State of Oregon Department of Environmental Quality

Water Quality Credit Trading in Oregon: A Case Study Report

I. Overview

Between 1977 and 2001, the Oregon Department of Environmental Quality (ODEQ) received 3 grants from the EPA for a total of $275,000. The two grants received prior to 2001 were used to identify issues related to trading, develop a manual entitled Resource Guide to Watershed-Based Trading,(Resource Guide) and initiate preliminary communication with potential trading partners. The activities completed under the first two grants were not sufficient to lead to trades, though they did help raise awareness about the concept.

The Resource Guide was developed prior to the completion of most of the TMDLs in Oregon, and is now obsolete. It describes in a general way how trading between point and nonpoint sources for nutrients and temperature can work, and provides some methodologies for calculating the impact of a limited range of BMPs. However, the Resource Guide did not anticipate the types of trades eventually developed under the third grant. If Oregon's experience is any indication, it appears that the existence of a source with a strong interest in trading is more important in launching trading than having a manual on trading developed specifically for that state. In any case, the guidance developed by EPA in 2004 that is entitled Water Quality Trading Assessment Handbook provides significantly more detail than the Resource Guide on how to determine if trading can work for a particular watershed.

The third grant from the EPA was for $200,000 and was awarded in October 2002. In contrast to the first 2 grants, the money under this grant was used primarily to pay for a DEQ staff person rather than to pay for consultants, and the same staff person worked on the grant for its duration. Also, the third grant was established as a Cooperative Agreement with EPA, which allowed EPA to play an active role in the development of the model trade and the trading guidance. This continuity definitely contributed to the success of the project. The grant has been used to accomplish the following:

- Identify, develop and implement a model trade involving temperature as well as oxygen-demanding substances (BOD and ammonia) with Clean Water Services, the sewerage and surface water management agency for Washington County,
- Develop policy and guidance regarding trading,
- Explore the cooling potential associated with hyporheic flow (described in final report by Oregon State University), and
- Promulgate the lessons learned from the model trade in a variety of venues including national conferences, seminars and professional meetings.

II. Identifying the Model Trade

Under the third EPA grant, criteria for identifying a model trade were developed using the following sources:

- EPA's Draft Framework for Watershed-Based Trading (published in May 1996 and available on the EPA trading website listed below)
- EPA Office of Water's Water Quality Trading Policy Statement. To see this policy statement, go to http://www.epa.gov/owow/watershed/trading/tradingpolicy.html

Input from DEQ staff and the trading stakeholder group (which will be discussed in a later section in more detail) was also considered, and the following set of criteria was developed.

1. The trading partners are located in the same watershed. The proposed trade should not shift pollutant load reductions within a watershed in such a way that water quality standards are attained at the downstream end of the watershed while causing standards to be violated within an upstream portion of the watershed.
2. The impact of the proposed trade is quantifiable. The Department anticipates that the proposed trades will happen within the context of an approved TMDL, though the existence of a TMDL is not a necessary pre-condition for trading. In the absence of an approved TMDL, there must be sufficient data to quantify the proposed trade.
3. Trading partners are prepared to provide reasonable assurance that the proposed action(s) will be implemented. Examples of reasonable assurance include but are not limited to: performance bonds, memoranda of agreement and third party contracts.
4. For a trade within TMDL basins, the trade is consistent with the overall TMDL "budget" for the watershed.
5. For a trade involving one or more point sources, the point source(s) is/are operating at or better than technology-based limits.
6. Trading is considered for all parameters; however, priority will be given to the following parameters: temperature, nutrients, sediment, biological oxygen demand or chemical oxygen demand. Due to various complications, the Department does not anticipate trades that involve toxics or bacteria.
7. A trading partner cannot get credit for taking an action that is already required.

In addition to these criteria, it was also generally agreed that the model trade should provide elements of trading that will be useful or instructive to others in the watershed as well as throughout the state, so that a broader trading framework could be developed from the model trade.

DEQ developed a list of possible trades in February of 2002 based on conversations with its permit writers. The list was presented to the stakeholder group. Several members of the stakeholder group made it clear they did not consider talking to permit writers to be an adequate process for identifying a model trade, and that DEQ needed to look outside the agency for suggestions on possible trades.

In the interests of limiting the field, DEQ responded by developing a set of conditions likely to give rise to a trade. EPA's draft guidance on trading states that "Trading to comply with technology-based effluent limitations cannot be allowed, except as expressly authorized by federal regulations."[1] Based on this, DEQ concluded that trading is only an option when permit limits are water quality-based. Water quality-based permit limits are issued as a result of the following:

1. An analysis of the impact of the point source on the receiving stream indicates that technology-based permit limits will not be sufficiently protective of water quality, or
2. A TMDL analysis results in a wasteload allocation to the point source that cannot be met through application of technology-based limits.

Discussion with DEQ permit writers indicated that the first type of analysis is not likely to give rise to trades because such permit limits are generally developed as a result of toxicity concerns within the mixing zone. The Department believes it is not reasonable or appropriate to deal with toxicity issues in mixing zones via trading.

On the other hand, the Department concluded that trading might be an option worth exploring for point sources that have received wasteload allocations. The Department also noted that such trades were likely to involve temperature, since over 90% of the TMDLs in Oregon involve temperature.

Based on the above conclusions, a list of sources that might be interested in trading was developed. It was updated several times prior to the final selection of the model trade. A summary of the basins and parameters that the Department considered is shown below.

TMDL Basin Name	Parameter
Tillamook Bay	Temperature
Umatilla River Basin	Temperature
Western Hood	Temperature
Tualatin River Subbasin	Temp., Bact., Ammonia
Upper Klamath Lake Drainage	Phosphorus only
Snake River-Hells Canyon	Phosphorus only
Columbia River	Temperature

There were several sources for whom trading initially appeared to be a possibility; however, various factors served to discourage trading. Some of these factors were:

- Most of the smaller sources had access to solutions that were simpler than trading. For example, sources discharging warm water to a stream that was water quality-limited for temperature could choose to store the discharge during critical periods.
- In basins where nutrients were a problem, the TMDLs resulted in such small wasteload allocations for all of the parties involved (point as well as nonpoint) that effectively there was nothing left to trade.

[1] Existing technology-based effluent guidelines for the iron and steel industry allow intraplant trading of conventional and toxic pollutants between outfalls (40 CFR 420.3).

- The majority of sources did not want to be guinea pigs for a solution that was not "tried and true".

In the end, DEQ's decision of whom to work with in designing a model trade was straightforward: Clean Water Services (CWS), the sewerage and stormwater agency for Washington County. What distinguished CWS from the other sources for whom trading appeared to be a possibility was that CWS had already explored their options on their own, and had decided trading was not only consistent with the watershed approach for achieving environmental improvements, but it also presented the best opportunity for meeting their wasteload allocations for temperature. In marked contrast to other point sources who expressed little enthusiasm for pursuing trading, CWS initiated contact with DEQ on the subject and displayed considerable persistence in negotiating the particulars of the trade through to completion.

III. The Tualatin River Watershed

In discussing the trading concepts that were developed with Clean Water Services, it is useful to have some understanding of the Tualatin watershed. The TMDL report for the Tualatin contains a detailed description of the watershed. Some of this information is summarized below.

The Tualatin River watershed is in the northern part of Oregon occupying approximately 710 square miles and is situated west of the Portland metropolitan area. It is a subbasin of the Willamette Basin. The Tualatin River is approximately 80 miles long, originating in the forested Coast Range mountains and flowing eastward to the Willamette River. The Tualatin mainstem enters the Willamette River at an elevation of 49 feet above sea level just upstream of Oregon City. Major tributaries include Gales Creek, Scoggins Creek, Dairy Creek, Rock Creek and Fanno Creek.

About 93% of the land in the watershed is privately owned. The State of Oregon and the Bureau of Land Management each manage about 5% and 2% respectively. Land uses in the Tualatin watershed are predominantly forestry (49%) and agriculture (39%). About 12% of the area is urban and rural residential.

The map below shows land uses as well as streams in the watershed known to support salmonid spawning/rearing or migration. The Tualatin mainstem, which supports migration, is shown in black for clarity.

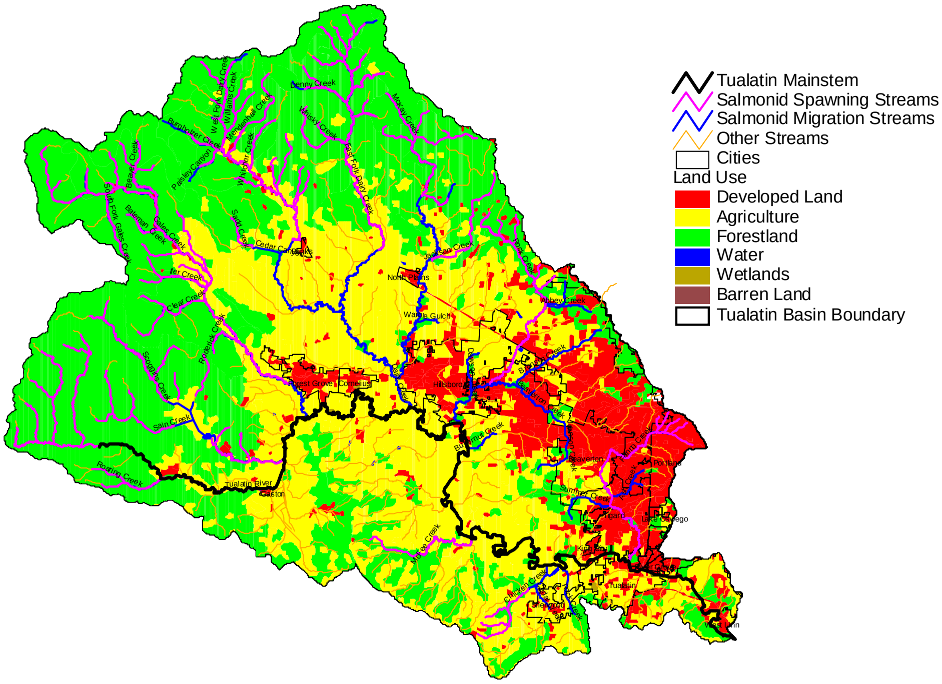

Figure 1: The Tualatin Watershed.

The following graph shows the change in temperature on the Tualatin River over its 80 mile length, as recorded on 7/27/1999. The river warms up significantly as in the downstream direction, primarily because of lack of shade. A dramatic cooling impact can be seen where Scoggins Creek enters the mainstem. Scoggins Creek drains Scoggins Reservoir, which in July, when this data was collected, is still relatively cool. Later in the season, the reservoir warms up and its impact is less dramatic.

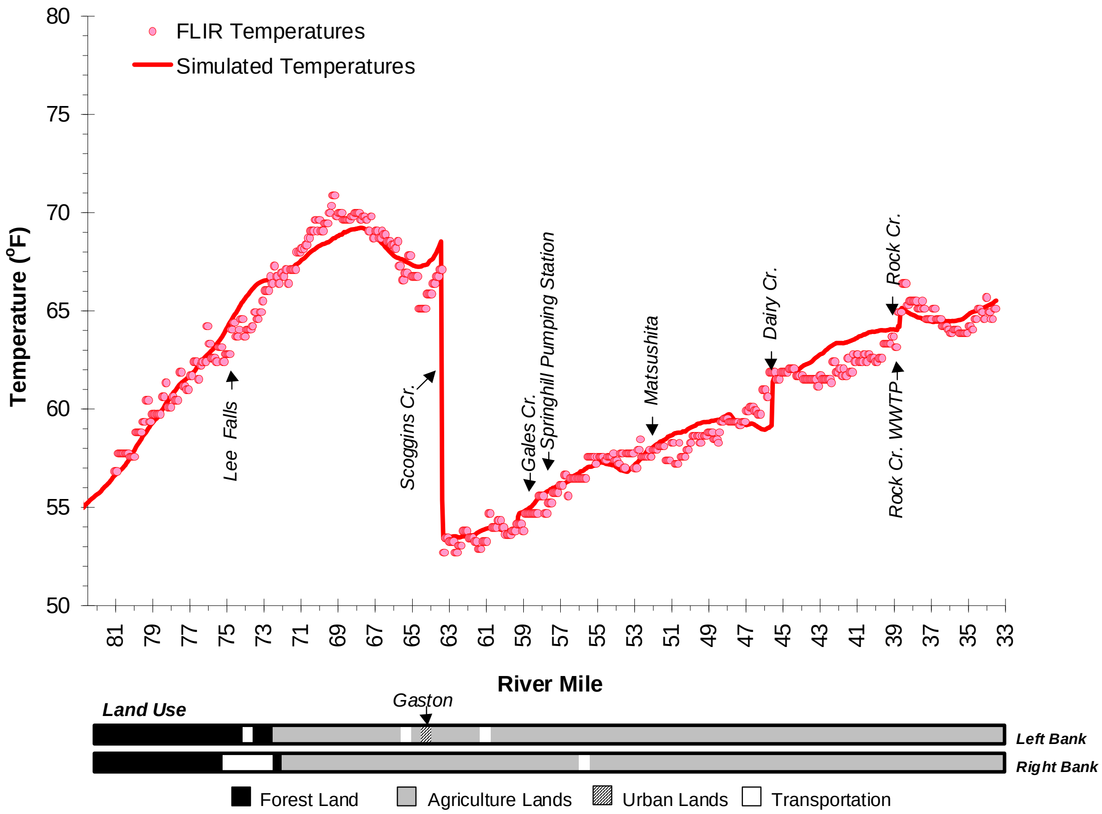

Figure 2: Tualatin River Observed and Predicted Spatial Temperature Data as a function of rivermile (data collected on 7/27/1999).

Clean Water Services has two wastewater treatment plants that discharge to the Tualatin in the summer. These are Rock Creek WWTP at about river mile 40 and Durham WWTP at rivermile 10. These two treatment plants discharge about 50 mgd of highly treated (tertiary) wastewater.

As can be seen from the graph, the impact of these two treatment plants on temperature is quite small relative to the nonpoint source impact. According to the TMDL report, if the river were at system potential temperature, it would be about 5 to 10 degrees cooler than the currently observed temperatures, depending on location[2]. At these cooler temperatures, the impact of the point sources would be much more visible. As a result, both plants have been given wasteload allocations that are less than 10% of their current heat load. The magnitude of the difference between their current heat load and the WLA in the TMDL report provides significant impetus for trading.

IV. Designing the Trade

IV. A. Milestones

[2] System potential for this TMDL included the dramatic increase in flow and reduced temperatures resulting from releases at Scoggins Reservoir.

The following list of milestones provides an overview of the various steps that went into developing the model trade.

DEQ Trading Project: Key Milestones	
2001	
October	Grant awarded.
November	DEQ staff are assigned to water quality trading project under new grant from EPA.
2002	
January	DEQ issues permit for Port of St Helens which contains temperature trading strategy for proposed new major industrial discharge. Though this permit was developed separate from the trading work that occurred under the EPA grant, it is listed because it set an important precedent for CWS trade.
February	List of potential trades is developed based on conversations with permit writers.
April	Criteria for a model trade are developed.
July	Conditions favorable to development of trades are developed and conversations with various sources are undertaken.
December	DEQ commits to pursuing the model trade with CWS.
2003	
	Details of trade are developed and the permit is negotiated.
December	CWS Draft permit is issued and public comment period is held.
2004	
February	Final permit is issued to CWS.
June	Temperature Management Plan describing implementation of temperature trade is submitted to DEQ.
2005	
January	DEQ finalizes policy document on trading.
March	Temperature Management Plan is finalized and incorporated into permit. First annual report on trading is submitted by CWS to DEQ and approved.
July	DEQ enters into contract with OSU to explore the cooling capability of hyporheic flow.
December	Final report is received from OSU on hyporheic cooling.
2006	
January	Final invoice is received from OSU, grant closed out.

IV. B. The Role of Other Entities in Designing the Trade
Though the trade was designed primarily by DEQ and CWS working together, other entities played key roles as well. The support provided by EPA under the grant's Cooperative Agreement cannot be overstated. Rather than simply providing funding and acting as a final reviewer/arbiter regarding the trade, EPA served as a technical resource on trading and as a sounding board for the many different trading possibilities that DEQ considered. EPA's willingness to revise the workplan and extend the length of the grant period as new information became available was also critical to the eventual success of

the trade. It is worth noting that the grant was actually set up as a cooperative agreement, and this allowed EPA to function as a partner rather than simply overseeing the grant.

The open show of support by other agencies such as Oregon Department of Agriculture (ODA) and the Department of Fish and Wildlife (ODFW) contributed to a climate that was definitely helpful in designing the trade. ODA was glad to endorse a program that was not only voluntary, but financially beneficial to farmers. ODFW was happy to support a program likely to result in improved conditions for fish.

DEQ also made use of a stakeholder group while designing the trade. This is discussed in more detail in a later section. Throughout the development of the trade, DEQ staff also spoke at a variety of public venues (see Appendix A), and the generally positive response at these various meetings helped cement various ideas about how to design the trade.

CWS itself made ample and effective use of its own advisory groups when designing incentive programs that are a critical part of the plan to get riparian areas planted on private land.

IV. C. The Role of the Trading Stakeholder Group

As mentioned previously, DEQ made use of an informal stakeholder group to help identify and design the model trade. The group differed in several respects from the advisory committees that DEQ often employs when developing new standards or policies. The biggest difference was that membership to the trading stakeholder group was open, which meant that new members could join at any time. The role of the group was also more fluid than the usual advisory group. At times it served as a sounding board for directions DEQ was considering, other times it suggested new directions. Once the model trade with Clean Water Services was identified, the group had a less active role.

In some ways, the less-formal-than-usual structure of the stakeholder group served the process well. The executive director of a local environmental group remarked that compared to the advisory committees to DEQ that she had served on, the members of this group showed more flexibility than usual and avoided getting locked into particular positions. This may have been because the group had some redundant membership (for example, several municipalities were represented) so individuals were less likely to feel on the spot for representing a particular constituency at all times. The anticipated downside to having an open membership, that the same information would have to be repeated over and over to get newcomers on the same page, did not really turn out to be a problem. Individuals came to meetings where they had some familiarity/interest in the issues and stayed away from others.

The working of the group became more problematic once the CWS trade was decided upon. On the one hand, some stakeholders perceived that their input wasn't being given enough weight, while on the other hand, CWS complained that the meetings were turning into permit negotiation sessions and that such meetings should take place with only CWS and DEQ at the table. At the fifth meeting, mistrust was expressed by one member of the stakeholder group and CWS declined to participate further. Because of this, no more meetings were scheduled until after the permit was issued. For the last several months of permit negotiation, stakeholder meetings were replaced with individual meetings between DEQ and the Tualatin Riverkeepers, the group perceived as the most likely to challenge the permit. The sixth and final meeting of the stakeholder group, which took place after the permit had been finalized, focused on DEQ's trading policy document rather than on the trade with CWS.

To some extent, the tension that developed between DEQ, CWS and the stakeholder group was inevitable. DEQ did not embark on this process with a set of policies regarding trading already in place, let alone a clearly-defined trade. Because of this, DEQ staff wanted to include stakeholders in the conversation so that, as one stakeholder put it, the group could "keep DEQ from designing a train wreck." By contrast, CWS wanted as much as possible to work only with DEQ in designing the trade, and viewed criticism from the stakeholders as unnecessary interference. It remains the opinion of DEQ staff involved in the trade that hearing criticism and constructive suggestions from a stakeholder group is preferable experiencing a legal challenge after much effort has been expended to develop a permit.

One consequence of the tension that developed after the CWS trade was identified was that no stakeholders were involved in the development of the Revised Temperature Management Plan. This plan provided detail on the implementation of the temperature trade, and took nearly a year for DEQ and CWS to hammer out. The lack of precedent for this document made it difficult to put together, and it took a long time for DEQ staff to fully articulate the concerns the document needed to address. DEQ staff would have very much appreciated the opportunity for informal conversations and check-ins with stakeholders, and such conversations might have allowed issues to surface in a timelier manner than DEQ staff managed on their own. CWS' position was that stakeholders could give input during the public comment period. The problem with waiting to the public comment period is that once a document goes out for public comment, DEQ has a vested interest in not changing it very much because significant changes can necessitate yet another public comment period and cause delays in implementation. It can be much easier to incorporate ideas and suggested changes from informal comments received prior to the public comment period than it is to incorporate significant ideas and changes suggested in formal comments received during the public comment period.

Despite the challenges described above, the stakeholder group gave DEQ input that was critical to the eventual success of the trade. In addition, although members of the stakeholder group regularly expressed skepticism regarding trading, in several cases the stakeholder group proposed ideas that were more expansive or flexible than what DEQ had been considering. Specifically, the stakeholder group suggested the following:

- Pursue trades involving shade. DEQ did not initially intend to do this because of the perception that the creation of shade should be the responsibility of landowners bordering streams. Hearing from a range of stakeholders that "if you don't pursue trades involving shade, you will be missing an opportunity," convinced the agency to reconsider its position and pursue such trades.

- Limit duration of the temperature credits achieved via shading to 20 years. CWS was not willing to accept responsibility for trees planted on private land in perpetuity, and it wasn't clear to DEQ that the trade could go forward if this assurance could not be provided. Members of the stakeholder group pointed out that 20 years is a typical planning horizon for a treatment plant, therefore it seemed reasonable for this project as well.
- Design the trade to compensate for the fact that it takes time for trees to grow. The stakeholder group suggested that an acceptable compensation would be to plant twice as much as necessary to offset the excess heat load.

The fact that these ideas came from a stakeholder group, rather than from the agency itself, made it easier for DEQ to promote them.

The stakeholder group also agreed with the following points that were critical to DEQ being able to negotiate a successful trade with CWS:

- Riparian restoration may take place on tributaries as well as on the mainstem. One justification for this is that it is easier to achieve a closed canopy on a small tributary than on the mainstem, and so the same amount of shade on a tributary is likely to achieve more than a similar project on the mainstem. Another justification is that salmon spend a greater proportion of their lifecycle in tributaries than they do on the mainstem, and so would benefit more from restoration projects taking place on tributary streams.
- A certain amount of uncertainty is acceptable if the overall environmental gain associated with trading is clearly greater than it would be achieved with a technology-based solution at the outfall.

The group functioned best when DEQ presented it with information on the general direction that DEQ intended to take, and then asked the group for feedback. By contrast, the group did not provide useful feedback on anything especially detailed or technical. For example, the group did not respond to requests for feedback on the permit language the Department came up with for planting riparian areas, or on the methodology for evaluating shade density. The group also did not do well with open-ended questions such as "what should trading look like?"

Suggestions for improving on the stakeholder process are as follows:

- Have a professional facilitator run the meetings and make sure that different viewpoints get heard.
- Limit DEQ's involvement with the stakeholder group to developing questions for consideration by the group, providing necessary technical information and explaining regulatory constraints.
- Phrase questions as a matter of policy rather than focusing on a particular permit. Have the stakeholder group give input on policy rather than focus on a particular permit.
- Make sure that a meeting schedule, agendas and minutes all get posted on the DEQ website.
- Keep the open membership; however, identify a subgroup of individuals who are willing to review and provide detailed comments on draft documents.

- Keep the group focused on policy questions rather than on a specific permit. In the case of the CWS trade, it was difficult to do this since the CWS permit was the only permit on the table involving trading. However it is important to try to separate policy discussions from discussion of a specific permit, because a process that influences the language and design of the permit is likely to be viewed by the permit holder as a permit negotiation session, and to be perceived negatively as a result. It is also important for the regulatory agency to display a willingness to draw the line on some suggestions from stakeholders, while emphasizing to the permit holder that working with stakeholders is preferable to litigation.

V. Description of the Model Trade with Clean Water Services (CWS)

V. A. Overview

The model trade that was developed with CWS actually involved two different types of trades:

1. Inter- and intraplant trading of oxygen-demanding substances, namely BOD[3] and ammonia, between the CWS Rock Creek and Durham treatment plants.
2. A temperature trade involving a combination of the following:
   - Increase shade along stream by planting riparian areas
   - Flow augmentation
   - Effluent reuse
   - Other mechanisms for offsetting excess heat load, as identified by CWS.

The permit authorizing trading may be found on DEQ's website as follows:
http://www.deq.state.or.us/wq/wqpermit/cwswatshedpermit.htm

Schedule D of the permit issued to CWS contains the language authorizing trading, while the details of how the temperature trade is being implemented are covered in Appendix C, the Temperature Management Plan. The details of the BOD/ammonia trade and the temperature trade are discussed below.

V. B. BOD/Ammonia Trade

The BOD/ammonia trade will be discussed first. This trade increases CWS' operational flexibility by allowing them to shift loads of oxygen-demanding substances between treatment plants as well as within a particular treatment plant.

The CWS permit does not contain a single set of numeric limits for BOD and ammonia. Instead it contains formulas that define allowable daily and weekly mass loads of ammonia, NBOD and CBOD for the Rock Creek and Durham treatment plants under a variety of conditions. These formulas were developed using a computer model of the

[3] BOD stands for Biochemical Oxygen Demand and is considered to be a measure of the "strength" of a wastewater. It is actually a measure of the amount of oxygen consumed by microorganisms as they decompose organic material present in the sample. BOD includes carbonaceous biochemical oxygen demand (CBOD) and nitrogenous oxygen demand (NBOD). CBOD is a measure of oxygen consumed by heterotrophic bacteria, or bacteria that consume organic carbon as food. NBOD is a measure of oxygen consumed by autotrophic bacteria, or bacteria that oxidize ammonia to nitrites and nitrates. NBOD is often determined indirectly by measuring nitrogen-containing materials such as ammonia.

Tualatin River developed by the USGS. This is the same model that was used to develop the Tualatin TMDL for dissolved oxygen. The model was run under a variety of conditions to determine what levels and combinations of BOD and ammonia could be released from the Rock Creek and Durham treatment plants without violating water quality standards. More specifically, the model was used to determine what discharge levels of these substances would result in water quality violations at the Lake Oswego dam. The Lake Oswego dam is the location in the Tualatin River watershed where oxygen levels have consistently been found to be at their lowest level.

The formulas contained in the permit cover the full range of stream conditions likely to be encountered. They take into account:

- Instream flow
- Instream DO levels
- Month of the year
- River temperature

Schedule A of the CWS permit contains the formulas and language pertaining to the BOD/ammonia trade.

V. B. 1. BOD/Ammonia Trade: Establishing Compliance

When CWS decides to trade BOD/ammonia between treatment plants, they must report it on their monthly DMR (Discharge Monitoring Report) form and use the formulas provided in Schedule A of the permit to demonstrate that they are in compliance (or not) with their permit. To aid in this task, CWS modified the proprietary software that they use for DMR reporting to incorporate the trading provisions contained in Schedule A. To be more specific, lookup tables have been added in which the person doing DMR data entry defines the conditions under which the trade has taken place. The software then calculates the allowable loads of CBOD, NBOD and ammonia from the Rock Creek and Durham plants using the formulas in Schedule A of the permit. These may then be compared to the actual loads.

As of this writing, no BOD/ammonia trades have taken place. Since the permit was issued, the treatment plants have been able to meet their permit limits without resorting to trading. Trading may become necessary as loads to the various CWS treatment plants increase.

V. C. Temperature Trade

The 2001 TMDL developed by DEQ for temperature requires CWS to reduce the temperature impact of its treatment plants on the Tualatin River by about 95%, from 9×10^8 kcal/day down to 4.4×10^7 kcal/day[4]. The magnitude of this reduction provided CWS with strong motivation for trading.

[4] Table 9 on page 41 of the TMDL report actually gives 1.5×10^7 kcal/day as the allowable thermal load. A footnote to this table states that these numbers are based on one set of conditions, and that they may be recalculated if conditions such as flow rates differ. Data available at the time of permit development indicated that the WLAs should be updated. This process is described in the permit evaluation report for the CWS permit.

The technological control option that would be sufficient to completely eliminate the temperature impact of CWS' effluent would be to install refrigeration equipment to cool the effluent. This would be extremely expensive. CWS has estimated that it would cost between $60 million and $150 million to install the necessary refrigeration equipment at both treatment plants. Yearly operational costs would be between $2.5 and $6 million. Besides the considerable expense, such an approach would have negative consequences for the environment. Significant amounts of electricity would be required to power the refrigeration equipment. If the electricity came from hydroelectric dams, salmon migration would likely be impacted by the dams. Electricity from conventional power plants would likely increase air pollution and contribute to global warming. Last but not least, the water quality benefits of refrigeration would be limited to a very small part of the watershed, the part of the Tualatin River that lies directly downstream of the treatment plants. Given the lack of adequate riparian area in the mainstem and the breadth of the channel, the river would warm up within a few miles of the treatment plants, negating efforts by CWS to achieve cooling.

Because of the expense associated with refrigeration, the environmental side effects and the limited environmental benefit, DEQ and CWS decided to pursue water quality trading as a way to offset the excess thermal load from the CWS treatment plants.

It should be noted that the permit issued in March 2004 did not fully describe the anticipated temperature trade; rather, it authorized trading and required CWS to submit a revised Temperature Management Plan (TMP) within 3 months of permit issuance that would describe how temperature trading would occur. The permit contains a list of elements that the revised TMP needs to include. The TMP was submitted to DEQ as required, and underwent a lengthy review by DEQ and EPA, as well as going through a public review process. The permit and the final TMP may be found at: http://www.deq.state.or.us/wq/wqpermit/cwspermit.htm

The TMP is basically CWS's plan for how they will offset their excess thermal load as defined in the NPDES permit. It includes the following:

- A discussion of various temperature reduction methods investigated by CWS,
- A justification for the temperature reduction methods selected,
- Information/discussion on how these measures will be implemented, and
- Benchmarks for how many miles of stream CWS intends to plant each year.

Appendix B contains the fact sheet that was developed for parties interested in reviewing the TMP.

CWS is employing several methods to meet its permit requirements for temperature and is continuing to explore other opportunities. Methods that do not involve trading include: reuse (which refers to using effluent to irrigate non-food crops), treatment facility improvements ,and source control[5]. At this point, there do not appear to be significant opportunities for CWS to reduce its excess heat load through treatment facility

[5] Other methods, such as removal of instream ponds, are also being explored; however, the overall impact of such projects is expected to be small.

improvements or source control. There are likely to be some opportunities for reuse, though it is likely that these will be small relative to the amount of cooling that needs to be achieved. Methods that do involve trading include flow augmentation and riparian shading. These are further explained below.

Flow Augmentation: CWS owns water rights at Scoggins and Barney reservoirs, located in the headwaters of the Tualatin. CWS has been managing the release of water from these reservoirs to benefit water quality in the mainstem of the Tualatin for many years. Historically, the focus has been on managing flows to maintain adequate levels of dissolved oxygen; however, the flow benefits temperature as well. Stored water is typically released during the summer and fall period. Until late summer, the stored water releases are cooler than the mainstem and has a direct cooling impact. From late summer and into fall, flow augmentation helps cool the river by increasing the amount of flow. Increased flow means that the river is deeper and moves faster, and so the warming impact from the sun is reduced. A methodology for quantifying the impact of flow augmentation is included in CWS's revised Temperature Management Plan.

Riparian shading, which basically means planting trees along streams, is another means by which CWS expects to offset its excess heat load. When the surface of the river is shaded, the sun is not able to warm the water. There are many miles of stream in the Tualatin Sub-basin that lack adequate shade. Shading areas highest in the basin would be the most efficient strategy because it is easier to prevent water from heating up than it is to cool it after it has been heated. Increasing shade also provides ancillary benefits, such as reduced erosion and increased wildlife habitat.

Increases in stream shade will likely be a significant means of generating heat load credits. CWS is developing and implementing several programs that provide incentives for landowners to enroll in a program that would plant shade-producing vegetation along streams. To the extent possible, these programs build upon existing programs, such as the USDA's Conservation Reserve Enhancement Program (CREP). Prior to CWS's involvement with CREP, no farmers in Washington County chose to participate in CREP because the financial incentives offered to farmers were not sufficient to encourage participation.

CWS developed Enhanced CREP based on extensive farmer input, and the experience was instructive. The farmers said that the program had to be simple, and that they did not want there to be a bidding process to determine participation. Instead they preferred that CWS come up with a generally fair price for the use of their land, and pay everyone the same amount. Their reasoning for not wanting a bidding process was as follows: they said the riparian areas represented such a small percentage of their holdings that it would not be worth it for an individual farmer to do the homework to come up with a bid. They were also uncomfortable with the idea of farmers competing against one another for CWS's riparian dollars, despite the fact that farmers already compete in other venues. Since it was in CWS' best interest to come up with a price perceived as fair by farmers, they used the advisory committee to help them do so.

CWS's revised Temperature Management includes information on the other incentive programs that CWS has developed and intends to develop. Most are being implemented through agreements with third parties. The intent of each program is to provide incentives specifically tailored to the needs of one or more landowner groups, such as urban, agricultural and small woodland property owners. Incentives may include cost sharing assistance, free vegetation and related planting materials, program enrollment payments, land/easement acquisition, and the purchase of plant cuttings from landowners.

The duration of the credit for shading is 20 years. This was established by the DEQ based on consideration of local conditions and other options available to CWS. In the Tualatin watershed, areas with less-than-adequate shade are commonly dominated by Himalayan blackberry. Local experts on riparian vegetation agree that this forms an extremely stable monoculture, and that shade-producing vegetation consisting of overstory trees will not develop in such areas unless there is active planting. One could argue that if this is the case, then CWS should get credit for the trees they plant for as long as they make sure the trees stay planted. However, to do so would amount to double-counting -- that is, giving CWS credit for shade that should ultimately be the responsibility of private landowners in the basin. Under Senate Bill 1010[6], farmers do have some responsibility for protecting water quality but the responsibility is limited. In the Tualatin, landowners in TMDL basins are encouraged to allow shade-producing vegetation to become established in riparian areas however they are not required to actively plant those areas. Furthermore, the Oregon Department of Agriculture, which is charged with implementing Senate Bill 1010, regards the presence of Himalayan blackberry as a "legacy condition" and therefore not the responsibility of farmers to correct[7]. In light of this, DEQ has decided to limit the duration of the credit to 20 years, which is approximately equal to the useful life of mechanical refrigeration equipment.

The magnitude of the credit will depend on the amount of shaded stream surface that CWS is able to achieve. This can be evaluated as follows:

Heat load offset by shade =

Area of Stream Shaded x Increase in Shade Density x Solar Insolation Rate

This calculation will have to be done for each riparian restoration project that CWS undertakes, and then a total for all the projects will have to be determined.

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[6] According to the Oregon Department of Agriculture website, Senate Bill 1010 directs the Oregon Department of Agriculture (ODA) to work with farmers and ranchers to develop area-wide water quality management plans for troubled watersheds. SB 1010 is a principal strategy as part of agriculture's role in responding to the federal Clean Water Act, the Coastal Zone Management Act, and other natural resource conservation mandates including listings and potential listings of fish under the Endangered Species Act.

[7] Himalayan blackberry was introduced to the Pacific Northwest in the late 1800s. It readily colonizes disturbed areas, and has become widespread partly as a result of the once-common farming practice of removing native vegetation from riparian areas to hasten drainage of agricultural fields. ODA was one of the promulgators of this practice, and does not believe that farmers should be held responsible for correcting a legacy that resulted from their acting on the best information available to them at the time.

Here is some explanation of the terms in this equation:

- Area of Stream Shaded = Average Stream Width x Stream Length

- Increase in Shade Density = Current Shade Density – Initial Shade Density. Shade density will be measured via a solar pathfinder, densiometer or alternate method proposed by CWS as long as adequate justification is provided.

- Solar Insolation Rate. According to a map of solar insolation rates from the Department of Energy, the solar insolation rate during the critical period in the Tualatin Basin is 6 kwh/m2day. This translates to 479 kcal/ft2day

To compensate for the fact that the heat load offset by shading will take years to establish, the Department has decided that at the end of the 20 years, the heat load offset by shading must be two times the actual excess thermal load. This can also be thought of as a 2-to-1 trading ratio.

The following equation will be used to determine the thermal credits required from stream surface shading.

Thermal Credits Required from Shading =
2 x [Thermal Load to be offset (Rock Creek) – Thermal Load associated with any Rock Creek Reuse- Thermal Credits from Stored Water release (as expressed at Rock Creek)]
+ 2 x [Thermal Load to be offset (Durham) – Thermal Load associated with any Durham Reuse - Thermal Credits from Stored Water release (as expressed at Durham)]

The revised TMP provides a calculated estimate of this area of stream surface for planning purposes. This area is expressed in terms of stream miles to be planted each year, and assumes the average stream to be planted is 10 feet across.

V. C. 1. Temperature Trade: Establishing Compliance
For the current permit cycle, compliance will be established with respect to CWS' revised TMP. Once shade is established, CWS' efforts to demonstrate compliance will shift from showing that an adequate number of plants are getting planted and are surviving, to showing how much shade they are producing. As required under Schedule D of the permit, CWS will be required to submit an annual report summarizing the results of its credit trading activities for the previous year. DEQ can, at its discretion, also inspect the riparian restoration projects described in the annual report.

It is expected that shade measurements will not be the primary tool used to demonstrate compliance for at least the first five years from the date of permit issuance.

V. C. 2. Potential Improvements to Temperature Trade
Since the trade was negotiated, it has become apparent that there are areas where the temperature trade negotiated with CWS could be improved on. These are as follows:

- Consider providing additional incentives for restoration on high priority areas. The permit negotiated with CWS does not contain such incentives. It should be noted that initially there were not enough enrollees for CWS to screen projects based on ecological value. As the number of farmers interested in participating has increased, CWS has started prioritizing projects based on ecological factors[8].

- Consider providing incentives for the completion of contiguous projects, since contiguous projects will have more value than disconnected projects. CWS provides an incentive called the Cumulative Impact Bonus to individual or neighboring landowners who enroll more than 50% of the stream bank in a 2-mile or 5-mile segment of stream. In spite of this, the projects that have occurred to date are generally disconnected, and in a number of cases, the projects have involved one side of a stream only.

- Consider developing a trading ratio that takes into account stream width. Smaller streams can be shaded in just a few years, and so a 2:1 ratio is not needed for such streams.

- Explore giving credit for protection. CWS requested that DEQ consider this during permit negotiation, on the grounds that protected areas are likely to have more ecosystem value than restored areas. CWS also offered anecdotal evidence regarding the impacts of development on restored areas: apparently restored areas suffered degradation after upstream and formerly pristine areas became developed. It is presumed that this degradation occurred because of higher peak flows resulting from development. Neither DEQ nor CWS attempted to quantify this connection; however, if it could be done, trading could be used to ensure protection of existing valuable habitat.

- Consider what to do if the trees don't stay planted. The TMP states that if trees are cut down prior to 20 years, CWS will have to re-plant to compensate, but the re-planting rate is not specified. A re-planting rate should be defined, and it should take into account that a new seedling will not provide the same amount of shade as, say, a 15 year-old tree.

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[8] The factors upon which CWS is now evaluating projects include the following:

- Current Riparian Conditions: Existing shade is less than 50% in the first 50 lateral feet of the riparian area and cropland/pasture is within 35 feet from the top of the bank.
- Fish Habitat: Reach is in anadromous spawning, rearing and/or transit habitat, and/or reach is in cutthroat trout habitat.
- Efficiency: 5 acres or greater in the first 50 lateral feet of the riparian area.
- Orientation: Stream frontage orientation is South or West
- Flow: Perennial streams with medium to high flow as defined by the drainage acreage area.
- Nutrient Filtration: Extent to which the vegetative buffer will filter nutrients and chemicals from adjacent agricultural practices.
- Wildlife Habitat Connectivity: Adjacent to other CRP projects, CWS projects or public lands.
- Irrigated Lands: The project contains irrigated land that would result in added streamflow.
- Conservation Easements: The landowner is interested in establishing a conservation easement in the project area.

The possibility that trees might be cut down prior to 20 years was explored in the development of the TMP. What CWS concluded, after working with farmers to design incentive programs to get riparian areas planted, was that requiring 20 years of "no touch" would significantly reduce participation in the incentive programs, and that significant disincentives already existed for cutting down riparian areas. They decided that overall their best chance for succeeding with getting riparian areas planted would be to design programs so as to maximize landowner participation, rather than to guarantee that trees would remain planted. To avoid the expense of replanting, CWS has included in the incentive programs the option of a conservation easement, which is less expensive than mitigation, and provides the farmer with significant financial incentives to keep vegetated buffers intact.

CWS has learned that a way to increase participation in the conservation easement option is to make it available at any time within the first five years of entering into a contract to get riparian areas planted. This allows time for the farmer to develop comfort with the program and with the staff administering it. As one staff person at CWS explained, it isn't that farmers are not good stewards or are unwilling to keep areas restored , it is more than that "they do not see conservation easements as the only or best way to maintain that commitment. There are definitely trust issues to address here and establishing a working relationship with a landowner is critical to being able to secure a conservation easement."

- Consider defining a maximum buffer width based on the amount of shade needed or other ecosystem values. While it might seem obvious that wider buffers are better, the experience in the Tualatin watershed is again illuminating. A majority of the landowners in the Tualatin watershed now participating in the incentive programs that CWS developed have elected to go with maximum 180 ft buffer width that CREP will pay for. The difference in stream shade that is created by going from a 50 ft buffer to a 180 ft buffer is negligible, so there is little-to-no value to CWS in paying to plant these wider buffer widths. It has been suggested that some farmers who signed up for the maximum buffer widths regard the tree-planting as a long-term investment in timber, with the only up-front cost being the temporary loss of the land for other uses. If this is true, the funds might be better spent doing riparian restoration on more miles of stream. A narrowly-planted riparian area subject to seasonal inundation is less likely to be viewed as a timber investment than a buffer that is 180 feet wide and contains some upland area.

- Consider developing a trading ratio that takes into account stream width. Smaller streams can be shaded in just a couple years, and so a 2:1 ratio is not needed for such streams.

- Riparian restoration is a young science. Symptomatic of this, there are no widely-available performance standards by which the success of riparian projects might be evaluated, nor are there agreed-on planting densities and or expectations for follow-up care for riparian restoration projects. CWS has planting standards it has developed in-house that have resulted in variety of successful restoration projects in the Tualatin basin, and this was part of what convinced DEQ that a temperature trade that involved riparian restoration was a reasonable course of action. Entities that are not experienced in riparian restoration will need to give careful thought to the development of such standards. Appendix C suggests a possible approach. Appendix D contains a list of research questions obtained from a practitioner and teacher in the field of wetland/riparian restoration in the Pacific Northwest.

- When developing water quality standards, consider designing them so as to encourage trading schemes that might be beneficial to the environment.

- Explore other mechanisms for temperature trades such as hyporheic flow. Hyporheic flow refers to the flow of a river through the gravel that forms the river channel. As explained in a 2003 paper by Andrew Bowman of the organization Defenders of Wildlife, entitled *Ancillary Habitat Restoration Through Water Quality Trading: Expanding the Functional Hyporheic Zone of the Willamette River to Reduce Elevated Water Temperatures*:

  > The potential exists to take advantage of the cooling function of the river's hyporheic gravels to "treat" the river's elevated water temperature problems. Additional gravels could be accessed by the river if it were allowed to flow more freely over adjacent lands that historically were subject to at least periodic inundation by the river. In other words, if the river were allowed to regain some of its channel width and complexity, its natural functions could have a greater mediating effect on water temperature.

At 2005, DEQ contracted with OSU to explore this concept. The final report can be found on the DEQ trading webpage. Two hypothetical scenarios involving hyporheic flow were explored, and indicated that the degree of cooling associated with hyporheic flow can indeed be significant; however, since flow through gravel is much slower than flow in a river, it can take a large area to get the desired level of cooling via hyporheic flow.

VI. Development of Trading Guidance

Once the permit with Clean Water Services was negotiated, DEQ used the experience gained to develop a guidance document for future trades. This guidance document may be found at:
http://www.deq.state.or.us/wq/pubs/imds/wqtrading.pdf

As stated in the guidance document, its purpose is to provide a consistent framework within which trading opportunities can be pursued and implemented, and to identify key features of acceptable trades in order to promote trading, as well as to encourage the development of new kinds of trades. The guidance document identifies the following additional types of potential trades:

- Mitigation for the impact of dams and flow withdrawals. In situations where water quality standards are exceeded due to the impact of dams or flow withdrawals, trading could be used to mitigate these impacts. DEQ views the adoption of mitigation measures as preferable to simply removing designated uses or establishing a new designated use subcategory. Furthermore, trading may provide a tool for maintaining the use in other parts of the watershed. Therefore, when DEQ reviews a petition from an entity to change a designated use, it may consider opportunities for nonpoint source control as mitigation measures for the entity's impact.

- Sediment remediation. In waterbodies with identified sediment contamination problems, potentially responsible parties for cleanup sites located in the watershed could contribute toward instream sediment remediation activities. This would be in lieu of cleaning up to better-than-ambient levels at contaminated sites. DEQ would view this alternative as acceptable when it could be demonstrated that the environmental improvement resulting from the alternative action is essentially equivalent to the environmental improvement that would result from remediating sediment to risk-based concentrations.

- Stormwater treatment. In waterbodies with identified sediment contaminant problems, potentially responsible parties for upland as well as instream contaminated sites could contribute toward watershed-wide stormwater treatment. This would be in lieu of cleaning up to better-than-background levels on upland contaminated sites. DEQ would view this alternative as acceptable when it could be demonstrated that the environmental improvement resulting from the alternative action is essentially equivalent to the environmental improvement that would result from remediating sediment to risk-based concentrations.

The guidance document is meant to be a living document. It will be used to guide potential trading projects identified to date, and will be modified as necessary to allow DEQ to pursue additional trades that represent ways to better protect the environment at lower cost.

V. Lessons Learned

There are a variety of lessons that can be learned from DEQ's experience to date with trading. Some of these have been described already, such as those pertaining to the use of stakeholder groups in designing a trade, and potential improvements to the temperature trade. Some broader lessons are provided below.

- Trading can be a way to focus limited resources in the area(s) of the watershed where they will do the most good. The Tualatin basin has on the order of 900 miles of stream, and much of this is in a deteriorated condition, resulting in elevated stream temperatures. Though point sources in the basin do contribute to the problem, their contribution is extremely small relative to the nonpoint source contribution. To simply require the point sources to reduce temperatures at their outfalls misses the larger picture, which is that riparian areas throughout the basin are in a deteriorated condition. It should be noted that while the TMDL process is useful for describing and quantifying the magnitude of the problem, the completion of a TMDL does not mean that nonpoint source problems will be adequately dealt with.

- The development of TMDLs and TMDL Implementation plans needs to take into account the fact that regulatory control over nonpoint sources is generally limited. A TMDL that simply requires both point and nonpoint sources to reduce loads by 90% effectively precludes point/nonpoint source trading, because there are so few BMPs available to nonpoint sources that could reliably achieve a greater than 90% reduction in load. An unfortunate aspect to this situation is that given the lack of regulatory control over nonpoint sources, they are unlikely to achieve the 90% reduction anyway. Consequently, the intended reductions are not likely to be achieved, and trading is not an option, although with adequate trading ratios, it could potentially accomplish a greater overall reduction than might be achieved by the point sources alone.
- Our perceptions of what trading is or can be, can serve to limit the potential for trading. When DEQ first began exploring the possibility of trading in Oregon, it was assumed that any identified trades would involve nutrients, and would be between point and nonpoint sources. However, relatively few TMDLs in Oregon involve nutrients and those that do require such large reductions of both point and nonpoint sources that there is effectively nothing left to trade. Temperature is a bigger problem, and one that DEQ initially overlooked.
- Trading is an opportunity to think outside the box, and ask "what is the best way to protect the resource?" The Clean Water Act passed in 1972 focuses on control of point sources. This emphasis does not reflect our current understanding of the various causes of stream impairment. Yet it was written with the clear intent of protecting and improving water quality. In Oregon, the best way to protect water quality and improve stream health is to focus on improving riparian areas. By keeping this in mind, DEQ has managed to identify trading possibilities that achieve this.

Conclusions

Existing environmental regulations provide much more leverage for dealing with pollution problems caused by point sources than by nonpoint sources. It is likely that this will always be the case. Point sources are by definition readily identifiable while nonpoint sources are varied and diffuse. Examples of nonpoint source pollution include:

- Runoff that consists of more than just rainwater, i.e., it contains nutrients and/or sediment and/or toxics.
- Any cause of elevated stream temperature other than hot water flowing out of a pipe. This includes altered channel morphology and degraded riparian areas. Activities that can lead to altered channel morphology and degraded riparian areas

are as diverse and pervasive as the creation of impervious area[9] and the introduction of nonnative species such as Himalayan blackberry[10].

Given the variety of activities and conditions that can lead to elevated stream temperature, it is not surprising that the most widespread water quality problem in Oregon is temperature.

It has been estimated that about 60% of the roughly 900 miles of stream in the Tualatin watershed are in a degraded state, with riparian areas dominated by nonnative species[11]. Not coincidentally, many of these streams also exhibit elevated stream temperature. Existing laws, including Senate Bill 1010, are not sufficient to correct this problem. The passage of Measure 37 in Oregon, which seeks to compensate landowners for losses in property value that might result from regulations restricting property use, suggests that there is not a lot of momentum around creating laws that could further restrict the use of private property. It is also clear that the voluntary efforts underway in the basin and the public funds available for restoration are extremely limited relative to the magnitude of the problem.

Though the temperature impact of CWS is also very small relative to the overall problem, trading is being used to complete an estimated 35 miles of stream restoration that would not have happened otherwise. Furthermore, a number of useful lessons are emerging from CWS's experiences to date. The project is demonstrating how significant the obstacles to large scale restoration really are. In the Tualatin watershed, the passage of Senate Bill 1010 has not been sufficient to encourage a significant number of farmers restoring riparian areas[12]. In light of this, the most common criticism of the temperature trade negotiated with CWS, that it amounts to giving credit to CWS for something that farmers should be doing on their own, begins to seem irrelevant.

CWS's experiences have also shown that farmers are also not willing to commit to keeping areas restored even when there are significant financial incentives for doing so. They perceive that doing so would mean a loss of control over their land, and they do not

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[9] Impervious area refers to those portions of the built landscape (buildings, roads, parking lots) that cannot absorb rainfall. Increased impervious area means increased peak flows for rivers and streams. Higher peak flows mean increased erosion rates. These rates can become so extreme that it can become impossible to maintain a healthy, intact riparian area. In such cases, the banks must be armored with riprap or concrete to stabilize them.

[10] Himalayan blackberry supplants native vegetation without providing the range of benefits that native vegetation is capable of providing. This includes shade, habitat, erosion control and food for wildlife. It is true that some birds like the berries, but since Himalayan blackberry supplants food sources capable of providing food for more months of the year, its presence still represents a net loss for the ecosystem. Its introduction to the Pacific Northwest has been highly deleterious for the health of riparian and other areas.

[11] George Kral of Ash Creek Forest Management, personal communication.

[12] According to comments from CWS staff on a prior version of this document, though lack of financial incentive is an important piece to why restoration was not occurring … the critical component is that farmers lack the finances, resources and technical expertise to effectively restore riparian areas."

want this to happen, even temporarily. If efforts at large-scale restoration are ever successful, they will need to take this perspective into account.

A key factor in getting trading to take place in Oregon was the existence of a large source with a large problem that was convinced that trading could be used to solve the problem. This, combined with the DEQ's commitment to pursuing trading, as well as significant financial backing and ongoing involvement by the EPA, resulted in an innovative yet credible trade being developed and implemented.

This trade has in turn set the stage for the creation of the Willamette Partnership. A trading proposal by the Willamette Partnership recently received a grant for $779,000 from the EPA. The intent of the Partnership is to establish a bank of credits that will be available to multiple point sources. These credits will serve to create "a form of environmental currency used to leverage the collective resources of factories, farms, forests, cities, and sewer and water ratepayers to make the strategic, coordinated conservation investments that yield dividends to the entire ecosystem at less cost than traditional regulatory controls."

According to the Willamette Partnership website:

> The Partnership represents a diverse group of stakeholders with a common bond of interest in the Willamette River Basin. Some members of the Partnership are eager to advance restoration in the Basin; others are eager to develop cost-effective strategies to achieve that restoration. Together, they have collective resources that can be used in a market-oriented approach to watershed restoration. The Partnership board of directors is committed to implementing innovative solutions that supplement regulatory controls to increase the pace, scope and effectiveness of conservation and restoration efforts in the Willamette River Basin.

The Willamette Partnership proposal builds on the success of the temperature trade negotiated with CWS, and takes trading to the next level – trading on a basin-wide scale and with multiple pollutant markets, including temperature. If successful, the "Willamette Ecosystem Marketplace" will continue the important precedent set by CWS temperature trade in achieving protection of the environmental resource at less cost.

Appendix A
List of Public Speaking Engagements by DEQ Regarding Trading

	Date	Audience
1	2/25/02	Water Quality Trading Stakeholder Group
2	5/6/02	Water Quality Trading Stakeholder Group
3	10/15/02	Water Quality Trading Stakeholder Group
4	July 2002	ACWA conference in Bend
5	December 4, 2002	Tualatin Watershed Council
6	January 9, 2003	Tualatin Riverkeepers
7	January 14, 2003	Washington County SWCD
8	January 28, 2003	Water Quality Trading Stakeholder Group
9	March 21, 2003	TMDL Conference/Environmental Law Education Center
10	April 9, 2003	Wastewater Short School
11	April 29, 2003	Water Quality Trading Stakeholder Group
12	June 5, 2003	Water Trading and Marketing/Seminar Group
13	June 12, 2003	EPA Environmental Innovations Symposium
14	June 17, 2003	Water Quality Trading Stakeholder Group
15	June 19, 2003	EPA National Trading Group (teleconference)
16	June 25, 2003	EPA Ag Sector Conference
17	July 31, 2003	Utility Water Act Group
18	July 31, 2003	EPA Region 10
19	August 26, 2003	Water Quality Trading Stakeholder Group
20	September 16, 2003	EPA Water Quality Managers – national meeting
21	November 25, 2003	Hyporheic Zone Workshop
22	December 17, 2003	EPA National Trading Group (teleconference)
23	February 24, 2004	Willamette TMDL Group
24	May 18, 2004	DEQ EMT Retreat/Willamette Tour
25	June 2, 2004	Tualatin Watershed Council – panel discussion
26	August 16, 2004	Oregon Association of Water Utilities (OAWU)
27	October 5, 2004	Water Quality Trading Stakeholder Group (trading policy)
28	October 14, 2004	EPA - National Center for Environmental Economics
29	November 8, 2004	Tualatin Riverkeepers Citizens' Action Committee (TMP)
30		UAA Workgroup
31	December 8, 2004	Water Quality big meeting at Edgefield
32	June 1, 2005	PNCWA NPDES Workshop – Chemeketa College
33	December 14, 2005	EPA webcast on trading

Appendix B

NPDES WASTEWATER DISCHARGE PERMIT TEPERATURE MANAGEMENT PLAN EVALUATION

Department of Environmental Quality
Northwest Region – Portland Office
2020 SW 4th Ave., Suite 400, Portland, OR 97201
Telephone: (503) 229-5263

PERMITTEE: Clean Water Services (CWS) and Washington County
2550 SW Hillsboro Hwy
Hillsboro, OR 97123

Dept of Land Use and Transportation (DLUT)
1400 SW Walnut Street
Hillsboro, OR 97124

SOURCES: Durham Advanced Wastewater Treatment Facility (AWTF), 16580 SW 85th, Tigard
Forest Grove Wastewater Treatment Facility (WTF), 1345 Fernhill Road, Forest Grove
Hillsboro WTF, 770 South First Street, Hillsboro
Rock Creek AWTF, 3125 SE River Rd, Hillsboro
Washington County Municipal Separate Storm Sewer System (MS4)

SOURCE CONTACTS:

William C. Gaffi, General Manager, CWS — Telephone Number: 503-681-5108
Kathy Lehtola, Director, Washington County DLUT — Telephone Number: 503-846-3822

PERMIT WRITER:

Lyle Christensen — Telephone Number: 503-229-5295

WATER QUALITY TRADING PROJECT MANAGER:

Sonja Biorn-Hansen — Telephone Number: 503-229-5257

PROPOSED ACTION: Review of a revised Temperature Management Plan developed by CWS to comply with National Pollutant Discharge Elimination System (NPDES) permit.

SOURCE CATEGORY: Major municipal

TREATMENT SYSTEM CLASS: Level IV

COLLECTION SYSTEM CLASS: Level IV

Overview

In February 26, 2004, DEQ issued an NPDES permit to CWS that, among other things, authorized CWS to develop and implement water quality credit trading plans. It also required CWS to submit, for Department review and approval, a revised Temperature Management Plan, hereinafter referred to as the TMP, within 90 days of permit issuance. The purpose of this TMP is to explain how CWS intends to pursue temperature trading to offset its excess thermal load.

Though elements of the above-mentioned NPDES permit are being reconsidered, the current permit is in force and this provision of the permit needs to be met. Therefore the Department is reviewing the TMP submitted in accordance with the permit.

It should be noted that the temperature trade authorized by the NPDES permit issued in February is the first such trade to be authorized in the country. Consequently, the TMP submitted by CWS is also a first. CWS therefore did not have a model to follow in developing the plan, and likewise there is no model to follow in evaluating it.

The TMP addresses a wide range of issues associated with temperature trading. Much of the discussion pertains to riparian restoration work. Though there is a body of knowledge and expertise associated with this work, riparian restoration is itself a young science, and one that is evolving rapidly. DEQ hopes that practitioners in the field of riparian restoration will take this opportunity to comment on the TMP.

Evaluation of the TMP

DEQ has developed the following set of questions for evaluating the TMP. DEQ invites comment both on the TMP itself, and on DEQ's analysis of the TMP.

1. What does the TMP cover?
2. Is the plan consistent with state trading policy?
3. Will the trading program lead to achievement of the TMDL?
4. Will the implementation of the trading program lead to the exceedances of instream water quality standards in the Tualatin River?
5. What measures are proposed in the TMP for offsetting the impact of CWS' thermal discharge? These measures are expected to include, at a minimum, flow augmentation and riparian shading.
6. Is the impact of each of the measures that CWS proposes to offset their temperature impact quantified?
7. Does the TMP include a methodology for prioritizing riparian areas in the watershed for restoration? The goal of this prioritization scheme should be to maximize the benefits of riparian restoration projects for the protection of the most sensitive beneficial uses.
8. How will compliance with the temperature management plan, which when adopted will be part of CWS' permit, be established?
9. Does the TMP discuss reuse of treated effluent? Is there an estimate of the amount by which CWS' thermal load may be reduced through reuse?
10. Does the TMP specify a baseline for thermal credit trading?
11. Are the schedules contained in the plan reasonable?

12. Are the trading ratios described in the plan reasonable?
13. Does the TMP consider changes in water availability likely to occur in the watershed over the long-term?
14. Does the TMP describe reporting requirements for thermal load trading and are those requirements sufficient to demonstrate that the measures undertaken to offset the thermal load are adequate?
15. Does the TMP contain a plant list? Are the plants on the list appropriate for the Tualatin Basin?
16. Does the TMP contain a description of how CWS intends to work with potential growers and contractors involved in riparian restoration so that adequate plant materials are available, and contractors have adequate time to mobilize resources?
17. Does the TMP contain a description of the kinds of approaches that will be implemented to reach the target increase in stream shade?
18. Does the TMP contain a planting plan? Does the plan include expected plant survival rates, and justification for planting densities?
19. Does the TMP contain a monitoring plan to assess the amount of shade that is created?
20. Does the TMP contain a maintenance plan that will promote plant survival and reduce the impact of invasive species?

Here are the answers to the above questions.

2. What does the TMP cover?

The TMP is CWS' plan for how they will offset their excess thermal load as defined in the NPDES permit. It includes the following:

- A discussion of various temperature reduction methods investigated by CWS,
- A justification for the temperature reduction methods selected, and
- Information/discussion on how these measures will be implemented.

3. Is the plan consistent with state trading policy?

Yes. DEQ's trading policy covers a variety of issues pertaining to trading. These include but are not limited to: when trading may occur, pollutants and parameters that may be traded, trading models, quantifying credits, addressing uncertainty and establishing compliance. The trading policy describes the type of trading authorized by CWS' permit in some detail. If you would like to receive a copy of DEQ's trading policy, contact Sonja Biorn-Hansen at 503-229-5257 or at biorn-hansen.sonja@deq.state.or.us.

4. Will the trading program lead to achievement of the TMDL?

The trading program will result in progress towards achievement of the TMDL. Efforts by other sources and designated management agencies in the basin will also be necessary to fully achieve the TMDL.

5. What measures are proposed in the TMP for offsetting the impact of CWS' thermal discharge? These measures are expected to include, at a minimum, flow augmentation and riparian shading.

As anticipated, the TMP proposes offsetting the impact of CWS' thermal discharge via flow augmentation and riparian shading. Chapter 1, Sections C and D list some additional measures for reducing/offsetting thermal load. Though CWS intends to pursue some of these measures, CWS does not anticipate that their impact relative to their excess heat load will be significant.

The TMP also discusses CWS' efforts relative to reuse of treated effluent. It should be noted that while reuse is an acceptable way for CWS to reduce its excess thermal load, it is not considered to be trading per se.

6. Will the implementation of the trading program lead to exceedances of instream water quality standards in the Tualatin River?

The Tualatin already exhibits exceedances of instream water quality standards. The purpose of the trading program is to reduce instream temperatures and thus temperature exceedances, although the program will not be sufficient to lower temperatures to the system potential temperature identified in the TMDL.

It should be noted that CWS' temperature impact on the Tualatin is a small fraction of the general warming pattern seen over the river's length. The data on which the TMDL is based, collected in July of 1999, showed a 1.5°F temperature increase at CWS' Rock Creek treatment plant. This is a relatively small increase compared to the 10°F increase that was seen between the headwaters and the Rock Creek plant. A similar (10°F again) increase was seen in between the Rock Creek plant and the mouth of the Tualatin.

Under the proposed trading program, CWS will be allowed to offset their excess thermal load via riparian restoration both on the mainstem of the Tualatin and on its tributaries. It is possible that some projects will be located many miles from CWS' Rock Creek outfall. Given this and given normal year-to-year variability in stream temperature plus the anticipated impact of global warming, it is unlikely that the impact of individual restoration projects will be directly measurable at the outfall.

In recognition of this, DEQ has decided to base compliance on shade density measurements made at riparian restoration sites. These measurements will then be used to determine how much solar energy is being blocked by the newly-created shade.

7. Is the impact of each of the measures that CWS proposes to offset their temperature impact quantified?

Appendix B describes methodologies for assessing the impact of flow augmentation and riparian shading. For assessing the impact of flow augmentation, CWS developed empirical equations that relate instream flow, effluent flow and the rate of flow augmentation to temperature. These equations were developed by running the model that was used to develop the temperature TMDL under a variety of flow conditions. The model results were then plotted and equations were developed that describe the model results. Agreement between the model results and the empirical equations was high, with root mean square errors of less than 0.1 for both the Rock Creek and Durham treatment plants. DEQ considers the approach and the resulting equations to be satisfactory for evaluating the impact of flow augmentation relative to CWS' excess heat load.

The methodology for evaluating the impact of riparian shading in the TMP has been described previously by DEQ in the Permit Evaluation Report that came out along with the NPDES permit issued in March of 2004. The methodology described in the TMP draws on this, as well as on work done by DEQ to develop the temperature TMDL. DEQ considers this approach to be satisfactory, however, some terminology in the TMP needs to be clarified. Specifically, the equations and sample calculation in Appendix B of the TMP do not appear to account for shade that may have been present at the start of a particular restoration project. The TMP needs to identify the starting shade condition.

A note on the Shade-a-Lator referred to in Appendix B: this is a subroutine of HeatSource, the model used to develop the temperature TMDL for the Tualatin. A simplified version of this tool was used to demonstrate the impact of riparian shading at meetings of DEQ's Water Quality Trading Stakeholder Group held in 2003. The simplified version did not take into account stream aspect, near stream disturbance zone width or channel incision. CWS has elected to use the more sophisticated version of Shade-a-Lator, consistent with what was used to develop the temperature TMDL.

8. Does the TMP include a methodology for prioritizing riparian areas in the watershed for restoration? The goal of this prioritization scheme should be to maximize the benefits of riparian restoration projects for the protection of the most sensitive beneficial uses.

The prioritization categories that CWS intends to use are described in Chapter 3, Section G. This section also describes how priority areas will be targeted.

9. How will compliance with the temperature management plan, which when adopted will be part of CWS' permit, be established?

CWS will submit annual reports to DEQ in March of each year, the contents of which are listed in Chapter 5, Section C of the Temperature Management Plan. The results of CWS' thermal load credit trading activities will be compared to the benchmarks provided in Table 4 of Chapter 3, Section F to determine if CWS is on track with offsetting their excess thermal load. CWS will need to provide explanation for any identified shortfall.

If DEQ determines that CWS is falling short of offsetting their excess thermal load , CWS will have to submit a remedial plan to address the shortfall. DEQ anticipates that any identified shortfall will need to be met via riparian restoration rather than flow augmentation.

If DEQ determines that the causes of the shortfalls could reasonably have been anticipated by CWS, DEQ will proceed with the appropriate compliance action. If DEQ perceives that CWS is consistently falling short of the agreed-on targets, DEQ will require CWS to enter into a Mutual Agreement and Order with the Department to specify the necessary actions to come into compliance.

10. Does the TMP discuss reuse of treated effluent? Is there an estimate of the amount by which CWS' thermal load may be reduced through reuse?

Chapter 2, Section D discusses CWS' efforts with respect to reuse. CWS has just hired a new staff member to manage the development of the Clean Water Services Reclaimed Water Master Plan, therefore, CWS has not attempted to provide an estimate of the amount of reuse expected to occur at this time.

To the extent that CWS chooses to practice reuse of treated effluent, CWS' need to pursue flow augmentation and shade creating through riparian restoration will be reduced. How much CWS chooses to invest in reuse as opposed to flow augmentation and riparian restoration is a management decision to be made by CWS.

11. Does the TMP specify a baseline for thermal credit trading?

As described in Chapter 1, Part B of the TMP, the thermal load that CWS is required to offset will be based on average daily temperature and flow conditions from July 1 through August 31 of each year. This can be thought of as the trading baseline, though it should be noted that it will vary from year to year.

For planning purposes, CWS has developed an annual thermal budget for an average year. This may be found at the end of Appendix B.

12. Are the schedules contained in the TMP reasonable?

Chapter 3, Section F projects a schedule for how many miles CWS estimates will need to be planted to achieve the thermal load that needs to be offset via riparian planting. The number of miles to be planted in 2004 represents a modest increase over what CWS is currently managing to do under their Healthy Streams Plan. This seems reasonable given the amount of time that CWS needs to get the landowner incentive programs they have developed up and running. The number of stream miles to be planted increases significantly in the following years.

13. Are the trading ratios described in the TMP reasonable?

Yes. Two trading ratios are given in the TMP: one for streams over 7 feet across and another for streams that are 7 feet across and under. The intent of each is to adequately compensate for the years that it will take for shade to establish.

For streams over 7 feet across, DEQ has decided that a trading ratio of 2 will apply for shading projects. That is, at the end of 20 years (the duration of credit that DEQ has established for projects involving riparian shade), the heat load offset by shade must be two times the excess thermal load that CWS is responsible for. This is described in the Permit Evaluation Report that was issued along with the NPDES permit in March of 2004. The Department has since decided to modify this approach for smaller streams, defined as those that are less than or equal to 7 feet across. The decision to do this was based on an analysis contained in Appendix B of the TMP. The analysis concerns the number of stream miles required to offset the average excess thermal load. Not surprisingly, this number goes up dramatically as the stream width decreases. This means there is a disincentive for CWS to restore smaller streams. DEQ does not intend that CWS shall do stream restoration on streams over say, 10 feet across to the exclusion of streams that are only 5 feet across, particularly as some of these smaller streams provide valuable salmonid habitat. Furthermore, a closed canopy can be achieved on a smaller stream in significantly less than 20 years. Depending on site potential vegetation, it may be achieved in less than 10 years. In recognition of this, DEQ has decided that a 1 to 1 trading ratio for streams that measure less than 7 feet across is acceptable.

14. Does the TMP consider changes in water availability likely to occur in the watershed over the long-term?

CWS' efforts with respect to long range planning regarding water supply are discussed in Chapter 2, Section D.

Though not described in the TMP, CWS has also contracted with the Climate Impacts Group at the University of Washington to assess the impact of global warming on water supply in the Tualatin Basin. This is similar to the effort that has been undertaken by the city of Portland.

15. Does the TMP describe reporting requirements for thermal load trading and are those requirements sufficient to demonstrate that the measures undertaken to offset the thermal load are adequate?

Chapter 5, Section C lists the reporting requirements as well as the calculations and information that will be provided to support the various reporting requirements.

15. Does the TMP contain a plant list? Are the plants on the list appropriate for the Tualatin Basin?

Appendix G of the TMP contains a Tree and Shrub Species List. This was developed by CWS for developers who may or may not be well-versed in riparian restoration work. It was written with the following constraints in mind:

- Not all native plants are commercially available.
- Sizes need to be specified so that the plants that get planted are plainly visible to inspectors.

- A variety of plants needs to be specified so that a reasonable level of biodiversity is achieved.

16. Does the TMP contain a description of how CWS intends to work with potential growers and contractors involved in riparian restoration so that adequate plant materials are available, and contractors have adequate time to mobilize resources?

Chapter 4, Section B discusses CWS' plans and expectations regarding the securing of a reliable plant supply. CWS intends to purchase all of the plant material needed for riparian restoration projects. CWS intends to accomplish this by entering into multi-year contracts with commercial growers who are located in the basin or, if they are located outside the basin, are still familiar with the plants needed in the basin.

17. Does the TMP contain a description of the kinds of approaches that will be implemented to reach the target increase in stream shade?

Appendices C and D describe the incentive programs that CWS has designed for agricultural areas. CWS has been quite proactive in designing these programs, and began work on them more than a year prior to the date of permit issuance. CWS has gone to considerable effort to assess currently available programs and to work with members of the farming community to determine what would make an incentive program attractive to farmers. This work has usefulness and value that extend well beyond the context of the NPDES permit. CWS is continuing to develop other incentive programs. An effort is now underway to design a program for woodlot owners with riparian areas not covered by the Forest Practices Act.

18. Does the TMP contain a planting plan? Does the plan include expected plant survival rates, and justification for planting densities?

The subject of planting plans is discussed in a general way in Chapter 4, Section A. CWS anticipates that site-specific planting plans will be developed for specific projects.

CWS anticipates that riparian restoration projects will take place on urban lands, agricultural lands and possibly on forested lands. For projects in urban areas, CWS intends to follow the Design and Construction Standards found in Appendix F of the TMP. These were developed by CWS for use in urban areas over which CWS has jurisdiction. These standards have been reviewed by the city and county staff in the CWS service area as well as by the Healthy Streams Advisory Committee and NOAA Fisheries.

For projects in agricultural or forested areas, CWS anticipates that plans will be developed based on standards already in use by partner agencies such as the NRCS and ODF. When agricultural and forested area projects are under taken the standards under which planting will be conducted need to be included in the site plan.

19. Does the TMP contain a monitoring plan to assess the amount of shade that is created?

Yes. This may be found in Chapter 4, section D. There is a discussion of the monitoring method as well as what years a particular project will be monitored. It should be noted that the monitoring is scheduled to happen every 5 years for a particular project.

20. Does the TMP contain a maintenance plan that will promote plant survival and reduce the impact of invasive species?

Chapter 4, Section C discusses maintenance and monitoring in general terms, and lists the control methods that will be used to control invasive species. Appendix H contains CWS' Integrated Vegetation and Animal Management Guidance for urban areas.

Appendix C
Problem Statement regarding Riparian Restoration Projects

Riparian restoration is a young science. Symptomatic of this, there are no widely-available performance standards by which the success of riparian projects might be evaluated, nor are there agreed-on planting densities or expectations for site preparation or follow-up care. While it is true that performance standards along with planting densities, site preparation and follow-up care necessary to achieve them will always be site specific, the variation in planting densities employed by different organizations is striking.

For example, there is one organization in the Tualatin basin in Oregon that sometimes plants up to 3000 plants per acre and another that sometimes plants as few as 500. Both organizations claim they are aiming for a diverse assemblage of native trees, shrubs and grasses that will be capable of achieving site potential shade at maturity. While the individuals involved are doubtless planning for different site conditions and different levels of follow-up care and replanting, the fact remains that there seems to be a lack of agreement about what is necessary and what isn't.

It appears that riparian/wetland restoration projects are designed and performed on a somewhat ad hoc basis. This is not to say that they are never successful. What this lack of a formal body of knowledge does mean is that the successes are dependent on the direct involvement of particularly informed, experienced individuals and in general are more difficult to reproduce than is desirable.

There is a need for greater rigor in this field. From DEQ's perspective, it is important that projects involving riparian restoration perform as intended. Such projects may be performed in order to offset point source thermal loads. They may also be performed as part of mitigation for enforcement penalties. In both cases, it is important that the projects be successful as they are being used to compensate for environmental degradation. If it is not possible to provide a reasonable level of assurance that these projects will be successful, then it may become difficult for DEQ to justify their being done in the circumstances just described. This would be unfortunate, as there are clearly many streams in the state that would benefit from riparian restoration and there are limited funds available for such work.

If restoration is to take place on a large scale in a particular ecosystem, say for example in order to mitigate the impact of a dam, then it would be useful to develop a document for that ecosystem describing the state of the science. It should list outstanding questions, and make proposals for advancing the state of the science. Development of this document would involve a literature search as well as interviews of various riparian/wetland restoration professionals. The results could be used to help guide a discussion group composed of wetlands/riparian specialists and regulators. The goal of this group would be to come to consensus on how to perform, monitor and report on wetlands/riparian restoration projects in a manner that insures the state of the science continuously advances.

If the body of information for a particular ecosystem is nonexistent, the following approach can be used to develop initial planting densities.

A. Identify reference sites for developing planting densities. The ideal reference site would be a site where a riparian restoration project was undertaken at least 10 years ago the site with a diverse mix of native plants providing a significant level of shade.
B. Determine basal tree area (cross sectional area of trees/acre) for these sites. For areas where a significant amount of shade is provided by shrubs, the area defined by the drip line may be more appropriate than basal tree area.
C. Determine/define reasonable survival rates for planted trees (or shrubs).
D. Use above-determined survival rates and # trees (or shrubs)/acre needed, to establish necessary planting densities.
E. Define conditions under which re-planting is to be done. This basically means defining acceptable plant survival rates after 1 year, 2 years, 3 years, etc.
F. Define conditions under which non-natives must be removed. Some non-natives are less invasive than others or can be expected to eventually get shaded out by developing trees. Others are capable of proliferating widely and are so noxious that their presence cannot be tolerated. Acceptable methods of removal also need to be defined. It may be that several different methods will need to be evaluated simultaneously to determine which is the most effective, rather than locking in on one approach based on inadequate information.

Monitoring requirements would include the following:

1. Photographs before-and-after planting and over time.
2. Permit holder should also report on re-planting efforts and offer an explanation for why re-planting is needed.
3. Plant density. Monitored areas should be no less than 5% of planted area, and should be randomly chosen.
4. Plant survival rates. Monitoring frequencies could be as follows:
    - Every year for the first 5 years, and
    - Once every 5 years after that.
5. (Recommended) Plant vigor. This data should be collected and used to help establish whether or not re-planting is needed.
6. (Recommended) Presence of invasives.
7. Shade density:
    - At beginning of project and
    - Every 5 years after that.

Appendix D

Research Questions from Sound Native Plants, Inc. (Seattle, Washington)

Please inform Susan Buis if you or someone else decides to work on one of these.

1. Bareroot plants vs. containerized plants success rates. Does it make a difference on restoration sites? Does it depend on time of year planted? Irrigated the first summer? Mulched?
2. Small plants (1-2 gallon) vs. large plants (5 gallon or B&B, esp. B&B) success rates. There is research in landscaping situations that states that small plants do better, but I would like to see good data on the success rates of B&B on restoration sites. What factors does it depend on? See question #1.
3. Affects of weeding and mulching (how big an area is necessary?) on plant survival rates. If we could figure out some guidelines on the amount of work actually necessary to maintain a project until establishment, maybe we would be more successful in getting it done and thereby improving project success rates.
4. Minimum frequency and duration (depth) of summer irrigation necessary to get plants thru a summer drought. Ditto #3.
5. The affects of removing nitrogen from a site by tilling in carbon (i.e. sawdust) to see if it would favor native growth over non-native. Examples from Midwest prairie restoration and from PNW suppression of reed canarygrass growth (example from Mark Maurer at WASHDOT).
6. Other species that can successfully be used as live stakes and under what conditions (ninebark, salmonberry, twinberry, snowberry, red elderberry, etc.). If we could figure out how to make these species consistently thrive from live stakes, we could save projects (especially community based stream restoration type projects) big bucks. *(Paul Cereghino currently starting this project with 4 species: RUBSPE, SAMRAC, CORSER, SYMALB)*
7. how to improve red osier dogwood live stake survival success rates (track record is spotty).
8. seed collection and germination of Corylus cornuta (beaked hazelnut), how green can you collect the nuts and still get good germination (hard to beat the birds to them cause they don't mind them green and we prefer to collect ripe), check with 4th Corner Nursery before proceeding, make sure they haven't answered this already.
9. improving germination rates of Carex utriculata, Eleocharis palustris, and Scirpus acutus. We're having very low germination rates on these three.
10. Testing mycorrhizal inoculants on typical restoration sites in western WA to see if it made any difference in survival or growth rates after one year.
11. Does cedar wood chip mulch negatively affect the growth of native plants. If so, what percentage of cedar in a mix is acceptable?
12. Can wood chip mulch from diseased trees pass disease on to the plants being mulched?
13. Can sheet mulching with newspapers or cardboard under wood chips prevent water from reaching plants in the summer when the materials become dry? Does the cardboard or newspaper become so hydrophobic that re-wetting is difficult and the plant roots underneath suffer from drought even if irrigated?