WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

INTERIM ACTION REPORT
BREWSTER ELEMENTARY SCHOOL & SOFTBALL FIELD
BREWSTER, WASHINGTON

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1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this report is to detail cleanup activities conducted at the Brewster School Softball Field (Site) during the summer of 2006.

1.2 AREA-WIDE INTRODUCTION

Area-wide soil contamination is defined as contamination above state cleanup levels that is dispersed over a large geographic area. The soil contamination in this case is a result of central Washington's orchard industry. Much of the region consists of current or former orchard land, where long-term pesticide application has taken its toll. Lead arsenate, a pesticide commonly used between the years of 1905 and 1947 to control the codling moth, has been identified as the primary source of increased lead and arsenic concentrations.

Due to their chemical structure, lead and arsenic tend to bond with soil particles and often remain at or near ground surface level for decades, creating an exposure pathway through inhalation and/or ingestion.

Although lead and arsenic are naturally occurring elements, elevated concentrations have been proven to have a negative impact on human health. Young children are generally more susceptible than adults, which is why Ecology has focused remediation efforts on schools.

Because of the unique nature of area-wide contamination, traditional methods of remediation are not feasible. Therefore, the Area-Wide Soil Contamination Task Force was established in 2002 to identify and pursue effective statewide strategies. Recommendations from the Task Force included soil testing, qualitative evaluations, and protective measures at child-use areas.

In the central Washington region, Okanogan, Chelan, Douglas, and Yakima counties were targeted based on the large volume of apple and pear production during the first half of the 20th century. Ecology's Central Regional Office (CRO) began initial sampling and analysis during the spring of 2002 in the Wenatchee area. This area was chosen based on aerial photography from 1927 and 1947 that showed a high number of school properties located on former orchard land.

Results from the Wenatchee area showed several schools with soil contamination exceeding state cleanup standards. Based on these results, soil testing was implemented in the four priority counties. Over 100 public schools were tested for lead and arsenic during the summer of 2005. Of the schools sampled, Ecology's CRO identified 35 schools with soil contamination exceeding state cleanup standards.

The 35 schools were then prioritized for remedial activities. Remedial activities started during the summer of 2006. Eight schools were selected, including Brewster.

2 SITE DESCRIPTION

The Brewster School District softball field (Site) is located adjacent to Brewster High School within Brewster city limits in Okanogan County, Washington. Additionally, the Site is located in the NW ¼ of the SE ¼ of Section 14, Township 30 North, Range 24 East. The City of Brewster is situated on a point which extends southwest towards the Lake Pateros section of the Columbia River. The Site is located on this point at approximately ¼ mile north and ¼ mile west of the Columbia River. State Highway 97 is located ½ mile to the northwest.

Situated on the eastern boundary of the Cascade foothills, Brewster is located in a lowland carved out past glaciers and the Columbia River. The baseball field is located approximately 800 feet above sea level. Relief across the excavation area is minimal. Depth to groundwater is approximately 36 feet and will generally flow south-southwest toward the Columbia River.

According to the United States Department of Agriculture (USDA) Soil Survey of Okanogan County Area Washington, excavation area soils span between Cashmere and Pogue soil types. Cashmere and Pogue-type soils are considered part of the Pogue-Cashmont-Cashmere association. This association of soils was formed in glacial till and outwash and is commonly found on low-lying terraces throughout the area. Pogue and Cashmere-type soils are grayish-brown in color with a fine sandy loam surface layer. Pogue-type soils have a very gravelly sand sub-layer and Cashmere-type soils have a fine sandy loam or loamy fine sand sub-layer. Soils are well-excessively drained. This soil association is heavily used as orchard land.

The Soil Survey describes the following soil horizons:

- At 0-6 inches below ground surface (bgs), soil consists of a grayish-brown sandy loam with a weak, platy structure. Soil is soft and considered very friable, slightly sticky, and non-plastic. Soil is well impregnated with many fine roots and pores. Soil has a neutral pH.
- At 6-12 inches bgs, soil is a brown, fine sandy loam with a weak prismatic structure. Soil is soft and considered very friable, slightly sticky, and non-plastic. Soil is well impregnated with many fine roots and pores. Soil has a neutral pH.
- Between 12 and 29 inches bgs, soil becomes more yellowish-brown in color. Soil is a fine gravelly sandy loam with a weak, course prismatic structure. Gravel content is approximately 20 percent. Soil remains soft and friable, non-sticky and non-plastic with fine root intrusion. Soil is still considered moist, soft, and non-sticky but becomes slightly plastic. Soil remains neutral.
- At 29-60 inches bgs, soil becomes a multi-colored, very gravelly, single grain sand. Soil is loose and very porous.

Soil at the site was found to substantially similar to the above description. As is common in Pogue-type soils, soil at the site was occasionally found to be very stony within four feet of the surface.

3 SITE HISTORY

The Okanogan Health District and Ecology began soil screening for lead arsenate contamination at Brewster School District facilities in 2004. Analytical results determined several areas of concern, including newly developed soccer fields and an associated parking lot, baseball field, and playfield adjacent to modular classrooms at the elementary school. Sampling also identified uncontaminated areas, including the football and track facilities.

Identification of lead and arsenic impacted soils resulted in the remediation of the soccer field and adjacent parking. Although other areas of contamination remained, the soccer field was identified as a priority at the time. Arsenic and lead had been identified at concentrations of up to 113 ppm and 1052 ppm respectively, at this location.

To prevent exposure to contaminated soil a 6 inch clean soil cap and geo-textile barrier were installed above the soccer field. Turf replacement and a comprehensive maintenance plan, including installation of a new irrigation system, were also implemented to facilitate upkeep and prevent erosion of the imported soil. Because contamination was not removed from the site, a restrictive covenant was issued to restrict future improvements or redevelopment of the site. Remedial activities were completed by Brewster School District, with funding and technical support from Ecology.

The softball field, previously identified as containing lead and arsenic contamination, was selected for remediation during Area-Wide cleanup efforts in 2006. As with the soccer field, a soil cap was selected as the remedial method.

4 SITE CONTACT INFORMATION

This project was organized and completed by the Brewster School District (School District). All contracts were operated by the School District and invoices were submitted to Ecology for reimbursement. Ecology maintained contact with School District staff throughout site work to maintain a positive working relationship and exchange of information as needed.

School District maintenance staff completed all remedial activities at the Brewster High School property. Interaction between District and Ecology staff was primarily related to project funding.

The following table contains contact information for individuals with whom Ecology interacted throughout the remediation process.

Table 1: Site Contacts

Name	Organization	Position	Phone Number
Jim Kelly	Brewster School District	Superintendent	(509) 689-3418 Ext 257
Doug Poole	Brewster School District	Fiscal Officer	(509) 689-3418 ext 259

5 REMEDIAL ACTIVITIES

5.1 RISK

The potential exposure pathways for lead and arsenic in soil are inhalation, ingestion, and dermal absorption. It is important to consider that ingestion is not considered as an exposure pathway in the site hazard assessment ranking method. For the purpose of this cleanup, ingestion was considered as a significant exposure pathway. Ingestion of contaminated soil is expected to be the primary route of exposure for metals, particularly with young children. Metals in dust or soil can be ingested accidentally by hand-to-mouth activity. Pica behavior in young children, that is, eating of non-food items, will increase this exposure. Ingestion or inhalation of wind-blown soil or dust are additional pathways of exposure to lead and arsenic. Children are considered a sensitive population because they tend to ingest more soil and dust than adults and because they tend to absorb more of the lead they ingest. Metals are not readily absorbed through the skin, so dermal absorption of metals is not a significant concern at the concentrations found at schools in the area-wide cleanup program.

Evidence of groundwater contamination or the threat of groundwater contamination has not been found relative to area wide lead and arsenic contamination. Extensive soil profile sampling in Central Washington has demonstrated that lead and arsenic contamination does not extend below 30 inches bgs in undisturbed situations. High levels of lead and arsenic contamination (above 50 ppm for arsenic and above 500 ppm for lead) were not found below 12 inches bgs. These results may vary in climates with more precipitation, but in this region, the findings were very consistent. Due to the depth of groundwater found in the vicinity of the school, combined with the distribution of the contamination, the risk of lead and arsenic contamination in groundwater is minimal.

5.2 REMEDIAL PROCESS

5.2.1 SAFETY AND HEALTH

The site was restricted from public access throughout the construction period by a 6-foot high chain link fence. The contractor was required to provide a specific Safety & Health Plan for the site construction activities.

5.2.2 DUST CONTROL PLAN

The contactor was required to control dust and to prepare a dust control plan. Dust control measures at a minimum included a water truck.

5.2.3 REMEDIAL ACTIVITIES

Due to previous area-wide remedial activities at Brewster Schools, a restrictive covenant is already in place for several portions of the property. For this reason, it was determined that capping the remaining contamination would be the most efficient remedial option.

The remedial process was very simple. A geotextile membrane was used to cover the existing soil surface. The membrane was placed in rolls that were 15 feet wide and they were overlapped a minimum of 12 inches. It was secured with 6 inch long landscaping staples. The fabric was then covered with clean topsoil imported from a local quarry. The imported topsoil was tested for the presence of lead and arsenic prior to import. Neither lead nor arsenic were detected above background concentrations in 10 samples taken from the import topsoil. Approximately 1000 yards of topsoil were imported onsite. Following topsoil import, the Site was hydroseeded and additional infield clay was imported for the softball field.

5.2.4 SAMPLE RESULTS

Initial sampling between the surface and 8 inches bgs found average arsenic concentrations of 31 ppm with a maximum concentration of 64 ppm. Initial lead concentrations averaged 195 ppm with a maximum concentration of 582 ppm. Sample data can be viewed in the tables below.

<u>MTCA Method A Soil Cleanup Levels</u>

As- 20ppm

Pb- 250ppb

Table 2: Pre-Excavation Samples

Date	As	Pb	Sample ID	School
20-Aug-03	**9**	**65**	1	Brewster
20-Aug-03	**40**	**178**	2	Brewster
20-Aug-03	**<LOD**	**565**	3	Brewster
20-Aug-03	**56**	**551**	4	Brewster
20-Aug-03	**40**	**60**	5	Brewster
20-Aug-03	**29**	**17**	6	Brewster
20-Aug-03	**24**	**33**	7	Brewster
20-Aug-03	**40**	**104**	8	Brewster
20-Aug-03	**<LOD**	**69**	9	Brewster
20-Aug-03	**<LOD**	**22**	10	Brewster
20-Aug-03	**93**	**671**	11	Brewster
20-Aug-03	**64**	**582**	12	Brewster
20-Aug-03	**73**	**486**	13	Brewster
20-Aug-03	**66**	**447**	14	Brewster
20-Aug-03	**30**	**132**	15	Brewster
20-Aug-03	**40**	**148**	16	Brewster
20-Aug-03	**48**	**233**	17	Brewster
20-Aug-03	**67**	**578**	18	Brewster
20-Aug-03	**19**	**58**	19	Brewster
20-Aug-03	**<LOD**	**92**	20	Brewster
20-Aug-03	**9**	**14**	21	Brewster
20-Aug-03	**15**	**22**	22	Brewster
20-Aug-03	**38**	**203**	23	Brewster
20-Aug-03	**<LOD**	**39**	24	Brewster
20-Aug-03	**<LOD**	**11**	25	Brewster
20-Aug-03	**<LOD**	**64**	26	Brewster
20-Aug-03	**<LOD**	**103**	27	Brewster
20-Aug-03	**<LOD**	**98**	28	Brewster
20-Aug-03	**<LOD**	**14**	29	Brewster
AVERAGE	**31**	**195**		Brewster
MAXIMUM	**64**	**582**		Brewster

***<LOD: Below the Levels of Detection**

6 PROJECT SUMMARY

Soil samples collected at Brewster School (Site) in 2004 indicated lead and arsenic contamination existed in surface soils at concentrations above MTCA cleanup levels. The course of action that was taken was to cap the field. A non-woven permeable geotextile fabric was placed on top of the contaminated soil, followed by new topsoil and turf-hydroseed to restore the site to the original condition. As a result, the remaining lead and arsenic concentrations were contained within the site, and a restrictive covenant was issued to restrict future improvements or redevelopment of the site.

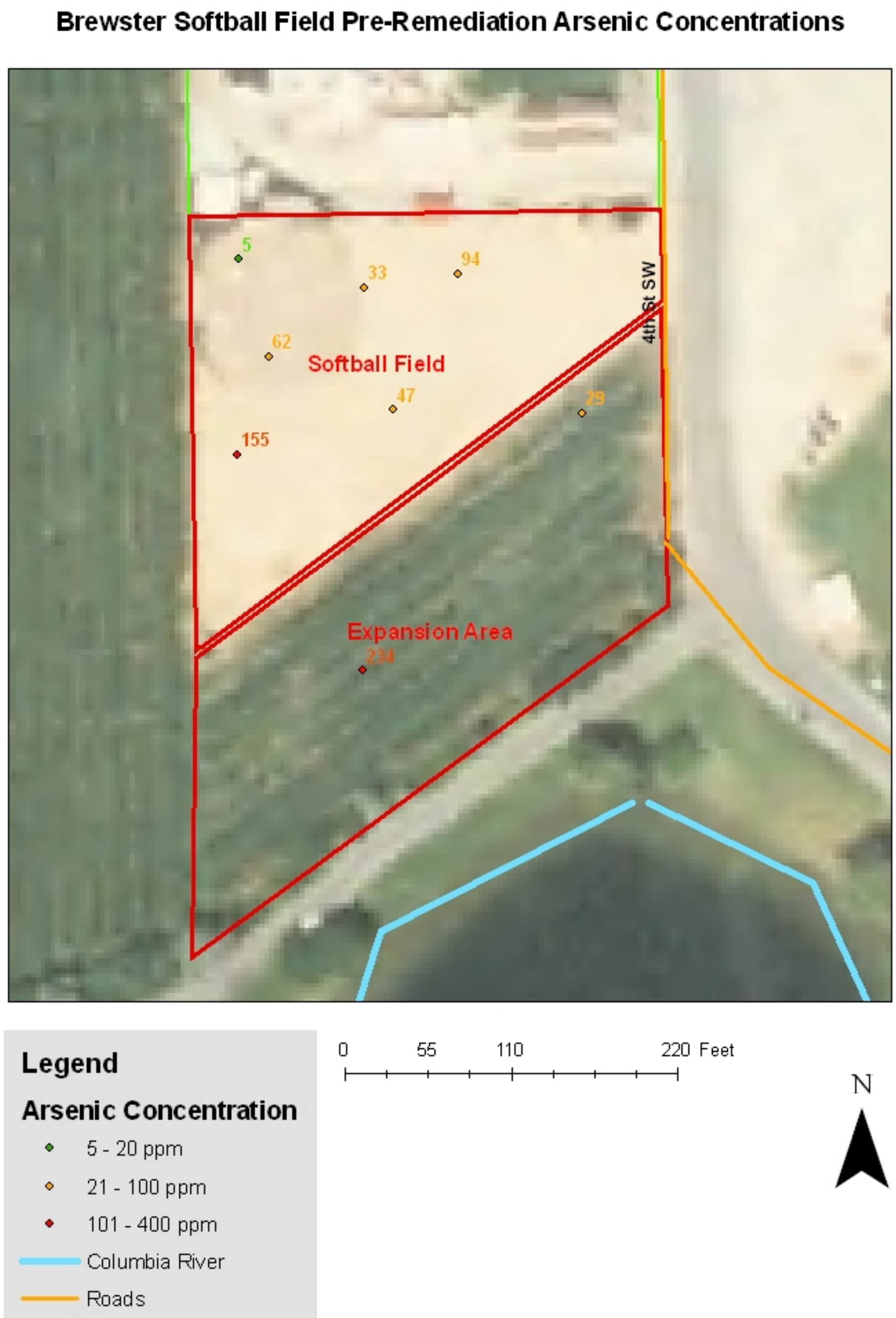
7 Appendices

Appendix A: FIGURES

Figure A-1: Vicinity

Map

Figure A-2: Pre-Remediation Samples



7.1 Appendix B: XRF USE

The summer 2006 area-wide contamination clean-up projects involved the collection and analysis of a vast number of soil samples. Concentrations of lead and arsenic in these soil samples provided information as to whether or not an area was contaminated, and this information was used to determine how the remedial activities would proceed. Therefore project staff needed a way to quickly and reliably evaluate soil arsenic and lead concentrations. This was achieved through the use of two portable X-Ray Fluorescence (XRF) Analyzers manufactured by Innov-x Systems.

The instruments use x-ray technology to excite elemental electrons in a soil sample and cause these elements to emit characteristic x-rays. The intensity of these elemental x-rays is then measured to determine the amount of a particular element present in the sample. The entire analysis is performed in approximately one minute and the data is stored in a removable Hewlett-Packard (HP) iPAQ personal data assistant which can transmit the information to a laptop.

The use of portable XRF units for the determination of soil elemental concentrations has been described by EPA Method 6200 and has been found to provide, “a rapid field screening procedure” for site characterization [US EPA]. Results from the study conducted by Ecology in 2002 (as shown in the graphs below) found that a portable Niton XRF had a correlation coefficient (r2 value) between field and Inductively-Coupled Plasma (ICP) laboratory analyses of 0.8057 for lead and 0.933 for arsenic. In addition, a verification study conducted by the EPA Superfund Innovative Technology Evaluation (SITE) Monitoring and Measurement Technology (MMT) Program provides additional support for the use of this technology. The investigation compared an Innov-x XRF model, similar to the one used by Ecology, with reference laboratory data and showed a correlation coefficient of 0.8762 for arsenic and 0.91 for lead [US EPA]. All of this data shows that an XRF can be an effective tool for characterizing large contamination sites.

Figure B-1: 2002 Arsenic Comparison

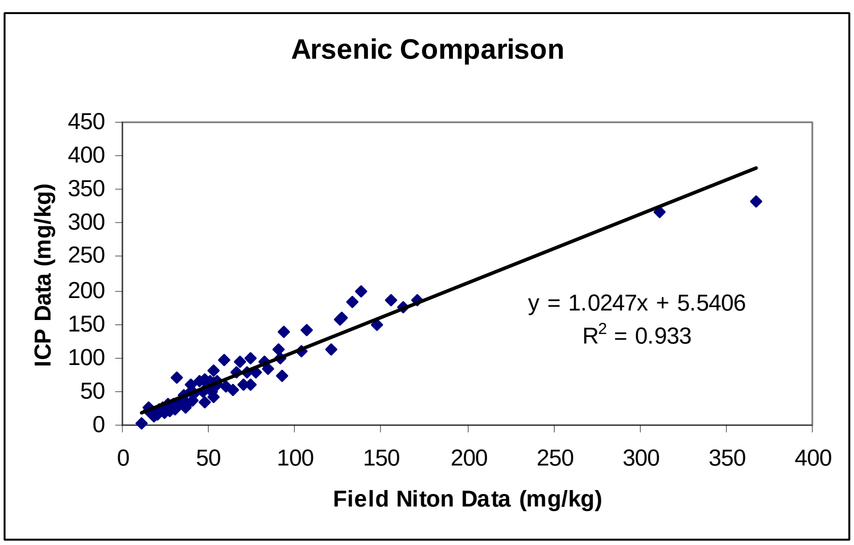
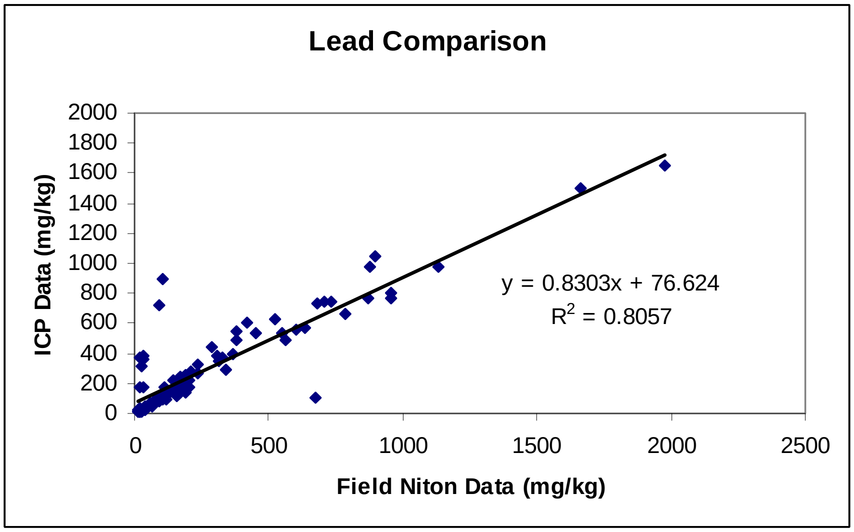


Figure B-2: 2002 Lead Comparison



During the summer 2006 projects, soil samples were collected and analyzed with the XRF instruments from a variety of locations. These locations included: undisturbed portions of the school playfields, sections of the playfields where initial soil excavations had occurred, and areas that had been processed by the deep mixer. As timely decision making was often required to keep the projects on schedule, the ability to assess the effectiveness of remediation activities with on-site soil analysis was invaluable to the overall success of the project. The XRF could determine concentrations of lead and arsenic in minutes. Sending samples for laboratory analysis at standard rates takes 2-3 weeks and would have drastically reduced the efficiency of remedial activities. Real-time results from these field analyses enabled project staff to make decisions such as whether the removal of additional soil was necessary or whether the barrel of the deep mixer should be raised to mix less soil or lowered to mix more.

Following the completion of the remediation projects conducted in 2006, additional samples were collected for comparison between XRF and Lab ICP methods. A total of 95 additional samples were collected and analyzed by both methods. These samples were analyzed by XRF prior to packaging in clean sealed jar. The analysis (as shown in the graphs below) found that the Innov-X XRF had a correlation coefficient (r2 value) between field and Inductively-Coupled Plasma (ICP) laboratory analyses of 0.779 for arsenic and 0.893 for lead. It should be noted that many of the data points were actually detection limits of both analysis methods for samples where lead or arsenic was not detected. When those non-detect data points are removed, the analysis found that the Innov-X XRF had a correlation coefficient (r2 value) between field and Inductively-Coupled Plasma (ICP) laboratory analyses of 0.838 for arsenic and 0.879 for lead.

Figure B-3: 2006 Arsenic Comparison

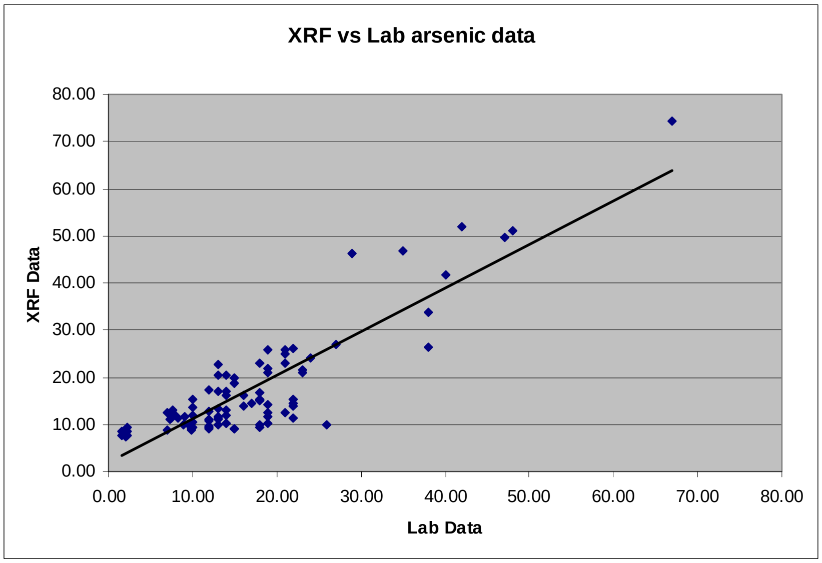
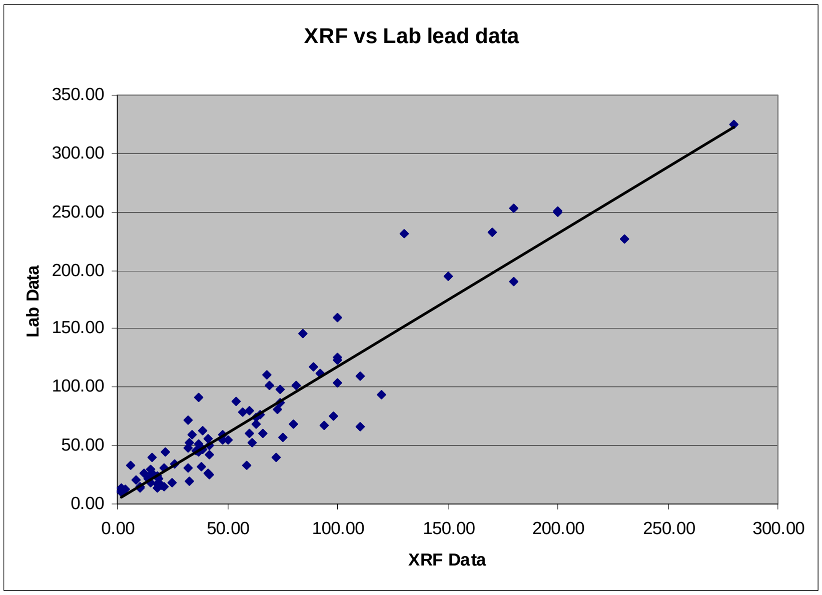


Figure B-4: 2006 Lead Comparison



Project staff followed all safety protocols for use of the XRF instruments including completion of mandatory information and safety trainings before sampling analysis began. In order to reduce health risks associated with radiation exposure, the instruments were operated while in a docking station and careful attention was paid to eliminate direct x-ray exposure. Actual amounts of radiation exposure as regulated by OSHA were monitored with the use of dosimeters which were carried by all sampling personnel.

Finally, in addition to the time saving benefits of the XRF instruments, their use proved to be a cost effective option for sample analysis. Due to the area (total acreage) covered during the school remediation projects, a large number of samples were required to characterize site progress. Use of the instruments resulted in a significant reduction in the number of soil samples sent off for laboratory analysis at a cost of $62-$66 per sample. Therefore, instead of project money being spent on one time analyses, it was invested in a second XRF instrument which enabled remediation work to occur simultaneously in several locations. Not only has the instrument paid for itself over the course of a single summer, but it will now be available for use in many future projects.

7.2 Appendix C: COSTS

Table 2: Brewster Elementary School Remediation Costs

Landscaping	
Soil Mix	$20,251
Soil Kit (infield clay)	$805
Top Soil	$23,944
Hydro Seeding	$2,500
Fencing	$1,978
Infield Conditioner	$1,120
Rakes	$1,928
Irrigation	
Pipe Supplies	$11,035
Miscellaneous	
Innov-X	$32,535
Woven Cover/Staples	$5,408
Electrician Services	$450
Hardware Supplies	$166
Fire Hydrant Extension	$569
Top Rail Supplies	$729
Labor Expenses	$3,962
Total	$101,971
Acres Remediated	1.24
Cost per Acre	$82,235.12
Square feet Remediated	54014.4
Cost per square foot	$1.88

7.3 Appendix D: PHOTO LOG

Photo D-1: Brewster Elementary School Pre-Remediation

Photo D-2: Brewster Elementary School placing geotextile

Photo D-3: Brewster Elementary School placing geotextile

Photo D-4: Brewster Elementary School complete

7.4 Appendix E: Bibliography

US EPA. Method 6200. "Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment". January 1998.

US EPA. "Innovative Technology Verification Report: XRF Technologies for Measuring Trace Elements in Soil and Sediment: Innov-X XT400 Series XRF Analyzer". EPA/540/R-06/002. February 2006.