INTERIM ACTION REPORT
MANSON ELEMENTARY SCHOOL
MANSON, WASHINGTON

October 30, 2006

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Toxics Cleanup Program
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1.0 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this report is to detail cleanup activities conducted at Manson Elementary School 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 coddling 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, four priority counties were identified. 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. Therefore, 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. Four Wenatchee area schools were chosen for initial activities due to close proximity between properties and summer break schedule. North Omak Elementary, Brewster High School, Manson Elementary, and Naches Intermediate were chosen for remediation following completion of soil excavation and mixing activities in Wenatchee. Yakima area schools are currently scheduled for remediation in 2007.

2.0 SITE DESCRIPTION

Manson Elementary School is located at 950 Totem Pole Road, Manson, Washington, within the town of Manson in Chelan County, Washington. More specifically, the site is located at 47º89’53”N and 120º16’19”W (GPS Coordinate) in the NE ¼ of the NE ¼ of Section 35, Township 28 North, Range 21 East. Manson Elementary is approximately ½ mile north of State Highway 150 as it terminates in downtown Manson and 10 miles northwest of the City of Chelan.

Situated on the eastern boundary of the Cascade foothills, Manson Elementary is located approximately 1350 feet above sea level on the north shore of Lake Chelan. Relief across the excavation area is minimal, but a steep grade of approximately 5 feet in length extends along its southern boundary. Depth to groundwater is not known but will generally flow south toward Lake Chelan.

According to the United States Department of Agriculture (USDA) Soil Survey of Chelan Area Washington, local soils are described as Antilon gravelly sandy loam. Antilon soils are the result of volcanic activity and are composed primarily of pumice and ash underlain by lake shore deposits, mostly clay. Antilon soils are considered moderately drained, moderately coarse in texture, and are common on terraces surrounding Lake Chelan.

The Soil Survey describes the following soil horizons:

- At 0-10 inches below ground surface, soil is very dark grayish-brown with a weak, medium, prismatic structure. Soil is described as soft and very friable, non-sticky and non-plastic. This soil horizon is well impregnated with fine root material and has low porosity. Soil pH is mildly alkaline.
- At 10-19 inches below ground surface, soil is grayish-brown gravelly sandy loam. Soil has a homogeneous texture and remains soft, very friable, non-sticky and non-plastic. This soil horizon is well impregnated with fine root material and has low porosity. Soil content is approximately 40% pumice and pH is mildly alkaline.
- Between 19 and 30 inches below ground surface, soil is brown gravelly sandy loam with a homogeneous texture. Soil is soft, very friable, non-sticky and non-plastic. This soil horizon is well impregnated with fine root material and has low porosity. Soil contains approximately 48% pumice and has a moderately alkaline pH.
- At 30 to 60 inches below ground surface, soil becomes light gray silty clay loam with areas of olive gray and light olive brown. Soil is described as having a strong, medium, sub-angular blocky structure and is very hard, very firm, sticky, and plastic in nature. Root impregnation is not noted in this soil horizon. Soil has low porosity and a strong alkaline pH.

3.0 SITE HISTORY

Investigation into possible lead arsenate soil contamination at Manson Elementary School began in 2004. Norman Hepner, an environmental engineer, led the initial soil investigation. Although the school was not identified as being located on historic orchard land, interviews with the school superintendent, Steve McKenna, revealed that the playfield had been graded with imported soil. The playfield was initially screened for lead arsenate contamination in November 2004.

Of nine samples collected, Model Toxics Control Act (MTCA) Method A cleanup levels were exceeded in seven samples. Arsenic contamination exceeded 100 parts per million (ppm) in three samples and lead exceeded 500 ppm in six samples. Confirmation sampling was conducted in July and August of 2005 to further delineate the area of contamination. To illustrate the extent of contamination, 26 of 30 samples collected randomly throughout the playfield in August 2005 were determined to be in excess of MTCA cleanup levels. Of those, 18 samples were in excess of 100 ppm arsenic or 500 ppm lead.

Following discovery of lead arsenate impacted fill, Ecology developed a draft plan for soil remediation. The plan called for excavation of the top 6 inches of topsoil from the playfield followed by import of clean topsoil. Initial scheduling called for work to be completed during the summer of 2005. However, work was delayed until 2006 to ensure funding availability and to coordinate cleanup efforts being completed at other schools.

4.0 SITE CONTACT INFORMATION

Contractual and planning phases of the project were reviewed by the Manson School District prior to beginning field operations. Ecology maintained contact with Manson Elementary School staff throughout site work to maintain a positive working relationship and exchange of information as needed.

Ecology acted as the general contractor for all work at Manson Elementary School. Excavation was completed by River’s Edge Services. Landscaping and irrigation was completed by Muffett & Sons.

The following table contains contact information for individuals responsible for various roles in the completion of remedial activities.

Name	Organization	Position	Phone Number
Steve McKenna	Manson School District	Superintendent	(509) 687-3140
Joan Pauly	Manson Elementary School	Principal	(509) 687-9502
Mike Torres	Manson Elementary School	Maintenance & Operations	(509) 687-9502
Paul Kemp	River’s Edge Services	Excavation	(206) 396-0271
Rod Muffett	Muffett & Sons	Landscaping & Irrigation	(509) 877-2153

5.0 REMEDIAL PROCESS

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 inhalations 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 below ground surface (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

The initial remediation plan for Manson Elementary was based upon sampling conducted across the site to a depth of approximately 12 inches. This data indicated that there was a distinct boundary at approximately 8 inches bgs between contaminated fill and clean native soils; the remediation plan called for excavation of the top 8 inches of soil across the site, no mixing or capping would be required. Clean topsoil would be required to provide a suitable growing surface after the surface soils were removed.

An excavator was used for excavation. After the excavator had removed the surface soils down to 8 inches, the XRF was used to analyze post-excavation surface concentrations and determine whether more excavation was required. All contamination in excess of MTCA cleanup levels was removed from the site. When post-excavation surface concentrations of less than 20 ppm were reached, excavation was considered complete for that area. Approximately 2000 cubic yards of soil was excavated from the site. Following excavation, the excavator loaded the stockpiles into trucks for transport to the landfill. Soil excavated from Manson Elementary was transported to the Okanogan County Landfill in Okanogan, Washington.

After excavation was complete, clean topsoil was imported to the site. The topsoil was taken from an undisturbed site and tested for lead and arsenic concentrations. Neither lead nor arsenic were detected above background concentrations in 10 samples taken from the import topsoil. Approximately 2000 yards of topsoil were imported onsite.

5.3 SAMPLE RESULTS

Remedial activities at Manson Elementary were intended to remove all soils containing concentrations of lead and arsenic. With this goal in mind, remediation was successful at Manson Elementary.

Initial sampling between the surface and 8 inches bgs found average arsenic concentrations of 68 ppm with a maximum concentration of 99 ppm. Initial lead concentrations averaged 469 ppm with a maximum concentration of 729 ppm. Excavation continued until surface concentrations did not exceed MTCA cleanup levels of 20 ppm arsenic and 250 ppm lead. Sample data can be viewed in the tables below. Maps containing this data are available as Figures 1 and 2.

Table 5-1: Pre-Remediation Samples

Date	As	Pb	School	Sample ID
10-Aug-06	84.32	382.22	Manson	MT-1 1-4"
10-Aug-06	86.86	729.18	Manson	MT-2 1-4"
10-Aug-06	98.83	670.88	Manson	MT-3 1-4"
10-Aug-06	33.69	362.17	Manson	MT-4 1-4"
10-Aug-06	34.05	204.07	Manson	MT-5 1-4"
Average	67.55	469.70		
Max	98.83	729.18		

Table 5-2: Post-Remediation Samples

Date	As	Pb	School	Sample ID
8-Aug-06	7.89	9.96	Manson	MexT-1
8-Aug-06	8.15	9.85	Manson	MexT-2
8-Aug-06	14.63	11.09	Manson	MexT-3
8-Aug-06	16.16	9.30	Manson	MexT-4
8-Aug-06	15.59	146.56	Manson	MexT-5
8-Aug-06	14.79	109.64	Manson	MexT-6
11-Aug-06	10.23	19.11	Manson	fill test - 1
11-Aug-06	13.55	18.56	Manson	fill test - 2

11-Aug-06	13.74	20.05	Manson	fill test - 3
11-Aug-06	13.60	18.88	Manson	fill test - 4
11-Aug-06	11.59	16.51	Manson	fill test - 5
11-Aug-06	13.11	19.54	Manson	fill test - 6
11-Aug-06	12.86	18.54	Manson	fill test - 7
11-Aug-06	11.32	18.99	Manson	fill test - 8
11-Aug-06	11.86	19.16	Manson	fill test - 9
11-Aug-06	10.99	16.89	Manson	fill test - 10
Average	12.50	30.16		
Max	16.16	146.56		

6.0 PROJECT SUMMARY

Soil samples collected at Manson Elementary School (site) during sampling events in 2004 indicated lead and arsenic contamination existed in surface soils at concentrations above MTCA cleanup levels. Excavation was used to remove the top 6” of contaminated soil from the site, and dispose of the material in a properly permitted landfill meeting the requirements of RCRA Subtitle D. New topsoil and turf were imported to restore the site to the original condition. As a result, lead and arsenic concentrations were removed from the site and the soil on site does not contain concentrations above MTCA cleanup levels. MTCA cleanup guidelines require no further action at a site when these conditions are met. Following remediation, the site was restored to its original condition.

7.0 APPENDICES

Appendix A: Figures

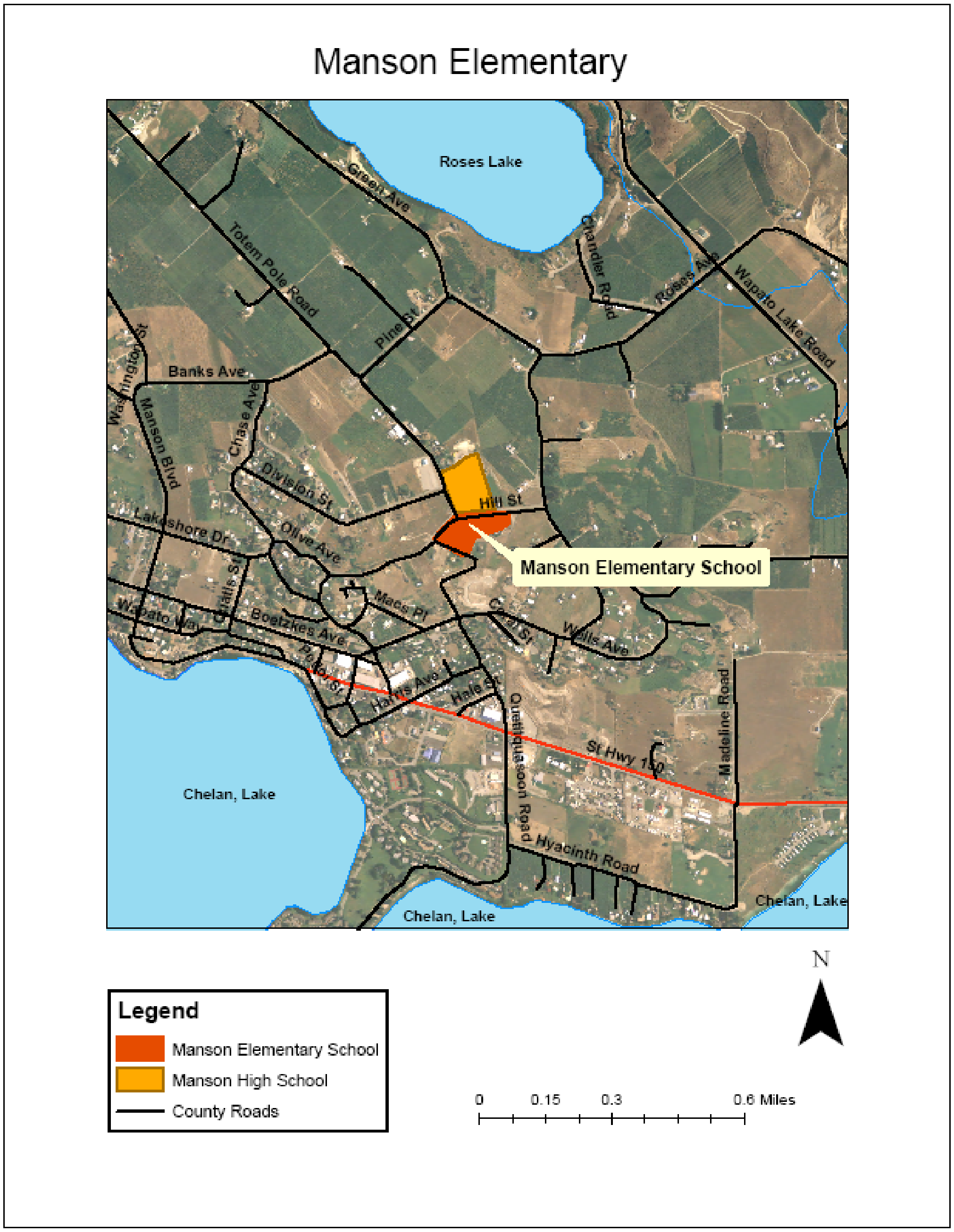


Figure F-1: Vicinity Map

Manson Elementary Pre-remediation Arsenic Concentrations

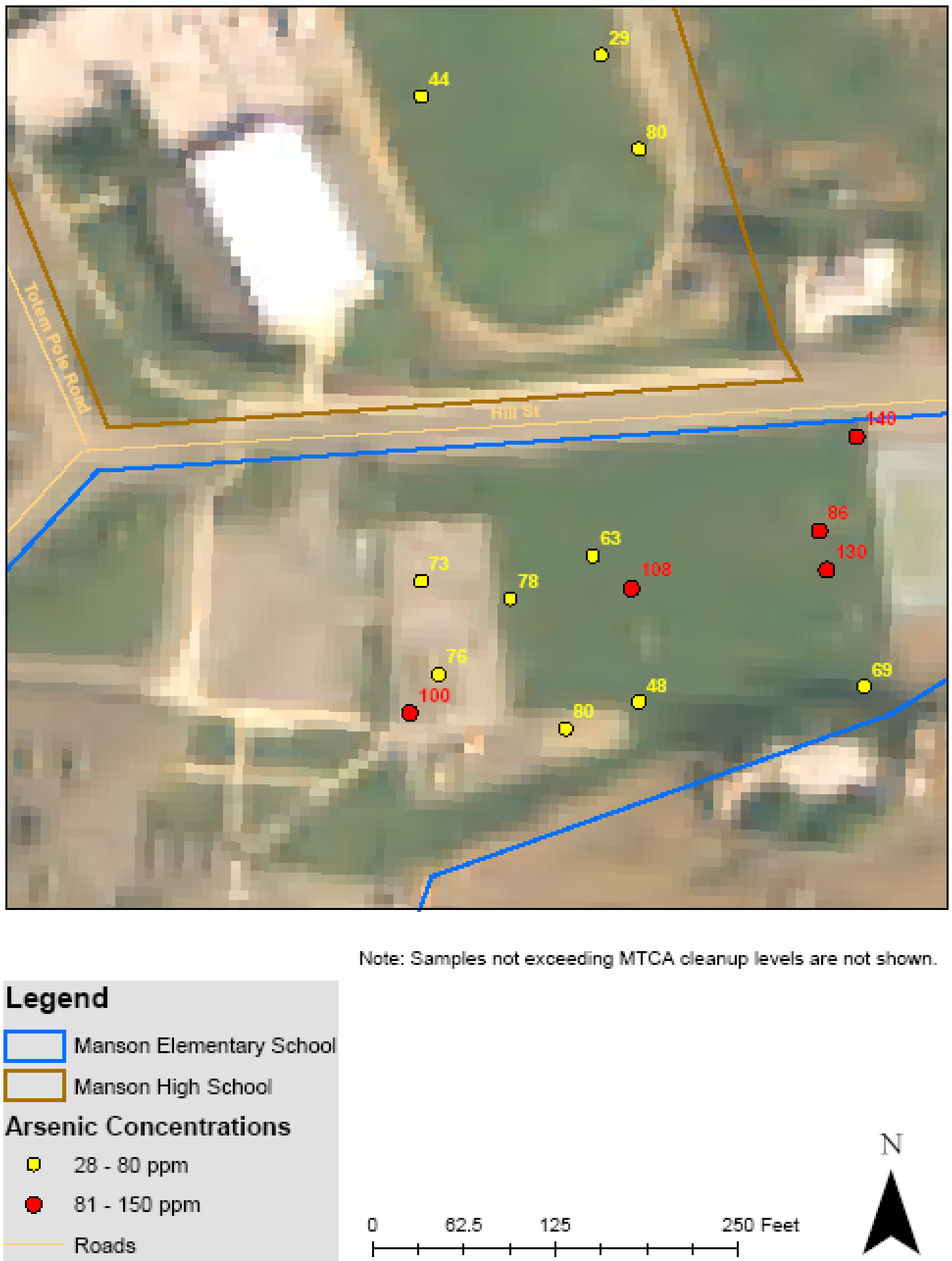


Figure F-2: Pre-Remediation Concentrations

Manson Elementary Post-remediation Arsenic Concentrations

Figure F-3: Post-Remediation Concentrations

Appendix B: XRF USE

The summer 2006 area-wide contamination cleanup 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

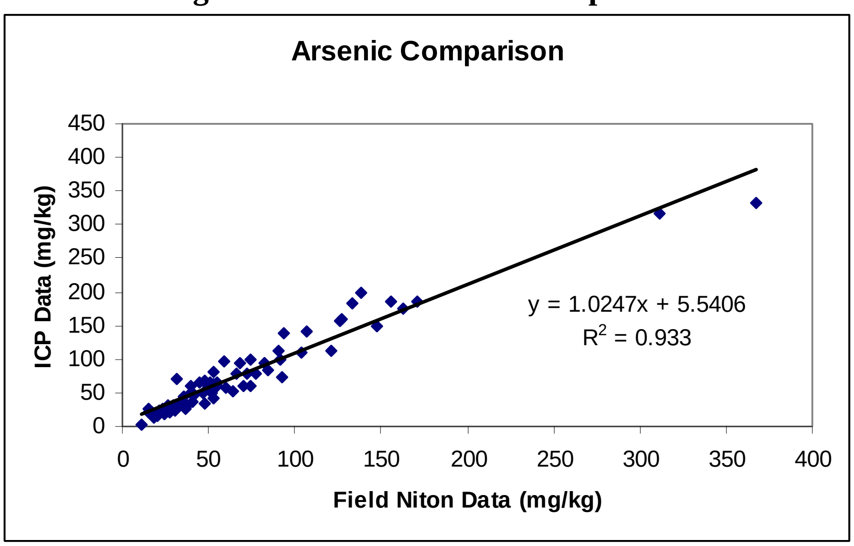
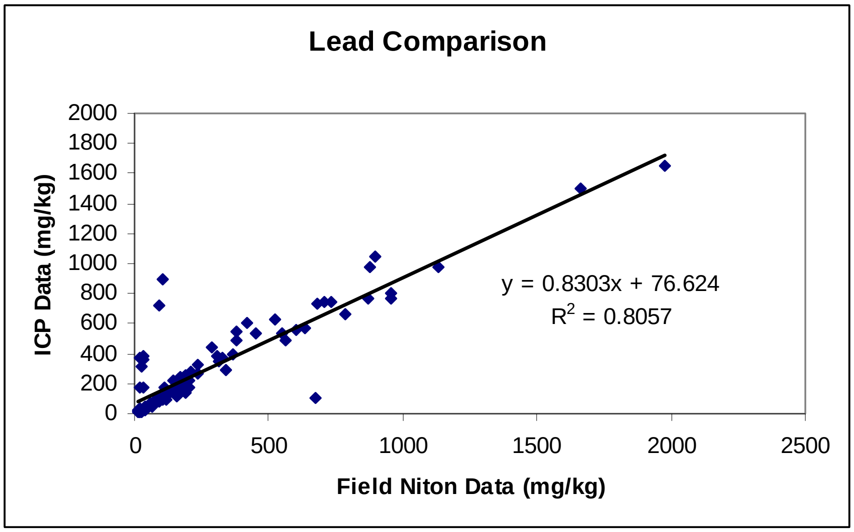


Figure B-2: 2002 Lead Comparison



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

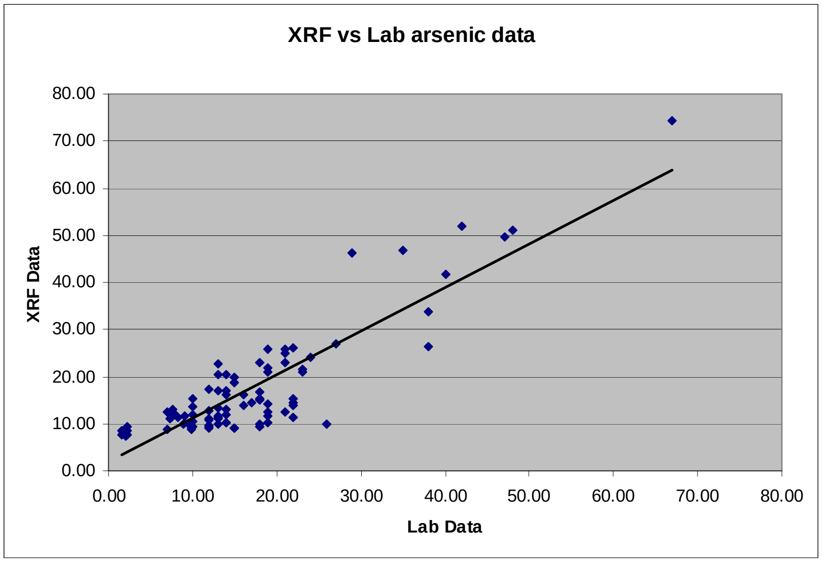
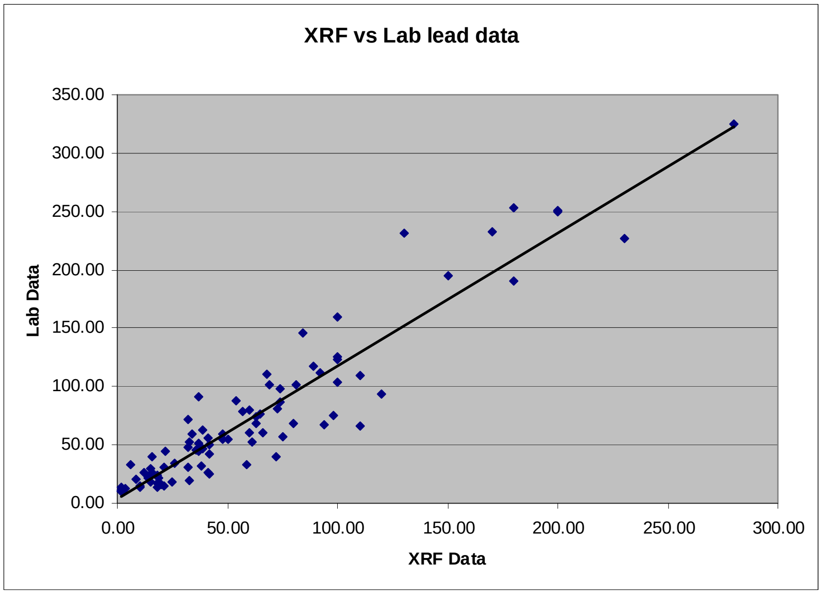


Figure B-4: 2006 Lead Comparison



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.

Appendix C: COSTS

Manson Elementary School Remediation Costs

Mobilization	
Mobilization/Demobilization	$3,000.00
Soil Transport/Disposal	$35,840.00
Grading and Compaction	$4,700.00
Excavation Costs	
Soil Excavation	$33,184.98
Landscaping	
Topsoil Purchase & Placement	$61,752.32
Sod Purchase & Placement	$28,160.00
Sod Mark-Up (12%)	$3,379.20
Irrigation	
Irrigation System	$32,000.00
Irrigation System Mark-Up (12%)	$3,840.00
Miscellaneous	
Grading and Compaction	$4,700.00
Additional Bonding	$6,000.00
Total	$214,756.50
Acres remediated	1.385
Cost per acre	$155,058.84
Square foot remediated	60330.6
Cost per square foot	$3.55

Appendix D: Photo Log

Photo P-1
Manson Elementary pre-remediation

Photo P-2
Manson Elementary play area post-excavation with some clean fill import

Photo P-3
Rubber mats used under play equipment

Photo P-4
Manson Elementary play area post-remediation

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.

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