Willamette Basin
TMDL Implementation Plan

City of Oregon City, Oregon

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Table 1-1 Acronyms and Abbreviations

ACWA	Oregon Association of Clean Water Agencies
BMP	Best Management Practice
CFR	Code of Federal Regulations
CWA	Federal Clean Water Act
CWR	Cold Water Refugia
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
ESA	Endangered Species Act
FTE	Full Time Equivalent
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
OM	Operations and Maintenance
PE	Public Education
PF	Program Funding
PI	Public Involvement
QA/QC	Quality Assurance and Quality Control
ROW	Right-of-Way
SWMP	Stormwater Management Program
TMDL	Total Maximum Daily Load
UGB	Urban Growth Boundary
USEPA	United States Environmental Protection Agency
WPCF	Water Pollution Control Facilities
WQ	Water Quality
WQRA	Water Quality Resource Area

1.0 Introduction and Background

The Oregon Department of Environmental Quality (DEQ) has set Total Maximum Daily Loads (TMDLs) for water bodies located in the Willamette River Basin. Any agency or municipality that has legal authority over activities or areas that are sources of pollutants that impact water quality are known as Designated Management Agencies (DMAs). DMAs that are responsible for areas discharging to a TMDL water body must develop an Implementation Plan describing strategies to be undertaken to address TMDL pollutants (DEQ 2006).

The City of Oregon City, located in the Clackamas and Middle Willamette subbasins of the Willamette River Basin, must comply with this requirement. The TMDL parameters of concern for these basins include temperature, bacteria, and mercury. This document represents the TMDL Implementation Plan for the City of Oregon City, specifically addressing the Willamette Basin TMDL for temperature. A detailed overview of management strategies for bacteria and mercury is also provided in this plan although compliance with the TMDL for these parameters is covered by the City's municipal separate storm sewer system (MS4) National Pollutant Discharge Elimination System (NPDES) stormwater permit.

This document is arranged in five sections. Section 1.0 provides an overview of the TMDL Implementation Plan and provides background on the Willamette Basin TMDL with respect to Oregon City. Section 2.0 provides an overview of how the City's MS4 NPDES permit addresses TMDL compliance with respect to bacteria and mercury. Section 3.0 provides the temperature portion of the TMDL Implementation Plan. Section 4.0 provides evidence of compliance with land use requirements. Section 5.0 discusses additional elements required in the Water Quality Management Plan (WQMP) for the Willamette Basin TMDL: public involvement, fiscal analysis, legal authority, and cold water refugia.

1.1 Total Maximum Daily Loads Summary

The Federal Clean Water Act (CWA) of 1977 gave authorization to the U.S. Environmental Protection Agency (EPA) to restore and maintain water quality in all water bodies within the United States. In response to the CWA, the EPA designated certain state agencies, DEQ for the State of Oregon, to develop water quality standards, perform water quality monitoring to understand current conditions, determine sources of pollution, and develop TMDLs as a tool to improve water quality and restore the beneficial uses of surface waters. When a water body is found not to meet water quality standards, it is first placed on the 303(d) list as an impaired water body, and the development of a TMDL follows.

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and it allocates pollutant loadings among point and non-point sources, background levels, reserves for future growth, and a margin of safety. Point sources are typically defined as those sources that enter surface waters through a pipe or defined conveyance system (i.e., municipal and industrial stormwater and/or wastewater). Wasteload allocations are provided in the TMDL for point sources. Nonpoint sources are typically defined as those sources that enter surface waters through more diffuse and dispersed overland flow (e.g., surface

runoff from agricultural and forested lands). Load allocations are provided in the TMDL for nonpoint sources.

Implementation plans are a DMA's response to the TMDL, describing management strategies that they will implement and monitor to mitigate excess loading of TMDL pollutants (DEQ 2006).

In September 2006, DEQ issued a TMDL for nine subbasins within the entire Willamette Basin in an effort to protect and restore the beneficial uses of the Willamette River. The Willamette Basin TMDL is the largest TMDL undertaken by the DEQ thus far. The Willamette River watershed is divided into 12 subbasins; however, the Tualatin Subbasin is not covered under this TMDL for bacteria and temperature since it already as a TMDL in place for those parameters, and the Molalla/ Pudding and Yamhill Subbasins are still under review by DEQ. Mercury, bacteria, and temperature have been identified as problematic constituents for the Willamette River. Additional pollutants have been identified as problematic for specific tributaries and portions of the mainstem Willamette River; these pollutants are dissolved oxygen, turbidity, and toxics and are not covered under the scope of this plan as they are not listed in the TMDL for areas covered by Oregon City (DEQ 2006).

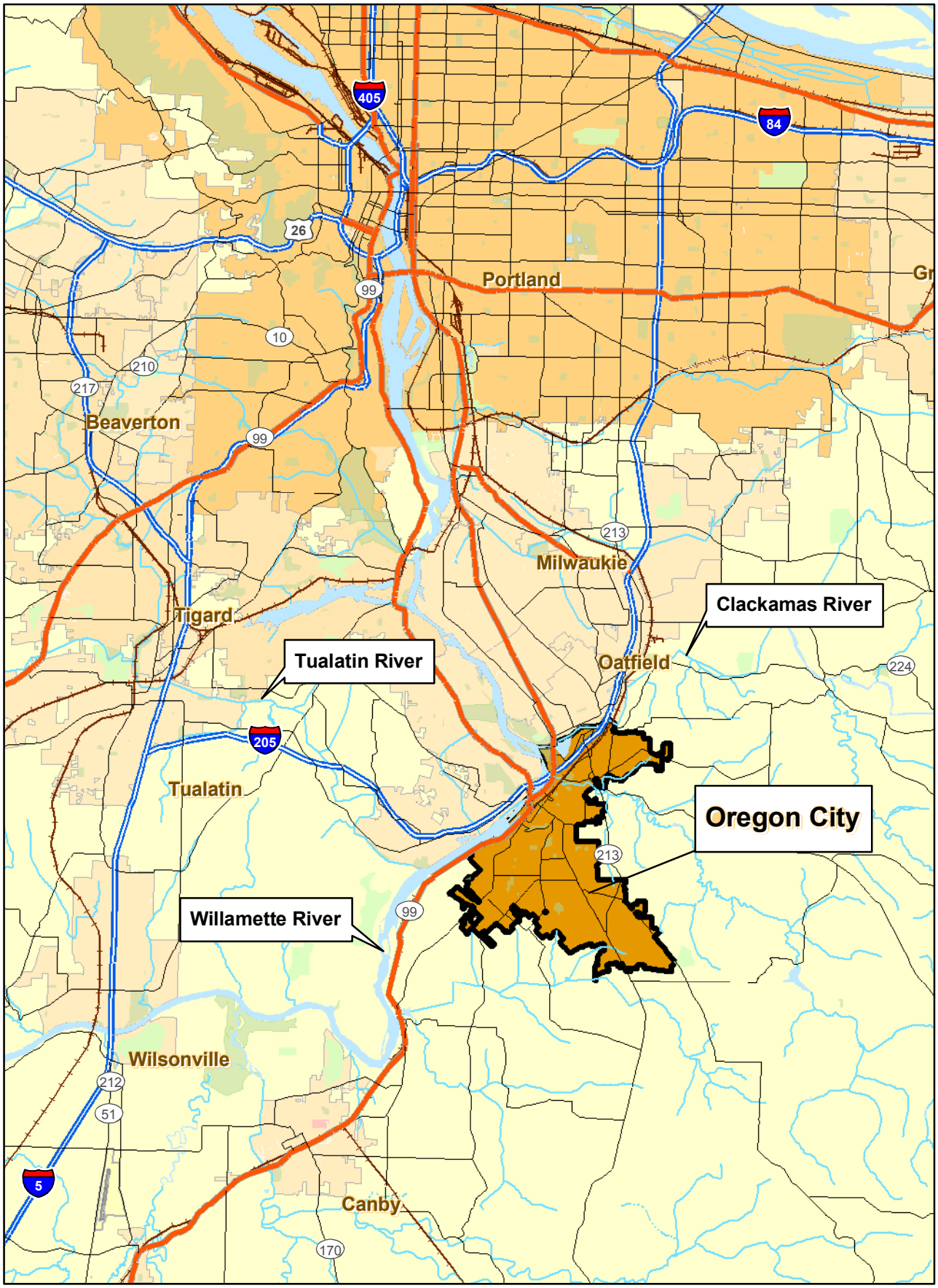
Chapter 14 of the Willamette Basin TMDL provides a Water Quality Management Plan, which presents optional management measures for jurisdictions discharging to the Willamette River, in order to comply with the TMDL requirements. In addition, a TMDL Implementation Plan Guidance for State and Local DMAs (May 2007) is available to jurisdictions to assist in preparing their individual TMDL Implementation Plans. Both documents are referenced in the preparation of this TMDL Implementation Plan.

1.2 Willamette River and Middle Willamette and Clackamas Subbasins

The Willamette River watershed encompasses 11,500 square miles and is home to 70% of Oregon's population, which equates to over two million people (DEQ 2006). The Willamette River and its tributaries are an important resource for residents of the watershed, providing beneficial uses such as private and public drinking water supply, industrial water supply, irrigation, recreation, aesthetic quality, natural habitat, and other functions.

Oregon City falls within the boundaries of two Willamette River subbasins: the Clackamas River and Middle Willamette Subbasins (Figure 1-1). Together, these two subbasins include portions of five counties and 20 cities, encompassing a total of 1,698 square miles.

The Clackamas Subbasin boundary extends northwest from the Mt. Hood National Forest to the Willamette River. Two wilderness areas, Bull of the Woods Wilderness Area and Salmon Huckleberry Wilderness Area are located within the subbasin collectively protecting 79,500 acres. The U.S. Forest Service manages the majority of the publicly owned land within the basin. Approximately one quarter of the Clackamas Subbasin is privately owned with a large portion of that land owned by timber companies. The majority of commercial and industrial land use is situated near the mouth of the Clackamas River as well as near the small urban areas and major roadways. Additionally, a small portion of the Warm Springs Indian Reservation is within



VICINITY MAP

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

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Print Date: March 3, 2008

FIGURE 1-1

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the Clackamas Subbasin (DEQ 2006). The Clackamas River itself has a TMDL for temperature and bacteria and is included as Chapter 6 in the Willamette Basin TMDL.

The Middle Willamette Subbasin includes the Willamette River from Willamette Falls at River Mile 26.6 to River Mile 108. From the East, the Middle Willamette Subbasin drains a portion of the Cascade foothills and the Coast Range from the West. The subbasin is further divided into the following four smaller watersheds: Abernethy Creek Watershed, Mill Creek Watershed, Rickreal Creek Watershed, and Willamette River tributaries/Chehalem Creek Watershed. Although there are small areas of public land located throughout the subbasin, it is comprised primarily of private land. Chief land uses include agriculture, forestry, and urban activities.

1.3 City of Oregon City Background

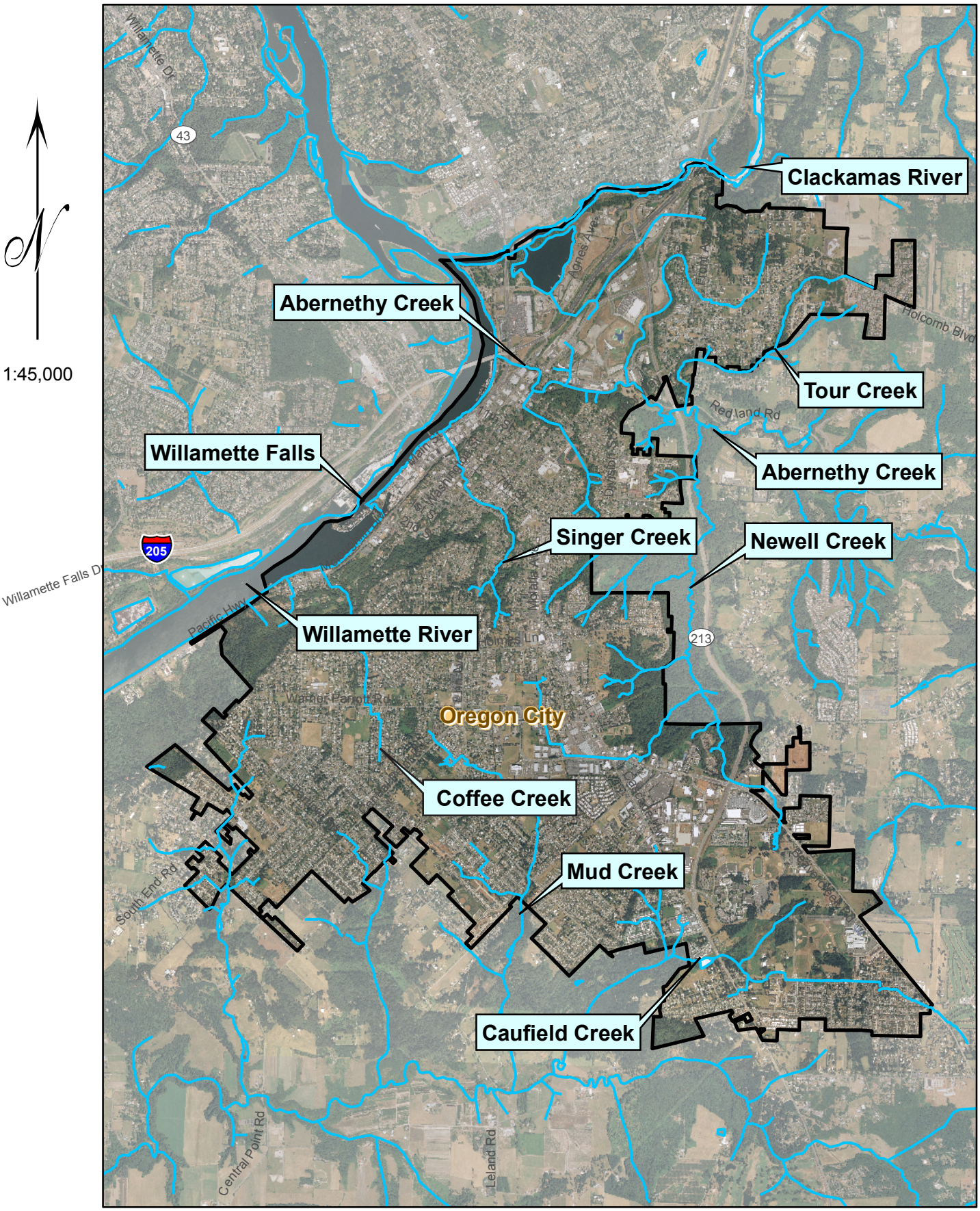
Oregon City is located in Clackamas County, 13 miles south of Portland, Oregon. It has a rich history as Oregon's first capital and incorporated city (Figure 1-1). Oregon City has a population of approximately 33,390 residents (Portland State University website). The city occupies a total of 7,857.7 acres, with 6,144.3 acres within the city limits and 1,713.4 acres outside the city limits but within the Urban Growth Boundary (UGB). Urbanization at the edge of Oregon City is constrained by the Willamette River and the City of West Linn to the west, the Clackamas River and the City of Gladstone to the north, and steep topography to the south and east. The City is comprised of mostly low density residential with most commercial and industrial land in the southeast portion of the City. There are no identified agricultural or forest land within the City limits (Oregon City Comprehensive Plan 2004).

The City is divided into 13 watersheds draining to the Willamette and Clackamas Rivers. Several tributaries flow through the City, feeding both the Willamette and Clackamas Rivers creating the City's physical configuration and providing unique topographic and ecologic areas within the City (Figure 1-2). Within the City, the Clackamas River, as well as Abernethy, Newell, Holcomb, Potter, and other creeks provide essential spawning and rearing habitat for steelhead trout, cutthroat trout, and coho salmon (Oregon City Comprehensive Plan 2004).

Oregon City obtained a MS4 NPDES permit from DEQ for its municipal stormwater discharges to surface waters as a co-permittee on Clackamas County's Phase 1 MS4 NPDES permit. The City's municipal stormwater discharges are considered to be point sources since they are covered by a permit. Oregon City includes some stormwater discharges that flow overland and enter receiving waters directly without first entering the City's stormwater conveyance system or MS4. While these discharges should be considered nonpoint sources, they have been included and covered under the City's NPDES permit for ease in management; therefore, the management strategies covered in Section 2.0 for bacteria and mercury cover both point and non-point sources as the City's NPDES permit covers both of these sources.

1.4 TMDL and Implementation Plan Goals

The primary goal of the Willamette Basin TMDL is to ensure that levels of temperature, bacteria and mercury are not exceeded because waterways that are too warm will not support healthy salmon and trout; bacteria-contaminated water can cause illness in humans; and elevated levels



OREGON CITY HYDROGRAPHY

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

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Print Date: November 29, 2007

FIGURE 1-2

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of mercury have resulted in health advisories to limit the amount of fish that can be safely consumed. The goal of this implementation plan is to meet TMDL requirements by developing management strategies and schedules to minimize pollutant loads of heat energy (temperature). Another goal is to provide an overview (for reference purposes only) of management strategies and schedules that are implemented under the City's MS4 NPDES stormwater permit to comply with the bacteria and mercury portions of the TMDL.

1.5 TMDL Implementation Plan Requirements

The Willamette Basin TMDL addresses bacteria, mercury, and temperature. DEQ created a WQMP for the Willamette Basin TMDL in 2006 meant to provide the framework for the management strategies to attain and maintain water quality standards within the Willamette Basin (Oregon Administrative Rule (OAR) 340-042-0040-(4)). Per the WQMP, these strategies are to be submitted by DMAs to the DEQ as a TMDL Implementation Plan. The TMDL Implementation Plans need to identify activities that the City is currently conducting, or planning to implement, to address the TMDL parameters and minimize their effects on receiving water quality.

For the Willamette Basin, the DMAs were to develop and submit these plans to the DEQ within 18 months after the release of the final TMDLs. The final TMDLs were released on September 21, 2006; consequently the TMDL Implementation Plans developed by the DMAs were due by March 31, 2008. The plan was again updated May 2014 to identify activities the City is currently conducting, or planning to implement, during the next five year period.

OAR 340-042-0080(3), requires the TMDL Implementation Plan to cover the following five components:

1. Management strategies that the DMA or other responsible person will use to achieve load allocations and reduce pollutant loading;

2. A timeline and schedule to achieve measurable milestones;

3. A plan for performance monitoring and periodic review and revision of the implementation plan;

4. Evidence of compliance with applicable statewide land use requirements; and

5. Any other analyses or information as specified in the Water Quality Management Plan.

Section 2.0 provides an overview and reference regarding strategies in the City's MS4 NPDES permit that address TMDL compliance for bacteria and mercury. The first three requirements above are discussed separately for temperature and are covered in Section 3.0. The fourth requirement requires evaluation of the plan's conformance with the City's land use goals and comprehensive plan. This is covered in Section 4.0. The fifth requirement, discussed in Section 5.0, addresses additional items identified in the WQMP that the DMA must address. These items include:

- Determine how to best provide for public involvement;
- Analyze funding to determine what additional resources are necessary to develop, implement, and maintain the management strategies;
- Include citations and brief descriptions of legal authority used to carry out the management strategies; and
- Address cold water refugia.

2.0 Bacteria and Mercury TMDLs

As described in Section 1.0, a TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and it allocates pollutant loadings among point and non-point sources, background levels, reserves for future growth, and a margin of safety. Wasteload allocations are provided for point sources (e.g., municipal stormwater and wastewater) and load allocations are provided for nonpoint sources (e.g., surface runoff from agricultural and forested lands). Excess bacteria and mercury in the Willamette River Basin come from both "point" and "nonpoint" sources.

Oregon City obtained an MS4 NPDES permit from DEQ for its municipal stormwater discharges to surface waters (i.e., their point sources). The City does not operate its own wastewater treatment plant; therefore, all municipal point sources of bacteria and mercury are represented by stormwater discharges and covered under the City's MS4 NPDES permit. As described in Section 1.0, Oregon City includes some stormwater discharges that flow overland and enter receiving waters directly without first entering the City's conveyance system (i.e., nonpoint sources). However, for ease of management, the NPDES permit best management practices (BMPs) have been voluntarily applied to these sources as well, and they have been considered to be subject to waste load allocations for stormwater discharges provided in the TMDL. Therefore, the City does not have any nonpoint sources of bacteria and mercury that would be subject to load allocations under the TMDL. The City's MS4 NPDES permit serves as the Willamette Basin TMDL Implementation Plan for bacteria and mercury. The purpose of this section is only to provide an overview of the strategies, schedules and monitoring activities that address bacteria and mercury that are included as part of the NPDES permit.

2.1 Management Strategies

DEQ addresses TMDL requirements within the City's MS4 NPDES permit, as they pertain to wasteload allocations for stormwater runoff. With respect to TMDLs, the NPDES permit requires Oregon City to develop benchmarks towards meeting TMDL wasteload allocations and requires an adaptive management approach that focuses on refining BMPs over time until wasteload allocations are achieved.

As mentioned above, Oregon City's MS4 NPDES permit serves as the compliance document for meeting the Lower Willamette Basin TMDL requirements for bacteria and mercury. The purpose of this section is only to provide an overview of Oregon City's management strategies included in their permit that address bacteria and mercury. These management strategies are listed and summarized in Appendix A. More detail related to each of these practices is provided in the City's Stormwater Management Plan (SWMP) that was updated in 2012 to correspond with permit language reflected in the City's renewed MS4 NPDES permit, dated March 16, 2012. Annual reports are prepared by Oregon City and submitted to DEQ by November 1st of each year to summarize annual progress with respect to implementing SWMP best management practices. A summary of the most recent annual report is also provided in the table in Appendix A. This stormwater management plan is an evolving document. Adaptive management may result in annual changes that are reported in the annual compliance reports. Therefore, Appendix A only represents the current SWMP through the end of the permit term in 2017.

Since the Willamette Basin TMDL had not been finalized when the City's NPDES permit was issued in 2004, the requirement to develop benchmarks for the Willamette Basin TMDL parameters (bacteria and mercury) did not yet apply. However, as mentioned, the City was required to submit an application to renew their permit in the fall of 2008. Benchmarks for bacteria with respect to Willamette River and Clackamas River wasteload allocations were included in the permit renewal application. Mercury is a phased TMDL with monitoring requirements expected for the first phase to support DEQ's development of wasteload allocations for the second phase. A requirement for the development of benchmarks for mercury will apply when DEQ develops wasteload allocations for mercury.

2.2 Timeline and Schedule

The City's NPDES stormwater management plan includes measurable goals for each BMP. These represent the schedule for implementing the TMDL implementation strategies for bacteria and mercury. The table in Appendix A includes the goals and schedules that are currently listed in the City's SWMP for each best management practice. As mentioned, these goals have the potential to change on an annual basis through adaptive management.

2.3 Monitoring

Two types of monitoring are described in this section. Implementation monitoring relates to the tracking of BMP (management strategy) implementation and ensuring that BMP (management strategy) implementation goals are met. Effectiveness monitoring relates to the analysis and evaluation of stormwater and instream concentrations of pollutants with respect to meeting pollutant load reduction benchmarks.

2.3.1 Implementation Monitoring

With respect to implementation monitoring, Oregon City is required to submit an annual compliance report that summarizes implementation activities for all BMPs in their NPDES stormwater management plan. Along with each BMP, the table in Appendix A includes a list of measurable goals and also provides an example of what the City's annual stormwater reports include as far as tracking and recording activities associated with those measurable goals (i.e., implementation tracking measures).

2.3.2 Effectiveness Monitoring

The City of Oregon City has been conducting effectiveness monitoring in the form of sample collection and analysis at various instream and stormwater outfall sites throughout the City. Stormwater quality related monitoring activities are conducted in conjunction with the monitoring requirements listed in their MS4 NPDES permit. The City of Oregon City is currently participating in a coordinated monitoring program (updated June 30, 2013) with eight Clackamas County co- permittees. Under the current permit, Oregon City is collecting samples from six instream sites and two outfall sites and the samples collected from these sites are analyzed for bacteria.

Mercury monitoring at one outfall was conducted during one wet-weather storm event and one dry-weather storm event between October 1, 2012 and September 30, 2013 per the City's current MS4

NPDES permit. Details can be found in the Comprehensive Clackamas County NPDES MS4 Stormwater Monitoring Plan, June 2013.

3.0 Temperature TMDL

DMAs, including the City of Oregon City, must develop temperature TMDL Implementation Plans in order to address TMDL exceedances for temperature, as mandated in the Willamette Basin TMDL. These plans must describe how each DMA will reduce temperature in order to meet water quality standards. The method most often used for reducing water temperatures is the installation of riparian vegetation where it is lacking along the banks of a stream. As riparian vegetation matures, it produces shade and creates a microclimate around the waterway that regulates and minimizes heating from solar radiation. Although other techniques are available for reducing water temperatures, the installation of native riparian corridors provides a cost-effective and relatively simple (low engineering/earthwork) approach that provides ancillary benefits beyond temperature regulation. Ancillary benefits include primary production of organic materials, source of large woody debris for in-stream channel complexity and habitat features, wildlife corridor connectivity, displacement of noxious vegetation, improved bank stability, and improved visual aesthetics.

Salmonids require cool, well-oxygenated water to survive. Elevated water temperature is a common problem in many tributaries to the Willamette River, resulting in TMDL load allocations and waste load allocations designed to protect and remedy impaired aquatic habitats. Water temperatures in excess of water quality standards make streams unsuitable for coldwater fish and other coldwater aquatic species. Excessively warm streams lead to a variety of ill effects on many salmon and trout species, ranging from decreased spawning success to death (EPA 2003). Given the opportunity, juvenile and adult salmon will occupy water that is 13-18º C (55-64º F), with warmer water selected only if excess food is available. Water temperatures of approximately 23-25º C (73-77º F) are lethal to salmon and steelhead. Colder water is required for spawning, as genetic abnormalities or mortality of salmonid eggs can occur above 11º C (52º F) (WDOE 2000). The maximum temperature that salmonids can tolerate varies with species, life-stage (e.g., fry, fingerling or adult), prior acclimation, oxygen availability, duration of warmer temperature, and the presence of pollutants.

The purpose of this section is to describe Oregon City's development of an implementation plan to address temperature. Section 3.1 provides a summary of the load allocations and shade curves that are provided in the Willamette TMDL document. Section 3.2 provides a summary of an analysis conducted to evaluate existing shade in Oregon City's riparian areas. Section 3.3 describes the City's strategies for addressing effective shade given the results of the riparian area analysis. Section 3.4 outlines the timeline and schedule for implementation, and Section 3.5 summarizes proposed monitoring.

3.1 TMDL Load Allocations for Temperature

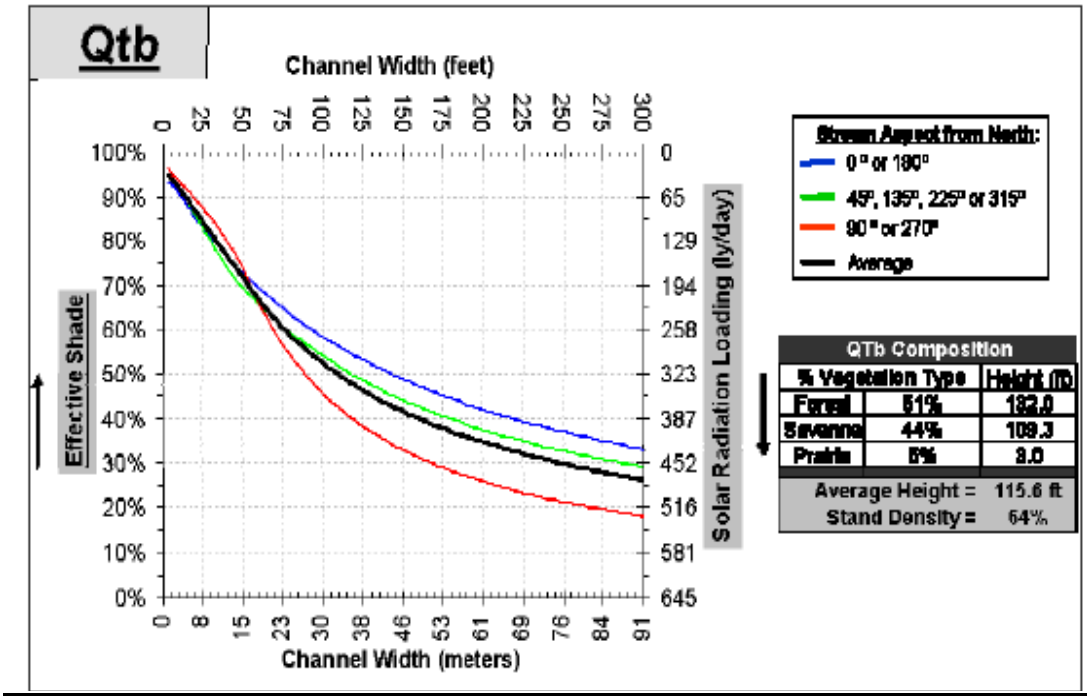
As mentioned above, there are several factors that can contribute to elevated instream temperatures such as changes in watershed processes and channel morphology, climate, geographic location, riparian vegetation, dams, reservoirs, and point sources such as industrial waste water discharges (DEQ 2006). DEQ has found that the largest contributor to temperature is the increased impacts from solar radiation loads due to disturbances of riparian vegetation. In response to this finding, DEQ has defined effective shade targets as a surrogate measure for

addressing temperature. Effective shade is determined through the use of shade curves on a region-specific basis. DEQ has developed shade curves for 15 different geomorphic units. The shade curves, along with stream orientation and width, provide a target for percent effective shade and corresponding solar radiation loading (DEQ 2006).

Shade is more effective on narrower streams than wider streams because shadows from trees in the riparian zone will cover a larger percent of water surface. Since most tributaries to the Willamette are 20 feet wide or less including those within the City boundaries, riparian vegetation casting shade over the streams is expected to be very effective. This can be projected through the use of the shade curves.

Using Figures 6.11 in Chapter 6 for the Clackamas Subbasin and Figure 7.8 in Chapter 7 for the Middle Willamette Subbasin in the Willamette TMDL, the primary corresponding geomorphic unit for the City is QTb (Quaternary Boring Lava). Figure 3-1 is the corresponding shade curve for geomorphic unit QTb. This curve is specific to the soils for the City. By knowing the width of the channel and its direction from the north, this curve will provide the "amount of percent effective shade that each geomorphic unit tree composition provides to the stream based on the stream's channel width and stream aspect from north" (DEQ 2006).

Figure 3-1 Effective Shade Curve for Oregon City



Since most tributaries within the City of Oregon City's UGB are less than 20 feet wide, the percent effective shade was taken from Figure 3-1 using a channel width range of 0-20 feet. This resulted in an effective shade goal for the City of between 85% - 95%. This is interpreted to mean historically prevalent riparian vegetation should block the majority (at least 85%) of solar radiation loading from the streams' water surface. It should be noted that based on this curve, percent effective shade decreases significantly as the width of the channel increases. Because of

this, the most effective way to manage temperature in the mainstem of the Willamette River is through its smaller, narrower tributaries. To relate these shade goals to Oregon City, an analysis was conducted to evaluate the current condition of riparian areas and to identify opportunity areas for shading. The analysis is described in the following section.

3.2 Analysis of Current Riparian Area Conditions With Respect to Shade

The City of Gresham along with Pacific Habitat Services conducted a study on the benefits of effective shade on streams (Majidi 2007). The study looked at the amount of solar radiation blocked by riparian stream buffers of varying stream widths, aspects, and groupings of streambank plantings (i.e., south only versus south and north streambank plantings). The study made a key determination that the effective shade benefit of riparian plantings is diminished beyond 50 feet from a stream edge for typical regional riparian species. Using this Gresham study, URS developed a simplified method for identifying and prioritizing riparian shade restoration opportunities for Oregon City to assist with the development of their temperature TMDL Implementation Plan.

The results of the Gresham study are applicable to perennial creeks averaging 20 feet in width or less. These streams receive the most effective shade benefit from riparian plantings. Larger waterways, like the Clackamas and Willamette Rivers, receive less effective shade benefit from riparian vegetation simply due to their width. Tributaries of the Willamette River within the UGB for Oregon City, with the exception of the Clackamas River, are generally less than 20 feet wide. Therefore, a 50-foot vegetated area was used as the goal for Oregon City tributaries. The following text outlines the steps conducted to identify opportunity areas for shading.

The first step in identifying opportunity areas was to create a core riparian study area that included all areas within 50 feet of the ordinary high water mark (OHWM) of a stream. This resulted in a study area that was approximately 120 feet wide in cross section within the Oregon City UGB consisting of a 50^{ft} buffer + stream width (up to 20^{ft}) + 50^{ft} buffer. Where the OHWM has not been delineated, and only the stream centerline is available, the buffer was increased to ~60 feet to include the width of the stream. This buffer area was created around the most recent stream delineation available from the City's GIS staff. City GIS staff created a stream approximation layer by using 2-foot resolution contours derived from LIDAR data obtained in 2006.

The next step was the identification and elimination of hard and soft planting "constraints" from the study area. Hard constraints included all impervious areas and areas where streams are routed beneath the ground surface (generally through culverts). Soft constraints included roadway, utility, and/or rail right-of-way (ROW) corridors as these generally have planting restrictions. Some ROW corridors may be planted with shrubs, but most do not allow trees to be planted as they reduce aerial visibility, which is required for safety/maintenance flyovers. Soft constraints included wetland areas that are too deeply inundated at various periods of the growing season to support mature woody vegetation and seasonal streams that lack surface water during the summer when temperature standards are most likely to be exceeded. Thus, shade is ineffective in substantially reducing water temperatures in these areas. Where detailed wetland data were available, wetlands capable of being planted with trees (e.g., potential forested wetlands) were not considered to be a constraint. In fact, forested wetlands provide some of the

best opportunities for thermoregulation in perennially saturated areas due to the slow movement of water and often spring-fed water sources.

Within the remaining unconstrained portions of the study area, high-resolution aerial photography and other GIS data were used to delineate areas that appeared devoid of mature woody vegetation. Aerial photography data provided to URS by Oregon City included 2006 color aerial photography, false infrared photography (same year), and 2005 leaf-off aerial photos. Other GIS data used in this step include digital elevation model datasets, 2-foot topographic contours, local wetlands inventory data, and existing riparian delineation data. These sources further illuminated areas where mature vegetation would be most beneficial. The resulting polygons were identified as opportunity areas for shading.

The analysis yielded a total of 85 shade opportunity sites within the city limits. A site included all individual shade opportunity patches within an individual tax parcel. Although some shade opportunity sites are contiguous with other opportunity sites located on an adjacent tax parcel, it was assumed that they would require separate land use and protection agreements, and thus were considered different sites.

An additional 25 shade opportunity areas were identified outside of the city limits but within the City UGB. As these sites are outside the City's regulatory authority, the City has little influence over these areas until they are annexed. Therefore, these sites are presented but not described in as much detail as those sites within the city limits. The City felt that these areas should be documented and included in the analysis, prioritization, and mapping efforts, as the City may coordinate with volunteer groups on planting activities and, when the areas are annexed, pursue riparian enhancement efforts.

The riparian study area within the city limits is approximately 447 acres. Of this, approximately 21 acres were identified as potential shade opportunity areas. The majority of the study area is already shaded by mature vegetation. In addition, many segments of the streams throughout Oregon City are constrained from planting as they are buried and flow through underground pipes and culverts. Table 3-1 summarizes the breakdown of the study area within the City.

The acreage identified as opportunity area in Table 3-1 is a conservative estimate, as the acreage was determined assuming a planting area of 50 feet on either side of the stream. In many cases, the stream width is significantly smaller than the estimated 20 feet, and therefore a planting area less than 50 feet on either side of the stream would be sufficient to provide shade for the stream.

Table 3-1 Summary of Opportunity Areas for Shading

Description of Area	**Area**	**% of Total Study Area**
Currently Shaded	240 Acres	54%
Constraints Exist for Planting	186 Acres	41%
Opportunities Exist for Planting	21 Acres	5%
Total Study Area:	**447 acres**	**100%**

Based on these results, two major strategies emerged for meeting shade targets: the development of a plan to provide shade where opportunities exist, and the implementation of protection measures for areas that are already currently shaded. In addition, measures to promote groundwater recharge may help to reduce elevated stream temperatures. These strategies are all described in Section 3.3.

3.3 Implementation Strategies

This section describes the proposed locations and measures that the City will undertake to plant effective shade along their creeks and streams in areas within the city limits and where opportunities exist, and it also describes the measures already in place to protect riparian areas and promote groundwater recharge. A summary of all strategies to address temperature is provided in Appendix C.

3.3.1 Opportunities for Planting to Provide Additional Shade

The approximately 21 acres (representing 85 sites) within the city limits that were identified as opportunity areas for planting to provide additional shade were further analyzed and prioritized for planting. The seven acres (representing 25 sites) outside the city limits but within the City UGB were also prioritized. This section provides the process used to prioritize and select sites.

The prioritization of shade opportunity areas was based on measures of maximum shade benefits, procedural and economic ease of site acquisition/protection, duration of shade (stream aspect), fish use, size, and proximity to potential cold water thermal refugia. Each site was numerically scored as described below for the following factors:

- Ease of Acquisition/Protection: Public site (score =5), private site (score =1).
- Aspect (Duration of Shade): South bank (score =5), west bank and east bank (score =4), west bank only (score =3), east bank only (score =2), or north bank only (score =1).

  Explanation: Where an opportunity for revegetation exists along both sides of a creek, that opportunity offers additional microclimate benefits, which additionally regulates solar radiation. Thus, sites having west and east bank shade opportunities were scored slightly higher. For other sites that include multiple bank aspects, these sites were scored based on the highest scoring bank site involved (e.g., a site with both north and south opportunities was scored as a south bank site). Because the hottest part of the day occurs after noon, sites on the west bank of a stream received a higher priority than those on the east bank. Vegetation on the south bank of a stream provides the maximum duration of shade for a stream.
- Rare Species Support: Presence of species listed as federally endangered or threatened (score =3) or species not protected under the federal Endangered Species Act (score =0).
- Size: Of the 85 shade opportunity sites identified within the city limits and 25 shade opportunity areas identified outside of the city limits but within the UGB, only three were larger than one acre. Thus the size factor was scored as follows: Area ≥ 0.5 acre (score =5), between 0.25 acre and 0.49 acre (score =3), and area smaller than 0.24 acre (score =1).

- Protection of Cold Water Refugia (CWR): Within 50^{ft} buffer of CWR (score =3), within 50ft - 100ft buffer of CWR (score =1), or beyond 100^{ft} from CWR (score =0). The definition of CWR and the methods for its identification are provided in Section 5.0.

The priority score for each site was the sum of the five individual scoring criteria. Because there were a wide range of scores for all identified shade opportunity sites (from a low of 3 to a high of 17), the scores were broken into three subjective priority categories for mapping purposes. These priority categories allowed the high-scoring sites to be easily identified on the map, whereas using a different color code for each of the 12 different scores would be difficult to easily and quickly interpret.

For sites within the city limits, sites that received a score greater than 11 (13 sites) were mapped as "high priority" opportunities. Sites within the city that received a score of 10 or 11 (22 sites) were mapped as "moderate priority" opportunities. All sites within the city that received a score less than 10 were mapped as "lower priority" opportunities (50 sites). These three categories were based on a subjective review of scores and were only meant to be used for highlighting the best opportunities on a map (Figure 3-2). Sites outside the city limits but within the UGB were also prioritized in the same manner and mapped, but were labeled with a "UGB" prefix to denote that these sites are within the UGB but outside the city limits. Figure 3-2 at the end of this section shows detailed aerials of the identified shade opportunity areas for both sites within the city limits and sites within the UGB but outside the city limits. Appendix B contains a larger map of the entire area.

Table 3-2a, 3-2b, and 3-3, at the end of this section, show the prioritization ranking, tax lot number, drainage system, and other characteristics used to score the sites. Table 3-2a is the shade opportunity sites within the city limits, sorted by priority score; table 3-2b is the shade opportunity sites within the city limits, sorted by drainage system; table 3-3 is the shade opportunity sites outside the city limits but within the UGB, sorted by drainage system.

Based on soil survey data and local site knowledge, the species listed in Tables 3-4 and 3-5 are recommended for planting the shade opportunity sites depending on the hydrologic regime of an individual site. In order to estimate the resources necessary to plant the shade opportunity area, a cost estimate was prepared. For all areas, the cost estimate assumed a six foot-on-center planting density. This planting density resulted in 1,210 trees per acre. Containerized and dormant cuttings should occur in the spring or fall when precipitation is abundant. If bare root plant materials are used, planting should occur in the late winter/early spring only. Summer planting will require irrigation, which is costly and not accounted for in the prices provided by this plan for planning purposes. In addition, cost estimates do not take into account property acquisitions/easements or permitting costs. These costs do not include site preparation costs, including weed removal, as this would vary largely between sites. Plant costs are based on 1-gallon, containerized plant stock installed at six foot-on-center and estimated at $3/plant. Materials include a 2-day utility vehicle charge ($100/day), plant protectors ($0.50/plant), and mulch ($0.50/plant). Labor includes a crew of 4 laborers at $16/hour each (i.e., $64/hour) plus one supervisor, ($32/hour) assuming a planting rate of 40 trees per hour (i.e., 10 trees per person per hour). Under this scenario, each acre will take approximately 30 hours to install, so the cost estimate below is displayed on a per acre basis.

Table 3-4 Planting Recommendations for Lower Streambanks and Wetlands

Species (Common Name)	Scientific Name	Percentage of Area Planted
Oregon ash	*Fraxinus latifolia*	30
Black cottonwood	*Populus balsamifera* spp. *Trichocarpa*	20
Red alder	*Alnus rubra*	20
Pacific willow	*Salix lucida*	10
Red-osier dogwood	*Cornus sericea*	10
Sitka willow	*Salix sitchensis*	10

Table 3-5 Planting Recommendations for Upper Streambanks and Floodplain

Species (Common Name)	Scientific Name	Percentage of Area Planted
Red cedar	*Thuja plicata*	25
Douglas fir	*Pseudotsuga menziesii*	25
Bigleaf maple	*Acer macrophylum*	25
Red alder	*Alnus rubra*	15
Black cottonwood	*Populus balsamifera* spp. *Trichocarpa*	10

Cost Estimate:

Plants: $3,630/acre
Materials:
$1,410/acre Labor:
$2,880/acre Total per
acre: $7,920

As stated above, this cost does not include permitting, summer irrigation, or site preparation costs, which could be a significant addition.

In summary, while a 50-foot buffer is a goal, many of Oregon City's streams are very narrow in width (i.e., less than 10 feet) and even smaller buffer widths will provide significant shade benefits. Therefore, when space is constrained, the City will work to maximize the benefits of the available opportunity.

The City plans to allocate $5,000 per year over the next five years to planting, plant maintenance during the plant establishment period, and supplementary irrigation in the prioritized opportunity areas within the city limits. Efforts will initially focus on the seven acres of publicly owned area identified as shade opportunity within the city limits. Other tasks the City will continue to pursue for improving creek side shade include:

- Using volunteers, environmental groups, community college educational programs and other volunteer interest groups to further inventory and refine the site needs (ground truthing) and prioritization of shade opportunity sites.
- Attend regularly scheduled coordination meetings with the Greater Oregon City Watershed Council.
- Review / inspect planted sites to determine survival of plantings, influence of invasive, and maintenance needs.

Shade opportunity sites were identified remotely using GIS and ground truthing was not conducted. Conditions may have changed since the aerial photographs were taken. Ground truthing will be conducted as the City works its way through the list of opportunity areas for planting. This will be especially important in the case of wetland areas identified by LWI. These areas, if capable of supporting wetland trees, can potentially offer excellent thermal regulation with forest cover because water is generally moving slowly through these shaded features near the surface.

Table 3-2a Summary and Ranking of Opportunity Areas for Shading within the City Limits (Sorted by Priority)

Priority Score	Shade Opportunity ID (see Figure 3-2)	Drainage System	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
15	A-10	Abernethy Creek	N	22E29CD00100	0.454	Public	Yes- 50	Yes- Coho, winter Steelhead
15	A-13	Abernethy Creek	S	22E29DC01000	0.431	Private	Yes- 50	Yes- Coho, winter Steelhead
15	MC-8	Mud Creek	N, S	32E05C 00812	2.227	Public	No	No
15	MC-9	Mud Creek	S	32E08B 00102	0.872	Public	No	No
14	A-8	Abernethy Creek	S	22E29CC00900	0.194	Public	Yes- 50	No
13	A-14	Abernethy Creek	N,S	22E29DB00800	0.352	Private	Yes- 100	Yes- Coho, winter Steelhead
12	CC-10	Caufield Creek	S	32E16BA09900	0.192	Public	Yes- 100	No
12	MC-11	Mud Creek	N, S	32E07DD09300	0.348	Private	Yes- 50	No
12	MC-18	Mud Creek	N, S	32E07DD09300	0.133	Public	Yes- 100	No
12	MC-19	Mud Creek	W	32E07DB06100	0.134	Public	Yes- 50	No
12	CP-5	Central Point Creek	W, E	32E07CB09500	0.427	Public	No	No
12	CP-6	Central Point Creek	W, E	32E07CB09400	0.312	Public	No	No
12	SEC-1	South End Creek	S, N	31E01DC00316	0.163	Public	Yes- 100	No
11	CC-1	Caufield Creek	N, S	32E16AA18800	0.165	Public	No	No
11	CC-2	Caufield Creek	N, S	32E16AB03900	0.070	Public	No	No
11	CC-3	Caufield Creek	N, S	32E16AA18900	0.075	Public	No	No
11	CC-4	Caufield Creek	N, S	32E16AB04000	0.211	Public	No	No
11	CC-6	Caufield Creek	N, S	32E09D 01500	0.563	Private	No	No
11	MC-7	Mud Creek	N, S	32E06DD00700	0.653	Private	No	No
11	MC-17	Mud Creek	N, S	32E07DB03011	0.079	Public	No	No
11	NC-7	Newell Creek	N, S, E, W	32E05C 00200	0.659	Private	No	No
10	A-7	Abernethy Creek	S	22E29CC00800	0.065	Private	No	Yes- Coho, winter Steelhead
10	PPC-2	Park Place Creek	W,E	22E29 00900	1.716	Private	No	No

Priority Score	Shade Opportunity ID (see Figure 3-2)	Drainage System	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
10	CC-11	Caufield Creek	S, N	32E16BA10600	0.056	Private	Yes- 50	No
10	CC-18	Caufield Creek	W, E	32E08A 02500	0.533	Private	No	No
10	MC-1	Mud Creek	W, E	32E18 01300	0.748	Private	No	No
10	MC-12	Mud Creek	N, S	32E07DA12900	0.061	Private	Yes- 50	No
10	MC-13	Mud Creek	N, S	32E07DA13000	0.080	Private	Yes- 50	No
10	MC-14	Mud Creek	N, S	32E07DD09400	0.090	Private	Yes- 50	No
10	MC-20	Mud Creek	W	32E07DB05900	0.078	Public	Yes- 100	No
10	SEC-10	South End Creek	W, E	31E12BA14700	0.231	Public	No	No
10	NC-6	Newell Creek	W, E	32E05C 00811	0.190	Public	No	No
10	NC-9	Newell Creek	W, E	32E05AB03003	0.063	Public	No	No
10	NC-10	Newell Creek	W, E	32E05AB03003	0.192	Public	No	No
10	NC-11	Newell Creek	W, E	32E05AB03003	0.062	Public	No	No
9	PPC-3	Park Place Creek	W	22E29 00900	1.097	Private	No	No
9	CC-7	Caufield Creek	N, S	32E09C 00300	0.478	Private	No	No
9	CC-15	Caufield Creek	S	32E09C 01400	0.260	Private	No	No
9	SEC-8	South End Creek	E, W	31E12A 02003	0.165	Private	Yes- 50	No
9	SEC-9	South End Creek	E, W	31E12A 02002	0.061	Private	Yes- 50	No
8	A-6	Abernethy Creek	E	22E29CC02302	0.076	Public	No	No
8	A-11	Abernethy Creek	N	22E29DB00900	0.096	Public	Yes- 100	No
8	A-12	Abernethy Creek	S	22E29DC01100	0.108	Private	Yes- 100	No
8	CC-5	Caufield Creek	E, W	32E09D 01400	0.263	Private	No	No
8	MC-15	Mud Creek	N, S	32E07DA13100	0.074	Private	Yes- 100	No
8	SEC-5	South End Creek	N, S	31E12A 02000	0.061	Private	Yes- 100	No
7	A-2	Abernethy Creek	N,S	22E29CA02800	0.227	Private	No	No
7	CC-12	Caufield Creek	E	32E09C 00200	0.102	Private	Yes- 50	No
7	CC-14	Caufield Creek	S	32E09C 01300	0.158	Private	No	No
7	MC-10	Mud Creek	S, N	32E07DA06700	0.080	Private	No	No
7	MC-16	Mud Creek	N, S	32E07DA13200	0.067	Private	No	No
7	SEC-3	South End Creek	W, N	31E12A 01700	0.344	Private	No	No
7	SEC-7	South End Creek	E, W	31E01 02000	0.170	Private	Yes- 100	No
7	SEC-16	South End Creek	N	31E12CA04600	0.132	Public	No	No

Priority Score	Shade Opportunity ID (see Figure 3-2)	Drainage System	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
7	NC-3	Newell Creek	S	32E04C 01300	0.146	Private	No	No
6	CC-16	Caufield Creek	W, E	32E08AC05400	0.173	Private	No	No
6	CC-17	Caufield Creek	W, E	32E08AC05300	0.108	Private	No	No
6	CC-19	Caufield Creek	W, E	32E08A 01900	0.074	Private	No	No
6	MC-2	Mud Creek	W, E	32E18 01201	0.237	Private	No	No
6	MC-3	Mud Creek	W, E	32E18 01206	0.062	Private	No	No
6	MC-4	Mud Creek	W, E	32E18 01204	0.227	Private	No	No
6	MC-5	Mud Creek	W, E	32E18 01282	0.079	Private	No	No
6	MC-6	Mud Creek	W, E	32E18 01000	0.121	Private	No	No
6	CP-2	Central Point Creek	W, E	32E07BC02400	0.102	Private	No	No
6	CP-3	Central Point Creek	W, E	32E07BC02300	0.080	Private	No	No
6	NC-2	Newell Creek	W, E	32E09C 00800	0.062	Private	No	No
6	NC-4	Newell Creek	E, W	32E05CB01400	0.144	Private	No	No
6	NC-5	Newell Creek	E, W	32E05CB01500	0.184	Private	No	No
5	Coff-1	Coffee Creek	W	32E06BB03901	0.134	Private	No	No
5	PPC-1	Park Place Creek	E	22E29DB00800	0.180	Private	Yes- 100	No
5	CC-8	Caufield Creek	W	32E09C 00400	0.080	Private	No	No
5	SEC-15	South End Creek	W	31E12CA04707	0.085	Private	No	No
5	NC-12	Newell Creek	W	22E32CA06601	0.056	Private	No	No
4	A-3	Abernethy Creek	E	22E29CC02300	0.059	Private	No	No
4	CC-20	Caufield Creek	E	32E08A 01900	0.121	Private	No	No
4	CC-21	Caufield Creek	E	32E08DA06600	0.108	Private	No	No
4	CC-22	Caufield Creek	E	32E08DA06600	0.115	Private	No	No
4	CP-4	Central Point Creek	E	32E07BC01400	0.055	Private	No	No
4	SEC-2	South End Creek	E	31E12A 01700	0.163	Private	No	No
3	A-1	Abernethy Creek	N	22E29CB02400	0.092	Private	No	No
3	T-1	Tour Creek	N	22E28CB03200	0.094	Private	No	No
3	CC-9	Caufield Creek	N	32E16BA10500	0.082	Private	No	No
3	CC-13	Caufield Creek	N	32E09C 00700	0.087	Private	No	No

Priority Score	Shade Opportunity ID (see Figure 3-2)	Drainage System	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
3	NC-1	Newell Creek	N	32E04C 01300	0.178	Private	No	No
3	NC-8	Newell Creek	N	32E05C 00200	0.080	Private	No	No

Table 3-2b Summary and Ranking of Opportunity Areas for Shading within the City Limits (Sorted by Drainage System)

Drainage System	Shade Opportunity ID (see Figure 3-2)	Priority Score	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
Abernethy Creek	A-10	15	N	22E29CD00100	0.454	Public	Yes- 50	Yes- Coho, wint Steelhead
Abernethy Creek	A-13	15	S	22E29DC01000	0.431	Private	Yes- 50	Yes- Coho, wint Steelhead
Abernethy Creek	A-8	14	S	22E29CC00900	0.194	Public	Yes- 50	No
Abernethy Creek	A-14	13	N,S	22E29DB00800	0.352	Private	Yes- 100	Yes- Coho, wint Steelhead
Abernethy Creek	A-7	10	S	22E29CC00800	0.065	Private	No	Yes- Coho, wint Steelhead
Abernethy Creek	A-6	8	E	22E29CC02302	0.076	Public	No	No
Abernethy Creek	A-11	8	N	22E29DB00900	0.096	Public	Yes- 100	No
Abernethy Creek	A-12	8	S	22E29DC01100	0.108	Private	Yes- 100	No
Abernethy Creek	A-2	7	N,S	22E29CA02800	0.227	Private	No	No
Abernethy Creek	A-3	4	E	22E29CC02300	0.059	Private	No	No
Abernethy Creek	A-1	3	N	22E29CB02400	0.092	Private	No	No
Caufield Creek	CC-10	12	S	32E16BA09900	0.192	Public	Yes- 100	No
Caufield Creek	CC-1	11	N, S	32E16AA18800	0.165	Public	No	No
Caufield Creek	CC-2	11	N, S	32E16AB03900	0.070	Public	No	No
Caufield Creek	CC-3	11	N, S	32E16AA18900	0.075	Public	No	No
Caufield Creek	CC-4	11	N, S	32E16AB04000	0.211	Public	No	No
Caufield Creek	CC-6	11	N, S	32E09D 01500	0.563	Private	No	No
Caufield Creek	CC-11	10	S, N	32E16BA10600	0.056	Private	Yes- 50	No
Caufield Creek	CC-18	10	W, E	32E08A 02500	0.533	Private	No	No
Caufield Creek	CC-7	9	N, S	32E09C 00300	0.478	Private	No	No
Caufield Creek	CC-15	9	S	32E09C 01400	0.260	Private	No	No
Caufield Creek	CC-5	8	E, W	32E09D 01400	0.263	Private	No	No
Caufield Creek	CC-12	7	E	32E09C 00200	0.102	Private	Yes- 50	No
Caufield Creek	CC-14	7	S	32E09C 01300	0.158	Private	No	No
Caufield Creek	CC-16	6	W, E	32E08AC05400	0.173	Private	No	No

Drainage System	Shade Opportunity ID (see Figure 3-2)	Priority Score	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
Caufield Creek	CC-17	6	W, E	32E08AC05300	0.108	Private	No	No
Caufield Creek	CC-19	6	W, E	32E08A 01900	0.074	Private	No	No
Caufield Creek	CC-8	5	W	32E09C 00400	0.080	Private	No	No
Caufield Creek	CC-20	4	E	32E08A 01900	0.121	Private	No	No
Caufield Creek	CC-21	4	E	32E08DA06600	0.108	Private	No	No
Caufield Creek	CC-22	4	E	32E08DA06600	0.115	Private	No	No
Caufield Creek	CC-9	3	N	32E16BA10500	0.082	Private	No	No
Caufield Creek	CC-13	3	N	32E09C 00700	0.087	Private	No	No
Central Point Creek	CP-5	12	W, E	32E07CB09500	0.427	Public	No	No
Central Point Creek	CP-6	12	W, E	32E07CB09400	0.312	Public	No	No
Central Point Creek	CP-2	6	W, E	32E07BC02400	0.102	Private	No	No
Central Point Creek	CP-3	6	W, E	32E07BC02300	0.080	Private	No	No
Central Point Creek	CP-4	4	E	32E07BC01400	0.055	Private	No	No
Coffee Creek	Coff-1	5	W	32E06BB03901	0.134	Private	No	No
Mud Creek	MC-8	15	N, S	32E05C 00812	2.227	Public	No	No
Mud Creek	MC-9	15	S	32E08B 00102	0.872	Public	No	No
Mud Creek	MC-11	12	N, S	32E07DD09300	0.348	Private	Yes- 50	No
Mud Creek	MC-18	12	N, S	32E07DD09300	0.133	Public	Yes- 100	No
Mud Creek	MC-19	12	W	32E07DB06100	0.134	Public	Yes- 50	No
Mud Creek	MC-7	11	N, S	32E06DD00700	0.653	Private	No	No
Mud Creek	MC-17	11	N, S	32E07DB03011	0.079	Public	No	No
Mud Creek	MC-1	10	W, E	32E18 01300	0.748	Private	No	No
Mud Creek	MC-12	10	N, S	32E07DA12900	0.061	Private	Yes- 50	No
Mud Creek	MC-13	10	N, S	32E07DA13000	0.080	Private	Yes- 50	No
Mud Creek	MC-14	10	N, S	32E07DD09400	0.090	Private	Yes- 50	No
Mud Creek	MC-20	10	W	32E07DB05900	0.078	Public	Yes- 100	No
Mud Creek	MC-15	8	N, S	32E07DA13100	0.074	Private	Yes- 100	No
Mud Creek	MC-10	7	S, N	32E07DA06700	0.080	Private	No	No

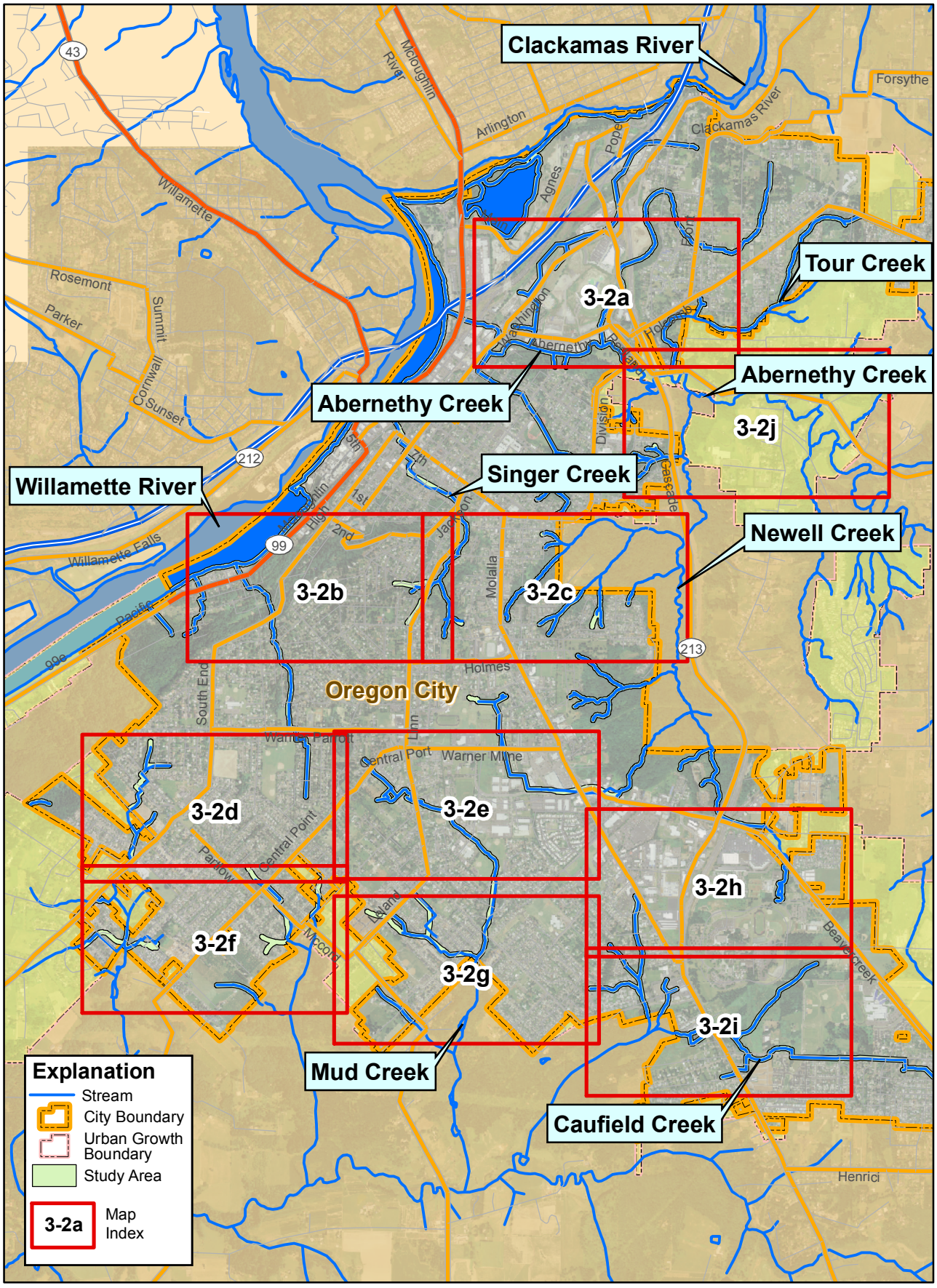
Drainage System	Shade Opportunity ID (see Figure 3-2)	Priority Score	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
Mud Creek	MC-16	7	N, S	32E07DA13200	0.067	Private	No	No
Mud Creek	MC-2	6	W, E	32E18 01201	0.237	Private	No	No
Mud Creek	MC-3	6	W, E	32E18 01206	0.062	Private	No	No
Mud Creek	MC-4	6	W, E	32E18 01204	0.227	Private	No	No
Mud Creek	MC-5	6	W, E	32E18 01282	0.079	Private	No	No
Mud Creek	MC-6	6	W, E	32E18 01000	0.121	Private	No	No
Newell Creek	NC-7	11	N, S, E, W	32E05C 00200	0.659	Private	No	No
Newell Creek	NC-6	10	W, E	32E05C 00811	0.190	Public	No	No
Newell Creek	NC-9	10	W, E	32E05AB03003	0.063	Public	No	No
Newell Creek	NC-10	10	W, E	32E05AB03003	0.192	Public	No	No
Newell Creek	NC-11	10	W, E	32E05AB03003	0.062	Public	No	No
Newell Creek	NC-3	7	S	32E04C 01300	0.146	Private	No	No
Newell Creek	NC-2	6	W, E	32E09C 00800	0.062	Private	No	No
Newell Creek	NC-4	6	E, W	32E05CB01400	0.144	Private	No	No
Newell Creek	NC-5	6	E, W	32E05CB01500	0.184	Private	No	No
Newell Creek	NC-12	5	W	22E32CA06601	0.056	Private	No	No
Newell Creek	NC-1	3	N	32E04C 01300	0.178	Private	No	No
Newell Creek	NC-8	3	N	32E05C 00200	0.080	Private	No	No
Park Place Creek	PPC-2	10	W,E	22E29 00900	1.716	Private	No	No
Park Place Creek	PPC-3	9	W	22E29 00900	1.097	Private	No	No
Park Place Creek	PPC-1	5	E	22E29DB00800	0.180	Private	Yes- 100	No
South End Creek	SEC-1	12	S, N	31E01DC00316	0.163	Public	Yes- 100	No
South End Creek	SEC-10	10	W, E	31E12BA14700	0.231	Public	No	No
South End Creek	SEC-8	9	E, W	31E12A 02003	0.165	Private	Yes- 50	No
South End Creek	SEC-9	9	E, W	31E12A 02002	0.061	Private	Yes- 50	No
South End Creek	SEC-5	8	N, S	31E12A 02000	0.061	Private	Yes- 100	No
South End Creek	SEC-3	7	W, N	31E12A 01700	0.344	Private	No	No
South End Creek	SEC-7	7	E, W	31E01 02000	0.170	Private	Yes- 100	No
South End Creek	SEC-16	7	N	31E12CA04600	0.132	Public	No	No
South End Creek	SEC-15	5	W	31E12CA04707	0.085	Private	No	No
South End Creek	SEC-2	4	E	31E12A 01700	0.163	Private	No	No

Drainage System	Shade Opportunity ID (see Figure 3-2)	Priority Score	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
Tour Creek	T-1	3	N	22E28CB03200	0.094	Private	No	No

Table 3-3 Summary and Ranking of Opportunity Areas for Shading outside City Limits and inside UGB (Sorted by Drainage System)

Drainage System	Shade Opportunity ID (see Appendix B)	Priority Score	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
Abernethy Creek	UGB-A-25b	17	S,W	22E33A 02600	0.764	Private	Yes- 50	Yes- Coho, wint Steelhead
Abernethy Creek	UGB-A-27	15	S,W	22E33A 02000	0.493	Private	Yes- 50	Yes- Coho, wint Steelhead
Abernethy Creek	UGB-A-25c	14	W,E	22E33A 02301	0.430	Private	Yes- 50	Yes- Coho, wint Steelhead
Abernethy Creek	UGB-A-24	12	N,S	22E33A 02300	0.372	Private	Yes- 50	No
Abernethy Creek	UGB-A-17	11	N,E	22E28CC02091	0.416	Public	No	No
Abernethy Creek	UGB-A-20	10	S,N	22E33B 01400	0.195	Private	No	Yes- Coho, wint Steelhead
Abernethy Creek	UGB-A-15a	9	N,S	22E29DD01000	0.304	Private	No	No
Abernethy Creek	UGB-A-15b	9	N,S	22E29DC00800	0.366	Private	No	No
Abernethy Creek	UGB-A-29	9	E	22E33A 01700	0.546	Private	Yes- 100	No
Abernethy Creek	UGB-A-19	8	N,W	22E33B 00600	0.220	Private	No	Yes- Coho, wint Steelhead
Abernethy Creek	UGB-A-26	8	S	22E33A 02391	0.086	Private	Yes- 100	No
Abernethy Creek	UGB-A-21a	7	S	22E33B 00500	0.156	Private	No	No
Abernethy Creek	UGB-A-21b	7	S	22E33B 00200	0.077	Private	No	No
Abernethy Creek	UGB-A-22b	7	S,N	22E33A 02500	0.172	Private	No	No
Abernethy Creek	UGB-A-28	7	E	22E33A 01800	0.151	Private	Yes- 50	No
Abernethy Creek	UGB-A-23	6	N	22E33A 02400	0.106	Private	No	Yes- Coho, wint Steelhead
Abernethy Creek	UGB-A-18	5	N	22E33B 00700	0.287	Private	No	No
Abernethy Creek	UGB-A-22a	4	E,N	22E33B 00300	0.238	Private	No	No
Central Point Creek	UGB-CP-1	6	E, W	32E07B 03600	0.116	Private	No	No
South End Creek	UGB-SEC-14	9	E	31E12BD06400	0.411	Private	Yes- 50	No
South End Creek	UGB-SEC-4	8	W, E	31E12A 01900	0.333	Private	No	No
South End Creek	UGB-SEC-6	8	N, S	31E12A 02201	0.075	Private	Yes- 100	No

Drainage System	Shade Opportunity ID (see Appendix B)	Priority Score	Bank Aspect	Tax Lot Number	Acres	Public/ Private	Near Cold Water Refugia?	ESA Fish Present?
South End Creek	UGB-SEC-12	5	W	31E12BD06600	0.091	Private	No	No
South End Creek	UGB-SEC-13	5	E	31E12BD06600	0.059	Private	Yes- 100	No
South End Creek	UGB-SEC-11	3	N	31E12BA01300	0.107	Private	No	No



OREGON CITY
SHADE OPPORTUNITIES - MAP INDEX

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

URS

Print Date: March 13, 2008

FIGURE 3-2

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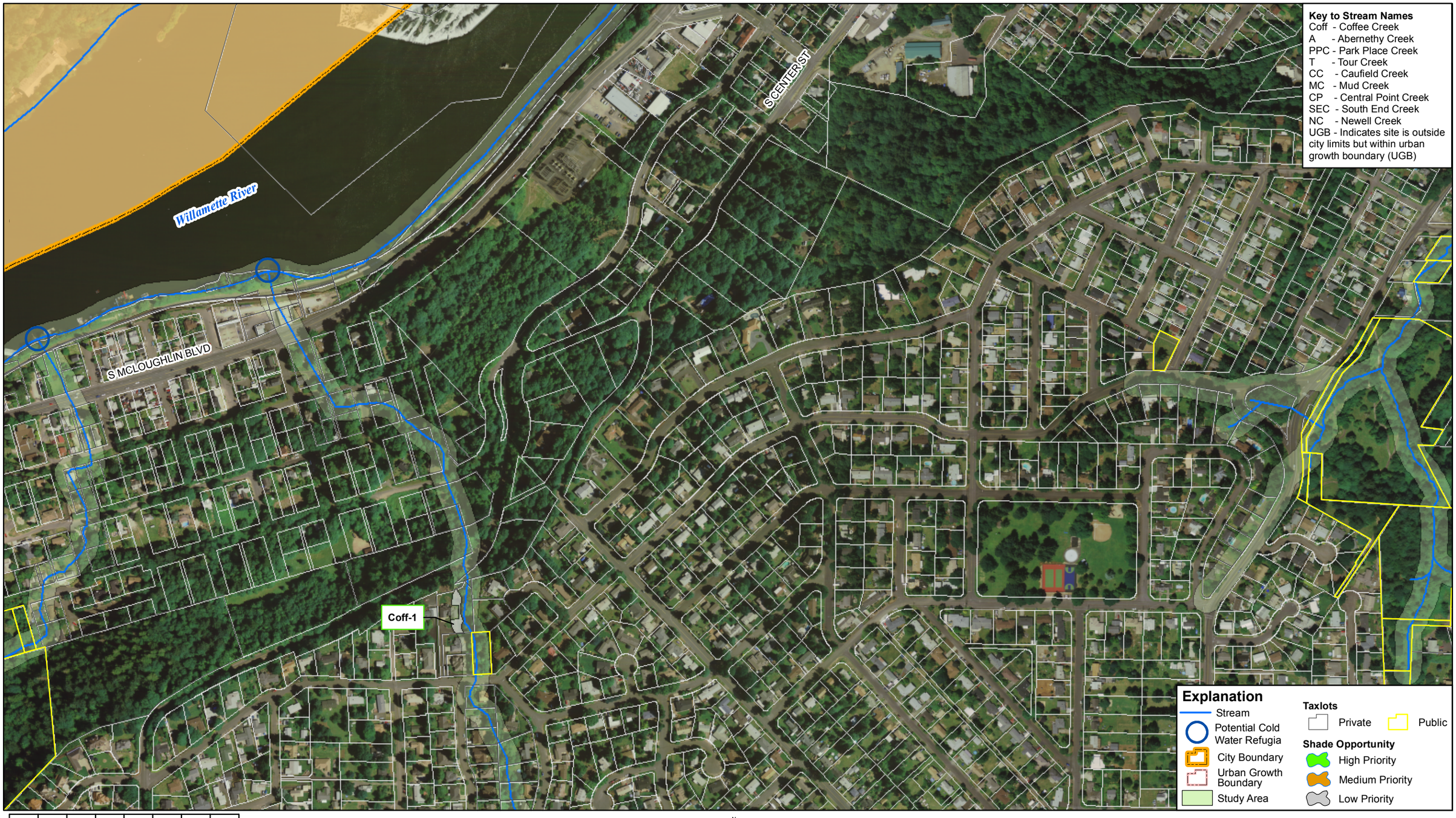
OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

URS

Print Date: March 18, 2008

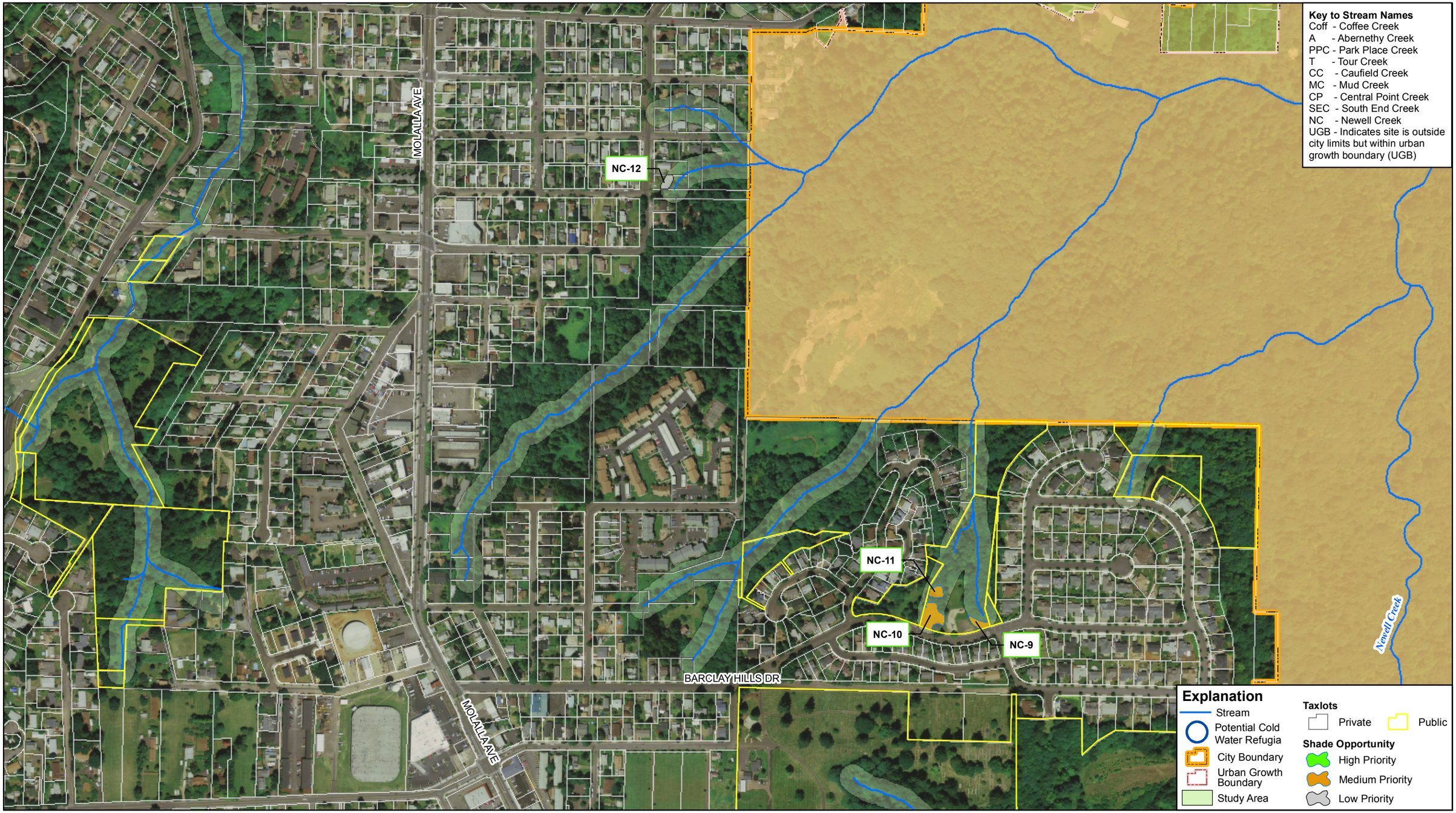
FIGURE 3-2a
Map 1 of 10



OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2b
Map 2 of 10



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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2c
Map 3 of 10

Key to Stream Names
Coff - Coffee Creek
A - Abernethy Creek
PPC - Park Place Creek
T - Tour Creek
CC - Caufield Creek
MC - Mud Creek
CP - Central Point Creek
SEC - South End Creek
NC - Newell Creek
UGB - Indicates site is outside city limits but within urban growth boundary (UGB)

SEC-1
SEC-2
SEC-3
UGB-SEC-4
SEC-6
UGB-SEC-6
SEC-8
SEC-7
SEC-9
SEC-10
UGB-SEC-11
SOUTH END RD
CENTRAL POINT RD

Explanation
Stream
Potential Cold Water Refugia
City Boundary
Urban Growth Boundary
Study Area
Taxlots
Private
Public
Shade Opportunity
High Priority
Medium Priority
Low Priority

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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2d
Map 4 of 10

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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2e
Map 5 of 10

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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2f
Map 6 of 10

Key to Stream Names
Coff - Coffee Creek
A - Abernethy Creek
PPC - Park Place Creek
T - Tour Creek
CC - Caufield Creek
MC - Mud Creek
CP - Central Point Creek
SEC - South End Creek
NC - Newell Creek
UGB - Indicates site is outside city limits but within urban growth boundary (UGB)

Explanation
- Stream
- Potential Cold Water Refugia
- City Boundary
- Urban Growth Boundary
- Study Area

Taxlots
- Private
- Public

Shade Opportunity
- High Priority
- Medium Priority
- Low Priority

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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2g
Map 7 of 10

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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2h
Map 8 of 10

Key to Stream Names
Coff - Coffee Creek
A - Abernethy Creek
PPC - Park Place Creek
T - Tour Creek
CC - Caufield Creek
MC - Mud Creek
CP - Central Point Creek
SEC - South End Creek
NC - Newell Creek
UGB - Indicates site is outside city limits but within urban growth boundary (UGB)

Explanation
- Stream
- Potential Cold Water Refugia
- City Boundary
- Urban Growth Boundary
- Study Area

Taxlots
- Private
- Public

Shade Opportunity
- High Priority
- Medium Priority
- Low Priority

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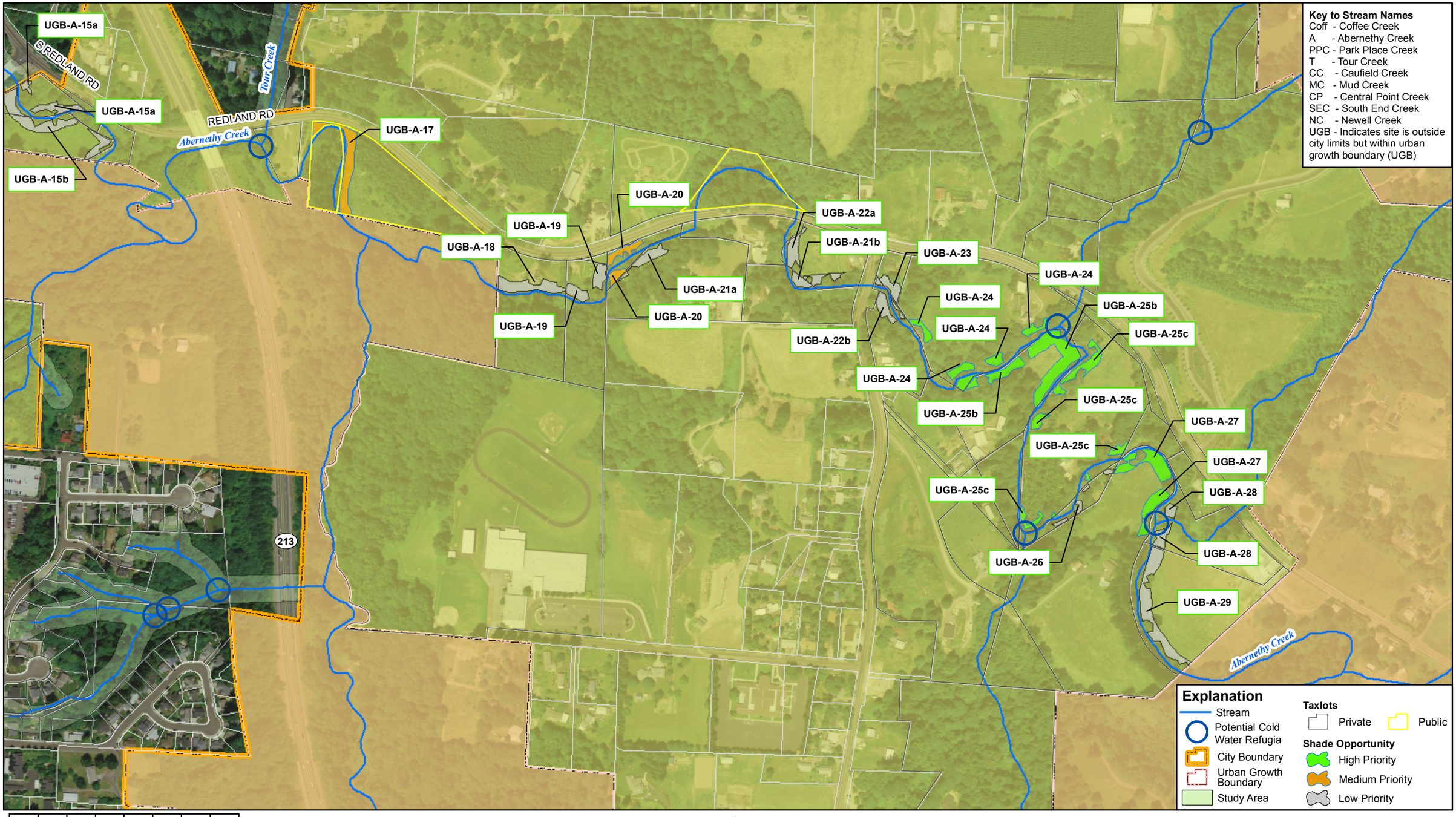
Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2i
Map 9 of 10



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Print Date: March 18, 2008

OREGON CITY
SHADE OPPORTUNITIES

CITY OF OREGON CITY, OREGON
TEMPERATURE TMDL IMPLEMENTATION PLAN

FIGURE 3-2j
Map 10of 10

3.3.2 Measures to Protect Existing Shaded Areas

The Willamette Basin TMDL defines shade as the surrogate for thermal load allocations. Encouraging the preservation and enhancement of riparian vegetation, especially shade-producing riparian vegetation, is one of the most important methods for reducing stream temperatures. To positively affect stream temperature, the amount and quality of the riparian shading must increase, so it is important to not only plant more shade-producing vegetation, but also preserve what is there. Based on the results of the riparian analysis shown in Table 3-1, a majority of Oregon City's riparian areas are already shaded. Therefore, protecting the vegetation that already exists in these areas will be an important implementation strategy.

Related to the preservation and maintenance of riparian shade, Metro developed Title 3 and Title 13, two sections of Metro's Urban Growth Management Plan that address development in the riparian corridor. Specifically, Title 3 prohibits new development within specified established buffers, and provides replanting requirements for unavoidable new development. Title 13 establishes protected areas (habitat conservation areas or HCAs) for both upland and riparian wildlife. Since preserving and restoring shade are important strategies for addressing the temperature TMDL, jurisdictions that currently comply with Title 3 and/or Title 13 are already utilizing strategies for addressing temperature. Section 3.3.2.1 describes Title 3 and Title 13 in more detail. Section 3.3.2.2 describes Oregon City's efforts to comply with Metro's Urban Growth Management Plan as related to Titles 3 and 13.

3.3.2.1 Summary of Title 3/Title 13 Requirements

Title 3

Title 3, specifically the Title 3 model ordinance, was developed in 1997 by Metro, which is a regional government serving the Portland metropolitan area including 25 cities. The purpose of Title 3 is to implement the Oregon Statewide Land Use Goals 6 and 7 that address protecting streams, rivers, wetlands, and floodplains. Title 3 provides this protection by avoiding, limiting, or mitigating the impact on these areas from development. This title limits development in identified water quality resource areas (WQRAs) and flood management areas (FMAs) and it limits development that would cause any extent of erosion within the Metro Boundary. Title 3 defines the WQRA as the protected water feature and associated vegetated corridor adjacent to the water feature and provides the method for determining the appropriate width of this vegetated corridor. Native vegetation within the WQRA should be maintained, enhanced or restored, if disturbed. Metro developed the Water Quality and Flood Management Areas map identifying these areas with input from the cities and counties within the Metro region. Table 3.07-3 in Title 3 is shown below and summarizes the vegetated buffer widths for protected water features.

Table 3-6 Title 3– Required Width of Vegetated Corridor

Table 3.07-3 - Protected Water Features
(Section 3.07.340(B(2)(a))

Protected Water Feature Type (see definitions)	Slope Adjacent to Protected Water Feature	Starting Point for Measurements from Water Feature	Width of Vegetated Corridor
Primary Protected Water Features[1]	< 25%	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	50 feet
Primary Protected Water Features[1]	≥ 25% for 150 feet or more[5]	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	200 feet
Primary Protected Water Features[1]	≥ 25% for less than 150 feet[5]	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	Distance from starting point of measurement to top of ravine (break in ≥25% slope)[3], plus 50 feet.[4]
Secondary Protected Water Features[2]	< 25%	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	15 feet
Secondary Protected Water Features[2]	≥ 25%[5]	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	50 feet

[1] **Primary Protected Water Features** include: all perennial streams and streams draining greater than 100 acres, Title 3 wetlands, natural lakes and springs

[2] **Secondary Protected Water Features** include intermittent streams draining 50-100 acres.

[3] Where the Protected Water Feature is confined by a ravine or gully, the top of ravine is the break in the ≥ 25% slope (see slope measurement in Appendix).

[4] A maximum reduction of 25 feet may be permitted in the width of vegetated corridor beyond the slope break if a geotechnical report demonstrates that slope is stable. To establish the width of the vegetated corridor, slope should be measured in 25-foot increments away from the water feature until slope is less than 25% (top of ravine).

[5] Vegetated corridors in excess of 50-feet for primary protected features, or in excess of 15-feet for secondary protected features, apply on steep slopes only in the *uphill* direction from the protected water feature.

The cities and counties within the Metro region were given three alternatives for implementing Title 3:

1. Amend comprehensive plans and ordinances to adopt all or part of the Title 3 model ordinance or language that substantially complies with the Title, and adopt either the Metro Water Quality and Flood Management Area map or a map that substantially complies with the Metro map;
2. Demonstrate that existing city and county comprehensive plans and ordinances already substantially comply with the performance standards and the intent of Title 3; or

3. A combination of the first two alternatives that substantially complies with all performance standards of Title 3.

To implement Title 3, many cities have adopted Table 3.07-3, along with a portion of the Title 3 model ordinance into their city code. Several exemptions are allowed for various reasons and are outlined specifically in Title 3 (Metro 1998).

Title 13

The Title 13 model ordinance was also created by Metro in 2006. However, it was created to provide clear objective standards and a discretionary review process for implementation of Oregon Statewide Land Use Goal 5. Goal 5 is focused on the protection of natural resources and open space. The purpose of Title 13 is to provide guidelines in order for local jurisdictions to 1) conserve, protect, and restore a continuous ecologically viable streamside corridor that is integrated with upland wildlife habitat, and 2) control and prevent water pollution in order to protect public health and improve the region's water quality.

Title 13 focuses on regulating development that would affect riparian or upland wildlife habitat, as documented on the Habitat Conservation Area (HCA) map that Metro has produced. The HCA map was created by Metro and should be adopted by local jurisdictions in the same manner as the Water Quality and Flood Management Areas map developed for Title 3 compliance. HCA priority levels (high, medium, and low) were assigned to areas by cross-referencing habitat classifications (e.g., Class I and Class II Riparian and Class A and Class B Upland Wildlife) and urban development values.

New development restrictions differ depending on the HCA priority level as well as zoning type.

Cities and counties are given three alternatives for implementation of Title 13:

1. Adopt Title 13 model ordinance and map;
2. Demonstrate that the existing or amended comprehensive plan and ordinances "substantially" comply with the title, and existing or adopted maps also comply with Metro's HCA map; or
3. Demonstrate that an alternative program with comparable protection and restoration results has been implemented.

Several exemptions are allowed for various reasons and are outlined specifically in the title. In essence, Title 13 promotes vegetative buffers around water bodies for protection of wildlife habitat through the preservation and improvement of designated habitat conservation areas. Title 13 and its corresponding model ordinance describe specific design and construction practices to minimize impacts on wildlife corridors and fish passage. Performance and implementation objectives and measurable targets are outlined in the title, specifically related to design and construction practices that would be employed.

Metro is developing a process to monitor the region's progress toward implementation of Title 13, and cities and counties are required to submit progress reports on their efforts (Metro 2005).

Title 3 and Title 13 Comparison

Both Title 3 and Title 13 promote the protection of vegetative buffers around water bodies. The goal for Title 3 is to protect water quality and flood areas while Title 13 aims to protect and improve riparian and wildlife habitat. Because Title 3 and Title 13 have different goals, the methods for implementation and performance standards are not identical. Title 13 is more specific than Title 3 in that it has specific numerical targets. However, Title 13 also enables the cities to use their own discretion when defining the protective buffer areas by evaluating the economic effects (urban development values), which is not a component of Title 3 (Metro 1998 and Metro 2005).

3.3.2.2 Oregon City Compliance with Title 3/Title 13 Requirements

Chapter 17.49, Willamette River, Water Quality Resources Area Overlay District, of Oregon City's development code implements the intent of Title 3 as developed by Metro. This chapter establishes a water quality resources overlay district in order to "provide a vegetated corridor to separate protected water features from development." One of the main functions of the corridor, as described in the code, is to "maintain or reduce stream temperatures."

The overlay district is delineated on the City's adopted water quality and flood management areas map, consistent with the requirements of Title 3. Chapter 17.49 also includes an adopted version of Table 3.07-3 from Title 3 (Section 3.3.2.1). This chapter of the development code prohibits new development and uncontained areas of hazardous materials within the overlay district. Provisional uses such as measures to abate nuisances, new utility facility construction, and new stormwater pre-treatment facilities are allowed in the overlay district but are subject to application requirements such as vegetation inventory, impacts analysis, and alternative analysis showing no practicable alternatives to the proposed development exist that will not disturb the water quality resources area.

Consistent with the Title 3 model ordinance, Chapter 17.49 of Oregon City's development code provides specific mitigation requirements when it has been demonstrated that no practicable alternatives to development in the water quality resource area exist. Oregon City is currently implementing Title 3 through Chapter 17.49 of its development code. Since Title 3 has been determined to address temperature and provide practices for maintaining or reducing stream temperatures, Oregon City is currently implementing management strategies to address the Willamette Basin TMDL for temperature. As Chapter 17.49 of Oregon City's development code is focused primarily on new development restrictions within the water quality resources overlay district, the City currently enforces Title 3 through its development review process.

In addition to the City's compliance with Metro's Title 3 through OCMC Chapter 17.49 of the development code, Oregon City was deemed to be in substantial compliance with Title 13 per a Metro letter dated June 3, 2009 with the passage of:

- Ord. No. 08-1014, §§ 1—3 (Exhs. 1—3), 7-1-2009; and
- Ord. No. 10-1003, § 1 (Exh. 1), 7-7-2010.

3.3.3 Other Measures (Design Standards for New Development)

Although shade is the surrogate measure defined by DEQ to address the temperature TMDL, other City activities including the use of infiltration for stormwater runoff disposal activities promotes reduction in surface water temperatures.

As development occurs, increases in impervious areas can decrease the natural pre-development levels of groundwater recharge. Because less water infiltrates into the ground, less groundwater recharge occurs. This can result in a reduction of summer stream base flows, which in turn results in higher temperatures due to unnaturally shallow base-flow conditions. By using best management practices associated with development that promote the infiltration of runoff, groundwater recharge is increased thus augmenting streamflow during the warmer dry season, and reducing temperature impacts.

Oregon City defines its stormwater policies, minimum requirements, and design standards (for stormwater quality and quantity) and procedures for stormwater management in Chapter 13.12 of their development code. For stormwater quality control, the City requires stormwater treatment for the following:

- Construction of four or more single family residences;
- Development creating more than 500 square feet of impervious area or disturbing more than 1,000 square feet of existing impervious area within a designated WQRA;
- Development creating more than 8,000 square feet of new impervious surfaces, other than single family residences; and
- High pollutant generating development as defined in the Public Works Stormwater and Grading Design Standards.

The City does not promote specific post-construction, structural stormwater BMPs, but some structural BMPs that developers may use for stormwater treatment (e.g., bioswales, infiltration trenches, detention and retention ponds, and stormwater wetlands) promote infiltration and evapotranspiration in addition to treatment via sedimentation, filtration, and vegetative uptake. Low impact development practices (specifically ecoroofs, porous pavement, green streets, and raingardens) generally result in even greater rates of infiltration than the other structural BMPs. The City's code does not currently specify, require or provide incentives for low impact development strategies for stormwater, but it allows for the use of these alternative designs or methods if they are approved and authorized by the City Engineer.

The City's development code (Section 17.52.090 Parking Lot Landscaping) also contains provisions for reducing impacts as related to temperature. The code provides landscaping standards to achieve these goals such as a minimum of one tree per six parking spaces and both perimeter and interior landscaping requirements. The code also encourages alternative 'green' designs. The city has also implemented code for street tree requirements, including provisions for tree spacing.

An example of a "green design" is the 2007 Beavercreek Road project, which included several square feet of curbside rain gardens. The project design team was led by City staff, who advocated use of green design techniques. Project obstacles included space constraints and steep

topography. In addition, the identified locations for offsite treatment and detention were located downstream of the project site, along Newell Canyon where there were erosive and landslide prone soils, which didn't make offsite disposal a feasible option. This project was a pilot project for the City, and as a result the City now recommends and approves more of these kinds of enhanced infiltration solutions.

3.4 Timeline and Schedule

This Section provides the anticipated timeline and schedule for implementation of management strategies for temperature as defined in Section 3.3.

3.4.1 Shading and Planting for Currently Exposed Areas

The City has committed to contribute $5,000 a year for the next five years towards efforts to enhance riparian vegetation, specifically in those identified opportunity areas. This initial inventory of shade opportunity areas will provide the City with a point of direction and justification for budgeting time and resources in the future. Over the five year period, the City anticipates that the first few years of implementation will focus on the high priority, public shade opportunity areas within the city limits. Specifically, sites such as existing detention pond facilities, parks, and other City owned parcels can be vegetated and enhanced without complicated property approval or acquisition issues. Ground truthing is expected to occur prior to planting activities, as ground truthing was not conducted when the original opportunity areas were identified. Other sites with anticipated land use approvals would be conditioned for planting during the plan approval process. The City anticipates using City staff, volunteers, and planting contractors to complete the work.

In addition, as opportunities, the City anticipates using newsletters and direct mail to encourage property owners to sponsor privately funded shade-planting projects.

3.4.2 Protection of Existing Shaded Areas

The City of Oregon City currently implements Chapter 17.49, WR Water Quality Resources Area Overlay District, of their development code to address Title 3 requirements. The code is consistent with the Metro Title 3 model ordinance and includes the City's version of Table 3.07- 3 of Title 3. The main intent of Chapter 17.49 is to avoid disturbance of designated water quality resource areas. The water quality resource areas include the protected water feature and its vegetated corridor, including shade-producing vegetation in the corridor. Through Oregon City's enforcement of Chapter 17.49 of its development code, the City is currently taking measures to protect existing shade-producing riparian vegetation.

As previously described in Section 3.3.2.2, Oregon City has been deemed in substantial compliance with Metro's Title 13. Title 13 is intended to protect habitat conservation areas, which includes riparian habitat and shade-producing vegetation within the designated habitat conservation areas. Since Oregon City has implemented the title, the City has expanded its efforts to protect existing shade-producing riparian vegetation.

3.4.3 Other Measures

The City of Oregon City is currently implementing Chapters 13 and 17 of their development code which includes provisions allowing for infiltration practices and tree planting. These codes will be implemented on an ongoing basis.

The City has begun an update to their design standards for compliance with their current MS4 NPDES permit. Concepts for new standards and guidelines for new development were discussed internally and initially presented in two completed concept plans. Oregon City, with funding through Metro and significant community involvement, has completed the Beaver Creek Road (August 2008) and the Park Place (March 2008) concept plans.
Both areas are urban growth expansion areas, currently located outside the city limits, but have been annexed into the City's UGB during the last regional UGB expansion. These concept plans specifically discuss protection of natural corridors, tree protection, and green development standards. Development of these two concept plans was a significant effort for the City and unique for Metro as a funding source.

Additionally, the South End concept plan was approved (April 2014) recommending a low impact design approach to stormwater management. One goal of this plan notes that streams, trees, wetlands and wildlife habitat should be protected and enhanced through a network of natural areas.

3.5 Monitoring

The City of Oregon City is required to submit a TMDL Implementation Plan progress report to DEQ annually, although not specifically stated in the TMDL Implementation Plan Guidance Document, related to their implementation of identified management strategies. In order to provide progress reports, the City will track planting efforts by acreage and by shade opportunity ID#'s. Additional information tracked will include modifications to development/ design codes where relevant to the promotion of enhanced infiltration or protection of vegetation and efforts to sponsor related programs.

With respect to effectiveness monitoring some water quality sampling and analysis conducted for the City's MS4 NPDES permit (described in Section 2.3.2), includes the collection of instream temperature samples. Progress reports for the TMDL Implementation Plan will refer to actual monitoring results if collected in close proximity to an improved riparian vegetation location and if significant data exist to make statistically sound conclusions.

4.0 Evidence of Compliance with Applicable Land Use Requirements

OAR 340-042-0080(3)(a)(D) defines one of the required elements of a TMDL Implementation Plan to be evidence of compliance with applicable statewide land use requirements. Per the TMDL Implementation Plan Guidance Document, this would consist of the following:

1) Identify applicable acknowledged local comprehensive plan provisions and land use regulations, and
2) Explain how the implementation plan is consistent with these local planning requirements or what steps will be taken to make the local planning requirements consistent with the implementation plan.

Per item #1 above, Oregon City's comprehensive plan was acknowledged by the Land Conservation and Development Commission (LCDC) in 1982 to be in compliance with the Statewide Planning Goals. The plan underwent a major revision that was completed in June 2004. The City's Comprehensive Plan is founded on a number of principles, meant to shape the City's future growth and development. As the City's comprehensive plan aligns with LCDC statewide goals, there are three specific sections within Oregon City's comprehensive plan that contain intentions similar to the strategies described in this TMDL Implementation Plan. These are Sections 5.0, 6.0, and 11.0.

Per item #2 above, this TMDL Implementation Plan is consistent with the City's acknowledged comprehensive plan to the extent required by law. The above mentioned sections of the City's comprehensive plan (Sections 5.0, 6.0, and 11.0) align with specific components of the TMDL Implementation Plan, as the two documents contain similar goals and methods for improving water quality.

Section 5.0 of the City of Oregon City comprehensive plan is titled "Open Spaces, Scenic and Historic Areas, and Natural Resources," which recognizes the importance of protecting the City's valuable natural resources. Goal 5.4 under Section 5 addresses natural resources and water quality, specifically discussing the importance of the conservation and restoration of riparian corridors to increase shade, reduce erosion and provide habitat for salmonids and other aquatic species. Section 5.0 of the comprehensive plan aligns with management strategies to preserve and enhance riparian vegetation as described in Section 3.0 of this plan.

Section 6.0 of the City's comprehensive plan covers air, water, and land resources quality. Specifically, Goal 6.2 Water Quality states "prevent erosion and restrict the discharge of sediments into surface and groundwater by requiring erosion prevention measures and sediment control practices." TMDL strategies as described in Section 2.0 and 3.0 address erosion control and removal of sediment.

Finally, in Section 11.0, Goal 11.4 of Oregon City's comprehensive plan addresses the City's storm drainage system. Policies listed under Goal 11.4 states that green streets standards should be adopted to reduce the amount of impervious surface; parking lot designs should mitigate stormwater impacts through a reduction in runoff and use of systems to allow infiltration; flow

control must be considered for discharge to surface water bodies; and stormwater management services should be consistent with the NPDES MS4 permit requirements. The TMDL Implementation plan includes reference to NPDES MS4 permit requirements and to stormwater design standards and capital projects to address stormwater pollutants (e.g., bacteria and mercury) and promotes infiltration to address temperature.

In general, Oregon City's acknowledged comprehensive plan contains goals and strategies that coincide with the management strategies contained in this TMDL Implementation Plan. Based on the above findings, this TMDL plan is considered to be compatible with the land use requirements as set forth in the comprehensive plan.

5.0 Additional Requirements

The fifth component of TMDL Implementation Plans required by OAR 340-042-0025 is "any other analyses or information as specified in the Water Quality Management Plan." The WQMP for the Willamette Basin TMDL requires a fiscal analysis, a summary of legal authority, and requires that cold water refugia to be addressed for DMAs below river mile 50 of the Willamette mainstem. This section addresses these requirements.

5.1 Legal Authority

The City has existing ordinances that provide authority for implementation of portions of the TMDL Implementation Plan. As the City currently operates under an MS4 NPDES permit, they have ordinances for illicit discharges, erosion control, and post-construction site runoff, as necessary to implement the BMPs outlined in their permit and also to implement the management strategies described in Section 2.0 to address bacteria and mercury. MS4 NPDES annual compliance reports submitted to DEQ have included, as required, a demonstration of continued legal authority to implement the programs outlined in the SWMP. The City also has ordinances to implement Title 3 requirements, including the establishment of a Water Quality Resources Area Overlay District, in addition to having a comprehensive plan that addresses the LCDC statewide planning goals. These ordinances all pertain to the management strategies proposed to address the temperature TMDL (Section 3.0).

5.2 Funding

The City currently charges a monthly stormwater fee that pays for implementation of the BMPs described in their MS4 NPDES permit in order to comply with permit requirements. On June 20, 2012 the City Commission approved the following stormwater rate increases from the current $8.55 (2013) per Equivalent Residential Unit, to $8.80 (2014), to $9.05 (2015), to $9.35 (2016), to $9.65 (2017). Rate increases take effect January 1 of each year noted.

The financial commitment of $5,000 per year towards revegetation, plant maintenance during the establishment period, and supplemental watering will likely come from the stormwater fee as well, but other methods of funding may be explored and utilized.

5.3 Cold Water Refugia

Per the WQMP, the TMDL Implementation Plans for areas below river mile 50 of the Willamette mainstem "shall look at identifying existing cold water refugia and provide options for protecting or enhancing such areas." Cold water refugia (CWR) can be described as patches of water within a stream that are one or two degrees cooler than the surrounding ambient stream temperature resulting from the cool in-flow of tributaries and/or upwelling of groundwater.

Studies indicate that CWR may provide critical habitat for salmonids in basins affected by warm temperatures (Bartholow 1995). CWR are associated with different aspects of stream morphology, including side channels, alcoves, lateral seeps, and floodplain spring brooks (Ebersole 2003). McIntosh et. al. (1998), in their study of CWR in the Klamath Basin using

forward-looking infrared (FLIR), concludes that areas of CWR appeared to be at a junction where tributaries meet.

Because tributary junctions are easy to map, a likely source of cool groundwater, and associated with CWR, these tributary junction points were utilized as potential CWR. Riparian areas at tributary junctions that would be accessible to fish from the mainstem Willamette River are identified in Figure 3-2: Shade Opportunities. To address cold water refugia these identified areas were used in the prioritization of shade opportunities (Section 3.3.1). If an area was identified as an opportunity area for planting, it received a higher score or ranking if it was also identified as potential cold water refugia. Using this prioritization scheme, these areas will be addressed first when developing planting plans.

5.4 Public Involvement

DEQ has promoted public involvement for the TMDL and TMDL Implementation Plans with existing interest groups having an interest in the Willamette TMDLs. The City addresses public involvement for management measures described in Section 2.0 through their NPDES Permit and SWMP. Public involvement will be addressed for the vegetation efforts and for the TMDL Plan as a whole through use of the City's newsletter, website, and involvement with the Greater Oregon City Watershed Council. The TMDL plan will be posted on the City's website, available for public review.

5.5 Record Keeping and Reporting

The TMDL Guidance Document requires the DMA to submit two types of reports to DEQ on a regular basis: 1) progress report and 2) an implementation plan review report. The progress report would provide the results of implementation and effectiveness monitoring, as described above in Sections 2.3 and 3.5. The progress reports would be submitted to DEQ on an annual basis.

The implementation plan review report would use existing data and other information to evaluate this TMDL Implementation Plan's effectiveness relative to pollutant reduction goals. If evidence indicates that the Plan and associated management strategies are not adequate, then modifications may be considered. The implementation plan review report would be submitted to DEQ once every five years or as determined by DEQ.

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APPENDIX A

Summary of Strategies to Address Bacteria and Mercury for the Willamette Basin TMDL

Appendix A. Status of Implementing Components of Oregon City's 2012 SWMP

Key to Pollutant Symbols
A full circle (●) indicates the BMP is expected to address the parameter.
An empty circle (○) indicates the BMP may be expected to address the parameter.
A blank cell indicates that the effect of the BMP is unknown at this time.

Best Management Practice or Activity	Addresses Bacteria?	Addresses Mercury?	Responsible Department	Measurable Goals (2012 SWMP)	Tracking Measures (2012 SWMP)	Annual Report Information: Tracking Measure Status, Permit Year 2012–2013	Additional Detail Related to Activities Conducted
Element #1 Illicit Discharge Detection and Elimination							
BMP 1-1: Implement the Illicit Discharge Elimination Program	●	●	Oregon City Public Works Department	• Document and implement updated Standard Operating Procedures for the IDDE Program by November 1, 2012. • Conduct actions to remove identified illicit discharges in conjunction with timeframes outlined in the City's MS4 NPDES Permit. • Track and record all identified illicit discharges and how such discharges were removed.	1) Track status of documenting and updating the IDDE SOP. 2) Track the number, location, type of discharge, resolution and enforcement action for any illicit discharge investigation conducted.	1) The City of Oregon City developed an IDDE SOP (effective date: November 1, 2012), in conjunction with other Clackamas County co-permittees. The SOP includes guidelines for identification and enforcement of illicit discharges. 2) No illicit discharge investigations were deemed necessary as a result of annual Dry Weather Field Screening conducted during this reporting period. See BMP 1-2, below.	
BMP 1-2: Conduct Annual Dry Weather Field Screening	○	○	Oregon City Public Works Department	• Conduct dry-weather field screening once per year, at a minimum, at major outfalls. • Characterize dry weather flows as permissible, non-permissible, or unknown. • Conduct sampling, analysis, and investigations for non-permissible and unknown dry weather discharges. • Maintain maps of major outfalls and dry weather field screening locations. • Notify the Public Works Operations Manager of all identified illicit discharges and take necessary steps to eliminate them. • Update procedures for dry weather field screening by November 1, 2012.	1) Track the number and location of outfalls inspected annually. 2) Summarize inspection results and track the number and location of outfalls requiring monitoring and/or investigations. 3) Report the outcome and resolution of any investigation activities. 4) Report the outcome and resolution of any code enforcement actions. 5) Track the status of updating standard procedures.	1) 15 outfalls were inspected as part of the annual dry weather field screening activities. 2) Outfalls were inspected on 8/10/12. Flow was observed at 7 of the outfalls; discharge was characterized as permissible so no monitoring and/or investigations were required. 3) N/A 4) N/A 5) The City of Oregon City developed an IDDE SOP (effective date: November 1, 2012).. The SOP includes procedures for conducting dry weather field screening.	Dry weather screening was conducted at the following outfalls: • South Willamette at 99E & 5th Street (OC001 A & OC001 B) • Abernethy Creek at 14th John Adams (OC002) • Park Place Creek at Abernethy Road at Tri-Let (OC003) • Livesay Creek at Beemer Way (OC004) • Park Place Creek at Clackamas River Drive (OC005) • Clackamas River at Metro Wetlands Pond (OC006) • Coffee Creek at Barker Road (OC007) • Singer Creek at Linn Ave and Charman Street (OC008) • Singer Creek at Holmes Lane (OC009) • Mud Creek at Kaen Road (OC010) • Mud Creek at Meyers Road (OC011) • Caufield Creek at Falcon Drive (OC012) • Newell Creek at Falcon Drive (OC013) • Newell Creek at Beavercreek and Hwy 213 (OC014)
BMP 1-3: Implement the Spill Response Program	○	○	Clackamas Fire District #1 (Hazardous Materials Team) and Oregon City Public Works Department	• Respond to reports of hazardous and non-hazardous spills and follow the Oregon City Spill Response Plan. • Report all hazardous and non-hazardous spills to DEQ as necessary.	1) Indicate the number of spills reported to Public Works and DEQ. 2) Track responses to reported spills. 3) Indicate sources, causes, and types of discharges resulting from spill activities. 4) Track any changes to the Oregon City Spill Response Plan.	1) Three spills were reported to Oregon City Public Works (OCPW) during the 2012-2013 reporting period. None required DEQ reporting. 2) OCPW responded to these spills by cleaning with absorbent pads, sweeping, and proper disposal. 3) These were minor fuel or oil spills resulting from vehicle accidents or mechanical failure. No discharges resulted and no DEQ reports were required. 4) In June 2013 Oregon City Public Works Revised its Spill Response Plan.	In June 2013, Oregon City revised its Spill Response Plan for hazardous & non-hazardous spills to reflect the most current guidelines provided by Oregon DEQ. Training regarding these revisions was conducted with the Oregon City Public Works Operations employees on August 21, 2013.
Element #2 Industrial and Commercial Facilities							
BMP 2-1: Screen Existing and New Industrial Facilities	○	○	Oregon City Public Works Department	• Review the business license inventory for 1200Z industries once over the permit term. • Notify DEQ of any existing or new industrial facilities within the City that may be subject to an industrial stormwater NPDES permit.	1) Track the number of existing or new facilities subject to a stormwater industrial NPDES permit during the permit term.	1) In development of the City's Industrial/ Commercial Facility Inspection Program Standard Operating Procedures (SOP) (completed July 1, 2013), City staff queried the DEQ database and identified seven current, active industrial stormwater permittees. An initial screening of the City's business license database in June 2013 did not identify additional facilities potentially subject to an industrial stormwater permit. The Water Quality Coordinator continues to review all new business license applications for potential water quality-related issues. 133 business license applications were reviewed during the 2012-2013 reporting period.	DEQ provided additional guidance on industrial facility screening in June 2013. Oregon City's consultant has coordinated with DEQ related to the methodology and process for identifying "potential" 1200-Z permittees.
BMP 2-2: Implement an Industrial/ Commercial Inspection Program for High Priority Facilities	○	○	Oregon City Public Works Department	• Pursue approval to hire staff to implement a business inspection program. • Develop a priority list of industrial/commercial facilities for inspection. • Investigate 25% of the City's manufacturing businesses once during the permit term. • Develop an industrial/commercial inspection procedure by July 1, 2013.	1) Track the number of inspections conducted. 2) Report on inspection results and follow up actions. 3) Report on status of documenting and updating procedures.	1) No inspections were conducted during the 2012-2013 reporting period. 2) N/A 3) The City developed an Industrial/ Commercial Facility Inspection Program Standard Operating Procedures (SOP) July 1, 2013. The SOP includes procedures and guidelines related to facility screening, DEQ notification of potential industrial stormwater permit needs, and high pollutant source facility inspections. The SOP identifies a total of 31 manufacturing businesses potentially subject to inspection.	The City has currently not been able to hire staff to implement the business inspection program; the City may utilize seasonal/intern assistance until additional staff can be added.

Best Management Practice or Activity	Addresses Bacteria?	Addresses Mercury?	Responsible Department	Measurable Goals (2012 SWMP)	Tracking Measures (2012 SWMP)	Annual Report Information: Tracking Measure Status, Permit Year 2012–2013	Additional Detail Related to Activities Conducted
Element #3 Construction Site Runoff Control							
BMP 3-1: Implement the Erosion Control Ordinances	●	○	Oregon City Public Works Department	• Review erosion control plans for all developments greater than 1,000 square feet. • Require erosion and sediment control plans not in compliance with standards to be amended and approved prior to construction. • By November 1, 2014, adopt the Clackamas County erosion control manual or revise the City's manual in accordance with the MS4 NPDES permit requirements.	1) Record the number of erosion control plan reviews completed and approved. 2) Track the number of erosion control permits issued annually. 3) Report on the status of adopting the Clackamas manual or updating the City's manual.	1) 248 erosion control plans were reviewed and approved. 2) 248 erosion control permits were issued. 3) The City continues to consider adoption of all or part of Clackamas County's Manual and will comply with the November 1, 2014 due date per MS4 NPDES permit requirements.	
BMP 3-2: Provide Educational Information to Construction Site Operators	○	○	Oregon City Public Works Department	• Continue to provide the City's most current erosion control manual on the City website. • Continue to offer discounts on erosion control permits to contractors completing the Erosion Control Certification Program.	1) Track the number of contractors receiving a discount on erosion control permit fees.	1) No contractors received a discount on permit fees.	
BMP 3-3: Conduct Erosion Control Inspections	●	○	Oregon City Public Works Department	• Conduct a minimum of three erosion control inspections at each permitted site. • Conduct appropriate enforcement activities for erosion control violations.	1) Record the number of erosion control inspections conducted annually. 2) Report the number of notices of non-compliance issued during inspections.	1) A total of 620 erosion control inspections were conducted this permit year. Due to the time frames with which construction occurs, some sites had all three required inspections, and some sites have only had one or two inspections at this time (construction is still ongoing). 2) 2 notices of non-compliance were issued. 1 stop work order was issued.	The total number of inspections are comprised of: • 278 Initial site visits, Inspection 1 • 254 Random inspections, Inspection 2 • 88 Final inspections, Inspection 3
Element #4 Education and Outreach							
BMP 4-1: Provide Public Education and Outreach Materials Regarding Stormwater Management	○	○	Oregon City Public Works Department	• Include a water quality related article in each City newsletter, distributed to citizens three times per year. • Participate in the Regional Coalition of Clean Rivers and Streams. • Seek out opportunities to partner with other agencies/ jurisdictions/ organizations to educate and promote watershed health and low impact development. • Periodically install signs near water quality structures and around the City promoting water quality. • Sponsor the volunteer catch basin stenciling program. • Distribute an annual water quality report to Oregon City residents.	1) Track the number, types and topics of public educational materials distributed to the public. 2) Report any large scale public educational campaigns initiated during a given year. 3) Track coordinated public outreach activities with other permittees.	1) The following educational activities were conducted (see Appendix C for details): - A total of 7 water quality-related articles were included in Trail News. - OC promoted and/or participated in a total of 4 special events. - The September utility bill included a message about car washing – soap up your car, not your river! - Mailed 15,658 copies of the Annual Water Quality Report to OC residents. - Stormwater banner displayed at city hall (5/31/13-6/14/13). 2) No large scale public education campaigns were initiated. 3) Coordinated efforts included: - Continued to sponsor the "Do the Right Thing" campaign via KOIN media outlets. - Continued participation in the Regional Coalition of Clean Rivers and Streams. - Continued participation with other agencies to promote water quality education through Clackamas River Water Providers.	Specific details on the public education and awareness activities conducted by the City of Oregon City are available in Appendix C. During this reporting year the Regional Coalition of Clean Rivers and Streams (Coalition) continued to utilize online media, websites, and social media profiles to implement a diverse campaign. The Coalition's annual report summarizes these efforts. Oregon City continues to conduct catch basin marking and stenciling to increase public awareness. During this reporting period 1,318 "No Dumping, Drains to Waterway" markers were installed at catch basins. 436 catch basins were stenciled with the message "Dump No Waste – Drains to Stream".
BMP 4-2: Participate in a Public Education Effectiveness Evaluation	○	○	Oregon City Public Works Department	• Coordinate with other local, Phase I jurisdictions in providing/compiling information regarding a public education effectiveness evaluation by July 1, 2015.	1) Report on activities conducted annually.	1) The ACWA Stormwater Committee initiated a coordinated effort to compile existing educational survey information and develop conclusions to inform how public education efforts result in behavioral change. A proposal was received from DHM Consulting. ACWA coordinated with DEQ to ensure that the study would meet DEQ's intended requirements. ACWA developed a cost share breakdown among interested Phase I and Phase II communities, and Oregon City has agreed to participate in the effort.	
BMP 4-3: Conduct Staff Training for Pest Management	○	○	Oregon City Public Works Department and Parks Department	• Ensure Public Works and Parks staff conducting pest management activities are certified for spraying activities according to OSHA requirements. •Ensure licensed staff attends annual refresher courses.	1) Track the number of employees licensed for spraying activities. 2) Report number of employees that attended initial or refresher training.	1) Public Works staff licensed for spraying activities = 5; Parks Dept staff = 5 2) 5 Public Works staff and 5 Parks Dept staff attended refresher training classes during the reporting period.	

Best Management Practice or Activity	Addresses Bacteria?	Addresses Mercury?	Responsible Department	Measurable Goals (2012 SWMP)	Tracking Measures (2012 SWMP)	Annual Report Information: Tracking Measure Status, Permit Year 2012–2013	Additional Detail Related to Activities Conducted
BMP 4-4: Conduct Staff Training in Spill Response	○	○	Oregon City Public Works Department	• Provide non-hazardous spill response training annually through monthly safety meetings. • Coordinate annual training and refresher courses for staff initially responding to spills using OSHA hazardous materials educational resources.	1) Track spill-related training and education.	1) During a safety meeting on March 19, 2013 a representative from SAIF provided OCPW staff information on changes to Hazard Communication and new labeling requirements.	This training provided important information for anyone responding to a spill incident.
BMP 4-5: Ensure Municipal Staff Training in Stormwater Pollution Prevention	○	○	Oregon City Public Works Department	• Conduct municipal training for employees associated with stormwater management in the City. • Coordinate with other Clackamas County co-permittees regarding regional water quality efforts. • Participate in training and advisory committee opportunities available through state and local agencies and groups. • Conduct regular stormwater staff meetings one to two times per year.	1) Track the number of employees receiving training in stormwater management annually. 2) Track Oregon City staff participation in groups, committees, and organizations relevant to stormwater quality management. 3) Track regular stormwater staff meetings and staff attendance at those meetings.	1) Employees receiving training in stormwater management: - Three OCPW employees attended the Annual ACWA Stormwater Summit 6/4/13. - OCPW Director attended APWA conferences 10/3/12-10/5/12 and 4/2/13-4/5/13. - OCPW Operations Manager attended APWA conference 4/2/13-4/5/13. - Four OCPW employees attended the annual NWPCA Water Environment School 3/26/13-3/28/13. - OC Erosion Control Officer attended IECA conference 2/10/13-2/13/13. 2) OC staff participates in the following groups and organizations: - Association of Clean Water Agencies (ACWA) and active participant in the ACWA Phase I Stormwater subcommittee. - Continued collaboration with other co-permittees on Comprehensive Clackamas Stormwater Monitoring Program (CCCSMP). - Greater Oregon City Watershed Council (GOCWC). - Clackamas Water Education Team. - Regional Coalition for Clean Rivers and Streams. 3) There were18 stormwater staff meetings conducted during the 2012-2013 reporting period. Dates, topics, and attendees are summarized in Table 4 in Section 6.0 of the 2012-2013 NPDES MS4 annual report.	
Element #6 Post-Construction Site Runoff							
BMP 6-1: Implement Municipal Construction Standards	●	●	Oregon City Community Development Department	• Per City's Development Code, review all new development and applicable redevelopment for conformance with current City stormwater standards and ordinances.	1) Track the number of development applications reviewed and approved for compliance with stormwater regulations. 2) Track the number, type, and drainage area of treatment facilities constructed annually.	1) 38 development applications were reviewed and approved for compliance with water quality/water quantity standards. 2) 4 treatment/ detention facilities were constructed during the reporting period of 7/1/2012 through 6/30/2013: - 3 detention pipes/tanks and 1 swale - Total Drainage area = 110,460 sq ft	Details of treatment facility construction: TRG Logistics Site – 5 sumped catch basins (private) and stormtech detention; Total contributing drainage area = 22,700 sq ft Warner Milne Professional Offices Site - 2 sumped catch basins and a 75'x48" diameter detention pipe; Total contributing drainage area = 8,000 sq ft Crabtree Terrace No.2 Site - 8 sumped catch basin and a bioswale; Total contributing drainage area = 13,760 sq ft Providence Willamette Falls Parking Lot Addition Site – 3 sumped catch basins and a detention tank; Total contributing drainage area = 66,000 sq ft
BMP 6-2: Review and Update Code and Development Standards related to Stormwater Quality Control	●	●	Oregon City Community Development Department	• Review the City's current/ planned stormwater treatment and detention standards for compliance with new MS4 NPDES permit language. • Review the City's current public works development code provisions to ensure that applicable barriers to LID or green infrastructure (GI) are minimized and eliminated where practicable. • If necessary, update the City's post-construction stormwater design standards and code language by November 1, 2014.	1) Track progress related to review of the City's code and development standards per provisions in the MS4 NPDES permit. 2) Track any code/ standards modifications made by ordinance.	1) The City's consultant conducted a review of the pending LID Design Manual and Standards per the updated MS4 NPDES permit language. Modifications to the pending standards would be required to address the current MS4 NPDES permit language. 2) The City began their code and development standard update process September 2013.	Completion of design standards and code updates is not required until November 1, 2014.

Best Management Practice or Activity	Addresses Bacteria?	Addresses Mercury?	Responsible Department	Measurable Goals (2012 SWMP)	Tracking Measures (2012 SWMP)	Annual Report Information: Tracking Measure Status, Permit Year 2012–2013	Additional Detail Related to Activities Conducted
Element #7 Pollution Prevention for Municipal Operations							
BMP 7-1: Conduct Street Sweeping and Roadway Repair Activities	●	●	Oregon City Public Works Department	• Sweep city streets every 3-4 months on average, more frequently in high traffic areas and during leaf pick up and following deicing activities.	1) Track the average number of citywide sweeps per year. 2) Estimate the miles of streets swept per year. 3) Track volume of debris removed.	1) 4.07 citywide sweeps for this reporting period. 2) During the 2012-2013 reporting period, 2,996 miles of roadway were swept. 3) 574 cubic yards of debris were removed as a result of sweeping and leaf pickup activity.	
BMP 7-2: Minimize Pollutant Discharges Associated with Landscape Management Practices	○	○	Oregon City Public Works Department and Parks Department	• All chemical applicators, both contractor and city, must follow state laws related to the use of pesticides. • Applicators will complete spray reports for the application of chemicals.	1) Track any program changes regarding chemical application practices used by the City.	1) Both city and contracted chemical applicators comply with 2300-A, pesticide general permit requirements. Pesticide applications are kept at least three feet away from any water's edge.	
BMP 7-3: Implement a Program to Reduce the Impact of Stormwater Runoff from Municipal Facilities	○	○	Oregon City Public Works Department	• By July 1, 2013, inventory municipal facilities subject to this permit requirement. • By July 1, 2013, identify whether there is a need for additional strategies to minimize discharge from these facilities.	1) Track updates to strategies used to minimize pollutant discharge from municipal waste storage facilities	1) The City developed a Stormwater Pollution Prevention Strategy document for municipal operations (SWPPS) July 1, 2013. The SWPPS include a description of each of the City's six facilities that treat, store, or transport municipal waste. Additionally, it identifies potential pollutant sources as well as short and long term pollution reduction strategies.	
BMP 7-4: Control Infiltration and Cross Connections to the City's Stormwater Conveyance System	●		Oregon City Public Works Department	• Review new and redevelopment for possible cross-connections. • Eliminate cross connections upon identification.	1) Report whether any cross connections were discovered and describe follow up activities.	1) No cross connections were discovered during this reporting period.	
BMP 7-5: Coordinate with Local Fire Department related to Pollutant Discharge from Fire Fighting Training Activities			Oregon City Public Works Department	• By November 1, 2012, contact Clackamas Fire District #1 to determine what activities are conducted to minimize pollutant discharges associated with fire fighting training activities. • As applicable, provide educational information to Clackamas Fire District #1 by November 1, 2012.	1) Track contacts made with Clackamas Fire District #1.	1) On 9/12/12 Oregon City's Water Quality Coordinator contacted Clackamas Fire District #1 to discuss fire fighting training activities conducted in Oregon City. Per an email dated 9/13/12 the Battalion Chief for Training & Safety confirmed that all foam drills were conducted at their primary training facility in Clackamas. Any training activities at the four Oregon City stations use water only.	
BMP 7-6: Conduct Master Planning and Implement Capital Projects for Stormwater Quality Enhancement	●	●	Oregon City Public Works Department	• The Citywide Master Plan will be updated by the end of the permit term. • Prioritize CIPs by funding availability and water quality/ flood control benefit. • Update maps to include location and drainage area of any new stormwater quality CIPs.	1) Track master planning activities. 2) Track number and cost of major (water quality) CIP projects and discuss added benefit. 3) Map the location and drainage area of water quality related CIPs.	1) The City continues with the planning phase for updating their existing Citywide Drainage Master Plan. 2) A total of six water quality related CIP projects were constructed during this reporting period. - One project was contracted out, for a total cost of $108,000. - Five projects were completed in-house, for a total cost of $63,500. 3) Mapping: - The one contracted CIP is pending. - Three of the five in-house CIP projects have been mapped; two pending.	Following are details of the contracted CIP projects completed during this reporting period: - OR213:I-205 – Redland Rd Improvements Project – Six water quality swales along local roadways and a water quality pond for local roadways and highway drainage. Following are details of the in-house CIP projects completed during this reporting period: - 317 Pearl St – installed one sumped catch basin and 145 ft of pipe - 19438 McCord Rd – installed one sumped catch basin - 1722 Jackson St – installed three sumped catch basins and 225 ft of pipe - 19446 McCord Rd – installed three sumped catch basins and 170 ft of pipe - 1610 10th St – installed 165 ft of pipe to eliminate erosion/sinkhole issue

Best Management Practice or Activity	Addresses Bacteria?	Addresses Mercury?	Responsible Department	Measurable Goals (2012 SWMP)	Tracking Measures (2012 SWMP)	Annual Report Information: Tracking Measure Status, Permit Year 2012–2013	Additional Detail Related to Activities Conducted
Element #8 Stormwater Management Facilities Operation and Maintenance							
BMP 8-1: Conduct Stormwater Conveyance System Cleaning and Maintenance	●	●	Oregon City Public Works Department	• Maintain, repair, and/or replace conveyance system components when needed, based on ongoing inspections. • Update the stormwater system map when discrepancies are found.	1) Estimation of the volume of debris removed per year during public conveyance system cleaning activities (in conjunction with BMP 8-2).	See BMP 8-2.	
BMP 8-2: Conduct Catch Basin Cleaning and Maintenance	●	●	Oregon City Public Works Department	• Inspect at least 33% of the public catch basins annually. • Schedule the repair, and replacement of catch basins as needed, based on inspections. • Update the stormwater system map when discrepancies are found.	1) Track the percentage of total public catch basins inspected and/or maintained annually. 2) Track the volume of sediment removed during cleaning activities conducted annually (also includes volume from BMP 8-1). 3) Track the number of catch basin replacements annually. 4) Track the number of public catch basins added to the City's catch basin inventory annually.	1) 42% of public catch basins were maintained during this reporting period. 2) 132 cy of sediment were removed (includes sediment from pipes, culverts, manholes, open channels, and catch basins). 3) Two catch basins were replaced. 4) Eight catch basins were added to, and two catch basins were removed from, the City's inventory.	42% = 1,757 public catch basins
BMP 8-3: Public Structural Control Facility Cleaning and Maintenance	●	●	Oregon City Public Works Department	• Inspect and maintain public structural control facilities in accordance with documented frequencies and procedures. • Update the public structural control facility inventory as needed. • Update the stormwater system map in accordance with new public facility installations and when discrepancies are found.	1) Track the number of public structural facilities inspected and maintained. 2) Track the volume of sediment removed during cleaning. 3) Track changes to the public structural control facility inventory as needed.	1) 142 public structural facilities and 2,175 feet of bioswale were inspected during the reporting period. See the next column for maintenance details. 2) 32 cy of sediment were removed during maintenance/cleaning. 3) One new water quality facility was added to the inventory: - Sunset Meadows – 180 ft vegetated swale	1) The following public structural facilities were inspected and maintained during the reporting period: - Ponds = 76 inspected; 76 maintained - Swales = 2,175 ft maintained - Raingardens = 3 inspected; 3 maintained - Detention Pipes = 20 inspected; 6 cleaned - WQ Vaults = 1 inspected; no maintenance required - Pollution Control Manholes = 42 inspected; 15 cleaned
BMP 8-4: Private Structural Control Facility Cleaning and Maintenance	●	●	Oregon City Public Works Department	• Require new private water quality facilities to submit maintenance agreements to the City. • Compile an inventory of existing private structural water quality facilities and work to collect maintenance agreements for these by July 1, 2013. • Implement an inspection strategy for private water quality facilities by July 1, 2013.	1) Track the number of maintenance agreements submitted to the City each year. 2) Track progress related to the inventory and mapping of existing private structural facilities. 3) Track the status of updating the inventory and map of private water quality facilities. 4) Track the status of developing procedures in accordance with permit requirements.	1) The City continues to require maintenance agreements for private water quality facilities. No maintenance agreements were received during this reporting period. 2) Files have been reviewed for existing private structural facilities. An inventory list has been created. 3) Initial mapping is complete; refinements ongoing. 4) The City developed standard operating procedures (SOPs) for public water quality facilities and private water quality facilities July 1, 2013. The SOPs outline procedures for ongoing mapping and inventory activities, as well as facility inspections. For private facilities, the City requires a maintenance agreement and submission of annual inspection records.	

APPENDIX B

Shade Prioritization and Opportunity Area Map

APPENDIX C

Summary of Strategies to Address Temperature for the Willamette Basin TMDL

Table 1
City of Oregon City
Summary of Strategies to Address Temperature

Best Management Practice or Activity	Responsible Division	Commitment/ Implementation Strategy *What will be done in the next five years*	Measurable Goal *Specific ways to implement strategy (Fiscal analysis as needed)*	Performance Measure *How implementation will be demonstrated*	Timeline *When goal will be achieved*	Milestone *Intermediate indicators of progress*	Status *Progress update for reporting period (Gap analysis discussion as needed)*
Public Education	Public Works	Attend regularly scheduled coordination meetings with the Greater Oregon City Watershed Council.	Attend a minimum of one meeting during the implementation period.	Track meetings attended.	Ongoing throughout the cycle.	Receive and review draft meeting agendas.	
		Include articles regarding temperature-related issues and shade planting projected in the City newsletter and through direct mailings.	Ensure a minimum of one temperature-related piece of educational material during the implementation period.	Record temperature-related educational materials.	Ongoing throughout the cycle.	Ensure temperature-related article for spring Trail News.	
Implement Stormwater Design Standards	Public Works	Implement provisions of Chapters 13 and 17 of the City's development code, which includes provisions for use of infiltration-based stormwater treatment systems and tree planting.	Update design standards to include LID and additional infiltration-based guidelines for stormwater treatment during the implementation period.	Track modifications to the City's development standards related to use of LID and BMPs for new and redevelopment.	Ongoing throughout the cycle.	N/A	
Preservation of Existing Shade	Planning and Public Works	Continue to enforce regulations pertaining to the protection of riparian vegetation and buffer areas.	Continue to implement Chapter 17.49 of the City's development code to address Title 3 and Title 13.	Track any enforcement actions taken to protect existing shade.	Ongoing throughout the cycle.	N/A	
Planting Activities for Identified Shade Opportunity Areas	Public Works	Conduct planting, plant maintenance, and supplemental irrigation activities for the identified shade opportunity areas.	Utilize annual committed funds towards shading and planting activities for identified opportunity areas. *($5,000 allocated annually for planting activities.)*	Track ground truthing activities to refine priority opportunity areas.	Public priority areas by June 2015.	Recruit intern for ground truthing activities.	
				Track planting activities for public, high priority areas.	Ongoing throughout the cycle.	Review priority list annually by December 1st; select next area for planting.	
				Track planting activities for other identified shade opportunity areas.	Ongoing throughout the cycle.	Review as planting opportunities arise.	
				Track any re-vegetation and maintenance activities required.	Ongoing throughout the cycle.	Evaluate need for re-planting annually by June 30th.	