# *Phase II Environmental Site Assessment*
# *Mirror Pond, Bend, Oregon*

Prepared for:
Bend Parks and Recreation District
and Deschutes County

September 20, 2016
2112-00.014

APEX

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**City of Bend Department of Parks and Recreation and Deschutes County**

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# 1.0 Introduction

This Phase II Environmental Site Assessment (ESA) Report describes environmental investigation activities completed at Mirror Pond, located on the Deschutes River, in Bend, Oregon (the Site; see Figure 1). The Phase II ESA was performed to assess Site conditions and included the investigation of pond sediments.

This report was prepared for Bend Parks and Recreation District and Deschutes County, using funding provided by U.S. Environmental Protection Agency (EPA) Community-Wide Assessment Grant No. BF00J8001.

## 1.1 Purpose

The purpose of the Phase II ESA was to: (1) assess Mirror Pond sediments for suitability for future upland use as fill; (2) obtain chemical constituent data to assess potential hazardous substance risks to human health and the environment; and (3) while not the primary focus of this investigation, obtain chemical constituent data suitable for supporting future sediment dredging decisions and associated permitting.

## 1.2 Scope of Work

The scope of work was completed in accordance with the *Phase II Environmental Site Assessment Work Plan* (Work Plan) dated May 19, 2016 (Apex Companies, LLC [Apex], 2016). Activities consisted of the following tasks:

1) Collect both composite and location-discrete sediment samples at selected locations within Mirror Pond;
2) Analyze sediment samples for physical properties and contaminants of interest (COI); and
3) Prepare a Phase II ESA report that discusses field activities, physical and analytical results, and presents an evaluation for potential beneficial reuse of dredged sediment and of potential hazardous substance risks to human health and the environment.

# 2.0 Background

This section, also presented in the Work Plan, presents a description of the Site, the regional and local geology and hydrogeology, and the Site history.

## 2.1 Site Location and Description

Mirror Pond is located along the Deschutes River in downtown Bend, Oregon. The pond was created by a dam constructed in 1909, which backs up the river for approximately a mile upstream. Mirror Pond is defined

upstream by the Galveston Avenue bridge and downstream by the hydroelectric dam located approximately 200 feet to the northeast of Newport Avenue. Drake Park bounds the pond on the east, and the west side of the pond is bounded by residences and Brooks Park and Harmon Park.

## 2.2 Geology and Hydrogeology

The following is a discussion of the topography, geology, and hydrogeology of the Site and vicinity.

Topography. The Site and the immediate vicinity are generally flat with a ground surface elevation of about 3,600 feet above mean sea level (MSL). The Deschutes watershed drainage basin increases in elevation heading southward to an elevation of approximately 6,600 feet 50 miles to the south of Bend. Between Benham Falls, located approximately 10 miles south of Bend, and Mirror Pond, there is over 1,000 feet of elevation difference and several rapids as the river flows through basaltic rock. To the south of Benham Falls, there are significantly fewer rapids.

Regional Geology and River Hydrology and Geomorphology. The lithology of the Upper Deschutes watershed is comprised of volcanic materials, including basalts of the Newberry Volcano as well as ash, cinder, and pumice deposits and glacial till. These volcanic materials form well drained ashy, silty, sandy soils that are typically not well suited for agriculture.

Mirror Pond (the Site) was created on the Deschutes River by the construction of a power dam. The Deschutes is considered a groundwater dominant river, as the river basin's porous soils allow for the infiltration of surface water to recharge groundwater aquifers and ultimately the river system. As a result, the Deschutes is stable hydrologically, with little natural fluctuation in water flow. Under natural conditions, water flows in the Deschutes River were documented as near-constant. Water storage and irrigation diversions have modified the natural flows such that flows are much lower in the winter months and higher during the summer irrigation season. The average flow at the Colorado Avenue Dam, located 0.5 miles downstream from the Galveston Avenue Bridge, was estimated to range from 600 cubic feet per second (cfs) during the late fall to approximately 1,500 cfs during the summer flow peak (OTAK, 2013).

## 2.3 Potential Areas of Concern

Mirror Pond was last dredged in 1983. A review of historical reports and environmental databases do not indicate any likely sources of contamination of pond sediments since the last dredging event. However, given the location of Mirror Pond between a residential and urban corridor, a few potential sources of contamination were identified which warranted further investigation.

Storm Drain Outfalls. A map provided by the City of Bend indicated eleven storm drain outfalls to Mirror Pond. The outfalls are shown on Figure 2. During preparation of the Work Plan (Apex, 2016) several historical current and former dry cleaning facilities were identified in the downtown business district adjacent to the

northeastern extent of Mirror Pond. While no active environmental cleanup sites were identified associated with those dry cleaning facilities, the potential for hazardous contamination migration through a preferential pathway (*i.e*. storm drain/sewer) warranted the collection of sediment samples at stormwater outfalls near the business district. Furthermore, the potential for runoff from vehicle usage to storm sewers also warranted the further characterization of sediments near outfalls to Mirror Bond adjacent to the Mirror Pond business district. Evaluation of storm drain outfalls along the west bank of Mirror Pond was conducted to evaluate impacts to sediments through the storm sewers that may have originated in the residential neighborhood, and include the analysis of samples for contaminants such as herbicides and pesticides.

Pacific Power Dam. The Pacific Power dam is located at the northeast corner of Mirror Pond to the north of the Newport Avenue bridge, as shown on Figure 2. The Work Plan identified the area north of the Newport Avenue bridge at the power station associated with the PacifiCorp dam, as an area for additional evaluation, given the potential for hazardous substances, such as polychlorinated biphenyls (PCBs) associated with power station facilities. The Bend power station is listed in the Environmental Cleanup Site Information (ECSI) database as a site for which the Oregon Department of Environmental Quality (DEQ) recommends additional investigation.

# 3.0 Pre-Investigation Activities

Site Health and Safety Plan. A Site-specific health and safety plan (HASP) was prepared for the field activities and was included in the Work Plan. The HASP was prepared in general accordance with the Occupational Safety and Health Administration (OSHA) requirements in CFR 1910.120 and applicable Oregon Administrative Rules (OARs). A copy of the HASP was maintained on-site during the field activities.

Property Access. Private landowners currently own the bottom of Mirror Pond. Bend Parks and Recreation District contacted the property owners who allowed access to the pond for sampling purposes. The field scientists physically accessed Mirror Pond at the public parks located along the pond. An access agreement was signed between Bend Parks and Recreation and PacifiCorp to allow access north of the Newport Avenue bridge for the purpose of sediment sampling. This included sampling within the Pacific Power dam boom (see Figure 2). Prior to the sampling event, Apex conducted a site visit to verify that the water levels were sufficient for site access and to scope out any potential access issues associated with sampling in the vicinity of the dam.

Subcontractor Solicitation. ESC Lab Sciences of Mt. Juliet, Tennessee was selected to perform laboratory analytical services and Northwest Testing, Inc. of Wilsonville, Oregon was selected to perform laboratory geotechnical services.

Underground Utility Location. Underground utilities were located and marked prior to beginning the field investigation work. This included contacting the Oregon Utility Notification Center, who in turn notified the various utilities in the area to mark any underground installations.

Agency Consultation. Prior to conducting the sampling, Apex contacted Oregon Department of State Lands and the U.S. Army Corps of Engineers (USACE) to verify that the sampling scope did not require any permits.

Cultural Resources Consultations. Prior to initiating field activities, Apex consulted with the Oregon State Historic Preservation Office (SHPO) and the following tribes: (1) the Confederated Tribes of Warm Springs; (2) the Klamath Tribes; (3) the Burns Paiute Tribe; and (4) the Confederated Tribes of the Siletz Indians of Oregon. SHPO did not identify any cultural resources at the Site. The Tribes did not comment.

# 4.0 Site Investigation Activities and Findings

The Phase II ESA was conducted in general accordance with the Work Plan. Representative photographs of the field activities are included in Appendix A of this report. Field activities included sediment coring, collecting and, in some instances, compositing samples, and analysis of sediment samples for both analytical and structural composition. These activities are described below.

## 4.1 Sediment Sampling Methodology

From June 7 through 9, 2016, field scientists from Apex collected sediment samples in Mirror Pond while positioned on a non-motorized raft equipped with coring equipment For the bulk of the sample locations, the pond was accessed along the southern boundary of the pond at Drake Park. For the samples collected to the north of the Newport Avenue Bridge, the water was accessed along the western edge of the Pacific Power parking lot. A summary of the sample locations, the rationale for their selection, the analytical program, and the sediment sampling methodology is summarized in the subsections below.

Sediment samples were collected from the vessel using a Russian Peat corer. The hand coring device consists of a manually driven sampler for discrete interval sampling in sediments. Once the sample core was obtained, the rods and sampler were back-hammered out of the bore hole and the sample was processed into sample containers for laboratory analysis. For some locations, multiple sample runs were necessary to collect the laboratory-required sample volumes. Coring logs for each sampling location are provided in Appendix B. A detailed description of sampling and analytical methods is provided in the Sampling and Analysis Plan provided in the Work Plan (Apex, 2016).

## 4.2 Sample Locations, Analyses, and Rationale

The sediment sampling locations are shown on Figure 2 and the following table provides a summary of sample location, sample type (grab or composite), rationale for the sample location, and a summary of the laboratory analyses performed for that sample. Coring logs for each sampling location are provided in Appendix B.

| Sample Location | Sample Types | Rationale | Laboratory Analyses |
|---|---|---|---|
| SS-1 through SS-3 | 3-point composite grab sample | Characterize sediments between Galveston Avenue Bridge and Drake Park. | DRO, PAHs, metals, herbicides/pesticides Grain Size (SS-1 only) |
| SS-4 through SS-6 | 3-point composite grab sample (Sampling Unit #2) | Characterize sediments in Mirror Pond from Drake Park east to Newport Avenue bridge | DRO, PAHs, metals, herbicides/pesticides Grain size (SS-4 and SS-6 only). |
| SS-7 and SS-8 | Grab sample | Evaluate sediment immediately upstream from the Pacific Power dam for possible impacts from dam operations and/or the substation. | DRO, PAHs, metals, PCBs. Grain size and TOC |
| SS-09 and SS-10 | Grab sample | Evaluate sediment at stormwater outfalls along the east bank of Mirror Pond, with storm drains originating in the business district of Bend. Evaluate for contaminants associated with vehicle traffic and dry cleaning facilities. | DRO, VOCs, PAHs, metals. |
| SS-11 and SS-12 and SW-16 | Grab sample | Evaluate sediment at stormwater outfalls along the west bank of Mirror Bond, with storm drains originating in primarily residential area. | DRO, metals, PAHs, pesticides/herbicides. |
| SS-13 | Grab sample | Evaluate sediment immediately downstream from the Galveston Avenue bridge for possible impacts at the stormwater outfall and from upstream activity. | DRO, PAHs, metals, pesticides/herbicides |
| SS-14 and SS-15 | Grab Sample | Provide geotechnical information for sediment relocation. | Grain Size. |

Deviations from Work Plan. Due to the presence of coarse gravel and cobbles at locations SS-11 and SS-12, equipment refusal was encountered at 1.0 and 2.5 feet below mudline (bml), respectively. In order to collect a longer core representative of sediments in the vicinity of the west bank storm drains, an additional

(out-of-scope) core was advanced at location SS-16. The coring device penetrated to a depth of 4 feet bml at location SS-16.

### *4.2.1 Composite Samples*

Recent historical analytical data from Mirror Pond suggested relatively low concentrations of chemicals/metals in sediments, and that analyte concentrations are relatively uniform throughout the Pond. As a result, several samples were collected from discrete locations and composited into one sample considered representative of the sampling unit. Two sampling units were identified in the Work Plan (Apex, 2016): one between Drake Park and the Galveston Avenue bridge and a second from Drake Park to the Newport Avenue bridge. Two 3-point composite samples were collected from each sampling unit as summarized in the table above. A composite from sample locations SS-1 through SS-3 was used to evaluate bulk sediment conditions in the western half of the pond (sampling unit #1), and a composite sample from locations SS-4 through SS-6 was used to evaluate bulk sediment conditions in the eastern half of the pond (sampling unit #2; see Figure 2). Care was taken to place these sampling locations away from any potential point source of contaminants such as a municipal outfall or the dam. A figure depicting historical boring locations, and tables summarizing historical sediment data, are provided in Appendix B.

At each composite sample location, the coring device was advanced to a depth of approximately 5 feet bml, or until practical refusal, whichever occurred first. Sample depth intervals are listed in Tables 1 through 5. An attempt was made to collect sediment samples from two depth intervals from each composite sampling location: (1) 0 to 4 feet, which accounts for a potential dredge prism and (2) from 4 to 5 feet, which represents the estimated post- dredge surface. A 0 feet to 4 feet sample was achievable at sample locations SS-1 through SS-6. At sample locations SS-1, SS-2 and SS-4, instrument refusal was encountered at 4 feet bml due to the presence of rock and gravel, and a 4 to 5-foot sample could not be collected.

Samples from locations SS-1 through SS-3 were composited into one (0 to 4 feet) sample for laboratory analysis. A discrete sample from SS-3 collected from 4 to 5 feet was submitted to be representative of the 4 to 5 feet interval from Sampling Unit #1. Samples from locations SS-4 through SS-6 were composited into one (0 to 4 feet) sample for laboratory analysis, while (4 to 5 feet) samples from SS-5 and SS-6 were composited to be representative of that depth interval in Sampling Unit #2. A description of compositing procedures is presented in the Work Plan sampling and analysis plan (SAP; Apex, 2016).

### *4.2.2 Discrete (Grab) Samples*

At each discrete (non-composite) sampling location, a manual coring device was used to collect a sediment core to a maximum depth of approximately 4 feet bml. In some cases, instrument refusal was encountered shallower than 4 feet bml due to the presence of rock and gravel beneath the sediments. At each discrete sampling location, a sample was collected from the first 6 inches of sediment, and a second sample was

collected from 6 inches to 4 feet bml. Where refusal occurred at a shallower depth than 4 feet, a sample was collected from 6 inches to the depth of refusal.

#### *4.2.3 Grain Size Analysis*

Additional sediment volume was collected from locations SS-1, SS-4, SS-6 through SS-8, SS-14, and SS-15 for grain size analysis. At each location, an aliquot of sediment was removed from the corer and placed into a plastic bag for submittal to Northwest Testing Inc., of Wilsonville, Oregon, for grain size distribution using mechanical and hydrometer sieve analysis. The grain size distribution charts are provided in Appendix D.

### 4.3 Analytical Program

Samples for chemical analysis were analyzed by ESC Lab Sciences. The analytical program is summarized in the table in Section 5.2 and discussed in detail in the SAP of the Work Plan (Apex, 2016).

The laboratory method for each analysis is listed below.

- Diesel/oil-range hydrocarbons by Northwest Method NWTPH-Dx,
- Volatile organic compounds (VOCs) by EPA Method 8260B,
- Polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270C-SIM,
- Metals (antimony, arsenic, barium, cadmium, chromium, lead, copper, mercury, selenium, silver and zinc) by EPA 6010/6020 method,
- Mercury by EPA 7471b
- PCBs Aroclors by EPA Method 8082.
- Pesticides by EPA 8081
- Herbicides by EPA 8151
- Total Organic Carbon (TOC)– EPA 5310B mod of EPA 9060
- Grain Size (%) – ASTM D-422 mod

## ***5.0 Analytical Results and Risk Screening***

Sediment analytical results are listed in Tables 1 through 5. Analytical data reports, along with a data quality assurance review, are provided in Appendix D.

The sediment data in Tables 1 through 5 are compared to the following screening criteria:

- Upland Clean Fill Criteria. DEQ, 2014. These values are used to screen sediments for potential unrestricted upland reuse. For metals, these criteria are listed as Regional Background Values.
- DEQ Risk-Based Concentrations – Soil Direct Contact – Occupational Worker Scenario. These values are used to screen human health risk associated with direct contact with pond sediments. The occupational scenario was selected as it best represents the extent of exposure associated with recreational use of the pond, where humans may come in contact with pond sediments.
- DEQ Ecological Risk Assessment Level II values for sediment bioaccumulation. These values are used to screen ecological risk associated with accumulation in the food chain for both human and ecological receptors.
- Sediment analytical results were also screened against Benthic Toxicity Screening Levels for Freshwater (SLVs; USACE, 2016). These values are used to screen for the suitability for reuse of sediments in water, and may be used to support dredge permit decisions.

Figure 3 depicts the sediment sampling locations where one or more screening levels were exceeded.

## 5.1 Composite Sediment Sample Results

Concentrations of TPH-Diesel/heavy oil range, PCBs, VOCs, PAHs, herbicides, and pesticides were either below analytical method reporting limits or were detected below relevant screening levels for the composite samples representative of Sampling Unit #1 (SS-1 – SS-3) and Sampling Unit #2 (SS-4 – SS-6).

Nickel was detected in each of the composite samples at concentrations below the Regional Background Levels, but in exceedance of the Benthic Toxicity SLVs for Freshwater. Arsenic was detected in each of the composite samples at concentrations below the Regional Background Levels but in exceedance of the RBC for occupational direct contact. Silver was detected in composite sample (SS-1 – SS-3) at a concentration of 0.840 milligrams per kilogram (mg/kg) which exceeded the Regional Background Level of 0.68 mg/kg and the Benthic Toxicity SL1 of 0.57 mg/kg.

## 5.2 Discrete Sediment Samples

Total petroleum hydrocarbons in the diesel and heavy oil range were detected in several sediment samples, although none were detected at concentrations in exceedance of RBCs for occupational direct contact or for Benthic Toxicity SLVs for freshwater.

Samples were collected for PCB analysis at locations SS-7 and SS-8 near the power dam. No PCBs were detected at those locations.

Herbicides and Pesticides were not detected in the discrete sediment samples above laboratory method reporting limits.

Samples were collected for VOC analysis at locations SS-9 and SS-10 located near outfalls adjacent to the Bend downtown business district. A few VOCs were detected in these samples at concentrations below RBCs for occupational direct contact. The reporting limits for three VOCs (acrylonitrile, 1,2-Dibroo-3-Choropropane, and 1,2-Dibromomethane) were slightly above the Clean Fill levels in one or more samples. Given that VOC concentrations were consistently low or non-detect, it is not likely that concentrations in those samples would exceed the Clean Fill criteria if lower reporting limits had been achieved.

Benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were detected in the 0.5 to 4 feet sample at location SS-16 at concentrations that slightly exceeded the Clean Fill criteria. Sample SS-16 is located adjacent to a municipal storm drain outfall along the residential western bank of Mirror Pond.

Arsenic was detected in several discrete samples at concentrations below the Regional Background Levels, ranging from 1.28 mg/kg to 4.86 mg/kg, but in exceedance of the RBC for occupational direct contact of 1.9 mg/kg. Copper was detected in the 0.5 to 3 feet sample from location SS-8 at a concentration that exceeded both Regional Background Levels as well as Benthic Toxicity SLVs. Lead concentrations exceeded Regional Background Levels at locations SS-9 (all depths), SS-10 (all depths), and SS-11 (0.5 to 1 foot), but were an order of magnitude below Benthic Toxicity Screening SLVs and Occupational Direct Contact RBCs. Mercury was detected in the 4 to 5 feet sample from SS-3, at a concentration of 0.0727 mg/kg, which slightly exceeds the Regional Background Level. Nickel was detected in each discrete sample at concentrations below Regional Background Levels, but above the Benthic Toxicity SLVs for Freshwater.

For arsenic, cadmium, lead, silver, and mercury, the Sediment Bioaccumulation Screening Level Values (DEQ, 2007) default to the Regional Background Levels (DEQ, 2013). Lead concentrations exceed Regional Background Levels in samples from location SS-9 (surface and 0.5 to 4 feet), SS-10 (surface and 0.5 to 4 feet) and SS-11 (0.5 to 1 foot). Mercury concentrations exceed Regional Background Levels in SS-3 (4 to 5 feet) and SS-9 (0.5 to 4 feet).

## 5.3 TOC and Sediment Grain Size Analysis

The results of the complete (mechanical and hydrometer) gradation testing indicates that the shallow sediments (0 to 5 feet) present in the pond are broadly uniform. The samples were somewhat well graded and consisted of 80 to 90 percent silts and fine sands. Clay size particle contents were generally in the range of 10 percent. The exception was Sample SS-14 which we understand was taken from a higher energy portion of the pond (see coring logs in Appendix B). That sample consisted of gravelly sand with some silt.

The gradation results are consistent with a depositional source within a dammed stream. The river is relatively quiescent while maintaining a consistent current and frequent turnover of water. The retention time within the pond is insufficient for large quantities of clay to settle out but the stream velocity is insufficient to transport

significant quantities of course sand and gravel through the pond. As such, silt-sized particles make up the bulk of the sediments.

The total organic carbon measured in the Mirror Pond sediments ranged from 22,500 mg/kg to 71,500 mg/kg.

# 6.0 Conclusions and Recommendations

The data collected for this Phase II ESA are intended to provide a general screening for constituents in the sediments of Mirror Pond, based on our understanding of current and historical land use adjacent to and in the vicinity of Mirror Pond. Based on a comparison of results to the relevant screening levels defined in Section 5, conclusions regarding human, ecological risk, and potential reuse of sediments are presented in Section 6.1 below. Information on the structural suitability of sediments for upland reuse is discussed in Section 6.2.

## 6.1 Chemical Suitability of Sediment for Reuse and Evaluation of Potential Exposure Risk

With the exception of PAHs at location SS-16 and metals (at multiple sample locations), no chemicals of concern have been detected above applicable screening levels in the Mirror Pond sediment samples.

The concentration of constituents was compared to RBC soil direct contact values (DEQ, 2015) for the occupational exposure scenario. This scenario was selected to evaluate for the extent of exposure to sediments in a recreational setting such as wading in water or sitting on a beach. With the exception of arsenic in each of the sediment samples, no samples exceeded direct contact RBCs in the sediment samples collected from Mirror Pond. The arsenic values were all below regional background levels, so are not considered an exposure concern.

The concentrations of constituents were compared to Oregon Clean Fill Tables for Uplands (DEQ, 2014) to determine the suitability of sediments for upland reuse. With the exception of three PAHs from sample SS-16 (0.5 to 4 feet) and some metals, there were no exceedances of Clean Fill values. The sample collected from location SS-16 was in the immediate vicinity of a municipal storm drain outfall. Metals are evaluated for upland use/disposal based on Regional Background Levels. Copper exceeded the Clean Fill and Regional Background Level in sample SS-8, located near the Pacific Power dam. Lead exceeded Clean Fill/Background levels at sample locations SS-9 through SS-11, which are located in the immediate vicinity of municipal storm drain outfalls. Mercury exceeded background levels at locations SS-3 and SS-9. The mercury concentration at SS-3 of 0.0727 mg/kg only slightly exceeded the background level of 0.06 mg/kg. The mercury concentration at SS-9 (0.5 to 3 feet) was approximately five times the background level, and the sample was collected in the immediate vicinity of a municipal stormwater drain outfall. Silver slightly exceeded the Clean Fill/Regional Background Level for composite samples SS-1 through SS-3 (0 to 4 feet). The data

suggest that while there are some sporadic exceedances of regional background levels when taken has a whole data set, the sediments would likely be allowed for upland reuse. As previously mentioned, this investigation was intended as a broad survey of Mirror Pond sediments conditions. If Mirror Pond sediments were to be removed for upland reuse or disposal, location specific sampling would be recommended in the vicinity of the storm drain outfalls and near the power dam.

The concentrations of constituents were compared to DEQ Ecological Risk Sediment Bioaccumulation SLVs. These values are used to screen ecological risk associated with accumulation in the food chain for both human and ecological receptors. As previously discussed, for arsenic, cadmium, lead, silver, and mercury, the Sediment Bioaccumulation Screening Level Values (DEQ, 2007) default to the Regional Background Levels (DEQ, 2013). Lead exceeded the Regional Background Levels at sample locations SS-9, SS-10, and SS-11. Each of these locations is located immediately adjacent to a municipal storm drain outfall. While the bulk of sediment sampled throughout Mirror Pond do not contain constituents in exceedance of Sediment Bioaccumulation SLVs, there may be some ecological risk associated with sediment in the immediate vicinity of storm drain outfalls. It is highly unlikely that freshwater fish spend the majority of their time in the vicinity of the pond outfalls, so any fish exposure to elevated metals in sediment is likely minimal.

The concentrations of constituents were compared to Benthic Toxicity Screening Levels for Freshwater (USACE, DRAFT, 2016). These values are used to determine the suitability of sediments for in-water reuse and to support dredging decisions. For each sediment sample, nickel concentrations are below Regional Background Levels, but exceed the Benthic Toxicity SLV1, which corresponds to a concentration below which adverse effects to benthic communities would not be expected. Silver also exceeds the Benthic Toxicity SLV1 in the composite sample representative of Sampling Unit #1. Additional investigation may be required to determine the suitability of pond sediments for in-water redistribution (which also includes dredging). Under the Sediment Evaluation Framework for the Pacific Northwest, tissue testing may be necessary if biological chemicals of concern are present at levels of concern (or above background concentrations if sediment bioaccumulation guidelines are not available) and follow-up bioaccumulation testing is warranted (USACE, 2009).

## 6.2 Structural Suitability of Sediment for Reuse

With respect to use as structural fill, silts can be difficult to work with. They have a narrow range of optimum moisture content at which they can be adequately compacted and require high levels of moisture conditioning. The sediments are likely to be quite wet and perhaps saturated when initially excavated, requiring moisture removal prior to placement as structural fill. Fortunately, the low clay content would indicate that the silts would likely drain reasonably quickly and could be placed upland and dewatered in fairly short order. In addition to being difficult to grade, non-plastic silts are highly erodible. Erosion control, dust control, and stabilization with planting will be necessary to maintain the fill surfaces during and after grading. In our practice, we generally do not recommend silt sediments for use as structural fill and limit their use to landscaping areas.

In the agricultural vernacular, a mixture of silt and sand is considered a loam. Loams are frequently used in landscaping purposes for plantings as they drain relatively well while retaining moisture. The surface sands present throughout Central Oregon are often too free draining and have low moisture retention, making them difficult to support lawns and surface covers. Historically, silty sands produced as a byproduct of pumice mining were used for surface cover but those soils are not as prevalent as in times past. The pond sediments could, therefore, be used on site or exported for use as landscape soil. The sediments are relatively inorganic and would need to be significantly amended in order to support plant growth but should work well once amended.

# ***7.0 References***


Apex Companies, LLC (Apex), 2016. *Phase II Environmental Site Assessment Work Plan, Mirror Pond, Bend, Oregon.* May 19, 2016.

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DEQ, 2012. *Risk-Based Decision Making for Petroleum-Contaminated Sites.* September 2003. Updated June 2012.

DEQ, 2007. *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment*. Last updated April 3, 2007.

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United States Army Corps of Engineers (USACE), 2007. *Sediment Evaluation Framework for the Pacific Northwest*. May 2009. Benthic Toxicity Screening Levels for Freshwater.

Table 1
Sediment Analytical Results – TPH Diesel and Heavy Oil Range and PCB Aroclors
Mirror Pond
Deschutes County

| Sample ID | SS-1-SS-3 | SS-3 | SS-4-SS-6 | SS-5-SS-6 | SS-7 | SS-7 | SS-8 | SS-8 | SS-9 | SS-9 | SS-10 | SS-10 | SS-11 | SS-11 | SS-12 | SS-12 | SS-13 | SS-13 | SS-16 | SS-16 | **RBC Occupational Direct Contact** | **Clean Fill Criteria For Upland Disposal** | Sediment Bioaccumulation Screening Level Values (SLVs)[11] | | Benthic Toxicity Screening Levels Freshwater | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Composite | Discrete | Composite | Composite | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | | | | | | |
| Sample Date | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | | | | | | |
| Depth Below Mudline (feet) | 0-4 | 4-5 | 0-4 | 4-5 | 0 - 0.5 | 0.5 - 2.5 | 0 - 0.5 | 0.5 - 3 | 0 - 0.5 | 0.5 - 4 | 0 - 0.5 | 0.5 - 4 | 0 - 0.5 | 0.5 - 1 | 0 - 0.5 | 0.5 - 2.5 | 0 - 0.5 | 0.5 - 3 | 0 - 0.5 | 0.5 - 4 | | | | | | |
| TPH Dx (mg/kg) | | | | | | | | | | | | | | | | | | | | | | | Fish (freshwater) | Human (general) | SL1[1] | SL2[2] |
| Diesel Range | <3.15 | 6.64 J | <3.81 | <4.29 | <3.46 | <2.74 | 5.89 J | <3.35 | 41.7 | 17.6 | 146 | 13.3 | 266 J | 85.0 J | <4.08 | <3.73 | 5.15 J | 3.94 J | <3.81 | 8.16 J | 20,000 | -- | -- | -- | 340 | 510 |
| Residual Range | <7.89 | 19.6 J | <9.32 | <10.7 | <8.66 | <6.86 | 26.8 J | <8.37 | 87.0 | 56 | 810 | 72.9 | 1770 | 656 | <10.2 | 9.74 J | 10.7 J | 14.2 J | <9.52 | 43.1 | 36000 | -- | -- | -- | 3,600 | 4,400 |
| PCB Aroclor (mg/kg) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aroclor 1016 | -- | -- | -- | -- | <0.00918 | <0.00727 | <0.0111 | <0.00888 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Aroclor 1221 | -- | -- | -- | -- | <0.0141 | <0.0112 | <0.0171 | <0.0136 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Aroclor 1232 | -- | -- | -- | -- | <0.0109 | <0.00867 | <0.0132 | <0.0106 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Aroclor 1242 | -- | -- | -- | -- | <0.00834 | <0.00661 | <0.0101 | <0.00807 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Aroclor 1248 | -- | -- | -- | -- | <0.00827 | <0.00655 | <0.0100 | <0.00799 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Aroclor 1254 | -- | -- | -- | -- | <0.0124 | <0.00981 | <0.0150 | <0.0120 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Aroclor 1260 | -- | -- | -- | -- | <0.0130 | <0.0103 | <0.0157 | <0.0125 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Total PCBs (Aroclors) | -- | -- | -- | -- | ND | ND | ND | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.2 | 0.022 | 0.00039 | 110 | 2,500 |

*Notes:*

1. mg/kg = milligrams per kilogram.
2. TPH-Dx = Total Petroleum Hyrocarbons -Diesel Range by NWTPH-Dx.
3. PCB = polychlorinated biphenyls.
4. Benthic Toxicity Screening Levels for Freshwater. Northwest Regional Sediment Interpretive Guidelines. Regional Sediment Framework for the Pacific Northwest (USACE, DRAFT, 2016).
5. SL1 = Corresponds to a concentration below which adverse effects to benthic communities would not be expected.
6. SL2 = Corresponds to a concentration above which more than minor adverse effects may be observed in benthic organisms. Chemical concentrations at or below the SL2 but greater than the SL1 correspond to sediment quality that may result in minor adverse effects to the benthic community.
7. J = The identification of the analyte is acceptable; the reported value is an estimate.
8. < = Compound not detected above MDL.
9. -- = Not applicable or not available.
10. RBC = Oregon DEQ Risk Based Concentration for listed exposure pathway, dated November, 2015.
11. DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, April 3, 2007. Human values indicate general/recreational fish consumption.
12. ND = Not-Detected. Individual Aroclors not detected above reporting limits. Total Aroclors listed as ND.

Table 2
Sediment Analytical Results – VOCs
Mirror Pond
Deschutes County

| Sample ID | SS-9 | SS-9 | SS-10 | SS-10 | RBC Occupational Soil Direct Contact | Clean Fill Criteria for Upland Disposal |
|---|---|---|---|---|---|---|
| Sample Date | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | | |
| Depth Below Mudline (feet) | 0 - 0.5 | 0.5 - 4.0 | 0 - 0.5 | 0.5 - 4.0 | | |
| VOCs (mg/kg) | | | | | | |
| Acetone | 0.0452 J | 0.0711 J | 0.316 | 0.0789 J | -- | 59.92 |
| Acrylonitrile | <0.00495 | <0.00544 | <0.00576 | <0.00391 | 4.00 | 0.00029 |
| Benzene | <0.000747 | <0.000821 | 0.00122 J | 0.000610 J | 37 | 0.0093 |
| Bromobenzene | <0.000786 | <0.000864 | <0.000916 | <0.000621 | -- | 4.068 |
| Bromodichloromethane | <0.000703 | <0.000773 | <0.000819 | <0.000553 | 15 | 0.0025 |
| Bromoform | <0.00117 | <0.00129 | <0.00137 | <0.000925 | 260 | 0.084 |
| Bromomethane | <0.00370 | <0.00408 | <0.00431 | <0.00292 | 750 | 0.098 |
| n-Butylbenzene | <0.000715 | <0.000785 | <0.000833 | <0.000562 | -- | -- |
| sec-Butylbenzene | <0.000556 | <0.000611 | <0.000648 | <0.000439 | -- | -- |
| tert-Butylbenzene | <0.000571 | <0.000627 | <0.000665 | <0.000450 | -- | -- |
| Carbon tetrachloride | <0.000909 | <0.000998 | <0.00106 | <0.000716 | 34 | 0.028 |
| Chlorobenzene | <0.000588 | <0.000645 | <0.000685 | <0.000463 | 8,700 | 7 |
| Chlorodibromomethane | <0.00103 | <0.00113 | <0.00120 | <0.000815 | 17 | 0.0033 |
| Chloroethane | <0.00262 | <0.00288 | <0.00305 | <0.00206 | >1,000,000 | 320 |
| 2-Chloroethyl vinyl ether | <0.00647 | <0.00712 | <0.00753 | <0.00510 | -- | -- |
| Chloroform | <0.000635 | <0.000697 | <0.000739 | <0.000499 | 26 | 0.003 |
| Chloromethane | <0.00104 | <0.00114 | <0.00121 | <0.000819 | 25,000 | 2.2 |
| 2-Chlorotoluene | <0.000833 | <0.000916 | <0.000970 | <0.000657 | -- | -- |
| 4-Chlorotoluene | <0.000664 | <0.000730 | <0.000773 | <0.000523 | -- | -- |
| 1,2-Dibromo-3-Chloropropane | <0.00292 | <0.00319 | <0.00340 | <0.00229 | -- | 0.000012 |
| 1,2-Dibromoethane | <0.000951 | <0.00104 | <0.00111 | <0.000748 | -- | 0.00012 |
| Dibromomethane | <0.00106 | <0.00116 | <0.00123 | <0.000835 | -- | 0.0876 |
| 1,2-Dichlorobenzene | <0.000845 | <0.000928 | <0.000984 | <0.000666 | 36,000 | 70 |
| 1,3-Dichlorobenzene | <0.000662 | <0.000727 | <0.000770 | <0.000521 | -- | -- |
| 1,4-Dichlorobenzene | <0.000625 | <0.000687 | <0.000728 | <0.000493 | 64 | 0.081 |
| Dichlorodifluoromethane | <0.00197 | <0.00217 | <0.00230 | <0.00156 | -- | 94 |
| 1,1-Dichloroethane | <0.000551 | <0.000605 | <0.000642 | <0.000435 | 260 | 0.037 |
| 1,2-Dichloroethane | <0.000733 | <0.000806 | <0.000853 | <0.000579 | -- | 0.0014 |
| 1,1-Dichloroethene | <0.000838 | <0.000922 | <0.000976 | <0.000662 | 29,000 | 11 |
| cis-1,2-Dichloroethene | <0.000652 | <0.000715 | <0.000759 | <0.000512 | 2,300 | 1.2 |
| trans-1,2-Dichloroethene | <0.000730 | <0.000803 | <0.000850 | <0.000577 | 23,000 | 2.5 |
| 1,2-Dichloropropane | <0.000990 | <0.00109 | <0.00115 | <0.000786 | -- | 0.009 |
| 1,1-Dichloropropene | <0.000877 | <0.000964 | <0.00102 | <0.000692 | -- | -- |
| 1,3-Dichloropropane | <0.000573 | <0.000630 | <0.000668 | <0.000452 | -- | 7.62 |
| cis-1,3-Dichloropropene | <0.000725 | <0.000797 | <0.000845 | <0.000573 | -- | -- |
| trans-1,3-Dichloropropene | <0.000740 | <0.000812 | <0.000862 | <0.000584 | -- | -- |
| 2,2-Dichloropropane | <0.000772 | <0.00849 | <0.000899 | <0.000610 | -- | -- |
| Di-isopropyl ether | <0.000686 | <0.000754 | <0.000799 | <0.000541 | -- | 18.06 |
| Ethylbenzene | <0.000823 | <0.000903 | <0.000959 | <0.000649 | 150 | 0.16 |
| Hexachloro-1,3-butadiene | <0.000946 | <0.00104 | <0.00110 | <0.000746 | -- | 0.068 |
| Isopropylbenzene | <0.000671 | <0.000739 | <0.000782 | <0.000530 | 57,000 | -- |
| p-Isopropyltoluene | <0.000564 | 0.00101 J | 0.0147 | 0.000853 J | -- | -- |
| 2-Butanone (MEK) | <0.0130 | <0.0142 | 0.0337 | 0.0116 J | -- | 27.48 |
| Methylene Chloride | <0.00277 | <0.00304 | <0.00322 | <0.00218 | -- | -- |
| 4-Methyl-2-pentanone (MIBK) | <0.00519 | <0.00572 | <0.00605 | <0.00411 | -- | -- |
| Methyl tert-butyl ether | <0.000588 | <0.000645 | <0.000685 | <0.000463 | 1,100 | 0.092 |
| Naphthalene | <0.00277 | <0.00304 | <0.00322 | <0.00218 | 23 | 0.087 |

*Please see notes at end of table.*

Table 2
Sediment Analytical Results – VOCs
Mirror Pond
Deschutes County

| Sample ID | SS-9 | SS-9 | SS-10 | SS-10 | RBC Occupational Soil Direct Contact | Clean Fill Criteria for Upland Disposal |
|---|---|---|---|---|---|---|
| Sample Date | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | | |
| Depth Below Mudline (feet) | 0 - 0.5 | 0.5 - 4.0 | 0 - 0.5 | 0.5 - 4.0 | | |
| VOCs (mg/kg) | | | | | | |
| n-Propylbenzene | <0.000571 | <0.000627 | <0.000665 | <0.000450 | -- | -- |
| Styrene | <0.000647 | <0.000712 | <0.000753 | <0.000510 | 130,000 | 300 |
| 1,1,1,2-Tetrachloroethane | <0.000730 | <0.000803 | <0.000850 | <0.000577 | -- | 0.0156 |
| 1,1,2,2-Tetrachloroethane | <0.00101 | <0.00111 | <0.00118 | <0.000798 | -- | 0.0024 |
| 1,1,2-Trichlorotrifluoroethane | <0.00101 | <0.00111 | <0.00118 | <0.000798 | 26 | -- |
| Tetrachloroethene | <0.000764 | <0.000840 | <0.000890 | <0.000603 | 1,000 | 2.4 |
| Toluene | <0.00120 | <0.00132 | 0.0387 | 0.00175 J | 88,000 | 200 |
| 1,2,3-Trichlorobenzene | <0.000848 | <0.000931 | <0.000987 | <0.000668 | -- | 20 |
| 1,2,4-Trichlorobenzene | <0.00107 | <0.00118 | <0.00125 | 7 | -- | 0.4704 |
| 1,1,1-Trichloroethane | <0.000791 | <0.000870 | <0.000922 | <0.000625 | 870,000 | 400 |
| 1,1,2-Trichloroethane | <0.000767 | <0.000843 | <0.000893 | <0.000605 | 26 | 0.0046 |
| Trichloroethene | <0.000772 | <0.000849 | <0.000899 | <0.000610 | 51 | 0.02 |
| Trichlorofluoromethane | <0.00106 | <0.00116 | <0.00123 | <0.000835 | 130,000 | 190 |
| 1,2,3-Trichloropropane | <0.00205 | <0.00225 | <0.00239 | <0.00162 | -- | 0.0282 |
| 1,2,4-Trimethylbenzene | <0.000583 | <0.000642 | <0.000679 | <0.000461 | 2,000 | 16 |
| 1,2,3-Trimethylbenzene | <0.000794 | <0.000873 | <0.000924 | <0.000627 | -- | 1.938 |
| 1,3,5-Trimethylbenzene | <0.000735 | <0.000809 | <0.000856 | <0.000582 | 12,000 | 92 |
| Vinyl chloride | <0.000806 | <0.000885 | <0.000939 | <0.000636 | 4.40 | 0.00051 |
| Xylenes, Total | <0.00193 | <0.00212 | <0.00225 | <0.00152 | 25,000 | 25 |

*Notes:*
1. mg/kg = milligrams per kilogram.
2. J = The identification of the analyte is acceptable; the reported value is an estimate.
3. < = Compound not detected above MDL.
4. RBC = Oregon DEQ Risk Based Concentration for listed exposure pathway, dated November, 2015.
5. Clean Fill Criteria For Uplands, DEQ, last updated June 10, 2014.
6. -- = Not applicable or not available.

Table 3
Sediment Analytical Results – PAHs
Mirror Pond
Deschutes County

| Sample Identification | SS-1-SS-3 | SS-3 | SS-4-SS-6 | SS-5-SS-6 | SS-7 | SS-7 | SS-8 | SS-8 | SS-9 | SS-9 | SS-10 | SS-10 | SS-11 | SS-11 | SS-12 | SS-12 | SS-13 | SS-13 | SS-16 | SS-16 | RBC Occupational Soil Direct Contact | DEQ Clean Fill Criteria for Uplands | Sediment Bioaccumulation Screening Level Values (SLVs)[7] | | Benthic Toxicity Screening Levels Freshwater[9] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Below Mudline (feet) | 0 - 4 | 4 - 5 | 0 - 4 | 4 - 5 | 0 - 0.5 | 0.5 - 2.5 | 0 - 0.5 | 0.5 - 3.0 | 0 - 0.5 | 0.5 - 4.0 | 0 - 0.5 | 0.5 - 4.0 | 0 - 0.5 | 0.5 - 1.0 | 0 - 0.5 | 0.5 - 2.5 | 0 - 0.5 | 0.5 - 2.5 | 0 - 0.5 | 0.5 - 4.0 | | | | | | |
| Type | Composite | Discrete | Composite | Composite | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | | | | | | |
| Date | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | | | Fish (freshwater) | Humans (general ) | SL1 | SL2 |
| PAHs - EPA 8270D-SIM | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Anthracene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | <0.00183 | <0.0171 | <0.00130 | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0473 | 350,000 | 29 | -- | -- | -- | -- |
| Acenaphthene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | <0.00183 | <0.0171 | <0.00130 | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0156 J | 70,000 | 29 | -- | -- | -- | -- |
| Acenaphthylene | <0.00143 | 0.00644 J | <0.00173 | 0.00489 J | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | 0.00463 J | <0.0171 | <0.00130 | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | <0.00173 | -- | -- | -- | -- | -- | -- |
| Benzo(a)athracene | <0.00143 | <0.00188 | <0.00173 J2 | <0.00195 | <0.00157 | 0.00164 J | 0.00312 J | <0.00152 | <0.00294 | 0.00310 J | 0.0217 J | <0.00130 | 0.0748 J | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.173 | 2.90 | 0.15 | -- | -- | -- | -- |
| Benzo(a)pyrene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | 0.00126 J | 0.00248 J | <0.00152 | <0.00294 | 0.00309 J | <0.0171 | 0.00132 J | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.162 | 0.290 | 0.015 | -- | -- | -- | -- |
| Benzo(b)fluoranthene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | 0.00153 J | 0.00305 J | <0.00152 | 0.00305 J | 0.00440 J | <0.0171 | 0.00165 J | 0.0678 J | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.178 | 2.90 | 0.15 | -- | -- | -- | -- |
| Benzo(g,h,i)perylene | <0.00143 | 0.00260 J | <0.00173 | 0.00274 J | <0.00157 | 0.00132 J | <0.00191 | <0.00152 | 0.00441 J | 0.00404 J | 0.0229 J | 0.00292 J | 0.103 J | 0.0299 J | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0874 | -- | -- | -- | -- | -- | -- |
| Benzo(k)fluoranthene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | <0.00183 | <0.0171 | <0.00130 | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0719 | 29 | 1.5 | -- | -- | -- | -- |
| Chrysene | <0.00143 | <0.00188 | <0.00173 J2 | <0.00195 | <0.00157 | 0.00145 J | 0.00272 J | <0.00152 | <0.00294 | 0.00284 J | <0.0171 | <0.00130 | 0.0729 J | 0.0228 J | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.213 | 290 | 14 | -- | -- | -- | -- |
| Dibenz(a,h)anthracene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | <0.00183 | <0.0171 | <0.00130 | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0287 | 0.290 | 0.015 | -- | -- | -- | -- |
| Fuoranthene | <0.00143 | 0.00385 J | <0.00173 | 0.00349 J | 0.00212 J | 0.00220 J | 0.00558 J | 0.00215 J | 0.0114 J | 0.00470 J | 0.0284 J | 0.00205 J | <0.0632 | 0.0455 J | <0.00185 | <0.00170 | 0.00321 J | <0.00115 | <0.00173 | 0.461 | 30,000 | 29 | 37 | 510 | -- | -- |
| Fluorene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | <0.00183 | <0.0171 | <0.00130 | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0231 | 47,000 | 29 | -- | -- | -- | -- |
| Ideno(1,2,3-cd)pyrene | <0.00143 | <0.00188 | <0.00173 | <0.00195 | <0.00157 | <0.00125 | <0.00191 | <0.00152 | <0.00294 | 0.00260 J | <0.0171 | 0.00131 J | <0.0632 | <0.0209 | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.0772 | 2.90 | 0.15 | -- | -- | -- | -- |
| Naphthalene | <0.00478 | 0.0178 J | <0.00577 | 0.0135 J | <0.00525 | <0.00416 | <0.00635 | <0.00508 | <0.00980 | 0.0213 J | <0.0571 | 0.00552 J | <0.211 | <0.0697 | <0.00618 | <0.00565 | <0.00448 | <0.00382 | <0.00577 | <0.00578 | 23 | 1.09 | -- | -- | -- | -- |
| Phenanthrene | <0.00143 | 0.00351 J | <0.00173 | 0.00316 J | <0.00157 | <0.00125 | 0.00478 J | <0.00152 | 0.00376 J | 0.00377 J | <0.0171 | <0.00130 | <0.0632 | 0.0263 J | <0.00185 | <0.00170 | <0.00135 | <0.00115 | <0.00173 | 0.469 | -- | -- | -- | -- | -- | -- |
| Pyrene | <0.00143 | 0.00672 J | <0.00173 J2 | 0.00635 J | 0.00193 J | 0.00260 J | 0.00575 J | <0.00152 | 0.00636 J | 0.00686 J | 0.0218 J | 0.00239 J | 0.0921 J | 0.0360 J | <0.00185 | <0.00170 | 0.00227 J | <0.00115 | <0.00173 | 0.469 | 23,000 | 1700 | 1.9 | 380 | -- | -- |
| 1-Methylnaphthalene | <0.00478 | <0.00627 | <0.00577 | <0.00651 | <0.00525 | <0.00416 | <0.00635 | <0.00508 | <0.00980 | <0.00608 | <0.0571 | <0.00432 | <0.211 | <0.0697 | <0.00618 | <0.00565 | <0.00448 | <0.00382 | <0.00577 | <0.00578 | -- | -- | -- | -- | -- | -- |
| 2-Methylnaphthalene | <0.00478 | <0.00627 | <0.00577 | <0.00651 | <0.00525 | <0.00416 | <0.00635 | <0.00508 | <0.00980 | <0.00608 | <0.0571 | <0.00432 | <0.211 | <0.0697 | <0.00618 | <0.00565 | <0.00448 | <0.00382 | <0.00577 | <0.00578 | -- | -- | -- | -- | -- | -- |
| 2-Chloronaphthalene | <0.00478 | <0.00627 | <0.00577 | <0.00651 | <0.00525 | <0.00416 | <0.00635 | <0.00508 | <0.00980 | <0.00608 | <0.0571 | <0.00432 | <0.211 | <0.0697 | <0.00618 | <0.00565 | <0.00448 | <0.00382 | <0.00577 | <0.00578 | -- | -- | -- | -- | -- | -- |
| Total PAHs | ND | 0.04092 | ND | 0.03413 | 0.00405 | 0.012 | 0.0275 | 0.00215 | 0.02898 | 0.06133 | 0.0948 | 0.01716 | 0.4106 | 0.1605 | ND | ND | 0.00548 | ND | ND | 2.4762 | -- | -- | -- | Total PAHs | 17000 | 30000 |

*Notes:*
1. All values in milligrams per kilogram (mg/kg). Detections are shown in Bold.
2. <3.41= Analyte not detected at or above the method reporting limit indicated.
3. -- = not available or not applicable.
4. ND = Non Detected above method reporting limit.
5. 1 = DEQ Occupational Risk-Based Concentration (RBC) for Ingestion, Inhalation, Dermal Contact (Nov. 2015).
6. 2 = DEQ Draft Clean Fill Critera for Uplands - (June,2014).
7. DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, April 3, 2007. Human values indicate general/recreational fish consumption.
8. Not detected. No total calculated for PAHs.
9. Benthic Toxicity Screening Levels for Freshwater. Northwest Regional Sediment Interpretive Guidelines. Regional Sediment Framework for the Pacific Northwest (USACE, DRAFT, 2016).
10. SL1 = Corresponds to a concentration below which adverse effects to benthic communities would not be expected.
11. SL2 = Corresponds to a concentration above which more than minor adverse effects may be observed in benthic organisms. Chemical concentrations at or below the SL2 but greater than the SL1 correspond to sediment quality that may result in minor adverse effects to the benthic community.
12. Shaded values exceed the DEQ Clean Fill Criteria for Uplands.

Table 4
Sediment Analytical Results – Metals and Total Organic Carbon
Mirror Pond
Deschutes County

| Sample ID | SS-1-SS-3 | SS-3 | SS-4-SS-6 | SS-5-SS-6 | SS-7 | SS-7 | SS-8 | SS-8 | SS-9 | SS-9 | SS-10 | SS-10 | SS-11 | SS-11 | SS-12 | SS-12 | SS-13 | SS-13 | SS-16 | SS-16 | RBC Occupational Soil Direct Contact[13] | Clean Fill Criteria and Regional Background Levels[4] | Sediment Bioaccumulation Screening Level Values (SLVs)[11] | | Benthic Toxicity Screening Levels Freshwater [5] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Composite | Discrete | Composite | Composite | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | | | | | | |
| Sample Date | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | | | | | | |
| Depth Below Mudline (feet) | 0 - 4 | 4 - 5 | 0 - 4 | 4 - 5 | 0 - 0.5 | 0.5 - 2.5 | 0 - 0.5 | 0.5 - 3.0 | 0 -0.5 | 0.5 - 4.0 | 0 - 0.5 | 0.5 - 4.0 | 0 -0.5 | 0.5 - 1.0 | 0 - 0.5 | 0.5 - 2.5 | 0 -0.5 | 0.5 - 3.0 | 0 -0.5 | 0.5 - 4.0 | | | | | | |
| Metals (mg/kg) | | | | | | | | | | | | | | | | | | | | | | | Fish (freshwater) | Human (general) | SL1[1] | SL2[2] |
| Antimony | <1.79 | <2.35 | <2.16 | <2.44 | <1.97 | <1.56 | <2.38 | <1.90 | <1.84 | <2.28 | <2.14 | <1.62 | <1.58 | <1.31 | <2.32 | <2.12 | <1.68 | <1.43 | <2.16 | <2.17 | -- | 0.35 | -- | -- | -- | -- |
| Arsenic | 2.36 J | 3.52 J | 3.17 J | 3.84 J | 2.97 J | 2.61 J | 2.76 J | 3.29 J | 4.86 J | 3.54 J | 2.10 J | 2.37 J | <1.37 | 1.28 J | 3.58 J | 3.01 J | 1.76 J | 2.39 J | 4.0 J | 2.84 J | 1.9 | 7.2 | [12] | [12] | 14 | 120 |
| Barium | 104 | 118 | 108 | 131 | 104 | 100 | 121 | 108 | 109 | 104 | 59.9 | 73.7 | 50.6 | 48.0 | 115 | 116 | 81.4 | 85.1 | 117 | 112 | 220,000 | 790 | -- | -- | -- | -- |
| Cadmium | <0.167 | <0.219 | <0.202 | <0.228 | <0.184 | <0.145 | <0.222 | <0.178 | 0.349 J | 0.325 J | 0.233 J | 0.217 J | 0.173 J | 0.187 J | <0.216 | <0.198 | <0.157 | <0.134 | <0.202 | <0.202 | 1,100 | 0.78 | [12] | [12] | 2.1 | 5.4 |
| Chromium | 21.80 | 24.6 | 22.3 | 24.0 | 22.1 | 21.6 | 25.7 | 23.4 | 28.7 | 24.5 | 25.5 | 17.7 | 16.3 | 27.6 | 24.1 | 24.4 | 18.0 | 18.0 | 24.5 | 23.9 | >1,000,000 | 140 | -- | -- | 72 | 88 |
| Copper | 14.9 | 26.4 | 16.5 | 21.7 | 16.0 | 44.4 | 19.7 | 1060 | 28.8 | 25.2 | 52.1 | 21.1 | 25.0 | 25.8 | 19 | 19.9 | 14.0 | 10.4 | 17.1 | 21.2 | 47,000 | 62 | -- | -- | 400 | 1,200 |
| Lead | 4.72 | 10.5 | 4.13 | 8.37 | 4.8 | 11.1 | 5.34 | 4.72 | 53.0 | 37.8 | 28.9 | 31.6 | 4.82 | 74.3 | 4.72 | 8.36 | 7.50 | 14.3 | 4.14 | 12.8 | 800 | 21 | [12] | [12] | 360 | <1,300 |
| Nickel | 28.6 | 26.7 | 27.6 | 28.0 | 28.5 | 33.2 | 31.5 | 30.4 | 38.9 | 27.6 | 60 | 27.3 | 37.6 | 28.3 | 28.6 | 30.5 | 26.8 | 29.6 | 31.1 | 27.6 | 22,000 | 75 | -- | -- | 26 | 110 |
| Selenium | <1.77 | <2.32 | <2.13 | <2.41 | <1.94 | <1.54 | <2.35 | <1.88 | <1.81 | <2.25 | <2.11 | <1.60 | <1.56 | <1.29 | <2.29 | <2.09 | <1.66 | <1.41 | <2.13 | <2.14 | -- | 0.54 | [12] | [12] | 11 | <20 |
| Silver | 0.840 | <0.877 | <0.807 | <0.911 | <0.735 | <0.582 | <0.889 | <0.711 | <0.686 | <0.852 | <0.799 | <0.605 | <0.59 | <0.488 | <0.865 | <0.791 | <0.628 | <0.535 | <0.808 | <0.809 | 5,800 | 0.68 | -- | -- | 0.57 | 1.7 |
| Zinc | 40.2 | 77.6 | 43.7 | 54.5 | 40.1 | 44.4 | 47.0 | 43.5 | 195 | 77.3 | 125 | 71.8 | 133 | 115 | 45.0 | 51.6 | 38.4 | 38.8 | 46.2 | 70.2 | -- | 140 | -- | -- | 3,200 | >4,200 |
| Mercury | 0.0112 J | 0.0727 | 0.011 J | 0.0270 J | 0.0107 J | 0.0188 J | 0.0132 J | 0.0153 J | 0.0122 J | 0.327 | 0.0200 J | 0.0252 J | <0.0059 | 0.00573 J | 0.0201 J | 0.0164 J | 0.00985 J | 0.0145 J | 0.0115 J | 0.0361 J | 350 | 0.06 | [12] | [12] | 0.66 | 0.8 |
| TOC (mg/kg) | 34800 | 71500 | 38200 | 56700 | 31500 | 37000 | 41700 | 33900 | 65500 | 60800 | 39600 | 32500 | 59500 | 22500 | 39600 | 43700 | 34200 | 29000 | 33000 | 44600 | | | | | | |

*Notes:*
1. mg/kg = milligrams per kilogram.
2. < = Compound not detected above MDL.
3. -- = Not applicable or not available.
4. Oregon Department of Environmental Quality Background Levels of Soils For Cleanup, March 20, 2013. Background levels are also Clean Fill Criteria.
5. Benthic Toxicity Screening Levels for Freshwater. Northwest Regional Sediment Interpretive Guidelines. Regional Sediment Framework for the Pacific Northwest (USACE, DRAFT, 2016).
6. SL1 = Corresponds to a concentration below which adverse effects to benthic communities would not be expected.
7. SL2 = Corresponds to a concentration above which more than minor adverse effects may be observed in benthic organisms. Chemical concentrations at or below the SL2 but greater than the SL1 correspond to sediment quality that may result in minor adverse effects to the benthic community.
8. J =The identification of the analyte is acceptable; the reported value is an estimate.
9. TOC=Total Organic Carbon
10. Shaded values exceed Regional Background Levels AND Direct Contact RBC. Stippled values exceed Benthic Toxicity Screening Levels for Freshwater.
11. DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, April 3, 2007. Human values indicate general/recreational fish consumption.
12. DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment footnote indicates to screen using default reigonal background concentrations.
13. DEQ Occupational Risk-Based Concentration (RBC) for Ingestion, Inhalation, Dermal Contact (Nov. 2015).

**Table 5**
**Sediment Analytical Results – Pesticides and Herbicides**
**2016 Mirror Pond Sediment Sampling**
**Deschutes County**

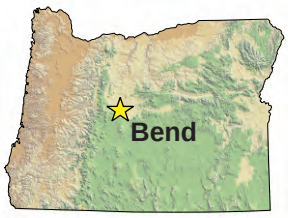
| Sample ID | SS-1-SS-3 | SS-3 | SS-4-SS-6 | SS-5-SS-6 | SS-7 | SS-7 | SS-8 | SS-8 | SS-9 | SS-9 | SS-10 | SS-10 | SS-11 | SS-11 | SS-12 | SS-12 | SS-13 | SS-13 | SS-16 | SS-16 | RBC Occupational Soil Direct Contact [4] | DEQ Clean Fill Criteria for Uplands[5] | Benthic Toxicity Screening Levels Freshwater [5] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Composite | Discrete | Composite | Composite | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | Discrete | | | | |
| Sample Date | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/7/2016 | 6/8/2016 | 6/8/2016 | 6/7/2016 | 6/7/2016 | | | | |
| Depth Below Mudline (Feet) | 0-4FT | 4-5FT | 0-4FT | 4-5FT | 0-0.5 FT | 0.5 FT-2.5FT | 0-0.5 FT | 0.5 FT-3FT | 0-0.5 FT | 0.5 FT-4FT | 0-0.5 FT | 0.5 FT-4FT | 0-0.5 FT | 0.5 FT -1FT | 0-0.5 FT | 0.5 FT-2.5FT | 0-0.5 FT | 0.5 FT-3FT | 0-0.5 FT | 0.5 FT-4FT | | | SL1[1] | SL2[2] |
| *Pesticides by EPA 8081A (mg/kg)* | | | | | | | | | | | | | | | | | | | | | | | | |
| Aldrin | <0.0023 | <0.00423 | <0.00389 | <0.00439 | <0.00354 | <0.00281 | <0.00429 | <0.00343 | <0.00331 | <0.00411 | <0.00385 | <0.00292 | <0.00284 | <0.00235 | <0.00417 | <0.00381 | <0.00303 | <0.00258 | <0.00389 | <0.00390 | 0.13 | 0.011 | -- | -- |
| Alpha-BHC | <0.00325 | <0.00426 | <0.00392 | <0.00442 | <0.00357 | <0.00283 | <0.00432 | <0.00345 | <0.00333 | <0.00414 | <0.00388 | <0.00294 | <0.00286 | <0.00237 | <0.00420 | <0.00384 | <0.00305 | <0.00260 | <0.00392 | <0.00393 | -- | -- | -- | -- |
| Beta-BHC | <0.00382 | <0.00501 | <0.00461 | <0.00521 | <0.00420 | <0.00333 | <0.00508 | <0.00406 | <0.00392 | <0.00487 | <0.00457 | <0.00346 | <0.00337 | <0.00279 | <0.00494 | <0.00452 | <0.00359 | <0.00306 | <0.00462 | <0.00463 | -- | -- | -- | -- |
| Delta BHC | <0.00342 | <0.00448 | <0.00412 | <0.00465 | <0.00375 | <0.00297 | <0.00454 | <0.00363 | <0.00350 | <0.00435 | <0.00408 | <0.00309 | <0.00301 | <0.00249 | <0.00442 | <0.00404 | <0.00321 | <0.00273 | <0.00412 | <0.00413 | -- | -- | -- | -- |
| Gamma BHC | <0.00347 | <0.00454 | <0.00418 | <0.00472 | <0.00381 | <0.00301 | <0.00461 | <0.00368 | <0.00355 | <0.00441 | <0.00414 | <0.00313 | <0.00305 | <0.00253 | <0.00448 | <0.00410 | <0.00325 | <0.00277 | <0.00418 | <0.00419 | -- | -- | -- | -- |
| Chlordane | <0.0932 | <0.122 | <0.112 | <0.127 | <0.102 | <0.0811 | <0.124 | <0.0990 | <0.0956 | <0.119 | <0.111 | <0.0843 | <0.0821 | <0.0680 | <0.120 | <0.110 | <0.0875 | <0.0745 | <0.112 | <0.113 | 7.4 | 1.3 | | |
| 4,4'-DDD | <0.00373 | <0.00489 | <0.00450 | <0.00507 | <0.00409 | <0.00324 | <0.00496 | <0.00396 | <0.00382 | <0.00475 | <0.00445 | <0.00337 | <0.00329 | <0.00272 | <0.00482 | <0.00441 | <0.00350 | <0.00298 | <0.00450 | <0.00451 | 12 | 0.021 | 310 | 860 |
| 4,4'-DDE | <0.00368 | <0.00483 | <0.00444 | <0.00501 | <0.00404 | <0.00320 | <0.00489 | <0.00391 | <0.00377 | <0.00468 | <0.00439 | <0.00333 | <0.00324 | <0.00268 | <0.00476 | <0.00435 | <0.00345 | <0.00294 | <0.00444 | <0.00445 | 8.2 | 0.021 | 21 | 33 |
| 4,4'-DDT | <0.00478 | <0.00627 | <0.00577 | <0.00651 | <0.00525 | <0.00416 | <0.00635 | <0.00508 | <0.00490 | <0.00608 | <0.00571 | <0.00432 | <0.00421 | <0.00349 | <0.00618 | <0.00565 | <0.00448 | <0.00382 | <0.00577 | <0.00578 | 8.5 | 0.021 | 100 | 8,100 |
| Dieldrin | <0.00363 | <0.00476 | <0.00438 | <0.00494 | <0.00399 | <0.00316 | <0.00483 | <0.00386 | <0.00372 | <0.00462 | <0.00434 | <0.00329 | <0.00320 | <0.00265 | <0.00469 | <0.00429 | <0.00341 | <0.00290 | <0.00438 | <0.00439 | 0.14 | 0.0049 | 4.9 | 9.3 |
| Endosulfan I | <0.00356 | <0.00467 | <0.00430 | <0.00485 | <0.00391 | <0.00310 | <0.00473 | <0.00378 | <0.00365 | <0.00453 | <0.00425 | <0.00322 | <0.00314 | <0.00260 | <0.00460 | <0.00421 | <0.00334 | <0.00285 | <0.00430 | <0.00431 | -- | -- | - | - |
| Endosulfan II | <0.00382 | <0.00501 | <0.00461 | <0.00521 | <0.00420 | <0.00333 | <0.00508 | <0.00406 | <0.00392 | <0.00487 | <0.00457 | <0.00346 | <0.00337 | <0.00279 | <0.00494 | <0.00452 | <0.00359 | <0.00306 | <0.00462 | <0.00463 | -- | -- | - | - |
| Endosulfan Sulfate | <0.00361 | <0.00473 | <0.00435 | <0.00491 | <0.00396 | <0.00314 | <0.00480 | <0.00383 | <0.00370 | <0.00459 | <0.00431 | <0.00326 | <0.00318 | <0.00263 | <0.00466 | <0.00427 | <0.00339 | <0.00288 | <0.00436 | <0.00436 | -- | -- | - | - |
| Endrin | <0.00375 | <0.00492 | <0.00453 | <0.00511 | <0.00412 | <0.00326 | <0.00499 | <0.00398 | <0.00385 | <0.00478 | <0.00448 | <0.00339 | <0.00331 | <0.00274 | <0.00485 | <0.00444 | <0.00352 | <0.00300 | <0.00453 | <0.00454 | 250 | 0.04 | - | - |
| Endrin Aldehyde | <0.00308 | <0.00404 | <0.00372 | <0.00420 | <0.00339 | <0.00268 | <0.00410 | <0.00327 | <0.00316 | <0.00392 | <0.00368 | <0.00279 | <0.00272 | <0.00225 | <0.00398 | <0.00365 | <0.00289 | <0.00246 | <0.00372 | <0.00373 | -- | -- | - | - |
| Endrin ketone | <0.00394 | <0.00517 | <0.00476 | <0.00537 | <0.00433 | <0.00343 | <0.00524 | <0.00419 | <0.00404 | <0.00502 | <0.00471 | <0.00357 | <0.00348 | <0.00288 | <0.00510 | <0.00466 | <0.00370 | <0.00315 | <0.00476 | <0.00477 | -- | -- | 8.5 | - |
| Hexachlorobenzene | <0.00296 | <0.00389 | <0.00358 | <0.00403 | <0.00404 | <0.00258 | <0.00394 | <0.00315 | <0.00304 | <0.00377 | <0.00354 | <0.00268 | <0.00261 | <0.00216 | <0.00383 | <0.00350 | <0.00278 | <0.00237 | <0.00358 | <0.00358 | 0.93 | 0.26 | - | - |
| Heptachlor | <0.00368 | <0.00483 | <0.00444 | <0.00501 | <0.00422 | <0.00320 | <0.00489 | <0.00391 | <0.00377 | <0.00468 | <0.00439 | <0.00333 | <0.00324 | <0.00268 | <0.00476 | <0.00435 | <0.00345 | <0.00294 | <0.00444 | <0.00445 | 0.45 | 0.1 | - | - |
| Heptachlor Epoxide | <0.00385 | <0.00505 | <0.00464 | <0.00524 | <0.00422 | <0.00335 | <0.00511 | <0.00409 | <0.00394 | <0.00490 | <0.00459 | <0.00348 | <0.00339 | <0.00281 | <0.00497 | <0.00455 | <0.00361 | <0.00308 | <0.00464 | <0.00465 | 0.24 | 0.053 | - | - |
| Methoxychlor | <0.00425 | <0.00558 | <0.00513 | <0.00579 | <0.00467 | <0.00370 | <0.00565 | <0.00452 | <0.00436 | <0.00541 | <0.00508 | <0.00385 | <0.00375 | <0.00310 | <0.00550 | <0.00503 | <0.00399 | <0.00340 | <0.00513 | <0.00515 | -- | 310 | - | - |
| Toxaphene | <0.0860 | <0.113 | <0.104 | <0.117 | <0.0945 | <0.0748 | <0.114 | <0.0914 | <0.0882 | <0.110 | <0.103 | <0.0778 | <0.0758 | <0.0628 | <0.111 | <0.102 | <0.0807 | <0.0688 | <0.104 | <0.104 | 2.1 | 0.44 | -- | -- |
| *Chlorinated Acid Herbicides by EPA 8151A (mg/kg)* | | | | | | | | | | | | | | | | | | | | | | | | |
| 2,4-D | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | -- | - | - |
| Dalapon | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | 2.448 | - | - |
| 2,4-DB | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | -- | - | - |
| Dicamba | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | 5.694 | - | - |
| Dichloroprop | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | -- | - | - |
| Dinoseb | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | 61 | - | - |
| MCPA | <2.92 | <3.82 | <3.52 | <3.97 | <3.20 | <2.54 | <3.88 | <3.10 | <2.99 | <3.71 | <17.4 | <2.64 | <2.57 | <10.6 | <3.77 | <3.45 | <2.74 | <2.33 | <3.52 | <3.53 | - | 0.24 | - | - |
| MCPP | <2.92 | <3.82 | <3.52 | <3.97 | <3.20 | <2.54 | <3.88 | <3.10 | <2.99 | <3.71 | <17.4 | <2.64 | <2.57 | <10.6 | <3.77 | <3.45 | <2.74 | <2.33 | <3.52 | <3.53 | - | 0.2256 | - | - |
| 2,4,5-T | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | -- | - | - |
| 2,4,5-TP (Silvex) | <0.0263 | <0.0345 | <0.0317 | <0.0358 | <0.0289 | <0.0229 | <0.0349 | <0.0279 | <0.0270 | <0.0335 | <0.157 | <0.0238 | <0.0232 | <0.0959 | <0.0340 | <0.0311 | <0.0247 | <0.0210 | <0.0317 | <0.0318 | - | -- | - | - |

*Notes:*
1. mg/kg = milligrams per kilogram.
2. < = Compound not detected above method detection limit.
3. DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, April 3, 2007. Human values indicate general/recreational fish consumption.
4. DEQ Occupational Risk-Based Concentration (RBC) for Ingestion, Inhalation, Dermal Contact (Nov. 2015).
5. DEQ Draft Clean Fill Critera for Uplands - (June,2014).
6. Benthic Toxicity Screening Levels for Freshwater. Northwest Regional Sediment Interpretive Guidelines. Regional Sediment Framework for the Pacific Northwest (USACE, DRAFT, 2016).
   SL1 = Corresponds to a concentration below which adverse effects to benthic communities would not be expected.
   SL2 = Corresponds to a concentration above which more than minor adverse effects may be observed in benthic organisms. Chemical concentrations at or below the SL2 but greater than the SL1 correspond to sediment quality that may result in minor adverse effects to the benthic community.


***Note:*** Base map prepared from USGS 7.5-minute quadrangle of Bend, OR, dated 2014 as provided by USGS.gov.

0 2,000 4,000

Approximate Scale in Feet

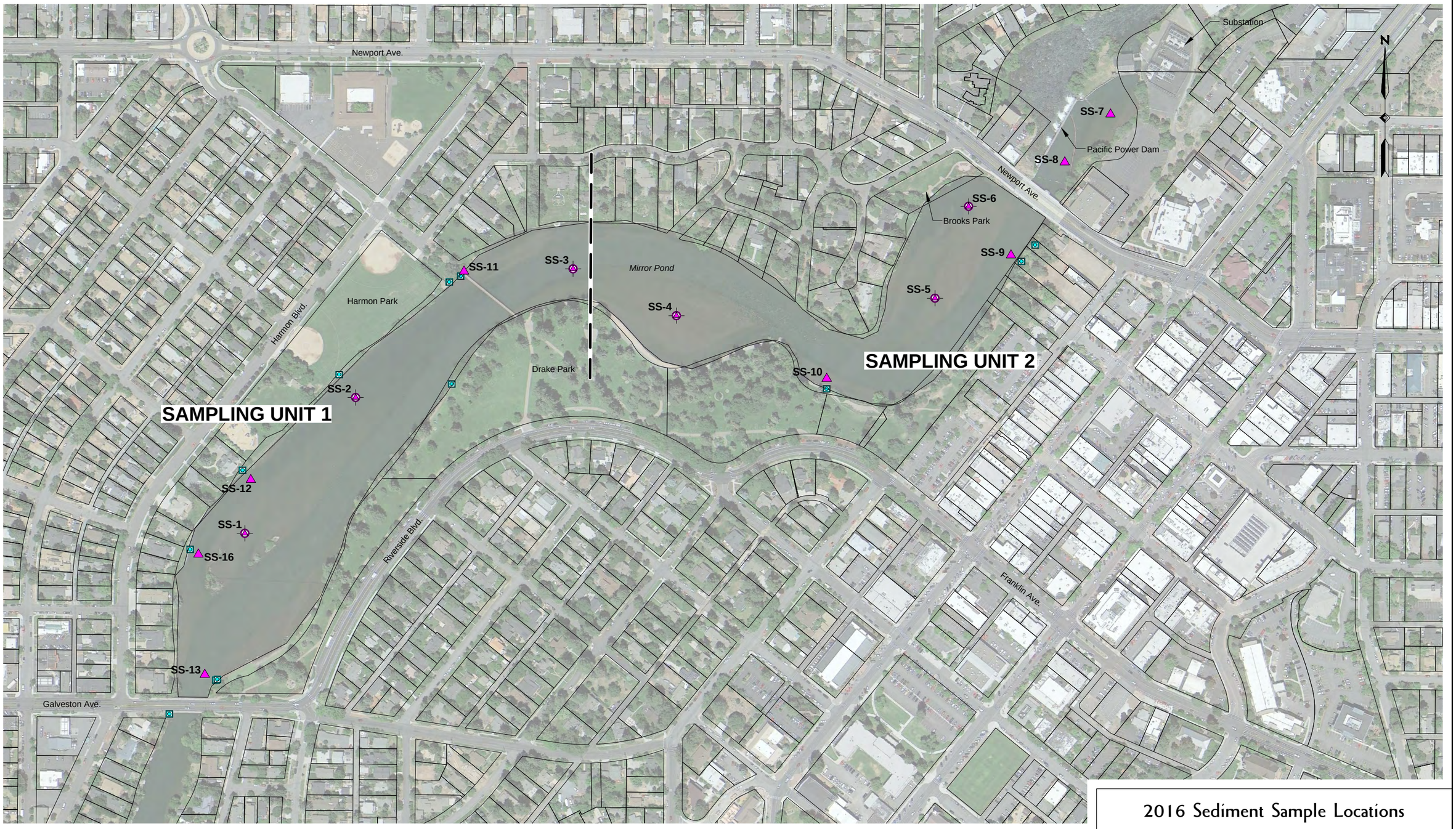



N

# Site Location Map

Phase II Environmental Site Assessment Report
Mirror Pond
Bend, Oregon

| | | | |
|---|---|---|---|
| APEX Apex Companies, LLC<br>3015 SW First Avenue<br>Portland, Oregon 97201 | Project Number | 2112-00 | Figure |
| | August 2016 | | 1 |




**Legend:**

- SS-1 Composite Sample Location (One Composite per Sampling Unit)
- SS-7 Discreet Sample Location
- SS-14 Grain Size Analysis Location
- Outfall Location

0 300 600

Scale in Feet

Base map prepared from deschutes_taxlots.shp provided by Deschutes County (OR83-SIF) and Google Earth Pro (aerial dated July 6, 2014)

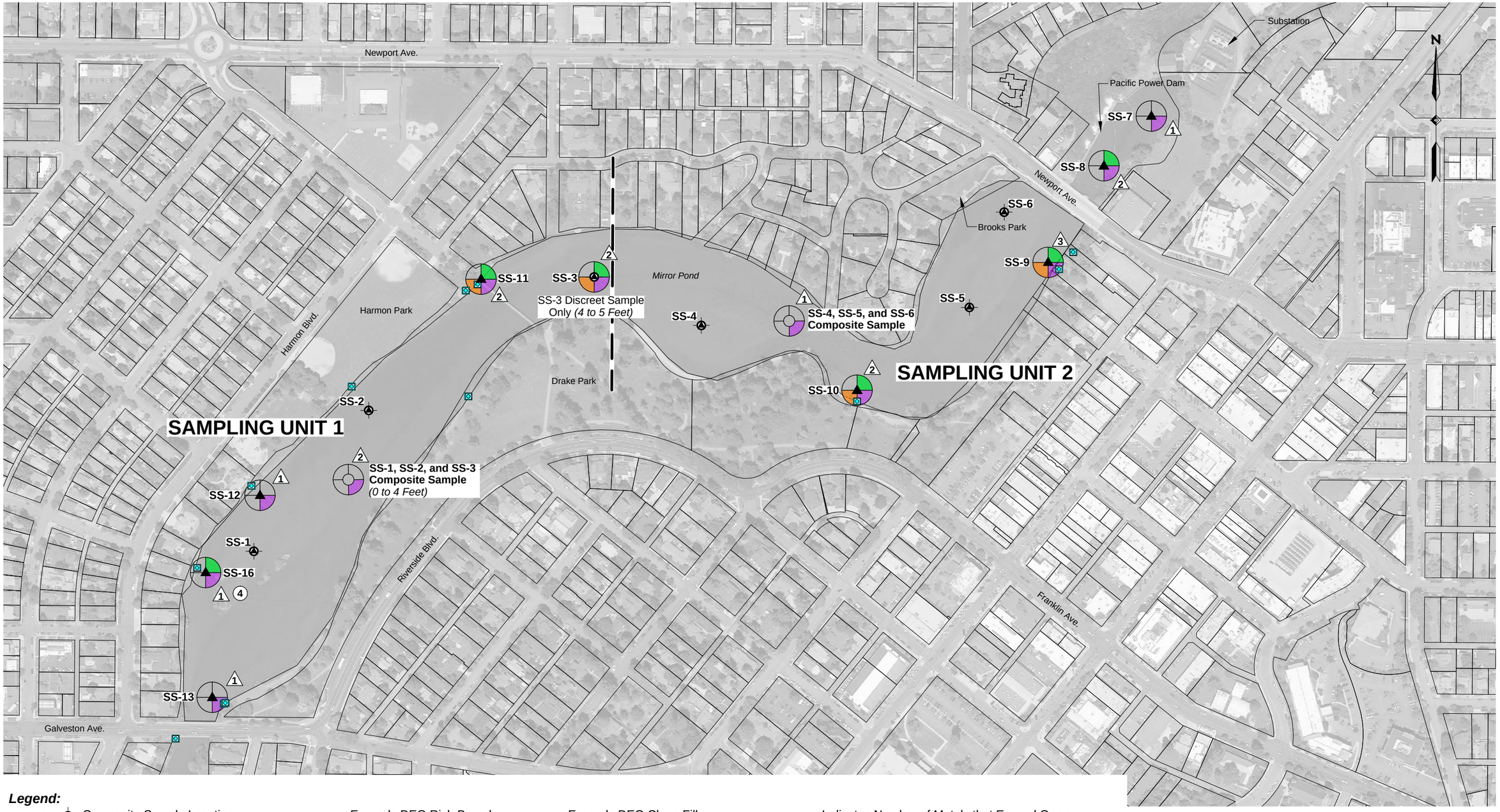
# 2016 Sediment Sample Locations

Phase II Environmental Site Assessment Report
Mirror Pond
Bend, Oregon

APEX

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

| Project Number | 2112-00 | Figure |
|---|---|---|
| August 2016 | | 2 |




**Legend:**

SS-1 Composite Sample Location (One Composite per Sampling Unit)

SS-7 Discreet Sample Location

Outfall Location

Exceeds DEQ Risk-Based Concentration for Occupational Soil Direct Contact

Exceeds DEQ Clean Fill Criteria and Regional Background Levels

Exceeds Sediment Bioaccumulation Screening Level Values

Exceeds Benthic Toxicity Screening Level for Freshwater

1 Indicates Number of Metals that Exceed One or More Applicable Screening Levels at that Location

4 Indicates Number of Polycyclic Aromatic Hydrocarbons (PAHs) that Exceed One or More Applicable Screening Levels at that Location

*NOTE: Exceedances of Risk-Based Concentrations for Direct Contact (Occupational) are not shown if Analytical Results are Below Regional Background Levels*

0 300 600

Scale in Feet

Base map prepared from deschutes_taxlots.shp provided by Deschutes County (OR83-SIF) and Google Earth Pro (aerial dated July 6, 2014)

# 2016 Exceedance of Screening Level Criteria (Metals and PAHs)

Phase II Environmental Site Assessment Report
Mirror Pond
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

| Project Number | 2112-00 | Figure |
|---|---|---|
| August 2016 | | 3 |