DEPARTMENT OF
ECOLOGY
State of Washington

Monitoring, Sampling and Analysis Report

Spokane River Shoreline Sediment Sites
Heavy Metals (As, Cd, Pb, Zn)
Post-Remediation Monitoring

April 2015

Publication Information

Publication No. Not Applicable

Data for this project will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search User Study ID, SpokRivMetals## where "#" is the two digits of a sampling year.

Author and Contact Information

Brendan Dowling
4601 N. Monroe St.
Washington State Department of Ecology
Spokane, WA 99205

For more information contact: Communications Consultant, phone 360-407-6834.

Washington State Department of Ecology - www.ecy.wa.gov/

o	Headquarters, Olympia	360-407-6000
o	Northwest Regional Office, Bellevue	425-649-7000
o	Southwest Regional Office, Olympia	360-407-6300
o	Central Regional Office, Yakima	509-575-2490
o	Eastern Regional Office, Spokane	509-329-3400

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Abstract

Areas of the Spokane River and its banks have been impacted by contaminants such as arsenic, cadmium, lead and zinc as a result of mining activities taking place in the Silver Valley area of North Idaho and surrounding region. The U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) have identified specific locations along the Spokane River for remedial action based on potential human and ecological exposures in the Record of Decision for the Bunker Hill Mining and Metallurgical Complex Operable Unit. The areas of recreation that were identified for remedial action are associated with areas that have a fine-grained sediment composition which is more commonly enriched by heavy metals. Cleanup of the identified beaches started in 2006. The beach cleanups that were undertaken are:

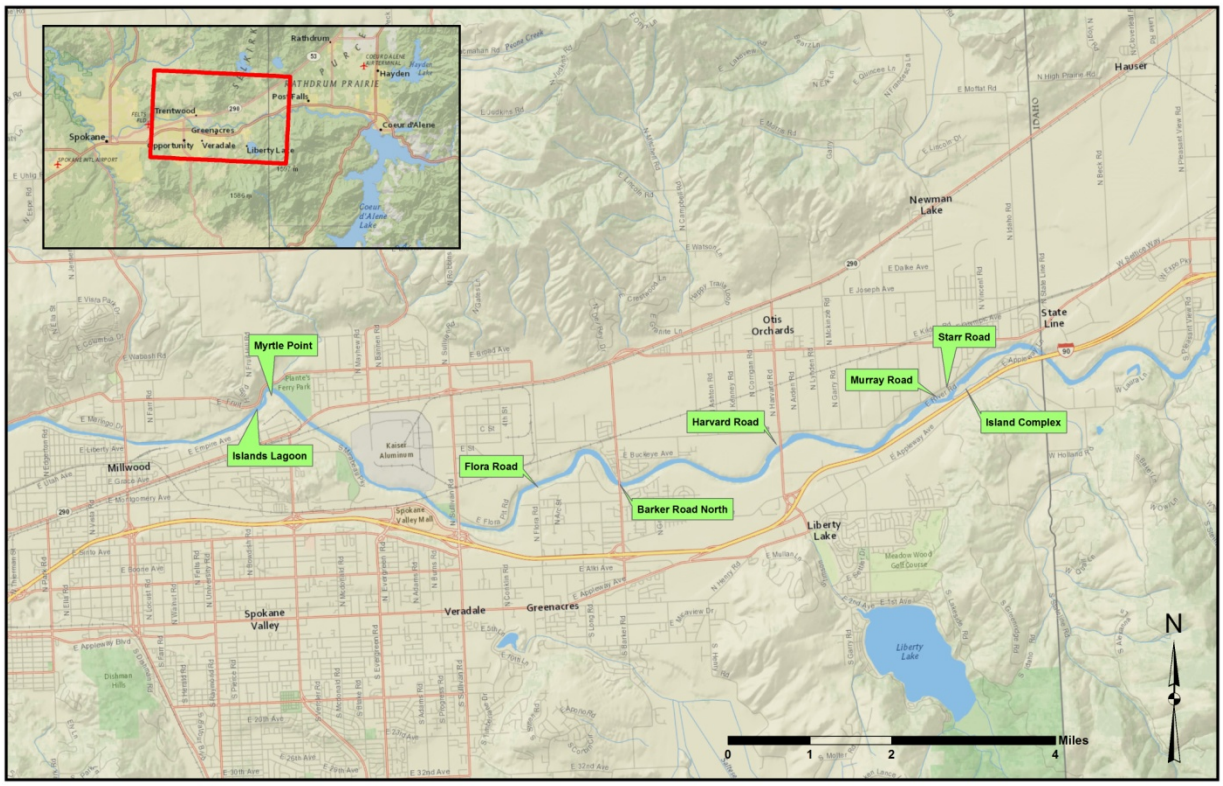
- 2006: Starr Road (~ river mile 94.7)
- 2007: Murray Road (~ river mile 94.2, Island Complex (~ river mile 95) and additional work at Starr Road
- 2008: Harvard Road (~ river mile 92.7)
- 2010: Flora Road (~ river mile 89.1); additional work was done in 2012
- 2012: Barker Road North (~ river mile 90.4), Islands Lagoon (~ river mile 84.3), and Myrtle Point (~ river mile 84.9)

The purpose of this Monitoring, Sampling and Analysis Report (MSAR) is to document the findings of the November 27, 2013 sampling of the Starr Road, Island Complex, Murray Road and Harvard Road beach sites and the April X, 2014 observational site visits of the Flora Road, Barker Road North, Myrtle Point and Islands Lagoon beach sites as a part of the long-term monitoring of the Spokane River Shoreline Sediment Sites following the approved Monitoring, Sampling and Analysis Plan (MSAP) that was developed in fall of 2013. This report will support periodic reviews of the cleanup actions taken at each of the shoreline sediment sites.

Background

The Spokane River Shoreline Sites are located between Upriver Dam and the Idaho state line (Figure 1). The Sites are associated with State Park recreational land and are heavily used by humans and ecological receptors. Following is a general description of each of the Sites that were remediated by Ecology and are covered in this MSAP. Further discussion of the history of the sites and the remediation actions done at each of the sites can be found in Spokane River Beaches Capping Construction Completion Report (GeoEngineers 2013).

Figure 1. Overview of Spokane River Beach Cleanup Site Locations



In September 2002, the United State Environmental Protection Agency (USEPA) established Risk-based Screening Concentrations (RBC's) for the sites along the Spokane River in Washington as a part of the Bunker Hill Mining and Metallurgical Complex, Operable Unit Record of Decision (ROD). The RBC's were adopted as site-specific levels protective of human health and are displayed below in Table 1. The cleanup of the beach sites occurred prior to Washington State adopting freshwater sediment cleanup levels for the protection of ecological health, however an estimated appropriate range of sediment cleanup guidelines (SCG) based on current research were made and were used to help delineate remediation areas at each of the beach sites that were identified as critical habitat. Both the RBCs and SCGs are provided in Table 1.

Table 1: RBC's from USPEA's ROD and SCGs

Contaminant	RBC	SCG [1,2,3]
Arsenic	~10 (background)	33 - 51
Cadmium	49	3 - 5
Lead	700	128 - 430
Zinc	17,109	270 - 459

(all values mg/kg)

2013 Sampling Event Study Areas

An aerial photograph of each site that depicts the area that was remediated and also the locations of samples collected during the 2013 sampling event can be found in Appendix A.

Starr Road: The Starr Road Site is adjacent to River Road just downstream of the Idaho state line. During the spring runoff, the area of concern at the Site is underwater but is exposed during the summer and fall low flow period. Surrounding the Site to the north is a small area of trees surrounded by brush located on the steep slope directly adjacent to the Site. During remediation activities, the trail was enhanced to provide access to the Site from River Road. The river bar area bordering the fine-grained depositional area to the south, acting as a barrier to the main flow of the Spokane River, contains fish spawning sized gravel intermixed with fine-grained sediment. Approximate total area: ~ 3.0 acres.

Murray Road: The Murray Road Site is adjacent to River Road. During the spring runoff the area of concern at the Site is underwater but is exposed during the summer and fall low flow period. Surrounding the Site to the north is a small area of trees surrounded by brush located on the steep slope directly adjacent to the Site to the north. In the upriver direction of the Site is a recreational trail area that is sparsely covered by trees and small brush which the River flows through during times of high flow. The river bar area bordering the fine-grained depositional area to the south, acting as a barrier to the main flow of the Spokane River, is heavily armored with river cobble. Approximate total area: ~ 1.4 acres.

Island Complex: Access to the Island Complex Site is from a gravel trail that was enhanced during cleanup activities from a parking lot adjacent to the river near Exit 299 on I-90. Portions of the Site are contained within Riverside State Park, and the Site is a popular recreation area. The Site contains a backwater area that has served as a depositional zone for fine-grained contaminated sediments. The Spokane River flows by the Site to the north year-round, and during the spring runoff the River flows in a side-channel to the south and west of the Site. The

[1] Long E.R. and L.G. Morgan. (1991). The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA, 175 pp + appendices

[2] MacDonald D. D., C.G. Ingersoll and T.A. Berger. (2000). Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39, 20-31.

[3] Michelsen, T. (2003). Phase II Report: Development and recommendations of SQV's for freshwater sediments in Washington State. Avocet Consulting. Publication Number: 03-09-088.

main river channel area to the north and the seasonal side-channel to the west bordering the fine-grained depositional area contain fish spawning-sized gravel intermixed with fine-grained sediment. During cleanup work, a multi-layered soil cover was placed over contaminated sediments, and native trees and shrubs were planted to stabilize the bank in the backwater area that is formed during high flows. In addition, river gravels were placed below the Ordinary High Water Mark to act as a part of the cover and limit erosion. Approximate total area: ~ 0.25 acres.

Harvard Road: The Harvard Road Site, located on the north side of the Spokane River and just downstream of the Harvard Road Bridge. The Site is accessed through an unimproved dirt road. The Site acts as both as a recreational area for river users and a rainbow trout spawning area. The portion of the Site closest to the bridge acts as a gravel boat launch and is separated from the rest of the Site by large boulders that were placed during cleanup activities to prevent vehicular traffic from accessing the remaining part of the Site. Also during cleanup activities, fish spawning-sized gravel was placed as a part of the cap to promote rainbow trout spawning at the site. The area downstream of the Site is sparsely covered in vegetation during low flows and is heavily armored in cobble-sized rock. Approximate total area: ~ 0.60 acres.

Flora Road: The Flora Road Site is accessed via a short footpath that leads down from the Centennial Trail. During the spring runoff parts of the recreational shoreline area of concern is underwater but is dry and exposed during the summer and fall low flow period. The resulting exposed areas provide an area associated with recreational activity in areas with fine-grained sediment. The area adjacent to the Site to the east is sparsely covered with brush underlined predominantly with gravel and sand with the area adjacent to the Site to the west occupied by cobble- and boulder-sized river rock. Approximate total area: ~ 0.30 acres.

Barker Road North: The Barker Road North Site is located upstream of the Barker Road Bridge along the north bank. During the high flow spring runoff parts of the shoreline area of concern can be flooded but are exposed and dry during the summer and fall low flow period. The Site is surrounded by residential land to the north and east of the Site. The ease of access to the Site from Barker Road and the level plane of the Site provide an area associated with high recreational activity, primarily as a canoe and kayak launch site in areas of fine-grained sediment. Approximate total area: ~ 0.40 acres.

Myrtle Point: The Myrtle Point Site is easily accessible from the adjacent Centennial Trail along the southerly bank and upstream of the Centennial Trail Footbridge. The Site is located on the upstream end of a bend of the Spokane River providing for slow current water that is associated with recreational activity in areas with fine-grained sediment. Access to the Site is gained via a footpath leading from the Centennial Trail. During the spring runoff, parts of the recreational shoreline area of concern is underwater but becomes dry and exposed during the summer and fall low flow period. Adjacent to the Centennial Trail and surrounding the Site to the east and west are areas heavily covered with small trees and brush. Approximate total area: ~ 0.05 acres.

Islands Lagoon: The Islands Lagoon Site is upstream of the Centennial Trail Footbridge. The Site is bounded by large basalt monoliths and gravel bars within the main channel of the Spokane River, providing a calm water area associated with high recreational activity in areas with fine-grained sediment. During the spring runoff, parts of the recreational shoreline area of concern at the Site is underwater but is exposed during the summer and fall low flow period. Adjacent to the Centennial Trail and surrounding the Site to the south are small slopes covered with trees and

brush. The area adjacent to the Site to the west is sparsely covered with brush underlain predominantly with gravel and sand. Approximate total area: ~ 0.05 acres.

Sampling Procedures

Sample Collection

On November 27, 2013, materials were collected from stations distributed over the Island Complex, Starr Road, Murray Road and Harvard Road Sites that targeted material that was deposited on top of the surface layer of the respective caps following the protocols outlined in the MSAP. Sample locations were determined in the field and were based on where remediation activities occurred, previous sampling results, surface geology, and sediment depositional patterns. Four to five discrete stations were sampled at each site (Table X). Appendix A includes figures of the remediated area at each beach site in addition to depicting the locations of the discrete stations that were sampled at each site.

Soil/sediment collected from each station was homogenized as a single sample. Upon collection, materials were placed in 1-gallon zip-locking plastic bags. Each bag was labeled with proper identification of sample location, date and time. Samples were named according to each location number and the name of the site. A handheld Trimble Global Positioning System (GPS) unit was used to record the coordinates of each sample location. Photographs were also taken of each sample location and can be found in Appendix B. Decontamination of sampling equipment was conducted between samples following the protocols in the MSAP. Samples were stored in a refrigerator in the Ecology ERO sampling room until the samples were prepared for chemical analysis. A field duplicate sample was collected however during transportation back to the ERO sampling the plastic zip lock bag containing the material was accidently opened and the material became potentially compromised. The material for the duplicate sample was not sent to the laboratory for analysis.

Sample Preparation Procedure

Sample preparation was performed in the Ecology ERO sampling room. Each of the samples were dried out prior to sieving. Material that passed the 2mm sieve was collected, placed in glass jars and appropriately labeled for shipment Manchester Environmental Laboratory (MEL) for analysis. All material that did not pass the 2mm sieve was properly disposed of following the MSAP.

Sample Analysis

Samples were analyzed at MEL on January 21, 2014 following the procedures outlined in the MSAP.

Field Observations

At each beach site, field observations were noted in the monitoring log (Appendix B). General areas of focus for inspection at each site were:

- Integrity of the Gravel Cap: Noted whether the cap is intact and undamaged. If it is damaged, noted the extent of damage and suspected or apparent cause(s). Noted if any debris has accumulated on top of the cap.
- Sediment Deposition Patterns: Noted whether sediment or other materials have deposited on or near the cap since the cleanup or last monitoring event.
- Health of Introduced Vegetation: At some of the shoreline sites, plantings were utilized as a part of the remediation. Noted the success (health) of those plantings, estimated growth from the previous monitoring event and if other (non-introduced) vegetation has established.

Sampling Results

The results of the analytical testing of each of the samples can be found in Table 2.

Table 2: Analytical Results of the 2013 Sampling Event.

		Analyte (mg/kg)			
		Arsenic	Cadmium	Lead	Zinc
RBC		~10	49	700	17,109
SCG		33-51	3-5	128-430	270-459
Site	Sample ID				
Island Complex	IC 1	15.6	19.5	872	1830
	IC 2	16.6	3.09	147	524
	IC 3	16.8	16.8	733	1520
	IC 4	11.2	5.94	308	1120
Starr Road	Starr 1	9.52	3.99	147	643
	Starr 2	10.2	2.82	89.2	412
	Starr 3	5.82	1.46	56.5	289
	Starr 4	5.90	2.23	86.8	533
	Starr 5	6.63	3.85	146	623
Murray Road	Murray 1	10.9	2.01	74.1	365
	Murray 2	7.82	2.19	186	530
	Murray 3	10.8	2.33	71.3	366
	Murray 4	8.69	0.312	20.6	92.4
	Murray 5	17.4	4.57	151	650
Harvard Road	Harvard 1	8.72	3.28	260	820
	Harvard 2	7.84	2.49	158	757
	Harvard 3	10.5	14.0	336	1510
	Harvard 4	6.70	14.8	407	1390

Discussion

Contaminant concentrations ranged between the four sites that were sampled in addition to within each site. Arsenic, cadmium and lead showed a decreasing trend as you move downstream between the Island Complex site and Murray Road. However, contaminant concentrations saw an increase at Harvard Road in comparison to the Murray Road site, the closest site upstream. It was also observed that the highest concentrations found at Harvard Road for all four contaminants were from samples that were collected further up on the shore potentially indicating that the Harvard Road site acts as a depositional area during high-flows and as the flows decline the material from the lower parts of the site is removed leaving relatively uncontaminated material behind.

The results were compared to samples collected prior to remediation efforts (Table 3). At each of the beach sites, contaminant concentrations were generally less after the remedial actions. At the Island Complex site, similar results were found after the post-remediation sampling. This is most likely due to the significant amount of new material that was observed at the site that had been deposited since the remedial action. This is indicates that potential upstream sources exist that are likely to impact the Spokane River in the future.

Due to the little to no change in the contaminant concentrations at Island Complex, it is recommended that additional sampling occurs at the site as a part of the 2014 sampling event of the further downstream sediment sites.

At the locations that were not sampled as a part of the 2013 sampling event (Barker Road North, Flora Road, Myrtle Point and Islands Lagoon) observations were noted in the monitoring log. It was generally observed that each of the locations the remedy was intact with little to no additional sediment accumulation had occurred.

Table 3: Sampling results prior to remedial actions at each site.

		Analyte (mg/kg)			
		Arsenic	Cadmium	Lead	Zinc
Site	Sample ID				
Island Complex[4]	IC 1	<24	-	48	497
	IC 2	<34	-	<36	656
	IC 3	<32	-	<33	642
	IC 4	<47	-	144	1919
	IC 5	<40	-	105	1130
Starr Road (2004)[5]	SRUP1	36	16	1760	3020
	SRUP2	39	20	326	3300
	SRUP3	39	16	1390	4460
	SRUP4	33	15	630	3690
Murray Road (2007)	Murray 1	28.3	10.1	584	2710
	Murray 2	22.6	7.12	466	2670
	Murray 3	18.1	13.1	268	2400
	Murray 4	22.3	6.56	405	2590
	Murray 5	19.5	7.13	611	2300
	Murray 6	30.6	8.4	653	2670
	Murray 7	27.7	11.4	739	2100
	Murray 8	32.0	7.14	509	2670
	Murray 9	26.6	8.68	808	2300
	Murray 10	22.1	11.2	351	2000
	Murray 11	18.0	7.64	866	1800
	Murray 12	31.1	16.6	1710	2720
Harvard Road (2007	Harvard 1	16.5	8.48	414	1670
	Harvard 2	20.9	7.99	103	2850
	Harvard 3	17.6	8.35	414	2840
	Harvard 4	19.2	10.2	628	2420
	Harvard 5	16.7	9.8	816	2680
	Harvard 6	16.8	11.4	453	2980

[4] Samples were analyzed using a hand-held X-Ray Fluorescent device

[5] U.S. Army Corps of Engineers. WA Recreational Sites Starr Road and Island Complex Field Sampling Report. 2005. Prepared for U.S. Environmental Protection Agency.

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Appendices

Appendix A. Sampling Locations at Beach Site
Appendix B. Monitoring Check-List Forms and Site-Photos
Appendix C. Health and Safety Plans
Appendix D. Glossary, Acronyms, Abbreviations

Appendix A. Sampling Locations at Beach Site

Figure A-1. Island Complex

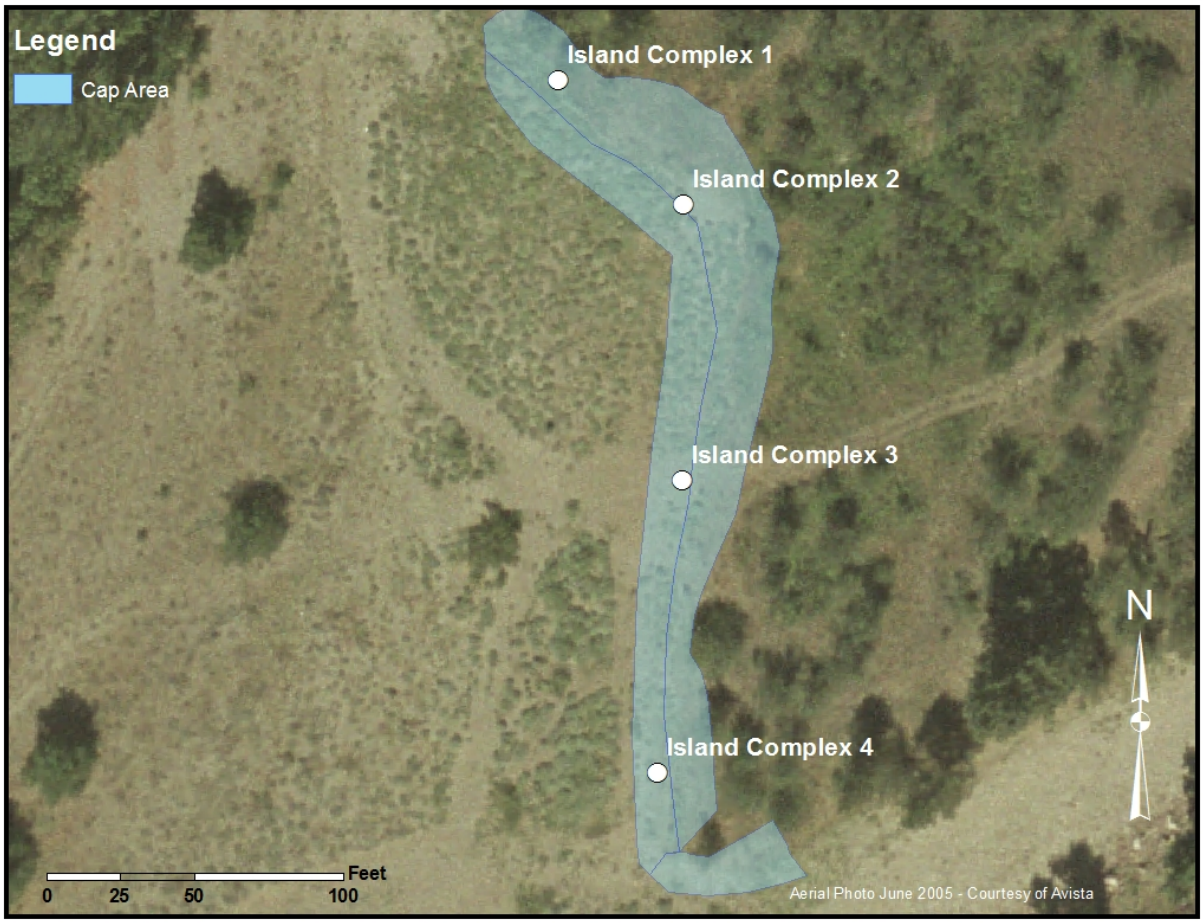


Figure A-2. Starr Road

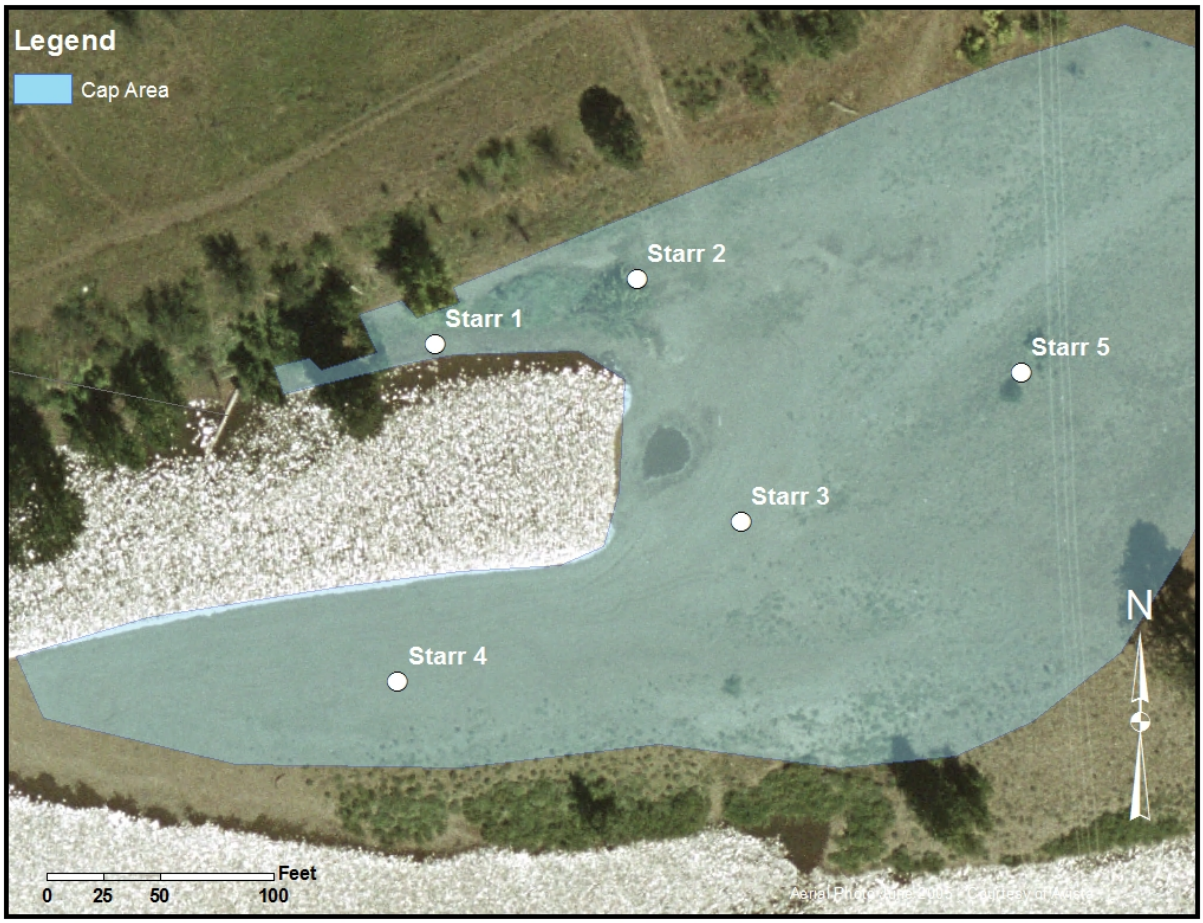


Figure A-3. Murray Road

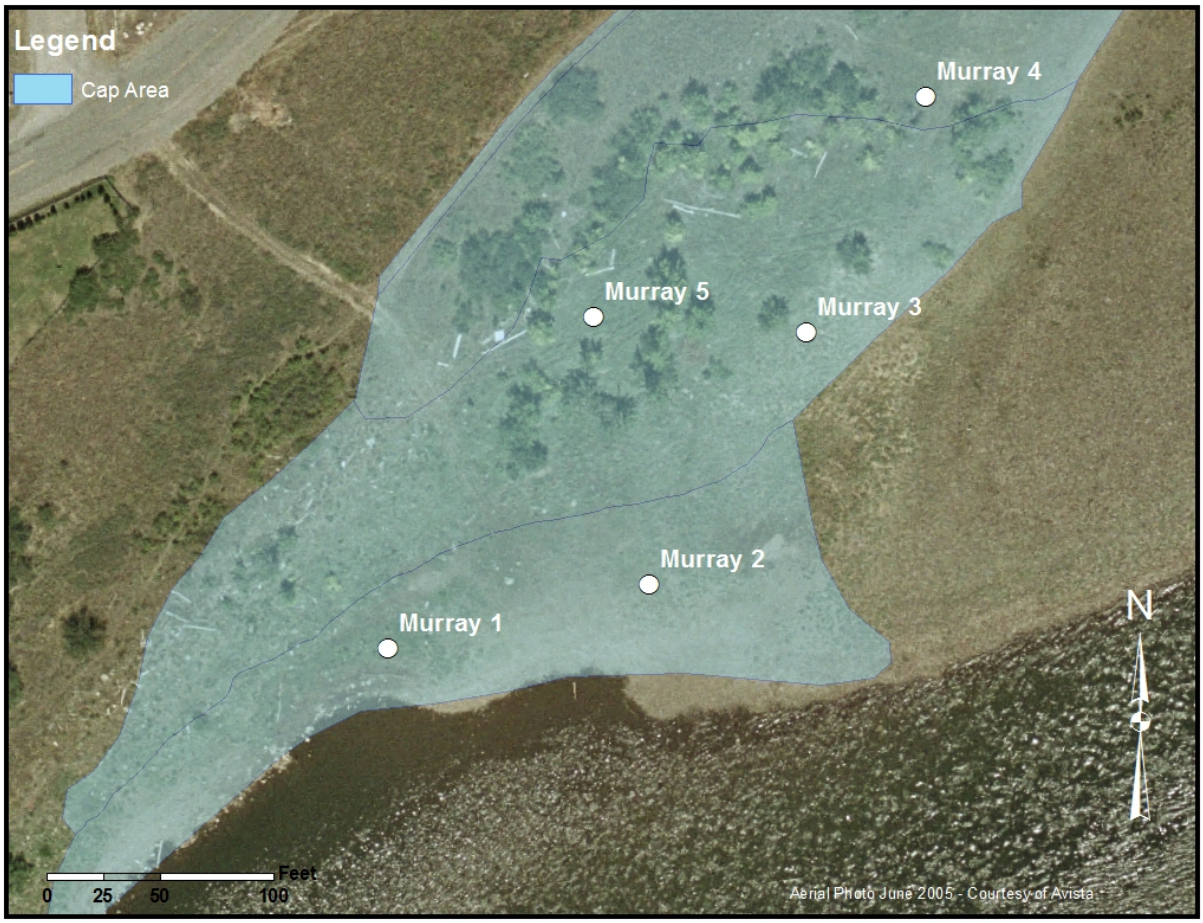
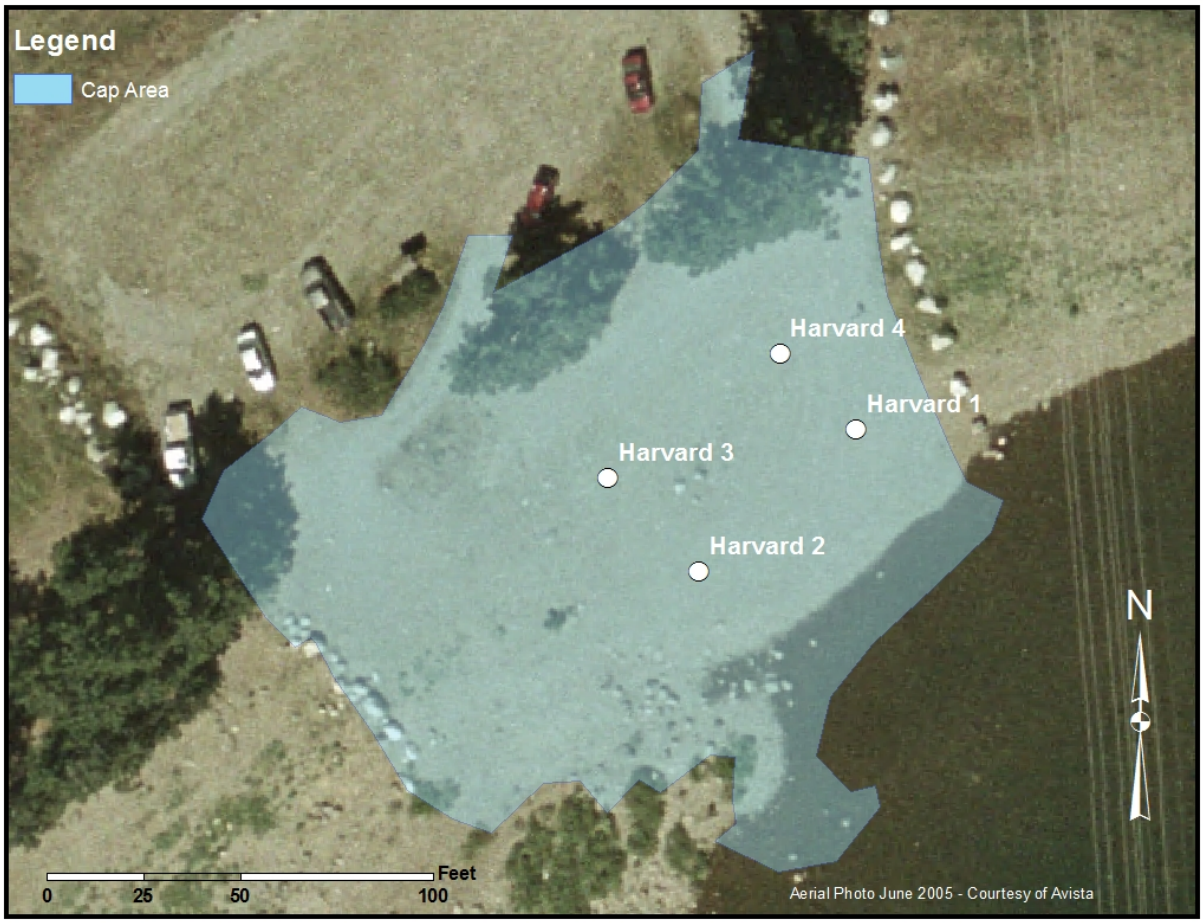


Figure A-4. Harvard Road



Appendix B. Monitoring Check-List Forms and Site Photos

Spokane River Metals Beach Sites
Site-Visit Monitoring Log

Site Name: Island Complex Date of Visit: 11/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO ____ If YES, how many? 4

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES X NO ____ If YES, note the areas and amount of newly deposited sediment: - Sand and fine-grained particles intermixed in the coir fabric - Significant amounts of new sand/gravel in the chevron area adjacent to the cap

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - Signs present - Pedestrian trail still present but worn in places as a result of river flows

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

- about ~50% of orginal plantings are present/alive
- Varied growth across the site

Estimated amount of growth since last monitoring event:

- several inches

Has additional (non-introduced) vegetation established on the cap?
YES X NO_____
If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event:

- weeds in areas of the coir fabric
- some places has overtaken planted species
  - Sage brush

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES_____ NO X

If NO, note the areas/extent of damage and suspected or apparent cause(s):

- most areas the coir fabric is intact. Some places it has been cut or pulled back
- material placed with the coir fabric is predominantly still present

Note any debris that has accumulated on top of the cap:

- woody debris

Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading):

—

Photo Log	
Photo ID	**Description**
DSC 00156.JPG	- view of trail to site w/ signage
" " 157	- looking north of the site
" " 158	- looking to the east in middle of site
" " 159	- looking towards the southeast portion of the site
" " 160	- looking to the north end of the site
" " 161	- sample 1
" " 162	- Sample 2
" " 163	- Sample 3
" " 164	- armored area of the site - southern most extent
" " 165	- Sample 4

DSC00156

DSC00157

DSC00158

DSC00159

DSC00160

DSC00161

DSC00162

DSC00163

DSC00164

DSC00165

Spokane River Metals Beach Sites
Site-Visit Monitoring Log

Site Name: Starr Road Date of Visit: 11/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO ____ If YES, how many? 5

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES X NO ____ If YES, note the areas and amount of newly deposited sediment: Fine grained material intermixed with the gravel layer of the cap.

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: -overgrown in areas → most likely due to lack of use -signs present

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

NA

Estimated amount of growth since last monitoring event:

—

Has additional (non-introduced) vegetation established on the cap?
YES X NO_____
If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event:
- minor weeds growth in some areas

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES X NO_____

If NO, note the areas/extent of damage and suspected or apparent cause(s):

Note any debris that has accumulated on top of the cap:

- some organics
  eg. logs, twigs

Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading):

None

Photo Log	
Photo ID	**Description**
DSC00148.JPG	- Fw view looking downstream of the site from the access trail
" "149	- view looking on the upstream area of the site towards the south
" " 150	- Sample 1
" " 151	- Sample 2
" " 153	- sample 3
" " 154	- Sample 4
" " 155	- Sample 5

DSC00148

DSC00149

DSC00150

DSC00151

DSC00153

DSC00154

DSC00155

Spokane River Metals Beach Sites
Site-Visit Monitoring Log

Site Name: Murray Road Date of Visit: 11/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO _____ If YES, how many? 5

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES X NO _____ If YES, note the areas and amount of newly deposited sediment: - Fine grained material on top of/intermixed with the gravel layer

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - intact

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

N/A - Cap C mix (soil w/ grass not well established)

Estimated amount of growth since last monitoring event:

—

Has additional (non-introduced) vegetation established on the cap?
YES X NO _____
If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event:

- weeds established in the Cap C area predominantly

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES N/A NO X

If NO, note the areas/extent of damage and suspected or apparent cause(s):

- most areas is intact (Cap A/B areas)
- Some areas of Cap C are damaged (washed away) as a result of highwater flows

Note any debris that has accumulated on top of the cap:

- lots of woody debris
- some garbage

Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading):

— None

Photo Log	
Photo ID	**Description**
DSC 141.JPG	-view to the south overlooking the western (downstream) end of the site
" 142	- view to the southeast overlooking the upstream end of the site
" 143	-Sample 1
" " 144	-Sample 2
" " 145	Sample 3
" " 146	-Sample 4
" " 147	-Sample 5

DSC00141

DSC00142

DSC00143

DSC00144

DSC00145

DSC00146

DSC00147

Spokane River Metals Beach Sites
Site-Visit Monitoring Log

Site Name: Harvard Road Date of Visit: 11/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO ____ If YES, how many? 4

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES X NO ____ If YES, note the areas and amount of newly deposited sediment: Fine grained material intermixed within the gravel layer of the cap.

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: Intact.

Vegetation Health
Note the success (health) of plantings that were used as a part of the remedy: Estimated amount of growth since last monitoring event: Has additional (non-introduced) vegetation established on the cap? YES X NO_____ If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event: -Sage-brush covering lower-mid extent of the cap.

Gravel Cap Observations
Is the gravel cap intact and undamaged? YES X NO_____ If NO, note the areas/extent of damage and suspected or apparent cause(s):
Note any debris that has accumulated on top of the cap: -organics (logs, twigs, pine needles)
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading): None

Photo Log	
Photo ID	**Description**
DSC00133.JPG	- ~~north~~ view looking downstream (west) of the site
" " 134	- view looking to the south towards the river from sign
" " 135	- view looking to the east of the site
" " 136	- Sample 1
" " 137	- Sample 2
" " 138	- Sample 3
" " 139	- Sample 3
" " 140	- Sample 4

DSC00133

DSC00134

DSC00135

DSC00136

DSC00137

DSC00138

DSC00139

DSC00140

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Barker Road North Date of Visit: 8/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES _____ NO X If YES, how many? _____

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES_____ NO X If YES, note the areas and amount of newly deposited sediment:

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - access path shows signs of use however in good condition with only minor erosion - display sign present

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

- plantings put in by local use groups present and in good condition

Estimated amount of growth since last monitoring event:

—

Has additional (non-introduced) vegetation established on the cap?

YES X NO_____

If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event:

- minor weed growth in small areas

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES X NO_____

If NO, note the areas/extent of damage and suspected or apparent cause(s):

- minor erosion of the cap directly upstream and under Barker Rd. Bridge noted → cap material still present and covering native soils

Note any debris that has accumulated on top of the cap: - none
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading): - none

Photo Log	
Photo ID	**Description**
DSC00082.JPG	-Standing on Barker Road Bridge (approx 1/2 across) looking down on the site to the north
DSC00083.JPG	-Standing on Barker Road Bridge (directly adjacent to the site) looking down on the site to the east.

DSC00082

DSC00083

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Flora Road Date of Visit: 8/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES _____ NO X If YES, how many? _____

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES_____ NO X If YES, note the areas and amount of newly deposited sediment:

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - Intact with some usage of access noted - minor erosion at the trail but overall in good condition

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

- N A

Estimated amount of growth since last monitoring event:

—

Has additional (non-introduced) vegetation established on the cap?

YES X NO ~~X~~

If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event: - Sage brush growth on downstream (west) end of the cap

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES X NO_____

If NO, note the areas/extent of damage and suspected or apparent cause(s):

Note any debris that has accumulated on top of the cap: - minor litter from users
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading): - none

Photo Log	
Photo ID	**Description**
DSC00085.JPG	- Standing on Centennial Trail at access trail to the site
" " 86.JPG	- standing in middle of the site looking downstream (west) onto the rest of the site
" " 87.JPG	- standing towards riveredge part of the site looking downstream onto the site (west)
" " 88.JPG	- standing towards riveredge part of the site looking towards access trail (South)

DSC00085

DSC00086

DSC00087

DSC00088

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Myrtle Point Date of Visit: 8/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES _____ NO X If YES, how many? _____

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES_____ NO X If YES, note the areas and amount of newly deposited sediment:

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: N/A

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

N/A

Estimated amount of growth since last monitoring event:

—

Has additional (non-introduced) vegetation established on the cap?

YES X NO_____

If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event: - minor weed / sage brush growth in a few scattered spots

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES X NO_____

If NO, note the areas/extent of damage and suspected or apparent cause(s):

Note any debris that has accumulated on top of the cap: - none
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading): - none

Photo Log	
Photo ID	**Description**
DSC00090.JPG	Standing on opposite side of the boat looking across the river onto the site
DSC00095.JPG	Standing in middle of site by river edge looking upstream (SE)
DSC00097.JPG	Standing in middle of site by river edge looking downstream (NW) onto the site

DSC00090

DSC00095

DSC00097

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Islands Lagoon Date of Visit: 8/27/13

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES _____ NO X If YES, how many? _____

Sediment Deposition Patterns
Has additional sediment deposited on or near the cap since the last monitoring event? YES_____ NO X If YES, note the areas and amount of newly deposited sediment:

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: NA

Vegetation Health

Note the success (health) of plantings that were used as a part of the remedy:

NA

Estimated amount of growth since last monitoring event:

—

Has additional (non-introduced) vegetation established on the cap?

YES_____ NO X

If YES, note the areas and types of new vegetation and is estimated growth since the last monitoring event:

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES X NO_____

If NO, note the areas/extent of damage and suspected or apparent cause(s):

Note any debris that has accumulated on top of the cap:
- rocks placed in some areas of the cap -most likely due to beach users / no damage caused
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading):
- none

Photo Log	
Photo ID	**Description**
DSC00092.JPG	Standing on downstream (west) end of the site looking upstream
" 00094.JPG	Standing on boulder on upstream (east) end of the site looking to the west

DSC00092

DSC00094

Appendix C. Health and Safety Plans

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) ~~Island Complex~~ Brendan Dowling

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 11/27/13 Arrival time

Total anticipated time on site 30-60 min

Site name Island Complex

Site location Sediment bar on island feature on southside of the river

Nearest city Spokane Valley Nearest hospital Spokane Valley

Emergency numbers Statewide - 911 Hospital Ambulance

Name of contractor (if on site) —

Is the site currently active? Yes ___ No X Will the buddy system be used? Yes ___ No ~~X~~

Site description same

Scope/objective of work Sediment sampling

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation ___ Dermal X No exposure ___

Overall risk of chemical exposure: Serious ___ Moderate ___ Low X Unknown ___

Physical hazards: Confined space ___ Noise ___ Heat/cold stress ___

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

—

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C (D)

Personal protective equipment required—

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled___

As, Cd, Pb, Zn

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment ✓ Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brendan Dowling

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 11/27/13 Arrival time

Total anticipated time on site < 30 min - 1 hr

Site name Starr Road

Site location Near WA/ID Border Northside of Spokane River

Nearest city Spokane Valley Nearest hospital Spokane Valley

Emergency numbers Statewide - 911 Hospital Ambulance

Name of contractor (if on site) NA

Is the site currently active? Yes ___ No X Will the buddy system be used? Yes ___ No X

Site description Sediment bar on shore of Spokane River

Scope/objective of work Sediment Sampling

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation ___ Dermal X No exposure ___

Overall risk of chemical exposure: Serious ___ Moderate ___ Low X Unknown ___

Physical hazards: Confined space ___ Noise ___ Heat/cold stress ___

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

—

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C D

Personal protective equipment required —

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled___

As, Cd, Pb, Zn

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment X Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brendan Dowling

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 11/27/13 Arrival time

Total anticipated time on site 30-60min

Site name Murray Road

Site location Near WA/ID Border. Northside of river

Nearest city Spokane Valley Nearest hospital Spokane Valley

Emergency numbers Statewide - 911 Hospital _____ Ambulance

Name of contractor (if on site) NA

Is the site currently active? Yes___ No X Will the buddy system be used? Yes___ No X

Site description Sediment bar on Spokane River

Scope/objective of work Sediment samplins

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation_____ Dermal X No exposure___

Overall risk of chemical exposure: Serious___ Moderate_____ Low X Unknown____

Physical hazards: Confined space_____ Noise_____ Heat/cold stress Cold

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

—

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C (D)

Personal protective equipment required—

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled___

As, Cd, Pb, Zn

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment X Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brendan Dowling

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 11/27/13 Arrival time

Total anticipated time on site 30-60 min

Site name Harvard Road

Site location ~~Southside~~ Northside of Harvard Road Bridge

Nearest city Spokane Valley Nearest hospital ~~Spokane~~ Valley

Emergency numbers Statewide - 911 Hospital Ambulance

Name of contractor (if on site) NA

Is the site currently active? Yes No X Will the buddy system be used? Yes No X

Site description ~~Sediment~~ Beach along northside of Spokane River

Scope/objective of work Sediment Sampling

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation Dermal X No exposure

Overall risk of chemical exposure: Serious Moderate Low X Unknown

Physical hazards: Confined space Noise Heat/cold stress

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

—

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C (D)

Personal protective equipment required —

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled___

As, Cd, Pb, Zn

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment X Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brandon Dowling

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 8/27/13 Arrival time –

Total anticipated time on site ~20 min

Site name Barker Road North

Site location – adjacent to Barker Road Bridge

Nearest city Spokane Valley Nearest hospital Spokane Valley

Emergency numbers Statewide - 911 Hospital _____ Ambulance_

Name of contractor (if on site) –

Is the site currently active? Yes___ No ✓ Will the buddy system be used? Yes___ No ✗

Site description

- sediment bar on north side of the Spokane River

Scope/objective of work

- walk site and observe conditions and take photos

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation_____ Dermal ✗ No exposure___

Overall risk of chemical exposure: Serious____ Moderate_____ Low ✗ Unknown____

Physical hazards: Confined space_____ Noise_____ Heat/cold stress_____

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

No

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C (D)

Personal protective equipment required___

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled None

Arsenic, Lead

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment_____ Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brendan Donlins

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 8/27/13 Arrival time –

Total anticipated time on site 120 min

Site name Flora Road

Site location –adjacent to centennial trail approx. 1 mile downstream of Barker Road. site accessed at Flora Road

Nearest city Spokane Valley Nearest hospital Spokane Valley

Emergency numbers Statewide - 911 Hospital _____ Ambulance_

Name of contractor (if on site) –

Is the site currently active? Yes___ No X Will the buddy system be used? Yes___ No X

Site description

–Sediment bar on South side of the Spokane river adjacent to Centennial trail

Scope/objective of work

-walk site and observe conditions and take photos

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation_____ Dermal X No exposure___

Overall risk of chemical exposure: Serious___ Moderate_____ Low X Unknown____

Physical hazards: Confined space_____ Noise_____ Heat/cold stress_____

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

No

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C (D)

Personal protective equipment required —

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled None

_____

_____

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment_____ Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brendan Donlin,

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 8/27/13 Arrival time

Total anticipated time on site 120 min

Site name Myrtle Point

Site location adjacent to centennial trail near Argonne Road and across from Plantes Ferry Park

Nearest city Spokane Nearest hospital Spokane

Emergency numbers Statewide - 911 Hospital Ambulance

Name of contractor (if on site) —

Is the site currently active? Yes___ No ✓ Will the buddy system be used? Yes___ No X

Site description

-Sediment bar on west side of the spokane river

Scope/objective of work

-walk site and observe conditions and take photos

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation_____ Dermal X No exposure___

Overall risk of chemical exposure: Serious___ Moderate_____ Low X Unknown___

Physical hazards: Confined space_____ Noise_____ Heat/cold stress_____

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

No

Was air monitoring conducted? Yes___ No X

Personal protection level required A B C (D)

Personal protective equipment required___

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low X Unknown_____

Expected parameters/contaminants to be sampled___

None

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment_____ Containers_____ Other_____

HEALTH AND SAFETY SITE PLAN

Name of Ecology inspector(s) Brendan Donlin

Training requirements for this inspection NA

Medical monitoring requirements NA

Date 8/27/13 Arrival time

Total anticipated time on site ~20 min

Site name Islands Lagoon

Site location -adjacent to centennial trail footbridge near Arsonne Road

Nearest city Spokane Nearest hospital Spokane

Emergency numbers Statewide - 911 Hospital Ambulance

Name of contractor (if on site) —

Is the site currently active? Yes___ No X Will the buddy system be used? Yes___ No X

Site description

-sediment bar bar on south side of the river adjacent to centennial trail near centennial trail foot bridge

Scope/objective of work

-walk site and observe conditions and take photos

Known contaminants on site As, Cd, Pb, Zn

Routes of chemical exposure: Inhalation Dermal X No exposure

Overall risk of chemical exposure: Serious Moderate Low ✓ Unknown

Physical hazards: Confined space Noise Heat/cold stress

(continued on next page)

Describe any area on site that could function as a confined/enclosed space_

No

Was air monitoring conducted? Yes___ No_x_

Personal protection level required A B C (D)

Personal protective equipment required—

Other (specify)_____

Overall risk of physical hazards: Serious_____ Moderate_____ Low_x_ Unknown_____

Expected parameters/contaminants to be sampled___

None

Sampling matrix: Air_____ Surface water_____ Groundwater_____ Soil_____
Sediment_____ Containers_____ Other_____

Appendix D. Acronyms, and Abbreviations

Acronyms and Abbreviations

Following are acronyms and abbreviations used frequently in this report.

BMP	Best management practices
e.g.	For example
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
et al.	And others
GIS	Geographic Information System software
GPS	Global Positioning System
i.e.	In other words
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
QA	Quality assurance
ROD	Record of Decision
RM	River mile
RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard operating procedures
SRM	Standard reference materials
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code

Units of Measurement

dw	dry weight
ft	feet
g	gram, a unit of mass
kg	kilograms, a unit of mass equal to 1,000 grams
m	meter
mg	milligram
mg/Kg	milligrams per kilogram (parts per million)
ug/g	micrograms per gram (parts per million)