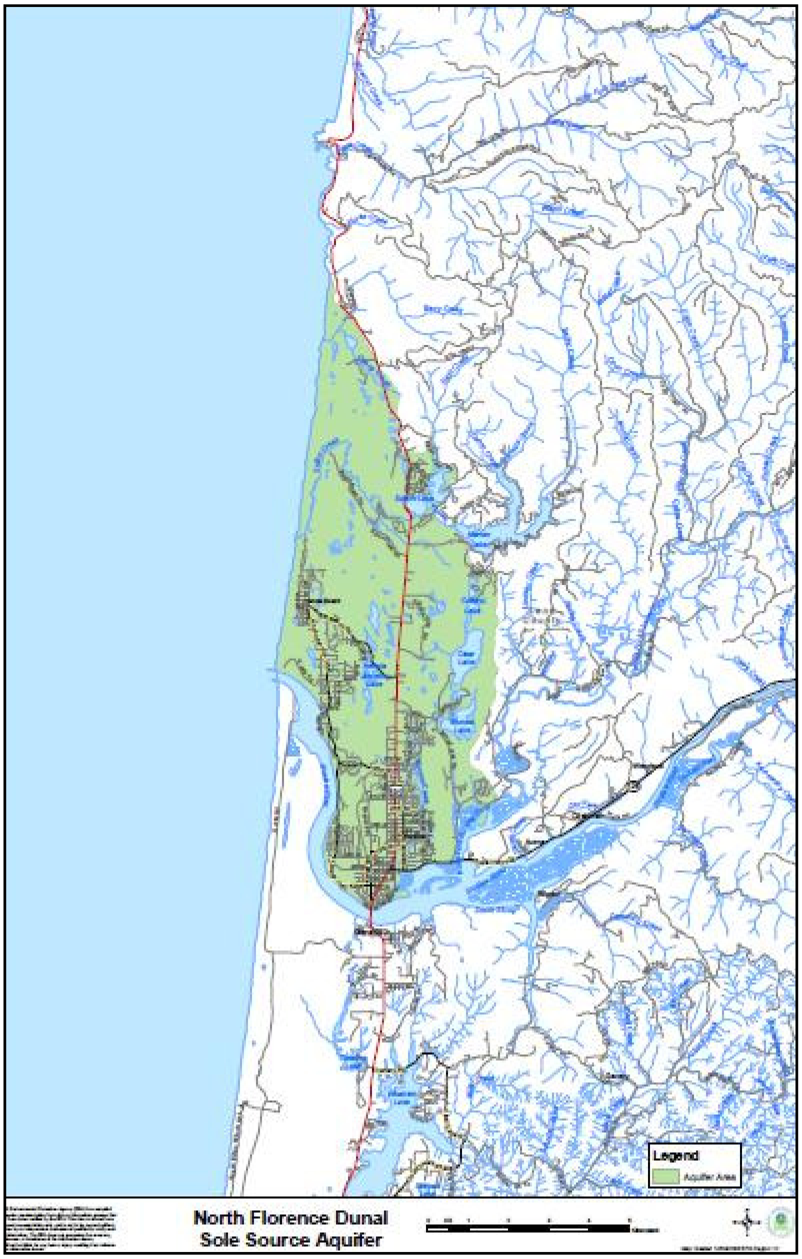
Siuslaw Estuary Partnership

An Integrated Multiple Objective Approach To Watershed Protection and Restoration

Aquifer Protection Plan
For the North Florence Sole Source Dunal Aquifer



September 18, 2013

This Plan was adopted as part of the Florence Realization 2020 Comprehensive Plan through adoption of the following Ordinances. The Contingency Plan was adopted by the City, but was not adopted as part of the Comprehensive Plan.

- City of Florence Ordinance No. 2, Series 2013
- Lane County Ordinance No. PA 1299

This Plan was certified by the Oregon Department of Environmental Quality (DEQ) on September 18, 2013. See letter on following page.

Oregon

John A. Kitzhaber, MD, Governor

Department of Environmental Quality
Western Region Eugene Office
165 East 7th Avenue, Suite 100
Eugene, OR 97401
(541) 686-7838
FAX (541) 686-7551
TTY 711

September 18, 2013

Mr. Mike Miller, Public Works Director
City of Florence
250 Highway 101
Florence, Oregon 97439

RE: Certification of Florence's Aquifer Protection Plan (Public Water System #4100299)

Dear Mr. Miller:

Oregon DEQ and Oregon Health Authority (OHA) congratulate you on the certification of Florence's Aquifer Protection Plan in accordance with Oregon Administrative Rules (OARs) 340-40-0170 and 340-40-0180. This comprehensive plan reflects the significant dedication of time and resources by the City of Florence, public officials, stakeholder groups, and concerned residents who participated in its development. We also commend the City's partnership with Lane County to co-adopt the Aquifer Protection Plan, as well as the City's adoption of the Drinking Water Protection Overlay Zone to reduce risk of groundwater contamination from hazardous materials.

Florence's Aquifer Protection Plan not only lays the groundwork for long-term protection of your sole source dunal aquifer; it also serves as an excellent model for other water systems across the state to follow as they develop their own drinking water protection strategies and plans. The plan includes a wide variety of effective strategies to engage residents in safeguarding groundwater resources for future generations. Furthermore, the integration of drinking water protection into the Siuslaw Estuary Partnership Project demonstrates the City's holistic approach for conserving and protecting all vulnerable water resources in your area.

All approved and certified drinking water protection plans are evaluated at approximate five-year intervals to ensure that responsible management authorities are participating in efforts to reduce the risk of contamination within drinking water source areas. The recertification of your plan will be based on an evaluation of the progress made towards risk reduction and an evaluation of any new elements or areas of the plan that may no longer be adequate or relevant. Specific requirements are provided in OAR 340-40-0190.

Once again, DEQ and OHA appreciate the hard work and commitment by the City, consultants, and stakeholders to protect Florence's unique groundwater resource. Please contact me at (541) 686-7898 if you need further assistance as you begin implementing the Aquifer Protection Plan.

Sincerely,

Jacqueline Fern

Jacqueline Fern, Drinking Water Protection Specialist
Oregon Department of Environmental Quality

cc: Nola Xavier, Mayor of Florence
Jacque Betz, City Manager
Kelli Weese, City Recorder
Carol Heinkel, Siuslaw Estuary Partnership Project Coordinator
Tom Pattee, OHA Drinking Water Program
Sheree Stewart, Oregon DEQ Drinking Water Protection Program
Shawn Stevenson, OHA Drinking Water Program

This page intentionally left blank.

Table of Contents

**Note: Portions of these sections of the plan apply aquifer-wide and are not intended for certification of a Source Water Protection Plan under OAR 340-040-0170.*

Table of Contents (continued)

Acknowledgements

The City of Florence gratefully acknowledges the following City staff and consultants, Stakeholders, and Aquifer Protection Plan Technical Advisory Committee for their contributions to this Aquifer Protection Plan.

City of Florence

Jacque Betz, City Manager
Mike Miller, Florence Public Works Director, Project Manager
Carol Heinkel, Florence Planning Consultant, Project Coordinator
Dennis Nelson; Suzanne de Szoeke, GSI Water Solutions, Hydrogeologist Consultants
Kelli Weese, GIS Technician, City Recorder, Interim Planning Director
Michelle Pezley, Florence Assistant Planner

Stakeholders

Community Stakeholder Group

Audubon Society and Local Birdwatcher Group: Adele Dawson
Central Oregon Coast Board of Realtors: Rob Shepherd
Florence Chamber of Commerce: Lisa Walter-Sedlacek
Fisheries, Steelheader Group: David Hunnington
Florence Area Hospitality Association: Tiffany Rogato
Florence Planning Commissioners: Mark Tilton
Lane County Planning Commission: Nancy Nichols
Oregon Shores Conservation Coalition: Anne Caples and Sue Noble
Scuba Club/Divers: Clarence Lysdale
STEP (Salmon Trout Enhancement Program): Bill Hennig
Surfrider Foundation: Gus Gates
Volkswalkers: Jean White
Ocean Dunes Golf Links: Randy Curtola
Coast Village: Mary McGann
Sand Ranch: Deacon Mathews
Florentine Estates: Nola Xavier and Del Phelps
Koning and Cooper (business owners): Art Koning and Gary Cooper
Recycling and Solid Waste: Dave Twombly

Elected Official Stakeholder Group

Siuslaw Watershed Council Leadership Board: Jim Grano, Chair
Florence City Council: Phil Brubaker, Mayor; Sue Roberts, Councilor
Lane County Board of Commissioners: Jay Bozievich, Commissioner
Heceta Water District Board: Jerry Nordin, Board Member
Port of Siuslaw Board: Joshua Green, Board Member
Tribal Council of the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians: Bob Garcia, Tribal Chairman
Siuslaw Soil and Water Conservation District Board: Fuzzy Gates, Board Member

Aquifer Protection Plan Technical Advisory Committee

- Jacqueline Fern, David Waltz, Mike Kucinski, Randy Trox, Oregon Department of Environmental Quality (DEQ)
- Tom Pattee, Sean Stevenson, Oregon Health Authority, Drinking Water Program
- Dan Hurley and Kier Miller, Lane County
- Jason Kirchner, John Spangler, Bob Buckman, Oregon Department of Fish and Wildlife
- Dave Perry, Amanda Punton, Oregon Department of Land Conservation and Development
- Bart Bretherton, Oregon Department of Transportation
- Michael Mattick, Oregon Department of Water Resources
- Seth Mead, Siuslaw Soil and Water Conservation District
- Liz Vollmer-Buhl, Siuslaw Watershed Council
- Howard Crombie, Natural Resources Program Director, Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
- Janet Robbins, US Bureau of Land Management
- Jeff Young, National Oceanic and Atmospheric Administration, National Marine Fisheries Service

This project has been funded in part by the United States Environmental Protection Agency under assistance agreement WC-00J04801-0 to City of Florence. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Executive Summary

This Aquifer Protection Plan for the North Florence Sole Source Dunal Aquifer was prepared through the work of the Siuslaw Estuary Partnership, a collaborative effort by the City of Florence and its federal, state, local, and tribal partners to protect and improve water quality and fish and wildlife habitat in the lower Siuslaw River Watershed. As such, the plan incorporates the Partnership's Guiding Principles, endorsed by the City and its partners. Portions of this plan also serve as the Source Water Protection Plan for the City in accordance with the Oregon Department of Environmental Quality's (DEQ) administrative rules for groundwater quality protection.

This project was managed by the City's Public Works Director. The plan was developed over the course of three years by the City of Florence's Planning Consultant, together with the City's consulting Hydro-geologists, and the Interdisciplinary Team, particularly staff from the Oregon Department of Environmental Quality and the Oregon Health Authority. The plan benefitted from the input of two Stakeholder Groups: the Community Stakeholders and the Elected Official Stakeholders; and it was presented for public review and comment as part of an extensive public outreach program.

Purpose and Scope

The purpose of this Aquifer Protection Plan is to protect water quality within the City of Florence's urban growth boundary (UGB) in the North Florence Dunal Aquifer, the sole source of drinking water for the Florence community. The scope of this plan is aquifer-wide for three key reasons:

1. The aquifer, designated "sole source" by the US Environmental Protection Agency (EPA) in 1987, is the only source of drinking water available in this area.
2. Surface waters and groundwater are highly interconnected in the aquifer; they flow primarily to the Siuslaw Estuary; and the estuary, with its surrounding watershed, provides significant habitat to many threatened and endangered species.
3. The health of the natural environment is key to Florence's economic vitality. As good stewards of these resources, the City of Florence and its partners have determined that this plan should have an aquifer-wide focus.

Source Water and Drinking Water Protection Areas (DWPAs) (Chapter 2)

- Florence's drinking water is supplied by a single wellfield comprising 12 City-owned and operated wells, with one additional well to come on line in the near future. The City's municipal wellfield is located on 80 acres adjacent to the Ocean Dunes golf course on the eastern edge of Florence bordered by Willow Ridge Court to the south and 35th Street to the north. The wells produce water year round and serve as the City's sole water supply source.

- The City has four above-ground reservoirs: an elevated 250,000-gallon tank near the City shop (currently offline and not in use); a 500,000-gallon steel tank on the east hills; and two 2,000,000-gallon tanks near the Sand Pines Golf Course. Water diverted under all of the City's groundwater rights is treated at the City's water treatment plant. Currently, the plant has a capacity of 4.6 cubic feet per second (cfs) or 3 million gallons per day (mgd). This capacity is 1.24 cfs (0.8 mgd) less than the full value of the City's existing groundwater rights. The City's distribution system consists of four pressure zones served by three water storage reservoirs and three booster pumping stations.

- Currently, the existing City wells do not have the capacity to produce the full amount of water authorized by the City's water rights. Furthermore, the City's population and demand for water are increasing and are projected to exceed the existing water supply within the 20-year planning period (2030) for the City's Water Management and Conservation Plan (WMCP). For these reasons, this plan contains a new well site analysis for a proposed wellfield to provide for water supply redundancy and expand water supply. The additional wellfield site is located northwest of the existing wellfield. It is likely that new water rights would be required for the additional wellfield.

- The Drinking Water Protection Areas (DWPAs) or "capture zones" for the existing and proposed wellfields, shown in Figures ES 1 and ES 2, outline the land surface that overlies that part of the aquifer that supplies groundwater to the well over a given time period. The DWPAs in this plan show the capture zones for the 1, 2, 5, 10, 20, and 30 year Time of Travel Zones (TOT). The TOT represents the length of time it takes for a molecule of water entering the groundwater at a specific location to reach the City's wells.

- The Oregon Health Authority (OHA) has certified the DWPA delineation for the existing wellfield (see Appendix D). This certification assures that the delineations meet minimum requirements for the system size as outlined in OHA Oregon Administrative Rule (OAR) 333-61-0057 and that the delineation is a hydro-geologically reasonable representation of the capture zone of the well, wellfield, or spring.

- The delineation of capture zones for the proposed wellfield was not certified by OHA because the wells do not yet exist. OHA did approve the use of the delineation for the proposed wellfield for protection of possible future drinking water resources (Appendix D).

- In general, the closer a contaminant source is to a well, the greater the risk of contamination, although some contaminants, namely dense non-aqueous phase liquids, or DNPLs, are a threat to the water supply regardless of distance traveled to the well. This is because DNPLs, such as chlorinated solvents, are liquids that are both denser than water and do not dissolve in water. DNAPLs are extremely expensive and difficult to remediate.http://en.wikipedia.org/wiki/Dense_non-aqueous_phase_liquid - cite_note-0#cite_note-0

- This Plan also contains information about the Source Water Assessments conducted for Heceta Water District and the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (see Appendices E-1 and E-2).

Water Monitoring Program and Potential Contaminant Sources (Chapter 3)

Surface and Groundwater Monitoring Program

- The Siuslaw Estuary Partnership includes a Surface- and Groundwater Monitoring Program to protect the North Florence Sole Source Dunal Aquifer and to protect and improve water quality in Munsel and Ackerley Creeks and the Siuslaw River.

- The Siuslaw River has been classified as Water Quality Limited under the Clean Water Act and on the state's 303(d) list of Impaired Water Bodies.

- Sixteen groundwater "test wells" are installed throughout the aquifer to monitor levels and quality; and stream gages, sondes, and grab sampling are used in Munsel and Ackerley Creeks to monitor stream flow and water quality. The Surface and Groundwater Monitoring Program is operating under an EPA-approved Quality Assurance Project Plan (QAPP) (Appendix F).

- Data on water levels, fluctuation, and flow collected and analyzed through the City's Surface and Groundwater Monitoring Program were used in the Groundwater Flow Model and all monitoring results have been reported in quarterly and annual reports prepared by GSI Water Solutions, Inc., the hydro-geologists retained as consultants to the Partnership. These reports are included in Appendix A of this plan along with reports from the Oregon Beach Monitoring Program.

Potential Contaminant Source (PCS) Inventories

- Potential Contaminant Source Inventories were developed for both existing and future land use for both the existing wellfield and the proposed wellfield.

- The inventory is a very valuable tool for the local community in that it:
  - Provides information on the locations of PCSs, especially those that present the greatest risks to the water supply,
  - Provides an effective means of educating the local public about potential problems, and
  - Provides a reliable basis for developing a local management plan to reduce the risks to the water supply.

- Chapter 4 of this plan contains management goals and strategies to address potential contaminant source inventories, as summarized in the section below, Management Goals and Strategies.

Management Goals and Strategies (Chapter 4)

Chapter 4 of this plan contains management goals and strategies for the following three areas:

1. Aquifer-wide
2. Existing Wellfield
3. Proposed Wellfield

Management strategies for the existing and proposed wellfield are tied to the Potential Contaminant Source Inventories for existing and planned land uses. The Goals and Strategies are presented in Tables 4.1, 4.2, and 4.3 for the three categories and the priorities shown reflect the following:

H (High): Begin to implement immediately or continue to implement, if already being done
M (Medium): Begin to implement in next two fiscal years

L (Low): Implement as time and financial resources are available

The priorities and implementing groups and their roles were determined through the team and stakeholder processes. For all strategies, the City will take the lead role in implementation, unless noted otherwise.

Management goals are broad vision statements describing desired conditions or activities for the future. They provide direction for the development of management strategies. The management strategies more specifically describe a course of action for protecting the aquifer and Drinking Water Protection Areas (DWPAs).

The implementation of management strategies is key to the ultimate success of the Plan. Following City and County approval of the plan and certification of the plan by the Oregon Department of Environmental Quality (DEQ), the City will initiate amendments to the Comprehensive Plan and Code and begin to implement management strategies. Amendments that apply within city limits will be submitted for adoption by the City Council; amendments that apply outside the City, within the UGB, will be submitted to the County Board for adoption as well.

1. Aquifer-Wide Management Goals and Strategies[1]

Aquifer-wide management goals and strategies apply throughout the aquifer. They are presented in Table 4.1 with the implicated priority for implementation and implementing groups and their roles. Goals and strategies fall into four categories:

1. Surface and Groundwater Monitoring (H)
2. Public Education (H)
3. Coordination with Public and Non-profit Partners (H)
4. Integrated Pest Management (M)

2. Management Goals and Strategies for the Existing Wellfield

Three types of land uses have been identified in the DWPA for the existing wellfield:

1. Residential
2. Private Open Space
3. Public

Management goals and strategies and implementing priorities and groups/roles are linked to these existing and planned land use types and associated high- and moderate-risk potential contaminant sources in Table 4.2, starting with strategies that apply to all land use types in the DWPA.

Goals and strategies fall into the following categories:

1. Conduct targeted public education and outreach (M)
2. Continue to monitor potential contaminant sources (H)

[1] The aquifer-wide strategies in Chapter 4 apply aquifer-wide and are not intended for certification of a Source Water Protection Plan under OAR 340-040-0170, except as they are cross-referenced in the specific DWPA sections of this chapter.

3. Work with realtors (H)
4. Target integrated pest management efforts to DWPA (M)
5. Adopt comprehensive plan policies and code amendments (H)
6. Work with home owners associations (H)
7. Continue to work with golf course managers (H)
8. Continue to monitor sewer lines (H)

3. Management Goals and Strategies for the Proposed Wellfield

Four types of land use have been identified in the DWPA for the proposed well-field:

1. Residential
2. Commercial/Industrial
3. Private Open Space
4. Public

Management goals and strategies and implementing priorities and groups/roles are linked to these existing and planned land use types and associated high- and moderate-risk potential contaminant sources in Table 4.3, starting with strategies that apply to all land use types in the DWPA.

Goals and strategies are presented in Table 4.3 that fall into the following categories:

1. Conduct targeted public education and outreach (M)
2. Adopt comprehensive plan policies and code amendments (H)
3. Continue to monitor potential contaminant sources (H)
4. Work with realtors (H)
5. Target integrated pest management efforts to DWPA (M)
6. Adopt drinking water protection overlay zone (H)
7. Inventory and rank chemicals used in the DWPA and prepare related responses (H)
8. Provide business assistance (H)
9. Continue to work with golf course managers (H)
10. Continue to monitor sewer lines (H)

Implementation Plan

The City will take the following actions to implement the management strategies:

1. The City Council concurred by motion with the Plan on July 11, 2012; The Lane County Board concurred by Board Order on July 25, 2012.
2. An initial draft locally accepted plan was submitted to the Oregon Department of Environmental Quality (DEQ) and OHA for review in July 2012 and a revised draft was submitted in December 2012. The City will request certification prior to final adoption.
3. City will initiate amendments to the Comprehensive Plan and Code, including Drinking Water Protection Overlay Zone, and begin to implement management strategies: April 30, 2013 (target date).
4. City will submit to Lane County, for co-adoption, Comprehensive Plan amendments that apply outside the City, within the UGB: to be scheduled
5. City will set up internal procedures and assign staff to develop and implement annual work programs to implement the management strategies. City has ob-

tained the assistance of a RARE program participant to assist in the administration of the strategies.

Contingency Plan (Chapter 5)

In the event contamination or loss of the water source should occur, the City needs to be prepared to react to with a contingency plan. The Contingency Plan in Chapter 5 is a designed response to the contamination or disruption of Florence's current water supply. Procedures to deal with contamination threats are also outlined in Chapter 5.

The Contingency Plan focuses on:

- Identification of the primary potential threats to the aquifer and water supply;
- Developing procedures that will be followed should the threats materialize.

Florence's contingency plan addresses ten elements required by the Oregon Drinking Water Protection Program:

1. Potential threats to the drinking water supply
2. Protocols for incident response
3. Prioritization of water usage
4. Key personnel and development of a notification roster
5. Short-term and long-term replacement of water supplies
6. Short-term and long-term conservation measures
7. Plan testing, review, and update
8. Personnel training
9. Provisions for public education
10. Logistical and financial resources

Primary threats to Florence's drinking water system are related to an interruption of water delivery or contamination of the aquifer used for the drinking water supply. The following types of events could cause an interruption in delivery and/or contamination of the water supply, in order of most likely events:

1. Electrical/mechanical problems: power outage, broken pipeline, pump failure
2. Spill in area surface waters, i.e., creeks, lakes, wetlands, beaches, stormwater systems that discharge to surface waters; stormwater contamination resulting in well water contamination; releases from a leaking underground fuel storage tank; chemical spill at a nearby business; or other hazardous materials spills (highway spills)
3. Flooding
4. Contamination at a wellhead
5. Earthquakes or Tsumanis (see "City of Florence Multi-Jurisdictional Natural Hazards Mitigation Plan")

- The most likely threats to the drinking water supply are electrical/mechanical failure, contamination at or near a wellhead, a chemical release within the drinking water protection area (DWPA) or highway spills, a spill in area surface waters or in stormwater systems that discharge to surface waters. Of the identified risks, the one with the most potential for serious contamination is a spill from a transport vehicle traveling on Highway 101 adjacent to the DWPA. The likelihood of this happening is low, but the potential for contamination, should a spill occur is high. Should an incident like this occur, the Siuslaw Valley Incident Command Team would respond immediately and work to contain the spread of the hazardous material as detailed in their

Emergency Response Plan.

- The City Water Treatment Plant has an operations manual that provides detailed procedures for containment of spills or other potential contaminant events. The pertinent portion of the Procedures Manual is located in Appendix K. Ocean Dunes Golf Course also has a spill containment plan, as part of the requirement for certification for application of agricultural chemicals.

- Breaks or leakage in city sewer lines are repaired by City staff or by a contractor under City direction. Breaks are repaired under an emergency operations plan (see Appendix K). Leaks are identified and repaired through the use of routine TV surveillance of all sewer lines and routine manhole cover surveillance.

- Prevention of contaminant incidents related to stormwater is the preferred option. The City's stormwater system is a combination of piped and infiltration facilities. The City requires oil and silt separator catch basins in all development, and has a stenciling program for all storm drains.

- In the event of a contaminant incident in an infiltration system, standard containment procedures would be utilized according to the Florence Water Management and Conservation Plan. In the event of a contaminant incident in a piped system, if identified soon enough, the contaminating substance would be isolated in the affected area of the piped system. If identified only at the time a contaminant was detected at the outfall, standard containment procedures would be utilized. If the outfall were in the Siuslaw River, the Emergency Response Plan would provide for containment of the contaminant to the smallest possible affected area.

- Lane County has established procedures for dealing with potential contaminant incidents at its facilities.

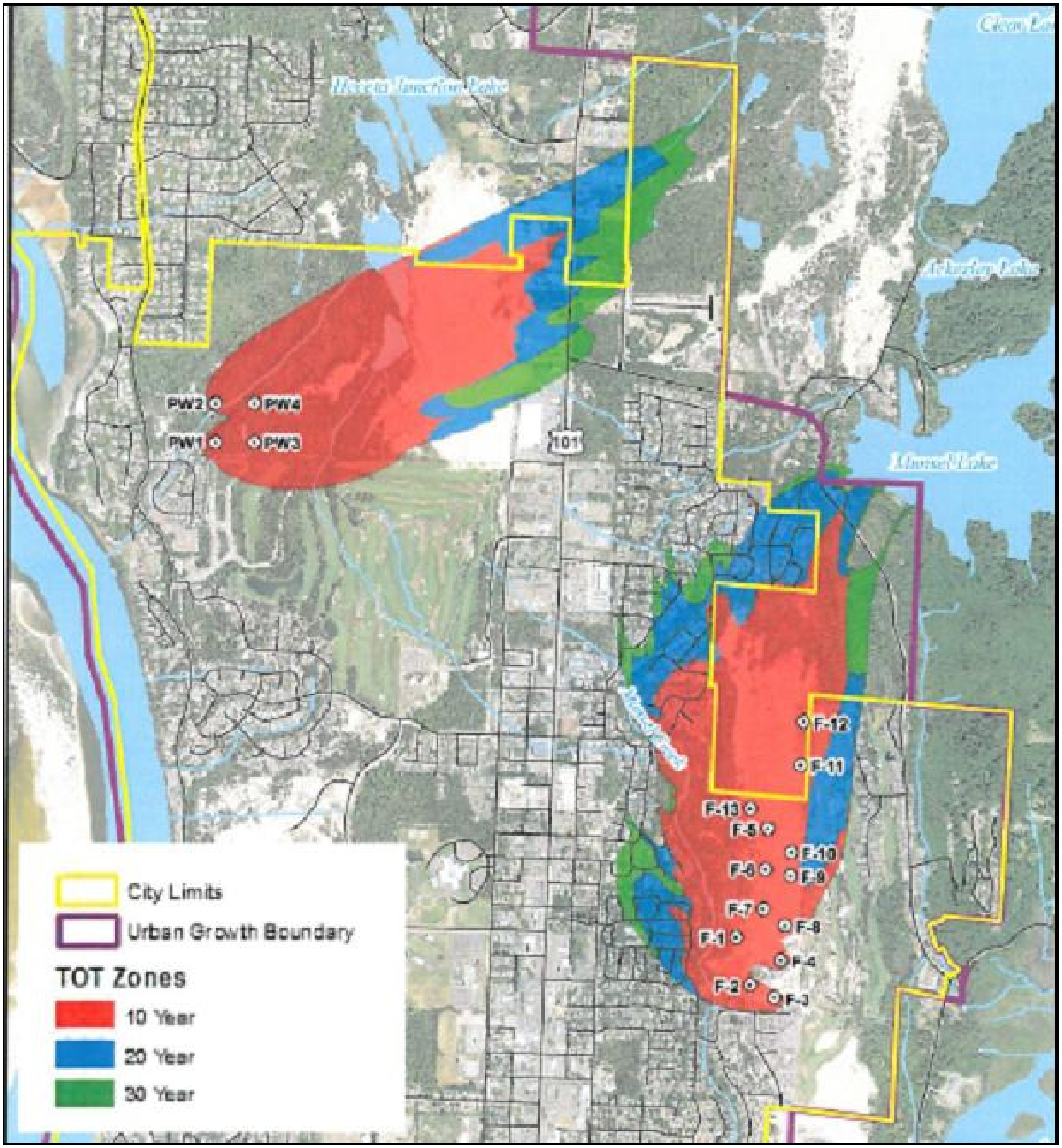
New Well Site Analysis (Chapter 6)

- The 2011 Florence Water Master Plan recommends that the City expand the existing groundwater supply system by adding up to 4 new wells in a new wellfield to increase capacity by approximately 350 gpm (0.5 mgd) in order to provide a total supply capacity of 3.2 mgd at the end of the 20-year planning horizon in 2030. The City's projected demand in 2020 will require all of the City's existing 2.7 mgd supply capacity, thus supply expansion is recommended between 2015 and 2020.

- The proposed new well field is located west of Highway 101 and immediately north of Sand Pines Golf Course (Figure ES 1 and ES 2). This site and its delineated drinking water protection area (DWPA) are shown in Figures 6.1 and 6.2. This DWPA has been given "provisional" certification by OHA, as explained in their letter in the delineation report in Appendix D. It should be noted that the actual well locations will most likely be farther to the south and west of where they are shown in these figures. The actual DWPA would also move accordingly to accurately reflect well locations.

- The proposed site for this report was analyzed from a groundwater risk perspective. Selecting a preferred site from a groundwater risk view involves an analysis of various land use components such as property ownership and contamination risks associated with various land uses within that well's delineated protection area.

Figure ES 1. Regional view showing the 30-year capture zones (DWPAs) of the existing wellfield (lower right) and the proposed wellfield (upper left). Shading indicates the TOT zones: red = 10-yr, blue = 20-yr, and green = 30-yr TOT. Existing wells one through 13 and proposed wells 1 through 4 are shown.



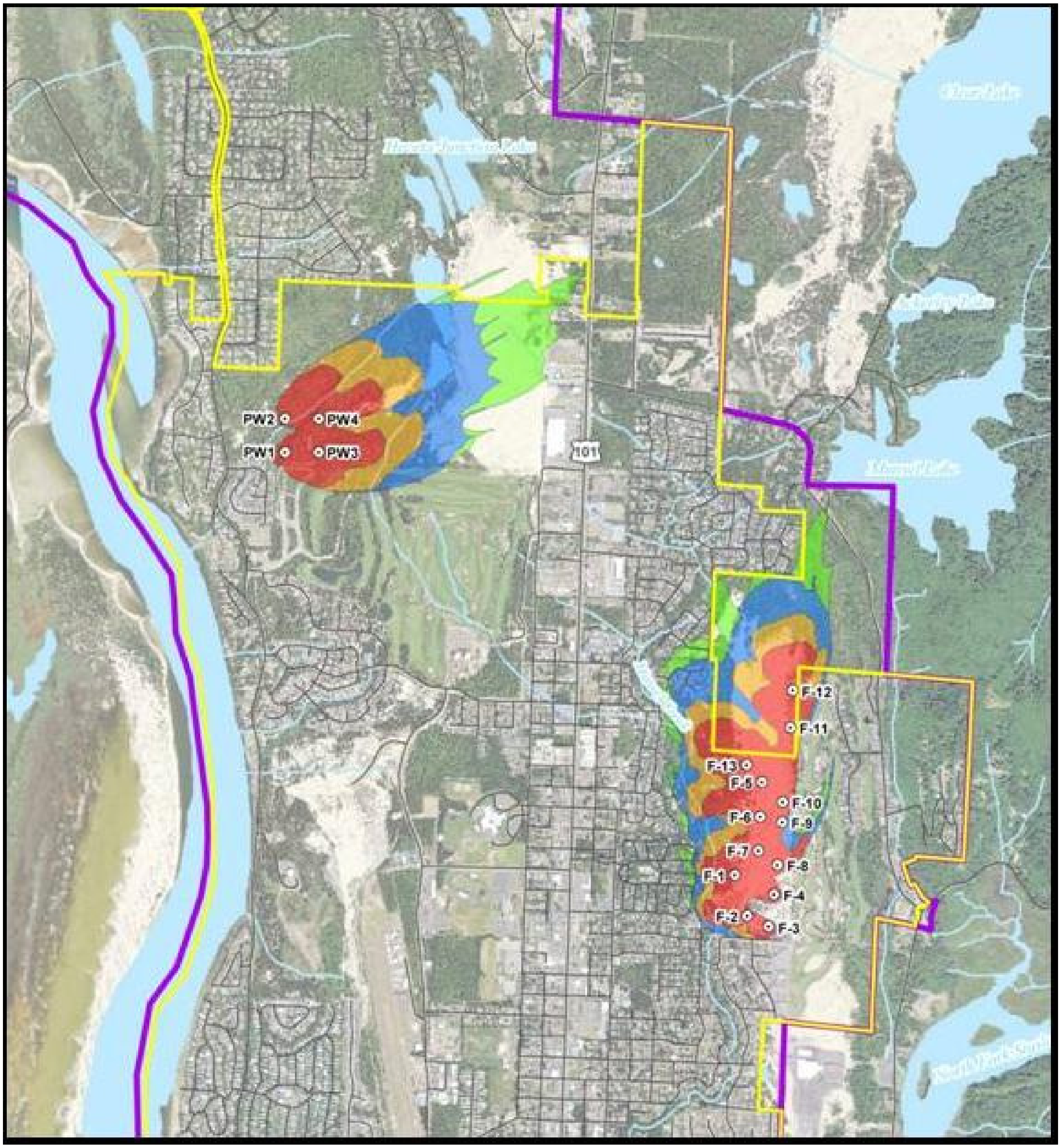


Figure ES 2. Ten-year capture zones for Florence's existing and proposed Wellfields. Different Time of Travel (TOT) zones indicated by shading: red = 1-year TOT, orange = 2-year TOT, blue = 5-year TOT, and green = 10-year TOT.

Chapter 1: Introduction

This Aquifer Protection Plan protects water quality in the North Florence Dunal Aquifer within the City of Florence's urban growth boundary (UGB), the sole source of drinking water for the Florence community. The scope of this plan is the North Florence Sole Source Dunal Aquifer. Portions of this plan serve as the Source Water Protection Plan for the City in accordance with OAR 340-040-170.[2] The state certified Source Water Protection Plan includes all sections of this document except portions of those sections marked with an asterisk in the Table of Contents and footnoted as such in the body of this plan.

This Plan is organized into six chapters. Chapter 1 outlines the plan's organization and provides the purpose and background of the Aquifer Protection Plan. In addition, this chapter provides an overview of the Florence community, natural environment, and sole source aquifer; the public involvement and Technical Advisory Committee; and the Siuslaw Estuary Partnership Guiding Principles and Measurable Outcomes that guided the development of this plan.

Chapter 2 provides information about the City's water system, the nature and characteristics of the aquifer, the Groundwater Flow Model, and Source Water Protection Areas. Chapter 3 describes the City's Surface and Groundwater Monitoring Program methodology and results, and the Potential Contaminant Source Inventories for the Delineated Source Water Protection Areas.

Chapters 4 through 6 focus on solutions. Chapter 4 includes the goals and specific management strategies for reducing contamination risks and for responding to contamination incidents within the drinking water protection areas and the aquifer. Chapter 5 identifies the primary threats leading to disruption and/or contamination of Florence's water system and details protocols to be used in the event of an emergency. Finally, Chapter 6 provides an analysis of new well sites based on criteria related to source water protection.

Chapters 4, 5, and 6 are not intended to be exclusive "solutions." Other solutions may be identified and reviewed for potential implementation through the ordinance process. Further, not all of the solutions presented may be ultimately adopted through the ordinance process. The solutions to be implemented by ordinance will be selected after further examination, dialogue, and review between the City and its partners and Stakeholders. During that process, factors such as enforcement responsibilities and apportionment of costs will be discussed.

Purpose and Background

Purpose

The purpose of this Aquifer Protection Plan is to update the December 2003 Florence Drinking Water Protection Plan and expand the scope to encompass the North Florence Sole Source Dunal Aquifer within the Florence Urban Growth Boundary (UGB).

The scope of this plan is aquifer-wide for several reasons. The aquifer is "sole source" meaning that there are no alternative drinking water sources available. In addition, sur-

[2] See certification approval letter from the Oregon Department of Environmental Quality (DEQ) in the front of this plan.

face waters and groundwater are highly interconnected in the aquifer; so, contamination of one can contaminate the other. Further, the Siuslaw estuary and surrounding watershed provide significant habitat to many threatened and endangered species; and the health of the natural environment is key to Florence's economic vitality. As good stewards of these resources, the City of Florence and its partners have determined that this plan should have an aquifer-wide focus.

Specific objectives are to:[3]

1. Protect the North Florence Sole Source Dunal Aquifer.
2. Incorporate the Guiding Principles of the Siuslaw Estuary Partnership into the Aquifer Protection Plan.*
3. Protect drinking water quality and quantity in the City's existing wells and new well sites.
4. Locate new sites for City production wells where they will not cause water levels in creeks and wetlands to go below threshold levels that would harm fish and wildlife habitat.
5. Update the delineation of the Drinking Water Protection Areas (DWPAs) for existing and future wells; expand the Zone of Contribution to the 30 Year Time of Travel Zone for certification of DWPAs.
6. Protect fish and wildlife habitat and align Aquifer Protection Plan with Goals and Strategies for protecting fish and wildlife habitat.*
7. Incorporate and address results from the Surface and Groundwater Monitoring Program.*
8. Identify and obtain agreement from stakeholders on Goals and Strategies for protecting water quality in the aquifer.
9. Engage the public in the process to improve awareness of threats to drinking water quality.
10. Update the list of potential contaminants and Potential Contaminant Source Inventory.
11. Integrate maps into GIS: Delineation Map; Potential Contaminant Map; Aquifer Sensitivity Map.
12. Adopt measures to protect the DWPAs, and the aquifer.*
13. Meet state DEQ requirement to update the Plan every 5 years.

Background

The aquifer was designated a "sole source" aquifer by the US Environmental Protection Agency (EPA) in 1987 (Figure 1.1).[4] It was, and continues to be, the only "sole source" aquifer in the State of Oregon. Residents and businesses within the Florence urban growth boundary (UGB) rely entirely on water from the aquifer for their public water supply. In addition, all streams, creeks, lakes, and wetlands (surface waters) in the aquifer boundary are "hydrologically connected" with the groundwater system.

The aquifer lies within the lower Siuslaw River Watershed, a significant natural area that provides critical habitat for endangered and threatened animal species. In all, about 23

[3] The objectives, or portions of objectives, shown with an asterisk (*) apply aquifer-wide and are not intended for certification of a Source Water Protection Plan under OAR 340-040-0170).
[4] The Environmental Protection Agency (EPA) defines a sole source aquifer as "an underground water source that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. These areas have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer for drinking water."

species of fish, almost 200 species of birds, and numerous species of marine mammals use the estuary and the surrounding wetlands, lakes, riparian and upland areas. The watershed supports spawning runs of fall Chinook, winter steelhead, coho, and sea-run cutthroat; and receives significant waterfowl use. Historically, the Siuslaw Basin was one of the most abundant anadromous fish producers in the Pacific Northwest. Once the Oregon Coast's largest Coho-producing system next to the Columbia, the Siuslaw River's salmon production is drastically diminished.

The lower Siuslaw River watershed health is degraded and a significant amount of restoration action is needed to improve watershed conditions (Oregon Watershed Enhancement Board, 2007). The watershed is limited by all factors in aquatic/instream areas, tideland, riparian, freshwater wetlands, and upland areas. The Siuslaw River is classified as Water Quality Limited under the Clean Water Act and is included on the state's 303(d) list of Impaired Waterbodies by the Oregon Department of Environmental Quality. The River is failing in all these parameters: Dissolved Oxygen, Fecal Coliform, Habitat Modification, and Temperature, and potentially Alkalinity. Beneficial Uses impaired by these listed parameters include resident fish and aquatic life; salmonid fish spawning and rearing; anadromous fish passage; trout rearing and migration; and shellfish growing.

Urbanization of the UGB, development of rural areas along stream corridors for housing, and environmental changes will exacerbate long-term watershed changes caused by established land use patterns, including altered sediment and detritus deposition patterns, changed peak flows, water circulation patterns, flooding regimes, and surface and groundwater contamination from septic systems and non-point source pollution. The presence and increased discharge of nitrates and other pollutants into the ecosystem through urban groundwater and surface water activities, and the loss of riparian and floodplain function, can be expected to further degrade the system. Another deleterious effect is increased erosion, which is already a problem in developed portions of the estuary and along Munsel Creek.

Community concern for the aquifer, the Siuslaw estuary, and the area's streams, lakes, and wetlands and is well-documented in City Comprehensive Plan policies and annual City Council Goals. In October, 2009, the City and its partners from 19 federal, state, tribal, and local agencies, embarked on a three-year, EPA-funded project called the Siuslaw Estuary Partnership (EPA Cooperative Agreement #WC-00J04801-0). The mission of the project is to protect and improve water quality and fish and wildlife habitat in the lower Siuslaw watershed. This three-year project is funded by project partners and the US Environmental Protection Agency (EPA). This Aquifer Protection Plan is one of the products included in the Partnership work plan and the Partnership grant helps fund the City's Surface and Groundwater Monitoring Program, described in detail in Chapter 3. The Siuslaw Estuary Partnership Guiding Principles, endorsed by the City and its partners, provide guidance for this plan (see below).

Community Sketch

Florence is an incorporated city in Lane County, Oregon, with a 2010 city limit population of 9,590 and a 2008 estimated urban growth boundary (UGB) population, including city limits, of 10,767 (Portland State University estimates). The UGB covers 5 square miles of land and 0.6 square miles of water along the Siuslaw River estuary and the Pacific Ocean. Florence is Lane County's major coastal city and the largest city in the Siuslaw watershed. The UGB population is projected to grow to 16,323 by 2030, almost double the UGB population in 2000. This growth is expected to occur primarily through urbanization of “urbanizable” land within the UGB. Land cover includes urban development within city limits and developable rural lands and uses outside.

The Siuslaw River estuary, designated a Shallow Draft Development estuary under the Oregon Estuary Classification System, is managed for navigation and other public needs with jetties and a main channel maintained by dredging at 22 feet or less. The geomorphology of the area is that of a Drowned River Mouth estuary. The estuary’s broad floodplain, numerous wetlands, and tidal islands, lead to the dunes along the coastal plain at Florence. Here the land is characterized by barren sand dunes interspersed with pine woodlands and deflation plain lakes or wetlands.

The quality of the groundwater is critical to the physical health of the community. Water quality in both groundwater and surface waters is also critical for the economic well being of residents and businesses. The area is an important recreational area providing opportunities for fishing, boating, beach walking, shopping, dining, bird watching, and many other active and passive recreational activities.

Since the decline of the forest industry, most of the revenue generated in the area is from tourism, recreation, and commercial fishing. Local community members, both tribal and nontribal, engage in subsistence fishing for marine and stream resources. The Siuslaw River is Water Quality Limited; steps to improve its quality are imperative for both humans and animals residing in or using the watershed. Protecting the North Florence Sole Source Dunal Aquifer is key to ensuring all of these resources are available for future generations to enjoy.

North Florence Sole Source Dunal Aquifer

The North Florence Dunal Aquifer encompasses the entire continuous body of sand north of the Siuslaw River and east of the Pacific Ocean, the primary discharge points for the aquifer. About 85 percent of the rain percolates into the water table.[5] Groundwater moves rapidly and almost uniformly toward a discharge point. Multiple seeps and springs occur along the coastline and riverbank, although the aquifer discharges mostly as underflow. Few streams cross the dunal area since most rainfall quickly infiltrates to the water table which is at the surface most of the year. Where streams flow across the sand, they are hydrologically connected with the groundwater system, as are Munsel Lake and Clear Lake. When the last comprehensive testing of the aquifer was done 23 years ago, the groundwater was of good quality “from a human health standpoint.”

The City is currently monitoring water levels, flow, and quality in the groundwater and in Munsel and Ackerley Creeks. The results of that testing program are summarized in Chapter 3 and the full reports are included in Appendix A. The 1987 EPA Sole Source Aquifer Resource Document states, “Possible sources of aquifer contamination include fuel storage tank failure, accidental spills of hazardous material, septic tank effluent, storm runoff, pesticides, and chemical fertilizers.” Discharge of pharmaceutical byproducts is also an environmental threat. The Potential Contaminant Source Inventories in Chapter 3 provide a detailed list of potential threats to water quality in the City’s Drinking Water Protection Areas from existing and future land uses.

[5] *EPA Resource Document: For Consideration of the Norht Florence Dunal Aquifer as a Sole Source Aquifer*, September 1987.

Public Involvement and Technical Advisory Committee

The Public Involvement Plan (PIP) for the Siuslaw Estuary Partnership was approved by the Florence Planning Commission on January 12, 2010 and is included as Appendix B of this plan. In accordance with the approved PIP, public involvement for the plan involved a Technical Advisory Committee, Stakeholder Groups, and Public Education and Outreach.

Technical Advisory Committee

The Siuslaw Estuary Partnership Inter-disciplinary Team served as the Technical Advisory Committee (TAC) for this plan (see Acknowledgments). The Water Quality and Quantity sub-Team was enhanced to include staff from the Department of Land Conservation and Development (DLCD) and the US Bureau of Land Management (BLM). The TAC met on October 5, 2011 and February 1, 2012. At their October meeting, the TAC reviewed and commented on the revised Scope of Work and the proposed wellhead delineations. At their February meeting, the TAC reviewed and commented on the Potential Contaminant Source Inventory and proposed Potential Management Strategies to forward to the Stakeholder Groups for comment.

Stakeholder Groups

The Florence City Council approved the use of two Stakeholder Groups for the Partnership: a Community Stakeholder Group and an Elected Official Stakeholder Group (see PIP in Appendix B and Acknowledgments). The Community Stakeholder Group was expanded in order to include representative interests in the DWPAs on the Group. Specifically, these interests were: Ocean Dunes Golf Links, Coast Village, Sand Ranch, Florentine Estates, Koning and Cooper business owners, and Recycling and Garbage. Both Stakeholder Groups met in February and March, 2012 to review and comment on the components of the plan and they both forwarded the proposed Management Strategies to the Open House, on April 30, 2012, for public comment.

Public Education and Outreach

Public Education and Outreach involved three Open Houses and three newsletters, "Waters in Common," which were distributed throughout the UGB to residents, property owners, or both. Each of these newsletters provided information about the aquifer and the need to protect water quality. The third newsletter, distributed in April 2012, provided information about the Aquifer Protection Plan and ways to provide comment on the plan. That newsletter was included in water bills and mailed directly to all owners of property in the DWPAs. At the third Open House, the elements of the plan, including the DWPAs, the Potential Contaminant Source Inventories, and the Potential Management Strategies, were presented in detail in the power point presentation and in hard copies available for the public. Comment forms were available as well, although no one submitted a completed form. Over 50 members of the public attended the April 30, 2012 Open House and heard the presentation.

All products and Stakeholder meeting packets have been posted to the project web site: www.SiuslawWaters.org and the public has been encouraged to review and comment.

Siuslaw Estuary Partnership: Guiding Principles and Measurable Outcomes

Guiding Prinicples

The following Guiding Principles for Water Quality and Quantity were endorsed by Florence City Council, Siuslaw Watershed Council, Siuslaw Soil and Water Conservation District, Heceta Water District, Lane County Board of Commissioners, and Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians. These Guiding Principles are intended to guide the development of products from the Siuslaw Estuary Partnership, including this Aquifer Protection Plan.

1. Protect water quality for human consumption in the North Florence Sole Source Dunal Aquifer and Clear Lake from known contamination threats; and adopt plans and strategies to respond to potential threats.

2. Protect the quality of water in surface waters, i.e., the estuary, creeks, lakes, wetlands, and ocean/beach, from contamination threats that could impair the quality of the water for fish and wildlife habitat and human recreation.

3. Protect water quality in ground and surface waters from the effects of urbanization through land use and development policies and procedures.

4. Understand the natural state of water quantity and quality through the establishment of base line data and a surface and groundwater assessment and monitoring program and through research and monitoring of climate change.

5. Protect the water storage function of wetlands and water flow in creeks and the estuary through water management planning and practices that maintain groundwater levels and surface water flows so that they do not impair water quality or impact fish and wildlife habitat.

6. Prevent adverse flooding conditions through natural storage and slow release of surface water and runoff.

7. Locate, design, and operate production wells so that they do not reduce groundwater at levels below that necessary to support fish and wildlife habitat.

8. Foster and support the design and use of innovative stormwater management practices, including the incorporation of properly-designed constructed wetlands into public and private stormwater systems.

9. Tailor stormwater management plans and practices for new development and redevelopment to the Oregon coastal environment in a manner that can adapt to changes in temperature and precipitation, and other notable climate change impacts.

10. Promote water conservation through efficient landscape and irrigation, including water reuse and recycling, and other strategies to reduce water consumption, and to reduce the need for new drinking water sources and/or expanded water storage.

Measurable Outcomes

The following measurable outcomes are used by staff to evaluate how well this plan and the water monitoring program work toward serving the Guiding Principles. These are provided for illustrative purposes only. Endorsement of Outcomes was not requested or required.

Short Term Outcomes

Water Quantity

1. Existing conditions (base line data) are known for aquifer flow patterns (volume, direction, and speed) and water table levels and seasonal variability
2. Model and data capacity exist to evaluate how future production well sites might affect groundwater flow, wetlands, and overall aquifer production.
3. Storage capacity of aquifer and wetlands is known; information is used to inform City Stormwater System Plans and projects *(note: this needs to be combined with wetlands outcomes worksheet).*
4. Baseline data are better understood on the impact of groundwater flow (water quantity) into Munsel and Ackerley Creeks, the estuary, the ocean/beach, Clear Lake, and wetlands.
5. Existing hydrograph conditions (baseline data) for Munsel and Ackerley Creeks will be established.
6. Impacts of fluctuation in rainfall (short term) are known, to the extent a transient model or another measuring tool is available to the Project.
7. Impacts of land use on the water table are better understood.
8. Sites for new city production wells are identified.
9. Risk (e.g., overloading) to groundwater of artificial infiltration of stormwater is reduced through modeling results and analyses.
10. Flood storage is improved through the protection of natural areas with flood storage capacity, thus, preventing further impacts to the hydrograph of the aquifer and surface waters.

Water Quality

1. Existing conditions of water quality in aquifer (background levels for each constituent included in the Quality Assurance Project Plan) are established.
2. Impacts of land uses on surface water and groundwater quality are better understood.
3. Appropriate trigger levels are set for groundwater contaminant concentration.
4. Variability of contaminant concentrations in the area is established.
5. Variability of contaminant concentrations as a function of season is determined.
6. Existing aquifer contamination is identified, assessed, and corrected, as feasible.
7. Contamination threats are identified, assessed, and prioritized for strategies in the Source Water Protection Plan.
8. Potential threats to drinking water from contaminated storm runoff and surface contaminants being carried into the aquifer via percolation are better understood and addressed or prioritized for future actions.
9. Preliminary baseline data are established for existing conditions of water quality in Munsel and Ackerley Creek and estuary and marine as specified in the Quality Assurance Project Plan.
10. Impacts of Stormwater Demonstration Project on estuary water quality, as specified in the Quality Assurance Project Plan, are known and any modifications to BMPs that are indicated are made.

11. Goals and strategies for protecting water quality in the aquifer are agreed upon and submitted for local adoption and State approval.
12. Risk to groundwater quality of artificial infiltration of stormwater is reduced.
13. Impacts of stormwater runoff to water quality in estuary are evaluated and reduced as data become available.
14. The impacts from septic systems, if any, to the water quality of the aquifer are better understood, and if necessary management actions can be developed and implemented.

Fish and Wildlife Habitat

1. Human-induced and naturally occurring changes in water levels in wetlands and area lakes from water table fluctuations are understood, and the effects on fish and wildlife habitat are better understood, through the data collection, analysis, and modeling described in the Quality Assurance Project Plan.
2. Impacts of stormwater outfalls on the hydrograph of Munsel Creek are known, and the effects on fish habitat are better understood.
3. Preliminary threshold level, i.e., allowable drop in water table, is set that does not have a significant impact on lakes, streams and wetlands, as determined through data collection, analysis, and response.
4. Preliminary threshold level, above, is considered in location of new production wells.
5. If a transient model is available, recharge capacity can be gauged and different impervious surface scenarios can be evaluated. As a result, the potential threats to fish and wildlife from water quantity impacts of runoff and groundwater flowing into surface waters will be better understood and addressed or prioritized for future actions.
6. Effect of land uses on surface water quantity, and thus fish and wildlife habitat and human contact recreation, is better understood.
7. Runoff and groundwater contaminants flowing into Clear Lake, Munsel and Ackerley Creeks, wetlands, estuary, and ocean/beach are better understood. As a result, water quality data will provide a basis for better understanding the effects on fish and wildlife habitat.
8. Potential threats (e.g., pharmaceuticals) to fish and wildlife from runoff and groundwater contaminants flowing into surface waters are better understood and addressed or prioritized for future actions.
9. Effect of land uses on surface water quality, and thus fish and wildlife habitat, is better understood.
10. Source Water Protection Plan is aligned with Goals and Strategies for protecting fish and wildlife habitat.
11. Production well sites selected do not cause water levels in creeks and wetlands to go below threshold levels set above.
12. New stormwater practices reduce impacts to fish and wildlife habitat by reducing pollutants entering surface waters through groundwater seepage and by reducing stormwater discharge impacts to wetlands and the hydrograph of Munsel Creek.
13. Stormwater Demonstration showcases state-of-the-art Best Management Practices in established commercial area adjacent to an estuary with high habitat values.

Medium Term Outcomes

Water Quantity

1. Aquifer flow patterns (volume, direction, and speed), water table levels and seasonal variability are monitored and better understood.
2. Future production well sites are evaluated for their potential effect on groundwater flow, wetlands, and overall aquifer production.
3. City Stormwater System Plans and projects take into account the storage capacity of aquifer and wetlands.
4. The impact of groundwater flow (water quantity) into Munsel and Ackerley Creeks, the estuary, the ocean/beach, Clear Lake, and wetlands is monitored and better understood.
5. Hydrograph conditions for Munsel and Ackerley Creeks are better understood.
6. Stormwater policy and practices incorporate knowledge about the impacts of fluctuation in rainfall (short term) (requires transient model).
7. Known impacts of land use on the water table are addressed in modifications to land use and development policies and practices.
8. New city production wells are planned.
9. Risk (e.g., overloading) to groundwater of artificial infiltration of stormwater is reduced through modeling results and analyses.
10. Flood storage is improved through the protection of natural areas with flood storage capacity, reducing reliance on culverts for stormwater discharge and, thus, preventing further impacts to the hydrograph of the aquifer and surface waters.
11. Water quantity in Munsel Creek is monitored.

Water Quality

1. Water quality in aquifer is monitored.
2. Impacts of land uses on surface water and groundwater quality are monitored.
3. Groundwater contaminant concentration and variability are monitored and maintained below trigger levels in all seasons.
4. Aquifer contamination is identified, assessed, and corrected, as feasible.
5. Strategies in the Source Water Protection Plan are adopted and implemented to protect water quality.
6. Water quality in Munsel and Ackerley Creek, the estuary and marine is monitored.
7. Modifications to BMPs are made, as indicated by the impacts of Stormwater Demonstration Project on estuary water quality, as described in the Quality Assurance Project Plan.
8. Goals and strategies for protecting water quality in the aquifer are adopted by the City and approved by the appropriate State agencies.
9. Groundwater quality is protected from artificial infiltration of stormwater.
10. Impacts of stormwater runoff to water quality in estuary are monitored and continue to be reduced.
11. Water quality in Munsel Creek is monitored.

Fish and Wildlife Habitat

1. The threat to water levels in wetlands and area lakes from water table fluctuations, and the effects on fish habitat, are reduced.
2. Impacts of stormwater outfalls on the hydrograph of Munsel Creek, and the effects on fish habitat, are reduced.

3. Drop in water table is monitored and significant impact on lakes and wetlands, and thus fish and wildlife habitat, from drop is reduced.
4. New production wells are planned that will be designed and operated so as not to allow the water table to go below threshold levels. These levels are set to reduce significant impact on lakes and wetlands, and thus fish and wildlife habitat, from drop, as described in the Quality Assurance Project Plan.
5. Plans and strategies are in place to prevent threats to fish and wildlife and human contact recreation from runoff and groundwater seeping into surface waters (assumes transient model is available.)
6. Land use and development policies are pursued to reduce impacts to surface water quantity and quality, and thus fish and wildlife habitat.
7. Runoff and groundwater contaminants seeping into Clear Lake, Munsel and Ackerley Creeks, wetlands, estuary, and ocean/beach are reduced, improving conditions for fish and wildlife habitat and human contact recreation.
8. Source Water Protection Plan and City Comprehensive Plan amendments are adopted, and contain strategies to protect drinking water and fish and wildlife habitat.
9. Production well sites are planned in a manner that will not negatively affect fish and wildlife habitat.
10. New stormwater practices are monitored for continued reduction of impacts to fish and wildlife habitat and human contact recreation by reducing pollutants entering surface waters through groundwater seepage and by reducing stormwater discharge impacts to wetlands and the hydrograph of Munsel Creek.
11. Stormwater Demonstration showcases state-of-the-art Best Management Practices in established commercial area adjacent to an estuary with high habitat values.

Long Term Outcomes

1. The quality of water for human consumption in the North Florence Sole Source Dunal Aquifer and Clear Lake is protected from known contamination threats; and plans and strategies are adopted to respond to any unforeseen threats.
2. The quality of water in surface waters, i.e., the estuary, creeks, lakes, wetlands, and ocean/beach is protected from contamination threats that could impair the quality of the water for fish and wildlife habitat or human contact recreation.
3. Water quality in ground and surface waters is protected from the effects of urbanization through adopted land use and development policies and procedures.
4. Groundwater levels and fluctuations, and runoff volumes and velocity, are maintained at levels and flow patterns that do not impair the function of wetlands, creeks, and the estuary for fish and wildlife habitat.
5. Stormwater management plans and practices for new development and redevelopment are tailored to the Oregon coastal environment; and can adapt to changes in temperature and precipitation, and other notable climate change impacts.

Figure 1.1 North Florence Sole Source Dunal Aquifer

This page intentionally left blank.

Chapter 2: Source Water and Drinking Water Protection Areas

This chapter describes the City's current water source and the delineated Drinking Water Protection Areas for the existing and proposed wellfields. It also includes a discussion of other Source Water Assessments prepared for the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (CLUSI) and Heceta Water District.

City of Florence Water Source

This section describes Florence's source water, including the wellfield and wells, the location of the drinking water source, groundwater use, and source construction. Detailed information about the City of Florence's water system is shown in Figure 2.1 and contained in the *Florence Water Management and Conservation Plan,* March, 2010 *and the Florence Water System Master Plan Update*, January, 2011. Figure 2.1, "Water System Map," from the *Water System Master Plan Update* illustrates the City's Water System, including pressure zones, water system facilities and distribution mains.

Currently, Florence's drinking water is supplied by 13 wells owned and operated by the City. The City's municipal wellfield is located on 80 acres adjacent to the Ocean Dunes golf course on the eastern edge of Florence bordered by Willow Ridge Court to the south and 35th Street to the north (Figure 2.1). The wells produce water year round and serve as the City's sole water supply source.[6]

Currently the City holds three groundwater rights totaling 3.8 million gallons per day (mgd) [5.89 cubic feet per second (cfs)]. Based on the City's recently completed Water Management and Conservation Plan (WMCP), the 12 existing City wells produce approximately 2.7 mgd (4.2 cfs) from a dunal aquifer with high levels of iron and manganese present in the native groundwater. Groundwater from the wells is pumped to the approximately 3.0 mgd Water Treatment Plant located adjacent to the City's wellfield near the intersection of Willow Street and 24th Street. The treatment plant uses pressurized biological reactors and pressurized green sand filters for iron and manganese removal and sodium hydroxide for pH adjustment. Sodium fluoride is added to the treated groundwater before it enters the distribution system and storage reservoirs.

Existing Water System

The City's municipal water supply is from groundwater supplied by Wells 1 through 13 (well #13 is drilled but not in production – we anticipate well #13 to be online by Spring 2013), located along the eastern margin of the City, that appropriate water from a dunal aquifer (Figure 2.1). Currently, these wells do not have the capacity to produce the full amount of water authorized by the City's water rights. Furthermore, the City's population and demand for water are increasing and are projected to exceed the existing water supply within the 20-year planning period (2030) for the City's Water Management and Conservation Plan (WMCP). The City also holds a water right to divert water from Munsel Creek, tributary to the Siuslaw River, but this water right is not currently in use. Historically, the City purchased a portion of its water supply from Heceta Water District

---

6 . The City has an intertie with Heceta Water District (HWD) for emergency use only. HWD derives its water from the aquifer via Clear Lake and it does not have the capacity to supply all of Florence's water needs.

(HWD); however, the City stopped purchasing water from HWD in 2003 after the expansion of the water treatment plant (WTP) and wellfield that included Wells 8-12.
The City has four aboveground reservoirs: an elevated 250,000-gallon tank near the City shop (currently offline and not in use); a 500,000-gallon steel tank on the east hills; and two 2,000,000-gallon tanks near the Sand Pines Golf Course. Water diverted under all of the City's groundwater rights is treated at the City's water treatment plant. Currently, the plant has a capacity of 4.6 cubic feet per second (cfs) or 3 million gallons per day (mgd). This capacity is 1.24 cfs (0.8 mgd) less than the full value of the City's existing groundwater rights. The City's distribution system consists of four pressure zones served by three water storage reservoirs and three booster pumping stations.

The City of Florence's existing water distribution system includes four service levels, or pressure zones. Pressure zones are generally defined by ground topography and designated by overflow elevations of water storage facilities or discharge hydraulic grades of pressure reducing or booster pumping facilities serving the zone. The Main Pressure Zone serves the majority of City of Florence water customers by gravity from storage facilities. The Main Zone covers the area from 35th Street south to the Siuslaw River. The North Pressure Zone serves areas north of 35th Street from the constant pressure Sand Pines Booster Pump Station. The East and Ocean Dunes Pressure Zones each serve a small group of customers in the City's east hills from constant pressure booster pump stations.

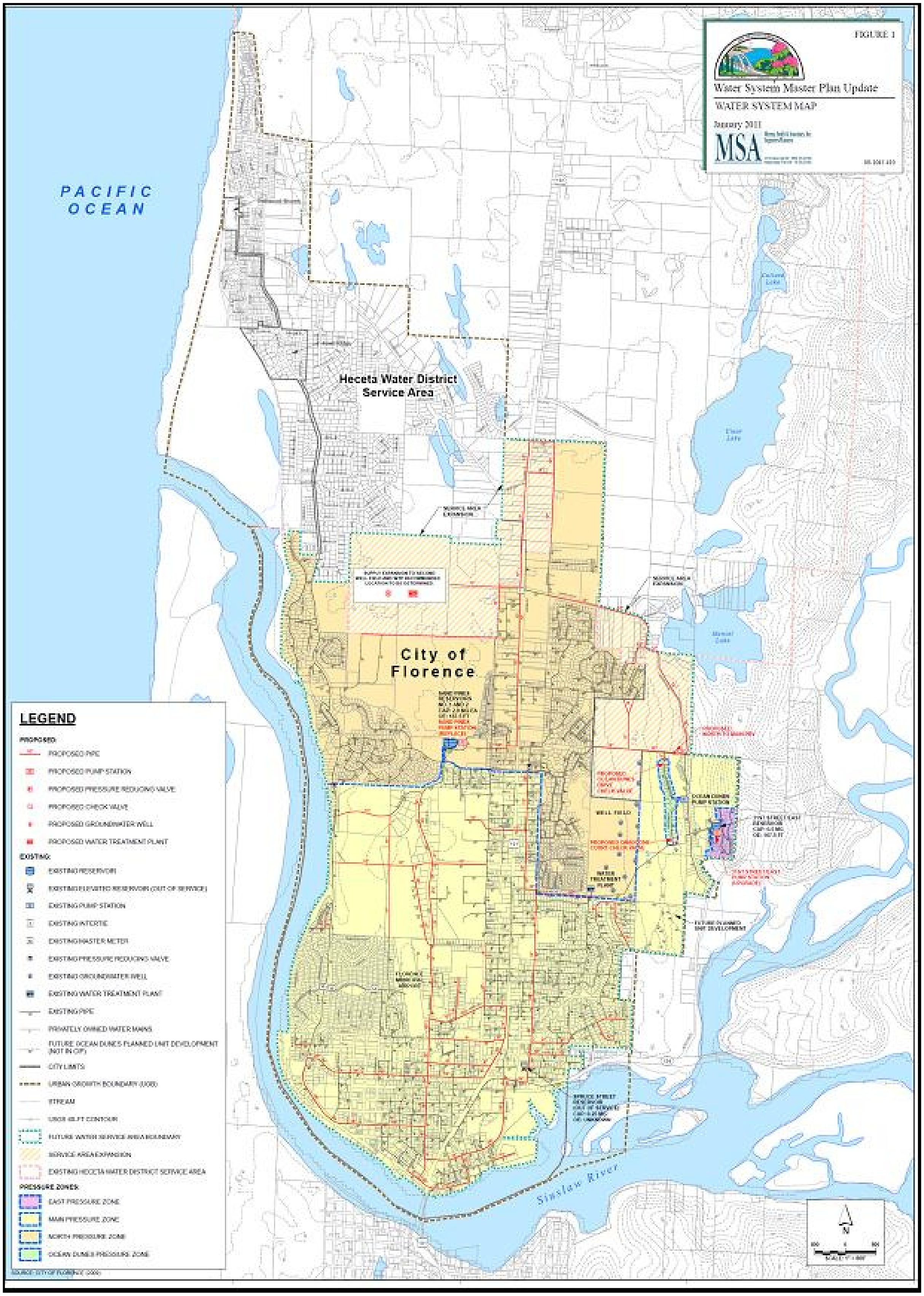
The City 's three active storage reservoirs provide 4.5 million gallons (MG) of storage by gravity to the Main Pressure Zone. Emergency storage is also provided from these facilities by pumping to the North and East pressure zones through adjacent pump stations. The Sand Pines Reservoirs No. 1 and 2 are identical 2.0 MG welded steel tanks with an approximate overflow elevation of 167.5 feet. The 31st Street/East Reservoir is a 0.5 MG welded steel tank constructed in 1965 with an approximate overflow elevation of 167.5 feet.

A fourth Main Zone reservoir, the elevated, welded-steel Spruce Street Reservoir was taken offline approximately ten years ago and remains off-line and not in use. It has been reported by City staff that the reservoir experienced rapid uncontrolled fluctuations in water level. Based on discussions with City staff, the Spruce Street Reservoir may have a lower overflow elevation than the other three reservoirs which supply the Main Zone; and this could cause it to overflow during low demand times when the other three reservoirs are full. Due to these and other issues, the tank will remain off-line indefinitely.

The City's distribution system includes three booster pump stations designed to deliver water from the Main Pressure Zone reservoirs and distribution mains up to customers in the North, East and Ocean Dunes Pressure Zones.

Wellfield and Wells

The City of Florence is supplied drinking water by a single wellfield comprising 12 wells, with one additional well to come on line in the near future (Figure 2.1). Seven wells were installed between 1964 and 1994; and five wells were constructed between 2003 and 2004. Each of the wells is constructed in a manner consistent with Standards for Construction as outlined in Oregon Administrative Rules (OARs). Each of the wells has a concrete pad and locked enclosures to protect the wellheads from surface water contamination and public trespassing, respectfully. Each of the wells is located on City owned property. OWRD construction logs and copies of the well reports for the 13 wells are included in Appendix C.



.

Figure 2.1 Florence Water System Map

Location of the Drinking Water Source

The location of City wells is shown in Table 2.1 and Figure 2.1.

Table 2.1 Location of Florence Wells

Well	Longitude	Latitude
Well 1	43° 59’24.851”N	124°5’31.462”W
Well 2	43° 59’18.978”N	124°5’28.603”W
Well 3	43° 59’17.735”N	124°5’22.309”W
Well 4	43° 59’22.497”N	124°5’21.383”W
Well 5	43° 59’38.727”N	124°5’26.815”W
Well 6	43° 59’33.553”N	124°5’26.790”W
Well 7	43° 59’28.560”N	124°5’26.882”W
Well 8	43° 59’27.549”N	124°5’16.516”W
Well 9	43° 59’33.825”N	124°5’15.994”W
Well 10	43° 59’36.791”N	124°5’16.461”W
Well 11	43° 59’47.737”N	124°5’15.665”W
Well 12	43° 59’53.037”N	124°5’15.445”W
Well 13	43° 59’41.027”N	124°5’30.035”W

Groundwater Use

The City’s water system currently provides potable water to approximately 9,580 people within the city limits through residential, commercial and industrial service connections. The current water service area lies entirely within the existing city limits. The City’s current wellfield production capacity is 2.7 mgd during the dry summer months (Table 2.2, GSI, 2008). The City’s existing groundwater rights total 3.8 mgd. Expansion of the drinking water treatment plant from 3.0 mgd to 4.0 mgd is feasible.

Table 2.2 City of Florence Well Capacities (August 2007)

Wells	Combined Capacities (mgd)	Capacity Pump Rate/Well (gpm)
Wells 1 through 7	1.2	120
Wells 8 through 12	1.6	222

The City anticipates an average annual population growth rate of 3.5 percent. Information provided by the City indicates that water production/demand has also grown, but at a slower rate than the projected 3.5 percent rate of population increase. GSI (2008) calculated the expected average rate of increase in water demand during the highest demand months at 2.9 percent, assuming no constraints to increased demand, such as well production capacity or drinking water treatment capacity limitations.

Source Construction

The City has drilled an additional well (#13) in the field and will bring it on line in the near future (Figure 2.1). However, additional sources will be needed and the City is adding a second wellfield. The location of the second wellfield has been identified (Figure 2.2) and the delineation of this wellfiled was included in the delineation model. The purpose of delineating the proposed wellfield is to provide information that can be used to protect this future source of water.

Nature and Characteristics of the Aquifer

This section describes the nature and characteristics of the North Florence Sole Source Dunal Aquifer, which supplies drinking water to the City of Florence wellfield. For additional detail, refer to Appendix D, *Delineation of Drinking Water Protection Areas City of Florence, Oregon,* February 15, 2012, GSI Water Solutions, Inc.

As described in the well construction discussion above, the depth to first water encountered in the wells and the static water level after well completion is the same in the aquifer. This implies that the groundwater is under atmospheric pressure only and is thus unconfined, i.e., there are no materials of low permeability separating the aquifer, or water table, from the surface. Based on the well reports, the aquifer appears to range in thickness from ~100 to ~130 feet thick, although this will vary with season, being thicker in the spring after the winter precipitation recharge when water table rises. The mean sea-level (MSL) elevation of the well screens varies from -11 feet MSL (Well 2) to -43 feet MSL (Well 3).

Both of the studies described in the next section indicate that groundwater discharges to the Siuslaw River to the south and southwest, and to the Pacific Ocean to the west northwest. As a result, groundwater flow direction varies from north to south in the southern part of the City and to the west in the northern part of the area.

The local geology consists of younger (< 10,000 yrs) Holocene dunes overlying older (24-100,000 years) Late Pleistocene dunes. The ancestral Siuslaw River cut channels in the older dunes prior to the deposition of the younger dunes. This resulted in the Holocene dunes having variable thickness across the area. The variable thicknesses are shown in Appendix D *(OSU Geophysics Group. 1980)* and vary from less than 20 feet to more than 200 feet. Thicker sections, e.g., along the eastern margin of the dune field apparently mark the locations of past channels of the ancestral Siuslaw River (Peterson, 2011, personal communication), while shallow sections represent topographic highs on the underlying sedimentary rock surface.

Seismic data indicate the variable thickness of the dune deposits in the Florence Area. Deep troughs produce sand thicknesses of up to 200 ft. These troughs mark the locations of past channels of the ancestral Siuslaw River. Shallow (~20 feet) sand accumulations mark the location of topographic highs on the underlying sedimentary rock surface.

<u>Recharge</u>: Virtually the entire recharge to the Dunal Aquifer is from direct infiltration of precipitation that falls on the dune surfaces. Total rainfall in Florence varies from 47 inches in a dry year to 122 inches in a wet year, with an average of 69 inches (Florence Stormwater Management Plan, 2000).

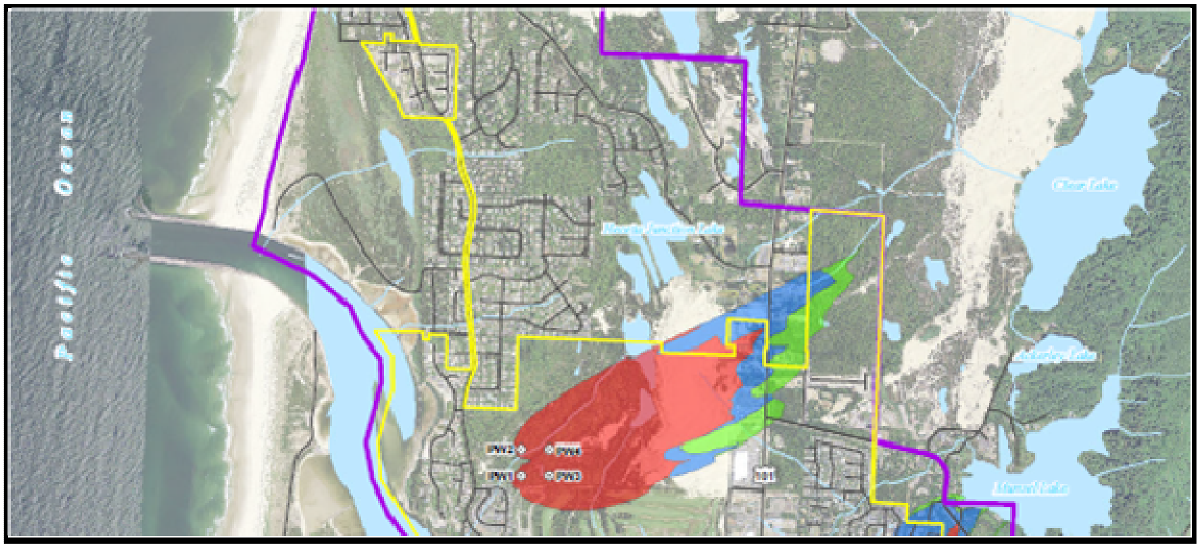


Figure 2.2 Proposed wellfield. Red=10 yr TOT; blue=20 yr TOT; green=30 yr TOT.

Rainfall in the Florence area during the 2010-2011 rainfall year varied from 67.1 to 78.2 inches (from individual resident records). Accounting for evapotranspiration, Hampton (1963) estimated that annual recharge to the aquifer was 55 inches/year.

Porosity. The porosity, the volume fraction of the bulk material that consists of open pore space, is a function of particle size. Hampton (1963) demonstrated that the dunal sands in the Florence area are very uniform in size. Based on the data he provides, it would appear that ~80% of the sand is in the size range of 0.2 to 0.275 mm and therefore is considered to be fine to medium sand. The effective porosity of fine to medium sand varies from 0.23 to 0.28 (Moss and Moss, 1990).

Hydraulic Conductivity. The hydraulic conductivity (K) of the aquifer was initially based on aquifer tests within the City's current wellfield. These tests indicated that the hydraulic conductivity of the sand deposits varied from 50 to 100 ft/day (Brown and Caldwell (2001). Aquifer thickness in the area of the wellfield suggested that the deposits were in excess of 200 feet thick (the SE trough in Figure 2 in Appendix D). After a review of well reports and specific capacity data, DHS (2003) determined that the aquifer's permeability was higher in the eastern part of the area near the current wellfield than in the west. It was also noted that the variable thickness of the aquifer would significantly influence the movement of groundwater in specific regions of the Dunal Aquifer.

Groundwater Flow Model

The Groundwater Flow Model is described in detail in the *Drinking Water Protection Areas Delineation Report*, February 15, 2012, GSI Water Solutions Appendix D. Groundwater flow in the Florence area was modeled using the numerical finite element model MODFLOW 2000 (Harbaugh and others, 2000) packaged in the program Groundwater Vistas® 5.44 (Environmental Simulations, Inc., 2007). Numerical models allow the modeler to divide (discretize) the area of interest into discrete rectangular volumes (cells) in three dimensions that can be individually characterized in terms of aquifer properties, assigned head, boundary conditions, etc. The use of multiple layers and cell volumes/layer is permissible.

Numerical models use input data provided by the modeler to calculate the distribution of hydraulic head within the model area (domain). The input data is developed from a conceptual model of the area in which the modeler develops an understanding of the local geology, hydrogeologic units, their characteristics, including aquifer thickness, permeability and porosity, areal recharge, and boundary conditions, e.g., streams, geologic contacts, etc.

As a means of constructing a representative model, the model is generally “calibrated” to one degree or another against data, generally hydraulic head, collected in the field as a check. An important resource in developing the Florence area conceptual model was the U.S. Geological Survey Water Supply Paper, “Groundwater in the Coastal Dune Area Near Florence, Oregon” (Hampton, 1963). This publication provides descriptions of the major hydrogeologic units in the area and a map showing the distribution of hydraulic head in the area. A study by Brown and Caldwell (2001) provided a basis for estimating aquifer characteristics. The head map produced by Hampton (1963) and the model results of a three dimensional groundwater model developed by EGR & Associates (1997) for the purpose of evaluating the impact of increasing use of Clear Lake water, were used as first order calibration targets in this study.

Three layers were established initially to be able to account for subtle variations in the amount of clay associated with the sand. However, based on a seismic study, it became apparent that the properties chosen for the aquifer layers needed to be done in a manner to more accurately reflect the topographic high of the bedrock beneath the dunes in the central area and to establish the vertical and horizontal variation of the transmissivity (permeability X thickness) of the aquifer. No specific boundaries marking the layers are implied by the layer boundaries.

Model Grid. For characterization of model parameters, a rectangular grid, comprising 90 columns by 160 rows, was constructed as 3 layers. Each cell has a dimension of 200 x 200 feet (Figure 2.4). This grid spacing was arbitrarily chosen to provide for a manageable number of cells given the size of the model area. For a larger scale head map of the active wellfield to qualitatively evaluate the modeled interference of the individual wells each cell was refined to a 100 x 100 foot grid (see below).

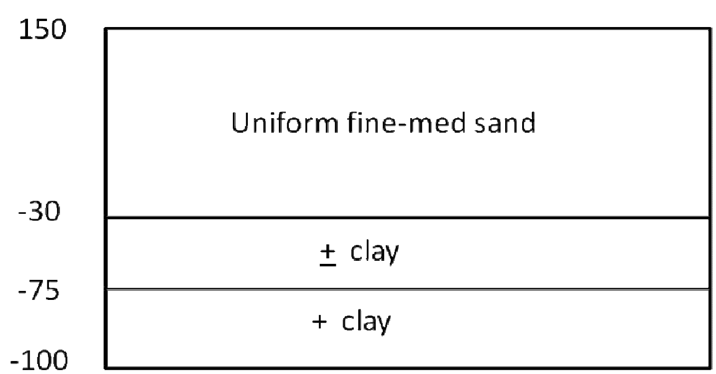


Figure 2.3. Schematic diagram of the layers originally established for the Florence Dunal Aquifer model (see text for discussion). Numbers on the y-axis reflect elevation (mean sea level).

The model grid was anchored to a specific location with UTM and Oregon State Plan coordinates. Specifically, the origin of the grid is at the UTM coordinates 409050E and 4868000N or x =3964455.55 and y = 857063.85, NAD83 Oregon State Plane, South Zone, International feet, respectively.

Model Boundaries. The eastern boundary of the dune deposits (Figure 2.5) is marked by a topographic slope break at the contact between the dune deposits and underlying Flournoy Formation of Middle Eocene. These rocks, exposed in outcrop just east of Florence on Highway 26, consist of fine grained sediments, chiefly siltstone. Based on exposures, the Flournoy contains some fracturing. For the purpose of this model, the sedimentary unit was considered impermeable and was considered to be a no flow boundary, i.e., not contributing groundwater to the dune sands. Also considered to be a no flow boundary is the northernmost boundary arbitrarily drawn at 45^{o} 3.1' N. The Pacific Ocean forms the western boundary and is considered to be a constant head at a value of 0.0 feet.

Surface Water. The rivers, the lakes, and Munsel Creek were integrated into the flow model based on available data. The stage of the Siuslaw River and the North Fork of the Siuslaw were estimated based on digital elevations derived from the Florence 7.5 minute topographic map. Munsel Creek headwater stage was set at the average elevation of the outflow of Munsel Lake where the creek originates. Average lake elevations were determined from Portland State University's Center for Lakes and Reservoirs. Parameters used as input to the model are given in Table 2.3.

Recharge: Runoff coefficients were used to adjust the recharge rate as a function of land use (City of Florence, 2008)), e.g., open dunes = 0, residential areas = 0.4, and commercial/industrial = 0.6 (Dunne and Leopold, 1978).

Porosity. For modeling purposes, a porosity value of 0.26 was chosen for the aquifer.

Hydraulic Conductivity. The distribution of hydraulic conductivity in the Dunal Aquifer was weighted as a function of the thickness of the sand deposits. The final model values of K varied 5 to 55 ft/day.

Wells. Individual well locations were determined using gps latitude-longitude measurements converted in model coordinates. Well locations are independent of cell location. Casing diameters were used as well diameters.

Model Results. The flow model was run through a number of iterations, during which input parameters were varied within hydrogeologically reasonable limits, until the predicted distribution of hydraulic head (elevation of the water table) matched reasonably well the data from direct measurement. The resulting predicted head contours are compared with the measured head distribution (January 2012) shown in Figure 2.6 below. The predicted vs. measured head contours are similar in overall pattern indicating that the model is a reasonable representation of actual conditions.

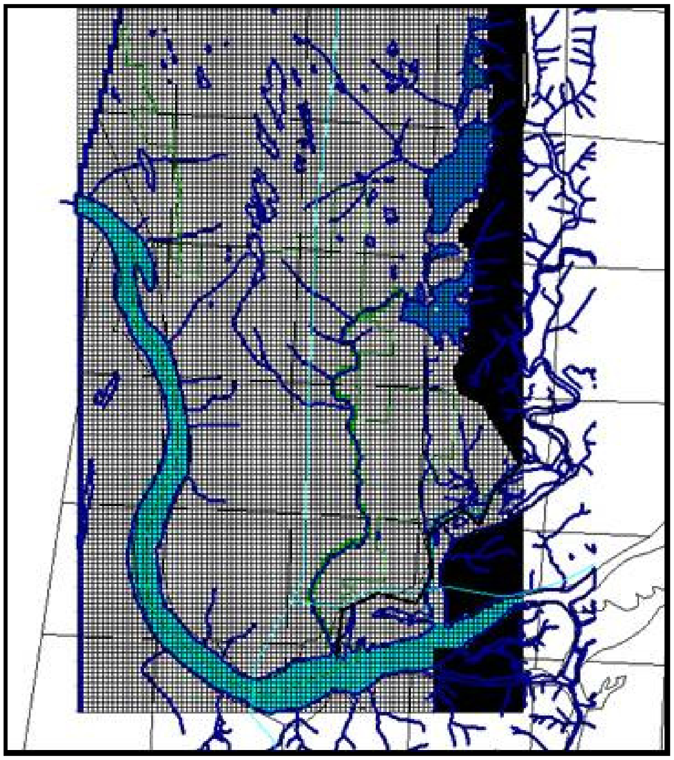


Figure 2.4. Model domain showing grid design, comprising 90 columns and 160 rows of cells with dimensions of 200 x 200 feet (14,400 individual cells).

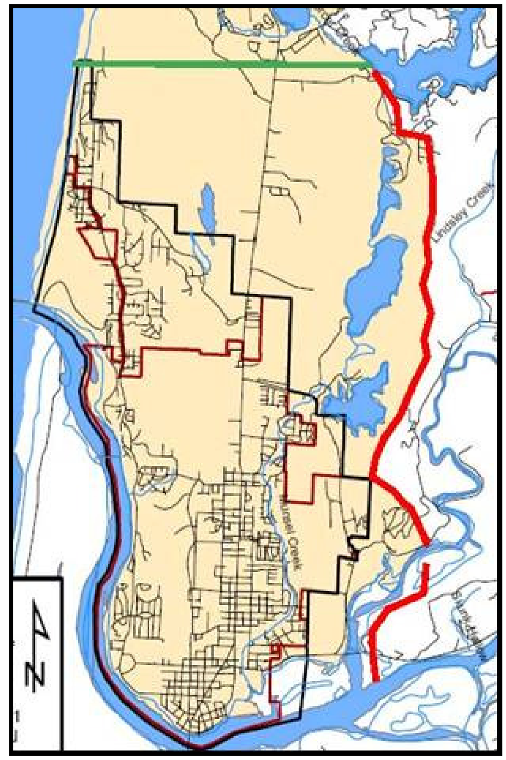


Figure 2.5. Map showing the approximate extent of the Florence Dunal Aquifer. Thin red line is the City limits of Florence while the thin black line represents the urban growth boundary (UGB). Thick red line represents the eastern no-flow boundary of the model. The Siuslaw River and the Pacific Ocean form the southern and western boundaries. The thick green line forming the northern boundary is a no-flow boundary arbitrarily drawn at 45° 3.1' N.

Table 2.3. Model input for lakes, rivers and streams, Florence groundwater model.

	Stage (ft msl)	Bed Thickness	K (permeability) (ft/day)	W x L within cell
Siuslaw River	0	5 – 10	2 – 0.1	200 x 200
N. Fork Siuslaw River	2 - 0	3	2 -1	100 x 200
Munsel Creek	89 – 0	2 – 1	1 – 0.5	50 x 200
Munsel Lake	89	3	0.5	NA
Ackerly Lake	93.5	3	0.5	NA
Clear Lake	98	3	0.5	NA
Collard Lake	115	3	0.5	NA

After the groundwater flow model described above was calibrated to a satisfactory level, the distribution of hydraulic head (Figure 2.6(a)) was used to predict the direction of groundwater flow in the vicinity of the existing and proposed wellfields. This was accomplished by using a reverse particle tracking method by which the model tracks the movement of water backwards in time. This allows for the determination of the boundaries and details of the Drinking Water Protection Area (DWPA).

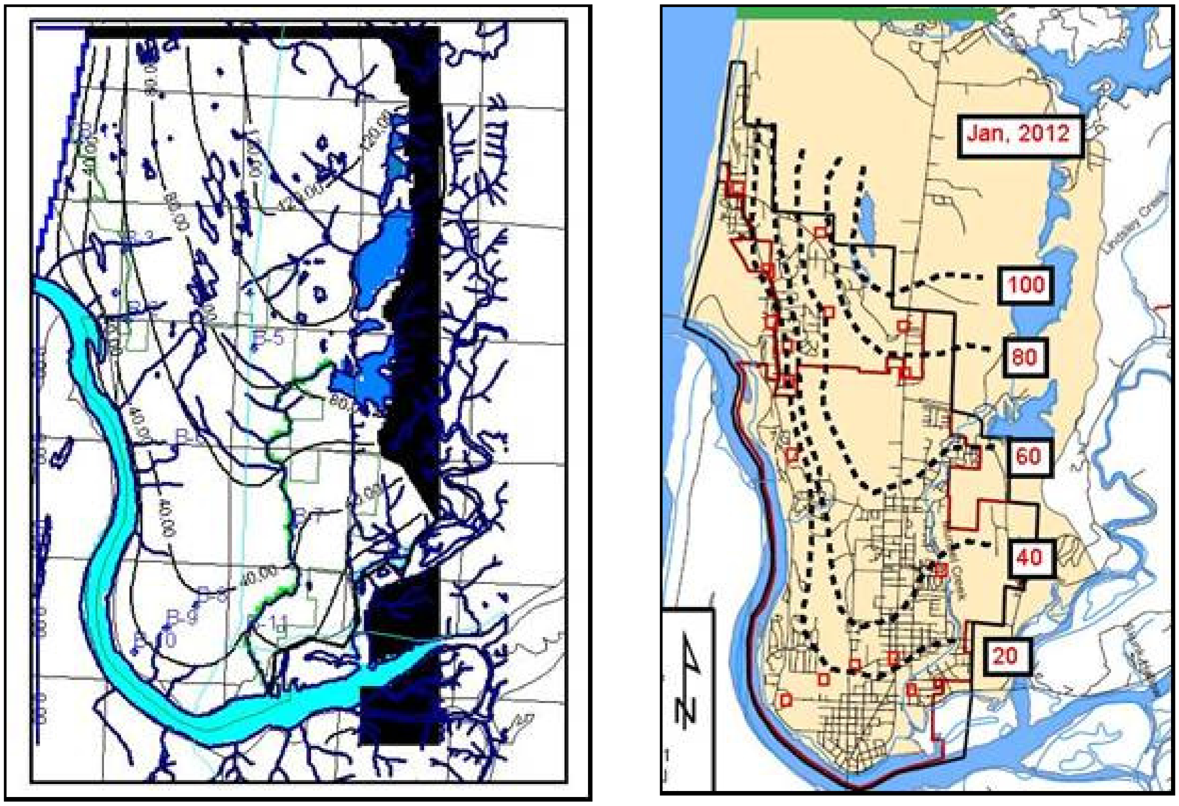
Drinking Water Protection Areas

The Oregon Health Authority (OHA) has certified the DWPA delineation for the existing wellfield (see *Drinking Water Protection Areas Delineation Report*, in Appendix D.) This certification assures that the delineations meet minimum requirements for the system size as outlined in OHA Oregon Administrative Rule (OAR) 333-61-0057 and that the delineation is a hydro-geologically reasonable representation of the capture zone of the well, wellfield or spring.

The delineation of capture zones for the proposed wellfield was not certified by OHA because the wells do not yet exist. OHA did approve the use of the delineation for the proposed wellfield for protection of possible future drinking water resources.

As stated in the certification letter from OHA in Appendix D, “The City of Florence has more than 3,000 service connections. As such, OHA DWP certification qualifies the existing wellfield delineation (i.e., wells 1 through 13) as a significant groundwater resource for the purposes of Statewide Planning Goal 5 (LCDC OAR 660-23-140).”

The DWPAs, or “capture zones,” for the wellfields outline the land surface that overlies that part of the aquifer that supplies groundwater to the well over a given time period. For the delineation of the Florence DWPAs, the full well capacities determined by GSI (2007) and shown in Table 2.2 were used. Well 13 was not operational at the time of the GSI report; so, for planning purposes, the well was added to the model using a pumping rate of 220 gpm; and the pumping rate of 250 gpm was assumed for each of the proposed future wells.



a. **b.**

Figure 2.6. A comparison of model head distribution prediction (a) with the actual head distribution during January 2012 (b).

OHA asks that specific time-of-travel (TOT) zones be delineated within a given capture zone, specifically, the 1-, 2-, 5-, and 10-year TOTs. For planning purposes, the City of Florence desired to extend the delineations out to include the 20- and 30-year TOTs. The results of the delineation modeling effort are shown in a regional view (30-yr) in Figure 2.7, a more focused view of the 10-yr TOTs for both wellfields in Figure 2.8, and closeup views of the 10-year TOT zones for the existing and proposed wellfields are shown in Figures 2.9 and 2.10, respectively.

Other Source Water Assessments (see Appendix E)

Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians Source Water Assessment, June 2007 (Appendix E-2)

The Ancestral Territory of the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians is located along the central and south-central coast of Oregon. This homeland includes the coast, estuaries, tributaries, lakes, and upland forests of the Coos, lower Umpqua (including Smith) and Siuslaw Rivers, a portion of the North Fork Coquille River, and coastal tributaries from Tenmile Creek (Lane County) in the north to Whiskey Run Creek in the south.

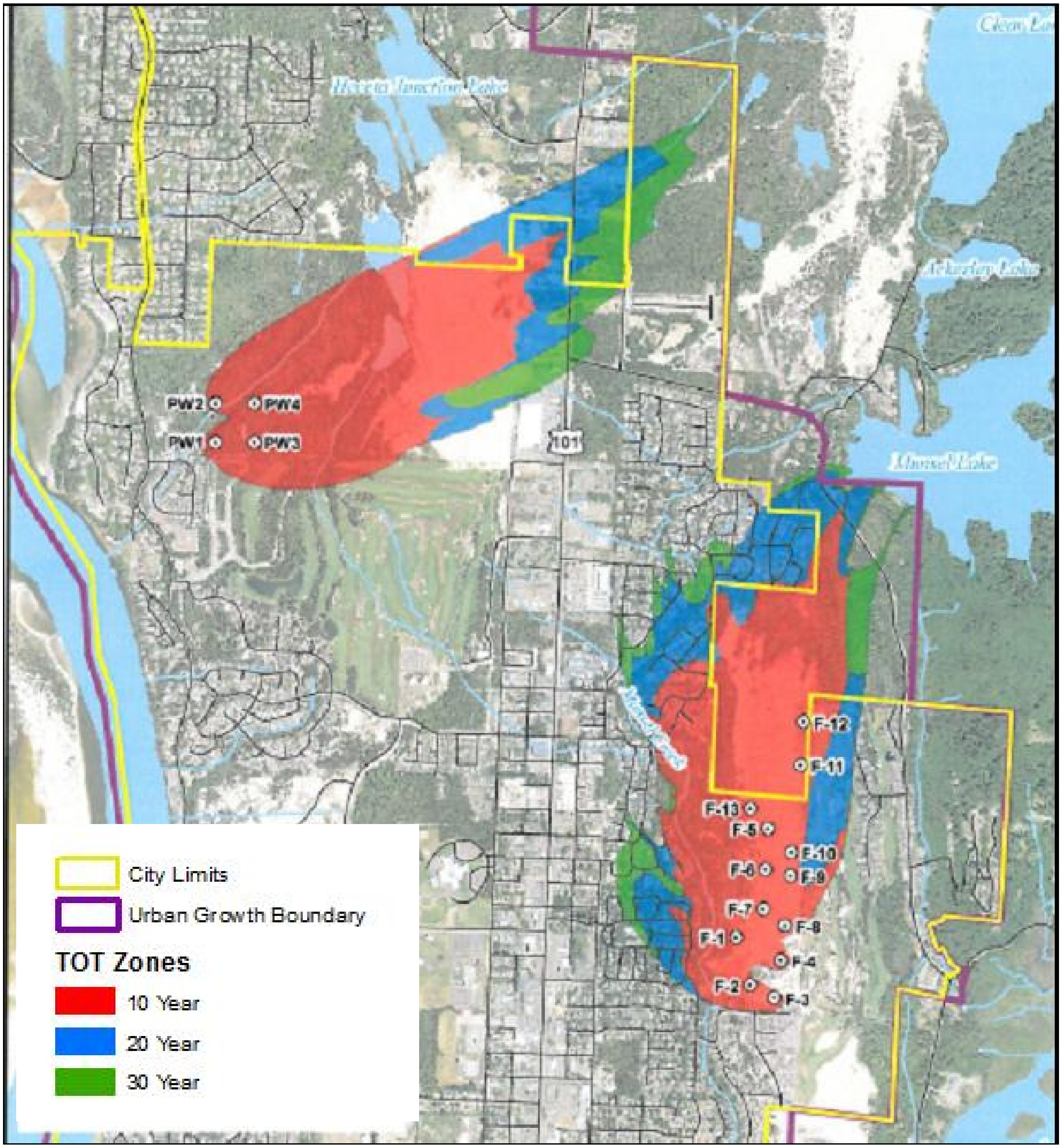


Figure 2.7. Regional view showing the 30-year capture zones of the existing wellfield (lower right) and the proposed wellfield (upper left). Shading indicates the TOT zones: red = 10-yr, blue = 20-yr, and green = 30-yr TOT. Existing wells one through 13 and proposed wells 1 through 4 are shown.

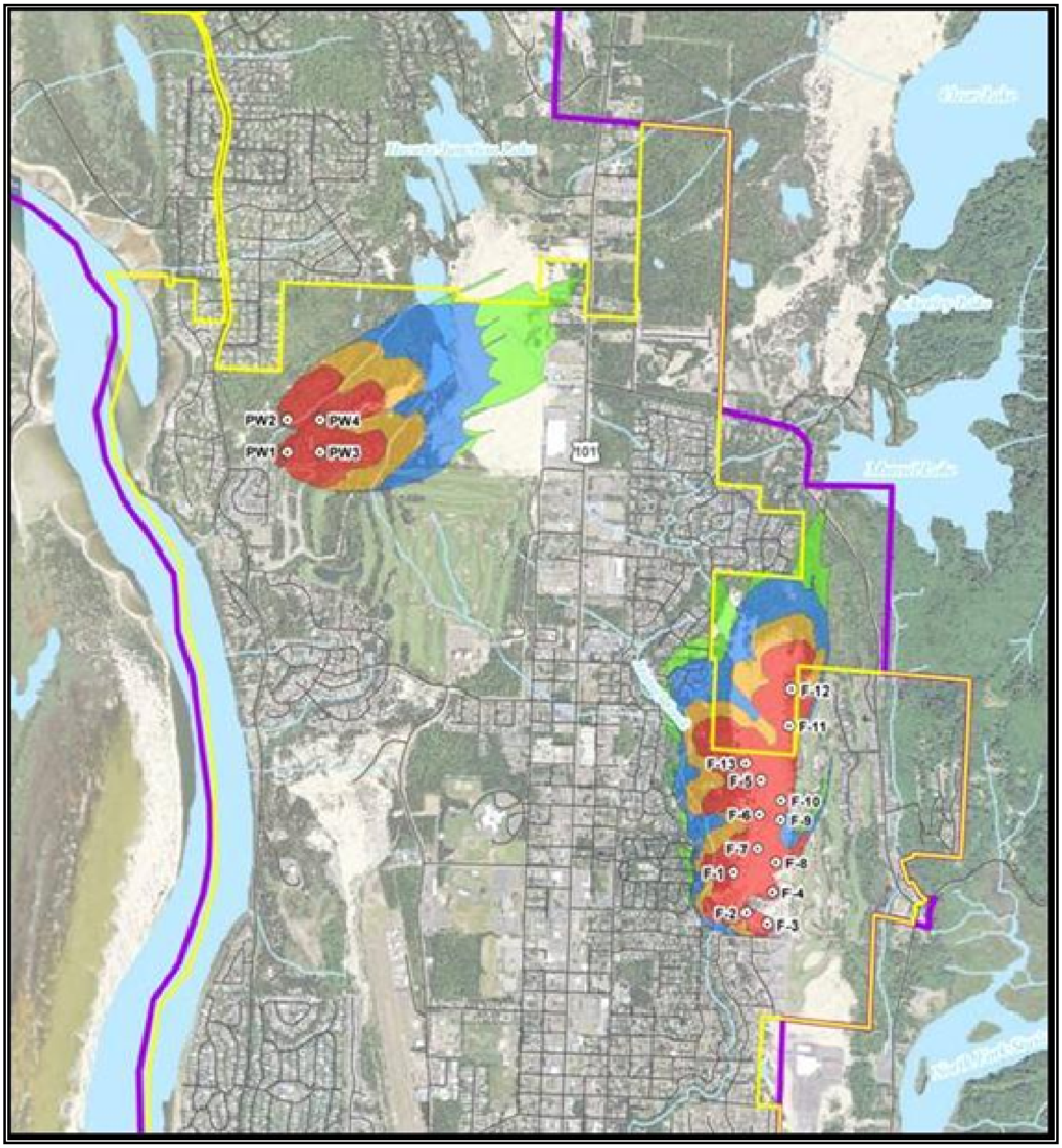


Figure 2.8. Ten-year capture zones for Florence's existing and proposed Wellfields. Different TOT zones indicated by shading: red = 1-yr TOT, orange = 2-yr TOT, blue = 5-yr TOT, and green = 10-yr TOT.

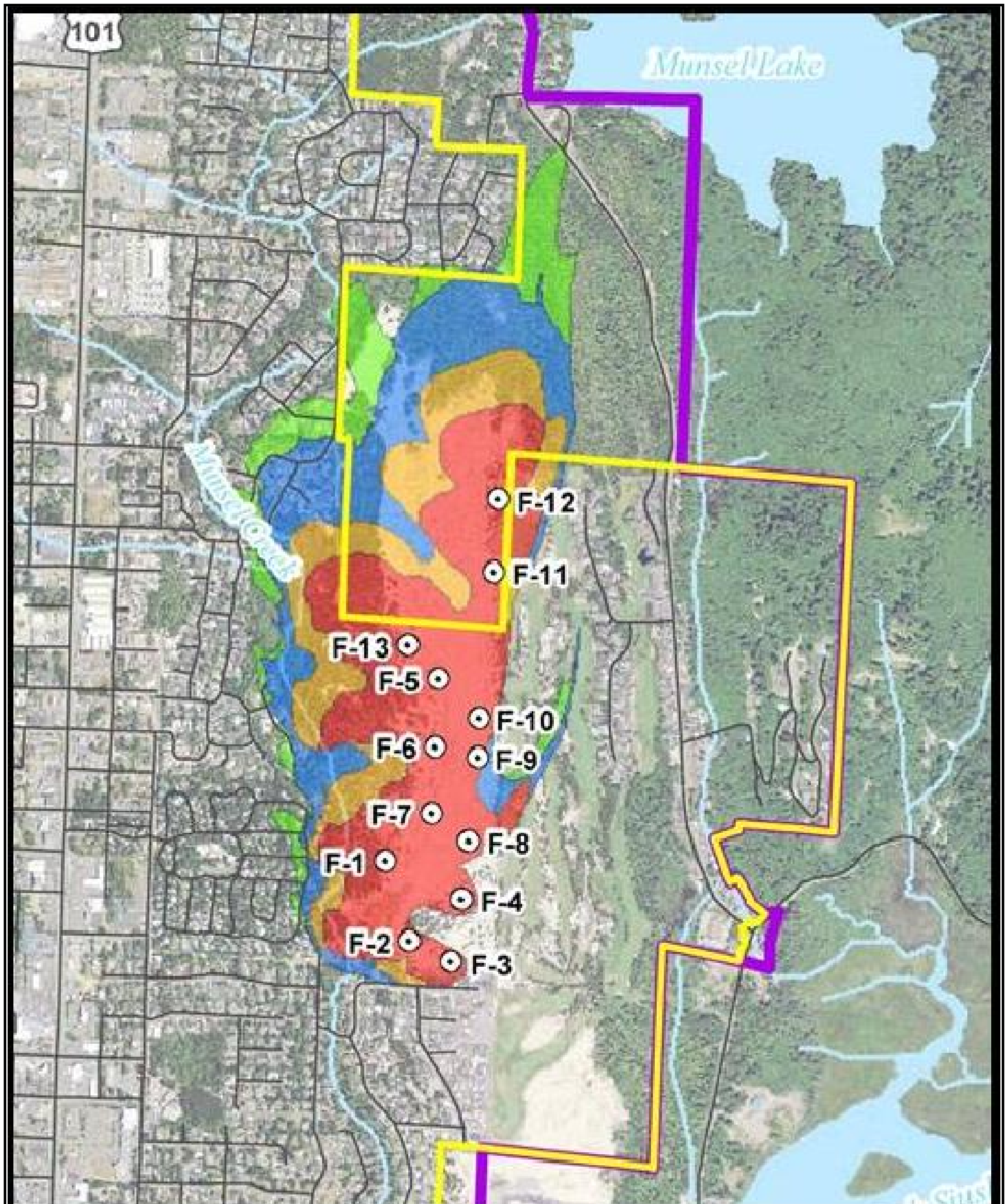


Figure 2.9. Existing wellfield 10-year TOT capture zones. Florence wells 1 through 13 are shown. Different TOT zones indicated by shading: red = 1-yr TOT, orange = 2-yr TOT, blue = 5-yr TOT, and green = 10-yr TOT.

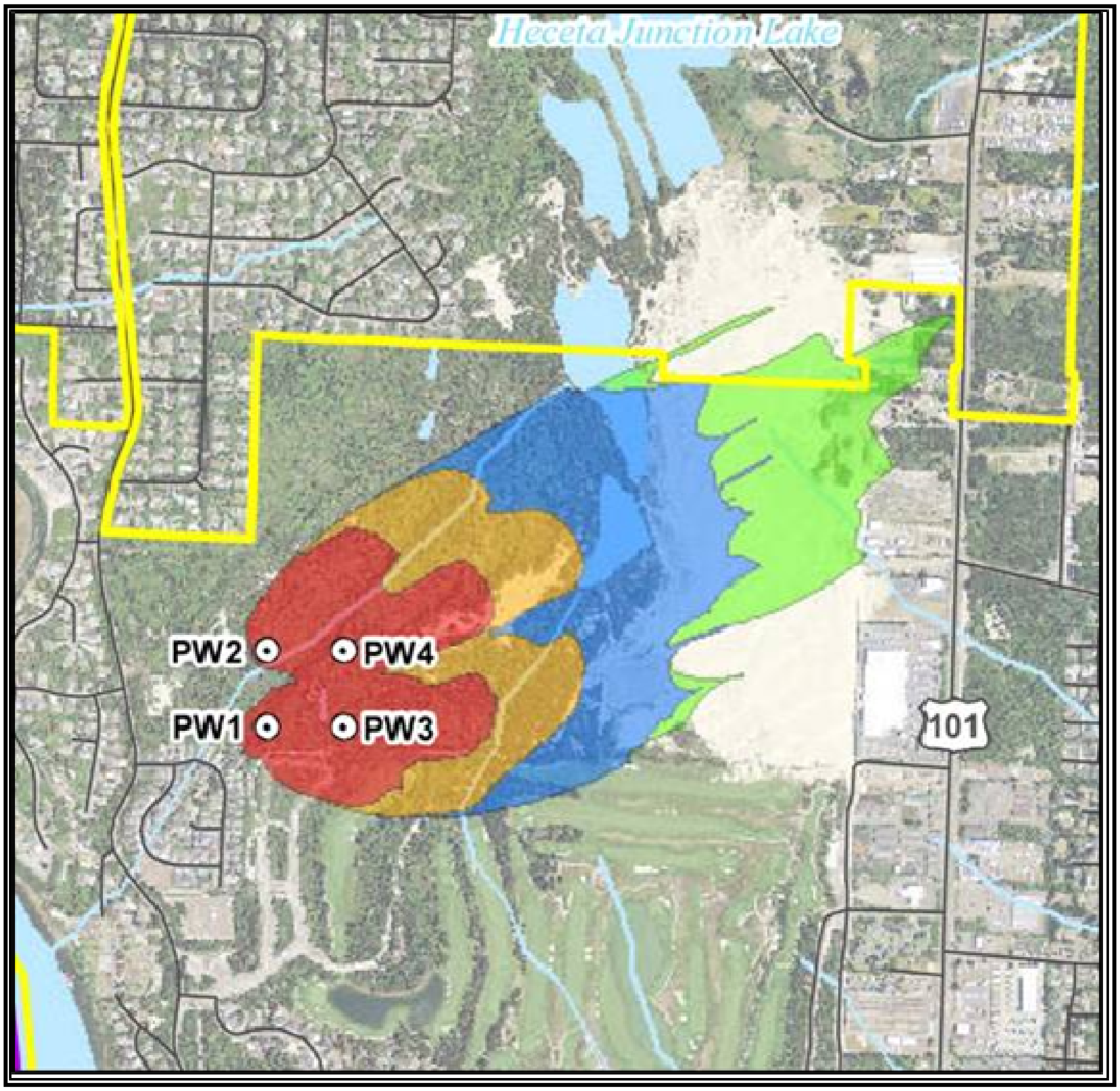


Figure 2.10. Proposed wellfield 10-year TOT capture zones. Florence wells 1 through 13 are shown. Different TOT zones indicated by shading: red = 1-yr TOT, orange = 2-yr TOT, blue = 5-yr TOT, and green = 10-yr TOT.

Currently, the reservation and trust land base of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI) consists of nineteen small and fragmented land holdings totaling 130 acres. These land holdings are scattered among the state of Oregon's Lane, Coos, and Curry counties. Only one of the Tribes' nineteen parcels is currently drawing source water directly from an aquifer. The other parcels either have no source water access or are reliant upon municipal water systems for drinking and waste water distribution.

Water and wastewater distribution to Tribal offices located in the Florence area are managed and maintained by the City of Florence. CTCLUSI's Department of Natural Resources (DNR) staff acquired copies of the City's reports for current and future assessment purposes. The Hatch Tract, located near the City of Florence, is not reliant upon a municipal water source and is drawing water directly from an aquifer. Water and wastewater distribution at the Hatch Tract is managed and maintained by the Tribes. The Tribes' Source Water Assessment describes source water conditions on the Tribes

Hatch Tract development site, identifies potential sources of contamination with a significant potential effect on Tribal source water quality at this site, and provides guidance for the Tribes' Hatch Tract source water management activities. The majority of development activities at the site are those associated with the Tribes' Three Rivers Casino (TRC) located on the Hatch Tract.

The Tribes' Hatch Tract and the Casino site location is a 98 acre parcel located in Lane County approximately 2 miles east of the City of Florence, Oregon at the confluence of the Siuslaw North Fork River and Mainstem of the Siuslaw River. The western part of the site is underlain by active dunes, whereas the eastern portion is underlain by a deflation plain. Segments of the North Fork Siuslaw River and Siuslaw Estuary are included on or immediately adjacent to portions of this tract. Hatch Tract is located over a sole source aquifer. According to the February 22, 2004 GeoScience, Inc. report titled *Dunal Aquifer Hydrogeology* prepared for the Confederated Tribes, "The site hydrology can be characterized as a dunal aquifer system which is recharged by precipitation and which discharges to surface water." Municipal wells for the City of Florence are reported to each yield 325 to 450 gallons per minute, or 468,000 to 648,000 gpd (gallons per day) (*ibid.*) Summer irrigation of the golf course to the north of the Hatch Tract can use 400,000 gpd. The Three Rivers Casino currently uses approximately 10,000 gallons per day. Future development of the site is not expected to use more than 70,000 to 200,000 gpd, based on other Tribal developments of this nature in western Oregon.

Water level measurements conducted at the Hatch Tract during December 2003, January 2004, and February 2004, indicate the groundwater gradient across the site is towards the southeast, at approximately 0.4 percent during periods of lower precipitation and 1.2 to 1.5 percent during periods with heavier precipitation. The highest elevations of the potentiometric surface are located in the northwestern portion of the site, where the seasonal high elevation is around 30 feet above mean sea level (AMSL). The minimum seasonal high elevation of the potentiometric surface at the Hatch Tract is likely located in the southeastern part of the site. Flowing and standing water was observed at the southern portion of the site at elevations of approximately 12 feet to 14 feet AMSL. This observation is consistent with an elevation change of the potentiometric surface across the southern two thirds of the site of approximately 27 feet over a distance of 1800 feet (1.5 percent).

Well logs from the City of Florence municipal wells, located approximately ½ mile north-northwest of the Hatch Tract (Map 4), indicate the thickness of the dune sand deposit in that area ranges from 120 to 170 feet. Municipal well elevations were determined using a USGS topographic map. The topographic map analysis indicated that the elevations in the vicinity of the municipal well field are similar to those at the Hatch Tract. The saturated thickness of the aquifer in that vicinity ranges from 100 to 120 feet. If the gradient remains similar to those measured at the site, it is probable that the saturated thickness of the aquifer beneath the site is approximately 80 to 100 feet.

The wells in the municipal field are constructed with screened intervals 30 to 40 feet long which terminate from 0 to 20 feet above the bottom of the aquifer. This indicates that salt water intrusion has not been considered a potential problem to date. The wells are located 2.5 miles from the ocean, with the Siuslaw River forming a barrier against salt water intrusion from the west and south. The presence of fine-grained sediments at the bottom of the aquifer reduces the risk of salt water intrusion.

Potential on site contaminant sources identified by the Tribes' Department of Natural Resources Staff (DNR) during site surveys and reviews of Hatch Tract construction plans are: pesticide/fertilizer/ petroleum/ storage(above ground storage tanks – ASTs), handling, mixing and cleaning areas; stormwater outfalls; potential impacts to groundwater associated with cone of depression well interference or well head cone of depression induced recharge from the North Fork River or wetland located below the Hatch Tract's drain field; and percolation of reclaimed water irrigation used for dune stabilization on the site.

According to the Florence Source Water Assessment Report, the North Florence Dunal Aquifer is considered to be highly sensitive and susceptible to contamination from viral contaminant sources located within the two-year time-of –travel zone for the city's drinking water protection area (e.g. sewer lines and septic systems associated with residential housing).

The City of Florence Source Water Assessment Report includes an inventory of potential contaminant sources and an analysis of the results in terms of current, past, and future land uses; their time of travel (TOT) relationship to the well site; and their associated risk rating. In general, land uses that are closest to the well and those with the highest risk rating pose the greatest threat to the City of Florence and the Tribes' Hatch Tract drinking water supply.

The City of Florence's delineated two-year time-of-travel zone is primarily dominated by residential and municipal land use. Four potential contaminant sources were located within the two-year time-of-travel zone for all the wells located in the city's DWPA and included Ocean Dunes Golf Course, high density housing, the City of Florence Drinking Water Treatment Plant, and city sewer lines. The potential contaminant sources within the two-year time-of-travel all pose a risk of transmitting micro-organisms to the groundwater. A description of the potential contaminant sources associated with each of the municipal wells is provided below along with a map displaying these wells relative to TRC. The municipal drinking water protection area within the five-year and ten-year time of travel zones is primarily occupied by residential and municipal land use. Three potential contaminant sources were identified in this area and include B&E RV Park, stormwater outfalls, and Munsel Lake.

The City of Florence's Drinking Water Protection Area is upgradient of the Tribes' Hatch Tract facilities and does not include Hatch Tract in its delineation. However, due to the close proximity of Hatch Tract to the City of Florence's Drinking Water Protection Area, the potential contaminant sources for Hatch Tract source water are the same as those identified by the City of Florence Source Water Assessment Report.

Figure 2.11. Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians Drinking Water Source location.

Seven monitoring wells have been installed around the perimeter of the Hatch Tract drainfield area. These wells have been placed to provide maximum protection to surrounding sensitive resources. There are three potentially sensitive resources located near the area. First, the drainfield is located downgradient of the casino's domestic wells and approximately 9,000 feet to the northwest. Down gradient to the drainfield lies a wetland area. This wetland area is located approximately 200 feet to the southeast of the drainfield. The third sensitive area is a residential area located cross gradient approximately 4,500 feet to the northeast. This residential area is serviced by well water rather than municipal supply.

Prior to moving into the protection phase, the Tribal Drinking Water Protection Team will review the information presented in this document in detail to clarify the presence, location, operational practices, actual risks, etc. of the identified facilities and land use activities.

Heceta Water District Source Water Assessment

Heceta Water District's Source Water Assessment was performed by the Oregon Department of Environmental Quality (DEQ) and the Oregon Health Division (now Oregon

Health Authority). The Assessment was formally transmitted to Heceta Water District on September 11, 2001 and is included in Appendix E-1.

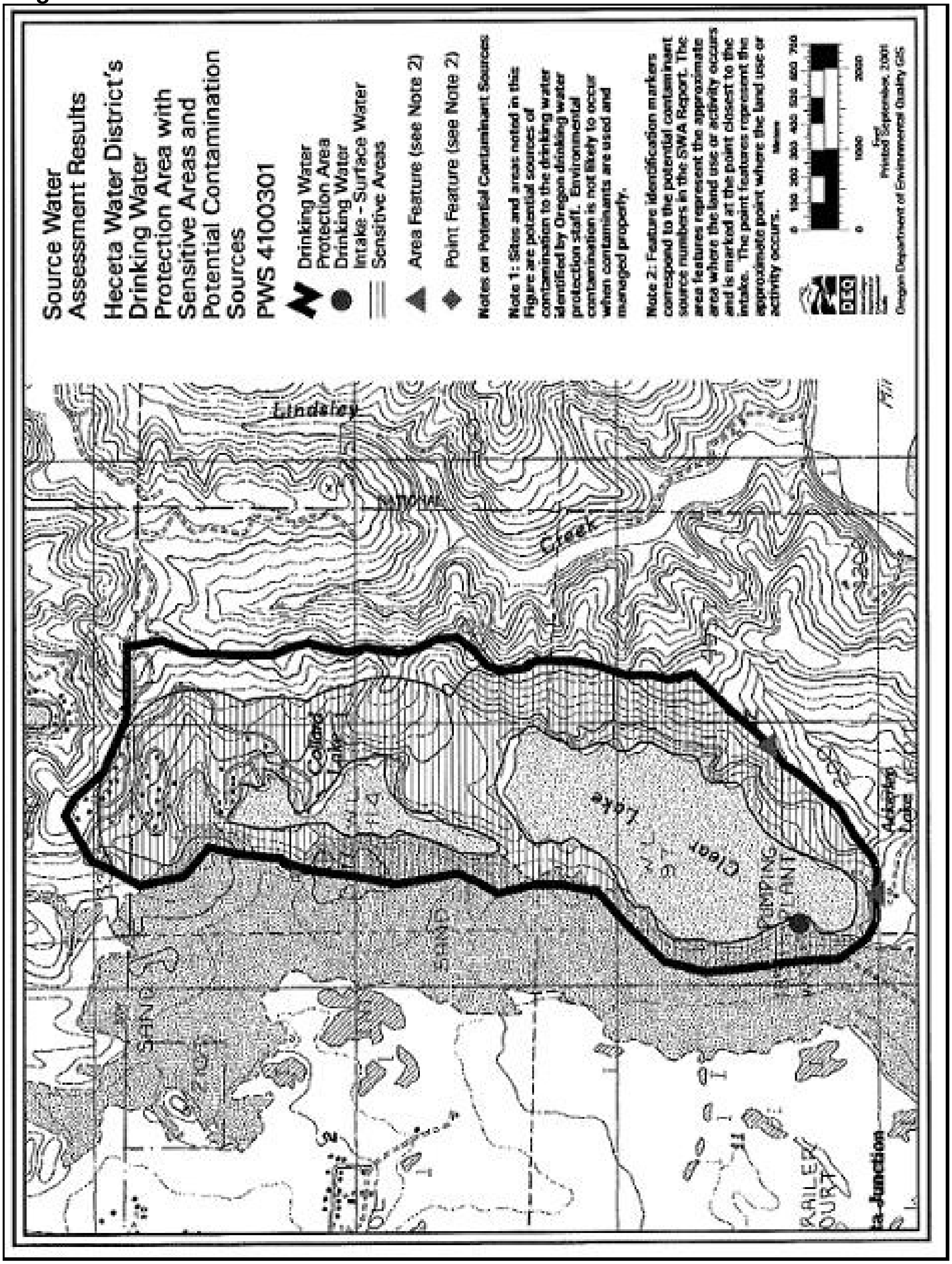
The drinking water for Heceta Water District is supplied by an intake on Clear Lake. This public water system serves about 4,500 citizens. The intake is located in the Lower Siuslaw River Watershed in the Siuslaw sub-basin of the Northern Oregon Coastal Basin. The geographic area providing water to Heceta Water District's intake, the Drinking Water Protection Area (DWPA), includes 149.6 acres of lakes (Clear Lake and Collard Lakes) and 0.23 miles of streams. The DWPA encompasses a total area of 0.96 square miles. The elevation change from the upper edge of the watershed to the intake is about 400 feet and the intake is located at an approximate elevation of 100 feet. Forestlands primarily dominate the delineated drinking water protection area.

The results of the Source Water Assessment are presented in Figure 2.12. As shown, the primary contaminants of concern for surface water intakes are sediments/turbidity, microbiological, and nutrients. The sites and areas identified are potential sources of contamination and water quality impacts are likely to occur only when contaminants are not used and managed properly.

Two potential sources of contamination were identified, both within sensitive areas: rural residential areas and future land development. These sources pose a relatively higher to moderate risk to the drinking water supply. These sources, if improperly managed, could impact the water quality in the watershed.

The existing Potential Contaminant Source Types in the DWPA are improperly installed or maintained wells and abandoned wells; and septic systems on lots less than one acre in size. The majority of the homes that could present a risk are around Collard Lake. Future land development in Lane County southeast of Clear Lake, outside the Florence UGB, is another potential contaminant source.

Figure 2.12. Heceta Water District's Source Water Assessment Results



Chapter 3: Water Monitoring and Potential Contaminant Source Inventories

This Chapter presents the City's surface and groundwater monitoring process and results and discusses the sensitivity of the aquifer and the Drinking Water Protection Areas (DWPAs) to these findings. Also presented are the results of the Potential Contaminant Source (PCS) Inventories for the existing and proposed wellfields. The results of the PCS inventory are combined with the sensitivity determination to provide an evaluation of the susceptibility of groundwater to those potential sources.

Surface and Groundwater Monitoring Process and Results

The EPA-funded Siuslaw Estuary Partnership includes a Surface- and Groundwater Monitoring Program to protect the North Florence Sole Source Dunal Aquifer and to protect and improve water quality in Munsel and Ackerley Creeks and the Siuslaw River, classified as Water Quality Limited under the Clean Water Act and on the state's 303(d) list of Impaired Water Bodies. Sixteen groundwater "test wells" are installed throughout the aquifer to monitor levels and quality; and stream gages, sondes, and grab sampling are used in Munsel and Ackerley Creeks to monitor stream flow and water quality. The Surface and Groundwater Monitoring Program is operating under an EPA-approved Quality Assurance Project Plan (QAPP) (Appendix F).

Appendix A contains the report "Water Quantity and Quality: Summary of Observations, October 2010-September 2012" prepared by GSI Water Solutions (Appendix A-1) and the report on Oregon beach Monitoring Program results (Appendix A-2). Eventually, data on the estuary, as available, from the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians will also be examined.[7] As of this writing, the City and its partners have collected, analyzed, and reported on two years of data on groundwater levels and quality and surface water flow rates and quality. The City was recently awarded an Urban Waters Small Grant to help fund continuation of the monitoring program for another two years.

Data collected and analyzed through the City's Surface and Groundwater Monitoring Program were used in the Groundwater Flow Model and all monitoring results have been reported in quarterly reports prepared by GSI Water Solutions, Inc., the hydrogeologists retained as consultants to the Partnership. These reports are summarized in Appendix A of this plan.

These data make a significant contribution to local, state, and federal knowledge about baseline conditions and issues in this highly sensitive urban environment. Through this Partnership, the City and its partners have also gained tools, such as groundwater monitoring wells, stream flow gages, temperature sondes, and hand-held measuring devices, and training in data collection, analysis, and reporting. The City is also a part of the Oregon Department of Environmental Quality's (DEQ) Volunteer Monitoring Program through which the groundwater and surface water data are entered into state and federal databases.

[7] The tribes have agreed to place a sonde in the estuary near the Siuslaw Bridge in order to collect data on urban impacts on the estuary. As of this writing, the sonde has not yet been placed.

As reported in monthly and annual monitoring reports on the City's web site, the City has identified some contamination threats in both surface water and groundwater, including *E. coli*, coliform bacteria, caffeine, and elevated nitrate levels. Caffeine clearly indicates human impact on water quality. As discussed in Chapter 4, the City is working with its partner agencies to problem solve these findings. The City and some of its partners have agreed to continue to work together on the monitoring program for at least two more years in order to get a better sense of the trends, beyond the data being collected now.

At the same time, coho salmon, a federally-listed threatened species, have been observed spawning in both Munsel and Ackerley Creeks and the Salmon and Trout Enhancement Program (STEP) volunteers report that over 250 coho returned to Munsel Creek in the last year. The Confederated Tribes and the Watershed Council are sharing data on water quality in the estuary in order to begin to identify associated trends; the additional two years of monitoring will better enable these partners to start to identify and address urban impacts on the estuary.

Figure 3.1. Surface water monitoring sites:
ACK: Ackerley Creek upstream of Martin Road
MLK: Munsel Creek upstream of Munsel Lake Road
MGP: Munsel Creek at Munsel Greenway Park
PWS: Munsel Creek at Public Works on Spruce St.

Surface Water

Surface water flow and quality are monitored at four locations: three in Munsel Creek and one in Ackerley Creek (Figure 3.1).

The following is a summary of monitoring results as of October 1, 2012. See Appendix A for the full report.

Streamflow. City personnel measured streamflow monthly from November 2010 to September 2012 at the four surface water monitoring sites: Munsel Upstream (Munsel Creek upstream of Munsel Lake Road near the outlet of Munsel Lake), Munsel Midstream (Munsel Creek at Munsel Greenway Park), Munsel Downstream (Munsel Creek at the Public Works Department on Spruce Street), and Ackerley (Ackerley Creek upstream of Martin Road). Figure 3.1 shows the monitoring sites on a map.

Streamflow has peaked in each year in the spring (primarily April) and has reached its lowest levels in September at all monitoring sites. The peak in the spring is the result of a combination of spring rainfall, leading to a rise in the water table and causing more groundwater to discharge at the surface, and the addition of high discharge from upgradient. The trough in September is the result of a prolonged period of decreased rainfall and a low water table, and lower discharge (less surface runoff and lower groundwater discharge) from upgradient. No data points are shown in the winter for Ackerley Creek, because the City did not enter the creek to measure streamflow because of the presence of salmon redds. The high streamflow measured in July at Munsel Upstream is an outlier, which City personnel believe may have been caused by the removal of a beaver or debris dam at the outlet of Munsel Lake that day, as City personnel found a large amount of recent debris on the banks near the outlet. City personnel explained that streamflow levels were low the day before streamflow measuring and when collecting water quality samples, and were surprisingly high the day of streamflow monitoring. City personnel said that streamflow at the other sites appeared reasonable the day of streamflow monitoring, suggesting either the increase in flows had not reached downstream or had dissipated along its course.

Munsel Upstream averaged 9.9 cubic feet per second (cfs), Munsel Midstream averaged 11.9 cfs, and Munsel Downstream averaged 13.6 cfs. This shows an increase in streamflow from upstream to downstream that suggests that Munsel Creek is generally a gaining stream, consistent with the conclusions concerning groundwater-surface water relationships discussed above.

In addition, continuous water level measurements are taken every 15 minutes by pressure transducers at Munsel Upstream, Munsel Midstream, and Ackerley Creek. The Oregon Water Resources Department (OWRD) owns the pressure transducer at Munsel Midstream while the City owns the others. GSI Water Solutions, Inc. (GSI), staff members are working with OWRD's regional staff to find someone to transform the water level data into streamflow data.

Water Quality

City personnel collected stream temperature, DO, specific conductance, and pH on a monthly basis from October 2010 through September 2012 using a hand-held probe. City personnel also deployed water temperature data loggers at each monitoring site that record stream temperature continuously every 30 minutes. The following describes this water quality data.

Water Temperature. Stream temperatures peak in July or August and drop to their lowest levels in the winter, particularly January. This is in contrast to groundwater temperatures (discussed above), which reach their lowest temperatures in the early spring. Ackerley and Munsel Upstream had the highest maximum stream temperatures of 19.9˚C and 18.7˚C, respectively. The Munsel Midstream and Munsel Downstream had maximum stream temperatures of 16.9˚C and 16.6˚C, respectively. These groupings reflect a trend that Ackerley and Munsel Upstream appear to have similar stream temperatures to each other while stream temperatures in Munsel Midstream and Munsel Downstream are similar. Minimum stream temperatures ranged from 6.3˚C to 7.0˚C among the four monitoring sites.

For comparison to the instantaneous probe readings taken in the morning, Ackerley and Munsel Upstream had maximum stream temperatures of 26.6˚C and 23.9˚C, respectively. Munsel Midstream and Munsel Downstream had maximum stream temperatures of 20.7˚C and 18.1˚C, respectively. This apparent "cooling downstream" is probably the result of the influx of groundwater, with temperatures generally less than 15˚C. These stream temperature groupings are consistent with the probe stream temperature groupings described above. Minimum stream temperatures ranged from 3.4˚C to 5.4˚C among the four monitoring sites. These data from the data loggers demonstrate the value of continuous temperature recording and its capability of recording the full extent of stream temperature fluctuations. The data logger maximum stream temperatures were as much as 6.7˚C greater and minimum stream temperatures were as much as 2.9˚C less than instantaneous stream temperatures recorded with the probe. The data logger also recorded diurnal stream temperatures fluctuations, which showed Munsel Upstream and Ackerley with large changes in daily stream temperature in the summer compared with the other two sites. Both Munsel Upstream and Ackerley are near the outlets of lakes.

Dissolved Oxygen. DO concentrations are temperature dependent, being higher at cooler temperatures and lower at warmer temperatures. DO concentrations are generally close to or more than 10 mg/L from November through April. DO then drops in the summer months to about 8 mg/L in Munsel Midstream and Munsel Downstream and to about 6 mg/L or less in Munsel Upstream and Ackerley. These DO data correspond with the stream temperature data presented above: DO is higher in the winter months when stream temperatures are cooler and is lower in the summer months when stream temperatures are highest. The groupings of sites by similar DO concentrations correspond with the groupings by similar stream temperatures. In addition, the lowest DO levels occur in the summer when streamflow is at its lowest, likely reflecting how lower streamflow results in less oxygenation of the water.

Specific conductance. Specific conductance measures the ability of water to conduct an electrical current. Specific conductance depends on the water temperature and on the concentration of positively and negatively charged dissolved ions, and it is directly proportional to the concentrations of ions in the water. Ions can come from natural sources, such as soil and rocks, or from humans, such as human and livestock waste, fertilizers, and herbicides. As a result, spikes in specific conductance can indicate anthropogenic inputs in the stream. The specific conductance values reported in this study fall within the typical range for Oregon Coast Range streams of 150 µS/cm or less (Water Quality Monitoring, 1999). Specific conductance (reported at 25˚C to account for the effect of temperature) has remained around 60 µS/cm throughout the study in Munsel Upstream and Ackerley. Munsel Midstream and Munsel Downstream were generally higher in specific conductance than the other two sites, potentially caused by groundwater discharging to the creek (see discussion of groundwater conductance above), and also had increases in specific conductance, most notably in periods of lower flow when the decreased streamflow likely concentrated the ions. The reason for the sudden decrease in specific conductance in those two streams in October 2011 could be related to 3.5 inches of rain that fell between October 2 and October 5.

pH. pH describes how acidic or basic water is by measuring the concentration of hydrogen ions in water. pH can affect fish egg production and survival along with the functioning of other biota. A primary cause for pH changes in streams is seasonal and daily variation in photosynthesis by aquatic plants. The process of photosynthesis uses hydrogen molecules, which cause the hydrogen ion concentration to decrease, resulting in an increase in pH. Conversely, respiration and decomposition lower pH. The pH of water, such as in streams, typically ranges from 6.5 to 8.5 (Washington Department of Ecology, 2012). pH at the monitoring sites generally has stayed within that typical range, with a few exceptions in Munsel Upstream in August and September and in Munsel Downstream in December 2011. The reasons for these exceptions are unknown, but in Munsel Upstream appear to be related to summertime stream conditions or human activities near the monitoring site.

Lab Results

Water quality grab samples were taken at each monitoring site for laboratory analysis to better characterize stream conditions. *E. coli* sampling occurred monthly, nitrate and total phosphorus sampling occurred quarterly, and a comprehensive sampling occurred semi-annually in March and September. The comprehensive sampling included testing for *E. coli*, nitrate, total phosphorus, alkalinity, total organic carbon, common ions, zinc and copper at Munsel Downstream only, lead in Munsel Creek below a gun club only, VOCs, inorganic compounds (IOC)(e.g., arsenic and chromium), glyphosate, chlorinated acid herbicides (e.g., 2,4-D), and caffeine.

Table 3.1 summarizes some of the lab results from surface water quality samples to date. Nitrate; total phosphorus; VOCs; glyphosate; 2,4-D; and chromium were not detected during the study. Arsenic was detected in Munsel Midstream in September 2012 only (0.0026 mg/L, just above the reporting limit of 0.002 mg/L). Lead was detected only below the gun club in September of 2011 and 2012, suggesting that streamflow, or perhaps increased use of the facility in the summer, may influence the detection of lead. The lead detections were just above the reporting limit of 0.0001 mg/L (0.00011 in 2011 and 0.000169 mg/L in 2012). Caffeine was detected at all four sites at least once during this study (ranging from 2.4 ng/liter (ng/L) to 49 ng/L) and the most detections occurred in September when streamflow was lower. Caffeine is used as an indicator of anthropogenic contamination because caffeine does not occur naturally in the environment and only humans consume it. *E. coli* was detected at levels of concern in 7 months of 2011 and 3 months in 2012, and is discussed in greater detail below.

Table 3.1. Lab results from surface water quality samples. MLK=Munsel Upstream, MGP= Munsel Midstream, PWS=Munsel Downstream, ACK=Ackerley.

Parameter	Sampling Date	Result
Nitrate	10/10, 3/11, 6/11, 9/11, 11/11, 3/12, 6/12, 9/12	Not Detected
Total Phosphorus	3/11, 6/11, 9/11, 11/11, 3/12, 6/12, 9/12	Not Detected
VOCs	3/11, 9/11, 3/12, 9/12	Not Detected
Glyphosate/2,4-D	3/11, 9/11, 3/12, 9/12	Not Detected
Chromium	3/11, 9/11, 3/12, 9/12	Not Detected
Arsenic	3/11, 9/11, 3/12	Not Detected
	9/12	Detected (MGP)
Lead	3/11, 3/12	Not Detected
	9/11, 9/12	Detected (Below Gun Club)
Caffeine	3/11 9/11 3/12 9/12	Detected (PWS) Detected (MGP, MLK, ACK) Detected (MGP) Detected (PWS, MGP, MLK, ACK)
E. coli	11/10, 1/5/11, 1/31/11, 3/11, 5/11, 11/11, 1/12, 3/12, 4/12, 5/12, 6/12, 7/12	Detection Below Level of Concern
	4/11, 6/11, 7/11, 8/11, 9/11, 10/11, 12/11, 2/12, 8/12, 9/12	Possible Concern (See Table 3.2)

E. coli

A water body is considered to be in exceedance of the state standard for *E. coli,* and thus "impaired," when results show a "30-day log mean greater than 126 *E. coli* organisms per 100 ml based on a minimum of five (5) samples, or more than 10 percent of the samples exceed 406 *E. coli* organisms per 100 ml, with a minimum of at least two exceedances" (Oregon's 2010 Integrated Report). When *E. coli* samples cannot be taken frequently during the course of a month, as was the case with this monitoring program, a single sample criterion can be used to characterize the level of risk associated with *E. coli* levels. *E. coli* levels equal to and above the single sample criterion of 406 mpn/100 mL ("mpn" refers to an estimate of *E. coli* content using the Most Probable Number [mpn] method) are considered to be at "high risk"of impairment and between 127and 405 mpn/100 mL are considered to be at "moderate risk" of impairment.

E. coli sampling in this monitoring program occurred on a monthly basis from late November 2010 to September 2012, with the exception of Ackerley, which could not be sampled on one occasion because of the presence of spawning salmon. Table 3.2 shows the sampling dates when at least one site had *E. coli* levels considered "moderate risk" or "high risk." For sampling dates not shown, *E. coli* levels were less than levels of concern at all sites.

Of the 22 sampling events to date, approximately 45 percent of the months had "moderate risk" or "high risk" *E. coli* levels. The incidences of elevated *E. coli* levels occurred throughout the year, instead of just one season. Twenty seven percent (6 of 22) of Munsel Downstream samples and 18 percent (4 of 18) of Munsel Midstream samples exceeded the 406 mpn/100 mL standard described above, which is more than the 10 percent that could indicate that Munsel Creek is "impaired." Ackerley had two exceedances and Munsel Upstream had one exceedance. In addition, five samples from the three Munsel Creek sites exceeded 406 mpn/100 mL within a 30-day period (June 8 to July 7). (Note: the sites are relatively close to one another and may be "autocorrelated," and thus, not independent.) Overall, these levels are sufficient to trigger concern and possibly may indicate that Munsel Creek is "impaired." Consequently, GSI recommends continued monitoring to determine whether *E. coli* levels continue to exceed the single sample criterion, particularly at Munsel Downstream and Munsel Midstream (PWS and MGP). Based on that information, more intensive monitoring studies can be planned to better characterize possible bacteria sources.

Table 3.2. *E. coli* lab results from surface water quality samples. Red indicates "High risk," more than 406 *E. coli* per 100 mL, and yellow indicates "Moderate risk," 127 to 406 *E. coli* per 100 mL.

Site	Date									
	4/6/11	6/8/11	7/7/11	8/2/11	9/6/11	10/5/11	12/7/11	2/8/12	8/1/12	9/5/12
PWS	131.4	1119.9	517.2	112.6	187.2	980.4	770.1	1732.9	2420	45
MGP	816.4	1046.2	579.4	344.8	137.6	387.3	488.4	101.7	6	178
MLK	ND	1986.3	36.9	76.7	142.1	42	142.1	2	116	22
ACK	ND	365.4	5.2	19.9	27.5	34.5	686.7	2	20	548

Stormwater. Stormwater samples were collected on December 28, 2011, January 18, 2012, and March 21, 2012. The samples were taken at four sites: Munsel Downstream (PWS), a stormwater outfall into Munsel Creek at 38th Street (M38), a stormwater outfall in Old Town (OT), and at Rhododendron Drive near 35th Street (Site A). The stormwater sampling included testing for *E. coli*, nitrate, total phosphorus, alkalinity, total organic carbon, common ions, VOCs, IOCs (e.g., arsenic and chromium), glyphosate, chlorinated acid herbicides (e.g., 2,4-D and pentachlorophenol), caffeine, and total petroleum hydrocarbons (TPH). In addition, stormwater samples were tested for zinc and copper at PWS only and for lead in Munsel Creek below a gun club only.

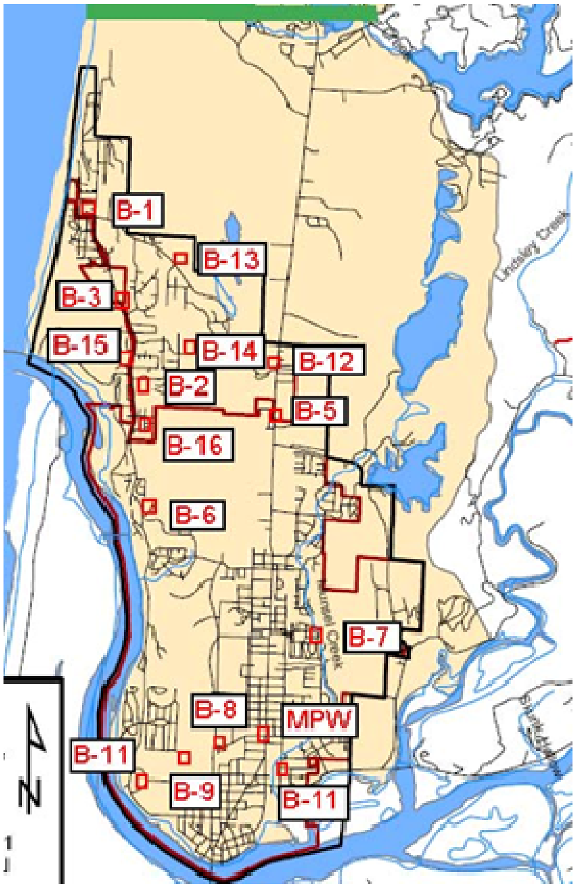
Nitrate, VOCs, glyphosate, and 2,4-D were not detected. Phosphorus was detected at PWS in January (0.1 mg/L, the reporting limit), arsenic was detected at Site A in both samples (0.0026 mg/L in December and 0.0025 mg/L in March; 0.002 mg/L reporting limit), and lead was detected near the gun club in both samples (0.00018 mg/L in January and 0.00011 mg/L in March). Several constituents were detected at multiple sites. Pentachlorophenol and chromium (total; the lab did not determine the concentration as a function of valence) were detected at PWS and OT in both samples (December and March, at levels close to the reporting limit). TPH in the form of lube oil was detected at PWS and OT all three storm events, at M38 in January and March, and at Site A in January. Caffeine was detected at all four sites on both sampling dates (December and March, ranging from 6 ng/L to 960 ng/L) and *E. coli* was detected at levels of concern at all four sites in all three stormwater sampling events, with the exception of M38, which had a detection that was less than the level of concern in March 2012. Zinc and copper also were found at PWS in March.

Groundwater

Monitoring Wells

Data regarding the elevation of the water table, the overall configuration of the water table, and, ultimately, inferences regarding groundwater flow, were collected from a series of monitoring wells in the Florence area (Figure 3.2). Monitoring Wells B-1 through B-11 (B-4 was a failed attempt) were installed in September 2010. The locations of the monitoring well sites were selected to capture water derived from beneath the primary land use activities in Florence and in its urban growth boundary (UGB) (e.g., commercial/business, transportation corridors, sewered areas, non-sewered areas, etc.). The wells are shallow, varying from 15 to 25 feet deep, and are screened in the lower 10 feet. City personnel have collected monthly water levels and water quality data from these wells since October 1, 2010. Monitoring Wells B-12 through B-16 were installed by the City in March 2011. These wells vary from 20 to 30 feet deep, and are screened in the lower 10 feet. Wells B-12 through B-16 were designed to fill gaps, as needed, and to provide upgradient information. Data collection from these wells began in early April 2011.

The City's Miller Park Well (MPW in Figure 3.2) was added to the monitoring well list in May 2011. This well is deeper, derives its water from a greater depth (>57 feet), and has higher temperature and pH than the shallower monitoring wells (see discussion below). This information is interpreted as indicating that the well is "sampling" water that has been removed from the atmosphere longer than that from the shallow wells, and, therefore, the water quality data may not be directly comparable. The implications of the Miller Park Well data are discussed below.



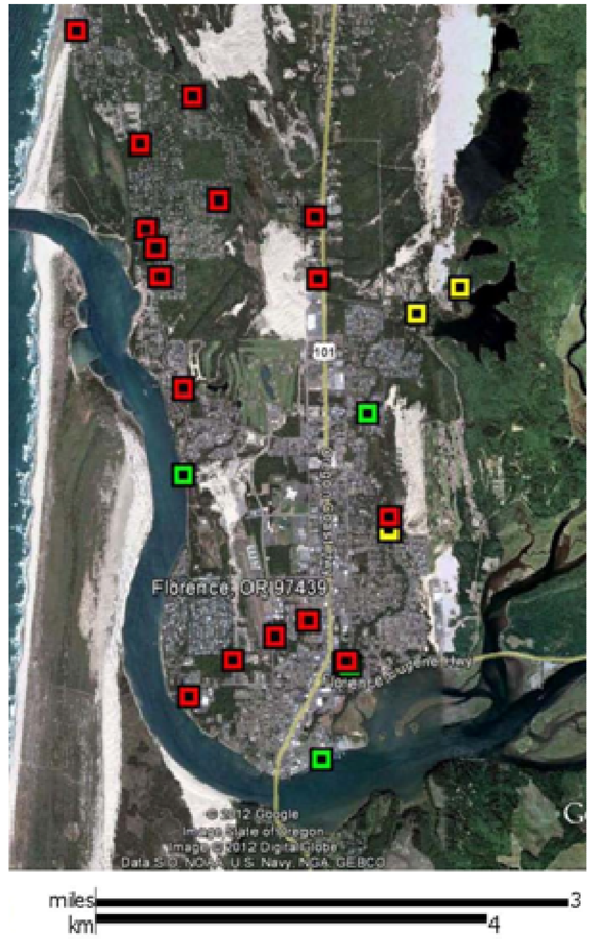
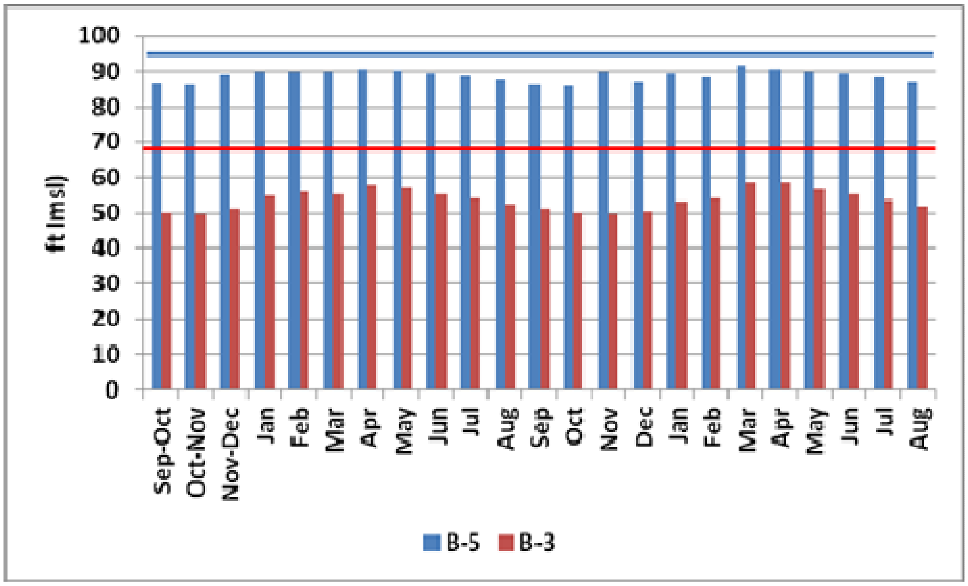


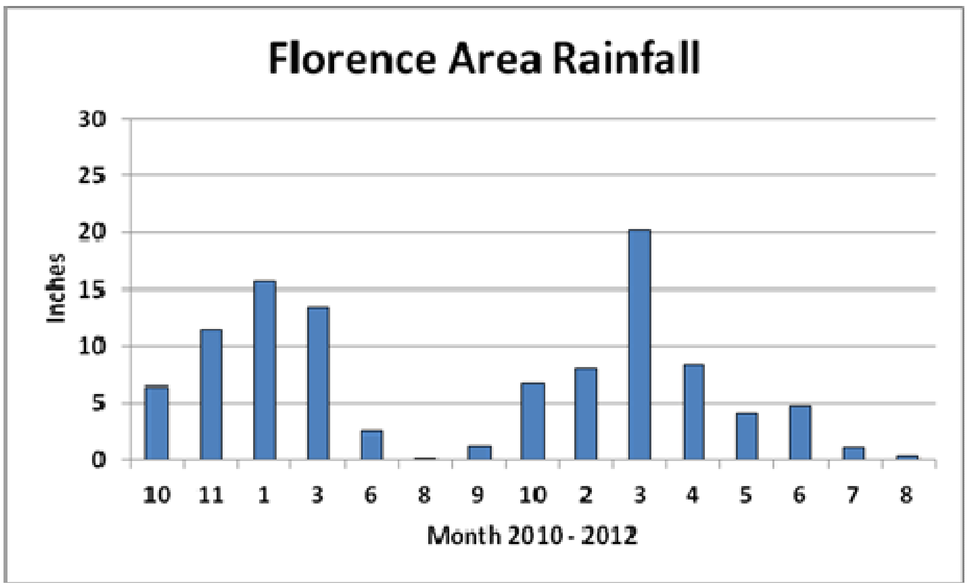
Figure 3.2. Maps of the Florence city limits and UGB. (a) An aerial view. (b) A Google image showing monitoring well locations (red symbols), surface water sites (yellow symbols), and stormwater sites (green symbols). The monitoring wells are all less than 30 feet deep. Wells B-1 through B-11 have been sampled monthly since October 1, 2010. Wells B-12 through B-16 have been sampled since April 1, 2011. The City-owned Miller Park Well (shown as MPW) derives its water from a depth > 50 feet. The Public Works Department, located just north of the Florence-Eugene Hwy, is the site of surface water, stormwater, and groundwater sampling.

Water Quantity

<u>Water Table Elevation and Relation to Precipitation.</u> It has been established that the elevation (head) of the water table undergoes significant variations as a function of season, with the most important controlling parameter being precipitation. Figure 3.3 illustrates how the elevation of the water table at two individual monitoring well sites varied from October 2010 through August 2012 for Wells B-3 and B-5. Well B-3 is near the coast at an elevation of 68.5 feet, while B-5 is farther inland and at a higher elevation of 95.6 feet (see Figure 3.2). Figure 3.3b provides the average rainfall per month for the Florence area. Data from monitoring wells (Figure 3.3a) during the year suggest that the water table is at its lowest near October 1 and at its highest near April 1.



(a)



(b)

Figure 3.3. (a) Average changes in the water table elevation at monitoring Wells B-3 and B-5 monthly (msl = mean sea level). Blue horizontal line is the ground elevation at B-5 (95.6 feet), while the red horizontal line is the ground elevation at B-3 (68.5 feet). (b) Average rainfall in the Florence area from October 2010 through August 2012.

Comparing Figures 3.3a with 3.3b indicates that the lowest water table lags behind the lowest precipitation by up to 2 months, while the higher water table corresponds closely with higher amounts of rainfall. This is consistent with the shallow water table and the rapid infiltration of precipitation. There is a significant rise (> 4 feet at several wells) in the water table in March 2012 in response to heavy rainfall.

Water Table Configuration and Groundwater Flow. Even though the water table elevation at an individual monitoring well might change significantly as a function of precipitation, in some cases as much as 4+ feet, the relative configuration of the water table as a whole remains similar in character. In other words, although the positions of the contours change, no significant changes in groundwater flow direction, generally perpendicular to the contours, is indicated. As in previous measurement periods, the water table slopes toward the Siuslaw River, the Pacific Ocean, and Clear and Munsel Lakes, implying that groundwater discharges directly to the lakes, to the Siuslaw River Estuary, and indirectly via streams, culminating in Munsel Creek's discharge.

Water Table Elevation and Ground Elevation

A review of the topography over the Florence Dunal Aquifer reveals that the elevation varies from more than 200 feet in the northeast area to near sea level to the south and west (see Figure 3.4). Data from the monitoring wells installed during this project suggest that at high water levels, the depth to the water table varies from 5 feet or less in the interior area of the aquifer to 15 to 20 feet near the Siuslaw River Estuary Figure 3.5). This seemingly paradoxical situation results from two circumstances. First, the ground surface slopes gently to the south and west. Secondly, in contrast to ground elevation, the elevation of the water table is fixed by sea level and, therefore, the water table slopes more steeply than does the land surface. (Figure 3.6)

Figure 3.4. Approximate depth to the water table in the Florence Dunal Aquifer. This map is based on measurements taken at the monitoring wells in the City. Data reflected here were collected in April 2011, when the water table, coincident with rainfall, was high. Notice that the depth to the water table increases as one approaches the Siuslaw River Estuary.

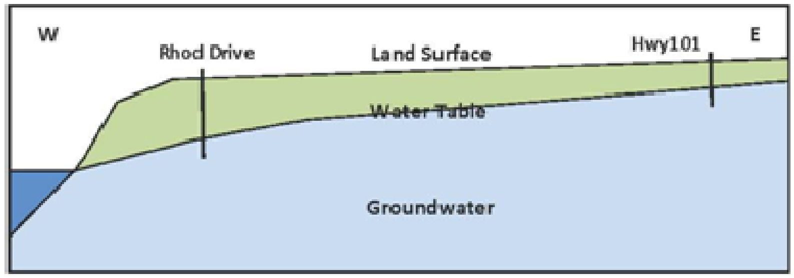


Figure 3.5. A diagrammatic profile of the water table elevation in the Florence Dunal Aquifer from east to west. The water table is tied to sea level and, therefore, slopes at a steeper rate than does the land surface.

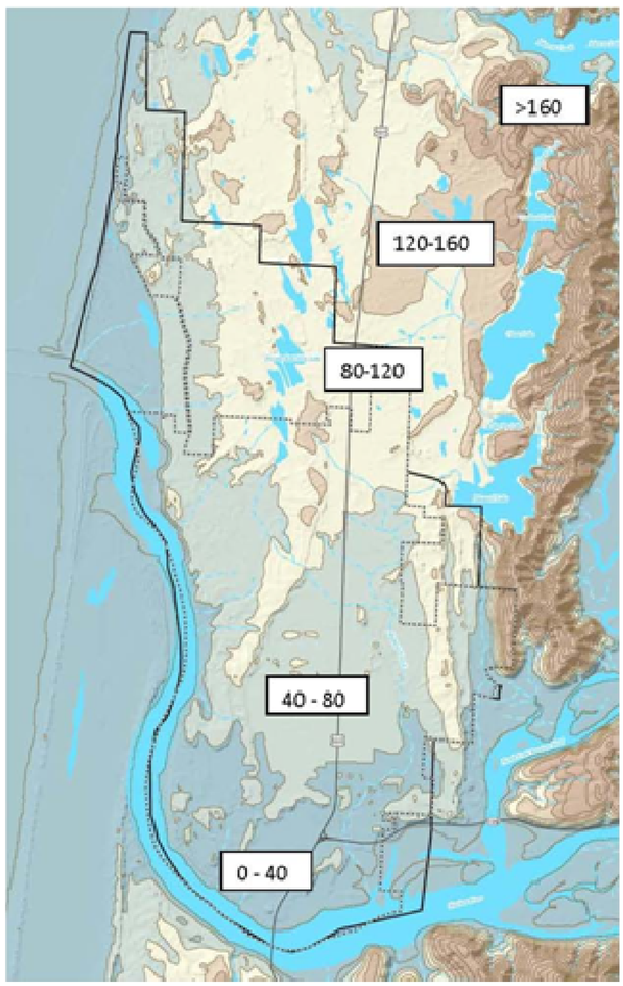


Figure 3.6. Map showing the general elevation of ground surface in the Florence Dunal Aquifer. Elevation varies from sea level to more than 160 feet. Elevation is shown in 40-foot increments as labeled and color coded.

In Figure 3.7, we provide an illustration of the inferred groundwater flow paths in the study area (dashed blue lines). It was clear to us early on that a correlation exists between water table elevation and ground surface elevation and that groundwater flow paths moved from areas of higher topography to areas with lower ground elevation. We have extended that inference throughout the Florence Dunal Aquifer, suggesting a coincidence of high topography and a groundwater high (mound) in the northeast part of the aquifer.

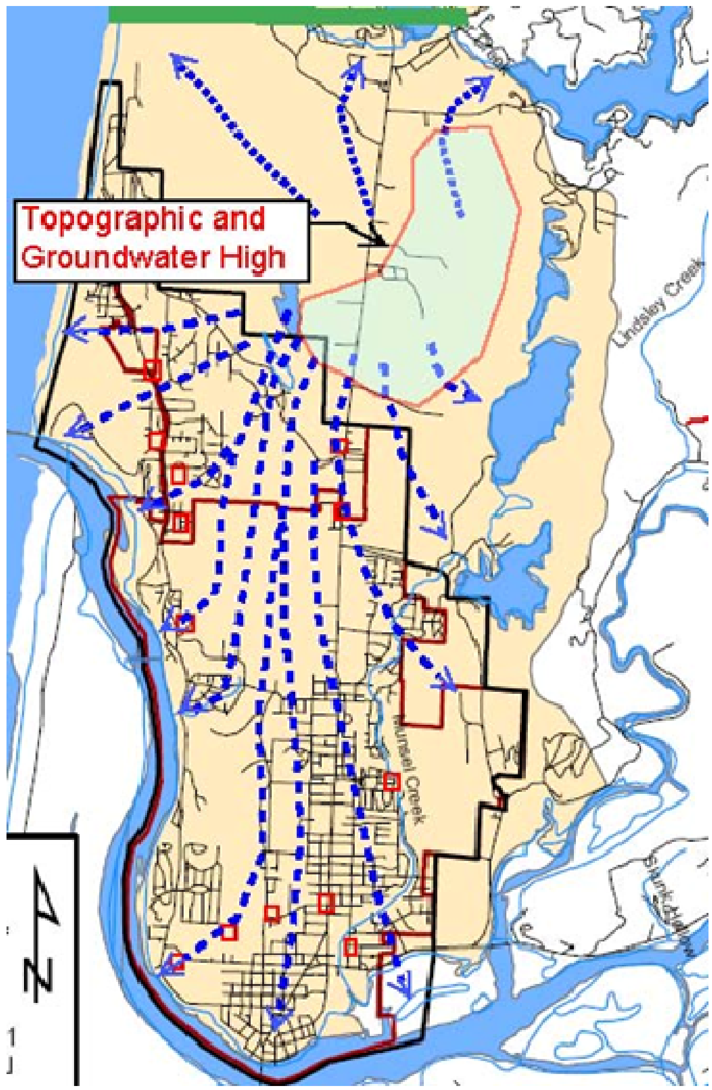


Figure 3.7. Approximate groundwater flow directions (dashed blue lines) as determined from contoured monitoring well data. It is inferred that in the northern part of the Dunal aquifer, groundwater flows northward (dotted blue lines) towards Sutton Lake and Sutton Creek. Pathways appear to originate from a topographic high that presumably is also a groundwater high as well (see text).

The ground penetrating radar (GPR) survey data provided clear evidence that groundwater is discharging to Clear and Munsel Lakes with groundwater flow moving in an easterly direction. To the west, direct water table elevation measurements indicate that groundwater is discharging to the west. That groundwater flows in opposite directions to the east and west of Hwy 101 indicates the presence of a groundwater mound separating the two areas. Traveling north on Hwy 101 through the Florence Dunal Aquifer, one finds that the elevation of the highway peaks at about 120 to 130 feet just north of monitoring Well 12. At Well 12, the elevation of the water table is 100± feet. As one proceeds northward, the elevation drops to approximately 50 feet near Sutton Lake. It is assumed that the elevation of lake surface, 30± feet, reflects the elevation of the water table at that location. The inferred drop in water table elevation from 100 feet to 30 feet from Well 12 to Sutton Lake is consistent with groundwater flow from a high near Well 12 to the northern parts of the Florence Dunal Aquifer.

Figure 3.6 shows an area where the elevation is approximately 120+ feet and suggest that the area is coincident with a groundwater high. It is important to realize that this groundwater high area is not the sole area of groundwater recharge for the aquifer. Recharge occurs throughout the aquifer, infiltrating downward from the surface. Naturally, where the topography is higher, downward percolation will result in the elevation of the water table also being higher. It is common to find that for an unconfined aquifer, the water table mimics, in a subdued way, the topography. Figure 3.6 also shows the groundwater flow directions based on the monitoring wells (dashed lines) as well as flow directions (dotted lines) based on the interpretation that a groundwater mound is coincident with the topographic high of the dune field. GSI's interpretation is that groundwater is flowing in a northerly direction in the northern dunal aquifer, discharging to Sutton Lake and Sutton Creek.

Groundwater Quality

Temperature. Groundwater temperature remains fairly uniform across the Florence area; however, small but significant seasonal changes are observed. Groundwater temperature varies by approximately 2.5°C. It also appears that the groundwater temperature lags behind the air temperature by 1 to 2 months. The lowest average temperature is in April, while the lowest air temperatures are generally in January or February.

pH. The pH of area groundwater has remained fairly stable. From December 2010 through September 2012, the average pH of the shallow groundwater varied from 5.36 to 6.09, with no apparent seasonal trend. Some outliers were seen (e.g., Well B-7 at 7.08 in November 2011 and Well B-2 at 4.7 in October 2011). Lower pH values (5.5 to 6.0) are typical of shallow groundwater. The pH of the Miller Park Well typically is higher than the other wells (e.g., 6.1 to 6.5 compared to 5.4 to 5.7). The Miller Park Well is deeper. Both the temperature and pH difference in groundwater from the Miller Park Well compared to that from the shallow monitoring wells are consistent with a longer residence time for the deeper groundwater.

Groundwater Conductance. Conductivity is related to the dissolved mineral load of the water. An approximate relationship between the two is that the total dissolved solids (TDS) (milligrams per liter [mg/L]) of a sample is approximately 50 percent of the conductivity (micro Siemens per centimeter [µS/cm]) of that sample. Conductivity varies in wells from <70 to >500 µS/cm, with the bulk of the analyses at 100 to 160 µS/cm. Well B-2 is approximately 1.1 miles downgradient from Well B-5 in an area that is served by individual septic systems. Well B-6 is within the City, approximately 1.1 miles downgradient from Well B-5, and is downgradient from the Sand Pines Golf Course. Wells B-8 and B-10 are 2.3 and 2.85 miles, respectively, downgradient from Well B-5 in the City's downtown area and commercial area. Well B-11 is in the City, near Munsel Creek, approximately 2.6 miles from Well B-5 and downgradient from a commercial area.

As would be expected, the upgradient Well B-5 has lower and more uniform conductivity (TDS) values, while the downgradient wells (B-2, B-6, B-8, B-10, and B-11) tend to have higher conductivity values. Given the shallow nature of the water table, and the potential for local influence on a given well's water quality, it is not just water-rock reactions along a flow path that are controlling the conductivity values as is evidenced by the lack of correlation between flow path length and conductance. This can be most clearly seen in the anomalous behavior of Well B-2 where conductivity values vary significantly and have exceeded 600 µS/cm. Reactions between groundwater and the aquifer (which contains quartz, feldspar, and rock fragments) are likely to be slow. The values seen at Well B-2, in the 400 to 600 µS/cm range, are unlikely to be the result of natural causes, suggesting that the groundwater at this well site has been affected by surface or near surface activities.

Groundwater Dissolved Oxygen. Dissolved oxygen (DO) varies from 0.09 mg/L (< 1 percent saturated) to more than 10 mg/L (> 90 percent saturated) in groundwater from the Florence Dunal Aquifer. Although the DO data collected thus far from study area monitoring wells do not seem to indicate any regional pattern to the values, the DO at a given monitoring well does not change significantly with time, often varying by less than 1 mg/L over time. Upgradient wells can have quite different values (e.g., Well B-7 = 10.1 mg/L, Well B-5 = 0.13 mg/L), as can downgradient wells (e.g., Well B-2 = 9.31 mg/L, Well B-6 = 0.47 mg/L).

Oxidation-Reduction Potential (ORP). Similar to DO, the ORP values do not display any regional pattern and, at a given site, are relatively consistent over time. The ORP is a measure of the ability of the environment to initiate oxidizing and reducing reactions and is a more complex parameter than is DO. Due to the lack of a regional pattern of the ORP parameter, and the relative consistency of the ORP value at a given site, a conclusion is reached that is the same as with DO, i.e., the ORP value is a function of what is happening in the immediate area of the well.

Chemical Analyses. Laboratory analyses in March and September of 2011 and 2012 included the full range of analytes, as detailed in the original proposal to the U.S. Environmental Protection Agency (EPA) (i.e., volatile organic chemicals [VOCs], select pesticides, metals, nitrate, and the common ions, [e.g., Ca, Na, K, HCO_3, Cl, and SO_4] as well as the routine bacterial testing). This testing was conducted on Wells B-1 through B-11. Coliform and *E.coli* data were collected monthly from October 2010 through September 2012. Nitrate was collected monthly from March 2011 through September 2012.

Volatile Organic Chemicals and Pesticides. <u>No VOCs or pesticides were detected in any of Florence's monitoring wells.</u>

Metals and Nonmetals. This group of chemicals typically is found in areas of commercial and industrial land uses, but also may occur in a variety of other activities. Only two detections were noted: chromium was detected in Well B-2 at a concentration of 0.0056 mg/L and arsenic was detected in Well B-6 at 0.0052 mg/L. Both of these concentrations are below the respective drinking water standards (i.e., 0.10 mg/L for chromium and 0.010 mg/L for arsenic). No other detections were recorded and further metal analysis was discontinued.

Nitrate. The drinking water standard for nitrate is 10 mg/L NO_3-N. Natural concentrations of nitrate rarely exceed 2 to 3 mg/L. Concentrations exceeding natural levels often reflect areas affected by animal feedlots, septic systems, or over-application of fertilizer.

Elevated nitrate in shallow wells in areas not served by municipal sewer lines may reflect the impact of effluent from septic systems. Traditional septic systems are designed to discharge to groundwater. They are not designed to remove nitrate from domestic waste. A given area of land, with a given thickness of soil material above the water table, can assimilate (dilute, use, or convert) nitrate from domestic sewage up to a threshold controlled by the nature of that soil and the character of the aquifer. If that threshold is exceeded, nitrate may infiltrate to groundwater. Most of the area monitoring wells exhibit low to non-detect levels of nitrate concentrations (see Tables 3.3 and 3.4). Significant variations do occur. Nitrate has been found in Wells B-2 and B-10. Nitrate concentrations in Well B-10 are low (1.8 to 2.6 mg/L), while the nitrate concentrations for Well B-2 have varied from non-detect to as high as 45 mg/L. Well B-2 is within Florence's UGB, in an area serviced by individual septic systems. Elevated nitrate concentration is not the case for all wells in the areas downgradient from septic systems, which is evident from the lack of nitrate in groundwater from Well B-3, a nearby monitoring well. The conductivity of Well B-3 is much lower than Well B-2, and is similar to other downgradient wells (e.g., Wells B-6, B-8, and B-11 are located in areas serviced by sewers).

Table 3.3. Nitrate data for Florence-area monitoring wells: October 2010 to September 2011

Date	Oct 2010	Nov 2010	Mar 2011	Apr 2011	Jun 2011	Aug 2011	Sep 2011
B-1	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-2	**29.7**	**27.7**	ND[1]	NA[2]	**12.6**	**45**	**22.8**
B-3	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-5	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-6	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-7	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-8	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-9	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-10	ND[1]	ND[1]	**2.6**	NA[2]	**1.8**	ND[1]	ND[1]
B-11	ND[1]	ND[1]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]
B-12	NA[2]	NA[2]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]
B-13	NA[2]	NA[2]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]
B-14	NA[2]	NA[2]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]
B-15	NA[2]	NA[2]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]
B-16	NA[2]	NA[2]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]

[1]Not detected
[2]Not analyzed

Table 3.4. Nitrate data for Florence-area monitoring wells: October 2011 to September 2012

Date	Oct 2011	Nov 2011	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012
B-1	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-2	**33.1**	NA[2]	**19.2**	ND[1]	**4.9**	ND[1]	**4.9**	**16.4**	**18.2**	**15.2**
B-3	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-5	NA[2]	ND[1]	NA[2]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-6	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-7	NA[2]	ND[1]	NA[2]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-8	NA[2]	ND[1]	NA[2]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-9	NA[2]	ND[1]	NA[2]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-10	ND[1]	ND[1]	NA[2]	**2.1**	NA[2]	**2.3**	**1.8**	ND[1]	ND[1]	ND[1]

Table 3.4. Nitrate data for Florence-area monitoring wells: October 2011 to September 2012										
Date	**Oct 2011**	**Nov 2011**	**Feb 2012**	**Mar 2012**	**Apr 2012**	**May 2012**	**Jun 2012**	**Jul 2012**	**Aug 2012**	**Sep 2012**
B-11	ND[1]	ND[1]	NA[2]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-12	NA[2]	ND[1]	NA[2]	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-13	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-14	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-15	ND[1]	NA[2]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
B-16	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]

[1]Not detected
[2]Not analyzed

Nitrate is often non-detect during periods of high rainfall, suggesting that high rates of infiltration during these high rainfall periods may have led to a dilution of nitrate concentrations. Typical precipitation rates decrease from late spring through early to late fall and increase from late fall to late spring. Conductivity values do the opposite, increasing from late spring to fall and decreasing during the rainy season. One explanation for this observation is that as the amount of dilution (rainfall) decreased, the relative concentration of dissolved chemical species increased. As noted above, nitrate reflects a similar trend (i.e., non-detect during high precipitation periods and higher concentrations as the dilution decreases). Nitrate concentrations show a moderate correlation with conductivity, suggesting a relationship between the two. The variation in the amount of dilution, driven by rainfall at the surface, produces the observed variations in both conductivity and nitrate.

Caffeine. Selected wells located within the land use areas residential non-sewered, residential sewered, residential/commercial sewered, and commercial sewered were analyzed for caffeine testing on a quarterly basis during the period from March 2011 through September 2012 (Table 3.5). Caffeine, because it is consumed exclusively by humans, is a commonly used indicator of groundwater contamination by infiltrating effluent from septic system drainfields. Because of the nitrate and bacterial monitoring history of Well B-2 (downgradient in a non-sewered area), it was suspected that this particular well was the most likely to contain caffeine. In fact, groundwater from Well B-2 was non-detect for this chemical in two out of the four quarterly sampling events. Caffeine concentration in water from B-2 was 3.4, ng/L (1 ng = 1 billionth [10^{-9}] of a gram or 1 nanogram) in September 2011 and 41 ng in September 2012. Three other wells in this area also had periodic detections of caffeine (i.e., B-3 [12 ng in March 2011 and 7.8 ng in September 2012], B-1 [4.1 ng in September 2012], and B-16 [4.3 ng in September 2012]). The presence of caffeine in these wells is anomalous and may suggest impact from septic effluent.

It is important to note, however, that other wells, within the City limits, have also had caffeine detections (i.e., Wells B-6 and B-7 have had caffeine detections). Well B-11 had two unconfirmed caffeine detections (not detected in a duplicate sample). Caffeine also has been detected in samples from Munsel Creek and in samples collected within the City limits during storm events (see Surface Water discussion below). The caffeine detections within the City are currently unexplained; however, leakage from Munsel Creek and local infiltration of stormwater may offer an explanation.

Table 3.5 Results of caffeine analysis – Florence monitoring wells 2011-2012 (see Figure 1a for well locations)		
Date	**Wells Sampled/Land Use**	**Results**
March 2011	B-1, B-2, B-3/UGB, non-sewered residential B-11/sewered residential and commercial	B-1 and B-2: non-detect B-3: 12 ng B-11: non-detect

Table 3.5 Results of caffeine analysis – Florence monitoring wells 2011-2012 (see Figure 1a for well locations)		
Date	**Wells Sampled/Land Use**	**Results**
September 2011	B-2, B-3, B-15/non-sewered residential	B-2: 3.4 ng B-3 and B-15: non-detect
March 2012	B-1, B-2, B-3, B-5, B-12, B-13, B-14, B-15, B-16/UGB, non-sewered residential B-6 and B-7/sewered residential B-11/sewered residential and commercial	All non-detect B-6: 3.2 ng, B-7: 12 ng Non-detect
September 2012	B-1, B-2, B-3, B-5, B-12, B-13, B-14, B-15, B-16/UGB, non-sewered residential B-6 and B-7/sewered residential B-11/sewered residential and commercial B-8 and B-10/downtown commercial	B-1: 4.1 ng, B-2: 41 ng, B-3: 7.8 ng, B-16: 4.3 ng; all others non-detect Non-detect Non-detect Non-detect

Common Ions. General Interpretations. The common ions include Ca, Mg, Na, K, HCO_3, Cl, and SO_4 and often reflect the nature of the aquifer in which the groundwater resides, the amount of residence time (i.e., how long the groundwater has been in contact with the aquifer materials), and, potentially, land use activities in the area. It is clear that, with the exception of sodium and chloride concentrations in Wells B-2 and B-3, the wells are similar in common ion concentrations. Further, the upgradient Well B-5 and downgradient Well B-6 compare similarly with the Menlo Park precipitation. The sodium and chloride concentrations in downgradient Wells B-2 and B-3 are in marked contrast to the concentrations of those components in downgradient Well B-6. The relationship of Na and Cl between Wells B-2 and B-3 with the other wells remains so throughout the year.

Natural increases in sodium and chloride in groundwater may result from evaporation or dissolution of sodium and chloride bearing minerals. Evaporation cannot explain the high sodium and chloride in Wells B-2 and B-3 because the process would affect all of the constituents. Further, it is unlikely that any chloride-bearing minerals occur in the dunal sands. If they did occur, it would be reasonable to conclude that groundwater from Well B-6 would have encountered the mineral as well. Another possible reason for the elevated sodium and chloride, and one that also has been considered (and discussed above) to explain anomalous conductivity and nitrate data and the caffeine occurrence in Well B-3, is that the elevated sodium and chloride reflect an impact of septic system effluent. Domestic septic effluent can add dissolved minerals to groundwater, especially sodium and chloride. Elevated chloride is a particularly good indicator of septic effluent, because of its nonreactive chemical behavior in the aquifer, it tends to reflect its source. It may be tempting to ascribe the elevated sodium and chloride to the proximity of the ocean; however, the hydraulic head of these wells is 40 to 50 feet above sea level, precluding seawater migrating into the shallow aquifer at these sites.

Groundwater-Surface Water Connections

One of the goals of this project is to determine the physical relationship, or the degree of hydraulic connection, between groundwater and surface water. Figure 3.8 compares the common ion data of the four surface water sites with nearby groundwater (Wells B-7 and B-11). Surface monitoring sites along Munsel Creek are: PWS = Florence Public

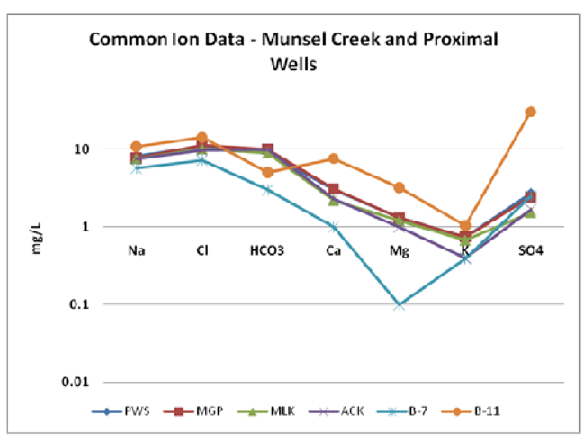


Figure 3.8 A comparision of the common ion concentrations in Munsel Creek (see below) with groundwater

Works building (Munsel Downstream), MGP = Munsel Greenway Park (Munsel Mid-stream), MLK = Munsel Lake (Munsel Upstream), and ACK = Ackerley Creek.

Coliform Bacteria. Groundwater from the monitoring wells is tested monthly for bacteria. If a sample comes back positive for the occurrence of total coliform, the lab routinely tests for *E. coli*. Total coliforms are common in the environment, but are not indigenous to groundwater (i.e., the aquifer). Their presence in groundwater generally indicates a potential problem with well construction (e.g., improper or failing well seal, or a nearby coliform source). *E. coli*, however, is a type of fecal coliform that originates from human or other warm-blooded animal waste. Detections of *E. coli* in the Florence monitoring wells are few, limited to being "Present" in Wells B-2 and B-10 in November 2010. Total coliforms were found in the Florence wells, primarily in the downgradient wells.
Several points are evident:

- Upgradient wells in all areas generally have been total coliform free.
- Downgradient wells in sewered areas are generally total coliform free.
- Downgradient wells in areas served by septic systems have experienced total coliform positive results.
- Downgradient wells in commercial areas have experienced total coliform positive results.

Although the source of coliform for wells in the last two bullets above is currently unknown, the wells were installed by licensed well drillers and well construction is not the likely cause of the detections.

Sensitivity Analysis

Most groundwater contamination originates at the surface (accidental/deliberate spills, chemical applications, roadway/parking lot runoff, etc.) or in the shallow subsurface (underground storage tanks, septic systems, shallow injection wells, etc.); therefore, a review of water quality monitoring results for each water system can provide valuable information regarding aquifer sensitivity. Clearly, if a contaminant has been detected in the water source, a pathway from the surface to the aquifer must exist.

As a means of protecting public health, public water systems in Oregon are required to routinely monitor drinking water quality for contaminants identified by the EPA as hazardous to human health. However, it is important to understand that the results from a given sample only provide information regarding water quality at the time that the sample was collected. Water quality within an aquifer can change with time for a number of reasons, including contamination and seasonal recharge. The fact that a water sample, or series of water samples, is free of contaminants is no guarantee that contamination of the aquifer cannot happen in the future.

This sensitivity analysis refers to the existing and proposed wellfields only. As described above, the City has been routinely monitoring since late 2010 – early 2011. These monitoring results are relevant to the sensitivity of the aquifer in general; they are not, however, within the wellfield capture zones and will not be considered at this stage of evaluation. A review of the water quality monitoring history, including all Volatile Organic Compounds (VOCs), Synthetic Organic Compounds (SOCs), Inorganic Compounds (IOCs), nitrate, and coliform monitoring results available in OHA's Drinking Water Program SDWIS on-line database has been completed. Required routine monitoring for nitrate and coliform occurs more frequently than that for VOCs, SOCs, and IOCs; therefore, both nitrate and coliform are particularly useful as indicators of contaminant pathways into the aquifer. Coliform bacteria are ubiquitous in the environment and their presence in source water (i.e., the aquifer) may indicate a microbial source nearby. Likewise nitrate provides similar information and is highly mobile compared to most contaminants and in some cases will act as a precursor to other contaminants entering the aquifer. Therefore an aquifer yielding water that meets any of the following criteria is considered highly sensitive to contamination:

- Any VOC or SOC detections,
- IOC detections greater than 50 percent of the EPA established maximum contaminant level,
- Source-related coliform detections, and/or
- Nitrate concentrations of 5 mg/L or greater.

The water table below the existing wellfield varies from less than 15 feet to more than 70 feet below the surface depending on the well. In some areas, the water table rises to even shallower depths (< 5 ft) in the spring after recharge of winter precipitation. The potential of contaminants migrating to the water table is based entirely on the geologic description included on the well driller's report for the individual wells. The permeability of the sands, based on past well pumping tests, varies between 50 and 100 ft/day. Based on this observation, the travel time for water to move from the surface to the water table occurs in a matter of hours. Using an average precipitation rate of 65 inches (Hampton, 1963) and the high infiltration rates associated with sandy soils, an annual recharge rate to the aquifer in excess of 40 inches was estimated, which combined with the permeability indicates a very high infiltration rate. Under these conditions, very little attenuation of contaminant concentration would likely occur.

Well report records indicate that there are approximately 120 other wells within the sections containing the City of Florence Wells. Of these, 100 were drilled prior to 1979, when well construction requirements were significantly upgraded by the Oregon Water Resources Department. The remaining wells were drilled after 1979. This leads to an Other Well Score of 420, a score that exceeds OHA's recommended significant risk indicator threshold of 400. Thus, other wells in the area potentially represent a significant risk to the water system in that they provide a conduit for contamination to migrate to the water table.

OHA Drinking Water Program records indicate that nitrate has not been detected at the entry point for the well field. Records also indicate that there have not been any positive detections for total coliform. Detections of VOCs, di(2-ethylhexyl)phthalate (0.0006 mg/L) on April 16m 2008, toluene (0.0023 mg/L on August 14, 2002) and chloromethane (methylchloride) (0.0034 to 0.0075 mg/L), have occurred. However, di(2-ethylhexyl)phthalate was not detected in subsequent analyses. With respect to toluene, it was later determined that the detections were false and a result of compounds contained in the tape used to secure sample caps (see Appendix G). Chloromethane has only been detected in the finished water produced by the City's treatment plant not in the raw water from the well field. It is thought to be simply a product of the chlorination process at the treatment plant. Sodium has been detected up to concentrations of 37 mg/L.

In the 2003 Source Water Assessment prepared by OHA, the aquifer sensitivity for the system was summarized on the sensitivity summary sheet (see Appendix G).

Potential Contaminant Source Inventories

The primary intent of the inventories is to identify and locate significant potential sources of any of the contaminants of concern within the DWPAs. Significant sources of contamination can be defined as any facility or activity that stores, uses, or produces the contaminants of concern and has a sufficient likelihood of releasing such contaminants to the environment at levels that could contribute significantly to the concentration of these contaminants in the source waters of the public water supply. The inventory is a very valuable tool for the local community in that it:

- Provides information on the locations of PCSs, especially those that present the greatest risks to the water supply,
- Provides an effective means of educating the local public about potential problems, and
- Provides a reliable basis for developing a local management plan to reduce the risks to the water supply.

Potential Contaminant Source Inventories were developed for both existing and future land use for both the existing wellfield and the proposed wellfield.

Potential Contaminant Source Inventory: Existing Land Use

Inventory results for existing land uses in the Existing Wellfield are shown in Figure 3.5 and Table 3.6; inventory results for the Proposed Wellfield are shown in Figure 3.6 and Table 3.7. Except for a few additions, the PCS Inventory for the Existing Wellfield has not substantially changed from that provided in the 2003 Source Water Assessment (Appendix G).

Inventories were focused primarily on the potential sources of contaminants regulated under the federal Safe Drinking Water Act. This includes contaminants with a maximum contaminant level, contaminants regulated under the Surface Water Treatment Rule, and the microorganism Cryptosporidium. The inventory was designed to identify several categories of potential sources of contaminants including microorganisms (i.e., viruses, Giardia lamblia, Cryptosporidium, and bacteria); inorganic compounds, (i.e., nitrates and metals); and organic compounds (i.e., solvents, petroleum compounds, and pesticides). Contaminants can reach a water body (groundwater, rivers, lakes, etc.) from activities occurring on the land surface or below it. Contaminant releases to water bodies can also occur on an area-wide basis or from a single point source.

It is advantageous to identify as many potential risks as possible within the DWPA during the inventory. It is important to remember the sites and areas identified in this section are only <u>potential</u> sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly. Not all of these inventoried activities pose actual high risks to the City's water supply. The day-to-day operating practices and environmental (contamination) awareness varies considerably from one facility or land use activity to another.

When identifying potential risks to a public water supply, it is necessary to make "worst-case" assumptions. This is important because it is the potential risk that must be determined. The worst-case assumption that has to be made when considering potential risks to water bodies is that the facility or activity is not employing good management practices or pollution prevention. Also, assumptions are made about what sources are included in particular types of land use. For example, it is assumed that rural residences associated with farming operations have specific PCSs such as fuel storage, chemical storage and mixing areas, and machinery repair shops.

Past, current, and possible future potential sources of contaminants were identified through a variety of methods and resources. In completing this inventory, DEQ used readily available information including review of DEQ and other agencies' databases of currently listed sites, interviews with the public water system operator, and field observation as discussed below. In-depth analysis or research was not completed to assess each specific facility's compliance status with local, state and/or federal programs or laws. Further, the inventory process did not include an attempt to identify unique contamination risks at individual sites such as facilities (permitted or not) that do not safely store potentially hazardous materials.

The process for completing the updated inventory for the City of Florence's DWPA included several steps: (1) Conducted a DEQ database search of known cleanup sites and variously permitted sources, as well as sites registered with the Oregon Fire Marshal. (2) Reviewed aerial photography to identify sites not necessarily visible on the ground. (3) Conducted a field (windshield) survey, with the assistance of Shawn Stevenson of OHA, of the newly identified source water protection areas, primarily those associated with the future well field site. Activities recognized as potential contaminant sources, based on DEQ documents, were field and GPS located and rendered into a GIS coverage. (4) The original Source Water Assessment inventory of PCSs were reviewed and updated with any changes (e.g. new sites, sites that are no longer existing, etc.). As appropriate, these were also GPS-located for future GIS coverages. (5) The delineations were overlain onto the land use planning map of the Florence area to anticipate, for management purposes, the possible land uses that might be considered within the source water protection areas in the future.

Relative risk rankings of higher-risk, moderate-risk, or lower-risk were assigned to each PCS based on the Oregon Source Water Assessment Plan (1999).[8] The comments section of the tables provides justification for any modifications to the risk rating that may have resulted from field observations that were different from what is typically expected for the specific facility. Relative risk ratings are considered an effective way for the water supply officials and community to prioritize management efforts for the DWPA.

A final summary of the inventoried sources (Tables 3.6 and 3.7) and the GIS base maps (Figures 3.5 and 3.6) were prepared and included in this report. Several PCS sites outside the delineated DWPA were included for completeness; however, their relative risk factors were downgraded because of their locations.

[8] This resource lists risk levels associated with specific land-uses: http://www.deq.state.or.us/wq/dwp/docs/swainvimpacts.pdf.

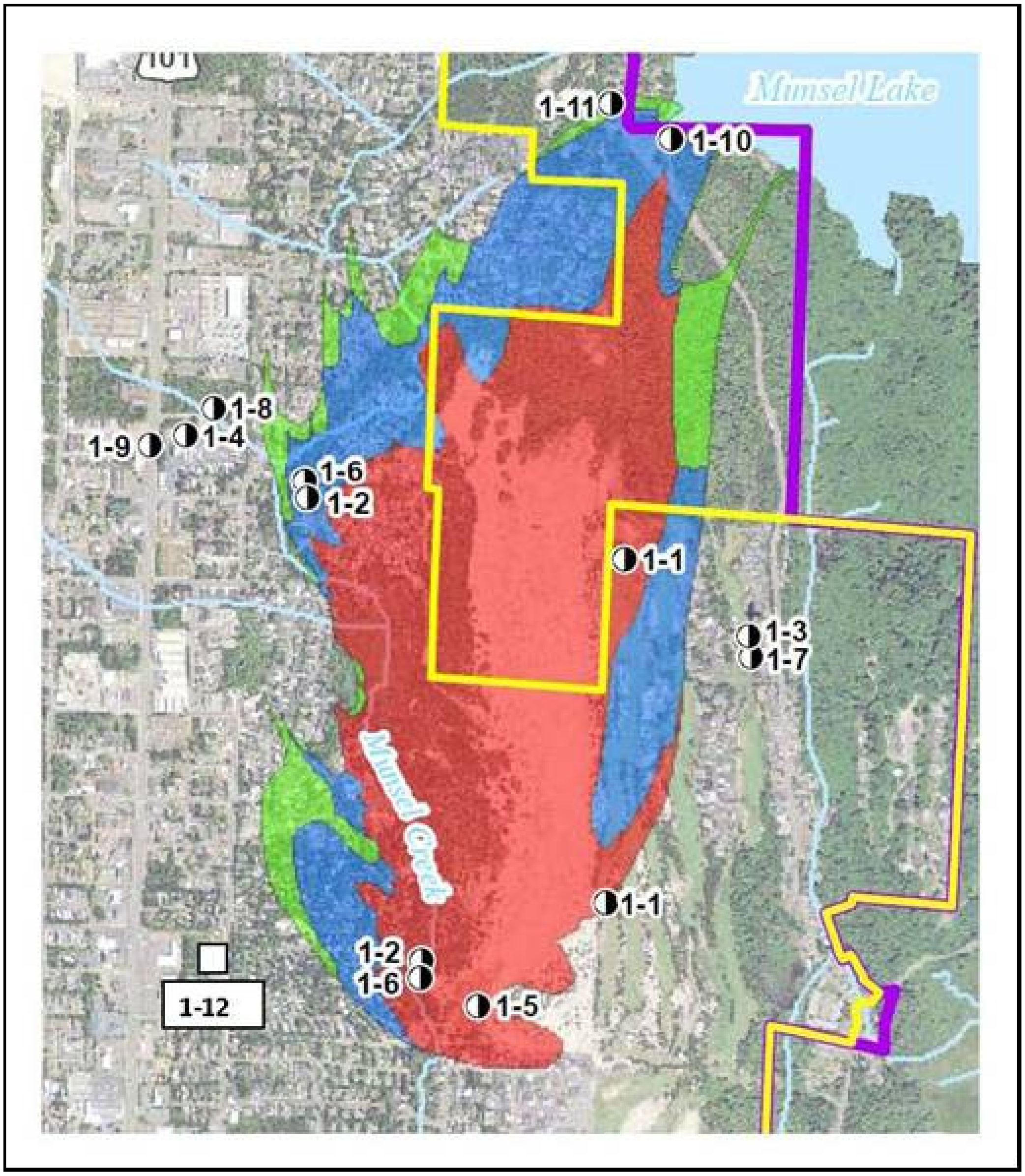


Figure 3.5. Potential Contaminant Source Inventory for existing land uses in and near the DWPA for the existing wellfield. Sites were identified in OHA's 2003 Source Water Assessment. Number designations, e.g., 1-2, refer to the specific PCSs listed in Table 3.6. Site 1-12 is located some distance from the DWPA and is included here for information purposes. The red areas are within the 10 year time of travel zone (TOTZ); blue are in the 20 year TOTZ; and green are in the 30 year TOTZ.

Table 3.6 Potential Contaminant Source Inventory Existing Wellfield: Existing Land Uses (Sites 1-1 through 1-10 are from the 2003 Source Water Assessment)

Map Reference No.	PCS Source Type	Approximate Location	Time of Travel Zone	Relative Risk Level	Potential Impacts	Comments
1-1	Golf Course	In city limits; East-central part of Wellfield	1 year Wells 9, 10, 11	M	Over-application or improper handling of pesticides and fertilizers. Excessive irrigation may cause contaminant transport or runoff towards the wells	Identified in 2003 Source Water Assessment
	Above Ground Fuel Storage Tanks	In city limits; East of Wellfield	Just outside DWPA Boundary	M	Spills, leaks, or improper handling of stored fuel may impact drinking water source	Diesel and gasoline ASTs. Identified in 2003 Source Water Assessment
	Pesticide and Fertilizer storage, handling, mixing, etc.	In city limits; East of Wellfield	Just outside DWPA Boundary	H	Spills, leaks, or improper handling of stored pesticides and fertilizers may impact drinking water source	Identified in 2003 Source Water Assessment
1-2	Housing Density [>2 Dwelling Units (DU) per acre]	In city limits; Western margin of wellfield	1 year for Wells 1 and 2, 2-10 year for other wells along western side of field.	M	Improper use, storage, and disposal of household chemicals may impact drinking water supply. Stormwater runoff or infiltration may contaminate the drinking water supply	
1-3	Housing Density (>2 Dwelling Units (DU) per acre)	In city limits; East of wellfield	Outside of eastern boundary of DWPA	M	Improper use, storage, and disposal of household chemicals may impact drinking water supply. Stormwater runoff or infiltration may contaminate the drinking water supply	Identified in 2003 Source Water Assessment
1-4	Campgroundw/RV Park	In city limits; West of wellfield	Outside of western boundary of DWPA	L	Leaks or spills of automotive fluids or improperly management of wastewater may impact drinking water supply	Identified in 2003 Source Water Assessment
1-5	Drinking Water Treatment Plant	In city limits; Southern End of Wellfield	1 year	M	Treatment chemicals and equipment maintenance materials may impact drinking water supply	Identified in 2003 Source Water Assessment
1-6	Sewer Lines	In city limits; Sewered resi-	1 – 5 year	H	If not properly designed, installed, and maintained may impact wells if within 2 year TOT	Identified in 2003 Source Water Assessment

Table 3.6 Potential Contaminant Source Inventory Existing Wellfield: Existing Land Uses (Sites 1-1 through 1-10 are from the 2003 Source Water Assessment)

Map Reference No.	PCS Source Type	Approximate Location	Time of Travel Zone	Relative Risk Level	Potential Impacts	Comments
		dential areas west side of DWPA				
1-7	Sewer Lines	In city limits; Sewered residential areas east of DWPA	Outside of eastern boundary of DWPA	H	If not properly designed, installed, and maintained may impact wells if within 2 year TOT	Identified in 2003 Source Water Assessment
1-8	Stormwater outfalls	In city limits; From 42nd Street	Outside of western boundary of DWPA	L	Stormwater runoff may contain contaminants from residential homesites and road	Identified in 2003 Source Water Assessment
1-9	Hwy 101	In city limits; Runs N-S west of DWPA	Outside of western boundary of DWPA	M	Vehicle use increases the risk for leaks or spills of fuel and other hazardous materials. Stormwater may infiltrate to groundwater. Over application/impoper handling of pesticides may impact water supply.	Identified in 2003 Source Water Assessment
1-10	Upstream Munsel Lake	Outside city limits; Northern tip of DWPA	10-20	L	During major storm events, discharge from the Lake may influence Munsel Creek which flows through DWPA	Effect on groundwater may me minimal
1-11	Septic systems (>1 system/acre)	Outside city limits; Northern tip of DWPA	20-30	M	If too high of density, infiltration of household wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater.	
1-12	Cleanup, Hazardous Waste	In city limits; 2630 Hwy 101	Outside of DWPA; West of southern end of delineated area	L-M	Improper placement of lead contaminated sludge; Lead and total petroleum hydrocarbons in soil, chromium in soil and groundwater	DEQ recommends further evaluation of this site

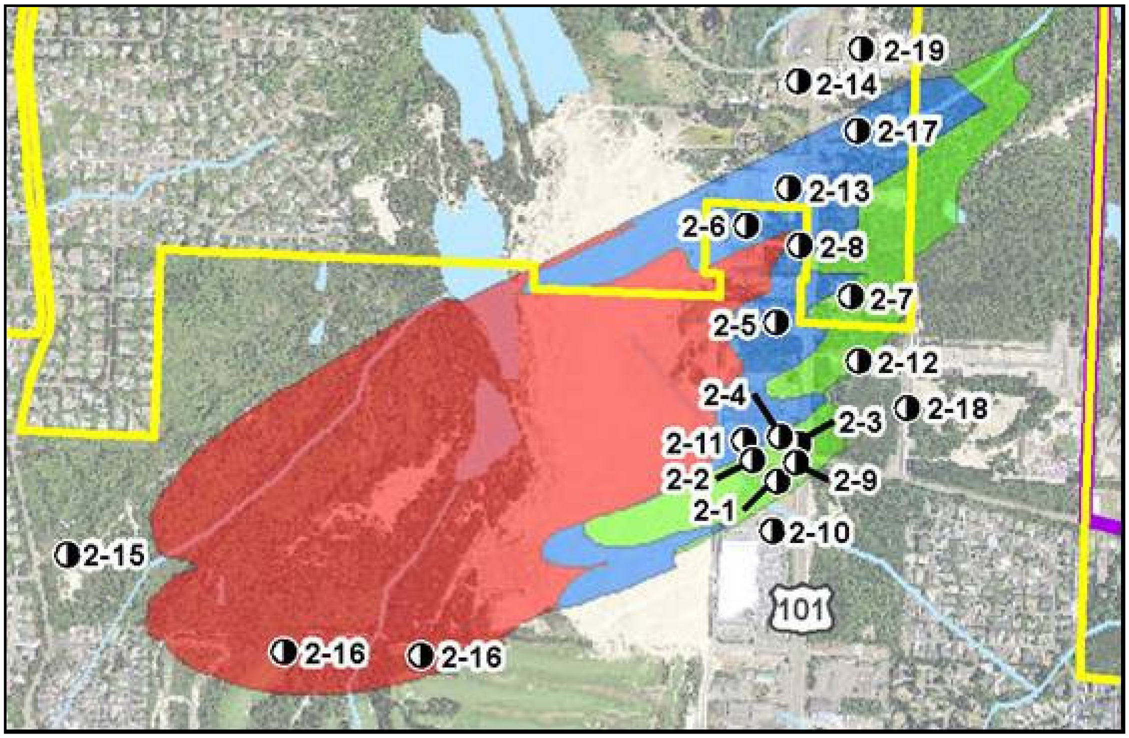


Figure 3.6. Potential Contaminant Source Inventory from Existing Land Uses in the Proposed Wellfield. 10-year (red), 20-year (blue), and 30-year (green) time-travel zones.

Table 3.7 Potential Contaminant Source Inventory Proposed Wellfield: Existing Land Uses

Map Reference No.	PCS Source Type	Approximate Location	Time of Travel Zone	Relative Risk Level	Potential Impacts	Comments
2-1	Parking Lot >50 cars	In city limits; Intersection Hwy 101 and Munsel Lk Rd	20-30 year	H	Spills, leaks of automotive fluids may impact the drinking water supply	Currently not in use
	Office Buildings/Complexes			L	Spills, leaks, or improper handling of chemicals and other materials stored and used in maintenance	Minimal use at present
2-2	Bud's Upholstery	In city limits; 4981 Hwy 101	20-30 year	M	Spills, leaks, or improper handling of chemicals and other materials stored and used	Activity uncertain
2-3	Quilt Emporium	In city limits; Intersection Hwy 101 and Munsel Lk Rd	20-30 year	L	Spills, leaks, or improper handling of chemicals and other materials stored and used	
2-4	Ron's Paint Supply	In city limits; 5071 Hwy 101	10-20 year	M	Spills, leaks, or improper handling of chemicals and other materials stored and used	
2-5	Sand Master Park	In city limits; 5351 Hwy 101	10-20 year	M	Spills, leaks, or improper handling of fuels, chemicals and other materials stored and used may impact drinking water supply	Sand boarding, dune buggy tours, helicopter tours
2-6	Central Disposal	In city limits; 5405 Hwy 101	5-10 year	M	Improper management of water contacting waste material may impact the drinking water supply.	Activity uncertain
2-7	Automobile Disposal-Storage	Outside city limits; N of intersection of Hwy 101 and Munsel Lake Rd	10-20 year	H	Spills, leaks, or improper handling of automotive chemicals, batteries, and other waste materials during storage and disposal may impact the drinking water supply; septic system infiltration of wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater.	Several vehicles present
2-8	Sand Ranch	In city limits; S of intersection of Hwy 101 and Hetceta Beach Rd	10-20 year	H	Leachate from mining operations or equipment use may contain chemicals and wastes that may impact the drinking water supply	Sand mining, bagging, and distribution
2-9	Golden Rule RV Sales	In city limits; Intersection of Hwy 101 and Munsel Lake Rd	20-30 year	L	Spills, leaks, or improper handling of automotive fluids and other waste materials during transportation and storage and disposal may impact the drinking water supply	Facility closed
2-10	Fred Meyer Gas Sta-	In city limits; North-		H	Spills, leaks, or improper handling of fuels and	

Table 3.7 Potential Contaminant Source Inventory Proposed Wellfield: Existing Land Uses

Map Reference No.	PCS Source Type	Approximate Location	Time of Travel Zone	Relative Risk Level	Potential Impacts	Comments
	tion	ern part of Fred Meyer facility	Just outside 20-30 year boundary		other materials during transportation, transfer, and storage impact drinking water supply	
2-11	RV/Mini Storage	In city limits; Located behind Ron's Paint Supply	10-20 year	L	Spills, leaks, or improper handling of fuels and other materials during transportation, transfer, and storage impact drinking water supply	
2-12	Historic Wrecking Yard	In city limits; East of Hwy 101 north of Munsel Lake Rd	20-30 year	H	Spills, leaks, or improper handling of automotive chemicals, batteries, and other waste materials during storage and disposal may impact the drinking water supply	
2-13	Heceta Self Storage	Outside city limits; S of intersection of Hwy 101 and Heceta Beach Rd	10-20 year	L	Spills, leaks, or improper handling of fuels and other materials during transportation, transfer, and storage impact drinking water supply; septic system infiltration of wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater.	
2-14	Steve's Automotive	Outside city limits; SW of intersection of Hwy 101 with Heceta Beach Rd	Just outside 10-20 year	H	Spills, leaks, or improper handling of automotive fluids, solvents and repair materials during transportation, use, storage and disposal may impact drinking water supply; septic system infiltration of wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater.	
2-15	Pesticide use	In city limits; West of proposed well sites along N Rhododedron Drive	Just outside 1 year	M	Over-application or improper handling of pesticides may impact drinking water supply	Herbicide use to control blackberries – downgradient from proposed wellfied
2-16	Golf Course	In city limits; SE of proposed wellfield	1 year	M	Over-application or improper handling of pesticides or fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants to groundwater	
2-17	Residential Area: Density > 2 DU/Acre	Outside city limits; E of Hwy 101 just	10-20 year	M	Improper use, storage, and disposal of household chemicals may impact drinking water supply.	

Table 3.7 Potential Contaminant Source Inventory Proposed Wellfield: Existing Land Uses

Map Reference No.	PCS Source Type	Approximate Location	Time of Travel Zone	Relative Risk Level	Potential Impacts	Comments
		south of intersection with Heceta Beach Rd			Stormwater runoff or infiltration may contaminate the drinking water supply; septic system infiltration of wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater.	
2-18	Residential Development	In city limits; E of Hwy 101, along 52nd Street	Upgradient of 30 year TOT	L	Stormwater runoff into roadside swales. infiltration may contaminate the drinking water supply	
2-19	Septic systems – Density <1 system/acre; Residential Development	Outside city limits; E of Hwy 101 at intersection of 101 and Heceta Beach Rd	Upgradient of 30 year TOT	L	If too high of density, infiltration of household wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater. Stormwater runoff into roadside swales may lead to infiltration, potentially contaminating the drinking water supply	2 of 3 drainfields have failed. Repair in process.
Not specifically marked	Hwy 101	In and outside city limits; runs N-S through DWPA	10-20 year	M	Vehicle use increases the risk for leaks or spills of fuel and other hazardous materials. Stormwater may infiltrate to groundwater. Over application/impoper handling of pesticides may impact water supply.	

Potential Contaminant Source Inventory: Planned Land Use

In addition to existing land use, planned land use could pose a potential threat to the DWPAs and the City's wellfields. Planned land uses are shown in Figure 3.7, which overlays the boundaries of the DWPAs onto the Comprehensive Plan designations. Inventory results for both the Existing Wellfield and the Proposed Wellfield are shown in Table 3.8.

As with the Potential Contaminant Source Inventory (PCSI) for existing land uses, the PCSI for planned land uses provides a "worst case" scenario. In the planning context, all land uses that are allowed in a given Plan designation category could eventually locate there. For the purposes of this analysis, it is assumed that the allowed land uses that would have the greatest impact on the resource will locate there in the future and the risk associated with that occurrence is indicated. This analysis is a useful tool for determining how land use regulations might be used to minimize future risks to the drinking water source. Two types of these "source controls" are included in the management strategies in Chapter 4.: a Drinking Water Protection Overlay Zone in the DWPA for the proposed wellfield; and Comprehensive Plan and Code amendments to address the threat from future septic systems in both the existing and the proposed wellfield.

Susceptibility of the Drinking Water Source

Drinking water susceptibility can be defined as the potential for contamination within the DWPA to reach the well(s) and/or spring(s) being used by a Public Water System. The overall purpose of the susceptibility analysis is to identify the potential threats to drinking water quality and help prioritize community efforts for minimizing the contamination risk associated with those threats. Therefore, the susceptibility analysis is dependent on four factors: (1) identifying the location of the DWPA; (2) the sensitivity of the constructed intake (i.e., well); (3) the sensitivity of the aquifer to contamination; and (4) the occurrence and distribution of high- and moderate-risk PCSs within the DWPA. These four steps were accomplished during the delineation, sensitivity analysis, and PCS inventory phases of this project.

The susceptibility analysis is a management guidance tool that should be used to recognize and identify environmental conditions that are favorable for contamination of the drinking water supply. For example, if a contaminant is released to soils or groundwater in an area of high sensitivity, there is a greater likelihood that contamination of the aquifer will occur if remedial action is not taken. However, the susceptibility analysis should not be used to predict when or if contamination will actually occur.

The susceptibility analysis is generally completed by overlaying the PCS inventory results onto a map of the highly and moderately sensitive aquifer areas inside the DWPA (Figure 3.5). Florence's entire dunal aquifer area is considered to be highly sensitive. The PCSs identified here for the existing wellfield are largely the same as those discussed in the 2003 Source Water Assessment (Appendix G). PCS inventory results are analyzed in terms of current, past, and future land uses; their time of travel relationship or proximity to the well(s) and their associated risk rating (Figures 3.5, 3.6 and 3.7). High- and moderate-risk contaminant sources have been defined as any facility or activity that stores, uses, or produces a contaminant of concern in large enough quantities that if released, could be detectable in the public water supply.

In general, land use activities which pose the greatest threat to the drinking water supply are those which are closest to the wells and have the highest associated risk rating.

Therefore, the DEQ and OHA Drinking Water Programs strongly recommend that the community address all high- and moderate-risk PCSs that occur within their DWPA in order to reduce the risk of their drinking water supply becoming contaminated. How the PCSs are prioritized and the level of management strategies that are appropriate depend on the relative risk of the PCS and the proximity of the PCS to the well(s).

The City's drinking water source is considered to be susceptible to contamination, and it is recommended that the City identify those condition(s) that lead to the susceptibility and take steps to protect the resource (see Chapter 4).

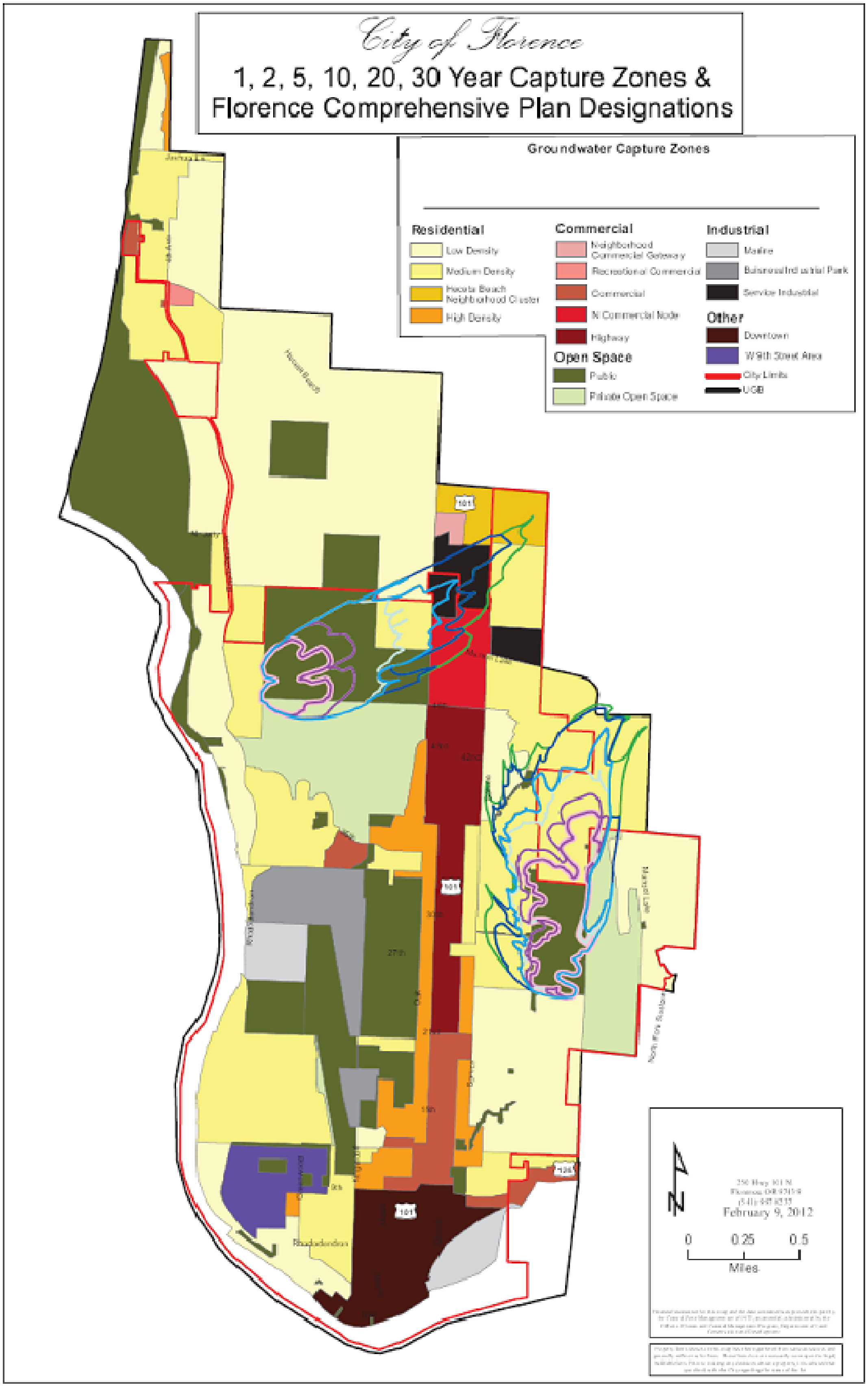


Figure 3.7 Planned land uses within capture zones of existing and proposed wellfields.

Table 3.8 Potential Contaminant Source Inventory: Planned Land Uses

Plan Designations in Delineated Areas	Where Located	Allowed Uses	Relative Risk Level	Potential Contaminants
Residential				
LOW DENSITY RESIDENTIAL Intended for areas where existing lot sizes are in the neighborhood of 9,000 square feet or larger, and for areas where environmental constraints preclude smaller lots. The corresponding zoning district is Restricted Residential.	■ Existing Wellfields: 20 & 30 YR TOTZ (inside city limits) ■ Proposed wellfields: 10 & 20 YR TOTZ (outside city limits)	■ Single family homes ■ Sand mining and non-motorized recreational uses (Conditional Use) (in portion that is privately owned sand dunes suitable for non-motorized sand related recreational activities)	L	■ Yard and garden: pesticide, herbicide, and fertilizer application ■ Future septic systems (outside city limits)
MEDIUM DENSITY RESIDENTIAL Intended for areas where existing lot sizes are about 5,000 – 6,500 square feet, and for the majority of developable land remaining in the City, as well as urbanizable lands east of Highway 101. The corresponding zoning district is Single Family Residential.	■ Existing Wellfields: 1, 2, 10, 20 & 30 YR TOTZ (inside & outside city limits) ■ Proposed wellfields: 5,10 YR TOT inside city limits; 20, 30 TOT outside city limits)	■ Single family homes ■ Duplexes (Conditional Use)	H: Existing wellfield outside city limits M: Existing wellfield inside city limits; and proposed wellfield	■ Yard and garden: pesticide, herbicide, and fertilizer application ■ Future septic systems (outside city limits)
HECETA BEACH	■ Existing	■ Commercial		■ Yard and garden: pesticide, herbicide, and

Table 3.8 Potential Contaminant Source Inventory: Planned Land Uses

Plan Designations in Delineated Areas	Where Located	Allowed Uses	Relative Risk Level	Potential Contaminants
NEIGHBORHOOD CLUSTER Intended for the development of a mix of housing units at densities not exceeding 6,000 square feet per unit. The location of the various types of housing units should be planned around the capability of the land in a manner which allows natural features such as significant wetlands to become an open space feature within the housing complexes. The implementing zoning districts are Multi-family along Highway 101 and Single Family.	Wellfields: no ■ Proposed wellfields: 20 & 30 YR TOTZ (outside city limits)	(Neighborhood Commercial Gateway) ■ Medium and High Density Housing that may include mix of duplexes, triplexes, townhouses and multi-family units, and single family units, with a mix of owned and rented units.	M: proposed wellfield	■ fertilizer application ■ Future septic systems (outside city limits) ■ Heavy metals and petroleum products from parking areas (outside city)
Commercial				
North Commercial Node Established to address recent interest in regional commercial development where opportunities exist for large single parcels or consolidation of vacant parcels. Highway commercial uses are typically more auto-oriented due to their proximity to Highway 101. The implementing zoning district for this Plan designation is North Commercial District.	■ Existing Wellfields: no ■ Proposed wellfields: 10, 20 & 30 YR TOTZ (inside city limits)	■ Large retail and service ■ Professional offices ■ Motels ■ Residential in conjunction with commercial	H: proposed wellfield	■ Pesticide, herbicide, and fertilizer application ■ Potential use of hazardous chemicals ■ Heavy metals and petroleum products from parking areas
Industrial				
SERVICE INDUSTRIAL	■ Existing Wellfields:	■ Service businesses and	H: proposed wellfield	■ Potential use of hazardous chemicals ■ Existing and future septic systems ■ Heavy metals and petroleum products from

Table 3.8 Potential Contaminant Source Inventory: Planned Land Uses

Plan Designations in Delineated Areas	Where Located	Allowed Uses	Relative Risk Level	Potential Contaminants
The purpose is to provide lands for construction and development service businesses and related uses, while continuing the North Gateway theme begun in the Neighborhood Commercial Gateway designation. Heavy vegetation and berms will be used to separate the business/office structures along Highway 101 from the processing, storage, maintenance, and other more industrial functions to be located at the rear of the berms.	no ▪ Proposed wellfields: 10, 20 & 30 YR TOTZ (inside and outside city limits)	related uses ▪ Processing, storage, maintenance activities ▪ Non-motorized sand related recreational activities (portion on private sand dunes)		parking areas
Other Plan Designations				
PUBLIC Intended to identify existing, and planned locations for, public and semi-public uses. Future sites and public facility developments may take place within other plan designations subject to need and appropriate review. The implementing zoning districts are: Open Space District and Public Use Airport Zone (for the airport). Public Use Airport Safety and Compatibility Overlay Zone applies to the airport and to lands near the airport	▪ Existing Wellfields: 1 YR TOTZ (inside city limits) ▪ Proposed wellfields: 1, 2, 5, 10 YR TOTZ (inside city limits)	▪ Airport ▪ Public parks ▪ Schools ▪ Community colleges ▪ Cemeteries ▪ Other public buildings ▪ Major utility facilities.	H	▪ Pesticide, herbicide, and fertilizer application ▪ Potential use of hazardous chemicals ▪ Heavy metals and petroleum products from parking areas

Table 3.8 Potential Contaminant Source Inventory: Planned Land Uses

Plan Designations in Delineated Areas	Where Located	Allowed Uses	Relative Risk Level	Potential Contaminants
PRIVATE OPEN SPACE Intended to identify areas where the predominant character is a less intense development pattern consisting of natural uses or open areas. Any development shall be in such a manner that maintains the natural features of the site. Natural features include but are not limited to drainage ways, wetlands, scenic vistas, historic areas, groundwater resources, beaches and dunes, and habitat for sensitive species. Development within a Private Open Space area may occur subject to the Planned Unit Development process.	▪ Existing Wellfields: 1, 2, 10 & 20 YR TOTZ (inside city limits) ▪ Proposed wellfields: 1, 2, 5, & 10 YR TOTZ (inside city limits)	▪ Crop production ▪ Recreation ▪ Animal grazing ▪ Fish and wildlife habitat ▪ Golf courses ▪ Other similar uses	H	▪ Pesticide, herbicide, and fertilizer application ▪ Potential use of hazardous chemicals ▪ Heavy metals and petroleum products from parking areas

Well Susceptibility
As described in the sensitivity analysis, the wells of the City of Florence's wellfield are not considered to contribute to the sensitivity of the drinking water source. Therefore, it is reasonable to assume that the wells themselves do not contribute to the overall water system susceptibility. It is assumed that future wells in the Proposed Wellfield will be constructed in like manner.

Aquifer Susceptibility
The aquifer is considered to be highly sensitive due to its shallow unconfined nature and its high transverse and infiltration potentials. The aquifer is also considered to be moderately sensitive due to the presence of highly permeable soils throughout the DWPA and the large number of private wells in the area.

Results
The results of the inventory were analyzed in terms of current, past, and future land uses; their time of travel relationship to the well site; and their associated risk rating. In general, land uses that are closest to the well and those with the highest risk rating pose the greatest threat to the City's drinking water supply.

The susceptibility analysis is a management guidance tool that should be used to recognize and identify environmental conditions that are favorable for contamination of the drinking water supply. For example, if a contaminant is released to soils or groundwater in an area of high sensitivity, it is likely that contamination of the aquifer will occur if remedial action is not taken. However, the susceptibility analysis should not be used to predict when or if contamination will actually occur. Given the high sensitivity of the entire aquifer beneath the DWPAs, the susceptibility of the community's drinking water supply to contamination from each PCS can be determined by overlaying the PCS location map onto the individual DWPAs and associated time-of-travel zones. The tables below indicate the relationship between PCS risk and estimated contaminant travel time at the wells for the Existing Wellfield (Table 3.9) and Proposed Wellfield (Table 3.10).

The PCS location numbers on the inventory map are used in conjunction with the relative risk rankings for each PCS (Tables 3.6, 3.7, and 3.8) and respective time-of-travel zones to identify the susceptibility of the drinking water source to contamination from each PCS and to guide action for reducing the risk accordingly. The existing and proposed wellfields are treated separately.

Table 3.9 Relative risk of existing sites (Figure 3.5 & Table 3.6) and planned land uses (Figure 3.7 & Table 3.8) by time-of-travel zone in Existing Wellfield.*

Risk Ranking	Time-of-Travel Zone					
	<2	2 – 5	5 – 10	10 – 20	20 – 30	Proximity**
High	1-6; Planned land uses: Medium Density Residential outside city limits; Public; & Private Open Space				1-11	1-1, 1-7

Table 3.9 Relative risk of existing sites (Figure 3.5 & Table 3.6) and planned land uses (Figure 3.7 & Table 3.8) by time-of-travel zone in Existing Wellfield.*

Risk Ranking	Time-of-Travel Zone					
	<2	2 – 5	5 – 10	10 – 20	20 – 30	Proximity**
Moderate	1-1, 1-2, 1-5			Planned land uses: Medium Density Residential inside city limits		1-1, 1-3,1-9, 1-12
Low				1-10		1-4, 1-8

** Proximity column lists PCS that are within close proximity to the identified DWPA (See Figure 3.5)

Table 3.10 Relative risk of existing sites (Figure 3.6 & Table 3.7) and planned land uses (Figure 3.7 & Table 3.8) by time-of-travel zone in Proposed Wellfield.*

Risk Ranking	Time-of-Travel Zone					
	<2	2 – 5	5 – 10	10 – 20	20 – 30	Proximity**
High	Planned Land Uses: Public & Private Open Space			2-8, 3-6; Planned Land Uses: North Commercial Node, Service Industrial	2-1, 2-7, 2-12	2-14
Moderate	2-15, 2-16		2-6, 3-2, 3-7; Planned Land Uses: Medium Density Residential inside city limits	2-4, 2-5, 2-17, Hwy 101	2-2, 3-3; Planned Land Uses: Medium Density Residential Areas outside city limits	
Low				2-11, 2-13, 3-1	2-3, 2-9	2-10, 2-18, 2-19

** Proximity column lists PCS that are within close proximity to the identified DWPA (See Figure 3.6)

This page intentionally left blank.

Chapter 4: Management Goals and Strategies

In this chapter, management goals and strategies are presented in three categories: Aquifer-wide, Existing Wellfield, and Proposed Wellfield, followed by the Implementation Plan. The Management Strategies are presented in Tables 4.1, 4.2, and 4.3 for the three categories and the priorities shown reflect the following:

H (High):	Begin to implement immediately or continue to implement, if already being done
M (Medium):	Begin to implement in next two fiscal years
L (Low):	Implement as time and financial resources are available

The priorities and implementing groups and their roles were determined through the team and stakeholder processes. For all strategies, the City will take the lead role in implementation, unless noted otherwise.

Management goals are broad vision statements describing desired conditions or activities for the future. They provide direction for the development of management strategies. The management strategies more specifically describe a course of action for protecting the aquifer and Drinking Water Protection Areas (DWPAs).

The implementation of management strategies is key to the ultimate success of the Plan. Following City and County approval of the plan and certification of the plan by the Oregon Department of Environmental Quality (DEQ), the City will initiate amendments to the Comprehensive Plan and Code and begin to implement management strategies. Amendments that apply within city limits will be submitted for adoption by the City Council; amendments that apply outside the City, within the UGB, will be submitted to the County Board for adoption as well.

Aquifer-Wide Management Goals and Strategies[9]

Aquifer-wide management goals and strategies apply throughout the aquifer. They are presented in Table 4.1 with the implicated priority for implementation and implementing groups and their roles. Goals and strategies fall into four categories:

1. Surface and Groundwater Monitoring
2. Public Education
3. Coordination with Public and Non-profit Partners
4. Integrated Pest Management

[9] The aquifer-wide strategies in this chapter apply aquifer-wide and are not intended for certification of a Source Water Protection Plan under OAR 340-040-0170, except as they are cross-referenced in the specific DWPA sections of this chapter.

Table 4.1 Aquifer-wide Management Goals and Strategies

Management Goals and Strategies	Priority* and Implementing Groups and Roles The City of Florence will work with the following entities:
1. Surface and Groundwater Monitoring **Management Goal:** Protect water quality in Florence's sole source Dunal Aquifer through early detection of, and response to, contamination threats. **Strategies:** The City of Florence will pursue the following strategies to implement this goal: a. Continue the City of Florence Surface and Groundwater Monitoring Program for another two years b. Seek funding to continue the program long-term c. Continue to participate in DEQ's Volunteer Water Quality Monitoring Program d. Adjust the monitoring program over time as indicated by results. e. Continue to partner with DEQ, OHA, ODFW, federal, local, and other state agencies to share data and collaborate on solutions to contamination incidents (see "Options for Responding to Contamination Threats in the North Florence Sole Source Dunal Aquifer, Appendix H)	**Priority: H** **Groups and Roles:** - Siuslaw Watershed Council (SWC): share data - Surfriders: share data - Tribes: share data - Lane County: help to address threats - Oregon Department of Environmental Quality (DEQ): collect data and address threats - Oregon Health Authority (OHA): address threats - Heceta Water District (HWD): collect data and help to address threats
2. Public Education **Management Goal:** Increase awareness among community members about aquifer vulnerability, sources of contamination, and methods for reducing the potential for contamination. **Strategies:** The City of Florence will pursue the following strategies to implement this goal: a. Use and promote existing educational materials (flyers, brochures, newsletters, etc.) to raise awareness and educate people about the aquifer and the need to protect water quality; put item on City Council agendas for discussion; and distribute existing educational materials (see Appendix I for Resource List). Distribute educational materials through City Newsletter, Public Service Announcements, radio spots, through local groups (Rotary, Garden Clubs, etc.), permit process, at City	**Priority: H** **Groups and Roles:** - DEQ, OHA, and STEP: technical assistance and educational materials and other resources (see Appendix I) - Chamber of Commerce, Realtors, local businesses, local groups (Garden Clubs, Rotary, etc.), Home Owners Associations, local newspaper and radio: help get the word out - HWD: distribute information to customers - Port of Siuslaw: include information on aquifer

Table 4.1 Aquifer-wide Management Goals and Strategies

Management Goals and Strategies	Priority* and Implementing Groups and Roles The City of Florence will work with the following entities:

counters, and in utility bills. Make the flyer and other information graphic – to catch people's attention and make them available at various places in and around the City (e.g., the City library, local Chamber of Commerce, banks, doctor's offices and clinics, and restaurants).
b. Develop or tailor existing fliers to convey educational information, such as:
▪ The vulnerability of the City's groundwater
▪ How each citizen's actions can affect groundwater quality
▪ Why it is important to reduce the cumulative effects of groundwater impacts
▪ The consequences of groundwater contamination
▪ Tips on how each citizen can reduce the likelihood of contributing contaminants to the groundwater
▪ Non-toxic alternatives to common contaminants
▪ Safe use, disposal, and storage of toxic materials and hazardous waste
▪ DEQ Technical Assistance Program.
▪ Hazardous Waste events and information : contact local newspapers and radio and post to city web site:
    ▪ Information and notices about the City's and Lane County's Hazardous Waste Programs and notices of the City and Lane County spring and fall hazardous waste collection days in the city, well in advance of the events;
    ▪ promote the use of less hazardous alternatives to common household hazardous waste products
▪ Upkeep and maintenance of home heating oil tanks
▪ Upkeep and maintenance of septic systems (coordinate with Oregon State University on use of their materials)
▪ Resources available to citizens
▪ The City's "take back" program for pharmaceuticals
▪ What to do in the event of a spill
▪ Information on landscaping strategies to encourage the use of plants to protect water quality and control floods
c. Hazardous Waste: contact local newspapers and radio and post to city web site:
1) Information and notices about the City's and Lane County's Hazardous Waste Programs and notices of the City and Lane County spring and fall hazard-
	protection in materials handed out at campground and in historic education sessions now being planned
	▪ Siuslaw School District: add to curricula; help get the word out
	▪ Florence Public Works Department: use web site to distribute information and directly implement portions of education program through annual work programming
	▪ EMAC: help get the word out and enlist volunteers to help implement the strategy

Table 4.1 Aquifer-wide Management Goals and Strategies

Management Goals and Strategies	Priority* and Implementing Groups and Roles The City of Florence will work with the following entities:
ous waste collection days in the city, well in advance of the events; 2) Educational material promoting the use of less hazardous alternatives to common household hazardous waste products 3) Information and copies of the brochure explaining the DEQ Hazardous Waste Technical Assistance Program (see Appendix J) d. Continue to work with the Siuslaw School District to request that they incorporate information about the aquifer and the DWPAs in the curricula for elementary and middle school and seek involvement at the high school level. e. Consider applying to be a Groundwater Guardian Community, see: www.groundwater.org/gg/gg.html f. Have Aquifer Protection Plan and educational materials available to the public at the Florence Annual Green Fair g. Post signs at key locations (e.g., Old Town) for visitors to know how to dispose of waste appropriately; and at boat access areas at lakes to inform users of the DWPA and its vulnerability, with details on what precautions should be taken to prevent contamination. h. Devote a segment of the Public Works web site to Aquifer Protection and post the Aquifer Protection Plan to the web site. i. Work with Home Owners Associations to place articles in their newsletters and information in their community bulletin boards. j. Work with the City's Emergency Management Advisory Committee (EMAC) to enlist their assistance in some of these educational efforts. k. Work with businesses, including starting up a city-wide "green award" for actions to protect the aquifer.	
3. Coordination **Management Goal:** Continue to work with public and non-profit partners to build on products and processes already in place, described below, and to develop new products and processes, described below, to protect water quality in the aquifer and to respond to contamination incidents.	**Priority: H** **Groups and Roles:** ▪ Lane County: Hazardous Waste Events ▪ School District: include curricula and help get the word out ▪ SWC, Siuslaw Soil and Water Conservation Dis-

Table 4.1 Aquifer-wide Management Goals and Strategies

Management Goals and Strategies	Priority* and Implementing Groups and Roles The City of Florence will work with the following entities:
Strategies: The City of Florence will pursue the following strategies to implement this goal: a. Lane County: Continue to coordinate with Lane County's Hazardous Waste Events. Use utility bills and City newsletter to get the word out about the events; ask Lane County to increase the hazardous waste program in Florence and to provide a storage area; obtain, and make available to the public, county-wide educational materials. b. School District: continue to work with the Siuslaw School District to include information on the aquifer, Drinking Water Protection Areas, and Management Strategies in middle and elementary school curricula; seek high school student involvement. c. Collaborate with community partners such as Siuslaw Watershed Council, Siuslaw Soil and Water Conservation District, Surfriders, and STEP on fish stenciling program and installing fish on drains using a more permanent method than in the past, and educating their membership on Drinking Water Protection Areas and the aquifer. d. Department of Environmental Quality (DEQ) Technical Assistance Program: use materials available on web site and confer with staff on questions related to protecting water quality in the aquifer e. Work with DEQ, Siuslaw Valley Fire and Rescue, and other emergency response providers (see Chapter 5). f. Continue to work with project partners, including Lane County, DEQ, OHA, STEP, ODFW, and the Watershed Council, to develop and implement strategies to respond to contamination incidents in the UGB (see Chapter 5). g. Coordinate with Heceta Water District and the Confederated Tribes on management strategies that provide mutual benefit for the Drinking Water Source Areas of all three entities.	trict (SWCD): help with fish stenciling program and education ▪ DEQ: Technical Assistance and resources (Appendix I) ▪ DEQ, Siuslaw Valley Fire and Rescue: Emergency Response ▪ Lane County, DEQ, OHA, STEP, ODFW and SWC: develop and implement strategies to respond to contamination incidents ▪ HWD and Confederated Tribes: Source Water Management Strategies of mutual benefit
4. Implement an Integrated Pest Management Strategy. **Management Goal:** Minimize the use of chemical-based products used to reduce or eliminate invasive species or insects that damage structures.	**Priority: M** **Groups and Roles:** ▪ OSU Extension Program:

Table 4.1 Aquifer-wide Management Goals and Strategies

Management Goals and Strategies	Priority* and Implementing Groups and Roles The City of Florence will work with the following entities:
Strategies: The City of Florence may pursue the following strategies to implement this goal: a. Educate landowners on the potential risk to groundwater from over application of pesticides, using existing available resources as much as possible, e.g., Oregon State University (OSU) Extension Program's Master Gardeners. b. Start on City-owned property and use Lane County and ODOT program as a model. c. Consider targeting education and outreach to areas where the aquifer is particularly sensitive to contamination from the leaching of pesticides. d. Consider requesting the School District to incorporate aquifer protection concepts into the Siuslaw School District's Integrated Pest Management program.	educational materials and technical assistance to residents and businesses ■ Lane County and ODOT: share information ■ School District: include aquifer protection concepts ■ Port: use integrated pest management for Port properties ■ HWD: help promote program with customers

* H (High): Begin to implement immediately or continue to implement, if already being done; M (Medium): Begin to implement in next two fiscal years; or L (Low): Implement as time and financial resources are available.

Existing Wellfield Management Goals and Strategies

DEQ and the Oregon Health Authority (OHA), and project consultants have identified planned and existing land uses that are in, or in close proximity to, the DWPA that pose a potential risk of contamination.

Management strategies are presented in Table 4.2 for existing and planned land uses with a high (H) or moderate (M) risk of DWPA contamination. Please see Potential Contaminant Source Inventory tables and figures in Chapter 3 for details on these and low risk uses. A susceptibility assessment is also provided in Chapter 3 that will help guide the implementation of management strategies. PCS with a High or Moderate risk rating are considered a priority for implementation.

Three types of land uses have been identified in the DWPA for the existing wellfield:

- Residential
- Private Open Space
- Public

Management goals and strategies and implementing priorities and groups/roles are linked to these existing and planned land use types and associated high- and moderate-risk potential contaminant sources in Table 4.2, starting with strategies that apply to all land use types in the DWPA.

Goals and strategies fall into the following categories:

- Conduct targeted public education and outreach
- Continue to monitor potential contaminant sources
- Work with realtors
- Target integrated pest management efforts to DWPA
- Adopt comprehensive plan policies and code amendments
- Work with home owners associations
- Continue to work with golf course managers
- Continue to monitor sewer lines

Table Notes: **1.** See Table 3.9, 3.6 and Figures 2.9 and 3.5; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7. **3.** High: Begin to implement immediately or continue to implement; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.2 Management Goals and Strategies for the Existing Wellfield

<table>
<tr><th>PCS from Existing Land Use[1]</th><th>PCS from Planned Land Use[2]</th><th>Management Goals and Strategies</th><th>Priority[3] and Implementing Groups and Roles

The City of Florence will work with the following entities:</th></tr>
<tr><td colspan="4">All Land Uses and Potential Contaminant Sources (PCS)</td></tr>
<tr><td colspan="3">Management Goal: Protect water quality in the DWPA for the existing wellfield; reduce or eliminate contamination threats; and respond to contamination incidents.

Strategies:</td><td></td></tr>
<tr><td colspan="3">1. Conduct Targeted Education and Outreach
a. Target aquifer-wide education and outreach to all uses in the DWPA (see Aquifer-wide Strategies)
b. Work with Lane County and Heceta Water District to distribute educational materials to residents and businesses in the DWPA (see Aquifer-wide Strategies); and to educate them specifically about the DWPA and potential risk to their drinking water supply.
c. Develop a household hazardous waste education program for the DWPA.
d. Post information about the DWPA and the DWPA map to City web site.
e. Consider making an interactive web tool to allow property owners to access a tax lot specific map and get responses to specific queries.</td><td>Priority: M
Groups and Roles:
■ Lane County and HWD: distribute educational materials in DWPA
■ Florence Public Works: maps and web site (H)</td></tr>
<tr><td colspan="3">2. Continue to Monitor Potential Contaminant Sources
a. Develop a map, using GIS, of the DWPA that is overlaid on streets and maintains shapes so that it can easily be communicated to members and organizations within the City;
b. Identify corresponding township, range, and sections to encompass this area for purposes of identifying locations inside the DWPA when reviewing building permit applications.</td><td>Priority: H
Groups and Roles:
■ Florence Public Works: maps and web site</td></tr>
<tr><td colspan="3">3. Work with Realtors
a. Provide them information on the aquifer and the Drinking Water Protection Area to show prospective buyers (research public education materials produced by other sources)
b. Realtors can get credits through Realtor Training Board, as part of the already established program.
c. Tie in with information on wetlands and riparian areas</td><td>Priority: H
Groups and Roles:
■ Central Oregon Coast Board of Realtors and local agents: provide in-</td></tr>
</table>

Table Notes: **1.** See Table 3.9, 3.6 and Figures 2.9 and 3.5; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7. **3.** High: Begin to implement immediately or continue to implement; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.2 Management Goals and Strategies for the Existing Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
		4. Target Integrated Pest Management: Target aquifer- wide Integrated Pest Management efforts to all uses in the DWPA (see Aquifer-wide Strategies).	formation to clients **Priority: M** **Groups and Roles:** See Aquifer-wide Strategies
Residential Land Uses			
■ Housing >2 Dwelling Units (DU) per acre in 1-10 year TOT and in close proximity to the DWPA: improper use, storage, and disposal of household chemicals through stormwater runoff or infiltration may contaminate the drinking water supply (M). ■ Septic systems outside City limits in 20-30 year TOT: infiltration of household wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater (M)	■ Medium Density Residential: single family homes and duplexes outside city limits (future septic systems) in 1, 2 year TOT (H) and 10, 20, 30 year TOT (M)	**Management Goal:** Protect water quality in the DWPA and address potential threats from potential contaminant sources from existing and planned residential land uses. **STRATEGIES:** **1. Adopt Comprehensive Plan Policies that apply in DWPA:** a. City will adopt, and request Lane County to co-adopt, Plan policy to protect the DWPA for existing wellfield. b. City will consider adopting a Comprehensive Plan recommendation to determine if transfer of development rights is a feasible tool in Florence. **2. Adopt City and County Code Requirements that apply in DWPA** a. City will consider specifying criteria and standards for transfer of development rights in City Code and work with	**Priority: H** **Groups and Roles:** ■ Florence Community Development Department will prepare amendments ■ Lane County staff will work with City on language **Priority: H** **Groups and Roles:** ■ Florence Community Development Department will pre-

Table Notes: **1.** See Table 3.9, 3.6 and Figures 2.9 and 3.5; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7. **3.** High: Begin to implement immediately or continue to implement; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.2 Management Goals and Strategies for the Existing Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
		County to adopt similar standards, if this tool is determined to be feasible for Florence. **3. Conduct targeted public education and outreach in DWPA:** a. Work with Homeowners Associations (HMA) in the DWPA to distribute educational materials (see Aquifer-wide Public Education and Outreach); and meet with HMAs to distribute materials and discuss issues and concerns.	pare amendments ▪ Lane County staff will work with City on language **Priority: H** **Groups and Roles:** ▪ PWD will work with HMAs to distribute materials
Private Open Space Land Uses			
▪ Pesticide and fertilizer storage, handling, mixing, etc. just outside DWPA: spills, leaks, or improper handling of pesticides and fertilizers (H) ▪ Above ground fuel storage tanks just outside DWPA: spills, leaks or improper handling of stored fuel (M) ▪ Golf course in 1 year TOT: over application or improper handling of pesticides and fertilizers; excessive irrigation may cause contaminant transport or runoff towards the wells (M).[4]	▪ Golf courses in 10 and 20 year TOT inside city limits (H): pesticide, herbicide, and fertilizer application; potential use of hazardous chemicals; heavy metals and petroleum products from parking areas.	**Management Goal:** Protect water quality in the DWPA and address potential threats from potential contaminant sources from existing and planned private open space land uses. **STRATEGIES:** **1. City Public Works Department (PWD) will:** a. Provide golf course manager with information and technical assistance in continuing to use, and identifying new, best management practices (BMPs), includ-	**Priority: H** **Groups and Roles:** ▪ Florence Public Works Department (PWD) will work with golf course managers

Table Notes: **1.** See Table 3.9, 3.6 and Figures 2.9 and 3.5; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7. **3.** High: Begin to implement immediately or continue to implement; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.2 Management Goals and Strategies for the Existing Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
		ing: BMPs related to the use and storage of fertilizers and other chemicals; and to continued use of available groundwater-friendly products. b. Request golf course manager to provide the PWD with annual well reports and integrated fertilizer/pest management plans, as available. c. Provide golf courses a "green award" and public recognition for implementing BMPs; and to renew the award only as necessary when new BMPs are implemented over time, based on advance communication of new standards or information to the managers by the PWD.	
Public Land Uses			
■ Drinking Water Treatment Plant in 1 year TOT: treatment chemicals and equipment maintenance materials may impact drinking water supply (M) ■ Sewer lines in 1- 5 year TOT: if not properly designed, installed, and maintained, may impact wells if within 2 year TOT (H) ■ Highway 101, outside DWPA:	■ Airport, public parks, schools, community colleges, cemeteries, other public buildings, and major utility facilities in 10, 20, and 30 year TOT inside city limits	**Management Goal:** Protect water quality in the DWPA and address potential threats from potential contaminant sources from existing and planned public land uses. **STRATEGIES:** **1. Continue to monitor sewer lines.** a. Ensure that the sewer lines in the DWPA are carefully monitored to prevent contamination to the drinking wa-	**Priority: H** **Groups and Roles:** ■ PWD to continue to monitor sewer lines

Table Notes: **1.** See Table 3.9, 3.6 and Figures 2.9 and 3.5; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7. **3.** High: Begin to implement immediately or continue to implement; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.2 Management Goals and Strategies for the Existing Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
vehicle use increases the risk for leaks or spills of fuel and other hazardous materials. Stormwater may infiltrate to groundwater. ■ Over application/improper handling of pesticides may impact water supply (M)	(H): pesticide, herbicide, and fertilizer application, potential use of hazardous chemicals, heavy metals and petroleum products from parking areas	ter; b. continue aggressive infiltration/inflow program meeting federal and state regulations to insure that sewer pipes have limited leakage; c. prioritize pipe replacement projects to repair aging infrastructure where appropriate; d. perform video surveys of sewer lines; and e. monitor water from the City wells for contaminants of concern on a frequent basis.	and City wells

Proposed Wellfield Management Goals and Strategies

For the proposed wellfield, existing and planned land uses in, or in close proximity to, the DWPA that pose a potential risk of contamination have been identified in cooperation with the DEQ and the Oregon Health Authority (OHA). Management strategies are presented in Table 4.3 for existing and planned land uses with a high (H) or moderate (M) risk of DWPA contamination. Please see Potential Contaminant Source Inventory tables and figures in Chapter 3 for details on these and low risk uses. A susceptibility assessment is also provided in Chapter 3 that will help guide the implementation of management strategies. PCS with a High or Moderate risk rating are considered a priority for implementation.

Four types of land use have been identified in the DWPA for the proposed wellfield:

- Residential
- Commercial/Industrial
- Private Open Space
- Public

Management goals and strategies and implementing priorities and groups/roles are linked to these existing and planned land use types and associated high- and moderate-risk potential contaminant sources in Table 4.3, starting with strategies that apply to all land use types in the DWPA.

Goals and strategies are presented in Table 4.3 that fall into the following categories:

- Conduct targeted public education and outreach
- Adopt comprehensive plan policies and code amendments
- Continue to monitor potential contaminant sources
- Work with realtors
- Target integrated pest management efforts to DWPA
- Adopt drinking water protection overlay zone
- Inventory and rank chemicals used in the DWPA and prepare related responses
- Provide business assistance
- Continue to work with golf course managers
- Continue to monitor sewer lines

Implementation Plan

City will take the following actions to implement the management strategies:

1. The City Council concurred by motion with the Plan on July 11, 2012; The Lane County Board concurred by Board Order on July 25, 2012.
2. Locally accepted initial draft plan was submitted to the Oregon Department of Environmental Quality (DEQ) and OHA for review on July 25 and a revised draft that included all recommended changes was submitted in December 2012. City will request certification prior to adoption.
3. City will initiate amendments to the Comprehensive Plan and Code, including Drinking Water Protection Overlay Zone, and begin to implement management strategies: April 30, 2013.
4. City will submit to Lane County, for co-adoption, Comprehensive Plan amendments that apply outside the City, within the UGB: to be scheduled
5. City will set up internal procedures and assign staff to develop and implement annual work programs to implement the management strategies. City has obtained the assistance of a RARE (Resource Assistance for Rural Environments) Program participant to assist in the administration of the strategies.

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

<table>
<tr><th>PCS from Existing Land Use[1]</th><th>PCS from Planned Land Use[2]</th><th>Management Goals and Strategies</th><th>Priority[3] and Implementing Groups and Roles

The City of Florence will work with the following entities:</th></tr>
<tr><td colspan="4">All Land Uses and Potential Contaminant Sources (PCS)</td></tr>
<tr><td colspan="3">Management Goal: Protect water quality in the DWPA for the proposed wellfield; reduce or eliminate contamination threats; and respond to contamination incidents.

STRATEGIES:</td><td></td></tr>
<tr><td colspan="3">1. Conduct targeted public education and outreach
a. Target aquifer-wide education and outreach to all uses in the DWPA (see Aquifer-wide Strategies);
b. Work with Lane County and Heceta Water District to distribute educational materials to residents and businesses in the DWPA (see Aquifer-wide Strategies); and to educate them specifically about the DWPA and potential risk to their drinking water supply.
c. Develop a household hazardous waste education program for the DWPA.
d. Post information about the DWPA and the DWPA map to City web site.
e. Consider making an interactive web tool to allow property owners to access a tax lot specific map and get responses to specific queries.</td><td>Priority: M
Groups and Roles:
- Lane County and HWD: distribute educational materials in DWPA
- Florence Public Works: maps and web site (H)</td></tr>
<tr><td colspan="3">2. Adopt Comprehensive Plan Policies that apply in DWPA
a. City will adopt, and request Lane County to co-adopt, Plan policy to protect the DWPA for proposed wellfield
b. City will consider adopting a Comprehensive Plan recommendation to determine if transfer of development rights is a feasible tool in Florence.</td><td>Priority: H
Groups and Roles:
- Florence Community Development Department will prepare amendments
- Lane County staff will work with City on language</td></tr>
<tr><td colspan="3">3. Adopt City and County Code Requirements that apply in DWPA
a. City will consider specifying criteria and standards for transfer of development rights in City Code and work with County to adopt similar standards, if this tool is determined to</td><td>Priority: H
Groups and Roles:
- Florence Planning Depart-</td></tr>
</table>

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
be feasible for Florence.			ment will prepare amendments ■ Lane County staff will work with City on language
4. Continue to monitor potential contaminant sources a. Develop a map, using GIS, of the DWPA that is overlaid on streets and maintains shapes so that it can easily be communicated to members and organizations within the City; b. Identify corresponding township, range, and sections to encompass this area for purposes of identifying locations inside the DWPA when reviewing building permit applications.			**Priority: H** **Groups and Roles:** ■ Florence Public Works: maps and web site
5. Work with realtors a. Provide them information on the aquifer and the Drinking Water Protection Area to show prospective buyers (research public education materials produced by other sources) b. Realtors can get credits through Realtor Training Board, through the existing program c. Tie in with information on wetlands and riparian areas			**Priority: H** **Groups and Roles:** ■ Central Oregon Coast Board of Realtors and local agents: provide information to clients
6. Target Integrated Pest Management: Target aquifer- wide Integrated Pest Management efforts to all uses in the DWPA (see Aquifer-wide Strategies).			**Priority: M** **Groups and Roles:** See Aquifer-wide Strategies
Residential Land Uses			
■ Housing >2 Dwelling Units (DU) per acre in 1-10 year TOT and outside DWPA: improper use, storage,	■ Medium Density Residential (5, 10 year TOT inside city; 20, 30 year TOT outside city); Heceta Beach Neighbor-	**Management Goal:** Protect water quality in the DWPA and address potential threats from potential contaminant sources from existing and planned residential land uses.	

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
and disposal of household chemicals through stormwater runoff or infiltration may contaminate the drinking water supply (M) ■ Septic systems outside City limits >1 system/acre in 20-30 year TOT: infiltration of household wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater (H)	hood Cluster (20, 30 year TOT outside city limits) (M): yard and garden pesticide, herbicide, and fertilizer application; future septic systems; heavy metals and petroleum products from parking areas	**STRATEGIES:** 1. **Public Education:** See Aquifer-wide Strategies.	**Priority: M** **Groups and Roles:** See Aquifer-wide Strategies
Industrial and Commercial Land Uses			
■ Parking lots >50 cars along Highway 101 in 20-30 year TOT: spills, leaks of automotive fluids may impact the drinking water supply (H) ■ Automobile disposal and Storage along Highway 101 in and	■ Neighborhood Commercial Gateway uses in Heceta Beach Neighborhood Cluster in 20 and 30 year TOT outside city limits: pesticide, herbicide, and fertilizer application; future septic systems; heavy metals and petroleum products from parking	**Management Goal:** Protect water quality in the DWPA and address threats from potential contaminant sources from existing and planned industrial and commercial land uses. **STRATEGIES:** 1. **Adopt Drinking Water Protection Overlay Zone** a. City will adopt a Drinking Water	**Priority: H** **Groups and Roles:** ■ City will prepare overlay

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
just outside 10-20 year TOT: spills, leaks, or improper handling of automotive chemicals, batteries, and other waste materials during storage and disposal may impact the drinking water supply; spills, leaks, or improper handling of automotive fluids, solvents and repair materials during transportation, use, storage and disposal may impact drinking water supply. (H) ■ Sand mining (H) along Highway 101 in 10-20 year TOT: leachate from mining operations or equipment use may contain chemicals and wastes that may impact the drinking water supply (H) ■ Fred Meyer Gas	areas (M). ■ North Commercial Node large retail and service, professional offices, motels, residential in conjunction with commercial in 10, 20, and 30 year TOT inside city limits: pesticide, herbicide, and fertilizer application; potential use of hazardous chemicals; heavy metals and petroleum products from parking areas (H). ■ Service Industrial businesses and related uses; processing, storage, maintenance activities; non-motorized sand related recreational activities (portion on private sand dunes) in 10, 20, and 30 year TOT inside and outside city limits: potential use of hazardous chemicals; existing and future septic systems (outside city limits); heavy metals and petroleum products	Protection Overlay Zone and apply the zone to commercial and industrial uses in the DWPA for the proposed wellfield. b. Specific code provisions will be determined through a separate ordinance process. The zone will restrict the use of certain hazardous chemicals in the Drinking Water Protection Area (DWPA), also called Time of Travel Zones (TOT) for the proposed wellfield. The City of Springfield Drinking Water Protection Overlay Zone in Appendix M will serve as a starting point for a City of Florence Ordinance. c. City Public Works and Planning Departments will implement the zone. **2. Inventory and rank chemicals used in the DWPA and prepare related responses.** Dense nonaqueous phase liquids (DNAPL) chemicals are an extreme risk in this aquifer setting and immediate clean up and removal is necessary.	zone and submit for City adoption ■ City was granted a RARE (Resource Assistance for Rural Environments Program with the University of Oregon) participant to assist with setting up administration **Priority: H** **Groups and Roles:** ■ PWD will prepare Inventory and Ranking from chemical use information to be requested in permit application.

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
Station just outside 20-30 year TOT: spills, leaks, or improper handling of fuels and other materials during transportation, transfer, and storage impact drinking water supply (H) ▪ Wrecking yard in 20-30 year TOT: spills, leaks, or improper handling of automotive chemicals, batteries, and other waste materials during storage and disposal may impact the drinking water supply (H) ▪ Septic system infiltration of wastes, cleaning chemicals, prescription drugs, etc., may impact shallow groundwater. (H) ▪ Other commercial and industrial uses, i.e., upholstery, paint	from parking areas (H).	**3. Provide business assistance** a. Help businesses to adopt groundwater protection strategies supplementing the regulatory structure by evaluating business practices working with DEQ Technical Assistance. The risk evaluation leads to reduced hazardous wastes and has many benefits for businesses: lower costs when alternatives are used; reduced liability; less risk to workers; less fire and spill hazard; and possible avoidance of citations. b. Conduct outreach to business support organizations, such as Chamber of Commerce and various industry-specific consortiums to get the word out. c. Create and distribute a letter/information flyer to businesses located in the DWPA that informs them of the drinking water protection effort and "green award program." City will provide information on technical assistance available at the local (Lane County Pollution Prevention Coalition), state (DEQ) and federal	**Priority: H** **Groups and Roles:** ▪ Chamber of Commerce, local business groups, businesses in DWPA: work with PWD to provide assistance to businesses in meeting requirements, and to provide incentives (green awards) to encourage best management practices ▪ DEQ: Technical assistance through the Pollution Prevention Program ▪ Siuslaw Valley RFP District: work with PWD on outreach to medium and high risk businesses ▪ CDD to work with new businesses on site design ▪ See Aquifer-wide strategies

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
supply, sand master park, central disposal, in 5-30 year TOT: spills, leaks, or improper handling of fuels, chemicals and other materials stored and used; improper management of water contacting waste material; and improper management of water contacting waste material may impact the drinking water supply. (M)		levels (see example letter and flyer in Appendix I). City may encourage businesses to prepare an Integrated Turf Management Plan for fertilizers, herbicides and pesticides for developments with large turf areas (consider partnering with Oregon State University in this effort). d. Encourage safe storage and handling of hazardous materials. City Public Works staff will help both new and existing businesses properly store and handle hazardous materials by identifying and addressing potential and existing problems. e. Give presentations to the Chamber of Commerce and other business groups about the City's drinking water protection efforts and provide information to members. f. Encourage local businesses to donate a sign to identify the DWPA and paint stencils on their storm drains. g. Provide hazardous materials regulation form and educational information with permit appli-	

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
		catons. h. Work with the Siuslaw Valley RFP District to establish visits to medium- and high-risk businesses located within the DWPA to discuss safe storage and handling of hazardous materials and to verify locations/quantities of hazardous materials according to their schedule. i. Work with new businesses on their building's site design to minimize risk to the groundwater. j. Continue local hazardous waste collection and disposal opportunities in which businesses are strongly encouraged to participate. k. Provide information to businesses on how to dispose of hazardous waste through: collection opportunities, agency contacts, private businesses, insurance company or underwriter; and continue to publicize this information in a flyer to mail to businesses, distribute with permits, and distribute at the time of Fire District visits.	

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
Private Open Space Land Uses			
▪ Golf course in 1 year TOT: over application or improper handling of pesticides and fertilizers; excessive irrigation may cause contaminant transport or runoff towards the wells (M). ▪ Pesticides used to eradicate blackberries near the wellfield: over application of pesticides may impact the aquifer.	▪ Golf courses and other similar uses in 1, 2, 5, and 10 year TOT inside city limits (H): pesticide, herbicide, and fertilizer application; potential use of hazardous chemicals; heavy metals and petroleum products from parking areas.	**Management Goal:** Protect water quality in the DWPA and address threats from potential contaminant sources from existing and planned private open space land uses. **STRATEGIES:** **1. City Public Works Department (PWD) will:** a. Work with Sand Pines Golf Course owners to ensure that wells in the City's proposed wellfield are drilled far enough north on the proposed site so that the golf course is removed from the DWPA.	**Priority: H** **Groups and Roles:** ▪ Florence Public Works Department (PWD) will work with golf course managers
Public Land Uses			
▪ Highway 101 in 10-20 year TOT: vehicle use increases the risk for leaks or spills of fuel and other hazardous materials. Stormwater may infiltrate to groundwater. Over application/improper han-	▪ Airport, public parks, schools, community colleges, cemeteries, other public buildings, and major utility facilities in 1, 2,5, 10, 20, and 30 year TOT inside city limits: pesticide, herbicide, and fertilizer application, potential use of hazardous	**Management Goal:** Protect water quality in the DWPA and address threats from potential contaminant sources from existing and planned public land uses. **STRATEGIES:** **1. Continue to monitor sewer lines**	**Priority: H** **Groups and Roles:**

Table Notes: 1. See Table 3.10, 3.7 and Figures 2.10 and 3.6; **2.** See Table 3.10, 3.8 and Figures 2.10 and 3.7; **3.** High: Begin to implement immediately; Medium: Begin to implement in next two fiscal years; Low: Implement as time and financial resources are available; **4.** Due to the location of this use and its proximity to some of the City's wells, the risk/benefit assessment recommends this land use be given a higher priority with respect to implementation of management strategies.

Table 4.3 Management Goals and Strategies for the Proposed Wellfield

PCS from Existing Land Use[1]	PCS from Planned Land Use[2]	Management Goals and Strategies	Priority[3] and Implementing Groups and Roles The City of Florence will work with the following entities:
dling of pesticides may impact water supply (M).	chemicals, heavy metals and petroleum products from parking areas (H)	a. Ensure that the sewer lines in the DWPA are carefully monitored to prevent contamination to the drinking water; b. continue aggressive infiltration/inflow program meeting federal and state regulations to insure that sewer pipes have limited leakage; c. prioritize pipe replacement projects to repair aging infrastructure where appropriate; d. perform video surveys of sewer lines; and e. monitor water from the City wells for contaminants of concern on a frequent basis.	■ PWD to continue to monitor sewer lines and City wells

Chapter 5: Contingency Plan

Goals and management strategies presented in Chapter 4 focus on proactive efforts that are intended to protect the aquifer from contamination. In the event contamination or loss of the water source should occur, the City also needs to be prepared to react to with a contingency plan. A contingency plan is a designed response to the contamination or disruption of Florence's current water supply.

The contingency plan focuses on:

- Identification of the primary potential threats to the aquifer and water supply;
- Developing procedures that will be followed should the threats materialize.

Florence's contingency plan addresses ten elements required by the Oregon Drinking Water Protection Program:

1. Potential threats to the drinking water supply
2. Protocols for incident response
3. Prioritization of water usage
4. Key personnel and development of a notification roster
5. Short-term and long-term replacement of water supplies
6. Short-term and long-term conservation measures
7. Plan testing, review, and update
8. Personnel training
9. Provisions for public education
10. Logistical and financial resources

Potential Threats to the Drinking Water Supply

Primary threats to Florence's drinking water system are related to an interruption of water delivery or contamination of the aquifer used for the drinking water supply. The following types of events could cause an interruption in delivery and/or contamination of the water supply, in order of most likely events:

1. Electrical/mechanical problems: power outage, broken pipeline, pump failure
2. Spill in area surface waters, i.e., creeks, lakes, wetlands, beaches, stormwater systems that discharge to surface waters; stormwater contamination resulting in well water contamination; releases from a leaking underground fuel storage tank; chemical spill at a nearby business; or other hazardous materials spills (highway spills)
3. Flooding
4. Contamination at a wellhead
5. Earthquakes or Tsumanis (see "City of Florence Multi-Jurisdictional Natural Hazards Mitigation Plan")

The most likely threats to the drinking water supply are electrical/mechanical failure, contamination at or near a wellhead, a chemical release within the drinking water protection area (DWPA) or highway spills, a spill in area surface waters or in stormwater systems that discharge to surface waters. Of the identified risks, the one with the most potential for serious contamination is a spill from a transport vehicle traveling on Highway 101 adjacent to the DWPA. The likelihood of this happening is low, but the potential for contamination, should a spill occur is high. Should an incident like this occur, the Siuslaw Valley Incident Command Team would respond immediately and work to contain the spread of the hazardous material as detailed in their Emergency Response Plan.

The City Water Treatment Plant has an operations manual that provides detailed procedures for containment of spills or other potential contaminant events. The pertinent portion of the Procedures Manual is located in Appendix K. Ocean Dunes Golf Course also has a spill containment plan, as part of the requirement for certification for application of agricultural chemicals.

Breaks or leakage in city sewer lines are repaired by City staff or by a contractor under City direction. Breaks are repaired under an emergency operations plan (see Appendix K). Leaks are identified and repaired through the use of routine TV surveillance of all sewer lines and routine manhole cover surveillance.

Prevention of contaminant incidents related to stormwater is the preferred option. The City's stormwater system is a combination of piped and infiltration facilities. The City requires oil and silt separator catch basins in all development, and has a stenciling program for all storm drains.

In the event of a contaminant incident in an infiltration system, standard containment procedures would be utilized according to the Florence Water Management and Conservation Plan. In the event of a contaminant incident in a piped system, if identified soon enough, the contaminating substance would be isolated in the affected area of the piped system. If identified only at the time a contaminant was detected at the outfall, standard containment procedures would be utilized. If the outfall were in the Siuslaw River, the Emergency Response Plan would provide for containment of the contaminant to the smallest possible affected area.

Should a spill occur with the potential for contamination, then the RV Park would call the Siuslaw Valley Incident Command Team.

Lane County has established procedures for dealing with potential contaminant incidents at its facilities.

Procedures to deal with contamination threats are outlined below.

Protocols for Incident Response

ELECTRICAL/MECHANICAL PROBLEMS AND FLOODING

Responses to these events include:

1. Rely on water source capacity and power system redundancy to the extent possible. During the summer peak demand times there is no excess source capacity. During the remainder of the year sources can be activated that are not affected by the interruption.
2. In the short-term (less than one-half day in summer and about one day in winter) rely on water tank storage.
3. Apply conservation measures, below.
4. Institute adopted four-stage water curtailment plan, below.

CONTAMINATION AT A WELLHEAD

The required response to detection of contamination at a wellhead depends on whether the contamination is less than or exceeds the maximum contaminant level (MCL) The MCL is considered to be the maximum allowed concentration of contaminant in drinking water. The community has applied a much higher standard in responding to man-made chemicals, like Dense Non-Aqueous Phase Liquids (DNAPL), and other volatile, semi-volatile, and synthetic organic chemicals. Every effort will be made to eliminate any detectable amounts of these man-made substances from the drinking water supply.

- Notify the Oregon Health Authority and the Department of Environmental Quality (DEQ) of any confirmed detection. (Contact Portland phone duty 971-673-0405 or local technical services contact 541-726-2587)

If the contamination exceeds MCL, take the following actions:

1. Shut down the affected wells. Follow OAR- 333-061-0025(2): take immediate corrective action-consult with OHA technical services. If an emergency exists and permission to use the well is granted by OHA and DEQ, water will be mixed with water from other wells to reduce the contaminant in the distribution system to below MCL, minimizing the concentration of the contaminant to the greatest extent possible.
2. Notify the City Council and Lane County Board of Commissioners
3. Follow OHA Public Notice requirements identified in OAR 333-061-0042
4. Send news release to the local media.
5. Flush affected system and reservoirs.
6. Implement curtailment or conservation plan as needed.
7. Work with the Oregon Water Resources Department to notify other nearby well owners and minimize contaminant movement. Water Master, Michael Mattick, 541-746-1856.
8. Expand cooperation with agencies investigating the contamination.

If the contaminant level is below the MCL, take the following actions:

1. Turn off well if not absolutely needed (non-critical demand periods). If an emergency exists, water will be mixed with water from other wells to reduce the contaminant in the distribution system to below the MCL, minimizing the concentration of the contaminant to the greatest extent possible.
2. Notify City Council and County Board of Commissioners.
3. Modify well operation to *last on, first off* during critical demand periods.
4. A minimum of quarterly monitoring (depending on the contaminant) will occur to track changes in contaminant levels over time and verify that contaminant levels remain below the MCL.
5. Run only in conjunction with other wells.
6. Send news release to local media.
7. Implement first stage conservation measures, below.
8. Work with WRD to notify other nearby well owners and minimize contaminant movement.
9. Cooperate with agencies investigating the contamination.

CONTAMINATION FROM HAZARDOUS MATERIALS RELEASE OR SPILLS

The release of contaminant from spills and leaking underground fuel storage tanks is primarily addressed through proactive management strategies intended to reduce the likelihood of this risk. Standard operating procedure between the City Public Works Department and the Fire District is for notification of all releases in Florence and up-gradient of the aquifer from the Fire District to water suppliers (City and HWD). The suppliers coordinate their responses based on the risk of drinking water contamination.

In the event of a contaminant release or spill in the aquifer or surface waters, the following protocol applies.

Within Drinking Water Protection Area (DWPA)

1. Local public safety agencies such as law enforcement, fire and emergency medical services, normally provide the first response to an incident. Access to this local assistance is through 9-1-1.[10]
   a. If City staff is first on the scene, or if emergency services responds, local public agencies would call OERS at 800-452-0311 or Salem Area 503 378 6377. If necessary, responsible parties would then call the National Response Center at 800-424-8802.[11]
   b. Contact CHEMTREC (1-800-424-9300) to determine spilled chemical characteristics and clean-up recommendations.
   c. Notify all responders that the release is within the DWPA.
2. Notify OHA and local elected officials
3. Shut off nearby public water supply wells as an immediate precaution.
4. Determine short-, medium, and long-term well operation.
5. Work to facilitate an expedited cleanup, but leave cleanup to the responsible party.
6. Coordinate with responsible party's HAZMAT clean-up crew; and cooperate with DEQ and other responsible agencies to facilitate clean-up and any remedial action.
7. Implement conservation or curtailment plan as appropriate.
8. Send news release to local media.
9. Work with WRD to notify other nearby well owners and minimize contaminant movement.

Background:

When hazardous materials are released into the environment, the Hazardous Materials Emergency Response Team for the region that includes Lane County will respond. In 1989, the Oregon Legislature authorized the Office of State Fire Marshal (OSFM) to establish a statewide Hazardous Materials Emergency Response system. Oregon was the first state in the nation to respond to the hazardous materials response crisis, created by the new federal standards, with a statewide Hazardous Materials Emergency Response system. To date, Oregon is one of the few states able to establish and maintain a program of this type. The Hazardous Materials Emergency Response Teams program is a partnership between local government, industry, and the OSFM. For Team Configuration, see:
http://www.oregon.gov/OSP/SFM/ERU_IMTeams.shtml#Team_Configuration
For the Regional Team that responds in Florence, contact the City of Eugene Fire and EMS Department, 1705 W. Second Avenue, Eugene, OR 97402; Ph: 541-682-7100; Fax: 541-682-7116.

[10] Source: OERS web site.
[11] Id.

SPILL IN SURFACE WATERS OR STORMWATER SYSTEMS THAT DISCHARGE TO SURFACE WATERS

1. Follow protocol for emergency response, above.
2. Notify the Oregon Department of Fish and Wildlife (ODFW) because a contaminant release in the Florence area surface waters could impact fish and wildlife, including threatened or endangered species.
3. Shut off nearby public water supply wells down-gradient of contamination as an immediate precaution.
4. Monitor outflows to receiving drainage ways for contaminants; the Fire District and Public Works should take extra precautions to prevent contaminant runoff.

Prioritization of Water Usage

Curtailment planning is the development of proactive measures to reduce demand during supply shortages resulting from prolonged drought, or system failure from unanticipated events including catastrophic events (flooding, landslides, earthquakes, and contamination), mechanical or electrical equipment failure, or events not under the control of the City (for example, localized or area-wide power outages and intentional malevolent acts). The City's current Curtailment Plan is presented below and is excerpted from Chapter 4 of the Florence Water Management and Conservation Plan, March 2010 (Appendix K).

The goal of this curtailment plan is to have objective criteria that trigger actions that will ensure sufficient water to meet the water demands of the water supply system, without jeopardizing the health, safety, or welfare of the community.

History of System Curtailment Episodes
OAR 690-086-0160(1)

Although the City has not needed to impose mandatory water curtailment measures, the City placed ads in the newspaper encouraging residents to voluntarily conserve water during a drought in the early 1990s. The City has limited in-line storage. In the event of a major water supply disruption, the City's 4.5 million gallons (maximum) of stored water would need to be managed carefully, and major restrictions could be needed on all types of municipal water use. In the event of a drought, reduced aquifer recharge could reduce the City's ability to access groundwater from its wellfield. The provisions of the City's curtailment plan, as described below, are intended to address what would happen during such events.

Curtailment Stages and Event Triggers
OAR 690-086-0160(2) and OAR 690-086-0160(3)

Table 5.1 summarizes the stages and initiating triggers for the City's water curtailment plan.

Table 5.1 Water Shortage Stages and Initiating Conditions Shortage

Shortage Stage	Initiating Conditions
Stage 1: Water Shortage Alert	1. General recognition of drought conditions in Lane County; or 2. Demand reaches 80 percent of water supply capacity as determined by the City Manager for a period of 3 or more consecutive days; or 3. Water supply approaches the minimum required for fire protection or other essential needs as determined by the City Manager.
Stage 2: Serious Water Shortage	Governor has declared a drought in Lane County and the continuation of hot, dry weather is predicted, or if the City's water demand is 81 to 90 percent of water supply capacity for 3 or more consecutive days as a result of a natural or human caused event.
Stage 3: Severe Water Shortage	Water demand is more than 90 percent of water supply capacity for 3 or more consecutive days for any reason, whether natural or human-caused.
Stage 4: Critical Water Shortage	Failure of a system component or non-drought emergency conditions results in an immediate shortage of water. Examples include: failure of main transmission lines, failure of the intake or WTP, chemical spills, or a malevolent attack on the system that introduces a contaminant at some point in the system.

Stage 1: Water Shortage Alert

Stage 1: Water Shortage Alert will activate a program to inform customers of the potential for drought and water shortages, and reasons to voluntarily conserve water. Stage 1 will be activated by the City Manager and will be triggered when any of the following conditions exist:

1. General recognition of a drought in Lane County
2. Demand reaches 80 percent of water supply capacity as determined by the City Manager for a period of 3 or more consecutive days
3. Water supply approaches the minimum required for fire protection or other essential needs as determined by the City Manager.

Under Stage 1, the City will issue a written notice requesting voluntary reduction in water use by all customers. The notice will include a description of the current water situation, the reason for the requested conservation measures, and a warning that mandatory restrictions will be implemented if voluntary measures are not sufficient to achieve water use reduction goals. A similar notice could be issued through local media (such as newspaper, radio, or TV). However, if the drought is regional, the media already may be alerting users of water supply concerns. Therefore, the City's Stage 1 plan does not automatically involve press releases or paid media announcements.

When Stage 1 is triggered, the City will ask customers to voluntarily comply with the following:

- Minimize landscape watering between 10 a.m. and 6 p.m., the period of highest water loss resulting from evaporation.
- Water landscapes on alternate days (even-numbered addresses water on even numbered days and odd-numbered addresses on odd-numbered days).

Stage 2: Serious Water Shortage

Stage 2 is similar to Stage 1 except the voluntary measures regarding outdoor water use will be made compulsory by the City Manager, and additional non-essential water use will be prohibited. Stage 2 will be initiated by the City Manager if the Governor has declared a drought in Lane County and the continuation of hot, dry weather is predicted, or if the City's water demand is 81 to 90 percent of water supply capacity for 3 or more consecutive days as a result of a natural or human-caused event.

Under Stage 2, City customers will be notified of the following water restrictions:

1. Water landscapes only between 6 p.m. and 10 a.m.
2. Water landscapes only when allowed by the odd/even schedule.
3. No water use for washing motorbikes, motor vehicles, boat trailers, or other vehicles except at a commercial washing facility that practices wash water recycling. (Exceptions include vehicles that must be cleaned to maintain public health and welfare, such as food carriers and solid waste transfer vehicles.)
4. No water use to wash sidewalks, walkways, driveways, parking lots, tennis courts, and other hard-surfaced areas.
5. No water use to wash building structures, except as needed for painting or construction.
6. No water use for a fountain or pond for aesthetic or scenic purposes, except where necessary to support fish life.
7. Discourage serving water to customers in restaurants unless water is requested by the customer. This action does not provide significant water savings, but is useful for generating awareness of the need to curtail use.
8. No water use for dust control unless absolutely necessary, as determined by the City Manager.

Stage 3: Severe Water Shortage

Stage 3 will be initiated by the City Manager when water demand is more than 90 percent of water supply capacity for 3 or more consecutive days for any reason, whether natural or human-caused. Stage 3 measures include the following:

1. Perform actions indicated for Stage 2.
2. Replace the restriction of odd/even watering from Stage 2 with a prohibition on all outdoor watering (exceptions include new lawn, grass, or turf planted after March 1st of the calendar year in which restrictions are being imposed; sod farms; high-use athletic fields; or park and recreation areas specifically designated by the City Council.)

3. No water use to fill, refill, or add to any indoor or outdoor swimming pools or hot tubs, except if one of the following conditions is met: the pool is used for a neighborhood fire control supply, the pool has a recycling water system, the pool has an evaporative cover, or the pool's use is required by a medical doctor's prescription.
4. No water use from hydrants for construction purposes (except on a case-by-case basis approved by the City Manager), fire drills, or any purpose other than fire fighting.
5. Implement limitations on commercial uses of water, depending on the severity of the shortage.
6. Issue public service announcements to notify customers of the severity of the conditions.

Stage 4: Critical Water Shortage

Stage 4 will be initiated by the City Manager when failure of a system component or non-drought emergency conditions results in an immediate shortage of water. Examples include failure of main transmission lines, failure of the WTP, chemical spills, or a malevolent attack on the system that introduces a contaminant at some point in the system. If the emergency causes, or is expected to cause, a shortage of water, the City will implement the curtailment measures of Stage 2 or Stage 3, as appropriate, in addition to the steps outlined below.

If water in the system is unsafe to drink (such as in the event of a chemical spill or malevolent attack) the City Manager will direct staff to notify customers as quickly as possible using local radio, print media, the City's website, and any other appropriate means. In addition, the City Manager will implement the following:

1. Contact the Oregon Drinking Water Program, Oregon Health Authority, and request its assistance in responding to the problem.
2. Notify the local news media, if appropriate, to ask for their assistance in notifying customers.
3. Call an emergency City Council meeting.
4. Contact the Oregon State Police and County Sheriff to obtain help in contacting customers.
5. Determine whether to use water system interties with other water providers, such as Heceta Water District (see "Mutual Emergency Water Agreement Between City of Florence and Heceta Water District, July 6, 2010, Appendix L.
6. The City will continue to investigate and develop specific backup plans for a Stage 4 emergency. These plans may include renting a water hauling truck and purchasing water from neighboring communities, sending customers to a pre-designated water distribution location, or supplying bottled water.

Key Personnel and Development of a Notification Roster

In the event of an emergency situation threatening the water supply, key people must be notified and response procedures coordinated among the City, the Fire District, Lane County, and State of Oregon personnel.

1. Call 9-1-1. If a call is received by the 9-1-1 center, the Fire District and City Police Department are to be dispatched to the event of an emergency spill.
2. Notify City Public Works immediately (541-997-4106) if a spill occurs within the DWPA. The police and public works personnel are responsible for aiding the fire chief in adequate, appropriate, and safe actions.

- The nature of the incident determines who is dispatched. If the incident involves a vehicle accident, the police department is often the first to be notified.
- If the event is non-vehicle related and a spill is reported, the appropriate fire department is normally the first to be notified by the 9-1-1 dispatch center.
- Both fire and police will be notified if a contaminant is known to be present.
- The incident commander will notify dispatch of the need for the Regional HAZMAT Response Team.
- With all spill reports in the Florence area, the Dispatch Center will notify the Florence Public Works Treatment Plant and relay all information available.
- During an emergency spill event, an incident command center is established to safely control the situation. The incident command system is dynamic, meaning that as events unfold, roles and responsibilities of personnel may change as the situation progresses.
- The person in charge may also change depending on which agency responds first. For example, police may be first on the scene and in control until the fire district arrives.

KEY PERSONNEL

Key personnel and their roles are listed below. An up-to-date list of these persons' name and their contact information will be posted in specific locations in each agency office.

Florence Police (Emergency 9-1-1) and Administrative.
Police personnel are often the first to be dispatched and respond to an emergency event. Police are in charge of public safety until fire personnel arrive, then the incident command control is relinquished to fire personnel. At the direction of the fire district incident commander, the police are responsible for keeping the area secured and providing support help.

Fire. Siuslaw Valley Fire & Rescue. 2625 Highway 101, Florence, OR 97439 (541) 997-3212.
The fire chief or other designated fire personnel will be responsible for determining if local personnel can adequately and safely respond to a spill event. The incident commander will contact Oregon Emergency Response System and request a Regional HAZMAT Response Team if the situation and/or contamination is beyond local equipment and personnel capabilities. If it is determined that local response is adequate, the incident commander determines and directs what is needed from police, Public Works, and other City personnel through a unified command system.

Florence Public Works Director (541) 997-4106.
This person coordinates necessary actions, making any decisions regarding the operation of the water system. The Director provides technical assistance and backup support as directed by the incident commander. It is this person's responsibility to inform the incident commander of the spill location within the DWPA and suggest any additional precautionary measures that need to be considered. Operational situations that may affect the Department will be coordinated directly with the responsible department representative as soon as possible. The OHA will be immediately notified in the event of any drinking water contamination. The director will designate a media relations person who will prepare a press release and handle all media contacts for the City.

Heceta Water District Manager (541) 997-2446.
This person coordinates necessary actions, making any decisions regarding the operation of the Heceta water system. Heceta Water District Manager provides technical assistance and backup support as directed by the incident commander. It is this person's responsibility to inform the incident commander of the spill location within the DWPA and suggest any additional precautionary measures that need to be considered. Operational situations that may affect the City will be coordinated directly with the responsible City representative as soon as possible. The OHA will be immediately notified in the event of any drinking water contamination. Heceta Water District Manager will designate a media relations person who will prepare a press release and handle all media contacts for the District.

Lane County Sheriff's Office, Emergency Response Coordinator (541) 682-6744.
The Lane County Emergency Coordinator should be notified and will inform the Lane County Public Health Department and the Oregon Emergency Response System, who in turn notifies other appropriate state agencies. Usually, the fire chief notifies the county coordinator if the event requires county resources for response. However, if the county coordinator is notified first, he will notify the City and Heceta Water District when a spill emergency occurs within the DWPA.

Other local officials to be notified include:

- Florence City Manager (541) 997-3437
- Florence Mayor (541) 997-3437

Other contacts include:

- Oregon Emergency Response System (OERS) 800-452-0311
- Oregon Health Authority (OHA): 1-971-673-0405
- Oregon Department of Environmental Quality (DEQ) 888-997-7888
- National Response Center: 1-800-424-8802
- Oregon Water Resources Department (WRD), Water Master: 541-682-3620
- Oregon State Fire Marshall: 503-378-3473
- Oregon Department of Fish and Wildlife (ODFW): 541-902-1384
- CHEMTREC 1-800-424-9300, www.cmahq.com
  Call this 24-hour Emergency Notification number to report transportation related spills and to get MSDS sheet and related clean-up information on chemicals that have been spilled.

Short-term and Long-term Replacement of Water Supplies

In the event of an emergency, the minimum water needs of the community must be met with water that meets applicable health standards. Short-term options are those where the alternative supply is needed for a few hours or days. Long-term options are considered for a permanent replacement supply.

Short-term:

- Implement curtailment plan and conservation practices.
- Purchase water from Heceta Water District
- Bottled water (The City will establish distribution sites, and allocation rates per household based upon events)

- Deliver potable water from non-affected wells with private tanker trucks and/or National Guard
- Make water available for only a short duration each day and issue a Boil Water notice to insure public health; and, when applicable, insert language for bacteriological concerns.

Long-term:

- Develop new wells
- Construct well treatment facility(s)
- Construct surface water treatment plant
- Purchase water from Heceta Water District

A key concern for the City is that its entire water supply relies on a sole source, consisting of a number of wells located in a small area. In the event of an emergency, such as a chemical spill or malicious attack, the City may not be able to use its current wellfield. To provide for water supply redundancy and expand water supply, the City is evaluating a potential additional wellfield site located northwest of the existing wellfield. It is likely that new water rights would be required for the additional well field. This plan contains a "new well site analysis" for a new wellfield which will provide redundant supply (Chapter 6).

Florence primarily relies on reservoir capacity to meet water demands. The City of Florence has three active storage reservoirs providing 4.5 million gallons (MG) of storage by gravity to the Main Pressure Zone. Emergency storage is also provided from these facilities by pumping to the North and East pressure zones through adjacent pump stations. The Sand Pines Reservoirs No. 1 and 2 are identical 2.0 MG welded steel tanks with an approximate overflow elevation of 167.5 feet. The 31st Street/East Reservoir is a 0.5 MG welded steel tank constructed in 1965 with an approximate overflow elevation of 167.5 feet.

The City maintains two metered emergency interties with Heceta Water District at the northern boundary of the City's existing water service area. The first is an 8-inch diameter intertie on Rhododendron Drive between Treewood and Rhodowood Drives that can be used to supply water from the District to the City's system. At the second, 10-inch intertie on Highway 101 and Munsel Lake Road, water can be provided either from the District to the City or to the District from the City.

An updated emergency water supply agreement between the City and the District was approved on July 6, 2010 (Appendix L). The agreement provides for the purchase of water from the District in the event of an emergency. The source of HWD water is Clear Lake, a surface source located north and up-gradient of the DWPA for the City's well field. HWD has an Emergency Response Plan for incidents affecting their water source.

As described above, the City relies exclusively on its groundwater supply from Wells 1 through 12. The City does not use its water right on Munsel Creek, and it is unlikely that the City could obtain new surface water rights.

The City's water conservation and management measures can be a significant factor in slowing the growth of demand for water, but are not likely to eliminate all such growth. As previously described, the majority of the City's water use is for residential and multifamily use, which has a very low average per capita use. Moreover, the City has an overall average daily per capita use of 120 gpcd, which has slowly declined over the last 4 years. These low values and trends are likely to continue given the City's conservation efforts such as its rate structure and landscape ordinance. These low values and assumed trends are incorporated into the demand projections in the City's Water Management and Conservation Plan. The City intends to implement the various water management and conservation practices outlined in this WMCP in an effort to maximize the benefits of conservation, as well.

The City can purchase surplus water supply from HWD pursuant to an IGA using the existing infrastructure interties. However, the amount of water the City could obtain from HWD is limited by the capacity of the interties and by the amount of "surplus" water that HWD decides is available for sale. HWD may be able to provide a portion of the City's demand, but is unable to sustain a long-term supply for the City. For example, HWD's ability to receive water under its water rights is limited by easements that restrict the flow of water across the easement lands.

The City's most feasible and economical alternative is to develop the remaining portion of groundwater permit G-15056 (0.6 cfs), which is the amount of "green light water" that the City requests access to in its Water Management and Conservation Plan (WMCP). It is likely that the City's groundwater rights authorize enough water to meet the City's MDD through the end of the WMCP's 20-year planning period. However, the City's actual water production is significantly less than its authorized water rights. The City needs to take immediate action to address its water infrastructure constraints. The City may need to pursue additional water rights within the 20-year planning period of the WMCP. Projections indicate a potential for demand to exceed the City's water rights by approximately 2026. Moreover, the City's infrastructure may not be sufficient to fully utilize the City's existing water rights, conveying the need for a new water right.

While conservation measures may help Florence avoid the need to have a new water right to meet MDDs, conservation measures will not eliminate the need for Florence to provide water supply/water right redundancy. Currently, Florence depends on a single source and a single well-field to supply water to the community. Florence needs, first and foremost, a new water right for redundancy that will provide security for its water supply, a need which conservation measures cannot avoid. It is unlikely that the City could obtain additional water rights for surface water sources in light of fish protection issues, regulatory requirements, and infrastructure constraints. MDD could equal actual well production as early as 2010, and could be equal to WTP capacity by 2013.

The City is investigating options to maximize its ability to divert groundwater under its existing water rights. Options include well rehabilitation, drilling new wells, and pursuing water right transfers to allow for use of water from additional wells. For instance, the City is evaluating submittal of a transfer application and construction of a new well (Well 13), and may pursue new water rights for a potential additional wellfield site north of the current wellfield. Because the City's entire water supply relies on a sole source, the City is focused on trying to provide a redundant supply. In an emergency, such as an infrastructure failure, chemical spill, or malicious attack, the City may not be able to use its current wellfield. The addition of a second wellfield could provide the City with additional source flexibility.

Short-term and Long-term Conservation Measures

Conservation of water use will lessen demands on Florence's public water supply system in the event of an emergency situation. The extent of conservation/curtailment measures necessary will depend on the nature and extent of the emergency. Conservation/curtailment practices and procedures are described in the section above, Prioritization of Water Usage.

Plan Testing, Review, and Update

This contingency plan will be evaluated, reviewed, and updated based on an annual review and mock exercise. The City and Heceta Water District will review any personnel or situational changes and make adjustments to the Plan annually. A copy of the Contingency Plan is included in the City's Water Production Emergency Procedure Manual. The Emergency Procedure Manual is reviewed and updated quarterly with corrections or modifications to the plan taking place during that process. In addition a simulated emergency (Mock exercise) will alow emergency responders to make necessary adjustments to the plan. Mock exercises will also serve as an educational tool for local citizens, reminding the community of the importance of protecting their drinking water supply and of the curtailment measures that might be imposed in the event of an emergency. The Public is informed of the exercise via the Public Works web site and local media.

Personnel Training

To be effective, contingency plans must rely on properly trained people operating within a well-organized and effective system with up-to-date information. County and state emergency responders have been professionally trained to deal with HAZMAT responses. Local personnel should also be trained in initial HAZMAT response because they could be the first to arrive on site. Police officers receive HAZMAT awareness level training as part of their officer training program. Currently, all fire personnel receive HAZMAT operations level of training. With this training, local personnel are able to adequately identify and contain many hazardous materials.

Provisions for Public Education

Public notification and education information builds and maintains support for the plan. It further encourages assistance and understanding when an emergency arises and the plan is put into effect. Management strategies for this plan have a strong educational imperative that satisfies this component of the contingency plan. However, before an emergency occurs, residents and businesses must be informed about the conservation and curtailment measures they will be expected to apply. This information should be prepared and distributed prior to a contamination or supply interruption.

Logistical and Financial Resources

The City and Heceta Water District should participate in an emergency response situation only to the extent of providing assistance and information regarding the water system and the particular needs of the community. The City and Heceta should not attempt any clean up on their own, although containment may be necessarily appropriate. The responsible party is legally obligated to report and clean up chemical releases. If no responsible party is found, the community may need to finance contamination clean up or treatment. Potential funding sources include:

- State emergency funds
- Federal emergency funds
- A bond measure for replacement, treatment, or cleanup needs.

This page intentionally left blank.

Chapter 6: New Well Site Analysis

Evaluating potential new well sites from a groundwater risk perspective allows the City to develop proactive approaches to guide existing and future land use activities to protect their future drinking water source(s). The City has identified one potential new well field site. This chapter provides an evaluation and analysis of the need for new wells and for the selected well field site.

Need for New Wells

The 2011 Florence Water Master Plan recommends that the City expand the existing groundwater supply system by adding up to 4 new wells in a new wellfield to increase capacity by approximately 350 gpm (0.5 mgd) in order to provide a total supply capacity of 3.2 mgd at the end of the 20-year planning horizon in 2030. The City's projected demand in 2020 will require all of the City's existing 2.7 mgd supply capacity, thus supply expansion is recommended between 2015 and 2020.

The City holds sufficient groundwater rights to allow production of 3.8 mgd from existing and future wells. Existing treatment plant capacity is limited to approximately 3.0 mgd; thus further study is recommended to identify potential options for treating the recommended supply expansion. The Water Master Plan assumes that the City will develop two new supply wells and associated treatment facilities. The proposed treatment facilities should be designed to accommodate future upsizing to allow treatment capacity to be expanded as needed beyond the 20-year planning horizon.

Future Service Area

The City's future service area extends beyond the existing city limits. Although the City's Urban Growth Boundary (UGB) extends significantly further north of the existing city limits, customers in this area are currently served by the neighboring Heceta Water District (District). As land north of the City develops it is assumed that there will be some adjustment in water service area boundaries for both the City and District but the majority of new City water customers are anticipated to be within the city limits. The future service area includes the area within the City of Florence's existing city limits, areas on either side of Highway 101 between Munsel Lake Road and the UGB and areas west and south of Munsel Lake Road near Florentine Estates. Two recently annexed areas to the north, Driftwood Shores Resort and Conference Center and the Fawn Ridge subdivisions are not included in the study area and will continue to be served by the District.

Projected Population and Water Demand

The City of Florence's population forecasts are taken from the City's current Water Master Plan and are supported by population estimates from the Lane County Rural Comprehensive Plan: Coordinated Population Forecasts for Lane County and its Urban Areas, which have been incorporated into the Florence Comprehensive Plan. Future water demands are also taken from the current Water Master Plan which estimates water demands using a constant per capita approach. Both population and water demand projections are established assuming growth will occur within the current city limits. In the Water Master Plan, representative gallons per day per capita (gpcd) water demands based on historical population and demand were determined to be:

Average Day Demand (ADD) = 120 +/- 11 gpcd
Maximum Day Demand (MDD) = 225 +/- 25 gpcd

Planning and Analysis Criteria

The following criteria are used to assess the water system's ability to provide adequate water service under existing conditions and to guide improvements needed to provide for future water needs.

Water Supply and Treatment Criteria: The City's supply and treatment systems should be capable of providing estimated MDD through the end of the 20-year planning period.

Distribution System Criteria: The distribution system should be capable of supplying the maximum day demand while maintaining a minimum service pressure at any meter in the system of approximately 35 pounds per square inch (psi). The recommended minimum pipe size for new mains is 12-inch in commercial and industrial areas and 8-inch in all other areas.

Service Pressure Criteria: Minimum static system service pressures within each pressure zone should be at least 35 psi, with a recommended maximum upper limit of approximately 100 psi.

Pump Station Capacity Criteria: Pump stations supplying constant pressure service without the benefit of storage, such as those in Florence, should have sufficient firm pumping capacity to meet the pressure zone's MDD while simultaneously supplying fire suppression flow for the largest recommended fire flow rate in the pressure zone. Firm pumping capacity is the station's capacity with the largest pump out of service. All constant-pressure pump stations should also be equipped with emergency backup power generating facilities because water storage is not available to serve these areas by gravity flow alone.

Storage Volume Criteria: Recommended storage volume capacity for the City is the sum of the operational, emergency and fire storage volume components. Recommended operational storage volume is 25 percent of maximum day demand (MDD). Recommended emergency storage is 100 percent of MDD. The fire storage volume is determined by multiplying the largest recommended fire flow rate by the duration of that flow as defined in the 2007 Oregon State Fire Code.

Fire Flow Criteria: The distribution system should be capable of supplying the recommended fire flow rates while maintaining minimum residual pressures everywhere in the system of 20 psi.

Proposed New Well Field

The proposed new well field is located west of Highway 101 and immediately north of Sand Pines Golf Course. This site and its delineated drinking water protection area (DWPA) are shown in Figures 6.1 and 6.2. This DWPA has been given "provisional" certification by OHA, as explained in their letter in the delineation report in Appendix D. It should be noted that the actual well locations will most likely be farther to the south and west of where they are shown in these figures. The actual DWPA would also move accordingly to accurately reflect well locations.

The proposed site for this report was analyzed from a groundwater risk perspective. Selecting a preferred site from a groundwater risk view involves an analysis of various land use components such as property ownership and contamination risks associated with various land uses within that well's delineated protection area.

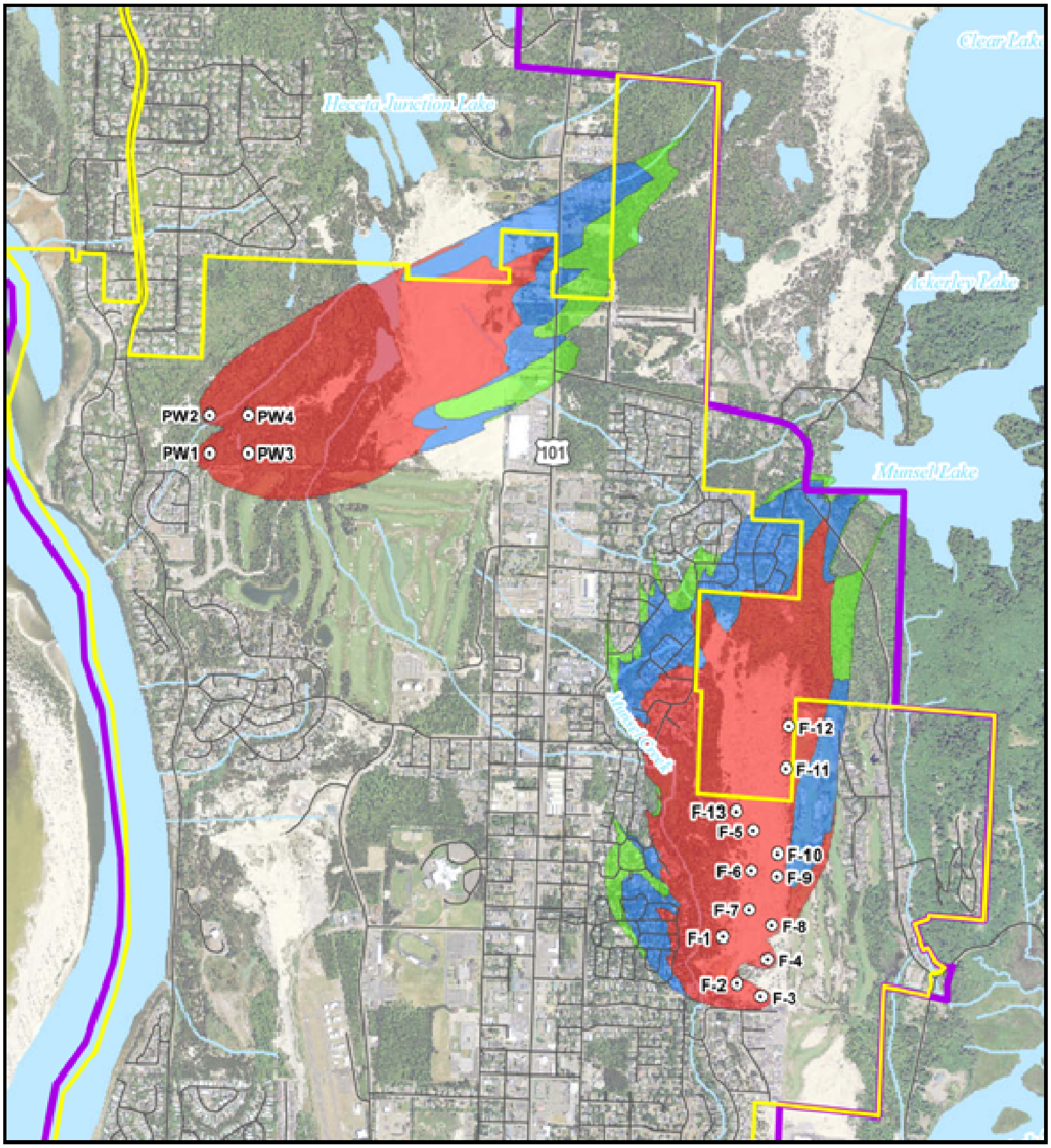


Figure 6.1. Regional view showing the 30-year capture zones of the existing well-field (lower right) and the proposed wellfield (upper left) for the City of Florence. Shading indicates the TOT zones: red = 10-yr, blue = 20-yr, and green = 30-yr TOT.

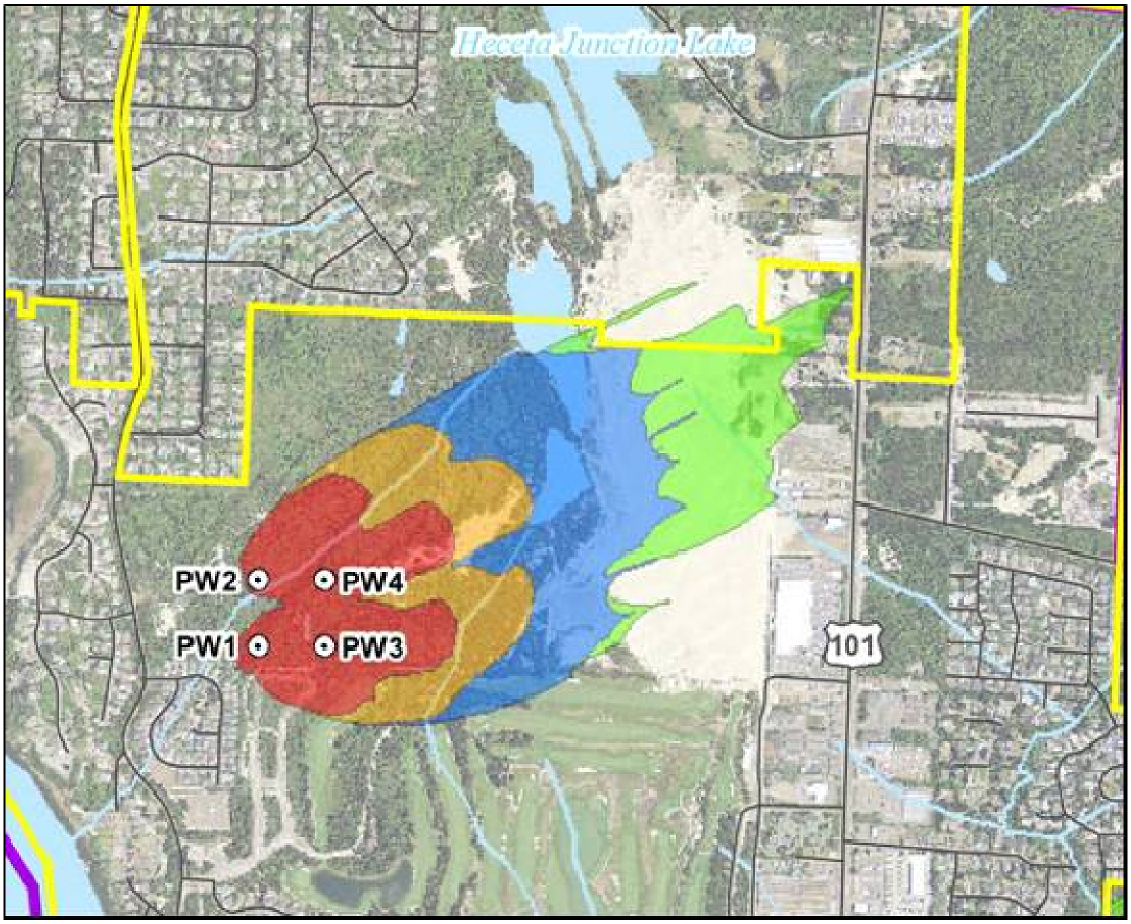


Figure 6.2. Proposed wellfield 10-year TOT capture zones. Approximate location of proposed wells 1 through 4 is shown. Different TOT zones indicated by shading: red = 1-yr TOT, orange = 2-yr TOT, blue = 5-yr TOT, and green = 10-yr TOT.

Selection Criteria

When selecting a future well field site, consideration should be given to the site's contamination potential using the criteria listed below:

- **City ownership of wellhead property**. City ownership (or possibility of purchase) of the property on which the wells are located is considered a top priority for a new well field. Having control over the immediate vicinity of the wellhead helps ensure protection of this most critical area.
- **Number of property owners.** Protecting and managing a DWPA generally becomes more complex with increasing numbers of property owners within the area. There is a greater chance that some of those property owners will not be supportive of a drinking water protection program and will increase the risk of contamination.

- **Cooperation of property owners.** Cooperative landowners within the drinking water protection area help ensure that the area will be protected to the best ability of those property owners. Property owners who are opposed to a siting of the new well field are less likely to voluntarily take extra precautions in protecting the area.

- **Risks associated with current land uses**. Land uses vary in the type and degree of potential risk to groundwater. The higher the overall risk associated with differing land uses within the DWPA, the less desirable that site is for selection of a new well field location.

- **Risks associated with expected future land uses**. Future land uses can influence the vulnerability of the DWPA if future land uses would exacerbate existing potential sources or present a higher risk than existing land uses. Potential future land uses are all uses currently allowed by Comprehensive Plan designation and zoning. The best opportunity for addressing future land uses that may pose a significant threat to the sole source aquifer is before those land uses locate in the DWPA.

Analysis

The City currently owns the property containing the proposed well field. All potential risks to the DWPA are identified and quantified in Table 2.10. Management strategies are included in Chapter 4 of this Plan to address all of these risks. Primary among these are education and, for industrial and commercial activities, the Drinking Water Protection Overlay Zone. This zone will prohibit the use of specific hazardous materials in the specific capture zones for the proposed wellfield. See Springfield Drinking Water Protection Overlay Zone in Appendix M for an example of one way this overlay zone could be applied in Florence.

The most significant risks to development of the proposed well field are as follows.

- **Highway 101 corridor.** A variety of hazardous materials are transported along this corridor, posing a risk primarily due to the potential of a spill event. Stormwater may infiltrate to groundwater. Over application/improper handling of pesticides may impact water supply.

- **Commercial and Industrial Activity.** Spills, leaks, or improper handling of motor vehicle fuels and other fluids, solvents, paints and repair materials during transportation, use, storage and disposal may impact drinking water supply. Planned land uses present a greater risk if development, e.g., dry cleaning services, uses hazardous materials.

- **On-site sewer treatment systems**. The potential risk of on-site sewage treatment systems in areas up gradient of the future well field site should be addressed. The density of septic systems can have a strong influence on nitrate levels because the septic system drainfields allow effluent to percolate into the soil. New septic systems require a permit from the DEQ. Lane County administers the permit process for most residential systems within the county as a contract agent of DEQ. Factors that are considered in granting the permit include the seasonal depth to the water table, soil characteristics, density, and required setbacks from waterways, wells, and other features. Housing development greater than 1 or 2 units per acre that rely on septic systems can be of moderate to high risk because of the potential for elevated nitrate levels.

- **Golf course activities.** Over application of improper handling of pesticides or fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants to groundwater
- **Application of Pesticides.** Over-application or improper handling of pesticides may impact drinking water supply
- **Residential Development.** Stormwater runoff into roadside swales infiltration may contaminate the drinking water supply.