



LEWIS RIVER ADA FISHING SITE FEASIBILITY STUDY



LEWIS RIVER HYDROELECTRIC PROJECTS, WASHINGTON

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Acknowledgements



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Section 1. Site Selection

Introduction

PacifiCorp operates the Lewis River Hydroelectric Projects, which consists of three reservoirs along the Lewis River in Cowlitz County, Clark County, and Skamania County, Washington. According to their Federal Energy Regulatory Commission (FERC) Hydroelectric Project licenses, PacifiCorp is required to provide for public recreation use of the reservoirs. The federal license agreement stipulates that PacifiCorp provide a new Americans with Disabilities Act (ADA) compliant accessible bank fishing facility.

This study was conducted to determine the best location on the Lewis River for a new ADA accessible bank fishing facility, and then to propose alternate design concepts for such a facility.

Design Criteria

The following are considerations used in evaluating sites for an ADA accessible fishing facility:

- Environmental Constraints – Wetlands, stream buffers, unstable slopes, and critical habitat/nesting areas shall be avoided.
- Quality of fishing – The site should be where salmon, steelhead and trout are known to feed and congregate, free of weeds and obstructions that can snag fishing gear.
- Fishing seasons – The range of water levels in the lakes is relatively large. The water levels that are typical during the peak fishing seasons should be considered in determining key elevations of the fishing pier or float. It is assumed that an all-season facility is desired, and that deeper water is better for fishing.
- Aesthetics – Desired qualities include a scenic and rural environment, tranquil and without road noise, few insects, open to the south for sun exposure but with some shade, a comfortable micro-climate.
- Visibility – Site can be seen from SR 503, seen from side roads, seen from water, or seen from an existing recreation facility.
- Ease of access – A site close to major roads and population centers is better than a remote site, all else being equal. The site needs to be accessible from an existing side road or private drive, because adding a new driveway directly off of SR 503 (Lewis River Road) will likely not be approved by the Washington Department of Transportation.
- Property Ownership – PacifiCorp-owned land is preferred.
- Existing Recreation Opportunities – Using an existing PacifiCorp recreation facility can reduce the cost of new infrastructure required for the project.

- Developable Slopes - The site must allow for ADA accessible parking to be connected to the fishing facility by an ADA accessible route.
- Reservoir level fluctuation – Less variation in lake levels is preferred.
- Bathymetry – Considering the widely variable lake levels, steeper banks are preferred because they minimize the length of pier required to provide access to the water throughout the year.
- Sub-surface geology – Dense granular soils that are easy for pile driving and provide structural support without excessive pile length are desired. The cost of a pile supported pier can increase substantially if shallow bedrock, soft or liquefiable soils, boulders, or adverse pile driving conditions are present.
- Wind, waves, currents, ice, scour and shoreline erosion – Smaller waves and currents are desired to minimize loads on the structure, minimize rolling and motion of a floating pier, and reduce scour potential. A stable shoreline, neither eroding nor accreting is also preferred to minimize construction costs and potential maintenance dredging needs. Lake ice should be further investigated as ice cover is a possibility during severe winters. The Columbia River near Portland has frozen over in the past.
- Vegetation – Avoid sites that would require removal of protected trees such as 20"+ dbh firs.
- Ease and cost of permitting (may vary by county) and potential land use conflicts with neighbors, WSDOT, local tribes and others.

Additional design criteria information can be found in the following publications:

ADA Checklist for Existing Facilities – Fishing Piers and Platforms

<http://www.adachecklist.org/doc/rec/fishing/fishing.pdf>

Accessible Fishing Piers and Platforms, US Access Board, June 2003.

Design Handbook for Recreational Fishing and Boating Facilities, States Organization for Boating Access (SOBA), May 2006.

Design Guidelines for Recreational Fishing Facilities, Connecticut Department of Environmental Protection, September 2010.

Input Data and Assumptions

PacifiCorp provided the following GIS data which was used to select and compare potential sites:

- Bathymetry contours
- Upland contours

- Slopes
- Aerial photography
- Wetlands and wetland buffers
- Vegetation cover
- Waterbodies and streams
- Stream buffers
- Land ownership
- PacifiCorp recreation facilities
- Highways and roads

PacifiCorp provided historic lake level data, and information regarding fish from both PacifiCorp's own biologists and from the Washington Department of Fish and Wildlife (WDFW).

Water Levels

The Lewis River reservoirs and accordingly the water levels are regulated by dams. The water levels in Table 1 list preliminary information readily available on government websites (Figures 1 and 2). The annual range of water level is relatively large, about 16 feet and 20 feet in Lake Merwin and Yale Lake respectively, in a typical year. However, a range of 30 feet may be appropriate for design operating conditions. The reservoirs are sometimes lowered for dam repairs. For example, in 2004 Yale Lake was drawn down to an elevation of 460 feet to accommodate repairs to the Swift 2 Canal and power house.

Table 1. Water Elevations in Lake Merwin and Yale Lake (NGVD 29)

Elevation	Lake Merwin	Yale Lake
Full Pool	239.6 feet	490 feet
Minimum during 2010-2016	212 feet	459 feet
Range	27.6 feet	31 feet

References:

National Weather Service,
<http://forecast.weather.gov/product.php?site=NWS&product=RVM&issuedby=PQR>

US Geological Survey,
http://waterdata.usgs.gov/wa/nwis/dv?cb_62614=on&format=gif_stats&site_no=14218500&referred_module=sw&period=&begin_date=2009-10-01&end_date=2016-04-25

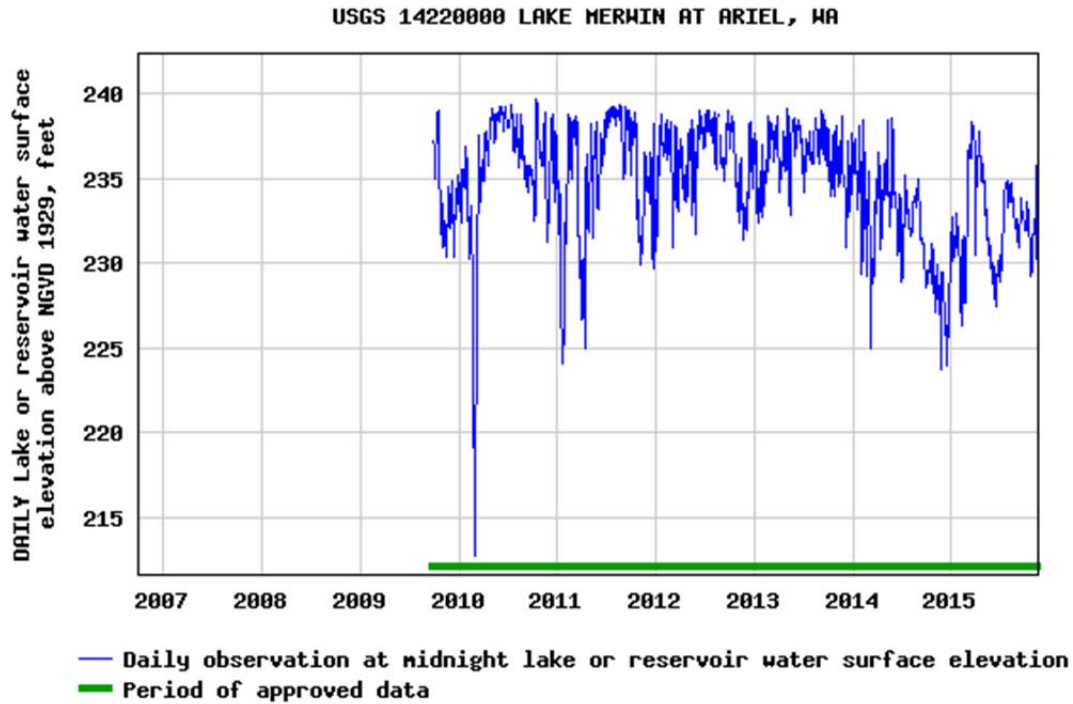


Figure 1. Water Levels in Lake Merwin 2010 to 2016

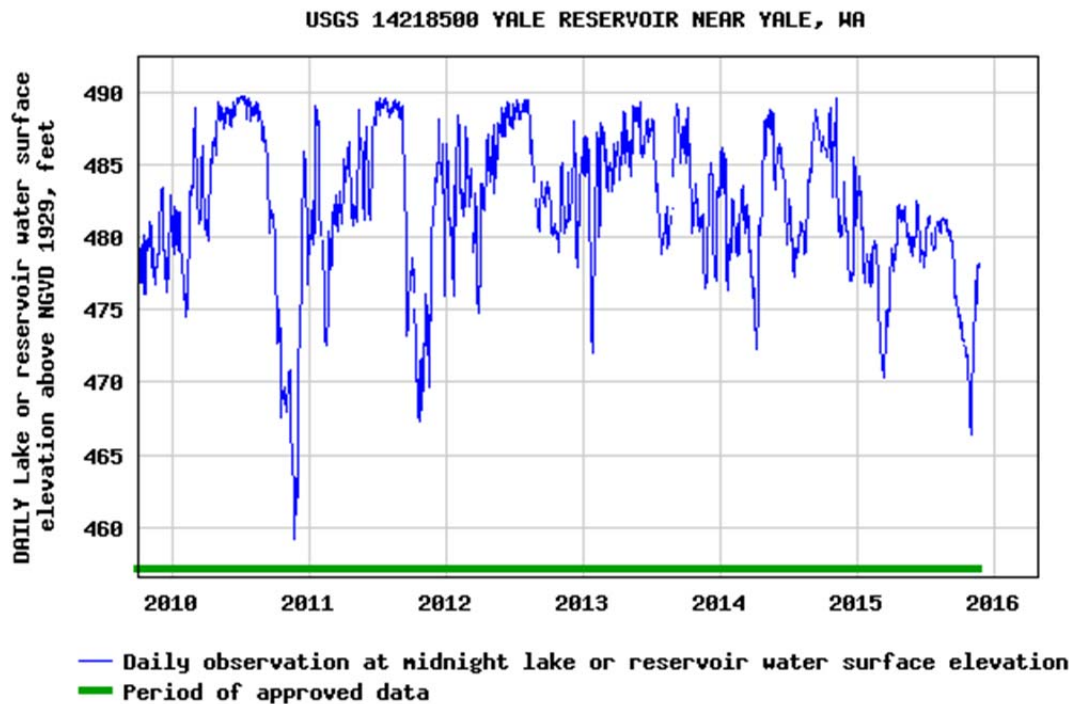


Figure 2. Water Levels in Yale Lake 2010 to 2016

Assessment of Potential Sites

Because of the potential to lower construction costs for new infrastructure, the existing PacifiCorp recreation sites were first evaluated as potential sites for the new accessible fishing facility. All recreation sites from Island Boat ramp below Merwin Dam up to Eagle Cliff past the upper end of Swift Lake were initially evaluated using GIS data provided by PacifiCorp. One undeveloped site on PacifiCorp land was also included in the initial evaluation because of its ease of access and proximity to an existing PacifiCorp recreation facility.

After a round of initial elimination, eight sites were selected for more in-depth evaluation. MacKay Sposito prepared three GIS exhibits for each of the eight sites: Aerial Photography, Topographic Constraints, and Ownership and Environmental Constraints. (See Appendix 1 for the three GIS exhibits prepared for Speelyai Bay Park.) The eight sites are listed and briefly described below. Only one undeveloped site was evaluated, since there were so many good options at existing PacifiCorp sites that would require less infrastructure investment.

Based on the evaluation of the eight potential sites, four were selected as the primary sites for further consideration: Speelyai Bay Park, Cresap Day Use Area, Yale Park, and Beaver Bay Day Use Area.

Speelyai Bay Park (primary site)

This boat launch and day use picnic area are open year-round. Recent construction includes new accessible parking, vault toilet, and accessible routes throughout the site. Speelyai Bay Hatchery is nearby. This site is in a bay and likely has relatively small waves at the planned pier or float. The bank is steeper than the other options.

Cresap Day Use Area (primary site)

This site is near where the Lewis River enters Lake Merwin and therefore may be a good fishing spot. The site is more exposed than Speelyai Bay with a long fetch to the west. The floating breakwaters at the boat ramps at this site are an indication that waves at this site are larger here than other parts of the lake.

Yale Park (primary site)

The site is on a point of land, making it more exposed to wind and waves. It has attractive views across Yale Lake, but the nearby road along the coast and open area around the boat launch is less desirable. The tip of the preliminary 60 feet long pier is at elevation 468, shallower water than the other three locations.

Beaver Bay Day Use Area (primary site)

This site may need maintenance dredging due to coastal sediment movement, as suggested by aerial photo history on Google Earth. It could be that the photos were taken when the lake levels were different, resulting only in the appearance of shoreline retreat/advance.

Cougar Campground

This site on the eastern shore of the campground is relatively protected from wind waves, but coastal sediment movement in the area may result in shallow water in the future.

Near Yale Bridge on SR 503

The narrow river location has small waves because of the small fetch, but probably not a preferred site due to the lack of existing infrastructure and noise from the nearby bridge.

Undeveloped Site Northwest of Cresap Campground

This site is protected from westerly waves. It appears attractive and rural, but other than a rough access road there is no existing infrastructure.

Merwin Park

This site is near Merwin dam and there may be currents caused by water intakes. It is exposed to a long fetch distance to the northeast. It is not a natural, rural environment.

PacifiCorp conducted internal reviews of these four sites to check for conflicts with known historical or cultural artifact protections, and for environmental constraints, and nothing was found that would preclude development.

Preferred Site

Based on its clear advantages over the other potential sites, PacifiCorp chose Speelyai Bay Park as the preferred site for the accessible bank fishing facility. Deciding factors include:

- There is an existing road connection to SR 503.
- There is existing infrastructure including recently constructed accessible parking, accessible vault toilet, and accessible path connecting the parking and toilet to a picnic area overlooking the lake.
- The park and boat launch are open all year.
- Lake Merwin has the least lake level fluctuations of all three reservoirs.
- There is an open grassy area beyond the main picnic area, at the shoreline, which is relatively unused.
- Speelyai Bay extends north from the north shoreline of Lake Merwin, and provides some shelter from wind and waves.
- The bathymetry shows that the bank near the picnic area falls away steeper than most other sites evaluated, which minimizes the size of pier required.
- The Speelyai Bay Hatchery is at the north end of Speelyai Bay, and may provide opportunities to catch returning Kokanee salmon.

See Appendix 1 for the GIS analysis exhibits used in part to select Speelyai Bay Park.

Section 2. Concept Alternatives

Site Reconnaissance

MacKay Sposito, Mott MacDonald, and PacifiCorp conducted a site visit to review and record the existing conditions at Speelyai Bay Park and evaluate the practicality of adding a new fishing facility. Among the items reviewed were accessibility, parking, pedestrian circulation, vehicular circulation, vegetation, the shoreline, views, sun and shade exposure, and the locations of existing park uses and concentrations of activity. The information was collected in the form of field notes and photos.

Inventory and Analysis

(See Appendix 2 for Inventory and Analysis exhibits)

A base map for the inventory and analysis exhibit was prepared by MacKay Sposito, derived from a 2011 survey by MacKay Sposito and bathymetry contours provided by PacifiCorp. This information was supplemented with information discovered and verified in the field during the site reconnaissance.

Using this information, MacKay Sposito analyzed and identified the opportunities and constraints of the site with relationship to the design criteria.

The results of the analysis were recorded on the Inventory and Analysis exhibit (see Appendix 2). In general, the Inventory and Analysis exercise confirmed that Speelyai Bay Park is a good site to locate the new accessible fishing facility, and it identified general locations for the fishing facility itself and the accessible route leading to it.

Considerations for Bank Fishing Facilities

A key decision point is whether the fishing pier is floating or a pile supported pier. Both will likely require pile driving. A solid fill pier or bulkhead is assumed not desired, but may be the most economical if deep water and good fishing are located close to shore.

A floating pier is closer to the water, which is preferred for fishing. However, a floating pier is more sensitive to waves and currents, with higher loads. The motion of a floating pier may not be acceptable for an ADA accessible pier at times. A floating pier also requires a boarding ramp/gangway, which needs to be no steeper than 1:12 for ADA access. If the range of water levels is large the gangway may become longer than typical, requiring special design features. A floating pier may require it to be grounded at low water at some sites, or built with a fixed approach pier to deeper water. In general, a floating pier is more complex to analyze and design than a fixed pier. It is not clear which would have a higher construction cost. A simple, narrow light-weight float would be less expensive than a fixed pier. However, a relatively wide and heavy concrete float would be more suitable considering the need to minimize rolling motion due to wind, waves and currents.

Concept 1: Pier, Gangway, and Float

(See Appendix 3 for Overall Site Plan and Concept 1 plan)

This concept consists of a short fixed pier, a 120' long gangway, a landing float and a fishing float. This provides the option of fishing from the elevated pier, or closer to the water on the float. The pier will provide fishing access to the water 99% of the time, and the float will provide fishing access 100% of the time for the general public. ADA access to the float will be limited to 78% of the time because at lower water levels the gangway will exceed the maximum 12h:1v slope allowed by ADA.

Concept 2: Pier to Deeper Water

(See Appendix 3 for Overall Site Plan and Concept 2 plan)

This concept is a single long elevated pier, which provides fishing access to the water for 100% of the time for both the general public and for ADA access.

Concept 3: Pier Close to Shore

(See Appendix 3 for Overall Site Plan and Concept 3 plan)

This is similar to Concept 2, except the elevated pier is shorter and thus less construction cost. It is also constructed with concrete piles on concrete footings, so will require a lake drawdown during construction (Concepts 1 and 2 use steel piles which can be installed in water). It provides fishing access to the water approximately 99% of the time for both the general public and for ADA access.

Concept 4: Fishing Platform

(See Appendix 3 for Overall Site Plan and Concept 4 plan)

This concept consists of a simple concrete platform on a new concrete retaining wall built in line with the existing wood bulkhead. It would include a guardrail with lowered sections for accessible fishing. This option would only provide fishing access when the lake levels are relatively high, and at most times would require casting technique to move the lure out into the water. However this option is by far the lowest cost to build.

Cost Estimation

A conceptual level cost estimate was developed for each of the four concepts:

Upland Construction (applies to all four concepts below):

\$5,000	Extend existing accessible path to fishing pier
\$5,000	Grading, erosion control, staking, relocate picnic tables, site restoration
<u>\$3,000</u>	Design and engineering
\$13,000	Subtotal Upland Construction (included with each concept below)

Concept 1: Pier, Gangway, and Float:

\$50,000	Mobilization
\$230,000	Steel pile supported pier
\$144,000	Gangway
\$135,000	Landing float
\$135,000	Fishing float
\$45,000	Design and engineering
\$15,000	Sub-surface geotechnical investigation
\$10,000	Surveying
\$45,000	Construction management
<u>\$13,000</u>	Upland construction
\$822,000	Subtotal Concept 1
\$63,300	7.7% Washington sales tax
<u>\$164,400</u>	20% construction contingency
\$1,049,700	Concept 1 Total (not including permitting fees)

Concept 2: Pier to Deeper Water:

\$50,000	Mobilization
\$476,000	Steel pile supported pier
\$34,000	Design and engineering
\$15,000	Sub-surface geotechnical investigation
\$10,000	Surveying
\$34,000	Construction management
<u>\$13,000</u>	Upland construction
\$632,000	Subtotal Concept 2
\$48,700	7.7% Washington sales tax
<u>\$126,400</u>	20% construction contingency
\$807,100	Concept 2 Total (not including permitting fees)

Concept 3: Pier Close to Shore

\$25,000	Mobilization
\$243,800	Concrete pile supported pier
\$32,000	Design and engineering

\$15,000	Sub-surface geotechnical investigation
\$10,000	Surveying
\$32,000	Construction management
<u>\$13,000</u>	Upland construction
\$370,800	Subtotal Concept 3
\$28,600	7.7% Washington sales tax
<u>\$74,200</u>	20% construction contingency
\$473,600	Concept 3 Total (not including permitting fees)

Concept 4: Fishing Platform:

\$5,400	Concrete paving
\$2,000	Concrete seat wall at back of platform
\$13,000	Concrete retaining wall
\$5,600	Excavation and backfill for retaining wall
\$15,000	Guard rail
\$1,000	Site furnishings
\$15,000	Design and engineering
\$5,000	Sub-surface geotechnical investigation
\$5,000	Surveying
\$20,000	Construction management
<u>\$13,000</u>	Upland construction
\$94,000	Subtotal Concept 4
\$7,300	7.7% Washington sales tax
<u>\$18,800</u>	20% construction contingency
\$120,100	Concept 4 Total (not including permitting fees)

Section 3. Anticipated Regulatory and Permitting Summary

Project Description

Pursuant to Section 11.2.14 of the Lewis River Settlement Agreement, PacifiCorp shall conduct a feasibility study to identify the most feasible location for one ADA-accessible bank fishing access site in one of the following areas: the Lewis River between Merwin Dam and the Island River Access, Swift Reservoir, Yale Lake, and Lake Merwin. PacifiCorp is then to construct an ADA-accessible bank fishing facility at that site. Site inventories and assessments associated with this project conclude the most feasible location is at Speelyai Bay Park. Specifically, the project is proposed to be located on the North side of Merwin Reservoir in Cowlitz County, Washington, approximately 19 miles east of the City of Woodland, Washington. The proposed improvements for Speelyai Bay Park, associated with the ADA-accessible bank fishing access may include the following elements:

- Extending the existing ADA-accessible path through the picnic area to the fishing access
- Construction of an ADA-accessible bank fishing structure, designed as either a fixed pier structure or a floating pier system.

For purposes of permitting the Project, the full pool elevation for Merwin Reservoir (240 feet above mean sea level (MSL), will constitute the Ordinary High Water Mark (OHWM) for the Reservoir. The following elements will likely involve impacts to areas below the OHWM of Merwin Reservoir.

- Fixed or floating pier support structure(s) and associated access walkways

Speelyai Bay Park currently provides vehicle access for boats, picnicking, and swimming along Merwin Reservoir. Construction of the proposed Project is scheduled for 2018.

The following is intended to provide a brief overview of the necessary permits required for construction improvements at Speelyai Bay Park, and potential design considerations needed to avoid impacts to sensitive resources.

Required Federal, State and County Permits

The Project area has been previously surveyed for wetlands, waters, and critical areas, during park improvement projects completed in 2014. It is confirmed the site has delineated wetlands and is within Critical Bull Trout habitat (discussed below). The wetlands are not likely to be affected by the proposed project and will be flagged as “no work” zones. An additional site visit will be needed once the Area of Potential Impact (API) is finalized to confirm that wetlands can be avoided.

DOE and ACOE Permits

As currently proposed, installation of a new fixed or floating ADA-accessible fishing pier will occur below the OHWM of Merwin Reservoir. Due to the proposed work within waters, the Project will require discharge authorizations from the U.S. Army Corps of Engineers (ACOE) and Washington Department of Ecology (DOE) (corresponding to Sections 404 and 401 of the Clean Water Act, respectively). Given the observations noted above regarding wetlands, an additional Wetland Delineation Report would not be required unless wetland impacts cannot be avoided in the ADA path extension alignment. It is likely that the impacts below the OHWM of Merwin Reservoir can be authorized under a Nationwide Permit (NWP) No. 42 (Recreational Facilities) from the ACOE. In addition, the following NWPs may apply to the proposed Project: NWP No. 18 (Minor Discharges), and/or NWP No. 25 (Structural Discharges). A Joint Aquatic Resources Permit Application (JARPA) would need to be submitted in an application for the Section 404 and Section 401 permits. The JARPA will need to include a discussion of alternatives for the proposed Project in order to document that the proposed design is the best practicable alternative with the least amount of impact to waters.

It is anticipated that the Project will result in minimal waters impacts. Therefore, we do not anticipate the need for a formal compensatory wetland or waters mitigation plan for this Project. Both a National Pollutant Discharge Elimination System (NPDES) Permit and a Stormwater Pollution Prevention Plan (SWPPP) will be required by DOE if the project results in disturbance of more than one acre.

WDFW and USFWS Approvals

The Project will require Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) because portions of the Project will be conducted within waters of the State of Washington (ADA-accessible fishing pier supports) and will use, divert, obstruct, or change the bed or flow of State waters. The JARPA will also serve as an application for the HPA.

PacifiCorp wildlife biologist Kendel Emerson has noted that the closest, known, active bald eagle (*Haliaeetus leucocephalus*) nest is located east of Speelyai Bay Park within Cowlitz County and greater than 1,000 feet from the Project area. Kendel Emmerson did note that bald eagles utilize the Project area for foraging. If a bald eagle nest is subsequently located in proximity to the Project area, restrictions may be placed on the timing and types of activities permitted to occur during Project construction as required under the Bald and Golden Eagle Protection Act (BGEPA). These restrictions would include limiting work during the breeding season (January 1-August 15) if the Project is within 660 feet of the active nest. Washington state has revised its Bald Eagle Protection Rules (WAC 232-12-292) such that the U.S. Fish and Wildlife Service (USFWS) is now solely responsible for consultation and permit issuance under the BGEPA when there is a potential for disturbance to bald eagles.

Following the issuance of USFWS Biological Opinion (BiOp) 1-3-06-F-0177 (USFWS 2006) for the FERC Relicensing of the Lewis River Hydroelectric Projects, the USFWS designated additional critical habitat for Bull trout (*Salvelinus confluentus*) not previously considered in the BiOp. Direct effects of the proposed Project to bull trout and their habitats are covered and were considered in the BiOp; however, potential effects to critical habitat, as it is designated today, for this species was not specifically addressed. A brief letter requesting Informal Consultation for

potential impacts to bull trout critical habitat would need to be prepared and submitted to USFWS.

SEPA Checklist

To comply with the state of Washington's State Environmental Policy Act (SEPA), a SEPA Checklist will need to be submitted that addresses the project plans and potential impacts. Cowlitz County will be the lead agency reviewing the SEPA Checklist.

Shoreline Permits

Since the Project is proposed to occur within 200 feet of Merwin Reservoir, Shoreline Permits are required from Cowlitz County. The Project area shoreline has been designated a Conservancy Management District per the Cowlitz County Shorelines Management Master Plan (SSMP). The proposed Project will fall under the Recreation Use category and is subject to the following conditions:

- Except for those facilities which require a location adjacent to a body of water, all facilities shall be prohibited within 10 feet of the OHWM as measured on a horizontal plane; buildings exceeding 35 feet in height above average grade level must be at least 50 feet from the OHWM, as measured on a horizontal plane.
- Parking areas shall be prohibited within 20 feet of the OHWM as measured on a horizontal plane.
- A recreational facility or structure which detracts from the character of the local environment shall be prohibited.
- Access roads to recreational facilities shall comply with regulations under the use activity Roads.
- Parking facilities shall be prohibited within twenty (20) feet of the shoreline as measured on a horizontal plan and surface runoff must meet all city, county, and state requirements in view of water quality.
- Little or no major change of environment by man-made structures, contrivances shall be permitted.

Construction of an ADA-accessible fishing pier will also fall under the Marinas Use category and will need to meet the requirements below. For the purposes of the Cowlitz County SSMP, public recreation docks fall under the Marinas Use.

- Any person proposing to undertake a marina development, construction, expansion and/or alteration, or any phase thereof which constitutes a complete project, shall apply for a permit.
- A permit for marina development, construction, expansion and/or alteration or, any phase thereof which constitutes a complete project, may be granted subject to the following regulations:
 - The latest revision 'Criteria Governing the Design of...Marinas...for Protection of Fish and Shellfish Resources' adopted by the Washington State Department of

Fisheries in 1971, which criteria are incorporated herein by reference, and are to be adjusted to local tidal levels.

- Parking facilities shall be set back from the ordinary high water mark at its location following marina development by a minimum of twenty (20) feet measured on a horizontal plane to provide public access to and viewing from the immediate shoreline area.
- Sewage pump-out and treatment facilities shall be installed within two years of the establishment of the US. Coast Guard regulations on marine sanitation devices or at the beginning of operations of any new marina or of an expansion of any 'existing' marina, whichever date is latest.
- Development of marina shall comply with state and local health agencies, regulations.
- A single, joint-use moorage facility shall be required of any subdivisions, motels, multi-family residences, or commercial and industrial enterprises in close proximity to each other.
- Special attention shall be given to the design development of operational procedures for fuel handling and storage in order to minimize accidental spillage and provide satisfactory means for handling those spills that do occur.

The signage components of the proposed Project will fall under the Outdoor Advertising, Signs and Billboards Use category and will need to meet the following requirements:

- Off-premise outdoor advertising will be limited to areas of high-intensity land use such as commercial and industrial areas.
- Outdoor advertising, signs and billboards shall be allowed, provided, if they are:
 - Official in nature.
 - A commercial sign advertising commodities for sale, non-illuminating, 32 square feet or less in size, and does not exceed ten (10) feet at its highest point from the ground.
 - A real estate sign offering for sale, lease, or rent, non-illuminating, 32 square feet or less in size, and does not exceed ten (10) feet at its highest point from the ground.
 - Of any nature placed on the side of a building, 32 square feet or less in size, and non-illuminating.
 - Not obstructing or degrading a view or scenic vista.
 - Integral in nature marking monuments, historic or cultural places, and
 - Does not obstruct sight distance to motorized travelers.

If the proposed Project meets the Recreation, Marinas, and Outdoor Advertising, Signs and Billboards Use requirements above, the proposed Project will likely qualify for a Shoreline Substantial Development Permit. The JARPA and SEPA Checklist, in conjunction with project plans, will serve as the application for a Cowlitz County Shoreline Substantial Development Permit.

Critical Areas

Cowlitz County will review the proposed Project's potential impacts to Critical Areas prior to issuing other permits. The County is charged with making a determination of which Critical Areas are on site. The proposed Project's likely requirements with respect to each type of Critical Area are discussed below.

Fish and Wildlife Habitat Conservation Area: Merwin Reservoir is a Type S (Type 1) waters inventoried as "shorelines of the state." As such, the proposed Project will impact a Classification 5 (Waters of the State) Fish and Wildlife Habitat Conservation Area and its 150 foot Riparian Habitat Area (RHA) buffer. In addition, the Reservoir is a Classification 1 Fish and Wildlife Habitat Conservation Area due to the presence of Columbia River Distinct Population Segment (DPS) Bull trout, a federally listed threatened species. The Project area may also be considered a Classification 2 Fish and Wildlife Habitat Conservation Area because it provides foraging habitat for bald eagle, a state priority species. Due to the proposed Project's in-water and shoreline work in the Fish and Wildlife Habitat Critical Area, a Level Two Critical Areas Assessment will likely be required.

Miscellaneous County Permits

Construction of the facility will likely trigger Cowlitz County Building and Engineering Review of project plans. In addition, if the proposed Project involves grading more than 100 cubic yards of material, Cowlitz County will also require a Clear and Grade Permit.

Section 4. Appendices

Appendix 1: Site Selection Exhibits



LEWIS RIVER ADA ACCESSIBLE FISHING
SITE FEASIBILITY STUDY

PRIMARY POTENTIAL SITE:

SPEELYAI BAY PARK

LAKE MERWIN, OHWM 239.6'

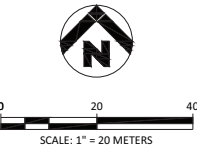
AERIAL PHOTOGRAPHY

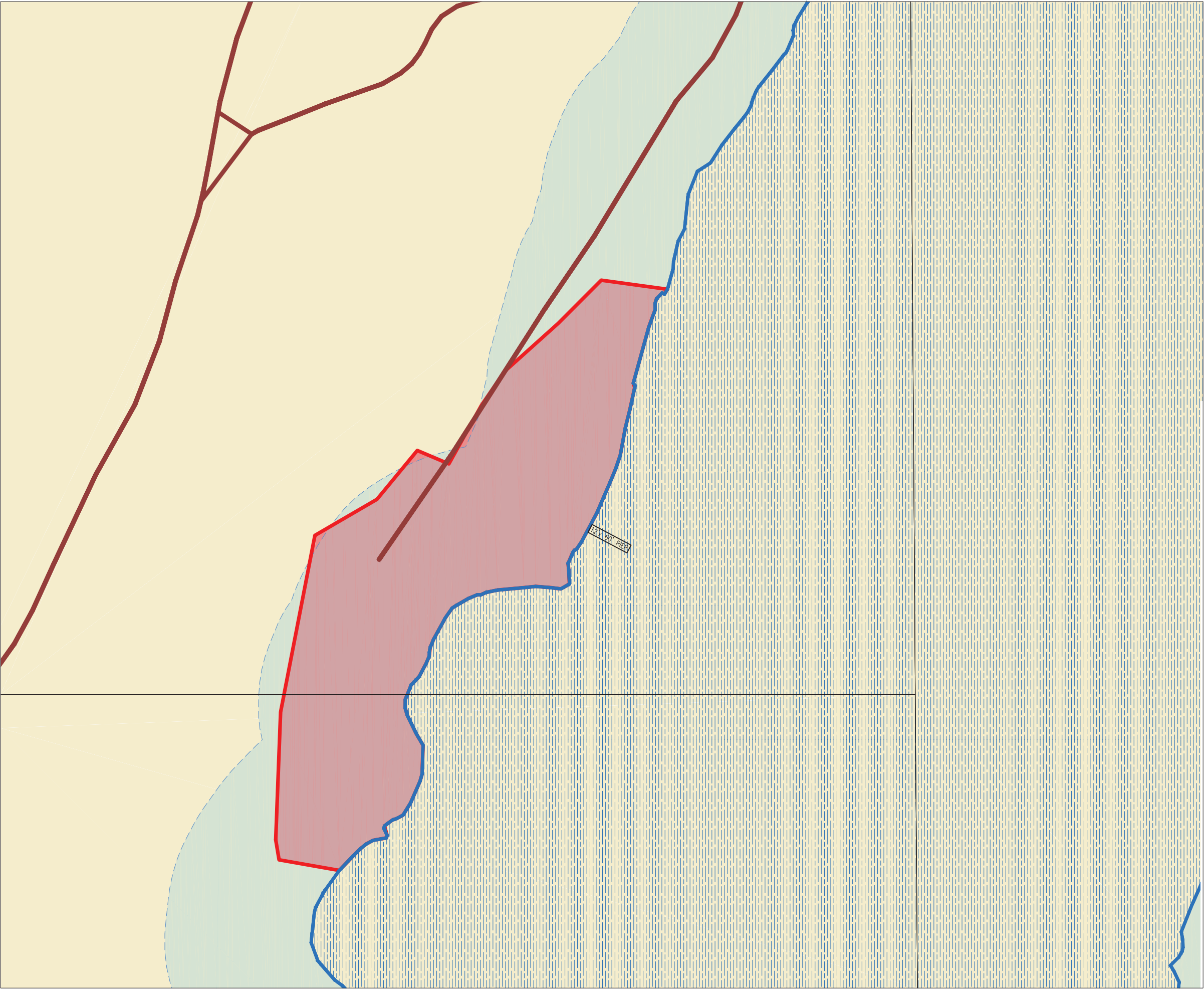
MARCH 22, 2017



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bus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the





LEWIS RIVER ADA ACCESSIBLE FISHING
SITE FEASIBILITY STUDY

PRIMARY POTENTIAL SITE:

SPEELYAI BAY PARK

LAKE MERWIN, OHWM 239.6'

**OWNERSHIP AND ENVIRONMENTAL
CONSTRAINTS MAP**

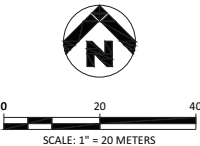
MARCH 22, 2017

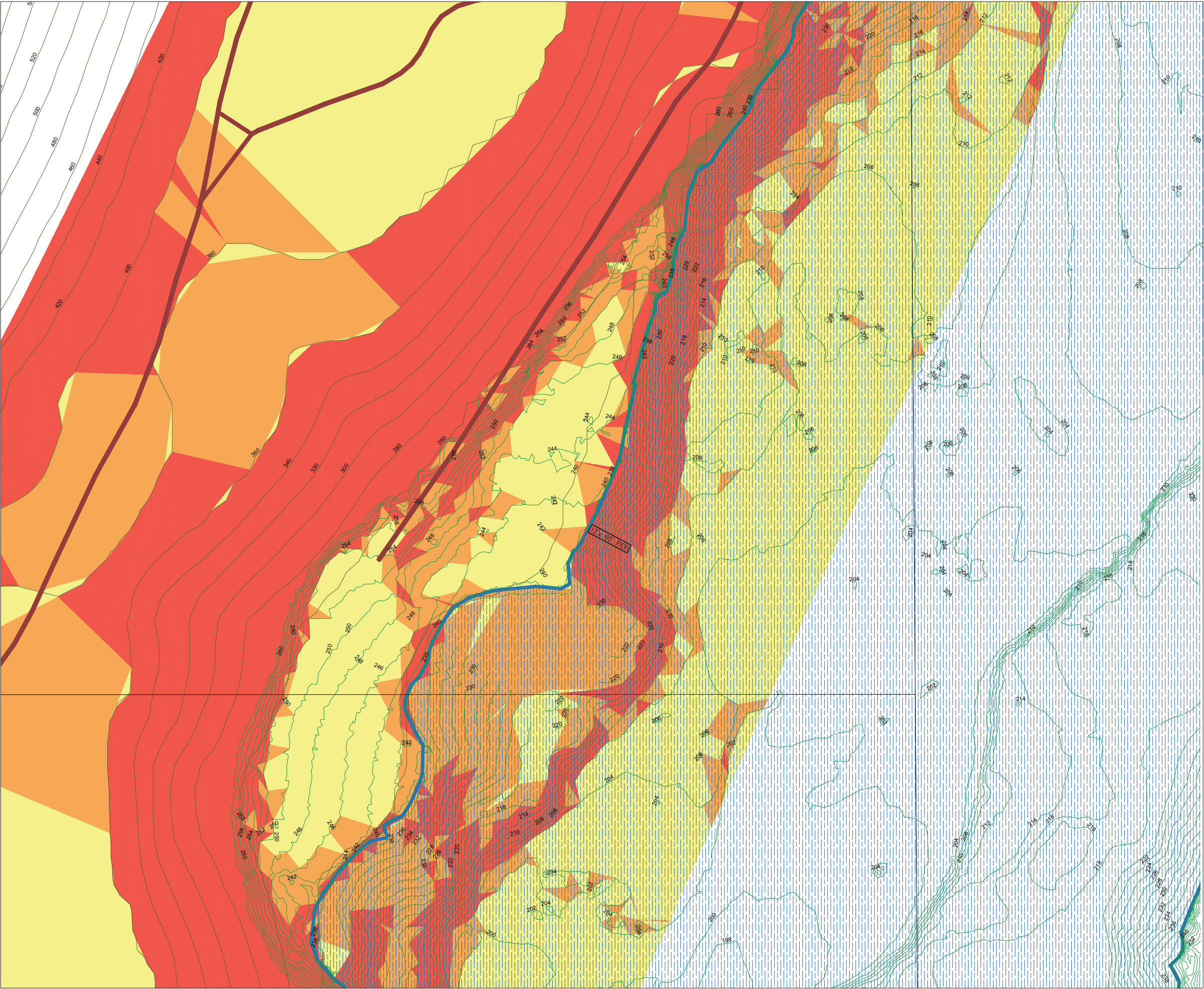


ENERGY PUBLIC WORKS LAND DEVELOPMENT
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LEGEND

-  ROADS
-  LAKE OR RIVER
-  STREAM AND STREAM BUFFER
-  WETLAND AND WETLAND BUFFER
-  PACIFICORP RECREATION SITE
-  PACIFICORP OWNED PARCEL
-  PUBLICLY OWNED PARCEL
-  OTHER PRIVATELY OWNED PARCEL





LEWIS RIVER ADA ACCESSIBLE FISHING
SITE FEASIBILITY STUDY

PRIMARY POTENTIAL SITE:

SPEELYAI BAY PARK

LAKE MERWIN, OHWM 239.6'

TOPOGRAPHIC CONSTRAINTS MAP

MARCH 22, 2017



ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

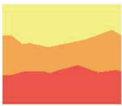
LEGEND



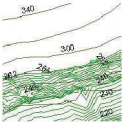
ROADS



LAKE OR RIVER



SLOPE:
0% TO 8% (YELLOW)
9% TO 20% (ORANGE)
OVER 20% (RED)

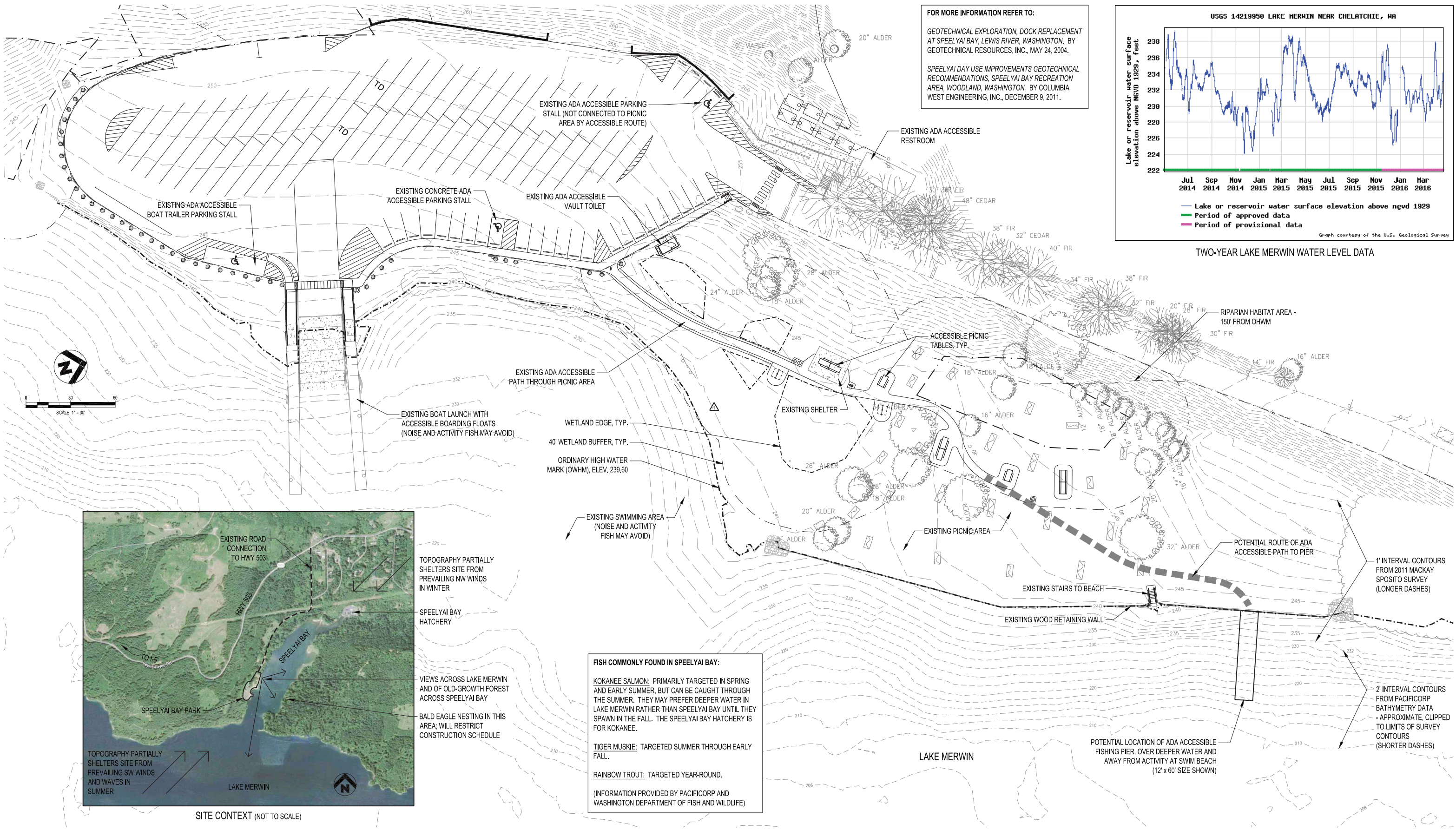


20' UPLAND CONTOURS
2' BATHYMETRY CONTOURS



0 20 40
SCALE: 1" = 20 METERS

Appendix 2: Inventory and Analysis Exhibits





VIEW NORTHEAST ACROSS SPEELYAI BAY FROM PICNIC AREA, TOWARD HATCHERY



VIEW SOUTHEAST ACROSS SPEELYAI BAY FROM PICNIC AREA, TOWARD EAGLE NESTING AREA



VIEW SOUTH ACROSS SPEELYAI BAY AND LAKE MERWIN FROM PICNIC AREA



ADA ACCESSIBLE PATH FROM PARKING LOT THROUGH PICNIC AREA

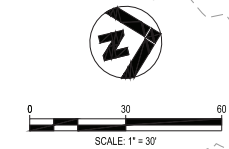
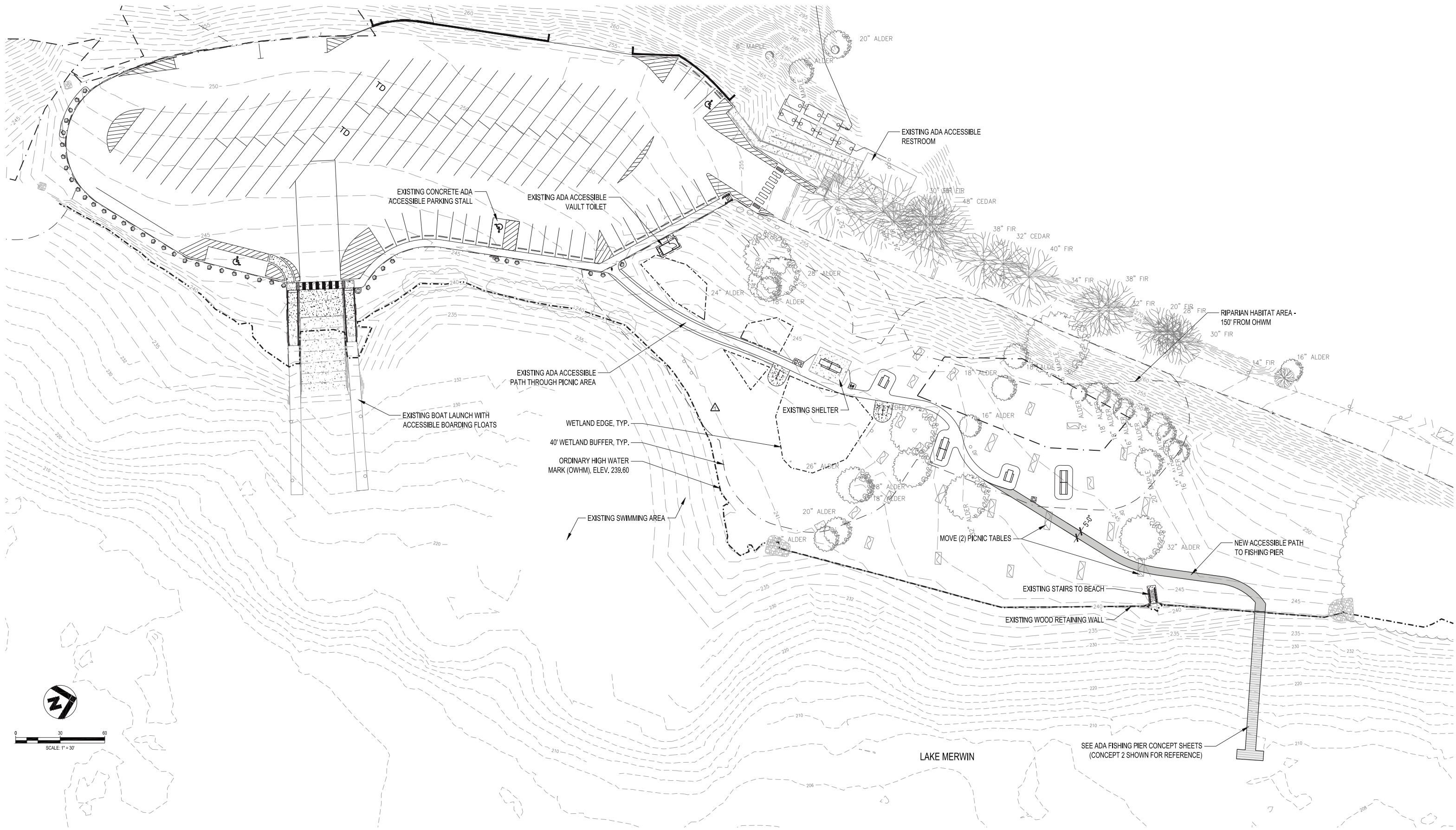


END OF EXISTING ADA ACCESSIBLE PATH, WHERE PATH TO NEW FISHING PIER WOULD POTENTIALLY START

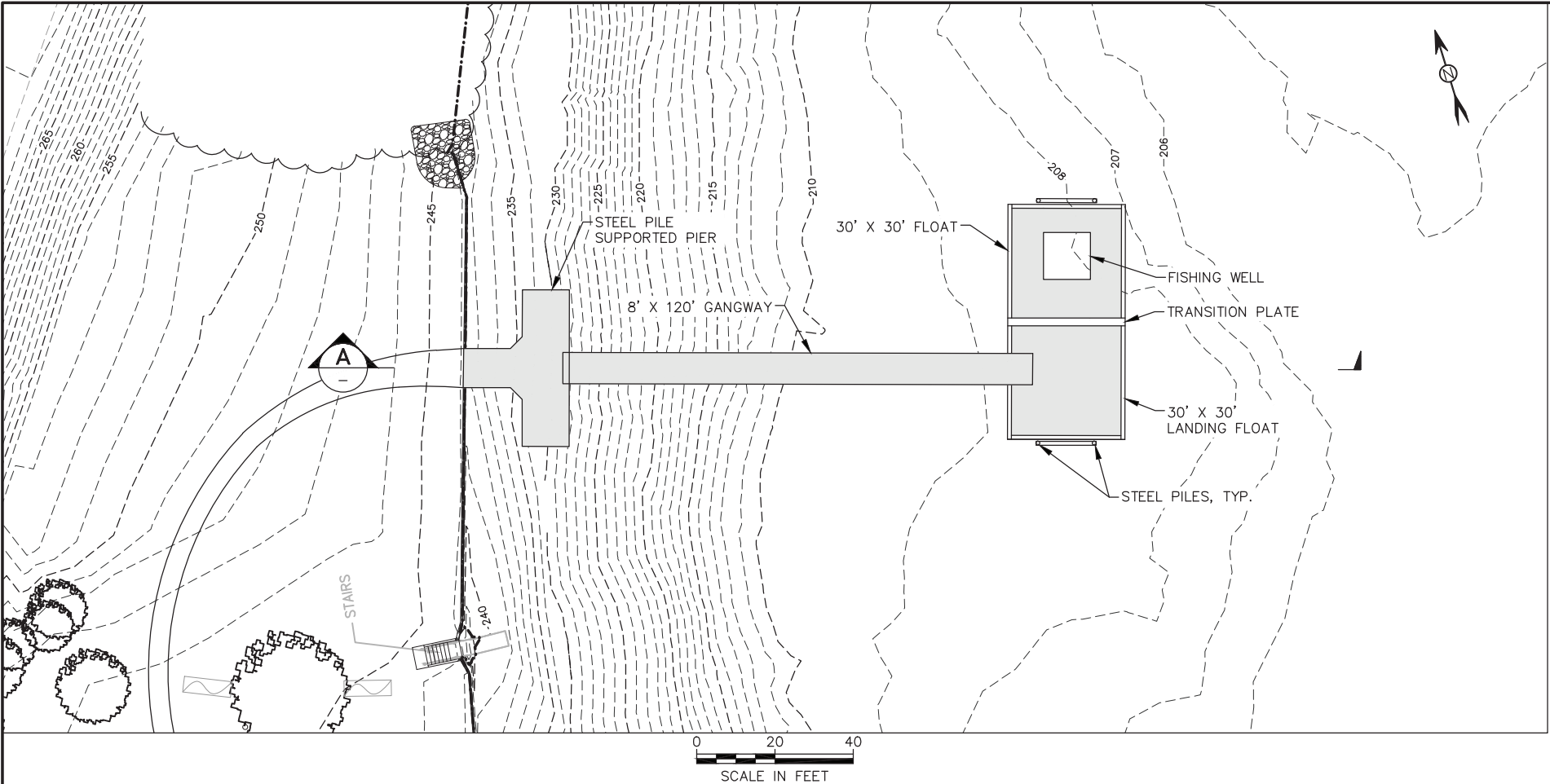


EXISTING WOOD BULKHEAD AND STAIRS

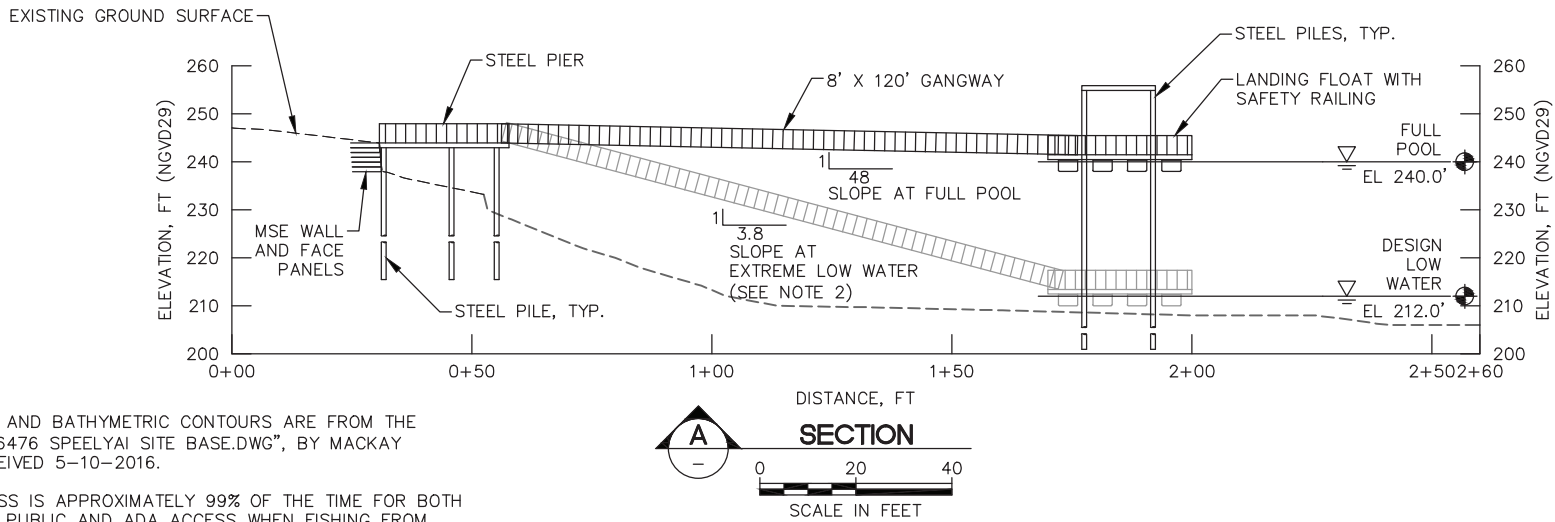
Appendix 3: Concept Alternative Exhibits



FILE: Z:\351325 - Mackay Spósito Saddle Dam, Yole Day Use, Lewis River\7 - Design\CAD\Lewis R Fishing Pier\351325-Site Plan.dwg PLOT DATE: 2016-05-19



GANGWAY AND LANDING FLOAT, TYPICAL



NOTES

1. TOPOGRAPHIC AND BATHYMETRIC CONTOURS ARE FROM THE BASE MAP "16476 SPEELYAI SITE BASE.DWG", BY MACKAY SPOSITO, RECEIVED 5-10-2016.
2. FISHING ACCESS IS APPROXIMATELY 99% OF THE TIME FOR BOTH THE GENERAL PUBLIC AND ADA ACCESS WHEN FISHING FROM THE FIXED PIER ONLY. APPROXIMATELY 1% OF THE TIME THE WATER LEVEL WILL BE BELOW THE GROUND ELEVATION AT THE END OF PIER.
3. FISHING ACCESS FROM THE FLOAT IS 100% OF THE TIME FOR GENERAL PUBLIC AND 78% OF THE TIME FOR ADA ACCESS. THE ADA SLOPE LIMIT OF 12H:1V IS EXCEEDED ON THE GANGWAY WHEN THE RESERVOIR WATER LEVEL IS LOWER THAN 232.1 FEET, NGVD, WHICH IS 22% OF THE TIME.

DESIGNED BY	JL				
ENTERED BY	CT				
CHECKED BY	NS			JOB NUMBER	
PROJECT ENGINEER	SP			351325	
PROJECT MANAGER	NS			CONTRACT NO.	
DATE	REVISION	BY			

SCALE	
HORIZ.: AS NOTED	
VERT.: AS NOTED	
VERIFY SCALE	
BAR IS ONE INCH ON 22x36	
DRAWINGS AND HALF INCH ON	
11x17 DRAWINGS, IF NOT, ADJUST	
SCALES ACCORDINGLY	
0 1"	

M
MOTT
MACDONALD

110 JAMES STREET, SUITE 101
EDMONDS, WA 98020
PHONE 425.778.2542
FAX 425.778.6883

PACIFICORP
A PACIFICORP COMPANY

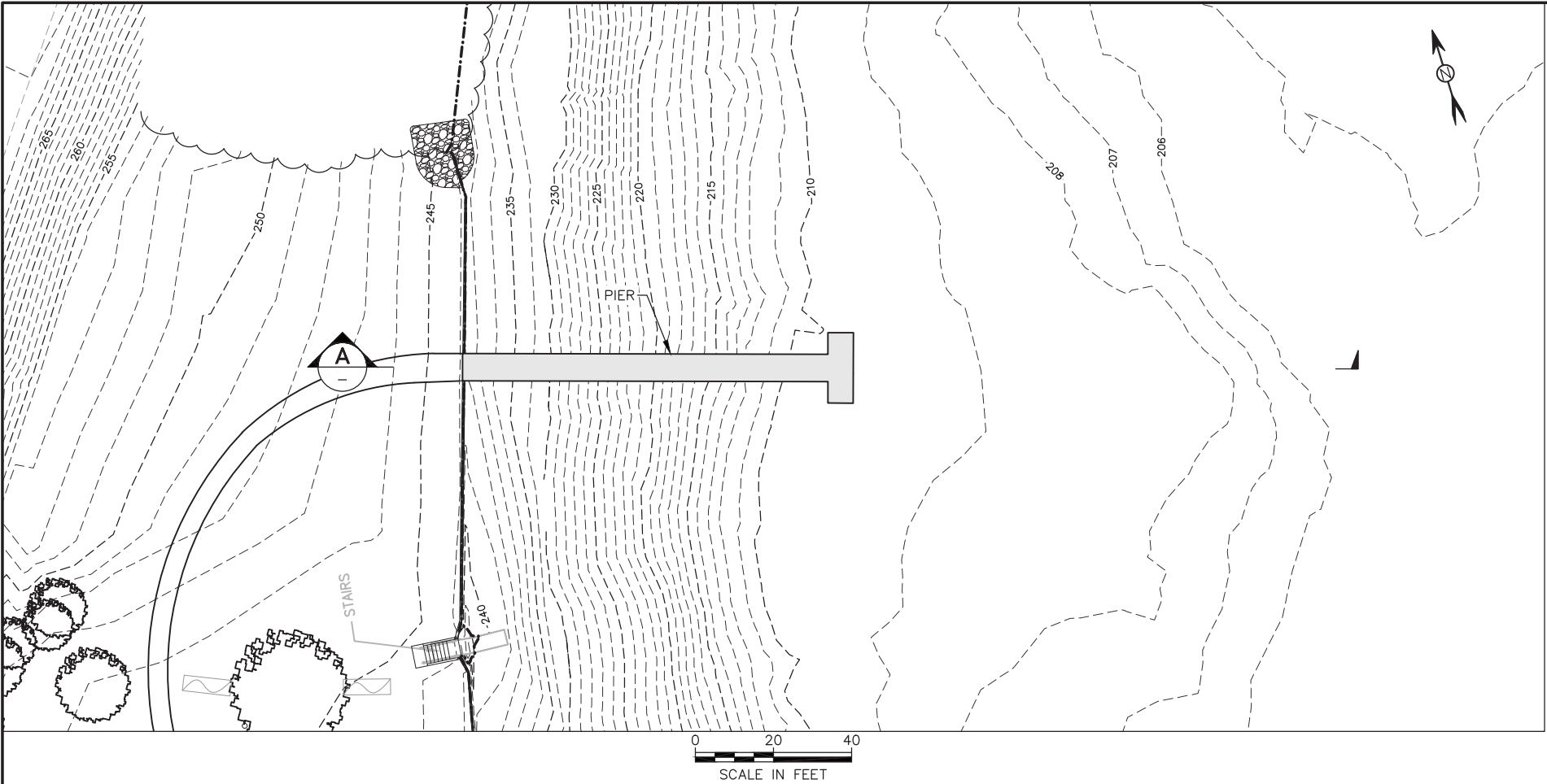
LEWIS RIVER
ADA FISHING PIER
FEASIBILITY ASSESSMENT

CONCEPT 1

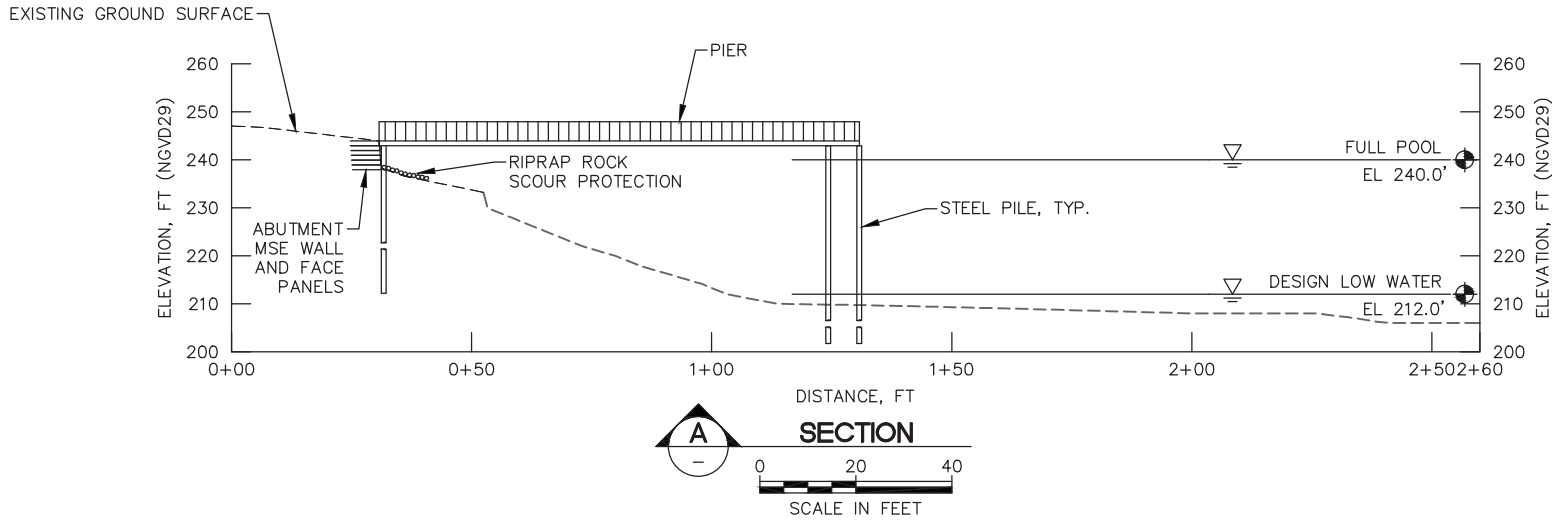
REFERENCE
SHEET
NUMBER

SHEET
1
OF
3
SHEETS

FILE: Z:\351325 - Mackay Sposito Saddle Dam, Yale Day Use, Lewis River\7 - Design\CAD\Lewis R Fishing Pier\351325-Site Plan.dwg PLOT DATE: 2016-05-19



FISHING PIER AT BURKETT LAKE



- NOTES
1. TOPOGRAPHIC AND BATHYMETRIC CONTOURS ARE FROM THE BASE MAP "16476 SPEELYAI SITE BASE.DWG", BY MACKAY SPOSITO, RECEIVED 5-10-2016.
 2. FISHING ACCESS IS 100% OF THE TIME FOR BOTH GENERAL PUBLIC AND ADA ACCESS.

DESIGNED BY	JL				
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PROJECT ENGINEER	SP			351325	
PROJECT MANAGER	NS			CONTRACT NO.	
DATE		REVISION		BY	

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BAR IS ONE INCH ON 22x36	
DRAWINGS AND HALF INCH ON	
11x17 DRAWINGS, IF NOT, ADJUST	
SCALES ACCORDINGLY	
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PHONE 425.778.2542
FAX 425.778.6883

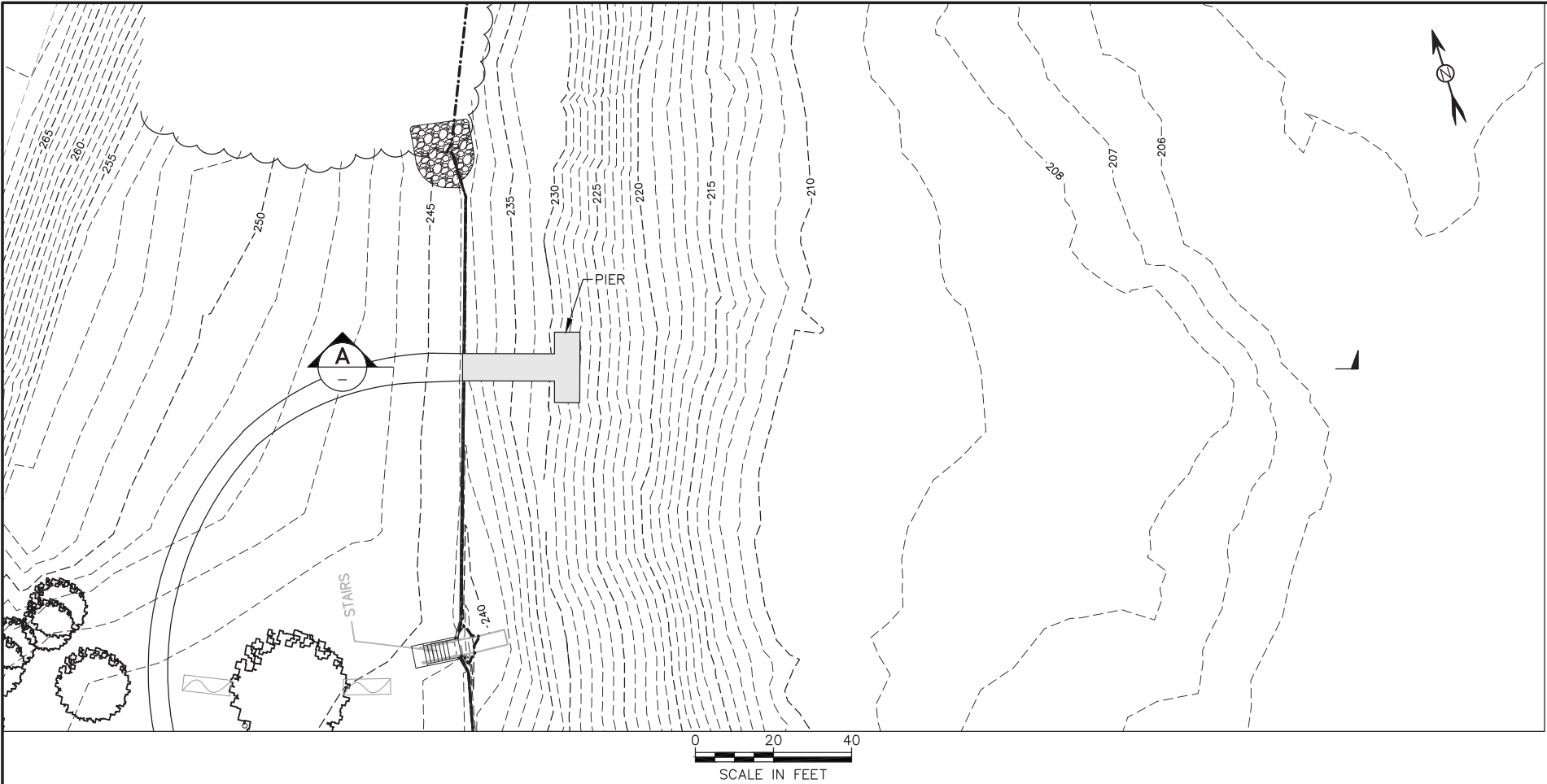


LEWIS RIVER
ADA FISHING PIER
FEASIBILITY ASSESSMENT

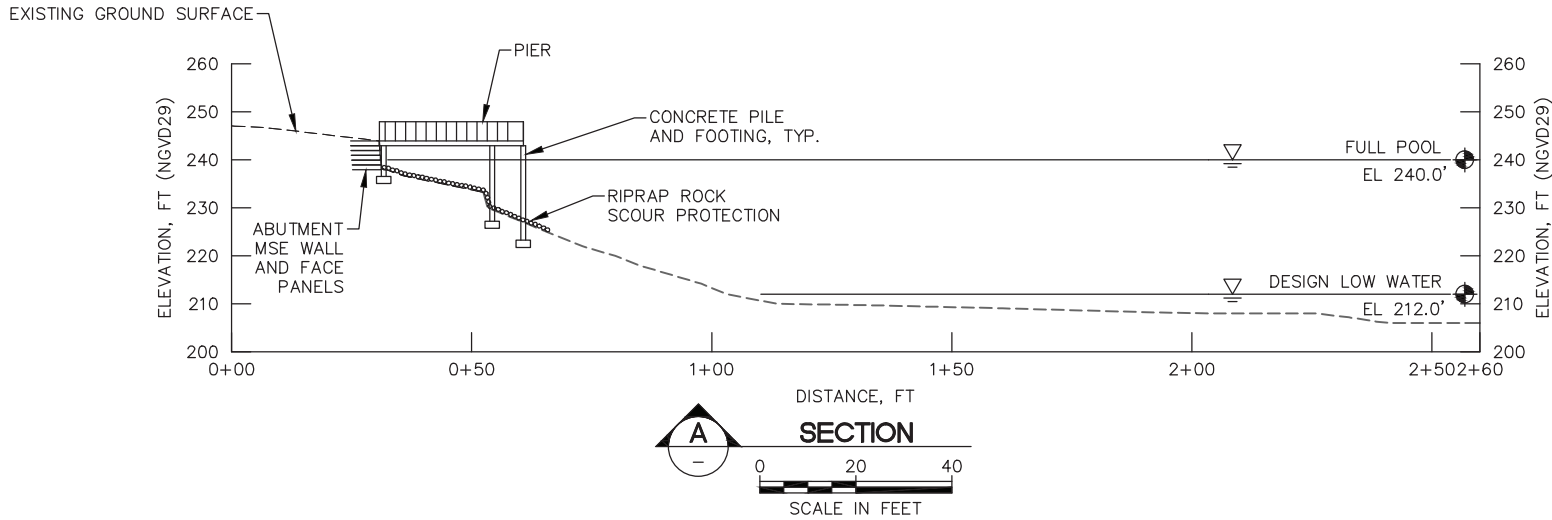
CONCEPT 2

REFERENCE SHEET NUMBER
SHEET 2 OF 3 SHEETS

FILE: Z:\351325 - Mackay Sposito Saddle Dam, Yale Day Use, Lewis River\7 - Design\CAD\Lewis R Fishing Pier\351325-Site Plan.dwg PLOT DATE: 2016-05-19



FISHING PIER AT SWIFT 2 CANAL



- NOTES
1. TOPOGRAPHIC AND BATHYMETRIC CONTOURS ARE FROM THE BASE MAP "16476 SPEELYAI SITE BASE.DWG", BY MACKAY SPOSITO, RECEIVED 5-10-2016.
 2. FISHING ACCESS IS 99% OF THE TIME FOR BOTH GENERAL PUBLIC AND ADA ACCESS. WATER LEVEL BELOW 225.0 FEET, NGVD29, APPROXIMATE 1% OF THE TIME.

DESIGNED BY	JL				
ENTERED BY	CT				
CHECKED BY	NS			JOB NUMBER	
PROJECT ENGINEER	SP			351325	
PROJECT MANAGER	NS			CONTRACT NO.	
DATE		REVISION		BY	

SCALE
HORIZ.: AS NOTED
VERT.: AS NOTED
VERIFY SCALE
BAR IS ONE INCH ON 22x36
DRAWINGS AND HALF INCH ON
11x17 DRAWINGS, IF NOT, ADJUST
SCALES ACCORDINGLY
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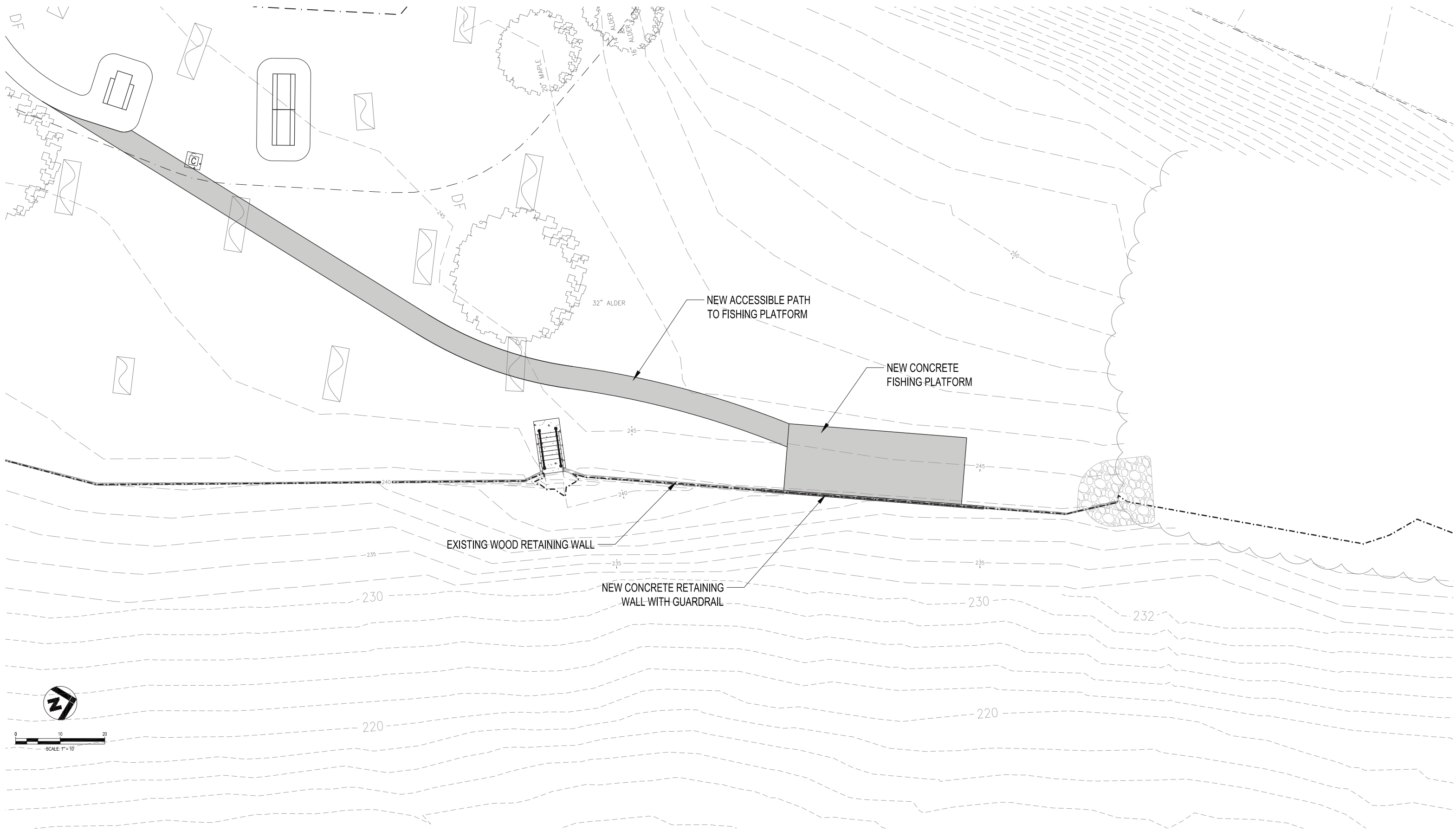
110 JAMES STREET, SUITE 101
EDMONDS, WA 98020
PHONE 425.778.2542
FAX 425.778.6883



LEWIS RIVER
ADA FISHING PIER
FEASIBILITY ASSESSMENT

CONCEPT 3

REFERENCE SHEET NUMBER
SHEET 3 OF 3 SHEETS



Appendix 4: Geotechnical Reports



Columbia West Engineering, Inc.

GEOTECHNICAL • ENVIRONMENTAL • SPECIAL INSPECTIONS • MATERIAL TESTING

December 9, 2011

Mr. Bryan Cole
MacKay and Sposito, Inc.
1325 SE Tech Center Drive, Suite 140
Vancouver, Washington 98683

**Re: Speelyai Day Use Improvements Geotechnical Recommendations
Speelyai Bay Recreation Area, Woodland, Washington
CWE W.O. No. 11155**

Dear Mr. Cole:

Columbia West Engineering, Inc. (Columbia West) is pleased to submit this letter regarding geotechnical recommendations for the proposed day use improvements at Speelyai Bay Recreation Area, located approximately 21 miles east of Woodland, Washington. The purpose of this letter is to document existing subsurface conditions at the site and provide construction recommendations and soil infiltration rates for proposed site improvements. The specific scope of services was outlined in a proposal contract dated October 4, 2011. This report is subject to the limitations expressed herein and in Appendix C.

GENERAL SITE INFORMATION AND DESCRIPTION

As indicated on Figures 1 and 2, the proposed improvements are located within the Day Use and Boat Launch area of Speelyai Bay Recreation Area, a recreational facility owned and operated by PacifiCorp adjacent to Merwin Lake in Cowlitz County, Washington. The approximate latitude and longitude are N 45° 58' 54" and W 122° 25' 09" and the legal description is a portion of the SE ¼ of Section 22, T6N, R3E, Willamette Meridian.

Speelyai Bay Recreation Area is accessed via Speelyai Bay Recreation Road, approximately 21 miles east of Woodland, Washington on S.R. 503. The day use area consists of a large parking lot with boat launch ramp and restroom facility, a large open field and picnic area, and beach access to Merwin Lake. The day use area is situated on a small river terrace between a steep hill slope and the North Fork Lewis River (Merwin Lake). Elevations range from approximately 280 feet above mean sea level near the existing camp host area and overflow boat parking area to approximately 240 feet near the bottom of the boat launch ramp. The ordinary high water mark of Merwin Lake is approximately 239 feet amsl.

PROJECT DESCRIPTION

According to review of preliminary site plans, the project consists of constructing stormwater quality control infiltration trenches and associated catchment and conveyance systems surrounding the boat launch parking lot, as well as development of a new septic field and delivery system for the existing restroom facility. Additional improvements include beach area enhancements, restroom upgrades, and construction of a paved pathway to the picnic area from the main boat launch parking lot. This letter is based upon proposed development as described above and may not be applicable if modified.

REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Southern Cascades physiographic region of Washington. The Southern Cascades consist primarily of Cenozoic-era basaltic and andesitic volcanic rocks and associated deposits. The region is flanked by the Portland Basin/Puget Lowlands basins

to the south and west, the Columbia Basin on the east, and the Northern Cascades to the north. The incision of the Columbia River Gorge separates the Southern Cascades from the Western Cascades region of Oregon to the south. The site is located near the southwestern border with the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

According to the *Geologic Map of the Amboy Quadrangle, Clark and Cowlitz Counties, Washington* (Evarts, US Dept. of the Interior, USGS, Scientific Investigations Map 2885, 2005), near-surface geology is expected to consist of Pleistocene deposits of the Cougar eruptive stage of Mount St. Helens (Qsc). These lahar and lahar-runout deposits consist of a complex assortment of sand and gravel composed of dacitic debris from Mount St. Helens volcanic activity. The formation overlies portions of glacial drift from the Amboy glacial period in several areas of the Lewis River valley.

The *Soil Survey of Cowlitz Area, Washington* (United States Department of Agriculture, Soil Conservation Service [USDA SCS], February, 1974) identifies surface soils near the proposed improvements as predominately Riverwash stratified gravel to sand. Riverwash soils form on flood plains in active river valleys and are generally medium- to coarse-textured sand and gravel soils with cobbles. Riverwash soils exhibit highly variable properties due to the nature of river valley flood deposits. Soils surrounding the boat launch and picnic area are identified as Cinebar silt loam. These fine-textured soils form in volcanic ash and related colluvium over glaciofluvial deposits. These soils are well drained, have slight to severe erosion hazard, and low shear strength.

GEOTECHNICAL FIELD INVESTIGATION AND SUBSURFACE OBSERVATIONS

Columbia West personnel conducted visual and physical reconnaissance of the subject site on October 24, 2011. Field reconnaissance consisted of a site walk, slope observations, and two hand-auger soil explorations (HA-1 and HA-2). In-situ infiltration testing was conducted within proposed infiltration trench areas. The subsurface soil profile was logged in accordance with Unified Soil Classification System (USCS) specifications. The hand-auger locations are indicated on Figure 2. Results of particle-size analysis conducted on a sample of the soil profile are presented in Appendix A. Soil descriptions and classification information are provided in Appendix B.

Subsurface Profile

Hand-auger soil exploration in two separate locations revealed a subsurface profile consisting of approximately 4 inches of sod and topsoil underlain by medium dense, well graded SAND with silt and gravel. Particle-size analysis performed on a representative sample of the sand obtained from the upper 24 inches of the explored profile indicates that the soil is classified as SW-SM according to the USCS. The well graded sand soil extended to the maximum depth explored of 3.5 feet below ground surface. Particle-size and distribution remained fairly consistent throughout the explored depth with minor amounts of 1- to 6-inch rounded gravels encountered. Bedding planes were observed at several elevations within the soil profile indicating likely emplacement or reworking by river activity. The observed soil profile was consistent with Riverwash soils identified by the USDA Soil Conservation Service. Ground surface elevation at the hand-auger locations is approximately 2 feet below edge of asphalt elevation at each location. Groundwater was not encountered within the hand-auger explorations. Groundwater elevation in the vicinity of the explored locations likely coincides with fluctuating lake surface elevation.

Infiltration Testing

To investigate the feasibility of disposal of stormwater via concentrated and dispersed infiltration, in-situ falling-head infiltration tests were performed in each hand-auger location. Shallow infiltration tests were conducted at a depth of approximately 1.5 feet below existing ground surface in hand auger HA-1 and approximately 2 feet below existing ground surface in hand-auger HA-2. Recommended infiltration rates are presented below in the *Geotechnical Recommendations: Infiltration Rate Calculations* section of this letter.

Slope Observations

Proposed improvements to the existing septic system include the construction of a new septic field on an upper terrace of the river valley approximately 130 vertical feet higher than the existing restroom facility. The proposed location will require the construction of a conveyance system along the steep, heavily vegetated hill slope north of the day use boat launch area. Columbia West personnel examined the slope to investigate the potential of local slope instability and possible detrimental effects on proposed septic piping.

Slope angles generally range from 25 to 45 degrees in the vicinity of the proposed septic piping alignment. Shallow, 12- to 24-inch hand-dug test pits indicate that slope soils are consistent with the Cinebar silt loam group identified by the USDA Soil Conservation Service. The fine-textured soils along the hill slope are capped by significant amounts of loose, organic-rich topsoil. Outcrops of poorly consolidated volcanoclastic bedrock were observed in the hill slope several hundred feet to the east of the proposed piping alignment, but no bedrock was observed on the surface or encountered in shallow test pits within the proposed alignment. No evidence of recent slope movement, including bent trees, soil bulges, or hummocky topography, was observed in the vicinity of the proposed septic piping alignment. Surficial soil creep may be anticipated to occur within soils on the steep hill slope, especially in years of heavy rainfall. Construction recommendations for installation of septic conveyance piping are presented below in the *Geotechnical Recommendations: Utility Installation* section of this letter.

GEOTECHNICAL RECOMMENDATIONS

Site Preparation

Vegetation should be cleared and topsoil stripped from areas identified for structural facilities and site grading. Stripped topsoil should be stockpiled prior to removal or placed in a separate designated location away from other material. Stripped topsoil may be used as landscape fill in nonstructural areas with slopes less than 25 percent. The stripping depth is anticipated to be approximately 4 inches for stormwater and pathway improvements, and may significantly increase for septic piping alignment construction on the hill slope.

Previously disturbed soils, debris, or undocumented fill encountered during grading or construction activities should be removed completely and thoroughly. Site grading activities should be performed in accordance with requirements specified in the *2009 International Building Code (IBC), Chapter 18 and Appendix J*, with exceptions noted in the text herein. Site preparation, soil stripping, and grading activities should be observed and documented by an experienced geotechnical engineer or designated representative.

Engineered Structural Fill and Aggregate Base

Areas proposed for fill placement or pathway pavement should be appropriately prepared as described in the preceding text. Surface soils should then be scarified and compacted prior to additional fill placement. Engineered structural fill should be placed in loose lifts not exceeding 12 inches in depth and compacted using standard conventional compaction

equipment. A field density at least equal to 90 percent of the maximum dry density, obtained from the modified Proctor moisture-density relationship test (ASTM D1557), is recommended for scarified soils and structural fill placement. Engineered structural fill placed on sloped grades should be benched to provide a horizontal surface for compaction.

Aggregate base placed as a foundation for paved pathways should consist of 1 ¼"-0 crushed aggregate with less than 10 percent passing the No. 200 sieve. Crushed aggregate should be compacted and tested in accordance with the specification outlined above for engineered structural fill. Compaction of engineered structural fill and crushed aggregate base should be verified by nuclear gauge field compaction testing performed in accordance with ASTM D6938. Field compaction testing should be performed for each vertical foot of engineered fill placed. Engineered fill placement should be observed by an experienced geotechnical engineer or designated representative.

Engineered structural fill placement activities should be performed during dry summer months if possible. If fill placement occurs during dry weather conditions, clean medium- to fine-textured native soils may be suitable for use as structural fill if adequately moisture-conditioned to achieve recommended compaction specifications. Because they are moisture-sensitive, fine-textured soils are often difficult to excavate and nearly impossible to compact during wet weather conditions. If adequate compaction is not achievable with clean native soils, import structural fill consisting of well-graded granular material with a maximum particle size of three inches and no more than five percent passing the No. 200 sieve is recommended.

Foundations

Restroom upgrades may require building addition construction. Foundations for proposed structures may consist of shallow continuous perimeter footings or column spread footings. Typical building loads are not expected to exceed approximately 4 to 6 kips per foot for perimeter footings or 100 kips per column. Footing design should conform to requirements specified by the structural engineer, with exceptions as noted.

The existing ground surface should be prepared as described above. Foundations should bear upon firm native soil or engineered structural fill. Footings should extend to a depth at least 24 inches below lowest adjacent exterior grade to provide adequate bearing capacity and protection against frost heave.

Foundations should not be permitted to bear upon disturbed soft soil or organic-rich topsoil. Because soil is often heterogeneous and anisotropic, an experienced geotechnical engineer or designated representative should observe foundation excavation and compaction of structural fill prior to placing forms or reinforcing bar to verify adequate subgrade support conditions.

Slabs on Grade

Proposed building additions may have slab-on-grade flooring. Slabs may be supported on competent native soils or engineered structural fill. Disturbed soils, organic-rich topsoil, or undocumented fill in the proposed slab locations should be removed and replaced with structural fill. Preparation and compaction beneath the slab should be performed in accordance with the recommendations presented above. Slabs should be underlain by at least six inches of free-draining crushed aggregate. Geotextile filter fabric may be used below the crushed aggregate to increase subgrade support. A moisture barrier may be constructed beneath the slab. A typical moisture barrier consists of 6 mil visqueen plastic overlain with two inches of fine sand constructed over the crushed aggregate subgrade.

Alternative moisture barriers may be specified by a licensed, experienced structural engineer or architect. Slabs should be appropriately waterproofed in accordance with the anticipated type of finished flooring. Slab thickness and reinforcement should be designed by an experienced structural engineer.

Infiltration Rate Calculations

Based upon correspondence with MacKay and Sposito, Inc., infiltration systems may be considered for the disposal of concentrated stormwater from impervious surfaces. Infiltration rates for site soils were calculated based upon shallow infiltration testing at a depth of approximately 1.5 feet and 2 feet below existing ground surface. Observed infiltration rates are presented below in Table 1. Figure 2 identifies the approximate test locations. Soil laboratory analytical test reports are provided in Appendix A.

Infiltration tests were prepared by inserting a rigid standpipe several inches into subsurface soil at the test elevation. Tests were conducted by filling the apparatus with water and recording time and water level drop measurements. Using Darcy's Law for saturated flow in homogeneous media, the coefficient of permeability (k) was calculated.

Table 1. Observed Shallow Infiltration Rates

Infiltration Test Location	Test Depth (ft)	USCS Soil Type Classification	Passing No. 200 Sieve (%)	Approximate depth to lake surface elevation (ft)	Observed Infiltration Rate + (in/hr)
HA-1	1.5	SW-SM	—	5.5	28.5
HA-2	2.0	SW-SM	10.4	5	3.5

-- Not Tested or Not Applicable

+ Infiltration rate as defined by the soil's approximate vertical coefficient of permeability (k).

Reported infiltration rates, as defined by the soil coefficient of permeability, reflect approximate raw calculated data, without application of a factor of safety. As indicated in Table 1, some portions of the proposed trench alignment exhibited low vertical infiltration. Variations in soil permeability rates at different elevations within the same soil profile indicates the presence of interbedded layers of fine-grained soils which may hinder vertical conductivity. The presence of interbedded silt layers was also noted during visual observations of hand-auger explorations.

Infiltration facilities may be more appropriately designed if increased consideration is given to overall soil index properties, including depositional environment, rather than localized constraints. The potential presence of interbedded fine-grained layers should be considered when determining the design infiltration rate for systems constructed within the Riverwash formation. Proposed infiltration trench systems should have a gravity overflow discharge to an approved location. Because observed soils and their associated permeability were variable, the invert elevation of proposed overflows should be below all other rim elevations to limit the potential for flooding in developed areas. If infiltration is considered for the site, system installation should be closely monitored by a geotechnical engineer and the observed infiltration rates should be reduced by an appropriate factor of safety prior to use in design calculations.

Excavation and Dewatering

Subsurface soils at the site were explored to a maximum depth of 3.5 feet with hand-operated equipment during the field investigation. Bedrock was not encountered and blasting is not anticipated. However, bedrock was observed along the hill slope north of the

restroom facility in locations outside of proposed development indicating the potential to encounter bedrock during septic piping installation. Bedrock in the area is anticipated to consist of poorly consolidated volcanoclastic deposits which may not be easily excavated with conventional earthmoving equipment. If deep burial of septic piping is anticipated, further investigation regarding bedrock depth within the hill slope may be required to alleviate potential construction difficulties or delays.

Based upon laboratory analysis, near-surface soils may be Washington State Industrial Safety and Health Administration (WISHA) Type C. For temporary open-cut excavations deeper than four feet, but less than 20 feet in soils of these types, the maximum allowable slope is 1.5H:1V. WISHA soil type should be confirmed during field construction activities by the contractor. Because soil is often anisotropic and heterogeneous, it is possible that WISHA soil types determined in the field may differ from those described above.

The contractor should be held responsible for site safety, sloping, and shoring. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of all applicable local, state, and federal laws. This includes Washington Administrative Code (WAC), Chapter 296-155 Part N.

Groundwater elevation and hydrostatic pressure should be carefully considered during design of stormwater facilities, utilities, retaining walls, or other structures that require below-grade excavation. As described previously, the static ground water depth may be relatively shallow throughout the site and will likely fluctuate with lake surface elevation. Buoyancy estimations for below-grade structures should be calculated based upon worst-case conditions of ground water rising toward surface grades.

Shallow groundwater elevations may present significant dewatering challenges. Utility trenches in shallow ground water areas or excavations and cuts that remain open for even short periods of time may undermine or collapse due to ground water effects. Significant pumping and dewatering may be required to temporarily reduce the ground water elevation to allow construction of proposed below-grade structures, installation of utilities, or placement of structural fills. Dewatering via a sump within the excavation zone may be insufficient to control ground water and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around the proposed excavation areas. Well pumps should remain functioning at all times during the excavation and construction period. Suitable back-up pumps and power supply should be available to prevent unanticipated shut-down of dewatering equipment. Failure to operate pumps full-time may result in flooding of the excavation zones, resulting in damage to forms, slopes, or equipment. Site-specific dewatering analysis and engineering of appropriate safety mechanisms may be required prior to construction of significant below-grade structures.

Utility Installation

Utility installation at the site may require subsurface excavation and trenching. Excavation, trenching and shoring should conform to federal Occupational Safety and Health Administration (OSHA) (29 CFR, Part 1926) and WISHA (WAC, Chapter 296-155) regulations. Site soils may slough when cut vertically and sudden precipitation events or shallow ground water may result in accumulation of water within excavation zones and trenches. These areas should be dewatered in accordance with appropriate discharge regulations.

Utilities should be installed in general accordance with manufacturer's recommendations. Utility trench backfill should consist of crushed aggregate or other coarse-textured, free-draining material. Onsite coarse-textured native soils may be suitable for use as utility trench backfill if approved by the site geotechnical engineer. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). The remaining backfill should be compacted to at least 95 percent of maximum dry density as determined by the standard Proctor moisture-density test (ASTM D698). Clean, free-draining, fine bedding sand is recommended for use in the pipe zone. With exception of the pipe zone, backfill should be placed in loose lifts not exceeding 12 inches in thickness. Compaction of utility trench backfill material should be verified by nuclear gauge field compaction testing performed in accordance with ASTM D6938.

As indicated on Figure 2, proposed septic piping is anticipated to be installed along the steep hill slope north of the existing restroom facility. To reduce potential serviceability problems due to soil creep, pipes conveying sanitary effluent over slope surfaces or buried within the slope should be fitted with flexible joints. Periodic observation and maintenance is recommended to minimize the potential for leaks and ensure proper conveyance to the new septic field. Leaking pipes may lead to saturated subsurface conditions and reduced slope stability, as well as unsanitary environmental conditions.

CONCLUSIONS AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report, and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Even slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate significantly from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services

not provided. Additional report limitations and important information about this document are presented in Appendix C. This information should be carefully read and understood by the client and other parties reviewing this document.

Please call me at 360-823-2900 if you have any questions or need additional information.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.



Alan S. Rutherford, GIT

Staff Geologist



Daniel E. Lehto, PE

Principal Engineer

Attachments: Figures

Appendix A - Laboratory Test Results

Appendix B - Soil Classification Information

Appendix C – Report Limitations and Important Information



References

Annual Book of ASTM Standards, Soil and Rock (I), v04.08, American Society for Testing and Materials, 1999.

Call, Willard A., *Soil Survey of Cowlitz Area, Washington*, Soil Conservation Service, United States Department of Agriculture, February, 1974.

Clark County Maps Online (<http://gis.clark.wa.gov/ccgis/mol/property.htm>)

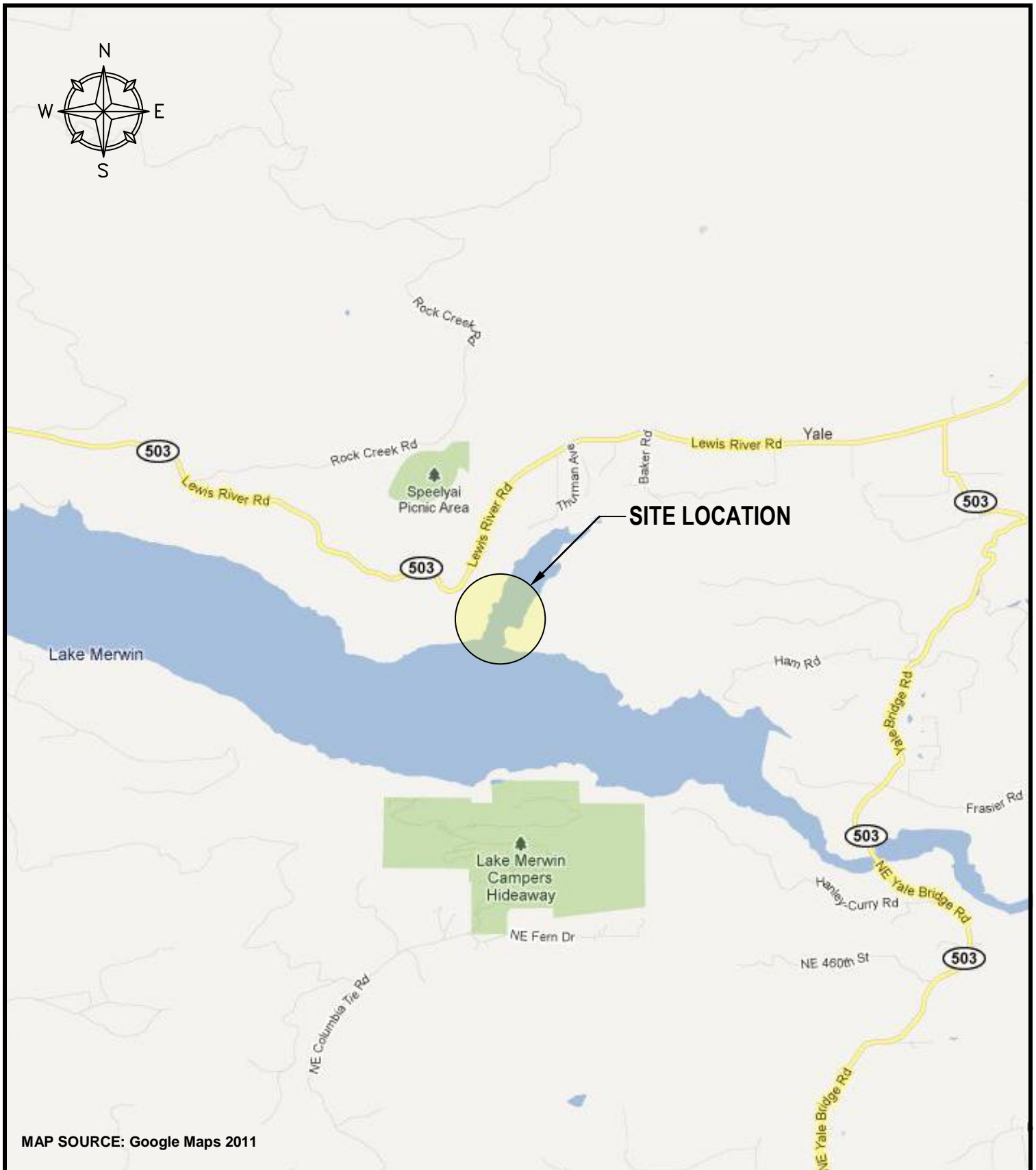
Evarts, Russell C., *Geological Map of the Amboy Quadrangle, Clark and Cowlitz Counties, Washington*, US Department of the Interior, US Geological Survey, Scientific Investigations Map 2885, 2005.

International Building Code: 2009 International Building Code, 2006 edition, International Code Council, 2009.

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FIGURES



**Columbia West
Engineering, Inc.**

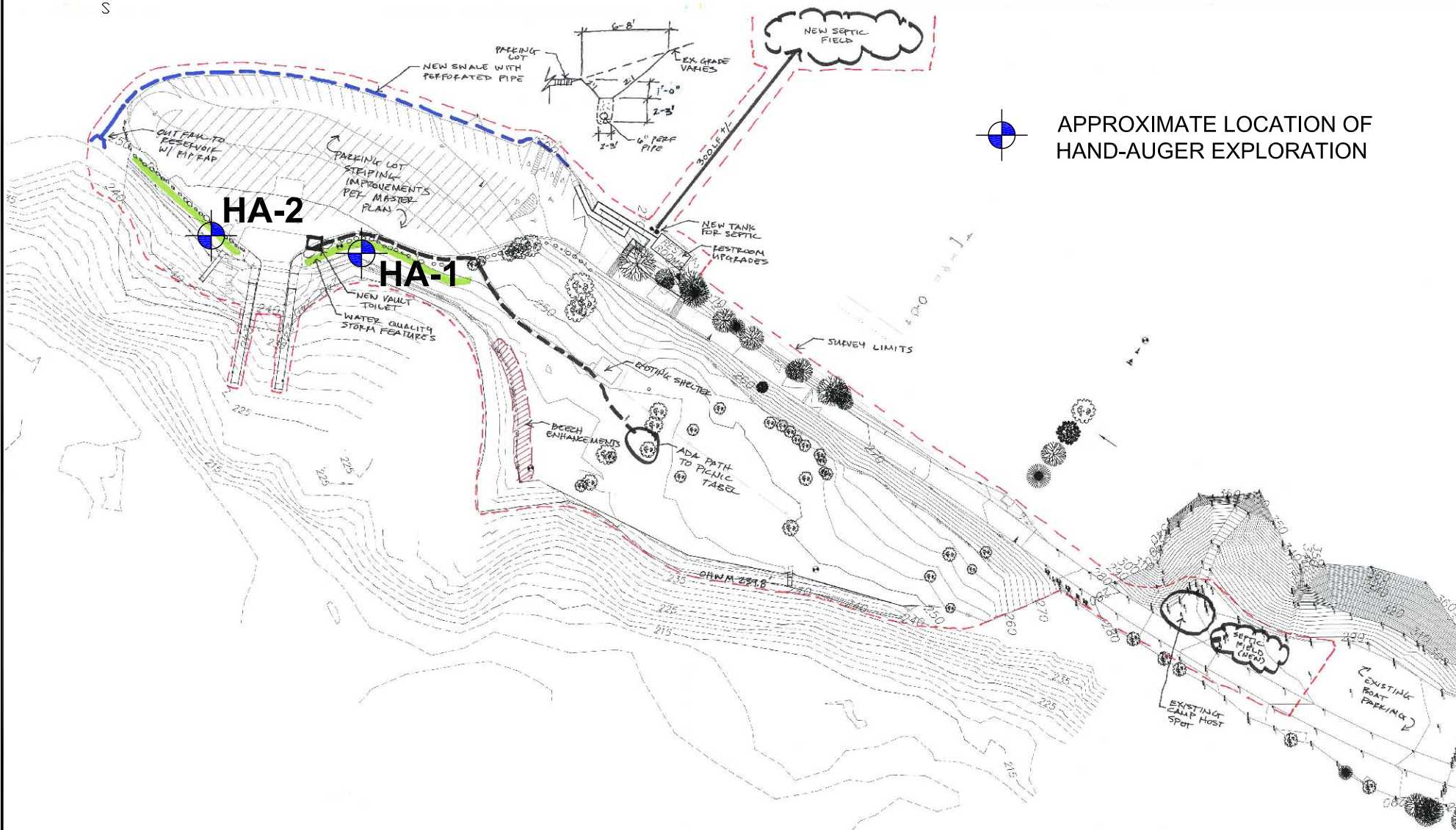
11917 NE 95th Street
Vancouver, WA 98682
p: 360-823-2900
f: 360-823-2901

Design	Drawn: ASR		
Checked: LVL	Date: 12/16/11		
Client: M&S	Rev	By	Date
Job No.: 11155			
CAD File: FIGURE 1			
Scale: ~1:50,000			

SITE LOCATION MAP

SPEELYAI DAY USE IMPROVEMENTS
WOODLAND, WASHINGTON

FIGURE
1



1. SITE LOCATION: SPEELYAI BAY RECREATION ROAD, COWLITZ COUNTY, WA.
2. DRAWING IS NOT TO SCALE.
3. BASE MAP PROVIDED BY MACKAY AND SPOSITO, INC..
4. HAND-AUGER LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.



Design:	Drawn: ASR		
Checked: LVL	Date: 12/07/11		
Client: M&S	Rev	By	Date
Job No: 11155			
CAD File: FIGURE 2			
Scale: NONE			

SPEELYAI DAY USE IMPROVEMENTS
WOODLAND, WASHINGTON

FIGURE
2

APPENDIX A
LABORATORY TEST RESULTS



PARTICLE-SIZE ANALYSIS REPORT

PROJECT Speelyai Day Use Improvements Cowlitz County, Washington	CLIENT MacKay & Sposito, Inc. Bryan Cole 1325 SE Tech Center Dr., Ste 140 Vancouver, Washington 98683	PROJECT NO. 11155	LAB ID S11-369
		REPORT DATE 11/02/11	FIELD ID TP2.1
		DATE SAMPLED 10/24/11	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED Well-graded SAND with Silt and Gravel	MATERIAL SOURCE Infiltration Test IT-02 Test Pit TP-02, depth = 0 to 24-inches	USCS SOIL TYPE SW-SM, Well-graded Sand with Silt and Gravel
SPECIFICATIONS none		AASHTO SOIL TYPE A-1-b(0)

LABORATORY TEST DATA

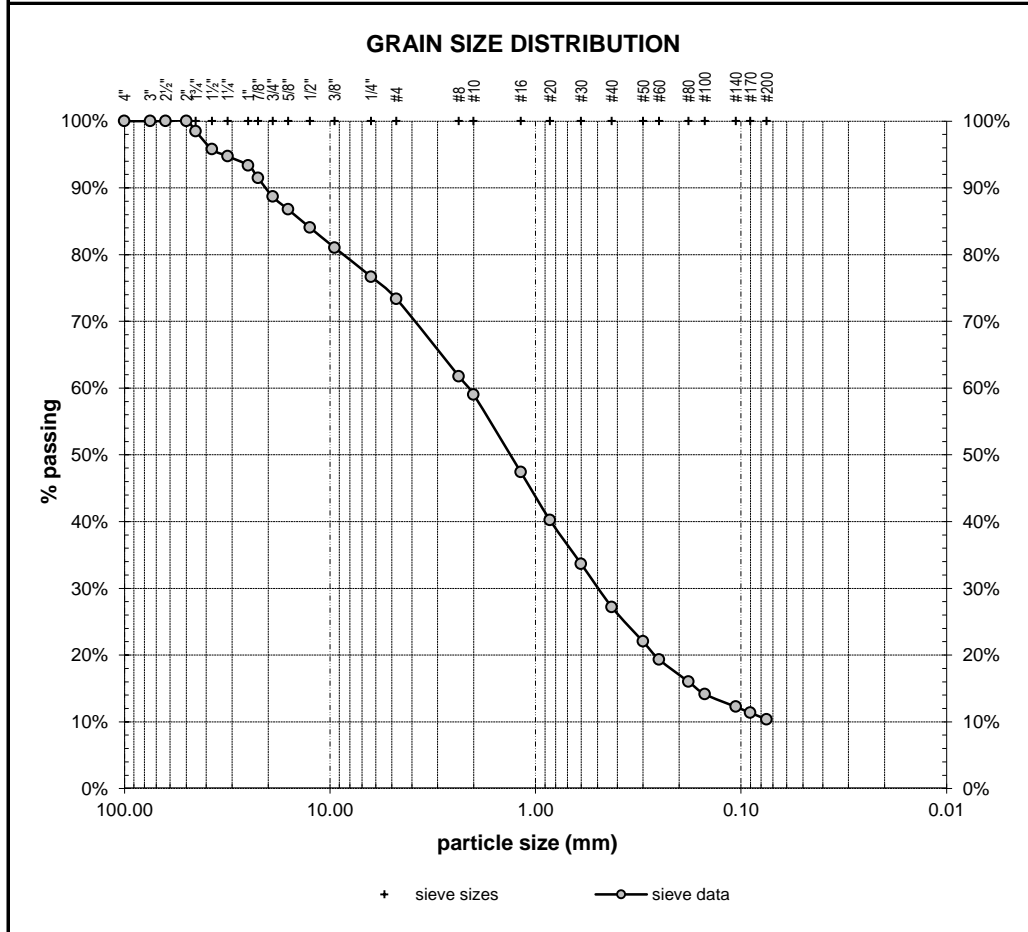
LABORATORY EQUIPMENT Rainhart "Mary Ann" Sifter 637	TEST PROCEDURE ASTM D6913, D422
ADDITIONAL DATA initial dry mass (g) = 9894.9 * % sieve loss = 0.02% natural moisture content = 18.6% coefficient of curvature, C_c = 1.65 liquid limit = 0 coefficient of uniformity, C_u = 30.44 plastic limit = 0 effective size, $D_{(10)}$ = 0.070 mm plasticity index = 0 $D_{(30)}$ = 0.494 mm fineness modulus = 3.82 (interpolated) $D_{(60)}$ = 2.123 mm * Note: entire sample used	SIEVE DATA % gravel = 26.6% % sand = 63.0% % silt and clay = 10.4%

SIEVE SIZE	PERCENT PASSING			
	US	mm	act.	interp.

GRAVEL	6.00"	150.0	100.0%	
	4.00"	100.0	100.0%	
	3.00"	75.0	100.0%	
	2.50"	63.0	100.0%	
	2.00"	50.0	100.0%	
	1.75"	45.0	98.5%	
	1.50"	37.5	95.8%	
	1.25"	31.5	94.7%	
	1.00"	25.0	93.4%	
	7/8"	22.4	91.5%	
SAND	3/4"	19.0	88.7%	
	5/8"	16.0	86.8%	
	1/2"	12.5	84.0%	
	3/8"	9.50	81.0%	
	1/4"	6.30	76.7%	
	#4	4.75	73.4%	
	#8	2.36	61.8%	
	#10	2.00	59.0%	
	#16	1.18	47.4%	
	#20	0.850	40.2%	
	#30	0.600	33.7%	
	#40	0.425	27.2%	
	#50	0.300	22.0%	
	#60	0.250	19.3%	
	#80	0.180	16.0%	
	#100	0.150	14.1%	
	#140	0.106	12.2%	
	#170	0.090	11.3%	
	#200	0.075	10.4%	

DATE TESTED 11/01/11	TESTED BY BJR
-------------------------	------------------

[Signature]
COLUMBIA WEST ENGINEERING, INC. authorized signature



APPENDIX B
SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	2	less than 0.25
Soft	2 to 4	0.25 to 0.50
Medium Stiff	4 to 8	0.50 to 1.0
Stiff	8 to 15	1.0 to 2.0
Very Stiff	15 to 30	2.0 to 4.0
Hard	30 to 60	greater than 4.0
Very Hard	greater than 60	-

Relative Density for Granular Soil

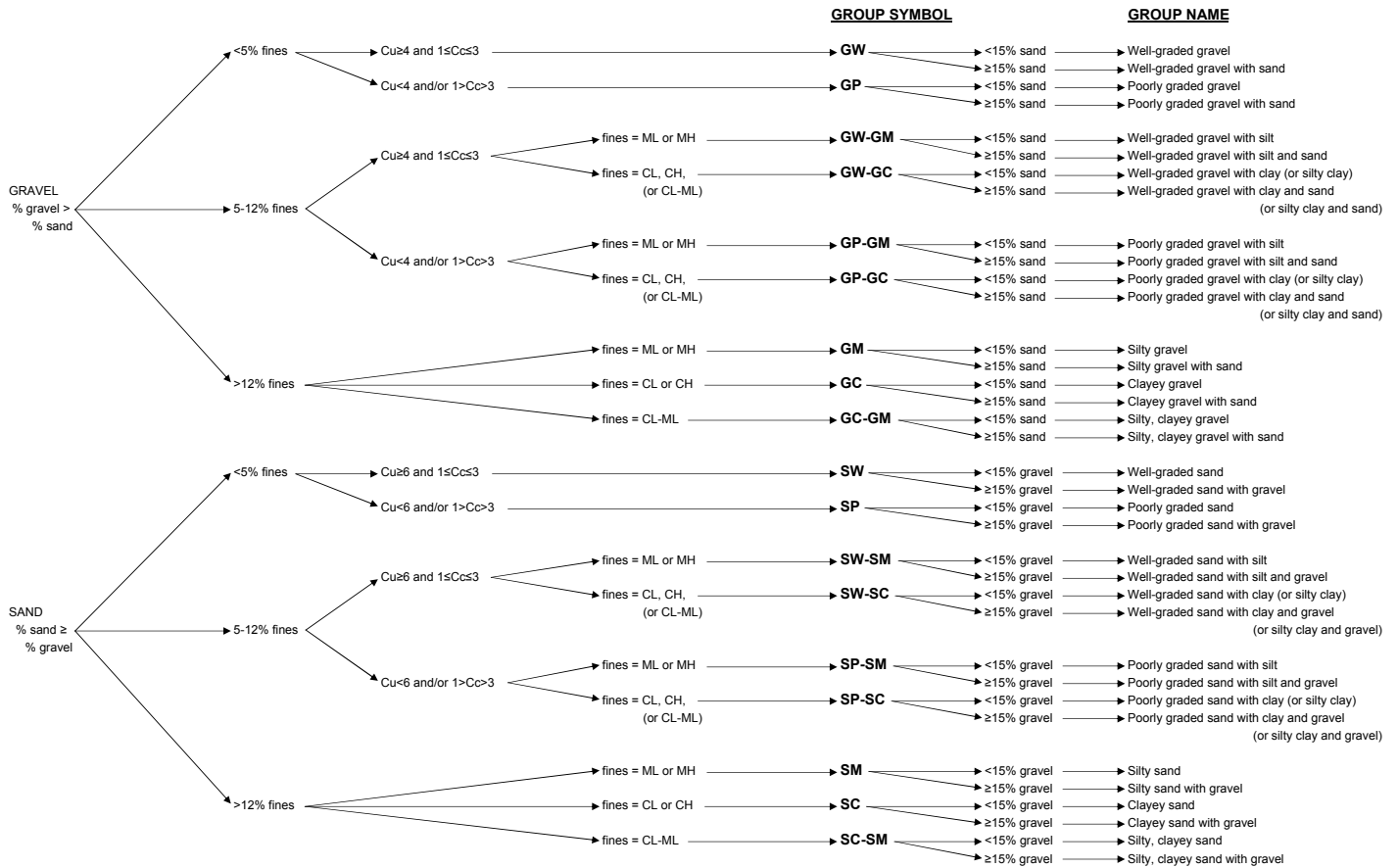
RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Moisture Designations

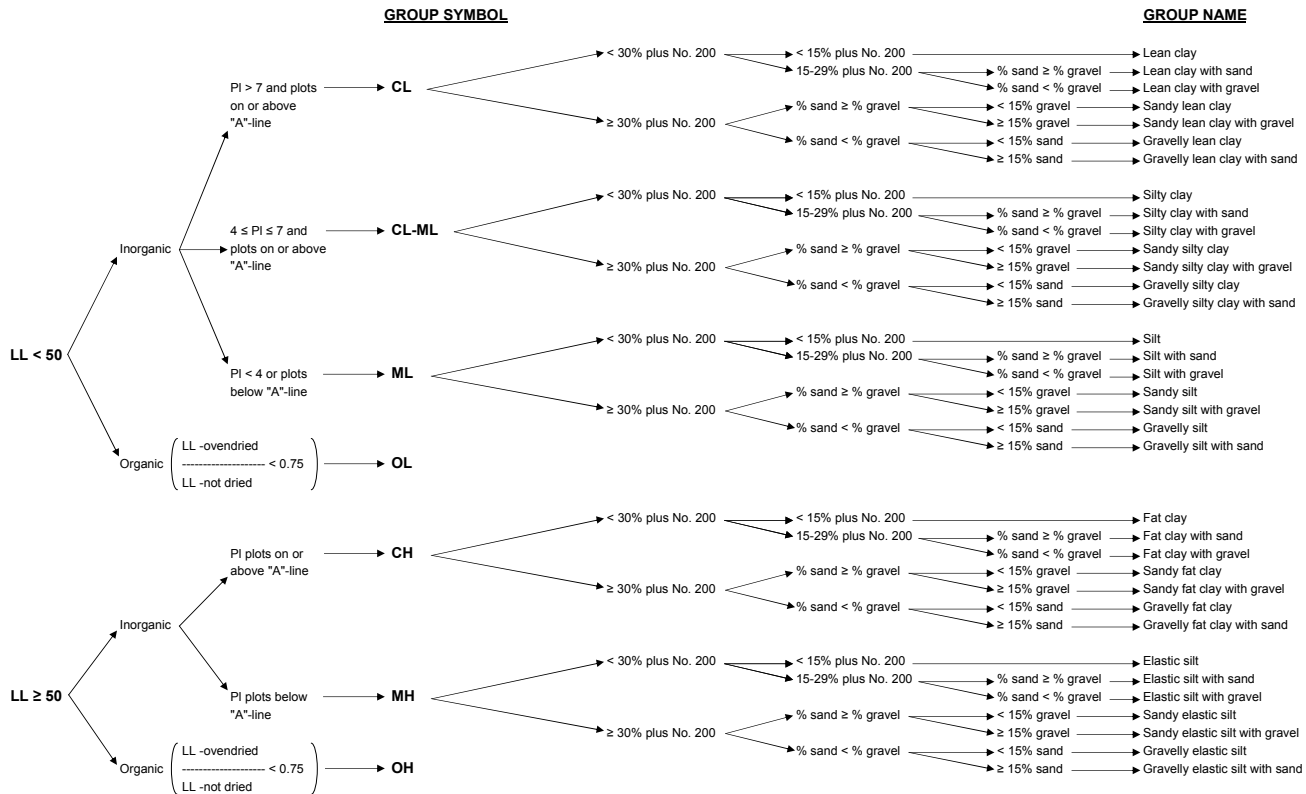
TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

ASTM SOIL CLASSIFICATION SYSTEM

ASTM D2487-02: Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)



Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)			Silt-Clay Materials (More than 35 Percent Passing 0.075)			
	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-	-	-	-	-
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm. (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good			Fair to poor			

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)						Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)						
	A-1		A-2				A-7						
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6		
Sieve analysis, percent passing:													
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-		
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-		
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min		
Characteristics of fraction passing 0.425 mm (No. 40)													
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min		
Plasticity index		6 max	N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min		
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand								Silty soils	Clayey soils
General ratings as subgrade	Excellent to Good						Fair to poor						

Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

APPENDIX C
REPORT LIMITATIONS AND IMPORTANT
INFORMATION



Columbia West Engineering, Inc.

Date: December 9, 2011

Project: Geotechnical Recommendations

Speelyai Day Use Improvements, Woodland, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Geotechnical • Environmental • Special Inspections • Materials Testing

11917 NE 95th Street Vancouver, Washington 98682 • Phone: 360-823-2900, Fax: 360-823-2901

www.columbiawestengineering.com

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.



Geotechnical & Environmental Consultants

9725 SW Beaverton Hillsdale Hwy, Ste 140
Portland, Oregon 97005-3364
PHONE 503/641/3478 FAX 503/644/8034

May 24, 2004

4069 SPEELYAI BAY GEOTECHNICAL RPT

PacifiCorp
825 NE Multnomah, Suite 1500
Portland, OR, 97232

Attention: Will Shallenberger, PE

**SUBJECT: Geotechnical Exploration
Dock Replacement at Speelyai Bay
Lewis River, Washington**

At your request, GRI has conducted a subsurface investigation for the proposed dock replacement located at Speelyai Bay. The purpose of our investigation was to drill exploratory borings at the site and evaluate the feasibility of pile installation for support of the new dock. This report documents the work accomplished and provides the results of the subsurface investigation and our conclusions regarding pile installation at the site.

Site and Project Description

Speelyai Bay is located on a northeast-trending finger of Lake Merwin on the Lewis River. The Site Plan, Figure 1, shows the general layout of the boat ramp and the adjacent parking area. Review of available topographic information indicates the ground surface at the landside end of the boat ramp is at about elevation 245 ft. The ramp slopes down into the water to about elevation 224 ft. Floating walkways on either side of the ramp may be held in position by pipe piles installed below the mudline adjacent to the ramp.

A large, asphalt-covered parking area is located just west of the boat ramp. A relatively steep slope is located west of the parking area. The materials exposed in the slope consist of relatively hard basalt rock and cemented sand and gravel.

A summary of the field explorations is provided below.

Subsurface Conditions

The subsurface materials and conditions at the landside end of the dock were investigated on April 15, 2004, with two borings, designated B-1 and B-2. The locations of the borings are shown on the Site Plan, Figure 1. All field explorations were observed by an engineer provided by our firm, who maintained a detailed log of the materials disclosed during the course of the work. The following sections contain a detailed description of the field investigation completed for this project.

Borings B-1 and B-2 were advanced to a depth of 33 and 31 ft, respectively. The borings were completed using mud-rotary techniques using a truck-mounted CME-75 drill rig provided and operated by Cascade Drilling, Inc. of Clackamas, Oregon. Disturbed samples were obtained from the borings at about 5-ft intervals of depth using a standard split-spoon sampler. At the time of sampling, the Standard Penetration Test was conducted using an automatic hammer. This test consists of driving a standard split-spoon sampler

into the soil a distance of 18 in. using a 140-lb hammer dropped 30 in. The number of blows required to drive the sampler the last 12 in. is known as the Standard Penetration Resistance, or N-value. The N-values provide a measure of the relative density of granular soils, such as sand, and the relative consistency or stiffness of cohesive soils, such as silt. The soil samples obtained in the split-spoon sampler were carefully examined in the field, and representative portions were saved in airtight jars for further examination and physical testing in our laboratory.

Logs of borings B-1 and B-2 are provided on Figures 2 and 3. Each log presents a descriptive summary of the various types of materials encountered in the boring and notes the depth where the materials and/or characteristics of the materials change. To the right of the descriptive summary, the numbers and types of samples taken during the drilling operation are indicated. Farther to the right, N-values are shown graphically along with the natural moisture contents. The terms used to describe the soils are defined in Table 1.

For the purpose of discussion, the materials disclosed by the explorations have been grouped into the following major units based on their physical characteristics and engineering properties.

- 1. SAND and GRAVEL**
- 2. BASALT**

1. SAND and GRAVEL. Sand and gravel were encountered below the asphaltic-concrete and base course pavement section in both borings. The sand and gravel were encountered to a depth of about 24 to 26 ft, which corresponds to an elevation of 218 and 215 ft, respectively. Based on the samples recovered and the action of the drill rig during drilling, it appears the sand is fine to coarse grained, and the gravel ranges from fine to coarse. No indication of cobble- or boulder-size rock was encountered during drilling; however, cobbles were observed along the lake shore. N-values ranging from about 6 to 32 blows/ft indicate the sand and gravel are loose to dense, with the N-values indicating that the majority of the sand and gravel is medium dense.

2. BASALT. The borings indicate the sand and gravel are underlain by soft to hard basalt. The top of the basalt was encountered at elevation 215 and 218 ft. Drill action and drilling speed indicate there was very little, if any, weathered rock on the surface of the basalt. It should be noted that the hardness of the basalt was estimated from drill cuttings and observations of drill rig performance.

Conclusions

Based on our experience with similar materials and pile types, it is our opinion that the proposed open-end pipe pile will penetrate the medium dense to dense sand and gravel encountered in the borings using conventional impact or vibratory hammers. However, we anticipate the piles will only penetrate the soft to hard basalt on the order of 1 to 2 ft. It is not possible to estimate the total thickness of sand and gravel overlying hard rock at the proposed pile locations with the available subsurface information.

Limitations

This report has been prepared to aid the design team in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project. The conclusions submitted in this report are based

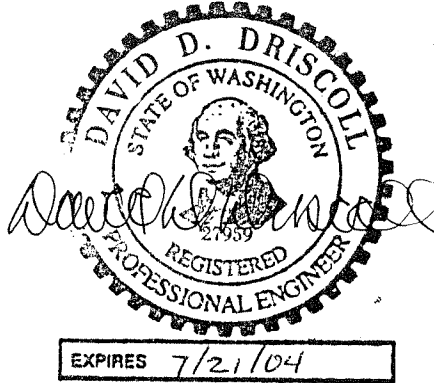
on the information discussed in this report. In this regard, it is acknowledged that variations in soil conditions may exist. The nature and extent of variation may not become evident until construction.

Please contact the undersigned if you have any questions regarding this report.

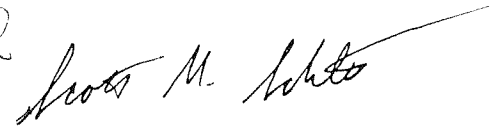
Submitted for GRI,



Michael W. Reed, PE
Principal



David D. Driscoll, PE
Principal



Scott M. Schlechter, PE
Staff Engineer

Table 1

GUIDELINES FOR CLASSIFICATION OF SOIL

Description of Relative Density for Granular Soil

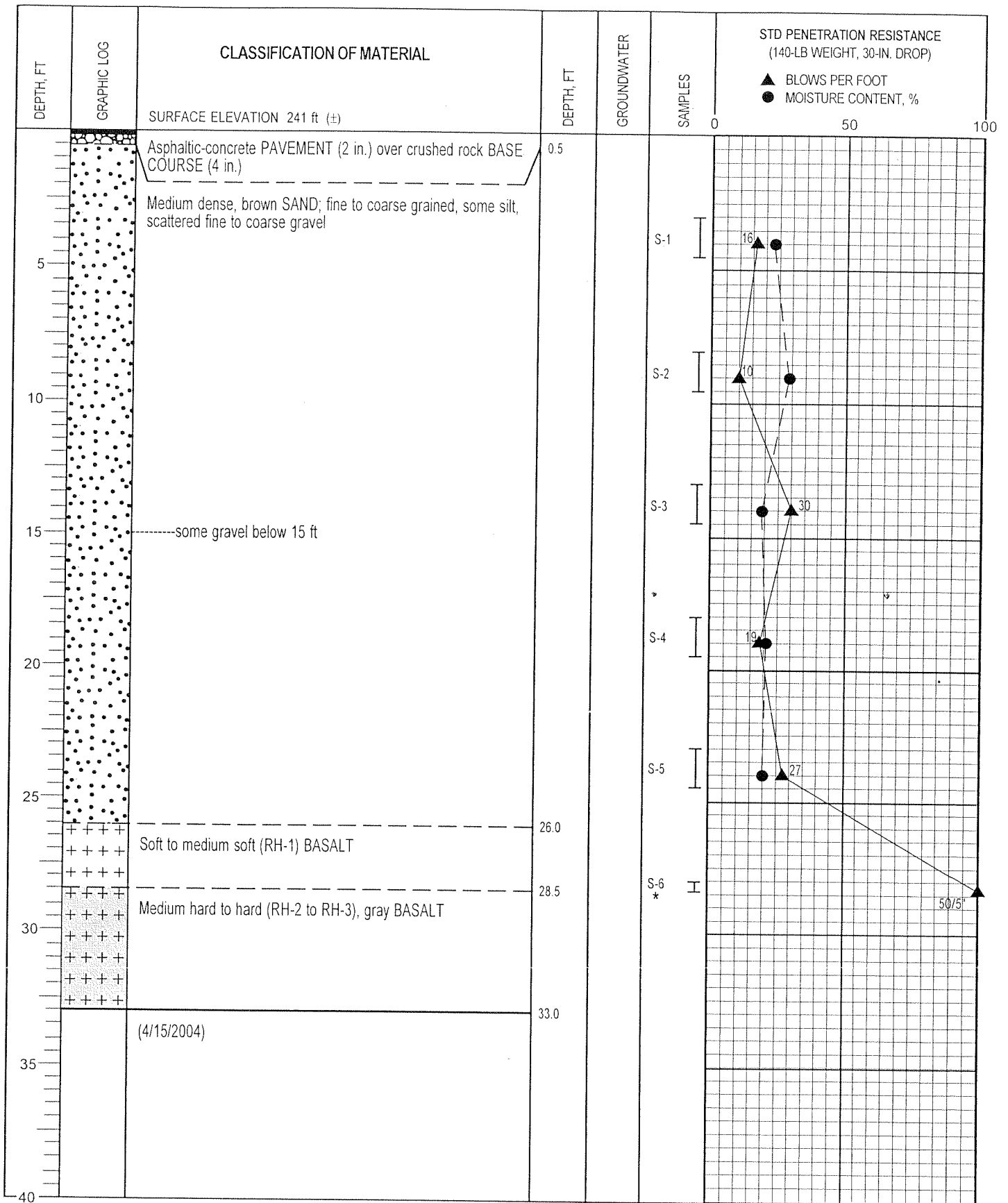
<u>Relative Density</u>	<u>Standard Penetration Resistance (N-values) blows per foot</u>
very loose	0 - 4
loose	4 - 10
medium dense	10 - 30
dense	30 - 50
very dense	over 50

Description of Consistency for Fine-Grained (Cohesive) Soils

<u>Consistency</u>	<u>Standard Penetration Resistance (N-values) blows per foot</u>	<u>Torvane Undrained Shear Strength, tsf</u>
very soft	2	less than 0.125
soft	2 - 4	0.125 - 0.25
medium stiff	4 - 8	0.25 - 0.50
stiff	8 - 15	0.50 - 1.0
very stiff	15 - 30	1.0 - 2.0
hard	over 30	over 2.0

Sandy silt materials that exhibit general properties of granular soils are given relative density description.

<u>Grain-Size Classification</u>	<u>Modifier for Subclassification</u>	
<i>Boulders</i> 12 - 36 in.		Percentage of Other Material In Total Sample
	<u>Adjective</u>	
<i>Cobbles</i> 3 - 12 in.	clean	0 - 2
<i>Gravel</i> $\frac{1}{4}$ - $\frac{3}{4}$ in. (fine) $\frac{3}{4}$ - 3 in. (coarse)	trace some	2 - 10 10 - 30
<i>Sand</i> No. 200 - No. 40 sieve (fine) No. 40 - No. 10 sieve (medium) No. 10 - No. 4 sieve (coarse)	sandy, silty, clayey, etc.	30 - 50
<i>Silt/Clay</i> - pass No. 200 sieve		



- I 2-IN.-OD SPLIT-SPOON SAMPLER
- II 3-IN.-OD THIN-WALLED SAMPLER
- G GRAB SAMPLE OF DRILL CUTTINGS
- NX CORE RUN
- SLOTTED PVC PIPE
- ▼ Water Level (date)

- ◆ TORVANE SHEAR STRENGTH, TSF
- UNDRAINED SHEAR STRENGTH, TSF
- * NO RECOVERY



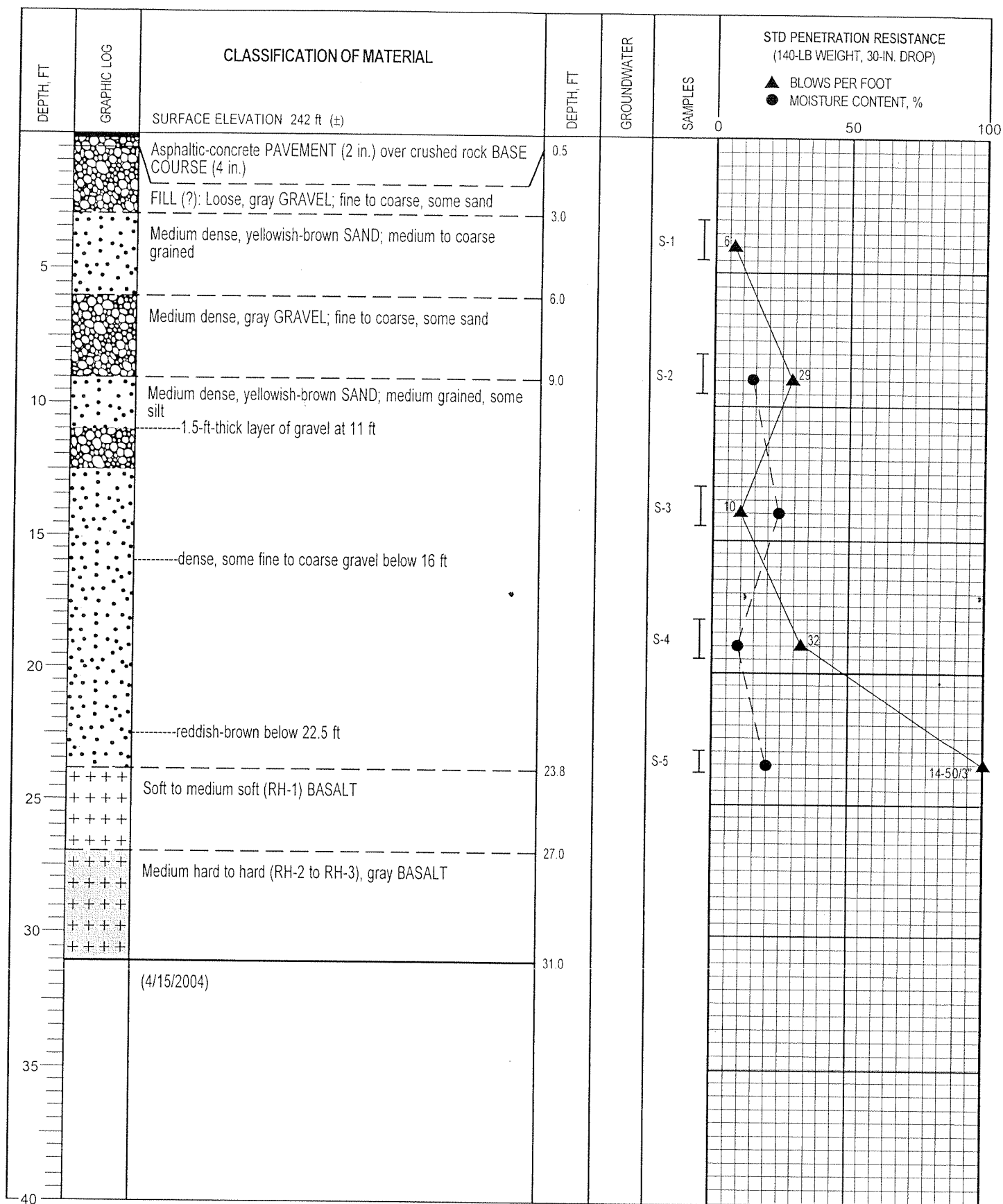
GRI

MAY 2004

BORING B-1

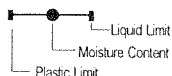
JOB. NO. 4069

FIG. 2



- I 2-IN.-OD SPLIT-SPOON SAMPLER
- II 3-IN.-OD THIN-WALLED SAMPLER
- G GRAB SAMPLE OF DRILL CUTTINGS
- NX CORE RUN
- SLOTTED PVC PIPE
- ▼ Water Level (date)

- ◆ TORVANE SHEAR STRENGTH, TSF
- UNDRAINED SHEAR STRENGTH, TSF
- * NO RECOVERY



GRI

BORING B-2

MAY 2004

JOB. NO. 4069

FIG. 3