

Context & Trends

Chapter 2

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CHAPTER 2 – CONTEXT & TRENDS

This chapter describes the context for storm and surface water planning in Olympia. It starts with an overview of the physical setting: regional characteristics, geography, geology and soils, climate and precipitation, and watersheds. The second section describes land use and population trends, and the third section reviews the history of stormwater management in Olympia from the Utility's origin in 1986, evolving priorities since then, and current challenges.

2.1 Physical Setting

The Puget Sound region and landscape are the physical context for the Utility's work and shape its mission and goals. Understanding the opportunities, challenges, and limitations of regional geography, climate and precipitation, soils and geology is necessary to effectively manage flooding, improve water quality, and protect and enhance aquatic habitat.

Regional Characteristics

The Salish Sea is a large (6,900 square mile), ecologically rich inland sea that includes Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia in Canada (Map 2.1). The fjord of Puget Sound formed during the Pleistocene period through a number of glacial advances of the Fraser glaciation. The Vashon Stade was the last advance, reaching a maximum around 15,000 years ago extending as far south as Tenino. It retreated between 11,000 and 14,000 years ago. The topography, soils, and character of the Salish Sea ecosystem bear the mark of the region's glacial past.

Southern Budd Inlet was home to Salish villages and families who are the ancestors of the modern Squaxin Island Tribe and other local tribes. The abundance of natural resources – including fish, shellfish, game, and food plants in local streams, marine waters, upland forests, wetlands, and prairies – supported a significant indigenous population.

Geography of South Puget Sound

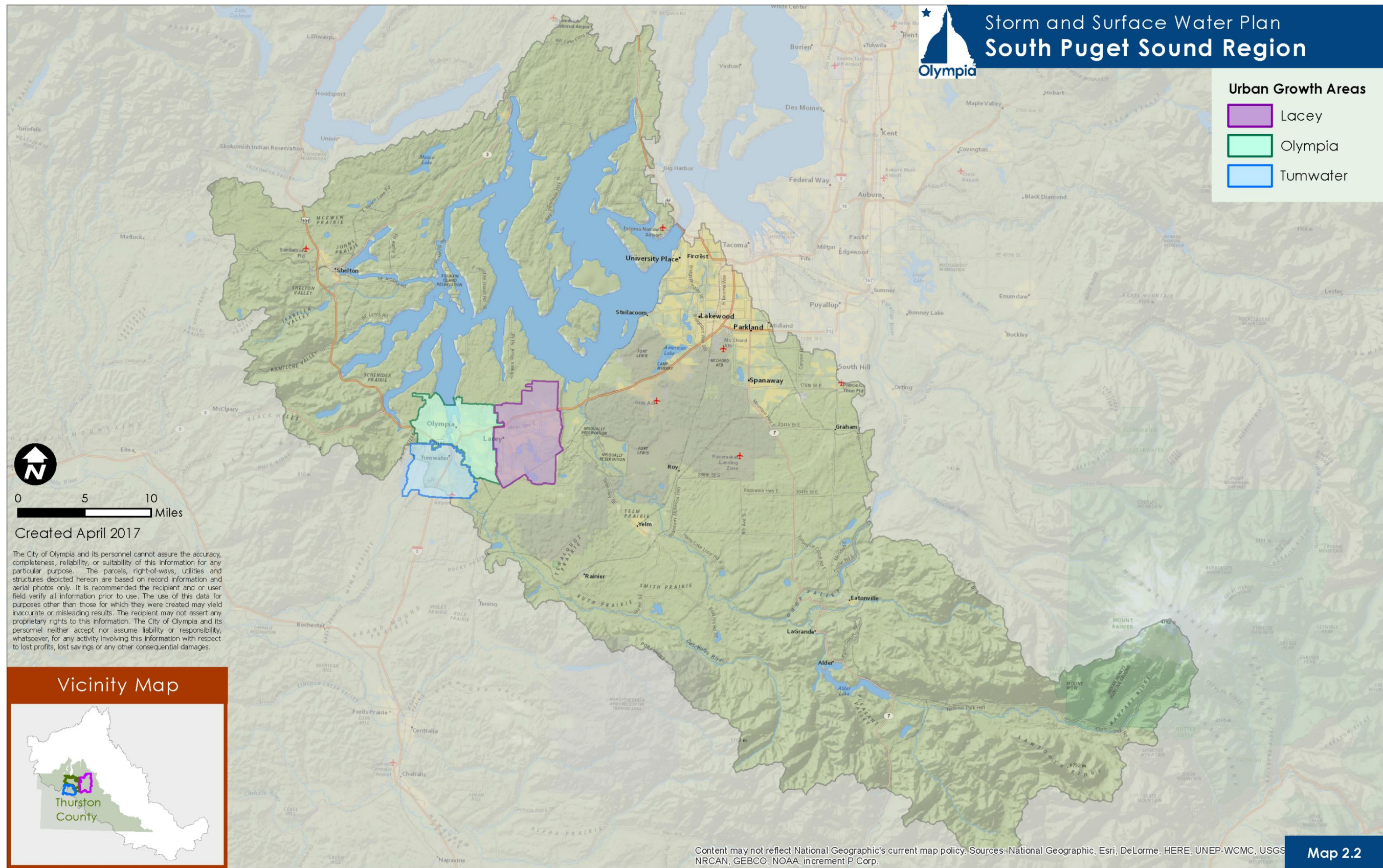
Olympia is located within Thurston County at the southern tip of the Puget Sound along the shores of Budd Inlet and the mouth of the Deschutes River (Map 2.1). Southeast of Olympia, the Black Hills rise to 2,664 feet at Capitol Peak. Most rainfall flows to Budd Inlet or the Deschutes River via eight major streams and many small creeks, which originate in or flow through Olympia, portions of Thurston County, and adjacent cities of Lacey to the east and Tumwater to the south. Part of west Olympia drains to Eld Inlet via Green Cove Creek, and part of east Olympia flows to Henderson Inlet via Woodard Creek and Woodland Creek. In urban areas, much of the rain falling on hard (or impervious) surfaces flows into pipes that lead to streams, wetlands, or Puget Sound.

Tidal range within Puget Sound varies greatly from north to south due to the influence of its bathymetry, length, and configuration of interconnected basins and channels. This large, complex fjord restricts south end flushing and contributes to higher tides in Budd Inlet. Olympia's tidal amplitudes are roughly 75 percent greater than in Port Townsend, near the entrance to Puget Sound. High tides up to 16-17 feet MLLW and low tides down to -4 MLLW occur yearly in Olympia. The maximum tidal range on a yearly basis is over 20 feet with a mean tidal change of 10.5 feet per tidal cycle.

Within the city are over six miles of marine shoreline, four major lakes, eight streams, and many acres of wetlands. A number of closed depressions – remnants of the region's glacial history – exist throughout the area as lakes (e.g. Ward and Hazard) or wetland kettles; there is no surface water outlet to streams in such areas. Upland areas are on a flat glacial plain ranging from 0-380 feet in elevation (North American Vertical Datum of 1988, NAVD88). Between 1893 and 2007, 15 dredge and fill projects added 434 acres and 1.9 miles of shoreline to downtown Olympia, including most of the Port of Olympia peninsula (TRPC 2008).



Map 2.1 Salish Sea & Surrounding Basin, 2009
 Source: Stefan Freelan, Western Washington University.



Map 2.2 South Puget Sound Region
Source: Puget Sound Partnership GIS data

Geology and Soils

The geology of Olympia and Thurston County is largely the result of glacial activity. Materials deposited during many successive glacial periods vary from fine-grained sand and clay to gravel and boulders. These materials are dispersed throughout the area in a complex series of geologic formations created by thousands of years of land, water, and ice movement.

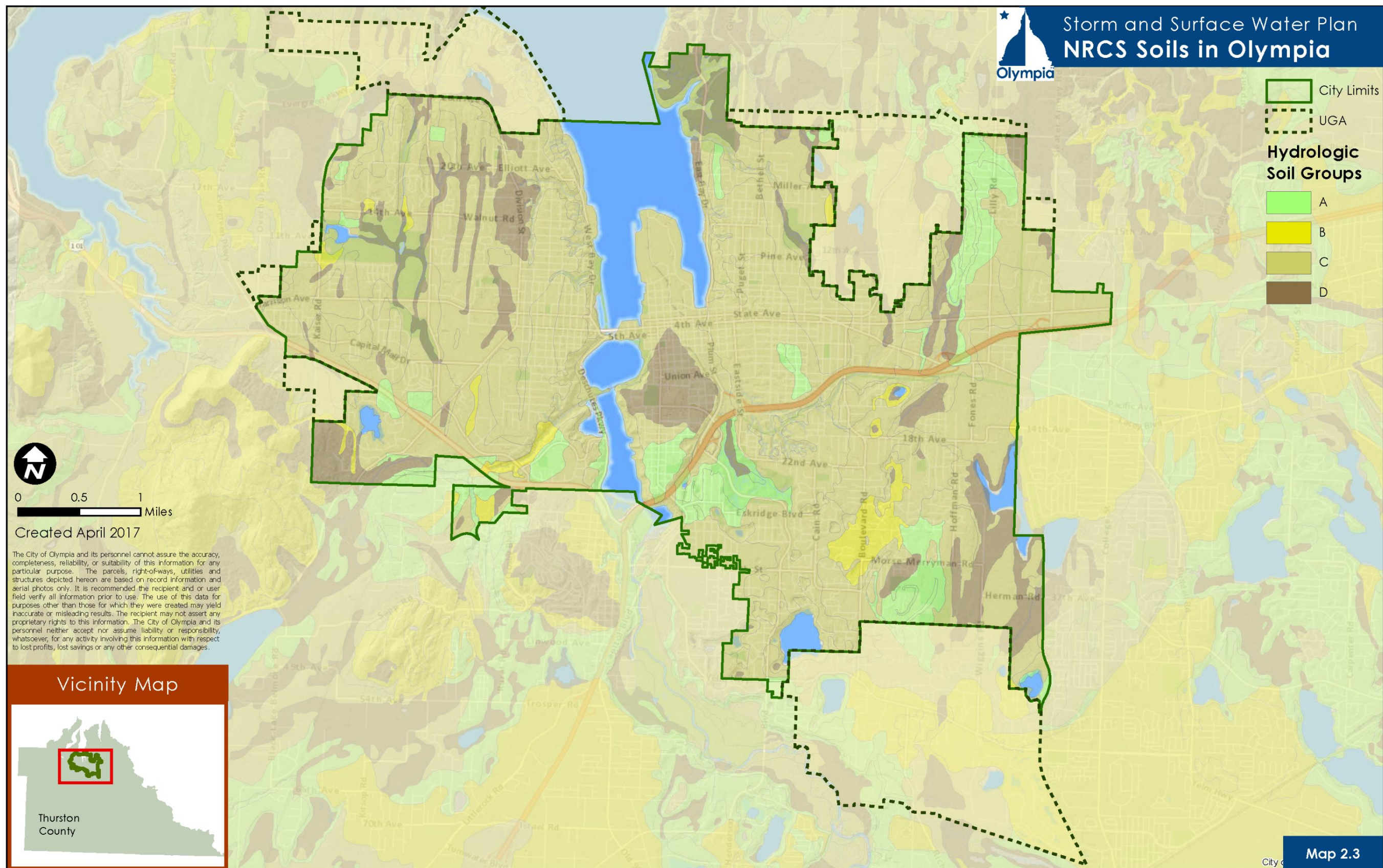
Soils formed as the result of glacial movement and deposition, are primarily glacial outwash, highly compacted glacial till, or lake-derived deposits of clay and silt. Outwash is the loose gravel and sand moved around by glacial meltwaters as the ice receded. Outwash is typically relatively deep and generally well-drained. Till, also known as hardpan, is a compacted and consolidated subsoil (sand, gravel, silt and clay) formed by the weight of glacial ice over 10,000 years ago. Till, clay and silt soils are slow draining.

Soils are grouped into hydrologic soil groups ranging from Group A - high infiltration rates and low runoff potential (outwash) to Group D – low infiltration rates with high runoff potential (e.g. saturated soils). Groups B (e.g. lake deposits) and C (e.g. till) have moderately low infiltration rates and high runoff potential (Map 2.3).

Groundwater

Many geologic formations are permeable and contain Olympia's significant aquifers. Major portions of Olympia are underlain by shallow hardpan (glacial till) with limited infiltration capacity, which often results in perched groundwater. Aquifer recharge areas contain permeable soils that allow rainfall and infiltration to recharge groundwater. These are primarily located in outwash soils and other permeable soils. Groundwater predominately flows from precipitation-driven recharge areas in southern Thurston County north toward Puget Sound. This water discharges to the larger rivers, streams, shallow lakes, natural seeps, and springs (e.g. at Watershed Park), and directly to Puget Sound. The combination of steep glacially formed bluffs, and soil conditions with varying drainage characteristics creates perched water tables and seepage along slope faces. This combination often leads to shallow landslides in the wet winter months. Slope stability along shoreline bluffs is a concern throughout the Puget Sound region.

Olympia relies heavily on groundwater to supply municipal drinking water. Groundwater directly connects with the surface via lakes, streams, wetlands, seeps, and springs. The aquifers under Olympia are both confined and unconfined. Confined aquifers drive the artesian conditions of many wells in low-lying areas along the Deschutes River and Budd Inlet. Additional information on local groundwater conditions can be found in Olympia's 2015-2020 Water System Plan.



Map 2.3 Hydrologic soil groups in Olympia
Source: Natural Resource Conservation Service Soil Survey GIS data

Climate and Precipitation

Olympia's climate is tempered by weather coming from the Pacific Ocean. Summers are warm and dry with infrequent hot days. Winters are cool and wet with abundant precipitation between November and March. Typically, one or two cold periods each winter bring snow and freezing weather. Average January high/low temperatures are 44°/32° F and average August high/low temperatures are 78°/50° F.

Olympia's climate is characterized by wet mild winters with frequent storms arriving from the Pacific Ocean and dry warm summers with little rainfall. The combination of warm dry summers and cool wet winters, glacial history, and underlying geology has shaped the region's landscape, native forests, plant communities, soil characteristics, and water resources.

Olympia's 50-inch average rainfall is significantly greater than Seattle's 38 inches (<http://wrcc.dri.edu>). This is because Olympia is almost directly in the path of Pacific storms coming through the Chehalis Valley from the coast, while Seattle lies partially in the rain shadow of the Olympic Mountains. Pacific storms each fall and winter can bring heavy precipitation events, called atmospheric rivers, which funnel tropical moisture toward the Pacific Northwest. Winter snowfall averages 18 inches at the Olympia Airport (1948-2015), but is highly variable from year to year with significantly less in most recent years. Rainfall varies across the city, in some places higher (typically to the west) and in others lower (typically to the east) than at NOAA's official Olympia Airport weather station.

Climate change may be influencing and likely continue to influence weather in Olympia in the future, with warmer temperatures, drier summers, and wetter winters. See Chapter 6 and 8 for details.

Table 2.1 Olympia Precipitation

Month	Olympia Airport (SE) Monthly Average (2000-2014) ¹	South Bay Fire (NE) Monthly Average (2006-2014) ¹	County Courthouse (SW) Monthly Average (2001-2014) ¹	Green Cove/ Kaiser Rd (NW) Monthly Average (2002-2013) ¹	Olympia Airport Average Daily Maximum (Highest) (1948-2015) ²
October	4.49	4.17	4.85	5.29	1.23 (4.12)
November	8.34	8.58	8.06	9.46	1.68 (4.33)
December	7.54	6.39	7.30	8.16	1.67 (3.5)
January	7.72	5.52	8.18	8.87	1.53 (4.82)
February	3.97	4.39	3.98	3.50	1.25 (3.64)
March	5.67	5.78	5.96	6.75	1.11 (3.40)
April	3.47	3.11	3.71	3.57	0.82 (3.11)
May	2.74	2.97	2.86	2.84	0.59 (1.54)
June	1.73	1.43	1.40	1.39	0.57 (1.60)
July	0.53	0.51	0.55	0.38	0.34 (1.34)
August	1.13	0.83	1.11	1.01	0.49 (1.38)
September	2.38	2.79	2.32	2.52	0.68 (2.93)
Annual	49.71	46.47	50.28	53.74	2.51 (4.82)

Measurements are in inches.

¹ Source: <http://www.co.thurston.wa.us/monitoring/precip/precip-home.html> (January 2017). Average maximum day per year and extreme maximum day in period of record shown (1948-2015).

² Source: <http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wa6114> (June 2016).

Watersheds (Basins)

Rain in Olympia runs off hard surfaces, infiltrates into the ground, evaporates, or is used by plants. The area that flows to a given stream, river, or lake is called a watershed. Management of flooding, water quality, and aquatic habitat requires knowledge and watershed-scale evaluation. Most of Olympia's 12,622 acres (19.7 square miles) drain to Puget Sound, primarily to Budd Inlet. Smaller areas flow to Eld and Henderson Inlets. A few watersheds are contained within the City, while others span multiple jurisdictions. See Table 2.2 and Map 2.4.

A watershed's landscape conditions, land uses, and stormwater infrastructure (or lack of) has a large impact on flooding, water quality, and aquatic habitat conditions within and beyond its borders. See Appendix 2 for a detailed description of the various watersheds in Olympia. See also Chapters 4 and 8.

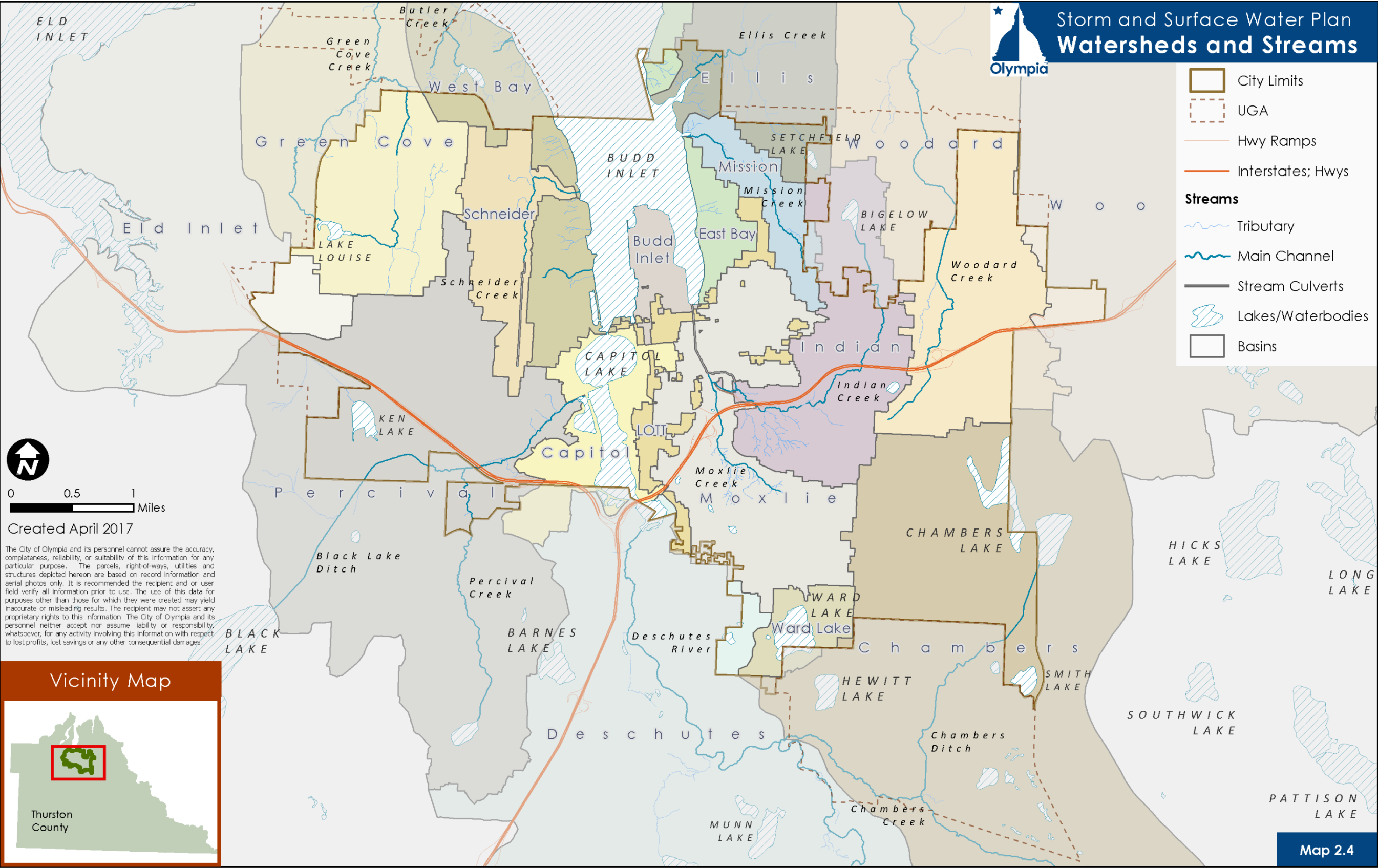
Many smaller drainage basins make up each larger watershed. Rainfall from these smaller basins flows into catch basins and ditches or filters into the ground. Water that filters into the ground recharges shallow aquifers, contributes to stream flow in dry periods, and provides water for seeps and wetlands. In urban areas, these important sources of shallow ground water are often greatly reduced or lost, impacting the health of aquatic habitats. Stormwater that does not infiltrate is conveyed by pipes and ditches to ponds, streams, lakes, or Puget Sound. Managing stormwater often occurs on this smaller basin scale.

Table 2.2 Olympia Watersheds

Name	Total Basin Area (Acres)	Area in City (Acres)	Other Jurisdictions
Budd Inlet*	4,675	1,086 (23%)	Thurston County
Capitol Lake	519	378 (73%)	Tumwater
Chambers Creek	7,559	917 (12%)	Lacey, Thurston County
Deschutes River	81,964	112 (.01 %)	Lacey, Tumwater, Thurston County
Eld Inlet	3,621	243 (7%)	Thurston County
Ellis Creek	1,441	292 (19%)	Thurston County
Green Cove Creek	2,530	1,042 (41%)	Thurston County
Indian Creek	1,322	1,001 (76%)	Thurston County
Mission Creek	406	374 (92%)	Thurston County
Moxlie Creek	1,562	1,541 (99%)	Tumwater
Percival Creek	5,340	1,713 (32%)	Tumwater, Thurston County
Schneider Creek	635	635 (100%)	NA
Ward Lake	226	201 (89%)	Thurston County
Woodard Creek	5,211	1,733 (33%)	Thurston County, Lacey
Woodland Creek	10,462	135 (1%)	Thurston County, Lacey

*Budd Inlet includes East Bay and West Bay

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data



2.2 Population and Land Use

Management of storm and surface water is directly affected by the size and growth of population and current and projected land use.

Population

In 2015, the estimated population of Olympia was 51,020 residents, with another 11,900 living in Olympia's Urban Growth Area (UGA). Forecasters expect the City population will increase to 68,410 by 2035, a rate of approximately 1.5 percent per year. Including Olympia's UGA, population could increase by approximately 2 percent per year to a total of 84,400 by 2035. Most this increase will be due to in-migration. People are attracted to living in Olympia because of the relatively stable economy, beautiful environment, friendly and safe neighborhoods, good schools, and living costs lower than cities to the north.

Demographic data presented here includes total population, number of single-family and multifamily households and total employment within Olympia City limits. Table 2.3 shows the current and projected demographics at specific planning horizons from 2015 to 2035.

Table 2.3 Olympia Population and Employment (2015-2035)

Year	Population	Single-family Households	Multi-family Households	Employment
2015	51,020	12,677	11,497	55,167
2025	60,750	14,903	14,651	62,485
2035	68,410	16,581	17,102	70,793

Note: Numbers do not include Olympia's Urban Growth Area.

Source: Estimates are based on the Thurston Regional Planning Council (TRPC) November 2012 data set.

Land Use

In cooperation with Olympia, Lacey, and Tumwater, Thurston County has established and periodically reviews Urban Growth Area boundaries. In these areas, urban growth is encouraged; outside of them, rural densities and services will be maintained.

Olympia and its Urban Growth Area total about 16,000 acres. This includes about 12,000 acres within City limits and about 4,000 acres in the unincorporated area, which may eventually be annexed into the City.

The growth and development of the City is guided by the Olympia Comprehensive Plan. Since most readily buildable parcels in the City are already developed to some degree, the Comprehensive Plan anticipates that most growth will be accommodated by more infill and redevelopment of already developed areas. Infill and redevelopment provides opportunities to restore degraded environments and invest in improving existing infrastructure and managing it more effectively.

The Comprehensive Plan focuses higher residential densities downtown, along urban corridors, and near neighborhood centers. It encourages commercial development along urban corridors, and directs industrial development along Budd Inlet, Fones Road, and at Mottman Industrial Park.

To ensure that the urban areas within Thurston County are large enough to accommodate 20 years of projected growth, Thurston County Regional Council periodically prepares a land capacity analysis. According to the Buildable Lands Report 2014 for Thurston County, new residential growth within the Olympia city limits reached a density of 6.45 units per acre from 2001-2005, increasing to 8.58 units per acre between 2006-2010. This level of residential density is expected to remain steady or increase slightly into the future as residential development occurs. The Buildable Lands Report concludes that the City of Olympia and its UGA has 20 percent more land available for residential development than required to accommodate the growth expected through 2035.

Since the Utility's inception 30 years ago Olympia has continued to urbanize and the storm and surface water issues facing the Utility have become more urban in nature. The next 30 years will continue to bring additional people and increased density to the City. As the population increases, the likelihood of flooding and water quality and aquatic habitat impacts will also increase. Due to limited land, redevelopment may be more common than new (Greenfield) development. Redevelopment offers opportunities to improve conditions by retrofitting to correct the lack of stormwater management by reducing the impacts of prior development.

2.3 History of Storm and Surface Water Management in Olympia

This section reviews the history of storm and surface water management, from the early days of little or no regulation, to the formation of the Utility, and the impact of federal laws and regulations to protect the health of natural resources and people. It summarizes the evolving priorities of the Utility over the past 30 years.

Creation of the Utility

The Storm and Surface Water Utility was formed in 1986. Prior to the mid-1980s, stormwater management focused on the conveyance of runoff to nearby streams, lakes and wetlands. Stormwater systems were often inadequately constructed to manage high flows and little thought was given to the water quality and aquatic habitat impacts of stormwater. As a result of increased development in Olympia in the 1970s and 1980s, runoff began overwhelming the stormwater system on a frequent basis. Property damage was common. Community concerns highlighted the need for better regulations and designs to minimize flooding. Simultaneously, the scientific community began to better understand the detrimental effects of stormwater on water quality and aquatic habitat. In 1990, Olympia responded to the need for better stormwater management by strengthening the role of the stormwater utility. More rigorous expectations for flood management, water quality improvement, and aquatic habitat protection were established through community dialogue and elected official mandates.

During this period, the Washington Department of Ecology (Ecology) began providing local jurisdictions with better scientific research and regulation for new development. Since 1992, Olympia has adopted and implemented several iterations of increasingly rigorous stormwater management design regulations.

The Utility developed its first *Storm and Surface Water Management Plan* in 2003 that, with minor revisions in 2010, has guided the Utility until today.

2003 Plan and 2010 Update

The 2003 Plan provided an organizational structure and policy direction for the Utility's programs and projects.

The objectives for the 2003 Plan were to:

- Provide a management vision and approach that reflects community expectations for the Storm and Surface Water Utility's future.
- Refine the understanding of current and potential flooding, water quality, and aquatic habitat problems faced by the Utility.
- Propose actions that will comply with regional, State, and federal requirements for storm and surface water management.
- Define services for flooding, water quality, and aquatic habitat management.
- Identify appropriate and cost-effective solutions for accomplishing preferred services.
- Include a process that enables the Plan to be regularly reviewed and revised in order to adapt to emerging information, problems, and regulations.
- Provide a basis to obtain adequate long-term funding for the Utility.
- Provide ongoing opportunities for internal and external customers to learn about stormwater issues, to participate in identifying problems and solutions, and to influence the future of the Utility.

In 2010, the Utility refined the guidance provided by the 2003 Plan by revising the Plan's water quality and aquatic habitat goals.

The 2003 Plan objectives remain relevant. However, the continued increase in State regulatory requirements and ongoing competition for financial and staff resources have created the need to completely update the 2003 Plan.

Evolving Utility Priorities

Early efforts in stormwater management focused on protection of public safety, health, and protection of property from flood damage. This approach often had negative impacts to downstream areas and habitat. Environmental concerns would not become the focal point for managing excess runoff until years later.

The Utility's success at resolving flooding problems during the last 15 years has created an opportunity to focus increasingly on water quality improvement, habitat protection, and scheduled replacement of aging pipe systems. Community expectations and regulations for managing stormwater have increased dramatically, resulting in a more holistic look at stormwater management and aquatic systems.

Flooding: Original Priority

The effectiveness of the City's stormwater system at managing flooding and protecting the natural environment varies depending on location. Private developments and City capital improvements constructed prior to the mid-1980s were required to provide only modest stormwater conveyance capacity, no water quality treatment, and very minimal storage of runoff in constructed ponds.

Since the advent of Ecology stormwater requirements and the implementation of drainage and erosion control standards for new development, the severity and frequency of flooding has been significantly reduced (see Chapter 6).

Water Quality: Increasing Levels of Stormwater Treatment

Stormwater and wastewater in South Puget Sound was not treated prior to the early 1950s when the first wastewater treatment plant went into operation on Budd Inlet. In the 1970s, discharge of pollutants from industrial point sources began to be regulated, following the adoption of the federal Clean Water Act.

Regulation of non-point pollution was minimal until after the 1989 *Puget Sound Water Quality Management Plan* was approved by the Washington legislature. Based on this plan, Ecology adopted its *Stormwater Management Manual for the Puget Sound Basin* in 1992. The Ecology manual established the first requirements for water quality treatment in the form of best management practices for stormwater including infiltration, sedimentation (wet ponds and wet vaults), and filtration by vegetation. Subsequent stormwater management manuals have further honed the levels of required treatment, adopted emerging treatment technologies, and established computer modeling procedures for sizing treatment facilities.

Olympia's current *Drainage Design and Erosion Control Manual*, adopted in 2016, requires new development to incorporate low impact development (LID) techniques. LID techniques encourage infiltration and onsite retention to reduce stormwater runoff. Water quality benefits from LID are associated with the reduced volumes of pollutant-laden runoff that may be transported to surface waters. See Chapter 6 for details about LID and other drainage manual requirements.

Aquatic Habitat

Capital funds were allocated annually for the purchase of aquatic habitat lands from the late 1990s until 2010. In 2012, with support from the Utility Advisory Committee (UAC), the Utility began reviewing potential opportunities for protecting and improving habitat. The 2013 *Habitat and Stewardship Strategy* recommended reorienting the capital funding focus toward habitat stewardship and restoration, in addition to land acquisition. Since then capital funding for land acquisition, as well as stewardship and enhancement has increased. Capital habitat projects have included hiring a Washington Conservation Corps crew to manage riparian and wetland vegetation and improving fish passage in local streams. Stormwater retrofit projects also benefit downstream aquatic habitats.

In 1999, the Puget Sound Chinook salmon and bull trout were listed as threatened under the Endangered Species Act (ESA). In response to a growing awareness that Puget Sound was in serious trouble, the Legislature created the Puget Sound Partnership in 2007. The Puget Sound Partnership is responsible for coordinating and leading the effort to protect and restore Puget Sound. Local municipalities are on the front line for addressing impacts to Puget Sound through actions such as growth management planning and managing surface water runoff. The Utility has an important role in implementing effective stormwater management practices and participating in salmon and ecosystem recovery efforts to meet the expectations of the ESA and to improve the health of Puget Sound.

2.4 Current Challenges

The Utility has made considerable progress in its first 30 years. As it embarks on its next phase, the Utility faces numerous challenges arising from the context and trends described above. The key challenges are listed below. For more details on these challenges and “Why” they are important to address in coming years, see Chapters 5-8 and 12.

General Challenges

- **Equitable and Predictable Rates and Fees.** Creating predictability for customers and developers is difficult in a complex and changing regulatory environment, with fluctuations in the amount of grant money available to fund Utility programs. (See Chapter 12.)
- **Legacy Development.** Most of Olympia’s stormwater infrastructure was constructed prior to current rigorous storm drainage design regulations. In older developed areas, subdivisions and infrastructure were constructed without stormwater treatment or wetland and stream protection and often lack the capacity to handle the increased runoff resulting from growth. Retrofits of older neighborhoods with modern stormwater control and treatment systems are a logistical and financial challenge, but are often necessary to improve flooding, water quality, and aquatic habitat conditions. The worst remaining legacy flooding problems are on Black Lake Boulevard, the Lakemoor subdivision and along Division Street. (See Chapters 6, 7, 8.)
- **Reliance on Choices by Individuals.** The Utility’s work is highly influenced by the cumulative impact of individual behaviors. Decisions about the extent of impervious surfaces on a property and care in keeping storm drains clear of debris can impact flooding. Decisions about yard care practices, onsite sewage system maintenance, car care, and driving habits all can impact water quality. Decisions about landscaping, tree planting or removal, and weed control can impact aquatic habitat. This dynamic adds to the complexity of the Utility’s work. (See Chapter 6, 7, 8.)
- **Land Development Pressure.** To protect agriculture and natural resources, including habitat, Washington’s Growth Management Act (GMA) requires population growth to be focused in urban growth areas like Olympia. Urban development continues to increase impervious surfaces, threatening further loss of forests and wetlands, curtailing the functioning of natural systems and impacting surface water quality. Increasing population densities will both create challenges for water quality and provide opportunities to retrofit and provide flow control and treatment. (See Chapters 7 and 8.)
- **Climate Change and Sea Level Rise.** Changing climate in the Pacific Northwest likely will influence aquatic habitats due to warmer temperatures, reduced precipitation in the summer, increased precipitation in other seasons, and a rising sea level. Older stormwater infrastructure will be the most vulnerable to overflows associated with more frequent and intense storm events, which could result in more localized flooding. Current science indicates that sea levels in Puget Sound may rise between 20 and 55 inches by 2100. The need for community awareness, education, and response regarding sea level rise will increase in the years to come. In order to make timely long-term decisions, City government and the public need to understand the dynamics of climate change and sea level rise. The Utility has a key role in undertaking the necessary research and strategic planning. (See Chapters 6 and 8.)

Flooding Challenges

- **Asset Management.** Properly functioning stormwater treatment and conveyance systems help to mitigate the negative impacts of development by moderating flows and removing sediments and pollutants before the stormwater enters water bodies. As facilities age, their functioning can be impacted. Understanding the condition of the Utility's stormwater infrastructure (both built and natural) informs replacement and maintenance decisions and is referred to as "asset management." Although significant staff effort has been dedicated to improving the Utility's understanding of the stormwater infrastructure, additional work is required to fully implement a robust asset management program. (See Chapter 6.)
- **Limitations of Low Impact Development (LID).** LID is a land planning and engineering design strategy that uses on-site natural features like bioswales and rain gardens to lessen the impact of development on stormwater quality and quantity, thereby mimicking pre-development conditions. LID practices may benefit water quality, but these are secondary to controlling the flow of stormwater. LID facilities are designed to be smaller and more numerous than centralized stormwater ponds to increase infiltration of rainwater over a larger area. The City's 2016 Drainage Manual requires LID in all new development. The sheer number of such facilities and the intensive maintenance required will likely make LID facilities more complex to manage than past stormwater facility designs. (See Chapter 6.)

Water Quality Challenges

- **Increasing Permit Requirements.** Many aspects of the Utility's work are mandated by the federal Clean Water Act. To discharge stormwater into "waters of the United States," the City must obtain and keep current a National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Discharge Permit (Permit). Permit requirements are continually being revised and expanded. Because more and more of the Utility's resources are needed to implement the Permit, significantly less discretionary staff time and budget is available for other aspects of the Utility's work. (See Chapters 5 and 7.)
- **Reliance on Public for Nonpoint Pollution Prevention.** The Utility is challenged in helping people understand their contribution to nonpoint sources of pollutants and the impact individuals have on water quality. The actions of the individual citizen through daily living activities like vehicle maintenance, lawn care, chemical management and pet care can contribute to either improving or degrading water quality. (See Chapter 7.)

Aquatic Habitat Challenges

- **Multiple Public/Private Ownership.** Habitat is located within a complex landscape of many large and small parcels, public and private ownership, and developed and redeveloping neighborhoods, commercial districts, and industrial areas. The Utility has limited authority on private property and must rely on voluntary programs, education and outreach, and incentives to encourage stewardship on private properties. (See Chapter 8.)
- **Habitat Fragmentation.** Large intact habitat areas are important for both wildlife and protection of aquatic resources. These core areas provide nesting/breeding, foraging, and resting habitat for wildlife, and protect water quality and hydrologic functions. Large habitat areas in Olympia are primarily located on public lands. Maintaining and improving the habitat quality of these areas requires tools and strategies that work across the landscape. (See Chapter 8.)

- **Habitat Impacts of Legacy Urban Development.** The changes brought by development of Olympia over the last 100 plus years have had a large impact on aquatic habitat. Budd Inlet was filled and dredged, shoreline armored, sections of streams placed in pipes, wetlands drained, and forests and natural vegetation converted to homes, businesses, roads and other infrastructure. These changes have vastly altered the landscape and hydrology of Olympia. The Growth Management Act encourages development in cities and urban growth areas rather than rural areas of the State. Working to maintain functional habitat in an urban landscape is challenging and requires creativity and flexibility to protect remaining habitat areas and maintain their health, while working to enhance and restore key habitats where possible (See Chapters 5 and 8).