Source Watershed Control Plan

City of Ilwaco

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Prepared for:

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1. Introduction

1.1 Background

Implementation of this Water Source Control Plan will protect the City's drinking water supply and the health of water system users. It is typically more efficient to protect drinking water in the source watershed than it is to treat dirty water or to find and replace a drinking water supply.

Communities using surface water for their drinking water are required to ensure adequate source watershed protection under the Safe Drinking Water Act and the Washington State Group "A" Public Drinking Water Supplies Rule, WAC 246-290. Protecting drinking water at its source is the first part of a "multi-barrier" line of defense including treatment and monitoring. State of Washington Department of Health gave Ilwaco's watershed a low susceptibility rating in 2014.

The multi-barrier approach uses a series of technical and managerial barriers to prevent contamination of the drinking water source and distribution system. The overall philosophy is that by having multiple means of preventing contamination, if one approach fails, consumers will still be protected. The multi-barrier approach includes:

- Risk Prevention: Select and protect the best source of drinking water.
- Risk Management: Install and operate effective treatment technologies, properly design and construct facilities, and employ trained and certified operators.
- Monitoring, Compliance & Enforcement: Use a combination of monitoring that includes source water, finished water, distribution system, and tap monitoring to detect and fix problems.
- Individual Action: Empower customers with information on drinking water quality and health effects of contaminants, and provide opportunities for customers to be involved in water system decision-making.

1.2 Watershed Control Program Requirements

In Washington State, under WAC 246-290, drinking water supply systems using a surface water source must develop and implement a watershed control plan in order to protect the water supply and the health of the water system customers. Protection of the City's source watershed ("watershed") can be accomplished through monitoring, limiting, and controlling to the best extent possible, all activities that may pollute the source water.

This plan complies with Washington State's watershed control program requirements. Regulatory criteria against which Ilwaco's source water protection is evaluated are provided in Washington's Administrative Code.

- WAC 246-290-135, Source Protection
- WAC 246-290-668, Watershed Control
- WAC 246-290-678, Reliability for Filtered System

In accordance with WAC 246-290-135(4), the City's Watershed Control Plan must include a description of the source protection area, hereafter referred to as the watershed, including information on its location, hydrology, land ownership, and any activities that may adversely affect source water quality. The state regulations also require a description of any and all written agreements, monitoring activities, and water

quality information, and a plan for protecting water quality in the protection area.

WAC 246-290-668 requires an evaluation of the Source Watershed Control Plan at least every six years. All changes in the watershed over the previous six years, and changes that affect water quality, must be described. New or improved knowledge about the watershed and its functional characteristics, including hydrology, should be incorporated into a new Source Watershed Control Plan. The purveyor must also have a monitoring program in place to assess the adequacy of the Source Watershed Control Plan.

The Source Watershed Control Plan is an amendment and addition to the 2011 City of Ilwaco Water System Plan.

2. Source Water System

The City collects its water from Indian Creek and its tributaries. Water is impounded by a dam and treated at an on-site water treatment facility. The water diverted for the City of Ilwaco would otherwise continue flowing through Indian Creek to the Bear River. The Bear River empties into the southern end of Willapa Bay. Treated City wastewater is discharged into Baker Bay. The Bear River is a minor source of water for Willapa Bay, which is supplied primarily by the North River, Nasselle River, and Willapa River. Willapa Bay is an estuary significant for its fishing, oyster farming, wildlife refuge, and recreational opportunities. The City is required by its water right to bypass a minimum flow into Indian Creek.

The City's drinking water intake is located behind the dam. Raw water from the impoundment flows by gravity to the water treatment plant. The water is filtered, disinfected using hypochlorite, and routed to a storage tank before flowing to the City's distribution system. The Indian Creek treatment facility currently has a production capacity of 1.5 mgd with both filters operating and water rights for 1.5 mgd.

Storage

Untreated water is stored in the Indian Creek Impoundment. The 60-foot-high earth dam is 750 feet long at the crest and 400 feet long at the base. The reservoir impounds 29.5 acre-feet (9.6 million gallons) of water at low pool (Elev. 45 feet), 847 acre-feet (276 million gallons) at normal pool (Elev. 90 feet) and 1,022 acre-feet (333 million gallons) at maximum pool (Elev. 94.7 feet). The reservoir covers 5.07 acres at low pool, 35.19 acres at normal pool and 48.39 acres at maximum pool.

In order to mitigate any adverse effects to aquatic spawning and rearing habitat, reservoir filling is limited to December, January, and February, with filling evenly distributed over these months. Stream water is not allowed to be diverted to the reservoir for filling during the salmon migration periods of October/November and March/April/May.

Intake

The reservoir has been designed so that 97 percent of the storage capacity can be released by gravity. An 18-inch steel pipe, encased in 10 inches of reinforced concrete, is located at an invert elevation of 22 feet (approximately 15 feet below the dam base). This pipe can remove 97 percent of the storage in a 10 to 20 day time period depending on inflow to the dam. The intake has two 12 inch diameter inlets that are screened. The pipe inlets are located at elevations of 75 and 60 feet.

Water is conveyed to the Ilwaco Water Treatment Plant by approximately 1,000 feet of 18-inch and 12-inch raw water transmission line.

Treatment

The pumping and transmission facilities are designed to handle the maximum projected flow rate of 1.5 mgd. The plant includes 2 - 700 mgd up flow clarifier package plants. The maximum allowable operating capacity of the plant is 1.5 mgd. This expansion allows the City to supply approximately 1.0 mgd while one 1.0 mgd filter unit is out of service.

When the raw water enters the treatment facility, a flow-through turbidimeter measures the raw water turbidity. The City adds alum, soda ash, polymer, and potassium permanganate to ensure the removal of turbidity, iron, and manganese required to provide a high quality finished water and meet regulatory standards. The amounts of water treatment chemicals vary, depending on the varying raw water quality.

The City's water treatment system includes chemically aided flocculation, clarification, and mixed media filtration to remove particulate matter, and chemical disinfection to provide an appropriate chemical residual within the distribution system. These conventional filtration treatment technologies meet DOH standards for treatment of surface water.

With its existing technology, the treatment equipment at the water treatment plant produces acceptable drinking water by removing particulates and large organic materials. The equipment is sufficient at removing bacterial contaminants such as *Giardia* and *Cryptosporidium* through filtration and disinfection using sodium hypochlorite.

However, the existing water treatment plant is not well equipped to remove VOCs or SOCs, which are typically associated with petroleum products, herbicides and pesticides. Additional filtration media equipment would need to be installed in order to remove and sequester VOCs and SOCs if these become persistent contaminants.

3. Delineation

Indian Creek Reservoir is recharged by precipitation that falls within its watershed:

- Stream channels intercept precipitation and convey it into the reservoir.
- Precipitation falls on and runs over the ground directly into the reservoir.
- Precipitation falls on the ground, infiltrates into the soil, and flows into the reservoir or into streams that then flow into the reservoir.

The extent to which water flowing underground that originates outside of the watershed reaches the Indian Creek Reservoir is unknown.

For the purpose of the Source Water Control Plan water balance analysis, the source water area is determined by the highest continuous ridge upstream from the reservoir (i.e. the ridgeline surrounding the watershed) as delineated by Gray and Osborne for the 2011 Water System Plan, totaling 808 acres according to that plan.

For the purpose of other source water control planning and implementation, the source watershed is determined by the highest points of land upstream from the watershed (i.e. the ridgeline surrounding the watershed), as delineated by Columbia River Estuary Study Taskforce in 2014, totaling 893 acres. The watershed delineation was altered in different locations for the following three reasons:

- To err on the side of inclusiveness in locations of topographic ambiguity.
- To include road sections and their source areas that may have ditch lines crossing into the source

watershed.
- To correct what appear to be minor errors in the 2011 delineation that excluded areas within the topographically defined watershed.

The 2014 watershed delineation was performed using GIS to manually digitize the watershed ridge line using USGS topographic and roads data at a scale of 1:8000.

4. Geography

4.1 Location

The Indian Creek Watershed is located in Pacific County, Washington, approximately 5.5 miles east-northeast of the City of Ilwaco, Washington. The impoundment dam is located approximately 5,500 feet upstream from the confluence of Indian Creek and Bear River.

The drainage basin located in Sections 27, 28, 29, 33, and 34 of Township 10N, Range 10W and Section 3 of Township 9N, Range 10W in Pacific County consists of approximately 893 acres. The terrain of the drainage basin consists of wooded slopes. The adjacent drainage basins to the north and east discharge to small creeks that are tributaries to the Bear River and the drainage basins to the west discharge to small creeks that are tributaries to the Chinook River.

The larger Bear River Watershed of which the source watershed is a part, has about 12.6 miles of main stem creek with an additional 30.7 lineal miles of tributaries. The drainage area comprises about 30 square miles, and is the southernmost watershed emptying into Willapa Bay. The lower 3.5 miles is tidally influenced and surrounded by marsh and deciduous brush. Further upstream, the gradient increases to become moderate and provides spawning and rearing habitat for chum, fall chinook, coho and winter steelhead (Phinney and Bucknell 1975; WDFW and WWTIT 1994). In the upper reaches, the uplands are mountainous with steep tributaries, providing spawning and rearing habitat for coho and winter steelhead.[1]

4.2 Climate

The Coastal mountain range influences the local climate by intercepting prevailing moist air moving inland from the Pacific Ocean. Mean annual precipitation to the drainage basin is approximately 79.43 inches per year, as measured at the Long Beach Experimental Station, the official rain gauge closest to the watershed. This should be considered a conservative estimate, as average annual rainfall has been estimated at 100 inches in the Willapa Hills, and 80 to 90 inches in the foothills.[2]

Autumn rains in the Indian Creek Watershed begin in October. Relatively high precipitation continues to occur throughout the winter months. Precipitation rates decrease towards and through the spring. The summer months of July, August and September are relatively dry. The daily maximum precipitation events for individual winter months between 2003 and 2014 at surrounding weather stations in Naselle, Columbia, and Grays River watersheds was about 2 to 4 inches, with rare daily events in the 5 to 6 inch range in the Naselle watershed.[3]

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[1] CWC Coastal Watersheds Consulting. 1998. A Watershed Level Conservation and Restoration Plan for the Bear River, Pacific County, WA. US Fish and Wildlife Service, Lacey, WA. 25pp

[2] http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/washington/WA627/0/wa627_text.pdf

[3] National Climate Data Center. 2014. http://www.ncdc.noaa.gov/cdo-web/datatools/findstation

4.3 Topography

Watershed elevations range from approximately 50 feet at the treatment plant to 1000 feet above sea level. Within the outer watershed ridgeline, several ridgelines descend into the watershed.

The interior ridges in the northern portion of the watershed are relatively low elevation, broad, and descend relatively gently, in some cases with flat and undulating sections. Headwater slopes in the northwestern most portion of the watershed are 10 to 20 degrees. Ridgetop elevations increase, ridge descents become increasingly steep, and side slopes become increasingly steep further south and east in the watershed, with typical slopes in 20 to 40 degree range, and many slopes as steep as 60 to 70 degrees around stream headwaters. Numerous vertical earth faces resulting from gravel mining, and natural, road related or harvest related sloughing were also observed from Walberg Road in the southern and eastern portions of the watershed.

4.4 Geology

Geological characteristics such as soil types, depths, sub-surface layers, thickness, and the slope of the land surface can all impact water quality and quantity. Porosity, particle size, soil uniformity, and composition will also impact the subsurface flows of water.

Soils in the drainage basin are primarily deep, well drained, silty loam with some poorly drained, silty, clay loam along the shores of Indian Creek. The soils are moderately permeable allowing rainfall to infiltrate into the soil and provide recharge to the Indian Creek reservoir throughout the year.[4] [5]

- Knappton Silt Loam (#60), occupying more of the watershed than any other soil type, is well drained and has moderate permeability, water capacity, erosion, runoff and rooting depth characteristics.

- Palix Silt Loam (#111, 112), covering much of the northern watershed, is well drained, has moderate permeability, high water capacity, and moderate runoff and erosion characteristics depending on slope, but is subject to slippage, with moderate rooting depths.

- Vesta Silt Loam (#149, 150), covering small isolated areas, is well drained, has moderate permeability, high water capacity, slow runoff, and slight erosion characteristics, with deep rooting depths

- Willapa Silt Loam (#155, 157) covering a small area in the northernmost section of the watershed, has moderate drainage and permeability, high water capacity, shallow rooting depth, slow runoff, and slight erosion hazard.

All of the soil units are described as being most favorable to growth of Western hemlock, with varying second best suitability for Douglas fir, Sitka spruce, Red cedar, and red alder. All units are described as having a one inch organic layer resting on top of the soil.

Field observations and topographic data suggest that some of the watershed's more severely steep slopes may have been misclassified as lesser slopes in the 1979 soil survey. Soil maps alone do not suggest obvious areas of relative landslide or erosion risk.

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[4] City of Ilwaco Water System Plan 2011

[5] USDA Soil Conservation Service. 1979. Soil Survey of Grays Harbor, Pacific, and Wahkiakum Counties. http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/washington/WA627/0/wa627_text.pdf (Map Sheet 148)

4.5 Land Cover

The Indian Creek Watershed is in the Marine West Coast Forest Coast Range Ecoregion.[6] Rural forested land in Pacific County is managed intensively for timber. The watershed is covered in 2nd and 3rd growth timber. Roughly half of the watershed was logged in the 1980's and has not been actively managed for any purpose since that time. Prior harvest dates in the remainder of the watershed are unknown; however the timber throughout this remainder is of merchantable quality.

Vegetation

The vegetation within the drainage basin consists primarily of woodland areas. The watershed's timber resources have not been systematically inventoried by the City. The principal trees include Western hemlock, Douglas fir, Red alder, and Sitka spruce. Limited observations indicate Western Hemlock dominance, which is consistent with historic soil surveys.[7] Alder grow in the ditch lines and beds of abandoned logging roads, platforms, and other disturbed areas. Alder stands also dominate portions of the watershed's northern slopes.

The watershed's plant communities have not been systematically inventoried. Dominant understory species include salmonberry, salal, red huckleberry, and western sword fern, although some of the watershed has no understory beneath densely growing hemlock.

Wetland grasses and sedges have established themselves at some observed ditch lines where the ditches exit primary roadways to overland dispersal. The impoundment's shoreline vegetation includes salal, sword fern, sedges, and rushes.

5. Hydrology

5.1 Precipitation

Mean annual precipitation to the drainage basin is approximately 79.43 inches per year, as measured at the Long Beach Experimental Station, the official rain gauge closest to the watershed. The 808 acre drainage basin receives approximately 5,350 acre-feet, or 1,740 million gallons of rainfall per year. Approximately 232 acre-feet, or 75.5 million gallons of precipitation falls directly onto the 35 acres of impoundment water surface.[8]

5.2 Streams & Wetlands

Streams in the watershed descend on 5 to 20 percent gradients to the reservoir, in between the steep interior ridge slopes. Upstream intermittent flows, overland flows, and perennial streams flow across steeper gradients up to 50 to 60 percent. Low elevation overland flows directly into the reservoir may also occur outside of stream channels. Additional channelized flows may occur in abandoned road drainage ditches that descend with the roads gradually from the watershed's exterior ridge towards the reservoir.

Primary tributary streams were not characterized in detail for this plan. A more detailed stream characterization that collects information on gradient, profile, discharge, and substrate could inform management decisions.

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[6] US EPA. Level III Ecoregions of North America
[7] 1979 Soil Survey
[8] City of Ilwaco. 2011. Water System Plan.

Wetland totaling less than five acres occur along Indian Creek in the southeastern portion of the watershed, several hundred yards downstream from the stream's intersection with the Walberg Road haul route extension in Section 34.

5.3 Water Balance

This water balance analysis was prepared using information from the 2011 Water System Plan.

The hydrology report prepared during the planning stages for the Indian Creek Dam provided a water balance for the impoundment. The Reservoir Permit (No. R 2-26649P) requires that the reservoir can only be filled during the months of December, January and February, and that a minimum of 2.0 cfs must be maintained in Indian Creek downstream of the dam during the spring and summer. The following Water Balance **Table 1** indicates that the impoundment is able to be filled by creek flow in December, January and February and the remainder of demands are met by available storage and Indian Creek flow during the remainder of the year.

The City measured the water surface elevation in the impoundment and the flow released to Indian Creek downstream of the dam approximately twice a month from 1990 through 1994. The normal pool elevation of 90 feet shown in the records indicates that the water surface elevation is just below the spillway. An elevation of 90+ feet indicates that water is exiting the impoundment over the spillway. The information presented in the water surface elevation records indicate that the minimum impoundment surface elevation experienced in the 5 years of record was 80 feet, equivalent to available storage of approximately 450 acre-ft.

As of the 2011 Water System Plan, the City planned to resume collection of weekly water surface elevation readings to track trends in the water level.

Table 1: Water Balance[9]

Month	Indian Creek Inflow[1]	Downstream Release (cfs)[2]	City Demand[3] (cfs)	Evaporation and Seepage Loss[4] (cfs)	Total Demand (cfs)	Surplus/ (Deficit) (cfs)	Available Storage (acre-ft)[5]
January	21.43	2.00	2.33	0.02	4.35	17.08	1022
February	14.82	2.00	2.33	0.03	4.36	10.46	1022
March	11.17	2.00	2.33	0.04	4.37	6.80	1022
April	6.86	2.00	2.33	0.07	4.40	2.46	1022
May	3.89	2.00	2.33	0.10	4.43	(0.54)	989
June	2.65	2.00	2.33	0.13	4.46	(1.81)	878
July	1.70	2.00	2.33	0.14	4.47	(2.77)	707
August	1.13	2.00	2.33	0.13	4.46	(3.33)	502
September	0.89	2.00	2.33	0.11	4.44	(3.55)	284
October	0.89	2.00	2.33	0.07	4.40	(3.51)	68
November	12.56	2.00	2.33	0.04	4.37	8.19	572
December	21.22	2.00	2.33	0.02	4.35	16.87	1022

1. From Table II-1, Town of Ilwaco Design Report for Water System Improvements, 1986. Evaluation of Indian Creek yield based on measured flow in Bear River and percentage of total acres in Bear River watershed attributable to the Indian Creek Watershed.
2. Minimum downstream release of 2.0 cfs during spring and summer applied to all months.
3. City demand assumed to be 1.5 mgd.
4. From Table II-4, town of Ilwaco Design Report for Water System Improvements, 1986

[9] City of Ilwaco Water System Plan. 2011.

5. Available storage varies by month primarily as a function of Indian Creek Inflow.

The City has adequate instantaneous and annual withdrawal water rights to meet projected demands according to the 2011 Water System Plan. The City's existing source of supply was capable of supplying maximum day demands through 2012 however a new treatment unit was needed to supply maximum day demands beyond 2012. The new treatment unit is expected to be installed in 2015. The City's system has sufficient storage and backup supply from the City of Long Beach to allow an outage of several days for treatment unit repair.

6. Water Quality

This analysis used information in the 2011 Water System Plan, and personal communication with the City's water system operators.

Degraded source water quality is an issue throughout the year. Primary operational issues occur in the fall when initial heavy rains flush tannins, sediments, and organic matter into the source water, and in the summer when algae grow in the source water, and tannins become concentrated at lower water levels. High turbidity and discoloration associated with flushing rain events recur throughout fall, winter, and spring

If high turbidity levels exceed the treatment plant's ability to meet drinking water quality standards, it could cause treatment plant shut downs. In addition, organic material that is found in the watershed—especially from plants—decomposes over time and this decayed organic matter leaches tannins into the water, causing discoloration. Tannins are generally not a health risk, but its presence – typified by coffee or tea colored water - is considered aesthetically unacceptable by many residents.

Organic compounds react chemically with disinfectant chemicals used in drinking water treatment, creating byproducts that have health impacts. As such there are regulatory limits on the amount of these byproducts that are allowed in treated drinking water. When the source water is high in turbidity and tannins, enhanced operator attention is required. The source water quality is highly variable across short time scales (a single day to a week), requiring intensive operator reaction in adjusting the water treatment system.

Existing state law regulates raw water quality, including bacteriological contaminants and various organic and inorganic chemicals. Minimum standards for water quality are specified in terms of Maximum Contaminant Levels (MCLs). Primary MCLs are based on chronic and/or acute human health effects. Secondary MCLs are based on factors other than health effects, such as aesthetics. Current MCLs are specified in WAC 246-290. The following sections discuss the applicable water quality regulations, analysis of the City's compliance with these regulations, and a summary of future regulations for each category.

Table 2 Drinking Water Regulations

Rule[1]	Contaminants Affected[2]	Action Required
Total Coliform Rule	Coliforms	Yes
Residual Disinfectant	Total Free Chlorine	Yes
Lead and Copper Rule	Lead, Copper	Yes
Arsenic Rule	Arsenic	Yes

Inorganic Chemicals, and Physical Parameters	IOCs	Yes
Volatile and Synthetic Organic Compounds	VOCs, SOCs	Yes
Surface Water Treatment Rule (SWTR)	Microbial Contaminants	Yes
Interim Enhanced Surface Water Treatment Rule	Microbial Contaminants	No
Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)	Microbial Contaminants	Yes
Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)	Microbial Contaminants	Yes
Filter Backwash Recycling Rule	Microbial Contaminants	No
Stage 1 Disinfectants/Disinfection Byproducts Rule (DBPR)	TTHMs, HAA5, Chlorite, Bromate	Yes
Stage 2 Disinfectants/Disinfection Byproducts Rule (DBPR)	TTHMs, HAA5, Chlorite, Bromate	Yes
Consumer Confidence Report	Reporting Only	Yes
Radionuclides Rule	Radionuclides	Yes
Ground Water Rule	Bacteriological	No

1. Drinking water regulations as of February 2014.
2. TTHM = Total Trihalomethanes, IOCs = Inorganic Chemical and Physical Characteristics VOCs = Volatile Organic Chemicals, SOCs = Synthetic Organic Compounds, HAA5 = Five Halo-Acetic Acids

6.1 Turbidity

Turbidity and total dissolved solids are two important quantitative measures of raw water quality. The City must take turbidity monitoring results every four hours. The turbidity reading must be below 0.3 NTU in at least 95 percent of the measurements taken each month. The maximum turbidity level is 1 NTU. Turbidity levels have not approached those that would require a plant shutdown.

6.2 Bacteriological

Coliform bacteria are a broad category of organisms routinely monitored in potable water supplies. Though not all coliform bacteria are pathogenic in nature, they are relatively easy to identify in laboratory analysis. If coliform bacteria are detected, then other pathogenic organisms may also be present. Bacterial contamination in a water supply can cause a number of waterborne diseases, so these tests are strictly monitored and regulated by DOH. Bacteriological data for raw water samples are kept on file with DOH. The City is in compliance with monitoring requirements for coliform. The City has not had a sample test positive for coliform since 1999.

6.3 Inorganic Chemicals

The State of Washington has adopted Federal MCLs and monitoring regulations for inorganic chemicals and physical parameters (IOCs), volatile organic compounds (VOCs), and synthetic organic compounds (SOCs). Water System Operators monitor raw water organic contaminants by sampling for standard panels of volatile organic compounds (VOCs) and synthetic organic compounds (SOCs). VOCs are a class of volatile compounds that include solvents, lighter petroleum products, and other lighter organic compounds while SOCs are larger, non-volatile compounds that include herbicides and pesticides.

The City has had samples that have exceeded the MCLs for color and manganese in the sixteen years preceding 2011. In July 2004, the City detected a level of manganese of 0.096 mg/L, which is above the MCL for manganese of 0.05 mg/L. In the same sample, the color level was 25 color units, which is above the MCL for color of 15 color units. However, the most recent IOC/VOC/SOC samples have had results below the MCLs for all contaminants.

6.4 Nitrate

The City presently monitors for nitrate as part of the general inorganic chemical testing every three years

per regulation.

6.5 Disinfectant By-Products

Disinfectants can react with naturally occurring organic materials in source water and form what are known as disinfection byproducts (DBPs). A number of these DBPs have been shown in laboratory animal tests to be carcinogenic or cause adverse reproductive and developmental effects.

The City's DBP monitoring has indicated that the extremities of the City's system have moderate amounts of both TTHM's and HAA5's. The City monitors for DBP's at Lakeview Estates and the State Park. The TTHM levels in the City's system typically range from 20-40 µg/L at Lakeview Estates and from 40-60 µg/L at the State Park. The HAA5 levels in the City's system typically range from 5-10 µg/L at Lakeview Estates and 10-30 µg/L at the State Park. The City has had individual samples that have exceeded the MCL for both TTHM's (117.8 µg/L in September of 2004 and 83.2 µg/L in September of 2006 at the State Park) and HAA5's (60.1 µg/L in September of 2004 at the State Park); however, the running annual average for the City's system has remained below the MCL's. DBP levels have decreased in recent years. The City will continue to monitor DBP levels and optimize the system to maintain DBP levels below the MCL.

6.6 Residual Disinfectant

The City treats and chlorinates its own water at the water treatment plant (WTP). The City has a chlorine analyzer at the outlet of the WTP that it uses to ensure the correct amount of chlorine has been added. The chlorine analyzer continually monitors the chlorine in the treated water

6.7 Asbestos

The City conducted asbestos sampling in 1999 and 2009 and found that the asbestos levels in the samples were below the detection limits.

6.8 Lead and Copper

The City completed lead and copper testing in 2005 and 2011, and all samples were below the action levels.

7. Land Use and Activities

7.1 Historical Land Use & Activities

The source watershed and neighboring watersheds have since European settlement been used for timber production, while providing many other ecosystem services. Lumber mills were present in Pacific County as early as the 1890's; however the dates of first and subsequent timber harvests in the Indian Creek watershed are not known.

In 1987 City of Ilwaco purchased several hundred acres in the watershed, constructed the impoundment, and started delivering water from Indian Creek in 1989. The City's property was harvested at around the time the impoundment was being constructed, and has not been actively managed since then.

City-owned portions of the watershed continue to be managed for drinking water. No recreational or other activities are allowed in these areas. Roads have been maintained to variable degrees; however no highly imminent or hazardous road issues were observed on roads while creating this plan.

Areas of the watershed not owned by the City are managed for commercial timber production. Typical activities taking place in these areas may have included road maintenance and decommissioning, pre-commercial thinning, herbicide application and other treatments, slash burning, and recreational trespass by members of the public. Some roads accessing land and timber not owned by the City have been improved in 2014 and 2015 to prepare for timber harvests.

1979 soil survey maps revealed only one historic "quarry or mine." No history was discovered regarding the site, however it appears now as a cut slope immediately adjacent and uphill from Walberg Road, in the southeastern end of the watershed.

Walberg Road, owned by the County, travels along the watershed's northern ridgeline. The road has been used historically for hauling timber and machines, and is designated by Pacific County as a road for OHV use.

7.2 Land and Timber Ownership

Land ownership is described by owner below. Some land is owned by The City, with reserved timber rights owned by Weyerhaeuser. The descriptions below are based on the Pacific County Tax Assessor's online mapping tools, and land sale documents included in the 2011 Water System Plan. There is ambiguity over the ownership of the east half of parcel 10103429000. Ownership information is based on Pacific County's online resources, and the 1987 Agreement. Ownership was not confirmed through research of original documents recorded with Pacific County.

City of Ilwaco

The 663 acres of the 893 drainage basin owned by the City of Ilwaco are wooded areas and are managed by the City as protective areas for the City's watershed. The area was previously logged in the mid 1980's. City-owned land was purchased from Weyerhaeuser per the agreement recorded in 1987, referred to hereafter as the "1987 Agreement." Of the 663 acres owned by the City, 488 acres are owned in fee title including timber rights. 175 acres that the City purchased has a reserved timber right held by Weyerhaeuser. The timber rights on this land will revert to the City in 2027, per the 1987 Agreement. The City owns 2.4 acres west of the WTP, which contains the Indian Creek Reservoir (water tanks) and approximately 100 acres immediately north of the treatment plant site.

Weyerhaeuser

Weyerhaeuser owns approximately 230 acres of land/timber in the southern portion of the City's watershed. Additionally, Weyerhaeuser owns the right to harvest timber on 175 acres of City owned land in the watershed until 2027. Weyerhaeuser is required to give the City notice of its intent to harvest these areas at least three years in advance, and has effectively done so, articulating intent to harvest the reserved areas in 2020. This probably does not preclude Weyerhaeuser from providing a revised notice for harvesting sooner (as soon as 2018 given that the present time is 2015).

While the timber reservations are in place, Weyerhaeuser may manage the areas according to generally accepted silvicultural practices (thinning, fire control, pest control, fertilization, etc.), provided that all actions comply with applicable laws governing operations in municipal watersheds. Weyerhaeuser may not apply pesticides without approval by the City. Weyerhaeuser will give the City notice at least 90 days before commencing any silvicultural practices, except in emergencies. Weyerhaeuser also reserved rights to use and maintain historic roads across City owned property for the purpose of accessing the timber that it has rights to.

The majority of property immediately east and north of the watershed (outside the watershed) is owned by Weyerhaeuser. Active harvests on the slope north of the watershed are taking place currently, and include use of Walberg Road for hauling machines and timber.

Hawaii Timberland LLC
Portions of Sections 29 and 33 Township 10N Range 10W to the west and south of the watershed belong to Hawaii Timberland LLC. Small portions of these parcels lie within the watershed. Recent aerial photographs indicate that the parcel located in Section 29 Township 10N Range 10W has been recently logged. A heavily vegetated buffer of City owned property is located between the logging activity and the impoundment. The Hawaii Timberland LLC property is managed as a timber resource. The Goulter Road access to City owned land and roads in the watershed crosses Hawaii Timberland LLC's land on the watershed's west side.

TC&I-Chinook LLC
Portions of Sections 27 and 28 Township 10N Range 10W outside of the north drainage basin boundary belong to TC&I-Chinook, Inc. The TC&I – Chinook property is managed as a timber resource and uses Walberg Road for access.

Mineral Rights
Weyerhaeuser retained the mineral rights to the property that it sold to the City within the watershed, which includes all of the parcels immediately surrounding the impoundment. These rights include the right to explore and mine for minerals.

7.3 Current Land Use & Activities

Areas of the watershed not owned by the City are managed for timber production. Weyerhaeuser since 2014 has been performing major reconstruction of some historic interior roads, to prepare for timber harvests scheduled between 2018 and 2027.

Walberg Road, a County road, provides limited access to the Indian Creek Watershed. The gravel and earth road begins at Chinook Valley Road and continues east past the Water Treatment Plant and along the watershed's northern ridgeline. Walberg road continues in private ownership into additional roads in the southeastern portion of the watershed. They extend out of the watershed connecting to a regional private forest road network.

West of the Water Treatment plant, an abandoned logging road connects Walberg Road with the reservoir's south and west side, with additional abandoned logging roads south of the reservoir, and an abandoned road that encircles the reservoir.

Additional access to the watershed for City staff is available via Goulter Road, which is traversable by vehicles to the south watershed boundary, where it connects with additional abandoned logging roads that can only be travelled by foot. Goulter Road has a locked city owned gate preventing public access at its entrance from Chinook Valley Road.

8. Source Water Vulnerability

State of Washington Department of Health gave Ilwaco's watershed a low susceptibility rating in 2014. The state rating provides a sense of the relative susceptibility of Ilwaco's watershed compared with other surface water sources in the state. Despite the rating, planned timber harvests in the next ten years

could substantially degrade source water quality. The "low susceptibility" rating for Ilwaco reflects the foresight of Ilwaco's leaders in selecting the source watershed, and purchasing substantial portions of it in the 1980's, and Ilwaco can consider itself as starting from a relatively strong position in continuing to make source water control program improvements.

8.1 Forest Practices

Forest Practices including timber harvest, road building, equipment operation, herbicide application can all impact water quality. All activities create the risk of spilling hydrocarbons, hydraulic fluids, and other mechanical fluids. Herbicide application can directly pollute the reservoir. Eroding sediment leads to turbidity issues.

Washington's forest practices regulations were not intended or designed to protect drinking water quality and cannot be relied upon for that purpose. State DNR review of timber harvest or road work applications requires only checking a box to indicate that the work will be near a public drinking water supply. Drinking water is factored into the forest practices application and permit review only if spraying were to take place near the impoundment.

Timber harvests scheduled for the years 2018 through 2027 may clear cut approximately 405 acres of 893 acre watershed (less RMZ's and existing cleared roads). Some roads and landings were being built in preparation for these harvests as of 2014-2015. All roads and trails in the watershed are unpaved, and some occur or cross waterways. Timber harvest, roads, and road construction are a source of erosion to the drinking water source.

Timber harvests remove vegetation that would otherwise intercept, interrupt, evaporate, and transpire precipitation. Harvest operations disturb soils leaving them more vulnerable to erosion. Roads intercept, and concentrate surface flows. They can increase the rate of runoff into streams (higher, quicker peak flows result). The likelihood of sediment arriving in streams increases when roads are used by heavy equipment during rains, when there is road construction, or when roads are poorly maintained. Other risk factors include high precipitation rates, steep slopes, exposed soils, saturated soils, and/or unstable soils.

Forest road runoff and runoff from recently harvested areas delivers organic coloration, organic matter, and nutrients, as well as sediments. During warmer months, nutrient loads support algal growth that exacerbates turbidity, essentially making erosion the source of a year round problem rather than just a rainy season problem.

The City of Ilwaco will utilize the Washington Department of Natural Resources Forest Practices Application Review System (FPARS) to monitor all forest related activities within its water shed.

8.2 Unmaintained Roads and Culverts

Unmaintained roads can become unstable and deliver both chronic and acute loads of sediment, organic matter, coloration, and nutrients. Ditch lines clogged by debris and growing trees cause water to flow down road surfaces, eventually creating ruts that persistently erode. Metal culverts corrode, typically on their bottoms, allowing water to pass through the road bed underneath the culvert, undermining the road.

Culverts clogged by debris, tree roots or complete collapse cause ponds to build up behind roads. Water then spills over the road surface, disturbing the surface and creating a persistent source of erosion. Alternately, clogged culverts can cause water to pass under the culvert, undermining the road bed. Finally, ponding water behind clogged and collapsed culverts can saturate the road bed, causing major

road failures and erosion events.

Unmaintained roads can compound other issues, leaving timber owners without the ability to travel them for fighting wildfire, or managing timber to prevent wildfire, pest outbreaks, and blowdowns.

Weyerhaeuser's roads are being reconstructed to Forest Practices rule standards for large forest landowners in preparation for planned harvests. City roads have received varying degrees of maintenance, but are not out of compliance with the Forest Practices Rules for small landowners. Walberg road is actively maintained, but exhibits some erosion due to recent hauling and recreational activity.

8.3 Mass Wasting and Rapid Slope Failure

Mass wasting and rapid slope failure risks may be compounded by timber harvest practices and road construction, despite some protections provided by the Washington Forest Practices act. Seismic events can trigger slope failures that would impact source water as well. Observed mass wasting and slope failure vulnerabilities are concentrated in the southern portions of the watershed, and limited to what could be observed from Walberg Road and its primary haul route extension.

Shallow rapid slope information summarized below was not created for assessing seismic landslide hazard risk or for site level landslide hazard risk characterization, but was created for pre-screening of forest practices applications. As such it can be considered appropriate for conceptual level watershed-scale planning, even though more detailed forest management prescriptions developed at a later date will require more detailed slope stability analysis.

Washington DNR slope stability data indicate concentrations of relatively severe slope instability in the central watershed, with relative stability in the northwestern third of the watershed, and concentrations of moderate to severe instability in the southeastern portions of the watershed. Slope instability in the watershed is associated with convergent landforms around headwater drainages.

Areas identified as severely unstable by WA DNR in the southeastern portions of the watershed correspond with nine identified slides in the 1979 Soil Survey of Grays Harbor, Pacific and Wahkiakum Counties[10], and with 2014 field observations of exposed soil faces. Washington DNR Geology and Earth Resources Division's 1:24,000 landslides data[11] does not include slides anywhere in the watershed.

In the northwestern portions of the watershed adjacent to the impoundment there are two small areas of severe instability, on the northwestern side of the reservoir adjacent and downhill from recently clear cut TCI & Chinook Timber, and at the southeastern end of the reservoir.

In the southeastern portions of the watershed, severe instability is associated with steeply sloped convergent landforms descending adjacent from Walberg Road into the watershed.

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[10] USDA. 1979. Soil Survey of Grays Harbor, Pacific, and Wahkiakum Counties

[11] WA DNR-DGER. 2014. Landslides Geodatabase.
http://www.dnr.wa.gov/BusinessPermits/Topics/ForestPracticesApplications/Pages/fp_gis_spatial_data.aspx
These data contain 1:24,000-scale polygons defining the extend of mapped landslides in the state of Washington. This dataset is compiled chiefly from pre-existing landslide databases created in different divisions of the Washington State Department of Natural Resources to meet a variety of purposes. Although it has been updated to include landslides from specific recent landslide events, it does not yet include landslides from recent geologic quadrangle mapping; this mapping will be included in a future release of this dataset. This dataset does not include landslides mapped at 1:100,000 scale; landslides at that scale are included in a separate geodatabase (surface_geology_100k.gdb).

City owned land north and northeast of the reservoir is relatively free of identified unstable slopes. City owned timber west of the reservoir has a mix of stable, moderate and severely unstable slopes. The Weyerhaeuser owned timber proposed for harvest in 2018 and 2027 in Section 33 has predominantly moderate slope instability, but includes highly unstable areas adjacent to Walberg Road.

A historic "mine or quarry" identified on the 1979 soil survey, adjacent to Walberg road and south of Indian Creek, was observed in the field as a large nearly vertical face of earth with some vegetation growing on it. Additional information on the specific activities that occurred there was not discovered.

A more recent gravel pit observed in areal images and the field is adjacent to Walberg Road, north of Indian Creek, immediately across Walberg Road from very steep slopes. The pit has vertical faces of approximately 30 feet with young alder growing at its base.

Based on the limited available information on landslide hazards, there are no identifiable areas that should be prioritized for special protections. Instead, the City should use the available information in making its own forest management plans and in working with Weyerhaeuser.

8.5 Alder Leaves and Other Organic Matter

Fallen alder leaves leach organic color during rain events.[12] This presumably contributes to discoloration in the source water. Nutrients from alder leaves and other organic matter can contribute to algae and associated turbidity issues as well.

8.6 Timber Blowdown

High winds blow down vulnerable timber, increasing soil surface exposure to erosion, and allowing stands of alder to establish themselves, which eventually deliver organic discoloration to the source water. Overstocked hemlock stands are vulnerable to blowdown because their stems become too thin to support them in heavy wind. Any other tree stand on the edge of a clear cut should also be considered vulnerable to blowdown.

Observed blowdown is occurring and recurring immediately south of the impoundment, adjacent to a 2013 clear cut that is outside of the watershed. Future blowdown is expected along intersections with the proposed Weyerhaeuser clear cuts that will occur in 2018 through 2027, and in overstocked hemlock stands on the north side of the impoundment.

8.7 Wildfire and Pests

Areas affected by wildfire and pests increase soil surface exposure to erosion. The USDA Forest Service gives the source watershed a very low to low fire risk on a relative scale applied to the entire United States.[13] However, fire does occur regularly in this region, and is typically caused by lightning and human activities, including fireworks, campfires and logging. Potential fire effects on the watershed's surface water can be divided into direct and indirect effects. The direct effects of vegetation loss include increased surface water temperature, dissolved nutrients, ash and charcoal. The indirect effects include modified channel morphology and increased sediment deposition and turbidity. Cedar stumps observed near roads north of the impoundment had black scarring from historic fires.

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[12] Taylor, R. Lynn, Adams, Paul W. RED ALDER LEAF LITTER AND STREAMWATER QUALITY IN WESTERN OREGON1 Journal of the American Water Resources Association. VL - 22, IS - 4. Blackwell Publishing Ltd. 1752-1688 http://dx.doi.org/10.1111/j.1752-1688.1986.tb01917.x

[13] USDA USFS. 2014. Wildland Fire Potential. ArcGIS Forest to Faucets Program Web Map Viewer.

As with blowdown areas, lack of management after the stand disturbance can result in alder dominated stands and resulting water quality impacts. The extent of threatening pests has not been investigated in the source watershed; however contributing factors to pest vulnerability include overstocked stands, such as those observed north of the impoundment. Overstocked stands also increase wildfire vulnerability, and reduce the City's capacity to fight wildfire.

8.8 Wildlife

The fecal matter of birds, deer, elk, and small mammals is a potential source of bacteria and parasites that may infect and sicken humans if ingested. Contamination can occur through an animal's direct contact with a stream, or microorganisms can be transported to surface waters via runoff. Pathogens found in animal waste may include Giardia lamblia, Salmonella, E. coli and Cryptosporidium.

8.9 Public Access

The presence of people in a watershed can increase the risk of pollution, including microbiological contamination from individuals or animals they bring with them such as dogs or horses, as well as petroleum products from vehicles. Fishers, hikers, hunters, or others that develop unmaintained trails or use off-road vehicles can also cause increased erosion. Pacific County's map designating County Roads open and closed to ORV/ATV use indicates that Walberg Road is open to ATV's and ORV's use.[14]

Observed sources of impact from the public includes minor and isolated amounts of trash on abandoned logging roads, rutted exposed soil adjacent to Walberg road from recreation vehicles, and a car that was dumped down a steep slope from Walberg Road. City staff report that the most common trespass is by fishers hiking down to the impoundment from Walberg road.

8.10 Land Conversion

Most of the watershed is zoned Transitional Forest (F-T), while very limited acreage is zoned Rural Lands (R-L)[15]. Neither zone is intended to protect surface source drinking water. Both zones are intended to provide flexibility in maintaining a rural landscape, while permitting a variety of activities including mining, dwellings, recreational vehicle camping, and contractor storage yards among many others. The County Comprehensive Plan does not provide policy guidance that is more protective of drinking water than the zoning code.

Property clear cut in 2013 outside of the watershed's western boundary in the Rural Land zone has areas sloped gently enough to support rural residential development. Other activities permitted under the zoning code could plausibly occur here or in the southeastern upstream sections of the watershed owned by Weyerhaeuser after the timber is liquidated, without the City having many avenues for recourse, although the watershed's steep slopes make it unsuitable for dense development. Any residential development would rely on septic systems.

The American Water Works Association and Trust for Public Land found that for every 10 percent increase in forest cover in drinking water source watersheds, drinking water treatment and chemical costs decreased by approximately 20 percent. This exact relationship cannot be applied to Ilwaco's watershed, but illustrates the benefits of preventing land use conversion from commercial timber to more intense uses.

[14] Pacific County. 2014. Ordinance 174 Map. http://www.co.pacific.wa.us/ordres/Ordinance-174-Map.pdf
[15] Pacific County . 2014. Ordinance 162. http://www.co.pacific.wa.us/ordres/index.htm

9. Existing Watershed Control Measures Evaluation

9.1 Access to the Source Watershed

Currently, there are no required permits for entry into the source watershed. The watershed may be accessed via regional private forest road networks. Goulter Road and Walberg Road are typically gated and locked, however either may be opened for weeks to months at a time during active forest practices.

No trespassing signs are located on Walberg Road and Goulter Road at their respective gates. The water treatment plant, and the road to the impoundment that is accessed via the water treatment plant parking area are surrounded by a barbed wire topped cyclone fence. Maintaining the gates and roads to limit vehicular access to impoundment is important for the long term health of the watershed.

9.2 Formal Agreements and Rights

Water Rights and Permits

City of Ilwaco's water rights and permits are summarized below.

Table 3: Water Rights

Date	Type	Number	Maximum Permitted Instantaneous Withdrawal (cfs)	Maximum Permitted Annual Withdrawal (acre-ft/year)	Maximum Permitted Storage (acre-ft/year)
4/24/1995	Permit	S2-29218	0.77	22	N/A
3/04/1991	Water Right Certificate	S2-25880	1.56	710	N/A
6/23/1986	Reservoir Permit	R2-26649	N/A	N/A	1,022

Water System Infrastructure

The City of Ilwaco owns and operates the infrastructure associated with the drinking water system, including the water diversions, pipes, reservoir, and treatment plant facilities.

Access rights or land use agreements

Access to the treatment plant facility and some portions of the northern watershed is provided by the County owned Walberg Road. A road privately owned by the City on City land provides access from the treatment plant to the impoundment and intake. Access to some other portions of the watershed is physically available on roads that cross private property; however any existing easements or rights of way were not assessed.

9.3 Forest Fire Protection

WA Department of Natural Resources fights fires on private and state-owned forest lands. In the case of a forest fire, DNR will work with the local fire district and the landowner to mobilize firefighting labor and equipment.

9.4 Relevant Land Use Regulations

Land use and environmental regulations such as County Zoning, the State Forest Practices Act, Federal Endangered Species Act and Clean Water Act, are not intended to protect drinking water. Drinking water

utilities and municipalities must negotiate directly with landowners to secure protective land use controls or measures. Pacific County's land use laws and their relation to land use conversion is described in section 8.10.

Shoreline Management Act and County Shoreline Master Program

The impoundment and the land surrounding the lake 200 feet landward is in the SMA required shoreline jurisdiction. The City owns all of the impoundment, and 99% of the land in the shoreline jurisdiction. The creeks draining into the impoundment are not in the SMA shoreline jurisdiction due to their small mean annual flow rates. The Shoreline Management Act does not provide any additional protection to the shoreline jurisdiction area beyond the City's own management goals for protecting drinking water quality.

Forest Practices Act and Rules, including SEPA Relationship

The Washington Forest Practices Act and its implementing rules (WAC 222) include limitations on harvesting to reduce erosion and landslides to ensure long term recruitment of large woody debris to fish bearing streams, and to ensure shading of fish bearing streams. The Forest Practices Board Manual provides extensive guidance on Forest Practices Act compliance and best management practices.

Riparian Management Zone harvest and operation limits vary depending on waterbody type, site classification, stand characteristics, and harvest options provided to the timber owner. The entire source watershed is designated Site Class III, and includes all stream types. The Appendix D Preliminary Stream Types and Zones Map illustrates typical buffers based on existing stream types in the watershed; however stream types are modified by DNR based on field reconnaissance prior to harvest. Stream types and buffers shown on the map may be classed down to lesser protections in the future.

Table 4. Washington DNR Water Types

Water Type	Description
Type "S" = Shoreline (formerly type 1)	Streams and waterbodies that are designated "shorelines of the state" as defined in chapter 90.58.030 RCW.
Type "F" = Fish (formerly type 2 or 3)	Streams and waterbodies that are known to be used by fish, or meet the physical criteria to be potentially used by fish. Fish streams may or may not have flowing water all year; they may be perennial or seasonal.
Type "Np" = Non-Fish Perennial (formerly type 4)	Streams that have flow year round and may have spatially intermittent dry reaches downstream of perennial flow. Type Np streams do not meet the physical criteria of a Type F stream. This also includes streams that have been proven not to contain fish using methods described in Forest Practices Board Manual Section 1Forest Practices Board Manual Section 13.
Type "Ns" = Non-Fish Seasonal (formerly type 5)	Streams that do not have surface flow during at least some portion of the year, and do not meet the physical criteria of a Type F stream.

Less than six acres of Type A and B Wetlands occur in the source watershed, the largest of which is less than four acres. With some variation for site specific conditions, Type A and B wetlands and a buffer averaging 50 feet around the wetland have restrictions on the number of trees harvested and harvest operations.

Harvest and Related Operation Restrictions (WAC 222-30)

The Forest Practices act provides a 50 foot no harvest "core zone" buffer to Type S and F waterbodies. Limited harvesting can occur in the 43 to 55 foot "inner zone" surrounding the core zone. Within some limitations, most trees in a 35 to 47 foot "outer zone" buffer surrounding the "inner zone" can be harvested. These concentric buffers comprise a total 140 foot Riparian Management Zone buffer on either side of a type S or F waterbody in areas of Site Class III, such as Ilwaco's watershed. Restrictions on yarding, felling, and bucking trees in and across type S and F waters are also provided by the Forest Practices Act.

Smaller streams identified by DNR as Type N include operation restrictions in a 30 foot zone on either side of the stream. Stream reconnaissance at the time of developing a forest practices application determines whether the stream receives the more stringent protections associated with Type Np streams (50 foot no harvest buffer on both sides of the stream), or the lesser restrictions associated with Type Ns streams (equipment entry restriction only). Even with Type Np streams, some harvesting is permitted in the 50 foot buffer depending on its proximity to streams typed S or F. Yarding, felling, and bucking activities may take place in and around Type N streams.

Pesticide and Fertilizer Restrictions (WAC 222-38)
Pesticide application is prohibited in the Core Zone and Inner Zone (approximately 100 feet on either side) of Type S and F waters and in the RMZ of Type Np waters (50 feet on either side). Additional buffers are applied depending on the application method. Fertilizer applications are permitted within RMZ's.

Reforestation (WAC 222-34)
Reforestation is required following clear cuts or selective harvests where more than 50% of timber volume is removed in a five year period. Reforestation is not required for thinning schemes that meet certain criteria. A reforested area must have 190 vigorous undamaged commercial seedlings per acre surviving one year after planting.

Road Construction and Maintenance (WAC 222-24)
Road construction and maintenance provisions are intended to protect public resources, and ecological function, including minimization of landslides and erosion. Timber harvest in and to the side of the road's path is permitted and typically associated with road and landing construction. Road regulations prescribe how roads, culverts, and drainage systems are built and maintained.

Road Maintenance and Abandonment Plan requirements are intended to ensure continuous improvement in the condition of forest roads over time. Large forest landowners such as Weyerhaeuser are required to submit Road Maintenance and Abandonment Plans, and to bring their road systems to the FPA standards by 2016. Small forest landowners such as the City of Ilwaco must submit a Road Maintenance and Abandonment Plan checklist with any new Forest Practices Applications. If the City makes plans to harvest more than two million board feet per year for a ten year period, it will be categorized as a large forest landowner and be subject to the more expansive RMAP regulations.

Landslide Hazard Avoidance
Forest Practices Rules and the Forest Practices Board Manual include procedures for evaluating and prescribing avoidance to landslide hazard risk associated with a proposed forest practice, (WAC 222-16-050 & WAC 222-10-030. Screening for landslide hazard is conducted on a site specific basis while developing and reviewing individual forest practices applications, and prescriptions are applied at that time. Proposed forest practices in rule identified landslide hazard situations are considered a Class IV Special Forest Practice; requiring a SEPA checklist, and potentially more detailed environmental assessments and review by licensed geologists. DNR's landslide hazard data indicates moderate to severe slope instability in locations throughout the watershed, particularly associated with convergent landforms near stream headwaters. Recent approved FPA's for road reconstruction indicate that Class IV FPA reviews for road construction are not necessarily triggered by the presence of slope instability in DNR's GIS data.

9.5 Monitoring and Surveillance Program

Forest & Roads Management Monitoring
There is no forest management program, plan or associated monitoring program that would monitor

water quality response to active forest and roads management and major weather events. There is not a systematic monitoring program to ensure that culverts and ditch lines are not blocked. The City will utilize the Washington Department of Ecology Water Quality Program white paper dated July 6, 2010 and entitled "Forest Practices Compliance with Water Quality Standards Focus on Roads and Turbidity".

Forest Practices Notification

The City Clerk is registered for forest practices notifications from WA DNR, and reviews applications through FPARS. The 1987 Agreement articulates Weyerhaeuser's obligations to provide notice to the City of forest practices in reserved timber areas. Weyerhaeuser owned lands in the watershed are not subject to the notification requirements of the 1987 Agreement.

Under Washington Administrative Code (WAC) 222-16-050, "Classes of forest practices" states, "There are four classes of forest practices created by the act. All forest practices (including those in Classes I and II) on nonfederal forest lands must be conducted in accordance with the forest practices rules. The department determines the classification of each forest practices proposal.
(1) **"Class IV-special."** Except as provided in WAC **222-16-051**, application to conduct forest practices involving the following circumstances requires an environmental checklist in compliance with the State Environmental Policy Act (SEPA), and SEPA guidelines, as they have been determined to have potential for a substantial impact on the environment. It may be determined that additional information or a detailed environmental statement is required before these forest practices may be approved.
*(a) Aerial application of pesticides in a manner identified as having the potential for a substantial impact on the environment under WAC **222-16-070** or ground application of a pesticide within a Type A or B wetland.
(b) Specific forest practices listed in WAC **222-16-080** on lands designated as critical habitat (state) of threatened or endangered species.
(c) Harvesting, road construction, aerial application of pesticides and site preparation on all lands within the boundaries of any national park, state park, or any park of a local governmental entity, except harvest of less than five thousand board feet within any developed park recreation area and park managed salvage of merchantable forest products.
*(d) Timber harvest, or construction of roads, landings, gravel pits, rock quarries, or spoil disposal areas, on potentially unstable slopes or landforms described in (d)(i) of this subsection that has the potential to deliver sediment or debris to a public resource or that has the potential to threaten public safety, and which has been field verified by the department." The City Clerk will request DNR to run Forest Practice applications through SEPA review if there is a potential for adverse effect on the City's water supply.

Forest practices applications require the applicant to obtain the signature of landowners in addition to the timber owners on the application form; however unless the City monitors forest practices applications on City owned land, the applications may be approved without the City's signature or knowledge.

Watershed Surveillance

City water system staff inspect the impoundment wall and intake area on a weekly basis as part of their routine operations. They drive and walk upper portions of the Source Watershed on an infrequent basis to ensure there is not any illegal dumping or trespassing activities, or if staff suspects a problem. The entire source watershed is not continually patrolled, monitored or surveyed for harmful activity. The City has a boat at the treatment plant that can be used to inspect the impoundment by water; however it may not be operational.

Water Quality Monitoring

The City performs water quality monitoring on a continual basis as is required by Washington State Department of Health (DOH) regulations.

9.6 System Operations and Emergency Provisions

The City's 2011 Water System Plan includes system operation and emergency provisions for the source watershed.

10. Action Plan

Potential actions and measures that can be taken to increase certainty that the City's drinking water will be protected are discussed below, and summarized with additional timing and cost information in **Table 5.**

Goal 1: Small Steps toward More Active Management

1.1 Short Term Road Maintenance

The City will implement the maintenance strategy outlined in the Selected Road Inventory (**Appendix E**):

- Remove accumulated debris and sediment from four culvert inlets and outlets
- Straighten crushed culvert inlets and outlets on two culverts
- Install culvert extensions and cobble sized rock underneath three culvert outfalls

1.2 Expanded/Documented Monitoring

City water system staff will continue their weekly inspection of the drinking water system, including the impoundment wall and intake area as described in the 2011 Water System Plan.

The remainder of the source watershed will be patrolled on a more frequent basis than it is currently to ensure there is no illegal dumping, trespassing, or significant changes in land or water conditions. Staff will document extraordinary conditions or trending conditions in writing from each patrol. These records can provide contextual information to assist water system staff in identifying activities and management practices that improve or harm water quality, and can provide a basis for productive communication with Weyerhaeuser about watershed conditions and forest practices.

Water quality data on turbidity and other pollutants of interest will be collected and stored in a format that facilitates analyzing the relationship between these pollutants, watershed actions, and weather events over time.

1.3 Review and Comment on Forest Practices Applications

After reviewing forest practice applications using the WA DNR notification and review system, the City can submit comments to DNR staff within fourteen days of the notification. The City may comment on every FPA in the watershed simply to notify DNR staff of the drinking water source. The City will at its discretion request that Forest Practices applications be reviewed as Type IV Special applications requiring a SEPA checklist, if the City is concerned about impacts to the drinking water source. The rationale for this request would typically be that there is potential for the forest practice to damage a public resource from sedimentation or landslides. In addition to any DNR contacts listed on the FPA notification, the City should submit comments to bruze.hazen@dnr.wa.gov and fp_pc@dnr.wa.gov. The city may consider including Washington Department of Health staff in the list of recipients.

1.4 Special circumstance water quality monitoring

Beyond continuing water quality monitoring prescribed by DOH, the city will consult with the Department of Health's Regional Engineer if known land use activities might cause water quality problems. The City will monitor Synthetic Organic Compounds before and after herbicide applications.

1.5. Timber trespass subject to treble damages

It appears that 2 to 4 acres of City owned timber may have been inadvertently harvested by a neighboring owner in recent years. The City will investigate whether or not this occurred, and if so use the provisions of RCW 4.24.630 and RCW 64.12.030 to correct the situation.

Goal 2: Complete a Forest Management Plan

2.1 Complete a Forest Management Plan

A comprehensive forest and roads management plan is needed to guide holistic, specific and cost effective management of the watershed. Forest management plans with the desired qualities include delineation of manageable timber stands, characterization of timber conditions in each stand, timber growth projections under alternate prescriptions for each stand, and recommendations for future thinning and/or harvests for each timber stand. The plan will also include a detailed road and culvert inventory, with cost estimated prescriptions for each road and culvert segment.

Timber management and road management recommendations will be interrelated, in that road maintenance and reconstruction represents a primary cost in choosing to manage any given stand of timber. This Source Water Control Plan includes a "head start" on the road management element of a comprehensive forest plan, by providing a detailed inventory of a portion of the watershed's road segments.

Use a Deliberative Multi-Stakeholder Process

The forest management plan will be built on a process that allows for the City Council and/or an advisory committee to establish policy level goals, consider alternative management approaches, and thereafter establish objectives and agree on management prescriptions. The process will also include time and resources for bringing together stakeholders such as Weyerhaeuser and Pacific County, and outside resources such as conservation investment funds.

Include Recommendations to support long term land and timber acquisitions

The forest management plan will provide management recommendations that would generate revenues to support the purchase of additional land or timber rights in the watershed, rather than revenues to only support ongoing management of the City's existing ownership.

Include Recommendations from a Consulting Forest Geologist in the Forest Management Plan

The City will include recommendations from a consulting forest geologist in the forest management plan to improve understanding of the Source Watershed's landslide prone areas.

Include a Road Inventory of remaining road sections in the Forest Management Plan

The road inventory completed for this plan under limited funding did not inventory several roads in the watershed, including Walberg Road, the road on the watershed's south side that descends the ridgeline to the impoundment from Goulter road, and an unnamed south watershed perimeter road that traverses City owned property.

Include Scheduled Monitoring and Maintenance

The forest management plan will include a schedule for regular monitoring, evaluation, and minor maintenance, to manage public access and ensure that roads and culverts are not allowed to rapidly degrade into problematic erosion sources.

Include Preparation for Alternative or Value Added Revenue Sources

The management plan will address the viability and actions that would need to be taken to generate revenue from alternative products and services provided by the watershed including carbon credits and Forest Stewardship Council certification.

2.2 Hire a Consulting Forester to guide implementation of the Forest Management Plan

After completing the forest management plan, the City will hire a consulting forester to assist in implementing the plan. While the plan will identify a schedule for thinning, harvests, and road management activities, a consulting forester would assist the City in bidding and managing timber and road work to maximize timber derived revenues, and ensure quality and timely completion of work by contractors. The management plan will estimate the cost of consulting forester services.

Goal 3: Take Collaborative Action with Neighbors

3.1 City-Weyerhaeuser Action

Schedule at least one in-person meeting per year with Weyerhaeuser's forester, or more often if activities warrant it, to update one another on respective operations and plans. An on-site visit to the watershed will be included at least once per year. Scheduled meetings are in addition to the ad hoc communications that occur or should occur between the Operator and the Weyerhaeuser Forester on an as-needed basis.

The Forester may be able to make slight management and operational changes to forest practices to accommodate the City's interests if there is a least an established relationship. Furthermore as the City begins to manage the watershed more actively, staff and contractors will need more regular access to the watershed. The City and Weyerhaeuser will need to communicate with each other proactively about forest practices that will temporarily close or create unsafe travel conditions on primary access roads. Weyerhaeuser's current Forester for the area is Chance Yeckley (360.355.0333, Chance.Yeckley@Weyerhaeuser.com)

3.2 City- County Action

The City will communicate with the County to ensure that drinking water quality values are reflected in the County Comprehensive Plan and Zoning Code, to limit the potential for land use conversion to non-forest uses.

The City will explore Walberg Road management opportunities with the County to prevent erosion and landslides from the county owned road. The City will also explore opportunities with the County to limit public use of Walberg road adjacent to the watershed, by removing it from the County map of roads open to ATV's, managing the primary access gate north of the impoundment, and working with Weyerhaeuser on limiting the impacts of forest practices to the road, including chronic erosion and landslide hazards.

The City will look for opportunities to collect Lidar data for the watershed as part of a larger Lidar data collection project possibly involving the county or other large landowners in the area. Lidar is useful for road and forest planning, and for evaluating landslide hazards.

Goal 4: Acquire Timber and Land

4.1 Short Term Acquisition

The City will negotiate for priority land and timber interests that will reduce the water quality impacts of proposed near term Weyerhaeuser harvests.

The City would seek to purchase from Weyerhaeuser in the near term the right to harvest expanded riparian or landslide protection buffers, or the entirety of reserved timber rights areas. Weyerhaeuser

may be more willing to sell entire blocks of reserved timber rather than expanded riparian buffers or timber and the land underneath it. Weyerhaeuser may also find value in changing reserved timber rights of the 1987 agreement to moderately extend further into the future.

Initiating preliminary discussion is a first step in understanding what Weyerhaeuser would be willing to negotiate over at this time. The City can then investigate opportunities within that scope of possibility to make short term acquisitions. Although some exploratory discussion has taken place with prior Weyerhaeuser or Longview Timber foresters, the City should engage directly with Weyerhaeuser's Property Development office by contacting Michelle Metcalf (360.442.4305, Michelle.Metcalf@Wyerheauser.com)

4.2 Privately Financed Conservation

At least one regional organization named Ecotrust, uses private capital (from individual or institutional investors) to buy and manage land and timber. The forests are managed for long term timber production, along with carbon sequestration, and wildlife values, in a manner that is profitable for the investors. Although the City's watershed may not be large enough to alone attract the interest of such groups, there may be opportunities for multiple local governments to participate in pooled acquisition finance opportunities, or pooled resource management planning in order to overcome economy of scale hurdles that many local governments face in initiating active management and acquisition programs in their source watersheds.

For example, it is conceivable that a conservation oriented forest investment fund could offer forest management planning assistance to multiple local governments with surface water watersheds, and offer to purchase land and timber from corporate owners, hold the land and timber for some time, and eventually sell it to the municipalities. The investment fund and planning partners would bring added value to the municipalities with carbon credits, and would achieve sufficient economies of scale in generating carbon credits by working with many municipalities at once.

4.3 Conservation Partnerships for Enhanced Grant Eligibility

As described in Appendix B Funding Sources, The City at this time is not eligible for some grant funding oriented towards wildlife habitat and small forest landowners, but could become more eligible for these funds if a small conservation organization owned and/or actively managed the land and timber in partnership with the City.

4.3 Long Term Acquisition

In the long term the City will seek to own and thereby control the whole watershed to the maximum extent possible. This is a long term aspiration, but is important to articulate separately from more short term and distinct acquisition goals.

Goal 5: Continually Improve Watershed Management

5.1 Learn from other forested source watersheds

The City of Ilwaco has ongoing opportunities to meet with other towns and landowners that are in a similar situation and learn from their experiences. WA Department of Health hosts workshops for municipalities with surface drinking water sources. Staff will attend these meetings to connect with potential technical and funding resources, learn from the experiences of other municipalities, and share information about Ilwaco's challenges and successes.

5.2 Update and Operationalize the Source Watershed Control Plan

DOH requires that the City update its Watershed Control Plan at least once every six years (next scheduled

update will be in 2021), and sooner if new information is available such as deleterious changes to water quality or quantity or if there are significant changes to the watershed such as a proposed development, or changes in land-use practices. If water quality or quantity is at risk then new information and insight will be reflected in management practices, even if the Watershed Control Plan itself has not yet been updated.

Goal 6: Increase Public Understanding

6.1 Improve Signage

Proactive signage and warnings at established entrances to the source watershed will alert road and trail users to the sensitivity of the area. Phrasing for signs may include: "No Trespassing," "Drinking water supply protection area," or "Sensitive Area." Additional language will be included to the effect of, "If you see suspicious activity, call City Clerk #."

Some existing signage at the Goulter Road gate, Walberg Road gate, and Walberg Road spur road on the north side of the impoundment are becoming less legible with age and vandalism.

There is currently not any signage at the entrance to abandoned spur connecting Walberg Road with unmaintained roads on the impoundment's south side. Hunters have been observed parking and walking down this road during the fall hunting season.

6.2 Water Quality Report and Utility Bill Communications

The City will use its annual consumer water quality report and utility bill mailings to deliver messages to the community about the value of the source watershed, the costs and benefits of active management, and improvements that the City makes in the Watershed.

6.3 K-12 Education/ Exhibits/ Tours

There are a few opportunities to provide enhanced outreach and education to the public and showcase watershed successes as the City makes achievements going forward. These include:

K-12 Education

Students in Ilwaco's schools could benefit from field trips that illustrate natural science concepts they are learning in school, while educating them about the importance of protecting the watershed.

Museum and Library Exhibits

Ilwaco's museum and library may both provide venues for the City to educate residents on the history of the source watershed and evolving issues.

Annual Tours

The City may find it beneficial to offer tours of the watershed to the public in the future to showcase successes and educate the public and watershed.

Goal 7: Leverage & Dedicate External Funding For the Watershed

7.1 Plan to Use to Some Tax or Ratepayer Funding

Although the City has opportunities to obtain grants and loans, and generate revenue from timber harvests, all funding sources will require the City to make some up front investments.

- Grants require match and consultant grant writing
- Loans require reserve funds and consultant assistance
- Timber harvests require cruises, appraisals, and consultant services.

Ultimately the City would have to pay for these investments using tax or ratepayer funds. The City will consider whether its general fund and water fund budgets typically provide the flexibility that would be needed for hiring consultants and providing match for grants. If the City intends to aggressively pursue funding sources for forest planning and land acquisition, and undertake informed negotiations with Weyerhaeuser for timber and land, it will consider using a source water protection surcharge from ratepayers, or dedicating a portion of water system revenues under the existing rate structure, to ensure that funding is available as opportunities present themselves.

7.2 Source Water Protection Fund

While considering the options described above in recommendation 7.1, The City will consider establishing a dedicated source water protection fund within the City's budget for source water protection activities, as a way of organizing its budget to ensure that the funding it does intend to spend on source water protection is set aside and used for that activity.

Table 5. Recommendations Summary

Potential Actions	Priority	Begin	End	Cost	Potential Source
1.1 Short Term Road Maintenance	High	2016	2016	Water Operator: 20 hours Contractor: 40 hours = $3,000 - $5,000 Culvert 3 x 20" Downspout/Extensions: $700 – $900 Delivered Rock 6 yds: $600 - $800	City, WA DOH Grant
1.2 Expanded/Documented Monitoring	High	2016	Ongoing	Water Operator Staff: 36 hours/ year	Staff time only
1.3 Review and Comment on Forest Practices Applications	High	2015	Ongoing	Clerk/ Treasurer Staff: 20 hours/ year	Staff time only
1.4 Special circumstance water quality monitoring	Future Actions				
1.5 Timber trespass and Treble Damages	High	2016	Ongoing	Clerk/Treasurer: 36 hours/year Boundary Line Survey: $2000 Legal Expenses: TBD	Staff time only City City
2.1 Complete a Forest Management Plan	High	2015	2017	Scoping/ Grant Proposal: 200 hours (City staff or consultant) Clerk/Treasurer: 200 hours Consultant: $40,000 - $50,000	WA DOH Grant
2.2 Hire a Consulting Forester to guide implementation of the Forest Management Plan	Future Actions				
3.1 City-Weyerhaeuser Action	High	2015	Ongoing	Clerk/ Treasurer: 10 hours/year	Staff time only
3.2 City- County Action	High	2015	Ongoing	Clerk/ Treasurer: 10 hours/year	Staff time only
4.1 Short Term Acquisition	High	2015	2018	Not estimated	WA DOH Grant WA Wildlife & Recreation WA Ecology Loans Conservation Partner
4.2 Conservation Finance Partnerships	High	2015	Ongoing	Not estimated	City
4.3 Long Term Acquisition	Future Actions				
5.1 Learn from other forested source watersheds	Medium	2015	Ongoing	Clerk/ Treasurer: 5 hours/ year	Staff time only
5.2 Update and operationalize the Source Watershed Control Plan	Medium	Ongoing	2021	Clerk/ Treasurer: 20 hours Consultant: $8,500	City, WA DOH Grant
6.1 Signage		2017	Ongoing	Water Operators: 3 hours Signs 10 x $30: $300	City, WA DOH Grant
6.2 Water Quality Report and Utility Bill Communications		2017	Ongoing		Staff time only
6.3 K-12 Education/ Exhibits/ Tours	Future Actions				
7.1 Tax or Ratepayer Funding		2016	2017	Not estimated	City
7.2 Source Water Protection Fund		2016	2017	Not estimated	Staff time only

Table 6. Funding for Major Near Term Actions

Action	Funding Source	Considerations
2.1 Complete a Forest Management Plan	WA DOH Source Water Protection Fund Grant	Apply in Summer/Fall 2015 or 2016. WA DOH funding would require a special commitment to manage watershed for drinking quality under a precautionary principle. Further preliminary eligibility discussion with DOH staff required.
	WA Department of Ecology Grants (319 & Centennial)	Apply in Fall 2016. The grant materials appear to support this type of project, however recent feedback from program staff was discouraging.
	Weyerhaeuser Family Foundation	Initiate discussion with non-profit applicant partner as soon as possible. Consider Ecotrust, a prior successful applicant.
	City General or Water Fund	Use for match and grant writing
4.1 Short Term Acquisition	Washington Wildlife & Recreation Program	Apply in Winter 2015 to Spring 2016. Wildlife Plan due in Spring 2016 required for some grant categories. Generally, City must be committed to managing acquired land for the benefit of priority species.
	City Timber Harvest outside watershed	Cruise city owned stands outside of watershed after initiating discussions with Weyerhaeuser. Cruise Weyerhaeuser stands simultaneously. Consider evaluation of City owned blown down timber south of impoundment in watershed as well.
	City General or Water Fund	Use for match, grant writing, transaction costs, and to subsidize purchase
	Assorted Loans	Initiate dialogue with loan program staff after reaching out to Weyerhaeuser.

11. Conceptual Acquisition Strategies

11.1 Goals

Two broad recommended acquisition goals are listed below. The alternatives that follow primarily address the short term goal, but are applicable to the long term goal as well. The goals and alternatives are based on the assumption that the City cannot afford to buy all land and timber interests in the watershed in the near term, and that some near term water quality impacts from limited clear cutting can be tolerated by the treatment system and ratepayers.

- Short term goal (0 – 5 years): Protect water quality by acquiring limited timber and other interests throughout the watershed.
- Long term goal 5 years and beyond): Protect water quality by acquiring all timber and land interests in the watershed.

11.2 Negotiation Elements

Some combination of the following conceptual elements would most likely result in the most optimal and practical agreement between the City and Weyerhaeuser.

Element 1: Negotiate for whole timber rights on entire units

The City would purchase the timber rights to prevent harvest in the reserved timber areas, with additional protective measures in other areas as described below.

Element 2: Negotiate for riparian buffers and other assurances

The City would negotiate for no aerial chemical spraying, limits on ground based spraying at key locations, larger riparian buffers and/or no logging within the 200 foot buffers (in contrast to thinning as allowed). The City may have to pay for forgone timber revenues. The 1987 Agreement provides that herbicide applications may not occur without the City's permission, but that permission should not be unreasonably withheld. This provision may provide a basis for the City to require special conditions for herbicide applications that lessen potential impacts on water quality.

Element 3: Negotiate for a staggered schedule of harvests

The City would negotiate to increase the duration between Weyerhaeuser harvests, to limit acute water quality impacts. For example, under this type of agreement, Weyerhaeuser might agree to delay its harvests in the reserved timber areas such that they would not occur until at least 10 years after the completion of Weyerhaeuser harvests on the land that Weyerhaeuser owns in the reminder of the watershed. Weyerhaeuser might find value in such an agreement if it perceived improved timber prices in the future, if it valued the timber volume that would be added during the ten year delay, and if the harvest schedule complimented other harvest plans in neighboring areas.

Element 4: Negotiate for discounted interests

The City should in any case negotiate for discounts that Weyerhaeuser may also find value in. Taxation frameworks and public relations may provide Weyerhaeuser an incentive to do so. For example as part of a larger deal that included purchase of timber rights in the reserved areas, Weyerhaeuser might be willing to sell its remaining land in the watershed at a reduced cost or as a donation after it liquidates the timber in those areas.

11.3 Conceptual Alternatives

The following alternatives are conceptual and are intended to illustrate two alternative approaches to acquisition.

Protective Approach

The City would purchase all or most of the timber rights in the reserved timber areas to prevent it from being clear cut in the near term, while negotiating for protective forest practices on the land that Weyerhaeuser owns, and ultimately the acquisition of that land after it is harvested.

Adaptive Approach

While attempting to purchase at least some timber rights on limited acreage in the immediate term, the City would negotiate to have Weyerhaeuser's harvests staggered over an extended period of time (ten years for example) but not attempt to prevent at least one small near term harvest. The City would thereafter revise its acquisition plans for outstanding land and timber rights based on its observations of water quality performance following the initial harvest. The initial negotiated harvest schedule should be sufficiently drawn out to provide water quality benefits on its own, but also sufficiently drawn out for the City to revise its acquisitions plans, raise capital, and negotiate for the purchase of land and timber before the subsequent harvests would occur.

11.4 Funding Sources

The City will likely have to use general tax funds or ratepayer funds in the form of cash or debt capacity and reserves in order to complete acquisitions. Additional funding sources for acquisition are described in Funding Appendix B, and include:

- Subsidized loan opportunities.
- Limited grant opportunities.
- Sale or exchange of City owned timber outside of the watershed
- Sale of select timber from commercial-restoration thinning within the watershed
- Carbon market participation (not a near term revenue source)
- Bridge financing opportunities with conservation investment funds

11.5 Value for Weyerhaeuser

In negotiating with Weyerhaeuser, the city should consider the full range of Weyerhaeuser's interests, including but not limited to the following considerations.

- Weyerhaeuser could find public relations value in helping the City achieve its goals at reduced cost to the City, and the City can help Weyerhaeuser achieve that value by promoting their partnership.
- Weyerhaeuser could find value in alternative harvest schedules, associated with added timber volume, anticipated increases in timber prices, or synergies with Weyerhaeuser's mill demands or neighboring harvest schedules.
- Weyerhaeuser could find value in being relieved of its post-harvest replanting obligations, and road maintenance and abandonment obligations.
- Weyerhaeuser would find value in cash provided by the City, whether its source was a loan, grant, or otherwise.
- Weyerhaeuser could find value in acquiring land and timber owned by the City outside of the watershed, and may be more efficient at managing and harvesting that timber than the City is.

11.6 Next Steps

The City should reach out to Weyerhaeuser's land development office to determine their willingness to engage in negotiation over any combination of these alternatives, and should do so as soon as the City is willing. A consulting forester and assured funding sources are not needed to make initial contact. Rather, initial contact and understanding of Weyerhaeuser's willingness to negotiate on alternative topics is needed to complete a funding strategy.

The initial contact should articulate the City's interest in purchasing all timber rights in the reserved areas, and its interest in acquiring the remainder of Weyerhaeuser's interests in the watershed as a donation or bargain sale after the areas are harvested, and should request Weyerhaeuser to articulate some indication of what it would cost to do so.

After reaching out to Weyerhaeuser, the City should have a timber cruise done on its timber outside of the watershed, any timber that the City is considering purchasing, and potentially the City owned blown down salvageable timber south of the impoundment. Based on an estimate of City owned timber value and the City's willingness to harvest it, realistic expectations can be established for the City to use the funds as grant match and loan collateral. The optimal time to formally appraise the timber may be later than the cruise, depending on the speed of negotiations and the requirements of grant and loan maker

Table 7 Parcels and Harvest Units in the Watershed

Unite # per 1987 Agreement [16]	County Parcel Number	Location (all in Township 10 North, Range 10 West)	Acres[17]	Last known harvest	Estimated future harvest[18]	Harvest Related Road Work[19]	Timber Owner[20]	Land Owner[21]
N/a	09100300000	Section 3 (Township 9N)	640 (20 inside watershed)	Unkn.	Unkn.	2015	Weyerhaeuser	Weyerhaeuser
N/a	10103428000	NE ¼, SE ¼, SW ¼ of Section 34	480 (150 inside watershed)	Unkn.	Unkn.	2015	Weyerhaeuser	Weyerhaeuser
N/a	10103429000 East Half	East ½ of NW ¼ of Section 33	80 (60 inside watershed)	Unkn.	Unkn.	2015	Weyerhaeuser	Weyerhaeuser
N/a	10103429000 West Half	West ½ of NW ¼ of Section 33	80	Unkn.	None	None	Ilwaco	Ilwaco
N/ a	10103322002	Portion of the NW ¼ of Section 33	80	Unkn.	None	None	Ilwaco	Ilwaco
N/ a	10102837000	South ½ the SW ¼ of Section 28	84	Unkn.	None	None	Ilwaco	Ilwaco
625	Portion of 10102822001	Portions of all quarters in Section 28	251(244)	1983	None	None	Ilwaco	Ilwaco
637	Portion of 10102822001			1983	None	None	Ilwaco	Ilwaco
644	Portion of 10102822001			1987	None	None	Ilwaco	Ilwaco
626	10102732001 & Portion of 10102822001	Portion of SW ¼ of Section 27 & Portion of SE ¼ of Section 28	52 (59)		2018 - 2027	2015	Weyerhaeuser	Ilwaco
759	10103312003	Portion of NE ¼ of Section 33	102	Unkn.	2018 - 2027	2015	Weyerhaeuser	Ilwaco
761		Portion of NE ¼ of Section 33 & Portion of SE ¼ of Section 33	14	Unkn.	2018 - 2027	2015	Weyerhaeuser	Ilwaco

[16] Unit numbers provided in text and Exhibit D of the 1987 Agreement. Parcel numbers obtained from Pacific County GIS webpage.

[17] Acres are approximate and not based on a survey. The 1987 agreement ambiguously includes a 7 acre portion of parcel 10102732001 in the timber reservation. Including that seven acres makes the total acreage of the Unit 626 reservation 59 acres.

[18] Estimated future harvest in the timber reservation areas is based on the 1987 agreement parameters, that notice of intent to harvest must be provided three years in advance, and that the harvests must be completed 40 years from recording of the agreement, which occurred in 1987.

[19] Road work information was obtained by reviewing forest practices act applications, and field observation. Not all approved road work has been initiated as of the writing of this plan.

[20] The timber owner is assumed to be the same as the landowner, unless specified otherwise in the 1987 agreement.

[21] Landowner information was obtained from Pacific County's GIS webpage and Assessors online parcel mapping tool, and the 1987 Agreement. Pacific County information sources indicate that the entirety of parcel 10103429000 is owned by City of Ilwaco, however forest practices application indicate that that the east half of the parcel remains in Weyerhaeuser ownership. Until more definitive information is available to settle the question, it is assumed for analysis purposes only that that Weyerhaeuser owns the east half of parcel 10103429000

Table 8. Order of Magnitude Estimate of Timber Value in Reserved Timber Areas

Parcel	Location	RMZ/ WMZ Acres Detail[22]	RMZ/ WMZ Adjusted Acres[23]	OM Board ft Detail[24]	OM Timber Value[25]
10103312003	Portion of NE ¼ of Section 33	4920 ft. of Type F 12 Core Zone Acres 22 Inner/Outer Acres 4224 ft of Type Nx 10 Acres	102 total acres Minus 27 RMZ/WMZ acres Equals 75 merchantable acres	22,000 – 25,000 bf per acre $300 - $350 per 1000 bf. Timber = $6,600 to $8,750 per acre	$495,000 - $656,250
10102732001 & Portion of 10102822001	Portion of SW ¼ of Section 27 & Portion of SE ¼ of Section 28	4771 ft. of Type Nx 11 Acres	59 total acres Minus 5.5 RMZ/WMZ acres Equals 53.5 merchantable acres	22,000 – 25,000 bf per acre $300 - $350 per 1000 bf. Timber = $6,600 to $8,750 per acre	$353,100 - $468,125
Total Order of Magnitude Estimate of Timber value in reserved timber areas					$848,100 - $1,124,375

[22] Parcel acres are approximate and not based on a survey. WA DNR stream type data were used to measure stream length by water type. Linear measurements were multiplied by FP rule buffer widths for RMZ's/WMZ's. Stream type classification and harvest options within RMZ zones are finalized at the time of forest practices application review, therefor the real harvestable timber will vary from the estimates provided here.

[23] Type F Inner and Outer Zone acres, and Nx acres were halved to approximately represent harvest limitations in these areas.

[24] The board foot volume per acre based on visual observation from roads is a preliminary estimate. The board foot value is based on a 2013 sample appraisal from SW Washington and personal communications with professional forest managers, and represents the net value of timber after the cost of harvest and hauling.

[25] Order of Magnitude (OM) Timber Value does not include acreage of spur road ROW's and platforms that have already been harvested. Although this biases the estimate towards being too high, Weyerhaeuser might expect to recuperate the sunk cost of road and platform reconstruction that has occurred. The estimate does not include transaction costs. An estimate of value for the reserved timber area used in prior City communications was $3,500 per acre; however the assumptions underlying that estimate aren't known and therefor were not used in this analysis. An order of magnitude estimate is accurate to within an order of magnitude.

Table 9. Order of Magnitude Estimate of the Bare Land Value Owned By Weyerhaeuser[26]

County Parcel Number	Location (all in Township 10 North, Range 10 West)	Acres[27]	Bare Land Value per Acre[28]	Order of Magnitude Bare Land Value[29]
09100300000	Section 3 (Township 9N)	640 (20 inside watershed)	$500 - $700 per acre	$10,000 - $14,000
10103428000	NE ¼, SE ¼, SW ¼ of Section 34	480 (150 inside watershed)		$75,000 - $105,000
10103429000 East Half	East ½ of NW ¼ of Section 33	80 (60 inside watershed)		$30,000 - $42,000
Total Order of Magnitude Estimated Value of Bare Land owned by Weyerhaeuser =				$115,000 - $161,000

[26] The land is currently forested. This estimate contemplates the value of the bare land after the timber is harvested.

[27] Acres are approximate and not based on a survey. The 1987 agreement ambiguously includes a 7 acre portion of parcel 10102732001 in the timber reservation. Including that seven acres makes the total acreage of the Unit 626 reservation 59 acres.

[28] Land value per acre range obtained from personal communication with professional foresters.

[29] The estimate does not include transaction costs. An order of magnitude estimate is accurate to within an order of magnitude. Exact acreage, market changes, and the interests of transaction participants affect value.

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Pacific County GIS Webpage

Western Regional Climate Center

Washington Department of Natural Resources Geosciences Portal

Washington State Forest Practices Spatial Datasets

Washington State Forest Practices Application Review System

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