# PRELIMINARY STORM DRAINAGE REPORT

for

## FOREST RIDGE PERFORMANCE BASED CLUSTER PLAT

December 14, 2009

Encompass Engineering & Surveying, Job No. 08008



***Prepared by:***

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## I. OVERVIEW

Forest Ridge Performance Based Cluster Plat (PBCP) is located approximately 1.25 miles north of Cle Elum, within Section 24, Township 20 North, Range 15 East, Willamette Meridian, Kittitas County, State of Washington. The project site takes up the entire north ¾ of Section 24 and it is located off of the extension of Columbia Street onto a County private road system within an upland region above the Yakima River valley, on the south face of Cle Elum Ridge. It is bounded by Creekside Road on the south, Balmer's Canyon on the west, and Main Ridge Road on the east.

The existing parcel is approximately 478.45 acres in size. The proposed performance based cluster plat will create 170 single-family residential lots, a community area, private access roads, and associated utilities. The project will also create Open Space Tracts for the portions of the project site located within the steep slopes, wetland, and stream buffer areas. Multiple storage and treatment facilities are proposed throughout the site, which will provide the required storage to meet the water quality treatment and flow control standards as specified in Title 12 of Kittitas County Code and the 2004 Washington State Department of Ecology Stormwater Management Manual for Eastern Washington (*SWMMEW*).

## II. PRE-DEVELOPMENT CONDITIONS

The project site is considered to be undeveloped open range land that is characterized as a mix of thinned forest area (mix of evergreen and deciduous trees), brush and grassland. The topography of the site is rolling in nature with steep slopes varying between 2 percent and 35 percent. The western ¼ of the property slopes southwest into Balmer's Canyon and remainder property slopes south and inward into Steiner's Canyon. There are no existing structures on-site. Based on a review of the Department of Natural Resources maps, there are two main streams (Balmer's Canyon and Steiner's Canyon) and several drainage courses located on-site that collect the existing on-site drainage. The project site has experienced selective logging within the past 20-years.

The Forest Ridge PBCP site is located in the northwest quadrant of the Upper Yakima River Watershed. The Upper Yakima River watershed, which is a part of the greater Yakima River watershed, drains an area 2,139 square miles in size. This watershed contains some of the most intensively irrigated lands in the United States. Below the outlet of the Lake Keechelus dam, the main tributaries to the Upper Yakima River are the Kachess River, Cle Elum River, and Teanaway River. There are many other smaller tributaries to the upper Yakima River. The drainage from the Forest Ridge PBCP project site flows to the south, southwest, and southeast into Balmer's Canyon and Steiner's Canyon. Balmer's Canyon enters City of Cle Elum Storm Drainage system and flows towards Yakima River. Steiner's Canyon enters Kittitas County ditching system and flows towards Teanaway River.

There have been flooding issues downstream of the project site in the past, especially the most recent floods in January of 2009, but the project site has not experienced any flooding. A preliminary drainage investigation with the City of Cle Elum was conducted in May of 2009 to gather written complaints and history of drainage patterns downstream. No written comments have been recorded, however verbal discussions with City and County officials indicate that yearly flooding occurs downstream of the property along the Balmer's Canyon and Steiner's Canyon. None of the project site is located within a 100 Year Flood Plain according to the latest F.E.M.A. maps.

The project site is located in Region 1 – East Slopes of the Cascade Mountains, according to the 2004 *SMMMEW*. The average annual precipitation is approximately 36 inches.

## III. SOIL ANALYSIS, STREAMS AND WETLANDS

Based on the USDA Natural Resource Conservation Service National Cooperative Soil Survey, the on-site soils are mapped as Teanaway Loam complex (10 to 25 percent slopes) throughout the project site. For Soil Map and Soil Information refer to Appendix B. Based on the knowledge of the local soils and soils percolation information provided by the Kittitas County Public Health Department, it is a conservative assumption that for the purposes of runoff calculations the Hydrologic Soil Group is "C".

There are two main streams and numerous drainage routes on the project site identified in the Department of Natural Resources Forest Practices Application Review System (DNR FPARS). All streams are identified as Type N (equates to Type 4-5) streams. A portion of Steiner's Canyon, located directly south of the Forest Ridge PBCP project site, is identified as Type F (equates to Type 3) stream. The Type F stream classification is described by DNR as streams and water bodies that are known to be used by fish; the Type N stream classification is described by DNR as streams that have flow year around or streams that do not have surface flow during at least some portion of the year, and do not meet the physical criteria to be used by fish.

The National Wetland Inventory (NWI) and Kittitas County Mapsifter maps for the project site show no wetlands on or near the project site. However, a site-specific investigation has been conducted by Sewell Wetland Consulting, Inc., but at the time of the writing of this report, the wetland and stream report has not been completed.

## IV. SITE SPECIFIC DRAINAGE BASIN

There are no known basin studies produced for the watershed that includes the Forest Ridge project site. For the purpose of this report, the sub-basin for the proposed Forest Ridge Performance Based Cluster Plat has been delineated based on USGS maps and other available information. The project site is within the sub-basin located on the north side of the City of Cle Elum, encompassing an area from the Town of Roslyn on the west, Cottage Avenue in the City of Cle Elum on the east, the top of Cle Elum Ridge on the north, 3rd Street and SR-903 within the City of Cle Elum on the south. This sub-basin is approximately 470 acres in size.

Based on preliminary findings, the majority of the Forest Ridge PCBP property hydrology is split between two significant drainage basins, Columbia Basin and Forest Ridge Basin. Columbia Basin collects the drainage from Balmer's Canyon, while Forest Ridge Basin collects the drainage from Steiner's Canyon. These basins are strongly influenced by snow melt and recharge over the upland areas, including on the Forest Ridge PCBP property. Large portions of these two drainage basins are located upstream of the proposed Forest Ridge PCBP project site. These upstream basins are not considered in the hydrologic analysis, and they will be by-passed via existing streams and drainage routes that dissect the project site. On the overall scale, the upstream basins discharge directly to these existing drainage routes. Only small portions of the upstream basins, located along the northern property line, may sheet flow onto the project site. These amounts would not adversely affect the intent of this analysis and could be either included in the final storm drainage calculations/analysis or by-passed via proposed rock-lined swales along the northern property line.

Encompass Engineering & Surveying analyzed the aerial topographic map prepared by Degross Aerial Mapping, Inc. (2009), and delineated six separate site-specific drainage basins. The site specific drainage basin and the project sub-basin area maps are shown in Appendix D. The level of detail utilized for the delineation of the site-specific basins is appropriate for the preliminary storm drainage calculation and analysis for the entire project site. A more detailed analysis of the drainage basins is recommended for the construction design. The site-specific drainage basin descriptions are as follows:

Basin A:
Basin A is located in the western-most area of the project site, and it is 55.18 acres in size. Run-off from this basin contributes to the headwaters of Balmer's Canyon to the west and southwest.

Basin B:
Basin B is located south of Basin A, and it is 23.67 acres in size. Run-off from this basin contributes to the headwaters of Steiner's Canyon to the southeast.

Basin C:
Basin C is located east of Basins A and B, and it is 77.04 acres in size. Run-off from this basin contributes to the headwaters of Steiner's Canyon to the south.

Basin D:
Basin D is located east and north of Basin C, and it is 169.54 acres in size. Run-off from this basin contributes to the headwaters of Steiner's Canyon to the south and southwest.

Basin E:
Basin E is located east of Basin D, and is 138.66 acres in size. Run-off from this basin contributes to the headwaters of Steiner's Canyon to the south.

Basin F:
Basin F is located in the southeast corner of the property and southeast of Basin D, and it is 14.36 acres in size. Run-off from this basin contributes to the headwaters of Steiner's Canyon to the southeast.

## V. UPSTREAM AND DOWNSTEAM ANALYSIS

Level 1 downstream analysis was performed by Encompass Engineering & Surveying in July 2009. The following is the summary of the analysis.

### *Upstream Basin Analysis:*

The upstream basin contributing to this site consists of approximately 300 acres of similar land characteristics immediately north of the property. 50% of the upstream basin sheet flows onto the property with the other 50% entering defined stream channels.

### *Downstream Basin Analysis:*

Storm runnoff on the site splits into two drainage basins, Columbia Basin and Forest Ridge Basin. Columbia Basin consists of Balmer's Canyon, which drains south, eventually crosses under Columbia Street / Creekside Road and enters Town Ditch just north of 2nd Street. From here, it heads south through the City of Cle Elum Storm Drainage system toward Yakima River. Forest

Ridge Basin consists of Steiner's Canyon, which drains south, crosses Creekside Road and heads southeast, enters Younger Ditch at White Road culvert crossing, and heads east toward Teanaway River. See the Off-Site Analysis Drainage System Table in Appendix C.

***Conclusion:***

Although there is no written history of drainage complaints within the City of Cle Elum or Kittitas County Public Works records, it is local knowledge that downstream flooding exists during spring runoff and large storm events. This report provides a good summary of the drainage system that exists today and will assist all future developments in designing methods to improve the system in the future. It should be made clear that the project site is located ¾ of a mile north of the City limits of Cle Elum. Responsibility of drainage improvements beyond ¼ of a mile are not typically done, but may be necessary to address annual problems for this area. Below are suggestions:

- City of Cle Elum & Kittitas County need to create a process to collect written documentation of drainage complaints.
- Forest Ridge PBCP should be proactive in establishing a maintenance strategy of streams, culverts & catch basins that convey stormwater on-site. City of Cle Elum, County and downstream neighbors should do the same for the off-site.
- Forest Ridge PBCP should establish a snow removal strategy of private streets that allow the majority of the stormwater systems to still convey stormwater. City and County should do the same for the off-site.
- Forest Ridge PBCP, at time of civil design, should perform a backwater analysis on portions of the downstream path to determine ditch & pipe velocities and capacities for the 100-yr. storm event. This analysis will determine if upgrades to the existing downstream system are necessary by either City, County or applicant.
- Forest Ridge PBCP, City, County and downstream neighbors need to stabilize channels, outlets and protect drain inlets
- Forest Ridge PBCP shall control on-site flow rates and pollutants per DOE's Stormwater Management Manual for Eastern Washington.
- Forest Ridge PBCP shall maintain BMPs

## VI. POST-DEVELOPMENT CONDITIONS

The owner proposes to develop a performance-based cluster plat that will subdivide the project site into 170 single-family residential lots, 1 community area lot, private paved access roads, and associated utilities. The project will also create Open Space Tracts for the portions of the project site located within the steep slopes, wetland, and stream buffer areas.

Density calculations for analyzing the percentage impervious areas are performed for each basin. On the average, it is assumed that 478.45 acres will be subdivided into 170 parcels. This yields a very low average number of 0.36 dwelling units per gross acre (du/ac). Based on 2009 King County Surface Water Design Manual, 15 percent impervious area is proposed for 1.0 dwelling units per gross acre land use approach. It is assumed that the percent impervious for 0.36 du/ac density would approximately be 10% on average for this project. The percent impervious for the community area lot is assumed to be 80%. For more information on post-development basin breakdown refer to Appendix D.

Drainage from the proposed development will be conveyed via roadside ditches to each proposed detention facility. These facilities will be used as on-site detention and treatment facilities sized to provide Basic Water Quality Treatment and Flow Control, based on Title 12 of the Kittitas County Code.

## VII. HYDROLOGIC ANALYSIS

Hydrologic analysis for the proposed Forest Ridge PBCP project is consistent with Title 12 of the Kittitas County Code and the 2004 *SMMMEW*. Runoff modeling was done using the Santa Barbara Urban Hydrograph method, SCS Type 1A, 24-hour storm event.

As required by 2004 *SWMMEW* and as defined in Section B.7 of 12.06.080 of the Kittitas County Code, the run-off analysis is performed for the 2-year and 25-year events. Due to existing flooding issues in the vicinity of the project site and considering that the project site is located within the flood plain, the 100-year storm event was also analyzed. The average annual precipitation information used for the pre-development and post-development run-off calculations for the project site is based on the Isopluvial Maps for Eastern Washington provided in the 2004 *SWMMEW*:

$P_{2yr} = 2.0"$
$P_{25yr} = 3.5"$
$P_{100yr} = 4.75"$

In order to account for the rain-on-snow event, a water equivalent value is calculated based on the average daily snow depth for Cle Elum and 20 percent moisture content, which is added to the average annual precipitation for each storm event. The water equivalent was calculated to be 1.34 inches. Thus, the revised average annual precipitation in the site area for the 24-hour duration is (See Appendix D):

$P_{2yr} = 3.34"$
$P_{25yr} = 4.84"$
$P_{100yr} = 6.09"$

### *Pre-Development Site Conditions:*

The pre-development condition of the entire project site is determined to be pervious. It is assumed that most of the pervious area is considered open space and pasture (see Appendix D).

| | Basin A | Basin B | Basin C | Basin D | Basin E | Basin F |
|---|---|---|---|---|---|---|
| $A_{pervious}$ (acres) | 55.18 | 23.67 | 77.04 | 169.54 | 138.66 | 14.36 |
| $CN_{pervious}$ | 80 | 80 | 78 | 79 | 75 | 75 |
| $A_{Impervious}$ (acres) | 0 | 0 | 0 | 0 | 0 | 0 |
| $CN_{pervious}$ | 98 | 98 | 98 | 98 | 98 | 98 |
| Tc (min.) | 12.54 | 5.56 | 12.89 | 28.07 | 22.85 | 5.00 |

Utilizing Santa Barbara Urban Hydrograph method, the following run-off quantities are calculated in cubic feet per second (cfs) (See Appendix D):

| | Basin A | Basin B | Basin C | Basin D | Basin E | Basin F |
|---|---|---|---|---|---|---|
| $Q_{2\text{-yr}}$ | 16.76 | 8.00 | 20.15 | 36.85 | 23.61 | 3.41 |
| $Q_{25\text{-yr}}$ | 33.68 | 15.81 | 42.66 | 77.45 | 55.87 | 7.66 |
| $Q_{100\text{-yr}}$ | 48.86 | 22.82 | 63.23 | 114.55 | 86.34 | 11.64 |

***Post-Development Site Conditions:***

IMPERVIOUS AREA – In addition to the proposed private access roads and approximate proposed surface area of the detention ponds, it is assumed that approximately 10% of each residential lot within the development area is used as impervious. Applying the basic dispersion method to the impervious area, it is assumed that 50% of the area is treated as impervious and 50% as grass. Community area lot is assumed to be 80% impervious.

PERVIOUS AREA – In addition to Open Space Tracts and additional open space to the northwest of the project site, it is assumed that the 90% of residential lot and 20% of the community area lot are used as pervious.

| | Basin A | Basin B | Basin C | Basin D | Basin E | Basin F |
|---|---|---|---|---|---|---|
| $A_{pervious}$ (acres) | 49.08 | 20.99 | 77.55 | 148.09 | 131.33 | 9.97 |
| $CN_{pervious}$ | 80 | 80 | 78 | 79 | 75 | 75 |
| $A_{Impervious}$ (acres) | 5.73 | 3.46 | 6.20 | 14.04 | 9.27 | 2.74 |
| $CN_{pervious}$ | 98 | 99 | 98 | 98 | 98 | 99 |
| Tc (min.) | 16.06 | 8.83 | 6.06 | 24.91 | 13.09 | 5.29 |

As it can be seen in the above table (see Appendix D for more details), the total post-development tributary area of each basin is different than the pre-development condition. This is due to the layout of the proposed access roads, roadway ditches and lots compared to the existing streams and other drainage routes. The percent difference is less than 9% for Basin A thru Basin E, and 11.5% for Basin F. In the case of Basin F, the post-development tributary area is smaller than pre-development condition. Observed from the overall perspective, these differences do not create an adverse effect since the total tributary area to each drainage basin, Columbia Basin and Forest Ridge Basin, is the same for the pre-development and the post-development condition. Utilizing

Santa Barbara Urban Hydrograph method, the following run-off quantities are calculated in cubic feet per second (cfs) (see Appendix D):

| | Basin A | Basin B | Basin C | Basin D | Basin E | Basin F |
|---|---|---|---|---|---|---|
| $Q_{2\text{-yr}}$ | 17.80 | 9.00 | 26.35 | 39.85 | 31.32 | 4.30 |
| $Q_{25\text{-yr}}$ | 34.36 | 17.15 | 53.29 | 81.31 | 70.33 | 8.51 |
| $Q_{100\text{-yr}}$ | 49.00 | 24.32 | 77.74 | 118.74 | 106.68 | 12.28 |

***Detention / Treatment Facility Sizing:***

A detention facility is proposed for each site specific basin. Locations of each detention facility vary from basin to basin. Refer to Figure D.2 in Appendix D for approximate proposed detention facility locations. Each proposed facility is designed to detain the post-development 2-year, 25-year and 100-year storm events. The run-off will be released at 50% of the pre-developed 2-year, pre-developed 25-year and pre-developed 100-year storm events, as required by the Department of Ecology's 2004 *SWMMEW*, into existing streams/drainage routes located adjacent to each basin.

Allowable discharge rates from the proposed detention ponds are based on the *SWMMEW* (see Appendix D):

Post-Development $Q_2$ = ½ Pre-Development $Q_2$
Post-Development $Q_{25}$ = Pre-Development $Q_{25}$
Post-Development $Q_{100}$ = Pre-Development $Q_{100}$

The following REQUIRED volumes are modeled in cubic feet (see Appendix D):

| | Basin A | Basin B | Basin C | Basin D | Basin E | Basin F |
|---|---|---|---|---|---|---|
| $V_{2\text{-yr}}$ | 54,701 | 22,551 | 64,921 | 150,725 | 100,889 | 9,261 |
| $V_{25\text{-yr}}$ | 73,100 | 34,465 | 107,484 | 211,377 | 153,203 | 14,787 |
| $V_{100\text{-yr}}$ | 82,830 | 39,757 | 136,163 | 238,154 | 189,848 | 17,436 |

The volumes above include the mitigation for the 100-year storm run-off. The criteria for the detention pond calculation and design differ for each basin. See Appendix D for criteria used to model storage volume for each basin.

As required by Ecology's 2004 *SWMMEW*, Core Element #5 – Runoff Treatment is required to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms to protect water quality so that beneficial uses of receiving waters are maintained and where applicable, restored (*SWMMEW*, Section 2.2.7). The most effective

basic treatment BMPs remove about 80 percent of total suspended solids contained in the runoff treated, and a much smaller percentage of the dissolved pollutants. It may be necessary to provide additional treatment to remove oil, metals, and/or phosphorus from stormwater runoff.

For the purposes of this preliminary report, treatment facilities were analyzed based on a water quality design volume utilizing Method 1 based on Core Element #5 – Runoff Treatment (*SWMMEW*, Section 2.2.5). This method specifies that the water quality design volume is determined by calculating the volume of runoff for the post-development condition from the regional storm with a 6-month, 24-hour return frequency. However, the actual design of treatment facilities will be based on this or other acceptable methods specified in *SWMMEW*. Pre-treatment facilities may be required, and will be designed based on a water quality design flow rate utilizing the SCS Type IA 24-hour storm with a 25-year return frequency as a conveyance system located "on-line". Following are the estimated required volumes for water quality treatment in cubic feet:

| | Basin A | Basin B | Basin C | Basin D | Basin E | Basin F |
|---|---|---|---|---|---|---|
| $V_{quality}$ | 58,216 | 25,969 | 65,003 | 140,209 | 76,755 | 10,992 |

In some instances, the outflow will start to discharge through the overflow structure at the 25-year and 100-year storm events. The Emergency Overflow was designed such that the proposed detention facility contains the 100-year storm event.

The infiltration of the post-development run-off was not studied during this analysis due to time constraints and the assumption that the infiltration capabilities of the local soils are not suitable. It is recommended that additional soil infiltration and groundwater studies be performed during the final engineering design in order to utilize the infiltration facilities on the project site.

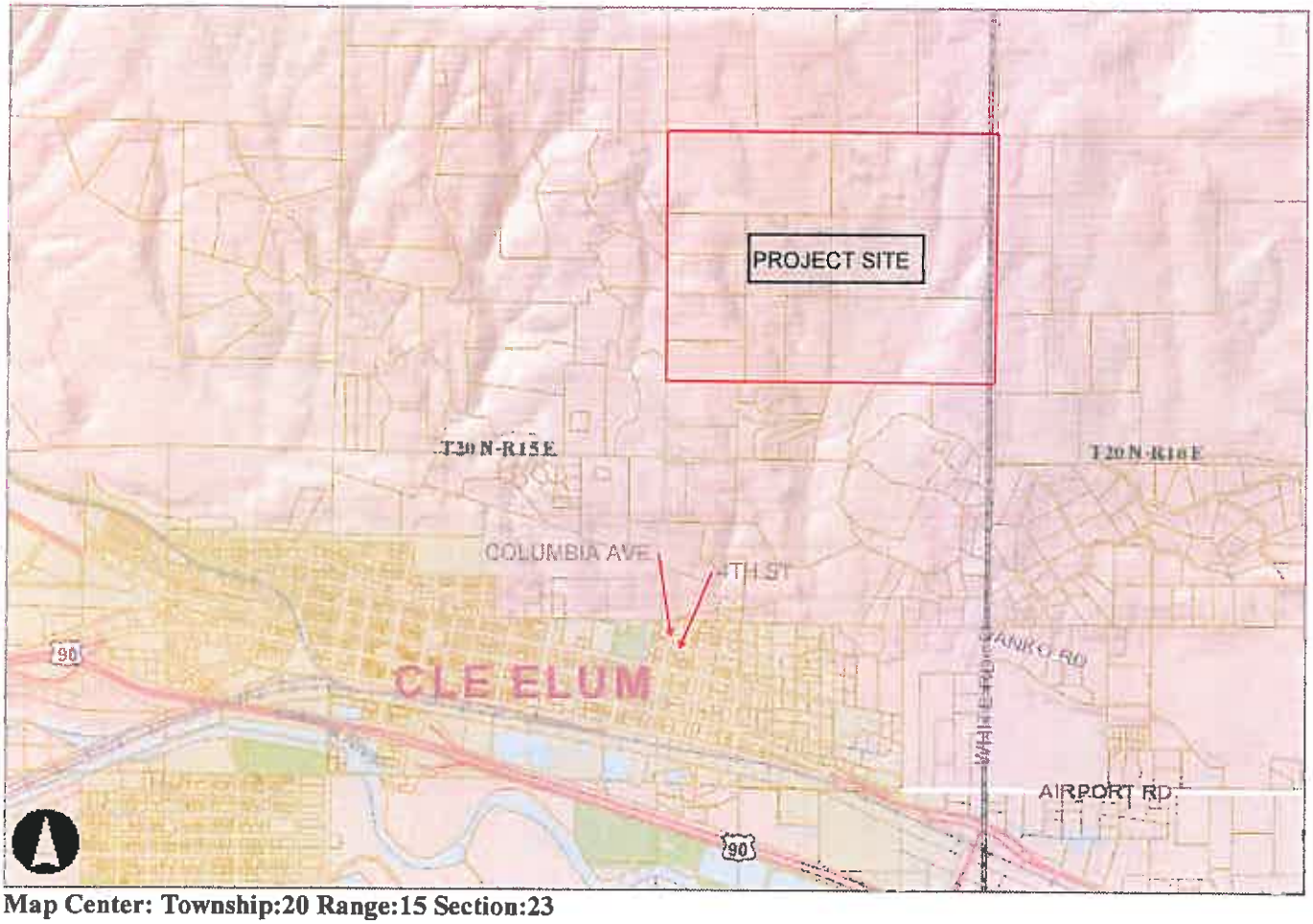
It is proposed that this project be constructed in eight (8) phases. A more detailed storm drainage analysis and design will be performed in the final design phase to more closely match proposed site layouts and proposed construction methods.

## VIII. OPERATION AND MAINTENANCE MANUAL

During final engineering design, an Operations and Maintenance Manual will be prepared in accordance with the 2004 *SWMMEW*.

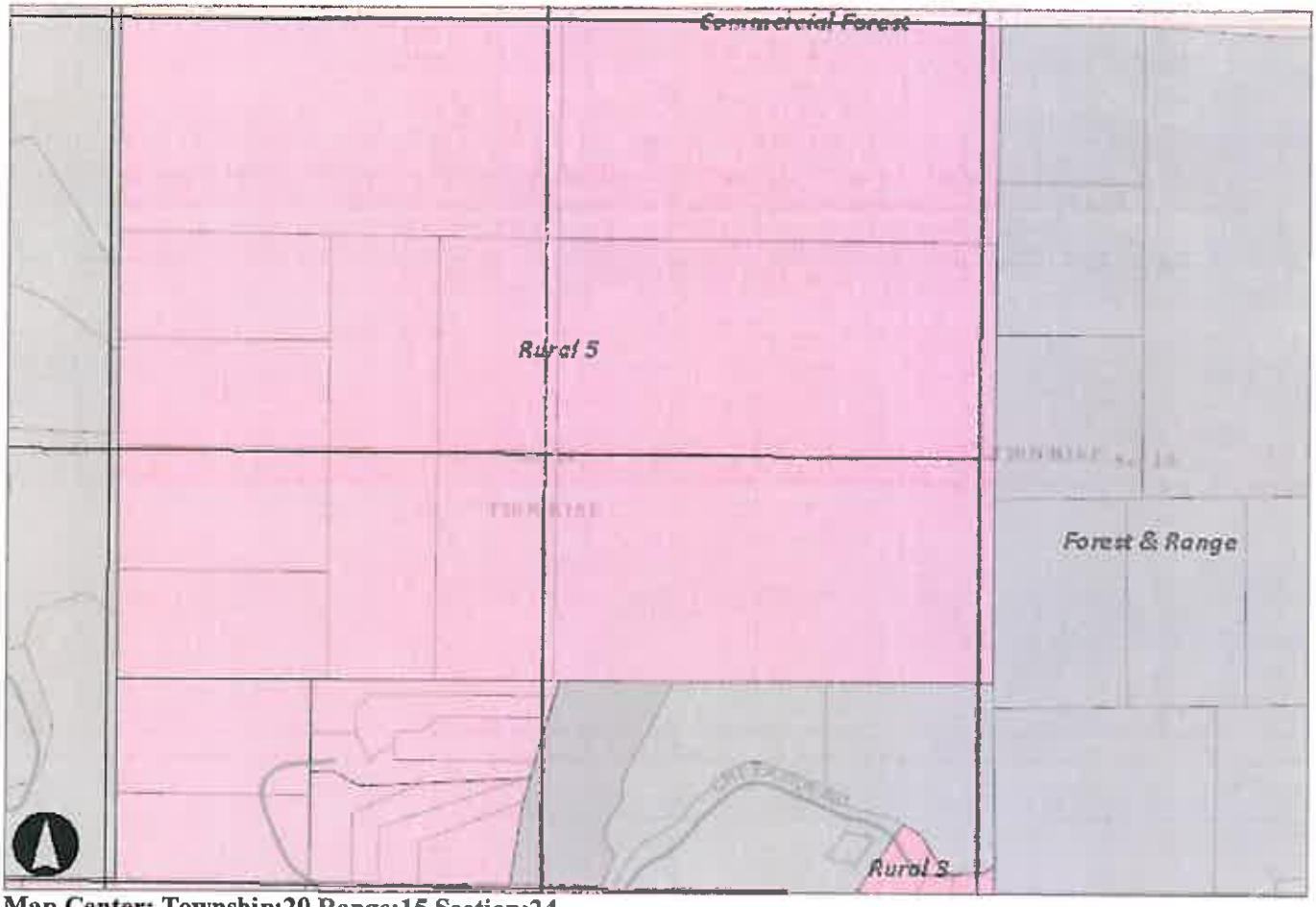
**APPENDIX 'A'**

# Forest Ridge PBCP Vicinity Map




**Map Center: Township:20 Range:15 Section:23**

# Forest Ridge PBCP Zoning Map




**Map Center: Township:20 Range:15 Section:24**

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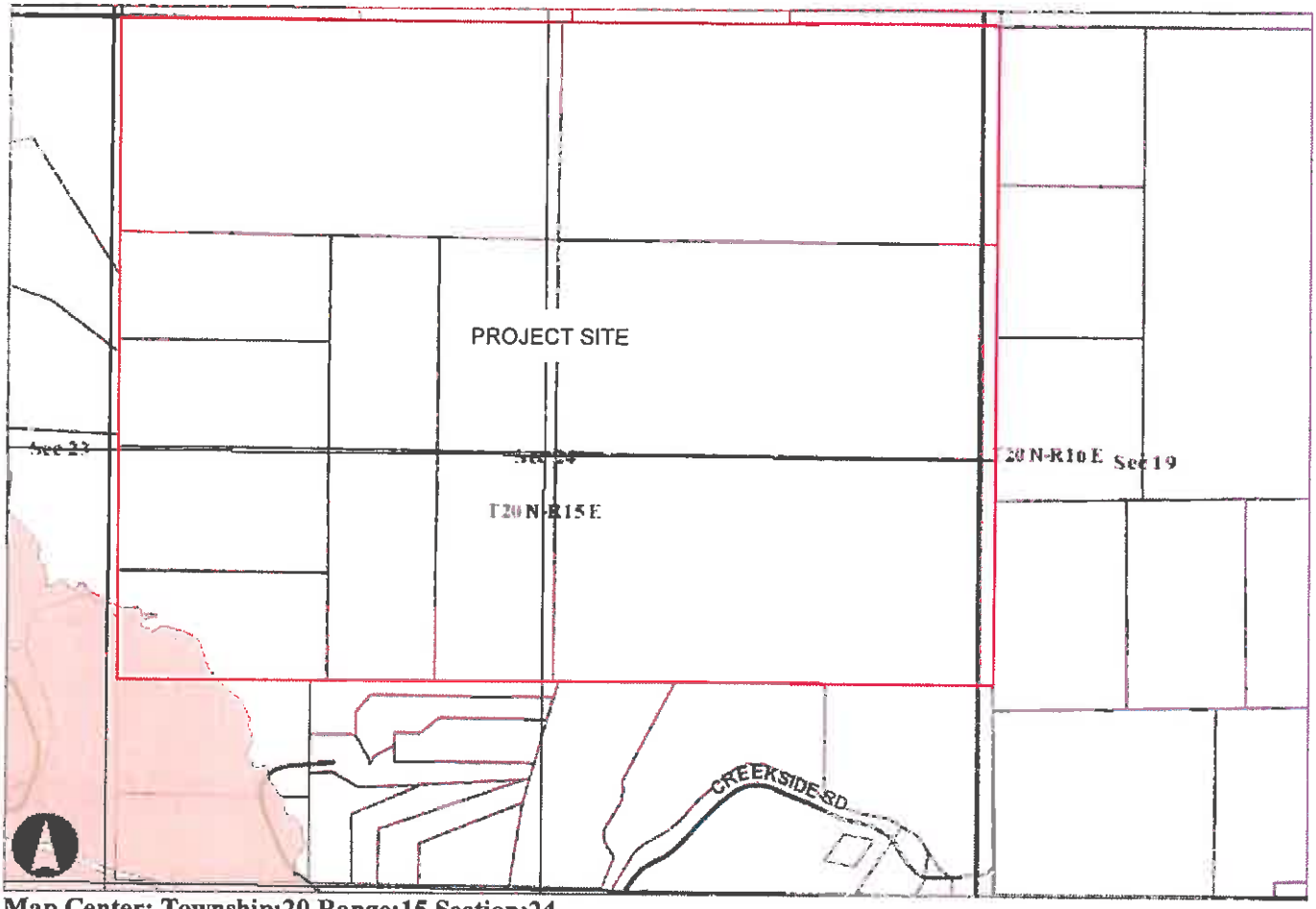
# Forest Ridge PBCP Coal Mine Shaft Boundary Map




**Map Center: Township:20 Range:15 Section:24**

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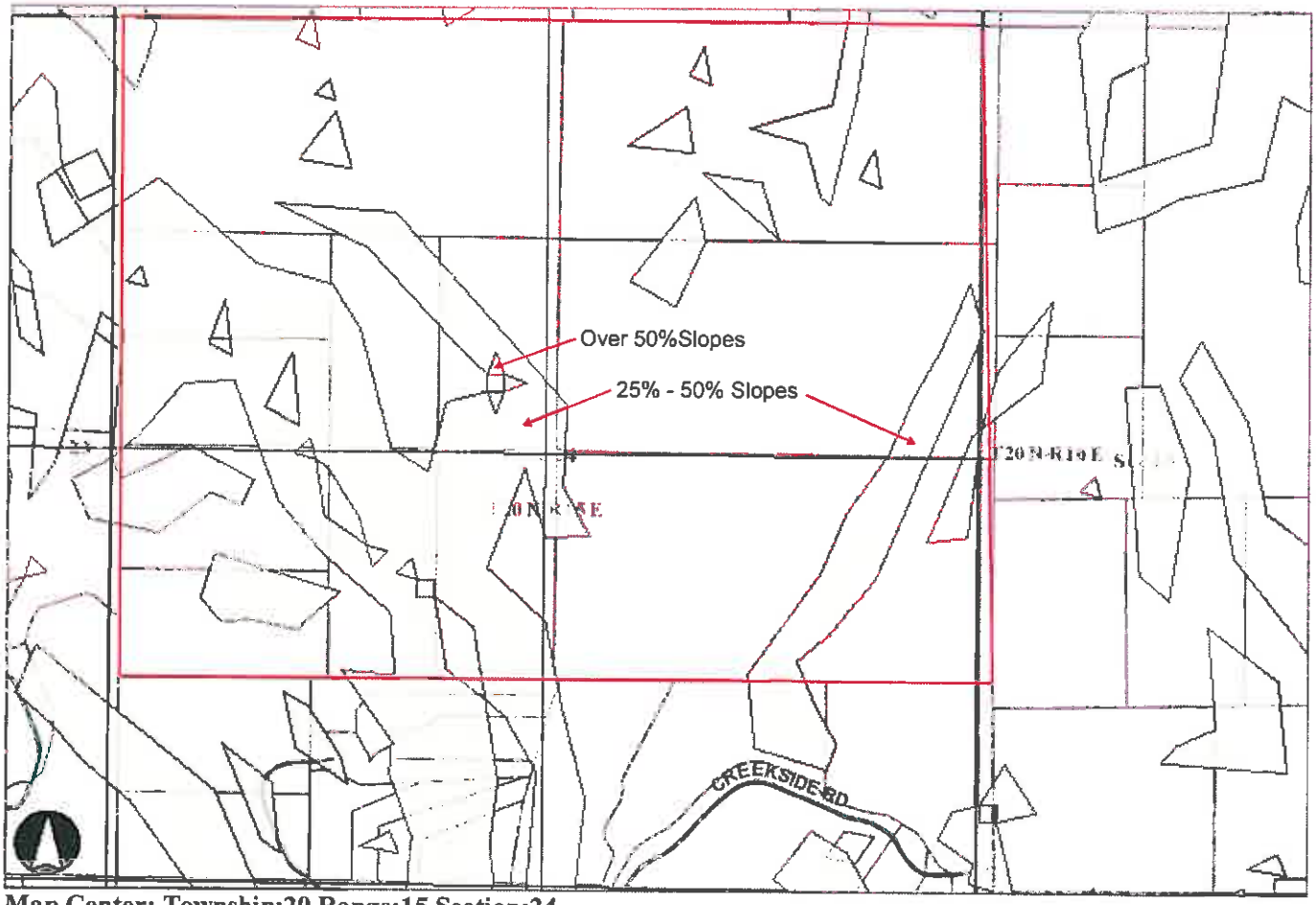
# Forest Ridge PBCP Hazardous Slope Map




**Map Center: Township:20 Range:15 Section:24**

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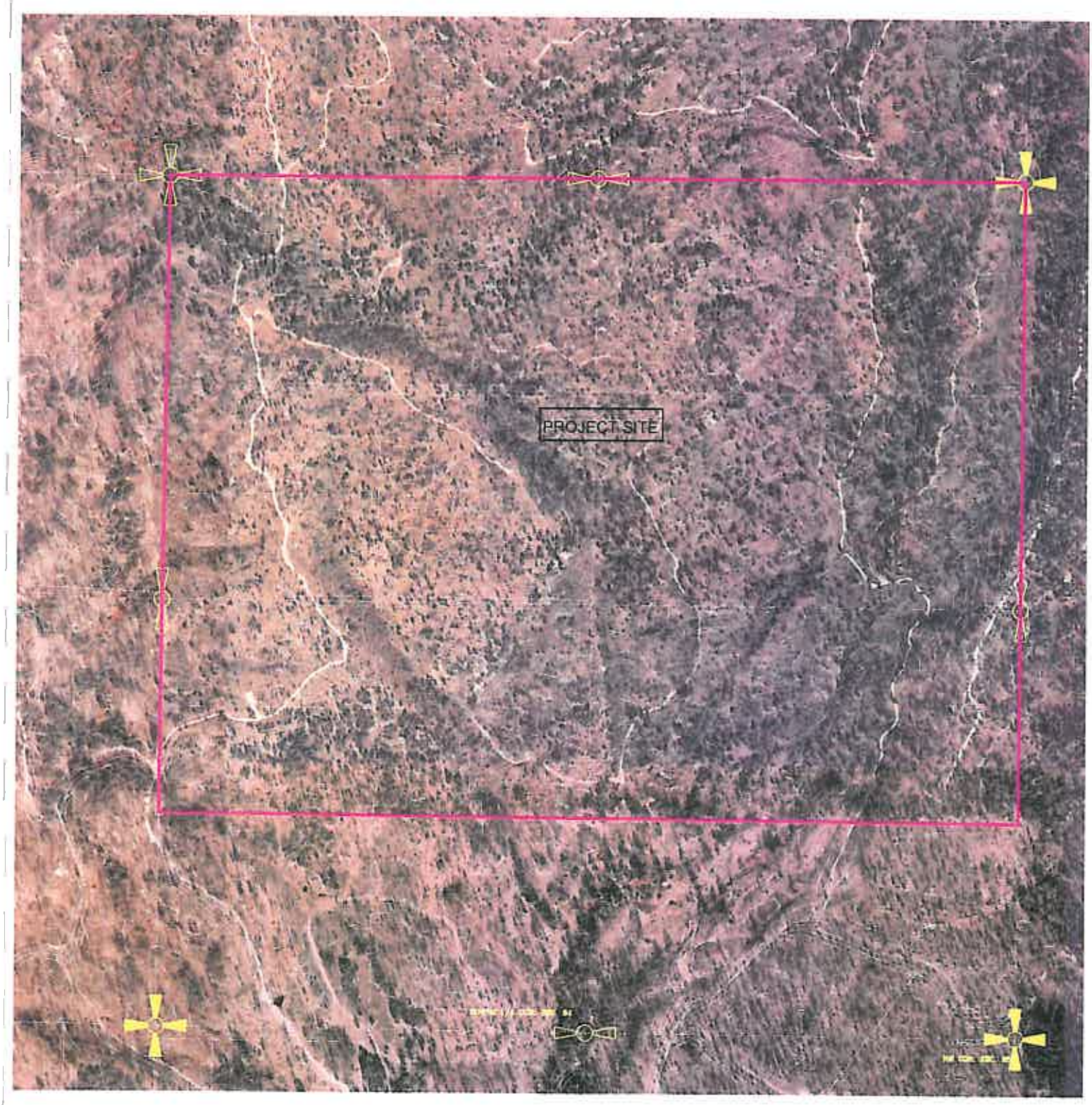
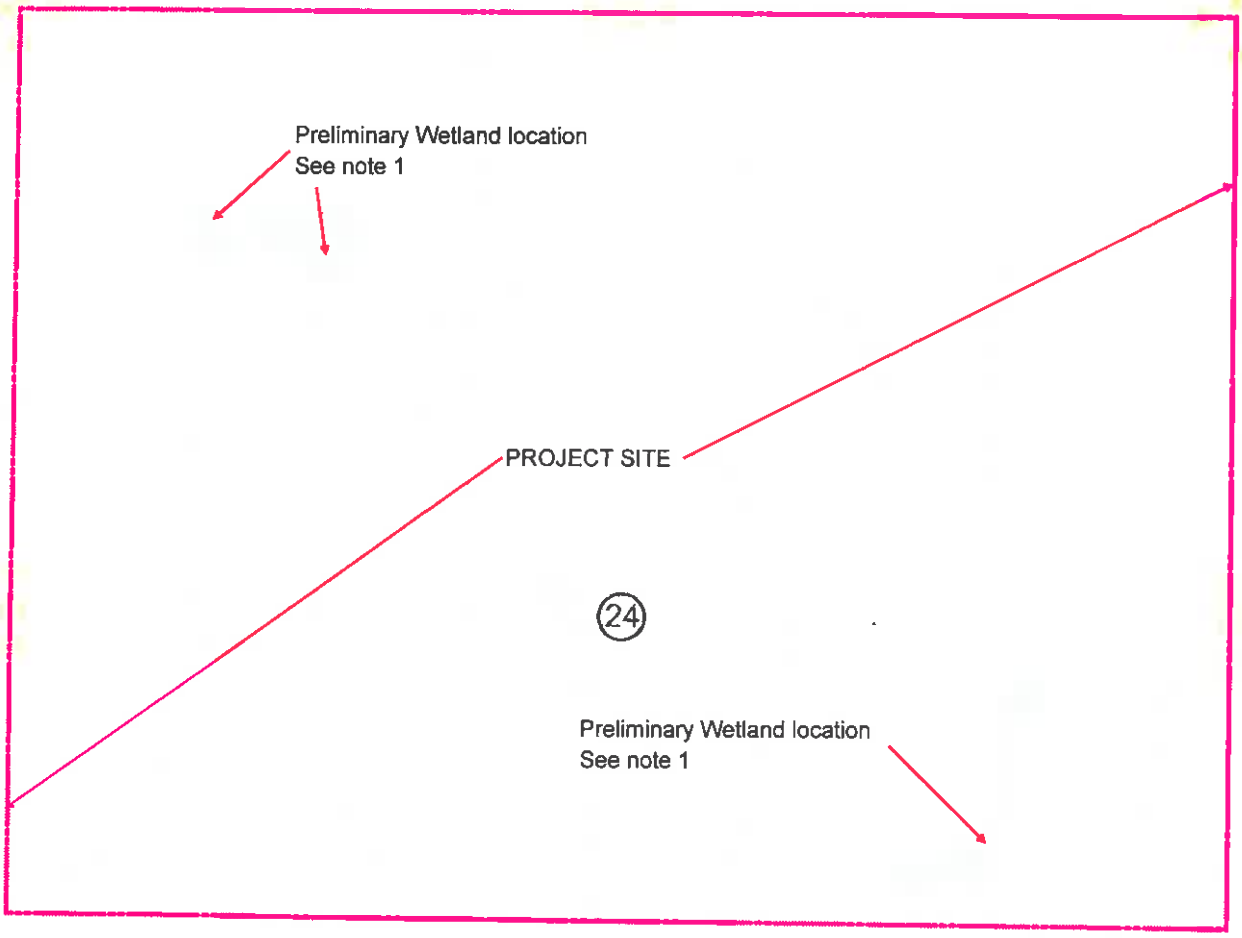
FOREST RIDGE PBCP AERIAL PHOTO MAP



Forrest Ridge PBCP Preliminary Wetland Map

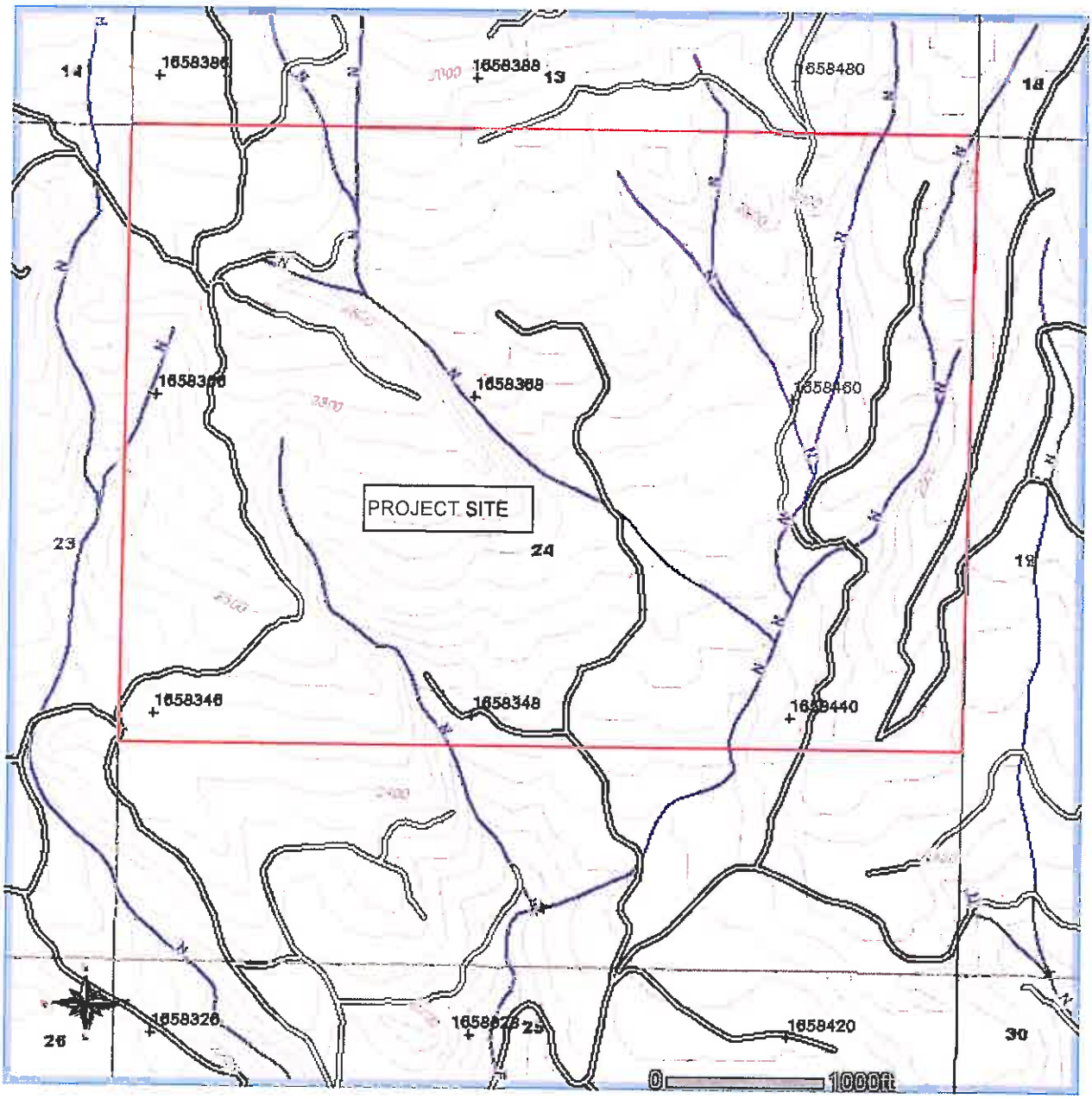



Notes:
1. These wetland locations are preliminary. Wetland delineation and report were not completed at the time of writinig of this report.

# FOREST PRACTICE WATER TYPE MAP

TOWNSHIP 20 NORTH HALF 0, RANGE 15 EAST (W.M.) HALF 0, SECTION 24

Application #:_____




Wednesday, December 09, 2009 9:26:05 PM
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**APPENDIX 'B'**

United States Department of Agriculture

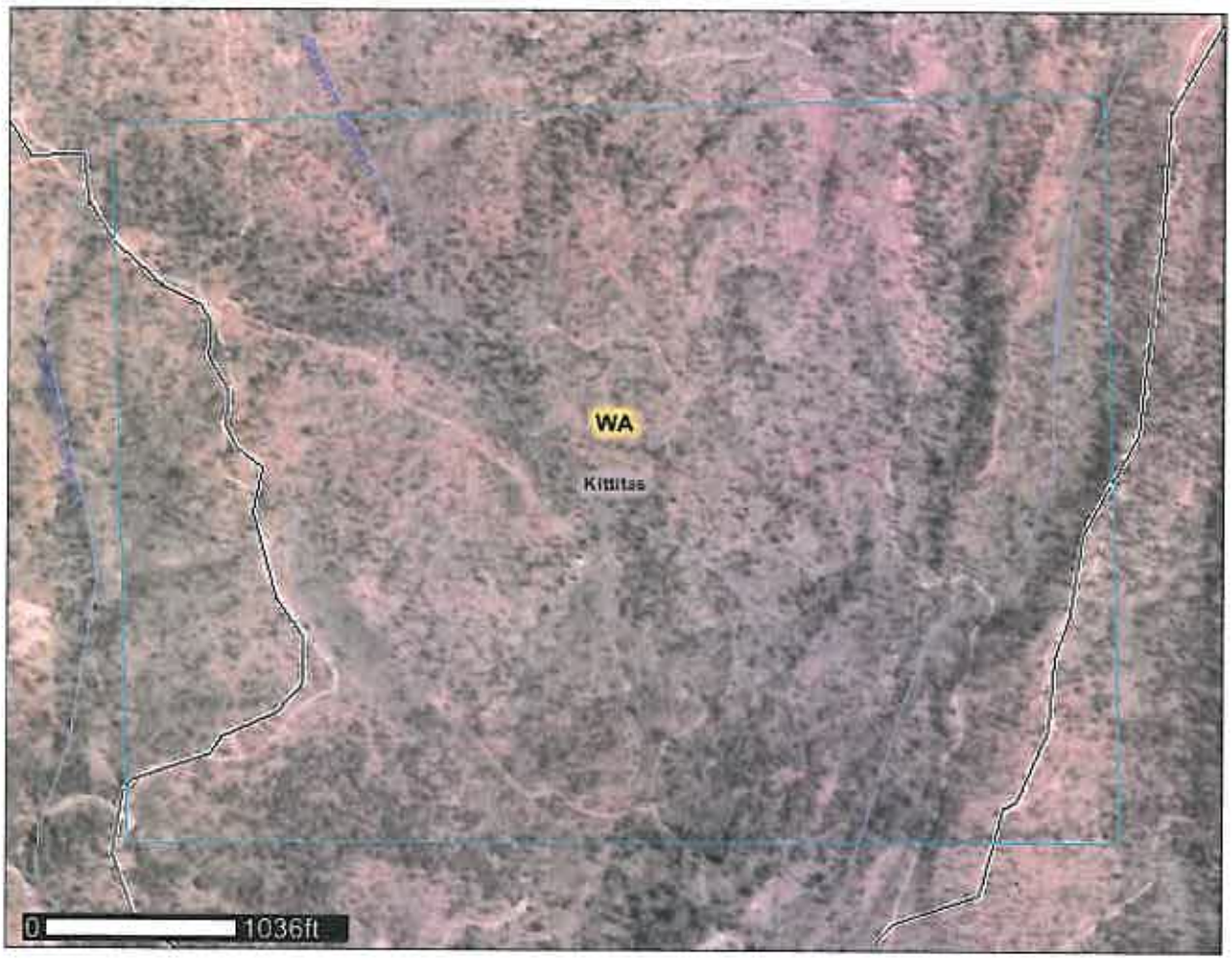
NRCS

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 Kittitas County Area, Washington

## FOREST RIDGE PBCP




December 10, 2009

# 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://soils.usda.gov/sqi/) 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://soils.usda.gov/contact/state_offices/).

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 Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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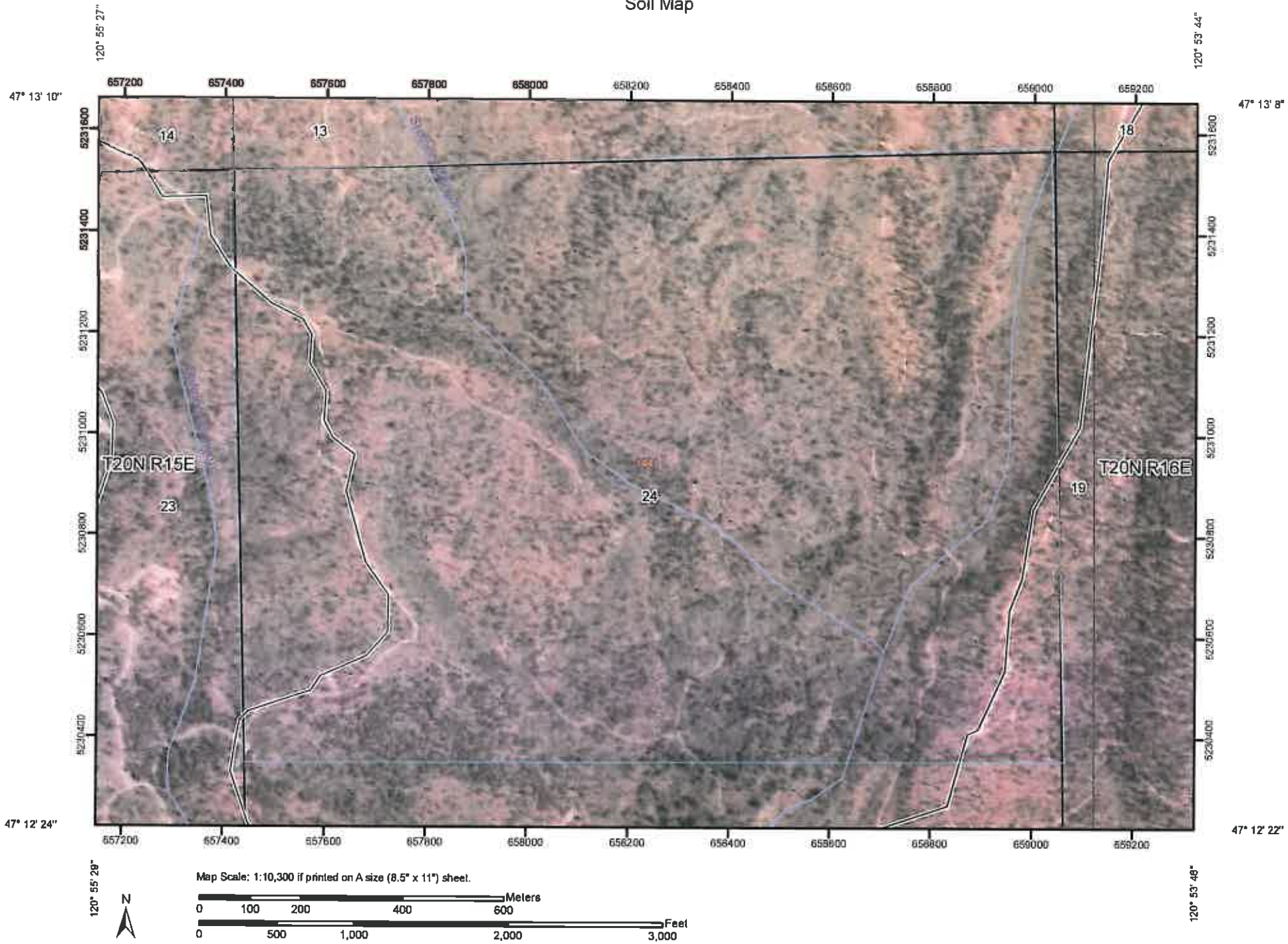
# Contents

# 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.

# Custom Soil Resource Report
## Soil Map



## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Units

**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**
- Gully
- Short Steep Slope
- Other

**Political Features**
- Cities
- PLSS Township and Range
- PLSS Section

**Water Features**
- Oceans
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

## MAP INFORMATION

Map Scale: 1:10,300 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kittitas County Area, Washington
Survey Area Data: Version 3, Jun 15, 2009

Date(s) aerial images were photographed: 7/27/2006

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

| Kittitas County Area, Washington (WA637) | | | |
|---|---|---|---|
| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
| 1441 | Teanaway loam, 10 to 25 percent slopes | 481.2 | 100.0% |
| **Totals for Area of Interest** | | **481.2** | **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.

# Kittitas County Area, Washington

## 1441—Teanaway loam, 10 to 25 percent slopes

### Map Unit Setting

*Elevation:* 1,800 to 3,600 feet
*Mean annual precipitation:* 25 to 40 inches
*Mean annual air temperature:* 46 to 48 degrees F
*Frost-free period:* 80 to 120 days

### Map Unit Composition

*Teanaway and similar soils:* 80 percent
*Minor components:* 20 percent

### Description of Teanaway

#### Setting

*Landform:* Mountain slopes
*Down-slope shape:* Linear
*Across-slope shape:* Convex
*Parent material:* Loess over glacial till or outwash with an influence of volcanic ash in the surface

#### Properties and qualities

*Slope:* 10 to 25 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Moderately well 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 39 to 51 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water capacity:* High (about 10.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 4e
*Land capability (nonirrigated):* 3e
*Other vegetative classification:* Douglas-fir/common snowberry/pinegrass (CDS638)

#### Typical profile

*0 to 3 inches:* Moderately decomposed plant material
*3 to 7 inches:* Loam
*7 to 22 inches:* Loam
*22 to 42 inches:* Loam
*42 to 51 inches:* Loam
*51 to 60 inches:* Gravelly loam

### Minor Components

#### Ampad

*Percent of map unit:* 10 percent

#### Swauk

*Percent of map unit:* 5 percent

**Nard**

*Percent of map unit:* 5 percent

# References

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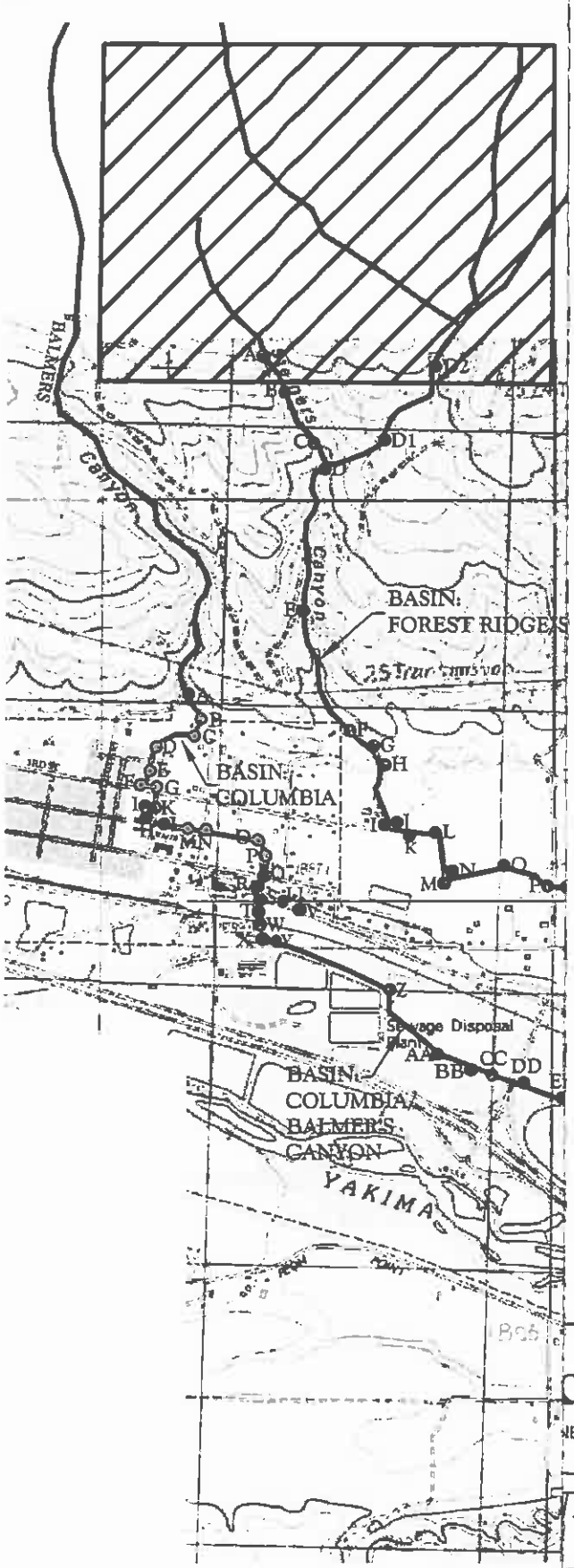
# APPENDIX 'C'




N

GRAPHIC SCALE

2000' 0 1000' 2000'

( IN FEET )
1 inch = 2000 ft.

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# INSTREAM DRAINAGE SYSTEM
## FOREST RIDGE
## PERFORMANCE BASED CLUSTER PLAT

## OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE SURFACE WATER DESIGN MANUAL, CORE REQUIREMENT #2

| Basin:Columbia | | | Sub. Balmer's Canyon | | Sub. Number: | |
|---|---|---|---|---|---|---|
| Symbol | Drainage, Component Type, Name and Size | Drainage Component Description | Slope | Distance from site discharge | Existing Problems/Potential Problems | Oberservations of field inspector, resource reviewer, or resident |
| see map | Type: Sheet flow, swale, stream, channel, pipe, pond: Size: diameter, surface area | Dranage basin, vegetation, cover, depth, type of sensitive area, volume | % | 1/4 mi = 1,320 ft. | Constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion | Tributary area, likelihood of problem overflow pathways, potential impacts |
| K | 6' diameter cmp under paved st. | ~ 60' long | 1% | K-L ~ 100' | | Ditch w/~36" homemade metal culvert enters swale @ W. end 6' culvert |
| N | 6' wide X 4' tall cmp squash pipe | ~ 50' long running under paved st. | <1% | N-O ~ 400' | | Partially silted @ E. end |
| O | Wire fence stretched across channel | | <1% | O-P~ 75' | Possible flow restriction | |
| | | | | | | |
| P | 3' tall X 4' wide cmp squash pipe under farm crossing | | <1% | P-Q ~ 125' | | Pipe beat up & misshapen |
| Q | Fence stretched across channel | | <1% | Q-R ~ 25' | | Suspended above H20 no flow restriction |
| S | 6' wide X 4' deep concrete box culvert | ~ 55' long under SR970 | | S-T ~ 70' | | |
| | | | | | | |
| T | 7' wide x 4' high concrete box culvert | ~25' long | 1% | T-U ~ 50' | | Bottom partially silted |

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| U | 36"cmp culvert | ~ 30' long under dirt rd. | 1% | U-V ~ 70' | | |
| V | 36' cmp culvert | ~20' long | 1% | V-W ` 70' | | |
| W | (2) 48' concrete culverts (side by side) | ~40' running under RR tracks | 2% | W-X ~ 50' | | |
| X | 48" cmp culvert | ~20' long running under gravel rd. | 1% | X-Y ~ 250' | | |
| Y | 36" diameter DIP suspended over H20 | | 1%-2% | Y-Z ~1300' | | Connects flowing ditch south to north. No flow restriction |
| Z | Wire fence suspended over channel | | 1% | Z-AA ~600' | | No flow restrictions |
| AA | Bend in Stream | | 1%-2% | | | |
| BB | Creek feeds swamp | Swamp filled w/cat tails to N. of bend in stream | <1% | BB-CC ~1200' | | Definite H20 detention area |
| CC | Bend in creek | | 1% | CC-DD ~ 550' | | |
| DD | 6' diameter concrete culvert | Flowing under overpass for freeway on ramp ~150' long culvert | 2% | DD-EE ~ 1300' | | |

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| EE | Change in channel/vegetation | Banks become more defined/channel becomes less defined | <1% | EE-FF ~ 600' | | |
| FF | Pond inlet to stream | Swampy area connecting pond to stream definite flow from pond to stream | 1% | FF-GG ~200' | Beaver dam + lodge @ Pond edge/Partial Dam in stream restricting flow | |
| GG | Stream meets Yakima River | Discernable channel downstream from "FF" | <1% | | | Beaver swamp lots of standing water & downed trees |

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| A | Dischard site | Creek | ~8% | 0 | | Ravine very choked w/brush+wood + debris |
| B | Waterfall/grade break | | ~100% | A-B=~800' | | Elevation drops |
| | | | | | | ~20% Inc. ~20% horizontal |
| C | Tributary Inflows from NE | | 2% | B-C=~400' | | 3' wide creek w/3'-4' high vertical banks |
| D | Culvert Crossing | 30" cmp~40' long | 2% | C-D=~150' | | |
| | | Under gravel road | | | | |
| E | Culvert crossing | 36" cmp~15' long under dirt rd. | 2% | D-E=~800' | | |
| F | Culvert crossing | 36"cmp~12' long under dirt rd. | 2% | E-F=~1000' | | |
| G | 3 culverts laid side by side | (2) 24" black corrugated plastic | 2% | F-G=~150' | | Creek widens to ~ 25' diameter pool |
| | | (1) 18" cmp | | | | Pool drains through 3 culverts |
| H | Culvert & crossing | 36" cmp | 2% | G-H=~200' | | |
| I | (2) culverts laid side by side | (2) 24" cmp~20' long | 1% | H-I=~900' | | |
| | | Under paved DW | | | | |
| J | Stream enters culvert | 36" cmp heading E. | 1% | I-J=~250' | | |

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| K | Manhole | 36" cmp Inflow from w. | | | | |
| | | 36" Black corrugated | | | | |
| | | Plastic outflow E. | | | | |
| D1 | Culvert crossing | | | | | |
| D2 | Discharge point | | | | | |
| L | Manhole | 36" Black corrugated plastic inflow from W. | 2% | K-L=~400' | | |
| | | 36" Black corruagted plastic outflow to S. | | L-M~=300' | | |
| M | 90% Elbow | Inflow from N. | | L-M~=300' | | Did not see. Buried |
| | | Outflow to E. | | | | Based on information from neighbor |
| N | End berm | Beam @ S. Bank ends | 1% | V-W~=200' | | Creek flows into wooded area |
| | End liner | Liner ends | | | | |

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| O | 2 culverts laid side by side ~15' long | (1) 18" cmp | 2% | N-O=~600' | | |
| | Under field crossing | (1) 18" concrete | | | | |
| P | Curlvert crossing | 36" cmp under paved rd. | 1% | O-P=~400' | | |
| | | ~65' long | | | | |
| Q | Tributary from SW | 36" cmp under paved rd. | 1% | P-Q=~65' | | |
| R | Irrigation takeoff | Gate valve feeding 18" cmp feeding ditch flowing SE | 1%-2% | Q-R=~1200' | | |
| S | Culvert Crossing | 24" cmp ~20' long under farm crossing | 1% | R-S=~50' | | |
| T | Culvert Crossing | 36"cmp ~50' long under paved rd. | 1% | S-T=~300' | | |
| U | Irrigation take off | Gate valve feeding small ditch to S. | 1% | T-U=~100' | | |
| V | Begin O ditch liner | Rubber liner in ditch | 1%-2% | U-V=~200' | | |
| W | End Berm | Berm @ S. Bank Ends | 1% | R-W=~200' | | Creek flows into wooded area |
| | End liner | Liner ends | | | | |

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| X | Irrigation take off | Notched log set in creek bank to regulate flow to ditch running N. | 1% | W-X=~50' | | |
| Y | Stream enters wetland/swamp | Multiple channels + pools no main channel | <1% | X-Y=~100' | | |
| Z | (3) culverts laid side by side under gravel DW | (2) 24' corrugated black plastic | <1% | Y-Z=~250' | | |
| | | (1) 18" corrugated black plastic | | | | |
| AA | Irrigation takeoff | Gate valve feeding 18" cmp heading S. under paved rd. | 3% | Z-AA=~1000' | | |
| BB | Culvert crossing | 30" cmp~30' long under gravel rd | 2% | AA-BB=~20' | | |
| CC | Culvert crossing | 30" concrete ~ 40' long under paved rd. | 2% | BB-CC=~175' | | Crossing under Airport Rd. |
| DD | Tributary joins | Outflow of pond to W. flows into creek | 1% | CC-DD=~400" | | |
| EE | Culvert Crossing under gravel rd. | (2) 30" cmp culverts laid side by side I 15' long | <1% | DD-EE=~1000' | | |
| FF | Stream enters swamp | No discernable channel | 1% | EE-FF=~400' | | |
| | | Sheet flow through lots of skunk cabbage | | | | |

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| GG | Stream Leaves Swamp | | 1% | FF-GG=+-800' | | Ground around stream still swampy, but channel is discernable |
| HH | Stream Enters Swamp | | 1% | GG-HH=+-500' | | Channel becomes Indiscernable |
| II | Stream Leaves Swamp | | 1% | HH-II=+-1100' | | Swamp Narrows into 20'-30' wide slow flowing wetland/channel |
| JJ | Culvert Crossing | 72" cmp culvert +- 45' long under gravel rd. | 1% | II-JJ=+-800' | | |
| KK | Stream enters swamp/beaver pond | | | JJ-KK=+- 600' | | Large areas of open water observed Beaver in pond |
| LL | Beaver Dam stream enters swamp | | 1% | KK-LL=+-150' | | 1 acre +- Beaver Pond/Swamp |
| MM | Culver Crossing | 2 20" cmp culverts +- 45' long under paved rd | 1% | LL-MM=+- 1200' | | |

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| NN | Conc. Box culvert | 4'x4' crossing SR 970 | 1% | 0'-100' | No obstructions | |
| OO | | Corr. Metal pipe cul. X-ing Driveway | | | No obstructions | |
| PP | | Natural Veg. Cat-Tails/reeds | 2% | 125'-225' | Naturally flowing no obstructions | |
| QQ | Pond 75' long X 30' wide | Cat-tails/reeds 1'-1.5' deep | 0%-1% | 225'-300' | | |
| RR | 30" metal culvert x-ing driveway | | 1% | 300'-325' | No obstructions | |
| SS | Stream 2:1 | Natural Veg. | 1%-2% | 325'-500' | Some debris in crk. No restrictions of flow | |
| TT | Channel 20'-30' wide | Heavily veg , shrubs, reeds, cat tails | 1% | 500'-1200' | Ponding/swampy outside of channel large weiland | |
| UU | Swamp 100'-400' wide | Trees, reeds & cat tails | 0%-1% | 1200'-3800' | Large swamp w/no obvious channel or flow | |
| | | 3800 Teanaway River | | | | |