CHAPTER 2
Tryon Creek Watershed Overview

INTRODUCTION

This chapter describes some of the landscape features, attributes, and functions of the overall Tryon Creek Watershed and subwatersheds. It also briefly reviews previous studies. The topics discussed include zoning and land use, physical characteristics, habitat and biological communities, public health and safety, water quality, sewerage infrastructure, and public involvement and stewardship.

The watershed characteristics described in this chapter are based mostly on information compiled in the Bureau of Environmental Services' (BES) Geographic Information System (GIS) database and on various studies performed by or for BES and other jurisdictions in the Portland area. The effective date of the information in the GIS database varies, based on the original source of the information.

The Map Atlas provided on CD-ROM includes detailed maps of the watersheds and subwatersheds. These maps are referred to throughout the report.

WATERSHED AND SUBWATERSHED DESCRIPTIONS

The Tryon Creek Watershed in southwest Portland covers an area of approximately 4,142 acres, or 6.5 square miles (Map 9-Tryon Creek Contour Maps by subwatershed, Map Atlas). Approximately 3,058 acres (nearly 80 percent of the watershed) is within Portland's city limits. The remaining watershed area is within the jurisdictions of Multnomah County, Clackamas County, and the City of Lake Oswego.

The Tryon Creek Watershed is bounded by the Fanno Creek Watershed to the west and north, Stephens Creek to the north, the Willamette River drainage basin to the east, and Oswego Lake to the south. The watershed is intersected by a highway and surface street network, including Interstate 5, Highway 99, Boones Ferry Road, Taylors Ferry Road, and Terwilliger Boulevard.

The Tryon Creek Watershed is divided into three subwatersheds: Tryon Creek mainstem, Arnold Creek, and Falling Creek (Table 2-1).

Table 2-1
Tryon Creek Subwatersheds

Tryon Creek Subwatersheds	Acres
Tryon Creek Mainstem	3,083.7
Arnold Creek	775.2
Falling Creek	283.6
Total	4,142.5

The Tryon Creek mainstem is about seven miles long and flows southeast from its headwaters near Multnomah Village (just north of Interstate 5 and Highway 99) to its confluence with the Willamette River in Lake Oswego at the Highway 43 crossing (Map 2-Tryon Creek Subbasin Map, Map Atlas). The Tryon Creek mainstem subwatershed comprises about 3,083 acres.

Arnold Creek joins Tryon Creek at the Boones Ferry Road crossing (Map 2-Arnold Creek Subbasin Map, Map Atlas). The Arnold Creek subwatershed comprises about 775 acres.

Falling Creek joins Tryon Creek at SW 26th Avenue and Taylors Ferry Road (Map 2-Falling Creek Subbasin Map, Map Atlas). The Falling Creek subwatershed is about 283 acres.

Other smaller tributaries flow into Tryon Creek both within and outside Portland's city limits.

ZONING AND LAND USE

Zoning

The predominant base zone in the Tryon Creek Watershed is single-family residential (Table 2-2 and Map 5-Tryon Creek Current Plan Maps by subwatershed, Map Atlas). Commercial and multi-family residential land uses are concentrated along major transportation corridors, including Interstate 5 and Barbur Boulevard.

Table 2-2
Base Zoning within the Tryon Creek Watershed

Land Use Category	Current Area	
	Area (acres)	*Percentage*
Commercial	127	3
Multi-family Residential	185	5
Parks/Open Space	592	14
Single-family Residential	2,289	55
Outside City Boundary	857	21
Insufficient Data	92	2
Total	**4,142**	**100**

Parks and Open Space

Parks and open space, including public and private property, total about 870 acres, or nearly 21 percent of the watershed (Table 2-3). The Tryon Creek mainstem subwatershed contains most of the open space, largely because of Tryon Creek State Natural Area (630 acres). Other major parks and open space throughout the watershed include Marshall Park (25 acres), Lewis and Clark College (23 acres), West Portland Park (21 acres), and Maricara Nature Park (17 acres).

Table 2-3
Open Space in the Tryon Creek Watershed

Subwatershed	Open Space (Acres)	Subwatershed Area (Acres)	Percentage of Subwatershed
Tryon Creek Mainstem	768.2	3,083.7	24.9
Arnold Creek	74.0	775.2	9.5
Falling Creek	27.6	283.6	9.8
Total (Watershed)	**869.8**	**4,142.3**	**21.0**

Public Land

About 780 acres of public land are located throughout the watershed (Table 2-4). Portland Public Schools owns about 58 acres; the City of Portland (including the Parks Bureau and BES) owns 73 acres; and Metro owns about 34 acres. The State of Oregon owns most of the remaining public land, including the 631-acre Tryon Creek State Natural Area. The Tryon Creek mainstem subwatershed contains the most public land, most of which is Tryon Creek State Natural Area.

Table 2-4
Public Land in the Tryon Creek Watershed

Subwatershed	Public Land (Acres)	Subwatershed Area (Acres)	Percentage of Subwatershed
Tryon Creek Mainstem	681.5	3,083.7	22.1
Arnold Creek	55.8	775.2	19.7
Falling Creek	44.9	283.6	5.8
Total (Watershed)	**782.3**	**4,142.3**	**18.9**

Environmental Zones

Portland has established environmental overlay zones to protect and conserve significant natural resources. The environmental overlay zones are the City's tool to implement the City's Comprehensive Plan Goal 8 and also Statewide Land Use Planning Goals 5, 6, and 7. They are based on extensive natural resource inventories that cover areas within the City's jurisdiction.

There are two types of environmental overlay zones, which currently affect approximately 20,000 acres city-wide. The **environmental protection zone** has been established in areas that

have very high-value resources and function. Development is allowed in the protection zone only in very limited circumstances. The **environmental conservation zone** also limits development in important resource areas. Development is allowed if it meets certain standards and approval criteria to ensure that impacts on significant resources are avoided, limited, and mitigated (City of Portland, Title 33, Chapter 33.430).

Environmental protection zones overlay about 550 acres and conservation zones overlay about 446 acres in the Tryon Creek Watershed. Overall, about 24 percent of the watershed is within environmental zones (Table 2-5). The Tryon Creek mainstem subwatershed has the most area covered by the environmental protection zone, most of which is located in Marshall Park and Tryon Creek State Natural Area (Map 4-Tryon Creek Current Plan Existing E-Zones Maps by subwatershed).

Table 2-5
Environmental Zones in the Tryon Creek Watershed

Subwatershed	C zone (acres)	P zone (acres)	Total E zones (acres)	Subwatershed Area (acres)	Percentage of Subwatershed
Tryon Creek Mainstem	237.0	499.6	736.6	3,083.7	23.9
Arnold Creek	211.4	47.6	259.1	775.2	33.4
Falling Creek	17.6	4.2	21.7	283.6	7.7
Total (Watershed)	**466.0**	**551.4**	**1,017.4**	**4,142.3**	**24.6**

Population

The current (US Census 2000) population of the Tryon Creek Watershed within Portland's city limits is 18,168. Map 3-Tryon Creek Neighborhood and Population Maps in the Map Atlas show population breakdown in each subwatershed.

Public Easements

Extensive public right-of-way and public utility easements exist in the Tryon Creek Watershed for a number of highways, roads, streets, and utilities (such as sanitary and water). In some cases, sewer easements are located in stream corridors. These easements are used by agencies and the public according to the terms of each individual easement.

Recreation

The Tryon Creek Watershed offers valuable recreational opportunities in the Portland metropolitan area. Tryon Creek State Natural Area provides the core of these opportunities through 8 miles of hiking trails, 3 miles of bike trails, and 3.5 miles of horse trails. In addition, city parks, open areas, and public schools provide opportunities for passive and active recreation.

Cultural Resources

No information has been compiled about cultural and archeological resource identification or inventory.

Transportation Network

Major transportation routes in the watershed include Interstate 5, Highway 99, Boones Ferry Road, Taylors Ferry Road, and Terwilliger Boulevard. Surface streets are distributed throughout the upper and southwestern portions of the watershed. As Table 2-6 shows, there are over 70 miles of surface streets. Nearly half of the paved streets are uncurbed. Unimproved streets, which include dirt roads and unimproved rights-of-way, total 13 miles.

Streets and highways, particularly those with high traffic volumes, accumulate pollutants from automobiles. Rain picks up these pollutants and carries them to streams, where they degrade aquatic habitat for fish and other wildlife. Streets and highways also prevent infiltration, increasing stormwater runoff.

Table 2-6
Miles of Surface Streets in the Tryon Creek Watershed

Subwatershed	Paved/Uncurbed	Paved/Curbed	Other	Unimproved	Total
Tryon Creek Mainstem	19.8	15.3	5.1	8.1	48.2
Arnold Creek	6.1	7.7	0.0	3.9	17.7
Falling Creek	1.8	4.6	0.2	1.1	7.7
Total (Watershed)	**27.8**	**27.6**	**5.3**	**13.1**	**73.7**

Source: City of Portland, Bureau of Transportation

PHYSICAL CHARACTERISTICS

This Tryon Creek Watershed's topographic features, soils, hydrology, impervious surfaces, hydraulic characteristics, climate, and rainfall are closely linked to the physical stability of the watershed and stream systems. They are critical in defining channel morphology and structure, slope stability, and soil erosion and sediment transport.

Overall, steep slopes, soils that are slow to infiltrate rainfall, and impervious surfaces result in a "flashy" urban stormwater system. This has severe impacts on the streams, such as channel incision, undercutting of streambanks, landslides and erosion, and sediment deposition (Booth 1991).

Topography

Topography (elevation) in the Tryon Creek Watershed varies from near mean sea level (msl) to 970 feet above msl. The lowest point in the watershed, about 10 feet above msl, is the confluence of Tryon Creek with the Willamette River; the highest point is at the top of Mt. Sylvania (BES 1997). Approximately 60 to 75 percent of the slopes within the watershed exceed a 30 percent grade (BES 1997). Some slopes exceed 50 percent grade, especially in the upper watershed (Map 9-Tryon Creek Contour Maps by subwatershed, Map Atlas). The *Southwest Hills Resource Protection Plan* (Bureau of Planning 1992) classifies slopes in excess of 30 percent grade as generally having "severe landslide potential." Prominent topographic features in the Tryon Creek Watershed are the Palatine Hills, Portland's West Hills, and Mt. Sylvania.

Soils

The Natural Resources Conservation Service (NRCS) places soils in the Tryon Creek Watershed in the Cascade series. The Cascade series consists primarily of silt loam that is high in aluminum-rich volcanic ash. The watershed's soils are poorly drained, dark-brown silt loam of about 8 inches. Below this layer is about 19 inches of dark-brown silt loam subsoil (PSU and Metro 1995). The Cascade silt loam includes a layer of low permeability from 24 to 60 inches deep, called fragipan (BES 1997). Most of the surface water and roots of trees do not penetrate the fragipan; trees therefore grow in shallow soils and can be easily toppled by high winds and mudslides. The fragipan contributes to slope instability and erosion by limiting the rooting depth of plants to 30 to 48 inches and by serving as a failure plane.

The hydrologic soil group classification for most of the soils in the Tryon Creek Watershed is Type C: sandy clay loam (Map 6-Tryon Creek Soil Types Maps by subwatershed, Map Atlas). Soils with this classification have a slow infiltration rate and high runoff potential. Isolated pockets of Type D (clay loam) soils, which are even slower to drain, also exist in the watershed. The low permeability of the soils limits the function of onsite wastewater and septic systems. Low soil permeability also affects the watershed hydrology through limited soil absorption and interflow, resulting in higher runoff peaks and lower base flows.

Given the urban nature of the upper watershed, the NRCS now designates soils in the upper watershed as Urban Land. This designation reflects the increase in impervious surfaces throughout the watershed (Green 1983).

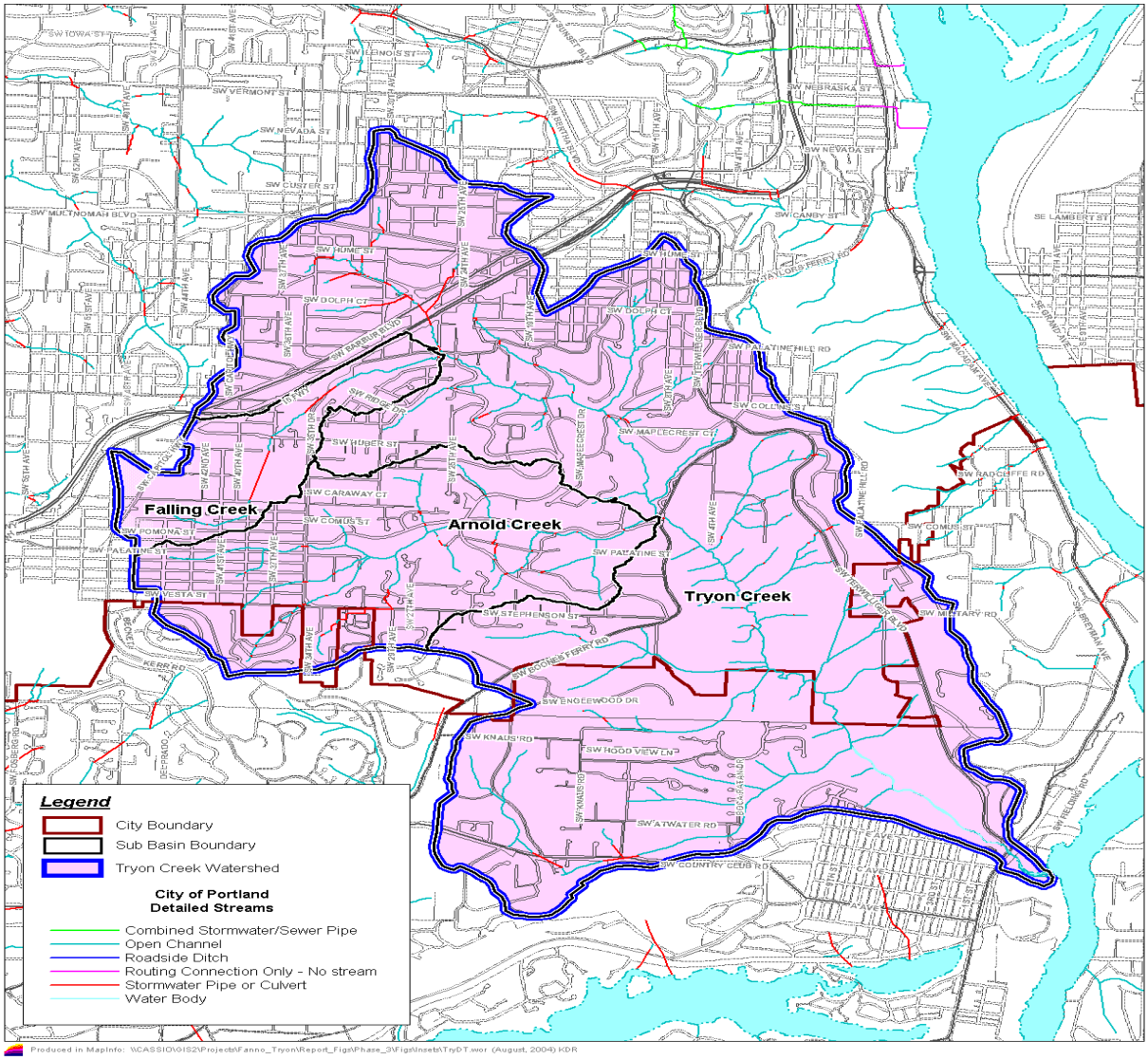
Hydrology

There are about 27 miles of open stream channel in the Tryon Creek Watershed. An additional three miles of streams are in culverts or pipes (Table 2-7). Figure 2-1 details the streams the within the watershed.

Table 2-7
Miles of Streams in the Tryon Creek Watershed

Subwatershed	Open Channel	Pipe or Culvert	Other
Tryon Creek Mainstem	20.9	2.1	0.0
Arnold Creek	5.6	0.9	0.0
Falling Creek	1.0	0.5	1.5
Total	**27.5**	**3.4**	**1.5**

Figure 2-1
Detailed Streams in Tryon Creek Watershed



Tryon Creek mainstem is a perennial stream that originates in the West Hills of Portland and flows southeaster from Multnomah Village, through Tryon Creek State Natural Area, to its confluence with the Willamette River at the Highway 43 crossing in Lake Oswego. It is one of the major remaining free-flowing tributaries that descend from Portland's West Hills. Tryon Creek is primarily a high-gradient, open-stream system, with the exception of culverts at road crossings (Map 9-Tryon Creek Contour Map, Map Atlas).

Tryon Creek's tributaries include Arnold Creek, Falling Creek, Oak Creek, Park Creek, and Nettle Creek.

Intact stream networks contain streams that flow year-round and streams that flow only part of the time. Streams that flow throughout the year containing both base flow and storm flow are classified as perennial or permanent. Ephemeral streams flow only in response to specific storms. Intermittent streams flow for periods of weeks or months, usually during rainy and snowmelt seasons.

Headwater springs or drainages serve as the source of a stream network. Within any intact stream system and river network, headwater streams make up most of the total channel length. Headwater streams are critically important to the health of the watershed. These small intact streams provide natural flood control, recharge groundwater, trap sediments and pollution from fertilizers, recycle nutrients, create and maintain biological diversity, and sustain the biological productivity of downstream rivers, lakes, and estuaries (Meyers et al. 2003).

Impervious Surfaces

Impervious surfaces include streets, parking lots, and buildings. Impervious surfaces comprise about 990 acres, or 24 percent, of the Tryon Creek Watershed (Table 2-8 and Map 8-Tryon Creek Impervious Areas Maps by subwatershed, Map Atlas). Impervious surface coverage is highest in the upper portions of Tryon Creek, particularly along Interstate 5 and SW Barbur Boulevard.

Impervious surface cover in this range reduces rainfall infiltration, increases storm water runoff volume and rate, and degrades storm water quality. In addition, Booth (1991) found that impervious cover greater than 10 percent reduces urban stream stability, resulting in unstable and eroding stream channels. These changes can degrade in-stream habitat and affect fish communities.

Table 2-8
Impervious Surface Cover in the Tryon Creek Watershed

Subwatershed	Impervious Area (Acres)	Subwatershed Area (Acres)	Percentage of Subwatershed
Tryon Creek Mainstem*	696.1	3,083.7	22.6
Arnold Creek	192.9	775.2	24.9
Falling Creek	105.9	283.6	37.3
Total (Watershed)	**994.9**	**4,142.3**	**24.0**

*Areas outside of the City of Portland derived from multi-spectral analysis layer

Hydraulic Characteristics

Steep slopes and stream gradient characterize the Tryon Creek Watershed. The physiographic characteristics of the watershed and its soil types have had severe impacts on the stream systems in terms of channel incision, undercutting of stream banks, landslides, and exposed sewer pipes.

In addition to open stream channels, stormwater is conveyed through culverts and storm pipes. Approximately (EL provide figure) lineal feet of storm drainpipes and 11 stormwater detention basins are within the watershed (Map 11-Tryon Creek Existing Storm Sewer Maps by

subwatershed, Map Atlas). As the watershed develops further, the ability of these conveyance elements to handle storm events designated as the City's basic level of service (conveyance of the 10-year storm) will be affected. BES completed a basin hydrologic analysis in 1997 that models current and future conditions and conveyance capacity (BES 1997). Hydrologic and hydraulic models were developed to characterize the watershed for this report.

Under an intergovernmental agreement with BES, the U.S. Geological Survey (USGS) installed a flow monitoring station on Tryon Creek mainstem in August 2001. BES and USGS will continue to fund operation of this gage.

Climate and Rainfall

Climate in the Tryon Creek Watershed is characterized by mild, wet winters and cool, dry summers. Temperatures range from 25 to 45 degrees Fahrenheit (°F) in the winter and from 70 to 90°F in the summer. The Tryon Creek Watershed receives approximately 35 inches of precipitation per year; 98 percent of that total is rain. Almost all the rain falls between October and May (Johnson 1987).

BES maintains a system of rain gages as part of its Hydrologic Data Retrieval and Acquisition (HYDRA) system. Rain data from a HYDRA gage at the Portland Community College (PCC) Sylvania campus in the adjacent Fanno Creek Watershed were used to develop rainfall characteristics in the Tryon Creek Watershed. Design storms were defined for modeling future conditions and testing conveyance system capacity. These storms were based on BES's design standards (BES 1991; BES 1997). Table 2-9 shows rainfall statistics for southwest Portland, including the Tryon Creek Watershed.

Table 2-9
Annual Average Rainfall at PCC Sylvania Campus

Characteristic	Winter (November - May)	Summer (June - October)	Annual
Rainfall (days per season or year)	98	42	140
Rainfall depth (inches per season or year)	25.7	9.5	35.2
Rain events per season or year	36	24	60
Volume per event (inches)	0.74	0.38	0.59
Peak intensity (inches per hour)	0.094	0.091	0.093
Duration per event (hours)	40	20	34
Dry time between storms (hours)	75	155	107

Source: HYDRA system data compiled by BES Modeling Group
Note: Period of record, 1976-1998

HABITAT AND BIOLOGICAL COMMUNITIES

The *Southwest Hills Resource Protection Plan* (City of Portland 1992) includes site-specific inventories of Arnold Creek headwaters, Marshall Park/Capitol Hill, Falling Creek, and Tryon Creek State Natural Area. These inventories describe each site's natural resources and wildlife

Existing conditions of riparian habitat, wildlife habitat, fish habitat, and streambank erosion potential in the upper watershed were characterized during development of the *Upper Tryon Creek Corridor Assessment* (BES 1997).

Pacific Habitat Services, Inc. performed a survey of Tryon Creek within Tryon Creek State Natural Area and its riparian area, and developed a management plan in 1996 (Pacific Habitat Services 1997). The plan describes the existing characteristics of Tryon Creek, including channel morphology, hydrologic and flood flow characteristics, sediment transport, areas of groundwater inflow, fish habitat such as pools and riffles, riparian vegetation and shade, temperature, and bank erosion.

More recently, the Oregon Department of Fish and Wildlife (ODFW) conducted habitat surveys of portions of Tryon and Arnold Creeks. These assessments, along with other available information and work performed by other agencies, are integrated into Chapter 9: Habitat and Biological Communities – Tryon Creek Watershed.

The Metro Council is currently working through a three-step planning process to conserve, protect, and restore urban streams and waterways, riparian areas, and significant upland wildlife habitat. During the first step, Metro developed an inventory of approximately 80,000 acres of regionally significant fish and wildlife habitat areas in the region. Approximately 30,000 of those acres (including land and water bodies) are in the City of Portland.

For the habitat inventory, Metro developed a model to identify and rank regionally significant wildlife habitat resources based on habitat characteristics, including habitat patch size, habitat interior area, connectivity and proximity to water resources, connectivity and proximity to other patches, habitats of concern, and habitats for unique and sensitive species. Riparian resources were ranked according to their contribution to specific riparian functions. These functions include microclimate and shade, stream flow moderation and water storage, bank stabilization, sediment and pollution control, large wood and channel dynamics, and organic material sources. The level of function was based primarily on the distance of the landscape feature from the water body, as recommended in current scientific literature. Metro also identified regionally significant habitats of concern, based on three criteria. The first criterion recognizes regionally at-risk, or priority, conservation habitat types, such as oak savannas, grasslands, and wetlands. These habitats are at risk because they formerly covered much more extensive areas, and they tend to be declining in quality where they still remain. The second criterion recognizes the extraordinary and unique value of riverine islands and delta areas. The third criterion recognizes known habitat patches that provide unique or critical wildlife functions. To qualify as a habitat of concern, an area needs to meet only one of the three criteria (Metro 2002).

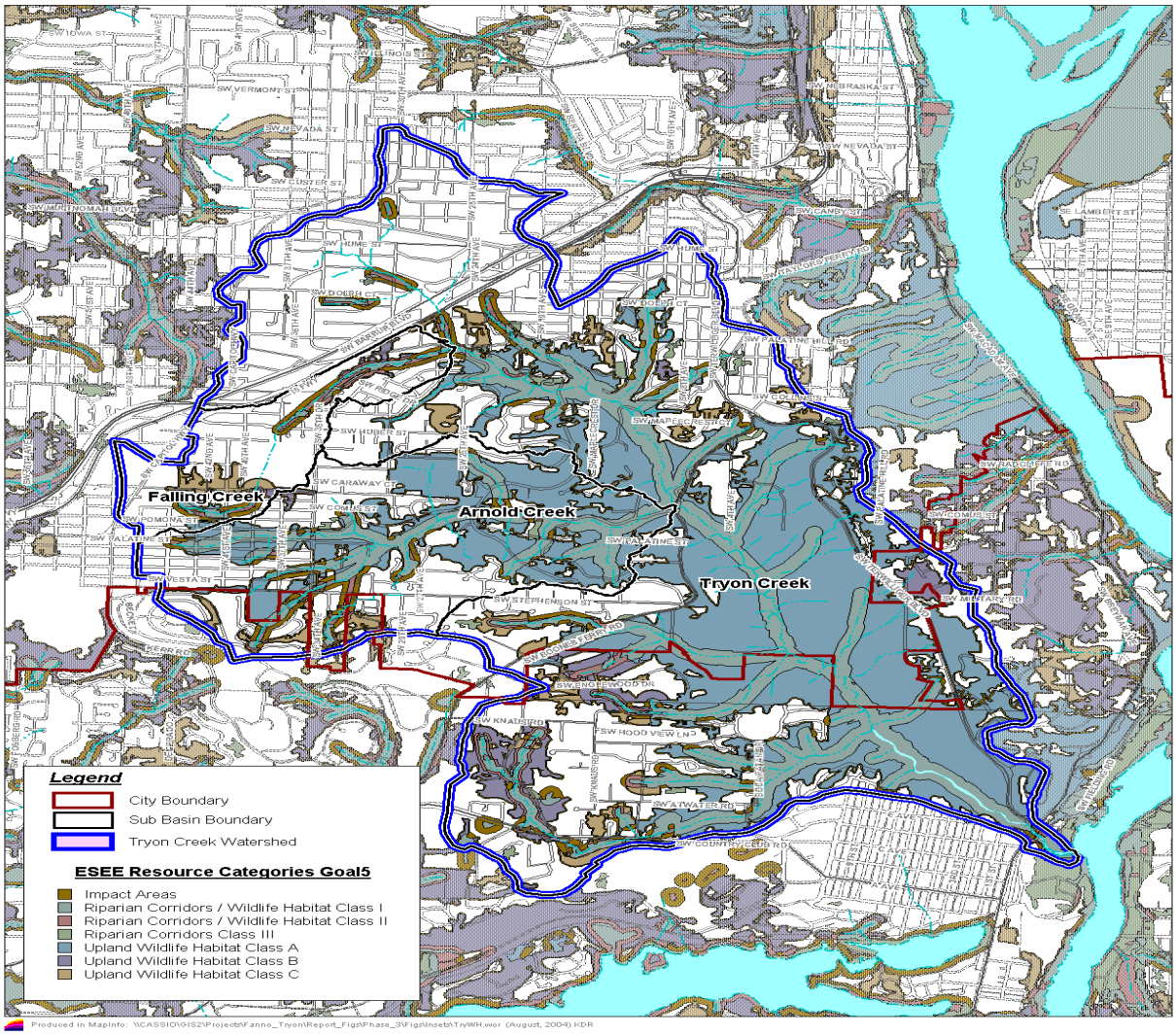
The second step is an economic, social, environment and energy (ESEE) analysis. For this analysis, Metro classified habitat into six classes, under two main categories: Riparian/wildlife and Upland Habitat. Each class covers a geographically discrete portion of the inventory, and may include riparian and/or wildlife functions and also may be a habitat of concern. Class 1 Riparian/wildlife and Class A Upland Wildlife Habitat are the highest value. Impact areas are areas where land uses and activities such as development, landscaping, and road construction may impact fish and wildlife habitat. In the third step, Metro will work with stakeholders throughout the region to formulate an integrated habitat protection and restoration program that is balanced with other goals for the region.

The inventory and ESEE analysis identified over 600 acres as Class 1 Riparian/Wildlife Habitat and over 1,000 acres as Class A Upland Wildlife Habitat in the Tryon Creek watershed, as shown in Table 2-10. Figure 2-2 shows the areas designated within each habitat resource category in the watershed.

Table 2-10
Metro Fish and Wildlife Classes for the Tryon Creek Watershed

Subwatershed	Fish and Wildlife Habitat Classes	Acres
Tryon Creek (mainstem)	Impact Areas	217.9
	Riparian Corridors / Wildlife Habitat Class I	474.9
	Riparian Corridors / Wildlife Habitat Class II	41.6
	Riparian Corridors Class III	23.3
	Upland Wildlife Habitat Class A	788.5
	Upland Wildlife Habitat Class B	76.5
	Upland Wildlife Habitat Class C	66.7
Arnold Creek	Impact Areas	77.3
	Riparian Corridors / Wildlife Habitat Class I	139.9
	Riparian Corridors / Wildlife Habitat Class II	10.1
	Riparian Corridors Class III	3.2
	Upland Wildlife Habitat Class A	217.1
	Upland Wildlife Habitat Class B	2.3
	Upland Wildlife Habitat Class C	17.1
Falling Creek	Impact Areas	29.3
	Riparian Corridors / Wildlife Habitat Class I	12.6
	Riparian Corridors / Wildlife Habitat Class II	11.2
	Riparian Corridors Class III	0.0
	Upland Wildlife Habitat Class A	6.4
	Upland Wildlife Habitat Class B	4.3
	Upland Wildlife Habitat Class C	14.4
Total (Watershed)		**2234.7**

Figure 2-2
ESEE Resource Categories Goal 5



Vegetation

Where vegetation has not been altered by human activities, the Tryon Creek Watershed is wooded. Nearly 37 percent of the watershed is a mix of forested areas (Map 7-Tryon Creek Vegetative Cover Maps by subwatershed, Map Atlas). The wooded areas have both coniferous and deciduous trees, including Douglas and grand fir, western hemlock, western red cedar, broadleaf maple, Oregon ash, Pacific dogwood, red alder, and vine maple. In addition to trees, there are numerous species of shrubs, grasses, wildflowers, ferns, mosses, lichens, and fungi throughout the watershed (Pacific Habitat Services 1997; BES 1997; PSU and Metro 1995). Many forested areas in the watershed, including Tryon Creek State Natural Area, are adversely affected by non-native invasive plants such as English ivy, Himalayan blackberry, English holly, garlic mustard, and western clematis (BES 1997).

Vegetation provides many benefits to the watershed, including habitat, nutrients to streams, shade cover that helps keep stream temperatures cool, streambank and slope stabilization, moderation of hydrology, and sources of large woody debris to streams, which provides critical refuge for fish.

Riparian Corridor

The *Upper Tryon Creek Corridor Assessment* (BES 1997) evaluated high-quality and sensitive habitat in terms of assessed riparian conditions, instream habitat conditions, bank erosion potential, and landslide data. The assessment concluded that riparian habitat quality was most limited in reaches where development has encroached on the riparian corridor and native vegetation has been removed. This encroachment has caused subsequent erosion and/or bank failure, leading to further vegetation loss. Invasive plants that tend to prevent development of habitat and structural diversity have replaced native vegetation. Habitat enhancement opportunities were identified to the extent possible within the project scope.

In 2001, ODFW conducted a habitat surveys for Tryon Creek mainstem and Arnold Creek (Map 14-Tryon Creek ODFW Survey Map 1 by subwatershed, Map Atlas) (ODFW 2002). Table 2-11 summarizes percentage of stream shading, which was one of the survey parameters. Percentages indicate the portion of each creek where shade cover exceeds 90 percent.

Table 2-11
Percentage of Stream Shading Exceeding 90 Percent

Creek Name	Portion of Creek Exceeding 90% Shade
Tryon Creek Mainstem	29
Arnold Creek	44

Generally, riparian integrity is largely intact throughout much of the lower portion of the Tryon Creek mainstem subwatershed. Riparian integrity varies upstream within Marshall Park, but is generally considered fair. Stream segments farther upstream exhibit marginal riparian condition, as residential development becomes a dominant landscape feature along the streambank.

Much of Arnold Creek exhibits high riparian integrity, with riparian widths greater than 100 feet. Riparian integrity declines in upper Arnold Creek. Falling Creek exhibits poor riparian integrity because residential development surrounds much of the stream corridor.

Degraded riparian conditions contribute to increased stream flow and channel incision, streambank instability, erosion and sedimentation, and lack of shading, which increases water temperature.

Floodplain

Floodplain interaction, the process by which streams overflow into surrounding flat riparian areas, creates habitat, deposits nutrients, and accommodates high stream flows. Throughout much of the Tryon Creek Watershed, steep slopes and stream gradients limit floodplain interaction. In addition, development is a prominent landscape feature upstream of (and including) Quail Creek, and potential floodplain interactions are limited by residential land use, impervious surfaces, road crossings, and vegetation composition. Additionally, much of the streambank area in these upper reaches of the watershed has been hardened and is incised. Tryon Creek, Arnold Creek, and Falling Creek do not experience prolonged floodplain interactions. Stream reaches with the lowest gradients and largest (and most integral) floodplains are located in Tryon Creek State Natural Area and are protected from near-stream urban development.

Aquatic Biology

Tryon Creek and its tributaries provided important habitat for various fish and other aquatic species before the turn of the century. Over the past decades, however, many major modifications have been made in the watershed and have significantly affected fish and aquatic habitat and passage (BES 1997; Pacific Habitat Services 1997; PSU and Metro 1995).

Macroinvertebrates

To date, information on macroinvertebrates in Tryon Creek and its tributaries is limited to observations by ODFW fish biologists as part of their work to assess fish and fish habitat. These observations have consistently pointed to unsuccessful spawning of salmonids and the absence of aquatic insects. In one report, the absence of aquatic insects was theoretically linked to some form of water quality problem.

Fish

Tryon Creek is entirely free- flowing within the Tryon Creek State Natural Area, where it seems to provide the best available habitat in the watershed. However, the Highway 43 crossing near the creek's confluence and the Boones Ferry Road crossing appear to restrict fish movement.

Most of the fish populations in the watershed are tolerant resident species (Friends of Tryon Creek State Park 1998). Over the past 17 years, ODFW has conducted several fish surveys in Tryon Creek State Park, with the following results:

- Surveys in July 1987 counted 25 coho salmon up to 7.3 centimeters (cm), one rainbow trout at 17 cm, five sculpin, one lamprey, and one crayfish. Numerous young fish were spotted, but were not counted because of recent stocking by ODWF. Residents along the creek also reported seeing fish larger than 50 cm.

- A 1994 stream survey (fish habitat) reported a few small fish and a few crawfish.

- In July 1995, a juvenile fish survey performed by Friends of Tryon Creek State Park and supervised by ODWF reported 20 cutthroat up to 24 cm, 19 rainbow/steelhead up to 8.4 cm, and 69 sculpin. One large fish was reported in 1995.

- Surveys in July 1996 counted five cutthroat up to 25 cm long, four rainbow steelhead up to 8.4 cm, 124 sculpin, and one lamprey.

- Surveys in July 1997 counted 22 cutthroat up to 18 cm, four rainbow/steelhead up to 8.5 cm, and 145 sculpin. One redd, a gravel nest in a stream where salmonids deposit their eggs, was possibly seen in April 1997.

- No large fish were reported in 1998.

In 2002, ODFW conducted extensive (spring, summer, and fall) and intensive (summer) stream surveys in Tryon Creek (ODFW 2002) (Maps 14 and 15-Tryon Creek ODFW Survey Maps 1 and 2 by subwatershed, Map Atlas). Coho, Chinook, steelhead, and cutthroat were observed in different parts of Tryon Creek during different seasons of the year. Of all the salmonid species observed, cutthroat trout were most abundant, with population estimates of 53 individuals in spring, 36 in summer, and 24 in fall. Salmonid densities averaged 0.059 fish per square meter basinwide, and ranged from 0.047 fish per square meter in lower Tryon Creek to 0.068 fish per square meter at the confluence of Tryon Creek and the Willamette confluence reach. Although the stream reaches running through Tryon Creek State Natural Area and above resulted in lower biotic integrity (IBI) scores, species density per water surface area was relatively equal throughout all of the Tryon Creek Watershed. IBI reflects important components of an ecosystem; taxonomic richness (number of native families and number of native species present), habitat guilds (benthic species, native water column species, hider species, sensitive species, nester species, and proportion of tolerant individuals), trophic guilds (percent filter-feeding individuals and percent omnivores) and individual health and abundance (percent of target species and percent individuals with anomalies). Fish survey data is queried to make-up the IBI rankings and subsequent scores. Large numbers of steelhead, Chinook, coho and cutthroat were not encountered in Tryon Creek, but individuals are present and use Tryon Creek during all or parts of their freshwater life stage.

Wetlands

Wetlands, even those without any obvious surface connection to streams, contribute to watershed hydrology by storing and slowly releasing water into streams and groundwater. No jurisdictional wetlands have been identified in the upper Tryon Creek Watershed. In general, the steep gradient of Tryon Creek and its tributaries and the steep/hilly terrain of the watershed do not provide the necessary hydraulic connectivity and supply to allow formation of well-functioning wetlands. Most of the “wetland” type areas are in the stream corridor areas and mainly within Tryon Creek State Natural Area.

According to the 1989 national wetlands inventory prepared by the U.S. Fish and Wildlife Service, the only significant wetlands in the Tryon Creek Watershed are within the stream regime. The lower end of Tryon Creek is classified as riverine system, upper perennial subsystem, open-water class, non-tidal water regime, and intermittently exposed/permanent. The upper reaches of Tryon Creek and its tributaries are classified as palustrine system, forested class, broadleaf deciduous subclass (indicating non-tidal water regime temporarily/intermittently flooded and saturated semi-permanent or seasonal flooding).

Wildlife

The Tryon Creek Watershed provides shelter to several wildlife species, most of which are nocturnal (BES 1997; Pacific Habitat Services 1997; PSU 1995). Black bear, cougar, and Roosevelt elk existed before development. Today, the watershed is still home to smaller, more adaptive mammals. The greenspace of the West Hills and the forested refuge of Tryon Creek State Natural Area provide the primary habitat for the wildlife species in the watershed. The most common mammals are bats, beavers, blacktail deer, chipmunks, coyotes, flying squirrels, mice, moles, opossums, rabbits, raccoons, red foxes, shrews, skunks, and squirrels.

More than 60 species of birds reside within the watershed for at least a portion of the year. Birds are attracted to the variety of habitats found within the watershed's evergreen forests, deciduous woods, stream corridors, fringes of open fields, and numerous backyard birdhouses. Some of the birds found in the Tryon Creek Watershed include chickadees, Cooper's hawks, ducks, great horned owls, great blue herons, hummingbirds, jays, juncos, kingfishers, nuthatches, robins, sparrows, thrushes, towhees, warblers, waxwings, western screech owls, woodpeckers, and wrens (BES 1997; Pacific Habitat Services 1997; PSU 1995).

Smaller creatures often go unnoticed. Many live in the West Hills streams, in the humus of the forest floor, or high up in the canopy of Tryon Creek State Natural Area. The mild and damp conditions of the watershed are ideal for a number of amphibians and reptiles, including frogs, salamanders, snakes, toads, and turtles.

PUBLIC HEALTH AND SAFETY

Flooding

A major flood event occurred in the Portland metropolitan area in February 1996. It surpassed the conveyance capacity of numerous facilities citywide. Although the flood event caused severe landslide, streambank, and streambed damage to Tryon Creek and its tributaries, it did not cause any significant flooding or property damage in the watershed (BES 1998). The effects of flooding will likely remain the same in the future. Changing hydrologic conditions may continue to cause damage to the stream system in the watershed, but may not result in any significant flooding of properties. Property damage resulting from excessive rainfall could occur in the form of landslides on steep and unstable slopes and along stream channels.

Public Contact

No chronic public health advisories are linked to contamination of Tryon Creek or its tributaries. Advisories may be posted if any unacceptable bacterial contamination of the water occurs as a result of sanitary sewer breakage or leaks. However, such episodes are rare. During storm events, bacteria counts in the water can be high as a result of animal waste washing off into the creeks. Private septic systems are another potential source of bacterial contamination. A cursory review of BES and Water Bureau billings in the Tryon Creek Watershed shows that about 90 properties/structures (less than five percent) do not pay for sewer service, which may be an indication of properties on private septic systems.

WATER QUALITY

Water quality concerns in the Tryon Creek Watershed include:

- Stream temperatures do not meet state standard in the summer. The elevated temperatures are likely caused by very low streamflows during the summer months, warmer air temperature resulting from urban heat island effects, reduced riparian vegetation (and consequent lack of stream shading), and stormwater runoff from impervious surfaces exposed to sunlight.
- Bacteria levels sometimes do not meet standards. Potential bacteria sources include both human sources (illegal sanitary connections and dumping to storm drains and failing septic systems) non-human sources (birds, dogs, cats, raccoons, and other animals).
- Elevated levels of suspended sediments and nutrients (phosphorous and nitrogen), especially during storm events. Sediment smothers fish spawning beds and transports a variety of pollutants, such as oil, grease, metals and pesticides. Excess nutrients can contribute to low dissolved oxygen levels in the creek, which is harmful to fish. Sedimentation may result from vegetation removal, landslides, and erosion caused by increased stormwater runoff. Excess nutrients are probably associated with sediments and with runoff from landscaped residential areas.
- Stormwater carries pollutants from upland land uses, including residential areas and transportation corridors such as Interstate 5, Barbur Boulevard, and Terwilliger Boulevard.

Detailed descriptions of water quality conditions are provided in Chapter 9: Water Quality – Tryon Creek Watershed.

Beneficial Uses

Pursuant to Oregon Administrative Rules (OAR), the Oregon Water Resources Commission establishes the beneficial uses of waters of the state. Numeric and narrative water quality standards are designed to protect the most sensitive beneficial uses. The Oregon Department of Environmental quality (DEQ) has identified Tryon Creek and its tributaries as waters of the state. Table 2-12 identifies the designated beneficial uses for Tryon Creek and its tributaries.

Table 2-12
Designated Beneficial Uses of Tryon Creek

Public Domestic Water Supply
Private Domestic Water Supply
Industrial Water Supply
Irrigation
Livestock Watering
Anadromous Fish Passage
Salmonid Fish Rearing
Salmonid Fish Spawning
Resident Fish and Aquatic Life
Wildlife and Hunting
Fishing
Boating

Water Contact Recreation
Aesthetic Quality
Hydro Power
Commercial Navigation and Transportation

DEQ maintains a state 303(d) list that identifies water bodies that are "water quality limited" because they do not meet water quality standards for certain parameters. Tryon Creek is listed for temperature. DEQ is expected to establish a total maximum daily load (TMDL) for temperature in the Tryon Creek Watershed in 2004. The TMDL will require local jurisdictions to develop a temperature management plan to address the temperature problem in the creek. A TMDL may not be established if a temperature management plan is developed first; it is assumed that beneficial uses are not impaired as long as water quality standards are met.

Monitoring Data

BES established an instream water quality monitoring program in Tryon Creek in 1997. This monitoring is necessary to determine the existing status of water quality in relation to DEQ standards and criteria. The monitoring is also essential for watershed planning and impact assessment related to various management activities in the watershed.

BES's water pollution control laboratory collects monthly grab samples from Tryon Creek at Boones Ferry Road. The samples are analyzed for 13 water quality parameters (Table 2-13). Analyses can be performed for additional parameters or constituents if needed. Although most of the parameters are analyzed in the laboratory, some are monitored in the field.

In May 1998, BES installed a continuous temperature monitoring device to collect hourly temperature data from May through October. BES's water quality and temperature monitoring data are electronically stored and available for retrieval.

Table 2-13
Water Quality Monitoring Summary for the Tryon Creek Watershed

Parameter	Reporting Limit Units	Monitoring Frequency
Ammonia Nitrogen	1 mg/l	Monthly
Nitrate-Nitrogen	0.1 mg/l	Monthly
Nitrite–Nitrogen	0.01 mg/l	Monthly
Ortho Phosphorous	0.02 mg/l	Monthly
Total Phosphorous	0.03 mg/l	Monthly
Total Solids	1 mg/l	Monthly
Total Suspended Solids	1 mg/l	Monthly
E. Coli	2 CFU/100ml	Monthly
Temperature	Degrees Celsius	Hourly (May-Oct)
Dissolved Oxygen	0.1 mg/l	Monthly
Turbidity	1 NTU	Monthly

pH	0.1	Monthly
Conductivity	1 micro ohms/cm	Monthly

To further characterize pollutant loads from different land uses, BES established four stormwater sampling sites in the Fanno Creek and Tryon Creek Watersheds, representing the predominant land use types in these watersheds: residential, multi-family residential, commercial, and transportation (highways). Four storms were sampled at these sites between September 2000 and January 2001.

Modeling

No water quality models have been developed for the Tryon Creek Watershed, with the exception of pollutant load models for the city's National Pollutant Discharge Elimination System (NPDES) Stormwater Program. No specific water quality studies or assessments have been performed in the watershed to date. BES is currently completing a GIS-based pollutant load analysis and will develop physically based water quality models for the watershed.

Water Quality Assessment

Tryon Creek and its tributaries within the City of Portland are small headwater streams located within an urban environment. They exhibit many of the characteristics typical of urban streams, including altered flow patterns and degraded water quality. These characteristics result from changes in hydrology and increased pollutant loadings from urban development.

Point sources of pollution to Tryon Creek include two stormwater outfalls classified as major outfalls under the City's NPDES stormwater permit: WCMS #3826 – 243D and WCMS # 3826-367D. Combined, these outfalls drain an area of 368 acres (BES 1993) and discharge directly into Tryon Creek at Interstate 5 and the Pacific Highway in the upper part of the watershed. The City is required to calculate seasonal pollutant load, investigate illicit connections, and evaluate the need for pollution reduction facilities for stormwater mitigation. These two outfalls contribute much of the total suspended solids (TSS) watershed load that enters Tryon Creek in both the wet and dry seasons (as calculated by the NPDES Stormwater Program, based on land use).

Nonpoint sources of pollution are managed through implementation of the City's NPDES stormwater permit. This includes tracking stormwater quality in the watershed through analyses of land use, and implementing best management practices (BMPs). BES has developed a priority pollutant matrix for the Tryon Creek Watershed, based on a stormwater quality load model. The matrix lists priority pollutants from various land uses. Elevated temperature, nutrients, and TSS are listed as high-priority pollutants in the watershed. This matrix helps select appropriate BMPs and management strategies to address stormwater quality issues.

Previous studies have also shown that the Tryon Creek Watershed is seriously compromised because the large woody material has been depleted. The continued removal of wood from stream channels to facilitate recreation and facility maintenance destabilizes the channel and causes degradation. Under these conditions, each high-water event flows unchecked downstream, surging from side to side, eroding the streambank, and preventing the reestablishment of vegetation needed to help restabilize the channel. The loss of wood from

these streams also affects the transport and storage of sediments. Large wood functions to temporarily store sediments within the channel. It also functions to slow and back up water, forcing flows out onto the floodplain area where sediments settle out. These deposits provide sites for vegetation to establish (National Riparian Service Team 2001).

SEWERAGE INFRASTRUCTURE

Separate sanitary and stormwater sewer systems serve the Tryon Creek Watershed. The sanitary sewer conduits generally run down the main channels of creeks and tributaries. Flow can be directed either to the Tryon Creek Wastewater Treatment Plant (TCWTP) in Lake Oswego or the Columbia Boulevard Wastewater Treatment Plant (CBWTP) in Portland (BES 1999b). Treated effluent is discharged into the Willamette River under an NPDES wastewater discharge permit from DEQ. Stormwater from developed areas is conveyed by a network of storm sewers and roadside ditches into the streams (BES 1997).

Sanitary System

The Tryon Creek sewer system serves a total area of approximately 4,454 acres. Of this area, 217 acres are outside the watershed drainage boundaries. The sanitary sewer basin contains a mixture of land uses, with significant areas of commercial and multi-family development along the Barbur Boulevard/I-5 corridor, Capitol Highway, and the Multnomah district. About 90 structures in the watershed are served by private septic systems (PSU and Metro 1995; BES 1999b).

There are three primary sewer lines in the watershed: the Tryon Creek sanitary trunk, the Falling Creek collector, and the Arnold Creek collector (Map 10-Tryon Creek Existing Sanitary Sewer System Maps by subwatershed, Map Atlas). The Tryon Creek sanitary trunk is the primary north-south conveyance line servicing the basin and ranges from 18 to 30 inches in diameter. The Arnold Creek and Falling Creek collectors are the main branches to the Tryon Creek sanitary trunk below the diversion manhole at SW 31 St. Avenue. The Falling Creek collector ranges from 10 to 12 inches in diameter. It begins south of I-5 and follows Falling Creek until it meets the lower basin trunk at the intersection of SW Taylors Ferry Road and Spring Garden Road. The Arnold Creek collector ranges from 10 to 15 inches in diameter and collects flow in the lower southwest portion of the basin. It runs along SW Arnold Street until it joins the lower basin trunk at the intersection of SW Arnold and Boones Ferry Road (BES 1999b).

Sanitary System Deficiencies

Projected land use planning for the Tryon Creek Watershed calls for expansion of all the existing high-density uses along major corridors, as well as development of a multi-family residential corridor along SW Boones Ferry Road. The lower portion of the Tryon Creek sanitary basin is not likely to change noticeably because it is mostly in the Tryon Creek State Natural Area (BES 1999b).

There are few system deficiencies specific to the Tryon Creek sanitary basin. The Tryon Creek sanitary basin is linked to the Fanno sanitary basin, however, which has a direct impact on the operation and capacity of the Tryon Creek sanitary system. Deficiencies in the Fanno basin are described in Chapter 3 Hydrology – Fanno Creek Watershed.

Recommended/Planned Modifications to the Sanitary System

The PFP identifies a number of recommendations and planned modifications to correct the Tryon Creek sanitary system deficiencies. The Tryon Creek basin has one project currently listed in BES's Capital Improvement Program (CIP): the Vermont gravity sanitary trunk line project. This project will provide approximately 6,400 feet of 24-inch-diameter gravity sewer along SW Vermont Street between SW 50th Avenue and the new Fanno pump station. The project is divided into two phases. During Phase 1, a sewer line will be constructed from the existing Vermont Hills pump station (SW 55th Avenue) to the Fanno Creek trunk near the existing Fanno Creek pump station. Phase 2 will extend the 24-inch sewer east along SW Vermont to SW 50th Avenue.

Flow monitoring data have been collected in Tryon Creek sanitary basin as part of the PFP development. The infiltration/inflow (I/I) rates in three subbasins were determined to be 11,771, 14,643, and 21,040 gallons per acres per day, respectively. Inflow is water that is dumped into the sewer system through improper connections, such as downspouts. Infiltration is groundwater that enters the sewer system through leaks in the pipe. These rates are considered extreme by common practice. The TCWTP Facilities Plan (BES 1999c) includes specific recommendations associated with local capacity deficiencies and potential I/I reduction improvements.

Wastewater Treatment

The TCWTP is located within the Lake Oswego city limits just north of Foothills Road, adjacent to the Willamette River. The plant is owned and operated by the City of Portland and also serves areas outside the Tryon Creek Watershed. Roughly half of the flow to the TCWTP comes from the City of Portland's Tryon Creek, Fanno Creek, and Riverview sanitary sewer basins, which discharge to the 30-inch-diameter Tryon Creek interceptor. The other half originates in the City of Lake Oswego sewer service area and discharges to a 24-inch-diameter line. Treatment is provided for both Lake Oswego and the City of Portland, in accordance with an interagency contract.

The existing TCWTP is designed for an average dry weather flow of 8.3 million gallons per day (mgd), with the capability to treat hourly peak flows of 35 mgd for short periods of time. The current average dry weather flow is 7.6 mgd, which is about 92 percent of design capacity (BES 1999b).

A facilities plan for the TCWTP was prepared in December 1989, and an update was completed in June 1999. The updated plan assesses the adequacy of existing facilities through the year 2040 and identifies necessary capital improvements, including new or modified facilities to meet wastewater treatment needs through the year 2040.

The TCWTP does not have capacity problems in terms of meeting future growth needs. Improvements at the plant are primarily process improvements for reliability, energy and treatment efficiency, and odor control. Specific areas of improvement include new headworks equipment, including odor control, replacement of the aeration system with a new diffused air system, addition of a third secondary clarifier, and odor control for solids handling facilities.

Stormwater System

The Tryon Creek stormwater system consists of 27 miles of open stream channels, (EL to provide final figure) lineal feet of storm drain pipes, and 11 detention basins (BES 1999b) (Map 11-Tryon Creek Existing Storm Sewer Maps by subwatershed, Map Atlas).

Hydrologic models of the upper mainstem of Tryon Creek, Falling Creek, and Arnold Creek were developed as part of the *Upper Tryon Creek Corridor Assessment* (BES 1997). Modeling goals included evaluating the existing flows in relation to pipe capacities and evaluating channel flow velocities relative to factors affecting riparian habitat areas. Velocity information was used to evaluate the impact on stream channel morphology and capacity restrictions.

Stormwater System Deficiencies

Major development of the upper, hilly portion of the watershed has resulted in bank erosion, channel incision, bank failure, and landslides. Most downstream portions of the Tryon Creek Watershed are in Tryon Creek State Natural Area. Although this park remains in natural conditions, upstream development has had an impact on the stream channels within it.

The *Upper Tryon Creek Corridor Assessment* documents numerous localized areas of concern because of active erosion from streambank instability. The study included detailed site inspection of the Tryon Creek mainstem, Falling Creek, and Arnold Creek. A channel assessment was performed, using the Rosgen stream classification method for characterizing channel stability and habitat (Rosgen 1994). Streamwalks performed as part of the studies verified that routinely high velocities occur in the upper reaches of the urbanized creeks and tributaries, contributing to general stream degradation.

A comparison of the channel conditions with the hydrologic analysis indicated that several reaches have velocities exceeding seven feet per second (fps) over most of the reach during the two-year storm. Velocities in excess of seven fps are likely to cause severe erosion and accelerate the stream erosional process. The two-year storm was selected to demonstrate steady, continuous conditions rather than infrequent, short-duration conditions. Field observations generally confirmed that stream reaches that exhibited high velocities showed a higher level of degradation in terms of channel incision, unstable slopes, and lack of channel structure complexity.

Storm pipe and culvert capacities were evaluated based on conveying the 25-year storm. Ten out of 73 storm-modeled storm pipes and culverts on upper Tryon Creek were found to be undersized for existing flow conditions. Three reaches were modeled on Falling Creek; one storm pipe out of 12 was found to be undersized. No storm pipe or culvert was found to be undersized on the mainstem of Arnold Creek, and the tributaries were not modeled.

Locations of recent flooding (recorded from 1988 to 1996) correspond to the addresses of residents who have called the city to report property flooding or other stormwater system operational concerns. Most of these complaints have been mainly linked to storm pipe and culvert flooding, stream backup against roads, and/or other constrictions. Some complaints have also been recorded concerning localized basement flooding and standing water in the streets during storm events.

Recommended/Planned Modifications for the Stormwater System

The PFP recommends two projects to address stream channel protection and culvert replacement/upsizing. Efforts were also made to identify feasible stormwater detention sites. Only one site appeared to meet the criteria for size, location, and accessibility; however, it was not forwarded as a recommended detention project. The PFP planning process did not identify any stormwater quality projects.

PUBLIC INVOLVEMENT AND STEWARDSHIP

Partnerships among agencies and community groups provide opportunities for collaborative restoration, education, and technical assistance for local area residents. Free programs such as Naturescaping for Clean Rivers are available to help raise awareness about how individual actions, such as landscaping practices and pesticide use, influence watershed health. BES's Community Watershed Stewardship Grants Program supports community groups and citizens working to improve the health of Portland's watersheds.

Partners in the Tryon Creek mainstem subwatershed include the Tryon Creek Watershed Council, Friends of Tryon Creek State Park, Southwest Neighborhoods, Inc. (SWNI), neighborhood associations, SOLV, the National Oceanic and Atmospheric Administration (NOAA), Portland Parks and Recreation, Tryon Creek State Natural Area, Lewis and Clark College, BES's Watershed Planning, Revegetation, and Stewardship Grant Programs, schools, and neighbors. Active stewardship sites include Tryon Creek State Natural Area, Marshall Park, Tryon "Headwaters," Foley Balmer Natural Area, and four private property sites coordinated by SOLV (Primrose, Plum Pocket, Quail Creek, and Spring Garden).

Multnomah Village has examples of stormwater solutions, such as porous pavement at the Lucky Lab and bioswales with porous parking lot at the Multnomah Center. The Tryon Creek Watershed Council has ranked Reach 4 of the Tryon mainstem, extends from upper Tryon Creek State Natural Area to Taylors Ferry Road, as a high priority for restoration on private land.

Partners in the Arnold Creek subwatershed include the Tryon Creek Watershed Council, SWNI, neighborhood associations, Portland Parks and Recreation, BES's Watershed Planning, Revegetation, and Stewardship Grant Programs, schools, and neighbors. Active stewardship sites include Maricara Nature Park and Stevenson Elementary School (Naturescaped garden). West Portland Park and the Kerr site are additional Portland Parks sites that could host community stewards.

BES's Revegetation Program is working with private landowners along Oak Creek, a tributary to Arnold Creek. The Tryon Creek Watershed Council has ranked Arnold Creek as a high priority for restoration on private land.

Partners in the Falling Creek subwatershed include the Tryon Creek Watershed Council, SWNI, neighborhood associations, BES's Watershed Planning, Revegetation, and Stewardship Grant Programs, Jackson Middle School, and neighbors. Active stewardship sites include Jackson Middle School revegetation and a BES revegetation site along Falling Creek at Indian Hills. The Tryon Creek Watershed Council has identified upper Falling Creek as a high priority for

restoration on private land.

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