WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

INTERIM ACTION REPORT
BARGE-LINCOLN ELEMENTARY SCHOOL
YAKIMA, WASHINGTON

Facility/Site ID # 5075703

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Prepared by Washington State Department of Ecology
Toxics Cleanup Program
Mark Dunbar (509) 454-7836

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1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this report is to document cleanup activities conducted at Barge-Lincoln Elementary School (Site) during the summer of 2010.

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 left persistent chemicals in the soil. 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 the Washington State Department of Ecology (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 at Barge-Lincoln Elementary were initiated and completed during the summer of 2010.

2 SITE DESCRIPTION

Barge-Lincoln Elementary is located at 219 E. I St, Yakima, WA 98902. The school is situated in a residential area in the NW quarter of Section 18, T13N, R19E. The portion of the school grounds remediated for lead and arsenic includes the playground equipment pits and virtually all of the grass area surrounding the school buildings, including the sports fields and grass courtyards between buildings. Grass areas outside of the perimeter fencing were not included in the remediation. Barge-Lincoln Elementary hosts approximately 629 students.

According to the NRCS Soil Survey for the Yakima County Area, soils at the site are classified as an Ashue loam or similar soils (classification 2). Ashue loam is formed on terraces from a parent material of alluvium, and occur at 0 – 2 percent slope. The classification states that the soil type occurs where mean annual precipitation is 6 to 9 inches, mean annual air temperature is 48 - 52 degrees F, and the frost-free period is 130 to 180 days. Ashue loam is described as being well drained with a depth to restrictive feature of 20 to 40 inches, and depth to water table of more than 80 inches. The typical soil profile is 0 to 10 inches loam, 10 to 29 inches very gravelly sandy clay loam, 29 to 34 inches very gravelly sandy loam, and 34 to 60 inches extremely gravelly sand.

3 SITE HISTORY

This site was included in an area-wide lead and arsenic sampling program which involved collecting samples from schools suspected of having a history of past pesticide use. Prior to the mid-1940s, lead arsenate was the most widely used chemical used to control codling moths on fruit trees. Lead (Pb) and arsenic (As) are known to be very stable in soil and tend to stay near the surface. Because of this historical background, it was suspected that the soil in the school playground might be contaminated with lead and arsenic. Ecology obtained permission from the Yakima School District to sample and test the soils from Barge-Lincoln Elementary for lead and arsenic.

The soils throughout the property were sampled by Ecology in 2005. Samples were taken at various depths from the surface using a core sampler. The samples were analyzed for lead and arsenic using X-Ray Fluorescence (XRF) Spectroscopy.

The analytic results of initial sampling at Barge-Lincoln Elementary indicated that contaminant levels in soil exceeded the Model Toxics Control Act (MTCA) Method A cleanup levels for arsenic (20 parts per million (ppm)) and/or lead (250 ppm) in 13 of 20 soil samples. The highest concentration of arsenic detected was 78.8 ppm. The highest concentration of lead detected was 595.2 ppm. These concentrations required the site be scored and ranked under the Washington Ranking Method (WARM). The site was ranked a "3" and placed on Ecology's Hazardous Sites List in 2007.

To prevent exposure to contaminated soil a geotextile barrier and 8-inch cap of clean soil and grass sod were installed over the existing play area. Play equipment pits were excavated to a depth of 16 inches, lined with geotextile fabric, and filled with engineered wood fiber. Because contamination was not removed from the site, a restrictive covenant will be issued to restrict future development or improvements on the site that could expose contaminated soil.

4 SITE CONTACT INFORMATION

Remedial activities were designed, supervised, and funded by Ecology. Construction was performed by a licensed general contractor, M Sevigny Construction, Inc. Ecology monitored construction on a daily basis and maintained contact with Yakima School District staff throughout the project.

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

Table 1: Site Contacts

Name	Organization	Position	Phone Number
Matt Sevigny	M Sevigny Construction, Inc.	Principal Manager	(509) 949-3547
Chuck Doan	Yakima School District	Director of Maintenance and Operations	(509) 573-7097

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 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 SAFETY AND HEALTH

The site was restricted from public access throughout the construction period using the existing perimeter fence and chain link fence sections. The contractor was required to provide a specific Safety & Health Plan for the site construction activities.

5.3 DUST CONTROL PLAN

The contactor was required to control dust and file a dust control plan with the Yakima Regional Clean Air Agency. The contractor utilized the existing irrigation system and a water truck for dust suppression during construction.

5.4 REMEDIAL PROCESS

Capping of existing soil with clean soil was chosen as the most efficient remedial option for the site. The remedial process was carried out as follows: Contaminated soil was excavated at hardscape edges such as pavement and foundations to allow the soil cap to meet existing grade. Existing grass turf was tilled to a depth of approximately six inches using a tractor-drawn rototiller, and the tilled surface was flattened with a roller in preparation for the cap. A permeable geotextile fabric was rolled out over the existing soil surface with 12 inches of overlap at the seams. A minimum of eight inches of clean, lightly compacted topsoil was then placed on top of the geotextile fabric. Following topsoil import and grading, grass sod was installed on the remediated area. Play equipment pits were also remediated. The pits were excavated to a depth of 16 inches and a 4-inch layer of pea gravel was applied to the bottom for drainage. The pits were then lined with geotextile fabric and filled to two inches above grade with engineered wood fiber. Prior to import, the clean topsoil was tested for the presence of lead, arsenic, pesticides, and petroleum products. No contaminants of concern were detected, and neither lead nor arsenic were detected above background concentrations. Excavated soils were stockpiled on site and characterized for disposal. Analytic results of the excavated soil samples indicated that the soil did not designate as a hazardous waste. All excavated soils were disposed at Terrace Heights landfill.

5.5 SAMPLE RESULTS

Table 2: Pre-Remedial Samples

Barge-Lincoln Elementary School

Date	Sample ID	As	Pb
8/25/2005	3	**41.14**	142.94
8/25/2005	5	**78.77**	**538.82**
8/25/2005	6	**67.89**	**595.17**
8/25/2005	9	**69.37**	**511.32**
8/25/2005	13	15.53	68.82
8/25/2005	22	**46.28**	**439.82**
8/25/2005	24	<LOD	16.98
8/25/2005	26	**25.6**	123.7
8/25/2005	31	<LOD	13.47
8/25/2005	41	**72.87**	143.01
8/25/2005	47	**44.01**	190.38
8/25/2005	54	**40.76**	190.95
8/25/2005	63	**31.51**	145.41
8/25/2005	79	**28.73**	81.05
8/25/2005	87	**20.89**	60.23
8/25/2005	102	12.53	72.18
8/25/2005	111	13.43	145.74
8/25/2005	111	16.4	71.3
8/25/2005	121	**26.26**	82.26
8/25/2005	125	9.92	27.17

Sampled on 8/8/2005
Analyzed on 8/25/2005
Location: N 46 36 53.5 W 120 30 32.8

*Bolded figures represent concentrations exceeding MTCA Method A cleanup levels.

6 PROJECT SUMMARY

Soil samples collected at Barge-Lincoln Elementary indicated lead and arsenic contamination existed in surface soils at concentrations above MTCA Method A cleanup levels. The course of action taken was to cap contaminated soils with clean soil and grass sod. Some contaminated soils were excavated to allow the soil cap to meet existing grade. A permeable geotextile fabric was placed over top of contaminated soils. Clean topsoil was placed over the geotextile, and sod was applied to restore the site to the original condition. Play equipment pits were excavated and lined with geotextile fabric, then filled with engineered wood fiber. As a result of the Interim Action, lead and arsenic contaminated soil is contained within the site, and a restrictive covenant will be filed to restrict future improvements or redevelopment of the site.

7 APPENDICES

7.1 Appendix A: FIGURES

Figure A-1: VicinityMap

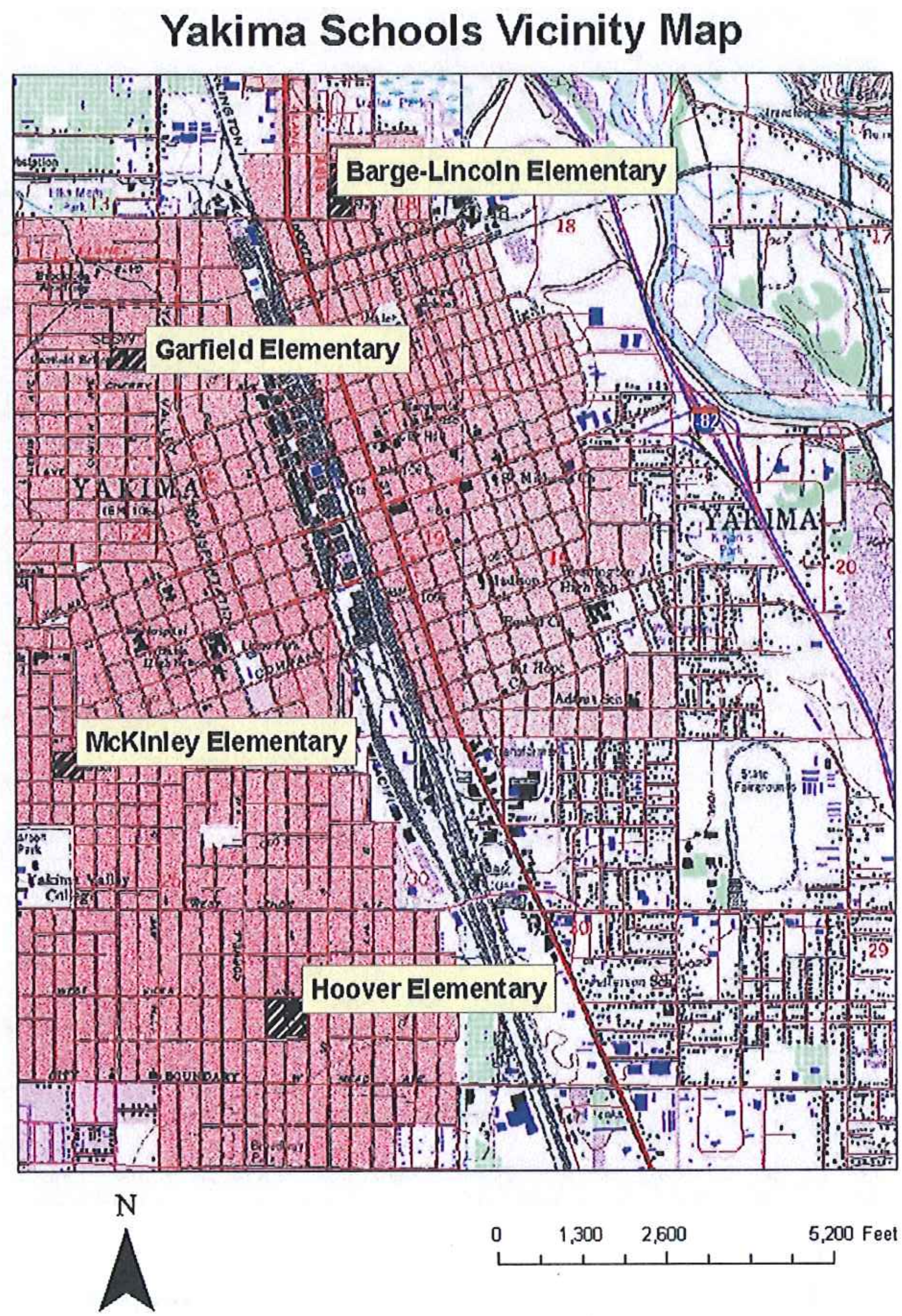


Figure A-2: Remediation Area Map

7.2 Appendix B: XRF USE

Sampling for the area-wide contamination clean-up projects involved the collection and analysis of a large 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. Project staff needed a way to quickly and reliably evaluate soil arsenic and lead concentrations both for pre-remedial data gathering and during remedial activities. 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 (R^2 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

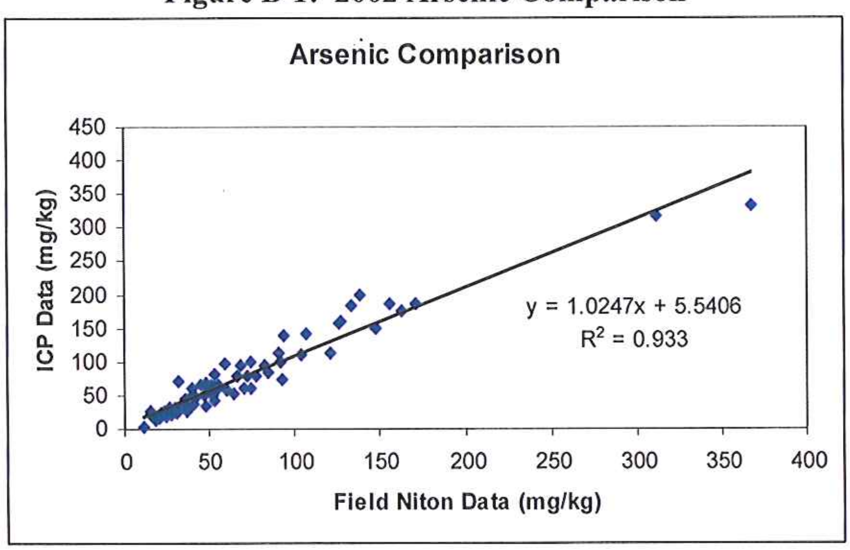
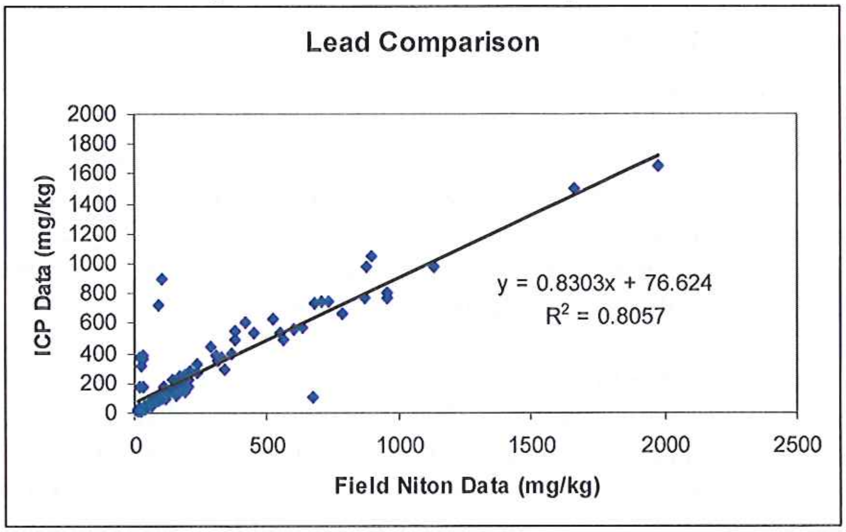


Figure B-2: 2002 Lead Comparison



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 (R^2 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 (R^2 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

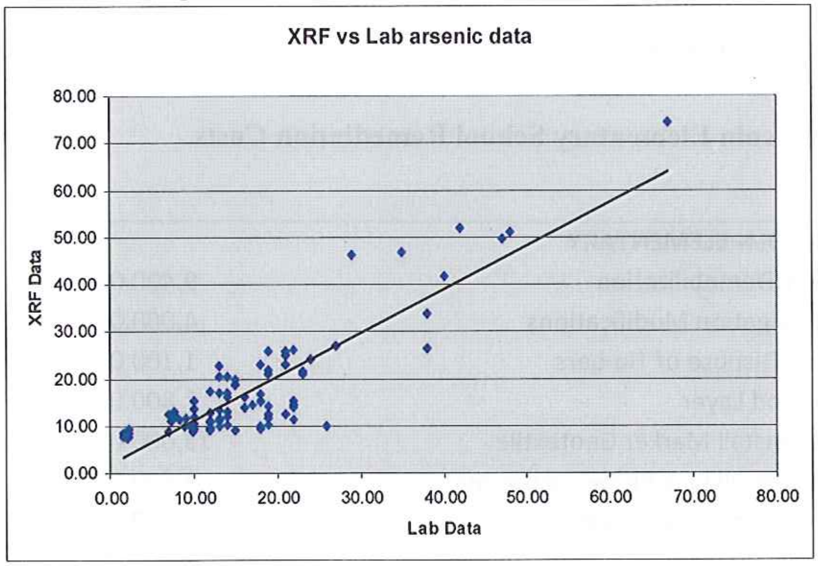
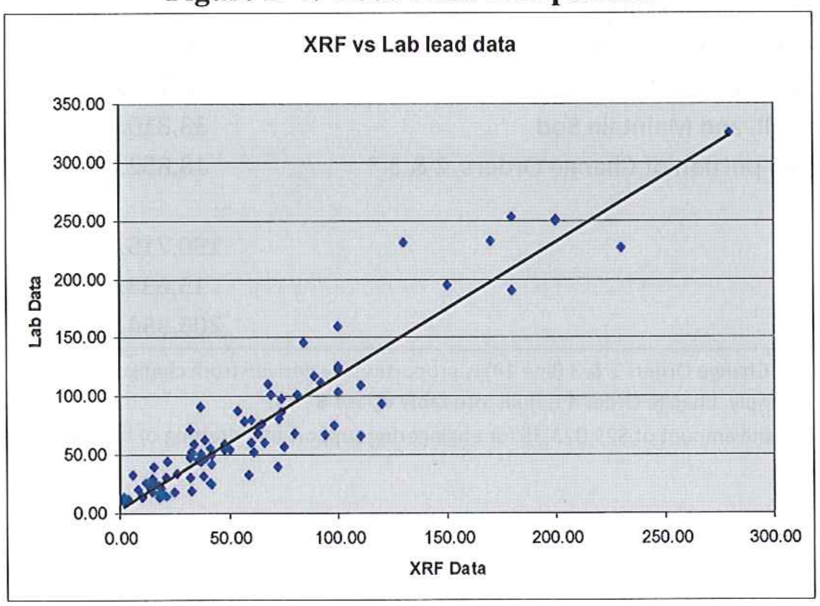


Figure B-4: 2006 Lead Comparison



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.

7.3 Appendix C: COSTS

Table 3: Barge-Lincoln Elementary School Remediation Costs

	BARGE-LINCOLN ELEMENTARY	
1	Mobilization/Demobilization	9,400.00
2	Utility and Irrigation Modifications	4,000.00
3	Remove and Dispose of Timbers	1,100.00
4	Till Existing Sod Layer	2,800.00
5	Furnish and Install Marker Geotextile	13,000.00
6	Furnish and Install Play Pit Geotextile and Border	3,600.00
7	Raising Sports Backstops/Goals	1,700.00
8	Excavation	6,992.09
9	Soil Transportation and Disposal	24,964.49
10	Furnish and Install Topsoil Cap	52,430.56
11	Furnish and Install Wood Fiber	15,966.72
12	Furnish and Install Pea Gravel	2,100.00
13	Furnish, Install, and Maintain Sod	33,810.00
14	Barge-Lincoln portion of Change Orders 2 & 3 *	18,852.01
	Subtotal	190,715.87
	Tax 8.2%	15,638.70
	**Total ** **	**206,354.57**

* Barge-Lincoln portion of Change Orders 2 & 3 (line 14) is proportionally derived from change order totals. Change Order 1 does not apply. Change Order 4 is built into table values 8 - 13.

** Total does not include the amount of $29,023.35 for engineering support and drafting of bid specifications for all four schools remediated 2010.

7.4 Appendix D: PHOTO LOG

Photo D-1: Barge-Lincoln Elementary School site preparation.

Photo D-2: Barge-Lincoln Elementary School installation of marker geotextile and soil cap.

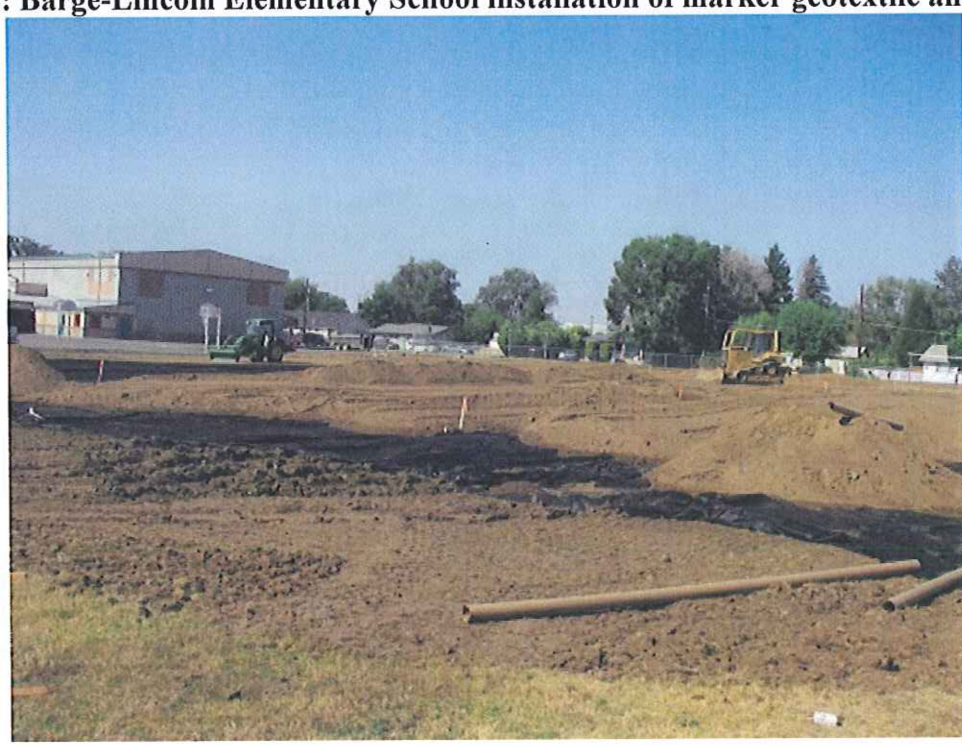


Photo D-3: Barge-Lincoln Elementary School playground equipment pit complete.

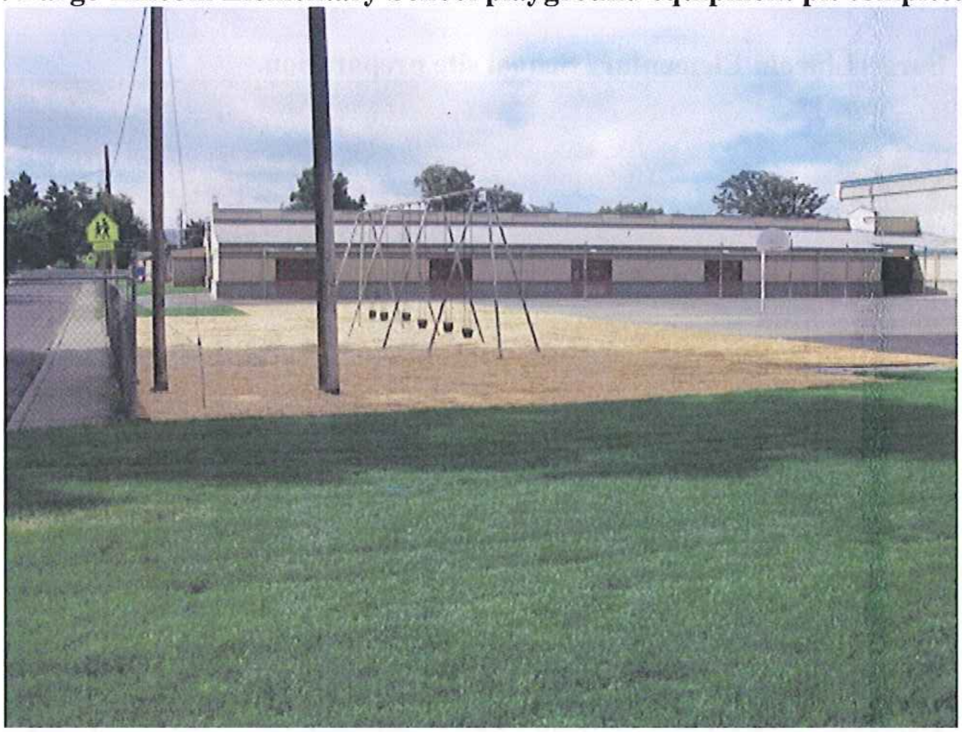
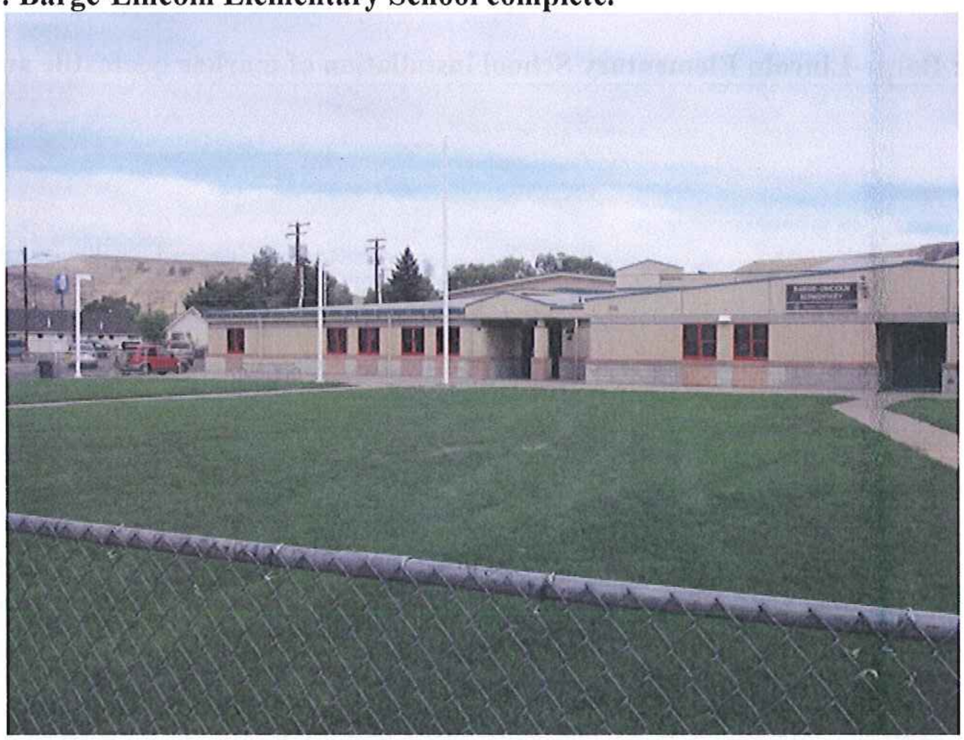


Photo D-4: Barge-Lincoln Elementary School complete.



7.5 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.

Natural Resources Conservation Service Web Soil Survey; National Cooperative Soil Survey, "Soil Survey Area: Yakima County Area, Washington," Version 10 June 12, 2009.