mean concentrations.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 37. Surface soil data (radionuclides) from lawns and gardens in Lincoln Park

Radionuclide		Samples from locations irrigated with contaminated well water	Samples from locations not irrigated with contaminated well water	CV (pCi/g)
Lead-210	Range (pCi/g)	0.8–3.0	0.7–4.2	NA
	Frequency of Detection	11/11	47/47	
	Average (pCi/g)	2.2	2.1*	
Radium-226	Range (pCi/g)	1.3–1.7	1.1–2.2	5 (UMTRCA, surface)
	Frequency of Detection	11/11	47/47	
	Average (pCi/g)	1.4	1.5	
Thorium-230	Range (pCi/g)	1.1–2.2	1.0–4.2	NA
	Frequency of Detection	11/11	47/47	
	Average (pCi/g)	1.6*	1.7	
Uranium, natural	Range (pCi/g)	0.871–3.417	0.6566–2.077	NA
	Frequency of Detection	26/26	47/47	
	Average (pCi/g)	1.514	1.05	
Uranium-234	Range (pCi/g)	0.436–1.709	0.328–1.039	NA
	Frequency of Detection	26/26	47/47	
	Average (pCi/g)	0.755	0.525	
Uranium-238	Range (pCi/g)	0.436–1.709	0.328–1.039	NA
	Frequency of Detection	26/26	47/47	
	Average (pCi/g)	0.755	0.525	

Source: Weston 1998

The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.

*The calculated averages for lead-210 and thorium-230 differ slightly from the reported mean concentrations in Table 3-3.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 38. Sediment sampling data (chemicals) from Sand Creek

Chemical	Location Concentration (ppm)						CV (ppm)
	SD01	SD02*	SD04			SD05	
			1	2	3		
Arsenic	NA	13.7	13	NA	17	<5	20 (c-EMEG, child)
Cadmium	NA	3.9	7.2	NA	7.6	1.5	10 (c-EMEG, child)
Cobalt	NA	11.3	43	NA	21	10	500 (i-EMEG, child)
Copper	19	52.3	46	NA	38	19	500 (i-EMEG, child)
Lead	27	106	93	NA	130	22	400 (SSL)
Molybdenum	4.4	2.6	8	NA	7.9	9.4	300 (RMEG , child)
Nickel	NA	17	63	NA	28	18	1,000 (RMEG, child)
Zinc	NA	343	540	NA	580	106	20,000 (c-EMEG, child)

Source: GeoTrans 1986

SD01 – mouth near the Arkansas River
SD02 – near spring where flow begins (reflects migration of contaminants in the groundwater)
SD04 – below the SCS Dam in
(1) an abandoned stock watering pond (formed by diversion of runoff water into a depression adjacent to Sand Creek)
(2) in drainage (reflects historical picture of uncontrolled emissions)
(3) in drainage above #2 (reflects historical picture of uncontrolled emissions)
SD05 – above the SCS Dam adjacent to the west property edge

Bolded text indicates that the concentration exceeded the comparison value for that chemical.
Samples were collected July 10–20, 1985.

*Values are the mean of three field replicates.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA's soil screening level for residential areas

Table 39. Sediment sampling data (radionuclides) from Sand Creek

Radionuclide	Location Average (pCi/g)						CV
	SD01	SD02	SD04			SD05	
			1	2	3		
Gross Alpha	22±3	47±9	240±40	74±9	39±7	22±5	NA
Gross Beta	29±6	43±8	90±20	34±7	32±7	32±6	NA
Radium-226	1.21±0.06	1.7±1	**12.8±0.6**	3.5±0.2	3.4±0.2	2.3±1	5 (UMTRCA, surface)
Throium-230	4.6±0.3	34±2	82±4	32±2	15.5±0.8	5.2±0.3	NA
Total Uranium	2.4	4.3	11.7	3.4	3.4	3.9	NA

Source: GeoTrans 1986

SD01 – mouth near the Arkansas River
SD02 – near spring where flow begins (reflects migration of contaminants in the groundwater)
SD04 – below the SCS Dam in
(1) an abandoned stock watering pond (formed by diversion of runoff water into a depression adjacent to Sand Creek)
(2) in drainage (reflects historical picture of uncontrolled emissions)
(3) in drainage above #2 (reflects historical picture of uncontrolled emissions)
SD05 – above the SCS Dam adjacent to the west property edge

Bolded text indicates that the concentration exceeded the comparison value for that radionuclide.
Samples were collected July 10–20, 1985.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 40. Chemical sampling for the Sand Creek Cleanup Project

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	CV (ppm)
Arsenic	7/7	2.7	3.9	6.9	20 (c-EMEG, child)
Barium	7/7	69	106	160	10,000 (c-EMEG, child)
Beryllium	7/7	0.2	0.3	0.6	100 (c-EMEG, child)
Chromium	7/7	7.4	9.5	12.8	200 (RMEG, child for hexavalent chromium)
Lead	7/7	17	35	75	400 (SSL)
Manganese	7/7	258	343	502	3,000 (RMEG , child)
Molybdenum	7/7	2.1	2.8	3.5	300 (RMEG , child)
Nickel	7/7	8	10.9	16	1,000 (RMEG , child)
Selenium	0/7	ND*	ND*	ND*	300 (c-EMEG, child)
Vanadium	7/7	16.1	20.3	26.1	200 (i-EMEG, child)

Source: Cotter 2000

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Samples were collected in April and May 1998.

*The selenium detection limit was 5 ppm.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ND – not detected
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 41. Surface water sampling data (chemicals) from Sand Creek

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	0/2	ND	ND	ND	--	10 (c-EMEG, child)	1988
Ammonia	N	2/35	0.5	0.43*	0.8	10-Nov-88	30 (LTHA)	1988–1994
Ammonium	T	0/3	ND	ND	ND	--	NA	1995
Chloride	N/T**	92/92	3	8	14	13-May-04	250 (Secondary MCL)	1986–2007
Iron	D	21/55	0.03	0.04	0.26	07-Nov-02	26 (RBC)	1986–1988, 1995–2007
Manganese	D	36/55	0.0084	0.04	**1.3**[†]	19-Nov-01	0.5 (RMEG, child)	1986–1988, 1995–2007
Molybdenum	D	98/104	0.005	0.02	**0.051**[†]	01-Dec-87	0.035 (SS); 0.05 (RMEG, child)	1986–2007
Nitrate	N/T**	75/87	0.5	1.1	4.7	03-May-06	10 (MCL)	1988–2007
Selenium	D	0/8	ND	ND	ND	--	0.05 (c-EMEG, child)	1986–1988
Sulfate	N/T**	94/94	12	65	**310**[†]	11-Oct-96	250 (Secondary MCL)	1986–2007
Total Dissolved Solids	N/T**	99/99	10.7	369	**1,372**[‡]	22-Aug-91	500 (Secondary MCL)	1986–2007
Uranium	D	101/101	0.006	0.012	0.0267	01-Aug-95	0.03 (MCL)	1986–2007
	S	8/48	0.000098	0.001	0.0031	10-Jan-00		1995–2007

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated "N" and post-1995 data were designated "T".

[†] Only the maximum concentration was above the CV.

[‡] This appears to be an outlier. The next highest concentration is 460 mg/L. Only the maximum concentration was above the CV.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 42. Surface water sampling data (radionuclides) from Sand Creek

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Date of Maximum	CV (pCi/L)	Years Sampled
Lead-210	D	40/49	-0.2	0.39	3.7	06-Aug-07	NA	1995–2007
	S	40/49	-0.1	0.40	4.6	06-Aug-07		1995–2007
Polonium-210	D	41/49	-0.1	0.15	0.6	28-Nov-06	NA	1995–2007
	S	40/49	0	0.13	1.6	09-Nov-99		1995–2007
Radium-226	D	45/49	0	0.12	0.6	03-May-06	5 (MCL radium-226/228)	1995–2007
	S	42/47	0	0.06	0.4	09-Nov-99, 28-Nov-06		1995–2007
Thorium-230	D	44/49	-0.1	0.13	0.8	28-Nov-06	NA	1995–2007
	S	41/46	0	0.16	0.9	06-Aug-07		1995–2007

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended

Table 43. Surface water sampling data (chemicals) from the DeWeese Dye Ditch

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	1/4	0.02	0.06*	0.02	14-Jun-95	10 (c-EMEG, child)	1981, 1995
Ammonia	N	0/2	ND	ND	ND	--	30 (LTHA)	1989, 1995
Chloride	N/T**	95/102	2	7	18	08-May-01	250 (Secondary MCL)	1981–1989, 1995–2007
Iron	D	22/50	0.029	0.9	**43**[†]	09-Jun-99	26 (RBC)	1981–1987, 1995–2007
Manganese	D	28/50	0.004	0.05	**1.9**[‡]	09-Jun-99	0.5 (RMEG, child)	1981–1987, 1995–2007
Molybdenum	D	10/120	0.001	0.013[§]	0.013	06-Aug-03	0.035 (SS); 0.05 (RMEG, child)	1981–2007
Nitrate	N/T**	7/26	0.1	0.3	0.8	10-May-00, 02-Aug-06	10 (MCL)	1989, 1995–2007
Selenium	D	4/76	0.005	0.003[††]	0.011	22-Jun-87, 25-Apr-88	0.05 (c-EMEG, child)	1981–1988, 1995
Sulfate	N/T**	102/102	6	31	95	28-Apr-82	250 (Secondary MCL)	1981–1989, 1995–2007
Total Dissolved Solids	N/T**	119/119	12.9	231	**1,647**[‡‡]	10-Sep-90	500 (Secondary MCL)	1981–2007
Uranium	D	86/116	0.0004	0.01	**0.11**[§§]	05-May-83	0.03 (MCL)	1981–2007
	S	0/8	ND	ND	ND	--		1996–1999

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.

* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
[†] This appears to be an outlier. The next highest concentration is 0.24 mg/L from the same location in 2003. Only the maximum concentration was above the CV.
[‡] Only the maximum concentration was above the CV.
[§] The calculated average is the same as the maximum detected concentration due to including ½ the detection limit in the calculation.

[††] The calculated average is the lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
[‡‡] This appears to be an outlier. The next highest concentration is 870 mg/L. Only three of the 119 samples were above the CV.
[§§] Only three of the samples were above the CV.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 44. Surface water sampling data (radionuclides) from the DeWeese Dye Ditch

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Date of Maximum	CV (pCi/L)	Years Sampled
Lead-210	D	8/8	0	0.3	1.2	09-May-96	NA	1996–1999
	S	8/8	0	0.09	0.2	12-May-97		1996–1999
Polonium-210	D	8/8	0	0.1	0.2	09-Jun-99, 02-Sep-99	NA	1996–1999
	S	8/8	0	0.05	0.2	09-Jun-99		1996–1999
Radium-226	D	8/8	0	0.04	0.1	09-May-96, 16-Jul-96, 02-Sep-99	5 (MCL radium-226/228)	1996–1999
	S	7/7	0	0.01	0.1	02-Sep-99		1996–1999
Thorium-230	D	8/8	0	0.025	0.2	12-May-97	NA	1996–1999
	S	7/7	0	0.07	0.2	09-Sep-98		1996–1999

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended

Table 45. Surface water sampling data (chemicals) from the Arkansas River

Chemical	Type		Upstream of Sand Creek at 1st Street (907)	Downstream of Sand Creek at Mackenzie Ave (904)	CV (mg/L)
Chloride	T	Range (mg/L)	3–60	3–14	250 (Secondary MCL)
		Frequency of Detection	127/130	127/130	
		Average (mg/L)	8	8	
Molybdenum	D	Range (mg/L)	0.0029–**0.046**	0.003–0.029	0.035 (SS); 0.05 (RMEG, child)
		Frequency of Detection	32/142	46/142	
		Average (mg/L)	0.025	0.025	
Molybdenum	S	Range (mg/L)	0.0019–0.022	0.0017–0.016	0.035 (SS); 0.05 (RMEG, child)
		Frequency of Detection	8/135	6/135	
		Average (mg/L)	0.025	0.025	
Molybdenum	T	Range (mg/L)	0.006	0.005	0.035 (SS); 0.05 (RMEG, child)
		Frequency of Detection	1/7	1/7	
		Average (mg/L)	0.003*	0.003*	
Sulfate	T	Range (mg/L)	10–**1,300****	5–**4,200****	250 (Secondary MCL)
		Frequency of Detection	130/130	130/130	
		Average (mg/L)	41	84	
Total Dissolved Solids	T	Range (mg/L)	45–**2,880**†	62–337	500 (Secondary MCL)
		Frequency of Detection	130/130	130/130	
		Average (mg/L)	172	192	
Uranium	D	Range (mg/L)	0.0003– 0.0135	0.0002–0.0155	0.03 (MCL)
		Frequency of Detection	129/130	130/130	
		Average (mg/L)	0.004	0.005	
Uranium	S	Range (mg/L)	0.0002– 0.014	0.0002–0.0043	0.03 (MCL)
		Frequency of Detection	16/121	14/121	
		Average (mg/L)	0.001	0.001	
Uranium	T	Range (mg/L)	0.0033–0.0056	0.0029–0.0054	0.03 (MCL)
		Frequency of Detection	7/7	7/7	
		Average (mg/L)	0.004	0.004	

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
All samples were collected between 1995 and 2007. The "T" samples for uranium were only collected in 1995.
* The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
** This appears to be an outlier. The next highest concentration is 200 mg/L. Only the maximum concentration was above the CV.
† This appears to be an outlier. The next highest concentration is 405 mg/L. Only the maximum concentration was above the CV.

CV – comparison value	mg/L – milligrams per liter	SS – Colorado state groundwater standard
D – dissolved	RMEG – reference dose media evaluation guide	T – total
MCL – maximum contaminant level	S – suspended	

Table 46. Surface water sampling data (radionuclides) from the Arkansas River

Radionuclide	Type		Upstream of Sand Creek at 1st Street (907)	Downstream of Sand Creek at Mackenzie Ave (904)	CV (pCi/L)
Lead-210	D	Range (pCi/L)	ND	3.7	NA
		Frequency of Detection	0/1	1/1	
		Average (pCi/L)	ND	3.7	
Lead-210	S	Range (pCi/L)	ND	0	NA
		Frequency of Detection	0/1	1/2	
		Average (pCi/L)	ND	0.25*	
Polonium-210	D	Range (pCi/L)	ND	ND	NA
		Frequency of Detection	0/1	0/1	
		Average (pCi/L)	ND	ND	
Polonium-210	S	Range (pCi/L)	ND	0.26–3.3	NA
		Frequency of Detection	0/1	2/2	
		Average (pCi/L)	ND	1.8	
Radium-226	D	Range (pCi/L)	0–0.6	0–0.4	5 (MCL radium-226/228)
		Frequency of Detection	119/128	116/127	
		Average (pCi/L)	0.13	0.07	
Radium-226	S	Range (pCi/L)	0–0.8	0–2.3	5 (MCL radium-226/228)
		Frequency of Detection	114/120	112/119	
		Average (pCi/L)	0.08	0.09	
Radium-226	T	Range (pCi/L)	0.1–0.7	0.1–0.7	5 (MCL radium-226/228)
		Frequency of Detection	7/7	7/7	
		Average (pCi/L)	0.3	0.3	
Thorium-230	D	Range (pCi/L)	-0.1–1	-0.1–1.2	NA
		Frequency of Detection	121/127	116/127	
		Average (pCi/L)	0.1	0.1	
Thorium-230	S	Range (pCi/L)	0–2.5	0–2.4	NA
		Frequency of Detection	115/120	113/119	
		Average (pCi/L)	0.2	0.2	
Thorium-230	T	Range (pCi/L)	0.1–0.7	0–0.6	NA
		Frequency of Detection	7/7	7/7	
		Average (pCi/L)	0.3	0.2	

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
Radium-226 and thorium-230 “D” and “S” samples were collected between 1995 and 2007. The radium-226 and thorium-230 “T” samples were only collected in 1995. Lead-210 and polonium-210 were sampled upstream (907) in 2005 (“D” and “S”) and downstream (904) in 2005 (“D”) and 2006 (“D” and “S”).

* The calculated average is higher than the detected concentration due to including ½ the detection limit in the calculation.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
ND – not detected
pCi/L – picocuries per liter
S – suspended
T – total

Table 47. Sampling data (chemicals) for local and supermarket foods

Chemical	Food Type	Average (mg/kg)	
		Local	Supermarket
Barium*	Vegetables	4.75	NA
Cadmium*	Vegetables	0.215	NA
Chromium*	Vegetables	0.095	NA
Manganese*	Vegetables	11.25	NA
Molybdenum	Chicken	0.19	0.72
	Fruits	0.079	0.017
	Vegetables	0.667	0.023
Selenium	Chicken	0.31	0.18
	Fruits	0.024	0.017
	Vegetables	0.061	0.020
Strontium*	Vegetables	22	NA
Uranium	Chicken	0.061	0.001
	Fruits	0.0056	0.0013
	Vegetables	0.0043	0.0013
Vanadium*	Vegetables	0.105	NA
Zinc*	Vegetables	7.5	NA

Source: Weston 1996

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.
Vegetables were also tested for arsenic, beryllium, cobalt, lead, mercury, nickel, and silver, but none of these chemicals were detected.

*Chicken and fruits were not analyzed for these chemicals.

NA – not available
mg/kg – milligrams per kilogram

Table 48. Sampling data (radionuclides) for local and supermarket foods

Radionuclide	Food Type	Average (pCi/kg)	
		Local	Supermarket
Lead-210	Chicken	1.26	1.70
	Fruits	1.48	1.18
	Vegetables	0.58	0.60
Polonium-210	Chicken	3.79	21.75
	Fruits	2.26	1.30
	Vegetables	1.13	1.56
Radium-226	Chicken	0.64	2.60
	Fruits	1.34	0.05
	Vegetables	1.37	0.07
Thorium-228	Chicken	0.39	ND
	Fruits	0.33	ND
	Vegetables	0.41	1.42
Thorium-230	Chicken	1.01	0.53
	Fruits	1.85	ND
	Vegetables	0.27	0.29
Uranium-234	Chicken	1.10	1.05
	Fruits	1.53	0.34
	Vegetables	0.55	0.76
Uranium-235	Chicken	ND	0.36
	Fruits	0.13	0.13
	Vegetables	0.13	0.14
Uranium-238	Chicken	1.59	0.53
	Fruits	1.41	0.23
	Vegetables	0.44	0.25

Source: Weston 1996

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.

ND – not detected
pCi/kg – picocuries per kilogram

Table 49. Sampling data (chemicals) for local produce irrigated with contaminated well water

Chemical		Fruits	Vegetables
Arsenic	Frequency of Detection	2/16	14/43
	Average (mg/kg)	0.051	0.077
	Maximum (mg/kg)	0.2	0.4
Barium	Frequency of Detection	7/16	33/43
	Average (mg/kg)	0.44	1.6
	Maximum (mg/kg)	0.9	15
Cadmium	Frequency of Detection	2/16	18/43
	Average (mg/kg)	0.041	0.034
	Maximum (mg/kg)	0.23	0.14
Chromium	Frequency of Detection	12/16	39/43
	Average (mg/kg)	0.052	0.056
	Maximum (mg/kg)	0.1	0.19
Cobalt	Frequency of Detection	0/16	6/43
	Average (mg/kg)	ND	0.02
	Maximum (mg/kg)	ND	0.07
Lead	Frequency of Detection	3/16	26/43
	Average (mg/kg)	0.13	0.2
	Maximum (mg/kg)	1.2	1.9
Manganese	Frequency of Detection	16/16	43/43
	Average (mg/kg)	0.87	2.4
	Maximum (mg/kg)	1.8	11
Molybdenum	Frequency of Detection	6/16	41/43
	Average (mg/kg)	0.11	0.68
	Maximum (mg/kg)	0.3	9.8
Nickel	Frequency of Detection	0/16	2/43
	Average (mg/kg)	ND	0.075
	Maximum (mg/kg)	ND	0.2
Strontium	Frequency of Detection	16/16	43/43
	Average (mg/kg)	1.6	4.9
	Maximum (mg/kg)	8.5	33
Uranium	Frequency of Detection	3/16	14/43
	Average (mg/kg)	0.0074	0.0071
	Maximum (mg/kg)	0.035	0.041
Vanadium	Frequency of Detection	0/16	16/43
	Average (mg/kg)	ND	0.046
	Maximum (mg/kg)	ND	0.21

Chemical		Fruits	Vegetables
Zinc	Frequency of Detection	16/16	43/43
	Average (mg/kg)	1.4	3.1
	Maximum (mg/kg)	4.0	10

Source: Weston 1998

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.

ND – not detected
mg/kg – milligrams per kilogram

Table 50. Sampling data (radionuclides) for local produce irrigated with contaminated well water

Radionuclide		Fruits	Vegetables
Lead-210	Frequency of Detection	3/16	8/43
	Average (pCi/kg)	12	21
	Maximum (pCi/kg)	21	51
Radium-226	Frequency of Detection	1/16	15/43
	Average (pCi/kg)	5.7	6.2
	Maximum (pCi/kg)	18	41
Thorium-230	Frequency of Detection	1/16	8/43
	Average (pCi/kg)	3.9	5.1
	Maximum (pCi/kg)	10	20
Uranium (natural)	Frequency of Detection	3/16	14/43
	Average (pCi/kg)	5.0	4.8
	Maximum (pCi/kg)	23	27

Source: Weston 1998

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.
pCi/kg – picocuries per kilogram

Table 51. Characteristics of Cotter Mill's Ambient Air Monitoring Stations

Monitor Code	*Monitor Location*	*Years of Operation*	*Monitor Type*	*Area Description*
AS-202	East Boundary	1979 – present	Perimeter	Eastern perimeter of Cotter Mill facility
AS-203	South Boundary	1979 – present	Perimeter	Southern perimeter of Cotter Mill facility
AS-204	West Boundary	1979 – present	Perimeter	Western perimeter of Cotter Mill facility
AS-206	North Boundary	1981 – present	Perimeter	Northern perimeter of Cotter Mill facility
AS-209	Mill entrance road	1994 – present	Perimeter	Entrance road to Cotter Mill
AS-210	Shadow Hills Estates	1997 – present	Off-site	Near Shadow Hills Golf Club
AS-212	Nearest resident	1999 – present	Off-site	Residential
LP-1/LP-2	Lincoln Park	1980 – present	Off-site	Residential
CC-1/CC-2	Cañon City	1979 – present	Off-site	Residential
OV-3	Oro Verde	1981 – present	Off-site	Remote (1 mile west of AS-204)

Notes: Both the Lincoln Park and Cañon City monitoring stations moved locations in the 1991-1992 time frame. The original station in Lincoln Park (LP-1) operated from 1980 to 1992, and the new station (LP-2) operated from 1991 to the present. The original station in Cañon City (CC-1) operated from 1979 to 1992, and the new station (CC-2) operated from 1991 to the present.

Table 52. Average Annual ^{nat}U Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	6.19E-15	1.50E-15	2.26E-15	--	--	--	--	--	1.00E-15	--
1980	3.71E-15	1.55E-15	2.82E-15	--	--	--	--	8.36E-16	1.40E-15	--
1981	4.07E-15	1.54E-15	5.28E-15	8.30E-15	--	--	--	1.03E-15	1.02E-15	1.37E-15
1982	2.31E-15	1.26E-15	2.48E-14	2.79E-15	--	--	--	5.28E-16	4.79E-16	5.96E-16
1983	1.26E-15	1.43E-15	1.32E-15	1.63E-15	--	--	--	4.77E-16	6.86E-16	5.03E-16
1984	5.50E-16	7.64E-16	8.36E-16	1.52E-15	--	--	--	2.78E-16	3.27E-16	4.01E-16
1985	1.42E-15	1.22E-15	8.96E-16	1.92E-15	--	--	--	4.56E-16	5.77E-16	6.66E-16
1986	6.71E-16	6.56E-16	4.05E-16	9.36E-16	--	--	--	2.95E-16	2.93E-16	4.84E-16
1987	8.08E-16	1.03E-15	1.09E-15	1.05E-15	--	--	--	4.66E-16	5.12E-16	4.60E-16
1988	6.73E-16	6.96E-16	9.03E-16	5.51E-16	--	--	--	1.85E-16	1.95E-16	1.89E-16
1989	9.58E-17	9.95E-17	2.86E-16	3.62E-17	--	--	--	8.37E-17	9.38E-17	6.38E-17
1990	5.59E-17	3.14E-17	1.06E-16	3.10E-17	--	--	--	6.18E-17	1.26E-16	9.09E-17
1991	1.12E-16	9.18E-17	2.65E-16	1.24E-16	--	--	--	1.70E-16	1.73E-16	2.60E-16
1992	6.55E-17	7.84E-17	1.12E-16	6.48E-17	--	--	--	9.71E-17	9.40E-17	8.23E-17
1993	7.13E-17	9.08E-17	1.61E-16	6.30E-17	--	--	--	8.26E-17	1.20E-16	2.55E-16
1994	1.25E-16	4.68E-17	1.00E-16	3.68E-17	1.55E-16	--	--	9.68E-17	8.12E-17	2.54E-16
1995	2.99E-16	5.86E-17	1.53E-16	5.23E-17	2.11E-16	--	--	9.34E-17	1.26E-16	4.83E-16
1996	2.25E-16	1.43E-16	2.26E-16	8.62E-17	2.44E-16	7.89E-17	--	9.73E-17	1.25E-16	5.93E-17
1997	1.23E-16	1.18E-16	2.20E-16	1.19E-16	1.51E-16	1.75E-16	--	1.27E-16	2.00E-16	9.48E-17
1998	1.32E-16	1.02E-16	3.29E-16	1.06E-16	2.27E-15	2.32E-16	--	8.13E-17	7.50E-17	2.43E-16
1999	4.06E-16	1.49E-16	2.91E-16	3.23E-16	1.46E-15	2.82E-16	4.59E-16	1.16E-16	9.41E-17	7.97E-17
2000	4.33E-16	2.04E-16	2.61E-16	1.63E-16	1.49E-15	1.89E-16	4.82E-16	5.39E-17	5.33E-17	5.39E-17
2001	4.96E-16	6.19E-16	4.96E-16	5.29E-16	1.32E-15	2.06E-16	2.88E-16	4.96E-17	3.80E-17	5.18E-17
2002	6.50E-16	4.93E-16	6.21E-16	3.24E-16	9.91E-16	3.69E-16	4.05E-16	2.46E-16	1.59E-16	2.05E-16
2003	3.55E-16	2.19E-16	2.55E-16	2.01E-16	4.91E-16	2.21E-16	2.20E-16	2.11E-16	2.07E-16	2.62E-16
2004	2.51E-16	1.95E-16	2.40E-16	1.99E-16	6.27E-16	1.40E-16	2.30E-16	9.69E-17	9.68E-17	8.61E-17
2005	4.54E-16	2.77E-16	2.87E-16	1.58E-16	3.97E-15	4.85E-16	5.25E-16	1.68E-16	1.29E-16	1.23E-16
2006	5.14E-16	2.68E-16	3.24E-16	2.12E-16	1.72E-15	6.62E-16	3.40E-16	2.20E-16	1.75E-16	1.87E-16
2007	3.56E-16	1.51E-16	2.03E-16	1.39E-16	3.13E-16	1.46E-16	1.33E-16	1.41E-16	1.43E-16	1.27E-16
2008	4.36E-16	8.61E-17	1.72E-16	8.44E-17	2.17E-16	9.77E-17	9.78E-17	9.02E-17	8.97E-17	6.43E-17

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2.
For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2.

Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 53. Average Annual ^{230}Th Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	2.33E-15	1.05E-15	8.08E-15	--	--	--	--	--	3.07E-16	--
1980	2.50E-16	8.76E-16	2.81E-16	--	--	--	--	8.17E-17	1.30E-16	--
1981	2.60E-15	3.50E-15	3.00E-14	6.93E-15	--	--	--	1.42E-16	8.17E-17	3.92E-16
1982	2.12E-14	1.94E-14	8.95E-14	1.26E-14	--	--	--	7.49E-16	9.18E-16	3.15E-15
1983	5.86E-15	9.79E-15	5.64E-15	8.26E-15	--	--	--	3.74E-16	3.12E-16	1.07E-15
1984	1.64E-15	2.98E-15	3.82E-15	6.35E-15	--	--	--	2.69E-16	2.00E-16	2.89E-16
1985	1.84E-15	2.15E-15	4.86E-15	3.73E-15	--	--	--	2.60E-16	2.64E-16	2.84E-16
1986	3.70E-15	5.55E-15	3.13E-15	4.68E-15	--	--	--	3.70E-16	3.08E-16	2.41E-16
1987	1.21E-15	1.29E-15	2.28E-15	1.08E-15	--	--	--	2.06E-16	1.77E-16	9.90E-17
1988	2.58E-15	3.51E-15	5.85E-15	2.05E-15	--	--	--	1.41E-16	1.72E-16	1.70E-16
1989	6.33E-16	3.85E-16	9.17E-16	1.08E-16	--	--	--	8.93E-17	9.03E-17	9.24E-17
1990	7.63E-16	4.00E-16	5.86E-16	1.09E-16	--	--	--	7.40E-17	7.04E-17	7.20E-17
1991	7.25E-16	4.59E-16	8.75E-16	2.83E-16	--	--	--	1.91E-16	1.25E-16	1.33E-16
1992	4.57E-16	2.20E-16	4.71E-16	9.46E-17	--	--	--	6.58E-17	5.98E-17	9.56E-17
1993	4.45E-16	3.03E-16	6.42E-16	9.32E-17	--	--	--	1.06E-16	9.17E-17	2.33E-16
1994	1.18E-15	2.96E-16	1.08E-15	1.24E-16	9.20E-16	--	--	1.54E-16	1.16E-16	2.83E-16
1995	1.65E-15	5.33E-16	1.24E-15	1.18E-16	8.88E-16	--	--	9.80E-17	1.12E-16	3.30E-16
1996	2.21E-15	2.95E-16	8.13E-16	8.85E-17	7.67E-16	2.33E-16	--	7.11E-17	5.08E-17	6.39E-17
1997	7.64E-16	1.31E-16	6.17E-16	6.49E-17	1.99E-15	3.82E-16	--	8.37E-17	7.86E-17	3.24E-17
1998	2.88E-15	2.02E-16	9.34E-16	1.15E-16	2.17E-15	3.32E-16	--	7.70E-17	7.99E-17	7.82E-17
1999	3.76E-15	3.24E-16	1.09E-15	1.84E-16	2.19E-15	4.15E-16	3.02E-16	7.37E-17	9.51E-17	1.11E-16
2000	1.22E-15	2.48E-16	1.01E-15	2.02E-16	4.16E-15	4.71E-16	6.69E-16	1.47E-16	1.57E-16	1.27E-16
2001	8.20E-16	5.19E-16	9.67E-16	2.61E-16	4.15E-15	4.04E-16	4.61E-16	1.56E-16	9.95E-17	1.13E-16
2002	5.84E-16	2.76E-16	5.95E-16	2.57E-16	1.25E-15	2.38E-16	3.13E-16	8.15E-17	8.54E-17	8.55E-17
2003	5.19E-16	2.62E-16	4.90E-16	9.73E-17	1.40E-15	4.11E-16	1.77E-16	8.27E-17	8.91E-17	5.30E-17
2004	2.17E-16	8.26E-17	3.87E-16	8.33E-17	6.57E-16	2.26E-16	1.08E-16	5.36E-17	5.62E-17	6.07E-17
2005	3.17E-16	1.97E-16	3.51E-16	2.64E-16	3.41E-15	4.85E-16	4.81E-16	1.04E-16	1.05E-16	1.08E-16
2006	5.17E-16	2.91E-16	4.74E-16	1.77E-16	1.40E-15	4.73E-16	3.27E-16	2.73E-16	2.04E-16	2.85E-16
2007	6.62E-16	1.90E-16	4.32E-16	1.48E-16	1.05E-15	2.77E-16	2.23E-16	1.68E-16	1.57E-16	1.53E-16
2008	7.21E-16	1.87E-16	5.12E-16	1.32E-16	6.21E-16	2.88E-16	2.05E-16	1.11E-16	1.08E-16	1.16E-16

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2. For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2.

Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating; bold cells are concentrations above Cotter Mill's regulatory limit

Table 54. Average Annual ^{232}Th Concentrations 2001-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP #2	CC #2	OV-3
2001	5.78E-17	7.62E-17	6.97E-17	6.37E-17	8.32E-17	4.58E-17	6.67E-17	6.85E-17	8.33E-17	5.68E-17
2002	4.67E-17	3.81E-17	3.09E-17	4.55E-17	4.34E-17	3.17E-17	3.35E-17	5.36E-17	3.51E-17	4.68E-17
2003	4.57E-17	4.14E-17	4.84E-17	2.06E-17	5.72E-17	4.61E-17	3.71E-17	6.21E-17	4.61E-17	3.96E-17
2004	1.39E-17	2.53E-17	2.53E-17	1.40E-17	1.57E-17	1.99E-17	1.65E-17	3.24E-17	2.28E-17	2.39E-17
2005	2.83E-17	2.40E-17	2.86E-17	3.09E-17	3.36E-17	2.53E-17	3.42E-17	3.99E-17	3.57E-17	3.45E-17
2006	4.11E-17	5.18E-17	4.82E-17	4.29E-17	5.54E-17	4.33E-17	4.79E-17	6.25E-17	4.98E-17	3.65E-17
2007	4.07E-17	3.47E-17	4.60E-17	4.14E-17	4.12E-17	3.99E-17	3.51E-17	5.43E-17	4.48E-17	3.92E-17
2008	1.08E-17	1.63E-17	1.15E-17	9.89E-18	1.57E-17	2.30E-17	1.26E-17	3.13E-17	2.25E-17	2.03E-17

Note: Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating

Table 55. Average Annual ^{226}Ra Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	**AS-203**	**AS-204**	**AS-206**	**AS-209**	**AS-210**	**AS-212**	**LP-1/2**	**CC-1/2**	**OV-3**
1979	1.55E-15	3.75E-16	7.89E-15	--	--	--	--	--	3.07E-16	--
1980	3.61E-15	7.81E-16	1.62E-15	--	--	--	--	2.78E-16	1.58E-15	--
1981	4.19E-15	2.35E-15	2.94E-15	2.96E-15	--	--	--	3.79E-16	4.59E-16	6.30E-16
1982	6.53E-15	6.92E-15	3.81E-15	3.82E-15	--	--	--	6.07E-16	4.02E-16	1.25E-15
1983	2.00E-15	5.08E-15	4.95E-15	2.85E-15	--	--	--	9.42E-17	1.76E-16	5.30E-16
1984	1.11E-15	1.84E-15	3.63E-15	2.20E-15	--	--	--	1.18E-16	1.67E-16	1.87E-16
1985	9.63E-15	1.11E-15	1.78E-15	1.97E-15	--	--	--	1.69E-16	1.88E-16	1.89E-16
1986	1.47E-15	1.98E-15	1.61E-15	2.60E-15	--	--	--	1.43E-16	3.45E-16	2.22E-16
1987	5.91E-16	7.52E-16	1.19E-15	4.74E-16	--	--	--	1.83E-16	1.15E-16	1.89E-16
1988	1.29E-15	2.05E-15	2.53E-15	3.60E-16	--	--	--	1.24E-16	5.09E-17	1.09E-16
1989	2.72E-16	1.81E-16	3.30E-16	4.79E-17	--	--	--	1.02E-16	8.89E-17	7.77E-17
1990	1.75E-16	1.68E-16	1.92E-16	4.36E-17	--	--	--	6.69E-17	8.36E-17	7.82E-17
1991	1.19E-16	1.25E-16	2.68E-16	6.17E-17	--	--	--	6.85E-17	7.16E-17	1.37E-16
1992	8.46E-17	7.30E-17	1.50E-15	3.71E-17	--	--	--	5.10E-17	5.80E-17	1.17E-16
1993	9.11E-17	1.14E-16	2.49E-16	5.99E-17	--	--	--	6.14E-17	6.72E-17	2.20E-16
1994	1.03E-16	7.57E-17	1.69E-16	4.96E-17	1.55E-16	--	--	7.80E-17	8.68E-17	2.64E-16
1995	1.21E-16	1.14E-16	2.07E-16	7.46E-17	2.06E-16	--	--	6.88E-17	1.05E-16	3.99E-16
1996	1.78E-16	1.02E-16	2.08E-16	5.33E-17	2.11E-16	5.82E-17	--	5.22E-17	6.67E-17	3.59E-17
1997	1.29E-16	7.55E-17	2.01E-16	5.66E-17	9.45E-16	1.06E-16	--	5.09E-17	5.40E-17	4.84E-17
1998	2.89E-16	8.22E-17	2.95E-16	9.43E-17	1.34E-15	1.21E-16	--	6.21E-17	6.71E-17	4.24E-17
1999	4.18E-16	1.29E-16	3.81E-16	1.02E-16	1.26E-15	1.46E-16	2.13E-16	8.27E-17	9.21E-17	5.90E-17
2000	3.37E-16	1.53E-16	4.64E-16	1.40E-16	2.38E-15	2.21E-16	4.60E-16	7.41E-17	4.64E-17	5.10E-17
2001	2.15E-16	2.09E-16	4.36E-16	1.38E-16	1.92E-15	1.51E-16	1.99E-16	7.01E-17	6.82E-17	5.16E-17
2002	1.55E-16	1.17E-16	2.34E-16	7.51E-17	3.83E-16	1.05E-16	1.14E-16	8.41E-17	6.07E-17	6.72E-17
2003	1.45E-16	1.10E-16	1.75E-16	8.02E-17	2.96E-16	1.23E-16	9.65E-17	9.70E-17	8.40E-17	8.93E-17
2004	7.81E-17	7.35E-17	1.41E-16	6.14E-17	3.30E-16	9.05E-17	8.14E-17	5.79E-17	6.26E-17	4.95E-17
2005	1.78E-16	1.56E-16	1.75E-16	1.97E-16	2.29E-15	2.49E-16	2.95E-16	1.08E-16	1.22E-16	9.58E-17
2006	4.10E-16	1.40E-16	2.17E-16	1.34E-16	7.52E-16	1.69E-16	1.42E-16	1.20E-16	1.03E-16	1.15E-16
2007	8.67E-16	1.11E-16	2.07E-16	1.00E-16	2.31E-16	1.16E-16	9.11E-17	1.09E-16	9.66E-17	1.11E-16
2008	7.92E-16	7.36E-17	2.00E-16	5.16E-17	1.78E-16	7.33E-17	5.71E-17	6.21E-17	5.91E-17	3.28E-17

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2. For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2. Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 56. Average Annual ^{210}Pb Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	2.11E-14	1.65E-14	2.08E-14	--	--	--	--	--	2.30E-14	--
1980	1.81E-14	1.69E-14	1.25E-14	--	--	--	--	1.86E-14	1.98E-14	--
1981	2.01E-14	1.72E-14	4.71E-14	2.34E-14	--	--	--	1.57E-14	1.70E-14	2.11E-14
1982	3.87E-14	4.35E-14	9.95E-14	4.07E-14	--	--	--	2.50E-14	3.31E-14	4.05E-14
1983	1.70E-14	1.73E-14	1.82E-14	1.95E-14	--	--	--	1.29E-14	1.79E-14	1.44E-14
1984	1.44E-14	1.46E-14	1.60E-14	1.43E-14	--	--	--	1.26E-14	1.15E-14	1.48E-14
1985	9.12E-15	8.12E-15	8.80E-15	9.30E-15	--	--	--	9.97E-15	1.14E-14	9.90E-15
1986	1.26E-14	1.19E-14	1.12E-14	1.22E-14	--	--	--	1.07E-14	1.22E-14	8.81E-15
1987	1.95E-14	1.92E-14	2.22E-14	2.35E-14	--	--	--	2.17E-14	2.01E-14	1.43E-14
1988	2.15E-14	1.94E-14	2.10E-14	1.93E-14	--	--	--	2.04E-14	2.11E-14	1.76E-14
1989	2.28E-14	2.30E-14	1.98E-14	2.34E-14	--	--	--	2.43E-14	2.35E-14	2.40E-14
1990	2.05E-14	2.10E-14	2.07E-14	2.07E-14	--	--	--	2.24E-14	2.00E-14	1.95E-14
1991	2.40E-14	2.15E-14	2.15E-14	2.13E-14	--	--	--	2.23E-14	2.15E-14	1.07E-14
1992	2.16E-14	2.00E-14	2.20E-14	2.19E-14	--	--	--	1.99E-14	1.61E-14	2.20E-14
1993	2.38E-14	2.35E-14	2.35E-14	2.49E-14	--	--	--	2.22E-14	2.13E-14	2.10E-14
1994	2.21E-14	2.07E-14	2.10E-14	2.24E-14	2.18E-14	--	--	2.33E-14	2.38E-14	2.06E-14
1995	2.07E-14	2.07E-14	2.02E-14	2.01E-14	2.11E-14	--	--	1.97E-14	2.03E-14	1.74E-14
1996	2.02E-14	2.01E-14	2.16E-14	2.21E-14	2.11E-14	--	--	2.08E-14	1.96E-14	1.98E-14
1997	2.21E-14	2.07E-14	2.12E-14	2.20E-14	2.26E-14	2.05E-14	--	2.13E-14	2.00E-14	1.98E-14
1998	2.01E-14	2.07E-14	1.98E-14	2.11E-14	2.01E-14	1.93E-14	--	2.01E-14	2.01E-14	1.93E-14
1999	2.14E-14	1.94E-14	1.83E-14	1.84E-14	2.03E-14	1.94E-14	2.03E-14	2.03E-14	1.94E-14	1.78E-14
2000	2.07E-14	2.05E-14	2.01E-14	2.23E-14	2.37E-14	2.00E-14	2.07E-14	2.16E-14	2.08E-14	2.03E-14
2001	3.10E-14	3.04E-14	2.91E-14	3.11E-14	3.06E-14	2.94E-14	3.12E-14	3.06E-14	2.96E-14	2.79E-14
2002	2.36E-14	2.20E-14	2.28E-14	2.25E-14	2.30E-14	2.37E-14	2.40E-14	2.46E-14	2.33E-14	2.17E-14
2003	2.19E-14	2.11E-14	2.16E-14	2.06E-14	2.28E-14	2.12E-14	2.18E-14	2.11E-14	1.94E-14	2.27E-14
2004	1.72E-14	1.64E-14	1.58E-14	1.60E-14	1.66E-14	1.45E-14	1.79E-14	1.56E-14	1.54E-14	1.59E-14
2005	2.45E-14	2.74E-14	2.82E-14	2.54E-14	3.11E-14	2.91E-14	2.92E-14	3.11E-14	3.15E-14	2.94E-14
2006	2.11E-14	2.31E-14	2.47E-14	2.31E-14	2.09E-14	2.08E-14	1.89E-14	1.98E-14	1.89E-14	2.12E-14
2007	1.88E-14	1.64E-14	1.79E-14	1.82E-14	1.54E-14	1.58E-14	1.49E-14	1.66E-14	1.61E-14	1.72E-14
2008	1.65E-14	1.48E-14	1.64E-14	1.93E-14	1.66E-14	1.73E-14	1.57E-14	1.67E-14	1.61E-14	1.61E-14

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2. For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2.

Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 57. ^{220}Rn/^{222}Rn Concentrations 2002-2008 (pCi/m^3)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	**AS-203**	**AS-204**	**AS-206**	**AS-209**	**AS-210**	**AS-212**	**CC-1**	**LP-1**	**OV-3**
2002	543	975	1125	693	1475	700	698	875	673	625
2003	700	825	775	900	625	675	700	375	800	567
2004	1500	850	1025	950	1100	850	925	825	875	825
2005	925	1025	850	700	1025	675	775	700	900	800
2006	1250	1275	1275	1450	1400	1125	1275	1075	1375	1200
2007	1000	1100	1175	1100	1250	975	825	925	1175	975
2008	850	900	925	950	1075	950	850	800	925	825

Notes: Data are presented for only those years when measurements quantified combined levels of the two isotopes.
Shaded cells are the highest annual averages for the calendar year.

Table 58. Environmental TLD Measurements, 1979-2008 (μR/hr)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	CC-1	LP-1	OV-3
1979	14.0	12.6	12.7	--	--	--	--	11.8	11.4	--
1980	13.4	11.7	12.9	--	--	--	--	10.4	11.4	--
1981	14.3	12.8	12.7	--	--	--	--	10.6	12.3	12.3
1982	13.7	12.6	14.7	20.4	--	--	--	9.9	11.2	12.7
1983	13.6	12.6	14.2	15.6	--	--	--	10.6	11.6	12.0
1984	14.5	14.3	14.6	14.8	--	--	--	12.3	11.2	13.2
1985	14.3	13.5	14.5	14.8	--	--	--	10.5	11.2	12.3
1986	13.9	13.7	14.5	14.2	--	--	--	11.0	10.7	11.8
1987	12.9	12.5	12.6	12.6	--	--	--	9.6	9.7	10.4
1988	15.0	13.6	12.8	13.4	--	--	--	9.3	11.6	10.2
1989	14.7	14.9	15.3	15.9	--	--	--	10.6	13.7	11.9
1990	13.2	13.1	14.8	15.2	--	--	--	9.6	11.5	11.7
1991	14.1	13.2	15.7	17.5	--	--	--	10.0	12.9	12.4
1992	13.7	13.2	16.0	18.3	--	--	--	9.6	12.1	11.3
1993	12.5	12.6	14.4	15.6	--	--	--	8.6	10.7	10.9
1994	14.3	13.8	15.9	16.2	27.8	--	--	10.8	12.1	12.3
1995	12.5	13.7	14.0	15.4	23.0	--	--	9.2	10.3	11.3
1996	13.1	13.2	14.5	16.2	27.2	13.0	--	9.7	10.9	11.4
1997	12.6	13.1	13.8	15.7	29.1	12.3	--	9.1	10.2	11.1
1998	12.3	12.0	13.4	15.9	28.0	12.0	--	9.0	10.3	11.5
1999	12.7	12.0	13.8	16.0	29.6	12.2	9.1	9.3	10.6	10.9
2000	12.7	12.6	14.7	16.6	27.7	12.5	9.3	9.5	10.7	11.4
2001	13.7	14.3	15.4	18.6	26.2	13.9	9.7	10.4	12.0	12.2
2002	14.0	14.4	15.9	17.7	30.3	14.3	10.5	10.5	12.3	12.6
2003	12.8	13.3	14.8	15.5	27.7	13.3	10.0	10.0	11.7	11.8
2004	13.6	14.1	15.5	14.7	25.5	14.2	10.9	10.5	12.2	12.5
2005	12.8	13.5	14.8	13.8	22.9	12.9	9.9	10.1	11.5	11.5
2006	12.7	13.4	14.6	14.2	21.5	12.6	9.5	10.1	11.5	11.7
2007	12.9	13.2	14.6	14.1	17.8	12.7	9.5	10.1	11.5	11.6
2008	13.9	13.5	15.5	14.9	18.7	13.3	10.2	10.8	12.2	12.6

Notes: Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 59. TSP Air Concentrations (μg/m^3) from 1969-1987

Year	Cañon City		Lincoln Park	
	Maximum	Average	Maximum	Average
1969	172	64.2	--	--
1970	200	55.9	--	--
1971	148	58.7	--	--
1972	240	69.9	--	--
1973	229	66.1	--	--
1974	187	58	--	--
1975	419	73.7	--	--
1976	174	56.8	--	--
1977	227	62.7	--	--
1978	313	84.7	--	--
1979	286	72.6	--	--
1980	304	70.4	--	--
1981	180	56.8	61*	8.2*
1982	525	84	228	51.7
1983	187	65.2	106	77.6
1984	571	70.9	--	--
1985	334	64.8	--	--
1986	402	66.3	--	--
1987	385	65.2	--	--

Notes: Data downloaded from EPA's Air Quality System database.
EPA's former annual average National Ambient Air Quality Standard for TSP was 75 μg/m^3.
* The TSP monitoring station in Lincoln Park started operating late in 1981; therefore, the statistics reported are not representative of the entire calendar year.

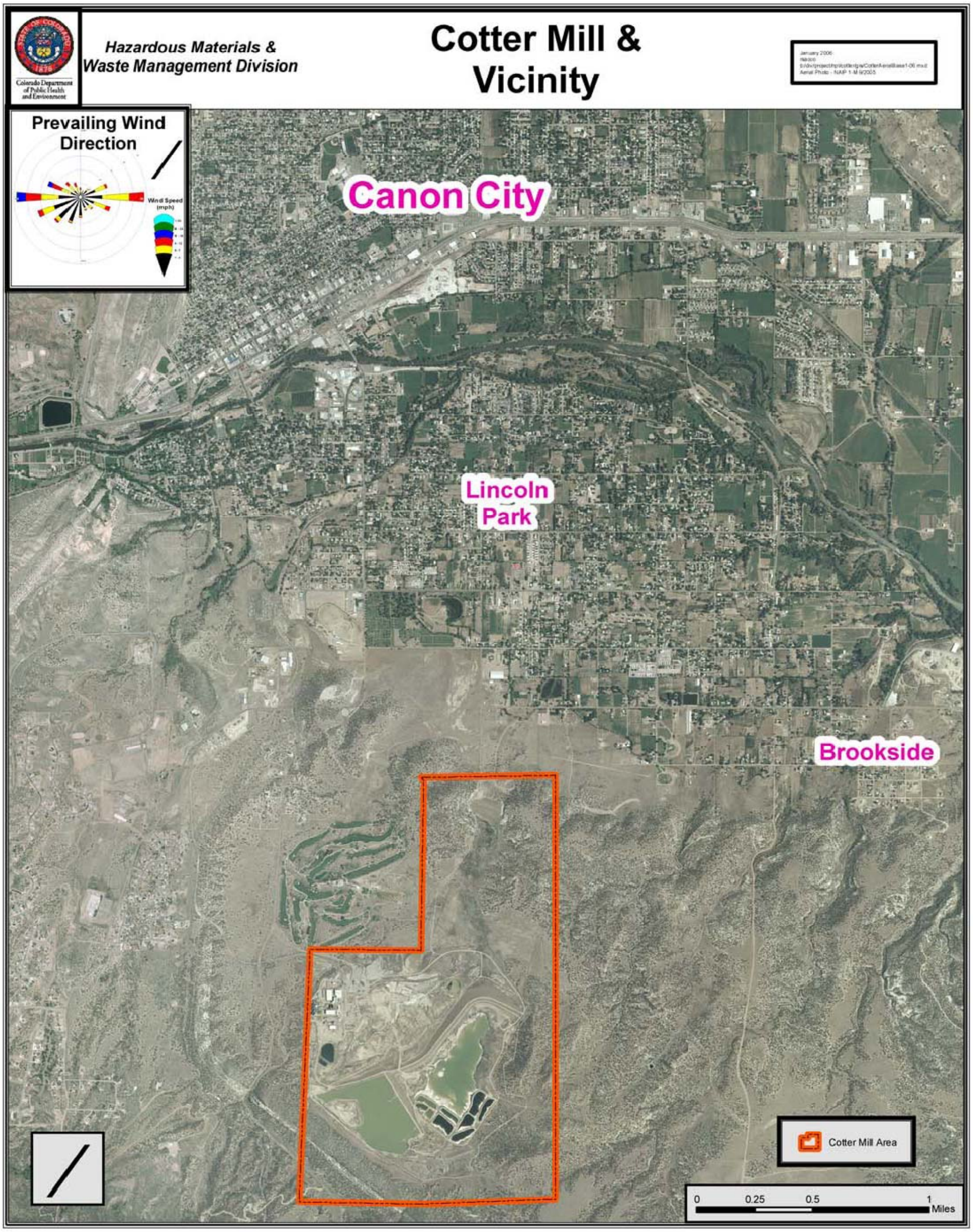
Table 60. Monitoring Data for Constituents in TSP (1978-1987)

Constituent	Location	Years of Data	Concentrations (μg/m^3)	
			Highest 24-Hour Average	Highest Annual Average
Iron	Lincoln Park	1981-1982	1.2	0.8
Lead	Lincoln Park	1981-1982	0.1	0.034
Manganese	Lincoln Park	1981-1982	0.03	0.0185
Nitrate	Cañon City	1978-1987	14.3	2.35
	Lincoln Park	1981-1982	4.7	1.81
Sulfate	Cañon City	1978-1987	18.4	5.99
	Lincoln Park	1981-1982	13	6.48
Zinc	Lincoln Park	1981-1982	0.04	0.0283

Notes Data downloaded from EPA's Air Quality System database.

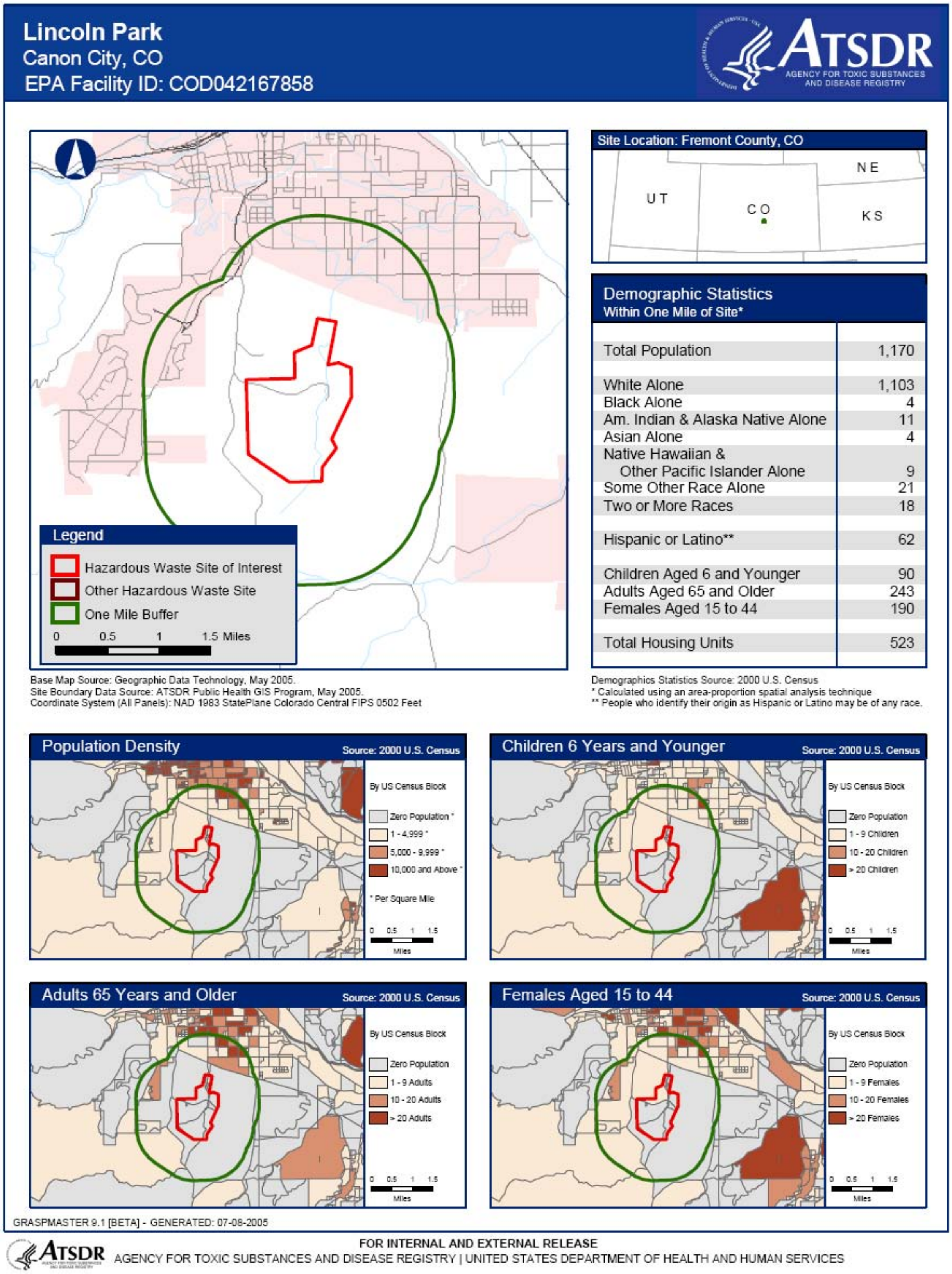
Appendix B - Site Figures

Figure 1. Location of the Cotter Mill, Lincoln Park, and Cañon City



Source: Galant et al. 2007

Figure 2. Demographics within 1 mile of the Cotter Mill property



Demographic Statistics
Within One Mile of Site*

Total Population	1,170
White Alone	1,103
Black Alone	4
Am. Indian & Alaska Native Alone	11
Asian Alone	4
Native Hawaiian & Other Pacific Islander Alone	9
Some Other Race Alone	21
Two or More Races	18
Hispanic or Latino**	62
Children Aged 6 and Younger	90
Adults Aged 65 and Older	243
Females Aged 15 to 44	190
Total Housing Units	523

Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Public Health GIS Program, May 2005.
Coordinate System (All Panels): NAD 1983 StatePlane Colorado Central FIPS 0502 Feet

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

GRASPMASTER 9.1 [BETA] - GENERATED: 07-08-2005

FOR INTERNAL AND EXTERNAL RELEASE
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY | UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES

Figure 3. Wind Rose for Cotter Mill, 2008

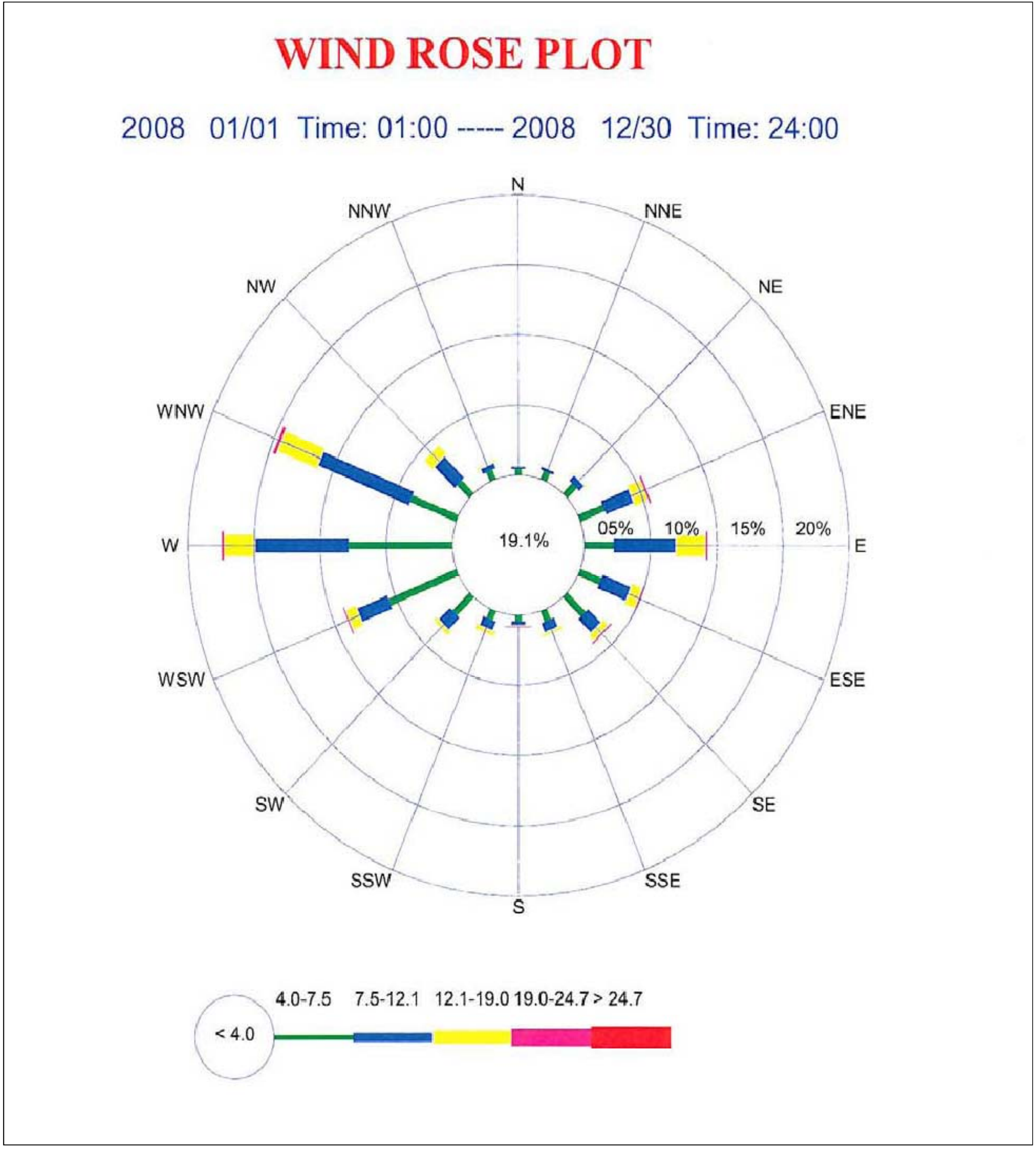
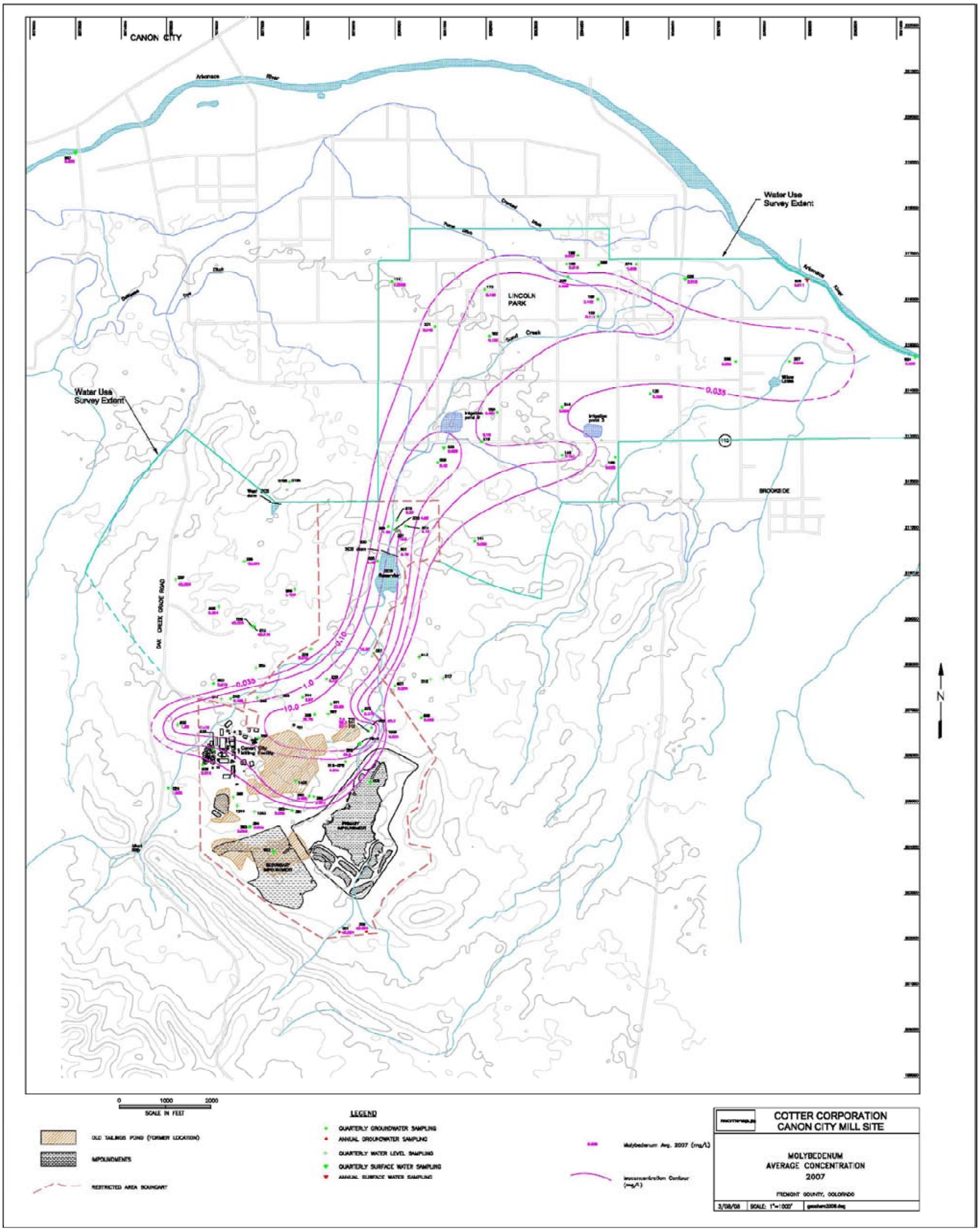
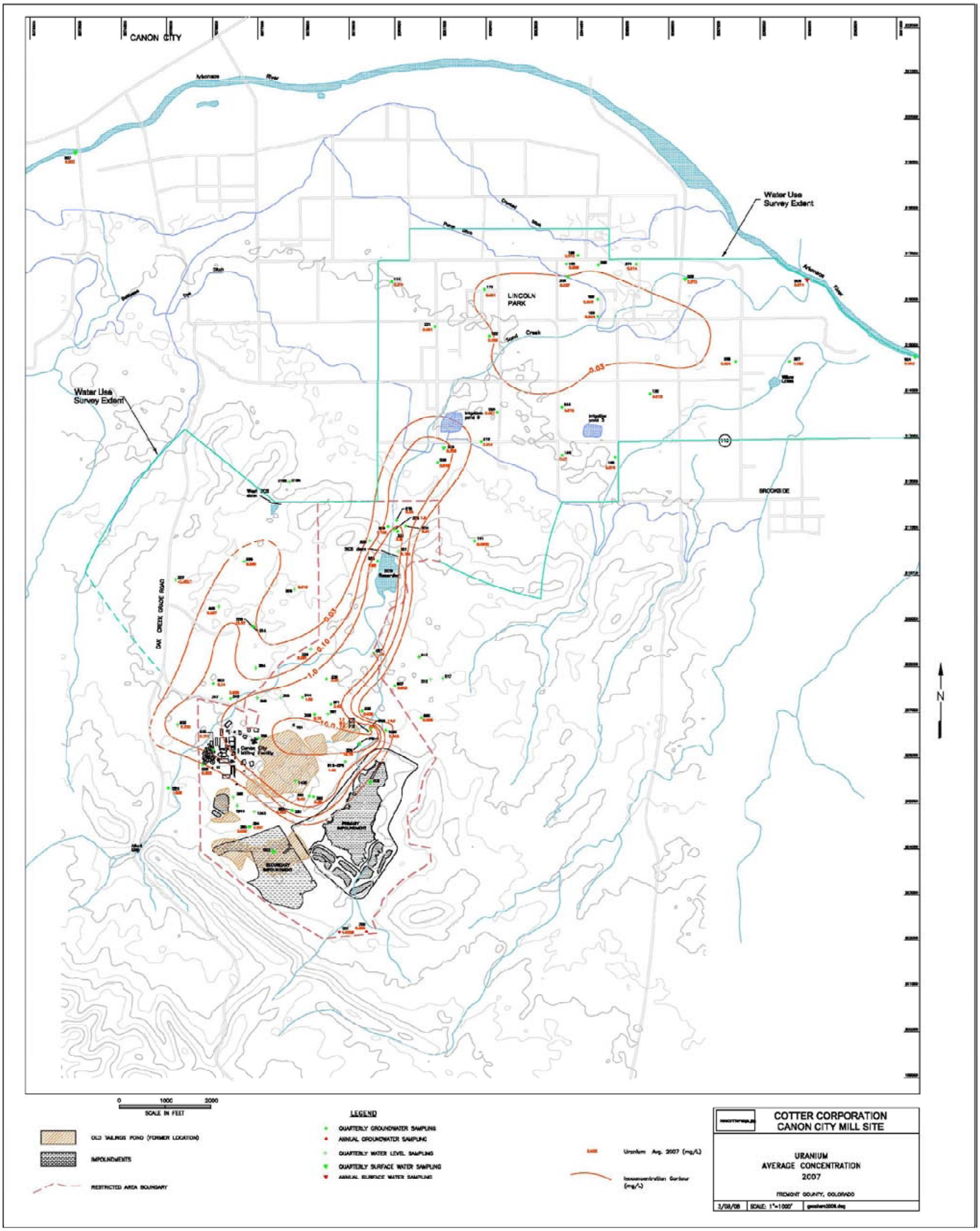


Figure 4. Molybdenum Plume Map



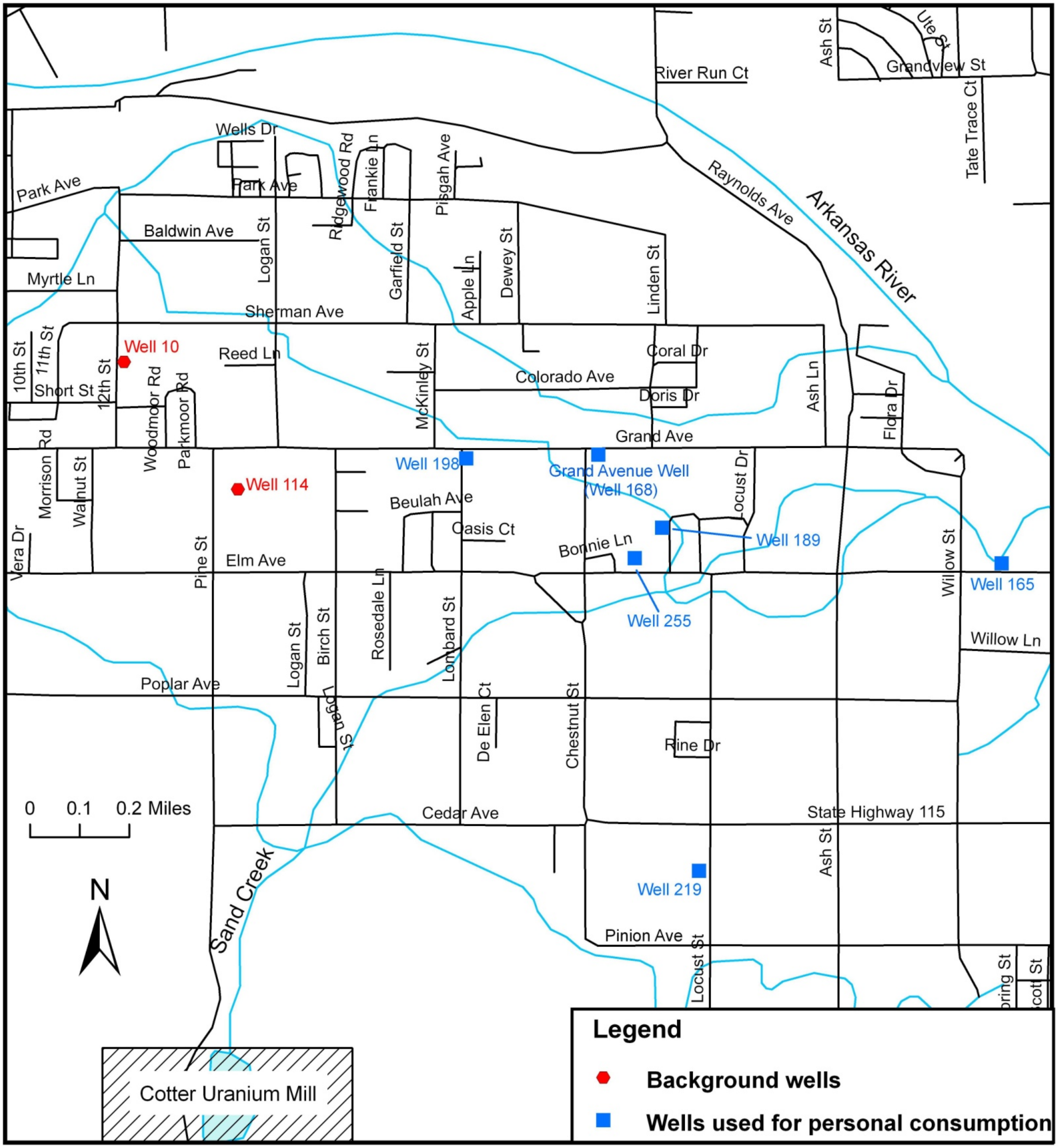
Source: Cotter 2008

Figure 5. Uranium Plume Map



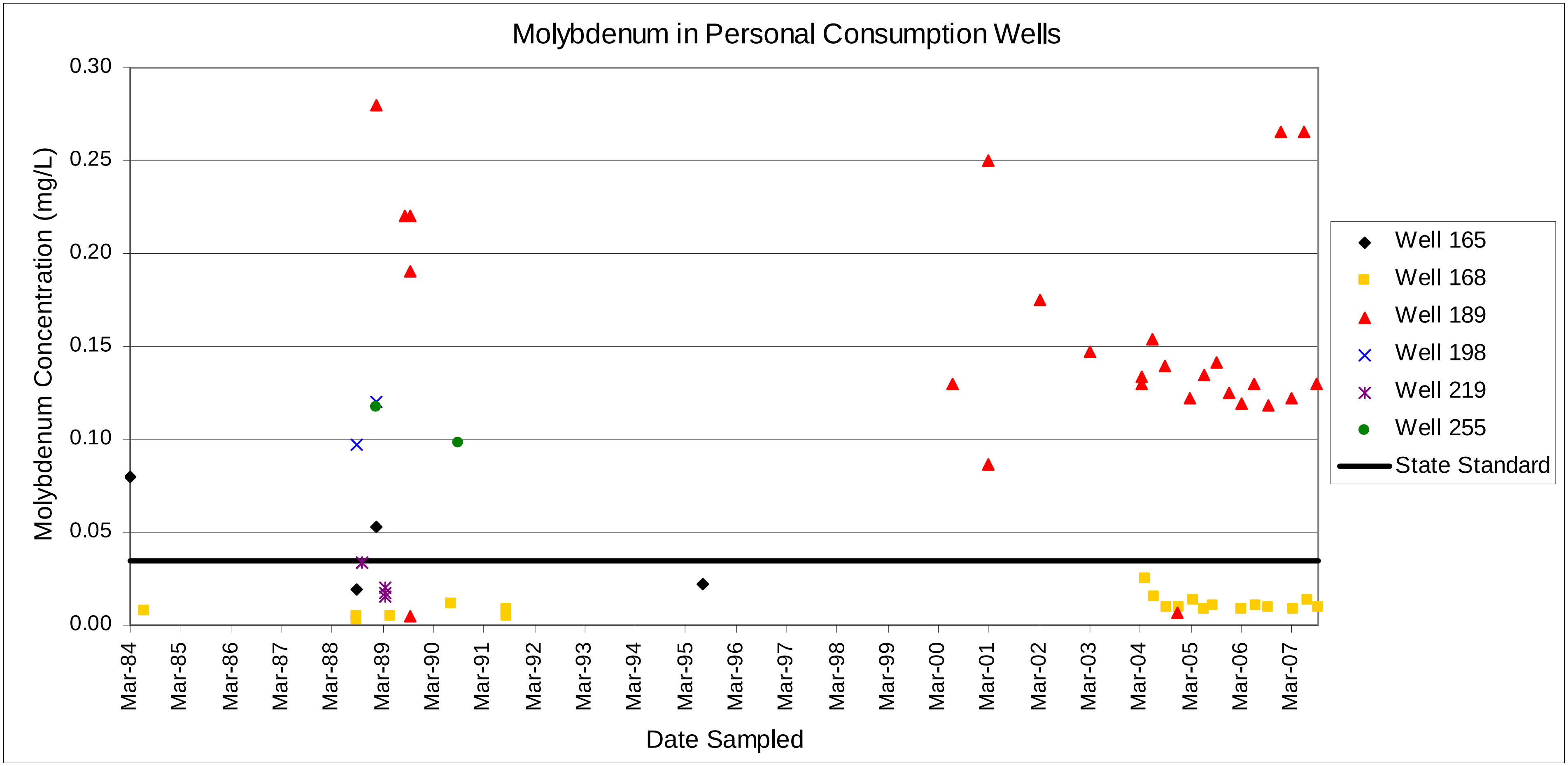
Source: Cotter 2008

Figure 6. Wells in Lincoln Park used for personal consumption



Source: CDPHE 2007b (coordinates)

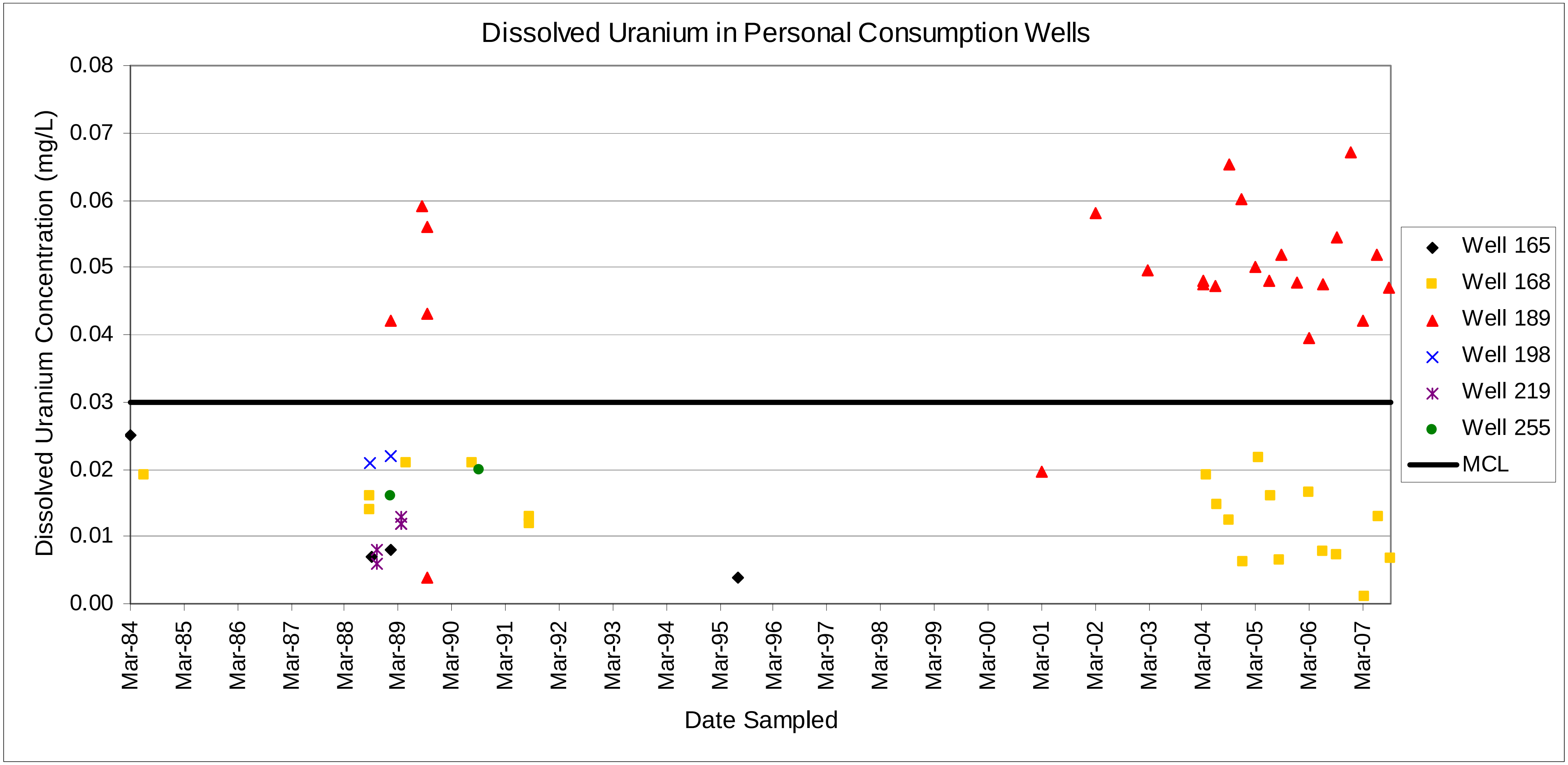
Figure 7. Molybdenum concentrations in wells used for personal consumption



Source: CDPHE 2007b

Non-detected concentrations were plotted as ½ the reporting detection limit.

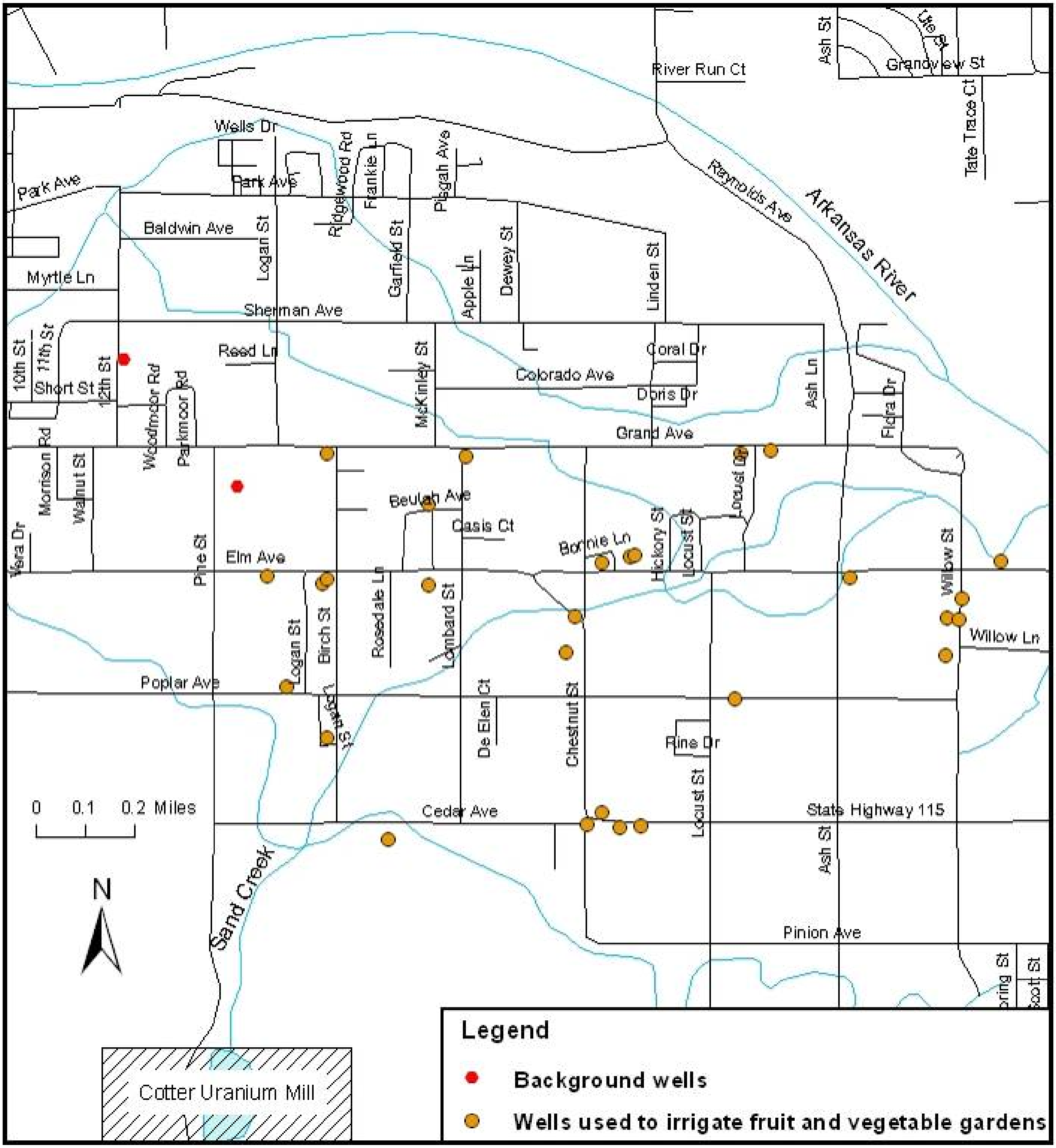
Figure 8. Dissolved uranium concentrations in wells used for personal consumption



Source: CDPHE 2007b

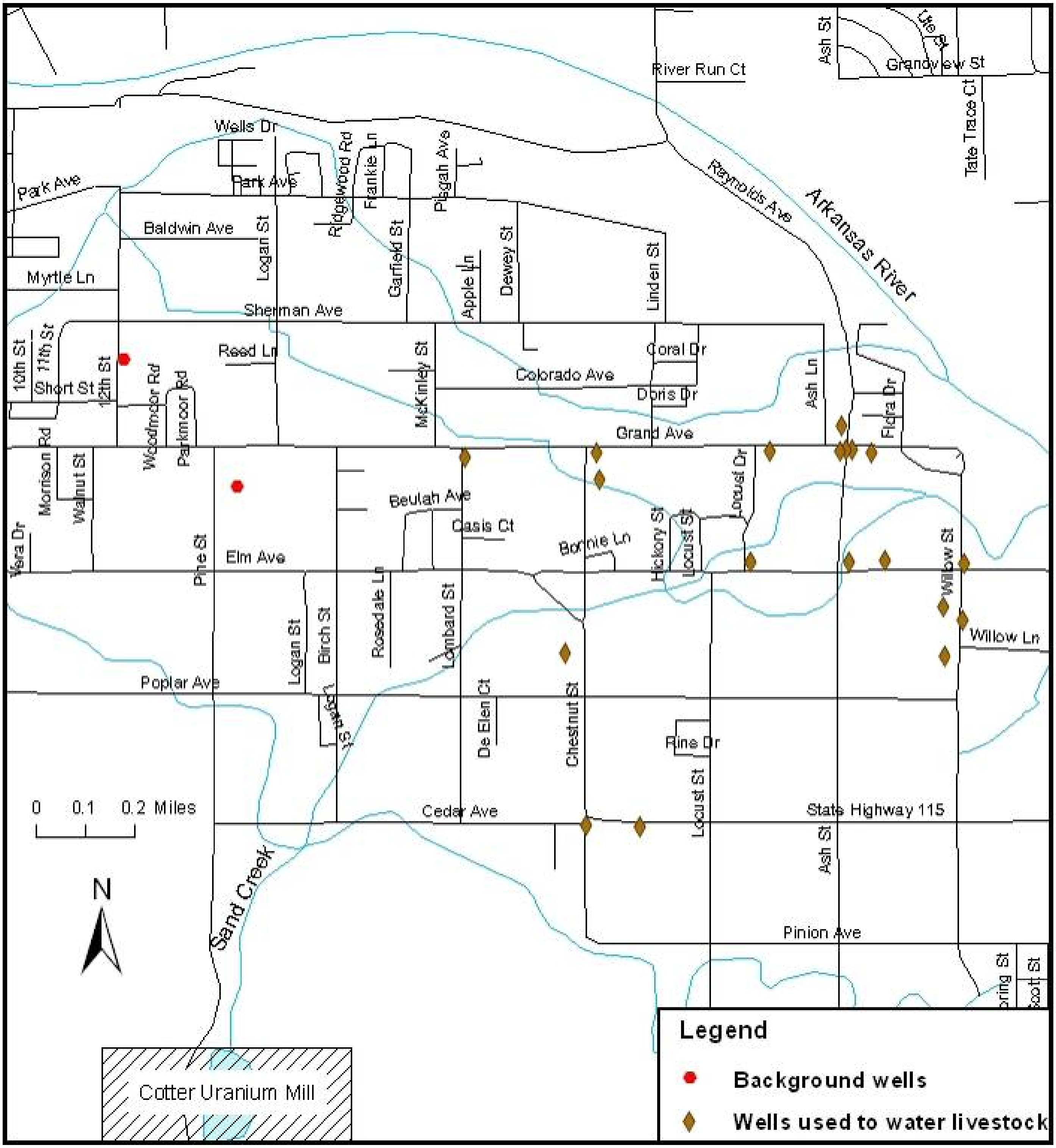
Non-detected concentrations were plotted as ½ the reporting detection limit.

Figure 9. Wells in Lincoln Park used to irrigate fruit and vegetable gardens



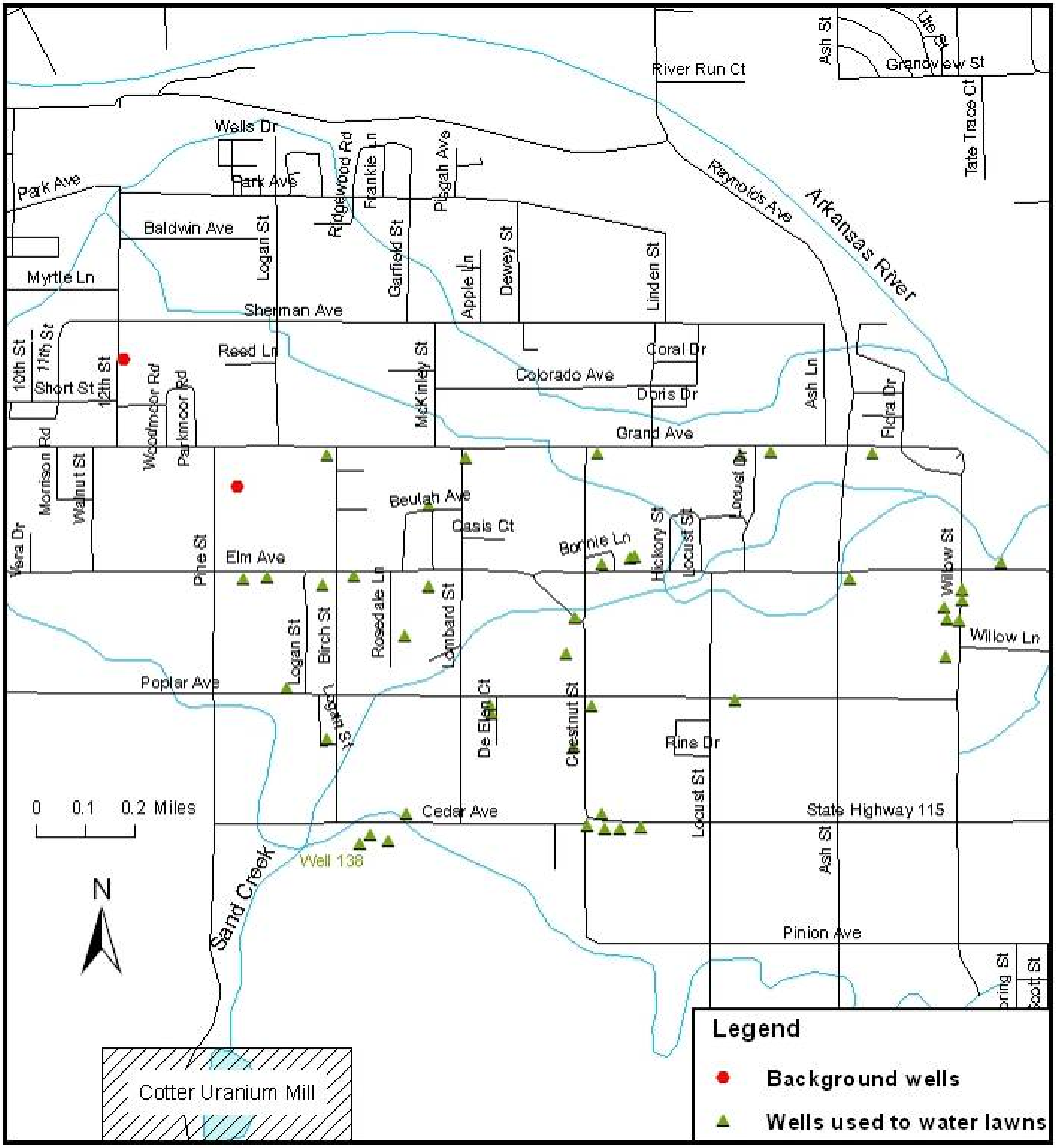
Source: CDPHE 2007b (coordinates)

Figure 10. Wells in Lincoln Park used to water livestock



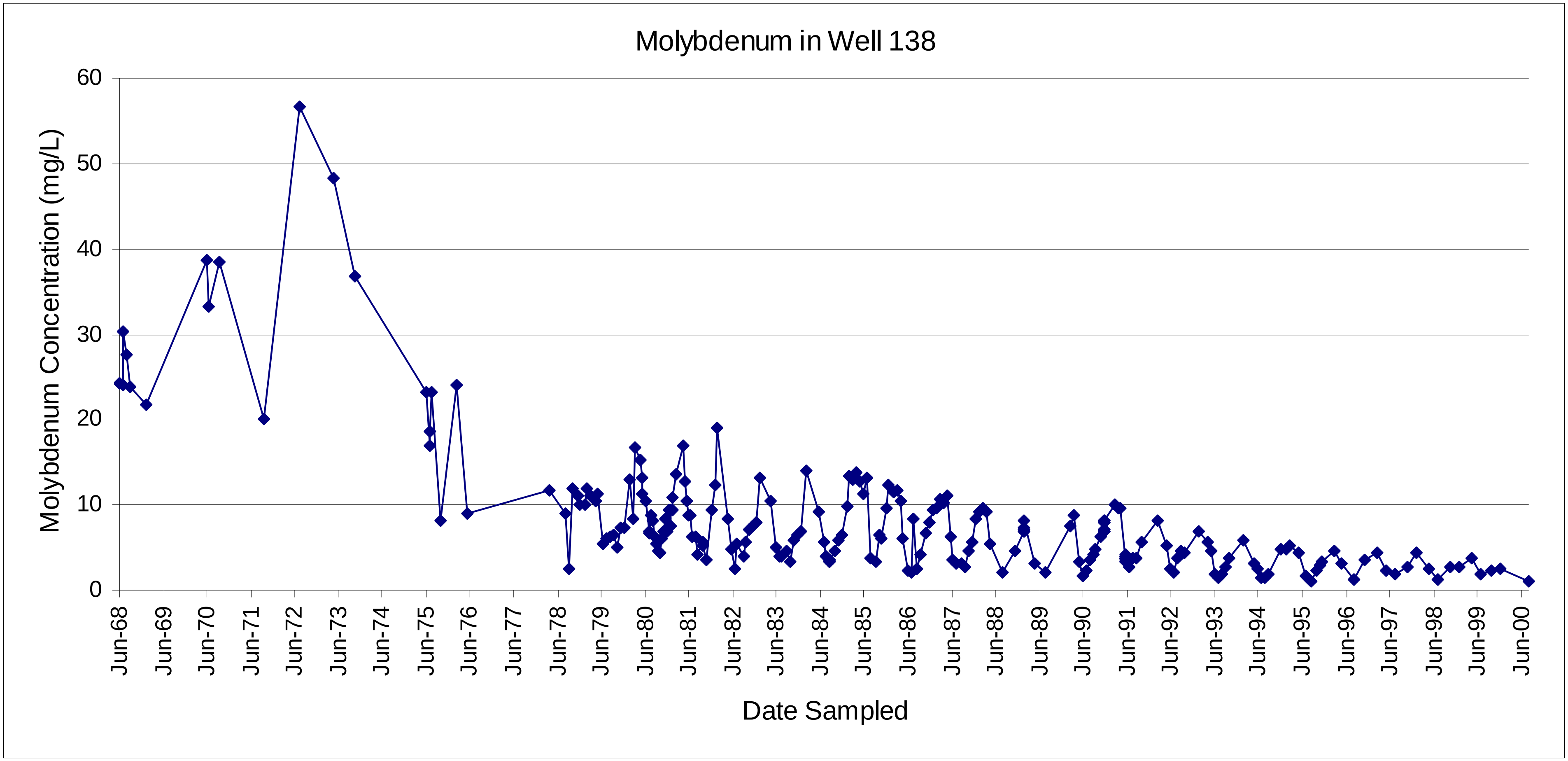
Source: CDPHE 2007b (coordinates)

Figure 11. Wells in Lincoln Park used to water lawns



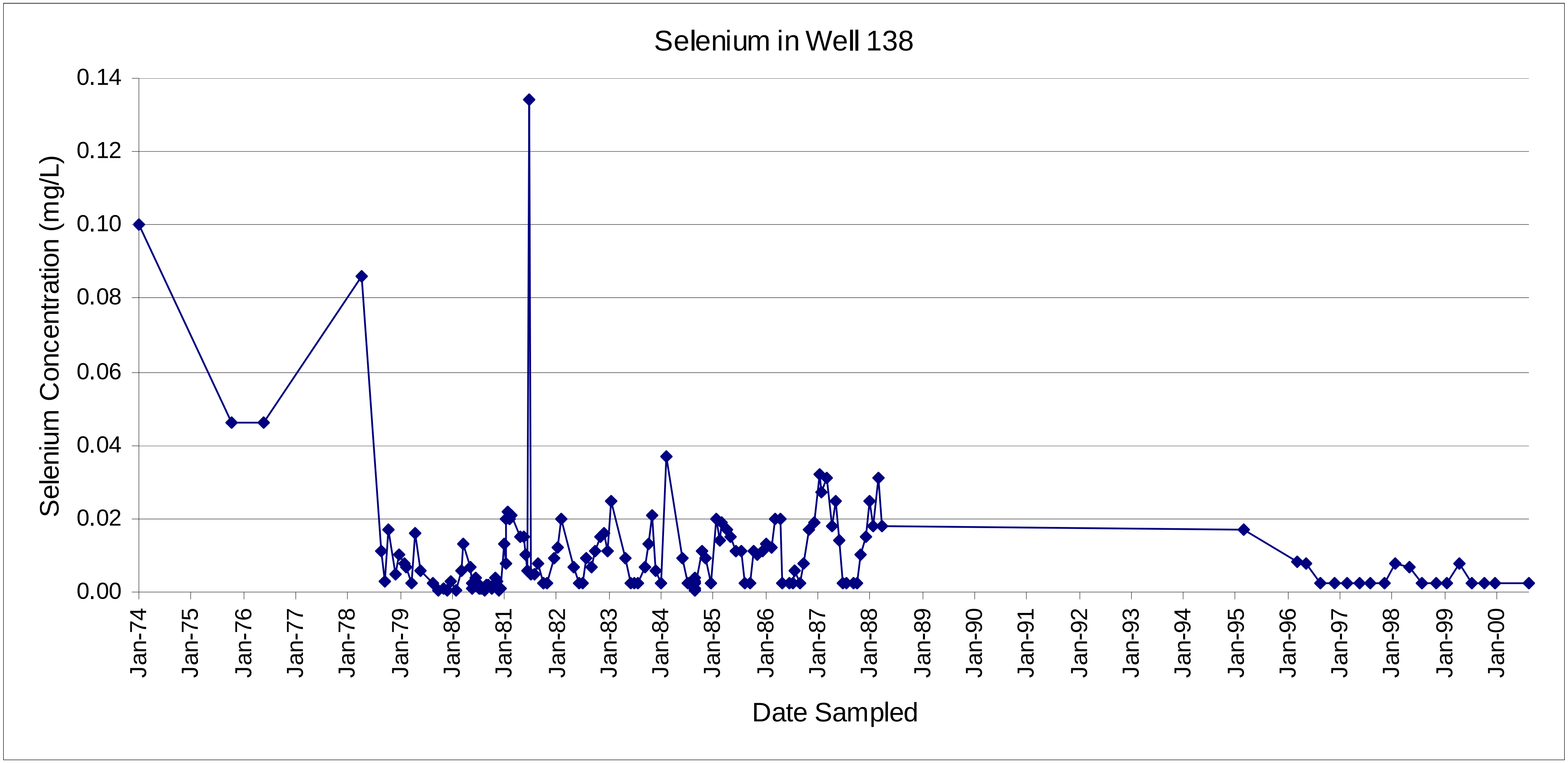
Source: CDPHE 2007b (coordinates)

Figure 12. Molybdenum concentrations in Well 138



Source: CDPHE 2007b

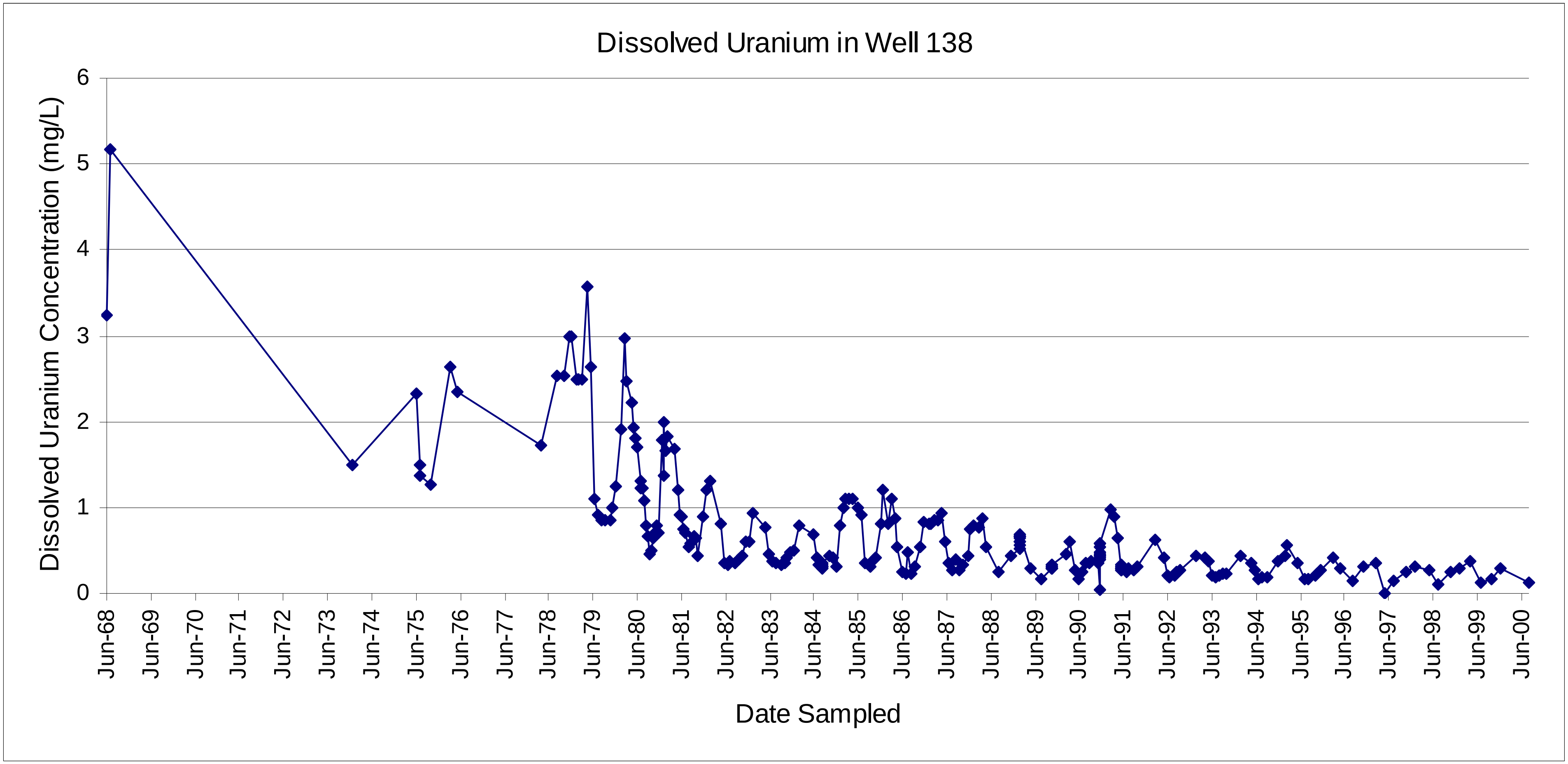
Figure 13. Selenium concentrations in Well 138



Source: CDPHE 2007b

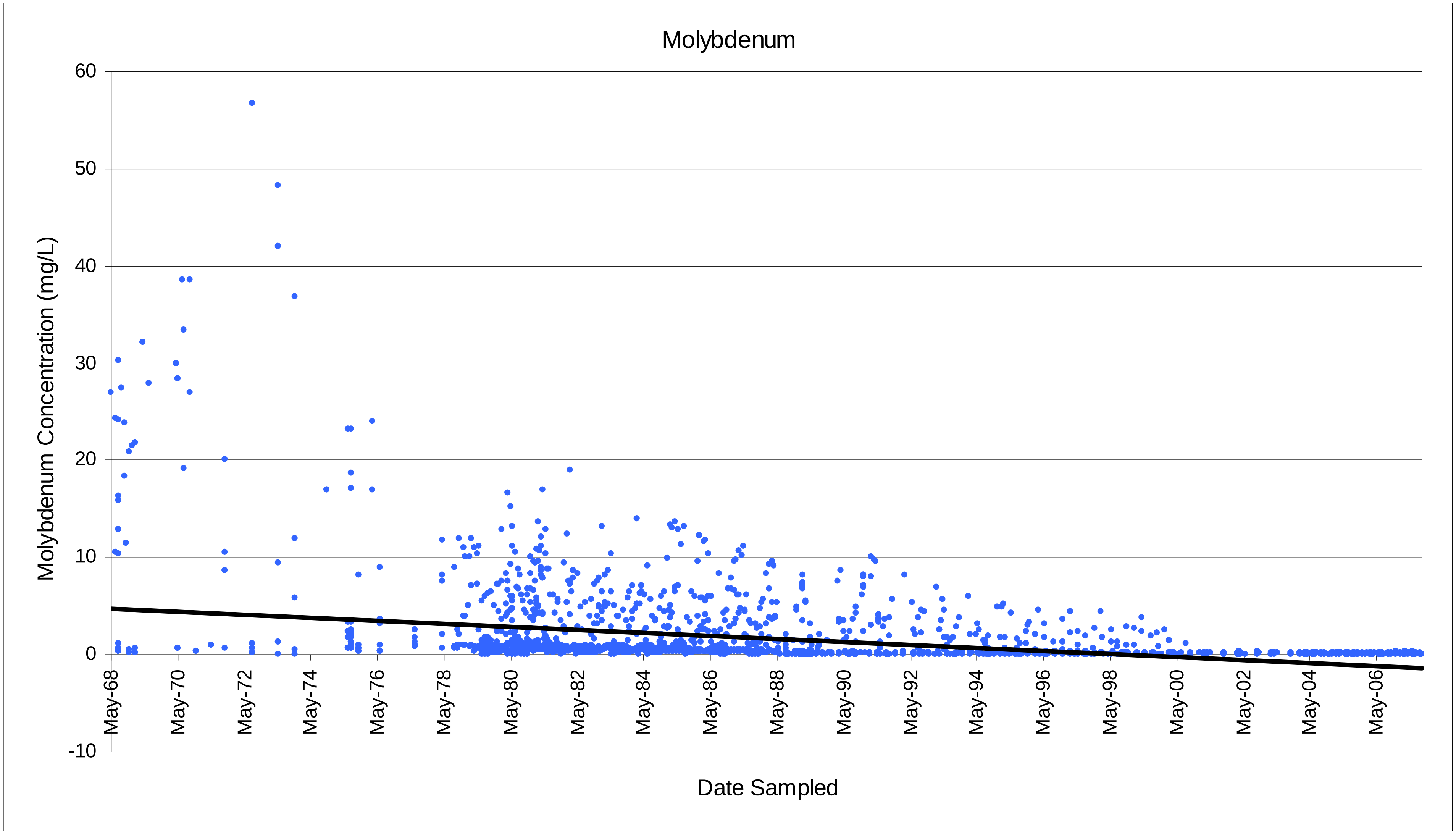
Non-detected concentrations were plotted as ½ the reporting detection limit.

Figure 14. Dissolved uranium concentrations in Well 138



Source: CDPHE 2007b

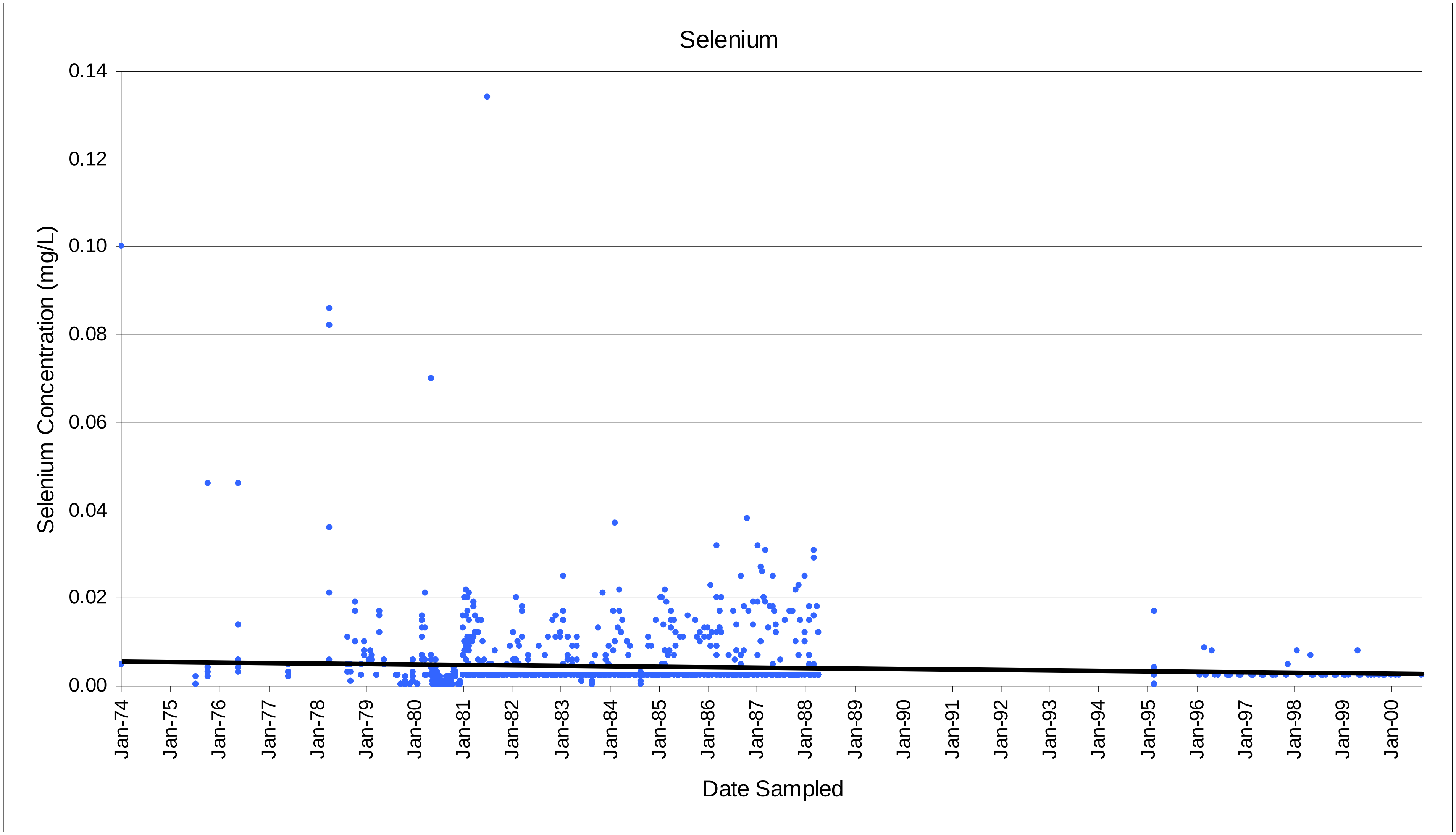
Figure 15. Molybdenum concentrations in all groundwater wells evaluated



Source: CDPHE 2007b

Non-detected concentrations were plotted as ½ the reporting detection limit.

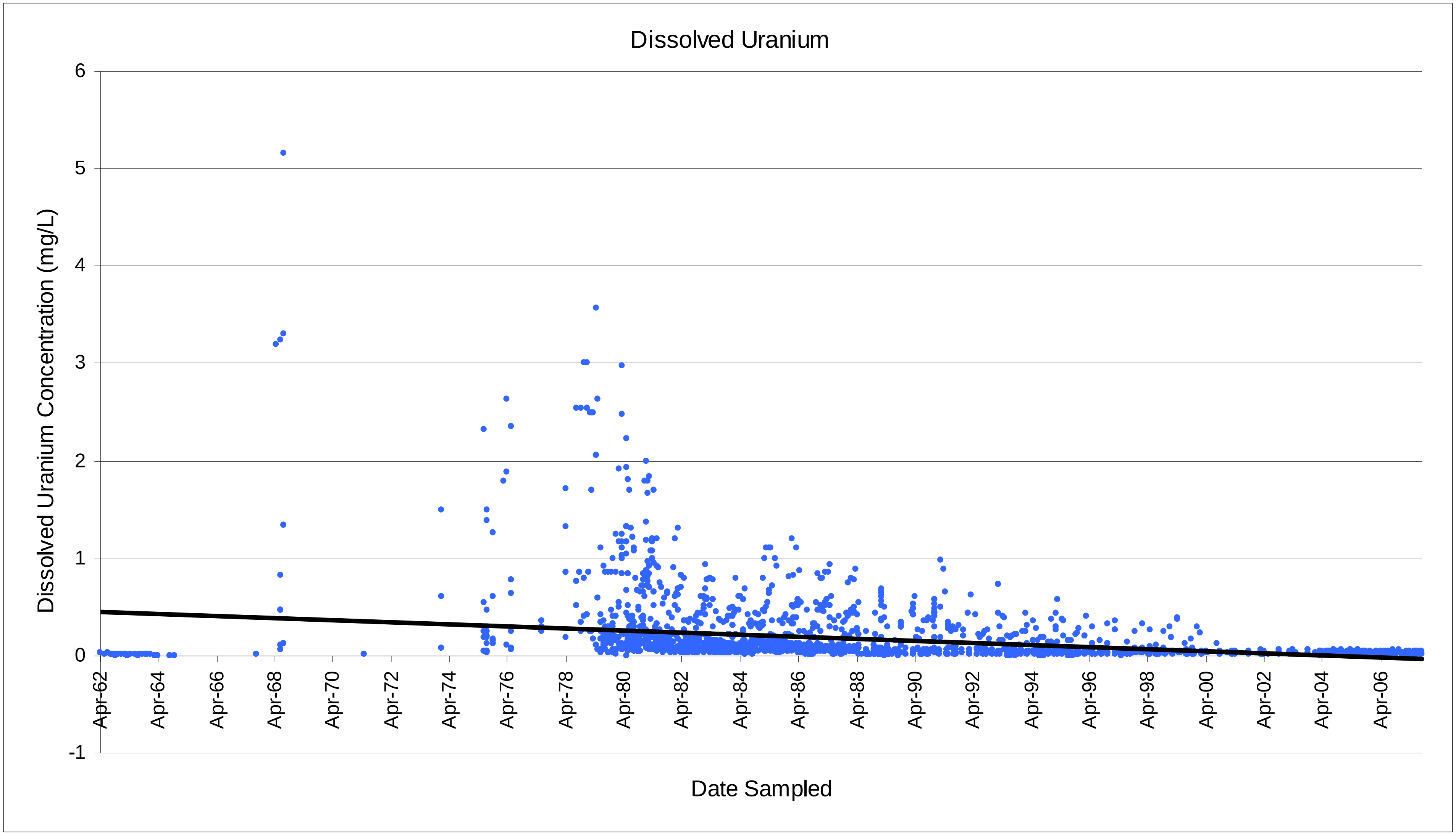
Figure 16. Selenium concentrations in all groundwater wells evaluated



Source: CDPHE 2007b

Non-detected concentrations were plotted as ½ the reporting detection limit.

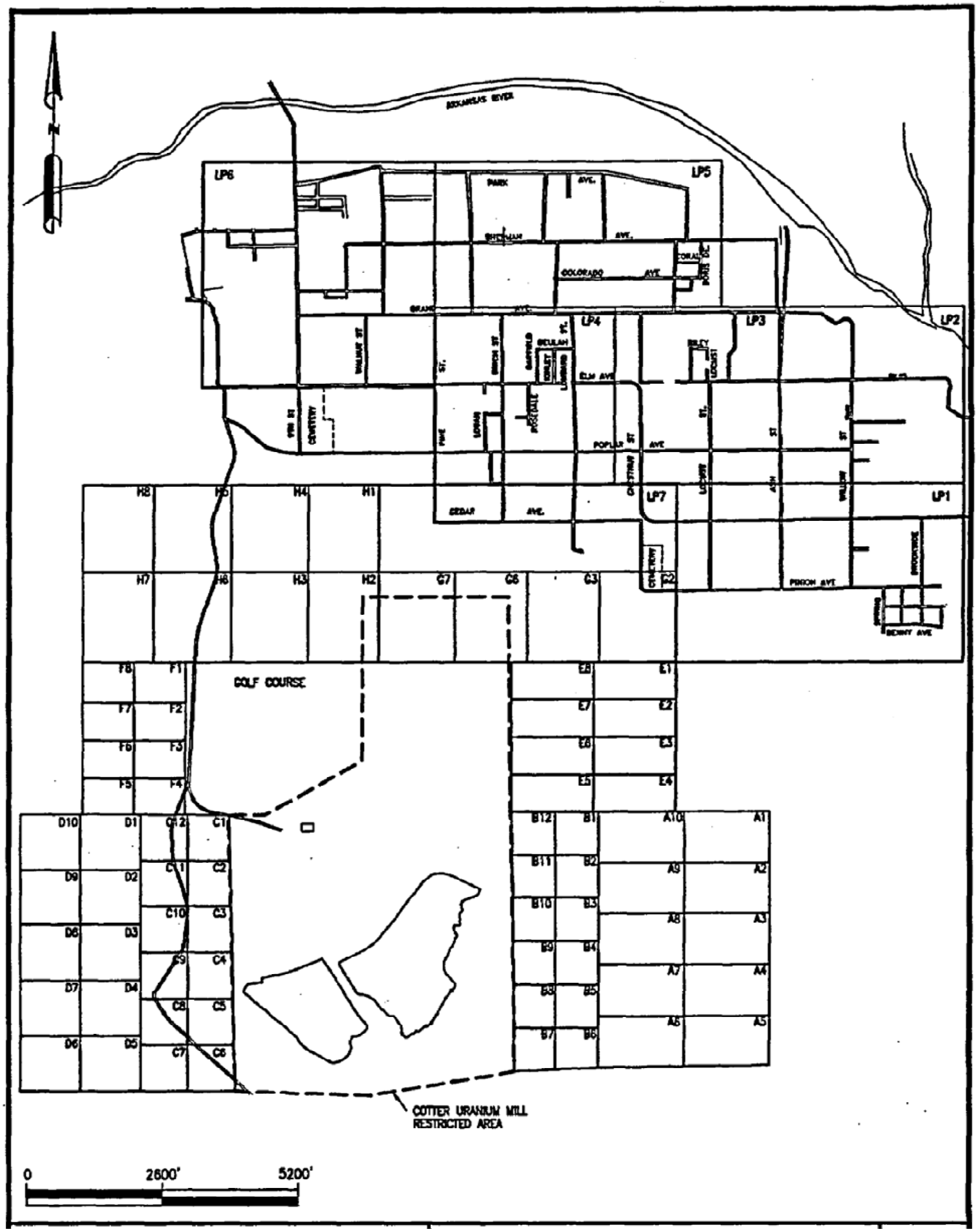
Figure 17. Dissolved uranium concentrations in all groundwater wells evaluated



Source: CDPHE 2007b

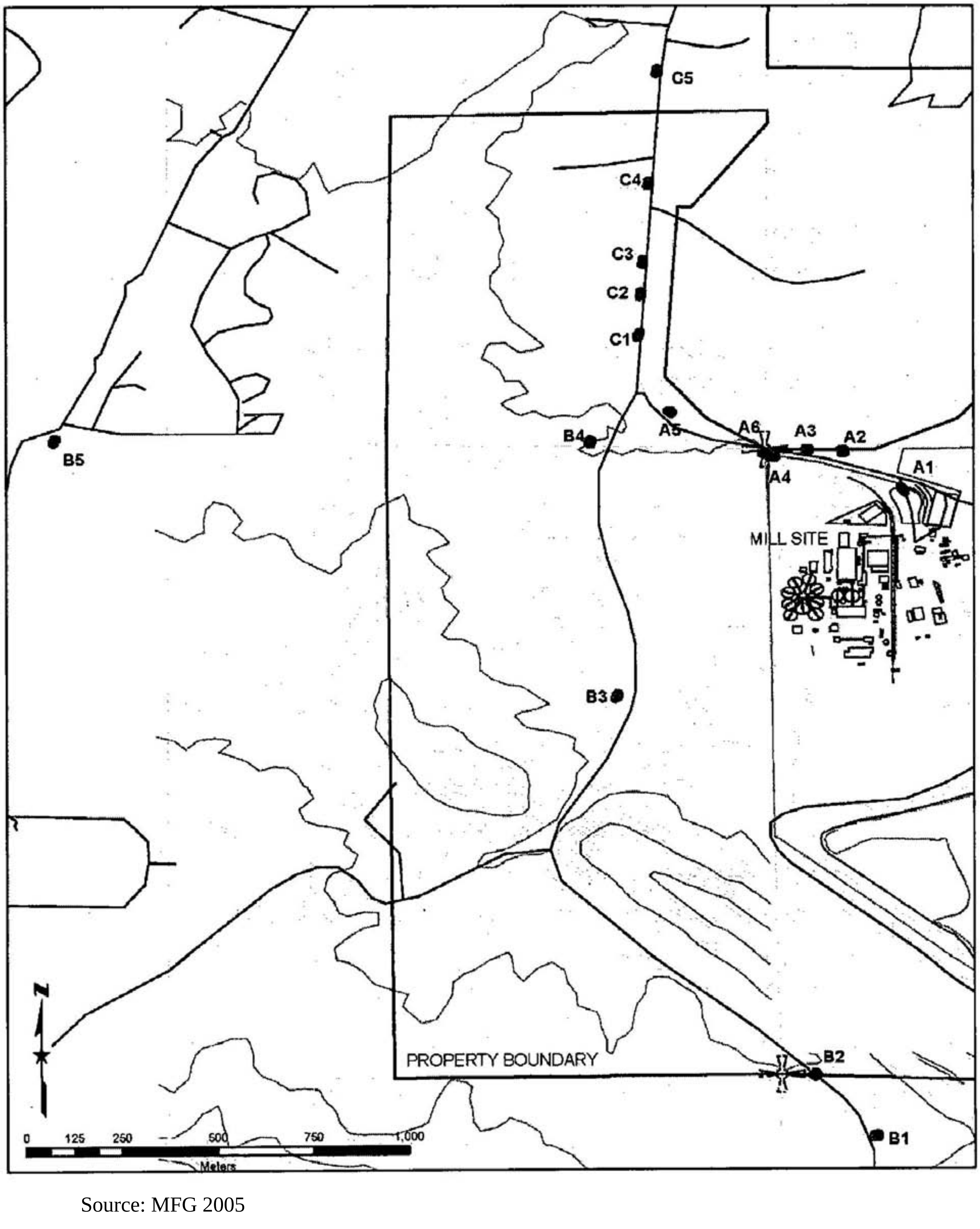
Non-detected concentrations were plotted as ½ the reporting detection limit.

Figure 18. Sampling zones established during the 1998 Supplemental Human Health Risk Assessment



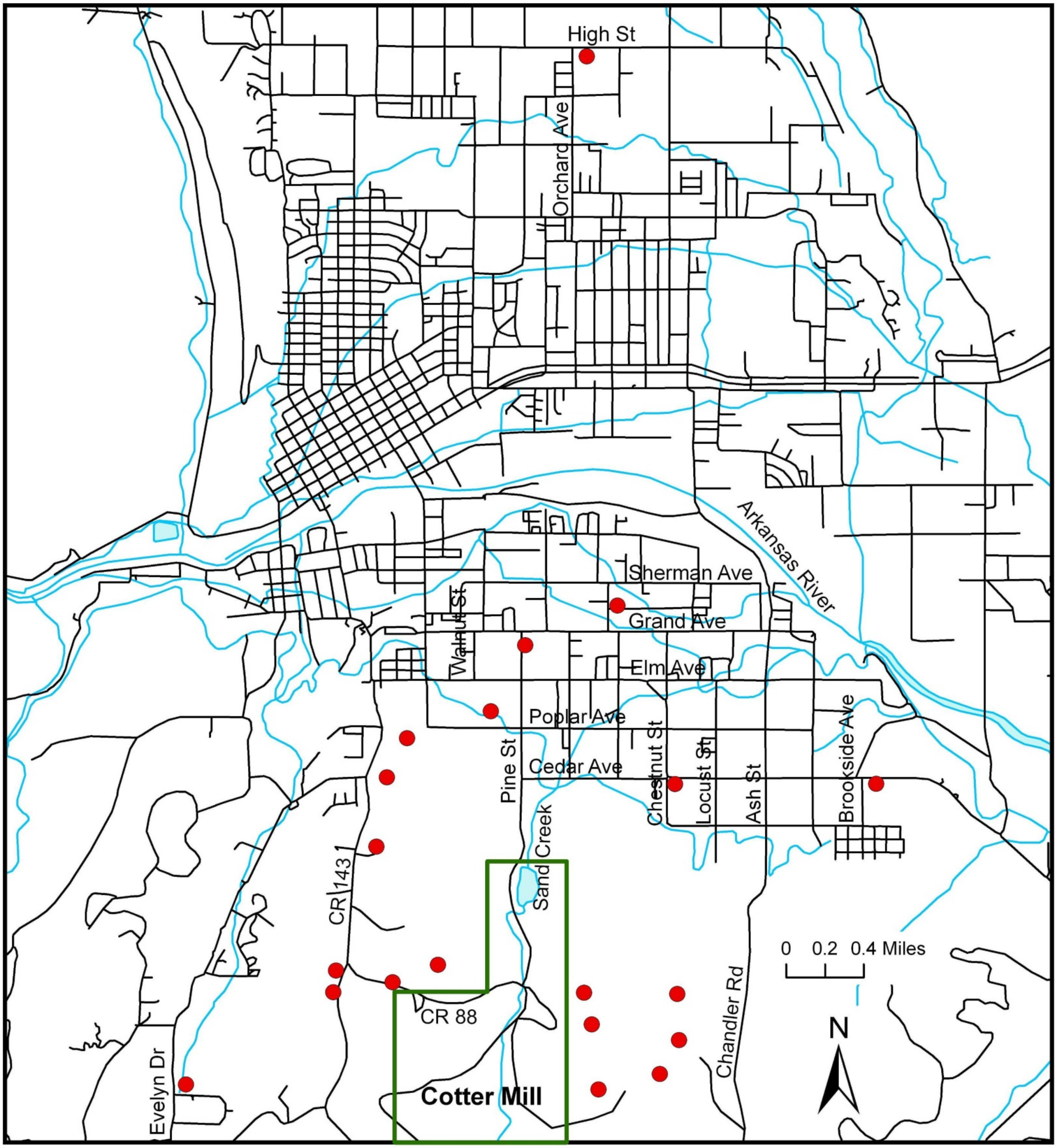
Source: Weston 1998

Figure 19. Locations of soil samples taken along the county road and Cotter Mill's access road



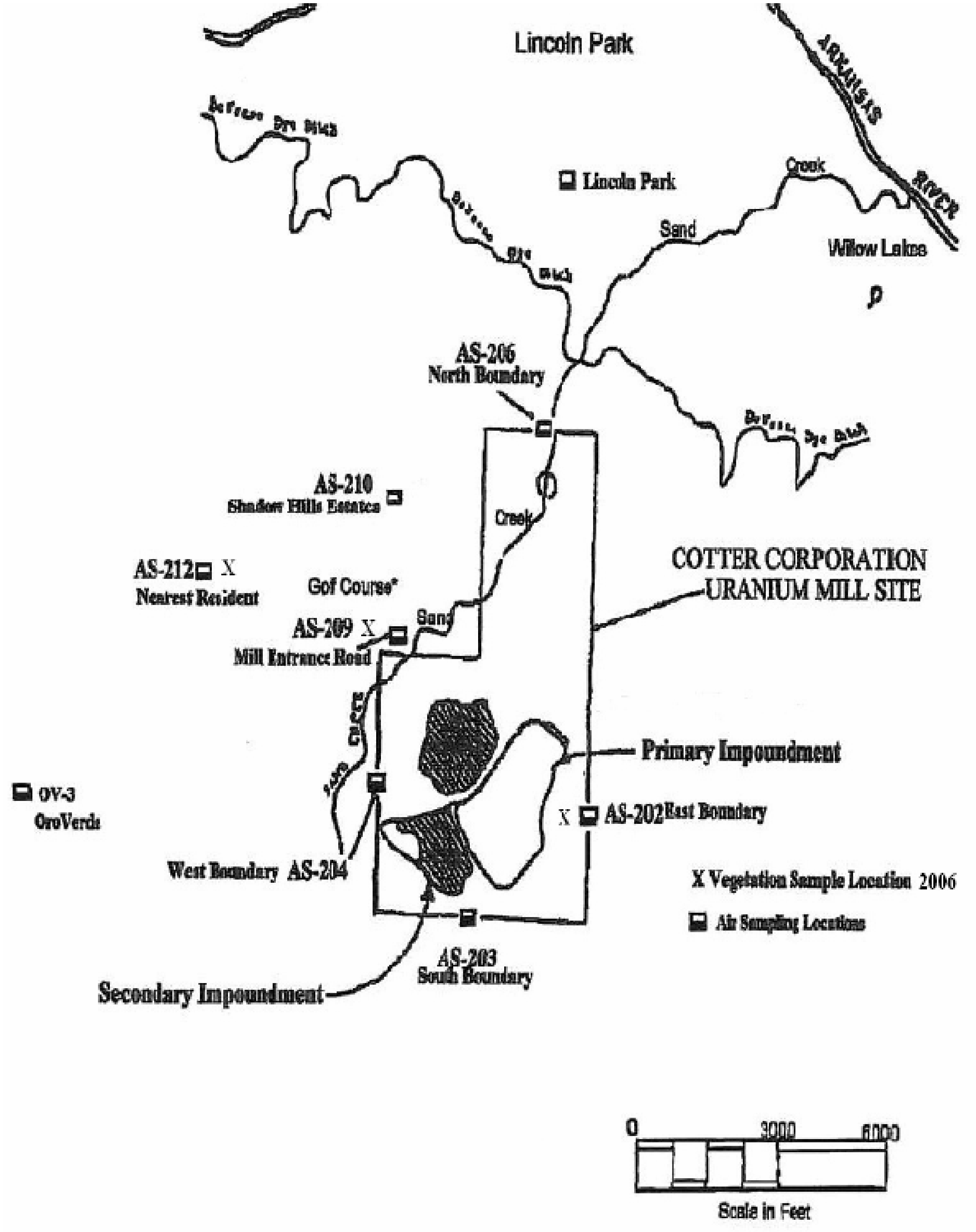
Source: MFG 2005

Figure 20. Locations of soil samples taken by CDPHE in January 2003



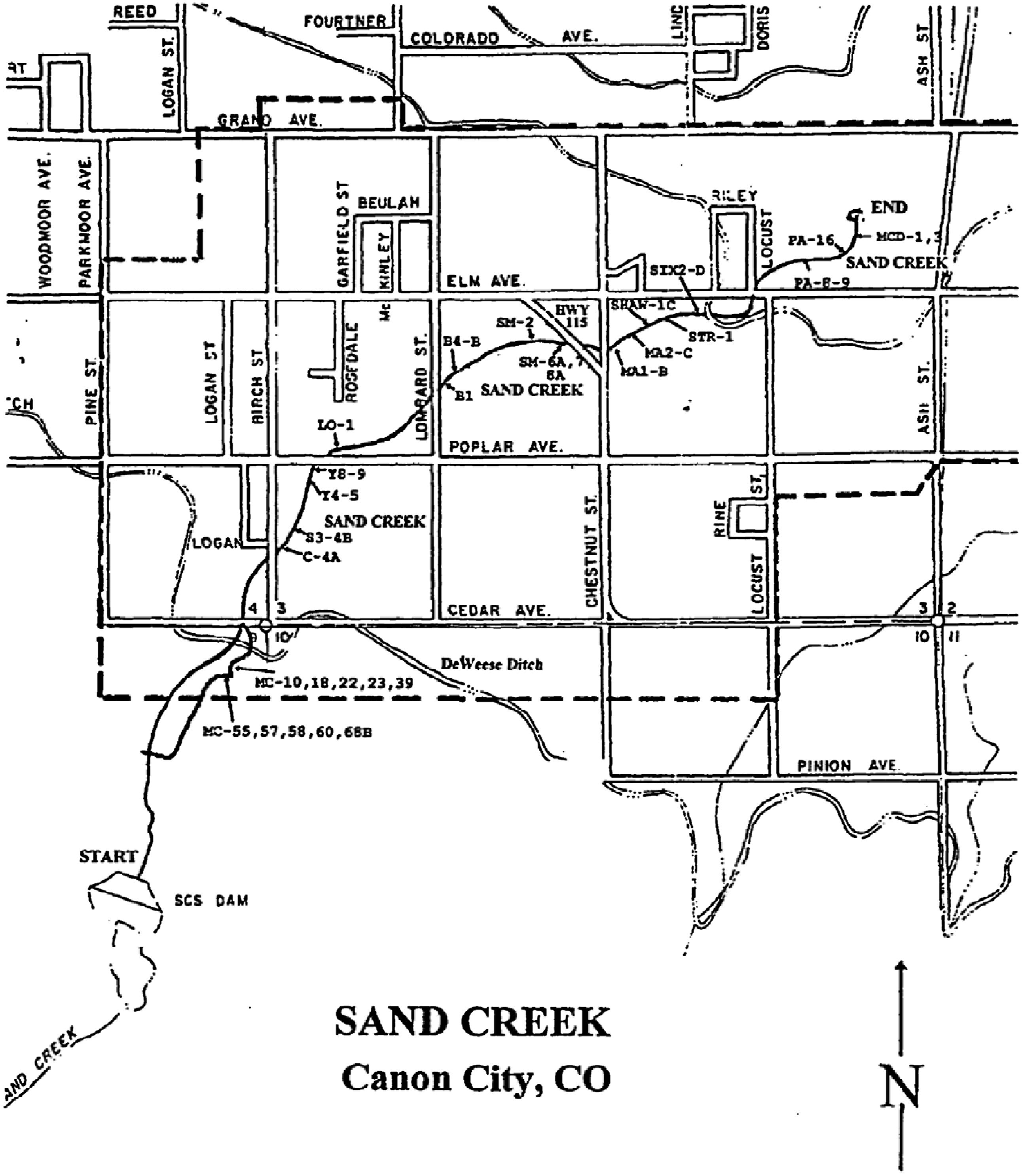
Source: CDPHE 2007b (coordinates)

Figure 21. Location of air sampling locations where soil samples are collected



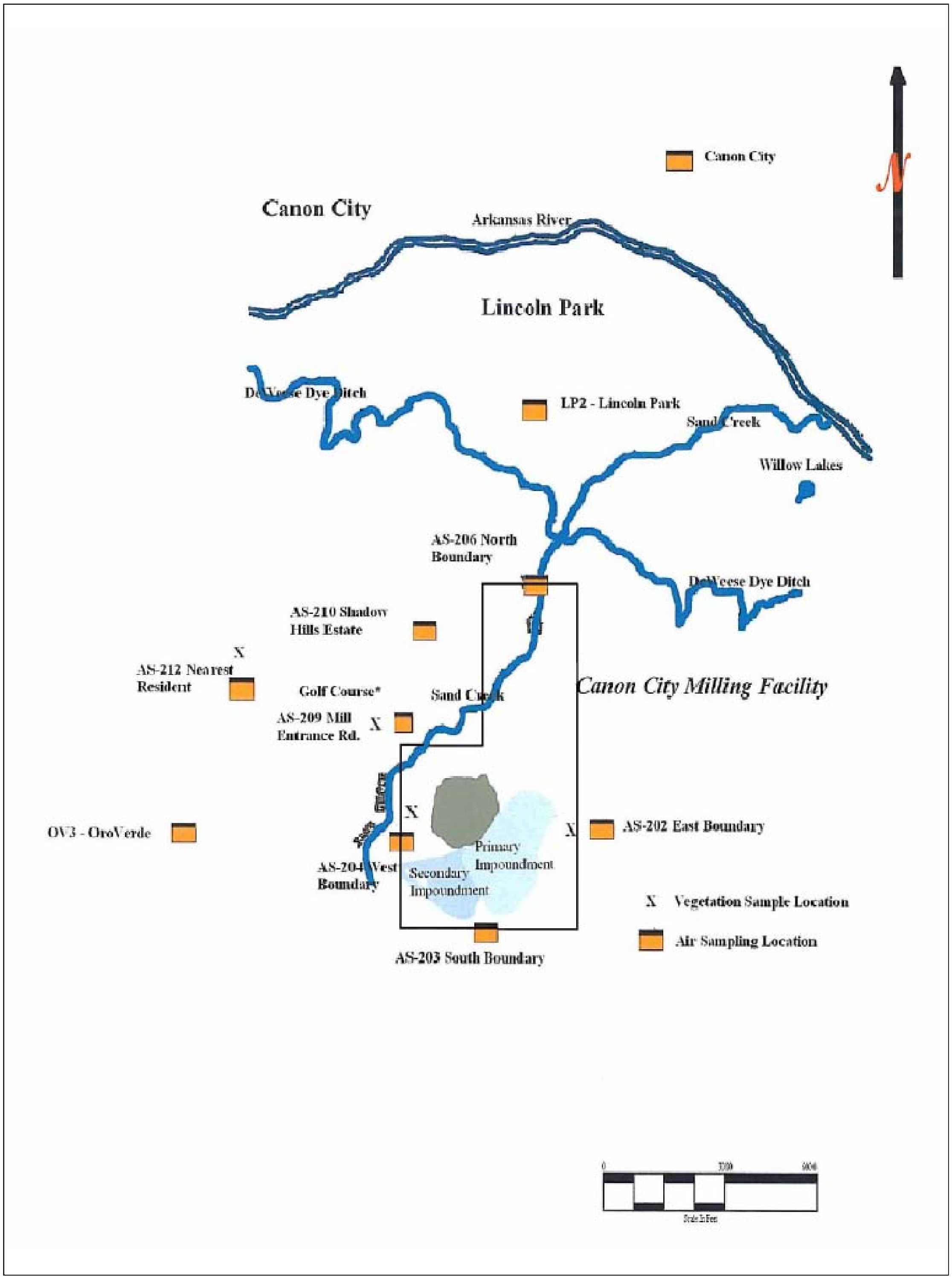
Source: Cotter 2007
Note: An additional air sampling station is located in Cañon City (not depicted on the figure).

Figure 22. Sand Creek Cleanup Project



Source: Cotter 2000

Figure 23. Approximate Locations of Cotter Mill Monitoring Stations



Notes: Figure reproduced from: Cotter 2008

APPENDIX C:
ATSDR's Evaluation Process And Exposure Dose Calculations

ATSDR's Evaluation Process

Step 1 – Comparison Values and the Screening Process

To evaluate the available data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, water, or soil that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. These values are used only to screen out chemicals that do not need further evaluation; CVs are not intended as environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based comparison values are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation risk unit. CVs based on cancerous effects account for a lifetime exposure (70 years) with an unacceptable theoretical excess lifetime cancer risk of 1 new case per 1 million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs). When a cancer and non-cancer CV exists for the same chemical, the lower of these values is used in the comparison for conservatism.

Step 2 – Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific exposure scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses is presented below. Calculated doses are reported in units of milligrams per kilograms per day (mg/kg/day). Separate calculations have been performed to account for non-cancer and cancer health effects, if applicable, for each chemical based on the health impacts reported for each chemical. Some chemicals are associated with non-cancer effects while the scientific literature many indicate that cancer-related health impacts are not expected from exposure.

Exposure Dose Factors and Calculations

When chemical concentrations at the site exceed the established CVs, it is necessary for a more thorough evaluation of the chemical to be conducted. In order to evaluate the potential for human exposure to contaminants present at the site and potential health effects from site-specific activities, ATSDR estimates human exposure to the site contaminant from different environmental media by calculating exposure doses.

A discussion of the calculations and assumptions used in this assessment is presented below. The equations are based on the EPA Risk Assessment Guidance for Superfund, Part A (1989), or ATSDR's Public Health Guidance Manual (2005), unless otherwise specified. Assumptions used were based on default values, EPA's Exposure Assessment Handbook (1997) or Child-Specific Exposure Factors Handbook (2008), or professional (site-specific) judgment. When available, site-specific information is used to estimate exposures.

Ingestion of Chemicals in Well Water:

The exposure dose formula used for the ingestion of chemicals in well water is:

$$\text{Exposure Dose (ED)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= concentration of contaminant in water in milligrams per liter (mg/L)*
IR *= ingestion rate in liters per day (L/day)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
BW *= body weight (kg)*
AT *= averaging time, days (equal to ED for non-carcinogens and 70 year lifetime for carcinogens, i.e., 70 years x 365 days/year)*

Note: In the intake equation, averaging time (AT) for exposure to non-carcinogenic compounds is always equal to ED; whereas, for carcinogens a 70 year AT is still used in order to compare to EPA's cancer slope factors typically based on that value.

This pathway assumes that an adult resident drinks 2 liters (L) of water per day for 350 days per year. In terms of exposure duration (ED), the adult resident is assumed to live in the same home and drink the same well water for 30 years. The drinking water ingestion rate for children was assumed to be 1 L per day for 350 days per year for 6 years. For average body weight, 70 kg and 16 kg were used for adults and children, respectively.

ATSDR used the average chemical concentration in Well 186 to represent a high exposure scenario from a single well. Well 186 was selected because it consistently contained the highest chemical concentrations over time. The average concentration for all private wells was used to represent exposures to a typical well user.

Table C1. Summary of Exposure Factors and Exposure Doses for the Drinking Water Pathway for Chemicals at the Cotter Mill Site

Chemical	Chemical Concentration (mg/L)	Daily Ingestion Rate (L/day)	Exposure Frequency (days/yr)	Exposure Duration (yrs)	Body Weight (kg)	Averaging Time (days)	Exposure Dose (mg/kg/day)	Health Guideline (mg/kg/day)
Drinking Water Pathway: Ingestion – ADULT and CHILD								
Molybdenum ADULT	0.16 *WELL 189** HIGH EXPOSURE	2	350	30	70	10950	0.004	0.005 Chronic Oral RfD
Molybdenum CHILD		1	350	6	16	2190	**0.010**	
Molybdenum ADULT	0.082 All wells TYPICAL EXPOSURE	2	350	30	70	10950	0.002	
Molybdenum CHILD		1	350	6	16	2190	0.005	
Uranium ADULT	0.048 Well 189* HIGH EXPOSURE	2	350	30	70	10950	0.001	0.002 Intermediate Oral MRL
Uranium CHILD		1	350	6	16	2190	**0.003**	
Uranium ADULT	0.028 All wells TYPICAL EXPOSURE	2	350	30	70	10950	0.0008	
Uranium CHILD		1	350	6	16	2190	0.002	

Bolded type exceeds a comparison value.

* "Well 189" represents a high exposure scenario. This well contained the highest level of chemicals in the sampled group.

"All wells" is used to represent an average exposure scenario for the average private well drinker.

Accidental Ingestion of Chemicals in Soil

The exposure dose formula for incidental ingestion of chemicals soil and/or sediment is:

$$\text{Exposure Dose (ED)} = \frac{C \times IR \times EF \times ED \times CF}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= concentration of contaminant in soil in milligrams per kilogram (mg/kg or ppm)*
IR *= ingestion rate in milligrams per day (mg/day)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
CF *= conversion factor (10^{-6} kg/mg)*
BW *= body weight (kg)*
AT *= averaging time, days (equal to ED for non-carcinogens and 70 year lifetime for carcinogens, i.e., 70 years x 365 days/year)*

This pathway assumes that the average adolescent (11 to 16 years of age) or adult resident accidentally ingests 100 milligrams of soil per day. Because the area is in a primarily vacant "buffer zone" between the Cotter Mill and residential homes, ATSDR assumed that very young children would not access the area. Adolescent and adults would access the site infrequently. Therefore, exposure duration (ED) for an adolescent and adult resident was assumed to be 2 days per week (or 104 days/year) for 30 years. For average body weight, 57 kg was used for an adolescent and70 kg was used for an adult.

In this evaluation, the bioavailability from incidental ingestion of arsenic in soil was assumed to be 80% because it is protective of health. Cadmium was assumed to be 100% bioavailable, which is also conservative but protective of health.

Direct Skin (Dermal) Contact with Chemicals in Soil

Dermal absorption of chemicals from soil depends on the area of contact with exposed skin, the duration of contact, the chemical and physical attraction between the contaminant and soil, the ability of the chemical to penetrate the skin, and other factors.

The exposure dose formula for dermal absorption of chemicals soil and/or sediment is:

$$\text{Exposure Dose (ED)} = \frac{C \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= chemical concentration (mg/kg)*
SA *= surface area exposed (square centimeters/day or cm^2/day)*

AF *= soil to skin adherence factor (milligrams per square centimeters or mg/cm^2)*
ABS *= Absorption factor (unitless)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
CF *= conversion factor (10^{-6} kg/mg)*
BW *= body weight (kg)*
AT *= averaging time (days)*

Note: Absorption factors (ABS) are used to reflect the desorption of the chemical from soil and the absorption of the chemical across the skin and into the bloodstream.

For the dermal contact pathway, ATSDR assumed that the surface area available in an adolescent for direct skin contact is 4,300 cubic centimeters per day (cm^2/day); the surface area available in an adult is 5,000 cm^2/day. An adherence factor of 0.07 milligrams per cubic centimeter (mg/cm^3) was used. An absorption factor of 0.03 was used for arsenic and 0.01 was used for cadmium. Individuals were assumed to weigh 57 kg as an adolescent and 70 kg as an adult, and to be exposed for 6 and 30 years, respectively.

The total soil oral and dermal non-carcinogenic dose was estimated as follows:

Total Dose (TD) = ***ID + DD***

Where:

TD *= total soil ingestion and dermal non-carcinogenic dose*
ID *= Soil ingestion non-carcinogenic dose (mg/kg/day)*
DD*= Soil dermal non-carcinogenic dose (mg/kg/day)*

Cancer Risk Estimates

EPA classifies arsenic as a Class A known human carcinogen by the oral and inhalation routes. Cadmium is classified by EPA as a probable human carcinogen, but only via the inhalation route of exposure. Therefore, only arsenic is evaluated for its carcinogenic risk.

The Lifetime Estimated Cancer Risk for arsenic is estimated as follows:

LECR = ***TDs x CSF x EF***

Where:

LECR *= lifetime estimated cancer risk*
TDs *= total soil oral and dermal non-carcinogenic dose (mg/kg/day)*
CSF *= cancer slope factor ($(\text{mg/kg-day})^{-1}$)*
EF *= Exposure factor (unitless) = exposure duration / lifetime = (30 years) / (70 years) = 0.4*

The cancer slope factor for arsenic is 1.5 mg/kg-day. Therefore, the LECR is 1.2 x 10^{-5}.

Table C2. Summary of Exposure Factors and Exposure Doses for the Soil Exposure Pathway for Chemicals at the Cotter Mill Site

Chemical	Chemical Concentration (mg/kg)	Daily Intake Rate (mg/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Exposure Dose (mg/kg/day)	Health Guideline (mg/kg/day)
Soil Exposure Pathway: Accidental Ingestion and Direct Skin Contact - ADULT and ADOLESCENT								
Arsenic (ingestion)	45	100	104	30	70	10950	0.00002	0.0003 MRL
Arsenic (dermal)		NA	104	30	70	10950	0.000002	
TOTAL DOSE ARSENIC - Adult							0.00002	*Below Guideline*
Cadmium (ingestion)	37	100	104	30	70	10950	0.00002	0.0001 MRL
Cadmium (dermal)		NA	104	30	70	10950	0.0000005	
TOTAL DOSE CADMIUM -Adult							0.00002	*Below Guideline*
Arsenic (ingestion)	45	100	104	6	54	2190	0.00002	0.0003 MRL
Arsenic (dermal)		NA	104	6	54	2190	0.000002	
TOTAL DOSE ARSENIC - Adolescent							0.00002	*Below Guideline*
Cadmium (ingestion)	37	100	104	6	54	2190	0.00002	0.0001 MRL
Cadmium (dermal)		NA	104	6	54	2190	0.0000006	
TOTAL DOSE CADMIUM - Adolescent							0.00002	*Below Guideline*

Incidental Ingestion of Chemicals in Surface Water

The ATSDR exposure dose formula used for the ingestion of chemicals in surface water while wading or swimming is:

$$\text{Exposure Dose (ED)} = \frac{C \times IR \times ET \times EF \times ED}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= concentration of contaminant in water in milligrams per liter (mg/L)*
IR *= ingestion rate in liters per day (L/day); based on contact rate of 50 ml/hr*
ET *= exposure time (hours/event)*
EF *= exposure frequency (events/year)*
ED *= exposure duration (years)*
BW *= body weight (kg)*
AT *= averaging time, days (equal to ED for non-carcinogens and 70 year lifetime for carcinogens, i.e., 70 years x 365 days/year)*

This pathway assumes that adult and children residents would accidentally swallow 50 milliliters of water per hour while swimming, wading or recreating in Sand Creek or the DeWeese Dye Ditch. In terms of exposure time and frequency, ATSDR conservatively assumed an adult and child resident would recreate in these waters for 2 hours per day, 2 days per week (or 104 days/year) for 30 years and 6 years, respectively. For average body weight, 70 kg and 16 kg were used for adults and children, respectively.

Direct Skin (Dermal) Contact with Chemicals in Surface Water

ATSDR's exposure dose formula for dermal absorption of chemicals soil and/or sediment is:

$$\text{Exposure Dose (ED)} = \frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= chemical concentration (mg/L)*
SA *= surface area exposed* (cm^2)
PC *= chemical-specific dermal permeability constant (cm/hr)*
ET *= exposure time (hours/day)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
CF *= volumetric conversion factor for water* ($1L/1000\ cm^3$)
BW *= body weight (kg)*
AT *= averaging time (days)*

The dermal contact pathway assumes that the total body surface area available for contact with water is 20,000 cm^2 for adults and 9,300 cm^2 for children. Adults were assumed to weigh 70 kg and to be exposed for 30 years. Children were assumed to weigh 16 kg and to be exposed for 6 years. Adults and children were conservatively assumed to swim in the contaminated water 2 days per week (104 days per year) for 2 hours per recreating event. A dermal permeability constant of 0.001 cm/hr was used for both manganese and molybdenum.

Table C3. Summary of Exposure Factors and Exposure Doses for the Surface Water Pathway for Chemicals at the Cotter Mill Site

Chemical	Chemical Concentration (mg/L)	Daily Ingestion Rate (L/day)	Exposure Frequency (days/yr)	Exposure Duration (yrs)	Body Weight (kg)	Averaging Time (days)	Exposure Dose (mg/kg/day)	Health Guideline (mg/kg/day)
Surface Water Exposure Pathway: Accidental Ingestion and Direct Skin Contact while Wading or Swimming – ADULT and CHILD								
Manganese* Adult Ingestion	1.9	0.1	104	30	70	10950	3.9 x 10^{-4}	0.05 Chronic Oral RfD
Manganese Adult Dermal		NA	104	30	70	10950	3.1 x 10^{-4}	
		TOTAL DOSE MANGANESE – Adult					7 x 10^{-4}	*Below Guideline*
Manganese Child Ingestion		0.1	104	6	16	2190	1.7 x 10^{-3}	0.05 Chronic Oral RfD
Manganese Child Dermal		NA	104	6	16	2190	6.3 x 10^{-4}	
		TOTAL DOSE MANGANESE - Child					2.3 x 10^{-3}	*Below Guideline*
Molybdenum† Adult Ingestion	0.051	0.1	104	30	70	10950	1.0 x 10^{-5}	0.005 Chronic Oral RfD
Molybdenum Adult Dermal		NA	104	30	70	10950	8.3 x 10^{-6}	
		TOTAL DOSE MOLYBDENUM - Adult					1.8 x 10^{-5}	*Below Guideline*
Molybdenum Child Ingestion		0.1	104	6	16	2190	4.5 x 10^{-5}	0.005 Chronic Oral RfD
Molybdenum Child Dermal		NA	104	6	16	2190	1.7 x 10^{-5}	
		TOTAL DOSE MOLYBDENUM - Child					6.2 x 10^{-5}	*Below Guideline*

*Maximum concentration of manganese in surface water detected in DeWeese Dye Ditch

†Maximum concentration of molybdenum in surface water detected in Sand Creek

Consumption of Homegrown Fruits and Vegetables

The following formula presents the method for calculating an exposure dose for a typical consumer of homegrown fruits and vegetables:

$$\text{Exposure Dose (mg/kg/day)} = \mathbf{C \times IR \times CF}$$

Where:

C *= contaminant concentration (mg/kg)*
IR *= intake rate of fruit or vegetable (g/kg/day)*
CF *= conversion factor* $(1 \times 10^{-3}\ \text{kg/mg})$

Exposure doses for ingestion of garden vegetables were calculated using the average detected concentration of each contaminant measured in fruit and vegetable samples, in mg/kg, multiplied by average consumption rates of homegrown fruits or vegetables in grams per kilogram of body weight per day (g/kg/day). Intake rates were taken from EPA's Exposure Factors Handbook for adults, and EPA's Child-Specific Exposure Factors Handbook for children, for the Western United States. The average consumption rate was used to represent a "typical" fruit and vegetable consumer. The 95 percentile consumption rate was used to represent an "above average" consumer of fruits and vegetables. The calculated value was multiplied by a conversion factor of 0.001 kilograms per gram.

Table C4. Summary of Exposure Doses for Local Fruits and Vegetables Irrigated with Contaminated Well Water

Chemical	Chemical Concentration/ Exposure Group	Exposure Dose Fruits (mg/kg/day)	Exposure Dose Vegetables (mg/kg/day)	Health Guideline (mg/kg/day)
Arsenic	Average consumer	0.0001	0.0001	0.0003, Chronic Oral MRL
	Above Average Consumer	0.0006	0.0005	
	Child	0.0002	0.0002	
	Infant	0.0004	0.0004	
Barium	Average consumer	0.001	0.003	0.2 Chronic Oral MRL
	Above Average Consumer	0.005	0.010	
	Child	0.002	0.004	
	Infant	0.004	0.008	
Cadmium	Average consumer	0.0001	0.0001	0.001, RfD
	Above Average Consumer	0.0005	0.0002	
	Child	0.0002	0.0001	
	Infant	0.0004	0.0002	
Chromium	Average consumer	0.0001	0.0001	1.5 RfD
	Above Average Consumer	0.0006	0.0003	
	Child	0.0002	0.0001	
	Infant	0.0005	0.0003	
Cobalt	Average consumer	ND	0.00004	0.01 Intermediate MRL
	Above Average Consumer	ND	0.00012	
	Child	ND	0.00005	
	Infant	ND	0.0001	
Lead	Average consumer	0.0003	0.0004	NA
	Above Average Consumer	0.001	0.001	
	Child	0.0005	0.0005	
	Infant	0.001	0.001	
Manganese	Average consumer	0.002	0.004	0.14 RfD
	Above Average Consumer	0.01	0.02	
	Child	0.004	0.006	
	Infant	0.008	0.01	
Molybdenum	Average consumer	0.0003	0.001	0.005 RfD
	Above Average Consumer	0.001	0.004	

Chemical	Chemical Concentration/ Exposure Group	Exposure Dose Fruits (mg/kg/day)	Exposure Dose Vegetables (mg/kg/day)	Health Guideline (mg/kg/day)
	Child	0.0005	0.002	
	Infant	0.001	0.004	
Nickel	Average consumer	ND	0.0001	0.02 RfD
	Above Average Consumer	ND	0.0005	
	Child	ND	0.0002	
	Infant	ND	0.0004	
Strontium	Average consumer	0.004	0.009	0.6 RfD
	Above Average Consumer	0.02	0.03	
	Child	0.007	0.01	
	Infant	0.01	0.03	
Uranium	Average consumer	0.00002	0.00001	0.002 Intermediate MRL
	Above Average Consumer	0.00008	0.00004	
	Child	0.00003	0.00002	
	Infant	0.00006	0.00004	
Vanadium	Average consumer	ND	0.00008	0.003 Intermediate MRL
	Above Average Consumer	ND	0.0003	
	Child	ND	0.0001	
	Infant	ND	0.0002	
Zinc	Average consumer	0.004	0.006	0.3 Chronic Oral MRL
	Above Average Consumer	0.02	0.02	
	Child	0.006	0.008	
	Infant	0.01	0.02	

Bolded text exceeds a health guideline.
ND = not detected
NA = not available

ATSDR's Evaluation of Cancer and Non-Cancer Health Effects

Non-Cancer Health Effects

The doses calculated for exposure to each individual chemical are compared to an established health guideline, such as a MRL or RfD, in order to assess whether adverse health impacts from exposure are expected. These health guidelines, developed by ATSDR and EPA, are chemical-specific values that are based on the available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice for deriving health guidelines is to identify, usually from animal toxicology experiments, a No Observed Adverse Effect Level (or NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The NOAEL is then modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of available data. Thus, exposure doses at or below the established health guideline are not expected to result in adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies. For non-cancer health effects, the following health guidelines are described below in more detail. It is important to consider that the methodology used to develop these health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer evaluation is necessary for potentially cancer-causing chemicals detected in samples at this site. A more detailed discussion of the evaluation of cancer risks is presented in the following section.

Minimal Risk Levels (MRLs) – developed by ATSDR

ATSDR has developed MRLs for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for different routes of exposure, such as inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or greater). At this time, ATSDR has not developed MRLs for dermal exposure. A complete list of the available MRLs can be found at http://www.atsdr.cdc.gov/mrls.html.

References Doses (RfDs) – developed by EPA

An estimate of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause non-cancerous health effects. RfDs consider exposures to sensitive sub-populations, such as the elderly, children, and the developing fetus. EPA RfDs have been developed using information from the available scientific literature and have been calculated for oral and inhalation exposures. A complete list of the available RfDs can be found at http://www.epa.gov/iris.

If the estimated exposure dose for a chemical is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. Non-cancer health effects from dermal exposure were evaluated slightly differently that ingestion and inhalation exposure. Since health guidelines are not available for dermal exposure, the calculated dermal dose was compared with the oral health guideline value (RfD or MRL).

If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the PHA. The known toxicological values are doses derived from human and animal studies that are presented in the ATSDR Toxicological Profiles and EPA's Integrated Information System (IRIS). A direct comparison of site-specific exposure doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. This in-depth evaluation is performed by comparing calculated exposure doses with known toxicological values, such as the no-observed adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from studies used to derive the MRL or RfD for a chemical.

Cancer Risks

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated excess risk of developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific adult exposure doses, with a slight modification, by EPA's chemical-specific Cancer Slope Factors (CSFs or cancer potency estimates), which are available at http://www.epa.gov/iris. Calculated dermal doses were compared with the oral CSFs.

An increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular contaminant. Therefore, the cancer risk calculation incorporates the equations and parameters (including the exposure duration and frequency) used to calculate the dose estimates, but the estimated value is divided by 25,550 days (or the averaging time), which is equal to a lifetime of exposure (70 years) for 365 days/year.

There are varying suggestions among the scientific community regarding an acceptable excess lifetime cancer risk, due to the uncertainties regarding the mechanism of cancer. The recommendations of many scientists and EPA have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 (or 1×10^{-5}) are not typically considered a health concern. An important consideration when determining cancer risk estimates is that the risk calculations incorporate several very conservative assumptions that are expected to overestimate actual exposure scenarios. For example, the method used to calculate EPA's CSFs assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. As previously stated, the method also assumes that there is no safe level for exposure. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.

Because of the uncertainties involved with estimating carcinogenic risk, ATSDR employs a weight-of-evidence approach in evaluating all relevant data. Therefore, the carcinogenic risk is also described in words (qualitatively) rather than giving a numerical risk estimate only. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions. The actual parameters of environmental exposures have been given careful and thorough consideration in evaluating the assumptions and variables relating to both toxicity and exposure. A complete review of the toxicological data regarding the doses associated with the production of cancer and the site-specific doses for the site is an important element in determining the likelihood of exposed individuals being at a greater risk for cancer.

Appendix D. ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-800-CDC-INFO (1-800-232-4636).

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

Anaerobic
Requiring the absence of oxygen [compare with aerobic].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause

harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often

and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life (t½)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR’s public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual’s exposure could negatively affect that person’s health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period

(acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR’s toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)
National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

EPA-413

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 08:59 AM		cc	
		bcc	
		Subject	Fw: Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:58 AM -----

From: "Paulson, Oscar (CCC)" <Oscar.Paulson@riotinto.com>
To: <Rosnick.Reid@epamail.epa.gov>
Cc: "Sweeney,Katie" <KSweeney@nma.org>
Date: 09/13/2010 12:45 PM
Subject: Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Reid Rosnick:

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*
- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation’s Canon City Mill and concluded:
    - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases

from the Canon City Mill. The filing states, “*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado.”* The filing continues by requesting that the Environmental Protection Agency (EPA), “ *Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid.”*

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project
P.O. Box 1500
42 Miles Northwest of Rawlins
Rawlins, Wyoming 82301-1500

Telephone: (307)-324-4924
Fax: (307)-324-4925
Cellular: (307)-320-8758

E-mail: oscar.paulson@riotinto.com

LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf

EPA-413

Reid Rosnick/DC/USEPA/US		To	Beth Miller
09/05/2012 08:59 AM		cc	
		bcc	
		Subject	Fw: Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:58 AM -----

From:	"Paulson, Oscar (CCC)" <Oscar.Paulson@riotinto.com>
To:	<Rosnick.Reid@epamail.epa.gov>
Cc:	"Sweeney,Katie" <KSweeney@nma.org>
Date:	09/13/2010 12:45 PM
Subject:	Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILL CAÑON CITY, FREMONT COUNTY, COLORADO - EPA FACILITY ID: COD042167585 - SEPTEMBER 9, 2010

Reid Rosnick:

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*
- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
    - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases

from the Canon City Mill. The filing states, “*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado.”* The filing continues by requesting that the Environmental Protection Agency (EPA), “ *Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid.”*

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project
P.O. Box 1500
42 Miles Northwest of Rawlins
Rawlins, Wyoming 82301-1500

Telephone: (307)-324-4924
Fax: (307)-324-4925
Cellular: (307)-320-8758

E-mail: oscar.paulson@riotinto.com

LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf

Public Health Assessment for

LINCOLN PARK/COTTER URANIUM MILL
CAÑON CITY, FREMONT COUNTY, COLORADO
EPA FACILITY ID: COD042167585
SEPTEMBER 9, 2010

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

NOVEMBER 9, 2010

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Agency for Toxic Substances and Disease Registry....................................Thomas R. Frieden, M.D., M.P.H., Administrator
Christopher J. Portier, Ph.D., Director

Division of Health Assessment and Consultation…………………………………….William Cibulas, Jr., Ph.D., Director
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Health Promotion and Community Involvement Branch………………………………Hilda Shepeard, Ph.D., M.B.A., Chief

Exposure Investigations and Consultation Branch……………………….……………………..Susan M. Moore, M.S., Chief

Federal Facilities Assessment Branch……………………………………………………….....Sandra G. Isaacs, B.S., Chief

Superfund and Program Assessment Branch .... Richard E. Gillig, M.C.P., Chief

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
Attn: Records Center
1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

You May Contact ATSDR Toll Free at
1-800-CDC-INFO or
Visit our Home Page at: http://www.atsdr.cdc.gov

PUBLIC HEALTH ASSESSMENT

LINCOLN PARK/COTTER URANIUM MILL

CAÑON CITY, FREMONT COUNTY, COLORADO

EPA FACILITY ID: COD042167585

Prepared by:

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Site and Radiological Assessment Branch

This information is distributed by the Agency for Toxic Substances and Disease Registry for public comment under applicable information quality guidelines. It does not represent and should not be construed to represent final agency conclusions or recommendations.

Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund law. This law set up a fund to identify and clean up hazardous waste sites. The Environmental Protection Agency (EPA) and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high-risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate possible the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the public comments that related to the document are addressed in the final version of the report.

Conclusions: The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Rolanda Morrison
ATSDR Records Center (MS F-09)
4770 Buford Hwy, NE
Building 106, Room 2108
Atlanta, GA 30341

Table of Contents

APPENDIX C - ATSDR'S EVALUATION PROCESS AND EXPOSURE DOSE CALCULATIONS

Acronyms and Abbeviations

CCAT	Colorado Citizens Against Toxic Waste
CDPHE	Colorado Department of Public Health and Environment
CREG	cancer risk evaluation guide
CV	comparison value
D	dissolved
EMEG	environmental media evaluation guide
EPA	US Environmental Protection Agency
LPWUS	Lincoln Park Water Use Survey
LTHA	lifetime health advisory for drinking water
MCL	maximum contaminant level
mg/L	milligrams per liter
μR/hr	microroentgen per hour
N	not defined in the CDPHE database
NA	not available
ND	not detected
NPL	National Priorities List
OU	operable units
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppm	parts per million
RAP	Remedial Action Plan
RBC	risk based concentration
RMEG	reference dose media evaluation guide
S	suspended
SCS	Soil Conservation Service
SSL	soil screening level
T	total
UMTRCA	1978 Uranium Mill Tailings Radiation Control Act
USGS	United States Geological Survey

I. SUMMARY

Introduction

ATSDR's top priority is to ensure that the community of Lincoln Park and surrounding communities have the best information possible to safeguard their health.

The purpose of this public health assessment (PHA) is to evaluate available data and information on the release of hazardous substances from the Cotter Uranium Mill to determine if people could be harmed by coming into contact with those substances. This PHA will also list actions, as needed, to be taken to protect the public's health.

Background

The Cotter Uranium Mill (Cotter) is located approximately two miles south of downtown Cañon City in Fremont County, Colorado. The community of Lincoln Park borders the site to the north and the housing developments of Dawson Ranch, Wolf Park, and Eagle Heights are located along Cotter's western boundary. The nearest residence is about 0.25 miles from the mill (Galant et al. 2007).

The 2,500-acre site includes two inactive mills, ore stockpile areas, a partially reclaimed tailings pond disposal area (i.e., the old ponds area), and a current tailings pond disposal area (i.e., the lined "main impoundment area"). A large portion of the site is used to store waste products in the impoundment area. The former mill area is fenced and is known as the "restricted area".

The Cotter Mill began operations in 1958, extracting uranium ore using an alkaline leach process. In 1979, the facility switched to an acid leach process for extracting uranium. Cotter suspended primary operations in 1987, and only limited and intermittent processing occurred until the facility resumed operations in 1999 with a modified alkaline-leaching capability until 2001. Cotter refabricated the mill circuits between 2002 and 2005 to operate using an acid process when it went into stand down in March 2006. Cotter is currently evaluating whether to re-engineer the mill for future operation.

Wastes containing metals and radionuclides were released from Cotter and entered the nearby environment. People could potentially be exposed to these wastes if they come into contact with them in drinking water, soil, sediment, biota (fruits and vegetables) or ambient air.

Conclusions

After evaluating the available data, ATSDR reached four important conclusions in this public health assessment:

Conclusion 1

ATSDR concludes that drinking water from contaminated private wells could harm people's health. This is a public health hazard.

Basis for Conclusion

Private well sampling data collected from 1984 to 2007 revealed the presence of molybdenum at levels that could harm people's health. A water use survey conducted in Lincoln Park in 1989 revealed that at least seven people used groundwater (from their private wells) for personal consumption. These and other residents whose private wells were affected by the highest molybdenum contamination may be at increased risk for health effects such as gout-like conditions. Individuals who do not take in enough dietary copper or who cannot process it correctly will be affected the most.

The lack of consistent monitoring over the years and the unknown usage of wells before the installation of the public water supply makes these past exposures difficult to accurately assess.

Most town residents are now connected to the public water supply and have thus eliminated their exposure to contaminated water. However, some residents are reported to have refused public water supply connections, and many may still have operational private wells. Additionally, no formal institutional controls exist to control groundwater use in Lincoln Park. Therefore, current and future uses of private wells for domestic purposes are still possible.

Conclusion 2

ATSDR concludes that accidentally eating or touching soil and sediment near the Cotter Mill property or in Lincoln Park will not harm people's health. However, ATSDR cannot make conclusions about whether lead in soils near Cotter Mill could harm people's health in the future.

Basis for Conclusion

Currently, the property near the Cotter Mill property is restricted access, vacant or used for industrial purposes; therefore, contact with soils near the property should be minimal. The soil sampling conducted at the site does not allow ATSDR to accurately assess potential exposures if the area is ever developed for residential, commercial or recreational uses. Therefore, a conclusion regarding future exposures cannot be made because not enough information is available about future development of this area.

ATSDR recommends that lead contamination in soil be re-evaluated if

Next Steps	the area is considered for development for residential or non-industrial uses.
Conclusion 3	ATSDR concludes that eating locally-grown fruits and vegetables irrigated with private well water will not harm most people's health. However, a person eating above-average amounts of fruits and vegetables (4 times the average consumer) might have a low increased risk for developing cancer over a lifetime. As a precaution, residents should limit their use of contaminated well water to irrigate their crops. In all cases, the crops should be thoroughly cleaned prior to eating.
Basis for Conclusion	Sampled locally-grown fruits and vegetables did not indicate the presence of contaminants at levels that would cause non-cancer health effects. The increased cancer risk is based on a person consuming more fruits and vegetables (95th percentile range) than a typical consumer. The cancer estimate is conservative because it assumes that a person would grow and eat fruits and vegetables that contain arsenic every day for 30 years. The amount of fruits and vegetables eaten will likely be much less than estimated, mainly because the growing season is not year-round. The amount of a contaminant ingested would depend upon the type of crop eaten, the likelihood of the crop bioaccumulating any of the contaminants, how often the crop is eaten, if contaminated well water is used to irrigate the crop, and if the crop is thoroughly cleaned prior to eating them.
Conclusion 4	ATSDR concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.
Basis for Conclusion	With the exception of thorium-230 levels observed in 1981 and 1982, associated with excavation of contaminated tailings, every radionuclide monitored has been more than a factor of ten below annual dose based health limits to the public. The excavation releases appear to have only exposed on-site workers, but still below occupational limits at that time.
	ATSDR is taking the following follow-up actions at this site:
Next Steps	ATSDR's Health Promotion and Community Involvement Branch (HPCIB) will conduct health-related educational activities in the community, as necessary.

ATSDR's HPCIB will coordinate community outreach and community involvement activities for the site.

ATSDR will continue to work with appropriate state and federal agencies and review additional relevant environmental data (including the water use survey) as it becomes available.

ATSDR will update the action plan for this site as needed. New environmental, toxicological, health outcome data, or implementing the above proposed actions may necessitate the need for additional or alternative actions at this site.

For More Information

If you have concerns about your health, you should contact you health care provider. You can also call ATSDR at 1-800-CDC-INFO for more information on the Lincoln Park/Cotter Uranium Mill site.

II. BACKGROUND

A. Site description and operational history

The Cotter Mill is located approximately two miles south of downtown Cañon City in Fremont County, Colorado (see Figure 1) [Galant et al. 2007]. The community of Lincoln Park borders the site to the north and the housing developments of Dawson Ranch, Wolf Park, and Eagle Heights are located along Cotter's western boundary. The nearest residence is about 0.25 miles from the mill [Galant et al. 2007].

The 2,500-acre site includes two inactive mills, ore stockpile areas, a partially reclaimed tailings pond disposal area (i.e., the old ponds area), and a current tailings pond disposal area (i.e., the lined "main impoundment area"). A large portion of the site is used to store waste products in the impoundment area. The former mill area is fenced and is known as the "restricted area" [Galant et al. 2007].

The Cotter Mill began operations in 1958, extracting uranium ore using an alkaline leach process. In 1979, the facility switched to an acid leach process for extracting uranium. Cotter suspended primary operations in 1987 [Weston 1998], and only limited and intermittent processing occurred until the facility resumed operations in 1999 with a modified alkaline-leaching capability until 2001 [EPA 2002]. Cotter refabricated the mill circuits between 2002 and 2005 to operate using an acid process when it went into stand down in March 2006 [Cotter 2007]. Cotter is currently evaluating whether to re-engineer the mill for future operation [CDPHE 2008].

Additional information about the history and licensing of the Cotter Mill can be found on the Colorado Department of Public Health and Environment's (CDPHE) and the US Environmental Protection Agency's (EPA) Web sites at http://www.cdphe.state.co.us/hm/cotter/sitedescript.htm and http://www.epa.gov/region8/superfund/co/lincolnpark/.

B. Remedial and regulatory history

Originally, mill tailings (i.e., solid ore processing waste), raffinate (liquid waste that remains after extraction), and other liquids from the alkaline leach process were stored in ten on-site unlined ponds. In 1978, lined impoundments were built on site to store process waste products. The main impoundment contained two cells to segregate acid-leach tailings and liquids in the primary impoundment cell from alkaline-leach tailings in the secondary impoundment cell (EPA 2002). By 1983, more than 2.5 million cubic yards of waste products from historic operations were transferred from the original unlined ponds to the secondary impoundment. All new process wastes are stored in the lined primary impoundment [Galant et al. 2007].

Because Cotter Mill operations released radionuclides and metals into the environment, soil around the mill and groundwater in the nearby Lincoln Park community became contaminated, primarily with molybdenum and uranium [CDPHE 2008]. In 1984, the Lincoln Park/Cotter Mill Site was added to the Superfund National Priorities List (NPL) [EPA 2008]. EPA divided the site into two operable

According to a signed Memorandum of Understanding, CDPHE is the lead regulatory agency overseeing cleanup at the Cotter Mill.

units (OUs)—OU1 consists of the on-site contamination and OU2 is the neighborhood of Lincoln Park (i.e., the off-site impacted area) [CDPHE 2008; EPA 2007]. Together, the Lincoln Park/Cotter Mill Superfund Site encompasses about 7.8 square miles (5,000 acres) [EPA 2004].

In 1988, the Cotter Corporation and CDPHE signed a Consent Decree and Remedial Action Plan (RAP) [Galant et al. 2007]. The purpose of the court-ordered action was to assess and mitigate human and environmental impacts from the Cotter Mill. As part of the settlement, Cotter agreed to clean up the site at the corporation's expense [EPA 2008]. The cleanup was estimated to take 16 years and cost $11 million [Galant et al. 2007]. EPA and the US Department of Energy have also contributed to cleanup costs [DOE 2003]. Remedial activities have focused on eliminating the sources of contamination at the Cotter Mill and eliminating exposures to Lincoln Park residents [CDPHE 2008]. Many of the activities outlined in the 1988 RAP have been completed, including the following:

- Connecting Lincoln Park residents to city water;
- Constructing a groundwater barrier at the Soil Conservation Service (SCS) Flood Control Dam to minimize migration of contaminated groundwater into Lincoln Park;
- Moving tailings and contaminated soils into a lined impoundment to eliminate them as a source of contamination; and
- Excavating contaminated stream sediments in Sand Creek.

The old ponds area was undergoing reclamation in late 2008 [Pat Smith, EPA Region 8, personal communication, August 2008]. Remaining activities include groundwater remediation and final site cleanup [CDPHE 2008; Galant et al. 2007]. Groundwater remediation activities have shown some positive results. However, the balance of the remedial activities listed in the Consent Decree have not been successful enough in mitigating the plume, and most have been discontinued (e.g., barrier wall, dam to ditch flushing, calcium-polysulfide fix/flush, and permeable reactive treatment wall). Table 1 below lists a timeline of process events, remedial activities, and government actions for the Lincoln Park/Cotter Mill Superfund Site.

Table 1. Lincoln Park/Cotter Mill Superfund Site Activity Timeline

Date	Type of Event[1]	Event[2]
July 1958	Process	Cotter Corporation began alkali leach process operations (licensing by the Atomic Energy Commission)
June 1965	Event	Flood that caused the unlined tailings ponds at the Cotter Mill to overflow into Lincoln Park
1971	Remediation	SCS Dam completed; dam pumps impounded surface water back to the main impoundment (groundwater barrier completed at a later date after 1988 RAP)
July 1972	Remediation	Pond 2 lined
June 1976	Remediation	Pond 10 lined
1978–1979	Remediation	A new lined impoundment consisting of two cells (primary and secondary) constructed adjacent to the old ponds area for management of wastes from the new mill (alkali process)
1979	Remediation	The old mill was demolished and new mill construction began
1979–present	Remediation	Impounded water at the SCS Dam pumped back to the main impoundment
1979–1998	Process	Operations switched from an alkali leach process to an acid leach mill; continuing operations intermittently
1980	Remediation	Old upstream method tailings ponds replaced by a full-height compacted earth embankment
1980	Remediation	Construction of Well 333 just north of Cotter; well removes contaminated water flowing from the old ponds area
June 1981	Remediation	Pond 3 lined
1981–1983	Remediation	Tailings from the unlined old ponds area (~2.5 million cubic yards) removed and placed in the new impoundment
December 9, 1983	Government Action	State of Colorado files a complaint against Cotter under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
September 21, 1984	Government Action	Cotter (OU1) and Lincoln Park (OU2) added to the NPL
1985–1986	Investigation	Remedial Investigation and Feasibility Study (GeoTrans 1986)
April 1986	Government Action	Memorandum of Agreement between EPA and the state of Colorado
April 8, 1988	Government Action	Consent decree signed, including a RAP that required cleanup activities
1988	Remediation	An additional 2 feet of soil was removed from the old ponds area and placed in the lined primary impoundment
1988	Remediation	Lined water distribution/surge pond constructed over Pond 7
1988	Remediation	Installation of a hydrologic clay barrier upgradient from the SCS Dam
1989	Remediation	The secondary impoundment cell was covered with liquid for dust control and to create evaporative capacity; additional contaminated soils were removed from the old ponds area and placed in the primary impoundment cell

Date	Type of Event[1]	Event[2]
1989–2000	Remediation	Installation of two hydraulic barriers (injection/withdrawal systems) to control groundwater flow from the old ponds area; discontinued in 2000 because the system was unproductive
1990–1996	Remediation	SCS Dam to DeWeese ditch flushing project
1990–1998	Remediation	Four pilot tests to evaluate the effectiveness of active flushing of vadose zone and aquifer for contaminant removal in OU1
October 29, 1991	Report	Health Risk Assessment of the Cotter Uranium Mill Site: Phase I (HRAP 1991)
January 7, 1993	Report	RAP final report, Willow Lakes (Cotter)
1993–1999	Remediation	Sand Creek Soil Cleanup Action identified and removed approximately 9,000 cubic yards of tailings, soil, and sediment from Sand Creek (Cotter 2000)
1995	Licensing	Cotter filed a license amendment with the state for alkaline leach processing of uranium ore (approved 2/97)
November 19, 1996	Report	Supplemental Human Health Risk Assessment: Phase II Final Report (Weston 1996)
1996–1998	Remediation	Flush/fixation process using Calcium Polysulfide in surface infiltration cells
February 1997	Government Action	Radioactive materials license amendment became effective
1998	Process	Mill reconverted to an alkaline leach process
September 29, 1998	Report	Ecological Risk Assessment, Lincoln Park Superfund Site (Stoller Corporation and Schafer & Associates)
1998	Report	Supplemental Human Health Risk Assessment, Phase III Final Report (Weston 1998)
1999	Remediation	Old ponds area surface soils (~100,000 cubic yards) were removed and placed in the lined primary impoundment
May 1999	Process	Cotter resumed operations (which had been intermittent since 1979) with modified alkaline-leaching capability
September 30, 1999	Investigation	Final Focused Feasibility Study, Lincoln Park
June 2000	Remediation	Installation of a permeable reactive treatment wall across Sand Creek channel, north of SCS Dam in DeWeese Dye Ditch flush (to fulfill EPA requirement to address contaminated groundwater that was bypassing the SCS Dam barrier)
2000–2005	Process	Cotter proposes modifications to the circuit to process zircon ore. Process was not successful and discontinued by 2005.
January 2002	Government Action	EPA issued a Record of Decision for Lincoln Park requiring “No Further Action” for surface soils within Lincoln Park (EPA 2002)
April 2002	Government Action	The governor of Colorado passed an emergency bill requiring an Environmental Assessment be conducted before shipping out-of-state radioactive waste to Cotter
July 9, 2002	Government Action	CDPHE denied Cotter’s license amendment request, preventing receipt of shipments for direct disposal

Date	Type of Event[1]	Event[2]
September 13, 2002	Government Action	State of Colorado allowed Cotter to receive limited amounts of waste material as a test of its handling/storage capability
2002/2003	Investigation	Sampling for plutonium, uranium, lead and molybdenum in the Canon City vicinity (CDPHE 2003)
January 3, 2003	Government Action	EPA issued a notice of unacceptability under the Off-Site Rule regarding the five Proposed Units and impoundments previously found acceptable
2003	Remediation	Permeable reactive treatment wall not functioning as designed
September 9, 2004	Investigation	Cotter submits Feasibility Study for Old Ponds Area with six alternatives
December 15, 2004	Government Action	State health officials approved a 5-year extension of Cotter's uranium-processing license but denied requests to become a disposal facility for off-site radioactive materials
February 1, 2005	Government Action	Cotter filed a request for a hearing regarding the conditions of the license renewal
October 2005	Investigation	Survey of lead in indoor dust, soils, and blood in Lincoln Park to investigate potential impacts of historic smelters (ATSDR 2006a, 2006b, 2006c, 2006d)
April 2006	Government Action	A judge recommended in CDPHE's favor and Cotter filed an exception on the direct disposal issue only
2006	Remediation	To replace the permeable reactive treatment wall, water building up behind barrier is pumped back to the impoundments
January 2007	Government Action	CDPHE signed a Final Agency Decision, affirming the judge's Decision on the license. Cotter filed an appeal to be able to dispose of out-of-state soils in its primary impoundment.
2008	Process	Cotter decides not to take the case to the Court of Appeals, effectively ending the licensing issues from the 2004 renewal.

[1] Describes the general nature of events/actions relating to the Lincoln Park/Cotter Mill Superfund Site.

[2] Includes events/actions most pertinent to ATSDR's evaluation of exposures and potential health effects. Not all site-related events and reports are included.

C. Demographics

ATSDR examines demographic data to identify sensitive populations, such as young children, the elderly, and women of childbearing age, and to determine whether these sensitive populations are exposed to any potential health risks. Demographics also provide details on population mobility and residential history in a particular area. This information helps ATSDR evaluate how long residents might have been exposed to contaminants. According to the 2000 census, 1,170 people live within one mile of the Cotter Mill property—90 of whom are age 6 or younger, 190 are women of childbearing age (15–44 years), and 243 are age 65 or older. Figure 2 in Appendix B shows the demographics within one mile of the mill.

Cañon City is the largest population center in Fremont County with 15,760 residents (see Table 2 below). The Cañon City Metro area includes Cañon City, North Cañon, Lincoln Park, Brookside, Prospect Heights, Four Mile Ranch, Shadow Hills, Dawson Ranch, and the Colorado State Correctional Facilities. Florence is the second largest community in the area with a population of 3,816. The unincorporated portions of Fremont County represent 55% of the population and include Lincoln Park, Prospect Heights, and Shadow Hills [Cotter 2007].

Table 2. Population of communities near the Cotter Mill

Community	2000 Census Population	2006 Population Estimate
Brookside	219	218
Cañon City	15,431	15,760
Coal Creek	303	380
Florence	3,653	3,816
Lincoln Park	3,904	Not available
Rockvale	426	432
Williamsburg	714	700
Fremont County	46,145	47,727

Source: Cotter 2007; Galant et al. 2007

The unincorporated community of Lincoln Park is located in the greater Cañon City area, south of the Arkansas River and north of the Cotter Mill (see Figure 1). The community consists of single and multi-family homes, trailer parks, and rural single family homes. Many of the residents are retired and own their homes. The Lincoln Park area is currently experiencing growth [Galant et al. 2007].

The largest employers in Fremont County are the Colorado Department of Corrections and the Federal Bureau of Prisons. Tourism is the second largest employer in the Cañon City area [Cotter 2007; Galant et al. 2007]. Additional industry and manufacturing employers in Fremont County include Portec, Inc.; Holcim, Inc.; Thermal Ceramics; and Cañon Industrial Ceramics [Cotter 2007]. The health care and school systems also employ a substantial number of people in the county [CCAT, personal communication, August 2008].

D. Land use and natural resources

The Cotter Mill is located within an industrial zone. All abutting lands are zoned for agriculture-forestry. The semi-rural community of Lincoln Park is comprised predominantly of residential developments, agricultural plots and orchards, and small grazing parcels. The Shadow Hills Golf Course is located to the north of the Cotter Mill complex. The land to the south and east of the site is largely undeveloped. Recently, several high end homes have been built near the golf course and in the Wolf Park and Dawson Ranch areas. The distance from Cotter Mill's restricted area to the nearest home is about 0.25 mile [Galant et al. 2007].

Fremont County contains a large amount of public land managed by the US Department of the Interior Bureau of Land Management and the US Department of Agriculture Forest Service. Some of these areas are leased for livestock grazing, aggregate mining, and firewood removal. Visiting the many scenic attractions in Colorado's High Country (e.g., the Royal Gorge Bridge) and rafting in the Arkansas River are popular recreational activities [Cotter 2007].

1. Hydrogeology

In the vicinity of the Cotter Mill, contaminated groundwater primarily migrates along the near surface alluvium and fractured, weathered bedrock immediately underlying the alluvium (<100 feet deep) [USGS 1999a]. Groundwater migration is generally in northerly directions from the mill area, along the Sand Creek drainage area, through a gap in Raton Ridge, and into Lincoln Park. However, groundwater contamination has also been found in the vicinity of the Shadow Hills Golf Course, which is west of the Sand Creek drainage [EPA 2007]. The hydrogeology of the Lincoln Park/Cotter Mill Superfund Site can be conceptually divided into two areas: the upgradient area near the mill and the downgradient area to the north-northeast in Lincoln Park [USGS 1999a].

- In the upgradient area near the mill, the rate of groundwater flow is limited by small hydraulic conductivities [USGS 1999a]. However, cracks in the bedrock, fractures, and weathering enhance water transmission and allow groundwater to travel at considerable rates. Monitoring wells in the upgradient area, specifically in the Poison Canyon Formation, yield small amounts of water.

- The downgradient area in Lincoln Park is characterized by an "alluvial aquifer" comprised of alluvium and terrace alluvium, to a depth of 0–60 feet, and the underlying weathered and/or fractured bedrock below the alluvium. In this area, groundwater can be transmitted at substantial rates. The mix of gravel, sand, silt, and clay in this aquifer yields 10 to 400 gallons per minute to wells in Lincoln Park. The aquifer discharges to Sand Creek, as well as to multiple springs and seeps as far downgradient as the Arkansas River, approximately 2.5 miles downgradient from the Cotter site.

2. Geology

The Cotter Mill is located in a topographic depression resulting from an underlying structure called the Chandler syncline. The core of the syncline is the Poison Canyon formation, which is the uppermost bedrock unit beneath the site. Soils near the mill are shallow and well drained.

The top layer consists of brown loam. The subsoil is a pale brown loam, grading into a yellowish brown sandy loam. Areas north of the mill are covered with Quaternary alluvium consisting of gravel, cobble, boulders, and sand [EPA 2002].

3. *Hydrology*

The Cotter Mill lies within the Sand Creek watershed [HRAP 1991]. The main hydrologic feature of the Lincoln Park/Cotter Mill Superfund Site is Sand Creek, a primarily ephemeral creek [EPA 2007]. The creek originates at Dawson Mountain (south of the Cotter Mill), travels north through the Cotter Mill, intersects the DeWeese Dye Ditch, and runs north-northeast through Lincoln Park. It becomes perennial for the last 0.25–0.5 mile before its confluence with the Arkansas River. The DeWeese Dye Ditch is one irrigation ditch that flows between the Cotter Mill and Lincoln Park.

An ephemeral creek has flowing water only during, and for a short duration after, precipitation. A perennial creek has flowing water year-round.

Alluvial material (sediment deposited by flowing water) associated with Sand Creek is the predominant migration pathway for mill-derived contaminants in groundwater. Sand Creek carved a channel into the Vermejo formation at the Raton outcrop in the vicinity of the SCS Dam, which filled with permeable sediments, creating a preferential pathway for alluvial groundwater into Lincoln Park. The alluvial aquifer in Lincoln Park receives recharge from the DeWeese Dye Ditch, Crooked Ditch, Pump Ditch, ditch laterals, and ponds filled by the DeWeese Dye Ditch [EPA 2007].

4. *Prevailing Wind Patterns*

Cotter's monitoring network includes an on-site meteorological station that continuously measures a standard set of meteorological parameters (e.g., wind speed, wind direction, temperature, and relative humidity). The wind rose in Figure 3 in Appendix B depicts the statistical distribution of measured wind speeds and wind directions. During 2008, wind patterns at the station were principally westerly (i.e., winds out of the southwest to northwest) and accounted for 55% of the total winds [Cotter 2008b]. Easterly winds (i.e., winds out of the southeast to northeast) accounted for a smaller, but still significant, portion (26%) of the observed wind directions. Southerly and northerly winds were much less common. A nearly identical profile was observed in 2007. Other average parameters measured in 2008 follow: air temperature of 53.4 °F; relative humidity of 41%; and rainfall of 5.18 inches.

The prevailing westerly and easterly wind patterns are reasonably consistent with trends in the observed concentrations. Ambient air concentrations of selected site-related pollutants were highest at the perimeter monitoring stations directly east and west of the primary operations. There is a hilly ridge that straddles the western border of the site, blocking much east/west wind flow. However, it should be noted that prevailing wind patterns measured at Cotter Mill may not be representative of surface winds throughout the area, especially considering the proximity of nearby terrain features.

E. Past ATSDR involvement

ATSDR has been involved with the Lincoln Park site in the past. In October 1983, ATSDR completed a Public Health Assessment for the site. After reviewing available groundwater data, ATSDR concluded that the potential long term health effects from consumption of the contaminated water were:

- cancer and kidney damage, from uranium;
- gout-like symptoms, from molybdenum; and
- possibly a group of physiological and psychological symptoms, from selenium.

None of the potential health effects were definitive.

Numerous questions and concerns have been voiced by residents of Lincoln Park regarding the historical sites of numerous milling and smelting facilities in the Cañon City area. Among the various concerns were specific concerns about residual lead contamination from these milling and smelting operations. In response to these concerns, and after a specific request by the EPA, ATSDR evaluated the health risks associated with lead contamination in the area. ATSDR focused on two primary issues: 1) the blood lead level of children living in the area and 2) lead contaminated dust in homes in the Lincoln Park area.

In September and October 2005, ATSDR conducted an Exposure Investigation (EI) to answer the questions presented by the community and EPA. Previously, ATSDR concluded that lead levels in house dust and lead exposures to children represented an indeterminate health hazard because of a lack of available data. ATSDR conducted the EI to gather data on blood lead levels in the children, and soil and indoor dust level from homes.

The activities of the EI included:

- Collecting 44 indoor dust samples from 21 homes in Lincoln Park
- Collecting 80 composite soil samples from 22 properties (sampling conducted by EPA)
- Obtaining 45 blood samples from 21 households (42 blood samples were analyzed)

After evaluating the data obtained during the EI, ATSDR concluded that blood lead levels in adults and children, lead levels in dust in homes, and lead levels in soil did not represent a public health harard. ATSDR recommended no further actions related to lead in dust in homes, but did recommend routine monitoring of children’s blood lead levels in the Lincoln Park area.

In September 2005, ATSDR conducted a blood lead testing program as a service to the community of Lincoln Park. A total of 115 children from a local school were tested for blood lead. None of the children tested had elevated blood lead levels. Therefore, ATSDR concluded that the children tested did not have unusual exposures to lead at the time of testing. ATSDR recommended that local and state agencies continue routine monitoring of lead levels in area children.

Full reports discussed above may be obtained by contacting any of the contacts listed at the end of this report, by visiting our website at www.atsdr.cdc.gov or by calling our toll-free hotline at 800-232-4636.

III. EVALUATION OF EXPOSURE PATHWAYS

A. What is meant by exposure?

An exposure pathway has five elements: (1) a source of contamination, (2) an environmental media, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. The *source* is the place where the chemical or radioactive material was released. The *environmental media* (such as groundwater, soil, surface water, or air) transport the contaminants. The *point of exposure* is the place where people come into contact with the contaminated media. The *route of exposure* (for example, ingestion, inhalation, or dermal contact) is the way the contaminant enters the body. The people actually exposed are the *receptor population*.

ATSDR's public health assessments are driven by exposure to, or contact with, environmental contaminants. Contaminants released into the environment have the potential to cause harmful health effects. Nevertheless, *a release does not always result in exposure*. People can only be exposed to a contaminant if they come in contact with that contaminant—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant. If no one comes in contact with a contaminant, then no exposure occurs, and thus no health effects could occur. Often the general public does not have access to the source area of contamination or areas where contaminants are moving through the environment. This lack of access to these areas becomes important in determining whether people could come in contact with the contaminants.

The route of a contaminant's movement is the *pathway*. ATSDR identifies and evaluates exposure pathways by considering how people might come in contact with a contaminant. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. Exposure can occur by breathing, eating, drinking, or by skin contact with a substance containing the chemical contaminant. ATSDR identifies an exposure pathway as completed or potential, or eliminates the pathway from further evaluation.

- *Completed exposure pathways* exist for a past, current, or future exposure if contaminant sources can be linked to a receptor population. All five elements of the exposure pathway must be present. In other words, people have or are likely to come in contact with site-related contamination at a particular exposure point via an identified exposure route. As stated above, a release of a chemical or radioactive material into the environment does not always result in human exposure. For an exposure to occur, a completed exposure pathway must exist.

- *Potential exposure pathways* indicate that exposure to a contaminant could have occurred in the past, could be occurring currently, or could occur in the future. It exists when one or more of the elements are missing but available information indicates possible human exposure. A potential exposure pathway is one which ATSDR cannot rule out, even though not all of the five elements are identifiable.

- An *eliminated exposure pathway* exists when one or more of the elements are missing. Exposure pathways can be ruled out if the site characteristics make past, current, and future human exposures extremely unlikely. If people do not have access to contaminated areas, the pathway is eliminated from further evaluation. Also, an exposure pathway is eliminated if site monitoring reveals that media in accessible areas are not contaminated.

Contact with contamination at the Cotter Mill is an eliminated exposure pathway.

Because the mill site itself is fenced and access is restricted, exposure to on-site contamination by the public at the Cotter Mill is limited. Further, remediation efforts have removed some of the on-site soil contamination, including moving millions of cubic yards of tailings and contaminated soils from unlined ponds to lined impoundments (EPA 2002). In some areas, contaminated soil was removed down to bedrock. In addition, various process changes reduced the release of contaminated materials (EPA 2002). Any potential exposure by the occasional trespasser to remaining impacted soils at the Cotter Mill would be too infrequent to present a health hazard.

B. How does ATSDR determine which exposure situations to evaluate?

ATSDR scientists evaluate site conditions to determine if people could have been, are, or could be exposed (i.e., exposed in a past scenario, a current scenario, or a future scenario) to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, sediment, water, air, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

If exposure was, is, or could be possible, ATSDR scientists consider whether contamination is present at levels that might affect public health. ATSDR scientists select contaminants for further evaluation by comparing them to health-based comparison values. These are developed by ATSDR from available scientific literature related to exposure and health effects. Comparison values are derived for each of the different media and reflect an estimated contaminant concentration that is *not likely* to cause adverse health effects for a given chemical, assuming a standard daily contact rate (e.g., an amount of water or soil consumed or an amount of air breathed) and body weight.

Comparison values are not thresholds for adverse health effects. ATSDR comparison values establish contaminant concentrations many times lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. If contaminant concentrations are above comparison values, ATSDR further analyzes exposure variables (for example, duration and frequency of exposure), the toxicology of the contaminant, other epidemiology studies, and the weight of evidence for health effects.

Some of the comparison values used by ATSDR scientists include ATSDR's environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs) and EPA's maximum contaminant levels (MCLs). EMEGs, RMEGs, and CREGs are non-enforceable, health-based comparison values developed by ATSDR for screening environmental contamination for further evaluation. MCLs are enforceable drinking water regulations developed to protect public health. Effective May 2008, Colorado established state groundwater standards for uranium and molybdenum.

You can find out more about the ATSDR evaluation process by calling ATSDR's toll-free telephone number, 1-800-CDC-INFO (1-800-232-4636) or reading ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/PHAManual/.

C. If someone is exposed, will they get sick?

Exposure does not always result in harmful health effects. The type and severity of health effects a person can experience because of contact with a contaminant depend on the exposure concentration (how much), the frequency (how often) and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of contaminants). Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status of the exposed individual influence how the individual absorbs, distributes, metabolizes, and excretes the contaminant. Together, these factors and characteristics determine the health effects that may occur.

In almost any situation, there is considerable uncertainty about the true level of exposure to environmental contamination. To account for this uncertainty and to be protective of public health, ATSDR scientists typically use worst-case exposure level estimates as the basis for determining whether adverse health effects are possible. These estimated exposure levels usually are much higher than the levels that people are really exposed to. If the exposure levels indicate that adverse health effects are possible, ATSDR performs more detailed reviews of exposure and consults the toxicologic and epidemiologic literature for scientific information about the health effects from exposure to hazardous substances.

D. What exposure situations were evaluated for residents living near the Cotter Mill?

ATSDR obtained information to support the exposure pathway analysis for the Lincoln Park/Cotter Mill Superfund Site from multiple site investigation reports; state, local, and facility documentation; and communication with local and state officials. The analysis also draws from available environmental and exposure data for groundwater, soil, surface water and sediment, and biota. Throughout this process, ATSDR examined concerns expressed by the community to ensure exposures of special concern are adequately addressed. ATSDR identified the following exposure pathways for further evaluation:

1. Exposure to site-related contaminants in groundwater in Lincoln Park.

2. Contact with site-related contaminants in soil adjacent to the Cotter Mill and in Lincoln Park.

3. Contact with site-related contaminants in surface water downstream from the Cotter Mill.

4. Exposure from eating produce locally grown in Lincoln Park.

5. Exposure from site-related soil contaminants in windborne dust.

6. Exposure from air emission sources (stacks and uncontrolled fugitive dust)

This exposure pathway analysis focuses on past, current, and future exposures for residents living near the Cotter Mill, with a focus on the community of Lincoln Park. Some attention is also paid to exposures at the Shadow Hills Golf Course and along the county road. Table 3 below provides a summary of exposure pathways evaluated in this public health assessment.

1. *Exposure to groundwater in Lincoln Park*

In the past, a number of residences used wells[1] on their property (GeoTrans 1986; IMS 1989). Based on a 1989 water use survey in Lincoln Park, 60 out of 104 wells, springs, and cisterns were used to obtain water for domestic purposes, including consumption and irrigation (IMS 1989). See Table 14 in Appendix A for the reported groundwater uses in the Lincoln Park area. Seven survey respondents indicated that they used groundwater for domestic consumption, accounting for 5 to 100% of their total water consumption. Based on the survey, five residents had private wells that were affected by contaminated groundwater; these residents were connected to the municipal water supply between 1989 and 1993 [EPA 2002]. The 1988 RAP requires Cotter to connect eligible affected users with legal water rights for a well to the town water supply [CDPHE 2005]. Cotter checks the State of Colorado's Engineer's Office database for new water permits and reports their findings in their annual ALARA reports [Pat Smith, EPA Region 8, personal communication, August 2008].

The use of private groundwater wells in the past was a completed exposure pathway. Most residences are now connected to the public water supply. The current and future use of these wells is a potential exposure pathway because the extent to which these wells are used is not well documented.

While the majority of town residents are now connected to the public water supply [Galant et al. 2007], several residences also have operational private wells. A 2005 summary of the RAP status reports that some residents have refused public water supply connections [CDPHE 2005]. Additionally, no formal institutional controls exist to control groundwater use in Lincoln Park [EPA 2007]. The United States Geological Survey (USGS) reports that existing private wells are used primarily for stock watering and irrigation [USGS 1999a]. However, a newspaper article reports that at least one residence, located on Grand Avenue in Lincoln Park, used private well water for consumption as recently as 2002 [Plasket 2002]. Based on a 2007 review of Colorado State well permits for residences in the plume configuration, at least one well is permitted for irrigation and domestic use, but no details of actual use are documented [EA 2007]. On properties that continue to use private wells, new purchasers are offered connection to the town's municipal water system [Galant et al. 2007]. In late 2008, EPA conducted another water use survey to verify whether groundwater is being utilized by residences in Lincoln Park. Well water samples were also collected and analyzed. Once available, ATSDR will review the information and will revise the public health assessment, if needed.

2. *Contact with soil adjacent to the Cotter Mill and in Lincoln Park*

People (especially children) might accidentally ingest soil or exposed sediment, and dust generated from these materials, during normal activities. Everyone ingests some soil or dust every day. Small children (especially those of preschool age) tend to swallow more soil or dust than any other age group because children of this age tend to have more contact with soil through play activities and have a tendency for more hand-to-mouth activity. Children in elementary school, teenagers, and adults swallow much smaller amounts of soil or dust. The amount of grass

---

[1] The term "well" is used to represent all groundwater sources, and includes both wells and springs.

cover in an area, the amount of time spent outdoors, and weather conditions also influence how much contact people have with soil.

a) Contact with soil near the Cotter Mill

Soils adjacent to the Cotter Mill have been contaminated by wind-blown particulates [CDPHE 2005]. Elevated levels are primarily detected in soils directly east and west of the facility [Weston 1998]. This distribution of contaminated soils is consistent with wind patterns in the area, which blow mainly from west to east with occasional flows from east to west. The primarily vacant areas directly east and west of the facility are referred to as a "buffer zone" between the Cotter Mill and residential developments [EPA 2002]. Therefore, limited opportunities for exposure to impacted site-adjacent soils exist—people are not expected to be in this area on a daily basis and for an extended period of time. One exception may be at the Shadow Hills Golf Course, located immediately north of the Cotter mill complex. Exposure to potentially impacted soil at this public golf course is unlikely due to grass cover.

Contact with contaminated soil near the Cotter Mill (i.e., in the buffer zone) is a past, current, and future potential exposure pathway.

For nearly 50 years, Cotter has intermittently hauled materials by truck, possibly losing some materials along the county road leading to the facility and along the access road entering the mill site [MFG 2005]. The public could be exposed to potentially impacted soils along the county road. However, there is limited potential for exposure to contaminants along the access road, since access to the Cotter Mill is restricted and Cotter remediated soil adjacent to the access road in 2007 and 2008.

b) Contact with soil and sediment in the community of Lincoln Park

The community of Lincoln Park is located approximately 1.5 miles north-northeast of the restricted area of the Cotter Mill. Contaminated materials from the Cotter Mill may have contributed to soil contamination in Lincoln Park in two ways:

1. Dust from soil or tailings associated with site operations could be transported by wind to Lincoln Park. However, wind patterns in the area suggest that wind-blown contamination is not likely a considerable source of soil contamination in Lincoln Park (Weston 1998). Additionally, on-site remediation at the Cotter Mill substantially reduced the sources of soil contamination.

2. Potentially impacted groundwater used for irrigation could lead to the accumulation of chemicals in town soils [Weston 1998].

Further, in the past, contaminated surface water runoff from the Cotter Mill entered Sand Creek, where it was transported downstream toward Lincoln Park [EPA 2002]. However, Sand Creek is not believed to be used for recreational activities—the creek is ephemeral and on private land until it goes under the river walk and enters the Arkansas River [Phil Stoffey, CDPHE, personal communication, June 2007].

Contact with contaminated sediment in Sand Creek was a past potential exposure pathway. Due to the remediation of Sand Creek, current and future contact is an eliminated exposure pathway.

Contact with contaminated soil in Lincoln Park was a past completed exposure pathway. Cotter has performed all required off-site soil cleanup activities, as outlined in the RAP [EPA 2002]. CDPHE reports that the Cotter Mill poses no risk to the residents of Lincoln Park by exposure to soil [Weston 1998], and EPA and CDPHE have advised “No Further Action” in regards to Lincoln Park soils [EPA 2002]. EPA’s Record of Decision states that surface-soil cleanup activities have eliminated or reduced risks to “acceptable” levels [EPA 2002, 2007]. Therefore, current and future contact with soil and sediment is an eliminated exposure pathway.

3. *Contact with surface water downstream from the Cotter Mill*

In the past, people could have come in contact with contamination in surface water during recreational activities. The Arkansas River is used primarily for fishing and boating or rafting, as well as some swimming [Phil Stoffey, CDPHE, personal communication, June 2007]. Sand Creek is on private land until it goes under the river walk and enters the Arkansas River, and is generally not used for recreational activities [Phil Stoffey, CDPHE, personal communication, June 2007]. Many Lincoln Park residents use water from the DeWeese Dye Ditch to irrigate their orchards and gardens [Galant et al. 2007].

Contact with contaminated surface water near the Cotter Mill was a past potential exposure pathway. Due to the construction of the SCS Dam and the remediation of Sand Creek, current and future contact is an eliminated exposure pathway.

4. *Exposure from eating locally grown produce*

Many Lincoln Park residents have orchards and gardens. Water from the DeWeese Dye Ditch is primarily used to irrigate the orchards and gardens, however, some residents use water from their groundwater wells [Galant 2007; IMS 1989]. If fruits and vegetables are grown in contaminated soil and/or irrigated with contaminated water, the people who eat this produce could be exposed to contamination.

5. *Exposure from breathing windborne dust*

Many Lincoln Park residents are concerned about the arid environment and the risks of breathing in contaminated dust from the site. The profile of air emission sources at Cotter Mill has changed considerably over the years. These sources include both releases through stacks and uncontrolled (or fugitive) dust emissions. Stack emissions occurred during times of active processing at Cotter Mill; however, the magnitude of these stack emissions has varied, depending on production rates and effectiveness of air pollution controls. The sources of fugitive dust emissions have also changed. In the past, the site had many uncontrolled sources of wind-blown dust, which would cause particulate matter (along with any chemical and radiological constituents) to be emitted into the air. Examples of these sources include ore handling operations, stockpiles, and the previous unlined holding ponds. Many of these sources of wind-blown dust have since been controlled or eliminated, causing facility-wide fugitive dust emissions to decrease considerably over the years, though some fugitive dust emissions (e.g., from unpaved roads) continue to occur.

Table 3. Exposure pathways for residents living near the Cotter Mill

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Groundwater							
Completed Exposure Pathway							
Private groundwater wells	Tailings and other wastes from the Cotter Mill (heavy metals and radionuclides)	Migration of groundwater into the Lincoln Park area	Residential tap water drawn from private wells	Residents, including children, who are not connected to the public water supply and rely on private wells	Ingestion, Dermal contact	Past	Past consumption of groundwater from private wells has been documented and was, therefore, a completed exposure pathway.
Potential Exposure Pathway							
Private groundwater wells	Tailings and other wastes from the Cotter Mill (heavy metals and radionuclides)	Migration of groundwater into the Lincoln Park area	Residential tap water drawn from private wells	Residents, including children, who are not connected to the public water supply and rely on private wells	Ingestion, Dermal contact	Current Future	The extent to which private wells are currently used in Lincoln Park is uncertain. Although most residents are supplied with town water, documents indicate that residents have been drinking private well water as recently as 2002, and are permitted to use wells for unspecified domestic purposes. However, it is believed that water from wells is used primarily for irrigation and other non-drinking purposes. Therefore, current and future use of water from private wells is a potential exposure pathway.

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Soil and Sediment							
Completed Exposure Pathway							
Surface soil and dust in Lincoln Park	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust; soil irrigated by contaminated groundwater	Residences and public areas	Residents, including children	Dermal contact, Incidental ingestion, Inhalation	Past	Prior to remediation, contaminants were detected in soil from residential lawns and gardens. Therefore, contact with contaminated soil in Lincoln Park was a past completed exposure pathway.
Potential Exposure Pathways							
Surface soil near the Cotter Mill	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust	The Shadow Hills Golf Course west of the Cotter Mill; along the county road leading to the Cotter Mill	Golfers at the public golf course; people on the county road	Dermal contact, Incidental ingestion, Inhalation	Past Current Future	Soils adjacent to the Cotter Mill have been contaminated by wind-blown particulates. Therefore, contact with soil near the Cotter Mill, especially at the public golf course and along the county road, is a past, current, and future potential exposure pathway.
Sediment in Sand Creek	Tailings, dusts, and other wastes from the Cotter Mill	Tailings carried in surface water runoff	Along Sand Creek	Recreational users; children playing along Sand Creek	Dermal contact, Incidental ingestion	Past	There were limited opportunities for exposure since Sand Creek was not used for recreational purposes. Therefore, exposure to sediments prior to the Sand Creek Cleanup project was a past potential exposure pathway.
Eliminated Exposure Pathways							
Surface soil at the Cotter Mill	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust; surface water runoff	Unauthorized access is not allowed	None	None	Past Current Future	Because the mill site itself is fenced and access is restricted, contact with on-site contamination is an eliminated exposure pathway. Further, remediation efforts have removed some impacted soils.

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Surface soil and dust in Lincoln Park	Tailings, dusts, and other wastes from the Cotter Mill	Windblown dust; soil irrigated with contaminated groundwater	Cleanup activities have eliminated or reduced risks to acceptable levels	None	None	Current Future	Due to the sampling and remediation in Lincoln Park, current and future contact with soil and dust is an eliminated exposure pathway.
Sediment in Sand Creek	Tailings, dusts, and other wastes from the Cotter Mill	Tailings carried in surface water runoff	Contaminated sediment was removed from Sand Creek	None	None	Current Future	Sediment in Sand Creek is no longer a hazard since the completion of the Sand Creek Cleanup project. Therefore, current and future contact with sediment in Sand Creek is an eliminated exposure pathway.
Surface Water							
Potential Exposure Pathway							
Surface water near the Cotter Mill	Tailings and other waste from the Cotter Mill	Surface water runoff; transport from Sand Creek to the Arkansas River	Along Sand Creek between the Cotter Mill and the Arkansas River; the DeWeese Dye Ditch; the Arkansas River	Recreational users (mostly in the Arkansas River, limited recreational use in Sand Creek); people irrigating with water from the DeWeese Dye Ditch	Incidental ingestion, Dermal contact	Past	In the past, surface water in Sand Creek was found to contain elevated levels of metals and radionuclides. Therefore, past contact with contaminated surface water near the Cotter Mill was a potential exposure pathway.
Eliminated Exposure Pathway							
Surface water near the Cotter Mill	Tailings and other waste from the Cotter Mill	Surface-water runoff; transport from Sand Creek to the Arkansas River	Contamination was removed from Sand Creek	None	None	Current Future	Due to the construction of the SCS Dam and the remediation of Sand Creek, current and future contact with contaminated surface water is an eliminated exposure pathway.

Exposure Pathway	Exposure Pathway Elements					Time Frame	Comments
	Sources of Contamination	Fate and Transport	Point of Exposure	Exposed Population	Route of Exposure		
Locally Grown Produce							
Potential Exposure Pathway							
Produce grown in Lincoln Park	Tailings, dusts, and other wastes from the Cotter Mill	Produce grown in contaminated soil or irrigated with contaminated water	Orchards and gardens in Lincoln Park	People who eat locally grown produce	Ingestion	Past Current Future	Because many Lincoln Park residents have orchards and gardens, eating locally grown produce is a past, current, and future potential exposure pathway.
Air Emissions							
Completed Exposure Pathway							
Ambient air near the Cotter Mill facility	Ground-level fugitive emissions (e.g., wind-blown dust) and elevated point sources (e.g., stacks)	Windblown dust; stack emissions into the air and transport to off-site locations	Off-site or down-wind locations	People who live in the vicinity of Cotter Mill or downwind of the stacks	Inhalation	Past Future Present	Cotter's air monitoring network monitors air concentrations at off-site locations. With the facility currently in "stand down" status, facility emissions are now predominantly fugitive; air quality impacts should be characterized by perimeter monitoring stations.

IV. EVALUATION OF ENVIRONMENTAL CONTAMINATION

A. Groundwater

Prior to 1980, Cotter disposed of waste in unlined ponds, which allowed contaminated liquids to leach into the groundwater [EPA 2002]. Groundwater was shown to be contaminated as far away as the Arkansas River, which is approximately 2.5 miles downgradient from the mill [EPA 2002]. Results from the 1984–1985 Remedial Investigation found that despite attempts at remediation, the new, lined impoundments were leaking and the old ponds area was a continuing source of groundwater contamination [GeoTrans 1986]. This study also found that a gap in the ridge at the SCS Dam, built in 1971 across Sand Creek on the Cotter property, was allowing shallow groundwater to move downgradient towards Lincoln Park, resulting in concentrations of molybdenum and uranium that were 2,000 times above background levels at that time.

Groundwater concentrations of molybdenum and uranium have decreased in recent years, but concentrations have not yet returned to background levels in some wells [Weston 1998]. Figures 4 and 5 show the extent of the molybdenum and uranium concentrations, respectively, above water quality standards (0.035 milligrams per liter [mg/L] for molybdenum and 0.03 mg/L for uranium). The highest levels in Lincoln Park were detected nearest to the Cotter property in the vicinity of the DeWeese Dye Ditch [Weston 1998]. Additionally, despite remediation efforts, the physical and chemical groundwater data suggest minor leakage from the primary impoundment at the Cotter site [CDPHE 2007a; EPA 2002; USGS 1999b].

1. Remedial actions for controlling groundwater contamination

Since the early- to mid-1980s, remedial actions aimed at controlling groundwater contamination and the spread of the resulting plume have taken place. Remediation has targeted the area along the primary surface groundwater migration pathway, which runs parallel to Sand Creek [USGS 1999a]. Remediation has included the following:

- In the early 1980s, contaminated materials were moved into lined impoundments [EPA 2002].

- In 1988, a hydrologic clay barrier was installed on the Cotter property to help contain the contaminated groundwater plume associated with the Cotter Mill.

- In 1989, a network of injection and withdrawal wells were constructed downgradient of the lined impoundment to reverse the hydraulic gradient and prevent the northward migration of contaminated groundwater. This system was discontinued in 2000, because the system had little or no discernable effect on groundwater conditions [CDPHE 2005].

- Dam to ditch flushing began in 1990. However, this effort was discontinued in 1996 due to citizens' concerns about contaminant concentrations rising in groundwater wells as the plume was being flushed [CDPHE 2005].

- In 2000, a permeable reactive treatment wall was constructed across Sand Creek channel in the DeWeese Dye Ditch flush, downstream of the SCS Dam [EPA 2002]. Although the permeable reactive treatment wall has not performed as anticipated, it is acting as a barrier to additional groundwater flowing into Lincoln Park [Phil Egidi, CDPHE, personal communication, July 2008].

These efforts have reduced groundwater contamination downgradient of the Cotter Mill [CDPHE 2008; EPA 2002; USGS 1999a], although the rate at which groundwater quality is being restored is slower than anticipated [EPA 2007]. Cotter and CDPHE continue to explore options for cleaning the groundwater. Until a solution is reached, contaminated groundwater is captured at the SCS Dam and pumped back to the on-site lined impoundments [CDPHE 2008].

2. Nature and extent of groundwater contamination in Lincoln Park

CDPHE maintains a database containing environmental sampling data from various sources dating back to 1961. The most recent data entered into the database are from September 2007. To evaluate exposures to residents of Lincoln Park, ATSDR identified data within the CDPHE database for the wells reported to be in use during the 1989 water use survey (see Table 14 in Appendix A). After discussions with a CDPHE representative, the following assumptions were made while summarizing the data within the database.

- For chemicals, samples that were designated "Y" in the detect flag column and contained a zero in the result value column, but no value in the reporting detection limit column were excluded from the summary statistics. For radionuclides, however, these samples were included in the summary statistics since zero is considered a valid result.

- Samples that were designated "N" in the detect flag column and had the same value in the result value column as the reporting detection limit column were included in the summary statistics as ½ the reporting detection limit.

- Negative result values for manganese and iron were assumed to be not detected and were included in the summary statistics as ½ the reporting detection limit.

- Negative values[2] for radionuclides were included in the summary statistics.

a) Wells used for personal consumption

The 1989 *Lincoln Park Water Use Survey* identified seven wells used for personal consumption (IMS 1989). Data for six of the wells are available in the CDPHE database (see Table 14). The seventh well had a broken pump at the time of the survey [IMS 1989]; no data for this well appear to be in the database. The data for wells reportedly used for personal consumption in 1989 are summarized in Table 15. Samples were collected intermittently from 1984 to 2007. The locations of these wells are shown in Figure 6. With the exception of molybdenum and uranium, the data are limited (e.g., only two wells were sampled for the majority of the chemicals and none were sampled for radionuclides).

When this document was written, data from EPA's 2008 water use survey were not yet available. ATSDR will update well use information when the data are available.

---

[2] Negative values for radionuclides occur when samples are not much different from background, since standard protocol is to subtract background radioactivity from the sample count.

However, all six wells were repeatedly tested for molybdenum and uranium, which were the only chemicals detected above comparison values (see Table 15). Of the personal consumption wells, Well 189 contains the highest molybdenum and uranium concentrations. Well 189 is the only well with levels of uranium consistently detected above the comparison value (see Figure 6).

It is difficult to evaluate the molybdenum and uranium data over time, because of the limited sampling data for these wells and the inconsistency of sampling the same wells over time. The molybdenum and uranium concentrations in the personal consumption wells over time are graphically shown in Figure 7 and Figure 8 in Appendix B, respectively. Well 168 (house well on Grand Avenue)[3] and Well 189 (house well on Hickory)[4] were sampled the most frequently. No clear pattern of decreasing concentrations from 1984 to 2007 exists.

The USGS identified Well 10 (So. 12th St.) and Well 114 (Pine) as representative of background for the Lincoln Park area [Weston 1998]. The data available in the CDPHE database for these two wells are summarized in Table 16.[5] The average concentration of molybdenum in the wells used for personal consumption (0.082 mg/L; see Table 15) is higher than the average concentration found in the background wells (0.023 mg/L; see Table 16). The average uranium concentration in the wells used for personal consumption (0.028 mg/L; see Table 15) is only slightly higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

(1) Grand Avenue Well

In a 2002 newspaper article, a resident on Grand Avenue reported drinking water from their well [Plasket 2002]. Limited data (1 to 20 samples) are available in the CDPHE database for this location (see Figure 6). Samples were collected and analyzed for most chemicals in 1984, and then from either 2004 or 2005 to 2007. Samples from this well were also tested for molybdenum and uranium from 1988 to1991. The water from this well was tested for several chemicals, but not for radionuclides. None of the samples detected chemicals above comparison values (see Table 17).

b) Wells used to irrigate fruit and vegetable gardens

When this document was written, data from EPA's 2008 water use survey were not yet available. ATSDR will update well use information when the data are available.

The 1989 *Lincoln Park Water Use Survey* identified 22 wells used to irrigate fruit and 21 wells used to irrigate vegetable gardens [IMS 1989].[6] Data for 28 of these wells are available in the CDPHE database (see Table 14). Samples were sporadically collected from these wells and analyzed for various chemicals between 1962 and 2007. Samples were collected and analyzed for radionuclides from

---

[3] There are five non-detected molybdenum values for Well 168. Four of them are most likely due to the detection limit being too high for the level of molybdenum in that well. The detection limits were 0.01 mg/L for three of the samples and 0.05 mg/L for one of the samples. The concentrations in that well hover around 0.01 mg/L.

[4] One of the non-detected molybdenum concentrations in Well 189 is unexplainable. The detection limit (0.01 mg/L) is low enough to have detected the level of molybdenum typically found in the well. The detection limit (0.5 mg/L) for the other non-detected concentration is too high for the level of molybdenum typically found in the well.

[5] Groundwater samples from the background wells were not tested for radionuclides.

[6] Some wells were used for both purposes.

1995 to 2000. The data for wells reportedly used to irrigate fruit and vegetable gardens in 1989 are summarized in Table 18 (chemicals) and Table 19 (radionuclides). The locations of these wells are shown in Figure 9. The data for these wells are much more robust than the data available for the wells used for personal consumption, in part due to the increased number of wells. Molybdenum and uranium were sampled in all 28 wells used for irrigation. Five wells were tested for radionuclides.

The maximum concentrations in the wells used to irrigate fruit and vegetable gardens exceeded the comparison values for molybdenum, selenium, sulfate, total dissolved solids, and uranium. The average concentrations exceeded comparison values only for molybdenum, total dissolved solids, and uranium. Looking at data from 2000 to 2007, only the average molybdenum concentration (0.1 mg/L) continued to exceed the comparison value.

The average concentration of molybdenum in the wells used to irrigate fruit and vegetable gardens (0.99 mg/L; see Table 18) is higher than the average concentration found in the wells that USGS identified as background for Lincoln Park (0.023 mg/L; see Table 16). Similarly, the average uranium concentration in the wells used to irrigate fruit and vegetable gardens (0.13 mg/L; see Table 13) is higher than the average concentration in the background wells (0.021 mg/L; see Table 16). The average concentration for total dissolved solids in the wells used to irrigate fruit and vegetable gardens (550 mg/L; see Table 18) is also higher than the average concentration found in the background wells (429 mg/L; see Table 16).

c) Wells used to water livestock

When this document was written, data from EPA's 2008 water use survey were not yet available. ATSDR will update well use information when the data are available

The 1989 *Lincoln Park Water Use Survey* identified 22 wells used to water livestock [IMS 1989]. Data for 19 of these wells are available in the CDPHE database (see Table 14). Samples were sporadically collected from these wells and analyzed for various chemicals between 1962 and 2007. Samples were collected and analyzed for radionuclides from 1995 and 1996. The data for wells reportedly used to water livestock in 1989 are summarized in Table 20 (chemicals) and Table 21 (radionuclides). The locations of these wells are shown in Figure 10. Only one to four wells were sampled for the majority of the chemicals, however, molybdenum and uranium were sampled in all 19 wells used to water livestock. Two wells were tested for radionuclides.

The maximum concentrations exceeded the comparison values for molybdenum, sulfate, total dissolved solids, and uranium. The average concentrations only exceeded comparison values for molybdenum and uranium. Looking at data from 2000 to 2007, only the average molybdenum concentration (0.08 mg/L) continued to exceed the comparison value.

The average concentration of molybdenum in the wells used to water livestock (0.212 mg/L; see Table 20) is an order of magnitude higher than the average concentration found in the wells that USGS identified as background for Lincoln Park (0.023 mg/L; see Table 16). The average uranium concentration in the wells used to water livestock (0.034 mg/L; see Table 20) is higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

d) *Wells used to water lawns*

When this document was written, data from EPA's 2008 water use survey were not yet available. ATSDR will update well use information when the data are available.

The 1989 *Lincoln Park Water Use Survey* identified 42 wells used to water lawns [IMS 1989]. Data for all 42 wells are available in the CDPHE database (see Table 14). Samples were sporadically collected from these wells and analyzed for various chemicals between 1962 and 2007. Samples were collected and analyzed for radionuclides from 1995 to 2000. The data for wells reportedly used to water lawns in 1989 are summarized in Table 22 (chemicals) and Table 23 (radionuclides). The locations of these wells are shown in Figure 11. Several wells were sampled for each chemical, and molybdenum and uranium were tested in all 42 wells used to water lawns. Seven wells were sampled for radionuclides.

The maximum concentrations exceeded the comparison values for chloride, molybdenum, selenium, sulfate, total dissolved solids, and uranium. The average concentrations exceeded comparison values for molybdenum, sulfate, total dissolved solids, and uranium. Looking at data from 2000 to 2007, only the average molybdenum concentration (0.1 mg/L) continued to exceed the comparison value from 2000 to 2007, while the average uranium concentration (0.03 mg/L) was at the comparison value.

The average concentration of molybdenum in wells used to water lawns (2.2 mg/L; see Table 22) is two orders of magnitude higher than the average concentration found in the wells that USGS identified as background for Lincoln Park (0.023 mg/L; see Table 16). The average sulfate concentration in wells used to water lawns (351 mg/L; see Table 22) is almost six times higher than the average concentration in the background wells (61 mg/L; see Table 16). The average concentration for total dissolved solids in wells used to water lawns (746 mg/L; see Table 22) is higher than the average concentration found in the background wells (429 mg/L; see Table 16). The average dissolved uranium concentration in wells used to water lawns (0.233 mg/L; see Table 22) is an order of magnitude higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

(1) Well 138

Well 138 (field well on Cedar Street; see Figure 11) was identified during the *1998 Supplemental Human Health Risk Assessment* as the maximally impacted off-site well [Weston 1998]. In 1989, Well 138 was used only to water the lawn [IMS 1989]. Adequate data for this well are available in the CDPHE database. Samples were collected from Well 138 and analyzed for various chemicals between 1968 and 2000. Samples were collected and analyzed for radionuclides from 1995 to 2000. The data for Well 138 are summarized in Table 24 (chemicals) and Table 25 (radionuclides).

The maximum concentrations exceeded the comparison values for chloride, molybdenum, selenium, sulfate, total dissolved solids, and uranium. The average concentrations also exceeded comparison values for molybdenum, sulfate, total dissolved solids, and uranium. A clear decrease in concentrations occurred over time for molybdenum (see Figure 12), selenium (see Figure 13), and uranium (see Figure 14).

Well 138 has higher levels of contamination than the wells that USGS identified as background for Lincoln Park. The average concentration of molybdenum in Well 138 (8.0 mg/L; see Table 244) is hundreds of times higher than the average concentration found in the background wells (0.023 mg/L; see Table 16). The average sulfate concentration in Well 138 (1,059 mg/L; see Table 24) is considerably higher than the average concentration in the background wells (61 mg/L; see Table 16). The average concentration for total dissolved solids in Well 138 (1,530 mg/L; see Table 24) is three times higher than the average concentration found in the background wells (429 mg/L; see Table 16). The average dissolved uranium concentration in Well 138 (0.73 mg/L; see Table 24) is more than an order of magnitude higher than the average concentration in the background wells (0.021 mg/L; see Table 16).

e) Groundwater trends over time

To evaluate the levels of molybdenum, selenium, and uranium in groundwater over time, ATSDR combined and graphed all the groundwater data for the wells used for personal consumption, irrigating fruit and vegetables, watering livestock, and watering lawns (Figures 15 through 17 in Appendix B). Figure 15 shows a pattern of decreasing concentrations of molybdenum in groundwater over time. The concentrations of selenium seem to hold steady, but do decrease slightly over time (see Figure 16). The concentrations of uranium also clearly decrease over time (see Figure 17).

B. Soil and sediment

1. Background levels

Cotter was required by the 1988 RAP to establish background levels of certain elements in soils and sediments. Twenty soil samples were collected from five sub-basins considered free from mill-related contamination to represent natural background typical of the area near the mill [HRAP 1991]. Table 4 below presents the results of that study, which were further supported by additional sampling [CDPHE 2005].

Table 4. Background soil and sediment levels

	Soil		Sediment	
	Average	Upper Confidence Limit	Average	Upper Confidence Limit
Molybdenum	2.4 ppm	4.6 ppm	2.3 ppm	4.7 ppm
Uranium	2.1 ppm	2.9 ppm	2.0 ppm	3.4 ppm
Radium-226	1.3 pCi/g	1.9 pCi/g	1.1 pCi/g	1.7 pCi/g
Thorium-230	1.8 pCi/g	3.2 pCi/g	1.5 pCi/g	3.1 pCi/g
Gamma Exposure Rates	9.4 µR/hr	--	--	--

Source: CDPHE 2005; HRAP 1991
pCi/g – picocuries per gram
ppm – parts per million
µR/hr – microroentgen per hour

2. *Off-site soil contamination and remediation*

As part of the 1988 RAP, Cotter was required to survey soils outside the restricted area (the fenced active mill site) and to remediate contaminated soils with levels of radium and molybdenum that are above the established background [CDPHE 2005].

As part of the *1998 Supplemental Human Health Risk Assessment* [Weston 1998], Weston (a contractor for Cotter) collected surface soil samples (0-2 inches) from eight zones around the mill property (see Figure 18 in Appendix B). Each zone was divided into 8 to 12 grids. Four samples were collected near the center of each grid and were composited (i.e., combined and homogenized) to form a single representative sample [Weston 1998]. The results of this sampling are shown in Table 26 (chemicals) and Table 27 (radionuclides). The maximum concentrations exceeded the comparison values for arsenic[7] in all eight zones, for cadmium in all zones except one (D), for lead in three zones (F, G, and H), and for radium-226 in four zones (A, B, C, and E). The average concentrations also exceeded comparison values for arsenic[7] in all eight zones, for cadmium in one zone (F), for lead in one zone (H), and for radium-226 in two zones (A and B). The average radium-226 and thorium-230 concentrations were higher than the established average background levels in all eight zones (see 4 for background).

There is limited potential for exposure to contaminants along the access road since access to the Cotter Mill is restricted and soils along the access road were remediated in 2007 and 2008.

Cotter has occasionally hauled ore and other materials by truck to the site for processing at their facility. To assess the potential that material has been lost alongside the county road leading to the mill and the access road entering the mill site, MFG (a contractor to Cotter) scanned the county road (assuming CR 143) from the road leading to the Shadow Hills Golf Course to the Cotter Mill access road for gamma radiation (see Figure 19). They also collected soil samples to establish a correlation between the gamma exposure rate and the concentration of gamma emitters in the soil. A total of 16 locations were sampled—five along the county road, five along the mill's access road, and six from background locations. The locations were not chosen to estimate an average concentration, but rather to provide data for a range of gamma exposure rates. Each sample was a composite of 10 aliquots within a 100 x 100 meter area [MFG 2005]. The results of this sampling are shown in Table 28. The maximum and average radium-226 and natural uranium concentrations exceeded the comparison values for samples taken along the mill's access road. The maximum and average radium-226 concentrations also exceeded the comparison value for samples taken along the county road. Average concentrations of all radionuclides sampled were higher along the county road and the mill's access road than from those areas designated as background (see Table 28).

To address public concerns about the impact of the Cotter Mill on the health of Cañon City residents, CDPHE collected 21 soil samples in January 2003 [CDPHE 2003]. Each sample was a composite of 30–40 scrape samples[8] from each location. Seven samples from Lincoln Park were

---

[7] The *1998 Supplemental Human Health Risk Assessment* found no discernible spatial pattern for arsenic around the Cotter Mill, indicating that arsenic levels have not been measurably altered by airborne releases from the mill (Weston 1998).

[8] Surface soil samples were collected using a method developed specifically to look for airborne contamination that settled to the ground (CDPHE 2003).

collected, including one sample of suspected flood sediment (Pine Street near Elm Avenue), two samples of dust (one from a barn loft and one from a residential attic), and four samples of surface soil (one from the McKinley Elementary School playground). Seven samples were collected from areas east of the mill, including the Brookside Head Start School. Six samples were collected from areas west of the mill, including a private residence. One sample was collected from the extreme northern part of Cañon City to represent the regional background (corner of Orchard Avenue and High Street). The sampling event was intentionally biased toward finding the highest amounts of contamination possible [CDPHE 2003]. Sample locations are shown in Figure 20. The data from this sampling event are summarized in Table 29 (chemicals) and Table 30 (radionuclides). The maximum concentrations for lead and radium-226 exceeded the comparison values. The average concentration for lead also exceeded the comparison value. The average concentration for radium-226 did not exceed the comparison value.

Since 1994, Cotter has been annually collecting surface soil samples (0–6 inches) at 10 environmental air monitoring stations that are located along the facility’s boundary and in residential areas (see Figure 21). From 1979 to 1993, soils were collected every 9 months. The data from this effort are summarized in Table 31. The maximum concentration for radium-226 exceeded the comparison value; however, the average concentration of samples over the timeframe did not.

a) The nearest resident

The nearest resident is located 0.25 mile from the restricted area [Galant et al. 2007]. One of the air monitoring stations annually monitored by Cotter was established as “the nearest resident” (AS-212). This location is between the Cotter Mill and an actual residence [Cotter 2007]. The limited data for this location are shown in Table 32 (chemicals) and Table 33 (radionuclides). The maximum concentration for radium-226 exceeded the comparison value; however, the average concentration did not.

b) Lincoln Park

As part of the 1988 RAP, Cotter was required to conduct a gamma scintillometer survey in Lincoln Park to evaluate whether soils had been contaminated by windblown and waterborne contaminants from the facility. In December 1988, 127 scintillometer readings were taken near intersections in Lincoln Park. The average external gamma radiation for Lincoln Park was 9.8 microroentgen per hour (µR/hr), which is considered to show “no elevated gamma in Lincoln Park” [CDPHE 2005; HRAP 1991].

EPA determined that sediment and soil in Lincoln Park are no longer an issue since the completion of the Sand Creek Cleanup project in 1998 [EPA 2002, 2007].

As part of the *1996 Supplemental Human Health Risk Assessment* [Weston 1996], Weston compiled data from several past soil studies, including the following:

- Samples collected at the air monitoring location in Lincoln Park in 1987 and 1988

- Samples collected from yards of 10 participants in the Lincoln Park water use survey in 1989
- Samples collected from residential gardens in Lincoln Park in 1990
- Samples collected from lawns and gardens in Lincoln Park in 1996

The data from these studies are collectively summarized in Table 34 (chemicals) and Table 35 (radionuclides). Only the maximum and average concentrations for arsenic exceeded the comparison value.

The soil samples collected from yards of the participants in the 1989 *Lincoln Park water use survey* were also analyzed for molybdenum and uranium. The average molybdenum concentration was 2.0 ppm and the average uranium concentration was 2.8 ppm [HRAP 1991]. The samples collected as part of the 1990 residential garden soil survey were also analyzed for molybdenum. The average concentration was 0.13 ppm [HRAP 1991]. These concentrations are well below the comparison values for molybdenum (300 ppm) and uranium (100 ppm).[9]

As part of the *1998 Supplemental Human Health Risk Assessment* [Weston 1998], 73 surface soil samples were collected from lawns (0–2 inches) and gardens (0–6 inches) in Lincoln Park. For sampling purposes, Lincoln Park was divided into seven areas and 6–16 samples were taken from each area [Weston 1998]. The results of this sampling are shown in Table 26 (chemicals) and Table 27 (radionuclides). Only the maximum and average arsenic concentrations exceeded the comparison value.

The effect of irrigation with contaminated well water on the levels in the soil was also examined during the *1998 Supplemental Human Health Risk Assessment* [Weston 1998]. The soil samples from Lincoln Park were divided into two categories—those irrigated with well water that had been impacted by mill releases and those not believed to have been irrigated with contaminated well water. These data are shown in Table 36 (chemicals) and Table 37 (radionuclides). The concentrations of arsenic, molybdenum, and uranium were statistically higher in soil samples irrigated with impacted well water [Weston 1998].

(1) Lead in Lincoln Park

Residents of Lincoln Park expressed concerns about lead contamination in soil and dust due to historical and current mining and milling operations in the area. Six potential sources of lead are located near the community of Lincoln Park—the Cotter Mill, the Empire Zinc Smelter (also known as New Jersey Zinc and the College of the Cañons), the US Smelter Facility, the Cañon City Copper Smelter, the Ohio Zinc Company, and the Royal Gorge Smelter [EPA 2004]. The Lincoln Park neighborhood is located generally east-southeast of these facilities and the general wind direction is west to east.

To address the residents' concerns, EPA requested that ATSDR assess the health risk associated with lead contamination in Lincoln Park. After a site visit and discussions with the community,

---

[9] The data for molybdenum and uranium are not summarized in Table because the raw data for these two chemicals are not presented in the *1996 Supplemental Human Health Risk Assessment* (Weston 1996).

ATSDR focused assessments on two primary issues—1) blood lead levels in children living in Lincoln Park and 2) lead contaminated dust in homes in Lincoln Park.

ATSDR reviewed the available data on blood lead levels in children and concluded that the rate of elevated blood lead levels for Fremont County is below the state average. However, it was not possible to evaluate whether area children, including “high risk” children, were being adequately screened for blood lead levels [ATSDR 2006a]. To further assess blood lead levels, ATSDR tested the blood level of 115 “at risk” school children in 2005. None of the children had elevated blood lead levels [ATSDR 2006b].

EPA’s report documenting the residential soils sampling project can be accessed at the following site: http://www.epa.gov/region8/superfund/co/lincolnpark/.

ATSDR reviewed the available data on lead levels in household dust and found the data to be sparse and/or lacking. ATSDR conducted a screening level evaluation of the available dust samples and concluded that the data were not sufficient to determine the magnitude or extent of the potential hazard associated with levels of lead in household dust [ATSDR 2006c]. To further assess the health impacts in Lincoln Park, ATSDR, in collaboration with the Colorado Citizens Against Toxic Waste (CCAT) and EPA, collected and analyzed 44 indoor dust samples, 80 surface soil samples (0–2 inches or 0–6 inches) from 22 properties, and 45 blood samples. The results of this exposure investigation did not indicate the presence of unusual levels of lead in residential indoor dust samples, the soil at those homes, or in the blood of occupants of those homes [ATSDR 2006d].

c) Sand Creek

Sand Creek is primarily an ephemeral creek that passes through the Cotter Mill and runs north-northeast through Lincoln Park. It becomes perennial for the last 0.25–0.5 mile before its confluence with the Arkansas River. Prior to the construction of the SCS Dam north of the Cotter Mill in 1971, surface water and sediment from the facility flowed down the Sand Creek drainage into Lincoln Park [CDPHE 2005; GeoTrans 1986]. Mill tailings in the Old Tailings Pond Area are the source of the mill-derived contaminants (primarily radium-226 and thorium-230) in Sand Creek [Cotter 2000].

During the *1986 Remedial Investigation* [GeoTrans 1986], sediment samples were collected from the following locations in Sand Creek to evaluate present (i.e., 1985) and historical loadings from the Cotter Mill.

- SD01 – mouth near the Arkansas River
- SD02 – near spring where flow begins (reflects migration of contaminants in the groundwater)
- SD04 – below the SCS Dam in
  (1) an abandoned stock watering pond (formed by diversion of runoff water into a depression adjacent to Sand Creek)
  (2) in drainage (reflects historical picture of uncontrolled emissions)
  (3) in drainage above #2 (reflects historical picture of uncontrolled emissions)

- SD05 – above the SCS Dam adjacent to the west property edge

The results of this sampling are presented in Table 38 and Table 39. Only the concentrations for arsenic and radium-226 exceeded ATSDR's comparison values.

As part of the 1988 RAP, Cotter was required to evaluate the mill's potential impacts to Sand Creek and remove sediments that exceeded the radium-226 cleanup goal of 4.0 picocuries per gram (pCi/g), which allows unrestricted use of the creek [Cotter 2000]. A total of 721 samples were systematically collected along the 1.25 mile stretch from just north of the Cotter Mill to where Sand Creek becomes perennial (see Figure 22). Surveying and cleanup began in the spring of 1993 and continued until remediation was completed in December 1998. Approximately 9,000 cubic yards of soil were removed from Sand Creek and disposed of on Cotter property [Cotter 2000]. The excavated areas were backfilled with clean soil [CDPHE 2005]. Thirty confirmatory samples established that the average site-wide radium-226 concentration was 1.5 pCi/g (below the cleanup goal of 4.0 pCi/g) and the average site-wide thorium-230 concentration was 3.9 pCi/g after remediation [Cotter 2000]. In addition to the sampling and remediation for radium-226, seven of the confirmation samples were analyzed for 10 chemicals in 1998 [Cotter 2000]. These results are presented in Table 40. Only the maximum and average concentrations for arsenic exceeded ATSDR's comparison value.

At the time of mill closure, Cotter was required by the 1988 RAP to survey molybdenum and radium-226 in sediments in the perennial stream segments of Sand Creek and Willow (Plum) Creek to determine whether these areas have been impacted by the mill. If necessary, sediments above background will be removed and properly disposed of (CDPHE 2005).

d) The Fremont Ditch

The Fremont Ditch system is downstream of Sand Creek. It diverts water from near the confluence of Sand Creek and the Arkansas River downgradient toward Florence. The ditch receives substantial amounts of water from Sand Creek during low flows in the Arkansas River. During these periods, any contaminants moving down Sand Creek would likely be transported to Fremont Ditch [GeoTrans 1986].

As part of the 1988 RAP, Cotter was also required to conduct a gamma survey of the dry beds of the Fremont Ditch. Cotter sampled sediment in Fremont Ditch from its head gate near Sand Creek to about a quarter mile downstream. The average radium-226 level was 1.86 pCi/g, which was below the cleanup standard of 4 pCi/g. The state agreed with Cotter that the Fremont Ditch did not require remediation because the concentrations of gross alpha (3.8 pCi/g), uranium (6.6 ppm), and molybdenum (2.2 ppm) were also low [CDPHE 2005].

C. Surface water

1. Nature and extent of contamination

The Cotter Mill is a non-discharge facility, meaning that Cotter does not release wastewater to the surface water system. All remediation water is pumped to on-site impoundments for evaporation or recycling. However, prior to construction of the SCS Dam in 1971, storm events carried contaminated surface water and sediments from the facility down the Sand Creek drainage [CDPHE 2005]. One event in particular, a flood in June 1965, caused the unlined tailings ponds at the Cotter Mill to overflow into Lincoln Park. Sediment in the Lincoln Park portion of Sand Creek was contaminated with tailings that were carried in surface water runoff from the mill [EPA 2007].

CDPHE maintains a database containing surface water monitoring data dating back to 1962. The most recent data entered into the database are from September 2007. To evaluate exposures to people living near the Cotter Mill, ATSDR extracted surface water data collected from Sand Creek, the DeWeese Dye Ditch, and the Arkansas River. After discussions with a CDPHE representative, the following assumptions were made while summarizing data within the database.

The SCS Dam was built to prevent surface water and sediment from flowing into Lincoln Park during storm-generated floods. Since the construction of the dam, Lincoln Park no longer receives runoff from the Cotter Mill. Additionally, since 1979, impounded water collected at the dam has been pumped back to the lined impoundment on site [EPA 2002; GeoTrans 1986; HRAP 1991].

- Samples that were designated “N” in the detect flag column and had the same value in the result value column as the reporting detection limit column were included in the summary statistics as ½ the reporting detection limit.
- Negative result values for manganese and iron were assumed to be not detected and were included in the summary statistics as ½ the reporting detection limit.
- Negative values[10] for radionuclides were included in the summary statistics.

a) Sand Creek

From 1993 to 1998, Cotter conducted the Sand Creek Cleanup project to identify and remove mill tailings that had moved into the creek bed as the result of surface water runoff from the Cotter Mill prior to the construction of the SCS Dam. Sediments above the radium-226 cleanup goal of 4.0 pCi/g were removed, which allows unrestricted use of the creek [Cotter 2000; EPA 2002].

Two locations in Sand Creek—one at Ash Street (008) and one at the confluence with the Arkansas River (506)—are sampled as part of the surface water monitoring program (Cotter 2007). The CDPHE database contains surface water monitoring data from these two locations, which are summarized in Table 41 (chemicals) and Table 42 (radionuclides). The maximum concentrations for manganese, molybdenum, sulfate, and total dissolved solids exceeded the comparison values. However, for all four of these chemicals, only the maximum concentrations exceeded comparison values—the second highest detected concentrations were below comparison values. None of the average concentrations exceeded comparison values.

---

[10] Negative values for radionuclides occur when samples are not much different from background, since standard protocol is to subtract background radioactivity from the sample count.

As part of the *1991 Health Risk Assessment of the Cotter Uranium Mill Site* [HRAP 1991], the Health Risk Assessment Panel (HRAP) reviewed over 18,000 samples collected from 1976–1989, from 55 different surface water locations. More than 95% of the surface water data were collected from 10 main locations. The location in Sand Creek at Ash Street (008, formerly known as 555) was one of these locations. The average molybdenum (0.009 mg/L) and uranium (0.016 mg/L) concentrations from this location were well below the comparison values (molybdenum: 0.035 mg/L; uranium: 0.03 mg/L).[11]

b) DeWeese Dye Ditch

The DeWeese Dye Ditch is an irrigation ditch that flows between the Cotter Mill and Lincoln Park. The ditch diverts water from Grape Creek to irrigate about 1,200 acres during the summer growing period [GeoTrans 1986]. The ditch crosses Sand Creek downstream from the SCS Dam, but does not join it. Seepage from the ditch recharges groundwater within the Sand Creek drainage. This process dilutes and flushes the contaminated groundwater under Lincoln Park [EPA 2002].

The CDPHE database contains surface water monitoring data from two locations in the DeWeese Dye Ditch—one upstream of the confluence with Forked Gulch (520) and one at Cedar Avenue (526). The location at Cedar Avenue is sampled as part of the surface water monitoring program [Cotter 2007]. The data for both locations are summarized in Table 43 (chemicals) and Table 44 (radionuclides). The maximum concentrations exceeded the comparison values for iron, manganese, total dissolved solids, and dissolved uranium. However, for iron and manganese, only the maximum concentrations exceeded comparison values—the second highest detected concentrations were below comparison values. Only three of the total dissolved solids samples and three of the dissolved uranium samples were detected above comparison values. None of the average concentrations exceeded comparison values.

Molybdenum and uranium data from 1984 to 1989, from the same two locations in the DeWeese Dye Ditch (520 and 526), are summarized in the *1991 Health Risk Assessment of the Cotter Uranium Mill Site* (HRAP 1991). The average molybdenum and uranium concentrations were well below the comparison values (see Table 5 below).

Table 5. Average molybdenum and uranium concentrations in the DeWeese Dye Ditch

Chemical	Average concentration at Location 520 (mg/L)	Average concentration at Location 526 (mg/L)	Comparison Value (mg/L)
Molybdenum	0.003	0.003	0.035
Uranium	0.002	0.0019	0.03

Source: HRAP 1991

Molybdenum data that were several orders of magnitude greater than any other observed sample (i.e., outliers) were not used to calculate the average concentrations (HRAP 1991).

It was not possible to determine whether these data are included in the CDPHE database.

c) Arkansas River

---

[11] It was not possible to determine whether these data are included in the CDPHE database.

From April 1989 to June 1990, Cotter and their consultant, Western Environmental Analysts, conducted bi-weekly sampling in the Arkansas River at the following five locations:

The Arkansas River sampling plan was approved by the CDPHE Water Quality Control Division [CDPHE 2005].

1. Parkdale (background)
2. Grape Creek
3. 1st Street (upstream of where Sand Creek enters the Arkansas River)
4. Mackenzie Avenue Bridge (downstream from where Sand Creek enters the Arkansas River)
5. Where Highway 67 to Florence crosses the river

Water, sediment, autotrophs (algae), primary consumers/detrivores (tadpoles, macroinvertebrates), and carnivores (fish) were collected and tested for molybdenum, uranium, radium-226, and thorium-230. Extremely low concentrations were detected, which indicated no statistical evidence of an increase in contamination downstream on the Arkansas River [CDPHE 2005].

In addition, four synoptic sampling events (i.e., sampling of water in-flows) were conducted between Canyon Mouth and Highway 67. The purpose of the synoptic sampling was to determine whether tributary flows reflect unusual sources of uranium or molybdenum. The sampling showed that other sources such as Fourmile Creek, as well as Sand Creek and Plum Creek, contribute to increases in the Arkansas River [CDPHE 2005].

Two locations in the Arkansas River—one upstream of Sand Creek at 1st Street (907) and one downstream of Sand Creek at Mackenzie Avenue (904)—are sampled as part of the surface water monitoring program [Cotter 2007]. The CDPHE database contains surface water monitoring data from these two locations, which are summarized in Table 45 (chemicals) and Table 46 (radionuclides). At both locations, the maximum concentrations exceeded the comparison value for sulfate. The maximum concentration for total dissolved solids exceeded the comparison value for the upstream location, but not the downstream location. In all three instances, these maximum concentrations appear to be outliers and are the only concentrations that exceeded comparison values—the second highest detected concentrations were below comparison values. The maximum concentration for molybdenum also exceeded the Colorado state groundwater standard for the upstream location, but not the downstream location. None of the average concentrations exceeded comparison values.

Data from 1984 to 1989, from two locations in the Arkansas River—one upstream of Sand Creek near Grape Creek (502) and one downstream of Sand Creek near Fourmile Bridge (504)—are summarized in the *1991 Health Risk Assessment of the Cotter Uranium Mill Site* [HRAP 1991]. The average molybdenum and uranium concentrations were well below the comparison values (see Table 6 below).

Table 6. Average molybdenum and uranium concentrations in the Arkansas River

Chemical	Average concentration upstream of Sand Creek near Grape Creek (502) (mg/L)	Average concentration downstream of Sand Creek near Fourmile Bridge (504) (mg/L)	Comparison Value (mg/L)
Molybdenum	0.00391	0.0056	0.035
Uranium	0.00532	0.00574	0.03

Source: HRAP 1991

Molybdenum data that were several orders of magnitude greater than any other observed sample (i.e., outliers) were not used to calculate the average concentrations (HRAP 1991).

d) Willow Lakes

The Willow Lakes are comprised of several small ponds near the Arkansas River in the Willow Creek watershed, which lies directly to the east of the Sand Creek watershed. The Willow Lakes receive water from shallow groundwater and surface runoff [HRAP 1991].

Cotter was required by the 1988 RAP to evaluate whether the Willow Lakes had been contaminated by the mill. Water, sediment, autotrophs (algae), primary consumers/detrivores (tadpoles, macroinvertebrates), and carnivores (fish) from the Willow Lakes and three comparison lakes were collected and tested for molybdenum, uranium, and radium. The information showed that the Willow Lakes had not been contaminated by the Cotter Mill [CDPHE 2005].

D. Locally grown produce

1. Nature and extent of contamination

As part of the *1996 Supplemental Human Health Risk Assessment* (Weston 1996), Weston compiled available food data from several past studies. Samples included chicken meat, fruit (apples, cherries, grapes), and vegetables (asparagus, carrots, lettuce, tomatoes, turnips). The local samples were compared to food collected from supermarkets. The data are presented in Table 47 and Table 48 in Appendix A. The limited sample data suggest that the chemicals and radionuclides found in the foods are probably natural in origin, however, it was not possible to exclude the possibility that some food types may be influenced by mill-related contaminants [Weston 1996].

To further evaluate exposures to residents who eat locally grown fruits and vegetables, a sampling program was initiated in Lincoln Park during the *1998 Supplemental Human Health Risk Assessment* [Weston 1998]. People were asked to donate locally grown produce samples for analysis. The fruits and vegetables sampled are presented in the table below. The samples were tested for heavy metals and radionuclides. The analytical results of the sampling program are summarized in Table 49 and Table 50 in Appendix A.

Fruits Sampled	**Vegetables Sampled**		
Apples	Acorn squash	Green Beans	Rhubarb
Cantaloupe	Beets	Green Onions	Squash
Grapes	Carrots	Kohlrabi	Tomatoes
Honey dew melon	Celery	Patty pan squash	Turnip Greens
Plums	Corn	Peppers	Turnips
Watermelon	Cucumbers	Pumpkin	Winter squash

The samples were divided into two categories—(1) produce that was grown in soil known to have been irrigated with contaminated well water (fruits n = 16; vegetables n = 43) and (2) produce that was grown in soil not believed to have been irrigated with contaminated well water (fruits n = 1; vegetables n = 6). A statistical comparison of the data for the two categories of vegetables indicated that irrigation with contaminated well water did not cause a significant increase in contaminant levels (Weston 1998). The following trends were also noted:

- The concentrations of most metals were higher in root vegetables than other types of vegetables and fruit.

- Concentrations were much lower in peeled turnips than in whole turnips, suggesting that most of the contamination was on or in the surface layer.

- There was high variability both within and between the different types of produce.

- Concentration values were below the limit of detection for many of the samples.

E. Ambient Air

ATSDR reviewed ambient air monitoring data and air sampling data collected from the following two sources:

- Cotter Mill has operated an ambient air monitoring program to characterize air quality impacts of radioactive particulates and radon for more than 20 years. ATSDR accessed summaries of the monitoring data from Cotter Mill's annual Environmental and Occupational Performance Reports, which are posted to the CDPHE's web site; and

- The state of Colorado operated three particulate monitoring stations in Fremont County, one each in Lincoln Park, Cañon City, and Florence. The station in Cañon City continues to operate today. ATSDR downloaded measured concentrations of particulate matter, and some chemical constituents of particulate matter, from EPA's Air Quality System (AQS) database—a publicly accessible online clearinghouse of ambient air monitoring data. Some of the measurements collected by these monitors date back 40 years.

Historically, Cotter Mill had two general types of air emission sources: ground-level fugitive emissions (e.g., wind-blown dust) that would be expected to have greatest air quality impacts nearest the source; and elevated point sources (e.g., stacks) that have the potential for having peak ground-level impacts at downwind locations. With the facility currently in "stand down" status, facility emissions are now predominantly fugitive and their air quality impacts should be adequately characterized by the perimeter monitoring stations.

1. Nature and extent of air contamination

ATSDR compiled and evaluated ambient air monitoring data to assess potential air quality impacts from Cotter Mill's past and ongoing operations. As will be discussed later, ambient air concentrations of some substances changed considerably from one year to the next—in some cases, annual average concentrations vary by more than a factor of 250 over the period of record. These substantial changes in measured air contamination levels can sometimes be traced back to site-specific activities.

To provide background information and context for the air quality trends documented later in this report, the following list identifies key milestones over the history of Cotter Mill's operations. The timeline is not intended to be a comprehensive listing of site-specific events, but rather focuses on events and activities expected to be *associated with notable changes in the facility's air emissions*.

- 1958: Cotter Corporation begins its uranium milling operations at the Cotter Mill site
- 1979: Continuous operations cease, but intermittent operations continue
- 1981-1983: Cotter excavates 2,500,000 cubic yards of contaminated tailings from unlined holding ponds and places the material in a newly constructed, lined surface impoundment
- 1987: Cotter suspends its primary milling operations and only limited and intermittent ore processing occurs for the next 12 years
- 1993-1999: Cotter excavates 9,000 cubic yards of contaminated tailings, soil, and sediment from 1.25 miles of Sand Creek near the facility
- 1999: Cotter excavates 100,000 cubic yards of contaminated soil in "near surface soils" from the on-site Old Pond Area and places this material into the lined, surface impoundment
- 1999: Milling operations using a different production process begin
- 2005: Cotter ceases its routine operations and enters "stand down" status; site remediation activities continue; stack emissions from most sources continue into 2006, after which the main operational stack is for the laboratory baghouse
- 2009: Cotter submits letter to CDPHE announcing its intent to refurbish the mill, rather than decommission it

The following sections summarize the data and air quality trends for particulate matter, selected particle-bound radionuclides, radon gas and gamma radiation.

a) Ambient Air Monitoring for Radioactive Substances

The Cotter Mill monitoring network is operated by Cotter Mill in accordance with guidelines and requirements set forth by the U.S. Nuclear Regulatory Commission (USNRC 1980) and the Radioactive Materials License established between Cotter Mill and the state of Colorado [CDPHE 2009]. The purpose of the network is to characterize the extent to which Cotter Mill's operations affect off-site air quality.

Cotter Mill's ambient air monitoring network has been operating from 1979 to the present, but the number of monitoring stations included in the network has changed over time. In 1979, four stations were fully operational; this increased to seven by 1981 and to ten by 1999. These ten monitoring stations continue to operate today. Each station is equipped with the same monitoring equipment: an environmental air sampler used to collect particulates for analysis of particle-bound radionuclides; a radon track etch measurement device; and an environmental thermoluminescent dosimeter (TLD) for measuring gamma exposure. The height of the sampling inlet probes was not specified in the reports that ATSDR reviewed to prepare this health assessment. Table 51 in Appendix A identifies the monitoring stations and their periods of operation. Figure 23 in Appendix B shows the approximate locations of the monitoring stations. For purposes of this evaluation, ATSDR has classified the ten monitoring stations as being either "perimeter" or "off-site." The five "perimeter" monitoring stations are located along or just within Cotter Mill's property line; and the five "off-site" monitoring stations are located off-site, anywhere from 0.5 mile to 4 miles from the Cotter Mill property line.

(1) Particulate Matter

At each of the 10 monitoring stations described above, Cotter Mill operates a high-volume total suspended particulate (TSP) sampling device. For each sampling period, the devices are loaded with glass fiber filters that collect airborne particulates as ambient air passes through the sampling apparatus. The TSP sampling devices collect 1-week integrated samples; when the sampling period ends, field personnel remove filters, record observations on chain-of-custody forms, and store filters for subsequent laboratory analysis.

Cotter prepares annual summary reports for its environmental monitoring network, and those reports document monthly average TSP concentrations measured at each station. ATSDR had access to the summary reports for 2006, 2007, and 2008. TSP data from earlier years can be accessed through data reports that CDPHE has on compact disk. Over the last three years, annual average TSP concentrations were consistently higher in the more populated areas (Lincoln Park and Cañon City) than at the perimeter monitoring stations. In 2008, for instance, the annual average TSP levels at Lincoln Park and Cañon City were 29.9 $\mu g/m^3$ and 26.5 $\mu g/m^3$, respectively; in contrast, annual average concentrations at the five perimeter monitoring stations ranged from 15.5 $\mu g/m^3$ to 21.4 $\mu g/m^3$.

Although quantitative quality control information was not available when summarizing Cotter's TSP data, these measurements can be compared to CDPHE's PM_{10} monitoring results in Cañon City during the same time frame. From 2006 to 2008, the annual average TSP levels measured by Cotter Mill in Cañon City were 26.6 $\mu g/m^3$, 26.3 $\mu g/m^3$, and 26.5 $\mu g/m^3$, respectively; the annual average PM_{10} levels measured by CDPHE in Cañon City during these same years were

16.5 µg/m^3, 16.4 µg/m^3, and 15.0 µg/m^3. The difference between the TSP and PM$_{10}$ annual average concentrations in Cañon City are within the expected range and direction (i.e., TSP levels exceeding PM$_{10}$ levels), which gives some assurance in the quality of the underlying data sets.

(2) Particle-Bound Radionuclides

Weekly particulate filters collected at the 10 stations mentioned in the previous section are not only weighed for mass loading but are also analyzed at Cotter Mill's analytical laboratory for concentrations of five radionuclides, identified below. All laboratory analyses are conducted according to methodologies approved by CDPHE.

Field sampling and laboratory analyses for particle-bound radionuclides are conducted according to specifications outlined in Cotter Mill's Quality Assurance Program Plan (QAPP). This document is revised periodically and submitted to CDPHE for review. The QAPP outlines many quality control and quality assurance procedures implemented to ensure that the network's measurements are of a known and high quality. Examples of specific procedures followed include: routine collection and analysis of blank samples to ensure sampling media and laboratory equipment are not contaminated; quarterly calibration of flow rates for the "high volume" samplers; audit of sampler flow rates using special equipment; collection of duplicate samples that are analyzed in replicate to quantify measurement precision; and participation in a "laboratory exchange program" through which a subset of environmental samples (mostly water samples, by all appearances) are split and sent to Cotter Mill's laboratory and two commercial laboratories for analyses. While these and other quality control procedures give some assurance that samples are collected and analyzed with fine attention to data quality, the reports available to ATSDR during this review generally did not present the actual data quality metrics (e.g., the relative percent difference in duplicate samples or for inter-laboratory audits, contamination levels found in blanks) for the particle-bound radionuclides.

The key findings from the monitoring program for the five radionuclides measured are below. For each substance, a section compares the measured concentrations to regulatory limits or health-based comparison values, comments on temporal and spatial variations, and then presents a brief summary.

- **Natural uranium (^{nat}U).** Table 52 in Appendix A presents the history of annual average ^{nat}U concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.
    - *Screening.* Cotter Mill compares measured concentrations of ^{nat}U to an "effluent concentration" (9.0 x 10^{-14} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 52 exceed this derived concentration guide. The highest annual average concentration over the period of record (2.5 x 10^{-14} µCi/ml at a perimeter monitoring station in 1982) is 3.6 times below this screening value. The highest annual average in 2008 (4.4 x 10^{-16} µCi/ml at a

perimeter monitoring station) was approximately 200 times below the screening value, and larger margins are observed for the off-site monitoring stations.

  - *Spatial and temporal variations.* Generally, the highest annual average concentrations of ^{nat}U were observed at perimeter monitoring stations, with lower levels observed at the off-site stations. During most years, the annual average values did not vary considerably (by more than an order of magnitude) across all of the stations. As an exception, the 1982 annual average ^{nat}U concentration observed at the west boundary monitoring station was roughly 50 times greater than the annual averages observed at the other monitoring stations during the same year; this "spike" at one station during one year was most likely caused by air emissions associated with an on-site tailings excavation project. As another exception, in several years between 1998 and 2006, annual average ^{nat}U concentrations at the mill entrance road monitoring station were more than an order of magnitude higher than those recorded at all other stations, which most likely reflects contributions from clean-up of the site entry road and delivery of ores (which mostly ended in 2006). As noted above, the highest annual average concentration of ^{nat}U was observed in 1982, and more recent (2004-2008) annual average levels are considerably lower.

  - *Summary.* Every annual average concentration of ^{nat}U recorded to date has been lower than Cotter Mill's health-based regulatory limit. In the last five years, the annual average concentrations at every station have been at least 20 times below this limit. It seems unlikely that air emissions from the mill would lead to an off-site "hot spot" of ^{nat}U concentrations that could be considerably higher than the levels measured by the monitoring network.

- **Thorium-230 (^{230}Th).** Table 53 in Appendix A presents the history of annual average ^{230}Th concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{230}Th to an "effluent concentration" (2.0×10^{-14} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. The annual average concentration at the west boundary monitoring station exceeded this value in 1981 and 1982, as did the annual average concentration in 1981 at the east boundary monitoring station. The highest annual average concentration recorded by this network (9.0×10^{-14} µCi/ml at the west boundary in 1982) was 4.5 times higher than the derived concentration guide. Concentrations decreased over the years, and the highest annual average in 2008 (7.2×10^{-16} µCi/ml at a perimeter monitoring station) was a factor of 28 times lower than the screening value, and larger margins are observed for the off-site monitoring stations.

  - *Spatial and temporal variations.* Without exception, the highest annual average concentrations of ^{230}Th were observed at perimeter monitoring stations, with considerably lower levels observed at the off-site stations—a spatial trend suggesting that Cotter Mill's emissions very likely account for a considerable portion of the measured levels. As with natural uranium, the ^{230}Th concentrations exhibited a notable "spike" in 1981-1982, when 2.5 million cubic yards of on-site tailings were excavated from the unlined ponds. As an illustration of this effect, the highest annual average concentration in 1981 (3.0×10^{-14} µCi/ml at a perimeter monitoring station) was nearly 370 times higher than the annual average concentration measured in Cañon City. Moreover, the highest concentrations were observed at the monitoring station closest to, and downwind from, the excavation activity. Average concentrations of ^{230}Th decreased markedly after the 1981-1982 peak: the most recent (2004-2008) annual average concentrations at perimeter stations are all at least 20 times lower than the highest levels from 1981-1982.

  - *Summary.* In 1981 and 1982, annual average concentrations of ^{230}Th at two perimeter monitoring stations exceeded Cotter Mill's health-based regulatory limit; however, for every other calendar year, every station's annual average concentration was lower than this limit. In the last five years, the annual average concentrations at every station were between six and 30 times below this limit. For the off-site monitoring stations, however, all annual average concentrations during this 5-year time frame were at least a factor of 40 below Cotter Mill's health-based regulatory limit.

- **Thorium-232 (^{232}Th).** Table 54 in Appendix A presents the history of annual average ^{232}Th concentrations measured in Cotter Mill's monitoring network. Laboratory analyses for this radionuclide first began in 2001. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{232}Th to an "effluent concentration" (4.0×10^{-15} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 54 exceed this derived concentration guide. In 2008, the highest annual average concentration (3.1×10^{-17} µCi/ml in Lincoln Park) was a factor of 128 lower than the screening value.

  - *Spatial and temporal variations.* Unlike ^{nat}U and ^{230}Th, for which measured concentrations were consistently (if not always) highest at perimeter monitoring stations, the highest annual average concentrations of ^{232}Th have always been observed at off-site monitoring stations, most commonly at the Lincoln Park monitoring station. Moreover, of all the radionuclides measured, annual average concentrations of ^{232}Th exhibited the least variability from station to station. For any given year between 2001 and 2008, annual average concentrations at the ten monitoring stations fell within a factor of three of each other. The annual average concentrations did not exhibit considerable variability from one year to the next.

  - *Summary.* Over the last five years, annual average concentrations of ^{232}Th at every monitoring station were more than 60 times lower than Cotter Mill's health-based regulatory limit. The spatial variations in ^{232}Th concentrations have been limited, suggesting that air emissions from Cotter Mill may be relatively insignificant for this radionuclide.

- **Radium-226 (^{226}Ra).** Table 55 in Appendix A presents the history of annual average ^{226}Ra concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{226}Ra to an "effluent concentration" (9.0 x 10^{-13} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 55 exceed this derived concentration guide. In 2008, the highest annual average concentration (7.9 x 10^{-16} µCi/ml at a perimeter monitoring station) was three orders of magnitude lower than the screening value.

  - *Spatial and temporal variations.* In almost every year between 1979 and 2008, the highest annual average concentrations of ^{226}Ra were measured at perimeter monitoring stations, and primarily at the west boundary and mill entrance road locations. For most years, the highest annual average value at the facility's perimeter was usually between one and two orders of magnitude greater than the lowest annual average concentration at off-site locations—a pattern that points to facility emissions as a likely source for contributing to at least part of the measured concentrations. At the four perimeter stations with the longest period of record, the highest annual average concentrations occurred prior to 1985, and the current (2008) levels at these stations are between 10 and 100 times lower than those peaks.

  - *Summary.* The spatial variations in ^{226}Ra concentrations suggest that Cotter Mill's emissions contribute to the measured levels. However, over the last five years, annual average concentrations of ^{226}Ra at every monitoring station were more than 390 times lower than Cotter Mill's health-based regulatory limit.

- **Lead-210 (^{210}Pb).** Table 56 in Appendix A presents the history of annual average ^{210}Pb concentrations measured in Cotter Mill's monitoring network. The shaded cells in the table are the highest annual average concentration for the year.

  - *Screening.* Cotter Mill compares measured concentrations of ^{210}Pb to an "effluent concentration" (6.0 x 10^{-13} µCi/ml), which is defined (10 CFR 20, Appendix B) as the radionuclide concentration which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem. None of the annual average concentrations in Table 56 exceed this derived concentration guide. In 2008, the highest annual average concentration (1.9 x 10^{-14} µCi/ml at a perimeter monitoring station) was more than a factor of 30 lower than the screening value.

- *Spatial and temporal variations.* The main distinguishing feature of the ^{210}Pb monitoring data (when compared to data for the other radionuclides) is the low variability, both spatially and temporally. Since 1983, annual average concentrations across the ten monitoring stations tended to fall within a factor of two; and year-to-year variability was of a comparable magnitude. This lack of variability points to a "background effect" (i.e., the measured concentrations likely are not the result of Cotter Mill's emissions, but reflect typical atmospheric levels for this part of the country). In 1981-1982, annual average concentrations at a perimeter monitoring station were slightly higher than what was routinely measured at all other locations and years; and these slightly elevated levels likely reflected air quality impacts from the excavation of the unlined holding ponds.

- *Summary.* Of all the radionuclides considered, ^{210}Pb showed the least variability in annual average concentrations, suggesting that the monitoring data characterize background levels and not a site-specific contribution. From 1983 to the present, annual average concentrations during every year and at every station were generally at least 20 times below Cotter Mill's health-based regulatory limit.

With one exception, the five radioactive substances measured by Cotter Mill's network were below their corresponding health-based regulatory limits at all 10 monitoring stations and for the entire 30 years of record. As the exception, annual average ^{230}Th concentrations exceeded health-based regulatory limits during a tailing pond excavation project, but this was limited to a short time frame (1981-1982) and the immediate proximity of the facility (two fenceline monitoring locations). The spike in measured concentrations during this time frame was far less pronounced (if not completely imperceptible) at monitoring stations in Lincoln Park or Cañon City. Another spatial variation linked to site activities is the relatively elevated readings (e.g., for ^{nat}U) observed at the "mill entrance road" monitoring station between roughly 1997 and 2006.

Over the last five years, annual average concentrations of every radionuclide were at least 20 times lower than health-based screening limits at the five off-site monitoring stations. This large margin provides some assurance that the monitoring network has adequate coverage in terms of monitors—it is quite possible that annual average ambient air concentrations of radionuclides at some un-monitored off-site locations exceed what has been measured to date, but it is far less likely that the network is failing to capture a "hot spot" with concentrations more than 20 times higher than the levels that are currently measured.

b) *Radon Gas*

Cotter measures radon gas concentrations at the same ten monitoring stations where particle-bound radionuclides are sampled. The annual environmental monitoring reports provide very limited information on the sampling methodology, other than noting that the detectors are apparently exposed to ambient air for a calendar quarter and then retrieved for laboratory analysis. Recent data summary reports suggest that a new sampling and analytical method was implemented in the second quarter of 2002. This new method outputs combined ^{220}Rn (from natural thorium) and ^{222}Rn (from natural uranium). However, the report does not describe what the previous sampling and analytical method measured.

According to Cotter's radon sampling procedures (Cotter 2004b), the sampling devices are "Landauer Type DRNF Radon Detectors." The reports provided to ATSDR suggest that various quality control measures have been implemented for this sampling (e.g., collection and analysis of duplicate samples to characterize precision), but they do not document quantitative data quality metrics. The method detection limit for the combined ^{220}Rn/^{222}Rn measurement is 70 pCi/m^3 (Cotter 2004b). This appears to offer adequate measurement sensitivity, because most quarterly average concentrations measured since this method was implemented are at least an order of magnitude greater than the detection limit.

Table 57 presents the annual average ^{220}Rn/^{222}Rn concentrations that Cotter has measured from 2002 to the present. Data are not presented for earlier years (1979 to 2001), as they may not be directly comparable due to the use of different measurement technologies. Cotter has recently concluded that its radon monitoring data "demonstrate slightly elevated readings at boundary locations [when compared to] readings in residential areas at background levels" (Cotter 2008b). This statement seems to be supported, in a general sense, by the monitoring results, though the difference between the perimeter and the off-site concentrations is much lower in certain years, particularly in 2008.

The approach used for screening the ^{220}Rn/^{222}Rn concentrations differs from that used for other radionuclides. Cotter screens the ^{220}Rn/^{222}Rn using an approach approved by CDPHE. In this approach, Cotter derives an "effective effluent limit" based on a baseline regulatory limit, an equilibration factor for the measurements, and average background concentrations that are calculated semi-annually. The details of this derivation are documented in a letter that CDPHE sent to Cotter in June, 2004. The net effect of this calculation approach is that the "effective effluent limit" (i.e., the concentration used for screening purposes) can vary across the monitoring stations and years. To illustrate this point, between 2006 and 2008, the "effective effluent limit" of ^{220}Rn/^{222}Rn concentrations ranged from 1,290 to 1,981 pCi/m^3, depending on the magnitude of the background concentrations at the time. During this time frame, measured concentrations at perimeter monitoring stations reached as high as 85% of the "effective effluent limit."

c) *Gamma Radiation*

Cotter measures gamma radiation levels at the same ten monitoring stations where particle-bound radionuclides are sampled. Measurements are made using thermoluminescent dosimeters (TLDs) that are exposed for 3-month periods before being sent off-site for analysis. Every calendar quarter, an additional duplicate TLD is deployed to at least one monitoring station to assess measurement precision, and a control TLD is placed in a lead-shielded box at another location to serve as a "blank" sample. However, the site reports provided to ATSDR did not contain any quantitative metrics of data quality (e.g., relative percent difference in co-located samples).

Table 58 presents annual average gamma radiation exposure rates between 1979 and 2008, by monitoring station; these annual averages were calculated from the quarterly TLD measurements from each calendar year. For every year on record, the highest annual average exposure rate was observed at one of the perimeter monitoring stations. Since Cotter installed the monitoring station at the mill's entrance road in 1994, this station has recorded the highest annual average exposure rates every year through the present. The relatively high readings at this location are believed to result primarily from past spillage or incoming materials entering the facility (Cotter 2008b). Under oversight from CDPHE, Cotter removed contamination alongside the entrance road in 2006 and 2007, with exposure rates decreasing thereafter.

Cotter's monitoring reports do not include health-based screening evaluations for these measurements, but they do acknowledge that the exposure rates near the facility perimeter (and particularly along the entrance road) exceed background levels. Specifically, the reports assume that the Cañon City station's measurements reflect "background" contributions from all external sources. The report indicates that the reported background level at this station (10.2 µR/hr) is equivalent to a dose of 89 mrem/year.

d) Ambient Air Monitoring for non-Radioactive Substances

To prepare this summary, ATSDR accessed all ambient air monitoring data that the state of Colorado collected in Fremont County and reported to EPA's Air Quality System (AQS), an online clearinghouse of monitoring data that states collect to assess compliance with federal air quality standards. The AQS database included monitoring results for three locations in Fremont County: one in Cañon City, one in Lincoln Park, and one in Florence. This section summarizes only those data collected in Cañon City and in Lincoln Park given their closer proximity to Cotter Mill. However, the monitoring summarized in this section was not conducted to characterize air quality impacts associated with Cotter Mill's emissions; the measured concentrations at these locations likely reflect contributions from many different local emission sources (e.g., mobile sources, wind-blown dust, wood-burning stoves). The AQS database does not specify quality control parameters for the monitoring results; however, state agencies that submit data to AQS are supposed to thoroughly validate measured concentrations before entering them into the database.

(1) Particulate Matter (TSP, PM_{10}, and $PM_{2.5}$)

The state-operated Cañon City and Lincoln Park monitoring stations measured three different size fractions of particulate matter between 1969 and the present. Following standard practice, all three size fractions were measured in 24-hour average integrated samples that were typically collected once every 6 days, though more frequent monitoring occurred during some years. Measurements were collected using either standard technologies (e.g., high-volume samplers for TSP and PM_{10}) or EPA-approved Federal Reference Method devices. A brief summary of the measurements follows:

- **TSP measurements.** From 1969 through 1987, high-volume sampling devices were used to measure TSP. Table 59 in Appendix A presents the maximum and annual average TSP concentrations measured by the two monitoring stations over the period of record. Annual average TSP in Cañon City did not change considerably from 1969-1987. In Lincoln Park, only two calendar years have complete data sets; the annual average concentration in 1982 was below the range of annual averages observed at Cañon City.

The fact that TSP levels were lower in Lincoln Park than in Cañon City suggests that Cotter Mill’s emissions are not the primary contribution to TSP levels in the area.

- **PM_{10} measurements.** The state of Colorado began monitoring PM_{10} in Cañon City in 1987 and continues this monitoring today. The monitoring station was originally located at the courthouse in Cañon City, but the state moved the monitoring equipment in 1987 to a less obstructed site at city hall. Annual average PM_{10} concentrations throughout the period of record range from 15 to 23 µg/m^3, well below EPA’s former National Ambient Air Quality Standard for annual average levels (50 µg/m^3). Between 1987 and 2009, only one measured 24-hour average concentration exceeded EPA’s current health-based standard; that occurred in 1988 and likely reflected contributions from many different local sources and should not be attributed solely to Cotter Mill’s emissions.

- **$PM_{2.5}$ measurements.** In 1991 and 1992, the state conducted $PM_{2.5}$ monitoring at its Cañon City station. All measured 24-hour average concentrations and both annual average concentrations were lower than the health-based standards that EPA would develop later in the 1990s. This monitoring occurred before EPA designated Federal Reference Methods for $PM_{2.5}$ measurement devices.

(2) Constituents of Particulate Matter

Between 1978 and 1987, the state of Colorado analyzed some of the TSP filters collected in Cañon City and Lincoln Park for chemical constituents. This included analyses for metals (iron, lead, manganese, and zinc) and ions (nitrate and sulfate). Table 60 summarizes these measurements by presenting the highest 24-hour average concentration and the highest annual average concentration for the period of record.

V. PUBLIC HEALTH EVALUATION

A. Introduction

This section of the public health assessment evaluates the health effects that could possibly result from exposures to site-related contaminants at or near the Cotter Mill site. For a public health hazard to exist, people must contact contamination at levels high enough and for long enough time to affect their health. The environmental data and conditions at the site revealed five completed exposure pathways:

1. Exposure to site-related contaminants in groundwater in Lincoln Park.
2. Contact with site-related contaminants in soil adjacent to the Cotter Mill and in Lincoln Park.
3. Contact with site-related contaminants in surface water downstream from the Cotter Mill.
4. Exposure from eating produce locally grown in Lincoln Park
5. Exposure to ambient air near the Cotter Mill facility

B. How Health Effects are Evaluated

The potential health effects associated with completed exposure pathways (listed above) will be evaluated in this section. For chemicals found to exceed comparison values, ATSDR calculated exposure doses and estimated non-cancer and cancer risks, where applicable. The calculations estimate the amount of the chemical to which a person may have been exposed. Calculated exposure doses are then compared to the available health guidelines to determine whether the potential exists for adverse non-cancer health effects. In the event that calculated exposure doses exceed established health guidelines (e.g., ATSDR's Minimal Risk Levels or EPA's Reference Doses), an in-depth toxicological evaluation is necessary to determine the likelihood of harmful health effects. ATSDR also may compare the estimated amount of exposure directly to human and animal studies, which are reported in ATSDR's chemical-specific toxicological profiles. Not only do the toxicological profiles provide health information, they also provide information about environmental transport, human exposure, and regulatory status.

A detailed explanation of ATSDR's evaluation process for determining cancer and non-cancer health effects is contained in Appendix C of this document. The equations to calculate exposure doses, the exposure scenarios, and the exposure assumptions used to estimate exposures at this site are also in Appendix C.

ATSDR's **Minimal Risk Level (MRL),** which is derived from human and animal studies, is an estimate of daily exposure to a contaminant below which non-cancer health effects are unlikely to occur.

EPA's **Reference Dose** An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's noncancer health assessments.

C. Groundwater Pathway: Private wells used for personal consumption

As discussed above, the data from the 1989 *Lincoln Park Water Use Survey* survey indicated approximately 7 wells are used for personal consumption; sampling data for 6 of the 7 wells were available to ATSDR for evaluation. Samples were collected intermittently from 1984 to 2007.

Although most residents in Lincoln Park currently use municipal water for drinking purposes, the survey reveals that residents at 7 locations still use their private wells for drinking purposes. It is not verified whether residents who reported using their well water for personal consumption also use their well water for other household purposes, such as bathing and showering. Some residents report that they and others used their private wells for personal consumption and other household uses in the past (before the installation of the municipal water line). Therefore, it is reasonable to assume that many more people obtained their drinking water from private wells in the past, and that some people are continuing to use their private wells for drinking, and possibly, household purposes.

Very little quantitative information is known about what levels of contamination residents may have been exposed to in the past. However, ATSDR attempted to address this issue by assuming that the average resident would have been exposed to the average chemical concentration (i.e., temporal average per well) detected in the 6 private wells for which we have sampling data. There is some uncertainty in using this estimate because some people may have been exposed to more, and some to less, than the estimated amount. To capture the resident who may have been more highly exposed (or a worst case scenario), ATSDR used the average chemical concentration from the single private well that consistently contained the highest chemical concentrations (Well 189). ATSDR assumed that adults and children drank the water from this well for 350 days per year for 30 years (adults) and 6 years (children), respectively.

Molybdenum was the only chemical in private wells that had an average detected level (0.082 mg/L) that exceeded its comparison value (0.05 mg/L). The average level of molybdenum in Well 189 (0.16 mg/L) also exceeded the comparison value for molybdenum in drinking water. Therefore, molybdenum was retained as a chemical of concern and evaluated for possible adverse health effects. The maximum detected level of uranium (0.067 mg/L), but not the average detected level (0.028 mg/L), also exceeded the comparison value of 0.03 mg/L for uranium. Additionally, the average detected level of uranium in Well 189 (0.048 mg/L) exceeded the comparison value for uranium. Therefore, ATSDR evaluated uranium more closely for potential adverse health effects. Table 7 below summarizes the estimated child and adult doses for molybdenum and uranium that guide the health discussion below. (See Table C1 in Appendix C for a detailed discussion of how these values were derived.)

Table 7. Estimated Child and Adult Doses for Molybdenum and Uranium in Drinking Water

Chemical	Exposure Group	Adult Estimated Dose (mg/kg/day)	Child Estimated Dose (mg/kg/day)	Health Guideline (mg/kg/day)
Molybdenum	Well 189 (high exposures)	0.004	**0.010**	0.005 Chronic Oral RfD
	All wells (average exposures)	0.002	0.005	
Uranium	Well 189 (high exposures)	0.001	**0.003**	0.002 Intermediate Oral MRL
	All Wells (average exposures)	0.0008	0.002	

1. Molybdenum

Molybdenum is a naturally occurring element found in various ores. Molybdenum is also considered an essential dietary nutrient in humans and animals. Foods such as legumes, leafy vegetables, nuts and cereals tend to be higher in molybdenum than meats, fruits, and root and stem vegetables [WHO 2003]. The Food and Nutrition Board (FNB) of the Institute of Medicine has determined the Tolerable Upper Intake Level[12] (UL) for molybdenum in children and adults [FNB 2001] as follows:

- children 1 to 3 years of age - 0.3 mg/kg/day;
- children 4 to 8 years of age - 0.6 mg/kg/day;
- children 9 to 13 years of age - 1.1 mg/kg/day;
- adolescents 14 to 18 years of age - 1.7 mg/kg/day; and
- adults - 2.0 mg/kg/day.

a) Health Evaluation of Molybdenum

Drinking water from a private well contaminated with molybdenum would result in an estimated dose of 0.002 mg/kg/day for an average adult and 0.005 mg/kg/day for an average child. The adult dose is lower than the oral RfD of 0.005 mg/kg/day for molybdenum. The estimated child dose is equal to the oral RfD (0.005 mg/kg/day) for molybdenum. Therefore, adverse health

---

[12] UL = maximum level of daily nutrient intake that is likely to pose no risk of adverse health effects in all individuals. The UL represents the total intake from food, water, and supplements.

effects are not expected for the average adult or child who drank from a private well contaminated with molybdenum.

Adults who may have had high exposures, such as those similar to Well 189, have an estimated dose of 0.004 mg/kg/day, and children who may have had high exposures have an estimated dose of 0.010 mg/kg/day. The adult high dose is less than the oral RfD for molybdenum. However, the estimated child high exposure dose is 2 times greater than the oral RfD of 0.005 mg/kg/day for molybdenum. Because the estimated exposure dose for children exceeds the long-term health guidelines for molybdenum, the possibility of health consequences from this exposure was evaluated further.

To further evaluate the possibility of adverse health effects, ATSDR divides the lowest observed adverse effect level (LOAEL) and/or the no observed adverse effect level (NOAEL) by the site-specific exposure doses. Interpretation of the resulting value is subjective and depends on a host of toxicological factors. Further evaluation consists of a careful comparison of site-specific exposure doses and circumstances with the epidemiologic and experimental data on the chemical. The purpose of the comparison is to evaluate how close the estimated exposure doses are to doses that cause health effects in humans or animals.

The oral RfD for molybdenum is based on a human epidemiological study that found a LOAEL of 0.14 mg/kg/day for increased serum uric acid levels and prevalence of gout-like condition in Armenian villagers [Koval'skiy 1961]. A higher incidence (18-31%) of a gout-like disease was associated with high intake of molybdenum (10-15 mg/day) from soil and plants. The gout-like condition was characterized by pain, swelling, inflammation and deformities of the joints, and, in all cases, an increase in the uric acid content of the blood. In a number of cases, illnesses of the GI tract, liver, and kidneys accompanied the condition [EPA IRIS]. In deriving the oral RfD, an uncertainty factor of 3 was used for protection of sensitive human populations and a factor of 10 was used for the use of a LOAEL instead of a NOAEL for a long-term study in a human population. The estimated child high dose (0.010 mg/kg/day) for molybdenum at the Cotter Mill/Lincoln Park site is 14 times lower than the LOAEL from this study. There was no NOAEL determination for molybdenum from this study.

Molybdenum is known to interfere with copper metabolism in ruminant animals (grazing animals that "chew their cud," such as sheep or cows); the resulting copper deficiency is reported to cause the animal's hair/wool to turn white [FNB 2001]. This is a problem with ruminant animals in particular because high dietary molybdenum reacts with moderate to high dietary sulfur in the rumen (the first stomach) to form thiomolybdates. These compounds greatly reduce copper absorption, and certain thiomolybdate species can be absorbed and interfere systemically with copper metabolism [Spear 2003]. This interaction between thiomolybdates and copper is not expected to occur to a significant degree in humans [Turnlund 2002]. Although the exact effect of molybdenum intake on copper status in humans remains to be clearly established, individuals who do not take in enough dietary copper or cannot process it correctly could be at increased risk of molybdenum toxicity [FNB 2001].

In conclusion, children who drink water containing high concentrations of molybdenum could be at increased risk of adverse health effects such as gout-like symptoms. However, molybdenum is not stored at high levels in the body, so it is unlikely that children will suffer long-term health effects once the exposure is stopped [FNB 2001]. In healthy people, excess molybdenum is not associated with adverse health outcomes. However, individuals who do not take in enough dietary copper or cannot process it correctly could be at increased risk for adverse health effects. The actual risk of adverse health effects occurring depends on the concentration of molybdenum in the water and how much water is drunk. Therefore, private wells known to be contaminated with molybdenum should not be used for drinking purposes.

b) Additional Comments about Molybdenum in Drinking Water

- ATSDR did not evaluate potential exposures to molybdenum that could occur if well water is used for other household purposes such as showering or bathing. If it is confirmed that residents are using their wells for other potable purposes, then exposure levels would increase, as well as the likelihood of adverse health effects. However, exposure to airborne and/or dermal molybdenum is not likely to be a major exposure pathway because of the physicochemical properties of molybdenum.

- The estimated dose for children and adults at this site did not exceed the Tolerable Upper Intake Level (UL) for molybdenum established by the Institute of Medicine. However, ATSDR's evaluation did not consider molybdenum intake from other sources, including food and supplements, which would increase total intake.

- Molybdenum is often found naturally in the geology of this region. The wells identified and sampled as background for the Lincoln Park area contained an average molybdenum concentration of 0.023 mg/L. This concentration is lower than the average of 0.082 mg/L found in private wells used for personal consumption. The maximum concentration of molybdenum in a background well (0.3 mg/L) was about the same as that in a private well (0.28 mg/L) used for personal consumption.

- Overall molybdenum levels in groundwater decreased over time. Molybdenum levels measured from 1968 to 2000 show a clear pattern of decrease in molybdenum concentrations. Therefore, exposures to molybdenum in groundwater were likely higher in the past, and may continue to decrease in the future.

People who currently own private wells are not prevented from using their private wells for any purpose. New residents who move to the area may install new wells in the contaminated zone and use their well for any purpose. Therefore, this exposure pathway will continue to exist as a potential exposure pathway in the future.

2. Uranium

Throughout the world uranium is a natural and common radioactive element. Uranium is a silver-white, extremely dense, and weakly radioactive metal. It is typically extracted from ores containing less than 1% natural uranium. Natural uranium is a mixture of three isotopes: 238U (99.2739%), 235U (0.7204%), and 234U (0.0057%). It usually occurs as an inorganic compound with oxygen, chlorine, or other elements [NHANES 2005]. Rocks, soil, surface and ground water, air, plants, and animals all contain varying amounts of uranium. Colorado ranks third, behind Wyoming and New Mexico, tied with Arizona and Utah, as the state with the most uranium reserves in the United States [EIA 2001].

a) Health Evaluation of Uranium

Natural uranium is radioactive but poses little radioactive danger—it releases only small amounts of radiation that cannot travel far from its source. Moreover, unlike other types of radiation, alpha radiation released by natural uranium cannot pass through solid objects, such as paper or human skin. You have to eat, drink, or breathe natural uranium in order to be exposed to the alpha radiation; however, no adverse effects from natural uranium's radiation properties have been observed in humans. The National Academy of Sciences determined that bone sarcoma is the most likely cancer from oral exposure to uranium; its report noted, however, that this cancer has not been observed in exposed humans and concluded that exposure to natural uranium may have no measurable effect [BEIR IV].

Scientists have seen chemical effects in people who have ingested large amounts of uranium. Kidney disease has been reported in both humans and animals that were exposed to large amounts of uranium; however, the available data on soluble (more bioavailable) and insoluble uranium compounds are sufficient to conclude that uranium has a low order of metallotoxicity in humans [Eisenbud and Quigley 1955].

When uranium is ingested most of it leaves the body through the feces and a small portion (approximately 2% for an adult) will be absorbed into the blood stream through the gastrointestinal (GI) tract. Most of the uranium in the blood is excreted from the body through urine excretion within a few days; however, a small amount will be retained in the kidneys, bone, and soft tissue for as long as several years. The percentage of the uranium retained in the kidneys over time is different for acute and chronic ingestion of uranium (as long as the individual continues to drink the water). When an individual discontinues drinking the uranium contaminated water, the percentage of retention in the kidney decreases similar to an acute exposure. In the case of chronic ingestion of drinking water containing uranium, the kidney retention (or kidney burden) increases rapidly in the first two weeks. After approximately 100 days, the amount present in the kidney is approximately 5% of the daily intake for an infant and approximately 3% for all other ages. After 25 years of chronic ingestion, the uranium kidney burden reaches equilibrium for all age groups at approximately 6.6% of the daily intake [Chen et al 2004].

Nephrotoxicity (kidney toxicity) occurs when the body is exposed to a drug or toxin such as uranium that causes temporary or permanent damage to the kidneys. When kidney damage occurs, blood electrolytes (such as potassium and magnesium) and chemical wastes in the blood (such as creatinine) become elevated indicating either a temporary condition or the development of kidney failure. Creatinine is a chemical waste molecule that is generated from muscle metabolism. The kidneys maintain the blood creatinine in the normal range. Creatinine is a fairly reliable indicator of kidney function. As the kidneys are impaired, the creatinine level in the blood will rise because of the poor clearance by the kidney. If detected early, permanent kidney problems may be avoided.

Several mechanisms for uranium-induced kidney toxicity have been proposed. In one of these, uranium accumulates in specialized (epithelial) cells that enclose the renal tubule, where it reacts chemically with ion groups on the inner surface of the tubule. This interferes with ion and chemical transport across the tubular cells, causing cell damage or cell death. Cell division and regeneration occur in response to cell damage and death, resulting in enlargement and decreased kidney function. Heavy metal ions, such as uranyl ions, may also delay or block the cell division process, thereby magnifying the effects of cell damage [Leggett 1989, 1994; ATSDR 1999].

Animal and human studies conducted in 1940s and 1950s provide evidence that humans can tolerate certain levels of uranium, suffering only minor effects on the kidney [Leggett 1989]. Most of these studies involved inhalation exposures to uranium; however, the kidney is the target organ for inhaled as well as ingested uranium. On the basis of this tolerance, the International Council on Radiologic Protection (ICRP) adopted a maximal permissible concentration of 3 µg of uranium per gram of kidney tissue for occupational exposure in 1959 [Spoor and Hursh 1973]. This level has often been interpreted as a threshold for chemical toxicity.

More recent papers have been published on effects of uranium at levels below 3 µg/g, and those papers have discussed possible mechanisms of uranium toxicity [Diamond 1989; Leggett 1989, 1994; Zhao and Zhao 1990; Morris and Meinhold 1995]. It is thought that the kidney may develop an acquired tolerance to uranium after repeated doses; however, this tolerance involves detectable histological (structural) and biochemical changes in the kidney that may result in chronic damage. Cells of the inner surface of the tubule that are regenerated in response to uranium damage are flattened, with fewer energy-producing organelles (mitochondria). Transport of ions and chemicals across the tubule is also altered in the tubule cells [Leggett 1989, 1994; McDonald-Taylor et al. 1997]. These effects may account for the decreased rate of filtration through the kidney and loss of concentrating capacity by the kidney following uranium exposure. Biochemical changes include diminished activity of important enzymes (such as alkaline phosphatase), which can persist for several months after exposure has ended. Therefore, acquired tolerance to uranium may not prevent chronic damage, because the kidney that has developed tolerance is not normal [Leggett 1989]. Acting on the basis of this recent information for uranium, researchers have suggested that exposure limits be reduced to protect against these chronic effects on the kidney.

Renal damage appears to be definite at concentrations of uranium per gram of kidney tissue above 3 µg/g for a number of different animal species, but mild kidney injury can occur at uranium concentrations as low as 0.1 to 0.4 µg/g in dogs, rabbits, guinea pigs, and rats after they inhale uranium hexafluoride or uranium tetrachloride over several months [Maynard and Hodge 1949; Hodge 1953; Stokinger et al. 1953; Diamond 1989]. Zhao and Zhao proposed a limit of uranium to the kidney of 0.26 µg/g based on renal effects in a man who was exposed to high concentrations of uranyl tetrafluoride dust for 5 minutes in a closed room [Zhao and Zhao 1990]. The man showed signs of kidney toxicity, including increased protein content in the urine (proteinuria) and nonprotein nitrogen. These signs persisted for 4.6 years, gradually returning to normal values. The kidney content 1 day after the accident was estimated to be 2.6 µg/g.

A study conducted in Finland and published in 2002 observed 325 people that had used their drilled wells for drinking water over a period of 13 years on average (range 1 – 34 years) [Kurttio et. al 2002]. The median uranium concentration in the water was 28 ppb (range 0.001 –

1,920 ppb). The study showed an association between increased uranium exposure through drinking water and tubular function, but not between uranium exposure and indicators of glomerular injury. The primary target is the proximal convoluted tubule of the kidney which is where most of the sodium, water, glucose, and other filtered substances are reabsorbed and returned to the blood. The authors of the study indicated that tubular dysfunction may merely represent a manifestation of subclinical toxicity, and it is unclear if it carries a risk of development into kidney failure or overt illness. This study concluded that "The public health implications of these findings remain uncertain, but suggest that the safe concentration of uranium in drinking water may be close to the guideline values proposed by the WHO and the U.S.EPA." However, this study found that altered tubular function was statistically significant at water uranium concentrations exceeding 300 μg/L [Kurttio et. al 2002], or 0.3 mg/L, which is an order of magnitude higher than EPA's guideline (0.035 mg/l) and the highest average concentration at the Lincoln Park site (0.048 mg/L). At 300 μg/L and assuming ingestion of two liters of water per day, the kidney burden after 25 years of chronic ingestion would be 39.6 μg of uranium with a uranium concentration per gram of kidney tissue of 0.13 μg/g.

A review of studies of uranium effects on the kidney [Morris and Meinhold 1995] suggests a probability distribution of threshold values for kidney toxicity ranging from 0.1 to 1 μg/g, with a peak at about 0.7 μg/g. The researchers proposed that the severity of effects increases with increasing dose to the kidney with probably no effects below 0.1 to 0.2 μg/g, possible effects on the kidney at 0.5 μg/g, more probable effects at 1 μg/g, and more severe effects at 3 μg/g and above [Morris and Meinhold 1995; Killough et al. 1998b].

If an adult in Lincoln Park drank 2 liters (L) of uranium-contaminated water per day (at the highest average exposure concentration of 0.048 mg/L, or 48 μg/L) for 25 years or longer, then the maximum daily ingestion would be 96 μg of uranium, resulting in a uranium kidney burden of 6.3 μg (96 μg × 0.066). The weight of both kidneys in adults is about 300 g [Madsden et al 2007]. Thus, the uranium concentration per gram of kidney tissue for an adult would be 0.02 μg/g. If a child drank 1 L of uranium-contaminated water per day (at the highest average exposure concentration of 0.048 mg/L, or 48 μg/L) for 100 days to 25 years, then the maximum daily ingestion would be 48 μg of uranium, resulting in a uranium kidney burden of 1.4 μg (48 μg x 0.03). The weight of both kidneys in a child is about 100 g; therefore, the uranium concentration per gram of kidney tissue to be 0.01 μg/g. The calculated kidney uranium concentration for adults and children is below the level found to cause harm in published studies.

ATSDR's health-based guidelines for ingested (and inhaled) uranium are lower than the lower limit threshold for kidney toxicity proposed by Morris and Meinhold (1995). ATSDR's guidelines are derived by use of levels of toxicity observed in animal studies, and those guidelines incorporate safety factors to account for uncertainty in extrapolating from animals to humans and to protect the most sensitive human individuals [ATSDR 1999].

Note that urinalysis has limitations as a test for kidney toxicity. First, the presence of substances in urine may indicate that kidney damage has occurred, but it cannot be used to determine whether the damage was caused by uranium. Second, most uranium leaves the body within a few days of exposure, so that urine tests can be used only to determine whether exposure has occurred in the past week or two. Finally, the tests may be used to detect mild effects on the kidney, but such effects are generally transient in nature and may not result in permanent damage. More severe effects involve greater damage to the kidney that is likely to be clinically manifest and longer lasting. The kidney has incredible reserve capacity and can recover even after showing pronounced clinical symptoms of damage; however, biochemical and functional changes can persist in a kidney that appears to have recovered structurally [Leggett 1989, 1994; CDC 1998].

The maximum average uranium concentration detected in a private well was 0.048 mg/L, or 48 µg/L. The residence where this concentration was detected is not connected to the municipal water supply and is noted to use a private well for personal consumption. Drinking water from this private well containing uranium would result in an estimated dose of 0.001 mg/kg/day for an adult and 0.003 mg/kg/day for a child. The adult dose is lower than the intermediate oral MRL. The estimated child dose slightly exceeds the MRL of 0.002 mg/kg/day for an intermediate-duration oral exposure. The MRL level for intermediate-duration oral exposure is also protective for chronic-duration oral exposure because the renal toxicity of uranium exposure is more dependent on the dose than on the duration of the exposure. The MRL is based on a LOAEL of 0.05 mg U/kg/day for renal effects in rabbits. The estimated child dose is an order of magnitude lower than the LOAEL; therefore, adverse health effects are not likely.

Although older evaluations suggested carcinogenicity of uranium among smokers, the U.S. EPA has withdrawn its classification for carcinogenicity for uranium; the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) have no ratings [NHANES 2005].

D. Soil Pathway: Surface Soil near Cotter Mill and Lincoln Park

As discussed above, surface soil samples were collected from areas around the Cotter Mill property, from property access roads and in the Lincoln Park area. Surface soil sampling data were available from eight designated zoned areas around Cotter Mill and in Lincoln Park. People who live or recreate in these areas could accidentally ingest some contaminated soil or get it on their skin. ATSDR evaluated these potential exposure scenarios to determine if concentrations of chemicals and radionuclides in soil are high enough to cause adverse health effects.

ATSDR assumed that the average adult would accidentally ingest 100 milligrams of soil per day and would also contact the contaminated soil with their skin (dermal). Small children were not assumed to access the soil around Cotter Mill because these areas are primarily industrial or vacant. The vacant area has been designated as a “buffer zone” between the Cotter Mill property and the residential areas. Therefore, it is unlikely that small children would access the area. A residential exposure scenario was used to evaluate potential exposures in Lincoln Park. For Lincoln Park, we assumed that a small child would ingest 200 mg of soil per day, and an adult would ingest 100 mg/day, for 350 days per year.

Concentrations of arsenic, cadmium and lead exceeded their comparison values in soil taken from the area surrounding Cotter Mill. The concentration of radium-226 was the only radionuclide to exceed its comparison value in soil near Cotter Mill. Arsenic was the only chemical to exceed its comparison value in soil in Lincoln Park. The highest zonal average concentration of arsenic, cadmium, lead and radium-226 was used to estimate exposure doses. If the highest zonal average concentration of a chemical would not result in adverse health effects, it follows that lower concentrations of the chemical would not as well.

1. Soil Near Cotter Mill

a) Arsenic

Arsenic is a naturally occurring element that is widely distributed throughout the earth's crust and may be found in air, water, and soil [ATSDR 2000]. Arsenic in soil exists as inorganic and organic arsenic. Generally, organic arsenic is less toxic than inorganic arsenic, with some forms of organic arsenic being virtually non-toxic. Inorganic arsenic occurs naturally in soil, and children may be exposed to arsenic by eating soil or by direct skin contact with soil containing arsenic [ATSDR 2007].

The estimated dose of arsenic for adolescents and adults at this site is 0.00002 mg/kg/day. This dose is lower than the Minimal Risk Level (MRL) of 0.0003 mg/kg/day for arsenic; therefore, non-cancer health effects are not likely from being exposed to arsenic in surface soil near Cotter Mill (Zones A through H). The chronic oral MRL of 0.0003 mg/kg/day for inorganic arsenic was derived by dividing the identified chronic No Observable Adverse Effect Levels (NOAEL) of 0.0008 mg/kg/day (obtained from human epidemiologic studies) by an uncertainty factor of three to account for the lack of data on reproductive toxicity and to account for some uncertainty as to whether the NOAEL accounts for all sensitive individuals [ATSDR 2007]. The Lowest Observed Adverse Effect Level (LOAEL) associated with these epidemiologic studies was 0.014 mg/kg/day, where exposure to arsenic above this level resulted in hyperpigmentation of the skin, keratosis (patches of hardened skin), and possible vascular complications [ATSDR 2007].

The U.S. Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) classify arsenic as a human carcinogen. The EPA has developed an oral cancer slope factor to estimate the excess lifetime risk for developing cancer. Using EPA's cancer slope factor for arsenic, and based on a 30 year exposure scenario, ATSDR calculated a lifetime estimated cancer risk level of 1×10^{-5} for exposure to arsenic in soil near Cotter Mill. Qualitatively, we interpret this as a very low increased lifetime risk of developing cancer.

b) Cadmium

The estimated dose for adolescents and adults for cadmium is 0.00002 mg/kg/day, which is lower than the MRL of 0.0001 mg/kg/day for cadmium; therefore, non-cancer adverse health effects are not likely. The U.S. Department of Health and Human Services (DHHS), IARC, and EPA have determined that cadmium is carcinogenic to humans. Although cadmium can be carcinogenic when inhaled, human or animal studies have not provided sufficient evidence to show that cadmium is a carcinogen by oral routes of exposure (ATSDR 1999b). Therefore, a cancer evaluation for cadmium was not done as part of this assessment.

c) Lead

The highest average concentration of lead detected in any of the zones (Zone H) is 445 ppm, which is only slightly higher than the soil screening value of 400 ppm for lead. A value of 400 ppm is commonly used to evaluate lead in soil in residential properties. The property near the Cotter Mill site is currently restricted, vacant or used for industrial purposes; therefore contact with these soils should be minimal. Adverse health effects are not expected to occur from these limited exposures to soils near the site. Exposures to lead, however, should be re-evaluated should the area ever be considered for residential or other non-industrial use.

Maximum lead concentrations in zones F, G and H are 800 ppm, 450 ppm, and 1,400 ppm, respectively. To protect children from exposure to lead, it is important to know the average lead level in a yard or other frequent play area. The *1998 Supplemental Human Health Risk Assessment* provides the only characterization of surface soils adjacent to the Cotter Mill property (See Figure 17, Zones A through H). The soil sample results in this report were generated by collecting four samples from the center of a grid and compositing the samples to form a single representative sample. The size of each sampled grids, however, appears to be larger than 100 x 100 feet, which is the size that triggers additional sampling for lead (EPA 1995). Although the sampling in the *1998 Supplemental Human Health Risk Assessment* measured contamination in soils at several properties near Cotter Mill, it does not allow ATSDR to evaluate contamination in individual exposure units (yards, playgrounds, etc), as would be required to accurately assess exposures in a residential setting, commercial or recreational setting. The sample design is sufficient for making general public health decisions about exposure to lead in soil based on current use patterns. However, any future public health decision regarding the soil near the Cotter Mill property must be made with the limitations of the current sampling design in mind.

The Centers for Disease Control and Prevention (CDC) has established a level of concern for case management of 10 micrograms lead per deciliter of blood (µg/dL). This means that when blood lead levels in children exceed 10 µg/dL, CDC recommends that steps be taken to lower their blood lead levels. However, some agencies and public health officials have mistakenly used this level in blood as a safe level of exposure or as a no effect level. Recent scientific research has shown that blood lead levels below 10 µg/dL cause serious harmful effects in young children, including neurological, behavioral, immunological, and development effects. Specifically, lead causes or is associated with decreases in intelligent quotient (IQ), attention deficit hyperactivity disorder (ADHD), deficits in reaction time, visual-motor integration, fine motor skills, withdrawn behavior, lack of concentration, sociability, deceased height, and delays in puberty, such as breast and pubic hair development, and delays in menarche [CDC].

d) Radium-226

The average concentrations of radium-226 detected in Zones A and B are higher than allowed by the Uranium Mill Tailing Act (UMTRA). That standard does not apply in this case, since the Cotter Mill is still considered active.

The highest average soil concentration of 9.2 pCi/g in surface soil would result in a dose from radium's decay gammas of 58 mrem per year above background, assuming that residents spend 12 hours per day 365 days per year sitting or lying on the highest measured radium concentration of 9.2 pCi/g on the haul road. Since Zones A and B are buffer areas (actually haul roads), the time spent in these areas would be much lower (less than 2 hours per day) and the resulting dose would be roughly 10 mrem per year above background, to a maximally exposed individual.

2. *Soil in Lincoln Park*

a) Arsenic

The estimated arsenic dose for an adult in Lincoln Park is 0.00003 mg/kg/day, which is an order of magnitude lower than the MRL of 0.0003 mg/kg/day for arsenic. The estimated arsenic dose for a child in Lincoln Park is 0.0003 mg/kg/day, which is equal to the MRL of 0.0003 mg/kg/day for arsenic. Children are estimated to have higher arsenic doses than adults because they tend to engage in activities that increase their soil ingestion exposure, and because they weigh less than adults. Neither children nor adults should experience adverse health effects from exposure to arsenic in soil in Lincoln Park.

Arsenic is a naturally occurring element in soil. Arsenic has also historically been used in a variety of industrial applications, including bronze plating, electronics manufacturing, preserving animal hides, purifying industrial gases, and mining, milling and smelting activities. Studies of background levels of arsenic in soils have revealed that background concentrations range from 1 ppm to 40 ppm, with average values around 5 ppm [ATSDR 2007]. The average arsenic concentration detected in Lincoln Park was 31 ppm, a concentration within the observed background range but higher than the average background concentration. The maximum concentration of arsenic detected in Lincoln Park was 50 ppm.

Although the maximum arsenic concentration is higher than the observed background concentration, this fact alone does not definitely point to an anthropogenic source for the arsenic found in soil in Lincoln Park. Uncertainty exists regarding whether the arsenic levels detected are a natural occurrence or from past milling operations in the area.

Several factors contribute to whether people have contact with contaminated soil, including:

- grass cover, which is likely to reduce contact with contaminated soil when grass cover is thick but increase contact with soil when grass cover is sparse or bare ground is present,
- weather conditions, which is likely to reduce contact with outside soil during cold months because people tend to stay indoors more often,
- the amount of time someone spends outside playing or gardening, and
- people's personal habits when outside, for instance, children whose play activities involve playing in the dirt are likely to have greater exposure than other children

Using EPA’s cancer slope factor for arsenic, and based on a 30 year exposure scenario, ATSDR calculated a lifetime estimated cancer risk level of 5×10^{-5} for exposure to arsenic in Lincoln Park. Qualitatively, we interpret this as no apparent increased lifetime risk of developing cancer.

E. Surface Water: Sand Creek, DeWeese Dye Ditch, and the Arkansas River

People who swim or wade in the surface waters of Sand Creek, the DeWeese Dye Ditch, or the Arkansas River will get surface water on their skin and they might also accidentally ingest some of the surface water. To estimate exposures to adults and children who may have come into contact with contaminated surface water, ATSDR assumed that adults and children will swallow 50 mL of water per hour while swimming or wading, for 104 days per year for 30 and 6 years, respectively. Molybdenum exceeded its comparison value in Sand Creek and the Arkansas River. Manganese exceeded its comparison value in Sand Creek and the DeWeese Dye Ditch. ATSDR conservatively selected the maximum concentration for each chemical to estimate exposures.

1. Manganese

The estimated exposure dose for manganese is 0.0007 mg/kg/day for adults and 0.0006 mg/kg/day for children. Both adult and child doses are considerably lower than the reference dose of 0.05 mg/kg/day for manganese. Therefore, no adverse health effects are expected to occur as a result of exposure to manganese in surface waters.

2. Molybdenum

The estimated exposure dose for molybdenum is 0.00002 mg/kg/day for adults and 0.00006 mg/kg/day for children. Both adult and child doses are below the chronic oral reference dose (RfD) of 0.005 mg/kg/day for molybdenum. Therefore, no adverse health effects are expected to occur as a result of exposure to molybdenum in surface waters.

F. Homegrown Fruits and Vegetables

Ingestion of contaminated foods is a potential exposure pathway for this site. Residents may have been exposed to contaminants when they ate homegrown fruits and vegetables after using contaminated groundwater (either surface water or private well water) to irrigate their crops, or after growing their crops in contaminated soil. The soil may become contaminated from contaminated water or from tailings, dusts and other wastes deposited in the soil in the past.

Eating fruits, vegetables, herbs, or other produce grown in gardens with contaminated soil can cause exposure. This type of exposure occurs because some plants slowly absorb small amounts of the chemicals found in soil into their plant tissue or because contaminated soil can adhere to the exterior surface of produce, particularly low-growing leafy produce or produce where the underground portion is eaten. Some of these absorbed chemicals are essential nutrients and are actually good for humans to eat, but other chemicals can present health hazards if they are found at high enough levels and are consumed on a regular basis.

Generally, there is not a strong relationship between levels of heavy metals in soils and plants [Vousta 1996]. The uptake of heavy metal concentration depends on speciation of metal, soil characteristics, the type of plant species and other characteristics [Laizu 2007]. Table 8 below developed by Sauerbeck (1988) provides a qualitative guide for assessing heavy metal uptake into a number of plants.

Table 8. Plant Uptake of Heavy Metals

High	Moderate	Low	Very Low
Lettuce	Onion	Corn	Beans
Spinach	Mustard	Cauliflower	Peas
Carrot	Potato	Asparagus	Melons
Endive	Radish	Celery	Tomatoes
Crest		Berries	Fruit
Beet			
Beet leaves			
Source: USEPA (1991), Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors."			

To address the concern regarding contaminated crops, residents contributed locally grown produce for sampling analysis. ATSDR used the sampling results to estimate an exposure dose for each contaminant using typical consumption rates for the average and above-average (95th percentile) consumer in the Western United States. Child and infant consumption rates were also used to assess exposures to these vulnerable populations. Table 9 below provides the consumption rates used by ATSDR for homegrown fruits and vegetables.

Table 9. Homegrown Fruit and Vegetable Consumption Rates for the Western United States

Food	Consumer Type†	Intake Rate (g/kg/day)	Standard Error
Homegrown fruits	Average consumer	2.62	0.3
	Above-average consumer	10.9	
	Child	4.1	NA
	Infant (1 to 2 years)	8.7	
Homegrown vegetables	Average consumer	1.81	0.1
	Above-average consumer	6.21	
	Child	2.5	NA
	Infant (1 to 2 years)	5.2	

Sources: EPA Exposure Factors Handbook, Volume II, 1997; Child-Specific Exposure Factors Handbook, 2008
g/kg/day: grams per kilogram per day
NA = not applicable
†An average consumer is represented here as a person who eats fruits and vegetables in the typical range (mean intake). An above average consumer is a person who eats more fruits and vegetables than is typical, represented here by the 95th percentile intake.

All of the estimated fruit and vegetable doses were below health guideline values except for those for arsenic (See Table C4 in Appendix C). The estimated doses for fruits for the above-average consumer (95th percentile intake rate) and for infants exceed the chronic health guideline for arsenic. The above-average consumer and infant doses for fruit are 0.0006 mg/kg/day and 0.0004 mg/kg/day, respectively. Also, the estimated doses for vegetables for the above-average consumer (95th percentile intake rate) and for infants exceed the chronic health guideline for arsenic. The vegetable doses are 0.0005 mg/kg/day for an above-average consumer and 0.0004 mg/kg/day for an infant. These doses exceed the chronic oral MRL of 0.0003 mg/kg/day for arsenic.

Next, ATSDR assumed that a person will eat both fruits and vegetables daily. To do this, we added the calculated doses for fruits and vegetables to derive a single dose. The estimated fruit and vegetable doses for the above-average consumer, child and infant exceed the health guideline of 0.0003 mg/kg/day for arsenic. The above-average consumer dose is 0.001 mg/kg/day; the child dose is 0.0004 mg/kg/day; and the infant dose is 0.0008 mg/day/day.

The chronic oral MRL of 0.0003 mg/kg/day for inorganic arsenic was derived by dividing the chronic No Observable Adverse Effect Level (NOAEL) of 0.0008 mg/kg/day (obtained from human epidemiologic studies) by an uncertainty factor of 3 to account for the lack of data on reproductive toxicity and to account for some uncertainty as to whether the NOAEL accounts for all sensitive individuals [ATSDR 2007]. The Lowest Observed Adverse Effect Level (LOAEL) associated with these epidemiologic studies was 0.014 mg/kg/day, where exposure to arsenic above this level resulted in hyperpigmentation of the skin, keratosis (patches of hardened skin), and possible vascular complications [ATSDR 2007]. The child and infant doses are below or equal to the NOAEL, and the above-average consumer dose is 14 times lower than the dose that caused adverse health effects in epidemiologic studies. Therefore, adverse health effects are not expected in infants, children or the above-average consumer.

Using EPA's cancer slope factor for arsenic and the above consumer exposure dose, and based on a 30 year exposure scenario, ATSDR calculated a lifetime estimated cancer risk level of 6×10^{-4} for exposure to arsenic in fruits and vegetables. Qualitatively, we interpret this as a low to moderate increased risk of developing cancer over a lifetime.

ATSDR conservatively assumed that every consumer ate homegrown fruits and vegetables every day for 30 years. In reality, it is likely that most people only eat homegrown fruits and vegetables during a defined season, usually a 3 to 4 month period during the summer/fall growing season. Therefore, the true risk to consumers is likely overestimated.

ATSDR also noted that the highest arsenic level detected in lawns and gardens in Lincoln Park was 50 ppm. This level is near what is typically observed as background arsenic levels (1 ppm to 40 ppm) in soil. This suggests that the contaminated well water used to irrigate crops is not contributing significantly to arsenic soil levels, or other soil additives may have been added that dilute soil contamination [ODEQ 2003]. The highest arsenic level detected in soil at the site was 86 ppm. There were no sampling data for arsenic in drinking or irrigation water. ATSDR is unsure if the arsenic found in soil at this site is a natural occurrence or from an anthropogenic (man-made) source.

Plants vary in the amount of arsenic they absorb from the soil and where they store arsenic. Some plants move arsenic from the roots to the leaves, while others absorb and store it in the roots only [Peryea 1999]. The best method of reducing exposure to external arsenic from homegrown vegetables is to soak and wash residual soil from produce before bringing it into the home and washing the produce again thoroughly indoors before eating [ATSDR 2007]. It is always a good health practice to wash all fruits and vegetables thoroughly before eating, whether they are bought or homegrown.

Molybdenum was the only other contaminant to approach a health guideline when calculating a single dose for fruits and vegetables. The above-average consumer and infant doses are 0.005mg/kg/day, which is equal to the chronic health guideline of 0.005mg/kg/day for molybdenum.

G. Air Pathway

ATSDR looked at all the air data collected from 1979 to present. Concentrations of radionuclides in air from direct release or re-suspension of radioactive contaminants in soil were less than a tenth of ATSDR's health based comparison value (100 millirem per year) at all off-site sampling locations (CC-1/2, LP-2, AS-210, AS-212, OV-3). ATSDR evaluated doses to all age groups and found that adults would have received the highest doses, because of their higher breathing rate. Infants only received one quarter the dose of an adult.

Table 10 below breaks down the dose estimates by age group and by the highest annual concentration measured for each radionuclide and by the highest location. The two highest doses were both in 1982, during the excavation of the unlined settling ponds and were measured at the on-site sampling location AS-204, that was directly adjacent to the dewatered ponds. Neither of those doses would have been to the public. The combined dose to a worker near AS-204 would have been less than a third of the sum in the table since the worker was there less than 8 hours per day for 5 days a week, or 70 mrem of inhalation dose for the year 1982, while the numbers in Table 10 reflect 24/7 exposure through the year. Doses listed in Table 10 did not result in any elevated exposures to the public.

Table 10. Annual Effective Doses by Highest Concentration, Location and Age Group

Radionuclide	Highest Year	Highest Location	Concentration (µCi/ml)	Dose to Infant (mrem/yr)	Annual Dose to Adult	Notes
Natural Uranium (µCi/ml)	1979	AS-204	2.48E-14	2.72	5.97	
Thorium-230 (µCi/ml)	1982	AS-204	8.95E-14	71.57	272.68	
Thorium-232 (µCi/ml)	2001	CC#2	8.33E-17	0.07	0.27	
Radium-226 (µCi/ml)	1985	AS-202	9.63E-15	1.25	2.75	
Lead-210 (µCi/ml)	1982	AS-204	9.95E-14	7.01	16.77	Dose from Radon Progeny
Radon-220/222 (pCi/l)	2004	AS-202	1.50E+00	NA	NA	No dose from Radon

Most of the calculated inhalation dose was from the isotope Thorium-230 (Th-230). Table 11 below lists just the dose from Th-230 for the highest annual average concentration at each sampling station. Again it can be seen that the on-site concentrations are consistently orders of magnitude higher than at off-site locations in Cañon City, Lincoln Park and west of the site boundary.

Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.

Table 11. Annual Doses from Thorium-230 by Location and Year

Year	Highest Location	Concentration (µCi/ml)	Annual Dose to Infant (mrem/yr)	Annual Dose to Adult(mrem/yr)
1982	AS-204	8.95E-14	71.57	272.68
1982	AS-202	2.12E-14	16.95	64.59
1983	AS-203	9.79E-15	7.83	29.83
1982	AS-206	1.26E-14	10.08	38.39
2000	AS-209	4.16E-15	3.33	12.67
2005	AS-210	4.85E-16	0.39	1.48
2000	AS-212	6.69E-16	0.53	2.04
1982	LP-1/2	7.49E-16	0.60	2.28
1982	CC-1/2	9.18E-16	0.73	2.80
1982	OV-3	3.15E-15	2.52	9.60

VI. COMMUNITY HEALTH CONCERNS

Responding to community health concerns is an essential part of ATSDR's overall mission and commitment to public health. The community associated with a site is both an important resource for and a key audience in the public health assessment process. Community members can often provide information that will contribute to the quality of the health assessment. Therefore, during site visits and telephone conversations with community members, ATSDR obtained information from the community regarding their specific health concerns related to the site.

In some cases, ATSDR was unable to address a community health concern because 1) adequate scientific information on the particular health effect is not available or is limited or 2) the available scientific data are insufficient to assess whether the specific health effect is related to exposure to a particular chemical. Where feasible, ATSDR addressed the health concerns identified by the community. Below is a summary of the community concerns and ATSDR's response to those concerns.

1. How did the 1965 flood event affect my health?

In June 1965, prior to the construction of the SCS Dam in 1971, a flood caused the unlined tailings ponds at the Cotter Mill to overflow into Lincoln Park. According to the residents, the waters flowed north through the gap in the ridge, down Pine Street, and ultimately down 12th Street (Sharyn Cunningham, CCAT, personal communication, February 2008). There is concern that this flood event contaminated groundwater wells and that dust from soil or tailings may have been resuspended by wind and distributed in Lincoln Park. Community members are very concerned that current illnesses may be a result of this tailings pond flood event.

> There is documentation that ponds at the Cotter Mill historically overflowed, which led to the construction of the SCS Dam. Aerial photography from October 1970 indicates that one of the evaporation ponds overflowed into an alluvial channel tributary to Sand Creek (Wilder et al. 1983). A chronology compiled by CDPHE states that in October 1970 and January 1971, an evaporation pond overflowed with high levels of total dissolved solids, sodium, molybdenum, sulfate, and high radiation (CDPHE 1975).However, since the construction of the SCS Dam, there are no recorded surface water discharges past the dam (GeoTrans 1986).

ATSDR tried to locate data to evaluate the potential health effects resulting from this flood event. No data from 1965 or 1966 exist in the CDPHE database. The *1986 Remedial Investigation* (GeoTrans 1986) states that off-site groundwater contamination in the Lincoln Park areas was first identified in 1968; therefore, any data prior to 1968 are unlikely to exist. The only data ATSDR found related to this flood event were from a sediment sample collected in January 2003 (CDPHE 2003). To address community concerns, CDPHE collected a sample of suspected flood sediment from Pine Street near Elm Avenue. This area was identified by a property owner who was present during the flood. The sample was collected from two locations. About 250 grams of soil were collected from each location to a depth of approximately 18 inches. No obvious soil horizons were identified, and no significant differences in gamma radiation were noted between shallow and deep soils. The results are presented in Table 12 below. All concentrations from this one sample are below comparison values.

The results of the sediment sample from the flood did not exceed any comparison values. If this sample was representative of the material moved by the floodwaters, it would not cause any adverse health effects.

Table 12. Concentrations found in a suspected flood sediment sample, January 2003

Chemical	**Concentration (ppm)**	**Comparison Value (ppm)**
Lead	87	400
Molybdenum	Not detected	300
Uranium	1.6	100
Radionuclide	**Concentration (pCi/g)**	**Comparison Value (pCi/g)**
Cesium-137	0.12	Not available
Lead-210	2.2	Not available
Plutonium-239, 240	Not detected	Not available
Potassium-40	22.5	Not available
Radium-226	2.2	15
Radium-228	1.3	15

Source: CDPHE 2003

2. Were an adequate number of soil samples collected during the *1998 Supplemental Human Health Risk Assessment*?

The community expressed concern that not enough samples were collected during the *1998 Supplemental Human Health Risk Assessment*. Weston, a contractor for Cotter, collected surface soil samples (0-2 inches) from eight zones around the mill property (see Figure). Each zone was divided into 8 to 12 grids. Four samples were collected near the center of each grid and were composited (i.e., combined and homogenized) to form a single representative sample (Weston 1998). The dates the samples were collected were not specified in the report; however, it is assumed to be in the 1994–1996 timeframe. In 1995, EPA released guidance for obtaining representative soil samples at Superfund sites (EPA 1995). The systematic grid sampling approach used by Weston conforms with EPA’s guidance for delineating the extent of contamination. The number of samples taken from each grid for compositing, however, is not entirely consistent with EPA’s guidance. For grids larger than 100 x 100 feet, which it appears that the grids established by Weston are, EPA recommends collecting nine aliquots from each grid. Compositing four aliquots from each grid is recommended for grids smaller than 100 x 100 feet (EPA 1995). Because the timeframe of the sampling is unclear, it is not known whether EPA’s 1995 guidance was available during Weston’s sampling effort.

3. Are there high levels of thorium near the Black Bridge?

The community expressed concern that high thorium levels were detected in surface water near the Black Bridge. This bridge is located where a railroad spur crosses the Arkansas River between the 4th Street and 9th Street bridges. The closest sampling location in the Arkansas River is upstream at 1st Street (907). Thorium-230 was sampled at this location as part of the surface water monitoring program between 1995 and 2007. These data are summarized below in Table 13. The highest thorium-230 concentration detected was 2.5 picocuries per liter (pCi/L) (suspended sample) in August 2007. This concentration is below levels known to cause adverse health effects. It should also be noted that the Black Bridge is located upstream of the confluence with Sand Creek.

Table 13. Thorium-230 data upstream of the Black Bridge

Chemical	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)
Thorium-230 (D)	121/127	-0.1	0.1	1
Thorium-230 (S)	115/120	0	0.2	2.5
Thorium-230 (T)	7/7	0.1	0.3	0.7

Source: CDPHE 2007b
Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
Thorium-230 “D” and “S” samples were collected between 1995 and 2007. Thorium-230 “T” samples were only collected in 1995.

D – dissolved
pCi/L – picocuries per liter
S – suspended
T – total

4. I grew up near the Cotter plant. Does this increase my risk of getting cancer?

Soil sampling data from the nearest residence to the Cotter plant did not indicate the presence of chemicals at levels above established guidelines. Soil sampling data from the Lincoln Park community did not reveal the presence of contaminants at levels associated with adverse health effects, including cancer. Air data do not indicate the presence of chemicals at levels associated with adverse health effects, including cancer. If you drank water from a contaminated private well, you might be at increased risk for gout-like conditions, such as pain, swelling, inflammation and deformities of the joints. However, once exposure is stopped, the risk of adverse health effects goes down.

5. I used water from my private well or surface water to irrigate my crops and garden vegetables. Am I going to get sick?

According to our evaluation, people who ate fruits or vegetables irrigated with contaminated well water are not at increased risk for non-cancer health effects. However, people who eat more than the average amount of fruits and vegetables (95th percentile consumers) might be at increased risk for developing cancer over a lifetime. This conclusion is based on a person eating approximately 4 times more fruits and vegetables than the average person every day for 30 years.

People who grew fruits and vegetables at their home and used their well water to irrigate their crops submitted crop samples for analysis. The analysis revealed that vegetables irrigated with well water did not cause a significant increase in contaminant levels (Weston 1998). As a precaution, however, we recommend washing all homegrown fruits and vegetables before eating them.

6. **I have lived in Lincoln Park since the 1960s. I know of many neighbors and family members who are sick. Is uranium from the mill making us sick?**

Uranium primarily acts as a heavy metal toxin. Renal toxicity is the hallmark effect of uranium exposure, specifically to the proximal tubules of the kidney. We looked at CDC's Compressed Mortality Database "WONDER" looking specifically at specific modes of kidney failure that could be associated with uranium toxicity. Fremont County in Colorado had an age adjusted rate for renal failure as the cause of death of 7.1 per 100,000, for the years 1999-2006. The state average during that same period was 12.1 per 100,000[13]. From the available health outcome data, it does not appear that residents in the area have elevated rates of kidney disease, which could be associated with uranium exposure.

7. **My husband worked at the plant. Was I possibly exposed when he brought his dirty work clothes home?**

Workers in industrial settings have the potential to expose their household members to work-related chemicals if residues attach to the worker's clothing, skin, shoes, or in their vehicles and is inadvertently brought into the home. Whether and to what magnitude these take-home exposures actually occur depends on a number of factors, including the nature of the job held by the worker, the occupational practices of the industrial facility (e.g., providing workers with disposable gowns and gloves), and the precautions/practices of the worker and other family members. ATSDR did not evaluate potential exposures to workers' families because the data needed to quantitatively or qualitatively make a determination on potential health effects were not available.

8. **I used contaminated water from my private well water for many years as a potable source of water for my family. Are we now at risk for adverse health effects?**

The levels of molybdenum were high enough in some wells to cause adverse health effects in individuals who were exposed for many years. Once exposure is stopped, the risk of adverse health effects goes down. Residents, particularly individuals who do not take in enough dietary copper or cannot process copper correctly, might be at increased risk for gout-like conditions. The levels of other contaminants are too low to cause adverse health effects.

9. **CCAT conducted a health survey and submitted it to ATSDR. Why didn't ATSDR use the results of this survey to determine if people are experiencing adverse health effects in the community?**

The community organization CCAT conducted a health survey in 2004–2005. The survey included responses from 239 individuals in the Lincoln Park area. Volunteers went door-to-door in Lincoln Park and the surrounding areas to administer the health surveys. Each person filled out a survey and submitted it to a volunteer. A tabulation of self-reported illnesses reported by respondents included occurrences of cancer; lung, health, skin, central nervous system, kidney, and thyroid problems; reproductive issues, including chromosomal and congenital defects;

---

[13] Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed Mortality File 1999-2006. CDC WONDER On-line Database, compiled from Compressed Mortality File 1999-2006 Series 20 No. 2L, 2009. Accessed at http://wonder.cdc.gov/cmf-icd10.html on Sep 30, 2009 10:42:05 AM

autoimmune disease, psychological disorders, and gout. Although ATSDR could not use the survey to make conclusions about disease associations, we did use the survey results to focus our attention and pursue a more in-depth scientific analysis of the health conditions identified by the community.

While the CCAT health survey was a good effort by the community to examine the frequency of their various health concerns, there are many issues that make it of limited use in determining the prevalence of adverse health effects present in the entire community and their potential associations with exposure to environmental contaminants. Some of these issues include the use of a relatively small convenience sample, the lack of medical verification of self-reported health outcomes, and the need for individual-level exposure data. Convenient samples are typically not representative of the entire population, so results cannot be extrapolated to the community. People who participate in nonrandomized surveys such as this may provide biased information because of perceived relationships between environmental contamination or other risk factors and their health. Many of the self-reported health outcomes measured in the survey are present in most populations and are related to several different potential causes beyond environmental exposures, such as lifestyle or genetics. Therefore, without any assessment of exposure, it is not possible to link the occurrence of disease to environmental concerns.

10. **CDPHE previously ordered Cotter to have all environmental samples analyzed by an external laboratory until Cotter could demonstrate that its laboratory had addressed various deficiencies. Why was this done and how did it affect the data used by ATSDR?**

Cotter’s license requires the company to collect and report a wide range of environmental measurements. Cotter’s own analytical laboratory conducted most of the measurements between the late 1970s and the present. The main exception is that an external analytical laboratory measured contamination levels in most of the samples collected in 2005 and 2006.

For many years, Cotter has participated in so-called “round robin” inter-laboratory performance evaluations. As part of these evaluations, selected environmental samples are split every calendar quarter and simultaneously sent to Cotter’s laboratory and to three external analytical laboratories for analysis. The measurement results are then compared to assess the performance of Cotter’s laboratory. CDPHE’s website presents data from these inter-laboratory comparisons from 2007 to the present. Earlier comparisons are not readily available, mostly because Cotter’s laboratory was not analyzing samples throughout much of 2005 and 2006 and data from earlier years have since been archived from CDPHE’s website.

In September 2008, Cotter submitted a letter to CDPHE documenting five quarters of inter-laboratory comparisons for groundwater samples [Cotter 2008]. These comparisons presented “round robin” data for more than two dozen substances or indicators, including uranium, molybdenum, selenium, nitrate, and selected radionuclides. In some cases, Cotter’s laboratory tended to measure higher concentrations than the other participating laboratories; but in other cases, the opposite was observed. With one exception, the differences between the measurements made by the various laboratories fell within the range typically observed or expected.

The exception is for molybdenum, for which Cotter's laboratory did not meet pre-established comparability limits for the "round robin" sampling. Specifically, in two out of the five quarters of samples that were collected, Cotter's laboratory did not meet the acceptable limits.[14] In contrast, the three external laboratories' molybdenum measurements met the pre-established comparability limits for all five quarters considered in this report. The table below presents the specific concentration measurements for the two quarters of interest, and these measurements show that (in these two instances) the molybdenum levels measured by Cotter were less than 50 percent of the average concentrations calculated from the three external laboratories' measurements.

After CDPHE requested that Cotter investigate the issue further, Cotter prepared a written response to the issue [Cotter 2009]. The response suggests that the poor performance on these samples resulted from the analytical method used. Cotter uses atomic adsorption to measure molybdenum levels in groundwater samples, and the external laboratories used a different method (inductively coupled plasma with mass spectrometry). When molybdenum concentrations are below roughly 0.5 mg/L, Cotter measures molybdenum by atomic adsorption *graphite furnace* analysis; but at higher concentrations, analysis is by atomic adsorption *flame* analysis. The two quarters with the poor comparisons both had concentration levels below 0.5 mg/L, leading Cotter to infer that the underreporting was associated with the graphite furnace analyses. In January 2009, Cotter proposed several measures that were believed to cause the graphite furnace analyses to perform better, and CDPHE approved of the proposed remedy.

Overall, the "round robin" studies have demonstrated that Cotter's analytical laboratory met pre-specified performance criteria for almost every one of the substances considered. Only for molybdenum was a performance issue noted, and it appears that Cotter's laboratory previously used a method that would understate molybdenum concentrations, but typically only when those concentrations were less than approximately 0.5 mg/L. This issue was observed for samples collected between January 2007 and March 2008, but it likely also affected earlier samples that Cotter's laboratory analyzed; and this negative bias should be considered in any uses of these data. Measurements collected since this timeframe likely do not exhibit the same negative bias, given the changes that Cotter proposed to its analytical methods.

Inter-Laboratory Comparison Results for Molybdenum: First Quarter 2007 & First Quarter 2008

Parameter	Analytical Laboratory			
	Cotter	Laboratory #1	Laboratory #2	Laboratory #3
Inter-Laboratory Comparison for First Quarter 2007				
Measurement 1 (mg/L)	0.012	0.0263	0.027	0.024
Measurement 2 (mg/L)	0.012	0.025	0.027	0.0232
Average (mg/L)	0.012	0.0257	0.027	0.0236
Avg across three comparison laboratories (mg/L)		0.025		
Inter-Laboratory Comparison for First Quarter 2008				
Measurement 1 (mg/L)	0.01	0.0281	0.029	0.0267
Measurement 2 (mg/L)	0.011	0.0274	0.029	0.0274
Average (mg/L)	0.011	0.0278	0.029	0.0271
Avg across three comparison laboratories (mg/L)		0.028		

Note: Every laboratory was supposed to analyze each sample twice, thus providing data allowing for intra-laboratory and inter-laboratory comparisons.

---

[14] CDPHE actually voiced concern about three quarters of Cotter's molybdenum data, even though only two of these three quarters did not meet the pre-established comparability limits.

VII. CONCLUSIONS

ATSDR reached four important conclusions in this public health assessment:

1. ATSDR concludes that drinking water for many years from contaminated private wells could harm people’s health. This is a public health hazard.

   Private well sampling data collected from 1984 to 2007 revealed the presence of molybdenum at levels that could harm people’s health. A water use survey conducted in Lincoln Park in 1989 revealed that at least seven people used groundwater (from their private wells) for personal consumption. These and other residents whose private wells were affected by the highest molybdenum contamination may be at increased risk for health effects such as gout-like conditions, particularly individuals who do not take in enough dietary copper or cannot process copper correctly.

   The lack of consistent monitoring over the years and the unknown usage of wells before the installation of the public water supply make these past exposures difficult to accurately assess.

   Most town residents are now connected to the public water supply and have eliminated their exposure to the contaminated well water. However, some residents are reported to have refused public water supply connections, and many may still have operational private wells. Additionally, no formal institutional controls exist to control groundwater use in Lincoln Park. Therefore, current and future uses of private wells for domestic purposes are still possible.

2. ATSDR concludes that accidentally eating or touching soil and sediment near the Cotter Mill property or in Lincoln Park will not harm people’s health. However, ATSDR cannot make conclusions about soils near Cotter Mill if the properties closest to the facility are developed for residential or other non-industrial uses in the future.

3. ATSDR concludes that eating locally-grown fruits and vegetables irrigated with private well water will not harm most people’s health. However, a person eating above-average amounts of fruits and vegetables (4 times the average consumer) might have a low increased risk for developing cancer over a lifetime. As a precaution, residents should limit their use of contaminated well water to irrigate their crops. In all cases, the crops should be thoroughly cleaned prior to eating.

4. ATSDR concludes that ambient air emissions of particle bound radionuclides have not resulted in completed exposures to the public at levels that could cause adverse health outcomes. With the exception of thorium-230 levels observed in 1981 and 1982, associated with excavation of contaminated tailings, every radionuclide monitored has been more than a factor of ten below annual dose based health limits to the public. The excavation releases appear to have only exposed on-site workers, but still below occupational limits at that time.

VIII. RECOMMENDATIONS

Based upon ATSDR's review of the environmental data and the concerns expressed by community members, the following recommendations are appropriate and protective of the health of residents in and around the Lincoln Park area.

- Residents should be informed about the health risks associated with contaminated private wells and advised to connect to the public water supply if possible. Local officials should advise new residents who move to the area of the groundwater contamination and that they should have their water supply tested before using groundwater for household purposes.

- Residents should discontinue of use of any impacted private wells for household purposes, including watering livestock and crops.

- CDPHE should continue to monitor the groundwater contaminant plume to assess whether additional wells may be impacted in the future.

- CDPHE should conduct a water use survey in the affected area to determine how groundwater is being utilized by residents in Lincoln Park.

- CDPHE should evaluate the need for further analysis of lead in soil should the areas adjacent to the Cotter Mill property change current use patterns.

- ATSDR in the short-term, and CDPHE in the long-term, should advise residents who have fruit and vegetable gardens to wash the crops thoroughly before eating them. This measure is just a precaution to remove soil adhering to the surface of the crop.

IX. PUBLIC HEALTH ACTION PLAN

The public health action plan for the site contains a description of actions that have been taken or will be taken by ATSDR or other government agencies at the site. The purpose of the public health action plan is to ensure that this document both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from exposure to the hazardous substances at this site.

Public health actions COMPLETED:

- ATSDR conducted site visits to gather community health concerns, to communicate to identified stakeholders, and to gather relevant site-related data;
- ATSDR's Exposure Investigations and Site Assessment Branch (EISB) performed two Exposure Investigations to 1) evaluate blood lead levels in children living in the Lincoln Park area and 2) evaluate lead in dust in homes in the Lincoln Park area. (These documents are available on our website at www.atsdr.cdc.gov.)

Public health actions PLANNED:

- ATSDR's Health Promotion and Community Involvement Branch (HPCIB) will conduct health-related educational activities in the community, as necessary.
- ATSDR's HPCIB will coordinate community outreach and community involvement activities for the site.
- ATSDR will continue to work with appropriate state and federal agencies and review, if requested, additional relevant environmental data (including the water use survey) as it becomes available.
- ATSDR will re-evaluate and revise the public health action plan if needed. New environmental, toxicological, health outcome data, or implementing the above proposed actions may necessitate the need for additional or alternative actions at this site.

X. SITE TEAM

Teresa Foster, MPH
Environmental Health Scientist
Division of Health Assessment and Consultation
Site and Radiological Assessment Branch

Michael Brooks, CHP
Health Physicist
Division of Health Assessment and Consultation
Site and Radiological Assessment Branch

Debra Joseph, MHA
Community Involvement Specialist
Division of Health Assessment and Consultation
Health Promotion and Community Involvement Branch

Carla Galindo,* MPH
Health Education Specialist
Division of Health Assessment and Consultation
Health Promotion and Community Involvement Branch

Dawn Arlotta, MPH, CHES
Health Education Specialist
Division of Health Assessment and Consultation
Health Promotion and Community Involvement Branch

ATSDR Regional Representatives:

Chris Poulet
Environmental Health Scientist
Division of Regional Operations

David Dorian
Environmental Health Scientist
Division of Regional Operations

Epidemiological Review:

Candis Mayweather Hunter, MSPH
Epidemiologist
Division of Health Studies

*Carla Galindo provided health education input until 2009. Carla is no longer employed at ATSDR.

XI. REFERENCES

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006a. Health Consultation, Blood Lead Levels in Children in the Lincoln Park Neighborhood, Cañon City, Fremont County, Colorado. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/LincolnParkBloodLeadLevels/LincolnPark-BloodLeadLevelsChildrenHC11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006b. Health Consultation, Blood Levels in the Cañon City Vicinity, Fremont County, Colorado. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/CanonCityBloodLevels/BloodLevels-CanonCityEI11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006c. Health Consultation, Lead in Dust in Homes in the Lincoln Park Neighborhood, Cañon City, Fremont County, Colorado. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/LincolnParkDustinLeadinHomes/LincolnPark-LeadinDustHC11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006d. Health Consultation, Exposure Investigation Report: Lead in Indoor Dust, Outdoor Soil, and Blood of Lincoln Park Neighborhood Residents. November 16, 2006. Available at: http://www.atsdr.cdc.gov/HAC/pha/LincolnParkLeadinIndoo%20Dust/LincolnPark-LeadEI11.16.06.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2007. Toxicological profile for arsenic (update). Atlanta: US Department of Health and Human Services. 2007.

[ATSDR] Agency for Toxic Substances and Disease Registry, 1999. Toxicological profile for uranium (update). Atlanta: US Department of Health and Human Services. September 1999.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2006e. ToxFACTS Chemical Agent Briefing Sheet - Arsenic. Atlanta: US Department of Health and Human Services. January 2006.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2004. Interaction Profile for: arsenic, cadmium, chromium, and lead. Atlanta: US Department of Health and Human Services. May 2004.

[BEIR IV]. Committee on the Biological Effects of Ionizing Radiations, National Research Council. 1988. Health risks of radon and other internally deposited alpha-emitters. Washington DC: National Academy Press.

[CCAT] Colorado Citizens Against Toxic Waste. 2004-2005 Lincoln Park Health Survey, Cañon City, Colorado 81212.

[CDC] Centers for Disease Control and Prevention. 1998. Estimation of the impact of the former Feed Materials Production Center (FMPC) on lung cancer mortality in the surrounding community. Atlanta: US Department of Health and Human Services Public Health Service; 1998 Dec.

[CDPHE 1975] Colorado Department of Public Health and Environment. 1975. Letter to Fred Matter, Cotter Corporation, from Joe Virgona, CDPHE, concerning the chronological report on Cotter Corporation. July 1975.

[CDPHE 2003] Colorado Department of Public Health and Environment, Laboratory Services Division. 2003. Results of Sampling for Plutonium, Uranium, Lead and Molybdenum in the Cañon City Vicinity. July 2003.

[CDPHE 2005] Colorado Department of Public Health and Environment. 2005. Cotter Cañon City Uranium Mill 1988 Remedial Action Plan, Summary and Status – August 2005. Available at: http://www.cdphe.state.co.us/hm/cotter/rapsummary050826.pdf.

[CDPHE 2007a] Colorado Department of Public Health and Environment. 2007a. Letter to Mr. John Hamrick, Cotter Corporation, from Steve Tarlton, CDPHE, concerning the Cotter Corporation Cañon City Mill Impoundments evaluation. June 14, 2007.

[CDPHE 2007b] Colorado Department of Public Health and Environment. 2007b. Cotter Mill Site Monitoring Database: data through September 25, 2007.

[CDPHE 2008] Colorado Department of Public Health and Environment. 2008. Cotter Corporation Uranium Mill Site Description. Available at: http://www.cdphe.state.co.us/hm/cotter/sitedescript.htm.

[CDPHE 2001] Colorado Department of Public Health and the Environment. 2001. 6 CCR 1007-1, Part 18, State Board of Health Licensing Requirements for Uranium and Thorium Processing. Hazardous Materials and Waste Management Division, Radiation Control, November 2001.

[CDPHE 2005b] Colorado Department of Public Health and the Environment. 2005. Cotter Cañon City Uranium Mill 1988 Remedial Action Plan Summary and Status – August 2005b.

[CDPHE 2005c] Colorado Department of Public Health and the Environment. 2005. 6 CCR 1007-1, Part 3, Licensing of Radioactive Material. Hazardous Materials and Waste Management Division, State Board of Health Rules and Regulations Pertaining to Radiation Control, July 2005.

[CDPHE 2009] Colorado Department of Public Health and the Environment. 2009. Radioactive Materials License 369-01, Amendment 50, February 2009.

Chen J, Meyerhof DP, Tracy BL. 2004. Model results of kidney burdens from uranium intakes. Health Phys 86(1):3-11 (2004).

Cotter. 2000. Sand Creek Project Cleanup Report. June 2000.

[Cotter 2007] Environmental and occupational performance report, ALARA review and annual report on remedial action plan activities. Calendar year 2006. Cañon City Milling Facility. June 29, 2007. Available at: http://www.cdphe.state.co.us/hm/cotter/LetterFromCotter/2006perfrpt/.

Cotter. 2008. Operational unit 2 (OU2) Lincoln Park water use survey. April 7, 2008. Available at: http://www.cdphe.state.co.us/hm/cotter/08cotterdocs.htm.

[Cotter 2004a] Cotter Corporation, Cañon City Milling Facility. 2004. Procedure: Environmental Air Particulate Sampling, #EV-020, Revision 5. July 2004.

[Cotter 2004b] Cotter Corporation, Cañon City Milling Facility. 2004. Procedure: Radon-222/220 Air Surveys, #EV-030, Revision 2. July 2004.

[Cotter 2008b] Cotter Corporation, Cañon City Milling Facility. 2008. Environmental and Occupational Performance Report, ALARA Review, and Annual Report on Remedial Action Plan Activities for Calendar Year 2008.

[Cotter 2009b] Cotter Corporation, Cañon City Milling Facility. 2009. Quality Assurance Program Plan for Environmental and Occupational Sampling and Monitoring Studies for the Cotter Corporation, Cañon City Milling Facility and Lincoln Park, Colorado Superfund Site. Prepared by Environmental Alternatives, Inc., May 2009.

Diamond GL. 1989. Biological consequences of exposure to soluble forms of natural uranium. Rad Protect Dosim 26: 23-33.

[DOE] United States Department of Energy. 2003. Fiscal year 2003 status report, Reimbursements to licensees of active uranium and thorium processing sites. Title X of the Energy Policy Act of 1992. September 2003.

[DOE 1993] U.S. Department of Energy. 1993. Order 5400.5 Change 2. Radiation Protection of the Public and the Environment. Office of Environment, Safety, and Health, January, 1993.

[EA] Environmental Alternatives, Inc. 2007. Report on Semi-Annual Review of Well Permits. March 20, 2007. Available at: http://www.cdphe.state.co.us/hm/cotter/LetterFromCotter/wellpermitreview070329.pdf.

[EIA] Energy Information Administration, 2001, Web site: U.S. Department of Energy, http://www.eia.doe.gov/.

Eisenbud M, Quigley JA. 1955. Industrial hygiene of uranium processing. AMA Archives of Industrial Health. p. 12–22.

[EPA] Environmental Protection Agency, Environmental Response Team. 1995. Superfund Program, Representative Sampling Guidance, Volume 1: Soil. Interim Final. Available at: http://www.clu-in.org/download/char/SF_Rep_Samp_Guid_soil.pdf.

[EPA] Environmental Protection Agency. 2002. Record of Decision: Lincoln Park Study Area Surface Soils, Lincoln Park Superfund Site, Cañon City, Colorado. Available at: http://www.epa.gov/region08/superfund/co/lincolnpark/LincolnPkROD.pdf.

[EPA] Environmental Protection Agency, Superfund Technical Assessment and Response Team 2 - Region 8. 2004. Cañon City Lead Data Compilation Report, Cañon City, Fremont County, Colorado. March 24, 2004. Available at: http://www.epa.gov/region8/superfund/co/lincolnpark/.

[EPA] Environmental Protection Agency, Region 8. 2007. Final First 5-year review report for Lincoln Park Superfund site, Operable Unit 2. September 2007. Available at: http://www.epa.gov/region08/superfund/co/lincolnpark/LincolnPark5YrRvw07.pdf.

[EPA] Environmental Protection Agency, Region 8. 2008. Superfund Program: Lincoln Park. Available at: http://www.epa.gov/region8/superfund/co/lincolnpark/.

[EPA] Environmental Protection Agency, Integrated Risk Information System (IRIS). Cincinnati, OH: Office of Health and Environmental Assessment, Environmental Criteria and Assessment. Accessed June 16, 2009 at http://www.epa.gov/ncea/iris/subst/0425.htm.

[FNB] Food and Nutrition Board, Institute of Medicine. 2001. Molybdenum. In: Dietary reference intakes for vitamin A, vitamin K, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington, D.C.: National Academy Press. p. 420–41.

[FDA] US Food and Drug Administration. 2008. Total Diet Study - Summary of Toxic and Nutritional Elements Found in TDS Foods. Accessed August 4, 2009 at . http://www.fda.gov/downloads/Food/FoodSafety/FoodContaminantsAdulteration/TotalDietStudy/UCM184301.pdf.

Galant, M.M., Linnert, T., and J. Dalton. 2007. Community involvement plan: Lincoln Park Superfund site and associated activities at the Cotter Corporation uranium mill. March 2007. Available at: http://www.cdphe.state.co.us/hm/cotter/lincolnparkcottercip.pdf.

[GeoTrans] GeoTrans, Inc. 1986. Remedial Investigation: Cotter Corporation Uranium Mill Site. February 1986.

[HRAP] Health Risk Assessment Panel, Cotter Uranium Mill Site. 1991. Health Risk Assessment of the Cotter Uranium Mill Site, Cañon City, Colorado. Prepared with the assistance of ENVIRON Corporation, Radiation Surveillance Associates, Radiant Energy Management, and Western Radiation Consultants. October 29, 1991.

Hodge HC. 1953. Resume of chapters 18 to 28. In: Voegtlin C and Hodge HC, eds. Pharmacology and toxicology of uranium compounds. National Nuclear Energy Series, Division VI, Vol 1, Part IV. New York: McGraw-Hill.

[IMS] IMS Inc. 1989. Lincoln Park Water Use Survey. Submitted to Cotter Corporation, Lakewood, Colorado. June 28, 1989.

[IPCS] International Programme on Chemical Safety. 2001.Environmental Health Criteria for Arsenic and Arsenic compounds. EHC 224, Chapter 1: Summary, section 4.

Juhasz, Albert L., Euan Smith, John Weber, Matthew Rees, Allan Rofe, Tim Kuchel, Lloyd Sansom, Ravi Naidu, Application of an In Vivo Swine Model for the Determination of Arsenic Bioavailability in Contaminated Vegetables. Chemosphere. Feb 7, 2008.

Killough GG, Case MJ, Meyer KR, et al. 1998. Fernald Dosimetry Reconstruction Project, Task 6—radiation doses and risk to residents from FMPC Operations from 1951-1988. Vol I and II (final report). Radiological Assessments Corporation Report No. CDC-1. Neeses, SC: 1998 Sep

[Koval'skiy] Koval'skiy, V.V., G.A. Yarovaya and D.M. Shmavonyan. 1961. Changes of purine metabolism in man and animals under conditions of molybdenum biogeochemical provinces. Zh. Obshch. Biol. 22: 179-191.

[Kurttio et al] Päivi Kurttio, Anssi Auvinen, Laina Salonen, Heikki Saha, Juha Pekkanen, Ilona Mäkeläinen, Sari B. Väisänen, Ilkka M. Penttilä, and Hannu Komulainen. Renal Effects of Uranium in Drinking Water. Environmental Health Perspectives Volume 110, Number 4, April 2002.

Laizu Jahanara. 2007. Speciation of arsenic in vegetables and their correlation with inorganic phosphate level. Bangladesh J Pharmacol 2007; 2:88-94.

Leggett RW. 1989. The behavior and chemical toxicity of U in the kidney: a reassessment. Health Phys 57(3): 365-383.

Leggett RW. 1994. Basis for ICRP's age-specific biokinetic model for uranium. Health Phys 67: 589-601.

[MFG] MFG, Inc. 2005. Assessment of potential dose to members of the public from materials along roads near the Cotter Corporation, Cañon City Milling Facility. May 2005. Available at: http://www.cdphe.state.co.us/hm/cotter/potentialdoseassessment.pdf.

Madsden KM, Nielsen S, Tisher CC. 2007. Chapter 2 – Anatomy of the Kidney from Brenner: Brenner and Rector's The Kidney, 8th ed. Oxford: Elsevier Science Ltd.

Maynard EA, Hodge HC. 1949. Studies of the toxicity of various uranium compounds when fed to experimental animals. In: Voegtlin IC, Hodge HC, eds. Pharmacology and toxicology of uranium compounds. National Nuclear Energy Series (VI). New York: McGraw-Hill; 309-376.

McDonald-Taylor CK, Singh A, Gilman A. 1997. Uranyl nitrate-induced tubule alterations in rabbits: a quantitative analysis. Toxicol Pathol 25(4): 381-389.

Morris SC, Meinhold AF. 1995. Probabilistic risk assessment of nephrotoxic effect of uranium in drinking water. Health Phys 69: 897-908.

[ODEQ] State of Oregon Department of Environmental Quality. 2003. Memorandum, Red Rock Road Project File, Evaluation Potential for Arsenic and Mercury Uptake into Garden Vegetables. September 22, 2003.

[NHANES] National Health and Nutrition Examination Survey. Third National Report on Human Exposure to Environmental Chemicals, Dept of Health and Human Services, Centers for Disease Control and Prevention. Atlanta, GA. July 2005.

Plasket, BJ. 2002. Cotter at the Crossroads: On the Hot Seat. The Daily Record News Group. Available at: http://www.timescall.com/cotter/cotter24.htm.

Spear JW. Trace mineral bioavailability in ruminants. J. Nutr. 2003; 133: 1506S—1509S.

Spoor NL, Hursh JB. 1973. Protection criteria. In: Hodge HC, Stannard JN, Hursh JB, eds. Handbook of experimental pharmacology. Berlin: Springer-Verlag; 241-270.

Stokinger HE, Baxter RC, Dygent HP, et al. 1953. In: Voegtlin C, Hodge HC, eds. Toxicity following inhalation for 1 and 2 years. National Nuclear Energy Series: Manhattan Project Technical Section, Div VI, Vol 1. New York: McGraw-Hill.

Turnlund JR. Molybdenum metabolism and requirements in humans. Met. Ions Bio. Syst. 2002; 39:727—739.

[USGS] United States Geological Survey. 1999a. Migration and Geochemical Evolution of Ground Water Affected by Uranium-Mill Effluent near Cañon City, Colorado. Water-Resources Investigations Report 98-4228. DT Chafin and ER Banta.

[USGS] United States Geological Survey. 1999b. Ground-Water Hydrology and Simulation of Five Remediation Alternatives for an Area Affected by Uranium-Mill Effluent near Cañon City, Colorado. ER Banta and DT Chafin.

[USNRC 1980] U.S. Nuclear Regulatory Commission. 1980. Regulatory Guide 4.14 Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1. Office of Standards Development, April 1980.

[USNRC 1996] U.S. Nuclear Regulatory Commission. 1996. Regulatory Guide 4.20 Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees other than Power Reactors. Office of Nuclear Regulatory Research, December 1996.

Vousta D, Grimanis A, Samara C. 1996. Trace elements in vegetables grown in an industrial area in relation to soil and air particulate matter. Environ Pollution 94(3):325–35.

[Weston] Roy F. Weston, Inc. 1996. Supplemental Human Health Risk Assessment. Lincoln Park Superfund Site. Cañon City, Colorado. Phase II Evaluation. Baseline Human Health Risks in 1988. Final Report. Prepared for CDPHE. November 19, 1996.

[Weston] Roy F. Weston, Inc. 1998. Supplemental Human Health Risk Assessment, Lincoln Park Superfund Site, Cañon City, Colorado: Phase III Evaluation, Baseline Human Health Risks in 1994-1996. January 1998.

Wilder, RJ, DJ Goode, P Huidobro, MO Kozik, DR Cogley, NH Krusell, ME Connolly, EJ Limberakis, and AW Levin. 1983. Assessment of data concerning ground water contamination in the Lincoln Park section of Cañon City, Colorado. Final report prepared for EPA by GCA Corporation. May 1983.

[WHO] World Health Organization. 2003. Molydbenum in Drinking water: Background document for development of WHO *Guidelines for Drinking-water Quality*.

Zhao LS, Zhao SF. 1990. Nephrotoxic limit and annual limit on intake for natural U. Health Phys 58: 619-623.

Appendix A - Tables

[Page intentionally left blank]

Table 14. Well Use in Lincoln Park, 1989

Well Number	Description	Reported Well Use				
		Personal Consumption	Irrigating Fruit	Irrigating Vegetable Gardens	Watering Livestock	Watering Lawns
117	Logan (LPWUS)		✓			✓
119	Birch (LPWUS)			✓		✓
122	Elm (LPWUS)					✓
123	Cedar (LPWUS)					✓
124	Elm (LPWUS)			✓		✓
129	Elm (LPWUS)		✓	✓		✓
130	Poplar (LPWUS)		✓			✓
138	Field well, Cedar (LPWUS)					✓
139	House well, Cedar (LPWUS)					✓
140	C. R. Ransom house well, Cedar (LPWUS)		✓	✓		✓
144	Cedar (LPWUS)		✓	✓	✓	✓
165	Spring, Elm (LPWUS)	✓		✓		✓
166	Willow (LPWUS)				✓	✓
168	Grand (house well) (LPWUS)	✓			✓	✓
173	Beulah (LPWUS)		✓			✓
174	Chestnut (LPWUS)		✓		✓	✓
189	Hickory (LPWUS)	✓				
198	Grand (LPWUS)	✓	✓	✓	✓	✓
206	Grand (field well) (LPWUS)				✓	
212	Cedar (LPWUS)		✓	✓		✓
219	Locust (LPWUS)	✓				
221	Elm (LPWUS)					✓
222	Elm (LPWUS)					✓

Well Number	Description	Reported Well Use				
		Personal Consumption	Irrigating Fruit	Irrigating Vegetable Gardens	Watering Livestock	Watering Lawns
223	Elm (LPWUS)				✓	
224	Elm (LPWUS)		✓			✓
226	Chestnut (LPWUS)					✓
229	Grand (LPWUS)				✓	✓
230	Birch (LPWUS)		✓			✓
231	Birch (LPWUS)		✓	✓		
235	Elm (LPWUS)				✓	
237	Elm (LPWUS)				✓	
239	Grand (LPWUS)		✓	✓	✓	✓
241	Grand (LPWUS)				✓	
243	Chestnut (LPWUS)					✓
245	Elm (LPWUS)				✓	
246	Elm (LPWUS)		✓			✓
252	Poplar (cistern* in barn) (LPWUS)					✓
255	Riley Dr. (LPWUS)	✓	✓			✓
261	Elm (LPWUS)		✓	✓		✓
262	Cedar (LPWUS)		✓	✓		✓
263	Willow (LPWUS)					✓
264	Chestnut (LPWUS)		✓	✓		✓
266	Willow (LPWUS)		✓	✓		✓
267	Willow (spring) (LPWUS)		✓	✓	✓	✓
269	Birch			✓		✓
273	Willow (cistern #1) (LPWUS)			✓		✓
274	Grand (LPWUS)		✓	✓		✓
278	Cedar (LPWUS)					✓

Well Number	Description	Reported Well Use				
		Personal Consumption	Irrigating Fruit	Irrigating Vegetable Gardens	Watering Livestock	Watering Lawns
280	Grand (LPWUS)				✓	
284	Spring - Grand St. (LPWUS)				✓	
285	Grand (LPWUS)				✓	
286	Willow (cistern #2) (LPWUS)				✓	
287	Willow (LPWUS)			✓		✓
288	Poplar (cistern* on porch)					✓
293	Cedar (LPWUS)		✓	✓	✓	✓
	Totals	6	22	20	19	42

Source: IMS 1989

*Modified from the original spelling: “cystern”
Street numbers have been excluded for privacy reasons.

LPWUS – Lincoln Park Water Use Survey

Table 15. Groundwater sampling data (chemicals) from wells used for personal consumption

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Chloride	N/T*	11/11	4.5	8.8	14	Spring, Elm [165]	13-Mar-84	250 (Secondary MCL)	165, 168	1984, 2005–2007
Iron	D	2/12	0.04	0.06	0.1	Grand (house well) [168]	19-Aug-05	26 (RBC)	165, 168	1984, 2004–2007
Manganese	D	2/12	0.002	0.008	0.01	Grand (house well) [168]	13-Dec-04	0.5 (RMEG, child)	165, 168	1984, 2004–2007
Molybdenum	D	52/59	0.007	**0.082**	**0.28**	Hickory [189]	19-Jan-89	0.035 (SS); 0.05 (RMEG, child)	165, 168, 189, 198, 219, 255	1984, 1988–1991, 1995, 2000–2007
Nitrate	T	8/8	0.5	2.9	7.7	Grand (house well) [168]	19-Mar-07	10 (MCL)	168	2005–2007
Selenium	D	0/2	ND	ND	ND	--	--	0.05 (c-EMEG, child)	165, 168	1984
Sulfate	N/T*	11/11	15	62	214	Grand (house well) [168]	19-Aug-05	250 (Secondary MCL)	165, 168	1984, 2005–2007
Total Dissolved Solids	N/T*	11/11	240	330	410	Spring, Elm [165]	13-Mar-84	500 (Secondary MCL)	165, 168	1984, 2005–2007
Uranium	D	56/57	0.001	0.028	**0.067**	Hickory [189]	15-Dec-06	0.03 (MCL)	165, 168, 189, 198, 219, 255	1984, 1988–1991, 1995, 2001–2007

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The source of water used for personal consumption at 1935 Elm [165] was a spring.

* For chloride, sulfate, and total dissolved solids, 1984 data were designated “N” and 2005–2007 data were designated “T”.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
SS – Colorado state groundwater standard
T – total

Table 16. Groundwater sampling data (chemicals) from background wells

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	0/25	ND	ND	ND	--	10 (c-EMEG, child)	1981, 1988–1994
Ammonia	N	3/45	0.02	0.4	4.2	26-Jan-90	30 (LTHA)	1988–1994
Ammonium	T	0/3	ND	ND	ND	--	NA	1995
Chloride	N/T*	168/168	3	12	110.3	07-Jan-80	250 (Secondary MCL)	1975, 1976, 1978–2007
Iron	D	24/79	0.02	0.03	0.3	16-May-89	26 (RBC)	1981–2007
Manganese	D	13/79	0.005	0.007	0.05	16-Mar-99	0.5 (RMEG, child)	1981–2007
Molybdenum	D	116/193	0.005	0.023	**0.3**	09-Nov-82, 09-Jun-76	0.035 (SS); 0.05 (RMEG, child)	1975, 1976, 1979–2007
Nitrate	N/T*	70/79	0.4	2.5	**50.4****	10-Feb-89	10 (MCL)	1988–2007
Selenium	D	10/103	0.001	0.003	0.015	15-Apr-80	0.05 (c-EMEG, child)	1975, 1977–1988, 1996–2000
Sulfate	N/T*	171/171	10	61	**434**[§]	18-Aug-80	250 (Secondary MCL)	1975–2007
Total Dissolved Solids	N/T*	171/171	286	429	**1,580**[†]	18-Aug-80	500 (Secondary MCL)	1980–2007
Uranium	D	155/193	0.004	0.021	**0.29**	07-Aug-79	0.03 (MCL)	1975–1977, 1979–2007

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The USGS identified Well 10 (1220 So. 12th St.) and Well 114 (1408 Pine) as representative of background for the Lincoln Park area (Weston 1998).

* For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
** Only two of 79 samples were above the CV.

[§] Only one of 171 samples was above the CV.
[†] The maximum concentration appears to be an outlier. The next highest concentration is 590 mg/L.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
SS – Colorado state groundwater standard
T – total

Table 17. Groundwater sampling data (chemicals) from the Grand Avenue Well

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Chloride	N/T*	10/10	4.5	8.250	11	20-Jun-84, 20-Jun-05	250 (Secondary MCL)	1984, 2005–2007
Iron	D	2/11	0.04	0.06	0.1	19-Aug-05	26 (RBC)	1984, 2004–2007
Manganese	D	2/11	0.002	0.009	0.01	13-Dec-04	0.5 (RMEG, child)	1984, 2004–2007
Molybdenum	D	15/20	0.008	0.01	0.015	21-Jun-04	0.035 (SS); 0.05 (RMEG, child)	1984, 1988–1991, 2004–2007
Nitrate	T	8/8	0.5	2.9	7.7	19-Mar-07	10 (MCL)	2005–2007
Selenium	D	0/1	ND	ND	ND	--	0.05 (c-EMEG, child)	1984
Sulfate	N/T*	10/10	15	58	214	19-Aug-05	250 (Secondary MCL)	1984, 2005–2007
Total Dissolved Solids	N/T*	10/10	240	322	402	19-Mar-07	500 (Secondary MCL)	1984, 2005–2007
Uranium	D	20/20	0.001	0.013	0.0218	28-Mar-05	0.03 (MCL)	1984, 1988–1991, 2004–2007

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
* For chloride, sulfate, and total dissolved solids, 1984 data were designated “N” and 2005–2007 data were designated “T”.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
SS – Colorado state groundwater standard
T – total

Table 18. Groundwater sampling data (chemicals) from wells used to irrigate fruit and vegetable gardens

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Aluminum	D	3/120	0.01	0.186*	0.02	Elm [124] & Elm [129]	15-Mar-95	10 (c-EMEG, child)	117, 119, 124, 129, 130, 140, 144	1981, 1988–1995
Ammonia	N	10/53	0.01	0.3	0.6	house well, Cedar [140]	23-Aug-88	30 (LTHA)	119, 124, 129, 130, 140, 144	1988–1995
Ammonium	T	0/3	ND	ND	ND	--	--	NA	119, 140, 144	1995
Cadmium	D	0/3	ND	ND	ND	--	--	0.002 (c-EMEG, child)	119, 140, 144	1995
Chloride	N/T**	784/793	2.5	19.6	232	house well, Cedar [140]	05-Apr-79	250 (Secondary MCL)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1975, 1976, 1978–2007
Copper	D	0/3	ND	ND	ND	--	--	0.1 (i-EMEG, child)	119, 140, 144	1995
Iron	D	114/398	0.011	0.029	0.31	Elm [129]	21-Apr-03	26 (RBC)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1981–2007
Manganese	D	69/397	0.0007	0.008	0.13	house well, Cedar [140]	09-Sep-94	0.5 (RMEG, child)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1981–2007
Molybdenum	D	1,052/1,077	0.004	0.99	42	house well, Cedar [140]	12-May-73	0.035 (SS); 0.05 (RMEG, child)	All 28 wells (see Table 14)	1968–2007
Nickel	D	0/3	ND	ND	ND	--	--	0.2 (RMEG, child)	119, 140, 144	1995

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Nitrate	N/T**	159/185	0.1	1.7	9.8	Cedar [144]	14-May-70	10 (MCL)	119, 124, 129, 130, 140, 144, 174, 224	1970, 1988–2007
Selenium	D	115/626	0.001	0.003	**0.082**†	house well, Cedar [140]	21-Apr-78	0.05 (c-EMEG, child)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224, 264	1974–1988, 1995–2000
Sulfate	N/T**	798/800	8	214	**25,460**‡	house well, Cedar [140]	07-May-79	250 (Secondary MCL)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1975–2007
Total Dissolved Solids	N/T**	767/767	31	**550**	**3,438**	house well, Cedar [140]	20-Apr-81	500 (Secondary MCL)	117, 119, 124, 129, 130, 140, 144, 165, 174, 224	1970, 1980–2007
Uranium	D	1,048/1,088	0.0003	**0.13**	**2.54**	house well, Cedar [140]	05-Jan-79	0.03 (MCL)	All 28 wells (see Table 14)	1962–1964, 1967, 1968, 1971, 1974–2007
	S	1/20	0.081	0.005§	**0.081**	house well, Cedar [140]	27-May-97		140, 174, 224	1995–2000
Vanadium	D	0/3	ND	ND	ND	--	--	0.03 (i-EMEG, child)	119, 140, 144	1995
Zinc	D	2/3	0.005	0.01	0.022	Birch [119]	25-Aug-95	3 (c-EMEG, child)	119, 140, 144	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The source of water used to water fruits and vegetable gardens at 1935 Elm [165] was a spring.

* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated "N" and post-1995 data were designated "T".
[†] Only two of 626 samples were above the CV.
[‡] The maximum concentration appears to be an outlier. The next highest concentration is 1,948 mg/L from the same well [140] in 1981.
[§] The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 19. Groundwater sampling data (radionuclides) from wells used to irrigate fruit and vegetable gardens

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Location of Maximum	Date of Maximum	CV (pCi/L)	Wells Sampled	Years Sampled
Lead-210	D	29/29	-0.2	0.22	1.5	Birch [119]	21-Jun-95	NA	119, 140, 144, 174, 224	1995–2000
	S	20/20	-0.1	0.15	0.6	house well, Cedar [140]	22-Feb-96, 05-May-99		140, 174, 224	1995–2000
Polonium-210	D	29/29	-0.1	0.13	0.6	Cedar [144]	08-Mar-95, 21-Jun-95,	NA	119, 140, 144, 174, 224	1995–2000
	S	20/20	0	0.12	0.6	house well, Cedar [140]	22-Feb-96, 05-Dec-96		140, 174, 224	1995–2000
Radium-226	D	29/29	0	0.12	0.5	house well, Cedar [140]	12-May-95	5 (MCL radium-226/228)	119, 140, 144, 174, 224	1995–2000
	S	19/19*	0	0	0	--	--		140, 174, 224	1995–2000
Thorium-230	D	28/28	-0.1	0.08	0.3	Birch [119] house well, Cedar [140]	25-Aug-95 21-Feb-95	NA	119, 140, 144, 174, 224	1995–2000
	S	17/17	0	0.08	0.3	house well, Cedar [140]	05-May-99		140, 174, 224	1995–2000

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
*The detect flag is "Y" for all 19 samples, however, the result value is zero for all 19 samples.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended

Table 20. Groundwater sampling data (chemicals) from wells used to water livestock

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Aluminum	D	0/19	ND	ND	ND	--	--	10 (c-EMEG, child)	144	1981, 1988–1995
Ammonia	N	0/10	ND	ND	ND	--	--	30 (LTHA)	144	1988–1995
Ammonium	T	0/1	ND	ND	ND	--	--	NA	144	1995
Cadmium	D	0/1	ND	ND	ND	--	--	0.002 (c-EMEG, child)	144	1995
Chloride	N/T*	160/160	2.5	14	185	Cedar [144]	24-Aug-83	250 (Secondary MCL)	144, 166, 168, 174	1970, 1975, 1976, 1979–1989, 1991–2007
Copper	D	0/1	ND	ND	ND	--	--	0.1 (i-EMEG, child)	144	1995
Iron	D	27/97	0.03	0.04	0.19	Cedar [144]	18-Oct-01	26 (RBC)	144, 166, 168, 174	1970, 1981–2007
Manganese	D	14/96	0.0007	0.007	0.02	Cedar [144]	13-Jul-81, 13-Sep-83, 17-May-01, 06-Jun-02, 23-Oct-03	0.5 (RMEG, child)	144, 166, 168, 174	1981–2007
Molybdenum	D	271/286	0.006	0.212	1	Cedar [144]	12-May-71	0.035 (SS); 0.05 (RMEG, child)	All 19 wells (see Table 14)	1968–1971, 1975–1977, 1979–2007
Nickel	D	0/1	ND	ND	ND	--	--	0.2 (RMEG, child)	144	1995

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Nitrate	N/T*	55/58	0.1	1.8	9.8	Cedar [144]	14-May-70	10 (MCL)	144, 168, 174	1970, 1988–2007
Selenium	D	10/119	0.001	0.003	0.011	Cedar [144]	19-Mar-80	0.05 (c-EMEG, child)	144, 166, 168, 174	1975–1977, 1979–1988, 1995–2000
Sulfate	N/T*	162/162	10	95	**1,650****	Cedar [144]	18-Aug-80	250 (Secondary MCL)	144, 166, 168, 174	1970, 1975–1977, 1979–1989, 1991–2007
Total Dissolved Solids	N/T*	162/162	195	465	**860**	Cedar [144]	18-Aug-80	500 (Secondary MCL)	144, 166, 168, 174	1970, 1980–2007
Uranium	D	283/302	0.001	**0.034**	**0.46**	Cedar [144]	28-Jun-68	0.03 (MCL)	All 19 wells (see Table 14)	1962–1964, 1967, 1968, 1971, 1975–1977, 1979–2007
	S	0/1	ND	ND	ND	--	--		174	1996
Vanadium	D	0/1	ND	ND	ND	--	--	0.03 (i-EMEG, child)	144	1995
Zinc	D	0/1	ND	ND	ND	--	--	3 (c-EMEG, child)	144	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
** The maximum concentration appears to be an outlier. The next highest concentration is 340 mg/L from the same well [144] in 1984.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 21. Groundwater sampling data (radionuclides) from wells used to water livestock

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Location of Maximum	Date of Maximum	CV (pCi/L)	Wells Sampled	Years Sampled
Lead-210	D	4/4	-0.1	0.1	0.3	Cedar [144]	08-Mar-95	NA	144, 174	1995, 1996
	S	1/1	0.2	0.2	0.2	Chestnut [174]	19-Sep-96		174	1996
Polonium-210	D	4/4	-0.1	0.3	0.6	Cedar [144]	08-Mar-95, 21-Jun-95	NA	144, 174	1995, 1996
	S	1/1*	0	0	0	Chestnut [174]	19-Sep-96		174	1996
Radium-226	D	4/4	0.1	0.1	0.1	--**	--**	5 (MCL radium-226/228)	144, 174	1995, 1996
	S	1/1*	0	0	0	Chestnut [174]	19-Sep-96		174	1996
Thorium-230	D	4/4	0	0.05	0.1	Cedar [144] Chestnut [174]	20-Sep-95 19-Sep-96	NA	144, 174	1995, 1996
	S	1/1*	0	0	0	Chestnut [174]	19-Sep-96		174	1996

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
* The detect flag is "Y" for the one sample, however, the result value is zero.
** All four result values were 0.1 pCi/L.

CV – comparison value
D – dissolved
MCL – maximum contaminant level

NA – not available
pCi/L – picocuries per liter
S – suspended

Table 22. Groundwater sampling data (chemicals) from wells used to water lawns

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Aluminum	D	11/239	0.01	0.19*	0.13	Field well, Cedar [138]	18-Dec-90	10 (c-EMEG, child)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144	1981, 1988–1995
Ammonia	N	21/112	0.01	0.3	0.9	Field well, Cedar [138]	23-Aug-88	30 (LTHA)	119, 122, 123, 124, 129, 130, 138, 139, 140, 144	1988–1995
Ammonium	T	0/5	ND	ND	ND	--	--	NA	119, 138, 139, 140, 144	1995
Cadmium	D	0/5	ND	ND	ND	--	--	0.002 (c-EMEG, child)	119, 138, 139, 140, 144	1995
Chloride	N/T**	1,362/1,372	2.5	30	450	Field well, Cedar [138]	12-Aug-80	250 (Secondary MCL)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1975, 1976, 1978–2007
Copper	D	0/5	ND	ND	ND	--	--	0.1 (i-EMEG, child)	119, 138, 139, 140, 144	1995
Iron	D	205/683	0.005	0.031	0.31	Field well, Cedar [138] Elm [129]	09-Mar-95 21-Apr-03	26 (RBC)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1981–2007

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Manganese	D	134/683	0.0005	0.008	0.13	house well, Cedar [140]	09-Sep-94	0.5 (RMEG, child)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1979, 1981–2007
Molybdenum	D	1,755/1,790	0.004	**2.2**	**56.7**	Field well, Cedar [138]	11-Aug-72	0.035 (SS); 0.05 (RMEG, child)	All 42 wells (see Table 14)	1968–2007
Nickel	D	0/5	ND	ND	ND	--	--	0.2 (RMEG, child)	119, 138, 139, 140, 144	1995
Nitrate	N/T**	277/314	0.1	1.8	9.8	Cedar [144]	14-May-70	10 (MCL)	119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 168, 174, 224	1970, 1988–2007
Selenium	D	320/1,105	0.001	0.005	**0.134**	Field well, Cedar [138]	13-Jul-81	0.05 (c-EMEG, child)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224, 264	1974–1976, 1978–1988, 1995–2000
Sulfate	N/T**	1,382/1,384	8	**351**	**25,460**[†]	house well, Cedar [140]	07-May-79	250 (Secondary MCL)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1975–2007

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Location of Maximum	Date of Maximum	CV (mg/L)	Wells Sampled	Years Sampled
Total Dissolved Solids	N/T**	1,311/1,311	31	**746**	**4,373**	Field well, Cedar [138]	06-Mar-81	500 (Secondary MCL)	117, 119, 122, 123, 124, 129, 130, 138, 139, 140, 144, 165, 166, 168, 174, 224	1970, 1980–2007
Uranium	D	1,733/1,789	0.0003	**0.233**	**5.161**	Field well, Cedar [138]	01-Aug-68	0.03 (MCL)	All 42 wells (see Table 14)	1962–1964, 1967, 1968, 1971, 1974–2007
	S	4/38	0.0067	0.010	**0.26**	Field well, Cedar [138]	27-May-97		138, 140, 174, 224	1995–2000
Vanadium	D	0/5	ND	ND	ND	--	--	0.03 (i-EMEG, child)	119, 138, 139, 140, 144	1995
Zinc	D	3/5	0.005	0.007	0.022	Birch [119]	25-Aug-95	3 (c-EMEG, child)	119, 138, 139, 140, 144	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated "N" and post-1995 data were designated "T".
† The maximum concentration and the second highest concentration (23,200 mg/L from Well 138 in 1978) appear to be outliers. The third highest concentration is 3,360 mg/L from Well 138 in 1979.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 23. Groundwater sampling data (radionuclides) from wells used to water lawns

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Location of Maximum	Date of Maximum	CV (pCi/L)	Wells Sampled	Years Sampled
Lead-210	D	53/53	-0.2	0.2	1.5	Birch [119]	21-Jun-95	NA	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	38/38	-0.1	0.1	0.6	house well, Cedar [140]	22-Feb-96, 05-May-99		138, 140, 174, 224	1995–2000
	T	1/1*	0	0	0	Field well, Cedar [138]	06-Sep-96		138	1996
Polonium-210	D	53/53	-0.1	0.2	0.9	Field well, Cedar [138]	04-May-99	NA	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	38/38	0	0.1	0.6	house well, Cedar [140]	22-Feb-96, 05-Dec-96		138, 140, 174, 224	1995–2000
	T	1/1	0.5	0.5	0.5	Field well, Cedar [138]	06-Sep-96		138	1996
Radium-226	D	51/51	0	0.1	0.5	house well, Cedar [140]	12-May-95	5 (MCL radium-226/228)	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	37/37**	0	0.003	0.1	Field well, Cedar [138]	30-Oct-95		138, 140, 174, 224	1995–2000
	T	2/2	0	0.05	0.1	Field well, Cedar [138]	06-Sep-96		138	1995–1996
Thorium-230	D	51/51	-0.1	0.08	0.4	Field well, Cedar [138]	06-Aug-98	NA	119, 138, 139, 140, 144, 174, 224	1995–2000
	S	34/34	0	0.06	0.3	house well, Cedar [140]	05-May-99		138, 140, 174, 224	1995–2000
	T	1/1	0.1	0.1	0.1	Field well, Cedar [138]	06-Sep-96		138	1996

Source: CDPHE 2007b
Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
* The detect flag is "Y" for the one sample, however, the result value is zero.
** For all but one sample, the result value is zero.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended
T – total

Table 24. Groundwater sampling data (chemicals) from Well 138

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	8/57	0.05	0.23*	0.13	18-Dec-90	10 (c-EMEG, child)	1981, 1988–1995
Ammonia	N	10/42	0.02	0.29	0.9	23-Aug-88	30 (LTHA)	1988–1995
Ammonium	T	0/1	ND	ND	ND	--	NA	1995
Cadmium	D	0/1	ND	ND	ND	--	0.002 (c-EMEG, child)	1995
Chloride	N/T**	199/199	5.5	70	450	12-Aug-80	250 (Secondary MCL)	1975, 1976, 1978–2000
Copper	D	0/1	ND	ND	ND	--	0.1 (i-EMEG, child)	1995
Iron	D	21/106	0.01	0.025	0.31	09-Mar-95	26 (RBC)	1981–2000
Manganese	D	21/107	0.01	0.008[§]	0.06	11-Jun-91	0.5 (RMEG, child)	1979, 1981–2000
Molybdenum	D	253/253	1.1	8.0	56.7	11-Aug-72	0.035 (SS); 0.05 (RMEG, child)	1968–1973, 1975, 1976, 1978–2000
Nickel	D	0/1	ND	ND	ND	--	0.2 (RMEG, child)	1995
Nitrate	N/T**	59/62	0.7	2.3	4.1	11-Jun-91	10 (MCL)	1988–2000
Selenium	D	102/151	0.001	0.011	0.134[†]	13-Jul-81	0.05 (c-EMEG, child)	1974–1976, 1978–1988, 1995–2000
Sulfate	N/T**	200/200	71	1,059	23,200[‡]	01-Nov-78	250 (Secondary MCL)	1975, 1976, 1978–2000
Total Dissolved Solids	N/T**	202/202	290	1,530	4,373	06-Mar-81	500 (Secondary MCL)	1980–2000

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Uranium	D	253/253	0.0005	**0.73**	**5.161**	01-Aug-68	0.03 (MCL)	1968, 1974–1976, 1978–2000
	S	3/18	0.007	0.016	**0.26**	27-May-97		1995–2000
Vanadium	D	0/1	ND	ND	ND	--	0.03 (i-EMEG, child)	1995
Zinc	D	0/1	ND	ND	ND	--	3 (c-EMEG, child)	1995

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.
§ The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
† Only three of 151 samples were above the CV.
‡ The maximum concentration appears to be an outlier. The next highest concentration is 3,360 mg/L in 1979.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
i-EMEG – intermediate environmental media evaluation guide
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 25. Groundwater sampling data (radionuclides) from Well 138

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Date of Maximum	CV (pCi/L)	Years Sampled
Lead-210	D	21/21	-0.2	0.22	1.1	03-Aug-95	NA	1995–2000
	S	18/18	0	0.08	0.2	27-May-97, 06-Feb-98, 29-Jul-99, 19-Oct-99		1995–2000
	T	1/1*	0	0	0	06-Sep-96		1996
Polonium-210	D	21/21	0	0.28	0.9	04-May-99	NA	1995–2000
	S	18/18	0	0.11	0.4	28-Aug-00		1995–2000
	T	1/1	0.5	0.5	0.5	06-Sep-96		1996
Radium-226	D	19/19	0	0.13	0.4	21-Mar-96	5 (MCL radium-226/228)	1995–2000
	S	18/18	0	0.006	0.1	30-Oct-95		1995–2000
	T	2/2	0	0.05	0.1	06-Sep-96		1995, 1996
Thorium-230	D	20/20	0	0.07	0.4	06-Aug-98	NA	1995–2000
	S	17/17	0	0.04	0.2	04-May-99, 29-Jul-99		1995–2000
	T	1/1	0.1	0.1	0.1	06-Sep-96		1996

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
*The detect flag is "Y" even though the result value is zero.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended
T – total

Table 26. Surface soil sampling data (chemicals) from eight zones around the Cotter Mill and from Lincoln Park

Chemical		Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Lincoln Park	CV (ppm)
Arsenic	Range (ppm)	**33–69**	**19–39**	**14–42**	**10–40**	**16–38**	**17–60**	**17–33**	**19–86**	**13–50**	0.5 (CREG), 20 (c-EMEG, child)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (ppm)	**45**	**30**	**25**	**26**	**28**	**35**	**26**	**42**	**31**	
Beryllium	Range (ppm)	0.5–1.6	0.5–0.9	0.6–1	0.5–1.2	0.6–1.7	0.5–0.7	0.6–0.7	0.5–0.9	0.5–1.7	100 (c-EMEG, child)
	Frequency of Detection	9/10	11/12	9/12	10/10	6/8	8/8	4/4	7/8	72/73	
	Average (ppm)	0.8	0.7	0.7	0.6	0.7	0.6	0.7	0.6	0.7	
Cadmium	Range (ppm)	**1.2–15**	**2.1–13**	**2.2–16**	2.5–6.8	**5.3–18**	**8.9–110**	**1.6–20**	**4.4–51**	0.5–5	10 (c-EMEG, child)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	68/73	
	Average (ppm)	6.9	6.4	6.4	4.1	9.8	**36.5**	7.9	**21.1**	1.4	
Lead	Range (ppm)	43–270	45–240	46–260	47–130	100–280	**68–800**	**37–450**	**61–1,400**	17–270	400 (SSL)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (ppm)	132	104	113	74	173	380	201	**445**	120	
Manganese	Range (ppm)	180–480	320–630	200–500	110–750	150–420	140–400	200–370	210–770	290–640	3,000 (RMEG , child)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (ppm)	336	422	356	391	298	268	290	439	424	
Selenium	Range (ppm)	5–7	39	7–16	5	ND	ND	ND	7	5–44	300 (c-EMEG, child)
	Frequency of Detection	5/10	1/12	2/12	1/10	0/8	0/8	0/4	1/8	7/73	
	Average (ppm)	4.2*	5.5*	4*	2.8*	ND	ND	ND	3.1*	3.5*	

Source: Weston 1998

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.

Each sample is a composite of four subsamples collected from the corners of a 10x10 square established near the center of the grid.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.
See Figure for a map of the sampling zones.

* The calculated averages are lower than the minimum detected concentrations due to including ½ the detection limit in the calculation.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
ND – not detected
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 27. Surface soil sampling data (radionuclides) from eight zones around the Cotter Mill and from Lincoln Park

Radionuclide		Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Lincoln Park	CV (pCi/g)
Lead-210	Range (pCi/g)	1.6–9.7	3.0–14.4	2.5–6.0	2.3–4.5	2.6–6.1	2.7–4.9	1.2–4.4	1.5–4.7	0.7–4.2	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	58/58	
	Average (pCi/g)	6.3	8.2	4.1	3.4	4.4	3.9	2.9	2.6	2.1	
Radium-226	Range (pCi/g)	2.4–10.7	3.6–16.5	1.3–5.7	1.4–2.3	2.5–5.6	1.9–3.0	1.4–1.9	1.2–2.2	1.1–2.2	5 (UMTRCA, surface)
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	58/58	
	Average (pCi/g)	6.6	9.2	2.6	1.8	3.9	2.5	1.7	1.5	1.5	
Thorium-230	Range (pCi/g)	3.6–35.3	5.8–40.1	1.6–21.7	1.8–4.4	4.3–12.1	3.6–8.3	1.7–2.8	1.6–11.9	1.0–4.2	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	58/58	
	Average (pCi/g)	17.7	20.9	5.9	2.5	7.7	5.2	2.4	3.3	1.7	
Uranium, natural	Range (pCi/g)	0.871–4.288	1.541–5.427	0.737–5.628	0.737–1.64	1.005–2.412	0.6432–1.943	0.5561–1.005	0.536–1.206	0.6566–3.417	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (pCi/g)	2.45	3.29	1.98	1.17	1.52	1.21	0.83	0.73	1.215	
Uranium-234	Range (pCi/g)	0.436–2.14	0.771–2.71	0.369–2.81	0.369–0.82	0.503–1.21	0.322–0.972	0.278–0.503	0.268–0.603	0.328–1.709	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (pCi/g)	1.23	1.65	0.991	0.584	0.758	0.606	0.413	0.366	0.607	

Radionuclide		Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Lincoln Park	CV (pCi/g)
Uranium-238	Range (pCi/g)	0.436–2.14	0.771–2.71	0.369–2.81	0.369–0.82	0.503–1.21	0.322–0.972	0.278–0.503	0.268–0.603	0.328–1.709	NA
	Frequency of Detection	10/10	12/12	12/12	10/10	8/8	8/8	4/4	8/8	73/73	
	Average (pCi/g)	1.23	1.65	0.991	0.584	0.758	0.606	0.413	0.366	0.607	

Source: Weston 1998

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that radionuclide.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.
Each sample is a composite of four subsamples collected from the corners of a 10x10 square established near the center of the grid.
See Figure for a map of the sampling zones.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 28. Surface soil sampling data (radionuclides) from the county road and the Cotter Uranium Mill access road

Radionuclide		Samples from background areas	Samples along the county road	Samples along the access road*	CV
Radium-226	Range (pCi/g)	0.8–2.1	3.8–**14**	2.7–**351**	5 pCi/g (UMTRCA, surface)
	Frequency of Detection	5/5	5/5	6/6	
	Average (pCi/g)	1.42	7.7	**65**	
Thorium-230	Range (pCi/g)	0.2–2.4	9.7–25	10–395	NA
	Frequency of Detection	3/5	5/5	6/6	
	Average (pCi/g)	1.53	20	87	
Uranium, natural	Range (ppm)	1.18–3.05	5.28–29.2	4.31–**922**	100 ppm (i-EMEG, child for highly soluble salts)
	Frequency of Detection	5/5	5/5	6/6	
	Average (ppm)	1.87	13.6	**161**	
Uranium-238**	Range (pCi/g)	0.39–1.01	1.74–9.64	1.42–304	NA
	Frequency of Detection	5/5	5/5	6/6	
	Average (pCi/g)	0.62	4.5	53	
Gamma Exposure Rates	Range (µR/hr)	NA	13.8–55.3	18.6–893	NA
	Frequency of Detection	NA	NA	NA	
	Average (µR/hr)	15.7	25.8	73.7	

Source: MFG 2005

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value.
Each sample consists of 10 aliquots taken from 0–6 inches within a 100 m^2 area.
See Figure for a map of the sampling locations.

*There is limited potential for exposure to contaminants along the access road since access to the Cotter Mill is restricted and soils along the access road were remediated in 2007 and 2008.
**Uranium-238 concentrations were calculated by multiplying the natural uranium concentrations by 0.33.

CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
µR/hr – microroentgen per hour
NA – not available
pCi/g – picocuries per gram
ppm – parts per million
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 29. Soil data (chemicals) from samples taken by CDPHE, January 2003

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Location of Maximum	CV (ppm)
Lead	20/20	23	410	3,651*	Private barn in Lincoln Park (dust sample)	400 (SSL)
Molybdenum	0/20	ND**	ND**	ND**	--	300 (RMEG , child)
Uranium	20/20	1.2	6.0	31	Mill Entrance Road	100 (i-EMEG, child for highly soluble salts)

Source: CDPHE 2003, 2007b

Concentrations from the Background Location[§]

Lead	36 ppm
Molybdenum	ND
Uranium	1.3 ppm

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
See Figure for a map of the sampling locations.
The sampling event was intentionally biased toward finding the highest amounts of contamination possible (CDPHE 2003).

*The second highest lead concentration is 908 ppm from a location northwest of the Cotter Mill.
**The molybdenum detection limit was 25 ppm.
[§] Concentrations from the background location on the corner of Orchard Avenue and High Street were not included in the table.

CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ND – not detected
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA's soil screening level for residential areas

Table 30. Soil data (radionuclides) from samples taken by CDPHE, January 2003

Radionuclide	Frequency of Detection	Minimum (pCi/g)	Average (pCi/g)	Maximum (pCi/g)	Location of Maximum	CV (pCi/g)
Cesium-137	20/20	0	0.64	1.33	Private residence in Lincoln Park (dust sample)	NA
Lead-210	20/20	1.9	9.7	22.8	East of the Cotter Mill	NA
Plutonium-239, 240	9/20	0.03	0.03*	0.06	East of the Cotter Mill & a private residence in Lincoln Park (dust sample)	NA
Potassium-40	20/20	17.6	22.6	31.9	East of the Cotter Mill	NA
Radium-226	20/20	1.4	7.8	21.2	East of the Cotter Mill	15 (UMTRCA, subsurface)
Radium-228	20/20	0.6	1.0	1.3	Private barn in Lincoln Park (dust sample), private residence in Lincoln Park (dust sample), Pine St near Elm Ave in Lincoln Park (sediment sample), Northwest of the Cotter Mill	15 (UMTRCA, subsurface)

Source: CDPHE 2003, 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that radionuclide.
Averages were calculated using ½ the reporting detection limit for non-detects.
See Figure for a map of the sampling locations.
The sampling event was intentionally biased toward finding the highest amounts of contamination possible (CDPHE 2003).

* The calculated average is the same as the minimum detected concentration due to including ½ the detection limit in the calculation.
** Concentrations from the background location on the corner of Orchard Avenue and High Street were not included in the table.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Concentrations from the Background Location**

Cesium-137	0.2 pCi/g
Lead-210	3.2 pCi/g
Plutonium-239, 240	ND
Potassium-40	19.5 pCi/g
Radium-226	1.9 pCi/g
Radium-228	1.0 pCi/g

Table 31. Surface soil sampling data from 10 air monitoring locations

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Location of Maximum	Date of Maximum	Years Sampled	CV (ppm)
Molybdenum	106/134	0.6	15.1	251.3	AS-204 (West Boundary)	2002	1992–2006*	300 (RMEG, child)
Radionuclide	**Frequency of Detection**	**Minimum (pCi/g)**	**Average (pCi/g)**	**Maximum (pCi/g)**	**Location of Maximum**	**Date of Maximum**	**Years Sampled**	**CV (pCi/g)**
Radium-224**	10/10	-5.7	-2.9	0.3	Lincoln Park	2006	2006	5 (UMTRCA, surface)
Radium-226	246/251	<0.5	3.9	**53.5**	AS-209 (Mill Entrance Road)	2002	1979–2006†	5 (UMTRCA, surface)
Thorium-230	107/107	0.4	22.2	354	AS-209 (Mill Entrance Road)	2002	1996–2006	NA
Thorium-232	60/60	0.5	1.4	7.9	AS-209 (Mill Entrance Road)	2002	2001–2006	NA
Uranium	258/262	<0.001	4.6	73.6	AS-209 (Mill Entrance Road)	2002	1979–2006	NA

Source: Cotter 2007; GeoTrans 1986

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value.
Uranium and radium-226 were also tested in soil from two additional off-site locations (Oro Verde #1 and Oro Verde #2) in 1983 and 1984.
See Figure for a map of the air monitoring locations.

*Data from 2006 are unavailable.
**Data are blank corrected.
†Results from 2005 were not reported based on quality assurance analysis (Cotter 2007).

CV – comparison value
NA – not available
pCi/g – picocuries per gram
ppm – parts per million
RMEG – reference dose media evaluation guide
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 32. Soil sampling data (chemicals) from location AS-212 (the Nearest Resident)

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Date of Maximum	Years Sampled	CV (ppm)
Lead	1/1	199	199	199	15-Jan-03	2003	400 (SSL)
Molybdenum	7/8	1.6	11.3	42.4	2005	1999–2005	300 (RMEG , child)
Uranium	1/1	4.9	4.9	4.9	15-Jan-03	2003	100 (i-EMEG, child for highly soluble salts)

Source: CDPHE 2007b, Cotter 2007

Averages were calculated using ½ the reporting detection limit for non-detects.
See Figure for the location of AS-212, the nearest resident.

CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 33. Soil sampling data (radionuclides) from location AS-212 (the Nearest Resident)

Radionuclide	Frequency of Detection	Minimum (pCi/g)	Average (pCi/g)	Maximum (pCi/g)	Date of Maximum	Years Sampled	CV (pCi/g)
Cesium-137	1/1	0.61	0.61	0.61	15-Jan-03	2003	NA
Lead-210	1/1	8	8	8	15-Jan-03	2003	NA
Plutonium-239, 240	1/1	0.03	0.03	0.03	15-Jan-03	2003	NA
Potassium-40	1/1	17.7	17.7	17.7	15-Jan-03	2003	NA
Radium-224*	1/1	-3.6	-3.6	-3.6	2006	2006	5 (UMTRCA, surface)
Radium-226	8/8	1.4	3.3	7.5	2004	1999–2004, 2006	5 (UMTRCA, surface)
Radium-228	1/1	0.9	0.9	0.9	15-Jan-03	2003	5 (UMTRCA, surface)
Thorium-230	8/8	3.3	10.1	20	2004	1999–2006	NA
Thorium-232	6/6	0.7	1.0	1.1	2001, 2002	2001–2006	NA
Uranium	8/8	2.0	5.2	13	2004	1999–2006	NA

Source: CDPHE 2007b, Cotter 2007

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that radionuclide.
See Figure for the location of AS-212, the nearest resident.

*Data are blank corrected.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 34. Surface soil sampling data (chemicals) from lawns and gardens in Lincoln Park

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	Location of Maximum	Years Sampled	CV (ppm)
Arsenic	15/15	31	44	50	garden soil	1996	0.5 (CREG), 20 (c-EMEG, child)
Beryllium	14/15	0.5	0.7	1.1	lawn soil	1996	100 (c-EMEG, child)
Cadmium	14/15	0.5	1.2	1.9	lawn soil	1996	10 (c-EMEG, child)
Manganese	15/15	290	428	640	lawn soil	1996	3,000 (RMEG , child)
Selenium	1/32	18	1.7*	18	garden soil	1990, 1996	300 (c-EMEG, child)

Source: Weston 1996 (some or all of these data may also be included in Table)

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.

* The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
ppm – parts per million
RMEG – reference dose media evaluation guide

Table 35. Surface soil sampling data (radionuclides) from yards, gardens, and air monitoring locations in Lincoln Park

Radionuclide	Frequency of Detection	Minimum (pCi/g)	Average (pCi/g)	Maximum (pCi/g)	Source of Maximum	Years Sampled	CV (pCi/g)
Lead-210	17/17	0.4	1.6	2.5	0–2” garden sample	1990	NA
Polonium-210	17/17	1.1	1.7	2.6	0–2” garden sample	1990	NA
Radium-226	19/19	0.8	1.5	2.0	0–2” garden sample	1987, 1988, 1990	5 (UMTRCA, surface)
Thorium-228	17/17	1.0	1.4	1.8	0–2” garden sample	1990	NA
Thorium-230	17/17	1.0	1.5	2.3	0–2” garden sample	1990	NA
Uranium-234	29/29	0.355	1.23	1.95	Soil from the yard of a participant in the LPWUS	1987–1990	NA
Uranium-235	0/17	ND*	ND*	ND*	--	1990	NA
Uranium-238	29/29	0.355	1.21	1.95	Soil from the yard of a participant in the LPWUS	1987–1990	NA

Source: Weston 1996

*The uranium-235 detection limit was 0.2 pCi/g.

CV – comparison value
LPWUS – Lincoln Park Water Use Survey
NA – not available
ND – not detected
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 36. Surface soil data (chemicals) from lawns and gardens in Lincoln Park

Chemical		Samples from locations irrigated with contaminated well water	Samples from locations not irrigated with contaminated well water	CV (ppm)
Arsenic	Range (ppm)	14–50	13–38	0.5 (CREG), 20 (c-EMEG, child)
	Frequency of Detection	26/26	47/47	
	Average (ppm)	**36***	**28***	
Beryllium	Range (ppm)	0.5–1.1	0.6–1.7	100 (c-EMEG, child)
	Frequency of Detection	25/26	47/47	
	Average (ppm)	0.7	0.8	
Cadmium	Range (ppm)	0.6–1.9	0.5–5	10 (c-EMEG, child)
	Frequency of Detection	23/26	45/47	
	Average (ppm)	1.2	1.5**	
Lead	Range (ppm)	17–270[†]		400 (SSL)
	Frequency of Detection	73/73[†]		
	Average (ppm)	122	121	
Manganese	Range (ppm)	290–640	320–580	3,000 (RMEG , child)
	Frequency of Detection	26/26	47/47	
	Average (ppm)	430	421**	
Molybdenum	Range (ppm)	*Data not available*[§]	*Data not available*[§]	300 (RMEG , child)
	Frequency of Detection	*Data not available*[§]	*Data not available*[§]	
	Average (ppm)	1.7*	0.5*	
Selenium	Range (ppm)	18	5–44	300 (c-EMEG, child)
	Frequency of Detection	1/26	6/47	
	Average (ppm)	3.1	3.8	
Uranium	Range (ppm)	*Data not available*[§]	*Data not available*[§]	100 (i-EMEG, child for highly soluble salts)
	Frequency of Detection	*Data not available*[§]	*Data not available*[§]	
	Average (ppm)	2.3*	1.6*	

Source: Weston 1998

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.

*The concentrations were statistically higher in irrigated soil samples.
**The calculated averages for cadmium and manganese differ slightly from the reported mean concentrations in Table 3-3.
[†] The raw data for lead are not presented by whether the samples were taken from locations irrigated with contaminated well water. However, Table 3-3 presents the mean concentrations by manner of irrigation.
[§] The raw data for molybdenum and uranium are not presented in the report. Therefore, the range and frequency of detection could not be determined. Table 3-3 presents the mean concentrations.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA's soil screening level for residential areas

Table 37. Surface soil data (radionuclides) from lawns and gardens in Lincoln Park

Radionuclide		Samples from locations irrigated with contaminated well water	Samples from locations not irrigated with contaminated well water	CV (pCi/g)
Lead-210	Range (pCi/g)	0.8–3.0	0.7–4.2	NA
	Frequency of Detection	11/11	47/47	
	Average (pCi/g)	2.2	2.1*	
Radium-226	Range (pCi/g)	1.3–1.7	1.1–2.2	5 (UMTRCA, surface)
	Frequency of Detection	11/11	47/47	
	Average (pCi/g)	1.4	1.5	
Thorium-230	Range (pCi/g)	1.1–2.2	1.0–4.2	NA
	Frequency of Detection	11/11	47/47	
	Average (pCi/g)	1.6*	1.7	
Uranium, natural	Range (pCi/g)	0.871–3.417	0.6566–2.077	NA
	Frequency of Detection	26/26	47/47	
	Average (pCi/g)	1.514	1.05	
Uranium-234	Range (pCi/g)	0.436–1.709	0.328–1.039	NA
	Frequency of Detection	26/26	47/47	
	Average (pCi/g)	0.755	0.525	
Uranium-238	Range (pCi/g)	0.436–1.709	0.328–1.039	NA
	Frequency of Detection	26/26	47/47	
	Average (pCi/g)	0.755	0.525	

Source: Weston 1998

The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.

*The calculated averages for lead-210 and thorium-230 differ slightly from the reported mean concentrations in Table 3-3.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 38. Sediment sampling data (chemicals) from Sand Creek

Chemical	**Location Concentration (ppm)**						**CV (ppm)**
	SD01	**SD02***	**SD04**			**SD05**	
			1	**2**	**3**		
Arsenic	NA	13.7	13	NA	17	<5	20 (c-EMEG, child)
Cadmium	NA	3.9	7.2	NA	7.6	1.5	10 (c-EMEG, child)
Cobalt	NA	11.3	43	NA	21	10	500 (i-EMEG, child)
Copper	19	52.3	46	NA	38	19	500 (i-EMEG, child)
Lead	27	106	93	NA	130	22	400 (SSL)
Molybdenum	4.4	2.6	8	NA	7.9	9.4	300 (RMEG , child)
Nickel	NA	17	63	NA	28	18	1,000 (RMEG, child)
Zinc	NA	343	540	NA	580	106	20,000 (c-EMEG, child)

Source: GeoTrans 1986

SD01 – mouth near the Arkansas River
SD02 – near spring where flow begins (reflects migration of contaminants in the groundwater)
SD04 – below the SCS Dam in
  (1) an abandoned stock watering pond (formed by diversion of runoff water into a depression adjacent to Sand Creek)
  (2) in drainage (reflects historical picture of uncontrolled emissions)
  (3) in drainage above #2 (reflects historical picture of uncontrolled emissions)
SD05 – above the SCS Dam adjacent to the west property edge

Bolded text indicates that the concentration exceeded the comparison value for that chemical.
Samples were collected July 10–20, 1985.

*Values are the mean of three field replicates.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA's soil screening level for residential areas

Table 39. Sediment sampling data (radionuclides) from Sand Creek

Radionuclide	Location Average (pCi/g)						CV
	SD01	SD02	SD04			SD05	
			1	2	3		
Gross Alpha	22±3	47±9	240±40	74±9	39±7	22±5	NA
Gross Beta	29±6	43±8	90±20	34±7	32±7	32±6	NA
Radium-226	1.21±0.06	1.7±1	**12.8±0.6**	3.5±0.2	3.4±0.2	2.3±1	5 (UMTRCA, surface)
Throium-230	4.6±0.3	34±2	82±4	32±2	15.5±0.8	5.2±0.3	NA
Total Uranium	2.4	4.3	11.7	3.4	3.4	3.9	NA

Source: GeoTrans 1986

SD01 – mouth near the Arkansas River
SD02 – near spring where flow begins (reflects migration of contaminants in the groundwater)
SD04 – below the SCS Dam in
  (1) an abandoned stock watering pond (formed by diversion of runoff water into a depression adjacent to Sand Creek)
  (2) in drainage (reflects historical picture of uncontrolled emissions)
  (3) in drainage above #2 (reflects historical picture of uncontrolled emissions)
SD05 – above the SCS Dam adjacent to the west property edge

Bolded text indicates that the concentration exceeded the comparison value for that radionuclide.
Samples were collected July 10–20, 1985.

CV – comparison value
NA – not available
pCi/g – picocuries per gram
UMTRCA – 1978 Uranium Mill Tailings Radiation Control Act

Table 40. Chemical sampling for the Sand Creek Cleanup Project

Chemical	Frequency of Detection	Minimum (ppm)	Average (ppm)	Maximum (ppm)	CV (ppm)
Arsenic	7/7	2.7	3.9	6.9	20 (c-EMEG, child)
Barium	7/7	69	106	160	10,000 (c-EMEG, child)
Beryllium	7/7	0.2	0.3	0.6	100 (c-EMEG, child)
Chromium	7/7	7.4	9.5	12.8	200 (RMEG, child for hexavalent chromium)
Lead	7/7	17	35	75	400 (SSL)
Manganese	7/7	258	343	502	3,000 (RMEG , child)
Molybdenum	7/7	2.1	2.8	3.5	300 (RMEG , child)
Nickel	7/7	8	10.9	16	1,000 (RMEG , child)
Selenium	0/7	ND*	ND*	ND*	300 (c-EMEG, child)
Vanadium	7/7	16.1	20.3	26.1	200 (i-EMEG, child)

Source: Cotter 2000

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Samples were collected in April and May 1998.

*The selenium detection limit was 5 ppm.

c-EMEG – chronic environmental media evaluation guide
CREG – cancer risk evaluation guide
CV – comparison value
i-EMEG – intermediate environmental media evaluation guide
ND – not detected
ppm – parts per million
RMEG – reference dose media evaluation guide
SSL – EPA’s soil screening level for residential areas

Table 41. Surface water sampling data (chemicals) from Sand Creek

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	0/2	ND	ND	ND	--	10 (c-EMEG, child)	1988
Ammonia	N	2/35	0.5	0.43*	0.8	10-Nov-88	30 (LTHA)	1988–1994
Ammonium	T	0/3	ND	ND	ND	--	NA	1995
Chloride	N/T**	92/92	3	8	14	13-May-04	250 (Secondary MCL)	1986–2007
Iron	D	21/55	0.03	0.04	0.26	07-Nov-02	26 (RBC)	1986–1988, 1995–2007
Manganese	D	36/55	0.0084	0.04	**1.3**†	19-Nov-01	0.5 (RMEG, child)	1986–1988, 1995–2007
Molybdenum	D	98/104	0.005	0.02	**0.051**†	01-Dec-87	0.035 (SS); 0.05 (RMEG, child)	1986–2007
Nitrate	N/T**	75/87	0.5	1.1	4.7	03-May-06	10 (MCL)	1988–2007
Selenium	D	0/8	ND	ND	ND	--	0.05 (c-EMEG, child)	1986–1988
Sulfate	N/T**	94/94	12	65	**310**†	11-Oct-96	250 (Secondary MCL)	1986–2007
Total Dissolved Solids	N/T**	99/99	10.7	369	**1,372**‡	22-Aug-91	500 (Secondary MCL)	1986–2007
Uranium	D	101/101	0.006	0.012	0.0267	01-Aug-95	0.03 (MCL)	1986–2007
	S	8/48	0.000098	0.001	0.0031	10-Jan-00		1995–2007

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
* The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated "N" and post-1995 data were designated "T".
† Only the maximum concentration was above the CV.
‡ This appears to be an outlier. The next highest concentration is 460 mg/L. Only the maximum concentration was above the CV.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
NA – not available
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 42. Surface water sampling data (radionuclides) from Sand Creek

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Date of Maximum	CV (pCi/L)	Years Sampled
Lead-210	D	40/49	-0.2	0.39	3.7	06-Aug-07	NA	1995–2007
	S	40/49	-0.1	0.40	4.6	06-Aug-07		1995–2007
Polonium-210	D	41/49	-0.1	0.15	0.6	28-Nov-06	NA	1995–2007
	S	40/49	0	0.13	1.6	09-Nov-99		1995–2007
Radium-226	D	45/49	0	0.12	0.6	03-May-06	5 (MCL radium-226/228)	1995–2007
	S	42/47	0	0.06	0.4	09-Nov-99, 28-Nov-06		1995–2007
Thorium-230	D	44/49	-0.1	0.13	0.8	28-Nov-06	NA	1995–2007
	S	41/46	0	0.16	0.9	06-Aug-07		1995–2007

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended

Table 43. Surface water sampling data (chemicals) from the DeWeese Dye Ditch

Chemical	Type	Frequency of Detection	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Date of Maximum	CV (mg/L)	Years Sampled
Aluminum	D	1/4	0.02	0.06*	0.02	14-Jun-95	10 (c-EMEG, child)	1981, 1995
Ammonia	N	0/2	ND	ND	ND	--	30 (LTHA)	1989, 1995
Chloride	N/T**	95/102	2	7	18	08-May-01	250 (Secondary MCL)	1981–1989, 1995–2007
Iron	D	22/50	0.029	0.9	**43**[†]	09-Jun-99	26 (RBC)	1981–1987, 1995–2007
Manganese	D	28/50	0.004	0.05	**1.9**[‡]	09-Jun-99	0.5 (RMEG, child)	1981–1987, 1995–2007
Molybdenum	D	10/120	0.001	0.013[§]	0.013	06-Aug-03	0.035 (SS); 0.05 (RMEG, child)	1981–2007
Nitrate	N/T**	7/26	0.1	0.3	0.8	10-May-00, 02-Aug-06	10 (MCL)	1989, 1995–2007
Selenium	D	4/76	0.005	0.003[††]	0.011	22-Jun-87, 25-Apr-88	0.05 (c-EMEG, child)	1981–1988, 1995
Sulfate	N/T**	102/102	6	31	95	28-Apr-82	250 (Secondary MCL)	1981–1989, 1995–2007
Total Dissolved Solids	N/T**	119/119	12.9	231	**1,647**[‡‡]	10-Sep-90	500 (Secondary MCL)	1981–2007
Uranium	D	86/116	0.0004	0.01	**0.11**[§§]	05-May-83	0.03 (MCL)	1981–2007
	S	0/8	ND	ND	ND	--		1996–1999

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.

---

* The calculated average is higher than the maximum detected concentration due to including ½ the detection limit in the calculation.

** For chloride, nitrate, sulfate, and total dissolved solids, pre-1995 data were designated “N” and post-1995 data were designated “T”.

[†] This appears to be an outlier. The next highest concentration is 0.24 mg/L from the same location in 2003. Only the maximum concentration was above the CV.

[‡] Only the maximum concentration was above the CV.

[§] The calculated average is the same as the maximum detected concentration due to including ½ the detection limit in the calculation.

[††] The calculated average is the lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
[‡‡] This appears to be an outlier. The next highest concentration is 870 mg/L. Only three of the 119 samples were above the CV.
[§§] Only three of the samples were above the CV.

c-EMEG – chronic environmental media evaluation guide
CV – comparison value
D – dissolved
LTHA – lifetime health advisory for drinking water
MCL – maximum contaminant level
mg/L – milligrams per liter
N – not defined in the CDPHE database
ND – not detected
RBC – risk based concentration for drinking water
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 44. Surface water sampling data (radionuclides) from the DeWeese Dye Ditch

Radionuclide	Type	Frequency of Detection	Minimum (pCi/L)	Average (pCi/L)	Maximum (pCi/L)	Date of Maximum	CV (pCi/L)	Years Sampled
Lead-210	D	8/8	0	0.3	1.2	09-May-96	NA	1996–1999
	S	8/8	0	0.09	0.2	12-May-97		1996–1999
Polonium-210	D	8/8	0	0.1	0.2	09-Jun-99, 02-Sep-99	NA	1996–1999
	S	8/8	0	0.05	0.2	09-Jun-99		1996–1999
Radium-226	D	8/8	0	0.04	0.1	09-May-96, 16-Jul-96, 02-Sep-99	5 (MCL radium-226/228)	1996–1999
	S	7/7	0	0.01	0.1	02-Sep-99		1996–1999
Thorium-230	D	8/8	0	0.025	0.2	12-May-97	NA	1996–1999
	S	7/7	0	0.07	0.2	09-Sep-98		1996–1999

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
pCi/L – picocuries per liter
S – suspended

Table 45. Surface water sampling data (chemicals) from the Arkansas River

Chemical	Type		Upstream of Sand Creek at 1st Street (907)	Downstream of Sand Creek at Mackenzie Ave (904)	CV (mg/L)
Chloride	T	Range (mg/L)	3–60	3–14	250 (Secondary MCL)
		Frequency of Detection	127/130	127/130	
		Average (mg/L)	8	8	
Molybdenum	D	Range (mg/L)	0.0029–**0.046**	0.003–0.029	0.035 (SS); 0.05 (RMEG, child)
		Frequency of Detection	32/142	46/142	
		Average (mg/L)	0.025	0.025	
Molybdenum	S	Range (mg/L)	0.0019–0.022	0.0017–0.016	0.035 (SS); 0.05 (RMEG, child)
		Frequency of Detection	8/135	6/135	
		Average (mg/L)	0.025	0.025	
Molybdenum	T	Range (mg/L)	0.006	0.005	0.035 (SS); 0.05 (RMEG, child)
		Frequency of Detection	1/7	1/7	
		Average (mg/L)	0.003*	0.003*	
Sulfate	T	Range (mg/L)	10–1,300**	5–4,200**	250 (Secondary MCL)
		Frequency of Detection	130/130	130/130	
		Average (mg/L)	41	84	
Total Dissolved Solids	T	Range (mg/L)	45–**2,880**†	62–337	500 (Secondary MCL)
		Frequency of Detection	130/130	130/130	
		Average (mg/L)	172	192	
Uranium	D	Range (mg/L)	0.0003– 0.0135	0.0002–0.0155	0.03 (MCL)
		Frequency of Detection	129/130	130/130	
		Average (mg/L)	0.004	0.005	
Uranium	S	Range (mg/L)	0.0002– 0.014	0.0002–0.0043	0.03 (MCL)
		Frequency of Detection	16/121	14/121	
		Average (mg/L)	0.001	0.001	
Uranium	T	Range (mg/L)	0.0033–0.0056	0.0029–0.0054	0.03 (MCL)
		Frequency of Detection	7/7	7/7	
		Average (mg/L)	0.004	0.004	

Source: CDPHE 2007b

Bolded text indicates that the average and/or maximum concentration exceeded the comparison value for that chemical.
Averages were calculated using ½ the reporting detection limit for non-detects.
All samples were collected between 1995 and 2007. The "T" samples for uranium were only collected in 1995.
* The calculated average is lower than the minimum detected concentration due to including ½ the detection limit in the calculation.
** This appears to be an outlier. The next highest concentration is 200 mg/L. Only the maximum concentration was above the CV.
† This appears to be an outlier. The next highest concentration is 405 mg/L. Only the maximum concentration was above the CV.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
mg/L – milligrams per liter
RMEG – reference dose media evaluation guide
S – suspended
SS – Colorado state groundwater standard
T – total

Table 46. Surface water sampling data (radionuclides) from the Arkansas River

Radionuclide	Type		Upstream of Sand Creek at 1st Street (907)	Downstream of Sand Creek at Mackenzie Ave (904)	CV (pCi/L)
Lead-210	D	Range (pCi/L)	ND	3.7	NA
		Frequency of Detection	0/1	1/1	
		Average (pCi/L)	ND	3.7	
Lead-210	S	Range (pCi/L)	ND	0	NA
		Frequency of Detection	0/1	1/2	
		Average (pCi/L)	ND	0.25*	
Polonium-210	D	Range (pCi/L)	ND	ND	NA
		Frequency of Detection	0/1	0/1	
		Average (pCi/L)	ND	ND	
Polonium-210	S	Range (pCi/L)	ND	0.26–3.3	NA
		Frequency of Detection	0/1	2/2	
		Average (pCi/L)	ND	1.8	
Radium-226	D	Range (pCi/L)	0–0.6	0–0.4	5 (MCL radium-226/228)
		Frequency of Detection	119/128	116/127	
		Average (pCi/L)	0.13	0.07	
Radium-226	S	Range (pCi/L)	0–0.8	0–2.3	5 (MCL radium-226/228)
		Frequency of Detection	114/120	112/119	
		Average (pCi/L)	0.08	0.09	
Radium-226	T	Range (pCi/L)	0.1–0.7	0.1–0.7	5 (MCL radium-226/228)
		Frequency of Detection	7/7	7/7	
		Average (pCi/L)	0.3	0.3	
Thorium-230	D	Range (pCi/L)	-0.1–1	-0.1–1.2	NA
		Frequency of Detection	121/127	116/127	
		Average (pCi/L)	0.1	0.1	
Thorium-230	S	Range (pCi/L)	0–2.5	0–2.4	NA
		Frequency of Detection	115/120	113/119	
		Average (pCi/L)	0.2	0.2	
Thorium-230	T	Range (pCi/L)	0.1–0.7	0–0.6	NA
		Frequency of Detection	7/7	7/7	
		Average (pCi/L)	0.3	0.2	

Source: CDPHE 2007b

Averages were calculated using ½ the reporting detection limit for non-detects.
Negative and zero result values were included in the summary statistics.
Radium-226 and thorium-230 “D” and “S” samples were collected between 1995 and 2007. The radium-226 and thorium-230 “T” samples were only collected in 1995. Lead-210 and polonium-210 were sampled upstream (907) in 2005 (“D” and “S”) and downstream (904) in 2005 (“D”) and 2006 (“D” and “S”).

* The calculated average is higher than the detected concentration due to including ½ the detection limit in the calculation.

CV – comparison value
D – dissolved
MCL – maximum contaminant level
NA – not available
ND – not detected
pCi/L – picocuries per liter
S – suspended
T – total

Table 47. Sampling data (chemicals) for local and supermarket foods

Chemical	Food Type	Average (mg/kg)	
		Local	Supermarket
Barium*	Vegetables	4.75	NA
Cadmium*	Vegetables	0.215	NA
Chromium*	Vegetables	0.095	NA
Manganese*	Vegetables	11.25	NA
Molybdenum	Chicken	0.19	0.72
	Fruits	0.079	0.017
	Vegetables	0.667	0.023
Selenium	Chicken	0.31	0.18
	Fruits	0.024	0.017
	Vegetables	0.061	0.020
Strontium*	Vegetables	22	NA
Uranium	Chicken	0.061	0.001
	Fruits	0.0056	0.0013
	Vegetables	0.0043	0.0013
Vanadium*	Vegetables	0.105	NA
Zinc*	Vegetables	7.5	NA

Source: Weston 1996

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.
Vegetables were also tested for arsenic, beryllium, cobalt, lead, mercury, nickel, and silver, but none of these chemicals were detected.

*Chicken and fruits were not analyzed for these chemicals.

NA – not available
mg/kg – milligrams per kilogram

Table 48. Sampling data (radionuclides) for local and supermarket foods

Radionuclide	Food Type	Average (pCi/kg)	
		Local	Supermarket
Lead-210	Chicken	1.26	1.70
	Fruits	1.48	1.18
	Vegetables	0.58	0.60
Polonium-210	Chicken	3.79	21.75
	Fruits	2.26	1.30
	Vegetables	1.13	1.56
Radium-226	Chicken	0.64	2.60
	Fruits	1.34	0.05
	Vegetables	1.37	0.07
Thorium-228	Chicken	0.39	ND
	Fruits	0.33	ND
	Vegetables	0.41	1.42
Thorium-230	Chicken	1.01	0.53
	Fruits	1.85	ND
	Vegetables	0.27	0.29
Uranium-234	Chicken	1.10	1.05
	Fruits	1.53	0.34
	Vegetables	0.55	0.76
Uranium-235	Chicken	ND	0.36
	Fruits	0.13	0.13
	Vegetables	0.13	0.14
Uranium-238	Chicken	1.59	0.53
	Fruits	1.41	0.23
	Vegetables	0.44	0.25

Source: Weston 1996

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.

ND – not detected
pCi/kg – picocuries per kilogram

Table 49. Sampling data (chemicals) for local produce irrigated with contaminated well water

Chemical		Fruits	Vegetables
Arsenic	Frequency of Detection	2/16	14/43
	Average (mg/kg)	0.051	0.077
	Maximum (mg/kg)	0.2	0.4
Barium	Frequency of Detection	7/16	33/43
	Average (mg/kg)	0.44	1.6
	Maximum (mg/kg)	0.9	15
Cadmium	Frequency of Detection	2/16	18/43
	Average (mg/kg)	0.041	0.034
	Maximum (mg/kg)	0.23	0.14
Chromium	Frequency of Detection	12/16	39/43
	Average (mg/kg)	0.052	0.056
	Maximum (mg/kg)	0.1	0.19
Cobalt	Frequency of Detection	0/16	6/43
	Average (mg/kg)	ND	0.02
	Maximum (mg/kg)	ND	0.07
Lead	Frequency of Detection	3/16	26/43
	Average (mg/kg)	0.13	0.2
	Maximum (mg/kg)	1.2	1.9
Manganese	Frequency of Detection	16/16	43/43
	Average (mg/kg)	0.87	2.4
	Maximum (mg/kg)	1.8	11
Molybdenum	Frequency of Detection	6/16	41/43
	Average (mg/kg)	0.11	0.68
	Maximum (mg/kg)	0.3	9.8
Nickel	Frequency of Detection	0/16	2/43
	Average (mg/kg)	ND	0.075
	Maximum (mg/kg)	ND	0.2
Strontium	Frequency of Detection	16/16	43/43
	Average (mg/kg)	1.6	4.9
	Maximum (mg/kg)	8.5	33
Uranium	Frequency of Detection	3/16	14/43
	Average (mg/kg)	0.0074	0.0071
	Maximum (mg/kg)	0.035	0.041
Vanadium	Frequency of Detection	0/16	16/43
	Average (mg/kg)	ND	0.046
	Maximum (mg/kg)	ND	0.21

Chemical		**Fruits**	**Vegetables**
Zinc	Frequency of Detection	16/16	43/43
	Average (mg/kg)	1.4	3.1
	Maximum (mg/kg)	4.0	10

Source: Weston 1998

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.

ND – not detected
mg/kg – milligrams per kilogram

Table 50. Sampling data (radionuclides) for local produce irrigated with contaminated well water

Radionuclide		Fruits	Vegetables
Lead-210	Frequency of Detection	3/16	8/43
	Average (pCi/kg)	12	21
	Maximum (pCi/kg)	21	51
Radium-226	Frequency of Detection	1/16	15/43
	Average (pCi/kg)	5.7	6.2
	Maximum (pCi/kg)	18	41
Thorium-230	Frequency of Detection	1/16	8/43
	Average (pCi/kg)	3.9	5.1
	Maximum (pCi/kg)	10	20
Uranium (natural)	Frequency of Detection	3/16	14/43
	Average (pCi/kg)	5.0	4.8
	Maximum (pCi/kg)	23	27

Source: Weston 1998

Averages were calculated using ½ the reporting detection limit for non-detects.
Concentrations are reported on a wet weight basis.
The dates the samples were collected were not specified in the report. It is assumed to be in the 1994–1996 timeframe.
pCi/kg – picocuries per kilogram

Table 51. Characteristics of Cotter Mill's Ambient Air Monitoring Stations

Monitor Code	*Monitor Location*	*Years of Operation*	*Monitor Type*	*Area Description*
AS-202	East Boundary	1979 – present	Perimeter	Eastern perimeter of Cotter Mill facility
AS-203	South Boundary	1979 – present	Perimeter	Southern perimeter of Cotter Mill facility
AS-204	West Boundary	1979 – present	Perimeter	Western perimeter of Cotter Mill facility
AS-206	North Boundary	1981 – present	Perimeter	Northern perimeter of Cotter Mill facility
AS-209	Mill entrance road	1994 – present	Perimeter	Entrance road to Cotter Mill
AS-210	Shadow Hills Estates	1997 – present	Off-site	Near Shadow Hills Golf Club
AS-212	Nearest resident	1999 – present	Off-site	Residential
LP-1/LP-2	Lincoln Park	1980 – present	Off-site	Residential
CC-1/CC-2	Cañon City	1979 – present	Off-site	Residential
OV-3	Oro Verde	1981 – present	Off-site	Remote (1 mile west of AS-204)

Notes: Both the Lincoln Park and Cañon City monitoring stations moved locations in the 1991-1992 time frame. The original station in Lincoln Park (LP-1) operated from 1980 to 1992, and the new station (LP-2) operated from 1991 to the present. The original station in Cañon City (CC-1) operated from 1979 to 1992, and the new station (CC-2) operated from 1991 to the present.

Table 52. Average Annual ^{nat}U Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	6.19E-15	1.50E-15	2.26E-15	--	--	--	--	--	1.00E-15	--
1980	3.71E-15	1.55E-15	2.82E-15	--	--	--	--	8.36E-16	1.40E-15	--
1981	4.07E-15	1.54E-15	5.28E-15	8.30E-15	--	--	--	1.03E-15	1.02E-15	1.37E-15
1982	2.31E-15	1.26E-15	2.48E-14	2.79E-15	--	--	--	5.28E-16	4.79E-16	5.96E-16
1983	1.26E-15	1.43E-15	1.32E-15	1.63E-15	--	--	--	4.77E-16	6.86E-16	5.03E-16
1984	5.50E-16	7.64E-16	8.36E-16	1.52E-15	--	--	--	2.78E-16	3.27E-16	4.01E-16
1985	1.42E-15	1.22E-15	8.96E-16	1.92E-15	--	--	--	4.56E-16	5.77E-16	6.66E-16
1986	6.71E-16	6.56E-16	4.05E-16	9.36E-16	--	--	--	2.95E-16	2.93E-16	4.84E-16
1987	8.08E-16	1.03E-15	1.09E-15	1.05E-15	--	--	--	4.66E-16	5.12E-16	4.60E-16
1988	6.73E-16	6.96E-16	9.03E-16	5.51E-16	--	--	--	1.85E-16	1.95E-16	1.89E-16
1989	9.58E-17	9.95E-17	2.86E-16	3.62E-17	--	--	--	8.37E-17	9.38E-17	6.38E-17
1990	5.59E-17	3.14E-17	1.06E-16	3.10E-17	--	--	--	6.18E-17	1.26E-16	9.09E-17
1991	1.12E-16	9.18E-17	2.65E-16	1.24E-16	--	--	--	1.70E-16	1.73E-16	2.60E-16
1992	6.55E-17	7.84E-17	1.12E-16	6.48E-17	--	--	--	9.71E-17	9.40E-17	8.23E-17
1993	7.13E-17	9.08E-17	1.61E-16	6.30E-17	--	--	--	8.26E-17	1.20E-16	2.55E-16
1994	1.25E-16	4.68E-17	1.00E-16	3.68E-17	1.55E-16	--	--	9.68E-17	8.12E-17	2.54E-16
1995	2.99E-16	5.86E-17	1.53E-16	5.23E-17	2.11E-16	--	--	9.34E-17	1.26E-16	4.83E-16
1996	2.25E-16	1.43E-16	2.26E-16	8.62E-17	2.44E-16	7.89E-17	--	9.73E-17	1.25E-16	5.93E-17
1997	1.23E-16	1.18E-16	2.20E-16	1.19E-16	1.51E-16	1.75E-16	--	1.27E-16	2.00E-16	9.48E-17
1998	1.32E-16	1.02E-16	3.29E-16	1.06E-16	2.27E-15	2.32E-16	--	8.13E-17	7.50E-17	2.43E-16
1999	4.06E-16	1.49E-16	2.91E-16	3.23E-16	1.46E-15	2.82E-16	4.59E-16	1.16E-16	9.41E-17	7.97E-17
2000	4.33E-16	2.04E-16	2.61E-16	1.63E-16	1.49E-15	1.89E-16	4.82E-16	5.39E-17	5.33E-17	5.39E-17
2001	4.96E-16	6.19E-16	4.96E-16	5.29E-16	1.32E-15	2.06E-16	2.88E-16	4.96E-17	3.80E-17	5.18E-17
2002	6.50E-16	4.93E-16	6.21E-16	3.24E-16	9.91E-16	3.69E-16	4.05E-16	2.46E-16	1.59E-16	2.05E-16
2003	3.55E-16	2.19E-16	2.55E-16	2.01E-16	4.91E-16	2.21E-16	2.20E-16	2.11E-16	2.07E-16	2.62E-16
2004	2.51E-16	1.95E-16	2.40E-16	1.99E-16	6.27E-16	1.40E-16	2.30E-16	9.69E-17	9.68E-17	8.61E-17
2005	4.54E-16	2.77E-16	2.87E-16	1.58E-16	3.97E-15	4.85E-16	5.25E-16	1.68E-16	1.29E-16	1.23E-16
2006	5.14E-16	2.68E-16	3.24E-16	2.12E-16	1.72E-15	6.62E-16	3.40E-16	2.20E-16	1.75E-16	1.87E-16
2007	3.56E-16	1.51E-16	2.03E-16	1.39E-16	3.13E-16	1.46E-16	1.33E-16	1.41E-16	1.43E-16	1.27E-16
2008	4.36E-16	8.61E-17	1.72E-16	8.44E-17	2.17E-16	9.77E-17	9.78E-17	9.02E-17	8.97E-17	6.43E-17

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2.

For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2.

Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 53. Average Annual ^{230}Th Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	2.33E-15	1.05E-15	8.08E-15	--	--	--	--	--	3.07E-16	--
1980	2.50E-16	8.76E-16	2.81E-16	--	--	--	--	8.17E-17	1.30E-16	--
1981	2.60E-15	3.50E-15	3.00E-14	6.93E-15	--	--	--	1.42E-16	8.17E-17	3.92E-16
1982	2.12E-14	1.94E-14	8.95E-14	1.26E-14	--	--	--	7.49E-16	9.18E-16	3.15E-15
1983	5.86E-15	9.79E-15	5.64E-15	8.26E-15	--	--	--	3.74E-16	3.12E-16	1.07E-15
1984	1.64E-15	2.98E-15	3.82E-15	6.35E-15	--	--	--	2.69E-16	2.00E-16	2.89E-16
1985	1.84E-15	2.15E-15	4.86E-15	3.73E-15	--	--	--	2.60E-16	2.64E-16	2.84E-16
1986	3.70E-15	5.55E-15	3.13E-15	4.68E-15	--	--	--	3.70E-16	3.08E-16	2.41E-16
1987	1.21E-15	1.29E-15	2.28E-15	1.08E-15	--	--	--	2.06E-16	1.77E-16	9.90E-17
1988	2.58E-15	3.51E-15	5.85E-15	2.05E-15	--	--	--	1.41E-16	1.72E-16	1.70E-16
1989	6.33E-16	3.85E-16	9.17E-16	1.08E-16	--	--	--	8.93E-17	9.03E-17	9.24E-17
1990	7.63E-16	4.00E-16	5.86E-16	1.09E-16	--	--	--	7.40E-17	7.04E-17	7.20E-17
1991	7.25E-16	4.59E-16	8.75E-16	2.83E-16	--	--	--	1.91E-16	1.25E-16	1.33E-16
1992	4.57E-16	2.20E-16	4.71E-16	9.46E-17	--	--	--	6.58E-17	5.98E-17	9.56E-17
1993	4.45E-16	3.03E-16	6.42E-16	9.32E-17	--	--	--	1.06E-16	9.17E-17	2.33E-16
1994	1.18E-15	2.96E-16	1.08E-15	1.24E-16	9.20E-16	--	--	1.54E-16	1.16E-16	2.83E-16
1995	1.65E-15	5.33E-16	1.24E-15	1.18E-16	8.88E-16	--	--	9.80E-17	1.12E-16	3.30E-16
1996	2.21E-15	2.95E-16	8.13E-16	8.85E-17	7.67E-16	2.33E-16	--	7.11E-17	5.08E-17	6.39E-17
1997	7.64E-16	1.31E-16	6.17E-16	6.49E-17	1.99E-15	3.82E-16	--	8.37E-17	7.86E-17	3.24E-17
1998	2.88E-15	2.02E-16	9.34E-16	1.15E-16	2.17E-15	3.32E-16	--	7.70E-17	7.99E-17	7.82E-17
1999	3.76E-15	3.24E-16	1.09E-15	1.84E-16	2.19E-15	4.15E-16	3.02E-16	7.37E-17	9.51E-17	1.11E-16
2000	1.22E-15	2.48E-16	1.01E-15	2.02E-16	4.16E-15	4.71E-16	6.69E-16	1.47E-16	1.57E-16	1.27E-16
2001	8.20E-16	5.19E-16	9.67E-16	2.61E-16	4.15E-15	4.04E-16	4.61E-16	1.56E-16	9.95E-17	1.13E-16
2002	5.84E-16	2.76E-16	5.95E-16	2.57E-16	1.25E-15	2.38E-16	3.13E-16	8.15E-17	8.54E-17	8.55E-17
2003	5.19E-16	2.62E-16	4.90E-16	9.73E-17	1.40E-15	4.11E-16	1.77E-16	8.27E-17	8.91E-17	5.30E-17
2004	2.17E-16	8.26E-17	3.87E-16	8.33E-17	6.57E-16	2.26E-16	1.08E-16	5.36E-17	5.62E-17	6.07E-17
2005	3.17E-16	1.97E-16	3.51E-16	2.64E-16	3.41E-15	4.85E-16	4.81E-16	1.04E-16	1.05E-16	1.08E-16
2006	5.17E-16	2.91E-16	4.74E-16	1.77E-16	1.40E-15	4.73E-16	3.27E-16	2.73E-16	2.04E-16	2.85E-16
2007	6.62E-16	1.90E-16	4.32E-16	1.48E-16	1.05E-15	2.77E-16	2.23E-16	1.68E-16	1.57E-16	1.53E-16
2008	7.21E-16	1.87E-16	5.12E-16	1.32E-16	6.21E-16	2.88E-16	2.05E-16	1.11E-16	1.08E-16	1.16E-16

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2. For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2.

Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating; bold cells are concentrations above Cotter Mill's regulatory limit

Table 54. Average Annual ^{232}Th Concentrations 2001-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP #2	CC #2	OV-3
2001	5.78E-17	7.62E-17	6.97E-17	6.37E-17	8.32E-17	4.58E-17	6.67E-17	6.85E-17	8.33E-17	5.68E-17
2002	4.67E-17	3.81E-17	3.09E-17	4.55E-17	4.34E-17	3.17E-17	3.35E-17	5.36E-17	3.51E-17	4.68E-17
2003	4.57E-17	4.14E-17	4.84E-17	2.06E-17	5.72E-17	4.61E-17	3.71E-17	6.21E-17	4.61E-17	3.96E-17
2004	1.39E-17	2.53E-17	2.53E-17	1.40E-17	1.57E-17	1.99E-17	1.65E-17	3.24E-17	2.28E-17	2.39E-17
2005	2.83E-17	2.40E-17	2.86E-17	3.09E-17	3.36E-17	2.53E-17	3.42E-17	3.99E-17	3.57E-17	3.45E-17
2006	4.11E-17	5.18E-17	4.82E-17	4.29E-17	5.54E-17	4.33E-17	4.79E-17	6.25E-17	4.98E-17	3.65E-17
2007	4.07E-17	3.47E-17	4.60E-17	4.14E-17	4.12E-17	3.99E-17	3.51E-17	5.43E-17	4.48E-17	3.92E-17
2008	1.08E-17	1.63E-17	1.15E-17	9.89E-18	1.57E-17	2.30E-17	1.26E-17	3.13E-17	2.25E-17	2.03E-17

Note: Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating

Table 55. Average Annual ^{226}Ra Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	1.55E-15	3.75E-16	7.89E-15	--	--	--	--	--	3.07E-16	--
1980	3.61E-15	7.81E-16	1.62E-15	--	--	--	--	2.78E-16	1.58E-15	--
1981	4.19E-15	2.35E-15	2.94E-15	2.96E-15	--	--	--	3.79E-16	4.59E-16	6.30E-16
1982	6.53E-15	6.92E-15	3.81E-15	3.82E-15	--	--	--	6.07E-16	4.02E-16	1.25E-15
1983	2.00E-15	5.08E-15	4.95E-15	2.85E-15	--	--	--	9.42E-17	1.76E-16	5.30E-16
1984	1.11E-15	1.84E-15	3.63E-15	2.20E-15	--	--	--	1.18E-16	1.67E-16	1.87E-16
1985	9.63E-15	1.11E-15	1.78E-15	1.97E-15	--	--	--	1.69E-16	1.88E-16	1.89E-16
1986	1.47E-15	1.98E-15	1.61E-15	2.60E-15	--	--	--	1.43E-16	3.45E-16	2.22E-16
1987	5.91E-16	7.52E-16	1.19E-15	4.74E-16	--	--	--	1.83E-16	1.15E-16	1.89E-16
1988	1.29E-15	2.05E-15	2.53E-15	3.60E-16	--	--	--	1.24E-16	5.09E-17	1.09E-16
1989	2.72E-16	1.81E-16	3.30E-16	4.79E-17	--	--	--	1.02E-16	8.89E-17	7.77E-17
1990	1.75E-16	1.68E-16	1.92E-16	4.36E-17	--	--	--	6.69E-17	8.36E-17	7.82E-17
1991	1.19E-16	1.25E-16	2.68E-16	6.17E-17	--	--	--	6.85E-17	7.16E-17	1.37E-16
1992	8.46E-17	7.30E-17	1.50E-15	3.71E-17	--	--	--	5.10E-17	5.80E-17	1.17E-16
1993	9.11E-17	1.14E-16	2.49E-16	5.99E-17	--	--	--	6.14E-17	6.72E-17	2.20E-16
1994	1.03E-16	7.57E-17	1.69E-16	4.96E-17	1.55E-16	--	--	7.80E-17	8.68E-17	2.64E-16
1995	1.21E-16	1.14E-16	2.07E-16	7.46E-17	2.06E-16	--	--	6.88E-17	1.05E-16	3.99E-16
1996	1.78E-16	1.02E-16	2.08E-16	5.33E-17	2.11E-16	5.82E-17	--	5.22E-17	6.67E-17	3.59E-17
1997	1.29E-16	7.55E-17	2.01E-16	5.66E-17	9.45E-16	1.06E-16	--	5.09E-17	5.40E-17	4.84E-17
1998	2.89E-16	8.22E-17	2.95E-16	9.43E-17	1.34E-15	1.21E-16	--	6.21E-17	6.71E-17	4.24E-17
1999	4.18E-16	1.29E-16	3.81E-16	1.02E-16	1.26E-15	1.46E-16	2.13E-16	8.27E-17	9.21E-17	5.90E-17
2000	3.37E-16	1.53E-16	4.64E-16	1.40E-16	2.38E-15	2.21E-16	4.60E-16	7.41E-17	4.64E-17	5.10E-17
2001	2.15E-16	2.09E-16	4.36E-16	1.38E-16	1.92E-15	1.51E-16	1.99E-16	7.01E-17	6.82E-17	5.16E-17
2002	1.55E-16	1.17E-16	2.34E-16	7.51E-17	3.83E-16	1.05E-16	1.14E-16	8.41E-17	6.07E-17	6.72E-17
2003	1.45E-16	1.10E-16	1.75E-16	8.02E-17	2.96E-16	1.23E-16	9.65E-17	9.70E-17	8.40E-17	8.93E-17
2004	7.81E-17	7.35E-17	1.41E-16	6.14E-17	3.30E-16	9.05E-17	8.14E-17	5.79E-17	6.26E-17	4.95E-17
2005	1.78E-16	1.56E-16	1.75E-16	1.97E-16	2.29E-15	2.49E-16	2.95E-16	1.08E-16	1.22E-16	9.58E-17
2006	4.10E-16	1.40E-16	2.17E-16	1.34E-16	7.52E-16	1.69E-16	1.42E-16	1.20E-16	1.03E-16	1.15E-16
2007	8.67E-16	1.11E-16	2.07E-16	1.00E-16	2.31E-16	1.16E-16	9.11E-17	1.09E-16	9.66E-17	1.11E-16
2008	7.92E-16	7.36E-17	2.00E-16	5.16E-17	1.78E-16	7.33E-17	5.71E-17	6.21E-17	5.91E-17	3.28E-17

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2. For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2. Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 56. Average Annual ^{210}Pb Concentrations 1979-2008 (µCi/ml)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	LP-1/2	CC-1/2	OV-3
1979	2.11E-14	1.65E-14	2.08E-14	--	--	--	--	--	2.30E-14	--
1980	1.81E-14	1.69E-14	1.25E-14	--	--	--	--	1.86E-14	1.98E-14	--
1981	2.01E-14	1.72E-14	4.71E-14	2.34E-14	--	--	--	1.57E-14	1.70E-14	2.11E-14
1982	3.87E-14	4.35E-14	9.95E-14	4.07E-14	--	--	--	2.50E-14	3.31E-14	4.05E-14
1983	1.70E-14	1.73E-14	1.82E-14	1.95E-14	--	--	--	1.29E-14	1.79E-14	1.44E-14
1984	1.44E-14	1.46E-14	1.60E-14	1.43E-14	--	--	--	1.26E-14	1.15E-14	1.48E-14
1985	9.12E-15	8.12E-15	8.80E-15	9.30E-15	--	--	--	9.97E-15	1.14E-14	9.90E-15
1986	1.26E-14	1.19E-14	1.12E-14	1.22E-14	--	--	--	1.07E-14	1.22E-14	8.81E-15
1987	1.95E-14	1.92E-14	2.22E-14	2.35E-14	--	--	--	2.17E-14	2.01E-14	1.43E-14
1988	2.15E-14	1.94E-14	2.10E-14	1.93E-14	--	--	--	2.04E-14	2.11E-14	1.76E-14
1989	2.28E-14	2.30E-14	1.98E-14	2.34E-14	--	--	--	2.43E-14	2.35E-14	2.40E-14
1990	2.05E-14	2.10E-14	2.07E-14	2.07E-14	--	--	--	2.24E-14	2.00E-14	1.95E-14
1991	2.40E-14	2.15E-14	2.15E-14	2.13E-14	--	--	--	2.23E-14	2.15E-14	1.07E-14
1992	2.16E-14	2.00E-14	2.20E-14	2.19E-14	--	--	--	1.99E-14	1.61E-14	2.20E-14
1993	2.38E-14	2.35E-14	2.35E-14	2.49E-14	--	--	--	2.22E-14	2.13E-14	2.10E-14
1994	2.21E-14	2.07E-14	2.10E-14	2.24E-14	2.18E-14	--	--	2.33E-14	2.38E-14	2.06E-14
1995	2.07E-14	2.07E-14	2.02E-14	2.01E-14	2.11E-14	--	--	1.97E-14	2.03E-14	1.74E-14
1996	2.02E-14	2.01E-14	2.16E-14	2.21E-14	2.11E-14	--	--	2.08E-14	1.96E-14	1.98E-14
1997	2.21E-14	2.07E-14	2.12E-14	2.20E-14	2.26E-14	2.05E-14	--	2.13E-14	2.00E-14	1.98E-14
1998	2.01E-14	2.07E-14	1.98E-14	2.11E-14	2.01E-14	1.93E-14	--	2.01E-14	2.01E-14	1.93E-14
1999	2.14E-14	1.94E-14	1.83E-14	1.84E-14	2.03E-14	1.94E-14	2.03E-14	2.03E-14	1.94E-14	1.78E-14
2000	2.07E-14	2.05E-14	2.01E-14	2.23E-14	2.37E-14	2.00E-14	2.07E-14	2.16E-14	2.08E-14	2.03E-14
2001	3.10E-14	3.04E-14	2.91E-14	3.11E-14	3.06E-14	2.94E-14	3.12E-14	3.06E-14	2.96E-14	2.79E-14
2002	2.36E-14	2.20E-14	2.28E-14	2.25E-14	2.30E-14	2.37E-14	2.40E-14	2.46E-14	2.33E-14	2.17E-14
2003	2.19E-14	2.11E-14	2.16E-14	2.06E-14	2.28E-14	2.12E-14	2.18E-14	2.11E-14	1.94E-14	2.27E-14
2004	1.72E-14	1.64E-14	1.58E-14	1.60E-14	1.66E-14	1.45E-14	1.79E-14	1.56E-14	1.54E-14	1.59E-14
2005	2.45E-14	2.74E-14	2.82E-14	2.54E-14	3.11E-14	2.91E-14	2.92E-14	3.11E-14	3.15E-14	2.94E-14
2006	2.11E-14	2.31E-14	2.47E-14	2.31E-14	2.09E-14	2.08E-14	1.89E-14	1.98E-14	1.89E-14	2.12E-14
2007	1.88E-14	1.64E-14	1.79E-14	1.82E-14	1.54E-14	1.58E-14	1.49E-14	1.66E-14	1.61E-14	1.72E-14
2008	1.65E-14	1.48E-14	1.64E-14	1.93E-14	1.66E-14	1.73E-14	1.57E-14	1.67E-14	1.61E-14	1.61E-14

Notes: For station LP-1/2, data from 1980-1992 were collected at LP-1, and data from 1993-2008 were collected at LP-2. For station CC-1/2, data from 1979-1992 were collected at CC-1, and data from 1993-2008 were collected at CC-2.

Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 57. ^{220}Rn/^{222}Rn Concentrations 2002-2008 (pCi/m^3)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	**AS-203**	**AS-204**	**AS-206**	**AS-209**	**AS-210**	**AS-212**	**CC-1**	**LP-1**	**OV-3**
2002	543	975	1125	693	1475	700	698	875	673	625
2003	700	825	775	900	625	675	700	375	800	567
2004	1500	850	1025	950	1100	850	925	825	875	825
2005	925	1025	850	700	1025	675	775	700	900	800
2006	1250	1275	1275	1450	1400	1125	1275	1075	1375	1200
2007	1000	1100	1175	1100	1250	975	825	925	1175	975
2008	850	900	925	950	1075	950	850	800	925	825

Notes: Data are presented for only those years when measurements quantified combined levels of the two isotopes.
Shaded cells are the highest annual averages for the calendar year.

Table 58. Environmental TLD Measurements, 1979-2008 (µR/hr)

Year	Perimeter Monitoring Stations					Off-Site Monitoring Stations				
	AS-202	AS-203	AS-204	AS-206	AS-209	AS-210	AS-212	CC-1	LP-1	OV-3
1979	14.0	12.6	12.7	--	--	--	--	11.8	11.4	--
1980	13.4	11.7	12.9	--	--	--	--	10.4	11.4	--
1981	14.3	12.8	12.7	--	--	--	--	10.6	12.3	12.3
1982	13.7	12.6	14.7	20.4	--	--	--	9.9	11.2	12.7
1983	13.6	12.6	14.2	15.6	--	--	--	10.6	11.6	12.0
1984	14.5	14.3	14.6	14.8	--	--	--	12.3	11.2	13.2
1985	14.3	13.5	14.5	14.8	--	--	--	10.5	11.2	12.3
1986	13.9	13.7	14.5	14.2	--	--	--	11.0	10.7	11.8
1987	12.9	12.5	12.6	12.6	--	--	--	9.6	9.7	10.4
1988	15.0	13.6	12.8	13.4	--	--	--	9.3	11.6	10.2
1989	14.7	14.9	15.3	15.9	--	--	--	10.6	13.7	11.9
1990	13.2	13.1	14.8	15.2	--	--	--	9.6	11.5	11.7
1991	14.1	13.2	15.7	17.5	--	--	--	10.0	12.9	12.4
1992	13.7	13.2	16.0	18.3	--	--	--	9.6	12.1	11.3
1993	12.5	12.6	14.4	15.6	--	--	--	8.6	10.7	10.9
1994	14.3	13.8	15.9	16.2	27.8	--	--	10.8	12.1	12.3
1995	12.5	13.7	14.0	15.4	23.0	--	--	9.2	10.3	11.3
1996	13.1	13.2	14.5	16.2	27.2	13.0	--	9.7	10.9	11.4
1997	12.6	13.1	13.8	15.7	29.1	12.3	--	9.1	10.2	11.1
1998	12.3	12.0	13.4	15.9	28.0	12.0	--	9.0	10.3	11.5
1999	12.7	12.0	13.8	16.0	29.6	12.2	9.1	9.3	10.6	10.9
2000	12.7	12.6	14.7	16.6	27.7	12.5	9.3	9.5	10.7	11.4
2001	13.7	14.3	15.4	18.6	26.2	13.9	9.7	10.4	12.0	12.2
2002	14.0	14.4	15.9	17.7	30.3	14.3	10.5	10.5	12.3	12.6
2003	12.8	13.3	14.8	15.5	27.7	13.3	10.0	10.0	11.7	11.8
2004	13.6	14.1	15.5	14.7	25.5	14.2	10.9	10.5	12.2	12.5
2005	12.8	13.5	14.8	13.8	22.9	12.9	9.9	10.1	11.5	11.5
2006	12.7	13.4	14.6	14.2	21.5	12.6	9.5	10.1	11.5	11.7
2007	12.9	13.2	14.6	14.1	17.8	12.7	9.5	10.1	11.5	11.6
2008	13.9	13.5	15.5	14.9	18.7	13.3	10.2	10.8	12.2	12.6

Notes: Shaded cells are the highest annual averages for the calendar year; "--" indicates that no data are available because the station was not yet operating.

Table 59. TSP Air Concentrations (μg/m^3) from 1969-1987

Year	Cañon City		Lincoln Park	
	Maximum	Average	Maximum	Average
1969	172	64.2	--	--
1970	200	55.9	--	--
1971	148	58.7	--	--
1972	240	69.9	--	--
1973	229	66.1	--	--
1974	187	58	--	--
1975	419	73.7	--	--
1976	174	56.8	--	--
1977	227	62.7	--	--
1978	313	84.7	--	--
1979	286	72.6	--	--
1980	304	70.4	--	--
1981	180	56.8	61*	8.2*
1982	525	84	228	51.7
1983	187	65.2	106	77.6
1984	571	70.9	--	--
1985	334	64.8	--	--
1986	402	66.3	--	--
1987	385	65.2	--	--

Notes: Data downloaded from EPA's Air Quality System database.
EPA's former annual average National Ambient Air Quality Standard for TSP was 75 μg/m^3.
* The TSP monitoring station in Lincoln Park started operating late in 1981; therefore, the statistics reported are not representative of the entire calendar year.

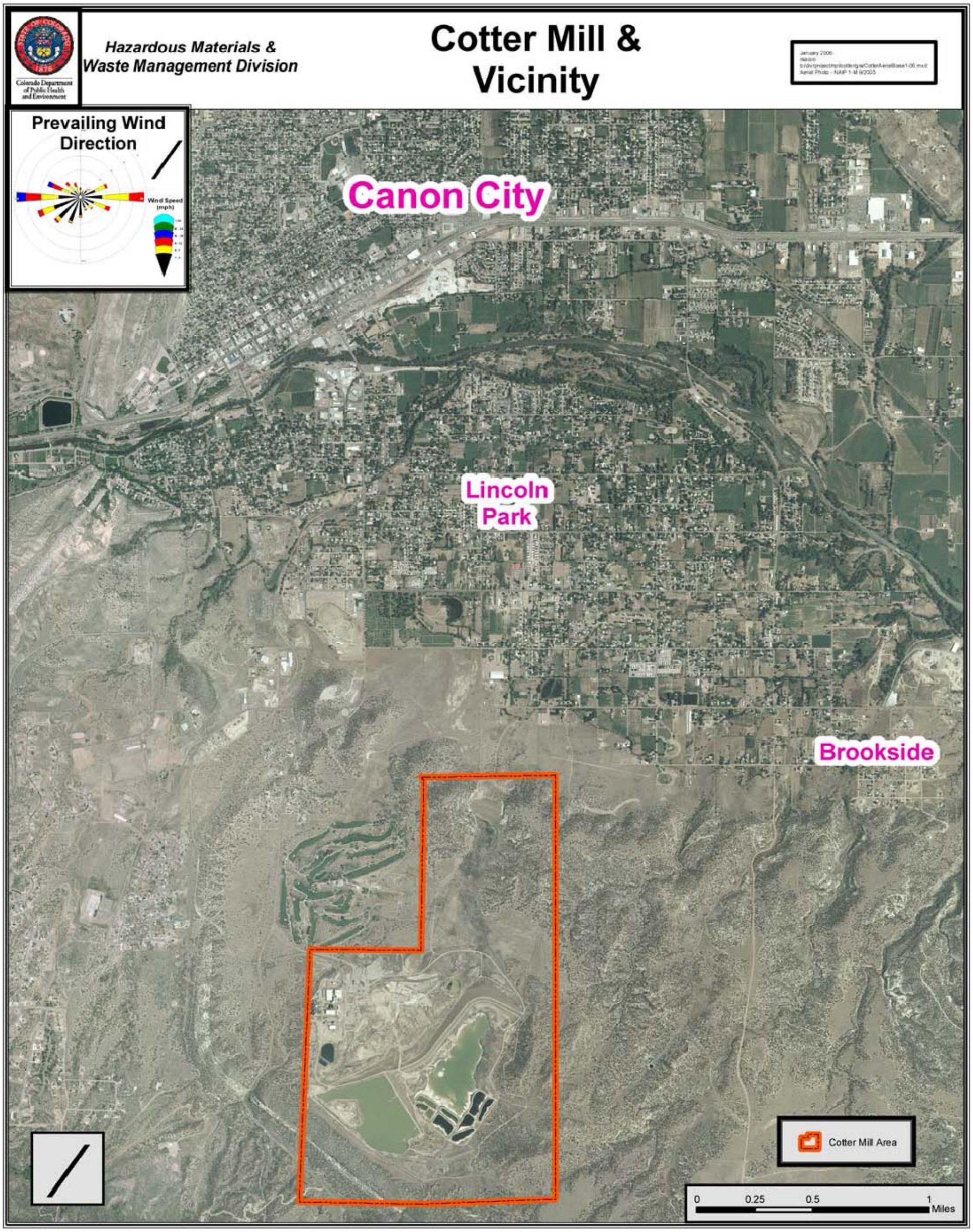
Table 60. Monitoring Data for Constituents in TSP (1978-1987)

Constituent	Location	Years of Data	Concentrations (μg/m^3)	
			Highest 24-Hour Average	Highest Annual Average
Iron	Lincoln Park	1981-1982	1.2	0.8
Lead	Lincoln Park	1981-1982	0.1	0.034
Manganese	Lincoln Park	1981-1982	0.03	0.0185
Nitrate	Cañon City	1978-1987	14.3	2.35
	Lincoln Park	1981-1982	4.7	1.81
Sulfate	Cañon City	1978-1987	18.4	5.99
	Lincoln Park	1981-1982	13	6.48
Zinc	Lincoln Park	1981-1982	0.04	0.0283

Notes Data downloaded from EPA's Air Quality System database.

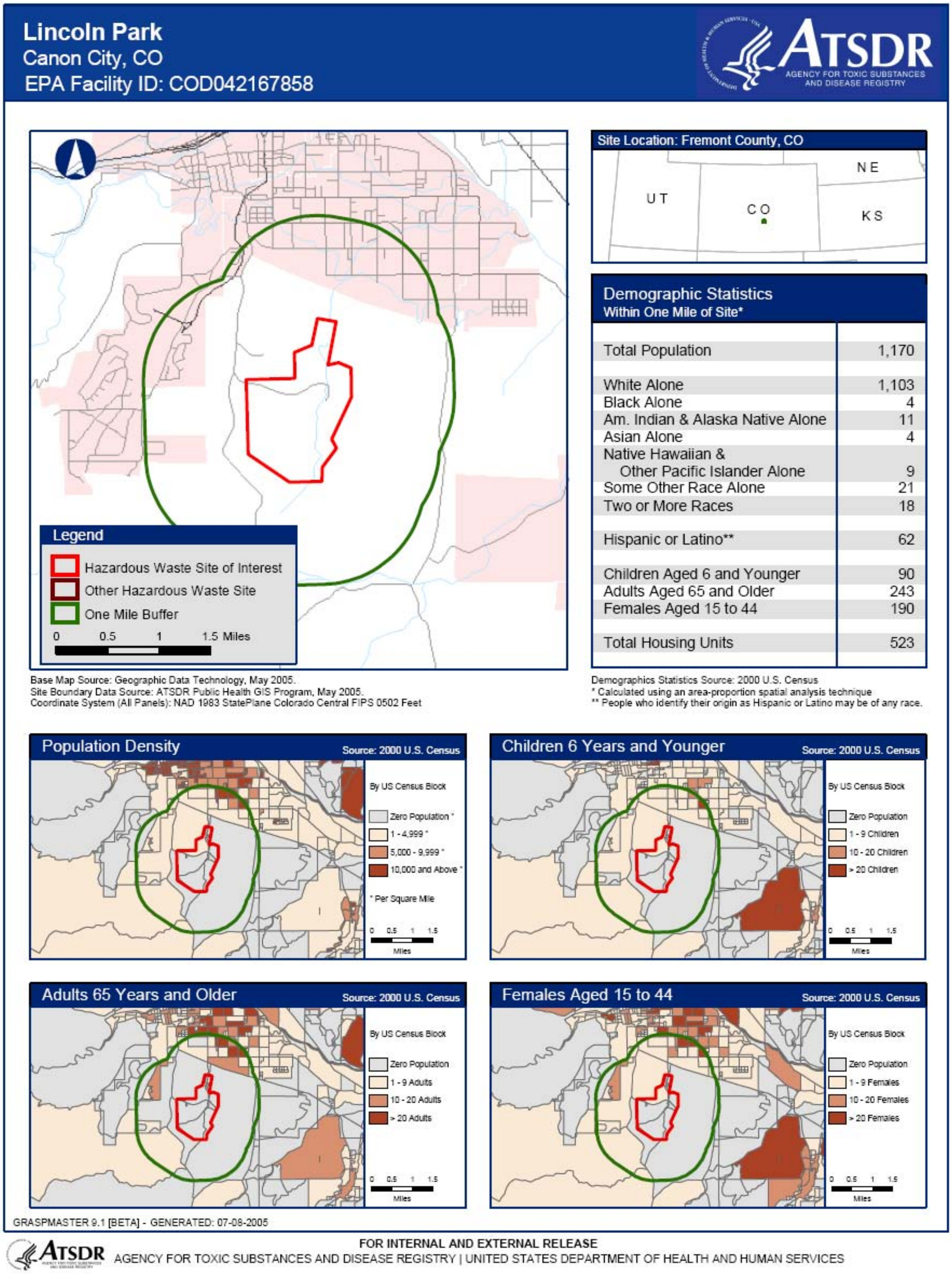
Appendix B - Site Figures

Figure 1. Location of the Cotter Mill, Lincoln Park, and Cañon City



Source: Galant et al. 2007

Figure 2. Demographics within 1 mile of the Cotter Mill property



Lincoln Park
Canon City, CO
EPA Facility ID: COD042167858

Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Public Health GIS Program, May 2005.
Coordinate System (All Panels): NAD 1983 StatePlane Colorado Central FIPS 0502 Feet

Demographic Statistics
Within One Mile of Site*

Total Population	1,170
White Alone	1,103
Black Alone	4
Am. Indian & Alaska Native Alone	11
Asian Alone	4
Native Hawaiian & Other Pacific Islander Alone	9
Some Other Race Alone	21
Two or More Races	18
Hispanic or Latino**	62
Children Aged 6 and Younger	90
Adults Aged 65 and Older	243
Females Aged 15 to 44	190
Total Housing Units	523

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

Population Density — Source: 2000 U.S. Census

Children 6 Years and Younger — Source: 2000 U.S. Census

Adults 65 Years and Older — Source: 2000 U.S. Census

Females Aged 15 to 44 — Source: 2000 U.S. Census

GRASPMASTER 9.1 [BETA] - GENERATED: 07-08-2005

FOR INTERNAL AND EXTERNAL RELEASE
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY | UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES

Figure 3. Wind Rose for Cotter Mill, 2008

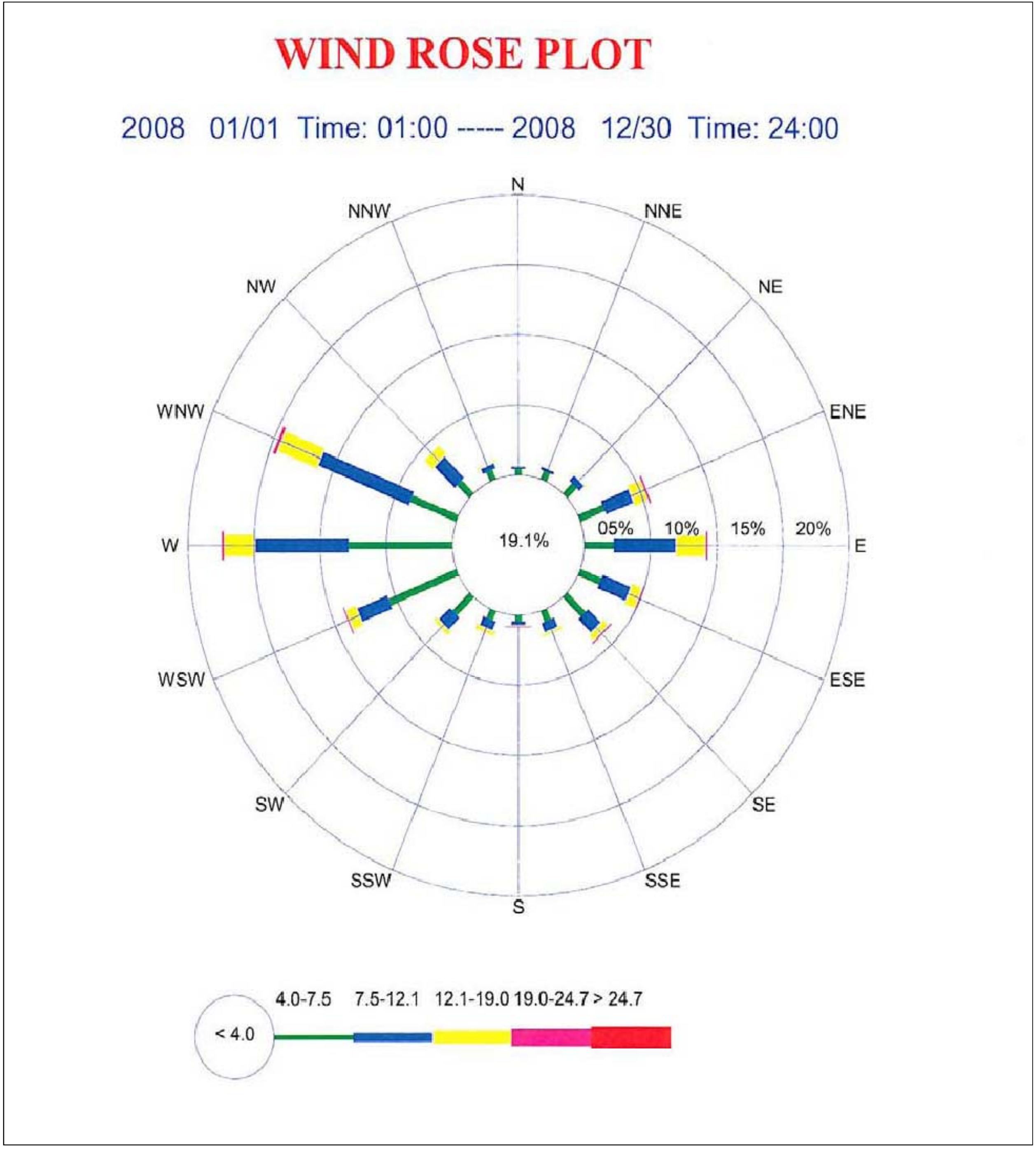
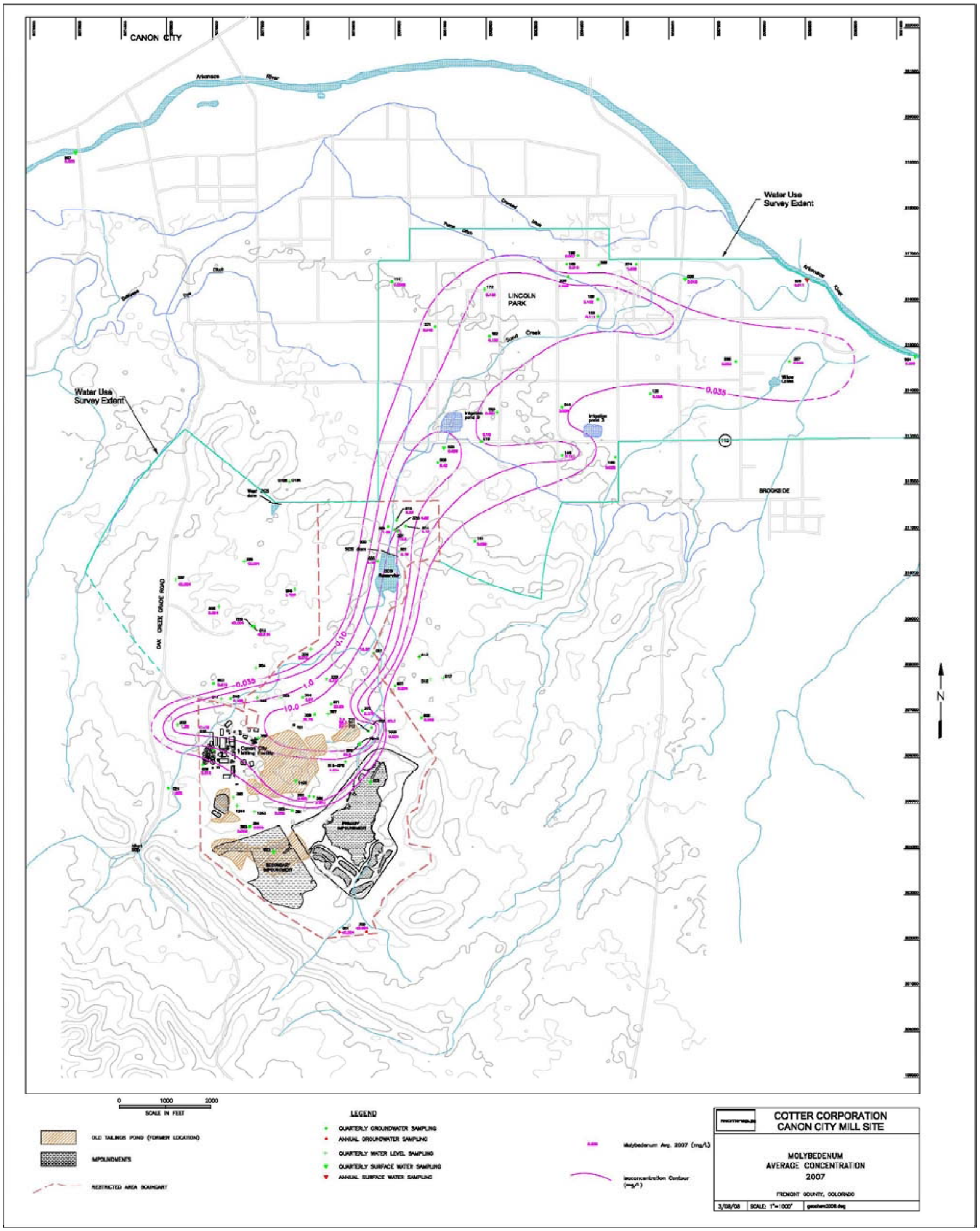
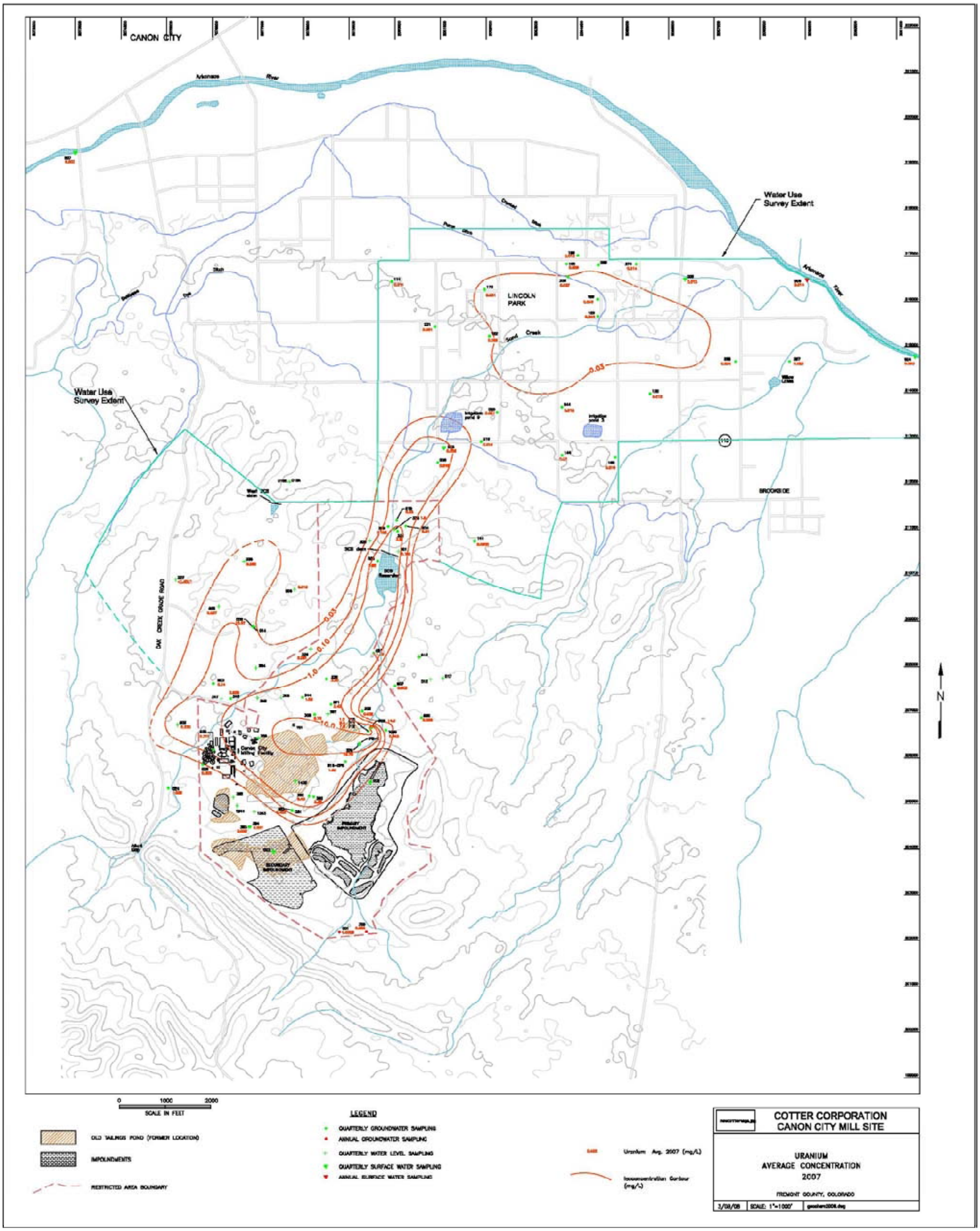


Figure 4. Molybdenum Plume Map



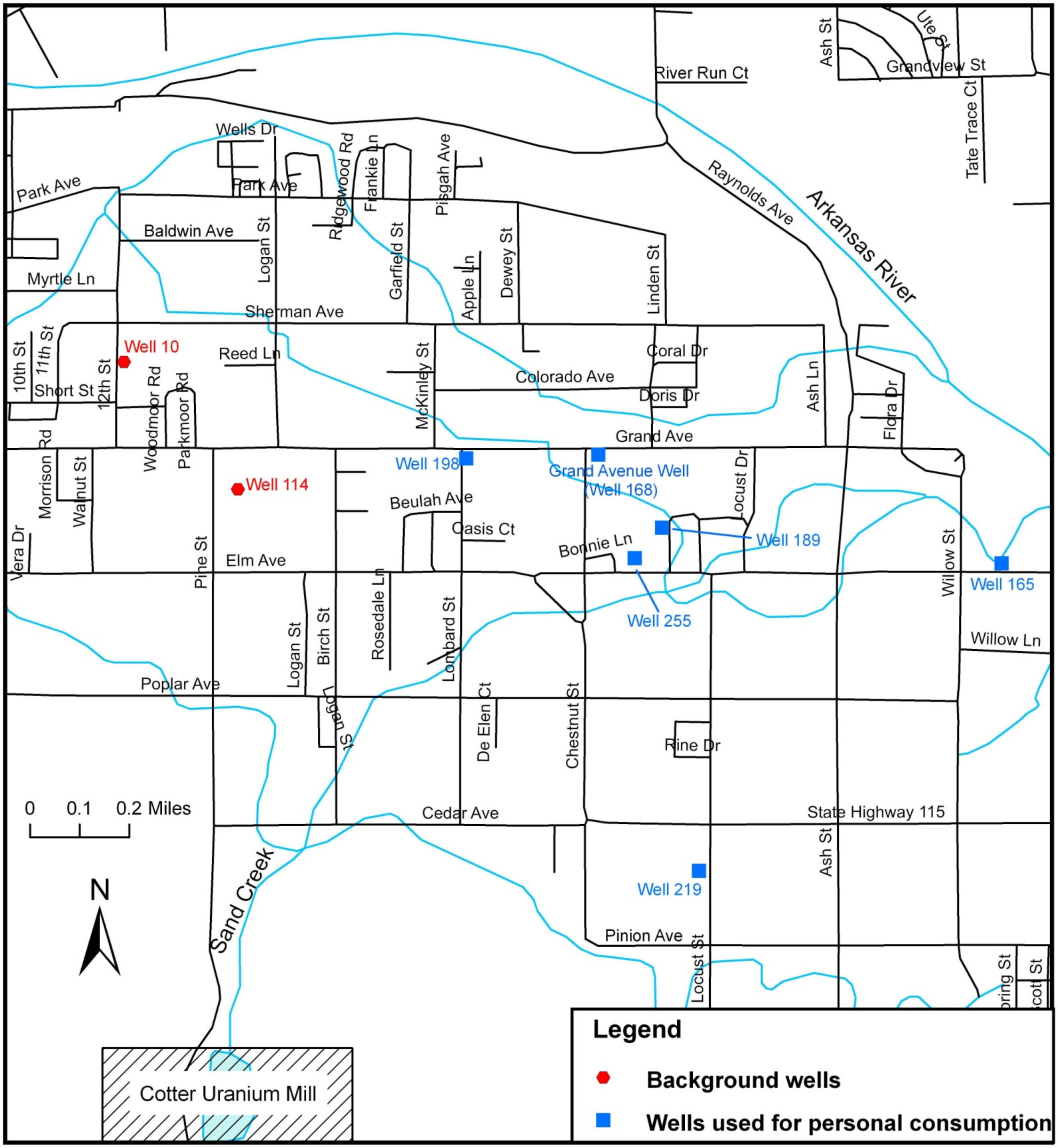
Source: Cotter 2008

Figure 5. Uranium Plume Map



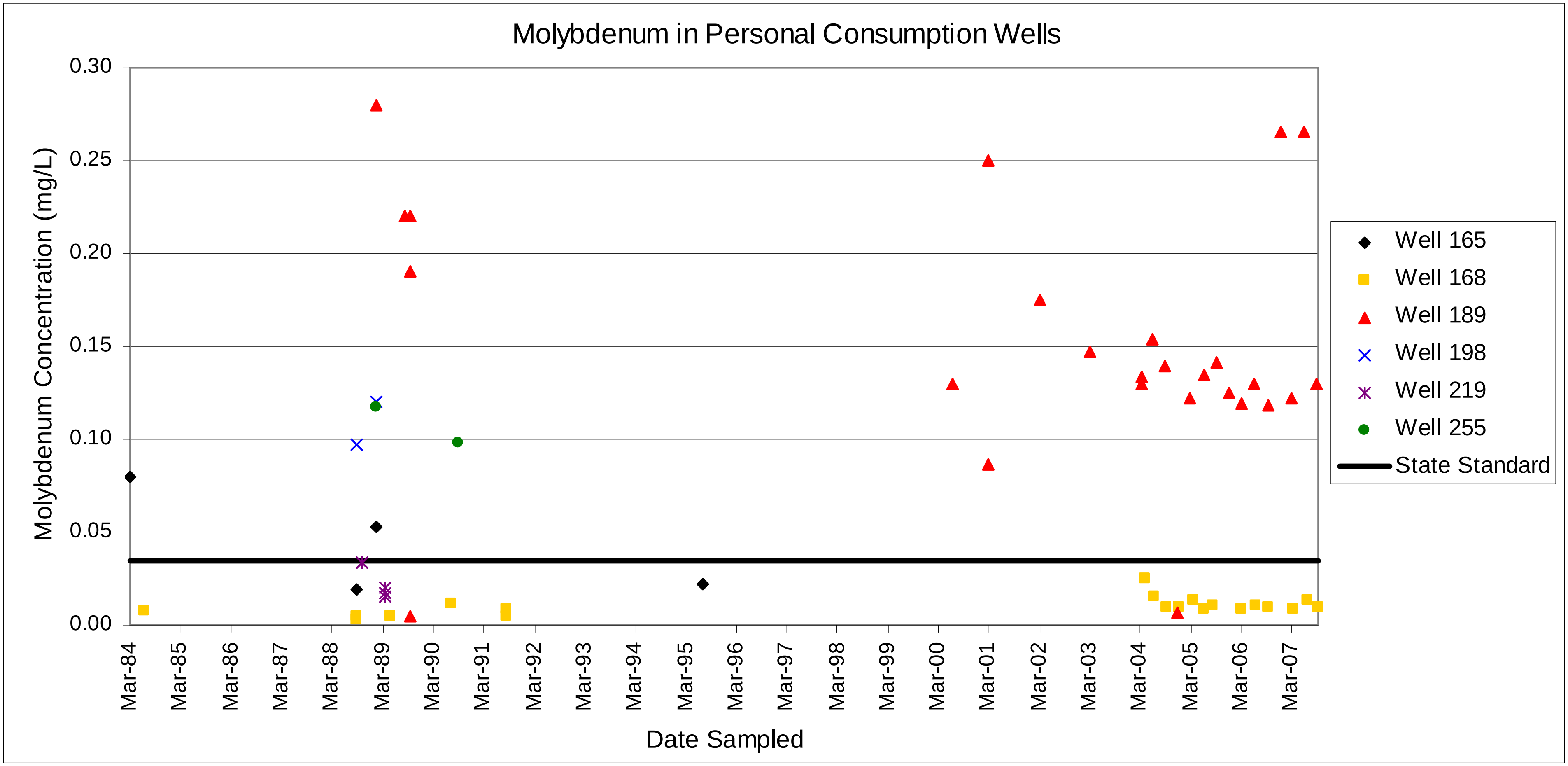
Source: Cotter 2008

Figure 6. Wells in Lincoln Park used for personal consumption



Source: CDPHE 2007b (coordinates)

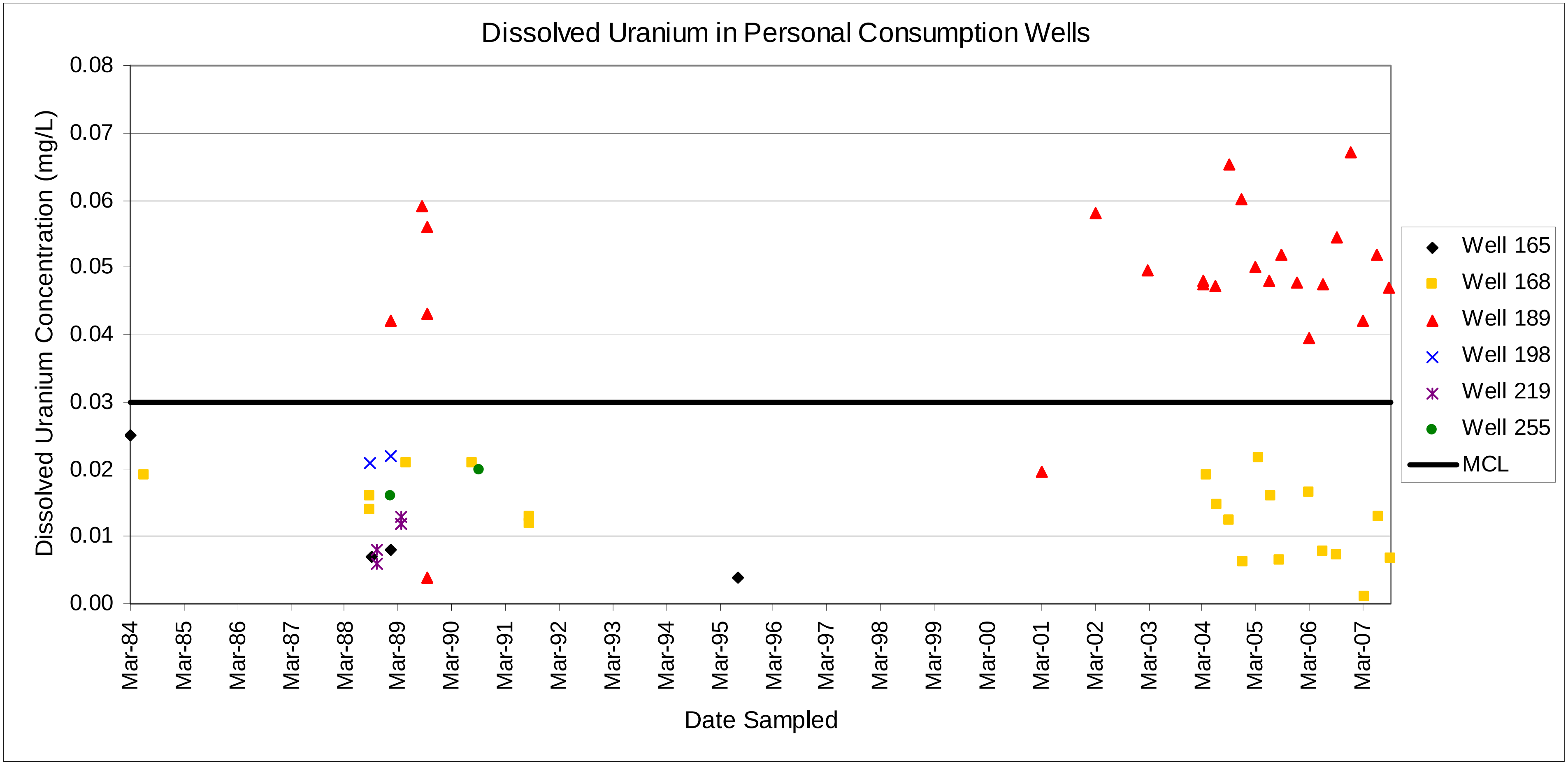
Figure 7. Molybdenum concentrations in wells used for personal consumption



Source: CDPHE 2007b

Non-detected concentrations were plotted as ½ the reporting detection limit.

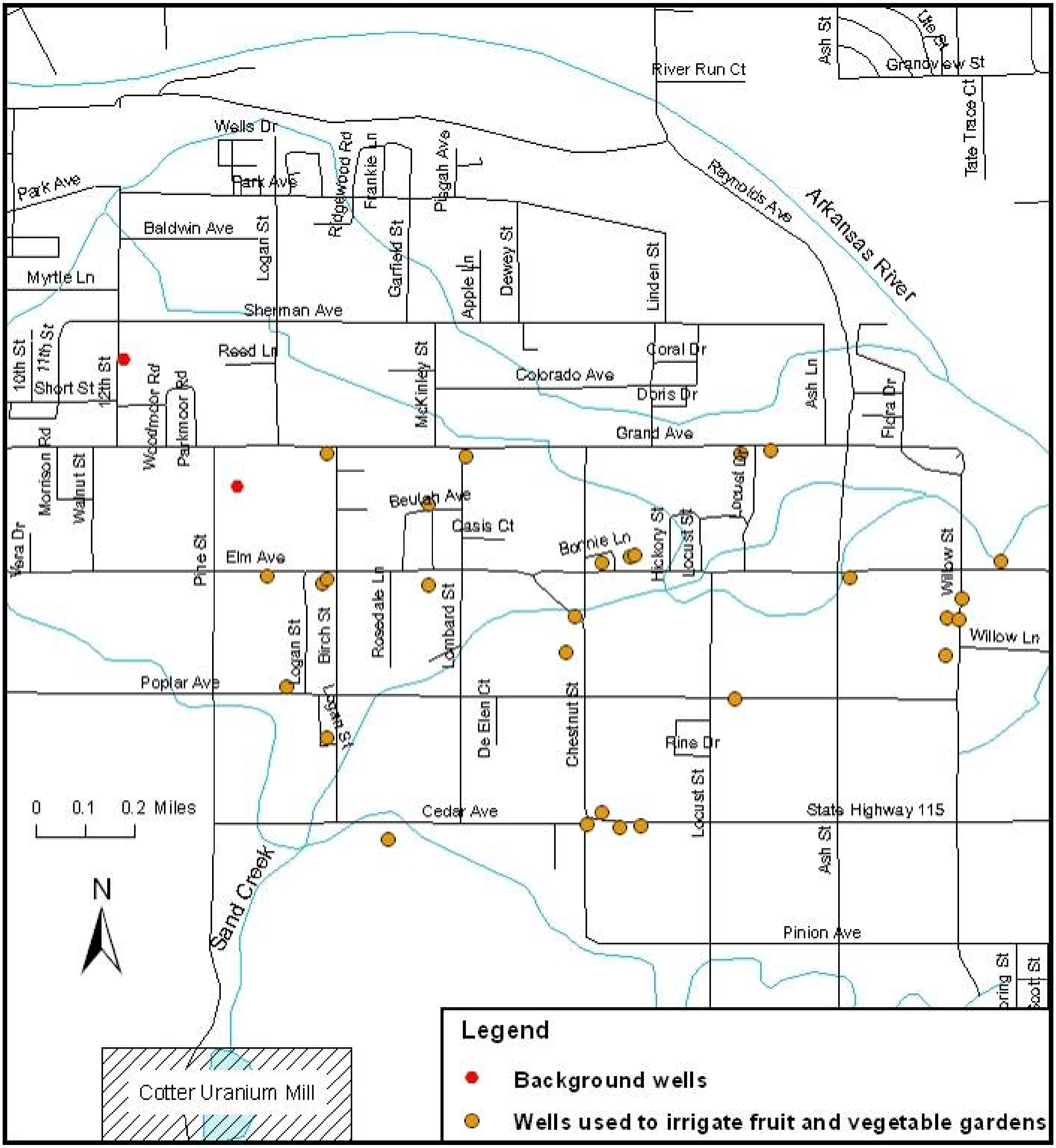
Figure 8. Dissolved uranium concentrations in wells used for personal consumption



Source: CDPHE 2007b

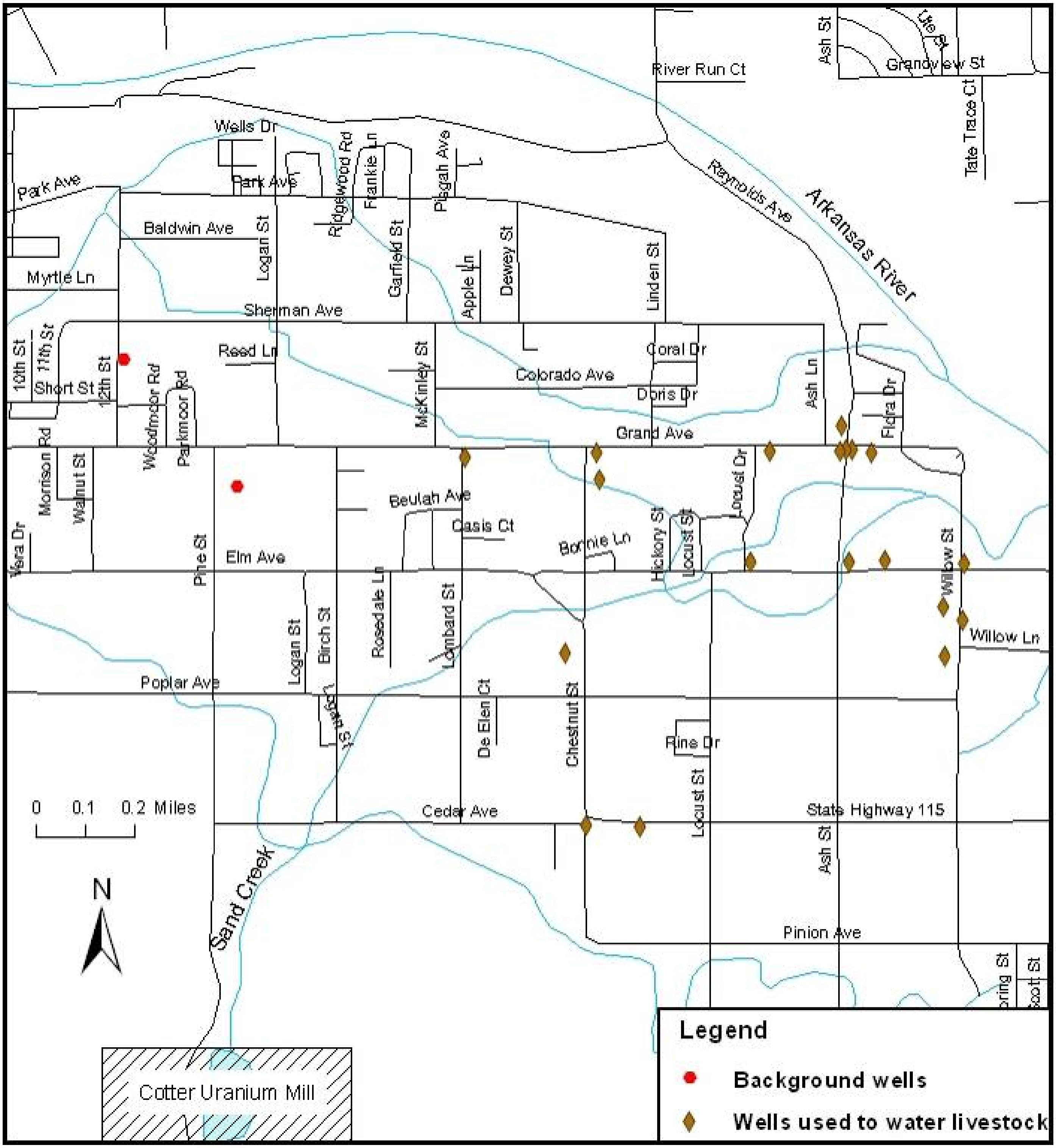
Non-detected concentrations were plotted as ½ the reporting detection limit.

Figure 9. Wells in Lincoln Park used to irrigate fruit and vegetable gardens



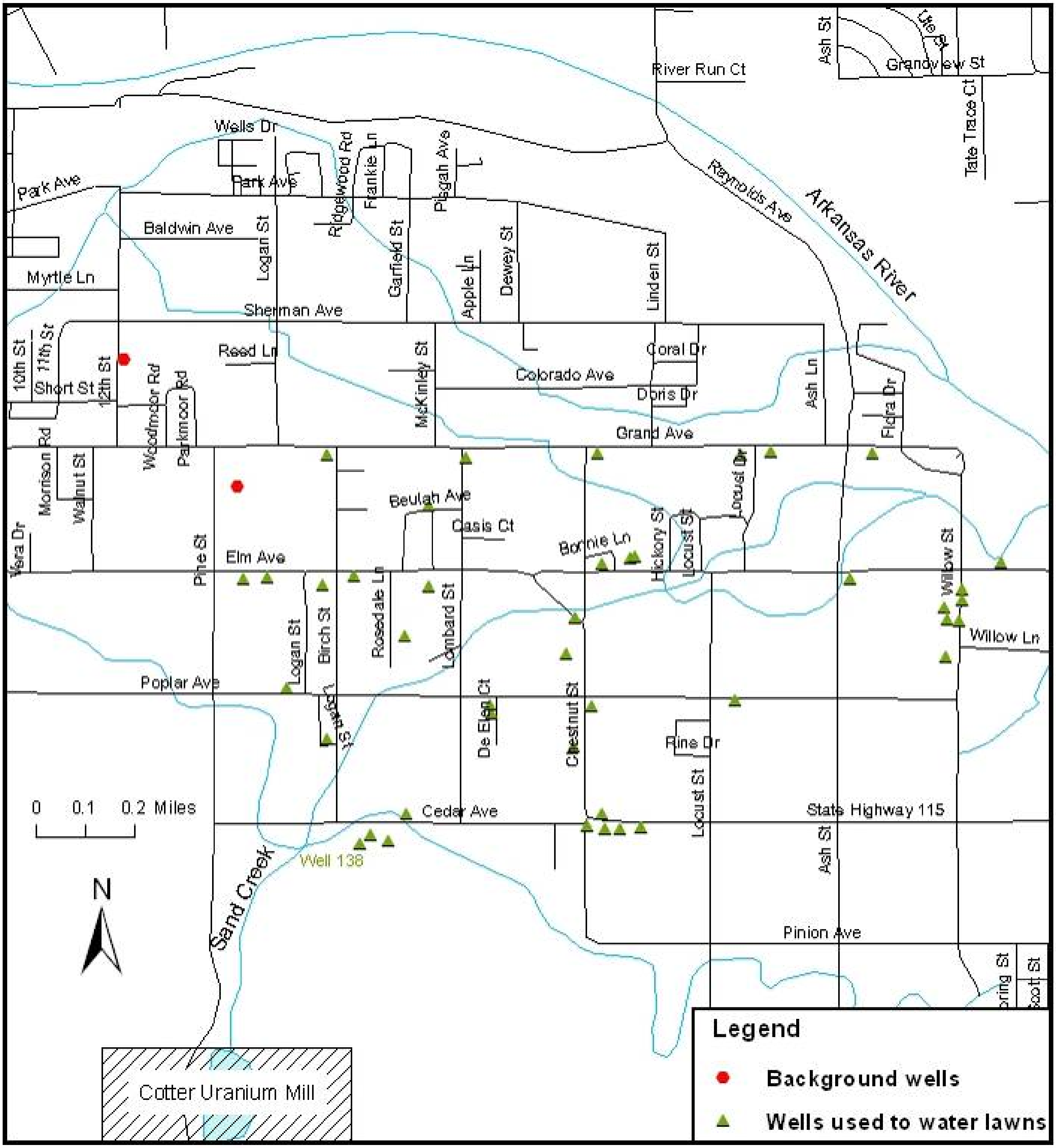
Source: CDPHE 2007b (coordinates)

Figure 10. Wells in Lincoln Park used to water livestock



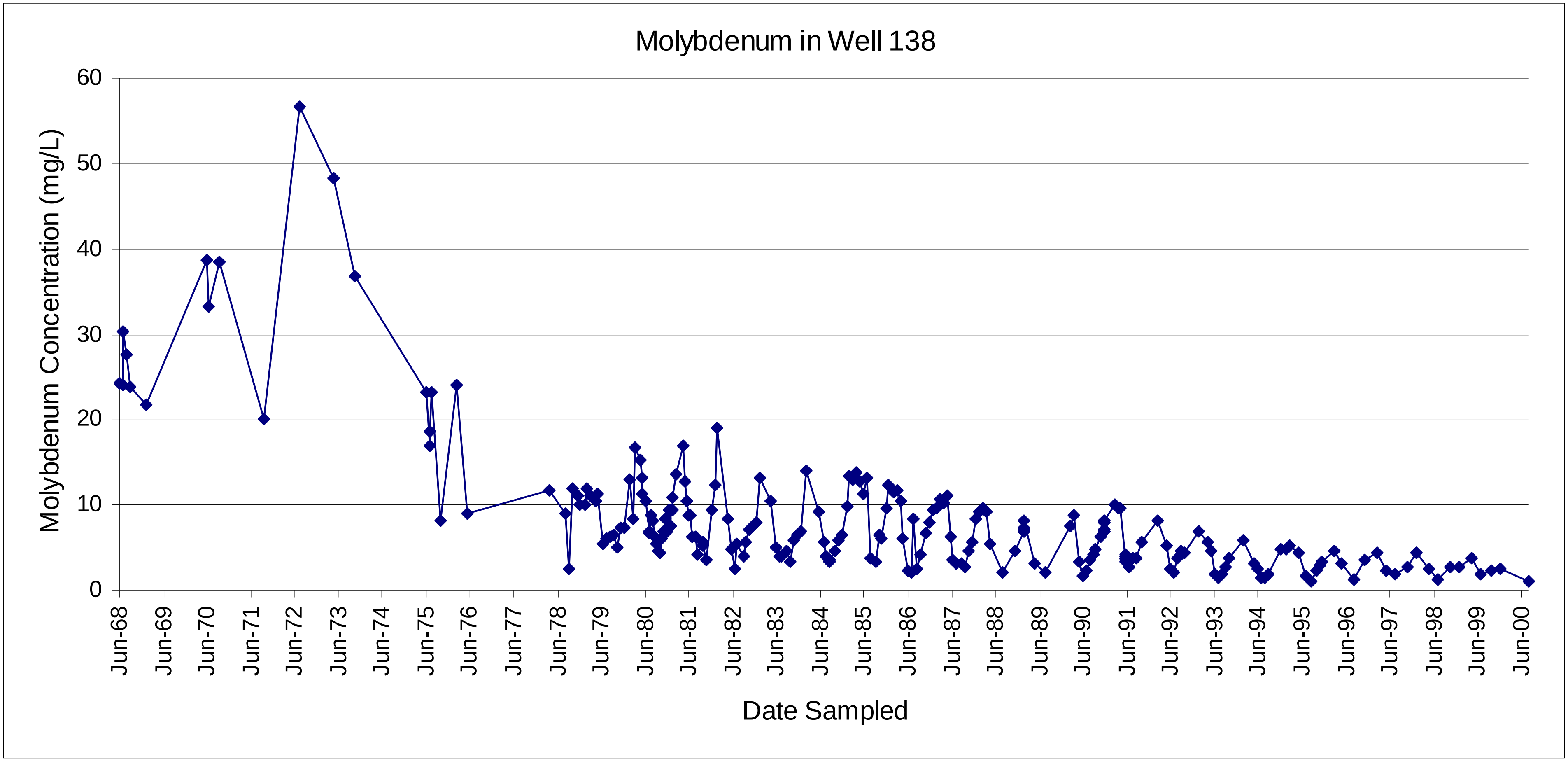
Source: CDPHE 2007b (coordinates)

Figure 11. Wells in Lincoln Park used to water lawns



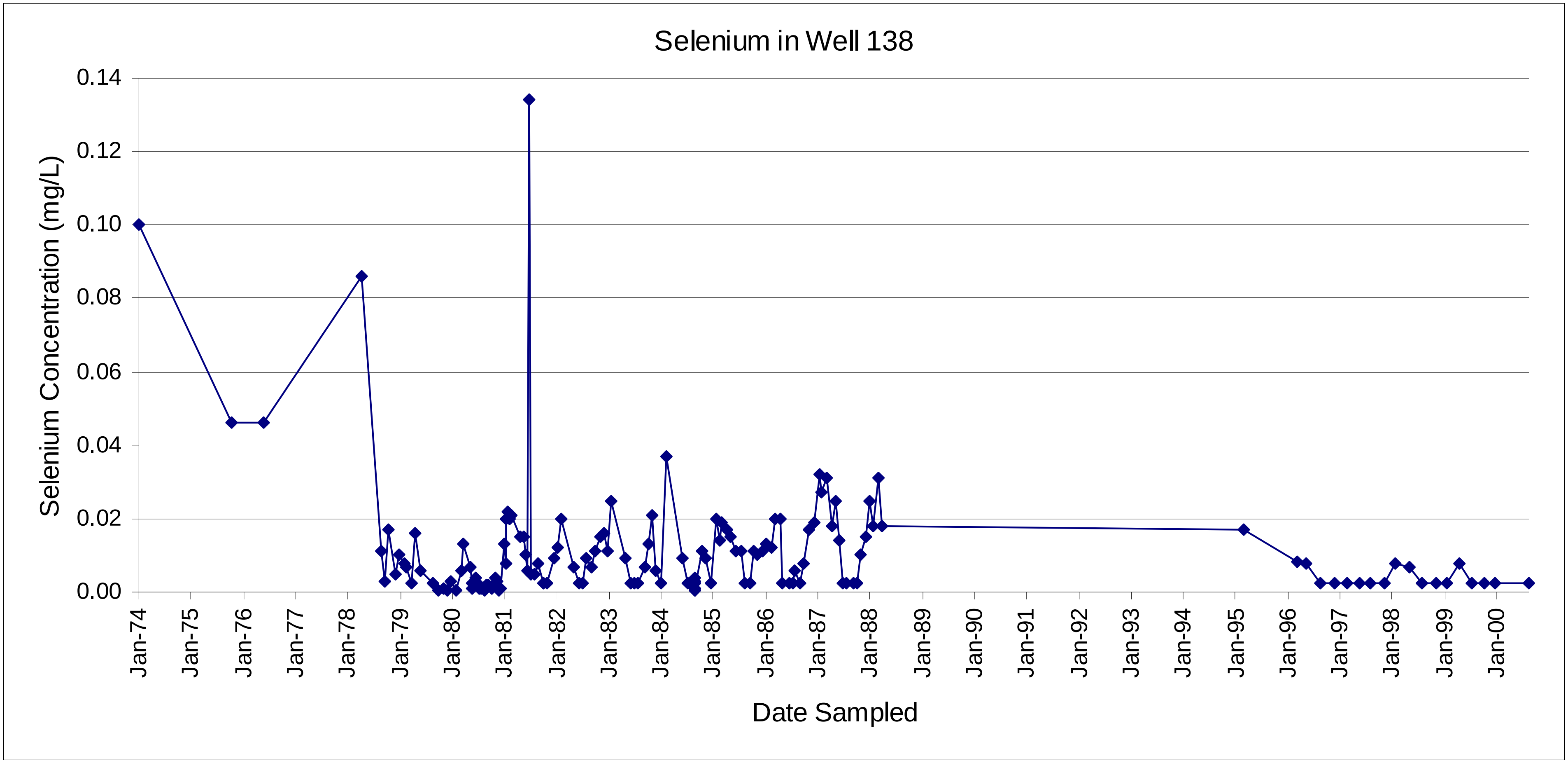
Source: CDPHE 2007b (coordinates)

Figure 12. Molybdenum concentrations in Well 138



Source: CDPHE 2007b

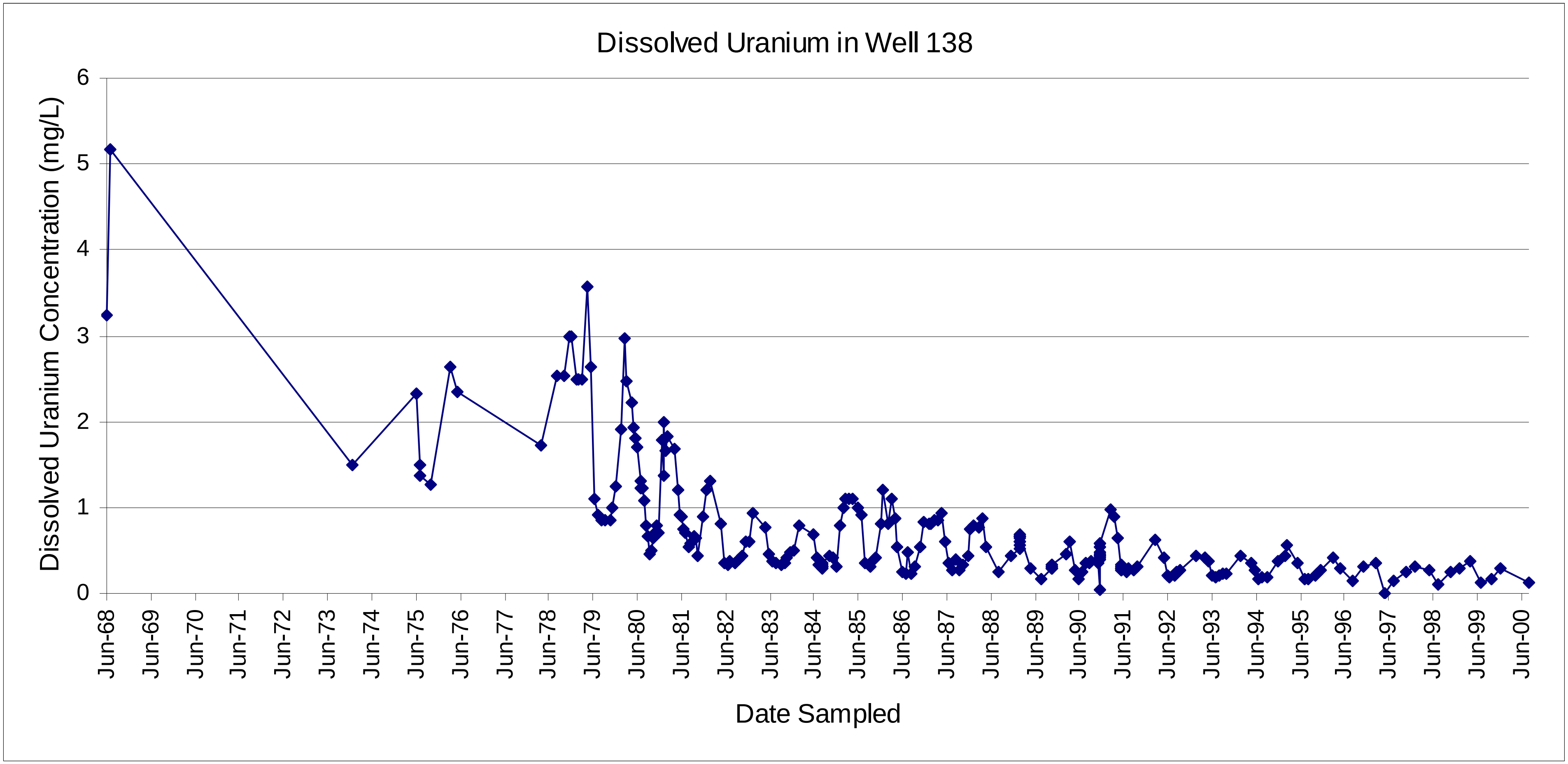
Figure 13. Selenium concentrations in Well 138



Source: CDPHE 2007b

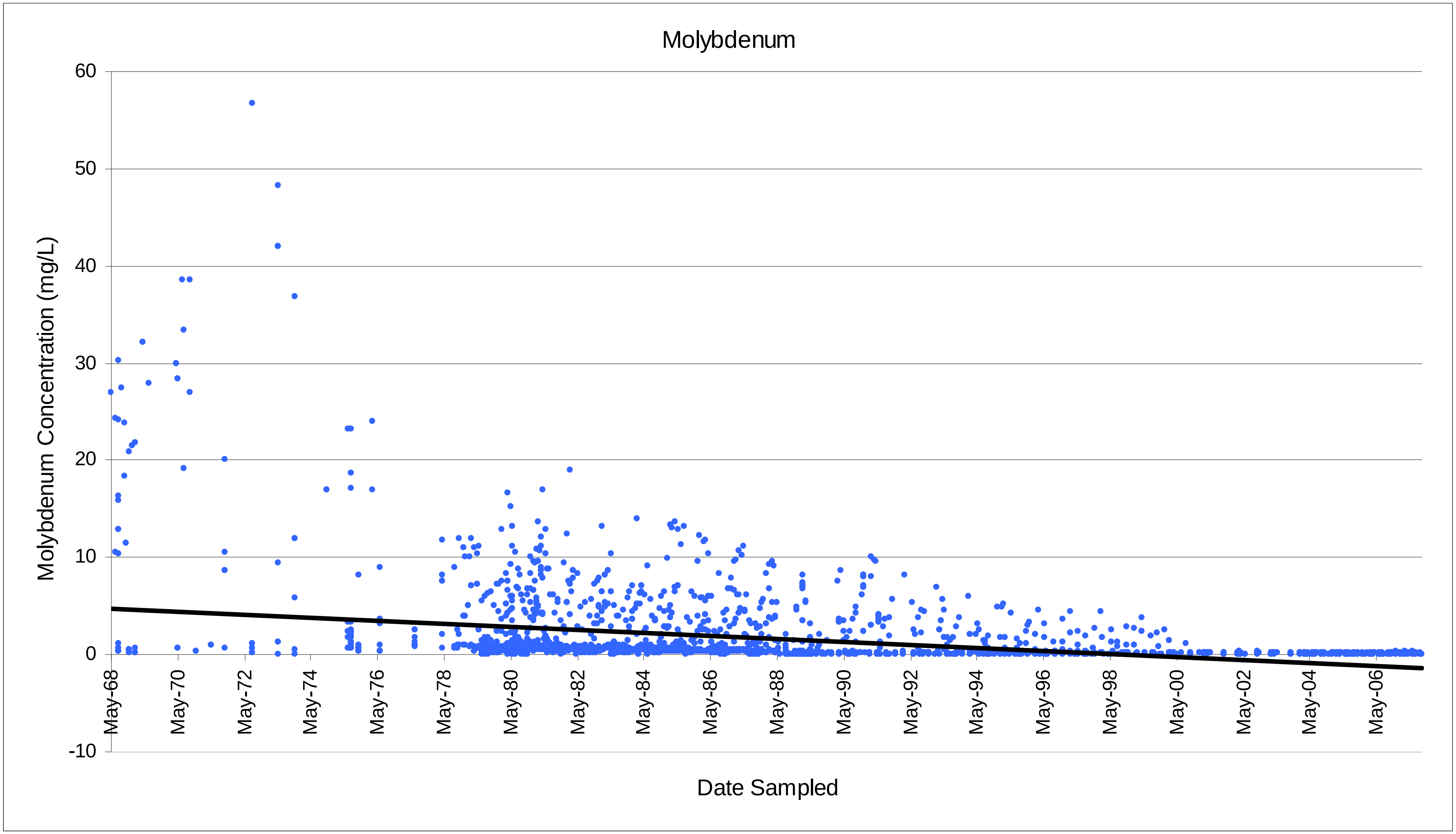
Non-detected concentrations were plotted as ½ the reporting detection limit.

Figure 14. Dissolved uranium concentrations in Well 138



Source: CDPHE 2007b

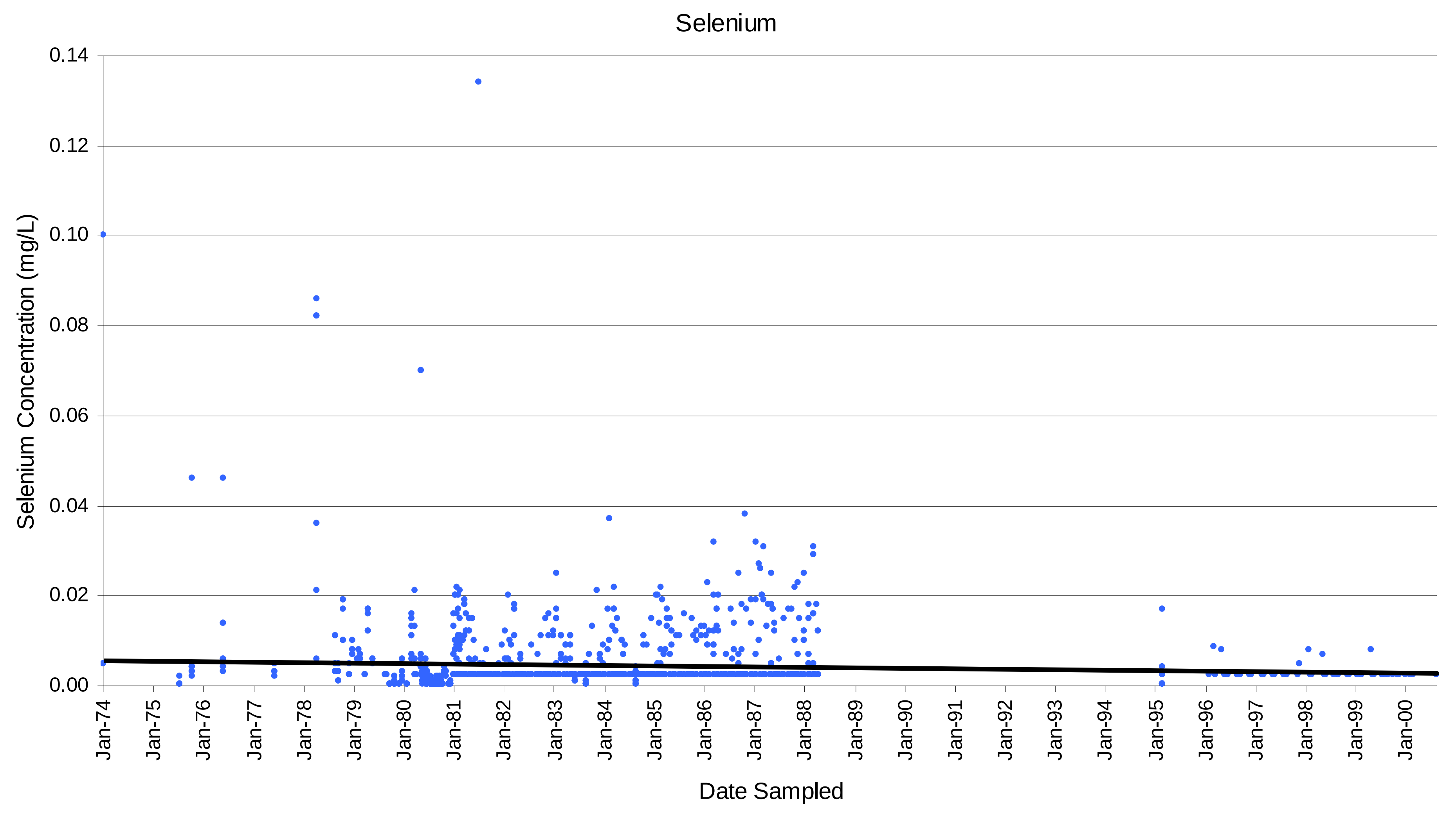
Figure 15. Molybdenum concentrations in all groundwater wells evaluated



Source: CDPHE 2007b

Non-detected concentrations were plotted as ½ the reporting detection limit.

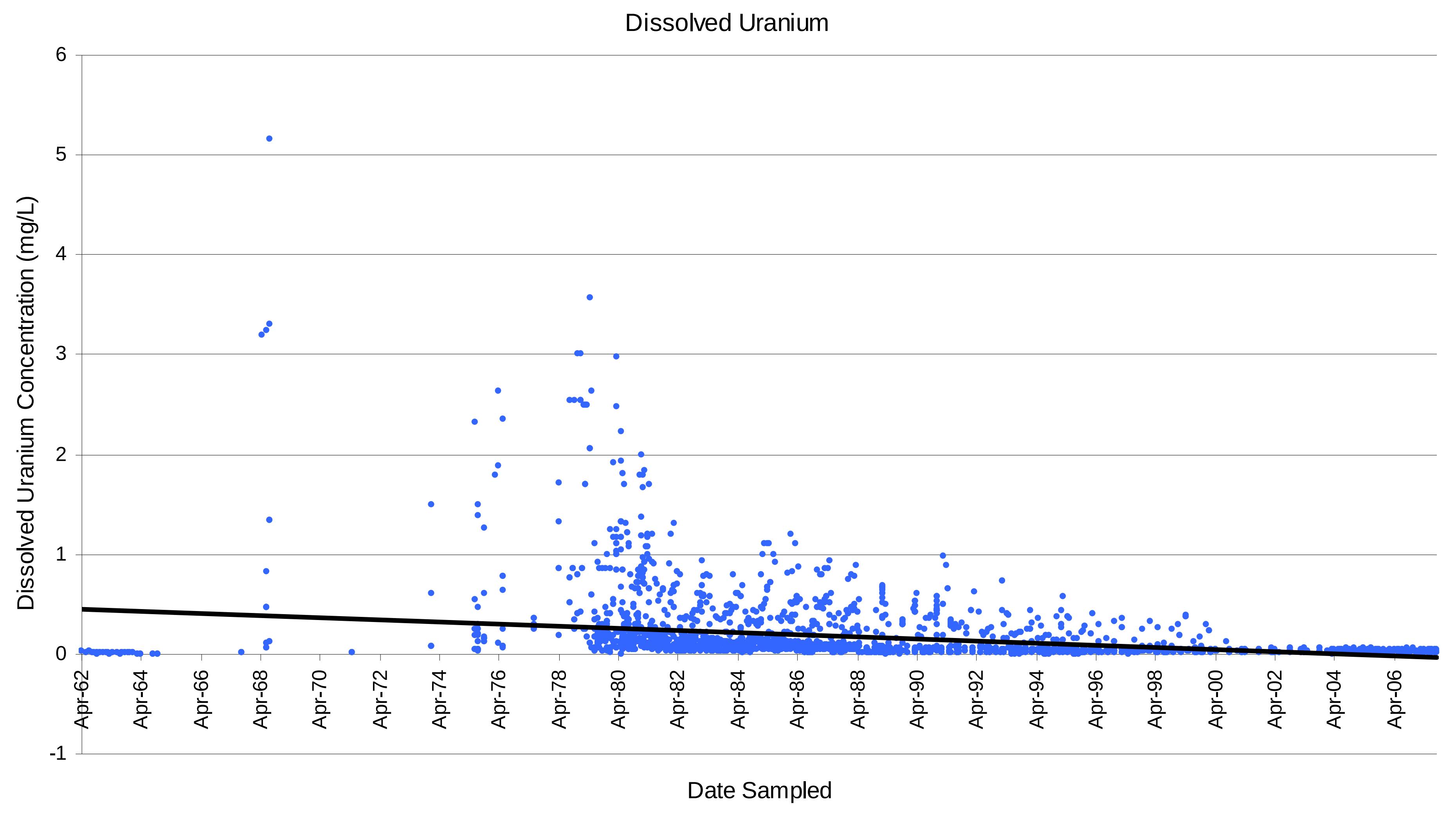
Figure 16. Selenium concentrations in all groundwater wells evaluated



Source: CDPHE 2007b

Non-detected concentrations were plotted as ½ the reporting detection limit.

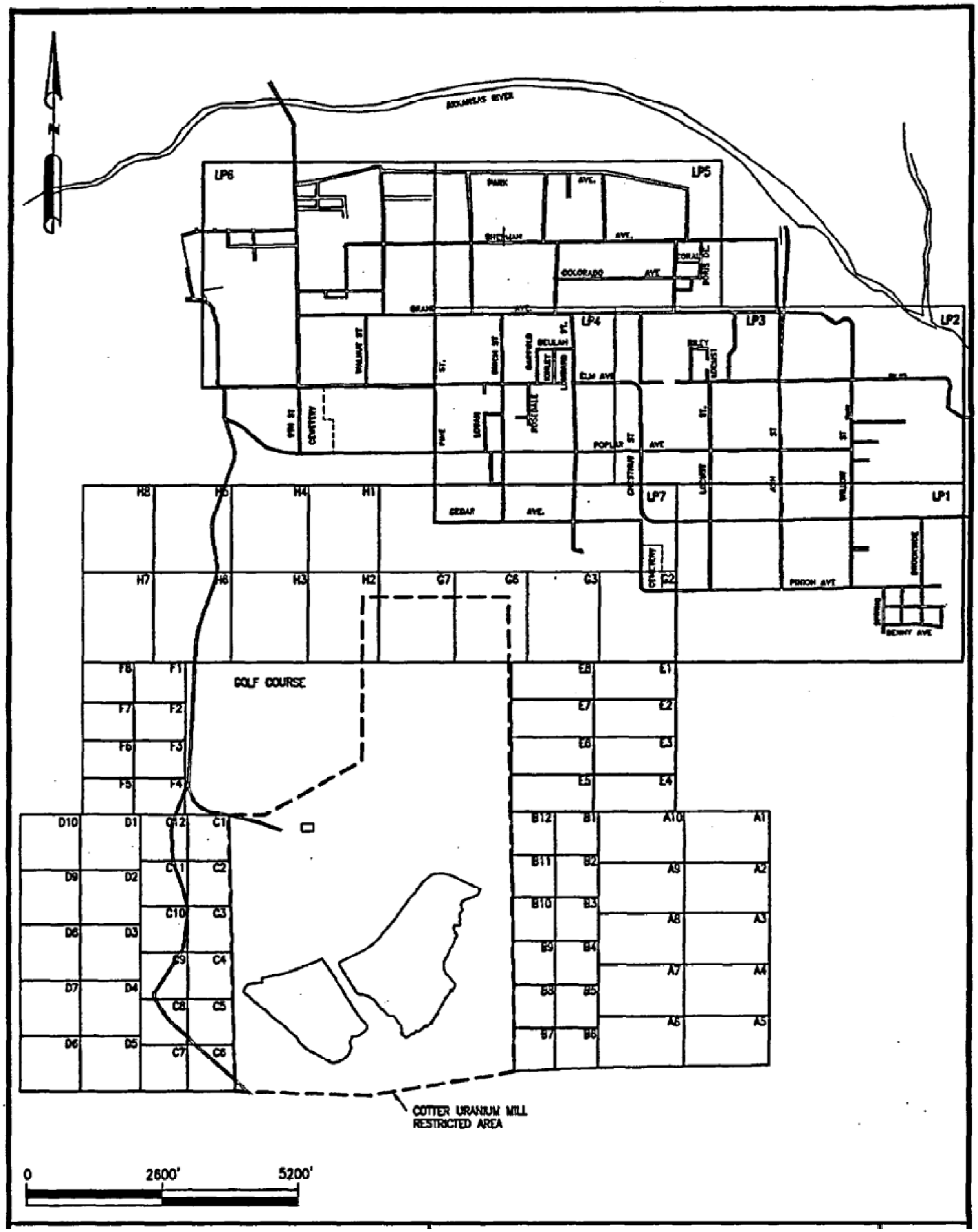
Figure 17. Dissolved uranium concentrations in all groundwater wells evaluated



Source: CDPHE 2007b

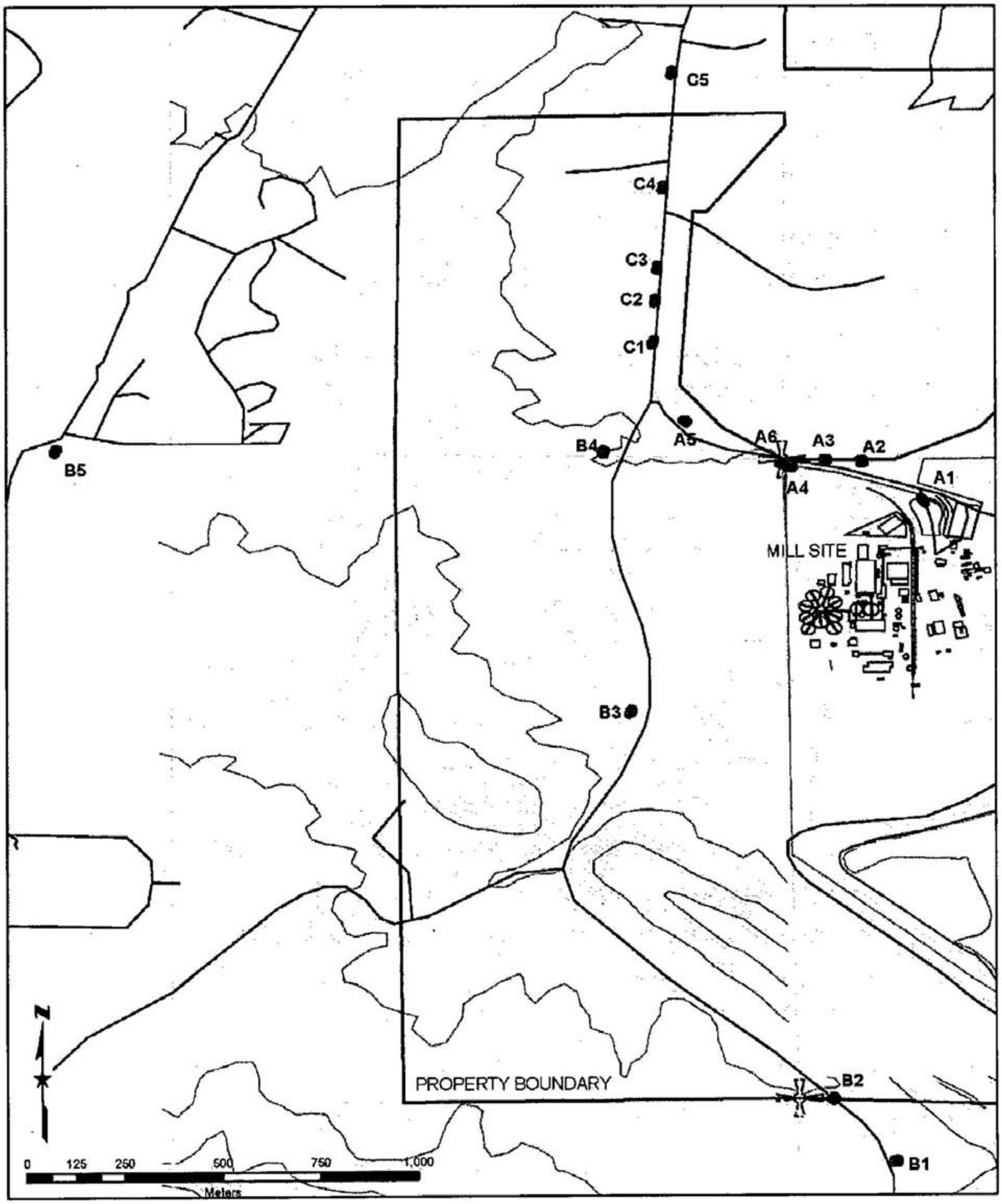
Non-detected concentrations were plotted as ½ the reporting detection limit.

Figure 18. Sampling zones established during the 1998 Supplemental Human Health Risk Assessment



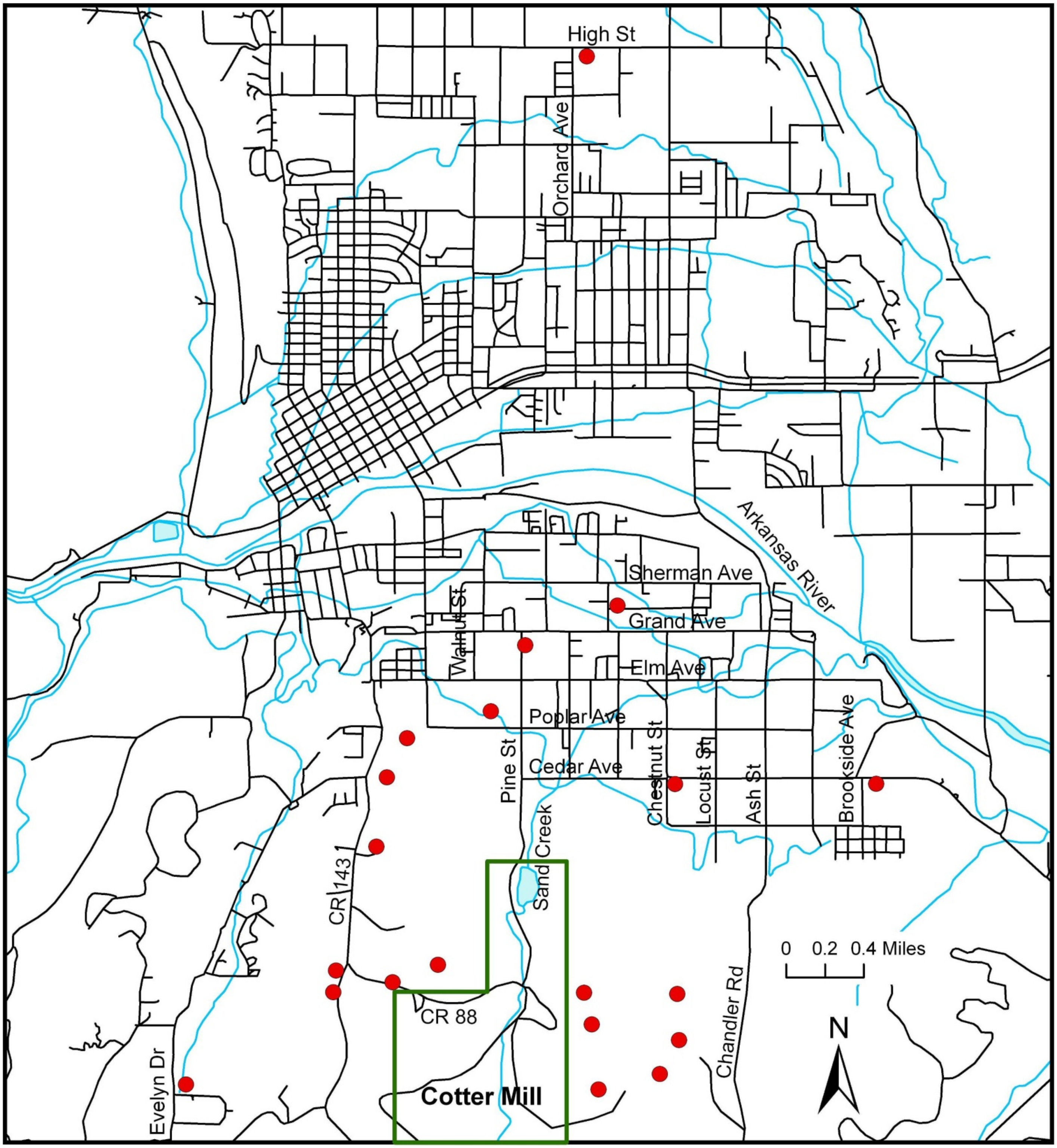
Source: Weston 1998

Figure 19. Locations of soil samples taken along the county road and Cotter Mill's access road



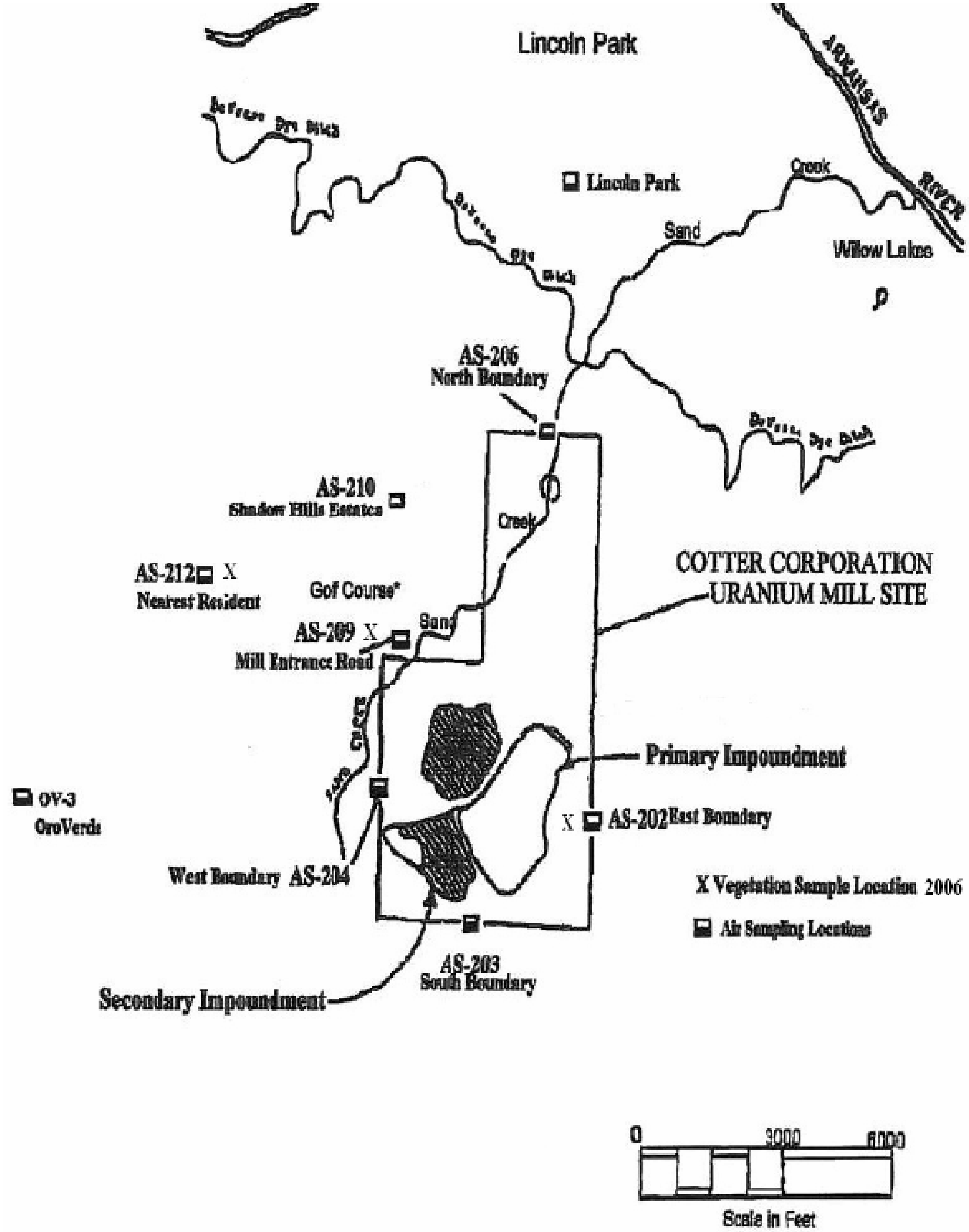
Source: MFG 2005

Figure 20. Locations of soil samples taken by CDPHE in January 2003



Source: CDPHE 2007b (coordinates)

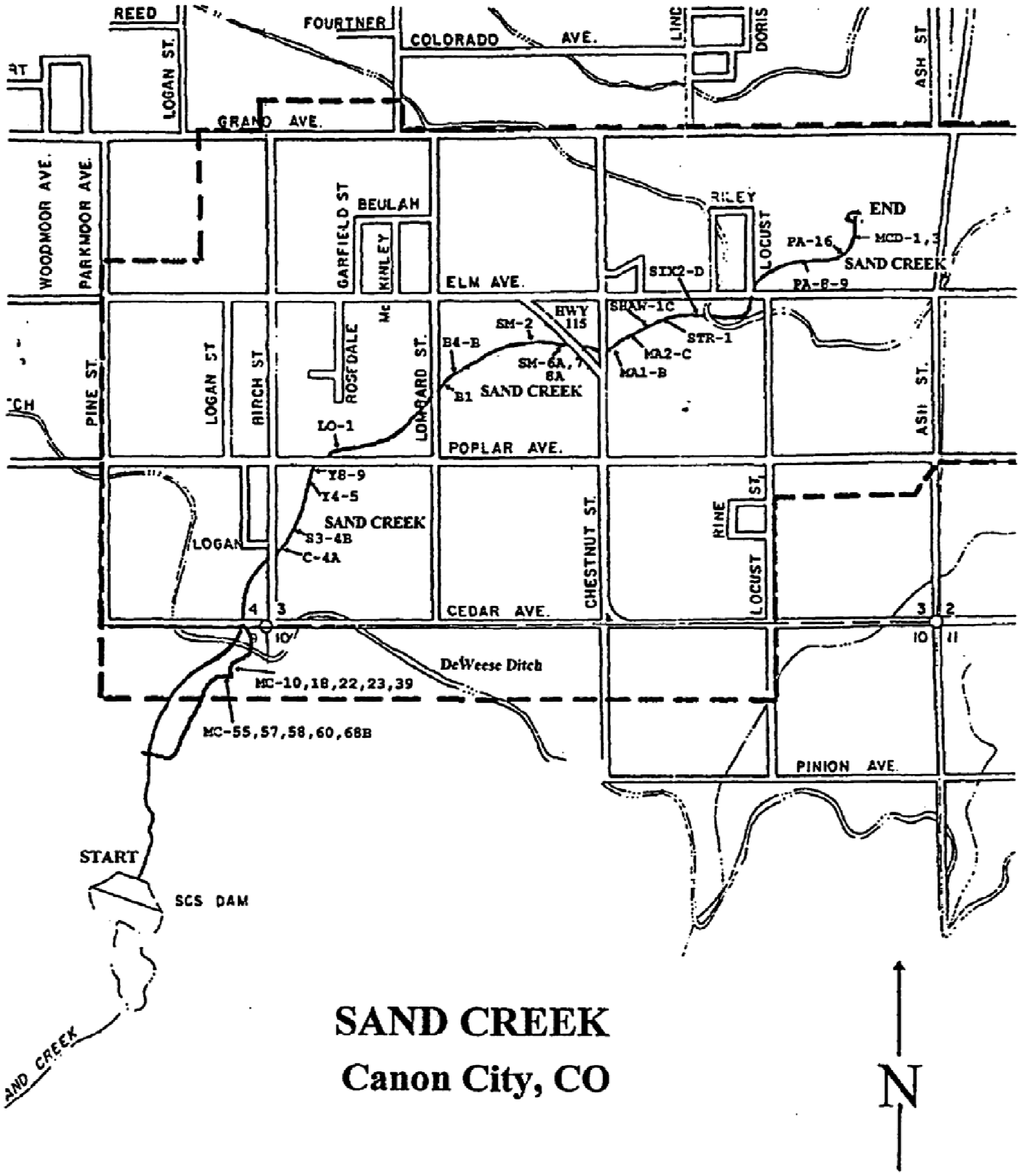
Figure 21. Location of air sampling locations where soil samples are collected



Source: Cotter 2007

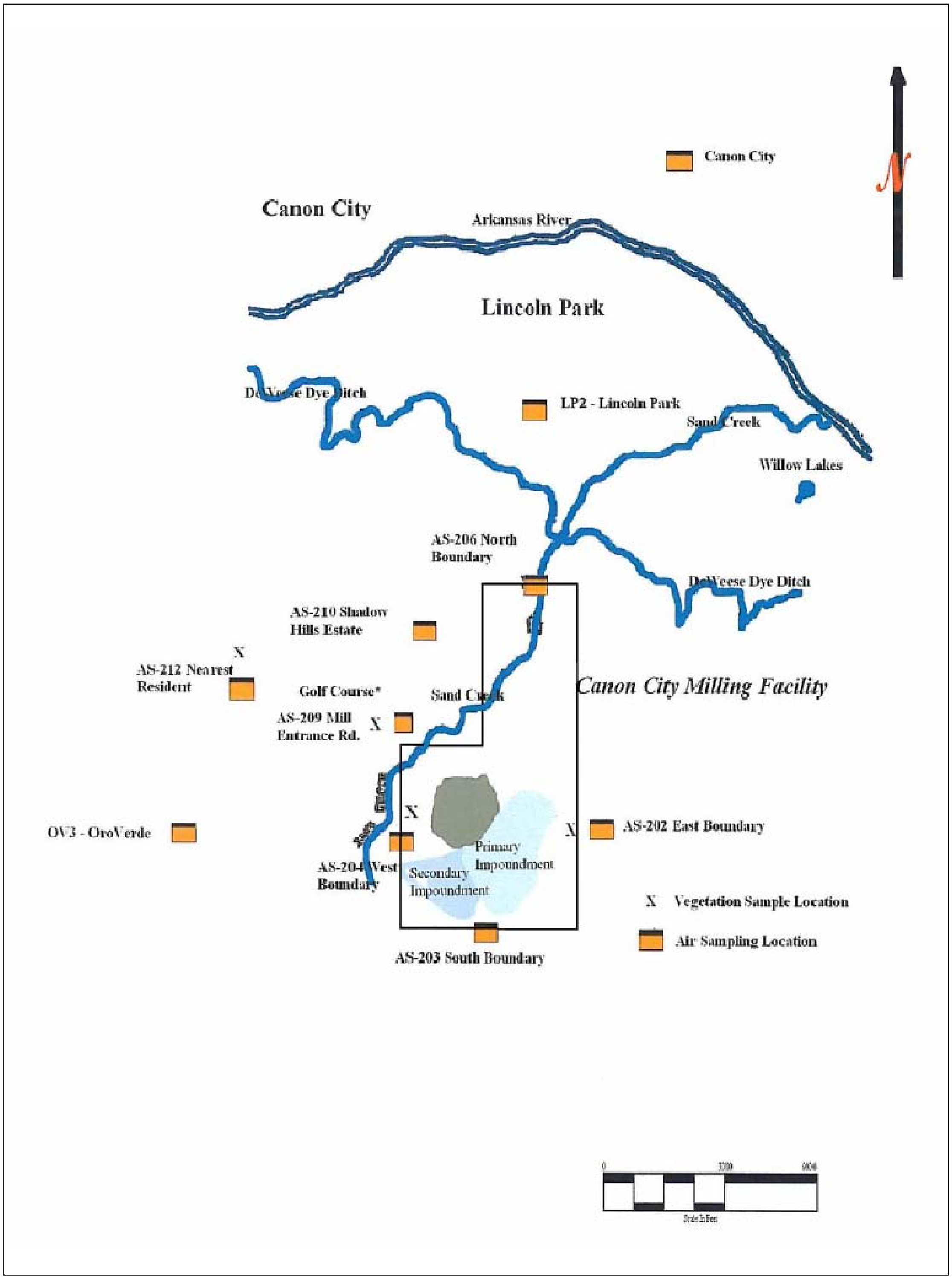
Note: An additional air sampling station is located in Cañon City (not depicted on the figure).

Figure 22. Sand Creek Cleanup Project



Source: Cotter 2000

Figure 23. Approximate Locations of Cotter Mill Monitoring Stations



Notes: Figure reproduced from: Cotter 2008

APPENDIX C:
ATSDR's Evaluation Process
And
Exposure Dose Calculations

ATSDR's Evaluation Process

Step 1 – Comparison Values and the Screening Process

To evaluate the available data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, water, or soil that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. These values are used only to screen out chemicals that do not need further evaluation; CVs are not intended as environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based comparison values are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation risk unit. CVs based on cancerous effects account for a lifetime exposure (70 years) with an unacceptable theoretical excess lifetime cancer risk of 1 new case per 1 million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs). When a cancer and non-cancer CV exists for the same chemical, the lower of these values is used in the comparison for conservatism.

Step 2 – Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific exposure scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses is presented below. Calculated doses are reported in units of milligrams per kilograms per day (mg/kg/day). Separate calculations have been performed to account for non-cancer and cancer health effects, if applicable, for each chemical based on the health impacts reported for each chemical. Some chemicals are associated with non-cancer effects while the scientific literature many indicate that cancer-related health impacts are not expected from exposure.

Exposure Dose Factors and Calculations

When chemical concentrations at the site exceed the established CVs, it is necessary for a more thorough evaluation of the chemical to be conducted. In order to evaluate the potential for human exposure to contaminants present at the site and potential health effects from site-specific activities, ATSDR estimates human exposure to the site contaminant from different environmental media by calculating exposure doses.

A discussion of the calculations and assumptions used in this assessment is presented below. The equations are based on the EPA Risk Assessment Guidance for Superfund, Part A (1989), or ATSDR's Public Health Guidance Manual (2005), unless otherwise specified. Assumptions used were based on default values, EPA's Exposure Assessment Handbook (1997) or Child-Specific Exposure Factors Handbook (2008), or professional (site-specific) judgment. When available, site-specific information is used to estimate exposures.

Ingestion of Chemicals in Well Water:

The exposure dose formula used for the ingestion of chemicals in well water is:

$$\text{Exposure Dose (ED)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= concentration of contaminant in water in milligrams per liter (mg/L)*
IR *= ingestion rate in liters per day (L/day)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
BW *= body weight (kg)*
AT *= averaging time, days (equal to ED for non-carcinogens and 70 year lifetime for carcinogens, i.e., 70 years x 365 days/year)*

Note: In the intake equation, averaging time (AT) for exposure to non-carcinogenic compounds is always equal to ED; whereas, for carcinogens a 70 year AT is still used in order to compare to EPA's cancer slope factors typically based on that value.

This pathway assumes that an adult resident drinks 2 liters (L) of water per day for 350 days per year. In terms of exposure duration (ED), the adult resident is assumed to live in the same home and drink the same well water for 30 years. The drinking water ingestion rate for children was assumed to be 1 L per day for 350 days per year for 6 years. For average body weight, 70 kg and 16 kg were used for adults and children, respectively.

ATSDR used the average chemical concentration in Well 186 to represent a high exposure scenario from a single well. Well 186 was selected because it consistently contained the highest chemical concentrations over time. The average concentration for all private wells was used to represent exposures to a typical well user.

Table C1. Summary of Exposure Factors and Exposure Doses for the Drinking Water Pathway for Chemicals at the Cotter Mill Site

Chemical	Chemical Concentration (mg/L)	Daily Ingestion Rate (L/day)	Exposure Frequency (days/yr)	Exposure Duration (yrs)	Body Weight (kg)	Averaging Time (days)	Exposure Dose (mg/kg/day)	Health Guideline (mg/kg/day)
Drinking Water Pathway: Ingestion – ADULT and CHILD								
Molybdenum ADULT	0.16 *WELL 189** HIGH EXPOSURE	2	350	30	70	10950	0.004	0.005 Chronic Oral RfD
Molybdenum CHILD		1	350	6	16	2190	**0.010**	
Molybdenum ADULT	0.082 All wells TYPICAL EXPOSURE	2	350	30	70	10950	0.002	
Molybdenum CHILD		1	350	6	16	2190	0.005	
Uranium ADULT	0.048 Well 189* HIGH EXPOSURE	2	350	30	70	10950	0.001	0.002 Intermediate Oral MRL
Uranium CHILD		1	350	6	16	2190	**0.003**	
Uranium ADULT	0.028 All wells TYPICAL EXPOSURE	2	350	30	70	10950	0.0008	
Uranium CHILD		1	350	6	16	2190	0.002	

Bolded type exceeds a comparison value.

* "Well 189" represents a high exposure scenario. This well contained the highest level of chemicals in the sampled group.

"All wells" is used to represent an average exposure scenario for the average private well drinker.

Accidental Ingestion of Chemicals in Soil

The exposure dose formula for incidental ingestion of chemicals soil and/or sediment is:

$$\text{Exposure Dose (ED)} = \frac{C \times IR \times EF \times ED \times CF}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= concentration of contaminant in soil in milligrams per kilogram (mg/kg or ppm)*
IR *= ingestion rate in milligrams per day (mg/day)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
CF *= conversion factor (10^{-6} kg/mg)*
BW *= body weight (kg)*
AT *= averaging time, days (equal to ED for non-carcinogens and 70 year lifetime for carcinogens, i.e., 70 years x 365 days/year)*

This pathway assumes that the average adolescent (11 to 16 years of age) or adult resident accidentally ingests 100 milligrams of soil per day. Because the area is in a primarily vacant "buffer zone" between the Cotter Mill and residential homes, ATSDR assumed that very young children would not access the area. Adolescent and adults would access the site infrequently. Therefore, exposure duration (ED) for an adolescent and adult resident was assumed to be 2 days per week (or 104 days/year) for 30 years. For average body weight, 57 kg was used for an adolescent and70 kg was used for an adult.

In this evaluation, the bioavailability from incidental ingestion of arsenic in soil was assumed to be 80% because it is protective of health. Cadmium was assumed to be 100% bioavailable, which is also conservative but protective of health.

Direct Skin (Dermal) Contact with Chemicals in Soil

Dermal absorption of chemicals from soil depends on the area of contact with exposed skin, the duration of contact, the chemical and physical attraction between the contaminant and soil, the ability of the chemical to penetrate the skin, and other factors.

The exposure dose formula for dermal absorption of chemicals soil and/or sediment is:

$$\text{Exposure Dose (ED)} = \frac{C \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= chemical concentration (mg/kg)*
SA *= surface area exposed (square centimeters/day or cm^2/day)*

AF *= soil to skin adherence factor (milligrams per square centimeters or* mg/cm^2*)*
ABS *= Absorption factor (unitless)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
CF *= conversion factor (*10^{-6} *kg/mg)*
BW *= body weight (kg)*
AT *= averaging time (days)*

Note: Absorption factors (ABS) are used to reflect the desorption of the chemical from soil and the absorption of the chemical across the skin and into the bloodstream.

For the dermal contact pathway, ATSDR assumed that the surface area available in an adolescent for direct skin contact is 4,300 cubic centimeters per day (cm^2/day); the surface area available in an adult is 5,000 cm^2/day. An adherence factor of 0.07 milligrams per cubic centimeter (mg/cm^3) was used. An absorption factor of 0.03 was used for arsenic and 0.01 was used for cadmium. Individuals were assumed to weigh 57 kg as an adolescent and 70 kg as an adult, and to be exposed for 6 and 30 years, respectively.

The total soil oral and dermal non-carcinogenic dose was estimated as follows:

$$\text{Total Dose (TD)} = \mathbf{ID + DD}$$

Where:

TD *= total soil ingestion and dermal non-carcinogenic dose*
ID *= Soil ingestion non-carcinogenic dose (mg/kg/day)*
DD*= Soil dermal non-carcinogenic dose (mg/kg/day)*

Cancer Risk Estimates

EPA classifies arsenic as a Class A known human carcinogen by the oral and inhalation routes. Cadmium is classified by EPA as a probable human carcinogen, but only via the inhalation route of exposure. Therefore, only arsenic is evaluated for its carcinogenic risk.

The Lifetime Estimated Cancer Risk for arsenic is estimated as follows:

$$LECR = \mathbf{TDs \times CSF \times EF}$$

Where:

LECR *= lifetime estimated cancer risk*
TDs *= total soil oral and dermal non-carcinogenic dose (mg/kg/day)*
CSF *= cancer slope factor (*$(mg/kg\text{-}day)^{-1}$*)*
EF *= Exposure factor (unitless) = exposure duration / lifetime = (30 years) / (70 years) = 0.4*

The cancer slope factor for arsenic is 1.5 mg/kg-day. Therefore, the LECR is 1.2 x 10^{-5}.

Table C2. Summary of Exposure Factors and Exposure Doses for the Soil Exposure Pathway for Chemicals at the Cotter Mill Site

Chemical	**Chemical Concentration (mg/kg)**	**Daily Intake Rate (mg/day)**	**Exposure Frequency (days/yr)**	**Exposure Duration (years)**	**Body Weight (kg)**	**Averaging Time (days)**	**Exposure Dose (mg/kg/day)**	**Health Guideline (mg/kg/day)**
Soil Exposure Pathway: Accidental Ingestion and Direct Skin Contact - ADULT and ADOLESCENT								
Arsenic (ingestion)	45	100	104	30	70	10950	0.00002	0.0003 MRL
Arsenic (dermal)		NA	104	30	70	10950	0.000002	
TOTAL DOSE ARSENIC - Adult							0.00002	*Below Guideline*
Cadmium (ingestion)	37	100	104	30	70	10950	0.00002	0.0001 MRL
Cadmium (dermal)		NA	104	30	70	10950	0.0000005	
TOTAL DOSE CADMIUM -Adult							0.00002	*Below Guideline*
Arsenic (ingestion)	45	100	104	6	54	2190	0.00002	0.0003 MRL
Arsenic (dermal)		NA	104	6	54	2190	0.000002	
TOTAL DOSE ARSENIC - Adolescent							0.00002	*Below Guideline*
Cadmium (ingestion)	37	100	104	6	54	2190	0.00002	0.0001 MRL
Cadmium (dermal)		NA	104	6	54	2190	0.0000006	
TOTAL DOSE CADMIUM - Adolescent							0.00002	*Below Guideline*

Incidental Ingestion of Chemicals in Surface Water

The ATSDR exposure dose formula used for the ingestion of chemicals in surface water while wading or swimming is:

$$\text{Exposure Dose (ED)} = \frac{C \times IR \times ET \times EF \times ED}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= concentration of contaminant in water in milligrams per liter (mg/L)*
IR *= ingestion rate in liters per day (L/day); based on contact rate of 50 ml/hr*
ET *= exposure time (hours/event)*
EF *= exposure frequency (events/year)*
ED *= exposure duration (years)*
BW *= body weight (kg)*
AT *= averaging time, days (equal to ED for non-carcinogens and 70 year lifetime for carcinogens, i.e., 70 years x 365 days/year)*

This pathway assumes that adult and children residents would accidentally swallow 50 milliliters of water per hour while swimming, wading or recreating in Sand Creek or the DeWeese Dye Ditch. In terms of exposure time and frequency, ATSDR conservatively assumed an adult and child resident would recreate in these waters for 2 hours per day, 2 days per week (or 104 days/year) for 30 years and 6 years, respectively. For average body weight, 70 kg and 16 kg were used for adults and children, respectively.

Direct Skin (Dermal) Contact with Chemicals in Surface Water

ATSDR's exposure dose formula for dermal absorption of chemicals soil and/or sediment is:

$$\text{Exposure Dose (ED)} = \frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

ED *= exposure dose in milligrams per kilogram per day (mg/kg/day)*
C *= chemical concentration (mg/L)*
SA *= surface area exposed (cm^2)*
PC *= chemical-specific dermal permeability constant (cm/hr)*
ET *= exposure time (hours/day)*
EF *= exposure frequency (days/year)*
ED *= exposure duration (years)*
CF *= volumetric conversion factor for water (1L/1000 cm^3)*
BW *= body weight (kg)*
AT *= averaging time (days)*

The dermal contact pathway assumes that the total body surface area available for contact with water is 20,000 cm^2 for adults and 9,300 cm^2 for children. Adults were assumed to weigh 70 kg and to be exposed for 30 years. Children were assumed to weigh 16 kg and to be exposed for 6 years. Adults and children were conservatively assumed to swim in the contaminated water 2 days per week (104 days per year) for 2 hours per recreating event. A dermal permeability constant of 0.001 cm/hr was used for both manganese and molybdenum.

Table C3. Summary of Exposure Factors and Exposure Doses for the Surface Water Pathway for Chemicals at the Cotter Mill Site

Chemical	**Chemical Concentration (mg/L)**	**Daily Ingestion Rate (L/day)**	**Exposure Frequency (days/yr)**	**Exposure Duration (yrs)**	**Body Weight (kg)**	**Averaging Time (days)**	**Exposure Dose (mg/kg/day)**	**Health Guideline (mg/kg/day)**
Surface Water Exposure Pathway: Accidental Ingestion and Direct Skin Contact while Wading or Swimming – ADULT and CHILD								
Manganese* Adult Ingestion	1.9	0.1	104	30	70	10950	3.9×10^{-4}	0.05 Chronic Oral RfD
Manganese Adult Dermal		NA	104	30	70	10950	3.1×10^{-4}	
		TOTAL DOSE MANGANESE – Adult					7×10^{-4}	*Below Guideline*
Manganese Child Ingestion		0.1	104	6	16	2190	1.7×10^{-3}	0.05 Chronic Oral RfD
Manganese Child Dermal		NA	104	6	16	2190	6.3×10^{-4}	
		TOTAL DOSE MANGANESE - Child					2.3×10^{-3}	*Below Guideline*
Molybdenum† Adult Ingestion	0.051	0.1	104	30	70	10950	1.0×10^{-5}	0.005 Chronic Oral RfD
Molybdenum Adult Dermal		NA	104	30	70	10950	8.3×10^{-6}	
		TOTAL DOSE MOLYBDENUM - Adult					1.8×10^{-5}	*Below Guideline*
Molybdenum Child Ingestion		0.1	104	6	16	2190	4.5×10^{-5}	0.005 Chronic Oral RfD
Molybdenum Child Dermal		NA	104	6	16	2190	1.7×10^{-5}	
		TOTAL DOSE MOLYBDENUM - Child					6.2×10^{-5}	*Below Guideline*

*Maximum concentration of manganese in surface water detected in DeWeese Dye Ditch

†Maximum concentration of molybdenum in surface water detected in Sand Creek

Consumption of Homegrown Fruits and Vegetables

The following formula presents the method for calculating an exposure dose for a typical consumer of homegrown fruits and vegetables:

$$\text{Exposure Dose (mg/kg/day)} = \mathbf{C \times IR \times CF}$$

Where:

C *= contaminant concentration (mg/kg)*
IR *= intake rate of fruit or vegetable (g/kg/day)*
CF *= conversion factor (*1×10^{-3} *kg/mg)*

Exposure doses for ingestion of garden vegetables were calculated using the average detected concentration of each contaminant measured in fruit and vegetable samples, in mg/kg, multiplied by average consumption rates of homegrown fruits or vegetables in grams per kilogram of body weight per day (g/kg/day). Intake rates were taken from EPA's Exposure Factors Handbook for adults, and EPA's Child-Specific Exposure Factors Handbook for children, for the Western United States. The average consumption rate was used to represent a "typical" fruit and vegetable consumer. The 95 percentile consumption rate was used to represent an "above average" consumer of fruits and vegetables. The calculated value was multiplied by a conversion factor of 0.001 kilograms per gram.

Table C4. Summary of Exposure Doses for Local Fruits and Vegetables Irrigated with Contaminated Well Water

Chemical	Chemical Concentration/ Exposure Group	Exposure Dose Fruits (mg/kg/day)	Exposure Dose Vegetables (mg/kg/day)	Health Guideline (mg/kg/day)
Arsenic	Average consumer	0.0001	0.0001	0.0003, Chronic Oral MRL
	Above Average Consumer	0.0006	0.0005	
	Child	0.0002	0.0002	
	Infant	0.0004	0.0004	
Barium	Average consumer	0.001	0.003	0.2 Chronic Oral MRL
	Above Average Consumer	0.005	0.010	
	Child	0.002	0.004	
	Infant	0.004	0.008	
Cadmium	Average consumer	0.0001	0.0001	0.001, RfD
	Above Average Consumer	0.0005	0.0002	
	Child	0.0002	0.0001	
	Infant	0.0004	0.0002	
Chromium	Average consumer	0.0001	0.0001	1.5 RfD
	Above Average Consumer	0.0006	0.0003	
	Child	0.0002	0.0001	
	Infant	0.0005	0.0003	
Cobalt	Average consumer	ND	0.00004	0.01 Intermediate MRL
	Above Average Consumer	ND	0.00012	
	Child	ND	0.00005	
	Infant	ND	0.0001	
Lead	Average consumer	0.0003	0.0004	NA
	Above Average Consumer	0.001	0.001	
	Child	0.0005	0.0005	
	Infant	0.001	0.001	
Manganese	Average consumer	0.002	0.004	0.14 RfD
	Above Average Consumer	0.01	0.02	
	Child	0.004	0.006	
	Infant	0.008	0.01	
Molybdenum	Average consumer	0.0003	0.001	0.005 RfD
	Above Average Consumer	0.001	0.004	

Chemical	Chemical Concentration/ Exposure Group	Exposure Dose Fruits (mg/kg/day)	Exposure Dose Vegetables (mg/kg/day)	Health Guideline (mg/kg/day)
	Child	0.0005	0.002	
	Infant	0.001	0.004	
Nickel	Average consumer	ND	0.0001	0.02 RfD
	Above Average Consumer	ND	0.0005	
	Child	ND	0.0002	
	Infant	ND	0.0004	
Strontium	Average consumer	0.004	0.009	0.6 RfD
	Above Average Consumer	0.02	0.03	
	Child	0.007	0.01	
	Infant	0.01	0.03	
Uranium	Average consumer	0.00002	0.00001	0.002 Intermediate MRL
	Above Average Consumer	0.00008	0.00004	
	Child	0.00003	0.00002	
	Infant	0.00006	0.00004	
Vanadium	Average consumer	ND	0.00008	0.003 Intermediate MRL
	Above Average Consumer	ND	0.0003	
	Child	ND	0.0001	
	Infant	ND	0.0002	
Zinc	Average consumer	0.004	0.006	0.3 Chronic Oral MRL
	Above Average Consumer	0.02	0.02	
	Child	0.006	0.008	
	Infant	0.01	0.02	

Bolded text exceeds a health guideline.
ND = not detected
NA = not available

ATSDR's Evaluation of Cancer and Non-Cancer Health Effects

Non-Cancer Health Effects

The doses calculated for exposure to each individual chemical are compared to an established health guideline, such as a MRL or RfD, in order to assess whether adverse health impacts from exposure are expected. These health guidelines, developed by ATSDR and EPA, are chemical-specific values that are based on the available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice for deriving health guidelines is to identify, usually from animal toxicology experiments, a No Observed Adverse Effect Level (or NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The NOAEL is then modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of available data. Thus, exposure doses at or below the established health guideline are not expected to result in adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies. For non-cancer health effects, the following health guidelines are described below in more detail. It is important to consider that the methodology used to develop these health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer evaluation is necessary for potentially cancer-causing chemicals detected in samples at this site. A more detailed discussion of the evaluation of cancer risks is presented in the following section.

Minimal Risk Levels (MRLs) – developed by ATSDR

ATSDR has developed MRLs for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for different routes of exposure, such as inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or greater). At this time, ATSDR has not developed MRLs for dermal exposure. A complete list of the available MRLs can be found at http://www.atsdr.cdc.gov/mrls.html.

References Doses (RfDs) – developed by EPA

An estimate of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause non-cancerous health effects. RfDs consider exposures to sensitive sub-populations, such as the elderly, children, and the developing fetus. EPA RfDs have been developed using information from the available scientific literature and have been calculated for oral and inhalation exposures. A complete list of the available RfDs can be found at http://www.epa.gov/iris.

If the estimated exposure dose for a chemical is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. Non-cancer health effects from dermal exposure were evaluated slightly differently that ingestion and inhalation exposure. Since health guidelines are not available for dermal exposure, the calculated dermal dose was compared with the oral health guideline value (RfD or MRL).

If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the PHA. The known toxicological values are doses derived from human and animal studies that are presented in the ATSDR Toxicological Profiles and EPA's Integrated Information System (IRIS). A direct comparison of site-specific exposure doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. This in-depth evaluation is performed by comparing calculated exposure doses with known toxicological values, such as the no-observed adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from studies used to derive the MRL or RfD for a chemical.

Cancer Risks

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated excess risk of developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific adult exposure doses, with a slight modification, by EPA's chemical-specific Cancer Slope Factors (CSFs or cancer potency estimates), which are available at http://www.epa.gov/iris. Calculated dermal doses were compared with the oral CSFs.

An increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular contaminant. Therefore, the cancer risk calculation incorporates the equations and parameters (including the exposure duration and frequency) used to calculate the dose estimates, but the estimated value is divided by 25,550 days (or the averaging time), which is equal to a lifetime of exposure (70 years) for 365 days/year.

There are varying suggestions among the scientific community regarding an acceptable excess lifetime cancer risk, due to the uncertainties regarding the mechanism of cancer. The recommendations of many scientists and EPA have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 (or 1×10^{-5}) are not typically considered a health concern. An important consideration when determining cancer risk estimates is that the risk calculations incorporate several very conservative assumptions that are expected to overestimate actual exposure scenarios. For example, the method used to calculate EPA's CSFs assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. As previously stated, the method also assumes that there is no safe level for exposure. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.

Because of the uncertainties involved with estimating carcinogenic risk, ATSDR employs a weight-of-evidence approach in evaluating all relevant data. Therefore, the carcinogenic risk is also described in words (qualitatively) rather than giving a numerical risk estimate only. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions. The actual parameters of environmental exposures have been given careful and thorough consideration in evaluating the assumptions and variables relating to both toxicity and exposure. A complete review of the toxicological data regarding the doses associated with the production of cancer and the site-specific doses for the site is an important element in determining the likelihood of exposed individuals being at a greater risk for cancer.

Appendix D. ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-800-CDC-INFO (1-800-232-4636).

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

Anaerobic
Requiring the absence of oxygen [compare with aerobic].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause

harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often

and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people’s past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth’s surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life (t½)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR’s public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual’s exposure could negatively affect that person’s health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period

(acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR’s toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people’s sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard
A category used in ATSDR’s public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)
National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

EPA-728

Reid Rosnick/DC/USEPA/US
09/05/2012 09:00 AM

To Beth Miller
cc
bcc
Subject Fw: S. Cohen and Associates Report Entitled Final Report Review of Existing and Proposed Tailings Impoundment Technologies

----

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 08:59 AM -----

From: "Paulson, Oscar (CCC)" <Oscar.Paulson@riotinto.com>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 06/03/2010 12:55 PM
Subject: S. Cohen and Associates Report Entitled Final Report Review of Existing and Proposed Tailings Impoundment Technologies

---

Reid:

The following pertains to the S. Cohen and Associates report entitled:

Final Report Review of Existing and Proposed Tailings Impoundment Technologies

- It lists only three (3) extant convention uranium mills in the United States (Sweetwater, Canon City and White Mesa). It fails to list the Tickaboo Mill and tailings impoundment owned by Uranium One. It incorrectly lists the owner of the White Mesa mill as UMETCO when in fact the owner is Denison Mines.
    - Table I from the report is below:

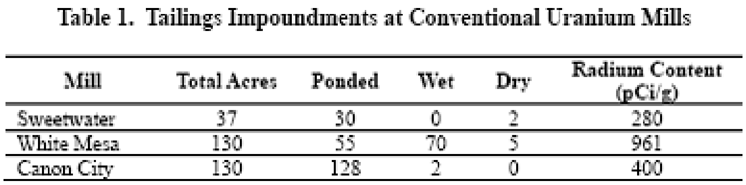


Table 1. Tailings Impoundments at Conventional Uranium Mills

Mill	Total Acres	Ponded	Wet	Dry	Radium Content (pCi/g)
Sweetwater	37	30	0	2	280
White Mesa	130	55	70	5	961
Canon City	130	128	2	0	400

    -
- Table 1 lists the Sweetwater Uranium Project tailings radium content as 280 pCi/g.
- Attached please find the Adobe Acrobat Portable Document Format (*.pdf) file *tailings_radium_226_activity.pdf* .
    - This table is from *Final Design Volume VI – Existing Impoundment Reclamation Plan – Sweetwater Uranium Project* submitted to the Nuclear Regulatory Commission (NRC) on August 26, 1997 and is part of Docket 040-08584 for Source Materials License (SML) SUA-1350.
    - This table provides an average Radium-226 activity for the tailings of 70.9 pCi/g based on twenty (20) samples.
    - This table also provides an average emanation coefficient of 0.188 based on laboratory determination of emanation coefficient for eighteen (18) samples. This value

is 54% of the default value of 0.35 used by the Nuclear Regulatory Commission (NRC) in *Regulatory Guide 3.64 – Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (U.S. Nuclear Regulatory Commission (NRC) – June 1989). The reason that this issue is being raised, is that when calculating radon flux from tailings and other earthen materials, the default emanation coefficient of 0.35 is often used and its use can lead to erroneously high radon fluxes.

- Table 3 from the report is shown below:

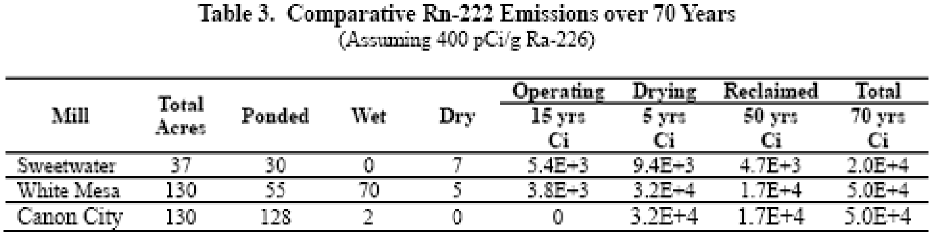


Table 3. Comparative Rn-222 Emissions over 70 Years
(Assuming 400 pCi/g Ra-226)

Mill	Total Acres	Ponded	Wet	Dry	Operating 15 yrs Ci	Drying 5 yrs Ci	Reclaimed 50 yrs Ci	Total 70 yrs Ci
Sweetwater	37	30	0	7	5.4E+3	9.4E+3	4.7E+3	2.0E+4
White Mesa	130	55	70	5	3.8E+3	3.2E+4	1.7E+4	5.0E+4
Canon City	130	128	2	0	0	3.2E+4	1.7E+4	5.0E+4

o

o It assumes a long term tailings Radium-226 activity of 400 pCi/g.

o As previously stated, the current Radium-226 activity in the impoundment averages 70.9 pCi/gram. Estimated Radium-226 activity of future tailings generated should operations resume, is 249 pCi/gram (weighted average of slimes and sand).

o This estimated activity is from Appendix H (Principal Parameters for Radiological Assessment (MILDOS Inputs) of the *Sweetwater Uranium Project – Revised Environmental Report* submitted to the Nuclear Regulatory Commission in August 1994 which is part of part of Docket 040-08584 for Source materials License (SML) SUA-1350.

o This estimated activity is based on the values in Appendix H specifically an estimate of 71% sand with a Radium-226 activity of 207 pCi/g and 29% slimes with a radium-226 activity of 353 pCi/g as per the table below:

	Activity	**Percentage**
Slimes:	353 picoCuries/gram	29%
Sand:	207 picoCuries/gram	71%
Weighted Average:	249 picoCuries/gram	100%

The above information pertains specifically to the three (3) items that were raised following your presentation. In addition, other discrepancies were noted in the report. The following are two (2) such items:

The document discusses Radon-222 source terms for in-situ uranium recovery. It discusses Radon-222 releases from mud pits and uses the variable [Ra] which is defined as Ra-226 concentration in the ore zone (pCi/g). The mud pit contains cuttings from the entire bore hole not just from the ore zone. The actual thickness of the ore zone is a fraction of the depth of the entire hole, thus the cuttings from the ore zone would be diluted with cuttings with substantially lower radium-226 activity from above the ore zone. In a typical 500 foot deep bore hole only ten (10) feet of it would be in an actual ore zone. Cuttings from the ore zone would only represent 2% of the total cuttings mass. Use of the Radium-226 activity of the ore zone to describe the activity of the entire drill cuttings mass is incorrect.

Table 4 lists the following operating in-situ uranium recovery operations:

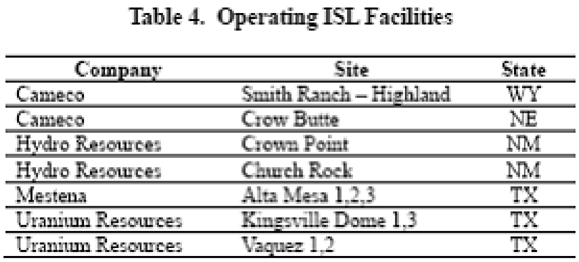


Table 4. Operating ISL Facilities

Company	Site	State
Cameco	Smith Ranch – Highland	WY
Cameco	Crow Butte	NE
Hydro Resources	Crown Point	NM
Hydro Resources	Church Rock	NM
Mestena	Alta Mesa 1,2,3	TX
Uranium Resources	Kingsville Dome 1,3	TX
Uranium Resources	Vaquez 1,2	TX

It lists Hydro Resources, Inc. Crownpoint and Churchrock facilities as operating, which they are not. In addition, I believe that Uranium Resources, Inc's Kingsville Dome and Vasquez Projects are currently not operating.

If you have any questions or require additional data please do not hesitate to contact me.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project
P.O. Box 1500
42 Miles Northwest of Rawlins
Rawlins, Wyoming 82301-1500

Telephone: (307)-324-4924
Fax: (307)-324-4925
Cellular: (307)-320-8758

E-mail: oscar.paulson@riotinto.com

-----Original Message-----
From: Rosnick.Reid@epamail.epa.gov [mailto:Rosnick.Reid@epamail.epa.gov]
Sent: Thursday, June 03, 2010 8:52 AM
To: Paulson, Oscar (CCC)
Subject: Website Information

Hello Oscar,

I trust your trip home from the NMA/NRC meeting was uneventful. I have a question; At the public meeting on May 23, you stated that found some discrepances with the radium concentrations in the Sweetwater tailings, and that you found the discrepancy in a contractor-produced document on the Subpart W website. I apologize for not taking better notes. Could you please name the document and the concentration issue? Thanks

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency

1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

tailings_radium_226_activity.pdf

Table A-5 Tailings Radiochemical Testing Results

Sample I.D	Sample Type/Date	Radium Activity (pCi/g)	Emanation Coefficient
1B	Grab - 11/96	27.7	0.188
2B	Grab - 11/96	188	0.258
3B	Grab - 11/96	193	0.070
4B	Grab - 11/96	26.3	0.238
5B	Grab - 11/96	183	0.116
6B	Grab - 11/96	21.6	0.122
7B	Grab - 11/96	11.6	0.089
8B	Grab - 11/96	31.9	0.070
9B	Grab - 11/96	19.5	*
10B	Grab - 11/96	22.0	0.170
TL-1 19'-21'	Split-Spoon - 4/97	42.3	0.271
TL-1 21'-23'	Split-Spoon - 4/97	88.5	0.320
TL-3 2'-4'	Split-Spoon - 4/97	17.8	0.111
TL-3 4'-6'	Split-Spoon - 4/97	17.2	0.195
TL-4 2'-4"	Split-Spoon - 4/97	254	0.140
TL-4 14'-16'	Split-Spoon - 4/97	20.2	0.270
TL-7 2'-4'	Split-Spoon - 4/97	21.7	*
TL-7 12'-14'	Split-Spoon - 4/97	35.0	0.146
TL-9 10'-11.3'	Split-Spoon - 4/97	126	0.333
TL-9 11.3'-15'	Split-Spoon - 4/97	69.7	0.281
Mean Value		**70.9 pCi/g[1]**	**0.188**

[1] This value was incorrectly reported as 70.4 pCi/g in Volume II, Data Report

EPA-510

Reid Rosnick/DC/USEPA/US
09/05/2012 09:02 AM

To Beth Miller
cc
bcc
Subject Fw: Comments on Subpart W Review

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov
----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:02 AM -----

From: "Sarah M. Fields" <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 11/25/2009 02:05 PM
Subject: Comments on Subpart W Review

Dear Mr. Rosnick,

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on
the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the
exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch
sarah@uraniumwatch.org
435-210-0166

memo_subpartWreview.091125.pdf

MEMORANDUM

TO: Reid Rosnick, Radiation Protection Division, Environmental Protection Agency
FROM: Sarah M. Fields, Uranium Watch
DATE: November 25, 2009
RE: EPA REVIEW OF 40 CFR PART 61, SUBPART W — RADON NESHAP FOR OPERATING URANIUM RECOVERY FACILITIES

Below are some issues that the Environmental Protection Agency (EPA) must address in their review of 40 C.F.R. Part 61, Subpart W, and any proposed rulemakings. This will be supplemented later.

The Environmental Protection Agency administers and enforces Subpart W, except in the State of Utah, since 1995. However, the EPA has an oversight responsibility for Utah's primacy program.

The EPA review is colored by the fact that the EPA failed in their Clean Air Act responsibilities in several departments, including:

- Failure to review Subpart W and other radionuclide NESHAPS in a timely manner.
- Failure to properly implement radionuclide NESHAPS for uranium mills in Colorado.
- Failure to set criteria for a definition of a "major source" of radionuclides.
- Leaving applications and approvals (pursuant to 40 C.F.R. §§ 61.07 and 61.08) outside the Title V and Part 70 permit process.
- Allowing the Nuclear Regulatory Commission to replace their radon emission program with the Subpart W reporting requirements at the White Mesa Mill.
- Failure to apply Subpart W to in situ leach (ISL) uranium recovery operations.
- Failure to establish an adequate program for states assuming authority for Part 61 radionuclide NESHAPS.

1. Subpart W can't be properly revised without also revising the General Requirements in Subpart A. 40 C.F.R. § 61.07, which applies to all Part 61 regulated sources, requires an application for approval of construction or modification. 40 C.F.R. § 61.08 provides the requirements regarding the approval of construction or modification. These are generic requirements and would need to be augmented for Subpart W sources.

Proposed changes:

A. Expanded list of technical information for a Subpart W source application. The technical information requirements at Section 61.07(b)(3):

> Technical information describing the proposed nature, size, design, operating design capacity, and method of operation of the source,

> including a description of any equipment to be used for control of emissions. Such technical information shall include calculations of emission estimates in sufficient detail to permit assessment of the validity of the calculations.

B. Modification of a Subpart W source: A modification is defined in Section 61.10(a) as "any physical or operational change to a stationary source which results in an increase in the rate of emission to the atmosphere of a hazardous pollutant to which a standard applies shall be considered a modification."

The EPA should spell out exactly what constitutes a "modification" of a uranium recovery facility that requires an application for a modification, pursuant to 40 C.F.R. § 61.07.

C. The EPA or state agency should make the applications, intent to deny or approve, final approval, etc., readily publicly available electronically.

D. Public Process: Apparently a NEPA process is not required for the review of applications pursuant to Part 61. There appears to be no EPA requirement for a notice and comment process. However, there should be a NEPA review process, with an opportunity for public review and comment. The EPA expected that primacy states would have a notice process, but did not actually require that for the State of Utah. Government records act regulations do not constitute a means of public notice of an application or agency approval.

2. The EPA should determine that radionuclide sources subject to the standards in Part 61 are "major sources," thereby removing any question regarding the applicability of 40 C.F.R. Part 70 and Title V regulations to applications and approvals for radionuclide sources regulated under Part 61.

3. History of implementation of the Part 61, Subpart W.

The EPA should conduct a full review of the EPA and Utah implementation of Subpart W, make documents readily available to the public, identify problems and concerns, and suggest remedies in a public process.

4. Background Documents for the Radionuclide NESHAPS, Air Docket A-79-11.

The EPA should inform the public of which Subpart W Background Documents are under review for possible revisions.

5. Need for new regulatory guidance.

An EPA guidance that spells out (with particularity and specificity) how the EPA and primacy states are to implement the Subpart W and other radionuclide NESHAPS is sorely needed. Draft guidance should be put out for public comment.
6. The EPA program for state programs implementing Part 61 NESHAPS must be revised.

7. Issues and Need for Changes in Subpart W.

A. Need for site boundary and off-site monitoring on a continuous basis.

B. Assessment and consideration of the emission and dispersion of radon progeny.

C. Consideration of higher standard for emissions from tailings.

D. Requirements for site-specific meteorological data and information.

E. Need for clarification: 40 C.F.R. § 61.250 (Designation of Facilities) states: "This subpart does not apply to the disposal of tailings." However, the standard does apply to the disposal of tailings, as is apparent in the regulation. This needs to be clarified.

F. There have been questions at the Cotter Mill about the applicability of the standard to tailings impoundment that are not being used for tailings disposal, but have not undergone final reclamation.

G. Determining Compliance: Method of measuring radon flux and frequency needs revision. Emissions form all sources of radon at a mill need to be measured, including ponds, ore piles, alternative-feed storage areas, buildings. Need for edge of site and offsite confirmatory sampling. Need to measure radon progeny.

H. Reports are currently required once a year, 120 days after the end of the year. Reports should routinely be submitted more often and within a shorter time period: quarterly or every six-months.

I. Need for increased sampling and reporting during time when liquid on impoundments, which acts as a radon barrier and suppresses the dispersion of dust, is drying out and before placement of interim cover or final radon barrier.

K. Need to address release of radon-220 from the placement of thorium-228 and thorium-232 in uranium mill tailings impoundments. It is unclear if the current techniques used to determine the radon flux on tailings impoundments could properly detect radon-220.

L. Methodology for sampling and determination of radon flux: Areas with high radon releases can be "averaged" with areas of low radon releases, creating a false impression of regulatory compliance.

M. The EPA must clarify the relationship of Subpart W to Part 192.
N. The EPA must clarify the relationship of Subpart W with 10 C.F.R. Part 40, Appendix A, Criterion 8, which is Nuclear Regulatory Commission standards for air emissions from uranium mills and other uranium recovery operations.

O. The EPA must apply the same exposure standard to uranium recovery operations as for uranium mines or justify the difference between annual dose standard for uranium recovery facilities and the more stringent standard for uranium mines. The standard for the dose to the nearest member of the public for uranium mines is 10 mrem/year; the standard for uranium recovery operations is 25 mrem/year.

P. The EPA must address compliance with the requirements of the Clean Air Act, Section 112(d).

Q. Are Subpart W sources "major sources" or area sources? If the EPA maintains the designation of Subpart W sources as non-major sources then the EPA must explicitly state that they are subject to Part 70 permit requirements (and Title V requirements) or exempt the sources from the requirement to obtain a Part 70 permit, pursuant to the requirement in 40 C.F.R. § 70.3(b)(2).

R. The EPA must clarify the meaning of a "non-operational" tailings impoundment and clarify when a tailings impoundment is no longer subject to the Subpart W monitoring and reporting requirements.

S. "Non-operational" radon sources: If an operator wishes to designate a tailings impoundment or other radon source subject to Subpart W as "non-operational" and no longer subject to Subpart W monitoring and reporting requirements, the EPA should require an application, approval by the EPA or primacy state (with EPA concurrence), and a public notice and comment process.

The EPA or state should not designate an impoundment or unit as "non-operational" until there is a current, approved reclamation plan for the reclamation of the "non-operational" impoundment. Decades old reclamation plans will not do. The EPA or state should not designate an impoundment or unit as "non-operational" until approved reclamation milestones have been approved by the NRC or NRC Agreement State and there is reasonable assurance that the impoundment would continue to meet the Subpart W standard and that interim measures will be undertaken if it does not. This is especially important when tailings impoundments that have a liquid cover start to dry out. At that time there is an increase in radon and radon progeny releases, along with an increase in the dispersion of dust and particulates from the impoundment.

Milestones must be technically justifiable. The reclamation milestones established for the former Atlas Uranium Mill, Moab, Utah, were not technically feasible, and the milestone process demonstrated that the NRC and the licensee where just going through the motions. Work that could have been done to clean up radioactive materials off-site was not done in a timely manner and the milestones for the placement of the final cover were completely unrealistic.

Sarah M. Fields
Uranium Watch
P.O. Box 344
Moab, Utah 84532
sarah@uraniumwatch.org
435-210-0166

EPA-510

Reid Rosnick/DC/USEPA/US
09/05/2012 09:02 AM

To Beth Miller
cc
bcc
Subject Fw: Comments on Subpart W Review

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/05/2012 09:02 AM -----

From: "Sarah M. Fields" <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 11/25/2009 02:05 PM
Subject: Comments on Subpart W Review

Dear Mr. Rosnick,

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on
the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the
exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch
sarah@uraniumwatch.org
435-210-0166

memo_subpartWreview.091125.pdf

MEMORANDUM

TO: Reid Rosnick, Radiation Protection Division, Environmental Protection Agency
FROM: Sarah M. Fields, Uranium Watch
DATE: November 25, 2009
RE: EPA REVIEW OF 40 CFR PART 61, SUBPART W — RADON NESHAP FOR OPERATING URANIUM RECOVERY FACILITIES

Below are some issues that the Environmental Protection Agency (EPA) must address in their review of 40 C.F.R. Part 61, Subpart W, and any proposed rulemakings. This will be supplemented later.

The Environmental Protection Agency administers and enforces Subpart W, except in the State of Utah, since 1995. However, the EPA has an oversight responsibility for Utah's primacy program.

The EPA review is colored by the fact that the EPA failed in their Clean Air Act responsibilities in several departments, including:

- Failure to review Subpart W and other radionuclide NESHAPS in a timely manner.
- Failure to properly implement radionuclide NESHAPS for uranium mills in Colorado.
- Failure to set criteria for a definition of a "major source" of radionuclides.
- Leaving applications and approvals (pursuant to 40 C.F.R. §§ 61.07 and 61.08) outside the Title V and Part 70 permit process.
- Allowing the Nuclear Regulatory Commission to replace their radon emission program with the Subpart W reporting requirements at the White Mesa Mill.
- Failure to apply Subpart W to in situ leach (ISL) uranium recovery operations.
- Failure to establish an adequate program for states assuming authority for Part 61 radionuclide NESHAPS.

1. Subpart W can't be properly revised without also revising the General Requirements in Subpart A. 40 C.F.R. § 61.07, which applies to all Part 61 regulated sources, requires an application for approval of construction or modification. 40 C.F.R. § 61.08 provides the requirements regarding the approval of construction or modification. These are generic requirements and would need to be augmented for Subpart W sources.

Proposed changes:

A. Expanded list of technical information for a Subpart W source application. The technical information requirements at Section 61.07(b)(3):

> Technical information describing the proposed nature, size, design, operating design capacity, and method of operation of the source,

> including a description of any equipment to be used for control of emissions. Such technical information shall include calculations of emission estimates in sufficient detail to permit assessment of the validity of the calculations.

B. Modification of a Subpart W source: A modification is defined in Section 61.10(a) as "any physical or operational change to a stationary source which results in an increase in the rate of emission to the atmosphere of a hazardous pollutant to which a standard applies shall be considered a modification."

The EPA should spell out exactly what constitutes a "modification" of a uranium recovery facility that requires an application for a modification, pursuant to 40 C.F.R. § 61.07.

C. The EPA or state agency should make the applications, intent to deny or approve, final approval, etc., readily publicly available electronically.

D. Public Process: Apparently a NEPA process is not required for the review of applications pursuant to Part 61. There appears to be no EPA requirement for a notice and comment process. However, there should be a NEPA review process, with an opportunity for public review and comment. The EPA expected that primacy states would have a notice process, but did not actually require that for the State of Utah. Government records act regulations do not constitute a means of public notice of an application or agency approval.

2. The EPA should determine that radionuclide sources subject to the standards in Part 61 are "major sources," thereby removing any question regarding the applicability of 40 C.F.R. Part 70 and Title V regulations to applications and approvals for radionuclide sources regulated under Part 61.

3. History of implementation of the Part 61, Subpart W.

The EPA should conduct a full review of the EPA and Utah implementation of Subpart W, make documents readily available to the public, identify problems and concerns, and suggest remedies in a public process.

4. Background Documents for the Radionuclide NESHAPS, Air Docket A-79-11.

The EPA should inform the public of which Subpart W Background Documents are under review for possible revisions.

5. Need for new regulatory guidance.

An EPA guidance that spells out (with particularity and specificity) how the EPA and primacy states are to implement the Subpart W and other radionuclide NESHAPS is sorely needed. Draft guidance should be put out for public comment.
6. The EPA program for state programs implementing Part 61 NESHAPS must be revised.

7. Issues and Need for Changes in Subpart W.

A. Need for site boundary and off-site monitoring on a continuous basis.

B. Assessment and consideration of the emission and dispersion of radon progeny.

C. Consideration of higher standard for emissions from tailings.

D. Requirements for site-specific meteorological data and information.

E. Need for clarification: 40 C.F.R. § 61.250 (Designation of Facilities) states: "This subpart does not apply to the disposal of tailings." However, the standard does apply to the disposal of tailings, as is apparent in the regulation. This needs to be clarified.

F. There have been questions at the Cotter Mill about the applicability of the standard to tailings impoundment that are not being used for tailings disposal, but have not undergone final reclamation.

G. Determining Compliance: Method of measuring radon flux and frequency needs revision. Emissions form all sources of radon at a mill need to be measured, including ponds, ore piles, alternative-feed storage areas, buildings. Need for edge of site and offsite confirmatory sampling. Need to measure radon progeny.

H. Reports are currently required once a year, 120 days after the end of the year. Reports should routinely be submitted more often and within a shorter time period: quarterly or every six-months.

I. Need for increased sampling and reporting during time when liquid on impoundments, which acts as a radon barrier and suppresses the dispersion of dust, is drying out and before placement of interim cover or final radon barrier.

K. Need to address release of radon-220 from the placement of thorium-228 and thorium-232 in uranium mill tailings impoundments. It is unclear if the current techniques used to determine the radon flux on tailings impoundments could properly detect radon-220.

L. Methodology for sampling and determination of radon flux: Areas with high radon releases can be "averaged" with areas of low radon releases, creating a false impression of regulatory compliance.

M. The EPA must clarify the relationship of Subpart W to Part 192.
N. The EPA must clarify the relationship of Subpart W with 10 C.F.R. Part 40, Appendix A, Criterion 8, which is Nuclear Regulatory Commission standards for air emissions from uranium mills and other uranium recovery operations.

O. The EPA must apply the same exposure standard to uranium recovery operations as for uranium mines or justify the difference between annual dose standard for uranium recovery facilities and the more stringent standard for uranium mines. The standard for the dose to the nearest member of the public for uranium mines is 10 mrem/year; the standard for uranium recovery operations is 25 mrem/year.

P. The EPA must address compliance with the requirements of the Clean Air Act, Section 112(d).

Q. Are Subpart W sources "major sources" or area sources? If the EPA maintains the designation of Subpart W sources as non-major sources then the EPA must explicitly state that they are subject to Part 70 permit requirements (and Title V requirements) or exempt the sources from the requirement to obtain a Part 70 permit, pursuant to the requirement in 40 C.F.R. § 70.3(b)(2).

R. The EPA must clarify the meaning of a "non-operational" tailings impoundment and clarify when a tailings impoundment is no longer subject to the Subpart W monitoring and reporting requirements.

S. "Non-operational" radon sources: If an operator wishes to designate a tailings impoundment or other radon source subject to Subpart W as "non-operational" and no longer subject to Subpart W monitoring and reporting requirements, the EPA should require an application, approval by the EPA or primacy state (with EPA concurrence), and a public notice and comment process.

The EPA or state should not designate an impoundment or unit as "non-operational" until there is a current, approved reclamation plan for the reclamation of the "non-operational" impoundment. Decades old reclamation plans will not do. The EPA or state should not designate an impoundment or unit as "non-operational" until approved reclamation milestones have been approved by the NRC or NRC Agreement State and there is reasonable assurance that the impoundment would continue to meet the Subpart W standard and that interim measures will be undertaken if it does not. This is especially important when tailings impoundments that have a liquid cover start to dry out. At that time there is an increase in radon and radon progeny releases, along with an increase in the dispersion of dust and particulates from the impoundment.

Milestones must be technically justifiable. The reclamation milestones established for the former Atlas Uranium Mill, Moab, Utah, were not technically feasible, and the milestone process demonstrated that the NRC and the licensee where just going through the motions. Work that could have been done to clean up radioactive materials off-site was not done in a timely manner and the milestones for the placement of the final cover were completely unrealistic.

Sarah M. Fields
Uranium Watch
P.O. Box 344
Moab, Utah 84532
sarah@uraniumwatch.org
435-210-0166

EPA-322

Beth Miller/DC/USEPA/US
09/05/2012 01:04 PM

To Reid Rosnick
cc
bcc
Subject Emails for posting

emails for posting.docx

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Mr. Rosnick

The Wyoming Mining Association (WMA) is very concerned about claims that uranium mining and processing may contribute to health impairment from the release of radon from uranium processing facilities. WMA would like to draw your attention to the attached report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010. In summary the study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.* The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded that outdoor concentration of radon contributed zero dust to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay.
I understand that there will be a conference call on October 6 to discuss 40 CFR Part 61 Subpart W which deals with this issue. WMA requests that this study be on the agenda for discussion during that conference call.

Thank you.

Marion Loomis

Reid Rosnick:

Thank you for your reply. Kennecott Uranium Company believes that the Agency for Toxic Substances and Disease Registry (ATSDR) draft Public Health Assessment applies directly to Subpart W regulation for the following reasons:

- 40 CFR Part 61 Subpart W regulates radon emissions from tailings impoundments via either the twenty (20) picocurie per meter squared second standard for existing impoundments or the work practices for new impoundments constructed after December 15, 1989. The goal of this regulation is to reduce exposures and doses to the general public from radon and its decay products from uranium mill tailings impoundments.
- The draft Public Health Assessment specifically addresses public dose from and exposure to radon and its decay products from a uranium mill tailings impoundment namely Cotter Corporation's Canon City Mill impoundment.
- The draft Public Health Assessment states:
  On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.
- This conclusion has direct bearing on the current effectiveness of 40 CFR part 61 Subpart W, specifically that as it now stands the doses from radon and its decay products from a tailings impoundment (Cotter Corporation's Canon City impoundment) regulated under 40 CFR Part 61 Subpart W do not represent a health threat.
- This conclusion goes directly to statements made in the lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action specifically the request to *"Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air…"*

The above reasons are why Kennecott Uranium Company is requesting that this draft Public Health Assessment be on the agenda for discussion on the Wednesday, October 6, 2010 conference call.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Dear Mr. Marschke:

The required environmental data to perform a radon risk assessment for the Sweetwater Uranium Project is either already in the possession of the Environmental Protection Agency (EPA) or publically available. The following applies to the required data:

- Radon flux testing data for the Sweetwater Uranium Project tailings impoundment for calendar years 1990 to 2010 has been submitted to the Agency as required by 40 CFR Part 61 Subpart W. and is already available to Agency staff.
- Meteorological data in the Revised Environmental Report dated August 1994, represents a good long term summary of site's meteorological conditions and as such is representative and suitable for use. This document is available on the Nuclear Regulatory Commission's (NRC's) web site at the link below:
- http://pbadupws.nrc.gov/docs/ML0810/ML081010327.pdf
- The meteorological data provided in this document including, I believe, joint frequency distributions, is site specific data.
- Upwind and downwind radon activity data for ambient air collected using Landauer, Inc.'s TrakEtch devices has been submitted semiannually to the Nuclear Regulatory Commission (NRC) as part of the facility's semiannual 40.65 Reports and is publically available in the Commission's online ADAMS system.
- In addition, I believe that upwind and downwind radon activity data for ambient air was summarized in a submittal to the Commission in either the first half of 1998 or 1999 so that the submittal plus any 40.65 Reports submitted from its date forward, provide a complete set of upwind and downwind radon activity data for the site. In any event, upwind and downwind radon activity data is submitted semiannually in the required 40.65 Reports and is available in the ADAMS system. I can check on the 1998 summary report when I return to the office and probably provide a link to it on the Nuclear Regulatory Commission's (NRC's) web site.

I am traveling this week and will return to the site on Tuesday, February 21, 2011. I would like to work with you upon my return to ensure that the risk assessment completed for the Sweetwater Uranium Project is based upon actual site conditions and measurements. Should you have any questions please call me at that time.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid Rosnick:

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public

Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*

- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
  - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases from the Canon City Mill. The filing states, "*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado."* The filing continues by requesting that the Environmental Protection Agency (EPA), "*Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid."*

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid:

The following pertains to the S. Cohen and Associates report entitled:

Final Report Review of Existing and Proposed Tailings Impoundment Technologies

It lists only three (3) extant convention uranium mills in the United States (Sweetwater, Canon City and White Mesa). It fails to list the Tickaboo Mill and tailings impoundment owned by Uranium One. It incorrectly lists the owner of the White Mesa mill as UMETCO when in fact the owner is Denison Mines.

- Table I from the report is below:
-

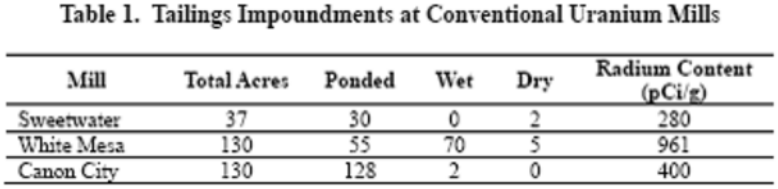


Table 1. Tailings Impoundments at Conventional Uranium Mills

Mill	Total Acres	Ponded	Wet	Dry	Radium Content (pCi/g)
Sweetwater	37	30	0	2	280
White Mesa	130	55	70	5	961
Canon City	130	128	2	0	400

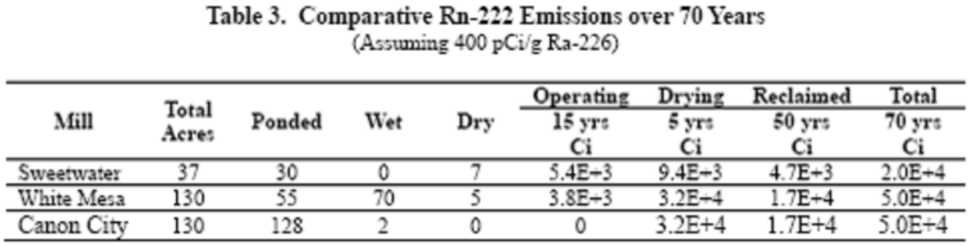
- Table 1 lists the Sweetwater Uranium Project tailings radium content as 280 pCi/g.
- Attached please find the Adobe Acrobat Portable Document Format (*.pdf) file *tailings_radium_226_activity.pdf*.
    - This table is from *Final Design Volume VI – Existing Impoundment Reclamation Plan – Sweetwater Uranium Project* submitted to the Nuclear Regulatory Commission (NRC) on August 26, 1997 and is part of Docket 040-08584 for Source Materials License (SML) SUA-1350.
    - This table provides an average Radium-226 activity for the tailings of 70.9 pCi/g based on twenty (20) samples.
    - This table also provides an average emanation coefficient of 0.188 based on laboratory determination of emanation coefficient for eighteen (18) samples. This value is 54% of the default value of 0.35 used by the Nuclear Regulatory Commission (NRC) in *Regulatory Guide 3.64 – Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (U.S. Nuclear Regulatory Commission (NRC) – June 1989). The reason that this issue is being raised, is that when calculating radon flux from tailings and other earthen materials, the default emanation coefficient of 0.35 is often used and its use can lead to erroneously high radon fluxes.
- Table 3 from the report is shown below:
    - 

Table 3. Comparative Rn-222 Emissions over 70 Years
(Assuming 400 pCi/g Ra-226)

Mill	Total Acres	Ponded	Wet	Dry	Operating	Drying	Reclaimed	Total
					15 yrs Ci	5 yrs Ci	50 yrs Ci	70 yrs Ci
Sweetwater	37	30	0	7	5.4E+3	9.4E+3	4.7E+3	2.0E+4
White Mesa	130	55	70	5	3.8E+3	3.2E+4	1.7E+4	5.0E+4
Canon City	130	128	2	0	0	3.2E+4	1.7E+4	5.0E+4

    - It assumes a long term tailings Radium-226 activity of 400 pCi/g.
    - As previously stated, the current Radium-226 activity in the impoundment averages 70.9 pCi/gram. Estimated Radium-226 activity of future tailings generated should operations resume, is 249 pCi/gram (weighted average of slimes and sand).
    - This estimated activity is from Appendix H (Principal Parameters for Radiological Assessment (MILDOS Inputs) of the *Sweetwater Uranium Project – Revised Environmental Report* submitted to the Nuclear Regulatory Commission in August 1994 which is part of part of Docket 040-08584 for Source materials License (SML) SUA-1350.
    - This estimated activity is based on the values in Appendix H specifically an estimate of 71% sand with a Radium-226 activity of 207 pCi/g and 29% slimes with a radium-226 activity of 353 pCi/g as per the table below:

	Activity	**Percentage**
Slimes:	353 picoCuries/gram	29%
Sand:	207 picoCuries/gram	71%
Weighted Average:	249 picoCuries/gram	100%

The above information pertains specifically to the three (3) items that were raised following your presentation. In addition, other discrepancies were noted in the report. The following are two (2) such items:

The document discusses Radon-222 source terms for in-situ uranium recovery. It discusses Radon-222 releases from mud pits and uses the variable [Ra] which is defined as Ra-226 concentration in the ore zone (pCi/g). The mud pit contains cuttings from the entire bore hole not just from the ore zone. The actual thickness of the ore zone is a fraction of the depth of the entire hole, thus the cuttings from the ore zone would be diluted with cuttings with substantially lower radium-226 activity from above the ore zone. In a typical 500 foot deep bore hole only ten (10) feet of it would be in an actual ore zone. Cuttings from the ore zone would only represent 2% of the total cuttings mass. Use of the Radium-226 activity of the ore zone to describe the activity of the entire drill cuttings mass is incorrect.

Table 4 lists the following operating in-situ uranium recovery operations:

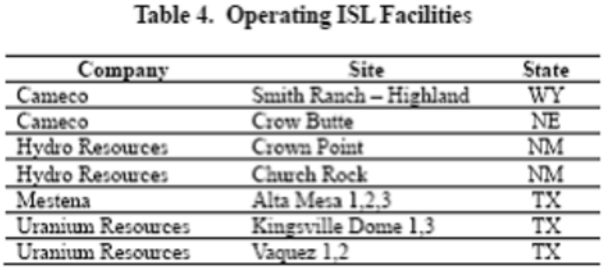


Table 4. Operating ISL Facilities

Company	Site	State
Cameco	Smith Ranch – Highland	WY
Cameco	Crow Butte	NE
Hydro Resources	Crown Point	NM
Hydro Resources	Church Rock	NM
Mestena	Alta Mesa 1,2,3	TX
Uranium Resources	Kingsville Dome 1,3	TX
Uranium Resources	Vaquez 1,2	TX

It lists Hydro Resources, Inc. Crownpoint and Churchrock facilities as operating, which they are not. In addition, I believe that Uranium Resources, Inc's Kingsville Dome and Vasquez Projects are currently not operating.

If you have any questions or require additional data please do not hesitate to contact me.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid,

Thanks for the e-mail. Please send me the CD to the following address.

My address is
Paul Carestia
1600 Chestnut St.
Canon City, CO 81212

I guess I am a little confused now by just what exactly your agency is going to be willing to share with the public regarding this matter and just what exactly you are going to be putting up on the website EPA will be creating.

I am also familiar with the Freedom of Information Act and have used it upon occasion with other federal government agencies. I have difficulty with any government agency when I am told information pertaining to my and the public's welfare is "sensitive and cannot be shared". Makes one feel one's government is withholding something it doesn't want me to see.

Any thoughts on this?

Thank you.

Paul Carestia

Dear Mr. Rosnick,

I note that the Subpart W review documents on the Subpart W Rulemaking Activity Website in the Historical Rulemakings section includes the Draft EIS for the Proposed Radionuclides rulemaking, dated February 1989. However, this is only Volume 1 of a 3-volume draft EIS.

I request that the all 3 volumes of the Final EIS, September 1989, be placed with the Historical Rulemakings documents.

Sarah Fields
Uranium Watch

Hello Reid,

During this morning's conference call re the Subpart W review, Cotter stated that they had not received
any request for information from the EPA.

Cotter was sent a letter in 2009 asking them for information; at least a letter that is addressed
to them is on the Subpart W Review website:

http://www.epa.gov/radiation/docs/neshaps/subpart-w/uranium%20cotter%20test.pdf

Sarah Fields
Uranium Watch

Reid,

The BLM/USFS Meeting on the expansion of the La Sal Mine is on January 13. I will not be there. I had already made plans
to go to Denver for the NRC uranium recovery workshop long before the BLM announced the scoping meeting in La Sal.

There are a number of outstanding issues related to the La Sal Mines, including Subpart B compliance.

Sarah

On Jan 7, 2011, at 6:28 AM, Rosnick.Reid@epamail.epa.gov wrote:

Hello Sarah,

You are correct that Cotter was sent a letter in 2009. That letter was an information request from our enforcement office, and asked for a number of items that are related to our discussion from Wednesday. However, the debate on Wednesday was focused on whether our contractor, in preparing the risk assessment draft document within the last 2 months, contacted Cotter for real-time radon flux data, as well as meteorological data specific to the Canon City area. As we discussed on Wednesday, most of that data is available on-line at NRC's ADAMS website. I am waiting for confirmation from the contractor on exactly how they obtained the Cotter data.

Separately, I saw that there was a BLM/USFS public meeting last night regarding the plan of operations amendment for the expansion of the LaSal mine. I would be interested in your take on the meeting. Thank you.

Reid

Dear Mr. Rosnick,

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch
sarah@uraniumwatch.org
435-210-0166

memo_subpartWreview.091125.pdf

Dear Reid,

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

Hello Reid,

Thanks for your message. After consulting with our group, we would choose the White Mesa Ute community meeting place, as it may be more accessible to people closest to the Mill, and Blanding residents could get there easily.
~~~~~~

A few people from Canon City will be making the trip, so a few miles one way or the other won't make a difference to us. May 24th seems quite a ways off, and we think would happen after our next scheduled conference call, which is unfortunate. The consensus here is that a date sooner than May 24th should be scheduled. Other than that, thanks for your efforts and asking for our opinion.

Sharyn

Hi Sharyn,

I hope you are well. I wanted to touch base with you regarding the possible time and location for the Utah public meeting. I have been corresponding with Sarah Fields, who gave me some good information on where we could locate the meeting. She has given me two locations: The first one is the White Mesa Ute community, about 5 miles south of Blanding, which is the community closest to the White Mesa Mill. They have a gym where the DOE held scoping and draft EIS hearings related to the disposition of the Moab Mill Tailings. The second location is the Blanding Arts and Events Center at the College of Eastern Utah. They apparently have a large meeting room. Either one of these locations would be fine with me, although I am leaning toward the White Mesa Ute facility, since it is closest to the mill. I welcome any input you have on the issue.

The second issue is the date of the meeting. I am currently looking at Monday, May 24th, at approximately 6 PM. I believe that Dr. Diaz will be accompanying me on the trip.

Please let me know if this works for you, so I can go ahead with the reservations for the room, etc. Thanks a lot.

Reid

Reid,

We are disappointed, but after conferring with Jeremy Nichols of RMCAA/Wild Earth Guardians, and Atty Travis Stills, we have chosen Dec. 3rd, Thursday, 1 pm, MST. I have some questions:

1. How soon can you give us call-in instructions in order for us to make our announcements to interested participants.
2. Will EPA provide an adequate number of lines for interested participants?
3. Will EPA announce the teleconferences, and how?
4. Who will be on the teleconference from EPA?

Thanks for your efforts on the website, as we would really appreciate being able to look at related documents prior to the call. Please do email me when it is up and available for access.

Again, thank you for all your help, and we're looking forward to these conferences.

Sharyn

Hi Sharyn,

I took your advice and spoke with Susan Stahle of our Office of General Council. She was more nervous than Travis with respect to missing the 30 day deadline for the conference calls. She explained to me that the 30 days is a hard and fast requirement, and we can't miss it. So, I apologize for the mix-up, but we need to think of another day that will work between now and up to December 3. I know that we had originally talked about Tuesdays, but really for me Tuesday, Wednesday or Thursday will work. If you could give me some dates that would work for you, I would greatly appreciate it. Again, sorry.

Regarding the web site, I hope to have it go live by next Thursday. We're putting the finishing touches on it, and it has a lot of information on it. Since its a work in progress, we hope to continue to add to it from any other sources we find here, as well as any information from the stakeholders. I'll let you know as soon as it is up and running.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Hi Reid,

I've spoken with Travis Stills and he sees no problem with going a few days past the 30-day deadline under the circumstances. Travis suggested that you might contact Susan Stahle for any input on your end:
Stahle.Susan@epamail.epa.gov

Thanks for the attendee list, and we're looking forward to the first teleconference. Any update on the development of the website?

Thanks, Sharyn

Hi Sharyn,

Sorry for the delay in responding, I was in Gallup, New Mexico last week for a Navajo uranium stakeholders conference.

Thanks for scheduling the time for the conference call. December 8 at 1 PM MST is fine with me except for just one issue. The settlement agreement became effective on November 3, and one of the issues we agreed to was that the conference calls would begin within 30 days of the agreement becoming final. The conference call date is 5 days beyond the 30 day stipulation. If you are OK with that, then so am I, but I need to make sure that we don't violate any terms of the agreement, which would force the call to happen on or before December 3. Please let me know if you're still willing to go with December 8. Thanks

I've also attached the sign-in sheet you requested for the meeting we had in Rapid City. Have a good day.

Reid

Hi Again,

Would it be possible for you to send me a copy of the sign-in sheet of people that attended your presentation in Rapid City?

Thanks, Sharyn

Hello Reid,

Things here are pretty good. We've had early snow and record breaking low temperatures, but have bounced back to warmer weather for the present. Sorry for the delay in responding, but I had to check with CCAT and others. The consensus is to start the teleconferences on Dec 8th, preferably 1 PM MST. That would allow for everyone to participate from all regions of the US. Keeping the same number and posting info about the teleconferences on the current or new website will be very helpful.

Many are looking forward to info and documents being posted on a website, especially where we could access documents while on a teleconference, if wanted. So, please do let me know when this becomes available.

Thanks very much, and I'll wait for your confirmation of Dec. 8th, 1 PM MST, and then we will notify our lists.

Sharyn

Subject: Dates for first conference call

Hi Sharyn,

I hope things are good. In anticipation of the settlement agreement being approved some time soon (November?) I thought we might discuss some dates for when we hold the first conference call. I don't really have any preferences, other than the call being held anytime after November 13. If you would like to stick to the schedule in the Agreement, it would be on a Tuesday, so that leaves November 17 and 24, and December 1 and 8. Again, I don't have any real preference at this time. Regarding time of day for the call, my preference would be sometime during the hours of 9 AM - 1 PM MST. My assumption is that the call would last about an hour. The call-in number will be posted on the web site no later than 5 days before the call, and I'll also e-mail the number to you per the Agreement. The way I'm working on this is that the number will remain the same throughout the time that we conduct the calls. Does any of this work for you?

The web site is coming together, and will be up within the 30 day period after the agreement becomes final. The site will be a work in progress, as I try to add more material and information to it during the life of the site.

I think that's it for now, I look forward to hearing from you.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)

Subject: Re: Web Posting

Reid,

Thanks very much, and yes the announcement language was very good.

Sharyn

Subject: Re: Web Posting

Hi Sharyn,

I trust that the language I used in the announcement is acceptable. I know that Jeremy Nichols is no longer representing Rocky Mountain Clean Air Action, but I felt obliged to mention them, since they are co-plaintiffs with your organization. The Region is continuing to work on determining placement of the announcements, and I reckon that we will have a resolution soon.

I will be sending 50 copies of the presentation tomorrow. That number is based on the 30-40 number of attendees you had estimated, plus 10 more for good measure. You should probably receive it on Monday or Tuesday. I'll also be sending the electronic versions of the presentation and the 2008 NMA presentation tomorrow afternoon. I'll also bring a CD with my presentation to use at the meeting, and you are welcome to keep that if you wish.

Thanks again for all your help.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

Thank you for putting a notice of the June 30th meeting on the Subpart W website at the EPA. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, the Cotter Uranium Mill & Superfund site on the CDPHE website, and the CDPHE Powertech website where ISL uranium mining is being proposed. Hopefully that will happen, as those are sites that the general public access periodically, people who may not be aware of the review of Subpart W. An ad in our local newspaper seems only appropriate for this meeting on a historical effort by EPA that will have a direct impact on our community. We will appreciate your continued effort, and efforts by others at EPA and CDPHE, to see that proper notification is offered to the public.

I'll be looking for your package of materials, the electronic versions of presentations on the subject to NMA and for this meeting by email, and will hopefully be getting back to you soon about our issues of concern.

Sharyn Cunningham
CCAT Co-Chair
(719)275-3432

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov

To: "Sharyn Cunningham" <Sharyn@bresnan.net
Cc: <Diaz.Angelique@epamail.epa.gov; "Jeremy Nichols"
<jnichols@wildearthguardians.org; "Carol Dunn" <rcdunn@bresnan.net;
<Stahle.Susan@epamail.epa.gov; <Peake.Tom@epamail.epa.gov;
<Shields.Glenna@epamail.epa.gov; <Burnett.Helen@epamail.epa.gov
Sent: Tuesday, June 16, 2009 9:39 AM
Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks to you and Carol Dunn for making all the arrangements and logistics for the meeting location. I will Fed-Ex the box of presentations to you on Friday. Additionally, I'll send you an electronic version and a copy of the presentation I made to NMA last year.

Regarding advertising for the meeting, I am in the process of placing a notice of a public meeting on EPA's Subpart W web page. It may take a day or two to get through our Product Review section. Angelique Diaz will make a request of the Regional Superfund group on whether they will update their web site. She will also see if CDPHE will allow for placement of an announcement on their web sites. For the Canon City Daily Record she will speak with the public affairs people to see if any funding is available for the advertisement. I'll update you as I hear about the success of the requests.

Thanks again, and as always, don't hesitate to contact me if you have questions or comments.

Reid

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location

name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the

websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the

meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks, have a great weekend.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham

CCAT Co-Chair

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share
for
our meeting on the 30th. If it's OK with you, I could give a
presentation on the basics of Subpart W, an update of what the
workgroup
has been doing, and an update of our status of other items that are
part
of the settlement agreement. After that, perhaps we could open it up
for
a question and answer period, where I can get a sense of issues that
are
of concern to you. My hope is that we can keep this meeting as
informal
as possible, I think that way we can have an open dialogue, with
sharing
of ideas that will be beneficial to both of us. Do you have an
estimate
of how many people would attend the meeting, and how much time would
be
needed? I'm just trying to get a feel on how to tailor my
presentation.

Regarding when we can speak by phone, I'll leave that to you as your
schedule dictates. Just let me know when you are available, and I'll
be
happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Hello Reid,

Thanks for your message. Our group has already begun looking at
potential
sites for the June 30th meeting in Canon City. We'll take steps to
help

confirm a location after we've had a chance to discuss the best time
for
the
meeting, if you would like. We would be happy to discuss the format
and

info desired, as well. Let me know when you would like to speak by
telephone.

Sharyn Cunningham
CCAT Co-Chair

Subject: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it
when
we last spoke in February. If you would kindly send it to me, I'll
give

you a call and we can discuss some of the logistics (time/place) for the
Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and
any issues you would like me to address. Thanks

Reid
Radiation Protection Division (6608J)

Subject: Re: Web Posting

Reid,

Thanks and I saw that the announcement was up last night after receiving your last message. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, and at the Cotter Mill & Superfund site website on the CDPHE website. Hopefully that will happen, as those are sites that the general public accesses periodically, people who may not be aware of the review of Subpart W. We will appreciate your continued effort to see that happens.

I'll be looking for your package of materials, the PPTs by email, and will hopefully be getting back to you soon about our issues of concern.

Thanks again,
Sharyn

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov
To: "Sharyn Cunningham" <Sharyn@bresnan.net
Sent: Wednesday, June 17, 2009 12:57 PM
Subject: Web Posting

Hi Sharyn,

I have managed to get an announcement about the June 30 meeting on our Subpart W web page. The link is:

http://www.epa.gov/radiation/neshaps/subpartw/index.html

The Region is still looking into the possibility of getting an announcement on the Lincoln Park Superfund site, the CDPHE websites, and the Canon City Daily Record. I'll keep you posted.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks, have a great weekend.

Reid

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair
Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up

for
a question and answer period, where I can get a sense of issues that
are
of concern to you. My hope is that we can keep this meeting as
informal
as possible, I think that way we can have an open dialogue, with
sharing
of ideas that will be beneficial to both of us. Do you have an
estimate
of how many people would attend the meeting, and how much time would
be
needed? I'm just trying to get a feel on how to tailor my
presentation.

Regarding when we can speak by phone, I'll leave that to you as your
schedule dictates. Just let me know when you are available, and I'll
be
happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Hello Reid,

Thanks for your message. Our group has already begun looking at
potential
sites for the June 30th meeting in Canon City. We'll take steps to
help

confirm a location after we've had a chance to discuss the best time
for
the
meeting, if you would like. We would be happy to discuss the format
and

info desired, as well. Let me know when you would like to speak by
telephone.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it
when
we last spoke in February. If you would kindly send it to me, I'll
give
you a call and we can discuss some of the logistics (time/place) for
the
Subpart W meeting on June 30. We can also discuss the format of the
meeting, and get a sense of what you would like me to talk about, and
any issues you would like me to address. Thanks

Reid

Subject: Re: Method 115

Reid,

We also appreciated the opportunity to speak with all of you this morning. Thanks for the document on Method 115. I'm encouraged that we've begun opening channels of communication on this important issue. I look forward to speaking with you in the future.

Sharyn Cunningham, Co-Chair
Colorado Citizens Against ToxicWaste, Inc.

Hi Sharyn,

I enjoyed speaking with you and Jeremy this morning. Please let me know if you have any other questions I can answer. In the meantime, attached is the copy of Method 115 I promised. This is the required test method for radon flux from Subpart W units.

Reid

(See attached file: Method 115.pdf)

Reid J. Rosnick

EPA-726

Reid Rosnick/DC/USEPA/US	To	Beth Miller
09/05/2012 01:13 PM	cc	
	bcc	
	Subject	Re: Emails for posting

Beth,

I went through and deleted addresses, phone numbers, etc. Could you please look through and make sure I got all of them? Thanks

emails for posting.rjr.docx

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Beth Miller Please consider the environment before printing... 09/05/2012 01:04:18 PM

From: Beth Miller/DC/USEPA/US
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 09/05/2012 01:04 PM
Subject: Emails for posting

[attachment "emails for posting.docx" deleted by Reid Rosnick/DC/USEPA/US]

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Mr. Rosnick

The Wyoming Mining Association (WMA) is very concerned about claims that uranium mining and processing may contribute to health impairment from the release of radon from uranium processing facilities. WMA would like to draw your attention to the attached report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010. In summary the study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.* The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded that outdoor concentration of radon contributed zero dust to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay.
I understand that there will be a conference call on October 6 to discuss 40 CFR Part 61 Subpart W which deals with this issue. WMA requests that this study be on the agenda for discussion during that conference call.

Thank you.

Marion Loomis

Reid Rosnick:

Thank you for your reply. Kennecott Uranium Company believes that the Agency for Toxic Substances and Disease Registry (ATSDR) draft Public Health Assessment applies directly to Subpart W regulation for the following reasons:

- 40 CFR Part 61 Subpart W regulates radon emissions from tailings impoundments via either the twenty (20) picocurie per meter squared second standard for existing impoundments or the work practices for new impoundments constructed after December 15, 1989. The goal of this regulation is to reduce exposures and doses to the general public from radon and its decay products from uranium mill tailings impoundments.
- The draft Public Health Assessment specifically addresses public dose from and exposure to radon and its decay products from a uranium mill tailings impoundment namely Cotter Corporation's Canon City Mill impoundment.
- The draft Public Health Assessment states:
  On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.
- This conclusion has direct bearing on the current effectiveness of 40 CFR part 61 Subpart W, specifically that as it now stands the doses from radon and its decay products from a tailings impoundment (Cotter Corporation's Canon City impoundment) regulated under 40 CFR Part 61 Subpart W do not represent a health threat.
- This conclusion goes directly to statements made in the lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action specifically the request to *"Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air…"*

The above reasons are why Kennecott Uranium Company is requesting that this draft Public Health Assessment be on the agenda for discussion on the Wednesday, October 6, 2010 conference call.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Dear Mr. Marschke:

The required environmental data to perform a radon risk assessment for the Sweetwater Uranium Project is either already in the possession of the Environmental Protection Agency (EPA) or publically available. The following applies to the required data:

- Radon flux testing data for the Sweetwater Uranium Project tailings impoundment for calendar years 1990 to 2010 has been submitted to the Agency as required by 40 CFR Part 61 Subpart W. and is already available to Agency staff.
- Meteorological data in the Revised Environmental Report dated August 1994, represents a good long term summary of site's meteorological conditions and as such is representative and suitable for use. This document is available on the Nuclear Regulatory Commission's (NRC's) web site at the link below:
- http://pbadupws.nrc.gov/docs/ML0810/ML081010327.pdf
- The meteorological data provided in this document including, I believe, joint frequency distributions, is site specific data.
- Upwind and downwind radon activity data for ambient air collected using Landauer, Inc.'s TrakEtch devices has been submitted semiannually to the Nuclear Regulatory Commission (NRC) as part of the facility's semiannual 40.65 Reports and is publically available in the Commission's online ADAMS system.
- In addition, I believe that upwind and downwind radon activity data for ambient air was summarized in a submittal to the Commission in either the first half of 1998 or 1999 so that the submittal plus any 40.65 Reports submitted from its date forward, provide a complete set of upwind and downwind radon activity data for the site. In any event, upwind and downwind radon activity data is submitted semiannually in the required 40.65 Reports and is available in the ADAMS system. I can check on the 1998 summary report when I return to the office and probably provide a link to it on the Nuclear Regulatory Commission's (NRC's) web site.

I am traveling this week and will return to the site on Tuesday, February 21, 2011. I would like to work with you upon my return to ensure that the risk assessment completed for the Sweetwater Uranium Project is based upon actual site conditions and measurements. Should you have any questions please call me at that time.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid Rosnick:

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public

Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*

- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
    - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases from the Canon City Mill. The filing states, "*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado."* The filing continues by requesting that the Environmental Protection Agency (EPA), "*Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid."*

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid:

The following pertains to the S. Cohen and Associates report entitled:

Final Report Review of Existing and Proposed Tailings Impoundment Technologies

It lists only three (3) extant convention uranium mills in the United States (Sweetwater, Canon City and White Mesa). It fails to list the Tickaboo Mill and tailings impoundment owned by Uranium One. It incorrectly lists the owner of the White Mesa mill as UMETCO when in fact the owner is Denison Mines.

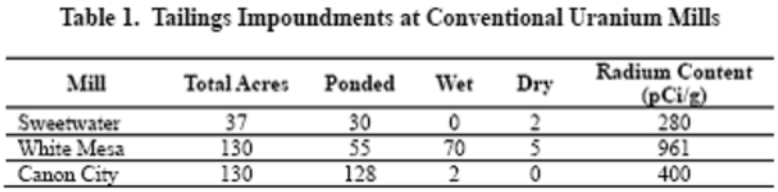
- Table I from the report is below:
- 

Table 1. Tailings Impoundments at Conventional Uranium Mills

Mill	Total Acres	Ponded	Wet	Dry	Radium Content (pCi/g)
Sweetwater	37	30	0	2	280
White Mesa	130	55	70	5	961
Canon City	130	128	2	0	400

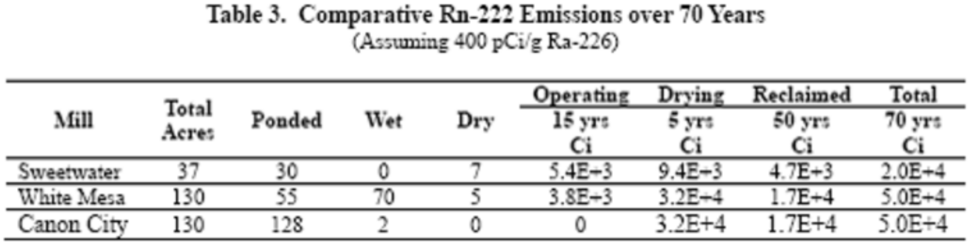
- Table 1 lists the Sweetwater Uranium Project tailings radium content as 280 pCi/g.
- Attached please find the Adobe Acrobat Portable Document Format (*.pdf) file *tailings_radium_226_activity.pdf*.
    - This table is from *Final Design Volume VI – Existing Impoundment Reclamation Plan – Sweetwater Uranium Project* submitted to the Nuclear Regulatory Commission (NRC) on August 26, 1997 and is part of Docket 040-08584 for Source Materials License (SML) SUA-1350.
    - This table provides an average Radium-226 activity for the tailings of 70.9 pCi/g based on twenty (20) samples.
    - This table also provides an average emanation coefficient of 0.188 based on laboratory determination of emanation coefficient for eighteen (18) samples. This value is 54% of the default value of 0.35 used by the Nuclear Regulatory Commission (NRC) in *Regulatory Guide 3.64 – Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (U.S. Nuclear Regulatory Commission (NRC) – June 1989). The reason that this issue is being raised, is that when calculating radon flux from tailings and other earthen materials, the default emanation coefficient of 0.35 is often used and its use can lead to erroneously high radon fluxes.
- Table 3 from the report is shown below:
    - 

Table 3. Comparative Rn-222 Emissions over 70 Years

(Assuming 400 pCi/g Ra-226)

Mill	Total Acres	Ponded	Wet	Dry	Operating 15 yrs Ci	Drying 5 yrs Ci	Reclaimed 50 yrs Ci	Total 70 yrs Ci
Sweetwater	37	30	0	7	5.4E+3	9.4E+3	4.7E+3	2.0E+4
White Mesa	130	55	70	5	3.8E+3	3.2E+4	1.7E+4	5.0E+4
Canon City	130	128	2	0	0	3.2E+4	1.7E+4	5.0E+4

    - It assumes a long term tailings Radium-226 activity of 400 pCi/g.
    - As previously stated, the current Radium-226 activity in the impoundment averages 70.9 pCi/gram. Estimated Radium-226 activity of future tailings generated should operations resume, is 249 pCi/gram (weighted average of slimes and sand).
    - This estimated activity is from Appendix H (Principal Parameters for Radiological Assessment (MILDOS Inputs) of the *Sweetwater Uranium Project – Revised Environmental Report* submitted to the Nuclear Regulatory Commission in August 1994 which is part of part of Docket 040-08584 for Source materials License (SML) SUA-1350.
    - This estimated activity is based on the values in Appendix H specifically an estimate of 71% sand with a Radium-226 activity of 207 pCi/g and 29% slimes with a radium-226 activity of 353 pCi/g as per the table below:

	Activity	**Percentage**
Slimes:	353 picoCuries/gram	29%
Sand:	207 picoCuries/gram	71%
Weighted Average:	249 picoCuries/gram	100%

The above information pertains specifically to the three (3) items that were raised following your presentation. In addition, other discrepancies were noted in the report. The following are two (2) such items:

The document discusses Radon-222 source terms for in-situ uranium recovery. It discusses Radon-222 releases from mud pits and uses the variable [Ra] which is defined as Ra-226 concentration in the ore zone (pCi/g). The mud pit contains cuttings from the entire bore hole not just from the ore zone. The actual thickness of the ore zone is a fraction of the depth of the entire hole, thus the cuttings from the ore zone would be diluted with cuttings with substantially lower radium-226 activity from above the ore zone. In a typical 500 foot deep bore hole only ten (10) feet of it would be in an actual ore zone. Cuttings from the ore zone would only represent 2% of the total cuttings mass. Use of the Radium-226 activity of the ore zone to describe the activity of the entire drill cuttings mass is incorrect.

Table 4 lists the following operating in-situ uranium recovery operations:

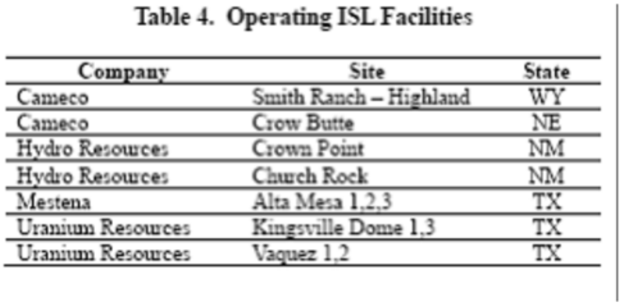


Table 4. Operating ISL Facilities

Company	Site	State
Cameco	Smith Ranch – Highland	WY
Cameco	Crow Butte	NE
Hydro Resources	Crown Point	NM
Hydro Resources	Church Rock	NM
Mestena	Alta Mesa 1,2,3	TX
Uranium Resources	Kingsville Dome 1,3	TX
Uranium Resources	Vaquez 1,2	TX

It lists Hydro Resources, Inc. Crownpoint and Churchrock facilities as operating, which they are not. In addition, I believe that Uranium Resources, Inc’s Kingsville Dome and Vasquez Projects are currently not operating.

If you have any questions or require additional data please do not hesitate to contact me.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid,

Thanks for the e-mail. Please send me the CD to the following address.

I guess I am a little confused now by just what exactly your agency is going to be willing to share with the public regarding this matter and just what exactly you are going to be putting up on the website EPA will be creating.

I am also familiar with the Freedom of Information Act and have used it upon occasion with other federal government agencies. I have difficulty with any government agency when I am told information pertaining to my and the public's welfare is "sensitive and cannot be shared". Makes one feel one's government is withholding something it doesn't want me to see.

Any thoughts on this?

Thank you.

Paul Carestia

Dear Mr. Rosnick,

I note that the Subpart W review documents on the Subpart W Rulemaking Activity Website in the Historical Rulemakings section includes the Draft EIS for the Proposed Radionuclides rulemaking, dated February 1989. However, this is only Volume 1 of a 3-volume draft EIS.

I request that the all 3 volumes of the Final EIS, September 1989, be placed with the Historical Rulemakings documents.

Sarah Fields
Uranium Watch

Hello Reid,

During this morning's conference call re the Subpart W review, Cotter stated that they had not received
any request for information from the EPA.

Cotter was sent a letter in 2009 asking them for information; at least a letter that is addressed
to them is on the Subpart W Review website:

http://www.epa.gov/radiation/docs/neshaps/subpart-w/uranium%20cotter%20test.pdf

Sarah Fields
Uranium Watch

Reid,

The BLM/USFS Meeting on the expansion of the La Sal Mine is on January 13. I will not be there. I had already made plans
to go to Denver for the NRC uranium recovery workshop long before the BLM announced the scoping meeting in La Sal.

There are a number of outstanding issues related to the La Sal Mines, including Subpart B compliance.

Sarah

On Jan 7, 2011, at 6:28 AM, Rosnick.Reid@epamail.epa.gov wrote:

Hello Sarah,

You are correct that Cotter was sent a letter in 2009. That letter was an information request from our enforcement office, and asked for a number of items that are related to our discussion from Wednesday. However, the debate on Wednesday was focused on whether our contractor, in preparing the risk assessment draft document within the last 2 months, contacted Cotter for real-time radon flux data, as well as meteorological data specific to the Canon City area. As we discussed on Wednesday, most of that data is available on-line at NRC's ADAMS website. I am waiting for confirmation from the contractor on exactly how they obtained the Cotter data.

Separately, I saw that there was a BLM/USFS public meeting last night regarding the plan of operations amendment for the expansion of the LaSal mine. I would be interested in your take on the meeting. Thank you.

Reid

Dear Mr. Rosnick,

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on
the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the
exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch

memo_subpartWreview.091125.pdf

Dear Reid,

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

Hello Reid,

Thanks for your message. After consulting with our group, we would choose the White Mesa Ute community meeting place, as it may be more accessible to people closest to the Mill, and Blanding residents could get there easily. A few people from Canon City will be making the trip, so a few miles one way or the other won't make a difference to us. May 24th seems quite a ways off, and we think would happen after our next scheduled conference call,
~~~~~~

which is unfortunate. The consensus here is that a date sooner than May 24th should be scheduled. Other than that, thanks for your efforts and asking for our opinion.

Sharyn

Hi Sharyn,

I hope you are well. I wanted to touch base with you regarding the possible time and location for the Utah public meeting. I have been corresponding with Sarah Fields, who gave me some good information on where we could locate the meeting. She has given me two locations: The first one is the White Mesa Ute community, about 5 miles south of Blanding, which is the community closest to the White Mesa Mill. They have a gym where the DOE held scoping and draft EIS hearings related to the disposition of the Moab Mill Tailings. The second location is the Blanding Arts and Events Center at the College of Eastern Utah. They apparently have a large meeting room. Either one of these locations would be fine with me, although I am leaning toward the White Mesa Ute facility, since it is closest to the mill. I welcome any input you have on the issue.

The second issue is the date of the meeting. I am currently looking at Monday, May 24th, at approximately 6 PM. I believe that Dr. Diaz will be accompanying me on the trip.

Please let me know if this works for you, so I can go ahead with the reservations for the room, etc. Thanks a lot.

Reid

Reid,

We are disappointed, but after conferring with Jeremy Nichols of RMCAA/Wild Earth Guardians, and Atty Travis Stills, we have chosen Dec. 3rd, Thursday, 1 pm, MST. I have some questions:

1. How soon can you give us call-in instructions in order for us to make our announcements to interested participants.
2. Will EPA provide an adequate number of lines for interested participants?
3. Will EPA announce the teleconferences, and how?
4. Who will be on the teleconference from EPA?

Thanks for your efforts on the website, as we would really appreciate being able to look at related documents prior to the call. Please do email me when it is up and available for access.

Again, thank you for all your help, and we're looking forward to these conferences.

Sharyn

Hi Sharyn,

I took your advice and spoke with Susan Stahle of our Office of General Council. She was more nervous than Travis with respect to missing the 30 day deadline for the conference calls. She explained to me that the 30 days is a hard and fast requirement, and we can't miss it. So, I apologize for the mix-up, but we need to think of another day that will work between now and up to December 3. I know that we had originally talked about Tuesdays, but really for me Tuesday, Wednesday or Thursday will work. If you could give me some dates that would work for you, I would greatly appreciate it. Again, sorry.

Regarding the web site, I hope to have it go live by next Thursday. We're putting the finishing touches on it, and it has a lot of information on it. Since its a work in progress, we hope to continue to add to it from any other sources we find here, as well as any information from the stakeholders. I'll let you know as soon as it is up and running.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Hi Reid,

I've spoken with Travis Stills and he sees no problem with going a few days past the 30-day deadline under the circumstances. Travis suggested that you might contact Susan Stahle for any input on your end: Stahle.Susan@epamail.epa.gov

Thanks for the attendee list, and we're looking forward to the first teleconference. Any update on the development of the website?

Thanks, Sharyn

Hi Sharyn,

Sorry for the delay in responding, I was in Gallup, New Mexico last week for a Navajo uranium stakeholders conference.

Thanks for scheduling the time for the conference call. December 8 at 1 PM MST is fine with me except for just one issue. The settlement agreement became effective on November 3, and one of the issues we agreed to was that the conference calls would begin within 30 days of the agreement becoming final. The conference call date is 5 days beyond the 30 day stipulation. If you are OK with that, then so am I, but I need to make sure that we don't violate any terms of the agreement, which would force the call to happen on or before December 3. Please let me know if you're still willing to go with December 8. Thanks

I've also attached the sign-in sheet you requested for the meeting we had in Rapid City. Have a good day.

Reid

Hi Again,

Would it be possible for you to send me a copy of the sign-in sheet of people that attended your presentation in Rapid City?

Thanks, Sharyn

Hello Reid,

Things here are pretty good. We've had early snow and record breaking low temperatures, but have bounced back to warmer weather for the present. Sorry for the delay in responding, but I had to check with CCAT and others. The consensus is to start the teleconferences on Dec 8th, preferably 1 PM MST. That would allow for everyone to participate from all regions of the US. Keeping the same number and posting info about the teleconferences on the current or new website will be very helpful.

Many are looking forward to info and documents being posted on a website, especially where we could access documents while on a teleconference, if wanted. So, please do let me know when this becomes available.

Thanks very much, and I'll wait for your confirmation of Dec. 8th, 1 PM MST, and then we will notify our lists.

Sharyn

Subject: Dates for first conference call

Hi Sharyn,

I hope things are good. In anticipation of the settlement agreement being approved some time soon (November?) I thought we might discuss some dates for when we hold the first conference call. I don't really have any preferences, other than the call being held anytime after November 13. If you would like to stick to the schedule in the Agreement, it would be on a Tuesday, so that leaves November 17 and 24, and December 1 and 8. Again, I don't have any real preference at this time. Regarding time of day for the call, my preference would be sometime during the hours of 9 AM - 1 PM MST. My assumption is that the call would last about an hour. The call-in number will be posted on the web site no later than 5 days before the call, and I'll also e-mail the number to you per the Agreement. The way I'm working on this is that the number will remain the same throughout the time that we conduct the calls. Does any of this work for you?

The web site is coming together, and will be up within the 30 day period after the agreement becomes final. The site will be a work in progress, as I try to add more material and information to it during the life of the site.

I think that's it for now, I look forward to hearing from you.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)

Subject: Re: Web Posting

Reid,

Thanks very much, and yes the announcement language was very good.

Sharyn

Subject: Re: Web Posting

Hi Sharyn,

I trust that the language I used in the announcement is acceptable. I know that Jeremy Nichols is no longer representing Rocky Mountain Clean Air Action, but I felt obliged to mention them, since they are co-plaintiffs with your organization. The Region is continuing to work on determining placement of the announcements, and I reckon that we will have a resolution soon.

I will be sending 50 copies of the presentation tomorrow. That number is based on the 30-40 number of attendees you had estimated, plus 10 more for good measure. You should probably receive it on Monday or Tuesday. I'll also be sending the electronic versions of the presentation and the 2008 NMA presentation tomorrow afternoon. I'll also bring a CD with my presentation to use at the meeting, and you are welcome to keep that if you wish.

Thanks again for all your help.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

Thank you for putting a notice of the June 30th meeting on the Subpart W website at the EPA. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, the Cotter Uranium Mill & Superfund site on the CDPHE website, and the CDPHE Powertech website where ISL uranium mining is being proposed. Hopefully that will happen, as those are sites that the general public access periodically, people who may not be aware of the review of Subpart W. An ad in our local newspaper seems only appropriate for this meeting on a historical effort by EPA that will have a direct impact on our community. We will appreciate your continued effort, and efforts by others at EPA and CDPHE, to see that proper notification is offered to the public.

I'll be looking for your package of materials, the electronic versions of presentations on the subject to NMA and for this meeting by email, and will hopefully be getting back to you soon about our issues of concern.

Sharyn Cunningham
CCAT Co-Chair

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov
To: "Sharyn Cunningham"
Sent: Tuesday, June 16, 2009 9:39 AM

Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks to you and Carol Dunn for making all the arrangements and logistics for the meeting location. I will Fed-Ex the box of presentations to you on Friday. Additionally, I'll send you an electronic version and a copy of the presentation I made to NMA last year.

Regarding advertising for the meeting, I am in the process of placing a notice of a public meeting on EPA's Subpart W web page. It may take a day or two to get through our Product Review section. Angelique Diaz will make a request of the Regional Superfund group on whether they will update their web site. She will also see if CDPHE will allow for placement of an announcement on their web sites. For the Canon City Daily Record she will speak with the public affairs people to see if any funding is available for the advertisement. I'll update you as I hear about the success of the requests.

Thanks again, and as always, don't hesitate to contact me if you have questions or comments.

Reid

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3.   On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4.   I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks, have a great weekend.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and

CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Hello Reid,

Thanks for your message. Our group has already begun looking at potential sites for the June 30th meeting in Canon City. We'll take steps to help confirm a location after we've had a chance to discuss the best time for the meeting, if you would like. We would be happy to discuss the format and info desired, as well. Let me know when you would like to speak by telephone.

Sharyn Cunningham
CCAT Co-Chair

Subject: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it when we last spoke in February. If you would kindly send it to me, I'll give you a call and we can discuss some of the logistics (time/place) for the Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and any issues you would like me to address. Thanks

Reid
Radiation Protection Division (6608J)

Subject: Re: Web Posting

Reid,

Thanks and I saw that the announcement was up last night after receiving your last message. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, and at the Cotter Mill & Superfund site website on the CDPHE website. Hopefully that will happen, as those are sites that the general public accesses periodically, people who may not be aware of the review of Subpart W. We will appreciate your continued effort to see that happens.

I'll be looking for your package of materials, the PPTs by email, and will hopefully be getting back to you soon about our issues of concern.

Thanks again,
Sharyn

----- Original Message -----
From: <Rosnick.Reid@epamail.epa.gov
To: "Sharyn Cunningham"
Sent: Wednesday, June 17, 2009 12:57 PM
Subject: Web Posting

Hi Sharyn,

I have managed to get an announcement about the June 30 meeting on our Subpart W web page. The link is:

http://www.epa.gov/radiation/neshaps/subpartw/index.html

The Region is still looking into the possibility of getting an announcement on the Lincoln Park Superfund site, the CDPHE websites, and the Canon City Daily Record. I'll keep you posted.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks, have a great weekend.

Reid

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair
Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Hello Reid,

Thanks for your message. Our group has already begun looking at potential sites for the June 30th meeting in Canon City. We'll take steps to help confirm a location after we've had a chance to discuss the best time for the meeting, if you would like. We would be happy to discuss the format and info desired, as well. Let me know when you would like to speak by telephone.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it when we last spoke in February. If you would kindly send it to me, I'll give you a call and we can discuss some of the logistics (time/place) for the Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and any issues you would like me to address. Thanks

Reid

Subject: Re: Method 115

Reid,

We also appreciated the opportunity to speak with all of you this morning. Thanks for the document on Method 115. I'm encouraged that we've begun opening channels of communication on this important issue. I look forward to speaking with you in the future.

Sharyn Cunningham, Co-Chair
Colorado Citizens Against ToxicWaste, Inc.

Hi Sharyn,

I enjoyed speaking with you and Jeremy this morning. Please let me know if you have any other questions I can answer. In the meantime, attached is the copy of Method 115 I promised. This is the required test method for radon flux from Subpart W units.

Reid

(See attached file: Method 115.pdf)

Reid J. Rosnick

EPA-240

Beth Miller/DC/USEPA/US

09/05/2012 02:03 PM

To Reid Rosnick

cc

bcc

Subject updated emails

emails for posting.docx

Please consider the environment before printing this e-mail.

Beth Miller
202-343-9223

Subject: Re: A Request For Documentation

Paul,

Sorry for the delay, I have been out of the office for two weeks.

I can send you the 1989 Risk Assessment documents, however, the file is too large to send electronically. If you would send me your address, I can send a CD of this information.

Regarding the Analytic Blueprint and Communication Plan, these documents are internal Agency documents, containing sensitive information that cannot be shared. I mentioned them in my presentation to give you a feel for the process we use, and the fact that we are indeed on a path forward, not waiting for any resolution to the lawsuit. I apologize for any misunderstanding.

Please let me know if sending you the CD of the risk assessment is acceptable. Thanks

Reid

Subject: A Request For Documentation

Reid,

At the June 30 meeting in Canon City I believe you told us that you would make available to us the following documents: 1989 Risk Assessment, EPA's Detailed Workplan, Communications Plan, and Analytic Blueprint.

I am aware that these documents will all appear at some future date on the website that EPA will be creating once the lawsuit is settled and all parties have signed the requisite documents. However,as slowly as the lawsuit is moving toward final signatures this is taking longer than I wish to wait.

So I am asking you to please send me the documents I've requested above.

Thank you.

Paul Carestia

Subject: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Reid,
Sharyn Cunningham asked me to send to you the document produced by MFG Inc, a firm hired by Cotter Corporation, which proposed the use of an Effective Effluent Limit (EEL) to gauge whether radon concentrations at the Cotter Mill perimeter were "safely within limits".
It is my understanding that you asked to see this document as a result of some discussion at the Rapid City WMAN Conference in October.
Attached is that document in .pdf form. Unfortunately it was scanned upside down, so you will have to use "View" on Adobe Reader's toolbar to rotate the document so it can be read on your computer screen.
I have read this document numerous times and as an engineer with a master's degree in electrical engineering and as an MBA with a fair number of statistics courses behind me, I have a number of issues

with the approach proposed and accepted by the Colorado Department of Health in this matter with Cotter. I have raised these issues with the Department of Health and the EPA in Region 8 to no avail. I am hoping that someone with the right expertise on your staff in Washington, D. C. will take a detailed, critical look at what is written here and will truly evaluate the science as appropriate and adequate. Region 8 of the EPA never responded to my documented concerns and Colorado Department of Health responses were obfuscating at best. I'll be happy to make their responses available to you as well if you wish. I have basically given up on getting anything reasonable from those folks, who are obviously stakeholders in this approach having given approval for its use.

The issues I have with the approach are as follows.

1. The sample sizes being used to calculate reliable, realistic means and standard deviations for background radon concentrations and perimeter radon concentrations are simply too small. Statistical theory shows that in order to have reliability in the calculation of the mean and standard deviation of a sample distribution, one needs a sample size somewhere between 30 and 50 samples. Four samples are used for perimeter radon concentrations (1 per quarter) and 4 samples are used from each of three background radon locations (1 per quarter), for a total of 12 background radon samples. These sample sizes are simply insufficient, especially when the resulting mean and standard deviation for background are used to predominantly set the upper limit for radon concentrations at the mill perimeter. I view this as highly unreliable for such an important metric of concern to public health and welfare.
2. The average background radon measurement and resulting background standard deviation are then used in the Effective Effluent Limit equation:

EEL Alternative Effluent Limit + Average Background + 2 times the standard deviation of Average Background

Alternate Effluent Limit is defined in the MFG document and is basically a constant number dependent upon distance of perimeter station from the tailings impoundment.

This EEL sets the upper limit against which mill perimeter average radon concentrations are compared. It is my contention that using such an approach will make it highly unlikely, if not impossible for the EEL to ever be exceeded. I think this approach is highly suspect, meaningless, and biased to give a result that will always say radon concentrations at the perimeter are "safely within limits".

You may recall in my presentation to you at the June 30 EPA meeting in Canon City I pointed out that while radon flux from the Cotter Primary Impoundment increased by 230% over a 3 year period, radon concentrations at the mill perimeter decreased by 30% over the same 3 year period. This makes absolutely no sense to me. Colorado Department of Health showed no interest in this concern, and for that matter neither did EPA in Region 8. Colorado Department of Health simply indicated that radon concentrations at the mill perimeter were "within EEL limits", so radon flux readings weren't really of relevance to them. They said they look at and count on radon concentrations at the perimeter. EEL as it is used in this case is being given an extremely high credence. I strongly question this.

3. All measurements in this approach, background as well as perimeter, are made using the same measurement technology, Laundauer's DRNF. I would assume then that all measurements are subject to the same random and real variation, not just background. The MFG document calls specific attention to this variation as it relates to background radon measurements and applies the 2 sigma 95% confidence interval for background to account for it. Yet the MFG document does nothing to take this variation into consideration for any of the perimeter measurements. I would argue that the appropriate 2 sigma for perimeter average measurements be added to those measurements to insure a 95% confidence in them as well. The approach as currently implemented is not an apples to apples approach.

I would appreciate very much having an EPA expert in Washington, D. C. study this document and the resulting approach. I respectfully request that this be undertaken and that the expert who does the review get back with me on their finding. I need corroboration from an expert, or I need to be shown where I am mistaken. Either outcome will suffice.

Thanks for your willingness to look into this matter. I appreciate it.

Paul Carestia

MFG Document.pdf

Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Reid,

I'm sending additional information to include with Paul Carestia's email sent earlier today. Attached is a series of letters exchanged between Cotter and the CDPHE in 2004 concerning radon. The MFG, Inc. paper was part of this process. These letters may shed additional light on the matter. Paul had not seen them, and he is reviewing them now and will send you his notes and thoughts on them later.

Though there may be other reasons that radon came up in 2004, one may be that leadership staff at the CDPHE radiation division changed in 2003 bringing a new approach to Cotter. Also, radon flux in 2002 was18.7 pCi/m2-sec, probably due to the Primary Impoundment drying out during a period of extended drought. A third contributing event, as seen in the February 12th Memorandum from Jan Johnson to Steven Landau, was soil sampling done in 2003 where high levels of stable lead were found in a private residence attic and barn, and some other locations near Cotter. It appears that CDPHE was questioning whether radon from Cotter's impoundment and facility was contributing to this contamination. I've also attached a CDPHE letter from 6-16-2003 regarding the 2002 radon flux that was sent to CDPHE Air Pollution Division.

Thank you, and we'll look forward to hearing from you.

Sharyn Cunningham

Cotter CDPHE Radon Correspondence 2004.pdf

2003-6-16 CDPHE Review Radon Flux 2002.pdf

Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Paul,

Thanks for all of the information. As I wrote to Sharyn, I was out of the office all last week on work unrelated to Subpart W, so this is the first chance I have had to respond. I probably won't get a chance to review the information until some time this weekend, but I'll respond when I have something to report. Thanks again.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

From: pdcarestia@aol.com
To: Reid Rosnick/DC/USEPA/US@EPA
Cc: sharyn@bresnan.net
Date: 10/14/2009 03:56 PM
Subject: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit

Reid,
Sharyn Cunningham asked me to send to you the document produced by MFG Inc, a firm hired by Cotter Corporation, which proposed the use of an Effective Effluent Limit (EEL) to gauge whether radon concentrations at the Cotter Mill perimeter were "safely within limits".
It is my understanding that you asked to see this document as a result of some discussion at the Rapid City WMAN Conference in October.
Attached is that document in .pdf form. Unfortunately it was scanned upside down, so you will have to use "View" on Adobe Reader's toolbar to rotate the document so it can be read on your computer screen.
I have read this document numerous times and as an engineer with a master's degree in electrical engineering and as an MBA with a fair number of statistics courses behind me, I have a number of issues with the approach proposed and accepted by the Colorado Department of Health in this matter with Cotter. I have raised these issues with the Department of Health and the EPA in Region 8 to no avail. I am hoping that someone with the right expertise on your staff in Washington, D. C. will take a detailed, critical look at what is written here and will truly evaluate the science as appropriate and adequate. Region 8 of the EPA never responded to my documented concerns and Colorado Department of Health responses were obfuscating at best. I'll be happy to make their responses available to you as well if you wish. I have basically given up on getting anything reasonable from those folks, who are obviously stakeholders in this approach having given approval for its use.
The issues I have with the approach are as follows.

1. The sample sizes being used to calculate reliable, realistic means and standard deviations for background radon concentrations and perimeter radon concentrations are simply too small. Statistical theory shows that in order to have reliability in the calculation of the mean and standard deviation of a sample distribution, one needs a sample size somewhere between 30 and 50 samples. Four samples are used for perimeter radon concentrations (1 per quarter) and 4 samples are used from each of three background radon locations (1 per quarter), for a total of 12 background radon samples. These sample sizes are simply insufficient, especially when the resulting mean and standard deviation for background are used to predominantly set the upper limit for radon concentrations at the mill perimeter. I view this as highly unreliable for such an important metric of concern to public health and welfare.
2. The average background radon measurement and resulting background standard deviation are then used in the Effective Effluent Limit equation:

EEL Alternative Effluent Limit + Average Background + 2 times the standard deviation of Average Background Alternate Effluent Limit is defined in the MFG document and is basically a constant number dependent upon distance of perimeter station from the tailings impoundment.

This EEL sets the upper limit against which mill perimeter average radon concentrations are compared. It is my contention that using such an approach will make it highly unlikely, if not impossible for the EEL to ever be exceeded. I think this approach is highly suspect, meaningless, and biased to give a result that will always say radon concentrations at the perimeter are "safely within limits".

You may recall in my presentation to you at the June 30 EPA meeting in Canon City I pointed out that while radon flux from the Cotter Primary Impoundment increased by 230% over a 3 year period, radon concentrations at the mill perimeter decreased by 30% over the same 3 year period. This makes absolutely no sense to me. Colorado Department of Health showed no interest in this concern, and for that matter neither did EPA in Region 8. Colorado Department of Health simply indicated that radon concentrations at the mill perimeter were "within EEL limits", so radon flux readings weren't really of relevance to them. They said they look at and count on radon concentrations at the perimeter. EEL as it is used in this case is being given an extremely high credence. I strongly question this.

3. All measurements in this approach, background as well as perimeter, are made using the same measurement technology, Laundauer's DRNF. I would assume then that all measurements are subject to the same random and real variation, not just background. The MFG document calls specific attention to this variation as it relates to background radon measurements and applies the 2 sigma 95% confidence interval for background to account for it. Yet the MFG document does nothing to take this variation into consideration for any of the perimeter measurements. I would argue that the appropriate 2 sigma for perimeter average measurements be added to those measurements to insure a 95% confidence in them as well. The approach as currently implemented is not an apples to apples approach.

I would appreciate very much having an EPA expert in Washington, D. C. study this document and the resulting approach. I respectfully request that this be undertaken and that the expert who does the review get back with me on their finding. I need corroboration from an expert, or I need to be shown where I am mistaken. Either outcome will suffice.
Thanks for your willingness to look into this matter. I appreciate it.

Paul Carestia

Subject: Response to your e-mail of 10/14/09

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m^2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

Subject: EPA to Cotter 2-24-09

Hi Reid,

I see that the website is up and we are really appreciative of your efforts. Just looking at correspondence between EPA & Cotter and see that the Feb 24, 2009, letter has even numbered pages of the document missing.

1. Could you please get the pages added and the letter reposted?

Also, there are no further letters after May 2009, either from Cotter or any EPA responses. If any further communication has gone on between EPA and Cotter since May 2009.

2. Would you please post correspondence since May 2009, as well?

One other thing - the aerial photos provided by Cotter in the information sent in May 2009 seem to be rather old. Attached are Nov 1, 2009, photos where it is very evident that tailings are now exposed in the Secondary Impoundment. In case you're unaware, Cotter made an inventory of Impoundment contents for EPA in 2003 (see attached) with details for the Primary. Other sources indicate that the Secondary does contain waste from the Manhattan project. We're really concerned about how radon is being controlled as Cotter is dewatering the Secondary Impoundment. This may be out of your jurisdiction, but I'm not as up on this, so am at least making you aware of the situation. We recently sent an email to Ms. Diaz about this, but thought you might like to see the photos in light of Cotter's response to request for information.

Thanks very much,

Sharyn Cunningham
CCAT Co-Chair

Cotter Secondary Impoundment Photos 11-1-09.pdf

Cotter Inventory Impmt Ponds 3-3-03.PDF

Subject: Re: EPA to Cotter 2-24-09

Hi Sharyn,

I'm glad that you saw the website. Our IT folks put it up because I needed to see it on my home computer to make sure that it "looked" the same as on the computers here at EPA. At the same time, I was making sure that all of the links work, and to make sure that everything was complete. In addition to the Cotter letter, I also found two broken links. Those will be repaired this morning, and I will be sending an e-mail today to everyone who wanted to be notified that the web site is officially launched. Please note that some of the documents are very large, up to 25 MB, and they take some time to download.

As for correspondence with Cotter, I am not aware of any further communication since May. I'll check with Angelique Diaz in Denver to see if she has anything.

Thanks for the photos, you are correct that Dr. Diaz is the person to talk with, and I'm sure that she is communicating with CDPHE as well.

For the conference call on 12/3, do you have any agenda items that you would care to see?

I'll be out of the office for the rest of the week, so have a very Happy Thanksgiving, and I'll talk to you next week.

Reid

Hi Reid,

I see that the website is up and we are really appreciative of your efforts. Just looking at correspondence between EPA & Cotter and see that the Feb 24, 2009, letter has even numbered pages of the document missing.

1. Could you please get the pages added and the letter reposted?

Also, there are no further letters after May 2009, either from Cotter or any EPA responses. If any further communication has gone on between EPA and Cotter since May 2009.

2. Would you please post correspondence since May 2009, as well?

One other thing - the aerial photos provided by Cotter in the information sent in May 2009 seem to be rather old. Attached are Nov 1, 2009, photos where it is very evident that tailings are now exposed in the Secondary Impoundment. In case you're unaware, Cotter made an inventory of Impoundment contents for EPA in 2003 (see attached) with details for the Primary. Other sources indicate that the Secondary does contain waste from the Manhattan project. We're really concerned about how radon is being controlled as Cotter is dewatering the Secondary Impoundment. This may be out of your jurisdiction, but I'm not as up on this, so am at least making you aware of the situation. We recently sent an email to Ms. Diaz about this, but thought you might like to see the photos in light of Cotter's response to request for information.

Thanks very much,

Sharyn Cunningham
CCAT Co-Chair
1614 Grand Ave

Subject: Re: EPA to Cotter 2-24-09

Hello Sharyn,

Thanks for the agenda items. I will incorporate them into an agenda, and I hope to have it posted on the web site later today. I have taken all of your suggestions, and I hope to give a brief update on all of the activities you requested. I want to make sure, however, that there is also sufficient time for questions from anyone on the call. My thinking at this point is that whatever I don't cover on this call can be picked up on the call in January.

Reid

Subject: Re: EPA to Cotter 2-24-09

Dear Reid,

Thanks for the effort put forth on the website and the upcoming teleconference. Everyone is looking forward to this update. After conferring with interested parties, our group and others, here are some agenda items we'd like to see covered on Dec. 3rd:

1. EPA Activity since previous meeting
    a. Website
    b. Accumulation of data from previous rulemaking

c. EPA response to request for additional meeting near Gallup/Grants in conjunction with White Mesa meeting in Blanding
d. Any further correspondence between EPA and industry regarding information requests?

2. Technical Issues
   - a. Describe EPA review teams by subject matter
   - b. Review issues raised by public or industry to date
   - c. 1989 Risk Assessment - status of current historical research?
   - d. Existing Technologies - status of current survey?
   - e. Method 115 - status of current research?
   - f. Status of Part 192 review as it applies to Subpart W regulations

3. EPA Activity before next call.
   - a. Interim reports?
   - b. Bids for contractors?

4. Define agenda items for next quarterly call, scheduled for January 5, 2010.

Sincerely,

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: EPA to Cotter 2-24-09

Hi Sharyn,

I'm glad that you saw the website. Our IT folks put it up because I needed to see it on my home computer to make sure that it "looked" the same as on the computers here at EPA. At the same time, I was making sure that all of the links work, and to make sure that everything was complete. In addition to the Cotter letter, I also found two broken links. Those will be repaired this morning, and I will be sending an e-mail today to everyone who wanted to be notified that the web site is officially launched. Please note that some of the documents are very large, up to 25 MB, and they take some time to download.

As for correspondence with Cotter, I am not aware of any further communication since May. I'll check with Angelique Diaz in Denver to see if she has anything.

Thanks for the photos, you are correct that Dr. Diaz is the person to talk with, and I'm sure that she is communicating with CDPHE as well.

For the conference call on 12/3, do you have any agenda items that you would care to see?

I'll be out of the office for the rest of the week, so have a very Happy Thanksgiving, and I'll talk to you next week.

Reid

Subject: Need Help

Reid,

I appreciate your time in reviewing this documentation that I sent you some time ago. I understand your position on these issues and realized up front that this was not a Subpart W issue. So thank you for the time you took to read over the MFG Inc. document that I sent you and for your advice on how I should move forward.

Colorado is an agreement state. The Colorado Department of Health and Environment have done little to assist me here and in fact have been reluctant and defensive, arguing with me about my understanding of the issue.

Today I made two attempts to contact the Nuclear Regulatory Commission, asking for the names of experts in the NRC who understand the science of radon emissions from mill tailings. The contacts were via e-mail to their Human Resources Office and their Office of Public Affairs. I don't feel really confident that either will be able to provide what I am looking for.

I am asking for your help here because you are inside the government and have some understanding of what it is that I need. Can you help me find an NRC expert who could possibly provide the knowledgeable, hopefully unbiased review of this approach to monitoring and safeguarding the public health and welfare? Or can you by way of introduction put me in contact with someone who can and will help me find the expertise I am looking for?

As a formally trained engineer with a Masters Degree who spent 32 years working for America's premiere research company, Bell Laboratories, I cannot accept without scientifically justified explanation the fact that radon flux from Cotter's Primary Impoundment increased 230% over a three year period while the radon concentration measurements at the perimeter of the mill property decreased by 30% over the same three year period. This is illogical, counter intuitive, and highly suspect. That additional radon went somewhere and to my way of thinking should have been evident in increased radon concentrations at the mill perimeter as a minimum.

We the people of Lincoln Park and greater Canon City cannot control the air we breathe and to a lesser degree, the ground water we drink or irrigate with. I need resolution to my concern and I need expert help to do that. Colorado Department of Health and Environment is not that resource. They are too close, too vested, too seemingly uninterested or unwilling to partnering with me to address this concern.

I believe you to be a reasonable, honest, concerned individual.

Please help me resolve this radon concern by directing me to someone in my government who can help me.

Thank you.

Happy Holidays!

Paul Carestia

> I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment.

Subject: Response to your e-mail of 10/14/09

Paul,

I have reviewed the document you provided to me in your e-mail of 14

October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard

deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

Hi Paul,

I have sent your request for someone knowledgeable in radon emissions from mill tailings to one of my contacts at NRC. I'll let you know when I hear something. This is a difficult time of year, because people are in and out of their offices. In fact, after today I'll be out of the office until January 4, 2010.

Happy Holidays to you, Paul.

Reid

Hi Paul,

I have sent your request for someone knowledgeable in radon emissions from mill tailings to one of my contacts at NRC. I'll let you know when I hear something. This is a difficult time of year, because people are in and out of their offices. In fact, after today I'll be out of the office until January 4, 2010.

Happy Holidays to you, Paul.

Reid

Subject: Re: NRC Contact

Reid,

Thank you very much. I truly appreciate your help here more than you will ever realize.

Paul

Hi Paul,

Yes, I spoke with Ron and his supervisor to make sure that he is the right person. I copied him on my original note to you, so he is expecting to hear from you. If he cannot address your radon questions, he promised that he would find someone who could.

Reid
Radiation Protection Division (6608J)

Reid,

Thank you for the fast response.

Will Mr. Burrows be aware that I am contacting him based upon your

referral? Will he know who I am when he sees an e-mail from me? I just

want to make sure my contact with him is not ignored.

If I understood correctly, you know Mr. Burrows. Just trying to grease

the skids a little.

I hope you and your family had a nice Holiday.

Paul Carestia

Subject: NRC Contact

Good Morning Paul,

Here is a contact at NRC for questions related to radon.

Ronald A. Burrows CHP, RRPT
U.S. Nuclear Regulatory Commission
Federal and State Materials and Environmental
 Management Programs
Uranium Recovery Licensing Branch

Subject: Fwd: Status of Request for NRC Help and Guidance

Reid,

Need you to see this one too..................I need to know just what is the "nature of my request"?

You need to know something..............I am the first son of a coal miner who had no more than a 6th grade education before my father made him quit school and go to work in the coal mines. I am the first grandchild in my family to get a college education. I have degrees from Colorado State University, Northwestern University, and the University of Chicago. I got there through hard work, scholastic achievement, determination, and never giving up.............and I will not be giving up on the issues I've brought to you as part of the Subpart W/Method 115 review.............or the issues I've asked and you have kindly agreed to help get resolved with the NRC.........and I am asking you and the NRC, not the state of Colorado, to address my concerns.

Both my mother and my father were diagnosed with cancer.........my mother died at the young age of 58 from brain cancer (glioblastoma multiforma, a word that has never left my mind since first hearing it. I got to watch her die a very slow, debilitating death.) and my father had prostate cancer, had surgery, was later again diagnosed with it returning as inoperable and terminal. Had he not tragically died in a car accident, cancer would have taken his life as well. I try not to think of what's in store for me, having lived all of my childhood life within 1 mile of the Cotter uranium mill during its operating heyday............breathing in the stench from that mill on hot summer nights with my bedroom windows open.............and having no idea what I was exposed to during my waking hours. There was no history of cancer in my family on my father or mother's sides. What would you think Reid if this were your situation? How would you feel? This mill or any uranium mill should not be in close proximity to people and communities in which they live and breathe! And I find the methodology used to monitor the radon emanating from this mill to be highly irregular, suspect, and without merit. And so do radiation scientists with a lot more knowledge and expertise than me.

This is visceral to me............visceral!.......please appreciate that. If I have to go to senators in Colorado and Washington D.C., I will..........right now I am pissed off...............very upset, very disappointed............and 1000% more determined to get action from those who are accountable to me as a tax payer in the country.

Senator Mark Udall will be visiting the Canon City and the Cotter Mill site in the not too distant future. I intend to be there when he does and I intend that he become involved in all of this............and I won't give up until he does.

I respectfully ask that my issues get addressed and answered. I think you'd all would rather be doing this at my request rather than his.

Thank you.

Paul Carestia

Subject: Re: Status of Request for NRC Help and Guidance

> As such, due to the nature of your request I have forwarded it to the State of Colorado Radiation Program Manager. His contact details are as follows:

Ron,

I'd appreciate you expounding on the "nature of my request". Just what in your eyes IS the nature of my request?

Thanks.

Paul Carestia

Subject: Status of Request for NRC Help and Guidance

Good afternoon, Paul.
We have had a chance to review the details of your request. As you may know, Colorado is an Agreement State. As such, due to the nature of your request I have forwarded it to the State of Colorado Radiation Program Manager. His contact details are as follows:
Steve Tarlton, Manager
Radiation Program
CO Department of Public Health & Environment
Regards,

Ronald A. Burrows

Subject: RE: Logistics for June 30 Subpart W Meeting

Hi all,

I have booked the Quality Inn here in Canon City, Hwy. 50 and Dozier, 719-275-8676. They have a meeting room for 30-50 people. We will have it from 6:00 to 9:00 p.m. on June 30. I will check with the Events Coordinator the week before to make sure they have the set up for PowerPoint, etc. By that time I will have input on how many people are coming and be able to decide what sort of seating/table arrangement will best suit. If any presenter has has any special needs along those lines let me know as soon as possible. Look forward to seeing you in Canon City.

Carol Dunn
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Mr. Rosnick

The Wyoming Mining Association (WMA) is very concerned about claims that uranium mining and processing may contribute to health impairment from the release of radon from uranium processing facilities. WMA would like to draw your attention to the attached report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010. In summary the study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.* The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded that outdoor concentration of radon contributed zero dust to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay.
I understand that there will be a conference call on October 6 to discuss 40 CFR Part 61 Subpart W which deals with this issue. WMA requests that this study be on the agenda for discussion during that conference call.

Thank you.

Marion Loomis

Reid Rosnick:

Thank you for your reply. Kennecott Uranium Company believes that the Agency for Toxic Substances and Disease Registry (ATSDR) draft Public Health Assessment applies directly to Subpart W regulation for the following reasons:

- 40 CFR Part 61 Subpart W regulates radon emissions from tailings impoundments via either the twenty (20) picocurie per meter squared second standard for existing impoundments or the work practices for new impoundments constructed after December 15, 1989. The goal of this regulation is to reduce exposures and doses to the general public from radon and its decay products from uranium mill tailings impoundments.
- The draft Public Health Assessment specifically addresses public dose from and exposure to radon and its decay products from a uranium mill tailings impoundment namely Cotter Corporation's Canon City Mill impoundment.
- The draft Public Health Assessment states:

  > *On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This conclusion has direct bearing on the current effectiveness of 40 CFR part 61 Subpart W, specifically that as it now stands the doses from radon and its decay products from a tailings impoundment (Cotter Corporation's Canon City impoundment) regulated under 40 CFR Part 61 Subpart W do not represent a health threat.
- This conclusion goes directly to statements made in the lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action specifically the request to *"Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air…"*

The above reasons are why Kennecott Uranium Company is requesting that this draft Public Health Assessment be on the agenda for discussion on the Wednesday, October 6, 2010 conference call.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Dear Mr. Marschke:

The required environmental data to perform a radon risk assessment for the Sweetwater Uranium Project is either already in the possession of the Environmental Protection Agency (EPA) or publically available. The following applies to the required data:

- Radon flux testing data for the Sweetwater Uranium Project tailings impoundment for calendar years 1990 to 2010 has been submitted to the Agency as required by 40 CFR Part 61 Subpart W. and is already available to Agency staff.
- Meteorological data in the Revised Environmental Report dated August 1994, represents a good long term summary of site's meteorological conditions and as such is representative and suitable for use. This document is available on the Nuclear Regulatory Commission's (NRC's) web site at the link below:
- http://pbadupws.nrc.gov/docs/ML0810/ML081010327.pdf
- The meteorological data provided in this document including, I believe, joint frequency distributions, is site specific data.
- Upwind and downwind radon activity data for ambient air collected using Landauer, Inc.'s TrakEtch devices has been submitted semiannually to the Nuclear Regulatory Commission (NRC) as part of the facility's semiannual 40.65 Reports and is publically available in the Commission's online ADAMS system.
- In addition, I believe that upwind and downwind radon activity data for ambient air was summarized in a submittal to the Commission in either the first half of 1998 or 1999 so that the submittal plus any 40.65 Reports submitted from its date forward, provide a complete set of upwind and downwind radon activity data for the site. In any event, upwind and downwind radon activity data is submitted semiannually in the required 40.65 Reports and is available in the ADAMS system. I can check on the 1998 summary report when I return to the office and probably provide a link to it on the Nuclear Regulatory Commission's (NRC's) web site.

I am traveling this week and will return to the site on Tuesday, February 21, 2011. I would like to work with you upon my return to ensure that the risk assessment completed for the Sweetwater Uranium Project is based upon actual site conditions and measurements. Should you have any questions please call me at that time.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid Rosnick:

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*

- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
  - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases from the Canon City Mill. The filing states, "*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado."* The filing continues by requesting that the Environmental Protection Agency (EPA), "*Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid."*

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid:

The following pertains to the S. Cohen and Associates report entitled:

Final Report Review of Existing and Proposed Tailings Impoundment Technologies

It lists only three (3) extant convention uranium mills in the United States (Sweetwater, Canon City and White Mesa). It fails to list the Tickaboo Mill and tailings impoundment owned by Uranium One. It incorrectly lists the owner of the White Mesa mill as UMETCO when in fact the owner is Denison Mines.

- Table I from the report is below:

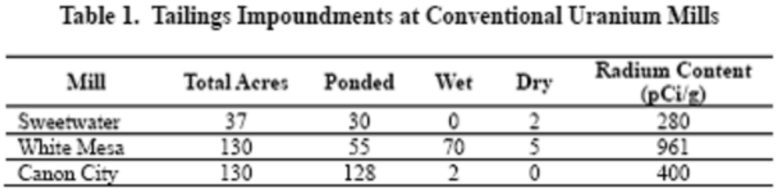


Table 1. Tailings Impoundments at Conventional Uranium Mills

Mill	Total Acres	Ponded	Wet	Dry	Radium Content (pCi/g)
Sweetwater	37	30	0	2	280
White Mesa	130	55	70	5	961
Canon City	130	128	2	0	400

- Table 1 lists the Sweetwater Uranium Project tailings radium content as 280 pCi/g.
- Attached please find the Adobe Acrobat Portable Document Format (*.pdf) file *tailings_radium_226_activity.pdf*.

  - This table is from *Final Design Volume VI – Existing Impoundment Reclamation Plan – Sweetwater Uranium Project* submitted to the Nuclear Regulatory Commission (NRC) on August 26, 1997 and is part of Docket 040-08584 for Source Materials License (SML) SUA-1350.
  - This table provides an average Radium-226 activity for the tailings of 70.9 pCi/g based on twenty (20) samples.
  - This table also provides an average emanation coefficient of 0.188 based on laboratory determination of emanation coefficient for eighteen (18) samples. This value is 54% of the default value of 0.35 used by the Nuclear Regulatory Commission (NRC) in *Regulatory Guide 3.64 – Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (U.S. Nuclear Regulatory Commission (NRC) – June 1989). The reason that this issue is being raised, is that when calculating radon flux from tailings and other earthen materials, the default emanation coefficient of 0.35 is often used and its use can lead to erroneously high radon fluxes.
- Table 3 from the report is shown below:
  -

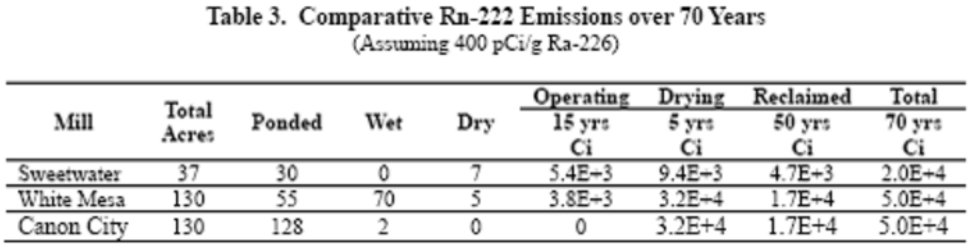


Table 3. Comparative Rn-222 Emissions over 70 Years
(Assuming 400 pCi/g Ra-226)

Mill	Total Acres	Ponded	Wet	Dry	Operating 15 yrs Ci	Drying 5 yrs Ci	Reclaimed 50 yrs Ci	Total 70 yrs Ci
Sweetwater	37	30	0	7	5.4E+3	9.4E+3	4.7E+3	2.0E+4
White Mesa	130	55	70	5	3.8E+3	3.2E+4	1.7E+4	5.0E+4
Canon City	130	128	2	0	0	3.2E+4	1.7E+4	5.0E+4

  - It assumes a long term tailings Radium-226 activity of 400 pCi/g.
  - As previously stated, the current Radium-226 activity in the impoundment averages 70.9 pCi/gram. Estimated Radium-226 activity of future tailings generated should operations resume, is 249 pCi/gram (weighted average of slimes and sand).
  - This estimated activity is from Appendix H (Principal Parameters for Radiological Assessment (MILDOS Inputs) of the *Sweetwater Uranium Project – Revised Environmental Report* submitted to the Nuclear Regulatory Commission in August 1994 which is part of part of Docket 040-08584 for Source materials License (SML) SUA-1350.
  - This estimated activity is based on the values in Appendix H specifically an estimate of 71% sand with a Radium-226 activity of 207 pCi/g and 29% slimes with a radium-226 activity of 353 pCi/g as per the table below:

	Activity	**Percentage**
Slimes:	353 picoCuries/gram	29%
Sand:	207 picoCuries/gram	71%
Weighted Average:	249 picoCuries/gram	100%

The above information pertains specifically to the three (3) items that were raised following your presentation. In addition, other discrepancies were noted in the report. The following are two (2) such items:

The document discusses Radon-222 source terms for in-situ uranium recovery. It discusses Radon-222 releases from mud pits and uses the variable [Ra] which is defined as Ra-226 concentration in the ore zone (pCi/g). The mud pit contains cuttings from the entire bore hole not just from the ore zone. The actual thickness of the ore zone is a fraction of the depth of the entire hole, thus the cuttings from the ore zone would be diluted with cuttings with substantially lower radium-226 activity from above the ore zone.

In a typical 500 foot deep bore hole only ten (10) feet of it would be in an actual ore zone. Cuttings from the ore zone would only represent 2% of the total cuttings mass. Use of the Radium-226 activity of the ore zone to describe the activity of the entire drill cuttings mass is incorrect.

Table 4 lists the following operating in-situ uranium recovery operations:

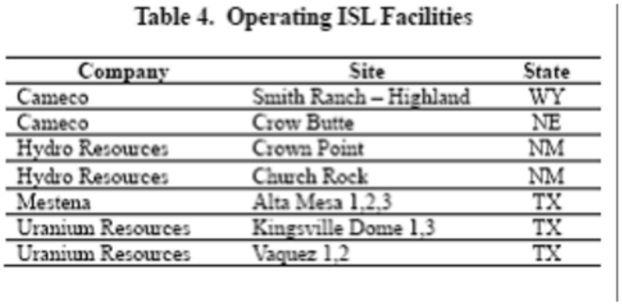


Table 4. Operating ISL Facilities

Company	Site	State
Cameco	Smith Ranch – Highland	WY
Cameco	Crow Butte	NE
Hydro Resources	Crown Point	NM
Hydro Resources	Church Rock	NM
Mestena	Alta Mesa 1,2,3	TX
Uranium Resources	Kingsville Dome 1,3	TX
Uranium Resources	Vaquez 1,2	TX

It lists Hydro Resources, Inc. Crownpoint and Churchrock facilities as operating, which they are not. In addition, I believe that Uranium Resources, Inc's Kingsville Dome and Vasquez Projects are currently not operating.

If you have any questions or require additional data please do not hesitate to contact me.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid,

Thanks for the e-mail. Please send me the CD to the following address.

I guess I am a little confused now by just what exactly your agency is going to be willing to share with the public regarding this matter and just what exactly you are going to be putting up on the website EPA will be creating.

I am also familiar with the Freedom of Information Act and have used it upon occasion with other federal government agencies. I have difficulty with any government agency when I am told information pertaining to my and the public's welfare is "sensitive and cannot be shared". Makes one feel one's government is withholding something it doesn't want me to see.

Any thoughts on this?

Thank you.

Paul Carestia

Dear Mr. Rosnick,

I note that the Subpart W review documents on the Subpart W Rulemaking Activity Website in the Historical Rulemakings section includes the Draft EIS for the Proposed Radionuclides rulemaking, dated February 1989. However, this is only Volume 1 of a 3-volume draft EIS.

I request that the all 3 volumes of the Final EIS, September 1989, be placed with the Historical Rulemakings documents.

Sarah Fields
Uranium Watch

Hello Reid,

During this morning's conference call re the Subpart W review, Cotter stated that they had not received any request for information from the EPA.

Cotter was sent a letter in 2009 asking them for information; at least a letter that is addressed to them is on the Subpart W Review website:

http://www.epa.gov/radiation/docs/neshaps/subpart-w/uranium%20cotter%20test.pdf

Sarah Fields
Uranium Watch

Reid,

The BLM/USFS Meeting on the expansion of the La Sal Mine is on January 13. I will not be there. I had already made plans to go to Denver for the NRC uranium recovery workshop long before the BLM announced the scoping meeting in La Sal.

There are a number of outstanding issues related to the La Sal Mines, including Subpart B compliance.

Sarah

On Jan 7, 2011, at 6:28 AM, Rosnick.Reid@epamail.epa.gov wrote:

Hello Sarah,

You are correct that Cotter was sent a letter in 2009. That letter was an information request from our enforcement office, and asked for a number of items that are related to our discussion from Wednesday. However, the debate on Wednesday was focused on whether our contractor, in preparing the risk assessment draft document within the last 2 months, contacted Cotter for real-time radon flux data, as well as meteorological data specific to the Canon City area. As we discussed on Wednesday, most of that data is available on-line at NRC's ADAMS website. I am waiting for confirmation from the contractor on exactly how they obtained the Cotter data.

Separately, I saw that there was a BLM/USFS public meeting last night regarding the plan of operations amendment for the expansion of the LaSal mine. I would be interested in your take on the meeting. Thank you.

Reid

Dear Mr. Rosnick,

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch

memo_subpartWreview.091125.pdf

Dear Reid,

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

Hello Reid,

Thanks for your message. After consulting with our group, we would choose the White Mesa Ute community meeting place, as it may be more accessible to people closest to the Mill, and Blanding residents could get there easily. A few people from Canon City will be making the trip, so a few miles one way or the other won't make a difference to us. May 24th seems quite a ways off, and we think would happen after our next scheduled conference call, which is unfortunate. The consensus here is that a date sooner than May 24th should be scheduled. Other than that, thanks for your efforts and asking for our opinion.

Sharyn
~~~~~~

Hi Sharyn,

I hope you are well. I wanted to touch base with you regarding the possible time and location for the Utah public meeting. I have been corresponding with Sarah Fields, who gave me some good information on where we could locate the meeting. She has given me two locations: The first one is the White Mesa Ute community, about 5 miles south of Blanding, which is the community closest to the White Mesa Mill. They have a gym where the DOE held scoping and draft EIS hearings related to the disposition of the Moab Mill Tailings. The second location is the Blanding Arts and Events Center at the College of Eastern Utah. They apparently have a large meeting room. Either one of these locations would be fine with me, although I am leaning toward the White Mesa Ute facility, since it is closest to the mill. I welcome any input you have on the issue.

The second issue is the date of the meeting. I am currently looking at Monday, May 24th, at approximately 6 PM. I believe that Dr. Diaz will be accompanying me on the trip.

Please let me know if this works for you, so I can go ahead with the reservations for the room, etc. Thanks a lot.

Reid

Reid,

We are disappointed, but after conferring with Jeremy Nichols of RMCAA/Wild Earth Guardians, and Atty Travis Stills, we have chosen Dec. 3rd, Thursday, 1 pm, MST. I have some questions:

1. How soon can you give us call-in instructions in order for us to make our announcements to interested participants.
2. Will EPA provide an adequate number of lines for interested participants?
3. Will EPA announce the teleconferences, and how?
4. Who will be on the teleconference from EPA?

Thanks for your efforts on the website, as we would really appreciate being able to look at related documents prior to the call. Please do email me when it is up and available for access.

Again, thank you for all your help, and we're looking forward to these conferences.

Sharyn

Hi Sharyn,

I took your advice and spoke with Susan Stahle of our Office of General Council. She was more nervous than Travis with respect to missing the 30 day deadline for the conference calls. She explained to me that the 30 days is a hard and fast requirement, and we can't miss it. So, I apologize for the mix-up, but we need to think of another day that will work between now and up to December 3. I know that we had originally talked about Tuesdays, but really for me Tuesday, Wednesday or Thursday will work. If you could give me some dates that would work for you, I would greatly appreciate it. Again, sorry.

Regarding the web site, I hope to have it go live by next Thursday. We're putting the finishing touches on it, and it has a lot of information on it. Since its a work in progress, we hope to continue to add to it from any other sources we find here, as well as any information from the stakeholders. I'll let you know as soon as it is up and running.

Reid

Hi Reid,

I've spoken with Travis Stills and he sees no problem with going a few days past the 30-day deadline under the circumstances. Travis suggested that you might contact Susan Stahle for any input on your end:
Stahle.Susan@epamail.epa.gov

Thanks for the attendee list, and we're looking forward to the first teleconference. Any update on the development of the website?

Thanks, Sharyn

Hi Sharyn,

Sorry for the delay in responding, I was in Gallup, New Mexico last week for a Navajo uranium stakeholders conference.

Thanks for scheduling the time for the conference call. December 8 at 1 PM MST is fine with me except for just one issue. The settlement agreement became effective on November 3, and one of the issues we agreed to was that the conference calls would begin within 30 days of the agreement becoming final. The conference call date is 5 days beyond the 30 day stipulation. If you are OK with that, then so am I, but I need to make sure that we don't violate any terms of the agreement, which would force the call to happen on or before December 3. Please let me know if you're still willing to go with December 8. Thanks

I've also attached the sign-in sheet you requested for the meeting we had in Rapid City. Have a good day.

Reid

Hi Again,

Would it be possible for you to send me a copy of the sign-in sheet of people that attended your presentation in Rapid City?

Thanks, Sharyn

Hello Reid,

Things here are pretty good. We've had early snow and record breaking low temperatures, but have bounced back to warmer weather for the present. Sorry for the delay in responding, but I had to check with CCAT and others. The consensus is to start the teleconferences on Dec 8th, preferably 1 PM MST. That would allow for everyone to participate from all regions of the US. Keeping the same number and posting info about the teleconferences on the current or new website will be very helpful.

Many are looking forward to info and documents being posted on a website, especially where we could access documents while on a teleconference, if wanted. So, please do let me know when this becomes available.

Thanks very much, and I'll wait for your confirmation of Dec. 8th, 1 PM MST, and then we will notify our lists.

Sharyn

Subject: Dates for first conference call

Hi Sharyn,

I hope things are good. In anticipation of the settlement agreement being approved some time soon (November?) I thought we might discuss some dates for when we hold the first conference call. I don't really have any preferences, other than the call being held anytime after November 13. If you would like to stick to the schedule in the Agreement, it would be on a Tuesday, so that leaves November 17 and 24, and December 1 and 8. Again, I don't have any real preference at this time. Regarding time of day for the call, my preference would be sometime during the hours of 9 AM - 1 PM MST. My assumption is that the call would last about an hour. The call-in number will be posted on the web site no later than 5 days before the call, and I'll also e-mail the number to you per the Agreement. The way I'm working on this is that the number will remain the same throughout the time that we conduct the calls. Does any of this work for you?

The web site is coming together, and will be up within the 30 day period after the agreement becomes final. The site will be a work in progress, as I try to add more material and information to it during the life of the site.

I think that's it for now, I look forward to hearing from you.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)

Subject: Re: Web Posting

Reid,

Thanks very much, and yes the announcement language was very good.

Sharyn

Subject: Re: Web Posting

Hi Sharyn,

I trust that the language I used in the announcement is acceptable. I know that Jeremy Nichols is no longer representing Rocky Mountain Clean Air Action, but I felt obliged to mention them, since they are co-plaintiffs with your organization. The Region is continuing to work on determining placement of the announcements, and I reckon that we will have a resolution soon.

I will be sending 50 copies of the presentation tomorrow. That number is based on the 30-40 number of attendees you had estimated, plus 10 more for good measure. You should probably receive it on Monday or Tuesday. I'll also be sending the electronic versions of the presentation and the 2008 NMA presentation tomorrow afternoon. I'll also bring a CD with my presentation to use at the meeting, and you are welcome to keep that if you wish.

Thanks again for all your help.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

Thank you for putting a notice of the June 30th meeting on the Subpart W website at the EPA. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, the Cotter Uranium Mill & Superfund site on the CDPHE website, and the CDPHE Powertech website where ISL uranium mining is being proposed. Hopefully that will happen, as those are sites that the general public access periodically, people who may not be aware of the review of Subpart W. An ad in our local newspaper seems only appropriate for this meeting on a historical effort by EPA that will have a direct impact on our community. We will appreciate your continued effort, and efforts by others at EPA and CDPHE, to see that proper notification is offered to the public.

I'll be looking for your package of materials, the electronic versions of presentations on the subject to NMA and for this meeting by email, and will hopefully be getting back to you soon about our issues of concern.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks to you and Carol Dunn for making all the arrangements and logistics for the meeting location. I will Fed-Ex the box of presentations to you on Friday. Additionally, I'll send you an electronic version and a copy of the presentation I made to NMA last year.

Regarding advertising for the meeting, I am in the process of placing a notice of a public meeting on EPA's Subpart W web page. It may take a day or two to get through our Product Review section. Angelique Diaz will make a request of the Regional Superfund group on whether they will update their web site. She will also see if CDPHE will allow for placement of an announcement on their web sites. For the Canon City Daily Record she will speak with the public affairs people to see if any funding is available for the advertisement. I'll update you as I hear about the success of the requests.

Thanks again, and as always, don't hesitate to contact me if you have questions or comments.

Reid

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks, have a great weekend.

Reid

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to ontact you.

I look forward to meeting you in a couple of weeks.

Reid

Hello Reid,

Thanks for your message. Our group has already begun looking at potential sites for the June 30th meeting in Canon City. We'll take steps to help confirm a location after we've had a chance to discuss the best time for the meeting, if you would like. We would be happy to discuss the format and info desired, as well. Let me know when you would like to speak by telephone.

Sharyn Cunningham
CCAT Co-Chair

Subject: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it when we last spoke in February. If you would kindly send it to me, I'll give you a call and we can discuss some of the logistics (time/place) for the Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and any issues you would like me to address. Thanks

Reid
Radiation Protection Division (6608J)

Subject: Re: Web Posting

Reid,

Thanks and I saw that the announcement was up last night after receiving your last message. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, and at the Cotter Mill & Superfund site website on the CDPHE website. Hopefully that will happen, as those are sites that the general public accesses periodically, people who may not be aware of the review of Subpart W. We will appreciate your continued effort to see that happens.

I'll be looking for your package of materials, the PPTs by email, and will hopefully be getting back to you soon about our issues of concern.

Thanks again,
Sharyn

Subject: Web Posting

Hi Sharyn,

I have managed to get an announcement about the June 30 meeting on our Subpart W web page. The link is:

http://www.epa.gov/radiation/neshaps/subpartw/index.html

The Region is still looking into the possibility of getting an announcement on the Lincoln Park Superfund site, the CDPHE websites, and the Canon City Daily Record. I'll keep you posted.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks, have a great weekend.

Reid

Dear Reid,

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Hello Reid,

Thanks for your message. Our group has already begun looking at potential sites for the June 30th meeting in Canon City. We'll take steps to help confirm a location after we've had a chance to discuss the best time for the meeting, if you would like. We would be happy to discuss the format and info desired, as well. Let me know when you would like to speak by telephone.

Sharyn Cunningham
CCAT Co-Chair

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it when we last spoke in February. If you would kindly send it to me, I'll give you a call and we can discuss some of the logistics (time/place) for the Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and any issues you would like me to address. Thanks

Reid

Subject: Re: Method 115

Reid,

We also appreciated the opportunity to speak with all of you this morning. Thanks for the document on Method 115. I'm encouraged that we've begun opening channels of communication on this important issue. I look forward to speaking with you in the future.

Sharyn Cunningham, Co-Chair
Colorado Citizens Against ToxicWaste, Inc.

Hi Sharyn,

I enjoyed speaking with you and Jeremy this morning. Please let me know if you have any other questions I can answer. In the meantime, attached is the copy of Method 115 I promised. This is the required test method for radon flux from Subpart W units.

Reid

(See attached file: Method 115.pdf)

EPA-123

Reid Rosnick/DC/USEPA/US
09/12/2012 09:36 AM

To	Susan Stahle
cc	Tom Peake
bcc	Beth Miller
Subject	Emails for Subpart W Website

Hi Sue,

I got your voice mail earlier, I'll be on the lookout for the language and I'll also scrub as you suggested.

Attached are emails that Sharyn Cunningham mentioned during the last Subpart W Stakeholders call. I have scrubbed these of phone numbers, email addresses, etc. I'm sure I haven't captured all of them, but it is time consuming, and I have other items on the plate. If you wish to look at them to determine if any should be deleted due to deliberative or confusing information, please feel free. Please let me know if you have questions or comments. Thanks

Subpart W emails.docx

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Subject: Re: Method 115 2/4/2009

Hi Sharyn,

I enjoyed speaking with you and Jeremy this morning. Please let me know if you have any other questions I can answer. In the meantime, attached is the copy of Method 115 I promised. This is the required test method for radon flux from Subpart W units.

Reid

(See attached file: Method 115.pdf)

2/4/2009

Reid,

We also appreciated the opportunity to speak with all of you this morning. Thanks for the document on Method 115. I'm encouraged that we've begun opening channels of communication on this important issue. I look forward to speaking with you in the future.

Sharyn Cunningham, Co-Chair
Colorado Citizens Against ToxicWaste, Inc.

END OF EMAIL

Subject: Logistics for June 30 Subpart W Meeting 6/5/2009

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it when we last spoke in February. If you would kindly send it to me, I'll give you a call and we can discuss some of the logistics (time/place) for the Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and any issues you would like me to address. Thanks

Reid
Radiation Protection Division (6608J)

Hello Reid, 6/8/2009

Thanks for your message. Our group has already begun looking at potential sites for the June 30th meeting in Canon City. We'll take steps to help confirm a location after we've had a chance to discuss the best time for the meeting, if you would like. We would be happy to discuss the format and info desired, as well. Let me know when you would like to speak by telephone.

Sharyn Cunningham

CCAT Co-Chair

Hi Sharyn, 6/9/2009

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to ontact you.

I look forward to meeting you in a couple of weeks.

Reid

Dear Reid, 6/11/2009

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our

efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting 6/9/2009

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Subject: RE: Logistics for June 30 Subpart W Meeting
6/12/2009

Hi all,

I have booked the Quality Inn here in Canon City, Hwy. 50 and Dozier, 719-275-8676. They have a meeting room for 30-50 people. We will have it from 6:00 to 9:00 p.m. on June 30. I will check with the Events Coordinator the week before to make sure they have the set up for PowerPoint, etc. By that time I will have input on how many people are coming and be able to decide what sort of seating/table arrangement will best suit. If any presenter has has any special needs along those lines let me know as soon as possible. Look forward to seeing you in Canon City.

Carol Dunn
CCAT Co-Chair

Hi Sharyn, 6/12/2009

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks,have a great weekend.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting 6/12/2009

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting 6/16/2009

Hi Sharyn,

Thanks to you and Carol Dunn for making all the arrangements and logistics for the meeting location. I will Fed-Ex the box of presentations to you on Friday. Additionally, I'll send you an electronic version and a copy of the presentation I made to NMA last year.

Regarding advertising for the meeting, I am in the process of placing a notice of a public meeting on EPA's Subpart W web page. It may take a day or two to get through our Product Review section. Angelique Diaz will make a request of the Regional Superfund group on whether they will update their web site. She will also see if CDPHE will allow for placement of an announcement on their web sites. For the Canon City Daily Record she will speak with the public affairs people to see if any funding is available for the advertisement. I'll update you as I hear about the success of the requests.

Thanks again, and as always, don't hesitate to contact me if you have questions or comments.

Reid

END OF EMAIL

Subject: Web Posting 6/17/2009

Hi Sharyn,

I have managed to get an announcement about the June 30 meeting on our Subpart W web page. The link is:

http://www.epa.gov/radiation/neshaps/subpartw/index.html

The Region is still looking into the possibility of getting an announcement on the Lincoln Park Superfund site, the CDPHE websites, and the Canon City Daily Record. I'll keep you posted.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting 6/17/2009

Dear Reid,

Thank you for putting a notice of the June 30th meeting on the Subpart W website at the EPA. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, the Cotter Uranium Mill & Superfund site on the CDPHE website, and the CDPHE Powertech website where ISL uranium mining is being proposed. Hopefully that will happen, as those are sites that the general public access periodically, people who may not be aware of the review of Subpart W. An ad in our local newspaper seems only appropriate for this meeting on a historical effort by EPA that will have a direct impact on our community. We will appreciate your continued effort, and efforts by others at EPA and CDPHE, to see that proper notification is offered to the public.

I'll be looking for your package of materials, the electronic versions of presentations on the subject to NMA and for this meeting by email, and will hopefully be getting back to you soon about our issues of concern.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Web Posting 6/17/2009

Reid,

Thanks and I saw that the announcement was up last night after receiving your last message. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, and at the Cotter Mill & Superfund site website on the CDPHE website. Hopefully that will happen, as those are sites that the general public accesses periodically, people who may not be aware of the review of Subpart W. We will appreciate your continued effort to see that happens.

I'll be looking for your package of materials, the PPTs by email, and will hopefully be getting back to you soon about our issues of concern.

Thanks again,
Sharyn

Subject: Re: Web Posting 6/18/2009

Hi Sharyn,

I trust that the language I used in the announcement is acceptable. I know that Jeremy Nichols is no longer representing Rocky Mountain Clean Air Action, but I felt obliged to mention them, since they are co-plaintiffs with your organization. The Region is continuing to work on determining placement of the announcements, and I reckon that we will have a resolution soon.

I will be sending 50 copies of the presentation tomorrow. That number is based on the 30-40 number of attendees you had estimated, plus 10 more for good measure. You should probably receive it on Monday or Tuesday. I'll also be sending the electronic versions of the presentation and the 2008 NMA presentation tomorrow afternoon. I'll also bring a CD with my presentation to use at the meeting, and you are welcome to keep that if you wish.

Thanks again for all your help.

Reid

Subject: Re: Web Posting 6/18/2009

Reid,

Thanks very much, and yes the announcement language was very good.

Sharyn

END OF EMAIL

Subject: A Request For Documentation
7/29/2009

Reid,

At the June 30 meeting in Canon City I believe you told us that you would make available to us the following documents: 1989 Risk Assessment, EPA's Detailed Workplan, Communications Plan, and Analytic Blueprint.

I am aware that these documents will all appear at some future date on the website that EPA will be creating once the lawsuit is settled and all parties have signed the requisite documents. However,as slowly as the lawsuit is moving toward final signatures this is taking longer than I wish to wait.

So I am asking you to please send me the documents I've requested above.

Thank you.

Paul Carestia

Subject: Re: A Request For Documentation 8/6/2009

Paul,

Sorry for the delay, I have been out of the office for two weeks.

I can send you the 1989 Risk Assessment documents, however, the file is too large to send electronically. If you would send me your address, I can send a CD of this information.

Regarding the Analytic Blueprint and Communication Plan, these documents are internal Agency documents, containing sensitive information that cannot be shared. I mentioned them in my presentation to give you a feel for the process we use, and the fact that we are indeed on a path forward, not waiting for any resolution to the lawsuit. I apologize for any misunderstanding.

Please let me know if sending you the CD of the risk assessment is acceptable. Thanks

Reid

Reid, 8/6/2009

Thanks for the e-mail. Please send me the CD to the following address.

I guess I am a little confused now by just what exactly your agency is going to be willing to share with the public regarding this matter and just what exactly you are going to be putting up on the website EPA will be creating.

I am also familiar with the Freedom of Information Act and have used it upon occasion with other federal government agencies. I have difficulty with any government agency when I am told information pertaining to my and the public's welfare is "sensitive and cannot be shared". Makes one feel one's government is withholding something it doesn't want me to see.

Any thoughts on this?

Thank you.

Paul Carestia

END OF EMAIL

Subject: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit 10/14/2009

Reid,
Sharyn Cunningham asked me to send to you the document produced by MFG Inc, a firm hired by Cotter Corporation, which proposed the use of an Effective Effluent Limit (EEL) to gauge whether radon concentrations at the Cotter Mill perimeter were "safely within limits".
It is my understanding that you asked to see this document as a result of some discussion at the Rapid City WMAN Conference in October.
Attached is that document in .pdf form. Unfortunately it was scanned upside down, so you will have to use "View" on Adobe Reader's toolbar to rotate the document so it can be read on your computer screen.
I have read this document numerous times and as an engineer with a master's degree in electrical engineering and as an MBA with a fair number of statistics courses behind me, I have a number of issues with the approach proposed and accepted by the Colorado Department of Health in this matter with

Cotter. I have raised these issues with the Department of Health and the EPA in Region 8 to no avail. I am hoping that someone with the right expertise on your staff in Washington, D. C. will take a detailed, critical look at what is written here and will truly evaluate the science as appropriate and adequate. Region 8 of the EPA never responded to my documented concerns and Colorado Department of Health responses were obfuscating at best. I'll be happy to make their responses available to you as well if you wish. I have basically given up on getting anything reasonable from those folks, who are obviously stakeholders in this approach having given approval for its use.

The issues I have with the approach are as follows.

1. The sample sizes being used to calculate reliable, realistic means and standard deviations for background radon concentrations and perimeter radon concentrations are simply too small. Statistical theory shows that in order to have reliability in the calculation of the mean and standard deviation of a sample distribution, one needs a sample size somewhere between 30 and 50 samples. Four samples are used for perimeter radon concentrations (1 per quarter) and 4 samples are used from each of three background radon locations (1 per quarter), for a total of 12 background radon samples. These sample sizes are simply insufficient, especially when the resulting mean and standard deviation for background are used to predominantly set the upper limit for radon concentrations at the mill perimeter. I view this as highly unreliable for such an important metric of concern to public health and welfare.
2. The average background radon measurement and resulting background standard deviation are then used in the Effective Effluent Limit equation:

EEL Alternative Effluent Limit + Average Background + 2 times the standard deviation of Average Background

Alternate Effluent Limit is defined in the MFG document and is basically a constant number dependent upon distance of perimeter station from the tailings impoundment.

This EEL sets the upper limit against which mill perimeter average radon concentrations are compared. It is my contention that using such an approach will make it highly unlikely, if not impossible for the EEL to ever be exceeded. I think this approach is highly suspect, meaningless, and biased to give a result that will always say radon concentrations at the perimeter are "safely within limits".

You may recall in my presentation to you at the June 30 EPA meeting in Canon City I pointed out that while radon flux from the Cotter Primary Impoundment increased by 230% over a 3 year period, radon concentrations at the mill perimeter decreased by 30% over the same 3 year period. This makes absolutely no sense to me. Colorado Department of Health showed no interest in this concern, and for that matter neither did EPA in Region 8. Colorado Department of Health simply indicated that radon concentrations at the mill perimeter were "within EEL limits", so radon flux readings weren't really of relevance to them. They said they look at and count on radon concentrations at the perimeter. EEL as it is used in this case is being given an extremely high credence. I strongly question this.

3. All measurements in this approach, background as well as perimeter, are made using the same measurement technology, Laundauer's DRNF. I would assume then that all measurements are subject to the same random and real variation, not just background. The MFG document calls specific attention to this variation as it relates to background radon measurements and applies the 2 sigma 95% confidence interval for background to account for it. Yet the MFG document does nothing to take this variation into consideration for any of the perimeter measurements. I would argue that the appropriate 2 sigma for perimeter average measurements be added to those measurements to insure a 95% confidence in them as well. The approach as currently implemented is not an apples to apples approach.

I would appreciate very much having an EPA expert in Washington, D. C. study this document and the resulting approach. I respectfully request that this be undertaken and that the expert who does the review get back with me on their finding. I need corroboration from an expert, or I need to be shown where I am mistaken. Either outcome will suffice.

Thanks for your willingness to look into this matter. I appreciate it.

Paul Carestia

MFG Document.pdf

Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit
10/14/2009

Reid,

I'm sending additional information to include with Paul Carestia's email sent earlier today. Attached is a series of letters exchanged between Cotter and the CDPHE in 2004 concerning radon. The MFG, Inc. paper was part of this process. These letters may shed additional light on the matter. Paul had not seen them, and he is reviewing them now and will send you his notes and thoughts on them later.

Though there may be other reasons that radon came up in 2004, one may be that leadership staff at the CDPHE radiation division changed in 2003 bringing a new approach to Cotter. Also, radon flux in 2002 was18.7 pCi/m2-sec, probably due to the Primary Impoundment drying out during a period of extended drought. A third contributing event, as seen in the February 12th Memorandum from Jan Johnson to Steven Landau, was soil sampling done in 2003 where high levels of stable lead were found in a private residence attic and barn, and some other locations near Cotter. It appears that CDPHE was questioning whether radon from Cotter's impoundment and facility was contributing to this contamination. I've also attached a CDPHE letter from 6-16-2003 regarding the 2002 radon flux that was sent to CDPHE Air Pollution Division.

Thank you, and we'll look forward to hearing from you.

Sharyn Cunningham

Cotter CDPHE Radon Correspondence 2004.pdf

2003-6-16 CDPHE Review Radon Flux 2002.pdf

Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit
10/22/2009

Paul,

Thanks for all of the information. As I wrote to Sharyn, I was out of the office all last week on work unrelated to Subpart W, so this is the first chance I have had to respond. I probably won't get a chance to review the information until some time this weekend, but I'll respond when I have something to report. Thanks again.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Subject: Response to your e-mail of 10/14/09 10/30/2009

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m^2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

END OF EMAIL

Subject: Dates for first conference call   10/27/2009

Hi Sharyn,

I hope things are good. In anticipation of the settlement agreement being approved some time soon (November?) I thought we might discuss some dates for when we hold the first conference call. I don't really have any preferences, other than the call being held anytime after November 13. If you would like to stick to the schedule in the Agreement, it would be on a Tuesday, so that leaves November 17 and 24, and December 1 and 8. Again, I don't have any real preference at this time. Regarding time of day for the call, my preference would be sometime during the hours of 9 AM - 1 PM MST. My assumption is that the call would last about an hour. The call-in number will be posted on the web site no later than 5 days before the call, and I'll also e-mail the number to you per the Agreement. The way I'm working on this is that the number will remain the same throughout the time that we conduct the calls. Does any of this work for you?

The web site is coming together, and will be up within the 30 day period after the agreement becomes final. The site will be a work in progress, as I try to add more material and information to it during the life of the site.

I think that's it for now, I look forward to hearing from you.

Reid

Hello Reid, 11/04/2009

Things here are pretty good. We've had early snow and record breaking low temperatures, but have bounced back to warmer weather for the present. Sorry for the delay in responding, but I had to check with CCAT and others. The consensus is to start the teleconferences on Dec 8th, preferably 1 PM MST. That would allow for everyone to participate from all regions of the US. Keeping the same number and posting info about the teleconferences on the current or new website will be very helpful.

Many are looking forward to info and documents being posted on a website, especially where we could access documents while on a teleconference, if wanted. So, please do let me know when this becomes available.

Thanks very much, and I'll wait for your confirmation of Dec. 8th, 1 PM MST, and then we will notify our lists.

Sharyn

Hi Again, 11/4/2009

Would it be possible for you to send me a copy of the sign-in sheet of people that attended your presentation in Rapid City?

Thanks, Sharyn

Hi Sharyn, 11/9/2009

Sorry for the delay in responding, I was in Gallup, New Mexico last week for a Navajo uranium stakeholders conference.

Thanks for scheduling the time for the conference call. December 8 at 1 PM MST is fine with me except for just one issue. The settlement agreement became effective on November 3, and one of the issues we agreed to was that the conference calls would begin within 30 days of the agreement becoming final. The conference call date is 5 days beyond the 30 day stipulation. If you are OK with that, then so am I, but I need to make sure that we don't violate any terms of the agreement, which would force the call to happen on or before December 3. Please let me know if you're still willing to go with December 8. Thanks

I've also attached the sign-in sheet you requested for the meeting we had in Rapid City. Have a good day.

Reid

Hi Reid,   11/9/2009

I've spoken with Travis Stills and he sees no problem with going a few days past the 30-day deadline under the circumstances. Travis suggested that you might contact Susan Stahle for any input on your end:
Stahle.Susan@epamail.epa.gov

Thanks for the attendee list, and we're looking forward to the first teleconference. Any update on the development of the website?

Thanks, Sharyn

Hi Sharyn,   11/10/2009

I took your advice and spoke with Susan Stahle of our Office of General Council. She was more nervous than Travis with respect to missing the 30 day deadline for the conference calls. She explained to me that the 30 days is a hard and fast requirement, and we can't miss it. So, I apologize for the mix-up, but we need to think of another day that will work between now and up to December 3. I know that we had originally talked about Tuesdays, but really for me Tuesday, Wednesday or Thursday will work. If you could give me some dates that would work for you, I would greatly appreciate it. Again, sorry.

Regarding the web site, I hope to have it go live by next Thursday. We're putting the finishing touches on it, and it has a lot of information on it. Since its a work in progress, we hope to continue to add to it from any other sources we find here, as well as any information from the stakeholders. I'll let you know as soon as it is up and running.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)

Reid,   11/10/2009

We are disappointed, but after conferring with Jeremy Nichols of RMCAA/Wild Earth Guardians, and Atty Travis Stills, we have chosen Dec. 3rd, Thursday, 1 pm, MST. I have some questions:

1. How soon can you give us call-in instructions in order for us to make our announcements to interested participants.
2. Will EPA provide an adequate number of lines for interested participants?
3. Will EPA announce the teleconferences, and how?
4. Who will be on the teleconference from EPA?

Thanks for your efforts on the website, as we would really appreciate being able to look at related documents prior to the call. Please do email me when it is up and available for access.

Again, thank you for all your help, and we're looking forward to these conferences.

Sharyn

END OF EMAIL

Subject: EPA to Cotter 2-24-09 11/23/2009

Hi Reid,

I see that the website is up and we are really appreciative of your efforts. Just looking at correspondence between EPA & Cotter and see that the Feb 24, 2009, letter has even numbered pages of the document missing.

1. Could you please get the pages added and the letter reposted?

Also, there are no further letters after May 2009, either from Cotter or any EPA responses. If any further communication has gone on between EPA and Cotter since May 2009.

2. Would you please post correspondence since May 2009, as well?

One other thing - the aerial photos provided by Cotter in the information sent in May 2009 seem to be rather old. Attached are Nov 1, 2009, photos where it is very evident that tailings are now exposed in the Secondary Impoundment. In case you're unaware, Cotter made an inventory of Impoundment contents for EPA in 2003 (see attached) with details for the Primary. Other sources indicate that the Secondary does contain waste from the Manhattan project. We're really concerned about how radon is being controlled as Cotter is dewatering the Secondary Impoundment. This may be out of your jurisdiction, but I'm not as up on this, so am at least making you aware of the situation. We recently sent an email to Ms. Diaz about this, but thought you might like to see the photos in light of Cotter's response to request for information.

Thanks very much,

Sharyn Cunningham
CCAT Co-Chair

PDF Cotter Secondary Impoundment Photos 11-1-09.pdf

PDF Cotter Inventory Impmt Ponds 3-3-03.PDF

END OF EMAIL

Dear Mr. Rosnick, 11/25/2009

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch

memo_subpartWreview.091125.pdf

END OF EMAIL

Hi Sharyn, 2/4/2010

I hope you are well. I wanted to touch base with you regarding the possible time and location for the Utah public meeting. I have been corresponding with Sarah Fields, who gave me some good information on where we could locate the meeting. She has given me two locations: The first one is the White Mesa Ute community, about 5 miles south of Blanding, which is the community closest to the White Mesa Mill. They have a gym where the DOE held scoping and draft EIS hearings related to the disposition of the Moab Mill Tailings. The second location is the Blanding Arts and Events Center at the College of Eastern Utah. They apparently have a large meeting room. Either one of these locations would be fine with me, although I am leaning toward the White Mesa Ute facility, since it is closest to the mill. I welcome any input you have on the issue.

The second issue is the date of the meeting. I am currently looking at Monday, May 24th, at approximately 6 PM. I believe that Dr. Diaz will be accompanying me on the trip.

Please let me know if this works for you, so I can go ahead with the reservations for the room, etc. Thanks a lot.

Reid

,
Hello Reid, 2/5/2010
Thanks for your message. After consulting with our group, we would choose the White Mesa Ute community meeting place, as it may be more accessible to people closest to the Mill, and Blanding residents could get there easily. A few people from Canon City will be making the trip, so a few miles one way or the other won't make a difference to us. May 24th seems quite a ways off, and we think would happen after our next scheduled conference call, which is unfortunate. The consensus here is that a date sooner than May 24th should be scheduled. Other than that, thanks for your efforts and asking for our opinion.

Sharyn

END OF EMAIL

Subject: Re: EPA to Cotter 2-24-09 11/24/2009

Hi Sharyn,

I'm glad that you saw the website. Our IT folks put it up because I needed to see it on my home computer to make sure that it "looked" the same as on the computers here at EPA. At the same time, I was making sure that all of the links work, and to make sure that everything was complete. In addition to the Cotter letter, I also found two broken links. Those will be repaired this morning, and I will be sending an e-mail today to everyone who wanted to be notified that the web site is officially launched. Please note that some of the documents are very large, up to 25 MB, and they take some time to download.

As for correspondence with Cotter, I am not aware of any further communication since May. I'll check with Angelique Diaz in Denver to see if she has anything.

Thanks for the photos, you are correct that Dr. Diaz is the person to talk with, and I'm sure that she is communicating with CDPHE as well.

For the conference call on 12/3, do you have any agenda items that you would care to see?

I'll be out of the office for the rest of the week, so have a very Happy Thanksgiving, and I'll talk to you next week.

Reid

11/30/2009

Dear Reid,

Thanks for the effort put forth on the website and the upcoming teleconference. Everyone is looking forward to this update. After conferring with interested parties, our group and others, here are some agenda items we'd like to see covered on Dec. 3rd:

1. EPA Activity since previous meeting
   a. Website
   b. Accumulation of data from previous rulemaking
   c. EPA response to request for additional meeting near Gallup/Grants in conjunction with White Mesa meeting in Blanding
   d. Any further correspondence between EPA and industry regarding information requests?

2. Technical Issues
   a. Describe EPA review teams by subject matter
   b. Review issues raised by public or industry to date
   c. 1989 Risk Assessment - status of current historical research?
   d. Existing Technologies - status of current survey?
   e. Method 115 - status of current research?
   f. Status of Part 192 review as it applies to Subpart W regulations

3. EPA Activity before next call.
   a. Interim reports?
   b. Bids for contractors?

4. Define agenda items for next quarterly call, scheduled for January 5, 2010.

Sincerely,

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: EPA to Cotter 2-24-09 12/01/2009

Hello Sharyn,

Thanks for the agenda items. I will incorporate them into an agenda, and I hope to have it posted on the web site later today. I have taken all of your suggestions, and I hope to give a brief update on all of the activities you requested. I want to make sure, however, that there is also sufficient time for questions from anyone on the call. My thinking at this point is that whatever I don't cover on this call can be picked up on the call in January.

Reid

END OF EMAIL

Subject: Need Help 12/21/2009

Reid,

I appreciate your time in reviewing this documentation that I sent you some time ago. I understand your position on these issues and realized up front that this was not a Subpart W issue. So thank you for the time you took to read over the MFG Inc. document that I sent you and for your advice on how I should move forward.

Colorado is an agreement state. The Colorado Department of Health and Environment have done little to assist me here and in fact have been reluctant and defensive, arguing with me about my understanding of the issue.

Today I made two attempts to contact the Nuclear Regulatory Commission, asking for the names of experts in the NRC who understand the science of radon emissions from mill tailings. The contacts were via e-mail to their Human Resources Office and their Office of Public Affairs. I don't feel really confident that either will be able to provide what I am looking for.

I am asking for your help here because you are inside the government and have some understanding of what it is that I need. Can you help me find an NRC expert who could possibly provide the knowledgeable, hopefully unbiased review of this approach to monitoring and safeguarding the public health and welfare? Or can you by way of introduction put me in contact with someone who can and will help me find the expertise I am looking for?

As a formally trained engineer with a Masters Degree who spent 32 years working for America's premiere research company, Bell Laboratories, I cannot accept without scientifically justified explanation the fact that radon flux from Cotter's Primary Impoundment increased 230% over a three year period while the radon concentration measurements at the perimeter of the mill property decreased by 30% over the same three year period. This is illogical, counter intuitive, and highly suspect. That additional radon went somewhere and to my way of thinking should have been evident in increased radon concentrations at the mill perimeter as a minimum.

We the people of Lincoln Park and greater Canon City cannot control the air we breathe and to a lesser degree, the ground water we drink or irrigate with. I need resolution to my concern and I need expert help to do that. Colorado Department of Health and Environment is not that resource. They are too close, too vested, too seemingly uninterested or unwilling to partnering with me to address this concern.

I believe you to be a reasonable, honest, concerned individual.

Please help me resolve this radon concern by directing me to someone in my government who can help me.

Thank you.

Happy Holidays!

Paul Carestia

Hi Paul, 12/22/2009

I have sent your request for someone knowledgeable in radon emissions from mill tailings to one of my contacts at NRC. I'll let you know when I hear something. This is a difficult time of year, because people are in and out of their offices. In fact, after today I'll be out of the office until January 4, 2010.

Happy Holidays to you, Paul.

Reid

Reid, 12/22/2009

Thank you very much. I truly appreciate your help here more than you will ever realize.

Paul

Subject: NRC Contact 1/4/2010

Good Morning Paul,

Here is a contact at NRC for questions related to radon.

Ronald A. Burrows CHP, RRPT
U.S. Nuclear Regulatory Commission
Federal and State Materials and Environmental
Management Programs
Uranium Recovery Licensing Branch

Reid, 1/4/2010

Thank you for the fast response.

Will Mr. Burrows be aware that I am contacting him based upon your referral? Will he know who I am when he sees an e-mail from me? I just want to make sure my contact with him is not ignored.

If I understood correctly, you know Mr. Burrows. Just trying to grease the skids a little.

I hope you and your family had a nice Holiday.

Paul Carestia

Subject: Re: NRC Contact 1/4/2010

Hi Paul,

Yes, I spoke with Ron and his supervisor to make sure that he is the right person. I copied him on my original note to you, so he is expecting to hear from you. If he cannot address your radon questions, he promised that he would find someone who could.

Reid
Radiation Protection Division (6608J)

Subject: Fwd: Status of Request for NRC Help and Guidance 1/27/2010

Reid,

Need you to see this one too..................I need to know just what is the "nature of my request"?

You need to know something..............I am the first son of a coal miner who had no more than a 6th grade education before my father made him quit school and go to work in the coal mines. I am the first grandchild in my family to get a college education. I have degrees from Colorado State University, Northwestern University, and the University of Chicago. I got there through hard work, scholastic achievement, determination, and never giving up.............and I will not be giving up on the issues I've brought to you as part of the Subpart W/Method 115 review.............or the issues I've asked and you have kindly agreed to help get resolved with the NRC.........and I am asking you and the NRC, not the state of Colorado, to address my concerns.

Both my mother and my father were diagnosed with cancer.........my mother died at the young age of 58 from brain cancer (glioblastoma multiforma, a word that has never left my mind since first hearing it. I got to watch her die a very slow, debilitating death.) and my father had prostate cancer, had surgery, was later again diagnosed with it returning as inoperable and terminal. Had he not tragically died in a car accident, cancer would have taken his life as well. I try not to think of what's in store for me, having lived all of my childhood life within 1 mile of the Cotter uranium mill during its operating heyday............breathing in the stench from that mill on hot summer nights with my bedroom windows open.............and having no idea what I was exposed to during my waking hours. There was no history of cancer in my family on my father or mother's sides. What would you think Reid if this were your situation? How would you feel? This mill or any uranium mill should not be in close proximity to people and communities in which they live and breathe! And I find the methodology used to monitor the radon emanating from this mill to be highly irregular, suspect, and without merit. And so do radiation scientists with a lot more knowledge and expertise than me.

This is visceral to me............visceral!.......please appreciate that. If I have to go to senators in Colorado and Washington D.C., I will..........right now I am pissed off...............very upset, very disappointed............and 1000% more determined to get action from those who are accountable to me as a tax payer in the country.

Senator Mark Udall will be visiting the Canon City and the Cotter Mill site in the not too distant future. I intend to be there when he does and I intend that he become involved in all of this...........and I won't give up until he does.

I respectfully ask that my issues get addressed and answered. I think you'd all would rather be doing this at my request rather than his.

Thank you.

Subject: Status of Request for NRC Help and Guidance 1/27/2010

Good afternoon, Paul.
We have had a chance to review the details of your request. As you may know, Colorado is an Agreement State. As such, due to the nature of your request I have forwarded it to the State of Colorado Radiation Program Manager. His contact details are as follows:
Steve Tarlton, Manager
Radiation Program
CO Department of Public Health & Environment
Regards,

Ronald A. Burrows

Paul Carestia

Subject: Re: Status of Request for NRC Help and Guidance 1/27/2010

Ron,

I'd appreciate you expounding on the "nature of my request". Just what in your eyes IS the nature of my request?

Thanks.

Paul Carestia
END OF EMAIL

Reid Rosnick: 9/21/2010

Thank you for your reply. Kennecott Uranium Company believes that the Agency for Toxic Substances and Disease Registry (ATSDR) draft Public Health Assessment applies directly to Subpart W regulation for the following reasons:

- 40 CFR Part 61 Subpart W regulates radon emissions from tailings impoundments via either the twenty (20) picocurie per meter squared second standard for existing impoundments or the work practices for new impoundments constructed after December 15, 1989. The goal of this regulation is to reduce exposures and doses to the general public from radon and its decay products from uranium mill tailings impoundments.
- The draft Public Health Assessment specifically addresses public dose from and exposure to radon and its decay products from a uranium mill tailings impoundment namely Cotter Corporation's Canon City Mill impoundment.
- The draft Public Health Assessment states:

  > *On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This conclusion has direct bearing on the current effectiveness of 40 CFR part 61 Subpart W, specifically that as it now stands the doses from radon and its decay products from a tailings impoundment (Cotter Corporation's Canon City impoundment) regulated under 40 CFR Part 61 Subpart W do not represent a health threat.
- This conclusion goes directly to statements made in the lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action specifically the request to *"Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air…"*

The above reasons are why Kennecott Uranium Company is requesting that this draft Public Health Assessment be on the agenda for discussion on the Wednesday, October 6, 2010 conference call.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Dear Mr. Marschke: 2/16/2011

The required environmental data to perform a radon risk assessment for the Sweetwater Uranium Project is either already in the possession of the Environmental Protection Agency (EPA) or publically available. The following applies to the required data:

- Radon flux testing data for the Sweetwater Uranium Project tailings impoundment for calendar years 1990 to 2010 has been submitted to the Agency as required by 40 CFR Part 61 Subpart W. and is already available to Agency staff.
- Meteorological data in the Revised Environmental Report dated August 1994, represents a good long term summary of site's meteorological conditions and as such is representative and suitable for use. This document is available on the Nuclear Regulatory Commission's (NRC's) web site at the link below:
- http://pbadupws.nrc.gov/docs/ML0810/ML081010327.pdf
- The meteorological data provided in this document including, I believe, joint frequency distributions, is site specific data.
- Upwind and downwind radon activity data for ambient air collected using Landauer, Inc.'s TrakEtch devices has been submitted semiannually to the Nuclear Regulatory Commission (NRC) as part of the facility's semiannual 40.65 Reports and is publically available in the Commission's online ADAMS system.
- In addition, I believe that upwind and downwind radon activity data for ambient air was summarized in a submittal to the Commission in either the first half of 1998 or 1999 so that the

submittal plus any 40.65 Reports submitted from its date forward, provide a complete set of upwind and downwind radon activity data for the site. In any event, upwind and downwind radon activity data is submitted semiannually in the required 40.65 Reports and is available in the ADAMS system. I can check on the 1998 summary report when I return to the office and probably provide a link to it on the Nuclear Regulatory Commission's (NRC's) web site.

I am traveling this week and will return to the site on Tuesday, February 21, 2011. I would like to work with you upon my return to ensure that the risk assessment completed for the Sweetwater Uranium Project is based upon actual site conditions and measurements. Should you have any questions please call me at that time.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid Rosnick: 9/13/2010

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*
- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
    - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases from the Canon City Mill. The filing states, "*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado.*" The filing continues by requesting that the Environmental Protection Agency (EPA), "*Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid.*"

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid: 6/3/2010

The following pertains to the S. Cohen and Associates report entitled:

Final Report Review of Existing and Proposed Tailings Impoundment Technologies

It lists only three (3) extant convention uranium mills in the United States (Sweetwater, Canon City and White Mesa). It fails to list the Tickaboo Mill and tailings impoundment owned by Uranium One. It incorrectly lists the owner of the White Mesa mill as UMETCO when in fact the owner is Denison Mines.

- Table I from the report is below:

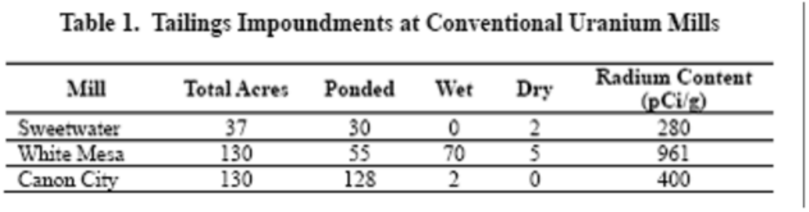


Table 1. Tailings Impoundments at Conventional Uranium Mills

Mill	Total Acres	Ponded	Wet	Dry	Radium Content (pCi/g)
Sweetwater	37	30	0	2	280
White Mesa	130	55	70	5	961
Canon City	130	128	2	0	400

- Table 1 lists the Sweetwater Uranium Project tailings radium content as 280 pCi/g.
- Attached please find the Adobe Acrobat Portable Document Format (*.pdf) file *tailings_radium_226_activity.pdf*.
  - This table is from *Final Design Volume VI – Existing Impoundment Reclamation Plan – Sweetwater Uranium Project* submitted to the Nuclear Regulatory Commission (NRC) on August 26, 1997 and is part of Docket 040-08584 for Source Materials License (SML) SUA-1350.
  - This table provides an average Radium-226 activity for the tailings of 70.9 pCi/g based on twenty (20) samples.
  - This table also provides an average emanation coefficient of 0.188 based on laboratory determination of emanation coefficient for eighteen (18) samples. This value is 54% of the default value of 0.35 used by the Nuclear Regulatory Commission (NRC) in *Regulatory Guide 3.64 – Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (U.S. Nuclear Regulatory Commission (NRC) – June 1989). The reason that this issue is being raised, is that when calculating radon flux from tailings and other earthen materials, the default emanation coefficient of 0.35 is often used and its use can lead to erroneously high radon fluxes.
- Table 3 from the report is shown below:

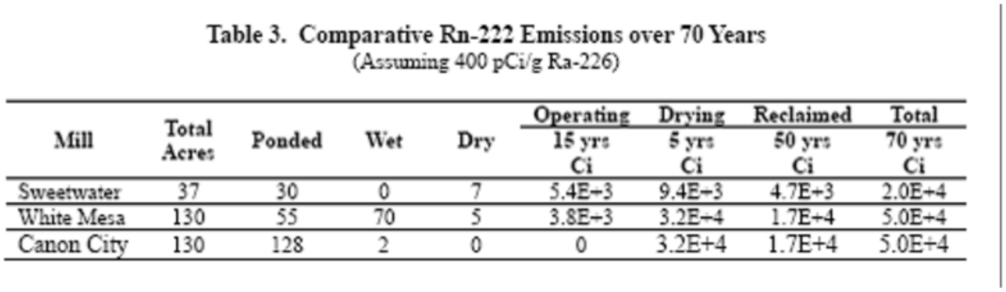


Table 3. Comparative Rn-222 Emissions over 70 Years
(Assuming 400 pCi/g Ra-226)

Mill	Total Acres	Ponded	Wet	Dry	Operating 15 yrs Ci	Drying 5 yrs Ci	Reclaimed 50 yrs Ci	Total 70 yrs Ci
Sweetwater	37	30	0	7	5.4E+3	9.4E+3	4.7E+3	2.0E+4
White Mesa	130	55	70	5	3.8E+3	3.2E+4	1.7E+4	5.0E+4
Canon City	130	128	2	0	0	3.2E+4	1.7E+4	5.0E+4

  - It assumes a long term tailings Radium-226 activity of 400 pCi/g.
  - As previously stated, the current Radium-226 activity in the impoundment averages 70.9 pCi/gram. Estimated Radium-226 activity of future tailings generated should operations resume, is 249 pCi/gram (weighted average of slimes and sand).

o This estimated activity is from Appendix H (Principal Parameters for Radiological Assessment (MILDOS Inputs) of the *Sweetwater Uranium Project – Revised Environmental Report* submitted to the Nuclear Regulatory Commission in August 1994 which is part of part of Docket 040-08584 for Source materials License (SML) SUA-1350.

o This estimated activity is based on the values in Appendix H specifically an estimate of 71% sand with a Radium-226 activity of 207 pCi/g and 29% slimes with a radium-226 activity of 353 pCi/g as per the table below:

	Activity	**Percentage**
Slimes:	353 picoCuries/gram	29%
Sand:	207 picoCuries/gram	71%
Weighted Average:	249 picoCuries/gram	100%

The above information pertains specifically to the three (3) items that were raised following your presentation. In addition, other discrepancies were noted in the report. The following are two (2) such items:

The document discusses Radon-222 source terms for in-situ uranium recovery. It discusses Radon-222 releases from mud pits and uses the variable [Ra] which is defined as Ra-226 concentration in the ore zone (pCi/g). The mud pit contains cuttings from the entire bore hole not just from the ore zone. The actual thickness of the ore zone is a fraction of the depth of the entire hole, thus the cuttings from the ore zone would be diluted with cuttings with substantially lower radium-226 activity from above the ore zone. In a typical 500 foot deep bore hole only ten (10) feet of it would be in an actual ore zone. Cuttings from the ore zone would only represent 2% of the total cuttings mass. Use of the Radium-226 activity of the ore zone to describe the activity of the entire drill cuttings mass is incorrect.

Table 4 lists the following operating in-situ uranium recovery operations:

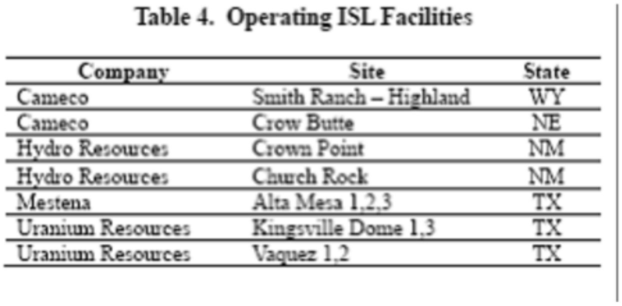


Table 4. Operating ISL Facilities

Company	Site	State
Cameco	Smith Ranch – Highland	WY
Cameco	Crow Butte	NE
Hydro Resources	Crown Point	NM
Hydro Resources	Church Rock	NM
Mestena	Alta Mesa 1,2,3	TX
Uranium Resources	Kingsville Dome 1,3	TX
Uranium Resources	Vaquez 1,2	TX

It lists Hydro Resources, Inc. Crownpoint and Churchrock facilities as operating, which they are not. In addition, I believe that Uranium Resources, Inc's Kingsville Dome and Vasquez Projects are currently not operating.

If you have any questions or require additional data please do not hesitate to contact me.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

END OF EMAIL

Mr. Rosnick 10/1/2010

The Wyoming Mining Association (WMA) is very concerned about claims that uranium mining and processing may contribute to health impairment from the release of radon from uranium processing facilities. WMA would like to draw your attention to the attached report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010. In summary the study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.* The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded that outdoor concentration of radon contributed zero dust to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay.
I understand that there will be a conference call on October 6 to discuss 40 CFR Part 61 Subpart W which deals with this issue. WMA requests that this study be on the agenda for discussion during that conference call.

Thank you.

Marion Loomis

END OF EMAIL

Dear Mr. Rosnick, 1/6/2011

I note that the Subpart W review documents on the Subpart W Rulemaking Activity Website in the Historical Rulemakings section includes the Draft EIS for the Proposed Radionuclides rulemaking, dated February 1989. However, this is only Volume 1 of a 3-volume draft EIS.

I request that the all 3 volumes of the Final EIS, September 1989, be placed with the Historical Rulemakings documents.

Sarah Fields
Uranium Watch

Hello Reid, 1/6/2011

During this morning's conference call re the Subpart W review, Cotter stated that they had not received
any request for information from the EPA.

Cotter was sent a letter in 2009 asking them for information; at least a letter that is addressed to them is on the Subpart W Review website:

http://www.epa.gov/radiation/docs/neshaps/subpart-w/uranium%20cotter%20test.pdf

Sarah Fields
Uranium Watch

On Jan 7, 2011, at 6:28 AM, Rosnick.Reid@epamail.epa.gov wrote:

Hello Sarah,

You are correct that Cotter was sent a letter in 2009. That letter was an information request from our enforcement office, and asked for a number of items that are related to our discussion from Wednesday. However, the debate on Wednesday was focused on whether our contractor, in preparing the risk assessment draft document within the last 2 months, contacted Cotter for real-time radon flux data, as well as meteorological data specific to the Canon City area. As we discussed on Wednesday, most of that data is available on-line at NRC's ADAMS website. I am waiting for confirmation from the contractor on exactly how they obtained the Cotter data.

Separately, I saw that there was a BLM/USFS public meeting last night regarding the plan of operations amendment for the expansion of the LaSal mine. I would be interested in your take on the meeting. Thank you.

Reid

Reid, 1/8/2011

The BLM/USFS Meeting on the expansion of the La Sal Mine is on January 13. I will not be there. I had already made plans
to go to Denver for the NRC uranium recovery workshop long before the BLM announced the scoping meeting in La Sal.

There are a number of outstanding issues related to the La Sal Mines, including Subpart B compliance.

Sarah

Dear Reid, 7/7/2011

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

END OF EMAIL

Dear Mr. Rosnick, 4/6/2012

Another issue that I failed to mention yesterday with respect the Subpart W rulemaking is the gapping regulatory hole when it comes to uranium mill tailings impoundments after they cease to be operational and, according to current EPA regulation, are no longer subject to the Subpart W flux standard. (For now, we'll just ignore the issues regarding exactly when that point in the life of a tailings impoundment occurs.)

My understanding is that one operation ceases and the closure period commences there is no radon flux standard. My understanding is that at the time the closure period commences there must be a closure plan and reclamation milestones that have been approved by the State or NRC.

The problem is, as stated in the 1989 Subpart W final rule:

"EPA recognizes that the risks from mill tailings piles can increase dramatically if they are dry and uncovered can be seen in the proposed rule, 54 FR 9645. That analysis assumed that the piles were dry and uncovered and the risks were as high as 3 x 10 (to the -3) with 1.6 fatal cancers per year." The EPA than assumes that the piles will be wet or covered, then be "disposed of."

The problem is that during the "closure" or "disposal" period tailings impoundments dry out more and, in fact, interim soil covers interfere with the drying and settling processes. Apparently, this is happening at the White Mesa Mill. Even now, I believe that the estimate of time for the drying/settling process for Cells 2 and 3 at White Mesa is 10 years. That may be a minimal estimate.
So whether an older cell with a radon flux standard or a newer 40-acre cell, there can be a period of time when radon emissions and potential for dispersal of radioactive particulates increases. Yet, there is no flux standard during this period, unless the period goes beyond the established reclamation milestone for the final radon barrier.
~~~~~~

This is something the EPA Subpart W changes must address.

Also, there are proposals for open pit uranium mines near uranium recovery operations. With the EPA failure to establish a radon standard for surface uranium mines, you would have a regulated NESHAP facility next to one where the EPA has fallen short of its regulatory responsibility.

Also, remember the FOIA response where you asked for me to agree to an extension of time for EPA response.?

Do you think that I ever got a response to that FOIA after the EPA sent me the letter of October 12, 2011? Did you ever check on that?

Well, I never did get the FOIA response. This does not surprise me.

I have good reason to be frustrated at the EPA, and the State of Utah's radioactive NESHAP program.

Sarah Fields
Program Director
Uranium Watch
PO Box 344
Moab, Utah 84532
435-259-9450

Dear Ms. Fields, 4/11/2012

Thank you for your comments. I will have them posted in the email section of the Subpart W website.

Regarding your comments on the FOIA, on October 18, 2011 you sent an email to me stating that you would like to proceed with the FOIA, but you were going to update the request to cover documents after the FOIA was submitted. We never received your request for the update. If you sent something to our FOIA office please forward it to me so we can track the breakdown in communications. Thank you.

Reid

EPA-78

Sarah Fields <sarah@uraniumwatch.org>
09/17/2012 02:32 PM

To	Reid Rosnick
cc	
bcc	
Subject	Subpart W Review and Rulemaking

2 attachments

TAC Ltr to NRC - UBHM & Ablation July 2012.pdf NRC Response 8-8-12 to UBHM.Ablation Ltr.pdf

Dear Reid,

I wish to bring to you attention an in situ uranium recovery technology that the Environmental Protection Agency (EPA) must address in its Subpart W review and rulemaking. The process of underground borehole mining (UBHM) has been proposed in Colorado.

For your information, I am sending you a copy of a recent letter from the Nuclear Regulatory Commission (NRC) to the Tallehassee Area Community regarding whether Colorado, as an NRC Agreement State, has regulatory jurisdiction for this kind of uranium recovery technology. The NRC letter states that uranium recovery operations using this technology would be regulated by the Colorado Dept. of Public Health and Environment. Therefore, The EPA must address the aspects of this process that would be subject to 40 CFR Part 61, Subpart W. For the surface facilities associated with this technology that fall under Atomic Energy Act and NRC/Agreement State authority, the EPA must determine how the radionuclide emissions would be regulated under Subpart W.

I am also enclosing the Tallehassee letter to the NRC.

Sincerely,

Sarah Fields
Uranium Watch
PO Box 344
Moab, Utah 84532
435-259-9450

Tallahassee Area Community, Inc.
Fremont County, Colorado

Board of Directors
P.O .Box 343
Cañon City, Colorado 81212
(www.taccolorado.com)

July 12, 2012

U.S Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attention:
Mr. Duncan White, Branch Chief, Agreement State Programs;
Division of Materials Safety and State Agreements
Mr. Randolph (Bill) Von Till, Branch Chief, Uranium Recovery ;
Division of Waste Management and Environmental Protection

Federal and State Materials and Environmental Management Programs

Via email attachment (Duncan.White@nrc.gov; RWV@nrc.gov)

Dear Mr. White and Mr. Von Till:

This letter is related to the reference to Emerging Technologies in Uranium Recovery at the recent April 17, 2012 IMPEP review meeting with the Radiation Management Unit of the Colorado Department of Public Health and Environment (CDPHE). Black Range Minerals, Ltd. (ASX:BLR) has made numerous recent announcements regarding their expected utilization of both Underground Bore Hole Mining (UBHM) and Ablation technologies for uranium recovery at their Hansen/Taylor Ranch Uranium Project. Please see: www.blackrangeminerals.com, Investor Relations, ASX Announcements.

The Tallahassee Area Community, Inc. (TAC) is a Colorado not-for-profit organization consisting of residents and property owners in the Tallahassee area of northwest Fremont County, Colorado who are concerned about the potential adverse human health and environmental impacts of large scale uranium exploitation in the immediate vicinity. Please see: www.taccolorado.com.

Both UBHM and Ablation for uranium recovery are acknowledged experimental technologies. To the best of our knowledge, neither have ever been used commercially nor have been specifically considered in NRC or Agreement State regulations or guidance.

TAC believes that their regulatory status is unclear and that there appears to be a conflict between NRC and Colorado definitions and possible interpretations with respect to the question of whether either or both of these technologies should require the issuance of Colorado Radioactive Materials Licenses.

A. **Underground Bore Hole Mining**

1. Black Range, and its consultant Kinley Exploration, LLC, describes the process as the injection of high pressure water, without added chemicals, into large bore holes drilled to the depth of the targeted uranium ore body which then, by use of an "under reamer", excavates a "cavern" by fragmenting the uranium containing rock and returning those fragments to the surface as a water slurry. http://www.blackrangeminerals.com/content/wpcontent/uploads/2012/05/New/BlackRangeSelectsDevelopmentApproachForHansenDeposit26Apr12.pdf

2. The company has not disclosed many details about the process ,however, TAC research has revealed that up to 50,000 gallons per hour of water pressurized to 1000 - 1500 psi or greater would be required to fragment the sandstone-embedded uranium ore body.

3. The water recovered from the slurry would be reused -- supplemented with make-up water, re pressurized and re injected into the bore hole -- until the cavern is exhausted of the targeted material.

4. It is, at present, unknown what concentration of atmospheric oxygen would be dissolved in the water injected into the bore hole. It would surely be greater than for water at standard temperature and pressure conditions. Oxidation of insoluble uranium oxide to the soluble state, depending on the pH and other conditions in the cavern, would be enhanced. It is expected that as the water is reused, the concentration of uranium, other radioactive constituents , and heavy metals would increase.

5. Some portion of this high pressure water would inevitably be forced out of the cavern into the surrounding sandstone aquifer and threaten the quality of the groundwater and local domestic water wells. Ultimately, the remaining water would be impounded on the surface and presumably left to evaporate away.

6. While UBHM poses many of the same environmental issues as does In-Situ Leach Uranium Recovery, it does not meet the current definition since only the fragmented ore pieces are processed for its uranium content; the "leachate" is not processed for recovery of uranium but rather would be treated as waste.

7. The Colorado Hard Rock Mining Rules distinguish between In-Situ Leach Uranium Mining, which it regulates concurrently with CDPHE, and In-Situ Mining. However, the point at which uranium mining ends and uranium processing begins appears to be defined by conflicting definitions of CDPHE and NRC. The difference is: precisely when does "ore" becomes "source material". CDPHE regulations specify that uranium ore prior to chemical processing is not source material but rather the product of mining. The NRC Office of General Counsel has ruled to the contrary.

8. OGC has said that the line between "mining" and "processing" is drawn at the point of "unrefined and unprocessed ore" in its "natural form" and when "its gross appearance...has not been altered from the point of mining". http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos184.html.

TAC believes that it is reasonable and prudent, in view of health & safety and environmental considerations of the UBHM technique, that the fragmenting of ore in the underground cavern be considered as a uranium processing activity requiring (in Colorado) a Radioactive Material License.

B. Ablation

1. The name of the technology should properly be "Impact Ablation" to distinguish this uranium concentration process from Laser Ablation, which is used to identify minerals and in other applications.

2. Black Range and Ablation Technologies, LLC, its consultant and recently announced Joint Venture partner, describes the process as follows: " In ablation, the slurry from UBHM is ejected from two opposing injection nozzles to create a high energy impact zone. This high energy impact separates the mineralized patina of uranium from the underlying grain. The uranium bearing particles are found in the fine fractions separated in a subsequent screening process. As tested on material from Hansen, ablation allows approximately 90% of barren material to be separated from mineralized material prior to milling, greatly reducing the total OPEX and CAPEX costs to process mineralized material. The final product is an "ablated concentrate" which consists of approximately 10% of the original mineralized material, which will be processed with conventional milling techniques." http://www.blackrangeminerals.com/content/wp-content/uploads/2012/07/07-06-2012-BLR-Secures-Rights-to-Ablation-Technology.pdf. (Emphasis added).

3. Clearly, the company does not consider that this process is "milling" and subject to licensing by CDPHE. It appears to be relying on the Colorado Radiation Control Regulations definition of "ore" as a product of mining and before it becomes "source material". ""Ore" means naturally occurring uranium-bearing, thorium-bearing, or radium-bearing material in its natural form, to be processed for its uranium or thorium content, prior to chemical processing including but not limited to roasting, beneficiating, or refining, and specifically includes material that has been physically processed, such as by crushing, grinding, screening, or sorting." 6 CCR 1007-1 Part 1.2 Definitions. (Emphasis included in the recent PowerPoint presentation by the Black Range Vice President of Regulatory Affairs to the National Mining Association in Denver). http://www.nma.org/pdf/urw_2012/grebb.pdf

4. Regardless of the determined status of the UBHM fragmented ore in the cavern, the material undergoing impact ablation is being subjected to source material processing and the resultant waste, both the "barren" rock and process water, is 11e.(2) byproduct material. The high energy impact which separates the uranium grains from the "barren" rock is the functional equivalent of crushing or grinding. The grains are then separated and sized by a screening and elutriation process to isolate the "ablated concentrate" which is then transported off-site to a conventional mill for final processing into yellowcake.

5. As stated in 40 CFR 261.4(b)(7) the beneficiation of ore (including uranium ore) includes every one of those steps. The fact that they would be done at other than a conventional mill does not change the fact that impact ablation is a milling activity subject to a Radioactive Materials License.

6. In the 2002 Office of General Counsel document entitled *Uranium Milling Activities at Sequoyah Fuels Corporation* , the question of "What Constitutes Uranium Milling" was considered: "A fundamental,

plain-language, working definition of uranium milling can be constructed from the somewhat circular references contained in the ... regulatory definitions (in 10 CFR 40.4, of uranium milling, byproduct material and source material): Uranium milling is an activity or series of processes that extracts or concentrates uranium or thorium from any ore primarily for its source material content, and the resulting tailings or waste are 11e.(2) byproduct material." http//www.nrc.gov/reading-rm/doc-collections/commission/secys/2002/secy2002-0095/attachment5.pdf.

7. The OGC document further discussed non-conventional milling and milling at multiple locations. It stated: " Non-conventional processing ... comprise other technologies.... The distinction among non-conventional milling activities is that these activities often occur at locations other than a uranium mill.... Uranium milling entails many processing steps , which ... are not required to occur at a single location, but often do."

We respectfully request that you consider the regulatory status of both UBHM and Impact Ablation uranium recovery technologies as promptly as possible since Black Range is expected to finalize their intentions for the Hansen/Taylor Ranch Uranium Project by the end of 2012.

Thank you for your attention. I look forward to your response.

Respectfully submitted,

Lee J Alter
Chairman, Government Affairs Committee
Tallahassee Area Community, Inc.

0489 Fremont County Road 21A
Cañon City, Colorado 81212
719.276.0864
AlterConsult@Starband.net

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 8, 2012

Lee J. Alter, Chairman
Government Affairs Committee
Tallahassee Area Community, Inc.
0489 Fremont County Road 21A
Cañon City, Colorado 81212

SUBJECT: INQUIRY REGARDING UNDERGROUND BORE HOLE MINING AND ABLATION TECHNOLOGIES FOR URANIUM RECOVERY

Dear Mr. Alter:

The U.S. Nuclear Regulatory Commission (NRC) is in receipt of your letter dated July 12, 2012, addressed to Bill Von Till and myself, regarding your concerns about the emerging technologies in uranium recovery including ablation technologies in the State of Colorado. After reviewing the issues related to Underground Bore Hole Mining and Impact Ablation, the NRC staff determined that the Colorado Department of Public Health and the Environment (CDPHE) is the regulatory authority with jurisdiction on these matters within the State of Colorado.

It is our understanding that although there have not yet been any applications submitted to CDPHE for licenses or permits requesting use of this technology in the State of Colorado; there are companies in Colorado investigating the possibility of doing so in the near future. The NRC will defer to the CDPHE to communicate with their potential licensees in this area to better understand the process that will be utilized in implementing this new technology. CDPHE may request technical assistance from the NRC to address this new technology for uranium recovery. Until then, the NRC will continue to monitor the state of the technology in order to consider what regulatory changes will be necessary should companies request NRC authority to utilize such technology for uranium recovery.

If you have any further questions or concerns regarding ablation technologies and their implementation in the State of Colorado, we suggest that you direct them to Steve Tarlton, Program Manager, at (303) 692-3423 or steve.tarlton@state.co.us.

Sincerely,

Duncan White, Branch Chief
Agreement State Programs Branch
Division of Materials Safety and State Agreements
Office of Federal and State Materials
and Environmental Management Programs

cc:
Steve Tarlton, Program Manager

EPA-349

Reid Rosnick/DC/USEPA/US
09/20/2012 08:47 AM

To Beth Miller
cc
bcc
Subject Fw: Subpart W Review and Rulemaking

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/20/2012 08:47 AM -----

From: Sarah Fields <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 09/17/2012 02:32 PM
Subject: Subpart W Review and Rulemaking

Dear Reid,

I wish to bring to you attention an in situ uranium recovery technology that the Environmental Protection Agency (EPA) must address in its Subpart W review and rulemaking. The process of underground borehole mining (UBHM) has been proposed in Colorado.

For your information, I am sending you a copy of a recent letter from the Nuclear Regulatory Commission (NRC) to the Tallehassee Area Community regarding whether Colorado, as an NRC Agreement State, has regulatory jurisdiction for this kind of uranium recovery technology. The NRC letter states that uranium recovery operations using this technology would be regulated by the Colorado Dept. of Public Health and Environment. Therefore, The EPA must address the aspects of this process that would be subject to 40 CFR Part 61, Subpart W. For the surface facilities associated with this technology that fall under Atomic Energy Act and NRC/Agreement State authority, the EPA must determine how the radionuclide emissions would be regulated under Subpart W.

I am also enclosing the Tallehassee letter to the NRC.

Sincerely,

Sarah Fields
Uranium Watch
PO Box 344
Moab, Utah 84532

435-259-9450

TAC Ltr to NRC - UBHM & Ablation July 2012.pdf
NRC Response 8-8-12 to UBHM.Ablation Ltr.pdf

Tallahassee Area Community, Inc.
Fremont County, Colorado

Board of Directors
P.O .Box 343
Cañon City, Colorado 81212
(www.taccolorado.com)

July 12, 2012

U.S Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attention:
Mr. Duncan White, Branch Chief, Agreement State Programs;
Division of Materials Safety and State Agreements
Mr. Randolph (Bill) Von Till, Branch Chief, Uranium Recovery ;
Division of Waste Management and Environmental Protection

Federal and State Materials and Environmental Management Programs

Via email attachment (Duncan.White@nrc.gov; RWV@nrc.gov)

Dear Mr. White and Mr. Von Till:

This letter is related to the reference to Emerging Technologies in Uranium Recovery at the recent April 17, 2012 IMPEP review meeting with the Radiation Management Unit of the Colorado Department of Public Health and Environment (CDPHE). Black Range Minerals, Ltd. (ASX:BLR) has made numerous recent announcements regarding their expected utilization of both Underground Bore Hole Mining (UBHM) and Ablation technologies for uranium recovery at their Hansen/Taylor Ranch Uranium Project. Please see: www.blackrangeminerals.com, Investor Relations, ASX Announcements.

The Tallahassee Area Community, Inc. (TAC) is a Colorado not-for-profit organization consisting of residents and property owners in the Tallahassee area of northwest Fremont County, Colorado who are concerned about the potential adverse human health and environmental impacts of large scale uranium exploitation in the immediate vicinity. Please see: www.taccolorado.com.

Both UBHM and Ablation for uranium recovery are acknowledged experimental technologies. To the best of our knowledge, neither have ever been used commercially nor have been specifically considered in NRC or Agreement State regulations or guidance.

TAC believes that their regulatory status is unclear and that there appears to be a conflict between NRC and Colorado definitions and possible interpretations with respect to the question of whether either or both of these technologies should require the issuance of Colorado Radioactive Materials Licenses.

A. **Underground Bore Hole Mining**

1. Black Range, and its consultant Kinley Exploration, LLC, describes the process as the injection of high pressure water, without added chemicals, into large bore holes drilled to the depth of the targeted uranium ore body which then, by use of an "under reamer", excavates a "cavern" by fragmenting the uranium containing rock and returning those fragments to the surface as a water slurry. http://www.blackrangeminerals.com/content/wpcontent/uploads/2012/05/New/BlackRangeSelectsDevelopmentApproachForHansenDeposit26Apr12.pdf

2. The company has not disclosed many details about the process ,however, TAC research has revealed that up to 50,000 gallons per hour of water pressurized to 1000 - 1500 psi or greater would be required to fragment the sandstone-embedded uranium ore body.

3. The water recovered from the slurry would be reused -- supplemented with make-up water, re pressurized and re injected into the bore hole -- until the cavern is exhausted of the targeted material.

4. It is, at present, unknown what concentration of atmospheric oxygen would be dissolved in the water injected into the bore hole. It would surely be greater than for water at standard temperature and pressure conditions. Oxidation of insoluble uranium oxide to the soluble state, depending on the pH and other conditions in the cavern, would be enhanced. It is expected that as the water is reused, the concentration of uranium, other radioactive constituents , and heavy metals would increase.

5. Some portion of this high pressure water would inevitably be forced out of the cavern into the surrounding sandstone aquifer and threaten the quality of the groundwater and local domestic water wells. Ultimately, the remaining water would be impounded on the surface and presumably left to evaporate away.

6. While UBHM poses many of the same environmental issues as does In-Situ Leach Uranium Recovery, it does not meet the current definition since only the fragmented ore pieces are processed for its uranium content; the "leachate" is not processed for recovery of uranium but rather would be treated as waste.

7. The Colorado Hard Rock Mining Rules distinguish between In-Situ Leach Uranium Mining, which it regulates concurrently with CDPHE, and In-Situ Mining. However, the point at which uranium mining ends and uranium processing begins appears to be defined by conflicting definitions of CDPHE and NRC. The difference is: precisely when does "ore" becomes "source material". CDPHE regulations specify that uranium ore prior to chemical processing is not source material but rather the product of mining. The NRC Office of General Counsel has ruled to the contrary.

8. OGC has said that the line between "mining" and "processing" is drawn at the point of "unrefined and unprocessed ore" in its "natural form" and when "its gross appearance...has not been altered from the point of mining". http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos184.html.

TAC believes that it is reasonable and prudent, in view of health & safety and environmental considerations of the UBHM technique, that the fragmenting of ore in the underground cavern be considered as a uranium processing activity requiring (in Colorado) a Radioactive Material License.

B. Ablation

1. The name of the technology should properly be "Impact Ablation" to distinguish this uranium concentration process from Laser Ablation, which is used to identify minerals and in other applications.

2. Black Range and Ablation Technologies, LLC, its consultant and recently announced Joint Venture partner, describes the process as follows: " In ablation, the slurry from UBHM is ejected from two opposing injection nozzles to create a high energy impact zone. This high energy impact separates the mineralized patina of uranium from the underlying grain. The uranium bearing particles are found in the fine fractions separated in a subsequent screening process. As tested on material from Hansen, ablation allows approximately 90% of barren material to be separated from mineralized material prior to milling, greatly reducing the total OPEX and CAPEX costs to process mineralized material. The final product is an “ablated concentrate” which consists of approximately 10% of the original mineralized material, which will be processed with conventional milling techniques." http://www.blackrangeminerals.com/content/wp-content/uploads/2012/07/07-06-2012-BLR-Secures-Rights-to-Ablation-Technology.pdf. (Emphasis added).

3. Clearly, the company does not consider that this process is "milling" and subject to licensing by CDPHE. It appears to be relying on the Colorado Radiation Control Regulations definition of "ore" as a product of mining and before it becomes "source material". ""Ore" means naturally occurring uranium-bearing, thorium-bearing, or radium-bearing material in its natural form, to be processed for its uranium or thorium content, prior to chemical processing including but not limited to roasting, beneficiating, or refining, and specifically includes material that has been physically processed, such as by crushing, grinding, screening, or sorting." 6 CCR 1007-1 Part 1.2 Definitions. (Emphasis included in the recent PowerPoint presentation by the Black Range Vice President of Regulatory Affairs to the National Mining Association in Denver). http://www.nma.org/pdf/urw_2012/grebb.pdf

4. Regardless of the determined status of the UBHM fragmented ore in the cavern, the material undergoing impact ablation is being subjected to source material processing and the resultant waste, both the "barren" rock and process water, is 11e.(2) byproduct material. The high energy impact which separates the uranium grains from the "barren" rock is the functional equivalent of crushing or grinding. The grains are then separated and sized by a screening and elutriation process to isolate the "ablated concentrate" which is then transported off-site to a conventional mill for final processing into yellowcake.

5. As stated in 40 CFR 261.4(b)(7) the beneficiation of ore (including uranium ore) includes every one of those steps. The fact that they would be done at other than a conventional mill does not change the fact that impact ablation is a milling activity subject to a Radioactive Materials License.

6. In the 2002 Office of General Counsel document entitled *Uranium Milling Activities at Sequoyah Fuels Corporation* , the question of "What Constitutes Uranium Milling" was considered: "A fundamental,

plain-language, working definition of uranium milling can be constructed from the somewhat circular references contained in the ... regulatory definitions (in 10 CFR 40.4, of uranium milling, byproduct material and source material): Uranium milling is an activity or series of processes that extracts or concentrates uranium or thorium from any ore primarily for its source material content, and the resulting tailings or waste are 11e.(2) byproduct material." http//www.nrc.gov/reading-rm/doc-collections/commission/secys/2002/secy2002-0095/attachment5.pdf.

7. The OGC document further discussed non-conventional milling and milling at multiple locations. It stated: " Non-conventional processing ... comprise other technologies.... The distinction among non-conventional milling activities is that these activities often occur at locations other than a uranium mill.... Uranium milling entails many processing steps , which ... are not required to occur at a single location, but often do."

We respectfully request that you consider the regulatory status of both UBHM and Impact Ablation uranium recovery technologies as promptly as possible since Black Range is expected to finalize their intentions for the Hansen/Taylor Ranch Uranium Project by the end of 2012.

Thank you for your attention. I look forward to your response.

Respectfully submitted,

Lee J Alter
Chairman, Government Affairs Committee
Tallahassee Area Community, Inc.

0489 Fremont County Road 21A
Cañon City, Colorado 81212
719.276.0864
AlterConsult@Starband.net

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 8, 2012

Lee J. Alter, Chairman
Government Affairs Committee
Tallahassee Area Community, Inc.
0489 Fremont County Road 21A
Cañon City, Colorado 81212

SUBJECT: INQUIRY REGARDING UNDERGROUND BORE HOLE MINING AND ABLATION TECHNOLOGIES FOR URANIUM RECOVERY

Dear Mr. Alter:

The U.S. Nuclear Regulatory Commission (NRC) is in receipt of your letter dated July 12, 2012, addressed to Bill Von Till and myself, regarding your concerns about the emerging technologies in uranium recovery including ablation technologies in the State of Colorado. After reviewing the issues related to Underground Bore Hole Mining and Impact Ablation, the NRC staff determined that the Colorado Department of Public Health and the Environment (CDPHE) is the regulatory authority with jurisdiction on these matters within the State of Colorado.

It is our understanding that although there have not yet been any applications submitted to CDPHE for licenses or permits requesting use of this technology in the State of Colorado; there are companies in Colorado investigating the possibility of doing so in the near future. The NRC will defer to the CDPHE to communicate with their potential licensees in this area to better understand the process that will be utilized in implementing this new technology. CDPHE may request technical assistance from the NRC to address this new technology for uranium recovery. Until then, the NRC will continue to monitor the state of the technology in order to consider what regulatory changes will be necessary should companies request NRC authority to utilize such technology for uranium recovery.

If you have any further questions or concerns regarding ablation technologies and their implementation in the State of Colorado, we suggest that you direct them to Steve Tarlton, Program Manager, at (303) 692-3423 or steve.tarlton@state.co.us.

Sincerely,

Duncan White, Branch Chief
Agreement State Programs Branch
Division of Materials Safety and State Agreements
Office of Federal and State Materials
and Environmental Management Programs

cc:
Steve Tarlton, Program Manager

EPA-349

Reid Rosnick/DC/USEPA/US
09/20/2012 08:47 AM

To Beth Miller
cc
bcc
Subject Fw: Subpart W Review and Rulemaking

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

----- Forwarded by Reid Rosnick/DC/USEPA/US on 09/20/2012 08:47 AM -----

From: Sarah Fields <sarah@uraniumwatch.org>
To: Reid Rosnick/DC/USEPA/US@EPA
Date: 09/17/2012 02:32 PM
Subject: Subpart W Review and Rulemaking

Dear Reid,

I wish to bring to you attention an in situ uranium recovery technology that the Environmental Protection Agency (EPA) must address in its Subpart W review and rulemaking. The process of underground borehole mining (UBHM) has been proposed in Colorado.

For your information, I am sending you a copy of a recent letter from the Nuclear Regulatory Commission (NRC) to the Tallehassee Area Community regarding whether Colorado, as an NRC Agreement State, has regulatory jurisdiction for this kind of uranium recovery technology. The NRC letter states that uranium recovery operations using this technology would be regulated by the Colorado Dept. of Public Health and Environment. Therefore, The EPA must address the aspects of this process that would be subject to 40 CFR Part 61, Subpart W. For the surface facilities associated with this technology that fall under Atomic Energy Act and NRC/Agreement State authority, the EPA must determine how the radionuclide emissions would be regulated under Subpart W.

I am also enclosing the Tallehassee letter to the NRC.

Sincerely,

Sarah Fields
Uranium Watch
PO Box 344
Moab, Utah 84532

435-259-9450

TAC Ltr to NRC - UBHM & Ablation July 2012.pdf
NRC Response 8-8-12 to UBHM.Ablation Ltr.pdf

Tallahassee Area Community, Inc.
Fremont County, Colorado

Board of Directors
P.O .Box 343
Cañon City, Colorado 81212
(www.taccolorado.com)

July 12, 2012

U.S Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attention:
Mr. Duncan White, Branch Chief, Agreement State Programs;
Division of Materials Safety and State Agreements
Mr. Randolph (Bill) Von Till, Branch Chief, Uranium Recovery ;
Division of Waste Management and Environmental Protection

Federal and State Materials and Environmental Management Programs

Via email attachment (Duncan.White@nrc.gov; RWV@nrc.gov)

Dear Mr. White and Mr. Von Till:

This letter is related to the reference to Emerging Technologies in Uranium Recovery at the recent April 17, 2012 IMPEP review meeting with the Radiation Management Unit of the Colorado Department of Public Health and Environment (CDPHE). Black Range Minerals, Ltd. (ASX:BLR) has made numerous recent announcements regarding their expected utilization of both Underground Bore Hole Mining (UBHM) and Ablation technologies for uranium recovery at their Hansen/Taylor Ranch Uranium Project. Please see: www.blackrangeminerals.com, Investor Relations, ASX Announcements.

The Tallahassee Area Community, Inc. (TAC) is a Colorado not-for-profit organization consisting of residents and property owners in the Tallahassee area of northwest Fremont County, Colorado who are concerned about the potential adverse human health and environmental impacts of large scale uranium exploitation in the immediate vicinity. Please see: www.taccolorado.com.

Both UBHM and Ablation for uranium recovery are acknowledged experimental technologies. To the best of our knowledge, neither have ever been used commercially nor have been specifically considered in NRC or Agreement State regulations or guidance.

TAC believes that their regulatory status is unclear and that there appears to be a conflict between NRC and Colorado definitions and possible interpretations with respect to the question of whether either or both of these technologies should require the issuance of Colorado Radioactive Materials Licenses.

A. **Underground Bore Hole Mining**

1. Black Range, and its consultant Kinley Exploration, LLC, describes the process as the injection of high pressure water, without added chemicals, into large bore holes drilled to the depth of the targeted uranium ore body which then, by use of an "under reamer", excavates a "cavern" by fragmenting the uranium containing rock and returning those fragments to the surface as a water slurry. http://www.blackrangeminerals.com/content/wpcontent/uploads/2012/05/New/BlackRangeSelectsDevelopmentApproachForHansenDeposit26Apr12.pdf

2. The company has not disclosed many details about the process ,however, TAC research has revealed that up to 50,000 gallons per hour of water pressurized to 1000 - 1500 psi or greater would be required to fragment the sandstone-embedded uranium ore body.

3. The water recovered from the slurry would be reused -- supplemented with make-up water, re pressurized and re injected into the bore hole -- until the cavern is exhausted of the targeted material.

4. It is, at present, unknown what concentration of atmospheric oxygen would be dissolved in the water injected into the bore hole. It would surely be greater than for water at standard temperature and pressure conditions. Oxidation of insoluble uranium oxide to the soluble state, depending on the pH and other conditions in the cavern, would be enhanced. It is expected that as the water is reused, the concentration of uranium, other radioactive constituents , and heavy metals would increase.

5. Some portion of this high pressure water would inevitably be forced out of the cavern into the surrounding sandstone aquifer and threaten the quality of the groundwater and local domestic water wells. Ultimately, the remaining water would be impounded on the surface and presumably left to evaporate away.

6. While UBHM poses many of the same environmental issues as does In-Situ Leach Uranium Recovery, it does not meet the current definition since only the fragmented ore pieces are processed for its uranium content; the "leachate" is not processed for recovery of uranium but rather would be treated as waste.

7. The Colorado Hard Rock Mining Rules distinguish between In-Situ Leach Uranium Mining, which it regulates concurrently with CDPHE, and In-Situ Mining. However, the point at which uranium mining ends and uranium processing begins appears to be defined by conflicting definitions of CDPHE and NRC. The difference is: precisely when does "ore" becomes "source material". CDPHE regulations specify that uranium ore prior to chemical processing is not source material but rather the product of mining. The NRC Office of General Counsel has ruled to the contrary.

8. OGC has said that the line between "mining" and "processing" is drawn at the point of "unrefined and unprocessed ore" in its "natural form" and when "its gross appearance...has not been altered from the point of mining". http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos184.html.

TAC believes that it is reasonable and prudent, in view of health & safety and environmental considerations of the UBHM technique, that the fragmenting of ore in the underground cavern be considered as a uranium processing activity requiring (in Colorado) a Radioactive Material License.

B. Ablation

1. The name of the technology should properly be "Impact Ablation" to distinguish this uranium concentration process from Laser Ablation, which is used to identify minerals and in other applications.

2. Black Range and Ablation Technologies, LLC, its consultant and recently announced Joint Venture partner, describes the process as follows: " In ablation, the slurry from UBHM is ejected from two opposing injection nozzles to create a high energy impact zone. This high energy impact separates the mineralized patina of uranium from the underlying grain. The uranium bearing particles are found in the fine fractions separated in a subsequent screening process. As tested on material from Hansen, ablation allows approximately 90% of barren material to be separated from mineralized material prior to milling, greatly reducing the total OPEX and CAPEX costs to process mineralized material. The final product is an “ablated concentrate” which consists of approximately 10% of the original mineralized material, which will be processed with conventional milling techniques." http://www.blackrangeminerals.com/content/wp-content/uploads/2012/07/07-06-2012-BLR-Secures-Rights-to-Ablation-Technology.pdf. (Emphasis added).

3. Clearly, the company does not consider that this process is "milling" and subject to licensing by CDPHE. It appears to be relying on the Colorado Radiation Control Regulations definition of "ore" as a product of mining and before it becomes "source material". ""Ore" means naturally occurring uranium-bearing, thorium-bearing, or radium-bearing material in its natural form, to be processed for its uranium or thorium content, prior to chemical processing including but not limited to roasting, beneficiating, or refining, and specifically includes material that has been physically processed, such as by crushing, grinding, screening, or sorting." 6 CCR 1007-1 Part 1.2 Definitions. (Emphasis included in the recent PowerPoint presentation by the Black Range Vice President of Regulatory Affairs to the National Mining Association in Denver). http://www.nma.org/pdf/urw_2012/grebb.pdf

4. Regardless of the determined status of the UBHM fragmented ore in the cavern, the material undergoing impact ablation is being subjected to source material processing and the resultant waste, both the "barren" rock and process water, is 11e.(2) byproduct material. The high energy impact which separates the uranium grains from the "barren" rock is the functional equivalent of crushing or grinding. The grains are then separated and sized by a screening and elutriation process to isolate the "ablated concentrate" which is then transported off-site to a conventional mill for final processing into yellowcake.

5. As stated in 40 CFR 261.4(b)(7) the beneficiation of ore (including uranium ore) includes every one of those steps. The fact that they would be done at other than a conventional mill does not change the fact that impact ablation is a milling activity subject to a Radioactive Materials License.

6. In the 2002 Office of General Counsel document entitled *Uranium Milling Activities at Sequoyah Fuels Corporation* , the question of "What Constitutes Uranium Milling" was considered: "A fundamental,

plain-language, working definition of uranium milling can be constructed from the somewhat circular references contained in the ... regulatory definitions (in 10 CFR 40.4, of uranium milling, byproduct material and source material): Uranium milling is an activity or series of processes that extracts or concentrates uranium or thorium from any ore primarily for its source material content, and the resulting tailings or waste are 11e.(2) byproduct material." http//www.nrc.gov/reading-rm/doc-collections/commission/secys/2002/secy2002-0095/attachment5.pdf.

7. The OGC document further discussed non-conventional milling and milling at multiple locations. It stated: " Non-conventional processing ... comprise other technologies.... The distinction among non-conventional milling activities is that these activities often occur at locations other than a uranium mill.... Uranium milling entails many processing steps , which ... are not required to occur at a single location, but often do."

We respectfully request that you consider the regulatory status of both UBHM and Impact Ablation uranium recovery technologies as promptly as possible since Black Range is expected to finalize their intentions for the Hansen/Taylor Ranch Uranium Project by the end of 2012.

Thank you for your attention. I look forward to your response.

Respectfully submitted,

Lee J Alter
Chairman, Government Affairs Committee
Tallahassee Area Community, Inc.

0489 Fremont County Road 21A
Cañon City, Colorado 81212
719.276.0864
AlterConsult@Starband.net

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 8, 2012

Lee J. Alter, Chairman
Government Affairs Committee
Tallahassee Area Community, Inc.
0489 Fremont County Road 21A
Cañon City, Colorado 81212

SUBJECT: INQUIRY REGARDING UNDERGROUND BORE HOLE MINING AND ABLATION TECHNOLOGIES FOR URANIUM RECOVERY

Dear Mr. Alter:

The U.S. Nuclear Regulatory Commission (NRC) is in receipt of your letter dated July 12, 2012, addressed to Bill Von Till and myself, regarding your concerns about the emerging technologies in uranium recovery including ablation technologies in the State of Colorado. After reviewing the issues related to Underground Bore Hole Mining and Impact Ablation, the NRC staff determined that the Colorado Department of Public Health and the Environment (CDPHE) is the regulatory authority with jurisdiction on these matters within the State of Colorado.

It is our understanding that although there have not yet been any applications submitted to CDPHE for licenses or permits requesting use of this technology in the State of Colorado; there are companies in Colorado investigating the possibility of doing so in the near future. The NRC will defer to the CDPHE to communicate with their potential licensees in this area to better understand the process that will be utilized in implementing this new technology. CDPHE may request technical assistance from the NRC to address this new technology for uranium recovery. Until then, the NRC will continue to monitor the state of the technology in order to consider what regulatory changes will be necessary should companies request NRC authority to utilize such technology for uranium recovery.

If you have any further questions or concerns regarding ablation technologies and their implementation in the State of Colorado, we suggest that you direct them to Steve Tarlton, Program Manager, at (303) 692-3423 or steve.tarlton@state.co.us.

Sincerely,

Duncan White, Branch Chief
Agreement State Programs Branch
Division of Materials Safety and State Agreements
Office of Federal and State Materials
and Environmental Management Programs

cc:
Steve Tarlton, Program Manager

EPA-243

Reid Rosnick/DC/USEPA/US
09/20/2012 08:48 AM

To Beth Miller
cc
bcc
Subject

Subpart W emails.docx

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Subject: Re: Method 115 2/4/2009

Hi Sharyn,

I enjoyed speaking with you and Jeremy this morning. Please let me know if you have any other questions I can answer. In the meantime, attached is the copy of Method 115 I promised. This is the required test method for radon flux from Subpart W units.

Reid

(See attached file: Method 115.pdf)

2/4/2009

Reid,

We also appreciated the opportunity to speak with all of you this morning. Thanks for the document on Method 115. I'm encouraged that we've begun opening channels of communication on this important issue. I look forward to speaking with you in the future.

Sharyn Cunningham, Co-Chair
Colorado Citizens Against ToxicWaste, Inc.

END OF EMAIL

Subject: Logistics for June 30 Subpart W Meeting 6/5/2009

Hi Sharyn,

I either misplaced your phone number, or I might not have gotten it when we last spoke in February. If you would kindly send it to me, I'll give you a call and we can discuss some of the logistics (time/place) for the Subpart W meeting on June 30. We can also discuss the format of the meeting, and get a sense of what you would like me to talk about, and any issues you would like me to address. Thanks

Reid
Radiation Protection Division (6608J)

Hello Reid, 6/8/2009

Thanks for your message. Our group has already begun looking at potential sites for the June 30th meeting in Canon City. We'll take steps to help confirm a location after we've had a chance to discuss the best time for the meeting, if you would like. We would be happy to discuss the format and info desired, as well. Let me know when you would like to speak by telephone.

Sharyn Cunningham

CCAT Co-Chair

Hi Sharyn, 6/9/2009

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to ontact you.

I look forward to meeting you in a couple of weeks.

Reid

Dear Reid, 6/11/2009

Sorry for the delay in responding as we had to put our heads together regarding what we believe we will need for this meeting. I've added to the cc's on this message, Jeremy Nichols from Rocky Mt Clean Air Action, and CCAT's other Co-Chair, Carol Dunn, as they are involved in the Settlement, and in coordination of this meeting. Your suggestions for the presentation, the basics of Subpart W, an explanation of the workgroup and update on its progress, and the status of items that are part of the settlement, would be very helpful. Q&A works best, in our opinion, if it follows each presentation. At the same time, keeping the meeting informal and open for dialogue is very desirable.

It's been difficult in deciding when to hold the meeting. A number of key people, like yourselves, will be traveling here, and a number of key people in the community work during the day. Therefore, we're suggesting that the meeting be held in the evening from around 6-9pm, with a break planned mid-way through the evening. Here are some suggestions of items or actions we would like to see:

1. We would like for and hour and a half to be made available for a few citizen presentations on specific concerns surrounding this issue. I'm not certain we would need the whole 1.5 hrs, but would like for it to be available, to best convey information to EPA.

2. Please let us know who will be attending from the EPA and their area and level of expertise on this issue. We would also appreciate, if possible, an electronic copy emailed with any presentation materials that will be used by you or EPA staff (e.g. PPT slides, informational documents, etc.). It would also be helpful if printouts of these materials were available as handouts to the audience or participants.

3. We would appreciate receiving copies of the presentation EPA used for the NMA on this topic last year, as well as any other documents or correspondence shared with the NMA on this topic.

4. Is EPA planning any sort of announcement or advertising for this meeting? If so, please let us know, so that we don't duplicate our

efforts.

We are uncertain as to the size of the audience. We just had a Superfund meeting on Monday with about 165 people in attendence. However, we don't anticipate that size of a crowd. Our best guess is that we will have anywhere from 30-40 in attendance, and believe that people north of our area, and other interested parties may travel here for the meeting. We have at least two possible locations, and would be happy to secure something appropriate. One location, if it's available, has the capability of expanding the room if needed.

Our group looks forward to hearing from you.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting 6/9/2009

Hi Sharyn,

Thanks for your response. I have a couple of ideas I'd like to share for our meeting on the 30th. If it's OK with you, I could give a presentation on the basics of Subpart W, an update of what the workgroup has been doing, and an update of our status of other items that are part of the settlement agreement. After that, perhaps we could open it up for a question and answer period, where I can get a sense of issues that are of concern to you. My hope is that we can keep this meeting as informal as possible, I think that way we can have an open dialogue, with sharing of ideas that will be beneficial to both of us. Do you have an estimate of how many people would attend the meeting, and how much time would be needed? I'm just trying to get a feel on how to tailor my presentation.

Regarding when we can speak by phone, I'll leave that to you as your schedule dictates. Just let me know when you are available, and I'll be happy to contact you.

I look forward to meeting you in a couple of weeks.

Reid

Subject: RE: Logistics for June 30 Subpart W Meeting
6/12/2009

Hi all,

I have booked the Quality Inn here in Canon City, Hwy. 50 and Dozier, 719-275-8676. They have a meeting room for 30-50 people. We will have it from 6:00 to 9:00 p.m. on June 30. I will check with the Events Coordinator the week before to make sure they have the set up for PowerPoint, etc. By that time I will have input on how many people are coming and be able to decide what sort of seating/table arrangement will best suit. If any presenter has has any special needs along those lines let me know as soon as possible. Look forward to seeing you in Canon City.

Carol Dunn
CCAT Co-Chair

Hi Sharyn, 6/12/2009

The meeting time you chose is fine with me. I know people work during the day, and it's difficult to schedule meetings during the week. I would ask that we go no later than 9 PM, as I have to drive back to Denver that night. I think the meeting format is good, and I want to allow as much time as possible for questions. If there are only 30-40 people in the room, perhaps we can make it more of a roundtable, and questions can be asked anywhere throughout my presentation.

I'm going to address each of your numbered items in order, so I don't forget anything.

1 I welcome the period for citizen presentations. If you know of specific citizen issues or concerns, please let me know beforehand, so I can attempt to address them in my presentation. Please remember that the focus of my work is limited to the radon emission standards of Subpart W, and the associated review and possible revision of those standards. If you have information or studies related to the protectiveness of the radon standard of 20 pCi/m2, I would be very interested in obtaining them.

While I am generally aware of issues with Cotter in other topic areas like ground water and drinking water, and though you may wish to discuss those types of issues, they are beyond the scope of my work, and I am not the technical person who could answer questions of this nature. I raise this point so that you know what you can expect me to address at the meeting. For questions outside of the scope of my Subpart W focus I will try to relay the questions to Region 8 staff.

2. As I write this, assume there will be two EPA folks attending the meeting, myself and Dr. Angelique Diaz from our Regional office in Denver. As I get more information on any other participants, I'll let you know immediately. I'm still in the process of putting my PPT presentation together, and I hope to e-mail it to you by no later than next Friday, June 19.

3. On June 19 I'll also e-mail you a copy of the presentation my colleague Loren Setlow and I made to NMA last year. Based on what I'm currently putting together, you'll find that a lot of the information is redundant. There are no other documents or correspondence that has been shared with NMA to my knowledge. Also, if you would kindly give me an address, I can ship out at least 50 copies of my presentation at the same time so that you have them prior to the meeting, and I'm not carrying a big box through airport security.

4. I am not aware of any other announcements or advertisements that EPA is planning for this meeting. I am turning to you to announce the meeting to the interested individuals. I assure you that once our web site is up and running we will announce future meetings. I also appreciate your securing a meeting room. I would appreciate it if the room had a projection system and screen. That way I can bring a flash drive with the presentation on it, and we can project it for all to see.

I believe I touched all the bases from your note. Thanks for your cooperation, Sharyn, and please don't hesitate to call or e-mail me if you have other questions or issues. Thanks,have a great weekend.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting 6/12/2009

Dear Reid,

We understand that the meeting will need to end at 9pm, and we greatly appreciate having this opportunity to participate in the Subpart W review and potential rulemaking. In response to your comments (using the same numbering system):

1.) In regard to citizen presentations at the meeting, I assumed that "this issue" would be understood as referring to the review of Subpart W, not water or any other concerns at this site. We will make every effort to provide information to you on citizen issues/questions prior to the meeting, or at least within one week of the meeting. We agree, it will be advantageous for all if you can think about these points before hand.

2. & 3.) We look forward to seeing Dr. Diaz again, and will appreciate receiving the PPT and NMA materials by email. You can mail your handouts for the meeting to: Sharyn Cunningham, 1614 Grand Ave, Canon City, CO 81212.

4.) We will make sure that a screen and projection system will be available for computers. Carol Dunn sent an email earlier today with the location name and address: Quality Inn and Suites, Hwy 50 & Dozier Ave, Canon City, CO (719-275-8676).

Can EPA place an ad for the meeting in our local newspaper, The Canon City Daily Record? Aside from that, we would appreciate it if EPA would put an announcement for this meeting, with links to Subpart W and a brief explanation of the purpose of the meeting, on these websites:

USEPA Lincoln Park Superfund website:
http://www.epa.gov/region08/superfund/co/lincolnpark/
CDPHE website for Cotter (OU1 of the Superfund Site):
http://www.cdphe.state.co.us/hm/cotter/index.htm
CDPHE website for Powertech (ISL Uranium Mining in Colorado):
http://www.cdphe.state.co.us/hm/rad/rml/powertech/

We'll look forward to an answer regarding an ad and announcements on the websites. If there's anything else we can do to make this a productive and educational meeting, please email or call. We look forward to hearing from you again, and seeing you and Dr. Diaz on June 30th.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Logistics for June 30 Subpart W Meeting 6/16/2009

Hi Sharyn,

Thanks to you and Carol Dunn for making all the arrangements and logistics for the meeting location. I will Fed-Ex the box of presentations to you on Friday. Additionally, I'll send you an electronic version and a copy of the presentation I made to NMA last year.

Regarding advertising for the meeting, I am in the process of placing a notice of a public meeting on EPA's Subpart W web page. It may take a day or two to get through our Product Review section. Angelique Diaz will make a request of the Regional Superfund group on whether they will update their web site. She will also see if CDPHE will allow for placement of an announcement on their web sites. For the Canon City Daily Record she will speak with the public affairs people to see if any funding is available for the advertisement. I'll update you as I hear about the success of the requests.

Thanks again, and as always, don't hesitate to contact me if you have questions or comments.

Reid

END OF EMAIL

Subject: Web Posting 6/17/2009

Hi Sharyn,

I have managed to get an announcement about the June 30 meeting on our Subpart W web page. The link is:

http://www.epa.gov/radiation/neshaps/subpartw/index.html

The Region is still looking into the possibility of getting an announcement on the Lincoln Park Superfund site, the CDPHE websites, and the Canon City Daily Record. I'll keep you posted.

Reid

Subject: Re: Logistics for June 30 Subpart W Meeting 6/17/2009

Dear Reid,

Thank you for putting a notice of the June 30th meeting on the Subpart W website at the EPA. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, the Cotter Uranium Mill & Superfund site on the CDPHE website, and the CDPHE Powertech website where ISL uranium mining is being proposed. Hopefully that will happen, as those are sites that the general public access periodically, people who may not be aware of the review of Subpart W. An ad in our local newspaper seems only appropriate for this meeting on a historical effort by EPA that will have a direct impact on our community. We will appreciate your continued effort, and efforts by others at EPA and CDPHE, to see that proper notification is offered to the public.

I'll be looking for your package of materials, the electronic versions of presentations on the subject to NMA and for this meeting by email, and will hopefully be getting back to you soon about our issues of concern.

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: Web Posting 6/17/2009

Reid,

Thanks and I saw that the announcement was up last night after receiving your last message. Only those informed on this particular issue will know to check that site. An effort to notify the public of this meeting and it's purpose really should be included at the Lincoln Park Superfund website on EPA, and at the Cotter Mill & Superfund site website on the CDPHE website. Hopefully that will happen, as those are sites that the general public accesses periodically, people who may not be aware of the review of Subpart W. We will appreciate your continued effort to see that happens.

I'll be looking for your package of materials, the PPTs by email, and will hopefully be getting back to you soon about our issues of concern.

Thanks again,
Sharyn

Subject: Re: Web Posting 6/18/2009

Hi Sharyn,

I trust that the language I used in the announcement is acceptable. I know that Jeremy Nichols is no longer representing Rocky Mountain Clean Air Action, but I felt obliged to mention them, since they are co-plaintiffs with your organization. The Region is continuing to work on determining placement of the announcements, and I reckon that we will have a resolution soon.

I will be sending 50 copies of the presentation tomorrow. That number is based on the 30-40 number of attendees you had estimated, plus 10 more for good measure. You should probably receive it on Monday or Tuesday. I'll also be sending the electronic versions of the presentation and the 2008 NMA presentation tomorrow afternoon. I'll also bring a CD with my presentation to use at the meeting, and you are welcome to keep that if you wish.

Thanks again for all your help.

Reid

Subject: Re: Web Posting 6/18/2009

Reid,

Thanks very much, and yes the announcement language was very good.

Sharyn

END OF EMAIL

Subject: A Request For Documentation
7/29/2009

Reid,

At the June 30 meeting in Canon City I believe you told us that you would make available to us the following documents: 1989 Risk Assessment, EPA's Detailed Workplan, Communications Plan, and Analytic Blueprint.

I am aware that these documents will all appear at some future date on the website that EPA will be creating once the lawsuit is settled and all parties have signed the requisite documents. However,as slowly as the lawsuit is moving toward final signatures this is taking longer than I wish to wait.

So I am asking you to please send me the documents I've requested above.

Thank you.

Paul Carestia

Subject: Re: A Request For Documentation 8/6/2009

Paul,

Sorry for the delay, I have been out of the office for two weeks.

I can send you the 1989 Risk Assessment documents, however, the file is too large to send electronically. If you would send me your address, I can send a CD of this information.

Regarding the Analytic Blueprint and Communication Plan, these documents are internal Agency documents, containing sensitive information that cannot be shared. I mentioned them in my presentation to give you a feel for the process we use, and the fact that we are indeed on a path forward, not waiting for any resolution to the lawsuit. I apologize for any misunderstanding.

Please let me know if sending you the CD of the risk assessment is acceptable. Thanks

Reid

Reid, 8/6/2009

Thanks for the e-mail. Please send me the CD to the following address.

I guess I am a little confused now by just what exactly your agency is going to be willing to share with the public regarding this matter and just what exactly you are going to be putting up on the website EPA will be creating.

I am also familiar with the Freedom of Information Act and have used it upon occasion with other federal government agencies. I have difficulty with any government agency when I am told information pertaining to my and the public's welfare is "sensitive and cannot be shared". Makes one feel one's government is withholding something it doesn't want me to see.

Any thoughts on this?

Thank you.

Paul Carestia

END OF EMAIL

Subject: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit 10/14/2009

Reid,
Sharyn Cunningham asked me to send to you the document produced by MFG Inc, a firm hired by Cotter Corporation, which proposed the use of an Effective Effluent Limit (EEL) to gauge whether radon concentrations at the Cotter Mill perimeter were "safely within limits".
It is my understanding that you asked to see this document as a result of some discussion at the Rapid City WMAN Conference in October.
Attached is that document in .pdf form. Unfortunately it was scanned upside down, so you will have to use "View" on Adobe Reader's toolbar to rotate the document so it can be read on your computer screen.
I have read this document numerous times and as an engineer with a master's degree in electrical engineering and as an MBA with a fair number of statistics courses behind me, I have a number of issues with the approach proposed and accepted by the Colorado Department of Health in this matter with

Cotter. I have raised these issues with the Department of Health and the EPA in Region 8 to no avail. I am hoping that someone with the right expertise on your staff in Washington, D. C. will take a detailed, critical look at what is written here and will truly evaluate the science as appropriate and adequate. Region 8 of the EPA never responded to my documented concerns and Colorado Department of Health responses were obfuscating at best. I'll be happy to make their responses available to you as well if you wish. I have basically given up on getting anything reasonable from those folks, who are obviously stakeholders in this approach having given approval for its use.

The issues I have with the approach are as follows.

1. The sample sizes being used to calculate reliable, realistic means and standard deviations for background radon concentrations and perimeter radon concentrations are simply too small. Statistical theory shows that in order to have reliability in the calculation of the mean and standard deviation of a sample distribution, one needs a sample size somewhere between 30 and 50 samples. Four samples are used for perimeter radon concentrations (1 per quarter) and 4 samples are used from each of three background radon locations (1 per quarter), for a total of 12 background radon samples. These sample sizes are simply insufficient, especially when the resulting mean and standard deviation for background are used to predominantly set the upper limit for radon concentrations at the mill perimeter. I view this as highly unreliable for such an important metric of concern to public health and welfare.
2. The average background radon measurement and resulting background standard deviation are then used in the Effective Effluent Limit equation:

EEL Alternative Effluent Limit + Average Background + 2 times the standard deviation of Average Background

Alternate Effluent Limit is defined in the MFG document and is basically a constant number dependent upon distance of perimeter station from the tailings impoundment.

This EEL sets the upper limit against which mill perimeter average radon concentrations are compared. It is my contention that using such an approach will make it highly unlikely, if not impossible for the EEL to ever be exceeded. I think this approach is highly suspect, meaningless, and biased to give a result that will always say radon concentrations at the perimeter are "safely within limits".

You may recall in my presentation to you at the June 30 EPA meeting in Canon City I pointed out that while radon flux from the Cotter Primary Impoundment increased by 230% over a 3 year period, radon concentrations at the mill perimeter decreased by 30% over the same 3 year period. This makes absolutely no sense to me. Colorado Department of Health showed no interest in this concern, and for that matter neither did EPA in Region 8. Colorado Department of Health simply indicated that radon concentrations at the mill perimeter were "within EEL limits", so radon flux readings weren't really of relevance to them. They said they look at and count on radon concentrations at the perimeter. EEL as it is used in this case is being given an extremely high credence. I strongly question this.

3. All measurements in this approach, background as well as perimeter, are made using the same measurement technology, Laundauer's DRNF. I would assume then that all measurements are subject to the same random and real variation, not just background. The MFG document calls specific attention to this variation as it relates to background radon measurements and applies the 2 sigma 95% confidence interval for background to account for it. Yet the MFG document does nothing to take this variation into consideration for any of the perimeter measurements. I would argue that the appropriate 2 sigma for perimeter average measurements be added to those measurements to insure a 95% confidence in them as well. The approach as currently implemented is not an apples to apples approach.

I would appreciate very much having an EPA expert in Washington, D. C. study this document and the resulting approach. I respectfully request that this be undertaken and that the expert who does the review get back with me on their finding. I need corroboration from an expert, or I need to be shown where I am mistaken. Either outcome will suffice.

Thanks for your willingness to look into this matter. I appreciate it.

Paul Carestia

MFG Document.pdf

Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit
10/14/2009

Reid,

I'm sending additional information to include with Paul Carestia's email sent earlier today. Attached is a series of letters exchanged between Cotter and the CDPHE in 2004 concerning radon. The MFG, Inc. paper was part of this process. These letters may shed additional light on the matter. Paul had not seen them, and he is reviewing them now and will send you his notes and thoughts on them later.

Though there may be other reasons that radon came up in 2004, one may be that leadership staff at the CDPHE radiation division changed in 2003 bringing a new approach to Cotter. Also, radon flux in 2002 was18.7 pCi/m2-sec, probably due to the Primary Impoundment drying out during a period of extended drought. A third contributing event, as seen in the February 12th Memorandum from Jan Johnson to Steven Landau, was soil sampling done in 2003 where high levels of stable lead were found in a private residence attic and barn, and some other locations near Cotter. It appears that CDPHE was questioning whether radon from Cotter's impoundment and facility was contributing to this contamination. I've also attached a CDPHE letter from 6-16-2003 regarding the 2002 radon flux that was sent to CDPHE Air Pollution Division.

Thank you, and we'll look forward to hearing from you.

Sharyn Cunningham

Cotter CDPHE Radon Correspondence 2004.pdf

2003-6-16 CDPHE Review Radon Flux 2002.pdf

Subject: Re: Documentation You Requested From Sharyn Cunningham on Effective Effluent Limit
10/22/2009

Paul,

Thanks for all of the information. As I wrote to Sharyn, I was out of the office all last week on work unrelated to Subpart W, so this is the first chance I have had to respond. I probably won't get a chance to review the information until some time this weekend, but I'll respond when I have something to report. Thanks again.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
202.343.9563
rosnick.reid@epa.gov

Subject: Response to your e-mail of 10/14/09 10/30/2009

Paul,

I have reviewed the document you provided to me in your e-mail of 14 October 2009. The document was produced for Cotter by MFG, Inc, dated 20 May 2004 with the subject heading of Proposed Sampler Specific Radon Concentrations. You asked me to review the proposed approach and comment on three issues that you raised in your e-mail.

1. Sample sizes being used to calculate means and standard deviations.
2. Creation of a background radon measurement by taking the mean and adding 2 standard deviations to create average background
3. Not applying the same statistical approach to the downgradient radon samples.

Before I answer your questions, I am including a couple of caveats. In reviewing this information it is clear to me that it is not part of any sampling program for NESHAP Subpart W. I can only assume therefore that this is a program that has been proposed in conjunction with the facility's operating license. This program is administered by the Nuclear Regulatory Commission (NRC) unless that program is run by an Agreement State. The State of Colorado is an Agreement State, and I am unclear on exactly why this sampling program was proposed. Also, since the memo was produced in May 2004, it is unclear to me whether this proposed method was actually reviewed and/or approved for use. I would need to examine considerably more documentation before I could determine the usefulness of this proposed sampling program, and frankly, since it is not related to Subpart W, I do not have the time to explore it for further follow-up. I suggest that you continue to raise this issue with the Colorado Department of Public Health and Environment. I will, however, answer your questions in a general sense, as it relates to Subpart W.

Regarding sample size as it relates to calculation of means/standard deviations, NESHAP Subpart W requires in Method 115 a specific number of flux measurements for a tailings facility:

Water saturated beaches – 100 flux measurements
Loose and dry top surfaces – 100 flux measurements
Sides – 100 flux measurements, unless soil is used in dam construction
Water covered areas – no flux measurements

Although no background measurements are specified in this test, it is generally assumed that flux measurements will be on the order of 100 in order to be consistent with the downgradient measurements. One hundred samples produce a more normal distribution, and allows for greater confidence in the data. As you know, in general sample sizes of less than 30 do not usually produce results accurate to a specified confidence and margin of error unless the population is normally distributed. Further, the locations for determining background are assumed to be free of tailings, and are truly representative of existing natural background for radon.

In Subpart W, after the samples are collected, the mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each sector of the tailings pile. Addition of any number of standard deviations is not permitted. The number of samples required more than compensates for using problematical statistical methods. Further, the weather conditions, moisture content of the tailings, and the area of the pile covered by water must be delineated in the analysis, and must be chosen at the time of measurement to provide representative long-term radon flux.

Lastly for Subpart W, the mean of the radon flux samples is compared to the mean of the background samples. There are no methods used to compensate for lack of data, such as employing the standard deviation to background, and comparing it to just the mean of the downgradient data. If the resultant flux rate is greater than 20 pCi/m^2/sec, the pile is in violation. I should mention that while we will possibly consider various alternatives to the sampling method utilized in Method 115, we will not be considering the use of alternate, unsupported or untenable statistical methods that gives the appearance of data treatment.

I hope this helps, as I stated earlier, I have responsibilities with Subpart W that are mandated by law, and I must concentrate my efforts to meet those deadlines. Thanks for the opportunity to have a look at the proposal.

Reid

END OF EMAIL

Subject: Dates for first conference call 10/27/2009

Hi Sharyn,

I hope things are good. In anticipation of the settlement agreement being approved some time soon (November?) I thought we might discuss some dates for when we hold the first conference call. I don't really have any preferences, other than the call being held anytime after November 13. If you would like to stick to the schedule in the Agreement, it would be on a Tuesday, so that leaves November 17 and 24, and December 1 and 8. Again, I don't have any real preference at this time. Regarding time of day for the call, my preference would be sometime during the hours of 9 AM - 1 PM MST. My assumption is that the call would last about an hour. The call-in number will be posted on the web site no later than 5 days before the call, and I'll also e-mail the number to you per the Agreement. The way I'm working on this is that the number will remain the same throughout the time that we conduct the calls. Does any of this work for you?

The web site is coming together, and will be up within the 30 day period after the agreement becomes final. The site will be a work in progress, as I try to add more material and information to it during the life of the site.

I think that's it for now, I look forward to hearing from you.

Reid

Hello Reid, 11/04/2009

Things here are pretty good. We've had early snow and record breaking low temperatures, but have bounced back to warmer weather for the present. Sorry for the delay in responding, but I had to check with CCAT and others. The consensus is to start the teleconferences on Dec 8th, preferably 1 PM MST. That would allow for everyone to participate from all regions of the US. Keeping the same number and posting info about the teleconferences on the current or new website will be very helpful.

Many are looking forward to info and documents being posted on a website, especially where we could access documents while on a teleconference, if wanted. So, please do let me know when this becomes available.

Thanks very much, and I'll wait for your confirmation of Dec. 8th, 1 PM MST, and then we will notify our lists.

Sharyn

Hi Again, 11/4/2009

Would it be possible for you to send me a copy of the sign-in sheet of people that attended your presentation in Rapid City?

Thanks, Sharyn

Hi Sharyn, 11/9/2009

Sorry for the delay in responding, I was in Gallup, New Mexico last week for a Navajo uranium stakeholders conference.

Thanks for scheduling the time for the conference call. December 8 at 1 PM MST is fine with me except for just one issue. The settlement agreement became effective on November 3, and one of the issues we agreed to was that the conference calls would begin within 30 days of the agreement becoming final. The conference call date is 5 days beyond the 30 day stipulation. If you are OK with that, then so am I, but I need to make sure that we don't violate any terms of the agreement, which would force the call to happen on or before December 3. Please let me know if you're still willing to go with December 8. Thanks

I've also attached the sign-in sheet you requested for the meeting we had in Rapid City. Have a good day.

Reid

Hi Reid, 11/9/2009

I've spoken with Travis Stills and he sees no problem with going a few days past the 30-day deadline under the circumstances. Travis suggested that you might contact Susan Stahle for any input on your end:
Stahle.Susan@epamail.epa.gov

Thanks for the attendee list, and we're looking forward to the first teleconference. Any update on the development of the website?

Thanks, Sharyn

Hi Sharyn, 11/10/2009

I took your advice and spoke with Susan Stahle of our Office of General Council. She was more nervous than Travis with respect to missing the 30 day deadline for the conference calls. She explained to me that the 30 days is a hard and fast requirement, and we can't miss it. So, I apologize for the mix-up, but we need to think of another day that will work between now and up to December 3. I know that we had originally talked about Tuesdays, but really for me Tuesday, Wednesday or Thursday will work. If you could give me some dates that would work for you, I would greatly appreciate it. Again, sorry.

Regarding the web site, I hope to have it go live by next Thursday. We're putting the finishing touches on it, and it has a lot of information on it. Since its a work in progress, we hope to continue to add to it from any other sources we find here, as well as any information from the stakeholders. I'll let you know as soon as it is up and running.

Reid

Reid J. Rosnick
Radiation Protection Division (6608J)

Reid, 11/10/2009

We are disappointed, but after conferring with Jeremy Nichols of RMCAA/Wild Earth Guardians, and Atty Travis Stills, we have chosen Dec. 3rd, Thursday, 1 pm, MST. I have some questions:

1. How soon can you give us call-in instructions in order for us to make our announcements to interested participants.
2. Will EPA provide an adequate number of lines for interested participants?
3. Will EPA announce the teleconferences, and how?
4. Who will be on the teleconference from EPA?

Thanks for your efforts on the website, as we would really appreciate being able to look at related documents prior to the call. Please do email me when it is up and available for access.

Again, thank you for all your help, and we're looking forward to these conferences.

Sharyn

END OF EMAIL

Subject: EPA to Cotter 2-24-09 11/23/2009

Hi Reid,

I see that the website is up and we are really appreciative of your efforts. Just looking at correspondence between EPA & Cotter and see that the Feb 24, 2009, letter has even numbered pages of the document missing.

1. Could you please get the pages added and the letter reposted?

Also, there are no further letters after May 2009, either from Cotter or any EPA responses. If any further communication has gone on between EPA and Cotter since May 2009.

2. Would you please post correspondence since May 2009, as well?

One other thing - the aerial photos provided by Cotter in the information sent in May 2009 seem to be rather old. Attached are Nov 1, 2009, photos where it is very evident that tailings are now exposed in the Secondary Impoundment. In case you're unaware, Cotter made an inventory of Impoundment contents for EPA in 2003 (see attached) with details for the Primary. Other sources indicate that the Secondary does contain waste from the Manhattan project. We're really concerned about how radon is being controlled as Cotter is dewatering the Secondary Impoundment. This may be out of your jurisdiction, but I'm not as up on this, so am at least making you aware of the situation. We recently sent an email to Ms. Diaz about this, but thought you might like to see the photos in light of Cotter's response to request for information.

Thanks very much,

Sharyn Cunningham
CCAT Co-Chair

PDF Cotter Secondary Impoundment Photos 11-1-09.pdf

PDF Cotter Inventory Impmt Ponds 3-3-03.PDF

END OF EMAIL

Dear Mr. Rosnick, 11/25/2009

Attached is a memo regarding the Subpart W review. I have not had a chance to review the documents you have posted on the Subpart W rulemaking website.

Also, yesterday I mailed the memos and exhibits re Title V and Part 70 permits. I had e-mailed the memos, but not the exhibits to the second memo. Will you receive the mail in a timely manner, or should I fax the exhibits (re Utah State Program) to you?

I will also submit comments regarding the EPA state program for radionuclide NESHAPS.

Sarah Fields
Uranium Watch

memo_subpartWreview.091125.pdf

END OF EMAIL

Hi Sharyn, 2/4/2010

I hope you are well. I wanted to touch base with you regarding the possible time and location for the Utah public meeting. I have been corresponding with Sarah Fields, who gave me some good information on where we could locate the meeting. She has given me two locations: The first one is the White Mesa Ute community, about 5 miles south of Blanding, which is the community closest to the White Mesa Mill. They have a gym where the DOE held scoping and draft EIS hearings related to the disposition of the Moab Mill Tailings. The second location is the Blanding Arts and Events Center at the College of Eastern Utah. They apparently have a large meeting room. Either one of these locations would be fine with me, although I am leaning toward the White Mesa Ute facility, since it is closest to the mill. I welcome any input you have on the issue.

The second issue is the date of the meeting. I am currently looking at Monday, May 24th, at approximately 6 PM. I believe that Dr. Diaz will be accompanying me on the trip.

Please let me know if this works for you, so I can go ahead with the reservations for the room, etc. Thanks a lot.

Reid

,
Hello Reid,   2/5/2010
Thanks for your message. After consulting with our group, we would choose the White Mesa Ute community meeting place, as it may be more accessible to people closest to the Mill, and Blanding residents could get there easily. A few people from Canon City will be making the trip, so a few miles one way or the other won't make a difference to us. May 24th seems quite a ways off, and we think would happen after our next scheduled conference call, which is unfortunate.   The consensus here is that a date sooner than May 24th should be scheduled. Other than that, thanks for your efforts and asking for our opinion.

Sharyn

END OF EMAIL

Subject: Re: EPA to Cotter 2-24-09 11/24/2009

Hi Sharyn,

I'm glad that you saw the website. Our IT folks put it up because I needed to see it on my home computer to make sure that it "looked" the same as on the computers here at EPA. At the same time, I was making sure that all of the links work, and to make sure that everything was complete. In addition to the Cotter letter, I also found two broken links. Those will be repaired this morning, and I will be sending an e-mail today to everyone who wanted to be notified that the web site is officially launched. Please note that some of the documents are very large, up to 25 MB, and they take some time to download.

As for correspondence with Cotter, I am not aware of any further communication since May. I'll check with Angelique Diaz in Denver to see if she has anything.

Thanks for the photos, you are correct that Dr. Diaz is the person to talk with, and I'm sure that she is communicating with CDPHE as well.

For the conference call on 12/3, do you have any agenda items that you would care to see?

I'll be out of the office for the rest of the week, so have a very Happy Thanksgiving, and I'll talk to you next week.

Reid

11/30/2009

Dear Reid,

Thanks for the effort put forth on the website and the upcoming teleconference. Everyone is looking forward to this update. After conferring with interested parties, our group and others, here are some agenda items we'd like to see covered on Dec. 3rd:

1. EPA Activity since previous meeting
    a. Website
    b. Accumulation of data from previous rulemaking
    c. EPA response to request for additional meeting near Gallup/Grants in conjunction with White Mesa meeting in Blanding
    d. Any further correspondence between EPA and industry regarding information requests?

2. Technical Issues
    a. Describe EPA review teams by subject matter
    b. Review issues raised by public or industry to date
    c. 1989 Risk Assessment - status of current historical research?
    d. Existing Technologies - status of current survey?
    e. Method 115 - status of current research?
    f. Status of Part 192 review as it applies to Subpart W regulations

3. EPA Activity before next call.
    a. Interim reports?
    b. Bids for contractors?

4. Define agenda items for next quarterly call, scheduled for January 5, 2010.

Sincerely,

Sharyn Cunningham
CCAT Co-Chair

Subject: Re: EPA to Cotter 2-24-09 12/01/2009

Hello Sharyn,

Thanks for the agenda items. I will incorporate them into an agenda, and I hope to have it posted on the web site later today. I have taken all of your suggestions, and I hope to give a brief update on all of the activities you requested. I want to make sure, however, that there is also sufficient time for questions from anyone on the call. My thinking at this point is that whatever I don't cover on this call can be picked up on the call in January.

Reid

END OF EMAIL

Subject: Need Help 12/21/2009

Reid,

I appreciate your time in reviewing this documentation that I sent you some time ago. I understand your position on these issues and realized up front that this was not a Subpart W issue. So thank you for the time you took to read over the MFG Inc. document that I sent you and for your advice on how I should move forward.

Colorado is an agreement state. The Colorado Department of Health and Environment have done little to assist me here and in fact have been reluctant and defensive, arguing with me about my understanding of the issue.

Today I made two attempts to contact the Nuclear Regulatory Commission, asking for the names of experts in the NRC who understand the science of radon emissions from mill tailings. The contacts were via e-mail to their Human Resources Office and their Office of Public Affairs. I don't feel really confident that either will be able to provide what I am looking for.

I am asking for your help here because you are inside the government and have some understanding of what it is that I need. Can you help me find an NRC expert who could possibly provide the knowledgeable, hopefully unbiased review of this approach to monitoring and safeguarding the public health and welfare? Or can you by way of introduction put me in contact with someone who can and will help me find the expertise I am looking for?

As a formally trained engineer with a Masters Degree who spent 32 years working for America's premiere research company, Bell Laboratories, I cannot accept without scientifically justified explanation the fact that radon flux from Cotter's Primary Impoundment increased 230% over a three year period while the radon concentration measurements at the perimeter of the mill property decreased by 30% over the same three year period. This is illogical, counter intuitive, and highly suspect. That additional radon went somewhere and to my way of thinking should have been evident in increased radon concentrations at the mill perimeter as a minimum.

We the people of Lincoln Park and greater Canon City cannot control the air we breathe and to a lesser degree, the ground water we drink or irrigate with. I need resolution to my concern and I need expert help to do that. Colorado Department of Health and Environment is not that resource. They are too close, too vested, too seemingly uninterested or unwilling to partnering with me to address this concern.

I believe you to be a reasonable, honest, concerned individual.

Please help me resolve this radon concern by directing me to someone in my government who can help me.

Thank you.

Happy Holidays!

Paul Carestia

Hi Paul, 12/22/2009

I have sent your request for someone knowledgeable in radon emissions from mill tailings to one of my contacts at NRC. I'll let you know when I hear something. This is a difficult time of year, because people are in and out of their offices. In fact, after today I'll be out of the office until January 4, 2010.

Happy Holidays to you, Paul.

Reid

Reid, 12/22/2009

Thank you very much. I truly appreciate your help here more than you will ever realize.

Paul

Subject: NRC Contact 1/4/2010

Good Morning Paul,

Here is a contact at NRC for questions related to radon.

Ronald A. Burrows CHP, RRPT
U.S. Nuclear Regulatory Commission
Federal and State Materials and Environmental
Management Programs
Uranium Recovery Licensing Branch

Reid, 1/4/2010

Thank you for the fast response.

Will Mr. Burrows be aware that I am contacting him based upon your referral? Will he know who I am when he sees an e-mail from me? I just want to make sure my contact with him is not ignored.

If I understood correctly, you know Mr. Burrows. Just trying to grease the skids a little.

I hope you and your family had a nice Holiday.

Paul Carestia

Subject: Re: NRC Contact 1/4/2010

Hi Paul,

Yes, I spoke with Ron and his supervisor to make sure that he is the right person. I copied him on my original note to you, so he is expecting to hear from you. If he cannot address your radon questions, he promised that he would find someone who could.

Reid
Radiation Protection Division (6608J)

Subject: Fwd: Status of Request for NRC Help and Guidance 1/27/2010

Reid,

Need you to see this one too..................I need to know just what is the "nature of my request"?

You need to know something..............I am the first son of a coal miner who had no more than a 6th grade education before my father made him quit school and go to work in the coal mines. I am the first grandchild in my family to get a college education. I have degrees from Colorado State University, Northwestern University, and the University of Chicago. I got there through hard work, scholastic achievement, determination, and never giving up.............and I will not be giving up on the issues I've brought to you as part of the Subpart W/Method 115 review.............or the issues I've asked and you have kindly agreed to help get resolved with the NRC.........and I am asking you and the NRC, not the state of Colorado, to address my concerns.

Both my mother and my father were diagnosed with cancer.........my mother died at the young age of 58 from brain cancer (glioblastoma multiforma, a word that has never left my mind since first hearing it. I got to watch her die a very slow, debilitating death.) and my father had prostate cancer, had surgery, was later again diagnosed with it returning as inoperable and terminal. Had he not tragically died in a car accident, cancer would have taken his life as well. I try not to think of what's in store for me, having lived all of my childhood life within 1 mile of the Cotter uranium mill during its operating heyday............breathing in the stench from that mill on hot summer nights with my bedroom windows open.............and having no idea what I was exposed to during my waking hours. There was no history of cancer in my family on my father or mother's sides. What would you think Reid if this were your situation? How would you feel? This mill or any uranium mill should not be in close proximity to people and communities in which they live and breathe! And I find the methodology used to monitor the radon emanating from this mill to be highly irregular, suspect, and without merit. And so do radiation scientists with a lot more knowledge and expertise than me.

This is visceral to me............visceral!.......please appreciate that. If I have to go to senators in Colorado and Washington D.C., I will..........right now I am pissed off...............very upset, very disappointed............and 1000% more determined to get action from those who are accountable to me as a tax payer in the country.

Senator Mark Udall will be visiting the Canon City and the Cotter Mill site in the not too distant future. I intend to be there when he does and I intend that he become involved in all of this...........and I won't give up until he does.

I respectfully ask that my issues get addressed and answered. I think you'd all would rather be doing this at my request rather than his.

Thank you.

Subject: Status of Request for NRC Help and Guidance 1/27/2010

Good afternoon, Paul.
We have had a chance to review the details of your request. As you may know, Colorado is an Agreement State. As such, due to the nature of your request I have forwarded it to the State of Colorado Radiation Program Manager. His contact details are as follows:
Steve Tarlton, Manager
Radiation Program
CO Department of Public Health & Environment
Regards,
Ronald A. Burrows

Paul Carestia

Subject: Re: Status of Request for NRC Help and Guidance 1/27/2010

Ron,

I'd appreciate you expounding on the "nature of my request". Just what in your eyes IS the nature of my request?

Thanks.

Paul Carestia
END OF EMAIL

Reid Rosnick: 9/21/2010

Thank you for your reply. Kennecott Uranium Company believes that the Agency for Toxic Substances and Disease Registry (ATSDR) draft Public Health Assessment applies directly to Subpart W regulation for the following reasons:

- 40 CFR Part 61 Subpart W regulates radon emissions from tailings impoundments via either the twenty (20) picocurie per meter squared second standard for existing impoundments or the work practices for new impoundments constructed after December 15, 1989. The goal of this regulation is to reduce exposures and doses to the general public from radon and its decay products from uranium mill tailings impoundments.
- The draft Public Health Assessment specifically addresses public dose from and exposure to radon and its decay products from a uranium mill tailings impoundment namely Cotter Corporation's Canon City Mill impoundment.
- The draft Public Health Assessment states:

  > *On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This conclusion has direct bearing on the current effectiveness of 40 CFR part 61 Subpart W, specifically that as it now stands the doses from radon and its decay products from a tailings impoundment (Cotter Corporation's Canon City impoundment) regulated under 40 CFR Part 61 Subpart W do not represent a health threat.
- This conclusion goes directly to statements made in the lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action specifically the request to *"Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air…"*

The above reasons are why Kennecott Uranium Company is requesting that this draft Public Health Assessment be on the agenda for discussion on the Wednesday, October 6, 2010 conference call.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Dear Mr. Marschke: 2/16/2011

The required environmental data to perform a radon risk assessment for the Sweetwater Uranium Project is either already in the possession of the Environmental Protection Agency (EPA) or publically available. The following applies to the required data:

- Radon flux testing data for the Sweetwater Uranium Project tailings impoundment for calendar years 1990 to 2010 has been submitted to the Agency as required by 40 CFR Part 61 Subpart W. and is already available to Agency staff.
- Meteorological data in the Revised Environmental Report dated August 1994, represents a good long term summary of site's meteorological conditions and as such is representative and suitable for use. This document is available on the Nuclear Regulatory Commission's (NRC's) web site at the link below:
- http://pbadupws.nrc.gov/docs/ML0810/ML081010327.pdf
- The meteorological data provided in this document including, I believe, joint frequency distributions, is site specific data.
- Upwind and downwind radon activity data for ambient air collected using Landauer, Inc.'s TrakEtch devices has been submitted semiannually to the Nuclear Regulatory Commission (NRC) as part of the facility's semiannual 40.65 Reports and is publically available in the Commission's online ADAMS system.
- In addition, I believe that upwind and downwind radon activity data for ambient air was summarized in a submittal to the Commission in either the first half of 1998 or 1999 so that the

submittal plus any 40.65 Reports submitted from its date forward, provide a complete set of upwind and downwind radon activity data for the site. In any event, upwind and downwind radon activity data is submitted semiannually in the required 40.65 Reports and is available in the ADAMS system. I can check on the 1998 summary report when I return to the office and probably provide a link to it on the Nuclear Regulatory Commission's (NRC's) web site.

I am traveling this week and will return to the site on Tuesday, February 21, 2011. I would like to work with you upon my return to ensure that the risk assessment completed for the Sweetwater Uranium Project is based upon actual site conditions and measurements. Should you have any questions please call me at that time.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid Rosnick: 9/13/2010

The following:

- Attached please find the Adobe Acrobat Portable Document format (*.pdf) file *LincolnParkCotterUraniumMillPublicCommentPHA09092010.pdf* that contains the U.S. Public Health Service - Agency for Toxic Substances and Disease Registry (ATSDR) draft report entitled *Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010.*
- Kennecott Uranium Company requests that this document be on the agenda for discussion on the Wednesday, October 6, 2010 40 CFR Part 61 Subpart W conference call.
- This study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.*
- The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded:
  - *Outdoor concentrations of radon contributed zero dose to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay. On the other hand, the dose from radon decay products (e.g., lead-210) attached to respirable dust held constant year over year and accounted for an annual inhalation dose of four to seven millirem annually. Radon decay product concentration off-site did not appear to be related to releases from the site. Radon and its decay products appear to be from natural background and do not represent any health threat at the reported concentrations.*
- This is an important conclusion since the current review of 40 CFR Part 61 Subpart W is the result of a lawsuit filed against the Environmental Protection Agency (EPA) by Colorado Citizens Against Toxic Waste, Inc. and Rocky Mountain Clean Air Action primarily over alleged releases from the Canon City Mill. The filing states, "*Both organizations and their members are actively involved and deeply committed to the protection of the air and health of their communities against the deadly pollution that is associated with uranium milling and the disposal of uranium tailings. Both organizations and their members are directly effected by the ongoing operation of the uranium mill and associated mill tailings disposal facilities in, among other places, Canon City, Colorado."* The filing continues by requesting that the Environmental Protection Agency (EPA), "*Declare that NESHAP Subpart W allows unsafe and unhealthy levels of radon to be released into the air, even though the uranium mills can meet more stringent standards, and therefore declare that the regulations at 40 C.F.R. Part 61 Subpart W, 40 C.F.R. § 61.250 et seq. are invalid."*

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

Reid: 6/3/2010

The following pertains to the S. Cohen and Associates report entitled:

Final Report Review of Existing and Proposed Tailings Impoundment Technologies

It lists only three (3) extant convention uranium mills in the United States (Sweetwater, Canon City and White Mesa). It fails to list the Tickaboo Mill and tailings impoundment owned by Uranium One. It incorrectly lists the owner of the White Mesa mill as UMETCO when in fact the owner is Denison Mines.

- Table I from the report is below:

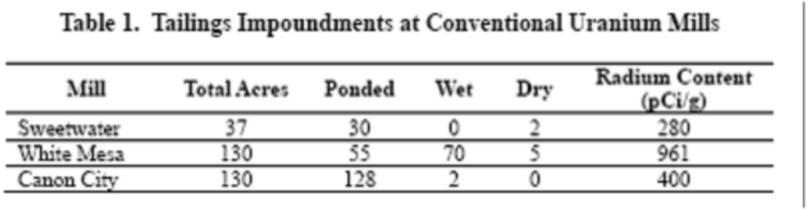


Table 1. Tailings Impoundments at Conventional Uranium Mills

Mill	Total Acres	Ponded	Wet	Dry	Radium Content (pCi/g)
Sweetwater	37	30	0	2	280
White Mesa	130	55	70	5	961
Canon City	130	128	2	0	400

- Table 1 lists the Sweetwater Uranium Project tailings radium content as 280 pCi/g.
- Attached please find the Adobe Acrobat Portable Document Format (*.pdf) file *tailings_radium_226_activity.pdf*.
  - This table is from *Final Design Volume VI – Existing Impoundment Reclamation Plan – Sweetwater Uranium Project* submitted to the Nuclear Regulatory Commission (NRC) on August 26, 1997 and is part of Docket 040-08584 for Source Materials License (SML) SUA-1350.
  - This table provides an average Radium-226 activity for the tailings of 70.9 pCi/g based on twenty (20) samples.
  - This table also provides an average emanation coefficient of 0.188 based on laboratory determination of emanation coefficient for eighteen (18) samples. This value is 54% of the default value of 0.35 used by the Nuclear Regulatory Commission (NRC) in *Regulatory Guide 3.64 – Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (U.S. Nuclear Regulatory Commission (NRC) – June 1989). The reason that this issue is being raised, is that when calculating radon flux from tailings and other earthen materials, the default emanation coefficient of 0.35 is often used and its use can lead to erroneously high radon fluxes.
- Table 3 from the report is shown below:

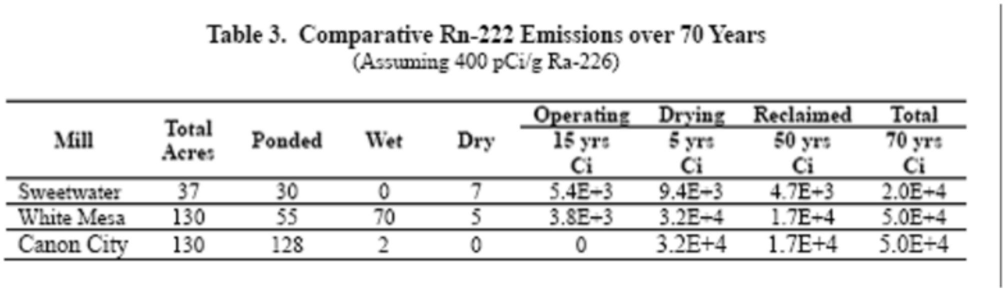


Table 3. Comparative Rn-222 Emissions over 70 Years
(Assuming 400 pCi/g Ra-226)

Mill	Total Acres	Ponded	Wet	Dry	Operating 15 yrs Ci	Drying 5 yrs Ci	Reclaimed 50 yrs Ci	Total 70 yrs Ci
Sweetwater	37	30	0	7	5.4E+3	9.4E+3	4.7E+3	2.0E+4
White Mesa	130	55	70	5	3.8E+3	3.2E+4	1.7E+4	5.0E+4
Canon City	130	128	2	0	0	3.2E+4	1.7E+4	5.0E+4

  - It assumes a long term tailings Radium-226 activity of 400 pCi/g.
  - As previously stated, the current Radium-226 activity in the impoundment averages 70.9 pCi/gram. Estimated Radium-226 activity of future tailings generated should operations resume, is 249 pCi/gram (weighted average of slimes and sand).

- This estimated activity is from Appendix H (Principal Parameters for Radiological Assessment (MILDOS Inputs) of the *Sweetwater Uranium Project – Revised Environmental Report* submitted to the Nuclear Regulatory Commission in August 1994 which is part of part of Docket 040-08584 for Source materials License (SML) SUA-1350.
- This estimated activity is based on the values in Appendix H specifically an estimate of 71% sand with a Radium-226 activity of 207 pCi/g and 29% slimes with a radium-226 activity of 353 pCi/g as per the table below:

	Activity	**Percentage**
Slimes:	353 picoCuries/gram	29%
Sand:	207 picoCuries/gram	71%
Weighted Average:	249 picoCuries/gram	100%

The above information pertains specifically to the three (3) items that were raised following your presentation. In addition, other discrepancies were noted in the report. The following are two (2) such items:

The document discusses Radon-222 source terms for in-situ uranium recovery. It discusses Radon-222 releases from mud pits and uses the variable [Ra] which is defined as Ra-226 concentration in the ore zone (pCi/g). The mud pit contains cuttings from the entire bore hole not just from the ore zone. The actual thickness of the ore zone is a fraction of the depth of the entire hole, thus the cuttings from the ore zone would be diluted with cuttings with substantially lower radium-226 activity from above the ore zone. In a typical 500 foot deep bore hole only ten (10) feet of it would be in an actual ore zone. Cuttings from the ore zone would only represent 2% of the total cuttings mass. Use of the Radium-226 activity of the ore zone to describe the activity of the entire drill cuttings mass is incorrect.

Table 4 lists the following operating in-situ uranium recovery operations:

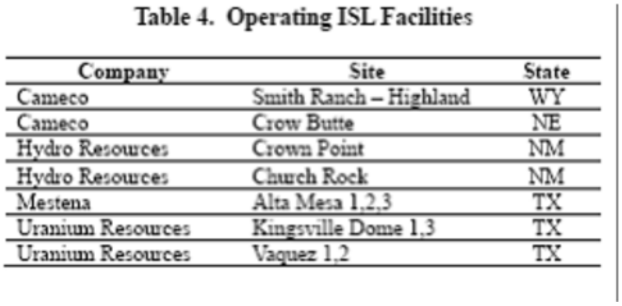


Table 4. Operating ISL Facilities

Company	Site	State
Cameco	Smith Ranch – Highland	WY
Cameco	Crow Butte	NE
Hydro Resources	Crown Point	NM
Hydro Resources	Church Rock	NM
Mestena	Alta Mesa 1,2,3	TX
Uranium Resources	Kingsville Dome 1,3	TX
Uranium Resources	Vaquez 1,2	TX

It lists Hydro Resources, Inc. Crownpoint and Churchrock facilities as operating, which they are not. In addition, I believe that Uranium Resources, Inc's Kingsville Dome and Vasquez Projects are currently not operating.

If you have any questions or require additional data please do not hesitate to contact me.

Oscar Paulson

Facility Supervisor
Kennecott Uranium Company
Sweetwater Uranium Project

END OF EMAIL

Mr. Rosnick 10/1/2010

The Wyoming Mining Association (WMA) is very concerned about claims that uranium mining and processing may contribute to health impairment from the release of radon from uranium processing facilities. WMA would like to draw your attention to the attached report entitled Public Health Assessment for LINCOLN PARK/COTTER URANIUM MILLCAÑON CITY, FREMONT COUNTY, COLORADO EPA FACILITY ID: COD042167585 SEPTEMBER 9, 2010. In summary the study *concludes that ambient air emissions of particle bound radionuclides have not resulted in exposures to the public at levels that could cause adverse health outcomes.* The ATSDR looked at all of the air data collected from 1979 to present related to Cotter Corporation's Canon City Mill and concluded that outdoor concentration of radon contributed zero dust to the public, because it is a noble gas and does not stay in the lungs long enough to radioactively decay.

I understand that there will be a conference call on October 6 to discuss 40 CFR Part 61 Subpart W which deals with this issue. WMA requests that this study be on the agenda for discussion during that conference call.

Thank you.

Marion Loomis

END OF EMAIL

Dear Mr. Rosnick, 1/6/2011

I note that the Subpart W review documents on the Subpart W Rulemaking Activity Website in the Historical Rulemakings section includes the Draft EIS for the Proposed Radionuclides rulemaking, dated February 1989. However, this is only Volume 1 of a 3-volume draft EIS.

I request that the all 3 volumes of the Final EIS, September 1989, be placed with the Historical Rulemakings documents.

Sarah Fields
Uranium Watch

Hello Reid, 1/6/2011

During this morning's conference call re the Subpart W review, Cotter stated that they had not received
any request for information from the EPA.

Cotter was sent a letter in 2009 asking them for information; at least a letter that is addressed to them is on the Subpart W Review website:

http://www.epa.gov/radiation/docs/neshaps/subpart-w/uranium%20cotter%20test.pdf

Sarah Fields
Uranium Watch

On Jan 7, 2011, at 6:28 AM, Rosnick.Reid@epamail.epa.gov wrote:

Hello Sarah,

You are correct that Cotter was sent a letter in 2009. That letter was an information request from our enforcement office, and asked for a number of items that are related to our discussion from Wednesday. However, the debate on Wednesday was focused on whether our contractor, in preparing the risk assessment draft document within the last 2 months, contacted Cotter for real-time radon flux data, as well as meteorological data specific to the Canon City area. As we discussed on Wednesday, most of that data is available on-line at NRC's ADAMS website. I am waiting for confirmation from the contractor on exactly how they obtained the Cotter data.

Separately, I saw that there was a BLM/USFS public meeting last night regarding the plan of operations amendment for the expansion of the LaSal mine. I would be interested in your take on the meeting. Thank you.

Reid

Reid, 1/8/2011

The BLM/USFS Meeting on the expansion of the La Sal Mine is on January 13. I will not be there. I had already made plans
to go to Denver for the NRC uranium recovery workshop long before the BLM announced the scoping meeting in La Sal.

There are a number of outstanding issues related to the La Sal Mines, including Subpart B compliance.

Sarah

Dear Reid, 7/7/2011

During our conference in April, heap leach was brought up. I thought you might be interested in knowing that Cotter sent a letter on June 17th to CDPHE announcing that they will be constructing a heap leach operation on top of their Secondary Impoundment. The letter is available here:

http://www.cdphe.state.co.us/hm/cotter/letterfromcotter/110617strategy.pdf

Sharyn
~~~~~~
Sharyn Cunningham
CCAT Co-Chair
RMC Sierra Club Uranium Milling-Mining Specialist

END OF EMAIL

Dear Mr. Rosnick,   4/6/2012

Another issue that I failed to mention yesterday with respect the Subpart W rulemaking is the gapping regulatory hole when it comes to uranium mill tailings impoundments after they cease to be operational and, according to current EPA regulation, are no longer subject to the Subpart W flux standard. (For now, we'll just ignore the issues regarding exactly when that point in the life of a tailings impoundment occurs.)

My understanding is that one operation ceases and the closure period commences there is no radon flux standard. My understanding is that at the time the closure period commences there must be a closure plan and reclamation milestones that have been approved by the State or NRC.

The problem is, as stated in the 1989 Subpart W final rule:

"EPA recognizes that the risks from mill tailings piles can increase dramatically if they are dry and uncovered can be seen in the proposed rule, 54 FR 9645. That analysis assumed that the piles were dry and uncovered and the risks were as high as 3 x 10 (to the -3) with 1.6 fatal cancers per year." The EPA than assumes that the piles will be wet or covered, then be "disposed of."

The problem is that during the "closure" or "disposal" period tailings impoundments dry out more and, in fact, interim soil covers interfere with the drying and settling processes. Apparently, this is happening at the White Mesa Mill.
Even now, I believe that the estimate of time for the drying/settling process for Cells 2 and 3 at White Mesa is 10 years. That may be a minimal estimate.
So whether an older cell with a radon flux standard or a newer 40-acre cell, there can be a period of time when radon emissions and potential for dispersal of radioactive particulates increases. Yet, there is no flux standard during this period, unless the period goes beyond the established reclamation milestone for the final radon barrier.
~~~~~~

This is something the EPA Subpart W changes must address.

Also, there are proposals for open pit uranium mines near uranium recovery operations. With the EPA failure to establish a radon standard for surface uranium mines, you would have a regulated NESHAP facility next to one where the EPA has fallen short of its regulatory responsibility.

Also, remember the FOIA response where you asked for me to agree to an extension of time for EPA response.?

Do you think that I ever got a response to that FOIA after the EPA sent me the letter of October 12, 2011? Did you ever check on that?

Well, I never did get the FOIA response. This does not surprise me.

I have good reason to be frustrated at the EPA, and the State of Utah's radioactive NESHAP program.

Sarah Fields
Program Director
Uranium Watch
PO Box 344
Moab, Utah 84532
435-259-9450

Dear Ms. Fields, 4/11/2012

Thank you for your comments. I will have them posted in the email section of the Subpart W website.

Regarding your comments on the FOIA, on October 18, 2011 you sent an email to me stating that you would like to proceed with the FOIA, but you were going to update the request to cover documents after the FOIA was submitted. We never received your request for the update. If you sent something to our FOIA office please forward it to me so we can track the breakdown in communications. Thank you.

Reid