600 NE Grand Ave.
Portland, OR 97232-2736

Metro | *Agenda*

Meeting:	Smith and Bybee Wetlands Advisory Committee (SBAC)
Date:	Tuesday, September 22, 2015
Time:	**5:30 p.m. – *8:00 p.m.**
Place:	Metro Regional Center – Room 270 600 NE Grand Ave, Portland Oregon 97232

5:30 p.m.	**Welcome and introductions**	**All**
5:35 p.m.	**Approve Jan. 2015 meeting minutes**	**Troy Clark**
5:40p.m.	**Smith Bybee Removal-Fill Law**	**Gary Shepherd**
6:05 p.m.	**Hydrologic Study Results**	**Katy Weil**
6:25p.m.	**Water Control Structure Update**	**Jeff Merrill**
6:40 p.m.	**Field Season Summary**	**Elaine Stewart**
7:05 p.m.	**Work Plan for 16-17**	**Elaine Stewart**
7:25 p.m.	**Goals and next meeting agenda**	**All**
7:30 p.m.	**Adjourn**	

Please note that the meeting time is until 8:00 p.m. Due to the full agenda and that we suspect certain topics may need more time.

Upcoming SBAC meetings:
Tuesday, November 24th at Metro Regional Center
For agenda/schedule information, contact Christy Carovillano at 503.797.1545 or Christy.Carovillano@oregonmetro.gov

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Metro | *Minutes*

Smith and Bybee Wetlands Advisory Committee

September 22, 2015

Committee members in attendance

Carrie Butler* .....Port of Portland (Vice Chair)
Troy Clark* .....Audubon Society of Portland (Chair)
Dave Helzer* .....City of Portland, Bureau of Environmental Services
Sara Henderson* .....St. Johns Neighborhood Association
Dan Moeller* .....Metro, Parks and Nature
Patt Opdyke* .....North Portland Neighbors
Eric Tonsager* .....Oregon Bass and Panfish Club

Others in attendance

Gary Shepherd .....Metro, OMA
Elaine Stewart .....Metro, Parks and Nature
Jeff Merrill .....Metro, Parks and Nature
Christy Carovillano .....Metro, Parks and Nature

Committee members not in attendance

Susan Barnes* .....Oregon Department of Fish and Wildlife
Bill Briggs* .....ORRCO
Pam Arden* .....40 Mile Loop Trust
Dale Svart* .....Friends of Smith & Bybee Lakes
Jane Van Dyke* .....Columbia Slough Watershed Council

*Denotes voting Smith and Bybee Wetlands Advisory Committee member.

WELCOME

Approval of the April 28, 2015 meeting minutes was suspended until the next meeting due to low number of committee members in attendance.

SMITH BYBEE REMOVAL-FILL LAW

Gary Shepherd discussed his research on the state removal-fill law specific to Smith and Bybee lakes, and how this may affect future projects at the site.

The statute states that it does not allow fill, which Gary says can seem quite alarming. However, the prohibition is below the 11 ft contour level, and the intent of the statute was to preserve what was left, not to correct what had already happened, and is specifically directed at stopping the landfill and allowing expansion of the wetland.

There have been past exceptions for specific projects focused on fish and wildlife restoration purposes, and Gary said that legislative history is on our side if we wish to get around this statute as our purposes fit fully in line with the intent of the legislation.

Discussion

The main Smith and Bybee project discussed in terms of the statute was the potential bridge over the north slough, because as Troy Clark mentioned, there is no other proposal of this magnitude out there. However, Elaine Stewart stated that although we have funding over the next two to three years for trail construction around the landfill and a pedestrian crossing across Columbia Boulevard, we do not have funding for the

bridge project. Elaine also mentioned there had been a feasibility study done at that time by Jane Hart looking at different design options, and meeting requirements of the statute may have contributed to the high cost of alternative designs; it should be revisited. Dan Moeller mentioned that they are looking for untapped funding sources to help cover this project and that Elaine is being a great advocate.

Elaine also brought up concerns about the new trail dead-ending on St. Johns where we're trying to foster wildlife restoration; the public wandering off and disturbing these important areas and interacting with the landfill closure infrastructure are not desirable. The bridge connection over North Slough is important to prevent those occurrences.

Elaine also posed the question of whether the statute can just be removed since its purpose has been served now that the landfill is closed, but also asked if it is not in place, and the same fill removal law that is in place across the state was applied to Smith and Bybee, would we have less protection. Gary said the answer to this question would be yes, but said that if we want to amend, we should amend the statute to allow fill for recreation purposes as he doesn't think this would be difficult. Jeff Merrill furthered this discussion by asking if the plan that was originally developed was expensive due to the design having to cater to the restrictions of the statute, and would the cost potentially go down if it is amended.

The next issue that was raised is that the statute has one definition of fill, but DSL rules define it again (as zero), and therefore, would DSL's definition also control the statute or does it just apply to their own permitting requirements. Both Patt Opdyke and Dave Helzer thought this was an important question to answer and said we need to know where DSL stands on this because it could negate parts of this discussion, and if there can be no fill, then that would force a change in design or statute, and we would have a better idea of where we stand. Gary said the value of getting DSL's take on the issue is great, but it could also change in a few years depending on who's there. He said that the only way to guarantee anything is through an amendment and believes the chances of getting one are high because it would be for the public good.

Discussion on the statute led to essentially three options:

1. Manage to have projects fit within the restrictions – simplest.
    a. Gary thinks the 11ft threshold is a feasible workaround – the landfill is higher than 11ft, and trails would be above 11ft.
    b. This would keep the statute in place which Troy is a strong advocate for.
2. Argue the statute – but we would like to avoid getting in a dispute.
3. Get an additional amendment – which is probably the more efficient path.
    a. Patt said we should explore what type of steps we'll need to take for an amendment so that we can start lining up legislative sponsors.

Troy said this was a great presentation and great timing for it; however, there is still not a lot of clarity around SBAC recommendations, especially with the large gap between what design will be feasible and what funding is available. He still thinks the statute is important even though it complicates things and would be most comfortable with it being amended, but not going away. The consensus was that we need to first determine what design we would want to implement before we will know how the removal-fill law will apply, and in turn, determine which route we want to try taking around it.

Next Steps

1. Map where the 11ft contour level is.
2. Determine what would need to be done under the 11ft contour level.
3. Determine location.
    a. Is the north slough is outside the prohibition area? According to Elaine, Jane's bridge feasibility study contained info that said the statute would not be applied to the north slough.
    b. If we were to reclaim part of the landfill, the statute would not apply.
4. Gary will get DSL's take based on the info we currently have and report back.

HYDROLOGIC STUDY RESULTS

Elaine Stewart presented on behalf of Katy Weil summarizing the findings of the hydrologic study done by Pacific Habitat Services (Attachment 1), and Metro's preferred approach to address concerns about how water level management can improve water quality and enhance site-appropriate vegetation, specifically with the drainage challenges at Smith Lake.

With the historical challenges over the last few years in mind, various options were presented to support the following six management objectives:

1. Provide off-channel habitat for salmonids.
2. Control reed canarygrass.
3. Support re-establishment of willows and emergent vegetation.
4. Create seasonal mudflats for shorebirds.
5. Provide habitat for wintering waterfowl.
6. Reduce the risk of botulism outbreaks.

The options to manage the hydrology of Smith and Bybee Lakes were as follows:

1. **No Action** – lowest cost, ensures low summer dissolved oxygen levels, but there would be no vegetation management at Smith Lake and non-native emergent species will continue to thrive.

   Troy Clark mentioned that the water control structure was left open last year and the willow was not affected because the water was withheld, to which Elaine replied that we would not stop managing Bybee Lake and most years we do intend to impound water and manage the canarygrass.

2. **Connection to the Columbia River** – probably unrealistic, 3000 ft pipe from river to Smith Lake and extends another 1400 ft into Smith Lake, also most expensive option coming in at an estimated $28 million and this does not include any permitting or public outreach costs and is considered unreasonable.

3. **Connection between Smith Lake and the Slough** – would make Smith Lake behave a lot like Bybee Lake but sediment accumulation would require regular maintenance and there would need to be a concrete slab extending 400 feet. There are two different connection options:
   a. A pipe with forebay bored beneath the natural levee – estimated at $200,000.
      850 feet long with fish screens at either end
      Extend approximately 700 feet into lake
   b. A ten foot wide opening in the natural levee – estimated at $1,667,000.
      Requires a bridge for utility maintenance vehicles

   Patt Opdyke asked if the sediment accumulation would need to be cleared about every six months and Elaine responded that it is hard to know, but believes it would be about this frequency. Patt then asked if this type of connection would also give us pretty soft substrate to which Elaine also responded yes.

   There was some discussion around the concrete slabs which would be needed to keep the pathway open and provide access for maintenance. Dave Helzer asked why it can't be natural to which Elaine said to keep in mind if all we are getting is late summer tidal action, it's going to be very different, but she is only guessing at how the consultants are thinking.

4. **Annual channel maintenance** – digging out beaver dams and small sediment removal, estimated at $20,000 to $40,000 per year, and sediment removal might make us liable towards sediment removal law.

5. **Channel dredging** – if we can get the water moving fast enough it would scour the channels, estimated at an initial $175,000 to $200,000 but would require maintenance dredging every 10 to 20 years.

6. **Change in water control structure management/design** – refurbish structure to draw down Bybee Lake rapidly and create a head gradient for sediment scouring in channel, would probably need to happen annually.

The Pacific Habitat Services report provided a comparison of the three options they recommend as the most feasible and meet the most objectives outlined above, which was as follows:

Management Option	Cost Estimate	Objectives Met
36-inch pipe to slough	$200,000	3 of 6
36-inch pipe to slough plus dredging channel	$400,000	4 of 6
Dredging channel	$200,000	6 of 6

Discussion

Troy asked why option six, change in water control structure management, was not on the recommended list and thinks that would be a good option to try first and might also prove to be the cheapest option; however, Elaine doesn't think we can get rid of the beaver dams by going that route, and Troy suggested blowing up the beaver dam first. Elaine was hesitant on this solution and said she really needs control back in the next three years.

Dan Moeller asked if there was a controlled pipe option and Elaine said she recalls discussion surrounding this but that Metro is not too keen on another water control structure because of staff and resource demands to manage them.

Patt then posed the question of what impact possible reduced spring freshets due to climate change may have on the wetlands and whether the Columbia water level changes were factored into the report's recommendations or if that would even be relevant. Elaine pointed out that spring freshets are already at 42 percent of historic discharge and that is why the water control structure is used to accumulate water in the wetlands through spring. She said precipitation models aren't as confident as temperature models for climate change scenarios, but they are predicting more winter storms which could be beneficial by bringing more precipitation with each storm - but there really is no way to know. Dave agreed the best guesses are pointing towards more frequent winter storms but less predictable spring freshets.

Dave then asked what Metro's preferred alternative is and Elaine replied that dredging, perhaps combined with changes in water control structure management, is the staff preference at this time. She mentioned there is an alternative human made ditch further up the peninsula between Smith and Bybee Lakes that may be a better location for dredging because it is a lot shorter. Staff would like to bring in hydrology consultants to compare the two areas. Eric Tonsager thinks a shorter channel would be better for moving water more quickly through it, and Elaine's suggestion is to move into the next step and look at firmer cost estimates and other options for cheaper dredging.

Troy would like to see a study to make sure we can achieve the purpose and suggests we leave the water control structure open again next year. He said the effect it had this year was fascinating and he is interested in seeing what we may be overlooking because we have kept the water perched in the past and may be over-managing it, but did acknowledge that we also had a dry year which may have helped contribute. Elaine said they want to keep the full range of diversity and they do plan on keeping the water control structure open again. It may be important to leave the water unmanaged in some years to support the native plant communities; her research is investigating these options.

WATER CONTROL STRUCTURE UPDATE

Jeff Merrill gave a brief update on Metro and Ducks Unlimited's staff work, including current direction, timeline for design and engineering work, and implementation and budget.

Upgrades and repairs to the water control structure are being analyzed based on functionality needs, better control of botulism outbreaks, increased ability to scour the channel, safety issue mitigation, and the structure's age.

Jeff said the Ducks Unlimited engineer who was the lead on this project is no longer with them which slightly set back the design recommendations, but the new engineer has experience with Smith and Bybee so that helped to get it up and running again and they are still pretty much on schedule.

Design recommendations are not due until September 25th, but Jeff provided some insight what he believes they will be:

1. **Aluminum stop logs** – a strong possibility, lighter, more ergonomic, and in uniform sizes to make things more standardized.
2. **Replacing stop logs with a gate device** – gate device will rise or lower instead of the pulling out of logs. There was question as to whether this would allow it to rise all at once, but Jeff wasn't entirely sure.
3. **Lock and combo gates** – would allow tidal influences in and keep them in, but also allow things out, would replace tidal gates.
4. **Boom log solutions** – up and downstream to keep debris at bay.
5. **Attached trash racks with locking capability** – trash racks were a real safety issue, this option would allow them to swing rather than pull up or down.

Next Steps

Dave Helzer suggested taking a look at the Multnomah County Drainage District which has a similar setup that includes some of the above options and getting input from their operations manager.

We will receive the report from Ducks Unlimited with a menu of options that outlines cost and feasibility. The water control structure team will then reconvene to discuss and choose what direction they want to go in with managers applying budgetary restrictions. The next phase would include design drawings, budget estimates, and a RFP for construction.

Implementation will probably not take place until next year, but at the November SBAC meeting Jeff hopes to be able to present the costs, what Metro has chosen, and an update on the design and construction plans.

Troy Clark is interested to see how it goes over the next year, especially given the discussion of option six from Elaine's hydrologic study presentation. He said the concrete in the channel between Bybee and Smith, from decades-old infrastructure, needs to be removed to allow better scouring.

FIELD SEASON SUMMARY & WORK PLAN FOR 16-17

Elaine Stewart presented a summary of the work that was completed during the spring and summer field season and a "State of the Wetlands" report, as well as a draft work plan for next year's (16-17) restoration actions including an update on the Rivergate Consent Decree and priorities for projects funded by it (Attachment 2).

Water Management

- It was a great 2015 for Smith Lake – dry and lush.
- PSU grad student starts fall 2015 and will be documenting the plant responses to dry conditions.

Columbia Sedge Meadow – *Jeff Merrill*

- Leadbetter peninsula.
- Expanding, site prep will continue for one more year.
- Seeds being collected and contractor will provide plugs to be plants in October 2016.

Ash Forest and Shrub – *Jeff Merrill*

- NE and SW Smith, S Bybee areas – 90 acres.
- Planted early so planting wouldn't drown.
- Not a lot of non-native undesirables have come back.

- Will reassess for next year.

St. Johns Prairie

- *Larks*
  - Ongoing habitat management, no nesting this year but ongoing vocal attraction work.
  - Safe Harbor Agreement has been going on for three years and will hopefully be wrapped up soon.
  - Elaine says Rivergate is not looking good for the larks as it is growing in with vegetation.
  - Troy Clark spoke to his observations that the larks seem to like it when the ground is settled and packed a bit, and he thinks it is hard to attract them up to the prairie because the ground there doesn't pack.
  - Dave Helzer believes the larks aren't showing up because of a combination of there not being enough of them due to their state of decline, and because they have high fidelity to sites. He hopes that since one of the sites is going away, maybe they'll be more apt to move to St. Johns.
- *SJP Phase 1*
  - Seeded 17 acres, a great response, lots of wildflowers this year.
- *SJP Phase 2*
  - 40 acres, seeding in about a year, maybe two, depending on how site prep goes.

Invasive Plant Management

- Yellow flag iris – 571 acres treated, $29,000 approximate cost.
- Ludwigia – 900 acres treated, $54,000 approximate cost.

Monitoring

- Birds on St. Johns Prairie – point counts of all breeding birds, area searches for streaked horned larks.
- Emergent wetland vegetation – intensive monitoring by grad student during 2015 and 2016.

Upcoming Projects

- *Ash Forest Phase 2 – Jeff Merrill*
  - Site prep on 50 acres on west side of Smith Lake completed summer 2015.
  - Fall site prep spray scheduled but waiting for green-up.
  - Planting this winter with ~30 acres to follow next year.
- *Columbia Sedge – Jeff Merrill*
  - Site prep of interlakes area completed summer 2015.
  - Fall site prep spray scheduled but waiting for green-up.
  - Will plant trees and shrubs this winter in the "matrix" around several pockets of sedge so we don't have artificial clumps of sedges.
  - Sedge planting October 2016 or 2017.
- *St. Johns Prairie*
  - Lark plot maintenance and vocal attraction.
  - Maintain newly seeded area.
  - Site prep and seed new unit.
- *Weed Treatments*
  - Re-treat ludwigia and yellow flag iris throughout.
  - Map and strategize for purple loosestrife.

Rivergate Consent Decree

- Legal settlement in citizen lawsuit against Corps of Engineers and Port of Portland in 2000 that included ~$285,000 for "mitigation" projects at Smith and Bybee.
- Corps of Engineers has to approve the projects.
- Metro re-initiated discussions with Corps in 2015.
- Elaine has three projects she would like to propose for the committee's review:
  1. Channel clearing/hydrologic fix.

2. Sedge meadow restoration.
3. Ash-willow forest restoration.

Dave Helzer asked for clarification around how this money can be spent that Elaine and Carrie Butler were going to look into after April's meeting. Elaine said projects should be more geared towards natural resource management and mitigation for the fill, not recreational; for example, the North Slough bridge and trail work would not gain approval. She thinks the hydrologic fix would fit best because it addresses underlying ecological processes, to which Dave agreed. Dave, Sara Henderson, and Troy Clark (remaining non-Metro committee members at this point in the meeting) all agree with the proposed projects and think the hydrologic fix is the way to go.

GOALS FOR NEXT MEETING AND WRAP-UP

- Gary Shepherd will come back to provide further updates on the removal-fill law, possibly with a planner since there may be crossovers between their topics.
- Dave Helzer asked about the possibility of having a trails meeting that was originally discussed a few meetings prior with the planning manager at that time. Troy Clark also agreed that this was a great idea. Dan Moeller said he will reach out to Lisa Goorjian, the new planning manager, to have her come and provide an update.

  In the interim, Dan reiterated the following information on the plan for Smith and Bybee trails: There is only funding for a terminal trail to a lookout on top of the landfill and a bridge across Columbia Boulevard to connect to trails there. Metro is concerned about the public wandering past the terminal trail into closed areas where they may encounter risks associated with landfill closure and infrastructure and/or may disturb wildlife and habitat. In terms of design and construction, it is at least a year out before anything would happen. There are no other new developments, and loop trails are off the table although they were discussed previously but had not been discussed internally at Metro.

  Troy feels a sense of urgency in Metro and thinks it would be beneficial to for a meeting to potentially stir up thoughts for further trails on the north slough to prevent the dead-ending.
- Dave Helzer also asked whether Metro will share the Pacific Habitat Services hydrology report, to which Dan replied yes. Christy Carovillano will touch base with Elaine Stewart and Katy Weil about sending out the whole report to the committee (Attachment 1).

Meeting adjourned at 7:43 p.m.

Options to Manage the Hydrology of the Smith and Bybee Lakes Natural Area

Prepared for

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September 10, 2015

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Executive Summary

The hydrology regime at Smith and Bybee Lakes is complex in its variability by season, by weather and by local and regional management actions. While the options described in this report represent a narrow subset of what might be surveyed, they offer a range of options that address Metro's concerns about how water level management can improve water quality and enhance site-appropriate vegetation. The findings in this report illustrate the challenge of selecting discrete activities to meet targeted results since actions that might improve certain conditions might degrade others.

Options

Vascular plants, algae and botulism

Seasonal water level fluctuations of the lakes on the timescale of 3 months driven by seasonal changes in Columbia River levels will have major effects on vascular vegetation around the edges of the lakes. The maintenance of high water levels in the lake tends to drown willows at the lake margins, although many willows seem to be adapted to high water early in the summer. Reed canarygrass can tolerate a wide range of conditions, but seems to produce little additional biomass after the summer solstice so that early season drowning is a possible control method. Under current management regimes lunar tidal fluctuations on the timescale of a week or two are seen in Bybee Lake and not in Smith Lake. Opening Smith Lake to either enhanced water exchange with Bybee Lake or direct water exchange with the Columbia Slough or Columbia River can be expected to produce weekly water level fluctuations in Smith Lake more like those seen in Bybee Lake with similar effects on the peripheral willows. Diurnal late season water level fluctuations on the order of a tenth of a foot resulting from a small additional water exchange with the slough are not likely to have great effect on the peripheral willow populations of Smith Lake or on reed canarygrass at the lake edge, but may stress some emergent dicot populations such as Bidens so that they are replaced by less susceptible plant populations.

Algal dynamics within Smith Lake appear to be the major driver for late summer avian botulism outbreaks. Both water depth and water temperature determine the rates of algal birth and death, but changes in the amount of solar radiation and surface winds in August are likely factors in the drop of living biomass that can trigger the germination of the ever-present *Clostridium* spores. Lowering the water level in Smith Lake in late summer may reduce the number of waterfowl that would be there if a botulism outbreak occurred, thereby reducing the spread of the disease.

Connection of Smith Lake to the Columbia Slough or the Columbia River

Several options exist for management of water surface elevations in Smith Lake. One option is a connection to the Columbia Slough. Such a connection would allow water levels to follow a more tidal pattern of water level fluctuation. A large connection would allow larger water level fluctuations. A small connection would allow Smith Lake water levels to follow the long-term

average water level of the Columbia Slough. The amount of fluctuation depends on the size of the opening between the Slough and Smith Lake. The temperature regime of Smith Lake is mostly driven by solar radiation and surface winds. Exchanges of water much less than the full tidal exchange (on the order of 1,800 cubic feet per second) would be unlikely to greatly affect temperature, but the water depth of the lake can be expected to have large effects on the thermal regime of the water column and the biota within the water column. The water chemistry of the lake can be expected to be significantly altered only for very large exchanges. The timing of changes to the lake water level has large effects on vascular vegetation at the lake margin.

A direct connection to the Columbia River could have similar water level effects, but head losses over the greater distance would require a larger opening to achieve the same effect as a connection to the Columbia Slough.

Removal of Beaver Dams in the Connector Channel

Beaver dams within the channel connecting Smith Lake and Bybee Lake are the principal impediment to water exchange between the lakes when the water levels in Bybee Lake are below the level of the top of the beaver dams (approximately 11 feet NAVD). When water levels drop in Bybee Lake, Smith Lake can be slowly drained by manually removing a portion of the beaver dam. Since previous experience has shown that the dam is likely to be rebuilt every night, manual opening of the dam would be required daily. The most important periods for dam removal are likely to be mid-June to mid-August.

Dredging the Connector Channel

Dredging the connector channel nearest Smith Lake would lower the water in Smith Lake. The entire channel would not need to be dredged because a significant portion of the channel is below the elevation of Smith Lake bottom (approximately 9 feet NAVD). Sediment may accumulate (perhaps over a period of years), requiring occasional removal.

Changes in the Water Control Structure Management

Changes in the management of the Bybee Lake water control structure are certain to have a large effect on water levels in both Bybee Lake and Smith Lake. The existing structure has many possible modes of operation and can be modified to produce many hydroperiods.

Preliminary Cost Estimates

Pipe connection between Smith Lake and the Columbia River

A 72-inch pipe connection between Smith Lake and the Columbia River is estimated to cost $28,200,000. This includes design, materials and construction but not associated costs for activities such as property easement agreements, permit processing, public meetings, etc. If a larger pipe is required, costs would be higher.

Pipe connection between Smith Lake and the Columbia Slough
A 36-inch pipe through the levee and a concrete slab extending 400 feet into Smith Lake is estimated to cost $200,000. This includes design materials and construction but not associate costs such as permit processing, public meetings, etc.

Open notch connection between Smith Lake and the Columbia Slough, with bridge at levee.
A 10-foot-wide opening through the levee, with a bridge, and a concrete slab extending 400 feet into Smith Lake, is estimated to cost $1,667,000. This includes design materials and construction but not associate costs such as permit processing, public meetings, etc.

Annual removal of beaver dams in the connector channel and maintenance
These actions are estimated to cost from $20,000 to $40,000.

Dredging connector channel
This action is estimated to cost from $175,000 to $200,000.

Comparison of management options
The beaver dams and siltation of the channel between Bybee and Smith Lakes compromise Metro's ability to draw down Smith Lake in summer. Only three of the options appear likely to support the need to complete drawdown by mid-August: dredging the channel between the lakes, installing a 36-inch pipe between Smith Lake and the Columbia Slough, and a combination of the two. Please refer to Table 1 (Appendix A).

The three options differ in their ability to support six management objectives:

1. Provide off-channel habitat for salmonids
2. Control reed canarygrass
3. Support re-establishment of willows and emergent vegetation
4. Create seasonal mudflats for shorebirds
5. Provide habitat for wintering waterfowl
6. Reduce the risk of botulism outbreaks

The only option to meet all six objectives is dredging the channel between Smith and Bybee Lakes.

Option	Cost estimate	Management objectives met
36 inch pipe to Columbia Slough	$200,000	3 of 6
36 inch pipe to Columbia Slough plus channel dredging	$400,000	4 of 6
Channel dredging	$200,000	6 of 6

1.0 INTRODUCTION

The Smith and Bybee Wetlands Natural Area covers approximately 2,100 acres and is one of the largest urban freshwater wetlands in the country. The area is managed by Metro. Historically, the wetlands were seasonally flooded from high stands of the Columbia and Willamette Rivers. Bybee Lake is hydrologically connected to the North Slough arm of the Columbia Slough. Smith Lake is hydrologically connected to Bybee Lake by an approximately 0.83-mile long channel.

The levees along the slough and the development of the surrounding land, coupled with construction of dams and flood management on the Columbia and Willamette Rivers, stopped the natural hydrologic cycle in the lakes and consequently their seasonal flooding and drawdown. In the most recent modification to the system, a water control structure was constructed in 2003 where Bybee Lake drains to the North Columbia Slough to manage hydrology in Bybee and Smith Lakes. Metro manages the control structure by holding as much water in the lakes during the winter and spring to improve habitat for waterfowl and juvenile salmonids and to inhibit the growth of reed canarygrass. The water control structure is gradually opened in late spring through summer. The water management of the lakes by Metro is intended as a variant of the historical annual cycle of flooding and drawdown.

Metro's Natural Areas management of the site recognizes the importance of maintaining flow control for the future, and the important interaction between beavers, nutria, invasive species, and water quality. The purpose of this report is to determine the feasibility of several options to control the water levels of Smith and Bybee Lakes. The options reviewed in this report are below. The locations of these options are shown in Figure 1:

1) Connection of Smith Lake to the Columbia River
2) Connection of Smith Lake to the Columbia Slough
   i) Pipe Options
   ii) Open channel (notch) and Bridge Options
3) Controlling Beaver Dams
4) Dredging Inter-Lake Connector Channel
5) Changes in Water Control Structure Management
6) No Action

This report begins with an overview of the vascular plants and algae found within the lake, plus a brief discussion of botulism. Following this is a discussion of the hydrology of the lakes. The final section is a discussion of the options to manage hydrology.

In recent years, beaver have constructed several dams within the channel that connects the two lakes. The beaver dams have additional impacts on wetland health, including killing willow stands along the perimeter of Smith Lake and improving the habitat for the nutria population. Ongoing high water limits development of emergent vegetation in the summer and prevents exposure of mudflats for migrating shorebirds. The dams, combined with increased sediment within the channel, impound water in Smith Lake much longer into the summer than occurred historically.

2.0 VASCULAR PLANTS, BOTULISM AND ALGAE

Exposing Smith Lake to seasonal, lunar, and daily water level fluctuations will affect its vegetation, though vascular vegetation responses to fluctuating water levels vary from taxon to taxon. Willows, which have grown in the margins of the lake system throughout its history, can tolerate early growing season inundation, but sustained inundation through late summer (i.e. greater than 2 feet) has caused mortality of willows. The Pacific willow (*Salix lasiandra*), which is the most common species around the lake, is among the most tolerant of inundation, but does not fare well with late season inundation. Columbia River willow (*Salix fluviatilis*), another species found around the lake margins, is better suited to shorter inundation periods (as occurs along the Columbia River), but it too cannot tolerate sustained late summer inundation.

Daily tidal oscillations in Smith Lake, which are expected under most management regimes discussed in this report, remain less than 0.2 feet per day. These small oscillations in water surface elevations are likely to have only a minor effect on willow populations. Lunar tidal oscillations rising and falling up to a foot in water surface elevation over the course of a week may have considerably greater effect than the smaller daily oscillations in water surface elevation. These oscillations can be expected with greater amounts of water exchange with the slough.

Little has been documented in the literature about the effect of late summer week-long changes in inundation on Pacific and Columbia River willows, but the effects do need to be examined along with the effects on forb populations. Monocot taxa may thrive within these water elevation fluctuations, but some of the dicot taxa (e. g. *Persicaria amphibia*, which is common in Smith Lake) may be rather stressed by such fluctuations under conditions of high temperature.

Lower water levels after the summer solstice may allow the willow populations to thrive, but will also be more favorable for the growth of weedy taxa. Late season drying allows weedy taxa, such as reed canarygrass (*Phalaris arundinacea*) and cocklebur (*Xanthium strumarium)*, to become established around the periphery of the lakes. Reed canarygrass can tolerate winter inundation and summer drought better than many native taxa, but extended periods of inundation have been successful as a means of controlling its spread.

Recently the lake system has been invaded by the South American water primrose (*Ludwigia peploides ssp. montevidensis*). This plant is favored by warm water temperatures and is able to

thrive and spread through various and fluctuating water depths. Regardless of the management regime, this species is unlikely to be completely extirpated.

In the late summer and early fall, the Smith and Bybee Wetlands Natural Area can experience outbreaks of avian botulism. This is especially true when the area experiences many days with warm temperatures and little or no rain. In recent years, beaver have constructed several dams within the channel that connects the two lakes. The dams, combined with increased sediment within the channel, impound water in Smith Lake much longer into the summer than occurred historically. The higher stand of Smith Lake during hot days creates conditions conducive to an outbreak of avian botulism. This occurred in early September 2012, when thousands of migrating waterfowl were present in the wetlands. Attracted by the open water of Smith Lake, the birds contracted avian botulism leading to the death of more than 3,000. Avian botulism is typically spread when birds eat maggots (from dead birds) carrying the toxin. To become active, the botulism bacteria needs warm temperatures, organic matter and an anaerobic environment. The birds generally die from drowning as the botulism bacteria produce a paralyzing toxin, which doesn't allow the birds to lift their necks.

Upon Oregon Department of Fish and Wildlife's (ODFW's) recommendation, Metro attempts to reduce the impact of the outbreak by lowering water levels in Smith Lake. In 2013, this was attempted by deconstructing, then demolishing with explosives, beaver dams in the channel between Bybee and Smith lakes. Although only modestly successful, these efforts highlighted the importance of maintaining flow control for the future and the important interaction between beavers, nutria, invasive species, and water quality. The beaver dams have additional negative impacts on wetland health, including killing willow stands along the perimeter of Smith Lake and improving the habitat for the nutria population.

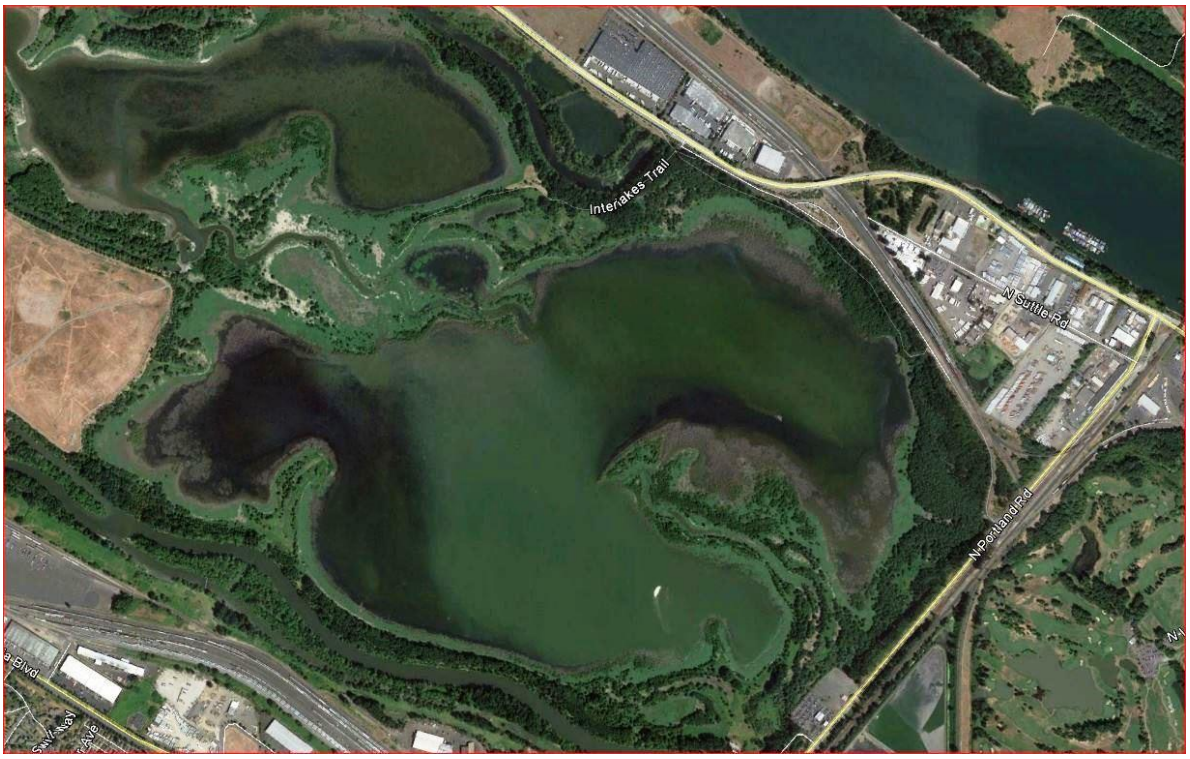
Avian botulism has been noted a number of times within the lakes under different tidal exchange conditions. Clifton's dissolved oxygen measurements suggest that while *Clostridium* spores are found throughout the lake system, active botulism only occurs when algal blooms rapidly die and generate anaerobic conditions at the top of the sediment layer [1].

The endospores (the bacteria's non-reproductive structure) form by a dehydration process when unfavorable conditions are satisfied: exposure to oxygen, drying, and amino acid starvation. The process appears to be driven by the biosynthesis of dipicolinic acid, which complexes with calcium ions and binds the cells' internal water. The endospores are long-lived and generally unresponsive to drought, pH fluctuations, and oxidative conditions. Under ideal growing conditions for the bacteria, the spores can germinate into active bacteria. Germination appears to require the presence of some amino acids (several seem to start germination, but alanine may be the most effective) and the presence of lactate. The lactate is formed from the decay of algal carbohydrate and the amino acids originate from the breakdown of proteins from algae or more

[1] Clifton. 1983. Water-quality data for Smith and Bybee Lakes, Portland, Oregon, June to November, 1982. Volume 83, Issue 204 of Open File Report

likely zooplankton. Germination times vary with the Clostridium strains, but generally take approximately two days.

The Avian botulism outbreak of 2012 in Smith Lake was preceded by a period of warm weather typical of late August. A cloudy period had occurred during the middle of the month with lower temperatures and reduced solar radiation input to the lake system. West winds at 10 to 15 mph preceding the botulism outbreak may have forced algal masses to the east side of Smith Lake. A Landsat false-color image of August 25, 2012, appears to confirm the algal masses in the eastern portions of Smith Lake. The Landsat thermal image also appears to show warmer water in the eastern portion of Smith Lake than in Bybee Lake or other portions of Smith Lake. A Google earth photograph of Smith Lake taken in August 2012 prior to the major outbreak of avian botulism



shows a broad green band across the center of Smith Lake, This algal bloom may be largely responsible for the botulism occurring among waterfowl grazing at the top of the sediment.

Allowing the water surface in Smith Lake to fluctuate will likely generate different populations of phytoplankton and zooplankton than are found in the much more slowly varying water surface elevation regimes that currently exist. Several kinds of algae were documented by Clifton during the summer of 1982 in the Smith and Bybee Lakes system. The predominant algal group was diatoms, which persisted year-round through the sampling period. Very minor amounts of blue- greens were noted and minor blooms of green algae were noted during the warm portions of the sampling season, with rapid decreases in population in September.

Water temperature is an important regulator of algal and zooplankton growth within the water

column. The numerous diatom taxa reported within Smith Lake do not appear to be as sensitive to water temperature changes as the green algal populations, which can dominate the phytoplankton during the warmer water periods of late summer. Botulism outbreaks appear to be the result of the growth of more temperature sensitive algal populations (likely green algae).

When a population of green algae is exposed to a rapid drop in water levels, the populations rapidly crashes and reducing conditions are created on the lake bottom. When this happens, *Clostridium* endospores can germinate, though this will take several days even under optimal conditions. *Clostridium* endospores may not germinate if they are exposed too soon to the atmosphere due to evaporative losses.

3.0 THE HYDROLOGY OF THE LAKES

Before pioneer settlement the Columbia River spring snowmelt freshets flooded the area annually and probably scoured the present lakes and inter-lake channels as well as some channels that are now filled with dredge spoils and industrial development.

Various exchange regimes with the Columbia Slough have produced daily tidal fluctuations in Bybee Lake ranging from 2-foot fluctuations to essentially static water surface elevations. Tidal exchange between Bybee Lake and the Columbia Slough system has probably always existed from the end of the last ice age until the construction of the levees along the Columbia River and the construction of the Columbia River dams changed the flooding regimes in the area.

When the inter-lake channel is occluded by debris and sediment, as happened in the mid-to late 2000s), the surface elevation of Smith Lake drops to where it no longer has any hydrological outlet or connection to Bybee Lake and the channel goes nearly dry. Typically, for about two months, Smith Lake has elevated water temperature and algal blooms which may affect water quality and, consequently, wildlife health. The duration of this low water, high temperature regime may contribute to avian botulism outbreaks.

Smith and Bybee Lakes are linked with common inundation much of the year when the Columbia River is high enough to influence them simultaneously. The lakes are only completely distinct in the summer when the common water surface elevation of the lakes falls below 13 feet NAVD. As such, the operational regime of the control structure between the north Columbia Slough and Bybee Lake can significantly alter conditions in both Bybee Lake and Smith Lake. A high water level into mid-summer in Bybee Lake will also mean a high water level in Smith Lake, and given the difference in lake volumes, a likely slower drawdown in Smith Lake. The combinations of gates, tide gates, and weirs within the Bybee control structure allow many options for the timing of water surface elevations in Bybee Lake.

The Bybee Lake water control structure was installed in 2003. It replaced an earthen dam and metal weir that was installed in the 1980s. The new structure was intended to allow additional

water to enter Bybee Lake from the slough. Part of the impetus for the new structure was invasion of Bybee Lake by reed canarygrass. The Bybee water control structure is capable of many rather different control regimes. A Biological Opinion (BiOp) issued by National Marine Fisheries Service (2003) includes the intended operation of the Bybee Lake Water Control Structure. The fish ladder at the north side of the structure maintains salmonid passage through the spring and early summer when juvenile salmonids are likely present. The BiOp dictated that water should be held at the top of the flash boards (at an elevation of approximately 15.23 feet NAVD (11.82 feet NGVD)[2] until the first of June. Water levels can then be dropped by 0.5 foot per week until the bottom of the stop logs is reached in mid-August.

After the major botulism outbreak in September 2012, the flashboards in the Bybee control structure were removed earlier in the summer and attempts were made to remove the beaver dams, resulting in lower water levels in Smith Lake by the end of August 2013.

The inter-lake channel is presently a channel modeled as trapezoidal, filled with silty sediment to an elevation of approximately 9.5 feet NAVD (6.1 feet NGVD) at the Smith Lake end. The channel grades slightly toward Bybee Lake with an average grade of approximately 0.00045, although many high spots occur along the channel especially at the east end. A former road crossing near the western end of the channel provides a pinch point. The remnants of a culvert system for the crossing can be seen at low water. A thalweg survey of the channel shows a number of high spots that doubtlessly impede water flow. In recent years, and possibly in earlier times as well, beaver and nutria activity has resulted in reduced flows. The channel was deeper than its present form in the early years of the water control structure, but has silted to a much shallower state in recent years.

Anecdotal evidence suggests that sediment from the channel was exported through the control structure or its antecedent in the north slough and out of the lake system, which no longer occurs. Beaver activity within the channel has resulted in a series of dams (several in 2008 and a single effective dam in 2014) that restrict flow through the channel and likely accumulate local deposits of silt. Considerable accumulation of sediment at the Smith Lake end of the channel that fans into

[2] Throughout this report, the vertical elevation datum is NAVD, with the equivalent NGVD elevation datum in parentheses. Since the bathymetry conducted by WEST Consultants was in NAVD, and since WEST had also obtained elevations for the Bybee control structure in NAVD, calculations for water exchanges between Bybee Lake and Smith Lake were made in NAVD. Previous ambiguity about the elevations of the control structure in NGVD made the calculations in NAVD preferable to the uncertain NGVD elevations. NGVD is 3.4 feet lower than NAVD.

the lake suggests that at times in its history, sediment has been moving through the channel into Smith Lake.

Since the construction of the Bybee water control structure, beavers have constructed dams across the inter-lake channel, resulting in higher water surface elevations of Smith Lake. The marginal willows around Smith Lake have died as a result of the sustained higher water levels. Two separate efforts in recent years have been made to remove the beaver dams and reduce the water levels in Smith Lake by opening the channel to allow drainage which could reduce the likelihood of an avian botulism outbreak and reduce the drowning of lake margin vegetation,

4.0 OPTIONS TO MANAGE HYDROLOGY

A connection between Smith Lake and the Columbia Slough or the Columbia River may be a way to lower Smith Lake more quickly, thereby reducing the time when its water is warm and shallow. It could also allow more complete drawdown of Smith Lake, supporting emergent and shrub communities around the perimeter and formation of mudflats. The connection will allow tidal fluctuations and, depending upon the configuration of the structure, may allow fish passage between the slough or river and the lake. If fish passage were provided, Smith Lake could see a greater seasonal population of salmonids. However, as proposed in the options that incorporate connector pipes instead of open channels, the lengths of the pipes (approximately 3,000 feet for a connection to the Columbia River and at least 400 feet for a connection to the Columbia Slough) make fish passage highly unlikely.

Connecting Smith Lake directly to the Columbia Slough requires opening the natural levee. This can be accomplished by installing a pipe or excavating an open notch. With an open notch, it is assumed the opening will need to incorporate a bridge crossing that will support heavy utility vehicles. If a bridge is used, passage will be provided to recreational boats (canoes, kayaks, etc.). Connecting Smith Lake to the Columbia River will require a large pipe.

Full tidal exchange between Smith Lake and the Columbia Slough or the Columbia River will require a conveyance of approximately 1,800 cubic feet per second (cfs). The full exchange would result in the lake going dry almost every day in late summer and rising to a depth of between 1.5 and 2 feet on a daily basis. Early summer water surface elevations could be expected to oscillate around the highstand elevations of the Columbia River during the snowmelt and salmonid smolt release periods of May and June. The highly fluctuating water levels would affect the vegetation communities in various ways during various portions of the growing season.

1. Connection of Smith Lake to the Columbia River

A connection to the Columbia River (specifically the North Portland Harbor Channel south of West Hayden Island) will require the construction of an approximately 3,000-foot long, buried

pipe (at least 72-inch-diameter). Within Smith Lake the pipe will need to extend approximately 1,400 feet from the existing edge of trees in order to access the deeper portion of the lake. The connection to the river will need to be far enough out to accommodate the fluctuations of the river level. Both ends of the pipe will require fish screens. Construction of the pipe will require formal consultation with the National Marine Fisheries Service (NMFS) and permits from the US Army Corps of Engineers (Corps), the Department of State Lands (DSL) and the City of Portland (City). All of the agencies will require an alternatives analysis demonstrating that other options have been explored and that the proposed project is the least detrimental. The pipe will need to be bored beneath N. Marine Drive, nine railroad tracks and beneath several private industrial businesses. The bore pits will need to be large enough and deep enough to accommodate boring equipment and to assure business owners, the railroad and other affected parties will not be affected by the buried pipe.

Installing a 72-inch-diameter pipe from Smith Lake to the Columbia River will require the following actions: preliminary and final design; agency and stakeholder consultation; state, federal and local permitting, public meetings; private property access and/or easement agreements; pipe construction; and construction management. This option assumes that the pipe is always open; options for closing the pipe sometimes would require further study.

Preliminary Cost Estimate:

Preliminary estimate of initial project costs based upon available information. Cost estimates for all of these elements cannot be determined, but a preliminary cost for design, materials and construction is $28,200,000. Additional elements could include a structure to close the pipe or manipulate the amount of water flowing through the pipe. This is dramatically more expensive than other construction options. This cost estimate does not include agency and stakeholder consultation, permitting and other costs.

2. Connection of Smith Lake to the Columbia Slough

Creating an opening between Smith Lake and the Columbia Slough would allow Smith Lake to dry up in late summer several weeks earlier than it does under current conditions. Depending on the design, the connection through the levee may accommodate passage by recreational boats (canoes, kayaks, etc.). The levee will need to continue to function as a road for heavy utility vehicles. The approximate location of an opening is shown in Figures 1 and 2.

The elevation of the top of the natural levee is approximately 28.0-feet NAVD (24.6 feet NGVD). Most of the lake bed elevation is approximately 9.5 feet NAVD (6.1 feet NGVD) although there are multiple unconnected lower areas (totaling approximately 40 acres) where the bed elevation is approximately 9.0 feet NAVD (5.6 feet NGVD). With beaver dams blocking the inter-lake channel, the typical late summer water surface is approximately 10.0-to-10.5 feet NAVD (6.6 to 7.1 feet NGVD).

i Pipe Options

A 36-inch circular, horizontal elliptical or arch steel pipe from Smith Lake to the Columbia Slough would have adequate capacity to dewater Smith Lake in late summer. It would be installed through the levee by horizontal directional drilling or installed in an excavated trench. Boat passage would not be possible. The top of the pipe would be 9.0 or 9.5 feet NAVD (5.6 or 6.1 feet NGVD). These options assume that the pipe is always open; options for closing the pipe sometimes would require further study.

Option 1. A 36-inch pipe would be installed through the levee and extended within a trench approximately 400 feet from the levee to where the lake bed elevation is 9.5 feet NAVD. The bed of the trench would be 6.5 feet NAVD (3.1 feet NGVD), with the top of the pipe at 9.5 feet NAVD (6.1 feet NGVD). A forebay or containment structure would be installed in the lake at the pipe inlet. Sediment and debris would be a regular maintenance concern. Fish screens would need to be installed at both ends of the pipe. A conceptual design of the pipe is illustrated on Figures 3 and 3A.

Option 2. A 36-inch pipe would be installed through the levee and extended within a trench from the levee to locations where the lake bed elevation is 9.0 feet NAVD (5.6 feet NGVD). The bed of the trench would be 6.0 feet NAVD (2.6 feet NGVD), with the top of the pipe at 9.0 feet NAVD (5.6 feet NGVD). The trench would be backfilled, leaving the finish grade matching the adjacent soil elevation. A forebay or containment structure would be installed in the lake at the pipe inlet. Sediment and debris would be a regular maintenance concern. Fish screens would be installed at both ends of the pipe. In order to dewater all of the areas where the bed elevation is 9.0 feet NAVD (5.6 feet NGVD), an extensive array of pipes or trenches would be needed to reach the many disconnected areas. The pipe/trench array could have an accumulated length of as much as 9,500 linear feet. Figure 4 shows a plan view of Option 2.

Preliminary Cost Estimates:

Option 1: Preliminary estimate of initial project costs based upon available information. $200,000 and possibly higher. This includes design, materials and construction. Adding a control feature to close the pipe would significantly increase the cost. This cost estimate does not include agency and stakeholder consultation, permitting and other costs.

Option 2: Preliminary estimate of initial project costs based upon available information. Greater than $250,000 and possibly higher. Costs cannot be determined due to

unknown extent of the array of drainage trenching. Adding a control feature to close the pipe would significantly increase the cost. This cost estimate does not include agency and stakeholder consultation, permitting and other costs.

ii Open Channel (Notch) and Bridge Options

Two methods of creating an opening through the levee were considered in discussions with Cornforth Consultants. One involved excavating the soil in the levee and creating a trapezoidal opening with a base width of ten feet. This involved removing approximately 7,000 cubic yards of soil and installing a bridge approximately 130 feet long to keep a utility road open on the levee. The banks would be a 3:1 slope (3 horizontal, 1 vertical) and would need to be armored to prevent erosion and slumping. A bridge span of 130 feet would require extensive support columns and structural features. This method was not explored further as it would be extremely expensive.

The method selected for consideration is a 10-foot-wide opening which would be excavated through the levee and a narrow bridge to keep the utility road open. Concrete walls or pilings on both sides of the opening would be installed to stabilize the banks and form support for the bridge. Vertical walls 20 feet high would require anchors into the levee. The 10-foot width would create an opening with adequate capacity to dewater Smith Lake in late summer and would be wide enough to allow boat passage. The bridge would be 20 feet long (perpendicular to the levee) and have a 16-foot road width. The concrete bed of the opening would have an elevation of 9.0 or 9.5 feet NAVD (5.6 or 6.1 feet NGVD). A 10-foot wide, level, concrete apron slab would be installed from the levee to the lake.

Option 1 Create an opening through the levee with a bed elevation of 9.5 feet NAVD (6.1 feet NGVD). Excavate a 10-foot-wide, level, apron slab channel from the edge of the levee, through the lake bank, approximately 400 feet north to where the cut matches the lake bed elevation of 9.5 feet NAVD (6.1 feet NGVD). This elevation is based on matching the connection invert elevation with the bed elevation of most of the lake. This would effectively drain most of the lake at least once a day in late summer except for some tidal exchange when the slough exceeds 9.5 feet NAVD (6.1 feet NGVD). The lower areas (9.0 feet NAVD (5.6 feet NGVD)) of the lake start approximately 950 feet from the levee. They will remain ponded in late summer until they dry up from evaporation, probably early fall. The apron slab will ease the routine removal of accumulated sediment. Figure 5 shows a conceptual design of Option 1.

Option 2. Create an opening through the levee with a bed elevation of 9.0 feet NAVD (5.6 feet NGVD). Install a 10-foot-wide, level apron slab from the edge of the levee, through the lake bank, approximately 950 feet north to where the cut first meets one of the low pockets where the lake bed elevation is 9.0 feet NAVD. Install an extensive array of drainage trenches (possibly transient) to

reach all of the unconnected pockets where the bed elevation is 9.0 feet NAVD (5.6 feet NGVD). This elevation is based on matching the connection invert elevation with the bed elevation of the lowest portions of the lake. This would effectively drain all of the lake at least once a day in late summer except for some tidal exchange when the slough exceeds 9.5 feet NAVD (6.1 feet NGVD). The apron slab will ease the routine removal of accumulated sediment. The additional trenches will require extensive, ongoing maintenance to remove sediment and plant debris.

Preliminary Cost Estimates:

Option 1: Preliminary estimate of initial project costs based upon available information. $1,667,000. This includes design, materials and construction. This cost estimate does not include agency and stakeholder consultation, permitting and other costs.

Option 2: Preliminary estimate of initial project costs based upon available information. Greater than $1,667,000. Costs cannot be determined due to unknown extent of the array of drainage trenching. This cost estimate does not include agency and stakeholder consultation, permitting and other costs.

Open Channel (Notch) or Pipe Maintenance Issues

Maintenance would be required for both a pipe and an open connection. A pipe would require greater maintenance than an opening. Debris and sediment will likely need to be routinely cleared from both ends of the pipe. Access would be problematic due to likely soft lake bed conditions.

Costs: Not available due to widely variable, unknown conditions.

Connecting to the Columbia Slough will likely require formal consultation with NMFS and permits from the Corps, DSL and the City. All of the agencies will require an alternatives analysis demonstrating that other options have been explored and that the proposed project is the least detrimental. Connecting to the slough will require the following actions: preliminary and final design; agency and stakeholder consultation; state, federal and local permitting, public meetings; construction; and construction management.

3. Removal of Beaver Dams in the Connector Channel

Annual removal of the beaver dams within the inter-lake connector channel may require state and federal permits and will require permits from the City. Maintenance could include the complete or partial removal of the dams or the installation and maintenance of "beaver reliever" pipes that allow water to flow through the dams. Sediment may continue to accumulate within the channel. As such, the effectiveness of the dam removal may diminish

over time.

Preliminary Cost Estimates:

Annual removal and maintenance base costs could range from $20,000 to $40,000.

4. Dredging Connector Channel

The removal of sediment within the connector channel would allow lake levels to behave much as they presumably did before the present control structure was installed, but the sediment removal may have a short-lived effect if the very slow lowering of water levels in Bybee Lake continues as it has in recent years. A localized excavation may be effective if head gradients between the lakes can be seasonally maintained at a high enough level to move sediment out of the channel (possibly through the narrow subchannel flowing to Bybee Lake at lowstands of Bybee Lake).

Significant mechanical removal of sediment from the connector channel can be accomplished once, with maintenance dredging required every 10 to 20 years depending on the rate of accumulation. The dredge spoils can be placed on top of the landfill to reduce costs. Side casting sediment onto the adjacent wetlands is not a preferred option due to the filling of existing wetland. Although wetland hydrology may still be maintained within the wetland, the smothering of existing vegetation could be seen as habitat conversion requiring mitigation.

Simulations of Smith Lake elevations with various dredging options in the inter-lake connector channel suggest that dredging of the generally lower elevation western portion of the channel will have little effect on late summer water levels of Smith Lake. The eastern portion of the channel has bottom elevations in excess of the Smith Lake bottom elevation (generally around 9.0 feet NAVD (5.6 feet NGVD)). Modelling of water exchanges between the lakes with trapezoidal channel bottoms at 8.0 feet NAVD (4.6 feet NGVD) and 9.5 feet NAVD (6.1 feet NGVD) suggest that late summer surface elevations of Smith Lake may be reduced without generating large tidal fluctuations by dredging the channel bottom elevation to 9.0 feet NAVD (5.6 feet NGVD). Since the elevations of the inter-lake channel bottom in excess of 9.0 feet NAVD (5.6 feet NGVD) are largely limited to the eastern portion of the channel (east of the connection to adjacent ponded areas), dredging of this portion of the channel to 9.0 feet NAVD (5.6 feet NGVD) is likely to have the greatest effect on late summer water levels in Smith Lake. Although the geometry of the channel in this portion is not very well known, such dredging is likely to require removal of approximately 3,500 to 4,000 cubic yards of silt. The location of the proposed dredging is shown on Figure 2.

The eastern end of the channel between Bybee Lake and Smith Lake has generally higher bottom elevations than the western portion of the channel. The silt at the east end of the channel extends in a broad fan into Smith Lake. The silt within the lake system is likely from flooding events of the Columbia River, but water level fluctuations of Bybee Lake and local bioturbation may have helped to move the fine sediment eastward toward Smith Lake. The photograph above, which was taken on the autumn equinox at the dry eastern end of the channel facing east across Smith Lake, shows the broad fan of silt extending into Smith Lake.

***Preliminary Cost Estimate*:**

Preliminary estimate of initial project costs based upon available information. $175,000 to 200,000, based on $50 per yard. This includes disposal on site but does not include permits and construction oversight. This cost estimate does not include agency and stakeholder consultation, permitting and other costs.

5. Changes in Water Control Structure Management

Various control options for the Bybee Lake water control structure have indirect effects on the timing of water levels in Smith Lake and also on the condition of the inter-lake channel. Slower drawdowns of Bybee Lake (e.g. 0.5 feet per week) maintain higher water levels in

Smith Lake later into the summer than a more rapid drawdown would produce. With a more gradual rate of drop, the head gradient through the inter-lake channel is lower and sediment transport into Bybee Lake is reduced. With a drop greater than 0.5 feet per day in the Bybee control structure, a higher gradient through the channel would result in greater flows through the channel and probably greater sediment movement into Bybee Lake and out of the system.

If the control structure were completely open (as has been the case through some of the Bybee Lake history), Bybee Lake would tend to draw down by mid-summer and be prone to invasion by flora (e. g. reed canarygrass) well suited to this kind of hydroperiod.

Sediment accumulation within the inter-lake channel appears to be at least partially the result of the slow lowering of the Bybee Lake water surface and is exacerbated with the beaver dams. One option for moving some of the accumulated sediment within the channel would be to keep Bybee Lake at a higher elevation (long enough to keep the reed canarygrass at bay and not long enough to drown the marginal willows) and then drop the Bybee Lake elevation rapidly enough to create sufficient head gradient between Smith Lake and Bybee Lake for sediment scouring into Bybee Lake. The present configuration of flashboards and tidegates very likely limits the lowering of Bybee Lake to a rate no greater than 0.5 feet per day. A system of crank-open gates similar to the existing small gated opening might allow more rapid control of water exit from the control structure. A change from the existing large tidegates to two-way flow through the structure would provide the option of more rapid drawdown when desired.

A series of simulations were run to examine the effects of various modes of tidal exchange with the Columbia Slough. The simulations were run as an initial value simulation of lake volumes for both Bybee Lake and Smith Lake. Water exchange between the two lakes was simulated with a Manning's formulation as a trapezoidal channel 80 feet wide with 2:1 sideslopes. Evaporation from the lake surface was calculated as a function of wetted lake surface area. The temporal integration was with a fourth order Runge-Kutta simulation using a 10-second time step. The tidal time series was from the Lombard Street gage for the summer of 2014. The initial condition for both Bybee Lake and Smith Lake was the Columbia River highstand on May 25, 2014.

Several simulations were run with the Bybee Lake control structure operated as in the NMFS BiOp issued prior to the construction of the present Bybee water control structure. Figure 1 shows the water surface elevation of Smith Lake with the existing lake conditions and several conditions of the inter-lake channel. With beaver dams in the channel up to an elevation of 11.0 feet NAVD (7.6 feet NGVD), Smith Lake does not drop to an elevation of 11.5 feet NAVD (8.1 feet NGVD) until early August and remains at an elevation greater than 10.7 feet NAVD (7.3 feet NGVD) through early September (Figure 6).

i Figure 6. Smith Lake Surface Elevation with Bybee Lake Control Structure as Described in NMFS 2003 Biological Opinion.

With the Bybee Lake control structure operated as in the NMFS BiOp and the beaver dams removed to an elevation of 9.5 feet NAVD, the water level in Smith Lake drops to an elevation of 11.0 feet NAVD (7.6 feet NGVD) in early August and reaches an elevation of 10 feet NAVD (6.6 feet NGVD) by late August and declines to an elevation of 9.5 feet NAVD (6.1 feet NGVD) by mid-September.

With the Bybee Lake control structure operated as in the BiOp and the inter-lake channel excavated to a depth of 8.0 feet NAVD (4.6 feet NGVD), the water levels in Smith Lake are nearly the same as the previous case until the third week of August and then drop rapidly to 9.5 feet NAVD (6.1 feet NGVD) by the first of September. The water levels drop gradually to an elevation of 9.3 feet NAVD (5.9 feet NGVD) by mid-September.

ii Figure 7. Smith Lake Surface Elevation with 10 foot Opening to Columbia Slough and Bybee Lake Control Structure as Described in NMFS 2003 Biological Opinion.

With the Bybee Lake control structure operated as in the BiOp and a 10-feet wide open channel constructed between the Columbia Slough and Smith Lake at an elevation of 9.5 feet NAVD (6.1 feet NGVD), the effects of the inter-lake channel condition are considerably reduced and the effects of tidal fluctuations are considerably increased. In the tides of the 2014 summer, the water surface of Smith Lake would drop to 11.5 feet NAVD (8.1 feet NGVD) by the summer solstice and rise again to 13.0 feet NAVD (9.6 feet NGVD) by the first of July. Smith Lake would drop to 11.0 feet NAVD (7.6 feet NGVD) by mid-July, rise about 0.7 feet in the week thereafter and decline to 10.0 feet NAVD (6.6 feet NGVD) by the first of August. After a lunar tidal rise to nearly 10.5 feet NAVD (7.1 feet NGVD) in the third week of August, water levels would decline to near 9.5 feet NAVD (6.1 feet NGVD) by mid-September. Diurnal tides can be expected to range from 0.1 – 0.2 feet superimposed on the larger lunar tidal fluctuations.

iii Figure 8. Smith Lake Surface Elevation with 36” Pipe to Columbia Slough and Bybee Lake as Described in NMFS 2003 Biological Opinion.

With the Bybee Lake control structure operated as in the BiOp and a 36-inch-diameter pipe extending between the Columbia Slough and the bottom of Smith Lake so that the pipe remains full of water so long as water remains in Smith Lake, Smith Lake drops rather gradually to 11.0 feet NAVD (7.6 feet NGVD) by the third week of July and reaches an elevation of 9.5 feet NAVD (6.1 feet NGVD) by mid-August. Inter-lake channel conditions make a significant difference in lake surface elevations only after mid-August.

iv Figure 9. Smith Lake Surface Elevation with Bybee Lake Control Structure Retaining Water until July 1 and Rapid Drawdown Thereafter.

Several simulations were run with the Bybee Lake control structure maintaining high water levels through June and rapid drops (0.5 feet per day) thereafter. With the present conditions of the lakes, water levels in Smith Lake would drop to 12.0 feet NAVD (8.6 feet NGVD) by mid-July and water levels in Smith Lake thereafter depend of the condition of the inter-lake connector channel. With beaver dams in the channel to an elevation of 11.0 feet NAVD (7.6 feet NGVD), Smith Lake drops to 11.0 feet NAVD (7.6 feet NGVD) by early August and gradually to 10.5 feet NAVD (7.1 feet NGVD) by mid-September. With the beaver dams removed to a channel elevation of 9.5 feet NAVD (6.1 feet NGVD), the Smith Lake surface drops to 10.2 feet NAVD (6.8 feet NGVD) and then with weekly 0.5 feet lunar tidal fluctuation to 9.5 feet NAVD (6.1 feet NGVD) by the first of September. With the inter-lake connector channel dredged to an elevation of 8.0 feet NAVD (4.6 feet NGVD), the lunar tidal fluctuations are larger (0.7 feet) with Smith Lake dropping to 9.5 feet NAVD (6.1 feet NGVD) by the third week of August and declining to 9.3 feet NAVD (5.9 feet NGVD) by mid-September.

v Figure 10. Smith Lake Surface Elevation with 10-foot Opening to Columbia Slough and Bybee Lake Control Structure Retaining Water Through June and Rapid Drawdown Thereafter.

For the scenario with a 10-foot opening to Columbia Slough, water retained by the Bybee Lake control structure through June and rapid drawdown thereafter, Smith Lake water levels fall to approximately 11.6 feet NAVD (8.2 feet NGVD) by the summer solstice, rise again to nearly 13.0 feet NAVD (9.6 feet NGVD) by the first of July, fall to nearly 11.0 feet NAVD (7.6 feet NGVD) by mid-July, and rise to nearly 12.0 feet NAVD (8.5 feet NGVD) by the third week of July. After the third week of July, inter-lake channel conditions make some differences in water elevations, with a more open channel producing larger fluctuations in water surface elevation.

vi Figure 11. Smith Lake Surface Elevation with 36" Pipe to Columbia Slough and Bybee Lake Control Structure Retaining Water Through June and Rapid Drawdown Thereafter.

For the scenario with a 36-inch pipe between the Columbia Slough and Smith Lake with the Bybee Lake water control retaining water through June and rapid drawdown thereafter, Smith Lake drops gradually to 13.0 feet NAVD (9.6 feet NGVD) by early July. With beaver dams in the inter-lake channel at 11.0 feet NAVD (7.6 feet NGVD), Smith Lake drops to 9.5 feet NAVD (6.1 feet NGVD) by the first week of August and remains near that level to mid-September. With the beaver dams removed to 9.5 feet NAVD (6.1 feet NGVD), lunar tidal fluctuations are larger, but the end of summer Smith lake water levels are the same. With the

inter-lake channel dredged to 9.0 feet NAVD (5.6 feet NGVD), Smith Lake can be expected to have daily wetting and drying through late August and early September (Figure 11).

6. No Action Option

Doing nothing will ensure that low summer dissolved oxygen levels remain; increasing the likelihood of avian botulism outbreaks, the expansion of invasive aquatic plants, and loss of marginal willow shrubland. Being unable to control Smith Lake's water level will ensure there is no direct management of vegetation. Non-native emergent species will continue to thrive and willow populations within the riparian area will continue to decrease.

Appendix A

Table 1

Table 1 – Comparison of Management Options for Smith and Bybee Lakes Natural Area

Management Objectives	Smith Lake to Columbia River pipe connection – always open	Smith Lake to Columbia Slough – Open channel	Smith Lake to Columbia Slough pipe connection – always open	Controlling Beaver Dams - annual inter-lake channel maintenance	Dredging Inter-Lake Connector Channel	Water control structure management	No action
1. Off-channel habitat for juvenile salmonids	No fish passage into Smith Lake through the pipe Large lunar tidal surface elevation changes that would occur with connections between Smith Lake and the Columbia River may alter habitat for salmonids and non-native warm water fish	Fish passage into Smith Lake through the open connection Large lunar tidal surface elevation changes that would occur with connections between Smith Lake and the Columbia Slough may alter habitat for salmonids and non-native warm water fish	No fish passage into Smith Lake through the pipe Large lunar tidal surface elevation changes that would occur with connections between Smith Lake and the Columbia Slough may alter habitat for salmonids and non-native warm water fish	Annual, early season beaver dam removal will extend the period of fish passage through the channel when Smith Lake surface elevation is between 9.5 and 11 feet NAVD (6.1 and 7.6 feet (NGVD) and juvenile salmonids may use Smith Lake longer into the summer than they otherwise would.	Enhance fish passage to Smith Lake. Smith Lake surface elevation changes will be more like changes in Bybee Lake. Fish passage through the inter-lake channel to Smith Lake may be fraught with predators.	Designed to allow fish passage With no Smith Lake connection to the Columbia River or the Columbia Slough, large lunar tidal surface elevation changes will not occur in Smith Lake.	Juvenile salmonids are believed to use the lake system during the early summer. Water temperatures are likely too high for salmonids during late summer. Carp, juvenile salmonid's major competitor, are the major warm-water non-native fish in Smith Lake, and are likely to remain the dominant bottom-feeders and the source of turbidity in most management scenarios.
2. Reed canarygrass control	With the open pipe to the Columbia River, Smith Lake water surface elevation will follow that of the river and, as such, pre-solstice water levels high enough to drown reed canarygrass are less likely to occur. This condition will enhance the survival of willow on the lake margin.	With the open channel to the Columbia Slough, Smith Lake water surface elevation will follow that of the slough and, as such, pre-solstice water levels high enough to drown reed canarygrass are less likely to occur. This condition will enhance the survival of willow on the lake margin.	With the open pipe to the Columbia Slough, Smith Lake water surface elevation will follow that of the slough and, as such, pre-solstice water levels high enough to drown reed canarygrass are less likely to occur. This condition will enhance the survival of willow on the lake margin.	With ongoing beaver dam removal, the more uniform, annual drawdown of Smith Lake would enhance the spread of reed canary grass on the edge of Smith Lake and, simultaneously, enhance willow survival.	A more open inter-lake channel will allow a more rapid drawdown of Smith Lake would enhance the spread of reed canarygrass and, simultaneously, enhance willow survival.	Water level controls for Bybee Lake (as intended for the structure) also provide a means for water level management in Smith Lake if water and sediment flows through the inter-lake channel can be maintained. High water surface water elevation in early summer, followed by rapid drawdown in late summer, may allow some reed canarygrass control without drowning the lake margin willows.	The late summer high water surface elevation of Smith Lake caused by limited flows through the inter-lake channel seem to be keeping the reed canarygrass at bay, but at the cost of the willow thickets along the lake margins.

Management Objectives	Smith Lake to Columbia River pipe connection – always open	Smith Lake to Columbia Slough – Open channel	Smith Lake to Columbia Slough pipe connection – always open	Controlling Beaver Dams - annual inter-lake channel maintenance	Dredging Inter-Lake Connector Channel	Water control structure management	No action
3. Willows and emergent vegetation	Lowered Smith Lake water levels in late summer may enhance willow survival on the margins the lake and, simultaneously, enhance the spread of reed canarygrass. Perennial emergents (e.g. *Lythrum salicaria*) may thrive in late summer fluctuating water levels. Annual emergents (e.g. *Cyperus erythrorhizos*) may colonize mudflats.	Lowered Smith Lake water levels in late summer may enhance willow survival on the margins the lake and, simultaneously, enhance the spread of reed canarygrass. Perennial emergents (e.g. *Lythrum salicaria*) may thrive in late summer fluctuating water levels. Annual emergents (e.g. *Cyperus erythrorhizos*) may colonize mudflats.	Lowered Smith Lake water levels in late summer may enhance willow survival on the margins the lake and, simultaneously, enhance the spread of reed canarygrass. Perennial emergents (e.g. *Lythrum salicaria*) may thrive in late summer fluctuating water levels. Annual emergents (e.g. *Cyperus erythrorhizos*) may colonize mudflats.	With ongoing beaver dam removal, the more uniform annual drawdown of Smith Lake would allow a stable willow population along the margin of Smith Lake and, simultaneously, enhance the spread of reed canarygrass. Perennial emergents (e.g. *Lythrum salicaria*) may thrive in late summer fluctuating water levels. Annual emergents (e.g. *Cyperus erythrorhizos*) may colonize mudflats.	A more open inter-lake channel will allow a more rapid drawdown of Smith Lake and prevent the late season drowning of marginal willow populations. A more open channel will enhance the spread of reed canarygrass. Perennial emergents (e.g. *Lythrum salicaria*) may thrive in late summer fluctuating water levels. Annual emergents (e.g. *Cyperus erythrorhizos*) may colonize mudflats.	Most of the willow taxa along the Columbia River are adapted to spring freshets of the river and can tolerate high water before the summer solstice. High stands after the summer solstice however seem to reduce the areal extent of lake margin willow populations. Early summer drawdown favors peripheral perennial plants. Rapidly growing annuals with long-lived seedbanks will invade mudflats upon drawdown.	Aerial photographs suggest a loss of Smith Lake marginal willow populations from August 2006 to August 2012 with higher late summer water levels in Smith Lake. If the Bybee control structure is operated in a similar fashion, this trend can be expected to continue.
4. Mudflats for shorebirds	The larger lunar tidal fluctuations generated by a direct connection with the Columbia River are likely to produce more invertebrate food for mudflat feeders. Early drawdown of the lake will leave larger mudflat areas for the shorebirds.	The larger lunar tidal fluctuations generated by a direct connection with the Columbia Slough are likely to produce more invertebrate food for mudflat feeders. Early drawdown of the lake will leave larger mudflat areas for the shorebirds.	The larger lunar tidal fluctuations generated by a direct connection with the Columbia Slough are likely to produce more invertebrate food for mudflat feeders. Early drawdown of the lake will leave larger mudflat areas for the shorebirds.	An open inter-lake channel will allow more rapid drawdown as water surface elevations drop in Bybee Lake, but the effects do not depend on previous years water levels.	A more open inter-lake channel will allow the water surface elevations to follow more closely the Bybee Lake surface and expose mudflats as Bybee Lake draws down.	Water level controls for Bybee Lake (as intended for the structure) also provide a means for water level management in Smith Lake if water and sediment flows through the inter-lake channel can be maintained. With an earlier drawdown of Bybee Lake, the lower surface elevations of Smith Lake will expose more mudflats.	With high water levels in early summer and limited flow through the inter-lake channel, water levels in Smith Lake remain high enough to expose very little mudflat area.

Management Objectives	Smith Lake to Columbia River pipe connection – always open	Smith Lake to Columbia Slough – Open channel	Smith Lake to Columbia Slough pipe connection – always open	Controlling Beaver Dams - annual inter-lake channel maintenance	Dredging Inter-Lake Connector Channel	Water control structure management	No action
5. Wintering waterfowl habitat	Rainfall and higher water levels in the Columbia River tend to produce seasonally higher surface elevations in Smith Lake, but an open connection to the river or slough will produce more short-term surface elevation, although these are not likely to significantly alter the wetted surface area of the lake during the winter.	Rainfall and higher water levels in the Columbia Slough tend to produce seasonally higher surface elevations in Smith Lake, but an open connection to the river or slough will produce more short-term surface elevation, although these are not likely to significantly alter the wetted surface area of the lake during the winter.	Rainfall and higher water levels in the Columbia Slough tend to produce seasonally higher surface elevations in Smith Lake, but an open connection to the river or slough will produce more short-term surface elevation, although these are not likely to significantly alter the wetted surface area of the lake during the winter.	An open inter-lake channel will allow Smith Lake to have a more rapid response to water surface elevations of Bybee Lake.	A more open inter-lake channel will allow the water surface elevations to follow more closely the Bybee Lake surface and keep large wetted surface area in Smith Lake if Bybee Lake is kept at high levels through the winter.	The control structure can be (and has been) used to keep high water levels through the winter, spring, and early summer. Other control options would permit water levels to vary more with Columbia River elevations, but these elevations are generally high enough to keep most of Smith Lake wetted.	Smith Lake is a very large lake with little change in wetted area at higher surface elevations. Winter wetted areas are not likely to vary much with different management scenarios.
6. Botulism risk management	Large exchanges with the Columbia River would likely lower the average water temperatures in Smith Lake, but at the cost of rapidly varying water depths. The rapid changes in water depth and temperature may result in more rapid changes in algal populations. The crashes in algal populations may exacerbate botulism blooms in late summer. Smaller exchanges are not likely to significantly alter the thermal regime within Smith Lake and will vary long-term water levels like the Columbia River.	Large exchanges with the Columbia River would likely lower the average water temperatures in Smith Lake, but at the cost of rapidly varying water depths. The rapid changes in water depth and temperature may result in more rapid changes in algal populations. The crashes in algal populations may exacerbate botulism blooms in late summer. Smaller exchanges are not likely to significantly alter the thermal regime within Smith Lake and will vary long-term water levels like the Columbia River.	Large exchanges with the Columbia River would likely lower the average water temperatures in Smith Lake, but at the cost of rapidly varying water depths. The rapid changes in water depth and temperature may result in more rapid changes in algal populations. The crashes in algal populations may exacerbate botulism blooms in late summer. Smaller exchanges are not likely to significantly alter the thermal regime within Smith Lake and will vary long-term water levels like the Columbia River.	Changes in late summer weather and their correlation with lunar tidal changes make botulism risks vary from summer to summer, but steady flow regimes maintained every summer are likely to minimize the risks.	More water flow through the inter-lake channel is likely to make aquatic conditions in Smith Lake more like conditions in Bybee Lake and reduce the risk of avian botulism.	Various options for water level management are possible for the existing control structure and presumably for a redesigned control structure. Risk for waterfowl from a botulism bloom may be reduced by limiting the water depth. Rapid temperature fluctuations within a shallow water column are more severe and may with weather fluctuations in August result in botulism conditions.	Deeper water levels in Smith Lake in late summer render the lake more susceptible to August changes in solar radiation and winds that may lead to rapid crashes in algal and zooplankton populations resulting in *Clostridium* toxins at the bottom of the water column.

Appendix B

Figures

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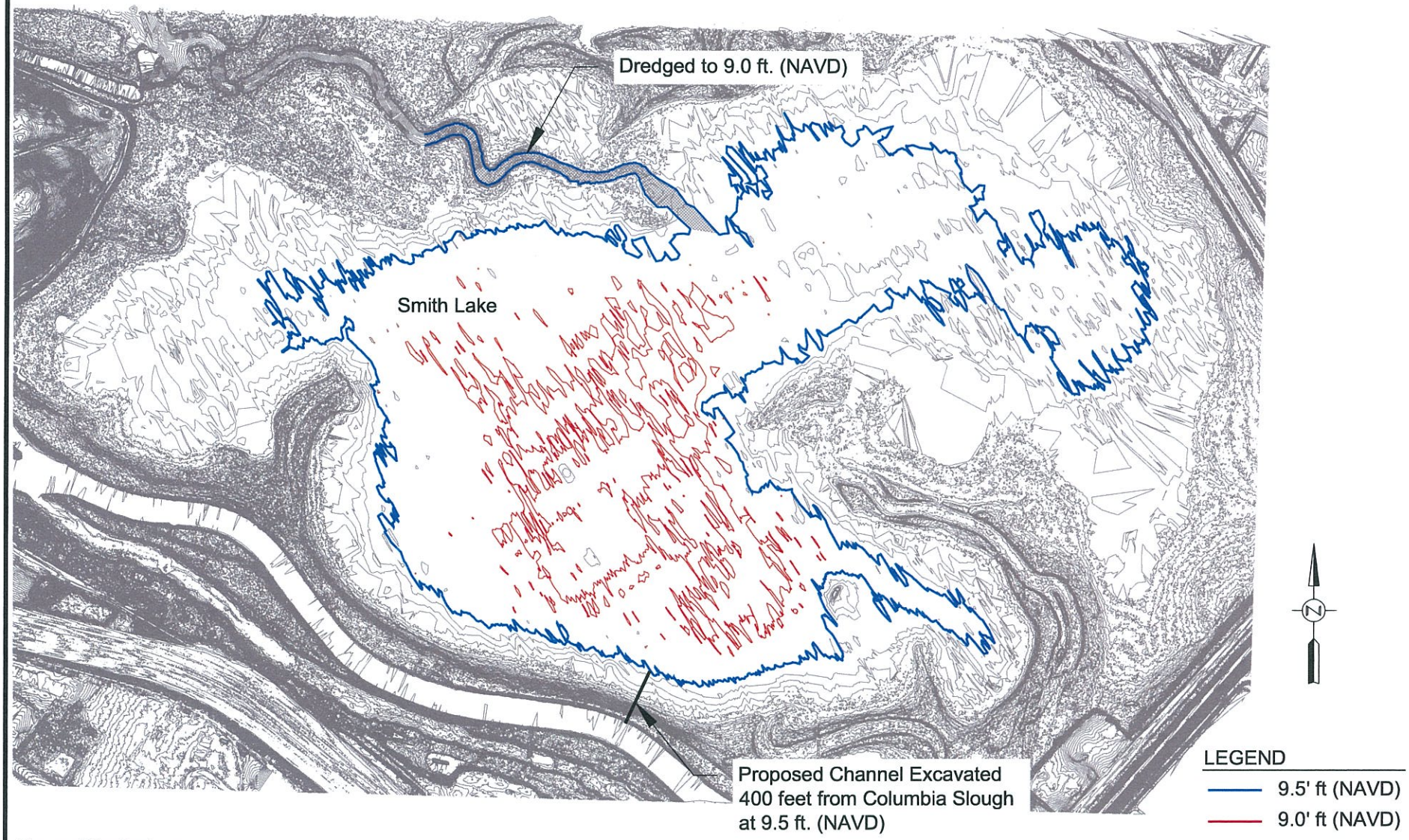
Aerial Photo (from Google Earth June 2005 chosen for clarity of the image)

Smith & Bybee Lakes

(Edge of water derived from aerial photos taken in August 2005 and August 2012)

FIGURE
1

05-28-2015



Source: Lidar Contours

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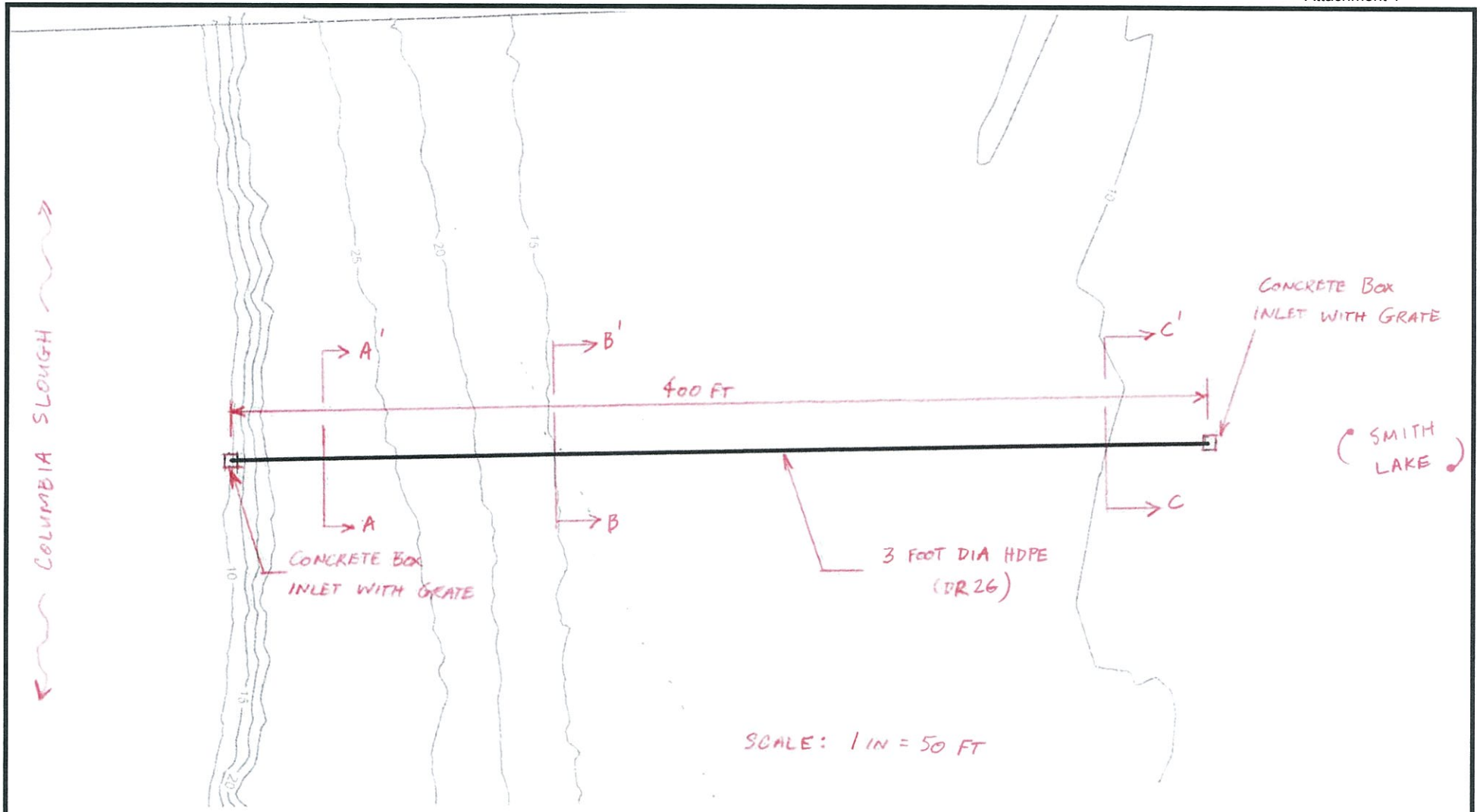
Smith Lake Approximate Edge of Water
(Edge of water derived from aerial photos taken in August 2005 and August 2012)

FIGURE
2

09-19-2014



Plan Provided by Cornforth Consultants

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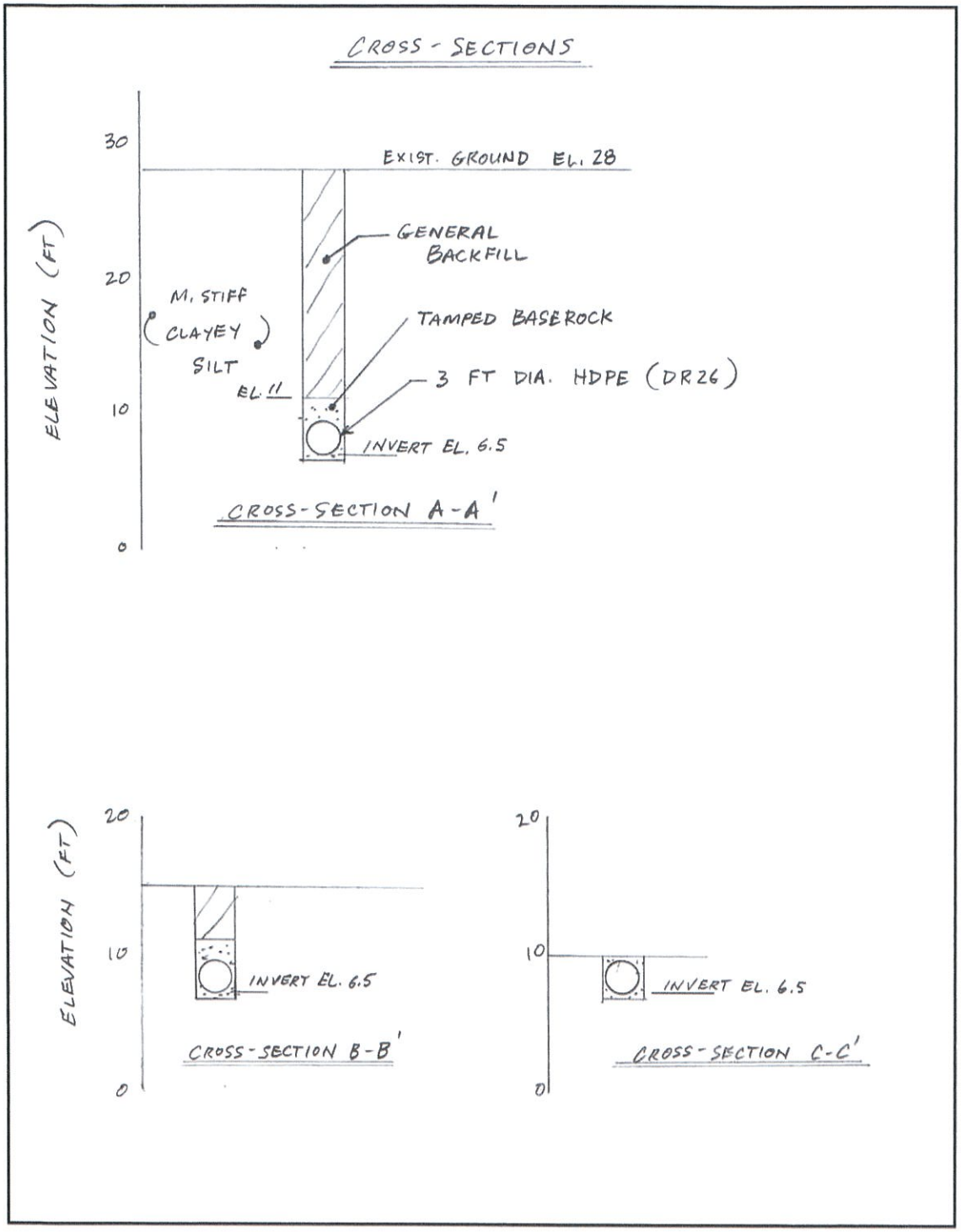
Concept - Pipe Connection Between Smith Lake and Columbia Slough (Plan View)

Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 3

05-28-2015



Sections Provided by Cornforth Consultants

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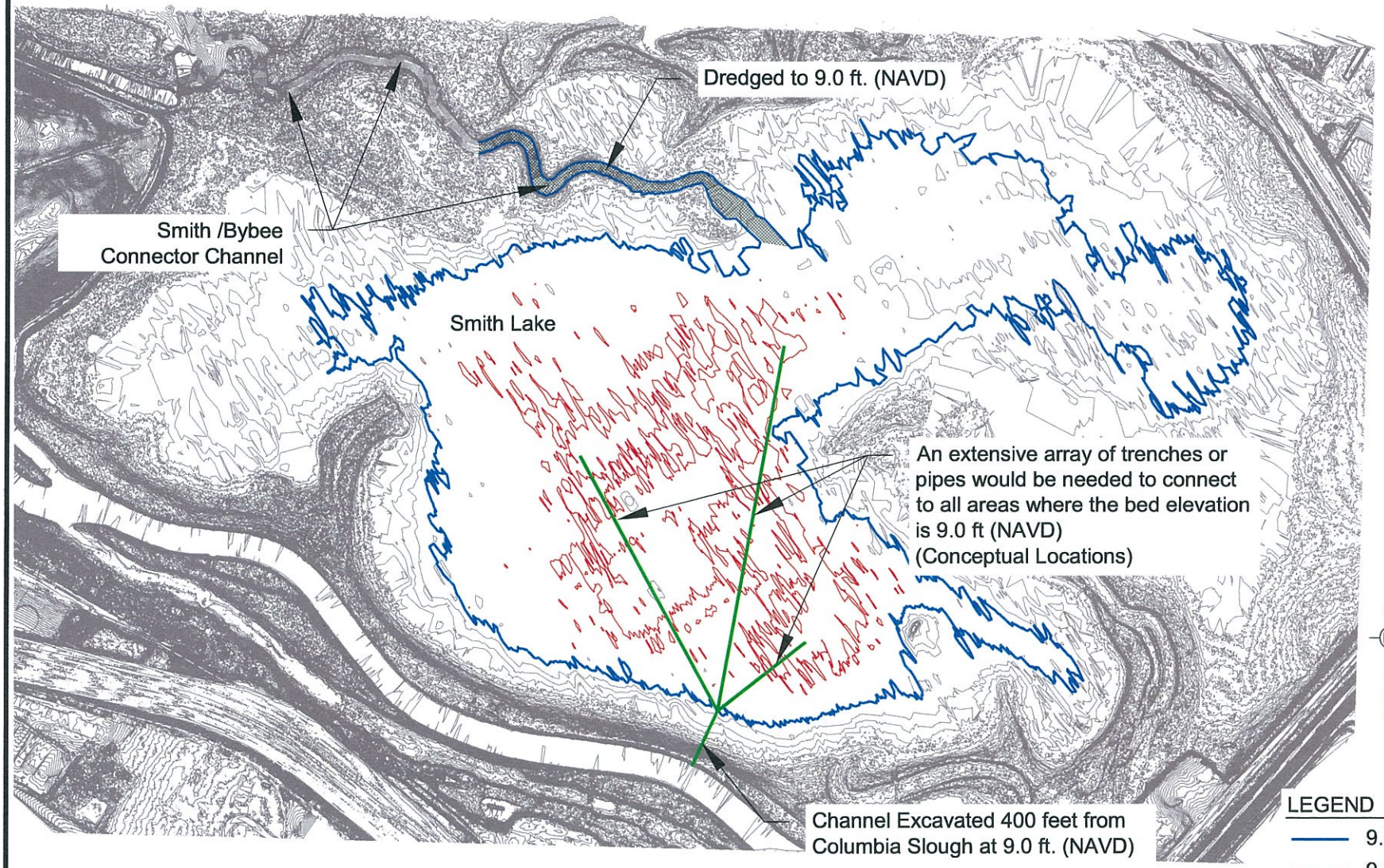
Concept - Pipe Connection Between Smith Lake and Columbia Slough (Section View)

Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 3A

05-28-2015



Source: Lidar Contours

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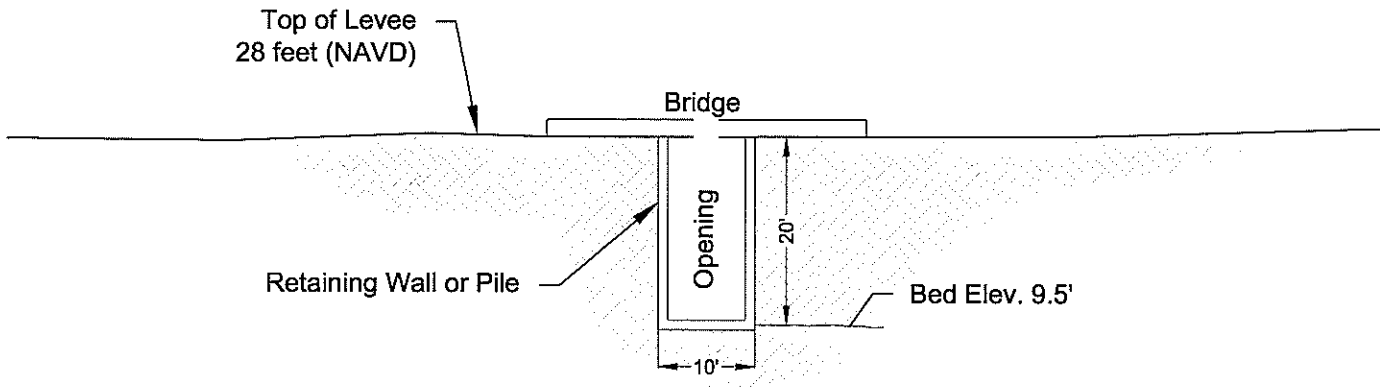
Smith Lake Approximate Edge of Water
(Edge of water derived from aerial photos taken in August 2005 and August 2012)

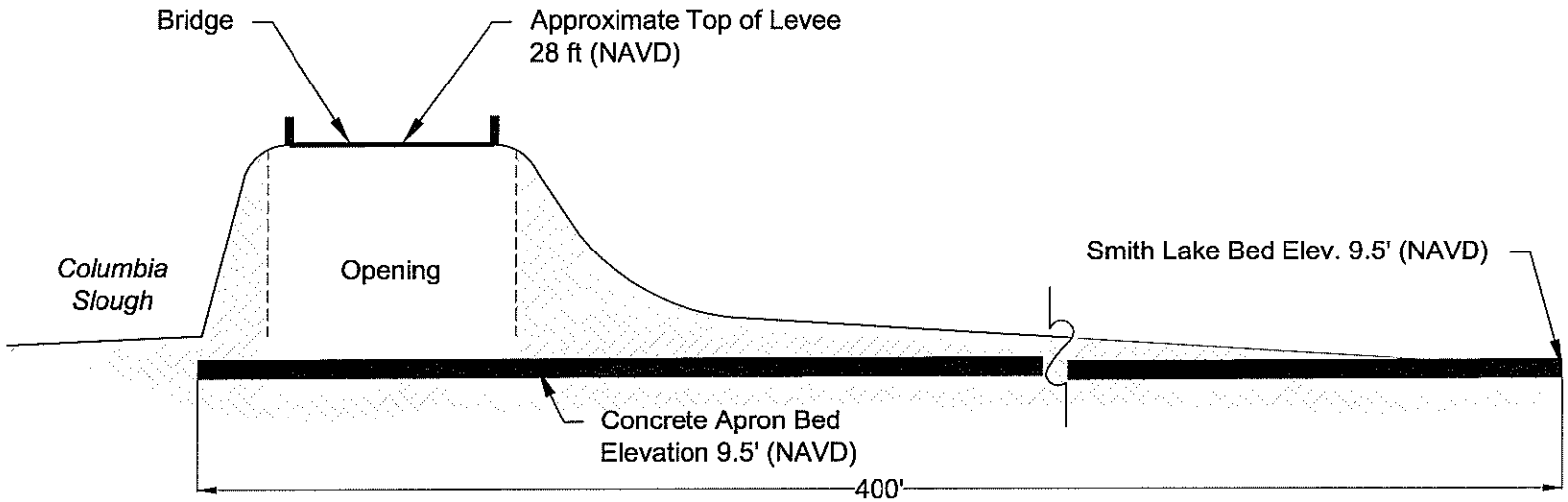
FIGURE
4

05-28-2015



SECTION - OPEN NOTCH

Scale 1"=20'



ELEVATION VIEW - OPEN NOTCH

Scale 1"=20'

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Concept - Option 1 - Open Notch and Bridge Connection Between Smith Lake and Columbia Slough

Smith and Bybee Wetlands Natural Area
Portland, Oregon

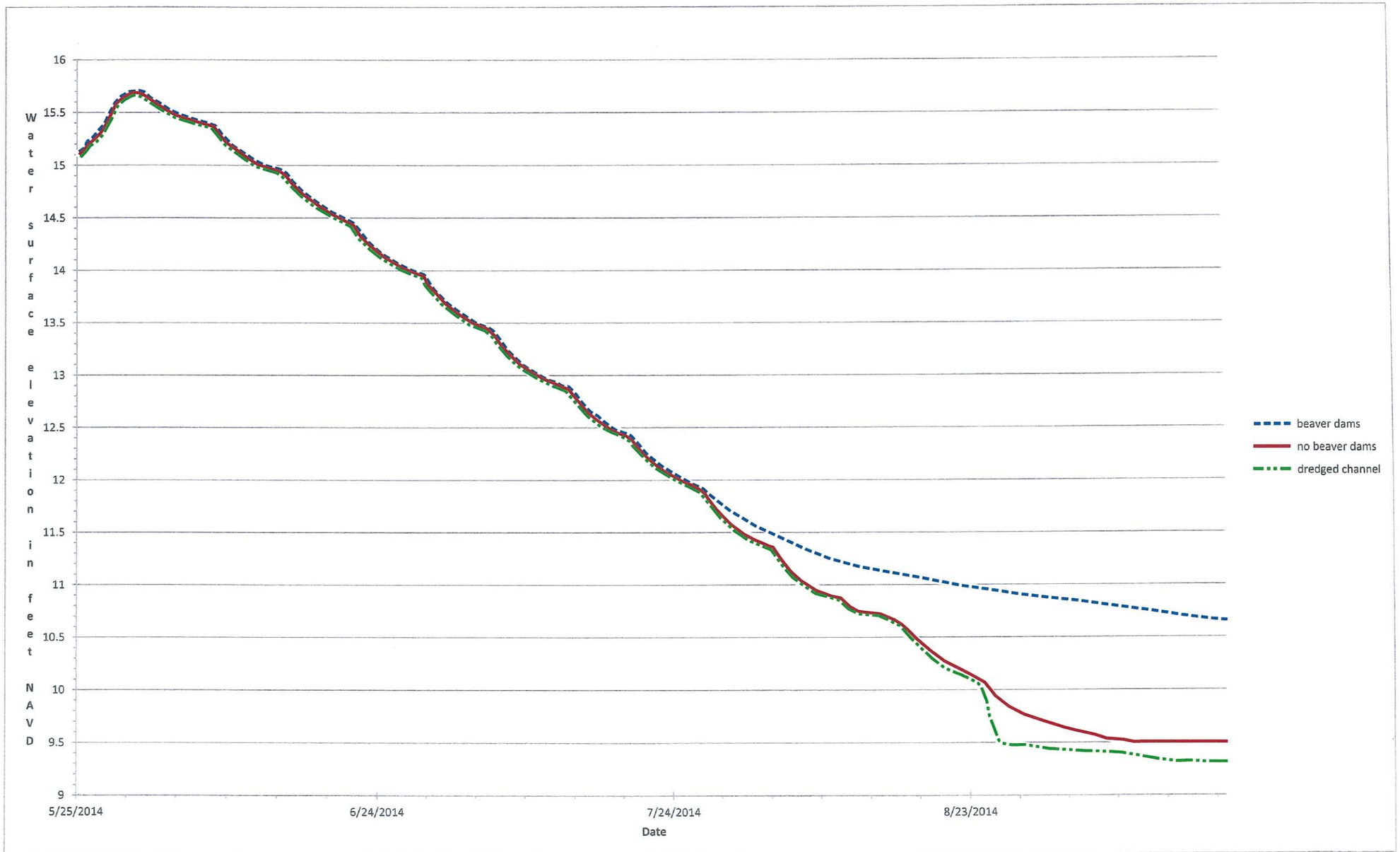
FIGURE
5

5-29-2014

Simulation results for various options for hydrologic management of Smith Lake. All simulations used the 2014 tidal and water surface elevation for Columbia Slough at the Lombard Bridge. Simulations explored the response of Smith Lake to drawdown pattern, management of beaver dams and silt in the inter-lake channel, and options to improve connectivity of Smith Lake to surrounding waters. Rapid drawdown means the Bybee Lake water control structure retains as much water as possible through end of June and is fully opened July 1st.

Figure #/Option	Drawdown	Channel/beaver dam	Mid-July elevation (feet)	Mid-August elevation (feet)	Mid-September elevation Feet)
6 / Bybee Lake Water Control Structure (WCS)	Biological Opinion (Bi-Op)	No alteration	12.5	11	10.5
6 / Bybee WCS	Bi-Op	Dam removed to 9.5 ft	12.5	10.5	9.5
6 / Bybee WCS	Bi-Op	Dredged to 8.0 ft	12.5	10.5	9.5
7 / 10-ft Columbia Slough opening	Bi-Op	No alteration	11	10.5	9.5
7 / 10-ft Columbia Slough opening	Bi-Op	Dam removed to 9.5 ft	11	10.5	9.5
7 / 10-ft Columbia Slough opening	Bi-Op	Dredged to 8.0	11	10.5	9.5
8 / 36-inch Columbia Slough pipe	Bi-Op	No alteration	12	9.5	9.5
8 / 36-inch Columbia Slough pipe	Bi-Op	Dam removed to 9.5 ft	12	10	9.5
8 / 36-inch Columbia Slough pipe	Bi-Op	Dredged to 8.0	12	10	9
9 / Bybee WCS	Rapid	No alteration	11.5	11	10.5
9 / Bybee WCS	Rapid	Dam removed to 9.5 ft	11	10	9.5

Figure #/Option	Drawdown	Channel/beaver dam	Mid-July elevation (feet)	Mid-August elevation (feet)	Mid-September elevation Feet)
9 / Bybee WCS	Rapid	Dredged to 8 ft	11	9.5	9.5
10 / 10-ft Columbia Slough opening	Rapid	No alteration	11	10	9.5
10 / 10-ft Columbia Slough opening	Rapid	Dam removed to 9.5 ft	11	10	9.5
10 / 10-ft Columbia Slough opening	Rapid	Dredged to 8.0	11	10	9.5
11 / 36-inch Columbia Slough pipe	Rapid	No alteration	11.5	9.5	9.5
11 / 36-inch Columbia Slough pipe	Rapid	Dam removed to 9.5 ft	11	10	9.5
11 / 36-inch Columbia Slough pipe	Rapid	Dredged to 9 ft	11	9.5	9



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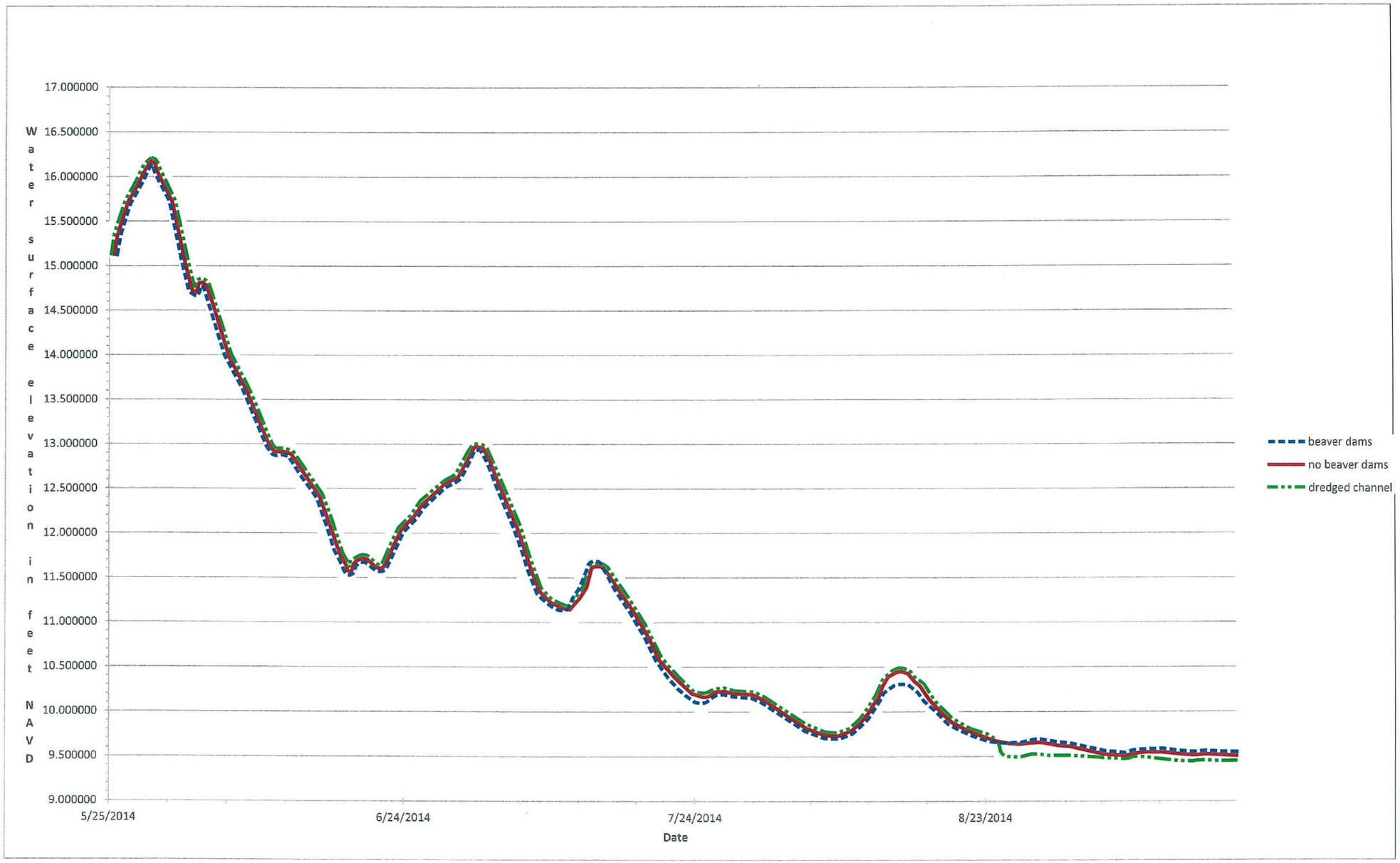
Smith Lake Surface Elevation with Bybee Lake Control Structure as Described in NMFS 2003 Biological Opinion

Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 6

9-11-2015



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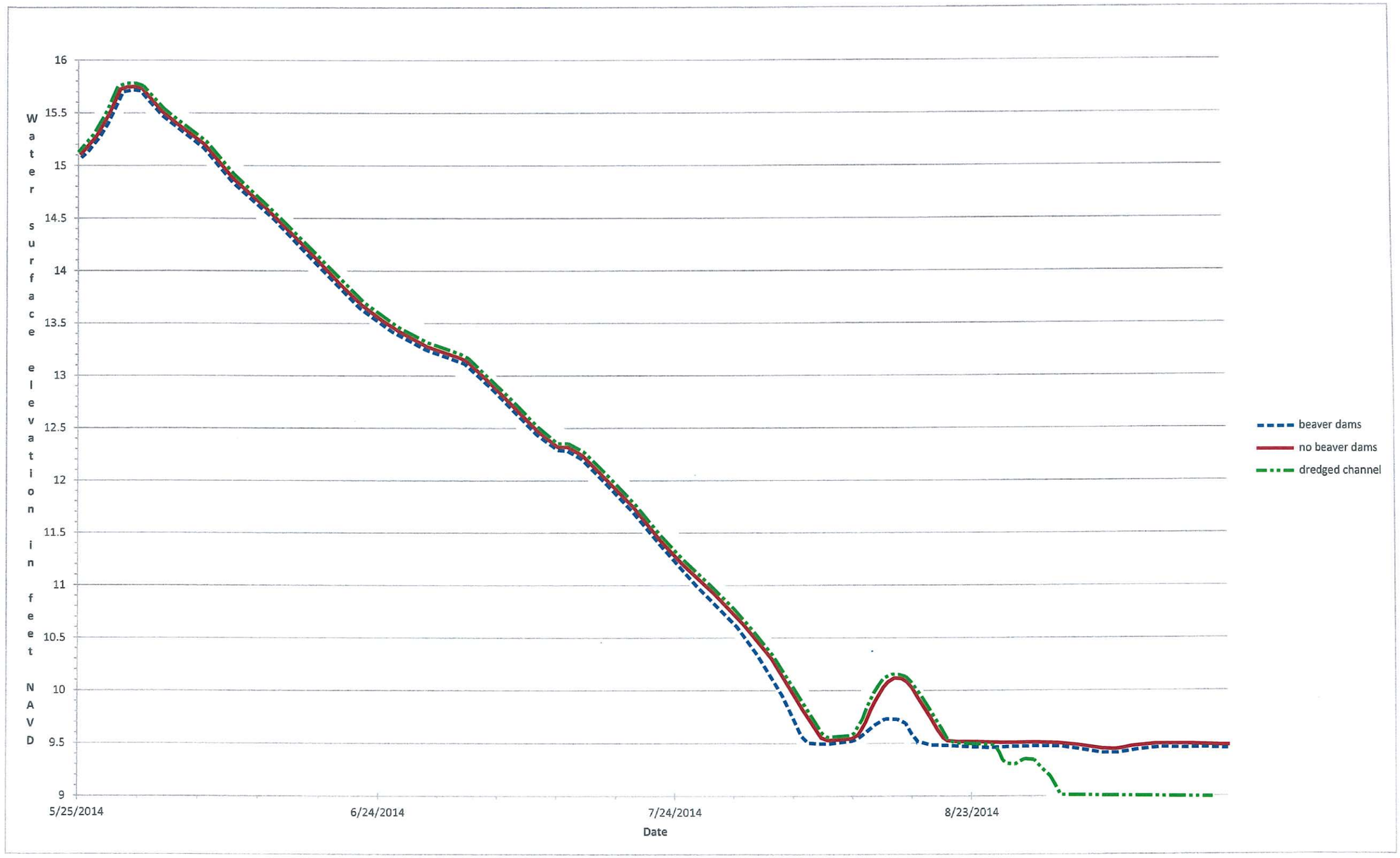
Smith Lake Surface Elevation with 10 foot Opening to Columbia Slough and Bybee Lake Control Structure as Described in NMFS 2003 Biological Opinion
Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 7

9-11-2015



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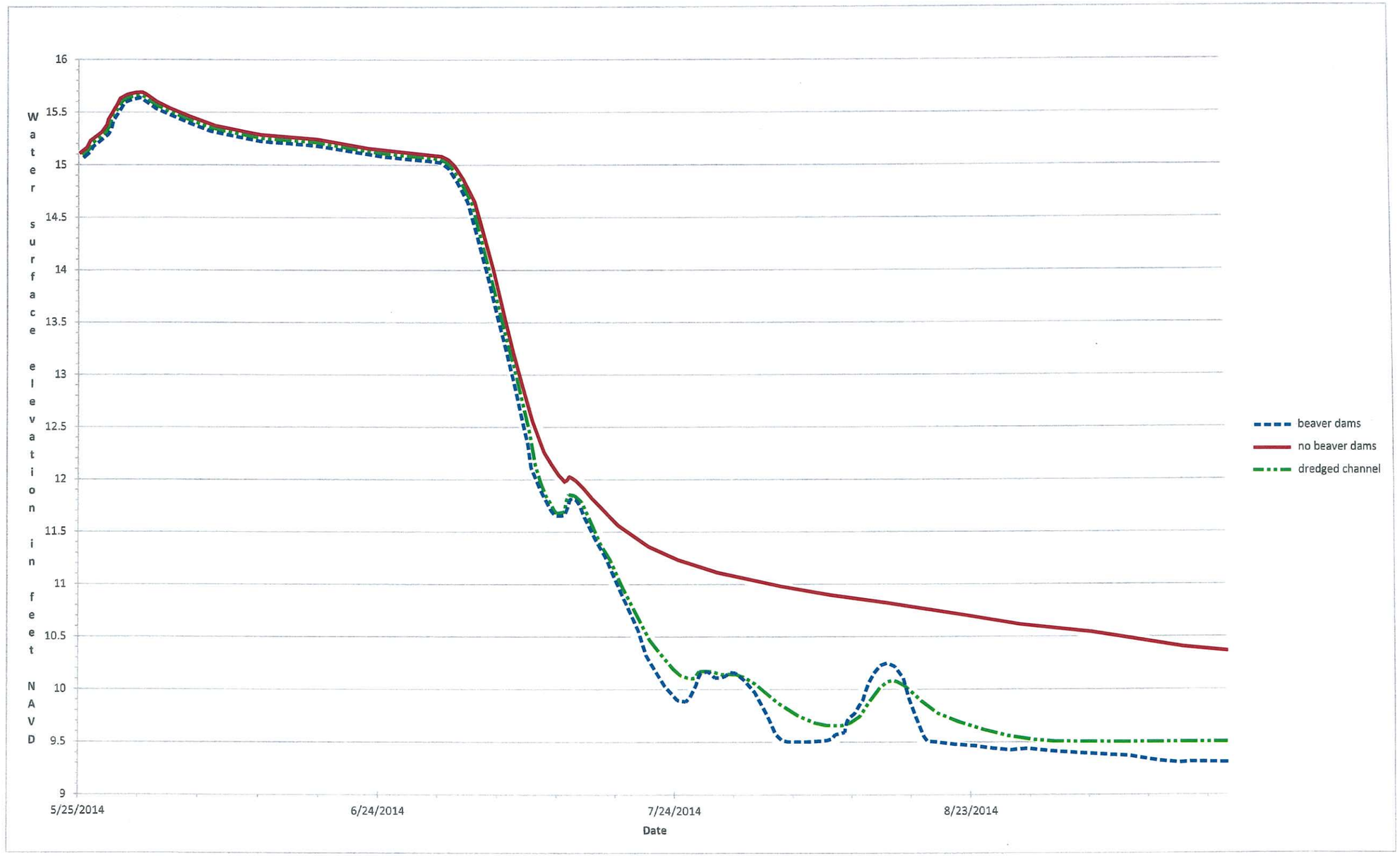
Smith Lake Surface Elevation with 36" Pipe to Columbia Slough and Bybee Lake as Described in NMFS 2003 Biological Opinion

Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 8

9-11-2015



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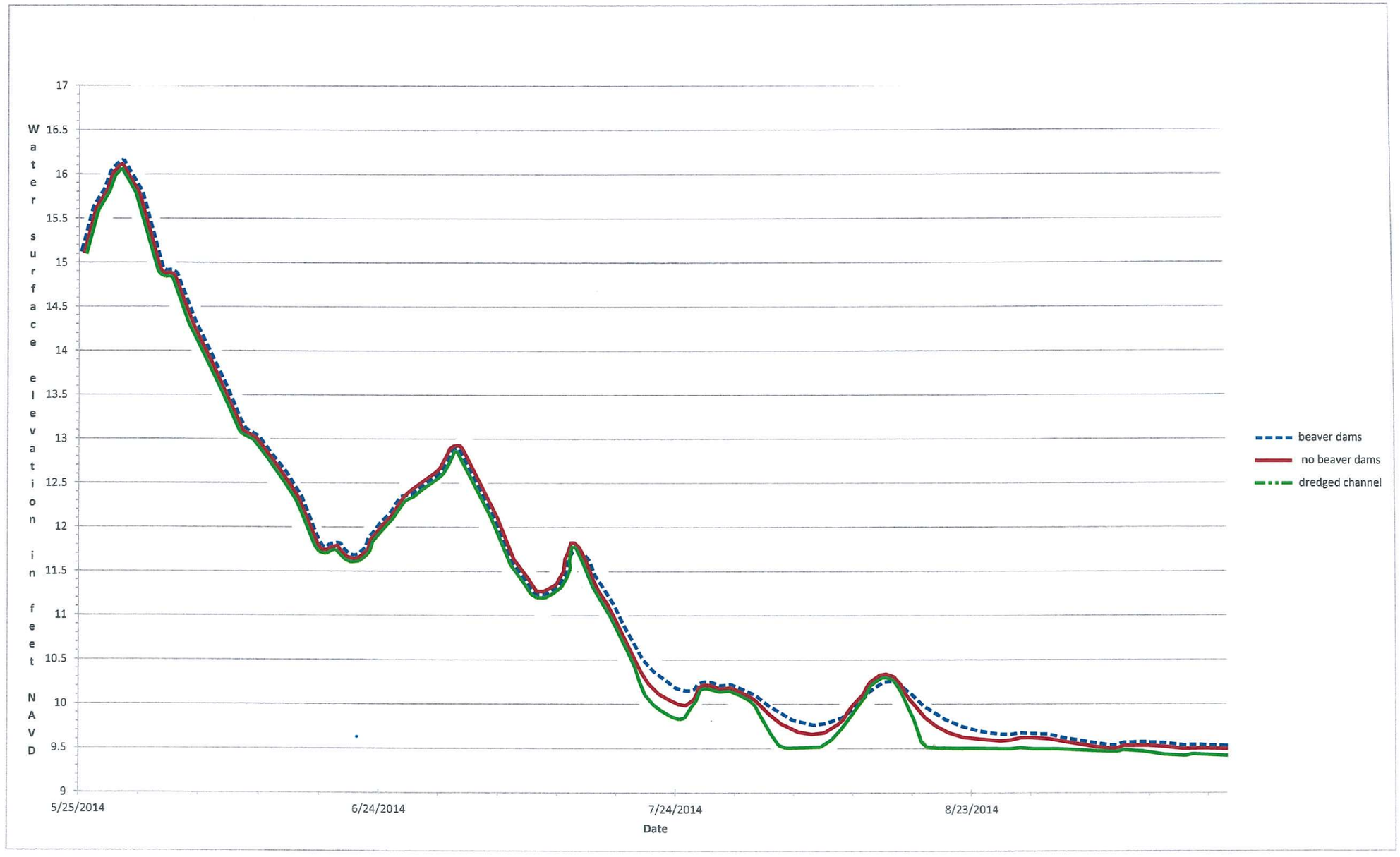
Smith Lake Surface Elevation with Bybee Lake Control Structure Retaining Water Through June 1 and Rapid Drawdown Thereafter
Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 9

9-11-2015



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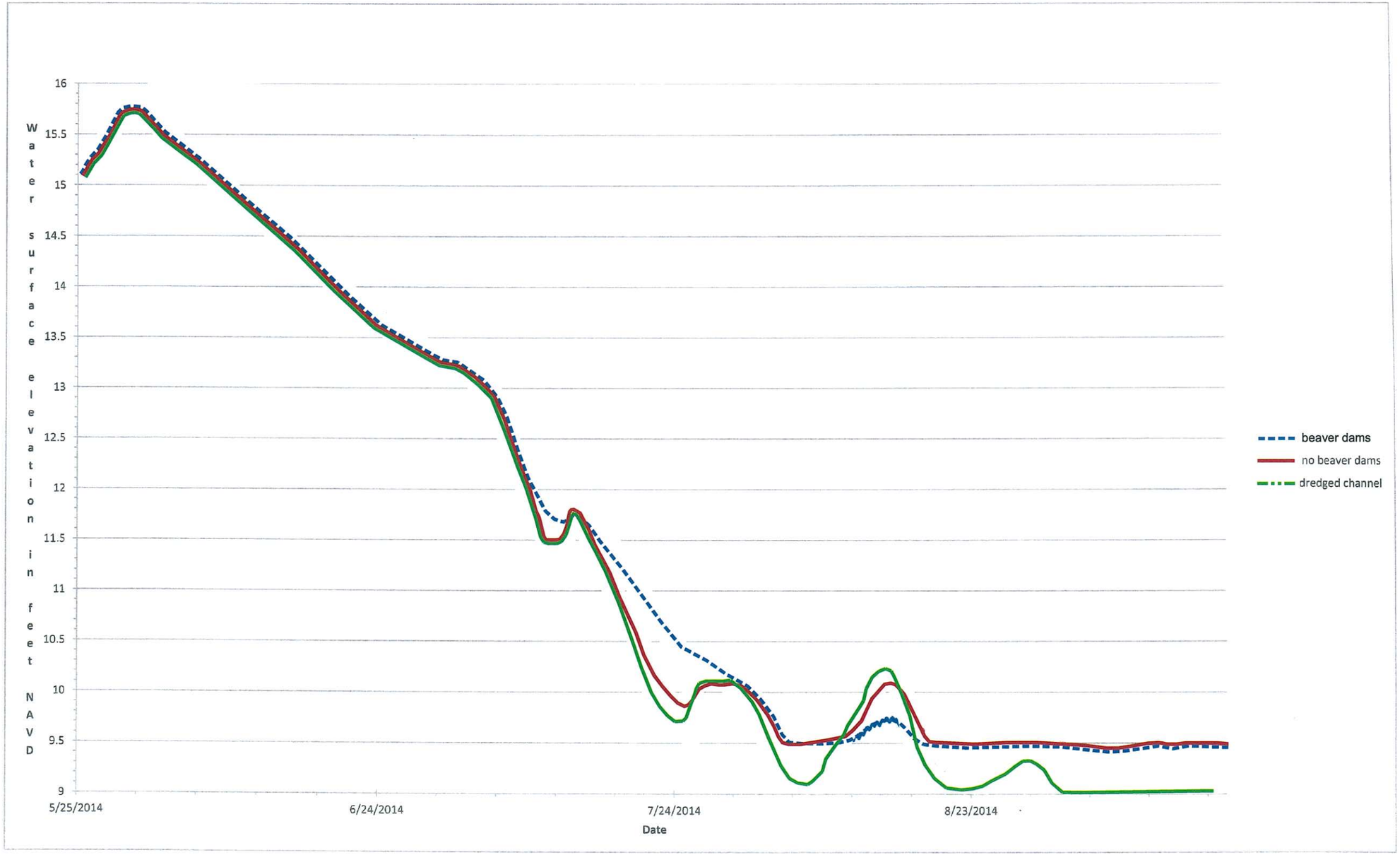
Smith Lake Surface Elevation with 10-foot Opening to Columbia Slough and Bybee Lake Control Structure Retaining Water Through June and Rapid Drawdown Thereafter

Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 10

9-11-2015



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Smith Lake Surface Elevation with 36" Pipe to Columbia Slough and Bybee Lake Control Structure Retaining Water Through June and Rapid Drawdown Thereafter

Smith & Bybee Wetlands Natural Area - Portland Oregon

FIGURE 11

9-11-2015

2015 Update and 2016 Work Plan

Smith and Bybee Wetlands Advisory Committee

Elaine Stewart, Jeff Merrill and Justin Cooley

September 22, 2015

Our Team

- Elaine Stewart, senior scientist
- Jeff Merrill, associate scientist
- Katy Weil, senior analyst
- Chris Hagel, lead specialist
- Kristina Prosser, specialist
- Justin Cooley, technician
- Therese Mitchell, technician (landfill)

Water Management

- Problem – unable to draw down Smith Lake
- Katy Weil's project provided solution
- Interim – not impounding water
- 2015: Smith Lake dry, lush
- PSU student starts fall 2015

Columbia Sedge Meadow

- Leadbetter Peninsula
  - Site prep 2014 & 2015
  - Seed collected for grow-out
  - Site prep will continue 2016
  - @200,000 plugs will be planted in October 2016

Ash Forest and Shrub

- NE and SW Smith, S Bybee areas
  - Close to 90 ac.
  - Planted in December 2014
  - Spring 2015 maintenance sprays completed
  - Fall maintenance sprays scheduled

St. Johns Prairie – Larks

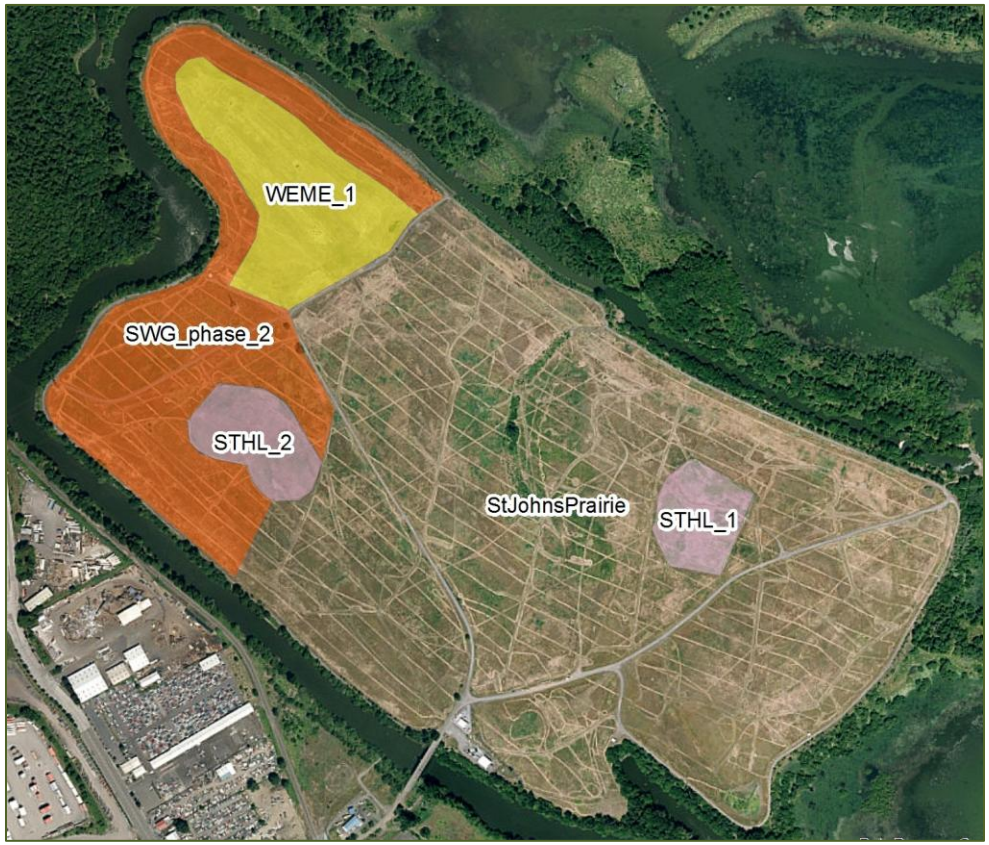
- Ongoing habitat management
- No nesting this year
- Ongoing vocal attraction work
- Safe Harbor Agreement getting closer

St. Johns Prairie

- Phase 1 – 17 acres
  - Seeded fall 2014
  - Forbs and grasses

SJP Phase 2

- 40 acres (orange on map)
- Seed fall 2016



Invasive plant management

- Yellow flag iris (*Iris pseudacorus*)
  - 571 acres covered in survey/treatments
  - $29,000 approximate cost
- *Ludwigia* (*peploides* ssp. *montevidensis*)
  - 900 acres surveyed/treated
  - $54,000 approximate cost

Iris near Columbia Sportswear

Attachment 2

Ludwigia

Attachment 2

Water lily and parrotfeather

Monitoring

- Birds
  - St. Johns Prairie
    - Point counts (all breeding birds)
    - Streaked Horned Larks (area searches)
- Emergent wetland vegetation
  - Intensive monitoring (grad student)
  - During 2015 & 2016

Ash Forest – Phase 2

- Site prep cutting reed canarygrass and blackberry on about 50 acres completed summer 2015 – West side of Smith Lake
- Fall site prep spray scheduled and waiting for green-up
- Planting this winter
- @ 30 acres to follow next year

2016 – Columbia sedge

- Interlakes area – site prep cutting of reed canarygrass this summer
- Fall site prep spray scheduled - waiting for green-up
- This unit includes the “matrix” around several pockets of sedge - we will plant trees and shrubs in the “matrix” this winter
- Sedge planting October 2016 or 2017

2016 – St. Johns Prairie

- Lark plot maintenance, vocal attraction
- Maintain newly seeded area
- Continue site preparation new unit
- Complete site prep and seed new unit

2016 – Weed Treatments

- Re-treat *Ludwigia* throughout
- Re-treat yellow flag iris throughout
- Map and strategy for purple loosestrife

Rivergate Consent Decree

- Legal settlement in 2000
- $285,000 plus interest for S&B
- Projects approved by Corps of Engineers
- Metro re-initiated with Corps in 2015
- Straw list of projects:
  - *Channel clearing/hydrologic fix*
  - Sedge meadow restoration
  - Ash-willow forest restoration