JOINT APPLICATION FOR PERMITS

U.S. ARMY CORPS OF ENGINEERS - IDAHO DEPARTMENT OF WATER RESOURCES - IDAHO DEPARTMENT OF LANDS

Authorities: The Department of Army Corps of Engineers (Corps), Idaho Department of Water Resources (IDWR), and Idaho Department of Lands (IDL) established a joint process for activities impacting jurisdictional waterways that require review and/or approval of both the Corps and State of Idaho. Department of Army permits are required by Section 10 of the Rivers & Harbors Act of 1899 for any structure(s) or work in or affecting navigable waters of the United States and by Section 404 of the Clean Water Act for the discharge of dredged or fill materials into waters of the United States, including adjacent wetlands. State permits are required under the State of Idaho, Stream Protection Act (Title 42, Chapter 38, Idaho Code and Lake Protection Act (Section 58, Chapter 13 et seq., Idaho Code). In addition the information will be used to determine compliance with Section 401 of the Clean Water Act by the appropriate State, Tribal or Federal entity.

Joint Application: Information provided on this application will be used in evaluating the proposed activities. Disclosure of requested information is voluntary. Failure to supply the requested information may delay processing and issuance of the appropriate permit or authorization. **Applicant will need to send a completed application, along with one (1) set of legible, black and white (8½"x11"), reproducible drawings that illustrate the location and character of the proposed project / activities to both the Corps and the State of Idaho.**

See Instruction Guide for assistance with Application. Accurate submission of requested information can prevent delays in reviewing and permitting your application. Drawings including vicinity maps, plan-view and section-view drawings must be submitted on 8-1/2 x 11 papers.

Do not start work until you have received all required permits from both the Corps and the State of Idaho

FOR AGENCY USE ONLY			
USACE NWW-	Date Received:	☐ Incomplete Application Returned	Date Returned:
Idaho Department of Water Resources No.	Date Received:	☐ Fee Received DATE:	Receipt No.:
Idaho Department of Lands No.	Date Received:	☐ Fee Received DATE:	Receipt No.:

INCOMPLETE APPLICANTS MAY NOT BE PROCESSED

1. CONTACT INFORMATION - APPLICANT Required:			2. CONTACT INFORMATION - AGENT:		
Name: Steve Klatt			Name: Jason Scott		
Company: Bonner County			Company: GeoEngineers, Inc.		
Mailing Address: 1500 Highway 2			Mailing Address: 523 East Second Avenue		
City: Sandpoint	State: ID	Zip Code: 83864	City: Spokane	State: WA	Zip Code: 99202
Phone Number *(include area code)*: 208-255-3630	E-mail:		Phone Number *(include area code)*: (509) 209-2816	E-mail: jscott@geoengineers.com	

3. PROJECT NAME or TITLE: Priest Lake Thorofare Improvements			4. PROJECT STREET ADDRESS: N/A		
5. PROJECT COUNTY: Bonner	6. PROJECT CITY: Coolin		7. PROJECT ZIP CODE: 83821		8. NEAREST WATERWAY/WATERBODY: Priest Lake
9. TAX PARCEL ID#: RP62N04W105550A	10. LATITUDE: 48°44'23.21"N LONGITUDE: -116°50'51.19"W		11a. 1/4: SW	11b. 1/4: NW	11c. SECTION: 10	11d. TOWNSHIP: 62 N	11e. RANGE: 4 W
12a. ESTIMATED START DATE: Oct 1, 2020	12b. ESTIMATED END DATE: Mar 15, 2021		13a. IS PROJECT LOCATED WITHIN ESTABLISHED TRIBAL RESERVATION BOUNDARIES? ☒ NO ☐ YES Tribe:		
13b. IS PROJECT LOCATED IN LISTED ESA AREA? ☐ NO ☒ YES			13c. IS PROJECT LOCATED ON/NEAR HISTORICAL SITE? ☒ NO ☐ YES		

14. DIRECTIONS TO PROJECT SITE: Include vicinity map with legible crossroads, street numbers, names, landmarks.

Access to the site will be accomplished by land and/or water: 1) Land access to the project would occur from the north on Sandpiper Shores Road. The Thorofare would be forded from an empty lot during low water (after November 1) to access the breakwater. 2) Access via water could be accomplished from the Lionhead boat ramp at Priest Lake Park. Equipment and materials would be loaded on flexi-float pontoons to be transported to the site.

15. PURPOSE and NEED: ☐ Commercial ☐ Industrial ☒ Public ☐ Private ☐ Other

Describe the reason or purpose of your project; include a brief description of the overall project. Continue to Block 16 to detail each work activity and overall project.

The purpose of this project is to provide navigable access from Priest Lake into the Thorofare during the recreational season. The overall objective of the project is to develop sustainable modifications to improve Thorofare access and navigability with channel deepening and replacement of the derelict breakwater. This project is supported by the Idaho Water Resources Board, Bonner County, Priest Lake businesses and numerous private stakeholders.

16. DETAILED DESCRIPTION OF EACH ACTIVITY WITHIN OVERALL PROJECT. Specifically indicate portions that take place within waters of the United States, including wetlands: Include dimensions; equipment, construction, methods; erosion, sediment and turbidity controls; hydrological changes: general stream/surface water flows, estimated winter/summer flows; borrow sources, disposal locations etc.:

Figures 1-3 and attached design plans illustrate the project. A solid breakwater will be installed along a slightly rotated alignment, with extension further into the lake. Thorofare dredging to the -2.0 ft Lake Datum will provide a 5-foot depth for navigation.
The western end of the breakwater would first be breached, to funnel flow into a remnant channel, providing a temporary migratory channel for fish. This would allow dredging, timber breakwater removal, and construction to occur in isolated conditions.
The footprint of the breakwater and western extension will require removal of 5,725 cubic yards (cy) of sediment to meet planned elevations.
Approximately 10,374 cy of stone, gravel, and cobble would then be hauled to the project area to build up the breakwater. The final breakwater will be about 1,300 feet long, and 42 feet wide. A 225-foot western extension of the breakwater will also be constructed to mitigate wave erosion risk and protect this section from bank erosion during high flow. It will consist of 660 cy of geobags and 492 cy of gravel/cobble built around the existing timber piles.
About 12,200 cy of sediment will be dredged for the channel. Of this, 11,418 cy of dredge spoils will be re-used and placed on the lake side (south) of the breakwater and extension as beach fill. These spoils will be graded at a 10:1 slope from the top of the breakwater to the lake. Native plants (e.g., willow) will be planted in the sandy spoils. The remainder of the dredge spoils (782 cy) would be hauled to an upland disposal site. The final dredge channel will be approximately 50 feet wide, and the dredge prism will cover roughly 3.5 acres.
A temporary haul road may be needed to ford the Thorofare at low water. 444 cy of gravel would be used, which would be removed after construction.
Access may also be completed from the Lionhead Boat Launch, requiring 200 cy of temporary fill and 115 cy for Ecology block stabilization in the lake.
A temporary erosion and sedimentation control (TESC) plan will be developed and implemented by the contractor. Silt fences will be installed along the perimeter of the work areas to confine sediment and runoff. Straw bales staked straw wattles, or similar measures will be added to the silt fencing. Sediment release from the initial breakwater breach, breakwater removal, breakwater construction, and re-watering may result in temporary, localized increases in suspended sediment and turbidity. However, this impact is expected to be brief and minimal. Please refer to the design memo for additional information.

17. DESCRIBE ALTERNATIVES CONSIDERED to AVOID or MEASURES TAKEN to MINIMIZE and/ or COMPENSATE for IMPACTS to WATERS of the UNITED STATES, INCLUDING WETLANDS: See Instruction Guide for specific details.

Several options were originally screened, and ultimately three alternatives were assessed (new bio-engineered, rubblemound, and sheet pile structures) for Thorofare improvements (see attached alternatives analysis. A bio-engineered structure would require a larger footprint in the lake, and highest maintenance costs, and was thus eliminated from consideration. The sheet pile option provides high constructibility, but no opportunity for habitat enhancement, and pile driving can be disruptive to fish. The rubblemound structure can provide additional habitat, can be constructed in isolated conditions, and does not have the high underwater noise levels, Thus, it was selected. The attached figures provide additional information regarding the details of the alternatives analysis.

Temporary minor impacts are anticipated from breach of the existing breakwater. However, this alternative enables continued fish migration and work to be completed in relatively dry conditions on the remainder of the breakwater. As such, this method allows work that would otherwise be completed in shallow water to be conducted in the dry, where sediment can be contained with erosion control features, and incidental emergency spills or fuel releases can be isolated without impacts to the lake. No wetlands will be impacted as a result of the proposed action.

Fish exclusion measures such as block nets or bubble curtains would be used to prevent impacts during disruptive construction activities.

18. PROPOSED MITIGATION STATEMENT or PLAN: If you believe a mitigation plan is not needed, provide a statement and your reasoning why a mitigation plan is NOT required. Or, attach a copy of your proposed mitigation plan.

Following development of the new breakwater, the sandy material on the lake (south) side will be planted with native vegetation (e.g., willow). Flow will be returned to the original Thorofare channel. Due to the deeper (5-foot) channel, fish migration should be improved between Priest Lake and the Thorofare. Upon completion of the project, temporary fill will be removed at the Lionhead boat ramp and the area will be restored. Other project areas will be returned to pre-disturbance conditions. No other mitigation measures are anticipated at this time because all impacts are considered temporary.

19. TYPE and QUANTITY of MATERIAL(S) to be discharged below the ordinary high water mark and/or wetlands:

Dirt or Topsoil:		cubic yards
Dredged Material:	11,418	cubic yards
Clean Sand:		cubic yards
Clay:		cubic yards
Gravel, Rock, or Stone:	10,866	cubic yards
Concrete:		cubic yards
Other (describe): Geobags	660	cubic yards
Other (describe: Temp gravel for ford and	644	cubic yards
TOTAL:	23,588	cubic yards

20. TYPE and QUANTITY of impacts to waters of the United States, including wetlands:

Filling:	8.42	acres	366,900	sq ft.	23,388	cubic yards
Backfill & Bedding:		acres		sq ft.		cubic yards
Land Clearing:		acres		sq ft.		cubic yards
Dredging:	3.5	acres	152,460	sq ft.	12,200	cubic yards
Flooding:		acres		sq ft.		cubic yards
Excavation:	1.45	acres	63,000	sq ft.	5,725	cubic yards
Draining:		acres		sq ft.		cubic yards
Other: Temp fill for boat ac	0.02	acres	1,070	sq ft.	315	cubic ya
TOTALS:	13.39	acres	583,430	sq ft.	41,628	cubic yards

21. HAVE ANY WORK ACTIVITIES STARTED ON THIS PROJECT? ☒ NO ☐ YES If yes, describe ALL work that has occurred including dates.

22. LIST ALL PREVIOUSLY ISSUED PERMIT AUTHORIZATIONS:

23. ☒ YES, Alteration(s) are located on Public Trust Lands, Administered by Idaho Department of Lands

24. SIZE AND FLOW CAPACITY OF BRIDGE/CULVERT and DRAINAGE AREA SERVED: 600 Square Miles

25. IS PROJECT LOCATED IN A MAPPED FLOODWAY? ☒ NO ☐ YES If yes, contact the floodplain administrator in the local government jsrisdiction in which the project is located. A Floodplain Development permit and a No-rise Certification may be required.

26a WATER QUALITY CERTIFICATION: Pursuant to the Clean Water Act, anyone who wishes to discharge dredge or fill material into the waters of the United States, either on private or public property, must obtain a Section 401 Water Quality Certification (WQC) from the appropriate water quality certifying government entity.
See Instruction Guide for further clarification and all contact information.

The following information is requested by IDEQ and/or EPA concerning the proposed impacts to water quality and anti-degradation:

☐ NO ☒ YES Is applicant willing to assume that the affected waterbody is high quality?
☐ NO ☒ YES Does applicant have water quality data relevant to determining whether the affected waterbody is high quality or not?
☒ NO ☐ YES Is the applicant willing to collect the data needed to determine whether the affected waterbody is high quality or not?

26b. BEST MANAGEMENT PRACTICTES (BMP's): List the Best Management Practices and describe these practices that you will use to minimize impacts on water quality and anti-degradation of water quality. All feasible alternatives should be considered - treatment or otherwise. Select an alternative which will minimize degrading water quality

BMPs will be incorporated into all project work as required, to minimize impacts to water quality, wildlife and habitat in the immediate area. The contractor will comply with all specific mitigation measures required on this project listed in the project environmental permits, and additional measures that may be required by applicable local, state, and federal laws, orders, regulations, and water quality standards.
Thorofare flows will be managed to allow the majority of the construction to occur in near dry or isolated groundwater conditions to minimize the work areas exposed directly to open lake surface waters. This will require the installation of temporary berm to isolate work areas and diversion of existing flow channels around the active work areas. Temporary sand berms may be constructed with on-site sand and limited imported materials to divert water through an existing remnant channel upstream of the primary breakwater structure, such that most construction and dredging can be executed in the dry or at the lowest possible water level. The footprint of a berm to divert flow is approximately 225 feet long by 40 feet wide. Work sites will be restored to pre-project conditions after the completion of construction.
The Contractor will be responsible for the preparation of an SPCC plan; Dredging and Dredge Material Hauling Plan; and comply with pre-dredge meetings with IDWR, IWRB, and other regulatory agencies to discuss their work plan The contractor will limit turbidity by strategic location of equipment; for example, by working within isolated areas rather than instream wherever possible. In general, the contractor should meet State of Idaho (IDAPA 58.01.02.250.02.e) DEQ turbidity criterion for water quality standards as follows: (1) Turbidity, below any applicable mixing zone set by DEQ shall not exceed background turbidity by more than 50 NTUs instantaneously or more than 25 NTUs for more than 10 consecutive days and/or for up to 3 continuous hours; (2) If 50 NTUs above background levels are detected, the contractor shall cease instream work; and (3) Activities will be allowed to proceed once the readings return to background levels or 10 NTUs. It should be noted, authorization of a mixing zone for dilution of pollutants in a discharge is not guaranteed and DEQ maintains the right to determine necessity and size.

Through the 401 Certification process, water quality certification will stipulate minimum management practices needed to prevent degradation.

27. LIST EACH IMPACT to stream, river, lake, reservoir, including shoreline: Attach site map with each impact location.

Activity	Name of Water Body	Intermittent Perennial	Description of Impact and Dimensions	Impact Length Linear Feet
Breakwater breach/removal	Priest Lake/Thorofare	Perennial	Minor, temporary increase in turbidity (24,000 square feet)	1,525
Breakwater construction	Breakwater construction	Perennial	Gravel, cobble, stone, beach sand fill (366,900 square feet)	1,525
Water re-entry	Priest Lake/Thorofare	Perennial	Dredged channel (152,460 square feet)	1,500
Temp fill for boat access	Priest Lake (Lionhead Boat Launch)	Perrenial	Temporary fill and stabilization for boat access (1,070 sf)	40
			TOTAL STREAM IMPACTS (Linear Feet):	4,590

28. LIST EACH WETLAND IMPACT include mechanized clearing, fill, excavation, flood, drainage, etc. Attach site map with each impact location.

Activity	Wetland Type: Emergent, Forested, Scrub/Shrub	Distance to Water Body (linear ft)	Description of Impact Purpose: road crossing, compound, culvert, etc.	Impact Length (acres, square ft linear ft
			TOTAL WETLAND IMPACTS (Square Feet):	

29. ADJACENT PROPERTY OWNERS NOTIFICATION REQUIREM: Provide contact information of ALL adjacent property owners below.

Name: Hungate, et al. (West) Mailing Address: 428 Beaver Creek Lane City: Nordman State: ID Zip Code: 83848 Phone Number (include area code): Not Available E-mail:	Name: Hungate, R & MJ Trust (West) Mailing Address: 429 Beaver Creek Lane City: Nordman State: ID Zip Code: 83848 Phone Number (include area code): Not Available E-mail:
Name: Nelson, Todd M & Tara M 50%; Ncf Corporation 50% (North) Mailing Address: Not Available City: State: Zip Code: Phone Number (include area code): Not Available E-mail:	Name: Elliott, Brian D & Roseann K (North) Mailing Address: 875 Sandpiper Shores City: Coolin State: ID Zip Code: 83821 Phone Number (include area code): Not Available E-mail:
Name: Ramey, Randall T & Lola C (North) Mailing Address: 887 Sandpiper Shores City: Coolin State: ID Zip Code: 83821 Phone Number (include area code): Not Available E-mail:	Name: Beck, Larry C (North) Mailing Address: 907 Sandpiper Shores City: Coolin State: ID Zip Code: 83821 Phone Number (include area code): Not Available E-mail:
Name: Aden, Mark D & Stephanie H (North) Mailing Address: 927 Sandpiper Shores City: Coolin State: ID Zip Code: 83821 Phone Number (include area code): Not Available E-mail:	Name: Petersen, Carl S & Peggy B (North) Mailing Address: Not Available City: State: Zip Code: Phone Number (include area code): Not Available E-mail:

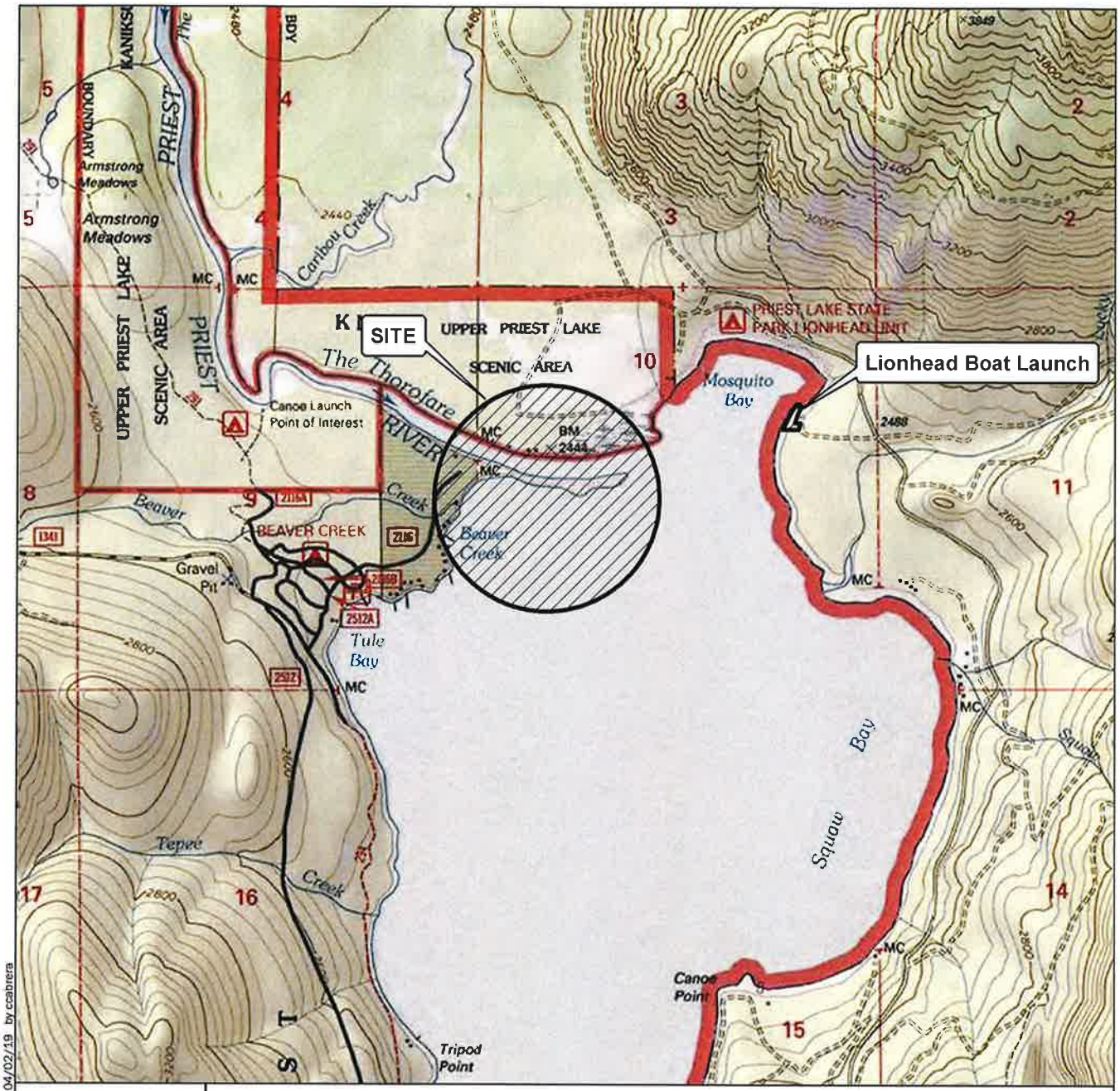
30. SIGNATURES: STATEMENT OF AUTHORIAZATION / CERTIFICATION OF AGENT / ACCESS

Application is hereby made for permit, or permits, to authorize the work described in this application and all supporting documentation. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein; or am acting as the duly authorized agent of the applicant (Block 2). I hereby grant the agencies to which this application is made, the right to access/come upon the above-described location(s) to inspect the proposed and completed work/activities.

Signature of Applicant: _____ *Date:* _____

Signature of Agent: _____ *Date:* 4/3/2019

This application must be signed by the person who desires to undertake the proposed activity AND signed by a duly authorized agent (see Block 1, 2, 30). Further, 18 USC Section 1001 provides that: "*Whoever, in any manner within the jurisdiction of any department of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious, or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both*".



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 11N

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Vicinity Map

Priest Lake Outlet Dam
Bonner County, Idaho

GeoEngineers

Figure 1

Legend

- Action Area
- Proposed Rubble Mound Breakwater
- Thorofare Channel Dredge Area
- Proposed Geobags Rock Scour Protection
- Proposed Dredge Spoils
- Temporary Stockpiling & Staging Area
- Temporary Access Road
- Temporary Sand Berm
- Potential East Access from Lionhead
- Potential North Access Corridor

400 0 400

Feet

Notes:

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Data Source: ESRI

Projection: NAD 1983 UTM Zone 11N

Action Area

Priest Lake Outlet Dam
Bonner County, Idaho

GeoEngineers

Figure 2a

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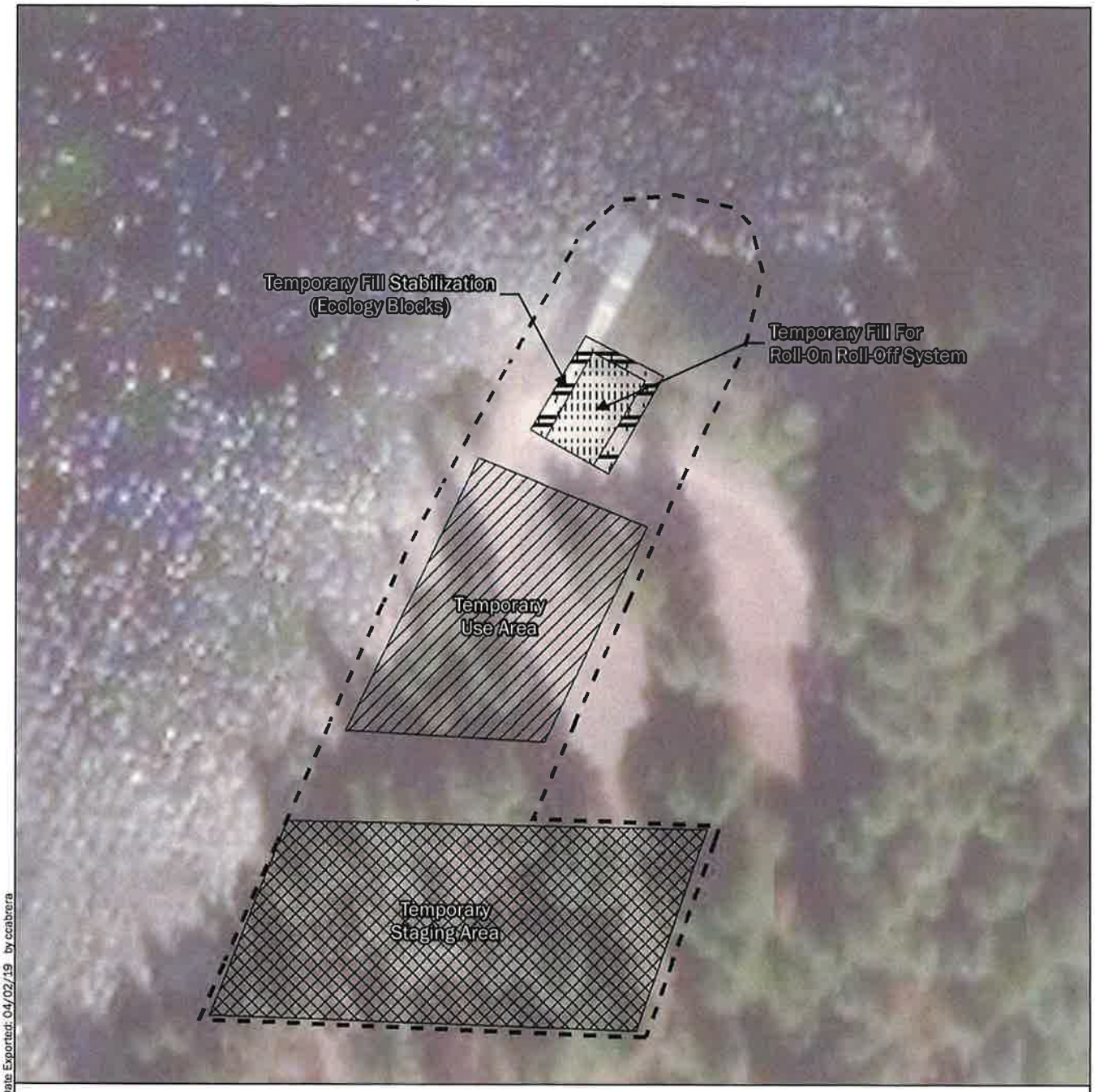

Legend

- Action Area
- Temporary Fill For Roll-On Roll-Off System
- Temporary Fill Stabilization (Ecology Blocks)
- Temporary Staging Area
- Temporary Use Area

N
W E
S

60 0 60
Feet

Notes:

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Data Source: ESRI

Projection: NAD 1983 UTM Zone 11N

Action Area -
Lionhead Boat Launch

Priest Lake Outlet Dam
Bonner County, Idaho

GeoEngineers

Figure 2b

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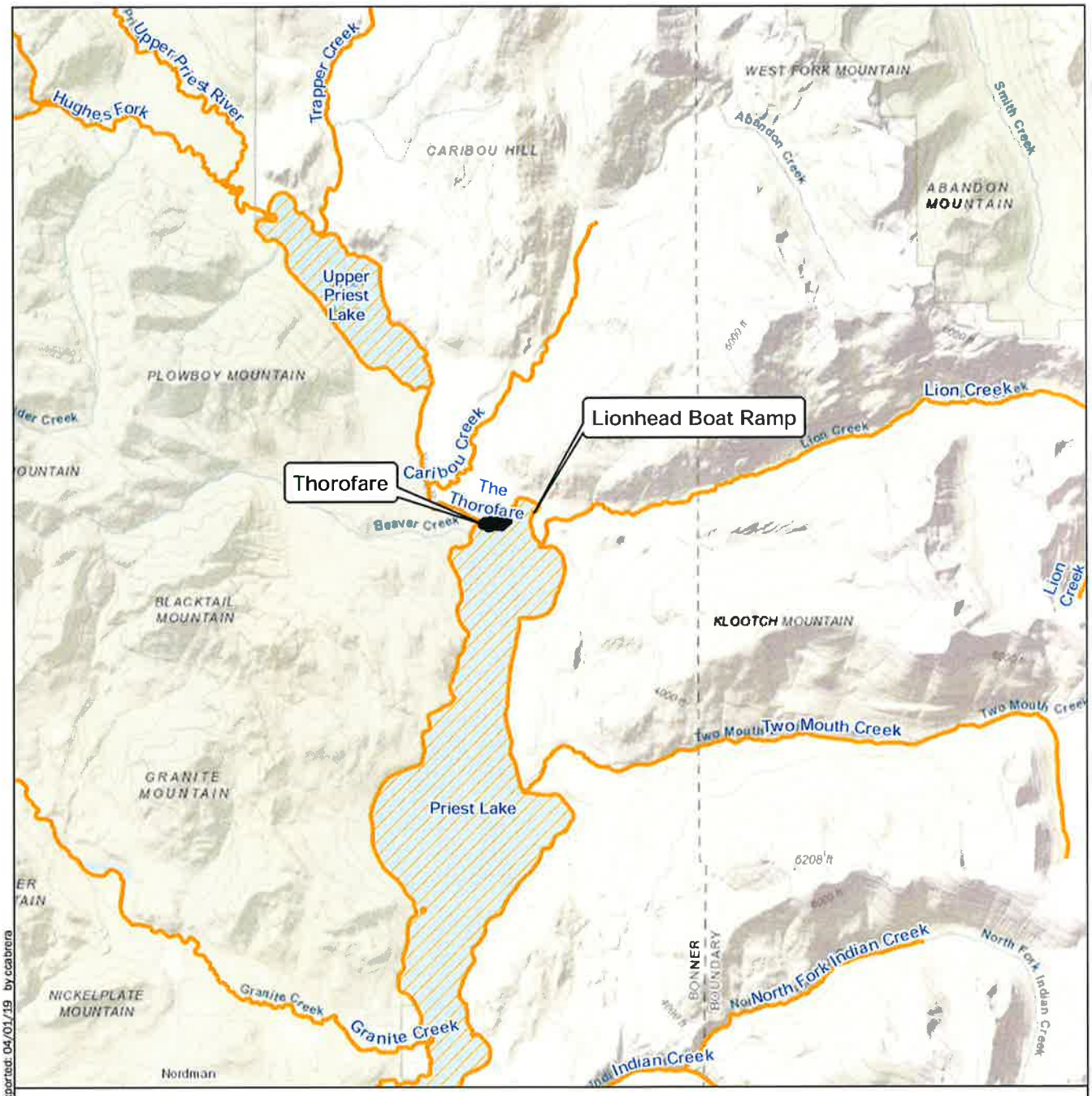

Legend

Bull Trout Critical Habitat

2 0 2

Miles

N

W E

S

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI. Bull Trout Critical habitat data fromo USFWS, https://www.fws.gov/pacific/bulltrout/.

Projection: NAD 1983 UTM Zone 11N

Critical Habitat for Bull Trout

Priest Lake Outlet Dam
Bonner County, Idaho

GeoEngineers

Figure 3

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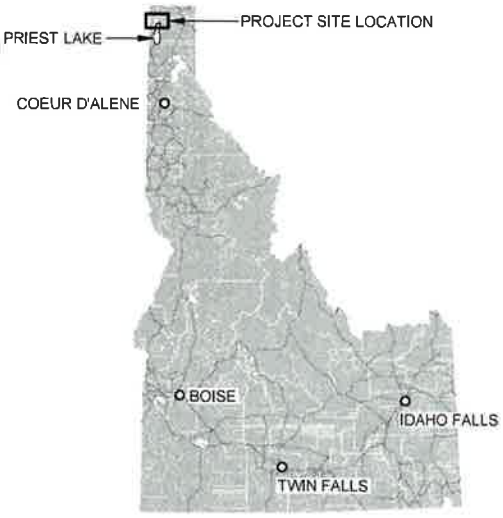
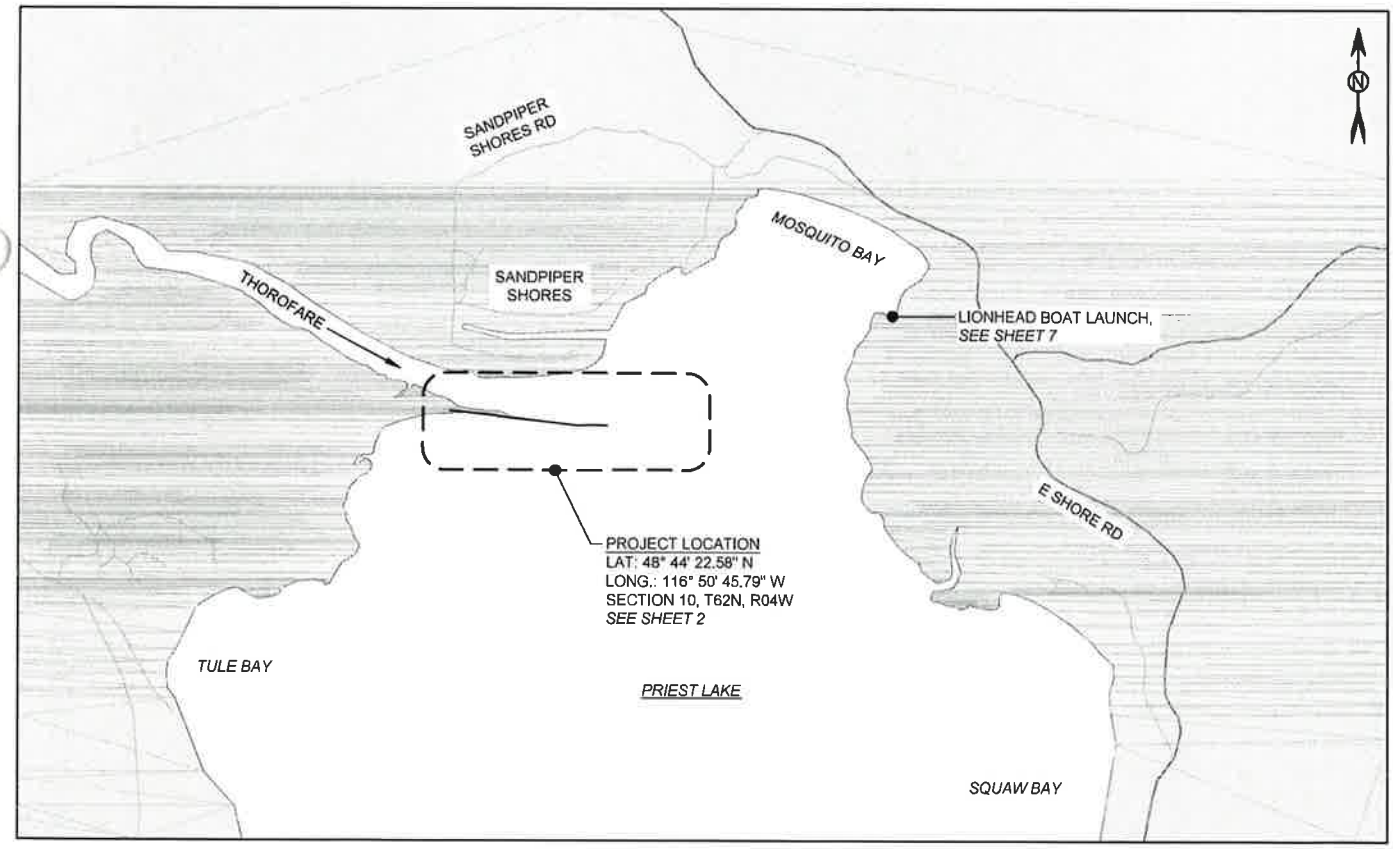
S10 T62N R04W



IDAHO KEY MAP

SHEET INDEX

SHEET NO.	TITLE
1	COVER SHEET
2	SITE PLAN - EXISTING
3	SITE PLAN - TEMP STAGING & WATER DIVERSION
4	SITE PLAN - PROPOSED
5	SECTIONS 1
6	SECTIONS 2
7	PLAN - TEMPORARY STRUCTURES



LOCATION MAP

0 800 1,600

SCALE IN FEET

PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS:

1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

COVER SHEET

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

PROPOSED: DREDGING AND NEW BREAKWATER

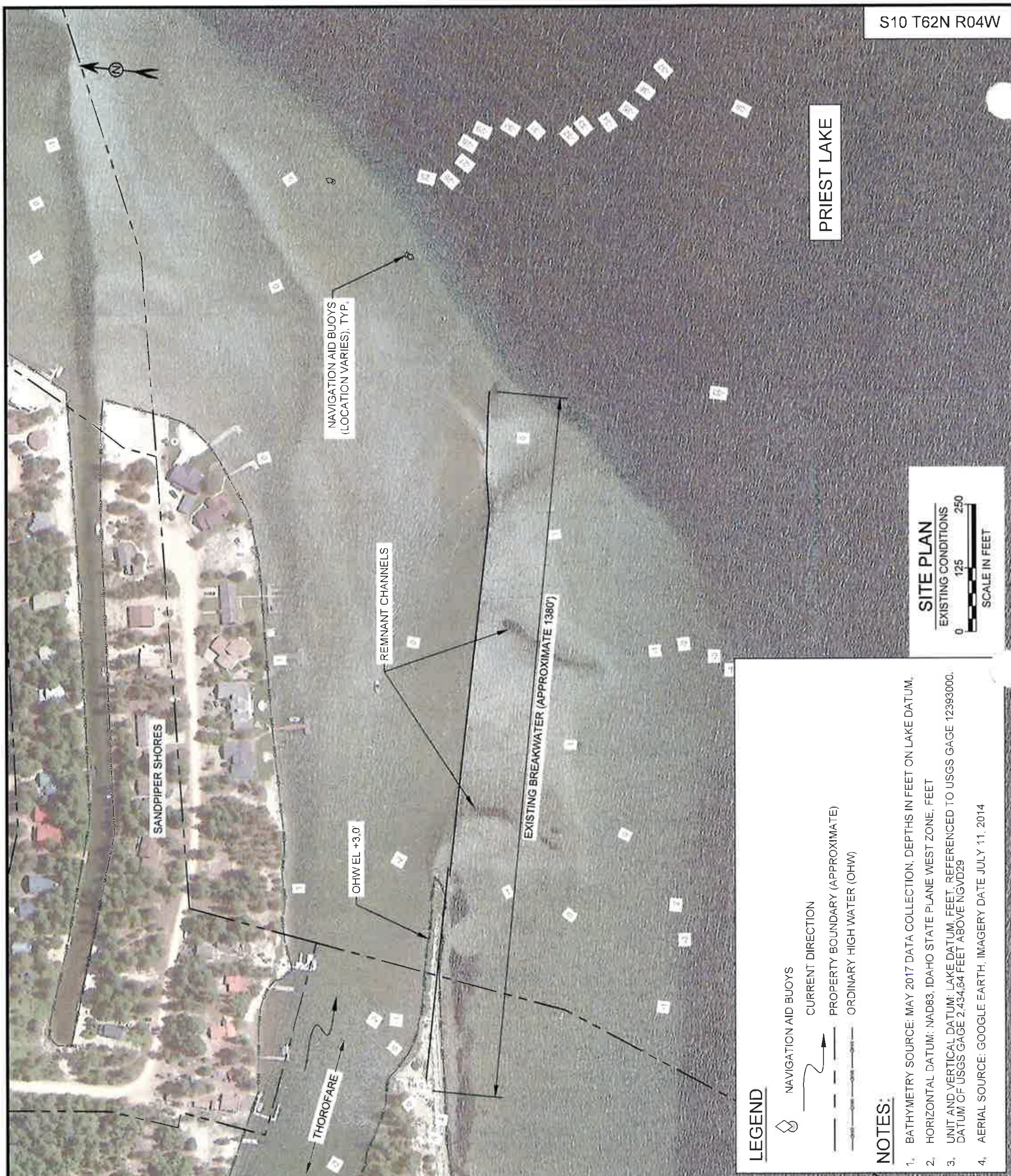
IN: THOROFARE

AT: PRIEST LAKE

COUNTY: BONNER

SHEET 1 OF 7

DATE: 3/13/19



PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS:
1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

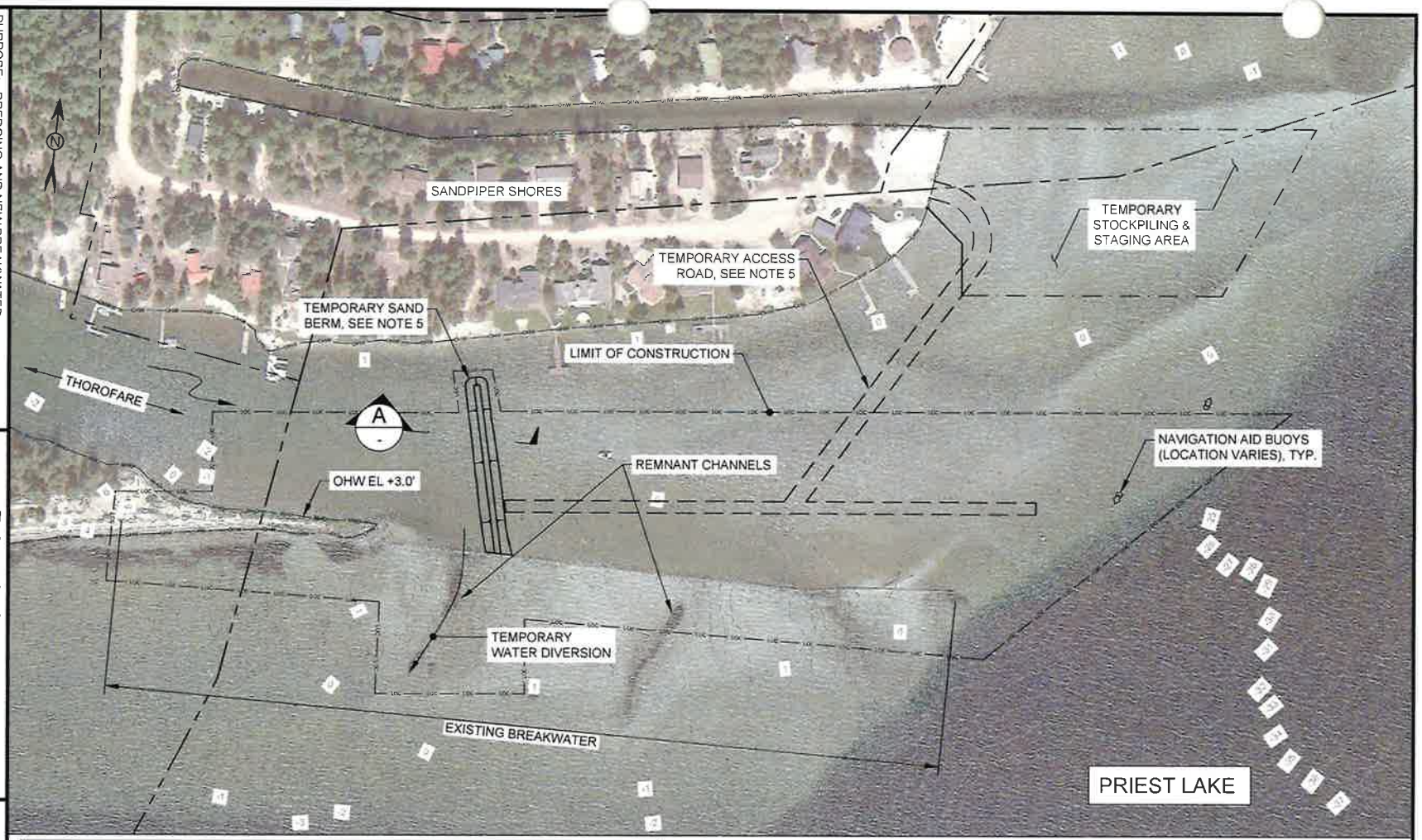
SITE PLAN - EXISTING

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

PROPOSED: DREDGING AND NEW BREAKWATER

IN: THOROFARE
AT: PRIEST LAKE
COUNTY: BONNER

SHEET 2 OF 7 DATE: 3/13/19



PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS.

1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

SITE PLAN - TEMP STAGING & WATER DIVERSION

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

PROPOSED: DREDGING AND NEW BREAKWATER

IN: THOROFARE

AT: PRIEST LAKE

COUNTY: BONNER

SHEET 3 OF 7

DATE: 3/13/19

LEGEND

- NAVIGATION AID BUOYS
- CURRENT DIRECTION
- PROPERTY BOUNDARY (APPROXIMATE)
- ORDINARY HIGH WATER (OHW)
- LIMIT OF CONSTRUCTION
- ACCESS CORRIDOR
- STAGING AREA

NOTES:

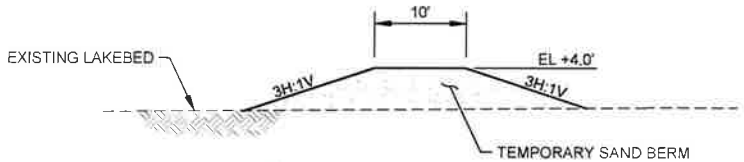
1. BATHYMETRY SOURCE: MAY 2017 DATA COLLECTION, DEPTHS IN FEET ON LAKE DATUM.
2. HORIZONTAL DATUM: NAD83, IDAHO STATE PLANE WEST ZONE, FEET
3. UNIT AND VERTICAL DATUM: LAKE DATUM, FEET, REFERENCED TO USGS GAGE 12393000. DATUM OF USGS GAGE 2,434.64 FEET ABOVE NGVD29. SUMMER LAKE LEVEL = 3.0' (2441.69' NAVD88).
4. AERIAL SOURCE: GOOGLE EARTH, IMAGERY DATE JULY 11, 2014
5. BERM TO BE CONSTRUCTED FROM DREDGED / EXCAVATED MATERIAL AND IMPACTED GRAVEL.
6. TEMPORARY FEATURES TO BE LABELED REMOVED AND SHALL BE RESTORED AFTER CONSTRUCTION.

SITE PLAN

EXISTING CONDITIONS

0 125 250

SCALE IN FEET



A

SECTION

TEMPORARY SAND BERM

0 10 20

SCALE: 1" = 10'

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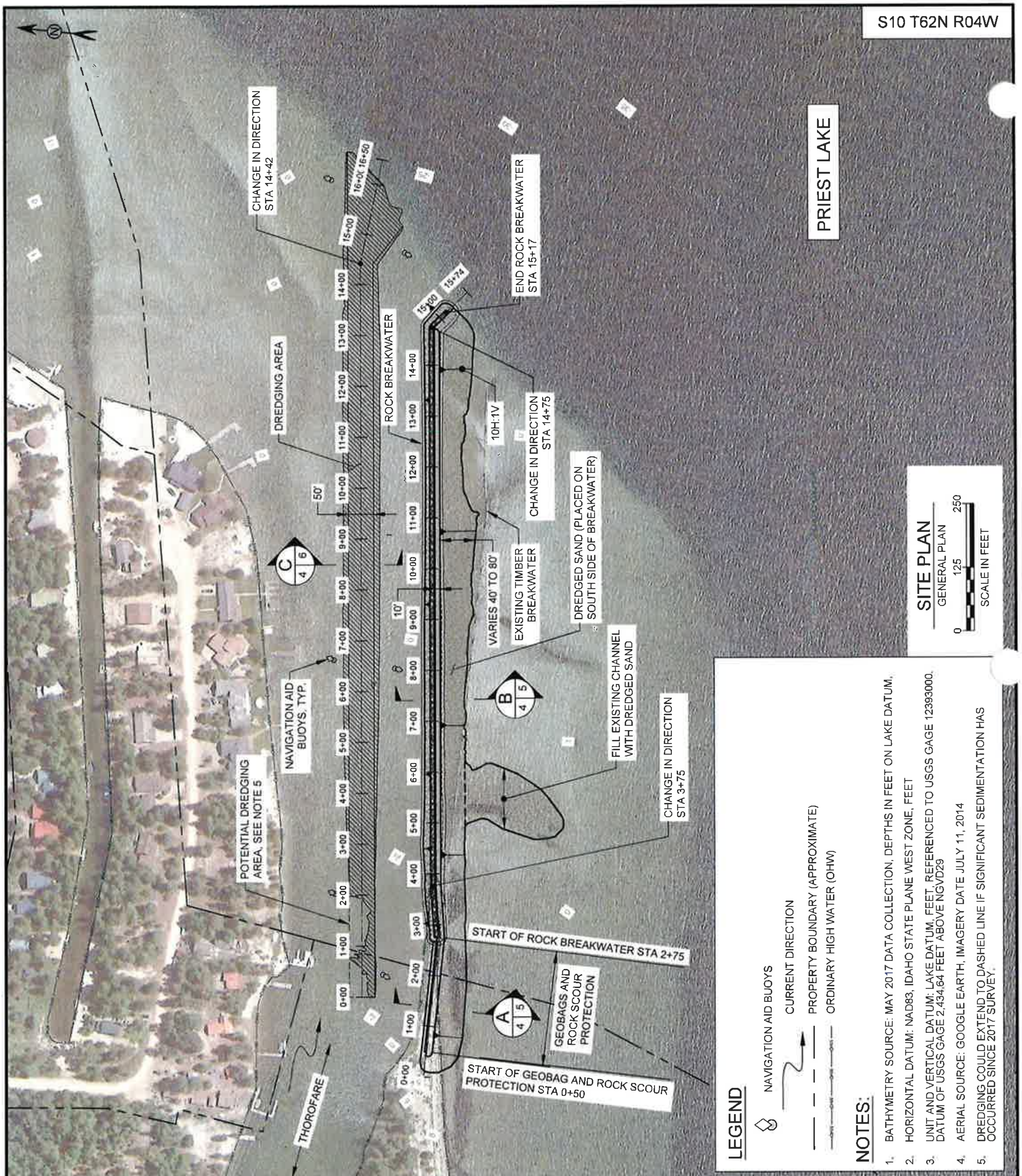


PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS:
1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

SITE PLAN - PROPOSED

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

PROPOSED: DREDGING AND NEW BREAKWATER

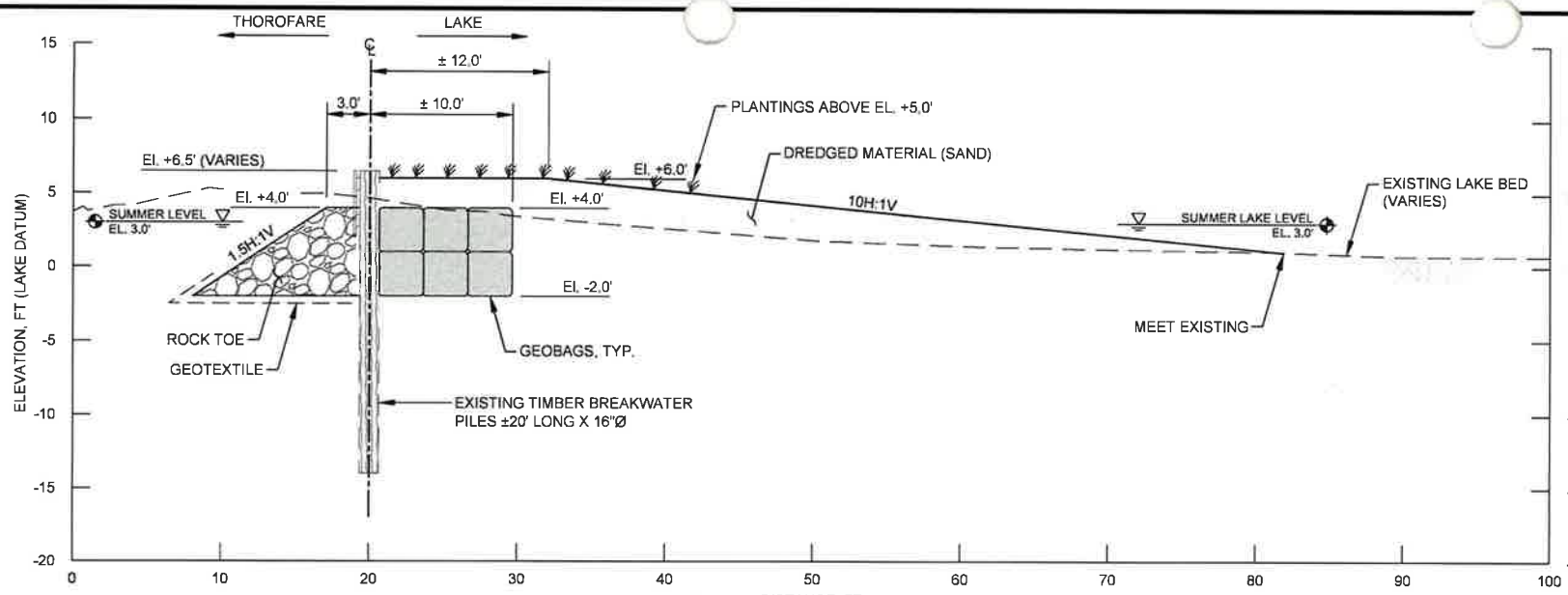
IN: THOROFARE

AT: PRIEST LAKE

COUNTY: BONNER

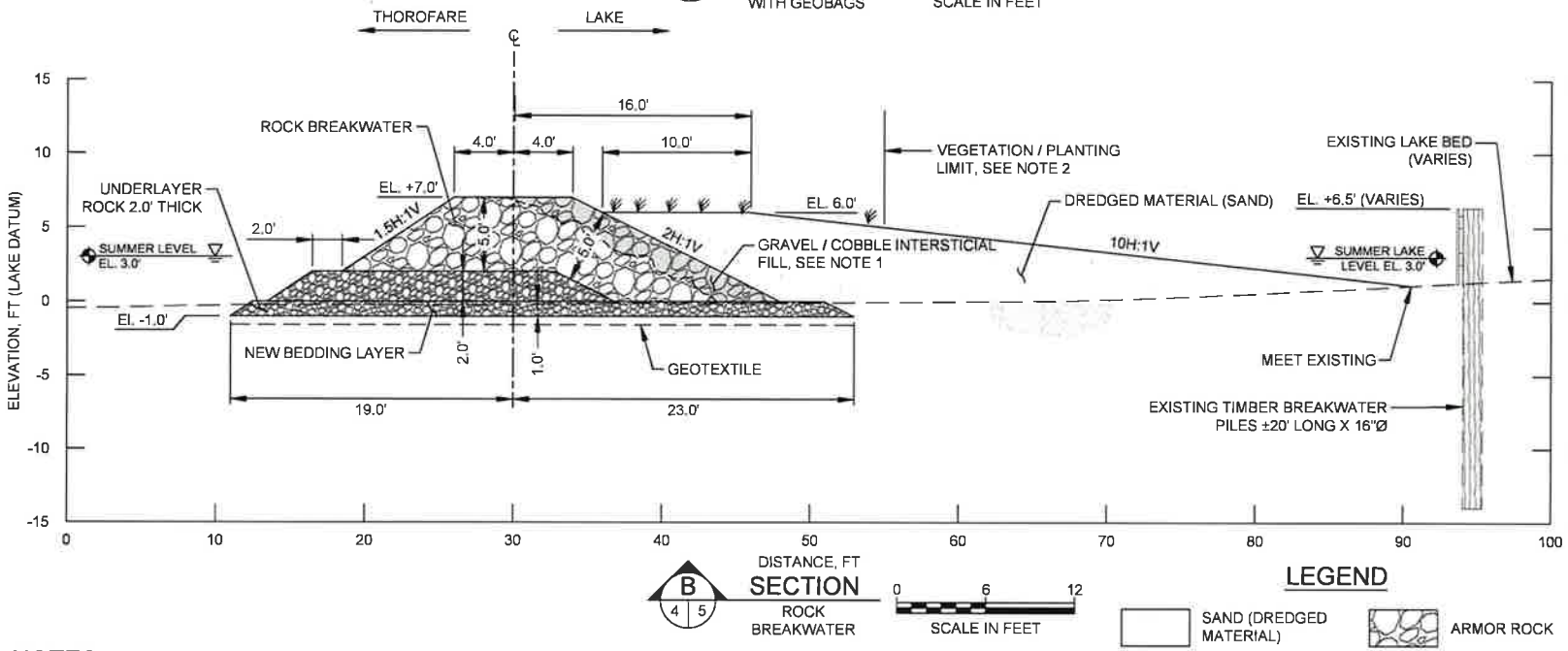
SHEET 4 OF 7

DATE: 3/13/19



A 4 5 SECTION
WEST END WITH GEOBAGS

SCALE IN FEET 0 6 12



B 4 5 SECTION
ROCK BREAKWATER

SCALE IN FEET 0 6 12

LEGEND

- SAND (DREDGED MATERIAL)
- ARMOR ROCK
- UNDERLAYER ROCK
- BEDDING ROCK
- GRAVEL / COBBLE FILL IN VOIDS
- VEGETATION / PLANTING

NOTES

1. PLACE GRAVEL / COBBLE IN VOIDS OF ARMOR ROCK SURFACE.
2. PLANTINGS SHALL BE LOW HEIGHT (LESS THAN 3.0' HIGH). NATIVE SPECIES TO BE DETERMINED.
3. PLANTINGS TO BE INSTALLED ALONG THE WESTERN 1/3 OF BREAKWATER ALIGNMENT.

PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS:
1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

SECTIONS 1

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

PROPOSED: DREDGING AND NEW BREAKWATER

IN: THOROFARE

AT: PRIEST LAKE

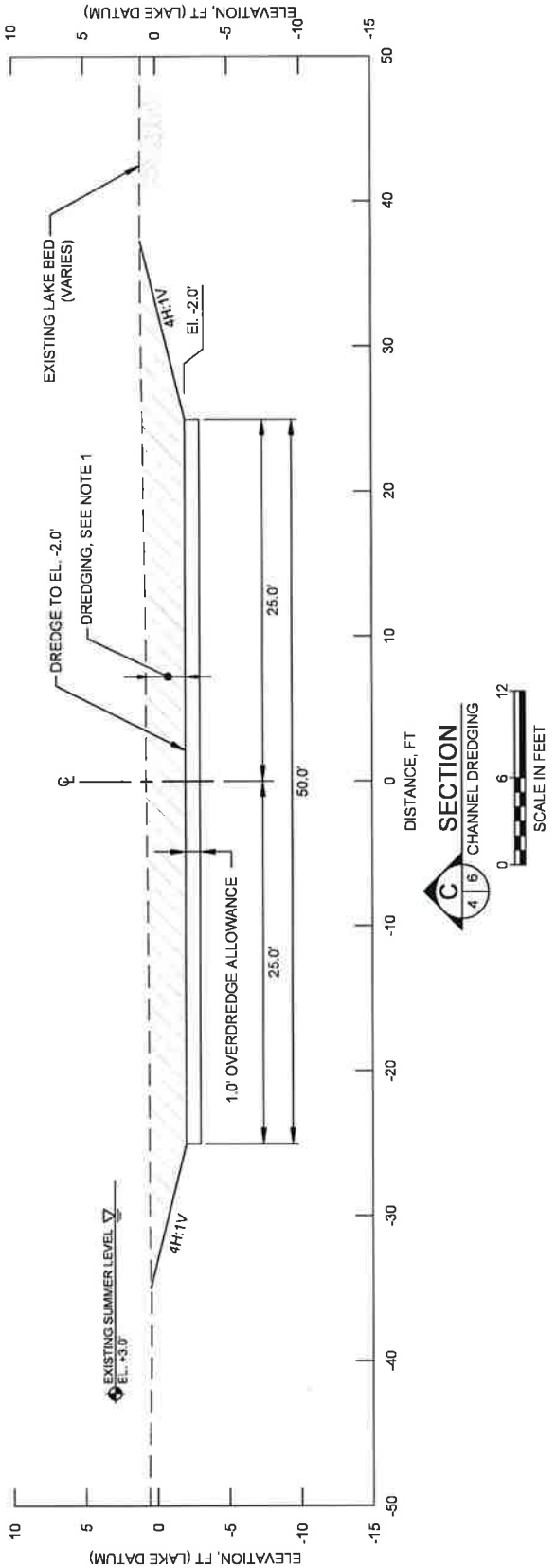
COUNTY: BONNER

SHEET 5 OF 7

DATE: 3/13/19

S10 T62N R04W

S10 T62N R04W



LEGEND

DREDGE AREA

NOTES

1. DREDGE TO EL. -2.0' AND PLACE MATERIAL ON SOUTH SIDE OF ROCK BREAKWATER AND PER PERMITS.

PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS:

1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

SECTIONS 2

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

PROPOSED: DREDGING AND NEW BREAKWATER

IN: THOROFARE

AT: PRIEST LAKE

COUNTY: BONNER

SHEET 6 OF 7

DATE: 3/13/19

PURPOSE: DREDGING AND NEW BREAKWATER

DATUM: LAKE DATUM

ADJACENT PROPERTY OWNERS:
1. SANDPIPER SHORES HOMEOWNERS
2. STATE OF IDAHO
3. FEDERAL GOVERNMENT
4. BEAVER CREEK CAMP HOMEOWNERS

Priest Lake Water Management Thorofare Breakwater & Dredging

PLAN - TEMPORARY STRUCTURES

APPLICATION BY:
IDAHO DEPARTMENT OF WATER RESOURCES

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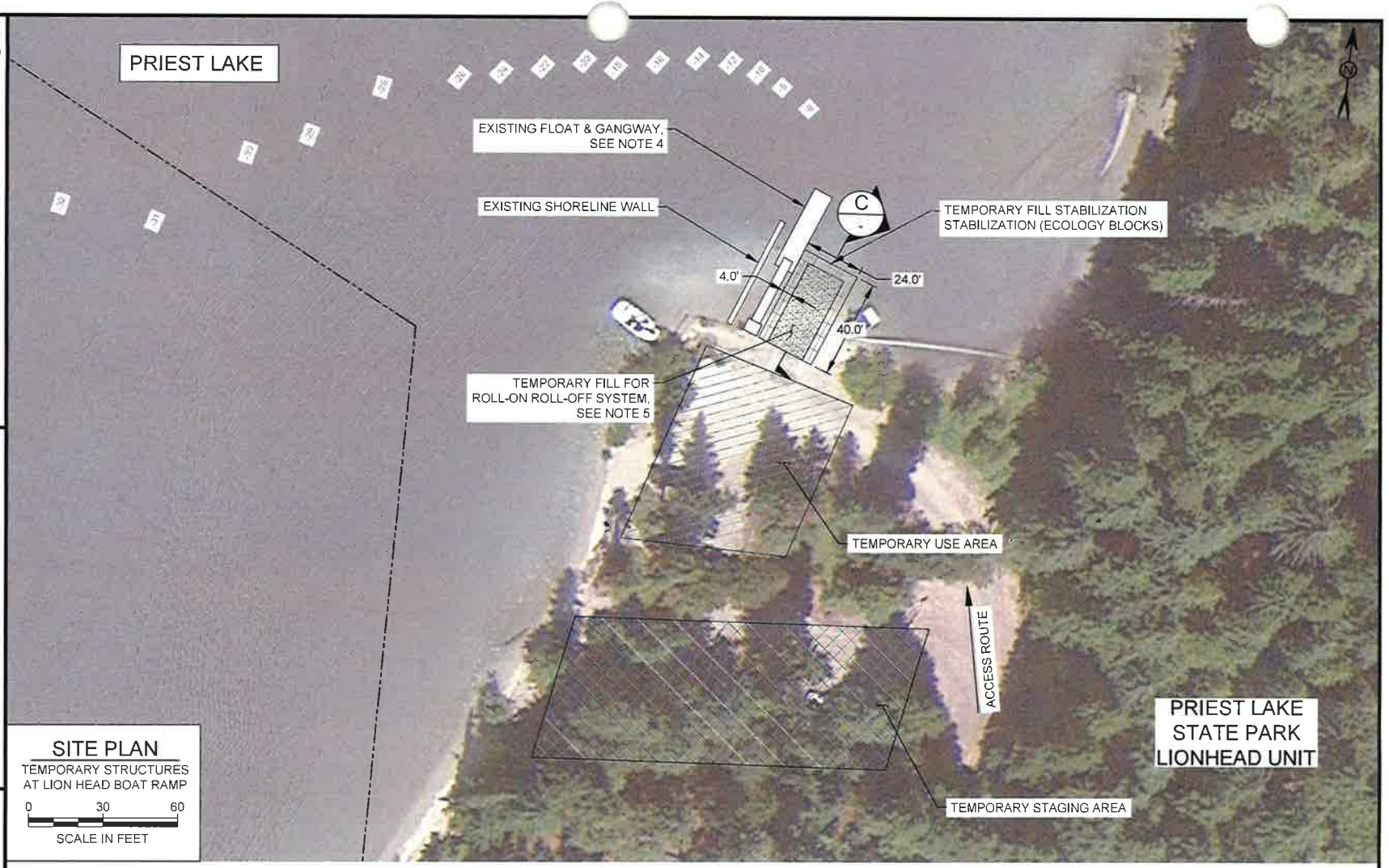
COUNTY: BONNER

SHEET 7 OF 7

DATE: 3/13/19

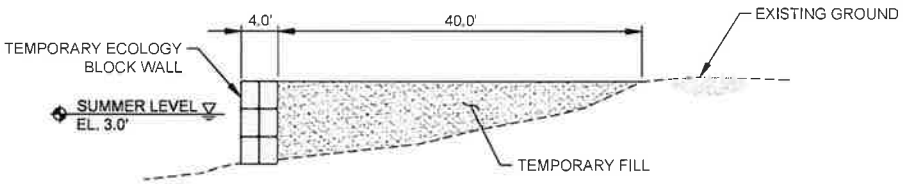


SITE PLAN
TEMPORARY STRUCTURES AT LION HEAD BOAT RAMP

0 30 60
SCALE IN FEET

LEGEND
- PROPERTY BOUNDARY (APPROX.)
- TEMPORARY USE AREA
- TEMPORARY STAGING AREA

NOTES:
1. BATHYMETRY SOURCE: MAY 2017 DATA COLLECTION, DEPTHS IN FEET ON LAKE DATUM.
2. HORIZONTAL DATUM: NAD83, IDAHO STATE PLANE WEST ZONE, FEET.
3. UNIT AND VERTICAL DATUM: LAKE DATUM, FEET, REFERENCED TO USGS GAGE 12393000. DATUM OF USGS GAGE 2,434.64 FEET ABOVE NGVD29.
4. AERIAL SOURCE: GOOGLE EARTH, IMAGERY DATE JULY 11, 2014. EXISTING BOAT RAMP WAS CONSTRUCTED IN 2015, SO NOT SHOWN ON AERIAL IMAGE.
5. TEMPORARY FILL AND ECOLOGY BLOCKS SHALL BE REMOVED AND THE SITE RESTORED AFTER CONSTRUCTION.



C
SECTION
TEMPORARY STRUCTURE

0 10 20
SCALE IN FEET

S10 T62N R04W

Priest Lake Water Management Project

Thorofare Preliminary Engineering - Progress Report
November 5, 2018

Prepared for

Prepared by

Outline

1. Phase 1 Results Review
2. Design Criteria
3. Steel Sheetpile Breakwater
4. Rock Breakwater
5. Quarries and Logistics
6. Cost Estimate
7. Alternatives Analysis

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Phase 1 Review

Breakwater Replacement – Armor Stone

Phase 1 - Alternative A

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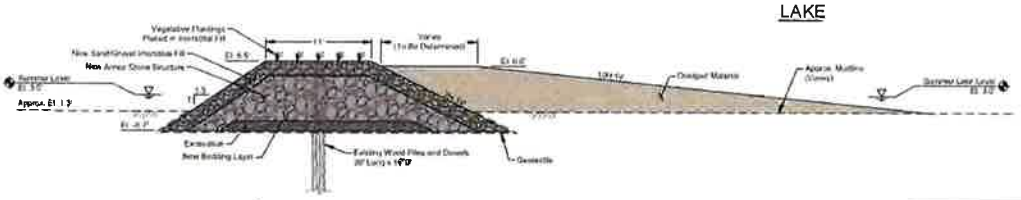
THOROFARE



LAKE

B TYPICAL SECTION

SCALE IN FEET

CONCEPTUAL

10/24/2017

Steel Sheetpile Vertical Breakwater

Phase 1- Alternative B

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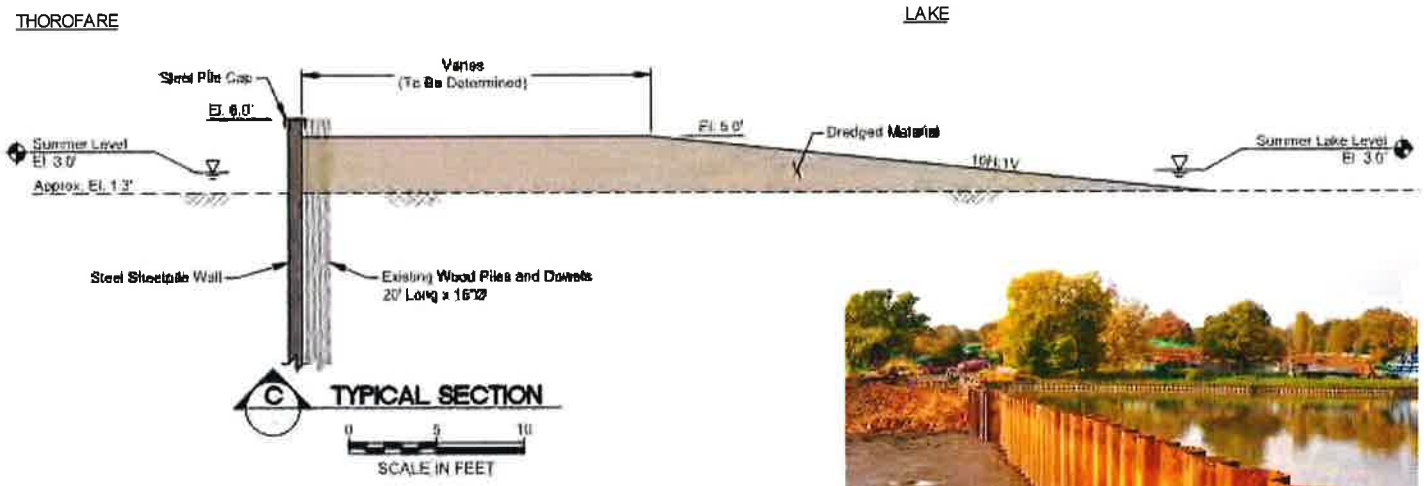

Alternative A – Stone (Site Plan)

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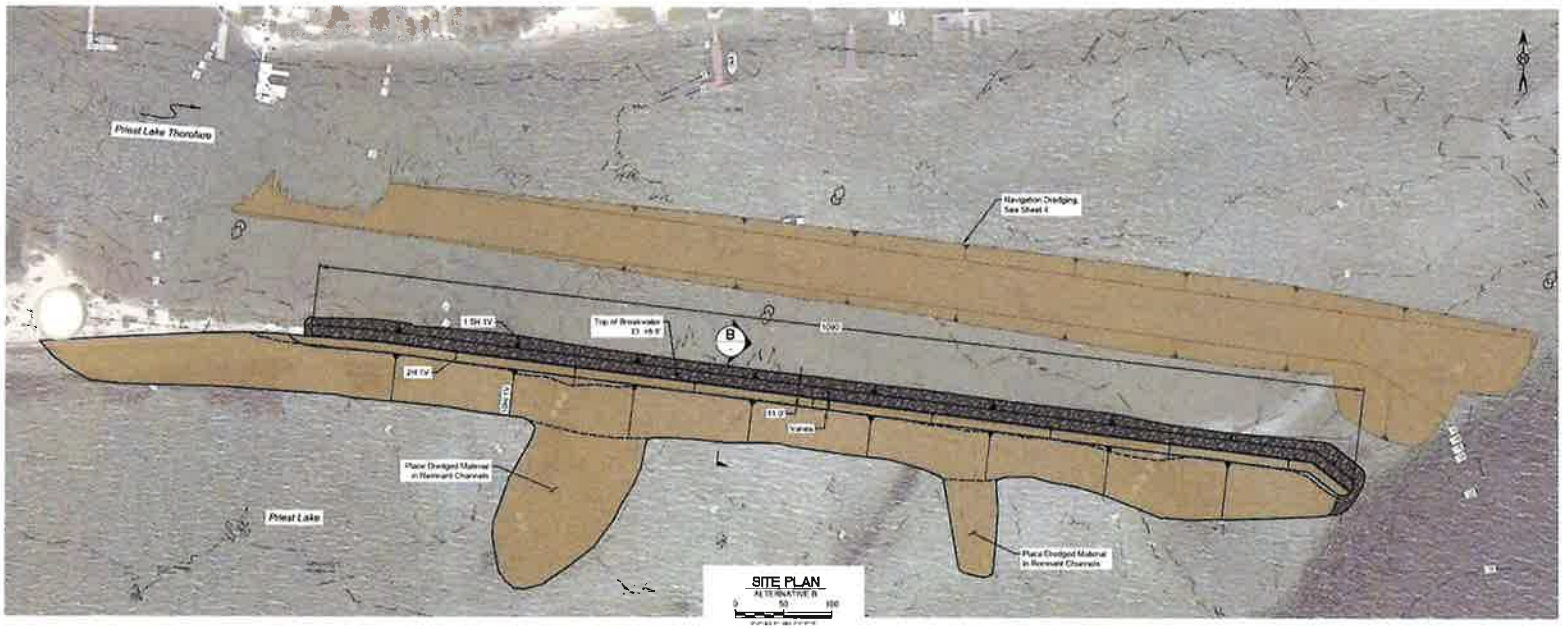

Phase 2 Design Refinement

- Design Concept Refinement & Selection of Preferred Concept
  - Stone vs. Steel Sheetpile
  - Updated Design Criteria
  - Local Community Preferences via Outreach
  - Regulatory Permitting Considerations

- Evaluate Constructability
  - Access – Water vs. Land
  - Water Diversion
  - Scheduling & Time of Year
  - Need for easements

- Updated Estimate of Construction Costs

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Design Criteria

Analysis of environmental conditions & determination of appropriate design criteria & considerations

Environmental Design Criteria

Vertical Datum: Lake Datum

0.0 Lake Datum ft. = 2434.64 ft NGVD29
(USGS gage No. 12393000)

Top elevation of existing breakwater: +6.5 feet

Assumed design high water level: +5.6 feet

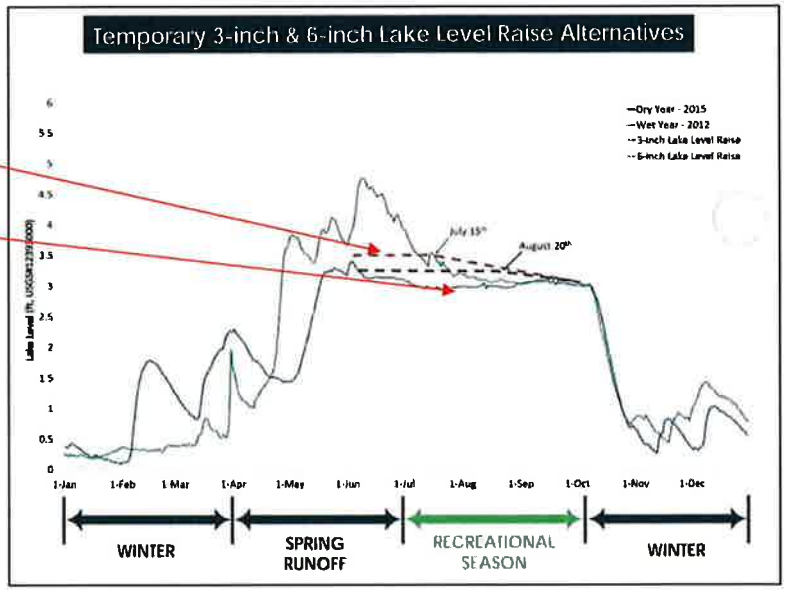
Dry Year Recreational Season Water Level (target) : +3.5 feet

Normal Year Recreational Season Water Level: +3.0 ft

Waves (Lake side only)
H_s = 3.0 feet
T_p = 4.6 seconds

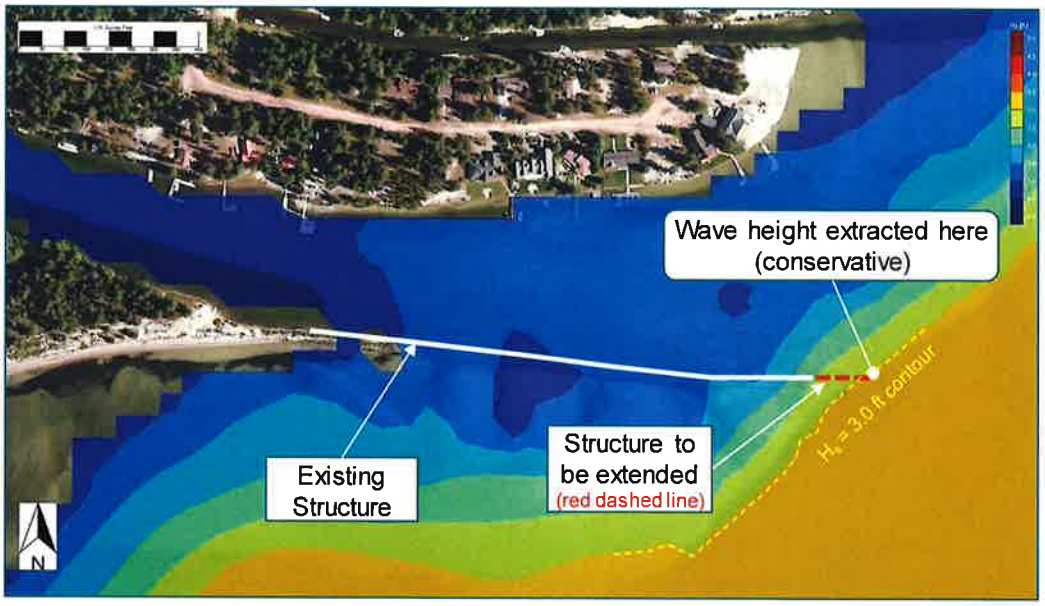
Currents (Thorofare side only)
u = 3.0 feet/second

Ice
thickness = 1.8'



Waves at Structure

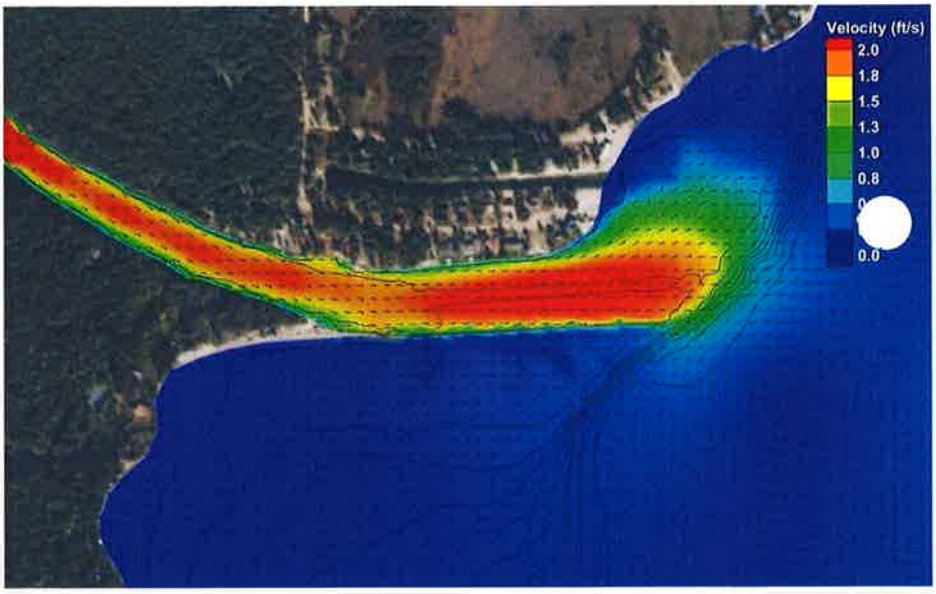
- 100yr waves from Phase 1 to be used for structure sizing & analysis
- Take waves at edge of shelf (conservative) where structure is to be extended
  - H_s = 3.0 ft
  - T_p = 4.6 s



Currents at Structure

Solid Breakwater (Rotated 15° CCW) with Idealized Dredged Channel

- Currents from Delft3D Flow modeling (from Phase 1)
- Model indicates mid-channel depth-avg. velocity, u = ~2.0 ft/s
- Assume u = 3.0 ft/s to be conservative
  - We design for the velocity at the center of the channel, as thalweg may meander post construction



Ice

Priest Lake in Winter at Lion Head
Source: Wikipedia

Temperature data since 2002 used to estimate the maximum ice thickness.

Design ice thickness (t_{ice}) = 1.8 feet.

Up to 3 feet of ice and compacted snow reported

Shallow water in winter protects from ice

Reference *Ice Engineering*

U.S. Army Engineer Research and Development Center, Hanover, New Hampshire

Regulatory and Permitting

- Phase 1 Concepts are permittable, no roadblocks evident, will start consultation when final design concept selected
- Likely self-mitigating
- Dredged material cannot all be placed at the breakwater, only the amount needed for the design & protection of structure or to enhance the environment
- No wetlands within the breakwater work area
- Stable materials for breakwater are needed
- Water quality, mixing zone & turbidity during construction must be controlled
- Compatible with natural environment is a consideration – dredged material reuse, stone, etc..
- Wave effects (reflection), impacts to other properties
- IDL (Idaho Department of Lands) - may require an 'easement' type permit
- Corps of Engineers – 404 or Individual permit, and maybe Section 10 (Navigable waters)
- IDWR – likely no permit required (because the Thorofare project is in Priest Lake, not within the protected rivers designation)

Other Design Considerations

- Material Type
  - Natural Materials – sand, gravel, stone in lieu of steel, concrete, etc...
  - Local Materials – utilize local materials to maximum extent possible
- Bioengineering
  - Plantings ok; needs to be lower growing shrubs and not large trees that would impact viewshed for property owners at Sand Piper Shores
- Geotechnical
  - Breakwater located on sand deposit; soft sediments not anticipated
  - Long-term settlement not a factor
  - Drivability of piles is feasible for site conditions
  - Offset from top edge of underwater steep slope to the edge of the structure is recommended to ensure adequate slope stability

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Construction Access, Materials and Logistics

Client name may be inserted in this section

Stone Sourcing - Quarries

- Local quarries near Coolin – shorter haul distance but less durable rock
- Laclede quarries (Peak Sand & Gravel) – good quality armor rock but longer haul distance.
- Truck haul in winter may not be feasible due to ice on roads

Dover Pit - LaClede

Photo: August 21, 2018

Rocky Mountain Quarry - Coolin

Photo: August 21, 2018

Stone Sourcing - Quarries

Table 1: Rock Source - Summary

Source	Owner	Description
Dover Pit	Peak Sand & Gravel	Good quality granite/diorite rock with large armor stones stockpiled. Near LaClede, the longest haul distance of the sites considered.
Bodie Pit	Peak Sand & Gravel	Good quality metamorphic rock, low yield likely for armor stone production due to fracture spacing. Located near Priest River.
Dickensheet Quarry	Woods Crushing & Hauling	Good quality rock but fractured and not suitable for armor stone, likely OK for underlayer and bedding stone. Located near Coolin.
Rocky Mountain Quarry	Storro Brothers Excavating	Good quality rock but fractured and not suitable for armor stone, likely OK for underlayer and bedding stone. Located near Coolin.
Bear Creek Pit	Idaho Department of Lands	The DOL said it is not available for this project. The site near mile marker 13.5 has not been visited by Mott MacDonald
Bugle Ridge	Idaho Department of Lands	Rock outcrop near the north end of the lake. The location is uncertain and it has not been visited by Mott MacDonald.
Cariboo Ridge	Idaho Department of Lands	Rock outcrop near the north end of the lake. The location is uncertain and it has not been visited by Mott MacDonald.

Recommendations

- Armor rock from Dover Pit (LaClede)
- Smaller rock from local source (Coolin)

Construction Schedule and Logistics – Stone Breakwater

Stone Material Procurement & Truck Delivery

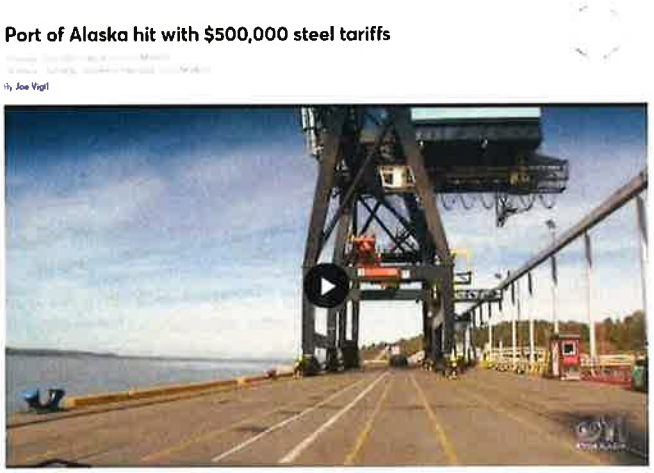
- Approximately15,100 Tons of Rock (8882 CY) required for Alternative A
  - 30 ton side dump trucks, 40 ton Idaho maximum vehicle weight, 25 tons of material per load.
    - → 650 truck loads
  - Dover Pit to Sandpiper Shores: one-way travel 69 miles, 1.6 hours
  - 650 trucks/ (6 trucks x 3 round-trips/day) = 36 days
- Plan for substantial time period needed for stone material delivery

Key Considerations

- Winter trucking should be avoided; delivery of stone for stockpiling will need to occur prior to late November even though construction timeframe may extend into the winter.
- Large number of trucks per day on local roads for up to 8 weeks would be required for delivery of materials.
- Back-haul dredged sand and stockpile at quarry for commercial beneficial reuse should be considered and accounted for during the permitting and easement acquisition process.

Pile Breakwater Materials Sourcing & Delivery

- Steel is the preferred pile material type. Will require corrosion protection; either galvanizing or coating system.
- Material Availability. Steel availability is good for the quantities & sizes required for the project; lead times are reasonable.
- Pricing. Marketplace pricing conditions are hard to predict in current conditions relative to tariffs.
- Delivery & Handling. Large flatbed truck delivery required. Handling of long piles to project site area requires special equipment to pick up, transport and stockpile for use by large crawler crane with pile hammer at the site.



Construction Access - Alternatives

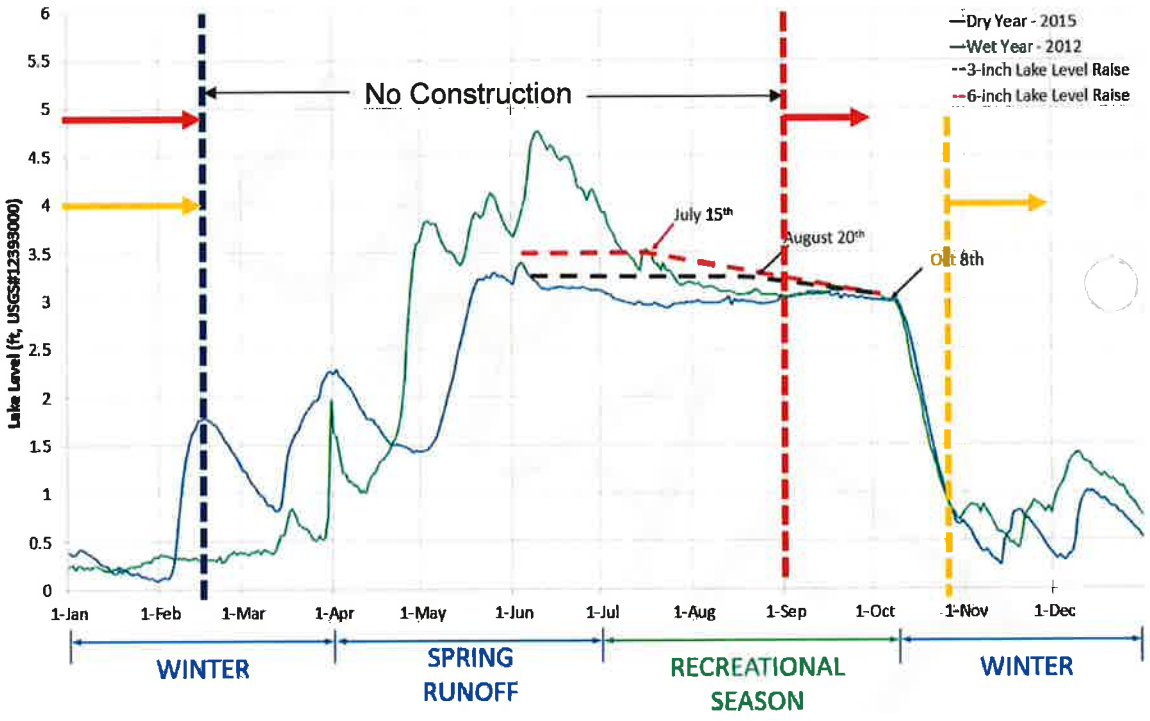
- Water Access: Boat Ramp at Lionhead (start trucking ± October 1)
- Land Access: Not Allowed from west, Maybe OK from north

Construction Schedule and Logistics – Water Levels

Start of Water Based Access

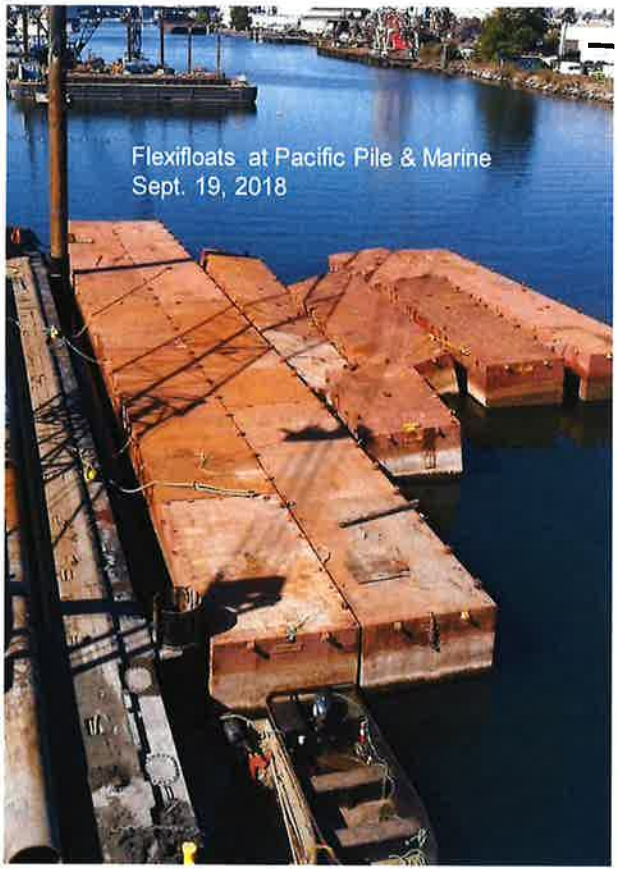
Start of Land Based Access

Note: Recreational Season Work Window to be developed in coordination with Steering Committee



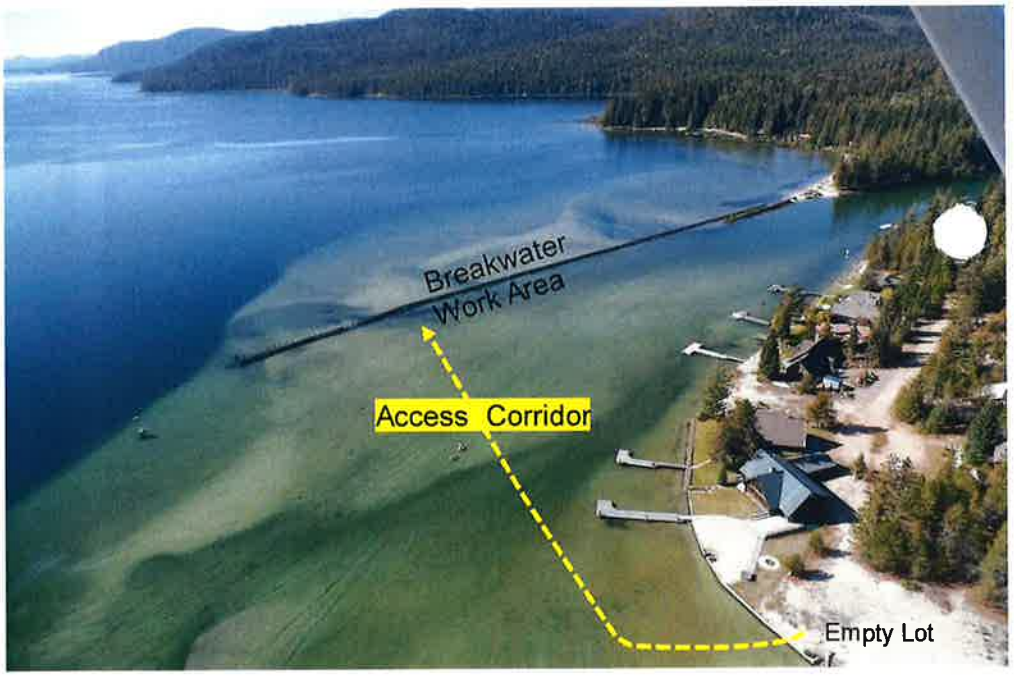
Construction Access - by Water

- Water Access: Boat Ramp at Lionhead assumed for equipment mobilization and material loading onto Flexi-Floats for re-handling from boat ramp to project work area
- Higher cost than Land Access



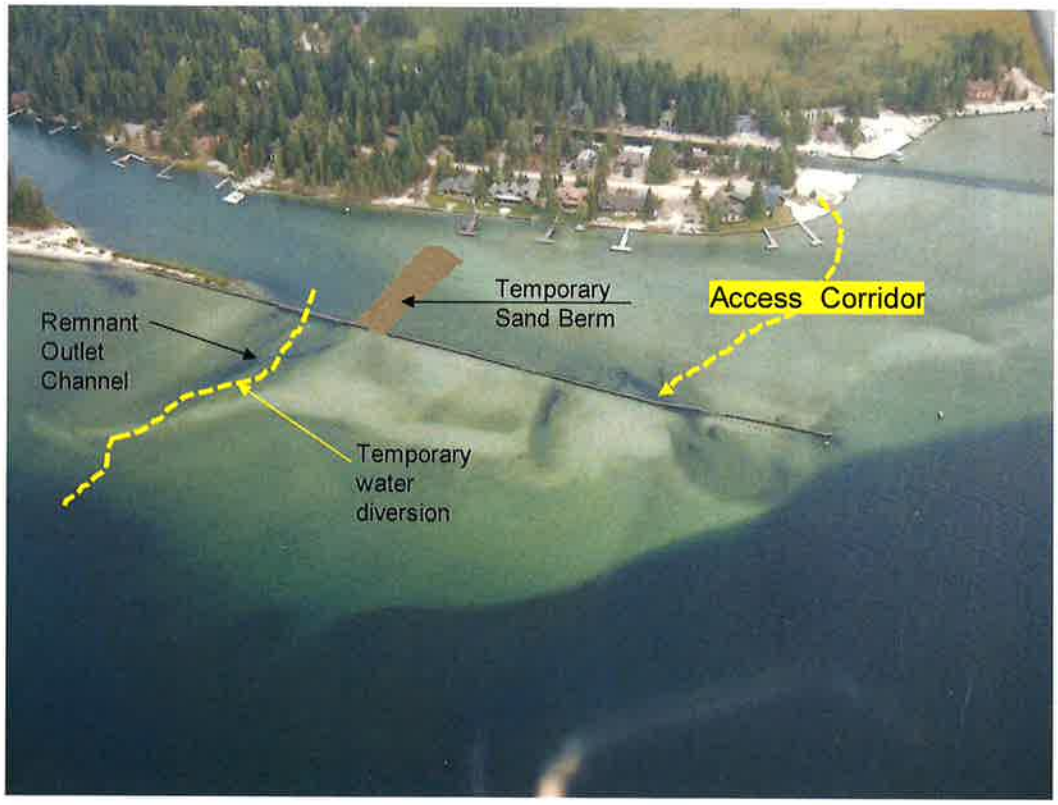
Construction Access - by Land

- Access from west side assumed not possible; access from north side (sand piper shore) is feasible if easement is acquired
- During low water period timeframe (after Nov 1)
- Divert stream into old remnant channel to the lake
- Cross (ford) the Thorofare at Low Water from the north
- Laydown area needed in upland area to stockpile stone for rehandling to the project work site



Land Construction Access – Overview (Summer Pool Water Level Shown)

- Access Point: Utilize local upland access nearby project site
- Timing: Conduct work during time period of year with lowest water levels to allow use of land based equipment
- Sequencing: Sequence work in such a manner to allow work to be done in dry.
- Water Diversion: Install temporary sand berms to divert flows into existing natural remnant channels to keep work in the dry to max extent possible



Construction Sequence

ov ember 2018

Conclusions - Logistics and Access

Access.

- Both marine and land based access is feasible.
- Land based access is preferred.
- Both options require new easements for access points to the Lake from public roads.
  - Boat Ramp – State Parks
  - Thorofare – Private Property
- Stockpile/staging area nearby project site is needed to allow for trucking of materials prior to adverse weather conditions

Stone Quarries

- Local sources of quality rock are available.
- Armor stone requires stone quality type that likely will require sourcing material from quarries located out of Priest Lake basin; longer haul distance.
- Smaller underlayer and bedding stone likely can be sourced from Priest Lake basin quarries.

Steel

- Steel tariffs and market conditions are harder to predict future costs.

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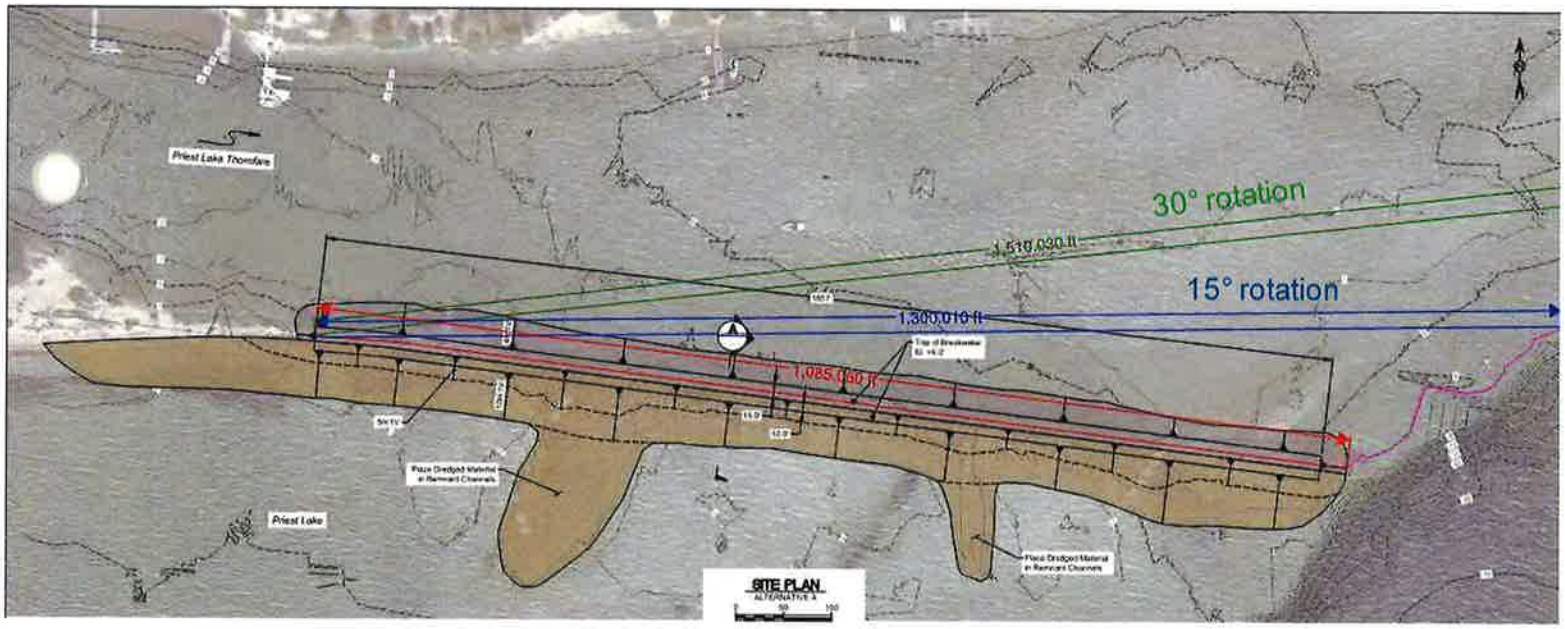
Alternatives Analysis & Preliminary Design

- Rock Breakwater
- Vertical Sheetpile Wall
- Dredging

Breakwater Layout

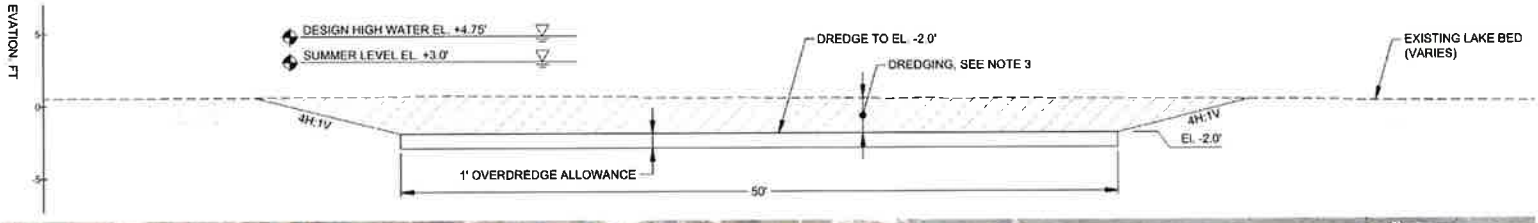
15 degree rotation from existing is recommended:

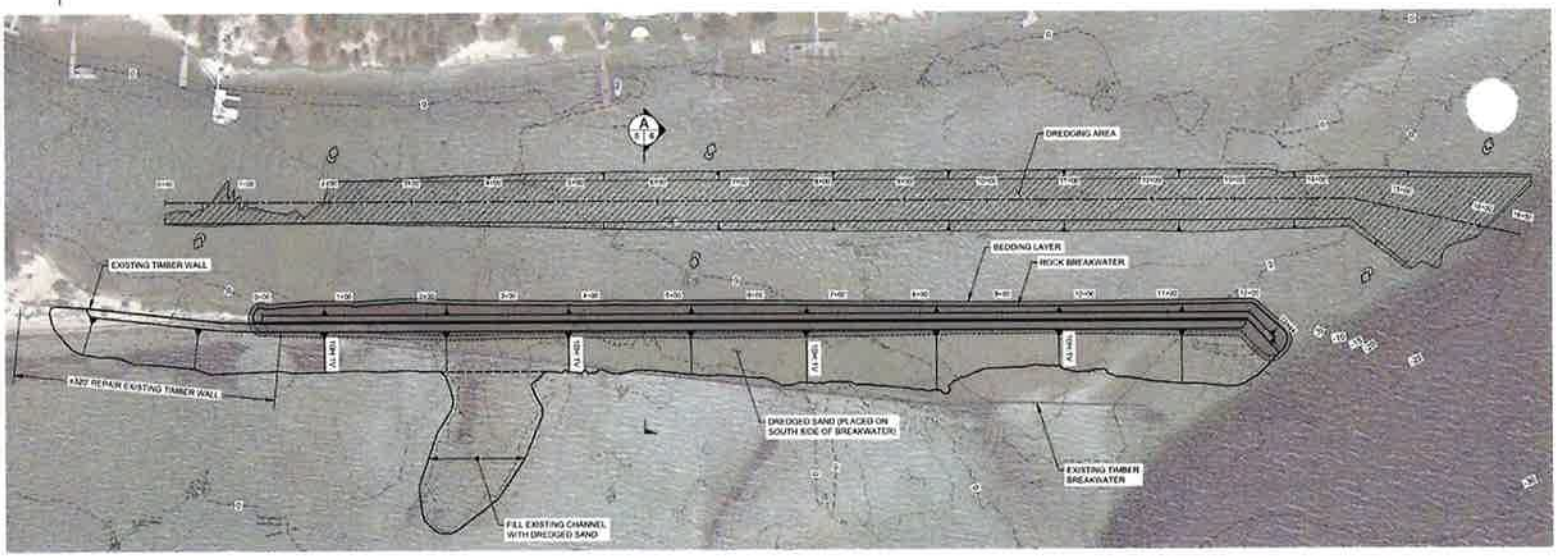
- Enhances flow, lowers sedimentation risk at mouth of Thorofare
- Length increases to 1300 ft.



Dredging

Dredge: 12,700 CY (channel, 1' overdepth, under BW)
Fill: 9,855 CY (placed at breakwater)



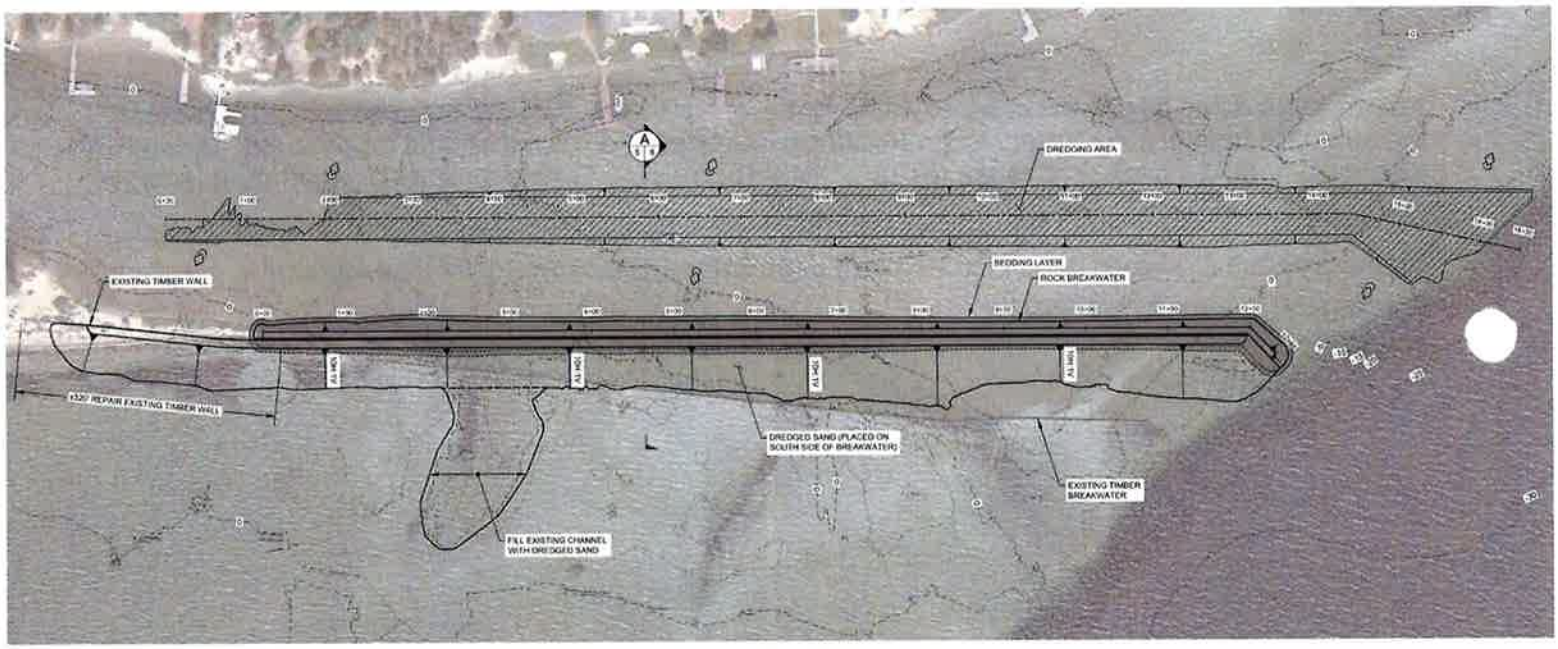


Dredging and Sediment Placement

Notes

- Not all volume can be placed at breakwater. Agencies will allow only the volume needed to protect the structure or improve habitat. A combination of in-water and upland should be pursued. Upland disposal should be beneficial reuse for commercial purposes. Obtain approval for commercial reuse.
- Dredge channel depth and width to be refined; maximum requirement as outlined in Phase 1.
- Slope of beach fill should be similar to existing (prototype) beaches ~ 10H:1V minimum
- Existing Wall Demolition? TBD

Rock Breakwater - Plan



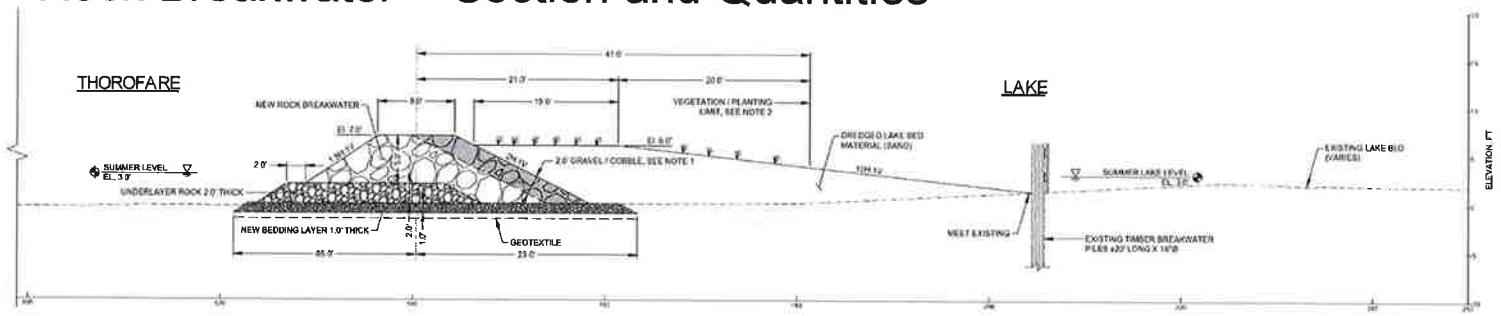
NOTES

1. BATHYMETRY SOURCE: 2017 MOTT MACDONALD SURVEY
2. HORIZONTAL DATUM: NAD83, WEST FEET
3. UNIT AND VERTICAL DATUM FEET REFERENCED TO USGS GAGE 12359800 DATUM. DATUM OF GAGE 2.434 64 FEET ABOVE NGVD29
4. AERIAL SOURCE: GOOGLE EARTH

SITE PLAN
EXISTING CONDITIONS

0 60 120
SCALE IN FEET

Rock Breakwater – Section and Quantities



N
1. [illegible] COBBLE IN VOIDS OF ARMOR ROCK SURFACE.
2. [illegible] PLANTINGS SHALL BE LOW HEIGHT (LESS THAN 3.0' HIGH).
3. DREDGE TO EL. -2.0' AND PLACE MATERIAL ON SOUTH SIDE OF ROCK BREAKWATER AND PER PERMITS

A SECTION
3 | 6 DREDGE AREA AND ROCK BREAKWATER
0 5 10
SCALE IN FEET

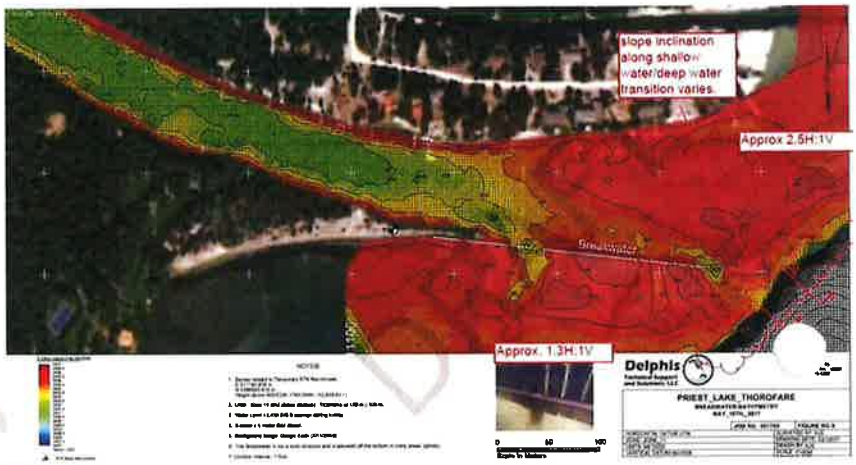
LEGEND
- ARMOR ROCK, W50 = 1500 LBS
- UNDERLAYER ROCK, W50 = 150 LBS
- BEDDING ROCK, W50 = QUARRY SPALLS, 8" MINUS
- VEGETATION / PLANTING
- SAND (DREDGED MATERIAL)
- GRAVEL / COBBLE FILL IN VOIDS

Quantities

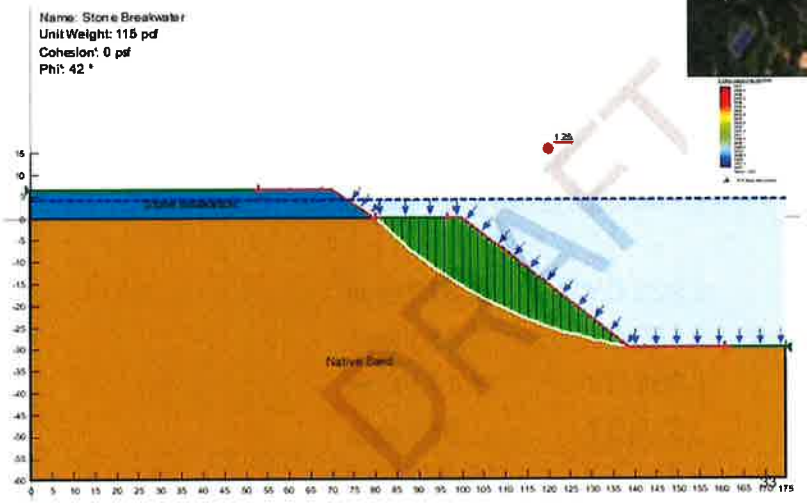
Dredging	12,700 CY	(9,855 CY placed at breakwater)
Armor rock	4,925 CY	8,373 tons
Underlayer rock	1,855 CY	3,154 tons
Bedding rock	1,865 CY	3,171 tons
Gravel/cobble	510 CY	860 tons
Total rock:	9,151 CY	15,557 tons

Geotechnical Report (Geoengineers)

Slope Stability



Slip circle analysis and recommendations for setback distance



- Maintain mid setback distance from top of underwater steep slope to edge of new structure for slope stability.

Rock Breakwater - Summary Discussion

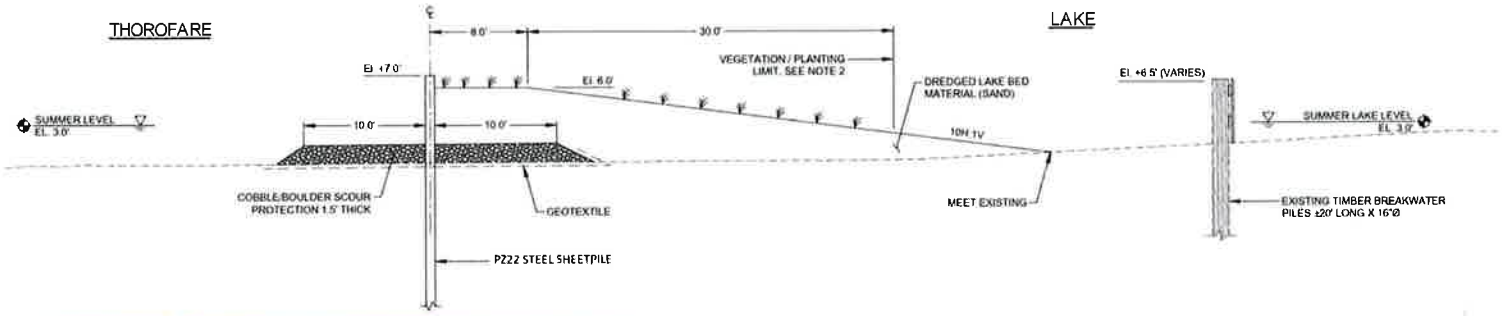
The rock breakwater meets the key design criteria

- Increases flow velocity to help maintain channel depths
- Durable, able resist wave and ice forces, and function with some damage
- Local economic benefit, uses local materials, labor and equipment
- Likely acceptable for regulatory and permitting, and local residents
- Aesthetic, will not block views
- Wave and vessel wake reflections minimized
- More compatible with dredged material reuse

Rock breakwater challenges

- Construction access, schedule and logistics – no clear path forward
- Truck traffic is an adverse impact, also a safety issue if trucking occurs on icy roads
- Larger footprint than a vertical wall

Vertical Wall – Section and Quantities



www.hammersteel.com

Quantities

Steel Sheet Pile PZ22	34,000 SF (550 tons galv. steel)
Pile Cap C12x20.7	1,300 LF (14 tons galv. Steel)
Gravel/cobble	510 CY (860 tons)
Dredging:	12,600 CY

Steel Sheetpile Breakwater Summary Discussion

The steel sheetpile breakwater meets the key design criteria

- Increases flow velocity to help maintain channel depths
- Steel is strong, better than wood wall to resist wave and ice forces
- Likely acceptable for regulatory and permitting, and local residents
- Same height as existing wall, will not block views

Steel sheetpile breakwater challenges

- Construction access, schedule and logistics (lesser concern than rock)
- Truck traffic
- Aesthetics (galvanized or bare steel not a natural material)
- Wave and vessel wake reflections
- Scour at toe of wall
- Less compatible with dredged material reuse

Rock Breakwater – Cost Estimate

Land Access

Item	Description	Unit Price	Unit	Quantity	Cost
1	Mobilization (10%)	$140,000	LS	1	$140,000
2	Environmental Protection	$35,000	LS	1	$35,000
3	Furnish and Install Rock	$55	Ton	15,600	$858,000
4	Geotextile	$6	SY	6,000	$36,000
5	Dredging	$25	CY	12,600	$315,000
6	Excavation and Fill (breakwater base prep & grading)	$25	CY	2,200	$55,000
8	Site Restoration - plantings	$15,000	LS	1	$15,000
9	Repair existing timber breakwater	$10	SF	2,240	$22,400
10	Surveying	$35,000	LS	1	$35,000
				Subtotal Cost	$1,511,400
				Bonner County Sales Tax (6.0%)	$90,684
				Contingency (25%)	$377,850
				Total Construction Cost:	$1,980,000
				final engineering and design (10%):	$198,000
				project management and construction administration (4%):	$80,000
				engineering services during bidding and construction (5%):	$99,000
				Recommended Project Budget:	$2,357,000

Notes: 1. Asssumes construction from land, all rock from Dover Pit, no barges

Barge Access

Item	Description	Unit Price	Unit	Quantity	Cost
1	Mobilization (10%)	$210,000	LS	1	$210,000
2	Environmental Protection	$35,000	LS	1	$35,000
3	Furnish and Install Rock	$100	Ton	15,600	$1,560,000
4	Geotextile	$6	SY	6,000	$36,000
5	Dredging	$25	CY	12,600	$315,000
6	Excavation and Fill (breakwater base prep & grading)	$25	CY	2,200	$55,000
8	Site Restoration - plantings	$15,000	LS	1	$15,000
9	Repair existing timber breakwater	$10	SF	2,240	$22,400
10	Surveying	$35,000	LS	1	$35,000
				Subtotal Cost	$2,283,400
				Bonner County Sales Tax (6.0%)	$137,004
				Contingency (25%)	[illegible]850
				Total Construction Cost:	[illegible]000
				final engineering and design (10%):	$300,000
				project management and construction administration (4%):	$120,000
				engineering services during bidding and construction (5%):	$150,000
				Recommended Project Budget:	$3,562,000

Notes: 1. Asssumes material delivered via flexi float barge & tug

Potential Cost Savings

- Reduce crest height and width (save $300,000)
- Assume smaller rock sourced from Coolin quarry – armor rock from Laclede (save $65,000)
- Credit for sale of sand from dredging (@$5/CY ➔ save $60,000)
- Eliminate excavation of 1' layer under breakwater (save $90,000)
- Reduce contingency to 20% (save $85,000)

Vertical Steel Sheetpile Breakwater – Cost Estimate

Land Access

Item	Description	Unit Price	Unit	Quantity	Cost
1	Mobilization (10%)	$160,000	LS	1	$160,000
2	Environmental Protection	$20,000	LS	1	$20,000
3	Furnish and Install Sheet Piling	$992	LF	1,300	$1,290,000
4	Steel pile cap (non-structural)	$60	LF	1,300	$78,000
5	Cobble-Boulder scour protection	$55	Ton	2,700	$148,500
6	Geotextile	$6	SY	4,400	$26,400
7	Site Restoration - plantings	$10,000	LS	1	$10,000
8	Repair existing timber breakwater	$10	SF	2,240	$22,400
9	Surveying	$15,000	LS	1	$15,000
10	Dredging	$25	CY	12,600	$315,000
				Subtotal Cost	$2,085,300
				Bonner County Sales Tax (6.0%)	$125,118
				Contingency (25%)	$521,325
				Total Construction Cost:	$2,732,000
				final engineering and design (10%):	$274,000
				project management and construction administration (4%):	$110,000
				engineering services during bidding and construction (5%):	$137,000
				Recommended Project Budget:	$3,253,000

Notes: 1. Asssumes material delivered via truck (easement required)

Barge Access

Item	Description	Unit Price	Unit	Quantity	Cost
1	Mobilization (10%)	$230,000	LS	1	$230,000
2	Environmental Protection	$20,000	LS	1	$20,000
3	Furnish and Install Sheet Piling	$1,223	LF	1,300	$1,590,000
4	Steel pile cap (non-structural)	$60	LF	1,300	$78,000
5	Cobble-Boulder scour protection	$100	Ton	2,700	$270,000
6	Geotextile	$6	SY	4,400	$26,400
7	Site Restoration - plantings	$10,000	LS	1	$10,000
8	Repair existing timber breakwater	$10	SF	2,240	$22,400
9	Surveying	$15,000	LS	1	$15,000
10	Dredging	$25	CY	12,600	$315,000
				Subtotal Cost	$2,576,800
				Bonner County Sales Tax (6.0%)	$154,608
				Contingency (25%)	$644,200
				Total Construction Cost:	$3,376,000
				final engineering and design (10%):	$338,000
				project management and construction administration (4%):	$136,000
				engineering services during bidding and construction (5%):	$169,000
				Recommended Project Budget:	$4,019,000

Notes: 1. Asssumes material delivered via flexi float barge

Construction Cost Estimate - Summary

Dec. 2017 Cost Estimate
(with 35% contingency)

Schedule 1 - Outlet Structure

Item	Description	Quantity/Units	Unit	Unit Cost	Total
1	Outlet Structure	1	LS	$2,635,000.00	$2,710,000.00

Schedule 2 - Thorofare Alternatives

Item	Description	Quantity/Units	Unit	Unit Cost	Total
1	Alternative A - Sand/Gravel Berm	1	LS	$2,504,000.00	$2,504,000.00
2	Alternative B - Rubblemound Breakwater	1	LS	$2,295,000.00	$2,295,000.00
3	Alternative C - Sheetpile Wall	1	LS	$2,443,000.00	$2,443,000.00

TOTAL COSTS

Item	Description	Quantity/Units	Unit	Unit Cost	Total
1	Alternative A - Sand/Gravel Berm	1	LS	$5,139,000.00	$5,139,000.00
2	Alternative B - Rubblemound Breakwater	1	LS	$4,930,000.00	$4,930,000.00
3	Alternative C - Sheetpile Wall	1	LS	$5,078,000.00	$5,078,000.00

Thorofare Alternative Refinements (7.5 ° Rotation and 84' Extension)

Item	Description	Quantity/Units	Unit	Unit Cost	Total
4	Alternative A - Sand/Gravel Berm - EXTENSION	1169	LF	$2,302.82	$2,692,000.00
5	Alternative B - Rubblemound Breakwater - EXTENSION	1169	LF	$2,111.21	$2,468,000.00
6	Alternative C - Sheetpile Wall - EXTENSION	1169	LF	$2,247.22	$2,627,000.00

TOTAL COSTS (w/ Rotation and Extension)

Item	Description	Quantity/Units	Unit	Unit Cost	Total
1	Alternative A - Sand/Gravel Berm	1	LS	$5,327,000.00	$5,327,000.00
2	Alternative B - Rubblemound Breakwater	1	LS	$5,103,000.00	$5,103,000.00
3	Alternative C - Sheetpile Wall	1	LS	$5,262,000.00	$5,262,000.00

Nov. 2018 Cost Estimate

Rock Breakwater
$2.4 million (land access) $3.6 million (barge)

Steel Sheetpile Wall Breakwater
$3.3 million (land access) $4.1 million (barge)

Notes:
1) All Costs include an estimated amount for Engineering, Permitting, Data Collection, and Contingency
2) Mitigation costs not included (if required)

06 November 2018

Alternatives – Pros and Cons

	Alternative	
	Rock Breakwater	**Vertical Wall Steel Sheetpile**
Construction Traffic/Noise	Truck Traffic	Shorter duration
Local Economic Benefit	Local Material Source	Steel – not local source
Equipment	Excavators and side-dump trucks	Pile driving equipment and labor
Hydrodynamic Impact	Rock structure absorbs wave energy	Wave reflections, potential waterfront impact
Footprint	Larger footprint	Smaller footprint, easier to permit
Ice	Sloped structure - lower ice forces	Vertical structure - higher to ice forces
Cost – Land Access	$2.4 million	$3.3 million
Cost – Barge Access	$3.6 million	$4.1 million
Aesthetics	Natural materials	Galvanized or bare steel

Recommended

Assessment

- A number of alternatives will meet the design criteria and project purpose (sustainable access)
- A solid breakwater is needed to confine Thorofare flows to increase velocities and improve sediment transport capability.
- Dredging is needed for all alternatives. Future dredging needs are uncertain. The channel will migrate over time.
- A rotated alignment is recommended, to further confine the flow, and is consistent with the first breakwater constructed.
- Discussions with contractors and material suppliers indicate both a rock breakwater and solid sheetpile wall are constructible at reasonable cost, but with uncertainties about logistics and access.
- Costs for easements and site restoration will need to be developed and added to the budget.

Conclusions & Recommendations

Breakwater Replacement Alternative

- A Rock Breakwater is recommended – It is the best material type for project site conditions (ice, access, hydrodynamics), locally available materials, and lower maintenance requirements

Additional Requirements – Next Steps

- Sediment sampling and testing (borings) and water level data collection reports are in development
- Acquire easement for land based construction
- Identify sediment disposal site (beneficial reuse)
- Regulatory agency consultation
- Refine dredged channel design
- Develop permit drawings
- Schedule planning, evaluate construction duration needed, is 2 months sufficient?
- Budget planning and coordination with outlet dam design

Priest Lake Water Management Project

Thorofare Preliminary Engineering - Progress Report
November 5, 2018

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