Connell Rail Interchange

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ENVIRO

Memo

Date: Wednesday, September 09, 2015

Project: Connell Rail Interchange Study

To: Jed Crowther – City of Connell

From: Marissa Gifford, AICP and Paul Weber – HDR

Subject: Environmental Overview Memo

Introduction

The City of Connell (City) has received a Community Economic Revitalization Board (CERB) planning grant to undertake the Connell Rail Interchange Study. This study will focus on the feasibility, preliminary design and cost estimate for improvements to the Columbia Basin Railroad (CBRR) and Burlington Northern Santa Fe (BNSF) rail intersection in Connell, WA. The current interchange is limited to exchanging trains of about 2,000 feet in total length in order to avoid significant delays to automotive traffic and railroad operations. At least 50 percent of the time, one or both of the railroads are delayed unnecessarily or experience inefficiencies at the interchange. The City intends to develop a proposed configuration that is more efficient for both railroads and automotive traffic as well as enhance safety.

The intent of this memorandum is to identify potential areas of concern from both the built environmental and the natural environment to be used during development of alternatives, site plans, infrastructure design, and permit acquisition. Three conceptual alignments have been analyzed in this memorandum: North Alignment; Middle Alignment; and the Initial Concept (see Figure 1).

Project Area Description

The conceptual alignments are located within the following Township/Range/Sections:

- North Alignment: Sections 1, 11, 12, and 14, Township 14N, Range 31E
- Middle Alignment: Sections 13, 14, 24, and 24, , Township 14N, Range 31E
- Initial Concept: Sections 35 and 36, , Township 14N, Range 31E; and Section 2, Township 13N, Range 31E

Zoning – Franklin County

The North Alignment is entirely within Franklin County, and portions of the Middle Alignment and Initial Concept are also within the County. These areas are zoned as Agricultural Production (AP-20 and AP-40) by the County.

Per the County Code Chapters 17.10 and 17.12, the Agricultural Production 20 and 40 zones are designed to maintain the agricultural economy of the county by reserving the farmlands that are used for farming and that are suited to such use. The Franklin County Code does not contain specific use

provisions related to rail or railroad development; however, the Comprehensive Plan contains provisions for preserving existing rail infrastructure and rail service within the county.

The Franklin County Board of County Commissioners has provided support for the Connell Rail Interchange Project to the CERB Board and Staff, as this project is considered regionally significant for agriculture and industry.

Zoning – City of Connell

The portions of the Middle Alignment and the Initial Concept that are within the City of Connell are zoned IL-Industrial Light (Middle Alignment), and A-Agriculture and IH-Industrial Heavy (Initial Concept). In addition, part of the North Alignment is within the City's urban growth area.

This project would likely be considered as a public or quasi-public use by the City of Connell. Per Connell Municipal Code (CMC) Chapter 17.02, "public and quasi-public uses" means those uses which are public and private not-for-profit educational institutions, civic buildings, community buildings and uses, public utility uses including substations, governmental buildings; churches, church-related uses; museums, art galleries, libraries; reservoirs, public recreational facilities; and essential services and similar uses

Per CMC Chapter 17.15, the purpose of IL district is to provide areas for less intensive manufacturing and industrial uses; warehousing, distribution operations; and retail uses to serve the district. Public and quasi-public uses are permitted in the IL district.

The purpose of the Agriculture district is to protect lands best suited as watersheds or farms from incompatible uses, and to preserve land suited for eventual urban development (CMC Chapter 17.05). Public and quasi-public uses such as this project would require a Conditional Use Permit in the A-Agriculture zone.

The purpose of the IH district is to provide for areas for general industrial processing and manufacturing uses, subject only to the protection of nearby uses and the required quality of air and water (CMC Chapter 17.16). Public and quasi-public uses are permitted in the IH district.

The Connell Rail Interchange Project has been identified as a high-priority project by the City of Connell.

Critical Areas

A summary of critical areas that might constrain development of this project is provided below.

Wetlands

According to the National Wetlands Inventory, there are no wetlands on or adjacent to the conceptual alignments. However, as the project area contains numerous coulees that may have adjacent wetlands this should be field-verified.

Critical Aquifer Recharge Areas and Wellhead Protection Areas

Per the EPA's Region 10 Sole Source Aquifers map, there are no sole-source aquifers in the project area.

Much of the city and areas to the southwest are within wellhead protection areas for numerous wells – the South Alignment are within these wellhead protection areas. Uses within the one-year wellhead

protection areas of the city's operable wells are limited to those uses which will not cause contamination of groundwater (CMC 17.24.050). Should the city determine that contamination of groundwater may occur from a proposed development or use, the applicant would be required to apply for a Conditional Use Permit.

Surface Water and Floodplains

The City of Connell is located at the junction of three coulees: Providence, Esquatzel, and Washtucna Coulees. These coulees are deep channels cut by Pleistocene cataclysmic floodwaters that washed across the region. The coulees experience seasonal runoff events and serve as a collector for irrigation water runoff from upslope farmlands (also known as a "wasteway"). The North Alignment generally follows the Providence Coulee, while the Middle Alternative and Initial Concept generally follow the Esquatzel Coulee (see Figure 2). Note that the Esquatzel Coulee is generally a natural channel from SR 260 to the south; and is a constructed channel north of SR 260.

According to floodplain data from the Washington State Department of Ecology (Ecology) and FEMA, portions of the conceptual alignments cross or are adjacent to the 100-year floodplain (see Figure 2).

There are no other surface water bodies on or adjacent to the conceptual alignments.

Wildlife

Per the Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species Mapping, all conceptual alignments are within a township-wide Ferruginous hawk breeding area (listed as threatened by the Washington Department of Fish and Wildlife (WDFW)). Portions of the Middle and Southern Alignments are within a quarter-township-wide regular concentration of Washington ground squirrel (considered a candidate species by WDFW).

Per Salmonscape (http://apps.wdfw.wa.gov/salmonscape/), there are no WDFW-regulated fish species in or near the project area.

Geologically Hazardous Areas

Per Franklin County's Liquefaction Susceptibility map, the conceptual alignments may contain areas of low-to-moderate and moderate-to-high liquefaction susceptibility. In addition, portions of the conceptual alignments may contain steep slopes, but such maps are not readily available from the City of Connell or Franklin County (this should be field-verified). Projects proposed in geologically hazardous areas will likely be required to prepare a Critical Areas Report.

Federally-Listed Species

Washington ground squirrel (a Candidate Species) may occur within the project area. The following Endangered Species Act (ESA) listed species are potentially occurring within Franklin County but are unlikely to occur within the project area:

- yellow-billed cuckoo
- bull trout
- gray wolf
- white bluffs bladderpod

Pipelines

Based on review of the Washington Utilities and Transportation Commission (UTC) Pipeline Map for Franklin County, there are no existing pipelines on or near the conceptual alignments.

Anticipated Agency Consultation

Local

Permits and approvals would be needed from the City of Connell and/or Franklin County, depending on the alignment selected.

The State Environmental Policy Act (SEPA) process would likely be triggered by this project, requiring completion of a SEPA Environmental Checklist and supporting environmental documentation. The City of Connell would likely act as the SEPA Lead Agency as they are the project proponent; or they may act as SEPA Co-Lead Agency with Franklin County.

State

The Washington State Department of Transportation (WSDOT) will be administering funds on this project, so they will likely review SEPA materials.

If bridges and culverts would be installed at drainage crossings, coordination and permits may be required from WDFW.

As disturbance of more than one acre is anticipated for this project, a Construction Stormwater NPDES Permit would likely be required from Ecology. Ecology would also review SEPA materials.

Construction of the North Alignment would affect Coyan Road which crosses the coulee at a grade separation – this would likely involve coordination with the Washington UTC.

Federal

All alignments are within the South Columbia Basin Irrigation District (SCBID) service area of the Columbia Irrigation Project (U.S. Bureau of Reclamation [USBR], Pacific Northwest Region), and may require review by the USBR and/or SCBID.

The U.S. Army Corps of Engineers (Corps) manages flood control along the constructed portion of the Esquatzel Coulee (generally north of the SR 260 bridge), and would likely require permits or approvals if modifications to the coulee or construction within its associated floodplain would occur. Additionally, if wetlands are identified within the project action area that would be affected a Section 404 permit may be required, if greater than 1/10th of an acre of wetlands were to be filled.

If federal funding or permits are needed for this project, the National Environmental Policy Act (NEPA) process may be triggered. This involves preparation of NEPA documentation, including environmental analysis, cultural review, and ESA consultation. Federal agencies which may need to be consulted if NEPA is triggered include:

- Corps
- U.S. Fish and Wildlife Service (USFWS)

- National Marine Fisheries Service (NMFS)/NOAA Fisheries
- USBR/SCBID

Additional coordination with the regulatory divisions of the federal agencies is required to determine the level of NEPA compliance and permitting would be triggered by each of the alignments.

Other Potential Review Groups

Permits or other approvals (real estate, easements, etc.) for project construction may be needed from BNSF, depending on the final project alignment.

Anticipated Permits

A preliminary table of anticipated permits or approvals is provided below. Note that additional discussion with the City of Connell, Franklin County, and federal agencies as well as detail on the chosen alignment and construction methods is required before a final list of anticipated permits can be compiled.

Agency	Permit/Approval
City of Connell	– SEPA Environmental Checklist and Determination – Critical Area Review/Report – Right of Way Permit (if new road crossings are proposed) – Conditional Use Permit (depending upon alignment)
Franklin County	– SEPA Environmental Checklist and Determination – Critical Area Review/Report – Land Use Permit (process unknown at this time)
WSDOT	– SEPA review
WDFW	– Hydraulic Project Approval (HPA)
Ecology	– Construction Stormwater NPDES Permit – SEPA review
Washington UTC	– Project review/approval (process unknown at this time)
Corps	– Project review/approval (process unknown at this time) – NEPA review (if triggered) – Section 404 Permit (if wetlands were filled)
USBR/SCBID	– Project review/approval (process unknown at this time) – NEPA review (if triggered)
USFWS	– ESA review (if NEPA is triggered)
NMFS/NOAA Fisheries	– ESA review (if NEPA is triggered)
BNSF	– Project review/approval (process unknown at this time)

Technical Memorandum

Date: Friday, October 23, 2015

Project: Connell Interchange – South Alternate

To: Jed Crowther, City Administrator, City of Connell

From: Matt Folwell, PE

Subject: Anticipated Esquatzel Coulee Drainage Impacts from Track Roadbed Construction

The purpose of this memorandum is to provide preliminary information about potential flow event impacts from track roadbed construction of the new interchange construction for the South Alternate. Available aerial surface information was used to perform an analysis of drainage impacts from the proposed construction. The term "potential" will apply to all information a statements contained herein as topographic survey data was not available and/or used to perform the preliminary review. This analysis does not consider irrigation runoff.

FEMA flood maps show the area impacted by the roadbed construction as Zone A6 near the bottom of the coulee, and Zone B at the perimeter of the coulee channel.

The drainage area contributing to Esquatzel Coulee at Connell consists of approximately 400 square miles. The coulee is heavily vegetated with brush and mature trees along the reach of the proposed interchange, and appears to have irrigation waste water entering the coulee south of State Highway 260. Stream flow event information was taken from the USGS StreamStats website. The flows volumes in the table below show the values used in the analysis:

StreamStats Flow Data (cubic feet per second)	
10 year event	1710
50 year event	3880
100 year event	5050

HEC-RAS (stream/river modeling analysis program) was used to analyze the flow data against the available aerial surface information. The 100 year flow elevations calculated for the existing conditions, without any proposed track roadway embankment included, generally agree with the FEMA flood map elevations. The flow elevations calculated are dependent upon several factors including assumed channel roughness and channel shape. FEMA likely used similar aerial or other USGS map surface information to determine the elevations shown on the flood map, however without the equivalent data and information, flow elevations can not be exactly matched.

The proposed tracks will follow along the west side of the existing BNSF mainline track bordering Esquatzel Coulee in several locations. The roadbed construction necessary for the interchange tracks may impact the coulee opposite the largest of the Con Agra Foods wastewater pond on the west side of the coulee. This earthwork impact would introduce a fill embankment on the east slope of the coulee at this location, extending to the bottom of the coulee and reduce the existing coulee channel width.

The reduction in coulee channel width will change the flow characteristics and capacity of the channel at the embankment location.

The HEC-RAS analysis results indicate an increase in water surface elevation of approximately 0.7 feet in the area where the embankment may be constructed. This increase in elevation was shown to quickly dissipate upstream from the largest change in surface elevation, and no change was observed 500 feet upstream. The increase in water surface elevation may have an impact on the Con Agra wastewater pond berm facing the coulee. Riprap appears to have been placed along the toe of the dam and supporting coulee bank to provide protection against higher flow events; the extents, size and design purpose of the riprap are unknown. Any modifications to the existing pond dam would likely require review and approval from the Washington State Department of Ecology, Dam Safety Division.

Per City of Connell Municipal Code 15.08.180 and Franklin County Municipal Code 15.08.220(F) allow water surface elevation increases from new development of up to 1 foot.

In the aerial surface information used to perform the analysis, there is not a detectable bench, limit or boundary between the wastewater pond dam embankment and the west bank of the coulee. It appears the dam may have been constructed partially in the floodplain. Due to this unknown grey area of dam construction limits, HDR will propose to attempt to construct the track roadbed as a "no rise" condition within the coulee floodway. This will require expanding the coulee floodway upstream of the pond dam to accommodate the additional floodwater accumulation upstream of any roadway embankment constriction within the coulee. Expansion of the coulee would potentially include excavation which would conjoin the coulee and allow pooling of additional water upstream of the construction without a rise in surface elevation of the floodwater along the face of the dam.

Considerations to potential flow restrictions and impacts to any existing engineered embankments will need to be addressed as design progresses for the interchange tracks. These considerations should not be limited to the issues identified in this memorandum once sufficient topographic data is collected and site investigations are performed.

Attachments:

1. Connell Rail Interchange – South Alternate Soil Report
2. Connell Rail Interchange – South Alternate FIRM Maps
3. Connell Rail Interchange – South Alternate HEC-RAS Summary Data

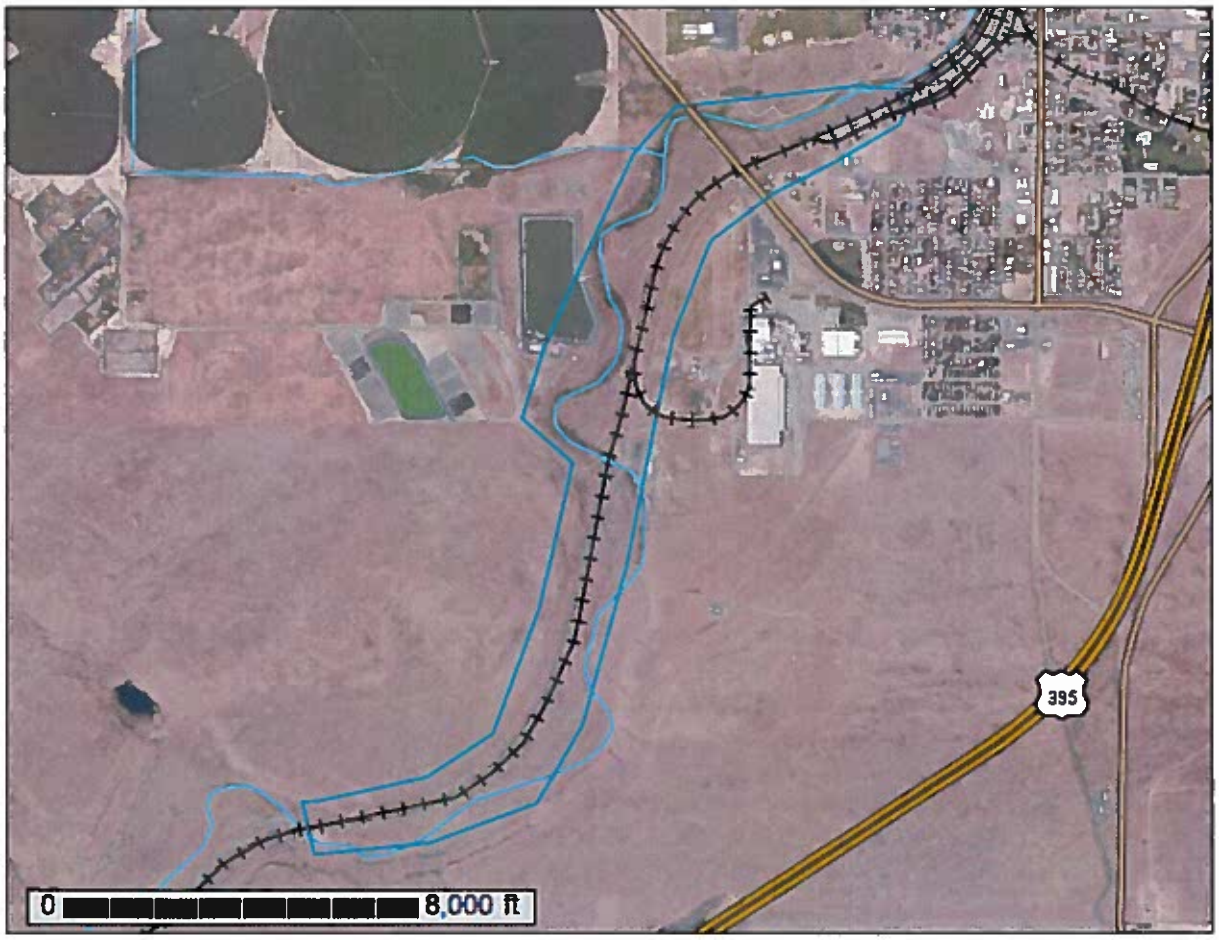
United States Department of Agriculture

NRCS

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 Franklin County, Washington



October 23, 2015

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 (http://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.

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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 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 identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

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.

Map Scale: 1:15,300 if printed on A portrait (8.5" x 11") sheet.

Meters
0 200 400 800 1200

Feet
0 500 1000 2000 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

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.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Franklin County, Washington
Survey Area Data: Version 13, Sep 14, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 6, 2010—Aug 7, 2010

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.

Map Unit Legend

Franklin County, Washington (WA021)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
13	Cleman fine sandy loam, 0 to 2 percent slopes	14.8	6.2%
59	Neppel fine sandy loam, 5 to 10 percent slopes	7.4	3.1%
61	Neppel very fine sandy loam, 2 to 5 percent slopes	46.2	19.3%
62	Neppel very fine sandy loam, 5 to 10 percent slopes	61.9	25.8%
65	Neppel-Finley complex, 15 to 50 percent slopes	29.1	12.1%
66	Novark silt loam, 2 to 5 percent slopes	35.0	14.6%
83	Prosser-Starbuck-Rock outcrop complex, 2 to 15 percent slopes	25.9	10.8%
133	Sagehill very fine sandy loam, 0 to 2 percent slopes	0.1	0.0%
169	Starbuck-Prosser-Rock outcrop complex, 15 to 30 percent slopes	11.5	4.8%
198	Warden very fine sandy loam, 10 to 15 percent slopes	1.4	0.6%
220	Water	6.4	2.7%
Totals for Area of Interest		**239.8**	**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.

Franklin County, Washington

13—Cleman fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2dfg
Elevation: 400 to 1,400 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Cleman and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cleman

Setting

Landform: Drainageways, flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: fine sandy loam
H2 - 11 to 28 inches: very fine sandy loam
H3 - 28 to 60 inches: stratified sand to silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: LOAMY BOTTOM 6-10 PZ (R007XY402WA)

59—Neppel fine sandy loam, 5 to 10 percent slopes

Map Unit Setting

National map unit symbol: 2dqd
Elevation: 400 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 135 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Neppel and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Neppel

Setting

Landform: Terraces
Parent material: Alluvium over glacial outwash

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 22 inches: fine sandy loam
H3 - 22 to 28 inches: gravelly fine sandy loam
H4 - 28 to 60 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 24 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: SANDY 6-10 PZ (R007XY501WA)

Minor Components

Prosser

Percent of map unit: 10 percent
Landform: Hills, ridges

Taunton

Percent of map unit: 10 percent
Landform: Terraces

61—Neppel very fine sandy loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2dqm
Elevation: 400 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Neppel and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Neppel

Setting

Landform: Terraces
Parent material: Alluvium over glacial outwash

Typical profile

H1 - 0 to 7 inches: very fine sandy loam
H2 - 7 to 30 inches: very fine sandy loam
H3 - 30 to 37 inches: gravelly very fine sandy loam
H4 - 37 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 24 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Minor Components

Prosser

Percent of map unit: 10 percent
Landform: Hills, ridges

Taunton

Percent of map unit: 10 percent
Landform: Terraces

62—Neppel very fine sandy loam, 5 to 10 percent slopes

Map Unit Setting

National map unit symbol: 2dqw
Elevation: 400 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Neppel and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Neppel

Setting

Landform: Terraces
Parent material: Alluvium over glacial outwash

Typical profile

H1 - 0 to 7 inches: very fine sandy loam
H2 - 7 to 30 inches: very fine sandy loam
H3 - 30 to 37 inches: gravelly very fine sandy loam
H4 - 37 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 24 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Minor Components

Prosser

Percent of map unit: 10 percent
Landform: Hills, ridges

Taunton

Percent of map unit: 10 percent
Landform: Terraces

65—Neppel-Finley complex, 15 to 50 percent slopes

Map Unit Setting

National map unit symbol: 2dr3
Elevation: 400 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Neppel and similar soils: 40 percent
Finley and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Neppel

Setting

Landform: Terraces
Parent material: Alluvium over glacial outwash

Typical profile

H1 - 0 to 7 inches: very fine sandy loam
H2 - 7 to 30 inches: very fine sandy loam
H3 - 30 to 37 inches: gravelly very fine sandy loam
H4 - 37 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: 24 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Description of Finley

Setting

Landform: Terraces
Parent material: Gravelly alluvium

Typical profile

H1 - 0 to 4 inches: very fine sandy loam
H2 - 4 to 13 inches: very fine sandy loam
H3 - 13 to 27 inches: very gravelly very fine sandy loam
H4 - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: 20 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: SANDY 6-10 PZ (R007XY501WA)

Minor Components

Sagehill

Percent of map unit: 5 percent
Landform: Terraces

Warden

Percent of map unit: 5 percent
Landform: Terraces

Hezel

Percent of map unit: 5 percent
Landform: Terraces

66—Novark silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2dr4
Elevation: 400 to 1,400 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 210 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Novark and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Novark

Setting

Landform: Terraces
Parent material: Loess over glacial outwash or alluvium

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 17 inches: silt loam
H3 - 17 to 21 inches: very fine sandy loam
H4 - 21 to 60 inches: fine sand

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 20 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Minor Components

Sagehill
Percent of map unit: 10 percent
Landform: Terraces

Warden
Percent of map unit: 10 percent
Landform: Terraces

Neppel
Percent of map unit: 5 percent
Landform: Terraces

83—Prosser-Starbuck-Rock outcrop complex, 2 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2dsv
Elevation: 400 to 1,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition
Prosser and similar soils: 35 percent
Starbuck and similar soils: 30 percent
Rock outcrop: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Prosser

Setting
Landform: Hills, ridges
Parent material: Loess and glaciofluvial deposits

Typical profile
H1 - 0 to 4 inches: silt loam
H2 - 4 to 22 inches: very fine sandy loam
H3 - 22 to 33 inches: silt loam
H4 - 33 to 43 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Description of Starbuck

Setting
Landform: Hills, ridges
Parent material: Loess, colluvium and alluvium

Typical profile
H1 - 0 to 9 inches: silt loam
H2 - 9 to 17 inches: silt loam
H3 - 17 to 27 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 15 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups
Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: STONY 6-10 PZ (R007XY202WA)

Description of Rock Outcrop

Typical profile
R - 0 to 60 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8

133—Sagehill very fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2dfs
Elevation: 500 to 1,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sagehill and similar soils: 75 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sagehill

Setting

Landform: Terraces
Parent material: Lacustrine deposits with a mantle of loess or eolian deposits

Typical profile

H1 - 0 to 6 inches: very fine sandy loam
H2 - 6 to 25 inches: very fine sandy loam
H3 - 25 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Minor Components

Kennewick

Percent of map unit: 15 percent

Landform: Terraces

169—Starbuck-Prosser-Rock outcrop complex, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2dhw
Elevation: 400 to 1,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Starbuck and similar soils: 40 percent
Prosser and similar soils: 30 percent
Rock outcrop: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Starbuck

Setting

Landform: Hills, ridges
Parent material: Loess, colluvium and alluvium

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 17 inches: silt loam
H3 - 17 to 27 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: STONY 6-10 PZ (R007XY202WA)

Description of Prosser

Setting

Landform: Ridges, hills
Parent material: Loess and glaciofluvial deposits

Typical profile

H1 - 0 to 4 inches: silt loam
H2 - 4 to 22 inches: very fine sandy loam
H3 - 22 to 33 inches: silt loam
H4 - 33 to 43 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8

198—Warden very fine sandy loam, 10 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2dkg
Elevation: 500 to 1,150 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Warden and similar soils: 90 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Warden

Setting
Landform: Terraces
Parent material: Lacustrine deposits with a thin mantle of loess

Typical profile
H1 - 0 to 6 inches: very fine sandy loam
H2 - 6 to 19 inches: silt loam
H3 - 19 to 60 inches: silt loam

Properties and qualities
Slope: 10 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 8 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.5 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: LOAMY 6-10 PZ (R007XY102WA)

Minor Components

Kennewick
Percent of map unit: 10 percent
Landform: Terraces

220—Water

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting
Landform: Alluvial cones

Interpretive groups
Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8

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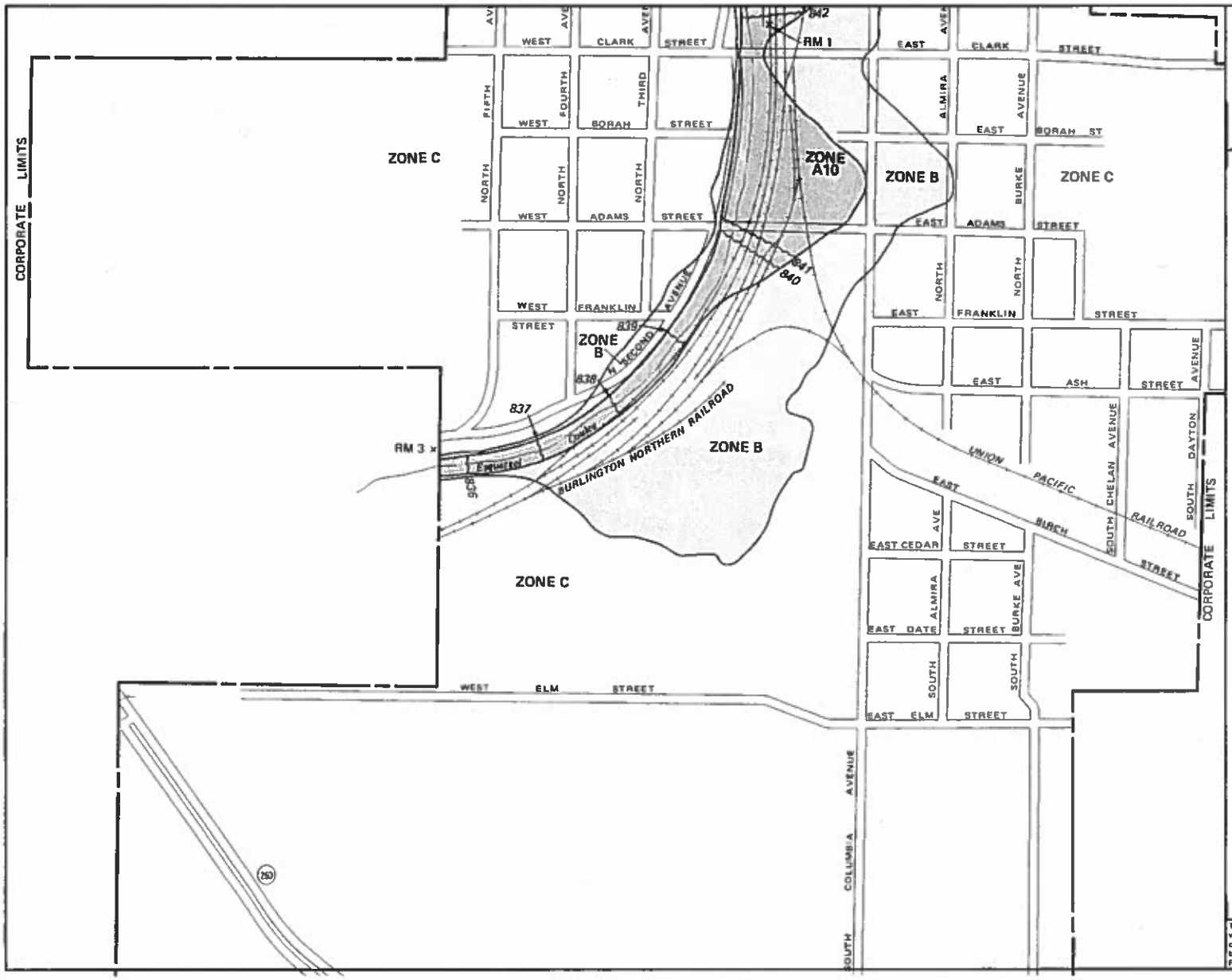

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

TOWN OF
CONNELL,
WASHINGTON
FRANKLIN COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
530280 0001 B

EFFECTIVE DATE:
SEPTEMBER 28, 1979

U.S. DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

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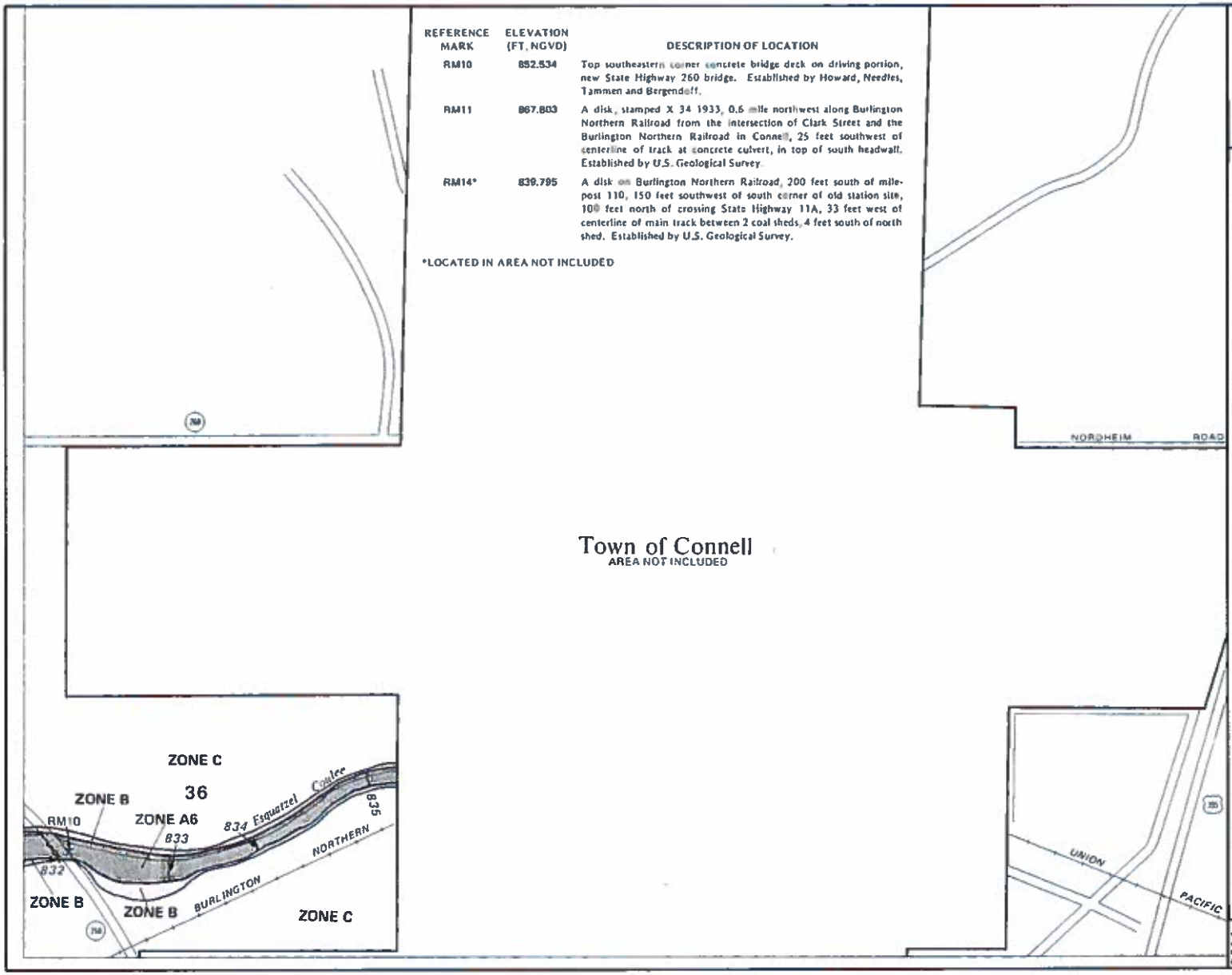
REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM10	852.534	Top southeastern corner concrete bridge deck on driving portion, new State Highway 260 bridge. Established by Howard, Needles, Tammen and Bergendoff.
RM11	867.803	A disk, stamped X 34 1933, 0.6 mile northwest along Burlington Northern Railroad from the intersection of Clark Street and the Burlington Northern Railroad in Connell, 25 feet southwest of centerline of track at concrete culvert, in top of south headwall. Established by U.S. Geological Survey.
RM14*	839.795	A disk on Burlington Northern Railroad, 200 feet south of mile-post 110, 150 feet southwest of south corner of old station site, 100 feet north of crossing State Highway 11A, 33 feet west of centerline of main track between 2 coal sheds, 4 feet south of north shed. Established by U.S. Geological Survey.

*LOCATED IN AREA NOT INCLUDED



APPROXIMATE SCALE

500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

FRANKLIN COUNTY, WASHINGTON
(UNINCORPORATED AREAS)

PANEL 136 OF 850
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
530044 0136 B

EFFECTIVE DATE:
MAY 1, 1980

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

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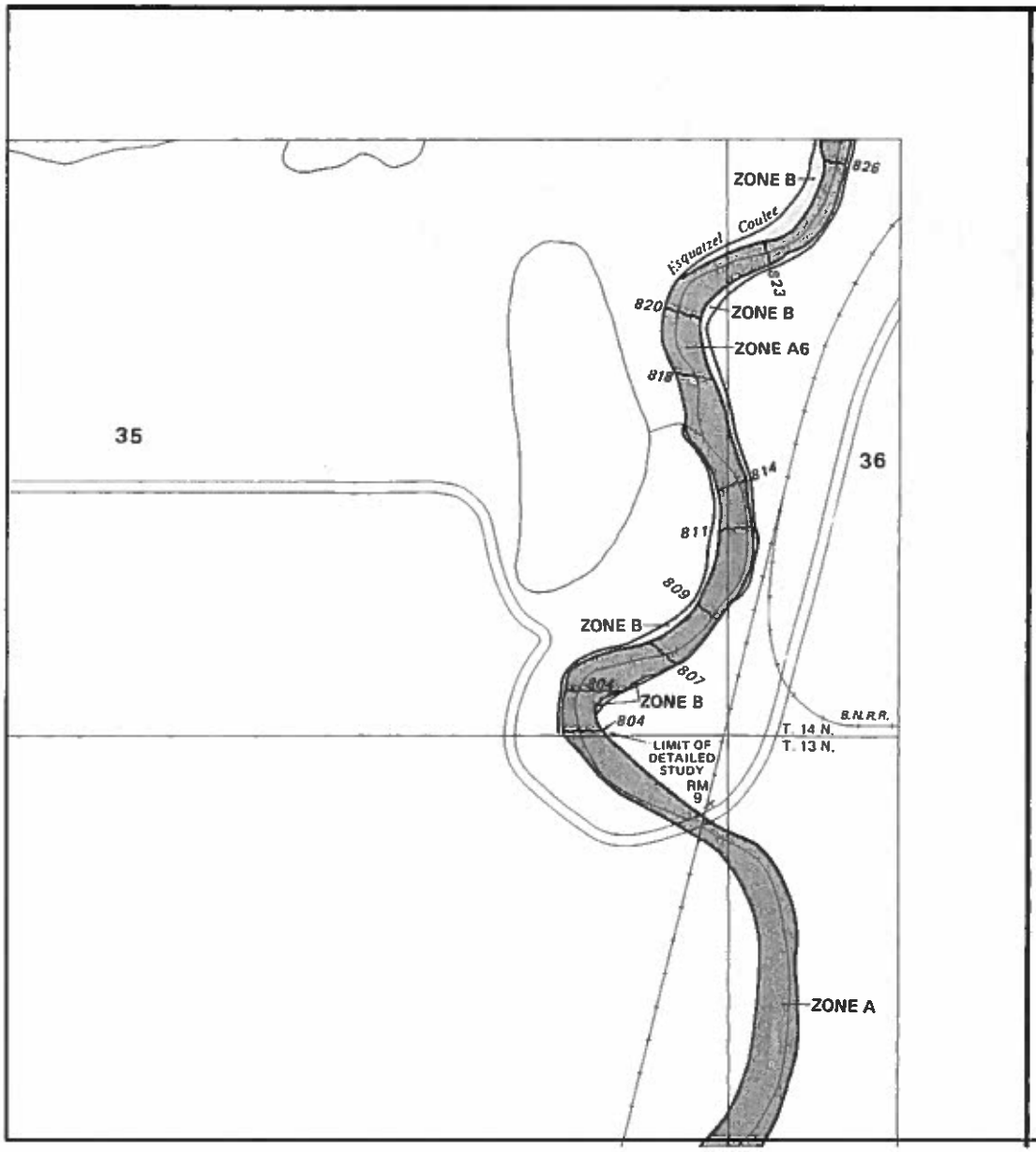

KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	
Zone Designations* With Date of Identification e.g., 12/2/74	ZONE A1 DATE / ZONE A5 DATE
100-Year Flood Boundary	
500-Year Flood Boundary	ZONE B
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation In Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7 ×
River Mile	• M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

APPROXIMATE SCALE

500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

FRANKLIN COUNTY, WASHINGTON
(UNINCORPORATED AREAS)

PANEL 119 OF 850
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
530044 0119 B

EFFECTIVE DATE:
MAY 1, 1980

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

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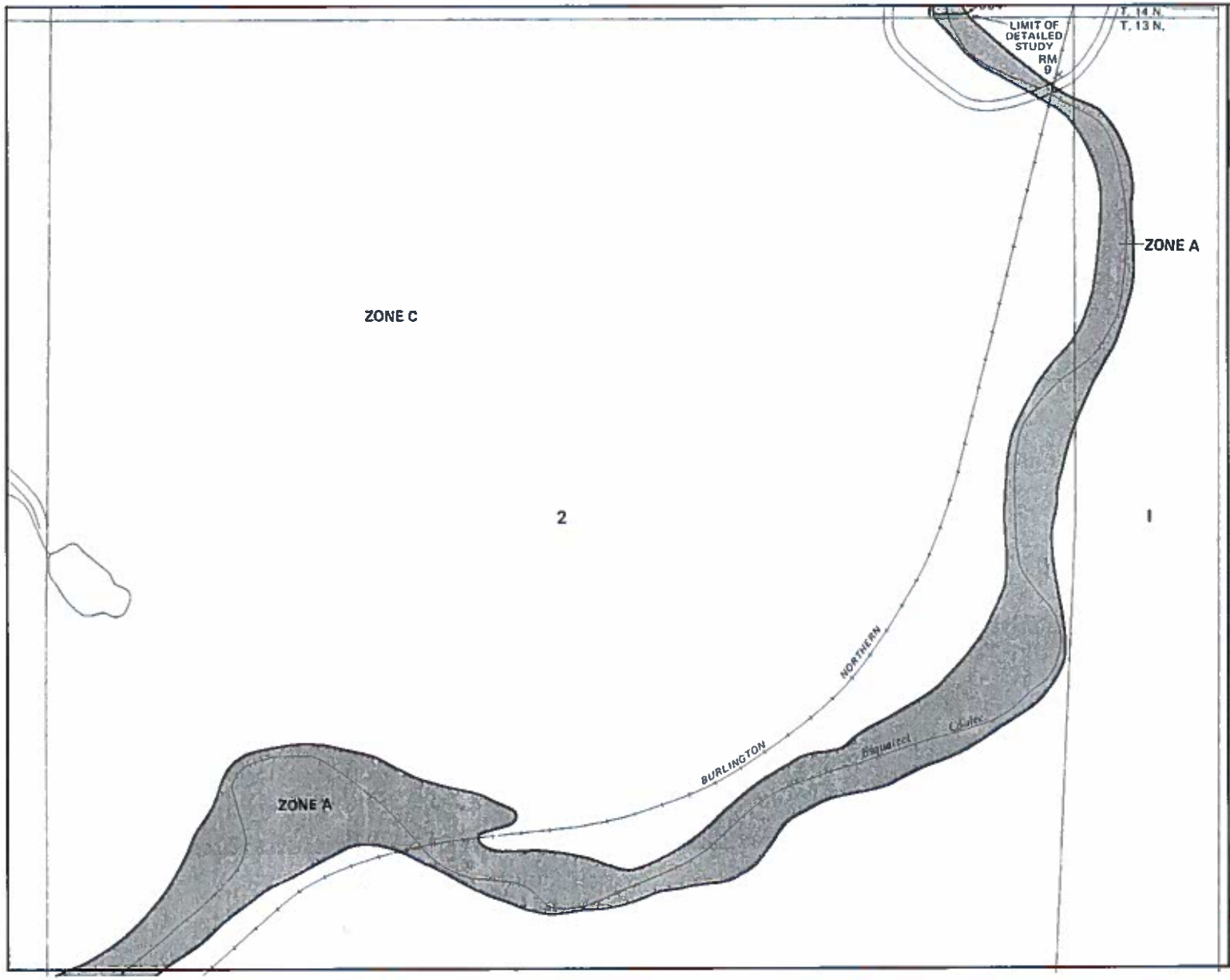

APPROXIMATE SCALE

500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

FRANKLIN COUNTY, WASHINGTON

(UNINCORPORATED AREAS)

PANEL 119 OF 850

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HEC-RAS Plan: Plan 03 River: South Opt - Sout Reach: South Opt - Sout

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South Opt - Sout	5700	10 yr	1710.00	791.81	794.10	794.10	794.93	0.023219	5.15	250.99	149.69	0.61
South Opt - Sout	5700	50 yr	3880.00	791.81	795.31	795.36	796.58	0.020003	6.38	455.25	186.88	0.61
South Opt - Sout	5700	100 yr	5050.00	791.81	795.76	795.88	797.27	0.020007	6.94	543.79	200.52	0.62
South Opt - Sout	5600	10 yr	1710.00	791.94	794.25	794.25	795.09	0.023853	5.31	247.40	143.75	0.62
South Opt - Sout	5600	50 yr	3880.00	791.94	795.55	795.55	796.76	0.019438	6.47	461.33	185.70	0.60
South Opt - Sout	5600	100 yr	5050.00	791.94	796.05	796.05	797.44	0.018766	6.94	559.07	201.81	0.60
South Opt - Sout	5500	10 yr	1710.00	791.97	794.18	794.18	794.99	0.022515	5.03	254.47	153.18	0.60
South Opt - Sout	5500	50 yr	3880.00	791.97	795.42	795.42	796.61	0.018713	6.18	469.32	193.14	0.59
South Opt - Sout	5500	100 yr	5050.00	791.97	795.92	795.92	797.27	0.017970	6.62	569.44	209.07	0.59
South Opt - Sout	5400	10 yr	1710.00	791.99	794.27	794.27	795.11	0.023423	5.25	250.24	147.66	0.61
South Opt - Sout	5400	50 yr	3880.00	791.99	795.55	795.55	796.75	0.019188	6.40	464.99	188.77	0.60
South Opt - Sout	5400	100 yr	5050.00	791.99	796.06	796.06	797.42	0.018472	6.86	565.13	206.11	0.60
South Opt - Sout	5300	10 yr	1710.00	792.00	794.25	794.25	795.06	0.021905	5.03	257.30	154.94	0.59
South Opt - Sout	5300	50 yr	3880.00	792.00	795.48	795.48	796.65	0.018516	6.19	472.59	195.42	0.58
South Opt - Sout	5300	100 yr	5050.00	792.00	795.96	795.96	797.31	0.018140	6.67	569.67	211.07	0.59
South Opt - Sout	5200	10 yr	1710.00	792.00	794.28	794.28	795.07	0.020174	4.82	265.99	165.68	0.57
South Opt - Sout	5200	50 yr	3880.00	792.00	795.47	795.47	796.66	0.016688	5.83	483.29	198.01	0.55
South Opt - Sout	5200	100 yr	5050.00	792.00	795.97	795.97	797.33	0.015939	6.23	584.95	211.33	0.55
South Opt - Sout	5100	10 yr	1710.00	792.00	794.47	794.47	795.31	0.022456	5.34	253.90	148.82	0.61
South Opt - Sout	5100	50 yr	3880.00	792.00	795.71	795.71	797.02	0.018758	6.43	453.59	172.39	0.59
South Opt - Sout	5100	100 yr	5050.00	792.00	796.26	796.26	797.76	0.017351	6.80	551.48	182.03	0.58
South Opt - Sout	5000	10 yr	1710.00	792.00	794.86	794.86	795.76	0.020622	5.36	250.61	130.52	0.59
South Opt - Sout	5000	50 yr	3880.00	792.00	796.22	796.22	797.58	0.018292	6.69	447.80	157.90	0.59
South Opt - Sout	5000	100 yr	5050.00	792.00	796.78	796.78	798.34	0.017686	7.19	539.57	168.69	0.60
South Opt - Sout	4900	10 yr	1710.00	792.84	796.78	796.78	798.22	0.042947	8.95	183.45	64.73	0.88
South Opt - Sout	4900	50 yr	3880.00	792.84	798.96	798.96	801.11	0.031937	10.87	338.82	78.27	0.82
South Opt - Sout	4900	100 yr	5050.00	792.84	799.85	799.85	802.32	0.029607	11.59	411.05	83.80	0.81
South Opt - Sout	4800	10 yr	1710.00	793.93	797.17	797.17	798.44	0.039345	8.30	193.87	77.65	0.83
South Opt - Sout	4800	50 yr	3880.00	793.93	799.05	799.05	801.05	0.029613	9.89	354.50	92.70	0.78
South Opt - Sout	4800	100 yr	5050.00	793.93	799.90	799.90	802.17	0.025936	10.29	435.87	98.26	0.75
South Opt - Sout	4700	10 yr	1710.00	794.00	797.01	797.01	798.20	0.032316	7.22	207.85	89.76	0.75
South Opt - Sout	4700	50 yr	3880.00	794.00	798.80	798.80	800.61	0.023753	8.55	383.21	105.54	0.70
South Opt - Sout	4700	100 yr	5050.00	794.00	799.55	799.55	801.62	0.022122	9.10	464.20	112.08	0.69
South Opt - Sout	4600	10 yr	1710.00	794.00	797.15	797.15	798.33	0.039767	8.25	198.01	86.99	0.84
South Opt - Sout	4600	50 yr	3880.00	794.00	798.94	798.94	800.70	0.027904	9.42	372.99	108.30	0.76
South Opt - Sout	4600	100 yr	5050.00	794.00	799.67	799.67	801.69	0.025232	9.85	455.90	116.19	0.74
South Opt - Sout	4500	10 yr	1710.00	796.20	799.94	799.94	801.17	0.036337	7.96	199.74	83.63	0.80
South Opt - Sout	4500	50 yr	3880.00	796.20	801.83	801.83	803.56	0.025478	9.18	382.65	109.76	0.73
South Opt - Sout	4500	100 yr	5050.00	796.20	802.57	802.57	804.52	0.023570	9.68	466.77	118.83	0.71
South Opt - Sout	4400	10 yr	1710.00	797.98	801.09	801.09	802.29	0.039015	8.15	198.30	86.06	0.83
South Opt - Sout	4400	50 yr	3880.00	797.98	802.92	802.92	804.69	0.027122	9.33	374.99	107.44	0.75
South Opt - Sout	4400	100 yr	5050.00	797.98	803.67	803.67	805.67	0.024761	9.80	458.27	116.24	0.73
South Opt - Sout	4300	10 yr	1710.00	798.00	801.70	801.70	802.95	0.043100	8.89	190.48	77.84	0.88
South Opt - Sout	4300	50 yr	3880.00	798.00	803.61	803.61	805.44	0.030358	10.21	361.04	100.39	0.80
South Opt - Sout	4300	100 yr	5050.00	798.00	804.36	804.36	806.47	0.027797	10.71	439.84	108.13	0.78
South Opt - Sout	4200	10 yr	1710.00	799.04	802.42	802.42	803.68	0.041593	8.55	192.32	79.43	0.86
South Opt - Sout	4200	50 yr	3880.00	799.04	804.32	804.32	806.21	0.029804	9.96	358.92	97.34	0.79
South Opt - Sout	4200	100 yr	5050.00	799.04	805.14	805.14	807.27	0.026394	10.38	441.74	104.83	0.76
South Opt - Sout	4100	10 yr	1710.00	799.95	803.00	803.00	804.21	0.037228	7.85	200.15	86.47	0.81
South Opt - Sout	4100	50 yr	3880.00	799.95	804.83	804.83	806.64	0.026356	9.11	374.18	104.47	0.73
South Opt - Sout	4100	100 yr	5050.00	799.95	805.62	805.62	807.65	0.023672	9.56	459.80	112.98	0.71
South Opt - Sout	4000	10 yr	1710.00	799.98	803.61	803.61	804.96	0.043076	8.93	186.04	70.02	0.88
South Opt - Sout	4000	50 yr	3880.00	799.98	805.64	805.64	807.72	0.031694	10.61	343.91	84.62	0.82
South Opt - Sout	4000	100 yr	5050.00	799.98	806.53	806.53	808.88	0.028209	11.12	421.91	90.45	0.79
South Opt - Sout	3900	10 yr	1710.00	800.00	803.50	803.50	804.63	0.041290	8.12	202.50	91.75	0.84
South Opt - Sout	3900	50 yr	3880.00	800.00	805.22	805.22	806.93	0.029466	9.37	377.95	112.48	0.77
South Opt - Sout	3900	100 yr	5050.00	800.00	805.93	805.93	807.89	0.026774	9.85	461.74	121.19	0.75

HEC-RAS Plan: Plan 03 River: South Opt - Sout Reach: South Opt - Sout (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South Opt - Sout	3800	10 yr	1710.00	801.98	804.73	804.73	805.84	0.032465	7.00	211.99	100.86	0.74
South Opt - Sout	3800	50 yr	3880.00	801.98	806.38	806.38	808.09	0.023174	8.09	391.94	116.96	0.68
South Opt - Sout	3800	100 yr	5050.00	801.98	807.08	807.08	809.06	0.021130	8.52	475.77	122.56	0.67
South Opt - Sout	3700	10 yr	1710.00	802.00	805.04	805.04	806.08	0.022490	6.23	217.60	106.00	0.63
South Opt - Sout	3700	50 yr	3880.00	802.00	806.62	806.62	808.16	0.017357	7.24	405.85	131.05	0.59
South Opt - Sout	3700	100 yr	5050.00	802.00	807.26	807.26	809.03	0.016416	7.67	492.14	139.84	0.59
South Opt - Sout	3600	10 yr	1710.00	803.83	806.45	806.45	807.46	0.037090	7.10	218.67	111.41	0.79
South Opt - Sout	3600	50 yr	3880.00	803.83	807.97	807.97	809.47	0.027056	8.29	408.95	138.98	0.73
South Opt - Sout	3600	100 yr	5050.00	803.83	808.62	808.62	810.31	0.024116	8.65	503.15	149.83	0.70
South Opt - Sout	3500	10 yr	1710.00	803.96	806.63	806.63	807.66	0.039814	7.53	213.19	107.71	0.82
South Opt - Sout	3500	50 yr	3880.00	803.96	808.19	808.19	809.72	0.028085	8.62	401.59	134.45	0.74
South Opt - Sout	3500	100 yr	5050.00	803.96	808.85	808.85	810.58	0.024876	8.95	494.91	145.18	0.72
South Opt - Sout	3400	10 yr	1710.00	804.78	807.81	807.81	808.83	0.034600	7.40	214.09	107.22	0.77
South Opt - Sout	3400	50 yr	3880.00	804.78	809.38	809.38	810.87	0.024562	8.36	406.84	137.68	0.70
South Opt - Sout	3400	100 yr	5050.00	804.78	810.00	810.00	811.70	0.022704	8.78	496.86	149.64	0.69
South Opt - Sout	3300	10 yr	1710.00	805.93	809.38	809.38	810.45	0.032478	7.51	213.30	97.97	0.76
South Opt - Sout	3300	50 yr	3880.00	805.93	811.01	811.01	812.60	0.024826	8.74	399.09	128.60	0.71
South Opt - Sout	3300	100 yr	5050.00	805.93	811.72	811.72	813.47	0.022059	9.04	494.21	141.20	0.69
South Opt - Sout	3200	10 yr	1710.00	807.63	810.59	810.59	811.63	0.032129	7.03	216.41	105.80	0.74
South Opt - Sout	3200	50 yr	3880.00	807.63	812.20	812.20	813.69	0.023095	8.08	412.02	137.23	0.68
South Opt - Sout	3200	100 yr	5050.00	807.63	812.84	812.84	814.52	0.021476	8.53	504.15	150.65	0.67
South Opt - Sout	3100	10 yr	1710.00	807.78	810.91	810.91	811.96	0.036152	7.67	210.60	104.14	0.79
South Opt - Sout	3100	50 yr	3880.00	807.78	812.46	812.46	814.02	0.025993	8.65	397.07	132.62	0.72
South Opt - Sout	3100	100 yr	5050.00	807.78	813.08	813.08	814.91	0.023630	9.00	481.54	138.84	0.70
South Opt - Sout	3000	10 yr	1710.00	807.93	811.21	811.21	812.23	0.037779	7.75	212.52	108.01	0.81
South Opt - Sout	3000	50 yr	3880.00	807.93	812.70	812.70	814.25	0.027388	8.73	397.87	136.02	0.74
South Opt - Sout	3000	100 yr	5050.00	807.93	813.35	813.35	815.13	0.024036	8.96	487.68	142.95	0.71
South Opt - Sout	2900	10 yr	1710.00	809.89	812.85	812.85	813.92	0.031515	7.09	215.33	100.73	0.74
South Opt - Sout	2900	50 yr	3880.00	809.89	814.43	814.43	816.08	0.024602	8.39	393.60	122.90	0.70
South Opt - Sout	2900	100 yr	5050.00	809.89	815.10	815.10	817.01	0.022356	8.79	477.68	128.61	0.68
South Opt - Sout	2800	10 yr	1710.00	809.97	813.82	813.82	815.03	0.041046	8.56	194.89	82.68	0.85
South Opt - Sout	2800	50 yr	3880.00	809.97	815.66	815.66	817.45	0.029079	9.81	367.01	103.99	0.78
South Opt - Sout	2800	100 yr	5050.00	809.97	816.39	816.39	818.46	0.026756	10.32	446.58	111.96	0.76
South Opt - Sout	2700	10 yr	1710.00	811.74	814.97	814.97	816.15	0.029092	7.05	210.60	90.11	0.72
South Opt - Sout	2700	50 yr	3880.00	811.74	816.73	816.73	818.51	0.022522	8.42	385.04	107.72	0.68
South Opt - Sout	2700	100 yr	5050.00	811.74	817.49	817.49	819.51	0.020519	8.87	469.80	114.42	0.66
South Opt - Sout	2600	10 yr	1710.00	811.98	815.08	815.08	816.21	0.038452	7.96	203.67	92.61	0.82
South Opt - Sout	2600	50 yr	3880.00	811.98	816.77	816.77	818.50	0.027734	9.15	379.21	113.54	0.75
South Opt - Sout	2600	100 yr	5050.00	811.98	817.50	817.50	819.47	0.024753	9.52	464.14	120.68	0.73
South Opt - Sout	2500	10 yr	1710.00	813.28	816.61	816.61	817.78	0.029482	6.95	213.10	89.46	0.72
South Opt - Sout	2500	50 yr	3880.00	813.28	818.36	818.36	820.13	0.023834	8.55	387.64	109.54	0.70
South Opt - Sout	2500	100 yr	5050.00	813.28	819.12	819.12	821.11	0.021648	9.01	474.56	117.76	0.68
South Opt - Sout	2400	10 yr	1710.00	813.98	817.03	817.03	818.18	0.037109	7.80	203.45	91.58	0.80
South Opt - Sout	2400	50 yr	3880.00	813.98	818.78	818.78	820.50	0.026217	8.96	381.25	111.74	0.73
South Opt - Sout	2400	100 yr	5050.00	813.98	819.50	819.50	821.47	0.024082	9.45	464.57	120.10	0.72
South Opt - Sout	2300	10 yr	1710.00	814.00	817.92	817.92	819.10	0.039431	8.33	197.89	85.63	0.84
South Opt - Sout	2300	50 yr	3880.00	814.00	819.73	819.73	821.44	0.027736	9.51	377.21	111.79	0.76
South Opt - Sout	2300	100 yr	5050.00	814.00	820.47	820.47	822.39	0.025089	9.93	463.56	122.34	0.74
South Opt - Sout	2200	10 yr	1710.00	815.85	819.34	819.34	820.53	0.040061	8.53	196.28	82.75	0.85
South Opt - Sout	2200	50 yr	3880.00	815.85	821.15	821.15	822.90	0.029287	9.86	369.87	108.44	0.78
South Opt - Sout	2200	100 yr	5050.00	815.85	821.92	821.92	823.87	0.025977	10.22	457.48	119.22	0.75
South Opt - Sout	2100	10 yr	1710.00	815.98	819.87	819.87	820.97	0.038981	8.33	203.03	94.11	0.83
South Opt - Sout	2100	50 yr	3880.00	815.98	821.55	821.55	823.19	0.027776	9.37	382.34	118.69	0.75
South Opt - Sout	2100	100 yr	5050.00	815.98	822.22	822.22	824.12	0.025658	9.83	465.16	128.10	0.74
South Opt - Sout	2000	10 yr	1710.00	817.86	820.83	820.83	821.95	0.033772	7.35	209.33	95.71	0.76
South Opt - Sout	2000	50 yr	3880.00	817.86	822.52	822.52	824.15	0.024865	8.59	392.83	121.19	0.71

HEC-RAS Plan: Plan 03 River: South Opt - Sout Reach: South Opt - Sout (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South Opt - Sout	2000	100 yr	5050.00	817.86	823.22	823.22	825.06	0.022856	9.05	480.23	131.48	0.70
South Opt - Sout	1900	10 yr	1710.00	817.97	821.22	821.22	822.40	0.038502	8.11	199.93	88.20	0.82
South Opt - Sout	1900	50 yr	3880.00	817.97	823.01	823.01	824.74	0.026909	9.25	379.53	112.74	0.74
South Opt - Sout	1900	100 yr	5050.00	817.97	823.78	823.78	825.70	0.023744	9.59	469.84	123.42	0.72
South Opt - Sout	1800	10 yr	1710.00	817.99	821.90	821.90	823.15	0.040171	8.43	193.94	79.90	0.84
South Opt - Sout	1800	50 yr	3880.00	817.99	823.82	823.82	825.57	0.027808	9.67	373.64	107.07	0.76
South Opt - Sout	1800	100 yr	5050.00	817.99	824.61	824.61	826.53	0.024986	10.10	462.73	119.44	0.74
South Opt - Sout	1700	10 yr	1710.00	819.45	822.46	822.46	823.52	0.031540	6.93	215.94	103.27	0.73
South Opt - Sout	1700	50 yr	3880.00	819.45	824.07	824.07	825.63	0.023454	8.12	403.52	129.11	0.68
South Opt - Sout	1700	100 yr	5050.00	819.45	824.72	824.72	826.51	0.021826	8.59	490.59	138.74	0.68
South Opt - Sout	1600	10 yr	1710.00	819.64	822.92	822.92	824.06	0.038924	8.16	201.30	91.38	0.83
South Opt - Sout	1600	50 yr	3880.00	819.64	824.63	824.63	826.30	0.027837	9.30	381.01	118.34	0.75
South Opt - Sout	1600	100 yr	5050.00	819.64	825.36	825.36	827.22	0.024531	9.60	470.83	128.47	0.72
South Opt - Sout	1500	10 yr	1710.00	819.83	823.06	823.06	824.11	0.035739	7.69	210.68	102.90	0.79
South Opt - Sout	1500	50 yr	3880.00	819.83	824.62	824.62	826.19	0.026154	8.73	395.28	130.69	0.73
South Opt - Sout	1500	100 yr	5050.00	819.83	825.30	825.30	827.07	0.023107	9.01	486.75	140.12	0.70
South Opt - Sout	1400	10 yr	1710.00	820.08	823.46	823.46	824.43	0.033542	7.24	219.71	115.65	0.76
South Opt - Sout	1400	50 yr	3880.00	820.08	824.90	824.90	826.37	0.024800	8.20	410.29	145.47	0.70
South Opt - Sout	1400	100 yr	5050.00	820.08	825.54	825.54	827.19	0.021800	8.44	506.86	156.45	0.67
South Opt - Sout	1300	10 yr	1710.00	820.76	823.69	823.69	824.59	0.032044	6.88	228.21	130.41	0.74
South Opt - Sout	1300	50 yr	3880.00	820.76	825.04	825.04	826.41	0.023159	7.66	425.88	158.66	0.67
South Opt - Sout	1300	100 yr	5050.00	820.76	825.60	825.60	827.19	0.021180	7.99	518.17	168.07	0.66
South Opt - Sout	1200	10 yr	1710.00	821.90	824.73	824.73	825.70	0.026588	6.31	233.09	121.62	0.67
South Opt - Sout	1200	50 yr	3880.00	821.90	826.17	826.17	827.55	0.020915	7.42	437.21	160.87	0.64
South Opt - Sout	1200	100 yr	5050.00	821.90	826.78	826.78	828.31	0.018839	7.71	539.39	175.19	0.62
South Opt - Sout	1100	10 yr	1710.00	821.97	825.13	825.13	826.09	0.041258	7.59	220.56	117.59	0.83
South Opt - Sout	1100	50 yr	3880.00	821.97	826.60	826.60	827.96	0.028942	8.58	424.35	159.14	0.75
South Opt - Sout	1100	100 yr	5050.00	821.97	827.19	827.19	828.71	0.026203	8.94	523.29	177.00	0.73
South Opt - Sout	1000	10 yr	1710.00	823.80	826.20	826.20	827.11	0.035586	6.50	235.88	133.59	0.76
South Opt - Sout	1000	50 yr	3880.00	823.80	827.58	827.58	828.91	0.025711	7.56	444.30	169.26	0.70
South Opt - Sout	1000	100 yr	5050.00	823.80	828.14	828.14	829.64	0.023429	7.94	544.09	183.24	0.68
South Opt - Sout	900	10 yr	1710.00	823.96	826.60	826.60	827.57	0.035564	7.00	223.11	119.22	0.77
South Opt - Sout	900	50 yr	3880.00	823.96	828.05	828.05	829.49	0.026081	8.07	417.19	149.08	0.71
South Opt - Sout	900	100 yr	5050.00	823.96	828.67	828.67	830.29	0.023173	8.38	513.62	160.32	0.69
South Opt - Sout	800	10 yr	1710.00	824.00	827.08	827.08	828.09	0.030932	6.86	221.40	112.46	0.73
South Opt - Sout	800	50 yr	3880.00	824.00	828.61	828.61	830.08	0.022628	7.87	416.56	141.65	0.67
South Opt - Sout	800	100 yr	5050.00	824.00	829.23	829.23	830.90	0.021021	8.30	507.75	153.08	0.66
South Opt - Sout	700	10 yr	1710.00	826.64	829.59	829.59	830.53	0.031432	6.77	225.34	122.97	0.73
South Opt - Sout	700	50 yr	3880.00	826.64	831.03	831.03	832.39	0.022566	7.65	429.62	158.91	0.66
South Opt - Sout	700	100 yr	5050.00	826.64	831.59	831.59	833.15	0.021171	8.06	521.14	170.70	0.66
South Opt - Sout	600	10 yr	1710.00	832.14	834.10	834.10	834.80	0.022367	4.50	273.51	203.29	0.58
South Opt - Sout	600	50 yr	3880.00	832.14	835.16	835.16	836.14	0.017134	5.31	526.88	275.30	0.55
South Opt - Sout	600	100 yr	5050.00	832.14	835.61	835.61	836.67	0.015537	5.57	659.03	310.33	0.53
South Opt - Sout	500	10 yr	1710.00	833.47	835.07	835.07	835.59	0.019747	3.53	316.39	305.43	0.52
South Opt - Sout	500	50 yr	3880.00	833.47	835.84	835.84	836.63	0.016301	4.28	576.22	354.72	0.51
South Opt - Sout	500	100 yr	5050.00	833.47	836.13	836.13	837.08	0.016009	4.61	680.70	357.31	0.51
South Opt - Sout	400	10 yr	1710.00	833.99	835.64	835.64	836.22	0.018184	3.26	305.81	274.66	0.49
South Opt - Sout	400	50 yr	3880.00	833.99	836.48	836.48	837.40	0.014669	4.05	549.81	296.66	0.48
South Opt - Sout	400	100 yr	5050.00	833.99	836.83	836.83	837.92	0.014255	4.40	653.15	299.19	0.49
South Opt - Sout	300	10 yr	1710.00	834.04	835.43	835.43	836.03	0.015714	2.48	299.56	251.94	0.44
South Opt - Sout	300	50 yr	3880.00	834.04	836.31	836.31	837.30	0.013758	3.54	528.88	265.68	0.45
South Opt - Sout	300	100 yr	5050.00	834.04	836.69	836.69	837.87	0.013244	3.94	632.12	268.13	0.46
South Opt - Sout	200	10 yr	1710.00	834.04	835.35	835.35	835.96	0.018263	3.15	295.70	244.86	0.49
South Opt - Sout	200	50 yr	3880.00	834.04	836.23	836.23	837.26	0.015320	4.09	515.59	253.40	0.49
South Opt - Sout	200	100 yr	5050.00	834.04	836.63	836.63	837.84	0.014471	4.45	616.79	255.76	0.49
South Opt - Sout	100	10 yr	1710.00	832.31	834.56	834.56	835.09	0.009750	2.89	363.78	296.67	0.38

HEC-RAS Plan: Plan 03 River: South Opt - Sout Reach: South Opt - Sout (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South Opt - Sout	100	50 yr	3880.00	832.31	835.31	835.31	836.18	0.011900	4.03	587.23	299.83	0.45
South Opt - Sout	100	100 yr	5050.00	832.31	835.63	835.63	836.68	0.012549	4.48	682.32	301.14	0.47