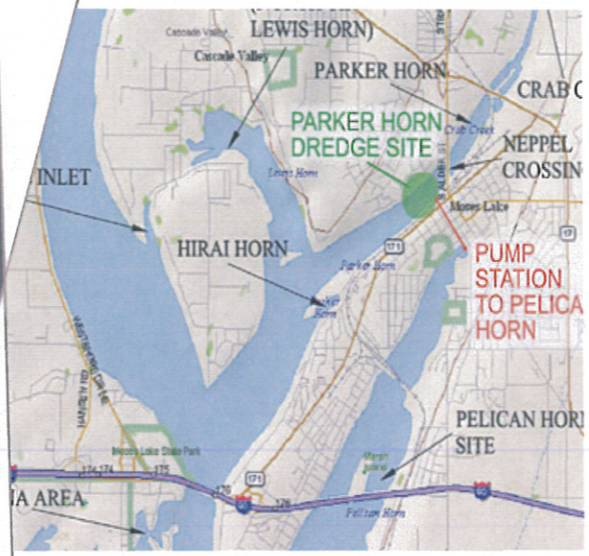
Comparison of Dredging Alternatives for Moses Lake



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1 Introduction

1.1 Moses Lake Irrigation and Rehabilitation District.

The Moses Lake Irrigation and Rehabilitation District (District) was established in 1928 with a mission of providing irrigation water, recreation facilities, and lake rehabilitation projects. In September 2009 the District released a Sediment Management Plan for Moses Lake (Grette Associates 2009). This plan is a comprehensive plan for management of sediments in Moses Lake and identifies actions throughout the Lake. As part of the District's commitment to improve conditions in Moses Lake, they have begun hydraulic dredging to remove 60 years of accumulated sediment from Parker Horn and create a catchment basin to collect new sediment entering Moses Lake from Crab Creek through Parker Horn.

Parker Horn is divided into two sections: upstream and downstream of Neppel Crossing. Upstream of Neppel Crossing Parker Horn has experienced significant sedimentation. Sediment has been deposited along both shores of the lake. Sediment deposits are between two and twelve feet deep. Upstream of Nepal Crossing, Cardno's recent bathymetric survey estimates that there may be as much as 430,000 cubic yards of deposited sediment (Appendix A Bathymetric Survey). The survey shows a large sediment bar developing along the east side which may contain approximately 375,000 cubic yards. The dredging activities will focus on sediment deposits that create navigation issues or impede the use of boat dock and other facilities on Moses Lake. Much of the sediment in Parker Horn will remain in place. Permits have been issued and agreements are in place with the agencies to preserve existing sand bars as habitat for migrating birds and waterfowl during low water periods.

The District's goals for Parker Horn as described in the 2009 Plan include:

1. Intercept sediment in Parker Horn before it is transported further into the lake;
2. Maintain open water for boating, fishing, and access to docks downstream of Neppel Crossing by limiting sediment transported from north of the crossing;
3. Protect waterfowl habitat complexity along the bar upstream of Neppel crossing; and
4. Maintain fish habitat resources both upstream and downstream of Neppel crossing.

1.2 Sediment Accumulation and Sources

Current sediments sources for Parker Horn include sediment delivered by Crab Creek, windblown sediment, and sediment released by wave action along the shoreline. The overwhelming majority of the sediment in Parker Horn was derived from water borne sediment entering from Crab Creek. Agricultural development in Crab Creek drainage has resulted in additional sediment delivery to Crab Creek. The increased flows through Crab Creek carried this sediment to Moses Lake. In addition, the construction and operation of the Rocky Coulee Wasteway, a concrete channel built in 1954 increased sediment supply to Moses Lake. Rocky Coulee Wasteway was built to allow the U.S. Bureau of Reclamation to divert water from the East Low Canal into Crab Creek, for delivery to the Potholes Reservoir, through Moses Lake (Figure 1). The land upstream of Rocky Coulee Wasteway is used as dry land farming and the land just upstream of the Rocky Coulee Wasteway is tilled. In wet years, there is sufficient flow across the tilled land to cut a new stream channel. During these years, increased sedimentation occurs in Parker Horn where the sediment is carried and deposited. Grette Associates (2009) noted that large volumes of sediment were found in the channel of Crab Creek upstream of the confluence with Rocky Coulee Wasteway. They concluded that in wet years, this sediment could be mobilized and transported to Moses Lake, adding to the sediment deposits in Parker Horn.

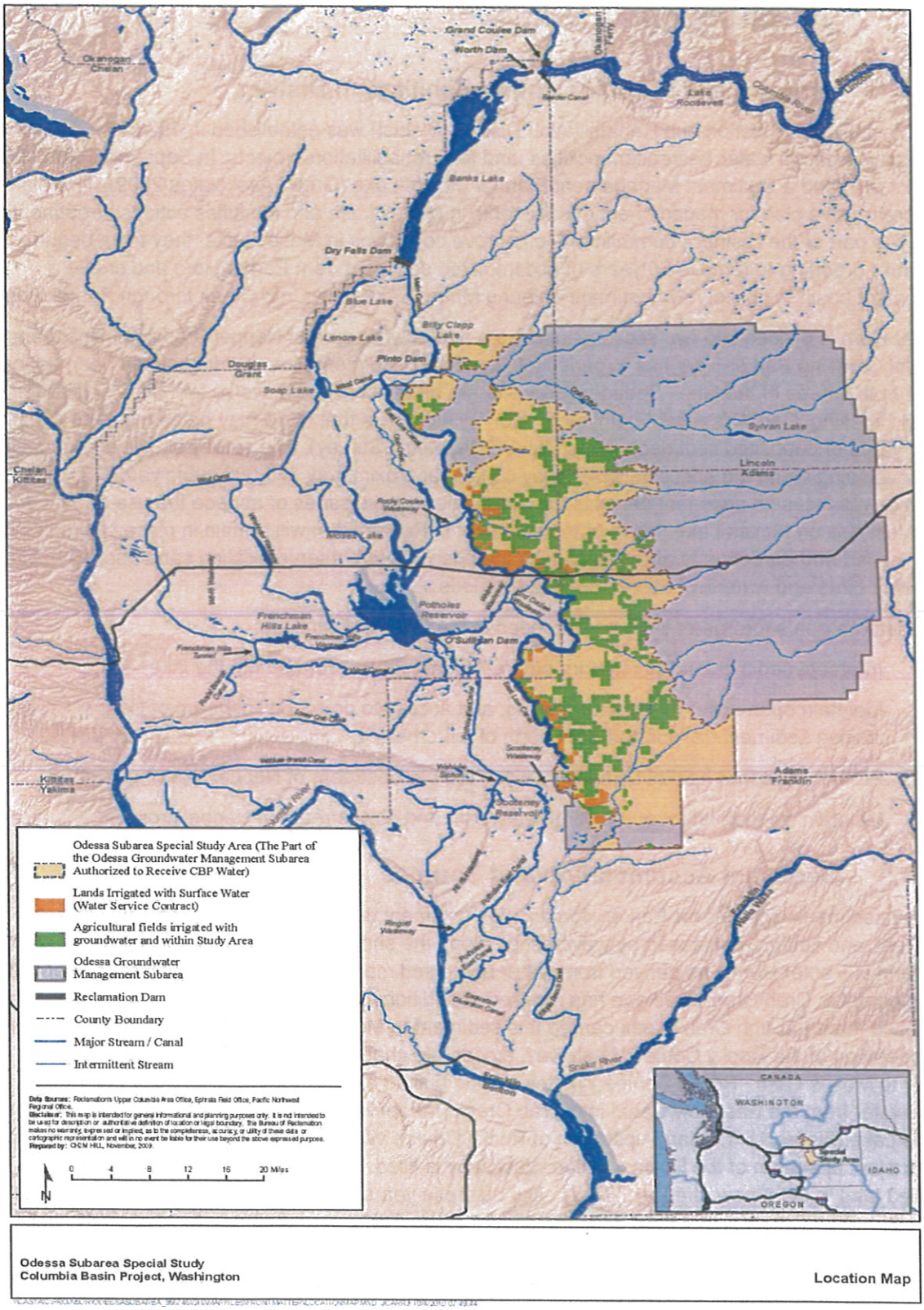

Figure 1. U.S. Bureau of Reclamation Diversion of Water for Delivery to the Potholes Reservoir (source: USDOI and DOE 2010).

With the anticipated increased water releases through Crab Creek related to interim actions to increase water delivery to downstream aquifers, there is a potential for increased sediment delivery to Parker Horn and a potential for the sediment stored upstream of Neppel Crossing to be transported further into the lake and deposited in Parker Horn downstream of Neppel Crossing. Further deposition here could adversely affect lakeside residences, access to private docks, recreational boating safety, and aquatic habitat.

The District is examining options to remove the accumulated sediment. The following report outlines the general differences between mechanical and hydraulic dredging processes as they relate to operation, permitting requirements, sediment/erosion control, general costs of each and the environment created by each process. Although some generalizations of the processes and assumptions have been made to aid in development of this report, the information included and discussions that follow are primarily a result of Cardno ENTRIX experience from past dredging projects.

1.3 Current and Future U.S. Bureau of Reclamation Operations

Under the current operating regime of Moses Lake, water levels begin increasing in late March and early April as water is delivered to begin filling the Potholes Reservoir in anticipation of the annual irrigation demand. Storage in Moses Lake is increased to an elevation of approximately 1,047 feet in April and remains high during the summer. In November, the elevation of the lake is drawn down to 1,042 feet to provide for flood control and to allow for maintenance activities. Currently, flow in Crab Creek is heavily influenced by releases from the East Low Canal through Rocky Coulee Wasteway.

The U.S. Bureau of Reclamation is planning to increase the flow rate through Moses Lake and Crab Creek to provide supplemental feed water to Potholes Reservoir for use by downstream irrigation interests in basins where groundwater overdraft is limiting agriculture (U.S. Department of the Interior 2007). The U.S. Bureau of Reclamation expects to increase the flow in Crab Creek by 100 to 500 cubic feet per second. For comparison, Crab Creek is usually at its highest flow levels in April (approximately 2,000 cubic feet per second) and lowest flow levels in December of approximately 20 cubic feet per second (Grette Associates 2009).The additional water represents from a 5 to 25 percent increase over current conditions.

2 Dredging Types

There are two approaches to dredging, hydraulic and mechanical. Hydraulic dredging includes the use of a pump to move solid material (in a slurry) via a pump while mechanical dredging relies on machinery to remove material. Each type of dredge is described in more detail below.

2.1 Hydraulic Dredging

Hydraulic dredging is conducted by pumping water from the head of the dredge back through the vessel and out a pipeline to a dewatering area. The pumped water creates a negative pressure that allows the sediment to be moved in slurry form through the pump and pipeline system. Water jets, augers, or cutter heads are types of cutting mechanisms used in hydraulic dredging to loosen the sediment which is then drawn though the pipeline system as a slurry.

Hydraulic dredges are identified by the diameter of their discharge pump. The smaller dredges are in the 10-inch range, such as the one being utilized for current dredging operations on Moses Lake. These smaller dredges require a crew to operate. Larger dredging operations have logistical support requirements in addition to the dredge operation crew, such as support boats, tenders (used to service the dredge) and other support craft.

2.2 Mechanical Dredging

Mechanical dredging involves the use of floating barges or land-based heavy equipment at the shoreline. Barge-mounted operations may involve draglines and a clamshell dredge or a long-reach excavator to remove the material. The dragline is connected to the clamshell dredge or long-reach excavator and used to maneuver the "bucket" for dredge operations. These operations use support barges to temporarily store dredged material. The barges would then be moved to shore where the material is off loaded onto trucks for disposal elsewhere. Land-based heavy equipment excavation is accomplished "in the dry" by installing a temporary enclosure (cofferdam) around the work area and removing water (dewatering), by waiting until water levels are low enough to allow access by land-based heavy equipment, or a combination of the two.

2.3 Efficiency and Time Requirements

Barge-mounted mechanical dredging requires double handling of sediment and is less efficient than hydraulic dredging. Land-based dredging can be more cost effective than barge-mounted dredging; however, it is still less efficient than hydraulic dredging. Even though both forms of mechanical dredges are less efficient than hydraulic dredging, mechanical dredges are capable of removing more sediment than a hydraulic dredge in the same length of time. The tradeoff generally is increased cost for mechanical dredging (see Section 6).

3 Permitting for Dredging Operations

The U.S. Army Corps of Engineers, Washington State Department of Fish and Wildlife, and Washington Department of Ecology require specific permits and environmental documentation/clearances for dredge operations. Depending on the scope of the project additional federal, state and local permits may also be required. To streamline the environmental permitting process for projects near the shoreline federal, state and local regulatory agencies have collaborated to create the Joint Aquatic Resources Permit Application that can be used to apply for multiple permits at a single time including:

Federal

> U.S. Army Corps of Engineers Section 404 Permit

State

> Washington Department of Ecology 401 Water Quality Certification

> Washington Department of Fish and Wildlife Hydraulic Project Approval

> Washington Department of Natural Resources Aquatic Use Authorizations for State-Owned Aquatic Lands

Local (City or County)

> Shoreline Substantial Development Permit

> Shoreline Variance

To apply for these permits a single Joint Aquatic Resources Permit Application would be completed and submitted to the federal and state lead agencies, in this case Grant County and the U.S. Army Corps of Engineers. The lead agencies would in turn distribute copies to the other relevant permitting agencies. The permits and environmental compliance documents that may be required by this project are described below.

3.1 Clean Water Act (Section 404 and 401), Federal Endangered Species Act and Section 106 (Historic Preservation Act compliance)

The U.S. Army Corps of Engineers regulates discharge of dredged or fill material into waters of the United States, including wetlands under Section 404 of the Clean Water Act. Proposed activities are regulated through a permit review process and can follow one of two pathways, an Individual Project Permit or a Nationwide Permit. An Individual Permit is required for potentially significant impacts while a Nationwide Permit is grated for projects with minimal adverse impacts. A Nationwide Permit eliminates individual review and can streamline the permitting process, reduce the process requirements, and save time and money compared with the Individual Project Permit which can take six months to two years to be issued. Nationwide permits that may apply to this project include:

> Nationwide Permit 3 – Maintenance of a previously authorized structure

> Nationwide Permit 33 – Temporary Construction, Access and Dewatering

> Nationwide Permit 35 – Maintenance Dredging of Existing Basins

It should be noted that Nationwide Permits are only available for actions that have very limited impacts on waters of the United States and thus are typically not available for projects of any substantial scope.

The type of permit required by a project is determined after the project's impacts on wetlands and waters of the United States (including wetlands, interstate lakes and impoundments of waters) are defined in the Wetland Delineation Report. Regardless of the permitting pathway, a Joint Aquatic Resources Permit Application is used for most small-to-moderate scale routine dredging projects. Resource studies required to comply with the Clean Water Act Section 404 permit include a Biological Assessment for any species listed under the Endangered Species Act and a Section 106 consultation on historical or cultural resources that may be affected. A Biological Assessment is prepared for projects when listed species, proposed species or designated critical habitat would be affected by the project's proposed activities. Since there are no listed species or critical habitat present in Moses Lake, a Biological Assessment would not be required. The Historic Preservation Act (Section 106) considers project effects to historic properties and cultural resources within the project area. An Archeological Survey Report was completed in 2004 and would likely provide much of the information needed to meet the requirements of Section 106 consultation for the project. Additional work would be required if the footprint of the project changes (i.e., the identification of additional disposal sites) or if the land disturbance sites change (new equipment ramp location).

Issuance of a Section 401 Water Quality Certification by the Washington Department of Ecology verifies that the applicant's project will comply with Washington State water quality standards under the Clean Water Act and other aquatic resource protection requirements under Ecology's authority. The Joint Aquatic Resources Permit Application serves as the Section 401 Water Quality Certification Application for Ecology. If approved, no further 401 Certification review by Ecology would be required. If partially denied without prejudice, an individual certification or Letter of Verification from Ecology is required for the 401 Certification. Nationwide Permit 3 (Maintenance of a previously authorized structure) and 33 (Temporary construction, access and dewatering) have been certified with conditions by Department of Ecology and Nationwide Permit 35 (Maintenance dredging of existing basins) requires the applicant to contact the Department of Ecology to determine if Certification is required. If the project is processed under an Individual Project Permit, Ecology will need to evaluate the project to determine if the project along with mitigation complies with Washington State water quality standards and other aquatic resource protection requirements under Ecology's authority.

3.2 Washington Department of Ecology National Pollution Discharge Elimination System Construction Stormwater Permit

Washington Department of Ecology is responsible for implementing all federal and state water pollution control laws and regulations. This permit requires construction site operators to install and maintain erosion and sediment control measures to prevent stormwater from washing soil, nutrients, chemicals and

other harmful pollutants into local water bodies. A wastewater discharge permit is required if clearing, grading or excavation activities disturb an area of one acre or more and discharge stormwater to surface waters of the state or a conveyance system that drains to surface waters of the state. This permit is also required if activities disturb an area smaller than one acre if it is part of a "larger common plan of development or sale" that will disturb one acre or more and discharge stormwater to surface waters of the state or a conveyance system that drains to surface waters of the state. In addition to the aforementioned permit triggers, Ecology reserves the right to require permit coverage at a construction site of any size, if they believe the site may be a significant contributor of pollutants to waters of the state or reasonably expects the site to violate water quality standards. The statewide general permit expires every five years, with the current permit set to expire on December 31, 2015. Coverage under the permit is valid until your site's permit coverage is revoked or terminated. If permit coverage is required past the general permit expiration date due to construction not being complete or eligible for termination, the renewal application must be submitted to Ecology at least 180 days prior to the expiration date to continue coverage under the re-issued general permit.

3.3 Washington Department of Fish and Wildlife's Hydraulic Project Approval

Washington Department of Fish and Wildlife requires a Hydraulic Project Approval for any form of work that uses divers, obstructs, or changes the natural flow or bed of any freshwater or saltwater of the State. This permit is part of the Joint Aquatic Resources Permit Application form and requirements of the Hydraulic Project Approval are similar to the Section 404 permit. This permit requires a notice of compliance with any applicable requirements of the State Environmental Policy Act.

3.4 Right to Entry to Washington State Lands

The Washington State Department of Natural Resources issues a permit for the Right of Entry for state-owned aquatic lands. This permit allows certain activities to occur on state-owned aquatic lands so long as the permitted activities do not interfere with the use and enjoyment of the lands by others. This permit is included in the Joint Aquatic Resources Permit Application form.

3.5 County Grading Permit

Grant County requires a grading permit for the land application of the dredge materials. Since the District is already in the process of disposing of the dredge materials in Connelly Park and the application of dredge materials to the Park, the existing grading permit should continue to provide authorization to apply the dredge material to Connelly Park. If other disposal sites are used, additional grading permits would be required.

3.6 State Environmental Policy Act Compliance

The State Environmental Policy Act requires state and local governments to consider the environmental impact of a proposed project before approving or rejecting the project. Typically the lead agency initially prepares an Environmental Checklist to assist in identification of negative impacts to the environment and then identifies mitigation measures to reduce or avoid impacts. If minimal impacts are identified and can be mitigated, the lead agency may issue a Determination of Non-significance completing State Environmental Policy Act compliance. If State Environmental Policy Act is required for the project it must be completed before local and state permits can be issued.

3.7 National Environmental Policy Act Compliance

Issuance of a permit by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act is a discretionary action that requires environmental review under the National Environmental Policy Act. The National Environmental Policy Act requires an evaluation of relevant environmental effects of a federal action (in this case the issuance of a permit). There are three levels of analysis that the Army Corps may undertake to comply with the law. These include: preparation of a Categorical Exclusion, preparation of

an Environmental Assessment and Finding of No Significant Impact; or preparation and drafting of an Environmental Impact Statement. A Categorical Exclusion is used for actions that do not involve significant environmental impacts. If the significance of impacts is uncertain, an Environmental Assessment would be prepared to assist in making the determination. An Environmental Impact Statement is required for any project that significantly affects the quality of the natural or human environment.

3.8 Shoreline Management Substantial Development Permit/Conditional Use Variance Permit

Shoreline management substantial development permits are required by the City of Moses Lake for all developments with total costs exceeding $6,416 (adjusted with consumer price index), or which materially interferes with the normal public use of waters or shorelines of the state. Certain types of developments, including watershed restoration projects and habitat improvement are exempt from obtaining this permit. Exempt activities may require variances or Conditional Use Permits. The City of Moses Lake, under the Shoreline Management Act of 1971, is responsible for issuing a shoreline conditional use permit and a conservation and reclamation zone conditional use permit. These permits are included in the Joint Aquatic Resources Permit Application form.

3.9 Floodplain Development Permits

Any development, including dredging and storage of equipment or materials, within the 100-year floodplain requires a Floodplain Development Permit. The Floodplain Development Permit is issued by local government (City or County) and requires site plans in duplicate drawn to scale showing the nature, location, dimensions and elevations of the area in question; existing or proposed structures, fill, storage of material, drainage facilities, and the location of the forgoing. In addition the Applicant is to provide a description of the extent to which any watercourse will be altered or relocated as a result of the proposed development. The Applicant must disclose potential impacts on wetlands within the base floodplain and the possible disruption of the wetland ability to reduce flood and storm drainage.

4 Hydraulic versus Mechanical Dredging Permit Requirements

The variability and complexity in permitting generally stem from the type of dredging, type and quality of sediment to be removed and sediment dewatering and disposal methodologies. Below is a general discussion of the permitting requirements for each type of dredging. The permitting description and cost estimates assume the dredged material is free of pollutants and would be considered “clean”.

4.1 Hydraulic Dredging Permitting

For the most part, small to moderate scale hydraulic dredge permitting is addressed using the Joint Aquatic Resources Permit Application described above in Section 3. Since dewatering and relocation of the hydraulically-dredged material to land would be required, the project description would need to address those operations. Additional permitting and monitoring may be required for the release of return water and disposal of the dewatered dredge material. If large areas are needed for sediment dewatering, the likelihood of impacting federal and state jurisdictional areas (e.g., wetlands) and/or archeological sites increases. However, these additional impacts could likely be addressed using the Joint Aquatic Resources Permit Process, but may require additional focused technical studies and detailed descriptions concerning these elements of the project.

4.2 Mechanical Dredging Permitting

Mechanical dredging performed from a barge-mounted platform would be permitted similarly to hydraulic dredging using Joint Aquatic Resources Permit Application. Many of the same issues would need to be

addressed including turbidity near the excavation site, dewatering of dredge material, trucking to a disposal site.

Mechanical dredging performed in "the dry" generally has a larger project area that requires resource permitting (e.g., waterbodies, wetlands, floodplains, etc.). The larger footprint results from the need for an ingress and egress from the dredge area during low-water periods, the installation of a temporary cofferdam, and potentially active dewatering of the dredge area. Consequently, it is likely that expanded Clean Water Act permitting would be required, and National Environmental Policy Act and State Environmental Policy Act documentation, would be needed to address the impacts of these activities. These impacts could include new or increased impacts to state and federal jurisdictional areas, water quality, construction traffic noise and emissions, and other impacts normally associated with and addressed in National Environmental Policy Act and State Environmental Policy Act permitting documents. In addition, local permits required for development within floodplains (Floodplain Development Permit), grading (Grant County Grading Permit), and construction activities (Shoreline Management Substantial Development Permit) associated with the cofferdam, or construction access to the dredge area, may increase in complexity over those required for hydraulic dredging.

Additional permitting and monitoring would be required for mechanical dredging activities due to relocation of dredged material to land. The need to dispose of dredge material on land could increase the likelihood of additional impacts to federal and state jurisdictional areas (e.g., wetlands) and/or archeological resources.

4.3 Hydraulic versus Mechanical Permit Comparison

Table 1-1 provides a comparison of permits required by the three different project types.

Table 1-1 Likely Permitting Requirements

Permit	Hydraulic Dredging	Barge Mounted Mechanical Dredging	Dry Mechanical Dredging
U.S. Army Corps of Engineers Section 404		X	X
Washington Department of Ecology Clean Water Act Section 401		X	X
Washington Department of Ecology National Pollution Discharge Elimination System Construction Stormwater Permit	X	X	X
Washington Department of Fish and Wildlife Hydraulic Project Approval	X	X	X[1]
Washington State Department of Natural Resources Right of Entry for Washington State Lands	X	X	X
Grant County and City of Moses Lake Grading Permit	X	X	X
State Environmental Policy Act	X	X	X
National Environmental Policy Act		X	X
City of Moses Lake Shoreline Management Substantial Development Permit	X	X	X
City of Moses Lake Conditional Use Variance Permit	X	X	X
Floodplain Development Permit (issued by City or County)			X
Columbia Basin Railroad Private Crossing Agreement	X	X	X

This table represents the most common permit pathways.

[1]Applicant would contact Washington Department of Fish and Wildlife with project details to determine if this permit is required.

5 Sediment and Erosion Control

Sedimentation and erosion control increases in difficulty commensurate with the size, scale and type of dredging operation. In general, the dredging operation with the smallest project footprint would have the lowest potential to cause erosion and generate sediment from project activities. As such, the smaller project footprint of the water-based hydraulic dredge operation would create the least potential for erosion while the land-based mechanical dredging operation would have the greatest potential for sedimentation due to access and activity required in, and near, Moses Lake.

With respect to dredging process and the generation of sediment, if a barge-mounted excavator or clam-shell dredge was to be used, containment of the fallback dredge material would be required. This would likely require the incorporation of a turbidity curtain around the dredging operations to prevent downstream sedimentation and degradation of water quality. This system would not be required for the hydraulic dredge operation as the dredged materials would be contained within the dredge hose which eliminate fallback of the dredge material.

6 Hydraulic versus Mechanical Dredging Costs

Dredging costs are highly variable and driven by type of dredging operations, land costs for dewatering sites, weather, topography, and characteristics of bottom sediments. These variables are such that cost estimates need to be based on site-specific circumstances. Consequently, there is no set "unit cost" applicable to dredging, but general estimates and ranges that can be inferred from previous projects. The main factor to consider when estimating a cost range is the type of sediment as it can have a significant effect on production, and therefore on unit costs. Environmental permitting, mobilization and demobilization, disposal of the dredged material and lake bottom conditions (e.g., treed, stumps or smooth) can also affect unit costs by a factor of two to four. Distance to the dredged solids dewatering site can affect unit costs, as would length of hose needed for hydraulic dredging and type and amount of heavy equipment for mechanical dredging. Land costs for dewatering areas can also significantly add to the cost depending on the dredge locations setting (rural, suburban or urban).

Based on available documentation, $9 to $11 per cubic yard would be a reasonable beginning point for the cost of hydraulic dredging of Moses Lake. This estimate does not include the cost of land acquisition, mobilization and demobilization, environmental permitting, dewatering basin construction, disposal, and other associated unit costs.

Mechanical dredging adds additional variables including the type of mechanical dredging proposed (land-based or barge based), engineering design, equipment purchase or rental, and whether a cofferdam or turbidity curtain would be required. A general estimate including mobilization and all labor and equipment would range from $25 to $35 per cubic yard for barge mounted dredging, and $30 to $40 per cubic yard for dry dredging depending on variables (based on 2011-12 costs for Crane Valley Seismic Retrofit Project barged-based dredging of 56,000 cubic yards). This estimate does not include the cost of land acquisition, environmental permitting, disposal, and other associated unit costs.

Table 1-2 Cost Comparison

	Hydraulic Dredging	Barge Mounted Mechanical Dredging	Dry Mechanical Dredging
Permit Cost[1]	$40,000 (Nationwide Permit)	$40,000 (Nationwide Permit) - $125,000 (Individual Project Permit)	$40,000 (Nationwide Permit) - $125,000 (Individual Project Permit)
Engineering Cost	Minimal	Minimal	$300,000-$500,000
Dredging Cost	$9-$11 cubic yard	$25-$35 cubic yard	$30-$40 cubic yard

Table 1-2 Cost Comparison

	Hydraulic Dredging	Barge Mounted Mechanical Dredging	Dry Mechanical Dredging
Duration	Long term	Short term	Short term

[1]The permit cost is an estimate for preparation of the Joint Aquatic Resources Permit Application.

7 Current Operations

The District chose to begin their sediment management program with hydraulic dredging. The District was able to purchase a 1985 Endicott 370 HP Dragon model Hydraulic dredge in 2008, which was completely refurbished by the District. Sediment ponds were constructed adjacent to Parker Horn. A ten inch line delivers the dredge slurry to the ponds. There are two parts to each sediment pond. The first portion is where the dredge slurry is initially pumped. The water from the slurry seeps into the second portion of the ponds leaving much of the sediment behind in the first pond. The District then removes the sediment from the pond using heavy equipment and loads it on trucks to be hauled to the disposal site. The District's permits allow dredging from July 1 to November 30 and then again in March. The District began dredging in July 1, 2011 after all the required permits were issued (Table 1-3).

The District's plan is to create a sediment trap where sediment transported from upstream of Neppel Crossing can be captured and held for later removal. The first step in this process is to excavate the sediment trap. This trap will prevent sediment from reaching other areas of the Parker Horn and facilitate the removal of the sediment. The size of the trap is expected to store approximately 7,000 cubic yards of sediment. The trap is located in an area where it is easy for the District's dredge to remove the accumulated sediment.

Table 1-3 Permits Issued and Studies Completed for Hydraulic Dredging of Parker Horn[1]

Agency	Permit/Study
Parker Horn Dredging Permits	
City of Moses Lake	Shoreline Conditional Use and Substantial Development Permit
City of Moses Lake	Grading Permit
Washington Department of Fish and Wildlife	Hydraulic Project Approval
Washington Department of Ecology	Shoreline Conditional Use Permit Approval
Washington Department of Ecology	National Pollution Discharge Elimination System Construction Stormwater Permit
Grant County Health District	Soil Analytical Test Results Review for Disposal
Columbia Basin Railroad	Private Crossing Agreement
U.S. Army Corps of Engineers	Section 404 Review to Determine Project is Exempt
Connelly Park Soil Disposal Permits	
Grant County	Grading Permit
Washington Department of Ecology	National Pollution Discharge Elimination System Construction Stormwater Permit
Parker Horn Dredging Permit Studies	
Washington Department of Fish and Wildlife	Clam and Mussel Survey and Sampling Plan

Table 1-3 Permits Issued and Studies Completed for Hydraulic Dredging of Parker Horn[1]

Agency	Permit/Study
Moses Lake, Washington Department of Ecology and U.S. Army Corps of Engineers	Wetland Delineation and Classification Report
U.S. Army Corps of Engineers	Technical Memorandum: Effects of Hydraulic Dredging
U.S. Army Corps of Engineers and Moses Lake	Archaeological Survey

[1]Grette Associates (Personal Communication, 2013)

During the initial dredging, the District found that the operation of the dredge did not produce harmful levels of turbidity and the sediments extracted by the dredge were clean and contained no contaminants which could eventually allow the sediment to be used as fill on public and private lands. In 2012, dredging was halted by the District Board of Directors when the voting majority felt mechanical dredging would be a better option.

Initial difficulties with drainage in the sediment ponds hampered progress. Operations were slowed, waiting until there was room in the ponds to deposit additional sediment. The District tried an innovative approach to speed up the pond draining process by getting permission to use end-guns to spray excess water onto adjacent property. This procedure allowed the District to continue dredging while waiting for the ponds to drain.

The elevations of the water control structure on the ponds were adjusted to facilitate better movement of water from the first pond where the sediment was deposited to the second pond where the water percolated into the ground. In addition, after one season of use the District was able to improve the ergonomic function of the dredge and substantially increase production. The dredging operations were tested in October of 2012 and found to be much improved. Permits are now in place that allows water to be returned to the lake, this will reduce the amount of time it takes for the water from the sediment ponds to percolate into the ground.

8 Summary and Conclusions

In comparing the two types of dredging, hydraulic and mechanical, their differences become apparent. Each has advantages and disadvantages. Hydraulic dredging uses a barge mounted pump to move material though a pipeline to an offsite location for dewatering and maybe moved to a second location for stockpiling or disposal. This type of dredging moves a prescribed amount of material based on dredge size, causes fewer environmental impacts, and is more easily permitted. Mechanical dredging uses heavy machinery to remove the sediment, which is then transferred to trucks for transport to an area for stockpiling or disposal offsite. Mechanical dredges use floating barges to perform work and dry mechanical dredges use land-based heavy equipment to excavate the sediment. Land-based heavy equipment can move large amounts of material, but requires waiting for low water levels or dewatering of the work area to allow for equipment access. Land-based dredging is often done in wet sediments and requires more permits and more environmental review than hydraulic dredging.

Hydraulic dredging generally has lower costs per cubic yard of material removed than both forms of mechanical dredging. Mechanical dredging has the advantage of being able to move large quantities of sediment more rapidly than a hydraulic dredge. Since mechanical dredging is very similar to a construction project, it required additional investigations like sediment coring, stability analyses and the development of engineering and construction plan. Because of this, the overall cost per cubic yard of material dredged is usually about 2.5 to 4.5 times greater when using a mechanical dredge over a hydraulic dredge.

As the District looks ahead to future sediment management, one concern is the sediment loading that enters Moses Lake through Crab Creek may increase. Grette (2009) found that there were extensive sediment deposits in the channel of Crab Creek upstream of the confluence with Rocky Coulee Wasteway, which could be mobilized during high flows and transported to Parker Horn. The increased water deliveries planned by Reclamation may also result in increased sediment deliveries to Parker Horn. If sediment loads increase, the District may need to investigate additional measures to control sedimentation in Parker Horn. Additional measures that the District could consider include upstream sediment control measures or increased dredging. Upstream control measures could include; source control upstream of Rocky Coulee, bank stabilization and wetland development that would slow the water depositing sediment before reaching Parker Horn. The District could potentially partner, or cost share, with private land owners or other state and federal agencies for some of these projects

9 Literature Cited

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