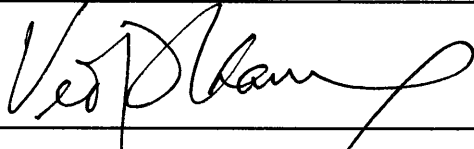


**Application For
Federal Assistance**

		2. DATE SUBMITTED	Applicant Identifier
1. TYPE OF SUBMISSION Application <input type="checkbox"/> Construction <input checked="" type="checkbox"/> Non-Construction	Preapplication <input type="checkbox"/> Construction <input checked="" type="checkbox"/> Non-Construction	3. DATE RECEIVED BY STATE	
		4. DATE RECEIVED BY FEDERAL AGENCY	
5. APPLICANT INFORMATION		State Application Identifier	
Legal Name: Department of Environmental Protection		Organizational Unit: Division of Science, Research and Technology	
Address (give city, county, state, and zip code) Department of Environmental Protection P.O. Box 420 Trenton, NJ 08625		Name and telephone number of person to be contacted on matters involving this application (give area code) Linda Bonanno (609) 984 - 9480	
6. EMPLOYER IDENTIFICATION (EIN): / DUNS# 21 - 6000228 / 60-741-5197		7. TYPE OF APPLICANT: (enter appropriate letter here) A A. State B. County C. Municipal D. Township E. Interstate F. Intermunicipal G. Special District H. Independent School District I. State Controlled Institution of Higher Learning J. Private University K. Indian Tribe L. Individual M. Profit Organization N. Other (Specify): _____	
8. TYPE OF APPLICATION <input checked="" type="checkbox"/> New <input type="checkbox"/> Continuation <input type="checkbox"/> Revision If Revision, enter appropriate letter(s) in box(es) A. Increase Award B. Decrease Award C. Increase Duration D. Decrease Duration Other Specify: _____		9. NAME OF FEDERAL AGENCY: US Environmental Protection Agency	
10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: 66. 034 TITLE: Surveys, Studies & Investigations		DESCRIPTIVE TITLE OF APPLICANT'S PROJECT Evaluation of Two Sampling and Analytical Methods for the Measurement of Hexavalent Chromium in Ambient Air	
12. AREAS AFFECTED BY PROJECT (cities, counties, states, etc.): State of New Jersey			
13. PROPOSED PROJECT:		14. CONGRESSIONAL DISTRICT OF:	
Start Date 11/01/07	End Date 10/31/09	a. Applicant: 12	b. Project Statewide
15. Estimated Funding		16. IS THIS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS	
a. Federal	\$ 675,000.00	a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESSES FOR REVIEW ON: DATE _____	
b. Applicant	\$ -	b. NO. <input type="checkbox"/> PROGRAM IS NOT COVERED BY E.O. 12372 <input type="checkbox"/> OR PROGRAM HAS NOT BEEN SELECTED FOR STATE FOR REVIEW	
c. State	\$ -	17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT? <input type="checkbox"/> Yes If "Yes" attach an explanation <input checked="" type="checkbox"/> No	
d. Local	\$ -		
e. Other	\$ -		
f. Program Income	\$ -		
g. TOTAL	\$ 675,000.00		
18. TO THE BEST OF MY KNOWLEDGE AND BELIEF. ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED			
a. Typed Name of Authorized Representative Ved P. Chaudhary		b. Title Assistant Commissioner	c. Telephone Number (609) 292-2916
d. Signature of Authorized Representative 		e. Date Signed 4/11/07	

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-045

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		Total (g)
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	
1. Surveys, Studies & Investigations	66. 034			\$ 675,000	\$ -	\$ 675,000
2.	.					
3.	.					
4.	.					
5. TOTALS				\$ 675,000	\$ -	\$ 675,000

SECTION B - BUDGET CATEGORIES

Object class categories	GRANT PROGRAM, FUNCTION, OR ACTIVITY				Total (5)
	(1) 1st Year	(2)	(3)	(4)	
a. Personnel	\$ 51,161				\$ 51,161
b. Fringe Benefits	\$ 17,778				\$ 17,778
c. Travel	\$ 2,500				\$ 2,500
d. Equipment	\$ -				\$ -
e. Supplies	\$ -				\$ -
f. Contractual	\$ 588,918				\$ 588,918
g. Construction	\$ -				\$ -
h. Other	\$ -				\$ -
I. Total Direct Charges (sum of 6a - 6h)	\$ 660,357				\$ 660,357
j. Indirect Charges	\$ 14,643				\$ 14,643
k. TOTALS (sum of 6i and 6j)	\$ 675,000				\$ 675,000
7. Program Income	\$ -				\$ -

SECTION C - NON-FEDERAL RESOURCES

Standard Form 424A (4-88)

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) Totals
8.	\$ -			\$ -
9.				
10.				
11.				
12. TOTAL (sum of lines 8 - 11)	\$ -			\$ -

SECTION D - FORECASTED CASH NEEDS

	Total for First Year	Future Funding Periods (Years)			
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 675,000	\$ 168,750	\$ 168,750	\$ 168,750	\$ 168,750
14. Non Federal	\$ -	\$ -	\$ -	\$ -	\$ -
15. TOTAL (sum of lines 13 and 14)	\$ 675,000	\$ 168,750	\$ 168,750	\$ 168,750	\$ 168,750

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	Future Funding Periods (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
16.	\$ -			
17.				
18.				
19.				
20. TOTALS (sum of lines 16 - 19)	\$ -	\$ -	\$ -	\$ -

SECTION F - OTHER BUDGET INFORMATION

(Attach additional sheets if necessary)

21. Direct Charges	\$ 660,357	22. Indirect Charges:	\$ 14,643
22. Remarks	21.24% of Salary plus Fringe		

**Evaluation of Two Sampling and Analytical Methods for the Measurement of
Hexavalent Chromium in Ambient Air
Budget Detail**

Personnel	# Years	Salary	% Time	Federal Share	Cost Share	Total
Professional	2.0	\$ 90,000	10%	\$ 51,161		
Total				\$ 51,161	\$ -	\$ 51,161

Fringe Benefit		Federal Share	Cost Share	Total
Regular/Overtime	34.75% / 7.65%	\$ 17,778	\$ -	\$ 17,778

Travel	Federal Share	Cost Share	Total
Conference, Site visits, meetings at UMDNJ/Laboratory Audits	\$ 2,500		\$ 2,500

Contractual	Federal Share	Cost Share	Total
UMDNJ	\$ 588,918		
Total	\$ 588,918	\$ -	\$ 588,918

Indirect Costs	Federal Share	Cost Share	Total
21.24% of Salaries plus Fringe	\$ 14,643		\$ 14,643

TOTAL BUDGET	Federal Share	Cost Share	Total
	\$ 675,000		\$ 675,000

A. Project Title: Evaluation of Two Analytical Methods and Sampling Trains for the Measurement of Hexavalent Chromium in Ambient Air.

B. Category: Methods Development / Evaluation

C. Applicant Information: New Jersey Department of Environmental Protection
P.O. Box 409
Trenton, NJ 08625-0409
Linda J. Bonanno, Ph.D.
Phone: (609) 984-9480 / Fax: (609) 292-7340
Email: linda.bonanno@dep.state.nj.us
<http://www.njleg.state.nj.us> .

New Jersey's Air Pollution Control Act N.J.S.A. 26:2C-1 et seq., N.J.A.C. 27-1 et seq. N.J.S.A. 13:1B-3. N.J.S.A. 13:1B-3(e). N.J.S.A. 13:1D-9. N.J.S.A. 13:1D-134 et seq..N.J.S.A. 26:2C-1 et seq. N.J.S.A. 39:8-61

D. Funding Requested: \$675,000

E. Total Project Cost: UMDN \$588,918
NJDEP salary \$ 83,582
NJDEP travel \$ 2,500

Please note that New York State (NYS) is donating the resources to supply two NATTS samplers for the field evaluation and the analysis for up to 120 filters by ERG. This is not counted in the total project cost because NYS has already allocated these funds.

F. Project Period: Nov 1 2007-Oct 31, 2009

G. Project Description

1. Background Information

Chromium primarily exists as trivalent and hexavalent states in nature [1]. Trivalent chromium (Cr(III)) is an essential micronutrient and plays a role in the control of glucose as well as the metabolism of lipids and proteins [1-3]. Hexavalent chromium (Cr(VI)) is listed as a Group 1 human carcinogen by the International Agency for Research on Cancer (IARC) [4].

Environmental chromium comes mostly from anthropogenic sources (60-70%), with a smaller, naturally occurring fraction (30-40%). Anthropogenic sources include steel production, automobile exhaust, chromate ore processing, tanning and spray paint operations [5-6]. The U.S. Environmental Protection Agency (USEPA) has listed hexavalent chromium as a hazardous air pollutant (HAP) in the 1990 Clean Air Act [7]. In the literature there is debate over which valence state is most abundant in the atmosphere. Seigneur and Constantinou found that typical atmospheric conditions favor the reduction of hexavalent chromium to its trivalent state while Nusko and Heumann found greater concentrations of hexavalent chromium than trivalent chromium in ambient air samples [8-9].

Numerous factors can affect the oxidation state of chromium during sampling and sample analysis. Factors that can affect conversion include, but are not limited to: temperature, pH, UV light, electrochemical potential (Eh), oxidizing and reducing agents and the presence of organic compounds [1, 2]. Low pH and low Eh favors trivalent chromium while high pH and high Eh favors hexavalent chromium.

Since hexavalent chromium is so toxic and with so many environmental factors influencing its oxidation state, it is imperative that care is taken during sampling and analysis to obtain accurate measurement of hexavalent chromium. For these reasons, a sampler that can collect hexavalent chromium and stabilize it during the sampling event until analysis is a requirement for accurate assessment. It is also of the utmost importance that any analytical technique does not change the oxidation state of the ambient chromium species. If conversion occurs during the sampling or analytical phase, it is important to quantify the interconversion so that the exact amount of hexavalent chromium present in the atmosphere can be determined.

Analytical Methods

There are two analytical methods which have been developed for the measurement of hexavalent chromium in ambient air particulate matter (PM). The first method was developed by Eastern Research Group

(ERG) for the United States Environmental Protection Agency (USEPA) [10] which has been implemented in the National Air Toxics Trends Site (NATTS) program. In the NATTS method, cellulose filters are first washed with nitric acid solution to remove background contaminants and then pretreated with sodium bicarbonate solution before sampling. Filters are collected the day after sampling ends and stored at -18°C until analysis. After sampling, chromium is extracted for 1 hour using a sodium bicarbonate solution. The hexavalent chromium is separated by ion chromatograph (IC) using an anion exchange analytical column (AS7, Dionex) with a supporting guard column (NG1, Dionex), derivatized by a post-column derivatization module with diphenylcarbohydrazide (DPC) to form a complex which can be detected at 540 nm by a UV detector. Method detection limits (MDLs) have been reported as 0.0074 ng/m^3 as of 2007 [ERG, personal communication, 2007]. The MDL was determined based on spiking a low level standard onto prepared filters, at a concentration of three times the estimated detection limit. At least seven filters were analyzed. The standard deviation of the seven runs is then multiplied by the value of the Student's t-test at the 99% confidence level. There are some concerns with the NATTS analytical method. First, due to the lack of standard material with known Cr(VI), the recovery of the method was determined based only on evaluation of filters spiked with Cr(VI) solution. Thus, the reported recovery may not represent the true recovery for Cr(VI) associated with ambient particulate matter. It is expected that there would be much stronger bonding between Cr(VI) and particles than with a liquid spike sample. Second, the interconversion between Cr(VI) and Cr(III) cannot be monitored by this method, which may bias the Cr(VI) measurements.

Another method has been developed at the Environmental and Occupational Health Sciences Institute (EOHSI) and was used during the Urban Community Air Toxics Monitoring Project, Paterson City, NJ (UCAMPP). This method uses non-acid washed cellulose filters pretreated with sodium bicarbonate to collect airborne hexavalent chromium. Filters are stored at -15°C after sampling until analysis. Filter samples were also spiked with hexavalent chromium enriched isotope solution using the stable isotope dilution mass spectrometry (SIDMS) technique outlined in USEPA method 6800 [12] to monitor the interconversion during sample processing. The SIDMS method uses enriched isotopes to measure the amount of a specific species in solution. Stable isotopes change the abundance ratios of the isotopes of chromium. Filter samples are extracted with $\text{pH} = 4$ nitric acid solution by sonication for 45 minutes. After sonication the extracts are injected into an ion chromatography (IC) and hexavalent and trivalent chromium are separated using a cation exchange guard column (CG5A, Dionex). The chromium species are detected by an inductively coupled plasma mass spectrometer (ICP/MS). The results have shown that the EOHSI method can recovery $> 80\%$ of hexavalent chromium spiked on the air particulate matter collected during the UCAMPP and for NIST 1648 particulate matter. This is consistent with previous findings [13]. Ashley et al. used sonication with weak nitric acid solutions to recover close to 100% of chromium from spiked air filter materials. Conversion was measured using the stable isotope method and found that there was no significant interconversion from Cr(VI) to Cr(III) ($< 20\%$) but between 20 to 30% of Cr(III) was oxidized to Cr(VI). The percent difference, measured for ten sets of duplicate samples, ranged from 2.5% to 36.5%, with the average percent difference at $15.9\% \pm 9.9\%$. Four sets of duplicates were not included in this calculation because one or both of the samples had values below the detection limit. Instrumental detection limits (IDLs) have been reported as 0.15 ng/mL , which is equivalent to 0.1 ng/m^3 for a sampling volume of 24 m^3 . The IDL is from the standard deviation which was obtained from the injection of a low level standard, ten times, and then multiplied by the corresponding value from the Student's t-test at the 99% confidence level. The MDL is 0.19 ng/m^3 based on the UCAMPP study ($n=11$). The MDL was based on three times the standard deviation of the field blanks collected over the entire study. Three field blank samples were not included in the calculation because of suspect high values from the lab blanks. However, there are also concerns with the EOHSI method. First, a surrogate of the maximum recovery has been achieved, for the current method, by testing the 1648 dust samples; but, as stated above, due to the lack of standard material, the true extraction efficiency cannot be determined. Second, the method detection limit is relatively high due to the variation of field blanks during the UCAMPP. Further investigation is needed to improve the method detection limit. The lab blanks are also relatively high when compared to ERG method, which may lead to the high MDLs encountered.

Sampling System

ERG developed a sampler (10, 11) which collects Total Suspended Particles (TSP) and is specified for use in the USEPA NATTS monitoring program. ERG has shown (via personal communication with ERG) that when filters are left in the NATTS sampler for longer than 12-24 hours, a loss of Cr(VI) occurs. When filters are with spiked Cr(VI) solution and left in the field for 33 to 105 hours, bias ranges from 30% to 58%, based on the relative percent difference ($n=4$) [11]. Therefore, the current NATTS method requires sample pickup the day after sampling

ends. This is not practical for many monitoring Agencies due to resource and workforce constraints, i.e., they have limited resources for overtime and weekend sample collection.

The NYS sampler was developed from a PM₁₀ FRM sampler to preserve the oxidation state of Cr(VI) during/after sample collection. The goal for post sample collection is to allow filter holding times in the sampler of up to 3 days. This period would allow the staff who routinely operate the filter based networks to integrate Cr(VI) sampling into their work schedules. The sampler preserves the oxidation state of Cr(VI) by reducing the humidity (goal is 20% below ambient) and temperature (goal is 10% below ambient) of the filter during collection by mixing a small flow of clean, cool, dry air from the time that the filter is placed into the sampler, throughout the sampling event. Once the sampling period has ended, the sampler uses a continuing small flow of clean, cool, dried air to insure continued stability of the sample. This approach should collect more Cr(VI) than a sampler operated at ambient conditions and this sampler should preserve these higher concentrations for longer periods after collection. The NYS sampler has been recently constructed at Clarkson and has not yet been field tested. In this proposed study, we will field test the performance of the sampler for preserving the integrity of Cr(VI) samples during and after sample collection.

2. Project Objectives:

The ultimate goals of this study are to evaluate two sampling and two analytical methods for the measurement of Cr(VI) in ambient air PM. Specifically, we propose to evaluate 1) two analysis methods that have been developed for the measurement of hexavalent chromium in ambient air PM, and 2) two sampling trains for collection of PM for analysis of Cr(VI); 3) ability of the NYS sampler to preserve sample integrity for at least 3 days following the sample collection period; and 4) inter-laboratory analysis variability

This study fits in Category 2: evaluate and improve existing methods for sampling and analysis of select priority Hazardous Air Pollutants (HAPs), i.e., those that emerged as national or regional drivers as a result of the 1999 National Air Toxics Assessment (NATA) and to evaluate available advanced HAP monitoring technologies that can potentially operate on a routine basis. This work is critical because Cr (VI) is known human carcinogen, a target compound for the NATTS program and a Hazardous Air Pollutant (HAPS). In addition, NATA 1999 modeled levels of Cr (VI) are a risk driver for parts of the county. It is also important to have precise methods with low bias with method detection limits that are at or below the 1 in a million risk level.

3. Project Tasks

a. Analytical Methods Evaluation.

To evaluate the recovery, precision and bias of the two analytical methods using filters spiked with certified NIST particle samples and known concentration of both natural Cr(VI) and Cr(VI) and Cr(III) isotopes. The two methods are the NATTS method, which uses sonication with bicarbonate solution, ion chromatographic separation (IC) and UV detection for the measurement of Cr(VI), and the Environmental and Occupational Health Sciences Institute (EOHSI) method, which uses sonication with dilute nitric acid, IC separation and detection by inductively coupled plasma mass spectroscopy (ICP/MS) for the identification of Cr(VI) and Cr(III).

In order to evaluate the recovery, precision and bias of both methods, acid washed and sodium bicarbonate treated filters will be spiked under the following conditions : 1) a known concentration of natural abundance Cr(VI) solution, 2) NIST 1648 dust which has a known total chromium but the ratio of Cr(VI) / Cr(III) is unknown, 3) stable isotope solution according the USEPA Method 6800, 4) 1648 dust and known Cr(VI) solution, 5) 1648 dust with stable isotope solution, and 6) 1648 dust, stable isotope and Cr(VI) solution. All of the filter samples will be prepared at EOHSI and shipped to Clarkson University and ERG for analysis. Each laboratory will receive 10 filters for each condition for each analytical method. They will also get three acid washed, sodium bicarbonate treated filters per method to serve as method blanks.

The filters will be spiked according to the following protocol. Filters are spiked with either the Cr(VI) natural abundance solution or the stable isotope solution using a glass syringe with no metal parts. Since a small amount of solution is used for the spike, it is expected that the filter will readily sorb the entire solution. For filters with 1648 dust, filters will be first weighed prior to spiking. The 1648 dust is ground into the filter using a glass stirring rod and then the filters loaded with dust will be reweighed to determine the dust mass on the filter. Filters are then folded and placed into glass vials for shipping to all the testing laboratories. The vials are shipped from EOHSI with dry ice to help preserve hexavalent chromium and sample integrity. Samples will remain on dry ice at EOHSI until ERG and Clarkson University receive the shipped samples and are ready to begin analysis.

Since all three laboratories will keep their samples on dry ice, variability that can occur from interconversion during shipping is expected to be reduced. This can be assessed with the filters that are spiked with the stable isotope solution and analyzed with the IC/ICPMS analytical method since the conversion of Cr(VI) and Cr(III) can be monitored. The original shipping vials will be rinsed with a small aliquot of extracting solution to make sure all of the dust is removed from the vial.

At EOHSI and Clarkson University the filters will be analyzed by both the NATTS and EOHSI method. At ERG only the NATTS method will be used. All laboratories will receive ten samples per analysis so that statistical analysis may be performed to test precision at the 95% confidence level. Analytical precision and bias should be within 20% or more analysis will be required. ERG will receive 60 filters + 3 blank filters while EOHSI and Clarkson University will be receiving 120 filters + 6 blank filters apiece since they are performing two different analytical methods.

The Speciated Isotope Dilution Mass Spectrometry (SIDMS) method illustrates one of the advantages of the EOHSI method. The NATTS method can only monitor the concentration of hexavalent chromium whereas the EOHSI method can measure both hexavalent and trivalent chromium and through SIDMS, measure the conversion that takes place over collection, storage, extraction and analysis. SIDMS has been shown to be the only method to accurately measure species interconversion [1]. Also, it has been shown that the greatest sensitivity, precision, rapidity and reproducibility obtained for chromium speciation and analysis is liquid chromatographic separation of the species with analysis by ICPMS [14].

Evaluating the two methods by three different laboratories will determine the effect of interlaboratory variability on chromium analysis and measurement. Understanding the interlaboratory variability is important for chromium analysis since so many factors can affect the interconversion and measurement of the species. Information obtained from this project for interlaboratory variability it will provide a more accurate assessment of chromium analysis for future projects. Method variability will also be assessed.

b. Field Evaluation.

NJDEP has identified up to six potential monitoring locations from the 2006 National Emissions Inventory. It will be necessary to do a more detailed assessment which will involve a microinventory of the sources in the area to determine how much Cr(VI) is emitted, a screening modeling effort to determine if the monitoring location will pick up any chromium from those sources, and an assessment of the ability to get permission to use the site, power availability, access, and safety and security for the field sampling staff and monitoring equipment.

Field testing will occur in winter and summer month to test the extreme conditions for Cr(VI) measurement and stability, i.e. low temperature, relative humidity and ozone in the winter and high temperature, relative humidity, and ozone in the summer. Before the actual study begins, we plan on sampling for 3 days as a pilot study. This will enable EOHSI to resolve any issues before starting the main study.

i. We will evaluate the ability of NATTS and NYS samplers to preserve Cr(VI) sample integrity in the field under the current the NATTS protocol. (i.e. pick up the sample on the day after active sampling ends). Two dual channel NATTS samplers (yielding four filters) and four single channel NYS samplers (yielding four filters) will be collocated and sample midnight to midnight.

The NYS sampler will be used in a side-by-side comparison with the ERG sampler. The concentrations of the samples collected by the two samplers on the same day and analyzed by the same method will be compared. If NYS sampler can minimize the sample breakdown and preserve any interconversion by controlling the temperature and humidity during and post sampling, the Cr(VI) concentrations measured for the samples collected by the NYS sampler will be relatively higher than those collected by the ERG sampler. Better precision for the replicate samples is also expected for the samples collected by the NYS sampler than those collected by the ERG samplers.

We plan on sampling for 22 days in the summer and 22 days in the winter when filters will be picked up the day after active sampling has ended to replicate the current NATTS protocol. We expect to yield 16 valid sampling days plus 2 field blank days per laboratory per method. We have budgeted two extra days incase something goes wrong, i.e., power/equipment/filter failure. During the 2 field blank days, filters will be loaded into the samplers and stay in the field for the same length of sampling time as regular sample but without air flowing through the filters. This will yield 6 sets of duplicates per sampler per method per laboratory and 2 field blanks per sampler per method per laboratory. ERG will get 8 sets of duplicates/sampler plus 2 field blanks/sampler. (See Figure 1). During each test, all filters will be spiked with stable isotopes before the sampling event to examine the effect of the natural environment on interconversion.

Figure 1.

Filter type	NATTS	NATTS	NATTS	NATTS	NYS	NYS	NYS	NYS
Day*								
1	C1	C1	C2	C2	C1	C1	C2	C2
2	U1	U1	U2	U2	U1	U1	U2	U2
3	E1	E1	C1	C1	E1	E1	C1	C1
4	E1	E1	C2	C2	E1	E1	C2	C2
5	E1	E1	U1	U1	E1	E1	U1	U1
6	E1	E1	U2	U2	E1	E1	U2	U2
7	C1	C1	U1	U1	C1	C1	U1	U1
8	C2	C2	U2	U2	C2	C2	U2	U2
Field Blank	E1	E1 _{fb}	C1	C1 _{fb}	E1	E1 _{fb}	C1	C1 _{fb}
Field Blank	F1	F1 _{fb}	C2	C2 _{fb}	F1	F1 _{fb}	C2	C2 _{fb}
Field Blank	F2	F2 _{fb}	F2	F2 _{fb}	F2	F2 _{fb}	F2	F2 _{fb}

*Repeat C1=@ Clarkson NATTS Analytical method

C2=@ Clarkson EOHSI Analytical method

U1=@ UMDNJ NATTS Analytical method

U2=@ UMDNJ EOHSI Analytical method

E1= @ ERG NATTS Analytical method

Please note: if a day is missed due to power failure etc, that day will be repeated.

ii. To evaluate the NYS sampler's ability to preserve the integrity of Cr(VI) on the filter when it is left in the field for 2-3 days following the end of active sampling. This is meant to replicate sampling for a routine monitoring network. Since ERG has already determined that their sampling train does not stabilize the chromium if the filters are left in the field after sampling [16], this study will only evaluate the NYS sampler's ability to preserve sample integrity when filters are left in the field for up to 3 days after active sampling ends. Only the EOHSI method will be used since it can detect both Cr(III) and Cr(VI) and monitor the conversion with the use of an isotope spike solution. We are budgeting 9 sampling days/season. Since there are 4 NYS samples, yielding 2 sets of duplicates /sampling event, we plan on sampling 7 days in the summer and 7 days in the winter plus two days of field blanks for both seasons. We budgeted two days will be reserved in case of problems in the field. This will yield a maximum of 14 sets of 2 filters and two sets with field blanks. One filter of the set will be retrieved the day after sampling ends and the other one will be left in the field for up to 3 days to replicate routine sampling. If the NYS Sampler can minimize chromium interconversion by cooling and dehumidifying, then Cr(VI) monitoring could occur on a routine basis, i.e. not being required to retrieve filters on weekends/holidays.

During each test, all filters will be spiked with stable isotopes before the sampling event to examine the effect of the natural environment on interconversion.

c. Data Analysis

i. Statistical Methods

Since the filters are not comparable across days, the data from a single day will be used to calculate measures of bias and precision. These will then be combined across days in an ANOVA analysis to generate tests and confidence intervals. Precision (the degree to which comparable measurements are consistent) will be studied by comparing the standard deviation of the methods, labs and samplers. The standard deviations will be calculated from the pairs in a single day within each Lab, Method and Sampler. Bias is defined as the difference between the measured and true values. This analysis will be confined to the spiked filters since true values are only known for these filters. The ANOVA analysis will include Lab, Method and Sampler as fixed effects. It could be argued that some of these should be random effects, but the focus here is on these specific Labs, Methods and Samplers, so fixed effects seems more appropriate. All analyses will be performed in SAS version 9.1.3 running under Microsoft Windows XP Professional.

ii. Power Calculations

An estimate of the error variability has been obtained from 14 duplicate samples in the EOHSI lab from the UCAMPP study. The standard deviations of the duplicates range from 0.004 ng/m³ to 0.200 ng/m³. The median is

0.03 ng/m³ and the mean is 0.05 ng/m³. The standard deviation of these precision measures is also 0.05 ng/m³ and this will be used in the power calculations as the measure of error. Under these conditions, with 4 precision measures per cell, a true mean difference of the precision between groups of 0.05 ng/m³ will be detected with a power of 0.75 with an alpha level of 0.05. For the analysis of the bias measure, there are 10 samples per cell. The error standard deviation is taken to be the mean standard deviation of the duplicates, which is 0.05ng/m³. Under these conditions, a true mean difference of the bias between groups of 0.03ng/m³ will be detected with a power of 0.75 with an alpha level of 0.05. In the analysis of the three day effect, we will look at the difference between the day 1 and day 3 samples. The variability in this case can not be estimated from available data. If we are willing to assume that the error variability is 0.05 as previously used, the standard deviation of the difference will be 0.07. Under these conditions, with 14 pairs, a true mean difference from Day 1 to Day 3 of 0.07 ng/m³ will be detected with a power of 0.82 with an alpha level of 0.05.

d. Timeline

July 2007	Award from USEPA
Nov 2007	Contract between NJDEP and UMDNJ. Contract UMDNJ and Clarkson
Nov-Dec 2007	Supplies/equipment acquired, personnel hired, assessment of monitoring locations
Jan – March 2008	Spike filters sent out to laboratories, field monitoring sites confirmed
April-May 2008	Initial data analysis
June-Sept 2008	Summer field sampling
Oct- Nov 2008	Data analysis
Dec 2008-March 2009	Winter field sampling
April-Oct 2009	Data analysis, report writing
Nov 1 2009	Final report to USEPA

e. Responsibilities

UMDNJ will be responsible for spiking the filters and sending them to Clarkson University and ERG for the analytical method evaluation. Each laboratory will be responsible for the first level of QA/QC. UMDNJ will be responsible for the second level of QA/QC. The NJDEP will be responsible for the final level of QA/QC and data validation. NJDEP will be responsible for the data analysis and final conclusion on the method evaluation. If it is determined that one method clearly is not effective at identifying Cr(VI) in ambient air, the project manager reserves the right to continue with the field sampling with only one method.

The NJDEP will be responsible for identifying and securing the field monitoring location. NJDEP and UMDNJ will be responsible for setting up the sampling equipment. UMNDJ will be responsible for field sampling, sending out the filters to the respective labs (see figure 1) and for sample analysis and first level of QA. The NJDEP will be responsible for final levels of QA/QC and data validation and data analysis. UMDNJ and NJDEP will be responsible for the final report to USEPA with assistance from Clarkson University and ERG. All laboratories will be required to submit quarterly report to the NJDEP. NJDEP will submit biannual reports to USEPA (unless otherwise noted)

4. Environmental Outputs/Outcomes

a. Outputs/Outcomes/Links/Transferability:

This proposed work will support the USEPA Strategic Plan Objective 1.1. Healthier Outdoor Air, Sub-Objective 1.1.2 Reduced Risk from Toxic Air Pollutants through the evaluation of analytical and sampling methods for measuring Cr(VI) in ambient air.

The ability to measure Cr(VI) in ambient air with a reproducible and precise method that can be implemented on a routine basis is integral to local, state and national goals of reducing risk from air pollution. This work will improve ambient monitoring methods that will result in more accurate exposure and risk assessments and help identify localized areas of high risk. This will help support the use of control measures that can promote risk reduction.

Short-term: Reliably identify levels of Cr(VI) in ambient air, assist in identifying sources, and to provide reliable data for emissions estimate evaluations.

Mid-term: Provide reliable data for local and state agencies to assist in formulating risk reduction, control strategies, cooperation of responsible parties, community action to reduce risk and implementation of routine monitoring on a wide scale basis. These outcomes are very important for New Jersey and New York.

Long-Term: Reliable data will assist in promoting the use of control technologies/ material substitution which will reduce Cr(VI) emissions, ambient concentrations, exposure, risk and adverse health effects.

B. Please see Data Analysis Section G.4.C on how the project will be evaluated.

5. Roles and Qualifications of Applicant and Project Partners

Linda J. Bonanno, Ph.D., NJDEP will be the project manager for this proposed study. Her responsibilities include overall project management; overseeing study design, tracking progress by requiring quarterly reports from all laboratories, identifying and coordinating the site for the field work, reviewing and editing the final report to USEPA and publications and overall coordination between NJDEP, laboratories and USEPA.

Lee Lippincott, Ph.D. NJDEP will be responsible for quality assurance/quality control and data validation for this project. He will also review and approve laboratory practices, e.g., SOPs.

Leo Korn, Ph.D. NJDEP will be primarily responsible for data analysis, interpreting the results and writing statistical sections of reports and journal articles.

Charlie Pietarinen, NJDEP, will consult on all aspects of the methods development with special emphasis on monitoring. Mr. Pietarinen's experience and contacts with other scientists in the monitoring and analytical fields is invaluable for gauging the progress of the proposed study, and communicating findings to other scientists investigating Cr(VI) sampling methods, as well as to interested parties at organizations such as the USEPA and Northeast States for Coordinated Air Use Management (NESCAUM).

Zhihua (Tina) Fan, Ph.D., EOHSI, will be the Principal Investigator for this project. She will be responsible for the overall implementation of the project, i.e., coordinating the analytical comparison and field sampling among EOHSI, Clarkson University, and ERG. She will work closely with Dr. Bonanno and other co-investigators for the study design and implementation. She will be responsible for evaluation of the quality of all collected data generated in the proposed study and be responsible for preparation of annual reports and publications.

Brian Buckley, Ph.D., EOHSI, is the co-Investigator of this proposed study. He will provide technical guidance for the study design and project execution, especially analytical method development, QA/QC plan, and assist in preparation of reports and publications.

Robert Stiles, Ph.D., EOHSI, Dr. Stiles will work closely with Drs. Fan and Buckley to implement the lab and field tests, conduct data analysis, and assist in preparation of annual report and publications

Lin Lin, Ph.D. EOHSI, will work closely with Dr. Fan to conduct field sampling, coordination of sample distribution and data information between EOHSI and Clarkson University and ERG, and assist in sample analysis, data analysis, and report preparation.

Phillip Hopke, Ph.D., Clarkson University, Dr. Phil Hopke will be responsible for the analysis of filters from the laboratory-spiked filters and the field study. His laboratory will analyze filters with the NATTS method (IC/UV) and UMDNJ method (IC/ICPMS). He will be responsible for the first level of quality assurance, will report quarterly to the NJDEP and will prepare manuscripts for publication and the final report to USEPA.

Dirk Felton, NYSDEC, Mr. Felton was instrumental in designing the NYS sampler and in communicating some of the original objectives that have lead to this project. He will consult on all aspects of the methods development / evaluation with special emphasis on monitoring. He will review all data / data analysis and be responsible for assisting in assessing the outcome of each objective. He will review the data analysis and report before it is sent to USEPA.

6. Biographical Information of Key Personnel

Linda J. Bonanno, Ph.D., NJDEP, is a Research Scientist with the Division of Science, Research and Technology of NJDEP. She earned a joint doctoral degree in Environmental Science and Public Health from Rutgers University and the University of Medicine and Dentistry of New Jersey. Dr. Bonanno has worked on sample analyses and data management for the National Human Exposure Assessment Survey (NHEXAS) study, field sampling for the Hudson County Chromium Study, supervised air sampling for the Particle Exposures of High-Risk Subpopulations study in NY, NY, and is the Principle Investigator for the Urban Community Air Toxics Monitoring Project, Paterson City, NJ (UCAMPP), and the Project Manager for Development and Optimization of

a Sampling and Analytical Method to Measure Hexavalent Chromium in Ambient Air and the Asthma Outreach and Education Initiative in Camden Waterfront South, She also has experience in monitoring indoor air contamination. Her present areas of research include air toxics, human health, cumulative risk assessment and data management/analyses.

Charlie Pietarinen, NJDEP, is Chief of the Bureau of Air Monitoring (BAM) with the NJDEP. Mr. Pietarinen received a BS degree in Biology from Valparaiso University and has over 25 years experience in air pollution including air toxics monitoring. BAM's program includes routine monitoring for criteria pollutants, air toxics and acid deposition. BAM is responsible for data acquisition, quality assurance, data reporting, special purpose monitoring projects and the oversight of third party monitoring projects. BAM operates and maintains over 25 continuous air monitoring stations and over 20 particulate sampling locations. Under Mr. Pietarinen's direction, four comprehensive air toxics monitoring sites have been established. He has extensive knowledge of ambient air monitoring instrumentation and practices and is the NJDEP's principal liaison with the USEPA and other parties on air monitoring issues.

Leo R. Korn, Ph.D., NJDEP is a Research Scientist with the Division of Science, Research and Technology of NJ DEP and Adjunct Assistant Professor, Division of Biometrics, UMDNJ-School of Public Health, Piscataway, NJ. Dr. Korn is a statistician who has worked on environmental, epidemiological and medical studies. He has been involved with many studies involving exposure to air pollutants, including several concerned with the effects of environmental exposures on various conditions such as Chronic Fatigue Syndrome and Gulf War related illness and exposure to particulate matter. His current research as a statistician is involved with the estimation of chemical concentrations in the environment. Several of his published articles are in this field and some software that he developed for his research has become part of a commercial software module, 'EnvironmentalStats for Splus'.

Lee Lippincott, Ph.D., NJDEP is a Research Scientist with the Division of Science, Research and Technology at NJDEP and an Assistant Professor of Chemistry with Mercer County College. He has over 30 years experience in the field of environmental and analytical chemistry and is the designated DSRT quality assurance officer. He serves as the leader of the ITRC perchlorate team, is a member of the Testing and Treatment Subcommittee of the NJ Drinking Water Quality Institute and is a past Chair of the NJ American Water Works Association Research and Technology Transfer Committee. His current research includes instrumental methods for detection chromium in various media, use of chemometric techniques for spatial data analysis, perchlorate innovative treatment technologies and hyperspectral chemical fluorescent imaging.

Zhihua (Tina) Fan, Ph.D., EOHSI, is an Assistant Professor in the Department of Environmental and Occupational Medicine at the University of Medicine and Dentistry of New Jersey. Her expertise is in air pollution, method development for air sampling and analyses, exposure measurement and assessment, atmospheric chemistry, and health effect study. She has conducted research on the development of an analytical method to measure cations and anions in acid rain and underground water from an oil field by ion chromatography, development and evaluation of USEPA standard methods to measure organic Hazardous Air Pollutants from different sources, and development of sampling devices to measure personal exposures to PAHs and carbonyls. She has also conducted research to investigate community exposure to air toxics, including hexavalent chromium, VOCs, PAHs, carbonyls, and PM_{2.5} in ambient air, and potential health effects. She is the Principle Investigator at EOHSI-UMDNJ for the UCAMPP and the recently funded USEPA project "Development and Optimization of a Sampling and Analytical Method to Measure Hexavalent Chromium in Ambient Air."

Brian Buckley, Ph.D., EOHSI, is an Analytical Chemist and is the Executive Director of Laboratories at EOHSI. Currently he is specializing in spectroscopic, mass spectrometric and chromatographic methods development for analysis of environmental contaminants and their metabolites. His research group has specialized in synthetic biofluid extractions for estimating bioavailability and human health risks of heavy metals, ultra-trace metals quantification and metal speciation by chromatography coupled to plasma mass spectrometry. He currently has methods to speciate Hg, As, and Cr. Dr. Buckley is the co-Investigator of the UCAMPP and the recently funded USEPA project "Development and Optimization of a Sampling and Analytical Method to Measure Hexavalent Chromium in Ambient Air."

Robert Stiles, Ph.D., EOHSI is a Post-doctor in the Department of Environmental and Occupational Medicine at the University of Medicine and Dentistry of New Jersey. His expertise is in environmental analytical chemistry. He has worked on method development for Cr (VI) measurement in soil samples. He also participated in field air sampling for the UCAMPP project and conducted all the sample analysis for Cr (VI) for the air samples collected from UCAMPP.

Lin Lin, Ph.D. EOSHI, is a senior staff (Research Teaching Specialist) in the Department of Environmental and Occupational Medicine at the University of Medicine and Dentistry of New Jersey. Her expertise is in the method development for analysis of environmental toxics using various chemical and biochemical techniques. She has conducted research on the development of an analytical method to on-site measure organic traces in PM_{2.5} in ambient air using dual-oven sample collecting system coupling with portable GC-MS. She has also conducted research to investigate metal analysis and speciation, including chromium, Uranium, Copper, lead, Zinc and Cadmium in waters. She is currently working on Cr-VI distribution as a function of particle size in chromium waste laden soils.

Philip K. Hopke, Ph.D., Clarkson University is the Bayard D. Clarkson Distinguished Professor and Director of the Center for Air Resources Engineering and Science at Clarkson University. Prof. Hopke has been studying atmospheric problems for 38 years and has published over 370 peer-reviewed journal articles. He has an active program of sampling, analysis and chemical characterization of the atmospheric aerosol as well as development of data analysis tools to better identify particle sources. He has served as a member and chair of USEPA's Clean Air Scientific Advisory Committee as well as on 7 National Research Council committees involving human exposure, risk, and air quality management. During the past year, Dr. Hopke has been collaborating with NYS DEC on the development and testing of the sampling system described in this proposal as the NYS Sampler.

Dirk Felton, BA. MS. PE., is a Research Scientist with the NYSDEC Division of Air Resources. Mr. Felton received his Bachelor of Arts degree in Physics from Kenyon College in 1987. He received his Master of Science degree in Environmental Engineering in 1993 from Stevens Institute of Technology and his New York Professional Engineer's license in 2003. Mr. Felton has worked for the Department of Environmental Conservation's Air Division in the monitoring Bureau for eleven years and for the State University of New York's Atmospheric Science Research Center for a year and a half. He implemented the PM-2.5 monitoring program in New York, collaborated on the USEPA Supersite program and serves on two National committees, CASAC AAMM and the NACAA Monitoring Steering Committee.

H. Detailed Itemized Budget

1. Personnel

NJDEP: Linda J. Bonanno, Ph.D., (10%/year) Research Scientist I, NJDEP will be responsible for the overall project **Lee Lippincott, Ph.D.** (10%/year) Research Scientist I, NJDEP, will be responsible for overall QA/QC, **Leo Korn, Ph.D.** (5% year 1 and 10% year 2) Research Scientist I, NJDEP, will be responsible for data analysis. NJDEP salary totals \$ 83,582 (includes fringe and indirect costs)

EOSHI-UMDNJ Zihua (Tina) Fan, Ph.D., Assistant Professor at EOHSI-UMDNJ (25% effort) will be the Principal Investigator for this project. She will take the overall responsibility for the implementation of the project, i.e., coordinating the analytical comparison and field sampling among EOHSI, Clarkson University, and ERG. She will work closely with Dr. Bonanno and other co-investigators for the study design and implementation. She will direct graduate students and technicians to conduct all the fieldwork and sample analysis that will be performed at EOHSI. She will be responsible for evaluation of the quality of all collected data generated in the proposed study and be responsible for preparation of annual reports and publications.

Robert Stiles, Ph.D., post-doc fellow, (100% effort), will work closely with Drs. Fan and Buckley to implement the lab and field tests, conduct data analysis, and assist in preparation of annual report and publications.

Lin Lin, Ph.D., Research Teaching Specialist III, (50% effort), will work closely with Dr. Fan to conduct field sampling, coordination of sample distribution and data information between EOHSI and Clarkson University and ERG, and assist in sample analysis, data analysis, and report preparation.

Graduate Student, doctoral graduate student, (100% effort), will work closely with Dr. Fan and Dr. Lin for field sampling and sample analysis.

T. Boutillette, Secretary (10% effort), will be responsible for purchasing, sample shipping to Clarkson University and ERG, and paper work of this project.

2. Fringe Benefits: NJDEP: Fringe is calculated at 34.75%. UMDNJ: Fringe benefits are calculated at 35.75%, increasing yearly at a rate of 1% for faculty and permanent staff. Postdoctoral Appointee and Graduate Student salaries are calculated at a rate of 7.65% in each year. Total salaries have been increased yearly based on an average of 3% inflationary factor.

3. Contractual Costs

NJDEP will contract with UMDNJ for \$588,918

UMDNJ:

1. Rutgers University - A sub-contract of \$30,208 will be initiated for Rutgers University
 - a. 5% effort for Dr. Brian Buckley. Dr. Buckley will be the co-Investigator of this proposed study. He will provide technical guidance for the study design and project execution, especially analytical method development, QA/QC plan, and assist in preparation of reports and publications.
 - b. \$14,400 is estimated for the instrument time (40 analytical days of the IC/ICPMS at EOHSI Analytical center @ \$45/hr, 8 hours/day) that will be used for all the sample analysis of this project.
2. Clarkson University - A sub-contract of \$135,148 will be initiated for Clarkson University (see attached itemized budget justification).

4. Travel

NJDEP budgeted \$2500 so that NJDEP can attend the National EPA monitoring conference and travel to monitoring site and EOHSI.

UMDNJ:

1. Local travel: The mileage for the round-trip from EOHSI to Camden (furthest possible location) is ~140 miles. Eighty round trips have been estimated for a total of ~40 sampling days (set up and pick up, plus field preparation). The mileage reimburse rate is @48.5c/mile. 40 trips for each year have been budgeted.
2. Domestic travel to DEP for meeting and conferences for PI and students.

Please note.

5. Equipment

1. Two NYS samplers (\$7,500/ea) will be purchased for hexavalent chromium air sample collection.
2. Parts for NYS sampler: cooler, Teflon coated filter holder, and other accessories for NYS samplers. Estimated \$1,250/sampler, \$2,500 is requested for 2 samplers.
3. A UV detector (~\$9,000), a post column for derivatization (\$600), and software for operating the IC/UV system (\$5,400/ea) will be purchased to go with the IC existed at EOHSI for analysis of Cr(VI) samples by EPA method (i.e. IC/UV method).

Please note that any sampling equipment purchased as part of this project will remain in the custody of NJDEP to be utilized for other Cr(VI) projects. The lab equipment will remain in the custody of each respective lab so that they may continue to work on Cr(VI) methods/issues

6. Supplies

1. Filters: Filters for both lab and field tests.
2. Cr isotope enriched solution: \$500/ea for Cr(VI) and Cr(III) isotopes. 3 sets have been requested for Year 1 and 2 sets for Year 2.
3. Chemicals: Cr(VI) and Cr(III) regular standards, NIST 1648 dust standards, high purity acids, and base for lab and field tests.
4. Office Supplies: \$2,000 has been budgeted for office supplies, such as printer supplies, paper, photocopying, etc
5. Field supplies: Year 1: \$4,500 for an outdoor closure for sampling equipment, 2 flow meters (one for NYS sampler \$800 and one for NATTS sampler, ~\$1,200/ea); Year 2, \$1,000 for field supplies including fittings, tubing, power extension, etc., and \$1,000 for utility.
6. Lab Supplies: \$2,000 for each year for lab supplies, such as vials, syringes, flasks, etc. for Cr (VI) sample collection and analysis

7. Other

1. Shipping postage: Shipment (Fedex) of samples from EOHSI to Clarkson University and ERG (estimate of 20 shipments in Year 1 and 80 shipments in Year 2 @ \$40/shipment), shipment of samplers from Clarkson University and ERG to EOHSI-UMDNJ. 6 samplers/\$250 ea.
2. Graduate student tuition and fees are budgeted for \$10,000 in year 01 and increase by 3% base on an inflationary factor.
3. Health Insurance for Postdoctoral Appointee and Graduate Student at the institutional rate of \$2,760/annually and increase by 3% for Year 2

4. \$800 is requested for publication.

8. Total Direct Cost is \$660,357

9. Indirect Cost for NJDEP is \$14,643

Please note that for the UMDNJ contract indirect costs are calculated @ 10% of modified total direct costs (MTDC). MTDC base excludes equipment, tuition, and the amount over the first \$25,000 on each subcontract. UMDNJ = \$38,251

10. Total Cost \$675,000

I. Environmental Results Past Performance

Numerous federally funded projects were successfully performed by the NJDEP over the last three years. Progress was made towards achieving the project goals, reports were submitted to the USEPA and results important to the scientific and public health communities were obtained. Some specific projects, managed by Dr. Bonanno include:

a. Asthma Outreach and Education Initiative-\$50,000 Reports regularly submitted to USEPA project officer. Work completed on time.

b. Urban Community Air Toxics Monitoring Project. \$495,242 Quarterly reports submitted to USEPA project officer. Delay in starting due to: delay by USEPA in awarding grant, Cr(VI) lab requested additional time for analysis, change in NJ legislation regarding equipment purchase, delay in getting contract out to UMDNJ from NJDEP. Presently, we are on schedule to provide USEPA with final report Jan 2008.

c. In-Cabin Particulate Matter Quantification and Reduction Strategies \$214,997. This project has just started. To date, the project is on schedule.

J. Programmatic Capability

The NJDEP has the staff and resources to manage this grant. The Division of Science, Research and Technology (DSRT) is the NJDEP's primary scientific research and technical support unit. The role of this division, through its studies, evaluations and monitoring efforts, is to provide NJDEP with a sound technical foundation upon which to base the department's policy and regulatory decisions. Numerous scientific studies were successfully performed by DSRT and the results were used and published in the scientific literature. DSRT scientists provide New Jersey with the needed technical role in standards development and research focused on recognizing developing environmental issues that could impact the environment in New Jersey. Particular emphasis is on fate, transport, exposure and risk to toxic substances. DSRT scientists have expertise which includes but is not limited to; field sampling, chemistry, modeling, statistics, GIS, toxicology and epidemiology

Evaluation of Two Sampling and Analytical Methods for the Measurement of Hexavalent Chromium in Ar

PI: Zhihua (Tina) Fan

DETAILED BUDGET FOR ENTIRE PROPOSED PERIOD

Personnel	Role	Appt.	Effort	Base	Year 01	Year 02	Total
Z. Fan, Ph.D.	PI	12	25%	\$81,767	\$20,442	\$21,055	\$41,497
R. Stiles, Ph.D.	Post-doc	12	100%	\$41,200	\$41,200	\$42,436	\$83,636
L. Lin, Ph.D.	RTS	12	50%	\$46,992	\$23,496	\$24,201	\$47,697
TBN	Grad Student	12	100%	\$24,000	\$24,000	\$24,720	\$48,720
T. Boutillette	Secretary	12	10%	\$39,976	\$3,998	\$4,118	\$8,116
Total Personnel:					\$113,136	\$116,530	\$229,666
Fringe:							
Faculty and Staff @35.75% Year 01; increased by 1% in Year 02					\$17,137	\$18,145	\$35,282
Post-doc and Graduate Student @ 7.65%					\$4,988	\$5,137	\$10,125
Total Fringe:					\$22,125	\$23,282	\$45,407
Equipment							
Felton Sampler (2 X \$7500/ea)					\$15,000	\$0	\$15,000
Parts for Felton Sampler					\$2,500	\$0	\$2,500
UV Detector and accessories					\$15,000	\$0	\$15,000
Total Equipment					\$32,500	\$0	\$32,500
Travel							
Local travel for sampling(0.485 cents/mile, 140 miles R/T, 80 trips in 2 years)					\$2,716	\$2,716	\$5,432
Domestic travel to DEP and conferences					\$2,500	\$3,500	\$6,000
Total Travel:					\$5,216	\$6,216	\$11,432
Supplies:							
Filters					\$1,000	\$1,000	\$2,000
Cr Isotope enriched solutions					\$3,000	\$2,000	\$5,000
Chemicals (Cr standard, NIST 1648 acid, base, etc.)					\$3,000	\$2,000	\$5,000
Office supplies					\$2,000	\$2,000	\$4,000
Field sampling supplies					\$6,500	\$2,000	\$8,500
Lab supplies					\$2,000	\$2,000	\$4,000
Total Supplies:					\$17,500	\$11,000	\$28,500
Other Expenses:							
Shipping postage					\$2,300	\$3,200	\$5,500
Tuition					\$10,000	\$10,300	\$20,300
Health Insurance					\$5,520	\$5,686	\$11,206
Publications					\$0	\$800	\$800
Total Other:					\$17,820	\$19,986	\$37,806
Subcontract:							
Rutgers University*-refer to the RutgersSubcontract sheet.					\$14,971	\$15,237	\$30,208
Clarkson University*-refer to the Clarkson Subcontract sheet					\$77,067	\$58,081	\$135,148
Total Subcontract:					\$92,038	\$73,318	\$165,356
Direct Costs					\$300,335	\$250,332	\$550,667
Indirect Costs @ 10%					\$20,577	\$17,674	\$38,251
Total Costs					\$320,912	\$268,006	\$588,918