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October 23, 2020

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RE: The DEQ approves the Willamette Water Supply System's revised Water Quality Trading Plan for Temperature on the Willamette River

Dear Ms. Walter,

The Oregon Department of Environmental Quality (DEQ) has reviewed the *Draft Willamette Water Supply System: Thermal Trading Plan* submitted on November 8, 2019. The DEQ appreciates the productive engagement by the Willamette Water Supply System (WWSS) during development of the draft Thermal Trading Plan. The Plan was made available for public comment and review consistent with OAR 340-039-0020(2).

Comments on the Plan were received during two public comment periods and during a public hearing conducted on July 1, 2020. These comments provided an important outside perspective and were used by the DEQ for their critical review of the Plan. Based in part on these comments, the DEQ requested that the WWSS make several updates to the plan, summarized as follows:

1) Information availability: Will WWSS post information regarding trading activities, such as trading plans and annual reports, to its (or a partner's) website?

2) There may be areas of the trading area that should be eliminated due to their location (for example, drainages above reservoirs). The DEQ requests that the WWSS review the trading area, and if no restoration or other BMPs may be applied to these areas, remove them from the trading area map.

3) The DEQ requests that the WWSS make the changes suggested by Cheryl Hummon of the ODA. If the WWSS believes that these changes are not needed, the DEQ requests that the WWSS describe why these changes are not necessary.

4) The DEQ recognizes that in Table 1, the row titled: "(f) local ordinances" states "Not applicable." under baseline requirement. The DEQ agrees that local ordinances applicable to individual BMPs may be identified at a future point in time (an eventuality that is alluded to in the plan). The DEQ requests that the WWSS update this plan to state that when identified, local ordinances are applicable to the project.

5) The applicant requests lowering the trading ratio due to the fact that they are generating credits years before they are used. However, the trading ratio is also important when accounting for attenuation between the point of use and BMP location. The DEQ requests that a 2:1 trading ratio be maintained to account for any combination of the following: 1) attenuation of water quality benefits between credit-generating BMPs and point of use; 2) uncertainty of BMP performance; or 3) uncertainty of water quality benefit measurement.

The Plan was revised in response to the above comments, and resubmitted to the DEQ on September 1, 2020. The WWSS has also communicated to the DEQ that the Plan will be publically available on their website.

The Plan meets the basic requirements for the development of Water Quality Trading Plans as specified in Oregon Administrative Rule 340-039-0025, and the DEQ approves this Plan. The Plan is required by the WWSS 401 Water Quality Certification (condition 28), and the features of this plan become enforceable conditions of this 401 Certification. A modification request (US Army Corps of Engineers No: NWP-2015-41) submitted by the WWSS does not appear to affect this Plan. However, if new temperature impacts arise through the redesign process, the DEQ may require the WWSS to submit a revised Temperature Trading Plan for public comment and approval.

Under this plan, the WWSS will submit annual reports on March 1 of each year. The DEQ may provide the ability to submit annual reports annual reports on an alternative date of each year. Electronic submission is sufficient for these annual reports. The WWSS is aware of the requirements for annual reporting under OAR 340-039-0017(3), and has listed those requirements in Appendix D of the Plan. The final requirement (g) pertains to adaptive management implementation measures. Consistent with this requirement, the DEQ encourages the WWSS to use knowledge gained from other stream restoration projects in Oregon and elsewhere. Practitioners of streamside restoration have reported to the DEQ the need to proactively anticipate rapid year-to-year changes in hydrology, geomorphology, and vegetation assemblages.

Last, it is important to mention that the DEQ issued a Revised Willamette Basin Mercury TMDL on November 22, 2019. On November 29, 2019, EPA disapproved the TMDL and subsequently established a revised TMDL on December 30, 2019. Although the revised TMDL has not taken effect at this time, the new Mercury TMDL and Water Quality Management Plan may eventually require updates to baseline requirements, and streamside shading and other BMPs. The DEQ anticipates it will be necessary to contact DMAs and responsible persons identified in the revised mercury TMDL, including members of the WWSS.

We look forward to your involvement in lowering water temperatures in the Willamette Basin and your ongoing commitment to improving water quality conditions. Should you have questions about water quality trading, Willamette Basin TMDLs, or anything else in this letter, please contact Brian Creutzburg via phone at (503) 229-6819 or email at creutzburg.brian@deq.state.or.us.

Sincerely,

Steve Mrazik

Water Quality Manager
Northwest Region

electronic cc: Jill Chomycia, Willamette Water Supply
Jacob Krall, Geosyntec Consultants on behalf of Willamette Water Supply
Jennifer Wigal, Deputy Administrator, DEQ Water Quality Division
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WILLAMETTE WATER SUPPLY SYSTEM: THERMAL TRADING PLAN

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Regulatory Background Supporting Trading in Oregon

The Oregon Department of Environmental Quality (DEQ) has been issuing permits that include thermal credit trading since 2004, when a permit was issued to Clean Water Services that allowed two publicly owned treatment works (POTWs) to receive thermal credits by restoring and managing riparian areas to create shade and releasing cold water from an upstream reservoir. The thermal trading credits allowed the POTWs to comply with water quality-based effluent limitations for temperature in their National Pollutant Discharge Elimination System (NPDES) permits.

In 2015, the Oregon Environmental Quality Commission (EQC) approved Oregon Administrative Rule (OAR) 340 Division 039, a set of rules outlining the basic requirements for a viable water quality trading program. Following this, in 2016, DEQ updated its Water Quality Trading Internal Management Directive (IMD)[1] to complement the changes in the new rules.

The Willamette Water Supply System Commission (WWSS Commission) is an Oregon intergovernmental entity formed by Tualatin Valley Water District (TVWD), the City of Hillsboro, and the City of Beaverton. The WWSS Commission was formed to build the Willamette Water Supply System (WWSS) in response to planned growth in their service areas. The WWSS will provide an additional, resilient water supply for Washington County. When complete, the WWSS will be one of Oregon's most seismically-resilient water systems—built to better withstand natural disasters, protect public health, and speed regional economic recovery through restoring critical services more quickly.

The Willamette River, one of Oregon's largest rivers, is the WWSS's new supply source. The raw water intake is located at the Willamette River Water Treatment Plant in Wilsonville. From there, raw water will be pumped to the WWSS Water Treatment Plant, a new state-of-the-art water filtration plant where multiple treatment processes will produce high quality drinking water. Drinking water will be pumped to reservoir facilities on Cooper Mountain, then will be gravity-fed to additional storage and customers in the TVWD, Hillsboro, and Beaverton service areas. The new system will be completed by 2026.

TVWD has been designated the Managing Agency for the WWSS Commission, and TVWD operates the Willamette Water Supply Program (WWSP) to plan, design, and construct the WWSS.

The WWSS will include more than 30 miles of water transmission pipelines ranging in diameter from 36 inches to 66 inches from the raw water facilities in Wilsonville north to Hillsboro and the TVWD service areas. The WWSS also includes constructing two finished-water storage tanks (terminal storage) and expanding the raw water facilities, including replacing the fish screens and seismic improvements at the existing intake facility on the Willamette River. The WWSS will provide the Partners and the region with a seismically resilient water supply to meet future water demands and provide redundancy in case of a future emergency event.

This Thermal Trading Plan (TTP) seeks to fulfill the temperature offset requirement of the Clean Water Act (CWA), Section 401 water quality certification (WQC) as it pertains to the WWSS.

Previous TTPs have been used to address discharges under NPDES permits. This TTP differs because it describes the plan for offsetting the temperature impact of a water withdrawal, as opposed to a discharge, and because it is associated with a Clean Water Act (CWA) Section 401 water quality certification (WQC), rather than a NPDES permit. While discharges typically result in their maximum impact at the discharge point, a withdrawal is different—its impact is likely to occur well downstream of the withdrawal after atmospheric conditions have had

[1] Oregon Department of Environmental Quality (2016), Water Quality Trading Internal Management Directive. March 31. A*vailable at* https://www.oregon.gov/deq/Filtered%20Library/WQTradingIMD.pdf

time to act on the reduced volume of water remaining in the river. These impacts are further discussed below in the section describing the trading area.

This TTP is consistent with OAR 340 Division 039 and the 2016 Water Quality Trading IMD.

Eligibility

OAR 340-039-0015: ELIGIBILITY

The WWSS Commission is pursuing this trading program as part of its Section 401 WQC and is therefore eligible to trade under OAR 340-039-0015(1). Temperature is one of the water quality parameters eligible for trading under OAR 340-039-0015(2). The Willamette River is eligible for trading under OAR 340-039-0015 (3) because it is consistent with water quality management plan in the 2006 temperature TMDL.[2]

Trading Plan

The following subsections describe how the WWSS Commission's trading plan aligns with each of the required components of a trading plan, as described in OAR 340-039-0025(5).

OAR 340-039-0025(5)(A): TEMPERATURE TRADING

A trading plan must identify the parameter for which water quality trading is developed. The WWSS Commission's trading plan is developed for water temperature.

OAR 340-039-0025(5)(B): BASELINE

Oregon defines the "trading baseline" as the "pollutant load reductions, BMP requirements, or site conditions that must be met under regulatory requirements in place *at the time of trading project initiation*." OAR 340-039-0005(6). A trading plan must identify "any applicable regulatory requirements from OAR 340-039-0030(1) that apply within the trading area and that must be implemented to achieve baseline requirements." Credits are generated when the trading project results in water quality benefits above the trading baseline. Establishing a baseline ensures that credits are not used to meet an existing regulatory obligation or used by more than one entity at any given time. Applicable regulatory requirements can include[3]:

- NPDES permit requirements
- CWA section 401 certifications
- Agricultural water quality management area rules
- Oregon Board of Forestry rules
- Federal management plans or agreements between the state and a federal agency
- Local ordinances
- Tribal laws or rules
- Requirements derived from a TMDL by designated management agencies responsible for TMDL implementation.

The WWSS Commission will evaluate whether any of the baseline requirements described in the rule apply to the potential trading sites. If affirmative requirements do apply to trading project sites, baseline BMPs can be installed or deductions to site thermal benefit totals can be made to ensure that credit is not being taken for actions that were required under baseline obligations. If no baseline obligations exist at the trading project site (described

[2] Oregon Department of Environmental Quality, (2006). The Willamette Basin Total Maximum Daily Load (TMDL) documents. *Available a*t https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Willamette-Basin.aspx

[3] Draft City of Ashland Trading Plan v3 (March 2018)

below), the baseline obligation would be equal to current conditions. Table 1 provides an overview of the baseline requirements listed in the trading rule that might apply to the trading projects.

Table 1. Overview of Baseline Requirements Potentially Applicable to WWSS Commission Proposed Trading Projects within the Trading Area.

ORS 340-039-0030(1)	BASELINE REQUIREMENT
(a) NPDES permit requirements	None
(b) Rules issued by Oregon Department of Agriculture for an agricultural water quality management area under OAR chapter 603 division 095	The WWSS Commission has identified potential trading projects in the Tualatin River Watershed Agricultural Water Quality Management Area Rules and the Molalla/Pudding/French Prairie/North Santiam Agricultural Water Quality Management Area Rules. Requirements will be evaluated on a case-by-case basis as trading projects are further defined.
(c) Rules issued by Oregon Board of Forestry under OAR chapter 629 divisions 610-680	Not currently applicable; forestry-zoned sites are not currently under consideration for implementation.
(d) Requirements of a federal land management plan, or an agreement between a federal agency and the state	Any projects within National Wildlife refuges will follow associated Comprehensive Conservation Plans. Other requirements will be evaluated on a case-by-case basis as trading projects are further defined.
(e) Requirements established in a Clean Water Act Section 401 water quality certification	Other than the Section 401 WQC, which this Thermal Trading Plan is intended to address, the WWSS Commission is not aware of any WQCs applicable to the proposed trading projects.
(f) Local ordinances	Not currently applicable. No applicable local ordinances have been identified that would impact the potential trading projects. The WWSS Commission will continue to evaluate any applicable local ordinances on a case-by-case basis as trading projects are further defined.
(g)Tribal laws, rules, or permits	Not currently applicable. The WWSS Commission is not aware of Tribal laws, rules or permits applicable to the potential trading projects. Requirements will be evaluated on a case-by-case basis as trading projects are further defined.
(h) Other applicable rules affecting nonpoint source requirements	Not currently applicable. The WWSS Commission is not aware of any other applicable rules affecting nonpoint source requirements at the potential trading projects. Requirements will be evaluated on a case-by-case basis as trading projects are further defined.

(i) Projects completed as part of compensatory mitigation, or projects required under a permit or approval issued pursuant to Clean Water Act section 404, or a supplemental environmental project used to settle a civil penalty imposed under OAR chapter 340 division 012 of the Clean Water Act	Project sites are being evaluated. On a case-by-case basis, the WWSS Commission will verify that the baseline requirements for a CWA or Supplemental Environmental Project site are met prior to calculating credits.
(j) Regulatory requirements a designated management agency established to comply with a DEQ-issued TMDL, water quality management plan or another water pollution control plan adopted by rule or issued by order under ORS 468B.015 or 468B.110.	The WWSS Commission will ensure that projects comply with baseline requirements associated with the Willamette River TMDL prior to calculating credits. Oregon State Parks is a designated management agency in the Willamette Temperature TMDL and may have requirements related to their land management activities. If any trading projects occur on state parks land, the associated baseline requirements will apply. Requirements will be evaluated on a case-by-case basis as trading projects are further defined.

The WWSS Commission will verify that all baseline requirements identified in Table 1 for its trading projects are met before calculating credits for its trading BMPs.

OAR 340-039-0025(5)(C): TRADING AREA

A trading plan must include a "description of the trading area including identification of the location of the discharge to be offset, its downstream point of impact, if applicable, where trading projects are expected to be implemented, and the relationship of the trading projects to beneficial uses in the trading area." Trades must occur within the same watershed or area covered by a TMDL so that the benefits of the trades occur in same waterbody where the discharge is occurring.[4] A trading area is also required to "encompass the location of the discharge to be offset, or its downstream point of impact, if applicable, and the trading project to be implemented."[5] Trading areas must also be consistent with the TMDL water quality management plans (WQMP), where they exist.[6]

The WWSS withdrawal is located at Willamette River Mile (RM) 38.7, approximately 3 miles upstream of the point where the Molalla River enters the Willamette (RM 35.6). The point of maximum impact of the WWSS withdrawal is located at RM 27.1, approximately 11.6 miles downstream of the withdrawal. The trading area will be the full Willamette River basin upstream of the point of maximum impact (see the map in Appendix A). The map indicates the location of the withdrawal, the point of maximum impact and the location of the reservoirs associated with the U.S. Army Corps of Engineers Willamette Valley Project, from which stored water may be available. The map also indicates the location of the Tualatin River, Pudding River and Molalla River, which enter the Willamette River between the withdrawal and the point of maximum impact. Riparian Shading, Floodplain Resiliency and In-stream Habitat Restoration BMPs (discussed below) may be identified and conducted on the Willamette River mainstem and its tributaries upstream of the point of maximum impact. The map in Appendix A also indicates HUC-12 watersheds which either include Willamette Valley Project reservoirs or are above Willamette Valley Project

[4] U.S. EPA, Water Quality Trading Policy, 68 Fed. Reg. at 1610. OAR 340-039-0040(1)
[5] OAR 340-039-0005(5)
[6] OAR 340-039-0035(2)

reservoirs. The map also indicates as HUC-12 watersheds above Trail Bridge Reservoir, part of the Carmen-Smith Hydroelectric Project on the McKenzie River. There are also other small reservoirs on minor Willamette River tributaries not shown on the map. The WWSS will not conduct Riparian Shade, Floodplain Resiliency or In-stream Habitat Restoration BMP projects upstream of reservoirs. These BMP project types are described in the next section. Additionally, as discussed below, purchase of stored water that would enter the Willamette upstream of the point of maximum impact would be quantitatively demonstrated to reduce the temperature impact at the point of maximum impact. The full trading area is within the Willamette River basin and covered by the 2006 Temperature TMDL.

OAR 340-039-0025(5)(D): BMPS

Pursuant to the trading rule, a trading plan must include a "description of the water quality benefits that will be generated, the BMPs that will be used to generate water quality benefits, and applicable BMP quality standards." A BMP is defined as "in-water or land-based conservation, enhancement or restoration actions that will reduce pollutant loading or create other water quality benefits. BMPs include, but are not limited to, structural and nonstructural controls and practices and flow augmentation."[7] A BMP quality standard must include "specifications for the design, implementation, maintenance and performance tracking of a particular BMP that ensure the estimated water quality benefits of a trading project are achieved, and that allow for verification that the BMP is performing as described in an approved trading plan."[8]

The primary BMP that will be used to generate thermal benefits under this thermal trading plan is the riparian shade BMP (Appendix B) at the proposed trading projects. The main purpose of the riparian shade BMP is to reduce thermal loading by blocking solar radiation. The methodology for calculating thermal credits will be discussed in the next section.

The BMP quality standard proposed by the WWSS Commission for riparian shade will include the following components:

- Projects will be implemented on public lands that have an established restoration plan and the intent of the land is for restoration and similar public benefit purposes. Conducting restoration on such properties will allow the associated benefits to be adequately preserved. If projects are to be implemented on private property, the appropriate easements and encumbrances will be acquired.
- Riparian Shade BMPs will be designed, implemented, monitored, verified, and tracked consistent with the TTP Standards for Riparian Restoration Projects (see Appendix B), which are based on the Willamette Partnership's Performance Standards for Riparian Revegetation (Willamette Partnership 2016).
- In accordance with maintenance plans developed at the outset of credit projects, BMPs will be visited regularly for maintenance, especially in early "establishment" years. During site establishment, minimum maintenance on most sites will usually include one spring ring spray, one summer mow or cut, and one fall spot spray. In irrigated riparian areas with water rights, irrigation may be an appropriate option during the first several years. Once a site has become established, maintenance activities will continue, but may occur at less frequent intervals.
- Details on the performance tracking and verification aspects of the WWSS Commission's proposed BMP quality standards are described below in the subsections corresponding with OAR 340-039-0025(5)(G) verification, and (H) tracking/reporting.

[7] OAR 340-039-0005(1)
[8] OAR 340-039-0005(2)

- Projects will include the removal of invasive species and replanting of native trees to increase stream side shading. Habitat restoration will be incorporated where replanting occurs.
- In addition to riparian shading, consideration will be given to increasing instream habitat complexity, enhancing riparian habitat, and reconnecting off-channel habitats. Where possible, efforts will be made to create cold water refugia, which are identified in the 2006 Willamette River TMDL as an important consideration because of the importance of offering migrating salmonids refugia from warmer river temperatures in the summer.

Two additional types of BMPs, Floodplain Resiliency and In-stream Habitat Restoration BMPs, are discussed in Appendix C. The floodplain habitat resiliency BMP focuses on habitat improvements along floodplains (generally within the 100-year floodplain and consisting of riparian and upland habitats) to improve the functions of native aquatic ecosystems. These improvements will allow for continued stream shading after a channel migrates across the floodplain, rather than channel migration into more degraded areas. The in-stream habitat BMP focuses on activities within the stream channel, including side channels inundated with at least a 2-year return interval. Key activities may include increasing stream habitat complexity, reconnecting or creating new side channels, improving cold water refugia access to fish and other activities supporting habitat for key species.

Additional BMP types may be proposed during the life of this TTP. Each new BMP type will be detailed in an addendum to this TTP, with review and approval by DEQ prior to implementation**.**

Stored Water

Water stored behind U.S. Army Corps of Engineers (USACE)-operated dams as part of the Willamette River Valley Project is in the process of being allocated; some of this water will be allocated to municipalities, including the WWSS partners. This water will become available for water supply and releasing some of this stored water may be a potential mitigation strategy for river water temperature impacts and augmenting summer water supplies for the WWSS partners.

The impact of utilizing stored water could be quantified through CE-QUAL-W2 model simulations. The releases would be added to the model(s) at the appropriate upstream locations and the impact on water temperatures, particularly at the point of maximum impact, could be evaluated using the CE-QUAL-W2 models developed for the Willamette River Temperature TMDL.

OAR 340-039-0025(5)(E): TRADING RATIOS

Trading ratios are "a numeric value used to adjust the number of credits generated from a trading project, or to adjust the number of credits that a credit user needs to obtain." In Oregon, trading ratios can be used to account for time lags, attenuation of water quality benefits, among other uncertainties.[9] A trading plan must include a "description of applicable trading ratios, the basis for each applicable trading ratio, including underlying assumptions for the ratio, and a statement indicating whether those ratios increase or decrease the size of a credit obligation or the number of credits generated from an individual trading project."

To date, in Oregon riparian shade restoration trading programs, DEQ has approved a 2:1 trading ratio. The WWSS proposes to use the same 2:1 trading ratio for its projects.

OAR 340-039-0025(5)(F): CREDITS

The trading rule requires that a trading plan include a "description of the credits needed to meet water quality-based requirements of an NPDES permit or 401 water quality certifications, including:

[9] OAR 340-039-0005(10)

- Quantity and timing: The number of credits needed and any credit generation milestones, including a schedule for credit generation;
- Methods used: How credits will be quantified, including the assumptions and inputs used to derive the number of credits; and
- Duration of credits: A description of the length of time credits are expected to be used."

Credits Needed

This subsection identifies the projected excess thermal load exceedance(s) throughout the year. For a discharge, thermal exceedance is equal to: (*Facility Excess Thermal Load*) – (*Excess Thermal Load Limit*), or ETL – ETLL, where:

ETL = (Flow $_{\text{effluent (cfs)}}$) x (°C $_{\text{effluent}}$ – °C $_{\text{Temperature Criteria}}$) x (Conversion Factor)
ETLL = (Flow $_{\text{river (cfs)}}$ + Flow $_{\text{effluent (cfs)}}$) x (Human Use Allowance) x (Conversion Factor)

Because the WWSS Commission's trading plan is for a withdrawal rather than a discharge, the credits to be offset must be calculated differently. Calendar year 2001 was a very dry year in which Willamette River flows were below the 7Q10 flows for much of the summer, making it an appropriate year for consideration of the water temperature impacts of the WWSS withdrawal. Calendar year 2002 was a more typical year, and previous modeling[10] indicated smaller water temperature increases. For each day during the modeled period for Calendar Year 2001 (April through October), a heat load was calculated as follows:

$$\Delta T * Q * 1000 \frac{kg}{m^3} * 86400 \frac{s}{day} * \frac{1\,kcal}{kg * °C} = \textbf{Heat Load (kcal/day)}$$

Where:
ΔT is the increase in Daily Maximum water temperature (above the baseline scenario discussed below), in degrees C
Q is the Daily Average flow in the river at the location of maximum impact, in cubic meters per second (cms)

The previous analysis considered two baseline scenarios:

- TMDL model, with no adjustment
- TMDL model, with 70 MGD of withdrawal to account for the already-permitted WRWTP withdrawal (Baseline-1)

For this analysis, an additional baseline scenario was considered (Baseline-2):

- TMDL model, with the 70-MGD WRWTP withdrawal and a 56-cfs (1.586 cms) withdrawal at the upstream end of the Middle Willamette River model to account for the 56-cfs water right purchased by the City of Hillsboro under Permit S-45565 (GSI, 2017).

The purchase of the 56 cfs water right guarantees that this amount of water remains in the river downstream to the point of the WWSS withdrawal under future conditions. This is analogous to flow augmentation and comparing the maximum WWSS withdrawal scenario to a baseline scenario which includes the 56 cfs of withdrawal upstream of the WWSS withdrawal provides an accurate assessment of the net impact of the increased WWSS withdrawal, which is partially offset by the augmentation of river flows in the middle Willamette River upstream of the withdrawal.

[10] Geosyntec, 2018. Temperature Modeling, Summary. Memorandum to Amy Simpson and Jim Bloom, ODEQ. May 23.

For consistency with the impact quantification approach applied in other trading plans (the City of Ashland Draft Trading Plan[11] and the Clean Water Services Thermal Load Management Plan[12]), after calculation of the heat load for each day according to the above formula, the maximum rolling 30-day average heat load was determined.

Based on this analysis, the maximum rolling 30-day average heat load is **30.2 million kcal/day.**

More detailed results are presented in Figure 1, which shows the backwards-looking rolling 30-day average heat load increase for the maximum scenario relative to the two baseline scenarios. The value for a given date is the average of the heat load increases for the preceding 30 days. For dates where the line is not visible, the 30-day average heat load increase is negative (i.e. the maximum scenario is colder than the baseline scenario). The figure indicates that the maximum rolling 30-day average heat load increase above the "Baseline-1" scenario is 237.3 million kcal/day. The maximum 30-day average heat load increase above the "Baseline-2" scenario, which accounts for the "flow augmentation" guaranteed by the purchase of the 56-cfs water right, occurs 10-days later and is 30.2 million kcal/day, 12.7% of the increase above "Baseline-1."

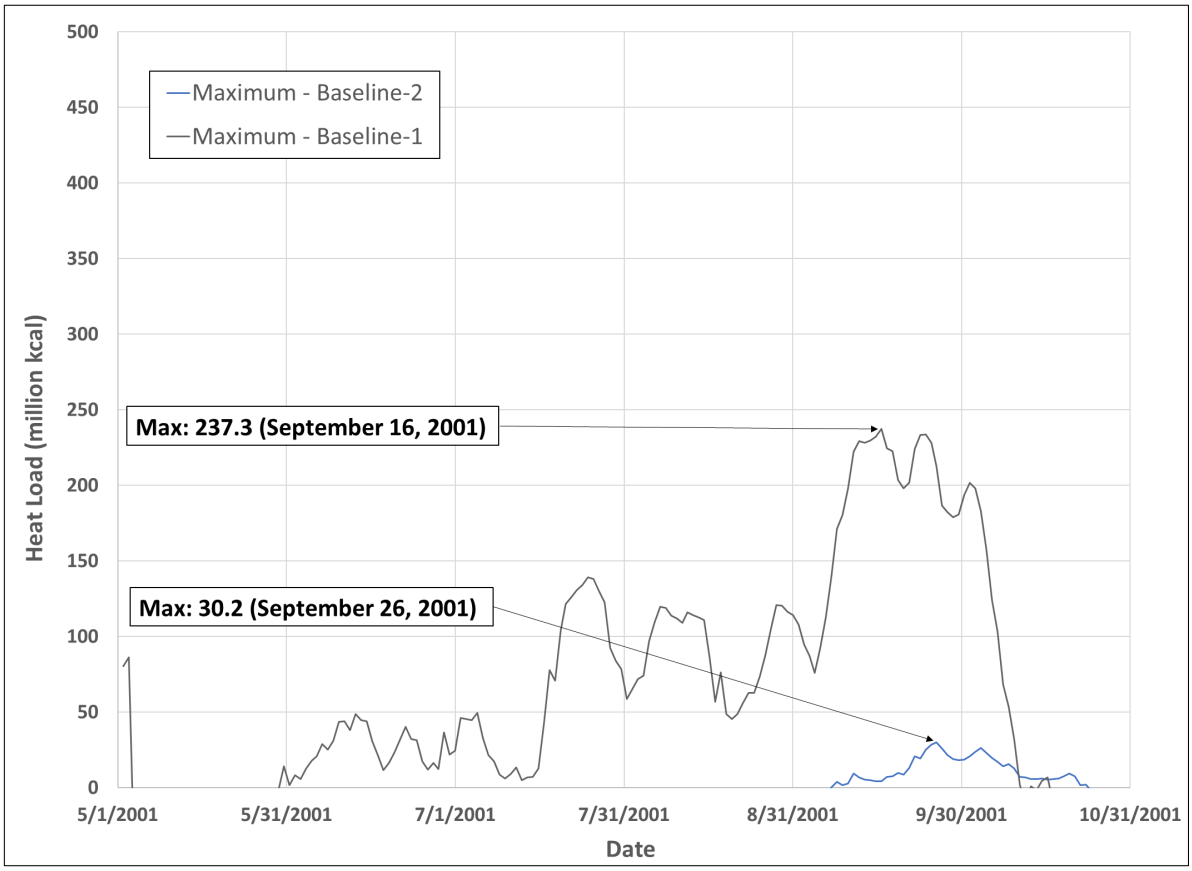


Figure 1. Rolling Backwards-Looking 30-Dav Average Heat Load Increase for the Maximum Scenario above Two Baseline Scenarios, at the Point of Maximum Impact (RM 27.1).

The average values for each calendar month (average of the daily heat-load increases for each day within the calendar month) are shown in Table 2. The calendar months where the average increases are negative (i.e. a decrease) are indicated. For both scenarios, the maximum rolling 30-day average includes dates from both August and September, explaining why the maximum values in Table 2 are lower than those indicated in Figure 1.

[11] Draft City of Ashland Trading Plan v3 (March 2018)
[12] Clean Water Services (2016). Thermal Load Management Plan Package. Memorandum to File. May.

Table 2. Average Daily Heat Load Increase for each calendar month for the Maximum Scenario above Two Baseline Scenarios, at the Point of Maximum Impact (RM 27.1).

Month	Maximum – Baseline-1 (million kcal/day)	Maximum – Baseline-2 (million kcal/day)
April	**70.2**	**<0**
May	**13.8**	**<0**
June	**24.7**	**<0**
July	**77.5**	**<0**
August	**107.7**	**<0**
September	**193.6**	**18.7**
October	**<0**	**<0**

Table 3 presents the highest backwards-looking rolling 30-day average heat load increase for each calendar month (e.g. the value for a given date represents the preceding 30 days—the value reported for July 31 would represent the average heat load increase for July 1 – July 30). April is thus omitted from the table because the first backwards-looking 30-day average heat load is reported in May. The table indicates that the maximum values occur in September, which is also demonstrated in Figure 1.

Table 3. Highest Backwards-Looking Rolling 30-Day Average Heat Load Increase Ending in Each Calendar Month for the Maximum Scenario above Two Baseline Scenarios, at the Point of Maximum Impact (RM 27.1).

Month	Maximum – Baseline-1 (million kcal/day)	Maximum – Baseline-2 (million kcal/day)
May	**86.2**	**<0**
June	**48.9**	**<0**
July	**139.2**	**<0**
August	**120.8**	**<0**
September	**237.3**	**30.2**
October	**201.7**	**26.3**

The methodology for calculating the credits will be demonstrated in a subsequent section. As previously discussed, the WWSS Commission proposes to use a trading ratio of 2:1.

Methods Used:

The WWSS Commission will estimate the thermal benefits from riparian shade best management practice projects (BMPs) using version 8 of DEQ's Shade-a-Lator model. Shade-a-Lator is a part of the Heat Source model, which is a stream assessment tool used by DEQ.[13] Heat Source was developed in 1996 as a Master's Thesis at Oregon State University in the Departments of Bioresource Engineering and Civil Engineering. DEQ currently maintains the Heat

[13] Boyd & Kasper, Analytical Methods for Dynamic Open Channel Heat and Mass Transfer: Methodology for the Heat Source Model Version 7.0 (2003), *available at* https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Tools.aspx. DEQ has posted this document on its website as a resource for generally describing the math and assumptions used in Heat Source. While the document explicitly covers Heat Source version 7 (and therefore Shade-a-Lator version 7), the math and assumptions in version 7 are mostly the same as version 8, and so DEQ considers this document appropriate for summarizing both versions 7 and 8.

Source methodology and software. TTools, an ArcGIS extension maintained by DEQ, will be used to sample geospatial data and assemble high-resolution topographic and vegetative inputs necessary to run the Heat Source model.

Shading credits will be evaluated using the Shade-a-Lator component of the Heat Source tool, not the full Heat Source model. This eliminates the need to use a model that has been calibrated to water temperature data since only the solar radiation blocked by baseline and project conditions shade will be considered.

To determine the potential reduction in solar loading that results from its project, the WWSS Commission will compare the current project area to a future conditions scenario that assumes BMP conditions at maturity. The difference in the incoming solar load (expressed in kilocalories per day) between the two scenarios represents the net thermal benefits generated from the BMPs.

Model inputs such as the upstream and downstream boundaries of the modeled stream reach, local topography, bank slope, and stream orientation will be assumed to be the same in the current condition and future condition scenarios. An exception is the wetted width of the stream, which may differ between future conditions scenarios due to the potential creation of new side channels during the project. The future conditions scenario will use the tree height and density based on the expected conditions after the project is complete.

For both the current and future conditions scenarios, the model calculates the sun angle at a series of calculation points (nodes along the center of the modeled stream reach for every model time step (typically once per minute). At each node, the model calculates the total load of incoming solar radiation by considering the physical characteristics surrounding the node and the characteristics of the topographic and vegetation present on the streambanks (Figure 2).

Figure 2 demonstrates that the sun angle is a key parameter in the Shade-a-Lator model. The time of day and time of year affect the sun angle and the associated incoming solar radiation that reaches the surface of the stream.

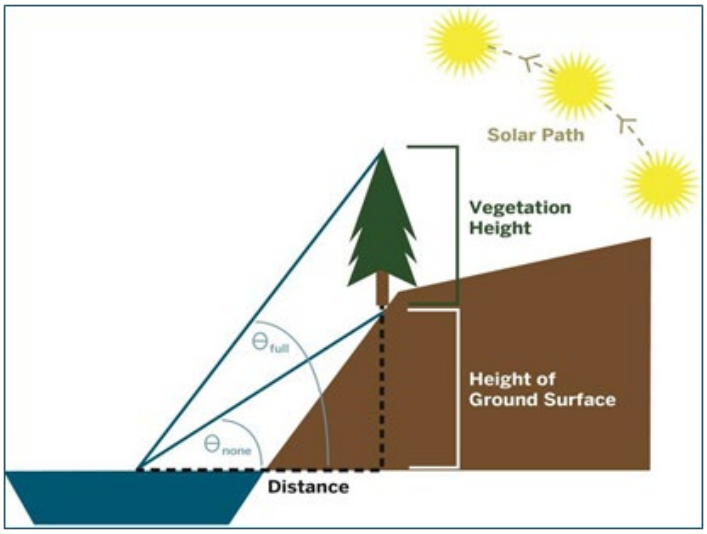


Figure 2. Schematic of the processes included in Shade-a-Lator modeling. When the sun angle is less than $\Theta_{none,}$ all incoming solar radiation is blocked by the local topography. When the sun angle is greater than $\Theta_{full,}$ all incoming solar radiation reaches the surface of the stream. When the sun angle is between Θ_{none} and $\Theta_{full,}$ vegetation attenuates a portion of the incoming solar radiation.

Credit Duration:

Credit duration refers to the "length of time credits are expected to be used."[14] This refers to the time period between when a credit becomes usable as an offset and when the credit is no longer valid. Credits are generated after a trading plan has been approved by DEQ and the restoration action has been implemented and verified. BMPs such as riparian restoration require time to realize their full benefits. Because of this, the projects must be durable and verification and ongoing monitoring and maintenance of project sites are critical parts of the program. The 2003 EPA Trading Policy provides that "credits may be generated as long as the pollution controls or management practices are functioning as expected.[15]" In addition, the Oregon rule definition of a credit identifies the need to specify the period over which water quality benefits will be generated.

For the purposes of this TTP, the WWSS Commission suggests both a minimum credit life consistent with the rules, and the appropriate start date for the credit life. For reference, the City of Ashland proposed a 20-year credit life for its credits.[16] The City of Medford's program uses an average 20-year credit life, protected by long-term leasehold interests in the properties where the restoration occurs.[17] Clean Water Services also uses a minimum 20-year credit life in its temperature management plan.[18] Consistent with the 2003 EPA Trading Policy and these previous programs, the WWSS Commission proposes that the credits it produces from riparian vegetation projects have a minimum 20-year credit life, with the possibility of extending those credits beyond the minimum life for as long as the restoration sites and shade continue to function as expected and as long as the credits are needed to offset the temperature impact. This approach is consistent with the minimum time period for which these projects are expected to function and the 2003 EPA Trading Policy. The WWSS Commission proposes that the credit life begins in 2026, when the withdrawals will begin. This would be conservative because benefits of trading projects will begin before 2026. Implementation of credit trading projects is expected to begin in Winter 2022. Table 4 below, shows a schedule for key events relevant to the timing of trading projects and the thermal impact of the withdrawal.

Table 4. Selected events relevant to the timing of trading projects and the thermal impact of the withdrawal.

Approximate Date	Event
Winter 2020	Expected TTP Approval
Winter 2022	Beginning of Credit Generation
2026	WWSS Comes Online, Credit Life Begins
2085	Full Water Temperature Impact Reached

OAR 340-039-0025(5)(G): MONITORING

Pursuant to the trading rule, a trading plan must include a "description of the following: (A) Proposed methods and frequency of trading project BMP monitoring; and (B) Proposed methods and frequency of how water quality benefits generated by a trading project will be monitored." In addition, an entity that engages in trading must submit an annual report that includes all of the elements described in OAR 340-039-0017(3) (See Appendix D).

The WWSS Commission will submit an annual report that includes the elements described in OAR 340-039-0017(3). In addition to submitting an annual monitoring report, the WWSS Commission proposes a monitoring schedule (Appendix B) that is based in part on the Willamette Partnership's February 2016 riparian addendum to its General

[14] OAR 340-039-0025(5)(f)(C)
[15] U.S. EPA, Water Quality Trading Policy, 68 Fed. Reg. 1608, 1610 (Jan. 13, 2003), *available at* https://www.gpo.gov/fdsys/pkg/FR-2003-01-13/html/03-620.htm.
[16] Draft City of Ashland Trading Plan v3 (March 2018)
[17] City of Medford, Medford Regional Water Reclamation Facility Thermal Credit Trading Program Plan (2011). https://www.oregon.gov/deq/FilterDocs/MedfordThermalTrading.pdf.
[18] Clean Water Services (2016). Thermal Load Management Plan Package. Memorandum to File. May.

Crediting Protocol. Consistent with that protocol, a specific combination of the following three types of monitoring approaches will be applied throughout the life of each riparian restoration project to demonstrate that the project continues to function as expected as it relates to the performance metrics identified in Appendix B:

1) **Quantitative monitoring**: the project developer, on behalf of the WWSS Commission, will implement a vegetation monitoring protocol (Appendix B) by sampling random plots on site; implementing repeat photo monitoring; and reporting on a comparison of monitoring data to performance standards.

2) **Qualitative monitoring**: an on-site, rapid, but standardized, qualitative review of site conditions and progress toward performance metrics will be accompanied by a subset of repeat photos from on-the-ground camera points used in quantitative years. The same set of camera points will be used in all qualitative monitoring years.

3) **Remote monitoring**: remote sensing information will be collected to provide visual evidence that the site still exists (e.g., a current year aerial image or LiDAR taken during the growing season to document site persistence). To remain consistent with Willamette Partnership approaches, the WWSS Commission proposes to monitor sites according to the schedule in Table 5.

Table 5. Monitoring and reporting approaches over the life of a project.

Monitoring Approach	Completed Growing Seasons After Planting and Initial Verification										
	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Quantitative Monitoring	•	•		•		•					•
Qualitative Monitoring			•		•		•		•		
Remote Monitoring[19]								•		•	
Monitoring Approach	**Completed Growing Seasons After Planting and Initial Verification**										
	Y11	**Y12**	**Y13**	**Y14**	**Y15**	**Y16**	**Y17**	**Y18**	**Y19**	**Y20**	
Quantitative Monitoring					•					•	
Qualitative Monitoring		•					•				
Remote Monitoring	•		•	•		•		•	•		

In addition to this standard proposed site monitoring, if project sites are damaged by causes beyond the reasonable control of the WWSS Commission (such as wildlife damage or vandalism), the WWSS Commission will report that damage to DEQ. The WWSS Commission proposes reporting such incidents to DEQ within 90 days of learning of the damage. The reporting would include a description of the event, including an assessment of the damage; a plan for addressing the damage; and a schedule for implementing the plan. Following the City of Ashland's Draft TTP, WWSS Commission proposes that natural restoration and/or active replanting of the damaged site be allowed if repair or continued maintenance of the damaged site provides the reasonable potential for long-term restoration of the thermal benefits of the site in an ecologically appropriate manner. Replacement with an alternative site or sites could also be pursued. The WWSS Commission proposes that damage to a project site that is beyond the reasonable control of the WWSS Commission should not in and of itself be considered a violation of its WQC requirements. Under such conditions, the WWSS Commission will demonstrate to DEQ that the sites will be restored, or alternative solutions will be implemented within a reasonable timeframe. This suggested approach follows the City of Ashland Draft TTP[20] and is consistent with the

[19] If remote information is not available for a monitoring year designated for remote monitoring, the qualitative monitoring approach can instead be used for that year. If this occurs, a later year designated as qualitative monitoring may be remotely monitored if this does not result in more than two consecutive years of remote monitoring in the first 10 years.

[20] Draft City of Ashland Trading Plan v3 (March 2018)

approach outlined in the City of Medford's NPDES permit.[21]

4) After the first 20 years, so long as credits are still required to offset the temperature impact of the WWSS, the WWSS Commission proposes that quantitative monitoring be conducted every 10 years. For qualitative and remote monitoring, the WWSS Commission proposes that the Year 11-20 pattern shown in Table 5 be repeated in each subsequent decade. For example, in Years 21, 23, 24, 26, 28, and 29 remote monitoring would be conducted and in years 22 and 27 qualitative monitoring would be conducted.

OAR 340-039-0025(5)(H): TRADING PLAN PERFORMANCE VERIFICATION

Pursuant to the trading rule, a trading plan must include a "description of how the entity will verify and document for each trading project that BMPs are conforming to applicable quality standards and credits are generated as planned."

The Oregon trading rules require an entity to verify and document that BMPs conform to quality standards, and that the credits are tracked and made available to the public. To be consistent with the Oregon water quality trading rule, the WWSS Commission will pursue a verification approach consistent with the Willamette Partnership's standards for verification.[22]

Specifically, after a project site has been implemented with BMPs, the project will undergo a review for verification. The review will include administrative review of the site's eligibility, an independent technical review of credit calculation, and a site visit to demonstrate that the project has been implemented in a manner consistent with the BMP quality standards included in this trading plan. Prior to Year 5 of the project, verifiers will review monitoring reports and attest that the site does not appear at risk of failure. At later milestones in the project (specifically, Years 5, 10 and 15), a third-party verifier will confirm that the site is continuing to mature and develop on a trajectory that is materially consistent with the as-built site and quality standards. In the years between these milestone verifications, verifiers will review annual monitoring reports and attest that the site does not appear at risk of failure. At year 20, a third-party verifier will review originally estimated credit calculations versus final credit calculations, a comparison of predicted Year 20 site conditions versus actual Year 20 site conditions, and an on-site visit to confirm that Year 20 quality standards have been met.

OAR 340-039-0025(5)(I): TRACKING AND REPORTING

Pursuant to the trading rule, a trading plan must include a "description of how credit generation, acquisition and usage will be tracked and how this information will be made available to the public."

Transparency is critical to a credible trading program. Therefore, in addition to completing monitoring (as described above), submitting annual compliance reports to DEQ and completing performance verification, the WWSS Commission will evaluate posting trading credit information on a publicly accessible website to disclose progress at the proposed trading project site. One example of a publicly accessible portal for information is MarkIt, an environmental credit registry being used for the City of Medford temperature compliance plan managed by the Freshwater Trust.

[21] Oregon Department of Environmental Quality, City of Medford National Pollutant Discharge Elimination System Waste Discharge Permit, No. 100985, Schedule D(7)(b)(v) (Dec. 13, 2011).

[22] Willamette Partnership, Ecosystem Credit Accounting System Third Party Verification Protocol Version 1.0 (2009), *available at* http://willamettepartnership.org/publications/.

Regarding tracking and reporting, the WWSS Commission will verify that:

- Individual thermal benefits and transactions are accounted for and can be tracked,
- Program implementation progress can be tracked, and
- Enough information is provided related to individual project site trajectory (i.e., annual monitoring reports).

OAR 340-039-0025(6): ADAPTIVE MANAGEMENT

Pursuant to the trading rule, a trading plan must include a "description of how monitoring and other information may be used over time to adjust trading projects and under what circumstances." Significant program amendments may require public review and comment (see OAR 340-039-0025(7)), but other small changes will fall under the scope of adaptive management.

The WWSS Commission recognizes the importance of long-term maintenance and monitoring to verify that the overall trading program and specific projects are successful, demonstrate ecological improvement in program areas, and are meeting the temperature condition of the 401 WQC. The monitoring plan described in this TTP is a key part of evaluating progress towards achieving the needed credits and achieving the thermal benefit described in this TTP. Because the proposed project will extend over a long (multi-decade) time frame, the ability to adapt any aspect of the program (monitoring, maintenance, implementation or reporting) is important. As technologies, BMP implementation, and monitoring practices evolve, the WWSS Commission will evaluate approaches to adapt its implementation plan as appropriate.

To adapt and improve the program over time, the WWSS Commission proposes a five-year adaptive management cycle. This length of time is an appropriate cycle to review information from the previous cycle and apply any new technologies, standards or lessons learned to update the plan to maintain sufficient progress towards the goals of the project. Periodic review also affords transparency and quality control. A five-year cycle is also an appropriate length of time to take into account any time-lag in measuring the effectiveness of the BMPs and provides more flexibility to appropriately collect and analyze these data. This process will be internal, but if substantive changes are required, the requirements of OAR 340-039-0025(7) will be met.

OAR 340-039-0025(7): TRADING PLAN REVISION

The WWSS Commission will comply with the requirements in OAR 340-039-0025(7) for trading plan revision if there are substantive changes that affect one of the trading plan elements as required by OAR 340-039-0025(5). Any revised trading plan will be submitted to DEQ for review.

Consistency with Water Quality Trading Purpose and Policy

OAR 340-039-0001: PURPOSE AND POLICY

"(1) Purpose. This rule implements ORS 468B.555 to allow entities regulated under the CWA to meet pollution control requirements through water quality trading. This rule establishes the requirements for water quality trading in Oregon.

(2) Policy. The Oregon Department of Environmental Quality may approve water quality trading only if it promotes one or more of the following Environmental Quality Commission policies: (a) Achieves pollutant reductions and progress towards meeting water quality standards; (b) Reduces the cost of implementing Total Maximum Daily Loads (TMDLs); (c) Establishes incentives for voluntary pollutant reductions from point and nonpoint sources within a watershed; (d) Offsets new or increased discharges resulting from growth; (e) Secures long-term improvement in water quality; or (f) Results in demonstrable benefits to water quality or designated uses the water quality standards are intended to protect."

This TTP is consistent with the EQC policies. The WWSS Commission trading plan is expected to create thermally

cooler water and thermal refugia for fish and will have substantial habitat benefits.

While not a discharge, the thermal impact of the WWSS withdrawal results in increased water temperatures downstream and the trading plan will offset the thermal impact of the increased withdrawal.

Consistency with Water Quality Trading Objectives

OAR 340-039-0003: WATER QUALITY TRADING OBJECTIVES

As stated in OAR 340-039-0003, Water quality trading under this rule must:

1) Be consistent with anti-degradation policies
2) Not cause or contribute to an exceedance of water quality standards
3) Be consistent with local, state, and federal water quality laws
4) Be designed to result in a net reduction of pollutants from participating sources in the trading area
5) Be designed to assist the state in attaining or maintaining water quality standards
6) Be designed to assist in implementing TMDLs when applicable
7) Be based on transparent and practical Best Management Practices (BMPs) quality standards to ensure that water quality benefits and credits are generated as planned
8) Not create localized adverse impacts on water quality and existing and designated beneficial uses.

This TTP is consistent with these objectives, as follows:

(1, 2, 4) Anti-degradation & Net Reduction in Pollutant Loading: Oregon's anti-degradation policy is found in OAR 340-041-0004. Oregon's anti-degradation policy generally prohibits the lowering of existing water quality. In line with the 2003 EPA Trading Policy[23], the 2016 water quality trading IMD[24] instructs DEQ staff to ensure that trades are designed to result in a net reduction of pollutants in the trading area as required in OAR 340-039-0003(4). The WWSS withdrawal has an impact only on temperature, and not other pollutants. This TTP describes how the temperature impact of the WWSS withdrawal will be mitigated and will not violate the anti-degradation or water quality standards.

(3) Consistent with local, state, and federal water quality laws:

The trading program is consistent with Oregon's anti-degradation policy, the 2006 Willamette River Temperature TMDL[25] and the Oregon trading rule (OAR 340-039). The TTP considers and is consistent with baseline regulations that ensure credits will be achieved above the baseline condition. A requirement for the development of this TTP is incorporated into the WWSS Commission's 401 WQC.

(5,6) Designed to Assist State in Attaining Water Quality Standards and Implementing a TMDL:

The 2006 Willamette River Temperature TMDL did not consider water temperature impacts of withdrawals, with the exception of temporary diversion along the McKenzie River. As a result, the WWSS is not assigned a heat load in the TMDL. The WWSS Commission will use water temperature credit trading, as described in this TTP, to offset its thermal impact. This TTP will assist the State in attaining water quality standards and meeting the criteria of the

[23] U.S. EPA, Water Quality Trading Policy, 68 Fed. Reg. 1608, 1610 (Jan. 13, 2003), *available at* https://www.gpo.gov/fdsys/pkg/FR-2003-01-13/html/03-620.htm.
[24] Oregon Department of Environmental Quality (2016), Water Quality Trading Internal Management Directive. March 31. A*vailable at* https://www.oregon.gov/deq/Filtered%20Library/WQTradingIMD.pdf
[25] Oregon Department of Environmental Quality, (2006). The Willamette Basin Total Maximum Daily Load (TMDL) documents. *Available a*t https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Willamette-Basin.aspx

Willamette River mainstem TMDL.

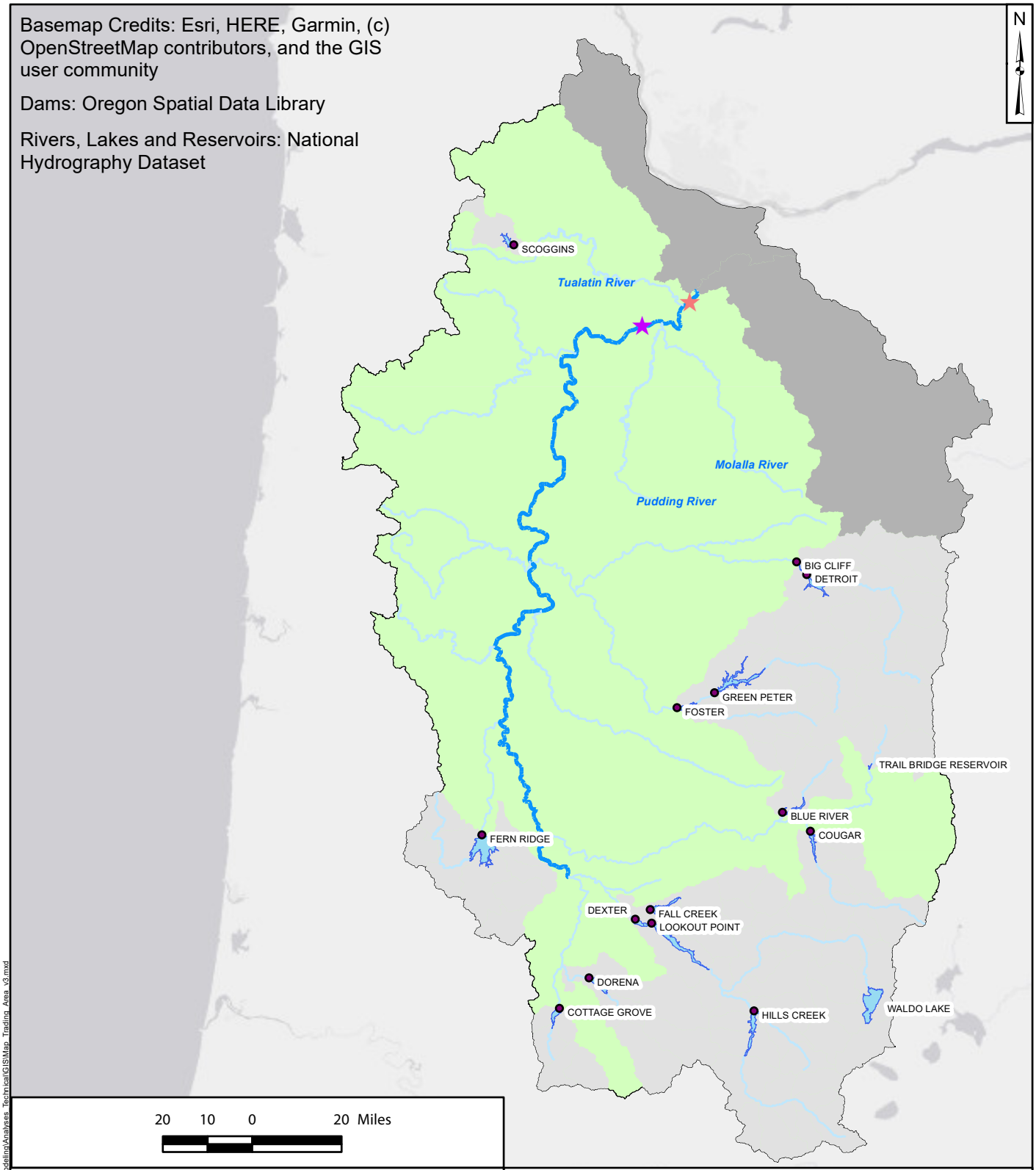
(8) Based on transparent and practical BMPs quality standards:

The proposed BMP quality standards are described in detail above.

(9) Avoidance of Localized Impacts on Fish:

The WWSS withdrawal location is at River Mile (RM) 38.7 and the point of maximum impact is at RM 27.1. The thermal impact of the withdrawal is not localized, because it takes time for the reduced river flow to result in increased water temperatures. Therefore, this criterion is not applicable to the WWSS withdrawal. In addition, the point of maximum impact is temporary in time and space and, as noted above, the maximum water temperature increase is very small (i.e. less than one-tenth of a degree).

Appendix A: Willamette Water Supply System Trading Area Map



Notes

Scoggins Dam, owned by the U.S. Bureau of Reclamation, is not operated by the U.S. Army Corps of Engineers but provides additional storage and is often included on WIllamette Project Maps.

Path: P:\Clients\Hillsboro_City_of\Projects\PNW0340_Temperature_Modeling\Analyses_Technical\GIS\Map_Trading_Area_v3.mxd

Willamette Water Supply System Trading Area Map

Oregon

Geosyntec consultants

Portland, Oregon | 27-Jul-2020

Figure

A-1

Appendix B: Riparian Shade BMP Performance Standards for the Willamette Water Supply System Thermal Trading Plan

Riparian Shade BMP Performance Standards for the

Willamette Water Supply System Commission's Temperature Trading Plan

Introduction

The following performance standards are to be applied to the Riparian Shade Best Management Practice (BMP) associated with the Willamette Water Supply System (WWSS) Commission's Temperature Trading Program (TTP). These standards have been developed based on the Performance Standards for Riparian Vegetation (Willamette Partnership 2016). Instances where the proposed standards deviate from the Willamette Partnership's are noted below (i.e. use of reference sites).

Performance Criteria

At the end of the 5th, 10th, 15th, and 20th restoration project year, monitoring data will demonstrate that the project meets the standard performance criteria shown in Table 1. Alternate performance criteria may be allowed if supported by appropriate documentation of suitable reference site conditions. Alternate criteria should be documented and approved by the Oregon Department of Environmental Quality (DEQ) prior to restoration project implementation.

TABLE 1 STANDARD PERFORMANCE CRITERIA FOR WWSS TTP RIPARIAN SHADE PROJECTS

<table>
<tr><th rowspan="2">Criteria</th><th colspan="4">Performance Criteria</th></tr>
<tr><th>Year 5</th><th>Year 10</th><th>Year 15</th><th>Year 20</th></tr>
<tr><td rowspan="2">EITHER:
Mean stem density of native shrubs and woody vines *
OR
Site average for combined native shrub and woody vine cover</td><td>Meets or exceeds 1,600 live native woody stems per acre</td><td>80% of the native woody stem density identified at the end of the fifth growing season</td><td>70% of the native woody stem density identified at the end of the fifth growing season</td><td>Same as performance criteria for year 15</td></tr>
<tr><td colspan="4">Site average for combined native shrub and woody vine cover >= 25%</td></tr>
<tr><td>% Canopy closure or cover</td><td>N/A</td><td>N/A</td><td colspan="2">>=25%</td></tr>
<tr><td>Native trees/acres</td><td>None</td><td colspan="3">>= 100 trees/acre **</td></tr>
<tr><td>Number of native woody species</td><td colspan="4">At least 5 native woody species present</td></tr>
<tr><td>Invasive woody and herbaceous cover</td><td colspan="4">No greater than 20% cover invasive herbaceous species.
No greater than 10% cover invasive woody species</td></tr>
<tr><td>Non-native woody and herbaceous cover</td><td colspan="4">Take and document actions reasonably necessary to evaluate the risk posed to project site by non-native species, where they are problematic (e.g., Phalaris arundinacea (reed canarygrass), Hedera helix (English ivy), Ilex aquifolium (English holly)), taking the steps</td></tr>
</table>

	necessary to control those non-native species such that their presence does not prevent the successful establishment and propogation of native ecosystem characteristics and functions. This includes monitoring and reporting percent cover of such species.
* Mean woody stem density is determined by counting all live woody stems taller than six inches (regardless of vigor) by species within reference sites. Count multi-stem species (e.g., *Symphoricarpos*, *Rosa*) as one stem per square foot (1' x 1'). ** Based on Willamette Partnership (2016) criteria for wet ecoregions	

The following definitions are associated with the above performance criteria:

Canopy closure	Canopy closure is an upward-looking point estimate of the coverage of a forest canopy, and may be measured in the field with a spherical densitometer (also called a mirror optometer) or by analyzing upward-looking hemispherical photographs.
Cover (or Absolute Cover):	Cover is a downward-looking measure of the percentage of the ground surface covered by living plant leaves and stems. Areas not covered by vegetation are counted as unvegetated substrate. Total cover may be greater than 100% if species are present in multiple strata (i.e., tree, shrub, and herbaceous layers.)
Cover (Canopy)	Absolute cover as viewed from above tree height
Cover (Native Shrub and Vine)	Absolute cover as viewed from beneath tree height.
Invasive species	A plant species should automatically be labeled as invasive if it appears on the current Oregon Department of Agriculture Noxious Weed list, plus known problem species including Mentha pulegium (pennyroyal) and Elaeagnus angustifolia (Russian olive).
Project year	Project year is measured as the number of completed growing seasons following initial verification, starting at 0. For example, where plantings are installed in the winter, the following fall would be considered the beginning of the project year 1, because the plantings have gone through one spring and summer growing season.
Shrub	A perennial woody plant that is usually multi-stemmed and normally grows no taller than 16 feet
Tree	A perennial woody plant, usually with a single stem or few stems, that normally grows taller than 16 feet

Reference Sites

The following discussion of reference sites contains a minor deviation from that proposed by the Willamette Partnership (2016). It allows for less intensive documentation of reference sites when using the standard performance criteria provided in Table 1.

Reference sites should be used to develop proposed restoration plans. Reference sites should be situated in similar ecological settings as the proposed restoration site (e.g. similar soils, hydrologic regime, general elevation range, geomorphic setting). The reference sites should have plant community characteristics similar to the desired mature condition of the proposed restoration site (e.g. moderate to high plant species diversity, percent cover by invasive plants less than 20 percent). If the standard criteria provided in Table 1 are used, then collection of reference site data may be of a qualitative nature to help develop a plant species list and general proportions of each species contribution to its plant community stratum (e.g. tree stratum cover totals approximately 80 percent, with approximately 60 percent black cottonwood and 20 percent Oregon ash). However, if the standard criteria are not being used, then quantitative sampling of the reference site will be required in order to justify changes to the standard criteria.

Monitoring

Annual monitoring shall occur that documents site conditions, management actions over the past year and proposed for the upcoming year, and overall progress toward the performance standards. Monitoring efforts shall be commensurate with the performance criteria listed in Table 1, with the scheduled intensity level as noted in the WWSS Commission's TTP (i.e. quantitative, qualitative, and remote monitoring). Monitoring shall include the use of random plots, repeat photo stations, and reporting on a comparison of monitoring data to performance standards.

Other BMPs

Additional BMP types may be proposed during the life of the WWSS Commission's TTP (e.g. improved summer time connectivity to cold-water refugia, floodplain vegetation management). Each new BMP type will be detailed in an addendum to the TTP, with review and approval by DEQ to occur prior to implementation.

Appendix C: Floodplain Resiliency BMP and In-stream Habitat Restoration BMP

Supplement to Willamette Water Supply System Thermal Trading Plan

Floodplain Resiliency BMP and In-stream Habitat Restoration BMP

Prepared for:

Willamette Water Supply
Our Reliable Water

City of Hillsboro Water Department
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August 2019

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1 INTRODUCTION

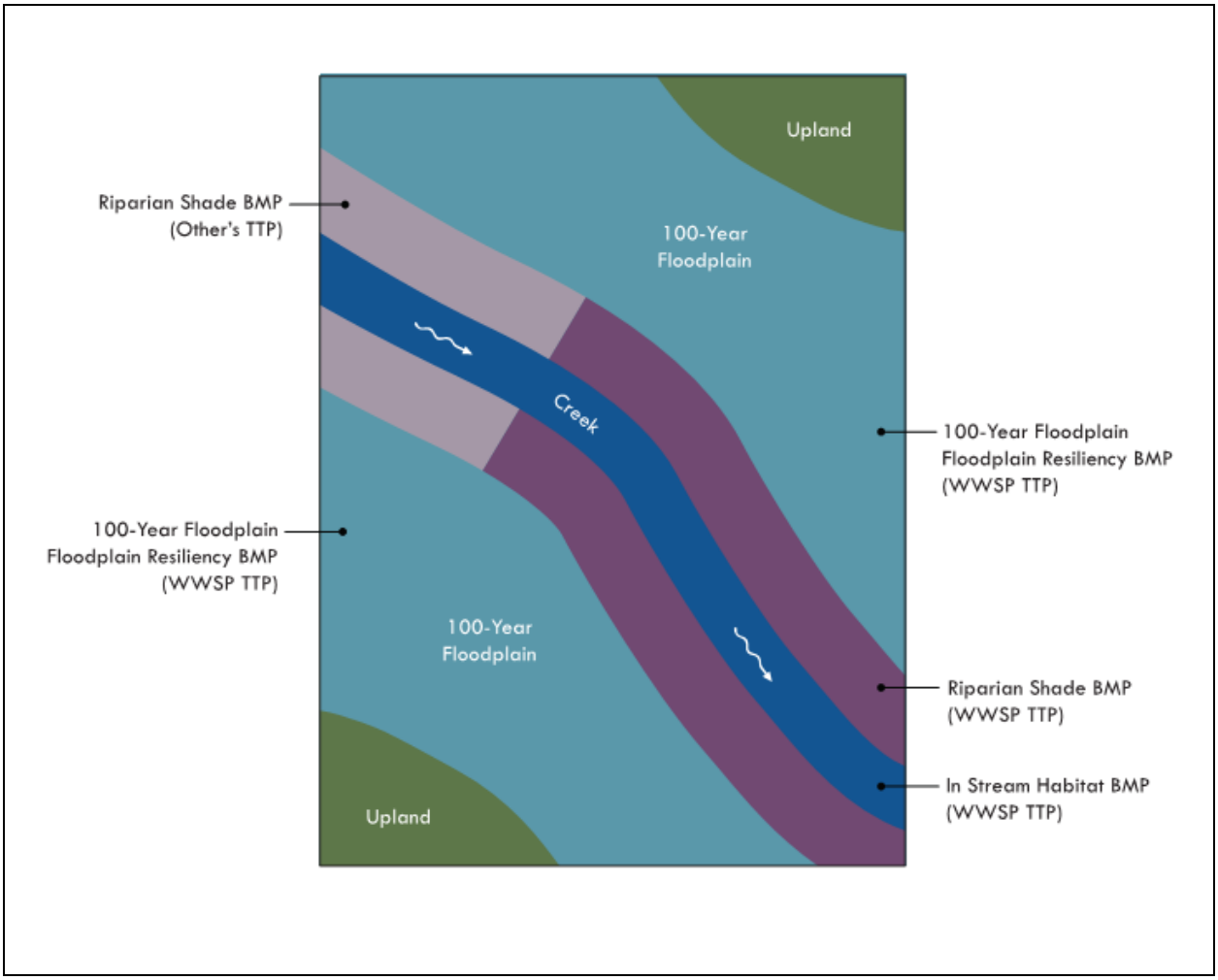
This report discusses proposed floodplain and in-stream habitat restoration Best Management Practices (BMPs) associated with the Willamette Water Supply System (WWSS) Commission's Thermal Trading Plan (TTP). These habitat restoration BMPs are distinguished from the Riparian Shade BMPs that have been included in the WWSS Commission's TTP as follows: the Riparian Shade BMP is focused solely on the thermal benefits associated with direct shading of streams from revegetation projects that can be quantified through the DEQ approved Shade-a-lator model (i.e. kilocalorie heat load reduction can be calculated). The floodplain and aquatic habitat restoration BMPs discussed in this report are focused on other types of habitat restoration actions that benefit the physical, chemical, and biological aspects of aquatic ecosystems but are currently difficult to quantify directly, in terms of their thermal load reduction benefits. However, the literature (see list of resources below) reveal the important linkages between habitat restoration actions and improvements to ecosystem functions – including benefits to water quality and improved vigor of native biological communities. These benefits help to offset the potential adverse effects of increased heat load in the main stem Willamette River that may result from water withdrawals for the WWSS.

The following BMPs are reviewed in this report:

- Floodplain Habitat Resiliency BMP
- In-stream Habitat Restoration BMP

To avoid the risk of double counting thermal load reductions, different BMP types proposed by the WWSS Commission will not overlap geographically with one another. However, it is anticipated that some BMPs will often occur adjacent to one another and will also be supportive of one another (e.g., the Riparian Shade BMP will support the In-stream BMP beyond just providing thermal benefits). Figure 1 shows how this may look at a single site with multiple BMP types, including BMP's that could be part of another entity's TTP.

Figure 1: Conceptual View of WWSP TSS BMPs at a Common Project Site



The following resources have informed this effort:

- A Scientific Rationale in Support of the Stream Function Assessment Method for Oregon (SFAM, Version 1.0) (Nadeau et. al 2018a)
- Stream Function Assessment Method for Oregon (SFAM, Version 1.0) Oregon Dept. of State Lands, Salem, OR, EPA 910-D-18-001, U.S. Environmental Protection Agency, Region 10, Seattle, WA. (Nadeau et. al. 2018b)
- Oregon Rapid Wetland Assessment Protocol (ORWAP, revised): Version 3.1 calculator spreadsheet, databases, and data forms. Oregon Dept. of State Lands, Salem, OR. (Adamus et. al. 2016)
- Performance Standards for Riparian Revegetation (Willamette Partnership 2016)
- Willamette Model Watershed Program Conceptual Model (Bonneville Environment Foundation date not specified)
- Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011)

2 BMP RATIONALE

The floodplain and in-stream BMPs may include a number of different actions that result in a net benefit to the aquatic ecosystems affected by the WWSS withdrawal by improving ecological processes and functions. For example, the Floodplain Habitat Resiliency BMP could include the following types of activities: controlling invasive species, planting native species, improving off-channel habitat, improving hydrologic connectivity between floodplain and associated streams, and promoting beaver activity. The In-stream Habitat Restoration BMP could include the following types of activities: improving in-stream habitat complexity (e.g. re-meandering straightened creek channels, placing large wood), removing fish barriers, increasing the amount of cold-water refugia, and improving access to cold-water refugia. These activities are intended as examples and do not preclude other types of activities from being considered. The connection between the activities listed above for each WWSS BMP and their associated benefits to aquatic ecosystems is described for each BMP in later sections of this report. A description of how the WWSS BMPs tie in to the strategies proposed by various Willamette River watershed ecosystem improvement efforts is provided below.

The Willamette Model Watershed Program, coordinated by the Bonneville Environment Foundation (BEF), has developed a detailed conceptual model that highlights the connections between key focal targets (e.g. aquatic ecosystems and native species) in the Willamette River basin, threats to these targets, and enhancement strategies to protect and improve conditions for the focal targets (BEF date not specified). Similarly, the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (Recovery Plan) (ODFW and NMFS 2011) provides a list of strategies to support the recovery of these species. Willamette Model Watershed Program and Recovery Plan strategies that directly relate to the proposed WWSS BMPs are listed in Table 1.

Table 1. Willamette Model Watershed Program and Upper Willamette River Chinook and Steelhead Recovery Plan Enhancement Strategies Related to the WWSS BMPs

Willamette Model Watershed Enhancement Strategies Related to WWSS BMPs	UWR Chinook and Steelhead Recovery Plan General Strategies Related to WWSS BMPs
• Manage invasive species • Reconnect floodplains/wetlands • Support persistence of beavers in appropriate areas • Increase hydraulic diversity and wood • Reconnect side channels, alcoves, and remeander channels • Revegetate riparian areas • Remove artificial fish passage and sediment transport barriers	• Protect and conserve natural ecological processes that support the viability of wild salmon and steelhead populations and their life history strategies throughout their life cycle. • Restore floodplain connectivity and function • Restore riparian condition and large woody debris recruitment • Restore passage and connectivity to habitats blocked or impaired by artificial barriers. • Restore and maintain hydrologic regimes that support ecological needs of wild salmon and steelhead populations. • Restore channel structure and complexity. • Restore impaired food web dynamics and function. • Restore degraded water quality • Reduce the impact of non-native plants and animals on wild salmon and steelhead populations and prevent introduction of new non-native plants and animals.

3 DESCRIPTION OF PROPOSED BMPS

3.1 FLOODPLAIN HABITAT RESILIENCY BMP

The Floodplain Habitat Resiliency BMP will consist of habitat improvements along floodplains, typically within the 100-year floodplain and consisting of wetland or upland riparian habitats, that will improve the long-term functions of native aquatic ecosystems. Actions will typically involve vegetation management (i.e., invasive species removal and native plant establishment) similar to the Riparian Shade BMP. Floodplain Habitat Resiliency BMP actions will be situated beyond the geographic extent of the Riparian Habitat BMP and, therefore, are not intended to provide direct shading/temperature benefits to the current location of an adjacent stream channel. However, such activities will still benefit the aquatic ecosystem by making it more resilient to future change. For example, as stream channels laterally migrate across the floodplain over time they will migrate into areas with high functioning riparian conditions, including forested vegetation that will continue to provide shade to the stream. Without this BMP, streams may otherwise migrate out of higher quality areas into degraded areas.

Supporting native riparian community development along the floodplain will also provide important benefits in the form of a host of important ecological functions that are highlighted by the Recovery Plan and Willamette Model Watershed Program, such as nutrient cycling; sediment retention; flood storage and delay; increased floodwater infiltration and subsequent release of cold water to the stream system; food and dam building material for beaver; and food and cover for other native wildlife. In addition to vegetation management actions, additional activities may include wetland habitat restoration or

enhancement including potential grading activities, and placement of large wood or other habitat structures. Other opportunities for floodplain improvements may also occur and will be evaluated on a case-by-case basis. Table 2 provides a list of activities that may be conducted as part of this BMP, along with the anticipated benefits to aquatic ecosystem processes.

Table 2: List of Potential Floodplain Habitat Resiliency BMP Activities and Anticipated Benefits to Aquatic Ecosystem (benefits derived from Nadeau et. al. 2018a and 2018b, and Adamus et. al. 2016)

Floodplain Habitat Resiliency BMP Activities	Example Benefits to Aquatic Ecosystem
Control of invasive species and re-planting with native species	Invasive plant species can reduce the long-term viability of existing native plant communities and prevent the successful establishment of native plant communities. Native plant communities are typically more supportive of native ecosystem functions.
Improvement of off-channel habitat	Provides off-channel habitat and refugia during times of flood. This can include side channels that are typically only connected during high flood events (e.g., greater than the ordinary high water elevation or 2-year channel forming flood event) or the broader floodplain.
Improving hydrologic connectivity between floodplain and associated streams (e.g. through levee removal)	Provides water quality benefits by allowing sediment to settle out onto floodplain, expanding area for biochemical processes to occur that support nutrient cycling processes, increased opportunity for groundwater recharge to occur with subsequent cool water return flow downstream. Allows for more diverse and complex habitat conditions to form, which support a greater diversity of native wildlife.
Promoting beaver activity (this may include activities similar to those listed above, but with emphasis on supporting beavers. For example, focusing plantings on species highly desired by beavers.)	Beavers are a keystone species in the Willamette River basin and their activities (e.g., dam building) are highly beneficial to supporting aquatic ecosystem processes. Beaver dams add complexity to streams and rivers while slowing water velocity. The ponds behind these dams store water, which is slowly released during low flow conditions (Beavers Northwest 2019). They also increase groundwater recharge and retention, store sediment and increase riparian habitat. Supporting recovery of beaver through increasing food and dam building material, particularly in protected areas, will benefit native ecosystems and water quality functions.

3.2 IN-STREAM HABITAT RESTORATION BMP

The In-stream Habitat Restoration BMP will entail restoration activities within the bed and banks of stream channels, including side channels that typically are inundated at least every other year (i.e., 2-year recurrence interval). Side channels that are inundated less frequently would likely fall within the Floodplain Resiliency BMP. As previously described, activities will include efforts that increase in-stream habitat complexity, creating new, or reconnecting old, side channels, removing fish barriers, improving cold water refugia access, and supporting beaver dam formation through installation of beaver dam analogs (i.e. simple structures that act like beaver dams and provide the scaffolding for beavers to further build upon).

The activities described above are highlighted by the Recovery Plan and Willamette Model Watershed Program as providing important functions that benefit the stream system and recovery of listed fish species. These activities also work hand in hand with the other WWSS BMPs. For example, restoring in-stream channel characteristics will help restore connectivity between the stream and its floodplain. Similarly, supporting native plant communities as part of the Floodplain Resiliency BMP and Riparian

Shade BMP will provide dam building materials for beavers within the active stream channel. Table 3 provides a list of activities that may be conducted as part of this BMP, along with the anticipated benefits to aquatic ecosystem processes.

Table 3. List of Potential In-stream Habitat Restoration BMP Activities and Anticipated Benefits to Aquatic Ecosystem (benefits derived from Nadeau et. al. 2018a and 2018b)

In-stream Habitat Restoration	Example Benefits to Aquatic Ecosystem
Improving in-stream habitat complexity (e.g. remeandering straightened creek channels, restoring channel form, placement of large wood)	Provides habitat for a more diverse array of native species and also better provides the variety of habitats needed by individual species (e.g., formation of deep pools provides cold water refuge for fish, while riffles provide sediment free substrates and oxygenated water for macroinvertebrates which are food sources for fish and amphibians and also improved spawning habitat for fish.).
Creation of side channel habitat	Provides for expanded in-stream habitat area. Provides refuge during periods of high flows.
Removing fish barriers	Allows fish and other aquatic species to migrate freely up and down the stream network. Also allows for geomorphic processes to occur more naturally (e.g., sediment transport).
Creation of and/or improved access to cold-water refugia	Allows fish and other native aquatic species to access areas of colder water during times of overall high water temperatures. High water temperatures can be adverse to the health and survival of individual organisms.
Beaver dam analogs	These features act as artificial beaver dams and also provide the scaffolding for beavers to further build upon. Beaver dams provide a host of ecological functions to the aquatic ecosystem (see Table 2 -Promoting Beaver Activity for additional details).

4 PERFORMANCE CRITERIA

Each BMP project will be required to meet a set of performance standards that can be readily monitored. These are described for each BMP below.

4.1 FLOODPLAIN RESILIENCY BMP PERFORMANCE CRITERIA

The majority of Floodplain Resiliency BMP project activities will consist of invasive vegetation control and establishment of native plant communities. These activities are similar to those described for the Riparian Shading BMP and, therefore, the same performance criteria are proposed. For some projects, additional activities may be proposed, such as installation of large woody debris habitat features or grading to improve hydrologic conditions. Performance criteria for such activities will be based on successful construction of such features in the approximate locations and quantities specified in the design plans (i.e. comparison of design to as-built conditions).

For vegetation management projects, the following performance criteria are provided and are the same as for the Riparian Shade BMP. At the end of the 5th, 10th, 15th, and 20th restoration project year, monitoring data will demonstrate that the project meets the standard vegetation performance criteria shown in Table 4. Alternate performance criteria may be allowed if supported by appropriate documentation of suitable reference site conditions or based on documented standard vegetation management practices (e.g., Clean Water Services Design and Construction Standards planting requirements). Table 5 provides the

performance criteria for potential non-vegetation related project elements. Alternate criteria, if proposed, should be documented and approved by DEQ prior to restoration project implementation.

Table 4. Standard Vegetation Performance Criteria for WWSP TTP Floodplain Resiliency BMP Projects

Criteria	Performance Criteria			
	Year 5	**Year 10**	**Year 15**	**Year 20**
EITHER: Mean stem density of native shrubs and woody vines * OR: Site average for combined native shrub and woody vine cover	Meets or exceeds 1,600 live native woody stems per acre	80% of the native woody stem density identified at the end of the fifth growing season	70% of the native woody stem density identified at the end of the fifth growing season	Same as performance criteria for year 15
	Site average for combined native shrub and woody vine cover >= 25%			
% Canopy closure or cover	N/A	N/A	>=25%	
Native trees/acres	None	>= 100 trees/acre **		
Number of native woody species	At least 5 native woody species present			
Invasive woody and herbaceous cover	No greater than 20% cover invasive herbaceous species. No greater than 10% cover invasive woody species			
Non-native woody and herbaceous cover	Take and document actions reasonably necessary to evaluate the risk posed to project site by non-native species, where they are problematic (e.g., *Phalaris arundinacea* (reed canarygrass), *Hedera helix* (English ivy), *Ilex aquifolium* (English holly)), taking the steps necessary to control those non-native species such that their presence does not prevent the successful establishment and propogation of native ecosystem characteristics and functions. This includes monitoring and reporting percent cover of such species.			

** Mean woody stem density is determined by counting all live woody stems taller than six inches (regardless of vigor) by species within reference sites. Count multi-stem species (e.g., Symphoricarpos, Rosa) as one stem per square foot (1' x 1').*

*** Based on Willamette Partnership (2016) criteria for wet ecoregions*

The following definitions are associated with the above performance criteria:

Canopy closure	Canopy closure is an upward-looking point estimate of the coverage of a forest canopy, and may be measured in the field with a spherical densitometer (also called a mirror optometer) or by analyzing upward-looking hemispherical photographs.
Cover (or Absolute Cover)	Cover is a downward-looking measure of the percentage of the ground surface covered by living plant leaves and stems. Areas not covered by vegetation are counted as unvegetated substrate. Total cover may be greater than 100% if species are present in multiple strata (i.e., tree, shrub, and herbaceous layers.)
Cover (Canopy)	Absolute cover as viewed from above tree height

Cover (Native Shrub and Vine)	Absolute cover as viewed from beneath tree height.
Invasive species	A plant species should automatically be labeled as invasive if it appears on the current Oregon Department of Agriculture Noxious Weed list, plus known problem species including Mentha pulegium (pennyroyal) and Elaeagnus angustifolia (Russian olive).
Project year	Project year is measured as the number of completed growing seasons following initial verification, starting at 0. For example, where plantings are installed in the winter, the following fall would be considered the beginning of the project year 1, because the plantings have gone through one spring and summer growing season.
Shrub	A perennial woody plant that is usually multi-stemmed and normally grows no taller than 16 feet
Tree	A perennial woody plant, usually with a single stem or few stems, that normally grows taller than 16 feet

Table 5. Standard Non-Vegetation Performance Criteria for WWSP TTP Floodplain Resiliency BMP Projects

Criteria	Performance Criteria		
	Year 0	**Year 1**	**Years 5, 10, 15, and 20**
Design feature intent has been met	As-built matches design	Constructed features remain stable within project design parameters (e.g. fixed rootwads remain in place, excessive erosion not observed). [1]	Same as Year 1

[1] This criterion acknowledges that floodplains are dynamic systems and that conditions are likely to change over time. So long as the constructed features function as intended, then they have met this criterion.

4.2 IN-STREAM HABITAT RESTORATION BMP PERFORMANCE CRITERIA

In-stream habitat restoration projects are likely to consist of several different activities (e.g., grading, installation of root wads and beaver dam analogs, removal of structures impeding fish passage, and potentially plantings). Due to the diverse nature of potential activities and because the proposed activities are likely to be very site dependent, it is not practical to provide a discreet set of performance criteria similar to the revegetation performance criteria provided for the Floodplain Resiliency and Riparian Shade BMPs. Therefore, performance criteria for the In-stream Habitat Restoration BMP will be tied more to a comparison of designed conditions to constructed conditions. In addition, performance criteria will be tied to a demonstration of increased stream function over time. Table 6 provides the proposed design elements performance criteria and Table 7 provides the functional performance criteria for the In-stream Habitat Restoration BMP.

Table 6. Design Performance Criteria for WWSP TTP In-stream Habitat Restoration BMP Projects

Criteria	Performance Criteria		
	Year 0	**Year 1**	**Years 5, 10, and 20**
Design feature intent has been met	As-built matches design	Constructed features remain stable within project design parameters (e.g. fixed rootwads remain in place, excessive erosion not observed). [1]	Same as Year 1

[1] This criterion acknowledges that streams are dynamic systems and that conditions are likely to change over time. So long as the constructed features function as intended, then they have met this criterion.

Table 7. Functional Performance Criteria for WWSP TTP In-stream Habitat Restoration BMP Projects

Criteria	Performance Criteria		
	Pre-project Baseline	**Year 5**	**Years 10 and 20**
Stream functional assessment shows increased functions relative to pre-project baseline conditions [1]	A functional assessment will be conducted to establish pre-project baseline conditions.	Functional assessment results show a net increase in stream function relative to pre-project baseline, with the majority of functions rating moderate or higher.	Functional assessment results show the same or increased stream function relative to Year 5 conditions.

[1] Stream Functional Assessment Method (SFAM) to be used or other method if in the future SFAM is no longer supported.

5 MONITORING

5.1 PERFORMANCE STANDARDS MONITORING

Annual monitoring shall occur that documents site conditions, management actions over the past year and proposed for the upcoming year, and overall progress toward the performance standards. Monitoring efforts shall be commensurate with the performance criteria. Monitoring shall include, as appropriate to the specific criteria, the use of random vegetation plots, repeat photo stations, comparison of design intent to as-built conditions, and reporting on a comparison of monitoring data to performance standards. Monitoring and reporting during in-between years (i.e. years not specified in Performance Criteria) will typically be of a lower intensity with the intent of directing management activities as needed in order to meet the Performance Criteria at the next specified Performance Criteria year. Reporting of monitoring results will be governed by the requirements provided in the TTP document.

5.2 SUPPLEMENTAL MONITORING AND DOCUMENTATION TO SUPPORT ADAPTIVE MANAGEMENT

Supplemental monitoring may occur on a voluntary basis to support management decisions and to gain a better understanding of ecological processes and project effectiveness. Such potential monitoring, along with the required monitoring described above, will support adaptive management.

Potential voluntary supplemental monitoring may include:

- Measurement of stream temperature and/or other water quality parameters
- Documentation of fish use

- Macroinvertebrate sampling

6 REFERENCES

Adamus, P., J. Morlan, K. Verble, and A. Buckley. 2016. Oregon Rapid Wetland Assessment Protocol (ORWAP, revised): Version 3.1 calculator spreadsheet, databases, and data forms. Oregon Dept. of State Lands, Salem, OR.

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Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS). 2011. Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead. August 5, 2011.

Willamette Partnership. 2016. Performance Standards for Riparian Revegetation. February 16, 2016.

Appendix D: Requirements for Annual Reporting

Consistent with the annual reporting requirements in OAR 340-039-0017(3), the annual reports submitted by the WWSS Commission will include:

(a) The location of each trading project and BMPs implemented in the preceding year;

(b) The trading project baseline;

(c) The trading ratios used;

(d) Trading project monitoring results;

(e) Verification of trading plan performance including the quantity of credits acquired from each trading project, and the total quantity of credits generated under the trading plan to date;

(f) A demonstration of compliance with OAR 340-039-0040(4), if applicable; and

(g) Adaptive management measures implemented under the trading plan, if applicable.