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

June 2019

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.

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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 commonly contaminated by heavy metals. Cleanup of the identified beaches started in 2006. The beach cleanups that were undertaken are:

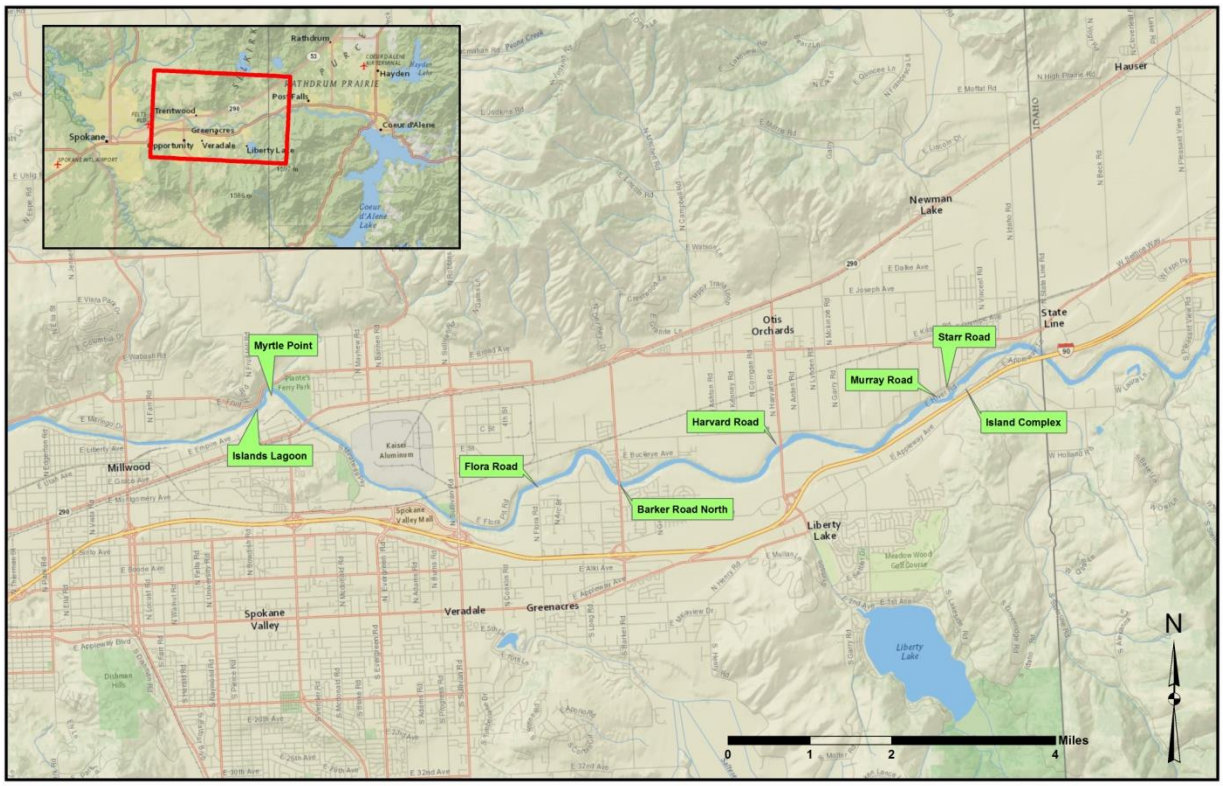
- 2006: Starr Road (~ river mile 94.7)
- 2007: Murray Road (~ river mile 94.2, Island Complex (~ river mile 95) and additional work at Starr Road
- 2008: Harvard Road (~ river mile 92.7)
- 2010: Flora Road (~ river mile 89.1); additional work was done in 2012
- 2012: Barker Road North (~ river mile 90.4), 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 October 1 and 3, 2018 sampling of the, Starr Road, Murray Road, Island Complex, Harvard Road, Barker Road North, Myrtle Point and Islands Lagoon beach sites and the October 1, 2018 observational site visit of the Flora Road beach site. The work is a part of the long-term monitoring of the Spokane River Shoreline Sediment Sites and follows the approved Monitoring, Sampling and Analysis Plan (MSAP) that was developed in fall of 2013. This report supports the periodic reviews of the cleanup actions taken at each of the shoreline sediment sites.

Background

The Spokane River Shoreline Sediment Sites are located between Upriver Dam and the Idaho state line (Figure 1). The Sites are associated with State Park recreational lands and are heavily used by humans and ecological receptors. Following is a general description of each of the Sites remediated by Ecology and are covered in this MSAR. Further discussion of the site history 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 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, at the time of cleanup sediment cleanup guidelines (SCG) were used to establish an appropriate benchmark. The SCG were based on current research and were used to help delineate remediation areas at each of the beach sites that were identified as critical habitat. Since the remediations, Washington State has adopted freshwater sediment quality values since the cleanups, but they may not be predictive of benthic community toxicity at sites that are impacted by metals mining, smelting and milling such as the Spokane River Beach Sites (WAC 173-204-563(2)(o)). For the purposes of this report, the Probable Effects Concentrations (PECs) developed by MacDonald et al 2003 will be used for comparative purposes for the protection of ecological health. Both the RBCs and PECs are provided in Table 1.

Table 1: RBC's from USEPA's ROD and PECs

Contaminant	RBC	PEC
Arsenic	~10 (background)	33
Cadmium	49	4.98
Lead	700	128
Zinc	17,109	459

(all values mg/kg)

Study Areas

An aerial photograph of each site depicting the area that was remediated including sample locations collected during the 2018 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 periods. Surrounding the Site to the north is a small area of trees and shrubs 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 acts as a barrier to the main flow of the Spokane River. This bar area 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 typically underwater, but is exposed during the summer and fall low-flow period. To the north of the site is a small area of trees and brush, which are located on the steep slope directly adjacent to the Site. In the upriver direction of the Site is a recreational trail area that is sparsely covered by trees and brush, which the River flows through during times of high flow. The river bar area bordering the fine-grained depositional area to the south acts as barrier to the main flow of the river. The bar area is heavily armored with river cobble. Approximate total area: ~ 1.4 acres.

Island Complex: The Island Complex Site is accessed from a gravel trail from a parking lot adjacent to the river near Exit 299 on I-90. The trail was improved during cleanup activities. 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 formed during high flows and 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 main river channel area to the north and the seasonal side-channel to the

west borders the fine-grained depositional area. The area contains fish spawning-sized gravel intermixed with fine-grained sediment. During cleanup work, a multi-layered soil cover was placed over the contaminated sediments, and native trees and shrubs were planted to stabilize the bank in the backwater area. 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 is 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 serves as a gravel boat launch and is separated from the rest of the Site by large boulders. The boulders were placed during cleanup activities to prevent vehicular traffic from accessing other portions of the Site. Also during cleanup activities, a cap was placed over the contaminated sediment. The cap consisted of fish spawning-sized gravel 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 from the Centennial Trail. The Site is used mostly for recreation. During the spring runoff parts of the recreational shoreline are underwater, but it is typically dry and exposed during the summer and fall low-flow periods. The resulting exposed areas are covered predominantly with fine-grained sediment and usually used for h recreational activity. The area bordering the Site to the east is sparsely covered with brush and mantled predominantly with gravel and sand while the area adjacent to the Site to the west underlain by cobble- and boulder-sized river rock. Approximate total area: ~ 0.30 acres.

Barker Road North: The Barker Road North Site is located along the north bank of the river upstream of the Barker Road Bridge. During the high flow spring runoff parts of the shoreline area of concern can be flooded, but this area is exposed and dry during the summer and fall low-flow periods. The Site is surrounded by residential land to the north and east of the Site. The Site is readily accessed from Barker Road and has high recreational use, primarily as a canoe and kayak launch site. The Site consists of 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 river's south bank and upstream of the Centennial Trail Footbridge. The Site is located on the upstream end of a river bend that provides recreational opportunities due to the slowing of the current. The area is underlain by 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 periods. 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. The areas provide a calm water river section usually associated with high recreational activity and the areas are typically underlain with fine-grained sediment. During the spring runoff, parts of the Site recreational shoreline area of concern are underwater but is exposed during the summer and

fall low-flow periods. Adjacent to the Centennial Trail and surrounding the Site to the south are gentle 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 October 1 and 3, 2018, 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 their respective caps. The samples were collected 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 2). Appendix A includes figures of the remediated area at each beach site in addition to depicting the locations of the discrete sampling stations 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 the proper identification of sample location and date. Samples were named according to each location number and the name of the site. Since the original MSAP was written, the Toxics Cleanup Program purchased a handheld Niton XL3t GOLDD+ XRF. It was decided that the XRF would be used in place of lab analyses due to its detection limits below the RBGs and PECs for the given metals. The XRF was used to analyze each of the samples on site following the manufacturer's protocols. Cadmium was not recorded due to a setting error. The XRF also recorded the coordinates of each sample location with its built-in GPS system. Photographs were 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. Once the sample was analyzed and photographs taken, samples were disposed of at the location they were collected.

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 2018 Sampling Event.

		Analyte (mg/kg)		
		Arsenic	**Lead**	**Zinc**
RBC		~10	700	17,109
PEC		33	128	459
Site	Sample ID			
Island Complex	IC 1	3.5	192	882
	IC 2	3.5	293	1130
	IC 3	20.98	157	748
	IC 4	63.2	347	1330
	IC 5	64.8	751	2090
	IC 6	52.1	919	2290
	IC 7	3.5	809	1730
	IC 8	28.21	173	837
	IC 9	10.32	76.5	764
Starr Road	Starr 1	29.9	238	1150
	Starr 2	30.4	63.0	565
	Starr 3	3.50	106	448
	Starr 4	27.6	169	1110
	Starr 5	13.7	77.6	436
	Starr 6	18.8	125	888
	Starr 7	16.3	105	1020
Murray Road	Murray 1	13.0	29.8	421
	Murray 2	9.3	30.9	226
	Murray 3	23.4	113	416
	Murray 4	114	1670	2690
	Murray 5	71.2	775	1630
	Murray 6	53.9	251	1180
	Murray 7	25.2	331	1320
	Murray 8	3.5	56.4	329
	Murray 9	24.7	175	1020
Harvard Road	Harvard 1	20.1	157	763
	Harvard 2	22.7	248	1100
	Harvard 3	30.1	165	1140
	Harvard 4	20.1	113	1370
	Harvard 5	56.4	462	2260
	Harvard 6	20.3	84	778
Barker North	Barker N. 1	3.5	122	634
	Barker N. 3	3.5	93.3	563
	Barker N. 3	3.5	140	669
	Barker N. 4	3.5	11.3	58.9
Myrtle Point	Myrtle 1	18.0	259	1090
	Myrtle 2	21.2	237	1060
	Myrtle 3	27.2	328	1020
	Myrtle 4	3.5	235	888
Islands Lagoon	Islands 1	16.6	22.7	170
	Islands 2	3.5	43.8	242
	Islands 3	14.2	51.6	362
	Islands 4	13.8	132	667
	Islands 5	9.47	18.6	249
	Islands 6	11.6	78.8	416

Discussion

Sediment Accumulation and Integrity of Remedial Actions

With the exception of Islands Lagoon, all of the beach sites that were sampled in 2018 had new sediment accumulation. The furthest upstream beach sites had the most sediment accumulation with Island Complex having the most significant new sediment accumulation. This corresponds to the sediment chemistry results with the upstream sites having the highest concentrations (see next section).

Each of the beach sites show signs of human use. There is minor damage seen at the Island Complex, Starr Road, and Barker Road North sites, however, this is mostly limited to access pathways that were constructed as a part of the remedial action. Island Complex has shown the most wear which is suspected to be as a result of the high-water flows that inundate the site during portions of the year.

At Flora Road, the only beach site that was not sampled as a part of the 2018 sampling event, observations were noted in the monitoring log. It was generally observed that the remedy was intact with little to no additional sediment accumulation.

2018 Analytical Results

Contaminant concentrations between the seven sites and within each site were varied. Arsenic and zinc concentrations showed a decreasing trend as you move downstream with a significant decrease starting at Barker Road North and continuing downstream. Lead concentrations, however, stayed relatively consistent until reaching the furthest downstream site (Islands Lagoon). Islands Lagoon had the lowest concentrations for arsenic, lead and zinc of all of the sites that were sampled.

Arsenic: Of the beaches sampled, the RBC for arsenic (~10 mg/kg) was exceeded by at least one sample at each of the sites with the exception of Barker Road North. The average arsenic concentration at Island Complex, Starr Road, Murray Road, Harvard Road and Myrtle Point exceeded the RBC. The PEC for arsenic (33 mg/kg) was exceeded in at least one sample at Island Complex, Murray Road and Harvard Road. Murray Road was the only beach site where the average arsenic concentration exceeded the PEC. The highest arsenic concentration (114 mg/kg) was observed at Murray Road.

Lead: The RBC for lead (700 mg/kg) was exceeded by at least one sample at Island Complex and Murray Road. The PEC for lead (128 mg/kg) was exceeded in at least one sample at all of the beach sites that were sampled in 2018. In addition, average site concentrations for lead exceeded the PEC for lead at all of the sites except for at Barker Road North and Islands Lagoon. The highest lead concentration (1,670 mg/kg) was observed at Murray Road.

Zinc: The RBC for zinc was not exceeded at any of the beach sites. The PEC for zinc (459 mg/kg) was exceeded in at least one sample at each of the beach sites sampled in 2018. The highest concentration for zinc was observed at Murray Road (2,690 mg/kg) while both Island Complex

and Harvard Road had zinc concentrations over 2,000 mg/kg (2,290 and 2,260 mg/kg respectively). All three sites also averaged zinc concentrations over 1,000 mg/kg.

Comparison to Pre and Post-Remediation Sampling Events

The results were compared to samples collected prior to remediation efforts and previous monitoring events (Table 3). At each of the beach sites, contaminant concentrations were generally less after the remedial actions with the exception being arsenic at the Murray Road and Harvard Road sites, and both lead and zinc at Island Complex. While concentrations are still less than pre-remedial action concentrations there has been an observed increase in concentrations for all contaminants at Harvard Road and the other upstream sites since post-remediation sampling has occurred. Beach sites downstream of Harvard Road currently do not have enough post-remediation sampling events to observe a temporal trend.

The increasing concentration trends and continued new sediment deposition indicates that potential upstream sources exist that are likely to impact the Spokane River in the future.

Table 3: Comparison of sediment concentrations by sampling event.

		Analyte (mg/kg)											
		Arsenic			Cadmium			Lead			Zinc		
Site	Study Year	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Island Complex	2007	35.4	24	47	-	-	-	73.2	33	144	969	497	1919
	2008	15	8.34	19.1	-	-	-	107	77.9	144	463	364	688
	2013	15	11.2	16.8	11	3.09	19.5	515	147	872	1250	524	1830
	2018	27.8	3.5	64.8	-	-	-	413	76.5	919	1310	748	2290
Starr Road	2004	37	33	39	17	15	20	1027	326	1760	3620	3020	4460
	2013	7.3	5.82	10.2	2.6	1.46	3.85	94	56.5	146	464	289	623
	2018	20.0	3.5	30.4	-	-	-	126	63.0	238	787	436	1150
Murray Road	2007	25	18	30.6	9.6	6.56	16.6	664	268	1710	2410	1800	2720
	2008	14.6	6.35	31.4	4.6	0.66	20.1	66.4	40.2	110	274	130	409
	2013	11	7.82	17.4	2.4	0.312	4.57	107	206	186	410	92.4	650
	2018	37.5	3.5	114	-	-	-	381	29.8	1670	1025	226	2690
Harvard Road	2007	18	16.5	19.2	9.4	7.99	11.4	471	103	816	2570	1670	2980
	2013	8.4	6.7	10.5	8.6	2.49	14.8	290	158	407	1120	757	1510
	2018	28.3	20.1	56.4	-	-	-	205	84.3	462	1235	763	2260
Barker Road North	2006	66.7	56	77	-	-	-	326	77.2	570	-	-	-
	2012	9.5	5.63	13	-	-	-	127	15.8	504	-	-	-
	2018	3.5	3.5	3.5	-	-	-	92.0	11.3	140	481	58.9	669
Flora Road*	2006	12.8	8.3	16.9	-	-	-	281	45.5	725	-	-	-
	2012	9.6	6.71	12.8	-	-	-	163	41.3	314	-	-	-
Myrtle Point	2006	16.7	3.4	27.9	-	-	-	504	111	1230	-	-	-
	2012	20.8	15.2	30.4	-	-	-	727	40.7	2020	-	-	-
	2018	17.5	3.5	27.2	-	-	-	265	235	328	1016	888	1090
Islands Lagoon	2006	15	4.17	20.2	-	-	-	256	30	1160	-	-	-
	2012	19.9	30	1160	-	-	-	439	17.2	1960	-	-	-
	2018	11.5	3.5	16.6	-	-	-	57.9	18.6	132	351	170	667

*=Initial remediation performed in 2010 with additional work in 2012

Pre-remediation

Post-remediation

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Appendices

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

Appendix A. Sampling Locations at Beach Sites

Figure A-1. Island Complex

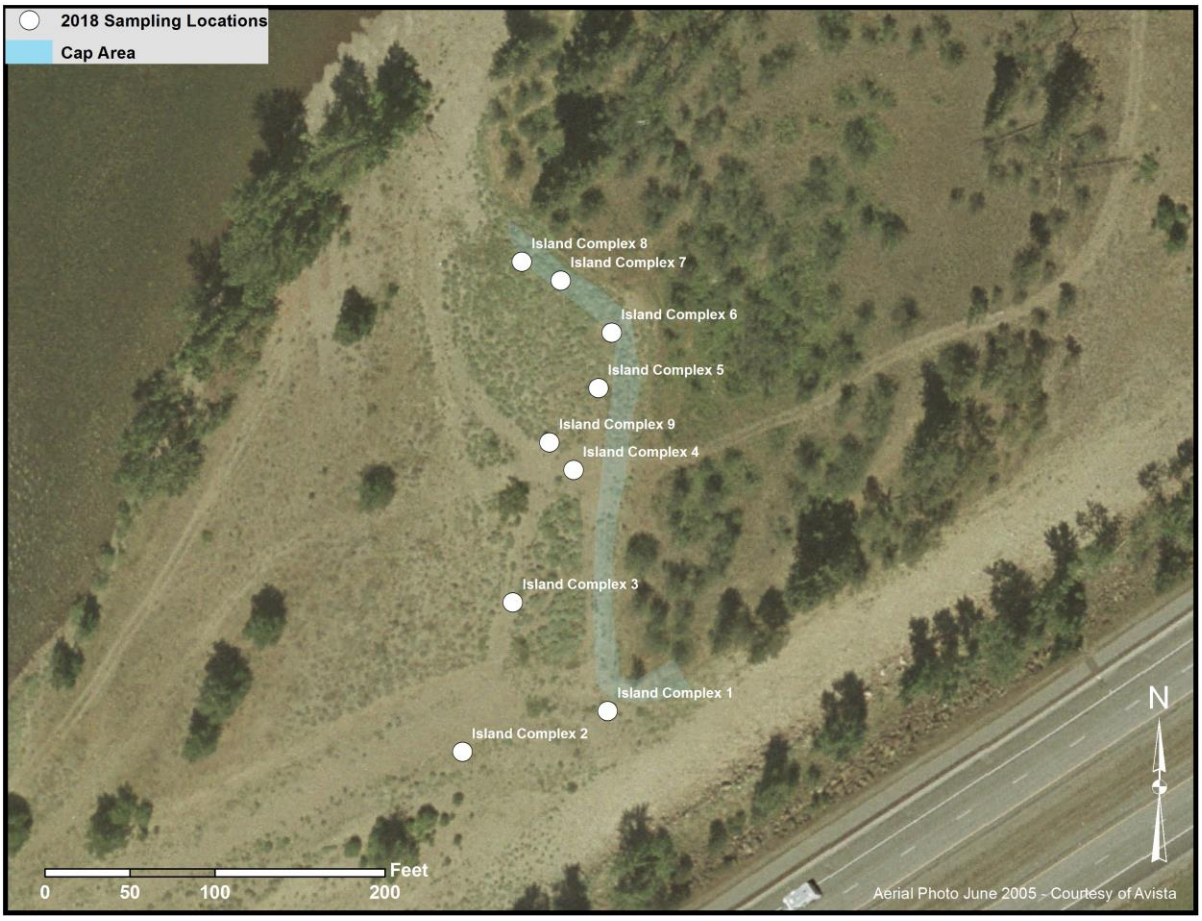

Figure A-2. Starr Road

Figure A-3. Murray Road

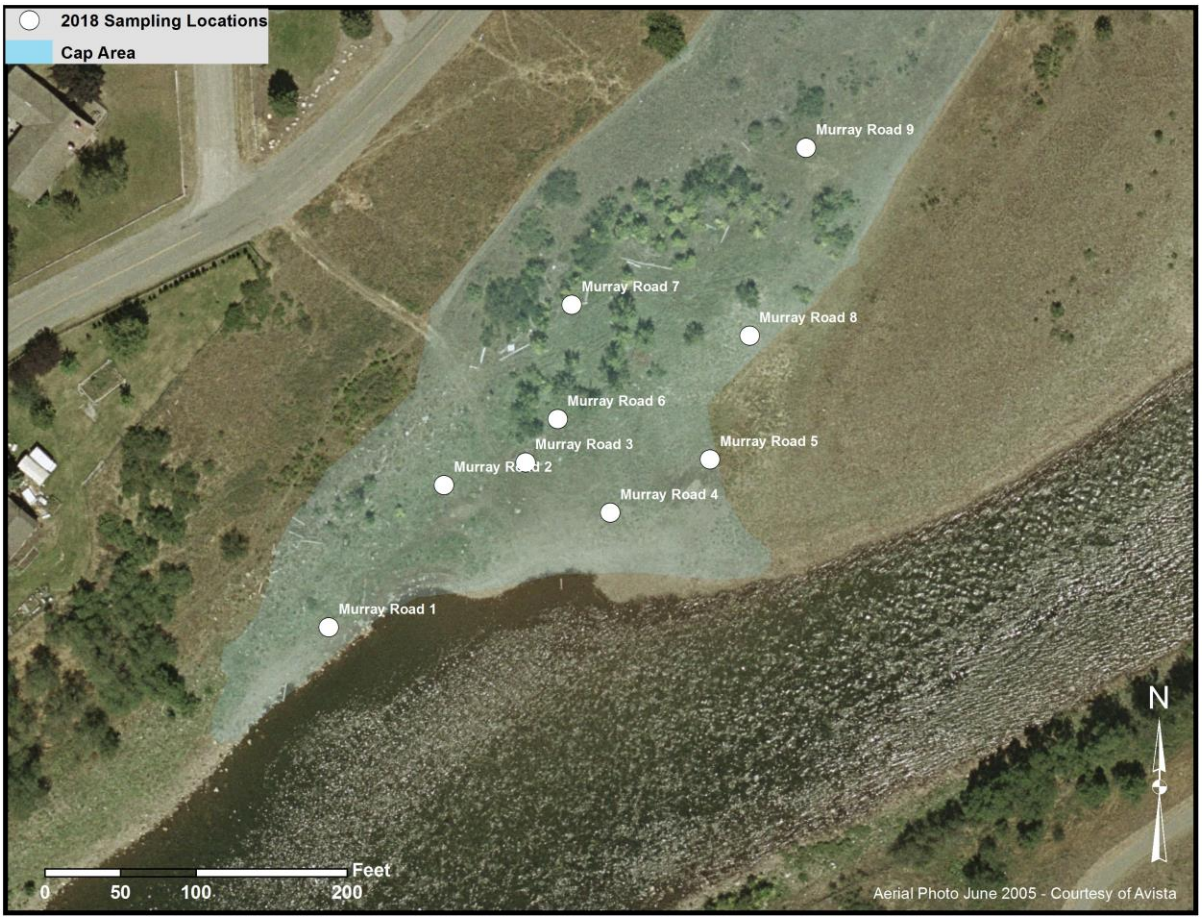

Figure A-4. Harvard Road

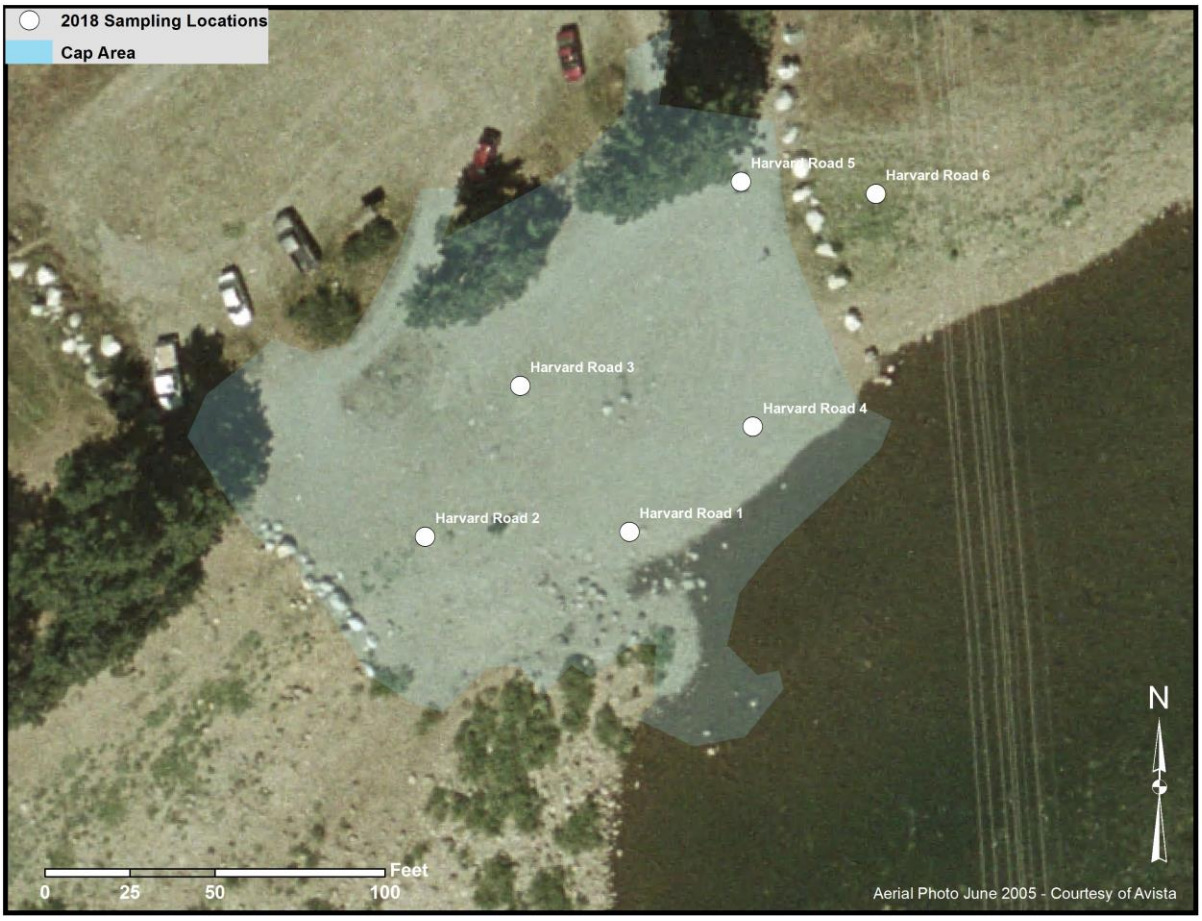

Figure A-5. Barker Road North

Figure A-6. Myrtle Point

Figure A-7. Islands Lagoon

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: 10/1/18

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO _____ If YES, how many? 9

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: - additional material in vegetated areas - Significant amounts of new sand/gravel adjacent to the cap

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - trail still present but worn due to flows. - Some fabric visible underneath trail - Signs still present

Vegetation Health

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

- about 30-50% success rate depending on area of the cap

Estimated amount of growth since last monitoring event:

- little to no growth

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 cap area among planted vegetation

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):

- coir fabric is starting to tear and become tattered in a few areas

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**
IMG_3847	View of the site looking towards the northern end of the chevron area
3848	middle of the chevron/vegetated area in view
3849	Southern end of the chevron area in view
3850	view standing at southern end looking north
3852	Sample 1
3853	Sample 2
3854	Sample 3
3855	Sample 4
3856	Sample 5
3857	Sample 6
3858	Sample 7
3859	Sample 8
3860	Sample 9

IMG_3847

IMG_3848

IMG_3849

IMG_3850

IMG_3852

IMG_3853

IMG_3854

IMG_3855

IMG_3856

IMG_3857

IMG_3858

IMG_3859

IMG_3860

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Starr Road Date of Visit: 10/3/18

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO _____ If YES, how many? 7

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/inter-mixed w/ cap gravel

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - overgrown with weeds - some erosion at edges - 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:

NA

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

Gravel Cap Observations

Is the gravel cap intact and undamaged? YES + 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 minor organics (branches, 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**
IMG-3879	View of the site near information sign
3880	View of the site to the south near info sign
3881	View of the site just east of backwater area
3882	Sample 1
3883	2
3884	3
3885	4
3886	5
3887	6
3888	7

IMG_3879

IMG_3880

IMG_3881

IMG_3882

IMG_3883

IMG_3884

IMG_3885

IMG_3886

IMG_3887

IMG_3888

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Murray Road Date of Visit: 10/3/18

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO _____ If YES, how many? 9

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 / inter-mixed w/ cap gravel

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

Vegetation Health

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

- Cap C mix not well established
- weeds are predominant vegetation

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 growth on Cap areas

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):

- Caps A/B Fairly intact; Cap C some minor damage due to water flows

Note any debris that has accumulated on top of the cap: -Some garbage and wood debris
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading): -

Photo Log	
Photo ID	**Description**
IMG_3889	looking to the south overlooking eastern end of the site
3890	same location but looking at western end of the site
3891	Sample 1
3892	" 2
3893	" 3
3894	" 4
3895	" 5
3896	" 6
3897	" 7
3898	" 8
3899	" 9

IMG_3889

IMG_3890

IMG_3891

IMG_3892

IMG_3893

IMG_3894

IMG_3895

IMG_3896

IMG_3897

IMG_3898

IMG_3899

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Harvard Road Date of Visit: 10/3/18

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO _____ If YES, how many? 6

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 / inter-mixed with capping

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:

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:

- Sagebrush on edges of cap
- weeds on some parts of 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: branches/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**
IMG_3900	Standing western edge of site near water looking upstream (east)
" 3901	Standing in middle of cap near the water looking north towards the cap
" 3902	Sample 1
" 3903	" 2
" 3904	" 3
" 3905	" 4
" 3906	" 5
" 3907	" 6

IMG_3900

IMG_3901

IMG_3902

IMG_3903

IMG_3904

IMG_3905

IMG_3906

IMG_3907

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Barker Road North Date of Visit: 10/3/18

Person Filling Out the Form: B. Downing

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: - only small deposits of fine-grained material inter-mixed between cobbles

Signage and Pedestrian Access
Condition of pedestrian access pathways and signage if placed as a part of the remedial action: - access path partially eroded from use/weather - signs still present

Vegetation Health

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

-plantings put in by local groups present

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 in some areas 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: 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**
IMG-3908	Standing at waters edge under bridge looking east towards site
" 3909	same spot looking towards pedestrian access gateway
" 3910	Sample 1
" 3911	" 2
" 3912	" 3
" 3913	" 4

IMG_3908

IMG_3909

IMG_3910

IMG_3911

IMG_3912

IMG_3913

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Flora Road Date of Visit: 10/3/18

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: -usage noted but intact

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:

- Sage brush / weeds in some parts 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: –
Effect of cap, if any, on beach area immediately up-stream or downstream (e.g. erosion, bulk-heading): –

Photo Log	
Photo ID	**Description**
IMG_3914	standing at eastern most edge of the site looking west
IMG_3915	standing at eastern most edge of the site near the water looking west

IMG_3914

IMG_3915

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Islands Lagoon Date of Visit: 10/3/14

Person Filling Out the Form: B. Dowling

Were sediment samples collected? YES X NO _____ If YES, how many? 6

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):

- minor erosion from usage but remedy still effective and in good condition

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): —

Photo Log	
Photo ID	**Description**
IMG_3918	Standing western most edge of the site looking east towards the site
" 3919	same spot with more focus on eastern part of the cap
" 3920	Sample 1
" 3921	" 2
" 3922	" 3
" 3925	" 4
" 3926	" 5
" 3927	" 6
~~3928~~	~~"~~

IMG_3918

IMG_3919

IMG_3920

IMG_3921

IMG_3922

IMG_3925

IMG_3926

IMG_3927

Spokane River Metals Beach Sites

Site-Visit Monitoring Log

Site Name: Myrtle Point Date of Visit: 10/3/18

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 present in a few spots

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 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 presence

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):

- minor erosion in a few areas but for most part intact

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): –

Photo Log	
Photo ID	Description
IMG-3928	Sample 1
" " 3929	Standing downstream of site looking upstream towards the site
" " 3930	Sample 2
" " 3931	Sample 3
" " 3932	Sample 4

IMG_3928

IMG_3929

IMG_3930

IMG_3931

IMG_3932

Appendix C. 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)