City of Fairview
Shade Modeling and
Riparian Inventory Report

Prepared for

City of Fairview
Fairview, Oregon 97024

Prepared by

Pacific Habitat Services, Inc.
Wilsonville, Oregon 97070
(503) 570-0800
(503) 570-0855 FAX

June 28, 2008

TABLE OF CONTENTS

Page

I. INTRODUCTION.....1

II. TEMPERATURE TMDL BACKGROUND 1
A. "Surrogate Measures for Meeting Temperature Criteria.....2
B. Fairview's Shade Targets 2
C. System Potential Vegetation 3
D. Determining the Buffer Needed to Meet Shade Targets 3

III. ANALYSIS OF EXISTING SHADE ALONG FAIRVIEW'S STREAMS 5
A. Overview of Fairview's Watersheds 5
B. Modeling Buffer Sizes for Fairview Streams.....6
C. Mapping Existing Shade along Fairview's Streams.....7
D. Defining Fairview's System Potential Vegetation 8

IV. MANAGEMENT STRATEGIES TO ACHIEVE SYSTEM POTENTIAL VEGETATION 10
A. Protection of Existing Shade 11
B. Planting to Increase System Potential Vegetation.....11
C. Identification of Constraints to Planting..... 12

APPENDIX A: Figures

Figure 1: Overview of Fairview, Oregon Streams
Figure 2: Fairview, Oregon Shade Categories
Figure 3: Public Lands within Functional Shade Buffer
Figure 4: Constraints to Planting within the Functional Shade Buffer

I. INTRODUCTION

The Oregon Department of Environmental Quality (DEQ) has set Total Maximum Daily Loads (TMDL) for water bodies in the Willamette Basin. In order to address temperature TMDLs, DEQ required that all Designated Management Agencies (DMA) (i.e., those entities with a known, demonstrable impact on water quality) prepare a TMDL Implementation Plan. The plan is the DMA's strategy to improve water quality standards within their streams and includes activities that will be implemented to address stream temperatures, a timeline for implementing the activities, evaluation methods for determining success, and reporting protocols. The City of Fairview is a DMA and submitted its temperature TMDL plan to DEQ in March 2008.

The City's Implementation Plan included reference to the determination of effective shade along all of the streams that drain to the Willamette River. The City retained Pacific Habitat Services, Inc. (PHS) to model the effective shade, to assess the existing conditions of the riparian areas and determine the appropriate plants needed to achieve system potential vegetation. This report presents the results of PHS's assessment.

II. TEMPERATURE TMDL BACKGROUND

DEQ has established temperature TMDLs for the Willamette Basin. Within these temperature TMDLs, DEQ set allowable stream temperatures to reflect conditions needed to support the most sensitive beneficial uses of each watershed. For the Lower Willamette Basin, DEQ has determined that resident fish and aquatic life and salmonid spawning, rearing and migration are the most sensitive temperature-related beneficial uses. DEQ has, therefore, set the stream temperature standard for Willamette River tributaries in the Lower Willamette basin to be 18°C (64.4^{o}F).

DEQ has identified practices and land uses leading to in-stream impounding or diversion of water, channel modifications, removal of shade-producing streamside vegetation, and development of large areas (specifically, large areas that previously received, stored and discharged rainfall as groundwater in drier seasons) as the primary factors leading to the higher stream temperatures seen in the Willamette Basin and throughout the state. Less obvious causes of stream warming include changes in watershed processes and channel morphology. Activities that interrupt groundwater flows and the critically important exchange of groundwater with surface waters reduce base flows as well as the availability of cool water refugia that are necessary for salmonids throughout their life cycle. Channel modifications such as downcutting, bank armoring, dike construction, aggregate mining, and wetland and floodplain filling contribute to loss of channel complexity, which reduces or eliminates cool water refugia and fish habitat. Although the impacts of such watershed and channel modifications on stream temperature are not quantified in the temperature TMDL language, the protection of diverse temperature environments and refugia is an important element of Oregon's temperature standards.

A. "Surrogate Measures" for Meeting Temperature Criteria

Many factors affect the temperature of streams; however, DEQ has determined that the increased solar radiation loads due to the removal of riparian vegetation is the major cause of the rise in water temperatures. Similarly, the predominance of scientific literature indicates that the most important human-caused effects on stream temperatures include increased direct sun exposure on the waterbody and streamside heating as a result of the removal or thinning of streamside vegetation. Because of the known, direct connection between riparian forests and stream temperature, DEQ established "shading targets" and "effective shade curves" that need to be met or retained by DMAs. These concepts represent the relationship between vegetation height and density, stream orientation, stream channel width, and resulting solar radiation that a stream would receive. Under the Willamette TMDL, shade targets and effective shade curves are applied as "surrogate measures" for temperature, allowing DMAs to address, monitor, and report on shade levels over a stream, rather than monitoring actual stream temperatures.

B. Fairview's Shade Targets

Because of the DEQ-established surrogate measures for temperature, the City of Fairview will not be monitoring stream temperatures to assess whether the 18°C temperature criteria is being reached. Rather, the City will maintain and restore shade-producing vegetation along its stream corridors in order to block solar loading during the summer months. The City will then monitor its progress in restoring and retaining forested riparian corridors.

Shade is more effective at maintaining low temperatures in narrow streams than in wider streams, given the same flow of water at a given point, because shadows cast by trees cover a greater percentage of the stream surface in narrow streams. On smaller streams, shade can effectively screen the water's surface from direct rays of the sun. As all of Fairview's streams are relatively small, it is anticipated that the City can meet a high level of shade through restoration and maintenance of streamside vegetation.

Chapter 5 of the Willamette Basin TMDL shows the potential effective shade curve for varying stream widths and orientations. These curves are based on ecoregions of the Lower Willamette Subbasin. The effective shade curve for the Willamette Valley, where western red cedar, Douglas fir and black cottonwood were historically the dominant riparian trees, is appropriate to use for assessing streams in Fairview.

Based on this shade curve, Fairview's small-width streams have effective shade curve goals of approximately 80 to 95 percent, meaning that historically prevalent streamside vegetation should be able to block most of the direct solar loading from reaching these smaller streams. One can clearly see from the curves that streamside trees would produce much less of a beneficial effect on very large rivers such as the mainstem of the Willamette. This provides more evidence of the importance of small tributaries as cool water inputs to the overall system.

C. System Potential Vegetation

To meet the shade goals established by DEQ, the City of Fairview and the other affected DMAs will need to plant and/or retain the "system potential vegetation" capable of providing significant shade benefit to surface waters. System potential vegetation is considered by DEQ to be necessary to achieve "system potential effective shade," and is defined as "the potential near-stream vegetation that can grow and reproduce on a site, given the climate, elevation, soil properties, plant biology, and hydrologic processes." This definition considers the vegetation types historically known to be present throughout the eco-region. These vegetation types would include those species still found in remnant patches of forest throughout Fairview's natural areas.

System potential does not consider management or land use as limiting factors; it is an estimate of the vegetated condition where the human-generated impacts to riparian vegetation that cause stream warming are minimized. System potential is also not an estimate of pre-settlement conditions. Although it is helpful to consider historic land cover patterns, channel conditions, and hydrology, many areas have been altered to the point that the historic condition is no longer attainable given drastic changes in stream location and hydrology (channel armoring, wetland draining, urbanization, etc.).

DEQ expects that DMAs will focus initial temperature TMDL implementation efforts on improving shade conditions by establishing and/or enhancing riparian vegetation conditions and in ensuring that existing and future development practices allow the attainment of shade targets. While it is recognized in the Willamette TMDL that it may take several years to several decades after full implementation of shade-producing measures to achieve the shade targets identified by DEQ, consistent progress toward achievement of the shade target is expected.

D. Determining the Buffer Needed to Meet Shade Targets

To determine the extent of active restoration that would be needed to show progress toward meeting shade targets, given existing riparian conditions, the following issues were considered:

1. What amount of direct shade benefit is realized as the distance of planted system potential vegetation is extended perpendicularly from a stream edge?
2. To what extent do stream orientation and slope of banks affect the amount of shade a stand of trees can provide?
3. Is there a temperature benefit from planting the north bank of a stream where the direct shade benefit is clearly less than on a south bank?

Staff reviewed regional jurisdictional temperature management plans and current research related to impacts of riparian vegetation on stream temperatures. Much of the literature explored impacts of riparian forest on stream temperature not just from direct shade, but also by maintenance of cooler soil temperatures, reducing exposure to wind, and preservation of insolating microclimate.

(It should be noted that most literature sources based their findings on vegetated buffers in forestry and agricultural areas; very little information on urban buffer impacts were found. No contradictions in information were found between the urban and non-urban research, however.) This literature review showed two predominant stream temperature benefits provided by riparian tree cover: (1) creation of direct shade over the adjacent surface waters, and (2) protection of an insolating microclimate, that minimizes temperature fluctuations throughout the day.

PHS created a model appropriate for Fairview's smaller stream sizes (i.e., less than 25 feet wide) that compared summer condition direct radiation loading for streams without a vegetated buffer to summer condition direct radiation loading for streams with vegetated buffers. The model used direct normal radiation data recorded for the Portland region through the National Solar Radiation Database (1961-1990). Stream loading ratios were developed as a function of stream orientation, slope angles and buffer widths. The effect of opposite bank vegetation on the stream loading ratios was also considered.

Results of the literature review and the PHS model provided similar conclusions in terms of minimum necessary buffers and optimal extents of vegetated buffers, when looking specifically at the impacts of buffers on stream temperatures. (It should be noted that there are multiple natural resource functions dependent on healthy vegetated riparian areas; the extent of buffer area needed to support those functions were not considered in this stream temperature-specific effort).

The literature review supported the conclusion that to realize direct shade through installation of system potential vegetation, a minimum of 35 feet of vegetated buffer was needed. Increasing the buffer widths from 35 to 55 feet resulted in significant increases in direct shade on the stream, and little additional benefit was realized from planting buffer vegetation beyond some distance dependent on stream azimuth and bank slope. This is consistent with the results one regional modeling expert found in manipulating variables within the Shade-A-Lator model—he found that 98% of the direct shade benefit that can be gained comes from planting the first 50 feet of riparian planting (when results are averaged across all variations for stream orientation, surrounding slope, maturity and density of vegetation, and stream sizes).

Recent research completed out of the Oregon Department of Forestry in conjunction with researchers from Oregon State University found that the microclimate of a riparian forest is as important in moderating stream temperatures on hot summer days. Under the canopy, the air temperature is lower during the day (though higher at night) and the relative humidity is higher, protecting stream temperatures from high temperatures outside the canopy. Researchers found a microclimate preservation benefit of buffers between 0 and 100 meters perpendicular from the stream edge. Several studies showed that the first 10 meter of buffer is of critical importance in maintaining that beneficial effect of microclimate on streams.

Given the direct shade and microclimate benefits within the first 35 feet of buffer, the Fairview TMDL team chose this as the minimum buffer width that would be used as the goal for planting.

III. ANALYSIS OF EXISTING SHADE ALONG FAIRVIEW'S STREAMS

A. Overview of Fairview's Watersheds

The City of Fairview spans watersheds of four main streams. The streams are Fairview Creek, Osburn Creek, No Name Creek, and Salmon Creek. Clear Creek, a short tributary of Fairview Creek, is also within the Fairview City limits. Fairview Creek, Osburn Creek and No Name Creek flow into Fairview Lake, which then flows into the Columbia Slough. The Columbia Slough flows to the Willamette River, making all streams flowing into it subject to DEQ's temperature TMDL requirements. Salmon Creek flows to the Columbia River, and thus, is not subject to the temperature TMDL requirements. Brief descriptions of each of these stream systems and the existing conditions within the riparian corridors associated with them are provided below. Figure 1 shows the location of streams within the City of Fairview. All Figures are in Appendix A.

1. Fairview Creek

Fairview Creek originates to the south of the City of Fairview in the City of Gresham. Fairview Creek enters the City of Fairview from the Fujitsu Ponds via a culvert under Glisan Street. Fairview Creek flows generally north and east, and then northward and northwestward through the City, before flowing into the eastern end of Fairview Lake. Much of Fairview Creek is bordered by residential and commercial development, though relatively long segments of the stream, particularly in the southern portion of the City, are bordered by undeveloped forested buffers.

2. Osburn Creek

Osburn Creek is located in the west-central portion of the City of Fairview. Osburn Creek originates as two small streams that flow together in the northwest quadrant of the Interstate 84/ Fairview Parkway Interchange. Osburn Creek flows generally northward through areas of residential, commercial and industrial development before flowing into Fairview Lake. Silent Creek, a short tributary of Osburn Creek, is present northeast of the Interstate 84/Fairview Parkway Interchange.

3. No Name Creek

No Name Creek is a tributary of Fairview Creek located in the east-central portion of the City of Fairview. No Name Creek originates in the City of Wood Village near the eastern limits of the City of Fairview. From there, No Name Creek flows northward through a residential area, under Interstate 84, and through an industrial area before flowing into Fairview Creek to the northeast of the NE Sandy Boulevard/NE 223rd Avenue intersection. While much of the stream is within residential and industrial areas, a portion of No Name Creek between NE Halsey Road and Interstate 84 is bordered by an undisturbed forested buffer.

A series of ditches parallels the south side of NE Halsey Street from just west of NE 227th Avenue eastward beyond the City limits. These ditches contain a stream that directs low flows to the east, into No Name Creek, and redirects high flows into Fairview Creek. This stream is bordered to the north by NE Halsey Street and to the south by industrial buildings and undeveloped fields with scattered trees growing along the ditch.

4. Clear Creek

Clear Creek is a tributary to Fairview Creek located in the southeastern portion of the City of Fairview. Clear Creek originates outside of the City limits in the City of Gresham. Clear Creek flows through a culvert under Glisan Street and then generally northward through a residential neighborhood and then into Fairview Creek northeast of the intersection of NE Market Drive and NE Clear Creek Way. A narrow wooded buffer is present along Clear Creek within this residential neighborhood.

5. Salmon Creek

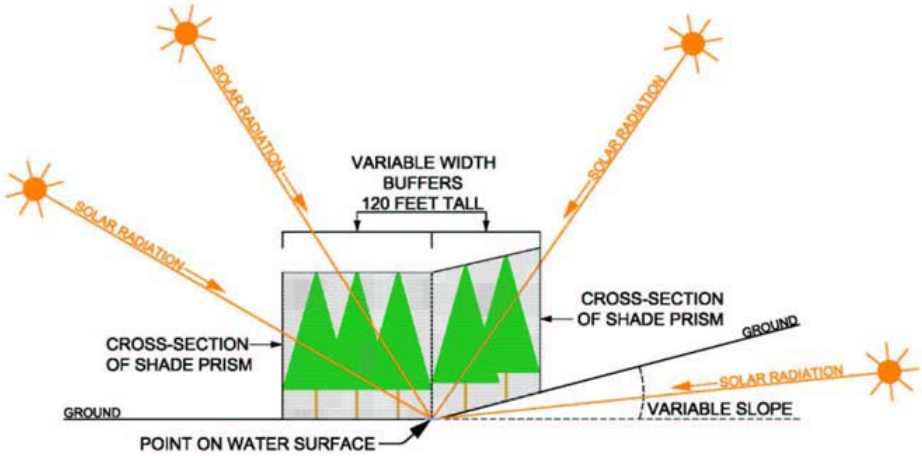
Salmon Creek is located within the northeastern portion of the City of Fairview. Salmon Creek originates within the City of Troutdale to the east of the City of Fairview. Within the City of Fairview, the Salmon Creek system consists of a series of channelized ditches and sloughs managed by the Sandy Drainage District, with water levels maintained by a series of pump stations that pump water from the sloughs and ditches to the Columbia River. The outflow channel from Blue Lake carries water from Blue Lake, north and east through the eastern portion of Blue Lake Park, and under NE 223rd Avenue to one of these pump stations located north of Marine Drive. Because the Salmon Creek system drains to the Columbia River, it is not subject to the TMDL requirements of the other streams within the City of Fairview, and thus, is not considered further in this analysis.

6. Unnamed Streams East of NE 223rd Avenue and North of the Railroad

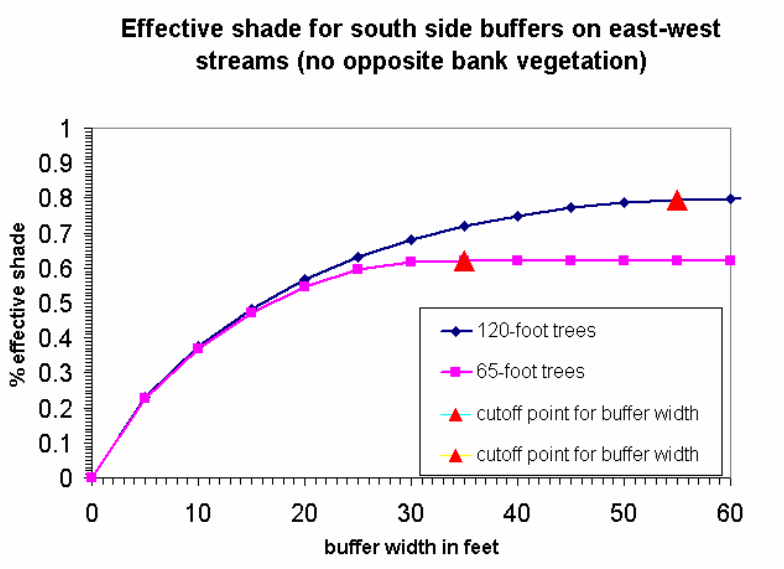
Several unnamed stream channels are present in the northeastern portion of the City of Fairview, east of NE 223rd Avenue and north of the railroad tracks. This system consists of two channels that originate in the City of Troutdale, east of the City limits and south of NE Marine Drive. These channels are generally parallel and are located in an area that consists largely of undeveloped forest and fields. A dike on the east side of NE 223rd Avenue impounds water in this area and prevents these streams from flowing into Fairview Lake. Because these streams do not flow to Fairview Lake, they are not subject to the TMDL requirements, and thus, are not considered further in this analysis.

B. Modeling Buffer Sizes for Fairview Streams

Pacific Habitat Services used a national database that provides direct solar radiation readings taken at stations scattered throughout Oregon. Data is generally available for the time period 1961 to 1990. These data were modeled and used in conjunction with meteorological data recorded at or near airports to generate a database for the years 1991 to 2005. The data for this period were inverse-distance weighted from the Troutdale airport and the Portland airport for the geographic center of the study area. Fairview Creek, Osburn Creek, No Name Creek, their tributaries, and other streams that drain to Fairview Lake were divided into reaches defined by changes in stream orientation. Within each resulting reach, the riparian zone was modeled as two prisms, with the dimensions of the prisms defined by a fixed tree height of 120 feet and a fixed slope away from the stream surface.



The fixed tree height of 120 feet was chosen as representative of the average system potential vegetation tree height for the Portland basin eco-region. Direct shade benefit was determined along each stream reach by comparing the riparian areas with and without vegetation using the sum of the July solar radiation taken from the database. The results were a function of stream aspect, slope angles, buffer width, tree height, and presence of opposite bank vegetation. Curves were generated that demonstrated the functional shade benefit realized as the extent of vegetation was extended from a buffer width of 5 feet to the width where a 5-foot increase in width produced less than a 1 percent increase in effective shade.



Regardless of slope, stream orientation, or presence of opposite bank vegetation, there was a similar diminishing shade benefit as the vegetative buffer width was extended perpendicularly from the edge of bank. Changes in stream orientation had the greatest impact on varying this point of diminishing returns, whereas changes in slope (with other factors remaining equal) had a negligible impact on the buffer width.

According to the model, there was a significant increase in effective shade when the opposite bank was vegetated. (Some of the daily solar radiation occurs when the sun is shining at low angles through the vegetation on the north bank). This supported the decision to set a goal of a minimum 35-foot buffer along all stream segments.

GIS technicians established a variable-width buffer along all modeled streams by creating an attribute table of buffer widths developed using the minimum buffer width of 35 feet, and the maximum buffer width appropriate for specific stream orientations. This methodology was applied to all streams subject to the temperature TMDL requirements, and from this, the "functional shade buffer", the riparian area where system potential vegetation plantings will have the most effect on reducing stream temperatures, was generated. Based on the results of PHS's model, the limits of the functional shade buffer extend 35 to 75 feet from the stream, and approximately 56.8 acres of land are within the functional shade buffer. The area of functional shade buffer along each of Fairview's stream systems is summarized in Table 1.

Table 1. Area of Functional Shade Buffer Along Each Stream System

Stream System	Area (acres)
Fairview Creek	32.1
Osburn Creek	11.3
No Name Creek	11.4
Clear Creek	2.0
Total	**56.8**

C. Mapping Existing Shade along Fairview's Streams

PHS inventoried the existing shade conditions along Fairview's streams by assessing existing tree cover within the functional shade buffers (FSB). Tree cover within the functional shade buffer was divided into three categories:

Category 1) tree cover <25%;
Category 2) tree cover = 25-75%; and
Category 3) tree cover >75%.

PHS overlaid the functional shade buffer boundaries onto digital aerial photography to evaluate percent cover by trees and identify contiguous segments of each shade category. Based on this evaluation and using AutoCAD, PHS mapped contiguous segments of each shade category within the functional shade buffer along each side of the stream. While mapping using aerial photographs, PHS identified areas to verify in the field, and then visited representative stream reaches to verify the accuracy of the shade category mapping and adjusted the shade mapping as necessary. The AutoCAD layers were then converted into shapefiles to be imported into the City's GIS.

Figure 2 shows each of the three shade categories within the functional shade buffers associated with Fairview's streams. Table 2 summarizes the relative proportion of each shade category within each watershed.

Table 2. Area of Land within each Shade Category

Stream System	Category 1		Category 2		Category 3	
	Acres	Percent of FSB	Acres	Percent of FSB	Acres	Percent of FSB
Osburn Creek	2.1	18.6	5.1	45.1	4.1	36.3
Fairview Creek	7.3	22.8	11.9	37.0	12.9	40.1
No name Creek	6.2	54.4	4.4	38.6	0.8	7.0
Clear Creek	0	0	1.2	61.5	0.8	38.5
Total:	**15.6**	**27.5**	**22.6**	**39.8**	**18.6**	**32.7**

D. Defining Fairview's System Potential Vegetation

General planting plans with specified plant communities were developed to ensure system potential vegetation is the target community installed when riparian planting is conducted by private homeowners, developers mitigating riparian impacts, utility maintenance staff, community volunteer groups, and others. As a starting point, the soil series within the functional shade buffer, as mapped by the Multnomah County Soil Survey, were identified. Table 3 lists the soil series mapped within the functional shade buffer.

Table 3. Soil Series Mapped within the Functional Shade Buffer

Soil Symbol	Soil Series
1A	Aloha silt loam, 0 to 3 percent slopes
25A	Latourell loam, 0 to 3 percent slopes
26A	Latourell – Urban Land Complex, 0 to 3 percent slopes
36C	Quafeno loam, 8 to 15 percent slopes
37B	Quatama silt loam, 3 to 8 percent slopes
40	Rafton silt loam, protected
46	Sauvie silty clay loam, protected
54B	Urban Land – Quatama Complex, 3 to 8 percent slopes
57	Wollent silt loam

Once the soil series within the functional shade buffers were identified, soil series were grouped according to similarity of soil type and landscape position, and plant species appropriate for planting within each soil series were identified. From this plant list recommended plant communities appropriate to the soil type and consistent with the guidelines for system potential vegetation were developed. Each planned plant community contains trees and shrubs that, when established, will provide a full multi-story community. Table 4 lists the tree and shrub species recommended for planting within each soil type.

Due to the large scale of the soils mapping, however, local conditions related to slope, topography and soil texture within any mapped soils unit may result in moisture conditions that differ significantly from those typically associated with the mapped soils. Consequently, the recommended plant communities for the mapped soil classification may not be appropriate on a particular site (or a portion of the site) due to the local site conditions. Therefore, the recommended plant communities (Table 4) were also related to soil moisture and landscape position so that those installing riparian plantings can select plant communities appropriate for their local site conditions. For example, if a particular site has mapped Latourell soils, but portions of the site have low areas with soils that are moist or saturated year-round, it may be appropriate to select plants from the moist riparian or wetland lists for planting in those wet areas, rather the plants typical for dry riparian conditions typically associated with Latourell soils.

Table 4. Recommended Tree and Shrub Species for Planting within Riparian Shade Zone

Site Conditions	Typical Soil Series	Recommended Plant Community	
		Trees	Shrubs
Floodplain and Wetlands	Rafton Sauvie Wollent	Black cottonwood Pacific willow Red alder Oregon ash Western red cedar	Douglas spiraea Pacific ninebark Red-osier dogwood Snowberry Twinberry Wild rose Willow
Moist Riparian	Aloha	Bigleaf maple Black cottonwood Grand fir Red alder Western red cedar	Bitter cherry Douglas hawthorn Hazelnut Indian plum Oregon grape Red elderberry Salal Salmonberry Snowberry Thimbleberry Vine maple
Dry Riparian	Latourell Quafeno Quatama	Bigleaf maple Douglas fir Oregon white oak	Hazelnut Indian plum Oceanspray Oregon grape Salal Snowberry Vine maple

To ensure the successful establishment of system potential vegetation and to achieve the target of 97 percent shade along the City's streams, we recommend planting densities and spacing of trees and shrubs established in Clean Water Services' Design and Construction Standards for Sanitary Sewer and Surface Water Management (June 2007).

Based on this standard, 436 trees and 2,178 shrubs would be planted per acre of functional shade buffer where no trees and shrubs currently exist. In areas where some trees and shrubs exist within the functional shade buffer but where supplemental plantings are necessary to increase shade cover, the number of tree and shrub plantings would be adjusted, based on the existing percent canopy coverage, as illustrated in Table 5. For example, if a functional shade buffer has an approximate 30 percent canopy cover (and therefore, 70 percent of the area does not have tree canopy coverage), a planting density of 305 trees (436 x 0.70, where 436 is the maximum number of planted trees and 0.70 is the approximate percent of the area lacking a canopy provided by woody vegetation) and 1,525 shrubs (2,178 x 0.70, where 2,178 is the maximum number of planted shrubs and 0.70 is the approximate percent of the area lacking a canopy provided by woody vegetation) would be planted per acre. Shrub plantings are recommended only in the portion of the buffer within 10 feet of the stream banks in Shade Categories 1 and 2. Fast-growing shrubs will provide shade benefits to streams much more quickly than trees, which typically grow more slowly than shrubs. Supplemental shrub plantings are not required in areas of Shade Category 3.

Table 5. Recommended Planting Densities[1]

Shade Category	Planting Densities[2] (plants per acre)	
	Trees	Shrubs[3]
1 (< 25% shade)	327 - 436	1,634 – 2,178
2 (25 to 75% shade)	110 - 326	545 – 1,633
3 (>75 % shade)	0 - 109	n/a

Notes:

1. Recommended densities based on planting requirements specified by Clean Water Services' Design and Construction Standards for Sanitary Sewer and Surface Water Management (June 2007), which requires a planting density of 436 trees and 2,178 shrubs per acre.
2. Actual planting densities will vary depending on existing percent canopy coverage within the buffer.
3. Shrub plantings recommended only in the portion of the buffer within 10 feet of the stream banks in Shade Categories 1 and 2. Fast-growing shrubs will provide shade benefits to streams much more quickly than trees, which typically grow more slowly than shrubs.

Following planting, regular maintenance should be performed to maximize the rate of plant survival. All sites should be regularly inspected for the presence of invasive, non-native species, such as English ivy and Himalayan blackberry, which can out-compete desirable native trees and shrubs. Appropriate control measures should be undertaken, as necessary, to control the spread of the invasive species. It is anticipated that over time, as the native trees and shrubs become established, the frequency of such maintenance activities will decrease.

IV. MANAGEMENT STRATEGIES TO ACHIEVE SYSTEM POTENTIAL VEGETATION

Management to achieve system potential vegetation includes the protection of existing shade along the City's streams as well as planting within the riparian shade zone.

A. Protection of Existing Shade

Because areas of existing shade-producing vegetation already exist along some stream reaches within the City, the City will work to protect existing vegetation in addition to increasing shade of the City's streams. For new development, protection of existing shade and planting of new shade can be made a requirement of new construction. Existing shade is protected within portions of the functional shade buffer on private properties through regulations already in place. Section 19.106.030 of the Fairview Municipal Code establishes a riparian buffer that includes the land within 50 feet of the top of bank (or from the mean high water where no distinctive bank can be determined) of the Columbia River, Fairview Creek, Osburn Creek, Clear Creek, No Name Creek, Salmon Creek and Columbia Slough. The purpose of the riparian buffer is to preserve, to the maximum extent possible, riparian vegetation within the riparian buffer. Trimming of vegetation to alleviate a hazard is allowed. The clearing of riparian vegetation or removal of any native tree with a diameter of six inches or greater at four feet above grade within the buffer, as specified in the Code, is allowed only after a permit has been granted. Replacement vegetation must be riparian species as approved in the permit. Removing existing vegetation does not apply to noxious weeds. This regulation assists in protecting existing shade along streams within the City.

B. Planting to Increase System Potential Vegetation

After the protection of existing shade-producing vegetation, the planting of new vegetation along the City's streams will be the next step in increasing shade along the City's streams and reaching system potential vegetation. Because of the potential ease of access, sites already under public ownership will be the top priority for focusing planting efforts. Such sites are likely easily available for immediate planting and offer excellent opportunities to demonstrate effective shade planting to the public. Publicly owned sites, with low existing shade (i.e., Shade Category 1) will take priority over sites with moderate to high levels of existing stream shading (i.e., Shade Categories 2 and 3). Figure 3 depicts areas of publicly owned lands within the functional shade buffers as well as the mapped shade categories within the buffers.

Planting of new shade-producing vegetation on private properties is more challenging and is limited to the property owners' willingness to participate. A two-pronged approach is recommended to encourage and recruit private property owners to plant the stream buffers on their properties to achieve system potential vegetation. The components of this approach would include 1) public education to identify the benefits and necessity of shading streams, and, 2) development of an incentive package for property owners to plant trees and shrubs within the stream buffers on their properties. Fairview will provide education to the public, in the form of ongoing programs, to describe the benefits and the need for shade. Media for public education include the City's newsletter, the City website and handouts and presentations at community events. In exchange for requiring property owners to provide long-term maintenance for newly planted vegetation, the City could consider providing technical assistance for the planting design and implementation and the acquisition of planting materials. Property owners could be required to water the vegetation until the planted trees and shrubs are established and to replace vegetation, as necessary.

C. Identification of Constraints to Planting

It is recognized that numerous constraints that prohibit the establishment of system potential vegetation exist throughout the functional shade buffers. Constraints to the establishment of system potential vegetation were identified and broken into two types: hard constraints (areas that logistically cannot be planted) and soft constraints (areas where plant communities other than system potential vegetation communities are more appropriate). Hard constraints within the functional shade buffer include utility corridors (e.g., gas, water, stormwater, and sanitary sewer corridors), transportation corridors (including future right-of-ways and setbacks for visual site distance), established trails, building footprints, and paved areas. Soft constraints include areas where, due to habitat, safety, or human use considerations, system potential vegetation cannot be installed but other plant communities would be appropriate. Examples of soft constraints include wetlands, constructed water quality facilities, power line easements (due to height restrictions), and developed park areas. Constraints were mapped and subtracted from the functional shade buffer to identify the potential plantable area. This plantable area was called the riparian shade zone. Figure 4 depicts the constraints to planting within the functional shade buffer as well as the area of each mapped shade category within the remaining plantable riparian shade zone. Table 6 summarizes the area of the riparian shade zone along each stream system.

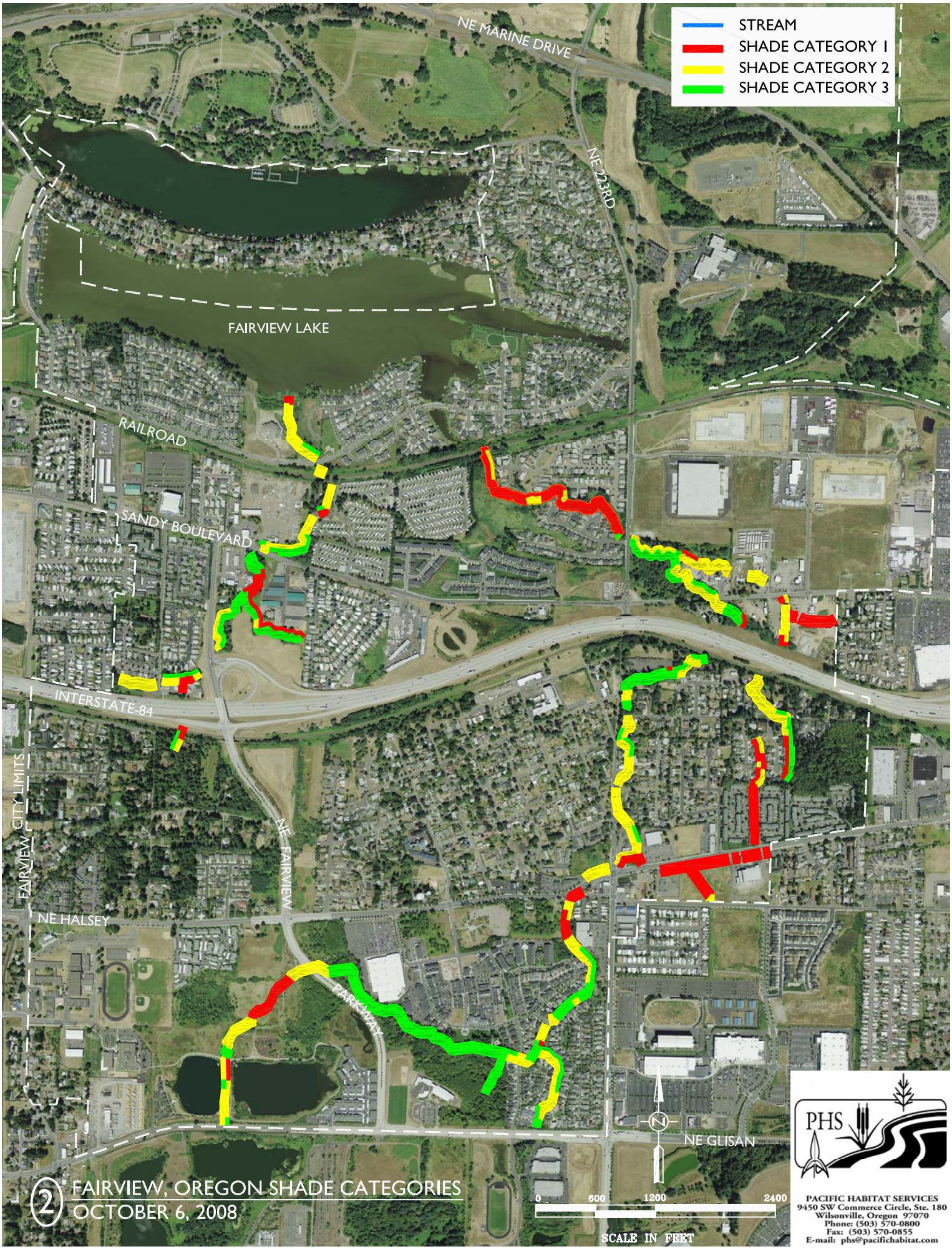
Table 6. Riparian Shade Zone Area within each Stream System

Stream System	Area (acres)	Percent of FSB
Fairview Creek	14.8	46.1
Osburn Creek	7.0	61.9
No Name Creek	6.6	57.9
Clear Creek	0.9	45.0
Total:	**29.3**	**51.6**

Throughout the City, approximately half of the functional shade buffer contained constraints to installing system potential vegetation; of the initial 56.8 acres in the functional shade buffer, a total of 27.5 acres of constraints were identified, leaving 29.3 acres of plantable riparian shade zone.

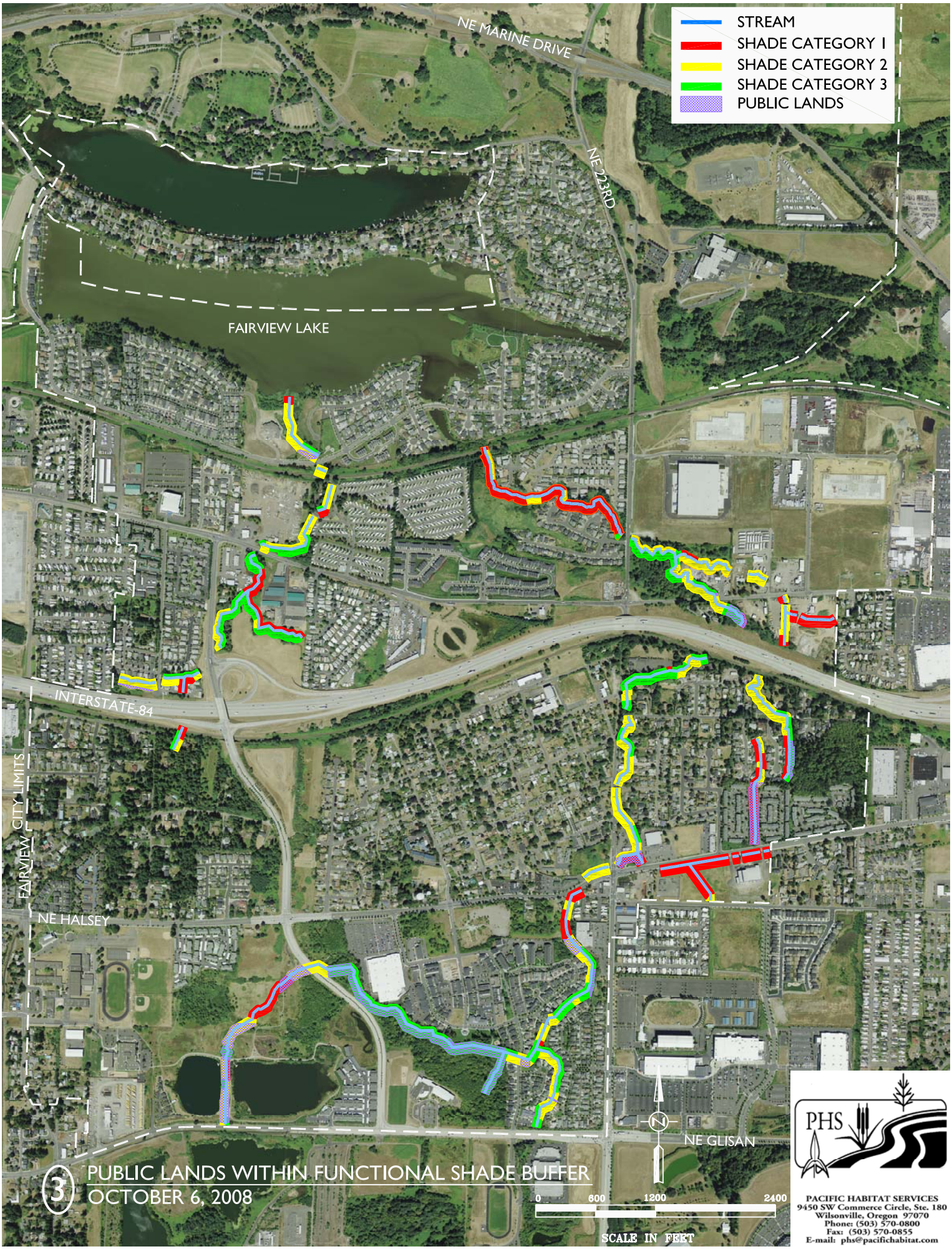
OVERVIEW OF FAIRVIEW, OREGON STREAMS
OCTOBER 6, 2008

PHS
PACIFIC HABITAT SERVICES
9450 SW Commerce Circle, Ste. 180
Wilsonville, Oregon 97070
Phone: (503) 570-0800
Fax: (503) 570-0855
E-mail: phs@pacifichabitat.com



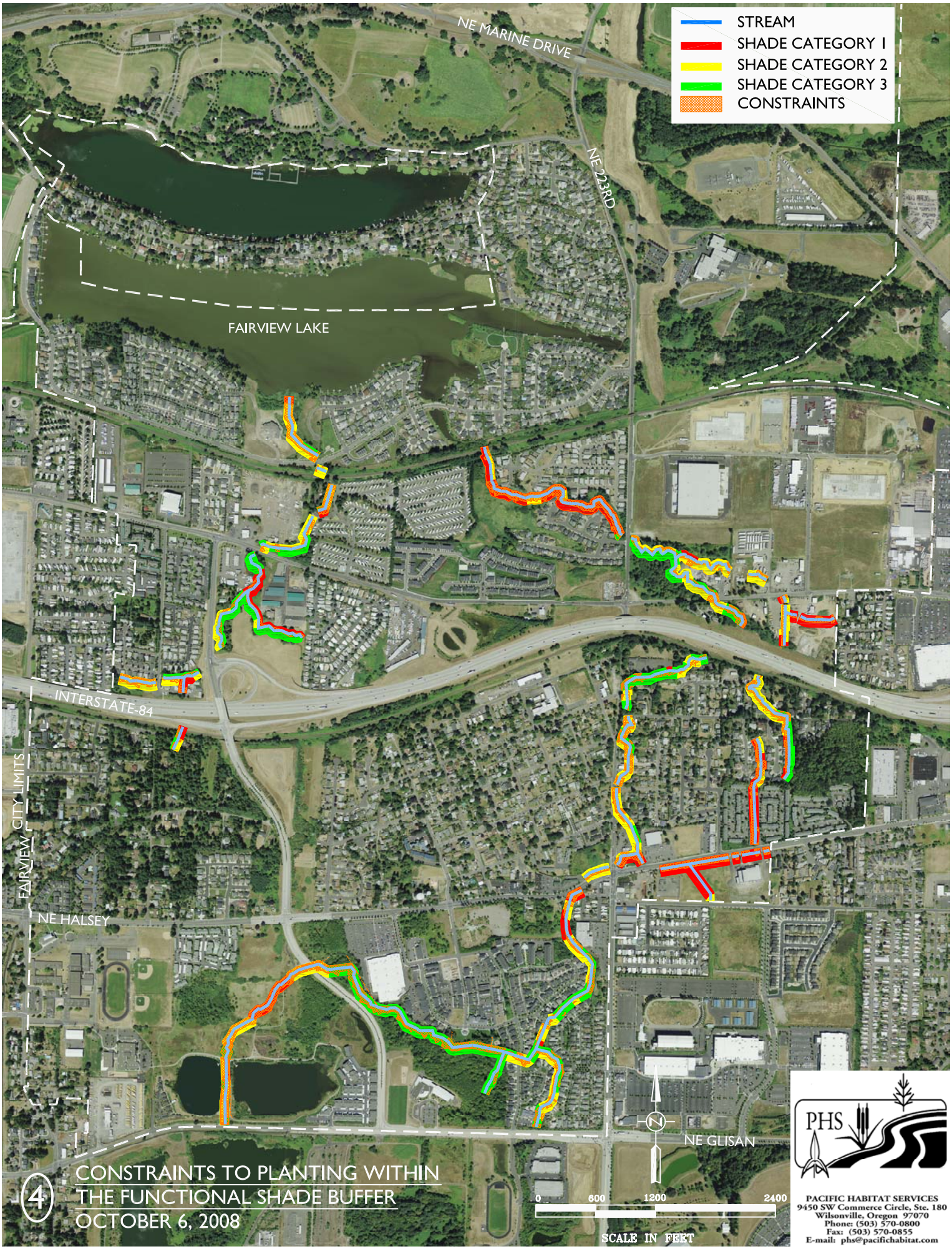
2 FAIRVIEW, OREGON SHADE CATEGORIES
OCTOBER 6, 2008

PACIFIC HABITAT SERVICES
9450 SW Commerce Circle, Ste. 180
Wilsonville, Oregon 97070
Phone: (503) 570-0800
Fax: (503) 570-0855
E-mail: phs@pacifichabitat.com



3 PUBLIC LANDS WITHIN FUNCTIONAL SHADE BUFFER
OCTOBER 6, 2008

PHS
PACIFIC HABITAT SERVICES
9450 SW Commerce Circle, Ste. 180
Wilsonville, Oregon 97070
Phone: (503) 570-0800
Fax: (503) 570-0855
E-mail: phs@pacifichabitat.com



4 CONSTRAINTS TO PLANTING WITHIN THE FUNCTIONAL SHADE BUFFER
OCTOBER 6, 2008

PHS
PACIFIC HABITAT SERVICES
9450 SW Commerce Circle, Ste. 180
Wilsonville, Oregon 97070
Phone: (503) 570-0800
Fax: (503) 570-0855
E-mail: phs@pacifichabitat.com