Minutes of the
CANNON BEACH PLANNING COMMISSION
Thursday, August 24, 2023

Present: Chair Clay Newton and Commissioners Erik Ostrander, Dorian Farrow, Anna Moritz attended in person; Aaron Matusick and Les Sinclair attended via Zoom.

Excused: Commissioners Mike Bates

Staff: Land Use Attorney Bill Kabeiseman, City Manager Bruce St. Denis, Community Development Director Steven Sokolowski, City Planner Robert St. Clair, and Community Development Administrative Assistant Emily Bare

CALL TO ORDER

Chair Newton called the meeting to order at 6:04 p.m.

ACTION ITEMS

(1) Approval of Agenda

Motion: Commissioner Moritz moved to approve the agenda as submitted; Commissioner Ostrander seconded the motion.

Vote: Sinclair, Matusick, Farrow, Moritz, Ostrander, and Chair Newton voted AYE; the motion passed 5:0.

(2) Consideration of the Minutes for the Planning Commission Meeting of June 22, 2023

Motion: Commissioner Ostrander moved to approve the minutes; Commissioner Farrow seconded the motion.

Vote: Sinclair, Moritz, Matusick, Farrow, Ostrander, and Chair Newton voted AYE; the motion passed 5:0.

(3) Dark Sky Initiative

The dark sky initiative was discussed.

- Zoning Ordinance
- STR/Hotel Lighting
- Amber Lighting
- Screen/Filter for Street Lights
- Frequency Ranges
- Enforcement

Public Testimony

Darrell Johnson
408 S Hemlock
Cannon Beach, OR 97110

Mr. Johnson spoke about hotels and short-term rental properties that have upward pointed lighting to their signs. He spoke with code enforcement and requested letters be sent to these properties to gain compliance with the city code. Johnson will revise the list and submit it to the Police Department.
Opponents:

Jan Siebert-Wahrmund
PO Box 778
Cannon Beach, OR 97110

Siebert-Wahrmund is thrilled that the Commission is dealing with the dark sky initiative and wanted to share a bit about a situation that had taken place a few years ago; when her husband and her lived near Sunset Blvd, her husband found a baby puffin in a parking lot that had gotten disoriented from the lights. She suggested hiring an expert to come help us update our policies as many people thought that Cannon Beach was a Dark Sky City.

INFORMATIONAL ITEMS

(8) Tree Report

St. Clair went over the July tree numbers utilizing the Public Notice Page of the City's website.

(9) Ongoing Planning Items

(10) Good of The Order

- Parking and restaurant seating in parking areas.
  Sokolowski explained that the outdoor seating is being dealt with through the City Council

- Speed Bumps

  Commissioner spoke to speeding concerns near Ecola State Park. Sokolowski suggested speaking with a City Council member and/or Public Works. St. Clair mentioned that ODOT may need to be contacted depending on the area of the State Park Rd.

(11) Adjournment

ADJOURNMENT
The meeting adjourned at 7:05 pm.

Emily Bare
Community Development
Administrative Assistant

CANNON BEACH COMMUNITY DEVELOPMENT
163 E. GOWER ST.
PO BOX 368
CANNON BEACH, OR 97110

Cannon Beach Planning Commission

Staff Report:

PUBLIC HEARING AND CONSIDERATION OF CU 23-02, RED CROW LLC/JAMIE LERMA, APPLICANT, ON BEHALF OF PATRICK/DAVE LLC, REQUEST FOR AN ELEVATED PEDESTRIAN ACCESS IN A WETLAND BUFFER AREA IN ORDER TO PROVIDE ACCESS TO PLANNED RESIDENTIAL DEVELOPMENT. THE PROPERTY IS AN UNDEVELOPED PARCEL ON THE NORTHERN PART OF FOREST LAWN DR. (TAXLOT 04100, MAP 51030DA) IN A RESIDENTIAL MODERATE DENSITY (R2) ZONING DISTRICT AND THE WETLANDS OVERLAY (WO) ZONE. THE CONDITIONAL USE REQUEST WILL BE REVIEWED AGAINST THE CRITERIA OF CANNON BEACH MUNICIPAL CODE, SECTION 17.43.045, CONDITIONAL USES AND ACTIVITIES PERMITTED IN WETLAND BUFFER AREAS; AND 17.80, CONDITIONAL USES.

Agenda Date: October 26, 2023 **Prepared By**: Community Development Department

GENERAL INFORMATION

NOTICE

Public notice for this October 26, 2023 Public Hearing is as follows:

A. Notice was posted at area Post Offices on October 6, 2023;

B. Notice was mailed on October 6, 2023 to surrounding landowners within 250’ of the exterior boundaries of the property.

DISCLOSURES

Any disclosures (i.e. conflicts of interest, site visits or ex parte communications)?

EXHIBITS

The following Exhibits are attached hereto as referenced. All application documents were received at the Cannon Beach Community Development office on September 21, 2023 unless otherwise noted.

“A” Exhibits – Application Materials

A-1 Conditional use application with project description and site plan;

A-2 Type 2 Development Permit application, File #DP23-35, with site plan, Todd Prager & Associates tree plan (June 22, 2023), Earth Engineers Inc geotechnical report (June 10, 2022), Oregon DSL wetland delineation concurrence WD# 2021-0153 (June 8, 2021), USACE Approved Jurisdictional Determination (April 15, 2021), and Morgan Civil Engineering utility plan (August 22, 2023);

A-3 Schematic drawings, received October 19, 2023

“B” Exhibits – Agency Comments

None received as of this writing;

"C" Exhibits – Cannon Beach Supplements

C-1 CU#23-02 Completeness determination, September 28, 2023;

C-2 Signed order and Findings of Fact for DP#23-28, August 9, 2023;

C-3 Photos of proposed work area from DP#23-28 review, August 1, 2023;

"D" Exhibits – Public Comment

None received as of this writing;

SUMMARY & BACKGROUND

The applicant, Jamie Lerma of Red Crow LLC, on behalf of property owner Patrick/Dave LLC, requests the installation of a private use boardwalk that will span an approximately 16 foot 6 inch portion of a delineated wetland buffer area for the purpose of providing pedestrian access to planned residential development on the subject property, information about which is included in Exhibit A-2 to provide context for this application. That application, DP#23-35, proposes two detached dwelling units on one upland portion of the subject property with a separate off-street parking area located on a separate upland portion adjacent to Forest Lawn Rd with these areas connected by the proposed walkway.

Previously the applicant requested a Type 2 permit for vegetation management in order to install a pedestrian walkway along the portion of the property adjacent to TL 4104. This application, DP#23-28 included as exhibits C-2 and C-3, was denied in August 2023 as the Type 2 permit was not the appropriate application type for the proposed activity and a conditional use review would be required.

APPLICABLE CRITERIA

Wetlands Overlay (WO) Zone Requirements

17.43.045(G) Footpaths – Conditional Uses and Activities Permitted in Wetland Buffer Areas

Staff Comment: During its review of DP#23-28 (Exhibit C-2) the City found that the provisions of the Municipal Code indicate that access improvements such as roads, driveways, and footpaths within a wetland buffer area are subject to conditional use review. That permit's application material contained a letter prepared by Chenowerth Law Group which asserted that private access improvements are exempt from conditional use review as they are not intended for public use. The City found that assertion inconsistent with the standards for residential development in the WO zone which requires conditional use review for both public and private access improvements in both wetlands and buffer areas.

17.43.050(A) General Standards

General Standards. Uses and activities in protected wetlands and in wetland buffer areas are subject to the following general standards. Development may also be subject to specific standards in subsequent subsections.

1. *Uses and activities in protected wetlands or wetland buffer areas may be approved only after the following list of alternative actions, listed from highest to lowest priority, have been considered:*

    a. *Avoiding the impact altogether by not taking a certain action or parts of an action (this would include, for example, having the use or activity occur entirely on uplands); and*

    b. *Minimizing impacts by limiting the degree or magnitude of action and its implementation (this would include, for example, reducing the size of the structure or improvement so that protected wetlands or wetland buffer areas are not impacted).*

2. *Where a use or activity can be located in either the protected wetland or the wetland buffer, preference shall be given to the location of the use or activity in the wetland buffer.*

Staff Comment: The planned residential developed that will be supported by the walkway proposed in this application is a permitted use in the underlying R2 Residential Moderate Density zoning classification. Duplex or two-family dwellings are defined as a building or buildings containing two dwelling units with or without a common wall or ceiling and where there are not direct interior connecting doorways. Due to a plat restriction the applicant is unable to establish access to the upland portion of the site from S. Hemlock St. and must access the property from Forest Lawn Dr.

In application DP#23-28 the City found that the natural terrain of the proposed walkway was unsuitable as a walkway and that fill would be required for this purpose. The June 20, 2023 Todd Prager and Associates report stated:

"Private access adjacent to trees 16 and 18 shall be constructed under arborist supervision without excavation below existing grade. At least four inches of base rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage."

The access arrangement proposed in this application, CU#23-02, would avoid the placement of fill or other material in the wetland or its buffer area by providing an elevated walkway that would span the wetland affected area. Use of a pedestrian walkway versus a vehicle bridge limits the size of the area being impacted by the proposed improvement and largely avoids the potential for the improvement to need to span the delineated wetland area.

17.43.050(G) Footpaths and Bicycle Paths

Footpaths and Bicycle Paths. Development of new footpaths, and maintenance of existing footpaths may be permitted in protected wetlands and in wetland buffer areas subject to the use restrictions in the zone and the following standards. Development of new bicycle paths may be permitted in wetland buffer areas.

1. *Footpaths across protected wetlands may only be developed or maintained without the use of fill material. Bridges shall be used to cross open water areas.*

2. *Footpaths in protected wetlands shall not restrict the movement of water.*

3. *Routes for new footpaths shall be chosen to avoid traversing protected wetlands. Footpaths around the perimeter of protected wetlands, and in wetland buffer areas, are preferred.*

4. *Routes for new bicycle paths shall not be located in protected wetlands but may be located in wetland buffer areas.*

Staff Comment: The proposed pedestrian access will avoid the use of fill material and be constructed in the buffer area in order to avoid traversing the delineated wetland site. It is positioned in a way that satisfies the placement preferences established in item 3.

Conditional Uses, Chapter 17.80

17.80.110 Overall Use Standards

Before a conditional use is approved, findings will be made that the use will comply with the following standards:

A. *A demand exists for the use at the proposed location. Several factors which should be considered in determining whether or not this demand exists include: accessibility for users (such as customers and* *employees), availability of similar existing uses, availability of other appropriately zoned sites, particularly those not requiring conditional use approval, and the desirability of other suitably zoned sites for the use.*

Staff Comment: Although not part of the applicant's materials, the 2019 Clatsop County Housing Strategies report prepared by Johnson Economics the City of Cannon Beach has a projected need for 185 new housing units during a 20-year period between 2018 and 2038 in order to accommodate projected population growth. Figure 5.2 of Appendix A of that report is included below. Based on this information there is an apparent general need for housing units such as those that would be supported by the pedestrian access proposed in this application.

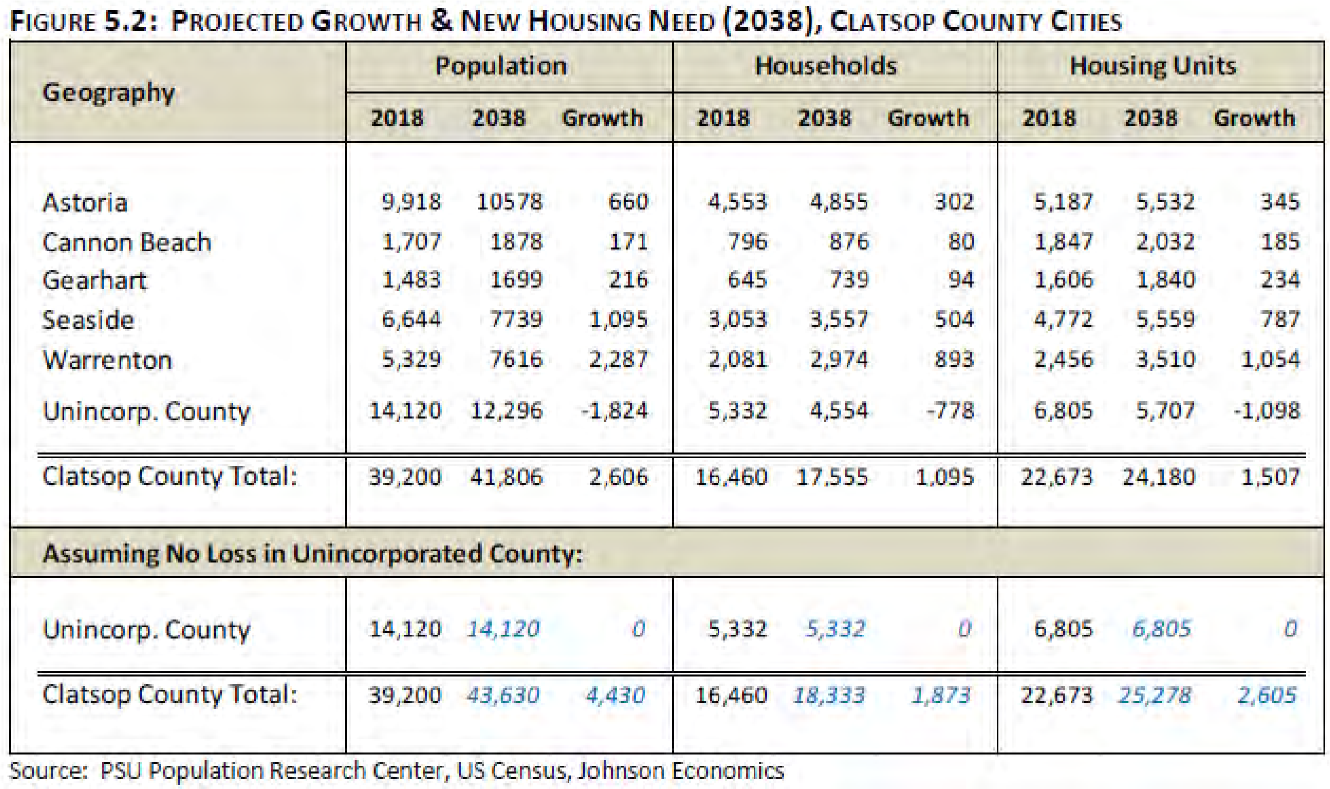


FIGURE 5.2: PROJECTED GROWTH & NEW HOUSING NEED (2038), CLATSOP COUNTY CITIES

Geography	Population			Households			Housing Units		
	2018	2038	Growth	2018	2038	Growth	2018	2038	Growth
Astoria	9,918	10578	660	4,553	4,855	302	5,187	5,532	345
Cannon Beach	1,707	1878	171	796	876	80	1,847	2,032	185
Gearhart	1,483	1699	216	645	739	94	1,606	1,840	234
Seaside	6,644	7739	1,095	3,053	3,557	504	4,772	5,559	787
Warrenton	5,329	7616	2,287	2,081	2,974	893	2,456	3,510	1,054
Unincorp. County	14,120	12,296	-1,824	5,332	4,554	-778	6,805	5,707	-1,098
Clatsop County Total:	39,200	41,806	2,606	16,460	17,555	1,095	22,673	24,180	1,507
Assuming No Loss in Unincorporated County:									
Unincorp. County	14,120	*14,120*	*0*	5,332	*5,332*	*0*	6,805	*6,805*	*0*
Clatsop County Total:	39,200	*43,630*	*4,430*	16,460	*18,333*	*1,873*	22,673	*25,278*	*2,605*

Source: PSU Population Research Center, US Census, Johnson Economics

B. *The use will not create excessive traffic congestion on nearby streets or overburden the following public facilities and services: water, sewer, storm drainage, electrical service, fire protection and schools.*

Staff Comment: The proposed use on this application, a pedestrian access walkway, does not appear to have any apparent impacts on traffic, public facilities, or fire protection. Residential development that would be supported by the proposed walkway will be reviewed by City Community Development and Public Works staff as well as the Cannon Beach Rural Fire Protection District in order to ensure that such development does not have significant negative impacts or create an overburden to the items detailed in this criterion.

C. *The site has an adequate amount of space for any yards, buildings, drives, parking, loading and unloading areas, storage facilities, utilities or other facilities which are required by city ordinances or desired by the applicant.*

Staff Comment: The proposed use on this application, a pedestrian access walkway, appears to satisfy this criterion by allowing the planned residential development to be arranged in a way that places structures, parking, on the upland portions of the subject property.

D. *The topography, soils and other physical characteristics of the site are appropriate for the use. Potential problems due to weak foundation soils will be eliminated or reduced to the extent necessary for avoiding hazardous situations.*

   Staff Comment: The proposed walkway will address this criterion by placing the footings in the upland portions on either side of the buffer area it will span.

E. *An adequate site layout will be used for transportation activities. Consideration should be given to the suitability of any access points, on-site drives, parking, loading and unloading areas, refuse collection and disposal points, sidewalks, bike paths or other transportation facilities required by city ordinances or desired by the applicant. Suitability, in part, should be determined by the potential impact of these facilities on safety, traffic flow and control and emergency vehicle movements.*

   Staff Comment: This criterion does not apply to this application. Generally, the considerations detailed in this criterion apply to commercial or high-density residential uses which may generate a high level of traffic.

F. *The site and building design ensure that the use will be compatible with the surrounding area.*

   Staff Comment: The uses surrounding the subject property are detached single-family dwellings on lots larger than 5,000 square feet. The planned residential development that would be supported by this proposal is consistent with that level of development.

Staff Recommendation

Staff recommends that the following conditions be applied to an approval of this application:

1. The applicant shall demonstrate legal means of access from S. Hemlock St. for the purpose of construction prior to the application for permits for residential development.

Procedural Requirements

This application is subject to ORS 227.178, requiring the City to take final action within 120 days after the application is deemed complete. It was submitted September 21, 2023; and determined to be complete on September 27, 2023. Based on this, the City must make a final decision before January 24, 2024.

The Planning Commission's October 26th meeting will be the first evidentiary hearing on this request. ORS 197.763(6) allows any party to request a continuance. If such a request is made, it should be granted. The Planning Commission's next regularly scheduled hearing date is Tuesday, November 21, 2023.

DECISION, CONDITIONS AND FINDINGS

Motion: Having considered the evidence in the record, based on a motion from Commissioner NAME, seconded by Commissioner NAME, the Planning Commission moves to (approve/approve with conditions/or deny) the Red Crow LLC application, on behalf of Patrick/Dave LLC, the conditional use request for the placement of an elevated pedestrian access, application **CU# 23-02,** as discussed at this public meeting (subject to the following conditions):

Site Map – Taxlot 51030DA04100, Forest Lawn Dr.

GIS information taken from City of Cannon Beach GIS records. This map is for reference only and is not a survey product.

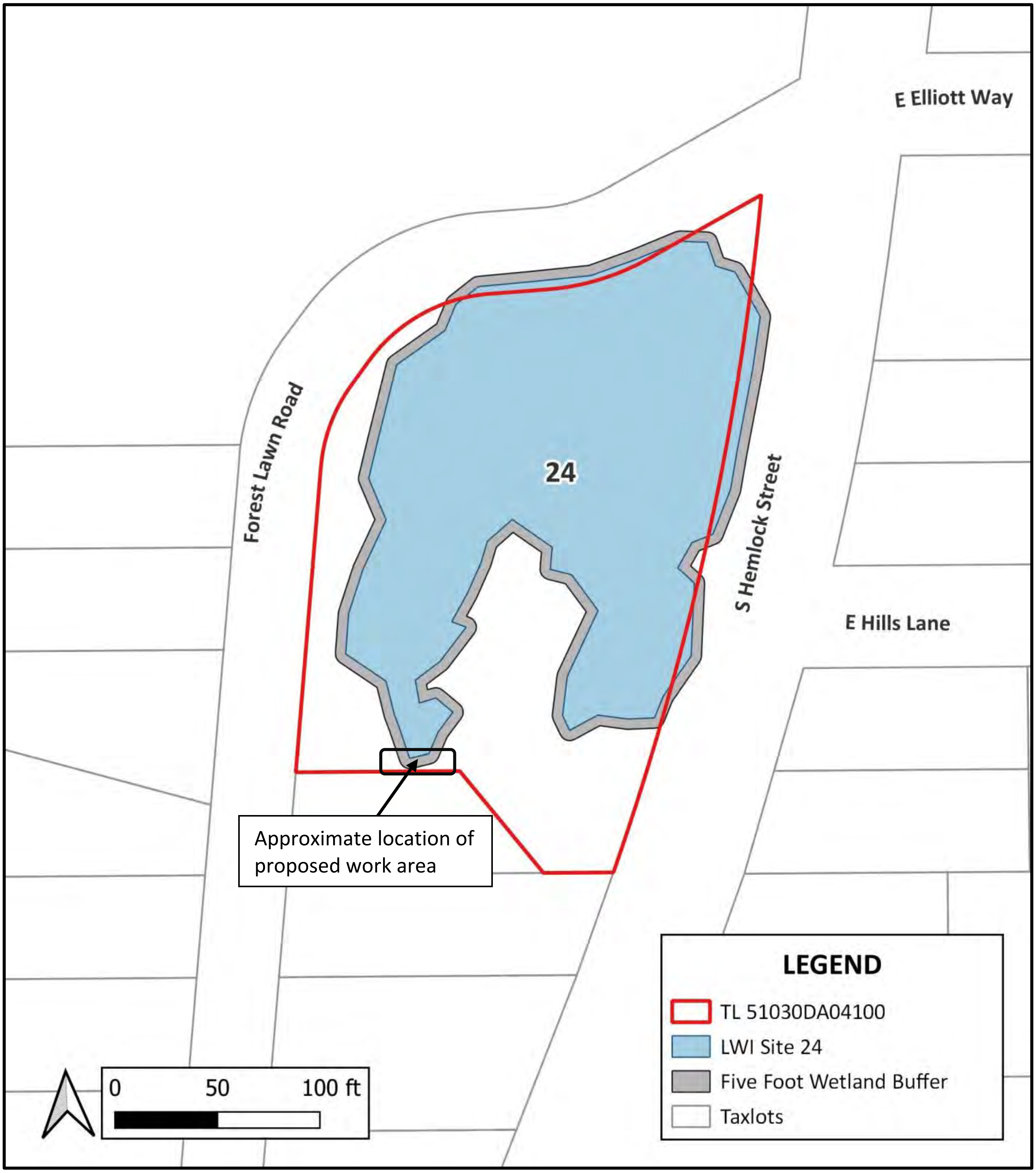


Exhibit A-1

CITY OF CANNON BEACH

CONDITIONAL USE APPLICATION

City of Cannon Beach
Finance Department
SEP 21 2023
Received

Please fill out this form completely. Please type or print.

Applicant Name: Red Crow, LLC/Jamie Lerma
Email Address: jamie@redcrowgc.com
Mailing Address: PO Box 825
Cannon Beach, OR 97110
Telephone: (503) 849-0258

Property-Owner Name: Patrick/Dave, LLC
(if other than applicant)
Mailing Address: 3514 NE US Grant Place, Portland, OR 97212
Telephone: 503-206-1071
Property Location: S. Hemlock and Forest Lawn Rd.
(street address)
Map No.: 51030DA Tax Lot No.: 04100

CONDITIONAL USE REQUEST:

1. Description of the proposal.

Private use board walk with footings in upland which spans 16'-6' of wetland buffer as shown on attached site plan and as recommended by the project wetland scientist. The proposed boardwalk is an accessory use to the proposed two-family detached dwelling. The boardwalk footings will be concrete, the beams will be pressure treated wood or structural steel per engineering, the walking surface will be wood or composite material, and any required railings will be cedar.

2. Justification of the conditional use request. Explain how the request meets each of the following criteria for granting a conditional use.

   a. Explain how a demand exists for the use at the proposed location. Several factors which should be considered include: accessibility for users (such as customers and employees); availability of similar existing uses; availability of other appropriately zoned sites, particularly those not requiring conditional use approval; and the desirability of other suitably zoned sites for the use.

The subject property is zoned R-2. The proposed detached two-family home is an outright allowed use in the R-2 zone. The proposed boardwalk provides the only point of ingress to and egress from the proposed detached two-family home from Forest Lawn Road, the proposed garage and the proposed parking areas. Vehicle access to the property from Hemlock St. is prohibited. The proposed boardwalk will provide adequate access for residents, guests, emergency personnel, delivery services, utility meter readers and other utility and/or service workers.

   b. Explain in what way(s) the proposed use will not create traffic congestion on nearby streets or over-burden the following public facilities and services: water, sewer, storm drainage, electrical service, fire protection and schools.

The site exceeds the off-street parking requirement. A private boardwalk to the homes will have no impact on the public facilities or services including water, sewer, or electric service, storm drainage, electric service, fire protection, or schools.

Exhibit A-1

c. Show that the site has an adequate amount of space for any yards, buildings, drives, parking, loading and unloading areas, storage facilities, utilities, or other facilities which are required by City Ordinances or desired by the applicant.

See attached site plan. The proposed development, including the proposed boardwalk meets all R-2 zoning requirements including lot dimension, property line setback and wetland setback requirements. The boardwalk provides future owners with safe, convenient access to their garage, storage, and refuse container enclosure as shown on the site plan.

d. Show that the topography, soils, and other physical characteristics of the site are appropriate for the use. Potential problems due to weak foundation soils must be shown to be eliminated or reduced to the extent necessary for avoiding hazardous situations.

See geotechnical report submitted as part of development permit application. The boardwalk contemplated will follow all structural and geotechnical engineering recommendations.

e. Explain in what way an adequate site layout will be used for transportation activities. Consideration should be given to the suitability of any access points, on-site drives, parking, loading and unloading areas, refuse collection and disposal points, sidewalks, bike paths or other transportation facilities required by City ordinances or desired by the applicant. Suitability, in part, should be determined by the potential impact of these facilities on safety, traffic flow and control and emergency vehicle movements.

The proposed boardwalk will provide safe access for owners, guests, emergency personnel, delivery services, etc. The boardwalk will provide owners safe and convenient access to the refuse area near the proposed garage. The site exceeds off-street parking requirements for loading, unloading, and emergency vehicles.

f. Explain how the proposed site and building design will be compatible with the surrounding area.

This conditional use [illegible] two-family home which is an outright allowed use. The underlying site and buildings meet all requirements of the R-2 zone.

Use extra sheets, if necessary, for answering the above questions. Attach a scale-drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structure, and dimensions of proposed development.

Application Fee: $750.00

Applicant Signature: Jamie B Lerma Date: 9/20/2023

Property Owner Signature: See attached page Date: ____________

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her behalf. Please attach the name, address, phone number, and signature of any additional property owners.

For Staff Use Only:

Date Received: ____________ By: ____________

Fee Paid: ____________ Receipt No.: ____________

(Last revised March 2021)

Exhibit A-1

c. Show that the site has an adequate amount of space for any yards, buildings, drives, parking, loading and unloading areas, storage facilities, utilities, or other facilities which are required by City Ordinances or desired by the applicant

See attached site plan. The proposed development, including the proposed boardwalk meets all R-2 zoning requirements including lot dimension, property line setback and wetland setback requirements. The boardwalk provides future owners with safe, convenient access to their garage, storage, and refuse container enclosure as shown on the site plan.

d. Show that the topography, soils, and other physical characteristics of the site are appropriate for the use. Potential problems due to weak foundation soils must be shown to be eliminated or reduced to the extent necessary for avoiding hazardous situations.

See attached geotechnical report. The boardwalk contemplated will follow all engineering recommendations.

e. Explain in what way an adequate site layout will be used for transportation activities. Consideration should be given to the suitability of any access points, on site drives, parking, loading and unloading areas, refuse collection and disposal points, sidewalks, bike paths or other transportation facilities required by City ordinances or desired by the applicant. Suitability, in part, should be determined by the potential impact of these facilities on safety, traffic flow and control and emergency vehicle movements.

The proposed boardwalk will provide safe access for owners, guests, emergency personnel, delivery services, etc. The boardwalk will provide owners safe and convenient access to the refuse area near the proposed garage. The site exceeds off-street parking requirements for loading, unloading, and emergency vehicles.

f. Explain how the proposed site and building design will be compatible with the surrounding area.

This conditional use permit application is not for a building; the underlying proposed development is for a detached two-family home which is an outright allowed use. The underlying site and buildings meet all requirements of the R-2 zone.

Use extra sheets, if necessary, for answering the above questions. Attach a scale-drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structure, and dimensions of proposed development.

Application Fee: $750.00

Applicant Signature: Date: 9/20/23

Property Owner Signature: Date: 9/20/23

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her behalf. Please attach the name, address, phone number, and signature of any additional property owners.

For Staff Use Only:

Date Received: ______ By: ______

Fee Paid: ______ Receipt No.: ______

(Last revised March 2021)

City of Cannon Beach
Finance Department
SEP 21 2023
PAID

Exhibit A-1

Exhibit A-1

SITE PLAN 2023-06-20

Exhibit A-1

Exhibit A-2

CITY OF CANNON BEACH

DEVELOPMENT PERMIT TYPE 2 APPLICATION

City of Cannon Beach
Finance Department
SEP 21 2023
Received

Please fill out this form completely. Please type or print.

Applicant Name: Red Crow, LLC/Jamie Lerma

Mailing Address: PO Box 825
Cannon Beach, OR 97110

Email Address: jamie@redcrowgc.com

Telephone: 503-849-0258

Property-Owner Name: Patrick/Dave, LLC
(if other than applicant)

Mailing Address: 3514 NE US Grant Place
Portland, OR 97212

Telephone: 503-206-1071

Property Location: Forest Lawn Rd. south of intersection with S. Hemlock St.
(street address)

Map No.: 51030DA Tax Lot No.: 04100

Nature of the Request

1. Description of proposed action which requires the development permit. On a separate sheet include a site diagram showing property dimensions, location of proposed activity or structure and its relationship to structures or improvements on the property.

Construction of a detached two-family home with a detached garage. There are no existing improvements on the property. Please see additional attached supporting documentation:

1. Site Plan
2. Tree Report by Todd Prager of Prager & Associates
3. Geotechnical Report by Earth Engineers, Inc.
4. Wetland Delineation by Pacific Habitat Services, Inc., DSL Concurrence, and US Army Corps of Engineers Jurisdictional Determination
5. Utility plan by Civil Engineer Jason Morgan
6. Conditional Use Permit application and supporting materials for boardwalk access spanning wetland buffer including site plan, and support letter from wetland scientist John Van Staveren of Pacific Habitat Services, Inc.

2. Explain how the request meets the standards which are applicable to the proposal.

The project site is zoned Residential Medium Density (R2) and contains wetlands mapped on the City's local wetland inventory that are subject to Cannon Beach Municipal Code (CBMC) Chapter 17.43 (Wetlands Overlay Zone). A detached two-family home is an outright allowed use per CMBC 17.14.020 (R2 Zone). The lot meets the minimum R2 zone lot area, lot width, and lot depth requirements, as well as the minimum upland area requirement for lots proposed within the Wetland Overlay (WO) zone of 1,000 square feet. Building site envelopes are identified for each proposed dwelling, showing that applicable wetland buffer and front, rear, and side setback standards are met. The lot provides at least 25 feet of frontage along a public street for required access. The site plan meets parking standards by providing 6 off-street parking spaces.

Exhibit A-2

3. Attach a scale drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structures, and the location and dimensions of the proposed accessory structure.

   See attached site plan. There are no existing improvements on the property.

4. Attach a drawing, photograph or other visual representation of the proposed structure. Include the dimensions of the structure and its height.

   Not required per City of Cannon Beach Community Development Department

Use Additional Sheets as Necessary.

Application Fee: $100.00

Applicant Signature: ______________ Date: 9/20/2023

Jamie B. Lerma

Property Owner Signature: See attached page Date: 9/20/2023

David Pietka

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her behalf. Please attach the name, address, phone number, and signature of any additional property owners. As Property Owner, my signature or an authorized applicant's signature, allows any duly authorized employee of the City to enter upon all properties affected by this permit for the purpose of follow-up inspection, observation, or measurement.

For Staff Use Only:

Received on: ______________ By: ______________

Fee Paid: ______________ Receipt No.: ______________

(Last revised March 2021)

Exhibit A-2

3. Attach a scale drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structures, and the location and dimensions of the proposed accessory structure.

   See attached site plan. There are no existing improvements on the property.

4. Attach a drawing, photograph or other visual representation of the proposed structure. Include the dimensions of the structure and its height.

   Not required per City of Cannon Beach Community Development Department

City of Cannon Beach
Finance Department
SEP 21 2023
PAID

Use Additional Sheets as Necessary.

Application Fee: $100.00

Applicant Signature: ______ Date: 9/20/2023
Jamie B. Lerma

Property Owner Signature: David Pietka Date: 9/20/2023
David Pietka

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her behalf. Please attach the name, address, phone number, and signature of any additional property owners. As Property Owner, my signature or an authorized applicant's signature allows any duly authorized employee of the City to enter upon all properties affected by this permit for the purpose of follow-up inspection, observation, or measurement.

For Staff Use Only:

Received on: ______ By: ______
Fee Paid: ______ Receipt No: ______

(Last revised March 2021)

Exhibit A-2

Exhibit A-2

#1

SITE PLAN 2023-06-20

1"=20'-0"

Exhibit A-2

Exhibit A-2

#2

Todd Prager & Associates LLC

MEMORANDUM

DATE: June 22, 2023
TO: Patrick/Dave, LLC
FROM: Todd Prager, RCA #597, ISA Board Certified Master Arborist
RE: Updated Tree Plan for the Forest Lawn Project

Summary

After additional adjustments to the proposed site design and infrastructure improvements, 36 trees are proposed to be retained and 5 trees are proposed to be removed at the Forest Lawn Project in Cannon Beach. The current proposed tree removal has been reduced from 11 trees to 5 trees since the May 26, 2022 submittal. The 36 trees to be retained with site design and infrastructure improvements will be protected according to the recommendations in this report.

Background

Patrick/Dave, LLC is proposing to construct two, 3-bedroom houses, a garage, parking area, pedestrian access, and infrastructure improvements at the vacant property located south of the intersection of Forest Lawn Road and South Hemlock Street in Cannon Beach, Oregon. Wetlands occupy much of the northern portion of the site with the buildable areas clustered towards the southern end. The proposed site plan is provided in Attachment 1.

Sitka spruce (*Picea sitchensis*) is the dominant tree species at the site with scattered red alder (*Alnus rubra*) along with a western hemlock (*Tsuga heterophylla*) and crabapple (*Malus sp.*). Small diameter Hooker's willow (*Salix hookeriana*) occupy much of the wetland, but their diameter's were smaller than required to be individually inventoried.

The submittal from May 26, 2022 anticipated the removal of 11 trees with future development of the site and lots. The plan was revised, and my arborist report dated July 21, 2022 included the removal of 7 trees. The current plan has been further revised to retain additional trees.

The assignment requested of my firm for this project was to:

- Coordinate with the project design team to identify opportunities for additional tree preservation;
- Provide my recommendations for tree preservation and removal based on the site constraints; and
- Provide tree protection recommendations for the proposed construction.

Exhibit A-2

Tree and Site Assessment

On July 17, 2022, I visited the site and reviewed the trees. The purpose of my site visit was to verify the tree assessment dated December 28, 2021 by Arbor Care Tree Specialists, Inc. in Attachment 2. During my visit I also reviewed the site to determine if there were opportunities for additional tree preservation. My scope of work did not include a re-inventory of the trees at the site since that work was already completed by another arborist.

The tree assessment data in Attachment 1 was generally accurate and relevant for this stage of the project. The following changes and additions to the inventory based on my site visit are summarized as follows:

- ***Tree 12***, a decayed red alder growing over a culvert, was removed by the City of Cannon Beach based on background I received.
- ***Tree 15***, a 60-inch diameter (DBH) Sitka spruce, had a thinning crown compared with other trees at the site.
- ***Tree 16***, a 50-inch Sitka spruce on a neighboring property, had a thinning crown compared with other trees at the site and a sweep in its lower trunk towards the northeast.
- ***Tree 20***, a 30-inch DBH western hemlock, leaned away from the site and was separated from South Hemlock Street by larger Sitka spruce that were adjacent to it.
- ***Tree 21.1*** was added to the site plan in its approximate location by my firm. It was a 36-inch DBH Sitka spruce in good health condition and fair structural condition with codominant stems at approximately 50 feet above ground. Its crown was moderately one sided due to competition with adjacent trees.
- ***Tree 34*** was a 35-inch DBH Sitka spruce with an approximately 15 percent live crown ratio. Live crown ratio is the ratio of the height of the tree's live foliage to the total height of the tree.
- ***Tree 36*** was a 36-inch DBH Sitka spruce with a sweep at its lower trunk towards South Hemlock Street.
- ***Tree 37b*** had a relatively low density of *Porodaedalea pini* conks.

With the removal of tree 12 from the inventory and addition of tree 21.1, the total inventoried tree count at the site remains at 41 trees.

Tree Preservation and Removal

I coordinated with the project team to review and adjust the updated plans in Attachment 1 with the goal of preserving additional trees. The following plan adjustments were made in coordination with the project team:

- *Access*: Driveway access to the buildings has been eliminated to preserve trees 15 and 19;
- *Buildings*: The southern building footprint has been adjusted to preserve tree 15;
- *Parking*: The parking area will be adjusted to preserve trees 29 and 40;
- *Utilities*: Utilities will be bored underground to avoid trees 15 and 19; and

Exhibit A-2

- *Wetland Trees*: Trees 20 and 37b will be retained and monitored by the owners so that no tree removal will occur within the wetland.

The May 26, 2022 submittal included the removal of 11 trees and the July 21, 2022 arborist report proposed the removal of 7 trees. Based on proposed site plan changes, the current proposal is to remove 5 trees. Table 1 below is a summary of the current status of the 11 trees previously proposed for removal. Trees with changes in status are bolded in Table 1.

Table 1: Current Status of 11 Trees Previously Proposed for Removal

Tree #	Type	DBH	Area	5/22/2022 Proposal	Current Proposal	Comments
12	**red alder**	**11**	**wetland**	**remove**	**n/a**	**Removed by city**
15	**Sitka spruce**	**60**	**upland**	**remove**	**retain**	**This tree can be retained by eliminating the access drive and boring utilities from South Hemlock**
17	Sitka spruce	50	upland	remove	remove	This tree has a poor live crown ratio, lean, heaving root plate, and will be impacted by construction of the south building
18	**Sitka spruce**	**29**	**upland**	**remove**	**retain**	**This tree can be retained by eliminating the access drive and boring utilities**
19	**Sitka spruce**	**36**	**upland**	**remove**	**retain**	**This tree can be retained by eliminating the access drive and boring utilities**
20	**western hemlock**	**30**	**wetland**	**remove**	**retain**	**This tree leans away from the building site and was separated from South Hemlock Street by larger Sitka spruce that were adjacent to it. The adjacent trees offer protection to the roadway. It may be retained and monitored at this time.**
23	Sitka spruce	32	upland	remove	remove	This tree conflicts with the north building footprint
34	Sitka spruce	35	upland	remove	remove	This tree conflicts with the north building footprint
35	Sitka spruce	35	upland	remove	remove	This tree conflicts with the north building footprint and is infected with *Fomitopsis pinicola*.
36	Sitka spruce	36	upland	remove	remove	This tree conflicts with the north building footprint
37b	**Sitka spruce**	**32**	**wetland**	**remove**	**retain**	**This tree is in the wetland and had a relatively low density of *Porodaedalea pini* conks. It may be retained and monitored at this time.**

Tree Protection Recommendations

The trees to be retained will require protection during construction. This section of the report includes my tree protection recommendations for the proposed construction.

- *Tree Protection Fencing*: Tree protection fencing shall be installed in the locations shown in Attachment 1 prior to construction. When fence adjustments or work is required in the tree protection zones, the project arborist shall be consulted to oversee the work.
- *Tree Removal*: The trees to be removed shall not contact or otherwise damage the trunks or branches of the trees to be retained. Piece removal of the trees will be required to protect the adjacent retained trees. No vehicles or heavy equipment shall be permitted within the tree protection zones during tree removal operations.
- *Stump Removal*: The stumps of the trees to be removed shall have their structural roots cut prior to removal to protect the root systems of the adjacent trees to be retained.
- *Underground utilities*: Underground utilities will need to be bored at a depth of at least five feet to avoid the typical minimum construction setback radii of the retained trees shown in Attachment 1.
- *Parking construction*: The parking area adjacent to trees 29 and 40 shall be constructed of clean crushed rock (with no fines) over geotextile fabric that is permeable to air and water. The surface litter layer shall be carefully removed under arborist supervision prior to fabric and rock placement to minimize damage and disturbance to any surface roots of trees to be retained. No excavation beyond the native soil surface is permitted. At least four inches of crushed rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.
- *Pedestrian Access*: Pedestrian access adjacent to trees 16 and 18 shall be constructed under arborist supervision without excavation below existing grade. At least four inches of base rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.

Exhibit A-2

- *Building Foundations*: The building foundations to be constructed within the typical minimum construction setback radii shown in Attachment 1 will need to be designed to protect structural roots that may be located within their footprints. This will involve pneumatic excavation to locate structural roots greater than 2-inches inches in diameter and bridging the foundations over the roots. A pier foundation is the least intrusive foundation type (Figure 1) and will be required to minimize root impacts. Any pneumatic excavation or foundation construction within the tree protection zones will need to occur under the onsite supervision of the project arborist. The elevation of the grade beams may need to be above existing grade to avoid large surface roots. The foundations adjacent to trees 15 and 19 may need to be cantilevered over their minimum ground disturbance setback radii to provide clearance for surface roots as shown in Attachment 1.

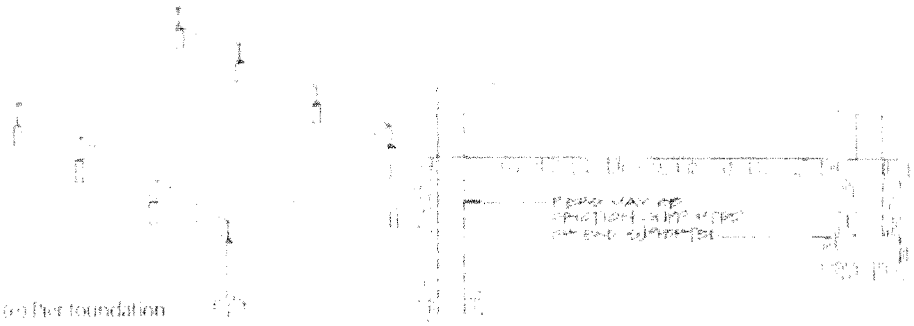


Figure 1: Pier Foundation Example[1]

- *Compaction Management and Root Protection*: Where needed for construction access, steel plates over a 6-inch layer of wood chips shall be placed on the ground surface and over visible surface roots in the approximate locations shown in Attachment 1. The project arborist will need to review and approve shifting of the fence locations and final placement of compaction management when required.
- *Crown Pruning Trees*: If the crowns of any trees need to be raised and/or reduced, it shall occur prior to construction. The pruning shall be conducted by an ISA certified arborist in accordance with ANSI A300 pruning standards in coordination with the project arborist. The pruning shall be the minimum necessary to achieve the required clearance for construction.
- *Erosion Control*: If erosion control is required within or directly adjacent to the tree protection fencing, straw wattles shall be used to avoid excavation.

Additional tree protection recommendations are included in Attachment 3.

---

[1] Figure 1 from: Matheny, N. P., & Clark, J. R. (1998). *Trees and development: A technical guide to preservation of trees during land development*. Champaign, IL: International Society of Arboriculture.

Conclusion

After further adjustments to the proposed site design, 36 trees are proposed to be retained and 5 trees are proposed to be removed. The original proposal included the removal of 11 trees.

The trees to be retained will be protected according to the recommendations in this report.

Please contact me if you have questions, concerns, or need any additional information.

Sincerely,

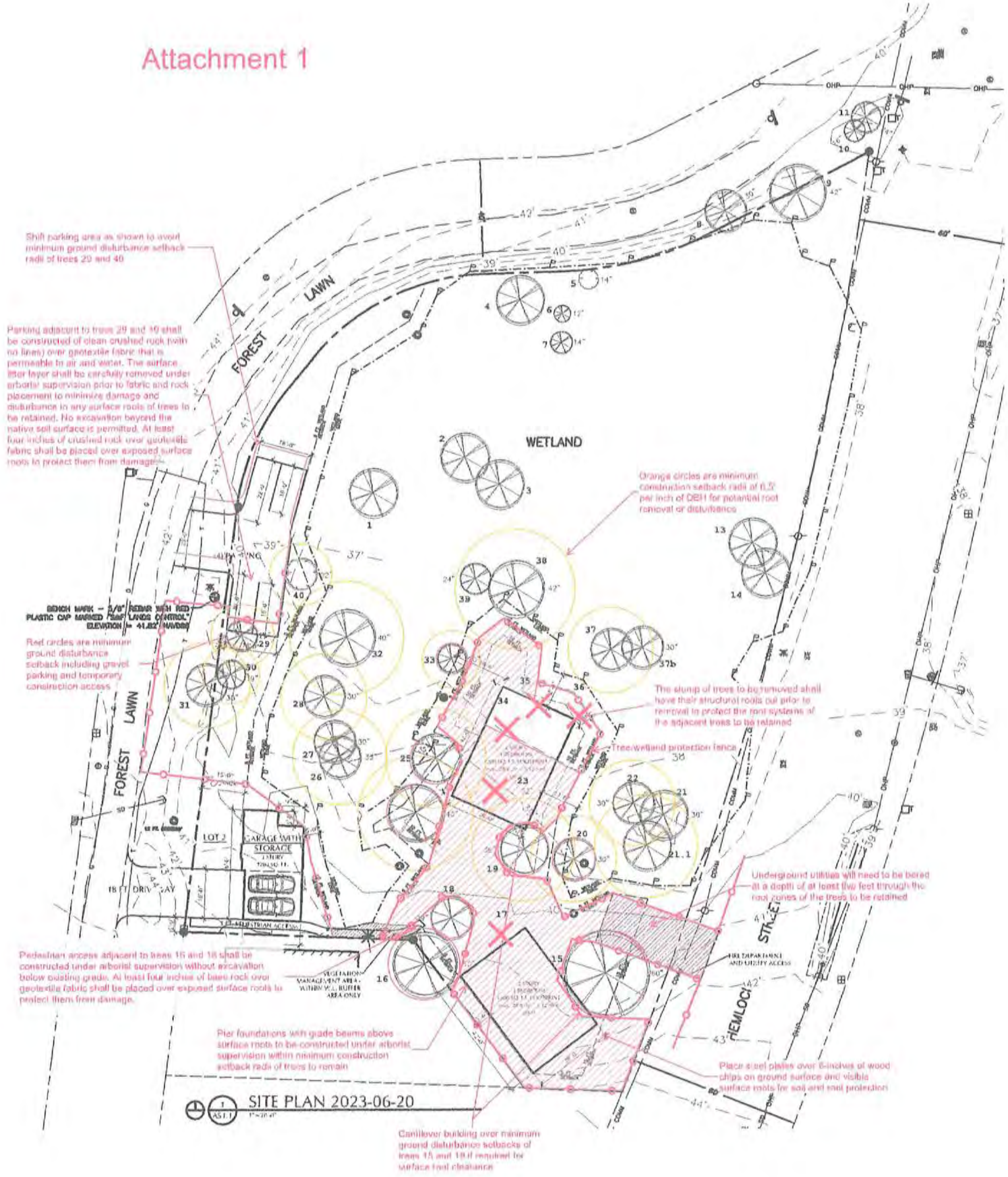
Todd Prager

Todd Prager
ASCA Registered Consulting Arborist #597
ISA Board Certified Master Arborist, WE-6723B
ISA Qualified Tree Risk Assessor
AICP, American Planning Association

Attachment 1:	Site Plan with Trees and Tree Protection
Attachment 2:	Tree Inventory
Attachment 3:	Tree Protection Recommendations
Attachment 4:	Assumptions and Limiting Conditions

Exhibit A-2

Attachment 1



BENCH MARK – 5/8" REBAR WITH RED PLASTIC CAP MARKED "S&F LANDS CONTROL" ELEVATION = 41.82' NAVD88

Shift parking area as shown to avoid minimum ground disturbance setback radii of trees 29 and 40

Parking adjacent to trees 29 and 40 shall be constructed of clean crushed rock (with no fines) over geotextile fabric that is permeable to air and water. The surface litter layer shall be carefully removed under arborist supervision prior to fabric and rock placement to minimize damage and disturbance to any surface roots of trees to be retained. No excavation beyond the native soil surface is permitted. At least four inches of crushed rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.

Red circles are minimum ground disturbance setback including gravel parking and temporary construction access

Orange circles are minimum construction setback radii of 0.5' per inch of DBH for potential root removal or disturbance

The stump of trees to be removed shall have their structural roots cut prior to removal to protect the root systems of the adjacent trees to be retained

Tree/wetland protection fence

Underground utilities will need to be bored at a depth of at least five feet through the root zones of the trees to be retained

Pedestrian access adjacent to trees 16 and 18 shall be constructed under arborist supervision without excavation below existing grade. At least four inches of base rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.

Pier foundations with grade beams above surface roots to be constructed under arborist supervision within minimum construction setback radii of trees to remain

Place steel plates over 6-inches of wood chips on ground surface and visible surface roots for soil and root protection

SITE PLAN 2023-06-20

Cantilever building over minimum ground disturbance setbacks of trees 15 and 19 if required for surface root clearance

Exhibit A-2

Todd Prager & Associates

Attachment 2

Tree Number	Common Name	Scientific Name	Comments from Arbor Care Tree Specialists	DBH
1	Sitka spruce	*Picea sitchensis*	Ok	22
2	Sitka spruce	*Picea sitchensis*	Ok	22
3	Sitka spruce	*Picea sitchensis*	Ok	12
4	Red alder	*Alnus rubra*	Ok, tipped tree with horizontal trunk. Stable	12
5	Red alder	*Alnus rubra*	Large decay pocket. No target. No action required	9
6	Sitka spruce	*Picea sitchensis*	Ok	9
7	Sitka spruce	*Picea sitchensis*	Ok	12
8	Sitka spruce	*Picea sitchensis*	Ok	35
9	Sitka spruce	*Picea sitchensis*	Phaeolus schweinitzii at base. Leans into wetland.	50
10	Sitka spruce	*Picea sitchensis*	Ok	12
11	Sitka spruce	*Picea sitchensis*	Ok	27
12	Red alder	*Alnus rubra*	Remove. Growing over culvert and decay in plane of lean toward road.	11
13	Sitka spruce	*Picea sitchensis*	Ok	30
14	Crab apple	*Malus sp.*	Ok. Cluster of 5 trunks	6-8
15	Sitka spruce	*Picea sitchensis*	Ok	60
16	Sitka spruce	*Picea sitchensis*	Ok	50
17	Sitka spruce	*Picea sitchensis*	Remove. Poor live crown ratio and heavy lean with a heaving root plate	50
18	Sitka spruce	*Picea sitchensis*	Ok	29
19	Sitka spruce	*Picea sitchensis*	Ok	36
20	Western hemlock	*Tsuga heterophylla*	Remove. Heavy lean with a heaving root plate	30
21	Sitka spruce	*Picea sitchensis*	Ok	36
21.1	Sitka spruce	*Picea sitchensis*	Added by Todd Prager based on July 21, 2022 site visit. Good health condition and fair structural condition with codominant stems at approximately 50 feet above ground. Crown was moderately one sided due to competition with adjacent trees	36
22	Sitka spruce	*Picea sitchensis*	Ok	30
23	Sitka spruce	*Picea sitchensis*	Ok	32
24	Sitka spruce	*Picea sitchensis*	Ok	40
25	Sitka spruce	*Picea sitchensis*	Ok	35
26	Sitka spruce	*Picea sitchensis*	Ok	33

Exhibit A-2

Todd Prager & Associates

Attachment 2

Tree Number	Common Name	Scientific Name	Comments from Arbor Care Tree Specialists	DBH
27	Sitka spruce	*Picea sitchensis*	Ok	30
28	Sitka spruce	*Picea sitchensis*	Ok	30
29	Sitka spruce	*Picea sitchensis*	Ok	21
30	Sitka spruce	*Picea sitchensis*	Ok	19
31	Sitka spruce	*Picea sitchensis*	Ok	40
32	Sitka spruce	*Picea sitchensis*	Ok	40
33	Sitka spruce	*Picea sitchensis*	Ok	20
34	Sitka spruce	*Picea sitchensis*	Ok	35
35	Sitka spruce	*Picea sitchensis*	Remove. Fomitopsis pinicola seen at 18ft.	35
36	Sitka spruce	*Picea sitchensis*	Ok	36
37	Sitka spruce	*Picea sitchensis*	Ok	30
37b	Sitka spruce	*Picea sitchensis*	Remove. Porodaedalea pini: multiple fruiting bodies extending up trunk	32
38	Sitka spruce	*Picea sitchensis*	Ok	42
39	Sitka spruce	*Picea sitchensis*	Ok	24
40	Red alder	*Alnus rubra*	Ok	22

*This tree inventory is adapted from information collected by Arbor Care Tree Specialists and compiled in their report dated 12-28-2021.

Attachment 3
Tree Protection Recommendations

Before Construction Begins

1. Notify all contractors of tree protection procedures. For successful tree protection on a construction site, all contractors must know and understand the goals of tree protection.
    a. Hold a tree protection meeting with all contractors to explain the goals of tree protection.
    b. Have all contractors sign memoranda of understanding regarding the goals of tree protection. The memoranda should include a penalty for violating the tree protection plan. The penalty should equal the resulting fines issued by the local jurisdiction plus the appraised value of the tree(s) within the violated tree protection zone per the current Trunk Formula Method as outlined in the current edition of the ***Guide for Plant Appraisal*** by the Council of Tree & Landscape Appraisers. The penalty should be paid to the owner of the property.
2. Fencing
    a. Trees to remain on site will be protected by installation of tree protection fencing as shown in Attachment 1.
    b. Unless otherwise noted, the fencing should be put in place before the ground is cleared to protect the trees and the soil around the trees from disturbances.
    c. Fencing should be established by the project arborist based on the needs of the trees to be protected and to facilitate construction.
    d. Fencing should consist of 6-foot-high steel fencing on concrete blocks or 6-foot metal fencing secured to the ground with 8-foot metal posts to prevent it from being moved by contractors, sagging, or falling down.
    e. Fencing should remain in the position that is established by the project arborist and not be moved without approval from the project arborist.
3. Signage
    a. All tree protection fencing should have signage as follows so that all contractors understand the purpose of the fencing:

TREE PROTECTION ZONE

DO NOT REMOVE OR ADJUST THE LOCATION OF THIS TREE PROTECTION FENCING
UNAUTHORIZED ENCROACHMENT MAY RESULT IN FINES

Please contact the project arborist if alterations to the location of the tree protection fencing are necessary.

Todd Prager, Project Arborist, Todd Prager & Associates, 971-295-4835

    b. Signage should be placed every 75-feet or less.

Exhibit A-2

During Construction

1. Protection Guidelines Within the Tree Protection Zones:
    a. No new buildings; grade change or cut and fill, during or after construction; new impervious surfaces; or utility or drainage field placement should be allowed within the tree protection zones.
    b. No traffic should be allowed within the tree protection zones. This includes but is not limited to vehicle, heavy equipment, or even repeated foot traffic.
    c. No storage of materials including but not limiting to soil, construction material, or waste from the site should be permitted within the tree protection zones. Waste includes but is not limited to concrete wash out, gasoline, diesel, paint, cleaner, thinners, etc.
    d. Construction trailers should not to be parked/placed within the tree protection zones.
    e. No vehicles should be allowed to park within the tree protection zones.
    f. No other activities should be allowed that will cause soil compaction within the tree protection zones.
2. The trees should be protected from any cutting, skinning or breaking of branches, trunks or woody roots.
3. The project arborist should be notified prior to the cutting of woody roots from trees that are to be retained to evaluate and oversee the proper cutting of roots with sharp cutting tools. Cut roots should be immediately covered with soil or mulch to prevent them from drying out.
4. Trees that have woody roots cut should be provided supplemental water during the summer months.
5. Any necessary passage of utilities through the tree protection zones should be by means of boring with oversight by the project arborist.
6. Any deviation from the recommendations in this section should receive prior approval from the project arborist.

After Construction

1. Carefully landscape the areas within the tree protection zones. Do not allow trenching for irrigation or other utilities within the tree protection zones.
2. Carefully plant new plants within the tree protection zones. Avoid cutting the woody roots of trees that are retained.
3. Do not install permanent irrigation within the tree protection zones unless it is drip irrigation to support a specific planting or the irrigation is approved by the project arborist.
4. Provide adequate drainage within the tree protection zones and do not alter soil hydrology significantly from existing conditions for the trees to be retained.
5. Provide for the ongoing inspection and treatment of insect and disease populations that can damage the retained trees and plants.
6. The retained trees may need to be fertilized if recommended by the project arborist.
7. Any deviation from the recommendations in this section should receive prior approval from the project arborist.

Exhibit A-2

Attachment 4
Assumptions and Limiting Conditions

1. Any legal description provided to the consultant is assumed to be correct. The information provided by Patrick/Dave, LLC and their consultants was the basis of the information provided in this report.
2. It is assumed that this property is not in violation of any codes, statutes, ordinances, or other governmental regulations.
3. The consultant is not responsible for information gathered from others involved in various activities pertaining to this project. Care has been taken to obtain information from reliable sources.
4. Loss or alteration of any part of this delivered report invalidates the entire report.
5. Drawings and information contained in this report may not be to scale and are intended to be used as display points of reference only.
6. The consultant's role is only to make recommendations. Inaction on the part of those receiving the report is not the responsibility of the consultant.
7. This report is a summary of my assignment which was to:
   - Coordinate with the project design team to identify opportunities for additional tree preservation;
   - Provide my recommendations for tree preservation and removal based on the site constraints; and
   - Provide tree protection recommendations for the proposed construction.

Exhibit A-2

#3

Earth
Engineers,
Inc.

2411 Southeast 8th Avenue • Camas • WA 98607
Phone: 360-567-1806
www.earth-engineers.com

June 3, 2022
Revised June 10, 2022

Patrick/Dave LLC
3514 Northeast U.S. Grant Place
Portland, Oregon 97212
Attention: David Pietka, Owner

Phone: (503) 206-1071
E-mail: dpietka@msn.com

Subject: **Geotechnical Investigation and Geologic Hazard Report**
Proposed Forest Lawn *Development*
Clatsop County Tax Lot No. 51030DA04100
Intersection of Forest Lawn Road and Hemlock Street
Cannon Beach, Clatsop County, Oregon
EEI Report No. 22-103-1-*R2*

Dear Mr. Pietka,

Earth Engineers, Inc. (EEI) is pleased to transmit our ***revised*** report for the above referenced project. This report includes the results of our field investigation, an evaluation of geotechnical factors and geologic hazards that may influence the proposed construction, and geotechnical recommendations for the proposed ***project*** and general site development. ***This report has been revised, as requested. Report revisions are denoted in bold, italics font.***

We appreciate the opportunity to perform this geotechnical study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Sincerely,
Earth Engineers, Inc.

Troy Hull, P.E., G.E.
Principal Geotechnical Engineer

Ken Andrieu, R.G.
Senior Geologist

Jacqui Boyer
Geotechnical Engineering Associate

Attachment: Geotechnical Investigation and Geologic Hazard Report

Distribution (electronic copy only): Addressee
Jamie Lerma, Red Crow, LLC (jamie@redcrowgc.com)

Exhibit A-2

GEOTECHNICAL INVESTIGATION AND GEOLOGIC HAZARD REPORT

for the

Proposed Forest Lawn *Development*
Clatsop County Tax Lot No. 51030DA04100
Intersection of Forest Lawn Road
and South Hemlock Street
Cannon Beach, Clatsop County, Oregon

Prepared for

Patrick/Dave LLC
3514 Northeast U.S. Grant Place
Portland, Oregon 97212
Attention: David Pietka, Owner

Prepared by

Earth Engineers, Inc.
2411 Southeast 8th Avenue
Camas, Washington 98607
Telephone (360) 567-1806

EEI Report No. 22-103-1-*R2*

June 3, 2022
Revised June 10, 2022

Earth Engineers Inc.

Jacqui Boyer
Geotechnical Engineering Associate

19206PE

Troy Hull, P.E., G.E.
Principal Geotechnical Engineer

KENNETH DAVID ANDRIEU
#G1988

EXP: 12/1/2022

Ken Andrieu, R.G.
Senior Geologist

Exhibit A-2

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Exhibit A-2

1.0 PROJECT INFORMATION

1.1 Project Authorization

Earth Engineers, Inc. (EEI) has completed a geotechnical investigation report for the proposed ***Forest Lawn Development*** on Clatsop County Tax Lot No. 51030DA04100 in Cannon Beach, Clatsop County, Oregon. Our services were authorized by David Pietka, owner of Patrick/Dave LLC, on April 19, 2022 by signing EEI Proposal No. 22-P182 dated April 18, 2022.

1.2 Project Description

Our current understanding of the project is based on the information Jamie Lerma with Red Crow, LLC provided to EEI by e-mail on June 18, 2023. ***As part of that e-mail, we were provided with a Site Plan drawing (Sheet AS1.1) by Tolovana Architect LLC, dated June 2, 2023***:

Briefly, we understand the plan is to develop a detatched two family home. It is our understanding that this project is in its preliminary stages. We have not been provided any detailed construction plans for the project. For the purposes of this report, we are assuming maximum foundation loads of 4 kips per linear foot for wall footings, 40 kips for column footings, and 150 psf for floor slabs. With regard to design grades, we are assuming that cuts and fills will be negligible (i.e. less than 2 feet). Finally, we have assumed that the homes will be constructed in accordance with the 2021 Oregon Residential Specialty Code (ORSC), or the 2019 Oregon Structural Specialty Code (OSSC).

Figure 1: Proposed site plan (source: Sheet AS1.1 by Tolovana Architect LLC, dated June 2, 2023) .

1.3 Purpose and Scope of Services

The purpose of our services was to explore the subsurface conditions at the site of the ***proposed Forest Lawn Development*** to better define the soil, rock, and groundwater properties in order to provide geotechnical related recommendations related to the proposed construction. Our site investigation consisted of advancing two Standard Penetration Test (SPT) borings (B-1 and B-2) located on the subject property using a trailer mounted Big Beaver drill rig subcontracted from Dan J Fischer, Inc of Forest Grove, Oregon. SPT samples were taken at regular intervals and transported to our laboratory for testing. We supplemented our drilled borings with three hand auger borings (HA-1 through HA-3) and drive probe testing. Laboratory testing was accomplished in general accordance with ASTM procedures.

This report briefly outlines the testing procedures, presents available project information, describes the site, assumed subsurface conditions, and presents recommendations regarding the following:

- A discussion of subsurface conditions encountered including pertinent soil and groundwater conditions.
- Seismic design parameters in accordance with ASCE 7-16.
- Geotechnical related recommendations for deep foundation design.
- Structural fill recommendations, including an evaluation of whether the in-situ soils can be used as structural fill.
- Retaining wall design parameter recommendations, including coefficient of friction and earth pressures.
- Floor slab support recommendations.
- A Geologic Hazard Report (GHR) in accordance with Clatsop County requirements
- Other discussion on geotechnical issues that may impact the project.

It should be noted, we consider this report to be preliminary for the project area as a whole. Due to accessibility issues, we were only able to advance deep borings on the perimeter of the project area, and limited hand tool explorations on the southern portion of the property. Once the project is further along and the site is more accessible, we can perform additional drilled borings (if requested). EEI should be informed when detailed construction drawings are made for the proposed residences so we can revise our report, if necessary.

Exhibit A-2

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Location and Description

The site for the proposed development is located at Clatsop County Tax Lot No. 51030DA04100 in Cannon Beach, Oregon. The site is bound to the north and west by Forest Lawn Road, to the south by residential properties and to the east by South Hemlock Street. See Figure 2 below for project vicinity.

Figure 2: Project vicinity showing the subject property (outlined in blue).
Source: https://delta.co.clatsop.or.us/apps/ClatsopCounty/.

The subject property is currently vacant, vegetated with grass, brush and mature trees. It should be noted, the northern portion of the property is densely vegetated with brush and trees; as a result, we were unable to advance any explorations in those areas. We also observed vegetation indicative of a wetland or a marsh along the northern portion of the property. In terms of topography, the subject property is level. According to Google Earth, the elevation ranges from 39 feet above mean sea level (msl) to 46 feet msl. While on site, we did not observe any signs of soil movement (i.e. cracking in the soil, leaning trees, landscape head scarps etc.). See Photos 1 through 5 below for the current site conditions.

Exhibit A-2

Photo 1: Current site conditions, taken from the southern property line facing north.

Photo 2: Current site conditions, facing northwest.

Photo 3: Current site conditions, facing northeast.

Photo 4: Current site conditions taken from the western property line, facing east.

Photo 5: Current site conditions taken from the northwestern property line, facing southeast

2.2 Subsurface Materials

The site was explored with two SPT borings (B-1 and B-2). For approximate exploration locations see the Exploration Location Plan in Appendix B. The SPT borings were advanced with a subcontracted trailer mounted drill rig subcontracted from Dan J. Fischer Excavating, Inc. of Forest Grove, Oregon. Boring B-1 was advanced to a depth of 33.5 feet below ground surface (bgs) and B-2 was advanced to a depth of 51.5 feet bgs. SPT samples were generally taken at regular intervals within the boring and transported to our laboratory for testing.

In addition, we supplemented our drilled borings with three hand auger explorations (HA-1 through HA-3) and drive probe testing. For approximate exploration locations see the Exploration Location Plan in Appendix B. The hand auger explorations were each advanced to a depth of 5 feet bgs and the drive probe testing was advanced to a depth of 8 feet bgs.

The drive probe test is based on a "relative density" exploration device used to determine the distribution and to estimate strength of the subsurface soil units. The resistance to penetration is measured in blows-per-½-foot of an 11-pound hammer which free falls roughly 39 inches driving a 3/4-inch outside diameter pipe with a 1-inch diameter endcap into the ground. This measure of resistance to penetration can be used to estimate relative density of soils. For a more detailed

Exhibit A-2

description of this geotechnical exploration method, please refer to the Slope Stability Reference Guide for National Forests in the United States, Volume I, USDA, EM-7170-13, August 1994, P 317-321. Results of the drive probe tests are reported in the hand auger logs in Appendix C.

Select soil samples were tested in the laboratory to determine material properties for our evaluation. Results of the explorations are reported in the Exploration Logs in Appendix C. Laboratory testing was accomplished in general accordance with ASTM procedures. The testing performed included moisture content tests (ASTM D 2216), fines content determinations (ASTM D1140) and Atterberg limit testing (ASTM D4318). The test results have been included on the Exploration Logs in Appendix C and the Report of Atterberg Limits Testing in Appendix E.

In general, we encountered a surficial layer of topsoil overlying compressible, organic soils which eventually transitioned to dense sandstone with depth. Each individual stratum encountered is discussed in further detail below.

TOPSOIL

In all of our explorations, we encountered topsoil as the surficial layer. The topsoil stratum was generally dark brown to black sandy silt with heavy organics (i.e. roots, rootlets and wood chips). The thickness of this stratum was 6-inches to 12-inches in our explorations.

COMPRESSIBLE, ORGANIC SOILS

In all of our explorations we encountered a thick layer of compressible soils underlying the topsoil described above. In B-2, the upper layer of compressible soils was generally a gray-brown sand with broken rock fragments, wood chips and rootlets. Laboratory moisture content testing on samples obtained within this stratum ranged from 21 to 32 percent. Fines content laboratory testing for a sample obtained within this stratum yielded a result of 8 percent passing the #200 sieve. Based on SPT sampling data, this stratum ranged from very loose to loose (N-value average of 5). This sand stratum extended to a depth of 5.5 feet bgs in B-2.

In all of our explorations (except for B-2), we encountered low plasticity silt underlying the topsoil described above. In B-2, this silt was underlying the upper sand stratum described above. This stratum was generally a blue-gray to gray-brown to dark brown silt with orange and gray mottling. We also encountered rootlets within this stratum. Laboratory moisture content testing on samples obtained within this stratum ranged from 53 to 72 percent. Fines content laboratory testing for samples obtained within this stratum ranged from 93 to 94 percent passing the #200 sieve. We also conducted Atterberg testing on a sample retrieved within this stratum from B-2 at 5 feet bgs. The testing indicated this stratum is a low plasticity silt (ML). Based on SPT sampling data, this stratum ranged from very soft to soft (N-value average of 2). This low plasticity silt stratum extended to the terminal depth of our hand tool explorations (i.e. 5 feet bgs), and to a depth of 10 feet bgs in of our drilled borings.

In our drilled borings, we encountered high plasticity silt underlying the low plasticity silt described above. This stratum was generally a blue-gray to gray to brown silt. We also encountered heavy organics (i.e. wood chips and rootlets) within this stratum. Laboratory moisture content testing on samples obtained within this stratum ranged from 50 to 388 percent. It should be noted the very high moisture readings are likely due to the presence of organics. Fines content laboratory testing for sample a sample obtained within this stratum yielded a result of 97 percent passing the #200 sieve. We also conducted Atterberg testing on a sample retrieved within this stratum from B-2 at 10 feet bgs. The testing indicated this stratum is a high plasticity silt (MH). Based on SPT sampling data, this stratum ranged from very soft to soft (N-value average of 2). This high plasticity silt stratum extended to a depth of 25 feet bgs in both of our explorations.

In our drilled borings, we encountered a layer of silty sand underlying the high plasticity silt described above. In B-2, we encountered silty sand and sandy silt underlying the high plasticity silt described above. This stratum was generally a brown to gray brown to blue gray silty sand/sandy silt with trace organics. Laboratory moisture content testing on samples obtained within this stratum ranged from 60 to 124 percent. It should be noted the very high moisture readings are likely due to the presence of organics. Fines content laboratory testing for samples obtained within this stratum ranged from 26 to 81 percent passing the #200 sieve. Based on SPT sampling data, the silty sand stratum ranged from very loose to medium dense and the sandy silt stratum was generally medium stiff (N-value average of 5). This stratum extended to a depth of 30 feet bgs in B-1 and 45 feet bgs in B-2.

DENSE SANDSTONE

In both of our boring explorations, we encountered a dense sandstone layer underlying the compressible, organic soils described above. This stratum was generally a gray to blue-gray sandstone with varying amounts of silt. Laboratory moisture content testing on samples obtained within this stratum ranged from 11 to 76 percent. Fines content laboratory testing for samples obtained within this stratum ranged from 9 to 39 percent passing the #200 sieve. Based on SPT sampling data, this stratum ranged from medium dense to very dense (N-value average of 42). This sandstone stratum extended to the terminal depths of our explorations (i.e. 33.5 feet bgs in B-1 and 51.5 feet bgs in B-2).

The classifications noted above were made in general accordance with the USCS as shown in Appendix D. The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The exploration logs included in the Appendix should be reviewed for specific information. These records include soil descriptions, stratifications, and locations of the samples. The stratifications shown on the logs represent the conditions only at the actual exploration location. Variations may occur and should be expected across the site. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these logs. The samples that were not altered by laboratory testing will be retained for 90 days from the date of this report and then will be discarded.

2.4 Groundwater Information

During our subsurface investigation, we encountered groundwater at depths ranging from 1 to 4 feet bgs.

In addition, we reviewed publicly available well logs from the Oregon Water Resources Department website (http://apps.wrd.state.or.us/apps/gw/well_log/) for historic information. We found two historical logs for a property located approximately 550 feet north of the subject property, advanced on June 1, 2015. The logs indicate that groundwater was encountered at a depth of 7 feet below ground surface. See Appendix F for a copy of these well log reports.

It should be noted that groundwater elevations can fluctuate seasonally and annually, especially during periods of extended wet or dry weather, or from changes in land use.

Exhibit A-2

3.0 GEOLOGIC HAZARD ASSESSMENT

3.1 Soil Survey

The United States Department of Agriculture (USDA) Soil Survey provides geographical information of the soils in Clatsop County as well as summarizing various properties of the soils. The USDA maps the surface soils on site as Unit 61E (Templeton-Ecola silt loams on 30 to 60 percent slopes) and Unit 71C (Walluski medial silt loam on 7 to 15 percent slopes.[1]

The Templeton-Ecola silt loam covers the western majority of the project area. The soil unit consists of well-drained soils formed on hillslopes and mountain slopes with a parent material of colluvium and residuum derived from sedimentary rock. A typical profile consists of slightly decomposed plant material overlying medial silt to silty clay loam which eventually transitions to weathered bedrock with depth. Although the USDA indicates this unit is mapped on 30 to 60 percent slopes we did not encounter any slopes up to 30 to 60 percent on the subject property.

The Walluski medial silt loam covers the eastern portion of the property. The soil unit consists of moderately well-drained soils formed on stream terraces with a parent material of mixed alluvium and/or fluviomarine deposits derived from sedimentary rock. A typical profile consists of slightly decomposed plant material overlying medial silt loam overlying silty clay loam.

3.2 Geology

The site is located approximately 120 feet east of a coastal bluff overlooking Cannon Beach on the Oregon Coast. The bluff is approximately 20 feet tall with a slope of approximately 2.1H:1V. The region is underlain by a framework of Miocene aged (23 to 5 million years ago) volcanic rocks and Oligocene (33 to 23 million years ago) to Miocene aged marine sedimentary deposits that have been deposited over a basement rock of Eocene-aged (54 to 33 million years ago) volcanic arc deposits. Overlying this framework are Quaternary–aged (1.8 million years ago to present) marine terrace deposits, beach and dune deposits, and landslide deposits.

More specifically, Niem and Niem (1985)[2] maps the underlying geology on the subject property as middle to lower Miocene aged Cannon Beach member (informal) of the Astoria Formation from the Astoria Group. This formation is described as a "well-bedded sequence of laminated to massive micaceous mudstone, with subordinate, rhythmically thin-bedded feldspathic sandstone and mudstone in the lower part of the unit". See Figure 3 below.

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[1] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed 5/24/2022.

[2] Niem, A.R., and Niem, W., 1985, Geologic map of the Astoria Basin, Clatsop and northernmost Tillamook Counties, northwest Oregon: Portland, Oregon, Oregon Department of Geology and Mineral Industries Oil and Gas Investigation Map OGI-14, Plate 1, scale 1:100,000.

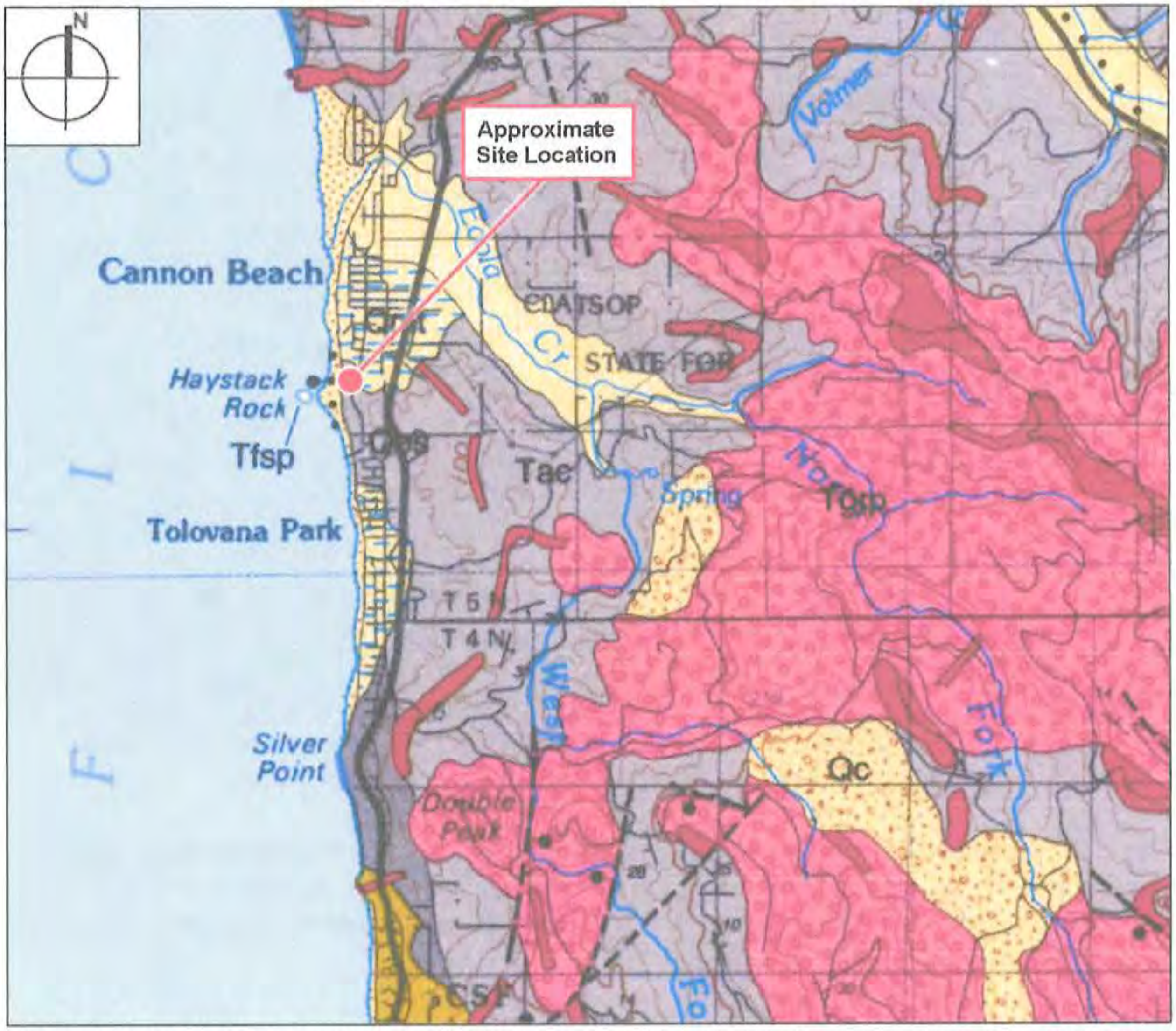

Figure 3: Geologic map of the subject property and its surrounding areas (base map source: Niem and Niem, 1985).

In addition, Schlicker and others (1972)[3] indicates that the subject property is mapped adjacent to an active landslide area. Active landslide areas are described as "areas where ground movement is continuous or periodic or areas in which historic movement has taken place. The area includes debris and rockfalls on the headlands, shallow slump failures along terraces fronting the ocean and bays, and areas of local slump in upland areas". The underlying bedrock unit in the active landslide area is mapped as Pleistocene aged marine terrace deposits (Qmt). See Figure 4 below.

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[3] Schlicker, H.G., Deacon, R.J., Beaulieu, J.D., and Olott, G.W., 1972. Environmental Geology of the Coastal Region of Tillamook and Clatsop Counties, Oregon, Oregon Department of Geology and Mineral Industries, Bulletin 74, 1:62,500.

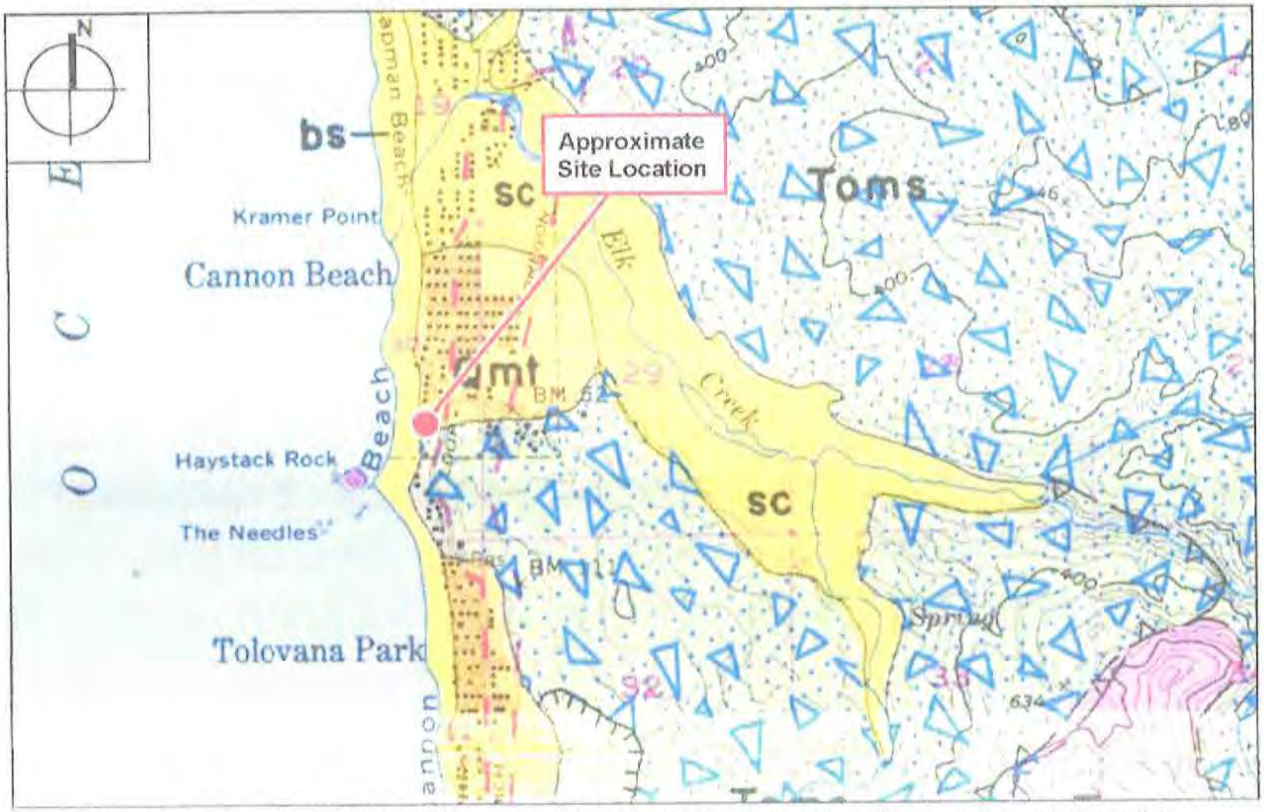

Figure 4: Geologic map of the area; the blue triangle pattern is symbolic of landslide topography (base map source: Schlicker and others, 1972).

We did not observe signs of recent or active landslides from our reconnaissance of the immediate area. Based on our observations of exposed and subsurface soils, as well as the geomorphic features of the site and nearby properties, it is our professional opinion that the site is likely at risk from shallow and deep global landsliding.

The upper, roughly 30 to 40 feet of soft soil is at risk of localized shallow landsliding or soil creep. Adding the weight of a home to this soil layer could increase that risk. As such, we recommend that any house foundations be supported on a deep foundation that extends through this soil layer.

The second landslide risk is from deep-seated block failure given the property may be sitting on a relatively deep portion of the landslide debris. Based on our explorations, it is our professional opinion that the sandstone encountered is the stable layer, therefore extending deep foundations through the upper, compressible soils and bearing them on the sandstone will mitigate the risk of deep global landsliding.

In summary, our recommended approach is to employ a deep foundation system that extends through the compressible, organic soils, and protects the house foundations from shallow, localized landsliding or slope creep that might occur in the future.

3.3 Seismicity

Oregon's position at the western margin of the North American Plate and its location relative to the Pacific and Juan de Fuca plates have had a major impact on the geologic development of the state. The interaction of the three plates has created a complex set of stress regimes that influence the tectonic activity of the state. The western part of Oregon is heavily impacted by the influence of the active subduction zone formed by the Juan de Fuca Oceanic Plate converging upon and subducting beneath the North American Continental Plate off the Oregon coastline.

The Cascadia Subduction Zone, located approximately 100 kilometers off of the Oregon and Washington coasts, is a potential source of earthquakes large enough to cause significant ground shaking at the subject site. Research over the last several years has shown that this offshore fault zone has repeatedly produced large earthquakes, on average, every 300 to 700 years. It is generally understood that the last great Cascadia Subduction Zone earthquake occurred about 300 years ago, in 1700 AD. Although researchers do not necessarily agree on the likely magnitude, it is widely believed that an earthquake moment magnitude (M_w) of 8.5 to 9.5 is possible. The duration of strong ground shaking is estimated to be greater than 1 minute, with minor shaking lasting on the order of several minutes.

Additionally, earthquakes resulting from movement in upper plate local faults are considered a possibility. Crustal earthquakes are relatively shallow, occurring within 10 to 20 kilometers of the surface. Oregon has experienced at least two significant crustal earthquakes in the past decade—the Scotts Mills (Mt. Angel) earthquake (M_w 5.6) on March 25, 1993 and the Klamath Falls earthquake (M_w 5.9) on September 20, 1993. Based on limited data available in Oregon, it would be reasonable to assume a M_w 6.0 to 6.5 crustal earthquake may occur in Oregon every 500 years (recurrence rate of 10 percent in 50 years). There are no mapped crustal faults in the immediate vicinity of the property, but there is a marine crustal fault approximately 3 miles west of the property[4].

3.3.1 Seismic Design Parameters

In accordance with ASCE 7-16, we recommend a Site Class E (soft soil with an average standard penetration resistance less than 15 blows per foot) when considering the average of the upper 100 feet of bearing material beneath the proposed foundations. This recommendation is based on the SPT N-values in our boring B-1 and our local knowledge of the area geology.

Inputting our recommended Site Class as well as the site latitude and longitude into the Structural Engineers Association of California (SEAOC) – OSHPD Seismic Design Maps website (http://seismicmaps.org) which is based on the United States Geological Survey, we obtained the

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[4] USGS U.S. Quaternary Faults Interactive Map, https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf.

seismic design parameters shown in Table 1 below. Note that the values for F_a and F_v in Table 1 were obtained from ASCE's Supplement 3 dated November 5, 2021 and issued for ASCE 7-16 to correct some seismic design issues in the original publication.

Table 1: Seismic Design Parameter Recommendations (ASCE 7-16, including Supplement 3 dated November 5, 2021)

PARAMETER	RECOMMENDATION
Site Class	E
S_s	1.317g
S_1	0.691g
F_a	1.200
F_v	2.000
S_{MS} (= S_s x F_a)	1.580g
S_{M1} (= S_1 x F_v)	1.382g
S_{DS} (=2/3 x S_s x F_a)	1.054g
S_{D1} (=2/3 x S_1 x F_V)	0.921g
Design PGA (= S_{DS} / 2.5)	0.422g
MCE_G PGA	0.664g
F_{PGA}	1.100
PGA_M (= MCE_G PGA * F_{PGA})	0.731g

Note: Site latitude = 45.8866, longitude = -123.963

The return interval for the ground motions reported in the table above is 2 percent probability of exceedance in 50 years.

Per Section 11.4.8 of ASCE 7-16 a site-specific ground motion hazard analysis shall be performed in accordance with Section 21.2 for the following conditions:

1. Structures on Site Class D sites with S_1 greater than or equal to 0.2g.

   Exception: ASCE 7-16 does not require a site-specific ground motion hazard analysis when the value of S_{M1} is elected to be increased by 50% for all applications of S_{M1} by the Structural Engineer. If S_{M1} is increased by 50% to avoid having to perform the seismic response analysis, then the resulting value of S_{D1} shall be equal to 2/3 * [1.5* S_{M1}])

2. Structures on Site Class E sites with values of S_s greater than or equal to 1.0, or values of S_1 greater than or equal to 0.2.

   Exception: ASCE 7-16 does not require a site-specific ground motion hazard analysis when:

   1. The Structural Engineer uses the equivalent lateral force design procedure and the value of Cs is determined by Eq. 12.8-2 for all values of T, or
   2. Where (i) the value of S_{ai} is determined by Eq. 15.7-7 for all values of T_i, and (ii) the value of the parameter S_{D1} is replaced with 1.5* S_{D1} in Eq. 15.7-10 and 15.7-11.

We classified this site as Site Class E. Because the S_s value is greater than 1.0 as shown in Table 1 above, a ground motion hazard analysis is required unless the Structural Engineer elects to increase the S_{M1} value by 50 percent (which results in increasing the S_{D1} value by 50 percent). **If the Structural Engineer elects not to utilize the 50 percent increase on S_{M1} and S_{D1}, then EEI should be retained to perform a site-specific ground motion hazard analysis in accordance with Section 21.2 of ASCE 7-16.**

3.3.2 Liquefaction

Based on our investigation, we consider the soils encountered in our exploration to be liquefiable. Liquefaction occurs when a saturated sand or silt soil starts to behave like a liquid. Liquefaction occurs because of the increased pore pressure and reduced effective stress between solid particles generated by the presence of liquid. It is often caused by severe ground shaking, especially that associated with earthquakes. For the purpose of our hazard evaluation, we consider only the saturated soils within the upper 50 feet of the ground surface to be potentially liquefiable. The liquefaction potential was evaluated based on the SPT N_{60}-values.

Assuming 2 to 3 percent vertical strain, we estimate that total dynamic settlement caused by an earthquake could be on the order of 9 to 13 inches. This assumes the potentially liquefiable layer is 36 feet thick (i.e. reference boring B-2 where it is potentially liquefiable from 4 to 40 feet). We estimate differential dynamic settlement due to liquefaction could be on the order of 50 to 75 percent of the total dynamic settlement; meaning anywhere from approximately 4.5- to 10-inches of differential dynamic settlement due to liquefaction could occur across the building footprints.

3.4 Geologic Hazards

The Oregon Department of Geology and Mineral Resources (DOGAMI) maps various geologic hazards, such as 100-year flooding, earthquake ground shaking, costal erosion, and landslides.[5] This service, generally referred to as Oregon's HazVu, shows the geologic hazards associated with development of this region of the site to include the following:

- Severe Cascadia earthquake expected shaking
- Very strong crustal earthquake expected shaking
- Low liquefaction (soft soil) hazard area
- Moderate landslide hazard area (i.e. landsliding possible)
- In close proximity to mapped landslide deposits
- In close proximity to mapped coastal erosion hazard area

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[5] Oregon HazVu: Statewide Geohazards Viewer, available online at: http://www.oregongeology.org/sub/hazvu/ accessed 5/31/2022.

Exhibit A-2

Figures 5 through 10 below show mapping of the geologic hazards as presented by Oregon's HazVu.

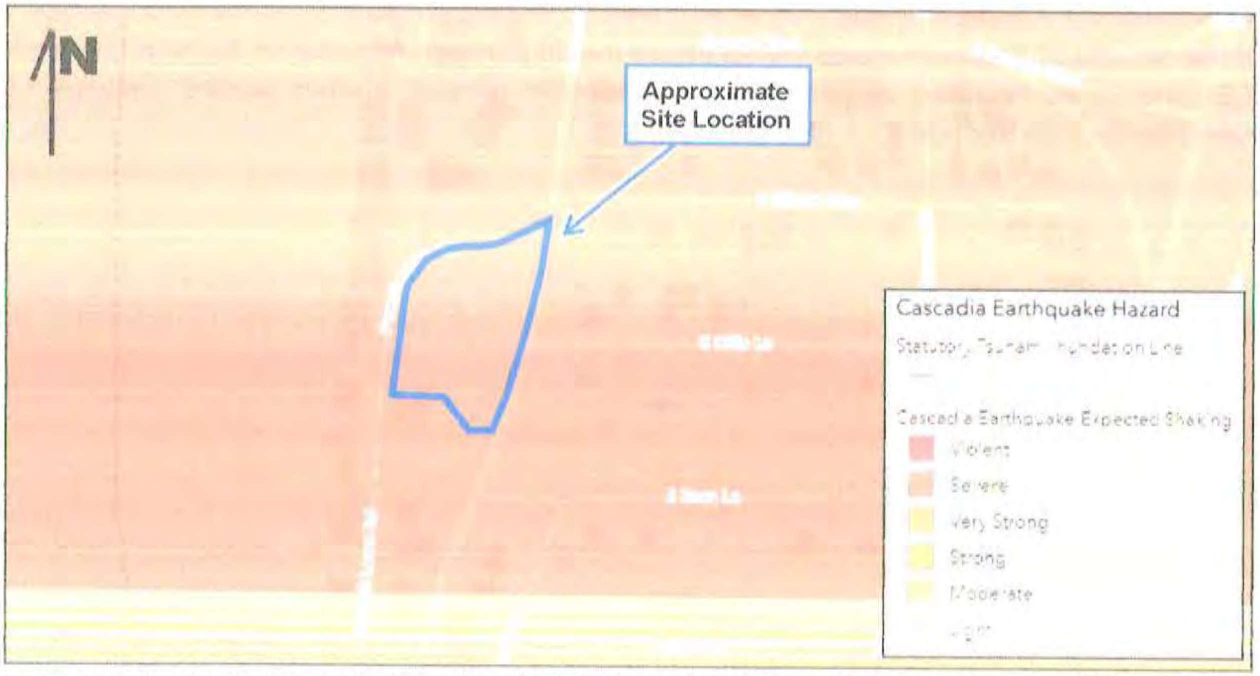

Figure 5: HazVu map showing the Cascadia earthquake expected shaking hazard zones.

Figure 6: HazVu map showing the crustal earthquake expected shaking hazard zones.

Exhibit A-2

Figure 7: HazVu map showing the liquefaction (soft soil) hazard area.

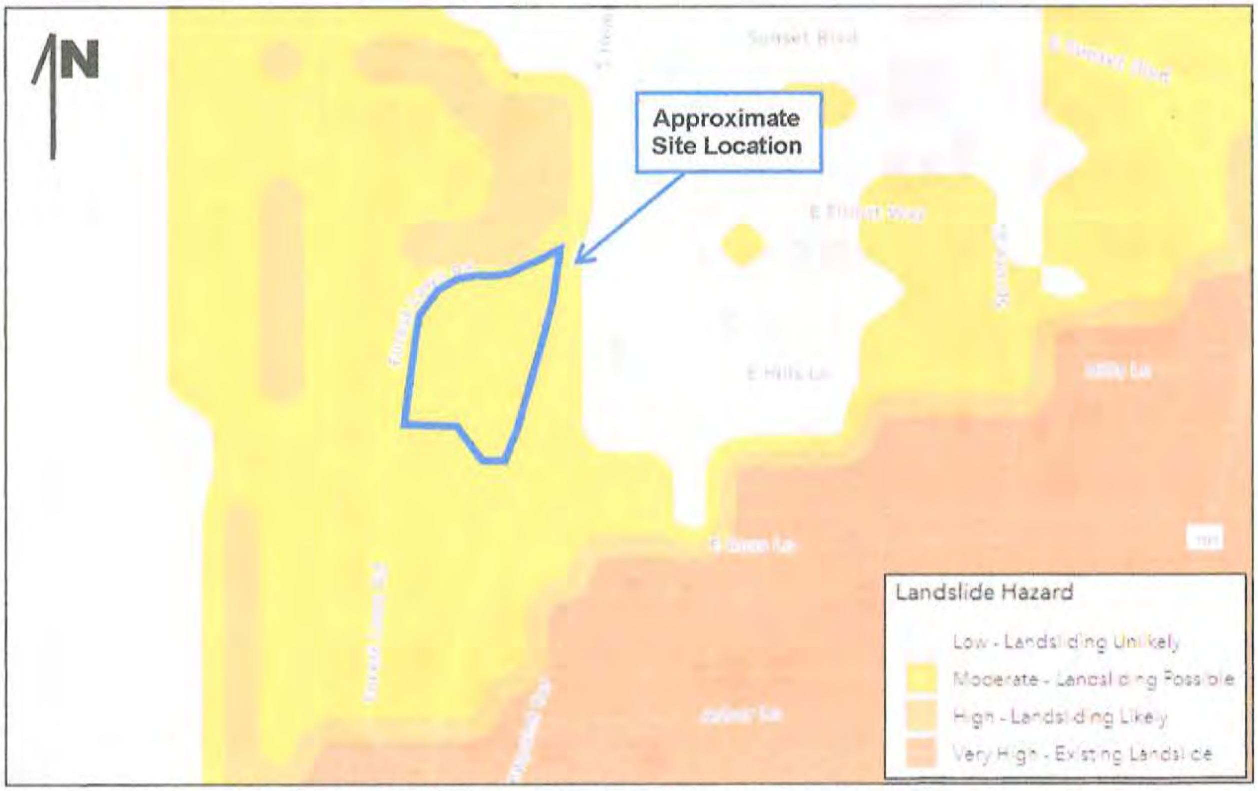

Figure 8: HazVu map showing the landslide hazard zones.

Exhibit A-2

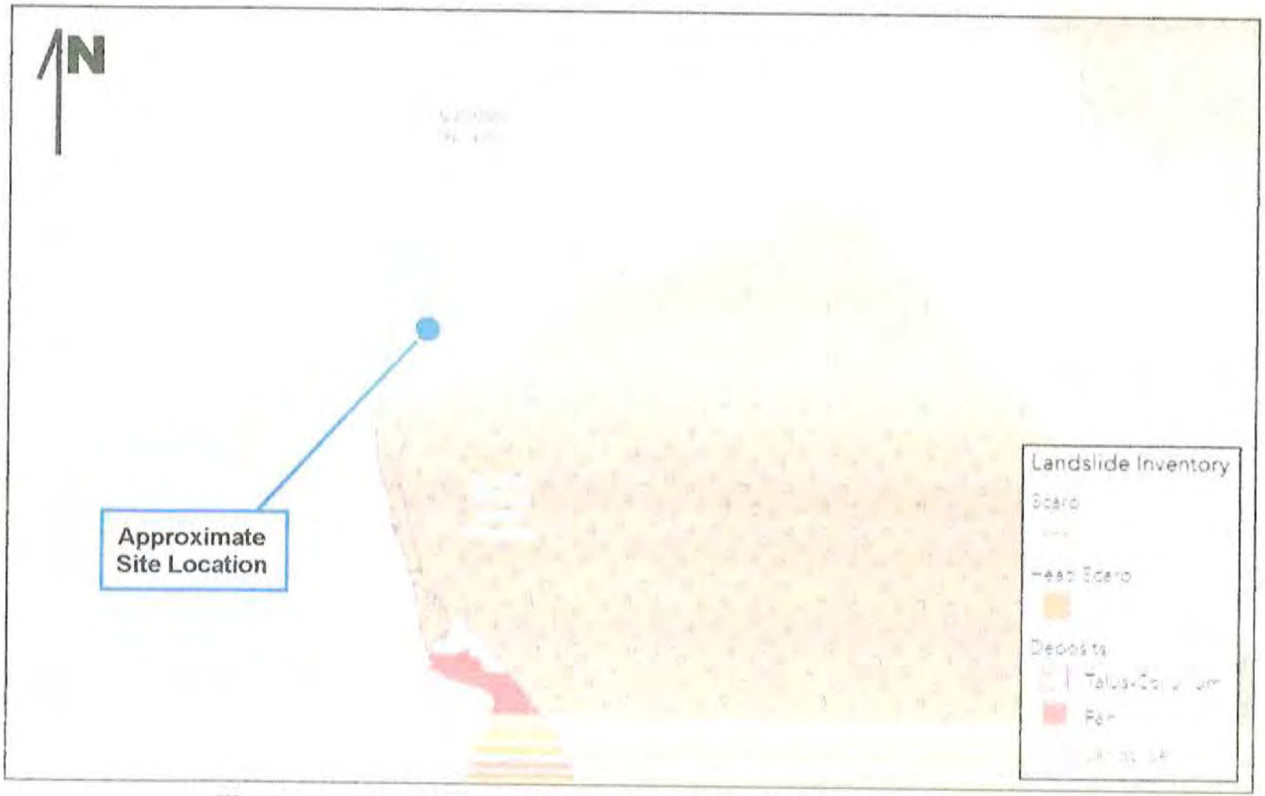

Figure 9: HazVu map showing the mapped landslide deposits.

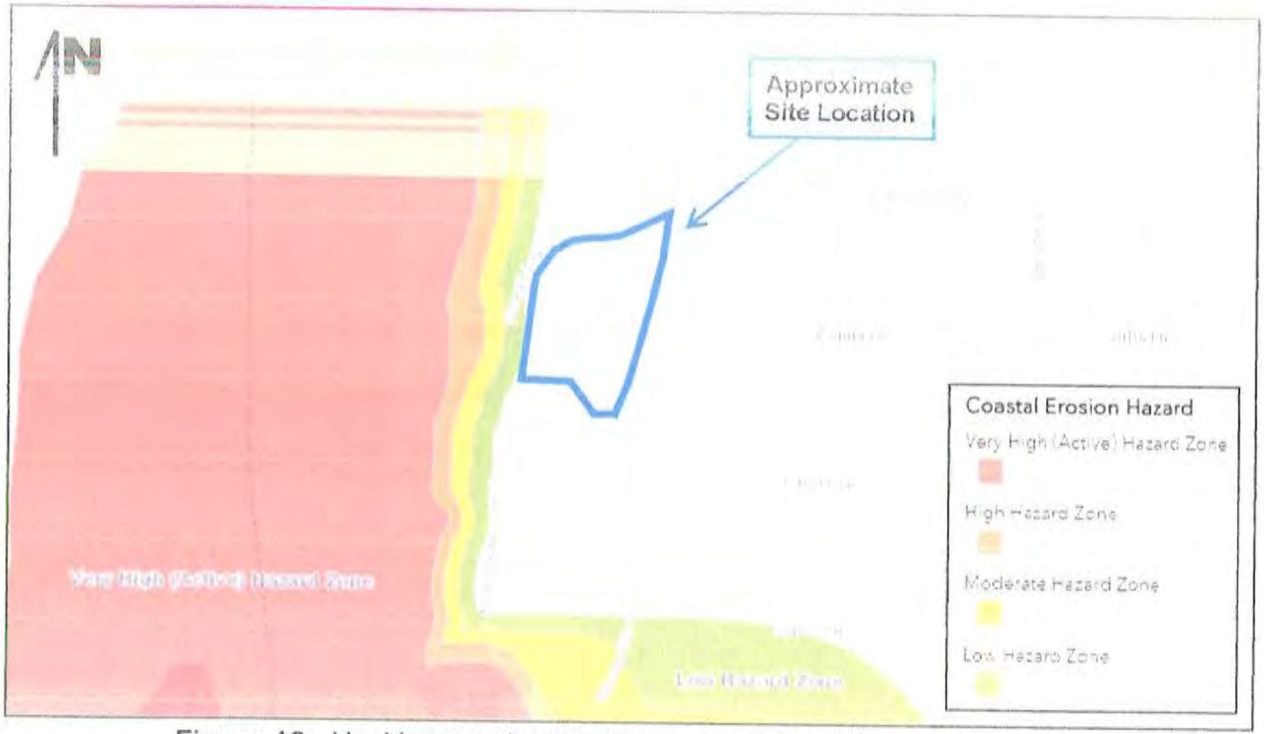

Figure 10: HazVu map showing the mapped coastal erosion hazard.

In addition, we reviewed the Northwest Association of Networked Ocean Observing Systems (NANOOS) Visualization System (NVS) for information on tsunami hazard in proximity to the subject property.[6] The NVS maps the subject property within a local earthquake and tsunami region. See Figure 11 below.

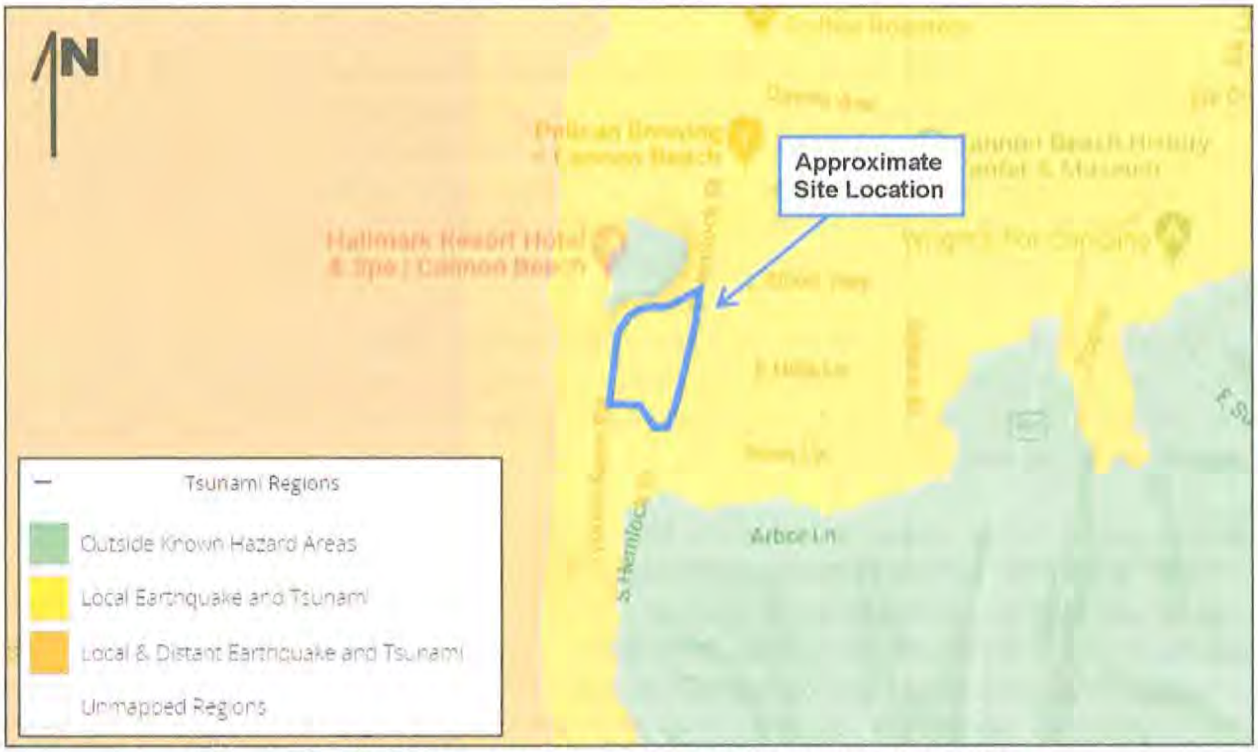

Figure 11: NVS map showing the mapped tsunami hazard region.

Based on our site reconnaissance, subsurface explorations, and office research, we consider the site to have the following geologic hazards:

- Earthquake shaking from regional seismic activity.
- Landslide hazard.
- Potential settlement/movement associated with compressible, near surface soils and liquefaction potential.
- Coastal erosion.
- Tsunami hazard from a local CSZ earthquake.

As stated above, the subject property is surrounded by ancient landslides, and is mapped within a moderate landslide hazard area (i.e. landsliding possible). Although the subject property is not mapped within an ancient landslide, the compressible, variable soils we encountered to depths of 30 to 40 feet are consistent with landslide material we have observed in the area. It is very normal/typical for the shallow, compressible soils to slide after wet winter weather or a seismic

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[6] Northwest Association of Networked Ocean Observing Systems (NANOOS) Visualization System (NVS), available online at http://nvs.nanoos.org/TsunamiEvac accessed 5/31/2022.

event. We do not believe this property is at any greater risk from this hazard than the other numerous existing developed lots in the neighborhood. That being said, we recommend that at a minimum, any house foundations be designed to protect life-safety (i.e. the house is allowed to be damaged by landsliding but the structure stays intact long enough for the occupants to evacuate).

As shown in Figure 10 above, the western property line is mapped within a low risk of coastal erosion hazard. Although we do not believe that the subject property is at immediate risk from coastal erosion, it could recede back towards the home gradually over time. We envision that it would occur in several sequences that would allow for addressing the issue before it ever reached the house. In addition, any structures would be protected from erosion if supported on a foundation that bears directly on the more stable sandstone stratum (i.e. piles).

As shown in Figure 11 above, the property is at risk of being inundated by a tsunami. We are not providing any geotechnical recommendations for mitigating that risk from tsunami level events. Developing on the lot means that the property owner needs to accept the risk of damage to the residences in the event of a tsunami.

In summary, it is our professional opinion that the proposed residential development on this property is feasible, subject to the geotechnical engineering recommendations and acceptance of geologic hazards risk presented in this report. Primary considerations should be made to not placing any new fill to raise site grades, and maintaining adequate site surface and subsurface drainage. Vegetation should also be maintained to prevent excessive erosion, and should only be removed where needed to complete the proposed construction. Additionally, the house foundations should extend to the native sandstone and be engineered with the idea of resisting the effects of earthquake shaking. These recommendations are discussed in more detail in Section 4 below. Ultimately, owning a home in this area means there is an acceptance of risk that the property is located among very large ancient landslide deposits and within a landslide hazard area that could reactivate at some time in the future, possibly en masse due to a Cascadia Subduction Zone earthquake event.

4.0 EVALUATION AND FOUNDATION RECOMMENDATIONS

4.1 Geotechnical Discussion

Based on our site reconnaissance, it is our professional opinion that the primary factors impacting the proposed development include the following:

1. **Presence of weak, compressible, organic soils** – As discussed above, we encountered compressible, organic soils to a depth of approximately 30 to 40 feet bgs. The compressible soils encountered had an N-value average of 2 (i.e. generally loose). It is our professional opinion that these compressible soils are not sufficient for shallow foundation support. As such, we recommend all foundations penetrate through these variable soils to bear on the medium dense to very dense sandstone first encountered in our borings at a depth of 30 to 40 feet bgs. See Section 4.5 below for detailed deep foundation recommendations (i.e. pin piles or helical piers).

2. **Presence of potentially liquefiable soils** – As stated above, there are potentially liquefiable soils located at the project site. Based on our analysis, approximately 9- to 13-inches of total dynamic settlement due to liquefaction could occur with potential differential settlements up to approximately 4.5- to 10-inches across the proposed buildings' footprints. This much settlement precludes the use of shallow foundations. As stated above, we are recommending deep foundations for the proposed development that will mitigate risk of settlement in a design level earthquake event.

3. **Presence of organics** – As stated above, we encountered heavy organics (i.e. wood chips and rootlets) in all of our explorations. The presence of organics extended to depths of 25 to 30 feet bgs. It is our professional opinion that this material is not sufficient to provide shallow foundation support without risking excess total and differential settlements. As such, we are providing deep foundation recommendations that penetrate through these organic soils to bear on the medium dense to very dense sandstone stratum encountered at a depth of approximately 30 to 40 feet bgs. In addition, the organic soils are unsuitable for use as structural fill.

4. **Shallow groundwater** – As previously mentioned, we encountered groundwater at depths ranging from 1 to 6 feet bgs across the subject property at the time of our subsurface investigation. The contractor should anticipate the need to dewater for any excavations deeper than about 1-foot. The need to dewater can be lessened if the construction occurs in the dry summer and early fall months. Detailed dewatering design is typically left up to the contractor's means and methods, and is not part of our current scope of services.

5. **Limited explorations** – As stated above, the project is in its preliminary stages. As a result, the property has not been cleared for accessibility and we were therefore only able

to advance drilled borings on the outer portion of the proposed development (i.e. along the property line). It should be noted we did advance hand tool explorations in the southern portion of the property (i.e. where it is not as densely vegetated), however based on the limited nature of hand tool explorations, we were unable to determine the depth to sandstone in these areas. Once the project is further along and the site is more accessible, we would be available to perform additional drilled borings. This is not a requirement; it is just a suggestion if there is a desire by the project team to better define the depth the piles will need to go to reach the dense sandstone stratum.

6. **Lack of detailed design drawings** – Given this project is in its preliminary stages, we have not been provided with a detailed design drawing set for the proposed construction. One the drawings are complete, we should be forwarded a copy to review for compliance with our geotechnical engineering recommendations.

In summary, this site appears to be developable provided our geotechnical engineering recommendations are followed and the geologic hazard risks are acceptable.

4.2 Site Preparation

Minimal site preparation will be required to install the piles. Any utilities present beneath the proposed construction will need to be located and rerouted as necessary and any abandoned pipes or utility conduits should be removed to inhibit the potential for subsurface erosion. Utility trench excavations should be backfilled with properly compacted structural fill as discussed in Section 4.3 below.

4.3 Structural Fill

Any structural fill placed should be granular, free of organic or other deleterious materials, have a maximum particle size less than 3 inches, be relatively well graded, and have a liquid limit less than 45 and plasticity index less than 25. In our professional opinion, on-site soils are **not** appropriate for use as fill due to the presence of organics. As such, we recommend importing granular, well graded, crushed rock structural fill. Typically, we recommend fill be moisture conditioned to within 3 percentage points below and 2 percentage points above optimum moisture as determined by ASTM D1557 (Modified Proctor). If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying.

Fill should be placed in a relatively uniform horizontal lift on the prepared subgrade. Each loose lift should be about 1 foot. The type of compaction equipment used will ultimately determine the maximum lift thickness. Structural fill should be compacted to at least 92 percent of the Modified Proctor maximum dry density as determined by ASTM D1557.

Each lift of compacted engineered fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. The fill should extend horizontally outward beyond the exterior perimeter of the building and pavements at least 5 and 3 feet, respectively, prior to sloping.

4.4 Foundation Recommendations

4.4.1 Pin Pile Recommendations

Once the site has been prepared, we recommend the proposed buildings be supported by 6-inch diameter, schedule 80 steel pipe piles driven to practical refusal using a hydraulic 2,000-pound hammer or equivalent. We also recommend the pin piles all be connected by an integrated, gridded system of rigid grade beams. Refusal for a 6-inch diameter pipe pile using a hammer of this size should be defined as less than 1-inch of penetration in 10 seconds or more. When practical, this refusal criteria should be met for the last 60 seconds of pile driving.

Assuming the piles are driven to refusal using these criteria, the allowable axial capacity for a pile installed vertically would be 30 kips in compression. This allowable axial capacity assumes a factor of safety of 2.0. We recommend a maximum lateral load resistance of 1.0 kip for each vertical pile as long as they are spaced a distance of at least 6D (measured from center to center) where D represents the diameter of the pile. If additional lateral load resistance is needed, we can provide battered pile recommendations.

Based on the known subsurface conditions we anticipate that properly constructed pin pile foundations driven to refusal will experience static settlements less than 1-inch and 1/2-inch of total and differential settlement, respectively. We estimate that the average pile driving refusal depth will be encountered at approximately 40 to 50 feet bgs.

4.4.2 Helical Pier Recommendations

We are also providing helical pier recommendations for the subject site to minimize noise disturbance (i.e. from driving the pin piles). It should be noted that helical piers can hit shallow refusal due to subsurface obstructions (i.e. rocks and/or debris). We encountered heavy organics and trace gravel in our explorations. As such, the contractor should anticipate the need to put in additional effort to get through the debris.

We recommend galvanized round shaft helical piers with a 12-inch diameter single helix. The helical piers should be installed so that the helix is embedded into the medium dense to very dense sandstone encountered at depths of 30 to 40 feet bgs in both of our explorations. In order to achieve the design loads outlined below, the helix needs to be embedded at least 1 foot. For preliminary budgeting purposes, we recommend the helical piers be planned for lengths of 35 to 45 feet.

We have assumed a 2-7/8 inch diameter round shaft helical piers will be used. The 2-7/8-inch diameter helical piers are typically manufactured to have a maximum axial compressive load capacity of 80 kips. Applying a FOS of 2, the piers can be designed for an allowable load capacity of 40 kips. If greater load capacity is needed, a larger shaft diameter can be selected. If requested, we can provide load capacities for larger shaft diameters. In order to use a FOS of 2, at least one helical pier should be load tested in compression for the project. If no load test is performed, then a FOS of 3 should be used.

Any helical piles installed vertically (i.e. not battered) may be designed for an allowable lateral load of up to 1 kip. If additional lateral loads are required the piles should be battered to achieve the necessary loads.

To utilize the fully recommended capacity, the helical piers should be laterally spaced no closer than 3 pier diameters, measured center to center (i.e. 3 feet for a piers with a 12-inch lead helical).

EEI should be scheduled to be on site when each helical pier is installed to inspect the installation and verify our recommendations are met. We also should be scheduled to be on site to inspect and approve the pile load test.

4.5 Floor Slab Recommendations

For the purposes of this report, we have assumed that maximum floor slab loads will not exceed 150 psf. Based on the existing soil conditions, the design of the floor slab can be based on a subgrade modulus (k) of 100 pci. This subgrade modulus value represents an anticipated value which would be obtained in a standard in-situ plate test with a 1-foot square plate. Use of this subgrade modulus for design or other on-grade structural elements should include appropriate modification based on dimensions as necessary.

In order to fully mitigate the risk of settlement, the concrete floor slab would need to be tied into the grade beams and supported on the deep foundation elements recommended above (i.e. designed as a structural floor slab). However, if a conventional, less expensive floor slab-on-grade is preferred, to at least partially mitigate the risk of potential settlement, the floor slab should be supported on at least 12-inches of properly compacted crushed rock gravel structural fill overlying the existing soils. This approach means that there is some acceptance of risk that there could be settlement cracking in floor slabs on grade. The structural fill recommendations are outlined in Section 4.3 above. The floor slabs should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage.

Prior to placing the structural fill, the exposed subgrade surface should be prepared as discussed in Section 4.2. In addition, we recommend a proof-roll utilizing a fully loaded, dual axle dump truck or water truck in order to identify any unstable areas that should be removed prior to structural fill placement. The proofroll should be observed by a representative of the Geotechnical Engineer. If the subgrade cannot be accessed with a dump truck, then the subgrade will need to be visually evaluated by a representative of the Geotechnical Engineer by soil probing. If fill is required, the structural fill should be placed on the prepared subgrade after it has been approved by the Geotechnical Engineer.

The 12-inch thick crushed rock structural fill should provide a capillary break to limit migration of moisture through the slab. If additional protection against moisture vapor is desired, a moisture vapor retarding membrane may also be incorporated into the design. Factors such as cost, special considerations for construction, and the floor coverings suggest that decisions on the use of vapor retarding membranes be made by the project design team, the contractor and the owner.

4.6 Retaining Wall Recommendations

As stated above, the project is currently in its preliminary stages. As such, we have not been made aware of any proposed retaining walls. Once more detailed plans are known about retaining walls (if any), we should be provided the drawings so that we can update our recommendations as necessary. For the purposes of this report, we have assumed that no walls will be greater than 10 feet tall.

Retaining wall footings should be designed in general accordance with the recommendations contained in Section 4.4 above (i.e. pin piles or helical piers). For insignificant landscape retaining walls not greater than 4 feet tall, where excessive wall movement due to ground movement is acceptable and not a risk to life-safety, they may be supported on conventional shallow foundations designed for an allowable soil bearing capacity of up to 1,500 pounds per square foot.

Lateral earth pressures on walls, which are not restrained at the top, may be calculated on the basis of an "active" equivalent fluid pressure of 35 pcf for level backfill, and 60 pcf for sloping backfill with a maximum 2H:1V slope. Lateral earth pressures on walls that are restrained from yielding at the top (i.e. stem walls) may be calculated on the basis of an "at-rest" equivalent fluid pressure of 55 pcf for level backfill, and 90 pcf for sloping backfill with a maximum 2H:1V slope. The stated equivalent fluid pressures do not include surcharge loads, such as foundation, vehicle, equipment, etc., adjacent to walls, hydrostatic pressure buildup, or earthquake loading. Surcharge loads on walls should be calculated based on the attached calculations/formulas shown in Appendix H.

We recommend that retaining walls be designed for an earth pressure determined using the Mononobe-Okabe method to mitigate future seismic forces. Our calculations were based on one-half of the Design Peak Ground Acceleration (PGA) value of 0.422g, which was obtained from Table 1 above. We have assumed that the retained soil/rock will have a minimum friction angle of 29 degrees and a total unit weight of about 115 pounds per cubic foot. For seismic loading on retaining walls with level backfill, new research indicates that the seismic load is to be applied at 1/3 H of the wall instead of 2/3 H, where H is the height of the wall[7]. We recommend that a Mononobe-Okabe earthquake thrust per linear foot of 13.7 psf * H^2 be applied at 1/3 H, where H is the height of the wall measured in feet. Note that the recommended earthquake thrust value is appropriate for slopes behind the retaining wall of up to 10 degrees.

Any minor amount of backfill for retaining walls should be select granular material, such as sand or crushed rock with a maximum particle size between ¾ and 1 ½ inches, having less than 5 percent material passing the No. 200 sieve. As stated above, the onsite soils do not meet the requirement for structural fill, and it will be necessary to import material to the project for structure backfill. Silty soils can be used for the last 18 to 24 inches of backfill, thus acting as a seal to the granular backfill.

All backfill behind retaining walls should be moisture conditioned to within ± 2 percent of optimum moisture content, and compacted to a minimum of 90 percent of the material's maximum dry density as determined in accordance with ASTM D1557. Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches. Care in the placement and compaction of fill behind retaining walls must be taken in order to ensure that undue lateral loads are not placed on the walls.

---

[7] Lew, M., et al (2010). "Seismic Earth Pressures on Depp Building Basements," SEAOC 2010 Convention Proceedings, Indian Wells, CA.

5.0 CONSTRUCTION CONSIDERATIONS

EEI should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. EEI cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundations if not engaged to also provide construction observation for this project.

5.1 Moisture Sensitive Soils/Weather Related Concerns

The upper soils encountered at this site are expected to be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. While not required, it will be advantageous to perform earthwork and foundation construction activities during dry weather.

5.2 Drainage and Groundwater Considerations

Water should not be allowed to collect in the foundation excavations or on prepared subgrades for the floor slab during construction. Positive site drainage should be maintained throughout construction activities. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff.

The site grading plan should be developed to provide rapid drainage of surface water away from the building areas and to inhibit infiltration of surface water around the perimeter of the building and beneath the floor slab. The grades should be sloped away from the building area. Stormwater should be piped (tightlined) to an existing city storm sewer or to a drainage ditch.

5.3 Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document and subsequent updates were issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

Exhibit A-2

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. EEI does not assume responsibility for construction site safety or the contractor's compliance with local, state, and federal safety or other regulations.

6.0 REPORT LIMITATIONS

As is standard practice in the geotechnical industry, the conclusions contained in our report are considered preliminary because they are based on assumptions made about the soil, rock, and groundwater conditions exposed at the site during our subsurface investigation. A more complete extent of the actual subsurface conditions can only be identified when they are exposed during construction. Therefore, EEI should be retained as your consultant during construction to observe the actual conditions and to provide our final conclusions. If a different geotechnical consultant is retained to perform geotechnical inspection during construction, then they should be relied upon to provide final design conclusions and recommendations, and should assume the role of geotechnical engineer of record, as is the typical procedure required by the governing jurisdiction.

The geotechnical recommendations presented in this report are based on the available project information, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform EEI in writing so that we may amend the recommendations presented in this report, if appropriate, and if desired by the client. EEI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Once construction plans are finalized and a grading plan has been prepared, EEI should be retained to review those plans, and modify our existing recommendations related to the proposed construction, if determined to be necessary.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of Patrick/Dave, LLC for the specific application to the proposed Forest Lawn ***Development*** located on County Tax Lot No. 51030DA04100 in Cannon Beach, Clatsop County, Oregon. EEI does not authorize the use of the advice herein nor the reliance upon the report by third parties without prior written authorization by EEI.

APPENDICES

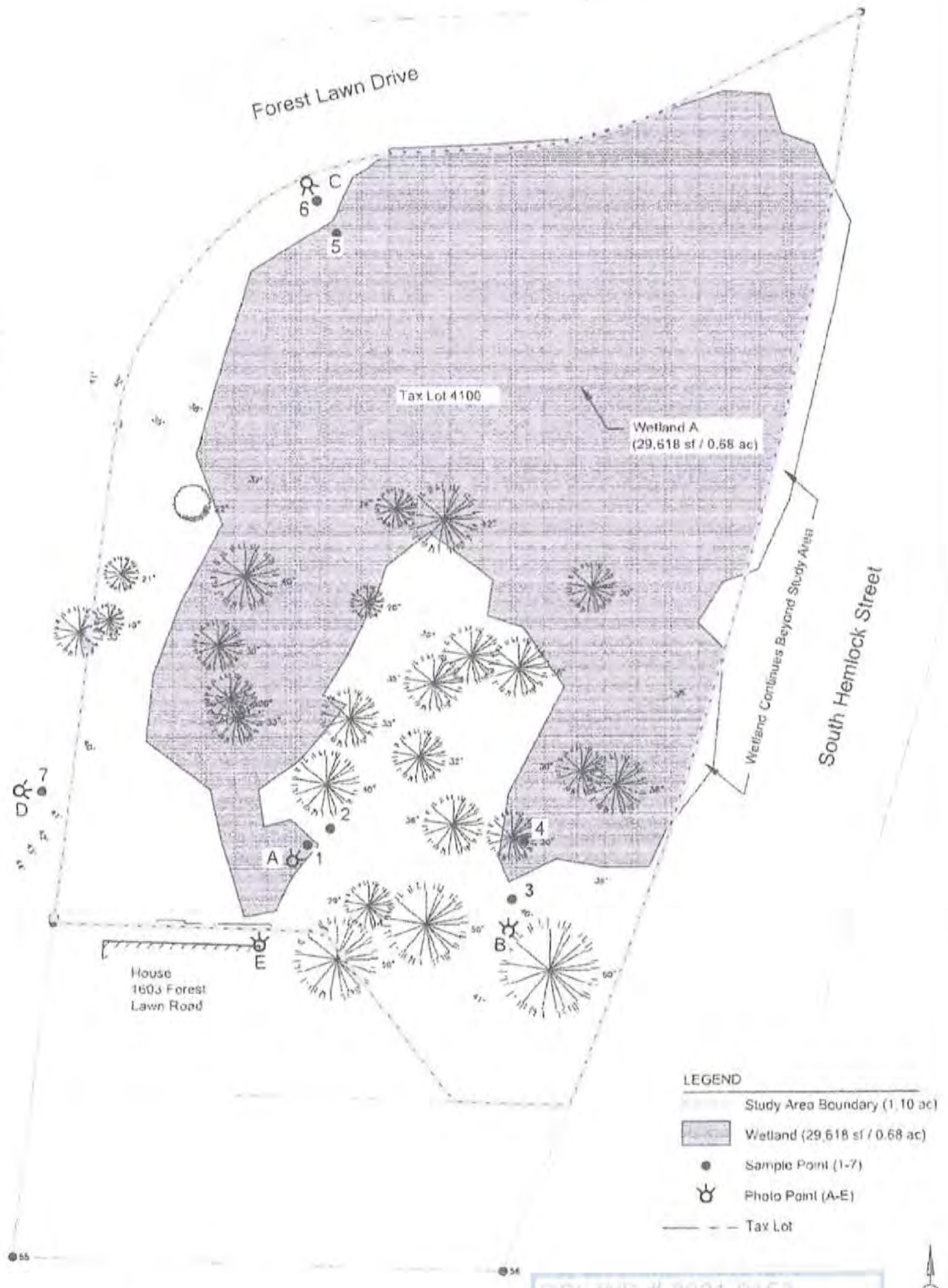
Exhibit A-2

APPENDIX F

NEARBY HISTORIC WELL LOGS

Exhibit A-2

#4



Survey provided by S&F Land Services, 2020. Accuracy of Survey, Sample Points, and Tax Lot boundaries is sub-centimeter.

DSL WD # 2021-0153
Approval Issued 6/8/2021
Approval Expires 6/8/2026

Pacific Habitat Services, Inc.

Wetland Delineation
Tax Lot 4100 - Cannon Beach, Oregon

FIGURE
6

Exhibit A-2

[redacted]

WETLAND DELIN. CONCUR.

Oregon

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
(503) 986-5200
FAX (503) 378-4844
www.oregon.gov/dsl
State Land Board

Kate Brown
Governor

Shemia Fagan
Secretary of State

Tobias Read
State Treasurer

June 8, 2021

Patrick/Dave, LLC
Attn: Patrick Gemma
2575 38th Avenue West
Seattle, WA 98199

Re: WD # 2021-0153 **Approved**
Wetland Delineation Report for Tax Lot 4100 on Forest Lawn Drive
Clatsop County; T5N R10W 30DA TL4100
Cannon Beach Local Wetlands Inventory, Wetland 24

Dear Mr. Gemma:

The Department of State Lands has reviewed the wetland delineation report prepared by Pacific Habitat Services for the site referenced above. Based upon the information presented in the report, we concur with the wetland boundaries as mapped in revised Figure 6 of the report. Please replace all copies of the preliminary wetland map with this final Department-approved map.

Within the study area, one wetland (Wetland A, totaling approximately 0.68 acres) was identified. This wetland is subject to the permit requirements of the state Removal-Fill Law. Under current regulations, a state permit is required for cumulative fill or annual excavation of 50 cubic yards or more in wetlands or below the ordinary high-water line (OHWL) of the waterway (or the 2-year recurrence interval flood elevation if OHWL cannot be determined).

This concurrence is for purposes of the state Removal-Fill Law only. We recommend that you attach a copy of this concurrence letter to any subsequent state permit application to speed application review. Federal or local permit requirements may apply as well. The U.S. Army Corps of Engineers will determine jurisdiction under the Clean Water Act, which may require submittal of a complete Wetland Delineation Report.

Please be advised that state law establishes a preference for avoidance of wetland impacts. Because measures to avoid and minimize wetland impacts may include reconfiguring parcel layout and size or development design, we recommend that you work with Department staff on appropriate site design before completing the city or county land use approval process.

Exhibit A-2

This concurrence is based on information provided to the agency. The jurisdictional determination is valid for five years from the date of this letter unless new information necessitates a revision. Circumstances under which the Department may change a determination are found in OAR 141-090-0045 (available on our web site or upon request). In addition, laws enacted by the legislature and/or rules adopted by the Department may result in a change in jurisdiction; individuals and applicants are subject to the regulations that are in effect at the time of the removal-fill activity or complete permit application. The applicant, landowner, or agent may submit a request for reconsideration of this determination in writing within six months of the date of this letter.

Thank you for having the site evaluated. If you have any questions, please contact the Jurisdiction Coordinator, Jessica Imbrie, at (503) 986-5250.

Sincerely,

Pete Ryan

Peter Ryan, SPWS
Aquatic Resource Specialist

Enclosures

ec: John van Staveren, SPWS, Pacific Habitat Services
City of Cannon Beach Planning Department (Maps enclosed for updating LWI)
Brad Johnson, Corps of Engineers
Dan Cary, SPWS, DSL
Oregon Coastal Management Program (coast.permits@state.or.us)

Exhibit A-2

Project #6978
2/16/2021

Pacific Habitat Services, Inc.
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

Tax Lot Map
Tax Lot 4100 - Cannon Beach, Oregon
The Oregon Map (ormap.net)

FIGURE
2

Exhibit A-2

[redacted]
Juris. Determ.

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, PORTLAND DISTRICT
P.O. BOX 2946
PORTLAND, OR 97208-2946

April 15, 2021

Regulatory Branch
Corps No.: NWP-2021-159

Patrick Gemma
Patrick/Dave, LLC
2575 38th Avenue West
Seattle, Washington 98199
pgemma@prologis.com

Dear Mr. Gemma:

The U.S. Army Corps of Engineers (Corps) received your request for an Approved Jurisdictional Determination (AJD) of the waters or water features, including wetlands, within the review area as shown on the enclosed drawings (Enclosure 1). The review area is located between Forest Lawn Road and South Hemlock Street Cannon Beach, Clatsop County, Oregon at Latitude/Longitude: 45.8864°, -123.9628°. Other waters or water features, including wetlands, that may occur on this property or on adjacent properties outside the review area are not the subject of this determination.

The Corps has determined Wetland A within the review area is not a water of the U.S. The enclosed drawings (Enclosure 1) identify the size and boundaries of the delineated wetland. The enclosed *Approved Jurisdictional Determination Form (Interim)* (Enclosure 2) provides the basis for jurisdiction. A copy of the AJD Form can also be found on our website at: http://www.nwp.usace.army.mil/Missions/Regulatory/Appeals/.

If you object to the enclosed AJD, you may request an administrative appeal under 33 CFR Part 331 as described in the enclosed *Notification of Administrative Appeal Options and Process and Request for Appeal* (*RFA*) form (Enclosure 3). To appeal this AJD, you must submit a completed *RFA* form to the Corps Northwestern Division (NWD) office at the address listed on the form. In order for the request for appeal to be accepted, the Corps must determine that the form is complete, that the request meets the criteria for appeal under 33 CFR Part 331.5, and the form must also be received by the NWD office within 60 days from the date on the form. It is not necessary to submit the form to the NWD office if you do not object to the enclosed AJD.

The delineation included herein has been conducted to identify the location and extent of the aquatic resource boundaries and/or the jurisdictional status of aquatic resources for purposes of the Clean Water Act for the particular site identified in this request. This delineation and/or jurisdictional determination may not be valid for the Wetland Conservation Provisions of the Food Security Act of 1985, as amended. If you

Exhibit A-2

or your tenant are U.S. Department of Agriculture (USDA) program participants, or anticipate participation in USDA programs, you should discuss the applicability of a certified wetland determination with the local USDA service center, prior to starting work.

This AJD is valid for a period of five years from the date of this letter unless new information warrants revisions of the determination.

We would like to hear about your experience working with the Portland District, Regulatory Branch. Please complete a customer service survey form at the following address: https://corpsmapu.usace.army.mil/cm_apex/f?p=136:4.

If you have any questions regarding our Regulatory Program or permit requirements for work in waters of the U.S., please contact Mr. Brad Johnson by telephone at (503) 808-4383 or e-mail at: Brad.A.Johnson2@usace.army.mil.

Sincerely,

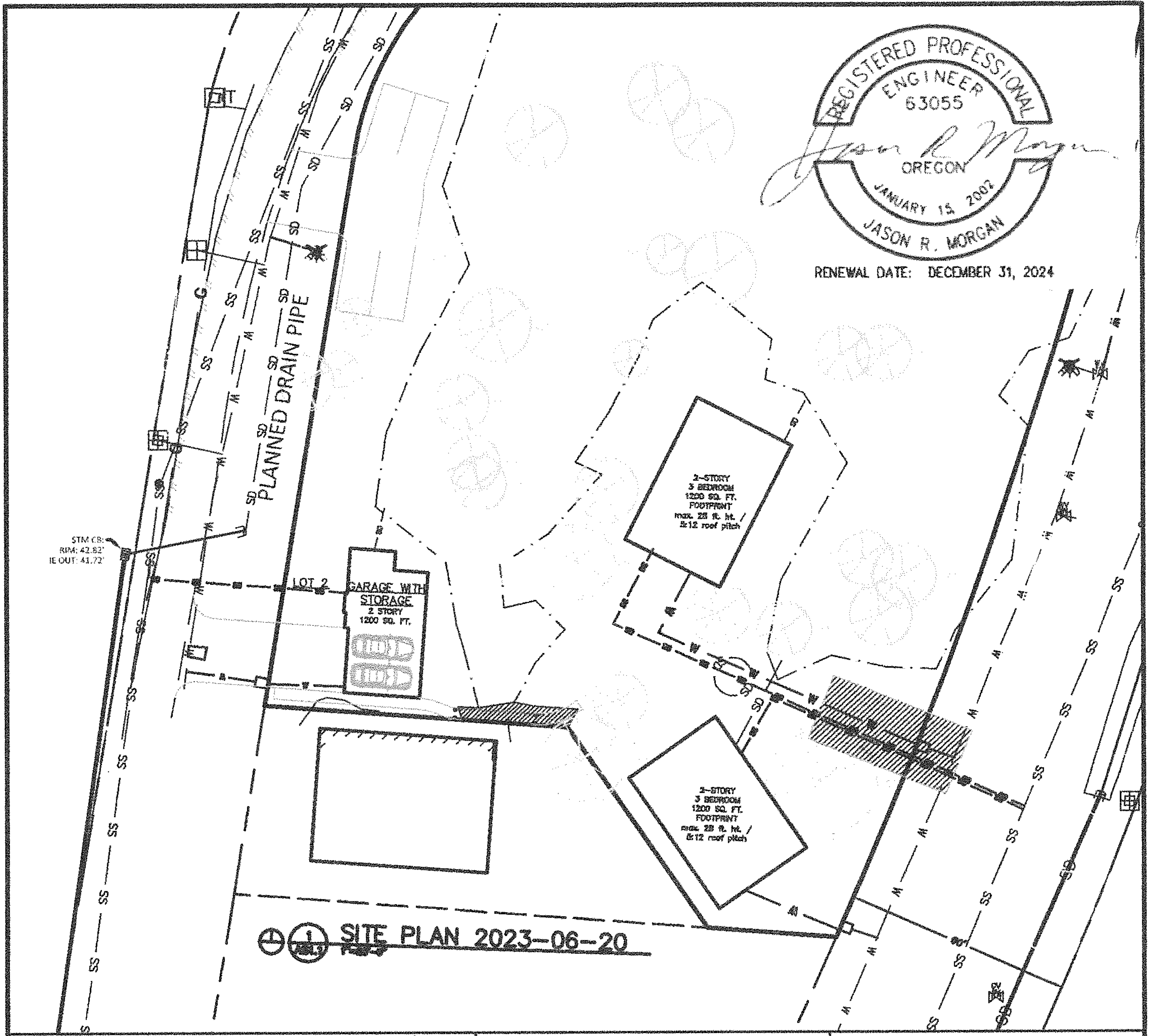
For: William D. Abadie
Chief, Regulatory Branch

Enclosures

cc with drawings:
Oregon Department of State Lands (Dan Cary, dan.cary@dsl.state.or.us)
Oregon Department of Environmental Quality (401applications@deq.state.or.us)
Pacific Habitat Services (John van Staveren, jvs@pacifichabitat.com)

Exhibit A-2

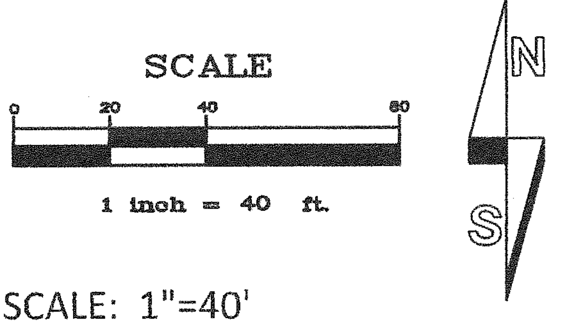
#5



REGISTERED PROFESSIONAL ENGINEER
63055
OREGON
JANUARY 15, 2002
JASON R. MORGAN

Jason R. Morgan

RENEWAL DATE: DECEMBER 31, 2024



SCALE: 1"=40'

EXISTING
- W — WATER MAIN
- SS — SEWER MAIN
- STORM PIPE

PROPOSED
- W — WATER SERVICE
- SS — SEWER SERVCIE
- SD — STORM MAIN

AUG 22, 2023

PATRICK GEMMA

TAX LOT 4100
FOREST LAWN DRIVE
UTILITY LAYOUT
CANNON BEACH/MAP 5N 10W 30DA

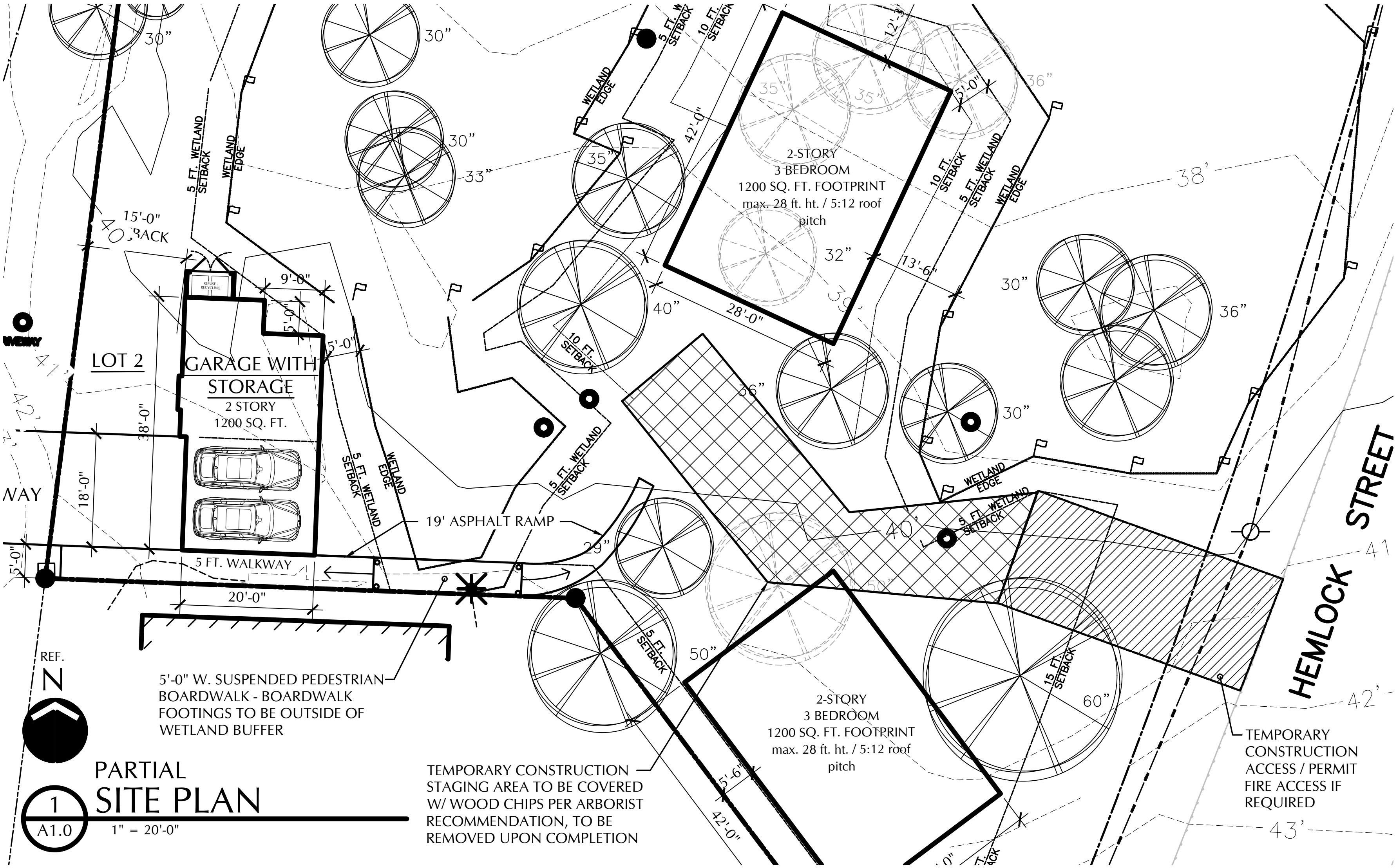
MORGAN CIVIL ENGINEERING, INC.

PO BOX 358
MANZANITA, OR 97130
(503) 801-6016
www.morgancivil.com

- CIVIL ENGINEERING
- INSPECTION
- PLANNING

Exhibit A-2

Exhibit A-3



A1.0

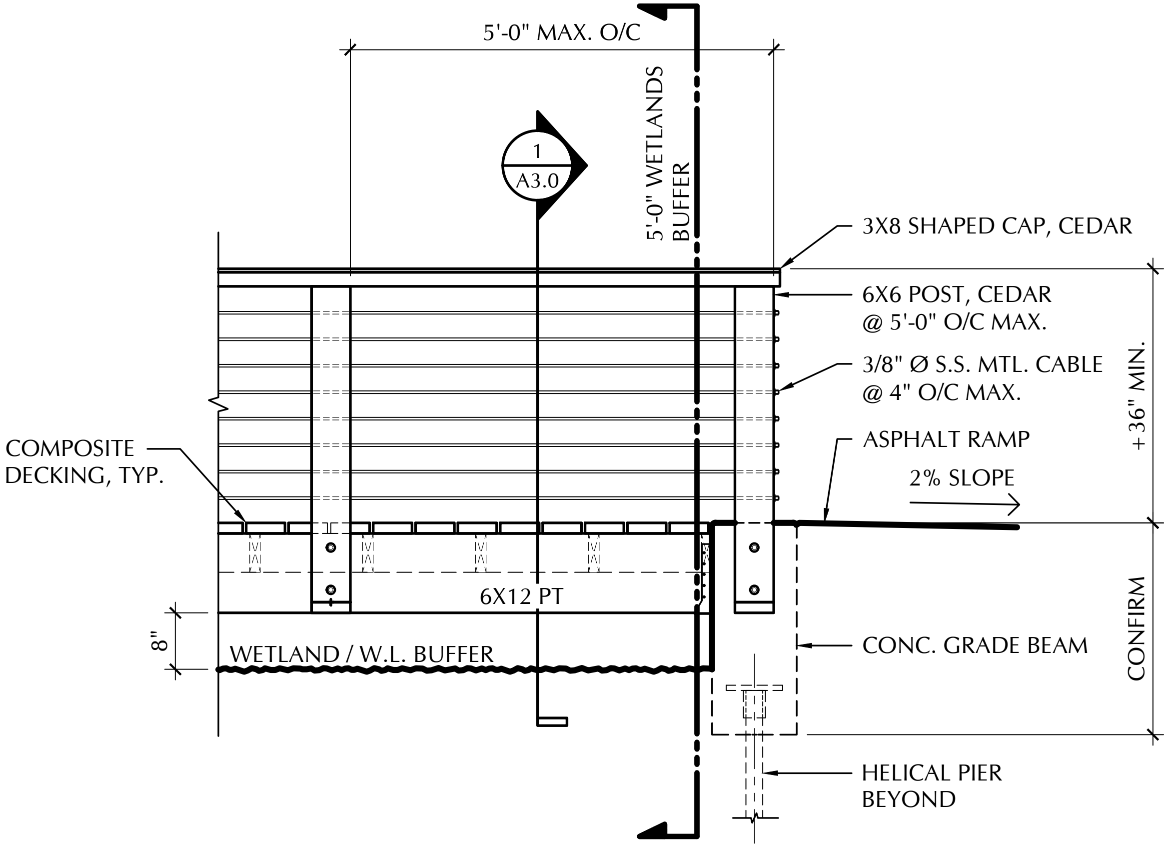
FOREST LAWN DEVELOPMENT
SITE PLAN

CANNON BEACH OR 97110
10-19-2023

Tolovana Architect LLC
P.O Box 563
Cannon Beach, Oregon 97110

REGISTERED ARCHITECT
STATE OF OREGON

Exhibit A-3



PARTIAL
BOARDWALK ELEVATION
1
A2.0
1/2" = 1'-0"

A2.0

FOREST LAWN DEVELOPMENT
BOARDWALK ELEVATION

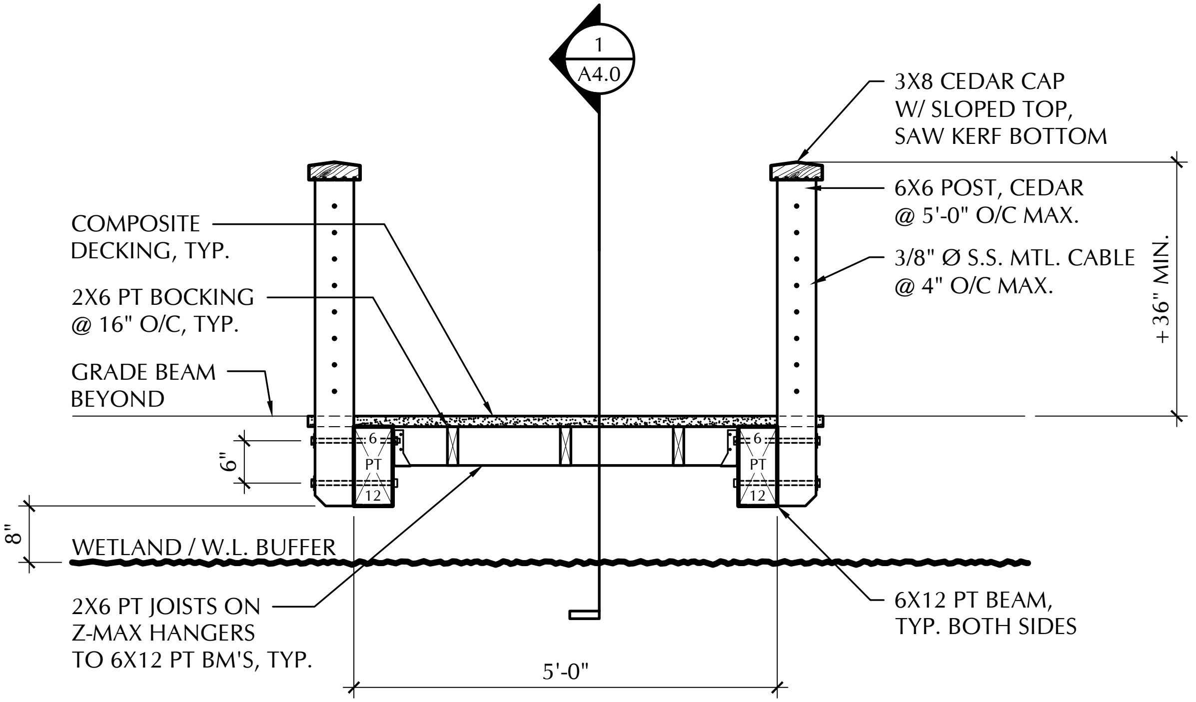
CANNON BEACH OR 97110
10-19-2023

Tolovana Architect LLC
P.O Box 563
Cannon Beach, Oregon 97110

COPYRIGHT
TOLOVANA ARCHITECTS, LLC
2023

REGISTERED ARCHITECT
STATE OF OREGON

Exhibit A-3



1
A3.0

BOARDWALK CROSS SECTION

1/2" = 1'-0"

A3.0

FOREST LAWN DEVELOPMENT

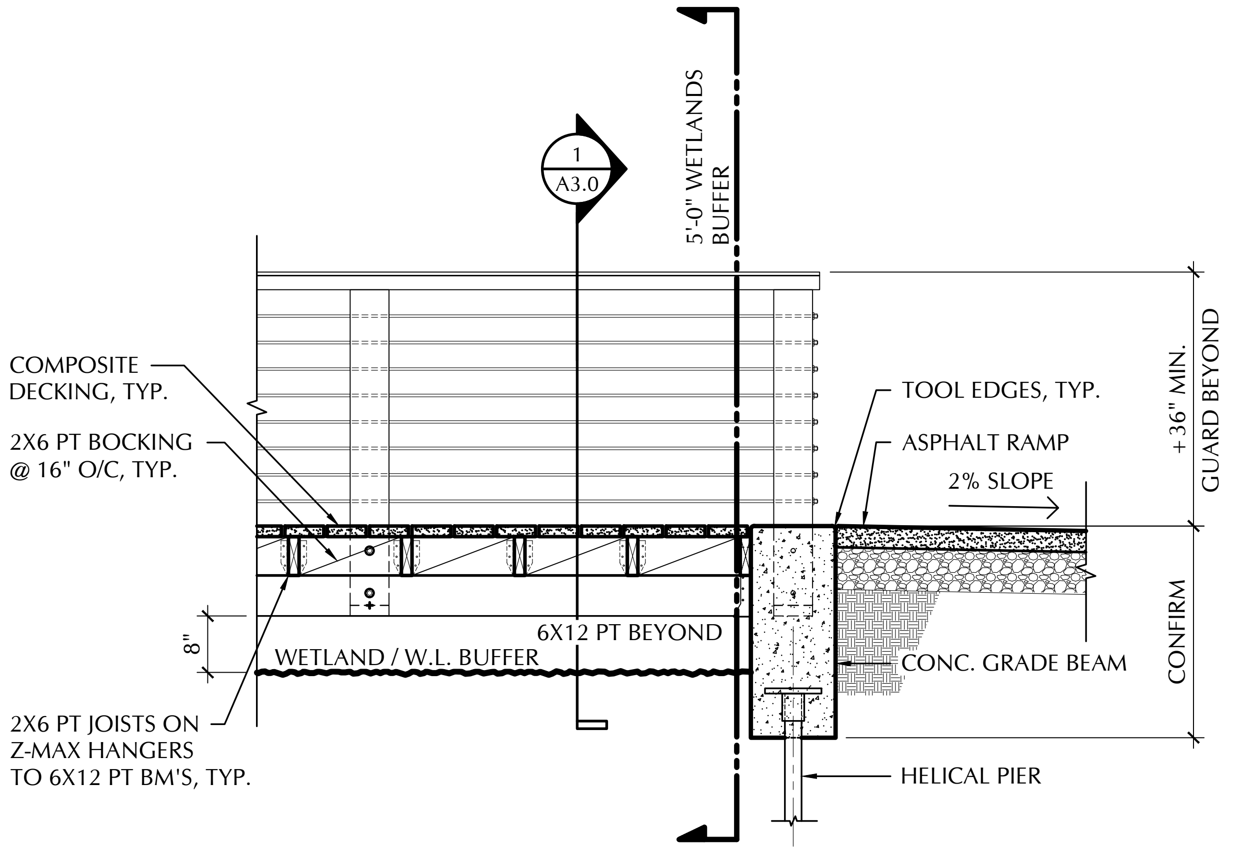
BOARDWALK CROSS SECTION

CANNON BEACH OR 97110

10-19-2023

Tolovana Architect LLC
P.O Box 563
Cannon Beach, Oregon 97110

Exhibit A-3



1
A4.0

BOARDWALK SECTION @ RAMP

1/2" = 1'-0"

A4.0

FOREST LAWN DEVELOPMENT
BOARDWALK SECTION @ RAMP

CANNON BEACH OR 97110
10-19-2023

Tolovana Architect LLC
P.O Box 563
Cannon Beach, Oregon 97110

REGISTERED ARCHITECT
1981
DA[illegible] VONADA
[illegible] OREGON
STATE OF OREGON

Exhibit C-1

CANNON BEACH COMMUNITY DEVELOPMENT
163 E. GOWER ST.
PO BOX 368
CANNON BEACH, OR 97110

September 28, 2023

Jamie Lerma
Red Crow LLC
P.O. Box 825
Cannon Beach, OR 97110

RE: Completeness Determination for Conditional Use Application at Taxlot 51030DA04100 on Forest Lawn Rd., (File: CU 23-02)

Dear Mr. Lerma:

Your application for a Conditional Use Permit for the construction of a pedestrian boardwalk in a wetland buffer area was received on September 21, 2023 and found to be complete on September 27, 2023. The City has 120 days from this date of determination to exhaust all local review, that period ends on Thursday, January 25, 2024. The first evidentiary hearing for this application will be held on October 26th at 6:00pm, you may participate in person or by Zoom.

The materials received with this application include:

- Conditional Use application with project description
- Site plan dated June 20, 2023
- Type 2 Development Permit application including:
  - Site plan dated June 20, 2023
  - Todd Prager & Associates tree plan dated June 22, 2023
  - Earth Engineers Inc geotechnical report dated June 10, 2022
  - Oregon DSL wetland delineation concurrence dated June 8, 2021
  - USACE Approved Jurisdictional Determination dated April 15, 2021

Please be aware that the determination of a complete application is not a decision or a guarantee of outcome for the application.

Please feel free to contact my office at (503) 436-8053, or by email at stclair@ci.cannon-beach.or.us if you have questions regarding this application matters.

Sincerely,

Robert St. Clair
Planner

Exhibit C-2

BEFORE THE CITY OF CANNON BEACH

IN THE MATTER OF A DEVELOPMENT PERMIT)
FOR THE CLEARING OF VEGETATION, GRADING,)
AND EXCAVATION IN CONJUNCTION WITH)
PROPOSED RESIDENTIAL DEVELOPMENT DENYING)
THE REQUEST AND ADOPTING FINDINGS)

FINDINGS OF FACT,
CONCLUSIONS, AND
ORDER DP#23-28

ZONE: Residential Medium Density (R2)
Wetlands Overlay (WO)

APPLICANT: Red Crow, LLC/Jamie Lerma
P.O. Box 825
Cannon Beach, OR 97110

The above-named applicant applied to the City for review and approval of a development permit for vegetation clearance, grading, and excavation in conjunction with proposed residential development on Taxlot 51030DA04100 on Forest Lawn Road. The project area is mostly located within 100 feet, but outside of, a delineated wetland and its buffer area, however a portion of the project area crosses a delineated wetland buffer. Any grading, excavation, or the placement of fill within a delineated wetland or its buffer requires the issuance of a Conditional Use Permit and cannot be permitted under a Type 2 Development Permit. The City of Cannon Beach orders that the request for a development permit for the clearing of vegetation, grading, and excavation is denied and adopts the following findings of fact and conclusions contained in Exhibit A.

The E-Permitting record for this application can be reviewed here: 164-23-000098-PLNG

This decision may be appealed to the Planning Commission by an affected party by filing an appeal with the City within fourteen days of this date.

DATED: August 9, 2023

Robert St. Clair
Planner

Exhibit C-2

EXHIBIT "A"

FINDINGS OF FACT

TL 51030DA04100 CLEARING, GRADING, AND EXCAVATION FOR PROPOSED RESIDENTIAL DEVELOPMENT – DP#23-28

PROPERTY DESCRIPTION:	Taxlot# 51030DA04100
PROPERTY LOCATION:	Undeveloped parcel on Forest Lawn Rd.
APPLICANT:	Red Crow LLC/Jamie Lerma
PROPERTY OWNERS:	Patrick/Dave LLC
ACTION:	Denied

BACKGROUND

The proposed project is the clearance of vegetation, grading, and excavation on Taxlot# 51030DA04100 on Forest Lawn Rd. in conjunction with planned residential development. The subject property is zoned R2 Residential Medium Density and contains the majority of Site 24 of the Cannon Beach Local Wetland Inventory.

The proposed residential development consists of a two-family dwelling with two detached units and a detached garage with storage. All structural proposed structural development on the upland portions of the subject property.

The detached garage and its driveway are accessed from Forest Lawn Rd. and connected to the dwelling units by a three-foot-wide pedestrian access that traverses the 5-foot buffer area of Site 24. Based on the site plan the construction equipment would access the project area from S. Hemlock St.

APPLICABLE CRITERIA

The following sections of the Cannon Beach Municipal Code are applicable to this application:

- 17.14.020 – Uses Permitted Outright, R2 Residential Medium Density Zone
- 17.62.030 – Grading and Erosion Control Permit
- 17.43.045 – Conditional Uses and Activities Permitted in Wetland Buffer Areas
- 17.43.050(B) – Standards, Residential Development, Wetland Overlay Zone
- 17.43.050(L) – Standards, Vegetation Management, Wetland Overlay Zone

(1) 17.14.040 – Uses Permitted Outright, R2 Residential Medium Density Zone

In an R2 zone the following uses and their accessories are permitted outright:

B. Two Family Dwelling

Findings:

Duplex or two-family dwellings are defined as a building or buildings containing two dwelling units with or without a common wall or ceiling and where there are not direct interior connecting doorways. The proposed development is a permitted use in the R2 zone.

(2) 17.62.030 – Grading and Erosion Control Permit

A. Development Permit Required.

1. Persons proposing to clear, grade, excavate or fill land (regulated activities) shall obtain a development permit as prescribed by this chapter unless exempted by Section 17.62.040. A development permit is required where:

a. The proposed clearing, grading, filling, or excavation is located within one hundred feet of a stream, watercourse or wetland;

Findings:

Clearing, grading, filling, or excavation located within 100 feet of a stream, watercourse, or wetland may be permitted through a Type 2 development permit so long as the proposed work is outside of a delineated wetland buffer area. The site plan shows the two dwelling units separated from the off-street parking area by the western portion of LWI Site 24 with a 3-foot-wide pedestrian access traversing the buffer zone through what the plan shows as a "vegetation management area." The utility plan also shows the water line serving the northern dwelling unit traversing the wetland buffer area.

Construction vehicle access appears to be from S. Hemlock St., however a plat note on Partition Plat 2000-037 indicates that access to the subject property is restricted to Forest Lawn Rd., the application does not include any information indicating that the applicant is authorized to access the site from S. Hemlock St.

The applicant's description of the 3-foot-wide pedestrian access as vegetation management is inconsistent with the definitions found in 17.43.050(L). This area is described on the site plan of the June 22, 2023 Todd Prager & Associates tree plan as:

"*Private access adjacent to trees 16 and 18 shall be constructed under arborist supervision without excavation below existing grade. At least four inches of base rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage*."

The placement of fill would be required to establish a pedestrian access between the off-street parking area and dwelling units as the natural terrain is unsuitable as a walkway in its current condition. Section 17.04.277 defines grading as "any excavation or filling or a combination thereof." As a portion of the pedestrian access and area to be excavated for underground utilities are located within a delineated wetland buffer area, the provisions of the Wetland Overlay zone are applicable to this application. Activities such as excavation or the development of access improvements are subject to the standards of that code and conditional use review.

(3) 17.43.045 – Conditional Uses and Activities Permitted in Wetland Buffer Areas

The following uses and activities may be permitted subject to the provision of Chapter 17.80 in wetland buffer areas in the WO zone, subject to applicable standards, if permitted outright or conditionally in the base zone:

A. Commercial structures;
B. Excavation;
C. Wetland enhancement;
D. Compensatory mitigation;
E. Roads or driveways, including an expansion of an existing right-of-way;
F. Bicycle paths;
G. Footpaths;

H. Point-source stormwater discharge;
I. Subdivisions, partitions, lot line adjustments.

Findings:

The provisions of this code indicate that access improvements such as roads, driveways, and footpaths within a wetland buffer area are subject to conditional use review. Application materials contain a letter prepared by Chenowerth Law Group which asserts that private access improvements are exempt from conditional use review as they are not intended for public use. The City finds that this assertion is inconsistent with the standards for residential development in the Wetland Overlay zone which requires conditional use review for both public and private access improvements in wetlands and buffer areas.

Underground or above ground utilities are permitted in wetland buffer areas as per 17.43.035, however the excavation needed to install them is a conditional use listed in this section.

(4) 17.43.050(B) – Standards, Residential Development, Wetland Overlay Zone

B. Residential Development. Where and when allowed, a single family dwelling, modular housing, or manufactured home may be permitted in a protected wetland or wetland buffer area subject to the following standards:

1. *New dwellings, when permitted, may be placed on piling or on posts, or may be cantilevered, in a manner that allows the free flow of water beneath the structure. No fill material may be used for the residence.*

2. *Building coverage will be minimized, and in no case shall it exceed two thousand five hundred square feet.*

3. *Driveways, utilities, landscaping, garages, accessory structures and other uses and activities accessory to a residence shall comply with applicable standards.*

Findings:

The residential development standards of the Wetland Overlay zone state that "uses and activities accessory to a residence shall comply with applicable standards." While the proposed dwellings themselves are located in the upland portion of the subject property, the access pathway needed to contact the dwellings to the off-street parking area on Forest Lawn Rd. traverses a delineated buffer area. Access improvements and excavation are activities accessory to a residence that are subject to conditional use review.

(5) 17.43.050(L) – Standards, Vegetation Management, Wetland Overlay Zone

L. Vegetation Management. Vegetation in protected wetlands and in wetland buffer areas may be managed (including planting, mowing, pruning and removal) subject to the following standards:

1. *Tree removal in protected wetlands and in wetland buffer areas shall be consistent with the criteria and standards in Chapter 17.70, tree removal.*

2. *Removal of vegetation, except trees covered by Chapter 17.70, in protected wetlands and in wetland buffer areas is permitted only if:*

   a. *Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or*

   b. *Necessary for maintenance of an existing structure, road or pathway; or*

   c. *Necessary for correction or prevention of a hazardous situation; or*

   d. *Necessary for completion of a land survey; or*

   e. *Part of an approved restoration, enhancement or compensatory mitigation plan.*

   Vegetation removal permitted under subsections L2a through e in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values. Vegetation removal permitted under subsections L2a through e in a wetland buffer area shall be the minimum necessary.

3. *Pruning or mowing of vegetation in protected wetlands and in wetland buffer areas is permitted only if:*

   a. *Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or*

   b. *Necessary for maintenance of an existing structure, road or pathway; or*

   c. *Necessary for correction or prevention of a hazardous situation; or*

   d. *Necessary for completion of a land survey; or*

   e. *Part of an approved restoration, enhancement or compensatory mitigation plan; or*

   f. *Part of a landscape plan approved by the city in conjunction with a building permit that minimizes adverse impacts on protected wetlands.*

   Pruning or mowing permitted under subsections L3a through f in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values. Pruning or mowing permitted under subsections L3a through f in a wetland buffer area shall be the minimum necessary.

4. *Planting new vegetation in protected wetlands is permitted subject to the following standards:*

   a. *The planting is part of an approved restoration, enhancement or mitigation plan; or*

   b. *The planting is part of a landscape plan involving native wetland plant species, and the plan is approved by the city in conjunction with approval of a building permit; or*

   c. *The planting is intended to replace dead or damaged plants that were either part of a maintained landscape or part of the existing wetland plant community.*

5. *Planting new vegetation in wetland buffer areas is permitted as part of a managed garden or landscape.*

6. *Vegetation management practices will be employed in protected wetlands and in wetland buffer areas that minimize short-term and long-term adverse impacts on wetlands. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with chemicals, unnecessary or excessive vegetation removal, or substantial alteration of native wetland plant communities. The following are not permitted as part of a vegetation management plan for protected wetlands or wetland buffer areas: alteration of wetland hydrology, use of herbicides, or application of soil amendments or fertilizer.*

Findings:

The removal or pruning of vegetation from a wetland buffer area is meets the definition of vegetation management if it meets one or more of the following conditions:

1. Necessary for the placement of a structure for which a building permit has been issued.
2. Necessary for the maintenance of an existing structure, road, or pathway.
3. Necessary for the correction or prevention of a hazardous situation.
4. Necessary for the completion of a land survey.
5. Part of an approved restoration, enhancement, or compensatory mitigation plan.
6. Part of a landscape plan approved by the City in conjunction with a building permit that minimizes adverse impacts on protected wetlands.

The establishment of a new road or pathway is not included in the definition of vegetation management. After a site visit, City staff has determined that a pathway does not exist within the “vegetation management area” described on the application’s plat map. No building permits have been issued at the subject property any provisions of the code regarding City approvals are not applicable to this application.

CONCLUSIONS

After evaluating conditions on the subject property, and reviewing the pertinent criteria, the City finds the following:

- The subject property has a plat restriction requiring access to be from Forest Lawn Rd., the applicant has not provided any documentation indicating that construction vehicles are authorized to access the property from S. Hemlock St.
- Grading and or fill would be required to install a pedestrian access through the wetland buffer area. This activity is subject to conditional use review.
- Excavation through the buffer area would be required to install the water line serving the northern dwelling unit. This activity is subject to conditional use review.
- Private access improvements such as driveways and footpaths are subject to conditional use review.
- The language of the Wetland Overlay code makes no distinction between public vs. private footpaths, walkways, or other means of describing pedestrian access.
- The installation of a new walkway is not vegetation management as defined by Municipal Code 17.43.050(L).

Based on these findings the City has determined that the application is not eligible for a Type 2 development permit.

Exhibit C-2

DECISION

The development permit application for vegetation clearance, grading, and excavation in conjunction with proposed residential development is denied.

This decision may be appealed to the Planning Commission by an affected party by filing an appeal with the City within fourteen days of the date of decision.

Exhibit C-2

Project Location Map, Development Permit #23-28

Taxlot# 51030DA04100, Forest Lawn Rd.

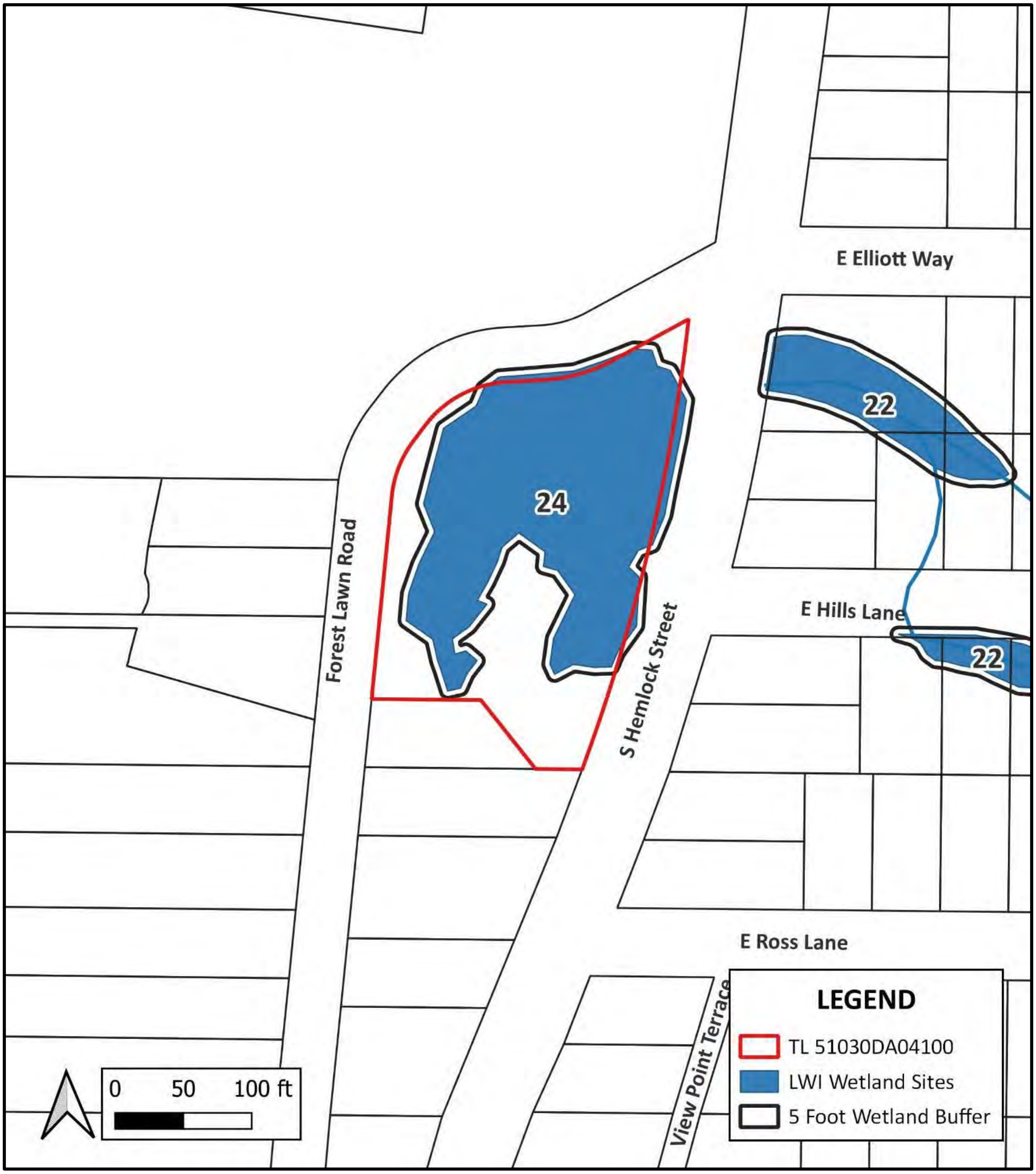


Exhibit C-2

DP 23-29

CITY OF CANNON BEACH

City of Cannon Beach
Finance Department
JUL 28 2023
Received

DEVELOPMENT PERMIT TYPE 2 APPLICATION

Please fill out this form completely. Please type or print.

Applicant Name: Red Crow, LLC/Jamie Lerma
Mailing Address: PO Box 825
Cannon Beach, OR 97110
Email Address: jamie@redcrowgc.com
Telephone: 503-849-0258

Property-Owner Name: Patrick/Dave, LLC
(if other than applicant)
Mailing Address: 3514 NE US Grant Place
Portland, OR 97212
Telephone: 503-206-1071
Property Location: Forest Lawn Rd. south of intersection with S. Hemlock St.
(street address)
Map No.: 51030DA Tax Lot No.: 4100

Nature of the Request

1. Description of proposed action which requires the development permit. On a separate sheet include a site diagram showing property dimensions, location of proposed activity or structure and its relationship to structures or improvements on the property.

Construction of a detached two-family home with a detached garage. There are no existing improvements on the property. Please see additional attached supporting documentation:

1. Site Plan
2. Letter from Chenoweth Law Group re; walkway
3. Project narrative by Architect David Vonada of Tolovana Architects
4. Tree Report by Todd Prager of Prager & Associates
5. Geotechnical Report by Earth Engineers, Inc.
6. Wetland Delineation by Pacific Habitat Services, Inc., DSL Concurrence, and US Army Corps of Engineers Jurisdictional Determination
7. Utility plan by Civil Engineer Jason Morgan

2. Explain how the request meets the standards which are applicable to the proposal.

The project site is zoned Residential Medium Density (R2) and contains wetlands mapped on the City's local wetland inventory that are subject to Cannon Beach Municipal Code (CBMC) Chapter 17.43 (Wetlands Overlay Zone). A detached two-family home is an outright allowed use per CMBC 17.14.020 (R2 Zone). The lot meets the minimum R2 zone lot area, lot width, and lot depth requirements, as well as the minimum upland area requirement for lots proposed within the Wetland Overlay (WO) zone of 1,000 square feet. Building site envelopes are identified for each proposed dwelling, showing that applicable wetland buffer and front, rear, and side setback standards are met. The lot provides at least 25 feet of frontage along a public street for required access. The site plan meets parking standards by providing 6 off-street parking spaces.

Exhibit C-2

3. Attach a scale drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structures, and the location and dimensions of the proposed accessory structure.

   See attached site plan. There are no existing improvements on the property.

4. Attach a drawing, photograph or other visual representation of the proposed structure. Include the dimensions of the structure and its height.

   Not required per City of Cannon Beach Community Development Department

City of Cannon Beach
Finance Department
JUL 28 2023
PAID

Use Additional Sheets as Necessary.

Application Fee: $100.00

Applicant Signature: ______________ Date: 7/19/2023
Jamie B. Lerma

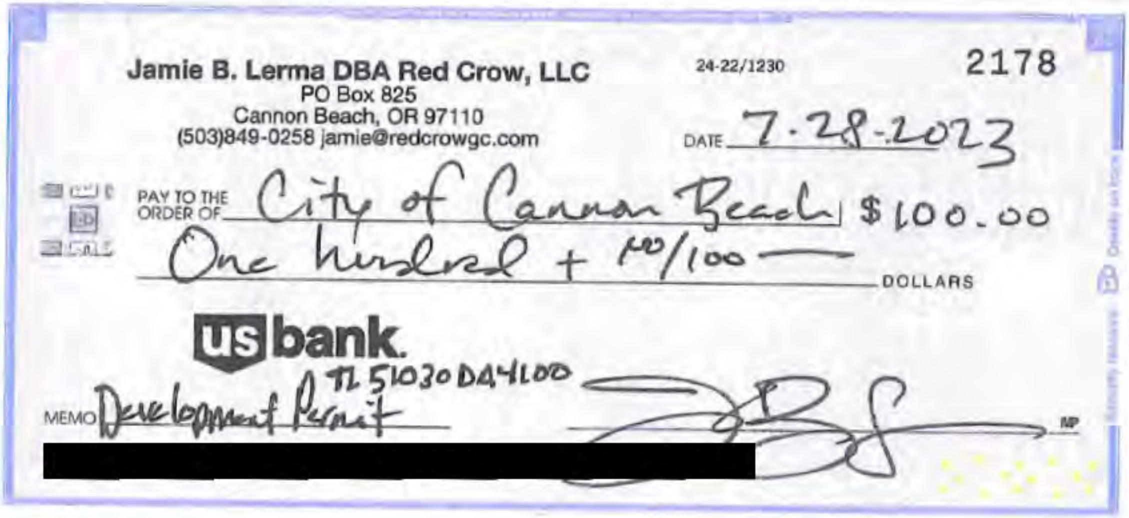
Property Owner Signature: ______________ Date: 7/19/2023
David Pietka

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her behalf. Please attach the name, address, phone number, and signature of any additional property owners. As Property Owner, my signature or an authorized applicant's signature, allows any duly authorized employee of the City to enter upon all properties affected by this permit for the purpose of follow-up inspection, observation, or measurement.

For Staff Use Only:

Received on: ______________ By: ______________
Fee Paid: ______________ Receipt No.: ______________

(Last revised March 2021)



Jamie B. Lerma DBA Red Crow, LLC
PO Box 825
Cannon Beach, OR 97110
(503)849-0258 jamie@redcrowgc.com

24-22/1230

2178

DATE 7-28-2023

PAY TO THE ORDER OF City of Cannon Beach $100.00

One hundred + 00/100 DOLLARS

us bank

TL 51030DA4100

MEMO Development Permit

[redacted]

Exhibit C-2

3. Attach a scale drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structures, and the location and dimensions of the proposed accessory structure.

See attached site plan. There are no existing improvements on the property.

4. Attach a drawing, photograph or other visual representation of the proposed structure. Include the dimensions of the structure and its height.

Not required per City of Cannon Beach Community Development Department

City of Cannon Beach
Finance Department
JUL 28 2023
PAID

Use Additional Sheets as Necessary.

Application Fee: $100.00

Applicant Signature: ______________________ Date: 7/19/2023
Jamie B. Lerma

Property Owner Signature: ______________________ Date: 7/19/2023
David Pietka

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her
behalf. Please attach the name, address, phone number, and signature of any additional property owners. As
Property Owner, my signature or an authorized applicant's signature, allows any duly authorized employee of the
City to enter upon all properties affected by this permit for the purpose of follow-up inspection, observation, or
measurement.

For Staff Use Only:

Received on: ______________________ By: ______________________
Fee Paid: ______________________ Receipt No.: ______________________

(Last revised March 2021)

#1

Exhibit C-2

SITE PLAN 2023-06-20

1/AS1.1 1" = 20'-0"

DEVELOPMENT PERMIT

Tolovana Architect LLC
P.O Box 363
Cannon Beach, Oregon 97110

DEVELOPMENT PLAN FOR
DAVE PIETKA
FOREST LAWN
CANNON BEACH, OREGON

MARK	DATE	DESCRIPTION

DATE: 2023-06-02
JOB:
FILE:
DRAWN: XX
CHECKED:

SITE PLAN

AS1.1

Plotted on Jul 20, 2023 – 3:38pm
Xrefs: XR_24x36 TITLE BLOCK_2022 DK_STAMP XR_SITE PLAN_2023-08-02_JO
C:\Users\Jay\Tolovana Architects Dropbox\Projects_Active\Pietka Forrest Lawn\ACAD\SHEET SETS\

Exhibit C-2

#2

CHENOWETH LAW GROUP

WITH ATTORNEYS LICENSED
TO PRACTICE IN OR, WA & CA

PHONE: (503) 221-7958
FAX: (503) 221-2182

ADDRESS: 510 SW FIFTH AVENUE, 4TH FLOOR
PORTLAND, OREGON 97204

WEBSITE: WWW.CHENOWETHLAW.COM

July 19, 2023

City of Cannon Beach
163 E. Gower St.
Cannon Beach, OR 97110

Re: *Patrick/Dave, LLC*
Our File No. 4061

GREETINGS:

This letter supplements the Development Permit Type 2 Application ("application") submitted by Patrick/Dave LLC ("applicant") and which seeks approval of a development permit for the 1.1-acre parcel located at Lot 4100, Map 51030DA, in Cannon Beach, Oregon ("property"). The application requests approval for the construction of two single-family dwellings on the property, which lies in a base zone of R2 medium density and a wetland overlay zone. The purpose of this letter is to clarify the applicant's intent to install a "pathway" or "walkway" along which residents and visitors will walk from Forest Lawn Road to the proposed dwellings. The applicant is not proposing to install a "footpath" that would otherwise be subject to the conditional use permitting process.

A. Background Facts

On May 10, 2023, Interim Planning Director Robert St. Clair sent an email to City of Cannon Beach attorney Bill Kabeiseman that stated the following:

> Attached is some information about an inquiry about development on the Forest Lawn parcel that I'd like your feedback on. [The applicant's] team is looking at developing a two family dwelling, which is permissible under the R2 zoning, and having them be separate structures which appears permissible under [Cannon Beach Municipal Code ("CBMC" or "the Code")] 17.04.195 defines a duplex or two family dwelling as a building or buildings containing two dwelling units with or without common walls or ceilings.
>
> They're looking to sell the two units separately which appears to be possible if the dwellings share a common lot and CC&Rs/an HOA arrangement is implemented. I recently dealt with a different duplex property in town that has this type of arrangement.
>
> The bigger issue is that of access and developing a driveway. They're looking at putting either a pedestrian or preferably a vehicle bridge across part of the wetland at the south end of the lot and are taking the position that this doesn't need a CUP because as a

Exhibit C-2

> bridge it wouldn't be in the wetland. I disagree because roads or driveways are defined as conditional uses and no distinction is made as to whether or not a bridge is involved.
>
> Any feedback you have about the bridge idea or any HOA issues to be aware of would be appreciated.

(Underline added). On May 12, 2023, Mr. Kabeiseman responded to Mr. St. Clair,

> I agree with your perspective - the two-family dwelling appears to be an allowed use in the R2 zone. However, even if the footings are in upland, the driveway or pedestrian bridge spanning the wetland would be in the Wetland Overlay Zone and I believe would require a conditional use.

That same day Mr. St. Clair forwarded Mr. Kabeiseman's response to Mr. Lerma. On May 17, 2023, Mr. St. Clair clarified in an email to Mr. Lerma that he considered the applicant to be proposing to install a footpath that would be subject to the conditional use permitting process. Mr. Lerma replied a couple hours later to Mr. St. Clair and Mr. Kabeiseman as follows:

> The access to the two homes we are proposing is not a high-traffic, public footpath that is referenced in the same code section as bike paths. Instead, we are proposing a private, pea-gravel, pedestrian access as part of a vegetation management plan as specified in CBMC 17.43.050 (L)(2)(a)(b) and L (3)(a)(b).
>
> It is clear that people can build houses with detached garages and they are allowed to walk on their private property to get from the garage to the house. Our connection between houses and garage will be through a vegetation management area which is an outright use. This is not a CUP footpath, this is private property landscaping with standards.
>
> For example, when a person gets out of their car in an open or garage parking space, once they step out of the car and walk to their front door they are not on a footpath, they are on their property to gain access to their front door. They are walking on wood decks, lawn, gravel or other surfaces to get to their front door. Clearly people are allowed to walk to their front door on their property without the code declaring the walking area a footpath.
>
> Can you please comment on this approach?

Finally, on May 23, 2023, Mr. St. Clair replied to Mr. Lerma, "I'm not seeing how installing a footpath equates to removing vegetation or vegetation management. The language in 17.43.040 and 045 simply specifies roads, driveways, and footpaths as being conditional uses in wetlands and buffer areas without making any sort of distinction between public and private use or purpose."

Exhibit C-2

The foregoing communications show that the City considers the proposed pathway for access between Forest Lawn Road and the proposed dwellings to be a "footpath" that is subject to the conditional use permitting process provided by CBMC chapter 17.80. The applicant is not proposing to install a "footpath" that would otherwise require a conditional use permit. Instead, the applicant is proposing to install a "pathway" or "walkway" that is permitted outright on the property.

B. The Applicant Intends to Install a "Pathway" or "Walkway," Which the Code Distinguishes as Being Different from a "Footpath."

A local government's interpretation of its own land use regulations will be rejected if it is inconsistent with the express language of the land use regulation. *Botts Marsh LLC v. City of Wheeler*, 326 Or App 215, 228 (2023); ORS 197.829(1)(a). Whether a local government's interpretation is inconsistent with the express language of its own land use regulations depends on whether the interpretation is plausible under the interpretive methodology established by *PGE Co. v. Bureau of Labor and Industries*, 317 Or 606, 611–12 (1993), as modified by *State v. Gaines*, 346 Or 160, 171–72 (2009). *Botts Marsh LLC*, 326 Or App at 228; *Griffin Oak Property Investments, LLC v. City of Rockaway Beach*, 318 Or App 777, 782 (2022); *Mark Latham Excavation, Inc. v. Deschutes County*, 250 Or App 543, 552–53 (2012).

This interpretative methodology aims to discern "the intention of the enacting body" by considering the text of the regulation in the context of the surrounding regulatory scheme. *Griffin Oak Property Investments, LLC*, 318 Or App at 782. Courts may also consider the regulation's "enactment history and, finally, if necessary to resolve any remaining ambiguity, maxims of interpretation." *Id.* When the text is not defined, Oregon courts determine the "plain, natural, and ordinary meaning" of the text by consulting dictionary definitions, "on the assumption that, if the [enacting body] did not give the term a specialized definition, the dictionary definition reflects the meaning that the [enacting body] would naturally have intended." *Comcast Corp. v. Dep't of Revenue*, 356 Or 282, 295–96 (2014).

The City cites CBMC 17.43.040 and/or CBMC 17.43.045 as supporting its position that the applicant must obtain a conditional use permit to install a "footpath." Those Code provisions allow "[f]ootpaths" to "be permitted subject to the provision of Chapter 17.80 [conditional uses] in the wetland portion [or wetland buffer areas] in the [wetland overlay] zone, subject to applicable standards, if permitted outright or conditionally in the base zone[.]" The Code does not define "footpath," and there does not appear to be any Oregon case law defining "footpath" in the context of zoning regulations.

The plain meaning of "footpath" is "a narrow path for pedestrians." *Footpath Definition*, merriam-webster.com/dictionary/footpath (last visited July 11, 2023). This definition shows that a footpath is intended for public use because the plain meaning of "pedestrian" is "a person going on foot." *Pedestrian Definition*, merriam-webster.com/dictionary/pedestrian (last visited July 11, 2023). A pedestrian is not someone walking from their home to their garage. Rather, a pedestrian is someone *traveling* by foot, i.e., instead of by vehicle. These definitions give "footpath" a plain meaning that refers to a path intended for pedestrians, or members of the public traveling by foot.

Exhibit C-2

The context surrounding "footpath" in CBMC 17.43.040/045 further gives that term a more specific meaning that demonstrates that term refers to paths used by the public. The other uses and activities permitted in wetlands and/or wetland buffers are "Commercial structures," "Excavation," "Roads," and "Bicycle Paths." These uses and activities involve substantial uses of land that go far beyond the activity of a homeowner walking from their home to a nearby street. Thus, "footpath" must refer to a substantial use of land on par with the other uses listed around that term.

CBMC 17.43.050 provides the standards applicable to uses and activities listed in CBMC 17.43.030 through 17.43.045, among which are standards applicable to "Footpaths and Bicycle Paths." The fact that these terms are grouped together in the Code shows the two terms overlap in meaning. It is uncommon, if it ever happens at all, for private property owners to construct bicycle paths on their properties solely for private use, particularly in medium density residential areas of Cannon Beach. Rather, bicycle paths are commonly established and used by the public for transportation purposes. This further supports the term "footpaths" refers to pedestrian pathways that are not limited to private use but are instead intended for public use, just as "bicycle paths" are for public use.

This is the only plausible interpretation in the context of establishing regulations to protect wetlands and buffers because the unregulated presence of regular, public foot-traffic could erode and imperil wetlands and buffers. Hence, the Code provides regulations to prevent that from happening. Conversely, it makes no sense that the Code would outright permit a dwelling to be constructed in a wetland overlay zone and yet require a private walkway connecting the dwelling to a nearby street to be subject to a conditional use permitting process.

Additionally, CBMC 17.43.050(G) sets standards for the "development of new footpaths" and choosing "[r]outes for new footpaths," which clearly applies to development activity more substantial than the simple installation of a pebble walkway for persons to walk from the street to the front door of a residence without getting their feet muddy. The applicant is not "develop[ing] a new footpath" or choosing a "route for a new footpath." Instead, the applicant is installing a walkway or a pathway between Forest Lawn Road and the proposed private dwellings. Mr. St. Clair's May 23, 2023 email implicitly acknowledges the common usage of the term "installation" as opposed to "development" because he described the applicant's proposal as "installing a footpath"—i.e., the applicant is not "developing" a footpath.

This interpretation of the Code is the only plausible interpretation, especially in light of the fact that the Code refers in other provisions to pedestrian paths intended for private use as "walkways" and "pathways"—not "footpaths." For example, CBMC 12.08 applies to "property entrances" and defines "entrance" to include "walkways," "pathways," "and any other improved approach from private property to such city streets and public ways." CBMC 12.08.010 (underline added). "Footpaths" are not included in that list of private entrances, because they are public in nature. The drafters of the Code could have included "footpaths" in that list because it is listed in CBMC 17.43, but they didn't. The drafters also decided not to include "pathway" or "walkway" in CBMC 17.43 so as to subject those uses to the conditional use permitting process. This shows that the drafters of the Code intended "footpaths" to

Exhibit C-2

have a different meaning from "walkway" or "pathway." The context of the Code further demonstrates that "footpath" is something different from a "walkway" or "pathway."

Neither "walkway" nor "pathway" are defined in the Code, but the plain meanings of those terms further support the conclusion that those terms have a meaning distinct from "footpath." The plain meaning of "walkway" is "a passage for walking." *Walkway Definition*, merriam-webster.com/dictionary/walkway (last visited July 12, 2023). The plain meaning of "pathway" is a "path, course." *Pathway Definition*, merriam-webster.com/dictionary/pathway (last visited July 12, 2023). Unlike the definition of "footpath" above, neither of the foregoing definitions refer to a "pedestrian" path intended to be used by members of the public.

The City's interpretation of "footpaths" as applying to a private pathway or walkway connecting a private dwelling to an adjacent street is not plausible based on the text and surrounding context of CBMC 17.43 and other Code provisions such as CBMC 12.08. By contrast, the text and context of those Code provisions mean the applicant's interpretation of "footpaths" as referring to a more substantial pedestrian path that is intended to be used by the public is the only plausible interpretation of "footpaths."

The applicant is not proposing to allow pedestrian traffic to access the proposed dwellings and is therefore not proposing to install a footpath. The applicant is proposing to install a pathway or walkway as an entrance to access the proposed private dwellings from Forest Lawn Road. That proposal is not subject to the conditional use permitting process. Instead, the proposal is governed by CBMC 12.08.

CBMC 12.08.020 requires the applicant to "file with the city a plan showing the proposed . . . construction . . . of such [pathway or walkway] at least ten days prior to the initiation of the work thereon." CBMC 12.08.030 imposes a duty on the "public works director to examine the plan and the site of the improvement and to determine the substantial compliance thereof with this chapter." CBMC 12.08.040(C) states,

> [t]he public works director may require that entrances [such as walkways or pathways] at the property line bordering the city street or way be constructed in such a fashion to provide for a minimum ten-inch diameter culvert drain capacity either by the installation of a minimum ten-inch culvert, and/or by the construction of an adequate bridge.

Chapter 12.08 provides no other standards for the construction or installation of a walkway or pathway. As shown in the application, the applicant's proposed walkway or pathway substantially complies with CBMC 12.08, and the City should permit the applicant to install the walkway or pathway.

C. Conclusion

As shown above, the Code differentiates between the terms "footpath," "walkway," and "pathway" such that "footpath" refers to a path intended for pedestrian use, whereas a "pathway" or "walkway" are intended for private use to connect a private dwelling to a nearby street. The applicant is proposing to

Exhibit C-2

install a pathway or walkway on the property that substantially complies with the Code. The applicant is not proposing to install a footpath that may otherwise be subject to the conditional use permitting process. The City should therefore approve the applicant's application, and the City should not decide that any component of the application is subject to the conditional use permitting process.

If you would like to discuss this matter further, please contact me at (503) 221-7958 or email me at bdc@chenowethlaw.com. Thank you for your attention to this matter.

SINCERELY,

BRIAN D. CHENOWETH
MANAGING ATTORNEY
CHENOWETH LAW GROUP

EC: CLIENT
ENCLOSURES: NONE

Exhibit C-2

#3

TOLOVANA
ARCHITECTS

Forest Lawn Residential Development

PROJECT NARRATIVE

June 19, 2023

INTRODUCTION

Patrick / Dave LLC is seeking administrative approval of a development permit for the 1.1 Acre parcel described as Lot 4100, Map 51030DA in Cannon Beach. The property is zoned R2 with a wetland overlay. This application is for 2 single family dwellings based on the current geotech, wetland, and arborist consultant's reports attached.

PROJECT DESCRIPTION

The project consists of two single family dwellings located on the southerly upland portion of the property with the required parking on the westerly portion, accessed off Forest Lawn Road. Even though houses are allowed in the wetlands, the location of the houses will meet the current 5 foot setback from the wetland delineation.

The parking will be accessed via a private walkway of minimal width along the southerly edge of the property, designed in conformance with the vegetation management plan, to be submitted and reviewed with the landscape plan as a part of the building permit submittal.

Please note that Landscaping is not regulated except meeting standards regarding native plants. Vegetation Management is part of landscaping as a standard.

ACCOMPANYING DOCUMENTS:

Geotechnical Report by Earth Engineers, Inc.
Arborists report by Todd Prager
Wetland Delineation Report by Pacific Habitat Services, Inc,

We respectfully request your approval of the Development Permit based on this submittal.

David Vonada, Tolovana Architect, LLC

Exhibit C-2

#4

Todd Prager & Associates

MEMORANDUM

DATE: June 22, 2023
TO: Patrick/Dave, LLC
FROM: Todd Prager, RCA #597, ISA Board Certified Master Arborist
RE: Updated Tree Plan for the Forest Lawn Project

Summary

After additional adjustments to the proposed site design and infrastructure improvements, 36 trees are proposed to be retained and 5 trees are proposed to be removed at the Forest Lawn Project in Cannon Beach. The current proposed tree removal has been reduced from 11 trees to 5 trees since the May 26, 2022 submittal. The 36 trees to be retained with site design and infrastructure improvements will be protected according to the recommendations in this report.

Background

Patrick/Dave, LLC is proposing to construct two, 3-bedroom houses, a garage, parking area, private access, and infrastructure improvements at the vacant property located south of the intersection of Forest Lawn Road and South Hemlock Street in Cannon Beach, Oregon. Wetlands occupy much of the northern portion of the site with the buildable areas clustered towards the southern end. The proposed site plan is provided in Attachment 1.

Sitka spruce (*Picea sitchensis*) is the dominant tree species at the site with scattered red alder (*Alnus rubra*) along with a western hemlock (*Tsuga heterophylla*) and crabapple (*Malus sp.*). Small diameter Hooker's willow (*Salix hookeriana*) occupy much of the wetland, but their diameter's were smaller than required to be individually inventoried.

The submittal from May 26, 2022 anticipated the removal of 11 trees with future development of the site and lots. The plan was revised, and my arborist report dated July 21, 2022 included the removal of 7 trees. The current plan has been further revised to retain additional trees.

The assignment requested of my firm for this project was to:

- Coordinate with the project design team to identify opportunities for additional tree preservation;
- Provide my recommendations for tree preservation and removal based on the site constraints; and
- Provide tree protection recommendations for the proposed construction.

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Tree and Site Assessment

On July 17, 2022, I visited the site and reviewed the trees. The purpose of my site visit was to verify the tree assessment dated December 28, 2021 by Arbor Care Tree Specialists, Inc. in Attachment 2. During my visit I also reviewed the site to determine if there were opportunities for additional tree preservation. My scope of work did not include a re-inventory of the trees at the site since that work was already completed by another arborist.

The tree assessment data in Attachment 1 was generally accurate and relevant for this stage of the project. The following changes and additions to the inventory based on my site visit are summarized as follows:

- ***Tree 12***, a decayed red alder growing over a culvert, was removed by the City of Cannon Beach based on background I received.
- ***Tree 15***, a 60-inch diameter (DBH) Sitka spruce, had a thinning crown compared with other trees at the site.
- ***Tree 16***, a 50-inch Sitka spruce on a neighboring property, had a thinning crown compared with other trees at the site and a sweep in its lower trunk towards the northeast.
- ***Tree 20***, a 30-inch DBH western hemlock, leaned away from the site and was separated from South Hemlock Street by larger Sitka spruce that were adjacent to it.
- ***Tree 21.1*** was added to the site plan in its approximate location by my firm. It was a 36-inch DBH Sitka spruce in good health condition and fair structural condition with codominant stems at approximately 50 feet above ground. Its crown was moderately one sided due to competition with adjacent trees.
- ***Tree 34*** was a 35-inch DBH Sitka spruce with an approximately 15 percent live crown ratio. Live crown ratio is the ratio of the height of the tree's live foliage to the total height of the tree.
- ***Tree 36*** was a 36-inch DBH Sitka spruce with a sweep at its lower trunk towards South Hemlock Street.
- ***Tree 37b*** had a relatively low density of *Porodaedalea pini* conks.

With the removal of tree 12 from the inventory and addition of tree 21.1, the total inventoried tree count at the site remains at 41 trees.

Tree Preservation and Removal

I coordinated with the project team to review and adjust the updated plans in Attachment 1 with the goal of preserving additional trees. The following plan adjustments were made in coordination with the project team:

- *Access*: Driveway access to the buildings has been eliminated to preserve trees 15 and 19;
- *Buildings*: The southern building footprint has been adjusted to preserve tree 15;
- *Parking*: The parking area will be adjusted to preserve trees 29 and 40;
- *Utilities*: Utilities will be bored underground to avoid trees 15 and 19; and

Exhibit C-2

- *Wetland Trees*: Trees 20 and 37b will be retained and monitored by the owners so that no tree removal will occur within the wetland.

The May 26, 2022 submittal included the removal of 11 trees and the July 21, 2022 arborist report proposed the removal of 7 trees. Based on proposed site plan changes, the current proposal is to remove 5 trees. Table 1 below is a summary of the current status of the 11 trees previously proposed for removal. Trees with changes in status are bolded in Table 1.

Table 1: Current Status of 11 Trees Previously Proposed for Removal

Tree #	Type	DBH	Area	5/22/2022 Proposal	Current Proposal	Comments
12	**red alder**	**11**	**wetland**	**remove**	**n/a**	**Removed by city**
15	**Sitka spruce**	**60**	**upland**	**remove**	**retain**	**This tree can be retained by eliminating the access drive and boring utilities from South Hemlock**
17	Sitka spruce	50	upland	remove	remove	This tree has a poor live crown ratio, lean, heaving root plate, and will be impacted by construction of the south building
18	**Sitka spruce**	**29**	**upland**	**remove**	**retain**	**This tree can be retained by eliminating the access drive and boring utilities**
19	**Sitka spruce**	**36**	**upland**	**remove**	**retain**	**This tree can be retained by eliminating the access drive and boring utilities**
20	**western hemlock**	**30**	**wetland**	**remove**	**retain**	**This tree leans away from the building site and was separated from South Hemlock Street by larger Sitka spruce that were adjacent to it. The adjacent trees offer protection to the roadway. It may be retained and monitored at this time.**
23	Sitka spruce	32	upland	remove	remove	This tree conflicts with the north building footprint
34	Sitka spruce	35	upland	remove	remove	This tree conflicts with the north building footprint
35	Sitka spruce	35	upland	remove	remove	This tree conflicts with the north building footprint and is infected with *Fomitopsis pinicola*.
36	Sitka spruce	36	upland	remove	remove	This tree conflicts with the north building footprint
37b	**Sitka spruce**	**32**	**wetland**	**remove**	**retain**	**This tree is in the wetland and had a relatively low density of *Porodaedalea pini* conks. It may be retained and monitored at this time.**

Exhibit C-2

Tree Protection Recommendations

The trees to be retained will require protection during construction. This section of the report includes my tree protection recommendations for the proposed construction.

- *Tree Protection Fencing*: Tree protection fencing shall be installed in the locations shown in Attachment 1 prior to construction. When fence adjustments or work is required in the tree protection zones, the project arborist shall be consulted to oversee the work.
- *Tree Removal*: The trees to be removed shall not contact or otherwise damage the trunks or branches of the trees to be retained. Piece removal of the trees will be required to protect the adjacent retained trees. No vehicles or heavy equipment shall be permitted within the tree protection zones during tree removal operations.
- *Stump Removal*: The stumps of the trees to be removed shall have their structural roots cut prior to removal to protect the root systems of the adjacent trees to be retained.
- *Underground utilities*: Underground utilities will need to be bored at a depth of at least five feet to avoid the typical minimum construction setback radii of the retained trees shown in Attachment 1.
- *Parking construction*: The parking area adjacent to trees 29 and 40 shall be constructed of clean crushed rock (with no fines) over geotextile fabric that is permeable to air and water. The surface litter layer shall be carefully removed under arborist supervision prior to fabric and rock placement to minimize damage and disturbance to any surface roots of trees to be retained. No excavation beyond the native soil surface is permitted. At least four inches of crushed rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.
- *Private Access*: Private access adjacent to trees 16 and 18 shall be constructed under arborist supervision without excavation below existing grade. At least four inches of base rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.

Exhibit C-2

- *Building Foundations*: The building foundations to be constructed within the typical minimum construction setback radii shown in Attachment 1 will need to be designed to protect structural roots that may be located within their footprints. This will involve pneumatic excavation to locate structural roots greater than 2-inches inches in diameter and bridging the foundations over the roots. A pier foundation is the least intrusive foundation type (Figure 1) and will be required to minimize root impacts. Any pneumatic excavation or foundation construction within the tree protection zones will need to occur under the onsite supervision of the project arborist. The elevation of the grade beams may need to be above existing grade to avoid large surface roots. The foundations adjacent to trees 15 and 19 may need to be cantilevered over their minimum ground disturbance setback radii to provide clearance for surface roots as shown in Attachment 1.

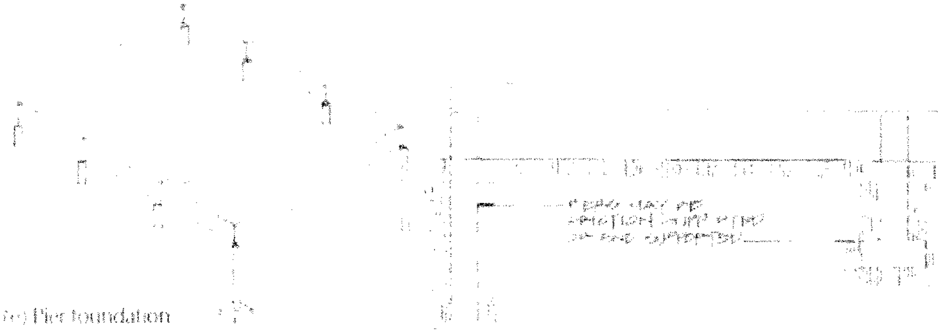


Figure 1: Pier Foundation Example[1]

- *Compaction Management and Root Protection*: Where needed for construction access, steel plates over a 6-inch layer of wood chips shall be placed on the ground surface and over visible surface roots in the approximate locations shown in Attachment 1. The project arborist will need to review and approve shifting of the fence locations and final placement of compaction management when required.
- *Crown Pruning Trees*: If the crowns of any trees need to be raised and/or reduced, it shall occur prior to construction. The pruning shall be conducted by an ISA certified arborist in accordance with ANSI A300 pruning standards in coordination with the project arborist. The pruning shall be the minimum necessary to achieve the required clearance for construction.
- *Erosion Control*: If erosion control is required within or directly adjacent to the tree protection fencing, straw wattles shall be used to avoid excavation.

Additional tree protection recommendations are included in Attachment 3.

---

[1] Figure 1 from: Matheny, N. P., & Clark, J. R. (1998). *Trees and development: A technical guide to preservation of trees during land development*. Champaign, IL: International Society of Arboriculture.

Exhibit C-2

Conclusion

After further adjustments to the proposed site design, 36 trees are proposed to be retained and 5 trees are proposed to be removed. The original proposal included the removal of 11 trees.

The trees to be retained will be protected according to the recommendations in this report.

Please contact me if you have questions, concerns, or need any additional information.

Sincerely,

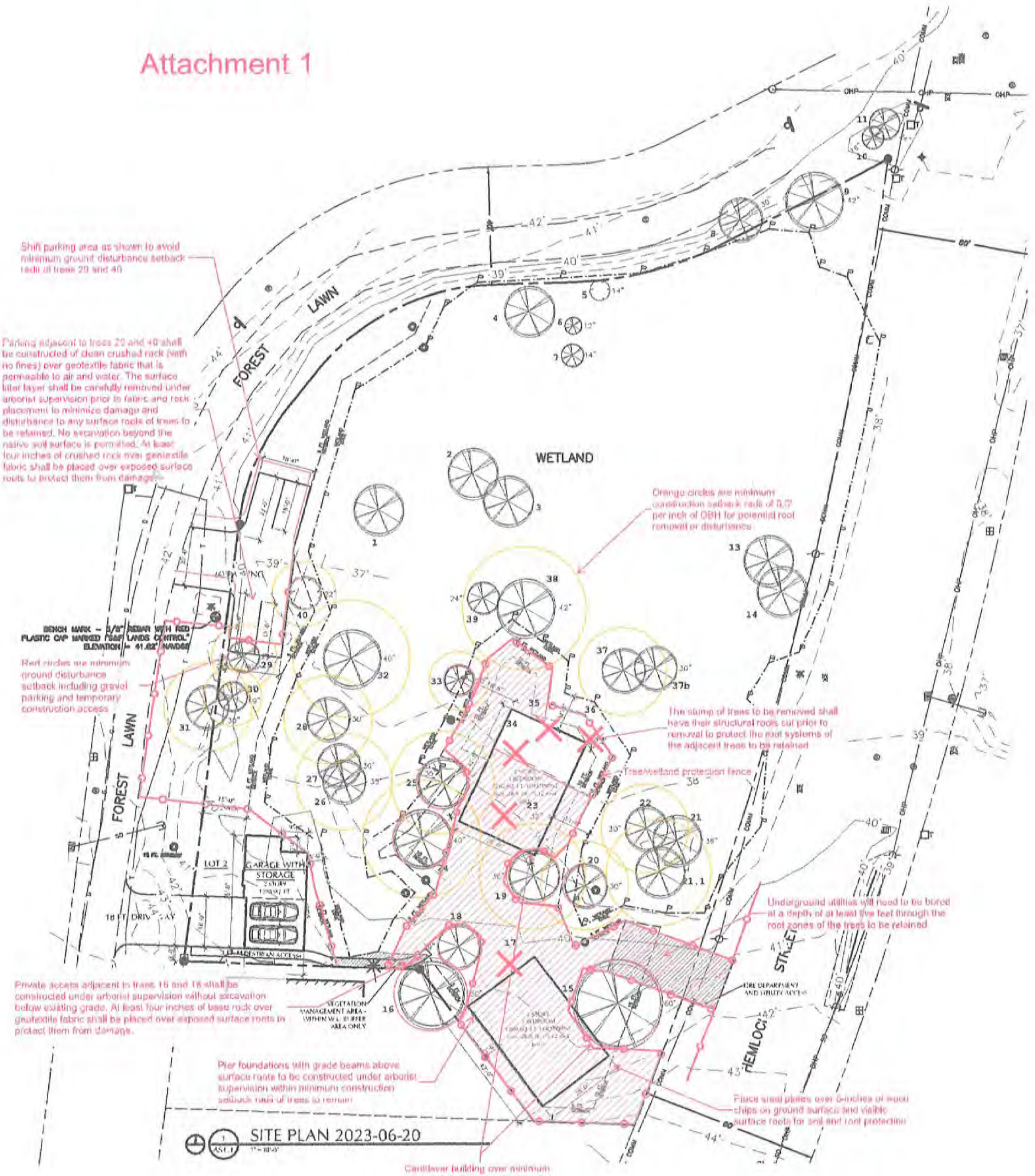
Todd Prager

Todd Prager
ASCA Registered Consulting Arborist #597
ISA Board Certified Master Arborist, WE-6723B
ISA Qualified Tree Risk Assessor
AICP, American Planning Association

Attachment 1:	Site Plan with Trees and Tree Protection
Attachment 2:	Tree Inventory
Attachment 3:	Tree Protection Recommendations
Attachment 4:	Assumptions and Limiting Conditions

Exhibit C-2

Attachment 1



BENCH MARK – 5/8" REBAR WITH RED PLASTIC CAP MARKED "S&F LANDS CONTROL" ELEVATION = 41.62' NAVD88

Shift parking area as shown to avoid minimum ground disturbance setback radii of trees 29 and 40

Parking adjacent to trees 29 and 40 shall be constructed of clean crushed rock (with no fines) over geotextile fabric that is permeable to air and water. The surface litter layer shall be carefully removed under arborist supervision prior to fabric and rock placement to minimize damage and disturbance to any surface roots of trees to be retained. No excavation beyond the native soil surface is permitted. At least four inches of crushed rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.

Red circles are minimum ground disturbance setback including gravel parking and temporary construction access

Orange circles are minimum construction setback radii of 0.5' per inch of DBH for potential root removal or disturbance

The stump of trees to be removed shall have their structural roots cut prior to removal to protect the root systems of the adjacent trees to be retained

Underground utilities will need to be bored at a depth of at least five feet through the root zones of the trees to be retained

Private access adjacent to trees 16 and 18 shall be constructed under arborist supervision without excavation below existing grade. At least four inches of base rock over geotextile fabric shall be placed over exposed surface roots to protect them from damage.

Pier foundations with grade beams above surface roots to be constructed under arborist supervision within minimum construction setback radii of trees to remain

Place steel plates over 6-inches of wood chips on ground surface and visible surface roots for soil and root protection

SITE PLAN 2023-06-20
1" = 10'-0"

Cantilever building over minimum ground disturbance setbacks of trees 15 and 10.1 required for surface root clearance

Exhibit C-2

Attachment 2

Tree Number	Common Name	Scientific Name	Comments from Arbor Care Tree Specialists	DBH
1	Sitka spruce	*Picea sitchensis*	Ok	22
2	Sitka spruce	*Picea sitchensis*	Ok	22
3	Sitka spruce	*Picea sitchensis*	Ok	12
4	Red alder	*Alnus rubra*	Ok, tipped tree with horizontal trunk. Stable	12
5	Red alder	*Alnus rubra*	Large decay pocket. No target. No action required	9
6	Sitka spruce	*Picea sitchensis*	Ok	9
7	Sitka spruce	*Picea sitchensis*	Ok	12
8	Sitka spruce	*Picea sitchensis*	Ok	35
9	Sitka spruce	*Picea sitchensis*	Phaeolus schweinitzii at base. Leans into wetland.	50
10	Sitka spruce	*Picea sitchensis*	Ok	12
11	Sitka spruce	*Picea sitchensis*	Ok	27
12	Red alder	*Alnus rubra*	Remove. Growing over culvert and decay in plane of lean toward road.	11
13	Sitka spruce	*Picea sitchensis*	Ok	30
14	Crab apple	*Malus sp.*	Ok. Cluster of 5 trunks	6-8
15	Sitka spruce	*Picea sitchensis*	Ok	60
16	Sitka spruce	*Picea sitchensis*	Ok	50
17	Sitka spruce	*Picea sitchensis*	Remove. Poor live crown ratio and heavy lean with a heaving root plate	50
18	Sitka spruce	*Picea sitchensis*	Ok	29
19	Sitka spruce	*Picea sitchensis*	Ok	36
20	Western hemlock	*Tsuga heterophylla*	Remove. Heavy lean with a heaving root plate	30
21	Sitka spruce	*Picea sitchensis*	Ok	36
21.1	Sitka spruce	*Picea sitchensis*	Added by Todd Prager based on July 21, 2022 site visit. Good health condition and fair structural condition with codominant stems at approximately 50 feet above ground. Crown was moderately one sided due to competition with adjacent trees	36
22	Sitka spruce	*Picea sitchensis*	Ok	30
23	Sitka spruce	*Picea sitchensis*	Ok	32
24	Sitka spruce	*Picea sitchensis*	Ok	40
25	Sitka spruce	*Picea sitchensis*	Ok	35
26	Sitka spruce	*Picea sitchensis*	Ok	33

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Todd Prager & Associates

Attachment 2

Tree Number	Common Name	Scientific Name	Comments from Arbor Care Tree Specialists	DBH
27	Sitka spruce	*Picea sitchensis*	Ok	30
28	Sitka spruce	*Picea sitchensis*	Ok	30
29	Sitka spruce	*Picea sitchensis*	Ok	21
30	Sitka spruce	*Picea sitchensis*	Ok	19
31	Sitka spruce	*Picea sitchensis*	Ok	40
32	Sitka spruce	*Picea sitchensis*	Ok	40
33	Sitka spruce	*Picea sitchensis*	Ok	20
34	Sitka spruce	*Picea sitchensis*	Ok	35
35	Sitka spruce	*Picea sitchensis*	Remove. Fomitopsis pinicola seen at 18ft.	35
36	Sitka spruce	*Picea sitchensis*	Ok	36
37	Sitka spruce	*Picea sitchensis*	Ok	30
37b	Sitka spruce	*Picea sitchensis*	Remove. Porodaedalea pini: multiple fruiting bodies extending up trunk	32
38	Sitka spruce	*Picea sitchensis*	Ok	42
39	Sitka spruce	*Picea sitchensis*	Ok	24
40	Red alder	*Alnus rubra*	Ok	22

*This tree inventory is adapted from information collected by Arbor Care Tree Specialists and compiled in their report dated 12-28-2021.

Exhibit C-2

Attachment 3
Tree Protection Recommendations

Before Construction Begins

1. Notify all contractors of tree protection procedures. For successful tree protection on a construction site, all contractors must know and understand the goals of tree protection.
    a. Hold a tree protection meeting with all contractors to explain the goals of tree protection.
    b. Have all contractors sign memoranda of understanding regarding the goals of tree protection. The memoranda should include a penalty for violating the tree protection plan. The penalty should equal the resulting fines issued by the local jurisdiction plus the appraised value of the tree(s) within the violated tree protection zone per the current Trunk Formula Method as outlined in the current edition of the ***Guide for Plant Appraisal*** by the Council of Tree & Landscape Appraisers. The penalty should be paid to the owner of the property.
2. Fencing
    a. Trees to remain on site will be protected by installation of tree protection fencing as shown in Attachment 1.
    b. Unless otherwise noted, the fencing should be put in place before the ground is cleared to protect the trees and the soil around the trees from disturbances.
    c. Fencing should be established by the project arborist based on the needs of the trees to be protected and to facilitate construction.
    d. Fencing should consist of 6-foot-high steel fencing on concrete blocks or 6-foot metal fencing secured to the ground with 8-foot metal posts to prevent it from being moved by contractors, sagging, or falling down.
    e. Fencing should remain in the position that is established by the project arborist and not be moved without approval from the project arborist.
3. Signage
    a. All tree protection fencing should have signage as follows so that all contractors understand the purpose of the fencing:

TREE PROTECTION ZONE

DO NOT REMOVE OR ADJUST THE LOCATION OF THIS TREE PROTECTION FENCING
UNAUTHORIZED ENCROACHMENT MAY RESULT IN FINES

Please contact the project arborist if alterations to the location of the tree protection fencing are necessary.

Todd Prager, Project Arborist, Todd Prager & Associates, 971-295-4835

    b. Signage should be placed every 75-feet or less.

During Construction

1. Protection Guidelines Within the Tree Protection Zones:
    - a. No new buildings; grade change or cut and fill, during or after construction; new impervious surfaces; or utility or drainage field placement should be allowed within the tree protection zones.
    - b. No traffic should be allowed within the tree protection zones. This includes but is not limited to vehicle, heavy equipment, or even repeated foot traffic.
    - c. No storage of materials including but not limiting to soil, construction material, or waste from the site should be permitted within the tree protection zones. Waste includes but is not limited to concrete wash out, gasoline, diesel, paint, cleaner, thinners, etc.
    - d. Construction trailers should not to be parked/placed within the tree protection zones.
    - e. No vehicles should be allowed to park within the tree protection zones.
    - f. No other activities should be allowed that will cause soil compaction within the tree protection zones.
2. The trees should be protected from any cutting, skinning or breaking of branches, trunks or woody roots.
3. The project arborist should be notified prior to the cutting of woody roots from trees that are to be retained to evaluate and oversee the proper cutting of roots with sharp cutting tools. Cut roots should be immediately covered with soil or mulch to prevent them from drying out.
4. Trees that have woody roots cut should be provided supplemental water during the summer months.
5. Any necessary passage of utilities through the tree protection zones should be by means of boring with oversight by the project arborist.
6. Any deviation from the recommendations in this section should receive prior approval from the project arborist.

After Construction

1. Carefully landscape the areas within the tree protection zones. Do not allow trenching for irrigation or other utilities within the tree protection zones.
2. Carefully plant new plants within the tree protection zones. Avoid cutting the woody roots of trees that are retained.
3. Do not install permanent irrigation within the tree protection zones unless it is drip irrigation to support a specific planting or the irrigation is approved by the project arborist.
4. Provide adequate drainage within the tree protection zones and do not alter soil hydrology significantly from existing conditions for the trees to be retained.
5. Provide for the ongoing inspection and treatment of insect and disease populations that can damage the retained trees and plants.
6. The retained trees may need to be fertilized if recommended by the project arborist.
7. Any deviation from the recommendations in this section should receive prior approval from the project arborist.

Exhibit C-2

Attachment 4
Assumptions and Limiting Conditions

1. Any legal description provided to the consultant is assumed to be correct. The information provided by Patrick/Dave, LLC and their consultants was the basis of the information provided in this report.
2. It is assumed that this property is not in violation of any codes, statutes, ordinances, or other governmental regulations.
3. The consultant is not responsible for information gathered from others involved in various activities pertaining to this project. Care has been taken to obtain information from reliable sources.
4. Loss or alteration of any part of this delivered report invalidates the entire report.
5. Drawings and information contained in this report may not be to scale and are intended to be used as display points of reference only.
6. The consultant's role is only to make recommendations. Inaction on the part of those receiving the report is not the responsibility of the consultant.
7. This report is a summary of my assignment which was to:
    - Coordinate with the project design team to identify opportunities for additional tree preservation;
    - Provide my recommendations for tree preservation and removal based on the site constraints; and
    - Provide tree protection recommendations for the proposed construction.

Exhibit C-2

#5

Earth
Engineers,
Inc.

2411 Southeast 8th Avenue • Camas • WA 98607
Phone: 360-567-1806
www.earth-engineers.com

June 3, 2022
Revised July 18, 2023

Patrick/Dave LLC
3514 Northeast U.S. Grant Place
Portland, Oregon 97212
Attention: David Pietka, Owner

Phone: (503) 206-1071
E-mail: dpietka@msn.com

Subject: **Geotechnical Investigation and Geologic Hazard Report**
Proposed Forest Lawn *Development*
Clatsop County Tax Lot No. 51030DA04100
Intersection of Forest Lawn Road and Hemlock Street
Cannon Beach, Clatsop County, Oregon
EEI Report No. 22-103-1-*R2*

Dear Mr. Pietka,

Earth Engineers, Inc. (EEI) is pleased to transmit our ***revised*** report for the above referenced project. This report includes the results of our field investigation, an evaluation of geotechnical factors and geologic hazards that may influence the proposed construction, and geotechnical recommendations for the proposed ***project*** and general site development. ***This report has been revised, as requested. Report revision additions are denoted in bold, italics font.***

We appreciate the opportunity to perform this geotechnical study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Sincerely,
Earth Engineers, Inc.

Troy Hull, P.E., G.E.
Principal Geotechnical Engineer

Ken Andrieu, R.G.
Senior Geologist

Jacqui Boyer
Geotechnical Engineering Associate

Attachment: Geotechnical Investigation and Geologic Hazard Report

Distribution (electronic copy only): Addressee
Jamie Lerma, Red Crow, LLC (jamie@redcrowgc.com)

Exhibit C-2

GEOTECHNICAL INVESTIGATION AND GEOLOGIC HAZARD REPORT

for the

Proposed Forest Lawn *Development*
Clatsop County Tax Lot No. 51030DA04100
Intersection of Forest Lawn Road
and South Hemlock Street
Cannon Beach, Clatsop County, Oregon

Prepared for

Patrick/Dave LLC
3514 Northeast U.S. Grant Place
Portland, Oregon 97212
Attention: David Pietka, Owner

Prepared by

Earth Engineers, Inc.
2411 Southeast 8th Avenue
Camas, Washington 98607
Telephone (360) 567-1806

EEI Report No. 22-103-1-*R2*

June 3, 2022
Revised July 18, 2023

Earth Engineers Inc.

Jacqui Boyer
Geotechnical Engineering Associate

19206PE

Troy Hull, P.E., G.E.
Principal Geotechnical Engineer

KENNETH DAVID ANDRIEU
#G1988

EXP: 12/1/2022

Ken Andrieu, R.G.
Senior Geologist

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1.0 PROJECT INFORMATION

1.1 Project Authorization

Earth Engineers, Inc. (EEI) has completed a geotechnical investigation report for the proposed ***Forest Lawn Development*** on Clatsop County Tax Lot No. 51030DA04100 in Cannon Beach, Clatsop County, Oregon. Our services were authorized by David Pietka, owner of Patrick/Dave LLC, on April 19, 2022 by signing EEI Proposal No. 22-P182 dated April 18, 2022.

1.2 Project Description

Our current understanding of the project is based on the information Jamie Lerma with Red Crow, LLC provided to EEI ***by e-mail on June 18, 2023. As part of that e-mail, we were provided with a Site Plan drawing (Sheet AS1.1) by Tolovana Architect LLC, dated June 2, 2023***:

Briefly, we understand the plan is to develop a ***detached two family home***. It is our understanding that this project is in its preliminary stages. We have not been provided any detailed construction plans for the project. For the purposes of this report, we are assuming maximum foundation loads of 4 kips per linear foot for wall footings, 40 kips for column footings, and 150 psf for floor slabs. With regard to design grades, we are assuming that cuts and fills will be negligible (i.e. less than 2 feet). Finally, we have assumed that the homes will be constructed in accordance with the 2021 Oregon Residential Specialty Code (ORSC), or the 2019 Oregon Structural Specialty Code (OSSC).

Figure 1: Proposed site plan (source: Sheet AS1.1 by Tolovana Architect LLC, dated June 2, 2023).

1.3 Purpose and Scope of Services

The purpose of our services was to explore the subsurface conditions at the site of the ***proposed Forest Lawn Development*** to better define the soil, rock, and groundwater properties in order to provide geotechnical related recommendations related to the proposed construction. Our site investigation consisted of advancing two Standard Penetration Test (SPT) borings (B-1 and B-2) located on the subject property using a trailer mounted Big Beaver drill rig subcontracted from Dan J Fischer, Inc of Forest Grove, Oregon. SPT samples were taken at regular intervals and transported to our laboratory for testing. We supplemented our drilled borings with three hand auger borings (HA-1 through HA-3) and drive probe testing. Laboratory testing was accomplished in general accordance with ASTM procedures.

This report briefly outlines the testing procedures, presents available project information, describes the site, assumed subsurface conditions, and presents recommendations regarding the following:

- A discussion of subsurface conditions encountered including pertinent soil and groundwater conditions.
- Seismic design parameters in accordance with ASCE 7-16.
- Geotechnical related recommendations for deep foundation design.
- Structural fill recommendations, including an evaluation of whether the in-situ soils can be used as structural fill.
- Retaining wall design parameter recommendations, including coefficient of friction and earth pressures.
- Floor slab support recommendations.
- A Geologic Hazard Report (GHR) in accordance with Clatsop County requirements
- Other discussion on geotechnical issues that may impact the project.

It should be noted, we consider this report to be preliminary for the project area as a whole. Due to accessibility issues, we were only able to advance deep borings on the perimeter of the project area, and limited hand tool explorations on the southern portion of the property. Once the project is further along and the site is more accessible, we can perform additional drilled borings (if requested). EEI should be informed when detailed construction drawings are made for the proposed residences so we can revise our report, if necessary.

Exhibit C-2

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Location and Description

The site for the proposed development is located at Clatsop County Tax Lot No. 51030DA04100 in Cannon Beach, Oregon. The site is bound to the north and west by Forest Lawn Road, to the south by residential properties and to the east by South Hemlock Street. See Figure 2 below for project vicinity.

Figure 2: Project vicinity showing the subject property (outlined in blue). Source: https://delta.co.clatsop.or.us/apps/ClatsopCounty/.

The subject property is currently vacant, vegetated with grass, brush and mature trees. It should be noted, the northern portion of the property is densely vegetated with brush and trees; as a result, we were unable to advance any explorations in those areas. We also observed vegetation indicative of a wetland or a marsh along the northern portion of the property. In terms of topography, the subject property is level. According to Google Earth, the elevation ranges from 39 feet above mean sea level (msl) to 46 feet msl. While on site, we did not observe any signs of soil movement (i.e. cracking in the soil, leaning trees, landscape head scarps etc.). See Photos 1 through 5 below for the current site conditions.

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Photo 1: Current site conditions, taken from the southern property line facing north.

Photo 2: Current site conditions, facing northwest.

Photo 3: Current site conditions, facing northeast.

Photo 4: Current site conditions taken from the western property line, facing east.

Photo 5: Current site conditions taken from the northwestern property line, facing southeast.

2.2 Subsurface Materials

The site was explored with two SPT borings (B-1 and B-2). For approximate exploration locations see the Exploration Location Plan in Appendix B. The SPT borings were advanced with a subcontracted trailer mounted drill rig subcontracted from Dan J. Fischer Excavating, Inc. of Forest Grove, Oregon. Boring B-1 was advanced to a depth of 33.5 feet below ground surface (bgs) and B-2 was advanced to a depth of 51.5 feet bgs. SPT samples were generally taken at regular intervals within the boring and transported to our laboratory for testing.

In addition, we supplemented our drilled borings with three hand auger explorations (HA-1 through HA-3) and drive probe testing. For approximate exploration locations see the Exploration Location Plan in Appendix B. The hand auger explorations were each advanced to a depth of 5 feet bgs and the drive probe testing was advanced to a depth of 8 feet bgs.

The drive probe test is based on a "relative density" exploration device used to determine the distribution and to estimate strength of the subsurface soil units. The resistance to penetration is measured in blows-per-½-foot of an 11-pound hammer which free falls roughly 39 inches driving a 3/4-inch outside diameter pipe with a 1-inch diameter endcap into the ground. This measure of resistance to penetration can be used to estimate relative density of soils. For a more detailed

Exhibit C-2

description of this geotechnical exploration method, please refer to the Slope Stability Reference Guide for National Forests in the United States, Volume I, USDA, EM-7170-13, August 1994, P 317-321. Results of the drive probe tests are reported in the hand auger logs in Appendix C.

Select soil samples were tested in the laboratory to determine material properties for our evaluation. Results of the explorations are reported in the Exploration Logs in Appendix C. Laboratory testing was accomplished in general accordance with ASTM procedures. The testing performed included moisture content tests (ASTM D 2216), fines content determinations (ASTM D1140) and Atterberg limit testing (ASTM D4318). The test results have been included on the Exploration Logs in Appendix C and the Report of Atterberg Limits Testing in Appendix E.

In general, we encountered a surficial layer of topsoil overlying compressible, organic soils which eventually transitioned to dense sandstone with depth. Each individual stratum encountered is discussed in further detail below.

TOPSOIL

In all of our explorations, we encountered topsoil as the surficial layer. The topsoil stratum was generally dark brown to black sandy silt with heavy organics (i.e. roots, rootlets and wood chips). The thickness of this stratum was 6-inches to 12-inches in our explorations.

COMPRESSIBLE, ORGANIC SOILS

In all of our explorations we encountered a thick layer of compressible soils underlying the topsoil described above. In B-2, the upper layer of compressible soils was generally a gray-brown sand with broken rock fragments, wood chips and rootlets. Laboratory moisture content testing on samples obtained within this stratum ranged from 21 to 32 percent. Fines content laboratory testing for a sample obtained within this stratum yielded a result of 8 percent passing the #200 sieve. Based on SPT sampling data, this stratum ranged from very loose to loose (N-value average of 5). This sand stratum extended to a depth of 5.5 feet bgs in B-2.

In all of our explorations (except for B-2), we encountered low plasticity silt underlying the topsoil described above. In B-2, this silt was underlying the upper sand stratum described above. This stratum was generally a blue-gray to gray-brown to dark brown silt with orange and gray mottling. We also encountered rootlets within this stratum. Laboratory moisture content testing on samples obtained within this stratum ranged from 53 to 72 percent. Fines content laboratory testing for samples obtained within this stratum ranged from 93 to 94 percent passing the #200 sieve. We also conducted Atterberg testing on a sample retrieved within this stratum from B-2 at 5 feet bgs. The testing indicated this stratum is a low plasticity silt (ML). Based on SPT sampling data, this stratum ranged from very soft to soft (N-value average of 2). This low plasticity silt stratum extended to the terminal depth of our hand tool explorations (i.e. 5 feet bgs), and to a depth of 10 feet bgs in of our drilled borings.

In our drilled borings, we encountered high plasticity silt underlying the low plasticity silt described above. This stratum was generally a blue-gray to gray to brown silt. We also encountered heavy organics (i.e. wood chips and rootlets) within this stratum. Laboratory moisture content testing on samples obtained within this stratum ranged from 50 to 388 percent. It should be noted the very high moisture readings are likely due to the presence of organics. Fines content laboratory testing for sample a sample obtained within this stratum yielded a result of 97 percent passing the #200 sieve. We also conducted Atterberg testing on a sample retrieved within this stratum from B-2 at 10 feet bgs. The testing indicated this stratum is a high plasticity silt (MH). Based on SPT sampling data, this stratum ranged from very soft to soft (N-value average of 2). This high plasticity silt stratum extended to a depth of 25 feet bgs in both of our explorations.

In our drilled borings, we encountered a layer of silty sand underlying the high plasticity silt described above. In B-2, we encountered silty sand and sandy silt underlying the high plasticity silt described above. This stratum was generally a brown to gray brown to blue gray silty sand/sandy silt with trace organics. Laboratory moisture content testing on samples obtained within this stratum ranged from 60 to 124 percent. It should be noted the very high moisture readings are likely due to the presence of organics. Fines content laboratory testing for samples obtained within this stratum ranged from 26 to 81 percent passing the #200 sieve. Based on SPT sampling data, the silty sand stratum ranged from very loose to medium dense and the sandy silt stratum was generally medium stiff (N-value average of 5). This stratum extended to a depth of 30 feet bgs in B-1 and 45 feet bgs in B-2.

DENSE SANDSTONE

In both of our boring explorations, we encountered a dense sandstone layer underlying the compressible, organic soils described above. This stratum was generally a gray to blue-gray sandstone with varying amounts of silt. Laboratory moisture content testing on samples obtained within this stratum ranged from 11 to 76 percent. Fines content laboratory testing for samples obtained within this stratum ranged from 9 to 39 percent passing the #200 sieve. Based on SPT sampling data, this stratum ranged from medium dense to very dense (N-value average of 42). This sandstone stratum extended to the terminal depths of our explorations (i.e. 33.5 feet bgs in B-1 and 51.5 feet bgs in B-2).

The classifications noted above were made in general accordance with the USCS as shown in Appendix D. The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The exploration logs included in the Appendix should be reviewed for specific information. These records include soil descriptions, stratifications, and locations of the samples. The stratifications shown on the logs represent the conditions only at the actual exploration location. Variations may occur and should be expected across the site. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these logs. The samples that were not altered by laboratory testing will be retained for 90 days from the date of this report and then will be discarded.

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2.4 Groundwater Information

During our subsurface investigation, we encountered groundwater at depths ranging from 1 to 4 feet bgs.

In addition, we reviewed publicly available well logs from the Oregon Water Resources Department website (http://apps.wrd.state.or.us/apps/gw/well_log/) for historic information. We found two historical logs for a property located approximately 550 feet north of the subject property, advanced on June 1, 2015. The logs indicate that groundwater was encountered at a depth of 7 feet below ground surface. See Appendix F for a copy of these well log reports.

It should be noted that groundwater elevations can fluctuate seasonally and annually, especially during periods of extended wet or dry weather, or from changes in land use.

Exhibit C-2

3.0 GEOLOGIC HAZARD ASSESSMENT

3.1 Soil Survey

The United States Department of Agriculture (USDA) Soil Survey provides geographical information of the soils in Clatsop County as well as summarizing various properties of the soils. The USDA maps the surface soils on site as Unit 61E (Templeton-Ecola silt loams on 30 to 60 percent slopes) and Unit 71C (Walluski medial silt loam on 7 to 15 percent slopes.[1]

The Templeton-Ecola silt loam covers the western majority of the project area. The soil unit consists of well-drained soils formed on hillslopes and mountain slopes with a parent material of colluvium and residuum derived from sedimentary rock. A typical profile consists of slightly decomposed plant material overlying medial silt to silty clay loam which eventually transitions to weathered bedrock with depth. Although the USDA indicates this unit is mapped on 30 to 60 percent slopes we did not encounter any slopes up to 30 to 60 percent on the subject property.

The Walluski medial silt loam covers the eastern portion of the property. The soil unit consists of moderately well-drained soils formed on stream terraces with a parent material of mixed alluvium and/or fluviomarine deposits derived from sedimentary rock. A typical profile consists of slightly decomposed plant material overlying medial silt loam overlying silty clay loam.

3.2 Geology

The site is located approximately 120 feet east of a coastal bluff overlooking Cannon Beach on the Oregon Coast. The bluff is approximately 20 feet tall with a slope of approximately 2.1H:1V. The region is underlain by a framework of Miocene aged (23 to 5 million years ago) volcanic rocks and Oligocene (33 to 23 million years ago) to Miocene aged marine sedimentary deposits that have been deposited over a basement rock of Eocene-aged (54 to 33 million years ago) volcanic arc deposits. Overlying this framework are Quaternary–aged (1.8 million years ago to present) marine terrace deposits, beach and dune deposits, and landslide deposits.

More specifically, Niem and Niem (1985)[2] maps the underlying geology on the subject property as middle to lower Miocene aged Cannon Beach member (informal) of the Astoria Formation from the Astoria Group. This formation is described as a "well-bedded sequence of laminated to massive micaceous mudstone, with subordinate, rhythmically thin-bedded feldspathic sandstone and mudstone in the lower part of the unit." See Figure 3 below.

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[1] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed 5/24/2022.

[2] Niem, A.R., and Niem, W., 1985, Geologic map of the Astoria Basin, Clatsop and northernmost Tillamook Counties, northwest Oregon: Portland, Oregon, Oregon Department of Geology and Mineral Industries Oil and Gas Investigation Map OGI-14, Plate 1, scale 1:100,000.

Exhibit C-2

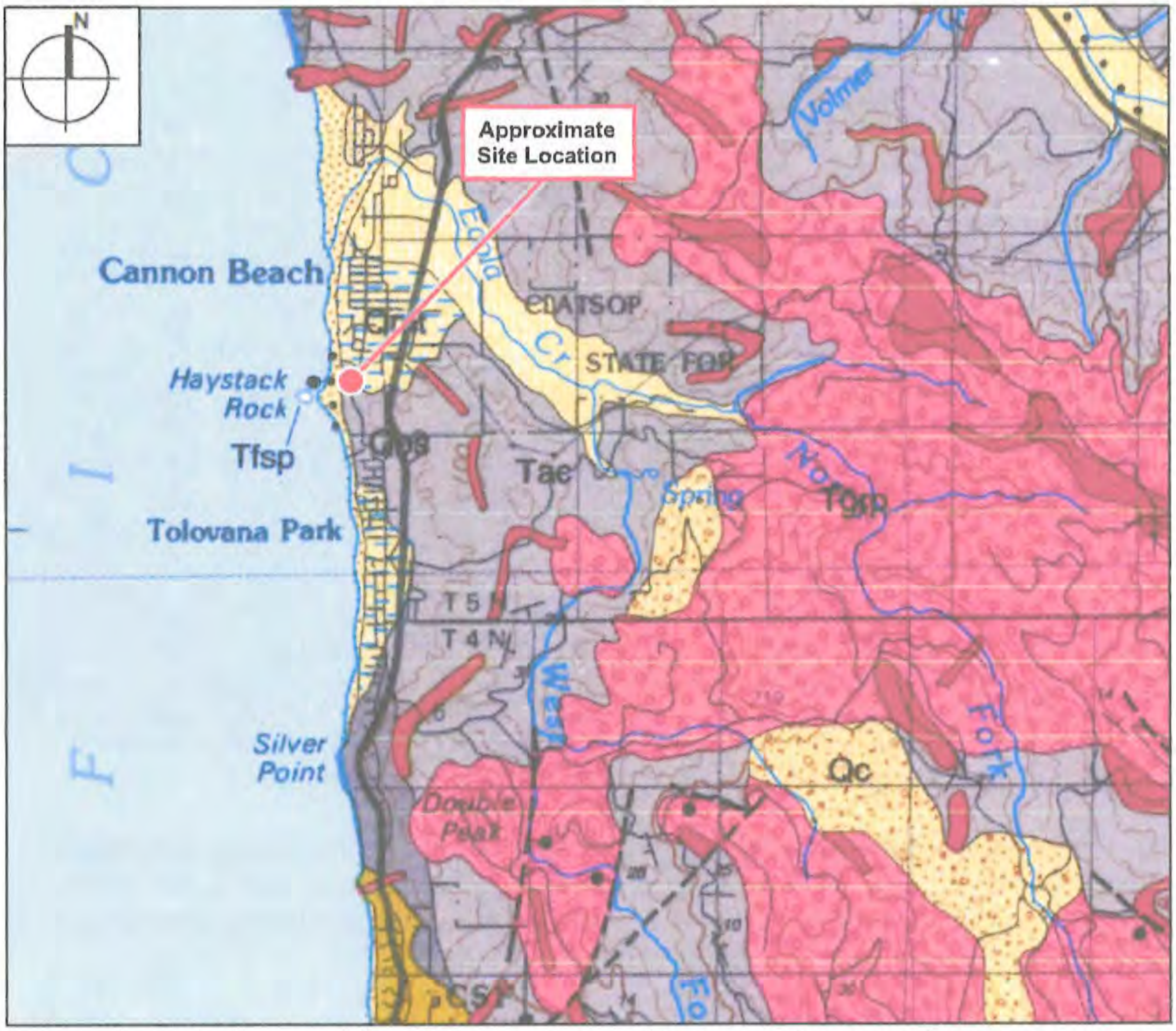

Figure 3: Geologic map of the subject property and its surrounding areas (base map source: Niem and Niem, 1985).

In addition, Schlicker and others (1972)[3] indicates that the subject property is mapped adjacent to an active landslide area. Active landslide areas are described as "areas where ground movement is continuous or periodic or areas in which historic movement has taken place. The area includes debris and rockfalls on the headlands, shallow slump failures along terraces fronting the ocean and bays, and areas of local slump in upland areas." The underlying bedrock unit in the active landslide area is mapped as Pleistocene aged marine terrace deposits (Qmt). See Figure 4 below.

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[3] Schlicker, H.G., Deacon, R.J., Beaulieu, J.D., and Olott, G.W., 1972. Environmental Geology of the Coastal Region of Tillamook and Clatsop Counties, Oregon, Oregon Department of Geology and Mineral Industries, Bulletin 74, 1:62,500.

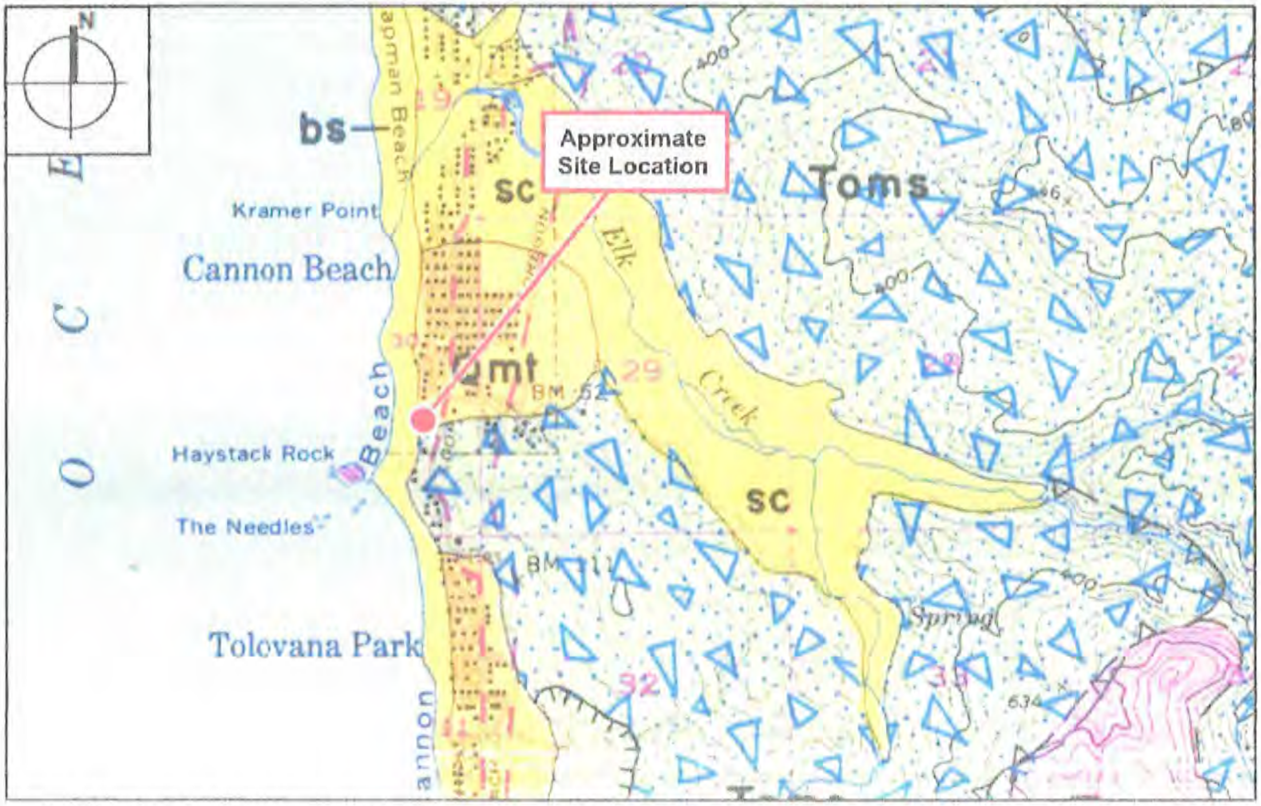

Figure 4: Geologic map of the area; the blue triangle pattern is symbolic of landslide topography (base map source: Schlicker and others, 1972).

We did not observe signs of recent or active landslides from our reconnaissance of the immediate area. Based on our observations of exposed and subsurface soils, as well as the geomorphic features of the site and nearby properties, it is our professional opinion that the site is likely at risk from shallow and deep global landsliding.

The upper, roughly 30 to 40 feet of soft soil is at risk of localized shallow landsliding or soil creep. Adding the weight of a home to this soil layer could increase that risk. As such, we recommend that any house foundations be supported on a deep foundation that extends through this soil layer.

The second landslide risk is from deep-seated block failure given the property may be sitting on a relatively deep portion of the landslide debris. Based on our explorations, it is our professional opinion that the sandstone encountered is the stable layer, therefore extending deep foundations through the upper, compressible soils and bearing them on the sandstone will mitigate the risk of deep global landsliding.

In summary, our recommended approach is to employ a deep foundation system that extends through the compressible, organic soils, and protects the house foundations from shallow, localized landsliding or slope creep that might occur in the future.

Exhibit C-2

3.3 Seismicity

Oregon's position at the western margin of the North American Plate and its location relative to the Pacific and Juan de Fuca plates have had a major impact on the geologic development of the state. The interaction of the three plates has created a complex set of stress regimes that influence the tectonic activity of the state. The western part of Oregon is heavily impacted by the influence of the active subduction zone formed by the Juan de Fuca Oceanic Plate converging upon and subducting beneath the North American Continental Plate off the Oregon coastline.

The Cascadia Subduction Zone, located approximately 100 kilometers off of the Oregon and Washington coasts, is a potential source of earthquakes large enough to cause significant ground shaking at the subject site. Research over the last several years has shown that this offshore fault zone has repeatedly produced large earthquakes, on average, every 300 to 700 years. It is generally understood that the last great Cascadia Subduction Zone earthquake occurred about 300 years ago, in 1700 AD. Although researchers do not necessarily agree on the likely magnitude, it is widely believed that an earthquake moment magnitude (M_w) of 8.5 to 9.5 is possible. The duration of strong ground shaking is estimated to be greater than 1 minute, with minor shaking lasting on the order of several minutes.

Additionally, earthquakes resulting from movement in upper plate local faults are considered a possibility. Crustal earthquakes are relatively shallow, occurring within 10 to 20 kilometers of the surface. Oregon has experienced at least two significant crustal earthquakes in the past decade—the Scotts Mills (Mt. Angel) earthquake (M_w 5.6) on March 25, 1993 and the Klamath Falls earthquake (M_w 5.9) on September 20, 1993. Based on limited data available in Oregon, it would be reasonable to assume a M_w 6.0 to 6.5 crustal earthquake may occur in Oregon every 500 years (recurrence rate of 10 percent in 50 years). There are no mapped crustal faults in the immediate vicinity of the property, but there is a marine crustal fault approximately 3 miles west of the property[4].

3.3.1 Seismic Design Parameters

In accordance with ASCE 7-16, we recommend a Site Class E (soft soil with an average standard penetration resistance less than 15 blows per foot) when considering the average of the upper 100 feet of bearing material beneath the proposed foundations. This recommendation is based on the SPT N-values in our boring B-1 and our local knowledge of the area geology.

Inputting our recommended Site Class as well as the site latitude and longitude into the Structural Engineers Association of California (SEAOC) – OSHPD Seismic Design Maps website (http://seismicmaps.org) which is based on the United States Geological Survey, we obtained the seismic design parameters shown in Table 1 below. Note that the values for F_a and F_v in Table

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[4] USGS U.S. Quaternary Faults Interactive Map, https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf.

1 were obtained from ASCE's Supplement 3 dated November 5, 2021 and issued for ASCE 7-16 to correct some seismic design issues in the original publication.

Table 1: Seismic Design Parameter Recommendations (ASCE 7-16, including Supplement 3 dated November 5, 2021)

PARAMETER	RECOMMENDATION
Site Class	E
S_s	1.317g
S_1	0.691g
F_a	1.200
F_v	2.000
S_{MS} (= S_s x F_a)	1.580g
S_{M1} (= S_1 x F_v)	1.382g
S_{DS} (=2/3 x S_s x F_a)	1.054g
S_{D1} (=2/3 x S_1 x F_V)	0.921g
Design PGA (= S_{DS} / 2.5)	0.422g
MCE_G PGA	0.664g
F_{PGA}	1.100
PGA_M (= MCE_G PGA * F_{PGA})	0.731g

Note: Site latitude = 45.8866, longitude = -123.963

The return interval for the ground motions reported in the table above is 2 percent probability of exceedance in 50 years.

Per Section 11.4.8 of ASCE 7-16 a site-specific ground motion hazard analysis shall be performed in accordance with Section 21.2 for the following conditions:

1. Structures on Site Class D sites with S_1 greater than or equal to 0.2g.

   Exception: ASCE 7-16 does not require a site-specific ground motion hazard analysis when the value of S_{M1} is elected to be increased by 50% for all applications of S_{M1} by the Structural Engineer. If S_{M1} is increased by 50% to avoid having to perform the seismic response analysis, then the resulting value of S_{D1} shall be equal to 2/3 * [1.5* S_{M1}])

2. Structures on Site Class E sites with values of S_s greater than or equal to 1.0, or values of S_1 greater than or equal to 0.2.

   Exception: ASCE 7-16 does not require a site-specific ground motion hazard analysis when:
   1. The Structural Engineer uses the equivalent lateral force design procedure and the value of Cs is determined by Eq. 12.8-2 for all values of T, or
   2. Where (i) the value of S_{ai} is determined by Eq. 15.7-7 for all values of T_i, and (ii) the value of the parameter S_{D1} is replaced with 1.5* S_{D1} in Eq. 15.7-10 and 15.7-11.

We classified this site as Site Class E. Because the S_s value is greater than 1.0 as shown in Table 1 above, a ground motion hazard analysis is required unless the Structural Engineer elects to increase the S_{M1} value by 50 percent (which results in increasing the S_{D1} value by 50 percent). If the Structural Engineer elects not to utilize the 50 percent increase on S_{M1} and S_{D1}, then EEI should be retained to perform a site-specific ground motion hazard analysis in accordance with Section 21.2 of ASCE 7-16.

3.3.2 Liquefaction

Based on our investigation, we consider the soils encountered in our exploration to be liquefiable. Liquefaction occurs when a saturated sand or silt soil starts to behave like a liquid. Liquefaction occurs because of the increased pore pressure and reduced effective stress between solid particles generated by the presence of liquid. It is often caused by severe ground shaking, especially that associated with earthquakes. For the purpose of our hazard evaluation, we consider only the saturated soils within the upper 50 feet of the ground surface to be potentially liquefiable. The liquefaction potential was evaluated based on the SPT N_{60}-values.

Assuming 2 to 3 percent vertical strain, we estimate that total dynamic settlement caused by an earthquake could be on the order of 9 to 13 inches. This assumes the potentially liquefiable layer is 36 feet thick (i.e. reference boring B-2 where it is potentially liquefiable from 4 to 40 feet). We estimate differential dynamic settlement due to liquefaction could be on the order of 50 to 75 percent of the total dynamic settlement; meaning anywhere from approximately 4.5- to 10-inches of differential dynamic settlement due to liquefaction could occur across the building footprints.

3.4 Geologic Hazards

The Oregon Department of Geology and Mineral Resources (DOGAMI) maps various geologic hazards, such as 100-year flooding, earthquake ground shaking, costal erosion, and landslides.[5] This service, generally referred to as Oregon's HazVu, shows the geologic hazards associated with development of this region of the site to include the following:

- Severe Cascadia earthquake expected shaking
- Very strong crustal earthquake expected shaking
- Low liquefaction (soft soil) hazard area
- Moderate landslide hazard area (i.e. landsliding possible)
- In close proximity to mapped landslide deposits
- In close proximity to mapped coastal erosion hazard area

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[5] Oregon HazVu: Statewide Geohazards Viewer, available online at: http://www.oregongeology.org/sub/hazvu/ accessed 5/31/2022.

Exhibit C-2

Figures 5 through 10 below show mapping of the geologic hazards as presented by Oregon's HazVu.

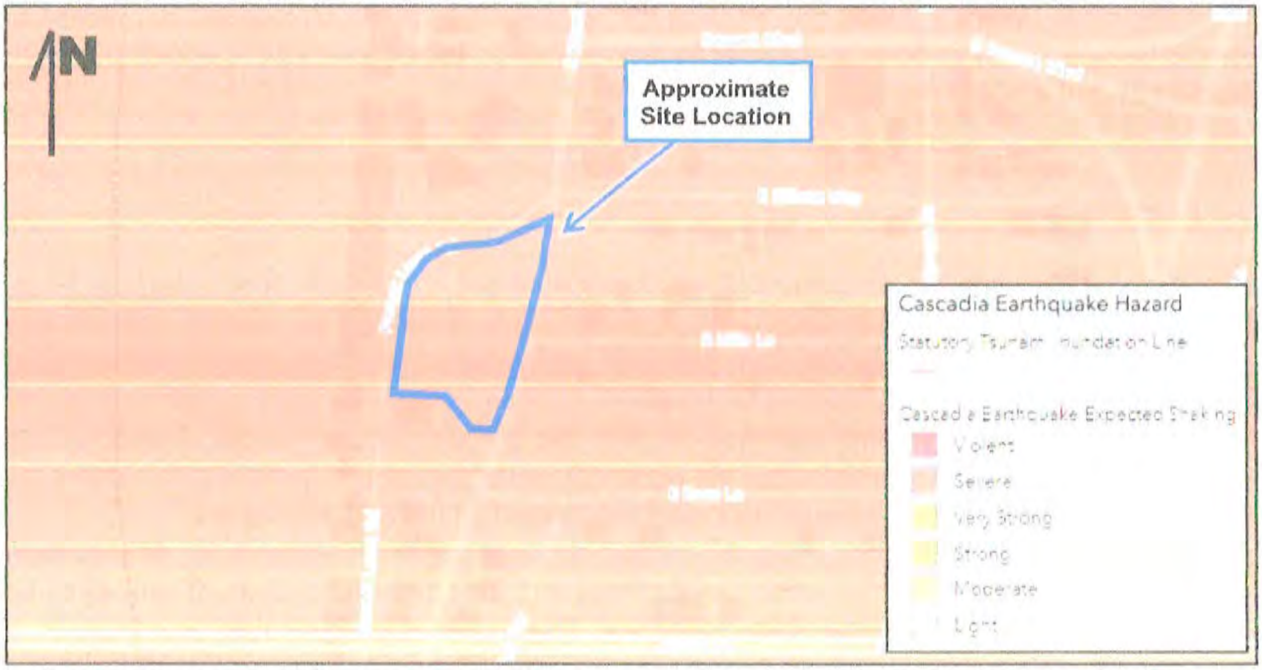

Figure 5: HazVu map showing the Cascadia earthquake expected shaking hazard zones.

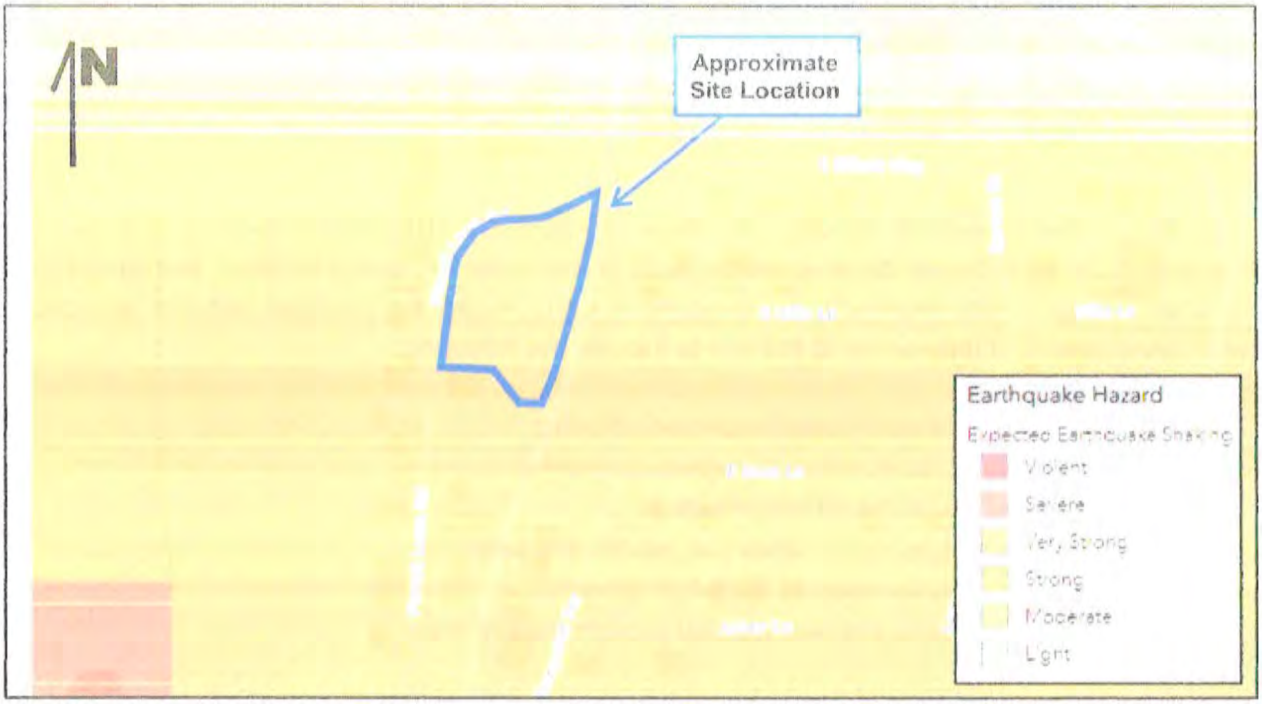

Figure 6: HazVu map showing the crustal earthquake expected shaking hazard zones.

Exhibit C-2

Figure 7: HazVu map showing the liquefaction (soft soil) hazard area.

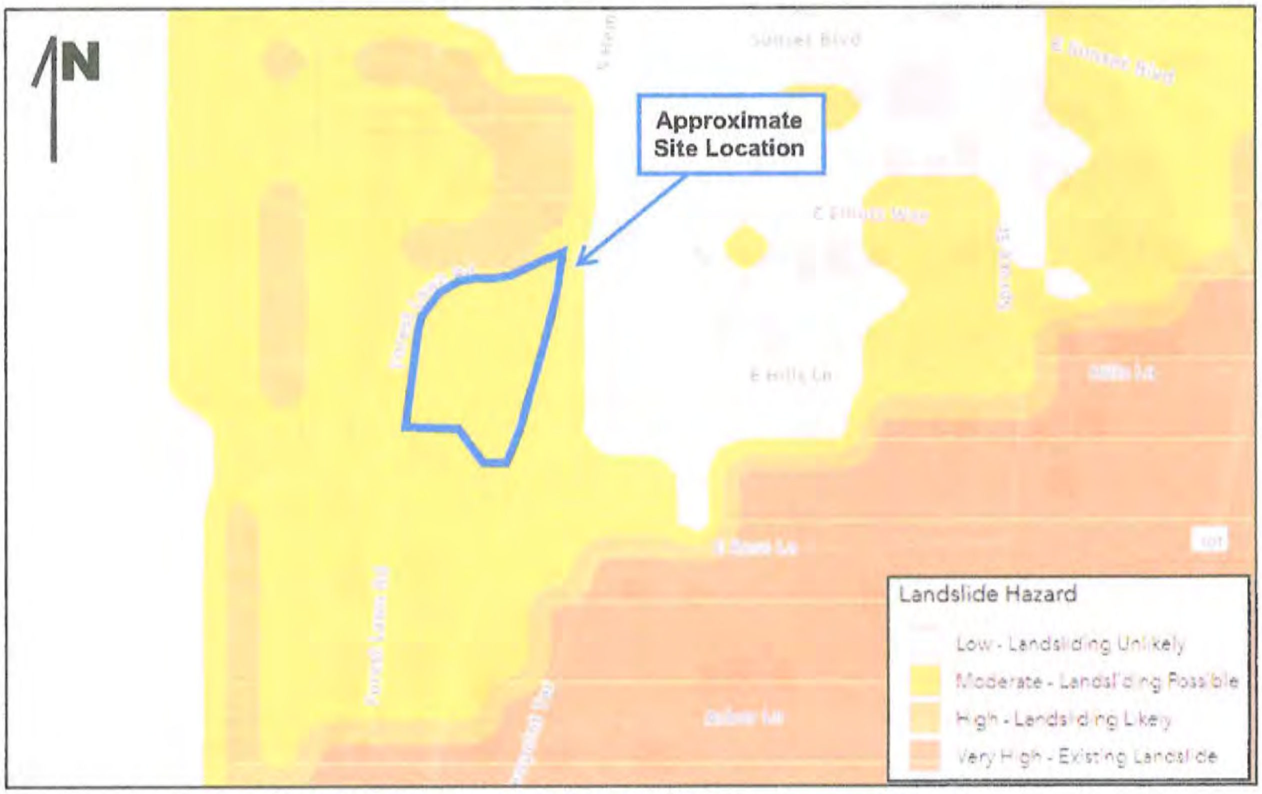

Figure 8: HazVu map showing the landslide hazard zones.

Figure 9: HazVu map showing the mapped landslide deposits.

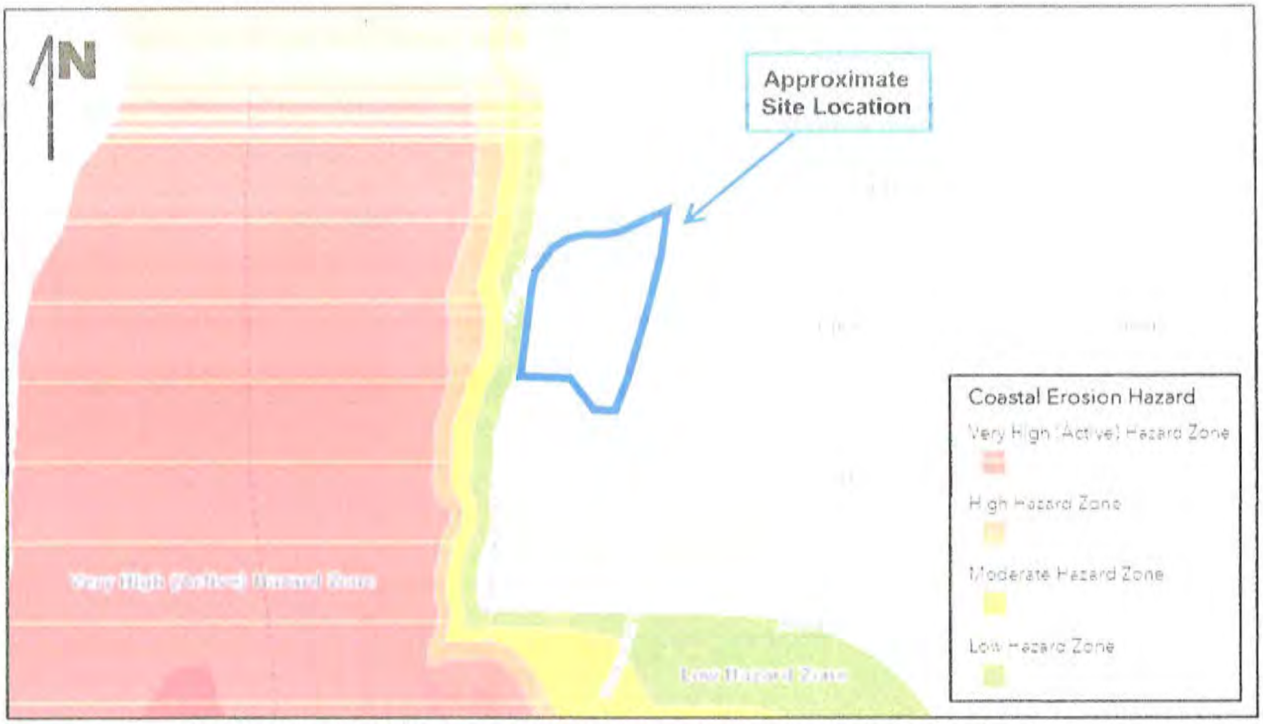

Figure 10: HazVu map showing the mapped coastal erosion hazard.

Exhibit C-2

In addition, we reviewed the Northwest Association of Networked Ocean Observing Systems (NANOOS) Visualization System (NVS) for information on tsunami hazard in proximity to the subject property.[6] The NVS maps the subject property within a local earthquake and tsunami region. See Figure 11 below.

Figure 11: NVS map showing the mapped tsunami hazard region.

Based on our site reconnaissance, subsurface explorations, and office research, we consider the site to have the following geologic hazards:

- Earthquake shaking from regional seismic activity.
- Landslide hazard.
- Potential settlement/movement associated with compressible, near surface soils and liquefaction potential.
- Coastal erosion.
- Tsunami hazard from a local CSZ earthquake.

As stated above, the subject property is surrounded by ancient landslides, and is mapped within a moderate landslide hazard area (i.e. landsliding possible). Although the subject property is not mapped within an ancient landslide, the compressible, variable soils we encountered to depths of 30 to 40 feet are consistent with landslide material we have observed in the area. It is very normal/typical for the shallow, compressible soils to slide after wet winter weather or a seismic

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[6] Northwest Association of Networked Ocean Observing Systems (NANOOS) Visualization System (NVS), available online at http://nvs.nanoos.org/TsunamiEvac accessed 5/31/2022.

Exhibit C-2

event. We do not believe this property is at any greater risk from this hazard than the other numerous existing developed lots in the neighborhood. That being said, we recommend that at a minimum, any house foundations be designed to protect life-safety (i.e. the house is allowed to be damaged by landsliding but the structure stays intact long enough for the occupants to evacuate).

As shown in Figure 10 above, the western property line is mapped within a low risk of coastal erosion hazard. Although we do not believe that the subject property is at immediate risk from coastal erosion, it could recede back towards the home gradually over time. We envision that it would occur in several sequences that would allow for addressing the issue before it ever reached the house. In addition, any structures would be protected from erosion if supported on a foundation that bears directly on the more stable sandstone stratum (i.e. piles).

As shown in Figure 11 above, the property is at risk of being inundated by a tsunami. We are not providing any geotechnical recommendations for mitigating that risk from tsunami level events. Developing on the lot means that the property owner needs to accept the risk of damage to the residences in the event of a tsunami.

In summary, it is our professional opinion that the proposed residential development on this property is feasible, subject to the geotechnical engineering recommendations and acceptance of geologic hazards risk presented in this report. Primary considerations should be made to not placing any new fill to raise site grades, and maintaining adequate site surface and subsurface drainage. Vegetation should also be maintained to prevent excessive erosion, and should only be removed where needed to complete the proposed construction. Additionally, the house foundations should extend to the native sandstone and be engineered with the idea of resisting the effects of earthquake shaking. These recommendations are discussed in more detail in Section 4 below. Ultimately, owning a home in this area means there is an acceptance of risk that the property is located among very large ancient landslide deposits and within a landslide hazard area that could reactivate at some time in the future, possibly en masse due to a Cascadia Subduction Zone earthquake event.

4.0 EVALUATION AND FOUNDATION RECOMMENDATIONS

4.1 Geotechnical Discussion

Based on our site reconnaissance, it is our professional opinion that the primary factors impacting the proposed development include the following:

1. **Presence of weak, compressible, organic soils** – As discussed above, we encountered compressible, organic soils to a depth of approximately 30 to 40 feet bgs. The compressible soils encountered had an N-value average of 2 (i.e. generally loose). It is our professional opinion that these compressible soils are not sufficient for shallow foundation support. As such, we recommend all foundations penetrate through these variable soils to bear on the medium dense to very dense sandstone first encountered in our borings at a depth of 30 to 40 feet bgs. See Section 4.5 below for detailed deep foundation recommendations (i.e. pin piles or helical piers).

2. **Presence of potentially liquefiable soils** – As stated above, there are potentially liquefiable soils located at the project site. Based on our analysis, approximately 9- to 13-inches of total dynamic settlement due to liquefaction could occur with potential differential settlements up to approximately 4.5- to 10-inches across the proposed buildings' footprints. This much settlement precludes the use of shallow foundations. As stated above, we are recommending deep foundations for the proposed development that will mitigate risk of settlement in a design level earthquake event.

3. **Presence of organics** – As stated above, we encountered heavy organics (i.e. wood chips and rootlets) in all of our explorations. The presence of organics extended to depths of 25 to 30 feet bgs. It is our professional opinion that this material is not sufficient to provide shallow foundation support without risking excess total and differential settlements. As such, we are providing deep foundation recommendations that penetrate through these organic soils to bear on the medium dense to very dense sandstone stratum encountered at a depth of approximately 30 to 40 feet bgs. In addition, the organic soils are unsuitable for use as structural fill.

4. **Shallow groundwater** – As previously mentioned, we encountered groundwater at depths ranging from 1 to 6 feet bgs across the subject property at the time of our subsurface investigation. The contractor should anticipate the need to dewater for any excavations deeper than about 1-foot. The need to dewater can be lessened if the construction occurs in the dry summer and early fall months. Detailed dewatering design is typically left up to the contractor's means and methods, and is not part of our current scope of services.

5. **Limited explorations** – As stated above, the project is in its preliminary stages. As a result, the property has not been cleared for accessibility and we were therefore only able

to advance drilled borings on the outer portion of the proposed development (i.e. along the property line). It should be noted we did advance hand tool explorations in the southern portion of the property (i.e. where it is not as densely vegetated), however based on the limited nature of hand tool explorations, we were unable to determine the depth to sandstone in these areas. Once the project is further along and the site is more accessible, we would be available to perform additional drilled borings. This is not a requirement; it is just a suggestion if there is a desire by the project team to better define the depth the piles will need to go to reach the dense sandstone stratum.

6. **Lack of detailed design drawings** – Given this project is in its preliminary stages, we have not been provided with a detailed design drawing set for the proposed construction. One the drawings are complete, we should be forwarded a copy to review for compliance with our geotechnical engineering recommendations.

In summary, this site appears to be developable provided our geotechnical engineering recommendations are followed and the geologic hazard risks are acceptable.

4.2 Site Preparation

Minimal site preparation will be required to install the piles. Any utilities present beneath the proposed construction will need to be located and rerouted as necessary and any abandoned pipes or utility conduits should be removed to inhibit the potential for subsurface erosion. Utility trench excavations should be backfilled with properly compacted structural fill as discussed in Section 4.3 below.

4.3 Structural Fill

Any structural fill placed should be granular, free of organic or other deleterious materials, have a maximum particle size less than 3 inches, be relatively well graded, and have a liquid limit less than 45 and plasticity index less than 25. In our professional opinion, on-site soils are **not** appropriate for use as fill due to the presence of organics. As such, we recommend importing granular, well graded, crushed rock structural fill. Typically, we recommend fill be moisture conditioned to within 3 percentage points below and 2 percentage points above optimum moisture as determined by ASTM D1557 (Modified Proctor). If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying.

Fill should be placed in a relatively uniform horizontal lift on the prepared subgrade. Each loose lift should be about 1 foot. The type of compaction equipment used will ultimately determine the maximum lift thickness. Structural fill should be compacted to at least 92 percent of the Modified Proctor maximum dry density as determined by ASTM D1557.

Each lift of compacted engineered fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. The fill should extend horizontally outward beyond the exterior perimeter of the building and pavements at least 5 and 3 feet, respectively, prior to sloping.

4.4 Foundation Recommendations

4.4.1 Pin Pile Recommendations

Once the site has been prepared, we recommend the proposed buildings be supported by 6-inch diameter, schedule 80 steel pipe piles driven to practical refusal using a hydraulic 2,000-pound hammer or equivalent. We also recommend the pin piles all be connected by an integrated, gridded system of rigid grade beams. Refusal for a 6-inch diameter pipe pile using a hammer of this size should be defined as less than 1-inch of penetration in 10 seconds or more. When practical, this refusal criteria should be met for the last 60 seconds of pile driving.

Assuming the piles are driven to refusal using these criteria, the allowable axial capacity for a pile installed vertically would be 30 kips in compression. This allowable axial capacity assumes a factor of safety of 2.0. We recommend a maximum lateral load resistance of 1.0 kip for each vertical pile as long as they are spaced a distance of at least 6D (measured from center to center) where D represents the diameter of the pile. If additional lateral load resistance is needed, we can provide battered pile recommendations.

Based on the known subsurface conditions we anticipate that properly constructed pin pile foundations driven to refusal will experience static settlements less than 1-inch and 1/2-inch of total and differential settlement, respectively. We estimate that the average pile driving refusal depth will be encountered at approximately 40 to 50 feet bgs.

4.4.2 Helical Pier Recommendations

We are also providing helical pier recommendations for the subject site to minimize noise disturbance (i.e. from driving the pin piles). It should be noted that helical piers can hit shallow refusal due to subsurface obstructions (i.e. rocks and/or debris). We encountered heavy organics and trace gravel in our explorations. As such, the contractor should anticipate the need to put in additional effort to get through the debris.

We recommend galvanized round shaft helical piers with a 12-inch diameter single helix. The helical piers should be installed so that the helix is embedded into the medium dense to very dense sandstone encountered at depths of 30 to 40 feet bgs in both of our explorations. In order to achieve the design loads outlined below, the helix needs to be embedded at least 1 foot. For preliminary budgeting purposes, we recommend the helical piers be planned for lengths of 35 to 45 feet.

We have assumed a 2-7/8 inch diameter round shaft helical piers will be used. The 2-7/8-inch diameter helical piers are typically manufactured to have a maximum axial compressive load capacity of 80 kips. Applying a FOS of 2, the piers can be designed for an allowable load capacity of 40 kips. If greater load capacity is needed, a larger shaft diameter can be selected. If requested, we can provide load capacities for larger shaft diameters. In order to use a FOS of 2, at least one helical pier should be load tested in compression for the project. If no load test is performed, then a FOS of 3 should be used.

Any helical piles installed vertically (i.e. not battered) may be designed for an allowable lateral load of up to 1 kip. If additional lateral loads are required the piles should be battered to achieve the necessary loads.

To utilize the fully recommended capacity, the helical piers should be laterally spaced no closer than 3 pier diameters, measured center to center (i.e. 3 feet for a piers with a 12-inch lead helical).

EEI should be scheduled to be on site when each helical pier is installed to inspect the installation and verify our recommendations are met. We also should be scheduled to be on site to inspect and approve the pile load test.

4.5 Floor Slab Recommendations

For the purposes of this report, we have assumed that maximum floor slab loads will not exceed 150 psf. Based on the existing soil conditions, the design of the floor slab can be based on a subgrade modulus (k) of 100 pci. This subgrade modulus value represents an anticipated value which would be obtained in a standard in-situ plate test with a 1-foot square plate. Use of this subgrade modulus for design or other on-grade structural elements should include appropriate modification based on dimensions as necessary.

In order to fully mitigate the risk of settlement, the concrete floor slab would need to be tied into the grade beams and supported on the deep foundation elements recommended above (i.e. designed as a structural floor slab). However, if a conventional, less expensive floor slab-on-grade is preferred, to at least partially mitigate the risk of potential settlement, the floor slab should be supported on at least 12-inches of properly compacted crushed rock gravel structural fill overlying the existing soils. This approach means that there is some acceptance of risk that there could be settlement cracking in floor slabs on grade. The structural fill recommendations are outlined in Section 4.3 above. The floor slabs should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage.

Prior to placing the structural fill, the exposed subgrade surface should be prepared as discussed in Section 4.2. In addition, we recommend a proof-roll utilizing a fully loaded, dual axle dump truck or water truck in order to identify any unstable areas that should be removed prior to structural fill placement. The proofroll should be observed by a representative of the Geotechnical Engineer. If the subgrade cannot be accessed with a dump truck, then the subgrade will need to be visually evaluated by a representative of the Geotechnical Engineer by soil probing. If fill is required, the structural fill should be placed on the prepared subgrade after it has been approved by the Geotechnical Engineer.

The 12-inch thick crushed rock structural fill should provide a capillary break to limit migration of moisture through the slab. If additional protection against moisture vapor is desired, a moisture vapor retarding membrane may also be incorporated into the design. Factors such as cost, special considerations for construction, and the floor coverings suggest that decisions on the use of vapor retarding membranes be made by the project design team, the contractor and the owner.

4.6 Retaining Wall Recommendations

As stated above, the project is currently in its preliminary stages. As such, we have not been made aware of any proposed retaining walls. Once more detailed plans are known about retaining walls (if any), we should be provided the drawings so that we can update our recommendations as necessary. For the purposes of this report, we have assumed that no walls will be greater than 10 feet tall.

Retaining wall footings should be designed in general accordance with the recommendations contained in Section 4.4 above (i.e. pin piles or helical piers). For insignificant landscape retaining walls not greater than 4 feet tall, where excessive wall movement due to ground movement is acceptable and not a risk to life-safety, they may be supported on conventional shallow foundations designed for an allowable soil bearing capacity of up to 1,500 pounds per square foot.

Lateral earth pressures on walls, which are not restrained at the top, may be calculated on the basis of an "active" equivalent fluid pressure of 35 pcf for level backfill, and 60 pcf for sloping backfill with a maximum 2H:1V slope. Lateral earth pressures on walls that are restrained from yielding at the top (i.e. stem walls) may be calculated on the basis of an "at-rest" equivalent fluid pressure of 55 pcf for level backfill, and 90 pcf for sloping backfill with a maximum 2H:1V slope. The stated equivalent fluid pressures do not include surcharge loads, such as foundation, vehicle, equipment, etc., adjacent to walls, hydrostatic pressure buildup, or earthquake loading. Surcharge loads on walls should be calculated based on the attached calculations/formulas shown in Appendix H.

We recommend that retaining walls be designed for an earth pressure determined using the Mononobe-Okabe method to mitigate future seismic forces. Our calculations were based on one-half of the Design Peak Ground Acceleration (PGA) value of 0.422g, which was obtained from Table 1 above. We have assumed that the retained soil/rock will have a minimum friction angle of 29 degrees and a total unit weight of about 115 pounds per cubic foot. For seismic loading on retaining walls with level backfill, new research indicates that the seismic load is to be applied at 1/3 H of the wall instead of 2/3 H, where H is the height of the wall[7]. We recommend that a Mononobe-Okabe earthquake thrust per linear foot of 13.7 psf * H^2 be applied at 1/3 H, where H is the height of the wall measured in feet. Note that the recommended earthquake thrust value is appropriate for slopes behind the retaining wall of up to 10 degrees.

Any minor amount of backfill for retaining walls should be select granular material, such as sand or crushed rock with a maximum particle size between ¾ and 1 ½ inches, having less than 5 percent material passing the No. 200 sieve. As stated above, the onsite soils do not meet the requirement for structural fill, and it will be necessary to import material to the project for structure backfill. Silty soils can be used for the last 18 to 24 inches of backfill, thus acting as a seal to the granular backfill.

All backfill behind retaining walls should be moisture conditioned to within ± 2 percent of optimum moisture content, and compacted to a minimum of 90 percent of the material's maximum dry density as determined in accordance with ASTM D1557. Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches. Care in the placement and compaction of fill behind retaining walls must be taken in order to ensure that undue lateral loads are not placed on the walls.

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[7] Lew, M., et al (2010). "Seismic Earth Pressures on Depp Building Basements," SEAOC 2010 Convention Proceedings, Indian Wells, CA.

5.0 CONSTRUCTION CONSIDERATIONS

EEI should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. EEI cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundations if not engaged to also provide construction observation for this project.

5.1 Moisture Sensitive Soils/Weather Related Concerns

The upper soils encountered at this site are expected to be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. While not required, it will be advantageous to perform earthwork and foundation construction activities during dry weather.

5.2 Drainage and Groundwater Considerations

Water should not be allowed to collect in the foundation excavations or on prepared subgrades for the floor slab during construction. Positive site drainage should be maintained throughout construction activities. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff.

The site grading plan should be developed to provide rapid drainage of surface water away from the building areas and to inhibit infiltration of surface water around the perimeter of the building and beneath the floor slab. The grades should be sloped away from the building area. Stormwater should be piped (tightlined) to an existing city storm sewer or to a drainage ditch.

5.3 Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document and subsequent updates were issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

Exhibit C-2

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. EEI does not assume responsibility for construction site safety or the contractor's compliance with local, state, and federal safety or other regulations.

Exhibit C-2

6.0 REPORT LIMITATIONS

As is standard practice in the geotechnical industry, the conclusions contained in our report are considered preliminary because they are based on assumptions made about the soil, rock, and groundwater conditions exposed at the site during our subsurface investigation. A more complete extent of the actual subsurface conditions can only be identified when they are exposed during construction. Therefore, EEI should be retained as your consultant during construction to observe the actual conditions and to provide our final conclusions. If a different geotechnical consultant is retained to perform geotechnical inspection during construction, then they should be relied upon to provide final design conclusions and recommendations, and should assume the role of geotechnical engineer of record, as is the typical procedure required by the governing jurisdiction.

The geotechnical recommendations presented in this report are based on the available project information, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform EEI in writing so that we may amend the recommendations presented in this report, if appropriate, and if desired by the client. EEI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Once construction plans are finalized and a grading plan has been prepared, EEI should be retained to review those plans, and modify our existing recommendations related to the proposed construction, if determined to be necessary.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

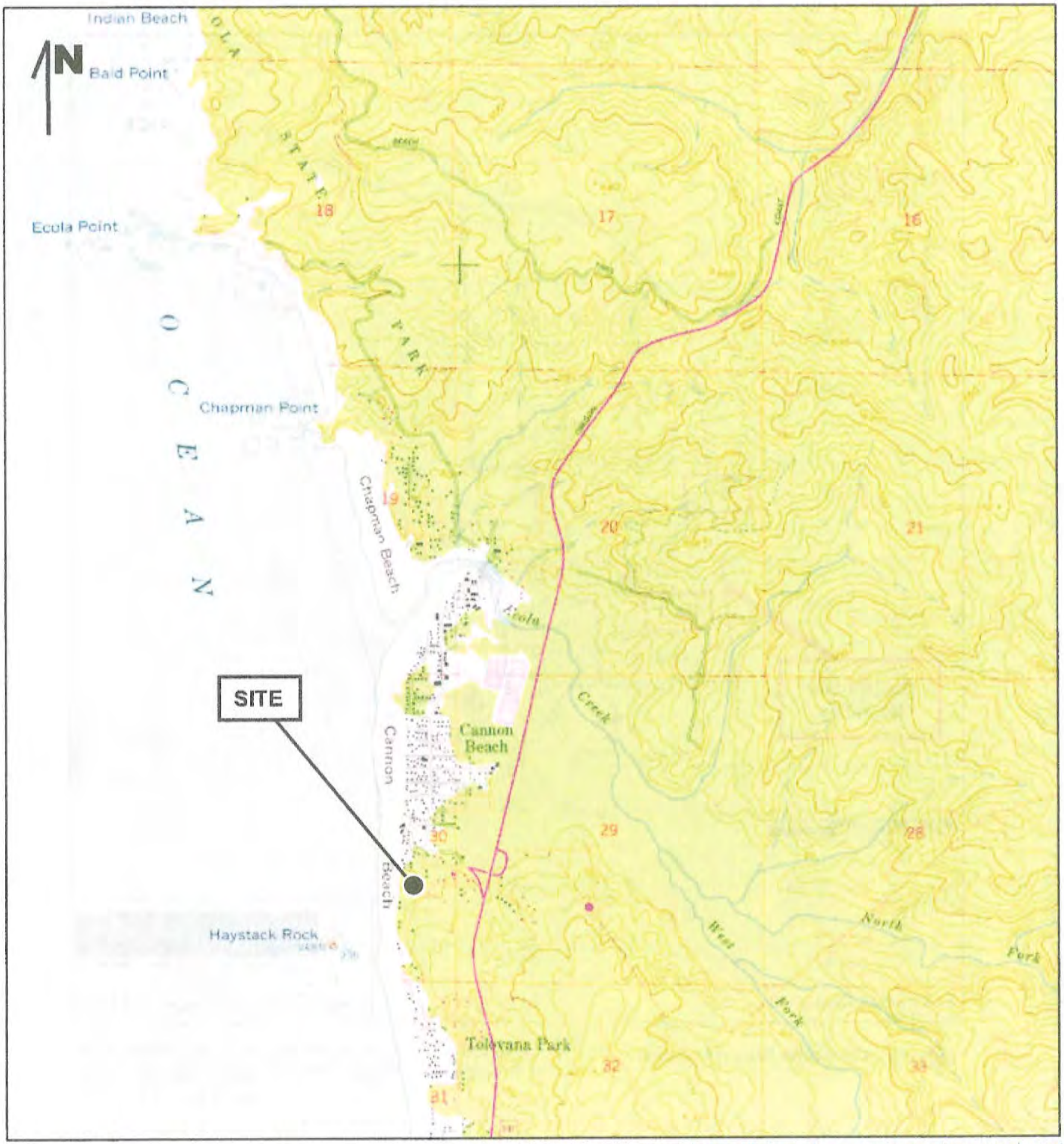
This report has been prepared for the exclusive use of Patrick/Dave, LLC for the specific application to the proposed Forest Lawn ***Development*** located on County Tax Lot No. 51030DA04100 in Cannon Beach, Clatsop County, Oregon. EEI does not authorize the use of the advice herein nor the reliance upon the report by third parties without prior written authorization by EEI.

Exhibit C-2

APPENDICES

Exhibit C-2

APPENDIX A – SITE LOCATION PLAN

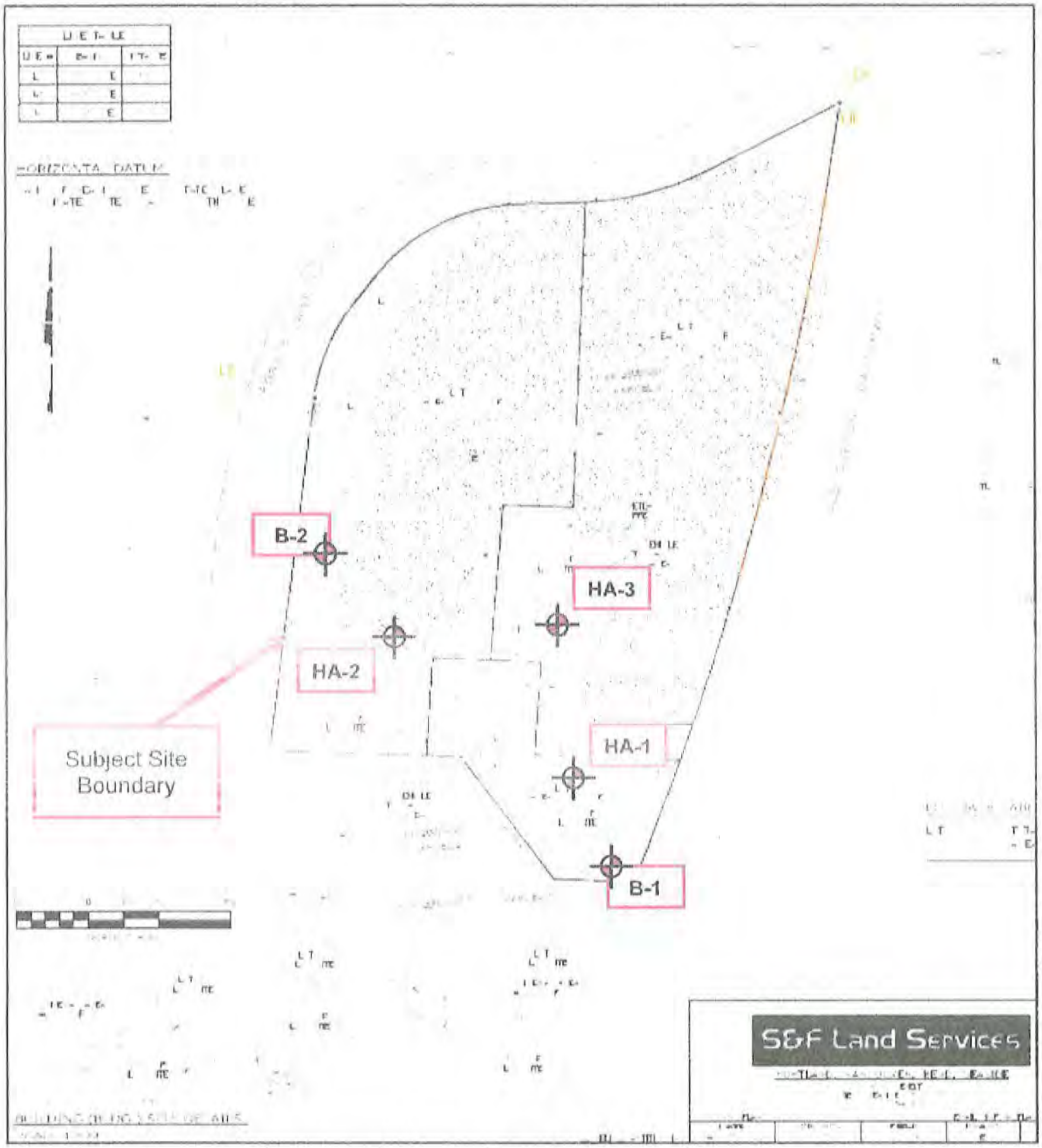


Base Map Source: https://livingatlas.arcgis.com/topoexplorer/

Earth Engineers, Inc.	**Proposed Forest Lawn *Development* *Clatsop County* Tax Lot #51030DA04100 Intersection of Forest Lawn Road and South Hemlock Street Cannon Beach, Clatsop County, Oregon**	**Report No. 22-103-1-*R2*** **June 3, 2022 *(revised July 18, 2023)***

Exhibit C-2

APPENDIX B – EXPLORATION LOCATION PLAN



⌖ = Approximate Boring Location

Base image source: Partition plan titled "Preliminary Forest Lawn Partition Plat" prepared by S&F Land Services, dated May 13, 2022.

Earth Engineers, Inc.

Proposed Forest Lawn *Development*
***Clatsop County* Tax Lot #51030DA04100**
Intersection of Forest Lawn Road and South Hemlock Street
Cannon Beach, Clatsop County, Oregon

Report No.
22-103-1-*R2*

June 3, 2022
(revised July 18, 2023)

Exhibit C-2

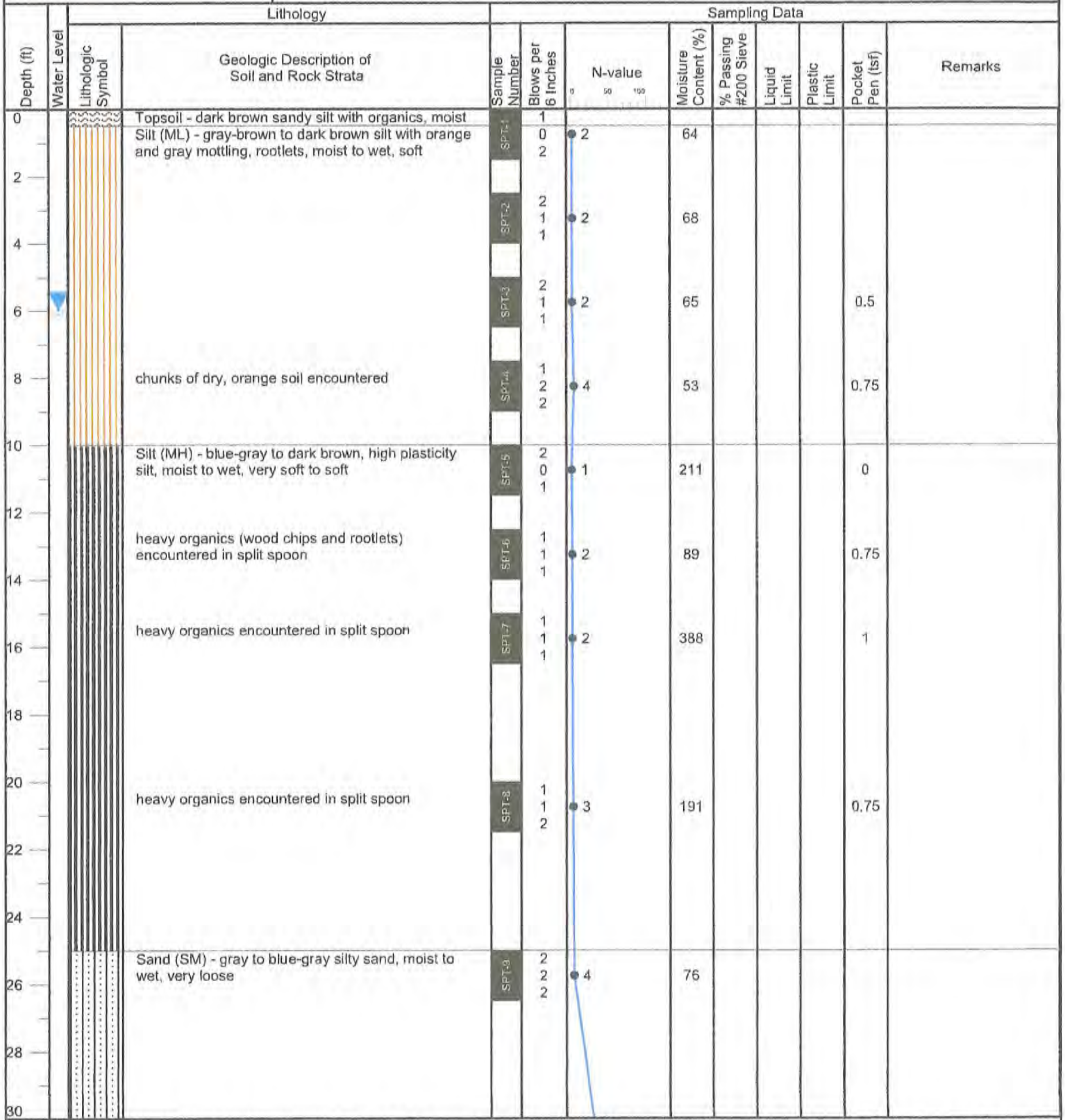
Earth Engineers, Inc.

Appendix C: Boring B-1

Sheet 1 of 2

Client: Red Crow, LLC
Project: Proposed Forest Lawn Partition
Site Address: Tax Lot No. 51030AA04402
Forest Lawn Road, Clatsop County, Cannon Beach, OR
Location of Exploration: See Appendix B
Logged By: Jacqui Boyer

Report Number: 22-103-1
Drilling Contractor: Dan J Fischer Excavating, Inc.
Drilling Method: Solid Stem Auger
Drilling Equipment: Big Beaver w/ SPT Cathead Hammer
Approximate Ground Surface Elevation (ft msl): 46
Date of Exploration: 5/4/2022



Water Level	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N-value	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
	Topsoil - dark brown sandy silt with organics, moist									
	Silt (ML) - gray-brown to dark brown silt with orange and gray mottling, rootlets, moist to wet, soft	SPT-1	1 0 2	2	64					
		SPT-2	2 1 1	2	68					
▼		SPT-3	2 1 1	2	65				0.5	
	chunks of dry, orange soil encountered	SPT-4	1 2 2	4	53				0.75	
	Silt (MH) - blue-gray to dark brown, high plasticity silt, moist to wet, very soft to soft	SPT-5	2 0 1	1	211				0	
	heavy organics (wood chips and rootlets) encountered in split spoon	SPT-6	1 1 1	2	89				0.75	
	heavy organics encountered in split spoon	SPT-7	1 1 1	2	388				1	
	heavy organics encountered in split spoon	SPT-8	1 1 2	3	191				0.75	
	Sand (SM) - gray to blue-gray silty sand, moist to wet, very loose	SPT-9	2 2 2	4	76					

Notes : Boring terminated at a depth of approximately 33.5 feet below ground surface (bgs) due to practical drilling refusal. Groundwater encountered at a depth of 6 feet bgs at the time of our exploration. Boring backfilled with bentonite chips on 5/4/22. N-values reported are based on the use of a cathead hammer (i.e. [illegible] correction factor). Approximate elevation from Google Earth.

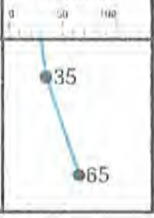
Exhibit C-2

Appendix C: Boring B-1

Sheet 2 of 2

Client: Red Crow, LLC
Project: Proposed Forest Lawn Partition
Site Address: Tax Lot No. 51030AA04402
Forest Lawn Road, Clatsop County, Cannon Beach, OR
Location of Exploration: See Appendix B
Logged By: Jacqui Boyer

Report Number: 22-103-1
Drilling Contractor: Dan J Fischer Excavating, Inc.
Drilling Method: Solid Stem Auger
Drilling Equipment: Big Beaver w/ SPT Cathead Hammer
Approximate Ground Surface Elevation (ft msl): 46
Date of Exploration: 5/4/2022

		Lithology		Sampling Data								
Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N-value	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
30			Sandstone - blue-gray sandstone with few to little silt, moist, dense to very dense	SPT-10	9 14 21	 35	26					drilling difficulty increased
32				SPT-11	26 31 34	65	11					drilling refusal
34												
36												
38												
40												
42												
44												
46												
48												
50												
52												
54												
56												
58												
60												

Notes : Boring terminated at a depth of approximately 33.5 feet below ground surface (bgs) due to practical drilling refusal. Groundwater encountered at a depth of 6 feet bgs at the time of our exploration. Boring backfilled with bentonite chips on 5/4/22. N-values reported are based on the use of a cathead hammer (i.e. no correction factor). Approximate elevation from Google Earth.

Exhibit C-2

Earth Engineers, Inc

Appendix C: Boring B-2

Sheet 1 of 2

Client: Red Crow, LLC
Project: Proposed Forest Lawn Partition
Site Address: Tax Lot No. 51030AA04402
Forest Lawn Road, Clatsop County, Cannon Beach, OR
Location of Exploration: See Appendix B
Logged By: Jacqui Boyer

Report Number: 22-103-1
Drilling Contractor: Dan J Fischer Excavating, Inc.
Drilling Method: Solid Stem Auger
Drilling Equipment: Big Beaver w/ SPT Cathead Hammer
Approximate Ground Surface Elevation (ft msl): 42
Date of Exploration: 5/4/2022

Lithology				Sampling Data								
Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N-value (0 50 100)	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Topsoil - dark brown sandy silt with organics, moist Sand (SM) - gray-brown to dark brown sand with trace broken rock fragments, woodchips and rootlets, moist to wet, very loose to loose	SPT-1	2 4 4	8	21					
2				SPT-2	2 2 1	3	32	8				
4	▼											
6			Silt (ML) - blue-gray silt with trace rootlets, moist to wet, very soft	SPT-3	0 0 0	0	72	93	42	32	0	
8				SPT-4	0 0 1	1	59	94			0	
10			Silt (MH) - gray to brown, high plasticity silt, moist to wet, very soft	SPT-5	1 1 1	2	50	97	58	46	0.75	
12												
14												
16			heavy organics (wood chips and rootlets) encountered in split spoon	SPT-6	1 1 1	2	125				0.5	
18												
20			heavy organics encountered in split spoon	SPT-7	1 1 1	2	165				0.5	
22												
24												
26			Sand (SM) - brown silty sand with trace organics, wet, very loose	SPT-8	1 2 2	4	124	26				
28												
30												

Notes : Boring terminated at a depth of approximately 51.5 feet below ground surface (bgs). Groundwater encountered at a depth of 4 feet bgs at the time of our exploration. Boring backfilled with bentonite chips on 5/4/22. N-values reported are based on the use of a cathead hammer (i.e. no correction factor). Approximate elevation from Google Earth.

Exhibit C-2

Appendix C: Boring B-2

Sheet 2 of 2

Client: Red Crow, LLC
Project: Proposed Forest Lawn Partition
Site Address: Tax Lot No. 51030AA04402
Forest Lawn Road, Clatsop County, Cannon Beach, OR
Location of Exploration: See Appendix B
Logged By: Jacqui Boyer

Report Number: 22-103-1
Drilling Contractor: Dan J Fischer Excavating, Inc.
Drilling Method: Solid Stem Auger
Drilling Equipment: Big Beaver w/ SPT Cathead Hammer
Approximate Ground Surface Elevation (ft msl): 42
Date of Exploration: 5/4/2022

		Lithology		Sampling Data								
Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N-value 0 50 100	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Silt (ML) - gray-brown sandy silt, moist to wet, medium stiff	SPT-9	2 2 3	5	60	81				
2												
4												
36				SPT-10	3 3 4	7	83	68				
38												
40			Sandstone - gray to blue-gray sandstone with few to some silt and trace gravel, moist to wet, medium dense to very dense	SPT-11	10 13 9	22	76	39				drilling difficulty increased
42												
44												
46			broken rock encountered at base of split spoon	SPT-12	5 5 9	14	76	9				
48												
50				SPT-13	6 24 50	74	30	15				
52												
54												
56												
58												
60												

Notes : Boring terminated at a depth of approximately 51.5 feet below ground surface (bgs). Groundwater encountered at a depth of 4 feet bgs at the time of our exploration. Boring backfilled with bentonite chips on 5/4/22. N-values reported are based on the use of a cathead hammer (i.e. no correction factor). Approximate elevation from Google Earth.

Exhibit C-2

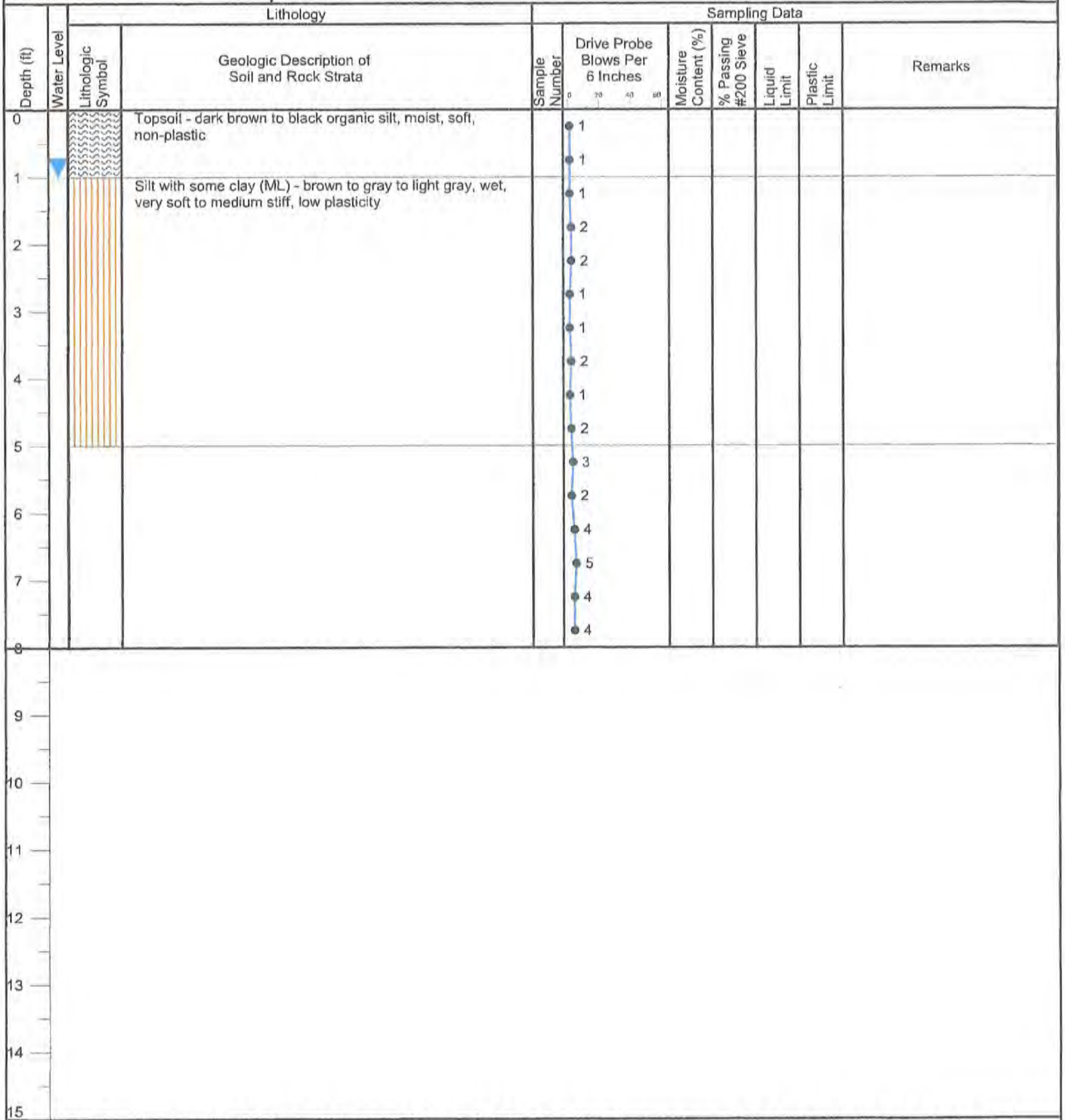
Earth Engineers, Inc

Appendix C: Hand Auger HA-1

Sheet 1 of 1

Client: Red Crow, LLC
Project: Forest Lawn Partition
Site Address: Tax Lot No. 51030AA04402
Forest Lawn Road, Clatsop County, Cannon Beach, OR
Location of Exploration: See Appendix B
Logged By: Matt Enos

Report Number: 22-103
Drilling Contractor: EEI
Drilling Method: N/A
Drilling Equipment: Hand Auger and Drive Probe
Approximate Ground Surface Elevation (ft msl): 41
Date of Exploration: 5/4/2022



Topsoil - dark brown to black organic silt, moist, soft, non-plastic

Silt with some clay (ML) - brown to gray to light gray, wet, very soft to medium stiff, low plasticity

Notes : Hand auger terminated at 5 feet bgs and drive probe terminated at 8 feet bgs. Groundwater encountered at a depth of 1-foot bgs at the time of our exploration. Boring loosely backfilled with excavated soils on 5/4/2022. Approximate elevation based on Google Earth.

Exhibit C-2

Appendix C: Hand Auger HA-2

Sheet 1 of 1

Client: Red Crow, LLC
Project: Forest Lawn Partition
Site Address: Tax Lot No. 51030AA04402
Forest Lawn Road, Clatsop County, Cannon Beach, OR
Location of Exploration: See Appendix B
Logged By: Matt Enos

Report Number: 22-103
Drilling Contractor: EEI
Drilling Method: N/A
Drilling Equipment: Hand Auger and Drive Probe
Approximate Ground Surface Elevation (ft msl): 40
Date of Exploration: 5/4/2022

		Lithology		Sampling Data						
Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Drive Probe Blows Per 6 Inches 0 20 40 60	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Remarks
0			Topsoil - dark brown to black organic silt, moist, soft, non-plastic		1					
	▼				1					
1			Silt with some clay (ML) - brown to gray to light gray, wet, very soft to medium stiff, low plasticity		1					
					2					
2					1					
					2					
3					2					
					2					
4					3					
					2					
5					4					
					4					
6					5					
					4					
7					5					
					6					
8										
9										
10										
11										
12										
13										
14										
15										

Notes : Hand auger terminated at 5 feet bgs and drive probe terminated at 8 feet bgs. Groundwater encountered at a depth of 1-foot bgs at the time of our exploration. Boring loosely backfilled with excavated soils on 5/4/2022. Approximate elevation based on Google Earth.

Exhibit C-2

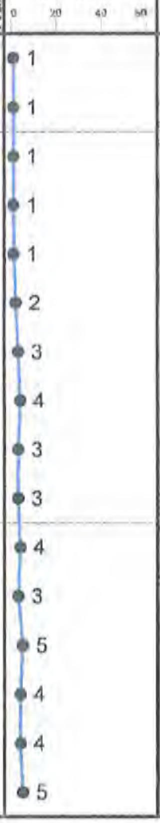
Earth Engineers, Inc

Appendix C: Hand Auger HA-3

Sheet 1 of 1

Client: Red Crow, LLC	Report Number: 22-103
Project: Forest Lawn Partition	Drilling Contractor: EEI
Site Address: Tax Lot No. 51030AA04402	Drilling Method: N/A
Forest Lawn Road, Clatsop County, Cannon Beach, OR	Drilling Equipment: Hand Auger and Drive Probe
Location of Exploration: See Appendix B	Approximate Ground Surface Elevation (ft msl): 39
Logged By: Matt Enos	Date of Exploration: 5/4/2022

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	Sampling Data: Drive Probe Blows Per 6 Inches	Sampling Data: Moisture Content (%)	Sampling Data: % Passing #200 Sieve	Sampling Data: Liquid Limit	Sampling Data: Plastic Limit	Remarks
0	▼		Topsoil - dark brown to black organic silt, moist, soft, non-plastic							
1			Silt with some clay (ML) - brown to gray to light gray, wet, very soft to medium stiff, low plasticity							



Notes : Hand auger terminated at 5 feet bgs and drive probe terminated at 8 feet bgs. Groundwater encountered at a depth of 1-foot bgs at the time of our exploration. Boring loosely backfilled with excavated soils on 5/4/2022. Approximate elevation based on Google Earth.

Exhibit C-2

APPENDIX D: SOIL CLASSIFICATION LEGEND

APPARENT CONSISTENCY OF COHESIVE SOILS (PECK, HANSON & THORNBURN 1974, AASHTO 1988)

Descriptor	SPT N_{60} (blows/foot)*	Pocket Penetrometer, Qp (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 2	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	2 – 4	0.25 – 0.50	0.12 – 0.25	Easily penetrated several inches by thumb
Medium Stiff	5 – 8	0.50 – 1.0	0.25 – 0.50	Penetrated several inches by thumb w/moderate effort
Stiff	9 – 15	1.0 – 2.0	0.50 – 1.0	Readily indented by thumbnail
Very Stiff	16 – 30	2.0 – 4.0	1.0 – 2.0	Indented by thumb but penetrated only with great effort
Hard	> 30	> 4.0	> 2.0	Indented by thumbnail with difficulty

* Using SPT N_{60} is considered a crude approximation for cohesive soils.

APPARENT DENSITY OF COHESIONLESS SOILS (AASHTO 1988)

Descriptor	SPT N_{60} Value (blows/foot)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

MOISTURE (ASTM D2488-06)

Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch, well below optimum moisture content (per ASTM D698 or D1557)
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table, well above optimum moisture content (per ASTM D698 or D1557)

PERCENT OR PROPORTION OF SOILS (ASTM D2488-06)

Descriptor	Criteria
Trace	Particles are present but estimated < 5%
Few	5 – 10%
Little	15 – 25%
Some	30 – 45%
Mostly	50 – 100%

Percentages are estimated to nearest 5% in the field. Use "about" unless percentages are based on laboratory testing.

SOIL PARTICLE SIZE (ASTM D2488-06)

Descriptor	Size
Boulder	> 12 inches
Cobble	3 to 12 inches
Gravel - Coarse Fine	¾ inch to 3 inches No. 4 sieve to ¾ inch
Sand - Coarse Medium Fine	No. 10 to No. 4 sieve (4.75mm) No. 40 to No. 10 sieve (2mm) No. 200 to No. 40 sieve (.425mm)
Silt and Clay ("fines")	Passing No. 200 sieve (0.075mm)

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2488)

Major Division			Group Symbol	Description
Coarse Grained Soils (more than 50% retained on #200 sieve)	**Gravel** (50% or more retained on No. 4 sieve)	Clean Gravel	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	Sand (> 50% passing No. 4 sieve)	Clean sand	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly-graded sands and gravelly sands, little or no fines
		Sand with fines	SM	Silty sands and sand-silt mixtures
			SC	Clayey sands and sand-clay mixtures
Fine Grained Soils (50% or more passing #200 sieve)	**Silt and Clay** (liquid limit < 50)		ML	Inorganic silts, rock flour and clayey silts
			CL	Inorganic clays of low-medium plasticity, gravelly, sandy & lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silt and Clay (liquid limit > 50)		MH	Inorganic silts and clayey silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

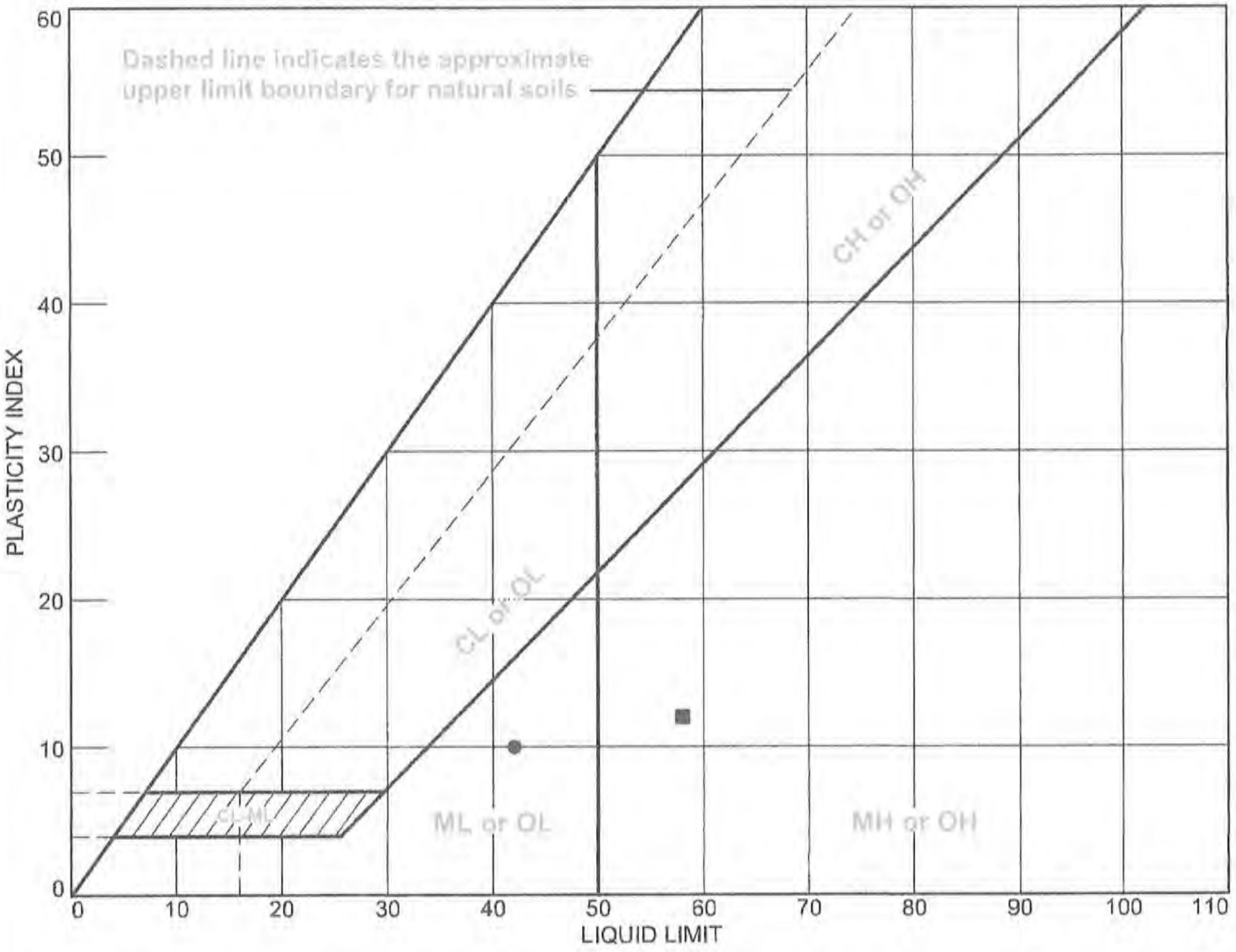
Earth
Engineers,
Inc

GRAPHIC SYMBOL LEGEND

GRAB	☒	Grab sample
SPT	■	Standard Penetration Test (2" OD), ASTM D1586
ST	▒	Shelby Tube, ASTM D1587 (pushed)
DM	▯	Dames and Moore ring sampler (3.25" OD and 140-pound hammer)
CORE	▥	Rock coring

Exhibit C-2

APPENDIX E - LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring 2	1	5	72.0	32	42	10	ML
■	Boring 2	2	10	49.9	46	58	12	MH

Earth Engineers Inc.

Client: Red Crow LLC

Project: Forest Lawn *Development*

Project No.: 22-103 **Figure No.**

Tested By: J. Hill

Exhibit C-2

APPENDIX F

NEARBY HISTORIC WELL LOGS

Exhibit C-2

CLAT 54498

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

6/8/2015

(1) OWNER/PROJECT

Hole Number CPT-1

PROJECT NAME/NBR: MARSAM 060115

First Name Last Name

Company PELICAN BREWING

Address PO BOX 189

City PACIFIC CITY State OR Zip 97135

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☒ Hollow stem auger
☐ Rotary Mud ☐ Cable ☒ Push Probe
☐ Other

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent
○ Uncased Permanent ○ Slope Stablity
○ Other
Other

(5) USE OF HOLE

GEOTECHNICAL

RECEIVED BY OWRD
JUL 27 2015
SALEM, OR

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ Attach copy)

Depth of Completed Hole 20.00 ft

BORE HOLE			SEAL				sacks/
Dia	From	To	Material	From	To	Amt	lbs
8	0	2	Concrete	0	1	1	S
2	2	20	Bentonite Chips	1	2	1	S
			Bentonite Grout	2	20	1	S

Backfill placed from ft to ft Material
Filter pack from ft. to ft Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature °F Lab analysis ☐ Yes By

Supervising Geologist/Engineer

Water quality concerns? ☐ Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLATSOP Twp 5.00 N N/S Range 10.00 W E/W WM

Sec 30 NW 1/4 of the SE 1/4 Tax Lot 300

Tax Map Number Lot

Lat ° ' " or DMS or DD

Long ° ' " or DMS or DD

● Street address of hole ○ Nearest address

1371 S. HEMLOCK ST CANNON BEACH, OREGON 97110

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐

WATER BEARING ZONES Depth water was first found 7.00

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
ASPHALT / BASE ROCK	0	1
SILT W/ GRAVELS	1	2
CLAY	2	15
SILTY SAND TO SANDY SILT	15	20

Date Started 6/1/2015 Completed 6/1/2015

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Concrete	0	1	1	S
Bentonite Chips	1	2	1	S
Bentonite Grout	2	20	1	S

Date Started 6/1/2015 Completed 6/1/2015

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer)

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10400 Date 6/8/2015

First Name ALLEN Last Name MEEUWSEN

Affiliation SUBSURFACE TECHNOLOGIES

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version

Exhibit C-2

GEOTECHNICAL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAT 54498

6/8/2015

Map of Hole

Exhibit C-2

CLAT 54497

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

6/8/2015

(1) OWNER/PROJECT

Hole Number B-1

PROJECT NAME/NBR: MARSAM060115

First Name ________ Last Name ________

Company PELICAN BREWING

Address PO BOX 189

City PACIFIC CITY State OR Zip 97135

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment

☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger

☒ Rotary Mud ☐ Cable ☐ Push Probe

☐ Other ________

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent

○ Uncased Permanent ○ Slope Stablity

○ Other

Other ________

(5) USE OF HOLE

GEOTECHNICAL

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)

Depth of Completed Hole 40.00 ft

BORE HOLE			SEAL				
Dia	From	To	Material	From	To	Amt	sacks/ lbs
5	0	40	Concrete	0	1	1	S
			Bentonite Chips	1	10	2	S
			Bentonite Grout	10	40	1	S

Backfill placed from ______ ft. to ______ ft. Material ________

Filter pack from ______ ft. to ______ ft. Material ________ Size ______

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature ______ °F Lab analysis ☐ Yes By ________

Supervising Geologist/Engineer ________

Water quality concerns? ☐ Yes (describe below) TDS amount ______

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLATSOP Twp 5.00 N N/S Range 10.00 W E/W WM

Sec 30 NE 1/4 of the SE 1/4 Tax Lot 300

Tax Map Number ________ Lot ________

Lat ____ ° ____ ' ____ " or ________ DMS or DD

Long ____ ° ____ ' ____ " or ________ DMS or DD

● Street address of hole ○ Nearest address

1371 S. HEMLOCK ST. CANNON BEACH, OREGON 97110

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐

WATER BEARING ZONES

Depth water was first found 7.00

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation ________

Material	From	To
ASPHALT / BASE ROCK	0	2
SANDY SILT	2	29
FINE SAND	29	40

Date Started 6/1/2015 Completed 6/1/2015

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Concrete	0	1	1	S
Bentonite Chips	0	10	2	S
Bentonite Grout	10	40	1	S

Date Started 6/1/2015 Completed 6/1/2015

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer)

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10400 Date 6/8/2015

First Name ALLEN Last Name MEEUWSEN

Affiliation SUBSURFACE TECHNOLOGIES

RECEIVED BY OWRD

JUL 2 7 2015

SALEM, OR

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version

Exhibit C-2

GEOTECHNICAL SOIL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAT 54497

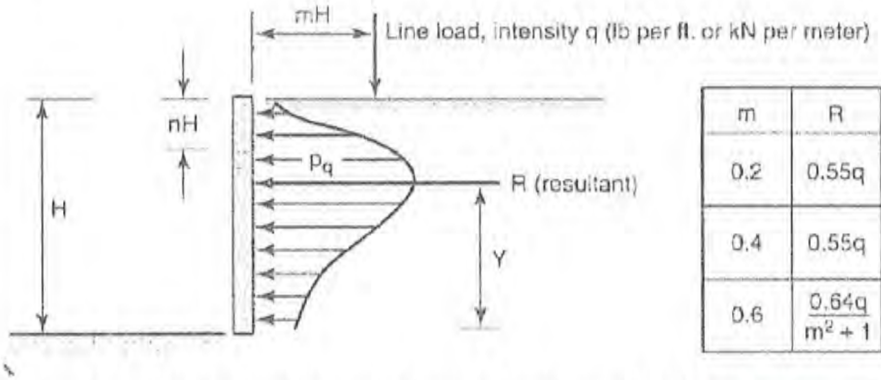
6/8/2015

Map of Hole

Exhibit G2

APPENDIX G: SURCHARGE-INDUCED LATERAL EARTH PRESSURES FOR WALL DESIGN

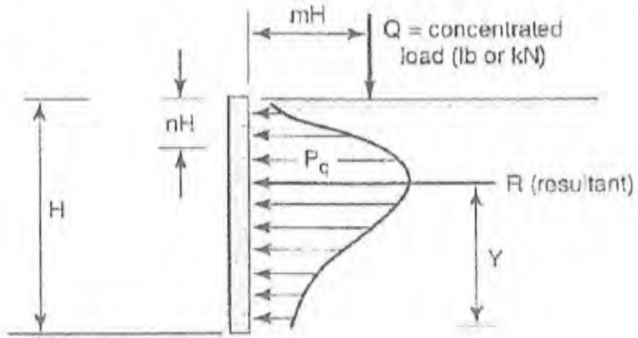
LINE LOAD (applicable for retaining walls not exceeding 20 feet in height):



m	R	Y
0.2	0.55q	0.60 H
0.4	0.55q	0.58 H
0.6	$\frac{0.64q}{m^2+1}$	0.52 H

Figure 16-28 Pressure distribution against vertical wall resulting from line load of intensity *q*.

CONCENTRATED POINT LOAD (applicable for retaining walls not exceeding 20 feet in height):



m	R	Y
0.2	$0.78\frac{Q}{H}$	0.59 H
0.4	$0.78\frac{Q}{H}$	0.59 H
0.6	$0.48\frac{Q}{H}$	0.48 H

Figure 16-27 Pressure distribution against vertical wall resulting from point load, *Q*.

AREAL LOAD:

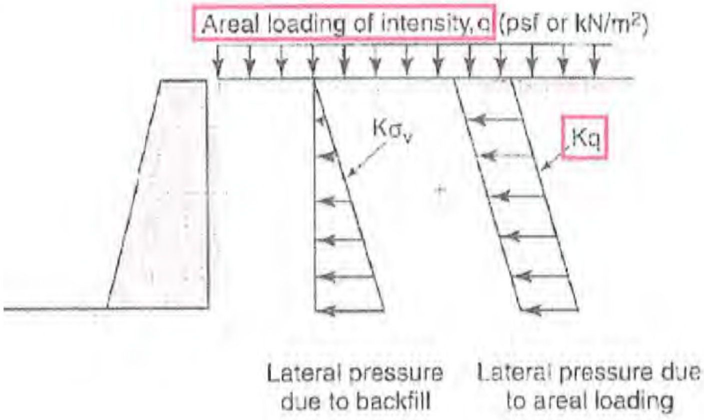
Figure 16-26 Influence of areal loading on wall pressures.

use K=0.4 for active condition (i.e. top of wall allowed to deflect laterally)

use K=0.9 for at-rest condition (i.e. top of wall not allowed to deflect laterally)

Resultant, R = K * q * H

Where H = wall height (feet)



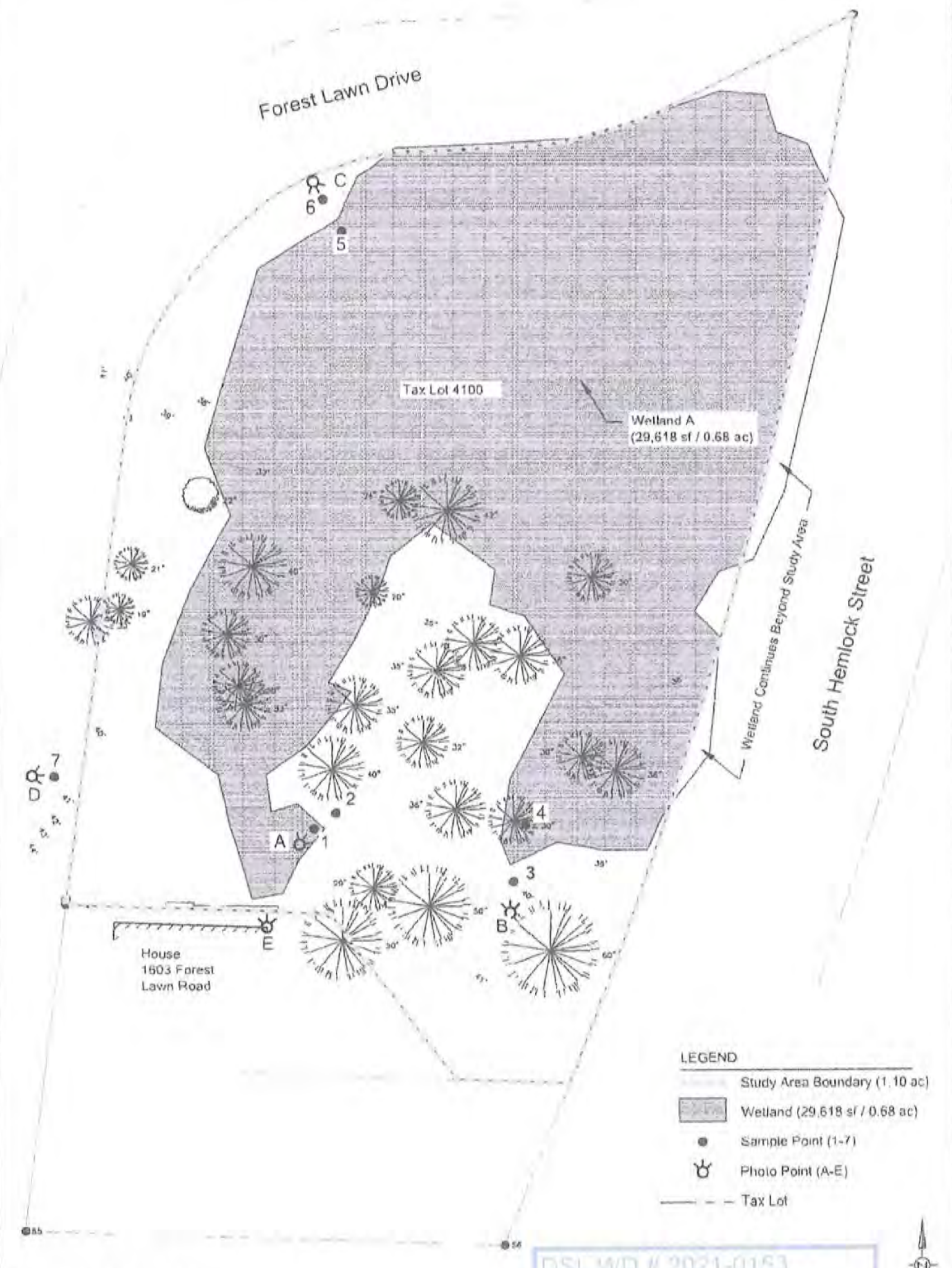
Source of Figures: McCarthy, D.F., 1998, "Essentials of Soil Mechanics and foundations, Basic Geotechnics, Fifth Edition."

Earth Engineers, Inc.	**Proposed Forest Lawn *Development*** ***Clatsop County* Tax Lot #51030DA04100** **Intersection of Forest Lawn Road and South Hemlock Street** **Cannon Beach, Clatsop County, Oregon**	**Report No. 22-103-1-*R2*** **June 3, 2022** ***(revised July 18, 2023)***

Exhibit C-2

Exhibit C-2

#6



Survey provided by S&F Land Services, 2020. Accuracy of Survey, Sample Points, and Tax Lot boundaries is sub-centimeter.

DSL WD # 2021-0153
Approval Issued 6/8/2021
Approval Expires 6/8/2020

PHS
Pacific Habitat Services, Inc.

Wetland Delineation
Tax Lot 4100 - Cannon Beach, Oregon

FIGURE
6

3-19-2021

Exhibit C-2

[redacted]
WETLAND DELIN. CONCUR.

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
(503) 986-5200
FAX (503) 378-4844
www.oregon.gov/dsl
State Land Board

Kate Brown
Governor

Shemia Fagan
Secretary of State

Tobias Read
State Treasurer

June 8, 2021

Patrick/Dave, LLC
Attn: Patrick Gemma
2575 38th Avenue West
Seattle, WA 98199

Re: WD # 2021-0153 **Approved**
Wetland Delineation Report for Tax Lot 4100 on Forest Lawn Drive
Clatsop County; T5N R10W 30DA TL4100
Cannon Beach Local Wetlands Inventory, Wetland 24

Dear Mr. Gemma:

The Department of State Lands has reviewed the wetland delineation report prepared by Pacific Habitat Services for the site referenced above. Based upon the information presented in the report, we concur with the wetland boundaries as mapped in revised Figure 6 of the report. Please replace all copies of the preliminary wetland map with this final Department-approved map.

Within the study area, one wetland (Wetland A, totaling approximately 0.68 acres) was identified. This wetland is subject to the permit requirements of the state Removal-Fill Law. Under current regulations, a state permit is required for cumulative fill or annual excavation of 50 cubic yards or more in wetlands or below the ordinary high-water line (OHWL) of the waterway (or the 2-year recurrence interval flood elevation if OHWL cannot be determined).

This concurrence is for purposes of the state Removal-Fill Law only. We recommend that you attach a copy of this concurrence letter to any subsequent state permit application to speed application review. Federal or local permit requirements may apply as well. The U.S. Army Corps of Engineers will determine jurisdiction under the Clean Water Act, which may require submittal of a complete Wetland Delineation Report.

Please be advised that state law establishes a preference for avoidance of wetland impacts. Because measures to avoid and minimize wetland impacts may include reconfiguring parcel layout and size or development design, we recommend that you work with Department staff on appropriate site design before completing the city or county land use approval process.

Exhibit C-2

This concurrence is based on information provided to the agency. The jurisdictional determination is valid for five years from the date of this letter unless new information necessitates a revision. Circumstances under which the Department may change a determination are found in OAR 141-090-0045 (available on our web site or upon request). In addition, laws enacted by the legislature and/or rules adopted by the Department may result in a change in jurisdiction; individuals and applicants are subject to the regulations that are in effect at the time of the removal-fill activity or complete permit application. The applicant, landowner, or agent may submit a request for reconsideration of this determination in writing within six months of the date of this letter.

Thank you for having the site evaluated. If you have any questions, please contact the Jurisdiction Coordinator, Jessica Imbrie, at (503) 986-5250.

Sincerely,

Pete Ryan

Peter Ryan, SPWS
Aquatic Resource Specialist

Enclosures

ec: John van Staveren, SPWS, Pacific Habitat Services
City of Cannon Beach Planning Department (Maps enclosed for updating LWI)
Brad Johnson, Corps of Engineers
Dan Cary, SPWS, DSL
Oregon Coastal Management Program (coast.permits@state.or.us)

Exhibit C-2

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

Fully completed and signed report cover forms and applicable fees are required before report review timelines are initiated by the Department of State Lands. Make the checks payable to the Oregon Department of State Lands. To pay fees by credit card, go [illegible]

Attach this completed and signed form to the front of an unbound report or include a hard copy with a digital version (single PDF file of the report cover from and report, minimum 300 dpi resolution) and submit to: Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279. A single PDF of the completed cover form and report may be e-mailed to Wetland_Delineation@dsl.state.or.us. For submittal of PDF files larger than 10 MB, e-mail DSL instructions on how to access the file from your ftp or other file sharing website.

Contact and Authorization Information

☒ Applicant ☒ Owner Name, Firm and Address

Patrick Gemma
Patrick/Dave, LLC
2575 38th Avenue West
Seattle, WA 98199

Business phone #
[illegible]
E-mail: pgemma@prologis.com

☒ Authorized Legal Agent, Name and Address

Business phone #
Mobile phone #
E-mail:

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: **Patrick Gemma** Signature:
Date: 3/19/2021 Special instructions regarding site access:

Project and Site Information

Project Name: **Tax Lot 4100 on Forest Lawn Drive**

Latitude: **45.8864** Longitude: **-123.9628**
decimal degree - centroid of site or start & end points of linear project
Tax Map # 5 10 30 DA

Proposed Use:
Residential subdivision

SW of the intersection of Forest Lawn Dr and South Hemlock Street

Cannon Beach

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:
Pacific Habitat Services
Attn: John van Staveren
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

Phone # 503-570-0800
Mobile phone # [illegible]
E-mail: [illegible]@pacifichabitat.com

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.
Consultant Signature: Date: 3/19/2021

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No | Study Area size: **1.10 acres** Total Wetland Acreage: **0.68**

Check Applicable Boxes Below

☐ R-F permit application submitted
☐ Mitigation bank site
☐ Industrial Land Certification Program Site
☐ Wetland restoration/enhancement project (not mitigation)
☐ Previous delineation/application on parcel?
If Known, previous DSL #

☐ Fee payment submitted **$475**
☐ Fee ($100) for resubmittal of rejected report
Request for Reissuance. See eligibility criteria (no fee)
DSL # Expiration Date
☐ LWI shows wetlands or waters on parcel?
Wetland ID Code W24

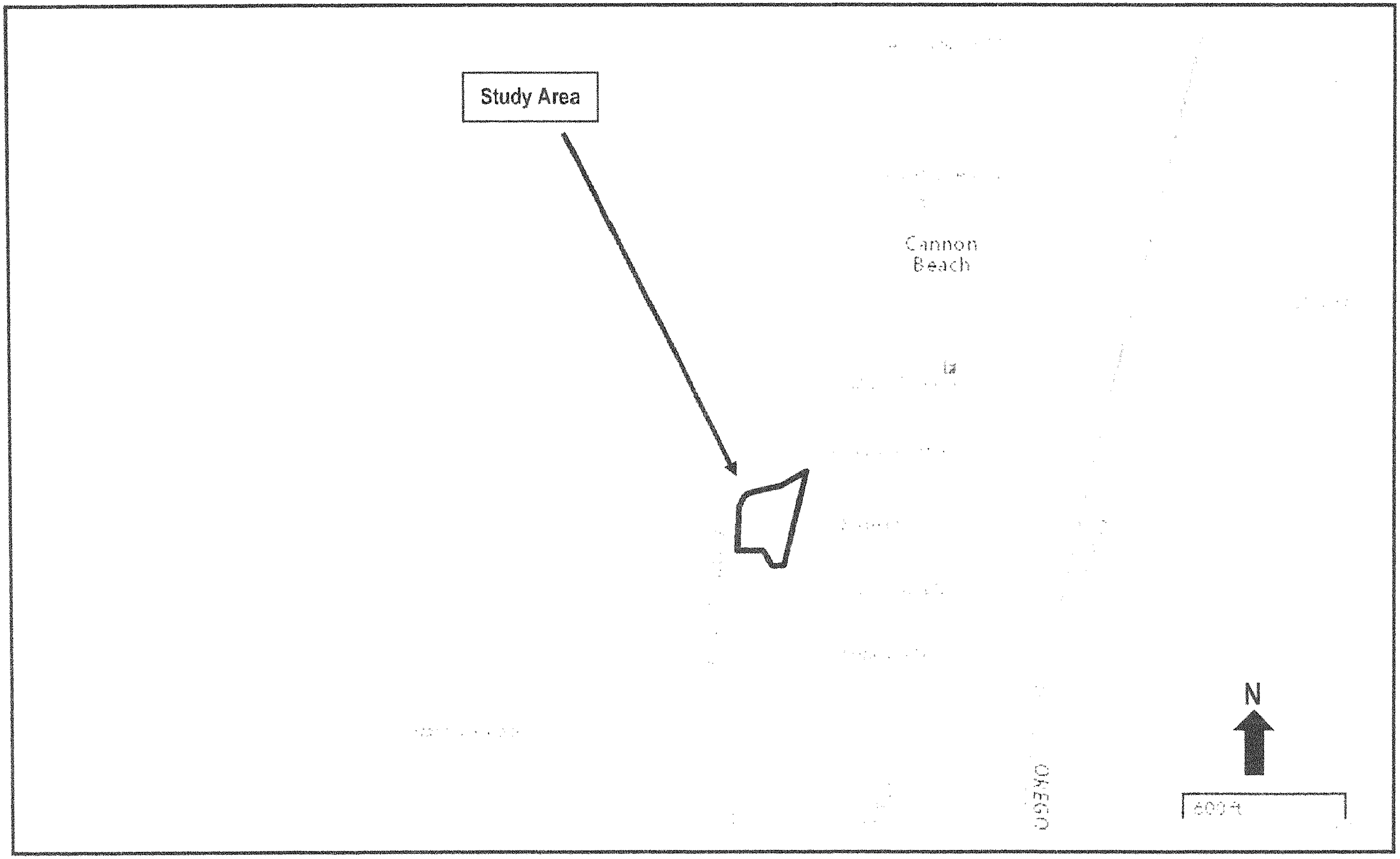
For Office Use Only

DSL Reviewer: Fee Paid Date: DSL WD # 2021-0153
Date Delineation Received: 3 / 23 / 21 Scanned ☐ Final Scan ☐ DSL App. #

Electronic Submittal

March 2015

Exhibit C-2



Project #6978
2/16/2021

Pacific Habitat Services, Inc.
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

General Location and Topography
Tax Lot 4100 - Cannon Beach, Oregon
United States Geological Survey (USGS) Tillamook Head, Oregon 7.5 quadrangle, 2020
(viewer.nationalmap.gov/basic)

FIGURE
1

Exhibit C-2

Project #6978
2/16/2021

Pacific Habitat Services, Inc.
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

Tax Lot Map
Tax Lot 4100 - Cannon Beach, Oregon
The Oregon Map (ormap.net)

FIGURE
2

Exhibit C-2

[redacted]
JURIS. DETERM.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, PORTLAND DISTRICT
P.O. BOX 2946
PORTLAND, OR 97208-2946

April 15, 2021

Regulatory Branch
Corps No.: NWP-2021-159

Patrick Gemma
Patrick/Dave, LLC
2575 38th Avenue West
Seattle, Washington 98199
pgemma@prologis.com

Dear Mr. Gemma:

The U.S. Army Corps of Engineers (Corps) received your request for an Approved Jurisdictional Determination (AJD) of the waters or water features, including wetlands, within the review area as shown on the enclosed drawings (Enclosure 1). The review area is located between Forest Lawn Road and South Hemlock Street Cannon Beach, Clatsop County, Oregon at Latitude/Longitude: 45.8864°, -123.9628°. Other waters or water features, including wetlands, that may occur on this property or on adjacent properties outside the review area are not the subject of this determination.

The Corps has determined Wetland A within the review area is not a water of the U.S. The enclosed drawings (Enclosure 1) identify the size and boundaries of the delineated wetland. The enclosed *Approved Jurisdictional Determination Form (Interim)* (Enclosure 2) provides the basis for jurisdiction. A copy of the AJD Form can also be found on our website at: http://www.nwp.usace.army.mil/Missions/Regulatory/Appeals/.

If you object to the enclosed AJD, you may request an administrative appeal under 33 CFR Part 331 as described in the enclosed *Notification of Administrative Appeal Options and Process and Request for Appeal* (*RFA*) form (Enclosure 3). To appeal this AJD, you must submit a completed *RFA* form to the Corps Northwestern Division (NWD) office at the address listed on the form. In order for the request for appeal to be accepted, the Corps must determine that the form is complete, that the request meets the criteria for appeal under 33 CFR Part 331.5, and the form must also be received by the NWD office within 60 days from the date on the form. It is not necessary to submit the form to the NWD office if you do not object to the enclosed AJD.

The delineation included herein has been conducted to identify the location and extent of the aquatic resource boundaries and/or the jurisdictional status of aquatic resources for purposes of the Clean Water Act for the particular site identified in this request. This delineation and/or jurisdictional determination may not be valid for the Wetland Conservation Provisions of the Food Security Act of 1985, as amended. If you

Exhibit C-2

or your tenant are U.S. Department of Agriculture (USDA) program participants, or anticipate participation in USDA programs, you should discuss the applicability of a certified wetland determination with the local USDA service center, prior to starting work.

This AJD is valid for a period of five years from the date of this letter unless new information warrants revisions of the determination.

We would like to hear about your experience working with the Portland District, Regulatory Branch. Please complete a customer service survey form at the following address: https://corpsmapu.usace.army.mil/cm_apex/f?p=136:4.

If you have any questions regarding our Regulatory Program or permit requirements for work in waters of the U.S., please contact Mr. Brad Johnson by telephone at (503) 808-4383 or e-mail at: Brad.A.Johnson2@usace.army.mil.

Sincerely,

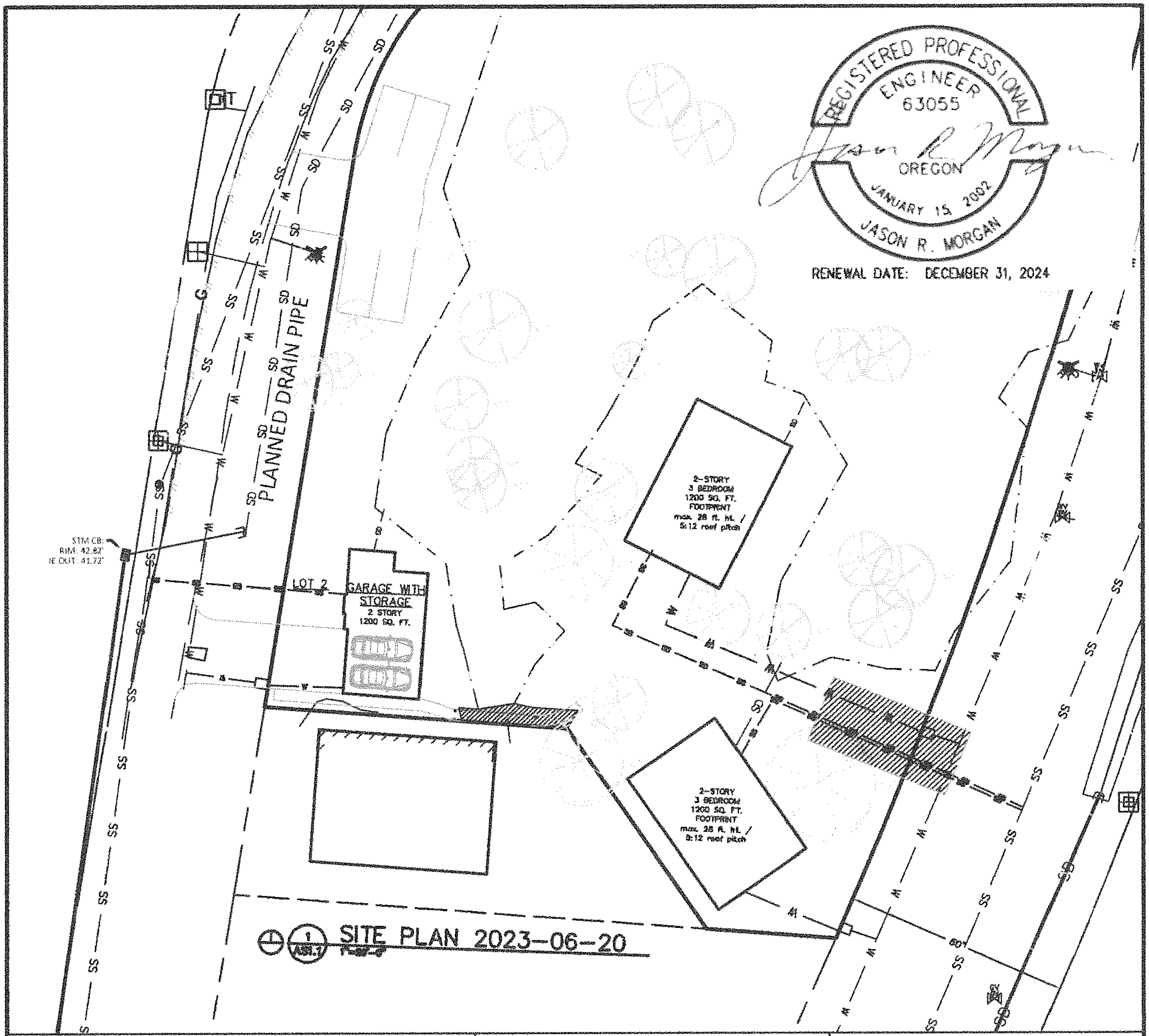
For: William D. Abadie
Chief, Regulatory Branch

Enclosures

cc with drawings:
Oregon Department of State Lands (Dan Cary, dan.cary@dsl.state.or.us)
Oregon Department of Environmental Quality (401applications@deq.state.or.us)
Pacific Habitat Services (John van Staveren, jvs@pacifichabitat.com)

Exhibit C-2

#7



REGISTERED PROFESSIONAL ENGINEER
63055
OREGON
JANUARY 15, 2002
JASON R. MORGAN

Jason R Morgan

RENEWAL DATE: DECEMBER 31, 2024

SCALE

0 20 40 80

1 inch = 40 ft.

N

S

SCALE: 1"=40'

EXISTING
— W — WATER MAIN
— SS — SEWER MAIN
STORM PIPE

PROPOSED
— W — WATER SERVICE
— SS — SEWER SERVCIE
— SD — STORM MAIN

JULY 26, 2023

PATRICK GEMMA

TAX LOT 4100
FOREST LAWN DRIVE
UTILITY LAYOUT

CANNON BEACH/MAP 5N 10W 30DA

MORGAN CIVIL ENGINEERING, INC.

PO BOX 358
MANZANITA, OR 97130
(503) 801-6016
www.morgancivil.com

- CIVIL ENGINEERING
- INSPECTION
- PLANNING

Exhibit C-3

1

Exhibit C-3

CITY OF CANNON BEACH

October 6, 2023

Dear Property Owner,

Cannon Beach Zoning Ordinance requires notification to property owners within 100 feet, measured from the exterior boundary, of any property which is the subject of the proposed applications. Your property is located within 250 feet of the above-referenced property or you are being notified as a party of record.

Please note that you may submit a statement either in writing or orally at the hearing, supporting or opposing the proposed action. Your statement should address the pertinent criteria, as stated in the hearing notice. Statements in writing must be received by the date of the hearing.

Enclosed are copies of the public hearing notice, a description of how public hearings are conducted and a map of the subject area. Should you need further information regarding the relevant Zoning Ordinance, Subdivision Ordinance or Comprehensive Plan criteria, please contact Cannon Beach City Hall at the address below, or call Emily Bare at (503) 436-8054 or email bare@ci.cannon-beach.or.us.

Sincerely,

EBare

Emily Bare
Administrative Assistant
Community Development

Enclosures: Notice of Hearing
Conduct of Public Hearings
Map of Subject Area

NOTICE OF PUBLIC HEARING
CANNON BEACH PLANNING COMMISSION

The Cannon Beach Planning Commission will hold a public hearing on **Thursday October 26, 2023,** at 6:00 p.m. at City Hall, 163 E Gower Street, Cannon Beach, regarding the following:

> **CU 23-02,** Red Crow LLC request on behalf of Patrick/Dave LLC for the Conditional Use Permit for the purpose of creating a private use board walk in an upland which spans 16'- 6' of wetland buffer. The property is located on South Hemlock and Forest Lawn Road (Tax Lot 04100, Map 51030DA). The property is currently zoned (R2) Residential Medium Density. The request will be reviewed under Municipal Code section 17.80, Conditional Uses.
>
> **P 23-01**, Integra Properties request on behalf of Steven Sinkler for the Partition Request for the purpose of dividing the tax lot between two existing buildings. The property is located at 124-126 N Hemlock Street (Tax Lot 05299 & 06300, Map 51019DD). The properties are currently zoned (C1) Limited Commercial. This request will be reviewed under Municipal Code section 16, Subdivisions.
>
> **ZO 23-02**, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetland Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070A, Amendments Criteria and the Statewide Planning goals.

All interested parties are invited to attend the hearings and express their views. Statements will be accepted in writing or orally at the hearing. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue.

Correspondence should be mailed to the Cannon Beach Planning Commission, Attn. Community Development, PO Box 368, Cannon Beach, OR 97110 or via email at planning@ci.cannon-beach.or.us. Written testimony received one week prior to the hearing will be included in the Planning Commissioner's meeting materials and allow adequate time for review. Materials and relevant criteria are available for review at Cannon Beach City Hall, 163 East Gower Street, Cannon Beach, or may be obtained at a reasonable cost. Staff reports are available for inspection at no cost or may be obtained at a reasonable cost seven days prior to the hearing. Questions regarding the applications may be directed to Robert St. Clair, 503-436-8041, or at stclair@ci.cannon-beach.or.us.

The Planning Commission reserves the right to continue the hearing to another date and time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator, at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097. Publications may be available in alternate formats and the meeting is accessible to the disabled.

Robert St. Clair
City Planner

Posted/Mailed: 10/6/23

NOTICE TO MORTGAGEE, LIEN-HOLDER, VENDOR OR SELLER:
PLEASE PROMPTLY FORWARD THIS NOTICE TO THE PURCHASER

CONDUCT OF PUBLIC HEARINGS BEFORE CANNON BEACH CITY COUNCIL and PLANNING COMMISSION

A. At the start of the public hearing, the Mayor or Planning Commission Chair will ask the following questions to ensure that the public hearing is held in an impartial manner:

1. Whether there is a challenge to the jurisdiction of the City Council or Planning Commission to hear the matter;

2. Whether there are any conflicts of interest or personal biases to be declared by a Councilor or Planning Commissioner;

3. Whether any member of the Council or Planning Commission has had any ex parte contacts.

B. Next, the Mayor or Planning Commission Chair will make a statement which:

1. Indicates the criteria which apply to the action;

2. Cautions those who wish to testify that their comments must be related to the applicable criteria or other criteria in the Comprehensive Plan or Municipal Code that the person testifying believes apply;

3. States that failure to raise an issue in a hearing, or failure to provide statements or evidence sufficient to afford the decision makers an opportunity to respond to the issue precludes appeal based on that issue;

4. Prior to the conclusion of the initial evidentiary hearing, any participant may request an opportunity to present additional evidence or testimony regarding the application. The City Council or Planning Commission shall grant such request by continuing the public hearing or leaving the record open for additional written evidence or testimony.

C. The public participation portion of the hearing will then proceed as follows:

1. Staff will summarize the staff report to the extent necessary to enable those present to understand the issues before the Council or Planning Commission.

2. The Councilors or Planning Commissioners may then ask questions of staff.

3. The Mayor or Planning Commission Chair will ask the applicant or a representative for any presentation.

4. The Mayor or Planning Commission Chair will ask for testimony from any other proponents of the proposal.

5. The Mayor or Planning Commission Chair will ask for testimony from any opponents of the proposal.

6. Staff will be given an opportunity to make concluding comments or respond to additional questions from Councilors or Planning Commissioners.

7. The Mayor or Planning Commission Chair will give the applicant and other proponents an opportunity to rebut any testimony of the opponents.

8. Unless continued, the hearing will be closed to all testimony. The Council or Planning Commission will discuss the issue among themselves. They will then either make a decision at that time or continue the public hearing until a specified time.

NOTE: Any person offering testimony must first state their name, residence, and **mailing address** for the record. If representing someone else, the speaker must state whom he represents.

Printed 10 / 6 / 2023

TAXLOTKEY	SITUS_ADDR	OWNER_LINE	STREET_ADD	CITY	STATE	ZIP_CODE
51030DA05600	1457 S Hemlock St	Cook Dale Michael	229 N Lloyd Circle	Idaho Falls	ID	83402
51030DA05700	1479 S Hemlock St	Tye Karen Y	PO Box 976	Cannon Beach	OR	97110
51030DA11400	107 Ross Ln	Korinsky Pamela	2111 Hammock Pine Blvd	Clearwater	FL	33761
51030DA06902	131 Elliott Way	Handel Robert B	157 Haslemere Ct	Lafayette	CA	94549
51030DA04700	1680 Forest Lawn Rd	Alleva Fileno A	28725 NE Tolt Hill Rd	Carnation	WA	98014
51030DA05900	132 Elliott Way	Popp Daniel K	27935 NE 26th St	Redmond	WA	98053
51030DA05500	107 Sunset Blvd	Salemann Emily	PO Box 1357	Fall City	WA	98024
51030DA04103	1688 Hemlock St	Henry John M	111 Reston Ln	Gilberts	IL	60136
51030DA04104	1603 Forest Lawn Rd	Quails Cove LLC	4955 NW 162nd Ter	Portland	OR	97229
51030DA05502		Cook Dale Michael	229 N Lloyd Circle	Idaho Falls	ID	83402
51030DA11500	1724 View Point TER #A	Sullivan Daniel A	3201 W 32nd Ave	Anchorage	AK	99517
51030DA02400	1400 S Hemlock St	Hay Family Limited Partnership	5 Centerpointe Dr Suite #590	Lake Oswego	OR	97035
51030DA04100		Patrick/Dave LLC	3514 NE US Grant Pl	Portland	OR	97212
51030DA04102	1696 S Hemlock St	Cardwell Dana Lynn Hartje	171 Terrance Loop	Bozeman	MT	59718
51030DA04204	1540 Forest Lawn Rd	Hanna Judith K Revocable Trust	24451 SW Valley View Rd	West Linn	OR	97068
51030DA07100	102 Hills Ln	Martin Joshua	1575 Edgewater Ct	West Linn	OR	97068-2772
51030DA11600	1732 View Point TER	Gonzalez Patricia J	6501 113th Pl SE	Bellevue	WA	98006
51030DA02300		Hay Family Limited Partnership	5 Centerpointe Dr Suite #590	Lake Oswego	OR	97035
51030DA04600	1658 Forest Lawn Rd	Klonoff Robert	PO Box 902	Cannon Beach	OR	97110
51030DA08901	1631 S Hemlock St	McDonald Mary Lisa	1427 Horseshoe Curve	Lake Oswego	OR	97034
51030DA04105	1625 Forest Lawn Rd	Snyder Ryan C/Stephanie	PO Box 219	Cannon Beach	OR	97110-0219
51030DA04200	1510 Forest Lawn Rd	Reiersgaard William L	2600 SE Ellsworth Rd	Vancouver	WA	98664
51030DA04201		Bernards Dale W/Karen L		Portland	OR	97258
51030DA04300	1616-1580 Forest Lawn Rd	WJ Investments	2600 SE Ellsworth Rd	Vancouver	WA	98664-5357
51030DA08902	115 Hills Ln	Fransen Larissa	252 Peakview Rd	Boulder	CO	80302
51030DA09200	108 Ross Ln	Zimmers Zak F TR	1205 NE Conroy Pl	Corvallis	OR	97330-6804
51030DA04101		Snyder Ryan	PO Box 219	Cannon Beach	OR	97110
51030DA04500	1624 Forest Lawn Rd	Nicholson Drake	1802 SW Black Lake Blvd #301	Olympia	WA	98512
51030DA06900		Graves Judy J	6611 SE Yamhill Ct	Portland	OR	97215-2036
51030DA07400		Gray Frederick T	PO Box 1248	Cannon Beach	OR	97110
51030DA06901	115 Elliott Way	Snider Martin	2219 Margaret Ct	Redondo Beach	CA	90278
51030DA09100	100 Ross Ln	Sprague William B Jr Rev Trust 1/2	2915 Arbor Dr	West Linn	OR	97068-1107
51030DA04400	1616 Forest Lawn Rd	Riverdale Investment LLC	2600 SE Ellsworth Rd	Vancouver	WA	98664-5357

51030DA05800	116 Elliott Way	Heath Diego Salvatore	PO Box 6	Cannon Beach	OR	97110
51030DA08903	131 Hills Ln	Avila Juan Antonio	9810 112th Ave NE	Kirkland	WA	98033
51030DD00100	1688 Forest Lawn Rd	Tutmarc Michael	3857 45th Ave NE	Seattle	WA	98105-5450
51030DA09000	1657 S Hemlock St	Wilson Scott W	3460 Kiowa Blvd N	Lake Havasu City	AZ	86404
51030DA08900	107 Hills Ln	Louie Steven K	7629 122nd Pl SE	Newcastle	WA	98056
51030DA09300		Zimmers Zak F TR	1205 NE Conroy Pl	Corvallis	OR	97330-6804
51030DA07200	108 Hills Ln	Kuester Stephen	230 Powderhorn Ct	Spearfish	SD	57783
51030DA11300	115 Ross Ln	Mast James L	2415 SW Ivon St	Portland	OR	97202
51030DA07000	1557 S Hemlock St	Sakai Lynn Y	6485 SW Murray Blvd	Beaverton	OR	97008-4907
51030DA07300	116 Hills Ln	Gray Frederick T	PO Box 1248	Cannon Beach	OR	97110-1248

CANNON BEACH COMMUNITY DEVELOPMENT
163 E. GOWER ST.
PO BOX 368
CANNON BEACH, OR 97110

Cannon Beach Planning Commission

Staff Report:

ZO 23-02, CITY OF CANNON BEACH REQUEST FOR ZONING ORDINANCE TEXT AMENDMENTS TO CHAPTER 17.43 WETLANDS OVERLAY ZONE. THE ZONING TEXT AMENDMENT REQUEST WILL BE REVIEWED AGAINST THE CRITERIA OF THE MUNICIPAL CODE, SECTION 17.86.070(A), AMENDMENTS CRITERIA, AND THE STATEWIDE PLANNING GOALS.

Agenda Date: October 26, 2023

Prepared by: Steve Sokolowski,
Community Development Director

GENERAL INFORMATION

NOTICE

Public notice for this October 26, 2023 Public Hearing is as follows:

A. Notice was posted at area Post Offices on September 29, 2023;

B. A Measure 56 notice was sent to potentially affected property owners on September 29, 2023;

DISCLOSURES

Any disclosures (i.e. conflicts of interest, site visits or ex parte communications)?

EXHIBITS

The following Exhibits are attached hereto as referenced.

"A" Exhibits – Application Materials

A-1	Wetland Overlay Adoption Draft, received October 19, 2023;
A-2	Buffer Comparison Maps
A-3	Affected Taxlots Comparison Maps
A-4	Zoning Maps
A-5	Aerial Maps

"B" Exhibits – Agency Comments

B-1	Email from A. Punton, DLCD, received October 4, 2023;

"C" Exhibits – Cannon Beach Supplements

C-1	Joint City Council/Planning Commission/Design Review Board Memo for September 13th joint meeting, received September 5, 2023;
C-2	Post Adoption Plan Amendment (PAPA) Memo to DLCD with proposed text revisions, sent September 14, 2023;

C-3 Public notice posting for October 26th Planning Commission hearing, dated September 29, 2023;

C-4 Measure 56 notice, sent September 29, 2023;

C-5 Wetland Ordinance revision public information release, dated October 17, 2023;

C-6 Summary of public comments memo, dated October 19, 2023;

"D" Exhibits – Public Comment

D-1 R. Benson-Jackson comment, received October 6, 2023;

D-2 D. Pietka comment, received October 6, 2023;

D-3 J. Graves comment, received October 16, 2023;

D-4 S. Logan comment, received October 18, 2023;

D-5 P. Lowry comment, received October 19, 2023;

SUMMARY & BACKGROUND

The City of Cannon Beach Planning Commission is holding its first evidentiary hearing regarding proposed changes to the Wetland Overlay Zoning Ordinance this evening. Revisions to the wetland overlay zone regulations have been prioritized by the City as part of the zoning code audit process. The initial effort was undertaken by a group of local citizens. The Urbsworks team, which is contracted to assist the City with Zoning Ordinance revision project, was asked to review the document, make recommendations as to how it might be further improved, and to help the City move the ordinance revisions through the City and State adoption process.

The goal of these revisions is to bring wetland protections in Cannon Beach up to the standard of other municipalities in Oregon. The focus throughout the process has been on maximizing environmental protection for our local wetlands while maintaining the ability for every lot owner to make use of their property.

During this hearing, and possible future hearings on this matter, the Commission will hear evidence regarding the proposal, conduct deliberations, and make a recommendation to the City Council regarding the proposed revisions to the ordinance. This is an opportunity for everyone who has an interest in local wetlands to have their voices heard. The City Council will then hold a public hearing where they will likewise hear evidence and conduct deliberations before making a decision on the proposed revisions. The date of the initial evidentiary hearing before the City Council is to be determined.

It should be noted that a Measure 56 notice has been issued to property owners with wetland affected properties advising them of rulemaking changes that may have potential impacts on their property values. The City has no way to verify whether, how, or when proposed land use regulations will affect the value of individual properties.

The Urbsworks team will provide an overview of the proposal. Then the Planning Commission will accept testimony during the hearing but will not be addressing property-specific questions. The Plan Commission will deliberate and then decide what action will be taken such as continue the hearing or make a formal recommendation to the City Council.

APPLICABLE CRITERIA

17.86.070 Criteria

A. Before an amendment to the text of the ordinance codified in this title is approved, findings will be made that the following criteria are satisfied:

1. *The amendment is consistent with the comprehensive plan;*

2. *The amendment will not adversely affect the ability of the city to satisfy land and water use needs.*

Staff Comment:

The proposed amendment is consistent with the City of Cannon Beach Comprehensive Plan and will not adversely affect the ability of the City to satisfy land and water use needs based on the meeting the following policies of the comprehensive plan:

- To ensure that development is designed to preserve significant site features such as trees, streams and wetlands.

- To support public education programs that promote the preservation and enhancement of streams, wetlands and associated riparian areas through landowner and land user stewardship.

- To protect, enhance and restore the functions and values of freshwater habitats necessary to support viable fish populations, particularly those of coastal coho salmon, in Ecola Creek and associated tributaries.

- To protect, enhance and restore the functions and values of riparian corridors, which include water quality protection, storm and flood water conveyance, fish and wildlife habitat, and open space

- The city will provide flexibility in regulations governing site design so that developments can be adapted to specific site conditions.

- Filling of wetlands or natural drainages shall be prohibited unless it is adequately demonstrated that it will not affect adjacent property, and the wetlands area is not, in the view of State or Federal resource agencies, valuable biologically.

- Citizens, including residents and property owners, shall have the opportunity to be involved in all phases of the planning efforts of the City, including collection of data and the development of policies.

- The purpose of the Cannon Beach Comprehensive Plan is to control and promote development which is most desirable to the majority of the residents and property owners of the City.

Exhibit A-1

u r b s w o r k s

Date 19 October 2023

Subject Cannon Beach Community Development Ordinance (CDO) Rewrite Project

To Steve Sokolowski, Community Development Director, City of Cannon Beach

From Marcy McInelly AIA, Urbsworks, Inc. and Keith Liden

Wetland Overlay Adoption Draft

Contents of this section:

- Background
- Land Use Planning Requirements of DLCD (Department of Land Conservation and Development)
- Outline for the ESEE (Economic, Social, Environmental, and Energy) Analysis
- Adoption Draft of the Wetland Overlay

Background

Since 2021, the City of Cannon Beach has engaged Urbsworks to conduct a top-to-bottom audit of the subdivision and development chapters of the Cannon Beach CDC (Community Development Code), particularly chapters 16 and 17 (Subdivision and Development Chapters, respectively).

The work has been conducted with direct participation from city planning and managerial staff, technical staff involved in implementation and enforcement of the code (e.g., public works, building permit and enforcement), and the Cannon Beach Code Audit Joint Commission made up of City Council, Planning Commission, and Design Review Board. Urbsworks recommendations were accepted in January of this year and Urbsworks is now engaged in Phase 2 of the project, called the Code Rewrite, to carry out the recommended actions.

In a related, parallel effort, members of the Joint Commission formed a wetland study group in early 2023 to review current regulations regarding wetlands within the urban growth boundary. There is concern that the current provisions, drafted and not comprehensively updated since 1993, are not able to sufficiently protect natural resource areas under today's pressures of development and litigation, and may not be implementing the Comprehensive Plan policies.

A primary objective of the proposed Wetland Overlay (WO) is to increase the current wetland buffer from 5 feet to 50 feet.

The committee's draft concept was taken over by the Urbsworks team starting in late spring. Since that time Urbsworks, Keith Liden, and Ethan Rosenthal (Project Manager and Ecologist with David Evans and Associates), have:

- Conducted technical review, including collecting comments from the city's legal team,

- Reorganized the code to align with the city's Zoning Ordinance and with code rewrite project best practices,
- Conducted administration testing with staff,
- Conducted several review and revision cycles, including with the Joint Commission and the original wetland drafting subcommittee
- Worked with staff to map and analyze the effect of the increased buffer area, and
- Met with DLCD staff

Land Use Planning Requirements of DLCD (Department of Land Conservation and Development)

This proposal increases the buffer area from 5 to 50 feet and triggers the city to comply with Goal 5 provisions that were passed in 1996 after Cannon Beach's Local Wetland Inventory (LWI) was adopted (1993). According to the Department of Land Conservation and Development (DLCD). The city will have to complete an ESEE analysis detailing the impacts of the increased buffer area by their economic, social, environmental, and energy impacts. Consultants will be filing an ESEE (Economic, Social, Environmental, and Energy) Analysis. The analysis needs to be adopted with the WO amendments.

Outline for the ESEE (Economic, Social, Environmental, and Energy) Analysis

Introduction

- Brief history referencing original Local Wetland Inventory (LWI work
- Current plan policies regarding wetlands
- Current Wetland Overlay Zone and rationale for the amendments

ESEE Analysis

<u>Background Information</u>

- LWI table and summary of findings
- Maps

<u>Identification of Conflicting Uses</u>

- Residential conflicts
- Commercial use conflicts
- Streets, pathways

Exhibit A-1

Determine Impact Area

- Existing and proposed buffers
- Describe properties affected

Analysis of ESEE Consequences

- Comparison of allowing, limiting, or prohibiting conflicting uses (tables)
- Example tables
- Consideration of plan goals, policies, and applicable statewide planning goals, esp. Goal 5

Program to Achieve Goal 5

- How the resource and conflicting uses will be balanced (referring to the existing and proposed WO Zone)
- Summarize how conflicting uses will be allowed, limited, or prohibited in the new WO Zone
- Findings regarding compliance with plan policy and statewide planning goals

Exhibit A-1

CHAPTER 17.43 WETLANDS OVERLAY (WO) ZONE

Draft – 10.19.23

17.43.010 Purpose

The purpose of the wetlands overlay zone is to protect wetland areas identified in the city's Local Wetland Inventory from uses and activities that are inconsistent with the maintenance of the wetland functions and values identified for those sites, which include, but are not limited to, providing food, breeding, nesting and/or rearing habitat for fish and wildlife; recharging and discharging ground water; contributing to stream flow during low flow periods; stabilizing stream banks and shorelines; storing storm and flood waters to reduce flooding and erosion; carbon sequestration; thermal refugia, and improving water quality through biofiltration, adsorption, retention, and transformation of sediments, nutrients, and toxicants. Wetland areas also serve significant community wellness purposes such as mental and emotional well-being and sense of community in nature. (Ord. 94-29 § 2). In addition to wetland protections covered by this chapter, the city also protects stream corridors (Chapter 17.71) and estuarine resources per the Ecola Creek Estuary Plan.

17.43.015 Definitions

"Best management practices" means structural or non-structural measures, practices, techniques, or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to protected wetlands.

"Building coverage" means the portion of the lot area that is covered by buildings. The area of the buildings shall be measured at their exterior perimeter. Buildings include dwellings, accessory structures, garages and carports.

"Buffer averaging" means reducing the standard 50-foot wetland buffer width around a wetland boundary in some locations and increasing it in other locations such that the total area within the wetland buffer after averaging remains equal to or greater than what was required by the standard buffer around that wetland.

"Contiguous" means lots that have a common boundary and includes lots separated by public streets.

"Erosion" means the process by which the land's surface is worn away by the action of wind, water, ice or gravity.

"Footprint" refers to the total area under the exterior walls of all structures on a lot.

"Low Impact Development Approaches" (LIDA) mitigate the impacts of increased runoff and stormwater pollution using a set of planning, design, construction techniques and stormwater management approaches that promote the use of natural systems for infiltration, evapotranspiration and reuse of rainwater. LIDA can occur at a wide range of landscape scales (i.e., regional, neighborhood and site) and include, but are not limited to, green roofs, porous pavement, and vegetated stormwater management approaches.

“Permeable” means surfaces that allow water to pass through whereas “impermeable” means blocking the flow of water through the surface.

“Point source stormwater discharge” means water from precipitation, surface or subterranean water from any source, drainage and nonseptic wastewater that flows from any discernible, confined, discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or vessel.

A “qualified wetland professional” is a person with experience and training in wetlands issues and with experience in performing delineations, analyzing wetland functions and values, analyzing wetland impacts, and recommending wetland mitigation and restoration. Qualifications include:

> A Professional Wetland Scientist certification from the Society of Wetland Scientists; or
>
> B.S. or B.A., or equivalent degree in biology, botany, environmental studies, fisheries, soil science, wildlife, agriculture or related field; two years of related work experience; and minimum of one-year experience delineating wetlands using the 1987 U.S. Army Corps of Engineers (Corps) Wetlands Delineation Manual and supporting guidance, and preparing wetland reports and mitigation plans; or
>
> Four years of related work experience and training; minimum of two years’ experience delineating wetlands using the 1987 Corps Manual and supporting guidance, and preparing wetland reports, and mitigation plans.

“Runoff” means storm water or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.

“Sediment” means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.

“Site” means the entire area included in the legal description of the land on which the land disturbing construction activity is proposed in the permit application.

“Upland” as used in this title is the portion of a wetland lot-of-record that is neither protected wetland or wetland buffer area.

“Utilities, underground or above ground” refers to City provided utilities as defined in Chapter 13.03.010 as well as private utilities such as but not limited to natural gas, electric, cable, and telecommunications infrastructure. Such utilities may occur below ground surface, at ground surface, or supported above ground surface.

“Vegetation” as used in this title shall include all living plant matter (e.g., all native and non-native vines, herbaceous, shrub, and tree species of any size or amount).

“Wetland” means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (Ord. 94-29 § 1)

Exhibit A-1

“Wetland buffer area” means a 50-foot-wide non-wetland area surrounding the delineated boundary of a protected wetland~~s~~ within the Wetlands Overlay (WO) zone. (Ord. 94-29 § 1)

“Wetland creation” means to convert an upland area that has never been a wetland to a wetland.

“Wetland delineation” means a determination of the presence of wetlands and other waters that includes marking boundaries on the ground and on a detailed map prepared by professional land survey or similar accurate methods. The delineation is to be undertaken in accordance with a method acceptable to the US Army Corps of Engineers and the Oregon Department of State Lands. (Ord. 9429 § 1)

“Wetland delineation map” means a map included in a wetland delineation report or provided with a Jurisdictional Determination by the Department of State Lands that shows the tax lot(s) and study area(s) investigated and the location, size, and boundaries of all wetlands and other waters.

“Wetland determination” means a decision that a site may, does, is unlikely to, or does not contain waters of the state of Oregon. A determination does not include the exact location or boundaries of water of the state of Oregon.

“Wetland enhancement" means to improve the condition and increase the functions and values of an existing degraded wetland.

“Wetland lot-of-record” is a lot or contiguous lots held in common ownership on August 4, 1993, which are subject to the provisions of this chapter. A wetland lot-of-record includes upland portions of the contiguous property that are not subject to the provisions of the wetlands overlay zone.

“Wetland mitigation, compensatory” means the creation, restoration or enhancement of a wetland area to maintain the functional characteristics and processes of the wetland system, such as its natural biological productivity, habitats, aesthetic qualities, species diversity, open space, unique features and water quality.

“Wetland Overlay Zone” includes protected wetlands and wetland buffer areas.

“Wetland, protected” are those areas in the wetlands overlay zone that have been identified on the Cannon Beach Local Wetland Inventory (LWI) or on a subsequent detailed wetland delineation as wetlands. Note that federal and state protections also exist, and the applicant is also responsible for addressing such regulations. Should discrepancies exist between federal and state wetland delineation jurisdiction, city protected wetlands shall match state regulated wetland boundaries.

“Wetland restoration" means to reestablish a former wetland.

17.43.020 Mapping

A. The maps identifying the Wetland Overlay (WO) zone boundaries shall be maintained and updated as necessary by the city. The Cannon Beach Local Wetland Inventory (LWI) maps dated September 20, 1994, as well as subsequent updates to the LWI, shall form the basis for the location of wetlands.

The original 1994 LWI is based upon wetland determinations, and subsequent updates will generally be wetland delineations. The WO zone includes both protected wetland and wetland buffer areas.

B. Site-specific wetland delineations are required to determine the exact location of the WO zone boundary prior to development on a property containing a protected wetland identified in the Cannon Beach LWI. For properties that only include wetland buffer area, the applicant may choose to rely upon the buffer area shown in the Cannon Beach LWI maps or provide a wetland delineation or determination to establish the wetland buffer boundary. Wetland delineations shall be conducted in accordance with the 1987 U.S. Army Corps of Engineers Wetlands Delineation Manual along with any supporting technical or guidance documents issued by the Department of State Lands and applicable guidance issued by the U.S. Army Corps of Engineers for the area in which the wetlands are located.

C. When an expert report or opinion is submitted by an applicant, the permitting authority may seek an independent expert opinion when reviewing the report or opinion. A qualified wetland professional retained or hired by the city under this subsection is expected to render independent expert opinion, consistent with the Society of Wetland Scientists Code of Ethics.

D. Where a wetland delineation or determination is prepared and accepted by the City, the mapping it contains shall replace that of the Cannon Beach LWI. Wetland delineations or determinations shall remain valid for a period of not more than 5 years from the date of their acceptance by the Department of State Lands. Any wetland delineation submitted to the City shall be accompanied by an electronic shapefile.

E. The continued reliance on a wetland delineation or determination that is more than 5 years old shall only be allowed when a renewal letter of concurrence from the Oregon Department of State Lands is provided.

F. When the wetland boundary from a delineation or determination is updated as described in this section, the corresponding wetland buffer shall be determined based upon the updated wetland boundary.

17.43.030 Applicability

The regulations of this chapter apply to the portions of all properties that contain protected wetlands or wetland buffer areas as shown on the city LWI maps or as described in a wetland delineation or determination as described in Section 17.43.020.

17.43.040 Administration

A. Activities permitted outright according to Table 17.43-1 shall be reviewed as a Type 2 Administrative review as provided in Section 17.92.010 C. 2.

B. All other development or activities within the Wetlands Overlay Zone shall be reviewed as a Planning Commission decision as provided in Chapter 17.88.

Exhibit A-1

17.43.050 Development and Activities Permitted

A. Uses and activities listed in Table 17.43-1 may be permitted in protected wetlands and wetland buffer areas, subject to the issuance of a development permit in accordance with the provisions of this title and the applicable standards in Section 17.43.070.

B. Uses and activities that may be permitted in protected wetland and wetland buffers are shown in Table 17.43-1.

C. Uses and activities in existence approved by a permitting authority before the effective date this Chapter 17.43, [to be specified on the date of ratification] (hereinafter referred to for purposes of this Chapter as the Effective Date), and which may not conform with the permitted or conditional uses set forth herein may qualify as a “nonconforming use” as provided Chapter 17.82.

D. The following development and activities may be permitted within protected wetlands and wetland buffer areas subject to the review procedures shown in Table 17.43-1.

Table 17.43-1 Permitted Development and Activities within the WO Zone

Development or Activity	**Review Process**
Vegetation management only to the extent necessary for hazard prevention	Type 2 Administrative review
Structures	Planning Commission review
Wetland enhancement	
Compensatory wetland mitigation	
Driveways	
Pedestrian/bike pathways	
Point source stormwater discharge	
Low Impact Development Approaches (LIDA)	
Underground or above ground utilities	

17.43.060 Application Submittal Requirements

A. Information Requirements. Information provided on the development plan shall conform to the following:

1. Drawings, along with an electronic copy, depicting the proposal shall be presented on sheets not larger than 24 inches by 36 inches in the number of copies directed by the city;

2. Drawings shall be at a scale sufficiently large enough to enable all features of the design to be clearly discerned.

B. Site Analysis Diagram. This element of the design review plan, drawn to scale, shall indicate the following site characteristics:

1. A survey of the property by a licensed land surveyor clearly delineating property boundaries. The city may waive this requirement where there is a recent survey which can be used to establish the applicant's property boundaries;

2. Location of the protected wetland boundary and wetland buffer area;

3. Location and species of trees greater than 6 inches in diameter at breast height (DBH), and an indication of which trees are to be removed or potentially affected by construction activity on the subject property and abutting properties;

4. On sites that contain steep slopes, potential geologic hazard or unique natural features that may affect the proposed development, the city may require contours mapped at 2-foot intervals;

5. Natural drainageways and other significant natural features;

6. All buildings, roads, retaining walls, curb cuts, and other manmade features on the subject property;

7. Developed and natural features, including trees, wetlands, structures, and impervious surfaces on adjoining property having a visual or other significant relationship with the site; and

8. The location and names of all existing streets within or on the boundary of the proposed development.

C. Site Photographs. Photographs depicting the site and its relationship to adjoining sites and natural features shall also be provided.

D. Site Development Plan. This element of the development plan shall indicate the following:

1. Boundary dimensions and area of the site.

2. Location of all existing structures, driveways, walkways, and landscaped areas proposed to be retained, including their site coverage and distances from the property line, and wetland and wetland buffer area boundaries;

3. Location of all new structures, driveways, walkways, and landscaped areas proposed to be retained, including their site coverage and distances from the property line, and wetland and wetland buffer area boundaries;

4. All external dimensions of existing and proposed buildings and structures;

5. Existing and proposed parking and vehicular and pedestrian circulation areas, including their dimensions;

6. Existing and proposed service areas for such uses as the loading and delivery of goods;

7. Locations, descriptions and dimensions of easements;

8. Grading and drainage plans, including spot elevations and contours;

9. Location of areas to be landscaped or retained in their natural state;

10. Exterior lighting including the type, intensity, height above grade and area to be illuminated; and

11. Other site elements which will assist in the evaluation of the application.

E. Site Alternatives Analysis. In the case where development is proposed within a protected wetland or wetland buffer, a site alternative analysis shall be provided that includes:

   1. Potential site layouts that avoid or minimize development in the protected wetland and/or buffer; and

   2. Explanation of the alternatives and the reasons why the site development plan is proposed to utilize portions of a protected wetland or buffer area.

F. Landscape Plan. Development proposals within a protected wetland or wetland buffer shall include the following:

   1. The size, species, and locations of plant materials to be retained or placed on the site, including eradication and replacement of invasive plant species;

   2. The layout of proposed irrigation facilities;

   3. The location and design details of walkways, decks, courtyards, patios, and similar areas;

   4. The location, type and intensity of lighting proposed to illuminate outdoor areas; and

   5. The location and design details of proposed fencing, retaining walls, and screening for service areas.

G. A stormwater management plan shall be required of the applicant and reviewed and approved by the public works director for the following types of developments where stormwater will move from the site into protected wetlands:

   1. New building covering more than 200 square feet; or

   2. New addition covering more than 200 square feet; or

   3. New road or driveway; or

   4. Road or driveway expansion; or

   5. New parking lot or parking lot expansion; or

   6. Point source stormwater discharge; or

7. Diversion of stormwater for any reason within the protected wetland or wetland buffer.

8. A stormwater management plan must include all information necessary to demonstrate to the public works director that the proposed stormwater management system will maintain pre-construction activity, or background, water quality and similar flow characteristics (e.g., volume, velocity, and duration) and be consistent with Public Works Department standards and the requirements of this Chapter. The stormwater management plan shall provide the following in addition to any information requested by the public works director:

   a. Site map or maps, drawing or specifications detailing the design, route, and location of the stormwater management system.

   b. A map or model of drainage patterns and stormwater flow before and after the development or activity; impacts to water quality in the wetland, changes to water quantity and timing that may adversely affect wetland function (e.g., affects of rapidly fluctuating water levels on amphibian egg masses, scour impacts to vegetation) and potential for sediment deposition into the wetland or wetland buffer.

   c. Best management practices and methods of treatment that will maintain or improve background levels of water quality, which includes but is not limited to: dissolved oxygen levels; pH; temperature; total dissolved solids; and contaminants.

H. When development is proposed within a protected wetland or wetland buffer as provided in Sections 17.43.070 F. 3. or 4., a mitigation plan shall be provided including the following information prepared by a qualified wetland professional: (mitigation plans developed according to DSL permitting requirements are also suitable, but must include discussion of affects to the wetland buffer in addition to the wetland):

1. Plan Overview (i.e. summary)

2. Proposed impact details:

   a. Description of existing site conditions within the protected wetland and the buffer including, but not limited to hydrologic characteristics, plant communities, and stressors.

   b. Existing conditions site plan, showing wetlands, buffers, and detailing different plant communities and/or ecological conditions on the subject site, including buffers that may occur on-site based on an estimate of adjacent off-site wetlands.

   c. Square footage of proposed impacts to the wetland and buffer by plant community.

3. Proposed mitigation details:

   a. Site location for the mitigation.

   b. If off-site mitigation is proposed:

      i. Tax lot and ownership of proposed mitigation site.

      ii. Justification for why on-site mitigation was not practicable and why the off-site location is appropriate.

      iii. Existing conditions plan for the mitigation site, showing wetlands, buffers, and plant communities and/or ecological conditions.

   c. Site plan showing proposed restoration or enhancement activities within the wetlands and/or buffer including but not limited to hydrologic improvements, invasive plant removal, native plantings, and habitat structures.

   d. Planting plan describing location, species, size, and quantities of plants to be provided.

   e. Monitoring plan, to include the following:

      i. Monitoring schedule including a minimum of once per year during the required 5-year monitoring period.

      ii. Methods to ensure success and plant replacement as needed.

      iii. Proposed photo point locations to be used during the monitoring period.

I. Narrative addressing the relevant standards in Section 17.43.070.

17.43.070 Development Standards

The following standards are applicable to the uses and activities listed in Section 17.43.050. The following standards are applicable in all areas under the wetlands overlay zone.

A. General Standards. Uses and activities in protected wetlands and in wetland buffer areas are subject to the following general standards:

1. The proposed uses and development comply with the applicable requirements in this title unless modified as provided in this chapter.

2. Uses and activities in protected wetlands or wetland buffer areas may be approved only after the following list of alternative actions, listed from highest to lowest priority, have been considered:

   a. Avoiding the protected wetland and wetland buffer areas entirely and locating uses and activities on upland portions of the property.

   b. When development within a protected wetland and/or wetland buffer is proposed, the applicant shall demonstrate how the affected land area is minimized by utilizing design options to reduce building footprints, multistory construction, impervious surface area, grading, and similar actions to the extent possible while properly accommodating the proposed use or activity.

c. Where a use or activity must be located in either the protected wetland or the wetland buffer, preference shall be given to the location of the use or activity in the wetland buffer and devoid of native vegetation.

3. The Planning Commission may approve an application for up to a 50 percent adjustment to the following development and dimensional standards to permit development outside of protected wetland and wetland buffer areas:

   a. Building setback requirements of the applicable base zone;

   b. Lot dimension requirements of the applicable base zone; and

   c. Minimum parking requirements in 17.78.020.

4. Valid permits from the US Army Corps of Engineers and from the Oregon Department of State Lands, or written proof of exemption from these permit programs, must be obtained before any of the following activities occur in protected wetlands:

   a. Placement of and amount of fill;

   b. Construction of any pile-support structure;

   c. Excavation (any amount);

   d. Compensatory mitigation;

   e. Wetland restoration; and

   f. Wetland enhancement.

5. Where a protected wetland is identified by the Cannon Beach LWI as riverine, uses and activities are also subject to the requirements of Chapter 17.71, stream corridor protection. If the riverine mapping only encompasses the active channel (i.e., no wetlands are present), then only Chapter 17.71 applies.

B. **Residential and Commercial Buildings and Structures**. A commercial building, residential structure, modular housing, manufactured home, or accessory structure may be permitted in a protected wetland or wetland buffer area subject to the following standards:

1. Structures, when permitted, shall be constructed in a manner that allows the free flow of water beneath the structure.

2. Building coverage will comply with the applicable requirements in Section 17.43.070 F. Wetland Lot-of-Record.

C. **Streets, Driveways and Off-Street Parking** shall comply with following applicable standards:

1. Driveways and off-street parking in the WO zone shall be constructed of permeable materials.

2. Streets and driveways crossing protected wetlands or wetland buffer areas shall be no wider than 20 feet.

3. Streets and driveways in protected wetlands shall constructed in a manner that allows the free flow of water beneath the driveway or street.

4. Streets, driveways, and off-street parking in wetland buffer areas may be placed on piling or fill, whichever is deemed least impactful by a qualified wetland professional.

D. **Sidewalks, Pathways and Other Non-Vehicular Improvements**. Development of new sidewalks, pathways and other non-vehicular improvements may be permitted in protected wetlands and in wetland buffer areas subject to the applicable requirements in this title and the following standards:

1. Sidewalks, pathways, and other non-vehicular improvements across protected wetlands or wetland buffer areas may only be developed or maintained in a manner that does not restrict water movement. Bridges shall be used to cross open water areas.

2. Routes for new sidewalks, pathways, and other non-vehicular improvements shall be chosen to avoid traversing protected wetlands. Route alignments around the perimeter of protected wetlands, and in wetland buffer areas, are preferred.

3. Sidewalks, pathways, and other non-vehicular improvements within protected wetlands and wetland buffers shall be a maximum of 12 feet wide and constructed of permeable material.

E. **Utilities**. Electric power lines, telephone lines, cable television lines, water lines, wastewater collection lines, and natural gas lines may be permitted in protected wetlands and in wetland buffer areas subject to the following standards:

1. Underground utilities, including water, wastewater, electricity, cable television, telephone, and natural gas service, may be routed through wetland buffer areas in trenches provided the following standards are met:

    a. Material removed from the trench is either returned to the trench as back-fill within a reasonable period of time, or, if other material is to be used to back-fill the trench, excess material shall be immediately removed from the protected wetland area. Side-casting into a protected wetland for disposal of material is not permitted;

    b. Topsoil and sod shall be conserved during trench construction or maintenance, and replaced on the top of the trench;

    c. The ground elevation shall not be altered by the utility trench construction or maintenance; and

   d. Routes for new utility trenches shall be selected to minimize vegetation removal and hydraulic impacts on protected wetlands.

2. Aboveground utilities, including electricity, cable television, and telephone service, may be routed through protected wetlands and wetland buffer areas on poles subject to the following standards:

   a. Routes for new utility corridors shall be selected to minimize adverse impacts on the wetland, and to minimize vegetation removal; and

   b. Vegetation management for utility corridors in protected wetlands and wetland buffer areas shall be conducted according to the standards in Section 17.43.070 J.

3. Utility maintenance roads in protected wetlands and in wetland buffer areas must meet applicable standards in Section 17.43.070 C.

4. Common trenches, to the extent allowed by the building code, are encouraged to minimize ground disturbance when installing utilities.

5. Underground utilities shall be routed under disturbed areas such as streets, driveways, and off-street parking areas whenever feasible.

F. **Wetland Lot-of-Record**

1. Reasonable use of a wetland lot-of-record is defined as an upland portion of a wetland lot-of-record that can accommodate 1,000 square feet of building coverage outside of a protected wetland and corresponding wetland buffer. This section defines the accommodations that can be made to allow reasonable use of a wetland lot-of-record the upland portion is not sufficient to allow such reasonable use.

2. Minor Wetland Buffer Reduction Where the upland portion of the lot-of-record cannot accommodate 1,000 square feet of building coverage, buffer averaging shall first be considered to allow reasonable use of a parcel when all of the following are met:

   a. The site alternative analysis prepared by the applicant demonstrates there are no feasible alternatives to the site design to accommodate 1,000 square feet of building coverage without utilizing a portion of the wetland buffer; and

   b. The proposed development or activity is designed to utilize the 50 percent adjustment to the dimensional standards listed in 17.43.070 A. 3. to develop within the available upland to the maximum extent practicable; and

   c. The reduced buffer width will not result in degradation of the wetland's functions and values as demonstrated by an assessment from a qualified wetland professional; and

   d. The building coverage within the wetland buffer does not exceed 1,000 square feet.

   e. The buffer at its narrowest point is never less than 75 percent of the required width or 37.5 feet.

3. Wetland Buffer Reduction. Where the upland portion of the lot-of-record cannot accommodate 1,000 square feet of building coverage, and the minor wetland buffer reduction cannot accommodate this amount of development, the wetland buffer width may be reduced by the approval authority when all the following criteria are met:

   a. The site alternative analysis prepared by the applicant demonstrates there are no feasible alternatives to the site design to accommodate 1,000 square feet of building coverage without utilizing a portion of the wetland buffer; and

   b. The proposed development or activity is designed to utilize the 50 percent adjustment to the dimensional standards listed in 17.43.070 A. 3. to develop within the available upland to the maximum extent practicable; and

   c. The reduced buffer width will not result in degradation of the wetland's functions and values as demonstrated by an assessment from a qualified wetland professional; and

   d. The building coverage within the wetland buffer does not exceed 1,000 square feet.

   e. Mitigation for the proposed encroachment into the wetland buffer shall be provided in accordance with Section 17.43.070 I.

4. Siting for Development. Where the upland portion of the lot-of-record cannot accommodate 1,000 square feet of building coverage, and the wetland buffer reduction cannot accommodate this amount of development, the approval authority shall allow development within the wetland buffer and/or protected wetland when all the following criteria are met:

   a. The site alternative analysis prepared by the applicant demonstrates there are no feasible alternatives to the site design to accommodate 1,000 square feet of building coverage without utilizing a portion of the wetland buffer and/or protected wetland; and

   b. The proposed development or activity is designed to utilize the 50 percent adjustment to the dimensional standards listed in 17.43.070 A. 3. to develop within the available upland to the maximum extent practicable; and

   c. The development will not result in degradation of the wetland's functions and values as demonstrated by an assessment from a qualified wetland professional; and

   d. The building coverage within the wetland buffer and protected wetland does not exceed 1,000 square feet.

   e. Mitigation for the proposed encroachment into the wetland buffer and/or protected wetland shall be provided in accordance with Section 17.43.070 I.

G. **Land Divisions and Lot Line Adjustments.**. In addition to the applicable requirements in Title 16, subdivisions, replats, partitions, and property line adjustments of the upland portion of a wetland lot-of-record are subject to the following standards:

1. The applicable requirements in Title 16.

2. Preliminary plat maps for proposed subdivisions, replats, partitions, and lot line adjustments involving a wetland lot-of-record must show the protected wetland and wetland buffer boundaries, as determined by a wetland delineation prepared by a qualified wetland professional.

3. Subdivisions, replats, partitions, and property line adjustments of upland portions of a wetland lot-of-record are permitted subject to the following standards:

    a. Each proposed lot shall include an upland area that contains a minimum of 2,500 square feet.

    b. Protected wetlands and wetland buffer areas may be counted towards meeting the base zone's minimum lot size for each lot.

H. **Stormwater Management**. Management of stormwater flowing into protected wetlands or wetland buffer areas is subject to the following standards:

1. The City recognizes that stormwater is an important component of wetland hydrology, and it shall regulate flow of stormwater into or out of protected wetlands and wetland buffers to ensure no net loss of wetland functions and values. It is the policy of the City that all stormwater that would naturally flow into protected wetlands and wetland buffers shall continue to flow into protected wetlands and wetland buffers in accordance with this Chapter. Uses and activities intended to remove stormwater away from or around protected wetlands and wetland buffers or to move stormwater within a protected wetland or wetland buffer are prohibited unless undertaken as part of an approved wetland mitigation or enhancement plan.

2. A stormwater management plan shall be submitted for approval by the public works director for the following types of developments where stormwater will move from the site into protected wetlands:

    a. New building covering more than 200 square feet; or

    b. New addition covering more than 200 square feet; or

    c. New road or driveway; or

    d. Road or driveway expansion; or

    e. New parking lot or parking lot expansion; or

    f. Point source stormwater discharge; or

g. Diversion of stormwater for any reason within the protected wetland or wetland buffer.

3. A stormwater management plan must include all information as required by the public works director:

I. **Mitigation and Wetland Enhancement**. All projects involving development, removal or fill in a protected wetland or wetland buffer must provide a mitigation and wetland enhancement plan that meets the following standards to retain wetland functions and values.

1. The proposed activities and development in protected wetlands or wetland buffer areas satisfy the requirements of Section 17.43.070 F.

2. The mitigation and wetland enhancement plan shall be prepared by a qualified wetland professional, and it shall address anticipated impacts of the proposed development on the wetland or wetland buffer along with proposed measures to mitigate the onsite wetland and wetland buffer impacts to the maximum extent possible. Mitigation actions shall include but not be limited to, the restoration of native vegetation; restoration of hydric soil; restoration of the clay pan or other natural water barriers; restoration of natural slopes and contours; restoration of natural drainage or water flows; restoration of the wetland's nutrient cycle; and the restoration of wildlife habitat that may be impacted by the proposed development or activity.

3. Mitigation ratios. When mitigation is required, following applicable requirements shall be satisfied:

   a. When wetland impacts require mitigation per federal or state regulations, then federal or state wetland mitigation ratios will apply, so long as equal to or greater than the City minimum requirement.

   b. If protected wetland impacts are exempt from federal or state regulations, then:

      i. Wetland mitigation that is provided within the wetland shall require a1:1 mitigation ratio.

      ii. Wetland mitigation that is provided within the adjacent wetland buffer shall required a 2:1 mitigation ratio.

   c. Wetland buffer mitigation that is provided within the wetland buffer shall satisfy one of the following:

      i. Wetland buffer mitigation can occur as expansion of buffer at a 1:1 ratio; or

      ii. Wetland buffer enhancement of marginal or degraded buffer conditions at a 1:1 ratio.

   d. Upon approval, the mitigation plan shall be integrated with the design package, and it shall be the responsibility of building officials to confirm compliance with the mitigation plan issuing a certificate of occupancy. In the event that mitigation efforts are not completed when occupancy is requested, the owner or the owner's agent may certify in writing that owner or its agent will complete the mitigation plan within a specified period. The certification shall represent the owner's or owner's agent's agreement in exchange for granting the certificate of occupancy that the mitigation plan will be completed in accordance with its terms.

e. If a landowner or responsible party fails to implement a mitigation plan, the City may undertake any action necessary to comply with mitigation plan and all associated costs and accrued interest thereon will become the immediate responsibility of the landowner or responsible party.

4. Any combination of the actions in subsection (I)(2) may be required to implement mitigation requirements.

4. Monitoring results shall be provided to the City on an annual basis prior to the end of the calendar year. If results show a risk of not meeting the success criteria detailed in the monitoring plan, then corrective actions to be implemented shall be described in the report. The mitigation plan will remain in effect for a period of 5 years following completion of the development or project, unless extended for non-compliance, with an affirmative obligation on the part of the applicant to restore or repair mitigation efforts, as required by conditions through the end of the effective period.

J. **Vegetation Management**. Vegetation in protected wetlands and in wetland buffer areas may be managed (including planting, mowing, pruning and removal) subject to the following standards:

1. Tree removal in protected wetlands and in wetland buffer areas shall be consistent with the criteria and standards in Chapter 17.70, tree removal.

2. Tree removal and pruning prohibited unless:

a. Necessary for placement of a dwelling or driveway approved pursuant to this chapter including required vehicular and utility access, subject to the requirements in Section 17.70.030(B) and (Q);

b. Necessary for maintenance of an existing dwelling or driveway;

c. Necessary for correction or prevention of foreseeable danger to public safety, or a foreseeable danger of property damage to an existing structure; or

d. Part of an approved restoration, enhancement or compensatory mitigation plan.

3. The fact that a tree or part thereof is or may be dead or compromised (e.g., a snag) is not sufficient criteria for its removal or pruning unless the property owner demonstrates foreseeable danger to public safety, or a foreseeable danger of property damage to an existing structure. An application for the removal of a dead tree shall require an ISA Tree Hazard Evaluation Form prepared by a certified arborist at the property owner's sole expense.

4. Tree trunks, stumps, roots, and bows of trees removed or pruned on protected wetlands and wetland buffers pursuant to this chapter shall be left by the property owner in situ. When a tree is removed, it shall be topped at the highest point possible that avoid hazards while leaving as much stump as possible for wildlife habitat.

5. In all cases, removal or pruning of trees from protected wetlands and wetland buffers must follow best professional standards to ensure protected wetlands and wetland buffer areas are not compromised.

6. Any tree removed in accordance with this title or damaged by activities authorized under this title shall be replaced by the property owner with a tree on the wetland lot-of-record of the same species.

7. Removal of vegetation, except trees covered by Chapter 17.70, in protected wetlands and in wetland buffer areas is permitted only if:

    a. Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or

    b. Necessary for maintenance of an existing structure, road or pathway; or

    c. Necessary for correction or prevention of a hazardous situation; or

    d. Necessary for completion of a land survey; or

    e. Part of an approved restoration, enhancement or compensatory mitigation plan.

    f. Vegetation removal in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values.

8. Pruning or mowing of vegetation in protected wetlands and in wetland buffer areas is permitted only if:

    a. Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or

    b. Necessary for maintenance of an existing structure, road or pathway; or

    c. Necessary for correction or prevention of a hazardous situation; or

    d. Necessary for completion of a land survey; or

    e. Part of an approved restoration, enhancement or compensatory mitigation plan; or

    f. Part of a landscape plan approved by the city in conjunction with a building permit that minimizes adverse impacts on protected wetlands.

g. Pruning or mowing permitted under subsections J8a through f in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values.

9. Planting new vegetation in protected wetlands is permitted subject to the following standards:

    a. The planting is part of an approved restoration, enhancement or mitigation plan; or

    b. The planting is part of a landscape plan involving native wetland plant species, and the plan is approved by the city in conjunction with approval of a building permit; or

    c. The planting is intended to replace dead or damaged plants that were either part of a maintained landscape or part of the existing wetland plant community.

10. Planting new vegetation in wetland buffer areas is permitted as part of a managed garden or landscape.

11. Vegetation management practices will be employed in protected wetlands and in wetland buffer areas that minimize short-term and long-term adverse impacts on wetlands. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with chemicals, unnecessary or excessive vegetation removal, or substantial alteration of native wetland plant communities. The following are not permitted as part of a vegetation management plan for protected wetlands or wetland buffer areas: alteration of wetland hydrology, use of herbicides, or application of soil amendments or fertilizer.

K. Construction Standards

1. Construction management practices will be employed in protected wetlands, wetland buffer areas, and the upland portion of a wetland-lot-of-record that address impacts to wetland values and function. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with construction waste or debris, unnecessary or excessive vegetation removal, or damage. At a minimum, erosion fencing shall be installed around protected wetlands and wetland buffers. Construction equipment shall be kept out of protected wetlands and wetland buffers unless required for an approved use and signs posted at appropriate intervals intended to restrict entry by equipment or personnel. Construction debris shall be removed from the site and properly disposed of. Chemicals, paints, and solvents, including paint tools, masonry equipment, and drywall tools, shall be used, cleaned, and stored in a manner that does not degrade water quality. Any and all washdown of concrete trucks shall occur offsite. All construction activities shall be conducted as required by the city building official and public works director.

2. Pile-supported construction may use wood piling (treated or untreated), steel piling, concrete piling, or other piling material meeting building code requirements. If treated wood piling or posts are used for structures in protected wetlands, the following standards are applicable:

    a. Treated wood shall be completely dry;

   b. Treated wood shall not have any wet wood preservative on the wood surface; and

   c. The type of chemical treatment chosen shall be the type that minimize possible contamination of the wetland environment.

3. When removal and fill are approved by the permitting authority, the following standards shall be satisfied:

   a. All fill material shall be clean and free of contaminants;

   b. Filled area sides shall be finished to a stable slope;

   c. Measures shall be incorporated into the fill design to minimize erosion or sloughing of fill material into protected wetlands;

   d. Fills shall be designed in a manner that does not worsen flooding on adjacent or nearby flood-prone lands, and avoids restricting the flow of water to or through protected wetlands; and

   e. Fill side slopes shall be revegetated with native plant species, as recommended by a qualified wetland professional, to stabilize the slope.

4. Draining, diverting water from, or reconfiguring the dimensions of a wetland to create upland is prohibited.

5. To avoid harm to protected wetlands and wetland buffers from excessive traffic and frequent visitors who are unaware of wetland protections, short term rentals shall provide protection signage or education materials regarding wetland protection.

6. Excavation in protected wetlands and in wetland buffer areas for any purpose must meet the following standards:

   a. Excavation for purposes of gravel, aggregate, sand, or mineral extraction is not permitted.

   b. Excavation for utility trenches in wetland buffer areas is subject to the following standards:

      i. Material removed from the trench is either returned to the trench (back-fill) or removed from the wetland area. Side-casting into a protected wetland for disposal of material is not permitted;

      ii. Topsoil shall be conserved during trench construction or maintenance, and replaced on the top of the trench; and

      iii. The ground elevation shall not be altered as a result of utility trench construction or maintenance. Finish elevation shall be the same as starting elevation.

   c. Excavation for building footings in protected wetlands is subject to the following standards:

   i. Material removed for approved footings is either returned to the trench (back-fill), or removed from the protected wetland or wetland buffer area. Side-casting for disposal of material is not permitted;

   ii. Disturbance of wetland vegetation and topsoil during footing construction shall be minimized; and

   iii. The ground elevation around a footing shall not be altered as a result of excavation for the footing, unless required to meet building code requirements for positive drainage. Finish elevation shall be generally the same as starting elevation.

d. Excavation for wetland enhancement is subject to the following standards:

   i. No more material than necessary and specified in the enhancement plan shall be excavated; and

   ii. Side-casting for disposal of excavated material is not permitted; however, excavated material may be placed in a protected wetland or wetland buffer area for enhancement purposes as specified in the enhancement plan.

Exhibit A-2

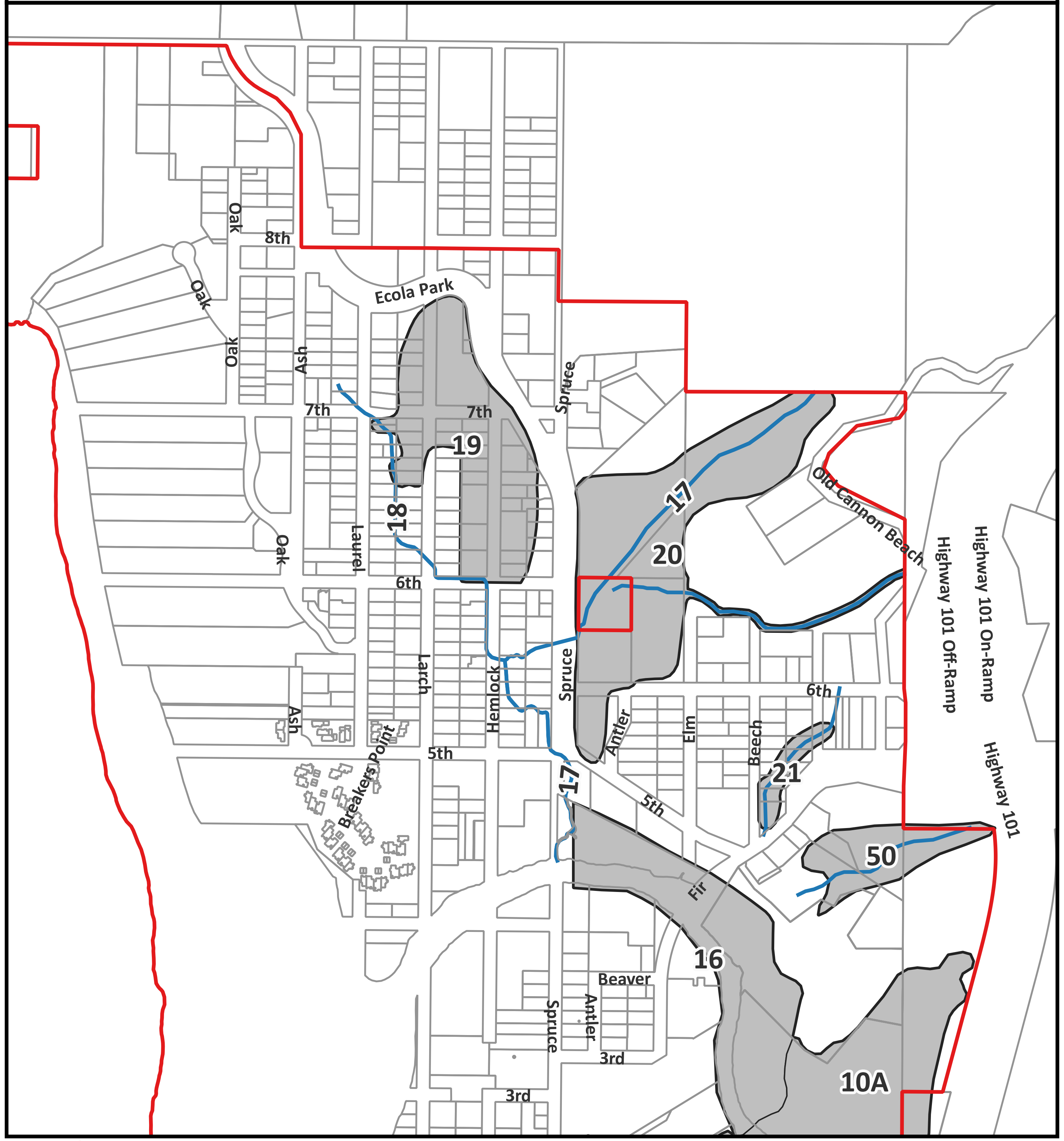
City of Cannon Beach Proposed Wetland Ordinance Revision
Map 1 - North End Neighborhood Wetlands & Buffer Areas

Legend

☐ Taxlots
🟥 City Limits
▨ LWI Wetland Sites
— LWI Stream Sites
■ Current 5 Foot Buffer
▨ Proposed 50 Foot Buffer

0 250 500 ft

Current 5 Foot Buffers



Proposed 50 Foot Wetland Buffers

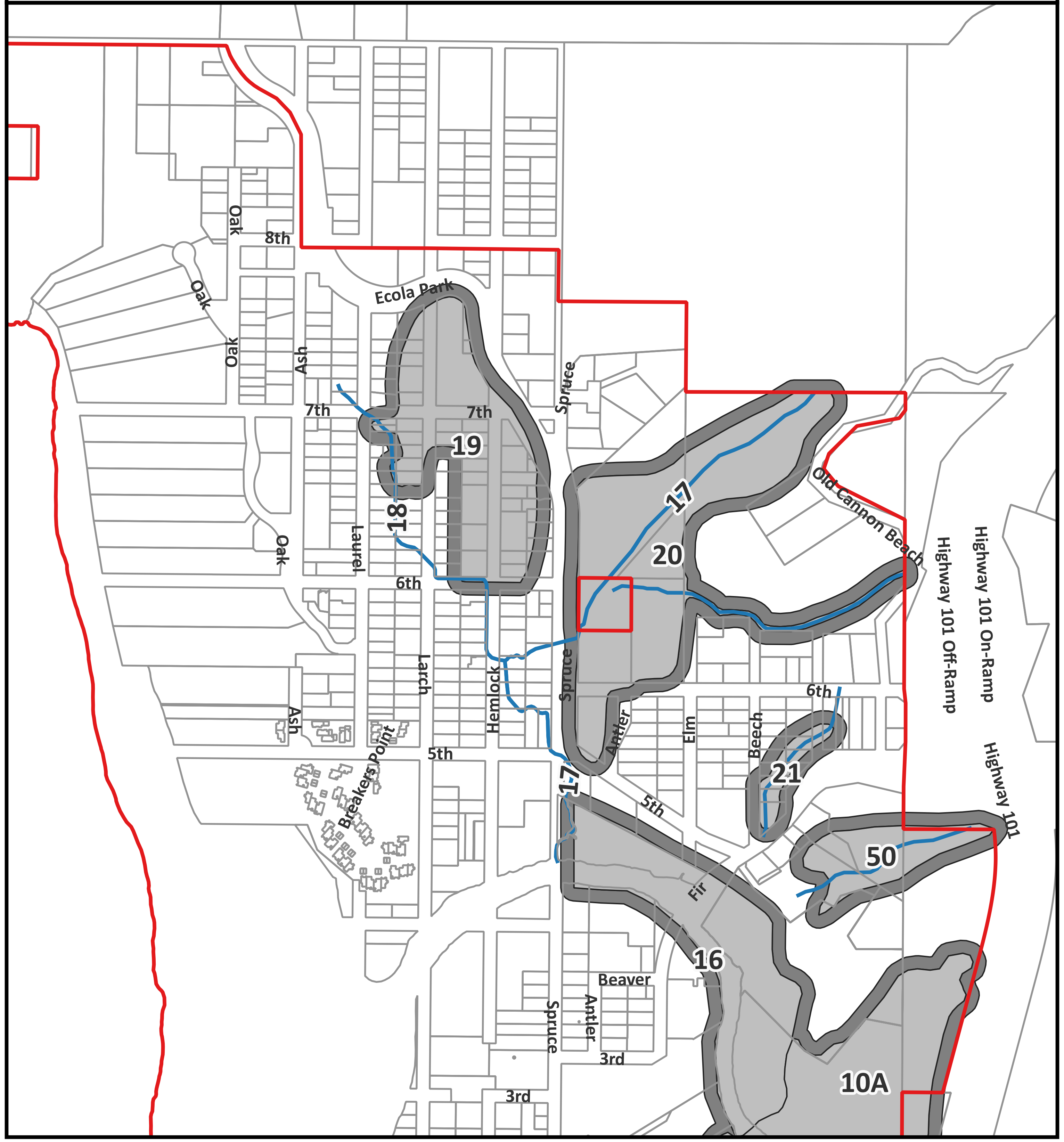


Exhibit A-2

City of Cannon Beach Proposed Wetland Ordinance Revision
Map 2 - Downtown Wetlands & Buffer Areas

Legend

- ☐ Taxlots
- 🟥 City Limits
- ▨ LWI Wetland Sites
- — LWI Stream Sites
- ■ Current 5 Foot Buffer
- ▨ Proposed 50 Foot Buffer

0 250 500 ft

Current 5 Foot Buffers

Proposed 50 Foot Wetland Buffers

Exhibit A-2

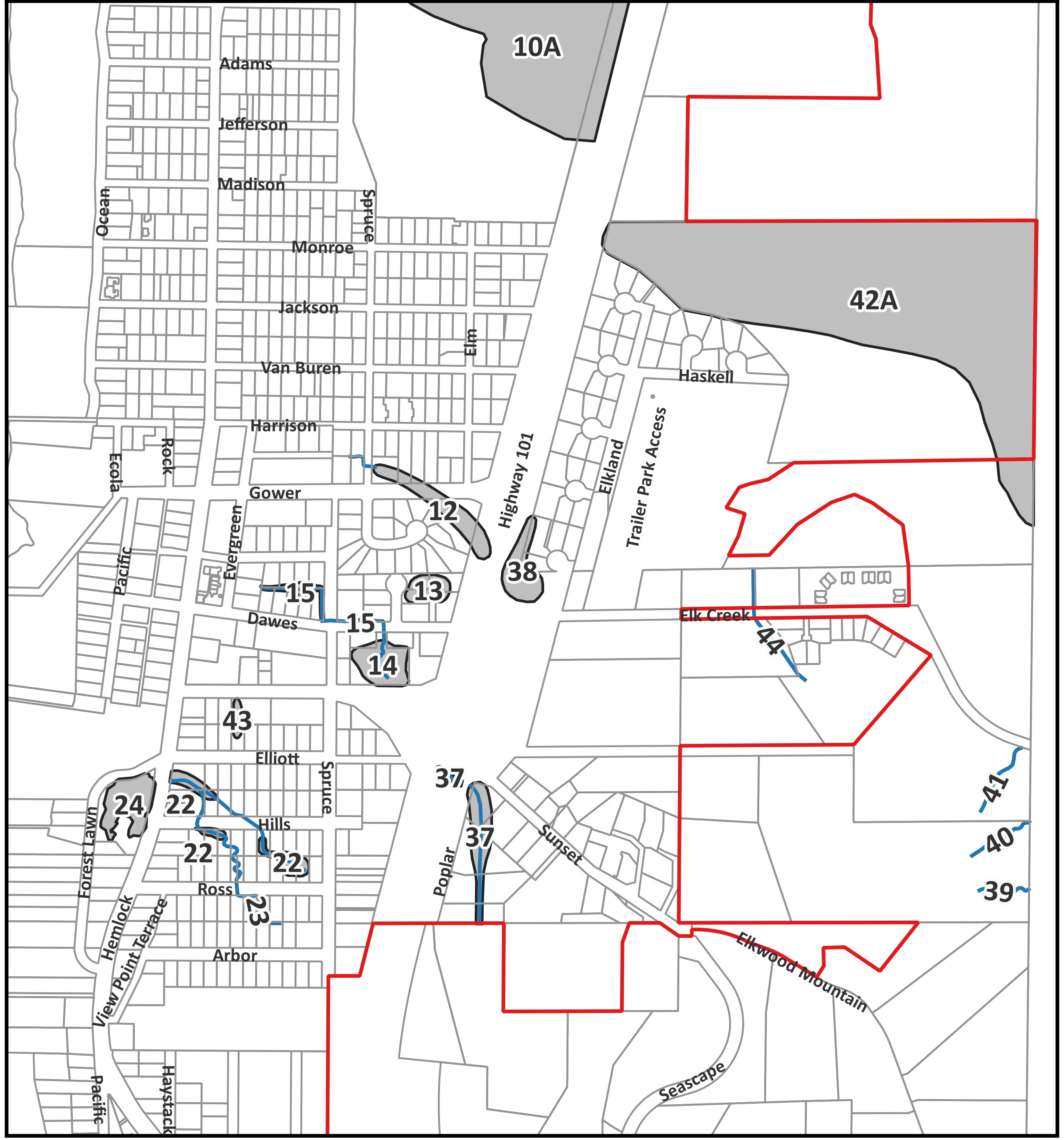
City of Cannon Beach Proposed Wetland Ordinance Revision
Map 3 - Presidentials & Midtown Wetlands & Buffer Areas

Legend

- ▭ Taxlots
- 🟥 City Limits
- ▨ LWI Wetland Sites
- — LWI Stream Sites
- ■ Current 5 Foot Buffer
- ▨ Proposed 50 Foot Buffer

0 250 500 ft

Current 5 Foot Buffers



Proposed 50 Foot Wetland Buffers

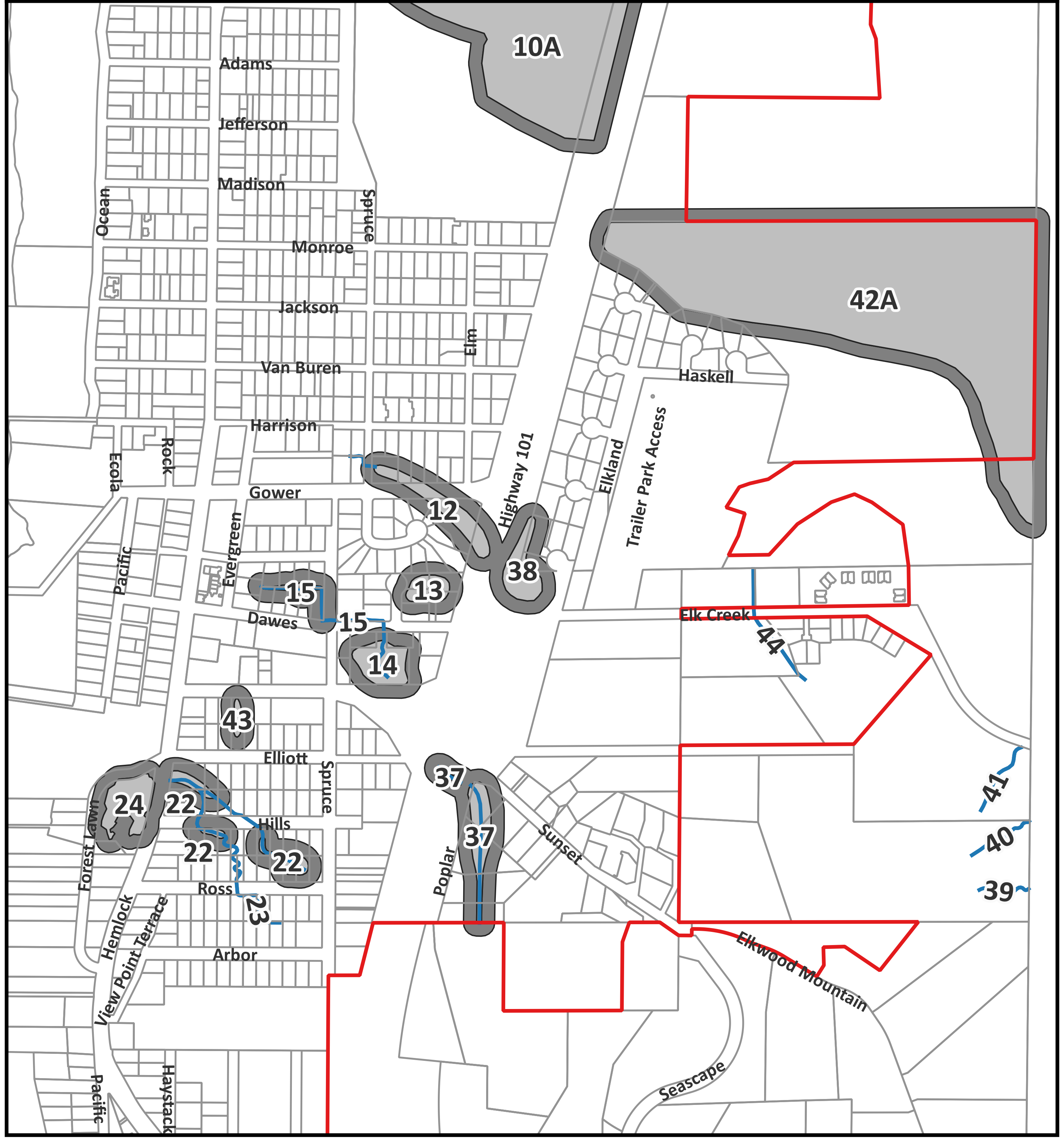


Exhibit A-2

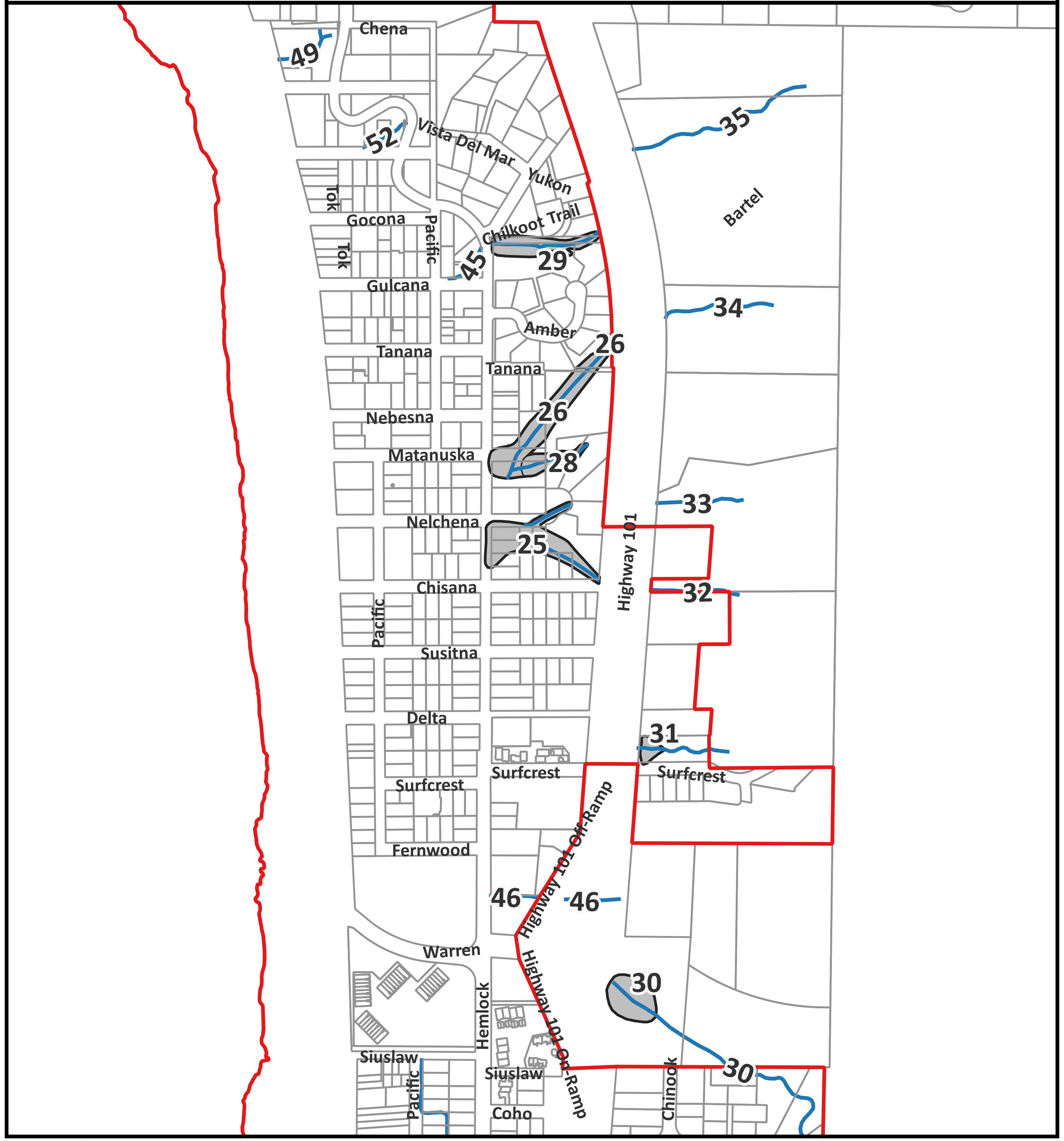
City of Cannon Beach Proposed Wetland Ordinance Revision
Map 4 - Tolovana North Neighborhood Wetlands & Buffer Areas

Legend

- ☐ Taxlots
- 🟥 City Limits
- ▨ LWI Wetland Sites
- — LWI Stream Sites
- ■ Current 5 Foot Buffer
- ■ Proposed 50 Foot Buffer

0 250 500 ft

Current 5 Foot Buffers



Proposed 50 Foot Wetland Buffers

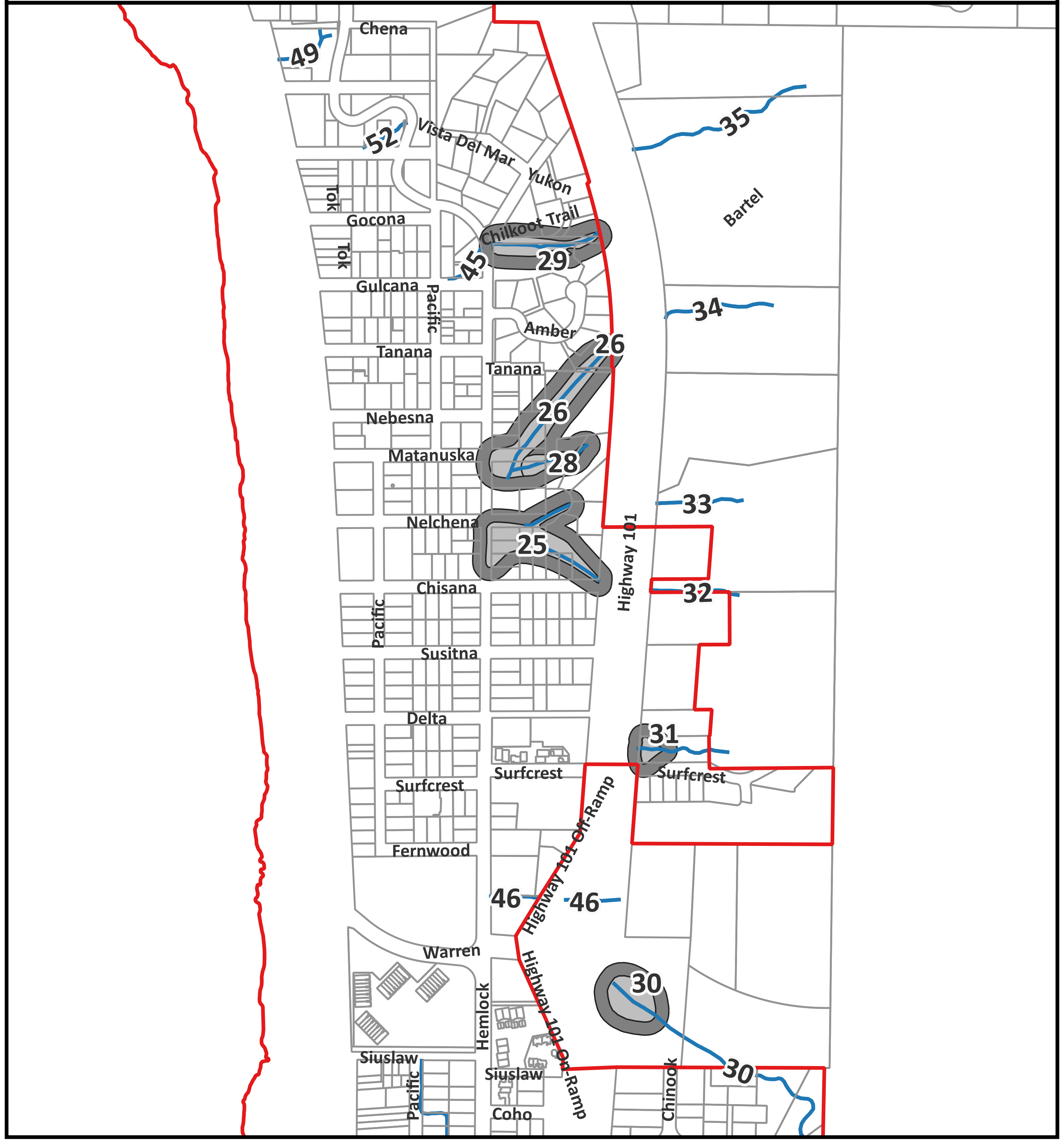


Exhibit A-2

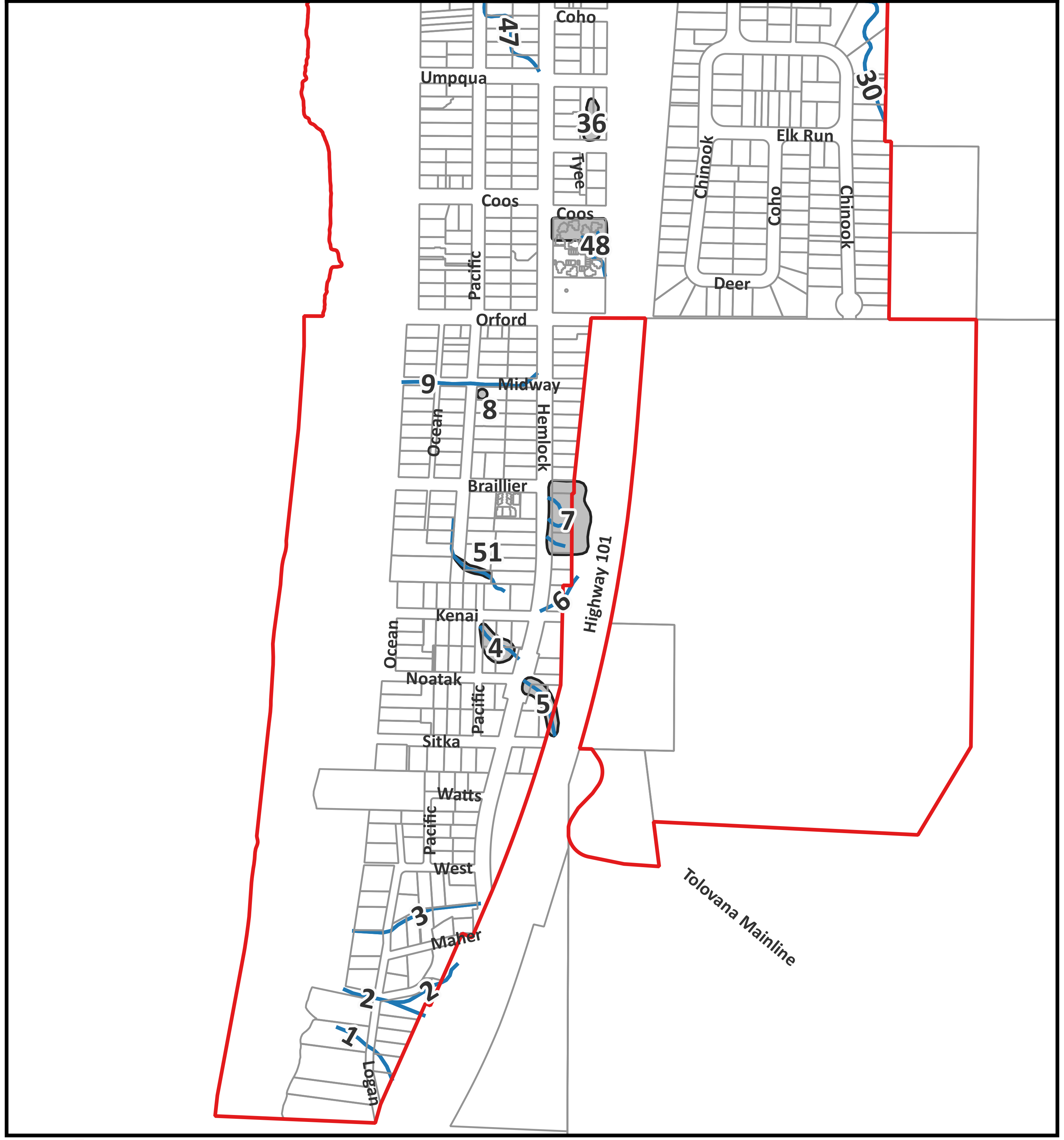
City of Cannon Beach Proposed Wetland Ordinance Revision
Map 5 - Tolovana South Neighborhood Wetlands & Buffer Areas

Legend

☐	Taxlots
🟥	City Limits
▨	LWI Wetland Sites
—	LWI Stream Sites
■	Current 5 Foot Buffer
▨	Proposed 50 Foot Buffer

0 250 500 ft

Current 5 Foot Buffers



Proposed 50 Foot Wetland Buffers

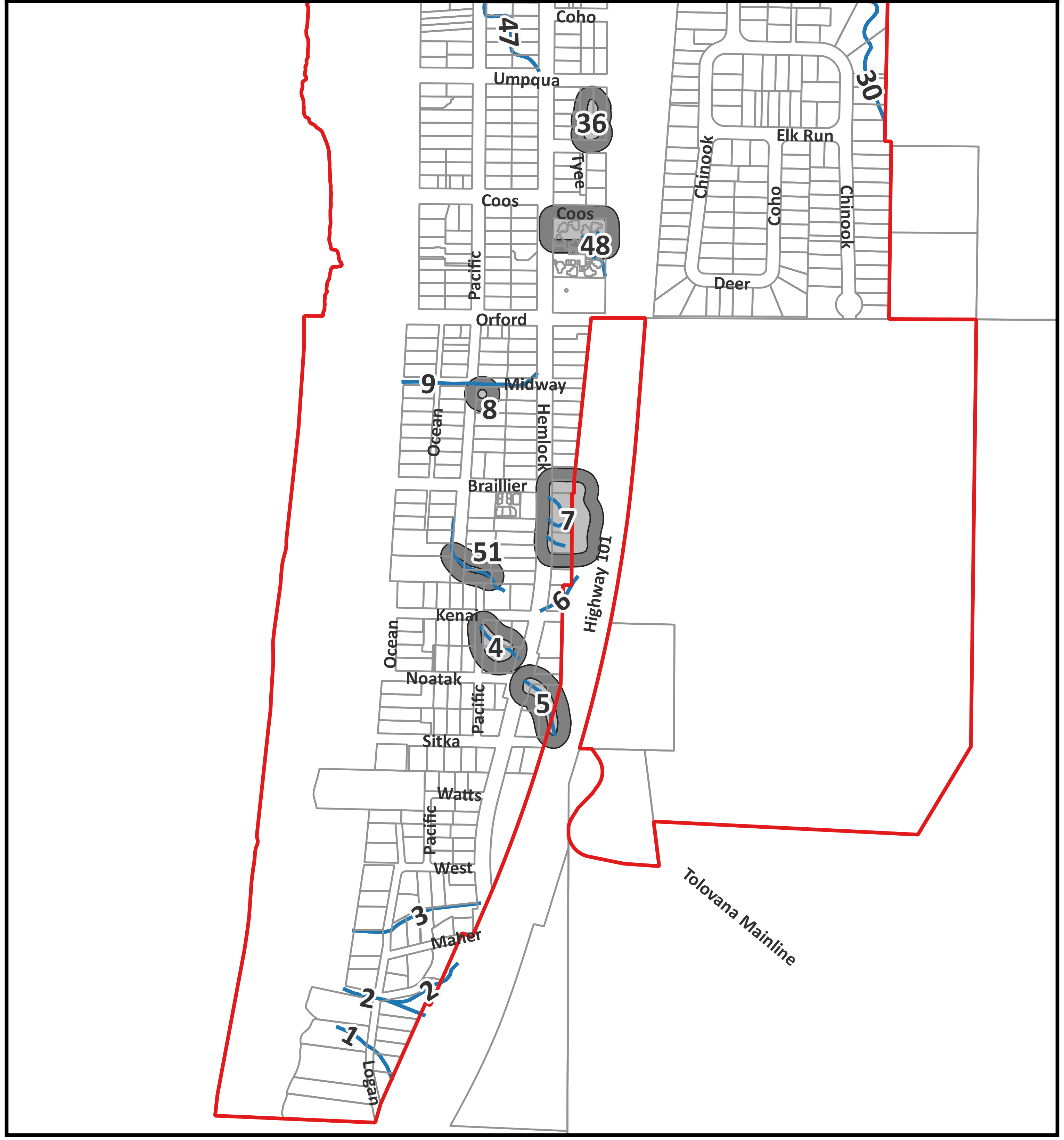


Exhibit A-3

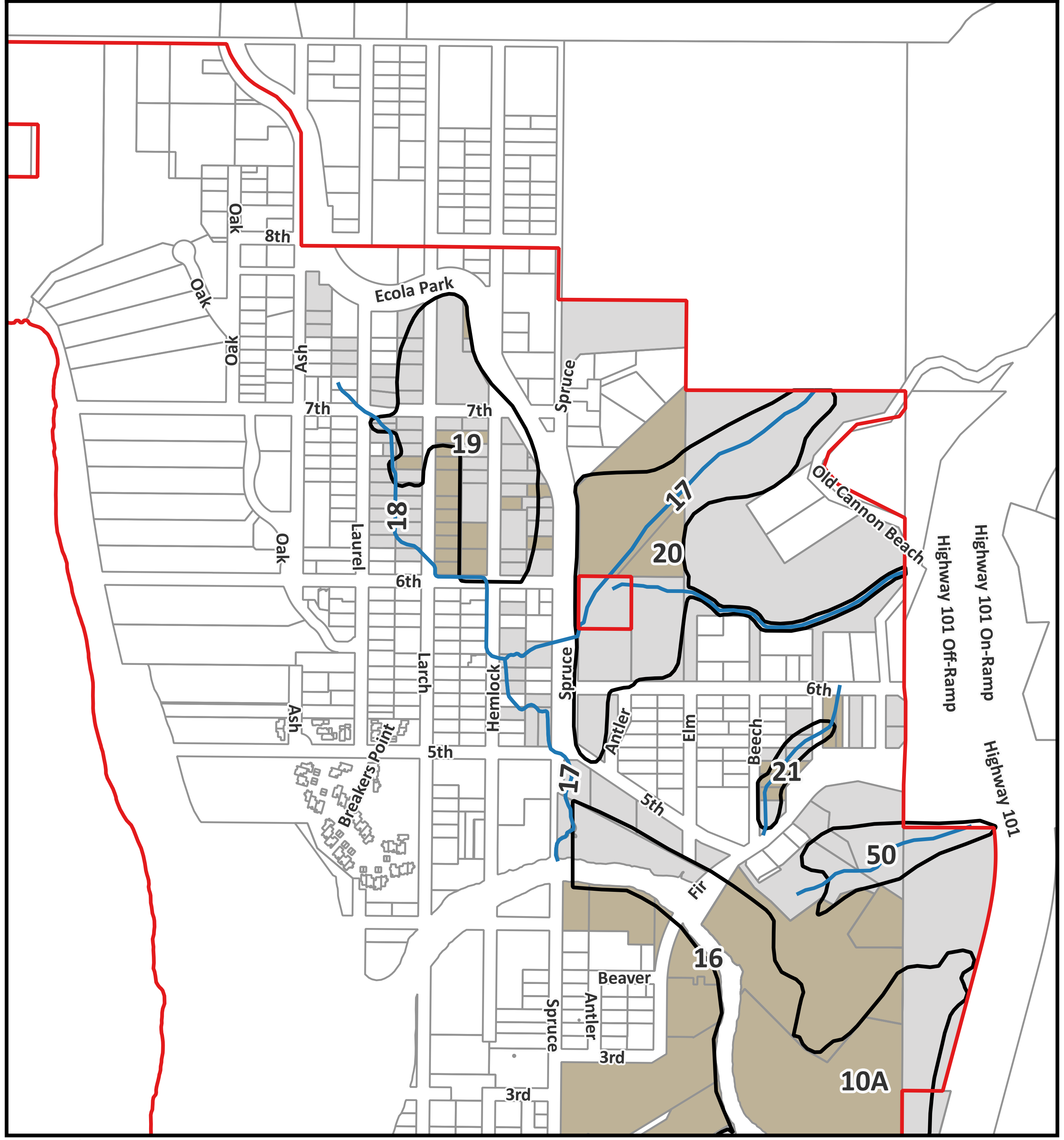
City of Cannon Beach Proposed Wetland Ordinance Revision
Map 6 - North End Neighborhood Wetland Affected Taxlots

Legend

- ☐ Taxlots
- ▭ Wetland Buffer Boundary
- ― LWI Stream Sites
- ▨ Current Affected Lots
- ▨ Unmapped Current Lots
- ▨ New Affected Lots

0 250 500 ft

Current 5 Foot Buffers



Proposed 50 Foot Wetland Buffers

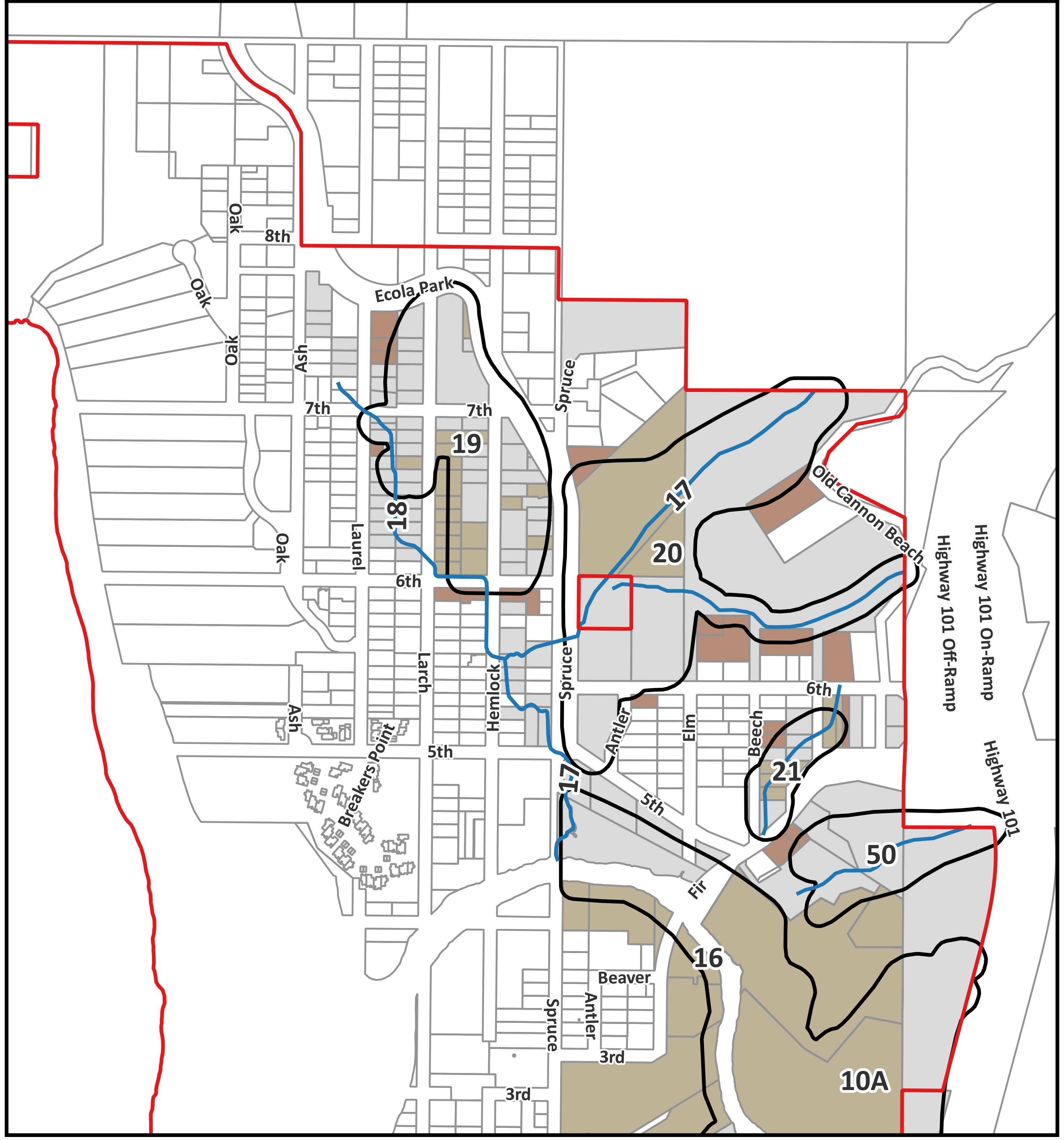


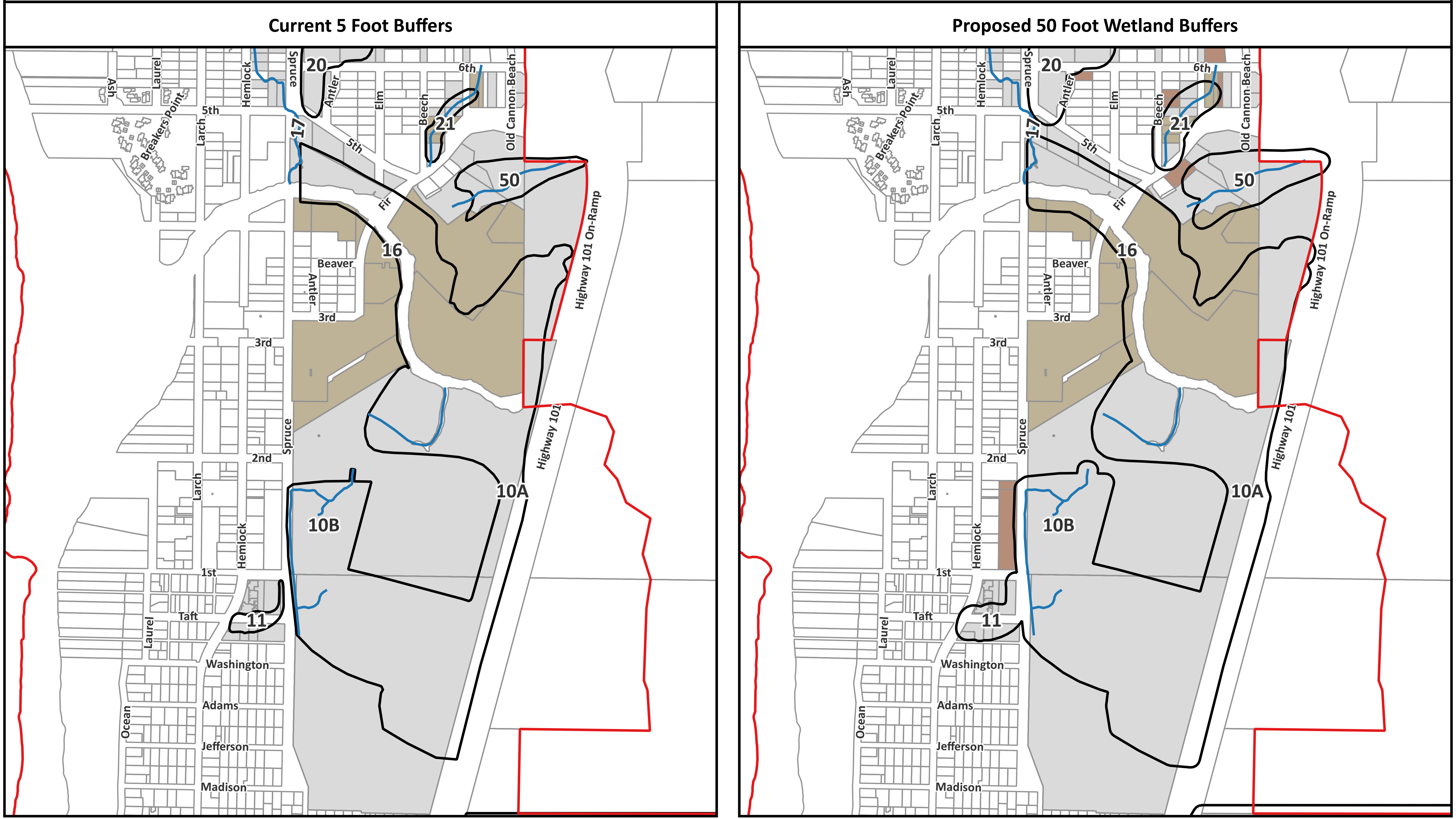
Exhibit A-3

City of Cannon Beach Proposed Wetland Ordinance Revision
Map 7 - Downtown Wetland Affected Taxlots

Legend

- ☐ Taxlots
- ☐ Wetland Buffer Boundary
- — LWI Stream Sites
- ▨ Current Affected Lots
- ▨ Unmapped Current Lots
- ▨ New Affected Lots

0 250 500 ft


Current 5 Foot Buffers

Proposed 50 Foot Wetland Buffers

Exhibit A-3

City of Cannon Beach Proposed Wetland Ordinance Revision
Map 8 - Presidentials & Midtown Wetland Affected Taxlots

Legend

☐ Taxlots
▭ Wetland Buffer Boundary
— LWI Stream Sites
▨ Current Affected Lots
▨ Unmapped Current Lots
▨ New Affected Lots

0 250 500 ft

Current 5 Foot Buffers

Proposed 50 Foot Wetland Buffers

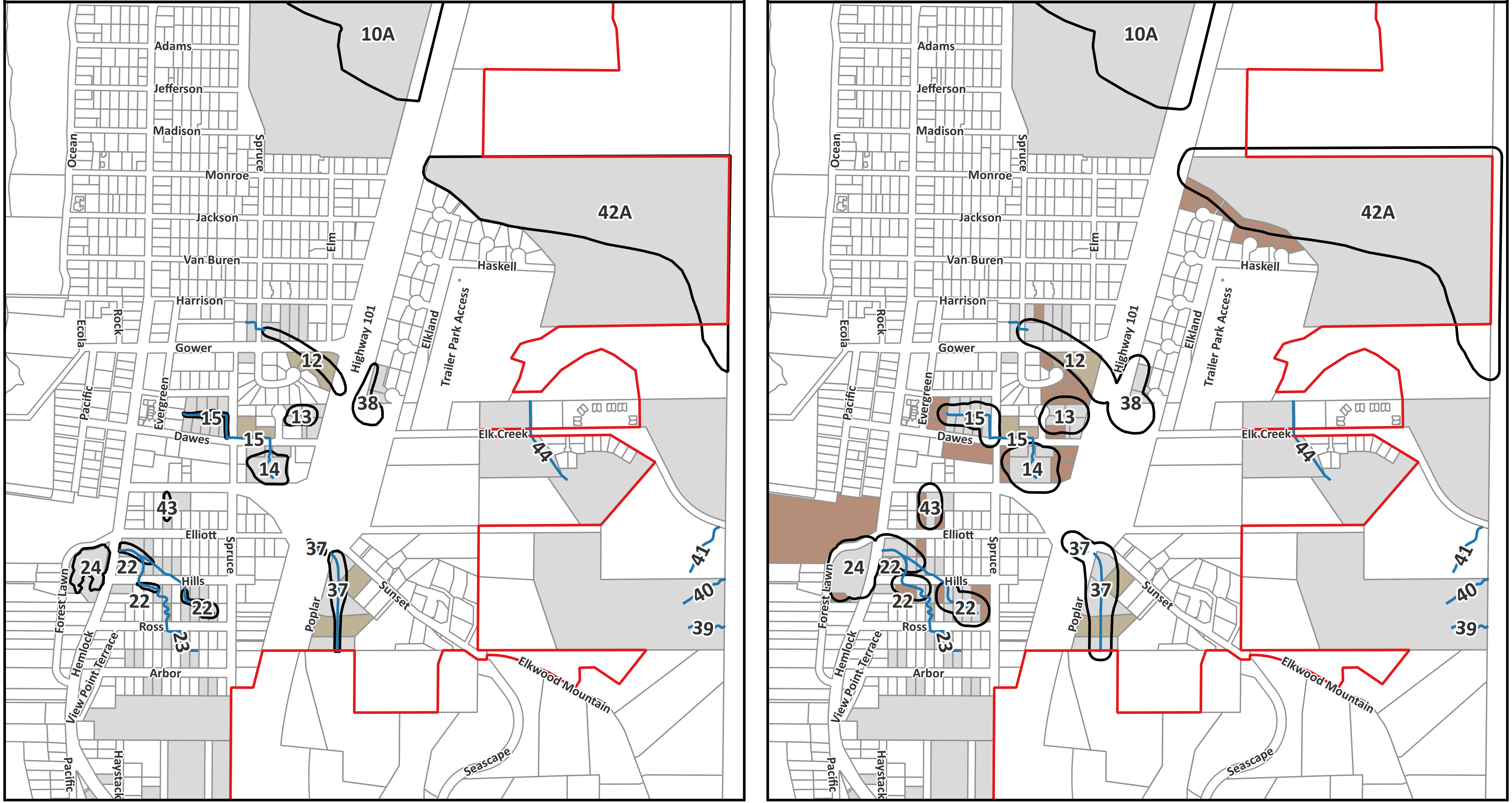


Exhibit A-3

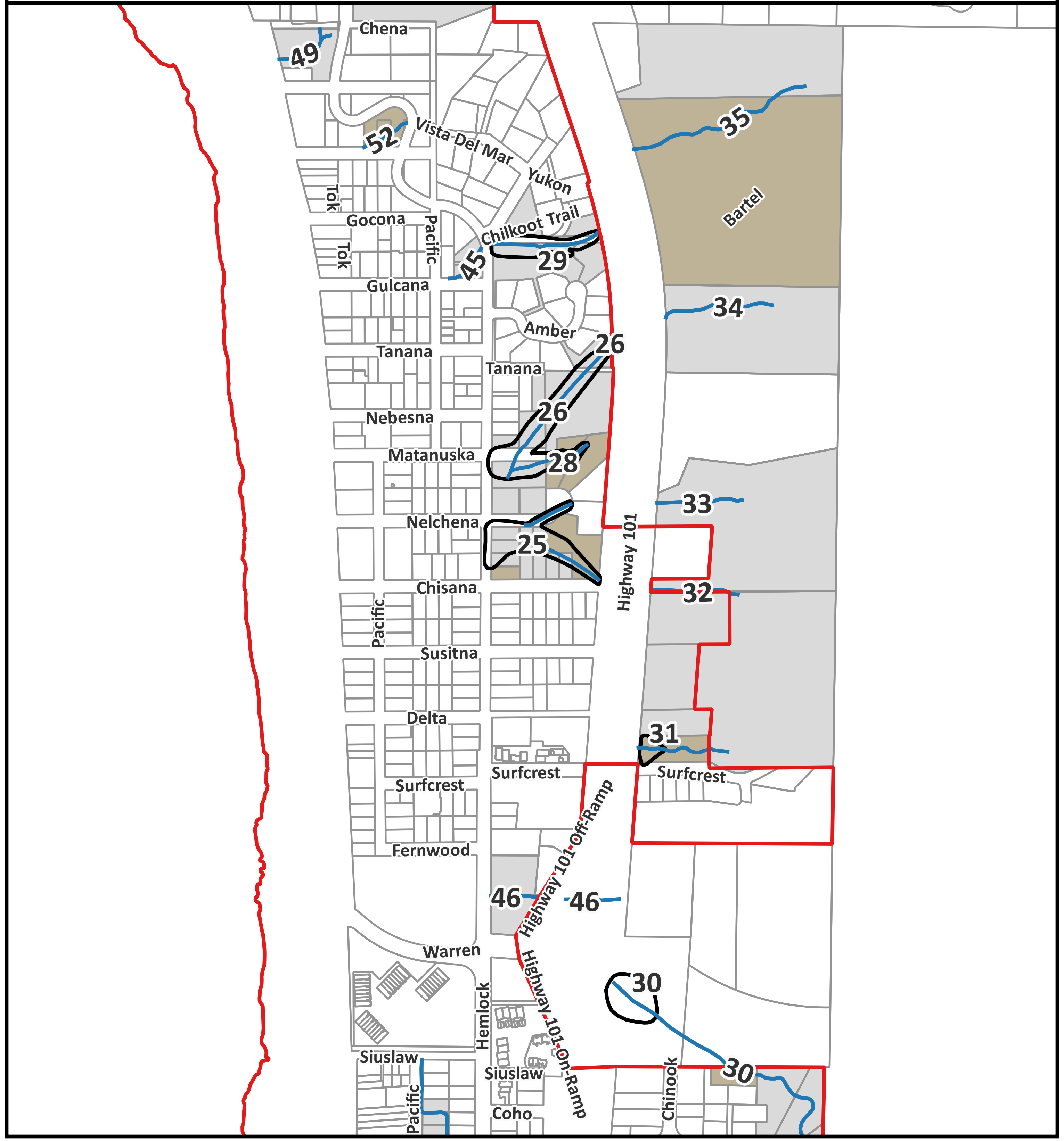
City of Cannon Beach Proposed Wetland Ordinance Revision
Map 9 - Tolovana North Neighborhood Wetland Affected Taxlots

Legend

☐ Taxlots
▭ Wetland Buffer Boundary
— LWI Stream Sites
▨ Current Affected Lots
▨ Unmapped Current Lots
▨ New Affected Lots

0 250 500 ft

Current 5 Foot Buffers



Proposed 50 Foot Wetland Buffers

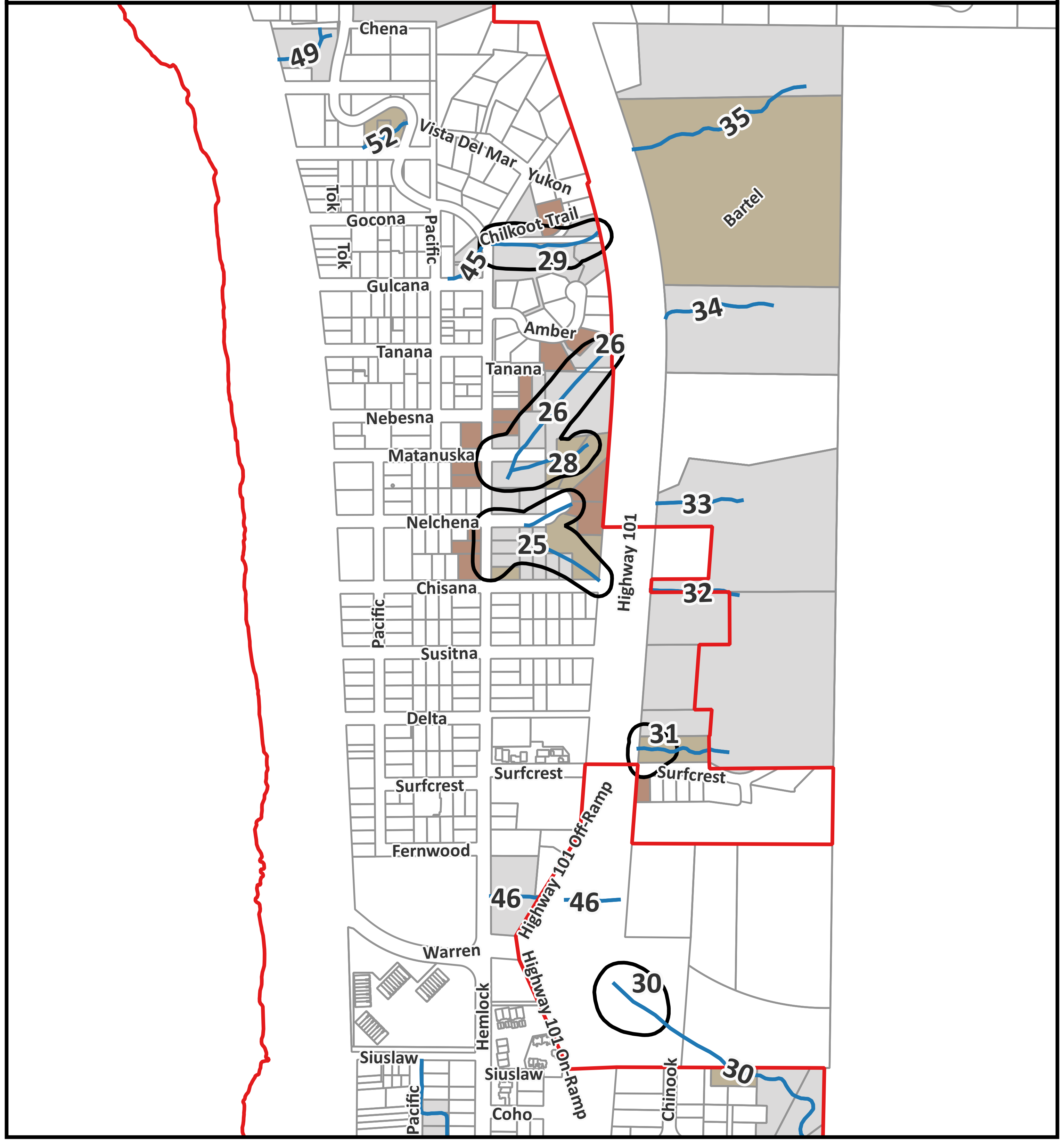


Exhibit A-3

City of Cannon Beach Proposed Wetland Ordinance Revision
Map 10 - Tolovana South Neighborhood Wetland Affected Taxlots

Legend

- ☐ Taxlots
- ▭ Wetland Buffer Boundary
- — LWI Stream Sites
- ▨ Current Affected Lots
- ▨ Unmapped Current Lots
- ▨ New Affected Lots

0 250 500 ft

Exhibit A-4

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 11 - North End Neighborhood Zoning

- (E) Estuary
- (OS) Open Space
- (PK) Park Management
- (C1) Limited Commercial
- (IN) Institutional
- (R3) Residential High Density
- (R2) Residential Medium Density
- (RM) Residential Motel
- (RL) Residential Lower Density
- (RVL) Residential Very Low Density
- (MP) Manufactured Dwelling/RV Park

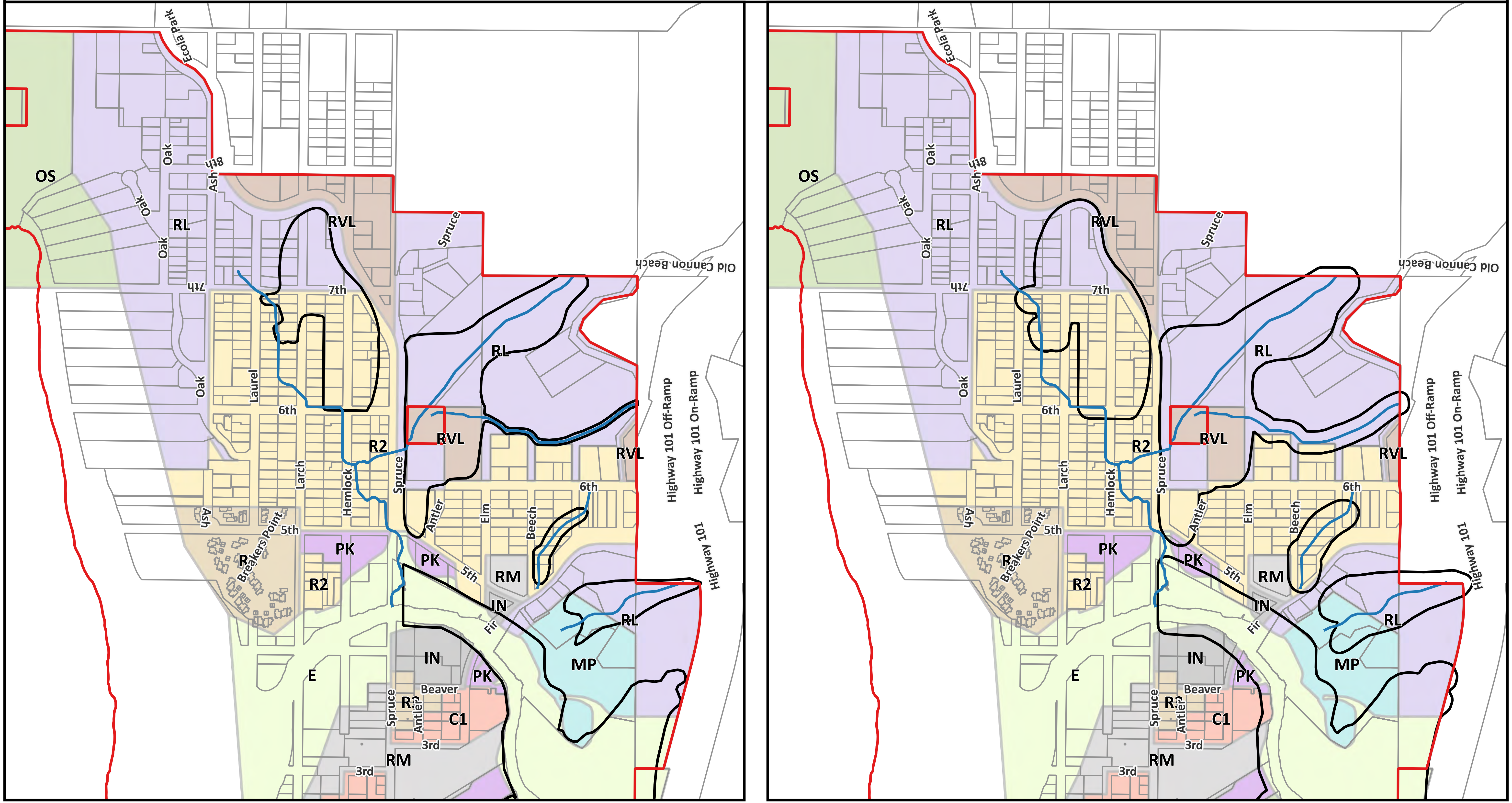
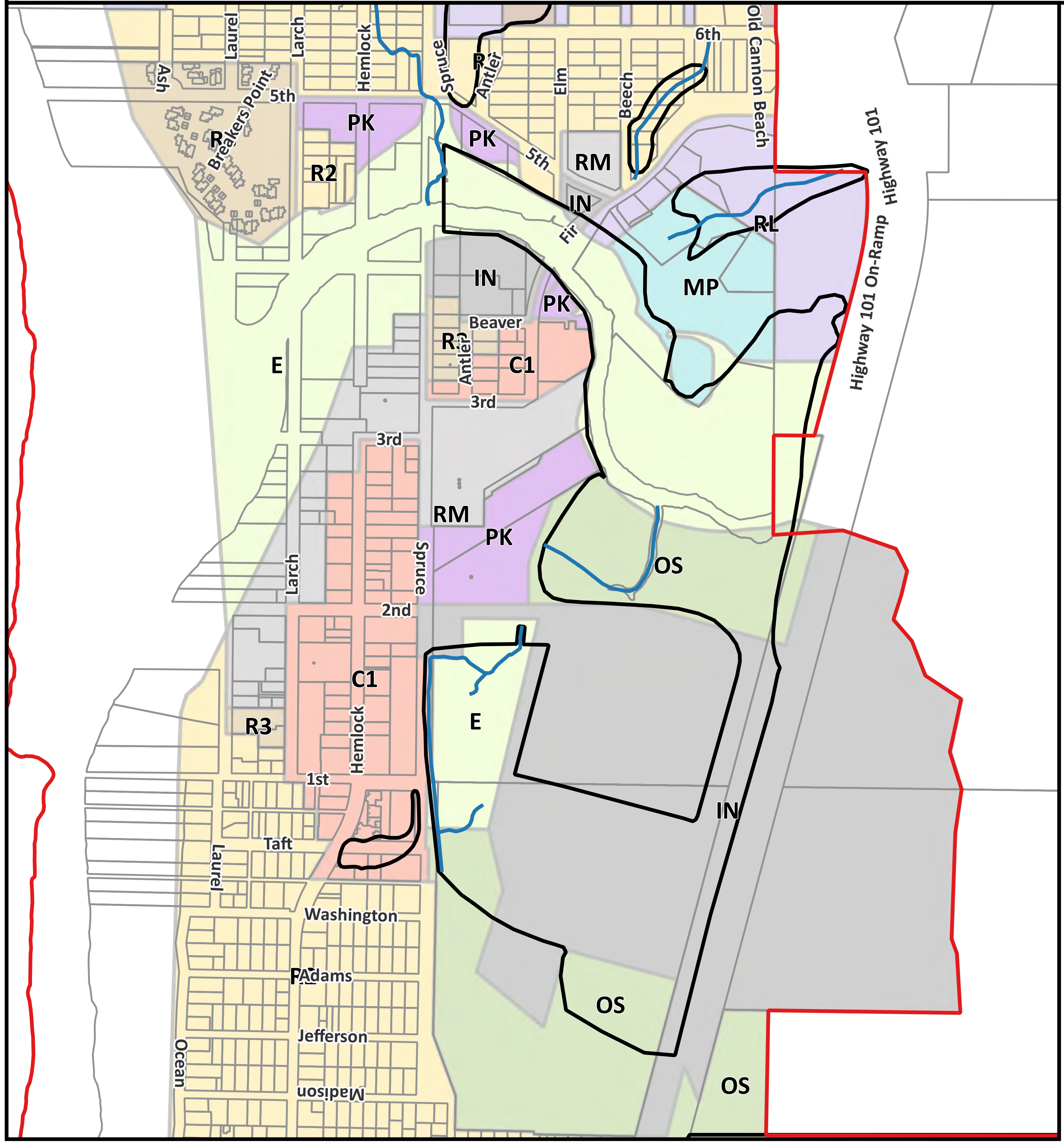


Exhibit A-4

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 12 - Downtown Zoning

- ▨ (E) Estuary
- ▨ (OS) Open Space
- ▨ (PK) Park Management
- ▨ (C1) Limited Commercial
- ▨ (IN) Institutional
- ▨ (R3) Residential High Density
- ▨ (R2) Residential Medium Density
- ▨ (RAM) Residential Manufactured Dwlg
- ▨ (RM) Residential Motel
- ▨ (RL) Residential Lower Density
- ▨ (RVL) Residential Very Low Density
- ▨ (MP) Manufactured Dwelling/RV Park



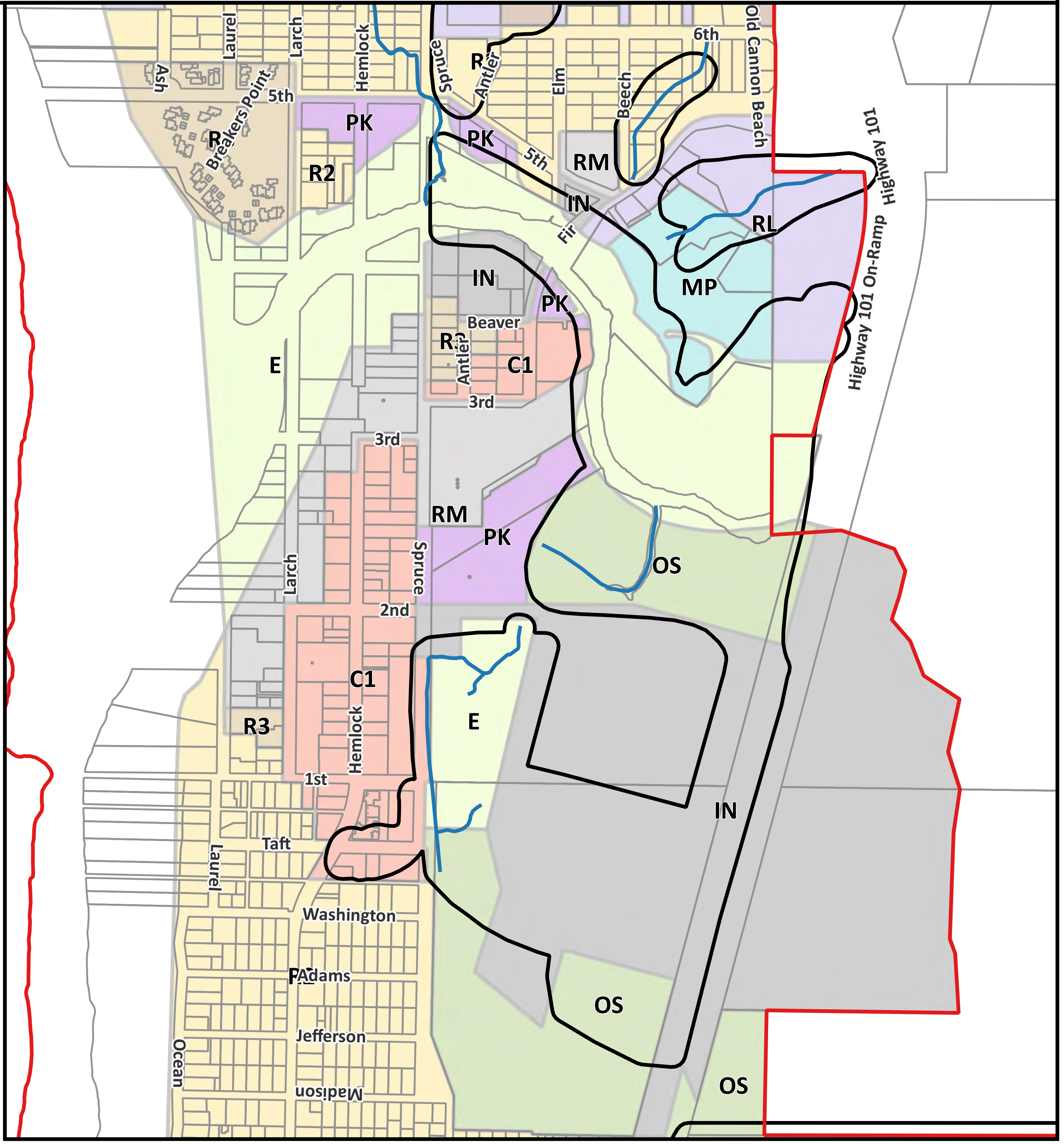


Exhibit A-4

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 13 - Presidentials & Midtown Zoning

- 🟩 (OS) Open Space
- 🟦 (OSR) Open Space Recreational
- 🟥 (C1) Limited Commercial
- 🟥 (C2) General Commercial
- ⬜ (IN) Institutional
- 🟨 (R2) Residential Medium Density
- 🟫 (R3) Residential High Density
- 🟩 (RAM) Residential Manufactured Dwlg
- ⬜ (RM) Residential Motel
- 🟪 (RL) Residential Lower Density
- 🟫 (RVL) Residential Very Low Density
- 🟦 (MP) Manufactured Dwelling/RV Park

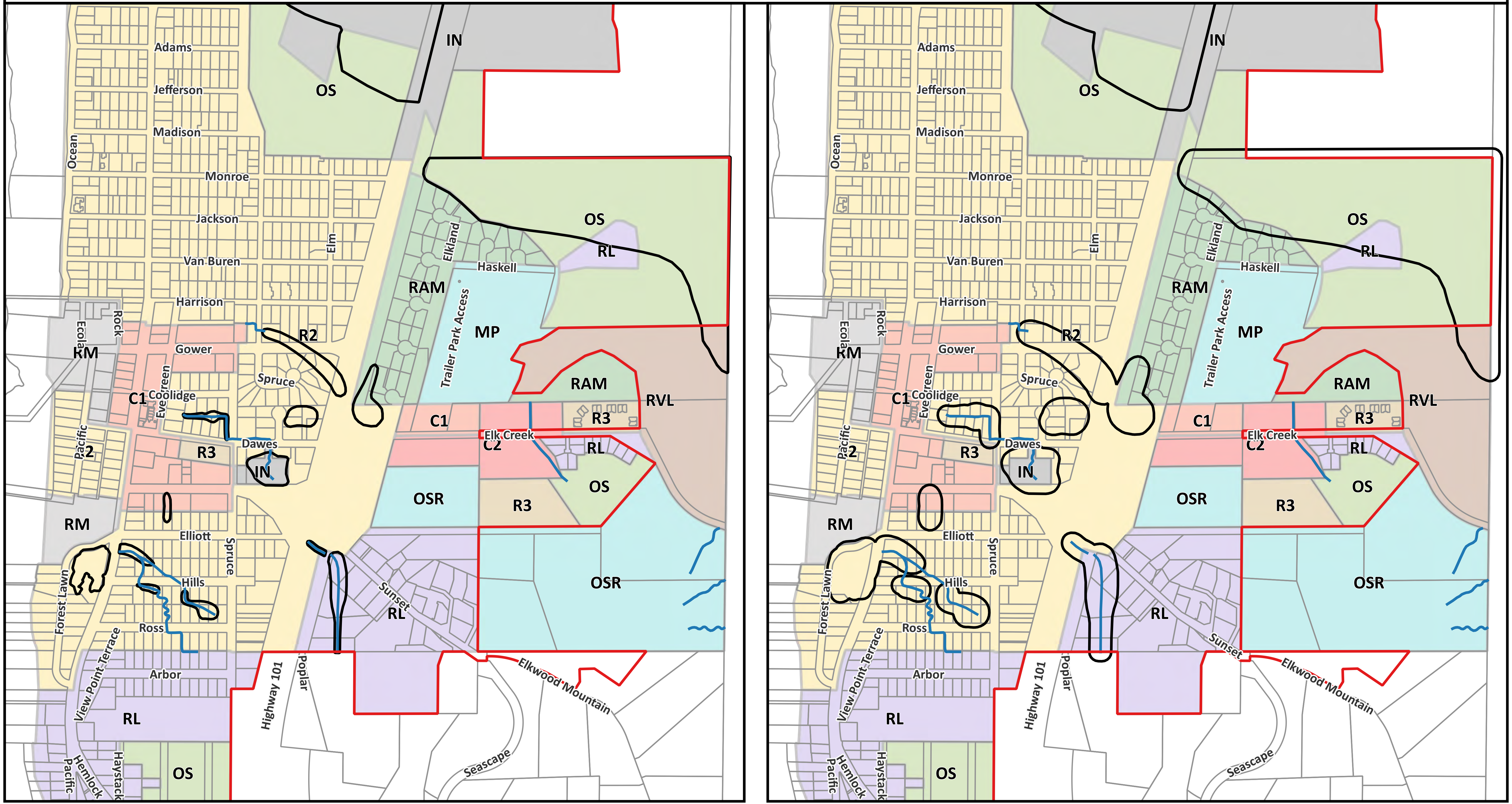


Exhibit A-4

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 14 - Tolovana North Zoning

- 🟩 (OS) Open Space
- 🟪 (PK) Park Management
- 🟥 (C1) Limited Commercial
- 🟨 (R1) Residential Moderate Density
- 🟨 (R2) Residential Medium Density
- 🟫 (R3) Residential High Density
- ⬜ (RM) Residential Motel
- 🟪 (RL) Residential Lower Density
- 🟫 (RVL) Residential Very Low Density

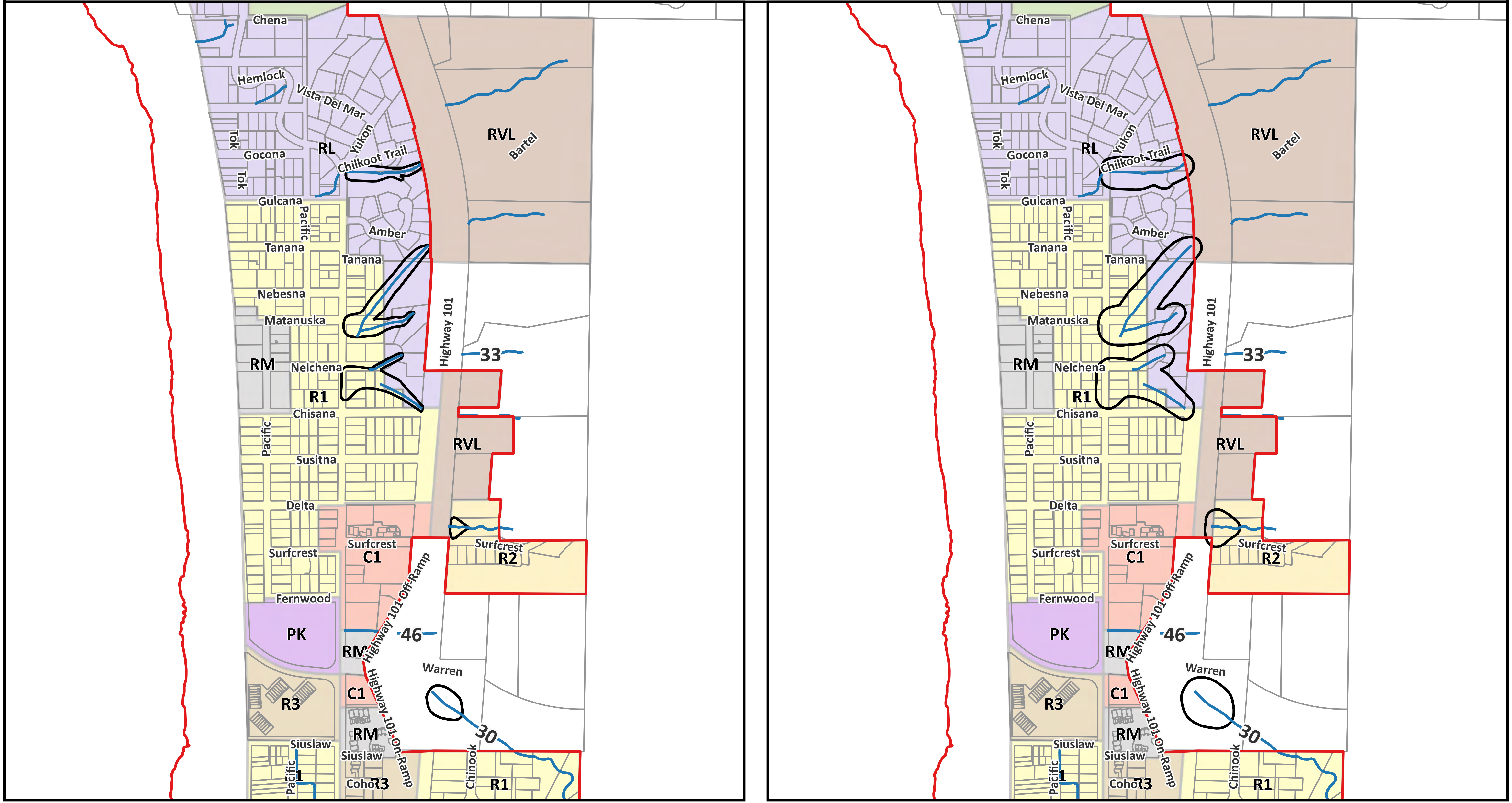
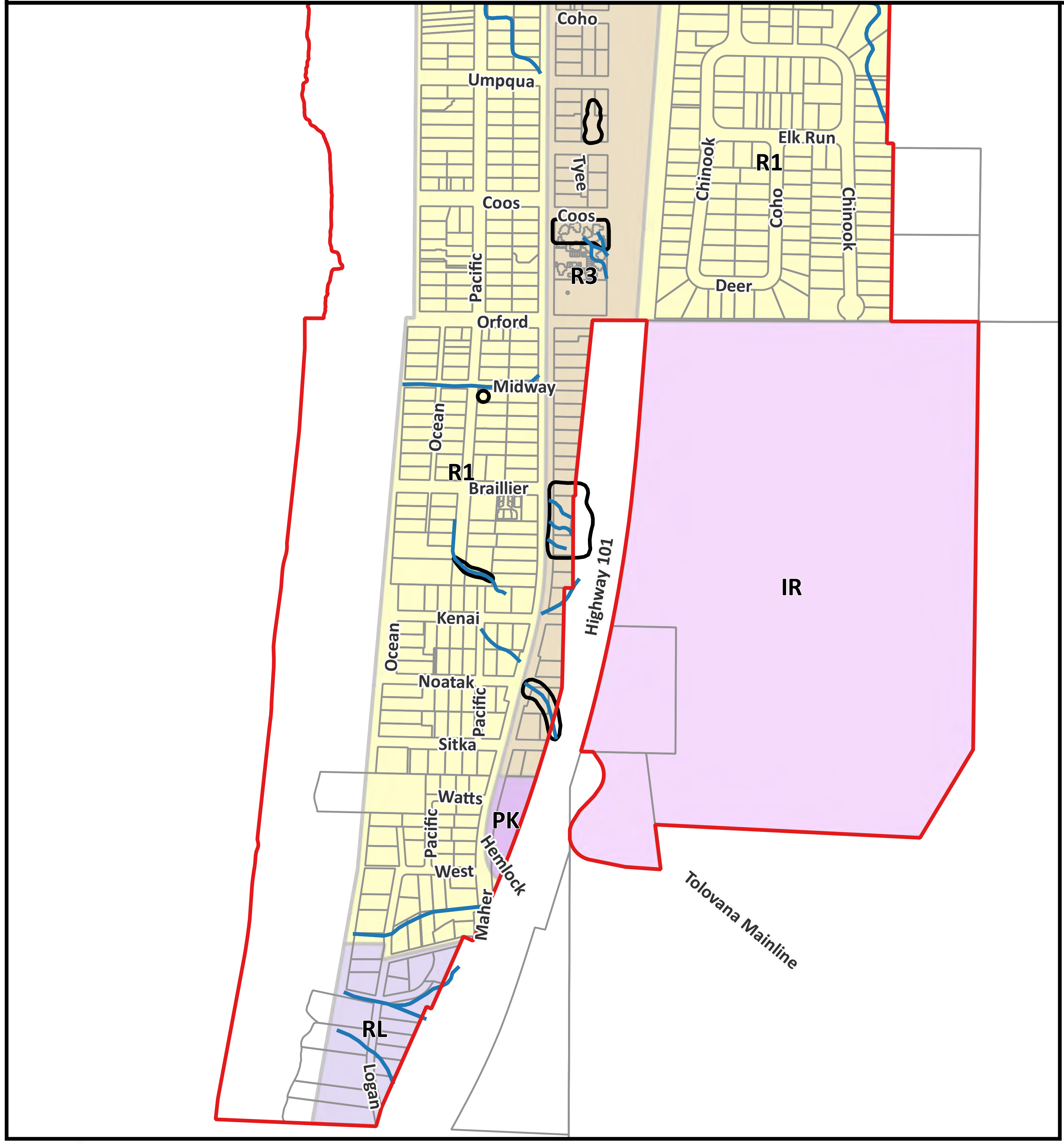


Exhibit A-4

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 15 - Tolovana South Zoning

▨ (R1) Residential Moderate Density
▨ (R3) Residential High Density
▨ (RM) Residential Motel
▨ (RL) Residential Lower Density
▨ (PK) Park Management
▨ (IR) Institutional Reserve



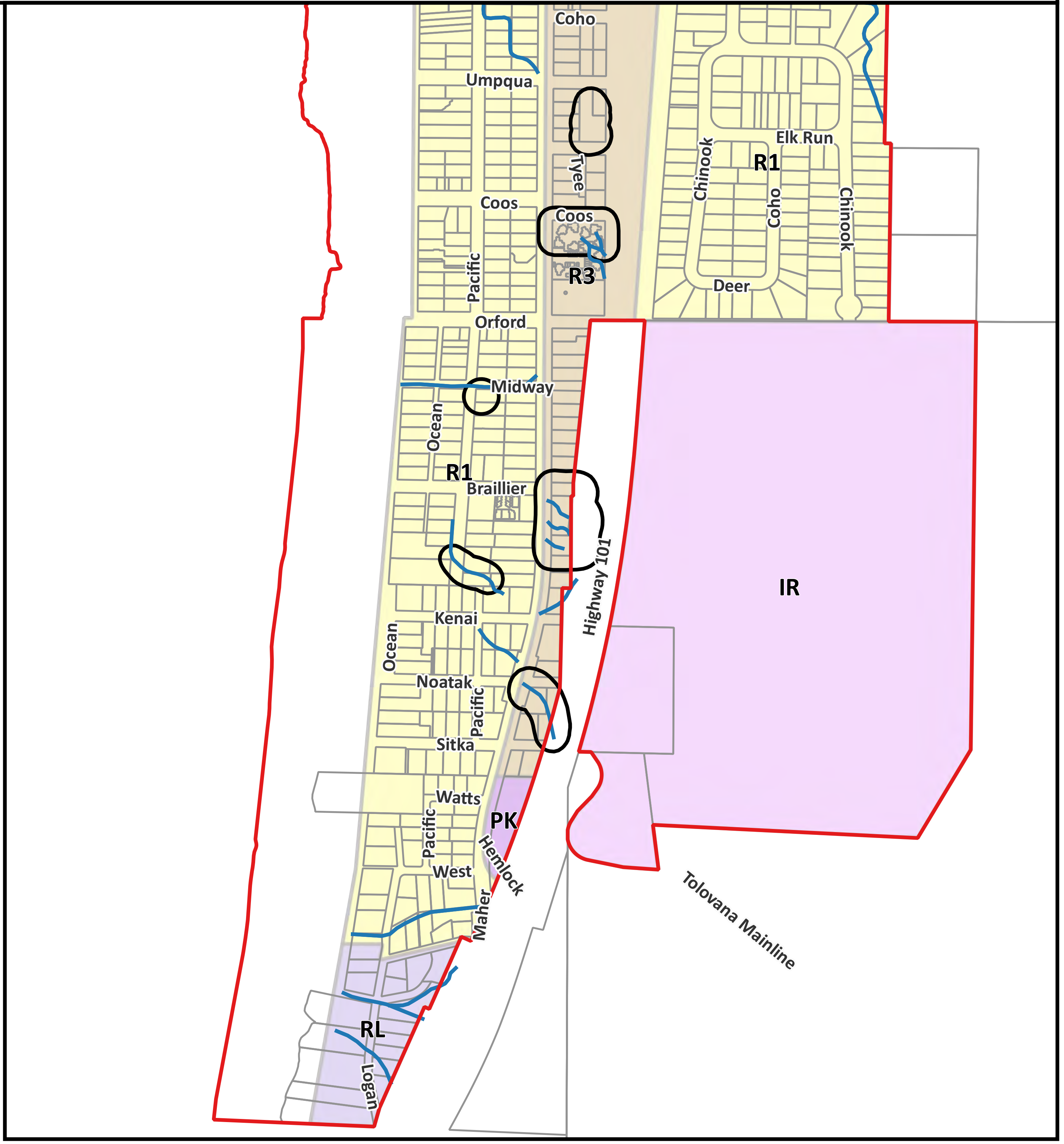


Exhibit A-5

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 16 - North End Neighborhood Aerial

Legend

- 🟩 Wetland Buffer Boundary
- — LWI Stream Sites
- ☐ Taxlots
- 🟥 City Limits
- ▨ Vacant Affected Taxlots
- ░ Undeveloped ROW

0 250 500 ft

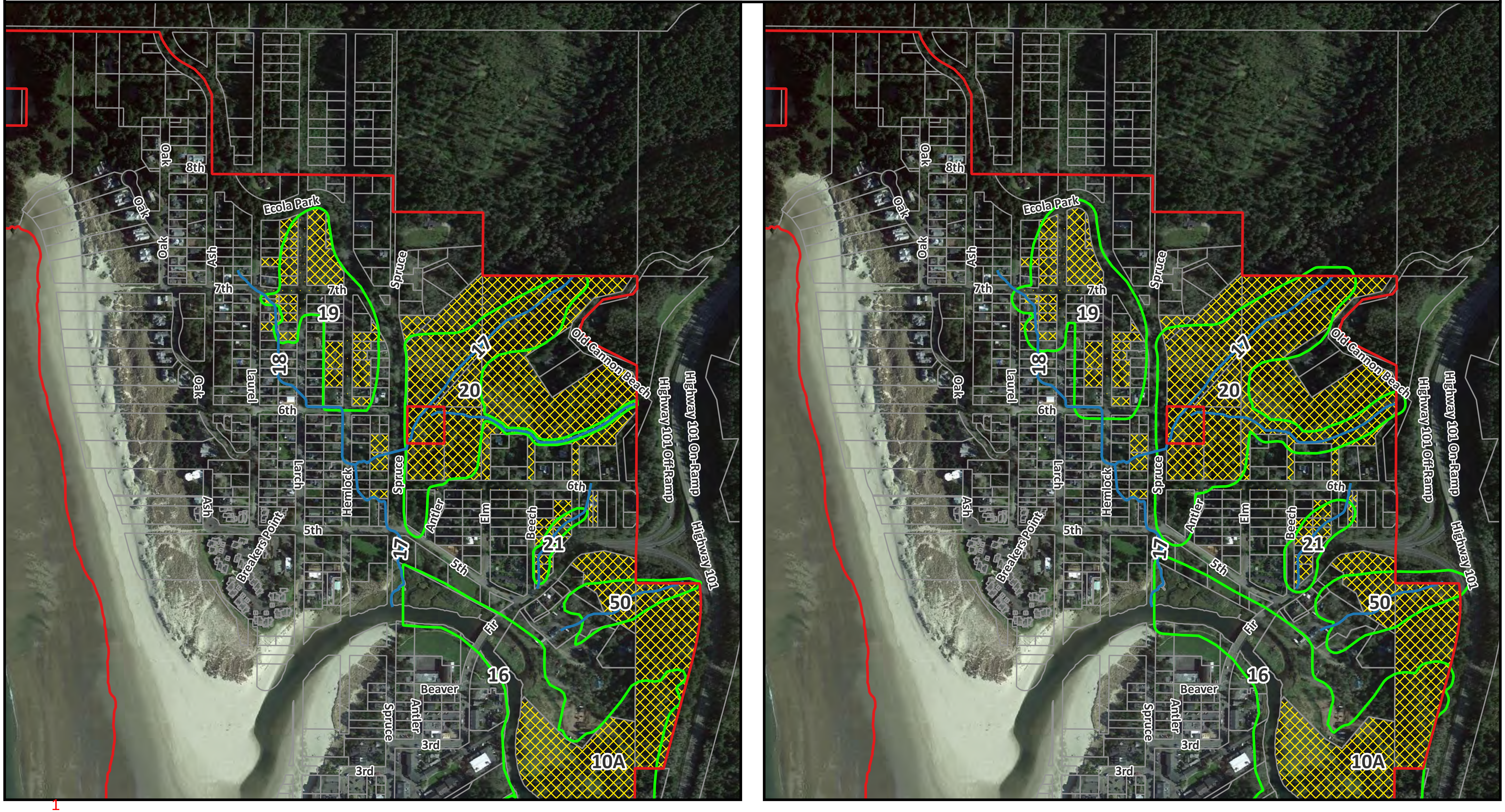


Exhibit A-5

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 17 - Downtown Aerial

Legend

- ▢ Wetland Buffer Boundary
- — LWI Stream Sites
- ▢ Taxlots
- ▢ City Limits
- ▨ Vacant Affected Taxlots
- ⋯ Undeveloped ROW

0 250 500 ft

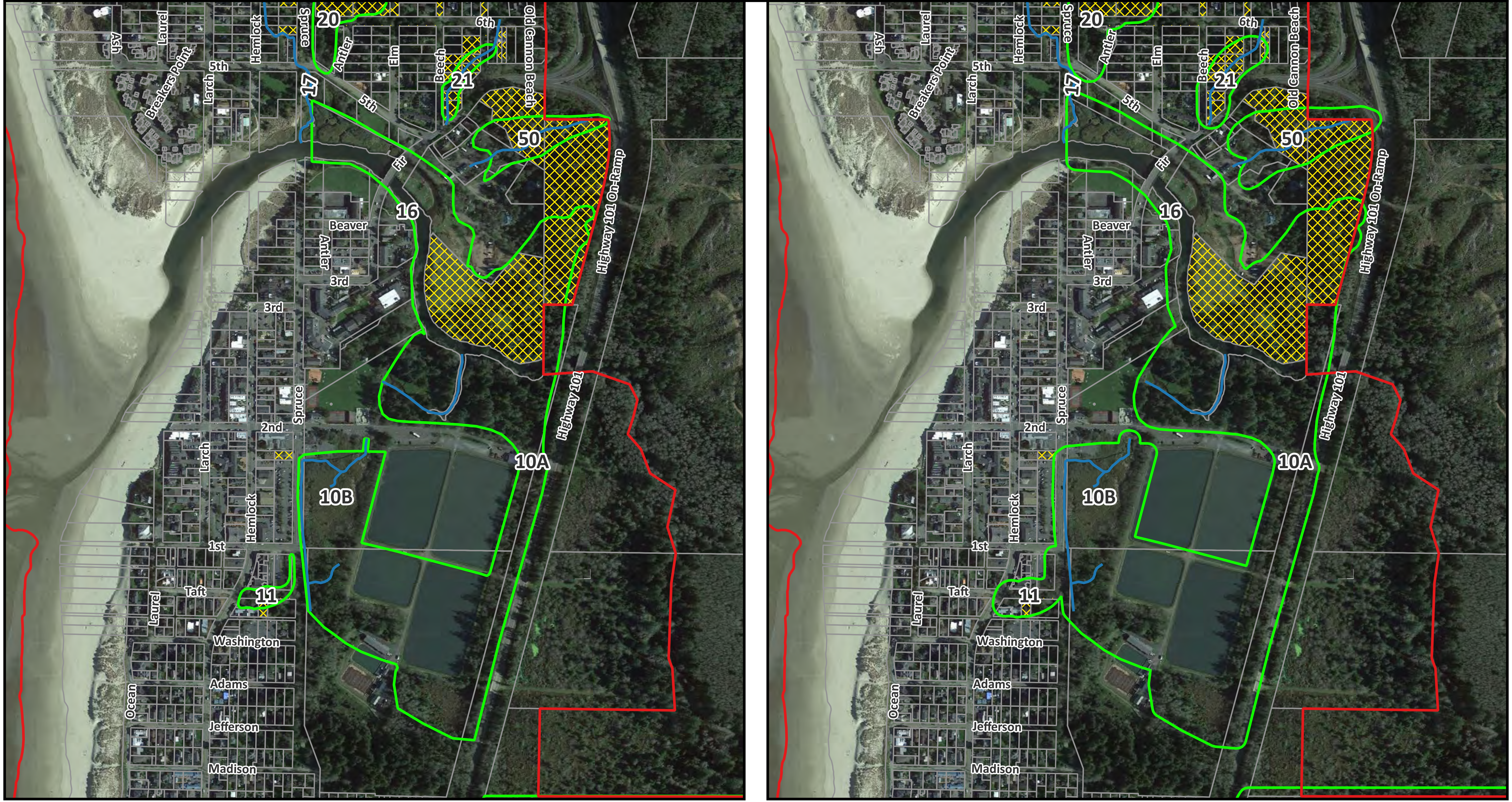


Exhibit A-5

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 18 - Presidentials & Midtown Aerial

Legend

- 🟩 Wetland Buffer Boundary
- — LWI Stream Sites
- ☐ Taxlots
- 🟥 City Limits
- ▨ Vacant Affected Taxlots
- ⋯ Undeveloped ROW

0 250 500 ft

Exhibit A-5

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 19 - Tolovana North Aerial

Legend

- 🟩 Wetland Buffer Boundary
- ― LWI Stream Sites
- ☐ Taxlots
- 🟥 City Limits
- ▨ Vacant Affected Taxlots
- ⋯ Undeveloped ROW

0 250 500 ft

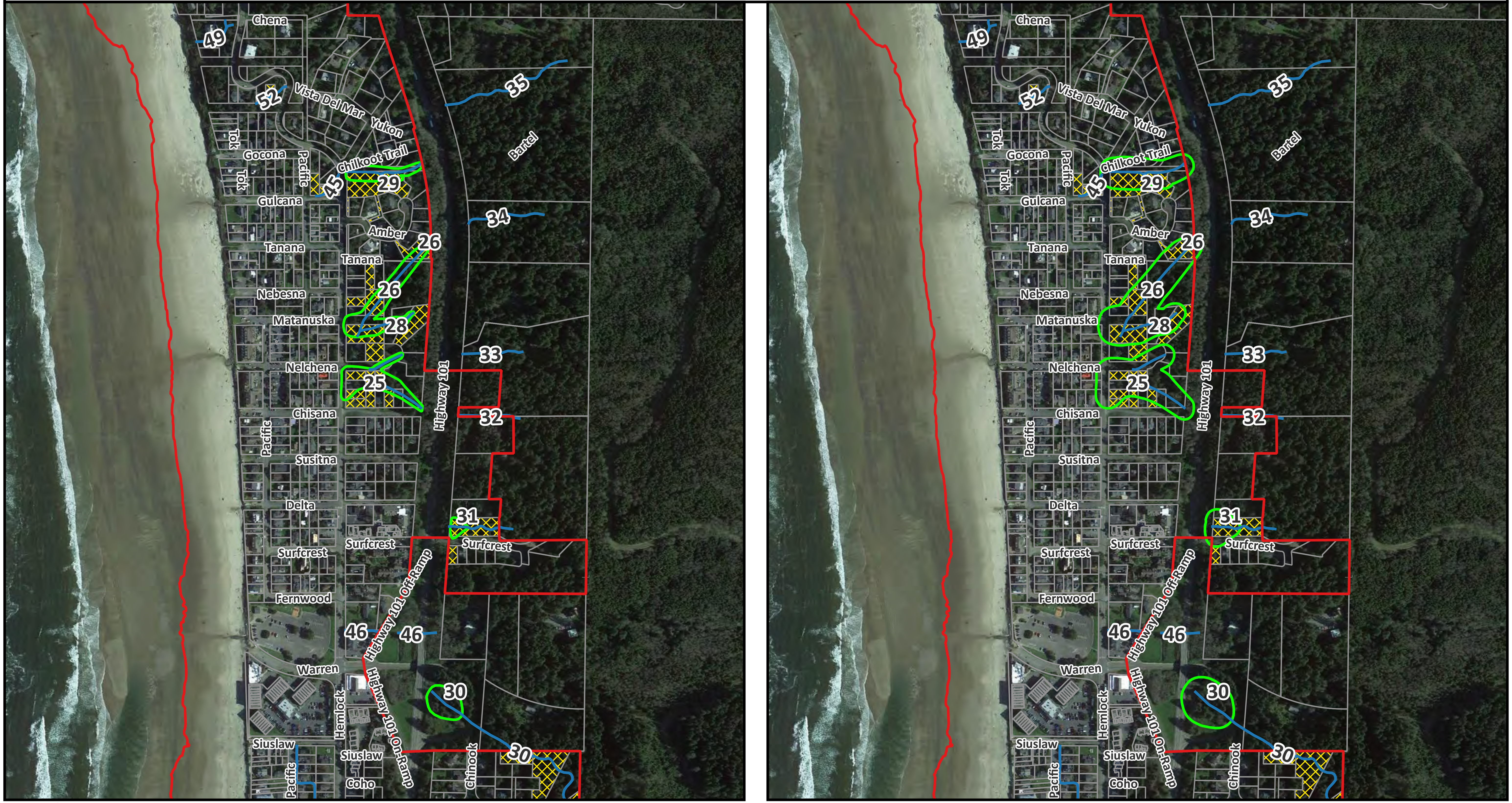


Exhibit A-5

City of Cannon Beach
Proposed Wetland Ordinance Revision
Map 20 - Tolovana South Aerial

Legend

🟩 Wetland Buffer Boundary
LWI Stream Sites
☐ Taxlots
🟥 City Limits
☒ Vacant Affected Taxlots
Undeveloped ROW

0 250 500 ft

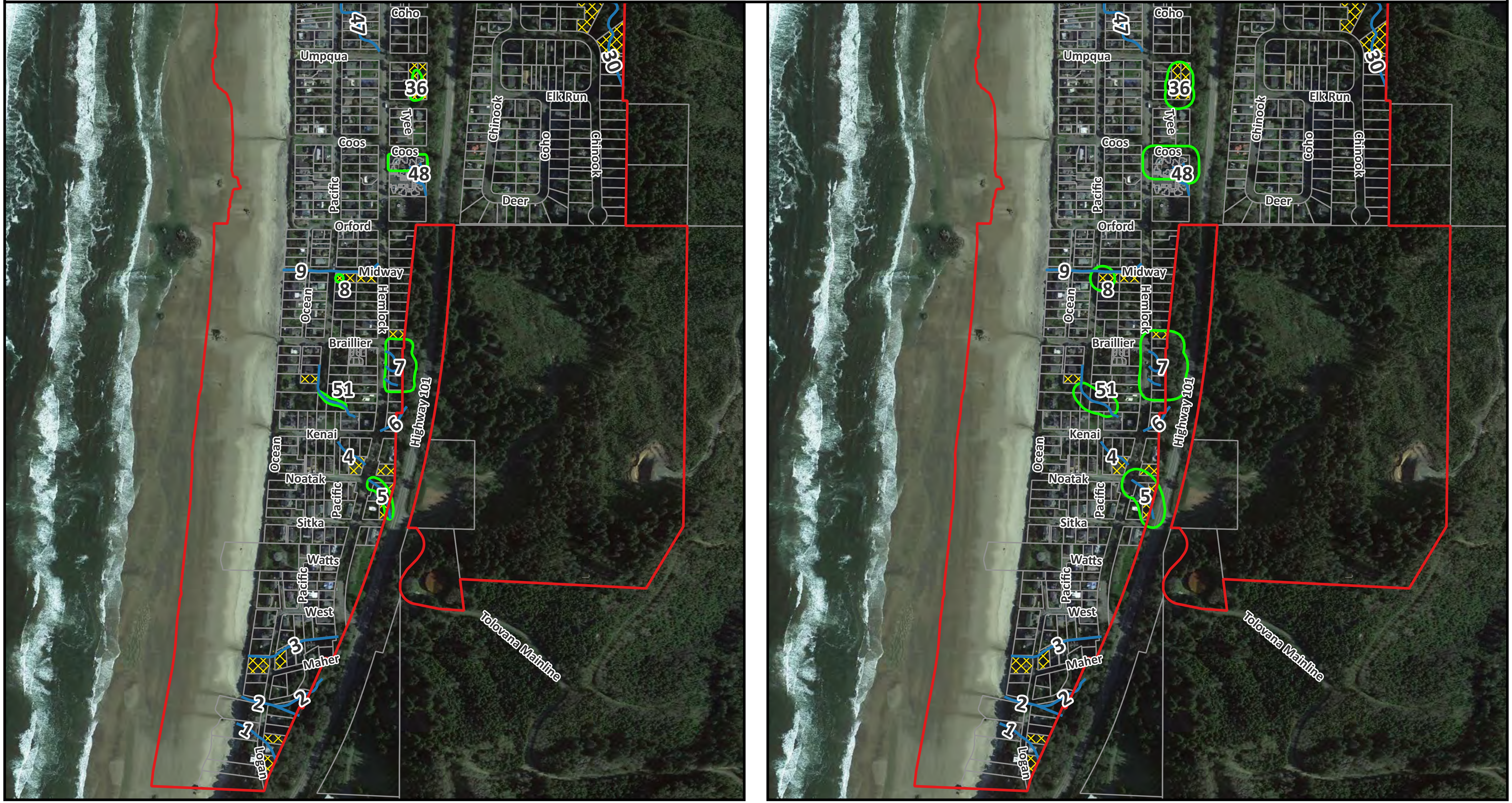


Exhibit B-1

Robert St. Clair

From: PUNTON Amanda * DLCD <Amanda.PUNTON@dlcd.oregon.gov>
Sent: Wednesday, October 4, 2023 3:11 PM
To: Robert St. Clair
Cc: Brett Estes
Subject: Cannon Beach PAPA 002-23, Local # ZO 23-02 - OARs relevant to proposed code amendments

Hi Robert,
If the city will be applying the "safe harbor" protection measures available for locally significant wetlands, there are two rules in OAR chapter 660, division 23 that are relevant to the code amendments being considered. If the city's protection strategy will include wetland buffers, it must be supported by an impact assessment (a.k.a. ESEE analysis), and OAR 660-023-0040 and 0050 also apply. I have included portions of a couple rules along with guidance below.

660-023-0250
Applicability
(1) This division replaces OAR 660, division 16, except with regard to cultural resources, and certain PAPAs and periodic review work tasks described in sections (2) and (4) of this rule. Local governments shall follow the procedures and requirements of this division or OAR 660, division 16, whichever is applicable, in the adoption or amendment of all plan or land use regulations pertaining to Goal 5 resources. The requirements of Goal 5 do not apply to land use decisions made pursuant to acknowledged comprehensive plans and land use regulations.
(2) The requirements of this division are applicable to PAPAs initiated on or after September 1, 1996. OAR 660, division 16 applies to PAPAs initiated prior to September 1, 1996. For purposes of this section "initiated" means that the local government has deemed the PAPA application to be complete.
(3) Local governments are not required to apply Goal 5 in consideration of a PAPA unless the PAPA affects a Goal 5 resource. For purposes of this section, a PAPA would affect a Goal 5 resource only if:
(a) The PAPA creates or amends a resource list or a portion of an acknowledged plan or land use regulation adopted in order to protect a significant Goal 5 resource or to address specific requirements of Goal 5;
(b) The PAPA allows new uses that could be conflicting uses with a particular significant Goal 5 resource site on an acknowledged resource list; or
(c) The PAPA amends an acknowledged UGB and factual information is submitted demonstrating that a resource site, or the impact areas of such a site, is included in the amended UGB area.
(4) Consideration of a PAPA regarding a specific resource site, or regarding a specific provision of a Goal 5 implementing measure, does not require a local government to revise acknowledged inventories or other implementing measures, for the resource site or for other Goal 5 sites, that are not affected by the PAPA, regardless of whether such inventories or provisions were acknowledged under this rule or under OAR 660, division 16.

If the city's code was adopted prior to September 1996, it was reviewed under division 16 and would have included an ESEE analysis. The safe harbor protection path is in division 23.

660-023-0100
Wetlands
(4) For significant wetlands inside UGBs and UUCs, a local government shall:
(a) Complete the Goal 5 process and adopt a program to achieve the goal following the requirements of OAR 660-023-0040 and 660-023-0050; or
(b) Adopt a safe harbor ordinance to protect significant wetlands consistent with this subsection, as follows:
(A) The protection ordinance shall place restrictions on grading, excavation, placement of fill, and vegetation removal other than perimeter mowing and other cutting necessary for hazard prevention; and

Exhibit B-1

(B) The ordinance shall include a variance procedure to consider hardship variances, claims of map error verified by DSL, and reduction or removal of the restrictions under paragraph (A) of this subsection for any lands demonstrated to have been rendered not buildable by application of the ordinance.

(7) All local governments shall adopt land use regulations that require notification of DSL concerning applications for development permits or other land use decisions affecting wetlands on the inventory, as per ORS 227.350 and 215.418, or on the SWI as provided in section (5) of this rule.

The safe harbor provisions severely limit development in locally significant wetlands and don't provide for a wetland buffer. An ESEE analysis must support a local protection program that includes wetland buffers. However, a significant riparian area adopted under the safe harbor inventory provision in OAR 660-023-0090 bumps out around significant wetlands adjacent to rivers and streams. We can talk more about this if you like.
I included OAR 660-0100(7) above, because if the city amends its code, it will need to include information about the city's obligation to submit wetland land use notices to the Department of State Lands.

Please contact me with any questions that arise.

Amanda

Amanda Punton
Natural Resource Specialist | Community Services Division
Oregon Department of Land Conservation and Development
635 Capitol Street NE, Suite 150 | Salem, OR 97301-2540
Cell: 971-718-3245 | Main: 503-373-0050
amanda.punton@dlcd.oregon.gov | www.oregon.gov/LCD

Exhibit C-1

urbsworks

Date 05 September 2023

Subject Cannon Beach Community Development Ordinance (CDO) Rewrite Project

To Steve Sokolowski, Community Development Director, and Code Audit Joint Commission (City Council, Planning Commission, and Design Review Board)

From Urbsworks Team: Keith Liden, AICP, and Marcy McInelly AIA

Copy Bruce St. Denis, City Manager, Robert St. Clair, Planner, City of Cannon Beach; Elizabeth Nelson, MPP (Urbsworks), Ethan Rosenthal, DEA

WETLAND OVERLAY AMENDMENTS (CODE REWRITE PROJECT)

Agenda

City Council Work Session with Planning Commission and Design Review Board (Code Rewrite Joint Commission)

Wednesday, 13 September, 2023 | 6:00 PM | Council Chambers, City Hall

1. Code rewrite task update – Status and schedule (Marcy)
2. Proposed Wetland Overlay amendments (Marcy and team)
    - Overview
    - Discussion of Development Standards

OVERVIEW OF WETLAND OVERLAY AMENDMENTS

Introduction

The city recognizes the environmental value of wetlands, and the Cannon Beach Municipal Code contains wetland regulations in Chapter 17.43 Wetlands Overlay (WO) Zone to protect them. The city formed a citizen committee to review the existing regulations and determine how to improve the existing WO Zone. The committee created a draft, and the Urbsworks team was asked to review the document and make recommendations as to how it might be further improved.

Process

Step 1 - Reorganization

As a first step, the Urbsworks team recommended a reorganization of the WO Zone draft to enhance readability and clarity. A revised outline was reviewed by the committee and city staff and found to be appropriate. The draft text was then reorganized accordingly into the new WO sections without adding or deleting any text.

Step 2 – Preliminary Editing

Following the reorganization, the text was edited primarily to eliminate duplicative language and to identify potential definitions and narrative additions to strengthen the WO chapter. The deletions and additions are shown in the attached discussion draft.

Exhibit C-1

DISCUSSION DRAFT

The discussion draft shows the proposed reorganization, with notes (highlighted) regarding where the text originated in the committee draft or from other portions of the code. New and deleted text are also shown. The resulting reorganization and preliminary editing are summarized below with explanatory notes .?

17.43.010 Purpose

The purpose statement in Section 17.43.010 of the committee draft was retained, and the regulatory portions were relocated elsewhere. The definitions were moved to a new Section 17.43.015.

17.43.015 Definitions

This is a new section.

- Recommend definitions ultimately going to 17.04 as a group of wetland definitions and being eliminating this subsection.
- Definitions for wetland, wetland buffer area, and wetland delineation in the Title 17 definitions section were added here.
- New definitions proposed as noted to clarify permitted activities in 17.43.050.
- May need to modify the wetland definition per Department of State Lands.

17.43.020 Mapping

This section is relatively unchanged, but the following amendments are recommended:

- Clarify relationship between city's LWI and subsequent delineations/determinations. We think that a delineation should modify the city's LWI because it's more current and site-specific. The wording proposed by the committee (and we believe in the current CDO) isn't very clear about what happens to the official city map once better information is available.
- Clarify what's meant in Subsection E. re: protected wetlands.

17.43.030 Applicability

This is a new proposed section to clarify when these regulations apply.

17.43.040 Administration

This is a new section to clarify how WO applications will be administered and reviewed. It assumes that Article II will be revised to include a consolidated description of the four basic review procedures currently used. A recommendation from the Code Audit calls for consolidating all procedural requirements in a new Article II and Type I-IV procedural categories that correspond to the city's current review procedures. For example, a Planning Commission review would be a Type III process.

17.43.050 Development and Activities Permitted

A table is proposed to simplify the narrative in Sections 17.43.030 – 17.43.045. This removes the reference to conditional use and showing most activities as requiring a Type III Planning Commission review. The following should be considered:

- Definitions for the terms highlighted.
- Determine if we have all development/activities covered and if some need to be added.
- Identify any additional types of development or activities that would be appropriate in buffer areas with a Type I or III review. In particular, minor activities in the buffer area, which will be expanded from 5 to 50 feet, may be appropriate for a Type I staff review.

17.43.060 Application Submittal Requirements

This new section is based on the site design review submittal requirements (17.44.050), and it is modified to coincide with a WO application. The stormwater submittal requirements found in subsection J. of the committee draft was moved here. The submittal requirements should be reviewed and modified as appropriate.

17.43.070 Development Standards

This section is from Section 17.43.050 of the committee draft. The list of standards is quite long, and not all standards apply to any one proposal. The Urbsworks team recommends that the standards in this section be reorganized to coincide more closely the location of a development proposal to help focus on the standards that pertain to a specific application. Such a reorganization could include:

- General standards that would apply in all or most cases regardless of location or magnitude.
- Standards for wetland lot-of-record applications.
- Standards for development and activities within wetlands.
- Standards for development and activities within wetland buffer areas only.
- Mitigation requirements.

DISCUSSION: DEVELOPMENT STANDARDS (17.43.070)

While the draft wetland amendments will be submitted for DLCD consideration by the time of the meeting next week, the technical expert team is testing and refining development standards. The timing of the Joint Commission work session provides an opportunity to discuss several key issues, see below.	
Organization of standards	The proposed organization is: × General Standards × Residential/Commercial development and accessory structures × Specific standards × Mitigation
General Standards – Considerations	Consider a general standards section similar to that proposed by the committee, which would apply to development in wetlands, wetland lots-of-record, and buffer areas. Criteria could include demonstrating the applicant has first utilized land outside of the wetland and buffer to the extent practicable, and provision of evidence of any necessary state and/or federal permits, etc.
Residential/Commercial development and accessory structures – Considerations	Distinguish between lot coverage for the entire property versus wetland/buffer because coverage in the latter matters most. Include numerical standards instead of terms like “minimize.” Current code amendments consider gravel to be an impervious surface, yet compacted gravel is regarded by civil engineers as impervious. Are piles always a better solution than fill? Combine sections (B. - D.) based on impact. Note: The stormwater management portion (subsection J.) mixes submittal requirements and standards, and the proposed draft moves the submittal provisions to 17.43.060.

Exhibit C-1

Specific standards – Consider standards and organization based on impact	In the draft code provided in this packet, wetlands and the 50′ buffer are restricted the same way. Consider that, while the buffers logically need to have restrictions to protect the adjoining wetland, restrictions for the buffer area might be more relaxed compared to those for the wetlands. Consider allowances for the different development activities by wetland, wetland lot-of-record, and buffer area with the wetland requirements being the most stringent, lot-of-record allowing only a house (for example), and buffer being more permissive. As a result the development standards chapter would be organized based on a hierarchy of standards based on impact.
Mitigation – Considerations	Consider standards that provide for mitigation as a way to handle development. Consider LIDA techniques (Low Impact Development Approaches).

Exhibit C-1

CHAPTER 17.43 WETLANDS OVERLAY (WO) ZONE

Draft Reorganization 8.20.23

17.43.010 Purpose

The purpose of the wetlands overlay zone is to protect wetland areas identified in the city's comprehensive plan from uses and activities that are inconsistent with the maintenance of the wetland functions and values identified for those sites, which include, but are not limited to, providing food, breeding, nesting and/or rearing habitat for fish and wildlife; recharging and discharging ground water; contributing to stream flow during low flow periods; stabilizing stream banks and shorelines; storing storm and flood waters to reduce flooding and erosion; carbon sequestration; thermal refugia, and improving water quality through biofiltration, adsorption, retention, and transformation of sediments, nutrients, and toxicants. Wetland areas also serve significant community wellness purposes such as mental and emotional well-being and sense of community in nature. (Ord. 94-29 § 2)

Commented [ER1]: I didn't see any mapping of wetlands in the comp plan maps. The only geographically specific wetland references in the comp plan text were to:

- Ecola Creek Management Plan
- area north of Elk Creek Rd on east side of US Hwy 101 (south of Ecola Creek Wetlands)

Comp plan does not reference City's Local Wetland Inventory. Perhaps this code should reference the LWI instead of the comp plan?

LWI available here: https://docs.dsl.state.or.us/PublicReview/0/doc/862663/Electronic.aspx

Commented [ER2]: same comment as previous. It is the LWI that ID'd specific wetlands and assessed functions.

Note functions assessed in LWI (1993) are similar to those listed here but not worded exactly the same as those listed in the code.

Commented [ER3]: Recommend noting that stream corridor protections are covered under Chapter 17.71. This reference is made on pg 9, but would be helpful upfront as well. If estuarine wetlands are covered by separate code chapter, a reference here would be helpful as well, including how this all relates to the Ecola Creek Estuary Plan.

17.43.015 Definitions [from 17.43.010]

Note: It is recommended that all definitions ultimately reside in a common definitions chapter in the CDO (currently proposed as Chapter 17.04 Definitions).

Alternative stormwater practices

"Best management practices" means structural or non-structural measures, practices, techniques, or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to protected wetlands.

"Buffer averaging" means reducing the standard buffer width (i.e., 50 feet) around a wetland in some locations and increasing it in other locations such that the total area within the buffer around a given delineated wetland after averaging remains at least equal to what was required by the standard buffer around that wetland.

Compensatory wetland mitigation

"Contiguous" means lots that have a common boundary and includes lots separated by public streets. [from 17.43.025]

Commented [KL4]: Consider adding this to the definitions, especially if the term is used elsewhere in the CDO. This term could be difficult to apply across streets when the lots are offset/corner to corner.

"Erosion" means the process by which the land's surface is worn away by the action of wind, water, ice or gravity.

"Footprint" refers to the total area under the exterior walls of all structures on a lot.

"Permeable" means surfaces that allow water to pass through whereas "impermeable" means blocking the flow of water through the surface.

Point source stormwater discharge

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"Protected wetlands" are those areas in the wetlands overlay zone that have been identified on the city's inventory or on a subsequent detailed wetland delineation as wetlands.

A "qualified wetland professional" is a person with experience and training in wetlands issues and with experience in performing delineations, analyzing wetland functions and values, analyzing wetland impacts, and recommending wetland mitigation and restoration. Qualifications include:

> A Professional Wetland Scientist certification from the Society of Wetland Scientists; or
>
> B.S. or B.A., or equivalent degree in biology, botany, environmental studies, fisheries, soil science, wildlife, agriculture or related field; two years of related work experience; and minimum of one-year experience delineating wetlands using the Unified Federal Manual and preparing wetland reports and mitigation plans; or
>
> Four years of related work experience and training; minimum of two years' experience delineating wetlands using the Unified Federal Manual and preparing wetland reports, and mitigation plans.

"Rainfall Collection Area" is the drainage system or catchment area upslope of the protected wetland that contributes either surface runoff or shallow subsurface seepage.

"Runoff" means storm water or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.

"Sediment" means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.

"Site" means the entire area included in the legal description of the land on which the land disturbing construction activity is proposed in the permit application.

"Upland" as used in this Chapter is the portion of a wetland lot-of-record that is neither protected wetland nor wetland buffer area.

Utilities, underground or above ground

"Vegetation" as used in this title ~~Chapter~~ shall include all plant and woody matter, including native willows and small diameter trees.

"Wetland" means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (Ord. 94-29 § 1) [from 17.04.566]

"Wetland buffer area" means a 50-foot-wide non-wetland area ~~in the wetlands overlay zone~~ surrounding ~~the~~ a protected wetland~~s~~ within the wetlands overlay zone. (Ord. 94-29 § 1)) [from 17.04.567].

"Wetland delineation" means a site-specific determination of the boundary between uplands and wetlands for a given parcel of land based on field indicators of vegetation, soils and hydrology. The

Commented [ER5]: Is this term just focused on City protections? Perhaps note that Federal and State protections also exist and applicant is responsible for addressing such regulations too (i.e. review by the City does not imply review by Federal or State agencies).

Commented [ER6]: Qualifications listed seem reasonable/fair.

Commented [ER7]: I had not heard of this reference before, and a Google search didn't turn up anything with this exact title. I would recommend replacing with the 1987 Manual and supporting guidance, similar to provided in Section 17.43.020.B.

Commented [ER8]: See previous comment

Commented [ER9]: Is it necessary to specify "…, including native willows and small diameter trees"? It begs the question of are large trees not "vegetation"? What about grasses or non-native vegetation? If this is intended to be a catch all, perhaps define it as "…, all plant matter (e.g., all native and non-native herbaceous, shrub, and tree species of any size or amount)."

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delineation is to be undertaken in accordance with a method acceptable to the US Army Corps of Engineers and the Oregon Division of State Lands. (Ord. 9429 § 1) [from 17.04.568]

Wetland enhancement

“Wetland lot-of-record” is a lot or contiguous lots held in common ownership on August 4, 1993, which are subject to the provisions of this chapter. A wetland lot-of-record includes upland portions of the contiguous property that are not subject to the provisions of the wetlands overlay zone. [from 17.43.025]

“Wetland Overlay Zone” ….

17.43.020 Mapping [from 17.43.020]

A. The maps delineating the wetland overlay (WO) zone boundaries shall be maintained and updated as necessary by the city. The Cannon Beach Local Wetland Inventory (LWI) maps dated September 20, 1994, as well as subsequent updates to the LWI, shall form the basis for the location of wetlands. The WO zone includes both wetland and wetland buffer areas which abut wetlands. ~~The wetland buffer area has a width of fifty feet measured perpendicular to the outer boundaries of the wetland.~~

B. Site-specific wetland delineations or determinations are required to determine the exact location of the WO zone boundary. Wetland determinations and delineations shall be conducted in accordance with the 1987 U.S. Army Corps of Engineers Wetlands Delineation Manual along with any supporting technical or guidance documents issued by the Division of State Lands and applicable guidance issued by the U.S. Army Corps of Engineers for the area in which the wetlands are located.

C. When an expert report or opinion is submitted by an applicant, the permitting authority may seek an independent expert opinion when reviewing the report or opinion. A qualified wetland professional retained or hired by the city under this subsection is expected to render independent expert opinion, consistent with the Society of Wetland Scientists Code of Ethics. [from 17.43.010]

~~C~~D. Where a wetland delineation or determination is prepared, and accepted by the City, the mapping it contains shall replace that of the Cannon Beach Local Wetland Inventory. Wetland delineations or determinations shall remain valid for a period of not more than five years from the date of their acceptance by the Division of State Lands. Any wetland delineation submitted to the City shall be accompanied by an electronic shapefile.

~~D~~E. The continued reliance on a wetland delineation or determination that is more than five years old requires the following additional new information:

1. An onsite re-inspection of the site by a qualified wetland professional to determine if there has been any change in circumstances;

2. If no change in circumstances is found, a short report shall be provided noting or including:

a. A description of site conditions and any changes between the date of the original wetland determination or delineation and the date of the re-inspection,

Commented [ER10]: Add definition and note that it includes both the “wetland’ and the “wetland buffer.” I realize this is noted in the next section, but seeing it in a brief definition with the other terms would be helpful for someone new to the code (like me 😊)

Commented [ER11]: At federal level, jurisdiction over some types of wetlands has fluctuated over the years due to either Supreme Court rulings and/or Presidential Administration interpretations/Executive Orders. The Corps has not regulated “isolated” wetlands for quite some time. Recent Supreme Court ruling may drastically reduce federal authority over many wetland types. DSL at state level tends to be quite consistent over the years, regulates isolated wetlands.

The references to the 1987 manual and other guidance is still appropriate. But it may be worth tying the City’s definition of a jurisdictional “wetland” to DSL’s.

Commented [KL12]: Permitting authority presumably refers to the city. Not using consistent terminology when referring to the city and the approval authority s currently an issue in the CDO.

Commented [KL13]: What does “accepted by the city” mean? The party responsible should be defined. I would recommend that it’s the community development director. Otherwise I could see where the Planning Commission or Design Review Committee would decide they have the authority to pass judgement on a technical document.

Commented [ER14]: Will the City require applicants to submit all delineations for DSL review and concurrence? I didn’t notice this requirement. This is typically not required unless wetland impacts are proposed as opposed to just wetland buffer impacts.

Commented [ER15]: Should specify the file format, coordinate system, datum, units and any attributes the City will require and to assure the mapping can seamlessly be pulled into the City’s GIS system:

For example (City GIS should provide guidance):
File format: ESRI GIS shapefile
Features: Wetland boundary, buffer boundary, stream (ordinary high water) boundary, as polygon features. Narrow features, less than 6ft wide can be provided as line features similar to DSL requirements). Wetland areas converted to buffer via approved permit.
Coordinate/datum: State Plane, Oregon North, NAD83
Units: International feet

Commented [ER16]: Will the applicant be required to submit this to DSL for concurrence renewal? Similar to previous comment, what if only buffer impacts are proposed?

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b. Any additional maps, aerial photographs or other documents consulted, and

c. Conclusions regarding the accuracy of the original wetland delineation or determination;

3. If a change in circumstances is noted, the information in subsection (D)(2) of this section shall be provided along with:

Commented [ER17]: Same as previous comments about need to submit to DSL for approval or not.

a. Additional field data, including wetland determination data in conformance with Division of State Lands standards needed to verify and document any change in the status of the wetland area that were or were not identified and mapped as part of the original delineation or determination,

b. A revised wetland map,

c. Data, documentation, and other information as needed to establish the nature and timing of the activity or activities that resulted in the change in circumstances.

~~E~~F. Protected wetlands that are legally filled under this chapter are no longer protected wetlands, but remain as wetland buffer areas under this overlay zone. Wetland buffer areas that are legally filled under this chapter remain as wetland buffer areas. (Ord. 08-1 § 40; Ord. 94-29 § 2)

Commented [ER18]: Curious what the consequences of this might be. Would an applicant need to submit for review any activity on a permitted developed area?

Commented [KL19R18]: I'm puzzled about this as well. Not sure what's intended.

Commented [ER20]: Should this be changed to "…but change to wetland buffer areas…"

17.43.030 Applicability

The regulations of this chapter apply to the portions of all properties that contain wetlands or wetland buffer areas as shown on the city maps or as described in a wetland delineation or determination as described in Section 17.43.020.

17.43.040 Administration

Activities permitted outright according to Table 17.43-1 shall be reviewed as a Type I city manager decision as provided in Article II.

All other development or activities within the Wetlands Overlay Zone shall be reviewed as a Type III Planning Commission decision as provided in Article II.

17.43.050 Development and Activities Permitted

A. Uses and activities listed in Table 17.43-1 may be permitted in wetlands and wetland buffer areas, subject to the issuance of a development permit in accordance with the provisions of this title and the applicable standards in Section 17.43.070.

B. Uses and activities in wetland and wetland buffers are prohibited unless specifically permitted in Table 17.43-1. Specific prohibition of any activity in this Chapter is not intended as authorization to engage in activity not specifically prohibited. Conflicts between this Chapter and any other provision of the Cannon Beach municipal code shall be resolved in favor of this Chapter. [from 17.43.010]

Commented [ER21]: How closely has this statement been vetted? Just concerned it could have unintended consequences. For example, should wetland rules override public safety issues such as provision of effective tsunami evacuation routes or fire service access, City water supply planning, etc.

C ~~D~~. Uses and activities in existence approved by a permitting authority before the effective date this Chapter 17.43, [to be specified on the date of ratification] (hereinafter referred to for purposes of this

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Chapter as the Effective Date), and which may not conform with the permitted or conditional uses set forth herein may qualify as a “nonconforming use” as provided ~~defined~~ in Chapter 17.82 ~~if they meet the requirements of Chapter 17.82 as of the Effective Date~~. [from 17.43.010]

~~A lot-of-record is subject to the provisions of this overlay zone if all or a portion of the lot is in the overlay zone.~~ [from 17.43.025 – propose deleting]

Commented [ER22]: Should this say “wetland lot-of-record”?

Table 17.43-1 Permitted Development and Activities within the WO Zone

Development or Activity	Wetland	Wetland Lot-of-Record	Wetland Buffer
Vegetation management only to the extent necessary for hazard prevention	I	I	I
Structures	III	III (1 max)	III
Wetland enhancement	III	III	III
Compensatory wetland mitigation	III	III	III
Driveways	III	III	III
Pedestrian/bike pathways	III	III	III
Point source stormwater discharge	III	III	III
Alternative stormwater practices	III	III	III
Underground or above ground utilities	III	III	III

I – Permitted subject to Type I review and approval
III – Subject to Type III review and approval

~~17.43.060 Development and Activities Permitted in Wetlands~~

~~The following development and activities may be permitted in the wetlands portion of the WO zone, subject to the issuance of a development permit in accordance with Section 17.92.010, and subject to applicable standards, and if permitted outright in the base zone:;~~

~~A. Vegetation management only to the extent necessary for hazard prevention. (Ord. 21-05 § 2; Ord. 94-29 § 2) (from 17.43.030 permitted in wetlands)~~

~~17.43.040 Conditional uses and activities permitted in wetlands.~~

~~The following uses and activities may be permitted subject to the provision of Chapter 17.80 in the wetland portion of the WO zone, subject to applicable standards, if permitted outright or conditionally in the base zone:~~

~~A. Subject to the requirements of 17.43.025, a commercial structure, residential structure, modular housing, or manufactured home meeting the standards of Section 17.68.020, limited to one structure on a wetland lot-of-record;~~

Commented [KL23]: This doesn’t seem to be a good way to limit development. I would recommend some other measure that gets at all types of development, such as total building footprint, impervious surface, etc. Depending on the circumstances two smaller buildings may be a better fit than one larger one.

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~~B. Wetland enhancement;~~

~~C. Compensatory mitigation;~~

~~D. Driveways;~~

~~E. Footpaths;~~

~~F. Point-source stormwater discharge;~~

~~G. Alternative stormwater management practices;~~

Commented [KL24]: What does this mean? Should be defined above.

~~H. Underground or above-ground utilities.~~ (~~from 17.43.040 CU permitted in wetlands~~)

~~17.43.070 Development and Activities Permitted in Wetland Buffer Areas~~

~~The following uses and activities may be permitted in wetland buffer areas of the WO zone, subject to the issuance of a development permit in accordance with Section 17.92.010, and subject to applicable standards, and if permitted outright in the base zone:~~

~~A. Vegetation management only to the extent necessary for hazard prevention. (Ord. 21-05 § 2; Ord. 94-29 § 2)~~

~~17.43.045 Conditional uses and activities permitted in wetland buffer areas.~~

~~The following uses and activities may be permitted subject to the provision of Chapter 17.80 in wetland buffer areas in the WO zone, subject to applicable standards, if permitted outright or conditionally in the base zone:~~

~~A. Subject to the requirements of 17.43.025, a commercial structure, residential structure, modular housing, or manufactured home meeting the standards of Section 17.68.020, limited to one structure on a wetland lot-of-record;~~

~~B. Accessory structure or building as provided for by Section 17.54.030;~~

~~C. Wetland enhancement;~~

~~D. Compensatory mitigation;s~~

~~E. Driveways;~~

~~F. Bicycle paths;~~

~~G. Footpaths;~~

~~H. Point-source stormwater discharge;~~

~~I. Alternative stormwater practices;~~

~~J. Underground or above-ground utilities. [from 17.43.045 CU permitted in buffers]~~

17.43.060 Application Submittal Requirements

Note: this is based on 17.44.050 Design Review Plan submittal requirements with irrelevant requirements deleted).

A. Information Requirements. Information provided on the ~~design review~~ development plan shall conform to the following:

1. Drawings depicting the proposal shall be presented on sheets not larger than twenty-four inches by thirty-six inches in the number of copies directed by the city;

2. Drawings shall be at a scale sufficiently large enough to enable all features of the design to be clearly discerned.

B. Site Analysis Diagram. This element of the design review plan, which may be in a freehand form to scale, shall indicate the following site characteristics:

1. A survey of the property by a licensed land surveyor clearly delineating property boundaries. The city may waive this requirement where there is a recent survey which can be used to establish the applicant's property boundaries;

2. Location of the wetland boundary and wetland buffer area;

3. Location and species of trees greater than six inches in diameter when measured four and one-half feet above the natural grade, and an indication of which trees are to be removed or potentially affected by construction activity on the subject property and abutting properties ;

4. On sites that contain steep slopes, potential geologic hazard or unique natural features that may affect the proposed development, the city may require contours mapped at two-foot intervals;

5. Natural drainageways and other significant natural features;

6. All buildings, roads, retaining walls, curb cuts and other manmade features on the subject property;

7. Developed and natural features, including trees, wetlands, structures, and impervious surfaces on adjoining property having a visual or other significant relationship with the site; and

8. The location and names of all existing streets within or on the boundary of the proposed development.

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C. Site Photographs. Photographs depicting the site and its relationship to adjoining sites and natural features shall also be provided.

D. Site Development Plan. This element of the ~~design review~~ development plan shall indicate the following:

~~1. Legal description of the lot;~~

1. Boundary dimensions and area of the site.

2. Location of all ~~new structures, and~~ existing structures, driveways, walkways, and landscaped areas proposed to be retained, including their site coverage and distances from the property line, and wetland and wetland buffer area boundaries;

3. Location of all new structures~~, and existing structures~~, driveways, walkways, and landscaped areas proposed to be retained, including their site coverage and distances from the property line, and wetland and wetland buffer area boundaries;

4. All external dimensions of existing and proposed buildings and structures;

~~6. The location of a building's windows, doors, entrances and exits;~~

5. Existing and proposed parking and vehicular and pedestrian circulation areas, including their dimensions;

6. Existing and proposed service areas for such uses as the loading and delivery of goods;

7. Locations, descriptions and dimensions of easements;

9. Grading and drainage plans, including spot elevations and contours ~~at close enough intervals to easily convey their meaning~~;

10. Location of areas to be landscaped or retained in their natural state;

~~12. Private and shared outdoor recreation areas;~~

~~13. Pedestrian circulation;~~

~~14. The location of mechanical equipment, garbage disposal areas, utility appurtenances and similar structures;~~

11. Exterior lighting including the type, intensity, height above grade and area to be illuminated;

12. Other site elements which will assist in the evaluation of the application ~~site development~~;

~~19. The location and names of all existing streets within or on the boundary of the proposed development;~~

~~13. A written summary showing the following:~~

~~a. For commercial and nonresidential development:~~

~~I. The square footage contained in the area proposed to be developed,~~

~~II. The percentage of the lot covered by structures,~~

~~III. The percentage of the lot covered by parking areas and the total number of parking spaces,~~

~~IV. The total square footage of all landscaped areas including the percentage consisting of natural materials and the percentage consisting of hard-surfaced areas such as courtyards,~~

E. Landscape Plan. Development proposals with a total project cost exceeding two hundred fifty thousand dollars shall have the landscape plan prepared by a licensed landscape architect or licensed landscape contractor. This element of the ~~design review~~ development plan ~~should~~ shall indicate the following:

1. The size, species and locations of plant materials to be retained or placed on the site;

2. The layout of proposed irrigation facilities;

3. The location and design details of walkways, plazas, courtyards and similar seating areas, including related street furniture and permanent outdoor equipment including sculpture;

4. The location, type and intensity of lighting proposed to illuminate outdoor areas;

5. The location and design details of proposed fencing, retaining walls and trash collection areas; and

F. A stormwater management plan shall be required of the applicant and reviewed and approved by the public works director for the following types of developments where stormwater will move from the site into protected wetlands:

1. New building covering more than two hundred square feet; or

2. New addition covering more than two hundred square feet; or

3. New road or driveway; or

4. Road or driveway expansion; or

5. New parking lot or parking lot expansion; or

6. Point source stormwater discharge; or

7. Diversion of stormwater for any reason within the protected wetland or wetland buffer.

8. A **stormwater management plan must include all information necessary to demonstrate to the public works director** that the proposed stormwater management system will maintain pre-construction activity, or background, water quality and similar flow characteristics (e.g., volume, velocity, and duration) and be consistent with the standards of this Chapter. The stormwater management plan shall provide the following in addition to any information requested by the public works director:

Commented [ER25]: "All information necessary" is very open ended. I think most applicants and their consultants would generally prefer something a little more specific. For example, if stormwater modeling is required, what model and what criteria should be used?

We can have a follow on this with a DEA Water Resource Engineer. We could point the team to the CWS stormwater manual or similar.

a. Property description

b. Site map or maps, drawing or specifications detailing the design, route, and location of the stormwater management system.

c. A map or model of drainage patterns and stormwater flow before and after the development or activity; impacts to water quality in the wetland, changes to water quantity and timing that may adversely affect wetland function (e.g., affects of rapidly fluctuating water levels on amphibian egg masses, scour impacts to vegetation) and potential for sediment deposition into the wetland or wetland buffer.

d. Best management practices and methods of treatment that will maintain or improve background levels of water quality, which includes but is not limited to: dissolved oxygen levels; pH; temperature; total dissolved solids; and contaminants. [from 17.43.050 J. Standards]

G. Narrative addressing the relevant standards in Section 17.43.070.

~~I. Property Survey.~~

~~1. A survey of the property by a licensed land surveyor clearly delineating property boundaries. The city may waive this requirement where there is a recent survey which can be used to establish the applicant's property boundaries;~~

~~2. Prior to the design review board meeting, the applicant will have clearly marked the corners of proposed buildings and other significant features proposed for the site. (Ord. 19-3 § 1; Ord. 14-6 § 2; Ord. 97-28 §~~

17.43.070 Development Standards [all from 17.43.050 stds. with lot of record standards at the end]

The following standards are applicable to the uses and activities listed in Section 17.43.050. The uses and activities are also subject to the standards of the base zone. The following standards are applicable in all areas under the wetlands overlay zone.

Commented [KL26]: List this as one of the criteria below instead of being embedded in this introductory statement.

Need to include remainder of wetland lot-of-record requirements here.

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A. General Standards. Uses and activities in protected wetlands and in wetland buffer areas are subject to the following general standards. Development may also be subject to specific standards in subsequent subsections.

1. Uses and activities in protected wetlands or wetland buffer areas may be approved only after the following list of alternative actions, listed from highest to lowest priority, have been considered:

a. Avoiding the impact altogether by not taking a certain action or parts of an action (this would include, for example, having the use or activity occur entirely on uplands); and

b. Minimizing impacts by limiting the degree or magnitude of action and its implementation (this would include, for example, reducing the size of the structure or improvement so that protected wetlands or wetland buffer areas are not impacted).

2. Where a use or activity can be located in either the protected wetland or the wetland buffer, preference shall be given to the location of the use or activity in the wetland buffer.

3. Valid permits from the US Army Corps of Engineers and from the Oregon Division of State Lands, or written proof of exemption from these permit programs, must be obtained before any of the following activities occur in protected wetlands:

Commented [ER27]: This section may address my previous comments, but may still be worth reviewing them.

a. Placement of fill (any amount);

b. Construction of any pile-support structure;

c. Excavation (any amount);

d. Compensatory mitigation;

e. Wetland restoration;

f. Wetland enhancement.

4. Where a wetland was (is) identified by the Cannon Beach wetland study as riverine, uses and activities are also subject to the requirements of Chapter 17.71, stream corridor protection.

Commented [ER28]: Riverine mapped wetlands are often just referring to streams. They can also include wetlands that receive flood water from the stream, but often times it is literally just the mapping of a stream channel. Would the 50 ft wetland buffer apply to all stream channels or just if there is a delineated wetland?

5. **Pile-supported construction** may use wood piling (treated or untreated), steel piling, concrete piling, or other piling material meeting building code requirements. If treated wood piling or posts are used for structures in protected wetlands, the following standards are applicable:

a. Treated wood shall be completely dry;

b. Treated wood shall not have any wet wood preservative on the wood surface; and

c. The type of chemical treatment chosen shall be the type that minimize possible contamination of the wetland environment.

6. Except as permitted for enhancement and mitigation, **fill and removal** are prohibited in protected wetland or wetland buffer areas. In cases of enhancement and mitigation, removal and fill may be allowed if approved by application to the Planning Commission, subject to the following standards:

a. All fill material shall be clean and free of contaminants;

b. Filled area sides shall be finished to a stable slope;

c. Measures shall be incorporated into the fill design to minimize erosion or sloughing of fill material into protected wetlands;

d. Fills shall be designed in a manner that does not worsen flooding on adjacent or nearby flood-prone lands, and avoids restricting the flow of water to or through protected wetlands; and

e. Fill side slopes shall be revegetated with native plant species to stabilize the slope.

Commented [ER29]: As written here, native species could simply mean a native erosion control seed mix. Is there a desire to create a forested or other more natural habitat condition? If yes, then should specify.

7. **Draining, diverting water** from, or reconfiguring the dimensions of a wetland to create upland is prohibited.

B. **Residential Development**. Where and when allowed, a residential structure, modular housing, or manufactured home may be permitted in a protected wetland or wetland buffer area subject to the following standards:

1. New dwellings and accessory structures, when permitted, shall be placed on piling or on posts, and shall be cantilevered, in a manner that allows the free flow of water beneath the structure. No fill material may be used for the residence.

2. Building coverage will be minimized in accordance with Section 17.43.025.

3. Driveways, utilities, landscaping, garages, accessory structures and other uses and activities accessory to a residence shall comply with applicable standards.

4. **Driveways, off-street parking, and other surfaces** including but not limited to patios and walkways in the WO zone shall be constructed of permeable materials.

5. For the purposes of calculating floor area ratio, the size of the lot shall be considered the upland portion only, i.e., the area of the lot that is neither wetland nor wetland buffer area.

6. To avoid harm to wetlands and wetland buffers from excessive traffic and frequent visitors who are unaware of wetland protections, **short term rentals** are prohibited in structures within the wetland overlay zone where any portion of the building or surrounding developed area such as patios, driveways, and walkways are within the wetland overlay zone. This prohibition applies to the wetland overlay zone as defined prior to adjustments permitted under section 17.43.025.

Commented [ER30]: Not my area of expertise, but this sounds problematic and is very specific. Are there similar restrictions on hotels, or are those considered short term rental too?

Perhaps reword to require short term rentals to provide protection signage and/or educational materials about wetland protection.

Commented [KL31R30]: Agree

C. **Commercial Development**. Where and when allowed by the base zone, a commercial building may be permitted in a protected wetland or wetland buffer area subject to the following standards:

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1. New commercial buildings shall be placed on piling or on posts in a manner that allows the free flow of water beneath the structure. No fill material may be used for commercial buildings in wetland buffer areas.

2. Lot coverage will be minimized in accordance with Section 17.43.025. Commercial development in protected wetlands or in wetland buffer areas is subject to site design review pursuant to Chapter 17.44.

3. Driveways, parking, utilities, landscaping, accessory structures and other uses and activities accessory to a commercial development shall comply with applicable standards.

D. **Accessory Structure or Building**. Buildings and structures subordinate to the principal structure may be permitted in wetland buffer areas subject to these standards, and subject to the requirements of the base zone:

1. New accessory structures or buildings shall be placed on piling or on posts in a manner that allows the free flow of water beneath the structure. No fill material may be used for an accessory structure or building in a protected wetland or in a wetland buffer area.

E. **Driveways**. Driveways through protected wetlands or wetland buffer areas may be permitted subject to the following standards:

1. Driveways crossing protected wetlands or wetland buffer areas shall be no wider than twenty feet, regardless of the length of frontage facing the right-of-way.

2. Driveways in protected wetlands shall be placed on piling in a manner that allows the free flow of water beneath the driveway. Pile-supported construction is required instead of fill for driveways. Water circulation shall be facilitated through use of culverts or bridges.

3. Driveways and off-street parking in wetland buffer areas may be placed on piling or constructed of gravel, whichever is deemed least impactful by a qualified wetland professional.

F. **Utilities**. Electric power lines, telephone lines, cable television lines, water lines, wastewater collection lines and natural gas lines may be permitted in protected wetlands and in wetland buffer areas subject to these standards, and subject to the requirements of the base zone:

1. **Underground utilities**, including water, wastewater, electricity, cable television, telephone and natural gas service, may be routed through wetland buffer areas in trenches provided the following standards are met:

a. Material removed from the trench is either returned to the trench as back-fill within a reasonable period of time, or, if other material is to be used to back-fill the trench, excess material shall be immediately removed from the protected wetland area. Side-casting into a protected wetland for disposal of material is not permitted;

b. Topsoil and sod shall be conserved during trench construction or maintenance, and replaced on the top of the trench;

Commented [KL32]: This appears to conflict with 17.43.040 and 045 which says only one building allowed (that I don't agree with).

Commented [KL33]: With all the concern about wetland protection, this seems pretty wide. Perhaps this could be added to the section allowing reduction of other standards including building setbacks.

Commented [ER34]: Is zero fill allowed in the wetland or buffer, or is some fill allowed in conjunction with a culvert or bridge to manage overall costs while still providing water circulation?

Commented [ER35]: Least impactful to just the wetland, the buffer, or both?

Commented [ER36]: Recommend specifying a minimum depth of top soil to be applied. I think 2 feet may be typical. Might also want to recommend that top soil dominated by non-native invasive vegetation (per ODA Noxious Weed List) be replaced with clean top soil. All areas of disturbed ground shall be replanted with a native plant community that minimizes conflicts with the associated utility (e.g., shallow rooted vegetation above gas lines, no tall trees below powerlines).

c. The ground elevation shall not be altered as a result of utility trench construction or maintenance. Finish elevation shall be the same as starting elevation; and

d. Routes for new utility trenches shall be selected to minimize hydraulic impacts on protected wetlands, and to minimize vegetation removal.

2. **Aboveground utilities**, including electricity, cable television and telephone service, may be routed through wetland areas on poles subject to the following standards:

a. Routes for new utility corridors shall be selected to minimize adverse impacts on the wetland, and to minimize vegetation removal; and

b. Vegetation management for utility corridors in protected wetlands and in wetland buffer areas shall be conducted according to the best management practices to assure maintenance of water quality, and subject to the vegetation management standards herein.

3. **Utility maintenance roads** in protected wetlands and in wetland buffer areas must meet applicable standards for roads in wetlands.

4. **Common trenches**, to the extent allowed by the building code, are encouraged as a way to minimize ground disturbance when installing utilities.

5. Underground utilities shall be routed under disturbed areas such as driveways and off-street parking areas whenever feasible. When utilities are routed under driveways and off-street parking areas, the surface shall be gravel to facilitate location and repair in the event of damage to the utility lines.

G. **Footpaths and Bicycle Paths**. Development of new footpaths, and maintenance of existing footpaths may be permitted in protected wetlands and in wetland buffer areas subject to the use restrictions in the zone and the following standards. Development of new bicycle paths may be permitted in wetland buffer areas.

1. Footpaths across protected wetlands may only be developed or maintained without the use of fill material. Bridges shall be used to cross open water areas.

2. Footpaths in protected wetlands shall not restrict the movement of water.

3. Routes for new footpaths shall be chosen to avoid traversing protected wetlands. Footpaths around the perimeter of protected wetlands, and in wetland buffer areas, are preferred.

4. Routes for new **bicycle paths** shall not be located in protected wetlands but may be located in wetland buffer areas.

5. Footpaths and bicycle paths within protected wetlands and wetland buffers shall be constructed of permeable material.

H. **Wetland Enhancement**. Efforts to enhance wetland values include removal of nonnative vegetation from a wetland, planting native wetland plant species, excavation to deepen wetland areas,

Commented [KL37]: Section reference?

Commented [ER38]: Veering beyond my area of expertise, but this seems like it could cause more harm than good. Gravel will be frequently run over by vehicles, be displaced, broken down and lead to fine sediments that could then wash into the wetland or stream. It will need to be replaced from time to time too, resulting in more maintenance cost to the property owner or utility. Also seems like the edge of the adjacent pavement could begin to deteriorate quicker. The frequency of repairs by the utility company on the other hand seems like it would be fairly minimal.

Commented [KL39]: Just curious. Why would bicycle paths be singled out and driveways allowed under more circumstances?

Commented [ER40]: It might be helpful to define "footpath". Is this any informal path or one that would typically require development review of some sort? Would the path typically have to meet ADA requirements and if so, then ADA considerations should be incorporated into the allowances below.

Commented [ER41]: "…wetlands, unless it is shown to be less impactful to the wetland (area and functions) than alternate routes or would conflict with ADA requirements."

Commented [ER42]: I don't know that this is always the case, and some jurisdictions specify a perpendicular crossing of the wetland and buffer since it will be the shortest distance (smallest footprint). But perhaps my addition above provides appropriate flexibility if needed.

Some jurisdictions do note that if the trail cannot avoid the buffer then placing it in the outer edge of the buffer is preferrable, with allowance for a spur trail to a viewing area.

placement of bird nesting or roosting structures, fish habitat enhancements, hydraulic changes designed to improve wetland hydrology, removal of fill material, adding new culverts under existing fill, and similar acceptable activities. Wetland enhancement **may be permitted** in protected wetlands and in wetland buffer areas subject to the use restrictions in the applicable zone, and subject to these standards:

1. An enhancement plan must be prepared by a qualified wetland professional before an enhancement project can proceed. The plan must describe the proposal; identify the wetland value or values to be enhanced; identify a goal or goals for the project; and describe evaluation techniques to be used to measure progress toward project goals. The project must follow the approved plan.

2. All components of the enhancement plan (planning, design, construction, cleanup, maintenance, monitoring, and remedial activity) must comply with applicable standards in this section.

I. **Excavation.** Excavation in protected wetlands and in wetland buffer areas for any purpose must meet the following standards:

1. Excavation for purposes of gravel, aggregate, sand or mineral extraction is not permitted.

2. Excavation for utility trenches in wetland buffer areas is subject to the following standards:

a. Material removed from the trench is either returned to the trench (back-fill), or removed from the wetland area. Side-casting into a protected wetland for disposal of material is not permitted;

b. Topsoil shall be conserved during trench construction or maintenance, and replaced on the top of the trench; and

c. The ground elevation shall not be altered as a result of utility trench construction or maintenance. Finish elevation shall be the same as starting elevation.

3. Excavation for building footings in protected wetlands is subject to the following standards:

a. Material removed for approved footings is either returned to the trench (back-fill), or removed from the protected wetland or wetland buffer area. Side-casting for disposal of material is not permitted;

b. Disturbance of wetland vegetation and topsoil during footing construction shall be minimized; and

c. The ground elevation around a footing shall not be altered as a result of excavation for the footing, unless required to meet building code requirements for positive drainage. Finish elevation shall be generally the same as starting elevation.

4. Excavation for wetland enhancement is subject to the following standards:

a. No more material than necessary and specified in the enhancement plan shall be excavated; and

Commented [ER43]: Would this apply to a property owner that just wants to plant some native plants in the buffer in their backyard? It seems excessive for them to have to hire someone for that and provide a lot of paperwork to the City. A voluntary program, perhaps with the local watershed council, would likely yield greater participation for such simple activities.

Commented [KL44R43]: Agree

Commented [ER45]: These don't seem like they belong in the Wetland Enhancement section. Seems like they belong under the allowed uses section and in the case of utilities I think this was already included.

This section should instead provide the details of what must be complied with as referred to in 2. above (yellow highlighted)

b. Side-casting for disposal of excavated material is not permitted; however, excavated material may be placed in a protected wetland or wetland buffer area for enhancement purposes as specified in the enhancement plan.

J. **Stormwater Management**. Management of stormwater flowing into protected wetlands or wetland buffer areas is subject to the following standards:

1. The City recognizes that stormwater is an important component of wetland hydrology, and it shall regulate flow of stormwater into or out of protected wetlands and wetland buffers to ensure no net loss of wetland functions and values. It is the policy of the City that all stormwater that would naturally flow into protected wetlands and wetland buffers shall continue to flow into protected wetlands and wetland buffers in accordance with this Chapter. Uses and activities intended to remove storm water away from or around protected wetlands and wetland buffers or to move storm water within a protected wetland or wetland buffer are prohibited unless undertaken as part of an approved wetland mitigation or enhancement plan.

2. A stormwater management plan shall be required of the applicant and reviewed and approved by the public works director for the following types of developments where stormwater will move from the site into protected wetlands:

a. New building covering more than two hundred square feet; or

b. New addition covering more than two hundred square feet; or

c. New road or driveway; or

d. Road or driveway expansion; or

e. New parking lot or parking lot expansion; or

f. Point source stormwater discharge; or

g. Diversion of stormwater for any reason within the protected wetland or wetland buffer.

3. A **stormwater management plan must include all information necessary to demonstrate to the public works director** that the proposed stormwater management system will maintain pre-construction activity, or background, water quality and similar flow characteristics (e.g., volume, velocity, and duration) and be consistent with the standards of this Chapter. The stormwater management plan shall provide the following in addition to any information requested by the public works director:

a. Property description

b. Site map or maps, drawing or specifications detailing the design, route, and location of the stormwater management system.

Commented [ER46]: "All information necessary" is very open ended. I think most applicants and their consultants would generally prefer something a little more specific. For example, if stormwater modeling is required, what model and what criteria should be used?

We can have a follow on this with a DEA Water Resource Engineer. We could point the team to the CWS stormwater manual or similar.

c. A map or model of drainage patterns and stormwater flow before and after the development or activity; impacts to water quality in the wetland, changes to water quantity and timing that may adversely affect wetland function (e.g., affects of rapidly fluctuating water levels on amphibian egg masses, scour impacts to vegetation) and potential for sediment deposition into the wetland or wetland buffer.

d. Best management practices and methods of treatment that will maintain or improve background levels of water quality, which includes but is not limited to: dissolved oxygen levels; pH; temperature; total dissolved solids; and contaminants.

e. An agreement to be recorded on the title obligating any owner of the property to remove contaminants from stormwater flowing from anywhere on the wetland lot-of-record into the protected wetland or wetland buffer, including a description of the plans to maintain methods used by the applicant to remove contaminants per section 17.43.050(J)(4)..

Commented [ER47]: Far from my area of expertise, but seems like this should have review by another attorney and/or real estate expert.

4. Standards

a. Stormwater runoff should be directed toward the same drainage system that would have handled the runoff under natural conditions. Where the public works director determines that stormwater volumes are or will be significant, stormwater management systems must disperse and potentially delay stormwater rather than discharging it at a single point.

b. Stormwater flowing onto protected wetlands and wetland buffers from any use or activity permitted under this Chapter 17.43 shall be treated to remove contaminants and sediment. There shall be a preference for passive methods of stormwater management, which may include but are not limited to: bioretention and rain gardens; vegetated swales, buffers and strips; roof leader disconnection; and impervious surface reduction and disconnection.

c. Where the use or activity involves point source water discharge, new or modification of an existing road or parking lot, one or more active methods shall be employed including but are not limited to: catch basins and catch basin inserts; hydrodynamic separators; media filters; and advanced water treatment.

K. **Mitigation**. All projects involving development, removal or fill in a protected wetland must meet the following standards. These standards are intended to help meet the city's goal of no net loss of wetland functions or values.

Commented [ER48]: Mitigation as used in this section is somewhat different than as used by DSL and Corps. Perhaps refer to this as Impact Avoidance and Minimization Measures and save Mitigation specifically for offsetting permanent impacts.

1. Construction management practices will be employed in protected wetlands, wetland buffer areas, and the upland portion of a wetland-lot-of-record that address impacts to wetland values and function. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with construction waste or debris, unnecessary or excessive vegetation removal or damage. At a minimum, erosion fencing shall be installed around protected wetlands and wetland buffers. Construction equipment shall be kept out of protected wetlands and wetland buffers unless required for an approved use and signs posted at appropriate intervals intended to restrict entry by equipment or personnel. Construction debris shall be removed from the site and properly disposed of. Chemicals, paints, and solvents, including paint tools, masonry equipment, and drywall tools, shall be used, cleaned, and stored in a manner that does not degrade water quality. Any and all washdown of concrete

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trucks shall occur offsite. The Planning Commission shall require preparation of a detailed management program indicating how these requirements are to be addressed. **(when? With application or condition?)**

2. Activities and development in protected wetlands or wetland buffer areas may be approved only after the following list of alternative and mitigating actions, listed from highest to lowest priority, have been considered and a mitigation plan has been approved:

a. Limiting the project to the upland portion of the wetland lot-of-record, exclusive of wetland buffer or protected wetland;

b. Limiting the project to the upland portion of the wetland lot-of-record and the wetland buffer;

c. Rectifying the impact by repairing, rehabilitating, or restoring the affected wetland and wetland buffer area (this would include removing wetland fills, rehabilitation of a resource use and/or extraction site when its economic life is terminated, etc.);

d. Reducing or eliminating the impact over time by preservation and maintenance operations.

3. If limiting the development or activity to the upland portion of the wetland lot-of-record per subsection 17.43.050.K.2(a) is not possible, the Planning Commission shall require a written mitigation plan prepared by a qualified wetland professional as a condition of approval. The mitigation plan shall address anticipated impacts of the proposed development on the wetland or wetland buffer and shall propose measures to mitigate the onsite impacts to the protected wetland and wetland buffer to the maximum extent possible, including but not be limited to, the restoration of native vegetation; restoration of hydric soil; restoration of the clay pan or other natural water barriers; restoration of natural slopes and contours; restoration of natural drainage or water flows; restoration of the wetland's nutrient cycle; and the restoration of wildlife habitat that may be impacted by the proposed develop or activity. The mitigation plan will remain in effect for a period of five years following completion of the development or project, unless extended, with an affirmative obligation on the part of the applicant to restore or repair mitigation efforts, as required by conditions through the end of the effective period.

Commented [ER49]: The plan should include measurable success/performance criteria that can be monitored to determine if all requirements have been met. For example, 80% cover by native vegetation at the end of 5 years or 80% survival planted trees and shrubs at the end of 5 years. No more than 20% cover by nonnative species.

Will the City require an annual monitoring report or just documentation at the end of 5 years?

Commented [ER50]: "…,unless extended for non-compliance,…"

a. Upon approval, the mitigation plan shall be integrated with the design package, and it shall be the responsibility of building officials to confirm compliance with the mitigation plan issuing a certificate of occupancy. In the event that mitigation efforts are not completed when occupancy is requested, the owner or the owner's agent may certify in writing that owner or its agent will complete the mitigation plan within a specified period. The certification shall represent the owner's or owner's agent's agreement in exchange for granting the certificate of occupancy that the mitigation plan will be completed in accordance with its terms.

b. If a landowner or responsible party fails to implement a mitigation plan, the City may undertake any action necessary to comply with mitigation plan and all associated costs and accrued interest thereon will become the immediate responsibility of the landowner or responsible party.

Commented [ER51]: Any need to include a statement that the City will notice the landowner to attempt to resolve issues prior to going out and doing any work?

4. Any combination of the actions in subsection (K)(2) may be required to implement mitigation requirements.

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5. The US Army Corps of Engineers or the Division of State Lands often require compensatory mitigation (subsection (K)(2)(e), of this section) as part of their approval of a fill permit. The city may require compensatory mitigation before approving a fill in a protected wetland when the US Army Corps of Engineers and the Division of State Lands do not require compensatory mitigation. Additional compensatory mitigation may be required by the city in those instances where it is also required as a condition of a state or federal fill permit.

Commented [ER52]: I couldn't find this subsection.

L. **Vegetation Management**. Vegetation in protected wetlands and in wetland buffer areas may be managed (including planting, mowing, pruning and removal) subject to the following standards:

Commented [KL53]: Are vegetation management plans something that must be approved by the PC as a CU? That seems a bit extreme and should, along with other minor actions/development be something the staff could review/approve.

1. Tree removal in protected wetlands and in wetland buffer areas shall be consistent with the criteria and standards in Chapter 17.70, tree removal.

2. Tree removal and pruning prohibited unless:

a. Necessary for placement of a dwelling or driveway approved pursuant to this chapter including required vehicular and utility access, subject to the requirements in Section 17.70.030(B) and (Q);

b. Necessary for maintenance of an existing dwelling or driveway;

c. Necessary for correction or prevention of foreseeable danger to public safety, or a foreseeable danger of property damage to an existing structure; or

d. Part of an approved restoration, enhancement or compensatory mitigation plan.

3. The fact that a tree or part thereof is or may be dead or compromised (e.g., a snag) is not sufficient criteria for its removal or pruning unless the property owner demonstrates foreseeable danger to public safety, or a foreseeable danger of property damage to an existing structure. An application for the removal of a dead tree shall require an ISA Tree Hazard Evaluation Form prepared by a certified arborist at the property owner's sole expense.

4. Tree trunks, stumps, roots, and bows of trees removed or pruned on protected wetlands and wetland buffers pursuant to this chapter shall be left by the property owner in situ. When a tree is removed, it shall be topped at the highest point possible that avoid hazards while leaving as much stump as possible for wildlife habitat.

5. In all cases, removal or pruning of trees from protected wetlands and wetland buffers must follow best professional standards to ensure protected wetlands and wetland buffer areas are not compromised.

6. Any tree removed in accordance with this Chapter or damaged by activities authorized under this Chapter shall be replaced by the property owner with a tree on the wetland lot-of-record of the same species.

7. Removal of vegetation, except trees covered by Chapter 17.70, in protected wetlands and in wetland buffer areas is permitted only if:

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a. Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or

b. Necessary for maintenance of an existing structure, road or pathway; or

c. Necessary for correction or prevention of a hazardous situation; or

d. Necessary for completion of a land survey; or

e. Part of an approved restoration, enhancement or compensatory mitigation plan.

Vegetation removal permitted under subsections L2a through e in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values. Vegetation removal permitted under subsections L2a through e in a wetland buffer area shall be the minimum necessary.

8. Pruning or mowing of vegetation in protected wetlands and in wetland buffer areas is **permitted** only if: (application review necessary?)

a. Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or

b. Necessary for maintenance of an existing structure, road or pathway; or

c. Necessary for correction or prevention of a hazardous situation; or

Commented [ER54]: Would this include veg management under powerlines or should that be called out separately?

d. Necessary for completion of a land survey; or

e. Part of an approved restoration, enhancement or compensatory mitigation plan; or

f. Part of a landscape plan approved by the city in **conjunction** with a building permit that minimizes adverse impacts on protected wetlands. (why only with building permit?)

Pruning or mowing permitted under subsections L3a through f in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values. Pruning or mowing permitted under subsections L3a through f in a wetland buffer area shall be the minimum necessary.

9. **Planting new vegetation** in protected wetlands is permitted subject to the following standards:

a. The planting is part of an approved restoration, enhancement or mitigation plan; or

b. The planting is part of a landscape plan involving native wetland plant species, and the plan is approved by the city in conjunction with approval of a building permit; or

c. The planting is intended to replace dead or damaged plants that were either part of a maintained landscape or part of the existing wetland plant community.

10. Planting new vegetation in wetland buffer areas is permitted as part of a managed garden or landscape.

11. Vegetation management practices will be employed in protected wetlands and in wetland buffer areas that minimize short-term and long-term adverse impacts on wetlands. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with chemicals, unnecessary or excessive vegetation removal, or substantial alteration of native wetland plant communities. The following are not permitted as part of a vegetation management plan for protected wetlands or wetland buffer areas: alteration of wetland hydrology, use of herbicides, or application of soil amendments or fertilizer.

M. **Land Divisions**. Subdivisions, replats, partitions, and property line adjustments are prohibited in protected wetlands and wetland buffer areas. Subdivisions, replats, partitions, and property line adjustments of the upland portion of a wetland lot-of-record are subject to the following standards:

1. Preliminary plat maps for proposed subdivisions, replats and partitions involving a wetland lot-of-record must show the wetland-upland boundary, as determined by a wetland delineation prepared by a qualified wetland professional. The city may seek independent expert opinion when reviewing a wetland delineation. A qualified wetland professional retained or hired by the city under this subsection is expected to render independent expert opinion, consistent with the Society of Wetland Scientists Code of Ethics.

2. Subdivisions, replats, partitions and property line adjustments of upland portions of a wetland lot-of-record are permitted subject to the following standards:

a. Upland portions of a wetland lot-of-record that is subject to subdivision, replats, partitions or property line adjustments must meet the minimum parcel dimension requirements for the parcel’s base zone.

b. There are two options for the size of the newly-created lot or parcel that contains wetlands and/or wetland buffer areas. If the newly-created lot or parcel is subject to a recorded conservation easement in perpetuity and transferred to the City at its discretion or an accredited land trust, there is no requirement for additional upland area. By contrast, if the newly-created lot or parcel will remain in the buildable lands inventory, the lot or parcel that contains wetlands and/or wetland buffer areas must also include a minimum of two thousand five hundred square feet of buildable upland area. .

c. Protected wetlands and wetland buffer areas may be counted towards meeting the base zone’s minimum lot size for each lot, and may not be included in front, side and rear yard setbacks.

d. Utility lines, including but not limited to, water lines, sewer lines, and storm water lines shall not be located in protected wetlands or wetland buffer areas, unless there is no alternative to serve lots meeting the standards of this subsection.

e. Streets shall not be located in protected wetland or wetland buffer areas.

Commented [ER55]: This appears to have addressed my earlier comments. However, is there a desire for a native plant community or are any species desired by the property owner okay?

Commented [ER56]: Does this exclude the use of mulch, which can sometimes aid plant establishment and weed suppresion?

Commented [KL57]: This doesn’t make sense because a property in its entirely must be part of a plat and can’t be excluded. Later this is contradicted in 2.b. It appears the intent is that you can’t create a lot without sufficient developable area outside of the wetland. Having the wetland in a dedicated tract, as is common practice, would also be fine.

Commented [KL58]: This same statement is made in 17.43.010 C, but with a reference to “permitting authority” instead of “city” used this time. This should be consolidated in one section and not repeated.

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3. Once a site has been subdivided, replatted, partitioned or lot lines adjusted subject to this subsection, no further land division or adjustment shall be permitted on any of the resulting lots or parcels.

4. For lots or parcels created subject to these provisions, the existence of protected wetland or wetland buffer areas shall not form the basis for a future setback reduction or variance request. (Ord. 94-29 § 2)

B. **Reasonable use of a wetland lot-of-record** is defined as an upland portion of the wetland lot-of-record that can accommodate one thousand square feet of lot coverage. This section defines the accommodations that can be made to allow reasonable use of a wetland lot-of record in the event uplands are not sufficient to allow such reasonable use. [from 17.43.025 Wetland Lot of record to B.3.h]

Commented [KL59]: Pet peeve of mine to not use numbers. Makes scanning the code much more difficult.

1. **Buffer Averaging**. Where the upland portion of the lot-of-record cannot accommodate one thousand square feet of lot coverage, buffer averaging to allow reasonable use of a parcel may be permitted when all of the following are met:

a. No feasible alternatives to the site design to accommodate one thousand square feet of lot coverage could be accomplished without buffer averaging; and

Commented [ER60]: Not sure if it matters, but DSL OAR's tend to use the term "practicable" instead of "feasible" in this context and define it as

"**Practicable** means capable of being accomplished after taking into consideration cost, existing technology and logistics with respect to the overall project purpose." https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=350

b. The averaged buffer will not result in degradation of the wetland's functions and values as demonstrated by a critical area report from a qualified wetland professional; and

Commented [ER61]: This term is not used elsewhere. It should be defined/described re: what info should be included. Recommend stating "Wetland functions for pre- and post-project conditions shall be assessed using a method currently approved for use by DSL, including the use of best professional judgement for wetland impacts <0.2 acres."

c. The total buffer area after averaging is equal to the area required without averaging; and

d. The buffer at its narrowest point is never less than 75 percent of the required width.

Commented [ER62]: Since the required width is a known 50 feet, perhaps just state that the narrowest point is never less than 37.5 ft (i.e., 50 x 0.75)

2. **Wetland Buffer Reduction** (Up to 50 Percent for Undeveloped Properties). Where reasonable use cannot be obtained through the combination of upland areas and buffer averaging, the wetland buffer may be reduced by application to the Planning Commission up to 50 percent where equal or better protection for identified resources will be ensured through restoration, enhancement, and similar measures. Specifically, the following criteria and conditions must be met to be eligible for a wetland buffer reduction. The applicant must demonstrate that:

Commented [ER63]: Is this referring to width or total area?

a. The application of the wetland buffer to the lot or parcel precludes all reasonable use of the lot or parcel and renders it not buildable, after consideration of all applicable limitations and restrictions in this code; and

b. The lot or parcel is a wetland lot-of-record in existence prior to the Effective Date in 17.43.010(D) (i.e., buffer reduction is not available for land divisions); and

c. The lot or parcel must be combined for development purposes with contiguous lots or parcels in the same ownership on the effective date of the ordinance codified in this chapter; and

Commented [KL64]: What is the intended purpose for requiring this? I would think it will unnecessarily complicate things without any environmental benefit.

d The proposed development shall minimize disturbance to the wetland buffer area by utilizing design options to minimize or reduce impacts of development: (i) multistory construction shall be used; (ii) parking spaces shall be minimized to no more than that required as a minimum for the use; (iii) no accessory structures allowed; (iv) paving shall be pervious; (v) engineering solutions shall be used to minimize additional grading and/or fill; and

e. The proposed development or activity is designed to minimize intrusion into the wetland buffer area. Specifically, the use or activity is designed using up to a 50 percent adjustment to any dimensional standard (e.g., front yard, side yard or other setbacks) to permit development as far outside or upland of the wetland buffer area as is possible; and

f. The protection of the wetland can be assured through restoration, enhancement, and other similar measures in the wetland buffer area in accordance with subsection 17.43.050(K).

3. Siting for Development. Where combined uplands, buffer averaging, and buffer reduction do not permit reasonable use of a wetland lot-of-record, minimum development of the wetland overlay area necessary to avoid a taking claim shall be permitted subject to compliance with the following standards:

a. The lot or parcel must be combined for development purposes with contiguous lots or parcels in the same ownership on the Effective Date of the ordinance codified in this Chapter; and

Commented [KL65]: Again, the rationale isn't clear to me.

b. The building footprint encroaching into the wetland overlay area shall be limited to that which is the minimum necessary to obtain reasonable use of the property; and

Commented [KL66]: This is loaded with interpretation. Recommend review/comment from city attorney.

c. The application of the wetland overlay zone to the lot or parcel precludes all reasonable use of the parcel and renders it not buildable, after consideration of all applicable limitations and restrictions in this code; and

d. Preference in location of the building footprint shall be given to areas devoid of native vegetation; and

e. Application may be made to the Planning Commission to **adjust the underlying zone setback standards** to the extent necessary to reduce or minimize encroachment into the protected wetland or wetland buffer area. The Planning Commission may approve an application for up to a 50 percent adjustment to any dimensional standard (e.g., front yard, side yard or other setbacks) to permit development as far outside or upland of the protected wetland and wetland buffer area as possible; and

Commented [KL67]: Will these always go to the PC? Depending on what happens with the rest of the CDO rewrite, this may be categorized as a Type III process.

f. The proposed development shall minimize disturbance to the protected wetland and wetland buffer area by **utilizing design options to minimize or reduce impacts** of development including but not limited to multistory construction, minimizing parking, garage space, and paving and use of retaining walls or other engineering solutions to minimize filling and grading; and

Commented [KL68]: This may mean going over the maximum building height of the base zone. Same for parking requirements. Consider adding this to the adjustment provisions above.

g. In no case shall the **impermeable surface area** of the residential use (including building footprint, driveway, and parking areas and accessory structures) exceed 1,000 square feet within **wetland overlay areas**; and

h. All applicable general criteria in 17.43.050, including minimum restoration and enhancement requirements shall be met.

Exhibit C-2

CANNON BEACH COMMUNITY DEVELOPMENT
163 E. GOWER ST.
PO BOX 368
CANNON BEACH, OR 97110

MEMORANDUM

RE: Proposed Wetland Overlay Amendments

September 14, 2023

Overview of Proposed Wetland Overlay Amendments

Introduction

The city recognizes the environmental value of wetlands, and the Cannon Beach Municipal Code contains wetland regulations in Chapter 17.43 Wetlands Overlay (WO) Zone to protect them. The city formed a citizen committee to review the existing regulations and determine how to improve the existing WO Zone. The committee created a draft, and the Urbsworks team was asked to review the document and make recommendations as to how it might be further improved.

Process

Step 1 - Reorganization

As a first step, the Urbsworks team recommended a reorganization of the WO Zone draft to enhance readability and clarity. A revised outline was reviewed by the committee and city staff and found to be appropriate. The draft text was then reorganized accordingly into the new WO sections without adding or deleting any text.

Step 2 – Preliminary Editing

Following the reorganization, the text was edited primarily to eliminate duplicative language and to identify potential definitions and narrative additions to strengthen the WO chapter. The deletions and additions are shown in the attached discussion draft.

Discussion Draft

The discussion draft shows the proposed reorganization, with notes (highlighted) regarding where the text originated in the committee draft or from other portions of the code. New and deleted text are also shown. The resulting reorganization and preliminary editing are summarized below with explanatory notes.

17.43.010 Purpose

The purpose statement in Section 17.43.010 of the committee draft was retained, and the regulatory portions were relocated elsewhere. The definitions were moved to a new Section 17.43.015.

17.43.015 Definitions

This is a new section.

- Recommend definitions ultimately going to 17.04 as a group of wetland definitions and eliminating this subsection.
- Definitions for wetland, wetland buffer area, and wetland delineation in the Title 17 definitions section were added here.

- New definitions proposed as noted to clarify permitted activities in 17.43.050.

- May need to modify the wetland definition per Department of State Lands.

17.43.020 Mapping

This section is relatively unchanged, but the following amendments are recommended:

- Clarify relationship between city's LWI and subsequent delineations/determinations. We think that a delineation should modify the city's LWI because it's more current and site-specific. The wording proposed by the committee (and we believe in the current CDO) isn't very clear about what happens to the official city map once better information is available.

- Clarify what's meant in Subsection E. re: protected wetlands.

17.43.030 Applicability

This is a new proposed section to clarify when these regulations apply.

17.43.040 Administration

This is a new section to clarify how WO applications will be administered and reviewed. It assumes that Article II will be revised to include a consolidated description of the four basic review procedures currently used. A recommendation from the Code Audit calls for consolidating all procedural requirements in a new Article II and Type IIV procedural categories that correspond to the city's current review procedures. For example, a Planning Commission review would be a Type III process.

17.43.050 Development and Activities Permitted

A table is proposed to simplify the narrative in Sections 17.43.030 – 17.43.045. This removes the reference to conditional use and showing most activities as requiring a Type III Planning Commission review. The following should be considered:

- Definitions for the terms highlighted.

- Determine if we have all development/activities covered and if some need to be added.

- Identify any additional types of development or activities that would be appropriate in buffer areas with a Type I or III review. In particular, minor activities in the buffer area, which will be expanded from 5 to 50 feet, may be appropriate for a Type I staff review.

Exhibit C-2

17.43.060 Application Submittal Requirements

This new section is based on the site design review submittal requirements (17.44.050), and it is modified to coincide with a WO application. The stormwater submittal requirements found in subsection J. of the committee draft was moved here. The submittal requirements should be reviewed and modified as appropriate.

17.43.070 Development Standards

This section is from Section 17.43.050 of the committee draft. The list of standards is quite long, and not all standards apply to any one proposal. The Urbsworks team recommends that the standards in this section be reorganized to coincide more closely the location of a development proposal to help focus on the standards that pertain to a specific application. Such a reorganization could include:

- General standards that would apply in all or most cases regardless of location or magnitude.
- Standards for wetland lot-of-record applications.
- Standards for development and activities within wetlands. Standards for development and activities within wetland buffer areas only.
- Mitigation requirements.

<u>Discussion: Development Standards (17.43.070)</u>

While the draft wetland amendments will be submitted for DLCD consideration by the time of the September 13th public meeting, the technical expert team is testing and refining development standards. The timing of the Joint Commission work session provides an opportunity to discuss several key issues, see below.	
Organization of standards	The proposed organization is: • General Standards • Residential/Commercial development and accessory structures • Specific standards • Mitigation
General Standards – Considerations	Consider a general standards section similar to that proposed by the committee, which would apply to development in wetlands, wetland lots-of-record, and buffer areas. Criteria could include demonstrating the applicant has first utilized land outside of the wetland and buffer to the extent practicable, and provision of evidence of any necessary state and/or federal permits, etc.
Residential/Commercial development and accessory structures – Considerations	Distinguish between lot coverage for the entire property versus wetland/buffer because coverage in the latter matters most. Include numerical standards instead of terms like “minimize.”

Exhibit C-2

	Current code amendments consider gravel to be an impervious surface, yet compacted gravel is regarded by civil engineers as impervious. Are piles always a better solution than fill? Combine sections (B. - D.) based on impact. Note: The stormwater management portion (subsection J.) mixes submittal requirements and standards, and the proposed draft moves the submittal provisions to 17.43.060.
Specific standards – Consider standards and organization based on impact	In the draft code provided in this packet, wetlands and the 50’ buffer are restricted the same way. Consider that, while the buffers logically need to have restrictions to protect the adjoining wetland, restrictions for the buffer area might be more relaxed compared to those for the wetlands. Consider allowances for the different development activities by wetland, wetland lot-of-record, and buffer area with the wetland requirements being the most stringent, lot-of-record allowing only a house (for example), and buffer being more permissive. As a result the development standards chapter would be organized based on a hierarchy of standards based on impact.
Mitigation – Considerations	Consider standards that provide for mitigation as a way to handle development. Consider LIDA techniques (Low Impact Development Approaches).

Exhibit C-2

CHAPTER 17.43 WETLANDS OVERLAY (WO) ZONE

Draft Reorganization 8.20.23

17.43.010 Purpose

The purpose of the wetlands overlay zone is to protect wetland areas identified in the city's Local Wetland Inventory from uses and activities that are inconsistent with the maintenance of the wetland functions and values identified for those sites, which include, but are not limited to, providing food, breeding, nesting and/or rearing habitat for fish and wildlife; recharging and discharging ground water; contributing to stream flow during low flow periods; stabilizing stream banks and shorelines; storing storm and flood waters to reduce flooding and erosion; carbon sequestration; thermal refugia, and improving water quality through biofiltration, adsorption, retention, and transformation of sediments, nutrients, and toxicants. Wetland areas also serve significant community wellness purposes such as mental and emotional well-being and sense of community in nature. (Ord. 94-29 § 2). In addition to wetland protections covered by this chapter, the city also protects stream corridors (Chapter 17.71) and estuarine resources per the Ecola Creek Estuary Plan.

17.43.015 Definitions

"Best management practices" means structural or non-structural measures, practices, techniques, or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to protected wetlands.

"Buffer averaging" means reducing the standard buffer width (i.e., 50 feet) around a wetland in some locations and increasing it in other locations such that the total area within the buffer around a given delineated wetland after averaging remains at least equal to what was required by the standard buffer around that wetland.

"Contiguous" means lots that have a common boundary and includes lots separated by public streets.

"Erosion" means the process by which the land's surface is worn away by the action of wind, water, ice or gravity.

"Footprint" refers to the total area under the exterior walls of all structures on a lot.

"Permeable" means surfaces that allow water to pass through whereas "impermeable" means blocking the flow of water through the surface.

"Protected wetlands" are those areas in the wetlands overlay zone that have been identified on the city's inventory or on a subsequent detailed wetland delineation as wetlands. Note that Federal and State protections also exist and applicant is responsible for addressing such regulations too (i.e. review by the City does not imply review by Federal or State agencies). Should discrepancies exist between federal and state wetland delineation jurisdiction, city protected wetlands shall match state regulated wetland boundaries. A "qualified wetland professional" is a person with experience and training in wetlands issues and with experience in performing delineations, analyzing wetland functions and values, analyzing wetland impacts, and recommending wetland mitigation and restoration. Qualifications include:

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> A Professional Wetland Scientist certification from the Society of Wetland Scientists; or
>
> B.S. or B.A., or equivalent degree in biology, botany, environmental studies, fisheries, soil science, wildlife, agriculture or related field; two years of related work experience; and minimum of one-year experience delineating wetlands using the 1987 U.S. Army Corps of Engineers (Corps) Wetlands Delineation Manual and supporting guidance, and preparing wetland reports and mitigation plans; or
>
> Four years of related work experience and training; minimum of two years' experience delineating wetlands using the 1987 Corps Manual and supporting guidance, and preparing wetland reports, and mitigation plans.

"Rainfall Collection Area" is the drainage system or catchment area upslope of the protected wetland that contributes either surface runoff or shallow subsurface seepage.

"Runoff" means storm water or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.

"Sediment" means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.

"Site" means the entire area included in the legal description of the land on which the land disturbing construction activity is proposed in the permit application.

"Upland" as used in this title is the portion of a wetland lot-of-record that is neither protected wetland nor wetland buffer area.

"Vegetation" as used in this title shall include all living plant matter (e.g., all native and non-native vines, herbaceous, shrub, and tree species of any size or amount).

"Wetland" means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (Ord. 94-29 § 1)

"Wetland buffer area" means a 50-foot-wide non-wetland area surrounding a protected wetland~~s~~ within the wetlands overlay zone. (Ord. 94-29 § 1)

"Wetland delineation" means a site-specific determination of the boundary between uplands and wetlands for a given parcel of land based on field indicators of vegetation, soils and hydrology. The delineation is to be undertaken in accordance with a method acceptable to the US Army Corps of Engineers and the Oregon Division of State Lands. (Ord. 9429 § 1)

"Wetland lot-of-record" is a lot or contiguous lots held in common ownership on August 4, 1993, which are subject to the provisions of this chapter. A wetland lot-of-record includes upland portions of the contiguous property that are not subject to the provisions of the wetlands overlay zone.

"Wetland Overlay Zone" includes the delineated wetland and wetland buffer area.

Exhibit C-2

17.43.020 Mapping

A. The maps delineating the wetland overlay (WO) zone boundaries shall be maintained and updated as necessary by the city. The Cannon Beach Local Wetland Inventory (LWI) maps dated September 20, 1994, as well as subsequent updates to the LWI, shall form the basis for the location of wetlands. The WO zone includes both wetland and wetland buffer areas which abut wetlands.

B. Site-specific wetland delineations or determinations are required to determine the exact location of the WO zone boundary. Wetland determinations and delineations shall be conducted in accordance with the 1987 U.S. Army Corps of Engineers Wetlands Delineation Manual along with any supporting technical or guidance documents issued by the Division of State Lands and applicable guidance issued by the U.S. Army Corps of Engineers for the area in which the wetlands are located.

C. When an expert report or opinion is submitted by an applicant, the permitting authority may seek an independent expert opinion when reviewing the report or opinion. A qualified wetland professional retained or hired by the city under this subsection is expected to render independent expert opinion, consistent with the Society of Wetland Scientists Code of Ethics.

~~C~~D. Where a wetland delineation or determination is prepared, and accepted by the City, the mapping it contains shall replace that of the Cannon Beach Local Wetland Inventory. Wetland delineations or determinations shall remain valid for a period of not more than five years from the date of their acceptance by the Division of State Lands. Any wetland delineation submitted to the City shall be accompanied by an electronic shapefile.

~~D~~E. The continued reliance on a wetland delineation or determination that is more than five years old requires the following additional new information:

1. An onsite re-inspection of the site by a qualified wetland professional to determine if there has been any change in circumstances;

2. If no change in circumstances is found, a short report shall be provided noting or including:

a. A description of site conditions and any changes between the date of the original wetland determination or delineation and the date of the re-inspection,

b. Any additional maps, aerial photographs or other documents consulted, and

c. Conclusions regarding the accuracy of the original wetland delineation or determination;

3. If a change in circumstances is noted, the information in subsection (D)(2) of this section shall be provided along with:

a. Additional field data, including wetland determination data in conformance with Division of State Lands standards needed to verify and document any change in the status of the wetland area that were or were not identified and mapped as part of the original delineation or determination,

b. A revised wetland map,

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c. Data, documentation, and other information as needed to establish the nature and timing of the activity or activities that resulted in the change in circumstances.

~~E~~F. Protected wetlands that are legally filled under this chapter are no longer protected wetlands, but shall change to wetland buffer areas under this overlay zone. Wetland buffer areas that are legally filled under this chapter remain as wetland buffer areas. (Ord. 08-1 § 40; Ord. 94-29 § 2)

17.43.030 Applicability

The regulations of this chapter apply to the portions of all properties that contain wetlands or wetland buffer areas as shown on the city maps or as described in a wetland delineation or determination as described in Section 17.43.020.

17.43.040 Administration

Activities permitted outright according to Table 17.43-1 shall be reviewed as a Type I city manager decision as provided in Article II.

All other development or activities within the Wetlands Overlay Zone shall be reviewed as a Type III Planning Commission decision as provided in Article II.

17.43.050 Development and Activities Permitted

A. Uses and activities listed in Table 17.43-1 may be permitted in wetlands and wetland buffer areas, subject to the issuance of a development permit in accordance with the provisions of this title and the applicable standards in Section 17.43.070.

B. Uses and activities in wetland and wetland buffers are prohibited unless specifically permitted in Table 17.43-1. Specific prohibition of any activity in this Chapter is not intended as authorization to engage in activity not specifically prohibited. Conflicts between this Chapter and any other provision of the Cannon Beach municipal code shall be resolved in favor of this Chapter.

C ~~D~~. Uses and activities in existence approved by a permitting authority before the effective date this Chapter 17.43, [to be specified on the date of ratification] (hereinafter referred to for purposes of this Chapter as the Effective Date), and which may not conform with the permitted or conditional uses set forth herein may qualify as a "nonconforming use" as provided Chapter 17.82

Table 17.43-1 Permitted Development and Activities within the WO Zone

Development or Activity	**Wetland**	**Wetland Lot-of-Record**	**Wetland Buffer**
Vegetation management only to the extent necessary for hazard prevention	I	I	I
Structures	III	III (1 max)	III
Wetland enhancement	III	III	III
Compensatory wetland mitigation	III	III	III

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Driveways	III	III	III
Pedestrian/bike pathways	III	III	III
Point source stormwater discharge	III	III	III
Alternative stormwater practices	III	III	III
Underground or above ground utilities	III	III	III

I – Permitted subject to Type I review and approval
III – Subject to Type III review and approval

17.43.060 Application Submittal Requirements

A. Information Requirements. Information provided on the ~~design review~~ development plan shall conform to the following:

1. Drawings depicting the proposal shall be presented on sheets not larger than twenty-four inches by thirty-six inches in the number of copies directed by the city;

2. Drawings shall be at a scale sufficiently large enough to enable all features of the design to be clearly discerned.

B. Site Analysis Diagram. This element of the design review plan, which may be in a freehand form to scale, shall indicate the following site characteristics:

1. A survey of the property by a licensed land surveyor clearly delineating property boundaries. The city may waive this requirement where there is a recent survey which can be used to establish the applicant's property boundaries;

2. Location of the wetland boundary and wetland buffer area;

3. Location and species of trees greater than six inches in diameter when measured four and one-half feet above the natural grade, and an indication of which trees are to be removed or potentially affected by construction activity on the subject property and abutting properties ;

4. On sites that contain steep slopes, potential geologic hazard or unique natural features that may affect the proposed development, the city may require contours mapped at two-foot intervals;

5. Natural drainageways and other significant natural features;

6. All buildings, roads, retaining walls, curb cuts and other manmade features on the subject property;

7. Developed and natural features, including trees, wetlands, structures, and impervious surfaces on adjoining property having a visual or other significant relationship with the site; and

8. The location and names of all existing streets within or on the boundary of the proposed development.

Exhibit C-2

C. Site Photographs. Photographs depicting the site and its relationship to adjoining sites and natural features shall also be provided.

D. Site Development Plan. This element of the development plan shall indicate the following:

1. Boundary dimensions and area of the site.

2. Location of all existing structures, driveways, walkways, and landscaped areas proposed to be retained, including their site coverage and distances from the property line, and wetland and wetland buffer area boundaries;

3. Location of all new structures, driveways, walkways, and landscaped areas proposed to be retained, including their site coverage and distances from the property line, and wetland and wetland buffer area boundaries;

4. All external dimensions of existing and proposed buildings and structures;

5. Existing and proposed parking and vehicular and pedestrian circulation areas, including their dimensions;

6. Existing and proposed service areas for such uses as the loading and delivery of goods;

7. Locations, descriptions and dimensions of easements;

9. Grading and drainage plans, including spot elevations and contours

10. Location of areas to be landscaped or retained in their natural state;

11. Exterior lighting including the type, intensity, height above grade and area to be illuminated;

12. Other site elements which will assist in the evaluation of the application

E. Landscape Plan. Development proposals with a total project cost exceeding two hundred fifty thousand dollars shall have the landscape plan prepared by a licensed landscape architect or licensed landscape contractor. This element of the development plan shall indicate the following:

1. The size, species and locations of plant materials to be retained or placed on the site;

2. The layout of proposed irrigation facilities;

3. The location and design details of walkways, plazas, courtyards and similar seating areas, including related street furniture and permanent outdoor equipment including sculpture;

4. The location, type and intensity of lighting proposed to illuminate outdoor areas;

5. The location and design details of proposed fencing, retaining walls and trash collection areas; and

F. A stormwater management plan shall be required of the applicant and reviewed and approved by the public works director for the following types of developments where stormwater will move from the site into protected wetlands:

1. New building covering more than two hundred square feet; or
2. New addition covering more than two hundred square feet; or
3. New road or driveway; or
4. Road or driveway expansion; or
5. New parking lot or parking lot expansion; or
6. Point source stormwater discharge; or
7. Diversion of stormwater for any reason within the protected wetland or wetland buffer.

8. A **stormwater management plan must include all information necessary to demonstrate to the public works director** that the proposed stormwater management system will maintain pre-construction activity, or background, water quality and similar flow characteristics (e.g., volume, velocity, and duration) and be consistent with the standards of this Chapter. The stormwater management plan shall provide the following in addition to any information requested by the public works director:

a. Property description

b. Site map or maps, drawing or specifications detailing the design, route, and location of the stormwater management system.

c. A map or model of drainage patterns and stormwater flow before and after the development or activity; impacts to water quality in the wetland, changes to water quantity and timing that may adversely affect wetland function (e.g., affects of rapidly fluctuating water levels on amphibian egg masses, scour impacts to vegetation) and potential for sediment deposition into the wetland or wetland buffer.

d. Best management practices and methods of treatment that will maintain or improve background levels of water quality, which includes but is not limited to: dissolved oxygen levels; pH; temperature; total dissolved solids; and contaminants.

G. Narrative addressing the relevant standards in Section 17.43.070.

17.43.070 Development Standards

The following standards are applicable to the uses and activities listed in Section 17.43.050. The uses and activities are also subject to the standards of the base zone. The following standards are applicable in all areas under the wetlands overlay zone.

A. General Standards. Uses and activities in protected wetlands and in wetland buffer areas are subject to the following general standards. Development may also be subject to specific standards in subsequent subsections.

1. Uses and activities in protected wetlands or wetland buffer areas may be approved only after the following list of alternative actions, listed from highest to lowest priority, have been considered:

a. Avoiding the impact altogether by not taking a certain action or parts of an action (this would include, for example, having the use or activity occur entirely on uplands); and

b. Minimizing impacts by limiting the degree or magnitude of action and its implementation (this would include, for example, reducing the size of the structure or improvement so that protected wetlands or wetland buffer areas are not impacted).

2. Where a use or activity can be located in either the protected wetland or the wetland buffer, preference shall be given to the location of the use or activity in the wetland buffer.

3. Valid permits from the US Army Corps of Engineers and from the Oregon Division of State Lands, or written proof of exemption from these permit programs, must be obtained before any of the following activities occur in protected wetlands:

a. Placement of fill (any amount);

b. Construction of any pile-support structure;

c. Excavation (any amount);

d. Compensatory mitigation;

e. Wetland restoration;

f. Wetland enhancement.

4. Where a wetland is identified by the Cannon Beach wetland study as riverine, uses and activities are also subject to the requirements of Chapter 17.71, stream corridor protection. If the riverine mapping only encompasses the active channel (i.e., no wetlands are present), then only Chapter 17.71 applies.

5. **Pile-supported construction** may use wood piling (treated or untreated), steel piling, concrete piling, or other piling material meeting building code requirements. If treated wood piling or posts are used for structures in protected wetlands, the following standards are applicable:

a. Treated wood shall be completely dry;

b. Treated wood shall not have any wet wood preservative on the wood surface; and

c. The type of chemical treatment chosen shall be the type that minimize possible contamination of the wetland environment.

6. Except as permitted for enhancement and mitigation, **fill and removal** are prohibited in protected wetland or wetland buffer areas. In cases of enhancement and mitigation, removal and fill may be allowed if approved by application to the Planning Commission, subject to the following standards:

a. All fill material shall be clean and free of contaminants;

b. Filled area sides shall be finished to a stable slope;

c. Measures shall be incorporated into the fill design to minimize erosion or sloughing of fill material into protected wetlands;

d. Fills shall be designed in a manner that does not worsen flooding on adjacent or nearby flood-prone lands, and avoids restricting the flow of water to or through protected wetlands; and

e. Fill side slopes shall be revegetated with native plant species to stabilize the slope.

7. **Draining, diverting water** from, or reconfiguring the dimensions of a wetland to create upland is prohibited.

B. **Residential Development**. Where and when allowed, a residential structure, modular housing, or manufactured home may be permitted in a protected wetland or wetland buffer area subject to the following standards:

1. New dwellings and accessory structures, when permitted, shall be placed on piling or on posts, and shall be cantilevered, in a manner that allows the free flow of water beneath the structure. No fill material may be used for the residence.

2. Building coverage will be minimized in accordance with Section 17.43.025.

3. Driveways, utilities, landscaping, garages, accessory structures and other uses and activities accessory to a residence shall comply with applicable standards.

4. **Driveways, off-street parking, and other surfaces** including but not limited to patios and walkways in the WO zone shall be constructed of permeable materials.

5. For the purposes of calculating floor area ratio, the size of the lot shall be considered the upland portion only, i.e., the area of the lot that is neither wetland nor wetland buffer area.

6. To avoid harm to wetlands and wetland buffers from excessive traffic and frequent visitors who are unaware of wetland protections, **short term rentals** are prohibited in structures within the wetland overlay zone where any portion of the building or surrounding developed area such as patios, driveways, and walkways are within the wetland overlay zone. This prohibition applies to the wetland overlay zone as defined prior to adjustments permitted under section 17.43.025.

Exhibit C-2

C. **Commercial Development**. Where and when allowed by the base zone, a commercial building may be permitted in a protected wetland or wetland buffer area subject to the following standards:

1. New commercial buildings shall be placed on piling or on posts in a manner that allows the free flow of water beneath the structure. No fill material may be used for commercial buildings in wetland buffer areas.

2. Lot coverage will be minimized in accordance with Section 17.43.025. Commercial development in protected wetlands or in wetland buffer areas is subject to site design review pursuant to Chapter 17.44.

3. Driveways, parking, utilities, landscaping, accessory structures and other uses and activities accessory to a commercial development shall comply with applicable standards.

D. **Accessory Structure or Building**. Buildings and structures subordinate to the principal structure may be permitted in wetland buffer areas subject to these standards, and subject to the requirements of the base zone:

1. New accessory structures or buildings shall be placed on piling or on posts in a manner that allows the free flow of water beneath the structure. No fill material may be used for an accessory structure or building in a protected wetland or in a wetland buffer area.

E. **Driveways**. Driveways through protected wetlands or wetland buffer areas may be permitted subject to the following standards:

1. Driveways crossing protected wetlands or wetland buffer areas shall be no wider than twenty feet, regardless of the length of frontage facing the right-of-way.

2. Driveways in protected wetlands shall be placed on piling in a manner that allows the free flow of water beneath the driveway. Pile-supported construction is required instead of fill for driveways. Water circulation shall be facilitated through use of culverts or bridges.

3. Driveways and off-street parking in wetland buffer areas may be placed on piling or constructed of gravel, whichever is deemed least impactful by a qualified wetland professional.

F. **Utilities**. Electric power lines, telephone lines, cable television lines, water lines, wastewater collection lines and natural gas lines may be permitted in protected wetlands and in wetland buffer areas subject to these standards, and subject to the requirements of the base zone:

1. **Underground utilities**, including water, wastewater, electricity, cable television, telephone and natural gas service, may be routed through wetland buffer areas in trenches provided the following standards are met:

a. Material removed from the trench is either returned to the trench as back-fill within a reasonable period of time, or, if other material is to be used to back-fill the trench, excess material shall be immediately removed from the protected wetland area. Side-casting into a protected wetland for disposal of material is not permitted;

Exhibit C-2

b. Topsoil and sod shall be conserved during trench construction or maintenance, and replaced on the top of the trench;

c. The ground elevation shall not be altered as a result of utility trench construction or maintenance. Finish elevation shall be the same as starting elevation; and

d. Routes for new utility trenches shall be selected to minimize hydraulic impacts on protected wetlands, and to minimize vegetation removal.

2. **Aboveground utilities**, including electricity, cable television and telephone service, may be routed through wetland areas on poles subject to the following standards:

a. Routes for new utility corridors shall be selected to minimize adverse impacts on the wetland, and to minimize vegetation removal; and

b. Vegetation management for utility corridors in protected wetlands and in wetland buffer areas shall be conducted according to the best management practices to assure maintenance of water quality, and subject to the vegetation management standards herein.

3. **Utility maintenance roads** in protected wetlands and in wetland buffer areas must meet applicable standards for roads in wetlands.

4. **Common trenches**, to the extent allowed by the building code, are encouraged as a way to minimize ground disturbance when installing utilities.

5. Underground utilities shall be routed under disturbed areas such as driveways and off-street parking areas whenever feasible. When utilities are routed under driveways and off-street parking areas, the surface shall be gravel to facilitate location and repair in the event of damage to the utility lines.

G. **Footpaths and Bicycle Paths**. Development of new footpaths, and maintenance of existing footpaths may be permitted in protected wetlands and in wetland buffer areas subject to the use restrictions in the zone and the following standards. Development of new bicycle paths may be permitted in wetland buffer areas.

1. Footpaths across protected wetlands may only be developed or maintained without the use of fill material. Bridges shall be used to cross open water areas.

2. Footpaths in protected wetlands shall not restrict the movement of water.

3. Routes for new footpaths shall be chosen to avoid traversing protected wetlands. Footpaths around the perimeter of protected wetlands, and in wetland buffer areas, are preferred.

4. Routes for new **bicycle paths** shall not be located in protected wetlands but may be located in wetland buffer areas.

5. Footpaths and bicycle paths within protected wetlands and wetland buffers shall be constructed of permeable material.

Exhibit C-2

H. **Wetland Enhancement**. Efforts to enhance wetland values include removal of nonnative vegetation from a wetland, planting native wetland plant species, excavation to deepen wetland areas, placement of bird nesting or roosting structures, fish habitat enhancements, hydraulic changes designed to improve wetland hydrology, removal of fill material, adding new culverts under existing fill, and similar acceptable activities. Wetland enhancement **may be permitted** in protected wetlands and in wetland buffer areas subject to the use restrictions in the applicable zone, and subject to these standards:

1. An enhancement plan must be prepared by a qualified wetland professional before an enhancement project can proceed. The plan must describe the proposal; identify the wetland functions or values to be enhanced; identify a goal or goals for the project; and describe evaluation techniques to be used to measure progress toward project goals. The project must follow the approved plan.

2. All components of the enhancement plan (planning, design, construction, cleanup, maintenance, monitoring, and remedial activity) must comply with applicable standards in this section.

I. **Excavation.** Excavation in protected wetlands and in wetland buffer areas for any purpose must meet the following standards:

1. Excavation for purposes of gravel, aggregate, sand or mineral extraction is not permitted.

2. Excavation for utility trenches in wetland buffer areas is subject to the following standards:

a. Material removed from the trench is either returned to the trench (back-fill), or removed from the wetland area. Side-casting into a protected wetland for disposal of material is not permitted;

b. Topsoil shall be conserved during trench construction or maintenance, and replaced on the top of the trench; and

c. The ground elevation shall not be altered as a result of utility trench construction or maintenance. Finish elevation shall be the same as starting elevation.

3. Excavation for building footings in protected wetlands is subject to the following standards:

a. Material removed for approved footings is either returned to the trench (back-fill), or removed from the protected wetland or wetland buffer area. Side-casting for disposal of material is not permitted;

b. Disturbance of wetland vegetation and topsoil during footing construction shall be minimized; and

c. The ground elevation around a footing shall not be altered as a result of excavation for the footing, unless required to meet building code requirements for positive drainage. Finish elevation shall be generally the same as starting elevation.

4. Excavation for wetland enhancement is subject to the following standards:

a. No more material than necessary and specified in the enhancement plan shall be excavated; and

b. Side-casting for disposal of excavated material is not permitted; however, excavated material may be placed in a protected wetland or wetland buffer area for enhancement purposes as specified in the enhancement plan.

J. **Stormwater Management**. Management of stormwater flowing into protected wetlands or wetland buffer areas is subject to the following standards:

1. The City recognizes that stormwater is an important component of wetland hydrology, and it shall regulate flow of stormwater into or out of protected wetlands and wetland buffers to ensure no net loss of wetland functions and values. It is the policy of the City that all stormwater that would naturally flow into protected wetlands and wetland buffers shall continue to flow into protected wetlands and wetland buffers in accordance with this Chapter. Uses and activities intended to remove storm water away from or around protected wetlands and wetland buffers or to move storm water within a protected wetland or wetland buffer are prohibited unless undertaken as part of an approved wetland mitigation or enhancement plan.

2. A stormwater management plan shall be required of the applicant and reviewed and approved by the public works director for the following types of developments where stormwater will move from the site into protected wetlands:

a. New building covering more than two hundred square feet; or

b. New addition covering more than two hundred square feet; or

c. New road or driveway; or

d. Road or driveway expansion; or

e. New parking lot or parking lot expansion; or

f. Point source stormwater discharge; or

g. Diversion of stormwater for any reason within the protected wetland or wetland buffer.

3. A **stormwater management plan must include all information necessary to demonstrate to the public works director** that the proposed stormwater management system will maintain pre-construction activity, or background, water quality and similar flow characteristics (e.g., volume, velocity, and duration) and be consistent with the standards of this Chapter. The stormwater management plan shall provide the following in addition to any information requested by the public works director:

a. Property description

b. Site map or maps, drawing or specifications detailing the design, route, and location of the stormwater management system.

c. A map or model of drainage patterns and stormwater flow before and after the development or activity; impacts to water quality in the wetland, changes to water quantity and timing that may adversely affect wetland function (e.g., affects of rapidly fluctuating water levels on amphibian egg masses, scour impacts to vegetation) and potential for sediment deposition into the wetland or wetland buffer.

d. Best management practices and methods of treatment that will maintain or improve background levels of water quality, which includes but is not limited to: dissolved oxygen levels; pH; temperature; total dissolved solids; and contaminants.

e. An agreement to be recorded on the title obligating any owner of the property to remove contaminants from stormwater flowing from anywhere on the wetland lot-of-record into the protected wetland or wetland buffer, including a description of the plans to maintain methods used by the applicant to remove contaminants per section 17.43.050(J)(4)..

4. Standards

a. Stormwater runoff should be directed toward the same drainage system that would have handled the runoff under natural conditions. Where the public works director determines that stormwater volumes are or will be significant, stormwater management systems must disperse and potentially delay stormwater rather than discharging it at a single point.

b. Stormwater flowing onto protected wetlands and wetland buffers from any use or activity permitted under this Chapter 17.43 shall be treated to remove contaminants and sediment. There shall be a preference for passive methods of stormwater management, which may include but are not limited to: bioretention and rain gardens; vegetated swales, buffers and strips; roof leader disconnection; and impervious surface reduction and disconnection.

c. Where the use or activity involves point source water discharge, new or modification of an existing road or parking lot, one or more active methods shall be employed including but are not limited to: catch basins and catch basin inserts; hydrodynamic separators; media filters; and advanced water treatment.

K. **Mitigation**. All projects involving development, removal or fill in a protected wetland must meet the following standards. These standards are intended to help meet the city's goal of no net loss of wetland functions or values.

1. Construction management practices will be employed in protected wetlands, wetland buffer areas, and the upland portion of a wetland-lot-of-record that address impacts to wetland values and function. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with construction waste or debris, unnecessary or excessive vegetation removal or damage. At a minimum, erosion fencing shall be installed around protected wetlands and wetland buffers. Construction equipment shall be kept out of protected wetlands and wetland buffers unless required for an approved use and signs posted at appropriate intervals intended to restrict entry by equipment or personnel. Construction debris shall be removed from the site and properly disposed of. Chemicals, paints, and solvents, including paint tools, masonry equipment, and drywall tools, shall be used, cleaned, and stored in a manner that does not degrade water quality. Any and all washdown of concrete

trucks shall occur offsite. The Planning Commission shall require preparation of a detailed management program indicating how these requirements are to be addressed.

2. Activities and development in protected wetlands or wetland buffer areas may be approved only after the following list of alternative and mitigating actions, listed from highest to lowest priority, have been considered and a mitigation plan has been approved:

a. Limiting the project to the upland portion of the wetland lot-of-record, exclusive of wetland buffer or protected wetland;

b. Limiting the project to the upland portion of the wetland lot-of-record and the wetland buffer;

c. Rectifying the impact by repairing, rehabilitating, or restoring the affected wetland and wetland buffer area (this would include removing wetland fills, rehabilitation of a resource use and/or extraction site when its economic life is terminated, etc.);

d. Reducing or eliminating the impact over time by preservation and maintenance operations.

3. If limiting the development or activity to the upland portion of the wetland lot-of-record per subsection 17.43.050.K.2(a) is not possible, the Planning Commission shall require a written mitigation plan prepared by a qualified wetland professional as a condition of approval. The mitigation plan shall address anticipated impacts of the proposed development on the wetland or wetland buffer and shall propose measures to mitigate the onsite impacts to the protected wetland and wetland buffer to the maximum extent possible, including but not be limited to, the restoration of native vegetation; restoration of hydric soil; restoration of the clay pan or other natural water barriers; restoration of natural slopes and contours; restoration of natural drainage or water flows; restoration of the wetland's nutrient cycle; and the restoration of wildlife habitat that may be impacted by the proposed develop or activity. The mitigation plan will remain in effect for a period of five years following completion of the development or project, unless extended for non-compliance, with an affirmative obligation on the part of the applicant to restore or repair mitigation efforts, as required by conditions through the end of the effective period.

a. Upon approval, the mitigation plan shall be integrated with the design package, and it shall be the responsibility of building officials to confirm compliance with the mitigation plan issuing a certificate of occupancy. In the event that mitigation efforts are not completed when occupancy is requested, the owner or the owner's agent may certify in writing that owner or its agent will complete the mitigation plan within a specified period. The certification shall represent the owner's or owner's agent's agreement in exchange for granting the certificate of occupancy that the mitigation plan will be completed in accordance with its terms.

b. If a landowner or responsible party fails to implement a mitigation plan, the City may undertake any action necessary to comply with mitigation plan and all associated costs and accrued interest thereon will become the immediate responsibility of the landowner or responsible party.

4. Any combination of the actions in subsection (K)(2) may be required to implement mitigation requirements.

5. The US Army Corps of Engineers or the Division of State Lands often require compensatory mitigation (subsection (K)(2)(e), of this section) as part of their approval of a fill permit. The city may require compensatory mitigation before approving a fill in a protected wetland when the US Army Corps of Engineers and the Division of State Lands do not require compensatory mitigation. Additional compensatory mitigation may be required by the city in those instances where it is also required as a condition of a state or federal fill permit.

L. **Vegetation Management**. Vegetation in protected wetlands and in wetland buffer areas may be managed (including planting, mowing, pruning and removal) subject to the following standards:

1. Tree removal in protected wetlands and in wetland buffer areas shall be consistent with the criteria and standards in Chapter 17.70, tree removal.

2. Tree removal and pruning prohibited unless:

a. Necessary for placement of a dwelling or driveway approved pursuant to this chapter including required vehicular and utility access, subject to the requirements in Section 17.70.030(B) and (Q);

b. Necessary for maintenance of an existing dwelling or driveway;

c. Necessary for correction or prevention of foreseeable danger to public safety, or a foreseeable danger of property damage to an existing structure; or

d. Part of an approved restoration, enhancement or compensatory mitigation plan.

3. The fact that a tree or part thereof is or may be dead or compromised (e.g., a snag) is not sufficient criteria for its removal or pruning unless the property owner demonstrates foreseeable danger to public safety, or a foreseeable danger of property damage to an existing structure. An application for the removal of a dead tree shall require an ISA Tree Hazard Evaluation Form prepared by a certified arborist at the property owner's sole expense.

4. Tree trunks, stumps, roots, and bows of trees removed or pruned on protected wetlands and wetland buffers pursuant to this chapter shall be left by the property owner in situ. When a tree is removed, it shall be topped at the highest point possible that avoid hazards while leaving as much stump as possible for wildlife habitat.

5. In all cases, removal or pruning of trees from protected wetlands and wetland buffers must follow best professional standards to ensure protected wetlands and wetland buffer areas are not compromised.

6. Any tree removed in accordance with this Chapter or damaged by activities authorized under this Chapter shall be replaced by the property owner with a tree on the wetland lot-of-record of the same species.

7. Removal of vegetation, except trees covered by Chapter 17.70, in protected wetlands and in wetland buffer areas is permitted only if:

Exhibit C-2

a. Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or

b. Necessary for maintenance of an existing structure, road or pathway; or

c. Necessary for correction or prevention of a hazardous situation; or

d. Necessary for completion of a land survey; or

e. Part of an approved restoration, enhancement or compensatory mitigation plan.

Vegetation removal permitted under subsections L2a through e in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values. Vegetation removal permitted under subsections L2a through e in a wetland buffer area shall be the minimum necessary.

8. Pruning or mowing of vegetation in protected wetlands and in wetland buffer areas is **permitted** only if:

a. Necessary for placement of a structure for which a building permit has been issued (or for which a building permit is not needed); or

b. Necessary for maintenance of an existing structure, road or pathway; or

c. Necessary for correction or prevention of a hazardous situation; or

d. Necessary for completion of a land survey; or

e. Part of an approved restoration, enhancement or compensatory mitigation plan; or

f. Part of a landscape plan approved by the city in **conjunction** with a building permit that minimizes adverse impacts on protected wetlands.

Pruning or mowing permitted under subsections L3a through f in a protected wetland shall be the minimum necessary and in no case shall it substantially impair wetland functions and values. Pruning or mowing permitted under subsections L3a through f in a wetland buffer area shall be the minimum necessary.

9. **Planting new vegetation** in protected wetlands is permitted subject to the following standards:

a. The planting is part of an approved restoration, enhancement or mitigation plan; or

b. The planting is part of a landscape plan involving native wetland plant species, and the plan is approved by the city in conjunction with approval of a building permit; or

c. The planting is intended to replace dead or damaged plants that were either part of a maintained landscape or part of the existing wetland plant community.

10. Planting new vegetation in wetland buffer areas is permitted as part of a managed garden or landscape.

11. Vegetation management practices will be employed in protected wetlands and in wetland buffer areas that minimize short-term and long-term adverse impacts on wetlands. Impacts to be avoided or minimized include turbidity, erosion, sedimentation, contamination with chemicals, unnecessary or excessive vegetation removal, or substantial alteration of native wetland plant communities. The following are not permitted as part of a vegetation management plan for protected wetlands or wetland buffer areas: alteration of wetland hydrology, use of herbicides, or application of soil amendments or fertilizer.

M. **Land Divisions**. Subdivisions, replats, partitions, and property line adjustments are prohibited in protected wetlands and wetland buffer areas. Subdivisions, replats, partitions, and property line adjustments of the upland portion of a wetland lot-of-record are subject to the following standards:

1. Preliminary plat maps for proposed subdivisions, replats and partitions involving a wetland lot-of-record must show the wetland-upland boundary, as determined by a wetland delineation prepared by a qualified wetland professional. The city may seek independent expert opinion when reviewing a wetland delineation. A qualified wetland professional retained or hired by the city under this subsection is expected to render independent expert opinion, consistent with the Society of Wetland Scientists Code of Ethics.

2. Subdivisions, replats, partitions and property line adjustments of upland portions of a wetland lot-of-record are permitted subject to the following standards:

a. Upland portions of a wetland lot-of-record that is subject to subdivision, replats, partitions or property line adjustments must meet the minimum parcel dimension requirements for the parcel’s base zone.

b. There are two options for the size of the newly-created lot or parcel that contains wetlands and/or wetland buffer areas. If the newly-created lot or parcel is subject to a recorded conservation easement in perpetuity and transferred to the City at its discretion or an accredited land trust, there is no requirement for additional upland area. By contrast, if the newly-created lot or parcel will remain in the buildable lands inventory, the lot or parcel that contains wetlands and/or wetland buffer areas must also include a minimum of two thousand five hundred square feet of buildable upland area. .

c. Protected wetlands and wetland buffer areas may be counted towards meeting the base zone’s minimum lot size for each lot, and may not be included in front, side and rear yard setbacks.

d. Utility lines, including but not limited to, water lines, sewer lines, and storm water lines shall not be located in protected wetlands or wetland buffer areas, unless there is no alternative to serve lots meeting the standards of this subsection.

e. Streets shall not be located in protected wetland or wetland buffer areas.

3. Once a site has been subdivided, replatted, partitioned or lot lines adjusted subject to this subsection, no further land division or adjustment shall be permitted on any of the resulting lots or parcels.

4. For lots or parcels created subject to these provisions, the existence of protected wetland or wetland buffer areas shall not form the basis for a future setback reduction or variance request. (Ord. 94-29 § 2)

B. **Reasonable use of a wetland lot-of-record** is defined as an upland portion of the wetland lot-of-record that can accommodate 1,000 square feet of lot coverage. This section defines the accommodations that can be made to allow reasonable use of a wetland lot-of record in the event uplands are not sufficient to allow such reasonable use.

1. **Buffer Averaging**. Where the upland portion of the lot-of-record cannot accommodate one thousand square feet of lot coverage, buffer averaging to allow reasonable use of a parcel may be permitted when all of the following are met:

a. No feasible alternatives to the site design to accommodate one thousand square feet of lot coverage could be accomplished without buffer averaging; and

b. The averaged buffer will not result in degradation of the wetland's functions and values as demonstrated by a an assessment from a qualified wetland professional; and

c. The total buffer area after averaging is equal to the area required without averaging; and

d. The buffer at its narrowest point is never less than 75 percent of the required width (i.e., 75% of 50 feet = 37.5 feet).

2. **Wetland Buffer Reduction** (Up to 50 Percent for Undeveloped Properties). Where reasonable use cannot be obtained through the combination of upland areas and buffer averaging, the wetland buffer may be reduced by application to the Planning Commission up to 50 percent where equal or better protection for identified resources will be ensured through restoration, enhancement, and similar measures. Specifically, the following criteria and conditions must be met to be eligible for a wetland buffer reduction. The applicant must demonstrate that:

a. The application of the wetland buffer to the lot or parcel precludes all reasonable use of the lot or parcel and renders it not buildable, after consideration of all applicable limitations and restrictions in this code; and

b. The lot or parcel is a wetland lot-of-record in existence prior to the Effective Date in 17.43.010(D) (i.e., buffer reduction is not available for land divisions); and

c. The lot or parcel must be combined for development purposes with contiguous lots or parcels in the same ownership on the effective date of the ordinance codified in this chapter; and

d The proposed development shall minimize disturbance to the wetland buffer area by utilizing design options to minimize or reduce impacts of development: (i) multistory construction shall be used;

(ii) parking spaces shall be minimized to no more than that required as a minimum for the use; (iii) no accessory structures allowed; (iv) paving shall be pervious; (v) engineering solutions shall be used to minimize additional grading and/or fill; and

e. The proposed development or activity is designed to minimize intrusion into the wetland buffer area. Specifically, the use or activity is designed using up to a 50 percent adjustment to any dimensional standard (e.g., front yard, side yard or other setbacks) to permit development as far outside or upland of the wetland buffer area as is possible; and

f. The protection of the wetland can be assured through restoration, enhancement, and other similar measures in the wetland buffer area in accordance with subsection 17.43.050(K).

3. Siting for Development. Where combined uplands, buffer averaging, and buffer reduction do not permit reasonable use of a wetland lot-of-record, minimum development of the wetland overlay area necessary to avoid a taking claim shall be permitted subject to compliance with the following standards:

a. The lot or parcel must be combined for development purposes with contiguous lots or parcels in the same ownership on the Effective Date of the ordinance codified in this Chapter; and

b. The building footprint encroaching into the wetland overlay area shall be limited to that which is the minimum necessary to obtain reasonable use of the property; and

c. The application of the wetland overlay zone to the lot or parcel precludes all reasonable use of the parcel and renders it not buildable, after consideration of all applicable limitations and restrictions in this code; and

d. Preference in location of the building footprint shall be given to areas devoid of native vegetation; and

e. Application may be made to the Planning Commission to **adjust the underlying zone setback standards** to the extent necessary to reduce or minimize encroachment into the protected wetland or wetland buffer area. The Planning Commission may approve an application for up to a 50 percent adjustment to any dimensional standard (e.g., front yard, side yard or other setbacks) to permit development as far outside or upland of the protected wetland and wetland buffer area as possible; and

f. The proposed development shall minimize disturbance to the protected wetland and wetland buffer area by **utilizing design options to minimize or reduce impacts** of development including but not limited to multistory construction, minimizing parking, garage space, and paving and use of retaining walls or other engineering solutions to minimize filling and grading; and

g. In no case shall the **impermeable surface area** of the residential use (including building footprint, driveway, and parking areas and accessory structures) exceed 1,000 square feet within **wetland overlay areas**; and

h. All applicable general criteria in 17.43.050, including minimum restoration and enhancement requirements shall be met.

Exhibit C-3

WETLAND OVERLAY AMENDMENTS

The Cannon Beach Planning Commission will hold a public hearing on the following date:

October 26, 2023, at 6:00 PM City Hall Council Chamber, 163 Gower St.

ZO 23-02, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetlands Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070 A, Amendments Criteria, and the Statewide Planning Goals.

All interested parties are invited to attend the hearing to express their views. Statements will be accepted in writing or orally at the hearing, either virtually or in person. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue. All correspondence or further inquiries should be sent to the Community Development Department, PO Box 368, Cannon Beach, OR 97110 or via email at planning@ci.cannon-beach.or.us. Staff reports or other materials will be available online seven (7) days prior to the hearing. The Planning Commission reserves the right to continue the hearing to another date/time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097

Posted/Mailed: 9/29/2023

NOTICE TO MORTGAGEE, LIEN-HOLDER, VENDOR OR SELLER:
PLEASE PROMPTLY FORWARD THIS NOTICE TO THE PURCHASER

Exhibit C-4

WETLAND OVERLAY AMENDMENTS

This is to notify you that the City of Cannon Beach has proposed a land use regulation that may affect the permissible uses of your property and other properties.

The Cannon Beach Planning Commission will hold a public hearing on the following date:
October 26, 2023, at 6:00 PM City Hall Council Chamber, 163 Gower St.

ZO 23-02, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetlands Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070 A, Amendments Criteria, and the Statewide Planning Goals.

State law requires the City to mail notices to property owners with specific language used on this flyer. Numerous property owners are receiving this notice and the City has no way to verify whether, how or when proposed land use regulations will affect the value of individual properties. Your receipt of this notice does not necessarily mean that this proposed amendment will limit the use of your property or impact the value of your property.

All interested parties are invited to attend the hearing to express their views. Statements will be accepted in writing or orally at the hearing, either virtually or in person. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue.

All correspondence or further inquiries should be sent to the Community Development Department, PO Box 368, Cannon Beach, OR 97110 or via email at planning@ci.cannon-beach.or.us. Staff reports or other materials will be available online seven (7) days prior to the hearing. The Planning Commission reserves the right to continue the hearing to another date/time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097

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PLEASE PROMPTLY FORWARD THIS NOTICE TO THE PURCHASER

City of Cannon Beach, P. O. Box 368, Cannon Beach, OR 97110
(503) 436-1581 • FAX (503) 436-2050 •TTY: 503-436-8097 • www.ci.cannon-beach.or.us

Exhibit C-5

CANNON BEACH COMMUNITY DEVELOPMENT
163 E. GOWER ST.
PO BOX 368
CANNON BEACH, OR 97110

City of Cannon Beach to Consider Revised Wetland Overlay Ordinance

Media Contact: Steve Sokolowski, sokolowski@cannon-beach.or.us

October 17, 2023

The City of Cannon Beach Planning Commission will hold its first evidentiary hearing regarding proposed changes to the Wetland Overlay zoning ordinance on Thursday, October 26, 2023 at 6:00pm at City Hall at 163 E. Gower St.

As those who have been following the City of Cannon Beach code audit process know, revisions to the wetland overlay zone regulations have been "fast tracked" and are ready to be unveiled. The initial effort was undertaken by a group of local citizens. The Urbsworks team, which is contracted to assist the City with Community Development Ordinance revision project, was asked to review the document and make recommendations as to how it might be further improved and is responsible for moving the revisions through the state review process and adoption.

The goal of these revisions is to bring wetland protections in Cannon Beach up to the standard of other municipalities in Oregon. The focus throughout the process has been on maximizing environmental protection for our dwindling local wetlands while maintaining the ability for every lot owner to make use of their property. Anyone who has an interest in this matter is encouraged to read the draft language, which will be available beginning Thursday, October 19, 2023, on the City's website.

The draft of the proposed revised ordinance will be formally introduced to the Planning Commission during a public hearing on Thursday, October 26, 2023. During this hearing, and possible future hearings on this matter, the Commission will hear evidence regarding the proposal, conduct deliberations, and make a recommendation to City Council regarding the proposed revisions to the ordinance. This is an opportunity for everyone who has an interest in local wetlands to have their voices heard. The City Council will then hold a public hearing where they will likewise hear evidence and conduct deliberations before making a decision on the proposed revisions. The date of the initial evidentiary hearing before City Council is to be determined.

It should be noted that a Measure 56 notice has been issued to property owners with wetland affected properties advising them of rulemaking changes that may have potential impacts to their property values. The City has no way to verify whether, how, or when proposed land use regulations will affect the value of individual properties. The Planning Commission will not be addressing property-specific questions during this hearing.

During this process the public is encouraged to submit written comments to both the Planning Commission and City Council and attend and participate in the public hearings. Comments may be sent to the following:

Email: planning@ci.cannon-beach.or.us

Mail: P.O. Box 368, Cannon Beach, OR 97110

CANNON BEACH COMMUNITY DEVELOPMENT
163 E. GOWER ST.
PO BOX 368
CANNON BEACH, OR 97110

MEMORANDUM

RE: Summary of Public Comments Received Regarding Proposed Wetland Overlay Zone Amendment

October 19, 2023

Below is a summary of the public comments that the Community Development Department has received regarding the proposed amendment to the Wetland Overlay Zone. As of the date of this writing five comments have been submitted to the City.

- Community Development has received a number of general inquiries about the ordinance proposal that included proposed amendments/changes, how the changes impact their uses and values, public hearings, opportunities for testimony, etc.

- People inquiring about the opportunity to receive the proposed documentation in a timely fashion to be able to properly prepare for the hearing.

- Page 4 of the draft reorganization of chapter 17.43 states that only one structure will be allowed on a wetland lot of record with a type 3 procedure. Please note that the wetland area is protected by the delineation and the buffer, and no further restriction is needed regarding the number of structures. Also, there is a substantial difference between the impact on a 5000 SF site and a 10-acre site with only a small area of wetland land and buffer on either. As written, a 10-acre site with 9 acres of upland could be restricted to one house—why? This defies logic. The goal is to protect wetlands, and nothing is gained by restricting the number of structures.

- The foot path definition needs to be clearly stated that it is addressing public access bike and foot paths, otherwise staff could inappropriately apply this to private walkways between a garage and a house.

- Please also note the conflict in the draft regarding the FAR limit being based on only the upland portion of a site. As written a 10,000 SF wetland lot of record with 1000 SF of upland could be restricted to .6 times 1000 SF or 600 SF, which is essentially a 100% taking. The FAR limit should be based on the underlying zoning code. The restriction suggested may also be in conflict with page 19 item B regarding "reasonable Use…" The overall goal should be to protect the wetland, any restriction that goes beyond that goal should be eliminated from the draft.

- On page 9 of the draft it says that home SHALL be built on piles, with no evidence that piles will be required to protect the wetlands. Each circumstance should be viewed individually regarding whether piling are required. The word SHALL should be replaced with MAY or this issue should be left up to wetland professionals.

- I would add a section that says " any limitation on development resulting from implementation of the code as written, can be overridden by evidence provided by property owner that proposed action will not detrimentally impact the wetland portion of a site." The goal should be only to protect the wetlands using science as a bases, and so long as it can be demonstrated that this goal can be achieve, human activity should be allowed on a site subject to zoning code. This statement is aligned with the 17.43.010 purpose statement that says the goal is to Protect wetland areas. The city is attempting to protect the wetlands in a complex manner presented in 20 pages of restrictions. If the goal can be achieved by mitigation or proof that wetlands are not impacted, normal zoning restrictions should apply.

- While I am in support of efforts being addressed to secure appropriate wetland protections within our City, I am disturbed by the inaccuracy of the maps specifically provided on the city website, which are intended to support this proposed wetland revision. The "LWI stream sites" included in the maps which represent the north end are inaccurate- *and should be corrected!*
  Without the assurance of accurate recording of the streams that currently exist in our area, there is a high likelihood that important factual information related to these proposed revisions will be overlooked and/or dismissed.

- Recently one of my neighbors and myself were informed of the results of a study which was contracted by the City, and conducted by "Windsor Engineering," in order to assess serious flooding events which occurred on our street (N. Laurel) in November of 2021, and again in January of 2022. The results of this study have been attached for your review- and for clarification of accurate stream bed representations - which should be implemented in this proposed "Revised Wetland Overlay Ordinance."

- In addition to the Windsor Engineering study, I have provided a close up view of one of the maps. Note how the map presented indicates a stream bed originating on N. Laurel St. and suggesting that the stream origin begins just above the intersection of Laurel St (which is actually N. Laurel St.) and 7th St. In reality, the origin of that stream bed begins several lots upward on N. Laurel St. and as you will see from the Windsor Engineering study, it is recognized as a "tributary of the Logan Creek." In fact, that "tributary of Logan Creek" enters into a culvert just north of where your map suggests that the stream *begins.*

- The Zoning Ordinance text amendments have not been posted to the City of Cannon Beach's website, yet in order for a property owner's comments to be included in the Planning Commission's meeting materials for the October 26, 2023 meeting, their comments are due today? This is an important topic that will impact numerous property owners, and the Planning Commission of the City of Cannon Beach should allow reasonable time to review the changes to the Zoning Ordinance and provide questions and/or comments. I ask that the Planning Commission delay this public hearing for at least 3 months to allow owners sufficient time to review the Ordinance.

- The Department of Public Works had some concerns regarding property owners allowing any surface water to run onto a neighboring property owner and do not want any conflicts with their ordinances which prevent this from occurring.

Exhibit D-1

Robert St. Clair

From: ROCHELLE BENSON-JACKSON <rbbenson19@msn.com>
Sent: Friday, October 6, 2023 11:23 PM
To: Planning Group
Cc: Brian Jackson; Rochelle Jackson
Subject: re: City of Cannon Beach Wetlands Buffer increase impact to property owners 10/6/2023

10/6/2023

To the Planning Commission and City Council,

I wanted to raise my concerns on a few issues regarding the Wetlands Buffer.

1. I strongly disagree with the prohibition of short-term rentals for wetlands buffer impacted properties. This seems like an arbitrary requirement which will impact the property value of my home. You could make the same argument about any tourist visiting Cannon Beach.
2. What is the impact to existing structures and driveways? Will existing structures be grandfathered?
3. When will we get a more definitive view of the new wetlands buffer on our property?
4. How can we petition for a property tax decrease for loss of value because of the wetlands buffer?

Thanks for your insight.

Rochelle Benson Jackson
207 E. Harrison
Cannon Beach, OR 97110
(503) 679-9957

Sent from my iPhone

Exhibit D-2

Robert St. Clair

From: dave pietka <dpietka@msn.com>
Sent: Friday, October 6, 2023 9:55 AM
To: Planning Group
Subject: Wetland lot of record comment

Dear Planning Commission and City Council: Page 4 of the draft reorganization of chapter 17.43, states that only one structure will be allowed on a wetland lot of record with a type 3 procedure. Please note that the wetland area is protected by the delineation and the buffer, and no further restriction is needed regarding the number of structures. Also, there is a substantial difference between the impact on a 5000 SF site and a 10 acre site with only a small area of wetland land and buffer on either. As written a 10 acre site with 9 acres of upland could be restricted to one house—why? This defies logic. The goal is to protect wetland and nothing is gained by restricting the number of structures.

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Please also note the conflict in the draft regarding the FAR limit being based on only the upland portion of a site. As written a 10,000 SF wetland lot of record with 1000 SF of upland could be restricted to .6 times 1000 SF or 600 SF, which is essentially a 100% taking. The FAR limit should be based on the underlying zoning code. The restriction suggested may also be in conflict with page 19 item B regarding "reasonable Use..." the overall goal should be to protect the wetland, any restriction that goes beyond that goal should be eliminated from the draft.

On page 9 of the draft it says that home SHALL be built on piles, with no evidence that piles will be required to protect the wetlands. Each circumstance should be viewed individually regarding whether piling are required. The word SHALL should be replaced with MAY or this issue should be left up to wetland professionals.

I would add a section that says " any limitation on development resulting from implementation of the code as written, can be overridden by evidence provided by property owner that proposed action will not detrimentally impact the wetland portion of a site." The goal should be only to protect the wetlands using science as a bases, and so long as it can be demonstrated that this goal can be achieve, human activity should be allowed on a site subject to zoning code. This statement is aligned with the 17.43.010 purpose statement that says the goal is to Protect wetland areas. The city is attempting to protect the wetlands in a complex manner presented in 20 pages of restrictions. If the goal can be achieved by mitigation or proof that wetlands are not impacted, normal zoning restrictions should apply.

Thanks,

David Pietka
503-206-1071

Exhibit D-3

Robert St. Clair

From: Judy Graves <judyjgraves@gmail.com>
Sent: Monday, October 16, 2023 7:32 AM
To: Planning Group
Subject: Wetland Overlay Amendments
Attachments: 115 Elliot Way Wetland Determination_final.pdf; WD20210600 AgencyDecision.pdf Wetland Final.pdf

To: Cannon Beach Planning Commission,

From: Judy Graves, property owner (lots 10 & 11, Spruce Park)

To whom it may concern,

In the summer of 2021, I contacted the Cannon Beach Planning department to inquire about the status of lots 10 and 11, Spruce Park bordered by Elliott Way and Hemlock. I was told by the planning department that I needed to have a Wetland Study completed since the possibility of wetlands had been noted in a previous study and that Columbia River Estuary Study Taskforce (Crest) did such work. Upon my request Crest completed the study. (See first attachment). In March of 2022 the Department of State Lands reviewed the study by Crest and approved the study with revisions.

These documents should be in your city records, but I'm not assuming anything since all this work took place during the pandemic years and things may have gone astray. For this reason, I am attaching two documents that will be useful on the Wetland Overlay work you are doing.

With regards,

Judy Graves

Exhibit D-3

Oregon
Kate Brown, Governor

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
(503) 986-5200
FAX (503) 378-4844
www.oregon.gov/dsl

State Land Board

Kate Brown
Governor

Shemia Fagan
Secretary of State

Tobias Read
State Treasurer

March 17, 2022

Judy Graves
6611 SE Yamhill Ct
Portland, OR 97215

Re: WD # 2021-0600 **Approved with Revisions**
Wetland Delineation Report for 115 Elliot Way
Clatsop County; T5N R10W S30DA TL6900
Cannon Beach Local Wetlands Inventory, Wetland 23

Dear Judy Graves:

The Department of State Lands has reviewed the wetland delineation report prepared by CREST for the site referenced above. upon the information presented in the report, a site visit on February 17, 2022, and additional information submitted upon request, we concur with the wetland boundaries as mapped in revised Figure 6 of the report. Please replace all copies of the preliminary wetland map with this final Department-approved map.

Within the study area, 2 wetlands (Wetland 1 and 2, totaling approximately 0.008 acres) were identified. They are subject to the permit requirements of the state Removal-Fill Law. Under current regulations, a state permit is required for cumulative fill or annual excavation of 50 cubic yards or more in wetlands or below the ordinary high-water line (OHWL) of the waterway (or the 2-year recurrence interval flood elevation if OHWL cannot be determined).

This concurrence is for purposes of the state Removal-Fill Law only. We recommend that you attach a copy of this concurrence letter to any subsequent state permit application to speed application review. Federal, other state agencies or local permit requirements may apply as well. The U.S. Army Corps of Engineers will determine jurisdiction under the Clean Water Act, which may require submittal of a complete Wetland Delineation Report.

Please be advised that state law establishes a preference for avoidance of wetland impacts. Because measures to avoid and minimize wetland impacts may include reconfiguring parcel layout and size or development design, we recommend that you work with Department staff on appropriate site design before completing the city or county land use approval process.

Exhibit D-3

This concurrence is based on information provided to the agency. The jurisdictional determination is valid for five years from the date of this letter unless new information necessitates a revision. Circumstances under which the Department may change a determination are found in OAR 141-090-0045 (available on our web site or upon request). In addition, laws enacted by the legislature and/or rules adopted by the Department may result in a change in jurisdiction; individuals and applicants are subject to the regulations that are in effect at the time of the removal-fill activity or complete permit application. The applicant, landowner, or agent may submit a request for reconsideration of this determination in writing within six months of the date of this letter.

Thank you for having the site evaluated. If you have any questions, please contact the Jurisdiction Coordinator for Clatsop County, Daniel Evans, PWS, at (503) 986-5271.

Sincerely,

Pete Ryan

Peter Ryan, SPWS
Aquatic Resource Specialist

Enclosures

ec: April Silva, CREST
Cannon Beach Planning Department (Maps enclosed for updating LWI)
Brad Johnson, Corps of Engineers
Dan Cary, SPWS, DSL
Oregon Coastal Management Program (coast.permits@state.or.us)

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

Exhibit D-3

A complete report and signed report cover form, along with applicable review fee, are required before a report review timeline can be initiated by the Department of State Lands. All applicants will receive an emailed confirmation that includes the report's unique file number and other information.

Ways to submit report:

- **Under 50MB** - A single unlocked PDF can be emailed to: wetland.delineation@dsl.oregon.gov.
- **50MB or larger** - A single unlocked PDF can be uploaded to DSL's Box.com website. After upload notify DSL by email at: wetland.delineation@dsl.oregon.gov.
- OR a hard copy of the unbound report and signed cover form can be mailed to: Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279.

Ways to pay review fee:

- By credit card on DSL's epayment portal after receiving the unique file number from DSL's emailed confirmation.
- By check payable to the Oregon Department of State Lands attached to the unbound mailed hardcopy OR attached to the complete signed cover form if report submitted electronically.

Contact and Authorization Information

☐ Applicant ☒ Owner Name, Firm and Address:

Judy Graves
6611 SE Yamhill Ct
Portland, OR 97215-2036

Business phone #
Mobile phone # (optional) (503) 720-5907
E-mail: judyjgraves@gmail.com

☒ Authorized Legal Agent, Name and Address (if different):

April Silva
CREST
818 Commercial St Ste 203
Astoria,OR 97103

Business phone # (503) 325-0435
Mobile phone # (optional) (503) 440-0434
E-mail: asilva@columbiaestuary.org

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: April Silva **Signature:** April Silva Digitally signed by April Silva Date: 2022.03.04 11:23:21 -08'00'

Date: 03/04/2022 Special instructions regarding site access: N/A

Project and Site Information

Project Name: 115 Elliot Way

Latitude: 45.887094 Longitude: -123.962136
decimal degree - centroid of site or start & end points of linear project

Proposed Use:
residential development

Tax Map # 51030DA06900
Tax Lot(s) 6900

Tax Map #
Tax Lot(s)

Project Street Address (or other descriptive location):
On the corner of Hemlock and Elliot Way near south of midtown entrance into Cannon Beach on west side of HWY 101.

City: Cannon Beach County: Clatsop

Township 5N Range 10W Section 30 QQ
Use separate sheet for additional tax and location information

Waterway: N/A River Mile: N/A

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:

April Silva
CREST
818 Commercial St Ste 203
Astoria,OR 97103

Phone # (503) 325-0435
Mobile phone # (if applicable) (503) 440-0434
E-mail: asilva@columbiaestuary.org

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.

Consultant Signature: April Silva Digitally signed by April Silva Date: 2022.03.04 11:23:42 -08'00' Date: 03/04/2022

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No Study Area size: 0.02 Total Wetland Acreage: 0.0080

Check Applicable Boxes Below

- ☐ R-F permit application submitted
- ☐ Mitigation bank site
- ☐ EFSC/ODOE Proj. Mgr:
- ☐ Wetland restoration/enhancement project (not mitigation)
- ☐ Previous delineation/application on parcel
  If known, previous DSL # _____
- ☐ Fee payment submitted $ _____
- ☐ Resubmittal of rejected report ($100)
- ☐ Request for Reissuance. See eligibility criteria. (no fee)
  DSL # _____ Expiration date_____
- ☒ LWI shows wetlands or waters on parcel
  Wetland ID code 23

For Office Use Only

DSL Reviewer: DE Fee Paid Date: _____ / _____ / _____ DSL WD # 2021-0600

Date Delineation Received: ___/ ___/ ___ DSL App.# ______________

Exhibit D-3

Figure 1

115 Elliot Way Location Map

Exhibit D-3

Figure 2

Tax Lot Map

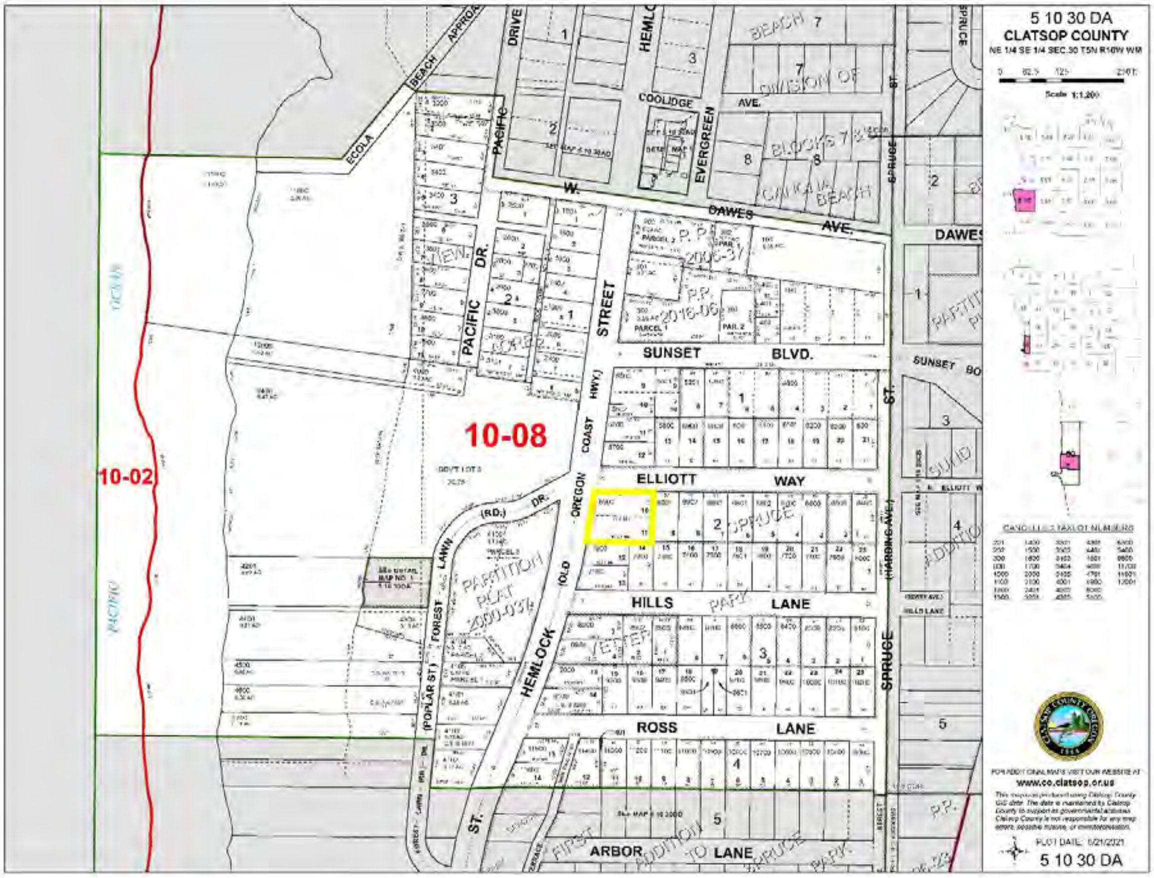
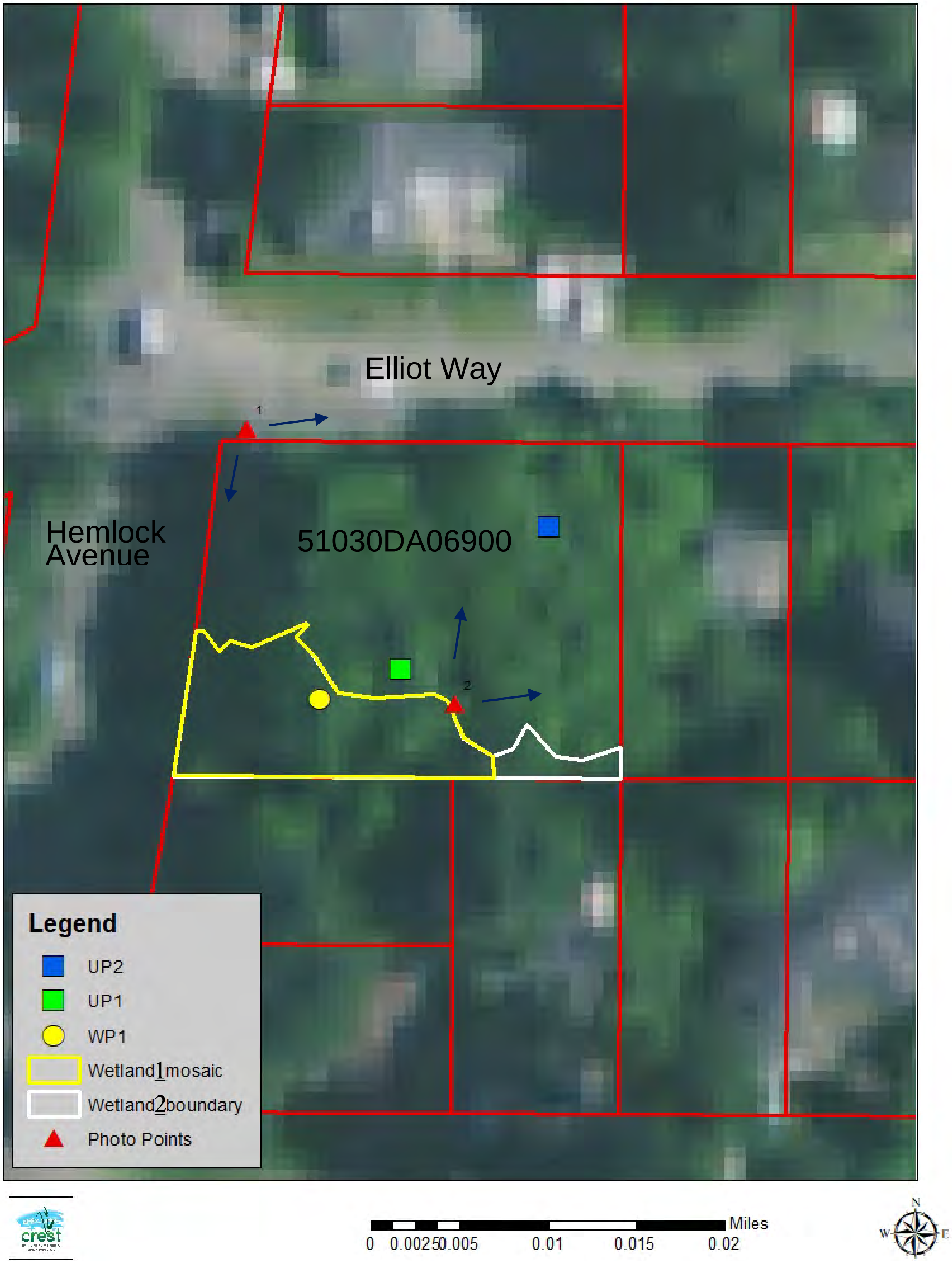


Exhibit D-3

DSL WD # 2021-0600
Approval Issued 3/17/2022
Approval Expires 3/17/2027

Figure 6

115 Elliot Way Wetland Map



Wetland 1: 0.006 acres (70% wetland) PFO-Depressional-Closed Nonpermanently Flooded

Wetland 2: 0.002 acres, PFO-Depressional-Closed Nonpermanently Flooded

Exhibit D-3

9/23/2021

Wetland Determination Report

115 Elliot Way, Cannon Beach, OR

April Silva
COLUMBIA RIVER ESTUARY STUDY TASKFORCE

Exhibit D-3

Introduction & Site Description

This report was prepared for Judy Graves by the Columbia River Estuary Study Taskforce. On September 13th, 2021, CREST's Lead Ecologist completed a wetland determination for taxlot 51030DA06900 in Cannon Beach, Oregon. The site is bordered to the west by Hemlock Street, to the north by Elliot Way, and by developed lots on the east and south. The site is entirely vegetated with a Red Alder canopy (*Alnus rubra*), a shrub layer of Red Elderberry (*Sambucus racemosa*), Black twinberry (*Lonicera involucrata*), Sword fern (*Polystichum munitum*), and Armenian blackberry (Rubus armeniacus). The herbaceous layer is dominated by Slough sedge (Carex obnupta), English ivy (*Hedera helix*), False Lily of the valley (*Maianthemum dilatatum*), and sword fern (Polystichum munitum), with patches of Pacific water parsley (*Oenanthe sarmentosa*).

Left: Elliot Way looking east.

Right: looking south into study area.

Methods

A routine onsite determination was performed to identify any wetlands or waters of the state within the project area. At each plot vegetation, hydrology, and soils were examined for wetland indicators. Depth of soil pits ranged from 15 to 16 inches. A 1-meter^2 quadrat was used for herbaceous vegetation, with a 3 meter and 5 meter circle used for shrubs and trees, respectively. Data collection followed the Field Guide for Wetland Delineations (Army Corp of Engineers 1987), and the Western Mountains, Valleys, and Coast Regional Supplement Version 2.0 for plant, soil, and hydrology wetland indicators (Army Corp of Engineers 2010). Prior to selecting sampling points the entire site was walked, around the borders and then in transects throughout to evaluate changes in microtopography, vegetation, and look for wetland or stream indicators. Once familiar with the site specific sampling plot locations were selected. Two plots were completed in the most 'suspicious' locations: lowest elevation and with vegetation with the highest wetland rating.

Exhibit D-3

Findings

Three wetland indicators are used for a determination: vegetation, soil, and hydrology. The study area has only one of the three indicators: hydrophytic vegetation. No evidence of a stream, even an ephemeral one, was found. Examination of soils at the plots revealed a complete lack of hydric soil and hydrologic indicators. Data plots were done in the lowest areas onsite with the premise that if there are no wetland indicators in the lowest most likely to be wetland areas, there will not be indicators at higher elevations with less hydrophytic vegetation present.

The National Wetland Inventory does not show any mapped wetlands in the study area. Soils are mapped as Walluski Silt Loam (71C), 7% to 15% slopes, these are non-hydric and moderately well drained non-wetland soils (NRCS Web Soil Survey). The study area represents a temperate forest environment, where enough shade and precipitation support typically wetland plants, but has neither a hydrologic input or poorly drained soils that would promote and support wetland establishment and persistence. The study area is not a depressional feature that would pond water to support wetland conditions, and the growth conditions of all vegetative strata (tree, shrub, herb) species attests to this as the non-wetland plants are thriving, and the wetland (hydrophytic) species are stunted and stressed.

Presence of Wetland Indicators		
Indicator	**Plot 1**	**Plot 2**
Vegetation	Yes	Yes
Soils	No	No
Hydrology	No	No

In conclusion, no wetlands were found in the study area. Wetland adapted plants are present and dominate the herbaceous layer, however dominant shrubs and tree species are species found in uplands as often as they are wetlands. Surface water was not present, soil was not saturated at 16 inches, and there was no water table present at that depth. No redox signatures, either relict or current, were visible in the soil.

Exhibit D-3

A 16 inch soil pit was excavated to investigate soil and hydrology conditions. Adjacent to the soil pit a 1 meter squared quadrat was used to evaluate vegetation.

Plot 1. Left: Soil profile. Right: Vegetation

Plot 2. Left: Soil profile. Right: Vegetation

Exhibit D-3

Soil Map—Clatsop County, Oregon
(115 Elliot Way, Cannon Beach, OR)

Map Scale: 1:425 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Exhibit D-3

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clatsop County, Oregon
Survey Area Data: Version 18, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 28, 2020—Jun 22, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Exhibit D-3

Map Unit Legend

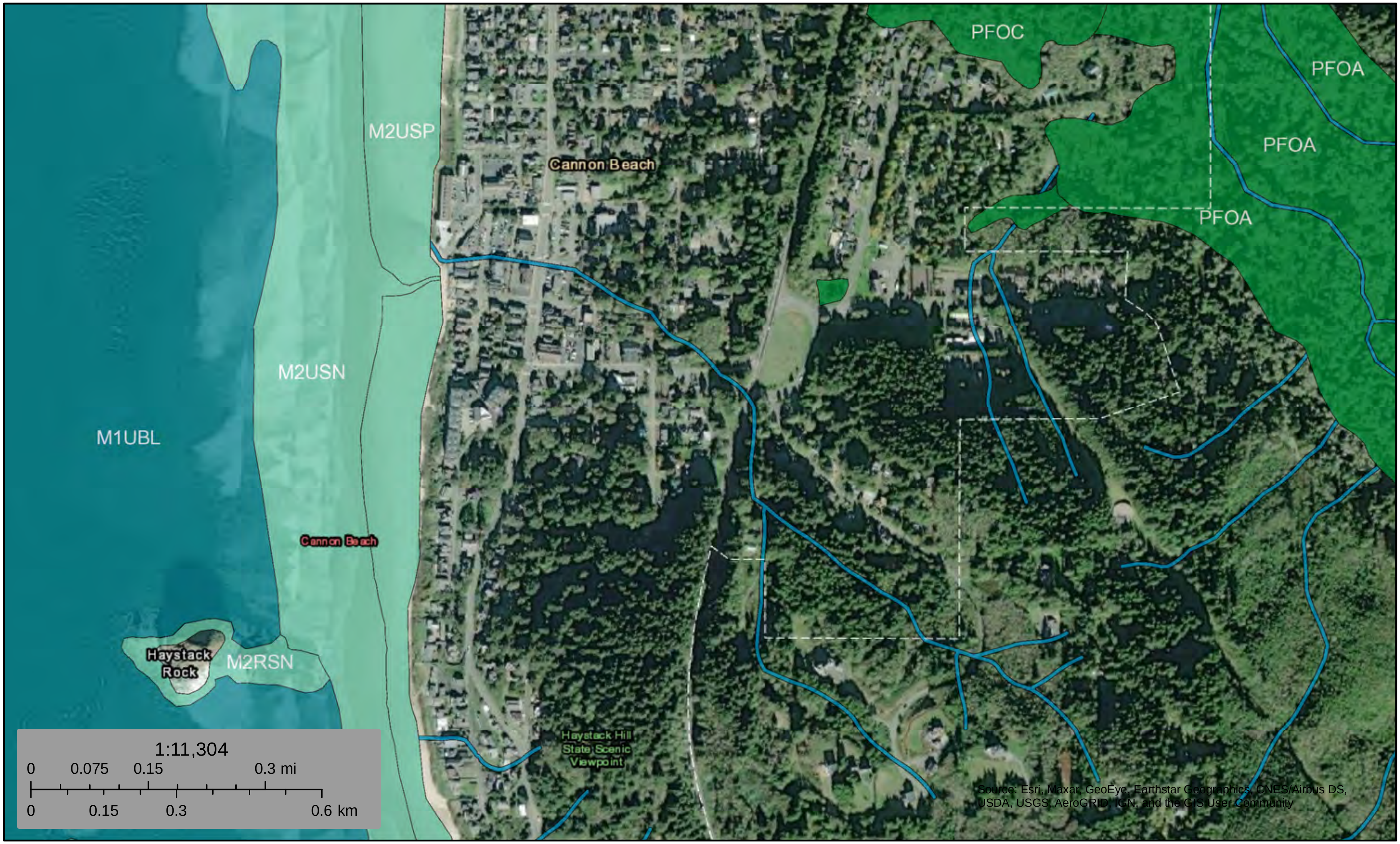
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71C	Walluski medial silt loam, 7 to 15 percent slopes	0.5	100.0%
Totals for Area of Interest		**0.5**	**100.0%**

Exhibit D-3

U.S. Fish and Wildlife Service

National Wetlands Inventory

Cannon Beach



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

September 23, 2021

Wetlands

- 🟦 Estuarine and Marine Deepwater
- 🟩 Estuarine and Marine Wetland
- 🟩 Freshwater Emergent Wetland
- 🟩 Freshwater Forested/Shrub Wetland
- 🟦 Freshwater Pond
- 🟪 Lake
- 🟫 Other
- 🟦 Riverine

Exhibit D-3

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: 115 Elliot Way City/County: Cannon Beach/Clatsop Sampling Date: 9/13/2021
Applicant/Owner: Judy Graves State: OR Sampling Point: Plot 1
Investigator(s): April Silva, Ian Edgar Section, Township, Range: Section 30 Township 5 Range 10
Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): none Slope (%): 0-2%
Subregion (LRR): LRR A Lat: ____ Long: ____ Datum: ____
Soil Map Unit Name: 71C Walluski Silt Loam NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)
Are Vegetation N , Soil N , or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ___
Are Vegetation N , Soil N , or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	**Is the Sampled Area within a Wetland?**	**Yes** ___	**No** X
Hydric Soil Present?	Yes ___	No X			
Wetland Hydrology Present?	Yes ___	No X			

Remarks: surveying wasn't possible under the established canopy.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5 m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Alnus rubra	100	Y	FAC
2.			
3.			
4.			
	100% = Total Cover		

Sapling/Shrub Stratum (Plot size: 3 m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Rubus armeniacus	1	N	FAC
2. Lonicera involucrata	10	Y	FAC
3. Sambucus racemosa	5	Y	FACU
4.			
5.			
	___ = Total Cover		

Herb Stratum (Plot size: 1m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. Hedera helix	15	Y	FACU
2. Carex obnupta	30	Y	OBL
3. Maianthemum dilatatum	15	Y	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	60% = Total Cover		

Woody Vine Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
	0% = Total Cover		

% Bare Ground in Herb Stratum 40%

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)
Total Number of Dominant Species Across All Strata: 6 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 67% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	30	x 1 =	30
FACW species	0	x 2 =	0
FAC species	126	x 3 =	378
FACU species	20	x 4 =	80
UPL species	0	x 5 =	0
Column Totals:	176 (A)		488 (B)

Prevalence Index = B/A = 2.77

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ 5 - Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks:

Exhibit D-3

SOIL

Sampling Point: Plot 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-2	10YR 2/2	100					Silty sand	Heavy roots
2-8	10YR 2/2	100					Silty sand	Less roots
8-11	10YR 3/2	100					Silty sand	No roots

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)

___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? Yes ______ **No** X

Remarks: soil profile was consistent throughout in regard to chroma and value, horizons were separated out mostly by the presence of roots and for the lowest profile chroma.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______
Water Table Present? Yes ___ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Exhibit D-3

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: 115 Elliot Way City/County: Cannon Beach/Clatsop Sampling Date: 9/13/2021
Applicant/Owner: Judy Graves State: OR Sampling Point: Plot 2
Investigator(s): April Silva, Ian Edgar Section, Township, Range: Section 30 Township 5 Range 10
Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): none Slope (%): 0-2%
Subregion (LRR): LRR A Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: 71C Walluski Silt Loam NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)
Are Vegetation N , Soil N , or Hydrology N significantly disturbed? Are “Normal Circumstances” present? Yes X No ___
Are Vegetation N , Soil N , or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ___
Hydric Soil Present? Yes ___ No X
Wetland Hydrology Present? Yes ___ No X

Is the Sampled Area within a Wetland? Yes ___ No X

Remarks: surveying wasn’t possible under the established canopy.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 5 m)			
1. Alnus rubra	100	Y	FAC
2.			
3.			
4.			
	100% = Total Cover		
Sapling/Shrub Stratum (Plot size: 3 m)			
1. Lonicera involucrata	40	Y	FAC
2.			
3.			
4.			
5.			
	40% = Total Cover		
Herb Stratum (Plot size: $1m^2$)			
1. Carex obnupta	15	Y	OBL
2. Maianthemum dilatatum	10	N	FAC
3. Lysichiton americanus	25	Y	OBL
4. Oenanthe sarmentosa	10	N	OBL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	60% = Total Cover		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
	0% = Total Cover		

% Bare Ground in Herb Stratum 40%

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)
Total Number of Dominant Species Across All Strata: 4 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	50	x 1 =	50
FACW species	0	x 2 =	0
FAC species	150	x 3 =	450
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	200 (A)		500 (B)

Prevalence Index = B/A = 2.5

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- x 2 - Dominance Test is >50%
- x 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes x No ___

Remarks:

Exhibit D-3

SOIL

Sampling Point: Plot 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 2/2	100					Silty sand	
6-16	10YR 3/2	100					Silty sand	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)

___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):

Type: ____________________

Depth (inches): ____________________

Hydric Soil Present? Yes ______ **No** __X__

Remarks: soil is completely dry, used water to moisten for texture.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No _X_ Depth (inches): ________
Water Table Present? Yes ___ No _X_ Depth (inches): ________
Saturation Present? (includes capillary fringe) Yes ___ No _X_ Depth (inches): ________

Wetland Hydrology Present? Yes ____ **No** _X_

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Exhibit D-4

Robert St. Clair

From:	Susan Logan <susie@susiestevens.com>
Sent:	Wednesday, October 18, 2023 12:51 PM
To:	Planning Group
Cc:	Jennifer Barrett
Subject:	"Revised Wetland Overlay Ordinance" notification, and resident concern regarding inaccurate map diagrams provided via City website
Attachments:	7th and Laurel Narrative_Final 2023-08-29 2.pdf; Screenshot CLOSE UP OF Urbsworks N. end Cannon Beach map and stream designation.pdf

Hello,

I am a resident of Cannon Beach, and my property is located on the north end of our town. While I am in support of efforts being addressed to secure appropriate wetland protections within our City, I am disturbed by the inaccuracy of the maps specifically provided on the City website, which are intended to support this proposed wetland revision. The "LWI stream sites" included in the maps (I assume, provided by "Urbsworks" ?) which represent the north end are inaccurate- *and should be corrected!*

Without the assurance of accurate recording of the streams that currently exist in our area, there is a high likelihood that important factual information related to these proposed revisions will be overlooked and/or dismissed.

Recently one of my neighbors and myself were informed of the results of a study which was contracted by the City, and conducted by "Windsor Engineering," in order to assess serious flooding events which occurred on our street (N. Laurel) in November of 2021, and again in January of 2022. The results of this study have been attached for your review- and for clarification of accurate stream bed representations - which should be implemented in this proposed "Revised Wetland Overlay Ordinance."

In addition to the Windsor Engineering study (which provides maps of the north end of Cannon Beach, included to assess the flooding on our N. Laurel street, on pp. 25-26 of the study), I have provided a close up view of one of the maps included by the "Urbsworks Team," who has been contracted by the City to assist this wetland revision ordinance. Note how the map that Urbsworks has presented indicates a stream bed originating on N. Laurel St. and suggesting that the stream origin begins just above the intersection of Laurel St (which is actually **N.** Laurel St.) and 7th St. In reality, the origin of that stream bed begins several lots upward on N. Laurel St. and as you will see from the Windsor Engineering study, it is recognized as a "tributary of the Logan Creek." In fact, that "tributary of Logan Creek" enters into a culvert just north of where your map suggests that the stream *begins.* A comparison of the maps provided by Windsor Engineering verses that of Urbsworks should provide the clarity (and corrections) which I hope to have addressed in this correspondence.

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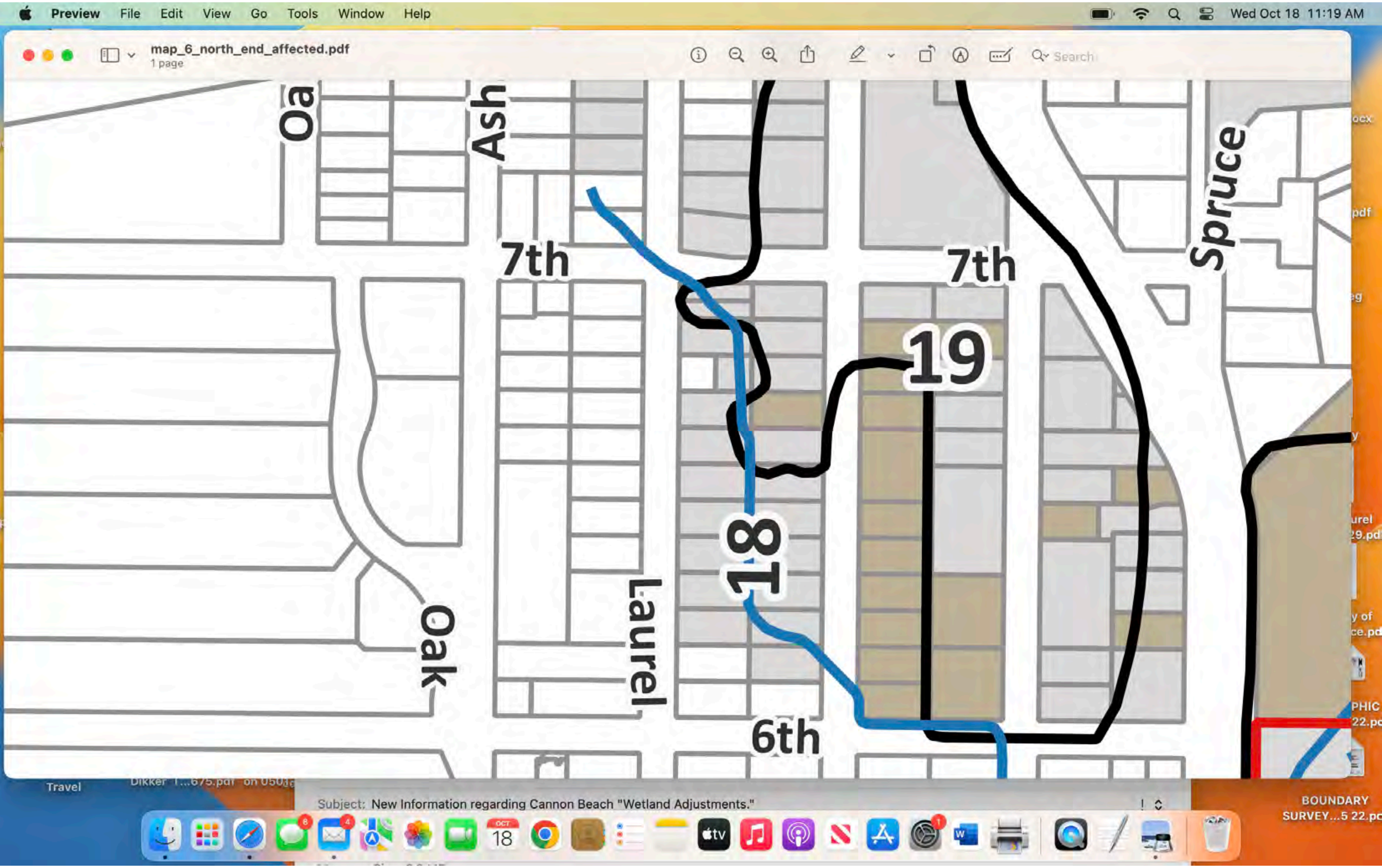

Subject: New Information regarding Cannon Beach "Wetland Adjustments."

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Thank you for your time,

Susie Stevens Logan

Inaccurate “Urbsworks” map of N. End stream representation:

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CITY OF CANNON BEACH
7th & Laurel Intersection

Stormwater & Flooding Assessment
AUGUST 29, 2023

Submitted by
Windsor Engineers
Civil, Mechanical & Electrical Engineers
27300 NE 10th Avenue
Ridgefield, WA 98642
360.610.4931

Prepared for
City of Cannon Beach
163 E. Gower St.
PO Box 368
Cannon Beach, OR 97110
503.436.5068

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1.0 PROJECT TEAM

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2.0 CERTIFICATION

CERTIFICATE OF THE ENGINEER

Title: Stormwater & Flooding Assessment

Project: 7th & Laurel

This Assessment was initially completed as a draft document in February 2023. All data references in this assessment collected prior to that date. This current August 2023 final version of the assessment includes minor edits, but does not include any new data or findings.

This Assessment has been prepared under my supervision and meets the standard of care for similar documents within the engineering community.

Windsor Engineers

REGISTERED PROFESSIONAL ENGINEER
60259PE
Travis Tormanen
OREGON
MARCH 9, 1999
TRAVIS W TORMANEN
Expires: 6/30/2024

Reviewed By: Travis Tormanen, PE

Designed By: Dan Koistinen, EIT

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3.0 REFERENCES

Clean Water Act. n.d. <https://www.epa.gov/laws-regulations/summary-clean-water-act>.

Oregon Department of Transportation Hydraulics Manual <https://www.oregon.gov/odot/GeoEnvironmental/Pages/Hydraulics-Manual.aspx>.

Nation Oceanic and Atmospheric Administration https://www.noaa.gov/

National Resources Conservation Service <https://www.nrcs.usda.gov/>

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4.0 PROJECT DESCRIPTION

4.1 General Project Description

Windsor Engineers (Windsor) has provided an assessment of flooding that occasionally occurs near the intersection of West 7th Street and North Laurel Street (7th and Laurel). Windsor was authorized to complete this assessment by Beery Elsner & Hammond LLP on November 30, 2022. It is our understanding that there have been localized flooding problems in the yards of at least two homes and that these have occurred during heavy rainfall events that happened at the same time as King Tide events occurred. One event occurred over November 4 and 5, 2021 and the other flooding occurred on January 6, 2022. Two local property owners contacted the City with concerns about the flooding.

This assessment analyzed several potential factors that may contribute to the flooding at the 7th and Laurel location:

- Unusually high tides (King Tides) and elevation
- Large rainfall events
- Undersized stormwater system
- Obstructions in the downstream drainage system
- Combination of several above

Figure 1: 7th & Laurel St. Drainage Basin

Exhibit D-4

5.0 DRAINAGE BASIN CHARACTERISTICS

5.1 Drainage Characteristics

The unnamed stream that flows under the 7th and Laurel intersection is a tributary of Logan Creek. The unnamed stream flows into Logan Creek near the intersection of Ecola State Park Rd and East 5th Street. The stream enters a private conveyance system near the rear yard of 716 North Laurel and appears to connect to the City stormwater conveyance system that flows under the intersection of 7th and Laurel. There are no known as-builts of the private stormwater system.

The stream that flows into the private conveyance system is approximately 2 feet (ft) wide by 1 ft deep. This is based on site observation. The stream begins in the Ecola State Park to the north and drains approximately 54.38 acres in total, draining under the 7th and Laurel intersection (see the blue pin in Figure 1). The basin has several types of land covers. The area breakdowns were estimated by available Clatsop County Geographic Information System (GIS) data and the City of Cannon Beach (City) GIS information. The area breakdown is seen in Table 1, below.

Table 1: Basin Characteristics

Land Cover	Hydrologic Soil Group		Total	Modeled Land Cover
	A	B		
Residential	3.07	4.40	7.47	1/8-acre average lot size
Streets/Roadway	0.00	1.65	1.65	Impervious Area, paved parking, gravel road
Native Forest/Wood	0.00	45.26	45.26	Woods - Good Condition
		TOTAL	**54.38**	

5.2 Soil Characteristics

The National Resource Conservation Service (NRCS) web soil survey lists Class A and Class B hydrological soil groups as the primary soils in the delineated basin. Class A soils have low runoff potential when thoroughly wet and water is transmitted freely through the soil. Class B soils have moderately low runoff potential when thoroughly wet and water is transmitted unimpeded through the soil. Approximately 86.4 percent (%) of the basin soil is classified as Skipanon gravelly medial silt loam (58E) which is a Class B soil. The last significant soil type found in the basin area is Waldport Fine Sand (70C & 70D), a Class A soil type. The basin is approximately 8.4% Waldport Fine Sand. A small portion (approximately 4.4%) of the basin on the north side in Ecola State Park is classified as Klootchie Silt Loam, a Class B soil. See **Appendix D** for the NRCS Web Soil Survey. Most of the drainage basin is sloped with slopes ranging from 30% to 80% and small areas of flat. The basin also has a geologic hazard overlay and landslide susceptibility according to the Clatsop County GIS mapping.

Exhibit D-4

The drainage basin area includes parts of the City of Cannon Beach residential areas to the native forests of Ecola State Park. The basin breakdown, as seen in Table 1, is primarily native vegetation and wooded area, at 45.26 acres. Approximately 1.65 acres of paved or gravel roads are within the drainage area. 7.47 acres of the basin are 1/8 acre lots (average) residential areas.

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6.0 ELEVATION AND TIDES

6.1 Important Elevations

Windsor researched the elevation of the unnamed tributary and Logan by authorizing Onion Peak Design to survey a few key locations associated with the 7th and Laurel intersection. Figure 2, below, highlights the elevation of the mouth of Logan Creek, the Logan Creek and 5th Street crossing, and the unnamed tributary crossing at the intersection of 7th Street and Laurel Street.

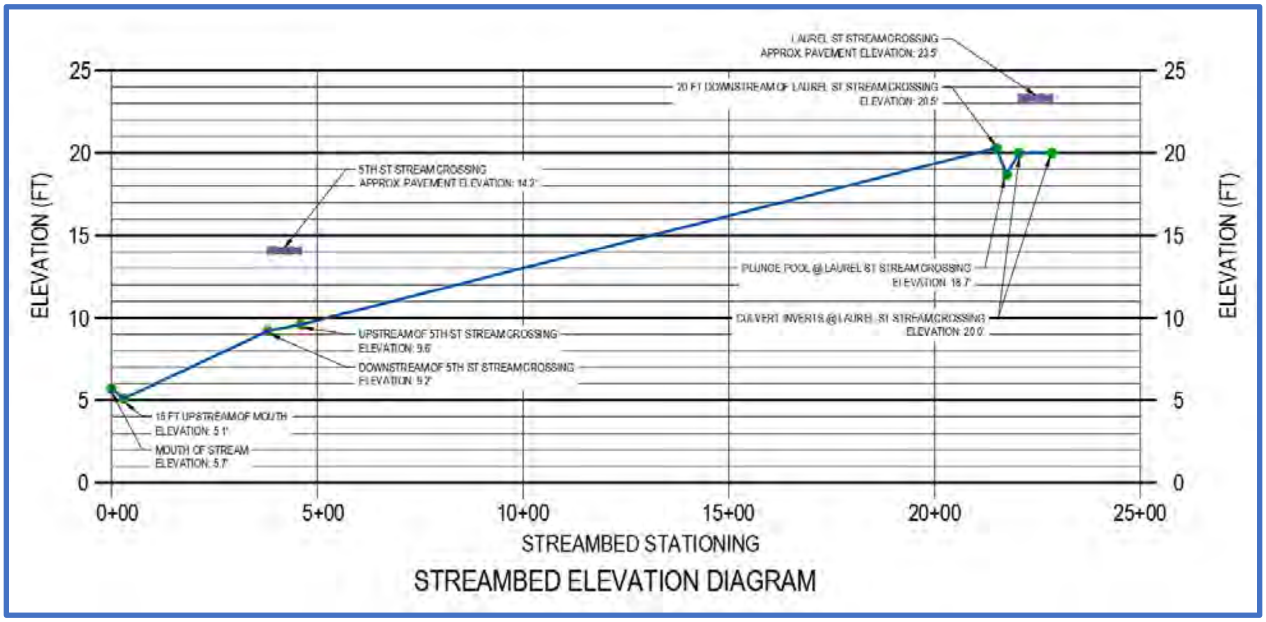

Figure 2: Streambed Elevation Diagram

6.2 Key Elevations

There are several key elevation differences shown on the diagram.

- Mouth of Logan Creek versus (vs) the storm system outlet at 7th & Laurel
    - 14.9 ft different
- 5th Street crossing vs the storm system outlet at 7th & Laurel
    - 5.8 ft different
- The elevation difference between the 5th Street crossing and the pavement at 7th & Laurel
    - 9.3 ft different

Exhibit D-4

6.3 Tides

The National Oceanic and Atmospheric Administration (NOAA) defines a King Tide as a *popular, non-scientific term used to describe exceptionally high tides*. One possibility of flooding at 7th and Laurel could be exceptionally high tides: King Tides. There are two NOAA tidal stations near Cannon Beach. One station is located approximately 30 miles away in Garibaldi, OR on Tillamook Bay and the other is located approximately 26 miles away near Astoria, OR on the Columbia River. The tidal data from Garibaldi was observed due to the proximity and lack of influence from the Columbia River. The tidal data was selected for this analysis based on a set of criteria:

- Dates that rainfall was recorded to be above 1.50 inches over 24 hours in Cannon Beach during the months of November, December, and January of 2021 to present.
- Dates prior to and after rainfall events of 1.50 inches over 24 hours
- Dates where tidal fluctuations called “King Tides.”
- Dates of known flooding at the 7th and Laurel intersection.

Tidal fluctuations measurement data is presented in several ways. The height of the tide compared to a baseline is called a ”datum.” The two main datums selected for the analysis are the Mean Sea Level Datum, *the arithmetic mean of hourly heights observed over the National Tidal Datum Epoch (NOAA),* and Mean High Water Level Datum, *the average of all the high-water heights observed over the NOAA*. See **Appendix A** for all tidal data.

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7.0 RAINFALL

7.1 Stormwater

Stormwater runoff is the precipitation that flows across the ground. The runoff may flow overland to nearby bodies of water including streams, lakes, rivers, and oceans, through infiltration into the ground, or evaporation into the atmosphere. Modern modeling software can analyze the amount of stormwater generated by the drainage basin based on rainfall events. Windsor analyzed the drainage basin for 7th and Laurel using a modeling software to compare Oregon State accepted design rainfall events to measure rainfall events of the dates flooding occurred.

7.2 Modeling Software

Windsor Engineers selected the single unit hydrograph software, WinTR-55, to model the drainage basin. WinTR-55 is released by the NRCS and is a single event, small runoff watershed hydraulic modeling software. The software can model both urban and rural areas. Inputs include land cover, design rainfall event, time of concentration, and other parameters. The output information flows in cubic feet per second (cfs) for associated rainfall events. WinTR-55 is accepted by the Oregon Department of Transportation (ODOT) Hydraulic Design Manual as an acceptable modeling software. See Section 12.10.1 of the ODOT Hydraulics Manual for more information on ODOT accepted modeling software. See **Appendix B** for a summary of the modeling with WinTR-55.

7.3 Rainfall Event

Design storms are hypothetical storm events where a depth of rainfall occurs for a return frequency (2-year [yr], 5-year, etc.), duration (24 hours), and timing distribution (IA). The design storm depths for Cannon Beach are estimated from rainfall maps called Isopluvial maps. Isopluvial maps for the State of Oregon are issued by two primary sources; the first is ODOT and the second is the NOAA. Table 2 shows the reoccurrence interval and design storm for the 7th and Laurel drainage system. See **Appendix C** for the Isopluvial maps.

Table 2: 7th & Laurel Drain Basin Analysis

NOAA		ODOT		Average
Return Frequency	**Inches per 24 hrs.**	**Return Frequency**	**Inches per 24 hrs.**	**Inches per 24 hrs.**
2 yr	3.8	2 yr	3.8	3.8
5 yr	4.5	-	-	4.5
10 yr	4.8	10 yr	4.6	4.7
25 yr	6.0	25 yr	6.0	6.0
50 yr	6.5	50 yr	6.5	6.5
100 yr	7.0	100 yr	7.0	7.0
-	-	500 yr	8.0	8.0
-	-	1000 yr	9.0	9.0

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The City has been recording rainfall since the early 2000s. Due to the extensive records, the rainfall data is available for the dates flooding occurred near 7th and Laurel. Windsor went through the results of rainfall events in the months of November, December, and January for 2021 to analyze the rainfall events over 1.50 inches in a 24-hour period. See the results in Section 9.0 Conclusions.

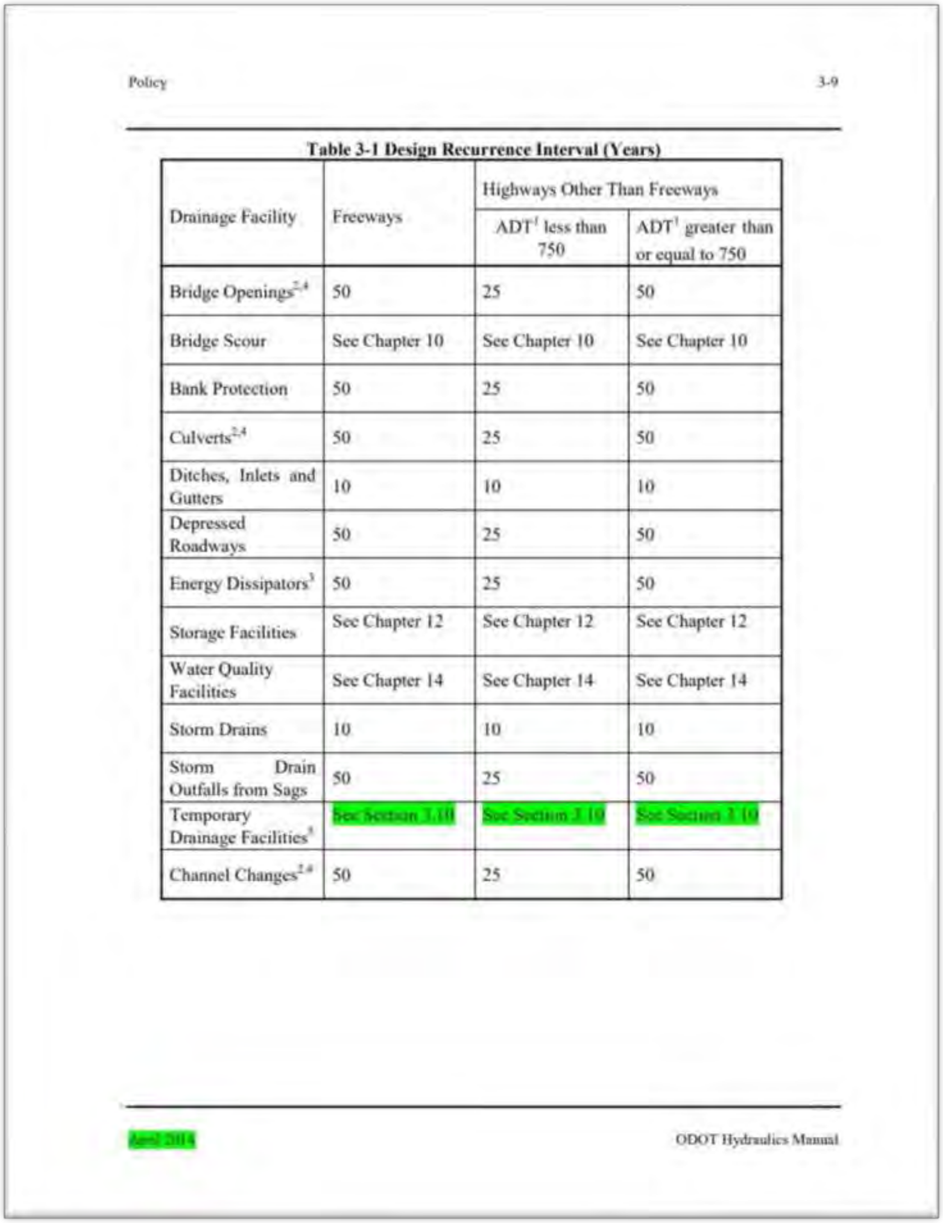
Exhibit D-4

8.0 OREGON DEPARTMENT OF TRANSPORTATION (ODOT) AND OREGON PARKS AND RECREATION DEPARTMENT (OPRD)

8.1 Design Requirements

Windsor Engineers reached out to ODOT and OPRD for available information on the infrastructure in Ecola State Park and the surrounding areas. No records were found.

Another item to consider is the sizing of the stormwater conveyance system. The ODOT design manual has the following design storm sizing requirements.



Policy 3-9

Table 3-1 Design Recurrence Interval (Years)

Drainage Facility	Freeways	Highways Other Than Freeways	
		ADT^1 less than 750	ADT^1 greater than or equal to 750
Bridge Openings^{2,4}	50	25	50
Bridge Scour	See Chapter 10	See Chapter 10	See Chapter 10
Bank Protection	50	25	50
Culverts^{2,4}	50	25	50
Ditches, Inlets and Gutters	10	10	10
Depressed Roadways	50	25	50
Energy Dissipators^3	50	25	50
Storage Facilities	See Chapter 12	See Chapter 12	See Chapter 12
Water Quality Facilities	See Chapter 14	See Chapter 14	See Chapter 14
Storm Drains	10	10	10
Storm Drain Outfalls from Sags	50	25	50
Temporary Drainage Facilities^5	See Section 3.10	See Section 3.10	See Section 3.10
Channel Changes^{2,4}	50	25	50

April 2014 ODOT Hydraulics Manual

Figure 3: ODOT Design Storm Sizing Table

Exhibit D-4

9.0 CONCLUSIONS

9.1 Results of Analysis

Below are the results from the analyses of events that took place with the following criteria:

- Tides greater than the Mean High-Water Level (MHW).
- Recorded rainfalls above 1.50 inches in 24 hours.
- Events over the dates when flooding occurred.

Table 3: Design Storm Events for Cannon Beach

Date of Storm Event	Return Period	24-hr Rainfall Depth (in)	Peak Flow (cfs)	Height of Tide Above Mean High Water Level (MHW) (ft)
N/A	2 yr	3.80	2.55	N/A
N/A	5 yr	4.50	6.50	N/A
N/A	10 yr	4.80	8.53	N/A
N/A	25 yr	6.00	17.96	N/A
N/A	50 yr	6.50	22.40	N/A
N/A	100 yr	7.00	27.05	N/A
12/22/2021	Less than 2 yr return period	1.51	0.08	1.92
12/11/2021		1.59	0.12	1.13
12/18/2021		1.67	0.16	1.82
1/2/2022		1.75	0.21	3.36
11/12/2021		2.22	0.55	0.42
12/26/2022		3.00	1.34	3.11
11/11/2022		3.04	1.38	0.59
1/11/2022		3.11	1.47	0.82
11/4/2022	Less than 10 yr return period	4.65	8.78	3.05
[1]1/6/2022	Greater than 10 yr return period	4.96	11.13	2.27
[1]**11/11/2021 - 11/12/2022	**Greater than 10 yr return period	5.26	13.53	0.51

**Please note that this storm event took place over 24 to 48 hrs.

[1]Dates that flooding occurred

Several pieces of evidence became apparent when evaluating the results. Two flooding events occurred; one on January 6, 2022, and the other event was November 11-12, 2021. The January 6th flooding simultaneously had King Tides while the storm event in November of 2021 (that resulted in

Exhibit D-4

flooding) experienced tides that were only 0.51 ft higher than the mean high-water level. Three other events on November 4, 2022, January 2, 2022, and December 26, 2022, had larger tides than the January 6, 2022, flood event, but no flooding occurred at these times.

One other piece of information that supports the results that King Tides do not affect the 7th and Laurel intersection is **Figure 2: Streambed Elevation Diagram.** The diagram shows that the streambed elevations in the mouth of Logan Creek and the 7th and Laurel conveyance system are 14.9 ft different in elevation. Several blocks of residential housing between the mouth of Logan Creek and 7th and Laurel would experience flooding if water, due to high tides, was to stack up in elevation high enough to influence the 7th and Laurel intersection. Furthermore, no other reports of flooding downstream of 7th and Laurel are known in connection to the flood events.

Conclusion: based on the data available for the timeframes described in this report, it can be observed that flooding occurred with and without the presence of a King Tide, suggesting that a King Tide does not likely affect the water level at 7th and Laurel.

Looking at the results table leads to an additional conclusion. Flooding occurs when storm events are greater than a 10-year design storm for this drainage basin. While there is not a large sample size of events since 2021, Cannon Beach observed flooding on both occasions where storms were larger than 4.80 inches of rainfall in 24 hours (10-yr design storm). ODOT standards for storm inlets, ditches, and storm drains are to convey the 10-yr design storm. The empirical data suggests that the intersection is able to convey the 10-yr storm but that there have been system capacity issues for storms larger than this size.

In conclusion, the results of the analysis suggest that the cause of the flooding is a consequence of large rain fall events and a lack of ability for the unnamed tributary to convey events larger than the 10-year design storm. Additional data from future storms would be helpful to further analyze the connection in storm sizes and flood events.

9.2 Capacity Issues

The reason that the system appears to have capacity issues when storms greater than the 10-yr design storm occur is likely associated with a combination of the following.

- The downstream creek has fallen trees and other debris that prevent optimized drainage of the 7th & Laurel intersection area.
- The topography of the area may not be conducive to avoiding flooding in storms that are greater than the 10-yr design storm event.
- Private stormwater system improvements are not fully documented. It is unknown what design criteria were used in sizing any private pipelines, culverts, inlets, and screens and whether the sizing and configuration is appropriate to avoid flooding.
- It is possible that some of the public and/or private pipelines are partially plugged.

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10.0 APPENDICES

Appendix A – Tidal Information

Appendix B – WinTR-55 Modeling

Appendix C – Isopluvial Maps

Appendix D – Soils Information

Exhibit D-4

APPENDIX A

Tide Data from NOAA

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Tide Information

		Cannon Beach Records		NOAA Station 9437540 - Garibaldi, OR		
		Rain Fall Data		Tide Height (Ft)		
	Tide	Date	Inch / 24 hrs	Datum: STI	Datum: MSL	Datum: MHW
		11/4/2021	1.35	14.65	6.16	3.05
🟩	king	11/5/2021	0.71	14.71	6.22	3.11
🟩	king	11/6/2021	0.88	14.85	6.36	3.25
🟩	king	11/7/2021	0.39	14.37	5.87	2.77
		11/11/2021	3.04	12.19	3.69	0.59
		11/12/2021	2.22	12.02	3.52	0.42
🟩	king	12/3/2021	0.00	13.66	5.16	2.06
🟩	king	12/4/2021	0.67	14.50	6	2.9
🟩	king	12/5/2021	0.01	13.93	5.43	2.33
		12/6/2021	0.36	14.32	5.83	2.73
		12/7/2021	0.36	13.71	5.22	2.12
		12/11/2021	1.59	12.72	4.23	1.13
		12/18/2021	1.67	13.42	4.93	1.82
		12/22/2021	1.51	13.52	5.02	1.92
🟩	king	1/1/2022	0.00	14.02	5.53	2.42
🟩	king	1/2/2022	1.75	14.96	6.47	3.36
🟩	king	1/3/2022	0.48	16.07	7.58	4.47
		1/4/2022	0.37	14.83	6.34	3.23
		1/5/2022	1.27	13.91	5.42	2.32
Flooded		1/6/2022	4.96	13.87	5.38	2.27
		1/7/2022	0.61	13.88	5.38	2.28
		1/8/2022	0.03	12.77	4.27	1.17
		1/9/2022	0.00	12.42	3.93	0.82
		1/10/2022	0.26	12.19	3.69	0.59
		1/11/2022	3.11	12.42	3.92	0.82
		1/12/2022	0.55	12.66	4.16	1.06
		11/3/2022	0.62	11.3	2.81	-0.29
		11/4/2022	4.65	12.62	4.12	1.02
		11/5/2022	0.36	13.16	4.67	1.57
		11/22/2022	0.48	13.68	5.19	2.09
		11/23/2022	0.1	13.56	5.07	1.97
🟩	king	11/24/2022	0.00	13.86	5.37	2.26
🟩	king	11/25/2022	0.11	13.79	5.29	2.19
🟩	king	11/26/2022	0.00	13.22	4.72	1.62
🟩	king	12/22/2022	0.13	14.01	5.51	2.41
🟩	king	12/23/2022	0.11	14.61	6.11	3.01
🟩	king	12/24/2022	1.22	14.64	6.15	3.04
		12/25/2022	1.41	14.5	6	2.9
		12/26/2022	3.00	14.71	6.22	3.11
		12/27/2022	1.12	15.29	6.8	3.69

Exhibit D-4

APPENDIX B

WinTR-55 Modeling

Exhibit D-4

Summary of Results

7th and Laurel Design Basin				
Date of Storm Event	**Return Period**	**24-hr Rainfall Depth (in)**	**Peak Flow (cfs)**	**Height of Tide Above Mean High Water Level (MHW) (ft)**
N/A	**2-Yr**	3.80	2.55	**N/A**
N/A	**5-Yr**	4.50	6.50	**N/A**
N/A	**10-Yr**	4.80	8.53	**N/A**
N/A	**25-Yr**	6.00	17.96	**N/A**
N/A	**50-Yr**	6.50	22.40	**N/A**
N/A	**100-Yr**	7.00	27.05	**N/A**
12/22/2021	**Less than 2 yr return period**	1.51	0.08	1.92
12/11/2021		1.59	0.12	1.13
12/18/2021		1.67	0.16	1.82
1/2/2022		1.75	0.21	3.36
11/12/2021		2.22	0.55	0.42
12/26/2022		3.00	1.34	3.11
11/11/2022		3.04	1.38	0.59
1/11/2022		3.11	1.47	0.82
11/4/2022	**Less than 10 yr return period**	4.65	8.78	3.05
[1] **1/6/2022**	**Greater than 10 yr return period**	4.96	11.13	2.27
[1]**** 11/11/2021 - 11/12/2022**	****Greater than 10 yr return period**	5.26	13.53	0.51

**Please note that this storm event took place over 24 to 48 hrs

[1] Dates that flooding occurred

Exhibit D-4

Tide Information

		Cannon Beach Records		NOAA Station 9437540 - Garibaldi, OR		
		Rain Fall Data		Tide Height (Ft)		
	Tide	Date	Inch / 24 hrs	Datum: STI	Datum: MSL	Datum: MHW
		11/4/2021	1.35	14.65	6.16	3.05
🟩	king	11/5/2021	0.71	14.71	6.22	3.11
🟩	king	11/6/2021	0.88	14.85	6.36	3.25
🟩	king	11/7/2021	0.39	14.37	5.87	2.77
		11/11/2021	3.04	12.19	3.69	0.59
		11/12/2021	2.22	12.02	3.52	0.42
🟩	king	12/3/2021	0.00	13.66	5.16	2.06
🟩	king	12/4/2021	0.67	14.50	6	2.9
🟩	king	12/5/2021	0.01	13.93	5.43	2.33
		12/6/2021	0.36	14.32	5.83	2.73
		12/7/2021	0.36	13.71	5.22	2.12
		12/11/2021	1.59	12.72	4.23	1.13
		12/18/2021	1.67	13.42	4.93	1.82
		12/22/2021	1.51	13.52	5.02	1.92
🟩	king	1/1/2022	0.00	14.02	5.53	2.42
🟩	king	1/2/2022	1.75	14.96	6.47	3.36
🟩	king	1/3/2022	0.48	16.07	7.58	4.47
		1/4/2022	0.37	14.83	6.34	3.23
		1/5/2022	1.27	13.91	5.42	2.32
Flooded		1/6/2022	4.96	13.87	5.38	2.27
		1/7/2022	0.61	13.88	5.38	2.28
		1/8/2022	0.03	12.77	4.27	1.17
		1/9/2022	0.00	12.42	3.93	0.82
		1/10/2022	0.26	12.19	3.69	0.59
		1/11/2022	3.11	12.42	3.92	0.82
		1/12/2022	0.55	12.66	4.16	1.06
		11/3/2022	0.62	11.3	2.81	-0.29
		11/4/2022	4.65	12.62	4.12	1.02
		11/5/2022	0.36	13.16	4.67	1.57
		11/22/2022	0.48	13.68	5.19	2.09
		11/23/2022	0.1	13.56	5.07	1.97
🟩	king	11/24/2022	0.00	13.86	5.37	2.26
🟩	king	11/25/2022	0.11	13.79	5.29	2.19
🟩	king	11/26/2022	0.00	13.22	4.72	1.62
🟩	king	12/22/2022	0.13	14.01	5.51	2.41
🟩	king	12/23/2022	0.11	14.61	6.11	3.01
🟩	king	12/24/2022	1.22	14.64	6.15	3.04
		12/25/2022	1.41	14.5	6	2.9
		12/26/2022	3.00	14.71	6.22	3.11
		12/27/2022	1.12	15.29	6.8	3.69

Exhibit D-4

Rainfall Information

No Data	king	1/20/2023	0.00
No Data	king	1/21/2023	0.29
No Data	king	1/22/2023	0.01

STND = Station Datum
MSL = Mean Sea Level
MHW = Mean High Water Level

Isopluvial Rainfall for 7th St and Laurel St

NOAA		ODOT		Average
Design Sto	In/24 hrs	Design Storm	In/24 hrs	Inch/24 hr
2 yr	3.8	2 yr	3.8	3.8
5 yr	4.5	-	-	4.5
10 yr	4.8	10 yr	4.6	4.7
25 yr	6.0	25 yr	6.0	6.0
50 yr	6.5	50 yr	6.5	6.5
100 yr	7.0	100 yr	7.0	7.0
		500 yr	8.0	8.0
		1000 yr	9.0	

Exhibit D-4

Summary of WinTR-55 Inputs and Outputs

	Basin 1	Units	Notes
Rainfall Distribution:	24-hour Type 1-A		
Drainage Area:	54.38	acres	per client data
Impervious Acres	1.65	acres	rural road/streets
Residential Acres	7.47	acres	1/8 acre lots (avg)
Pervious Acres	45.26	acres	woods/forest
Percent Impervious	99.8%		
Hydrologic Soil Group:	A & B		per NRCS Web Soil Survey
Time of Concentration (Tc)	0.307		Win-TR 55 Output
Sheet Flow			
Length	100		
Slope	0.2		from contours
Surface Mannings n	Dense woods (0.80)		
Shallow Concentrated Flow			
Length	250	ft	
Slope	0.31	ft/ft	from contours
Surface Mannings n	Unpaved		
Channel Flow			
Length	2,000	ft	
Slope	0.134	ft/ft	from contours
n	0.035		Stream - rocks, pools, riffles
Avg width (ft)	2	ft	
Avg depth (ft)	0.75	ft	
Area (ft2)	1.5	ft2	
WP (ft)	3.5	ft	
Velocity (f/s)	8.8	f/s	
Pipe/channel Flow			
Length	250	ft	
Slope	0.04	ft/ft	from contours
n	0.014		Corrugated Plastic Pipe
Pipe Diameter (ft)	1	ft	assumed
Area (ft2)	0.8	ft2	
WP (ft)	3.1	ft	
Velocity (f/s)	8.7	f/s	
WinTR-55 Design Storm Flows			
Peak Runoff (Q) - 2-yr storm (3.68 in):	2.46	cfs	Win-TR 55 Output
Peak Runoff (Q) - 5-yr storm (4.5 in):	3.88	cfs	Win-TR 55 Output
Peak Runoff (Q) - 10-yr storm (5 in):	4.84	cfs	Win-TR 55 Output
Peak Runoff (Q) - 25-yr storm (6.5 in):	7.95	cfs	Win-TR 55 Output
Peak Runoff (Q) - 50-yr storm (7in):	9.03	cfs	Win-TR 55 Output
Peak Runoff (Q) - 100-yr storm (8 in):	11.26	cfs	Win-TR 55 Output
Peak Runoff (Q) - 100-yr storm (8 in):	11.26	cfs	Win-TR 55 Output
WinTR-55 Measured Rainfall Flows			
Peak Runoff (Q) - 12/22/2021 (1.51 in):	0.08	cfs	Win-TR 55 Output
Peak Runoff (Q) - 12/11/2021 (1.59 in):	0.12	cfs	Win-TR 55 Output
Peak Runoff (Q) - 12/18/2022 (1.67 in):	0.16	cfs	Win-TR 55 Output
Peak Runoff (Q) - 01/02/2022 (1.75 in):	0.21	cfs	Win-TR 55 Output
Peak Runoff (Q) - 11/12/2021 (2.22 in):	0.55	cfs	Win-TR 55 Output
Peak Runoff (Q) - 12/26/2022 (3.00 in):	1.34	cfs	Win-TR 55 Output
Peak Runoff (Q) - 11/11/2022 (3.04 in):	1.38	cfs	Win-TR 55 Output
Peak Runoff (Q) - 01/11/2022 (3.11 in):	1.47	cfs	Win-TR 55 Output
Peak Runoff (Q) - 11/04/2022 (4.65 in):	8.78	cfs	Win-TR 55 Output
Peak Runoff (Q) - 01/06/2022 (4.96 in):	11.13	cfs	Win-TR 55 Output

Exhibit D-4

Basin Characteristics

Basin Characteristics				
Land Cover	Hydrologic Soil Group		Total	Modeled Land Cover
	A	B		
Residential	3.07	4.40	7.47	1/8 acre average lot size
Streets/Roadway	0.00	1.65	1.65	Impervious Area, Paved parking lots/roofs/driveways
Native Forest/Wood	0.00	45.26	45.26	Woods-grass combination - Fair Condition
		TOTAL	54.38	

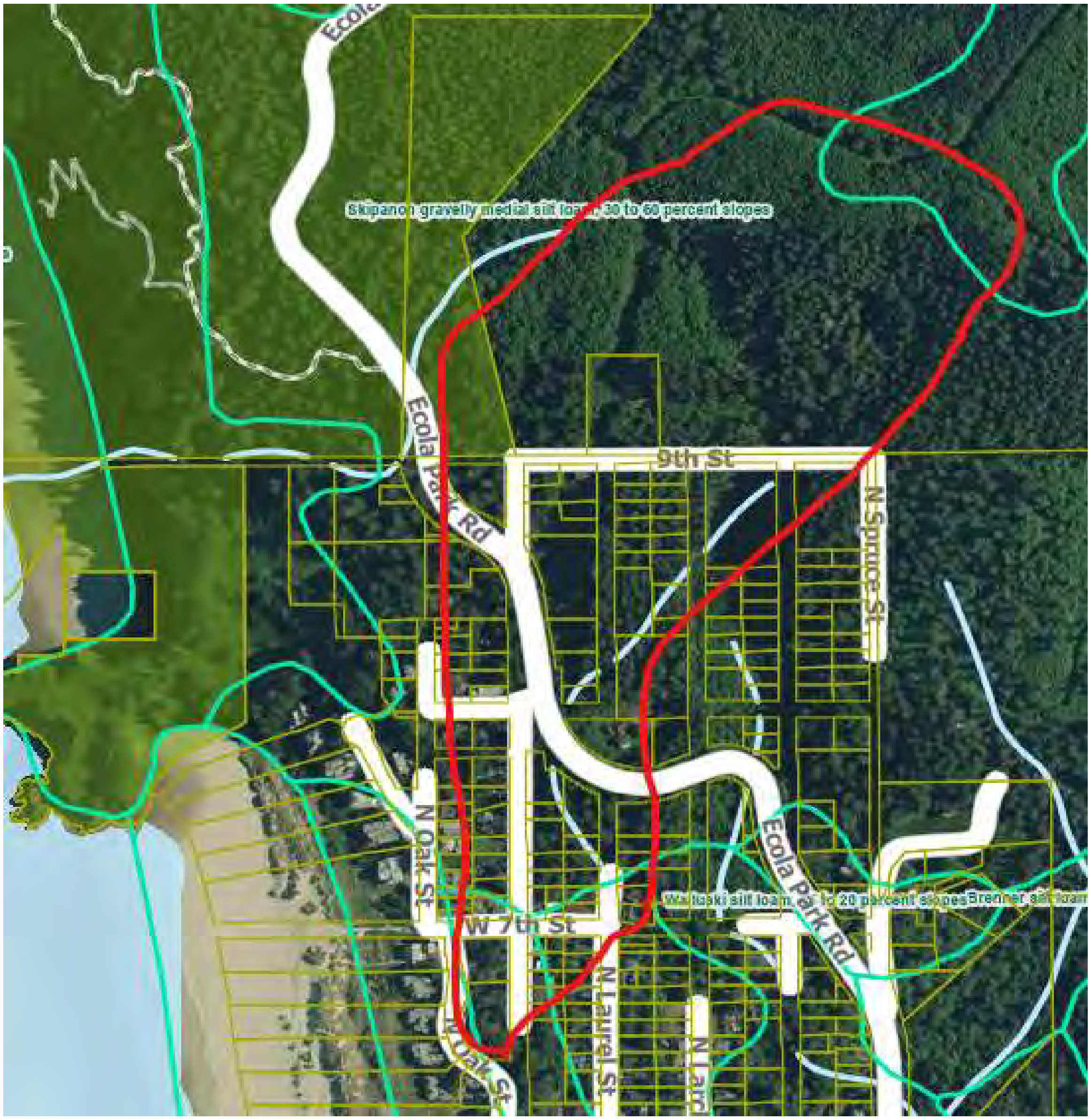
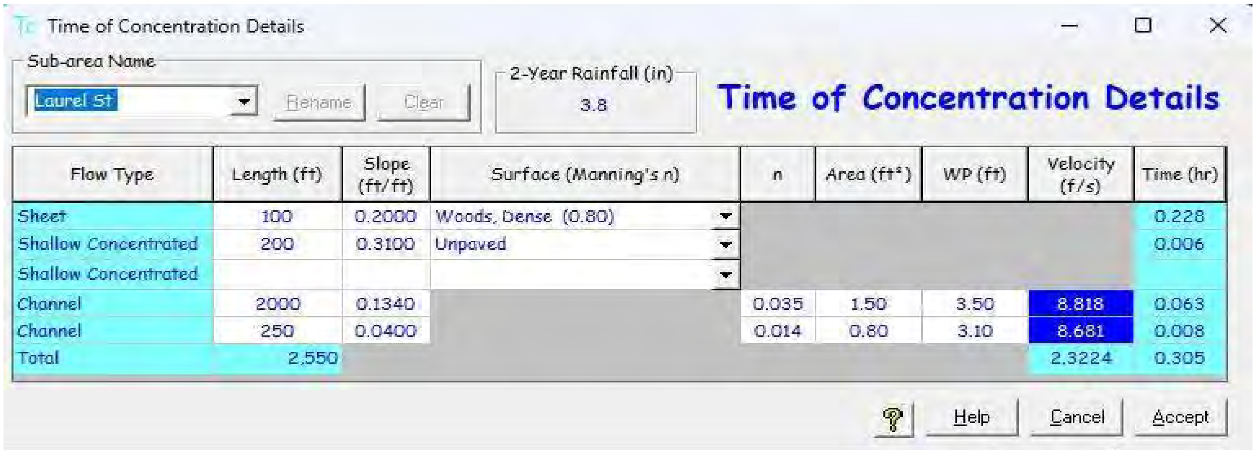


Exhibit D-4

WinTR-55 T.O.



Time of Concentration Details

Sub-area Name: Laurel St

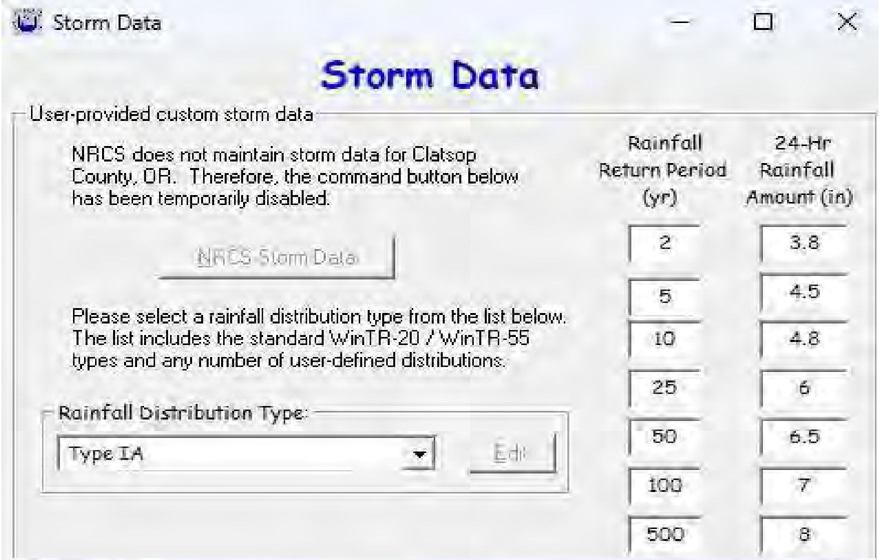
2-Year Rainfall (in): 3.8

Time of Concentration Details

Flow Type	Length (ft)	Slope (ft/ft)	Surface (Manning's n)	n	Area (ft²)	WP (ft)	Velocity (f/s)	Time (hr)
Sheet	100	0.2000	Woods, Dense (0.80)					0.228
Shallow Concentrated	200	0.3100	Unpaved					0.006
Shallow Concentrated								
Channel	2000	0.1340		0.035	1.50	3.50	8.818	0.063
Channel	250	0.0400		0.014	0.80	3.10	8.681	0.008
Total	2,550						2.3224	0.305

Exhibit D-4

WinTR-55 Rainfall Info



Storm Data

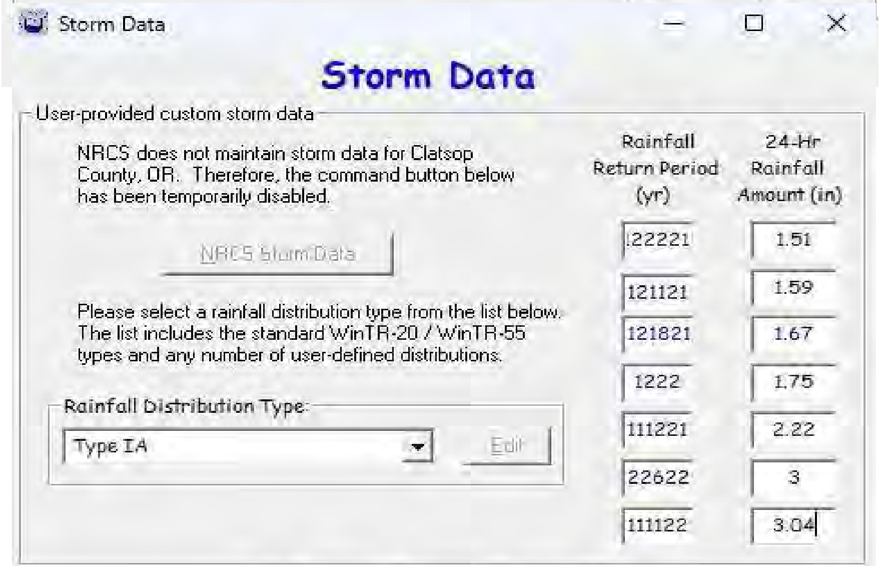
User-provided custom storm data

NRCS does not maintain storm data for Clatsop County, OR. Therefore, the command button below has been temporarily disabled.

Please select a rainfall distribution type from the list below. The list includes the standard WinTR-20 / WinTR-55 types and any number of user-defined distributions.

Rainfall Distribution Type: Type IA

Rainfall Return Period (yr)	24-Hr Rainfall Amount (in)
2	3.8
5	4.5
10	4.8
25	6
50	6.5
100	7
500	8



Storm Data

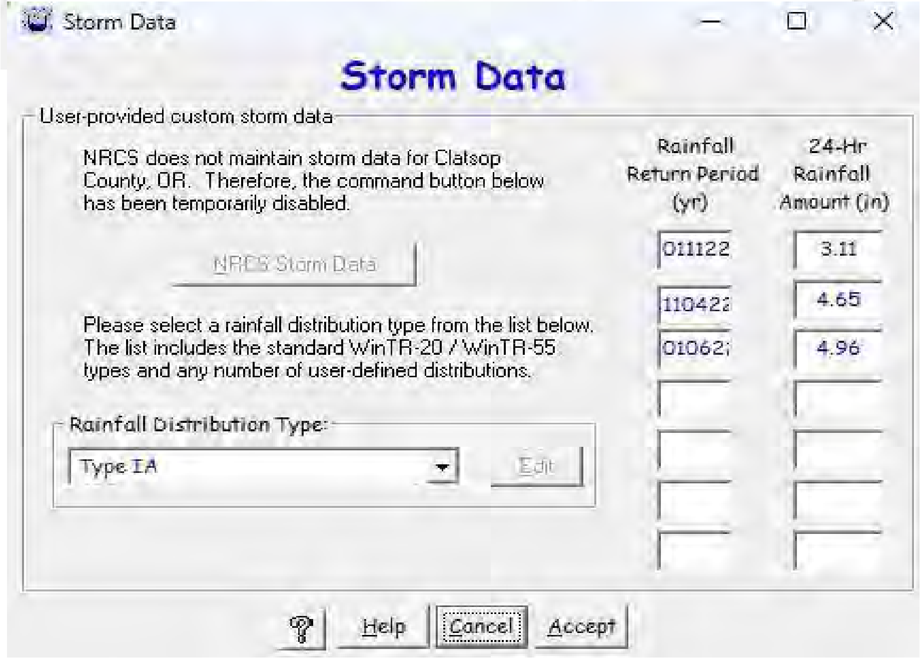
User-provided custom storm data

NRCS does not maintain storm data for Clatsop County, OR. Therefore, the command button below has been temporarily disabled.

Please select a rainfall distribution type from the list below. The list includes the standard WinTR-20 / WinTR-55 types and any number of user-defined distributions.

Rainfall Distribution Type: Type IA

Rainfall Return Period (yr)	24-Hr Rainfall Amount (in)
22221	1.51
121121	1.59
121821	1.67
1222	1.75
111221	2.22
22622	3
111122	3.04



Storm Data

User-provided custom storm data

NRCS does not maintain storm data for Clatsop County, OR. Therefore, the command button below has been temporarily disabled.

Please select a rainfall distribution type from the list below. The list includes the standard WinTR-20 / WinTR-55 types and any number of user-defined distributions.

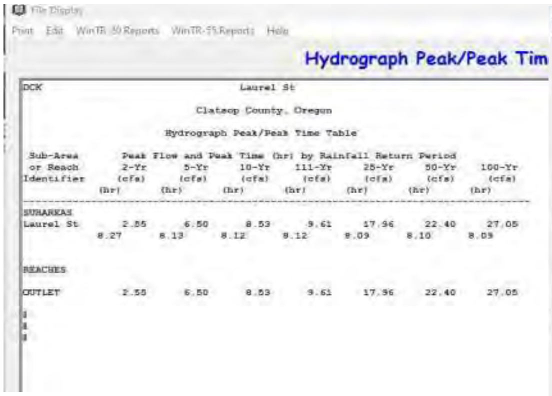
Rainfall Distribution Type: Type IA

Rainfall Return Period (yr)	24-Hr Rainfall Amount (in)
011122	3.11
11042	4.65
01062	4.96

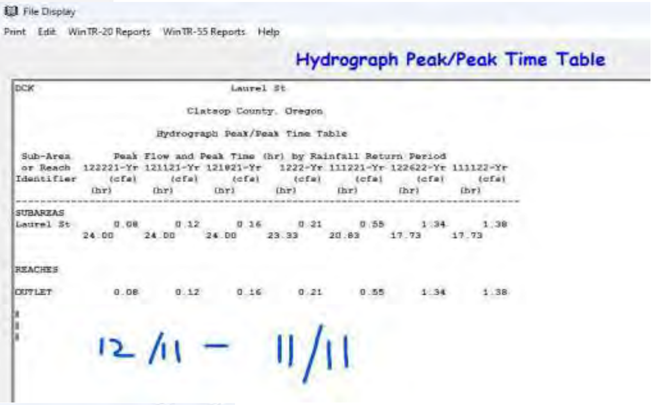
Exhibit D-4

WinTR-55 Results

WinTR-55 Peak Runoff		
Return Period	**24-hr Rainfall Depth (in)**	**Peak Flow (cfs)**
2-Yr	3.80	2.55
5-Yr	4.50	6.50
10-Yr	4.80	8.53
25-Yr	6.00	17.96
50-Yr	6.50	22.40
100-Yr	7.00	27.05
12/22/2021	1.51	0.08
12/11/2021	1.59	0.12
12/18/2021	1.67	0.16
1/2/2022	1.75	0.21
11/12/2021	2.22	0.55
12/26/2022	3.00	1.34
11/11/2022	3.04	1.38
1/11/2022	3.11	1.47
11/4/2022	4.65	8.78
1/6/2022	4.96	11.13
11/11/2021 - 11/12/2021	5.26	13.53

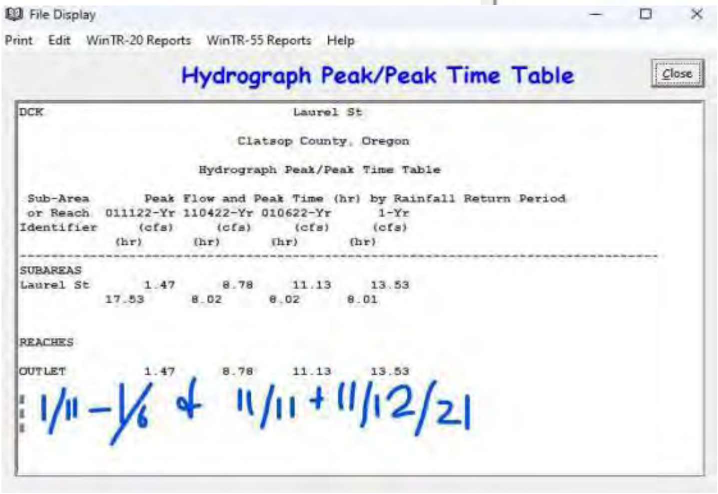


```
DCK                              Laurel St

                          Clatsop County, Oregon

                      Hydrograph Peak/Peak Time Table

 Sub-Area      Peak Flow and Peak Time (hr) by Rainfall Return Period
 or Reach       2-Yr      5-Yr      10-Yr     111-Yr     25-Yr     50-Yr     100-Yr
Identifier      (cfs)     (cfs)     (cfs)     (cfs)      (cfs)     (cfs)     (cfs)
             (hr)      (hr)      (hr)      (hr)      (hr)      (hr)      (hr)
---------------------------------------------------------------------------------
SUBAREAS
Laurel St       2.55      6.50      8.53      9.61      17.96     22.40     27.05
             8.27      8.13      8.12      8.12      8.09      8.10      8.09


REACHES

OUTLET          2.55      6.50      8.53      9.61      17.96     22.40     27.05
```



```
DCK                              Laurel St

                          Clatsop County, Oregon

                      Hydrograph Peak/Peak Time Table

 Sub-Area      Peak Flow and Peak Time (hr) by Rainfall Return Period
 or Reach  122221-Yr 121121-Yr 121021-Yr   1222-Yr 111221-Yr 122622-Yr 111122-Yr
Identifier     (cfs)     (cfs)     (cfs)     (cfs)     (cfs)     (cfs)     (cfs)
            (hr)      (hr)      (hr)      (hr)      (hr)      (hr)      (hr)
---------------------------------------------------------------------------------
SUBAREAS
Laurel St       0.08      0.12      0.16      0.21      0.55      1.34      1.38
            24.00     24.00     24.00     23.33     20.83     17.73     17.73


REACHES

OUTLET          0.08      0.12      0.16      0.21      0.55      1.34      1.38
```

12/11 – 11/11



```
DCK                         Laurel St

                     Clatsop County, Oregon

                 Hydrograph Peak/Peak Time Table

 Sub-Area       Peak Flow and Peak Time (hr) by Rainfall Return Period
 or Reach  011122-Yr 110422-Yr 010622-Yr      1-Yr
Identifier     (cfs)     (cfs)     (cfs)     (cfs)
            (hr)      (hr)      (hr)      (hr)
-------------------------------------------------------------------
SUBAREAS
Laurel St       1.47      8.78     11.13     13.53
            17.53      8.02      8.02      8.01


REACHES

OUTLET          1.47      8.78     11.13     13.53
```

1/11 – 1/6 + 11/11 + 11/12/21

Exhibit D-4

APPENDIX C

Isopluvial Maps

Exhibit D-4

NOAA ATLAS 2

Precipitation-Frequency Atlas of the Western United States

J. F. Miller, R. H. Frederick, and R. J. Tracey

Volume X–Oregon

U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

NATIONAL WEATHER SERVICE
George P. Cressman, Director
Silver Spring, Maryland–1973

For sale by the Superintendent of Documents, U.S. Government Printing Office
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Stock Number 0317-00151

Prepared for U.S. Department of Agriculture, Soil Conservation Service, Engineering Division

Exhibit D-4

NOAA ATLAS 2

Precipitation Frequency Atlas of the
Western United States

Volume	I.	Montana
Volume	II.	Wyoming
Volume	III.	Colorado
Volume	IV.	New Mexico
Volume	V.	Idaho
Volume	VI.	Utah
Volume	VII.	Nevada
Volume	VIII.	Arizona
Volume	IX.	Washington
Volume	X.	Oregon
Volume	XI.	California

UDC 551.577.36(084.4)(795)

551.5	Meteorology
.577	Precipitation
.36	Frequencies
(084.4)	Atlases
(795)	Oregon

Exhibit D-4

Contents

List of Illustrations

List of Tables

Exhibit D-4

Abstract

Each volume of this Atlas contains precipitation-frequency maps for 6- and 24-hr durations for return periods from 2 to 100 yrs for one of the 11 western states (west of about 103° W.). Also included are methods and nomograms for estimating values for durations other than 6 and 24 hrs. This new series of maps differs from previous publications through greater attention to the relation between topography and precipitation-frequency values. This relation is studied objectively through the use of multiple regression screening techniques which develop equations used to assist in interpolating values between stations in regions of sparse data. The maps were drawn on a scale of 1:1,000,000 and reduced to 1:2,000,000 for publication.

In addition to the maps, each volume includes a historical review of precipitation-frequency studies, a discussion of the data handling and analysis methods, a section on the use and interpretation of the maps, and a section outlining information pertinent to the precipitation-frequency regime in the individual state. This state section includes a discussion of the importance of snow in the precipitation-frequency analysis and formulas and nomograms for obtaining values for 1-, 2-, 3-, and 12-hr durations.

Preface

Previous precipitation-frequency studies for the 11 western states have considered topography in only a general sense despite the numerous mountain ranges present. As a result, variation in precipitation-frequency values is greater than was portrayed in these studies. In this Atlas, the relation between precipitation-frequency values and topography has been considered both objectively and subjectively.

This work has been supported and financed by the Soil Conservation Service, Department of Agriculture, to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention program (P.L. 566, 83d Congress and as amended).

Each volume of the Atlas can be considered to consist of three parts. The first part contains several sections giving a historical review of the field, a discussion of the approach and methods used in the development of the precipitation-frequency maps, and a discussion of how to interpret and use the maps. This section outlines the general background information and is applicable to all states. The second part of the Atlas contains a discussion of items pertinent to the individual state. Included in this section are methods and nomograms designed to estimate precipitation-frequency values for durations other than 6 and 24 hrs. These procedures were developed for broad geographic regions; the ones applicable to a particular state are included in the appropriate volume. The last part contains the maps for the 6- and 24-hr durations for return periods of 2, 5, 10, 25, 50, and 100 yrs.

Coordination with the Soil Conservation Service was maintained through Kenneth M. Kent, Chief, Hydrology Branch, Engineering Division, and through his successor, Robert E. Rallison. The work was done in the Special Studies Branch, Water Management Information Division, Office of Hydrology, National Weather Service. Hugo V. Goodyear, Chief of the Branch (since retired) made many contributions to the preparation of the final manuscript. Overall direction and guidance was furnished by William E. Hiatt, Associate Director (Hydrology), National Weather Service, his successor, Max A. Kohler, and Joseph Paulhus, former Chief, Water Management Information Division. Data tabulations, computations and many other assisting duties were done by the Branch meteorological technicians.

Exhibit D-4

Introduction

Objective

Although generalized maps of precipitation-frequency values have been available for many years, the construction of isopluvial lines in mountainous regions has been done considering topography and its effect on precipitation in a general sense only. Investigations for this Atlas were undertaken to depict more accurately variations in the precipitation-frequency regime in mountainous regions of the 11 conterminous states west of approximately 103° W. These investigations are intended to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention programs.

Primary emphasis has been placed on developing generalized maps for precipitation of 6- and 24-hr duration and for return periods of 2 to 100 yrs. Procedures also have been developed to estimate values for 1-hr duration. Values for other durations can be estimated from the 1-, 6-, and 24-hr duration values.

Historical Review

The first generalized study of the precipitation-frequency regime for the United States was prepared in the early 1930's by David L. Yarnell (1935). Yarnell's publication contains a series of generalized rainfall maps for durations of 5 min to 24 hrs for return periods of 2 to 100 yrs. Yarnell's study served as a basic source of frequency data for economic and engineering design until the middle 1950's. The maps were based on data from about 200 first-order Weather Bureau stations equipped with recording precipitation gages. In 1940, about 5 yrs after Yarnell's study was published, a hydrologic network of recording gages, supported largely by the U.S. Army Corps of Engineers, was installed. This was done to supplement the Weather Bureau recording-gage network and the network of a relatively large number of nonrecording gages maintained by private individuals in cooperation with the Weather Bureau, for a long period of years. The additional recording gages have subsequently increased the amount of short-duration (1- to 24-hr) precipitation data by a factor of about 20.

Weather Bureau Technical Paper No. 24, published in two parts, (U.S. Weather Bureau 1953–54a) was prepared for the Corps of Engineers, in connection with its military construction program. This Technical Paper contained the results of the first investigation of precipitation-frequency information for an extensive region of the increased hydrologic data network. The results showed the importance of the additional data for defining the short-duration rainfall-frequency regime in a mountainous region of the western United States. In many instances, the differences between the values given in Technical Paper No. 24 and those given by Yarnell reach a factor of three, with Yarnell's figures generally higher. Results from these two studies in the United States were then used to prepare similar reports for the coastal regions of North Africa (U.S. Weather Bureau 1954b) and for several Arctic regions (U.S. Weather Bureau 1955a) where recording-gage data were lacking. These reports were also prepared in cooperation with the Corps of Engineers to support its military construction program.

In 1955, the Weather Bureau and the Soil Conservation Service began a cooperative effort to define the depth-area-duration precipitation-frequency regime in the entire United States. *Weather Bureau Technical Paper* No. 25 (U.S. Weather Bureau 1955b), partly a byproduct of previous work done for the Corps of Engineers, was the first study published under the sponsorship of the Soil Conservation Service; it contains a series of precipitation intensity-duration-frequency curves for about 200 first-order Weather Bureau stations. This was followed by *Weather Bureau Technical Paper* No. 28 (U.S. Weather Bureau 1956) which was an expansion of information contained in Technical Paper No. 24 to longer return periods and durations. The five parts of *Weather Bureau Technical Paper* No. 29 (U.S. Weather Bureau 1957–60), for the region east of longitude 90° W., were published next. This Technical Paper included seasonal variation on a frequency basis and area-depth curves so that the point-frequency values could be transformed to areal-frequency values.

In the next study, *Weather Bureau Technical Paper* No. 40 (U.S. Weather Bureau 1961), the results of previous Weather Bureau investigations of the precipitation-frequency regime of the conterminous United States were combined into a single publication. Investigations by the Weather Bureau during the 1950's had not covered the region between longitudes 90° and 105° W. Technical Paper No. 40 contained the results of an investigation for this region, and was the first such study of the midwestern plains region since Yarnell's work of the early 1930's. Topography was considered only in a general sense in this and earlier studies.

Technical Paper No. 40 has been accepted as the standard source for precipitation-frequency information in the United States for the past decade. Results presented in that publication are most reliable in relatively flat plains. While the averages of point values over relatively large mountainous regions are reliable, the variations within such regions are not adequately defined. In the largest of these regions, the western United States, topography plays a significant role in the incidence and distribution of precipitation. Consequently, the variations in precipitation-frequency values are actually greater than portrayed in the region. Investigations reported herein were made using currently available longer records and the maximum number of stations possible (consistent with the constraints explained in the section on Basic Data).

Approach

The approach used for this Atlas is basically the same as that used for Technical Paper No. 40, in which simplified relations between duration and return period were used to determine numerous combinations of return periods and durations from several generalized key maps. For this Atlas, relations were developed between precipitation-frequency values and meteorologic and topographic factors at observing sites. These were used to aid in interpolating values between stations on the key maps.

The key maps developed in this study were for 2- and 100-yr return periods for 6- and 24-hr durations. The initial map developed was for the 2-yr return period for the 24-hr duration. This return period was selected because values for shorter return periods can be estimated with greater reliability than for longer return periods. The 24-hr duration was selected because this permitted use of data from both recording and nonrecording gages. Also, because an extensive nonrecording-gage network was in existence for many years before the recording-gage network was established in 1940, the period of record available for 24-hr observations is much longer than that for the 6-hr duration. The second map developed was for the 100-yr return period for the 24-hr duration. In the development of this map the advantage of maximum sample size and length of record was retained at the expense of some decrease in reliability of computed values. The 6-hr maps for the 2- and 100-yr return periods followed. For the 6-hr duration, the sample size was materially smaller in both numbers and length of record because only recording-gage data could be used. After these four maps were completed, values for intermediate return periods were computed for a grid of about 47,000 points, and appropriate maps were prepared.

In previous studies, topography was considered only in a general sense and the isopluvials were drawn by interpolating subjectively between the individual stations. In preparing this Atlas, multiple linear regression equations were developed for each of many regions of the western United States as an aid to estimating the precipitation-frequency values at each of about 47,000 grid points. These equations related topographic and climatologic factors to the variations in the precipitation-frequency values. Isopluvials were smoothed subjectively between values in adjoining regions. The subjective smoothing was based upon experience in analyzing precipitation-frequency maps; the amount of smoothing was rarely greater than the standard error of estimate for the equations in the adjoining regions.

Analysis

Basic Data

Station location. Frequency analysis of precipitation data requires a relatively long and stable station record. In analyzing a mean annual or a seasonal precipitation map, it is possible to use double-mass curve analysis to evaluate the effects of changes in station location or exposure. Within limits, the effects of differing locations on the annual precipitation values can be eliminated by use of relations determined from the double-mass curve analysis (Weiss and Wilson 1953). However, no technique for evaluation and modification of a series of extreme precipitation values has been developed. Therefore, it was necessary to ensure that the data used in this Atlas represented, as nearly as possible, observations taken from a single location.

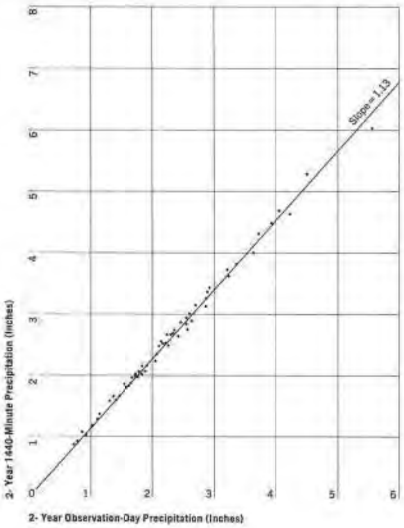
Official records of station locations (latitude, longitude, and elevation) were examined to determine physical moves. The criterion was adopted that if a move at any station changed the elevation 100 ft or more or changed the horizontal location 5 mi or more, its data were treated as though they came from separate stations. In some cases, a station retained the same name but investigation indicated that it had been moved beyond acceptable limits. In such cases, the records for the station were terminated and new records were started. In other cases, published sources indicated location changes beyond acceptable limits, but subsequent inspection of records indicated these changes were corrections to reported values of elevation, latitude, or longitude rather than actual physical moves. Thus, the observations for the station actually were continuous at one location. Occasionally, a lesser move resulted in a significant difference in exposure, such as from the windward to the lee side of a mountain range. Data from stations such as these also were treated as data from separate stations.

Types of data. The primary data used in this Atlas can be divided into two categories. First, there are data from recording gages; these data are published for clock-hour intervals. These data were processed to obtain maximum 6- and 24-consecutive clock-hour amounts for each month of record. The time interval selected did not have to start at a particular hour; for example, the 6-hr interval might be from 1 to 7 a.m., or from 3 to 9 p.m.; the 24-hr interval might be from 4 a.m. on one day to 4 a.m. on the following day, or from 2 p.m. on one day to 2 p.m. on the next. Second, there is the large amount of data from nonrecording gages. At these gages, observations are usually made once each day at a given time for each station. At observation time, the amount of precipitation that fell in the preceding 24-hr interval is measured; this precipitation may have fallen during any part or all of the 24-hr period. These data are commonly referred to as observation-day amounts.

A subset of data in the first category is the recording-gage data from the long-record first-order Weather Bureau (now National Weather Service) stations. There are approximately 200 such stations in the entire country (about 50 in the western United States). Maximum values for each year of record from these stations have been tabulated for the various durations to the nearest minute. The maximum 6-hr amount recorded each year is for a period of 360 consecutive minutes, regardless of the time beginning; for example, such a period might begin at 2:03 p.m. or at 3;59 p.m. Similarly, data for the 24-hr duration are for a 1,440-min period. These amounts are commonly referred to as *n*-minute amounts.

Exhibit D-4

Figure 1. *Relation between 2-yr 1,440-min precipitation and 2-yr observation-day precipitation.*



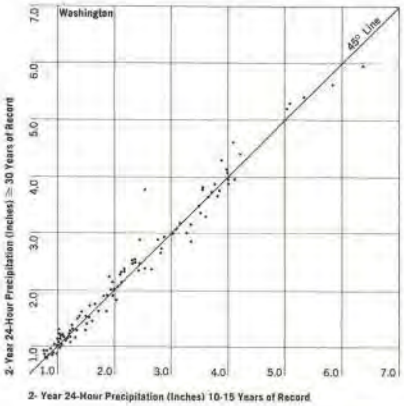


Figure 2. *Test of 2-yr 24-hr precipitation values from short- and long-record stations for the State of Washington.*

Fixed- versus true-interval precipitation values. The continuous clock-hour and observation-day data from most stations are available for intervals fixed by arbitrary clock intervals. Because the time of occurrence of precipitation is a random phenomenon, straddling often occurs; for example, part of the maximum precipitation may start in one time interval and end in the succeeding time interval. Seldom does maximum precipitation for a specified duration occur within a mandatory measurement interval. For this reason, it was necessary to use relations between fixed-time intervals (of actual occurrence) and the 360- and 1,440-min periods to make maximum use of available data.

These relations have been investigated in previous studies (U.S. Weather Bureau 1954a, 1956, 1957–60). It was found that on the average 1.13 times a statistical value for a particular return period, based on a series of annual maximum observation-day (fixed-interval) amounts, was equivalent to a statistical value for the same return period obtained from a series of 1,440-min (true-interval) values. The ratio of statistical values computed from a series of six consecutive clock-hour measurements to those from a series of 360-min observations is 1.02; a similar ratio of statistical values computed from 24 consecutive clock-hour amounts to those from 1,440 min values is 1.01.

These ratios (for example, *n*-year 1,440-min precipitation equals 1.13 times *n*-year observation-day precipitation) are not built on a causal relation. They are average index ratios because the distributions of observation-day, *n*-hour, and *n*-minute precipitation are irregular and unpredictable. For example, the annual maxima of the two series for the same year do not necessarily come from the same storm. Graphical comparison of the values for the 2-yr return period based on observation-day and 1,440-min precipitation data is shown in figure 1.

The frequency and amount of straddling that occur can be investigated on probability considerations as well as empirically. The time axis can be represented by a straight line separated into uniform time intervals by an evenly spaced series of points. These intervals can represent individual hours, 6- or 24-hr periods, an observation day, and so forth. The maximum precipitation for any duration can be assumed to occur at a uniform rate in a time unit exactly equal to one of the fixed intervals, but without regard to the location of the fixed intervals. This time unit may fall at random with respect to the fixed intervals and will, in general, overlap two adjacent intervals. Using probability theory, Weiss (1964) confirmed the empirical values used.

Data sources. The primary data sources used were *Climatological Data for the United States by Sections* (National Climatic Center 1897–1970) and *Hourly Precipitation Data* (National Climatic Center 1940–70). In California, it was possible to increase the data sample 15 to 20 percent by using unpublished data from gages maintained by the State, local agencies, private corporations, or individuals (California, Department of Water Resources 1900–69). Published data are routinely of high quality because of periodic checks of observing sites and observation techniques and the quality-control procedures used in the publication process. The quality of unpublished data must be checked by a review of the inspection records of the organization maintaining the gage and by a careful screening of the data.

Length and period of record. In preparing generalized maps of precipitation-frequency values, a uniform period of record several times the length of the return period desired and computed at a relatively dense network of stations (for sampling all data and topographic extremes) is the ideal. In practical work, compromises are necessary.

The use of a nonuniform record period, especially when the period is short, may result in unrealistic relations between stations. For instance, if data taken during a short-record period at one station were taken during a relatively dry period, while data from the neighboring station were taken during a relatively wet period, the interstation relation would not be valid. Because the objective of this investigation is to define the geographic variation in mountainous regions, it is desirable to minimize other causes of variation. Use of a standard base period would minimize the above variation. This is common practice in the preparation of mean annual precipitation maps and also can be applied to the preparation of precipitation-frequency maps for shorter return periods.

Determination of precipitation-frequency values is usually based upon the longest record available. These values are assumed to be reasonably representative of the values that would be obtained if the entire record were known. The use of a short-record base period requires testing to determine if the data provide unbiased results representative of values that would be obtained from use of a long-record base period. For most regions covered in this study, the most recent 15-yr period immediately preceding the period when the maps for this Atlas were developed was used to compute precipitation values for the 2-yr return period. At locations with at least 30 years of data, the 2-yr values from the 15-yr base period were compared with the 2-yr values computed using the total record. If the differences between the two series were small and randomly distributed, the 15-yr base period was adopted for all stations. Figure 2 shows the result of such a test for the 24-hr duration values for stations in Washington. The same test was made for the rest of the western states.

In most of California and Nevada, the values computed from the 15-yr base period data showed significant differences and some bias to values based upon the total record. In this region, it was necessary to use values based on the longest record possible for each station in preparation of the 2-yr maps. Stations without data during all or most of the more recent years were identified on the working maps.

To make use of data from the maximum number of stations, data from stations with 10 to 14 yrs of record were used in preparing the 2-yr maps. Such stations also were suitably identified on the working maps so that the analyst could use judgment in his interpretation of such values.

While a 15-yr record provides data several times the length of the return period for 2-yr maps, it provides only a small fraction of the length of the 100-yr return period. During a 15-yr period, some stations may experience precipitation amounts equivalent to a return period of 50, 100, or more years. However, the probability of having a 100-yr value in any preselected 15-yr period is only 0.14. Similarly, the probability of *not* having a true 15-yr return period value in any preselected 15-yr period is about 0.09. Thus, in a given 15-yr period, the probability that a station has received its true 100-yr value is not greatly different from the probability that its neighboring station has *not* experienced its true 15-yr value. While, admittedly, this would be an extreme case, this example shows the importance of using as long a record as possible when preparing precipitation-frequency maps for long return periods. In this study, records for as long as possible for each station (without violating the 100-ft or 5-mi criterion) were used to compute the 100-yr return period values. The length of record and a confidence band to indicate the range of values likely to be experienced at each station were included in the plotting model. With this information, the analyst could more effectively evaluate the reliability of each data point.

Published and unpublished data from approximately 3,300 stations were used in this study. The number of stations grouped by length of record and state are shown in table 1. Many recording gages were established at sites where nonrecording gages had been located for many years. In table 1, the first column for each state shows the number of stations with recording-gage data. The second column for each state shows the total period of record for which observation-day data were available for each of these stations. The total record includes both recording and nonrecording data for the recording-gage station. (Note: The total number of stations in columns 1 and 2 are equal.) The third column for each state shows the number of stations with nonrecording-gage data only.

Figure 3 shows the location of the 1,030 recording stations used in this study. The length of record indicated is for the longest available record and includes the period where only a nonrecording gage may have been located at the particular station. Figure 4 shows the location of the 2,292 nonrecording gages that, together with the recording gages, were used to provide data to define the 24-hr isopluvial pattern. A few additional stations with records of less than 10yrs were used to provide guidance for estimating the precipitation pattern in extremely mountainous regions where no other data were available. Most of the data were for observation days. Empirical adjustments were used to convert statistical analyses of these data to the equivalent of 1,440-min data.

Exhibit D-4

Table 1. *Number of precipitation stations by length and type of record in each Western State*

Years of record	State																	
	Arizona			New Mexico			Colorado			Utah			Wyoming			Montana		
	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR
10-14	6	5	38	29	10	33	18	18	28	13	8	20	23	16	31	29	22	78
15-19	9	8	28	8	16	34	14	11	29	2	0	11	2	1	11	5	3	19
20-24	23	12	30	34	12	36	52	36	31	18	9	16	31	20	14	59	50	23
25-29		1	15		7	15		3	15		2	7		3	7		2	15
30-34		1	9		3	15		3	7		1	7		1	8		2	14
35-39		2	10		3	11		0	9		4	4		2	6		2	9
40-44		6	53		2	16		2	10		1	9		1	8		1	8
45-49		0	1		4	16		0	10		0	5		3	8		1	5
50-54		1	1		5	13		4	12		2	13		2	6		5	11
55-59		1	4		8	14		2	7		1	3		5	8		1	9
60-64		0	1		1	3		0	6		2	14		0	5		4	3
65-69		1	1		0	4		1	8		3	4		2	2		0	1
70-74								4	6									
75-79																		
80-84																		
85-89																		
90-94																		
Number:																		
By type	38		191	71		210	84		178	33		113	56		114	93		195
Total stns		229			281			262			146			170			288	
Percent:																		
By type	3.7		8.3	6.9		9.2	8.2		7.8	3.2		4.9	5.4		5.0	9.0		8.5
Total stns		6.9			8.4			7.9			4.4			5.1			8.6	

Years of record	State															Total				Percent			
	Idaho			Washington			Oregon			Nevada			California										
	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	Stns.	RGR	TR	NR	Total
10-14	19	18	10	31	20	19	26	19	33	11	6	10	98	95	209	303	237	509	812	29.4	23.0	22.2	24.4
15-19	2	1	7	4	2	13	3	3	13	6	5	5	37	35	92	92	85	262	354	8.9	8.3	11.4	10.6
20-24	3	2	5	15	14	21	15	15	29	6	7	6	47	42	132	303	219	343	646	29.4	21.3	15.0	19.4
25-29	16	10	11	37	25	8	50	36	30	15	5	4	140	114	97	258	208	224	482	25.0	20.2	9.8	14.5
30-34		2	7		1	19		3	25		3	3	53	54	59	53	74	173	226	5.1	7.2	7.6	6.8
35-39		1	4		4	19		4	11		1	3	14	18	43	14	41	129	143	1.4	4.0	5.6	4.3
40-44		0	10		4	12		0	9		0	2	5	15	70	5	32	207	212	0.5	3.1	9.0	6.4
45-49		0	15		3	8		1	4		5	3	0	2	16	0	19	91	91	0.0	1.8	4.0	2.7
50-54		1	14		4	15		2	10		2	4	0	1	13	0	29	112	112	0.0	2.8	4.9	3.4
55-59		4	8		0	9		4	6		0	5	0	3	13	0	29	86	86	0.0	2.8	3.8	2.6
60-64		0	6		3	4		1	2		1	2	1	6	13	1	18	59	60	0.1	1.7	2.6	1.8
65-69		1	3		7	8		3	7		3	2	0	2	19	0	23	59	59	0.0	2.2	2.6	1.8
70-74					0	1		3	1				0	8	21	0	15	29	29	0.0	1.5	1.3	0.9
75-79													0	0	4	0	0	4	4	0.0	0.0	0.2	0.1
80-84													1	1	4	1	1	4	5	0.1	0.1	0.2	0.2
85-89														0	0		0	0	0	0.0	0.0	0.0	0.0
90-94														0	1		0	1	1	0.0	0.0	0.0	0.0+
Number:																							
By type	40		100	87		156	94		180	38		49	396		806	1,030		2,292	3,322				
Total stns		140			243			274			87			1,202			3,322						
Percent:																							
By type	3.9		4.4	8.4		6.8	9.1		7.9	3.7		2.1	38.4		35.1								
Total stns		4.2			7.3			8.2			2.6			36.1									

Note: RGR = stations having recording-gage record.
TR = stations having recording gage for part of the record; total record includes both recording- and nonrecording-gage record.
NR = stations having only nonrecording-gage record.

Data tabulations. The maximum observed 24-hr (and 1- and 6-hr for recording gages) precipitation amount for each month was tabulated for each station. The maximum amount for each year of record was determined from these maximum monthly amounts. In the tabulations, data for some stations were missing or of questionable reliability for all or part of one or more years. For each such case, the data were evaluated individually to obtain the maximum length of record for the station. For instance, if data for a few months were missing, the maximum amount recorded for the remainder of the year was used to determine the maximum yearly amount if it appeared reasonable when compared with other years and with the maxima for that year at surrounding stations. This could result in an underestimation of the accepted amount, but it is felt that such errors are small and of little consequence.

Every effort was made to keep spurious data to a minimum. Reports of unusually large amounts at a station, or of large amounts at one station surrounded by stations reporting little or no precipitation, were examined to determine whether these large amounts were meteorologically reasonable. Cool season data were examined to ascertain if unusually large amounts were depth of snow rather than its water equivalent. However, not all large amounts were examined, nor could conclusive determinations be made regarding all of the large amounts that were examined. It is believed that most of the spurious data have been corrected.

Frequency Analysis

Two types of series. There are two methods of selecting data for analysis of extreme values. The first method produces the annual series. This method selects the largest single event that occurred within each year of record. In the annual series, year may be calendar year, water year, or any other consecutive 12-mo period. The limiting factor is that one, and only one, piece of datum is accepted for each year. The second method of selecting data produces the partial-duration series. This method recognizes that large amounts are not calendar bound and that more than one large event may occur in the time unit used as a year. In a partial-duration series, the largest *N* events are used regardless of how many occur in the same year; the only restriction is that independence of individual events be maintained. The number of events used is at least equal to the number of years of record.

One requirement in the preparation of this Atlas is that the results be expressed in terms of partial-duration frequencies. To avoid the laborious processing of partial-duration data, the annual series data were collected and analyzed and the resulting statistics were transformed to partial-duration statistics.

Conversion factors between annual and partial-duration series. Table 2 gives the empirical factors used to multiply partial-duration series analysis values to obtain the equivalent annual series analysis values. It is based on a sample of about 200 widely scattered first-order Weather Bureau stations. Only about one-fourth of these stations are in the western United States. The factors used in table 2 were taken from *Weather Bureau Technical Paper* No. 40. Reciprocals of these factors were used to convert the statistics of the annual series to those of the partial-duration series.

These relations have also been investigated by Langbein (1949) and Chow (1950) with equivalent results. The quality of the relation between the mean of the partial-duration series and that of the annual series data for 6- and 24-hr durations is shown in figure 5. The means for both series are equivalent to the 2.3-yr return period. Tests for samples of from 10 to 50 yrs of record length indicate that the factors of table 2 are independent of the record length.

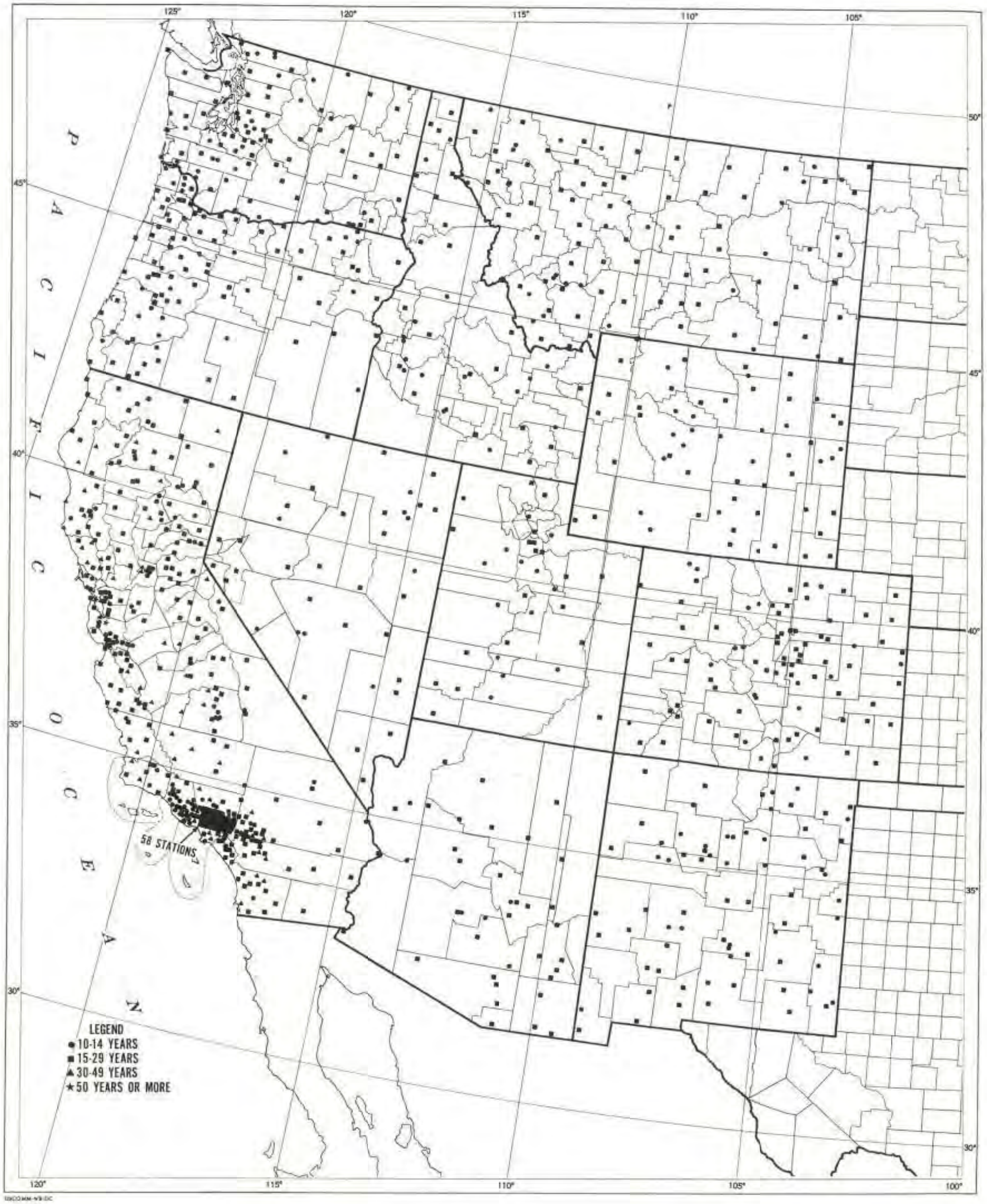
Return period	Conversion factor
2-yr	0.88
5-yr	0.96
10-yr	0.99

Table 2. *Empirical factors for converting partial-duration series to annual series*

Frequency distribution. The frequency distribution used was the Fisher-Tippett Type I distribution; the fitting procedure was that developed by Gumbel (1958). This distribution and fitting procedure were used by the National Weather Service in previous studies of short-duration precipitation values (U.S. Weather Bureau 1953, 1954a, 1954b, 1955a, 1955b, 1956, 1957–60, and 1961). Studies by Hershfield and Kohler (1960) and Hershfield (1962) have demonstrated the applicability of this distribution to precipitation extremes. The distribution was fitted by the method of moments. The 2-yr value measures the first moment, the central tendency of the distribution. The relation of the 2-yr to the 100-yr value is a measure of the second moment, the dispersion of the distribution. The 2-yr and 100-yr precipitation can be used for estimating values for other return periods.

The return-period diagram, figure 6, taken from *Weather Bureau Technical Paper* No. 40, is based on data from National Weather Service stations having long records. The spacing of the vertical lines on the diagram is partly empirical and partly theoretical. From 1- to 10-yr return periods, it is entirely empirical, based on freehand curves drawn through plottings of partial-duration series data. For 20-yr and longer return periods, reliance was placed on the Gumbel procedure for fitting annual series data to the Fisher-Tippett Type I distribution. The transition was smoothed subjectively between the 10- and 20-yr return periods. If

Exhibit D-4



precipitation values for return periods between 2 and 100 yrs are desired, it is necessary to obtain the 2- and 100-yr values from this series of generalized precipitation-frequency maps. These values are then plotted on the appropriate verticals and connected with a straight line. The precipitation values for the intermediate return periods are determined by reading values where the straight line intersects the appropriate verticals. If the rainfall values are then converted to the annual series by applying the factors of table 2 and plotted on either Gumbel or log-normal graph paper, the points will very nearly approximate a straight line.

Isopluvial Maps

Methodology. The factors considered to determine the sequence of preparation of the basic isopluvial maps for this series of generalized precipitation-frequency maps were (1) availability of data, (2) reliability of estimates for the return period, and (3) range of durations and return periods. Because of the large amount of data for the 24-hr duration and the relatively small standard error associated with the 2-yr values, a map showing such data was selected for preparation as the basic map for this series. The second map was prepared for the 24-hr duration and 100 yrs, the longest return period of interest. Next, the 2-yr 6-hr and the 100-yr 6-hr precipitation maps were prepared. These four key maps envelop the range of durations and return periods required and provide the data to be used for obtaining values for four intermediate return period maps at each duration.

Development of relations for interpolating precipitation-frequency values. The adequacy of the basic data network for determining precipitation-frequency values varies from place to place within the western United States. The greatest station density occurs along the Pacific coast west of the Cascade and Sierra Nevada Ranges (figs. 3 and 4). The lowest densities are in the intermountain plateau—between the Cascade-Sierra Nevada ranges and the Continental Divide—particularly in Nevada and in the Salmon River Mountains of Idaho. Even within particular regions, the stations are not evenly distributed. Most of the stations are located in the coastal plains, the river valleys, the western portion of the Great Plains, and the lower foothills of the mountains. Relatively few stations are located on steep slopes or on crests of mountains, in sparsely populated areas, or in areas where access is difficult.

It is desirable, therefore, to develop relations that can be used in interpolating precipitation-frequency values between stations in regions where data are relatively scarce. A preferred method is to relate variations in precipitation-frequency directly to variations in topographic factors; this is done when an adequate relation can be developed. The primary advantage of this procedure is that topographic factors can be determined at any point in a region. Topographic maps can be prepared from aerial photographs or surveys, or by other methods that do not require observations taken at a fixed point over a period of time. Among topographic factors frequently considered are: (1) elevation of the station, either the actual elevation or some effective elevation (an average elevation determined along a circle of a given radius around the station); (2) slope of the terrain near the station, both in the small and large scales; (3) distances from both major and minor barriers; (4) distances and directions from moisture sources; and (5) roughness of the terrain in the vicinity of the station.

Figure 3. *Geographic distribution of stations with recording gages. Symbols indicate total length of record available.*

Exhibit D-4

It has not been possible to develop such relations for all regions. Hence, it also was necessary to develop relations that included climatological or meteorological factors. The factors selected for use must be available at locations where precipitation data for durations of between 1 and 24 hrs are not available. Otherwise, they would not provide additional information needed for use in interpolating between locations with frequency values. An example of such a factor is normal annual precipitation. In the construction of such a map, data from snow courses, adjusted short records, and storage gages that give weekly, seasonal, or annual accumulations of precipitation can be used. Such records do not yield the short-duration precipitation amounts necessary for this study. Thus, normal annual precipitation data, particularly because it provides greater areal coverage in mountainous regions, might be of definite use in developing the patterns of the precipitation-frequency maps.

Several other meteorologic factors can be used in combination with normal annual precipitation data and topographic factors to interpolate short-duration precipitation-frequency values at intermediate points. Examples of such factors are: (1) number of thunderstorm days, (2) number of days or hours with precipitation above a threshold value, (3) percentage frequencies of various wind directions and speeds, and (4) percentage frequencies of class intervals of relative humidity. Since these factors can be obtained only where there are recording meteorological gages or where there are observers to record the data they do not supplement the available short-duration precipitation-frequency values by providing data at additional sites.

It would have been desirable to develop a single equation, utilizing physiographic factors, to interpolate between locations with short-duration precipitation-frequency values for the western United States. Such an equation could not be developed, so relations for interpolating the precipitation-frequency values were developed for each of several smaller regions considered to be meteorologically homogeneous. The extent of each region was determined from consideration of the weather situations that could be expected to produce large precipitation amounts. Among the questions asked and answered were: What is the source and from what direction does moisture for major storms come and are there major orographic barriers that influence the precipitation process? Figure 7 shows some of the principal paths of moisture inflow for the western United States and the major orographic barriers to such inflow.

The regions selected for their homogeneity normally are river basins or combinations of river basins. The river basins selected were usually bounded by major orographic barriers that significantly influence the precipitation regime. The size of these regions varied, partly because of meteorologic and topographic considerations and partly because of the availability of data. Some regions included more variability in topographic and meteorologic factors than was ideal. Efforts made to reduce the size of the regions were not successful because sample sizes decreased to less than acceptable limits.

After the geographic regions were selected, various topographic factors that could cause variation of precipitation-frequency values within limited regions such as slope, elevation, roughness, and orientation were examined. Individual precipitation-frequency values and exposures around the stations were examined to gain insight into topographic factors that could be im-

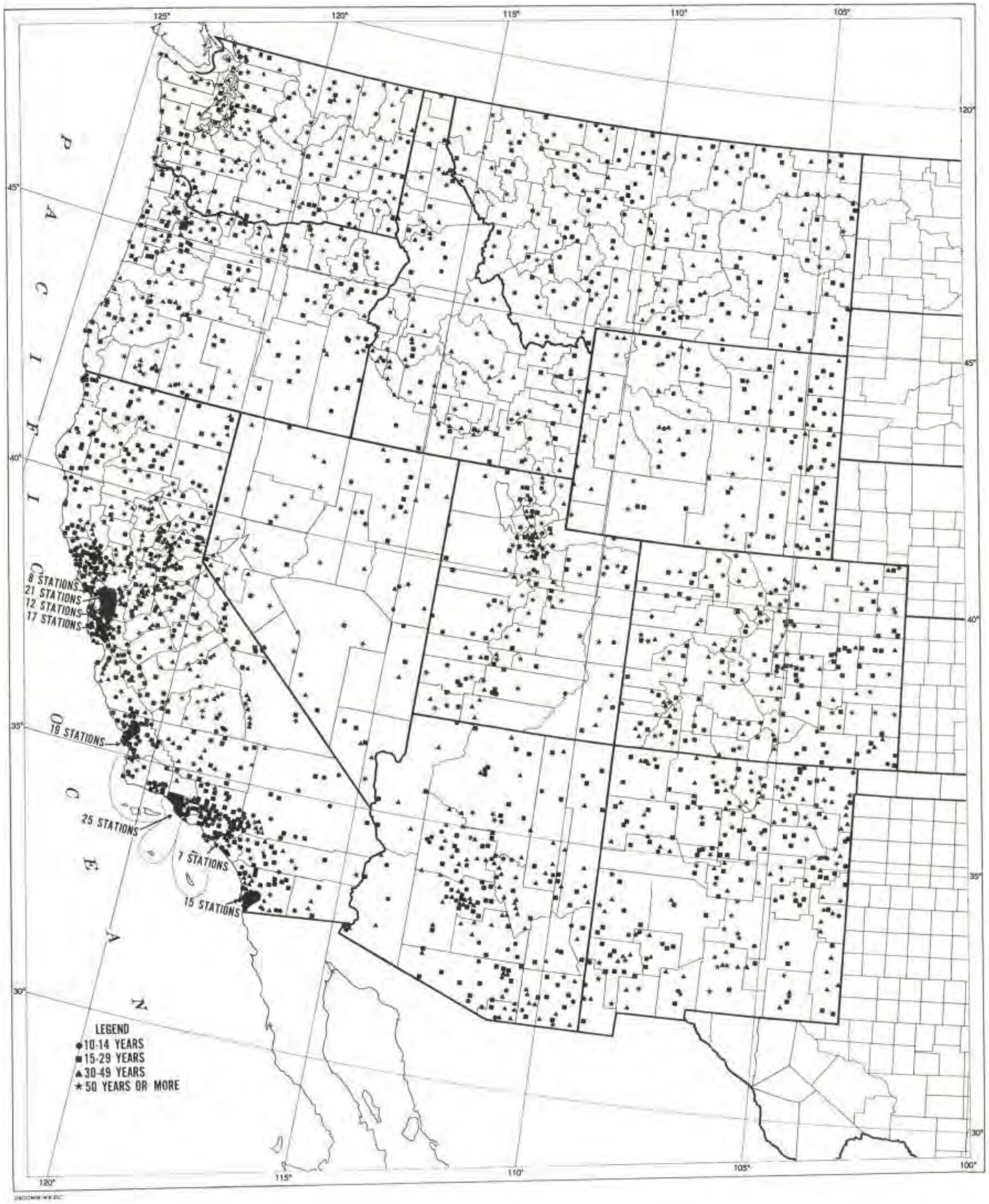
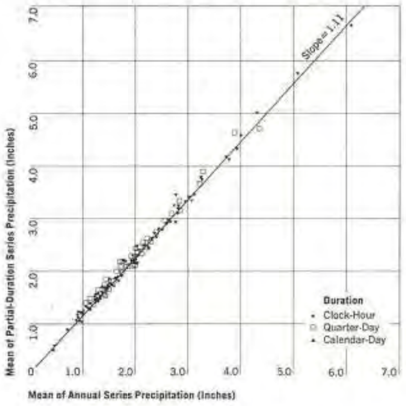


Figure 4. *Geographic distribution of stations with nonrecording gages. Symbols indicate total length of record available.*

Exhibit D-4

Figure 5. *Relation between annual and partial-duration series.*



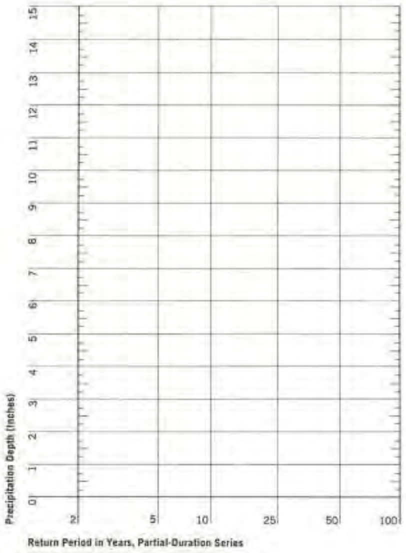


Figure 6. *Precipitation depth versus return period for partial-duration series.*

Figure 7. *Principal paths of moisture inflow in the western United States for storms producing large precipitation amounts. Toned areas are major orographic barriers.*

portant. Next, an examination was made of factors that combined topographic and meteorologic considerations, such as distance and direction to moisture sources. Each factor considered was a measure of some physical reality, and each was understandably related to variation in the precipitation-frequency regime.

Finally, various climatological and meteorological factors that could be indexes of variation of the precipitation-frequency values were considered. The procedure used for developing interpolating equations was a multiple-regression screening technique. This process was done by computer using a least-squares technique. The computer program was capable of accepting a total of 174 independent variables for as many locations as data were available. The number of variables screened for the various relations ranged between 60 and 100. This does not mean that 60 or more completely different factors could be identified. For example, several factors might involve different measures of slope. Moreover, these measures of slope might be over different distances or have different orientations. In each instance, the practice was to permit the computer to select the most critical of the various measures of each factor.

Although the computer program treated each variable as linear during the regression analysis, it was possible through internal computations to use logarithms, powers, roots, reciprocals, or combinations of any or all of the factors. The computer program selected the single variable most highly correlated with the precipitation-frequency value under investigation. The next step was to select the variable that, combined with the variable already selected, would explain the greatest variation in the precipitation-frequency values. The third, fourth, fifth, and further variables were selected in a similar manner. The program continued to select

Region of applicability[1]	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Gila, Williams, and lower Colorado River Basins (1)	0.84	86	1.86	0.21
Little Colorado, San Juan, and Virgin River Basins, except higher elevations of south-facing slopes (2)[2]	0.81	105	1.36	0.20
Higher elevations of south-facing slopes of Little Colorado, San Juan, and Virgin River Basins (2)[2]	0.93	41	1.31	0.13
Rio Grande Basin north of El Paso, Tex. (3)	0.77	110	1.35	0.18
Crest of Continental Divide and Sangre de Cristo Mountains to generalized 7,000-ft contour from southern Wyoming to southern tip of Sangre de Cristo Mountains (4)	0.83	122	1.43	0.22
Upper Colorado and Gunnison River Basins and Green River Basin below confluence of Green and Yampa Rivers (5)	0.79	69	1.12	0.13
Yampa River Basin, Green River Basin above confluence of Green and Yampa Rivers, and Bear River Basin east of Wasatch Mountains (6)	0.83	29	1.03	0.08
Mountains of central Utah (7)	0.85	86	1.35	0.18
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada Crest (8)[3]	0.71	79	1.03	0.13
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (8)[3]	0.71	55	1.04	0.15
Big Horn River Basin above Saint Xavier and minor portions of North Platte, Powder, Tongue, and Yellowstone River Basins (9)	0.78	55	1.25	0.21
Upper Missouri River Basin above Holter Dam, Mont.; Snake River Basin above Alpine, Wyo.; and upper Yellowstone River Basin above Springdale, Mont. (10)	0.76	57	1.19	0.16
From generalized 4,000-ft contour on east to crests of Crazy and Little Belt Mountains and Lewis Range on west (11)	0.80	52	1.67	0.26
West of Continental Divide, but east of Bitteroot Range and Cabinet and Selkirk Mountains (12)	0.85	44	1.36	0.12
Mountainous region of eastern Washington and Oregon and of Idaho west of Bitteroot Range crest and Continental Divide, and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour (13)	0.78	147	1.44	0.24
Orographic region east of crest of Cascade Range and west of Snake River Basin (14)	0.90	115	1.75	0.35
Western slopes of Coast Ranges, Olympic Mountains, and Cascade Range (15)	0.87	125	3.69	0.48
Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas, and Gladstone Creeks (16)	0.91	39	4.19	0.50
Russian River, Cache and Putah Creeks, and coastal drainages west of Russian River (17)	0.84	63	5.31	0.78
Santa Cruz Mountains and La Panza, Santa Lucia, and Coast Ranges (18)	0.95	55	4.32	0.45
Diablo, Gabilan, and Temblor Ranges (19)	0.82	58	2.21	0.35
San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (20)	0.88	149	3.98	0.59
Santa Ana, Santa Rosa, Coyote, and other extreme southern coastal mountains (21)	0.88	34	2.44	0.33
Northern Sierra Nevada north of Mokelumne River Basin (22)	0.92	84	4.56	0.53
Southern Sierra Nevada south of Consumnes River Basin (23)	0.88	61	3.43	0.53
Southeastern desert region of California (24)	0.89	41	1.07	0.16
Spillover zone east of Sierra Nevada crest (25)	0.94	41	2.05	0.27
Spillover zone east of crest of coastal mountains of southern California (26)	0.97	10	2.08	0.15

[1] Numbers in parentheses refer to geographic regions shown in figure 8.
[2] Two different equations were used in region 2. See text for explanation.
[3] Two different equations were used in region 8. See text for explanation.

Table 3. *Statistical parameters for relations used for interstation interpolation of 2-yr 24-hr precipitation values*

Exhibit D-4

variables until the variance explained by an additional variable was less than some preselected amount or until a fixed number of variables was selected. Final equations did not contain more than five independent variables.

In the development of these equations, data from all stations with daily or hourly observations were considered. The data sample used was not completely adequate. First, it did not include for each factor the full range of values that occur within the region. Application of the equation, therefore, required unavoidable extrapolation. Second, the number of data points used to develop these equations was occasionally less than desirable. Nevertheless, the equations provided the best available method of developing preliminary estimates of frequency values in regions lacking adequate data.

Relations for interpolating between 24-hr precipitation-frequency data points. Figure 8 shows generalized boundaries of the regions used to develop relations for interpolation between locations with 2-yr 24-hr precipitation values. Topographic maps show recognizable topographic barriers chosen as the boundary lines of most regions. For example, the boundary separating regions 3 and 4 from those to the west is the Continental Divide. The boundary separating region 15 from 14 is the crest of the Cascade Range. A few of the boundaries between adjoining regions may appear somewhat arbitrary, but examination of detailed topographic maps will show a physical basis for each.

In areas where topographic variation is gradual and where there are no large differences in elevations or slopes over short distances, precipitation-frequency values at a station usually are representative of a much larger area than are such values in a mountainous region. Within the western United States, some rather extensive regions met this criteria. Within these regions, there were also numerous stations with suitable records. The lack of topographic controls means only there is limited variation in precipitation-frequency values, and this variation is such that it can be depicted using the numerous station data points. No equations for interpolating between stations were developed for such regions (shown shaded in fig. 8).

The equations developed for interpolating between locations with 2-yr 24-hr precipitation values in regions of sparse data were not all equally reliable. On the average, the 28 equations developed for estimating the 2-yr 24-hr precipitation values at intermediate points in western United States explained about 70 percent of the variance. The standard error of estimate averaged about 13 percent of the average station value for 2-yr 24-hr precipitation. The correlation coefficient, the number of stations used, the average 2-yr precipitation value, and the standard error of estimate for each equation used to estimate 2-yr 24-hr precipitation values are shown in table 3.

The equation that explained the least variance, only slightly over one-half, was for western Utah and most of Nevada (region 8, fig. 8). This is a region with diverse topography and no well-defined orographic barrier. It is also a region where a wide variety of storms produce large precipitation amounts. The equation developed for the coastal mountains of California (region 18, fig. 8) explained the greatest portion of the variance, about 90 percent. The region consists primarily of mountain ranges oriented north-northwest to south-southeast; within this region, large precipitation amounts generally result from one storm type.

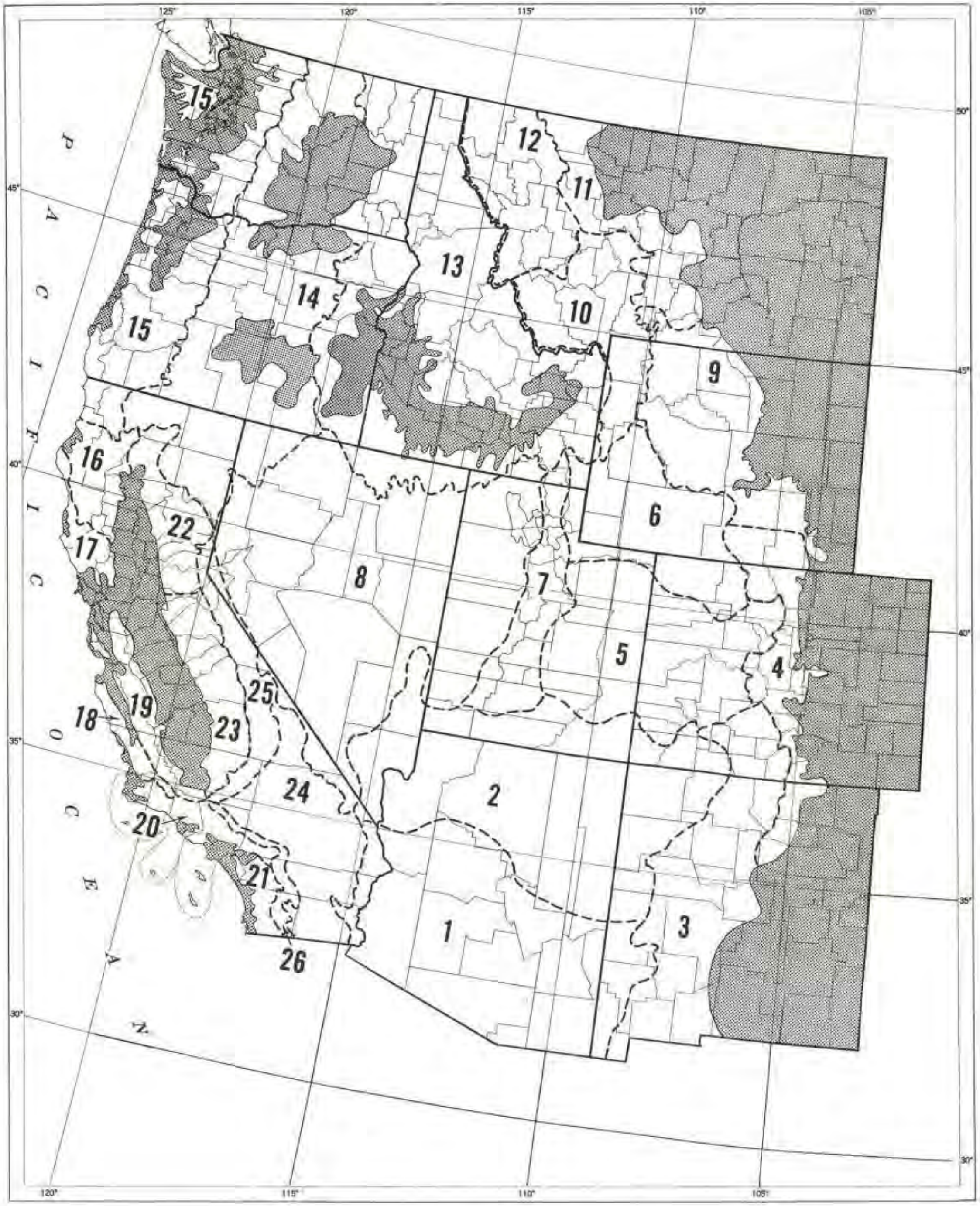


Figure 8. *Regions used to develop statistical parameters for interstation interpolation of 2-yr 24-hr precipitation values.*

Exhibit D-4

Table 4. *Factors most useful in relations for interstation interpolation for 2-yr 24-hr precipitation values*

Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
Slope	18	64	37	42
Normal annual precipitation	15	54	15	17
Barrier to airflow	10	36	11	12
Elevation	10	36	10	11
Distance to moisture	9	32	9	10
Location (latitude or longitude)	4	14	5	6
Roughness	2	7	2	2

Two equations were developed for region 8 (fig. 8), which includes western Utah and Nevada except for the Snake and Virgin River Basins and a spillover zone east of the Sierra Nevada. The two relations had nearly equal correlation coefficients and standard error of estimates. The first equation was developed using normal annual precipitation, the second topographic factors only. The equation using normal annual precipitation data was developed during preparation of maps for Utah because reliable normal annual precipitation maps were available. Investigations continued, and a relation that gave about equally reliable results was obtained during the development of the maps for Nevada. Values computed using both equations for points near the Nevada-Utah border showed results that did not differ greatly. The second equation was then used to prepare the maps for Nevada.

Table 4 shows the factors, grouped in general categories, found most useful in depicting variations in the 2-yr 24-hr precipitation values for the western United States. The first and second columns show the number and percent of equations in which each factor was used. The total for the second column is larger than 100 percent because several factors were used in the equations developed for each region. The third column shows the total number of times each factor was used, and the fourth what percentage each factor used was of the total number of factors. For example, of the 89 different factors used in the 28 equations, 37 were some measure of slope; the use of the slope factor represents 42 percent of the total number of factors used.

The single most important factor considered was slope, a topographic factor. Measurement of slope varied from region to region. In some regions, slope was measured directly by dividing the difference in height between two points by the distance between the points. In the Cascade and Coast Ranges of Washington and Oregon, the difference between the station elevation and the average elevation at a distance of 20 miles in the western quadrant proved to be the most significant factor. A less direct measure was used in north-central Wyoming and south-central Montana, where the greatest change in elevation between the station and the lowest point within 20 miles was used and the distance between the station and such a point was not involved. In several portions of California, a more complicated method was used. A path 5 miles wide was oriented along the prevailing direction of moist airflow. At 1-mi intervals along this path, the average height was measured. The difference in height between adjoining lines indicated whether there was an upslope or a downslope in this particular segment. The summation of the upslopes and downslopes, separately, was an indirect measurement of slope. A combination of these upslopes and downslopes, each divided by the distance between the station and the center of the area included between two adjoining lines, was a direct measurement of slope.

The second most important topographic factor was found to be the barrier to moist airflow; this factor is actually a combination of meteorology and topography. In selecting a barrier, the first consideration was the direction of moist air inflow. The barrier had to be normal, or nearly normal, to this direction. The barrier range, or ranges, had to be sufficiently massive to cause a significant disruption in the airflow. Barriers of limited lateral extent that would permit air to flow around as easily as over were not considered. A generalized crest line was drawn along the significant barrier, and measurements of barrier height or distances or directions to this barrier were then made from the station to this generalized crestline. The orientation of barriers to moist airflow was determined as appropriate for each region. For example, along the Pacific coast, a westerly direction of moist airflow was used; in Colorado and New Mexico, a southeasterly airflow was appropriate. The direction selected was determined from an examination of the moist air inflow in storms that produce large precipitation amounts in these regions. In some regions, the distance behind the barrier was important. In others, the height of the barrier proved to be more significant.

The distance to the principal moisture source, a combination of topographic and meteorologic influences, was another important factor. In northeastern New Mexico, central Colorado, and southeastern Wyoming (region 4, fig. 8), examination of a topographic map and consideration of the moist air inflow in storms that produced large precipitation amounts (fig. 7), made it evident that the general moist airflow was from the Gulf of Mexico. Distance to moisture was therefore measured in that direction.

Another topographic factor used frequently was the elevation of the station, either the actual station elevation or, preferably, where narrow valleys and ridges predominate in the area the average elevation around the station at some distance (effective elevation). Elevation alone usually correlated rather poorly with precipitation-frequency values. In many regions, the simple correlation between elevation and precipitation-frequency values was not statistically significant at either the 0.01 or 0.05 level. It was not elevation alone but a combination of elevation with other factors, such as slope, height of intervening barriers, and distance to moisture source, that was significant.

Normal annual precipitation was used in many of these index relations. However, the policy adopted was that normal annual precipitation was not used if an equally reliable relation could be derived solely on the basis of topographic factors, even though normals could have been used in almost every region. The one exception was the southeastern desert regions of California, where normal annual precipitation did not correlate well with precipitation-frequency values. Normal annual precipitation maps are most exact at points where data are available. Isopleths used to arrive at estimates in areas where data are not available are only as accurate as the standard error of estimate of the relation used in the interpolation and as the skill of the analyst will permit. Therefore, where estimates of normal annual precipitation (or other climatological factors) are used to develop precipitation-frequency maps, the error incorporated in development of the normal annual precipitation map is combined with the standard error of estimate of the relation for precipitation-frequency maps. Normal annual precipitation maps were, however, helpful and were used. Storage-gage and snow-course data, streamflow data, and vegetation maps are useful for drawing accurate normal annual or seasonal precipitation maps in regions where lack of short-duration precipitation data decreases the reliability of relations between frequency values and topographic factors. Normal annual precipitation was used as a factor where topographic factors could not be quantified to estimate the precipitation-frequency values with sufficient accuracy.

Table 5 shows the statistical parameters of the interpolating equations used to estimate the 100-yr 24-hr precipitation values. The equations were developed for the same regions as those for the 2-yr return period, with one exception (fig. 9). This was in Arizona where data from the Gila, Williams, and lower Colorado Basins were combined with data from the San Juan, Little Colorado, and Virgin River Basins. In regions relatively unaffected by orography, equations were developed that related the 2-yr 24-hr precipitation values to those for the 100-yr return period. These equations were developed as an additional aid for interpolating between stations in these regions because of the relatively few stations with long records available. Although the longest record stations were generally within the nonorographic regions, most states had less than 20 percent of the stations within these regions with 50 or more years of record. Equations for these regions provided an objective method of providing space-averaged ratios between 100-yr 24-hr precipitation values and 2-yr 24-hr precipitation values.

As with the relations for estimating the values for the 2-yr return period, the equations did not all have the same degree of reliability. The orographic region for which the equation accounted for the least variance (not quite one-half of the variation) was the region including the Yampa River Basin, the Green River Basin above the confluence of the Green and Yampa Rivers, and the Bear River Basin east of the Wasatch Mountains (region 5, fig. 9). For several regions in California, over 90 percent of the variance was accounted for by the equations. The equation developed for the San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (region 20, fig. 9) accounted for the greatest amount of the variation. On the average, the 35 equations developed to interpolate the 100-yr 24-hr precipitation values in this portion of the United States accounted for about 75 percent of the variance, and the standard error of estimate averaged about 12 percent of the average station value.

There was one region (region 7, fig. 9) for which two equations were developed. In the preparation of frequency maps for Utah, basins that were wholly or partly within Utah were investigated. One region extended westward from Utah to include most of Nevada. Within this region, a relation was developed that accounted for about 60 percent of the variance. During subsequent investigations, a superior relation was developed when frequency maps for Nevada were prepared. The newly developed equation accounted for about 80 percent of the variance.

Table 6 shows the factors found most useful for interpolating variations in the 100-yr 24-hr precipitation values in sparse-data areas of the western United States. This table is in the same format as table 4. The definitions of the variables—slope, distance to moisture, elevation, etc.—are the same as those for table 4. Again, slope is the most important topographic factor. The next most important topographic factor was elevation. In the equations, the 2-yr 24-hr precipitation values were used in interpolation. In table 6, it can be seen that the 2-yr 24-hr precipitation value was the most important variable. However, this may be misleading because about one-fourth of the regions for which equations were developed were considered nonorographic. In such regions, the use of the 2-yr 24-hr precipitation value in an equation was similar to using an average 100- to 2-yr ratio. Frequently, these equations included a location factor that reflected the variation of such a ratio over the region. As with other meteorological or climatological factors—for example, normal annual precipitation—it would have been preferable to avoid the use of precipitation-frequency values in the equations. However, this was not always possible.

Relations for estimating the 6-hr precipitation-frequency values. Data from both recording and nonrecording gages can be incorporated in equations for estimating precipitation-frequency values for the 24-hr duration. For durations of less than 24 hrs, only data from recording gages can be used. This frequently reduces the number of data points within a particular region by one-half or more. The effect of topography on precipitation-frequency values decreases as the duration decreases. Thus, there is less variability in the precipitation-frequency values for the 6-hr duration. For these reasons, larger regions are used to develop interpolation equations for 6-hr duration maps. Figure 10 shows the regions used to develop the equations for estimating 2-yr 6-hr precipitation values. The regions used for developing relations for the 100-yr return period were the same with one exception; the region south of the Snake, Bear, Yampa, and North Platte River Basins (region 1, fig. 10). This region was divided approximately along the Arizona-Utah and the New Mexico-Colorado boundary lines into Regions 1A and 1B.

The equation for the northern Sierra Nevada region of California (region 7, fig. 10) accounted for the least amount of variation—about 60 percent—in the 2-yr 6-hr precipitation values (table 7). The equation for the coastal mountains of California (region 6, fig. 10) accounted for over 90 percent of the variation and was the most reliable equation developed. On the average, the equations accounted for over 80 percent of the variations and had a standard error of estimate of about 11 percent of the average 2-yr 6-hr precipitation values.

For the 100-yr 6-hr precipitation values, the equation for the coastal mountains of California (region 6, fig. 10) accounted for the greatest amount of variation in these values (table 8). In this region, over 90 percent of the variation in the data sample was accounted for. The equation for the northern Great Basin (region 3, fig. 10) accounted for the least variation. In this region, the equation accounted for about 60 percent of the variation. On the average, the equations accounted for over 80 percent of the variation with a standard error of estimate of about 14 percent of the

Exhibit D-4

Region of applicability[1]	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Gila, Williams, San Juan, Little Colorado, and Virgin River Basins (1)	0.80	148	3.98	0.59
Rio Grande Basin north of El Paso, Tex. (2)	0.78	110	3.26	0.48
Crest of Continental Divide and Sangre de Cristo Mountains to generalized 7,000-ft contour from southern Wyoming to southern tip of Sangre de Cristo Mountains (3)	0.91	69	3.28	0.38
Upper Colorado and Gunnison River Basins and Green River Basin below confluence of Green and Yampa Rivers (4)	0.79	53	2.57	0.31
Yampa River Basin, Green River Basin above confluence of Green and Yampa Rivers, and Bear River east of Wasatch Mountains (5)	0.68	27	2.41	0.30
Mountains of central Utah (6)	0.88	65	2.84	0.25
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (7)[2]	0.77	64	2.50	0.29
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (7)[2]	0.90	55	2.42	0.22
Big Horn River Basin above Saint Xavier and minor portions of North Platte, Powder, Tongue, and Yellowstone River Basins (8)	0.94	47	3.10	0.31
Upper Missouri River Basin above Holter Dam, Mont.; Snake River Basin above Alpine, Wyo.; and upper Yellowstone River Basin above Springdale, Mont. (9)	0.88	48	2.68	0.34
From generalized 4,000-ft contour on the east to crests of Crazy and Little Belt Mountains and Lewis Range on the west (10)	0.85	41	3.71	0.44
West of Continental Divide, but east of Bitterroot Range and Cabinet and Selkirk Mountains (11)	0.90	37	2.87	0.20
Mountainous region of eastern Washington and Oregon and of Idaho west of Bitterroot Range crest and Continental Divide, and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour (12)	0.87	99	2.74	0.32
Orographic region east of crest of Cascade Range and west of Snake River Basin (13)	0.92	115	3.76	0.61
Western slopes of Coast Ranges, Olympic Mountains, and Cascade Range (14)	0.80	119	7.09	1.13
Spillover zone east of crest of Sierra Nevada (15)	0.91	28	5.39	0.75
Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas, and Gladstone Creeks (16)	0.85	26	8.34	1.42
Russian River, Cache and Putah Creeks, and coastal drainages west of Russian River (17)	0.88	35	10.17	1.24
Santa Cruz Mountains and La Panza, Santa Lucia, and Coast Ranges (18)	0.96	26	10.90	1.25
Diablo, Gabilan, and Temblor Ranges (19)	0.97	29	5.26	0.48
San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (20)	0.98	68	11.72	0.97
Santa Ana, Santa Rosa, Coyote, and other extreme southern coastal mountains (21)	0.87	29	6.74	1.06
Northern Sierra Nevada north of Mokelumne River Basin (22)	0.96	65	9.74	1.01
Southern Sierra Nevada south of Consumnes River Basin (23)	0.89	42	8.14	1.29
Southeastern desert region of California (24)	0.93	41	3.37	0.47
Spillover zone east of crest of coastal mountains of southern California (25)	0.98	10	6.20	0.50
New Mexico east of Rio Grande Basin (26)	0.66	136	5.28	0.88
Colorado east of generalized 7,000-ft contour, and southeastern Wyoming east of generalized 7,000-ft contour and south of North Platte River Basin (27)	0.82	119	4.73	0.52
Eastern Wyoming and southeastern Montana east of generalized 6,000- to 5,000-ft contour and south of generalized 4,000-ft contour in vicinity of Wyoming-Montana border (28)	0.83	66	4.08	0.45
Montana east and north of generalized 4,000-ft contour (29)	0.76	83	3.86	0.42
Snake River Valley below 5,000 ft (30)	0.85	48	2.25	0.21
Coastal Plain, Puget Sound region, and Williamette Valley below 1,000 ft (31)	0.94	146	5.47	0.62
Nonorographic region east of crest of Cascade Range (32)	0.71	50	2.07	0.25
Sacramento and San Joaquin River Valleys of California below 1,000 ft (33)	0.94	102	4.07	0.51
Coastal lowlands of California (34)	0.87	180	6.65	1.03

[1] Numbers in parentheses refer to geographic regions shown in figure 9.
[2] Two different equations were used in region 7. See text for explanation.

Table 5. *Statistical parameters for relations used for interstation interpolation of 100-yr 24-hr precipiation values*

average 100-yr 6-hr precipitation values.

The factors used most frequently in the equations for estimating the 2-yr 6-hr precipitation values are listed in table 9; those for the 100-yr 6-hr precipitation values are given in table 10. The format and definitions of variables of tables 9 and 10 are the same as those of table 4. For the 2-yr return period, the factor used most frequently was a measurement of slope. Most equations, however, related variations in the 6-hr precipitation values to variations in the 24-hr values. For the 100-yr return period, slope and elevation were equally important topographic factors. As with the 100-yr 24-hr and 2-yr 6-hr maps, precipitation-frequency values were used in the equations for some regions.

Typical multiple linear regression equations. It is beyond the scope of this publication to present all the equations used for estimating precipitation-frequency values for this Atlas. However, it is useful to discuss in some detail two equations used to estimate the 2-yr 24-hr precipitation values. The factors used and the accuracy of the results obtained are typical of other equations developed.

The first of these is the equation for the northern Coastal Mountains of California (region 16, fig. 8). This region includes the Eel River Basin, some southern portions of the Klamath River Basin, and the western portion of the Sacramento River Basin. This equation is

$$Y = 3.117 + 1.814(X_1) + 0.016(X_2) - 0.049(X_3), \quad (1)$$

where Y is the 2-yr 24-hr precipitation value in inches, and X_1 is the average elevation (in hundreds of feet) of the points on a 1-mile radius circle centered on the station and divided by the distance (in miles) to the coast. X_2 is the slope of the terrain near

Table 6. *Factors most useful in relations for interstation interpolation for 100-yr 24-hr precipitation values*

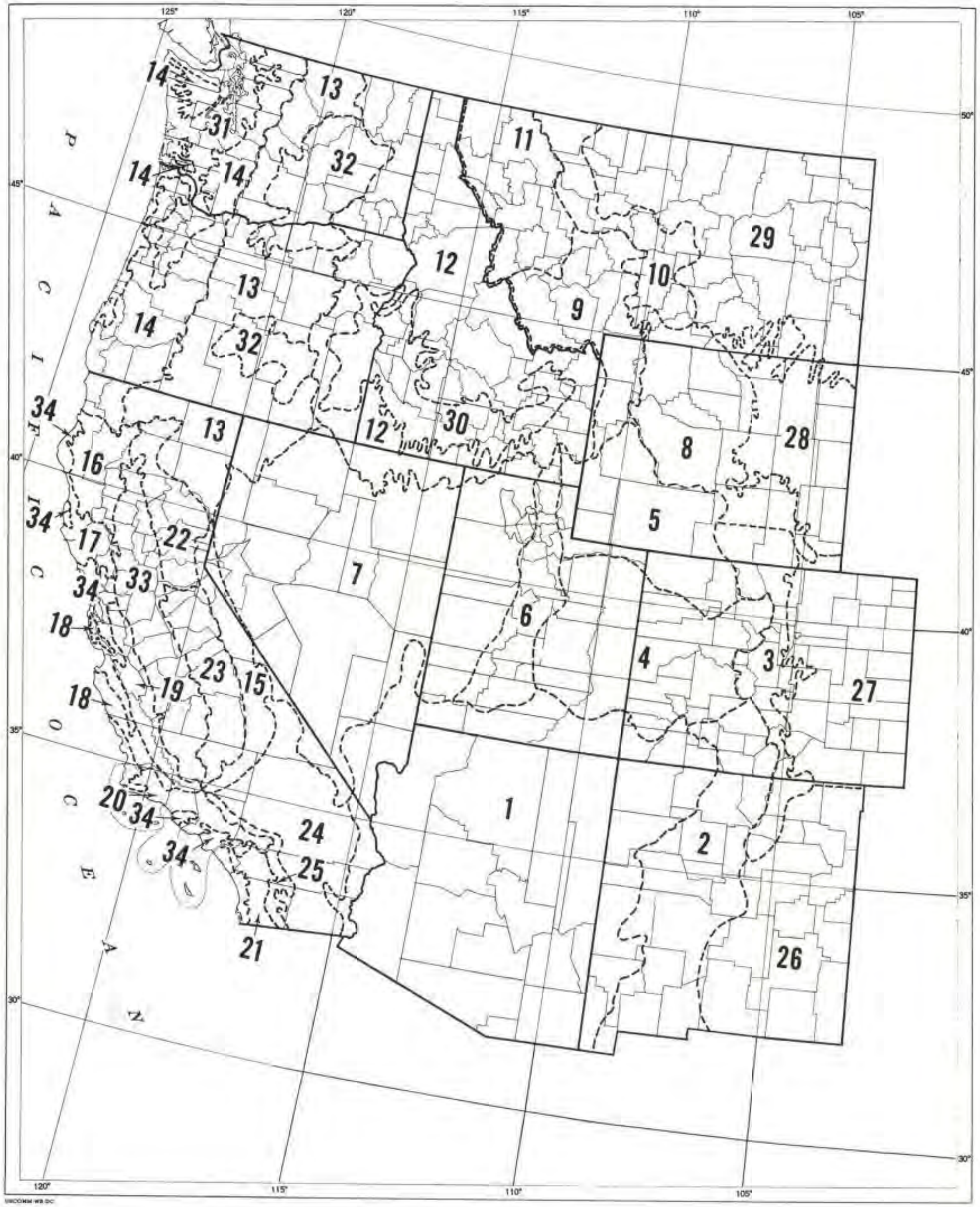
Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
2-yr 24-hr precipitation	27	77	27	29
Slope	26	74	26	28
Elevation	20	57	20	22
Distance to moisture	6	17	6	7
Location (latitude or longitude)	5	14	6	7
Normal annual precipitation	4	11	4	4
Barrier to airflow	2	6	2	2
Roughness	1	3	1	1

Region of applicability*	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Arizona, New Mexico, extreme eastern California, Nevada south of the Snake River Basin, Utah south of the Snake and Bear River Basins, and Colorado south of the Yampa and North Platte River Basins (1a and 1b)	0.92	262	1.10	0.16
Montana and Wyoming east of a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming (2)	0.94	125	1.07	0.10
Region north of the southern boundaries of the Snake, Bear, and Yampa River Basins and between a generalized crestline of the Cascades and a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming and northern Colorado (3)	0.91	151	0.73	0.07
Orographic regions of western Washington, Oregon, and California from the crest of the Cascade Range to the Pacific Ocean extending southward to include the area drained by the Klamath and Salmon Rivers in northern California (4)	0.78	57	1.66	0.23
Nonorographic coastal lowlands of Washington and Oregon (5)	0.97	59	1.41	0.10
Coastal mountains of California from the Trinity River Basin in the north to the Mexican border (6)	0.97	87	1.85	0.16
Northern Sierra Nevada north of Mokelumne River Basin (7)	0.78	31	2.03	0.34
Southern Sierra Nevada south of Consumnes River Basin (8)	0.92	26	1.68	0.18
Spillover zone east of the crests of the Sierra Nevada and the coastal mountains of southern California and the southeastern desert region of California (9)	0.86	25	0.84	0.12
Coastal lowlands and San Joaquin and Sacramento Valleys of California (10)	0.95	73	1.37	0.11

* Numbers in parentheses refer to geographic regions shown in figure 10.

Table 7. *Statistical parameters for relations used for interstation interpolation of 2-yr 6-hr precipitation values*

Exhibit D-4



the station (in hundreds of feet per mile). X_2 was computed by subtracting the average height along a 90° arc centered 10 miles southwest of the station (downwind for the most prevalent storm-wind direction) from the average height along a 90° arc centered 5 miles northeast of the station (upwind for the most prevalent storm-wind direction). X_3 is the average height (in hundreds of feet) of the final crest (measured along a 10° arc) divided by the distance (in miles) between the station and the final crest. The final crest was a generalized crestline that separated the Sacramento River Basin from basins to the west; it was drawn on a 1:1,000,000 World Aeronautical Chart. Distances to the east of this crest were considered negative.

The first factor, X_1, combines the measurements of the horizontal and vertical distances from moisture. It also measures the average slope between the station and the coast. The second factor, X_2, is a measure of the lift imparted to the airflow in the vicinity of the station—small-scale slope. The third factor, X_3, is a measure of large-scale lifting—large-scale slope. It can also be considered to represent the general distortion in the large-scale moist airflow caused by the major orographic barrier.

This equation explains about 84 percent of the variance in the 2-yr 24-hr precipitation values, with a standard error of estimate of 0.50 in. which is about 12 percent of the average 2-yr 24-hr precipitation value for stations in the region. Of the total variance, the first variable accounts for about 70 percent, the second, 9 percent, and the third, 4 percent. Other variables examined did not account for significant additional portions of the variance. The geographic distribution of the errors is shown in figure 11. The upper number at each station is the actual difference (in hundredths of inches) between the value computed from observed data and that estimated from the equation. The lower number is the error expressed in a percent of the 2-yr 24-hr precipitation value at the station. No discernible regional pattern in the errors was apparent. Although the factors used in this and the other equations have a physical meaning, the equation is a statistical relation of physical factors. There is no intention to imply a cause-and-effect relation. The requisite knowledge of the precipitation process is not yet available to develop equations that incorporate the dynamics of motion, condensation, and other factors to predict precipitation frequency.

The second illustrative equation was developed for the Big Horn River Basin, south of Saint Xavier, Mont. (region 9, fig. 8). Minor portions of the North Platte, Powder, Tongue, and Yellowstone River Basins were also included in this region. The equation is

$$Y = 1.497 + 0.027(X_4) + 0.002(X_5) - 0.023(X_6). \quad (2)$$

Y is the estimated 2-yr 24-hr precipitation value in inches. X_4 is the difference between the station elevation and the lowest elevation within 20 miles (in hundreds of feet). X_5 is the difference between the sum of the maximum heights within 40 miles along radials to the northwest, west, and southwest, and the sum of the maximum elevations within 40 miles along radials to the northeast, east, and southeast (in hundreds of feet). X_6 is the direction to the nearest point on the Continental Divide within the sector from southwest to north. If, however, there is a peak higher than 9,000 ft within this sector and it is closer to the station than is the Continental Divide, X_6 is the direction to this peak.

Figure 9. *Regions used to develop statistical parameters for interstation interpolation of 100-yr 24-hr precipitation values.*

Exhibit D-4

All three variables are related to the effect of the ground slope in the vicinity of the station. The first two variables measure differences in height over small and medium distances and reflect the importance of the steepness of the slope in the precipitation process. Here, the moist airflow of large storms comes from an easterly direction, frequently associated with a cyclonic center south or southeast of the region, and ground elevation generally increases toward the west or northwest. The third variable relates the orientation of the ground slope and its effectiveness in the precipitation process to an optimum inflow direction. The total amount of the variance accounted for by this relation is about 60 percent, with a standard error of estimate of 0.21 in., or about 17 percent of the average 2-yr 24-hr precipitation value. The first variable accounts for about 41 percent of the variance; the second, 11 percent; and the last, 8 percent. The geographic distribution of the errors from this equation is shown in figure 12.

It would have been possible to include normal annual precipitation in this relation. This factor would have accounted for an additional 15 percent of the variance and a corresponding decrease in the standard error of estimate. Where this factor could be determined from data, the use of normal annual precipitation would have improved the results. As indicated earlier, the results would include some points for which short-duration precipitation data were not available. At points where such data were not available, any improvement would have been dependent on the ability to estimate normal annual precipitation. In using an equation with normal annual precipitation, the standard error of estimate incorporated in the procedure for preparing normal annual precipitation maps is combined with the standard error of estimate for the interpolating equation for 2-yr 24-hr precipitation values. When this combined error is greater than the standard error of estimate for an interpolating equation for 2-yr 24-hr precipitation that does not include normal annual precipitation, there is a loss of accuracy through use of the equation including normal annual precipitation. Within this particular region, the uncertainty in estimating normal annual precipitation at nondata points was sufficiently large and an equation developed using only topographic factors was sufficiently reliable that use of the equation containing normal annual precipitation for estimating the 2-yr 24-hr precipitation values was not justified.

Drawing of isopluvial lines on four key maps. In preparing the isopluvial maps, the computed precipitation-frequency values for all stations were plotted. In addition to the computed values, the width of the confidence band, computed according to standard statistical procedures, was plotted for the 100-yr return-period maps. Values estimated from the equations described in the preceding section were plotted for a latitude-longitude grid with 5-min grid points. The total number of grid points was approximately 47,000. Along the boundaries of each region, values were estimated by the equations applicable to each of the adjoining regions.

In the construction of isopluvial lines, the question arises as to how much the station and grid-point data should be smoothed for the most effective use of the maps. When drawing the isopluvial lines through the field of grid points and station data, the standard error of estimate for the various multiple regression equations and the confidence band about the station data must be considered. Also, smoothing between adjoining regions, where multiple regression equations give somewhat different values at the boundary

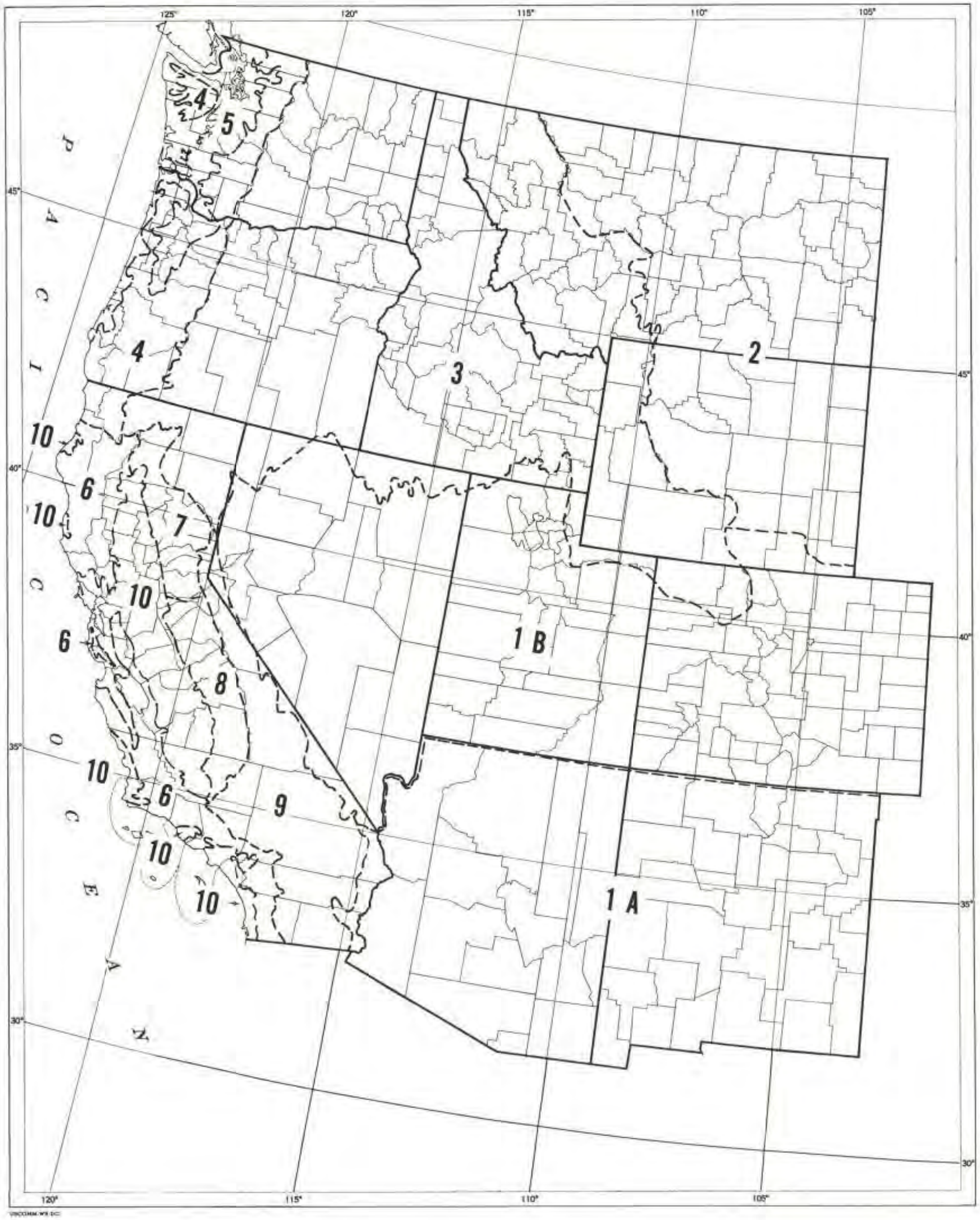


Figure 10. *Regions used to develop statistical parameters for interstation interpolation of 2-yr and 100-yr 6-hr precipitation values.*

Exhibit D-4

Table 8. *Statistical parameters for relations used for interstation interpolation of 100-yr 6-hr precipitation values*

Region of applicability*	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Arizona, New Mexico, and lower Colorado River Basin in southeastern California (1a)	0.91	103	3.16	0.50
Nevada south of the Snake River Basin, Utah south of the Snake and Bear River Basins, and Colorado south of the Yampa and North Platte River Basins (1b)	0.91	144	2.34	0.47
Montana and Wyoming east of a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming (2)	0.92	110	2.62	0.31
Region north of the southern boundaries of the Snake, Bear, and Yampa River Basins and between a generalized crestline of the Cascades and a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming and northern Colorado (3).	0.79	120	1.62	0.22
Orographic regions of western Washington, Oregon, and California from the crest of the Cascade Range to the Pacific Ocean extending southward to include the area drained by the Klamath and Salmon Rivers in northern California (4)	0.89	57	2.98	0.33
Nonorographic coastal lowlands of Washington and Oregon (5)	0.91	59	2.49	0.31
Coastal mountains of California from the Trinity River Basin in the north to the Mexican border (6)	0.97	87	3.95	0.39
Northern Sierra Nevada north of Mokelumne River Basin (7)	0.93	31	3.81	0.45
Southern Sierra Nevada south of Consumnes River Basin (8)	0.93	26	3.87	0.50
Spillover zone east of the crests of the Sierra Nevada and the coastal mountains of southern California and the southeastern desert region of California (9)	0.84	25	2.29	0.36
Coastal lowlands and San Joaquin and Sacramento Valleys of California (10)	0.87	71	2.98	0.41

* Numbers in parentheses refer to geographic regions shown in figure 10.

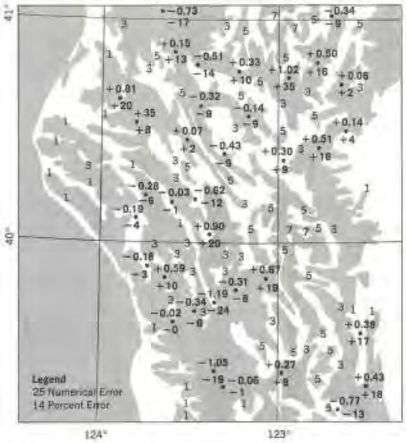
lines, must be considered separately. Isolines can be drawn to fit every point plotted on the map, although this would not allow for some of the random differences between adjoining grid points that result from errors in the multiple regression equation or sampling errors in station data. Also, the courseness of even a 5-min latitude-longitude grid is such that sometimes narrow ridges and valleys are missed. Because of these considerations, occasionally it was necessary to make additional computations for such locations. Some subjective smoothing must be used to make allowances for factors that could not be expressed quantitatively.

In analysis, smoothness and closeness of fit are basically inconsistent in that smoothing cannot be carried beyond a certain point without some sacrifice of closeness of fit and vice versa. As the isolines were drawn, the sampling error of the station values and the standard error of estimate were considered.

Additional working maps. Additional working maps were prepared showing the 100- to 2-yr ratios for the 6- and 24-hr durations and the 6- to 24-hr ratios for the 2- and 100-yr return periods. To minimize the exaggerated effect of an outlier (anomolous event) from a short record, only data from those stations with a minimum record length of 20 yrs for the 6- and 24-hr durations at the 100-yr return period were used in these working maps. Experience has shown that for long-record station data, the ratio of 6- to 24-hr values for the same return period and the 100- to 2-yr ratio for the same duration do not vary greatly over relatively large areas. The variation present is consistent with the variations in relations between meteorologic and topographic characteristics. Climatic factors that provide general guides on variations of precipitation-frequency values were examined and considered in a qualitative sense. Among these factors are the mean annual number of thunderstorm days (U.S. Weather Bureau 1952, 1947), normal monthly number of days above various threshold values (Environmental Science Services Administration, Weather Bureau, 1966), and mean number of days with rain (Environmental Science Services Administration, Environmental Data Service 1968).

Intermediate maps. The 47,000-point grid described earlier was also used in the analysis of the isopluvial patterns of the eight intermediate maps. These maps—for 5-, 10-, 25-, and 50-yr return periods for 6- and 24-hr durations were prepared primarily for the convenience of the user, because it is technically sufficient to provide two points of the frequency curve for a particular duration and to describe the method of interpolation. Four values, one from each of the four key maps, were read for each grid point. These four values were used in a computer program based on the return-period diagram (fig. 6) to compute values for eight additional maps. The key maps were used as underlays to maintain the basic isopluvial pattern on all maps.

Figure 11. *Geographic distribution of errors for equation used to interpolate 2-yr 24-hr precipitation values for the Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas; and Gladstone Creeks, California.*



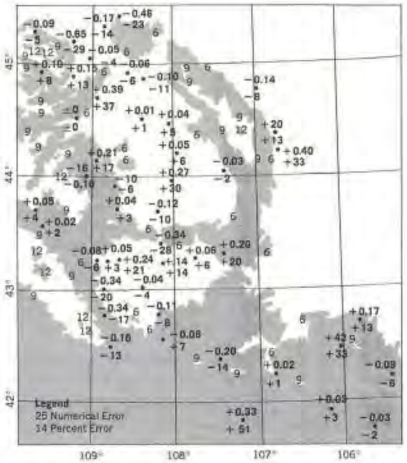
Eel River Basin

Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
Slope	4	40	10	38
2-yr 24-hr precipitation	7	70	7	27
Location (latitude or longitude)	4	40	4	15
Elevation	3	30	3	12
Barrier to airflow	1	10	1	4
Distance to moisture	1	10	1	4

Table 9. *Factors most useful in relations for interstation interpolation of 2-yr 6-hr precipitation values*

Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
2-yr 6-hr precipitation	5	55	5	23
100-yr 24-hr precipitation	4	36	4	19
Elevation	4	36	4	19
Slope	4	36	4	19
2-yr 24-hr precipitation	1	9	1	5
Normal annual precipitation ..	1	9	1	5
Distance to moisture	1	9	1	5
Location	1	9	1	5

Table 10. *Factors most useful in relations for interstation interpolation for 100-yr 6-hr precipitation values*



Big Horn River Basin

Figure 12. *Geographic distribution of errors for equation used to interpolate 2-yr 24-hr precipitation values for the Big Horn River Basin above Saint Xavier, Montana; minor portions of the North Platte, Powder, and Tongue River Basins in eastern Wyoming; and minor portions of the Yellowstone River Basin in northwestern Wyoming and southeastern Montana.*

Exhibit D-4

Interpretation of Results

Season of Occurrence

The maps in this Atlas are based upon data for the entire year. In certain sections of the West, precipitation is highly seasonal. Thus, rainy season precipitation-frequency values approach the annual values. In sections where the greatest annual *n*-hour precipitation amount may be observed in any season, seasonal precipitation-frequency maps would differ from those presented in this Atlas. In no case could the seasonal value be greater than the annual value. However, the seasonal values would be a certain percent of the annual values, with the percent varying according to the frequency of large storms during the season under investigation. Generalizations about the seasonal distribution of large storms can be obtained from ESSA, *U.S. Weather Bureau Technical Paper* No. 57 (Environmental Science Services Administration, Weather Bureau, 1966). Currently, there is no convenient manner of applying this knowledge to the maps of this Atlas, other than subjectively.

Within Vs. Among Storms

Data for the various duration maps and diagrams in this Atlas were determined independently; that is, there was no requirement that the maximum 6- or 1-hr amount for a particular year be included within the maximum 24-hr amount for that year. The maps, therefore, represent an "among" storm distribution. In regions where winter-type storms predominate, the 6-hr value for a particular return period would more closely approximate the 6-hr value within the 24-hr storm for the same return period than would generally be the case in regions where convective storms predominate. In a study for the United States east of the Mississippi River, Miller (1971) showed that the ratio between the 2-yr 1-hr value computed from the maximum 1-hr amount within the 24-hr maximum and the 2-yr 1-hr value computed using maximum 1-hr amounts varied between 0.52 and 0.91. Studies have not been undertaken of this relation in the West, but a wide range in such ratios and similar ratios for the 6-hr duration could be expected.

Point Probabilities

The maps in this Atlas are derived from and depict point probabilities; the data points are independent of each other. Precipitation over a region is variable, even in large general area storms; neighboring stations do not necessarily experience maximum annual amounts from the same storm. Thus, the individual points on these maps express individual probabilities. That a point within a particular watershed may receive an amount equal to or greater than its 50- or 100-yr value on a particular day does not affect probabilities for any other point within that watershed. A second point within the watershed may experience an amount equal to or greater than its 50- or 100-yr value within the same storm or on the next day, within the next week or at any other time.

Areal Analysis

A value read from an isopluvial map in this Atlas is the value for that point and the amount for that particular duration which will be equaled or exceeded, on the average, once during the period indicated on the individual map. In hydrologic design, engineers are more concerned with the average depth of precipitation over an area than with the depth at a particular point. Depth-area curves were developed to meet this need. The depth-area curve is an attempt to relate the average of all point values for a given duration and frequency within a basin to the average depth over the basin for the same duration and frequency.

Generally, there are two types of depth-area relations. The first is the storm-centered relation; that is, the maximum precipitation occurring when the storm is centered on the area affected (fig. 13). The second type is the geographically fixed-area relation where the area is fixed and the storm is either centered over it or is displaced so only a portion of the storm affects the area (fig. 13). We can say that storm-centered rainfall data represent profiles of discrete storms, whereas the fixed-area data are statistical averages in which the maximum point values frequently come from different storms. At times, the maximum areal value for the network is from a storm that does not produce maximum point amounts. Each type of depth-area relation is useful, but each must be applied to appropriate data. Generally, the storm-centered relations are used for preparing estimates of probable maximum precipitation, while the geographically fixed relations are used for studies of precipitation-frequency values for basins.

Dense networks of precipitation gages are required to furnish basic data used in developing depth-area relations for fixed areas. The criteria used in selecting dense networks for the determination of areal precipitation-frequencies by the National Weather Service have been:

1. A network should be composed entirely of recording gages. The use of nonrecording gages may greatly increase the number and density of stations within a network, but it involves the construction of mass curves and introduces additional subjectivity. Nonrecording gages are read at various hours, usually early morning, late afternoon, or midnight. Because of conflicting activities, a cooperative observer may not always be able to read his precipitation gage at the exact hour specified. In these cases, the exact time of the observation may not be available, so it is hard to relate the reported amounts to those of surrounding stations with the precision required for development of depth-area relations.

2. A minimum length of record should be established to ensure a reasonable estimate of the 2-yr areal precipitation.

3. Gage locations and exposures should remain consistent during the period of record analyzed.

4. Gages should be located so that there is at least one gage located within each 100 square-mile area.

The average depth-area curves in this Atlas (fig. 14) are for fixed areas and were developed from dense networks meeting the above criteria. The curves were first prepared for an earlier study (U.S. Weather Bureau 1957–60) and have since been rechecked against longer record data; no changes were needed. Application of these curves must be consistent with the manner in which they were developed. The following steps are used:

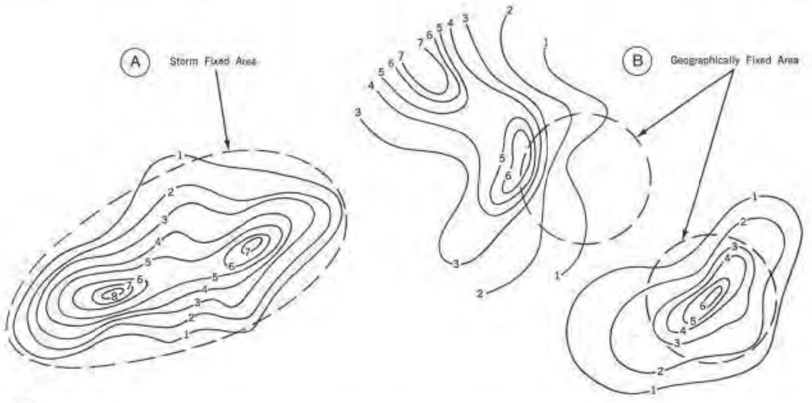
1. Estimate point values from a grid of many points over the basin of interest for the duration and return period required.

2. Compute an average of the point values obtained in step 1.

3. Use figure 14 to obtain an areal reduction factor required for the precipitation duration and size of area under consideration.

4. Multiply the average value obtained in step 2 by the ratio obtained in step 3. The value obtained in this step provides the areal value for the basin of interest for the duration and return period under consideration.

Figure 13. *Examples of (A) isohyetal pattern centered over basin as would be the case for storm-centered depth-area curves and (B) two possible occurrences of isohyetal patterns over a geographically fixed area as would be the case in development of curves for a geographically fixed area.*



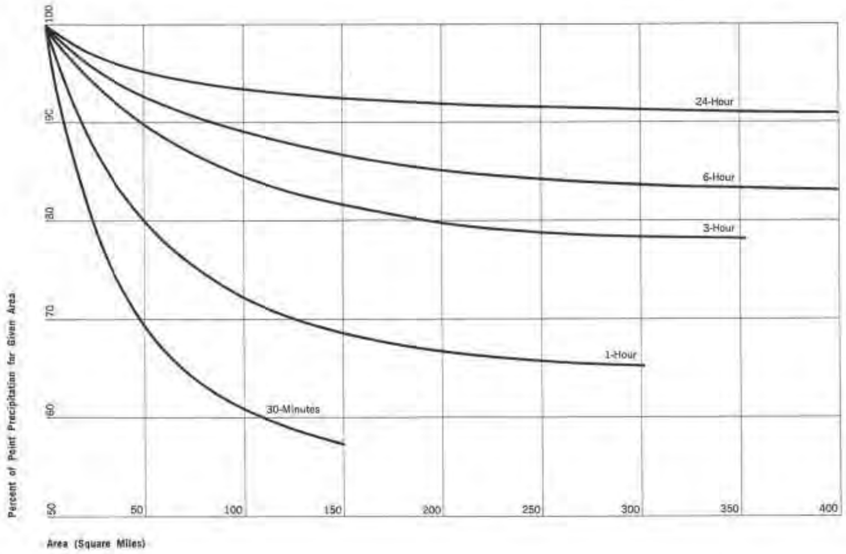


Figure 14. *Depth-Area curves.*

Exhibit D-4

Data used to develop and validate the curves of figure 14 exhibited no systematic regional pattern. Duration turned out to be the major factor. The curves shown are based on data for the 2-yr return period. Within the accuracy of the data available, it could be shown that neither magnitude nor return period was a significant factor.

Importance of Snow in Estimating Frequency Values

The contribution of snow amounts to the precipitation-frequency values for durations of 24 hours or less has been investigated in most of the western United States. In many parts of this region, particularly at higher elevations, snow accounts for over 50 percent of the normal annual precipitation. Thus, the importance of snowfall to short-duration (6- to 24-hr) precipitation-frequency values is of interest for a more complete understanding of the precipitation-frequency regime.

Mean annual precipitation containing a high percentage of snow occurrences does not necessarily mean that snow contributed significantly to the annual series of maximum 6- or 24-hr precipitation amounts. This problem was investigated by tabulating two sets of data for all stations where snowfall observations were made routinely. The first set of data contained the greatest 24-hr (and 6-hr amounts at recording-gage stations) precipitation amount for each year, regardless of type of precipitation (water equivalent for snowfall amounts). The second series was restricted solely to rainfall events. In some cases, the second series contained amounts as low as the fifth highest for a particular year. Results of these investigations are reported in the section for each state.

Reliability of Results

The term "reliability" is used here as an indication of the degree of confidence that can be placed in the accuracy of the results obtained from the maps. The reliability of these results is influenced by the sampling errors in time and space, and by the manner in which the maps were constructed. Sampling errors in time and space result from: (1) the chance occurrence of an anomalous storm which has a disproportionate effect on the statistics for one station, but not on those for a nearby station, and (2) the geographic distribution of stations. In the relatively nonorographic regions (shown shaded on fig. 8), the occurrence of large precipitation events can be considered to be relatively random over a limited geographic area. Thus, a large precipitation event (especially of convective nature) at a station could just as easily have occurred at a neighboring station or between stations. Results from a generalized analysis based on space-averaging techniques are considered more nearly correct than results determined from an analysis of only individual station data. In the more mountainous regions, orography has greater control on the location and magnitude of the largest storms and simple space averaging between neighboring stations is inappropriate; consideration must be given to effects of the slopes of surrounding terrain, station elevations, the intervening barrier between station location and moisture source, etc.

The locations of the stations used in the analyses are shown in figures 3 and 4. This geographic network of stations does not reveal with complete accuracy the very detailed structure of the isopluvial patterns in the mountainous regions of the West. The multiple regression equations discussed earlier were used to help in interpolation between values computed for these stations. The standard error of estimate for these relations should be considered when using the precipitation-frequency values shown on the maps. In general, the accuracy of the estimates obtained from the maps of this Atlas varies from a minimum of about 10 percent for the shorter return periods in relatively nonorographic regions to 20 percent for the longer return periods in the more rugged orographic regions.

The values shown on these maps are in general agreement with those of *Weather Bureau Technical Paper* No. 40 (U.S. Weather Bureau 1961). Differences are found because of the greater attention paid to physiographic features in the present study. Even though the precipitation-frequency maps presented are prepared considering physiographic factors, only those of a major scale could be considered. There are some basins, therefore, that are more sheltered or exposed than a generalized topographic map would indicate. The map values may not be representative of the precipitation regimes in such basins.

The major centers of large precipitation-frequency values are located on the most exposed and steepest slopes of the mountains. Objective studies (such as the regression analysis previously discussed) and experience in precipitation-frequency analysis have indicated some general guidelines for the placement of isopluvial centers along crests and on slopes of mountain ranges. Two examples will serve to illustrate such guidelines. For an initial completely exposed orographic barrier, where the crest of the range was 3,000 to 4,000 ft. above the plains region to the windward of the mountain and the slope was on the order of 300 ft per mile, the largest isopluvial line should extend past the crest and include a little of the lee side of the mountain. Where the crest of the range was 8,000 to 10,000 ft above the plains region to the windward of the mountain range and the slope was on the order of 1,000 ft per mile, the isopluvial center would generally be about 4,000 to 6,000 ft above the plains region. For mountain ranges with crests and slopes having other combinations of these values, the placement of the highest precipitation-frequency values would depend upon the degree of exposure of the mountain range to moisture-bearing wind, the steepness of the slope, the height of the crest, and other orographic factors. In general, isopluvial centers for the longer return periods tend to be located at lower elevations than the centers for the shorter return periods. The distance downslope that the center is displaced depends on the exposure and steepness of the slope. Centers will be displaced less on a steep slope than on a gentle slope similarly exposed.

Exhibit D-4

Oregon

Discussion of Maps

Figures 19 through 30 present precipitation-frequency maps for Oregon for 6- and 24-hr durations for return periods of 2, 5, 10, 25, 50, and 100 yrs. The isopluvial maps represent the 360- and 1,440-min durations for the partial-duration series. Data were tabulated for clock and observation-day intervals for the annual series and were adjusted by the empirical factors given in the ANALYSIS section.

Isoline interval. The isoline intervals selected were designed to provide a reasonably complete description of the isopluvial pattern in various regions of the state. For that portion of Oregon that extends from the eastern foothills of the Cascade Range westward to the coast, the isoline interval for the 24-hr duration is 0.5 in. for precipitation-frequency values below 8.0 in., with an interval of 1.0 in. above that value at the 2- and 5-yr return period. For the 10- through 100-yr return period, the 7-0-in. precipitation-frequency value separates the 0.5-in. and 1.0-in. intervals. At the 6-hr duration, the isoline interval in this part of the State is 0.1 in. below a precipitation-frequency value of 1.4 in. and 0.2 in. from 1.4 to 3.0 in. Above 3.0 in., the interval is 0.4 in. for 2- through 25-yr return periods and 0.5 in. for return periods of 50 and 100 yrs. For that portion of the state east of the eastern foothills of the Cascade Range, the isoline interval on the 24-hr precipitation-frequency maps is 0.2 in. for values up to 3.0 in. and 0.4 in. for values over 3.0 in. On the maps for the 6-hr duration, the interval is 0.1 in. for values to 1.6 in. on the 2- to 25-yr return periods and to 1.4 in. at the 50- and 100-yr return periods. From 1.6 in. (or 1.4 in. for the 50- and 100-yr maps) to 3.0 in., the isoline interval is 0.2 in. and above 3.0 in. the interval is 0.4 in. Dashed intermediate lines have been placed between widely separated isolines and in regions where a linear interpolation between the normal isopluvial interval would lead to erroneous interpolation. "Lows" that close within the boundaries of a particular map have been hatched on the low-valued side of the isoline.

Importance of snow in precipitation-frequency values. The maps in this Atlas represent frequency values of precipitation regardless of type. For many hydrologic purposes, precipitation falling as rain must be treated in a different manner from that falling as snow. The contribution of snow amounts to precipitation-frequency values in Oregon and the Pacific Northwest (roughly Idaho, Oregon, Washington, and small adjacent portions of California and Nevada) was investigated. In this area, there were 179 stations having 10 to 15 yrs of observations of snowfall as part of the precipitation observing program. Sixty-two of these stations are in Oregon. Table 11 shows the distribution of these stations by regions considered to be more meteorologically realistic than are state boundaries. For each of the 179 stations (56 of which were equipped with recording precipitation gages), two data series were formed as discussed under Interpretation of Results, Importance of Snow in Estimating Frequency Values.

A ratio was formed of the 2-yr 24-hr value for the series containing maximum annual events without regard to type of precipitation and the 2-yr 24-hr value for the series with snow occurrences eliminated. At more than 75 percent of the stations in the Pacific Northwest, this ratio showed differences between the two series to be 10 percent or less. A similar ratio for the 25-yr return period showed a difference as great as 10 percent at only about 5 percent of the stations. Further analysis was made for stations having ratios that showed the greatest difference between the two series.

Data from stations in the coastal plains region of Washington and Oregon (Region 31, fig. 9) showed that the maximum annual 24-hr event can contain snow, but such a case occurs only about 5 percent of the time. Less than half the stations within this region had any maximum annual event that included snow, and ratios for all durations and stations showed less than 10 percent difference between the two data series. Thus, snow was not considered to be of importance to precipitation-frequency values in this region.

Most of the mountainous portions of Oregon are included within Regions 13 and 14 of figure 9. In these regions, it is not unusual for the maximum annual event to include some snow or even to be composed of all or mostly snow. However, the areas where such events cause major differences between the series of all precipitation data regardless of type and the series composed exclusively of rain are relatively limited in extent. These areas are at the higher elevations of the Cascades and immediately to the lee of the crest of the Cascades. In this area of Washington and Oregon, data are available from about 20 stations ranging in elevation from 2,000 ft to over 6,500 ft. These data indicate that the 2-yr 24-hr values for a series containing only rain events would be 10 to 20 percent lower than the values presented on the precipitation-frequency maps in this Atlas at elevations of 2,000 to 4,000 ft, and the differences would range upward to 30 and possibly as much as 50 percent lower above 5,000 ft. The area to the lee of the crest of the Cascades would be limited to somewhat less than 50 mi in width; and in this narrow band, the rain-only series would be from 20 to as much as 35 percent less than the values presented on the 2-yr 24-hr map for Oregon.

Data from stations in the nonorographic regions east of the Cascades (Region 32, fig. 9) show snow to be of minor importance in the precipitation-frequency regime. Less than one maximum annual value out of every five will contain any snow, and 80 percent of the stations available for analysis showed differences of less than 10 percent in the two series of data tabulated.

The remainder of Oregon is included within Region 12, figure 9. Most of this region lies in Idaho. Analysis of the data for this region leads to the conclusion that snow is not an important factor in the precipitation-frequency regime. Ratios between 2-yr 24-hr values from the two series of data that were tabulated showed differences between the two series to be mostly small. It was found that maximum annual values that contained snow were most likely to be found in the lower two-thirds of the ranked data sample. This is discussed in more detail in NOAA Atlas 2, "Precipitation-Frequency Atlas of Western United States, Volume V—Idaho" (National Oceanic and Atmospheric Administration 1973).

The data analysis of the two series showed that the curves converge with increasing return period. At the 25-yr return period, only about 5 percent of the 179 stations showed differences greater than 10 percent between the two series. These stations were not concentrated in any region and did not show a geographic pattern. Generally, such differences result when one or a few of the larger values in the data series composed of all maximum annual events contains some snow, while the rain-only amount for that year is small and becomes a much lower ranked value in the exclusively rain series.

At the 6-hr duration, the data are restricted to stations with recording gages (12 recording precipitation-gage stations in Oregon). An analysis similar to that for the 24-hr duration showed that the ratio of the maximum annual series and the series without snow was lower at the 6-hr duration than at the 24-hr duration. This is meteorologically realistic since the portion of a 24-hr storm that contains snow is most likely to be of less intensity than is the maximum 6-hr period of that storm.

The conclusion was made that, except as previously noted, the elimination of amounts containing snow does not materially change the precipitation-frequency values on maps for Oregon. For the 24-hr duration where there are differences between results computed from the two series at the 2-yr return period, the differences would decrease to no more than half as large at the 25-yr recurrence interval and be negligible at the 100-yr recurrence interval.

In the selection of data for the series made up of amounts containing rain only, an observation was eliminated no matter how much snow was reported. Thus, an eliminated amount could have contained only a small portion of the precipitation as snow or it could have been all snow. In some cases, the amount of rain in a storm with little snow could have been greater than the value actually selected for that year since only a few stations report water content of snow (which would have enabled the tabulator to segregate such cases). Thus, the data could yield rain-only values actually less than the true amount but could not give results greater than the true amount. Therefore, the ratios compared tended to show maximum differences.

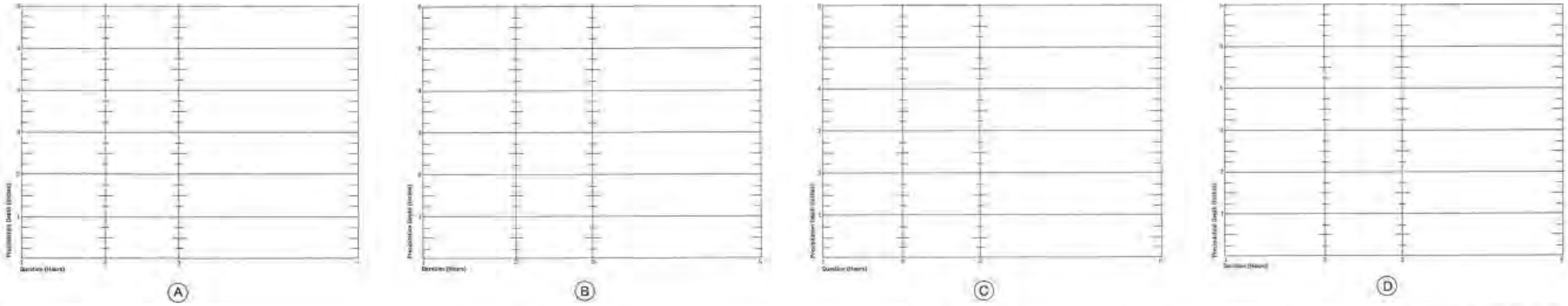


Figure 15. *Precipitation depth-duration diagram (1- to 6-hr).*
a. Mountainous regions of Washington and Oregon east of crest of Cascade Range and of Idaho and Montana west of Continental Divide and north of southern boundary of Snake River Basin (Region 1, fig. 18).
b. Nonorographic region east of crest of Cascade Range (Region 2, fig. 18).
c. Coastal plains, Puget Sound region, and Willamette Valley below 1,000 ft (Region 3, fig. 18).
Olympic Mountains, western slopes of Cascade and Coast Ranges (Region 4 fig. 18).
d. Southeastern Oregon drained by the Quinn River (Region 5, fig. 18).

Exhibit D-4

Procedures for Estimating Values for Durations Other Than 6 and 24 Hrs

The isopluvial maps in this Atlas are for 6- and 24-hr durations. For many hydrologic purposes, values for other durations are necessary. Such values can be estimated using the 6- and 24-hr maps and the empirical methods outlined in the following sections. The procedures detailed below for obtaining 1-, 2-, and 3-hr estimates were developed specifically for this Atlas. The procedures for obtaining estimates for less than 1-hr duration and for 12-hr duration were adopted from *Weather Bureau Technical Paper* No. 40 (U.S. Weather Bureau 1961) only after investigation demonstrated their applicability to data from the area covered by this Atlas.

Procedures for estimating 1-hr (60-min) precipitation-frequency values. Multiple-regression screening techniques were used to develop equations for estimating 1-hr values. Factors considered in the screening process were restricted to those that could be determined easily from the maps of this Atlas or from generally available topographic maps.

The 11 western states were separated into several geographic regions. The regions were chosen on the basis of meteorological and climatological homogeneity and are generally combinations of river basins separated by prominent divides. Five of these geographic regions are partially within Oregon. For convenience and use as an overlay on the precipitation-frequency maps, the regions are outlined on figure 18. The first region includes the mountainous sections of eastern Oregon east of the crest of the Cascades (Region 1, fig. 18). This is part of a larger region that includes all the mountainous sections from the crest of the Cascades eastward to the Continental Divide and north of the southern boundary of the Snake River Basin. Region 2, figure 18, is the essentially nonorographic portions of eastern Oregon. There are three such nonorographic regions between the crest of the Cascades and the Continental Divide found to have similar relations between data for 1-, 6-, and 24-hr durations. One of these is completely within Oregon, whereas the other two extend partially into Oregon from Washington and Idaho. The coastal lowlands and nonorographic sections of western Washington and Oregon below 1,000-ft elevation make up another region (Region 3, fig. 18). This includes the Willamette Valley below 1,000 ft. The fourth region consists of the western slopes of the Cascade and the Coast Ranges of Oregon (Region 4, fig. 18). This region extends into Washington, where it also includes the Olympic Mountains. Region 5, figure 18, in southeastern Oregon is a small portion of a region that extends from central Utah through Nevada and into the desert regions of California. In Oregon, this is the area drained by the Quinn River. Equations to provide estimates for the 1-hr duration for the 2- and 100-yr return periods are shown in table 12. Also listed are the statistical parameters associated with each equation. The variable $[(X_1)(X_1/X_2)]$ or $[X_3)(X_3/X_4)]$ can be regarded as the 6-hr value times the slope of a line connecting the 6- and 24-hr values for the appropriate return period. The variable Y_2 appears in the right side of the 100-yr 1-hr equations for Regions 3 and 4. If the 2-yr 1-hr value is not required, the equation for Y_2 can be substituted and the second equation for Y_{100} shown in table 12 can be used.

Table 11. *Percent of snowfall stations in Pacific Northwest by regions*

Number of region in figure 9	Region	Percent of stations
12	Mountainous region of Idaho west of Bitterroot Range crest and Continental Divide and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour	30
13	Orographic region east of crest of Cascade Range and west of Snake River Basin	20
14	Olympic Mountains and western slopes of Coast and Cascade Ranges	14
30	Snake River Valley below 5,000 ft	13
31	Coastal Plain, Puget Sound region, and Willamette Valley below 1,000 ft	12
32	Nonorographic region east of crest of Cascade Range	11

As with any separation into regions, the boundary can only be regarded as the sharpest portion of a zone of transition between regions. These equations have been tested for boundary discontinuities by computing values using equations from both sides of the boundary. Differences were found to be mostly under 15 percent. However, it is suggested that when computing estimates along or within a few miles of a regional boundary computations be made using equations applicable to each region and that the average of such computations be adopted.

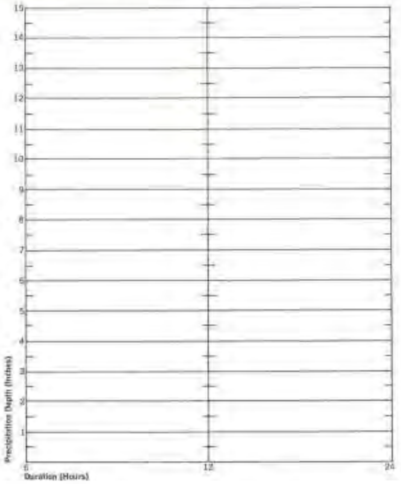


Figure 16. *Precipitation depth-duration diagram (6- to 24-hr).*

Estimates of 1-hr precipitation-frequency values for return periods between 2 and 100 yrs. The 1-hr values for the 2- and 100-yr return periods can be plotted on the nomogram of figure 6 to obtain values for return periods greater than 2 yrs or less than 100 yrs. Draw a straight line connecting the 2- and 100-yr values and read the desired return-period value from the nomogram.

Estimates for 2- and 3-hr (120- and 180-min) precipitation-frequency values. To obtain estimates of precipitation-frequency values for 2 or 3 hrs, plot the 1- and 6-hr values from the Atlas on the appropriate nomogram of figure 15. Draw a straight line connecting the 1- and 6-hr values, and read the 2- and 3-hr values from the nomogram. This nomogram is independent of return period. It was developed using data from the same regions used to develop the 1-hr equations.

The mathematical solution from the data used to develop figure 15 gives the following equations for estimating the 2- and 3-hr values:

For Region 1,	2-hr = 0.250 (6-hr) + 0.750 (1-hr)	(3)
figure 18	3-hr = 0.467 (6-hr) + 0.533 (1-hr)	(4)
For Region 2,	2-hr = 0.278 (6-hr) + 0.722 (1-hr)	(5)
figure 18	3-hr = 0.503 (6-hr) + 0.497 (1-hr)	(6)
For Regions 3	2-hr = 0.240 (6-hr) + 0.760 (1-hr)	(7)
and 4, figure 18	3-hr = 0.468 (6-hr) + 0.532 (1-hr)	(8)
For Region 5,	2-hr = 0.299 (6-hr) + 0.701 (1-hr)	(9)
figure 18	3-hr = 0.526 (6-hr) + 0.476 (1-hr)	(10)

Estimates for 12-hr (720-min) precipitation-frequency values. To obtain estimates for the 12-hr duration, plot values from the 6- and 24-hr maps on figure 16. Read the 12-hr estimates at the intersection of the line connecting these points with the 12-hr duration line of the nomogram.

Estimates for less than 1 hr. To obtain estimates for durations of less than 1 hr, apply the values in table 13 to the 1-hr value for the return period of interest.

Illustration of Use of Precipitation-Frequency Maps, Diagrams, and Equations

To illustrate the use of these maps, values were read from figures 19 to 30 for the point at 44°00′ N. and 118°00′ W. These values are shown in boldface type in table 14. The values read from the maps should be plotted on the return-period diagram of figure 6 because (1) not all points are as easy to locate on a series of maps as are latitude-longitude intersections, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. This has been done for the 24-hr values in table 14 (fig. 17a) and a line of best fit has been drawn subjectively. On this nomogram, the 2- and 25-yr values appear to be somewhat off the line. The value read from the maps is corrected (as shown by the strikeout in table 14); such corrected values are adopted in preference to the original readings.

The 2- and 100-yr 1-hr values for the point were computed from the equations applicable to Region 2, figure 18 (table 12) since the point is in the nonorographic region. The 2-yr 1-hr is estimated at 0.37 in. (latitude of 44° and longitude of 118° and the 2-yr 6- and 24-hr values from table 14); the estimated 100-yr 1-hr value is 1.07 in. (100-yr 6- and 24-hr values from table 14). By plotting these 1-hr values on figure 6 and connecting them with a straight line, one can obtain estimates for return periods of 5, 10, 25, and 50 yrs.

The 2- and 3-hr values can be estimated by using the proper nomogram of figure 15 or equations (5) and (6). The 1- and 6-hr values for the desired return period are obtained as above. Plot these points on the nomogram in figure 15 and connect them with a straight line. Read the estimates for 2 or 3 hrs at the intersections of the connecting line and the 2- and 3-hr vertical lines. An example is shown in figure 17b for the 2-yr return period. The 2-yr 2-hr (0.50 in.) and 2-yr 3-hr (0.55 in.) values are in italics in table 14 and compare closely with the values of 0.47 and 0.57, which would result from application of equations (5) and (6).

Exhibit D-4

Table 12. *Equations for estimating 1-hr values in Oregon with statistical parameters for each equation*

Region of applicability*	Equation	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Mountainous regions of Washington and Oregon east of crest of Cascade Range and of Idaho and Montana west of Continental Divide and north of southern boundary of Snake River Basin (1)	$Y_2 = 0.019 + 0.711[(X_1)(X_1/X_2)] + 0.001Z$ $Y_{100} = 0.338 + 0.670[(X_3)(X_3/X_4)] + 0.001Z$	0.82 .80	98 79	0.40 1.04	0.031 .141
Nonorographic region east of crest of Cascade Range (2)	$Y_2 = 0.077 + 0.715[(X_1)(X_1/X_2)] - 0.0004(X_5)(X_6)$ $Y_{100} = 0.187 + 0.833[(X_3)(X_3/X_4)]$	.86 .87	30 30	0.35 1.08	.034 .161
Coastal plains, Puget Sound region, and Willamette Valley below 1,000 ft (3)	$Y_2 = 0.157 + 0.513[(X_1)(X_1/X_2)]$ $Y_{100} = 0.324 + 0.752[(Y_2)(X_3/X_1)]$ $Y_{100} = 0.324 + 0.118\,(X_3/X_1) + 0.386[(X_1)(X_3/X_2)]$	.89 .82	61 61	0.52 1.01	.050 .113
Olympic Mountains, western slopes of Cascade and Coast Ranges (4)	$Y_2 = 0.160 + 0.520[(X_1)(X_1/X_2)]$ $Y_{100} = 0.177 + 0.965[(Y_2)(X_3/X_1)]$ $Y_{100} = 0.177 + 0.154(X_3/X_1) + 0.502[(X_1)(X_3/X_2)]$	.86 .74	70 66	0.54 1.10	.054 .171
Southeastern Oregon drained by the Quinn River (5)	$Y_2 = 0.005 + 0.852[(X_1)(X_1/X_2)]$ $Y_{100} = 0.322 + 0.789[(X_3)(X_3/X_4)]$	.89 .87	65 65	0.41 1.25	.047 .196

* Numbers in parentheses refer to geographic regions shown in figure 18. See text for more complete description.

List of variables

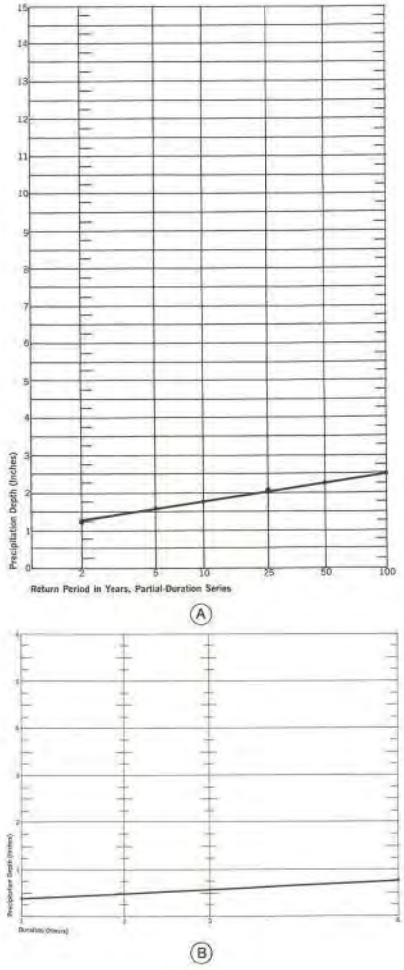
Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps
X_5 = latitude (in decimals) minus 40°
X_6 = longitude (in decimals) minus 100°
Z = point elevation in hundreds of feet

Duration (min)	5	10	15	30
Ratio to 1-hr	0.29	0.45	0.57	0.79

(Adopted from *U.S. Weather Bureau Technical Paper* No. 40, 1961.)

Table 13. *Adjustment factors to obtain n-min estimates from 1-hr values*

Figure 17. *Illustration of use of precipitation-frequency diagrams using values from precipitation-frequency maps and relations.*



	1-hr	2-hr	3-hr	6-hr	24-hr
2-yr	*0.37*	*0.47*	*0.57*	0.74	1.26 ~~1.23~~
5-yr				0.95	1.56
10-yr				1.12	1.75
25-yr				1.34	2.02 ~~2.05~~
50-yr				1.49	2.25
100-yr	*1.07*			1.63	2.50

Table 14. *Precipitation data for depth-frequency atlas computation point 44°00′ N., 118°00′ W.*

Exhibit D-4

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Exhibit D-4

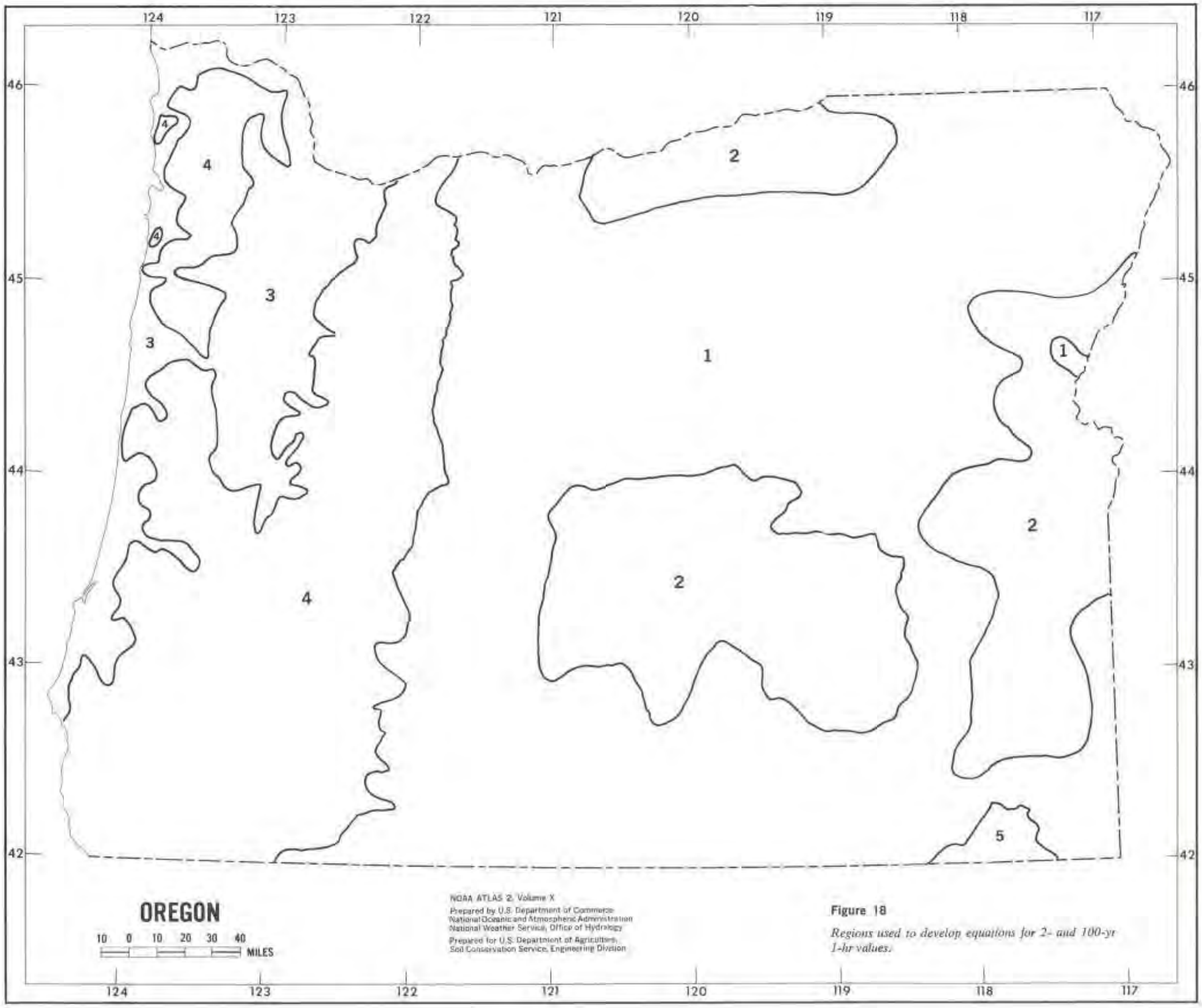

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Figure 18

Regions used to develop equations for 2- and 100-yr 1-hr values.

Exhibit D-4

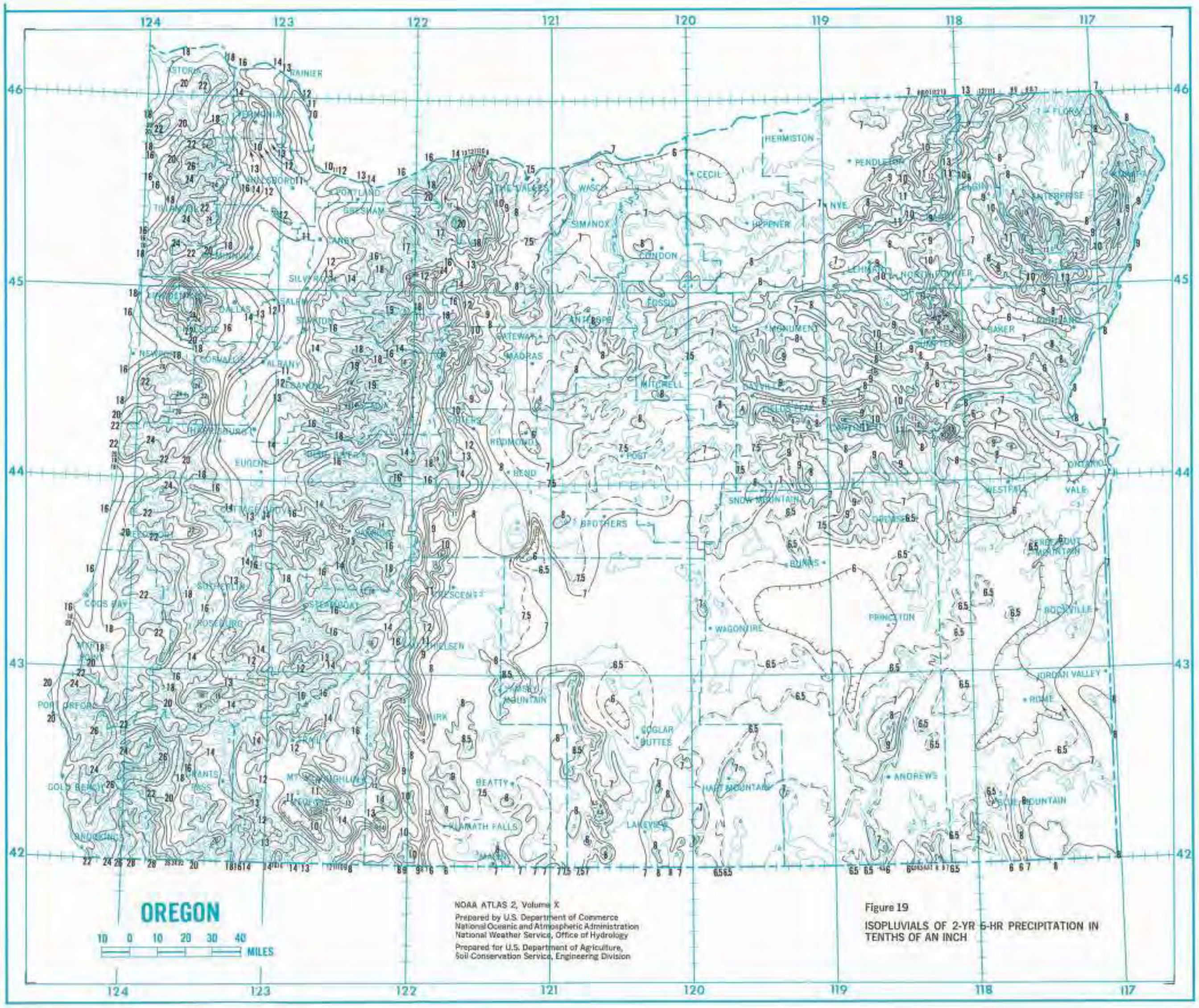

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Figure 19

ISOPLUVIALS OF 2-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

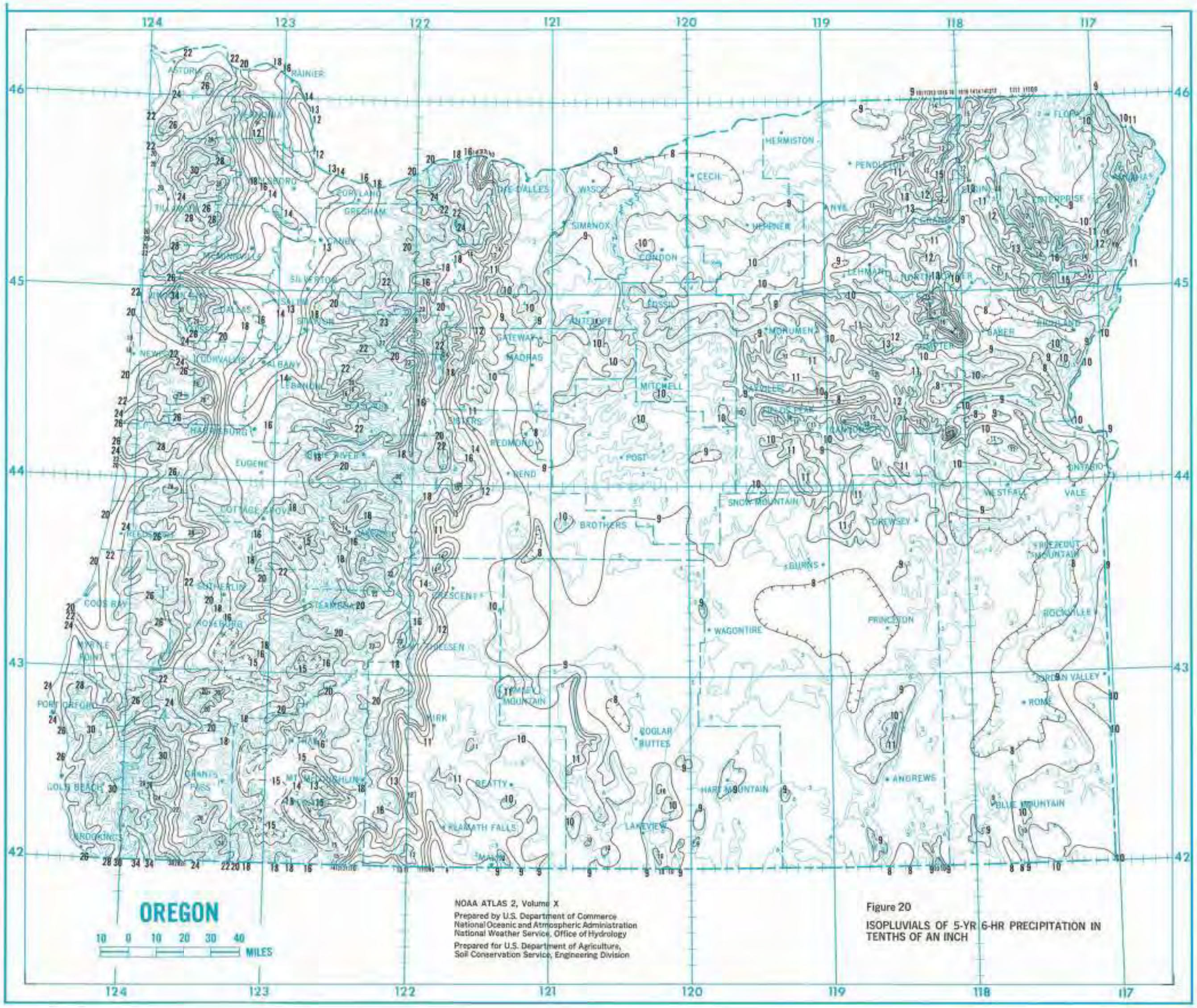

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Figure 20

ISOPLUVIALS OF 5-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

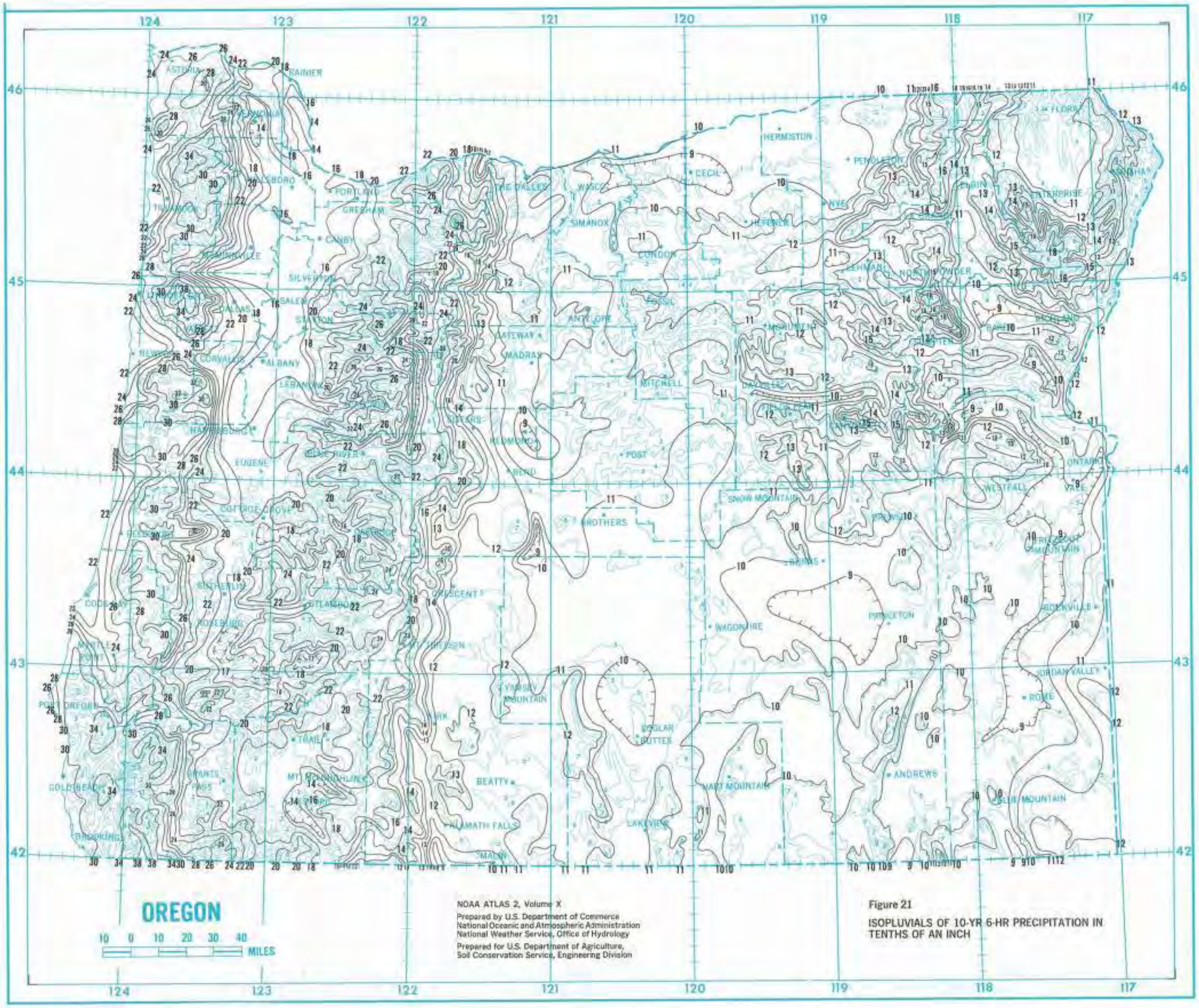

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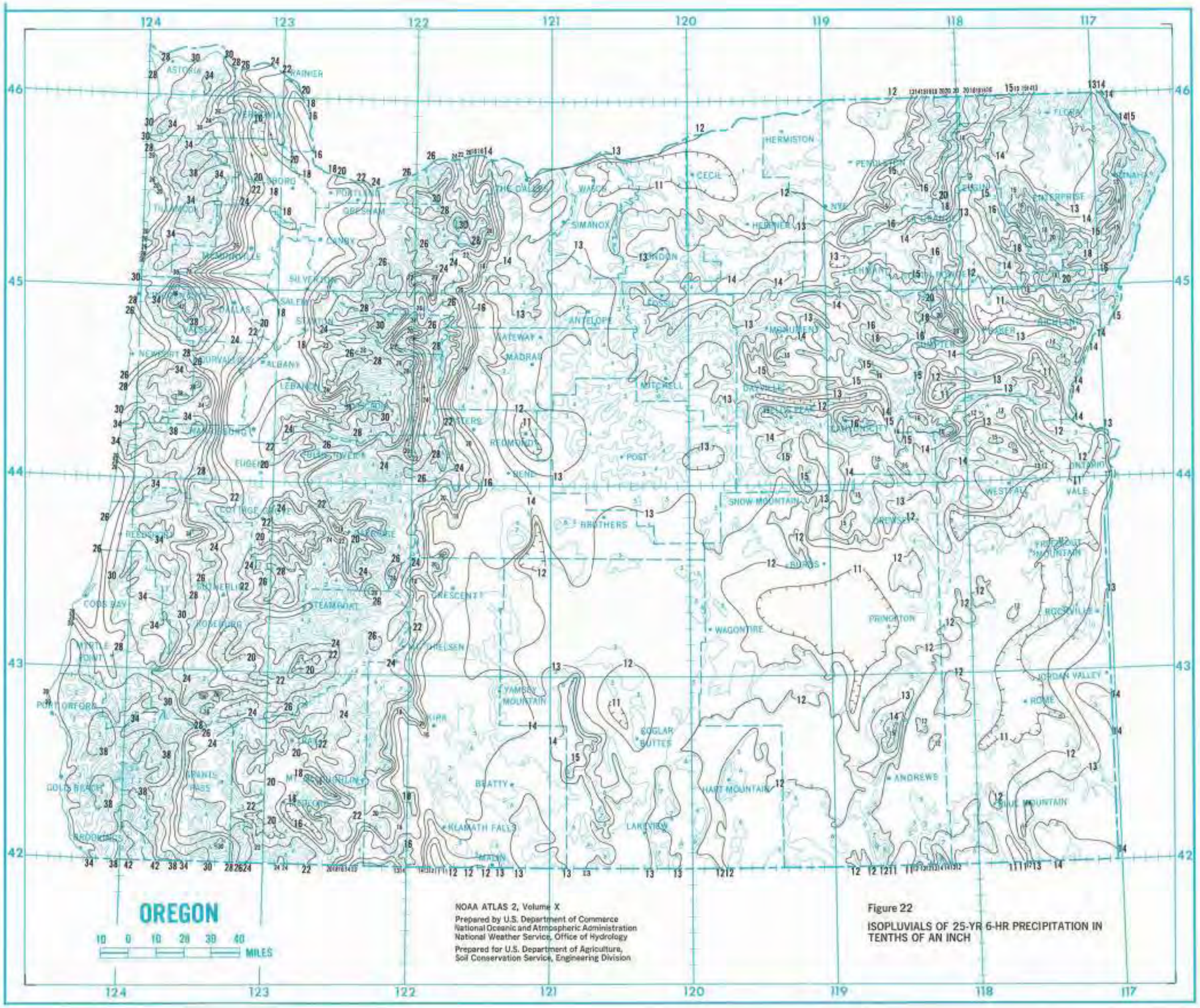
Figure 21
ISOPLUVIALS OF 10-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4



OREGON

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Figure 22

ISOPLUVIALS OF 25-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

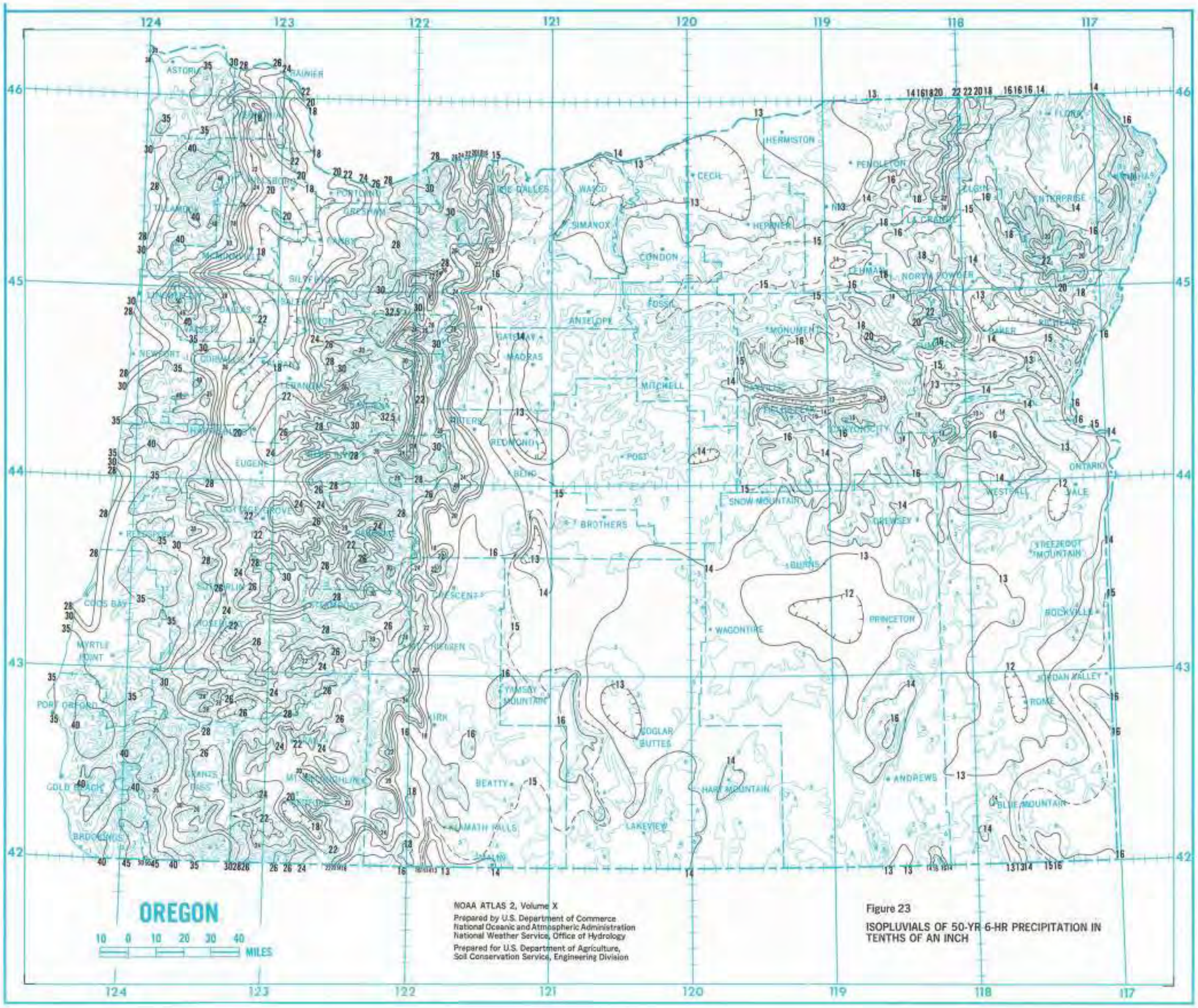

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Figure 23

ISOPLUVIALS OF 50-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

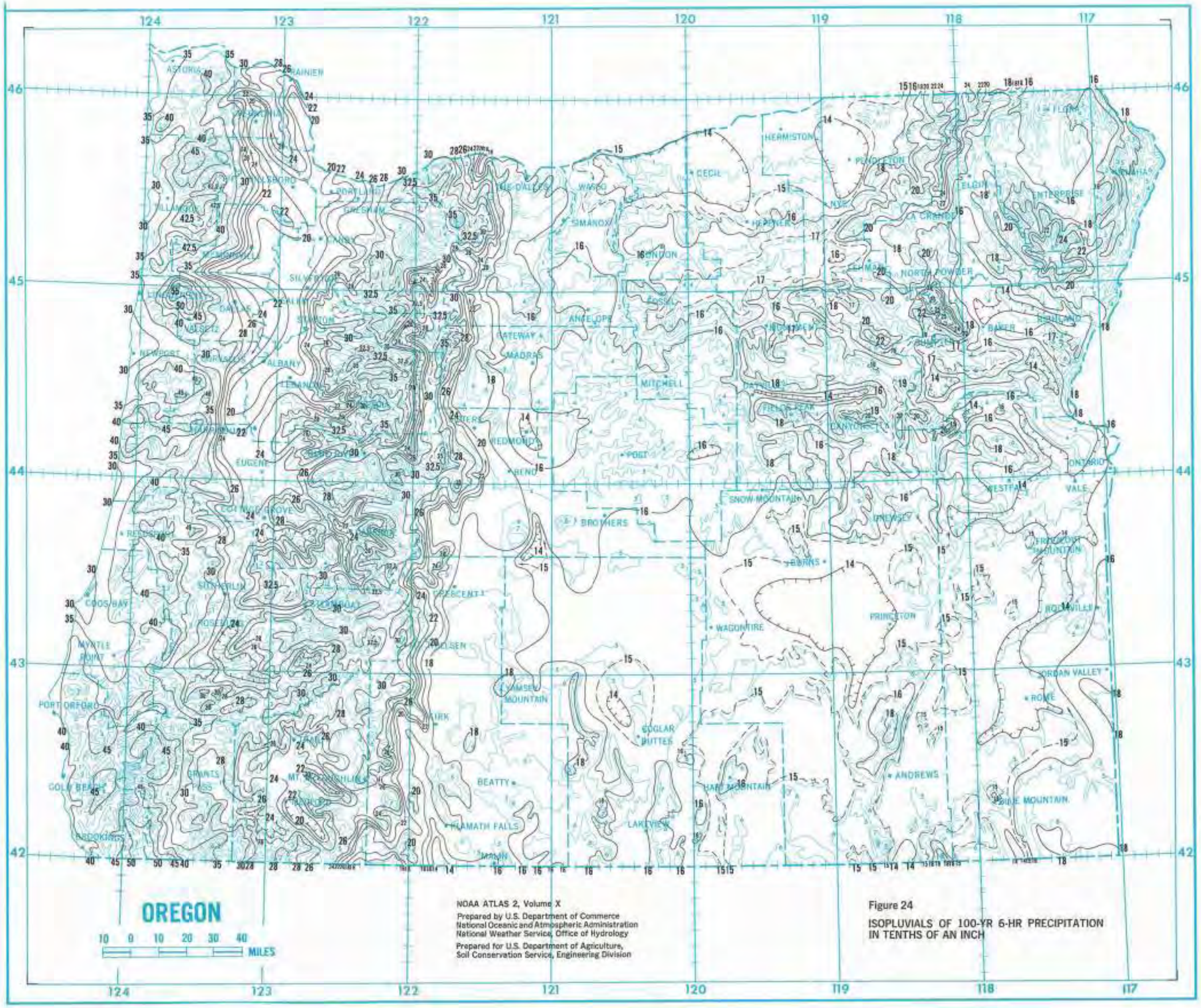

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Figure 24

ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

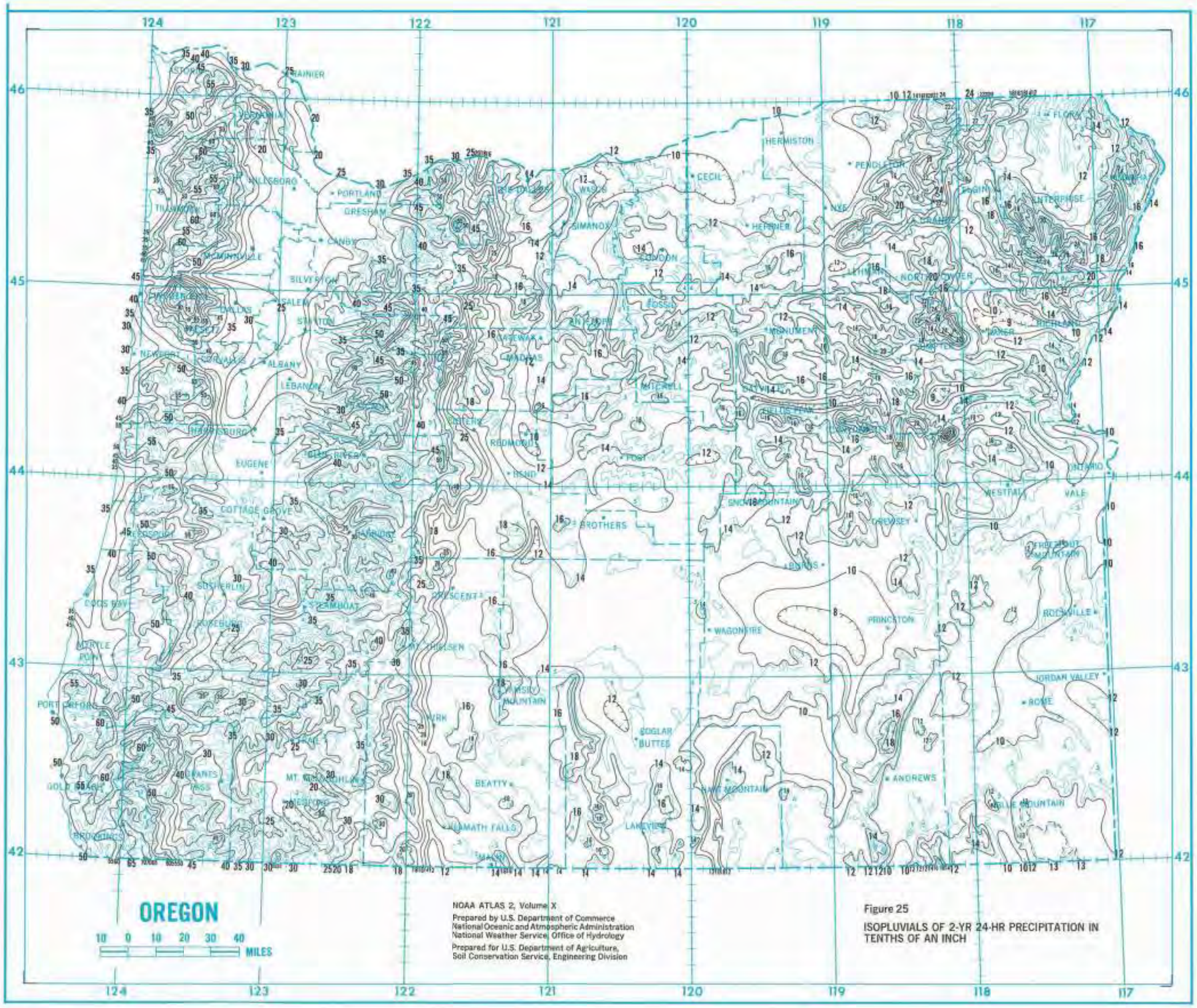

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Figure 25
ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

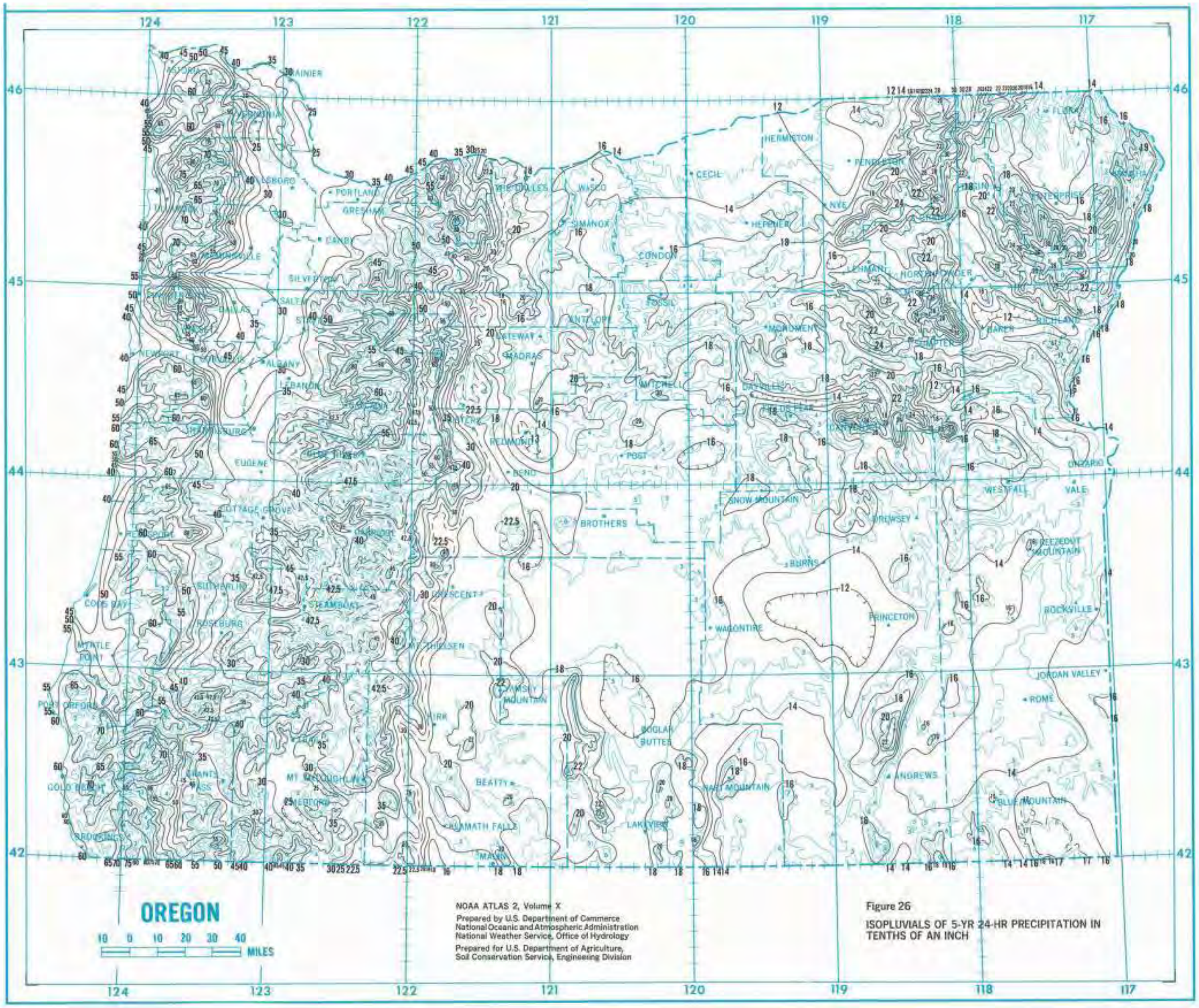

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Figure 26

ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

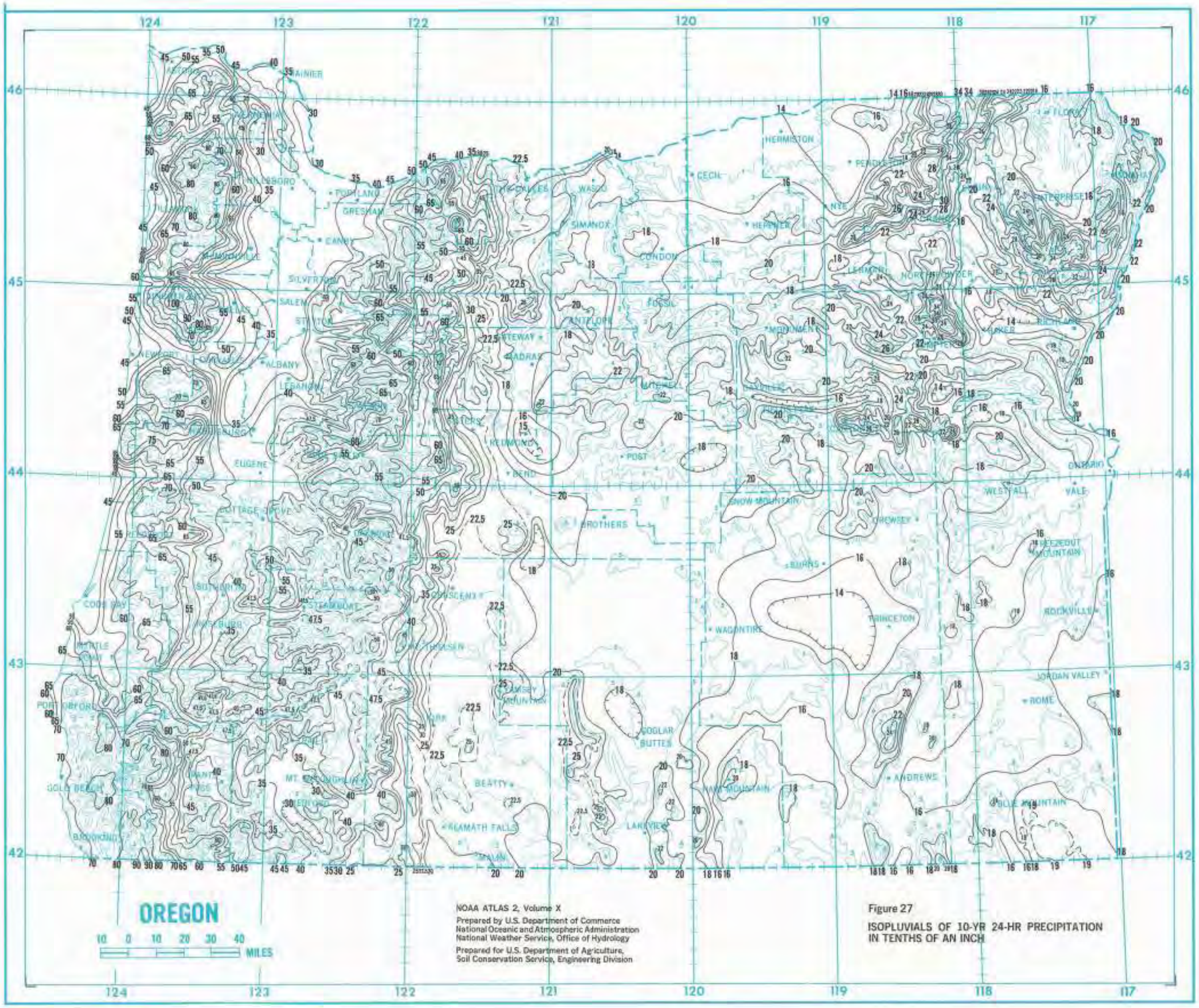

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Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

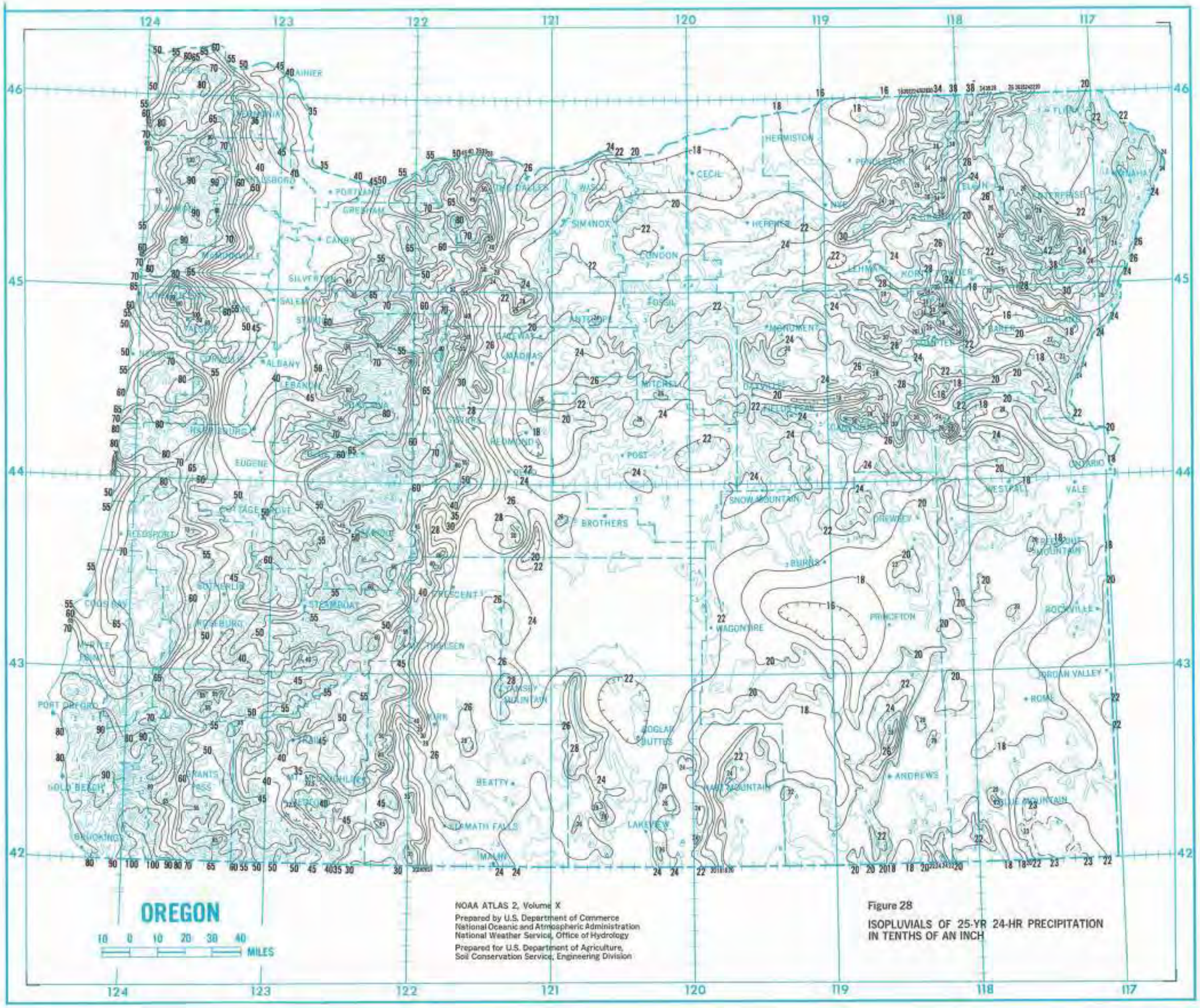

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Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

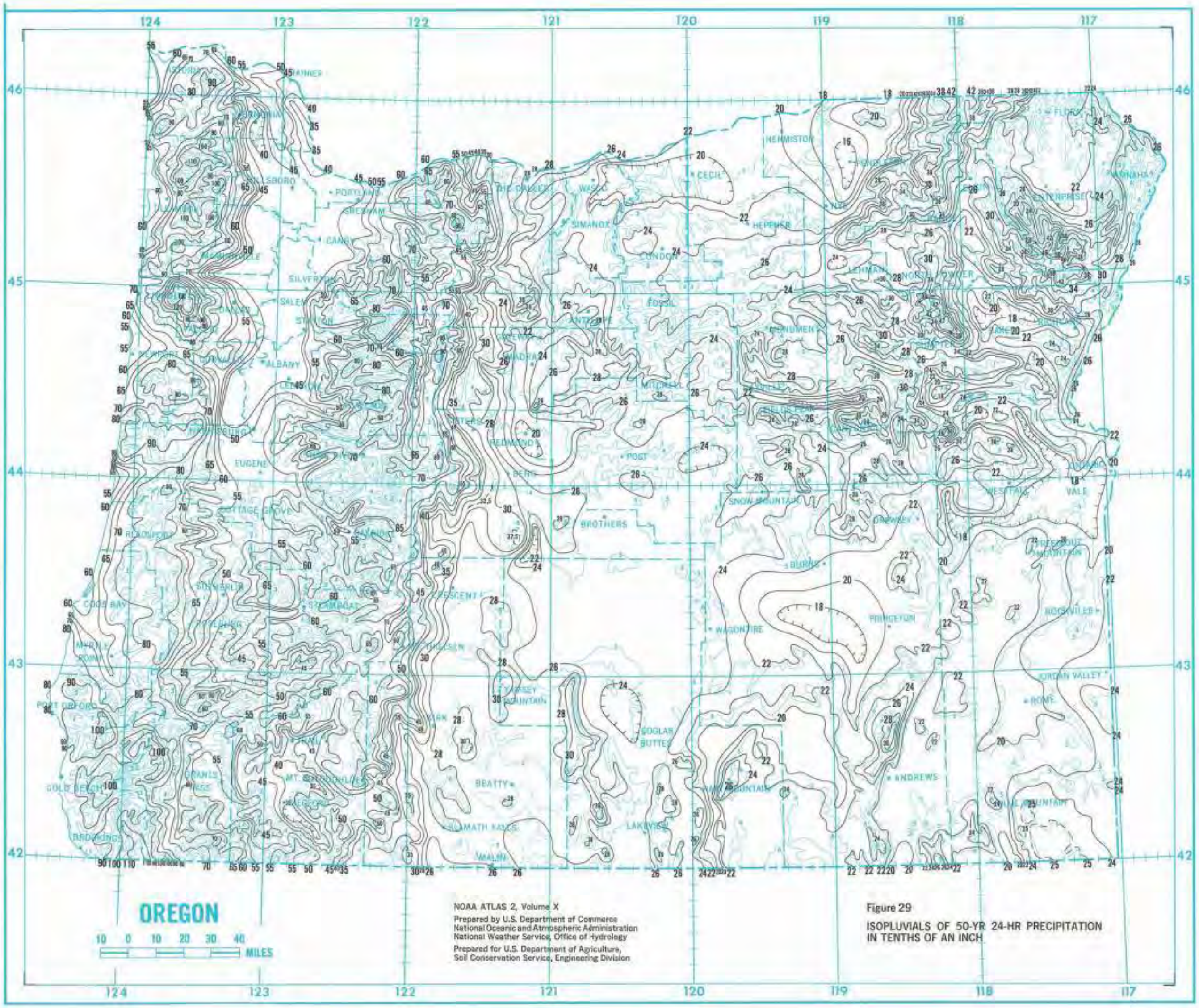

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Figure 29

ISOPLUVIALS OF 50-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

Exhibit D-4

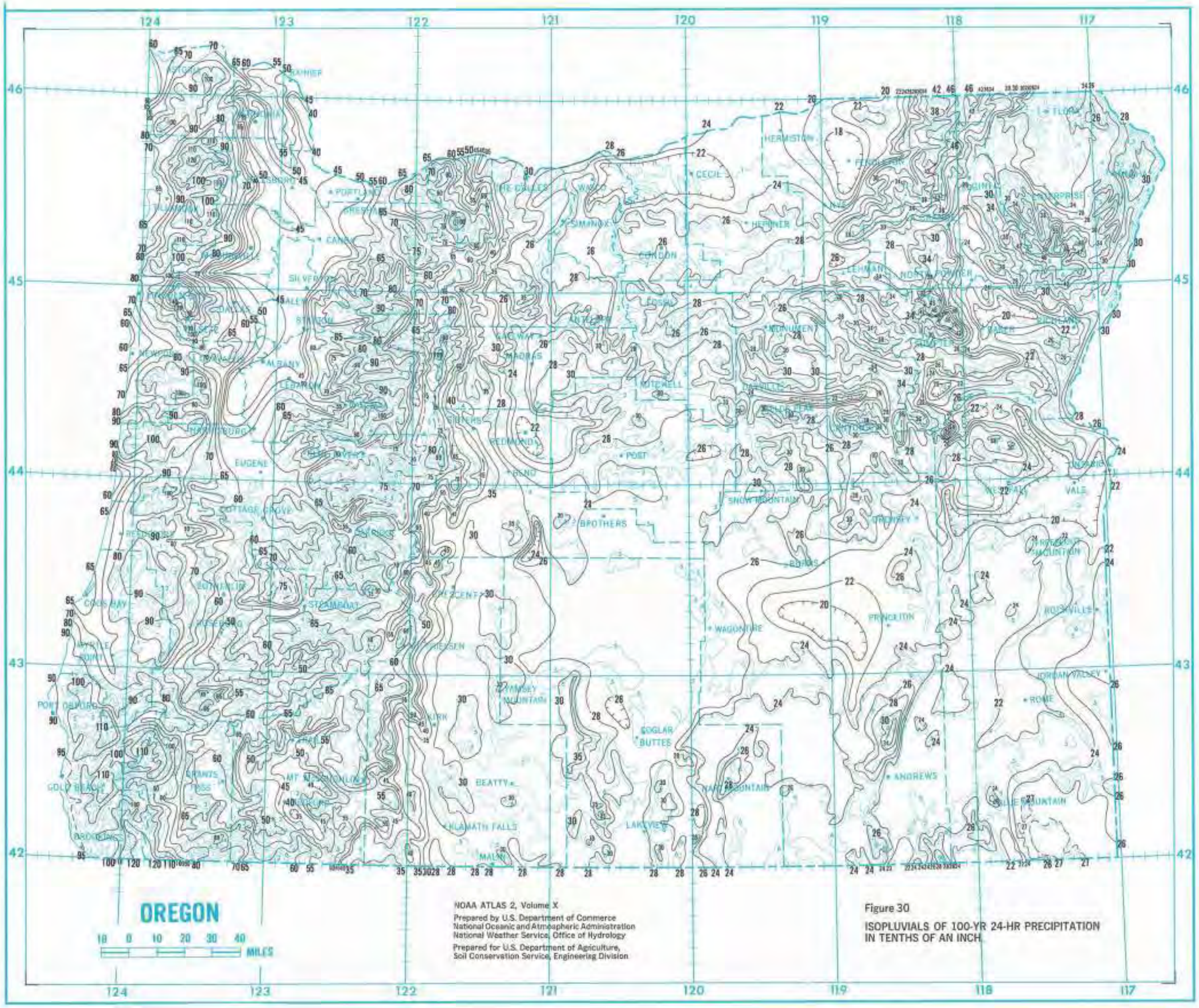

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Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

☆ U.S. GOVERNMENT PRINTING OFFICE : 1974 O—[illegible]

REGIONAL PRECIPITATION-FREQUENCY ANALYSIS AND SPATIAL MAPPING OF 24-HOUR PRECIPITATION FOR OREGON

Final Report

SPR 656

Exhibit D-4

Exhibit D-4

REGIONAL PRECIPITATION-FREQUENCY ANALYSIS AND SPATIAL MAPPING OF 24-HOUR PRECIPITATION FOR OREGON
Final Report

SPR 656

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16. Abstract

For this study regional frequency analyses were conducted for precipitation annual maxima in the state of Oregon for the 24-hour duration. A total of 693 precipitation gages in Oregon, southern Washington, western Idaho, northern California and northern Nevada were included in the study, representing 34,062 station-years of record. A regional analysis methodology was utilized that pooled data from climatologically similar areas to increase the dataset and improve the reliability of precipitation-frequency estimates. The regional analysis methodology included L-moment statistics, and an index-flood type approach for scaling the annual maxima data. L-moment statistics were used to: characterize the variability, skewness and kurtosis of the data; measure heterogeneity in proposed homogeneous sub-regions; and assist in identification of an appropriate regional probability distribution.

Spatial mapping techniques were employed for mapping of the precipitation-frequency information. This included spatial mapping of at-site means, L-moment ratio values of L-Cv and L-Skewness, and mapping of precipitation for selected recurrence intervals. Procedures were employed to minimize differences between mapped values and observed station values in a manner that was consistent with the regional behavior of the data and also recognized uncertainties due to natural sampling variability.

Color-shaded isopluvial maps were developed for the 6-month, 2-year, 10-year, 25-year, 50-year, 100-year, 500-year, and 1000-year precipitation recurrence intervals. Electronic gridded datasets are available for use in creation of GIS applications that utilize precipitation-frequency information.

A catalog of extreme storms was assembled that lists precipitation events that exceeded a 20-year return period for the various climatic regions. The information from the storm catalog was also used to conduct seasonality analyses that identified the occurrence frequency of extreme storms by month. In particular, the seasonality analyses identified those months that were the most likely and least likely for an extreme event to occur. This information is useful in rainfall-runoff modeling and can be used in conducting hydrologic analyses throughout the Oregon study area.

17. Key Words

CLIMATE , PRECIPITATION-FREQUENCY, RAINFALL, SPATIAL MAPPING, 24-HOUR PRECIPITATION, OREGON, WASHINGTON, IDAHO, CALIFORNIA

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
TEMPERATURE (exact)				
°F	Fahrenheit	(F-32)/1.8	Celsius	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.196	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
VOLUME				
ml	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
TEMPERATURE (exact)				
°C	Celsius	1.8C+32	Fahrenheit	°F

*SI is the symbol for the International System of Measurement

Exhibit D-4

ACKNOWLEDGEMENTS

The authors would like to acknowledge Chris Daly of the PRISM Group at OSU who provided the precipitation data layers which formed the basis for the spatial mapping. Cadee Hale of OCS and Joseph Smith of the PRISM Group were involved in collecting daily and hourly precipitation data.

DISCLAIMER

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Exhibit D-4

REGIONAL PRECIPITATION-FREQUENCY ANALYSIS AND SPATIAL MAPPING OF 24-HOUR PRECIPITATION FOR OREGON
Final Report

TABLE OF CONTENTS

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Includes: catalog of stations, precipitation annual maxima for all gages, gridded dataset for 24-hour mean annual maxima (at-site means), gridded datasets of L-moment ratios L-Cv and L-Skewness for 24-hour duration, gridded datasets of precipitation estimates for selected recurrence intervals, precipitation magnitude-frequency estimates for selected recurrence intervals for each station, catalog of extreme storms for 24-hour duration, final report and supporting graphics.

LIST OF TABLES

LIST OF FIGURES

Exhibit D-4

EXECUTIVE SUMMARY

Regional frequency analyses were conducted for precipitation annual maxima in Oregon State for the 24-hour duration. A total of 693 precipitation gages in Oregon, southern Washington, western Idaho, northern California and northern Nevada were included in the study, representing 34,062 station-years of record. A regional analysis methodology was utilized that pooled data from climatologically similar areas to increase the dataset and improve the reliability of precipitation-frequency estimates. The regional analysis methodology included L-moment statistics, and an index-flood type approach for scaling the annual maxima data. L-moment statistics were used to: characterize the variability, skewness and kurtosis of the data; measure heterogeneity in proposed homogeneous sub-regions; and assist in identification of an appropriate regional probability distribution.

It was found that the study area could be described by 17 climatic regions and two transition zones. The 17 climatic regions were geographic areas that had similar topographic and climatological characteristics and were subjected to similar meteorological conditions during storm events. Eight of the regions were in western Oregon, including windward and leeward mountain areas and interior lowlands. The other nine climatic regions were in eastern Oregon, comprising arid and semi-arid plains and mountain and inter-mountain areas. One transition zone was used near the crests of the Cascade and Klamath Mountains for spatial mapping of precipitation where precipitation characteristics changed rapidly over short distances. A second transition zone was used for spatial mapping of precipitation at the eastern foothills of the Cascade Mountains. Steep gradients in storm statistical measures were found along with a sharp change in the seasonality of storms in this eastern Cascade foothills area.

Separate regional analyses were conducted for each of the climatic regions. Within each climatic region, precipitation gages were assigned to groups where the gage sites had similar magnitudes of mean annual precipitation and latitude. A total of 68 sub-regions were formed by this process and were found to be acceptably homogeneous. Predictor equations were then developed to describe the variability of the L-moment ratios, L-Cv and L-Skewness, between the sub-regions and within and/or across climatic region boundaries. The sub-region L-moment ratio plots for L-Skewness and L-Kurtosis revealed the data to be near or slightly more kurtotic than the Generalized Extreme Value distribution. The four-parameter Kappa distribution was chosen to describe the regional magnitude-frequency relationship for the 24-hour precipitation annual maxima data.

Spatial mapping techniques were employed for mapping of the precipitation-frequency information. This included spatial mapping of at-site means, L-moment ratio values of L-Cv and L-Skewness, and mapping of precipitation for selected recurrence intervals. Procedures were employed to minimize differences between mapped values and observed station values in a manner that was consistent with the regional behavior of the data and also recognized uncertainties due to natural sampling variability.

Color-shaded isopluvial maps were developed for the 6-month, 2-year, 10-year, 25-year, 50-year, 100-year, 500-year, and 1000-year precipitation recurrence intervals. Electronic gridded datasets are available on a CD for use in creation of GIS applications that utilize precipitation-frequency information.

A catalog of extreme storms was assembled that lists precipitation events that exceeded a 20-year return period for the various climatic regions. The information from the storm catalog was also used to conduct seasonality analyses that identified the occurrence frequency of extreme storms by month. In particular, the seasonality analyses identified those months that were the most likely and least likely for an extreme event to occur. This information is useful in rainfall-runoff modeling and can be used in conducting hydrologic analyses throughout the Oregon study area.

1.0 OVERVIEW

This report documents the findings of regional precipitation-frequency analyses of 24-hour precipitation annual maxima for the State of Oregon. It also describes the procedures used for spatial mapping of precipitation-frequency estimates for selected recurrence intervals. This study is an update of the information contained in the precipitation-frequency atlas published by the National Weather Service (NWS) in 1973 (*Miller et al.*). Data collection for the NWS study ended in 1966, and this study includes the 40-years of precipitation records collected since. Additional data from sources not available in 1966 is also utilized. These additional data provide a precipitation database with more than double the record than was available in the original NWS study.

Since the original 1966 study, major advances have been made in methods for statistical analysis of precipitation annual maxima, and for spatial mapping of precipitation in complex terrain. Specifically, L-Moment statistical analysis techniques, conducted within a regional framework, have greatly improved the reliability of precipitation magnitude-frequency estimates, particularly for rare storm events (*Hosking 1990; Hosking and Wallis 1997).* Development of the PRISM model incorporating digital terrain data has also improved the spatial mapping of precipitation and increased the reliability of estimating precipitation in the broad areas between precipitation measurement stations (*Daly 1994*) These methodologies are particularly effective in areas with high topographic and climatic variability that exist in Oregon. Both of these methodologies have been utilized in this study in conducting the precipitation-frequency analyses and in developing the isopluvial maps for selected recurrence intervals.

Exhibit D-4

2.0 STUDY AREA

While the state of Oregon was the area of interest, the study area was expanded to provide additional data in border geographic areas. The Oregon study area included portions of southern Washington, western Idaho, northern California and northern Nevada (Figure 1). Specifically, the Oregon study area was bounded on the North by latitude 47°00′ N, to the south by latitude 41°00′ N, and to the east by latitude 116°00′ W. Addition of precipitation stations in the boundary areas also provided data from areas climatologically similar to data-sparse areas in Oregon such as locations in the Coastal Mountains, Cascade Mountains, Blue Mountains, Cabinet Mountains, and Klamath Mountains.

2.1 CLIMATIC AND METEOROLOGIC CHARACTERISTICS OF STUDY AREA

2.1.1 Annual Precipitation

Mean annual precipitation within the Oregon study area varies dramatically from the windward faces of the Coast Range and Cascade Mountains to the desert areas in central Oregon. Mean Annual Precipitation (MAP) ranges from a high of over 200-inches in the Coast Range, to a low near 6-inches in the inter-Mountain desert area in southeast Oregon (Figure 2.1) (*Oregon Climate Service 2000, 2005*).

2.1.2 Weather Systems and Sources of Atmospheric Moisture

In general, two ingredients are needed for precipitation to occur; a source of atmospheric moisture and a meteorological mechanism to release that moisture. There is also a greater potential for extreme precipitation events when the source of moisture originates in areas with warmer temperatures and higher dewpoints. There are four generalized geographic areas that are sources of atmospheric moisture to the study area. These four areas have differing characteristic temperatures and dew points (*Miller et al. 1973; National Weather Service 1966, 1994*). These source areas include: the Gulf of Alaska; the Pacific Ocean north of the Canadian border; and the Pacific Ocean from as far south as latitude 20°N, near the Hawaiian Islands. The Gulf of Mexico is the fourth source of moisture that occasionally penetrates sufficiently north to be a source of precipitation in warm months.

Storm systems moving in a southeasterly direction out of the Gulf of Alaska, primarily affect northern portions of the study area and generally contain cooler temperatures and dewpoints (*Miller et al. 1973; National Weather Service 1966, 1994*). Storm systems originating over the Pacific Ocean are the most common, while those that originate from southerly latitudes, near the Hawaiian Islands, have been responsible for many of the largest long-duration precipitation

Exhibit D-4

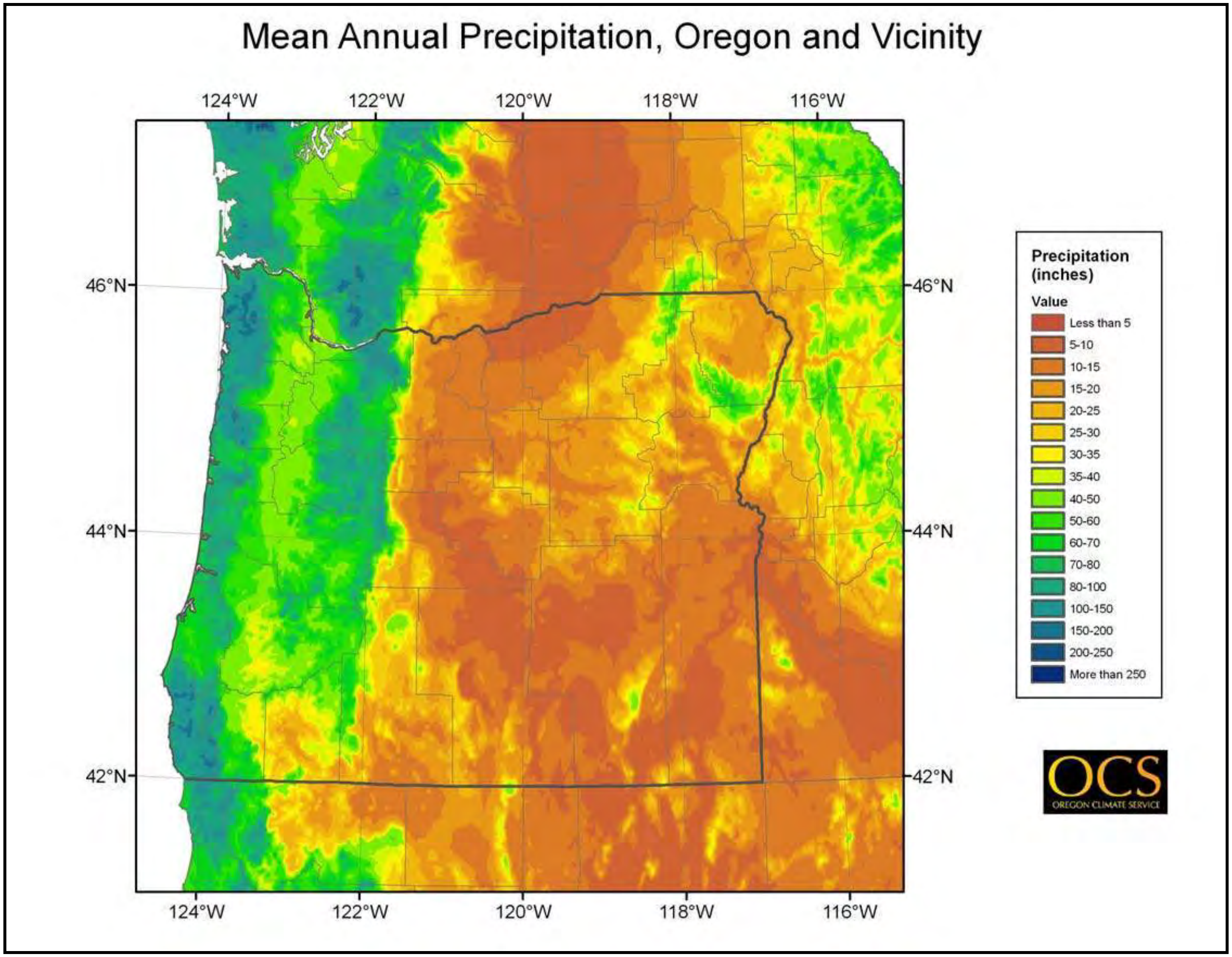


Figure 2.1: Mean Annual Precipitation for Oregon study area (*Oregon Climate Service 2000, 2005*).

Exhibit D-4

totals experienced in the winter months. Synoptic-scale cyclonic weather systems, and associated fronts, generally provide the mechanism for producing precipitation annual maxima (the greatest precipitation amount in a 12-month period for a specified duration at a given measurement site) at 24-hour and longer durations. Precipitation is enhanced in mountain areas as atmospheric moisture is lifted over the Coastal, Cascade, Klamath and Blue Mountains. This orographic component of precipitation has the greatest effect at 24-hour and longer time scales, and can significantly enhance the total accumulation of precipitation over several days. Precipitation annual maxima at 24-hour duration occur predominately in the fall and winter seasons in western Oregon and on east slopes of the Cascade and Klamath Mountains. Areas of eastern Oregon experience precipitation annual maxima at the 24-hour duration in both the fall and winter months as well as the spring and summer months. Additional information on the seasonality of precipitation annual maxima is presented in the discussion of climatic regions.

Exhibit D-4

3.0 DATA SOURCES

A precipitation annual maximum is the greatest precipitation amount in a 12-month period for a specified duration at a given measurement site. For the purpose of this study, the calendar year, January 1st through December 31st was used for determining 24-hour precipitation annual maxima.

Precipitation annual maxima and associated storm dates were obtained from precipitation records from a variety of sources. The majority of data were obtained from electronic files of the National Climatic Data Center (NCDC). Data from SNOTEL gages (see description in Section 3.1) located in mountain areas were obtained from electronic files of the Natural Resources Conservation Service (NRCS). Data were also obtained for precipitation gages operated by the State of California, whose electronic files were available through the California Data Exchange Center (CDEC).

3.1 PRECIPITATION GAGE TYPES, METHODS OF MEASUREMENT AND REPORTING

Precipitation is measured by a variety of devices and reported by a number of different agencies in the United States. Descriptions of the gage types and reporting methods are summarized below.

Daily Gages

Daily gages in US are standardized devices comprised of simple vertical cylinders that are open to the atmosphere. A variety of shields for protection from the wind are used, with shields being more common now than in the past. Precipitation is measured once each day at a specified time and represents the precipitation for the previous 24-hours.

Automated Gages

Automated gages, such as weighing buckets, Fisher-Porter tipping buckets, and other types of tipping buckets can provide information about precipitation depth and intensity on various time scales. The standards in the US are for reporting on either hourly or 15-minute intervals. Weighing bucket gages with paper strip charts came into use in the early 1940’s. Tipping bucket gages and automated reporting systems were installed at many sites beginning in the 1970’s. These gages are often given the generic term, “hourly gages” to distinguish them from daily gages.

SNOTEL Gages

Snotel gages are a type of automated gage commonly used in mountain areas. They have external heating systems and are designed for cold weather operation. Precipitation falling as snow is converted to liquid water for measurement. SNOTEL gages were first installed in the late 1970s and reported precipitation on a daily basis on a midnight-to-midnight reporting schedule. In the late 1990s, SNOTEL gages began reporting on an hourly schedule. The short record of hourly data currently available is insufficient for regional-frequency analysis and the SNOTEL data used in this study is equivalent to a daily gage with midnight to midnight reporting.

3.2 NUMBER OF GAGES AND GAGE TYPES

The number of gages and gage types used in the regional analyses are summarized in Table 3.1. Both daily and hourly precipitation gages were co-located at some precipitation measurement sites. In addition, sometimes there are clusters of gages located within short distances of each other. To avoid duplication of records when this occurred, only the gage with the longest record was utilized in analyses. When both daily and hourly records, with similar record lengths, were available at a given site, the record from the hourly gage was selected. This situation resulted in 156 gages/records in the study area being marked as duplicates. After these gages/records were removed, a total of 693 gages remained to be used in the study. The resultant precipitation station network is shown in Figure 3.1. The figure shows good spatial distribution that is representative of the diverse topographic and climatic characteristics in Oregon. Figure 3.2 depicts the range of record lengths for the 693 gages of various gage types.

Table 3.1: Number and Type of Gages Utilized for Analyses of 24-Hour Annual Maxima.

State	**Precipitation Gage Type**			**Station-Years**
	Daily	**Hourly**	**Snotel**	
Northern California	38	20	3	3,136
Western Idaho	34	9	9	2,903
Northern Nevada	12	6	10	1,124
Oregon	273	80	66	20,096
Southern Washington	99	19	15	6,803
Totals	**456**	**134**	**103**	**34,062**

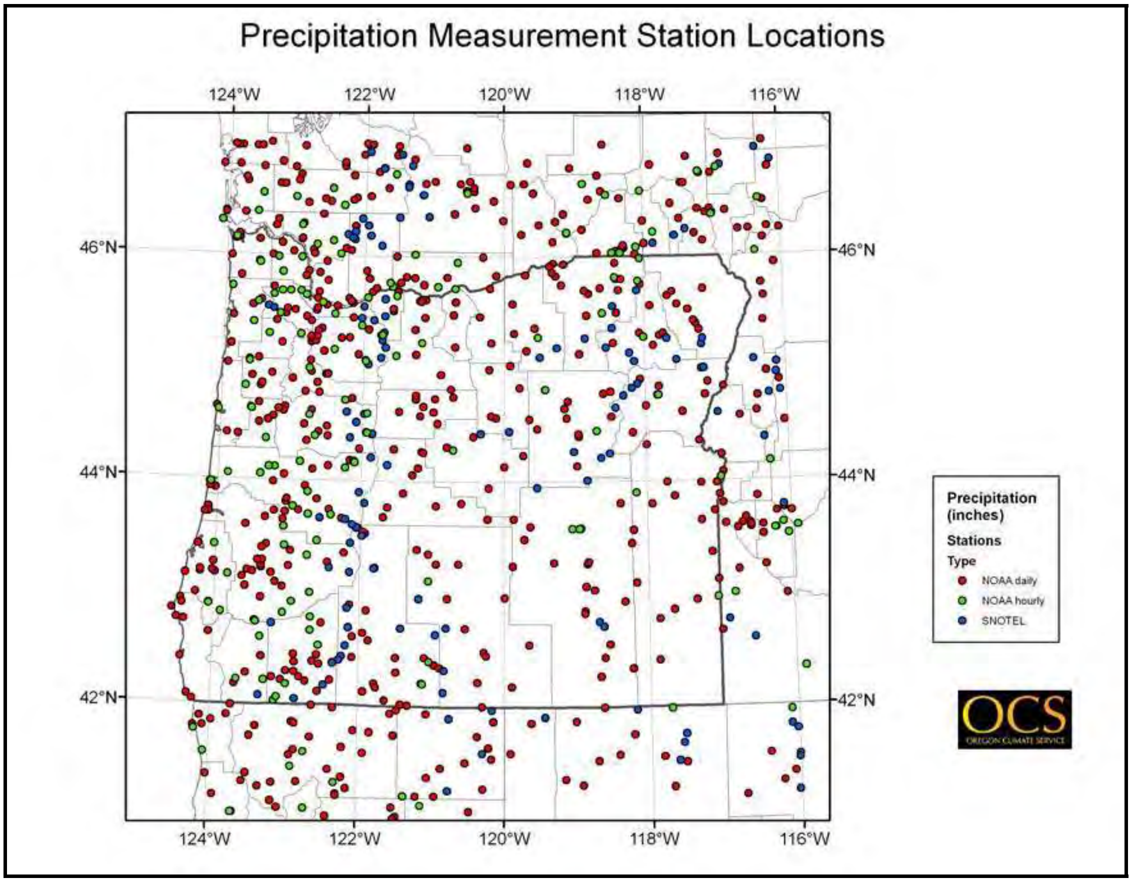


Figure 3.1: Precipitation Gaging Network for Oregon Study Area.

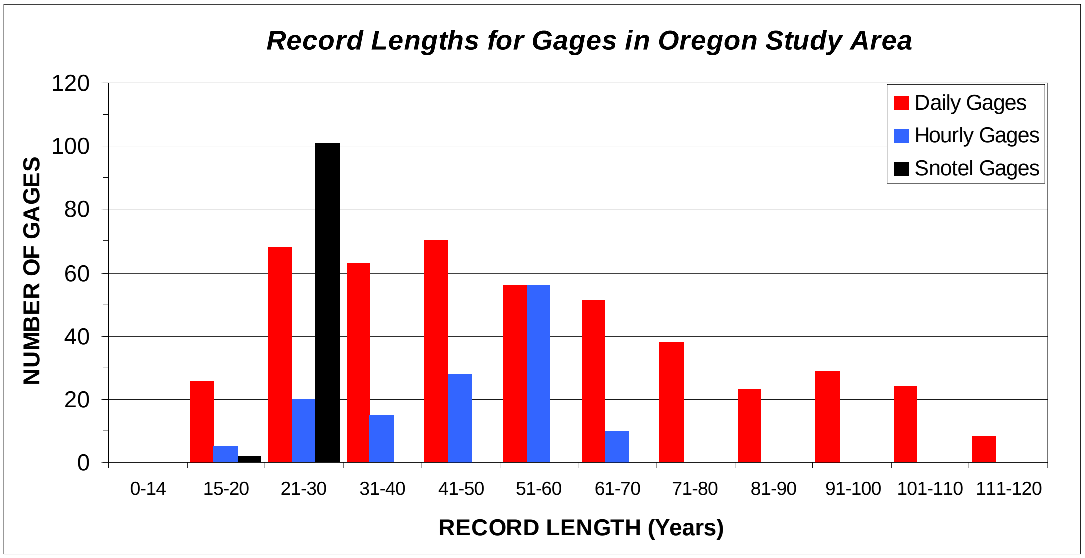


Figure 3.2: Record Lengths for Gages in Oregon Study Area.

Exhibit D-4

4.0 DATA SCREENING AND QUALITY CHECKING

Extensive efforts were made in screening and quality checking the annual maxima data. Quality checking was needed to eliminate false annual maxima associated with a variety of data measurement, reporting, transcription errors, and incomplete reporting during some years. The record for all sites and calendar-years was checked for completeness. In addition, all records were scanned for anomalously small or large precipitation amounts and the Hosking and Wallis measure of discordancy was used to identify gages whose sample statistics were markedly different from the majority of gages in a given climatic region (*Hosking and Wallis 1993, 1997*). Suspicious gages and data were checked to verify the validity of records. Nearby sites were also examined to corroborate the magnitude and date of occurrence of any anomalously small or large precipitation annual maxima. Data that were clearly erroneous were removed from the datasets.

4.1 STATIONARITY AND SERIAL INDEPENDENCE

Two underlying assumptions inherent in frequency analyses were the data were stationary over the period of observation and use, and the data at a given site (gage) were serially independent. As part of the data screening process, standard statistical tests for stationarity and serial independence were conducted.

To meet the stationarity criterion, the data had to be free from trends during the period of observation. This was confirmed by standard linear regression techniques where the station data were first rescaled by division of the at-site mean and then regressed against the year of occurrence, minus 1900. This approach allowed comparisons to be made among all gages and to interpret the relative magnitude of any trend over the past century. The average value of the slope parameter was -0.008 percent. The regression results for the collective group of gages were tested against a null hypothesis of zero slope (stationarity). The null hypothesis could not be rejected at the 5% level and the data were accepted as stationary.

To confirm independence of the annual maxima data, a serial correlation coefficient was computed for the data at each gage. The regression results for the collective group of gages were tested against a null hypothesis of zero serial correlation (independence). The null hypothesis could not be rejected at the 5 percent level. The annual maxima data were found to be serially independent, consistent with the findings in Washington and California (*Schaefer and Barker 2000; Schaefer et al. 2002, 2006*).

Exhibit D-4

5.0 REGIONAL FREQUENCY ANALYSIS METHODOLOGY

The cornerstone of a regional frequency analysis is that data from sites within a homogeneous region can be pooled to improve the reliability of the magnitude-frequency estimates for all sites. A homogeneous region may be a geographic area delineated on a map or it may be a collection of sites having similar characteristics pertinent to the phenomenon being investigated.

Early in the study it was recognized that the climatic and topographic diversity in the study area would likely preclude the use of large geographic areas that would meet statistical criteria for homogeneity. It was decided to employ climatic/geographic regions that had basic similarities in the climatic and topographic setting. It was anticipated that these regions might require further sub-division to meet homogeneity criteria for use in regional frequency analysis.

5.1 DESCRIPTION OF CLIMATIC/GEOGRAPHIC REGIONS

Identification of climatologically similar regions meant delineating geographic areas that had similar climatological and topographical characteristics. To assist in this effort, a literature review was conducted to examine region designations utilized in prior studies. This included a review of NOAA Atlas 2 (*Miller et al. 1973*), studies of extreme precipitation in the Pacific Northwest (*NWS 1966, 1994*), and prior regional frequency analyses conducted in mountain areas (*Schaefer 1989, 1990, 1997; Schaefer and Barker 1997, 2000; Schaefer et al. 2002, 2006*). Each of the region designations utilized in these prior studies were based, to some extent, on the spatial distribution of mean annual precipitation and topographic characteristics, particularly the orientation of mountain ranges relative to common storm tracks.

This information was augmented by seasonality analyses of 24-hour precipitation annual maxima. Those analyses revealed winter storms to be the dominate events in western Oregon and in the Cascade and Klamath Mountains (Figure 5.1). Areas east of the eastern Cascade Foothills exhibited seasonality characteristics with a mixture of winter (Nov-Apr), spring-summer (May-Aug) and fall (Sep-Oct) annual maxima (Figures 5.1, 5.2, and 5.3).

Seventeen climatic regions and two transition zones (Figure 5.4) were identified based on information contained in the previously discussed precipitation studies; the spatial distribution of mean annual precipitation; and the seasonality characteristics of precipitation annual maxima. The magnitude and gradient of mean annual precipitation were the primary measures used to define the boundaries between the regions. The following sections contain descriptions of the climatic regions and progress from climatic regions nearest the Pacific coast eastward across the study area.

Exhibit D-4

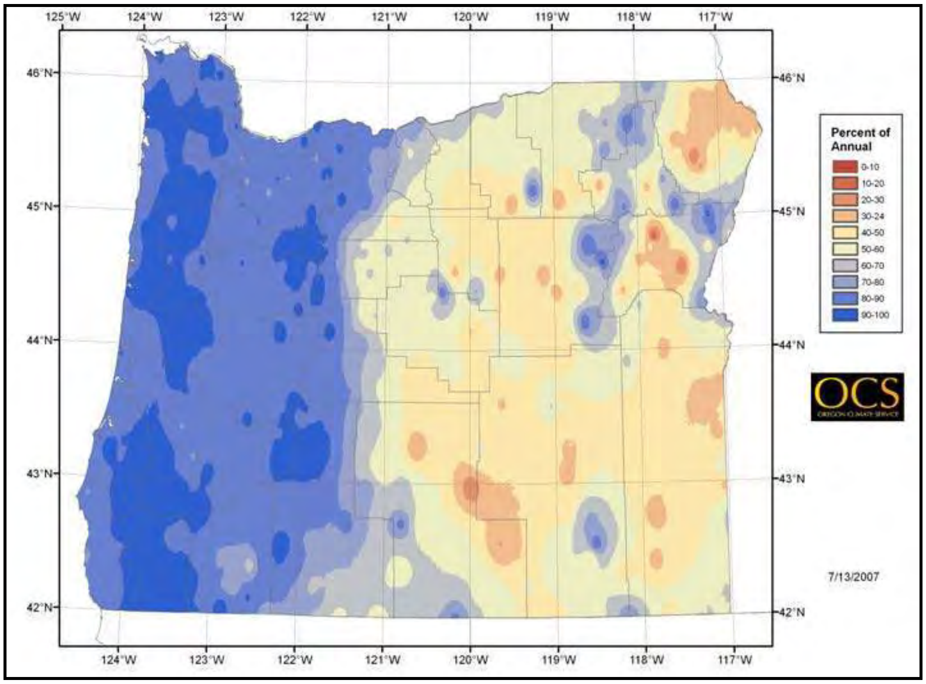


Figure 5.1: Frequency of Winter (November – April) 24-Hour Annual Maxima for Oregon Study Area.

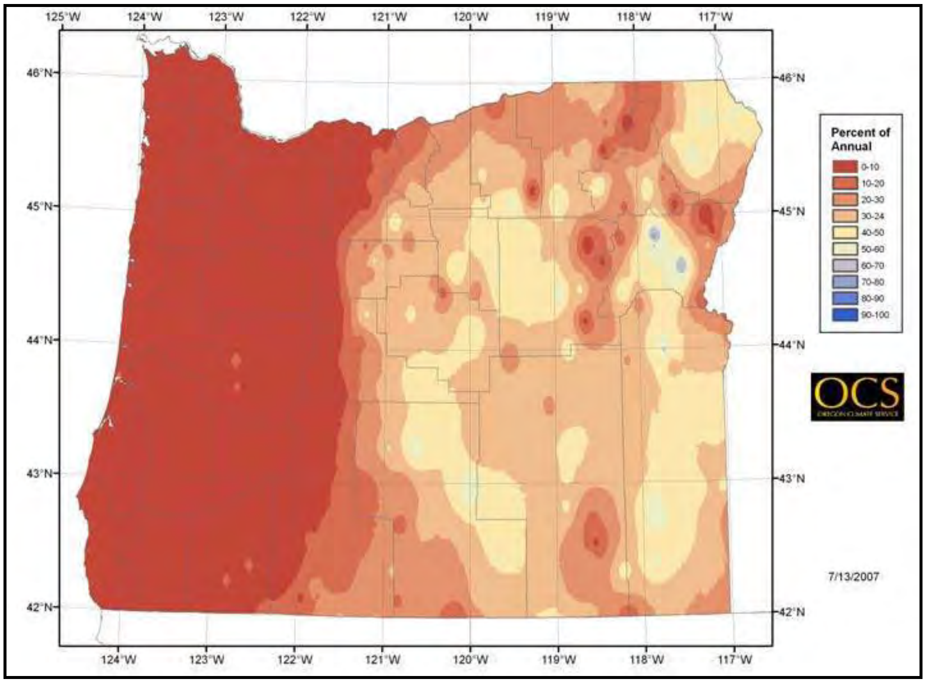


Figure 5.2: Frequency of Spring-Summer (May – August) 24-Hour Annual Maxima for Oregon Study Area.

Exhibit D-4

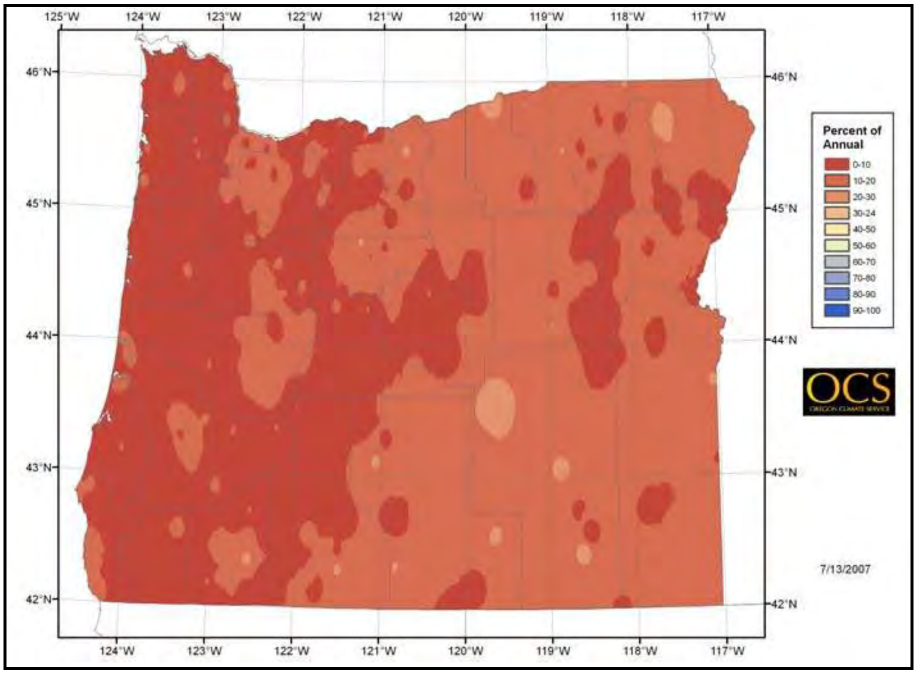


Figure 5.3: Frequency of Fall (September – October) 24-Hour Annual Maxima for Oregon Study Area.

Exhibit D-4

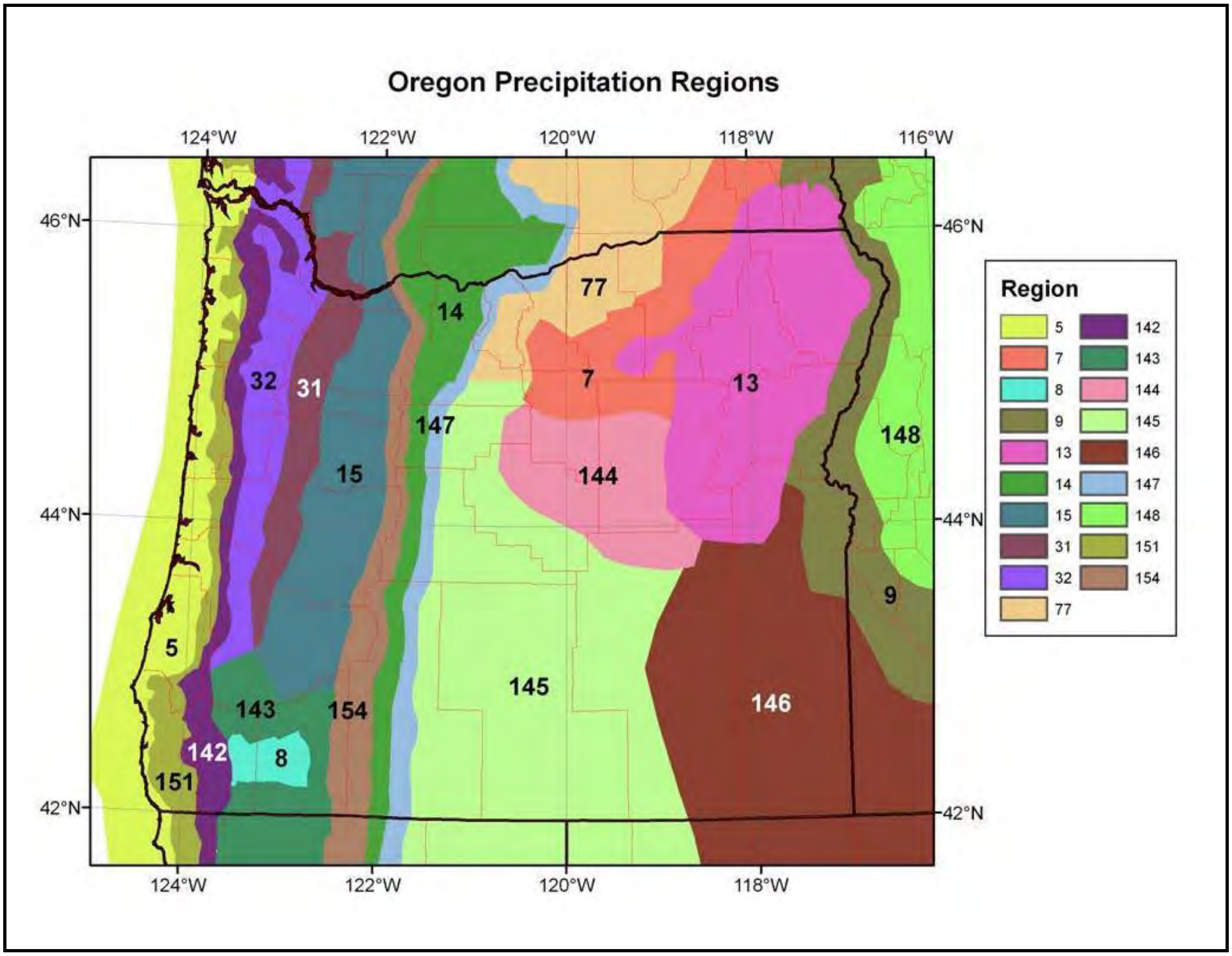


Figure 5.4: Delineation of Climatic Regions and Transition Zones for Oregon State and Surrounding Areas

5.2 CLIMATIC REGIONS FOR WESTERN OREGON STUDY AREA

Region 5 - Coastal Lowlands

This region includes the lowlands along the west coast of southern Washington, Oregon and northern California that are open to the Pacific Ocean. The eastern boundary is a generalized contour line of 1,000 feet elevation in the foothills of the coastal mountains.

Region 151 - Coastal Mountains West

This region includes the windward faces of the Coastal Mountains in southern Washington, Oregon and northern California above a generalized contour line of 1,000 feet elevation. These areas are bounded to the west by the 1,000 feet contour line, and bounded to the east by the ridgeline of mean annual precipitation near the crest line of the Coastal Mountains.

Region 142 - Coastal Mountains East

This region includes the leeward faces of the Coastal Mountains in southern Washington, Oregon, and northern California above a generalized contour line of 1,000 feet elevation. These areas are bounded to the west by the ridgeline of mean annual precipitation near the crest line of the mountain barrier, and bounded to the east by the 1,000 feet contour line.

Region 32 - Interior Lowlands West

The interior lowlands, primarily in the Willamette Valley, are below a generalized contour line of 1,000 feet elevation and are bounded to the east by the trough-line of mean annual precipitation through the Willamette Valley. This is a zone of low orography where mean annual precipitation generally decreases from west to east.

Region 31 - Interior Lowlands East

The interior lowlands, primarily in the Willamette Valley, are below a generalized contour line of 1,000 feet elevation and are bounded to the west by the trough-line of mean annual precipitation through the Willamette Valley. This is a zone of low orography where mean annual precipitation generally increases from west to east.

Region 15 - West Slopes of Cascade Mountains

This region is comprised of the windward faces of the Cascade Mountains in southern Washington, Oregon, and northern California, above a generalized contour line of 1,000 feet elevation. This region is bounded to the east by the ridgeline of mean annual precipitation near the Cascade crest that forms the boundary with Region 14.

Region 8 – Rogue Valley

This region is comprised of low elevation areas in southwestern Oregon between Medford and Grants Pass that reside in a rain-shadow created by the Coastal Mountains to the southwest.

Region 143 – Klamath Mountains and West Slope of Cascade Mountains

This region is comprised of the windward faces of the Klamath and Cascade Mountains in southern Oregon and northern California. This region is bounded to the west by the leeward faces of the Coastal Range (Region 142) and to the east by the ridgeline of mean annual precipitation near the Cascade crest.

5.3 CLIMATIC REGIONS FOR EASTERN OREGON STUDY AREA

Transition Zone 154 - Cascade Crest Transition Zone

This is a transition zone used for spatial smoothing of precipitation and is located near the crest of the Cascade Mountains between the west slopes of the Cascade Mountains (Regions 15 and 143) and the east slopes of the Cascade Mountains (Region 14). The transition zone has an average width of about six miles and the width varies with the steepness of the gradient of mean annual precipitation. This zone is wider where mean annual precipitation changes more slowly eastward of the Crest of the Cascade and Klamath Mountains. The transition narrows where there is a rapid drop-off of mean annual precipitation on the steeper leeward slopes of the Mountains.

Region 14 - East Slopes of Cascade and Klamath Mountains

This region is comprised of mountain areas on the east slopes of the Cascade and Klamath Mountains where precipitation annual maxima are produced predominately by winter storm events. This region is bounded to the west by the ridgeline of mean annual precipitation that generally parallels the crest line of the Cascade and Klamath Mountains. Region 14 is bounded to the east by the generalized contour line of 12-inches mean annual precipitation.

Transition Zone 147 - Cascade Foothills Transition Zone

This is a transition zone used for spatial smoothing of L-moment ratio statistics and precipitation in the eastern foothills of the Cascade Mountains. The transition zone is located between the east slopes of the Cascade Mountains (Region 14) and arid and semi-arid areas to the east. It also extends southward into the eastern Klamath Mountains. The transition zone has an average width of about 6 mile. The width varies with the steepness of the gradient of mean annual precipitation. The transition zone is narrower where there is a rapid drop-off of mean annual precipitation in the foothills of the Cascade Mountains.

Region 77 - Central Basin

The Central Basin region is comprised of the Columbia Basin and adjacent low elevation (non-orographic) areas in eastern Washington that extend into northern Oregon. It is bounded to the west by Region 14. The region is bounded to the northeast and southeast by the generalized (smoothed) contour line of 12-inches mean annual precipitation.

Region 7 – Pendleton-Palouse

This region is comprised of a mixture of lowland areas of low to moderate relief and extensive valley areas between mountain barriers. This includes areas near the Palouse, in southern Washington, and Pendleton, in northern Oregon. The region is bounded to the northwest by Region 77, which generally conforms to the contour line of 12-inches mean annual precipitation at the eastern edge of the Central Basin. It is bounded to the southeast by the Blue Mountains at the contour line of 22-inches mean annual precipitation.

Region 13 – Wallowa and Blue Mountains

This region is comprised of mountain areas in the northeastern part of Oregon where there is a significant orographic component to precipitation magnitudes. Mean annual precipitation ranges from a minimum of 22-inches to over 70-inches in the mountain areas. The western boundary of this region generally conforms to the contour line of 22-inches mean annual precipitation.

Region 9 – Snake River Canyon

This region is comprised of areas within and adjacent to the Snake River Canyon along the eastern border of Oregon.

Region 148 – Western Idaho Mountains

This region is comprised of mountain areas in western Idaho including the Selkirk, Clearwater and Salmon Mountains, where there is a significant orographic component to precipitation magnitudes. Mean annual precipitation ranges from a minimum of 22-inches to over 70-inches in these mountain areas. Region 9 forms the western boundary for this region.

Region 144 – Ochoco and Malheur

This region is comprised of mountain areas within the Ochoco and Malheur National Forests in central Oregon.

Region 145 – Fremont and Warner

This region is comprised of leeward slope mountain areas residing to the east of the Cascade Mountains in the Freemont National Forest and Warner Mountains. This region is bounded to the west by the crest line of mean annual precipitation in the Cascade Mountains (Regions 15 and 143) and bounded to the east by Climatic Region 146.

Region 146 –Pueblo and Crooked Creek Mountains

This region is a high desert intermountain area located in southeastern Oregon and northern Nevada. It is bounded to the west by the Fremont and Warner Region (Region 145).

5.4 REGIONAL GROWTH CURVE

Implicit in the definition of a homogeneous region, is the condition that all sites can be described by one probability distribution having common distribution parameters after the site data are rescaled by their at-site mean. Thus, all sites within a homogeneous region have a common regional magnitude-frequency curve (regional growth curve, Figure 5.5) that becomes site-specific after scaling by the at-site mean of the data from the specific site of interest. Thus, the at-site inverse Cumulative Distribution Function (CDF) is calculated as follows:

$$Q_i(F) = \hat{\mu}_i \; q(F) \qquad \textbf{(5-1)}$$

In this equation; $Q_i(F)$ is the at-site inverse Cumulative Distribution Function (CDF), $\hat{\mu}_i$ is the estimate of the population at-site mean, and $q(F)$ is the regional growth curve, regional inverse CDF. This is often called an index-flood approach to regional frequency analyses and was first proposed by Dalrymple (*1960*) and expanded by Wallis (*1980 and 1982*).

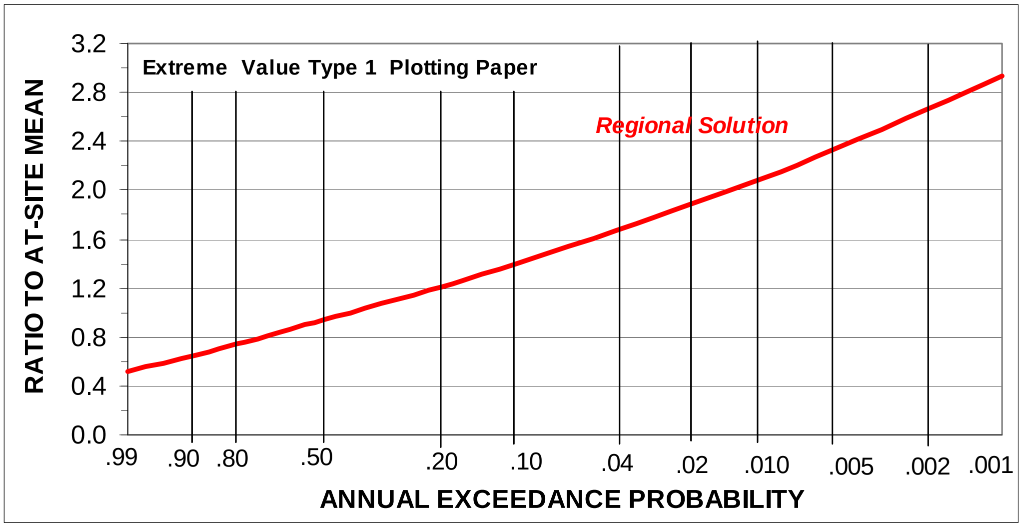


Figure 5.5: Example of Regional Growth Curve.

Exhibit D-4

6.0 FORMING HOMOGENEOUS SUB-REGIONS

Identification and formation of homogeneous regions is an iterative process. It was anticipated that the climatic regions defined here would require further subdivision to meet homogeneity criteria. The methodology used herein for forming and testing proposed homogeneous sub-regions follows the procedures recommended by Hosking and Wallis (*1993, 1997*).

The basic approach was to propose homogeneous sub-regions (grouping of sites/gages) based on the similarity of the physical/meteorological characteristics of the sites. L-moment statistics were then used to estimate the variability and skewness of the pooled regional data and to test for heterogeneity as a basis for accepting or rejecting the proposed sub-region formulation (Appendix C) (*Hosking and Wallis 1993, 1997*).

In general, proposed homogeneous sub-regions can be formed by utilizing some measure(s) of physical and/or climatological characteristics for assigning sites/gages to sub-regions. Candidates for physical features included such measures as: site elevation; elevation averaged over some grid size; localized topographic slope; macro topographic slope averaged over some grid size; distance from the coast or source of moisture; distance to sheltering mountains or ridgelines; and latitude or longitude (*Miller et al. 1973; NWS 1966, 1994*). Candidate climatological characteristics included such measures as: mean annual precipitation; precipitation during a given season; seasonality of extreme storms; and seasonal temperature/dewpoint indices.

A review of the topographic and climatological characteristics in the Oregon study area showed that the 17 climatic regions already had similarities regarding several of the physical and climatological measures listed above. As such, only two measures, mean annual precipitation (MAP) and latitude were needed for grouping of sites/gages into homogeneous sub-regions within a given climatic region. Homogeneous sub-regions were therefore formed with gages/sites within small ranges of MAP and latitude.

6.1 HETEROGENEITY MEASURES OF PROPOSED HOMOGENEOUS SUB-REGIONS

Heterogeneity measures were developed by Hosking and Wallis as indicators of the amount of heterogeneity in the L-moment ratios for a collection of sites/gages (*1993, 1997*). The statistics H1 and H2 measure the relative variability of observed L-Cv and L-Skewness sample statistics, respectively, for gages/sites in a sub-region. Specifically, these measures compared the observed variability to that expected from a large sample drawn from a homogeneous region of the Kappa distribution having weighted average L-moment ratios that were observed in the sub-region (*Hosking and Wallis 1997; Hosking 1988*). Initial recommendations from Hosking and Wallis were that: regions with H1 and H2 values less than 1.00 were acceptably homogeneous; values between 1.00 and 2.00 were possibly heterogeneous; and values greater than 2.00 indicated definite heterogeneity. When H1 and H2 values exceeded 2.00, Hosking and Wallis recommended that redefinition of the region and/or reassignment of sites/gages should be considered (*1993, 1997*)

These heterogeneity criteria measure statistical heterogeneity from known distributions and do not account for variability that arises from other sources. Most cooperative precipitation measurement networks include gages operated by various organizations and individuals that provide a varied level of quality control. Therefore, precipitation measurements often contain additional variability due to: gages being moved during the many years of operation; frequent change of operators and level of diligence in timely measurement; missing data arising from inconsistent reporting; lack of attention to measurement precision; and localized site and wind condition changes over time due to the construction of building or the growth of trees in the vicinity of the gage. Recognizing this additional variability, Wallis suggested that for precipitation annual maxima, H1 values less than 2.00 may be considered acceptably homogeneous and H1 values greater than 3.00 would be indicative of heterogeneity (*1997*). Both the H1 and H2 measures will be used later to assess the relative heterogeneity in proposed sub-regions.

6.2 ACCEPTANCE OF PROPOSED HOMOGENEOUS SUB-REGIONS

When a proposed sub-region is found to satisfy homogeneity criteria, the regional L-moment ratios are then used to conduct goodness-of-fit tests to assist in selecting a suitable probability distribution, and to estimate the parameters of the regional distribution (*Hosking and Wallis 1993, 1997*). Examples of this type of approach are described for Washington State (*Schaefer 1990; Schaefer et al. 2002, 2006*), southern British Columbia (*Schaefer 1997*), and the Sierra Mountains in California (*Schaefer and Barker* 2000). The basic approach adapted to this study is summarized in adopted methodology below.

Adopted Methodology

1. Form proposed homogeneous sub-regions by assigning gages within a climatic region to groups within a small range of mean annual precipitation and a small range of latitude.
2. Compute L-moment sample statistics for gages within the proposed homogeneous sub-regions.
3. Use L-moment heterogeneity criteria to test proposed homogeneous sub-regions.
4. Develop a mathematical predictor for describing the behavior of regional L-Cv and L-Skewness values with mean annual precipitation and latitude across the climatic region.
5. Conduct goodness-of-fit tests to identify a suitable probability distribution for regional growth curve.
6. Solve for the distribution parameters of the selected probability distribution for each sub-region using the regional values of L-Cv and L-Skewness (from Step 4).

6.3 SYSTEMATIC VARIATION OF L-CV AND L-SKEWNESS WITH MEAN ANNUAL PRECIPITATION AND LATITUDE

As described previously, climatic regions were comprised of numerous homogeneous sub-regions. A mathematical relationship was therefore needed to link the sub-regions and provide an estimate of L-moment ratios, L-Cv and L-Skewness across climatic regions, and for the full study area. The predictor relationships were formulated to provide continuity with adjacent climatic regions. This approach had the benefit of eliminating or minimizing discontinuities at the boundaries between the climatic regions. Recognizing that the sub-regions were formed as groupings of gages within a small range of mean annual precipitation (MAP) and latitude, it was found that MAP and latitude were suitable explanatory variables. Predictor equations for L-Cv and L-Skewness were obtained through regression analyses and took a variety of forms that included various combinations of 2nd order polynomials; linear and exponential formulations. Details about the predictor equations will be discussed in the sections that follow.

Exhibit D-4

Exhibit D-4

7.0 ANALYSES OF 24-HOUR PRECIPITATION ANNUAL MAXIMA

As described previously, homogeneous sub-regions were formed as collections of gages within small ranges of mean annual precipitation (MAP) and latitude within each of the climatic regions. The ranges of MAP and latitude were chosen so that about 7 to 15 gages, 350 to 750 station-years of record, were included in each sub-region. A minimum record length of 15-years was required to be included in the analysis. Record lengths at precipitation measurement stations varied from a minimum of 15-years to near 120-years; with nearly 50 percent of the stations having record lengths in excess of 50-years. Figure 3.2 depicts the number of stations within various ranges of record length.

As the analysis progressed, it was found that gages in adjoining climatic regions could often be grouped together with gages from the climatic region being analyzed. It was also found that resampling of gages in a region, or grouping of regions, was often required to separately evaluate the variation of L-Cv and L-Skewness with MAP and latitude. This approach resulted in the grouping of climatic regions as shown in Table 7.1 with a total of 68 sub-regions for the 24-hour duration.

Table 7.1: Number of Sub-Regions, Gages and Station-Years of Record for 24-Hour Duration Annual Maxima.

Study Area	**Climatic Regions**	**Number Of Sub-Regions**	**Number Of Gages**	**Station-Years Of Record**
Western Oregon	5, 151	7	60	3,227
	142, 32, 31, 15 (North of 43°N)	19	143	6,692
	142, 8, 143 (South of 43°N)	10	88	4,061
Eastern Oregon	154, 14, 147	11	102	4,632
	77, 7, 13, 144, 9, 148, 145, 146	21	327	16,427

7.1 REGIONAL SOLUTIONS FOR L-MOMENT RATIOS, L-CV AND L-SKEWNESS

Regional predictor equations for L-moment ratios were developed for groupings of climatic sub-regions using regression methods for various mathematical formulations with MAP and latitude as explanatory variables. Care was taken to select mathematical formulations that had the capability of minimizing discontinuities with adjoining climatic regions.

7.1.1 Spatial Variability of L-Cv

In western Oregon, latitude was found to explain the greatest proportion of variability in L-Cv, with MAP being of secondary importance. In examining the spatial variation of L-Cv over large areas of the west coast of North America, MAP was found to be an excellent explanatory variable for southern British Columbia and Washington State (*Schaefer 1997; Schaefer et al. 2002, 2006*). At the latitude of about 45°N, a combination of latitude and MAP provided the best predictors of L-Cv. Further south, on the west face of the Sierras, latitude was found to be the best predictor of L-Cv (*Schaefer and Barker 2000*). The change in correlation characteristics with MAP and latitude appeared to be associated with the frequency of storm tracks originating over the Pacific Ocean that affected different areas along the west coast. Areas in southern British Columbia and Washington were more centrally located relative to average storm tracks. Areas in southern Oregon and California were on the southerly end of the storm track, where there was greater variability in the number of large storms in any given year. The following relationships (Equations 7-1, 7-2, 7-3) provided the best predictors of spatial variation in L-Cv in the western portions of the Oregon study area. Figures 7.1 and 7.2 depict examples of the level-of-success of the predictor equations and a typical relationship of L-Cv with latitude (degrees Lat).

Regions 5, 151

$$L\text{-}C_v = 2.5883 -0.1010*Lat +0.001039*Lat*Lat +0.08*EXP(-0.060*MAP) \quad \textbf{(7-1)}$$

Regions 142, 32, 31, 15; North of 43°N

$$L\text{-}C_v = 9.2169 -0.3948*Lat +0.004297*Lat*Lat +0.08*EXP(-0.060*MAP) \quad \textbf{(7-2)}$$

Regions 142, 8, 143; South of 43°N

$$L\text{-}C_v = 0.08*EXP(-0.040*MAP) +0.172 \quad \textbf{(7-3)}$$

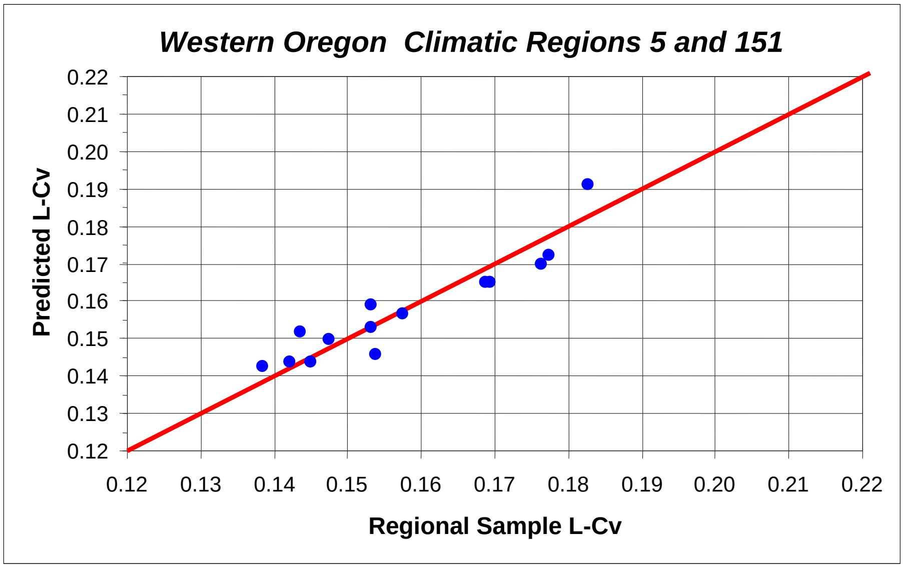


Figure 7.1: Comparison of Observed Regional Sample Values of L-Cv and Predicted L-Cv (Equation 7-1) for Climatic Regions 5 and 151.

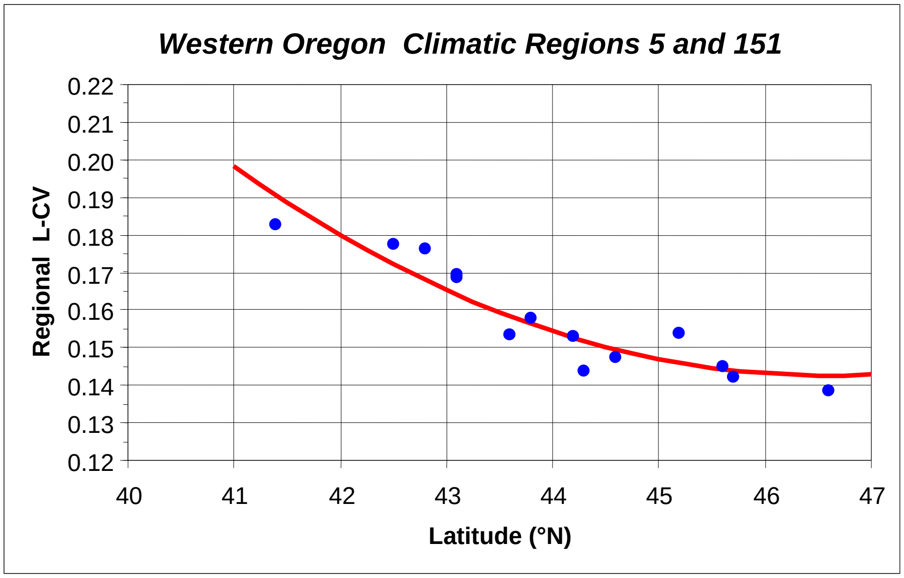


Figure 7.2: Relationship of Regional L-Cv with Latitude for Climatic Regions 5 and 151.

In eastern Oregon, MAP was found to be the primary factor in explaining spatial variation of L-Cv (Equations 7-4, 7-5). There was limited influence of latitude in the predictor equations for eastern Oregon. As indicated previously, the stronger correlation of latitude with L-Cv, in the western portion of the study area, appeared to be associated with the winter storm season that is dominant in that area. Conversely, precipitation annual maxima in eastern Oregon occurred across a wide range of seasons and the winter storm season is only a partial contributor. Figures 7.3 and 7.4 depict examples of the level-of-success of the predictor equations and a typical relationship of L-Cv with mean annual precipitation.

Regions 154, 14, 147

$L\text{-}C_v = 0.2195 - 0.00103*MAP + 0.00000036*MAP*MAP$; MAP < 92-inch **(7-4)**

$L\text{-}C_v = 0.155$; MAP $\geq$ 92-inch

Regions 77, 7, 13, 144, 9, 148, 145, 146

(7-5)

$L\text{-}C_v = 0.4071 - 0.0029*MAP + 0.0000268*MAP*MAP – 0.0041*Lat$; MAP < 55-inch

$L\text{-}C_v = 0.3288 – 0.0041*Lat$ MAP $\geq$ 55-inch

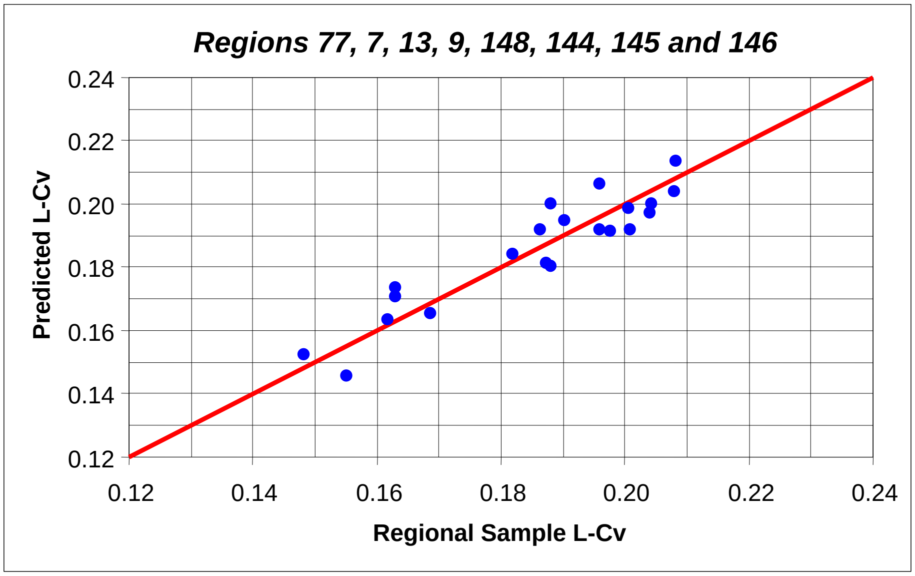


Figure 7.3: Comparison of Observed Regional Sample Values of L-Cv and Predicted L-Cv (Equation 7-1) for Climatic Regions 77, 7, 13, 9, 148, 144, 145, and 146.

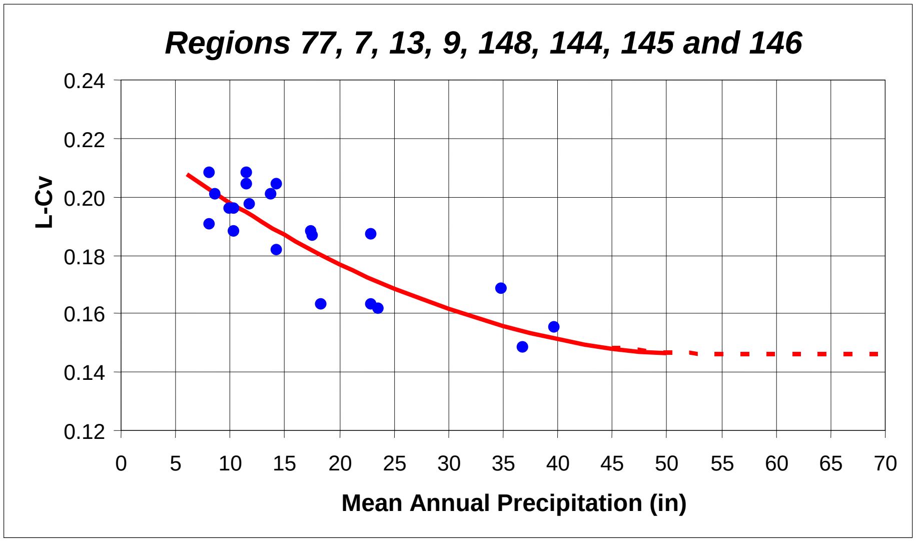


Figure 7.4: Relationship of Regional L-Cv with Mean Annual Precipitation for Climatic Regions 77, 7, 13, 9, 148, 144, 145, and 146.

Transition Zones

Transition zones were needed for mapping of L-Cv in several localized geographic areas. This was due to relatively steep gradients for L-Cv and/or moderate discontinuities in the predicted values of L-Cv at boundaries of adjacent climatic regions. Specifically, transition zones were used in the crest of the Cascade and Klamath Mountains (Transition Zone 154), and at the Foothills of the Cascade Mountains and eastern Klamath Mountains (Transition Zone 147). Transition Zone 147 delineated the break in the magnitudes of the variability measure L-Cv for the East Slopes of the Cascade Mountains relative to that in the arid and semi-arid regions further east (Figure 7.5). Review of Figures 5.1-5.3 also showed that a sharp change in storm seasonality accompanies this distinctive change in the magnitude of L-Cv at the Cascade foothills. Specifically, 24-hour precipitation annual maxima was predominately produced by winter storms on the east slopes of the Cascade Mountains. In areas further east, the 24-hour annual maxima were produced by a mixture of winter, spring and summer storms (Figures 5.1-5.3).

Figure 7.5 depicts the behavior of L-Cv across the eastern portion of the study area. This behavior of L-Cv, where there is an abrupt change at the foothills of the Cascade Mountains (Transition Zone 147), matched that observed in a prior study for eastern Washington (*Schaefer et al. 2006*). The figure depicts the relationship at latitude 44°N. There were very minor changes in L-Cv values to the north (smaller L-Cv) and to the south (larger L-Cv).

Exhibit D-4

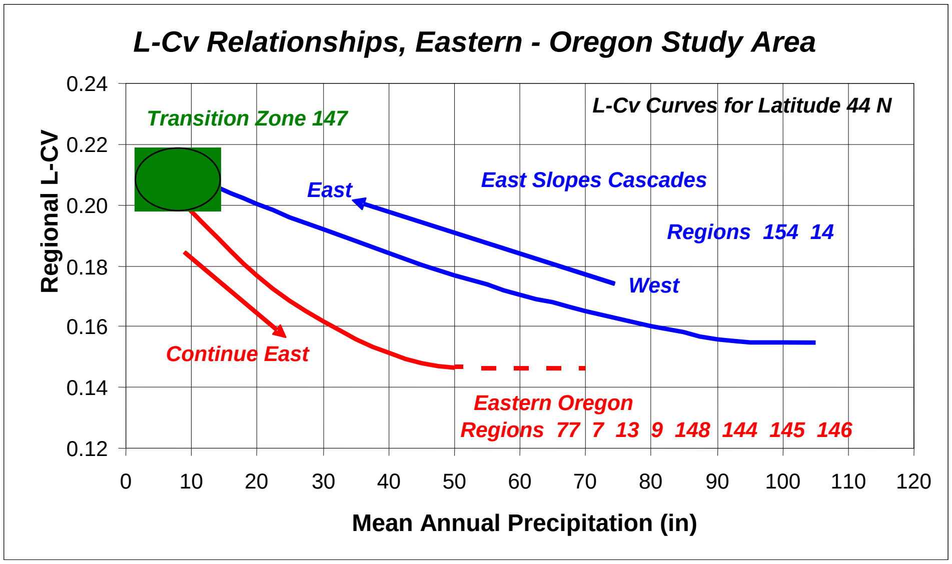


Figure 7.5: Behavior of L-Cv progressing eastward from the Crest of the Cascade Mountains, through the Eastern Foothills, and Across Eastern Oregon at Latitude 44°N.

7.1.2 Spatial Variability of L-Skewness

Skewness measures are highly variable for the record lengths commonly available for precipitation-frequency analysis. This greater sampling variability is exhibited in larger Root Mean Square Error (RMSE) values of the predictor equations for L-Skewness (Equations 7-6 and 7-7) (Table 7.2). Regional predictor equations for L-Skewness were developed in the same manner as that described above for L-Cv. Two predictor equations for L-Skewness were developed, one each, for the western and eastern portions of the study area. Homogeneous sub-regions, representing broad areas, were grouped for analysis to help reduce the effects of sampling variability and allow for a determination of the underlying behavior of L-Skewness. Figures 7.6 and 7.7 depict the predictor equations for L-Skewness for the western and eastern portions of the study area, respectively.

Regions 5, 151, 142, 3, 31, 15, 8 and 143

$$\text{L-Skewness} = 0.10*\text{EXP}(-0.024*\text{MAP}) + 0.3810 \ -0\ .0050*\text{Lat} \qquad \textbf{(7-6)}$$

Regions 154, 14, 147, 77, 7, 13, 144, 9, 148, 145 and 1467

$$\text{L-Skewness} = 0.08*\text{EXP}(-0.018*\text{MAP}) + 0.2680 \ -0\ .0025*\text{Lat} \qquad \textbf{(7-7)}$$

Exhibit D-4

Table 7.2: Root Mean Square Error (RMSE) of Predictor Equations for L-Cv and L-Skewness for Oregon Study Area.

Study Area	Climatic Regions	Standardized RMSE Of L-Cv Predictor Equation (Percent)	Standardized Rmse Of L-Skewness Predictor Equation (Percent)
Western Oregon	5, 151	3.2	15
	142, 32, 31, 15 (North of 43°N)	5.9	
	142, 8, 143 (South of 43°N)	4.1	
Eastern Oregon	154, 14, 147	3.3	8.5
	77, 7, 13, 144, 9, 148, 145, 146	3.8	

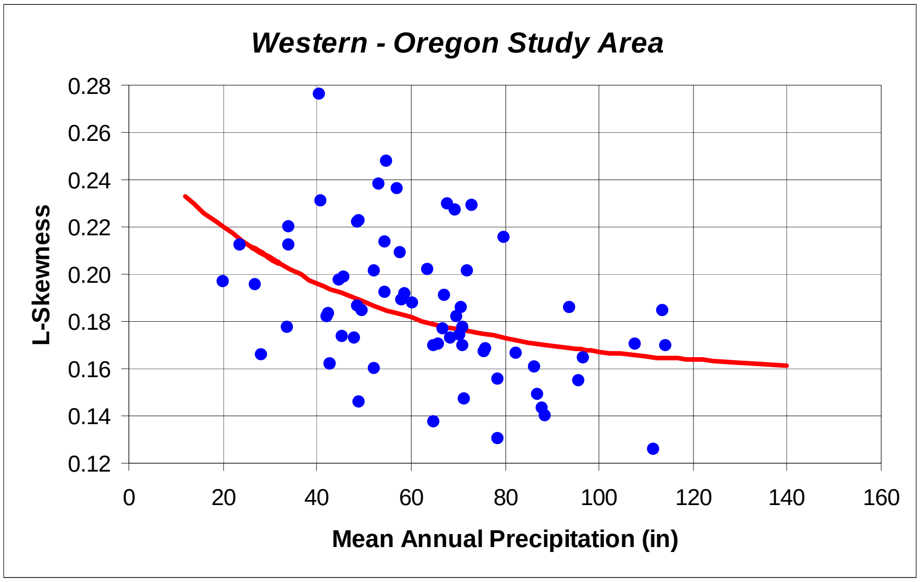


Figure 7.6: Relationship of Regional L-Skewness with Mean Annual Precipitation for Climatic Regions 5, 151, 142, 32, 31, 15, 8, and 143 in the Western Portion of Oregon Study Area.

Exhibit D-4

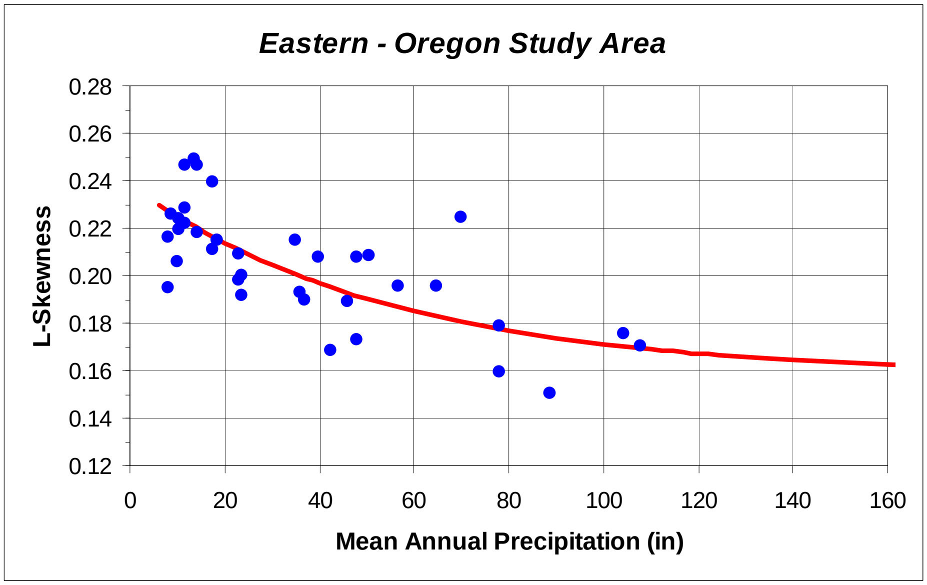


Figure 7.7: Relationship of Regional L-Skewness with Mean Annual Precipitation for Climatic Regions 154, 14, 77, 7, 13, 9, 148, 144, 145 and 146, in the Eastern Portion of Oregon Study Area.

7.2 HETEROGENEITY MEASURES, 24-HOUR DURATION

Heterogeneity measures H1 and H2 were used to judge the relative heterogeneity in the proposed sub-regions for L-Cv and L-Skewness, respectively (*Hosking and Wallis 1993, 1997*). Computation of H1 and H2 values for the various sub-regions indicated that nearly all sub-regions were acceptably homogeneous (Table 7.3). In those cases where computed heterogeneity measures exceeded acceptance criteria, the excursions were generally of a minor amount. In summary, small ranges of mean annual precipitation and latitude were excellent explanatory variables for grouping of stations/sites within climatic regions.

Exhibit D-4

Table 7.3: Results of Heterogeneity and Goodness-of-Fit Tests for 24-Hour Duration.

Study Area	Climatic Regions	Number Of Sub-Regions	Homogeneous Sub-Regions H1 ≤ 2.00	Homogeneous Sub-Regions H2 ≤ 1.00	Sub-Regions Accepting GEV Distribution
Western Oregon	5, 151	7	6	7	5
	142, 32, 31, 15 (North of 43°N)	19	16	15	15
	142, 8, 143 (South of 43°N)	10	10	7	8
Eastern Oregon	154, 14, 147	11	10	7	6
	77, 7, 13, 144, 9, 148, 145, 146	21	18	17	18
Total		**68**	**60**	**53**	**52**

7.3 IDENTIFICATION OF REGIONAL PROBABILITY DISTRIBUTION, 24-HOUR DURATION

One of the primary tasks in the regional analyses was to identify the best probability distribution for describing the behavior of the annual maxima data. Accordingly, a goodness-of-fit test statistic was computed for each sub-region for use in identifying the best three-parameter distribution (*Hosking and Wallis 1993, 1997*). Using the L-moment based test statistic, the Generalized Extreme Value (GEV) distribution was identified most frequently as the best three-parameter probability model (Table 7.3) (*Hosking and Wallis 1997; Schaefer et al. 2002, 2006*).

Plots of regional L-Skewness and L-Kurtosis values for 68 sub-regions in the western and eastern portions of the study area are shown in Figures 7.8 and 7.9. Nearness to the GEV distribution was clearly evident and consistent with the goodness-of-fit test results listed in Table 7.3.

The GEV was a suitable distribution for estimating precipitation quantiles out to the 500-year recurrence interval. If quantile estimates are desired for events more extreme than the 500-year recurrence interval, it would be worthwhile to refine the selection of the regional probability distribution. Given this consideration, it was decided to utilize the four-parameter Kappa distribution, which can mimic the GEV and produce a variety of regional growth curves immediately around the GEV (*Hosking 1988; Hosking and Wallis 1997*). The inverse form of the Kappa distribution is shown in the following equation (7-8):

$$q(F) = \xi + \frac{\alpha}{\kappa}\left\{1-\left(\frac{1-F^h}{h}\right)^{\kappa}\right\} \qquad \textbf{(7-8)}$$

In this equation: ξ, α, κ, and h are location, scale, and shape parameters, respectively.

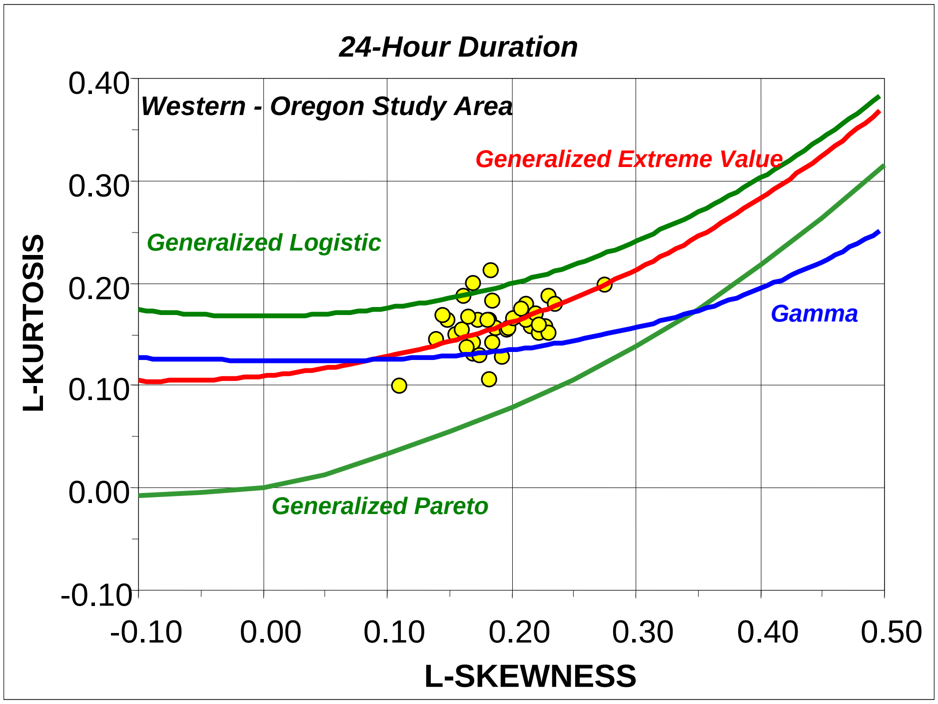


Figure 7.8: L-Moment Ratio Plot, for 24-Hour Duration, for Sub-Regions in Climatic Regions 5, 151, 142, 32, 31, 15, 8, and 143, in the Western Oregon Study Area.

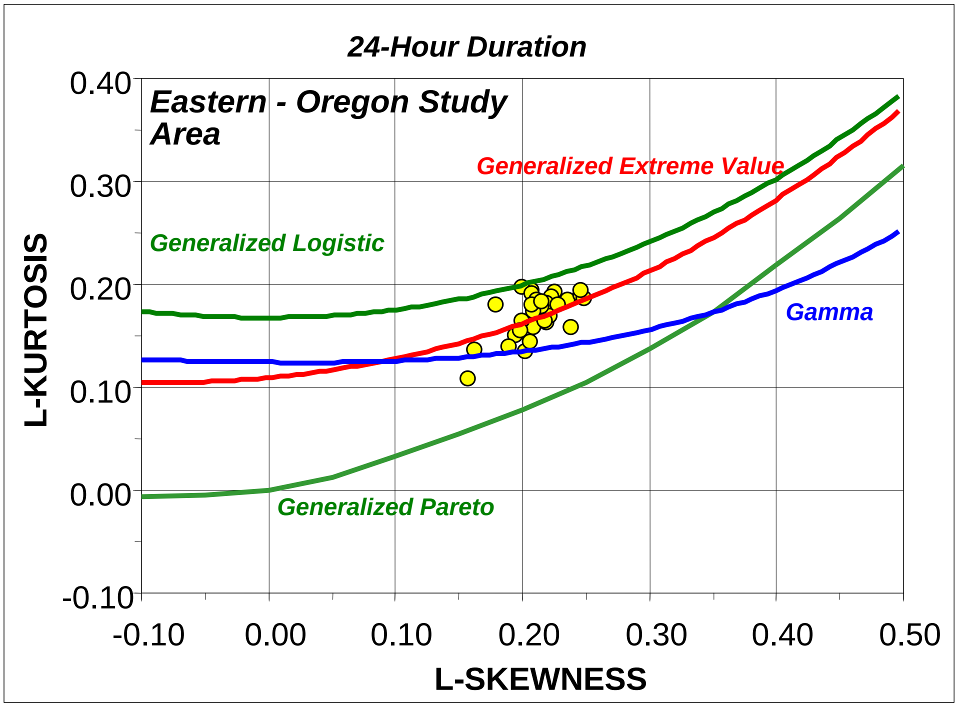


Figure 7.9: L-Moment Ratio Plot, for 24-Hour Duration, for Sub-Regions in Climatic Regions 154,14,147,77,7,13,9,148,144,145, and 146, in the Eastern Oregon Study Area.

Different distributions were produced with unique *h* values. The distributions were as follows: an *h* value of zero, led to the GEV distribution; an *h* value of one, produced the Generalized Pareto (GP) distribution; and an *h* value of -1, produced the Generalized Logistic (GL) distribution. Thus, positive values of *h* produced regional growth curves that were flatter than the GEV, and negative values of *h* produced steeper regional growth curves. Minor adjustments of *h*, near a zero value (GEV), allow fine-tuning of the regional growth curves. This minor adjustment of the *h* value only becomes important for the estimation of very rare quantiles.

To solve for an appropriate *h* value, a hierarchical approach was taken wherein the shape parameter *h* was computed as the average value from the group of sub-region solutions (*Fiorentino et al. 1979*). An average *h* value of -0.038 was computed with a standard error of estimation of approximately ± 0.058 for the western portion of the study area. For the eastern portion of the study area, an average *h* value of -0.060 was computed with a standard error of estimation of approximately ± 0.042. These values compared with an *h* value of -0.05 that was found in the prior studies in Washington (*Schaefer et al. 2002, 2006*) and eastern British Columbia (*Schaefer 1997*). A nominal *h* value of -0.05 was adopted for the Oregon study area, which was consistent with the findings of prior studies and was well within one standard deviation of the sample average. Thus a regional growth curve was produced that was slightly steeper than the GEV, for very rare events, and essentially matched the GEV out through approximately the 500-year recurrence interval.

Exhibit D-4

8.0 PRECIPITATION MAGNITUDE-FREQUENCY ESTIMATES FOR GAGED SITES

The first step in developing a site-specific precipitation magnitude-frequency curve is to compute the regional growth curve. The findings described in the previous sections provided the information necessary to develop the regional growth curve. Specifically, the first three parameters of the Kappa distribution (ξ, α, and κ) (*Hosking and Wallis 1997; Hosking 1988*) were solved using a mean of unity and the applicable regional values of L-Cv and L-Skewness, as indicated in Equations 7-1 through 7-7. The fourth parameter (*h*) of the Kappa distribution was set to the regional average value of -0.050, as discussed in the prior section. Equation 7-8 was then used to describe the regional growth curve. The site-specific precipitation-frequency curve was obtained by scaling the regional growth curve by the at-site mean.

$$\hat{\mu} = C_{nop}\,(\bar{x}) \qquad \textbf{(8-1)}$$

For gaged sites, the at-site mean ($\hat{\mu}$) could be computed from the gage mean ($\bar{x}$) using a correction factor. The correction factor accounted for the difference in sample statistics for precipitation measurement and reporting on a fixed time interval rather than on the desired 24-hour continuous basis. The correction factor (C_{nop}) varied with the length of the observational period (24-hours for daily gage). A correction factor of 1.13 was estimated from theoretical considerations of Weiss (*1964*) and has also been found in numerous studies (*Miller et al. 1973*). The value of 1.13 is commonly taken as a standard in humid environments subjected to numerous yearly storms and the typical duration of those storms approaches or exceeds the observational period.

In arid and semi-arid areas, there may be few noteworthy storms each year. The duration of these storms is also somewhat less than the length of the daily observational period. In these cases, it is possible that the correction factor for converting from maximum daily statistics, to maximum 24-hour precipitation statistics, is a value less than the conventional 1.13. Studies were previously conducted in Washington State to examine the magnitude of the correction factors (*Schaefer et al. 2006*). That study included precipitation stations sites in Oregon. The results of those analyses have been applied to the Oregon study area, and are listed in Table 8.1.

Table 8.1: Correction Factors (C_{nop}) Used to Adjust Gage Sample Statistics.

Climatic Regions	**Gage Type**	**Correction Factors 24-Hour Duration**
Western Oregon Study Area 5, 151, 32, 31, 15, 8, 143, 154	Daily and SNOTEL	1.13
East Slopes Cascade and Klamath Mountains 14, 147	Daily and SNOTEL	1.11
Eastern Oregon Study Area 77, 7, 13, 9, 148, 144, 145, 146	Daily and SNOTEL	1.08
All Regions	Automated/ Hourly Reporting	1.00
All Regions	Automated/ 15-Minute Reporting	1.00

8.1 EXAMPLES OF PRECIPITATION-FREQUENCY RELATIONSHIPS

The procedures for developing site-specific precipitation-frequency curves can be explained by using examples from existing gaged sites. The examples include a daily gauge from McMinnville, Oregon and an hourly gauge at the airport in Pendleton, Oregon.

8.1.1 24-hour Precipitation-Frequency Relationship: McMinnville, Oregon

The city of McMinnville, Oregon is located in Climatic Region 32 and has a daily gage. The mean annual precipitation for the site is 42.8-inches. The site is located at a latitude of 45.22° North. For the 24-hour duration, the regional value of L-Cv was 0.157, which was obtained from Equation 7-2. The regional value of L-Skewness was 0.191, which was obtained from Equation 7-6. The regional value of the h parameter was -0.05. Using a mean value of unity, the solution for the four distribution parameters of the Kappa distribution (*Hosking and Wallis 1997; Hosking 1988*), yields:

ξ= 0.8723, α= 0.2132, κ= -0.0450, and h= -0.05.

Application of Equation 7-8 yielded the regional growth curve depicted in Figure 8.1. McMinnville has a daily gage with a gage mean of 2.15-inches for 104-years of record. The precipitation-frequency curve for the daily gage was obtained by scaling (multiplying) the regional growth curve with the gage mean (Figure 8.2). The observed daily annual maxima for the McMinnville site, from 1894-2006, are also depicted in Figure 8.2 for a comparison with the regional solution. There is agreement between the historical data and that predicted by the regional solution.

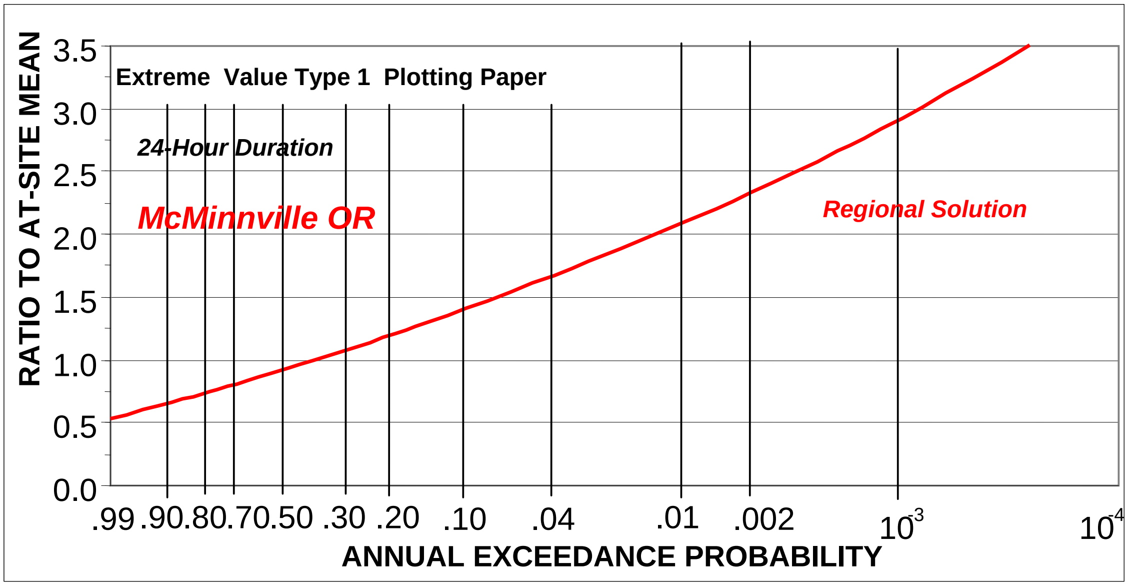


Figure 8.1: Regional Growth Curve for McMinnville, Oregon for 24-Hour Duration.

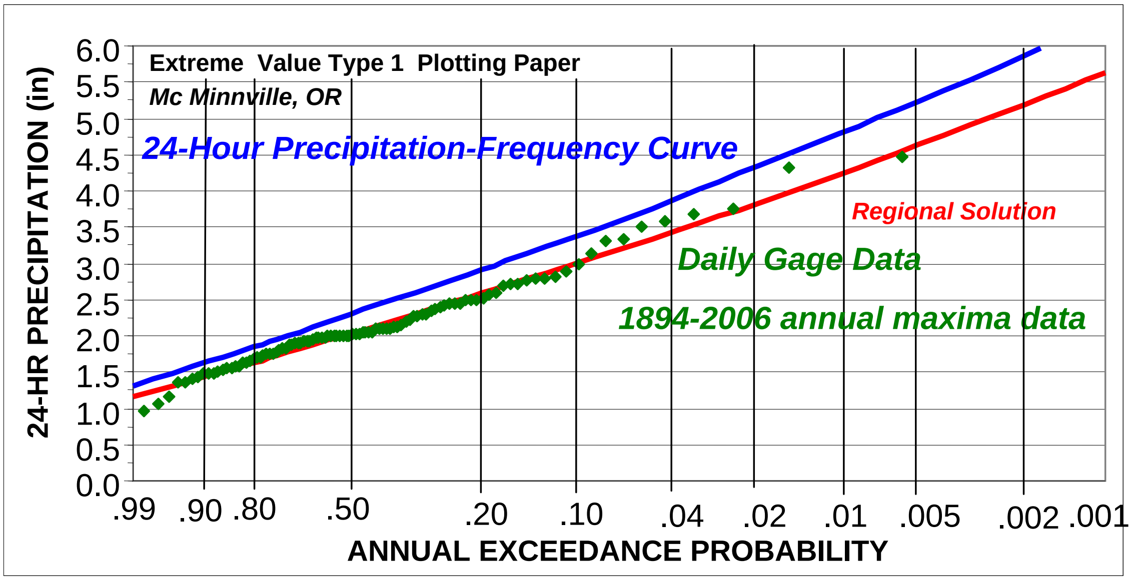


Figure 8.2: Precipitation Magnitude-Frequency Curve for McMinnville, Oregon for 24-Hour Duration.

Computation of the at-site precipitation-frequency curve (Figure 8.2) for the 24-hour duration required use of the correction factors listed in Table 8.1. Numerically, this is accomplished by multiplication of the distribution parameters for location (ξ) and scale (α) by the correction factor of 1.13 and reapplying Equation 7-8. The at-site precipitation-frequency curve for the 24-hour duration at McMinnville is shown as the blue curve in Figure 8.2. These types of computations for daily and SNOTEL gages (adjusting from a fixed daily observational period to a continuous 24-hour time-interval) are incorporated in the precipitation spatial mapping products that are described in later sections.

8.1.2 24-hour Precipitation-Frequency Relationship: Pendleton, Oregon

Another example of a 24-hour precipitation-frequency relationship is shown for the hourly gage at the Pendleton Airport in Oregon. The Pendleton Airport is located in eastern Oregon, in Climatic Region 7, at latitude 45.68°N. The mean annual precipitation is 13.0-inches. For the 24-hour duration, the station gage mean is 0.93-inches. The regional value of L-Cv was 0.187, which was obtained from Equation 7-5. The regional value of L-Skewness was 0.217, which was obtained from Equation 7-7. The regional value of the *h* parameter was -0.05. Using a mean value of unity, the solution for the four distribution parameters of the Kappa distribution (*Hosking and Wallis 1997; Hosking 1988*), yields:

$\xi = 0.8433$, $\alpha = 0.2437$, $\kappa = -0.0839$, and $h = -0.05$.

No corrections were required for hourly gages, and the at-site mean equaled the gage mean of 0.93-inches. Application of Equation 7-8, with the distribution parameters listed above, yielded the precipitation-frequency curve shown in Figure 8.3. The 24-hour annual maxima data for 1941-2006 have been plotted for comparison. There is good agreement between the regional solution for the precipitation-frequency relationship and the historical data.

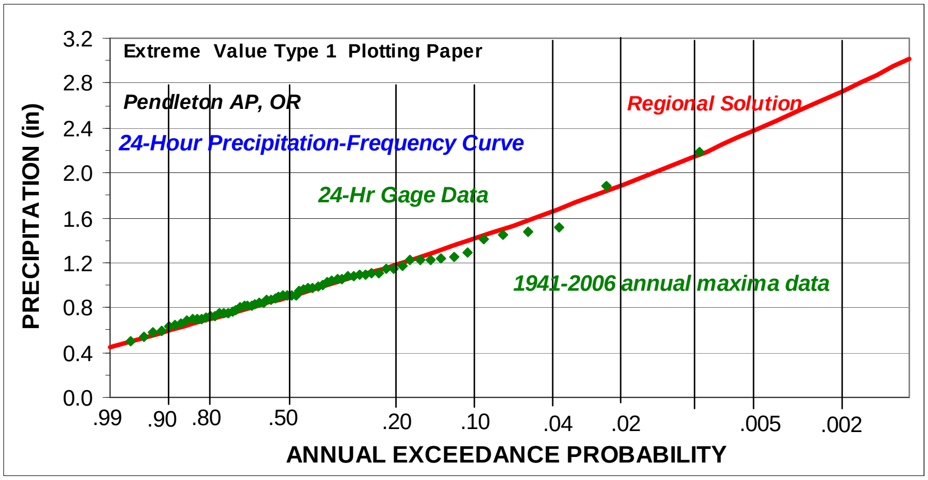


Figure 8.3: Precipitation Magnitude-Frequency Curve for 24-Hour Duration, for the Pendleton Airport in Oregon.

9.0 SPATIAL MAPPING OF PRECIPITATION-FREQUENCY INFORMATION

Products from the PRISM model (*Daly 1994*), operated by Oregon Climate Service, were used in conducting spatial mapping of precipitation for selected recurrence intervals. Gridded datasets and isopluvial maps were prepared for the 6-month, 2-year, 10-year, 25-year, 50-year, 100-year, 500-year and 1000-year recurrence intervals for the 24-hour duration. Precipitation estimates for the 6-month and 2-year recurrence intervals were converted from annual maxima to partial duration series equivalents (*Stedinger et al. 1992*) using the conversion developed by Langbein (*1949*). This was done to improve the frequency estimates for common events and to be consistent with past mapping products produced by the National Weather Service (*Miller et al. 1973*).

The spatial mapping of precipitation for selected recurrence intervals is dependent upon the production of two key components. The first component required is the spatial mapping of at-site means (station mean values, also called mean annual maxima). Grid-cell values of at-site means are used to scale dimensionless magnitude-frequency relationships to obtain precipitation estimates for the recurrence interval of interest. The second component required is the spatial mapping of regional statistical parameters. This provides L-moment ratio statistics L-Cv and L-Skewness applicable to each grid-cell in the study area domain, which are used to determine the probability distribution parameters for describing the magnitude-frequency relationship applicable to each grid-cell. Thus, the spatial mapping of at-site means and the spatial mapping of regional statistical parameters are the primary work products needed for isopluvial mapping.

9.1 MEAN ANNUAL PRECIPITATION

The gridded dataset of mean annual precipitation provided a basis for spatial mapping of both at-site means and L-moment statistics, and, is therefore, an important element of this project. An analysis of mean annual precipitation for the period from 1971 to 2000 has been completed for the study area by Oregon Climate Service using the PRISM model. The resultant map has been utilized in this study and has provided digital values of mean annual precipitation on a gridded latitude-longitude system with a nominal resolution of 0.50 minutes per grid-cell for the study area (about 0.23 mi^2). This resolution yields a study area domain that is a matrix of 840 rows by 1080 columns (907,200 grid-cells).

Exhibit D-4

10.0 SPATIAL MAPPING OF AT-SITE MEANS

Spatial mapping of at-site means encompasses a number of separate tasks that address spatial behavior and seeks to minimize differences between mapped values and sample values computed at precipitation measurement stations. The first task involved developing relationships between at-site means, computed at precipitation measurement stations, and climatic/physiographic factors. An example of this type of relationship is depicted in Figure 10.1, where mean annual precipitation and latitude were used as explanatory variables. These relationships were then used to populate the grid-cells in the study area domain with the values predicted from the applicable regression equation based on the climatic and physiographic factors representative of each grid-cell. At-site mean values for grid-cells within transition zones 154 and 147 were computed as a weighted average of the at-site mean values in adjacent climatic regions in the same manner had the grid-cell been located in the adjoining regions. This provided continuity with at-site mean values at region boundaries and provided a smooth transition between adjoining regions. It should be noted that discontinuities in the transition zones prior to smoothing were relatively minor, typically less than 5 percent of the mapped value.

Residuals were then computed for each of the station at-site means that quantified the magnitude of difference between mapped values and station values. This allowed analyses to be conducted of the residuals to identify if there was a coherent spatial pattern to the magnitude and sign of the residuals. When coherent residual patterns were encountered, they were used to adjust the original estimates. Lastly, standard bias and root mean square error measures were computed to quantify the overall goodness-of-fit of the mapped values, relative to the observations at the gages. The map of the at-site means for the 24-hour duration is shown in Figure 10.2.

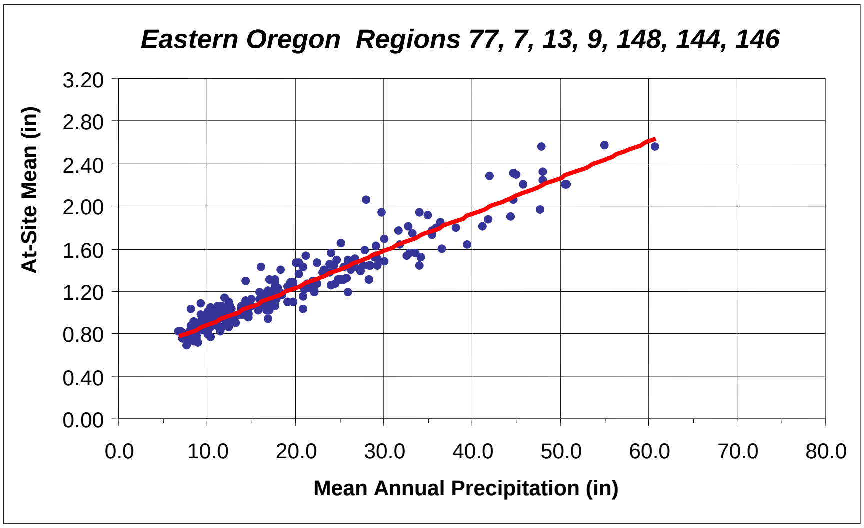


Figure 10.1: Example Relationship of Observed 24-Hour At-Site Mean with Mean Annual Precipitation for Eastern Oregon Study Area (Regions 77, 7, 13, 9, 148, 144, and 146).

Exhibit D-4

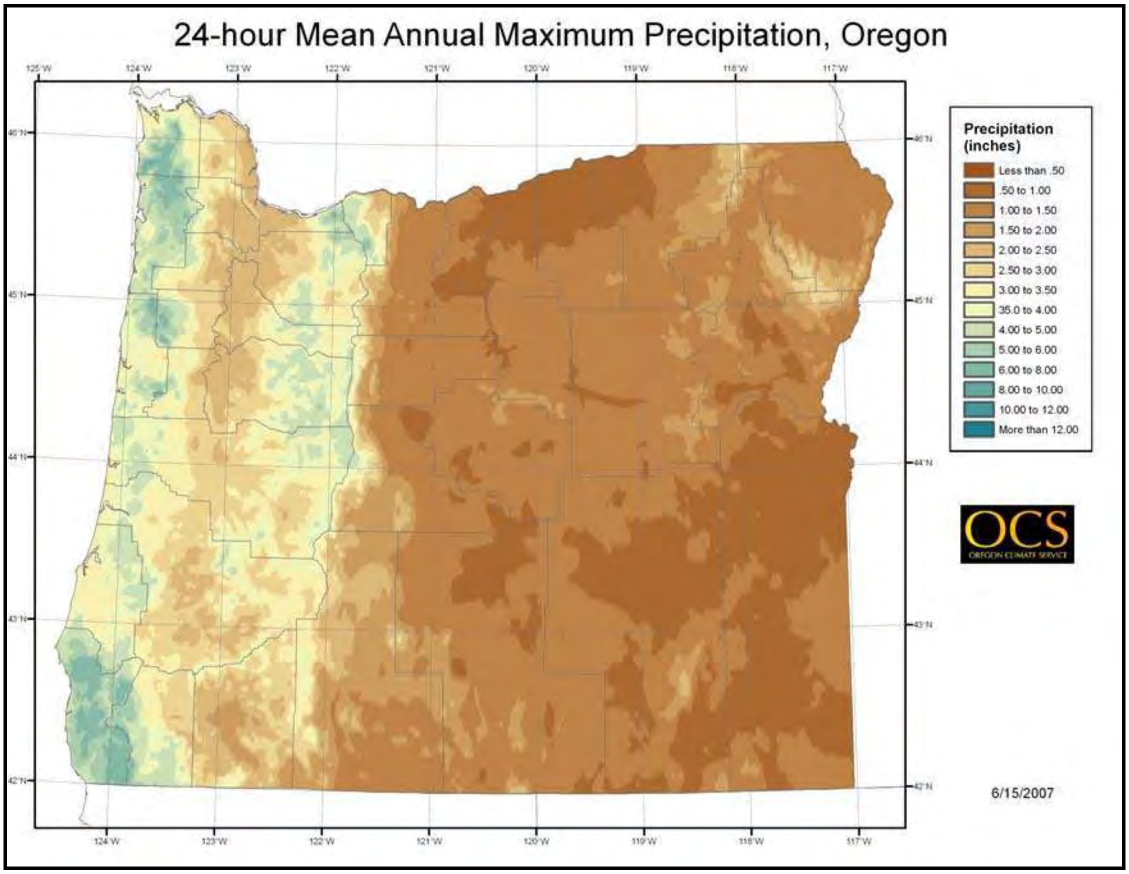


Figure 10.2: Map of At-Site Means for 24-Hour Duration for Oregon Study Area.

10.1 QUANTITATIVE ASSESSMENT OF SUCCESS ACHIEVED IN SPATIAL MAPPING OF AT-SITE MEANS

A quantitative measure was needed to assess the relative success of the spatial mapping procedures in capturing the spatial behavior of the at-site means. This is a difficult task in all studies of this type, because the true values of the at-site means are unknown. The logical standard for comparison is the station sample value of the at-site mean. However, station sample values of the at-site mean will differ from the true population values due to sampling variability, and other natural and man-related variability associated with precipitation measurement and recording.

This problem was approached by framing the question as: *how do the observed station values compare with the final mapped values*? Given this question, the bias and root mean square error (RMSE) computations (*Helsel and Hirsch 1992*) were expressed in standardized units using the mapped values as the predicted value. This equates to computing bias and RMSE for the standardized residuals (SR_2) as:

$$SR_2 = (S - P_2) / P_2 \qquad \textbf{(10-1)}$$

In this equation: S is the observed station value of the at-site mean (in); and P_2 is the mapped value of the station at-site-mean (in).

The computed standardized residuals are listed in Table 10.1 and a graphical example, comparing observed and mapped values, is shown in Figure 10.3. A review of Table 10.1 shows that the final mapped values of the at-site means are nearly unbiased. If the RMSE values for the stations are representative of the at-site mean maps taken as a whole, then the final maps of at-site means have a standard error of estimate that is near 5 percent. The RMSE of the final mapped values are generally similar in magnitude to that expected from natural sampling variability and, thus, are as low as can reasonably be expected.

Exhibit D-4

Table 10.1: Bias and Root Mean Square Error of Standardized Residuals for Final Mapped Values of Station At-Site Means for 24-Hour Duration.

Study Area	Climatic Regions	Final Mapped Values	
		Bias (%)	RMSE (%)
Western Oregon	Region 5 – Coastal Lowlands	0.0	3.7
	Region 151 – Windward Faces Coastal Mountains	-0.3	3.9
	Region 142 – Leeward Areas Coastal Mountains	1.6	5.0
	Region 32 – Interior Lowlands - West	-0.6	4.2
	Region 31 – Interior Lowlands - East	-0.3	4.6
	Region 15 – West Slopes of Cascade Mountains	-1.1	4.2
	Region 8 – Rogue Valley	-1.5	3.1
	Region 143 – Klamath Mountains and West Slopes Cascade Mountains	0.8	4.9
Eastern Oregon	Zone 154 – Transition Zone Crest Cascades and Klamath Mountains	-0.5	4.3
	Region 14 – East Slopes of Cascade Mountains	0.2	4.4
	Zone 147 – Transition Zone Cascade Foothills	0.1	4.3
	Region 77 – Central Basin	-0.9	2.8
	Region 7 – Pendleton-Palouse	0.2	2.6
	Region 13 – Wallowa and Blue Mountains	-0.6	4.0
	Region 9 – Snake River Canyon	-0.5	3.7
	Region 148 – Western Idaho Mountains	-1.3	3.1
	Region 144 – Ochoco and Malheur	-1.2	4.7
	Region 145 – Fremont and Warner	-1.0	4.9
	Region 146 – Pueblo and Crooked Creek Mountains	0.0	4.2
Weighted Averages for All Regions		**-0.4**	**4.1**

Exhibit D-4

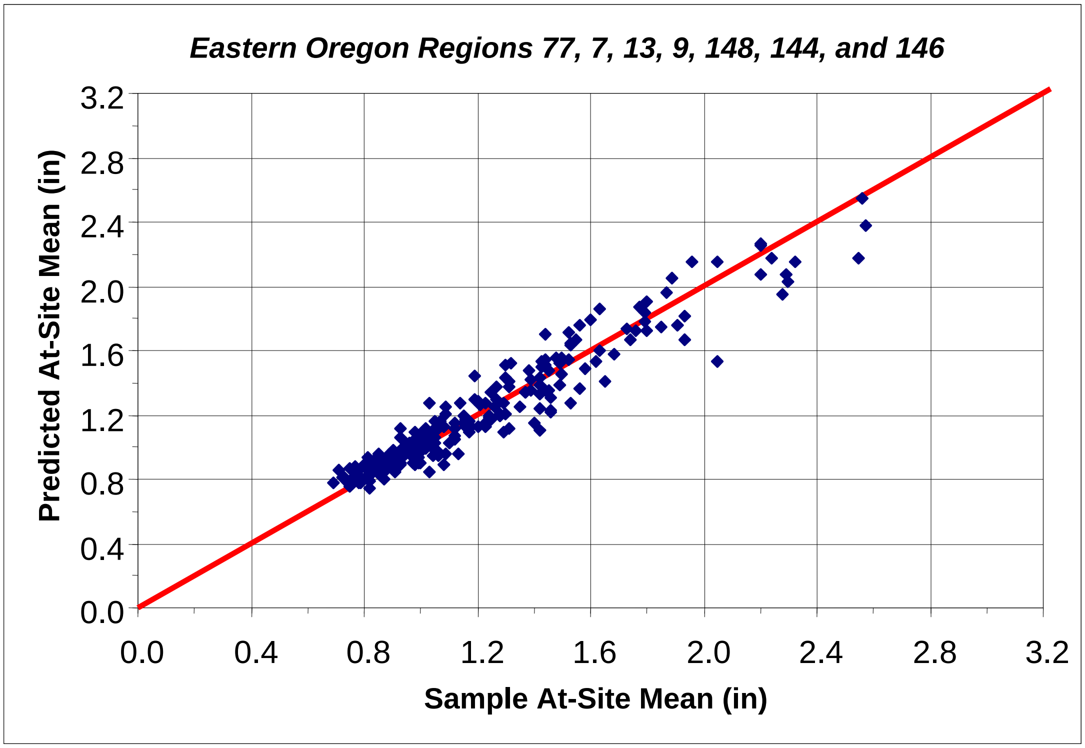


Figure 10.3: Comparison of Observed and Predicted Values of At-Site Means where Mean Annual Precipitation and Latitude were Used as Explanatory Variables for Climatic Regions 77, 7, 13, 9, 148, 144, 146 in Oregon Study Area).

Exhibit D-4

Exhibit D-4

11.0 SPATIAL MAPPING OF REGIONAL L-MOMENT STATISTICAL PARAMETERS

In order to compute precipitation estimates for the selected recurrence intervals, the appropriate value of L-Cv and L-Skewness had to be obtained for each grid-cell. This was accomplished by populating the grid-cells in the study area domain with the functional relationships for L-Cv and L-Skewness (Equations 7-1 through 7-7) that were developed in the regional precipitation-frequency analysis. Population of the grid-cells within transition zones 154 and 147 was accomplished as a weighted average of the L-moment ratio values. The weight factors were based on the nearness of a given grid-cell to the boundaries of the transition zone. This approach provided continuity at the region boundaries and a smooth transition between region boundaries within the transition zones. Discontinuities of L-Cv at L-Skewness in transition zones, prior to smoothing, were relatively minor; typically less than 5% of the mapped value.

Color-shaded maps of L-Cv and L-Skewness values are depicted in Figures 11.1 and 11.2. Separate gridded data files are included as electronic files with this report (Appendix A).

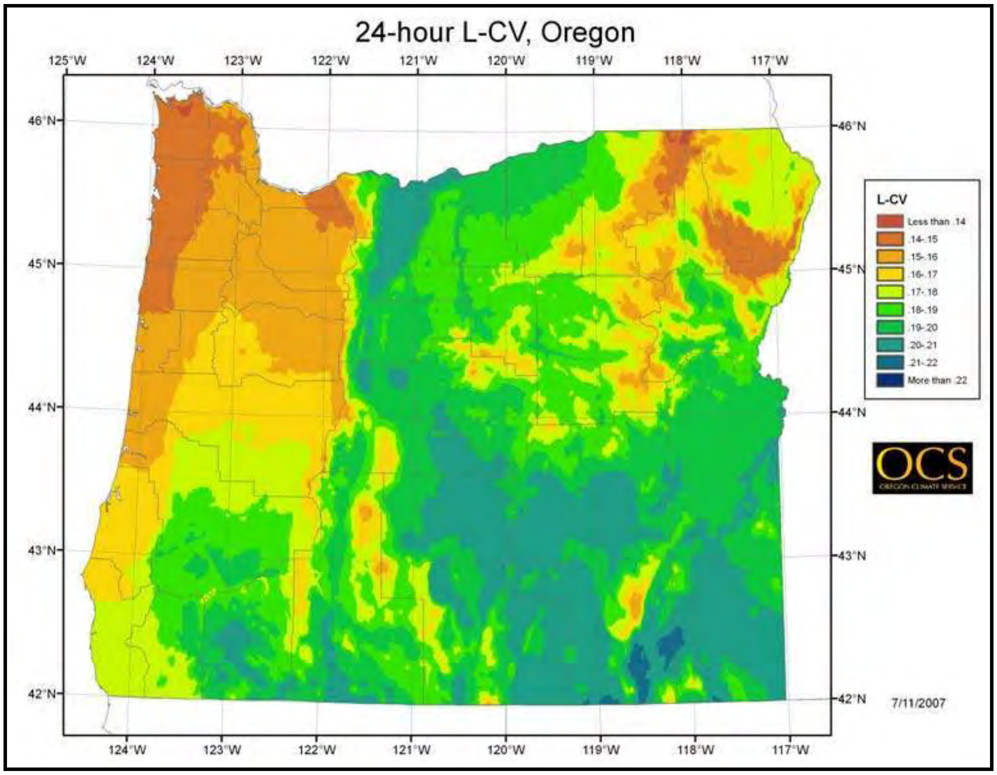


Figure 11.1: Oregon Variation of L-Cv for 24-Hour Precipitation Annual Maxima.

Exhibit D-4

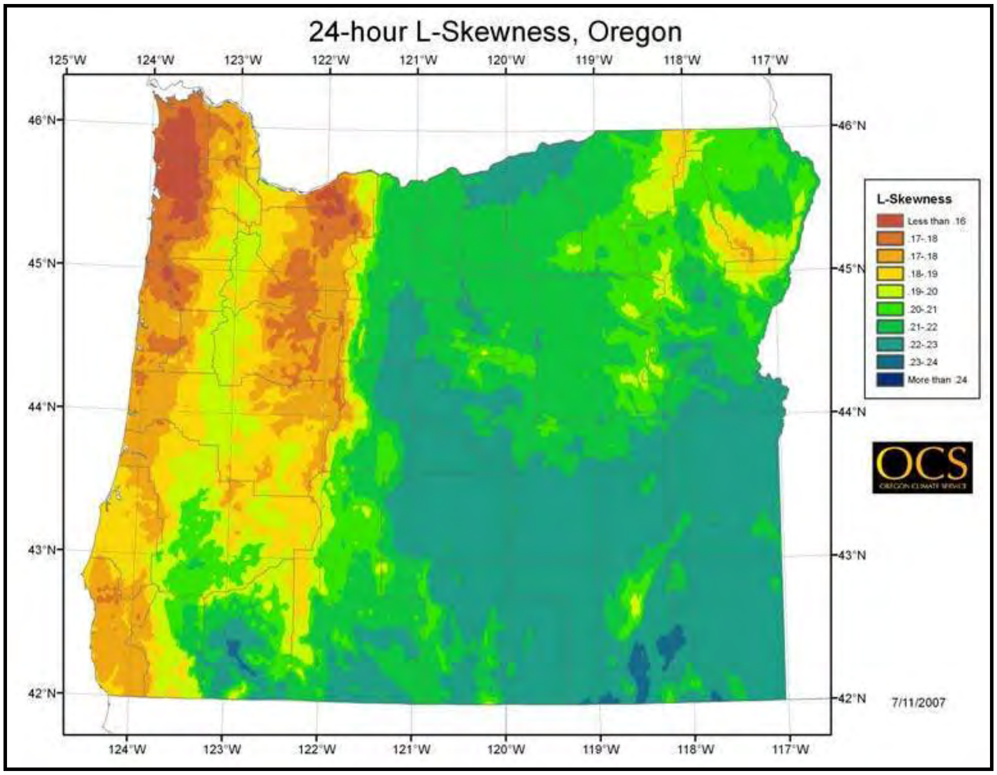


Figure 11.2: Oregon Variation of L-Skewness for 24-Hour Precipitation Annual Maxima.

12.0 PRODUCTION OF ISOPLUVIAL MAPS

The isopluvial maps were produced by incorporating the information described in prior sections. For each grid-cell, the applicable value of the at-site mean and L-moment ratios; L-Cv, and L-Skewness, were used to solve the distribution parameters for the four-parameter Kappa distribution (*Hosking 1988; Hosking and Wallis 1997*). The distribution parameters were then used in Equation 7-8 to compute the expected value of precipitation for the desired recurrence interval. This procedure was repeated for each grid-cell until the domain for the study area was populated. The resultant precipitation field was then contoured to yield isopluvials for selected values of precipitation.

12.1 PRECIPITATION MAGNITUDE-FREQUENCY ESTIMATES FOR MODERATE TO LARGE SIZE WATERSHEDS

The precipitation magnitude-frequency information contained in the gridded datasets, and depicted on the isopluvial maps, corresponded to 10-mi^2 precipitation for the 24-hour duration. Estimation of precipitation volumes of larger watersheds for a selected recurrence interval require analysis of historical storms or application of areal reduction factors. Areal reduction factors would be obtained from analyses of historical storms from climatologically similar areas. The topics of areal reduction factors, depth-area-duration analyses, and estimation of precipitation for moderate to large size watersheds, is beyond the scope of this report. It is mentioned here to alert the reader that precipitation values from the gridded datasets and isopluvial maps need to be adjusted in order to obtain estimates of precipitation volumes for moderate to large watersheds. Additional information on areal reduction factors can be found in articles by Bell (*1976*), Meyers and Zehr (*1980*), and Siriwardena and Weinmann (*1996*).

12.2 UNCERTAINTY BOUNDS FOR 100-YEAR VALUES

The accuracy of estimation of 100-year precipitation annual maxima, at a given location, is dependent upon the success attained in estimating the at-site mean, and L-moment ratios; L-Cv and L-Skewness, as well as the similarity between the chosen probability model (Kappa distribution), and what actually is occurring in nature.

In general, uncertainties associated with estimating L-moment ratios; L-Cv and L-Skewness, resulted in standard errors of estimation of about 5 percent at the 100-year recurrence interval. These relatively low levels of uncertainty were attributable to very large datasets that were used to estimate the L-moment ratios and identify a suitable probability model. The interaction of these standard errors of estimation with errors due to estimation of the at-site mean (Table 10.1), yielded the standard errors of estimation that is shown in Table 12.1. The range in standard errors of estimation for a given duration was primarily due to the region-to-region variation of standard errors for the at-site mean estimates for recurrence intervals cited in Table 12.1.

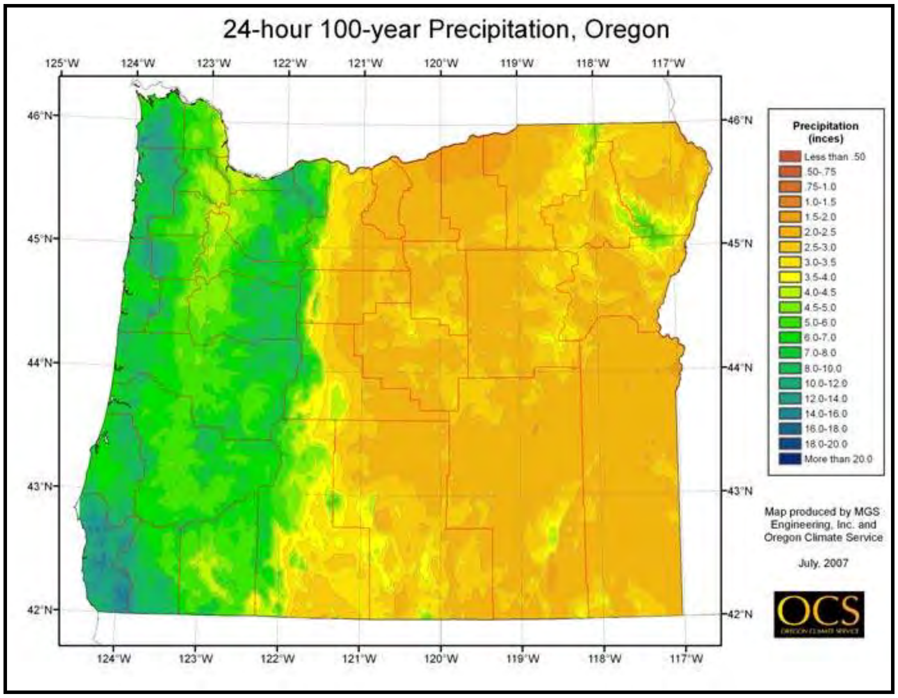
Table 12.1 shows the range of standard errors of estimation for selected recurrence intervals. The values shown in Table 12.1 are approximate. Detailed studies that compute uncertainty bounds have not been conducted at this time. The values shown in the table represent regional averages. Values applicable to a given location may be somewhat smaller or larger than those indicated in Table 12.1.

Table 12.1: Range of Standard Errors of Estimation for Selected Recurrence Intervals.

Duration	10-Year	100-Year
24-Hour	4% to 7%	7% to 10%

12.3 ISOPLUVIAL MAPS

An example of an isopluvial map, which was produced by processes described in this chapter, is depicted in Figure 12.1. The figure shows a color-shaded map of 24-hour, 100-year precipitation. Isopluvial maps for the other selected recurrence intervals are contained as electronic files as part of Appendix B.



Map produced by MGS Engineering, Inc. and Oregon Climate Service

July, 2007

Figure 12.1: Isopluvial Map of 24-Hour Precipitation for 100-Year Recurrence Interval for the State of Oregon.

13.0 SEASONALITY OF EXTREME STORMS

The seasonality of extreme storms can be a valuable tool for application of precipitation-frequency information to rainfall-runoff modeling. Specifically, information on the seasonality of storms is helpful when setting watershed conditions antecedent to the storm.

The seasonality of extreme storms was investigated by constructing frequency histograms of the storm dates for rare 24-hour precipitation amounts for groupings of climatic regions. Storms characterized as extreme, were those where the precipitation amounts had annual exceedance probabilities of less than 0.05 (rarer than a 20-year event). Precipitation amounts/gages with duplicate storm dates (generally dates within about 3 calendar days) were removed before the frequency histograms were constructed for each climatic region. The results of the seasonality analyses are discussed below.

13.1 SEASONALITY OF 24-HOUR EXTREME EVENTS

Well-defined seasonal patterns were apparent for storms which were rare at the 24-hour duration in western Oregon and on the eastern slopes of the Cascade and Klamath Mountains (Figures 13.1-13.5). These storms were the result of synoptic scale cyclonic weather systems and associated fronts. These storms remain organized and would penetrate a considerable distance inland from the coast. There was a rapid transition in the seasonality of storms at the foothills of the Cascade and Klamath Mountains into eastern Oregon where arid, semi-arid, and humid climatic regions showed extreme storms occurring throughout the year (Figures 13.6-13.8).

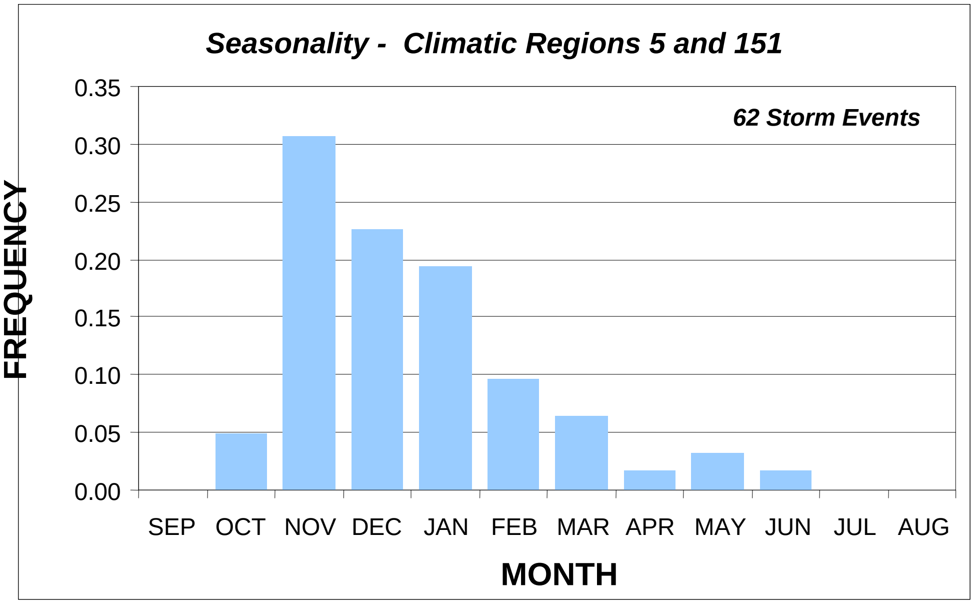


Figure 13.1: Seasonality of Extreme Storms in Climatic Regions 5 and 151 (Western Oregon – Coastal Lowlands and Windward Faces of the Coastal Mountains).

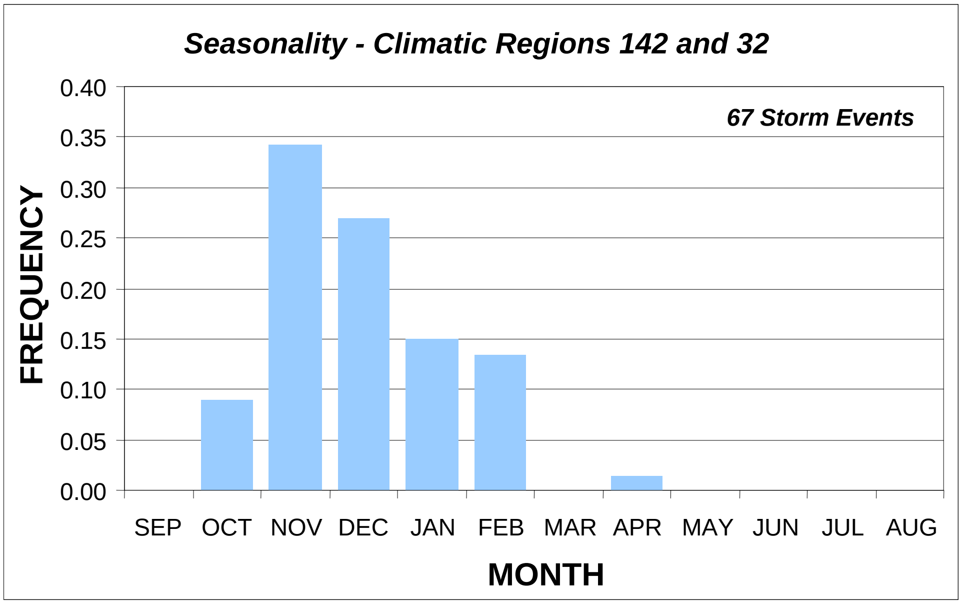


Figure 13.2: Seasonality of Extreme Storms in Climatic Regions 142 and 32 (Western Oregon – Leeward Faces of the Coastal Mountains and the Interior Lowlands to the West).

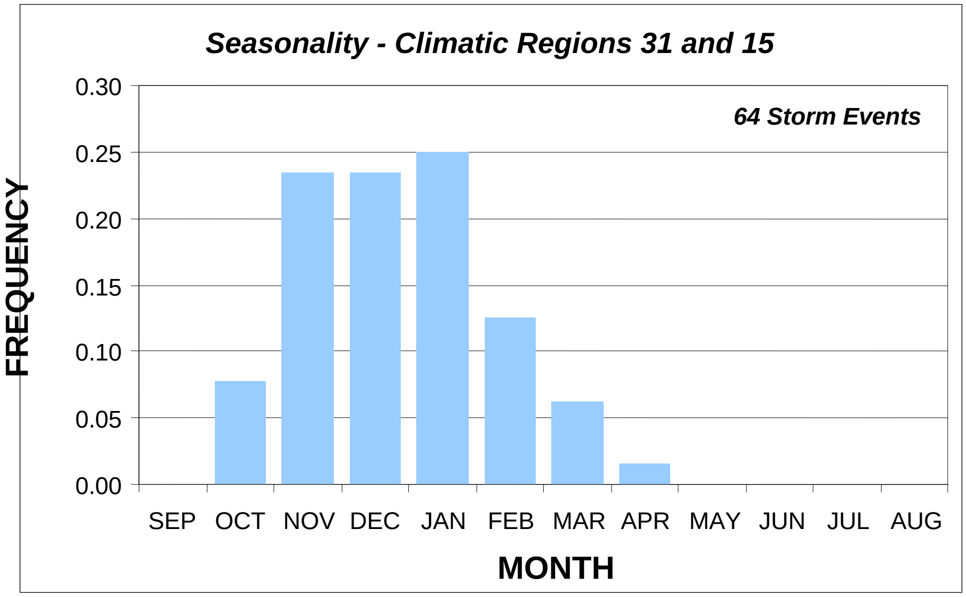


Figure 13.3: Seasonality of Extreme Storms in Climatic Regions 31 and 15 (Western Oregon -Interior Lowlands to the East and the Windward Faces of the Cascade Mountains).

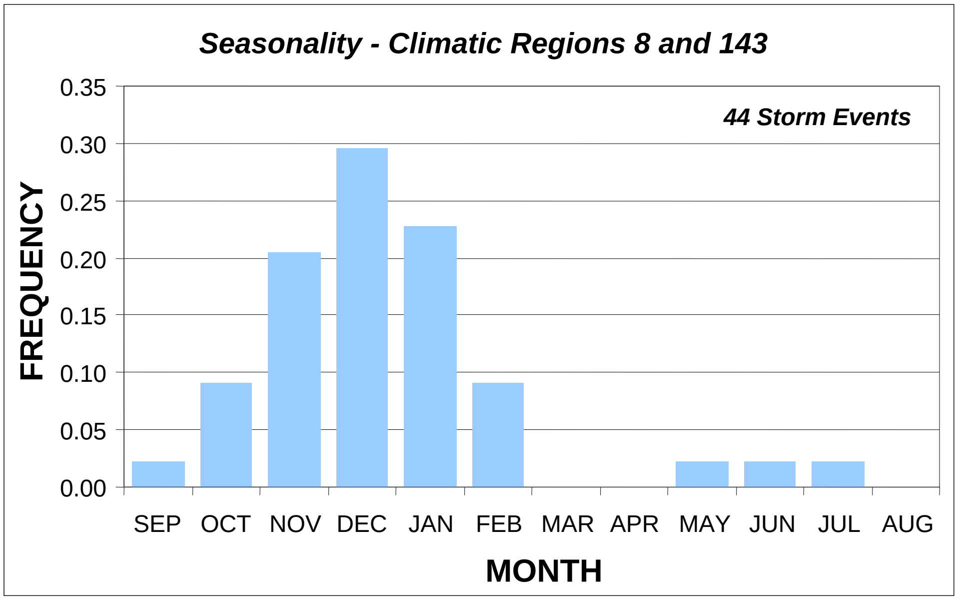


Figure 13.4: Seasonality of Extreme Storms in Climatic Regions 8 and 143 (Southwest Oregon – Rogue Valley and the Windward Faces of the Klamath Mountains).

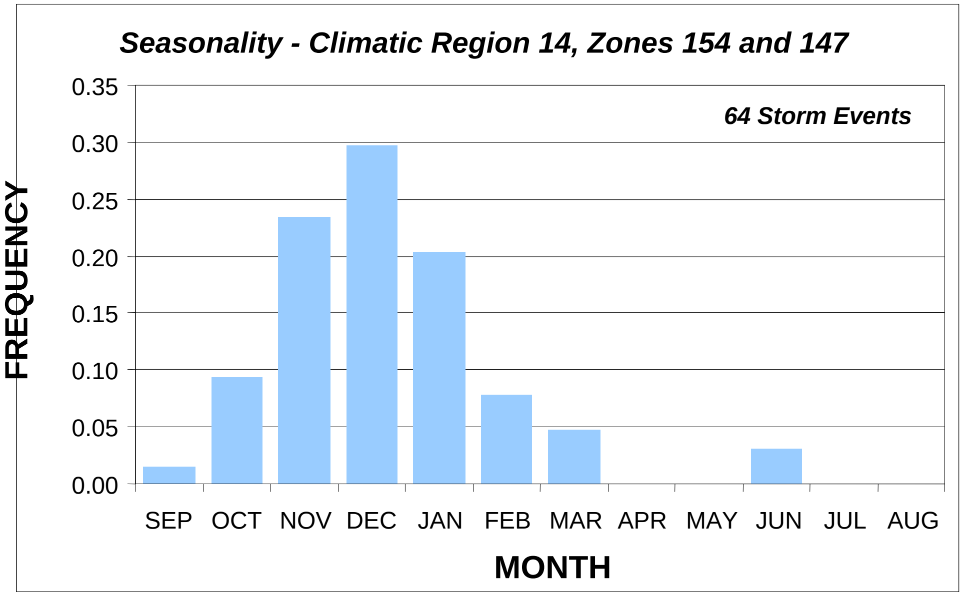


Figure 13.5: Seasonality of Extreme Storms in Climatic Region 14 and Transition Zones 154, and 147 (Eastern Oregon – Leeward Faces of the Cascade and Klamath Mountains).

Exhibit D-4

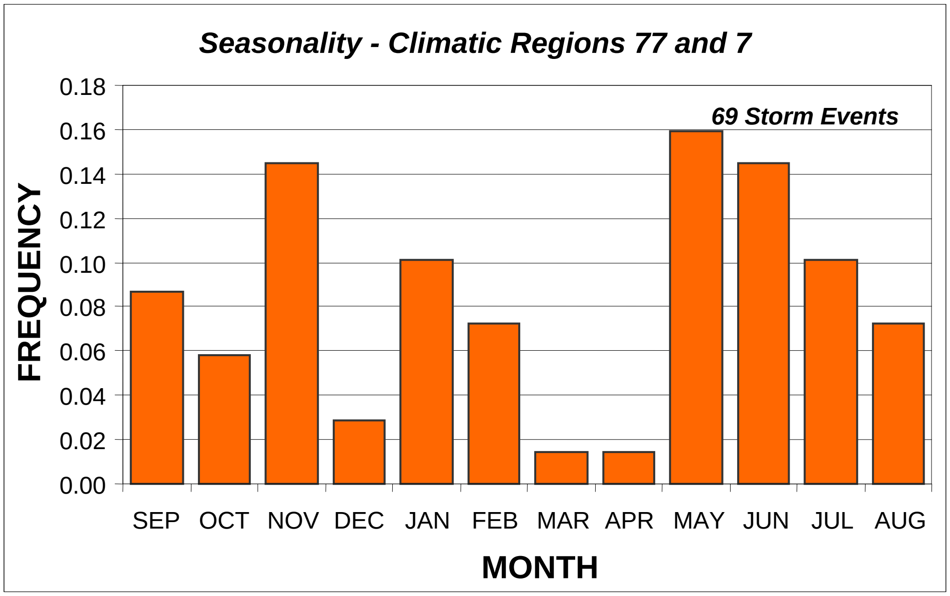


Figure 13.6: Seasonality of Extreme Storms in Climatic Regions 77 and 7
(Northeastern Oregon – Low Orographic Areas).

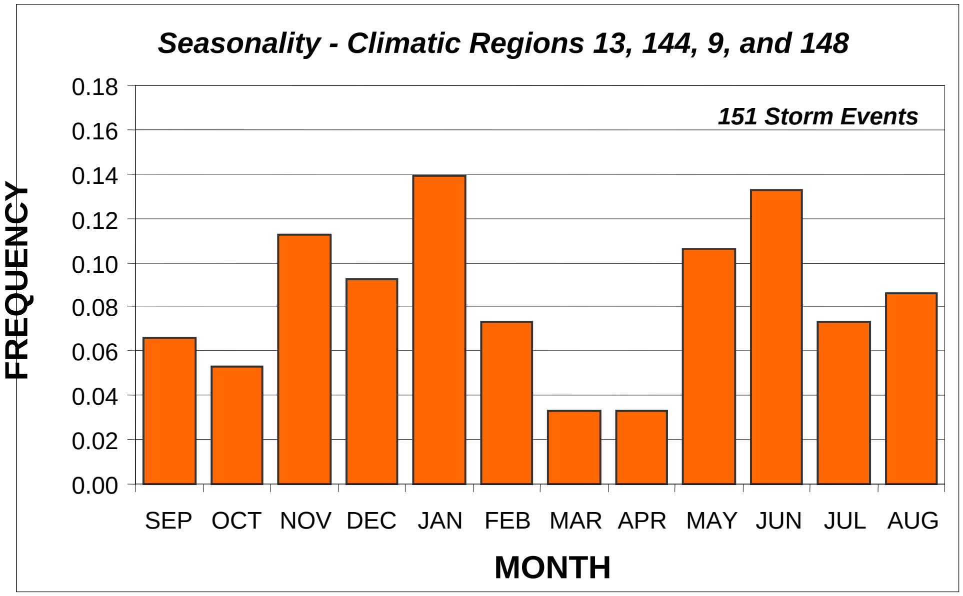


Figure 13.7: Seasonality of Extreme Storms in Climatic Regions 13, 144, 9, and 148
(Northeastern and Central Oregon – Mountainous Areas).

Exhibit D-4

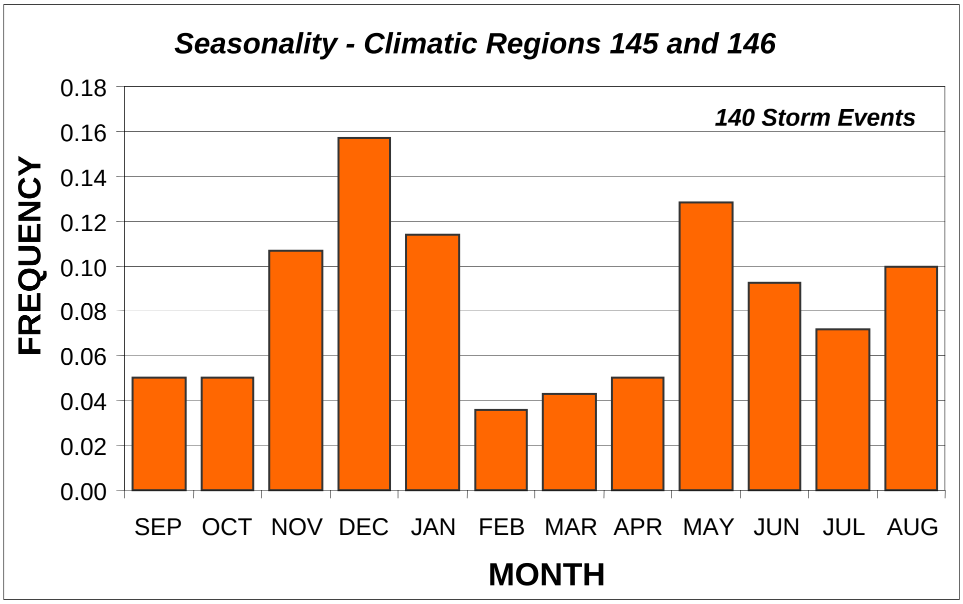


Figure 13.8: Seasonality of Extreme Storms in Climatic Regions 145 and 146 (Southeastern Oregon – Desert Mountain Areas).

Exhibit D-4

Exhibit D-4

14.0 SEASONALITY OF PRECIPITATION ANNUAL MAXIMA

Information on the seasonality of 24-hour annual maxima can be helpful early in the regional analysis for delineating climatic regions. Differences in the seasonality of annual maxima across a broad geographic area often indicate that there may also be systematic changes in L-Cv and L-Skewness across the area. Seasonality of annual maxima may be analyzed graphically, as depicted in the prior section. However, circular statistics are often more useful because they provide a quantitative measure of the differences in seasonality.

14.1 USE OF CIRCULAR STATISTICS FOR ASSESSING SEASONALITY OF 24-HOUR ANNUAL MAXIMA

Circular statistics are appropriate for seasonality analysis because of the continuous (circular) nature of the counting system for dates and months (*Fisher 1993*). For example, January (month 1) follows December (month 12). Arithmetic averaging of a group of numerical months or dates is not appropriate with conventional sample statistics because the counting system is circular not linear. Using circular statistics, the *average day of occurrence* is analogous to the arithmetic mean, and the *seasonality index* (*Dingman 2001*) is analogous to a standardized measure of variation. Specifically, values of the seasonality index range from zero to unity. Values near zero indicate a wide variation in the dates of occurrence. A seasonality index near unity indicates low variation in the dates of occurrence and strong clustering of dates.

Table 14.1 lists summary circular statistics for the various climatic regions. Review of values from the seasonality index, indicates that there are similar values for humid areas in western Oregon as there are on the eastern slopes of the Cascade Mountains. These relatively high values indicated strong clustering of 24-hour precipitation annual maxima in the fall and winter seasons. Graphics for seasonality of annual maxima for these climatic regions would be similar to that seen in Figures 13.1 through 13.5. By comparison, arid and semi-arid areas in the eastern portion of the study area had low seasonality index values, which indicated that the annual maxima occurred across a wide range of dates. These values were indicative of the wide variation in dates of annual maxima and would have a graphic depiction similar to that seen in Figures 13.6 through 13.8.

Review of Table 14.1 and Figures 2.1, 3.1, 3.2, 5.1-5.3 and 5.4 reveal that the seasonality index generally varies with mean annual precipitation (MAP). Climatic regions with larger MAP values tended to receive greater proportions of storms and annual maxima in the fall and winter seasons and had higher values of the seasonality index. This was true for regions in both the western and eastern portions of the study area, as mountain regions tended to have higher MAP and larger values of the seasonality index. Conversely, the driest climatic regions in the eastern portions of the study area had the lowest values of the seasonality index, with storms occurring throughout the year. The eastern Foothills of the Cascade Mountains (Zone 147) were a transition area where the annual maxima in the western areas were predominately fall-winter,

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and the frequency in eastern areas varied widely throughout the year. The value of the seasonality index in Transition Zone 147 was seen to be intermediate in magnitude between the wetter areas to the west and the drier areas to the east. The Rogue Valley (Region 8) was an interesting anomaly. The Rogue Valley exists in a rain-shadow that is down-slope from the Coastal Mountains and has generally low values of MAP. Yet the region has a high seasonality index because the annual maxima are caused by fall and winter storms. These findings are presented here as background information and as a supplement to the delineation of climatic regions presented earlier in this report. Equations for computation of circular statistics are presented in Appendix C.

Table 14.1: Summary of Circular Statistics for Seasonality of 24-Hour Annual Maxima for the Various Climatic Regions and Transition Zones.

Study Area	Region/Zone	Average Julian Day of Occurrence	Seasonality Index
Western Areas and East Slopes of the Cascade Mountains	Region 5 – Coastal Lowlands	362 (Dec)	0.697
	Region 151 – Windward Faces Coastal Mountains	360 (Dec)	0.764
	Region 142 – Leeward Areas Coastal Mountains	362 (Dec)	0.744
	Region 32 – Interior Lowlands - West	359 (Dec)	0.740
	Region 31 – Interior Lowlands - East	355 (Dec)	0.688
	Region 15 – West Slopes of Cascade Mountains	357 (Dec)	0.710
	Region 8 – Rogue Valley	353 (Dec)	0.695
	Region 143 – Klamath Mountains and West Slopes Cascade Mountains	358 (Dec)	0.730
	Zone 154 – Transition Zone Crest Cascades and Klamath Mountains	357 (Dec)	0.724
	Region 14 – East Slopes of Cascade Mountains	357 (Dec)	0.673
Eastern Areas	Zone 147 – Transition Zone Eastern Cascade Foothills	349 (Dec)	0.419
	Region 77 – Central Basin	338 (Dec)	0.178
	Region 7 – Pendleton-Palouse	043 (Feb)	0.159
	Region 13 – Wallowa and Blue Mountains	358 (Dec)	0.363
	Region 9 – Snake River Canyon	080 (Mar)	0.231
	Region 148 – Western Idaho Mountains	027 (Jan)	0.361
	Region 144 – Ochoco and Malheur	221 (Aug)	0.235
	Region 145 – Fremont and Warner	352 (Dec)	0.297
	Region 146 – Pueblo and Crooked Creek Mountains	107 (Apr)	0.289

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APPENDIX A

STATION CATALOG

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OVERVIEW

This appendix includes a station catalog for the stations/gages used in the study for analysis of precipitation annual maxima at the 24-hour duration. This listing includes the station identification number, station name, type of gage, climatic region number, latitude, longitude, elevation, and mean annual precipitation. This appendix is also included as an electronic file on a compact disc (CD).

Table A-1.1: Station Catalog of Gages Used in Analyses of Precipitation Annual Maxima at 24-Hour Duration.

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
450008	ABERDEEN	WA	46.966	-123.829	10	1891	2006	116	5	DY	83.2
350036	ADEL	OR	42.176	-119.896	4583	1956	2006	51	145	DY	10.8
20H13S	ADIN MTN	CA	41.250	-120.767	6200	1984	2006	23	145	Snotel	29.6
040029	ADIN RS	CA	41.200	-120.950	4193	1943	2006	64	145	DY	16.1
350041	ADRIAN	OR	43.733	-117.067	2231	1909	1972	64	9	DY	9.6
350078	ALBANY 1 N	OR	44.650	-123.100	210	1893	1963	71	32	DY	43.0
450094	ALDER DAM CAMP	WA	46.800	-122.317	1302	1917	1954	38	15	DY	47.8
350118	ALKALI LAKE	OR	42.969	-119.993	4332	1961	2006	46	145	DY	8.7
350126	ALLEGANY	OR	43.417	-124.017	50	1948	2006	59	5	HR	71.1
350145	ALSEA F H FALL CREEK	OR	44.404	-123.753	230	1954	2006	53	151	DY	87.5
040161	ALTURAS	CA	41.500	-120.533	4462	1905	2006	102	145	DY	12.2
450184	ANATONE	WA	46.133	-117.133	3573	1912	1981	70	13	DY	20.1
350188	ANDREWS 2 S	OR	42.433	-118.617	4104	1915	1942	28	146	DY	8.9
350189	ANDREWS WESTON MINE	OR	42.550	-118.550	4779	1969	1993	25	146	DY	17.8
17D02S	ANEROID LAKE #2	OR	45.214	-117.193	7300	1980	2006	27	13	Snotel	47.7
350197	ANTELOPE 6 SSW	OR	44.820	-120.753	3030	1924	2006	83	145	DY	13.8
350217	APPLEGATE	OR	42.245	-123.175	1282	1979	2006	28	8	DY	26.2
450217	APPLETON	WA	45.810	-121.282	2336	1959	2006	48	14	DY	33.7
19D02S	ARBUCKLE MTN	OR	45.191	-119.254	5400	1978	2006	29	13	Snotel	34.2
450242	ARIEL DAM	WA	45.950	-122.550	224	1930	1971	42	31	DY	73.6
350265	ARLINGTON	OR	45.721	-120.205	277	1893	2006	114	147	DY	9.1
350304	ASHLAND	OR	42.213	-122.714	1746	1892	2006	115	8	DY	20.2
350312	ASHWOOD 2 NE	OR	44.750	-120.717	2820	1945	2006	62	145	DY	13.7
450294	ASOTIN 14 SW	WA	46.201	-117.252	3500	1976	2006	31	13	DY	16.6
350318	ASTOR EXPERIMENT STN	OR	46.150	-123.817	49	1937	1973	37	5	DY	79.6
350324	ASTORIA	OR	46.183	-123.833	200	1892	1960	69	5	DY	77.8
350328	ASTORIA AP PORT OF	OR	46.150	-123.867	9	1953	2006	54	5	HR	71.7
350343	AURORA	OR	45.233	-122.749	98	1950	1969	20	31	DY	42.4
350356	AUSTIN 3 S	OR	44.575	-118.491	4213	1929	2006	78	13	DY	21.0
350409	BAKER #2	OR	44.767	-117.817	3467	1956	2006	51	13	HR	12.4
350412	BAKER CITY AIRPORT	OR	44.843	-117.809	3361	1943	2006	64	13	DY	10.7
350417	BAKER KBKR	OR	44.767	-117.833	3445	1928	1981	54	13	DY	12.2
350471	BANDON 2 NNE	OR	43.150	-124.402	20	1897	2006	110	5	DY	61.2
350501	BARNES STATION	OR	43.946	-120.217	3970	1961	2006	46	145	DY	13.6
450482	BATTLE GROUND	WA	45.779	-122.529	284	1928	2006	79	31	DY	52.5
260691	BATTLE MOUNTAIN 4 SE	NV	40.600	-116.883	4540	1948	2006	59	146	HR	9.1
16E11S	BEAR BASIN	ID	44.952	-116.143	5350	1981	2006	26	148	Snotel	36.7
16E10S	BEAR SADDLE	ID	44.604	-116.983	6180	1981	2006	26	9	Snotel	36.0
350571	BEAR SPRINGS RS	OR	45.117	-121.533	3360	1961	2006	46	14	HR	31.5
18D09S	BEAVER RESERVOIR	OR	45.145	-118.220	5150	1980	2006	27	13	Snotel	29.3
350595	BEAVERTON 2 SSW	OR	45.455	-122.820	270	1972	2006	35	32	DY	40.7
350631	BEECH CREEK	OR	44.567	-119.117	4715	1909	1949	41	144	DY	19.2

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STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
350652	BELKNAP SPRINGS 8 N	OR	44.287	-122.039	2152	1960	2006	47	15	DY	77.1
350673	BELLFOUNTAIN	OR	44.367	-123.350	322	1949	1977	29	32	HR	47.5
350694	BEND	OR	44.057	-121.285	3660	1901	2006	106	145	DY	11.7
350699	BEND 7 NE	OR	44.118	-121.211	3358	1991	2006	16	145	DY	10.3
450628	BENTON CITY 2 NW	WA	46.283	-119.500	679	1905	1964	60	77	DY	8.5
350723	BEULAH	OR	43.900	-118.150	3270	1948	2006	59	13	HR	11.9
450668	BICKLETON	WA	45.998	-120.301	3015	1927	2006	80	14	DY	13.9
040731	BIEBER	CA	41.117	-121.133	4125	1948	2006	59	145	HR	17.8
350753	BIG EDDY	OR	45.617	-121.117	131	1916	1957	42	14	DY	14.9
22G21S	BIG RED MOUNTAIN	OR	42.053	-122.855	6250	1980	2006	27	143	Snotel	54.5
23G15S	BIGELOW CAMP	OR	42.079	-123.344	5120	1980	2006	27	142	Snotel	65.0
22G13S	BILLIE CREEK DIVIDE	OR	42.407	-122.266	5300	1978	2006	29	154	Snotel	53.2
350773	BIRKENFELD 1 N	OR	46.000	-123.333	531	1939	1953	15	32	DY	73.5
350781	BLACKBUTTE 1 N	OR	43.583	-123.067	970	1948	2006	59	15	HR	58.9
21D33S	BLAZED ALDER	OR	45.428	-121.856	3650	1980	2006	27	15	Snotel	118.2
18E16S	BLUE MOUNTAIN SPRING	OR	44.248	-118.518	5900	1978	2006	29	13	Snotel	35.0
350853	BLY RANGER STN	OR	42.400	-121.033	4390	1949	2006	58	145	HR	14.5
350858	BOARDMAN	OR	45.840	-119.701	300	1971	2006	36	77	DY	8.5
101016	BOISE 3 E	ID	43.617	-116.117	3377	1972	2006	35	148	HR	19.9
101017	BOISE 7 N	ID	43.717	-116.200	3891	1973	2006	34	148	DY	17.8
101022	BOISE AIR TERMINAL	ID	43.567	-116.233	2814	1948	2006	59	148	HR	12.2
101018	BOISE LUCKY PEAK DAM	ID	43.517	-116.050	2840	1951	2006	56	148	HR	15.8
101022	BOISE WSFO AIRPORT	ID	43.567	-116.217	2858	1940	2006	67	148	DY	12.3
350897	BONNEVILLE DAM	OR	45.633	-121.950	62	1940	2006	67	154	HR	79.1
18E05S	BOURNE	OR	44.831	-118.188	5800	1978	2006	29	13	Snotel	34.3
18D20S	BOWMAN SPRINGS	OR	45.364	-118.467	4580	1978	2006	29	13	Snotel	28.4
351033	BRIGHTWOOD 1 WNW	OR	45.383	-122.033	978	1971	2000	30	15	HR	86.4
351055	BROOKINGS 2 SE	OR	42.030	-124.245	50	1912	2003	92	5	DY	71.9
450917	BROOKLYN	WA	46.783	-123.500	190	1927	1974	48	32	DY	82.2
351067	BROTHERS	OR	43.809	-120.600	4640	1959	2006	48	145	DY	9.2
101180	BROWNLEE DAM	ID	44.837	-116.898	1844	1966	2006	41	9	DY	17.1
16D09S	BRUNDAGE RESERVOIR	ID	45.043	-116.132	6300	1986	2006	21	148	Snotel	50.8
17H02S	BUCKSKIN LOWER	NV	41.751	-117.532	6700	1980	2006	27	146	Snotel	25.9
351124	BUENA VISTA STATION	OR	43.066	-118.868	4135	1957	2001	45	146	DY	9.8
450969	BUMPING LAKE	WA	46.867	-121.300	3442	1910	1967	58	14	DY	49.4
21C38S	BUMPING RIDGE	WA	46.810	-121.332	4600	1978	2006	29	154	Snotel	63.9
351149	BUNCOM 1 NNE	OR	42.183	-122.983	1949	1948	2006	59	143	HR	23.8
351174	BURNS JUNCTION	OR	42.777	-117.853	3930	1972	1999	28	146	DY	8.6
351175	BURNS MUNICIPAL AP	OR	43.583	-118.950	4140	1981	2006	26	145	HR	10.5
351176	BURNS WSO CITY	OR	43.583	-119.050	4141	1948	1981	34	145	HR	10.6
351207	BUTTE FALLS 1 SE	OR	42.533	-122.550	2500	1948	2006	59	143	HR	36.2
351222	BUXTON	OR	45.683	-123.183	355	1948	2006	59	32	HR	49.6
351227	BUXTON MOUNTAINDALE	OR	45.683	-123.067	360	1948	1975	28	32	HR	53.3
101380	CALDWELL 3 E	ID	43.667	-116.633	2421	1904	2006	103	9	DY	11.1
041316	CALLAHAN	CA	41.317	-122.800	3192	1943	2006	64	143	DY	22.2
101408	CAMBRIDGE	ID	44.573	-116.675	2650	1894	2006	113	148	DY	20.5
351324	CANARY	OR	43.917	-124.033	79	1932	1970	39	5	DY	84.5
351332	CANBY	OR	45.244	-122.686	94	1943	1966	24	31	DY	43.0
351329	CANBY 2 NE	OR	45.283	-122.667	89	1948	1979	32	31	DY	44.2
041476	CANBY RANGER STN	CA	41.450	-120.867	4310	1943	2006	64	145	DY	16.6
351352	CANYON CITY	OR	44.400	-118.950	3192	1938	1953	16	144	DY	15.4
351360	CAPE BLANCO	OR	42.833	-124.567	217	1952	1979	28	5	DY	76.4
451160	CARSON FISH HATCHERY	WA	45.868	-121.973	1134	1977	2006	30	154	DY	89.6
101514	CASCADE 1 NW	ID	44.523	-116.048	4896	1942	2006	65	148	DY	23.2
351407	CASCADE LOCKS	OR	45.683	-121.883	102	1894	1954	61	154	DY	78.7
351415	CASCADE SUMMIT	OR	43.583	-122.033	4843	1927	1947	21	154	DY	54.9

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STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
22F03S	CASCADE SUMMIT	OR	43.590	-122.060	4880	1980	2006	27	154	Snotel	60.3
351433	CASCADIA	OR	44.398	-122.486	860	1908	2006	99	15	DY	65.0
451189	CASTLE ROCK	WA	46.283	-122.900	112	1917	1941	25	31	DY	47.5
451191	CASTLE ROCK 2 NW	WA	46.267	-122.917	39	1954	1978	25	31	HR	47.7
451205	CATHLAMET 6 NE	WA	46.260	-123.299	180	1959	2006	48	32	DY	80.7
451207	CATHLAMET 9 NE	WA	46.317	-123.267	479	1937	1959	23	142	DY	87.2
351448	CAVE JUNCTION 1 WNW	OR	42.177	-123.675	1280	1962	2006	45	142	DY	61.8
041606	CECILVILLE	CA	41.142	-123.139	2310	1954	2003	50	143	DY	35.9
20H06S	CEDAR PASS	CA	41.583	-120.300	7100	1978	2006	29	145	Snotel	34.9
041614	CEDARVILLE	CA	41.534	-120.174	4670	1894	2006	113	145	DY	13.5
451257	CENTERVILLE 2 SW	WA	45.733	-120.950	1650	1941	1956	16	14	HR	16.1
451276	CENTRALIA	WA	46.720	-122.953	185	1902	2006	105	31	DY	46.5
351546	CHEMULT	OR	43.229	-121.789	4760	1937	2006	70	14	DY	27.1
21F22S	CHEMULT ALTERNATE	OR	43.226	-121.807	4760	1980	2006	27	14	Snotel	28.7
351552	CHERRY GROVE 2 S	OR	45.417	-123.250	781	1936	1983	48	32	DY	56.0
351571	CHILOQUIN 1 E	OR	42.583	-121.867	4193	1913	1979	67	14	DY	18.2
351574	CHILOQUIN 7 NW	OR	42.651	-121.948	4155	1980	2006	27	14	DY	20.6
451457	CINEBAR 2 E	WA	46.600	-122.483	1040	1941	2000	60	15	HR	65.9
21D13S	CLACKAMAS LAKE	OR	45.096	-121.753	3400	1980	2006	27	154	Snotel	55.3
451474	CLARKSTON HEIGHTS	WA	46.383	-117.083	1191	1937	1959	23	9	DY	14.6
351643	CLATSKANIE	OR	46.108	-123.206	22	1935	2006	72	32	DY	55.4
041799	CLEAR CREEK	CA	41.717	-123.450	981	1960	1977	18	143	DY	59.4
21D12S	CLEAR LAKE	OR	45.188	-121.691	3500	1980	2006	27	154	Snotel	50.8
041805	CLEAR LAKE DAM	CA	41.933	-121.067	4573	1907	1954	48	145	DY	15.0
351682	CLOVERDALE	OR	45.205	-123.893	187	1940	2006	67	5	DY	84.3
041886	COFFEE CREEK R S	CA	41.083	-122.700	2500	1961	2006	46	143	HR	53.7
22G24S	COLD SPRINGS CAMP	OR	42.533	-122.177	5880	1981	2006	26	154	Snotel	56.5
451586	COLFAX	WA	46.883	-117.350	1980	1892	1994	103	7	DY	19.8
351735	COLTON	OR	45.167	-122.417	680	1948	2006	59	31	HR	59.6
351765	CONDON	OR	45.233	-120.181	2840	1910	2006	97	7	DY	14.2
451690	CONNELL 1 W	WA	46.650	-118.867	1020	1960	2003	44	77	HR	8.8
451691	CONNELL 12 SE	WA	46.509	-118.788	1078	1951	2006	56	77	DY	10.2
041990	COPCO NO 1 DAM	CA	41.983	-122.333	2703	1959	2006	48	154	DY	20.7
351826	COPPER	OR	42.033	-123.133	1903	1948	1976	29	143	HR	28.6
351828	COPPER 4 NE	OR	42.067	-123.100	1820	1976	2006	31	143	HR	26.0
351836	COQUILLE CITY	OR	43.187	-124.203	23	1971	2006	36	5	DY	57.7
351852	CORNUCOPIA	OR	45.000	-117.200	4705	1909	1972	64	13	DY	48.1
351857	CORVALLIS	OR	44.566	-123.257	192	1936	1972	37	32	DY	43.5
351862	CORVALLIS STATE UNIV	OR	44.633	-123.189	225	1893	2006	114	32	DY	44.0
351877	CORVALLIS WATER BURE	OR	44.509	-123.458	592	1936	2006	71	32	DY	66.2
351897	COTTAGE GROVE 1 NNE	OR	43.808	-123.049	595	1916	2006	91	31	DY	45.4
351902	COTTAGE GROVE DAM	OR	43.718	-123.058	831	1943	2006	64	31	DY	49.6
102159	COTTONWOOD 2 WSW	ID	46.033	-116.383	3945	1948	2006	59	148	HR	22.5
451759	COUGAR 4 SW	WA	46.017	-122.350	520	1941	2006	66	15	HR	101.0
451760	COUGAR 6 E	WA	46.050	-122.200	659	1930	2006	77	15	DY	122.4
351914	COUGAR DAM	OR	44.117	-122.233	1260	1961	2006	46	15	HR	75.6
102187	COUNCIL	ID	44.750	-116.417	3153	1911	2006	96	148	DY	25.2
18D08S	COUNTY LINE	OR	45.191	-118.550	4800	1980	2006	27	13	Snotel	24.6
351926	COVE 1 E	OR	45.296	-117.790	3130	1917	2006	90	13	DY	22.6
102246	CRAIGMONT	ID	46.233	-116.467	3798	1980	1996	17	148	DY	22.3
351946	CRATER LAKE NPS HQ	OR	42.897	-122.133	6475	1919	2006	88	154	DY	66.6
042147	CRESCENT CITY 3 NNW	CA	41.796	-124.215	40	1893	2006	114	5	DY	64.9
042148	CRESCENT CITY 7 ENE	CA	41.800	-124.083	120	1953	2001	49	5	DY	82.9
042150	CRESCENT CITY MNTC S	CA	41.767	-124.200	49	1948	1984	37	5	HR	64.5
351978	CRESCENT LAKE JUNCTI	OR	43.533	-121.933	4764	1938	1973	36	14	DY	36.4
351998	CROW 6 ESE	OR	43.983	-123.233	502	1947	1968	22	31	DY	47.3

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
352010	CURTIN NEAR	OR	43.723	-123.209	400	1978	2006	29	31	DY	50.4
352112	DALLAS 2 NE	OR	44.946	-123.292	290	1935	2006	72	32	DY	49.4
451972	DALLESPORT 9 N	WA	45.750	-121.150	1923	1948	1980	33	14	DY	23.7
451968	DALLESPORT AP	WA	45.619	-121.167	235	1948	2006	59	14	DY	14.2
22E08S	DALY LAKE	OR	44.522	-122.087	3600	1980	2006	27	15	Snotel	88.3
042269	DANA 2 SE	CA	41.100	-121.517	3323	1959	1976	18	145	DY	29.4
352135	DANNER	OR	42.945	-117.339	4225	1929	2006	78	146	DY	12.3
042306	DAY	CA	41.200	-121.367	3650	1948	2006	59	145	HR	21.5
452030	DAYTON 1 WSW	WA	46.316	-118.001	1557	1893	2006	114	7	DY	19.8
452037	DAYTON 9 SE	WA	46.217	-117.850	2343	1940	1977	38	13	HR	32.7
352168	DAYVILLE	OR	44.467	-119.533	2362	1895	1978	84	144	DY	12.8
352173	DAYVILLE 8 NW	OR	44.556	-119.645	2260	1978	2006	29	144	DY	11.6
102444	DEER FLAT DAM	ID	43.576	-116.747	2510	1948	2006	59	9	DY	10.3
102451	DEER POINT	ID	43.750	-116.100	7156	1954	1970	17	148	DY	32.1
262229	DENIO	NV	41.990	-118.634	4190	1951	2006	56	146	DY	9.5
19E03S	DERR.	OR	44.446	-119.930	5670	1980	2006	27	144	Snotel	29.4
352277	DETROIT	OR	44.733	-122.150	1591	1909	1972	64	15	DY	81.2
352292	DETROIT DAM	OR	44.717	-122.250	1220	1955	2006	52	15	HR	89.3
352295	DEVILS FLAT	OR	42.817	-123.050	2030	1977	2006	30	143	HR	41.4
352305	DIAMOND 4 WNW	OR	43.033	-118.750	4163	1942	1957	16	146	DY	11.5
22F18S	DIAMOND LAKE	OR	43.188	-122.140	5315	1980	2006	27	154	Snotel	49.7
352325	DILLEY 1 S	OR	45.483	-123.124	165	1943	2006	64	32	DY	44.3
18H01S	DISASTER PEAK	NV	41.967	-118.189	6500	1980	2006	27	146	Snotel	21.0
20H12S	DISMAL SWAMP	CA	41.967	-120.167	7000	1980	2006	27	145	Snotel	49.1
352345	DISSTON 1 NE LAYING	OR	43.700	-122.733	1218	1948	2006	59	15	HR	56.6
452197	DIXIE 4 SE	WA	46.083	-118.100	2250	1940	2006	67	13	HR	39.6
352348	DIXIE MOUNTAIN	OR	45.683	-122.917	1430	1976	2006	31	32	HR	63.6
352370	DORA 2 W	OR	43.164	-123.996	95	1969	1999	31	5	DY	62.1
352371	DORAVILLE	OR	46.033	-123.033	751	1902	1936	35	32	DY	66.6
352374	DORENA DAM	OR	43.767	-122.950	820	1950	2006	57	31	HR	48.5
452220	DOTY 3 E	WA	46.633	-123.200	260	1958	2006	49	32	DY	55.5
352406	DRAIN	OR	43.666	-123.328	292	1902	2006	105	32	DY	48.1
352415	DREWSEY	OR	43.807	-118.376	3515	1970	2006	37	146	DY	10.7
452253	DRYAD	WA	46.633	-123.250	310	1937	1978	42	32	DY	55.8
352440	DUFUR	OR	45.455	-121.128	1330	1909	2006	98	14	DY	13.5
262394	DUFURRENA	NV	41.867	-119.017	4803	1959	2006	48	145	DY	7.3
042572	DUNSMUIR	CA	41.217	-122.267	2421	1906	1978	73	154	DY	59.5
042574	DUNSMUIR TREATMENT P	CA	41.200	-122.267	2170	1978	2006	29	154	DY	61.4
352482	DURKEE 3 NNW	OR	44.617	-117.483	2782	1948	1976	29	13	DY	11.6
102845	DWORSHAK FISH HATCHE	ID	46.500	-116.317	995	1967	2006	40	13	HR	25.5
352493	EAGLE CREEK 9 SE	OR	45.274	-122.202	926	1972	2006	35	15	DY	63.3
352564	ECHO	OR	45.750	-119.183	659	1903	1971	69	77	DY	10.6
18E03S	EILERTSON MEADOWS	OR	44.869	-118.114	5400	1980	2006	27	13	Snotel	30.2
452493	ELECTRON HEADWORKS	WA	46.900	-122.033	1732	1943	1980	38	15	DY	68.2
352597	ELGIN	OR	45.562	-117.920	2655	1937	2006	70	13	DY	24.0
16C20S	ELK BUTTE	ID	46.840	-116.123	5690	1982	2006	25	148	Snotel	60.8
102892	ELK RIVER 1 S	ID	46.783	-116.167	2913	1952	2006	55	148	DY	36.5
042749	ELK VALLEY	CA	41.987	-123.718	1705	1938	1976	39	142	DY	79.2
352633	ELKTON 3 SW	OR	43.595	-123.599	120	1936	2006	71	142	DY	52.5
452505	ELLENSBURG	WA	46.969	-120.540	1480	1893	2006	114	14	DY	9.2
452531	ELMA	WA	47.000	-123.400	70	1940	2006	67	32	DY	67.6
452542	ELTOPIA 8 WSW	WA	46.383	-119.150	700	1954	2006	53	77	DY	8.9
18D04S	EMIGRANT SPRINGS	OR	45.558	-118.454	3925	1980	2006	27	13	Snotel	35.5
102942	EMMETT 2 E	ID	43.854	-116.466	2390	1906	2006	101	148	DY	14.0
352678	ENTERPRISE 20 NNE	OR	45.708	-117.153	3280	1969	2006	38	13	DY	19.2
352672	ENTERPRISE R S	OR	45.426	-117.297	3815	1931	1981	51	13	DY	14.4

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
352693	ESTACADA 2 SE	OR	45.269	-122.319	450	1909	2006	98	31	DY	60.2
352697	ESTACADA 24 SE	OR	45.077	-121.971	2200	1920	1951	32	15	DY	57.9
352697	ESTACADA 24 SE	OR	45.067	-121.967	2200	1948	2006	59	15	HR	57.9
042899	ETNA	CA	41.450	-122.883	2950	1948	2006	59	143	HR	27.1
352706	EUGENE	OR	44.050	-123.083	390	1892	1945	54	31	DY	44.4
352709	EUGENE MAHLON SWEET	OR	44.117	-123.217	353	1948	2006	59	32	HR	44.5
352728	EULA	OR	43.833	-122.617	879	1923	1950	28	15	DY	55.4
042910	EUREKA WFO WOODLEY I	CA	40.800	-124.150	20	1948	2006	59	5	HR	40.6
352775	FAIRVIEW 4 NE	OR	43.259	-124.023	195	1974	2006	33	5	DY	69.7
352793	FALL RIVER HATCHERY	OR	43.767	-121.633	4304	1928	1942	15	14	DY	22.2
042964	FALL RIVER MILLS INT	CA	41.017	-121.467	3343	1923	2006	84	145	DY	21.0
352800	FALLS CITY 2 SSW	OR	44.836	-123.453	690	1896	1961	66	32	DY	73.5
352805	FALLS CITY NO 2	OR	44.858	-123.431	420	1961	2001	41	32	DY	66.2
16H08S	FAWN CREEK	NV	41.821	-116.101	7000	1980	2006	27	146	Snotel	31.7
352867	FERN RIDGE DAM	OR	44.117	-123.300	485	1948	2006	59	32	HR	44.5
18G02S	FISH CREEK	OR	42.711	-118.626	7900	1978	2006	29	146	Snotel	44.8
352928	FISH LAKE	OR	42.383	-122.350	4642	1918	1956	39	154	DY	45.0
22G14S	FISH LK.	OR	42.380	-122.349	4665	1980	2006	27	154	Snotel	45.3
352972	FLORENCE	OR	43.967	-124.100	12	1948	2006	59	5	HR	68.6
352974	FLOURNOY VALLEY	OR	43.191	-123.554	700	1978	1998	21	32	DY	45.0
355424	FORD EXPERIMENT S	OR	42.296	-122.870	1457	1937	2003	67	8	DY	20.9
352997	FOREST GROVE	OR	45.524	-123.103	197	1893	2006	114	32	DY	42.9
043157	FORT BIDWELL	CA	41.867	-120.150	4505	1911	2006	96	145	DY	18.2
043173	FORT DICK	CA	41.883	-124.133	59	1951	1988	38	5	DY	73.9
043176	FORT JONES 6 ESE	CA	41.583	-122.717	3323	1948	1977	30	143	HR	24.7
043182	FORT JONES RANGER ST	CA	41.600	-122.850	2723	1936	2006	71	143	DY	21.3
353038	FOSSIL	OR	44.999	-120.211	2650	1923	2006	84	7	DY	15.0
353047	FOSTER DAM	OR	44.400	-122.667	550	1970	2006	37	15	HR	54.1
22G12S	FOURMILE LAKE	OR	42.439	-122.229	6000	1978	2006	29	154	Snotel	52.0
452984	FRANCES	WA	46.550	-123.500	231	1941	2006	66	142	HR	96.8
353095	FREMONT 5 NW	OR	43.394	-121.212	4609	1909	1996	88	145	DY	12.5
353121	FRIEND	OR	45.350	-121.267	2441	1923	1976	54	14	DY	16.6
353193	GARDINER 1 N	OR	43.746	-124.122	30	1983	2006	24	5	DY	70.1
043357	GASQUET RANGER STN	CA	41.850	-123.967	384	1948	2006	59	151	DY	90.4
353232	GERBER DAM	OR	42.205	-121.131	4850	1925	1956	32	145	DY	18.6
353232	GERBER DAM	OR	42.200	-121.117	4850	1958	2006	49	145	HR	18.5
353250	GIBBON	OR	45.700	-118.367	1739	1972	1995	24	13	DY	28.0
353305	GLENDALE	OR	42.733	-123.417	1385	1950	2006	57	143	HR	40.3
453177	GLENOMA	WA	46.517	-122.133	840	1906	2004	99	15	DY	68.7
453183	GLENWOOD	WA	46.017	-121.283	1896	1941	2006	66	14	HR	32.3
353318	GLENWOOD 2 WNW	OR	45.650	-123.300	644	1948	2006	59	142	HR	61.7
353340	GOBLE 3 SW	OR	45.983	-122.917	530	1948	2006	59	32	HR	54.9
353356	GOLD BEACH RANGER ST	OR	42.404	-124.424	50	1948	2006	59	5	DY	77.9
18E08S	GOLD CENTER	OR	44.764	-118.312	5340	1980	2006	27	13	Snotel	26.1
453222	GOLDENDALE	WA	45.817	-120.817	1657	1906	2006	101	14	DY	16.6
353402	GOVERNMENT CAMP	OR	45.300	-121.733	3980	1955	2006	52	15	HR	88.9
353421	GRAND RONDE TREE FAR	OR	45.050	-123.617	395	1948	2006	59	5	HR	62.6
103760	GRAND VIEW	ID	42.983	-116.100	2362	1909	2006	98	9	DY	7.1
103771	GRANGEVILLE	ID	45.930	-116.115	3360	1922	2006	85	148	DY	23.9
353430	GRANITE 4 WSW	OR	44.800	-118.500	4944	1947	1967	21	13	DY	27.8
17H08S	GRANITE PEAK	NV	41.671	-117.566	7800	1980	2006	27	146	Snotel	34.1
353445	GRANTS PASS	OR	42.424	-123.324	930	1893	2006	114	8	DY	31.2
103811	GRASMERE 3 S	ID	42.333	-115.883	5140	1963	2006	44	146	HR	9.4
453320	GRAYLAND	WA	46.801	-124.086	10	1953	2006	54	5	DY	74.4
453333	GRAYS RIVER HATCHERY	WA	46.383	-123.567	100	1954	2006	53	5	HR	112.9
21C10S	GREEN LAKE	WA	46.548	-121.171	6000	1982	2006	25	14	Snotel	38.1

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP^{4,20} (in)
353509	GREEN SPRINGS POWER	OR	42.126	-122.545	2435	1960	2006	47	143	DY	23.3
21D01S	GREENPOINT	OR	45.622	-121.704	3200	1979	2006	28	14	Snotel	74.1
043614	GREENVIEW	CA	41.552	-122.907	2820	1943	2006	64	143	DY	23.2
353521	GRESHAM	OR	45.483	-122.417	310	1948	2006	59	31	HR	56.9
353542	GRIZZLY	OR	44.518	-120.939	3635	1934	2006	73	145	DY	13.3
353604	HALFWAY	OR	44.878	-117.113	2665	1936	2006	71	9	DY	21.3
453444	HANFORD A E C	WA	46.567	-119.583	722	1912	1944	33	77	DY	8.0
043761	HAPPY CAMP RANGER ST	CA	41.804	-123.376	1120	1914	2006	93	143	DY	50.8
353659	HARNEY BRANCH EXPERI	OR	43.583	-118.933	4144	1922	1954	33	145	DY	10.5
353666	HARPER	OR	43.867	-117.617	2513	1919	1975	57	146	DY	10.2
043791	HARRISON GULCH R S	CA	40.350	-122.950	2750	1949	2006	58	154	HR	37.1
353692	HART MOUNTAIN REFUGE	OR	42.548	-119.656	5616	1939	2006	68	145	DY	11.8
353705	HASKINS DAM	OR	45.300	-123.350	756	1948	2006	59	142	HR	75.1
043821	HAT CREEK RANGER STN	CA	40.800	-121.500	3353	1948	1975	28	145	HR	25.3
453546	HATTON 9 SE	WA	46.722	-118.651	1510	1905	2006	102	77	DY	10.2
353737	HAY CREEK	OR	44.950	-120.900	2943	1919	1944	26	145	DY	13.6
353770	HEADWORKS PTLD WTR B	OR	45.450	-122.154	748	1899	2006	108	15	DY	79.8
353827	HEPPNER	OR	45.365	-119.564	1885	1893	2006	114	7	DY	14.3
353830	HEPPNER 5 SSE	OR	45.283	-119.517	3240	1975	2006	32	7	HR	15.9
353847	HERMISTON 1 SE	OR	45.829	-119.264	640	1906	2006	101	77	DY	9.6
18D19S	HIGH RIDGE	OR	45.697	-118.105	4980	1978	2006	29	13	Snotel	48.1
353915	HILLS CREEK DAM	OR	43.700	-122.417	1247	1961	2006	46	15	HR	49.7
353908	HILLSBORO	OR	45.514	-122.990	160	1929	2003	75	32	DY	40.0
043987	HILTS SLASH DISPOSAL	CA	42.000	-122.617	2923	1939	1984	46	143	DY	24.1
21E06S	HOGG PASS	OR	44.421	-121.857	4760	1979	2006	28	154	Snotel	88.1
22F42S	HOLLAND MEADOWS	OR	43.669	-122.569	4900	1980	2006	27	15	Snotel	77.2
353971	HOLLEY	OR	44.353	-122.784	610	1940	2006	67	31	DY	50.7
104318	HOMEDALE 1 SE	ID	43.617	-116.917	2230	1990	2006	17	9	DY	9.1
353995	HONEYMAN STATE PARK	OR	43.929	-124.106	115	1971	2006	36	5	DY	71.1
354008	HOOD RIVER TUCKER BR	OR	45.650	-121.533	383	1941	2006	66	14	HR	32.0
044089	HOOPA	CA	41.033	-123.667	333	1948	2006	59	143	HR	55.3
453807	HOQUIAM BOWERMAN AP	WA	46.973	-123.930	12	1953	2006	54	5	DY	72.5
354060	HOWARD PRAIRIE DAM	OR	42.229	-122.381	4567	1960	2006	47	154	DY	32.6
354098	HUNTINGTON	OR	44.356	-117.255	2110	1901	2006	106	9	DY	14.0
044191	HYAMPOM	CA	40.600	-123.450	1275	1948	2006	59	143	HR	45.1
453883	ICE HARBOR DAM	WA	46.245	-118.879	368	1957	2006	50	77	DY	10.2
104450	IDAHO CITY 11 SW	ID	43.717	-116.000	5003	1948	1963	16	148	DY	28.1
044202	IDLEWILD HWY MNTNC S	CA	41.900	-123.767	1250	1959	1977	19	142	DY	78.7
354126	IDLEYLD PARK 4 NE	OR	43.371	-122.965	1080	1958	2006	49	15	DY	63.3
354133	ILLAHE	OR	42.629	-124.058	348	1938	2006	69	151	DY	82.7
354161	IONE 18 S	OR	45.318	-119.857	2130	1935	2006	72	77	DY	12.6
21F21S	IRISH TAYLOR	OR	43.804	-121.949	5500	1978	2006	29	154	Snotel	70.4
354175	IRONSIDE 2 W	OR	44.325	-117.996	3915	1955	2004	50	13	DY	12.4
16H02S	JACK CREEK UPPER	NV	41.547	-116.009	7250	1978	2006	29	146	Snotel	29.2
16H04S	JACKS PEAK	NV	41.517	-116.018	8420	1981	2006	26	146	Snotel	35.5
354216	JACKSONVILLE	OR	42.300	-122.983	1640	1893	1948	56	8	DY	24.0
044374	JESS VALLEY	CA	41.268	-120.295	5400	1948	2006	59	145	DY	18.0
354276	JEWELL WILDLIFE MEAD	OR	45.941	-123.528	570	1919	1943	25	142	DY	108.0
354276	JEWELL WILDLIFE MEAD	OR	45.933	-123.517	570	1954	2006	53	142	HR	102.6
354291	JOHN DAY	OR	44.423	-118.959	3063	1953	2006	54	144	DY	13.9
354321	JORDAN VALLEY	OR	42.967	-117.050	4390	1949	2006	58	146	HR	14.0
354329	JOSEPH	OR	45.346	-117.225	4260	1893	1954	62	13	DY	18.6
22E07S	JUMP OFF JOE	OR	44.386	-122.167	3500	1978	2006	29	15	Snotel	88.7
22C09S	JUNE LAKE	WA	46.148	-122.155	3340	1982	2006	25	15	Snotel	166.6
354357	JUNTURA 9 ENE	OR	43.800	-117.933	2830	1963	1996	34	146	DY	10.7
454077	KAHLOTUS 5 SSW	WA	46.583	-118.600	1552	1914	1996	83	77	DY	10.7

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
454085	KALAMA 5 ENE	WA	46.050	-122.750	902	1917	1967	51	15	DY	63.5
454084	KALAMA FALLS HATCHER	WA	46.016	-122.733	310	1967	2006	40	15	DY	69.1
104793	KAMIAH	ID	46.233	-116.017	1191	1913	2006	94	148	DY	24.1
454131	KELSO	WA	46.143	-122.916	20	1923	1953	31	31	DY	45.0
454154	KENNEWICK	WA	46.211	-119.101	390	1894	2006	113	77	DY	7.8
454159	KENNEWICK 10 SW	WA	46.133	-119.300	1503	1949	1974	26	77	DY	9.9
354403	KENO	OR	42.130	-121.930	4116	1927	2006	80	14	DY	20.0
354411	KENT	OR	45.197	-120.699	2598	1922	2004	83	77	DY	12.4
354420	KERBY	OR	42.217	-123.650	1270	1949	1967	19	142	HR	63.1
354426	KERBY 3 NNW	OR	42.217	-123.650	1210	1967	2006	40	142	HR	63.1
454201	KID VALLEY	WA	46.367	-122.617	689	1938	1980	43	15	DY	61.4
23G09S	KING MOUNTAIN	OR	42.724	-123.200	4000	1980	2006	27	142	Snotel	62.9
264236	KINGS RIVER VALLEY	NV	41.750	-118.233	423	1956	2006	51	146	DY	8.9
044577	KLAMATH	CA	41.567	-124.067	28	1948	2006	59	5	HR	73.5
354506	KLAMATH FALLS 2 SSW	OR	42.201	-121.781	4098	1898	2001	104	147	DY	13.9
354511	KLAMATH FALLS AG STA	OR	42.164	-121.755	4092	1948	2006	59	147	DY	12.5
044587	KNEELAND 10 SSE	CA	40.633	-123.900	2450	1954	2006	53	151	HR	62.8
454286	KOSMOS	WA	46.500	-122.183	781	1905	1965	61	15	DY	64.6
105038	KUNA 2 NNE	ID	43.517	-116.400	2690	1926	1996	71	9	DY	10.8
454328	LA CENTER	WA	45.850	-122.650	200	1896	1940	45	31	DY	48.3
354622	LA GRANDE	OR	45.317	-118.075	2755	1948	2006	59	13	DY	17.1
454360	LA GRANDE	WA	46.833	-122.317	961	1954	1983	30	15	DY	39.3
354620	LA GRANDE CAA AIRPOR	OR	45.283	-118.017	2707	1948	1966	19	13	HR	14.0
354603	LACOMB 1 WNW	OR	44.583	-122.750	650	1948	1987	40	31	HR	48.4
354606	LACOMB 3 NNE	OR	44.625	-122.719	520	1973	2006	34	31	DY	57.5
454338	LACROSSE	WA	46.816	-117.881	1450	1908	2006	99	7	DY	14.8
354632	LAKE 2 N	OR	43.267	-120.633	4366	1909	1978	70	145	DY	9.5
044675	LAKE CITY	CA	41.633	-120.217	4613	1929	1960	32	145	DY	21.4
354634	LAKE CREEK 2 S	OR	42.390	-122.626	1865	1955	1972	18	143	DY	26.0
354633	LAKE CREEK 3 NE	OR	42.450	-122.567	2400	1978	1995	18	143	DY	30.1
354635	LAKE CREEK 6 SE	OR	42.367	-122.533	1752	1917	1953	37	143	DY	30.2
18E18S	LAKE CREEK R.S.	OR	44.210	-118.638	5200	1981	2006	26	13	Snotel	25.5
354670	LAKEVIEW 2 NNW	OR	42.214	-120.364	4778	1893	2006	114	145	DY	15.8
17H07S	LAMANCE CREEK	NV	41.515	-117.631	6000	1980	2006	27	146	Snotel	29.8
354721	LANGLOIS #2	OR	42.924	-124.453	90	1956	2006	51	5	DY	74.8
105132	LAPWAI	ID	46.400	-116.800	889	1916	1938	23	9	DY	17.8
16H05S	LAUREL DRAW	NV	41.777	-116.028	6700	1979	2006	28	146	Snotel	26.0
354776	LAUREL MOUNTAIN	OR	44.923	-123.575	3589	1978	2006	29	142	DY	124.7
044838	LAVA BEDS NAT MONUME	CA	41.740	-121.507	4770	1959	2006	48	145	DY	14.6
354811	LEABURG 1 SW	OR	44.100	-122.688	675	1933	2006	74	15	DY	65.3
354824	LEES CAMP	OR	45.583	-123.517	655	1948	2006	59	151	HR	124.6
354835	LEMOLO LAKE 3 NNW	OR	43.360	-122.221	4077	1978	2006	29	154	DY	65.1
264527	LEONARD CREEK RANCH	NV	41.517	-118.719	4224	1954	2006	53	145	DY	9.6
105236	LEWISTON	ID	46.417	-117.017	810	1895	1955	61	9	DY	13.6
105241	LEWISTON AP	ID	46.367	-117.000	1436	1950	2006	57	9	HR	17.2
454679	LIND 3 NE	WA	46.998	-118.571	1630	1931	2006	76	77	DY	10.1
454702	LITTLE GOOSE DAM	WA	46.583	-118.033	702	1964	1979	16	77	HR	12.6
22E09S	LITTLE MEADOWS	OR	44.613	-122.226	4000	1980	2006	27	15	Snotel	111.8
354939	LITTLE RIVER	OR	43.233	-122.987	1060	1955	2006	52	15	DY	52.4
355008	LONDON	OR	43.650	-123.083	932	1947	1967	21	31	DY	52.4
21C26S	LONE PINE	WA	46.272	-121.964	3800	1981	2006	26	15	Snotel	100.8
454752	LONG BEACH 3 NNE	WA	46.383	-124.033	30	1953	1967	15	5	DY	78.3
454748	LONG BEACH EXP STN	WA	46.367	-124.033	30	1953	2006	54	5	DY	80.3
355020	LONG CREEK	OR	44.714	-119.101	3740	1957	2006	50	144	DY	16.6
454764	LONGMIRE RAINIER NPS	WA	46.750	-121.817	2762	1909	2006	98	15	DY	84.7
454769	LONGVIEW	WA	46.151	-122.916	12	1925	2006	82	31	DY	46.1

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
355026	LOOKINGGLASS	OR	43.181	-123.485	622	1978	2006	29	32	DY	39.4
045093	LOOKOUT 3 WSW	CA	41.200	-121.200	4183	1963	1977	15	145	DY	21.9
355050	LOOKOUT POINT DAM	OR	43.900	-122.750	712	1955	2006	52	15	HR	48.1
355055	LOST CREEK DAM	OR	42.667	-122.667	1580	1970	2006	37	143	HR	34.2
21C39S	LOST HORSE	WA	46.357	-121.081	5000	1990	2006	17	14	Snotel	34.9
264698	LOVELOCK	NV	40.183	-118.467	3975	1952	2006	55	145	HR	5.8
355080	LOWER HAY CREEK	OR	44.733	-120.975	1887	1938	2006	69	145	DY	11.1
454841	LOWER MONUMENTL DAM	WA	46.550	-118.533	460	1963	1979	17	77	HR	10.5
18D06S	LUCKY STRIKE	OR	45.275	-118.848	5050	1978	2006	29	13	Snotel	28.5
045231	MADELINE	CA	41.067	-120.483	5262	1908	1975	68	145	DY	14.7
19D03S	MADISON BUTTE	OR	45.105	-119.496	5250	1980	2006	27	13	Snotel	22.2
355139	MADRAS	OR	44.617	-121.001	3372	1920	2006	87	145	DY	10.7
355142	MADRAS 2 N	OR	44.666	-121.144	2414	1974	2006	33	145	DY	11.6
355160	MALHEUR BRANCH EXP S	OR	43.979	-117.025	2260	1942	2006	65	9	DY	10.2
355162	MALHEUR REFUGE HDQ	OR	43.266	-118.843	4109	1959	2006	48	146	DY	10.2
355170	MALIN	OR	42.017	-121.417	4052	1925	1946	22	145	DY	11.8
355174	MALIN 5 E	OR	42.008	-121.319	4627	1968	2006	39	145	DY	13.9
355206	MAPLETON 2 NNW	OR	44.050	-123.867	41	1975	2006	32	5	HR	83.6
355213	MARCOLA	OR	44.167	-122.867	545	1948	2006	59	31	HR	51.7
355218	MARIAL 7 N	OR	42.817	-123.900	2313	1956	1984	29	142	HR	90.8
21E04S	MARION FORKS	OR	44.594	-121.974	2600	1980	2006	27	15	Snotel	81.0
355221	MARION FRKS FISH HAT	OR	44.600	-121.933	2475	1948	2006	59	154	HR	77.2
355258	MASON DAM	OR	44.672	-117.994	3900	1969	2006	38	13	DY	17.0
455105	MAYFIELD	WA	46.483	-122.517	600	1893	1937	45	31	DY	59.7
455110	MAYFIELD POWER PLANT	WA	46.504	-122.594	280	1980	2006	27	31	DY	58.1
045449	MC CLOUD	CA	41.267	-122.133	3304	1909	2006	98	14	DY	51.4
355335	MC DERMITT 26 N	OR	42.411	-117.866	4464	1955	2006	52	146	DY	9.3
355357	MC KENZIE BRIDGE	OR	44.183	-122.167	1371	1954	1970	17	15	DY	76.4
355362	MC KENZIE BRIDGE R S	OR	44.178	-122.116	1478	1931	2006	76	15	DY	66.7
355384	MC MINNVILLE	OR	45.221	-123.162	98	1894	2006	113	32	DY	42.8
105708	MCCALL	ID	44.887	-116.105	5025	1905	2006	102	148	DY	27.4
264935	MCDERMITT	NV	41.983	-117.717	4527	1950	2006	57	146	HR	9.1
21E07S	MCKENZIE	OR	44.210	-121.873	4800	1981	2006	26	154	Snotel	95.7
355362	MCKENZIE BRIDGE RS	OR	44.167	-122.100	1478	1948	1975	28	15	HR	68.8
355375	MCKINLEY	OR	43.183	-124.033	141	1897	1944	48	5	DY	62.8
455231	MCNARY DAM	WA	45.941	-119.298	361	1954	2006	53	77	DY	8.5
355396	MEACHAM WSO AIRPORT	OR	45.500	-118.400	4050	1948	2006	59	13	DY	33.4
355429	MEDFORD INTL AP	OR	42.381	-122.872	1297	1928	2006	79	8	DY	18.4
355447	MEHAMA	OR	44.783	-122.617	620	1923	1966	44	15	DY	68.4
105841	MERIDIAN 1 SSW	ID	43.600	-116.400	2612	1911	1960	50	9	DY	11.4
355505	MERRILL 2 NW	OR	42.050	-121.633	4198	1949	1968	20	147	DY	12.0
455305	MERWIN DAM	WA	45.950	-122.550	224	1934	2006	73	31	DY	70.2
355515	METOLIUS 1 W	OR	44.583	-121.183	2503	1945	1993	49	145	DY	10.4
265105	MIDAS 4 SE	NV	41.200	-116.733	5203	1952	1969	18	146	DY	11.4
355545	MIKKALO 6 W	OR	45.467	-120.350	1550	1948	1994	47	77	DY	10.9
455377	MILL CREEK	WA	46.017	-118.117	2001	1915	1973	59	13	DY	45.8
455387	MILL CREEK DAM	WA	46.076	-118.274	1175	1948	2006	59	7	DY	19.6
355593	MILTON FREEWATER	OR	45.943	-118.409	970	1928	2006	79	7	DY	16.0
355610	MINAM 7 NE	OR	45.683	-117.600	3616	1955	1985	31	13	DY	26.9
455425	MINERAL 1 SW	WA	46.717	-122.183	1470	1935	1980	46	15	DY	82.5
355621	MIRA MONTE FARM	OR	45.267	-122.750	161	1893	1924	32	31	DY	42.4
355641	MITCHELL 2 NW	OR	44.583	-120.183	2645	1931	1994	64	144	DY	12.1
355656	MODOC ORCHARD	OR	42.450	-122.883	1220	1915	1966	52	8	DY	21.7
355677	MOLALLA	OR	45.150	-122.567	400	1935	1976	42	31	DY	45.0
355707	MONTGOMERY RANCH	OR	44.617	-121.483	1903	1930	1949	20	147	DY	16.1
355711	MONUMENT 2	OR	44.818	-119.419	1995	1961	2006	46	7	DY	14.8

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
355715	MONUMENT RANGER STN	OR	44.817	-119.417	1981	1948	2006	59	7	HR	14.8
355726	MORGAN 3 NE	OR	45.583	-119.883	951	1923	1979	57	77	DY	9.5
355734	MORO	OR	45.482	-120.724	1870	1917	2006	90	147	DY	11.6
21C17S	MORSE LAKE	WA	46.906	-121.483	5400	1978	2006	29	15	Snotel	83.9
106148	MOSCOW 5 NE	ID	46.783	-116.917	3000	1972	2006	35	148	HR	31.9
106152	MOSCOW U OF I	ID	46.733	-117.000	2631	1893	2006	114	148	DY	26.4
17D06S	MOSS SPRINGS	OR	45.272	-117.688	5850	1980	2006	27	13	Snotel	50.6
455656	MOTTINGER	WA	45.933	-119.150	312	1899	1946	48	77	DY	8.9
455659	MOUNT ADAMS RANGER S	WA	46.000	-121.540	1950	1924	2006	83	14	DY	42.6
355770	MOUNT ANGEL	OR	45.067	-122.750	489	1893	1926	34	31	DY	45.5
045941	MOUNT HEBRON RNG STN	CA	41.784	-122.045	4250	1942	2006	65	14	DY	12.6
045983	MOUNT SHASTA	CA	41.317	-122.300	3590	1948	2006	59	154	HR	41.7
455686	MOXEE	WA	46.583	-120.433	1001	1892	1945	54	77	DY	8.8
455688	MOXEE CITY 10 E	WA	46.500	-120.150	1550	1901	2006	106	77	DY	8.3
21D08S	MT HOOD TEST SITE	OR	45.321	-121.716	5400	1980	2006	27	154	Snotel	110.7
17D18S	MT. HOWARD	OR	45.265	-117.173	7910	1980	2006	27	13	Snotel	44.5
16G07S	MUD FLAT	ID	42.600	-116.559	5730	1980	2006	27	146	Snotel	17.8
21D35S	MUD RIDGE	OR	45.254	-121.737	3800	1978	2006	29	154	Snotel	71.5
355892	MYRTLE CREEK 12 ENE	OR	43.050	-123.067	1191	1955	1980	26	15	DY	41.2
355891	MYRTLE CREEK 8 NE	OR	43.091	-123.167	825	1980	2006	27	15	DY	39.9
356151	N WILLAMETTE EXP STN	OR	45.282	-122.752	98	1963	2006	44	31	DY	42.5
455736	NACHES HEIGHTS	WA	46.650	-120.633	1870	1910	1948	39	147	DY	11.1
106300	NAMPA 2 NW	ID	43.617	-116.583	2470	1946	1960	15	9	DY	10.6
106305	NAMPA SUGAR FACTORY	ID	43.600	-116.567	2470	1976	2006	31	9	DY	10.5
455774	NASELLE 2 ENE	WA	46.373	-123.753	50	1929	2006	78	5	DY	112.0
355969	NEHALEM	OR	45.717	-123.900	75	1948	2006	59	5	HR	99.4
355971	NEHALEM 9 NE	OR	45.814	-123.775	140	1969	2006	38	5	DY	119.8
21F10S	NEW CRESCENT LAKE	OR	43.512	-121.980	4800	1980	2006	27	154	Snotel	41.8
106388	NEW MEADOWS RANG S	ID	44.967	-116.283	3862	1905	2006	102	148	DY	24.7
356032	NEWPORT	OR	44.643	-124.056	122	1893	2006	114	5	DY	69.1
106424	NEZPERCE	ID	46.250	-116.200	3251	1948	2006	59	148	DY	21.8
356073	NORTH BEND FCWOS	OR	43.413	-124.244	6	1902	2006	105	5	DY	64.8
22D02S	NORTH FORK	OR	45.550	-122.003	3170	1979	2006	28	15	Snotel	143.2
356171	NOTI 2 ESE	OR	44.050	-123.417	449	1948	1984	37	32	HR	57.8
356179	NYSSA	OR	43.876	-116.990	2175	1937	2006	70	9	DY	10.5
356302	O O RANCH	OR	43.278	-119.311	4136	1950	2006	57	145	DY	10.2
046329	OAK KNOLL RANGER STN	CA	41.850	-122.883	1700	1972	2006	35	143	DY	24.7
046328	OAK KNOLL W C	CA	41.839	-122.850	1980	1943	2006	64	143	DY	25.3
356200	OAKLAND	OR	43.423	-123.300	430	1978	2006	29	31	DY	40.6
356213	OAKRIDGE FISH HATCHE	OR	43.743	-122.443	1275	1914	2006	93	15	DY	46.1
456011	OAKVILLE	WA	46.833	-123.233	80	1916	1997	82	32	DY	57.7
356238	OCHOCO DAM	OR	44.283	-120.717	3057	1949	2006	58	145	HR	11.8
20E02S	OCHOCO MEADOWS	OR	44.429	-120.331	5200	1980	2006	27	144	Snotel	29.0
356243	OCHOCO RANGER STATIO	OR	44.400	-120.433	3975	1909	2004	96	144	DY	16.2
356251	ODELL LAKE	OR	43.583	-122.050	4793	1948	1973	26	154	DY	58.9
356252	ODELL LAKE EAST	OR	43.549	-121.964	4800	1974	2006	33	154	DY	35.5
356254	ODELL LAKE WATER PAN	OR	43.583	-122.050	4793	1945	1959	15	154	DY	58.9
106586	OLA	ID	44.167	-116.267	3075	1948	2006	59	148	HR	23.3
356269	OLIVE LAKE	OR	44.783	-118.600	5945	1920	1947	28	13	DY	33.0
456114	OLYMPIA AIRPORT	WA	46.973	-122.903	188	1948	2006	59	32	DY	50.3
356294	ONTARIO KSRV	OR	44.033	-116.967	2145	1949	2006	58	9	HR	9.6
356334	OREGON CITY	OR	45.355	-122.605	167	1911	2006	96	31	DY	45.5
046498	ORICK PRAIRIE CREEK	CA	41.367	-124.017	160	1937	2006	70	151	DY	67.6
046508	ORLEANS	CA	41.309	-123.532	400	1903	2006	104	143	DY	52.9
106681	OROFINO	ID	46.483	-116.250	1030	1903	1981	79	148	DY	24.5
265818	OROVADA 4 WSW	NV	41.550	-117.833	429	1911	2006	96	146	DY	10.4

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
456215	OTHELLO 6 ESE	WA	46.789	-119.046	1190	1941	2002	62	77	DY	8.5
356366	OTIS 2 NE	OR	45.033	-123.924	150	1948	2006	59	5	DY	97.9
265869	OWYHEE	NV	41.950	-116.100	5397	1948	1975	28	146	HR	14.5
356405	OWYHEE DAM	OR	43.650	-117.247	2400	1935	2006	72	9	DY	9.9
356853	P RANCH REFUGE	OR	42.827	-118.888	4195	1942	2006	65	146	DY	12.8
456262	PACKWOOD	WA	46.609	-121.674	1060	1924	2006	83	15	DY	57.5
356426	PAISLEY	OR	42.692	-120.540	4360	1905	2006	102	145	DY	10.8
21C35S	PARADISE	WA	46.781	-121.747	5120	1980	2006	27	15	Snotel	115.9
266005	PARADISE VALLEY RANC	NV	41.500	-117.533	468	1894	2006	113	146	DY	11.2
356464	PARKDALE	OR	45.517	-121.583	1713	1912	1969	58	14	DY	41.6
356466	PARKDALE 1 NNE	OR	45.533	-121.583	1520	1928	2006	79	14	DY	37.7
456385	PARKWAY 6 S	WA	46.917	-121.533	3553	1943	1966	24	15	DY	56.3
106844	PARMA EXPERIMENT STN	ID	43.802	-116.944	2290	1922	2006	85	9	DY	10.0
456400	PASCO	WA	46.217	-119.100	350	1942	2003	62	77	HR	7.8
356500	PAULINA	OR	44.133	-119.997	3684	1961	2005	45	144	DY	11.7
106891	PAYETTE	ID	44.077	-116.929	2150	1892	2006	115	9	DY	10.8
21D14S	PEAVINE RIDGE	OR	45.041	-121.933	3500	1981	2006	26	15	Snotel	68.1
356532	PELTON DAM	OR	44.728	-121.251	1410	1958	2006	49	145	DY	10.9
356540	PENDLETON BR EXP STN	OR	45.721	-118.626	1487	1956	2006	51	7	DY	17.3
356541	PENDLETON DOWNTOWN	OR	45.670	-118.796	1040	1892	1936	45	7	DY	14.0
356541	PENDLETON DOWNTOWN	OR	45.670	-118.796	1040	1987	2006	20	7	DY	14.0
356546	PENDLETON E OR RGNL	OR	45.698	-118.855	1486	1928	2006	79	7	DY	13.0
456456	PEOLA	WA	46.333	-117.467	4003	1909	1936	28	9	DY	20.5
456477	PETERSONS RANCH	WA	46.050	-122.200	600	1927	1953	27	15	DY	122.4
356614	PHILOMATH 2 SE	OR	44.533	-123.333	220	1940	1972	33	32	DY	44.3
21C33S	PIGTAIL PEAK	WA	46.621	-121.386	5900	1981	2006	26	154	Snotel	72.7
356634	PILOT ROCK 1 SE	OR	45.476	-118.825	1720	1908	2006	99	7	DY	14.4
356636	PILOT ROCK 11 E	OR	45.500	-118.600	1920	1978	2006	29	13	HR	24.2
356655	PINE GROVE 5 ENE	OR	45.129	-121.256	2059	1969	1998	30	14	DY	17.7
046944	PIT RIVER P H 1	CA	41.000	-121.500	2880	1972	1996	25	145	DY	19.1
456553	PLEASANT VIEW	WA	46.517	-118.333	1670	1936	1979	44	77	DY	13.4
456610	POMEROY	WA	46.469	-117.589	1900	1929	2006	78	9	DY	17.6
356784	PORT ORFORD 2	OR	42.752	-124.501	42	1905	2006	102	5	DY	73.3
356795	PORT ORFORD 5 E	OR	42.739	-124.403	150	1971	2006	36	5	DY	122.7
356751	PORTLAND INTL AIRPOR	OR	45.583	-122.600	19	1941	2006	66	32	HR	38.4
356749	PORTLAND KGW-TV	OR	45.517	-122.683	160	1928	2006	79	32	DY	43.8
356761	PORTLAND WB CITY	OR	45.533	-122.667	200	1928	1973	46	32	DY	43.5
21C14S	POTATO HILL	WA	46.349	-121.514	4500	1981	2006	26	14	Snotel	66.3
107301	POTLATCH 1 SE	ID	46.900	-116.867	2592	1915	2006	92	148	DY	26.8
356820	POWERS	OR	42.889	-124.069	230	1932	2006	75	151	DY	59.8
356822	POWERS TELEMETERING	OR	42.883	-124.067	220	1971	2006	36	142	HR	58.1
356845	PRAIRIE CITY RS	OR	44.450	-118.700	3540	1949	2006	58	13	HR	17.7
456747	PRIEST RAPIDS DAM	WA	46.643	-119.910	460	1956	2006	51	77	DY	7.0
456753	PRINDLE 2 NW	WA	45.583	-122.167	249	1933	1949	17	31	DY	71.5
356883	PRINEVILLE	OR	44.307	-120.807	2915	1897	2006	110	145	DY	10.7
356907	PROSPECT 2 SW	OR	42.734	-122.516	2482	1905	2006	102	143	DY	41.7
456768	PROSSER	WA	46.200	-119.750	830	1913	2006	94	77	DY	8.6
456789	PULLMAN 2 NW	WA	46.750	-117.183	2545	1940	2006	67	13	HR	22.0
456784	PULLMAN EXP STN	WA	46.733	-117.167	2582	1893	1954	62	7	DY	21.4
20G06S	QUARTZ MOUNTAIN	OR	42.319	-120.825	5700	1980	2006	27	145	Snotel	21.8
356955	QUARTZVILLE 13 SW	OR	44.483	-122.500	820	1939	1962	24	15	DY	82.6
266504	QUINN RIVER CROSSING	NV	41.567	-118.433	409	1901	1951	51	146	DY	6.9
22F05S	RAILROAD OVERPASS	OR	43.659	-122.213	2750	1981	2006	26	15	Snotel	57.1
456887	RAINBOW FALLS PARK 2	WA	46.633	-123.183	279	1928	1963	36	32	DY	54.6
456892	RAINIER CARBON R ENT	WA	46.994	-121.911	1735	1926	1974	49	15	DY	71.9
456896	RAINIER OHANAPECOSH	WA	46.733	-121.567	1950	1941	2006	66	15	HR	76.9

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
456898	RAINIER PARADISE RNG	WA	46.786	-121.743	5427	1917	2006	90	15	DY	128.2
456909	RANDLE 1 E	WA	46.533	-121.933	900	1930	2006	77	15	DY	62.4
456914	RAYMOND 2 S	WA	46.653	-123.730	30	1980	2006	27	5	DY	85.0
21D04S	RED HILL	OR	45.465	-121.704	4400	1978	2006	29	154	Snotel	108.9
357056	REDMOND 1 SSE	OR	44.263	-121.158	3042	1930	1989	60	145	DY	9.3
357062	REDMOND AIRPORT	OR	44.256	-121.139	3043	1948	2006	59	145	DY	8.9
047342	REDWOOD CREEK O'KANE	CA	40.900	-123.800	880	1975	2006	32	142	HR	60.9
357082	REEDSPORT	OR	43.700	-124.117	200	1937	1983	47	5	DY	73.1
357112	RESTON	OR	43.131	-123.620	890	1955	2004	50	32	DY	49.9
357127	REX 1 S	OR	45.300	-122.900	515	1948	2006	59	32	HR	45.0
107648	REYNOLDS	ID	43.206	-116.749	3930	1961	2006	46	9	DY	10.9
357160	RICHLAND	OR	44.766	-117.160	2215	1893	2006	114	9	DY	12.7
457015	RICHLAND	WA	46.312	-119.263	373	1944	2006	63	77	DY	7.8
357169	RIDDLE	OR	42.951	-123.357	680	1899	2006	108	143	DY	32.3
107706	RIGGINS RANGER STN	ID	45.417	-116.300	1801	1896	2006	111	148	DY	17.9
457038	RIMROCK TIETON DAM	WA	46.650	-121.133	2733	1917	1977	61	14	DY	25.6
354003	RIVER EXP STN	OR	45.685	-121.518	500	1893	2006	114	14	DY	30.7
357208	RIVERSIDE 7 SSW	OR	43.451	-118.224	3380	1897	2006	110	146	DY	10.1
22F43S	ROARING RIVER	OR	43.901	-122.031	4900	1980	2006	27	154	Snotel	70.9
357250	ROCK CREEK	OR	44.910	-118.073	4095	1920	2006	87	13	DY	21.1
18F01S	ROCK SPRINGS	OR	44.009	-118.838	5100	1980	2006	27	144	Snotel	17.7
357277	ROCKVILLE 5 N	OR	43.364	-117.114	3670	1963	2006	44	146	DY	12.5
357310	ROME 2 NW	OR	42.859	-117.657	3405	1950	2006	57	146	DY	8.5
357331	ROSEBURG KQEN	OR	43.213	-123.366	425	1965	2006	42	32	DY	33.7
357326	ROSEBURG WB AIRPORT	OR	43.233	-123.367	505	1931	1965	35	32	DY	34.1
357354	ROUND GROVE	OR	42.341	-120.889	4888	1920	1987	68	145	DY	18.7
047581	ROUND MOUNTAIN	CA	40.783	-121.933	2100	1970	2001	32	145	HR	65.0
357391	RUCH	OR	42.223	-123.047	1550	1963	2006	44	143	DY	25.0
267192	RYE PATCH DAM	NV	40.450	-118.300	4135	1948	2006	59	145	HR	8.6
23D01S	SADDLE MOUNTAIN	OR	45.545	-123.373	3250	1979	2006	28	142	Snotel	103.9
357444	SAGINAW	OR	43.833	-123.033	620	1941	1971	31	31	DY	48.1
357500	SALEM AP MCNARY FIEL	OR	44.905	-123.001	205	1892	2006	115	31	DY	41.1
22F04S	SALT CREEK FALLS	OR	43.612	-122.118	4000	1980	2006	27	154	Snotel	74.4
357533	SAND CREEK	OR	42.850	-121.900	4682	1929	1948	20	14	DY	32.6
21E05S	SANTIAM JCT.	OR	44.435	-121.945	3750	1978	2006	29	154	Snotel	77.3
357554	SANTIAM JUNCTION	OR	44.433	-121.933	3750	1948	2006	59	154	HR	76.5
357559	SANTIAM PASS	OR	44.417	-121.867	4754	1963	1985	23	154	DY	87.0
457327	SATSOP	WA	46.967	-123.533	39	1928	1947	20	32	DY	82.2
457342	SATUS PASS 2 SSW	WA	45.950	-120.667	2610	1956	2006	51	14	HR	21.2
357572	SAUVIES ISLAND	OR	45.650	-122.833	40	1948	2006	59	32	HR	41.5
048025	SAWYERS BAR RS	CA	41.302	-123.133	2169	1931	1988	58	143	DY	40.1
17D08S	SCHNEIDER MEADOWS	OR	45.001	-117.165	5400	1980	2006	27	13	Snotel	48.0
357631	SCOTTS MILLS 9 SE	OR	44.947	-122.525	2315	1956	2001	46	15	DY	82.9
357641	SEASIDE	OR	45.987	-123.924	10	1930	2006	77	5	DY	75.0
23D02S	SEINE CREEK	OR	45.526	-123.297	2000	1980	2006	27	142	Snotel	77.5
357675	SENECA	OR	44.138	-118.975	4660	1931	2006	76	144	DY	13.7
22G33S	SEVENMILE MARSH	OR	42.698	-122.142	6200	1980	2006	27	154	Snotel	63.8
357698	SEXTON SUMMIT	OR	42.600	-123.350	3832	1948	2006	59	143	HR	33.4
048135	SHASTA DAM	CA	40.700	-122.400	1075	1948	2006	59	154	HR	62.3
357736	SHEAVILLE 1 SE	OR	43.121	-117.039	4620	1931	2004	74	146	DY	16.1
22C10S	SHEEP CANYON	WA	46.193	-122.254	4030	1980	2006	27	15	Snotel	135.9
267443	SHELDON	NV	41.850	-119.633	6506	1933	1972	40	145	DY	12.7
19H05S	SHELDON	NV	41.904	-119.445	5860	1989	2006	18	145	Snotel	10.8
16C01S	SHERWIN	ID	46.950	-116.340	3200	1982	2006	25	148	Snotel	41.2
108412	SILVER CITY 5 W	ID	43.000	-116.817	6160	1983	2006	24	146	HR	26.0
21F12S	SILVER CREEK	OR	42.956	-121.181	5720	1980	2006	27	145	Snotel	26.1

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STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
357809	SILVER CREEK FALLS	OR	44.873	-122.648	1350	1938	2006	69	31	DY	78.3
357817	SILVER LAKE RANGER S	OR	43.117	-121.050	4382	1968	2006	39	145	HR	10.3
357823	SILVERTON	OR	45.000	-122.767	408	1962	2006	45	31	HR	47.6
18G01S	SILVIES	OR	42.753	-118.688	6900	1979	2006	28	146	Snotel	33.6
357857	SISTERS	OR	44.284	-121.549	3180	1958	2006	49	14	DY	14.2
357866	SITKUM 1 E	OR	43.150	-123.817	610	1976	2006	31	151	HR	80.1
457680	SIXPRONG	WA	45.833	-120.117	1102	1906	1943	38	147	DY	10.6
457696	SKAMANIA FISH HATCHE	WA	45.623	-122.218	440	1965	2006	42	31	DY	87.5
457727	SMYRNA	WA	46.837	-119.663	560	1951	2006	56	77	DY	7.9
19F01S	SNOW MOUNTAIN	OR	43.949	-119.540	6220	1979	2006	28	144	Snotel	28.4
357940	SOUTH DEER CREEK	OR	43.171	-123.225	690	1978	2006	29	15	DY	36.5
16G01S	SOUTH MTN.	ID	42.765	-116.901	6500	1980	2006	27	146	Snotel	32.8
21C20S	SPENCER MEADOW	WA	46.180	-121.926	3400	1981	2006	26	15	Snotel	104.2
22C12S	SPIRIT LAKE	WA	46.095	-121.763	3120	1985	2006	22	154	Snotel	98.6
457919	SPIRIT LAKE RANGER S	WA	46.267	-122.150	3241	1932	1956	25	15	DY	99.6
358007	SPRAGUE RIVER 2 SE	OR	42.431	-121.489	4483	1953	2001	49	145	DY	16.0
358009	SPRAY	OR	44.833	-119.783	1742	1958	1978	21	7	DY	15.0
358029	SQUAW BUTTE EXP STAT	OR	43.487	-119.721	4660	1937	2006	70	145	DY	11.8
16E05S	SQUAW FLAT	ID	44.771	-116.249	6240	1981	2006	26	148	Snotel	45.0
357466	ST HELENS RFD	OR	45.861	-122.810	100	1976	2006	31	31	DY	45.0
358034	STAFFORD	OR	45.417	-122.750	410	1896	1919	24	32	DY	42.4
358079	STARKEY	OR	45.233	-118.450	3402	1909	1948	40	13	DY	18.0
19E07S	STARR RIDGE	OR	44.265	-119.021	5300	1980	2006	27	144	Snotel	20.9
358095	STAYTON	OR	44.789	-122.815	425	1951	2006	56	31	DY	53.5
358102	STEAMBOAT RANGER STN	OR	43.333	-122.733	1200	1955	2006	52	15	HR	50.1
20G09S	STRAWBERRY	OR	42.126	-120.836	5760	1980	2006	27	145	Snotel	23.0
358173	SUMMER LAKE 1 S	OR	42.959	-120.790	4192	1957	2006	50	145	DY	12.8
20G02S	SUMMER RIM	OR	42.696	-120.802	7100	1978	2006	29	145	Snotel	28.3
358182	SUMMIT	OR	44.637	-123.579	746	1909	1995	87	142	DY	65.6
358182	SUMMIT	OR	44.633	-123.567	746	1971	2006	36	142	HR	66.7
358190	SUMMIT GUARD STN	OR	45.300	-121.750	3904	1895	1951	57	15	DY	86.0
22F14S	SUMMIT LAKE	OR	43.449	-122.138	5600	1978	2006	29	154	Snotel	73.4
358221	SUNDOWN RANCH	OR	44.950	-122.500	2402	1931	1955	25	15	DY	79.1
458207	SUNNYSIDE	WA	46.324	-120.010	747	1894	2006	113	77	DY	7.3
358245	SUNRISE VALLEY	OR	43.100	-118.167	3714	1913	1936	24	146	DY	14.1
358250	SUNTEX	OR	43.600	-119.633	4311	1961	1990	30	145	DY	9.4
21C13S	SURPRISE LAKES	WA	46.095	-121.763	4250	1980	2006	27	154	Snotel	98.6
048703	SUSANVILLE 1 WNW	CA	40.417	-120.667	4555	1952	2006	55	145	HR	15.6
358263	SUTHERLIN 12 ENE	OR	43.417	-123.050	960	1955	2006	52	15	HR	63.7
358260	SUTHERLIN 2 W	OR	43.396	-123.359	500	1978	2006	29	32	DY	40.9
108928	SWAN FALLS P H	ID	43.244	-116.378	2325	1935	2006	72	9	DY	8.5
358338	TALENT	OR	42.250	-122.800	1552	1913	1960	48	8	DY	19.2
21G03S	TAYLOR BUTTE	OR	42.691	-121.426	5100	1978	2006	29	145	Snotel	22.6
15H09S	TAYLOR CANYON	NV	41.229	-116.030	6200	1980	2006	27	146	Snotel	13.2
17D07S	TAYLOR GREEN	OR	45.077	-117.551	5740	1979	2006	28	13	Snotel	38.2
048873	TERMO 1 E	CA	40.867	-120.433	5300	1948	2000	53	145	HR	10.7
358407	THE DALLES	OR	45.607	-121.205	150	1893	2006	114	14	DY	14.5
358420	THE POPLARS	OR	43.264	-120.945	4310	1941	2006	66	145	DY	11.7
21E13S	THREE CREEKS MEADOW	OR	44.144	-121.641	5650	1980	2006	27	14	Snotel	43.1
358466	THREE LYNX	OR	45.125	-122.072	1120	1923	2006	84	15	DY	72.2
358481	TIDEWATER	OR	44.412	-123.902	50	1940	2002	63	5	DY	91.2
458442	TIETON INTAKE	WA	46.667	-121.000	2280	1920	1972	53	14	DY	21.0
358494	TILLAMOOK 1 W	OR	45.457	-123.873	10	1948	2006	59	5	DY	90.1
358504	TILLAMOOK 12 ESE	OR	45.400	-123.583	420	1949	2006	58	151	HR	121.4
358514	TILLER	OR	42.917	-122.933	1040	1971	2006	36	15	HR	41.5
358512	TILLER 15 ENE	OR	43.000	-122.683	2500	1956	2006	51	15	HR	42.1

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
358522	TIMBER	OR	45.717	-123.300	942	1924	1976	53	142	DY	66.5
18E09S	TIPTON	OR	44.656	-118.426	5150	1980	2006	27	13	Snotel	25.2
358536	TOKETEE FALLS	OR	43.275	-122.450	2060	1953	2006	54	15	DY	48.6
458500	TOLEDO	WA	46.469	-122.841	325	1948	2006	59	31	DY	44.7
358549	TOLLGATE	OR	45.783	-118.083	4892	1948	1963	16	13	HR	55.4
458540	TOUCHET	WA	46.033	-118.667	440	1905	1940	36	7	DY	11.7
17C05S	TOUCHET	WA	46.119	-117.851	5530	1980	2006	27	13	Snotel	55.0
458543	TOUCHET RIDGE	WA	46.117	-117.983	3602	1909	1943	35	13	DY	44.7
358588	TRAIL 12 NE	OR	42.783	-122.667	1850	1951	1970	20	143	HR	43.4
358634	TROUTDALE	OR	45.553	-122.389	33	1948	2006	59	31	DY	44.7
049053	TULELAKE	CA	41.967	-121.467	4042	1932	2006	75	145	DY	11.5
049056	TULELAKE 5 WSW	CA	41.933	-121.550	4042	1932	1957	26	145	DY	11.2
268346	TUSCARORA	NV	41.317	-116.233	6184	1957	2006	50	146	DY	14.2
268349	TUSCARORA ANDRAE RAN	NV	41.400	-116.083	5863	1888	1956	69	146	DY	16.7
358717	TYGH VALLEY	OR	45.233	-121.167	1115	1972	2006	35	14	HR	15.4
358726	UKIAH	OR	45.136	-118.934	3400	1922	2006	85	7	DY	17.0
358734	UMATILLA	OR	45.917	-119.350	269	1892	1965	74	77	DY	8.7
358740	UMPQUA	OR	43.700	-124.167	112	1915	1937	23	5	DY	71.5
458688	UNDERWOOD 4 W	WA	45.733	-121.600	1260	1941	1962	22	14	HR	37.5
358746	UNION EXPERIMENT STN	OR	45.208	-117.876	2765	1911	2006	96	13	DY	14.8
358780	UNITY	OR	44.436	-118.188	4031	1936	2006	71	13	DY	11.0
358788	UPPER OLALLA	OR	43.047	-123.581	860	1978	2006	29	32	DY	42.2
358790	UPPER STEAMBOAT CREE	OR	43.467	-122.600	1855	1957	2006	50	15	HR	45.5
358797	VALE	OR	43.981	-117.244	2240	1893	2006	114	9	DY	10.3
358812	VALLEY FALLS	OR	42.484	-120.282	4325	1910	1964	55	145	DY	13.2
358818	VALLEY FALLS 3 SSE	OR	42.450	-120.250	4583	1965	1983	19	145	DY	17.3
358833	VALSETZ	OR	44.833	-123.667	1155	1948	1987	40	142	HR	122.8
458773	VANCOUVER 4 NNE	WA	45.678	-122.652	210	1898	2006	109	31	DY	42.5
458778	VANCOUVER INTERSTATE	WA	45.621	-122.674	2	1902	1959	58	31	DY	40.0
358884	VERNONIA 2	OR	45.850	-123.183	625	1954	2006	53	32	HR	50.5
049390	VOLTA POWER HOUSE	CA	40.450	-121.850	2220	1948	2006	59	145	HR	35.4
358924	VOLTAGE 2 NW SOD HOU	OR	43.283	-118.833	4114	1937	1959	23	146	DY	10.2
268810	VYA	NV	41.583	-119.917	5663	1959	1980	22	145	DY	14.2
358948	WAGONTIRE	OR	43.250	-119.883	4727	1960	1986	27	145	DY	9.9
458903	WAHLUKE	WA	46.650	-119.717	420	1904	1944	41	77	DY	7.3
358985	WALLA WALLA 13 ESE	OR	45.983	-118.050	2400	1940	2006	67	13	HR	42.1
458926	WALLA WALLA 3 W	WA	46.050	-118.400	801	1931	1962	32	7	DY	16.9
458928	WALLA WALLA FAA AIRP	WA	46.100	-118.283	1166	1949	2006	58	7	DY	19.9
458931	WALLA WALLA WSO CITY	WA	46.033	-118.333	949	1940	1988	49	7	HR	18.1
358997	WALLOWA	OR	45.572	-117.531	2923	1903	2006	104	13	DY	17.5
458959	WAPATO	WA	46.435	-120.420	841	1915	2006	92	77	DY	8.1
359038	WARM SPRINGS AGENCY	OR	44.767	-121.250	1503	1902	1928	27	145	DY	10.1
359046	WARM SPRINGS RESERVO	OR	43.567	-118.200	3343	1927	1967	41	146	DY	9.3
359051	WARREN	OR	45.817	-122.850	79	1950	1976	27	32	DY	45.0
359068	WASCO	OR	45.597	-120.696	1264	1907	2006	100	147	DY	11.9
458999	WASHOUGAL 8 ENE	WA	45.600	-122.183	761	1950	1964	15	31	DY	82.9
359083	WATERLOO	OR	44.500	-122.819	437	1923	2006	84	31	DY	45.9
459024	WAWAWAI 2 NW	WA	46.650	-117.400	702	1928	1965	38	7	DY	18.4
049490	WEAVERVILLE	CA	40.733	-122.933	2040	1948	2006	59	143	HR	37.0
049498	WEED	CA	41.433	-122.383	3514	1943	1957	15	154	DY	29.1
049499	WEED FIRE DEPT	CA	41.433	-122.383	3590	1957	1989	33	154	DY	29.1
109638	WEISER 1 S	ID	44.233	-116.950	2123	1911	2006	96	9	DY	12.4
16D08S	WEST BRANCH	ID	45.072	-116.455	5560	1980	2006	27	148	Snotel	41.9
359208	WEST LINN	OR	45.333	-122.650	69	1938	1968	31	31	DY	47.5
359176	WESTFALL	OR	43.990	-117.719	3040	1962	2006	45	146	DY	10.8
359213	WESTON	OR	45.817	-118.417	1922	1953	2006	54	7	HR	18.6

Exhibit D-4

STATION ID	STATION NAME	STATE	LAT	LONG	ELEV (ft)	YEAR START	YEAR END	YEARS OPEN	RGN	GAGE TYPE	PRISM MAP[4,20] (in)
359216	WESTON 2 SE	OR	45.800	-118.400	2103	1893	1954	62	7	DY	20.9
359219	WESTON 5 ESE	OR	45.800	-118.333	3202	1955	1982	28	13	DY	30.2
21C28S	WHITE PASS E.S.	WA	46.642	-121.381	4500	1980	2006	27	154	Snotel	52.5
459183	WHITE SALMON 4 NNE	WA	45.767	-121.483	2011	1911	1952	42	14	DY	32.8
459191	WHITE SWAN RANGER ST	WA	46.383	-120.717	971	1927	1981	55	147	DY	9.1
359290	WHITEHORSE RANCH	OR	42.337	-118.235	4380	1965	2006	42	146	DY	8.3
459200	WHITMAN MISSION	WA	46.033	-118.450	632	1963	2006	44	7	HR	14.5
359316	WICKIUP DAM	OR	43.682	-121.687	4358	1941	2006	66	14	DY	21.9
359324	WICOPEE	OR	43.667	-122.267	2881	1927	1954	28	15	DY	58.2
359372	WILLAMINA	OR	45.083	-123.489	385	1935	2006	72	32	DY	52.0
459291	WILLAPA HARBOR	WA	46.683	-123.750	10	1895	1979	85	5	DY	83.2
459295	WILLARD FISH LAB	WA	45.767	-121.633	770	1962	1976	15	14	HR	42.4
359390	WILLIAMS 1 NW	OR	42.217	-123.283	1450	1949	2006	58	143	HR	31.3
359398	WILLOW CREEK	OR	42.883	-124.433	249	1922	1951	30	5	DY	89.9
109846	WINCHESTER	ID	46.233	-116.617	3950	1939	2006	68	148	DY	24.9
359461	WINCHESTER	OR	43.283	-123.354	460	1950	2006	57	32	DY	35.8
459342	WIND RIVER	WA	45.800	-121.933	1150	1911	1977	67	15	DY	99.6
269171	WINNEMUCCA AIRPORT	NV	40.900	-117.800	4296	1948	2006	59	146	HR	8.5
18D21S	WOLF CREEK	OR	45.067	-118.152	5700	1978	2006	29	13	Snotel	29.2
459465	YAKIMA AIRPORT	WA	46.567	-120.533	1064	1940	2006	67	147	HR	8.4
359581	YAQUINA BAY	OR	44.617	-124.033	15	1966	2006	41	5	HR	68.5
359604	YONNA	OR	42.300	-121.483	4183	1907	1949	43	145	DY	15.6
049866	YREKA	CA	41.717	-122.633	2631	1893	2006	114	143	DY	19.2
359616	ZIGZAG RANGER STN	OR	45.350	-121.933	1385	1908	1953	46	15	DY	82.8

Exhibit D-4

APPENDIX B

ISOPLUVIAL MAPS FOR SELECTED RECURRENCE INTERVALS

Exhibit D-4

Exhibit D-4

OVERVIEW

Isopluvial maps for 24-hour precipitation for recurrence intervals for the 6-month, 2-year, 10-year, 25-year, 50-year, 100-year, 500-year and 1,000-year are included as part of this appendix. Estimates of precipitation for 6-month and 2-year recurrence intervals were made using standard conversions developed by Langbein (*1949; Schaefer and Barker 2006*) for conversion from annual maxima to partial duration series equivalents. Gridded datasets used to create these maps are contained on the Compact Disc (CD) included with this report.

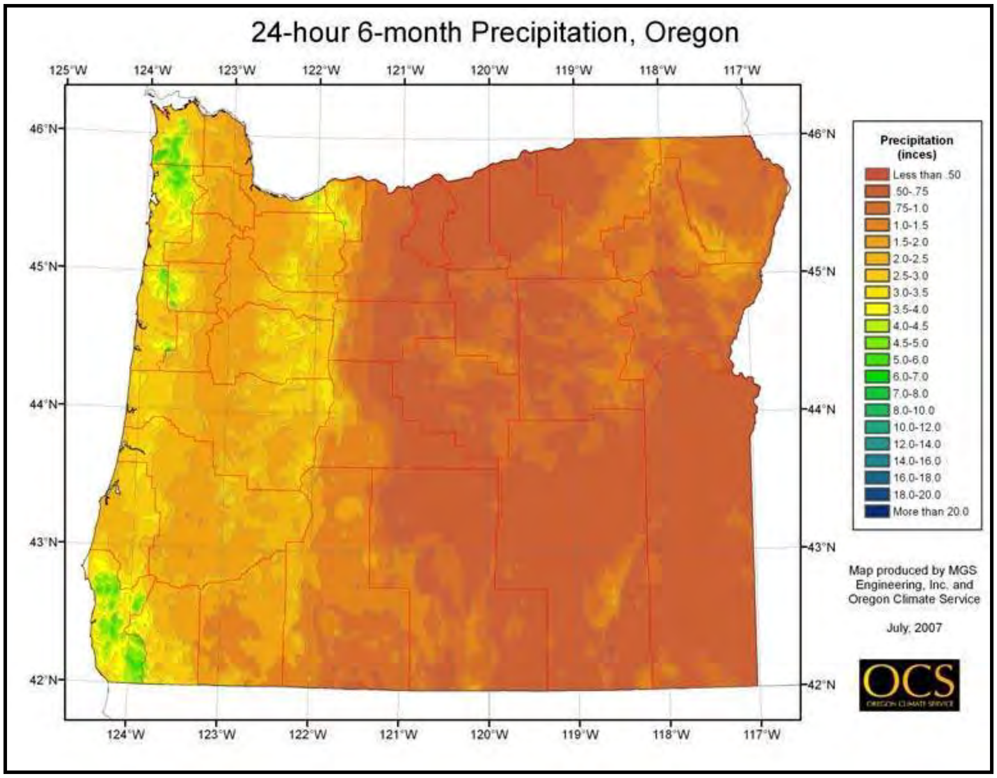

Figure B.1: Isopluvial Map of 24-Hour Precipitation for 6-Month Recurrence Interval for Oregon State.

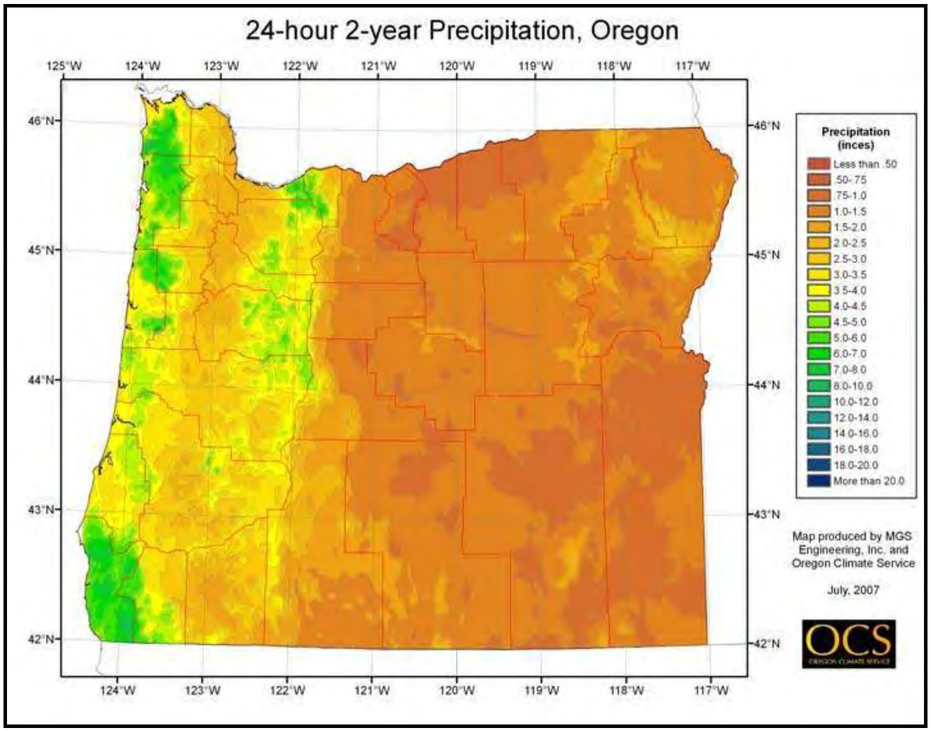

Figure B.2: Isopluvial Map of 24-Hour Precipitation for 2-Year Recurrence Interval for Oregon State.

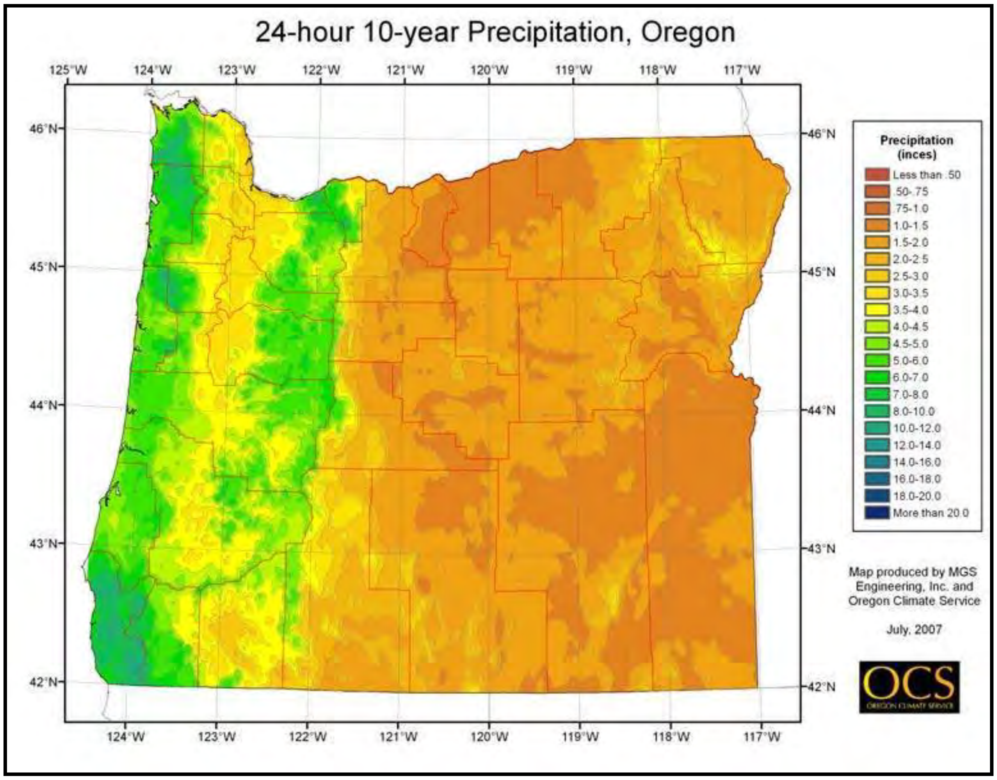

Figure B.3: Isopluvial Map of 24-Hour Precipitation for 10-Year Recurrence Interval for Oregon State.

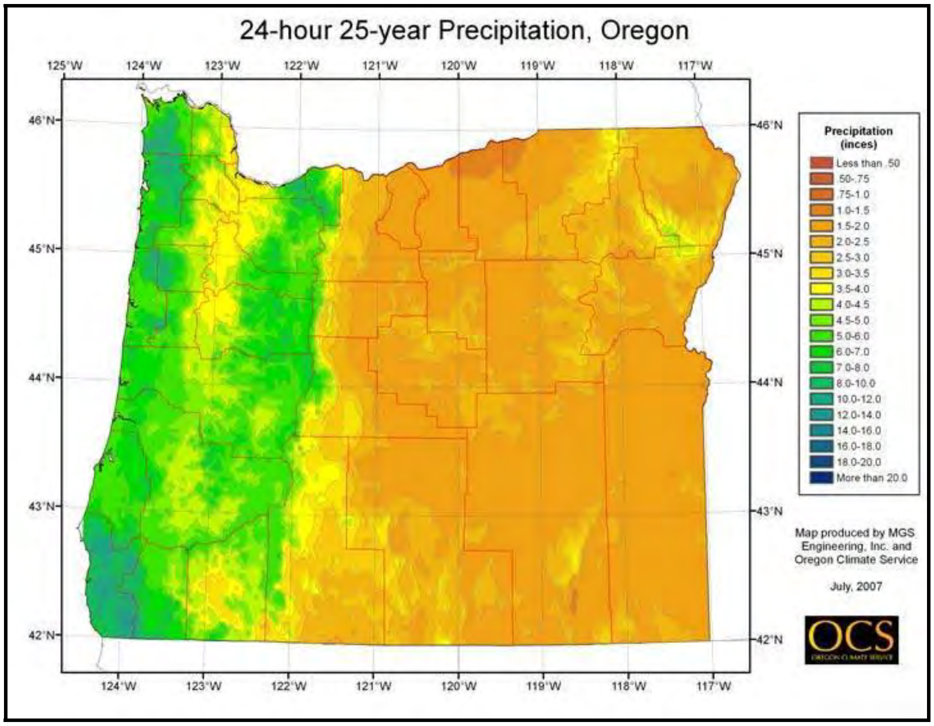

Figure B.4: Isopluvial Map of 24-Hour Precipitation for 25-Year Recurrence Interval for Oregon State.

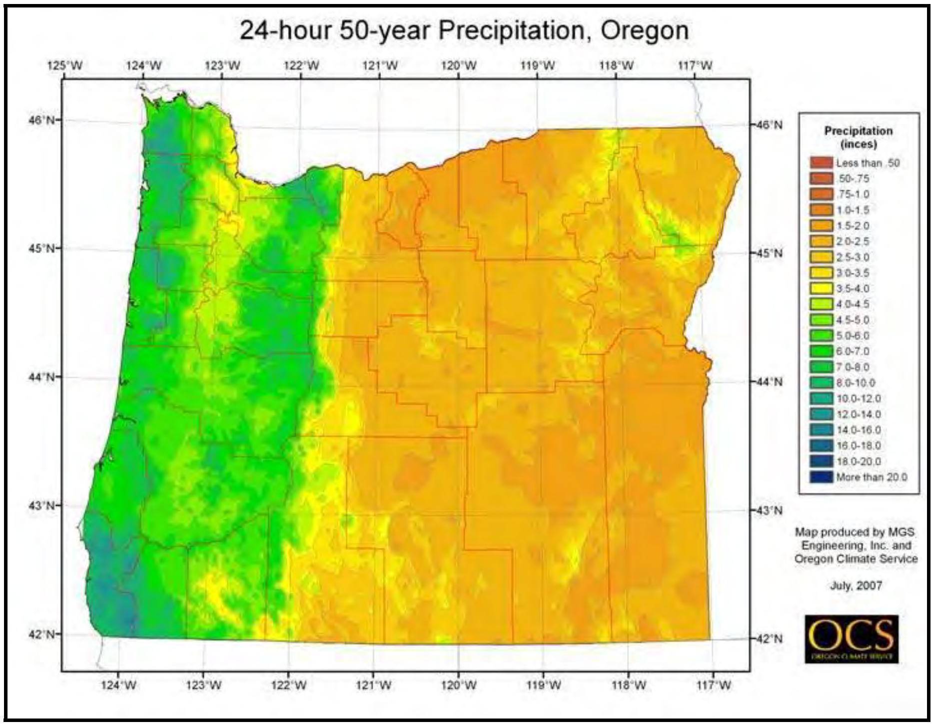

Figure B.5: Isopluvial Map of 24-Hour Precipitation for 50-Year Recurrence Interval for Oregon State.

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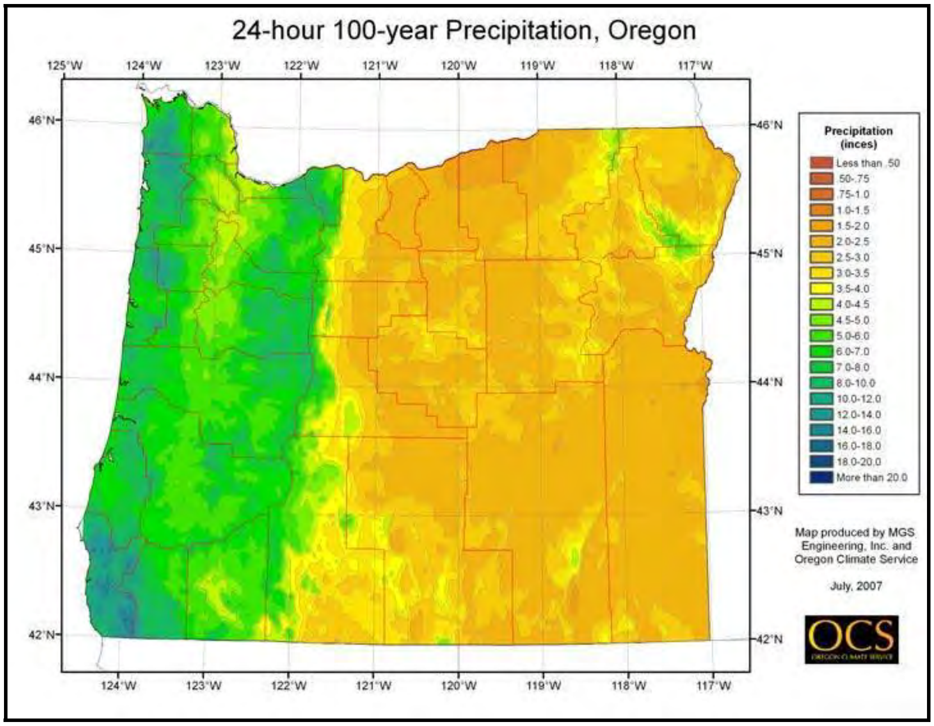
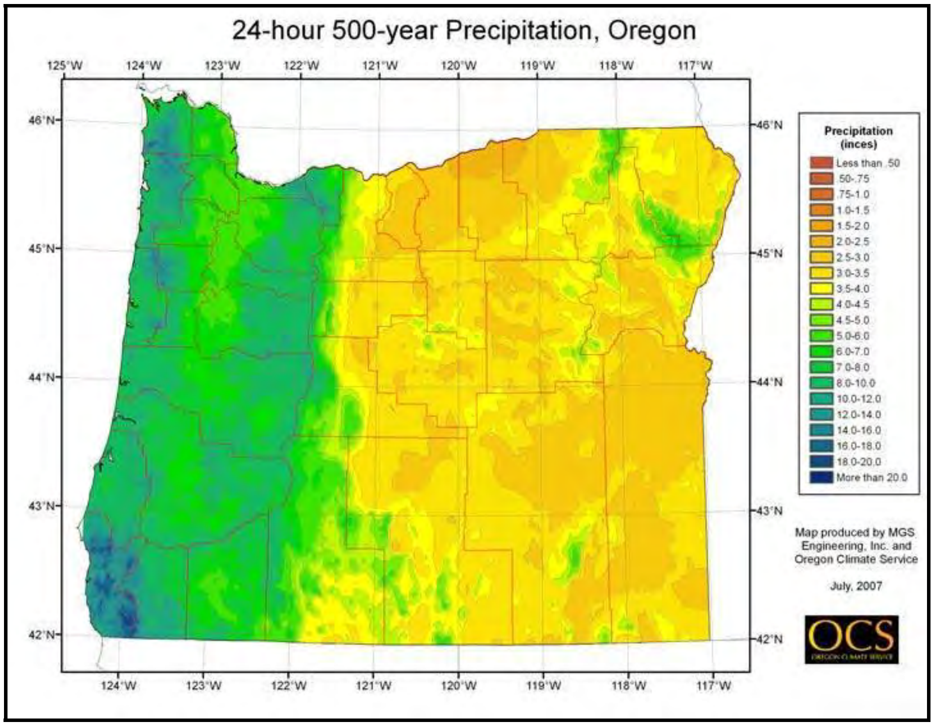


Map produced by MGS Engineering, Inc. and Oregon Climate Service

July, 2007

Figure B.6: Isopluvial Map of 24-Hour Precipitation for 100-Year Recurrence Interval for Oregon State.



Map produced by MGS Engineering, Inc. and Oregon Climate Service

July, 2007

Figure B.7: Isopluvial Map of 24-Hour Precipitation for 500-Year Recurrence Interval for Oregon State.

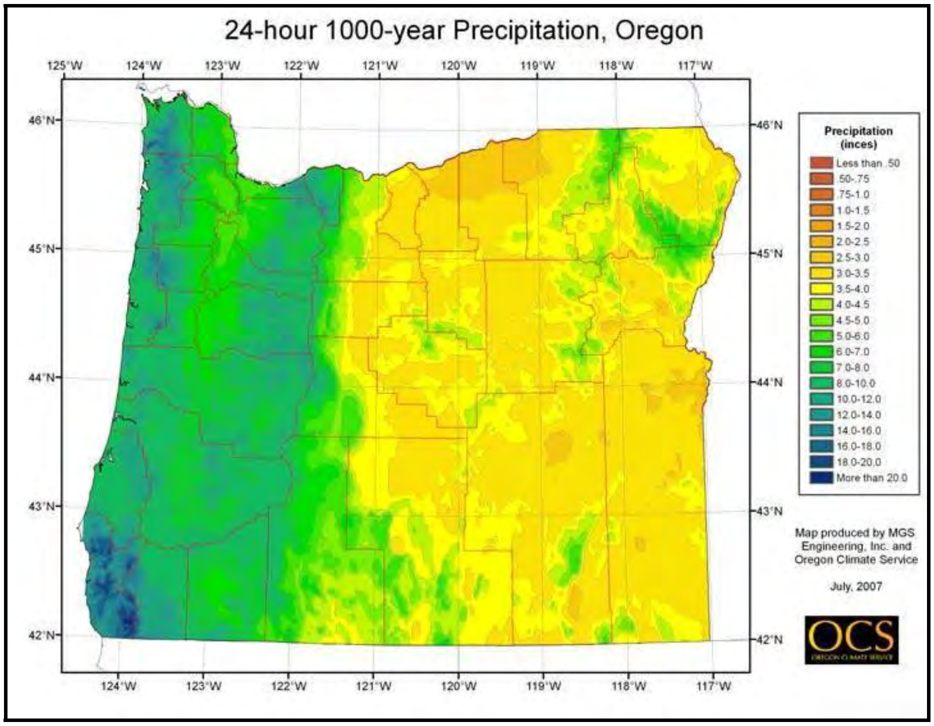


Figure B.7: Isopluvial Map of 24-Hour Precipitation for 1,000-Year Recurrence Interval for Oregon State.

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Exhibit D-4

APPENDIX C

L-MOMENT STATISTICS AND CIRCULAR STATISTICS

Exhibit D-4

L-MOMENT STATISTICS

L-moments are a dramatic improvement over conventional statistics for characterizing the variance and skewness of data, for describing the shape of a probability distribution, and for estimating the distribution parameters (*Hosking 1986, 1990; Hosking and Wallis 1997*). They are particularly useful for describing environmental data that are often highly skewed. The at-site L-moment measure of location, and L-moment ratio measures of scale, skewness and kurtosis are:

Location, mean:

$$\text{Mean} = L_1 \qquad (C1)$$

Scale, L-Cv (t_2):

$$t_2 = L_2/L_1 \qquad (C2)$$

L-Skewness (t_3):

$$t_3 = L_3/L_2 \qquad (C3)$$

L-Kurtosis (t_4):

$$t_4 = L_4/L_2 \qquad (C4)$$

where:

$$L_1 = \beta_0 \qquad (C5)$$

$$L_2 = 2\beta_1 - \beta_0 \qquad (C6)$$

$$L_3 = 6\beta_2 - 6\beta_1 + \beta_0 \qquad (C7)$$

$$L_4 = 20\beta_3 - 30\beta_2 + 12\beta_1 - \beta_0 \qquad (C8)$$

and where the at-site data are first ranked in ascending order from 1 to n ($x_{1:n}$) and:

$$\beta_0 = n^{-1} \sum_{j=1}^{n} x_j \qquad (C9)$$

$$\beta_1 = n^{-1} \sum_{j=2}^{n} x_j \, [(j-1)/(n-1)] \qquad (C10)$$

$$\beta_2 = n^{-1} \sum_{j=3}^{n} x_j \, [(j-1)(j-2)]/[(n-1)(n-2)] \qquad (C11)$$

$$\beta_3 = n^{-1} \sum_{j=4}^{n} x_j \, [(j-1)(j-2)(j-3)]/[(n-1)(n-2)(n-3)] \qquad (C12)$$

Regional L-moments ratios are obtained as weighted averages of the at-site L-moments ratios where the at-site values are weighted by record length. Specifically: n_i is the record length at site i of N sites: n_R is the total record length for the N sites in the region; t_2^i, t_3^i, t_4^i are L-moment ratios at site i ; and:

$$n_R = \sum_{i=1}^{N} n_i \tag{C13}$$

Regional Mean (L_1^R) is unity using the index-flood procedure:

$$L_1^R = 1 \tag{C14}$$

Regional L-Cv (t_2^R):

$$t_2^R = n_R^{-1} \sum_{i=1}^{N} n_i \, t_2^i \tag{C15}$$

Regional L-Skewness (t_3^R):

$$t_3^R = n_R^{-1} \sum_{i=1}^{N} n_i \, t_3^i \tag{C16}$$

Regional L-Kurtosis (t_4^R):

$$t_4^R = n_R^{-1} \sum_{i=1}^{N} n_i \, t_4^i \tag{C17}$$

The regional L-moment ratios for L-Skewness (t_3^R) and L-Kurtosis (t_4^R) were corrected for bias based on bias correction equations provided by Hosking and Wallis (*1995*, *1997*). These equations are valid for the range of regional L-moment ratios observed in the study area, where:

$$\text{bias } t_3^R = 4\text{N}(0.10 - t_4^R)/\, n_R \tag{C18}$$

$$\text{bias } t_4^R = 4\text{N}(0.15 - t_4^R)/\, n_R \tag{C19}$$

CIRCULAR STATISTICS

Circular statistics (*Fisher 1993*) are appropriate for analysis of data that are circular or directional in nature. Months of the year, days of the year (dates), and compass headings (wind direction) are all examples of circular data. For example, January (month 1) follows December (month 12). Arithmetic averaging of a group of numerical months or dates is not appropriate with conventional sample statistics because the counting system is circular not linear. In conducting the analysis of the seasonality of annual maxima or extreme storms, the Julian day of the year is used for describing the date of occurrence. The *average day of occurrence* is analogous to the arithmetic mean and the *seasonality index* (*Dingman 2001*) is analogous to a standardized measure of variation. Specifically, values of the seasonality index range from zero to unity, with values near zero indicating wide variation in the dates of occurrence. A seasonality index near unity indicates low variation in the dates of occurrence and strong clustering of dates. Circular statistics for dates of occurrence using Julian day-of-year are computed as follows:

Conversion of Julian day-of-year to compass direction (θ_i):

$$\theta_i = 360\ [\ J_i/Days_{total}] \tag{C20}$$

Compute vectors for compass direction:

$$S = \sum_{i=1}^{n} P_i\ [sin(\theta_i\ )] \tag{C21a}$$

$$C = \sum_{i=1}^{n} P_i\ [cos(\theta_i\ )] \tag{C21b}$$

Compute Average Day-of-Occurrence (Julian day-of-year J_{mean}):

$$\theta_2 = ArcTan(S/C) \tag{C22a}$$

$$\theta_m = \theta_2 \qquad if\ S>0\ and\ C>0 \tag{C22b}$$

$$\theta_m = \theta_2 + 180^{\circ} \qquad if\ C<0 \tag{C22c}$$

$$\theta_m = \theta_2 + 360^{\circ} \qquad if\ S<0\ and\ C>0 \tag{C22d}$$

$$J_{mean} = 365\ \theta_m \tag{C22e}$$

Compute Seasonality Index (*SI*):

$$SI = SQRT(S^2 + C^2\ )\ /\ P_{total} \tag{C23a}$$

$$P_{total} = \sum_{i=1}^{n} P_i \tag{C23b}$$

where:

J_i = Julian day-of-year for given date of interest; $Days_{total}$ is the total number of days in the current year; P_i is the precipitation value for a given date (J_i); n is the total number of precipitation and date pairs; and P_{total} is the sum of all precipitation values for the dataset.

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APPENDIX D

SELECTED DEFINITIONS

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SELECTED DEFINITIONS

At-Site - the term at-site is used in various ways. It may be used to distinguish analyses/data at a specific site from regional analyses/data. It may be used in reference to a given gage/station or a specific geographic location. Observed at-site precipitation is synonymous with observed point rainfall.

At-Site Mean - the mean value of precipitation for a specified duration at a specific location. For a gaged site, it is based on the gaged record for the specified duration. At an ungaged site, it is based on a statistical relationship. Also see mean annual maxima.

Climatic Region - a geographic area that has similar physical and climatological characteristics.

Convective Precipitation - precipitation that results from lifting of atmospheric moisture due to vertical instability in the air column. The thunderstorm is one type of convective precipitation producing mechanism.

Convergence Precipitation - convergence is intended to encompass all precipitation producing mechanisms associated with the circulation of a cyclonic weather system.

Extreme Storm - a precipitation amount for a specified duration that has an annual exceedance probability less than 0.05; rarer than a 20-year event.

Gage Mean - the mean value computed from the annual maxima data at a precipitation gage for some specified duration. At-site mean values are determined from gage mean values using minor correction factors to adjust from fixed measurement intervals to true intervals (*Weiss 1964*).

Gaged Site - a geographic location where a precipitation gage is used to measure and record precipitation data. See also ungaged site.

Homogeneous sub-region - a collection of sites/gages with similar physical and/or climatic characteristics that can be described by a common regional growth curve.

Mean Annual Maxima (MAM) - the mean value of precipitation annual maxima for a specified duration at a specific location. It is the terminology commonly used in Canada as an alternate to at-site-mean.

Mean Annual Precipitation (MAP) - the average precipitation for a calendar year (an example of an at-site-mean).

Orographic Precipitation - precipitation that occurs due to the lifting of atmospheric moisture over mountain barriers.

Precipitation Annual Maxima - the greatest precipitation amount in a 12-month period for a specified duration. The annual period may be a calendar year, or any other 12-month

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period such as the water-year, October 1st to September 30th. The calendar year was used as the annual period for this study of the State of Oregon.

Regional - the term regional is used in a generic manner to distinguish data/analyses for a group of sites/gages as opposed to individual at-site data/analyses. The term regional may be used in reference to homogeneous sub-regions or climatic regions.

Regional Growth Curve - a magnitude-frequency curve with a mean value of unity that is applicable to all sites within a homogeneous region.

Seasonality - frequency characteristics for the time of year (month) during which certain characteristics of precipitation have been observed to occur.

Station - refers to the weather station/collection site for precipitation. A particular station/location may contain any combination of daily, synoptic and automated gages. The term station and site are often used interchangeably.

Ungaged Site - a geographic location where no precipitation measurements are available.

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APPENDIX D

Soils Information

Exhibit D-4

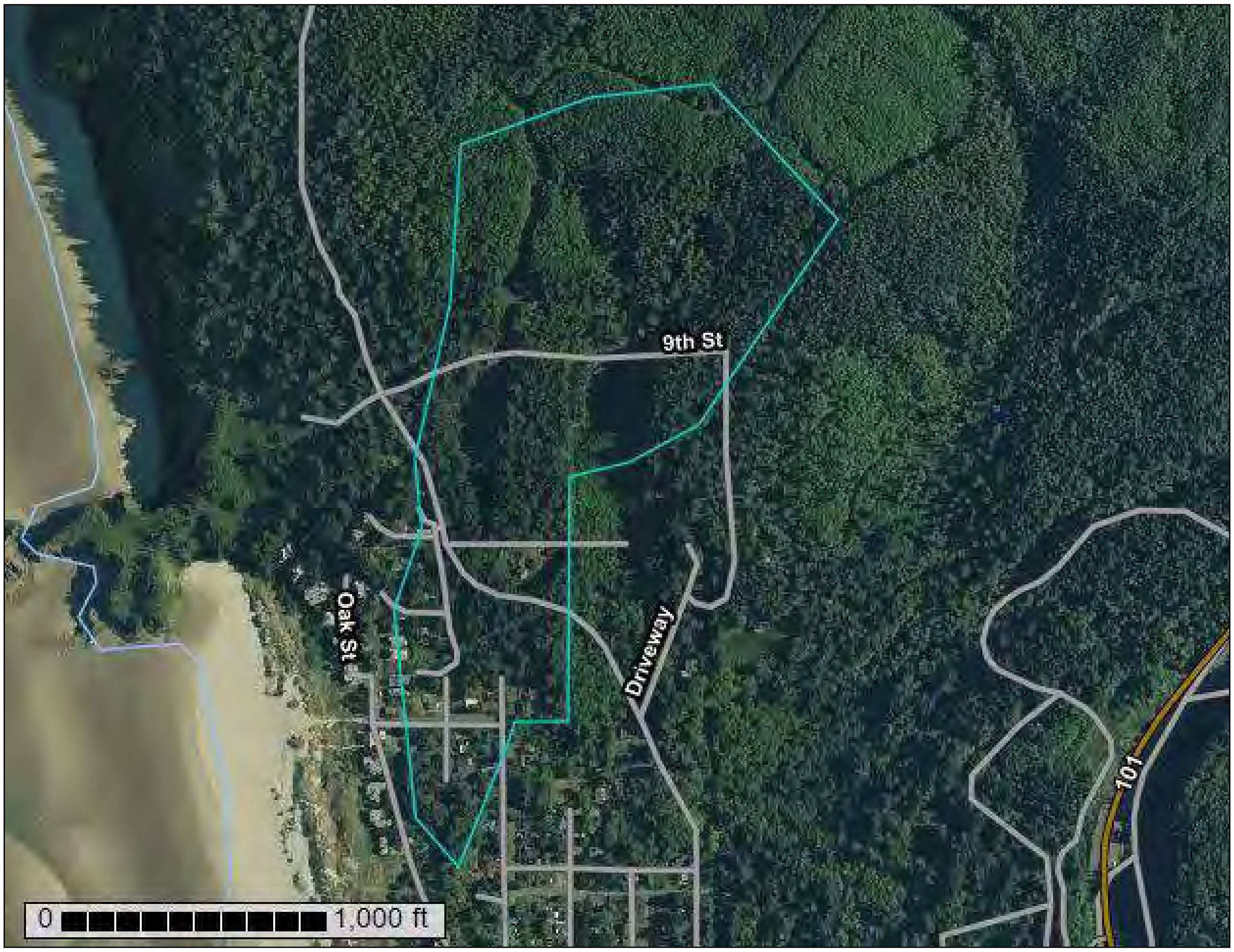
United States
Department of
Agriculture

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Clatsop County, Oregon



February 2, 2023

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Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

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scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Exhibit D-4

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

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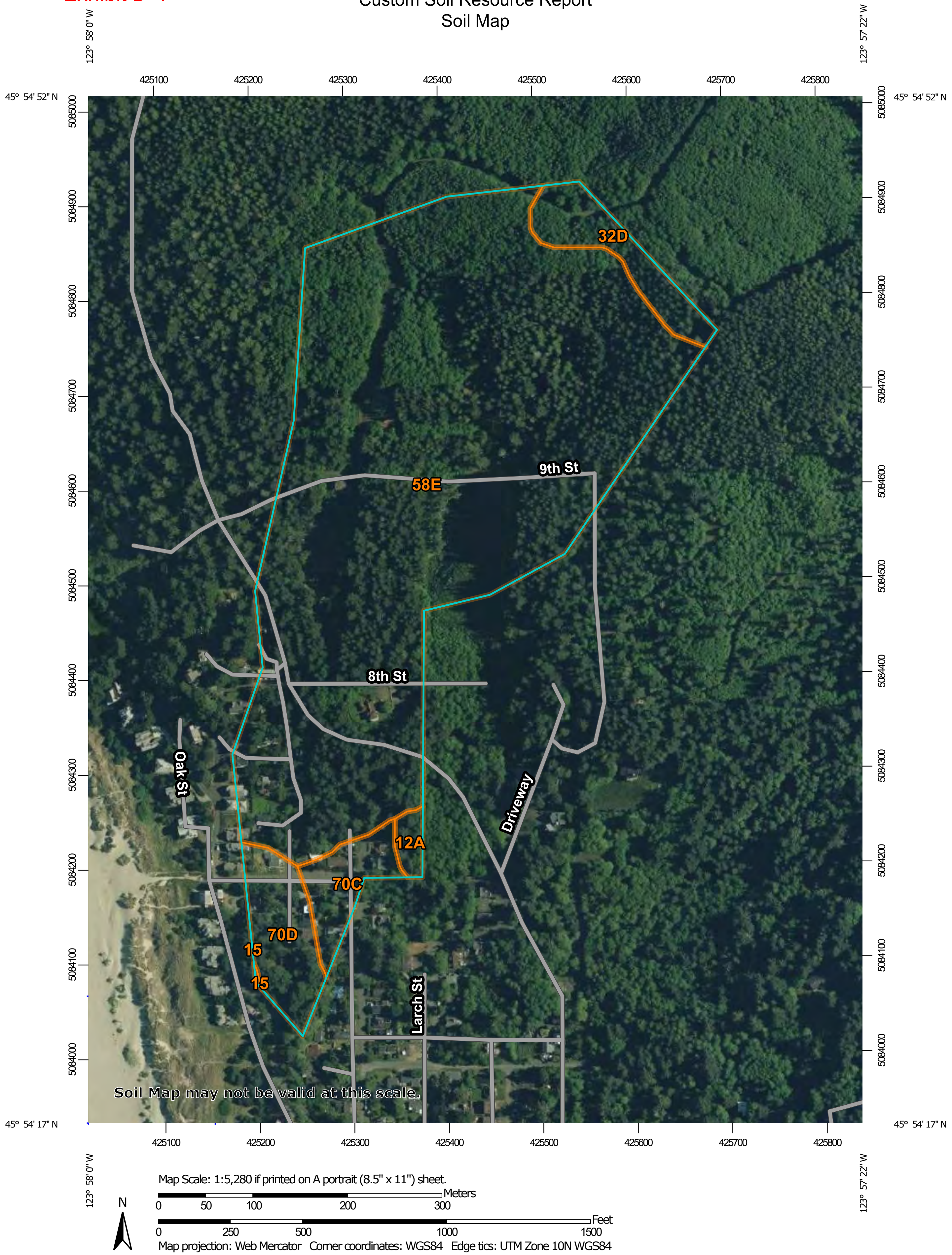
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Exhibit D-4

Soil Map



Map Scale: 1:5,280 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Exhibit D-4

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- □ Soil Map Unit Polygons
- Soil Map Unit Lines
- ■ Soil Map Unit Points

Special Point Features
- Blowout
- ☒ Borrow Pit
- Clay Spot
- ◇ Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- Rock Outcrop
- + Saline Spot
- Sandy Spot
- Severely Eroded Spot
- ◇ Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- △ Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clatsop County, Oregon
Survey Area Data: Version 21, Sep 8, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 28, 2020—Jun 22, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Exhibit D-4

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
12A	Coquille-Clatsop complex, protected, 0 to 1 percent slopes	0.5	0.8%
15	Dune land	0.0	0.0%
32D	Klootchie silt loam, 3 to 30 percent slopes	2.4	4.4%
58E	Skipanon gravelly medial silt loam, 30 to 60 percent slopes	47.2	86.4%
70C	Waldport fine sand, 3 to 15 percent slopes	1.8	3.4%
70D	Waldport fine sand, 15 to 30 percent slopes	2.7	5.0%
Totals for Area of Interest		**54.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Exhibit D-4

Clatsop County, Oregon

12A—Coquille-Clatsop complex, protected, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 219s
Elevation: 0 to 10 feet
Mean annual precipitation: 50 to 100 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 165 to 245 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Coquille, protected, and similar soils: 60 percent
Clatsop, protected, and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coquille, Protected

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 30 inches: silt loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: NoneRare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Ecological site: R004AB200OR - Tidal Marsh and Estuary
Forage suitability group: Very Poorly Drained (G004AY019OR)
Other vegetative classification: Very Poorly Drained (G004AY019OR)
Hydric soil rating: Yes

Description of Clatsop, Protected

Setting

Landform: Flood plains

Exhibit D-4

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

Oa - 0 to 6 inches: muck
H1 - 6 to 24 inches: silt loam
H2 - 24 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: NoneRare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 12.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Ecological site: R004AB200OR - Tidal Marsh and Estuary
Forage suitability group: Very Poorly Drained (G004AY019OR)
Other vegetative classification: Very Poorly Drained (G004AY019OR)
Hydric soil rating: Yes

Minor Components

Histosols

Percent of map unit: 3 percent
Landform: Flood plains
Hydric soil rating: Yes

Coquille, protected, very gravelly

Percent of map unit: 3 percent
Landform: Flood plains
Hydric soil rating: Yes

Coquille, protected, sandy substratum

Percent of map unit: 2 percent
Landform: Flood plains
Hydric soil rating: Yes

Psammaquents

Percent of map unit: 2 percent
Landform: Flood plains
Hydric soil rating: Yes

Exhibit D-4

15—Dune land

Map Unit Setting

National map unit symbol: 219w
Elevation: 0 to 80 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 180 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Dune land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dune Land

Setting

Landform: Dunes
Parent material: Eolian sands

Typical profile

C - 0 to 60 inches: fine sand

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Heceta

Percent of map unit: 15 percent
Landform: Interdunes
Hydric soil rating: Yes

32D—Klootchie silt loam, 3 to 30 percent slopes

Map Unit Setting

National map unit symbol: 21bq
Elevation: 50 to 1,800 feet
Mean annual precipitation: 70 to 130 inches
Mean annual air temperature: 45 to 52 degrees F

Exhibit D-4

Frost-free period: 100 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Klootchie and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Klootchie

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from basalt

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 14 inches: silt loam
H2 - 14 to 28 inches: silt loam
H3 - 28 to 45 inches: gravelly loam
H4 - 45 to 55 inches: weathered bedrock

Properties and qualities

Slope: 3 to 30 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: F004AB404WA - Coastal Upland Warm Forest
Hydric soil rating: No

Minor Components

Aquands

Percent of map unit: 3 percent
Landform: Mountains
Hydric soil rating: Yes

Exhibit D-4

58E—Skipanon gravelly medial silt loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 21cw
Elevation: 50 to 1,500 feet
Mean annual precipitation: 80 to 110 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 120 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Skipanon and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Skipanon

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, head slope, side slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Mass movement deposits derived from a mixture of igneous and sedimentary rock types overlying sedimentary rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A1 - 2 to 7 inches: gravelly medial silt loam
A2 - 7 to 15 inches: gravelly silt loam
Bw1 - 15 to 29 inches: gravelly clay loam
Bw2 - 29 to 44 inches: gravelly clay loam
C - 44 to 62 inches: paragravelly clay loam

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: F004AB404WA - Coastal Upland Warm Forest
Other vegetative classification: Sitka spruce/oxalis, swordfern-moist (902)

Exhibit D-4

Hydric soil rating: No

70C—Waldport fine sand, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 21dd
Elevation: 0 to 500 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 180 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Waldport and similar soils: 85 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waldport

Setting

Landform: Dunes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian sands

Typical profile

H1 - 0 to 3 inches: fine sand
H2 - 3 to 60 inches: fine sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F004AB202OR - Dune Forest
Hydric soil rating: No

Minor Components

Psammaquents

Percent of map unit: 7 percent
Landform: Interdunes
Hydric soil rating: Yes

70D—Waldport fine sand, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 21df
Elevation: 0 to 500 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 180 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Waldport and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waldport

Setting

Landform: Dunes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian sands

Typical profile

H1 - 0 to 3 inches: fine sand
H2 - 3 to 60 inches: fine sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: F004AB202OR - Dune Forest
Hydric soil rating: No

Minor Components

Psammaquents

Percent of map unit: 8 percent
Landform: Interdunes

Exhibit D-4

Hydric soil rating: Yes

Exhibit D-4

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Exhibit D-4

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Exhibit D-5

Robert St. Clair

From: Pete Lowry <pete.lowry@chartermechanical.com>
Sent: Thursday, October 19, 2023 7:21 AM
To: Planning Group
Subject: FW: City of Cannon Beach to Consider Revised Wetland Overlay Ordinance: October 2023

Steve,

My wife and I own the home at 4540 Logan Lane in Cannon Beach, Oregon. Please accept this e-mail as a public comment to the City of Cannon Beach's Planning Commision holding a public hearing on the below-referend proposed Zoning Ordinance on October 26, 2023.

The Zoning Ordinance text ammendments have not been posted to the City of Cannon Beach's website, yet in order for a property owner's comments to be included in the Planning Commisson's meeting materials for the October 26, 2023 meeting, their comments are due today? This is an important topic that will impact numerous propery owners, and the Planning Commision of the City of Cannon Beach should allow reasonable time to review the changes to the Zoning Ordinance and provide questions and/or comments. I ask that the Planning Commission delay this public hearing for at least 3 months to allow owners sufficent time to review the Ordinance.

Exhibit D-5

WETLAND OVERLAY AMENDMENTS

The Cannon Beach Planning Commission will hold a public hearing on the following date:

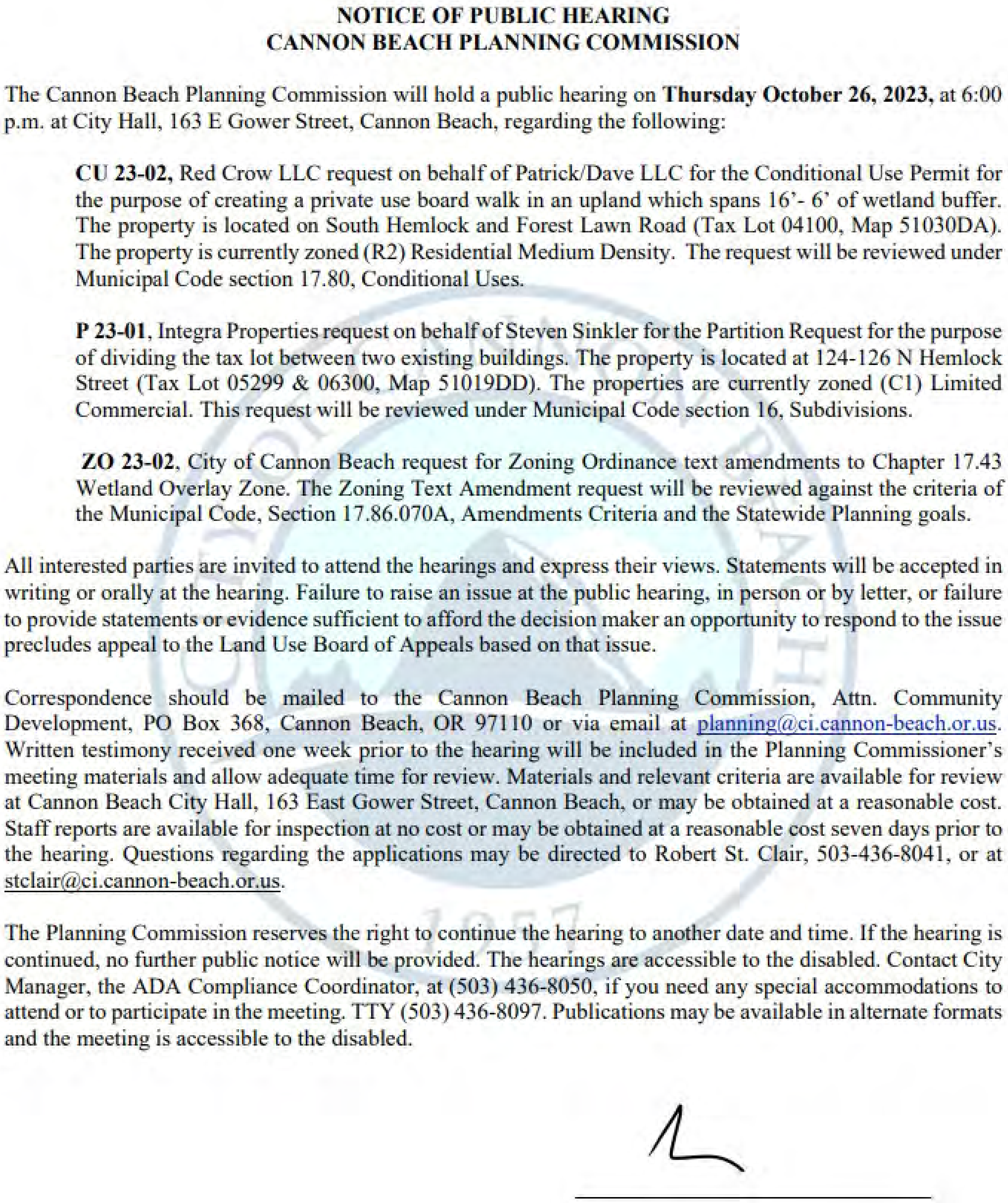
October 26, 2023, at 6:00 PM City Hall Council Chamber, 163 Gower St.

ZO 23-02, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetlands Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070 A, Amendments Criteria, and the Statewide Planning Goals.

All interested parties are invited to attend the hearing to express their views. Statements will be accepted in writing or orally at the hearing, either virtually or in person. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue. All correspondence or further inquiries should be sent to the Community Development Department, PO Box 368, Cannon Beach, OR 97110 or via email at planning@ci.cannon-beach.or.us. Staff reports or other materials will be available online seven (7) days prior to the hearing. The Planning Commission reserves the right to continue the hearing to another date/time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097

Posted/Mailed: 9/29/2023

Exhibit D-5



NOTICE OF PUBLIC HEARING
CANNON BEACH PLANNING COMMISSION

The Cannon Beach Planning Commission will hold a public hearing on **Thursday October 26, 2023,** at 6:00 p.m. at City Hall, 163 E Gower Street, Cannon Beach, regarding the following:

> **CU 23-02,** Red Crow LLC request on behalf of Patrick/Dave LLC for the Conditional Use Permit for the purpose of creating a private use board walk in an upland which spans 16'- 6' of wetland buffer. The property is located on South Hemlock and Forest Lawn Road (Tax Lot 04100, Map 51030DA). The property is currently zoned (R2) Residential Medium Density. The request will be reviewed under Municipal Code section 17.80, Conditional Uses.
>
> **P 23-01**, Integra Properties request on behalf of Steven Sinkler for the Partition Request for the purpose of dividing the tax lot between two existing buildings. The property is located at 124-126 N Hemlock Street (Tax Lot 05299 & 06300, Map 51019DD). The properties are currently zoned (C1) Limited Commercial. This request will be reviewed under Municipal Code section 16, Subdivisions.
>
> **ZO 23-02**, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetland Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070A, Amendments Criteria and the Statewide Planning goals.

All interested parties are invited to attend the hearings and express their views. Statements will be accepted in writing or orally at the hearing. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue.

Correspondence should be mailed to the Cannon Beach Planning Commission, Attn. Community Development, PO Box 368, Cannon Beach, OR 97110 or via email at planning@ci.cannon-beach.or.us. Written testimony received one week prior to the hearing will be included in the Planning Commissioner's meeting materials and allow adequate time for review. Materials and relevant criteria are available for review at Cannon Beach City Hall, 163 East Gower Street, Cannon Beach, or may be obtained at a reasonable cost. Staff reports are available for inspection at no cost or may be obtained at a reasonable cost seven days prior to the hearing. Questions regarding the applications may be directed to Robert St. Clair, 503-436-8041, or at stclair@ci.cannon-beach.or.us.

The Planning Commission reserves the right to continue the hearing to another date and time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator, at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097. Publications may be available in alternate formats and the meeting is accessible to the disabled.

Thank you,

Pete Lowry

Exhibit D-5

From: City of Cannon Beach <cityhall@ci.cannon-beach.or.us>
Sent: Wednesday, October 18, 2023 9:53 AM
To: Pete Lowry <pete.lowry@chartermechanical.com>
Subject: City of Cannon Beach to Consider Revised Wetland Overlay Ordinance: October 2023

View this email in your browser

Exhibit D-5

ffice prevented automatic download of this picture from the Internet.

Exhibit D-5

Our mailing address is:
City of Cannon Beach
163 E Gower St
PO Box 368
Cannon Beach, OR 97110-3026

Add us to your address book

NOTICE OF PUBLIC HEARING
CANNON BEACH PLANNING COMMISSION

The Cannon Beach Planning Commission will hold a public hearing on **Thursday, October 26, 2023,** at 6:00 **p.m.** at City Hall, 163 E Gower Street, Cannon Beach, regarding the following:

> **ZO#23-02**, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetland Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070A, Amendments Criteria and the Statewide Planning goals.

All interested parties are invited to attend the hearings and express their views. Statements will be accepted in writing or orally at the hearing. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue.

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The Planning Commission reserves the right to continue the hearing to another date and time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator, at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097. Publications may be available in alternate formats and the meeting is accessible to the disabled.

Robert St. Clair
City Planner

Posted/Mailed: 9/29/2023

NOTICE TO MORTGAGEE, LIEN-HOLDER, VENDOR OR SELLER:
PLEASE PROMPTLY FORWARD THIS NOTICE TO THE PURCHASER

City of Cannon Beach, P. O. Box 368, Cannon Beach, OR 97110
(503) 436-1581 • FAX (503) 436-2050 •TTY: 503-436-8097 • www.ci.cannon-beach.or.us

NOTICE OF PUBLIC HEARING
CANNON BEACH PLANNING COMMISSION

The Cannon Beach Planning Commission will hold a public hearing on **Thursday October 26, 2023,** at 6:00 p.m. at City Hall, 163 E Gower Street, Cannon Beach, regarding the following:

CU 23-02, Red Crow LLC request on behalf of Patrick/Dave LLC for the Conditional Use Permit for the purpose of creating a private use board walk in an upland which spans 16’- 6’ of wetland buffer. The property is located on South Hemlock and Forest Lawn Road (Tax Lot 04100, Map 51030DA). The property is currently zoned (R2) Residential Medium Density. The request will be reviewed under Municipal Code section 17.80, Conditional Uses.

P 23-01, Integra Properties request on behalf of Steven Sinkler for the Partition Request for the purpose of dividing the tax lot between two existing buildings. The property is located at 124-126 N Hemlock Street (Tax Lot 05299 & 06300, Map 51019DD). The properties are currently zoned (C1) Limited Commercial. This request will be reviewed under Municipal Code section 16, Subdivisions.

ZO 23-02, City of Cannon Beach request for Zoning Ordinance text amendments to Chapter 17.43 Wetland Overlay Zone. The Zoning Text Amendment request will be reviewed against the criteria of the Municipal Code, Section 17.86.070A, Amendments Criteria and the Statewide Planning goals.

All interested parties are invited to attend the hearings and express their views. Statements will be accepted in writing or orally at the hearing. Failure to raise an issue at the public hearing, in person or by letter, or failure to provide statements or evidence sufficient to afford the decision maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals based on that issue.

Correspondence should be mailed to the Cannon Beach Planning Commission, Attn. Community Development, PO Box 368, Cannon Beach, OR 97110 or via email at planning@ci.cannon-beach.or.us. Written testimony received one week prior to the hearing will be included in the Planning Commissioner’s meeting materials and allow adequate time for review. Materials and relevant criteria are available for review at Cannon Beach City Hall, 163 East Gower Street, Cannon Beach, or may be obtained at a reasonable cost. Staff reports are available for inspection at no cost or may be obtained at a reasonable cost seven days prior to the hearing. Questions regarding the applications may be directed to Robert St. Clair, 503-436-8041, or at stclair@ci.cannon-beach.or.us.

The Planning Commission reserves the right to continue the hearing to another date and time. If the hearing is continued, no further public notice will be provided. The hearings are accessible to the disabled. Contact City Manager, the ADA Compliance Coordinator, at (503) 436-8050, if you need any special accommodations to attend or to participate in the meeting. TTY (503) 436-8097. Publications may be available in alternate formats and the meeting is accessible to the disabled.

Robert St. Clair
City Planner

Posted/Mailed: 10/6/23

NOTICE TO MORTGAGEE, LIEN-HOLDER, VENDOR OR SELLER:
PLEASE PROMPTLY FORWARD THIS NOTICE TO THE PURCHASER

City of Cannon Beach, P. O. Box 368, Cannon Beach, OR 97110
(503) 436-1581 • FAX (503) 436-2050 •TTY: 503-436-8097 • www.ci.cannon-beach.or.us

Taxlot #	Situs Address	Owner	Mailing Address	City	State	Zip Code
41006BC02800	3888 S Hemlock St	Green Aaron C/Cathy E	PO Box 770	Cannon Beach	OR	97110-0770
41006BC02900		Mike and Mary Serres LLC	4137 NE Hazelfern Place	Portland	OR	97232
41006BC04300	4001 S Hemlock St	Wickham Lila A/Rock R	PO Box 208	Tolovana Park	OR	97145
41006BC04400	4011-4015-4021 Hemlock St	Brown Lynn A	2305 N 14th St	Boise	ID	83702-1110
41006BC04500	4071 Hemlock St	Mckean Lori	6126 Panorama Dr NE	Tacoma	WA	98422
41006BC04501	4039 Hemlock St	Susan Wunder M	431 Thorn Apple Way	Castle Pines	CO	80108-8253
41006BC04700	4088 S Hemlock St	Lombardi Sunny	6652 N Princeton St	Portland	OR	97203-4036
41006BC05700	4063 Pacific Ave	Berney Kristina 1/2	3827 NW Astor St	Camas	WA	98607
41006BC05800	4079 Pacific Ave	Silver Klapstein Family Trust	1990 SW Mill Street Ter	Portland	OR	97201-2434
41006BC05900	4032 Ocean Ln	Kelly Andrea	PO Box 747	Tolovana Park	OR	97145
41006BC06600	4064 Ocean Ln	Hutchison John P	6022 SW Riverpoint Ln	Portland	OR	97239-5906
41006BC09400	4241 S Hemlock St	Williams Susan M	PO Box 756	Cannon Beach	OR	97110
41006BC09500		Oregon State Dept Of Transport				
41006BC09800	188 W Noatak St	Lindstedt Carol K	2600 SW 75th Ter	Portland	OR	97225
41006BC09801	187 W Kenai St	Adleberg Allen M	1191 E Placita Rana	Tuscon	AZ	85718
41006BC09802		English Ellen	439 Garfield St	Denver	CO	80206
41006BC09900	163 Kenai St	Ridderbush Brian J	4605 NE 125th Cir	Vancouver	WA	98686-3369
41006BC10000	139 W Kenai St	Zirbes Donald L/Karen D	6501 222nd St SW	Mountlake Terrace	WA	98043-2429
41006BC10400	164 Kenai St	Stowers Debra	PO Box 964	Cannon Beach	OR	97110-0964

41006BC10600	4087 Hemlock St	Stevens Family Trust	1107 Amador Ave	Berkeley	CA	94707-2601
41006CB00901		Dinsdale Grace	569 Cavendish Beach Bay	Chestermere	AB	T1X 1H8
41006CB01700	139 West Way	Kroll Robert A	PO Box 1365	Cannon Beach	OR	97110
41006CB01803	132 Maher St	Klein Ann H	PO Box 653	Tolovana Park	OR	97145-0653
41006CB01805	164 Maher St	Crone Duane H	1500 4th Ave #904	Seattle	WA	98101
41006CB01806	156 Maher St	Utlaut Mark W	29340 Dutch Canyon Rd	Scappoose	OR	97056
41006CB01900		Dinsdale Grace	PO Box 447	Cannon Beach	OR	97110
41006CB03405		Hanson Heidi	13465 NW Overton St	Portland	OR	97229
41006CB03406	4671 Logan Ln	Hanson Heidi	13465 NW Overton St	Portland	OR	97229
41006CB03407		El-Mansy Joint Rev Trust	18820 SW Gassner Rd	Aloha	OR	97007
41006CB03408	4631 Logan Ln	Billett Julie	17014 NE 152nd St	Woodinville	WA	98072
41006CB03409	4632 Logan Ln	El-Mansy Family LLC	18820 SW Gassner Rd	Aloha	OR	97007
41006CB03411		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51019AA05602		Bennett Jacqueline Vu	PO Box 175	Cannon Beach	OR	97110-0175
51019AA05603	755 Ash St	Stastny Donald J Janet H	2309 SW 1st Ave Apt #1145	Portland	OR	97201-5040
51019AA05700	740 N Laurel St	Benefield Michael E/Stacy A	PO Box 1424	Cannon Beach	OR	97110-1424
51019AA05701		Benefield Michael E/Stacy A	PO Box 1424	Cannon Beach	OR	97110-1424
51019AA05801		Benefield Michael E/Stacy A	PO Box 1424	Cannon Beach	OR	97110
51019AA06200	771 Ash St	Bouton J Lauren	1244 Bond Ln	Eugene	OR	97401
51019AA06400		Wilkes Judith F	1402 Bancroft Way	Berkeley	CA	94702-1909

51019AA06500		Grant Barbara	PO Box 117	Cannon Beach	OR	97110-0117
51019AA06501		Souply Thomas C/Kathleen E	PO Box 139	Cannon Beach	OR	97110-0139
51019AA06502		Souply Thomas C	2719 13th ST Pl SW	Puyallup	WA	98373
51019AA06503		Bartl Rainmar	PO Box 117	Cannon Beach	OR	97110-0117
51019AA06600	707 N Laurel St	Souply Thomas C	2719 13th St Pl SW	Puyallup	WA	98373
51019AA06700	715 N Laurel St	Souply Thomas C/Kathleen E	PO Box 139	Cannon Beach	OR	97110-0139
51019AA06801		Souply Thomas C/Kathleen E	PO Box 139	Cannon Beach	OR	97110-0139
51019AA07500		Neikes James J	34755 Hwy 101 Business	Astoria	OR	97103-6664
51019AA07501		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51019AD00200		Oregon State Of				
51019AD00201		Robinson David G/Trina C	PO Box 1265	Cannon Beach	OR	97110-1265
51019AD00300	620 Ecola Park Rd	Thorgalsen Erling D	25730 SE 25th Way	Sammamish	WA	98075-7911
51019AD00301	663 N Hemlock St	Wegener Jean L Trust	8636 NE Eugene St	Portland	OR	97220-5405
51019AD00302		North Coast Land Conservancy	PO Box 67	Seaside	OR	97138-0067
51019AD00303		North Coast Land Conservancy	PO Box 67	Seaside	OR	97138-0067
51019AD00304	648 Ecola Park Rd	Tippie Michael E/Lisa C	21507 SE Main St	Gresham	OR	97030-3433
51019AD00305		Blanchette Robert/ Demuth Monica	35 RoseTree Rd NW	Calgary	Alberta	T3H3T6
51019AD00306	640 Ecola Park Rd	Given Janet H Tr	60898 Willow Creek Loop	Bend	OR	97702-9305
51019AD00307	632 Ecola Park Rd	Iandoli Claire C	2467 24th Ave	San Francisco	CA	94116-2336
51019AD00400	608 Ecola Park Rd	Meyer Erik/Kim	PO Box 932	Cannon Beach	OR	97110-0932

51019AD00500	679 N Hemlock St	Robinson David G/Trina C	PO Box 1265	Cannon Beach	OR	97110-1265
51019AD00600	687 N Hemlock St	Watson Marian M	PO Box 1468	Cannon Beach	OR	97110-1468
51019AD00700	696 N Hemlock St	OLeary Kevin D	696 N Hemlock St	Cannon Beach	OR	97110
51019AD00701	175 W 7th St	Beehler James	22110 NE 118th Circle	Brush Prairie	WA	98606
51019AD00800	680 N Hemlock St	Landrum Thomas H	PO Box 865	Cannon Beach	OR	97110
51019AD00900	664 N Hemlock St	Neikes Thomas R	PO Box 804	Astoria	OR	97103-0804
51019AD00904	672 N Hemlock St	Neikes Thomas	PO Box 804	Astoria	OR	97103-0804
51019AD10800		Gecho Peter M	5107 NE 81st Ave	Vancouver	WA	98662
51019AD10890		Cavell Rebecca L	2710 SW English Ln	Portland	OR	97201-1624
51019AD10900	136 E 5th St	Pryor Loralee	18965 SW Madeline St	Aloha	OR	97007-3006
51019AD10901	128 E 5th St	Gecho Peter M	5107 NE 81st Ave	Vancouver	WA	98662
51019AD11003	523 N Hemlock St	Good Susan C Trustee	13403 NE 193rd Pl	Woodinville	WA	98072
51019AD11100	539 N Hemlock St	Cameron Matthew S	12321 NE 293rd St	Battle Ground	WA	98604
51019AD11101	547 N Hemlock St	Hayes Lucinda W	PO Box 873	Cannon Beach	OR	97110-0873
51019AD11200	555 N Hemlock St	Mischel Rebecca	3728 NW Thurman St	Portland	OR	97210-1235
51019AD11302	571 N Hemlock St	Kirk Andrew T	925 13th St	Canmore, AB	Canada	T1W1W4
51019AD11303	587 N Hemlock St	Peart Gary L/Sherry L	19115 SW Oak St	Aloha	OR	97078
51019AD01500		Gallentine Melissa K	53977 McKay Dr	Scappoose	OR	97056
51019AD01600		Younker Mary Katherine	1029 South 1200 East	Salt Lake City	UT	84105
51019AD01601		Berman Sara Natasha	16192 SW 104th Ave	Tigard	OR	97224

51019AD01700		Fritzler David J Trustee	2920 SE Maple St	Hillsboro	OR	97123-7336
51019AD01800	656 N Larch St	Goossen Tabea	PO Box 19	Cannon Beach	OR	97110-0019
51019AD01900	640 N Larch St	Reynolds Karen A Trustee	1624 NE 153rd Pl	Portland	OR	97230-4639
51019AD01901	647 N Laurel St	Cook Linda	PO Box 722	Cannon Beach	OR	97110-0722
51019AD01902	648 N Larch St	Nick Eric W	5252 Pullman Ave NE	Seattle	WA	98105-2140
51019AD02000	632 N Larch St	Rodriguez Stacy C	PO Box 952	Cannon Beach	OR	97110-0952
51019AD02100	624 N Larch St	Kewley Living Trust	2590 Wisteria Ct	West Linn	OR	97068-7315
51019AD02200	616 N Larch St	Hofer Byron J	10560 S Mulino Rd	Canby	OR	97013-9748
51019AD02500	625 N Laurel St	Martz Jack	702 S 52nd St	Renton	WA	98055-6310
51019AD02600	631 N Laurel St	Kubaska Theodore E/Loretta	PO Box 1193	Cannon Beach	OR	97110-1193
51019AD02700	639 N Laurel St	Etlinger Gary J/Sandra E Tr	7245 SW Ascot Ct	Portland	OR	97225-6040
51019AD02800	655 N Laurel St	Gioia Liana Frances	2100 Peregrine Ct	West Linn	OR	97068
51019AD02900	663 N Laurel St	Elia Joseph Rocco	3908 SW Scholls Ferry Rd	Portland	OR	97221
51019AD03000		Benoit Macon	PO Box 657	Cannon Beach	OR	97110
51019AD03100		Benoit Macon	PO Box 657	Cannon Beach	OR	97110
51019AD03300	687 N Laurel St	Younker Norman J	1029 S 1200 East	Salt Lake City	UT	84105-1524
51019AD03400		Saban M L Residual Tr	14810 SE Anderson Rd	Damascus	OR	97089
51019AD03500		Saban M L Residual Tr	14810 SE Anderson Rd	Damascus	OR	97089
51020BC00100		Straus Steven A	11555 SW Riverwood Rd	Portland	OR	97219
51020BC00400		Real House Solution Inc	19391 SW Suncrest Ln	Beaverton	OR	97007-6056

51020BC00500	795 N Spruce St	Grant James D	621 NE Hazelfern Pl	Portland	OR	97232
51020BC00501		MLRL LLC	10443 N Central Ave	Phoenix	AZ	85020
51020BC00502		Byrne Diana Kathleen Trust	380 NW Hermosa Blvd	Portland	OR	97210-3313
51020CA00300		Oregon Dept of Transportation	355 Capitol St NE #420	Salem	OR	97301-3871
51020CB00200	596 Antler Rd	Azer Ashraf I/Kathleen A	4615 88th Ave SE	Mercer Island	WA	98040-4421
51020CB02400		McReary Revocable Living Trust	1006 Kessler Blvd	Longview	WA	98632
51020CB02402		Sevde James R/Barbara F	19430 Old River Dr	West Linn	OR	97068
51020CB02403		Schwarz Roberta O	2206 Tannler Dr	West Linn	OR	97068-4144
51020CB02405		Ludare LLC	6105 N Wilbur Ave	Portland	OR	97217
51020CB02410		Schwarz Edward W Jr	2206 Tannler Dr	West Linn	OR	97068-4144
51020CB02600		Palmeter Earl Allen	PO Box 982	Cannon Beach	OR	97110
51020CB02700	571 Cherry St	Sasaki Carol M	PO Box 1189	Cannon Beach	OR	97110
51020CB02701	595 Cherry St	Young Flora I	PO Box 1207	Cannon Beach	OR	97110-1207
51020CB02800		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51020CB03000		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51020CB03100		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51020CB03200		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51020CB03300		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51020CB03400	547 Fir St	Short Term Bible Schools Inc	PO Box 190	Cannon Beach	OR	97110-0190
51020CB03402		Short Term Bible Schools Inc	PO Box 190	Cannon Beach	OR	97110-0190

51020CB03700	415 N Alt Hwy 101 #14H	Swigart Terry W	PO Box 214	Cannon Beach	OR	97110-0214
51020CC00201	295 E 2nd St	Cannon Beach City of				
5.1029E+11	315 S Spruce St #A	New Cingular Wireless PCS LLC	754 Peachtree St NE #16th Floor	Atlanta	GA	30308
51029BC10900	403 Glenwood Ct	Broderick Jonathan Doreen Trust	PO Box 1032	Cannon Beach	OR	97110
51029BC11000	401 Glenwood Ct	Guretzki Abe/ Marlies	PO Box 1250	Cannon Beach	OR	97110-1250
51029BC07100	239 E Harrison St	Zavoshy Shaw	641 8 St	Lake Oswego	OR	97034
51029BC07101	263 E Harrison St	Gebhart Linda M	PO Box 915	Cannon Beach	OR	97110
51029BC07200	231 E Harrison St	Baker Anson R Trustee	PO Box 3279	Clackamas	OR	97015-3279
51029BC07400	207 E Harrison St	Benson Jackson Rochelle R	46665 Winthrop Ct	Lake Oswego	OR	97035
51029BC07500	216 E Gower Ave	Raglione Todd Austin	1504 SW Montgomery St	Portland	OR	97201
51029BC07600	197 E Harrison St	Wheeler David T	2550 Southshore Blvd	Lake Oswego	OR	97034
51029BC07900	1088 Spruce St	Mekenas Family Trust	PO Box 862	Cannon Beach	OR	97110-0862
51029BC08000	1102-1104 Spruce Ct	Shorewood Associates	9600 SW Oak St #200	Portland	OR	97223
51029BD00100	715 Haskell Ln	Logan Ronald S	PO Box 153	Cannon Beach	OR	97110-0153
51029CA00101		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51029CA00200	368 Elk Creek Rd	Cannon Beach Business Park LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100
51029CA00300		Bellman Shirley	PO Box 262	Cannon Beach	OR	97110
51029CA00301	365 Elk Creek Rd	Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51029CA00400		Cannon Beach Conference	PO Box 398	Cannon Beach	OR	97110-0398
51029CB01000	307 Sunset Blvd	Minihane Carol Ann	696 W Alder Ct	Washougal	WA	98671

51029CB01302	1600 S Poplar	Rowley Todd	PO Box 754	Cannon Beach	OR	97110-0754
51029CB01314	1680 S Poplar	Burns Joseph Peter	10285 SE Bristol Park Ter	Happy Valley	OR	97086-9147
51029CB01600		Creson Ronda K	PO Box 347	Seahurst	WA	98062-0347
51029CB01601	247 E Dawes Ave	Gustavson Susan Lee	PO Box 73	Cannon Beach	OR	97110
51029CB01604		Cannon Beach Historical Societ	PO Box 1005	Cannon Beach	OR	97110-1005
51029CB01801	296 E Dawes Ave	Monahan David	10501 176th Ave E	Bonney Lake	WA	98391
51029CB01805	1275 Cypress Ct	Koschoreck Kevin	13123 SW Clearview Way	Tigard	OR	97223-1730
51029CB01806	1285 Cypress Ct	Sugano Douglas I	PO Box 954	Cannon Beach	OR	97110
51029CB01808	290 E Dawes Ave	Stilwell Kenneth	3212 211th Ave NE	Sammamish	WA	98074-6330
51030AA03700	223 S Hemlock St	Pig N Pancake Inc	PO Box 9	Seaside	OR	97138-0009
51030AA03701		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51030AA03702		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51030AA03800	223 S Hemlock St	Pig N Pancake Inc	PO Box 9	Seaside	OR	97138-0009
51030AA04402		Coaster Properties LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100
51030AAD1		Coaster Properties LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100
51030AA90101	123 S Hemlock St #101	Joy Investment LLC	13207 11th Pl NW	Seattle	WA	98177
51030AA90102	123 S Hemlock St #102	Harwichportwest LLC	7950 SW Gleneden Ct	Beaverton	OR	97007
51030AA90103	123 S Hemlock St #103	Coaster Properties LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100
51030AA90104	123 S Hemlock St #104	Coaster Properties LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100
51030AA90105	123 S Hemlock St #105	Coaster Properties LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100

51030AA90106	123 S Hemlock St #106	Coaster Properties LLC	9770 SW Sunshine Ct	Beaverton	OR	97005-4100
51030AD12301	187 E Coolidge Ave	Sackett Julie A	15102 NW Troon Way	Portland	OR	97229
51030AD12302	179 Coolidge Ave	Coolidge Street LLC	2507 Candle Tree Cove	Midland	TX	79705
51030AD12303	171 Coolidge Ave	HM 171 LLC	4100 SE River Dr	Milwaukie	OR	97267
51030AD12304	163 Coolidge Ave	HM 163 LLC	4100 SE River Dr	Milwaukie	OR	97267
51030AD12305	148 E Dawes Ave	Carlson Steven A	969 W Golden Barrel Ct	Oro Valley	AZ	85755
51030AD12306	164 E Dawes Ave	Giguiere Alaina	PO Box 474	Cannon Beach	OR	97110-0474
51030AD12307		Shethar LeBlanc Properties LLC	3308 SE Lincoln St	Portland	OR	97214
51030AD12308		Branscomb Thomas Michael	1850 NE 60th Ave	Portland	OR	97213
51030AD12309	188 E Dawes Ave	Rouzee Dianna J	17701 SE Mill Plain Blvd #419	Vancouver	WA	98683
51030DA10000		Wilson James H/Marilyn R Trustee	760 Largo Ct	Fairfield	CA	94533-1418
51030DA10100		Wilson James H/Marilyn R Trustee	760 Largo Ct	Fairfield	CA	94533-1418
51030DA10700	163 Ross Lane	Moritz Linda	11002 NE Wilde Rd	Battle Ground	WA	98604
51030DA10800	155 Ross Ln	Shapiro Peter	70 Yosemite Ave #201	Oakland	CA	94611
51030DA10900		Spence Ronald J	8475 Drury Ln	Germantown	TN	38139-6320
51030DA04100		Diamond Susan A	1 E 66th St Apt #3D	New York	NY	10065-5862
51030DA05200		Feris Marie L	9755 SE French Acres Dr	Happy Valley	OR	97086-6911
51030DA06000	140 Elliott Way	AJ Family Holdings LLC	PO Box 879	Cannon Beach	OR	97110
51030DA06900		Graves Judy J	6611 SE Yamhill Ct	Portland	OR	97215-2036
51030DA06901	115 Elliott Way	Graves Judy Jean	6611 SE Yamhill Ct	Portland	OR	97215-2036

51030DA07200	108 Hills Ln	Kuester Stephen	8551 Jennie Ave NE	Bainbridge Island	WA	98110
51030DA07300	116 Hills Ln	Gray Frederick T	PO Box 1248	Cannon Beach	OR	97110-1248
51030DA07400		Gray Frederick T	PO Box 1248	Cannon Beach	OR	97110
51030DA07500	140 Hills Ln	Weight Alan Steven	140 Hills Lane	Cannon Beach	OR	97110
51030DA07601	156 Hills Ln	Barrios David J	1505 SW College St	Portland	OR	97201-2531
51030DA08300		Ratliff Jessica W	3149 NE 57th Ave	Portland	OR	97213
51030DA08400	171 Hills Ln	Lear Brooks Susan	4604 Meridian Ave N	Seattle	WA	98103
51030DA08500	163 Hills Ln	Wiederspan Peter M/Cheryl D	2832 15th St SE	Puyallup	WA	98374-1367
51030DA08700	147 Hills Ln	Garritt Marcie G	PO Box 480	St Paul	OR	97137-0480
51030DA08800	139 Hills Ln	White Donald Jr/Janet M Hollis	17469 SW Cody St	Beaverton	OR	97007-5373
51030DA08900	107 Hills Ln	Louie Steven K/Jolene I	7629 122nd Pl SE	Newcastle	WA	98056-1249
51030DA09600		Wilson Richard J	3505 Robinhood St	Houston	TX	77005-2229
51030DA09800	164 Ross Ln	Hogueisson Larry G/Christie P	4210 SE Malden St	Portland	OR	97206-8446
51030DA09900	172 Ross Ln	Misner Patricia A	PO Box 842	Cannon Beach	OR	97110-0842
51030DD00905		Holland David A	PO Box 132	Cannon Beach	OR	97110
51030DD01700	1848 Haystack Ln	Bocala Rico A	1075 NW Northrup St #1016	Portland	OR	97209
51030DD01800	1864 S Hemlock St	Dahl Barry J Fam Limited Prtsh	1604 Kessler Blvd	Longview	WA	98632-3633
51030DD04701		Oregon Parks and Recreation Dept	725 Summer St #C	Salem	OR	97301
51030DD05400	116 Arbor Ln	Pettis William B	3917 SW Altadena Ave	Portland	OR	97239-1327
51030DD05500		Schloetel David E Trustee	1514 NE 63rd Ave	Hillsboro	OR	97124-5086

51030DD06000	177 E Van Buren St	Corson Charles	3635 SW 87th Ave Apt #14	Portland	OR	97225-2838
51030DD06100	172 Arbor Ln	Schunzel Joseph Paul	25728 175th Way SE	Covington	WA	98042
51030DD06600		Seiber Roy	440 Topeka Rd	Kelso	WA	98626
51030DD06700		Seiber Roy	440 Topeka Rd	Kelso	WA	98626
51030DD07200	131 Arbor Ln	Hull Larry Alfred	PO Box 11	Cannon Beach	OR	97110
51030DD07300		Hull Larry Alfred	PO Box 11	Cannon Beach	OR	97110
51031AA00500	1981 Pacific Ave	Haystack Rock LLC	4332 SW Semler Way	Portland	OR	97221
51031AA05400		TMCJ Pacific LLC	12910 NE 32nd Pl	Bellevue	WA	98005
51031AA05401		TMCJ Pacific LLC	12910 NE 32nd Pl	Bellevue	WA	98005
51031AA05402	2364 S Hemlock St	TMCJ Pacific LLC	12910 NE 32nd Pl	Bellevue	WA	98005
51031DD00501	3580 S Hemlock St	Falco Frank/Ruth A	6236 SW Tower Way	Portland	OR	97221
51031DD00600	3588 S Hemlock St	Lewis Clifford L	PO Box 1095	Cannon Beach	OR	97110
51031DD00800	3579 Pacific St	Petersen Jim & Patti Rev Trust	11520 SE Sunnyside Rd #602	Clackamas	OR	97015-4314
51031DD00900	3571 Pacific St	Imholte Richard R/Jean	PO Box 217	Cannon Beach	OR	97110-0217
51031DD01001	3563 Pacific St	Nyberg Bernice M	3311 SW 28th Ct	Gresham	OR	97080
51031DD01002	3539 Pacific St	Shepherd Diana	PO Box 757	Cannon Beach	OR	97110
51032BB00117	415 Chilkoot Trail	Newman John J/Sandra L	PO Box 886	Cannon Beach	OR	97110-0886
51032BB00118		Moon Gary D Trustee	PO Box 428	Cannon Beach	OR	97110-0428
51032BB00121		Ohanlon James D	13207 11th Pl NW	Seattle	WA	98177-4107
51032BB00199	264 Chilkoot Trail	Smith Gary D/Janice A	PO Box 152	Cannon Beach	OR	97110-0152

51032BB00301	187 Amber Ln	Sperley Scott O	PO Box 202	Cannon Beach	OR	97110
51032BB00306		Alexander Brian Anthony	14270 SW Cherryhill Dr	Beaverton	OR	97008-4995
51032BB00316		Alexander Brian Anthony	14270 SW Cherryhill Dr	Beaverton	OR	97008-4995
51032BC00100		Sroufe Gerald B	PO Box 166	Cannon Beach	OR	97110-0166
51032BC00101		Moon Steven J	PO Box 162	Cannon Beach	OR	97110-0162
51032BC00102		Sroufe Peter C	PO Box 1191	Cannon Beach	OR	97110-1191
51032BC00300	81807 Hwy 101	Sroufe Gerald B	PO Box 166	Cannon Beach	OR	97110-0166
51032BC00400		Mcrayde Donald Douglas Jr	PO Box 12242	Olympia	WA	98508
51032BC00500	151 E Tanana Ave	Johnson M Michele	PO Box 924	Cannon Beach	OR	97110-0713
51032BC00601	147 E Tanana Ave	Lindsey Peter	PO Box 454	Cannon Beach	OR	97110
51032BC01200	2631 S Hemlock St	Piccini Silvio D Jr Trustee	3850 South Hampton Ct	West Linn	OR	97068
51032BC01300		Ensign Bo B	PO Box 854	Cannon Beach	OR	97110
51032BC01400		Ensign Bo B	PO Box 854	Cannon Beach	OR	97110
51032BC01401	2787 Hemlock St	Ensign Carey Jean	PO Box 4263	South Colby	WA	98384
51032BC01402	2787 Hemlock St	Ensign Carey Jean	PO Box 4263	South Colby	WA	98384
51032BC01500		Kindschuh Kevin J	3822 SW Idaho Ter	Portland	OR	97221
51032BC01501	172 E Chisana St	Daoud Lesley	PO Box 704	Tolovana Park	OR	97145-0704
51032BC01502		Daoud Lesley	PO Box 704	Tolovana Park	OR	97145-0704
51032BC01503	148 E Chisana St	Sellers Janice Rev Lvg Trust	17250 NW Sellers Rd	Banks	OR	97106-7119
51032BC01504		Sellers Janice Rev Liv Trust	17250 NW Sellers Rd	Banks	OR	97106

51032BC01505		Kindschuh Kevin J	3822 SW Idaho Ter	Portland	OR	97221
51032BC01506		Gray Nancy A	2002 NE 67th Ave	Portland	OR	97213
51032BC01507		Kindschuh Kevin J	3822 SW Idaho Ter	Portland	OR	97221
51032BC01600	2839 S Hemlock St	Nielsen David D	31947 W Ocean Ln	Arch Cape	OR	97102-0180
51032CB00900	3331 S Hemlock St	Allegretto Family LLC	3626 SE Steele St	Portland	OR	97202
51032CB01003	3339 S Hemlock St	Westover Inns Incorporated	PO Box 368	Wilsonville	OR	97070-0368
51032CC00901		Nelson Eleanor A Tr	PO Box 155	Tolovana Park	OR	97145-0155
51032CC03300	3679 E Chinook Ave	Lalich Margo D Rev Liv Trust	PO Box 1282	Cannon Beach	OR	97110-1282
51032CC03401	3663 E Chinook Ave	Taylor Merril Lynn	PO Box 158	Tolovana Park	OR	97145-0158
51032CC03600	3607 E Chinook Ave	Morgan Michael D	PO Box 132	Cannon Beach	OR	97110-0132
51032CC80001	3621 S Hemlock St #6	Fraser Lori A/ Richard H	5349 Southwood Dr	Lake Oswego	OR	97035-5784
51032CC80002	3621 S Hemlock St #5	Katon Ronald M Trustee	5658 Grand Oaks Dr	Lake Oswego	OR	97035-6735
51032CC80003	3621 S Hemlock St #4	Young Betty Ann	7757 Rockwood Rd	Joshua Tree	CA	92252
41006BC06602		McMillin Robert Y	PO Box 747	Tolovana Park	OR	97145
51020CC00100	100 E 3rd St	Cannon Beach Conference	PO Box 398	Cannon Beach	OR	97110-0398
51029CB01315	1660 S Poplar	Lewis Cliff/Janis	PO Box 1095	Cannon Beach	OR	97110-1095
51029CB01701	216 Dawes Ave	Daggett Peter W/Susanne S	PO Box 41	Cannon Beach	OR	97110-0041
51029CB01802	1290 Cypress Ct	Nelson Phillip G	7063 Beach Dr SW	Seattle	WA	98136-2051
51032BC00501	167 E Nelchena Ct	Marantette Christopher R	19104 NE 83rd St	Vancouver	WA	98682
51032BC00502		Olin Stephen Thomas/Laura Sadler	1029 Woods Ave	Lancaster	PA	17603-3126

51032BC00505	151 E Nelchena Ct	Jones Jeff	128 Wilson Ave	Long Beach	NY	11561
41006BC04601		Brown Lynn A	2305 N 14th St	Boise	ID	83702-1110
41006CB01807	188 Maher St	Norton William S	PO Box 856	Cannon Beach	OR	97110
51019AA07400		Oregon State Dept Of Transport				
51019AD00311	624 Ecola Park Rd	Zimmerman Diane G	5640 NE Hancock St	Portland	OR	97213
51019AD00312	656 Ecola Park Rd	Fisher Mark F/Mera M Tr	1000 E Island Blvd #1111	Aventura	FL	33160
51019AD00314		North Coast Land Conservancy	PO Box 67	Seaside	OR	97138-0067
51019AD00702	684-688 N Hemlock St N	Neikes Thomas	PO Box 804	Astoria	OR	97103-0804
51019AD00703	155 W 7th St	Mills Amy C Living Trust	2009 NE Cradle Mountain Way	Bend	OR	97701
51019AD00902		North Coast Land Conservancy	PO Box 67	Seaside	OR	97138-0067
51019AD00903	608 N Hemlock St	Whitcher Joann Chistine	12420 SW St. Andrews Lane	Portland	OR	97224
51019AD01000	607 N Larch St	Gordon Marilee / Morton	PO Box 778	Cannon Beach	OR	97110-0778
51019AD01100	631 N Larch St	Smith Raymond S	4318 St Cloud Ct	Oakland	CA	94619
51019AD01101	615 N Larch St	Howard Ronald M	PO Box 838	Cannon Beach	OR	97110-0838
51019AD01102	625 N Larch St	Washington Glen Leighton	PO Box 868	Cannon Beach	OR	97110-0868
51019AD01200	647 N Larch St	Meyer-Price Living Trust	PO Box 676	Cannon Beach	OR	97110
51019AD01300	663 N Larch St	Neikes Thomas	PO Box 573	Cannon Beach	OR	97110
51019AD01400	679 N Larch St	Winters Austin	3666 Francis Ave N #301	Seattle	WA	97103
51019AD01401	671 N Larch St	Saunders Gregory R	3119 NW 3rd Ave	Camas	WA	98607
51019AD01701	672 N Larch St	Wescott Steven M/ Janey	3711 N 36th St	Tacoma	WA	98407

51020BC00511		Cannon Beach City of	PO Box 368	Cannon Beach	OR	97110-0368
51020BC00512		The Victoria Group LLC	3429 Benham Ave	Nashville	TN	37215
51020CB02406		Straus Revocable Living Trust	11555 SW Riverwood Rd	Portland	OR	97219
51020CB02407	539 N Beech St	Klass Tim	1114 17th Ave #Ste C	Seattle	WA	98122
51020CB02408		Shore Christopher A	18113 Upper Hoh Rd	Forks	WA	98331
51020CB02601	603 E 6th St	Sinkler Steven J	PO Box 995	Cannon Beach	OR	97110
51020CB03705	200 Fir St	Swigart Carmen R	PO Box 214	Cannon Beach	OR	97110-0214
51020CB03800	351-387 Fir St	Cannon Beach Conference	PO Box 398	Cannon Beach	OR	97110-0398
51020CC00300		Swigart Carmen R	PO Box 214	Cannon Beach	OR	97110-0214
51029BC08013		North Coast Land Conservancy	PO Box 67	Seaside	OR	97138-0067
51029BC08014	1151-1153 Spruce Ct	Shorewood Associates	9600 SW Oak St #200	Portland	OR	97223
51029CB01001	325 Sunset Blvd	Majors Linda A/Bryce	PO Box 1164	Cannon Beach	OR	97110-1164
51030DA09601		Smith Gary Davis/Deborah S	17443 Blue Heron Dr	Lake Oswego	OR	97034-6603
51031AA00901	132 Nazina Ave	Tozer Adam C	989 S Greenway Ave	Pueblo	CO	81007
51031AA01600		Rowley Jeffrey Todd	PO Box 754	Cannon Beach	OR	97110
51032BB00101		Ohanlon James D	13207 11th Pl NW	Seattle	WA	98177-4107
51032BC01700	2887 S Hemlock St	Smith Jeffrey L	10959 SW Lindenwold Ct	Beaverton	OR	97005
51032CB00100		Moon Steven J	PO Box 162	Cannon Beach	OR	97110-0162
51032CC04001		Nofield Patrick	PO Box 843	Cannon Beach	OR	97110
51032CC70001	3621 S Hemlock (Sea Colony Condos) St #7	Cross Patrick E	5619 SE Hacienda	Hillsboro	OR	97123

51032CC70002	3621 S Hemlock St #8	Nelson Stephen W\Jacqueline K	4701 Cambridge Ct	Lake Oswego	OR	97035-5386
51032CC70003	3621 S Hemlock St #9	Cooper Janice K Property Trust	12422 243rd PL NE	Redmond	WA	98053
51032CC70004	3621 S Hemlock St #10	Geisler Andrew J	2400 H St	Vancouver	WA	98663-3253
51032CC70005	3741 S Hemlock St #11	Tymchenko Viktor/Mari	14136 Edenberry Dr	Lake Oswego	OR	97035-6720
51032CC70006	3745 S Hemlock St #12	Abingdon Property LLC	14147 SE Alta Vista Dr	Happy Valley	OR	97086
51032CC70007	3749 S Hemlock St #13	Weger Elisa C Family Trust	10204 SW Copperleaf Ln	Tigard	OR	97224-4897
51032CC80004	3621 S Hemlock St #3	Halstead Elizabeth Ann	PO Box 1094	Cannon Beach	OR	97110
51032CC80005	3621 S Hemlock St #2	Lurquin Paul F/Stone Linda	PO Box 369	Cannon Beach	OR	97110-0369
51032CC80006	3621 S Hemlock St #1	Perrin Richard R	PO Box 1039	Cannon Beach	OR	97110
51020CB90002	645 E 6th St #B	Ennis Matthew Raymond	PO Box 1313	Cannon Beach	OR	97110
51019AD01103	631 N Larch St	Meyer Price Wanda Faye	PO Box 676	Cannon Beach	OR	97110
41006BC01700	3916 Ocean Ave	Hanson Mary Ann	4045 Ferry St	Eugene	OR	97405-3932
41006BC02500	3887 Pacific Ave	Chartier David W	1053 E Cartagena Dr	Long Beach	CA	90807
41006BC03000	3923 Pacific Ave	Mike and Mary Serres LLC	4137 NE Hazelfern Pl	Portland	OR	97232
41006BC04200		Wickham Rockne R	PO Box 208	Tolovana Park	OR	97145
41006BC04900	4064 Hemlock St	Ludlow Walter W/Michele W Tr	1305 N 1350 E	Heber City	UT	84032
41006BC05000	4032 S Hemlock St	Bailey Daniel/Ann C	6421 27th Ave NW	Gig Harbor	WA	98335-1900
41006BC05002	4040 Hemlock St	Davis Thomas W	170 Harbor Square Loop #A-301	Bainbridge Island	WA	98110
41006BC05100	4008 S Hemlock St	Johnson Daryl D	PO Box 292	Cannon Beach	OR	97110-0292
41006BC09600	124 Sitka St	Jensen Tracy L	2413 D St	Vancouver	WA	98663

41006BC10301		Jacobsen Donald W	PO Box 1469	Cannon Beach	OR	97110
51019AA06800	731 N Laurel St	Bartl Rainmar	PO Box 117	Cannon Beach	OR	97110-0117
51019AA06900	739 N Laurel St	Kettlewell George	PO Box 177	Cannon Beach	OR	97110-0177
51019AA07000	780 Ecola Park Rd	Filley Grant Arnold	8242 SE 39th Ave	Portland	OR	97202-8017
51019AD10703	129 E 6th St	Manning John D	8592 Duran St	Juneau	AK	99801-8876
51019AD11300	595 N Hemlock St	Vanderford Carol L	PO Box 441	Cannon Beach	OR	97110
51019AD03200	679 N Laurel St	LucaRental LLC	PO Box 283	Cannon Beach	OR	97110
51019AD09300	109 W 6th St	Avila Pamela	PO Box 724	Cannon Beach	OR	97110
51019AD09301	595 N Larch St	Johnson Buzz W/Nancy S	PO Box 1374	Cannon Beach	OR	97110-1374
51019DD07001		H & W Beach Development Co	PO Box 21	Cannon Beach	OR	97110-0021
51020BC00101	623 N Elm St	Pattison Mary B	PO Box 674	Cannon Beach	OR	97110
51020BC00103	615 N Elm St	Bornfleth Catherine L	41 Newell Ct	Walnut Creek	CA	94595
51020BC00104	611 N Beech St	Coffey-Walker Living Trust	4910 SW Richardson Dr	Portland	OR	97239
51020BC00105	640 Old Cannon Beach Rd	Ienna Todd C	2232 SE Stephens St	Portland	OR	97214
51020BC00111	644 E 6th St	Ogilvie Brandon/Maureen	PO Box 793	Cannon Beach	OR	97110-0793
51020BC00510		Tiger Real Estate Marketing LLC	25 NW 23rd Pl #6	Portland	OR	97210
51020CB00301	595 Antler Rd	Swedenborg Frank	PO Box 3	Cannon Beach	OR	97110-0003
51020CB02401		Ludare LLC	6105 N Wilbur Ave	Portland	OR	97217
51020CB02500	579 N Beech St	Oregon Salal LLC	2300 NW High Lakes Loop	Bend	OR	97703
51020CB03500	539 Fir St	McAllister Carol M	10500 SW 69th Ave	Portland	OR	97223-9194

51020CB03600	531 Fir St	Taylor Ryan A	949 Omar St	Houston	TX	77009
51029BC07300	215 E Harrison St	Oznick Lauren Lynn	923 Evergreen Hills Rd	Dallas	TX	75208
51029BC08300	455 Elk Land Ct	Salciccia Gina Lucia	552-10 Bean Creek Rd	Scotts Valley	CA	95066
51029BC08400	453 Elk Land Ct	Smith Robert/Nancy	2526 SE Meadowlark Dr	Hillsboro	OR	97123-8345
51029BC08500	451 Elk Land Ct	Massebeau Phillip Eugene	PO Box 603	Cannon Beach	OR	97110-0603
51029BD00700	452-454 Elk Land Ct	Kleczek Katherine A	2080 Aldercrest St	Seaside	OR	97138
51029BD00900	547-549 Vine Maple Ct	Bonnett David W	PO Box 1418	Cannon Beach	OR	97110-1418
51029BD01000	552 Vinemaple Ct	Walker Travis S	PO Box 481	Cannon Beach	OR	97110
51029BD01100	550 Vinemaple Ct	Shepard Jay S	PO Box 550	Cannon Beach	OR	97110
51029BD01200	649 Salal Turn	Hull Jeffrey R/Carol A	PO Box 272	Cannon Beach	OR	97110-0272
51029BD01300	648 Salal Turn	Nofield John Paul/Susie Kay	PO Box 896	Cannon Beach	OR	97110-0896
51029CB01400	1387 Sunset Blvd	Cannon Beach Historical Society	PO Box 1005	Cannon Beach	OR	97110-1005
51029CB01500	1315 Spruce St	Dooney Dena S	2223 NE 31st Ave	Portland	OR	97212
51029CB01602	291 E Dawes Ave	Stahley Wayne A/Holly H	PO Box 817	Cannon Beach	OR	97110-0817
51029CB01603	275 E Dawes Ave	Burnett Cory S/Brook H	63355 Silverado Dr	Bend	OR	97703
51029CB01807	1295 Cypress Ct	Laws Marlene J	PO Box 945	Cannon Beach	OR	97110
51030AD12200	1225 Evergreen St	Crabbe Janowsky Trust Jeri/John	920 SW Plum Dr	Portland	OR	97219-4749
51030AD12201	140 E Dawes Ave	Giess Marilyn J	5269 17th Ave NE	Seattle	WA	98105-3407
51030AD12202	1255 S Evergreen St	Brave & Maple Holdings LLC	600 Broadway Ave NW #324	Grand Rapids	MI	49504
51030DA00100	147 E Dawes Ave	Cannon Beach 147 LLC	7203 34th Ave NW	Seattle	WA	98117

51030DA10200		Purdy Rachel K	14988 SW Lookout Dr	Tigard	OR	97224
51030DA02400	1400 S Hemlock St	Hay Family Limited Partnership	5 Centerpointe Dr #590	Lake Oswego	OR	97035
51030DA04104	1603 Forest Lawn Rd	Quails Cove LLC	4955 NW 162nd Ter	Portland	OR	97229
51030DA05201	131 Sunset Blvd	Sunset TLS LLC	PO Box 1053	Cannon Beach	OR	97110
51030DA05900	132 Elliott Way	Popp Daniel K	27935 NE 26th St	Redmond	WA	98053
51030DA06001	156 Elliott Way	Kerwiin Nicholas H	PO Box 125	Cannon Beach	OR	97110
51030DA06902	131 Elliott Way	Handel Robert B	157 Haslemere Ct	Lafayette	CA	94549
51030DA07000	1557 S Hemlock St	Sakai Lynn Y	6485 SW Murray Blvd	Beaverton	OR	97008-4907
51030DA07100	102 Hills Ln	Martin Joshua	1575 Edgewater Ct	West Linn	OR	97068-2772
51030DA08100	195 Hills Ln	Jones Jeffery C	128 Wilson Ave	Long Beach	NY	11561
51030DA08200	187 Hills Ln	Coughlin Barbara A	8945 Kari Ln NW	Bremerton	WA	98311-9060
51030DA08600	155 Hills Ln	McCarthy Nancy A	PO Box 1276	Cannon Beach	OR	97110-1276
51030DA08902	115 Hills Ln	Fransen Larissa	252 Peakview Rd	Boulder	CO	80302
51030DA08903	131 Hills Ln	Avila Juan Antonio	9810 112th Ave NE	Kirkland	WA	98033
51031AD00101	2716 S Hemlock St	Unverferth Craig	930 Tahoe Bvld #802	Incline Village	NV	89451
51031AD00102	2732 S Hemlock St	Dinihanian Harry M	6843 SW 63rd Ave	Portland	OR	97219
51031AD01101	109 W Nelchena St	Koblegarde B Rupert	1151 SW King Ave	Portland	OR	97205-1117
51031AD01200	2840 S Hemlock St	Schmiett Michael L	1905 E Atkin Ave	Salt Lake City	UT	84106
51031AD01301	2888 S Hemlock St	Acton Joseph Walter	PO Box 1467	Cannon Beach	OR	97110
51031AD06000	131 W Nebesna St	Blanchard David Neal	12901 NE 176th Circle	Battle Ground	WA	98604

51032BB00113	417 Chilkoot Trail	Seder Robert Tad	PO Box 89	Tolovana Park	OR	97145
51032BB00305	155 Amber Ln	Alexander Brian Anthony	1924 SE Bidwell St	Portland	OR	97202
51032BB00307	147 Amber Ln	Murray Jayson E	2911 2nd Ave #504	Seattle	WA	98121
51032BC00503	159 E Nelchena Ct	Mickelson Reid A	13315 SE 44th Pl	Bellevue	WA	98006-2124
51032BC00504	155 E Nelchena Ct	Deus Kevin Richard	11726 NE 141st St	Kirkland	WA	98034
51032BC00600		White Paul N	5264 NE 121st Ave #W240	Vancouver	WA	98682
51032BC01000	2601 S Hemlock St	Padgalskas Cannon Beach LLC	1223 W Riverside Ave	Spokane	WA	99201
51032BC01100		Piccini Silvio D Jr/Desiree Trustees	3850 South Hampton Ct	West Linn	OR	97068
51032CB00200		Janecek Jay	PO Box 1861	Veradale	WA	99037
51032CC00700	3623 S Hemlock St	Keller Delphine E	1335 NE Golf Ct Rd	Portland	OR	97211
51032CC00701	3615 A-3615 B S Hemlock St S	Coleman John G Trustee	PO Box 916	Travelers Rest	SC	29690
51032CC00702	3631 S Hemlock St	Littell Nancy Jean	PO Box 734	Cannon Beach	OR	97110
51032CC00800	140 Tyee St	Zeh Catherine A	22711 Lakeview Dr #C-2	Mountlake Terrace	WA	98043
51020CB90001	645 E 6th St #A	Davis Micah	PO Box 1312	Cannon Beach	OR	97110