Clackamas Whitewater Features
Pre-Design Report

We Love Clean Rivers

Clackamas County Department of Tourism and Cultural Affairs

May 28, 2014

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PART 1 BACKGROUND

1.1. Introduction and Purpose

This study was commissioned by We Love Clean Rivers a 501(c)(3) (WLCR) to identify the apparent best site for a man-made whitewater wave on the lower Clackamas River. A 2004 report commissioned by PGE to examine potential sites for a whitewater feature looked at 12 sites. It identified the Caradenzo bypass near Faraday powerhouse and the Milo McIver State Park as the best candidates. However, in early 2014 PGE presented these sites to fisheries agencies that deemed them unsuitable. The cited weaknesses of the two sites are their proximity to critical fish passage facilities at the dams and the potential to cause a delay in passing fish. Therefore, WLCR commissioned this study to consider two additional sites downstream, separate from the PGE facilities. Our work consists of a site selection Phase I (this report) and a conceptual design Phase II to be completed in the summer of 2014. This project is supported by a grant from the Clackamas County Department of Tourism & Cultural Affairs and by countless hours of pro-bono work from the whitewater park grant sub-committee. PGE has committed to help fund the project as well as in kind support from the Oregon Whitewater Association, Popina Swimwear, Reed College, eNRG Kayaking, and Alder Creek Kayak.

1.2. Scope of Work

The Phase I scope of work includes a two-day site reconnaissance trip, review of readily available data, research on required permits, and initial consultation with resource agencies. The goal is to identify the apparent best site for developing a whitewater park commensurate with the level of effort and funding. It is not an exhaustive alternative analysis or an engineering feasibility study as would be appropriate for large infrastructure project such as a dam or highway alignment.

1.3. Whitewater Sport

Whitewater kayakers and canoeists value standing waves and reversing currents or “holes” which allow paddlers to surf in one place and do aerial tricks without washing downstream. A good whitewater feature such as Bob’s Hole on the upper Clackamas is retentive enough that a skilled kayaker can do move after move without washing out. The reversing current, or “foam pile,” is powerful enough to hold a kayaker but not so powerful to prevent exiting the feature. Features of the caliber of Bob’s are rare on natural rivers and even rarer where they occur with convenient access and nearby parking. Features that have both the hydraulics and the parking fit into an established trend in whitewater sport towards “park and play” destination boating (as opposed to more traditional point to point river trips). Park and play has been reinforced by man-made whitewater waves that have been built over the last 25 years in urban areas. These urban “whitewater parks,” predominantly in Colorado and spreading to other regions as well, provide a boating outlet close to where participants live and work. Participants include:

- Whitewater kayakers and canoeists
- River surfers
- Stand-up paddle boarders (SUPs)
- Instruction programs including high school and collegiate level classes, outing clubs, and intramural activities; private instruction and outfitters; swift water rescue and safety classes; summer camps, etc.

In addition to convenience, the chief advantage of man-made features is that they can be built to use the summer low flow when natural features (like Bob’s) are no longer “in.” They can also be sited in areas with adequate room, parking, and support facilities for whitewater events. Possible events include:

- Freestyle kayaking/canoeing –contested at the regional, national and international level
- Slalom canoe/kayak-contested at the regional, national, international level and part of the summer Olympic program
- Downriver and head-to-head events—not an official event but sometimes added to river festivals as a crowd pleaser and sponsored prize money

1.4. Whitewater Fundamentals

The most important factors in creating a whitewater feature are flow, drop, and access.

Flow. A good whitewater feature can be created with a wide range of flows, from as little as 200 cubic feet per second (CFS) to over 10,000 CFS, depending on the size of the river, the amount of available drop, and its hydrology. The following section on site data (hydrology) indicates that there is adequate summer flow and includes a recommended target flow range where the feature would be most attractive. The timing of flow is important: Flow during the warmer, summer months is more valuable than in winter or early spring when there are more options for boating in the headwaters.

Drop. A good whitewater feature can be created with a little as 1.5 feet of natural fall in the river. Accordingly, the site reconnaissance focused on those areas where natural rapids or riffles occur.

Access. Access is a key factor at several levels:

- **Boaters** must be able to reach the site via public property or right of ways, and help must be able to reach a participant in case of trouble.
- **Construction access** is a major cost of creating a whitewater feature. A site within easy reach of roads, without major grade changes down to river, and without excessive impacts to sensitive riparian zones or cultural resources is best.
- **Economic development** depends on visual access to the activity on the water for the non-boating public. Existing courses within established commercial areas have had the greatest economic impact to the community, since the excitement of the sport attracts spectators. The increased foot traffic, in turn, attracts businesses. This virtuous cycle is complete when the increase in storefronts attracts yet more shoppers and diners, who then discover that there are river surfers and kayakers out on the river doing tricks (for them).

1.5. Economic Development and Whitewater Courses

Whitewater courses generally have positive effects on the local economy. When constructed in populous areas, they add value to surrounding real estate, increase tourism, stimulate business development, and add quality of life benefits to residents. Because of the demographic profile of users (generally college-educated, in their 20's though 40's, and predominantly male) and the active nature of the sport, whitewater courses are seen by business as helping to attract and retain an educated work force. Cities that have constructed whitewater courses have found the juxtaposition of a whitewater river in an urban setting to be dynamic and have reaped economic impacts:

- Clear Creek Whitewater Park in Golden, Colorado is reported to cost $170,000 and reports $1.4 million to $2 million in annual economic impact.
- Brennan's Wave in Missoula, Montana is reported to cost $360,000 and apparently has resulted in an economic impact of millions of dollars per year and the development of a second feature.
- Reno, Nevada completed a $4.5 million course on the Truckee River in 2003 and reports $1.9 million annual visitor spending.
- Columbus, Georgia opened a $20 m urban whitewater run and river restoration, and anticipates a $4 million to $7 million annual economic impact and a 60 percent increase in real estate value over 6 years, due to a dam removal and whitewater river restoration. Over 15,000 rafting customers floated the restored river in the first year.
- See also: www.allaboutrivers.com/bend/images/wwpark-brochure.pdf

As in all economic development projects, location, timing, and a long view are keys to success. An adequately funded project with solid fundamental characteristics as described in this report has the potential to help shape the future of Clackamas County.

MWDG has reviewed several economic studies done for whitewater parks in small towns to medium-size cities. The projected visitation and total economic impact is shown in the table below.[1] We divided the economic impact by the number of visitors for a per visit value shown in the right column.

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[1] Chattahoochee River Restoration, Columbus, Georgia and Phenix City, Alabama, Daniels, Michael J and Lazzara, Frank, R, 2005 p. iii and
Economic Impact Analysis of a Proposed Whitewater Park on the Sacandaga River, Saratoga and Warren Counties, New York, Crane and Associates, Inc. 2008

	Projected (Not Actual)		Estimated$/Vistor
	No. Visitors	Economic Impact	Economic Impact
Chattahoochee R., Columbus GA (low)	60,000	$ 4,200,000	$ 70
Chattahoochee R., Columbus GA (high)	100,000	$ 7,000,000	$ 70
Scandaga R. Hadley NY (low)	18,000	$ 630,000	$ 35
Scandaga R. Hadley NY (high)	25,000	$ 1,000,000	$ 40
		Average	$ 54

Figure 1 Visitation and impact per visitor from recent studies of whitewater parks

A conservative estimate of the payback period for an investment in a whitewater park can be obtained by using the lowest figure above of $35/visit and dividing by the overall cost in order to arrive at the break-even visitation rate. For each one million dollars invested the payback would be as follows:

Payback Years	
Per $1 million	No. Visitors
1	17,200
2	8,600
3	5,700
4	4,300
5	3,400

Figure 2 Break-even visitation using $35/visit

As an example, a $3 million project with an expected pay back of 5 years would need 10,200 visits per year.

PART 2 SITE DATA

2.1. Summary

As reconnaissance level study, readily available public information was reviewed and analyzed on an as-available basis. The most important data is historic flow statistics from USGS, which is analyzed below. It is clear that both sites have excellent hydrology; therefore, other factors such as cost, access, and gradient will tip the scales in favor of one site or another. From the data presented below, a target range of 800 cfs to 1100 cfs will encompass most summer flows.[2] This range is subject to refinement based on further statistical analysis and consideration of flow that may be required for other uses such as fish passage.

2.1.1. Obtained Data and Prior Reports

County GIS mapping of McIver site

County GIS aerial photos of both sites (with restrictions)

USGS hydrologic data

Bo Shelby and Doug Whittaker, Confluence Consulting *Clackamas River Hydroelectric Project, An assessment of potential playboating locations*, September, 2004

Google Earth and Google Maps imagery

FEMA flood insurance map for High Rocks area

2.2. Future Data Needs

1. AutoCAD Mapping3 of Preferred Site
2. FEMA model for river
3. Geotechnical report for I-205 bridge crossing
4. Surveyed water surface profiles, selected sites
5. McIver Park "Draft" Master Plan

2.2.1. Future Site Surveys in Preliminary Design Phase

1. Bathymetric survey of river bottom
2. Topographic mapping from a combination of aerial survey and ground data (Lidar methods may be most effective as it penetrates water, reducing the cost of the bathymetric survey.)
3. Historic / cultural resources literature search and follow on site investigations as needed
4. Wetlands delineation

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[2] Note that most natural river features operate in a flow range of plus or minus 50 percent from the optimal condition, so the range stated is not the outside limit of when the feature would be in.

[3] At the pre-design level of study AutoCAD mapping is created by converting County GIS mapping. It should include all layers related to topography, water bodies, pavement and green space, public utilities, property ownership, public easements and rights of way, buildings and significant cultural resources. At the design stage this information is supplemented with and aerial and bathymetric topographical survey and field locations of critical infrastructure such as utilities.

2.3. USGS Hydrologic Data

There are two USGS gages in the project area and, due to their close proximity to the two strongest sites, both are excellent indicators of flow conditions. The historic data presented below indicates that both sites have reliable and relatively consistent flows during the target summer season of July through October.

USGS 14210000 CLACKAMAS RIVER AT ESTACADA, OR
http://waterdata.usgs.gov/or/nwis/nwisman/?site_no=14210000&agency_cd=USGS
Clackamas County, Oregon
Hydrologic Unit Code 17090011
Latitude 45°18'00", Longitude 122°21'10" NAD27
Drainage area 671 square miles
Gage datum 286.93 feet above NGVD29

Estacada Gage												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
90th Percentile	7,967	7,102	5,890	5,558	5,526	4,064	1,760	1,120	1,240	2,248	6,332	8,595
50th Percentile	3,039	2,927	3,042	3,458	3,367	2,072	1,133	888	883	1,037	2,204	2,923
10th Percentile	1,555	1,589	1,856	2,191	1,841	1,227	845	706	686	714	978	1,331

Figure 4, Exceedance table

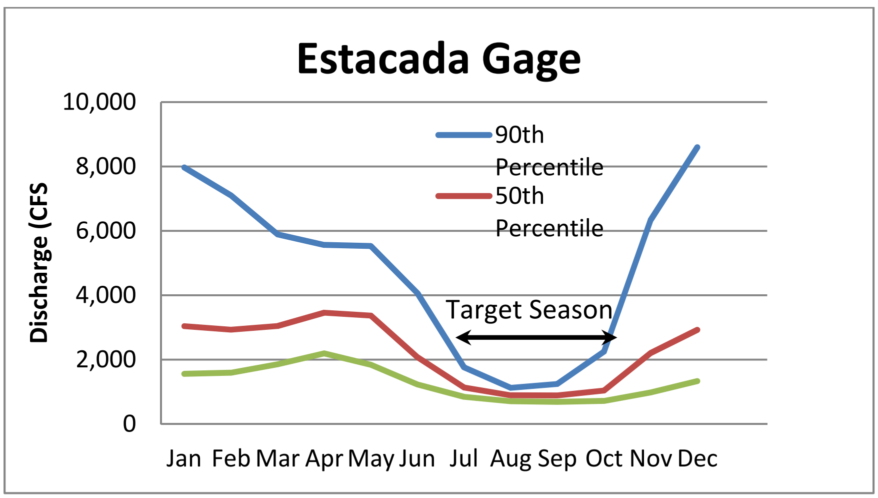

Figure 5, Exceedance graph

USGS 14211010 CLACKAMAS RIVER NEAR OREGON CITY, OR
http://waterdata.usgs.gov/or/nwis/uv/?site_no=14211010&PARAmeter_cd=00065,00060

Clackamas County, Oregon
Hydrologic Unit Code 17090011
Latitude 45°22'46", Longitude 122°34'34" NAD27
Drainage area 940 square miles
Gage datum 0.00 feet above NGVD29

Oregon City Gage												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
90th Percentile	19,363	8,525	10,378	9,250	8,246	5,763	1,879	1,249	1,721	2,412	9,396	14,525
50th Percentile	6,667	4,112	4,815	4,871	4,126	2,838	1,223	898	989	1,256	3,479	5,401
10th Percentile	2,083	1,797	1,859	2,969	2,098	1,318	840	706	717	795	1,103	1,384

Figure 6, Exceedance table

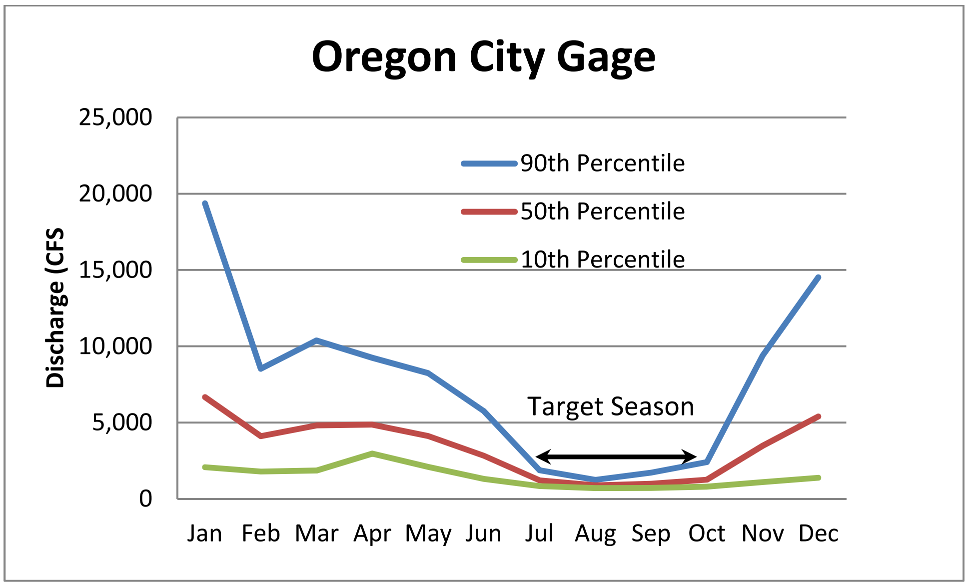

Figure 7, Exceedance graph

PART 3 SITE SELECTION AND SWOT ANALYSIS

3.1. Summary

SWOT Analysis (Strengths, Weaknesses, Opportunities, and Threats) is a business planning strategy. The study area includes the Clackamas River from Milo McIver State Park to High Rocks City Park in Gladstone. We visited five potential sites and identified the upper McIver Park boat ramp and the High Rocks Park as the two strongest candidates. These two sites were also examined in the 2004 PGE report. In our opinion, High Rocks is the apparent best site because of its location adjacent to existing commercial areas and the resulting potential to have a positive economic impact. However, High Rocks may not have sufficient gradient, may be the more expensive site to develop, has more potential user conflicts, and requires more structure in the river. Our preference for the High Rocks site reflects our heavy weighting of economic factors such as visual access to spectators and potential benefits to the surrounding business community. It is also a reflection of the project sponsor's interest in tourism dollars and creating overnight hotel/camping stays. Should these assumptions change at a later stage, the Milo McIver Park, with its more natural, shaded, secluded setting, and potentially lower cost to develop, could become the preferred site.

3.2. Limitations

- This analysis was done at a reconnaissance level of effort using readily available data. Significant technical, land ownership, or environmental issues could be discovered at either or both sites that would render them infeasible.
- A public process has not yet been done. Public comments and concerns about user conflicts could render the project politically/socially untenable.
- The budget costs presented are a best guess range based on our experience of similar projects. A 30 percent preliminary design would be required to develop costs within a 20 percent accuracy of an actual construction bid.
- A detailed permitting effort and site survey have not been conducted. The presence of wetlands or RTE species not previously identified could require unforeseen mitigation costs. In addition restrictions on timing of construction or restrictions on the use of concrete (typically a mainstay of whitewater parks) could require alternate construction methods, which could render the construction costs unacceptable.

3.3. Mileage to sites from selected cities

Travel Distance (mi)	Eugene	Salem	Oregon City	Portland
McIver Park entrance	123	54	17	31
High Rocks Park	108	41	2.5	17
Difference	15	13	14.5	14
*source, Google Maps				

Figure 8, Mileage table

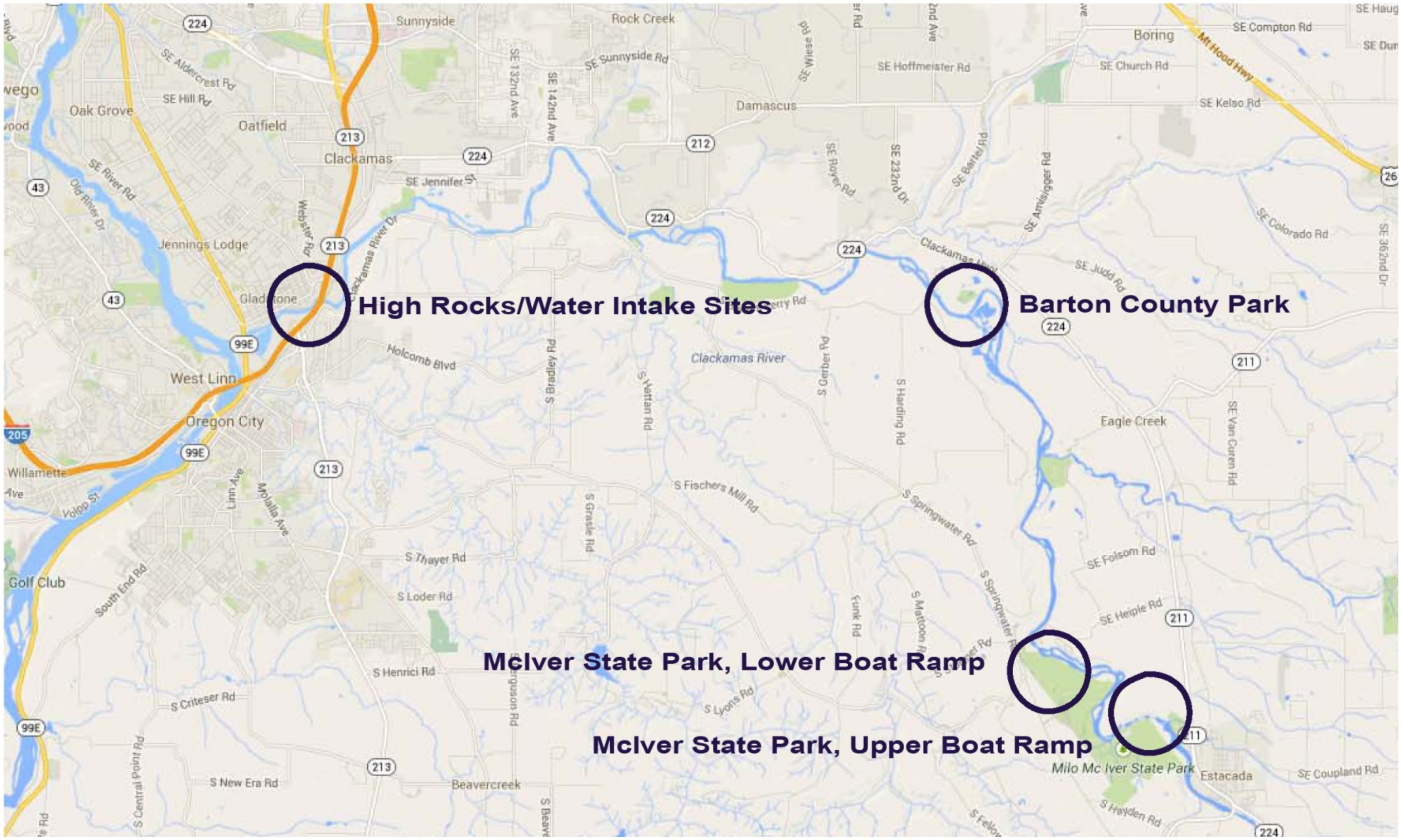

Figure 9, overall site map showing study area.

Figure 10, Upper McIver Park Boat Ramp Site including the region downstream of PGE's River Mill Dam.

Figure 11, High Rocks vicinity

3.4. Site Reconnaissance and SWOT Analysis

3.4.1. Summary

The two apparent best sites are Milo McIver State Park in Estacada and High Rocks Park in Gladstone. McIver Park has the best naturally occurring drop, a natural setting, and likely lower cost to develop, but it is further from population centers. McIver has the advantage of fewer user conflicts, since it is upstream of all boating access points.[4] Closer to Portland, High Rocks Park is a less natural setting. It has slightly more flow but less drop over a wider channel. The structure to create a play feature at High Rocks will likely more expensive but have more potential economic impact. Because of jet boat and drift boat traffic, there will be more concerns by these user groups over safety, navigability, and other conflicts.

Attending:

John Anderson, John Anderson Architect
Rick McLaughlin, McLaughlin/Merrick
Sam Drevo, We Love Clean Rivers
Cleve Steward, Steward Consulting, LLC (after 11:00AM)

The assembled group visited five sites of interest the morning of March 3 and had tour of the lower river by jet boat that same afternoon. The river was higher than average for the time of year, so it was not possible to see conditions that would be close to the summer low flow when the whitewater feature would be most needed. Instantaneous flow data from two USGS gages is included in Appendix 1 and ranged from approximately 8000 cfs to 10,000 cfs. The design flow would be in the range of 800 cfs to 1100 cfs.

Notes

1. SWOT Analysis (Strengths, Weaknesses Opportunities and Threats) originates with business planning. We adopted this methodology with a minor change of "Threats" renamed as "Concerns" when applied to potential user or environmental conflicts. (It would, after all, be impolitic to imply that other users are "threats.")
2. The site selection criteria was developed in the 2004 PGE study and adapted to reflect the narrower geographic range of this study, e.g. not within the upper Wild and Scenic designated reach.
3. The immediately following narrative on each site addresses the most significant aspects of each site as it relates to selection, or as can be assessed at the level of study.

[4] Anecdotal reports indicate that some drift boats row upstream from the boat ramp a short distance to fish the holding water at the middle rapid. The extent of this activity would have to be gaged in a public process.

3.4.2. McIver Park

There are three distinct whitewater drops in the region of the upper boat ramp and one near the lower boat ramp. The upstream-most drop was considered by PGE in their separate study for whitewater features (rejected by agencies). The following discussion relates to the middle drop (just upstream of the upper ramp), the lower drop (a short distance below the upper ramp), and the drop near the lower boat ramp.

Upper Boat Ramp, Middle Drop

Strengths

1. Sufficient drop for a good whitewater play feature
2. Sufficient flow in the summer when nothing else is available
3. Off line from most floating river traffic (tubes, drift boats, jet boats, etc.) (see footnote previous page)
4. Good water quality
5. Good access and parking nearby, albeit with admission fees to the park.[5]
6. Shaded, attractive site

Weaknesses

1. Further from population centers than High Rocks area. (See mileage table figure 8)
2. Whitewater feature is not in the recently completed park master plan

Opportunities

1. One good whitewater feature
2. Whitewater events

Concerns

1. Potential crowding on summer weekends from other park users[6]
2. Construction during summer will conflict with park uses
3. Gravel augmentation program just upstream (PGE)
4. Water intake for fish hatchery in the immediate vicinity (may affect ability to work in river)
5. Entrance to PGE fishway upstream
6. Challenging to permit, costs
7. Potential cost
8. Potential wetlands, potential RTE species in upland area to be used for construction access

[5] 2014 Admission to McIver Park: $5 Day pass, $30 annual, $50 two years
[6] Guy Rodriguez, park director, personal communication

Figure 12, McIver Middle drop, 7830 cfs

Upper Boat Ramp, Lower Drop

Strengths

1. More than sufficient drop for a good whitewater play feature
2. Sufficient flow in the summer when nothing else is available
3. Good water quality
4. Good access and parking nearby
5. Shaded, attractive site

Weaknesses

1. Further from population centers than High Rocks (see mileage table, Figure 8)

Opportunities

1. One good whitewater feature
2. Whitewater events

Concerns

1. Potential crowding on summer weekends from other park users
2. On line for other floating river traffic (tubes, drift boats.)
3. Construction during summer will conflict with park uses and most river traffic
4. Gravel augmentation program just upstream (PGE)
5. Entrance to fishway upstream, discharge from fish hatchery downstream
6. Challenging to permit, costs
7. Reported down-cutting of river bed due to sediment starvation[7]
8. Whitewater feature is not in the park master plan
9. Potential wetlands, potential RTE species in upland area to be used for construction access

[7] John Esler, PGE, personal communication.

McIver Park, Lower Boat Ramp (aka, "Paradise")

Strengths

1. Sufficient drop for a good whitewater play feature
2. Sufficient flow in the summer when nothing else is available
3. Good water quality
4. Good access and parking nearby

Weaknesses

1. Further from population centers (See mileage table figure 8)
2. Potentially unstable riverbed (cobble bar)

Opportunities

1. One or two good whitewater features
2. Whitewater events

Concerns

1. Construction during summer will conflict with park uses
2. Construction during summer may conflict with drift boats and jet boats
3. Potential crowding on summer weekends (the lower ramp is the take-out for the main tubing run).
4. Adjoining private land on river right, ex-urban residential character may be incompatible with active park use
5. Challenging to permit, costs
6. Whitewater feature is not in the recently completed park master plan
7. Potential very high cost due to wide river

Discussion of McIver Park

Park director Guy Rodriguez indicated that a draft park master plan is complete and waiting for county approval before it will be publicly available. The plan includes a wider boat ramp in order to increase capacity and some additional parking. The upper ramp is the put-in for a popular tubing run ending at the lower boat ramp, a three mile float. Anadromous fish are present year-round. (See permitting chapter which follows). Considering the close proximity of the two rapids, the upper one is preferred mainly due to fewer user conflicts. Therefore, the "McIver Park site" hereinafter refers to the drop upstream of the upper boat ramp.

3.4.3. Barton Park

The Clackamas River at Barton Park is the site of an environmental project to restore backwater areas adjacent to the main river channel and former gravel pit that were damaged in recent flooding. The site was inaccessible by foot due to high water but was toured in the jet boat later in the afternoon. The attraction of the site is the planned river restoration, but by inspection, the river is too unstable to consider for whitewater features. Access is also a concern. The site, therefore, was eliminated from further consideration.

3.4.4. Oregon City Water Intake Pump Stations Upstream of I-205

City of Oregon City has one active and one inactive water intake on the outside bend of the river adjacent to Clackamas River Drive, just upstream of the Interstate 205 crossing. The high water made it impossible to observe where the drop may occur at lower water, but from aerial imagery there appears to be a riffle bar about 200 feet upstream of the active water intake, and a small wave on the river left bank approximately 800 feet above the inactive water intake. There is limited river access and parking on the Clackamas River Drive side of the river. The client indicated that the river right side is owned by Clackamas County and may be developed for access to the features. Surface water elevation reading would need to be done at low water to determine if there is sufficient gradient at this site.

Figure 13, Water intake site, 9780 cfs

3.4.5. High Rocks City Park

The High Rocks Park is a popular summer destination next to a shopping center. It is a youth hang-out with sunning, swimming, and diving from the rocks. High Rocks has also been the site of several drownings and a nuisance sufficient to merit full-time lifeguards in the summer. There has also been a canoeing death at one of the rail bridge piers. Access to the High Rocks sunning area is from the adjacent shopping center. There is limited public parking on the right (north) shore. Landowners include the City of Gladstone, Oregon City, and the Oregon Department of Transportation, with the city of Gladstone being the dominant owner.

As the river passes under the I-205 bridge, it turns sharply left as it accelerates over a bar and then enters into a pool upstream of High Rocks. The river narrows and turns sharply right as it enters High Rocks. It is reported to be 25 feet deep throughout the narrow channel on the south side of the river. There is conjecture that the channel was blasted to clear the river of snags during the log driving days. Public safety is a concern at the site, and we do not recommend altering the river hydraulics adjacent to the swimming area where the river narrows against the left bank. The site options, therefore, are limited to the riffle bar upstream of the High Rocks, just below the I-205 crossing. The amount of drop at the gravel bar is marginal. Field measurements at low flow would have to be made in order to determine the feasibility, taking into account a small drop upstream of the I-205 bridge.

Strengths

1. Sufficient flow in the summer when nothing else is available
2. Good water quality
3. Good access
4. Close to population centers

Weaknesses

1. **May be insufficient drop for a good whitewater play feature**
2. Limited public parking

Opportunities

1. One whitewater feature
2. Whitewater events
3. Remote parking downstream areas for paddle-in access

Concerns

1. Potential crowding on summer weekends (limited parking)
2. On line for all floating river traffic (tubes, drift boats, jet boats)
3. Potentially unstable riverbed (cobble bar)
4. Construction during summer will conflict with park uses
5. Construction during summer may conflict with drift boats and jet boats (may require splitting the flow into two distinct paths, one for floating and one for the play feature).
6. Challenging to permit
7. Potential very high cost due to wide river and need to increase drop
8. Concerns from railroad, Oregon DOT
9. Potential backwater of existing water intake, about 1000 feet upstream

Figure 14, Panorama of High Rocks, 10,000 cfs

Figure 15, High Rocks at summer flows. The whitewater feature would be located at the riffle bar and would need to capture some of the drop upstream.

PART 4 BEST FIT DESIGN CONCEPT

During the March 2104 site reconnaissance trip, a "best fit" design concept for a whitewater feature was presented to WLCR in a PowerPoint presentation. This concept is described in the section and illustrated in Attachments 1 and 2 at the end of this report. A notable precedent feature of this type was built on the Kananaskis River in Alberta in the early 2000's. We believe that this concept is more likely to be permitted in Oregon since it does not create a river-wide sill, as do most whitewater features built to date. Sills are typically viewed by resource agencies as low weirs and therefore an impediment to fish passage.

Figure 16 The Kananaskis wave. Two side constrictions accelerate water over a mid-stream obstacle, creating a wave. We call this the "catcher's mitt". Note that the central third of the river is open, allowing adult fish passage. A separate side passage will likely be required in order to meet more stringent requirement for juvenile fish at the Clackamas project.

Figure 17, Whitewater sill in Reno, NV. Resource agencies may view these as potential impediments to fish passage, especially juveniles.

Figure 18, Recent physical model tests of the catcher's mitt show promise in creating a high quality surfing feature

Features:

1. Side constrictions to accelerate water
2. A bump or obstacle to create a wave
3. In alluvial rivers, armoring or hardening of the river bottom between the constrictions to prevent erosion and under mining the feature
4. A roughened (but unobstructed) side channel to pass fish
5. The side channel will also have sufficient depth for jet boats and drift boats to pass.

PART 5 ENVIRONMENTAL PERMITTING

5.1. Project Background

This section provides information on environmental permits that will likely be required by local, state, and federal agencies for developing a playboating feature, including in-water structures and onshore facilities, at Milo McIver State Park and High Rocks City Park. The proposal to expand whitewater recreation opportunities on the Clackamas River is consistent with a Settlement Agreement signed in 2006 by Portland General Electric Company (PGE) and stakeholders involved in the relicensing of four hydroelectric developments in the basin. The Settlement Agreement stated:

> "Within five years of license issuance, PGE will contract with a specialist in playboating feature construction and other appropriate experts to determine the feasibility of a playboating feature at one of the two most highly-rated sites identified during the Faraday Diversion Whitewater Boating Study (Shelby and Whittaker 2004). These two sites were the Faraday Diversion reach and the reach adjacent to McIver State Park, below River Mill Dam. If both of these sites are found to be infeasible, other sites may be considered."

The Federal Energy Regulatory Commission (FERC) granted PGE a license to operate their hydroelectric facilities in 2010, incorporating by reference the terms of the Settlement Agreement. As discussed below, the two sites identified by Shelby and Whittaker (2004) were determined to be infeasible. Two alternate sites were identified: the first at Milo McIver State Park immediately downstream of the one originally proposed and the second at High Rocks City Park. The following discussion pertains to permits that would be required to develop playboating features at these two sites and is based primarily on the pre-design information developed in this study and a consideration of the types of permits typically required of projects that substantially modify the channels and banks of rivers in which ESA-listed species of anadromous salmonids are present.

It should be emphasized that the permits required for this project to go forward cannot be ascertained without a preliminary engineering design of the to-be-constructed features, which would give a better idea of the impacts that would be caused by their construction. Moreover, the full complement of preventative, minimization, and mitigation measures prescribed in the permits will not be known until the project engineering design and specifications have been finalized. The level of review by the permitting agencies and any restrictions or mitigation they may require will depend on the potential impacts of the project, which, in turn, will depend on local conditions and project-specific factors, including the presence of sensitive species and aquatic resources, potential conflicts with other users, and the proposed design, construction, and operation of the playboating feature (Jarvie 2012).

5.2. Presence of Anadromous Salmonids

The McIver Park and High Rocks sites both have desirable features that recommend them as potential playboating sites. They also have potential drawbacks. From a permitting perspective, the primary concern of developing either site is the more or less year-round occurrence of winter steelhead, spring Chinook salmon, and Coho salmon – all listed as threatened species under the Endangered Species Act. Other fish species, including fall Chinook salmon, summer steelhead, cutthroat trout, and lamprey are also present at various times of the year. (Figure 20 below).

Virtually all of the anadromous adult salmonids that return to the Clackamas River basin to spawn must swim upriver through the High Rocks site located 1.2 miles upstream of the confluence of the Clackamas with the Willamette River. Fish runs are comprised of hatchery and naturally spawned fish. Most of the hatchery fish return to the Clackamas Fish Hatchery located at river mile 22.6 in McIver Park. The majority of naturally spawned adult fish (i.e., the progeny of fish that spawned in the Clackamas River and its tributaries) swim through McIver Park on their way to spawning areas in the upper basin. After spending anywhere from a few months to several years rearing in the system, the offspring of these fish migrate seaward passing downstream through McIver Park and High Rocks Park before reaching the Willamette.

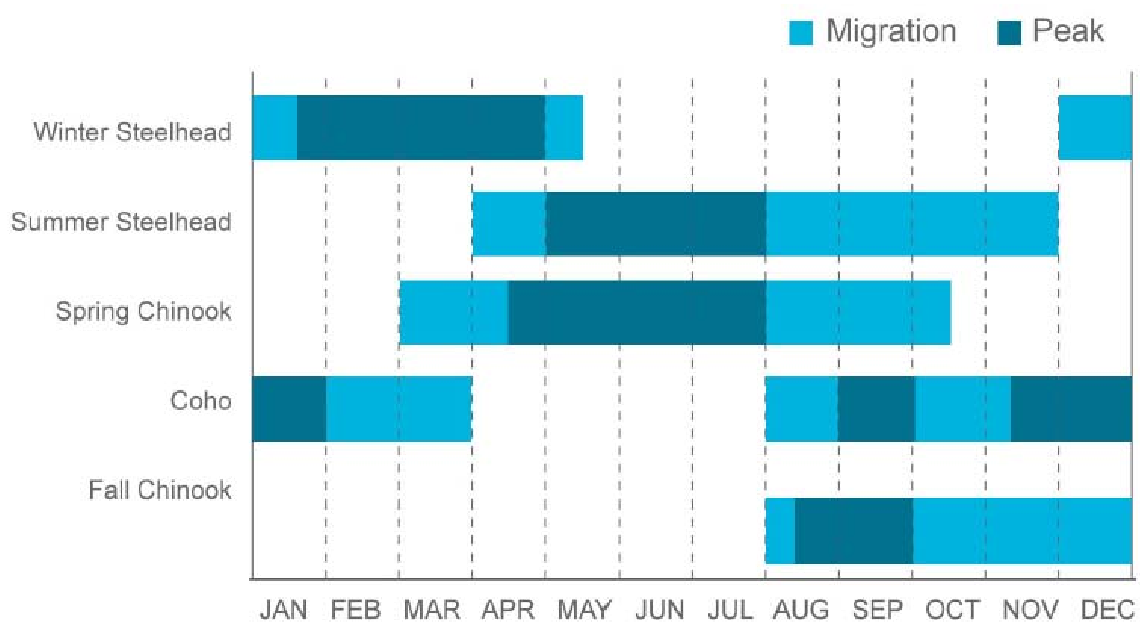

Figure 19, Timing of adult salmon and steelhead migration in the Clackamas River[8]*.*

5.3. McIver Park Site

Milo McIver State Park is located immediately downstream of PGE's River Mill Dam, a hydroelectric facility built in 1911. A fish ladder at the base of River Mill Dam enables upstream-bound fish (mostly adult salmonids) to pass over the dam. Fish that emigrate from the upper watershed (mostly juvenile salmonids) are collected at PGE's North Fork facility and routed via a bypass system approximately 6.6 miles to the tailrace of River Mill Dam. The entrance to the fish ladder and the exit of the downstream bypass are located in the large pool at the base of the dam. Fish often remain in this pool for extended periods prior to entering the fish ladder or recommencing their downstream migration. To protect juvenile and adult salmonids holding in this area, fishing is prohibited for a distance of 200 feet downstream of the fish ladder entrance.[9]

The channel in the McIver Park reach downstream of River Mill Dam has eroded to bedrock in many places and lacks fine sediment and coarse gravel. Exposed bedrock and large boulders form deep pools that alternate approximately every 750 feet with short, whitewater drops (rapids) in this reach. These characteristics are generally desirable from a whitewater boating standpoint.

In an earlier feasibility study of potential playboating sites on the Clackamas River, Shelby and Whittaker (2004) recommended a site that included the first pool and rapid below River Mill Dam. Although this site could be developed into a good playboating site, it would impact fish that are holding in this area. In an email to John Esler, PGE's Hydropower Licensing Project Manager, dated March 25, 2014, Oregon State Department of Fish and Wildlife (ODFW) fish biologist John Zauner noted that a playboating feature and associated boater activity at the River Mill Dam tailrace site would disturb fish that were present and "at a minimum" delay their upstream migration. His recommendation that a playboating feature not be constructed at this location was seconded in email by Michelle Day, NOAA Fisheries, and Ann Gray, United States Fish and Wildlife Service.[10] Based on their recommendations, the original McIver Park site was removed from further consideration as a potential playboating site.

I contacted each of the aforementioned agency representatives by phone to discuss their concerns about fish passage in general and the original McIver Park site in particular with respect to the proposal to construct playboating features on the Clackamas River. They reiterated their concern that increased activity at the sites might stress fish that were holding in the area. They also cautioned against constructing in-stream structures that would make fish passage more difficult and referred me to federal and state fish passage criteria, including velocity and vertical drop maxima, that must be met for all life stages of native migratory fish including non-salmonids. Oregon's fish passage requirements and design criteria be found in Appendix 2 (Oregon State Fish Passage Criteria).

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[8] Accessed online at http://www.portlandgeneral.com/community_environment/initiatives/protecting_fish/clackamas_river/clackamas_fish_runs.aspx.

[9] The 200-foot "no fishing" zone is stipulated by Oregon State law (John Zauner, ODFW, personal communication).

[10] The agency biologists, who all sit on PGE's Fish Committee, rejected another site recommended by Shelby and Whittaker (2004), this one located in the Faraday Diversion Dam reach, for similar reasons.

A second site (referred to the "middle drop" at the Upper McIver boat ramp earlier in this report) was identified in McIver Park that possessed the requisite physical characteristics but was less likely to disturb fish or present fish passage problems than the dam tailrace site. This McIver site is located approximately 2300 feet downstream of River Mill Dam and a few hundred feet upstream of the boat ramp on the left (south) bank. The site is comprised of a short, boulder-strewn rapid and adjoining pools. Boaters would access the site via the existing boat ramp.

5.4. High Rocks Site

The High Rocks site includes a large pool downstream of the I-205 Bridge and immediately upstream of a constriction in the natural bedrock channel. The constriction controls the upstream hydraulic characteristics of the pool, which include the formation of a large eddy. Downstream of the constriction, the channel remains narrow over a distance of 300 feet transitioning in slope from steep at its upper end to mild at its lower end where the channel widens and becomes shallower. Flow through this reach is non-uniform becoming increasingly turbulent at higher flows, especially at the upper end of the constricted reach.

Several options are available for modifying the McIver Park and High Rocks sites to enhance whitewater recreation opportunities including narrowing the channel, cementing large boulders to the bedrock, creating mid-channel barriers and partial channel-spanning weirs, and constructing wing walls and other flow deflectors along the shoreline. These features can be intentionally designed and located in areas where they would improve local fish passage and habitat conditions.

5.5. Permitting Considerations

Federal and State regulators will only issue permits for projects that are consistent with the protection, conservation, and best use of the water resources of the state and that do not unreasonably interfere with navigation, fishing, and recreational uses. Since the construction of playboating features at the McIver Park and High Rocks sites would cause significant physical disturbances (i.e., modifications of the active stream channel) and would have the potential to impact sensitive species and other beneficial uses, the federal and state permits required would be the same for projects at both sites. In the discussion that follows, we identify federal, state, and local government permits that are likely to be required based on currently available information.

5.5.1. Federal Permits

CWA Section 404 permit. The project will likely require a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (USACE). The application for a Section 404 permit would also serve as the application for a Removal-Fill Permit from the State Department of Lands (DSL; see below). Use of DSL's permit application form is recommended since it requires more information than the USACE form. The project will require separate authorizations from USACE and DSL before proceeding.

USACE would probably consider the playboating feature a "large or complex action," in which case an Individual Permit (as opposed to a Nationwide Permit) would be required. The USACE takes up to 120 days to process an Individual Permit (IP) depending on their need for supporting information and the time needed to solicit and respond to public comments on the project.

ESA Section 7 Consultation. Any action that has a federal nexus, such as issuance of a Section 404 permit, and that could potentially affect salmon and steelhead listed as threatened species under the Endangered Species Act, requires the federal agency involved to consult with NOAA Fisheries and/or the U.S. Fish and Wildlife Service (USFWS). Section 7 consultation would likely be required for the playboating project. USACE (or, more likely, our client, acting on behalf of the agency) would need to prepare a Biological Assessment (BA) to ensure that listed salmonids species and their habitat would not be adversely affected by the project. After reviewing the BA, NOAA Fisheries or USFWS will issue a Biological Opinion (BiOp) specifying whether the construction of a playboating feature is likely to jeopardize the continued existence of listed species, or result in the destruction or adverse modification of designated critical habitat. If adverse impacts are anticipated, the agencies may require that the project be modified and measures implemented to avoid, minimize, and/or mitigate for those impacts.

The BiOp also includes NOAA Fisheries' assessment of project effects on Essential Fish Habitat (EFH), as required by the Magnuson-Stevens Act. If the project is likely to adversely affect the habitat of fish species covered by Fishery Management Plans (which in this case includes all Clackamas River anadromous salmonids), NOAA Fisheries will require preventative and mitigative measures ("conservation recommendations") to be implemented.

On larger and more complex projects, the preparation of a BA and BiOp can take a year or more to complete. However, the proposed playboating project is not likely to cause significant impacts, so ESA consultation should proceed fairly rapidly and take less than 10 months to complete.

National Environmental Policy Act (NEPA) review. The issuance of a Section 404 permit automatically requires preparation of an environmental assessment (EA) by the USACE to determine whether a proposed project will cause significant environmental or socioeconomic impacts. If the project's impacts are considered significant, an Environmental Impact Statement (EIS) will have to be prepared. An EIS entails extensive environmental research and analysis, evaluation of alternatives, and, after a lengthy public involvement process and consultation with the agencies, selection of a preferred course of action.

It is reasonably certain that an EA will be required but that the potential impacts of proposed playboating feature would not be significant enough to trigger an EIS.

5.5.2. State Permits

Joint Removal-Fill Permit. The primary state permit that would be required by both projects is the Joint Removal-Fill Permit issued by the State Department of Lands (DSL). Depending on the location, timing, and anticipated impacts of a project, the processing of a Joint Removal-Fill Permit Application (JRFPA) incudes review and concurrence by several other state agencies related to fish passage and habitat mitigation requirements, in-water work timing, fish salvage operations, erosion and sediment control requirements, and re-vegetation needs.

It is very likely that DSL would require an Individual Joint Removal-Fill Permit (Individual Permit/IP) for the project since construction of a playboating feature would probably (1) involve more than one removal-fill activity and (2) cause more than minimal adverse effect to the Clackamas River. An IP would be triggered if either of these conditions is true. The IP process takes up to 120 days. DSL offers an expedited (i.e., 30-day) JRFP process referred to as a General Authorization for Waterway Habitat Restoration if a project improves (or at least does not worsen) fish passage and in-stream habitat conditions. Examples of engineered features that might qualify include "grade control structures that mimic natural material found in the system"and "low-profile porous weirs." Although playboating features of these types could conceivably be designed and constructed, it is still unlikely that the project will qualify for a GA due to the above-stated reasons. However, this possibility should be explored further with the agencies during the scoping and preliminary design phase of the project.

The effects of the proposed projects on fish passage, fishing, and other recreational activities would be carefully scrutinized by the agencies due to high utilization (by both fish and fishermen) of both sites and, in the case of McIver Park, its close proximity to the state-run Clackamas Fish Hatchery. Boater safety is likely to be more of an issue at the High Rocks site where jet boats, drift boats, canoes, and other types of non-motorized and motorized boats will be operated in the project area. The design of playboating features and the activity of playboaters will need to accommodate the safety and transit needs of fellow boaters at the High Rocks site.

The McIver Park site will present fewer challenges in this regard, since it is located in a reach upstream of the park boat ramp that, although accessible to boaters, is rarely used due to the presence of River Mill Dam a short distance upstream. The boat ramp itself, however, and the river downstream of the boat ramp is heavily used by tubers and boaters at various times of the year.

The State Historic Preservation Office would need to be consulted during the review of the JRFPA to determine the potential effect of the project on archaeological sites, historic structures, and other cultural resources. If the McIver Park or High Rocks projects include the development of onshore features that impact wetlands. A wetland determination and delineation would also need to be performed and submitted to DSL for review.

Ownership of the land on which components of the playboating features would be constructed would affect state, county, and city permitting requirements. In-water structures constructed in submerged lands (e.g., active river channels) owned by the state, such as the proposed project reach in McIver Park, require prior written approval of the Department of State Lands. Although not on state-owned land, a project at the High Rocks site may also require state approval due to the proximity of the I-205 Bridge.

5.5.3. County and City Permits

County and city permits and approval requirements for both projects need to be investigated further. Both sites would presumably be subject to county site development permitting requirements. The construction footprint at the High Rocks project site would primarily occur on property owned by the City of Gladstone; however, areas on the opposite bank that might conceivably be modified by the project lie within Oregon City jurisdictional boundaries. Whether the land is owned by the City or a private entity hasn't been determined, but City permitting requirements would apply nonetheless.

I am unaware of permitting requirements that pertain specifically to the safety of swimmers, tubers, boaters, and other people who use the river for recreation other than the licensing and boating safety course completion requirements imposed on all registered boaters by the Oregon State Marine Board. This matter will need to be looked into further.

5.6. Permitting Process and Timeline

The final list of federal, state, and local permits and associated requirements will depend on the specific design and construction activities of each project and the probable impact they will have on other beneficial uses including sensitive species and other natural resources protected under existing environmental laws. A 30% level engineering design is normally required by the permitting agencies to assess potential impacts and stipulate preliminary conditions for the project. This feedback may trigger significant changes in the design or operation of the project so that it becomes more acceptable to the agencies and stakeholders. The length of time and the amount of information required to secure the necessary permits is directly proportional to the complexity of the project, the probability that it will cause adverse impacts, and the reaction of the public and agencies to the proposed project. The strength and diversity of opinion expressed during the NEPA and JRFP public review and comment processes, in particular, will affect agency deliberations and, therefore, the project timetable and outcome.

It is important that project proponents allow sufficient time for the anticipated in-depth review and issuance of permits by relevant agencies. A reasonable timeline would include 12-16 months between the time permit applications are submitted (i.e., when 30% design drawings have been completed) and permits and approvals are received. Assuming that the in-water construction work window would commence around July 1, permit applications, in particular the JRFPA, should be submitted no later than March 1 of the preceding year. This would allow time to complete a final (100%) design and specifications, bid the project, and hire a contractor prior to construction.

5.7. References

Jarvie, K. 2012. An introduction to water-related permits and reviews issued by Oregon State agencies. Revision #2: August 2012. Oregon Department of State Lands.

Shelby, B. and D. Whittaker. 2004. Clackamas River Hydroelectric Project: An assessment of potential playboating locations. Prepared for Portland General Electric by Confluence Research and Consulting.

PART 6 NEXT STEPS

The immediate next step for this project is to obtain water surface measurements typical of summer flows. These measurements will be important in the hydraulic design. Referring to the table on the following page, the most time-consuming activity is permitting, which could require 12 to 16 months. Allowing reasonable time for preliminary design and site investigations prior to permitting, the earliest construction window is the summer of 2016. This schedule leave little time between phases for fundraising, so it quite possible that the construction will slip to June 2017.

The stakeholder outreach and public process should begin now when the project location and design is still malleable. The first public presentation is shown concurrent with the concept design completion in August.

Phase	1	2	3	4	5	6	7	8
	Site Selection	Concept Design	Economic Analysis	Preliminary Design	Permitting	Final Design	Bid Negotiate	Construction
Pre-Design								
Site Reconnaissance	X							
Data acquisition and review	X							
Agency consultation	X							
Site Selection and report	X							
Concept Design								
Basic hydraulic analysis		X						
Sketch concepts		X						
"Hard-line" drawing, one concept		X						
Artist's rendering			X	X				
Stakeholder outreach			X	X				
Public meetings			X	X				
Concept Design Report		X						
Economic Analysis								
Economic Impact Anaylsis			X					
Preliminary Design								
Bathymetric survey and mapping				X				
Geotechnical investigation				X				
Refined hard-line concept				X				
1-dimensional hydraulic modeling				X				
2-dimensional hydraulic modeling				X				
Itterative refinements to concept				X				
Preliminary design drawings (30% to 50%)				X				
Preliminary Design Report				X				
Permitting								
Agency consultation					X			
Environmental assessment					X			
Biological opinion/site surveys					X			
Joint fill/removal permit application					X			
401/404 permits/certification					X			
Local and other permits					X			
Final Design								
Physical model						X		
Refined hydraulic design						X		
Structural design						X		
Final design drawings (100%)						X		
Specifications and bid forms						X		
Bid Negotiate								
Advertise							X	
Pre-Bid conference							X	
Clarifications and addenda to bid docs.							X	
Receive and analyze bids							X	
Contract Award							X	
Construction Phase								
Mobilize								X
In-river work								X
Tuning and adjsutments								X
Overbank work and site restoration								X
Project close out								X
Estimated Cost (thousands)	$ 17	$ 10	$ 30	$ 60	$ 80	$ 120	$ 15	$2,500

Timeline: # ***$3,000 Project Budget***

2014										215												216											
Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Figure 20, Master time line, phasing and cash flow table.

Attachments

1 Outline concept for whitewater feature at McIver State Park
2 Outline concept for whitewater feature at High Rocks City Park

Appendixes

1 Hydrology
2 State Fish Passage Criteria

ATTACHMENT 1
MILO MCIVER STATE PARK
UPPER BOAT RAMP
APPROIMATE SCALE, 1"=100'

ATTACHMENT 2
HIGH ROCKS CITY PARK

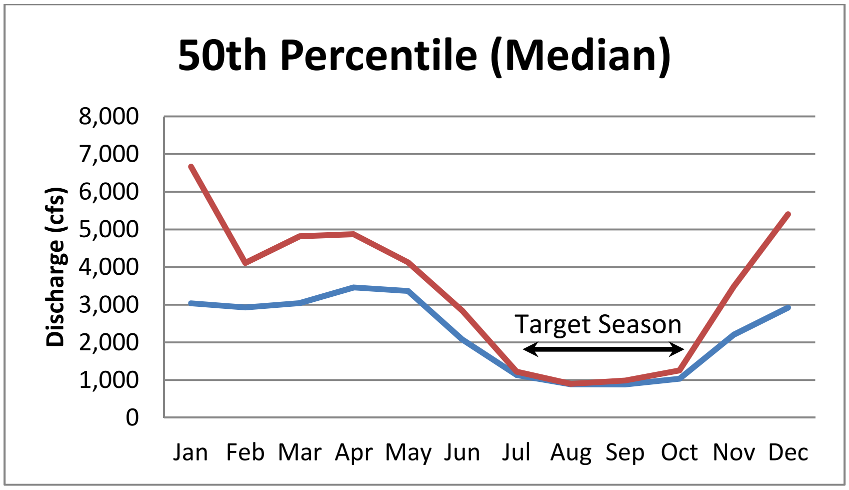
APPROIMATE SCALE, 1"=100'

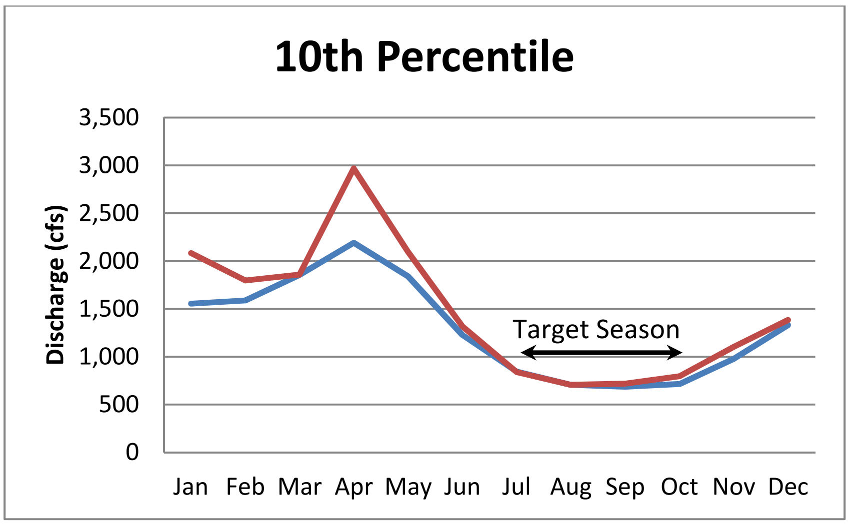
Appendix 1, Hydrology

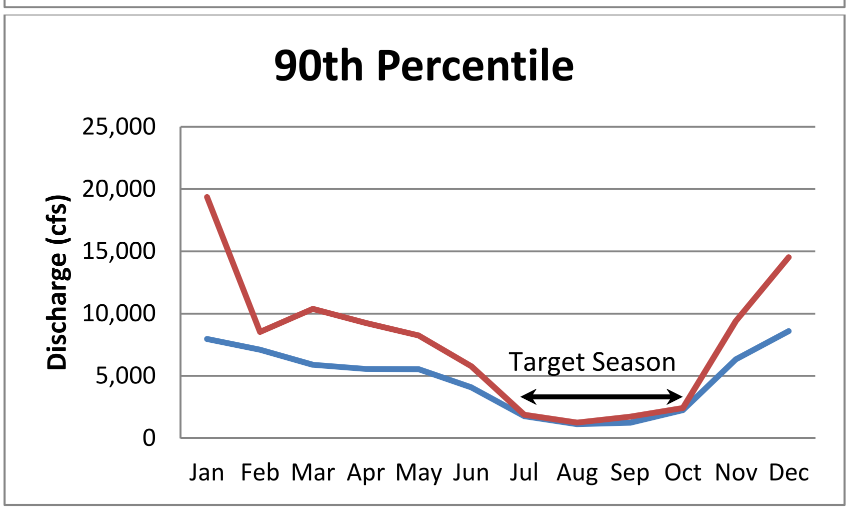
USGS Gage Information
USGS 14210000 CLACKAMAS RIVER AT ESTACADA, OR
http://waterdata.usgs.gov/or/nwis/nwisman/?site_no=14210000&agency_cd=USGS
Clackamas County, Oregon
Hydrologic Unit Code 17090011
Latitude 45°18'00", Longitude 122°21'10" NAD27
Drainage area 671 square miles
Gage datum 286.93 feet above NGVD29

USGS 14211010 CLACKAMAS RIVER NEAR OREGON CITY, OR
http://waterdata.usgs.gov/or/nwis/uv/?site_no=14211010&PARAmeter_cd=00065,00060
Clackamas County, Oregon
Hydrologic Unit Code 17090011
Latitude 45°22'46", Longitude 122°34'34" NAD27
Drainage area 940 square miles
Gage datum 0.00 feet above NGVD29

Comparative Hydraulics (Red=Oregon City, Blue=Estacada)







Data used in preparing these graphics is shown on the following 6 pages.

USGS Oregon City Gage 90th Percentile

00060, Discharge, cubic feet per second,												
Day of	90th percentile of daily mean values for each day for 12 - 12 years of record in, ft3/s (Calculation Period 2001-10-01 -> 2013-0											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average	***19,363***	***8,525***	***10,378***	***9,250***	***8,246***	***5,763***	***1,879***	***1,249***	***1,721***	***2,412***	***9,396***	***14,525***
1	21,300	26,900	5,560	14,700	7,940	6,460	3,380	1,270	1,140	1,640	5,670	9,340
2	40,400	14,600	5,690	12,600	7,040	6,990	3,150	1,280	1,150	1,310	5,570	10,200
3	21,300	12,600	6,030	10,700	7,270	11,300	2,970	1,260	1,150	1,430	4,490	13,700
4	18,200	12,100	5,850	8,660	8,600	11,800	2,720	1,210	1,140	1,760	4,810	21,900
5	12,100	10,000	5,710	11,000	9,610	10,700	2,560	1,190	1,100	1,670	5,600	19,100
6	12,200	7,820	5,580	10,100	11,800	8,180	2,370	1,180	1,260	1,350	7,020	12,300
7	13,300	6,560	11,600	9,740	12,100	8,370	2,220	1,160	1,170	1,360	21,300	10,200
8	19,500	6,730	15,500	9,010	9,540	7,230	2,160	1,150	995	1,400	15,300	7,550
9	15,400	5,710	11,400	7,220	7,760	6,330	2,060	1,140	1,030	1,540	8,310	8,980
10	21,300	4,810	11,100	7,230	6,650	6,780	1,970	1,140	1,060	1,580	6,060	14,900
11	29,300	5,310	9,840	8,060	6,100	7,230	1,910	1,100	987	1,540	6,580	13,700
12	18,800	4,920	11,900	8,010	6,140	6,140	1,870	1,120	1,020	1,560	6,640	16,300
13	18,700	4,580	9,360	8,540	5,520	5,470	1,830	1,090	1,040	1,280	14,800	20,700
14	18,100	4,210	7,670	17,300	6,290	5,200	1,760	1,070	1,270	1,170	10,500	23,000
15	13,200	5,310	10,100	12,100	7,500	4,940	1,760	1,060	1,380	1,280	6,910	23,600
16	24,800	13,400	18,400	10,300	9,190	4,880	1,720	1,050	1,640	2,320	8,950	13,700
17	30,200	10,700	12,800	10,200	11,000	4,640	1,710	1,050	1,720	1,590	7,550	14,600
18	19,000	8,970	9,490	8,300	11,700	4,420	1,670	1,090	2,310	1,330	8,620	10,300
19	23,600	8,170	8,150	7,240	10,700	4,190	1,630	1,120	2,430	3,150	7,710	7,790
20	26,300	7,260	7,570	8,120	10,100	4,220	1,580	1,340	2,310	3,810	20,100	7,050
21	22,300	6,920	10,800	8,260	10,000	4,300	1,550	1,730	1,870	3,960	16,000	8,160
22	16,700	8,710	12,900	8,090	9,590	4,160	1,500	1,200	1,610	2,900	11,100	10,600
23	11,900	9,750	12,600	8,500	8,030	3,970	1,470	1,630	1,520	2,840	11,500	14,100
24	14,200	7,710	8,920	8,710	7,000	3,720	1,430	1,130	1,370	2,420	12,400	13,500
25	16,700	7,110	7,580	7,770	7,000	3,490	1,400	1,490	1,420	2,750	10,400	11,100
26	15,300	7,440	8,510	8,580	6,810	3,420	1,360	1,770	1,300	2,820	7,930	12,100
27	12,700	5,600	11,100	7,980	6,500	3,430	1,330	1,740	1,180	2,520	7,060	13,100
28	9,340	4,800	11,800	7,090	6,790	3,440	1,330	1,410	1,760	3,830	5,470	15,000
29	17,800		10,700	6,480	7,420	3,840	1,290	1,210	4,450	7,420	9,940	16,400
30	21,500		18,400	6,920	7,280	3,660	1,310	1,200	7,840	4,920	7,590	24,100
31	24,800		19,100		6,660		1,290	1,150		4,320		33,200

USGS Oregon City Gage 50th Percentile (Median)

00060, Discharge, cubic feet per second,												
Day of	Mean of daily mean values for each day for 12 - 12 years of record in, ft3/s (Calculation Period 2001-10-01 -> 2013-09-30)											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	6,667	***4,112***	***4,815***	***4,871***	***4,126***	***2,838***	***1,223***	***898***	***989***	***1,256***	***3,479***	***5,401***
1	6,920	7,770	3,860	5,930	4,160	3,600	1,750	942	871	1,050	2,290	4,150
2	9,240	5,860	3,800	5,610	4,020	3,860	1,680	938	866	987	2,400	4,370
3	7,870	5,160	3,880	5,230	4,120	4,220	1,620	924	859	1,010	2,230	5,110
4	6,640	4,730	3,730	4,710	4,300	4,250	1,540	936	861	1,050	2,340	5,860
5	5,970	4,310	3,640	5,000	4,600	4,190	1,490	934	862	1,030	2,350	5,590
6	5,970	3,990	3,910	4,980	4,800	3,810	1,440	926	894	983	2,630	4,640
7	6,150	3,990	4,630	4,890	4,740	3,760	1,390	919	907	994	4,470	4,240
8	7,230	3,970	4,900	4,830	4,410	3,560	1,370	909	899	997	3,630	3,860
9	6,580	3,670	4,370	4,680	4,120	3,420	1,330	896	890	1,030	2,660	4,200
10	7,070	3,440	4,540	4,820	3,960	3,320	1,300	901	901	1,070	2,390	4,790
11	7,650	3,430	4,570	4,920	3,910	3,280	1,290	894	885	1,140	2,480	4,670
12	6,160	3,300	5,300	4,820	3,840	3,030	1,260	893	889	1,100	2,860	5,270
13	6,560	3,280	5,230	4,980	3,620	2,950	1,230	880	892	1,050	4,200	6,840
14	6,380	3,140	4,930	6,080	3,700	2,800	1,200	865	915	1,000	4,100	8,730
15	5,560	3,400	5,120	5,620	3,950	2,630	1,170	860	943	1,030	3,280	7,180
16	6,850	4,380	6,140	5,400	4,200	2,530	1,160	844	980	1,170	3,280	5,870
17	7,700	4,160	5,220	5,490	4,390	2,530	1,150	843	1,020	1,090	3,700	5,830
18	6,780	4,110	4,670	5,050	4,530	2,470	1,140	843	1,100	1,040	4,060	4,700
19	7,790	3,840	4,530	4,700	4,500	2,430	1,130	854	1,120	1,300	3,890	4,040
20	7,510	3,680	4,550	4,780	4,330	2,370	1,120	876	1,120	1,440	5,180	4,070
21	6,820	3,760	4,940	4,840	4,230	2,280	1,100	929	1,070	1,440	4,420	4,250
22	5,760	4,090	5,230	4,640	4,240	2,210	1,080	887	1,030	1,340	4,380	4,670
23	5,070	4,220	4,880	4,500	4,060	2,140	1,060	937	1,000	1,430	4,720	4,900
24	5,350	4,020	4,330	4,430	3,900	2,090	1,040	867	970	1,430	4,520	4,910
25	6,130	4,140	4,400	4,210	3,770	1,970	1,020	914	962	1,460	4,040	4,610
26	6,070	3,980	4,630	4,230	3,650	1,930	1,020	951	940	1,410	3,660	4,550
27	5,590	3,610	5,190	4,160	3,670	1,880	989	944	923	1,410	3,430	4,840
28	5,020	3,600	5,090	4,130	3,960	1,860	973	897	1,000	1,580	3,260	6,420
29	6,210	4,220	5,540	4,210	4,270	1,910	960	875	1,330	2,020	3,850	7,760
30	7,970		6,890	4,260	4,150	1,850	956	882	1,770	1,850	3,660	8,090
31	8,100		6,610		3,800		942	863		2,010		8,430

USGS Oregon City Gage 10^{th} Percentile

00060, Discharge, cubic feet per second,												
Day of	10th percentile of daily mean values for each day for 12 - 12 years of record in, ft3/s (Calculation Period 2001-10-01 -> 2013-0											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	2,083	***1,797***	***1,859***	***2,969***	***2,098***	***1,318***	***840***	***706***	***717***	***795***	***1,103***	***1,384***
1	2,240	2,040	1,730	2,960	2,440	1,650	1,010	713	681	750	808	988
2	2,090	1,930	1,690	2,790	2,570	1,570	1,000	734	661	767	825	1,210
3	1,960	1,850	1,660	2,670	2,420	1,540	983	750	663	749	826	1,330
4	1,900	1,880	1,620	2,720	2,360	1,530	962	745	650	737	845	1,020
5	1,810	1,950	1,590	2,820	2,340	1,510	959	752	644	724	782	982
6	1,740	2,040	1,570	2,820	2,300	1,600	939	755	642	774	791	1,050
7	1,820	2,100	1,530	2,840	2,220	1,570	928	754	714	793	821	1,040
8	1,970	2,020	1,530	2,870	2,280	1,510	928	755	732	801	825	975
9	1,950	1,940	1,480	2,750	2,280	1,470	915	725	728	823	849	941
10	1,830	1,890	1,460	2,830	2,200	1,430	894	730	743	805	899	1,020
11	1,730	1,840	1,460	2,900	2,450	1,380	882	721	760	802	1,050	1,270
12	1,750	1,830	1,550	3,040	2,320	1,400	875	732	742	786	1,220	1,540
13	1,710	1,980	1,510	3,120	2,210	1,380	853	723	741	810	1,310	1,480
14	1,670	1,930	1,500	3,320	2,060	1,360	846	695	728	779	1,290	1,430
15	1,640	1,850	1,610	3,340	1,970	1,290	833	700	752	788	1,310	1,460
16	1,630	1,750	1,580	3,270	2,010	1,300	833	686	748	797	1,210	1,390
17	1,770	1,690	1,700	3,220	2,020	1,300	807	688	758	823	1,480	1,320
18	2,500	1,660	1,580	3,100	2,000	1,190	806	689	770	763	1,480	1,250
19	2,480	1,590	1,600	3,000	1,970	1,130	821	697	741	777	1,500	1,320
20	2,370	1,580	1,820	3,230	1,950	1,170	789	652	745	808	1,430	1,340
21	2,320	1,550	1,850	3,220	1,970	1,210	792	679	733	806	1,290	1,320
22	2,410	1,510	1,810	3,130	1,850	1,230	787	677	726	843	1,230	1,340
23	2,590	1,590	1,770	3,230	2,080	1,160	767	696	715	818	1,190	1,290
24	2,600	1,680	1,770	3,070	2,120	1,180	730	684	712	762	1,200	1,280
25	2,470	1,630	1,810	2,890	1,950	1,150	759	674	711	795	1,190	1,340
26	2,390	1,600	2,200	2,830	1,860	1,110	755	665	704	812	1,170	1,420
27	2,350	1,620	2,900	2,910	1,930	1,060	743	667	690	814	1,090	1,540
28	2,250	1,790	2,900	2,870	1,860	1,050	721	671	697	825	1,050	2,350
29	2,300		2,980	2,730	1,770	1,060	700	687	705	855	1,050	2,250
30	2,220		2,950	2,590	1,670	1,050	721	697	780	853	1,070	2,210
31	2,110		2,920		1,610		694	680		821		2,220

USGS Estacada Gage 90th Percentile

00060, Discharge, cubic feet per second,												
Day of	90th percentile of daily mean values for each day for 105 - 105 years of record in, ft3/s (Calculation Period 1908-10-01 -> 2013											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average	***7,967***	***7,102***	***5,890***	***5,558***	***5,526***	***4,064***	***1,760***	***1,120***	***1,240***	***2,248***	***6,332***	***8,595***
1	7,620	8,160	6,030	6,620	5,380	5,010	2,690	1,210	1,100	1,360	3,710	8,510
2	7,100	8,410	5,710	6,170	5,040	5,030	2,720	1,200	1,100	1,410	3,850	9,740
3	7,950	7,430	5,680	6,150	5,650	4,750	2,440	1,190	1,090	1,710	3,850	8,650
4	7,260	6,080	5,410	5,450	5,520	4,760	2,370	1,180	1,080	1,700	4,310	8,920
5	8,830	6,460	5,180	5,780	5,980	4,800	2,220	1,150	1,100	1,710	4,660	8,740
6	7,900	6,510	5,220	5,560	5,890	4,920	2,220	1,140	1,190	1,490	4,200	9,000
7	7,370	8,550	5,500	5,650	5,760	5,110	2,080	1,130	1,100	1,490	4,420	8,520
8	7,080	7,300	5,320	5,400	5,460	5,620	2,030	1,120	1,120	1,820	5,260	6,950
9	7,680	6,830	5,210	5,220	5,850	5,050	2,010	1,140	1,110	2,070	5,410	6,820
10	7,750	7,250	5,840	5,430	5,700	4,700	2,060	1,110	1,100	2,210	5,020	5,990
11	7,160	6,970	5,890	5,290	5,680	4,270	1,970	1,120	1,150	2,060	4,540	8,640
12	7,770	6,150	6,000	5,160	5,360	3,960	1,850	1,090	1,250	2,130	4,850	9,110
13	8,860	7,170	6,330	5,430	5,270	4,180	1,810	1,080	1,150	1,910	5,570	9,150
14	9,330	6,970	5,590	5,570	5,670	3,800	1,790	1,100	1,180	2,250	6,130	9,260
15	9,600	6,650	5,740	5,520	6,070	3,890	1,640	1,060	1,330	1,900	6,640	7,270
16	8,660	7,140	6,130	5,390	5,670	3,770	1,580	1,120	1,370	1,810	5,960	8,270
17	9,480	9,210	6,070	5,320	5,630	3,600	1,610	1,080	1,400	1,840	6,090	7,590
18	9,250	8,180	5,900	5,480	5,960	4,030	1,570	1,070	1,260	1,930	5,850	6,680
19	8,610	7,360	6,030	5,390	5,590	3,960	1,520	1,120	1,290	2,260	6,450	7,710
20	7,280	7,090	5,990	5,650	5,350	3,720	1,540	1,080	1,340	2,440	8,190	9,580
21	8,040	6,900	6,520	5,920	5,420	3,610	1,500	1,100	1,300	2,570	7,620	10,500
22	7,820	8,140	6,080	5,650	5,310	3,830	1,430	1,160	1,450	2,640	7,710	9,570
23	8,520	7,190	5,690	5,500	5,200	3,570	1,400	1,140	1,300	2,790	8,040	8,580
24	8,100	6,970	5,750	5,610	5,360	3,540	1,390	1,100	1,270	3,400	7,830	8,140
25	8,640	6,460	5,810	5,550	5,440	3,570	1,340	1,120	1,330	2,840	9,730	7,920
26	7,320	6,000	5,910	5,290	5,560	3,390	1,360	1,120	1,390	2,900	9,810	8,550
27	7,790	5,600	6,240	5,400	5,450	3,070	1,300	1,120	1,350	2,760	9,560	10,300
28	6,480	6,460	5,800	5,520	5,180	2,970	1,330	1,080	1,350	2,760	8,970	8,950
29	7,010	6,380	6,300	5,470	5,290	2,780	1,300	1,090	1,350	2,650	8,290	9,750
30	7,030		6,720	5,200	5,460	2,660	1,250	1,090	1,290	3,310	7,450	9,120
31	7,680		7,010		5,160		1,240	1,110		3,560		9,960

USGS Estacada Gage 50th Percentile (Median)

00060, Discharge, cubic feet per second,												
Day of	50th percentile (median) of daily mean values for each day for 105 - 105 years of record in, ft3/s (Calculation Period 1908-10-											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	3,039	***2,927***	***3,042***	***3,458***	***3,367***	***2,072***	***1,133***	***888***	***883***	***1,037***	***2,204***	***2,923***
1	2,790	2,970	2,900	3,180	3,410	2,780	1,410	960	860	920	1,400	3,060
2	2,890	2,900	2,940	3,350	3,450	2,730	1,390	952	840	944	1,390	3,160
3	3,010	2,870	2,950	3,250	3,580	2,610	1,390	946	840	955	1,520	3,120
4	3,010	2,730	3,050	3,220	3,560	2,600	1,280	935	852	951	1,600	3,140
5	3,010	2,790	2,900	3,300	3,550	2,470	1,330	913	861	945	1,600	3,200
6	3,030	2,980	2,910	3,300	3,590	2,490	1,310	920	866	932	1,700	3,180
7	2,800	3,100	2,800	3,390	3,450	2,400	1,280	931	870	939	1,850	3,020
8	2,850	2,860	2,910	3,330	3,520	2,410	1,230	930	872	920	1,870	2,700
9	2,950	2,880	2,870	3,620	3,470	2,330	1,200	920	880	922	1,820	2,850
10	2,880	2,800	2,940	3,710	3,480	2,270	1,200	912	878	935	1,920	3,030
11	3,010	2,820	2,930	3,630	3,500	2,420	1,160	910	868	948	1,900	3,100
12	3,160	2,860	2,860	3,650	3,380	2,310	1,140	900	886	960	1,930	2,900
13	3,280	2,970	2,980	3,670	3,320	2,110	1,180	894	876	960	1,920	2,790
14	3,430	2,930	2,940	3,520	3,300	2,100	1,150	873	877	966	1,990	2,730
15	3,380	2,860	2,940	3,600	3,410	2,210	1,120	885	886	964	1,950	2,840
16	3,320	2,900	3,200	3,460	3,390	2,130	1,110	878	892	958	2,190	2,860
17	3,140	2,970	3,180	3,590	3,690	1,980	1,090	878	900	998	2,420	2,780
18	3,250	3,100	3,210	3,560	3,660	2,030	1,090	870	888	990	2,280	2,950
19	3,170	3,030	3,110	3,490	3,440	1,960	1,070	874	887	1,010	2,380	2,890
20	3,040	2,930	3,100	3,430	3,400	1,880	1,050	870	928	1,040	2,500	2,790
21	2,860	2,880	3,000	3,510	3,430	1,800	1,030	856	896	1,000	2,490	2,870
22	2,860	2,800	3,000	3,440	3,460	1,740	1,020	860	912	1,080	2,540	2,890
23	3,040	2,880	3,170	3,400	3,420	1,670	1,020	866	900	1,100	2,660	2,990
24	2,930	2,950	3,150	3,540	3,270	1,630	1,010	856	878	1,100	2,680	2,870
25	3,010	2,880	3,130	3,490	3,190	1,580	1,010	865	874	1,120	2,910	2,850
26	3,100	3,070	3,050	3,400	3,110	1,570	1,000	845	876	1,140	3,010	2,730
27	3,030	3,000	3,150	3,410	3,060	1,480	987	846	895	1,180	2,790	2,750
28	3,090	2,860	3,080	3,480	3,000	1,560	990	839	920	1,340	2,730	2,740
29	3,080	3,310	3,320	3,470	3,090	1,480	968	837	910	1,310	3,070	2,800
30	3,020		3,310	3,350	2,920	1,430	960	848	909	1,270	3,100	3,150
31	2,780		3,310		2,880		960	857		1,340		2,870

USGS Estacada Gage 10th Percentile

00060, Discharge, cubic feet per second,												
Day of	10th percentile of daily mean values for each day for 105 - 105 years of record in, ft3/s (Calculation Period 1908-10-01 -> 2013											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1,555	***1,589***	***1,856***	***2,191***	***1,841***	***1,227***	***845***	***706***	***686***	***714***	***978***	***1,331***
1	1,510	1,540	1,590	2,040	2,360	1,340	1,010	740	696	677	790	1,140
2	1,520	1,590	1,650	2,150	2,320	1,360	994	739	672	686	807	1,210
3	1,470	1,560	1,650	2,160	2,090	1,440	967	736	681	690	802	1,280
4	1,530	1,650	1,680	2,060	2,080	1,400	953	734	678	688	801	1,220
5	1,630	1,650	1,760	2,040	2,160	1,430	951	706	670	704	785	1,200
6	1,640	1,630	1,800	2,140	2,080	1,380	923	714	666	698	816	1,170
7	1,660	1,620	1,760	2,090	2,070	1,280	934	725	657	679	785	1,220
8	1,640	1,590	1,720	2,000	2,050	1,390	922	719	677	678	807	1,240
9	1,550	1,590	1,780	2,110	2,060	1,280	898	716	689	683	909	1,280
10	1,530	1,600	1,800	2,160	2,030	1,340	876	704	701	664	924	1,240
11	1,590	1,610	1,820	2,190	2,050	1,320	864	711	670	679	936	1,290
12	1,600	1,630	1,830	2,170	1,980	1,310	861	702	676	698	1,020	1,480
13	1,550	1,640	1,960	2,200	1,930	1,290	865	696	683	699	1,030	1,450
14	1,560	1,570	1,890	2,220	1,880	1,250	840	697	680	706	1,000	1,300
15	1,560	1,530	1,840	2,260	1,920	1,230	813	694	692	713	1,000	1,400
16	1,520	1,560	1,860	2,260	1,900	1,230	804	683	683	710	994	1,290
17	1,490	1,540	1,770	2,170	1,840	1,240	796	697	684	684	1,000	1,410
18	1,500	1,610	1,840	2,210	1,830	1,240	826	706	664	670	923	1,380
19	1,500	1,590	1,900	2,170	1,650	1,240	827	701	704	702	931	1,360
20	1,480	1,580	1,870	2,290	1,670	1,170	812	709	714	708	1,110	1,350
21	1,450	1,590	1,760	2,190	1,640	1,170	810	709	685	731	1,110	1,260
22	1,470	1,520	1,910	2,200	1,590	1,120	791	702	690	725	1,020	1,270
23	1,480	1,630	1,940	2,270	1,680	1,100	771	686	709	728	1,140	1,260
24	1,590	1,590	1,900	2,190	1,570	1,070	765	696	681	736	1,160	1,240
25	1,680	1,570	1,910	2,310	1,710	1,000	776	693	682	734	1,100	1,150
26	1,570	1,650	1,940	2,270	1,610	1,030	771	694	703	754	1,080	1,330
27	1,640	1,490	2,020	2,290	1,580	1,040	771	709	695	782	1,140	1,530
28	1,560	1,570	2,130	2,370	1,490	1,050	765	689	707	781	1,180	1,740
29	1,620	1,580	2,070	2,240	1,420	1,040	746	693	700	794	1,110	1,510
30	1,580		2,110	2,320	1,350	1,020	742	686	696	820	1,130	1,500
31	1,520		2,070		1,470		736	685		736		1,550

Gaged flow during observations of March 3, 2014

USGS Estacada Gage Real-Time Readings

03/03/2014 08:00 PST	7,420[P]	14.92[P]
03/03/2014 08:15 PST	7,460[P]	14.94[P]
03/03/2014 08:30 PST	7,500[P]	14.96[P]
03/03/2014 08:45 PST	7,550[P]	14.98[P]
03/03/2014 09:00 PST	7,850[P]	15.12[P]
03/03/2014 09:15 PST	7,910[P]	15.15[P]
03/03/2014 09:30 PST	7,930[P]	15.16[P]
03/03/2014 09:45 PST	7,930[P]	15.16[P]
03/03/2014 10:00 PST	7,930[P]	15.16[P]
03/03/2014 10:15 PST	7,960[P]	15.17[P]
03/03/2014 10:30 PST	7,930[P]	15.16[P]
03/03/2014 10:45 PST	7,930[P]	15.16[P]
03/03/2014 11:00 PST	7,930[P]	15.16[P]
03/03/2014 11:15 PST	7,960[P]	15.17[P]
03/03/2014 11:30 PST	7,910[P]	15.15[P]
03/03/2014 11:45 PST	8,040[P]	15.21[P]
03/03/2014 12:00 PST	8,560[P]	15.44[P]
03/03/2014 12:15 PST	8,750[P]	15.52[P]
03/03/2014 12:30 PST	8,650[P]	15.48[P]
03/03/2014 12:45 PST	8,560[P]	15.44[P]
03/03/2014 13:00 PST	8,490[P]	15.41[P]
03/03/2014 13:15 PST	8,560[P]	15.44[P]
03/03/2014 13:30 PST	8,680[P]	15.49[P]
03/03/2014 13:45 PST	8,750[P]	15.52[P]
03/03/2014 14:00 PST	8,750[P]	15.52[P]
03/03/2014 14:15 PST	9,340[P]	15.77[P]
03/03/2014 14:30 PST	10,100[P]	16.08[P]
03/03/2014 14:45 PST	10,000[P]	16.05[P]
03/03/2014 15:00 PST	9,800[P]	15.96[P]
03/03/2014 15:15 PST	9,730[P]	15.93[P]

USGS Oregon City Gage Real-Time Readings

03/03/2014 08:00 PST	28.91P	9,060P
03/03/2014 08:15 PST	28.90P	9,040P
03/03/2014 08:30 PST	28.98P	9,220P
03/03/2014 08:45 PST	28.98P	9,220P
03/03/2014 09:00 PST	28.91P	9,060P
03/03/2014 09:15 PST	29.03P	9,340P
03/03/2014 09:30 PST	29.04P	9,360P
03/03/2014 09:45 PST	29.03P	9,340P
03/03/2014 10:00 PST	29.05P	9,380P
03/03/2014 10:15 PST	29.07P	9,430P
03/03/2014 10:30 PST	29.14P	9,590P
03/03/2014 10:45 PST	29.02P	9,320P
03/03/2014 11:00 PST	29.07P	9,430P
03/03/2014 11:15 PST	29.09P	9,480P
03/03/2014 11:30 PST	29.11P	9,520P
03/03/2014 11:45 PST	29.20P	9,730P
03/03/2014 12:00 PST	29.22P	9,780P
03/03/2014 12:15 PST	29.33P	10,000P
03/03/2014 12:30 PST	29.36P	10,100P
03/03/2014 12:45 PST	29.37P	10,100P
03/03/2014 13:00 PST	29.40P	10,200P
03/03/2014 13:15 PST	29.41P	10,200P
03/03/2014 13:30 PST	29.45P	10,300P
03/03/2014 13:45 PST	29.45P	10,300P
03/03/2014 14:00 PST	29.55P	10,600P
03/03/2014 14:15 PST	29.47P	10,400P
03/03/2014 14:30 PST	29.50P	10,400P
03/03/2014 14:45 PST	29.49P	10,400P
03/03/2014 15:00 PST	29.62P	10,700P
03/03/2014 15:15 PST	29.62P	10,700P
03/03/2014 15:30 PST	29.73P	11,000P
03/03/2014 15:45 PST	29.76P	11,100P

Appendix 2. Oregon State Fish Passage Criteria
Source: Oregon Department of Fish and Wildlife webpage:
http://www.dfw.state.or.us/OARs/412.pdf

(1) General requirements for fish passage are:

(a) unless the owner or operator of an artificial obstruction chooses to provide year-round fish passage for all native migratory fish and life history stages, the Department shall determine:

(A) native migratory fish currently or historically present at the site which require fish passage,

(B) life history stages which require fish passage, and

(C) dates of the year and/or conditions when passage shall be provided for the life history stages and native migratory fish;

(b) the person submitting the fish passage plan to the Department for approval shall submit all information necessary to efficiently evaluate whether the design will meet fish passage criteria;

(c) if site-specific circumstances indicate that the fish passage criteria are not adequate to provide fish passage, the Department may require in writing that additional fish passage criteria be met;

(d) if native migratory fish- or site-specific circumstances warrant it, the Department may provide an exception to any specific fish passage criterion if the Department determines in writing that fish passage shall still be provided;

(e) all fish passage structures shall be designed to take into consideration their upstream and downstream connection and prevent undesirable impacts to fish passage, including but not limited to scour and headcuts;

(f) if joint state and federal approval is required, the Department shall take into account federal requirements during approval;

(g) primarily at sites with little existing site information or questionable design solutions, the Department may require monitoring and reporting to determine if a fish passage structure meets applicable criteria and/or is providing fish passage; and

(h) the person owning or operating an artificial obstruction shall maintain the fish passage structure in such repair and operation as to provide fish passage of native migratory fish at all times required by the Department.

(2) Requirements for fish passage at dams and other artificial obstructions which create a discontinuity between upstream and downstream water surface or streambed elevations are:

(a) fishways shall provide fish passage at all flows within the design streamflow range;

(b) the fishway entrance shall be located and adequate attraction flow shall be provided at one or more points where fish can easily locate and enter the fishway;

(c) fishway water velocities shall:

(A) range between 1 and 2 feet per second in transport channels,

(B) average no greater than 5 feet per second in baffled-chute fishways, including but not limited to Alaska steeppasses and denils, and

(C) not exceed 8 feet per second in discrete fishway transitions between the fishway entrance, pools, and exit through which fish must swim to move upstream, including but not limited to slots, orifices, or weir crests;

(d) at any point entering, within, or exiting the fishway where fish are required to jump to move upstream, the maximum difference between the upstream and downstream water surface elevations shall be 6 inches, except it shall be 12 inches if only salmon or steelhead adults require fish passage;

juveniles require passage and 12 inches where adults require passage, except:

(A) baffled-chute fishways, including but not limited to Alaska steeppasses and denils, shall have a minimum flow depth of 2 feet throughout the length of the fishway, and

(B) water depths shall be a minimum of 2 feet within jump pools which shall be located downstream of any point entering, within, or exiting the fishway where fish are required to jump to move upstream;

(f) all fishway locations through which fish must swim shall be at least 12 inches wide;

(g) fishway pools shall:

(A) be sized according to the native migratory fish and life history stages requiring passage and to avoid over-crowding,

(B) have $V \geq wQH/4$ at all flows within the design streamflow range, where:

(i) "V" is the water volume in cubic feet,

(ii) "w" is 62.4, the unit weight of water, in pounds per cubic foot,

(iii) "Q" is the fish ladder flow in cubic feet per second,

(iv) "H" is the energy head of pool-to-pool flow in feet, and

(v) 4 has a unit of foot-pounds per second per cubic foot,

(C) where the fishway bends 90 degrees or more, have turning pools with a flowpath centerline double the length of non-turning pools, and

(D) be placed at least every 25 feet of horizontal distance in baffled-chute fishways, including but not limited to Alaska steeppasses and denils;

(h) the fishway exit should be located to minimize the risk of fish unintentionally falling downstream of the artificial obstruction;

(i) fishway trash racks shall:

(A) allow for easy maintenance and debris removal,

(B) have a minimum clear space between vertical members of 9 inches, except:

(i) 10 inches shall be provided if adult chinook are present, and

(ii) at least 4 inches shall be provided if only juveniles are present, and

(C) lhave a minimum clear space between horizontal members of 12 inches;

(j) the fishway shall:

(A) have water temperatures which are within 1 degree Fahrenheit of the water entering the fishway,

(B) be designed to assure that fish do not leap out of the fishway,

(C) have all edges and fasteners which fish may contact ground smooth or chamfered,

(D) not have protrusions extend into the flow path of the fishway,

(E) have as much ambient lighting as possible,

(F) have fishway components which are not detailed in OAR 635-412-0035(2), including but not limited to auxiliary water systems, designed considering the most recent National Marine Fisheries Service or U.S. Fish and Wildlife Service fish passage criteria and guidelines, and

(G) meet the species-specific requirements in OAR 635-412-0035(7) if any of those native migratory fish require fish passage;

(k) requirements for specific types of fishways include:

(A) baffled-chute fishways, including but not limited to Alaska steeppasses and denils, shall not be used in areas where downstream passage will occur through the baffled-chute fishway,

(B) all fishways of a specific type with accepted configurations shall comply with those configurations, and

(C) fish passage plans for stream channel-spanning weirs, roughened channels (including but not limited to nature-like, rock, or engineered-stream fishways), and hybrid fishways (including but not limited to pool-and-chute ladders) which may combine criteria elements of natural streams and/or established fishway types (including but not limited to pool-and-weir, vertical slot, and baffled-chute fishways) shall clearly demonstrate how water depths, water velocities, water drops, jump pools, structure sizing, and fish injury precautions shall provide fish passage;

(l) for downstream fish passage: [Note: fish screening and bypass requirements for diverted water are separate from these requirements.]

(A) fish passage structures shall have an open water surface, except a submerged or enclosed conduit or orifice may be utilized if:

(i) acceptable guidance or collection mechanisms are used and kept free from debris,

(ii) water depth is greater than 4 inches during all flows,

(iii) water velocity is greater than 2 feet per second during all flows,

(iv) water is not pumped,

(v) conduits have smooth surfaces and avoid rapid changes in direction to preclude fish impact and injury, and

(vi) conduits are at least 10 inches wide;

(B) plunging flow moving past an artificial obstruction via spillways, outlet pipes, or some other means which may contain fish shall:

(i) at all flows, fall into a receiving pool of sufficient depth, depending on impact velocity and quantity of flow, to ensure that fish and flow shall not impact the stream bottom or other solid features, and

(ii) have a maximum impact velocity into a receiving pool, including vertical and horizontal velocity components, less than 25 feet per second; and

(C) water depth over spillways shall be greater than 4 inches during all flows.

(3) Requirements for fish passage at road-stream crossing structures such as bridges and culverts are:

(a) Stream Simulation Option:

(A) open-bottomed and closed-bottom road-stream crossing structures shall have beds under or within the structure that:

(i) are equal to or greater than the active channel width, as measured at sufficient locations outside the influence of any artificial or unique channel constrictions or tributaries both upstream and downstream of the site,

(ii) are equal to the slope of, and at elevations continuous with, the surrounding long-channel streambed profile, unless the Department approves maintaining a pre-existing road-impounded wetland,

(iii) have, for open-bottomed road-stream crossing structures, a minimum of 3 feet vertical clearance from the active channel width elevation to the inside top of the structure,

(iv) maintain average water depth and velocities that simulate those in the surrounding stream channel, and

(v) are composed of material that:

(I) assures the bed under or within the road-stream crossing structure is maintained through time,

(II) is either natural (similar size and composition as the surrounding stream) or supplemented to address site-specific needs including, but not limited to, bed retention and hydraulic shadow,

(III) contains partially-buried, over-sized rock if the road-stream crossing structure is greater than 40 feet in length,

(IV) is mechanically placed during structure installation rather than allowed to naturally accumulate, unless the surrounding streambed is primarily bedrock, and

(V) excluding partially-buried over-sized rock, is, for closed-bottom road-stream crossing structures, at a minimum depth of 20 percent of the structure height and a maximum depth of 50 percent of the structure height; and

(B) trash racks shall not extend below the active channel width elevation and shall have a minimum of 9 inches clear spacing between vertical members; or

(b) Alternative Option: the Department may approve road-stream crossing structures for which clear justification is provided, based on fish performance and/or fish behavior data and hydraulic conditions, that the alternative design shall provide fish passage.

(4) Requirements for fish passage at artificial obstructions in estuaries, and above which a stream is present, are:

(a) fish passage shall be provided at all current and historic channels;

(b) fish passage structures shall meet the criteria of OAR 635-412-0035(2) or (3), except fish passage structures shall be sized according to the cumulative flows or active channel widths, respectively, of all streams entering the estuary above the artificial obstruction; and

(c) tide gates and associated fish passage structures shall be a minimum of 4 feet wide and shall meet the requirements of OAR 635-412-0035(2) within the design streamflow range and for an average of at least 51% of tidal cycles, excluding periods when the channel is not passable under natural conditions.

(5) Requirements for fish passage at artificial obstructions in estuaries, floodplains, and wetlands, and above which no stream is present, are:

(a) Downstream Fish Passage

(A) downstream fish passage shall be provided after inflow which may contain native migratory fish;

(B) downstream fish passage shall be provided until water has drained from the estuary, floodplain, or wetland, or through the period determined by the Department which shall be based on one, or a combination of, the following:

(i) a specific date,

(ii) water temperature, as measured at a location or locations determined by the Department,

(iii) ground surface elevation,

(iv) water surface elevation, and/or

(v) some other reasonable measure;

(C) egress delays may be approved by the Department based on expected inflow frequency if there is suitable habitat and as long as passage is provided by the time the conditions in OAR 635-412-0035(5)(a)(B) occur;

(D) a minimum egress flow of 0.25 cubic feet per second (cfs) at one point of egress shall be provided;

(E) egress flow of 0.5 cfs per 10 surface acres, for at least the first 100 surface acres of impounded water, shall be provided;

(F) all plunging egress flows shall meet the requirements of OAR 635-412-0035(2)(l)(B);

(G) if egress flow is provided by a pump, it shall be appropriately screened;

(H) the minimum water depth and width through or across the point of egress shall be 4 inches;

(I) the ground surface above the artificial obstruction shall be sloped toward the point(s) of egress to eliminate isolated pools; and

(J) an uninterrupted, open connection with a minimum water depth of 4 inches shall be present from the point of egress to the downstream waters of this state, unless another connection is provided as per OAR 635-412-0035(2)(l)(A).

(b) Upstream Fish Passage: a fishway or road-stream crossing structure with or without a tide gate shall be provided during the period determined by the Department if there is current or historic native migratory fish spawning or rearing habitat within the estuary, floodplain, or wetland area impounded by the artificial obstruction.

(6) Requirements for fish passage at traps are:

(a) a collection permit issued by the Department is required to operate all traps;

(b) traps shall be constructed to prevent physical or physiological injury to native migratory fish;

(c) traps shall meet all requirements of OAR 635-412-0035(2)(g);

(d) traps located within a fishway (i.e., "in-ladder" traps) shall not inhibit native migratory fish from entering the fishway or trap and shall be removed if the Department determines that fish are not entering the trap;

(e) native migratory fish shall be processed through traps with minimal possible delay and as frequently as necessary to avoid over-crowding;

(f) all native migratory fish, excluding those which have approved take authorization from the Department and which do not require fish passage as per OAR 635-412-0035(1)(a), shall be returned to the stream by one of the following methods:

(A) movement from the trap to immediately-adjacent water which has fish passage, or

(B) transport within a watered container, including but not limited to lifts, hoppers, locks, and trucks, from the trap to a location approved by the Commission.

(7) Additional requirements for specific native migratory fish are:

(a) *Acipenser* species (sturgeon)

(A) the fish passage structure shall not require fish to jump when entering, within, or exiting the structure;

(B) the fish passage structure, including trash racks, shall be sized to accommodate the largest individual expected to require fish passage; and

(C) non-volitional transport within a watered container shall be allowed with Department approval.

(b) *Catostomus* and *Chasmistes* species (suckers)

(A) the fish passage structure shall not require fish to jump when entering, within, or exiting the structure;

(B) fishways shall have a maximum water velocity of 4 feet per second;

(C) fishways shall have a minimum water depth of 12 inches;

(D) fishways shall maximize downstream flow between pools to avoid back eddies;

(E) fishways shall have curved walls within turning pools; and

(F) fishways shall have a slope less than 4 percent.

(c) *Lampetra* species (lamprey)

(A) fishways shall not have overhanging surfaces;

(B) fishways shall have rounded or chamfered edge surfaces over which *Lampetra* species may pass;

(C) fishways shall, in locations with water velocities greater than 2 feet per second, have a passage route that:

(i) has a smooth, impermeable, uninterrupted surface or a simulated streambed,

(ii) has water velocities over the structure's surface less than 8 feet per second, and

(iii) is wetted.

(d) *Oncorhynchus* species (trout and salmon): fish passage structures for *Oncorhynchus keta* (chum) shall not require fish to jump when entering, within, or exiting the structure.

(e) *Ptychocheilus* species (pikeminnow): fish passage structures shall meet the requirements of OAR 635-412-0035(7)(a).

(f) if more than one native migratory fish species requires passage at a site and the requirements for the different species are mutually exclusive, the Department shall determine passage criteria.

(8) Requirements for artificial obstruction removal are:

(a) artificial obstruction removals shall follow the requirements of OAR 635-412-0035(10);

(b) if not completely removed, no parts of the remaining artificial obstruction shall:

(A) constrict the stream channel, or

(B) cause low flow depths less than the surrounding stream channel;

(c) after an artificial obstruction is removed the stream channel shall be restored; and

(d) the stream channel restoration shall address impacts to stream habitat caused by the artificial obstruction while in place and by its removal, including but not limited to upstream and downstream channel degradation, and provisions shall be made to address unexpected fish passage issues resulting from removal.

(9) Requirements for exclusion barriers are:

(a) exclusion barriers shall only be placed in the following situations, when fish passage is not required or is provided by other means:

(A) to guide fish to an approved fish passage structure or trap,

(B) to prevent fish from leaving waters of this state and entering human-made water supply conduits,

(C) to prevent fish from entering waters of this state associated with operations of another artificial obstruction that could lead to fish injury, or

(D) to achieve other fish management objectives approved in writing by the Department; and

(b) exclusion barriers shall comply with National Marine Fisheries Service or U.S. Fish and Wildlife Service criteria.

(10) Requirements for fish passage during construction of fish passage structures and periods when temporary artificial obstructions are in place are:

(a) all fish passage structures shall be constructed and temporary artificial obstructions shall be in place only during the site-specific in-water work period defined or approved by the Department;

(b) at times indicated by the Department as per OAR 635-412-0035(1)(a), downstream fish passage shall be provided and:

(A) the outfall of a stream flow bypass system shall be placed to provide safe reentry of fish into the stream channel, and

(B) if downstream fish passage during construction is not required and stream flow is pumped around the site, the site shall meet Department screening and/or bypass requirements;

(c) at times indicated by the Department as per OAR 635-412-0035(1)(a), upstream fish passage shall be provided and shall be based on the wetted-width or flows of the stream during the period of construction or temporary obstruction;

(d) in-stream construction sites shall be isolated from stream flow and fish;

(e) prior to in-stream construction activities, all fish shall be safely collected, removed from the construction site or de-watered reach, and placed in the flowing stream by an authorized person with a collection permit issued by the Department; and

(f) after construction, the construction site shall be re-watered in a manner to prevent loss of downstream surface water as the construction site's streambed absorbs water.

(11) Requirements for experimental fish passage structures are:

(a) experimental fish passage structures shall only be allowed in waters of the state after:

(A) laboratory testing with native migratory fish or similar species indicates that the structure is feasible to provide fish passage,

(B) field testing with a prototype structure, at a location where existing fish passage will not be compromised and where fish passage does not need to be addressed under OAR 635-412-0020(2) and (3), indicates that the structure is likely to provide fish passage, and

(C) in addition to information needed to evaluate the structure's design for the specific location, the following are submitted to the Department and approved:

(i) a written summary of the laboratory and field testing and how the results indicate that fish passage shall be provided,

(ii) a monitoring and reporting plan to determine if the installed experimental fish passage structure meets applicable design objectives and is providing fish passage, and

(iii) a modification plan for the experimental fish passage structure if monitoring indicates that fish passage is not being provided, including standard thresholds that will initiate these modifications;

(b) if at any time an experimental fish passage structure is deemed by the Department in writing to not provide fish passage, the owner or operator, in consultation with the Department, shall make such modifications to the structure or operation as are necessary to provide fish passage, and, after a reasonable period, if modifications are deemed by the Department in writing to not provide fish passage, a fish passage structure that meets the standard criteria of OAR 635-412-0035 shall be installed as soon as practicable but no later than the end of the next complete in-water work period after notification by the Department;

(c) the owner or operator of an experimental fish passage structure shall allow the Department to inspect experimental fish passage structures at reasonable times;

(d) five years after the experimental fish passage structure is installed and fish are present to attempt passage a final monitoring report shall be submitted to the Department and the Department shall determine if the experimental fish passage structure provides fish passage;

(e) if the Department determines that the experimental fish passage structure does not provide fish passage, a fish passage structure that meets the standard criteria of OAR 635-412-0035 shall be installed as soon as practicable but no later than the end of the next complete in-water work period after notification by the Department; and

(f) after three experimental fish passage structures of the same design concept are placed in waters of the state and deemed to provide fish passage by the Department, the experimental fish passage structure shall no longer be considered experimental.

Stat. Auth.: ORS 496.138
Stats. Implemented: ORS 509.585 and 509.610
Hist.: Adopted 1-6-06, f. & certified ef. 1-9-06