Multnomah County NPDES MS4 Phase I Permit
Stormwater Management Program

# Stormwater Retrofit Strategy

**Submitted to:**
*Oregon Department of Environmental Quality*
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*Submitted in Accordance with the Requirements*
*of the National Pollutant Discharge Elimination System*
*(NPDES) Permit Number 103004, File Number 120542*

**Submitted by:**
*Water Quality Program*
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## I. Introduction

Multnomah County manages stormwater runoff under a National Pollutant Discharge Elimination System Municipal Separate Stormwater System Phase I Permit (NPDES MS4 Phase I). One of the requirements of the permit includes developing a strategy for retrofit projects and improvements to existing stormwater infrastructure to reduce pollutants to the maximum extent practicable. This requirement is outlined in Schedule A.6 of the NPDES permit issued December 30, 2010.

Multnomah County is a unique jurisdiction with NPDES permit areas composed of several discrete urban pockets and road right-of-ways. Multnomah County's jurisdiction contains diverse topographic features, stormwater drainage systems, and roadway infrastructure that require consideration for development of the stormwater retrofit strategy.

The purpose of this document is to outline the strategy for improving water quality within Multnomah County's NPDES Permit Areas by providing stormwater treatment for existing impervious area within the County's right-of-way that lack stormwater quality controls. The NPDES Permit Areas are comprised of unincorporated urban pockets along the County's borders, and arterial roadways in Fairview, Troutdale, and Wood Village (See Appendix for County Permit Area Maps).

The goal of this strategy is to provide planning level estimates of preferred stormwater quality BMPs in high priority areas within the NPDES permit area: the urban roadways within the cities of Troutdale, Wood Village and Fairview (without existing stormwater treatment). These retrofits typically will be installed opportunistically, by integrating stormwater treatment into the design of major capital projects targeted for construction within the County's Capital Improvement Program.

The stormwater retrofit strategy includes the following elements:

- Summary of current stormwater retrofit measures and resources
- Identification of pollutants of concern
- Development of BMP selection criteria
- Characterization of permit areas and identification of preferred stormwater BMPs
- Priority project list and cost estimate

## II. Current Stormwater Retrofit Measures and Resources

The County incorporates stormwater treatment into capital roadway projects for water quality treatment, runoff volume reduction and flood control. During the previous ten years, the County has designed and constructed infiltration trenches, vegetated infiltration areas, and stormfilter vaults associated with capital projects, and previously the use of drywells (underground injection devices) was common. The design of stormwater treatment on arterial roadways has several challenges including limited right of way area, multi-modal transportation needs, and road wear from high traffic.

The County Road Services Division receives funding from the State Highway Trust Fund, which fluctuates depending on the state of the economy. Highway Trust Funds, which are constitutionally dedicated to

road related issues, includes the State gasoline tax, weight/mile tax on trucks, and vehicle registration fees. The County has no revenue from dedicated stormwater fees. This is a result of the County roads and unincorporated pockets being nested within other city jurisdiction's service areas.

## III. Pollutants of Concern

In developing the stormwater retrofit strategy, the targeted pollutants must be identified in order to determine potential BMPs that will reduce the Total Maximum Daily Load (TMDL) pollutants in tributaries and rivers within the permit area. Table 1 identifies the drainage basins within the NPDES permit areas and lists the pollutants of concern for those basins as outlined in the Multnomah County 2014 TMDL Implementation Plan for the Tualatin, Lower Willamette and Sandy River Basins (See Appendix for TMDL Watershed Map).

**Description of Pollutants of Concern:**

- **Bacteria:** Bacteria, namely E. coli, are an indicator of pathogens in water that can cause gastrointestinal illness through recreational contact and consumption. Stormwater runoff transports fecal waste containing bacteria and other pathogens to water-bodies; therefore, removal of stormwater volume by infiltration or retention decreases bacterial counts in waterways.

- **Metals:** Lead and mercury bio-accumulate in wildlife and consumption poses a severe health risk to the public. Mercury is a naturally occurring element in native soils and can be transported by sediments in stormwater. Commercial, industrial and traffic corridors are the largest contributors of lead in the stormwater. Proprietary filtration systems can reduce heavy metals in stormwater. Plants within stormwater facilities can also trap metals and prevent them from entering waterways. Filtration or separation of metals can be accomplished through removing contaminated sediments, or precipitating dissolved materials in stormwater.

- **Nutrients:** Nutrients, including nitrogen and phosphorus, contained within agricultural and residential fertilizers can harm tributary plants and wildlife. Stormwater runoff is a major contributor of nutrients and organic matter to water bodies. Reducing total suspended solids (TSS) and dissolved nutrients are important to maintaining healthy dissolved oxygen and pH concentrations. Fertilizers in sediment-laden stormwater runoff can spur algal blooms, which can cause crashes in dissolved oxygen (DO) for aquatic wildlife. Removal of nutrients can be accomplished through bio-retention in vegetated swales, planters and ponds. Proprietary filtration units are also effective.

  ***Nutrients as indicators of DO, chlorophyll A, pH***:* Dissolved oxygen, chlorophyll, and pH are apex indicators of waterway health. The levels of all three factors must be balanced correctly to support aquatic wildlife and plants. As apex indicators, they are heavily influenced by other contributing factors such as, nitrogen, phosphorous, calcium and other minerals. Stormwater quality BMPs target and reduce nutrients which directly affect dissolved oxygen, chlorophyll, and pH.

**Table 1: Pollutants of Concern for NPDES Permit Areas**

| Permit Area Name | Drainage Basin | Sub-Basin | Water Bodies | Pollutants of Concern |
|---|---|---|---|---|
| NW Portland – Unincorporated Pocket Area (Skyline Blvd) | *Tualatin* | *Rock Creek* | Bronson Creek<br>Beaverton Creek<br>Rock Creek | Temperature, Bacteria, DO, pH, chlorophyll, (nitrogen and phosphorus) |
| SW Portland – Unincorporated Pocket Area (Dunthorpe) | *L. Willamette* | **Tryon Creek*<br>*L. Willamette* | *Tryon Creek<br>Willamette River | Temperature,<br>Metals (Mercury) |
| SW Portland – Unincorporated Pocket Area (Scholls Ferry Rd, Patton Rd) | *Tualatin* | **Fanno Creek*<br>*L. Willamette* | *Fanno Creek<br>Beaverton Creek | Temperature, Bacteria, DO, pH, Chlorophyll, (nitrogen and phosphorus) |
| Interlachen Residential Area | *L. Willamette* | *Columbia Slough* | Columbia Slough | Metals (Lead, Mercury), Organic Toxins (DDT, PCB, 2,3,7,8 TCDD),<br>DO, pH, Chlorophyll |
| | *L. Willamette* | *Fairview Creek* | Fairview Creek | Temperature, Bacteria |
| Arterial Roadways in Wood Village, Fairview, and Troutdale | *L. Willamette* | *Columbia Slough* | Columbia Slough | Metals (Lead, Mercury), Organic Toxins (DDT, PCB, 2,3,7,8 TCDD), DO, pH, Chlorophyll |
| | *L. Willamette* | *Fairview Creek* | Fairview Creek | Temperature, Bacteria |
| | *Sandy* | *Beaver Creek* | Beaver Creek | Temperature, Bacteria |
| | *Sandy* | *Sandy River* | Gordon Creek | Temperature, Bacteria |
| SE Portland – Unincorporated Pocket Area (Between Portland and Gresham) | *L. Willamette* | *Johnson Creek* | Johnson Creek | Temperature, Metals (Mercury), Bacteria, DDT |

*References: 1, 2, 3, 4, 5*

*Areas are covered by intergovernmental agreements with other jurisdictions

- **Organic Toxins:** Pesticides applied to agricultural and residential areas bind to soil particles and are transported in stormwater runoff. Legacy contaminants such as DDT, 2,3,7,8 TCDD (tetrachloro-dibenzodioxin), Dieldrin, and PCBs linger in areas and breakdown into fat soluble hydrocarbons. These components can be found in soil and stormwater runoff leading to environmental harm through the accumulation of the toxins in fish and wildlife and can potentially lead to human health risks. Through filtration and sediment removal, pesticides can be reduced within stormwater runoff. Removal of pesticides can also be accomplished through bio-retention in vegetated swales, planters and ponds. Proprietary filtration units are also effective. Collection of these hydrocarbons in isolated facilities prevents them from causing harm to the public and other organisms within waterway ecosystems.

- **Temperature:** Temperature is considered to be a non-point source pollutant and is not associated with urban stormwater runoff. Temperature is regulated under the County's TMDL Implementation Plan and not under its NPDES stormwater permit.

- **Volume:** BMPs that provide a reduction in the volume of stormwater runoff discharged to streams are important in minimizing stormwater hydromodification impacts. Stormwater BMPs that can provide both water quality and volume reduction objectives are preferred.

## IV. Description of Stormwater BMP Facilities

Stormwater BMP facilities can be divided into two categories, vegetated and non-vegetated. Non-vegetated facilities remove pollutants through physical mechanisms, such as filters, sumps, and separators. The preferred BMPs use vegetation that allow for stormwater to be filtered through plants and soil media and then infiltrated rather than being conveyed through pipe systems to streams and rivers. These preferred BMPs provide flow reduction of stormwater from the site that reduces pollutants.

### Vegetated Facilities

- **Vegetated Swale:** Comprised of long vegetated depressions, swales slow runoff and provide opportunities for the sorption and sedimentation of pollutants through vegetation and soils. Swales allow for some infiltration but typically are designed to overflow into drainage systems and not be a method of disposal unless connected to a sub-grade rock gallery. Swales have gradual side slopes that require a larger facility area than planters but they are easier to maintain, less expensive to construct, and can maintain a recoverable slope for vehicles along roadways.
- **Vegetated Planters (rain gardens; bio-retention cells):** Planters are similar to swales, but have concrete walls and are typically used in developed and urban areas where space for stormwater facilities is limited and vehicles are traveling at slower speeds. Planters can be designed to

maximize infiltration to reduce both the pollutant load and runoff volume. Additionally, planters provide a functional use of the traditional landscape strip.

- **Grass Filter Strip:** Filter strips are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips should be constructed on mild slopes (<6%) to maintain sheet flow of stormwater runoff. Filter strips require a large amount of area relative to the drainage area served, but are suitable for road runoff if it is not concentrated flow. Filter strips are moderately effective at removing pollutants from stormwater by slowing runoff velocities and filtering out sediments and pollutants. Filter strips are relatively inexpensive because road designs where this BMP is applicable would utilize the existing surrounding topography. Grass filter strips are not typically considered as an alternative for a retrofit in urban areas where right of way is limited and street edges are curbed.
- **Trees:** Trees facilitate increased infiltration in soils, take up nutrients and other dissolved materials, and provide shade when used in conjunction with a stormwater facility. Trees also reduce runoff volumes by capturing and storing rainfall in their canopy and releasing the water into the atmosphere. If properly planted, trees can also help to stabilize slopes, and reduce overall erosion.
- **Dry/Wet Detention Pond:** Detention of stormwater runoff in ponds provides an opportunity for sedimentation and sorption to soil and vegetation. Ponds require larger site areas and are typically used for regional facilities in open spaces such as parks, rather than along roadways.

**Non-Vegetated Facilities**

- **Infiltration (Drywells with pretreatment):** Infiltration of stormwater runoff can be accomplished through various facilities including surface facilities and subsurface facilities. Infiltration facilities prevent pollutants from entering waterways and storm sewer systems through direct runoff. Infiltration also reduces peak runoff flows to drainage ways. Drywells provide infiltration, sorption to soil and limited microbial treatment. Field testing of soils to determine infiltration rates would be necessary to determine if infiltration would be an effective BMP. Drywells should not be installed in groundwater protection areas, in areas of high groundwater or near wells. They also may require a BMP for pollutant removal and an Oregon Department of Environmental Quality Underground Injection Control Permit (DEQ UIC).
- **Proprietary Filtration Facility:** In lieu of utilizing vegetative facilities, a proprietary filter uses media cartridges (perlite, composted leaves) to remove pollutants. Suspended solids can be filtered from stormwater using in-flow screens and sumps. Proprietary Filtration facilities provide sedimentation and sorption to filter media. Tree integrated filtration systems utilize a stormwater inlet with a media filter and tree planted within the media. The tree is planted in an engineered media that filters stormwater runoff. In addition to reducing stormwater runoff volumes, tree integrated filtration systems reduce bacteria, nutrients, and metals in stormwater runoff. This BMP is most appropriate when space constraints are a consideration and these facilities may have a higher initial cost and typically require annual maintenance.
- **Proprietary Separation Facility:** Facilities include hydrodynamic separator manholes that have the capability to provide stormwater quality treatment for larger areas within a small facility

footprint. These facilities remove sediment and oil from the stormwater runoff. Captured sediment can be removed through annual maintenance with standard equipment.

- **Sedimentation Manhole:** Suspended solids can be removed from stormwater by installing sedimentation manholes. Particulate is settled out from the stormwater and captured at the bottom of the manhole. Coupled with oil control facilities, sedimentation manhole installations can effectively reduce pollutants within a drainage basin with a relatively small facility footprint.
- **Porous Pavement:** Pervious concrete or asphalt can be utilized in areas with high infiltration potential. In areas with low infiltration potential the porous pavement section would include additional rock for storage and an underdrain system which will increase initial costs. This BMP provides infiltration, sorption to soil and some microbial treatment, but requires frequent maintenance to remove sediment and maintain infiltration capacity. It would be an appropriate BMP for roadway projects that included widening, sidewalks, or bike paths.

## V. BMP Facility Selection Criteria

The most important selection criteria for an effective BMP is to identify the pollutant that is targeted for removal. Table 2 lists the BMPs that should be considered for retrofit projects and their effectiveness related to the identified pollutants. The effectiveness ratings in the table below are qualitative but are based on both quantitative and qualitative data available for BMP effectiveness.

**Table 2: BMP Effectiveness Related to Removing Pollutants of Concern from Waterways**

| Good = ● Fair = ○ Poor = - | **Pollutants of Concern** | | | | |
|---|---|---|---|---|---|
| **BMP Facility** | Bacteria | Metals | Nutrients | Organic Toxins | Volume |
| Infiltration (Drywell with pretreatment) | ● | ● | ● | ● | ● |
| Vegetated Swale | - | ● | ● | ● | ● |
| Vegetated Planter | - | ● | ● | ● | ● |
| Grass Filter Strip | ○ | ● | ● | ○ | ○ |
| Trees | - | - | - | - | ○ |
| Dry/Wet Detention Pond | ○ | ● | ● | ● | ○ |
| Porous Pavement | ○ | ● | ● | ● | ● |
| Proprietary Filtration Facility | ○ | ● | ● | ○ | - |
| Proprietary Separation Facility | ○ | ● | ● | ○ | - |
| Sedimentation Manhole | - | ● | ● | ○ | - |

*References: 6, 7, 8, 9.11*

Multnomah County's NPDES permit areas contain diverse topographic features and physical characteristics that should be considered when choosing a stormwater BMP. Table 3 lists the physical characteristics that should be considered when selecting a BMP.

### Table 3: BMP Site Suitability Considerations

| Factor = ● Non-Factor = x | **Physical Feature** | | | |
|---|---|---|---|---|
| **BMP Facility** | Slope | Facility Area | In Situ Infiltration Rate | Groundwater Depth |
| Infiltration (Drywell with pretreatment) | x | x | ● | ● |
| Vegetated Swale | ● | ● | ● | ● |
| Vegetated Planter | ● | ● | ● | ● |
| Grass Filter Strip | ● | ● | ● | x |
| Trees | x | ● | x | x |
| Dry/Wet Detention Pond | ● | ● | ● | ● |
| Porous Pavement | ● | x | ● | ● |
| Proprietary Filtration Facility | x | x | x | x |
| Proprietary Separation Facility | x | x | x | x |
| Sedimentation Manhole | x | x | x | x |

*References: 6, 7, 8, 9, 11*

**Description of Physical Features**

- **Slope:** A minimal slope for vegetated facilities allows for treatment and infiltration of runoff. In comparison, facilities with small facility footprints will be less affected by the existing slope. Slope is a factor a BMP if it can have an impact on construction and proper function.
- **Facility Area:** The area a stormwater facility occupies limits whether or not it can be installed within a proposed project. Vegetated swales, planters, and filters strips require a larger area than a compact manhole or proprietary system. Likewise, trees cannot exceed a certain size in order to meet sight distance requirements. Facilities with larger areas or height considerations have facility area as a factor.
- **In Situ Infiltration Rate:** Soil infiltration rates allow for stormwater runoff to be captured within facility soils. If a facility uses infiltration to reduce runoff volumes it has in situ infiltration rates as a factor.
- **Groundwater Depth:** Groundwater depth describes how close to ground surface the water table is located. Soils at or below groundwater depth are fully saturated, and will not be able to accommodate additional runoff volumes. If a facility is affected by the depth of ground water for proper function it has the criteria included as a factor.
- **Maintenance Frequency:** The rate at which facilities require maintenance in order to allow them to function properly is represented by either high or low frequency factors.

- **Reliability:** The reliability of a facility relates to its lifespan and structural integrity. Facilities, typically structures, with high durability are listed as having high reliability factors.
- **Specialized Equipment:** Certain facilities require special equipment, such as replacement filters in proprietary units in order to maintain them. High factored facilities require this equipment, where low factored facilities do not.
- **Annual Cost:** Annual cost considers all factors related to maintenance, and quantifies whether the cost to maintain a facility within a given year is high relative to other stormwater facilities. In general, facilities that require specialized equipment or frequent service will have higher annual costs for maintenance.

Table 4 describes the level of maintenance required for BMP facilities based on several criteria including: annual cost, frequency of maintenance, and if specialty equipment or materials are required.

### Table 4: BMP Facility Maintenance Considerations

| High = ● Low = - | **Maintenance Considerations** | | | |
|---|---|---|---|---|
| **BMP Facility** | Maintenance Frequency | Reliability | Specialized Equipment | Annual Cost |
| Infiltration (Drywell with pretreatment) | - | ● | - | - |
| Vegetated Swale | - | - | - | - |
| Vegetated Planter | - | - | - | - |
| Grass Filter Strip | - | - | - | - |
| Trees | - | ● | - | - |
| Dry/Wet Detention Pond | - | - | - | - |
| Porous Pavement | ● | - | - | ● |
| Proprietary Filtration Facility | ● | ● | ● | ● |
| Proprietary Separation Facility | ● | ● | ● | ● |
| Sedimentation Manhole | ● | ● | - | ● |

## VI. Permit Area Characterization and Suggested Stormwater BMP

Tables 1-3 previously highlighted the targeted pollutant BMP effectiveness related to site considerations. The following section outlines BMP compatibility in regards to each permit area's physical characteristics.

Refer to NPDES Permit Area Maps in the Appendix for additional information on permit areas.

- **NW and SW Portland Unincorporated Pocket Areas – Skyline/Dunthorpe/Scholls Ferry**
  - **Characterization:** The unincorporated areas along the County's border with Washington County are separated into three distinct areas that all share similar characteristics. The areas are located in the unincorporated pocket area, as described in the NPDES MS4

permit for Multnomah County. The roadways in these areas are two-lane roads with paved shoulders, drainage ditches, and limited storm sewer systems. The Dunthorpe area has lower volume roadways within an older residential area adjacent to the Willamette. The other two areas in NW and SW Portland include higher volume roadways. All three areas have soils with low infiltration and high runoff rates classified as hydrologic group C.

- **Suggested BMP:** Vegetated planters and swales are suitable BMPs within the area. However, swales have a maximum effective grade of approximately 6% and would be difficult to implement in steep areas. Roadways with mild slopes will be able to more cost effectively utilize swales. Due to the lack of storm sewer infrastructure in these areas, incorporating swales and planters into the existing road system is the most effective means of reducing pollutants, stormwater volume, and peak flow. Swales and planters provide pollution reduction for the targeted pollutants, and can be integrated into the existing roadway section. Other BMP facilities would require installation of storm sewer conveyance systems with the BMP.

- **Interlachen Residential Area**
  - **Characterization**: The Interlachen neighborhood is an unincorporated area that lies between Blue Lake and Fairview Lake, and is an older residential development. The area has mild slopes and is comprised mostly of hydrologic soil group C. Two-lane residential roadways with curb and gutter serve the area and existing storm sewer systems discharge to the lakes.
  - **Suggested BMP:** The Interlachen area is a developed residential area making large footprint facilities difficult to implement due to lack of facility area. The installation of smaller vegetated swales and planters would improve stormwater runoff water quality, but installation of proprietary systems would be more effective in mitigating pollutants in the area such as bacteria.

- **Arterial Roadways in Wood Village, Fairview and Troutdale**
  - **Characterization:** Multnomah County's jurisdiction includes twenty-eight miles of arterial roadways in the cities of Wood Village, Fairview, and Troutdale. The area is heavily developed with residential and commercial buildings. The area is fairly flat, with slopes generally being of minimal grade. Approximately 75% of the District is comprised of hydrologic soil group C, with low infiltration rates. Areas near creeks have increased infiltration rates and are categorized as hydrologic group B. The majority of this area is developed, and stormwater drains into a mixture of drainage ditches and storm sewers.
  - **Suggested BMP:** Due to the generally flat nature of the district and moderate infiltration potential, all stormwater facilities are appropriate in this area. The arterial roadways include storm sewers and catch basins, mixed with drainage ditches. Vegetated planters and proprietary filters/separators can be implemented in areas with storm sewers. Filter strips, swales, and other larger footprint facilities can be implemented in areas where drainage ditches are prevalent. Drywells with pretreatment are already utilized within

the district and their use could be expanded depending upon site specific infiltration rates. Street tree installations along areas where sidewalks are to be constructed would help to reduce stormwater volume and decrease temperature. Porous pavement could be utilized for bike paths and sidewalks where infiltration potential is moderate to high. Infiltration, filtration, bio-retention of pollutants via vegetated facilities are all options within the area, and can be combined in order to maximize pollutant removal.

- **SE Portland Unincorporated Pocket Areas**
  - **Characterization:** Three distinct pockets of unincorporated Multnomah County are located between the SE boundary of Portland and SW boundary of Gresham. This area drains into Johnson Creek and soil infiltration rates are mild to moderate. Roadway slopes are fairly flat. The majority of this area consists of roadways with paved shoulders and drainage ditches but some areas contain curb, sidewalk and storm systems.
  - **Suggested BMP:** Swales and planters along roadway improvements would effectively reduce TMDL pollutants for the Johnson Creek sub-basin. Infiltration is moderate in this area; therefore drywells with pretreatment could be utilized depending upon site specific infiltration rates. Street tree installations along areas where sidewalks are to be constructed would reduce stormwater volume and decrease temperature. Porous pavement could be utilized for bike paths and sidewalks where infiltration potential is moderate to high. Proprietary filters could be installed in areas with existing or proposed storm sewer systems in order to reduce bacteria, nutrients, and metals in runoff. Generally mild slopes in this area allow for a variety of BMPs.

## VII. Priority Project List and Cost Estimate

Key factors for selecting the priority areas and projects for retrofit in this Stormwater Retrofit Strategy include traffic volume, land use, and location. High traffic roadways in the County produce more pollutants and runoff volume than residential areas in the County. The road segments in Troutdale, Wood Village and Fairview are found in commercial, industrial and high density residential land uses. Although not all subbasins in the Troutdale, Wood Village, and Fairview Area have TMDLs, road segments at this planning level often cross watershed boundaries, and given the nature of the roadways and pollutant volumes, the County considered this as a single priority area.

Preferred BMPs were selected because of their effectiveness and applicability for site conditions as described in the above sections. Facility maintenance is a consideration both in the near term, as reflected in a life cycle cost. Although long term analysis is beyond the scope of this initial strategy discussion, these costs will be represented during design phase of each capital project.

The attached spreadsheet shows the arterial roadway segments within Wood Village, Fairview and Troutdale and planning level construction costs for preferred BMPs. The planning level cost estimates are based on the unit cost of the BMP multiplied by the project impervious area.

## VIII. Summary

This document identifies stormwater structural BMPs and their effectiveness in reducing pollutants of concern in stormwater runoff. The preferred BMPs are low impact development strategies that allow stormwater infiltration through vegetation and soil media and reduce discharge to streams and rivers. Infiltration facilities not only provide water quality treatment, but also reduce hydromodification impacts to streams by reducing the volume of stormwater that enters streams and rivers. The proposed retrofit strategy prioritizes the installation of vegetated planters, porous pavement, and drywells with pretreatment where infiltration rates are acceptable in order to reduce the stormwater runoff volume to streams. The use of vegetated swales and proprietary filters may be alternatives where infiltration is low.

The BMPs listed in this retrofit strategy represent typical BMPs currently available and in use. The values assigned to BMP effectiveness should be considered guidelines, and will be evaluated further during project design, when specific facilities are identified for a particular project or site. As additional products and techniques become available, the BMPs suggested in this document may be updated with potentially more effective facilities and practices.

**References**

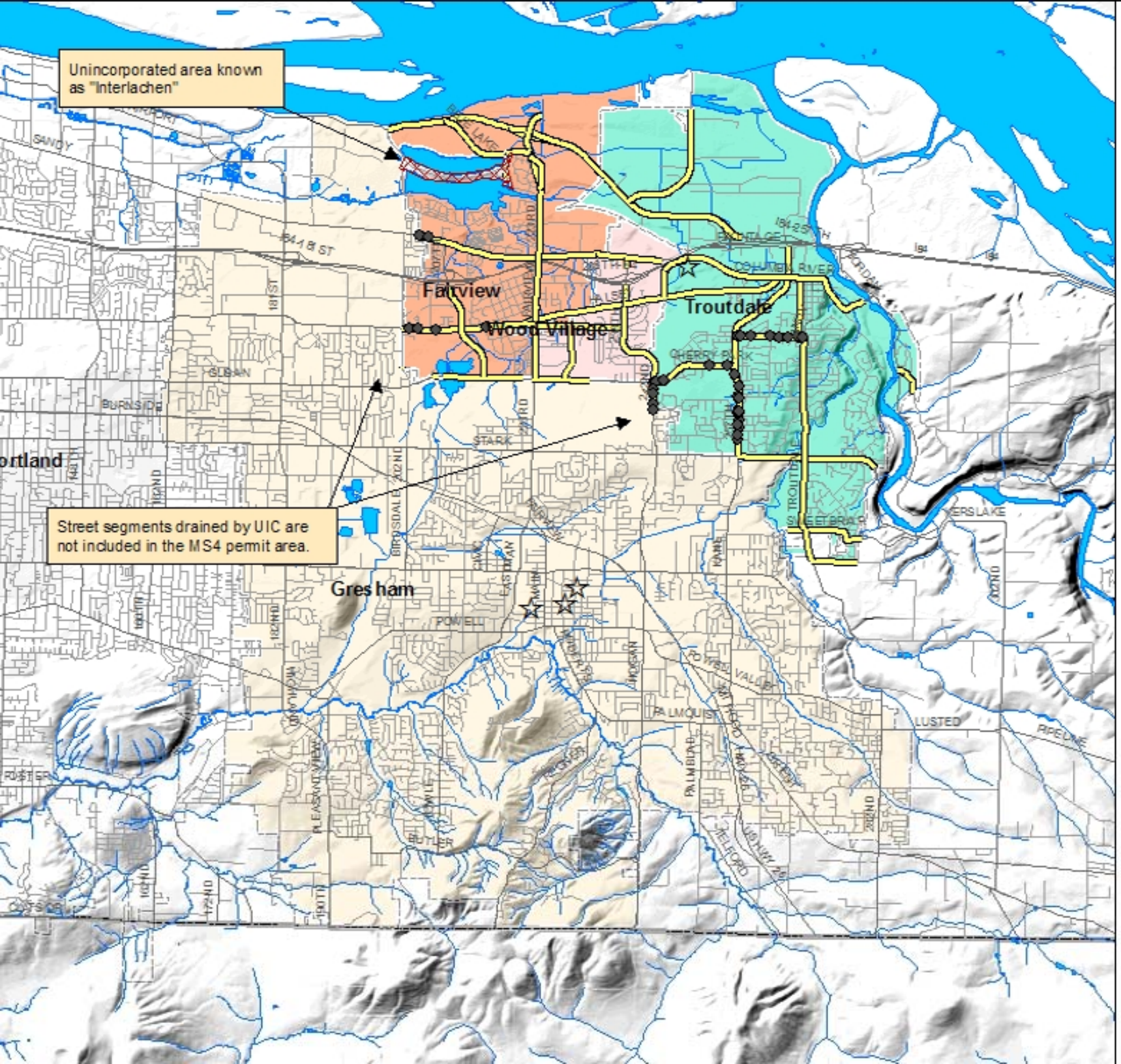

1. Multnomah County, “Stormwater Management Plan, NPDES MS4 Permit”. April 2011.
2. Multnomah County, “2014 TMDL Implementation Plan”. April 2014
3. Oregon DEQ, “TMDL Report, Chapter 5: Lower Willamette Sub-basin TMDL”. Approved by EPA Sept, 29, 2006.
4. Oregon DEQ,” Sandy River Basin TMDL Report”. March 2005.
5. Oregon DEQ, “Tualatin Sub-basin TMDL Report”. August 2001.
6. Oregon DOT, “Stormwater Treatment Program – BMP Selection Tool”. October 2008.
7. International BMP Database, “Database Pollutant Category Summary Statistical Addendum: TSS, Bacteria, Nutrients, and Metals”. July 2012.
8. International BMP Database, “Pollutant Category Summary: Fecal Indicator Bacteria”. December 2010.
9. International BMP Database, “Technical Summary: Volume Reduction”. January 2011.
10. Multnomah County, “Transportation Capital Improvements Plan and Program, Fiscal Years 2014-2018”. May 2013.
11. City of Gresham, “Stormwater Retrofit Strategy Development”. March 2012.

| Multnomah County Retrofit Strategy-Priority Project List and Cost Estimate for Preferred Stormwater BMPs for Roadways in Wood Village, Fairview and Troutdale | | | | | | | | | Stormwater BMPs | | | | | Planning Level Const. Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roadway | Segment | Basin | Sub-Basin | Portion of roadway included in CIP | Project Description | Est. Project Costs [1] | Existing Impervious Area (SF) [2] | Additional Impervious Area (SF)[3] | Option A. Infiltration Drywell with Pre-treatment[4] | Option B. Vegetated Swale (Water Quality and Flow Control) | Option C. Vegetated Planter (Water Quality and Flow Control) | Option D. Porous Pavement[5] | Option E. Proprietary Filtration Facility[6] | Water Quality Cost Range for Options A-E |
| NE Marine Dr | Interlachen Ln - Frontage Rd | *Columbia River* | *Salmon Creek (Arata Creek)* | Yes | Reconstruct Marine Drive between Interlachen Ln. and the frontage roads in Troutdale | $36,764,139 | 513,200 | 0 | $615,800 | $513,200 | $1,667,900 | $1,026,400 | $769,800 | $513,200 - $1,667,900 |
| NE 244th Ave | Historic Columbia River Hwy - Halsey St | *Columbia River* | *Arata Creek* | No | None planned | - | 38,000 | 0 | $45,600 | $38,000 | $123,500 | $76,000 | $57,000 | $38,000 - $123,500 |
| NE Blue Lake Rd | Marine Dr - 223rd Ave | *Columbia River* | *Salmon Creek* | No | None planned | - | 135,200 | 0 | $162,200 | $135,200 | $439,400 | $270,400 | $202,800 | $135,200 - $439,400 |
| NE Interlachen Ln | Fairview Lake Way -1800' East of Fairview Lake Way | *Columbia River* | *Salmon Creek (Blue Lake)* | No | Interlachen area improvements | - | 61,200 | 0 | $73,400 | $61,200 | $198,900 | $122,400 | $91,800 | $61,200 - $198,900 |
| NE Sandy Blvd | 238th Dr - 2000' East of 238th | *Columbia River* | *Salmon Creek (Arata Creek)* | No | None planned | - | 68,000 | 0 | $81,600 | $68,000 | $221,000 | $136,000 | $102,000 | $68,000 - $221,000 |
| NW Sundial Rd | 40 Mile Loop Trail - Fed Ex Driveway | *Columbia River* | *Salmon Creek* | No | None planned | - | 25,000 | 0 | $30,000 | $25,000 | $81,300 | $50,000 | $37,500 | $25,000 - $81,300 |
| NW Sundial Rd | Rogers Street - Arata Creek | *Columbia River* | *Salmon Creek* | No | None planned | - | 91,000 | 0 | $109,200 | $91,000 | $295,800 | $182,000 | $136,500 | $91,000 - $295,800 |
| NW 257th Ave (aka NE Graham Rd) | I-84 - Historic Columbia River Hwy | *Columbia River* | *Salmon Creek* | No | None planned | - | 114,000 | 0 | $136,800 | $114,000 | $370,500 | $228,000 | $171,000 | $114,000 - $370,500 |
| W Historic Columbia River Hwy | 244th Ave - Halsey St | *Columbia River* | *Salmon Creek (Arata Creek)* | Yes | Reconstruct to minor arterial standards with 2 travel lanes, center turn lane/median, bicycle lanes and sidewalks. Reconstruction of railroad bridge is not included in this project | $16,371,224 | 209,100 | 209,100 | $501,800 | $418,200 | $1,359,200 | $836,400 | $627,300 | $418,200 - $1,359,200 |
| NE Sandy Blvd | Fairview City Limits - 238th Dr | *L. Willamette* | *Fairview Creek* | Yes | Reconstruct Sandy Blvd to minor arterial standards with bike lanes, sidewalks, and drainage improvements, utilizing recommendations from TGM grant | $21,404,633 | 361,200 | 240,800 | $722,400 | $602,000 | $1,956,500 | $1,204,000 | $903,000 | $602,000 - $1,956,500 |
| NE Halsey | 238th Ave - Historic Columbia River Hwy | *L. Willamette* | *Fairview Creek* | Yes | Widen Halsey St to 3 lane minor arterial with center turn lane/median, sidewalk and bicycle lanes, consistent with Halsey Street Conceptual Design Plan | $10,807,290 | 330,990 | 855,400 | $1,423,700 | $1,186,400 | $3,855,800 | $2,372,800 | $1,779,600 | $1,186,400 - $3,855,800 |
| NE Halsey | 208th Ave - 238th Ave | *L. Willamette* | *Fairview Creek* | No | None planned | - | 510,900 | 0 | $613,100 | $510,900 | $1,660,400 | $1,021,800 | $766,400 | $510,900 - $1,660,400 |
| W Arata Rd | 223rd - Wood Village Blvd | *L. Willamette* | *Fairview Creek* | Yes | Construct to 3 lane collector standards with center turn lane/median, sidewalks, bicycle lanes, and water quality infiltration swales | $4,468,201 | 48,000 | 110,900 | $190,700 | $158,900 | $516,400 | $317,800 | $238,400 | $158,900 - $516,400 |
| W Arata Rd | Wood Village Blvd - 238th Ave | *L. Willamette* | *Fairview Creek* | No | None planned | - | 70,000 | 0 | $84,000 | $70,000 | $227,500 | $140,000 | $105,000 | $70,000 - $227,500 |
| NE Glisan St | 202nd Ave -Fairview Parkway | *L. Willamette* | *Fairview Creek* | Yes | Reconstruct northside of Glisan Street from 202nd Ave to Fairview Parkway to provide multimodal connection between Gresham-Fairview Trail and Salish Ponds Natural Area. Include bike lanes, sidewalks, two travel lanes in each direction per EMCP, and on-street parking. Design green-street treatment for drainage improvements, including Fairview Creek culvert replacement. South side of Glisan St is in Gresham, north is City of Fairview | $11,774,421 | 114,048 | 109,300 | $268,000 | $223,300 | $725,900 | $446,700 | $335,000 | $223,300 - $725,900 |
| NE Glisan St | Fairview Parkway - 242nd | *L. Willamette* | *Fairview Creek* | No | None planned | - | 272,000 | 0 | $326,400 | $272,000 | $884,000 | $544,000 | $408,000 | $272,000 - $884,000 |
| NE Fairview Pkwy | Sandy Blvd - 1035' South | *L. Willamette* | *Fairview Creek* | No | None planned | - | 58,000 | 0 | $69,600 | $58,000 | $188,500 | $116,000 | $87,000 | $58,000 - $188,500 |
| NE Fairview Pkwy | I-84 - Glisan St | *L. Willamette* | *Fairview Creek* | No | None planned | - | 352,200 | 0 | $422,600 | $352,200 | $1,144,700 | $704,400 | $528,300 | $352,200 - $1,144,700 |
| NE 223rd Ave | Chinook Landing Marine Park - Fairview Creek | *L. Willamette* | *Fairview Creek* | Yes | Improve 223rd Ave to major collector standards with 2 travel lanes, center turn lane/median, sidewalks and bicycle lanes. Requires reconstuction of RR bridge under another project. Bridge cost = $4,596,717 | $7,106,182 | 140,000 | 130,100 | $324,100 | $270,100 | $877,800 | $540,200 | $405,200 | $270,100 - $877,800 |
| NE 223rd Ave (aka Fairview Ave) | Cedar Street - NE Halsey St | *L. Willamette* | *Fairview Creek* | Yes | Reconstruct 223rd Ave to major collector standards with 2 travel lanes, center turn lanes/median, sidewalks, and bicycle lanes. | $7,106,182 | 50,000 | 60,000 | $132,000 | $110,000 | $357,500 | $220,000 | $165,000 | $110,000 - $357,500 |

| Multnomah County Retrofit Strategy-Priority Project List and Cost Estimate for Preferred Stormwater BMPs for Roadways in Wood Village, Fairview and Troutdale | | | | | | | | | Stormwater BMPs | | | | | Planning Level Const. Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roadway | Segment | Basin | Sub-Basin | Portion of roadway included in CIP | Project Description | Est. Project Costs[1] | Existing Impervious Area (SF)[2] | Additional Impervious Area (SF)[3] | Option A. Infiltration Drywell with Pre-treatment[4] | Option B. Vegetated Swale (Water Quality and Flow Control) | Option C. Vegetated Planter (Water Quality and Flow Control) | Option D. Porous Pavement[5] | Option E. Proprietary Filtration Facility[6] | Water Quality Cost Range for Options A-E |
| NE 223rd Ave | NE Halsey - NE Glisan St | *L. Willamette* | *Fairview Creek* | No | None planned | - | 50,000 | 0 | $60,000 | $50,000 | $162,500 | $100,000 | $75,000 | $50,000 - $162,500 |
| Wood Village Blvd | NE Halsey - W Arata Rd | *L. Willamette* | *Fairview Creek* | Yes | Construct extension of Wood Village Blvd as a major collector with 2 travel lanes, center lane/median, sidewalks, and bicycle lanes | $3,294,764 | 0 | 20,700 | $24,800 | $20,700 | $67,300 | $41,400 | $31,100 | $20,700 - $67,300 |
| Wood Village Blvd | W Arata Rd - NE Glisan St | *L. Willamette* | *Fairview Creek* | No | None planned | - | 122,000 | 0 | $146,400 | $122,000 | $396,500 | $244,000 | $183,000 | $122,000 - $396,500 |
| NE 238th Dr/NE 242nd Dr | NE Halsey - NE Glisan St | *L. Willamette* | *Fairview Creek* | Yes | System Management EMCP | $9,000,000 | 250,000 | 0 | $300,000 | $250,000 | $812,500 | $500,000 | $375,000 | $250,000 - $812,500 |
| NE 238th Dr | NE Halsey - NE Sandy Blvd | *L. Willamette* | *Fairview Creek* | No | None planned | - | 194,000 | 0 | $232,800 | $194,000 | $630,500 | $388,000 | $291,000 | $194,000 - $630,500 |
| SW Cherry Park Rd | SW 18th Way to 257th Ave | *Sandy River* | *Lower Sandy* | No | None planned | - | 175,000 | 0 | $210,000 | $175,000 | $568,800 | $350,000 | $262,500 | $175,000 - $568,800 |
| E Columbia River Hwy | 257th Ave - Historic Columbia River Hwy | *Sandy River* | *Sandy River (Beaver Creek)* | No | None planned | - | 152,100 | 0 | $182,500 | $152,100 | $494,300 | $304,200 | $228,200 | $152,100 - $494,300 |
| SE Stark St | 3100 ' West of 257th Ave - Troutdale Rd | *Sandy River* | *Beaver Creek* | Yes | Reconstruct Stark St. to minor arterial standards by widening the existing 2 lanes to provide for 4 traffic lanes, a continuous left-turn lane, bike lanes, sidewalks, and intersection improvements | $11,100,000 | 291,200 | 142,000 | $519,800 | $433,200 | $1,407,900 | $866,400 | $649,800 | $433,200 - $1,407,900 |
| SE Stark St | Troutdale Rd - 4200' East of Troutdale Rd | *Sandy River* | *Sandy River South* | Yes | Reconstruct road to arterial standards with 1 travel lane in each direction, center turn lane/median, sidewalks and bicycle lanes | $3,276,450 | 151,200 | 100,800 | $302,400 | $252,000 | $819,000 | $504,000 | $378,000 | $252,000 - $819,000 |
| SE Cochran Rd | Troutdale Rd - 2175' West of Troutdale Rd | *Sandy River* | *Beaver Creek* | Yes | Reconstruct to major collector standards with 2 travel lanes, center lane/median, sidewalks, bike lanes, and culvert replacement | $7,442,765 | 65,300 | 78,300 | $172,300 | $143,600 | $466,700 | $287,200 | $215,400 | $143,600 - $466,700 |
| SE Sweetbriar Rd | Troutdale Rd - Troutdale City Limits | *Sandy River* | *Sweetbriar Creek* | Yes | Widen to neighborhood collector standards with 2 travel lanes, sidewalks, and bike lanes | $2,740,748 | 88,200 | 58,800 | $176,400 | $147,000 | $477,800 | $294,000 | $220,500 | $147,000 - $477,800 |
| SE Strebin Rd | Troutdale Rd - 282nd Dr | *Sandy River* | *Sandy River South* | No | None planned | - | 114,000 | 0 | $136,800 | $114,000 | $370,500 | $228,000 | $171,000 | $114,000 - $370,500 |
| SW 257th Ave | Historic Columbia River Hwy - Cherry Pk Rd (West) | *Sandy River* | *Sandy River North* | No | None planned | - | 421,000 | 0 | $505,200 | $421,000 | $1,368,300 | $842,000 | $631,500 | $421,000 - $1,368,300 |
| Buxton Rd | E Columbia River Hwy - Cherry Park | *Sandy River* | *Sandy River North* | No | None planned | - | 95,000 | 0 | $114,000 | $95,000 | $308,800 | $190,000 | $142,500 | $95,000 - $308,800 |
| S Troutdale Rd | Cherry Park Rd - 19th St | *Sandy River* | *Sandy River North/Beaver Creek* | Yes | Widen to major collector standards with 2 travel lanes, center turn lane/median, sidewalks and bicycle lanes | $875,155 | 79,700 | 66,500 | $175,400 | $146,200 | $475,200 | $292,400 | $219,300 | $146,200 - $475,200 |
| S Troutdale Rd | 19th St - Stark St | *Sandy River* | *Beaver Creek* | Yes | Reconstruct to major collector standards with 2 travel lanes, center lane/median, sidewalks, bike lanes, and culvert replacement | $8,556,929 | 115,920 | 51,000 | $200,300 | $166,900 | $542,500 | $333,800 | $250,400 | $166,900 - $542,500 |
| S Troutdale Rd | Stark St - Strebin St | *Sandy River* | *Beaver Creek* | Yes | Improve to collector standards with 2 traffic lanes, center lane, bike lanes and sidewalks, intersection and drainage improvements | $8,446,060 | 138,500 | 166,100 | $365,500 | $304,600 | $990,000 | $609,200 | $456,900 | $304,600 - $990,000 |

1. Estimated Project Cost - Project Costs From Multnomah County Transportation Capital Improvement Plan and Program Fiscal Years 2014-2018
2. Existing Impervious Area - Estimated from Google Earth and ArcGIS mapping
3. Additional Impervious Area - Estimated from Multnomah County Transportation Capital Improvement Plan Project Descriptions
4. Drywell unit price assumes one sedimentation manhole and one drywell per 10,000 SF of Impervious Area
5. Additional cost of installing pervious asphalt rather than standard asphalt pavement for project impervious area
6. Proprietary Filtration unit price based on a Concrete 3-Cartridge Curb Inlet Unit

| | |
|---|---|
| Unit Cost for Vegated Swale ($/SF) = | $1.00 |
| Unit Cost for Vegetated Planter ($/SF) = | $3.25 |
| Drywell (4' Diameter, 20' Deep) with Sedimentation Ma | $1.20 |
| Additional Unit Cost for Pervious Asphalt Pavement ($/ | $2.00 |
| Proprietary Filtration Unit ($/SF) = | $1.50 |

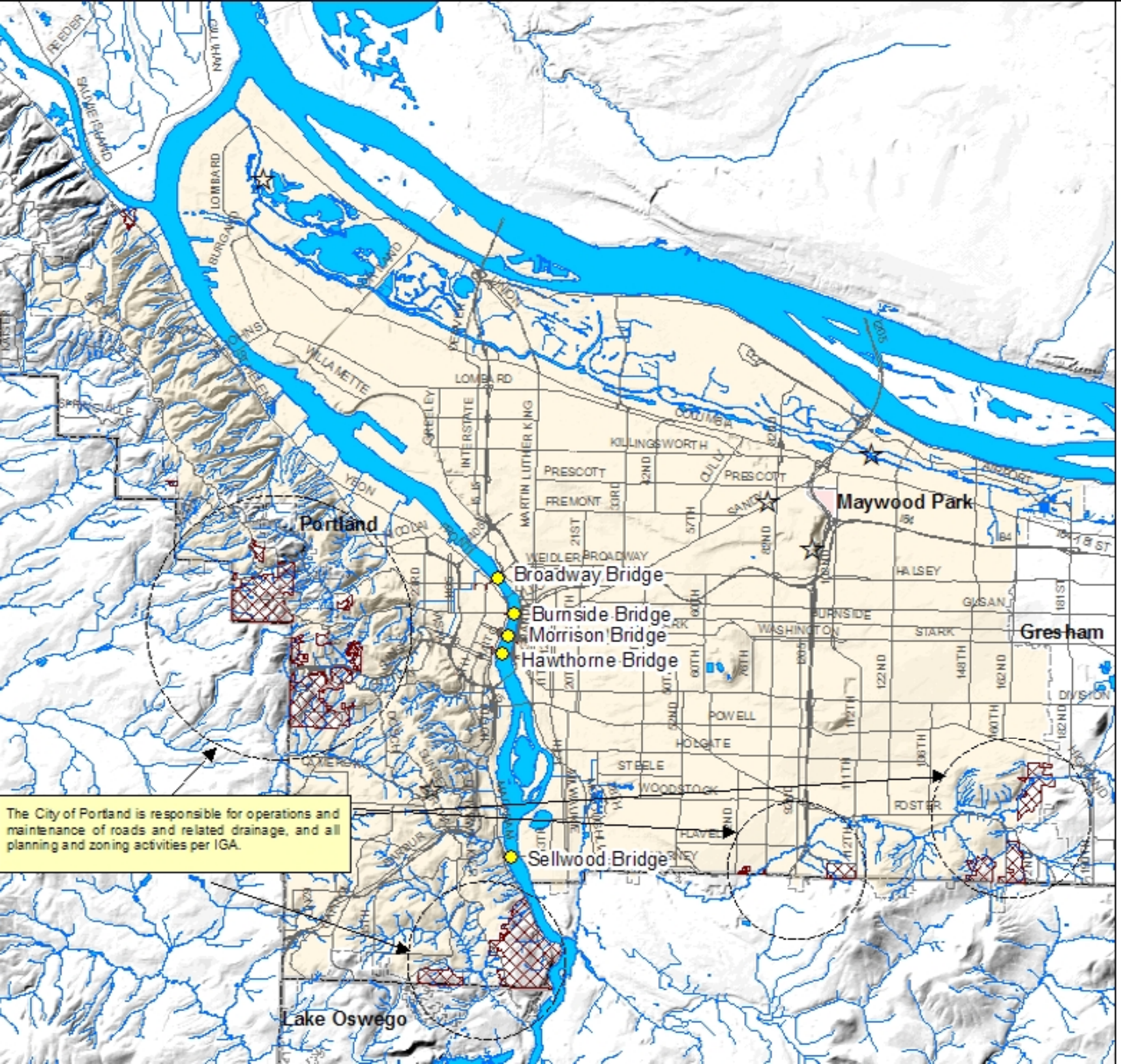



## Gresham Area.

- FacilitiesMS4
- Stormwater Drywells
- County Roads
- County Permit Area

June 2010

MULTNOMAH COUNTY




## Portland Area.

- County Facilities MS4
- Willamette River Bridges
- County Permit Areas

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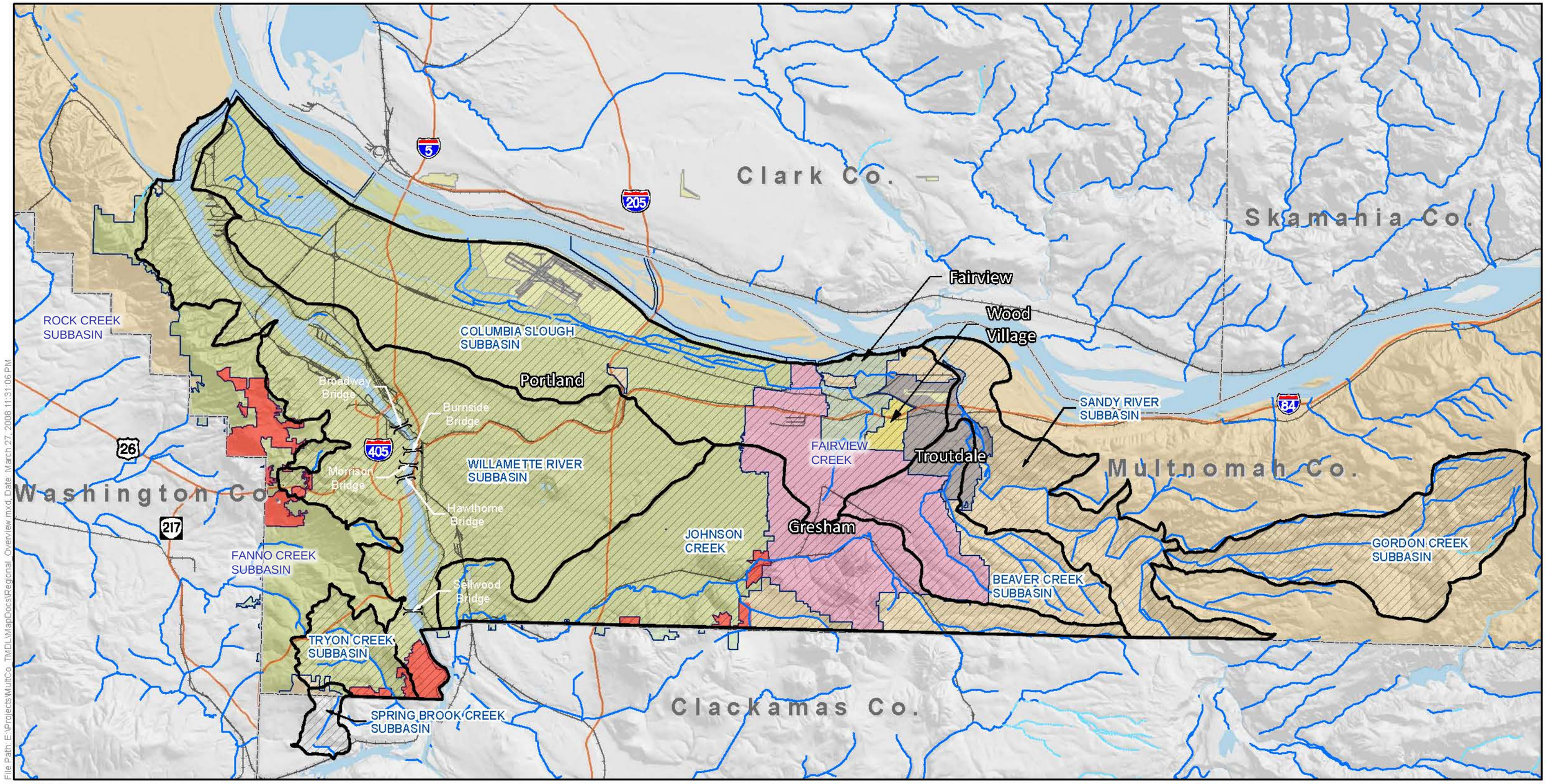


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Watersheds

Unincorporated Multnomah County

Unincorporated Multnomah County Under Portland Stormwater Management and Land Use Planning Authority

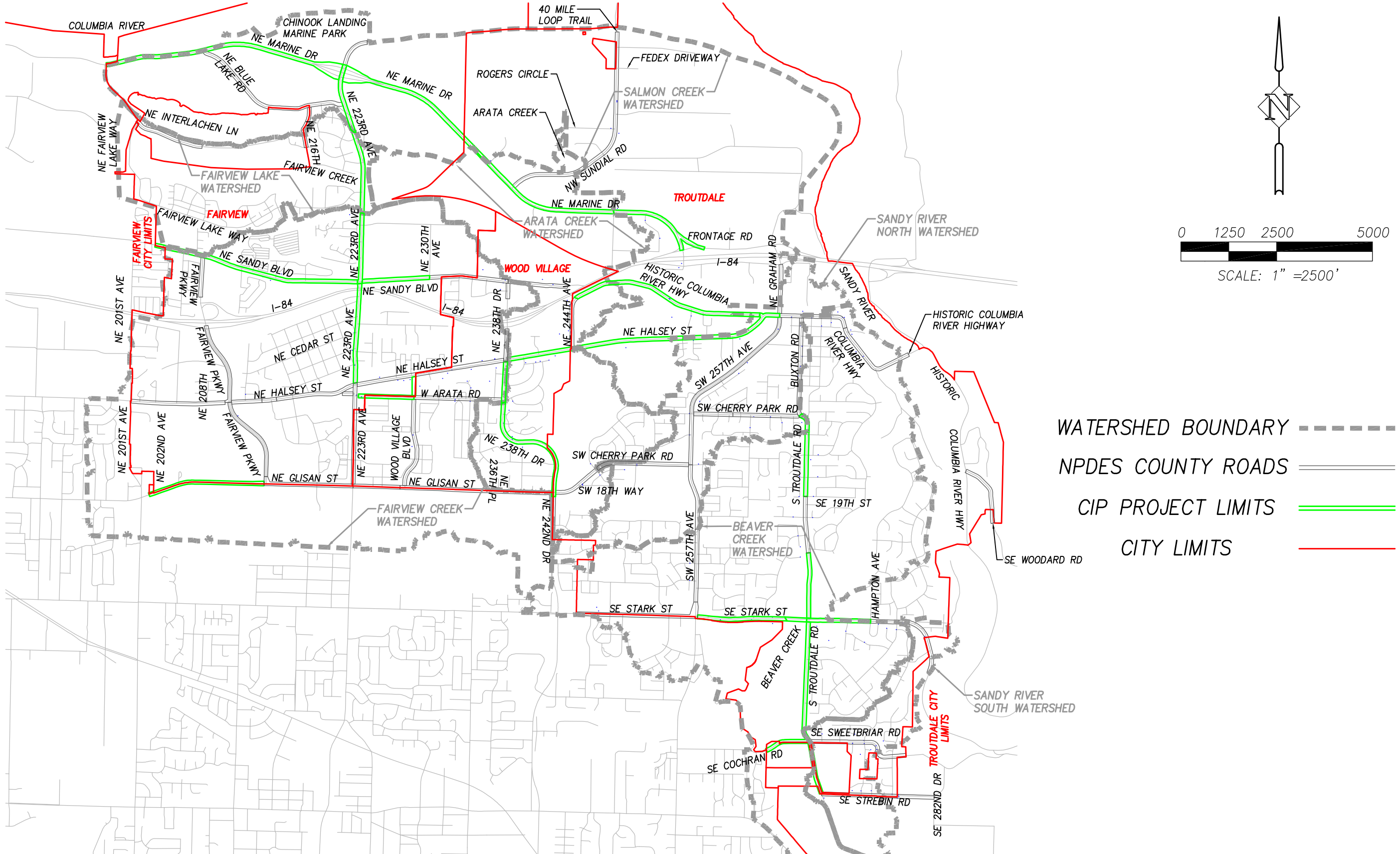
Multnomah County Willamette River Bridges

March 28, 2008

N

0 2.5 5 Miles

**Appendix A**
**Multnomah County TMDL Watersheds**
*Lower Willamette and Sandy River Basin*
*TMDL Implementation Plan*

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| DATE | NO. | DESCRIPTION |
|---|---|---|
| | | |

REVISIONS

DESIGNED: SPM
DRAWN: SPM
CHECKED: KAS
DATE: 10/02/2014


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MULTNOMAH COUNTY STORMWATER RETROFIT STRATEGY

# STORMWATER QUALITY PROJECT PLANNING

COUNTY ROADS IN FAIRVIEW, TROUTDALE, AND WOOD VILLAGE

SHEET NO. 1 1

JOB NO. MUL-06