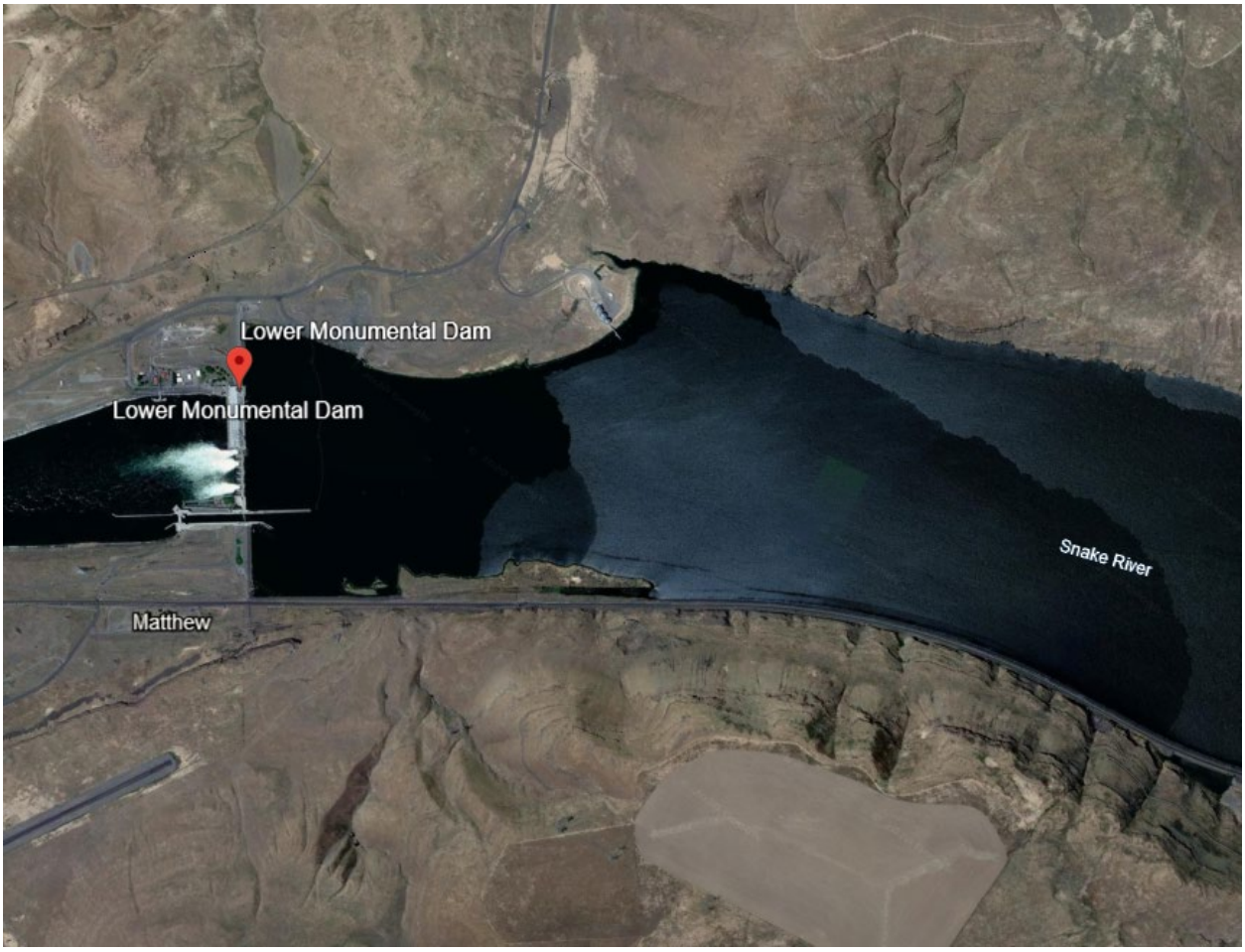
US Army Corps
of Engineers®
Portland District

SEDIMENT QUALITY REPORT

**LOWER MONUMENTAL RESERVOIR,
LAKE HERBERT G. WEST
COLUMBIA RIVER BASIN
SNAKE RIVER, WASHINGTON**

Lower Monumental Reservoir, Lake Herbert G. West



Sediment Quality Report
August 2020

EXECUTIVE SUMMARY

Lower Monumental Dam is located at River Mile (RM) 41.6 on the lower Snake River, approximately 29 miles downstream of Little Goose Dam (RM 70.3). The Lower Monumental Dam was constructed from 1961 to 1981, with the pool raised in 1969. This run-of-river dam has a total storage capacity of 432,000 acre-feet with a hydraulic height of the pool of 100 feet (Corps 2014). The reservoir formed by the dam is known as Lake Herbert G. West and spans the distance between Little Goose Dam and Lower Monumental Dam.

This report includes an evaluation of sediment conditions and quality on the portion of the Snake River bounded by Little Goose Dam upstream and Lower Monumental Dam on the downstream end. Figure 1-1 shows the Snake River Basin. Figure 1-2 shows the portion of the Snake River discussed herein. This evaluation of sediment conditions is not intended to support a specific dredging or other project, but rather to support the analysis of existing and future conditions, as well as aid in the evaluation of alternatives for the Columbia River System Operations Environmental Impact Statement.

CONTENTS

EXECUTIVE SUMMARY i
TABLE OF CONTENTS ii
ACRONYMS iv

SECTION 1 - INTRODUCTION 1-1

1.1 STUDY AREA 1-1
1.2 SEDIMENT EVALUATION FRAMEWORK 1-1

SECTION 2 - WATER QUALITY 2-1

2.1 GENERAL DESCRIPTION 2-1
2.1.1 Geology and Soils 2-1
2.1.2 Sediment Loading in the Reservoir 2-1
2.1.3 Past Dredging 2-2
2.1.4 303(d) Status 2-2
2.1.5 Land Use Within the Segment 2-4
2.1.6 Point Sources 2-4
2.2 MANAGEMENT AREAS AND EXISTING DATA 2-7
2.2.1 Sediment Characterization Studies 2-7
2.2.2 Physical Data 2-8
2.2.3 Chemical Data 2-10
2.2.4 Biological Data 2-13
2.2.5 Elutriate Data 2-13
2.3 CHEMICALS OF CONCERN 2-13
2.3.1 Sources of Chemicals of Concern 2-13
2.4 CONCEPTUAL SITE MODEL 2-14
2.4.1 Secondary Media and Release Mechanisms 2-15
2.4.2 Exposure Routes and Completeness 2-16

SECTION 3 - SUMMARY 3-1

3.1 SEDIMENT QUALITY 3-1
3.2 RECOMMENDATIONS 3-1
3.2.1 Conceptual Site Model 3-1
3.2.2 Chemicals of Concern 3-1
3.3 CONCLUSIONS 3-2

SECTION 4 - REFERENCES 4-1

TABLES

Table 2-1. 303(d) List Fish Tissue Impairments (Categories 4 and 5) 2-4
Table 2-2. Sites Identified in Database Search (STS. 2018) 2-7

Table 2-3. Summary of Grain Size Analyses from Previous Sampling Events in Lake Herbert G. West 2-8
Table 2-4. Summary of Organic Compounds Measured in Sediments in the Lake Herbert G. West 2-10
Table 2-5. Summary of Metals Measured in Sediments in Lake Herbert G. West 2-13
Table 2-6. Conceptual Site Model for Dredging Activities 2-15

FIGURES

Figure 1-1. Study Scope – Lower Snake River Overview..... 1-3
Figure 1-2. Lower Monumental Dam and Lake Herbert G. West 1-4
Figure 2-1. 303d List Status for Snake River in Washington 2-3
Figure 2-2. Potential Sources Identified in Database Search 2-6
Figure 2-3. 1997 Grain Size Sampling Locations and Grain Size 2-9
Figure 2-4. 1997 Pesticide Sampling Results..... 2-12

ACRONYMS

Acronym	Description
µg/kg	Micrograms Per Kilogram
Corps	U.S. Army Corps of Engineers
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
mg/kg	Milligrams Per Kilogram
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
RCRA	Resource Conservation and Recovery Act
RM	River Mile
RSET	Northwest Regional Sediment Evaluation Team
SEF	Sediment Evaluation Framework
TMDL	Total Maximum Daily Load
USGS	U.S. Geological Survey

SECTION 1 - INTRODUCTION

1.1 STUDY AREA

The Snake River originates in western Wyoming at Yellowstone National Park and flows approximately 1,609 kilometers (1,000 miles) through the states of Idaho, Washington, and Oregon to its confluence with the Columbia River near Pasco and Burbank, Washington. It is the largest tributary of the Columbia River and drains an area of approximately 282,000 square kilometers (109,000 square miles), including most of Idaho and portions of Oregon, Washington, Wyoming, Nevada, and Utah. The topography within the basin ranges from steep mountainous areas, mainly in the upper headwater areas, to extensive volcanic plateaus and plains that have been deeply incised by the river over geologic time. The total fall of the Snake River from its source near Two Ocean Plateau, Wyoming, to its confluence with the Columbia River is approximately 9,500 feet. Between Lewiston (confluence with the Clearwater River) and Pasco (confluence with the Columbia River), the lower Snake River falls approximately 400 feet vertically in a distance of approximately 140 miles, an average slope of approximately 3 feet per mile.

The lower Snake River includes a 225-kilometer (140-mile) reach extending from the point of confluence with the Columbia River (Pasco, Washington), upstream to the Clearwater River near Lewiston, Idaho. Between 1961 and 1985, the U.S. Army Corps of Engineers (Corps) completed construction and began operating four run-of-river lock and dam projects on this reach of the Snake River. These project uses include navigation, power generation, recreation, irrigation, and fish and wildlife.

Lower Monumental Dam is located at River Mile (RM) 41.6 on the lower Snake River, approximately 29 miles downstream of Little Goose Dam (RM 70.3). The Lower Monumental Dam was constructed from 1961 to 1981, with the pool raised in 1969. This run-of-river dam has a total storage capacity of 432,000 acre-feet with a hydraulic height of the pool of 100 feet (Corps 2014). The reservoir formed by the dam is known as Lake Herbert G. West and spans the distance between Little Goose Dam and Lower Monumental Dam.

This report includes an evaluation of sediment conditions and quality on the portion of the Snake River bounded by Little Goose Dam upstream and Lower Monumental Dam on the downstream end. Figure 1-1 shows the Snake River Basin. Figure 1-2 shows the portion of the Snake River discussed herein. This evaluation of sediment conditions is not intended to support a specific dredging or other project, but rather to support the analysis of existing and future conditions, as well as aid in the evaluation of alternatives for the Columbia River System Operations Environmental Impact Statement.

1.2 SEDIMENT EVALUATION FRAMEWORK

The Sediment Evaluation Framework (SEF) for the Pacific Northwest (Northwest Regional Sediment Evaluation Team [RSET] Agencies 2016) is a regional guidance

manual produced by Federal and state agencies. It provides a framework for the consistent characterization and assessment of sediment. Specifically, the framework can be used to determine the suitability of the materials for unconfined aquatic placement and to predict water quality impacts during dredging operations. The framework is intended for use in the states of Washington, Oregon, and Idaho. It serves as an implementation manual for the *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual* (Inland Testing Manual) (1998) produced by the U.S. Environmental Protection Agency (EPA) and the Corps for satisfying Clean Water Act testing requirements.

Although the SEF was produced specifically for the evaluation of dredged materials for unconfined aquatic placement, the framework is also used for evaluating non-navigational projects and for anti-degradation evaluations. Because the purpose of the Columbia River System Operations Environmental Impact Statement is similar to an anti-degradation evaluation, the SEF provides a suitable approach for this report.

The SEF provides a “tiered” approach to make risk-based sediment assessments. Level 1 includes an evaluation of historically available data and the development of a conceptual site model. Level 2 includes the physical, chemical, and biological evaluation of the sediment and is conducted if the information collected for Level 1 is insufficient to make a risk-based determination. This report focuses on a Level 1 evaluation; no additional sediment data will be collected at this time. This report does discuss data gaps and data needs for potential future project implementation and provides recommendations on future data collection.

Figure 1-1. Study Scope – Lower Snake River Overview

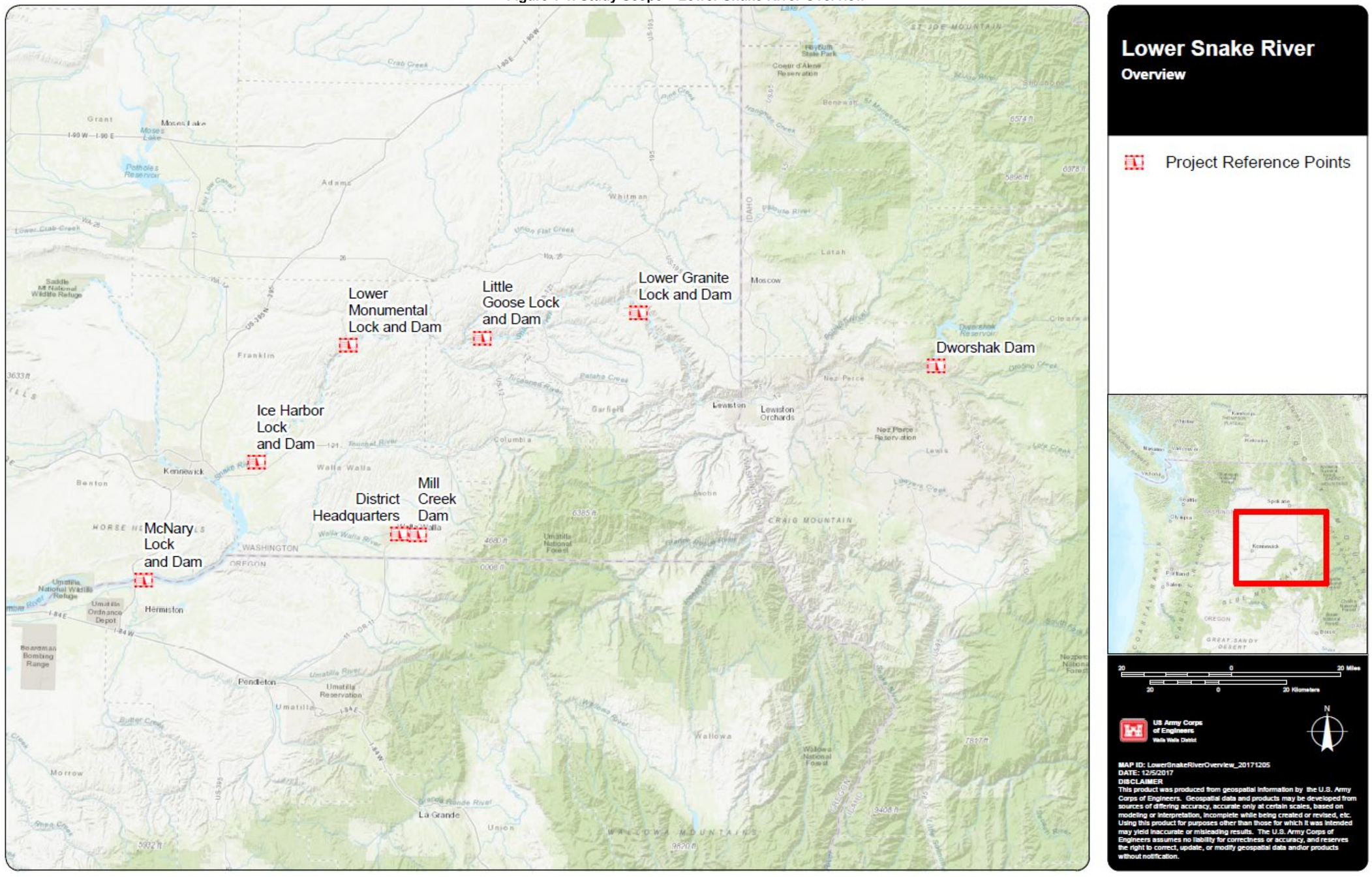
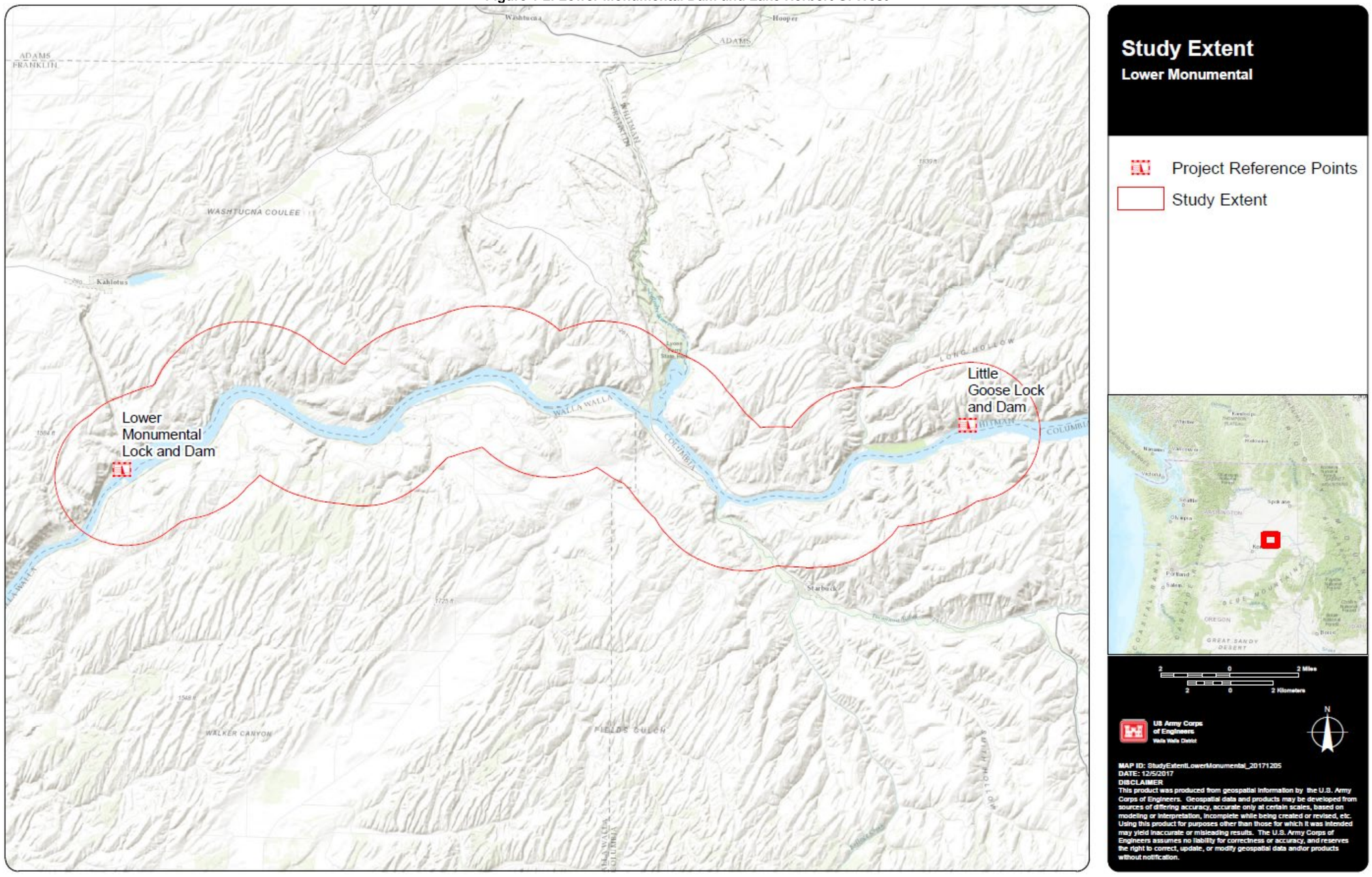


Figure 1-2. Lower Monumental Dam and Lake Herbert G. West



SECTION 2 - WATER QUALITY

2.1 GENERAL DESCRIPTION

2.1.1 Geology and Soils

The Lower Monumental drainage area includes the Palouse and Lower Snake–Tucannon Subbasins. The Palouse River and Tucannon River both enter the Snake River within Lake Herbert G. West. The geology of this area consists mainly of the Columbia River Basalt Group, a group of igneous rocks consisting of several major basalt formations (U.S. Geological Survey [USGS] 2017). These high strength rocks outcrop as “scabs” of bedrock (Corps 2014). The rock is covered with wind-blown loess and alluvial deposits (USGS 2017). The loess materials are fine grained and highly erodible. Soils typically consist of silt loams with slopes ranging from 0 to 65 percent (Natural Resource Conservation Service [NRCS] 2017). The relief in the scablands is high, averaging 100 to 200 feet (Corps 2014).

2.1.2 Sediment Loading in the Reservoir

The most recent and comprehensive evaluation of sediment movement in the lower Snake River is the Lower Snake River Programmatic Sediment Management Plan (Corps 2014). This study focused on the sediment loading to Lower Granite Dam, which is furthest upstream on the Snake River. The sediment loading from other tributaries and for other portions of the watershed were also discussed.

Lower Monumental Dam and Lake Herbert G. West are located within the Lower Snake-Tucannon and Palouse watersheds. The main tributaries or drainages to Lake Herbert G. West include the Palouse and Rock Rivers (the Rock River joins the Palouse upstream from the confluence with the Snake River), the Tucannon River, Alkali Flats Creek, and Fields Gulch.

Sediment that accumulates in Lake Herbert G. West must either pass through Little Goose Dam, directly enter the Snake River from the banks (as point or non-point discharges) along the shores of Lake Herbert G. West, or enter from one of the tributaries that feeds into the lake. The Tucannon and Palouse Rivers join the Snake River downstream of Little Goose Dam. The Palouse River is estimated to discharge approximately 1.5 million tons of sediment per year into the Snake River (Corps 2014). Discharges are highly variable, and land use is related to the sediment yield. Erosion is considered to be a significant issue in some areas of the Palouse watershed, with high erosion occurring on cultivated croplands (up to 30 tons per acre per year). Erosion from rangeland and forested areas is notably lower (Corps 2014). The Tucannon River contributes much less sediment to the system than the Palouse. Little information is available on Alkali Flats Creek and Fields Gulch, but these also appear to have below average rates of erosion. Overall, it is estimated that 4 million cubic yards of sediment has accumulated within Lake Herbert G. West and behind Lower Monumental Dam (Corps 2002).

In general, sediment loading to the lower Snake River appears to be increasing over time. A comparison of data collected in the 1970s to data collected in the last decade shows greater sediment concentrations. These effects are thought to be partly a function of wildfires in the upper reaches of the watershed (above Lower Granite Dam) (Corps 2014). The increase in erosion upstream on the Snake River would primarily impact Lower Granite Dam, although fine-grained materials would be transported further downstream. Although there are no measured sediment loading data for Lake Herbert G. West, the general trend would be anticipated to be generally consistent with the sediment loading to Lower Granite Dam.

2.1.3 Past Dredging

There has been no maintenance dredging within Lake Herbert G. West. The Programmatic Sediment Management Plan (Corps 2014) identified several locations with potential sediment issues, including the Little Goose Lock Approach and near Joso Habitat Management Unit (RM 56.5) (Corps 2014). Several park and recreation areas also potentially have sediment accumulation issues, as well as several water intakes. At this time, no specific dredging is planned.

2.1.4 303(d) Status

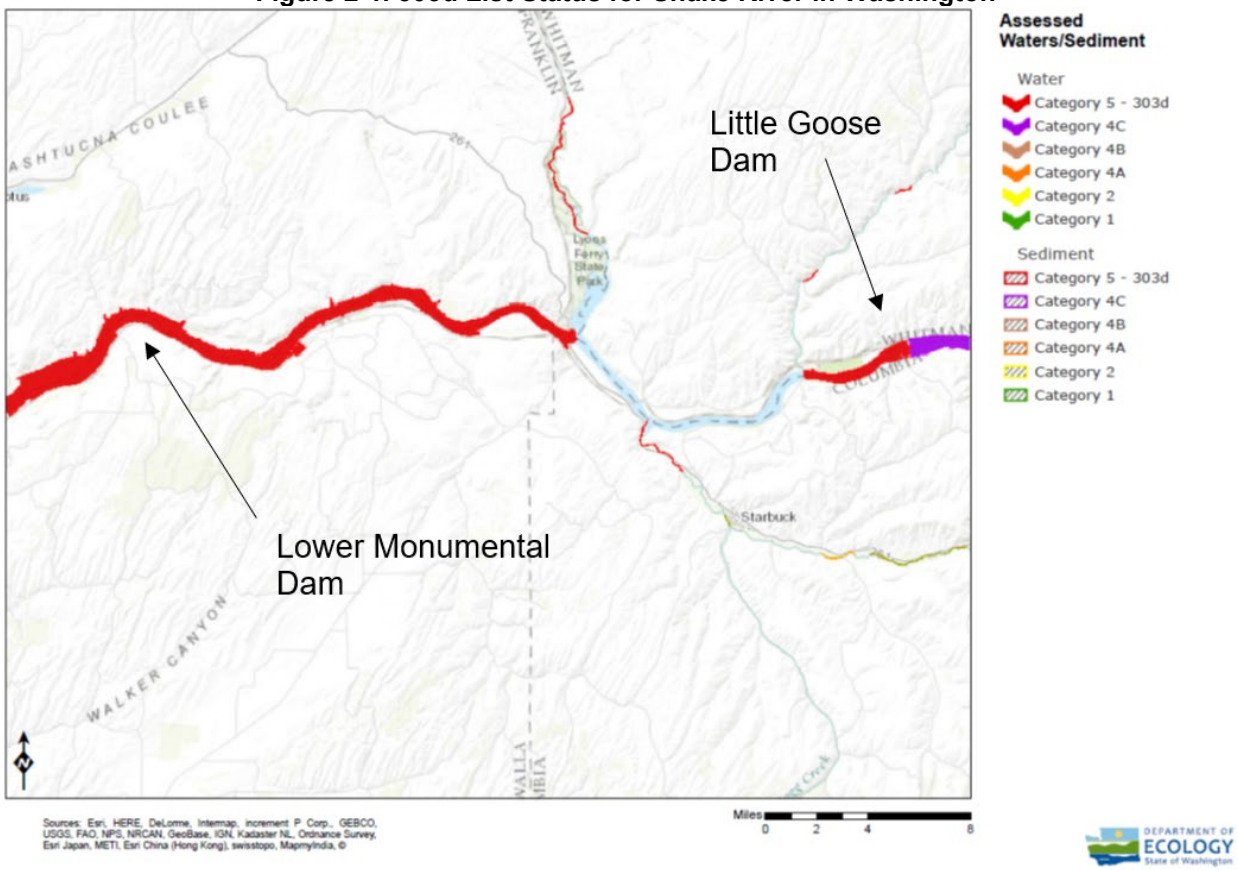
The Clean Water Act requires that all states restore their surface waters to be “fishable and swimmable.” The assessment required is covered under Section 303(d) of the Clean Water Act. States prepare a “303(d) report” that lists the results of the assessment. The 303(d) assessment for the State of Washington was reviewed to determine the condition of the lower Snake River between Little Goose Dam and Lower Monumental Dam (Lake Herbert G. West). Water quality is categorized by impairment and source for each river segment. Because sediment issues impact water quality and aquatic life, sediment contamination issues are also listed in the 303(d) report.

The most current 303(d) list for the State of Washington was prepared in 2015 and approved by EPA in July 2016 (Washington State Department of Ecology [Ecology] 2015). Figure 2-1 shows a map of the water quality assessment results for the Snake River above Lower Monumental Dam and Table 2-1 lists the identified fish tissue impairments. A large portion of the river is rated “Category 5” in the assessment, with one portion of Lake Herbert G. West rated “Category 4C.” Waters with a Category 5 rating are considered “impaired” and require a total maximum daily load (TMDL) study or other water quality improvement project. Category 4 covers waters that do not require a TMDL; Category 4C is impaired by a non-pollutant. In the case of Lake Herbert G. West, the non-pollutant impairment is related to habitat degradation due to the presence of an invasive species, Eurasian water-milfoil (*Myriophyllum spicatum*).

In Lake Herbert G. West, the water quality impairments are related to the altered flow patterns and discharges from the hydropower dams. The dams discharge water over spillways and during the spillage, gases are entrained at high concentrations. Similarly, the impoundment of water coupled with the controlled releases for hydropower generation are different from the naturally occurring hydrologic conditions in the river,

with a resulting impact on temperature and pH. The clear linkage to the hydropower facilities is evident from the map; impairments exist on the downstream side of Little Goose Dam and on the upstream side of Lower Monumental Dam, but not in the center of Lake Herbert G. West which, is outside the area of influence of these facilities.

Figure 2-1. 303d List Status for Snake River in Washington



Source: Ecology. 2019

In response to the water quality impairments identified in the Lake Herbert G. West, water quality improvement plans have been developed. Specifically, plans for temperature and total dissolved gas have been developed for the Columbia River, including the Snake River as its tributary. A TMDL was developed to allocate pollutant loads among dischargers and to set a limit for the total loading for the waterway. The TMDL for total dissolved gas was developed in 2003. The plan includes load allocations for each dam as measured at a specific distance below the spillway.

There are several related to fish tissues in this portion of the Snake River; these are all associated with fish from the center of the reach. The impairment information is listed in Table 2-1. All of the impairments are related to pesticides and other anthropogenic compounds (polychlorinated biphenyls [PCBs], dioxins) that are persistent in the environment. Fish tissue impairments can be related to poor quality sediment, among other causes; the fish with elevated tissue concentrations are species that feed on benthic organisms and may be exposed to sediment contaminants.

Table 2-1. 303(d) List Fish Tissue Impairments (Categories 4 and 5)

Compound and Listing IDs	Date Measured	Fish Tested for Tissue Impairment; Concentrations Exceeding Threshold Measured	Type of Sample	Fish Tested for Tissue Impairment; Threshold not Exceeded
Dieldrin 76319	2009	Channel catfish, common carp	Fillet, no skin	–
Toxaphene 76531	2009	Channel catfish, common carp	Fillet, no skin	–
PCBs 78962	2009	Channel catfish, common carp	Fillet, no skin	–
4,4'-DDE 72219	2009	Channel catfish, common carp	Fillet, no skin	–
Dioxin (2,3,7,8-TCDD) 78620	2009	Channel catfish, common carp	Fillet, no skin	–
Hexachlorobenzene 75612	2009	Common carp	Fillet, skin on	Channel catfish

Source: Ecology. 2019

2.1.5 Land Use Within the Segment

On the southern side of the Snake River, the Tucannon watershed is dominated by cultivated fields and agricultural uses (81 percent of land use). Forested areas occur in the far south of the watershed, in the Blue Mountains. Grasslands and shrublands are present in some areas but represent a small portion of the land. On the northern side of the Snake River, the western end of the Palouse watershed is native grassland, now given over mostly to cultivated fields and agricultural uses (81 percent of land use). Natural grasslands cover less than 2 percent of the land (Corps 2014). The vast majority of the land (92 percent), including the lands immediately adjacent to the Snake River, are privately owned (Corps 2014).

The Programmatic Sediment Management Plan (Corps 2014) included an evaluation of sediment sources and yields, and these are related to land use. Most of the non-forested land with slopes less than 45 percent is cultivated, with grazing and dryland agriculture representing major activities. In general, the conversion of the original perennial grasslands to planted cropland and grazing areas has increased runoff and erosion of fine sediment throughout the area (Corps 2014). Due to the nature of the fine-grained soils, the sloped lands, and the generally disturbed character of the land, the sediment delivery hazard is high. The use of no-till, buffer strip maintenance, and other soil conservation practices can generally reduce erosion and have the potential to reduce sediment entering Lake Herbert G. West.

2.1.6 Point Sources

A commercial database search (Sealaska Technical Services [STS]. 2018) was used to identify potential sources or other areas of contamination along the shore of Lake Herbert G. West. The extent of the search included a half-mile extent on either side of the high pool elevation line for Lake Herbert G. West, from Lower Monumental Dam to Little Goose Dam. A separate 1-mile search radius was used at both dam locations. Figure 2-2 shows a summary of the locations of "significant" sites found. In this study, "significance" is a matter of professional judgment and includes broad categories of

sites that might be expected to have an environmental impact on sediment quality (such as National Pollutant Discharge Elimination System (NPDES) point discharges, Resource Conservation and Recovery Act (RCRA)- or Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA)-listed sites, non-compliant facilities regulated under state or Federal laws, landfills including historic landfills, and other large and discrete sites or potential contamination sources). Sites that generally are expected to have little or no impact or only transient impacts were not plotted (including minor spill reports, clandestine drug labs, schools and day-care facilities, and conditionally exempt small quantity generators.) The database search results are being used for screening purposes only, to identify potential sources or impacts to Lake Herbert G. West so that any chemical parameters or pollutants reflective of these sources may affect sediment quality. The identification of the potential for sediment contamination from these sources does not imply that these are current sources or that regulatory action is recommended or required. Any specific proposed project would require a site-specific Phase I Environmental Assessment to adequately characterize existing site conditions.

The database search returned 11 sites of potential interest along the shore of Lake Herbert G. West. Table 2-2 gives a summary of the facilities that returned listings. Of these 11 facilities, none appears to be significant in terms of potential sources of contamination for Lake Herbert G. West. Several sites had underground storage tanks or historical RCRA activities, but the leaking tanks appear to have all been addressed and the RCRA sites appear to be current non-generators. Other issues (septic system, stormwater discharges, non-enforcement actions) do not appear significant for potential sediment impacts. It appears unlikely that any of the sites listed in Table 2-2 below are sources of sediment contamination for Lake Herbert G. West, and no additional pollutants of concern were identified.

Figure 2-2. Potential Sources Identified in Database Search

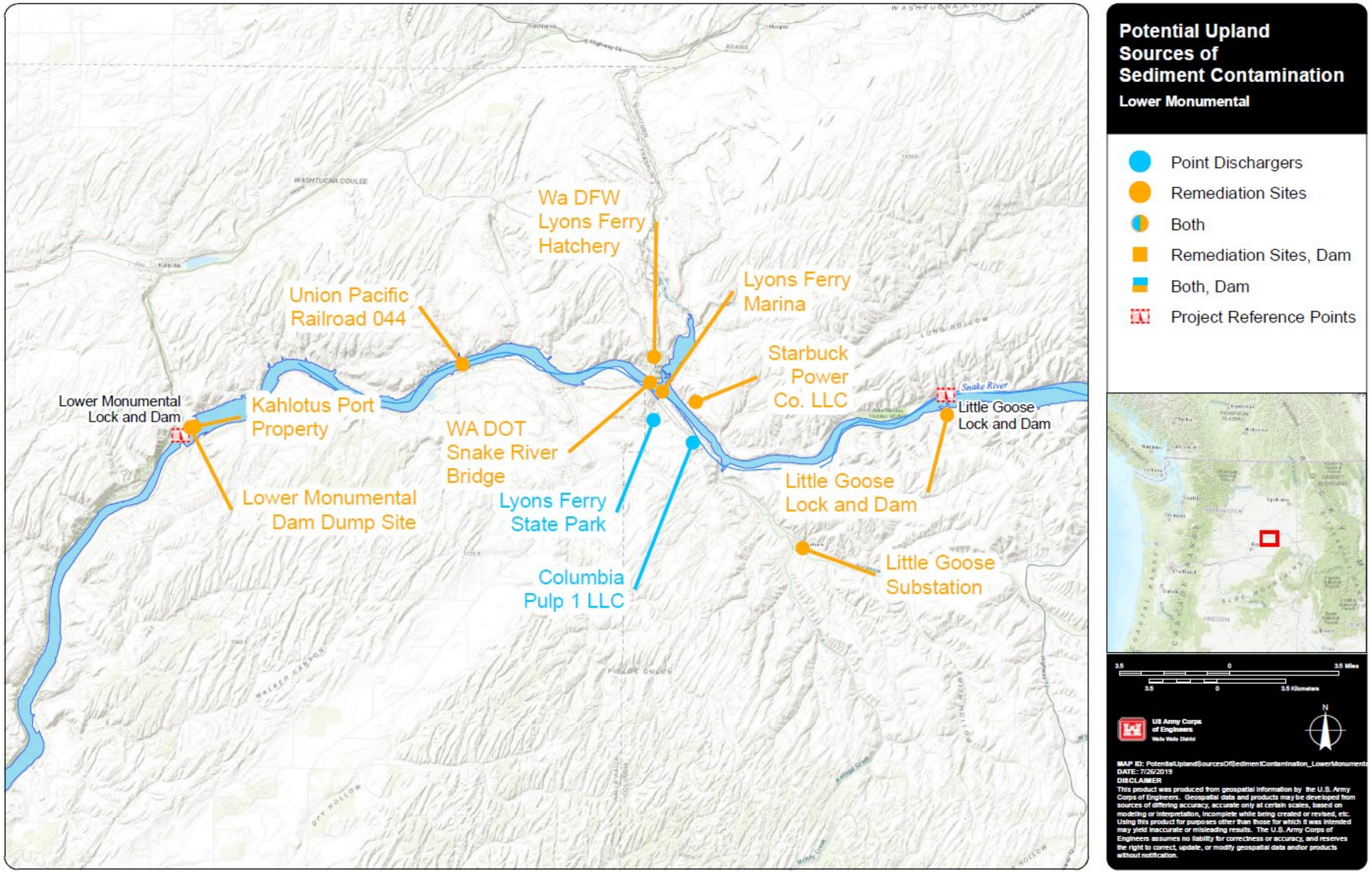


Table 2-2. Sites Identified in Database Search (STS. 2018)

Site Name	Comments
Lower Monumental Dam Dump Site ½ Mi NE of Lower Monumental Dam, Kahlotus, WA	Site is listed as an "independent clean up" site. The original report dates to 1996, and the site has a "no further action" date of 2011. It is not clear what the issue was, but because the site has apparently been remediated and is not immediately adjacent to the river, it appears to be a low risk for sediment contamination.
Kahlotus Port Property S34 T13N R34E SE1/4 NW1/4 Kahlotus, WA	This facility is a non-generator; at one time it appears to have been a RCRA generator but is not currently. The facility is currently in compliance.
Union Pacific Railroad 044 NE SW S19, T13N, R36E Ayer, WA	Site is listed as having one or more underground storage tanks. Site had a leaking tank listed in 1991, with cleanup overseen by the Washington State Department of Ecology and a "no further action" date of 2012.
Washington State Department of Fish and Wildlife Lyons Ferry Hatchery Highway 261, Starbuck, WA	The site is listed as having multiple underground storage tanks (at least some removed in 1996). Facility has a current NPDES permit.
Washington Department of Transportation Snake River Bridge State Route 261, Starbuck, WA	Site is verified to be a non-generator. Listing is related to historical activities.
Lyons Ferry Marina Highway 261, Starbuck, WA	Facility had multiple underground storage tanks (removed in 1996).
Lyons Ferry State Park State Route 261, Starbuck, WA	Facility has a septic system.
Starbuck Power Co. LLC	Facility is listed as having a "non-enforcement" action in 2008, which may have been related to a permit.
Columbia Pulp 1 LLC 1400 Highway 261, Starbuck, WA	Facility is listed as having a stormwater discharge permit (discharge to ground), as well as a temporary stormwater construction permit.
Little Goose Substation, Little Goose Dam, Starbuck, WA	Site had an underground storage tank, closed in 1996.
Little Goose Dam (also listed as U.S. Army Corps of Engineers–Little Goose Lock and Dam), Pasco, WA	Multiple small spills to the soil/ground have been reported. The dam is a permitted discharger with several informal violation letters prior to 2010. There is no evidence of issues that would impact sediment quality in Lake Herbert G. West.

2.2 MANAGEMENT AREAS AND EXISTING DATA

Routine navigational dredging is not conducted in Lake Herbert G. West. Specific, smaller management units would need to be delineated in support of a specific dredging project. For the purposes of this overall evaluation, all of Lake Herbert G. West is treated as one management unit.

2.2.1 Sediment Characterization Studies

Only one systematic sediment characterization study exists for Lake Herbert G. West (CH2M Hill. 1997). In 1997, a comprehensive evaluation of sediment conditions along the lower Snake River was completed. This single study includes grain size data and sediment chemical analysis results. The 1997 report is somewhat limited in usefulness due to the age of the data. Sediment is mobile; the quantity and quality of material at a given location changes over time as the sediment moves downstream. Over time,

sediment quality also changes based on inputs to the river (point and non-point discharges, erosion, spills, groundwater), as well as naturally occurring physical, chemical, and biological processes. Because discharge practices and land uses along the river have changed over the several decades since Lower Monumental Dam was constructed, it is expected that the sediment quantity and quality have changed over that period. Older data may be useful at identifying trends, but the actual numbers are normally not considered useful for statistical analysis purposes when greater than 5 years for a moderately ranked management unit (RSET Agencies 2016).

2.2.2 Physical Data

Comprehensive sampling of sediment for grain size analysis was included in the 1997 Juvenile Salmon Feasibility Study (CH2M Hill. 1997). Data were collected in transects and targeted locations where finer grained materials were more likely to have accumulated. These data were then used to select locations for samples intended for chemical analysis. A total of 77 grain size samples were taken in the Lower Monumental Reservoir. The 1997 data are shown in Figure 2-2, and a summary is provided in Table 2-3.

Table 2-3. Summary of Grain Size Analyses from Previous Sampling Events in Lake Herbert G. West

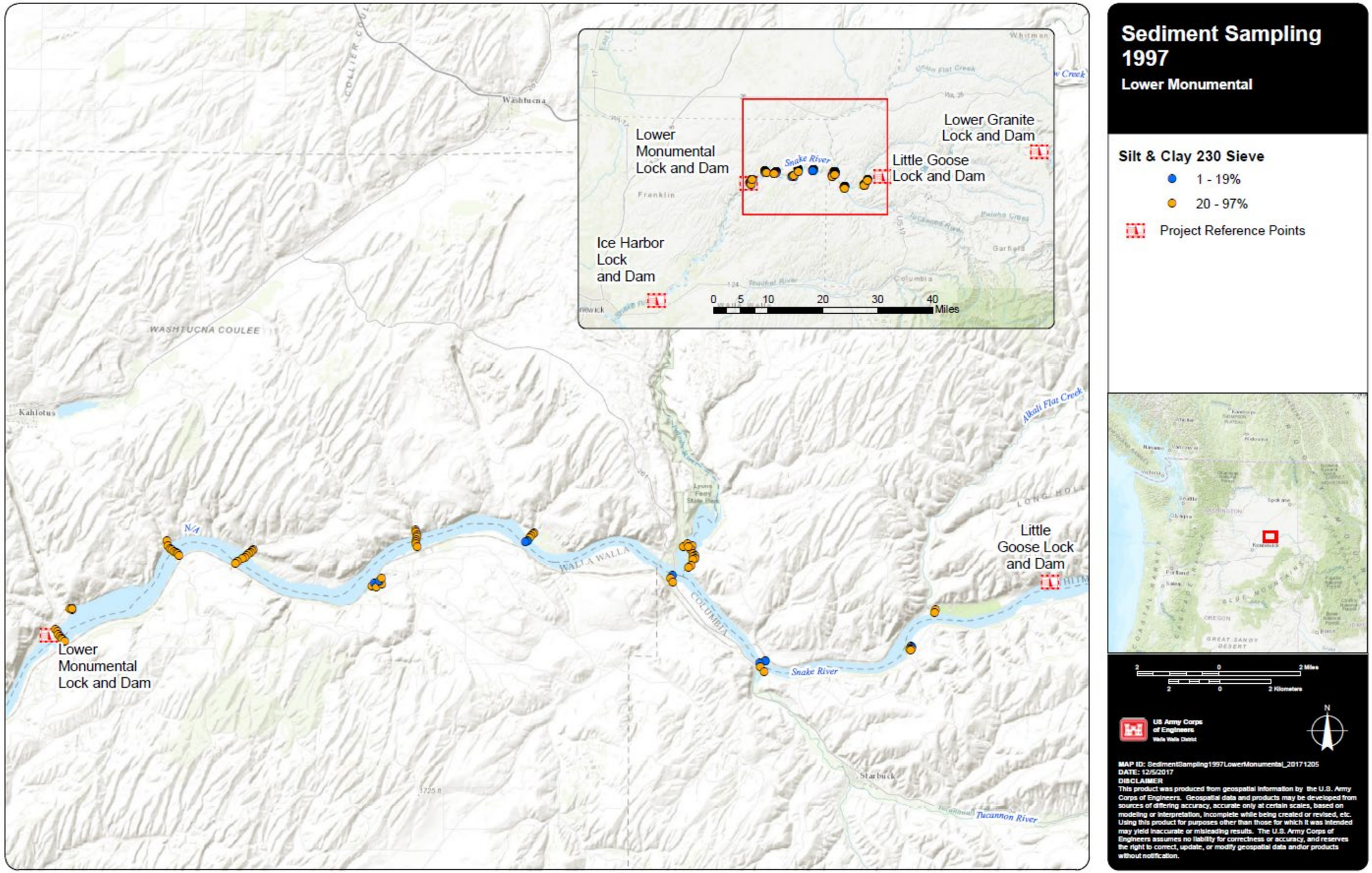
Sample Identification	% Sand	% Fines (passing #230 sieve)
1997 Lower Monumental RM 60–70[1/]	9–91	1–91[2/]
1997 Lower Monumental RM 50–60	3–98	1–97
1997 Lower Monumental RM 41–50[3/]	6–30	35–94

Notes: 1/ Little Goose Dam is at approximately RM 70. 2/ For this study, the total materials passing a #230 sieve were presented as a single value for each sample. 3/ Lower Monumental Dam is at approximately RM 41.

The 1997 sampling was conducted mostly as transects, sampling continuously across the river. The sediment grain size distribution reflects this. In general finer-grained materials (samples with >20 percent fine materials passing the #230 sieve) are found on the edges of the river where the flow rate is slower, while the coarser-grained materials are found in the middle channel. Most of the sediment samples from Lake Herbert G. West had fines greater than 20 percent. This is likely because coarser-grained materials are already settled in the pools of Lower Granite or Little Goose Dams, and only the finer materials travel downstream to the Lower Monumental pool (Figure 2-3).

In general, finer-grained materials tend to have higher concentrations of naturally occurring and anthropogenic compounds. This is due to the larger surface area of the fine-grained materials; the contaminants tend to adhere to the grain surface, and this is particularly true for the large, sparingly soluble organic compounds such as pesticides. In addition to the tendency for higher contaminant concentrations, finer-grained sediment tends to have fewer beneficial uses and is less desired for habitat creation, although it is often used for wetland creation.

Figure 2-3. 1997 Grain Size Sampling Locations and Grain Size



2.2.3 Chemical Data

Data from past studies are summarized in tables below. A range of concentrations is given to show the variability in the data, as opposed to a single average concentration. When a single value is given, all samples expressed the given result. Non-detectable concentrations are presented as “less than reporting limit” with the symbol “<” used for “less than” and the reporting limit given as a number. Data qualifiers have been dropped for this presentation; only data considered acceptable are reported. Data are compared to the benthic screening levels presented in the SEF. The “Screening Level 1” corresponds to concentrations below which adverse effects to benthic communities are not expected.

2.2.3.1 *Organic Compounds*

Table 2-4 shows the organic compounds present in the sediment. The 1997 sampling event included a wide range of pesticides from various chemical families, as well as dioxins, semi-volatile compounds, and petroleum hydrocarbons. It was expected that this study would find no pesticides, since the use of these compounds had already been halted or greatly reduced. Contrary to expectations, several pesticides were present at low levels. It is likely that pesticides persist within the system in areas that have not been dredged, including in fine grained materials which have accumulated behind Lower Monumental Dam.

Table 2-4. Summary of Organic Compounds Measured in Sediments in the Lake Herbert G. West

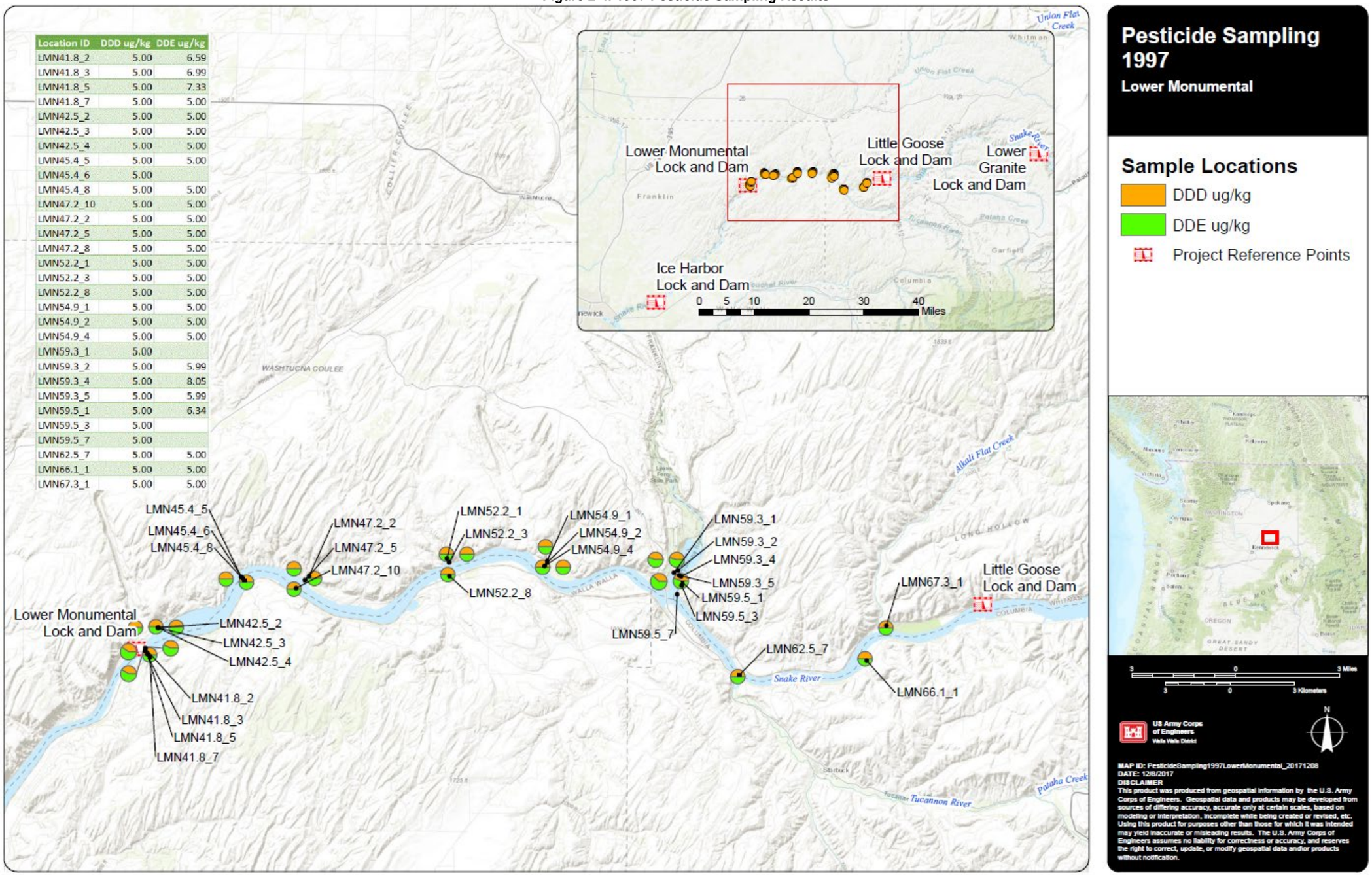
Compound (µg/kg dry weight)	Screening Level 1[1/]	1997 Average
Glyphosate	–[2/]	14.85
Aminomethylphosphonic acid (AMPA)	–	8.28
4,4’-DDD	310	3.06
4,4’-DDE	21	6.48
4,4’-DDT	100	1.72
Aldrin	9.5	0.87
Total petroleum hydrocarbons (TPH)	3,600[3/]	58.25

Notes: µg/kg = micrograms per kilogram. 1/ SEF screening level. 2/ No screening level or constituent not measured. 3/ Screening level for TPH-residual.

Dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE) (dichlorodiphenyltrichloroethane [DDT] metabolites) concentrations were plotted in Figure 2-4. The reporting limit was 5 µg/kg, and no measurements lower than this were reported. DDD was not detected in Lake Herbert G. West samples, but low concentrations of DDE were found at some spots. These locations correspond to locations with fines greater than 20 percent. The concentrations of DDE measured were less than the benthic screening level of 21 µg/kg (RSET Agencies 2016), but still present a concern. The presence of DDE many years after the use of DDT was halted is an indication of the persistence of large organic compounds in the environment. Since 1997, newer pesticides have been in use, and systematic sediment testing has not been completed to determine if these are present. The finding of DDE suggests that low levels of other persistent compounds may also be present in the sediment. A comprehensive sediment investigation would be needed to evaluate if this is true and whether concentrations are above benthic screening levels (indicating that harmful

ecological effects may be experienced and that the sediment is probably not suitable for beneficial use).

Figure 2-4. 1997 Pesticide Sampling Results



2.2.3.2 *Metals and Inorganic Compounds*

Table 2-5 summarizes the metals results found in the 1997 sampling event. All metals were below the screening levels for aquatic organisms. Sources of the metals are likely a combination of naturally occurring and anthropogenic sources. Aluminum, iron, and manganese are naturally occurring in the igneous rocks and soils of the Snake River watershed (Corps 2002). These compounds are typically less of a concern for aquatic life, and they were not measured in past studies.

Table 2-5. Summary of Metals Measured in Sediments in Lake Herbert G. West

Compound (mg/kg dry weight)	Screening Level 1[1/]	1997 Average
Arsenic	14	5.2
Cadmium	2.1	0.1
Chromium	72	23
Copper	400	29.8
Lead	360	12.9
Mercury	0.66	0.1
Nickel	26	16.6
Selenium	3	1.5
Silver	0.57	<0.4
Zinc	3200	61.4

Notes: mg/kg = milligrams per kilogram. 1/ Screening level from the SEF.

2.2.4 Biological Data

No biological testing data were found for sediment samples taken from Lake Herbert G. West.

2.2.5 Elutriate Data

There are no available elutriate data for sediment samples from Lake Herbert G. West.

2.3 CHEMICALS OF CONCERN

2.3.1 Sources of Chemicals of Concern

No compounds were found at concentrations above the screening level for aquatic organisms in the 1997 sampling event. This may be partly an artifact of the sampling conditions. The 1997 sampling event was systematic but not comprehensive, and the reporting limits for some parameters were high due to matrix interference. In addition, the 1997 data are too old to be considered representative of current conditions.

There are indications of compounds that could be issues. The 1997 sampling event found DDT and metabolites present in the fine-grained materials; DDE was the main compound present in Lake Herbert G. West. Although the concentrations were low, the presence of these persistent compounds decades after widespread use had been halted is an indication that other persistent compounds used more recently (other pesticides, for example) may also be present. In general, pesticides are of concern in this heavily agricultural watershed and should be included in any sediment analyses.

A number of metals were detected in the 1997 study, but at concentrations below the Screening Level 1. Because metals were detectable, potentially have human activity origins and can impact aquatic organisms, future testing should include the metals list. Ammonia was also present; ammonia and sulfide are not themselves considered problematic, but they are measured in part to inform bioassay testing regarding the potential for non-treatment effects (RSET Agencies 2016).

Other persistent, anthropogenic compounds not found in Lake Herbert G. West but potentially of concern within the watershed include phthalates, polycyclic aromatic hydrocarbons (PAHs), and PCBs. Some of these compounds have potential sources in the watershed, including upstream sections of the Snake River. In general, these compounds are widespread in the environment in low concentrations, have multiple potential human-related sources, and tend to adhere to fine-grained sediment. Due to the potential for the presence of these compounds and the lack of information on the sediment conditions, these compounds should be included in any future testing. A database search of regulated facilities along Lake Herbert G. West did not lead to the identification of any specific potential sources of sediment contamination, but a number of underground storage tanks, including leaking tanks, have been or currently are located within the area. A number of small spills were also reported within the lake. Due to the potential for spills or leaks, petroleum compounds (benzene, toluene, ethylbenzene, xylene) and/or oil and grease would also be appropriate compounds to measure in sediment sampling.

2.4 CONCEPTUAL SITE MODEL

Consistent with the SEF (RSET Agencies 2016), the management area for Lake Herbert G. West is ranked moderate based on past data and on the lack of current information. Additional data would be needed for any specific dredging project or to evaluate sediment conditions for other work in the future. Based on past data, the sediment may contain compounds (such as pesticides) known to bioaccumulate. Compounds potentially of concern upstream (phthalates, PCBs, PAHs) should also be investigated for Lake Herbert G. West because sediment travels downstream and there is no current data on sediment quality. Local sources of petroleum compounds are also possible, and volatile organic compounds (VOCs) or oil and grease should be included in the analytes. The management unit is ranked moderate to high due to a lack of information, as well as the potential for upstream materials to have migrated downstream and moved finer-grained materials containing low concentrations of chemicals of concern.

A conceptual site model was developed based on anticipated future conditions. Specifically, it is assumed that erosion and sediment loading, although possibly decreasing over time due to soil conservation practices, will continue with sediment accumulation behind Lower Monumental Dam and in low-flow or backwater areas along Lake Herbert G. West as identified in the Programmatic Sediment Management Plan (Corps 2014). The anticipated sediment placement is in water as beneficial use for habitat. Upland unconfined placement of sediment is also considered for completeness, although this is not likely to be the selected alternative unless aquatic placement is not

possible. Table 2-6 shows the conceptual site model for dredging and placement activities. In this conceptual site model, complete pathways are labeled "C." These include pathways for the exposure of benthic organisms and fish (potentially including threatened or endangered fish species) during dredging and aquatic placement, and pathways for the exposure of birds and mammals for upland unconfined placement. Complete but insignificant (I pathways) include those for birds and mammals for dredging and aquatic placement, and those for all receptors due to the water release for upland placement. Incomplete pathways include those for aquatic receptors (fish and benthic organisms) during upland placement activities. The release mechanisms and exposure pathways are discussed further, below. Additional conceptual models may be required to address possible future projects.

Table 2-6. Conceptual Site Model for Dredging Activities

Source of Contaminants	Release Mechanism(s)	Exposure Route	Receptors and Habitat				
			Benthic Invertebrates	Fish	ESA species[1/]	Birds/ Mammals	Humans
Dredge pathways							
Sediment →	Suspended sediment (water column) →	Direct contact →	C	C	C	I	I
		Dietary → tissue →	C	C	C	I	I
	Generated residuals (fallback, sloughing) →	Direct contact →	C	C	C	I	I
		Dietary → tissue	C	C	C	I	I
	Undisturbed residual →	Direct contact →	C	C	C	I	I
		Dietary → tissue →	C	C	C	I	I
Unconfined aquatic placement pathways							
Sediment →	Suspended sediment (water column) →	Direct contact →	C	C	C	I	I
		Dietary → tissue →	C	C	C	I	I
	Placed material surface →	Direct contact →	C	C	C	I	I
		Dietary → tissue →	C	C	C	I	I
Upland unconfined placement pathways							
Sediment →	Water release →	Direct contact →	I	I	I	I	I
		Dietary → tissue →	I	I	I	I	I
	Placed material surface →	Direct contact →	X	X	X	C	I
		Dietary → tissue →	X	X	X	I	I

Notes: C = complete pathway for receptor; I = complete but insignificant pathway for receptor; X = incomplete pathway for receptor. 1/ ESA = Endangered Species Act. Some salmon species and other fish are considered threatened and endangered within the Columbia River Basin. Endangered species are not called out further in this discussion because the exposure of aquatic species is considered overall and the exposure mechanisms are not anticipated to differ.

2.4.1 Secondary Media and Release Mechanisms

The release mechanisms would include the suspension of solids in the water column during dredging, as well as residual material left at the surface of the water/sediment

interface (including both fallback material and undisturbed sediment below the dredging cut). For sediment placement in aquatic habitat areas, the release mechanisms are similar: sediment mixing with the water column and the material at the water/sediment interface. Either of these situations could result in the release of contaminants from the sediment surface into the water column. Fish and benthic invertebrates would be exposed to compounds in the water and/or sediment. Many of the compounds of interest, such as large organic compounds, are sparingly soluble in water and tend to bioaccumulate in fatty tissues.

2.4.2 Exposure Routes and Completeness

The potential exposure routes include direct contact for benthic species and fish. It is unlikely that humans will have significant direct contact with high concentrations of suspended sediment or with residuals. The dredging and the placement areas are not beaches, and humans are typically prohibited from entering the water near dredging and placement operations. Birds and mammals are unlikely to congregate near these operations while equipment is active. Direct contact impacts can be at least partially mitigated by dredging and placing sediment outside migration periods for the anadromous fish populations and outside spawning periods for all fish.

Indirect exposure pathways exist for all species due to the potential for bioaccumulation in the tissues of fish and benthic invertebrates. This pathway is well documented because compounds historically found in the sediment were also identified in fish tissues in the Snake River as part of the 303(d) compliance reporting. However, the relative size of the historical dredging and placement areas compared to the portion of the river is small and does not represent a significant fraction of the fishing area. This pathway may need future reconsideration if large-scale sediment disturbance is planned.

For upland unconfined placement, the aquatic pathways are complete but insignificant. Water is typically settled or filtered prior to discharge, which has the effect of removing most of the contaminants (which tend to adsorb to the particle surface). Even if the water is discharged as a turbid stream to the river, the relative volume of water will be very small compared to the volume of the river. Some water will percolate into the ground; although this water may eventually migrate to the surface waters of the river, the original infiltration will be very dilute by the time it travels to the river. Placing the sediment upland effectively prevents any direct benthic or aquatic organism exposures to the dredged sediment. Typically, sediment placement sites are not open to the public so that direct human contact is limited and insignificant. Wildlife may enter the site, particularly birds, which view the freshly deposited sediment as a mudflat area for resting or nesting.

SECTION 3 - SUMMARY

3.1 SEDIMENT QUALITY

Sediment quality in Lake Herbert G. West is essentially unknown. Past studies have indicated that the sediment within the Lake Herbert G. West is variable in particle size and quality, but insufficient data exists to fully evaluate the existing conditions. Historical data indicates that the chemical quality of the sediment may reflect the grain size distribution, with the finer-grained materials being associated with higher concentrations of pesticides or other anthropogenic compounds. Historically, the sediment has included low levels (below screening levels for impacts to aquatic organisms) of pesticides and metals. Some of these compounds could be present at higher concentrations in materials that have accumulated over many years and that have not been dredged, such as directly behind the dam. The sediment within the reservoirs upstream (Lake Bryan and Lower Granite Reservoir) does contain at least low levels of anthropogenic compounds at the areas recently dredged, and the fine-grained materials could migrate downstream to at least a limited degree. The lack of recent data raises the risk level for the sediment condition.

3.2 RECOMMENDATIONS

Insufficient data exist to draw conclusions regarding the quality of sediment that has accumulated behind Lower Monumental Dam and within Lake Herbert G. West. No recent sediment sampling results exist for these areas. Due to the lack of data, a comprehensive sediment characterization study is strongly recommended to support any proposed future projects.

3.2.1 Conceptual Site Model

Conceptually, sediment that has accumulated in Lake Herbert G. West would be removed by dredging. The material would be placed in water along shallow areas to form habitat if the sediment quality is sufficiently high. Sediment could also be placed upland for beneficial use. It is recommended that specific management units be developed for proposed dredging areas or for sediment shoals that would be disturbed by a proposed project (and that may be removed proactively or that may be allowed to migrate downstream). Sediment sampling should include cores (segmented for chemical analysis) to represent the full range of sediment conditions for shoaled materials.

3.2.2 Chemicals of Concern

The chemicals of concern include compounds previously detected in sediment from Lake Herbert G. West, as well as chemicals of concern for the upstream dams on the lower Snake River. These chemicals include pesticides (currently in use as well as banned pesticides and pesticide metabolites), dioxin, PAHs, PCBs, phthalates, VOCs, metals, and nutrients. Sediment testing should include elutriate testing for the same compounds because in-water placement of the sediment would be desired.

3.3 CONCLUSIONS

Sediment quality in Lake Herbert G. West is unknown. The amount of sediment accumulation and the current sediment loading to this reservoir are also largely unknown. Due to the lack of current data on sediment conditions, a comprehensive sediment characterization study would be needed to delineate conditions in support of any specific proposed project, including dredging, dam removal, or structural changes to the river or dams.

SECTION 4 - REFERENCES

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