Figures

in the

Engineering Evaluation/Cost Analysis

Revised and Updated 2010

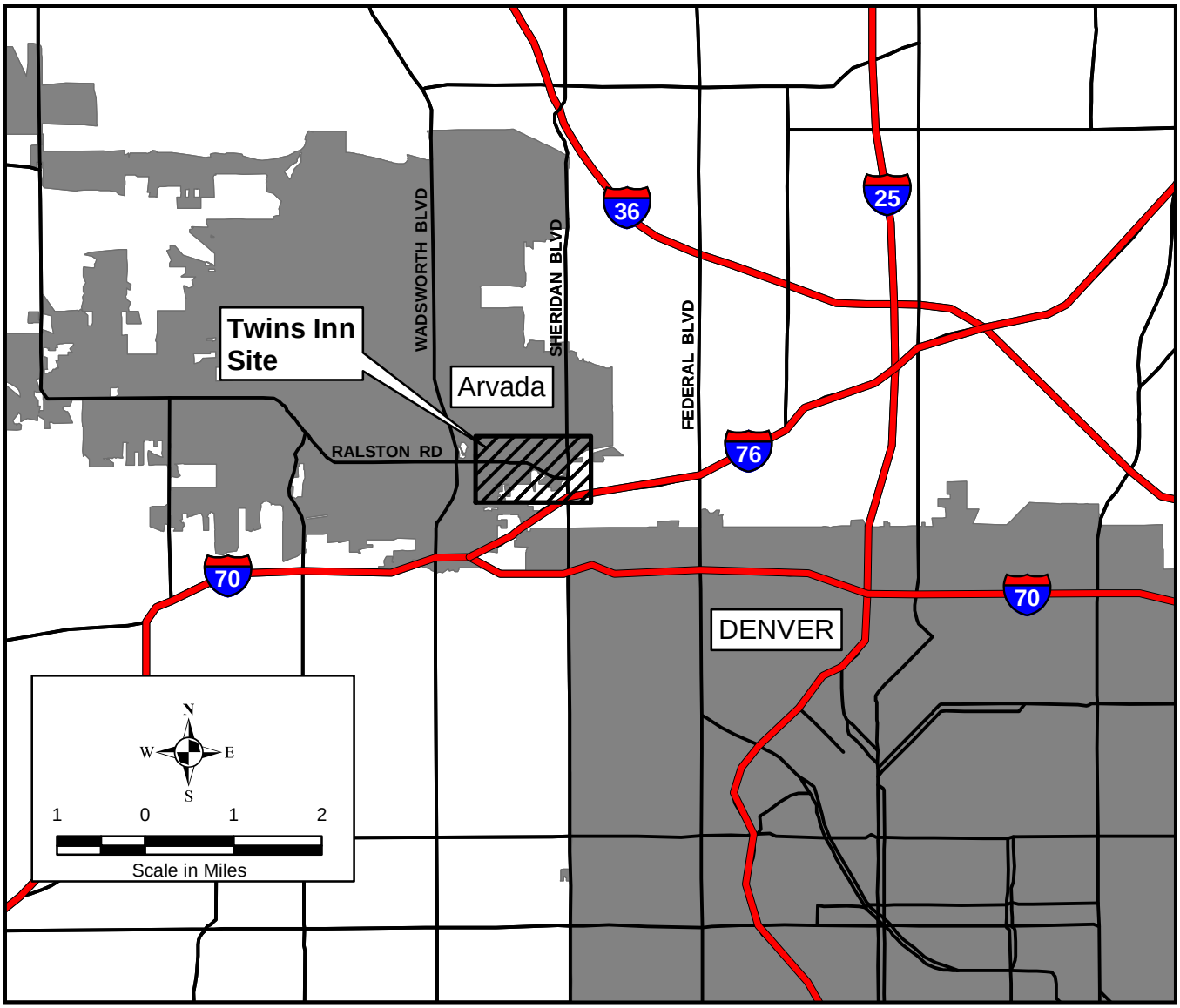
for the

Twins Inn Site

Arvada, Colorado

U.S EPA, Region 8

Figures



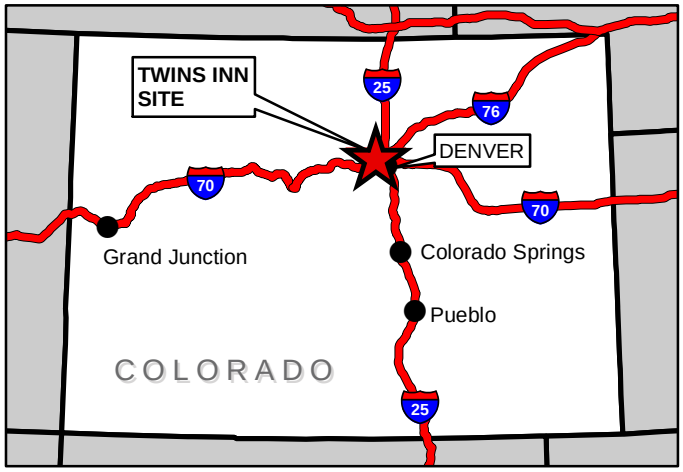
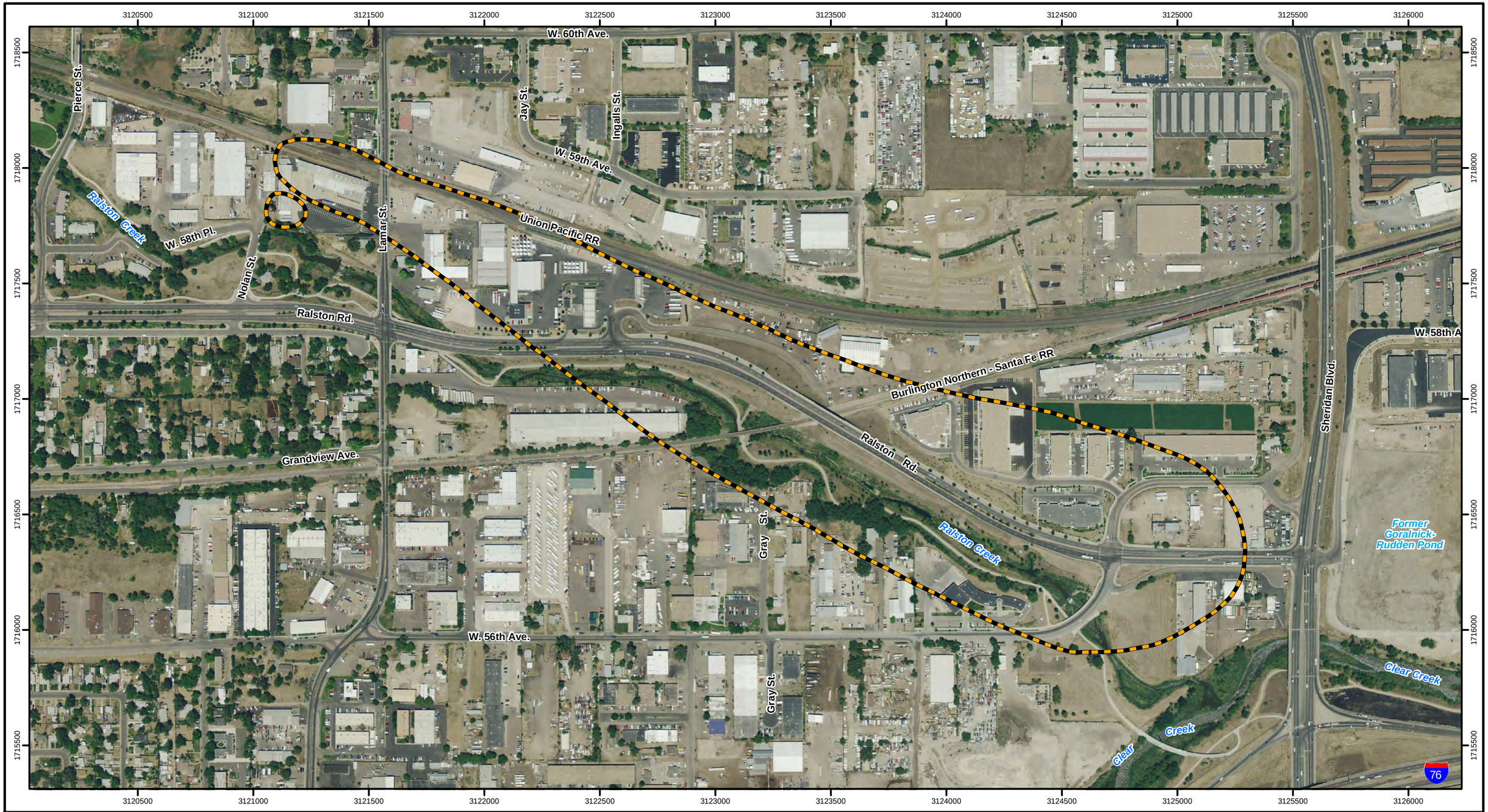


Figure 1-1 LOCATION OF THE TWINS INN SITE

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

URS

PROJECT NO.	DRAWING NO.	DATE
41568493	location_map.mxd	5/12/10



EXPLANATION

Plume Extent

NOTES:
Plume outline is based on TCE concentrations greater than 5 ug/L from September 2009.
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

400 0 400 Feet

Scale 1:4800 or 1" = 400'

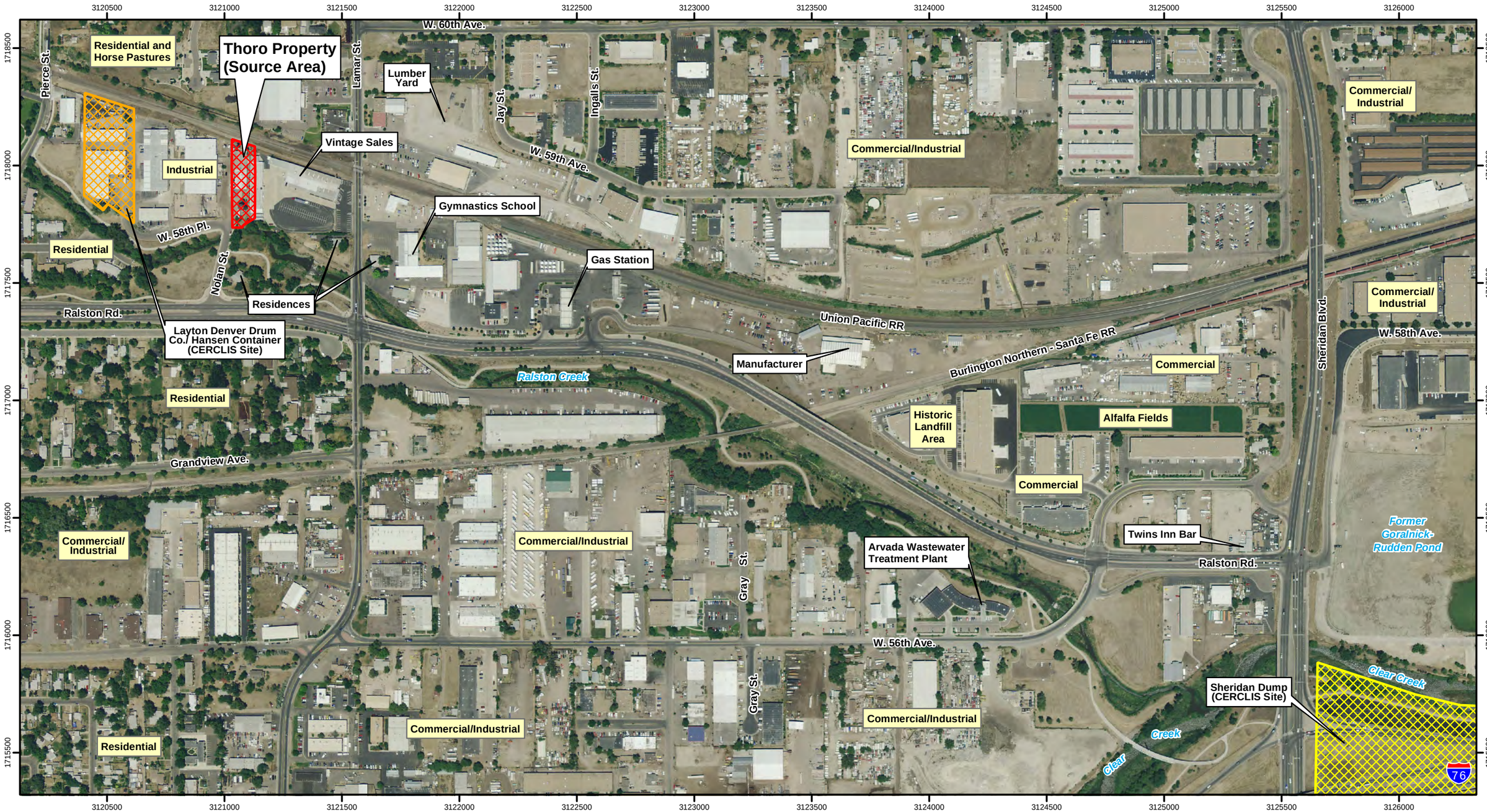
N W E S

URS

Figure 1-2 PLUME EXTENT (2009)

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	historical_plume.mxd	5/13/10



EXPLANATION

- Layton Denver Drum Co./Hansen Container (CERCLIS Site)
- Sheridan Dump (CERCLIS Site)
- Thoro Products Property

NOTES:
CERCLIS = Comprehensive Environmental Response, Compensation, and Liability Information System
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

400 0 400 Feet

Scale 1:4800 or 1" = 400'

N W E S

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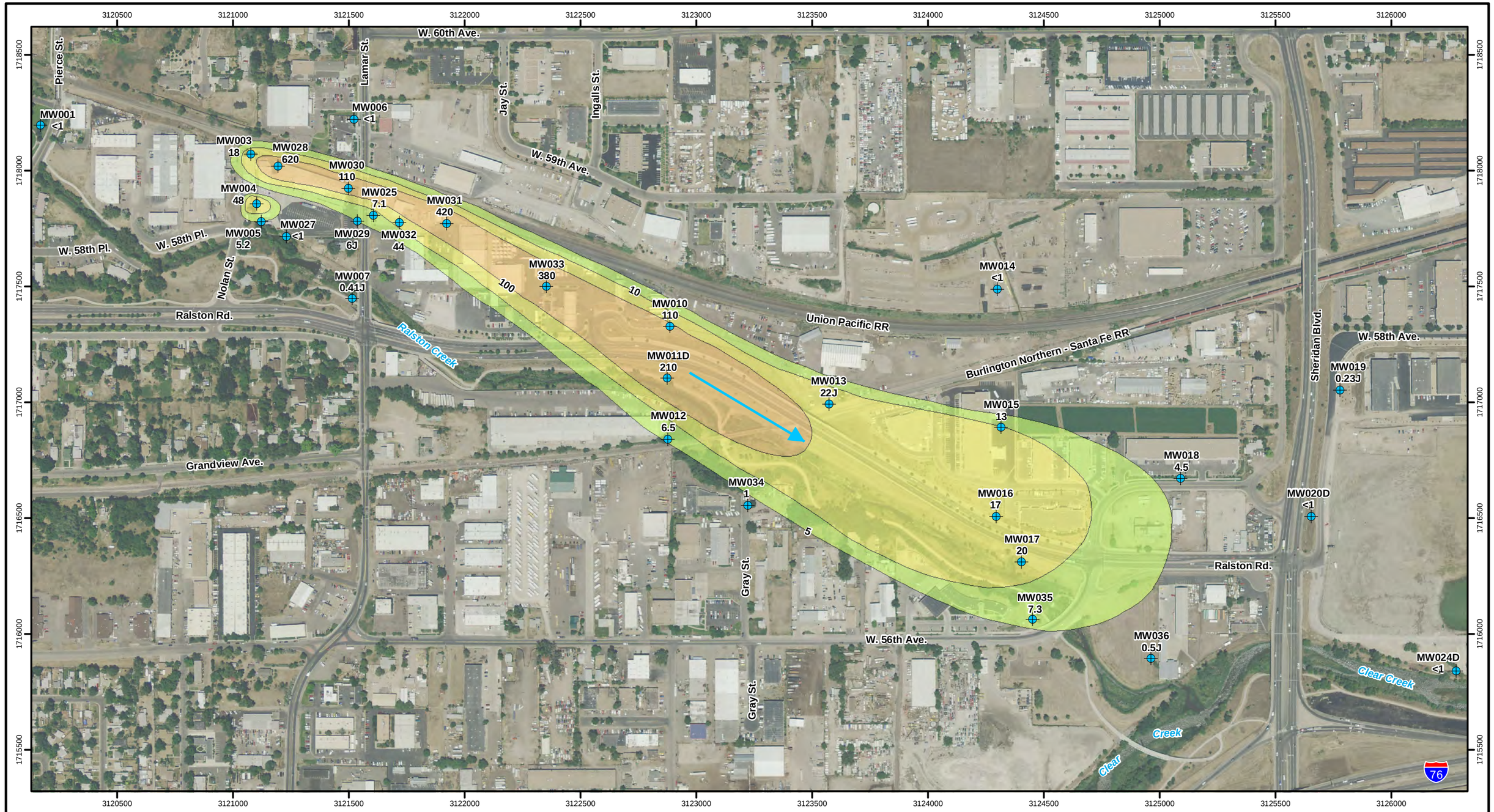
Figure 1-3 FEATURES IN THE VICINITY OF THE TWINS INN SITE

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	vicinity_features.mxd	5/13/10



EXPLANATION

Monitoring Well (MW)

Groundwater Flow Direction

September 2009 PCE Concentrations (µg/L)

- 5-9
- 10-99
- > 100

MCL/CBSG for PCE is 5 µg/L.

NOTES:
CBSG = Colorado Basic Standard for Groundwater
MCL = Maximum Contaminant Level
PCE = Tetrachloroethene
µg/L = Micrograms per liter
J = The associated value is an estimated value
Aerial photograph was taken July 2008
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88

400 0 400 Feet

Scale 1:4800 or 1" = 400'

N W E S

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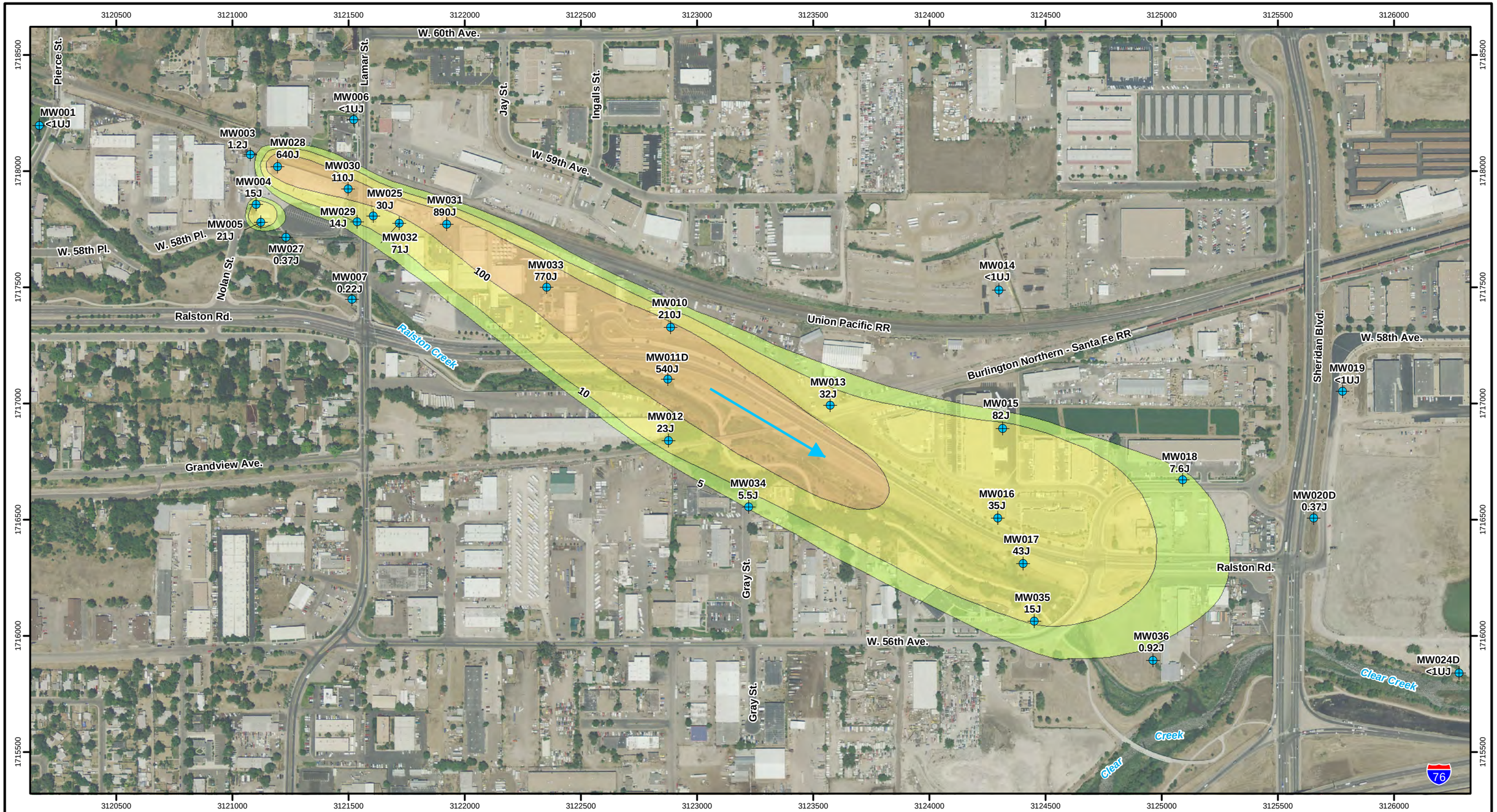
Figure 1-4 PCE CONCENTRATIONS IN GROUNDWATER, SEPTEMBER 2009

TWINS INN

ENGINEERING EVALUATION/COST ANALYSIS

ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	pce_0909.mxd	5/10/10



EXPLANATION

Monitoring Well (MW)

Groundwater Flow Direction

September 2009 PCE Concentrations (µg/L)

- 5-9
- 10-99
- > 100

MCL/CBSG for TCE is 5 µg/L.

NOTES:
CBSG = Colorado Basic Standard for Groundwater
MCL = Maximum Contaminant Level
TCE = Trichloroethene
µg/L = Micrograms per liter
< = The value is less than the Reporting Limit
J = The associated value is an estimated value
UJ = Trichloroethene was analyzed for, but was not detected. The associated value is an estimated value and may be inaccurate or imprecise.
Aerial photograph was taken July 2008
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88

400 0 400 Feet

Scale 1:4800 or 1" = 400'

N W E S

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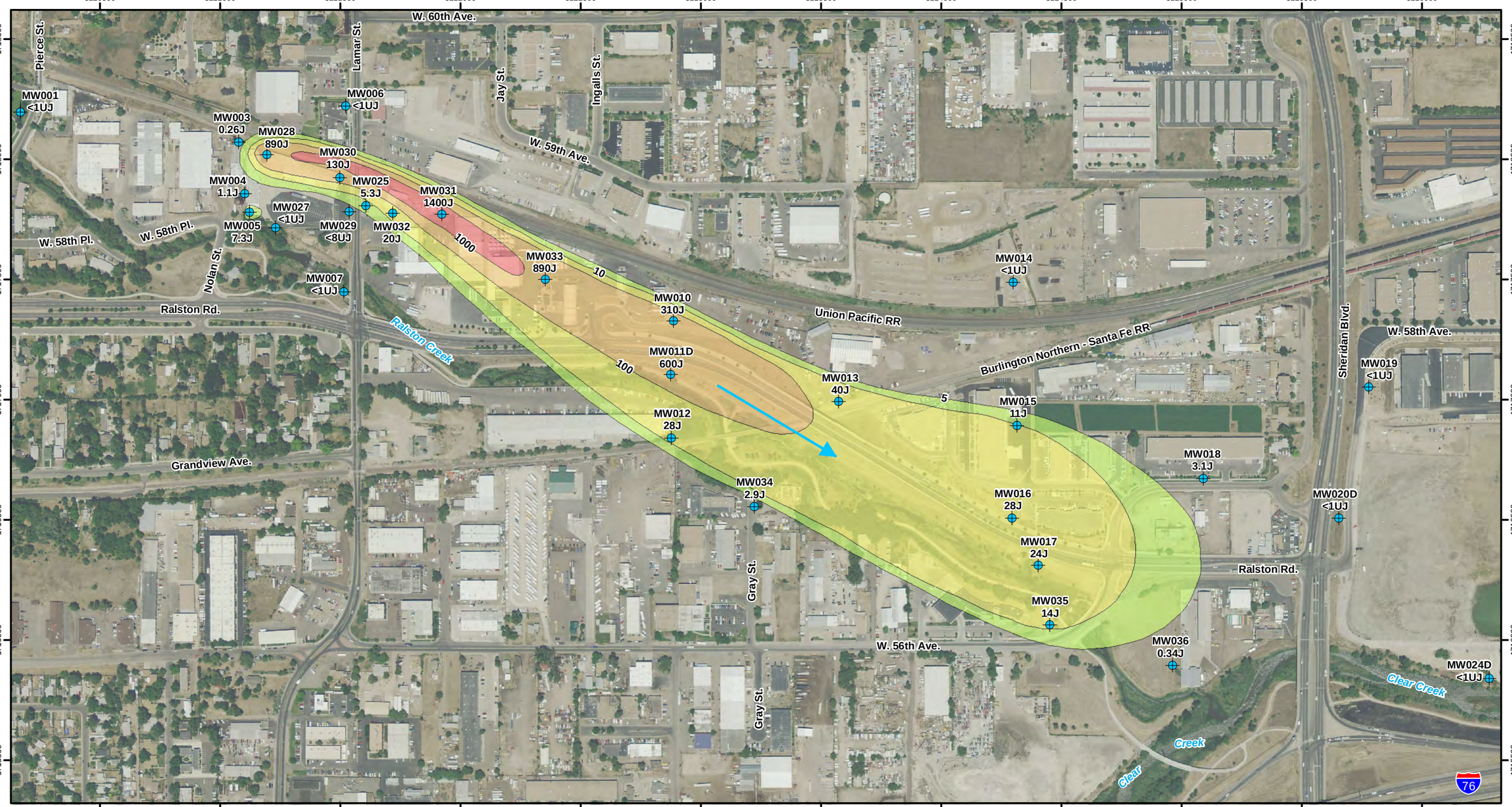
Figure 1-5 TCE CONCENTRATIONS IN GROUNDWATER, SEPTEMBER 2009

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	tce_0909.mxd	5/10/10



EXPLANATION

Monitoring Well (MW)

Groundwater Flow Direction

September 2009 1,1,1-TCA Concentration Contour (µg/L)

- 5-9
- 10-99
- 100-999
- > 1000

MCL/CBSG for 1,1,1-TCA is 200 µg/L.

NOTES:
CBSG = Colorado Basic Standard for Groundwater
MCL = Maximum Contaminant Level
1,1,1-TCA = 1,1,1-Trichloroethane
µg/L = Micrograms per liter
< = The value is less than the Reporting Limit
J = The associated value is an estimated value
UJ = 1,1,1-Trichloroethane was analyzed for, but was not detected. The associated value is an estimated value and may be inaccurate or imprecise.
Aerial photograph was taken July 2008
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88

400 0 400 Feet

Scale 1:4800 or 1" = 400'

N W E S

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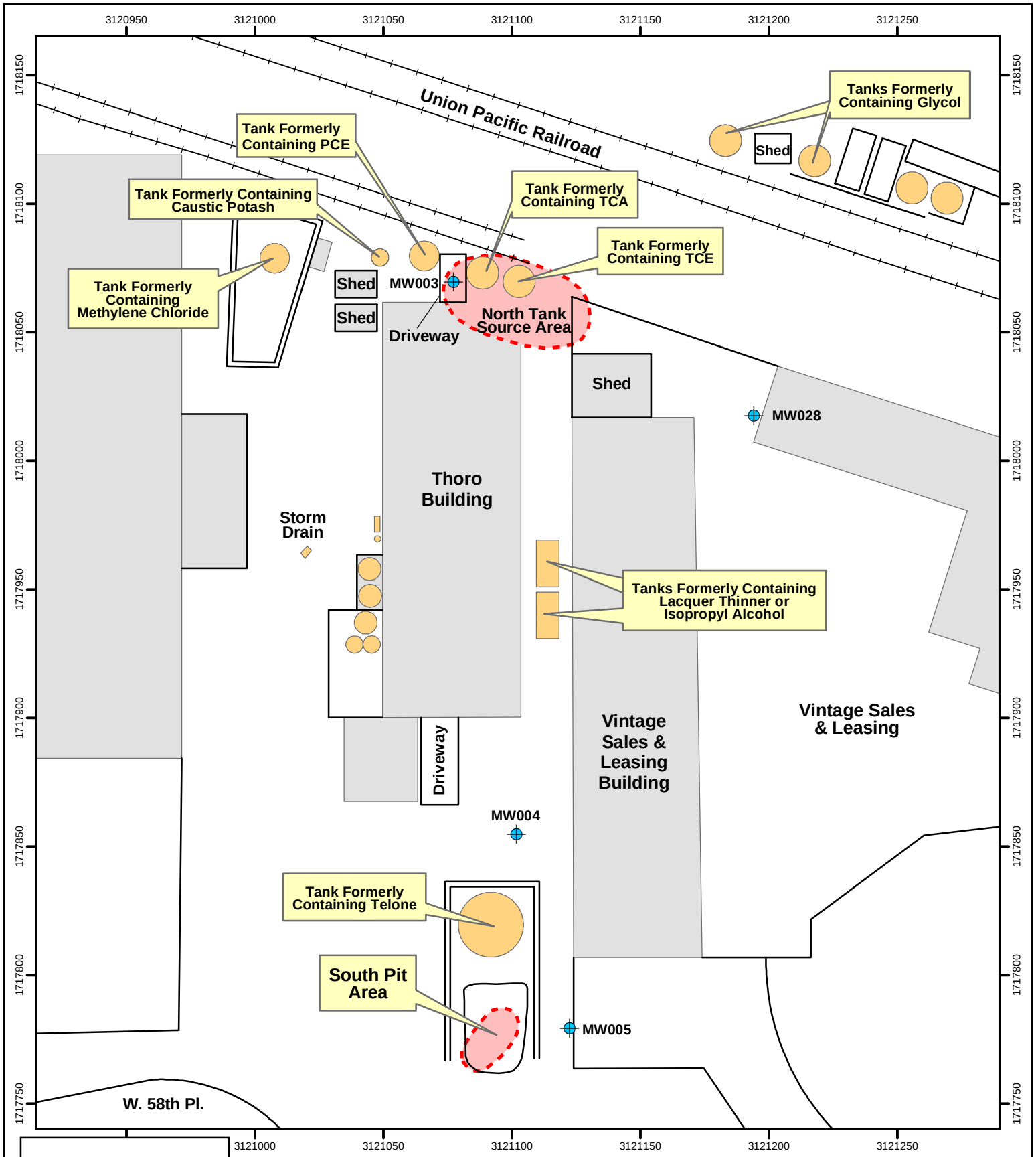
Figure 1-6 1,1,1-TCA CONCENTRATIONS IN GROUNDWATER, SEPTEMBER 2009

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	tca_0909.mxd	5/10/10



EXPLANATION

- Monitoring Well
- Railroad
- Approximate Source Area or Hot spot
- Aboveground Tank
- Existing Building

50 0 50 Feet

Scale 1:600 or 1" = 50 feet

NOTES:
Coordinates reference, State Plane Feet, Colorado North Zone, NAD83
TCE = Trichloroethene
PCE = Tetrachloroethene
TCA = Trichloroethane

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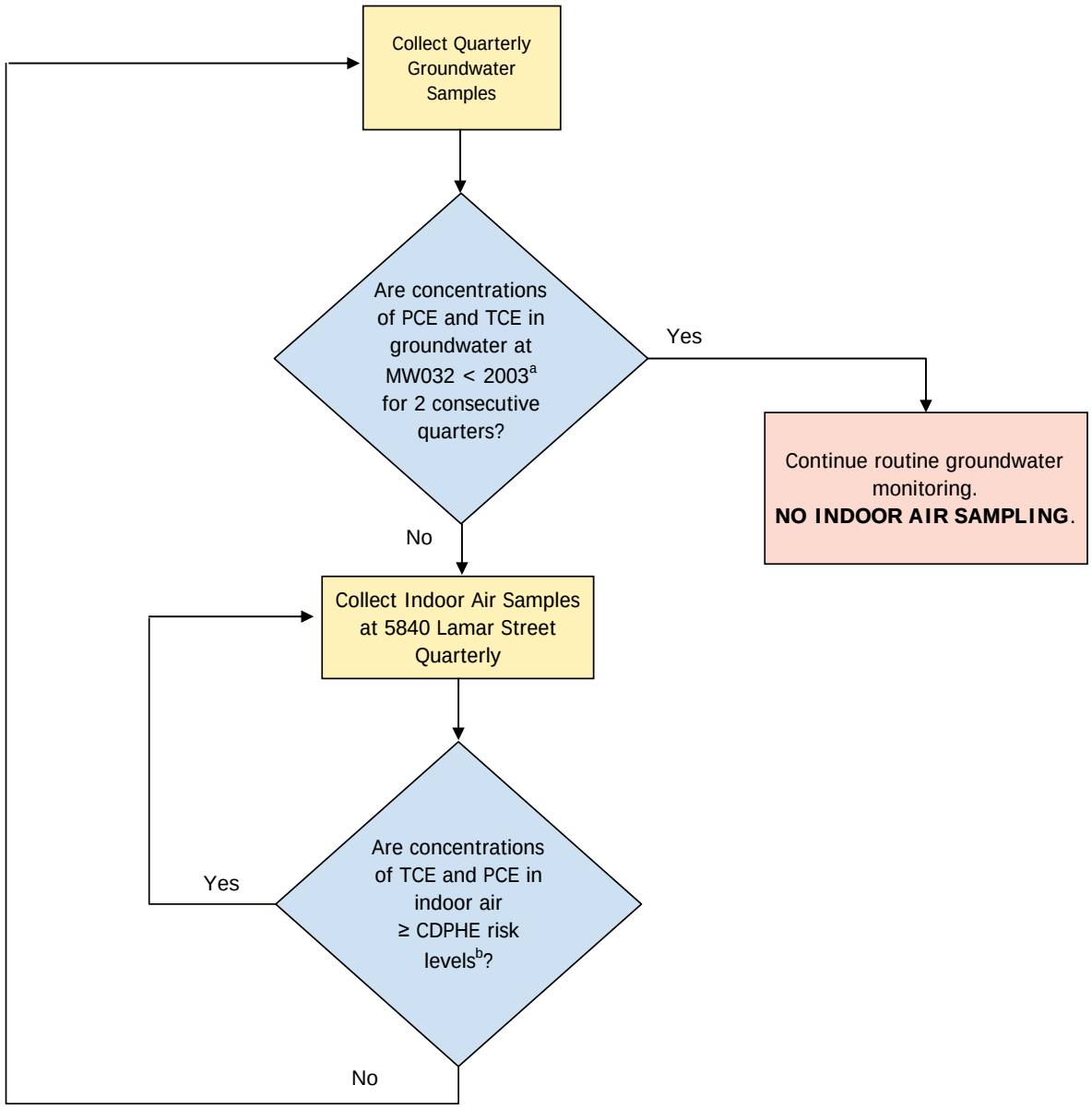
Figure 1-7 LOCATIONS OF THE NORTH TANK SOURCE AREA AND SOUTH PIT AREA

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	source_areas.mxd	5/10/10

Figure 1-8
Indoor Air Monitoring Decision Flow Chart
Twins Inn Site - Engineering Evaluation/Cost Analysis



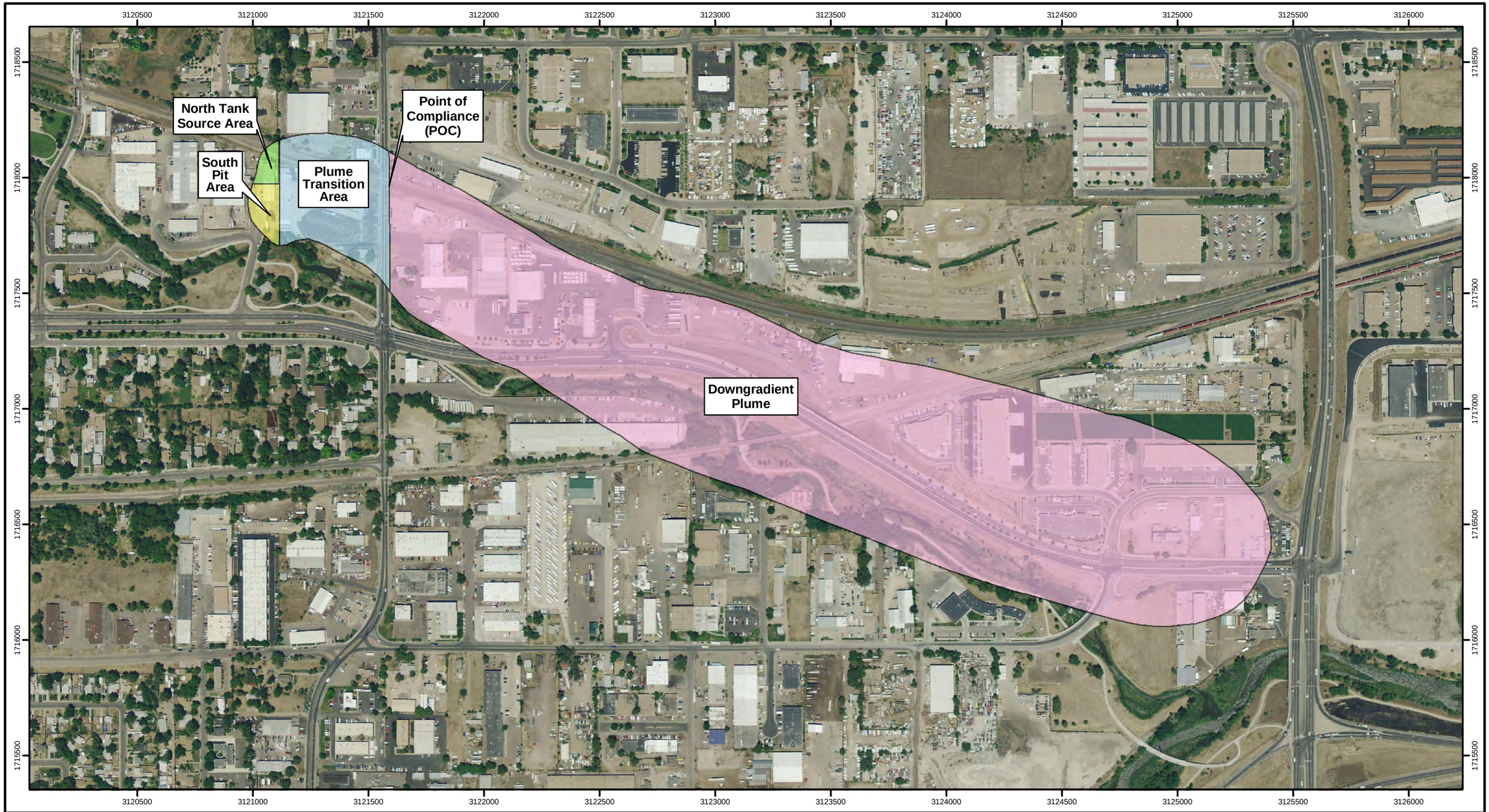
Notes:

[a] Per the Twins Inn Site, August 2003 Site-Wide Groundwater Sampling Event, Data Submittal (see table of 2003 Concentrations below)

	2003 Concentrations (µg/L)	
	PCE	**TCE**
MW032	170	190

[b] CDPHE Hazardous Materials and Hazardous Waste Management Division, Policy on an Interim Risk Evaluation and Management Approach for PCE dated August 16, 2006 and for TCE dated August 20, 2004.

CDPHE Indoor Air Interim Action Levels	
PCE	31 µg/m^3
TCE	1.6 µg/m^3



EXPLANATION

Plume Areas

- North Tank Source Area
- South Pit Area
- Plume Transition Area
- Downgradient Plume

NOTES:
POC = Point of Compliance - Not applicable for GW8
2006 Plume Extent Shown
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

400 0 400 Feet
Scale 1:4800 or 1" = 400'

N W E S

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Figure 2-1 LOCATIONS OF THE POC AND PLUME AREAS

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	poc_plume_areas.mxd	5/13/10

80 0 80 Feet

Scale 1:960 or 1" = 80'

NOTE:
Coordinates reference State, Plane Feet, Colorado Central Zone, NAD83
Aerial photograph was taken July 2008

EXPLANATION

Location of Grid Cell (10'x10')

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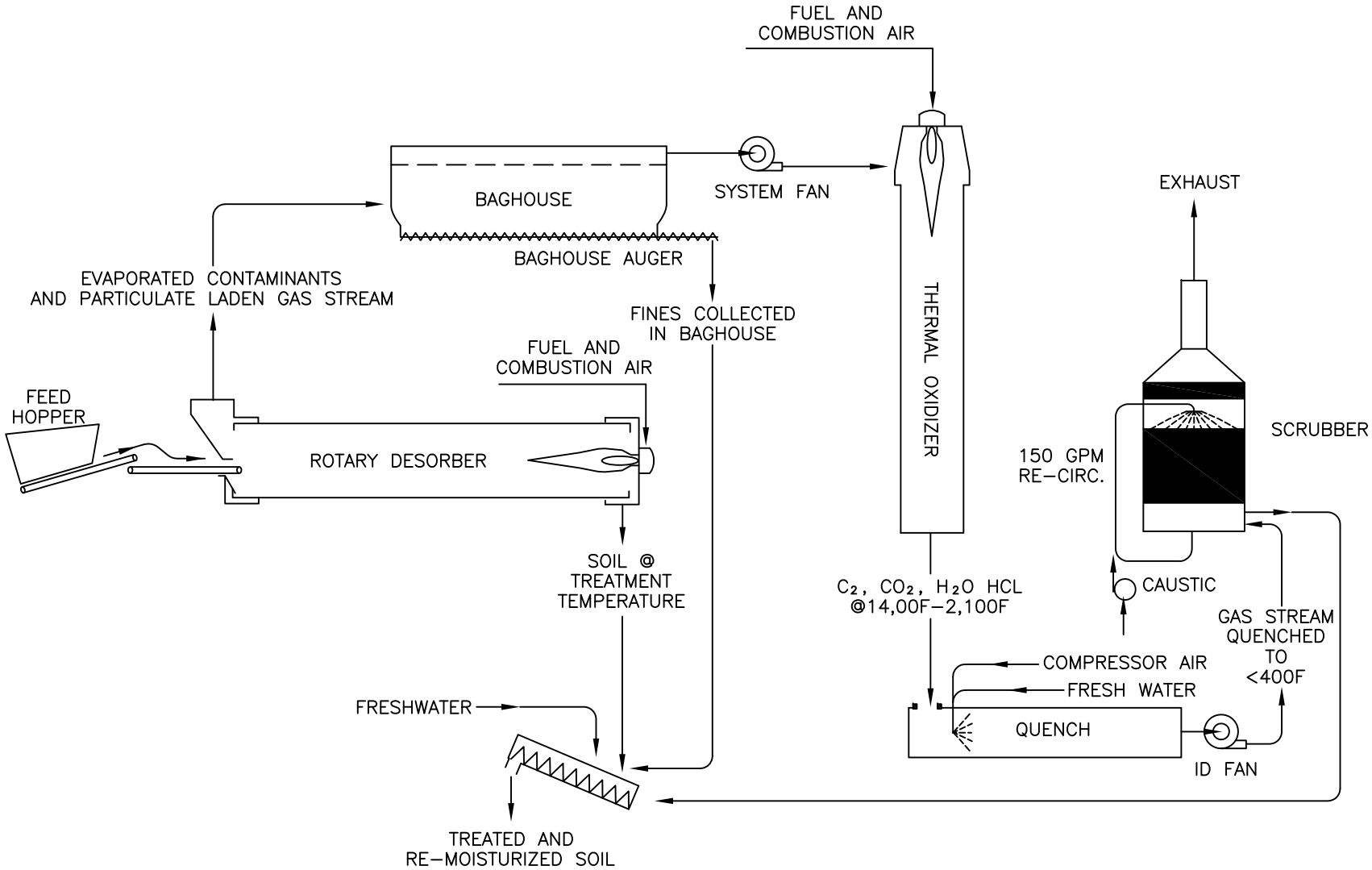
Figure 4-1 PROPOSED SOIL EXCAVATION AREAS

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

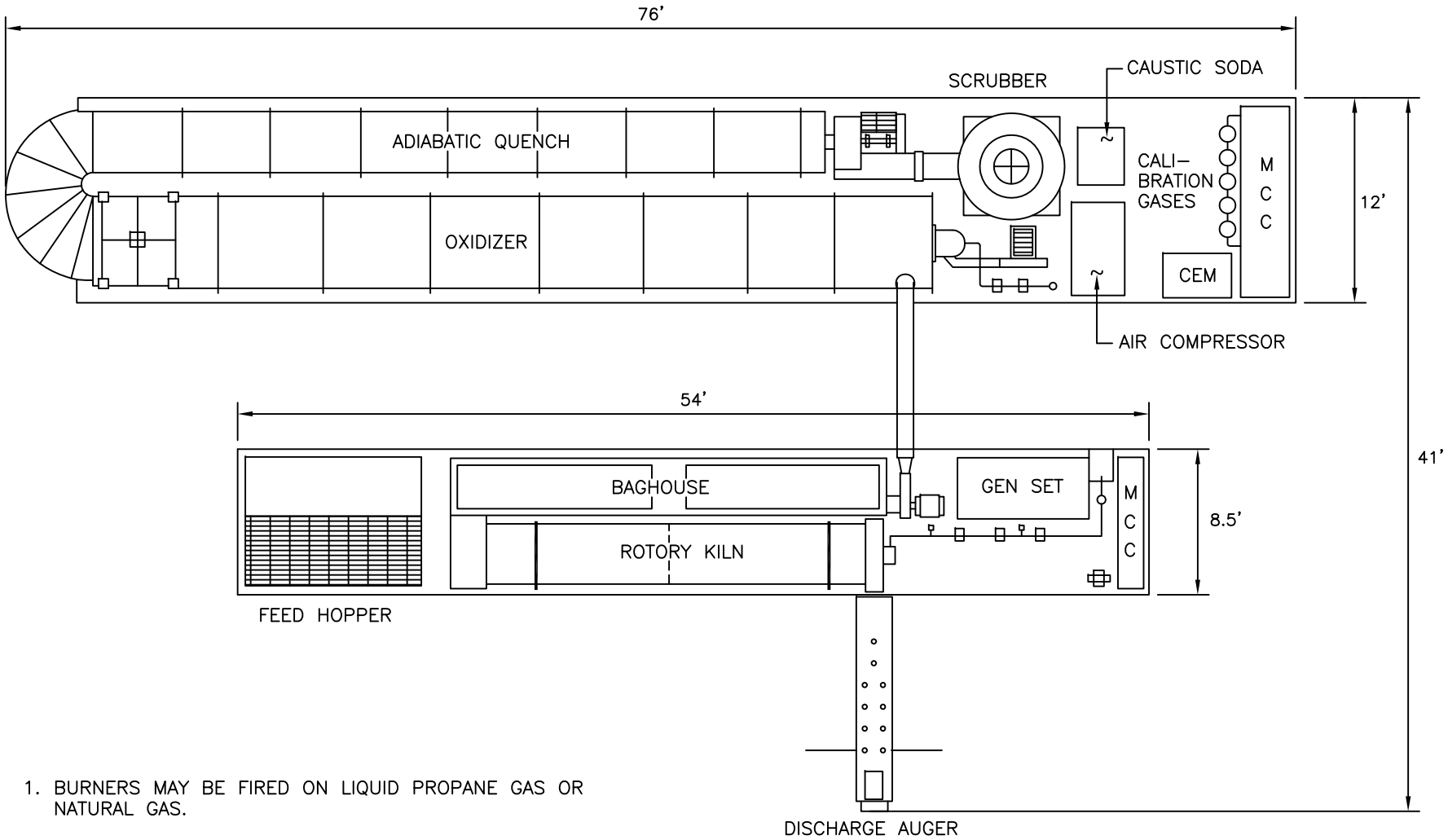
PROJECT NO.	DRAWING NO.	DATE
41568493	prop_exc_area.mxd	5/10/10



NOTE:
ORIGINAL DRAWING FROM MIDWEST SOIL REMEDIATION, INC. DATED 6/18/02

Job No. : 41568493	TWINS INN ENGINEERING EVALUATION/COST ANALYSIS
Prepared by : KLB	FIGURE 4-2 THERMAL DESORPTION PROCESS FLOW DIAGRAM
Date : 5/18/10	

Y:\GIS\Projects\Twins_Inn\68rad00216RI\projects_10\Eng_Eval_Cost_Analysis\TIFS-07.dwg



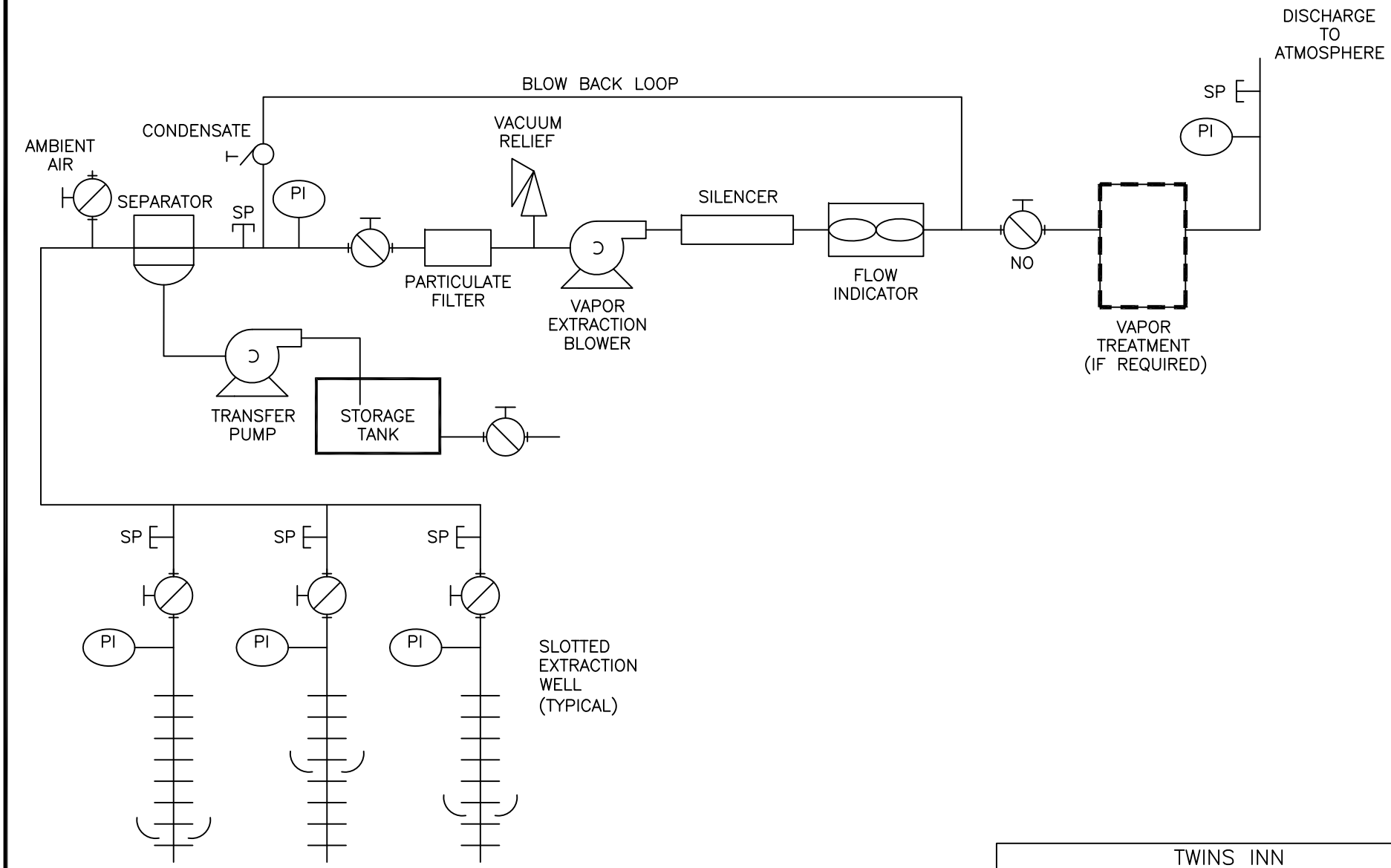
1. BURNERS MAY BE FIRED ON LIQUID PROPANE GAS OR NATURAL GAS.
2. GAS SUPPLIES SHALL BE SIZED FOR 30MMBTU.
3. WASTE FEED PROFILE WILL BE THE BASIS FOR CAUSTIC USAGE ESTIMATION.
4. WATER SUPPLY SHALL BE 45gpm @ 10psi MINIMUM.
5. ELECTRICITY SUPPLIED BY ON BOARD GENERATOR.
6. DIESEL CONSUMPTION IS 120 GAL/DAY (24 HRS.)

NOTE:
ORIGINAL DRAWING FROM MIDWEST SOIL REMEDIATION, INC. DATED 6/18/02

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS

Job No. : 41568493	FIGURE 4–3 THERMAL DESORPTION EQUIPMENT LAYOUT
Prepared by : KLB	
Date : 5/18/10	

Y:\GIS\Projects\Twins_Inn\68rad00216RI\projects_10\Eng_Eval_Cost_Analysis\TIFS–08.dwg



TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS

Job No. : 41568493	FIGURE 4-4
Prepared by : URS	TYPICAL SVE SYSTEM SCHEMATIC
Date : 5/18/10	

Y:\GIS\Projects\Twins_Inn\68rad00216RI\projects_10\Eng_Eval_Cost_Analysis\TIFS-09.dwg

EXPLANATION

Existing Monitoring Well (MW)

NOTES:
MNA = Monitored Natural Attenuation
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

400 0 400 Feet
Scale 1:4800 or 1" = 400'

N W E S

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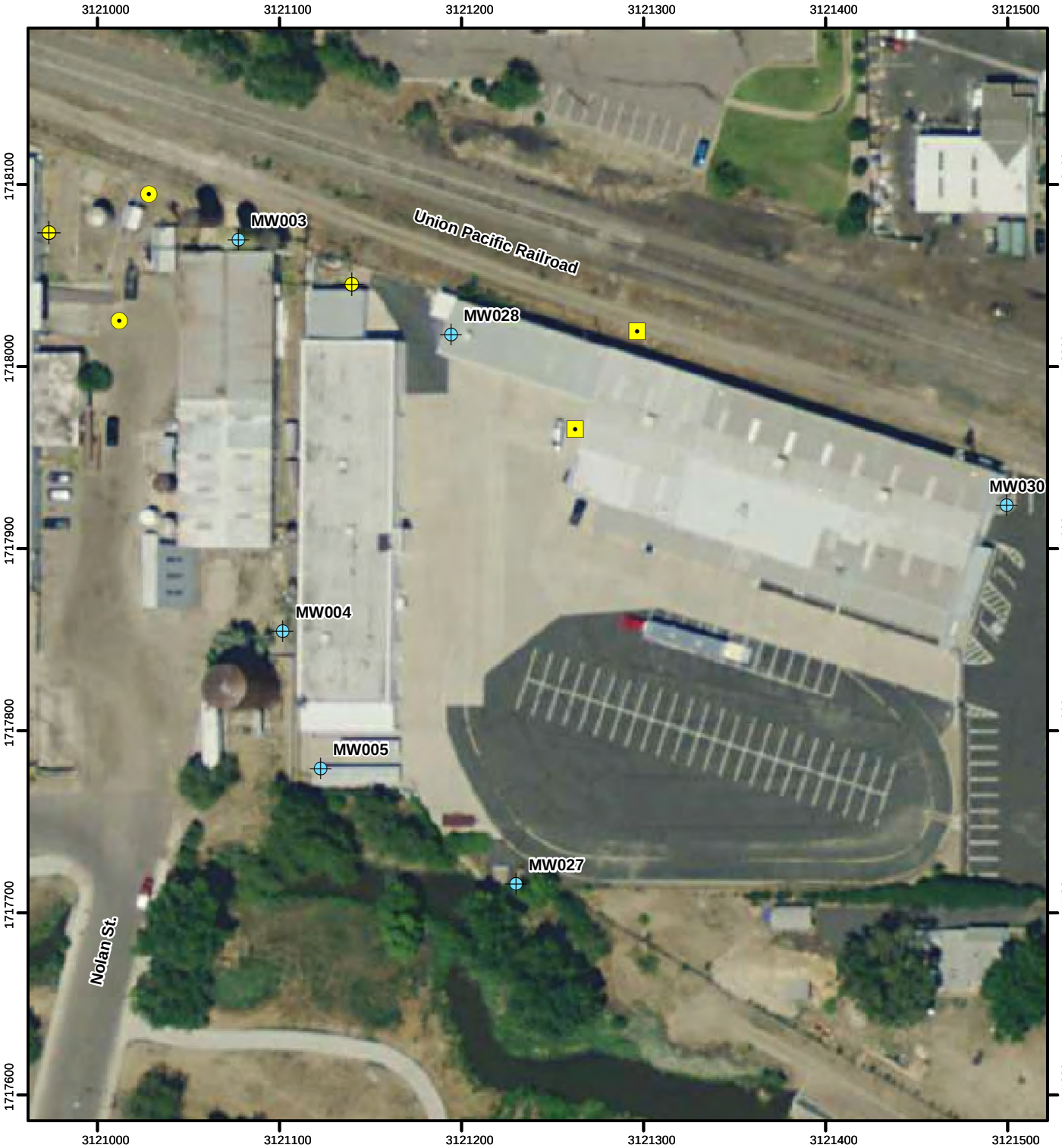
Figure 5-1 PROPOSED MNA PERFORMANCE MONITORING WELL LOCATIONS

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	mna_proposed.mxd	5/13/10



NOTES:
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83
Aerial photograph was taken July 2008

80 0 80 Feet

Scale 1:960 or 1" = 80'

EXPLANATION

Existing Monitoring Well (MW)

Proposed Locations

Extraction Well

Injection Well

New Monitoring Well

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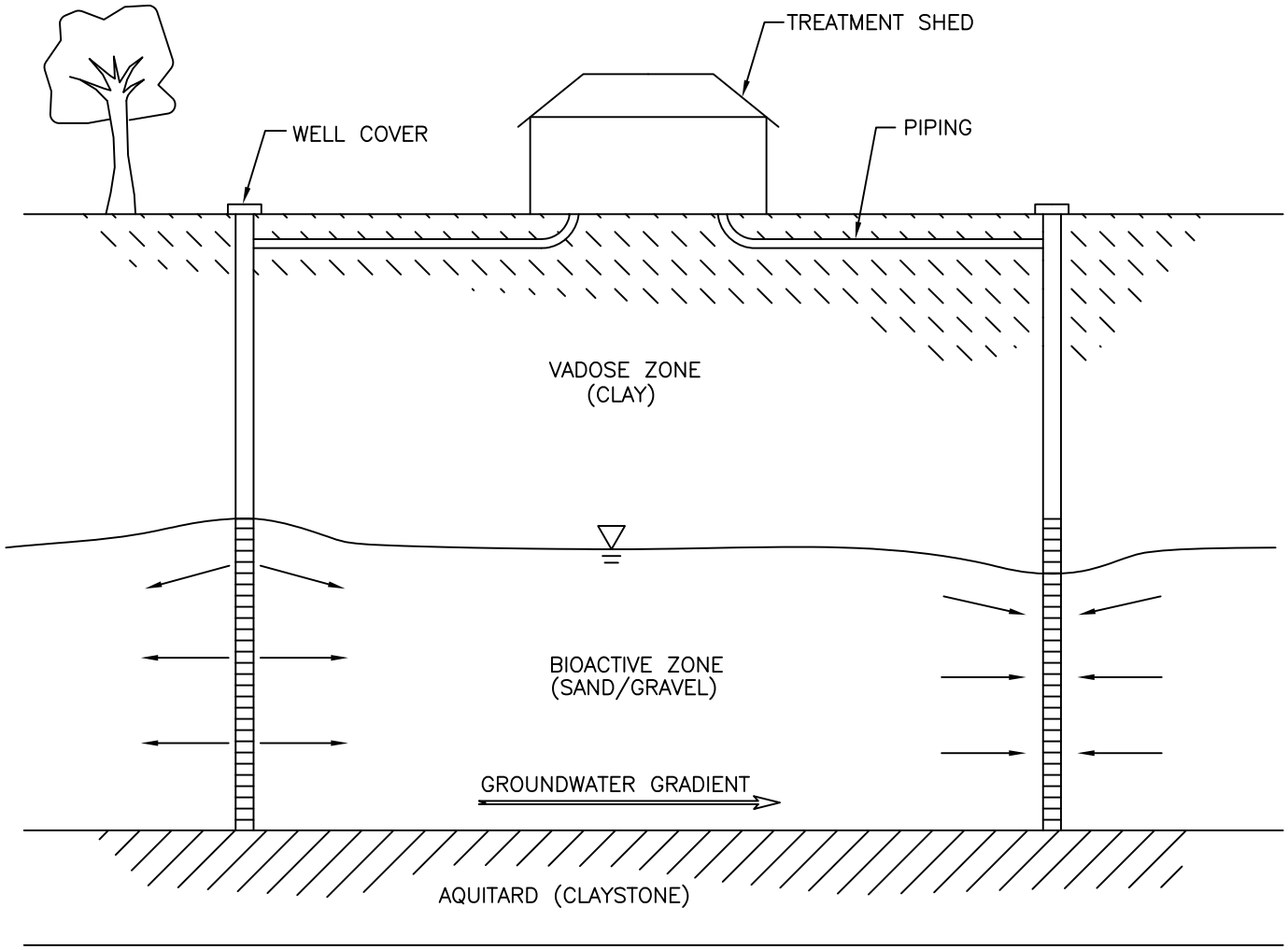
Figure 5-2 Proposed Anaerobic Biorecirculation System Extraction, Injection, and Monitoring Well Locations

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

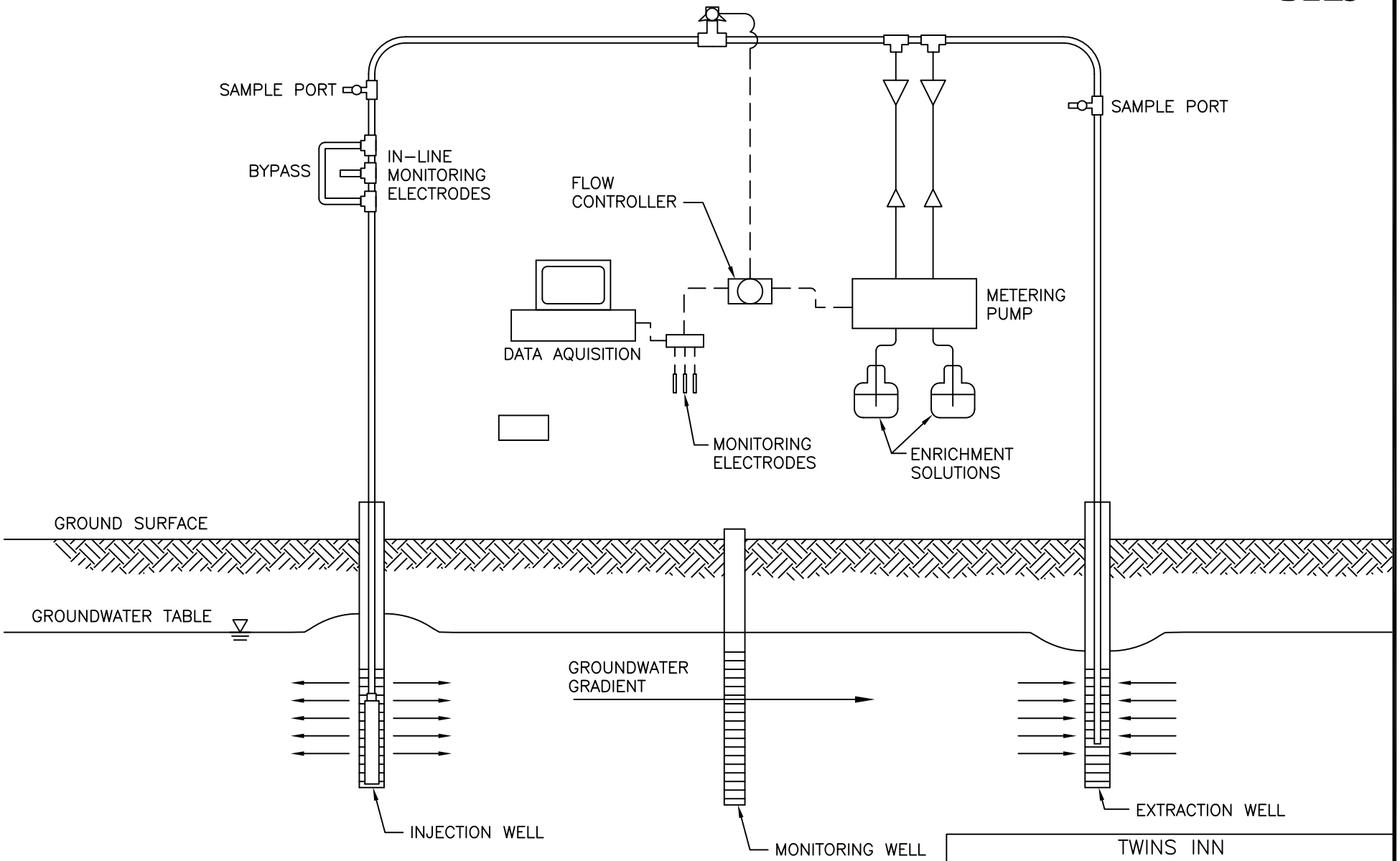
PROJECT NO.	DRAWING NO.	DATE
41568493	biorecirc_locs.mxd	5/10/10



TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS

Job No. : 41568493	FIGURE 5-3 ANAEROBIC BIORECIRCULATION SYSTEM CONCEPTUAL DRAWING
Prepared by : KLB	
Date : 5/18/10	

Y:\GIS\Projects\Twins_Inn\68rad00216RI\projects_10\Eng_Eval_Cost_Analysis\TIFS06.dwg



TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS

Job No. : 41568493	FIGURE 5-4
Prepared by : KLB	ANAEROBIC BIORECIRCULATION PROCESS FLOW DIAGRAM
Date : 5/18/10	

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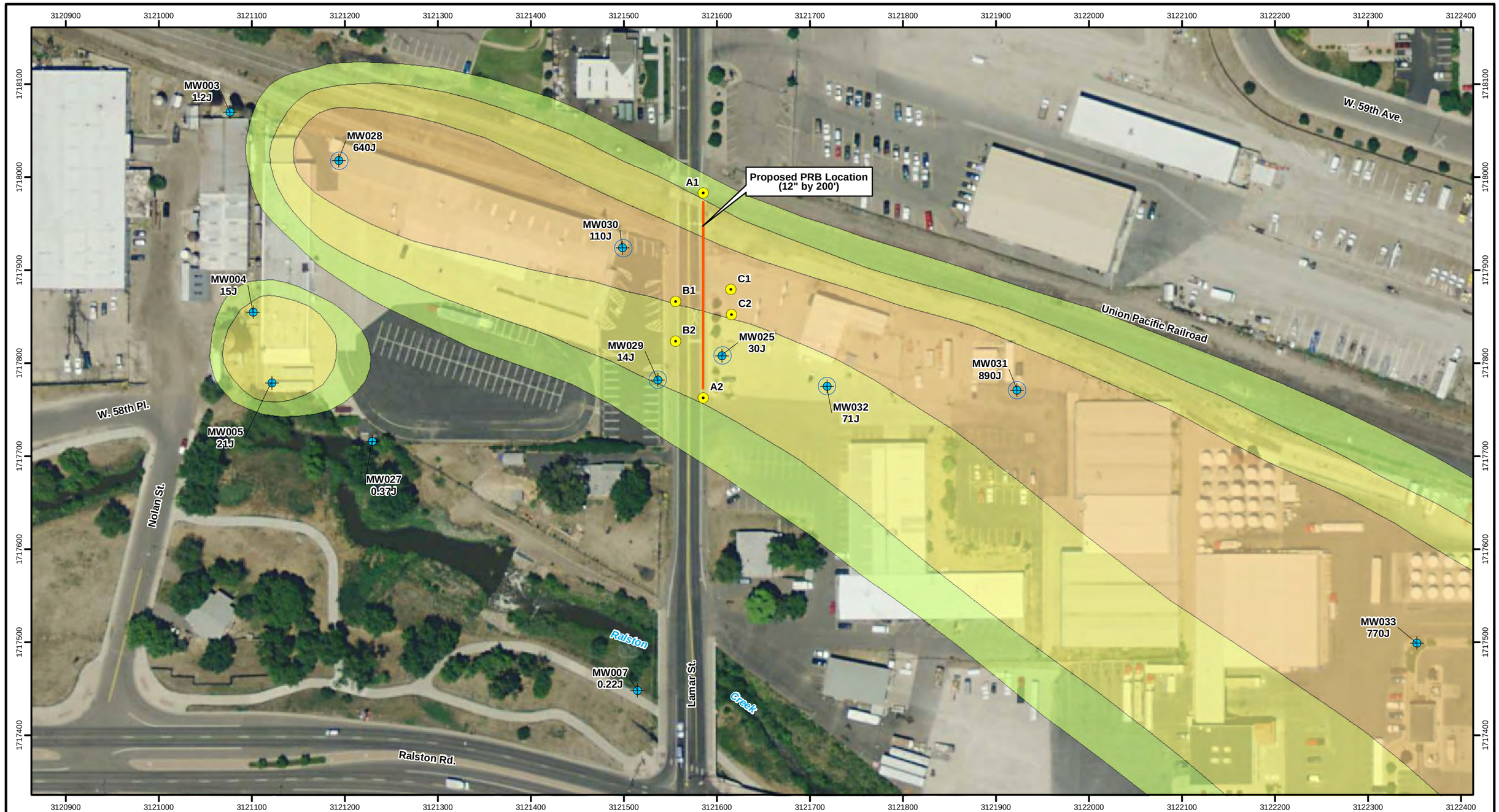

EXPLANATION

- Monitoring Well (MW)
- Proposed New Monitoring Well
- Proposed Existing Performance Groundwater Monitoring Well
- Proposed PRB Location

September 2009 TCE Concentrations (µg/L)

- 5-9
- 10-99
- > 100

MCL/CBSG for TCE is 5 µg/L.

NOTES:
CBSG = Colorado Basic Standard for Groundwater
MCL = Maximum Contaminant Level
PRB = Permeable Reactive Barrier
TCE = Trichloroethene
ZVI = Zero-Valent Iron
µg/L = Micrograms per liter
J = The associated value is an estimated quantity
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

100 0 100 Feet

Scale 1:1200 or 1" = 100'

N W E S

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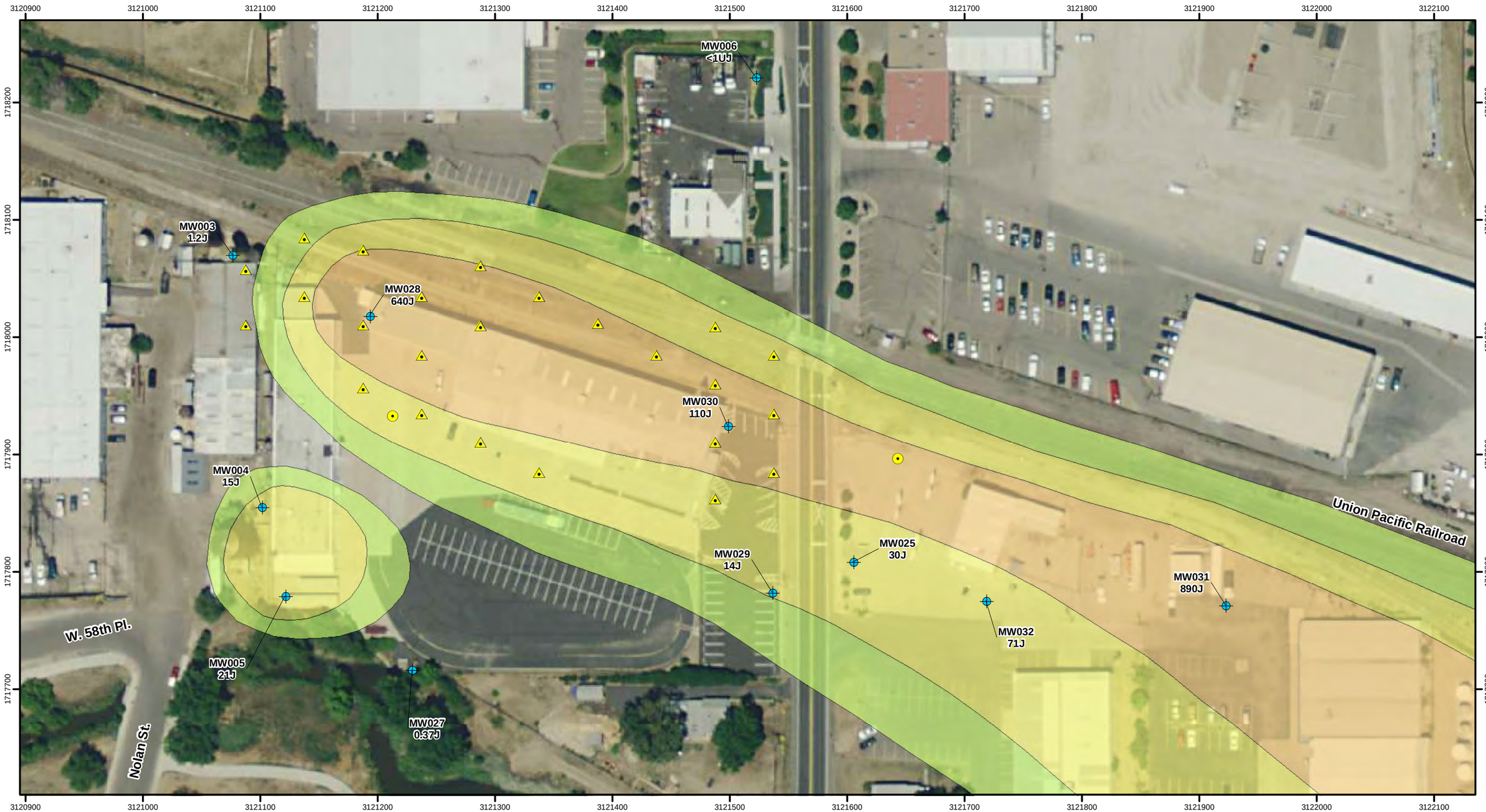
Figure 5-5 PROPOSED ZVI PRB LOCATION AND PERFORMANCE MONITORING WELLS

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	prb_locs.mxd	5/10/10



EXPLANATION

Monitoring Well (MW)

Proposed Location

New Monitoring Well

Direct Push Injection

September 2009 TCE Concentrations (µg/L)

5-9

10-99

> 100

MCL/CBSG for TCE is 5 µg/L.

NOTES:
CBSG = Colorado Basic Standard for Groundwater
MCL = Maximum Contaminant Level
TCE = Trichloroethene
µg/L = Micrograms per liter
J = The associated value is an estimated quantity
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

80 0 80 Feet

Scale 1:960 or 1" = 80'

N W E S

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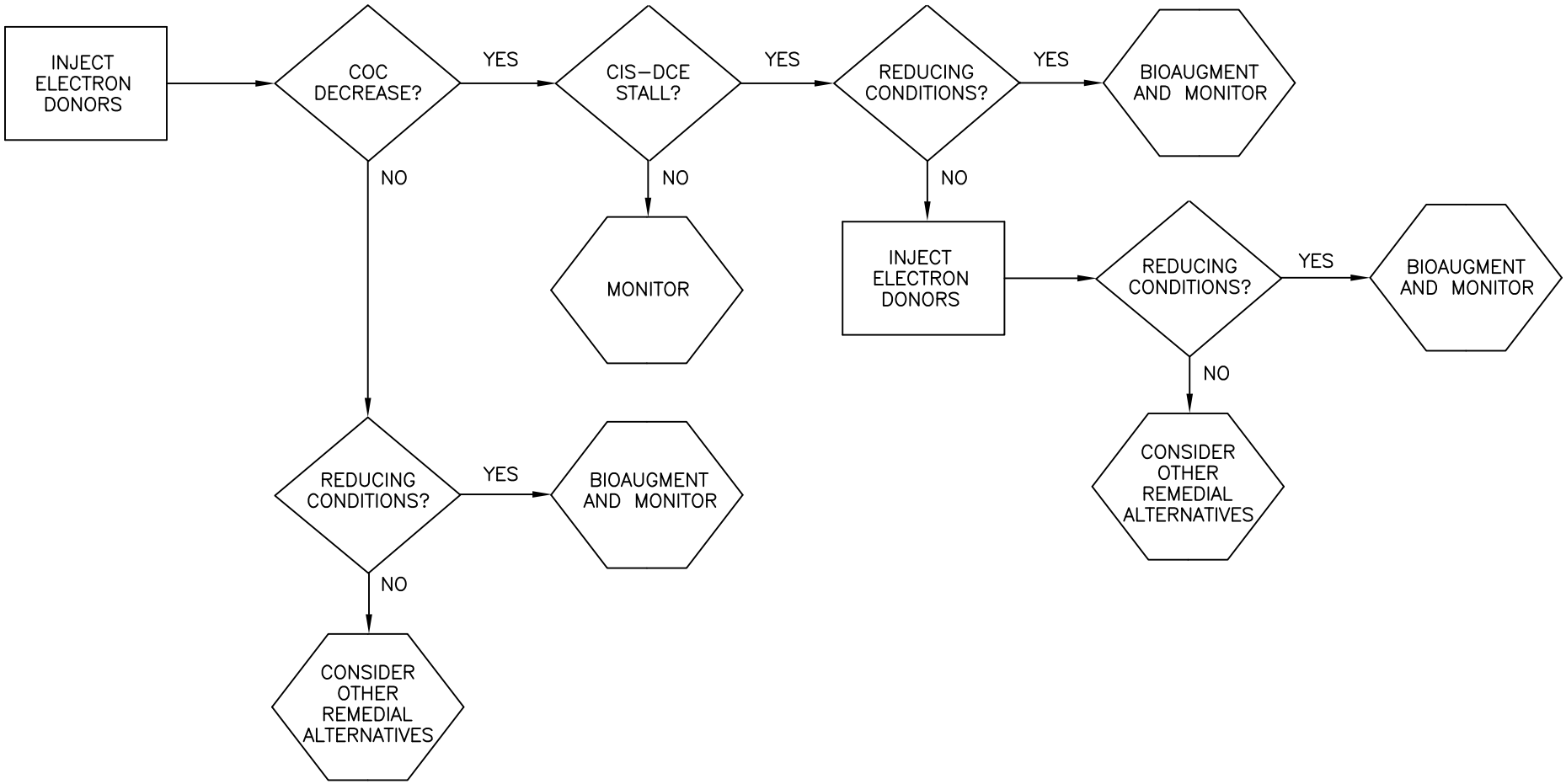
Figure 5-6 PROPOSED BIOREMEDIATION INJECTION LOCATIONS AND MONITORING LOCATIONS

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	rem_inj_loc.mxd	5/13/10



TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS

Job No. : 41568493	FIGURE 5–7 BIOREMEDIATION DECISION PROCESS FLOWCHART
Prepared by : KLB	
Date : 5/18/10	

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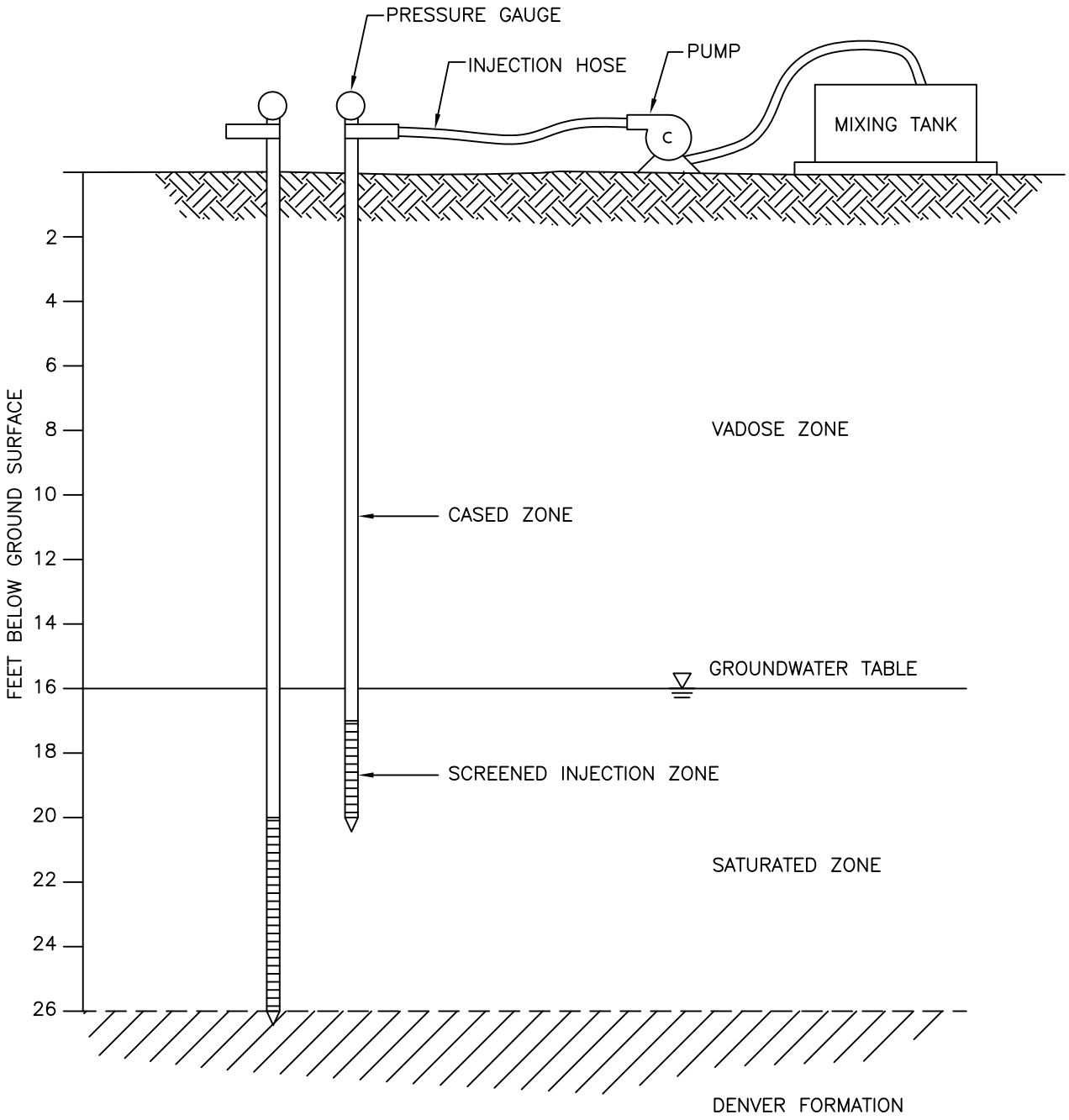
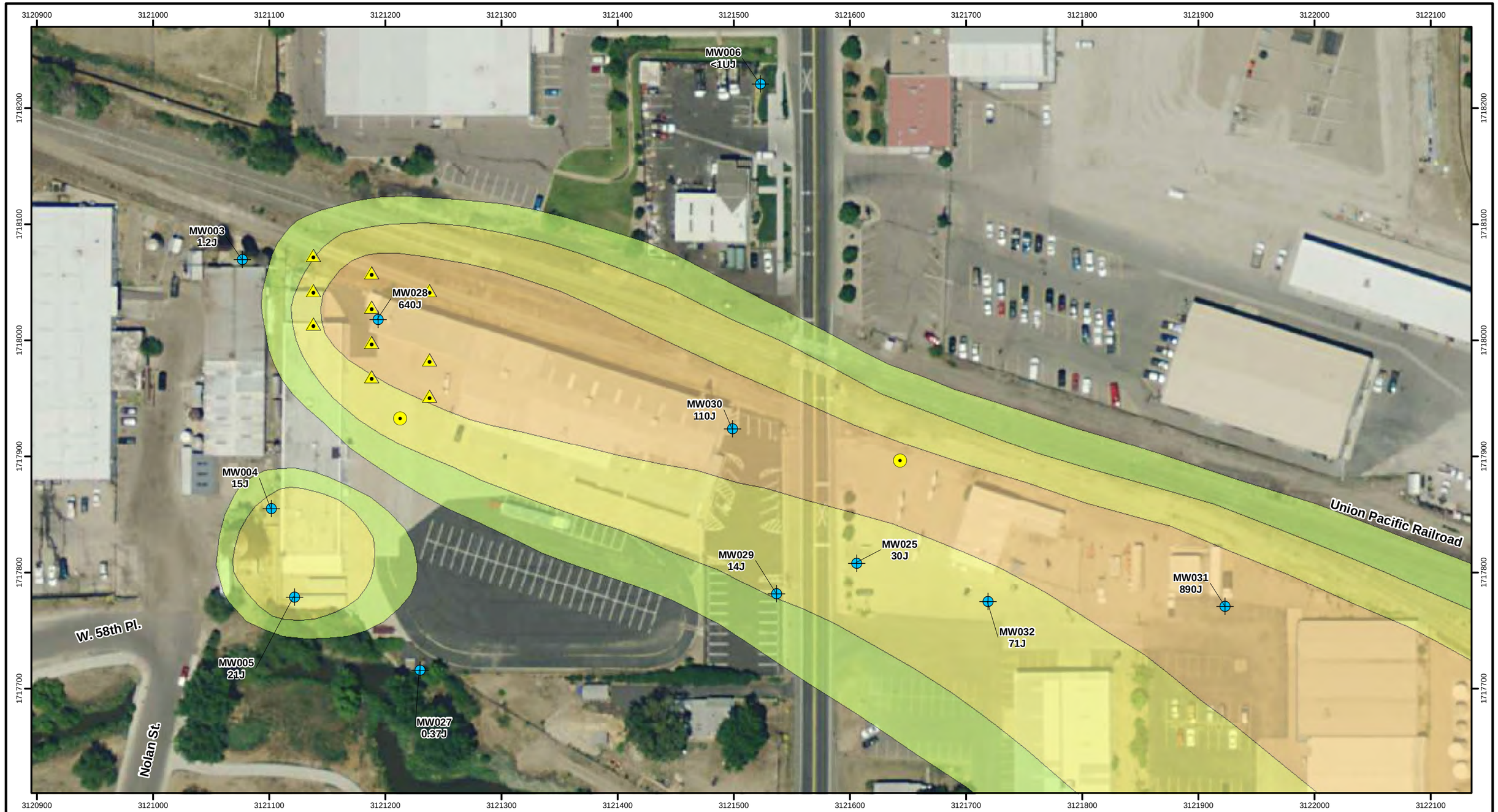


NOT TO SCALE

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS

Job No. : 41568493	FIGURE 5-8 BIOREMEDIATION AND CHEMICAL OXIDATION DIRECT PUSH INJECTION SCHEMATIC
Prepared by : RAM	
Date : 5/18/10	

Y:\GIS\Projects\Twins_Inn\68rad00216RI\projects_10\Eng_Eval_Cost_Analysis\TIFS-04.dwg



EXPLANATION

Proposed Location
- New Monitoring Well
- Direct Push Injection
- Monitoring Well (MW)

September 2009 TCE Concentrations (µg/L)
- 5-9
- 10-99
- > 100

MCL/CBSG for TCE is 5 µg/L.

NOTES:
CBSG = Colorado Basic Standard for Groundwater
MCL = Maximum Contaminant Level
TCE = Trichloroethene
µg/L = Micrograms per liter
J = The associated value is an estimated quantity
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88
Aerial photograph was taken July 2008

80 0 80 Feet

Scale 1:960 or 1" = 80'

N W E S

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Figure 5-9 PROPOSED IN SITU CHEMICAL OXIDATION INJECTION AND MONITORING LOCATIONS

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	chemox_inj.mxd	5/13/10

EXPLANATION

- Monitoring Well (MW)
- Plume Outline (see note)

NOTES:
Plume outline is based on TCE concentrations greater than 5 µg/L from September 2009
TCE = Trichloroethene
µg/L = Micrograms per liter
Aerial photograph was taken July 2008
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88

400 0 400 Feet

Scale 1:4800 or 1" = 400'

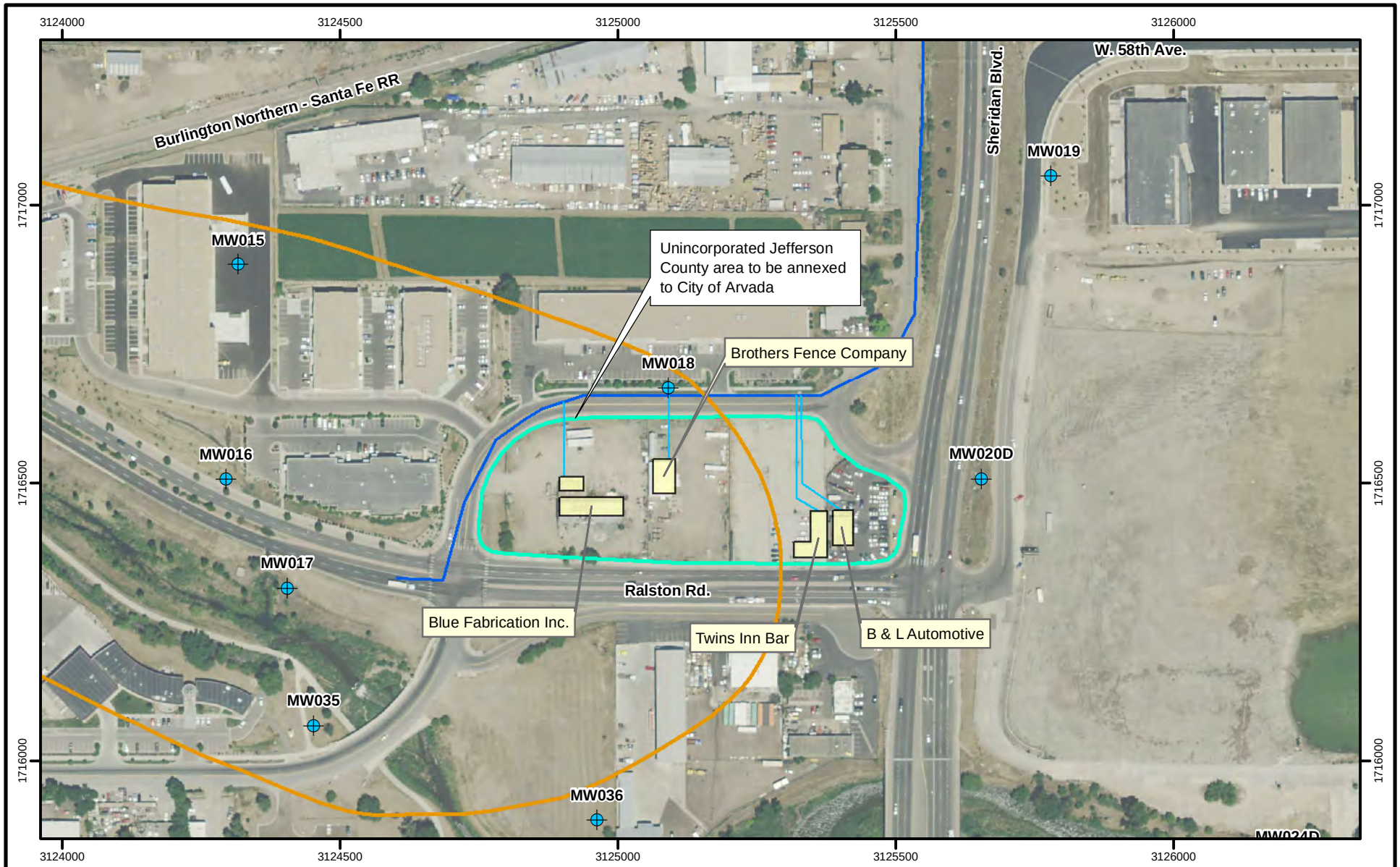
N W E S

URS

Figure 5-10 ALTERNATE WATER SUPPLY - LOCATION OF COMMERCIAL PROPERTIES

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	alt_water_supply_locs.mxd	5/18/10



EXPLANATION

- City of Arvada Water Main
- Proposed Service Line to Commercial Building
- Monitoring Well (MW)
- Plume Outline (see note)

NOTES:
Plume outline is based on TCE concentrations greater than 5 µg/L from September 2009
TCE = Trichloroethene
µg/L = Micrograms per liter
Aerial photograph was taken July 2008
Coordinates reference State Plane Feet, Colorado Central Zone, NAD83 Vertical Datum: NAVD-88

250 0 Feet
Scale 1:3000 or 1" = 250'

N W E S

URS

Figure 5-11 ALTERNATE WATER SUPPLY - CONCEPTUAL DESIGN

TWINS INN
ENGINEERING EVALUATION/COST ANALYSIS
ARVADA, COLORADO

PROJECT NO.	DRAWING NO.	DATE
41568493	alt_water_supply_conceptual.mxd	5/18/10