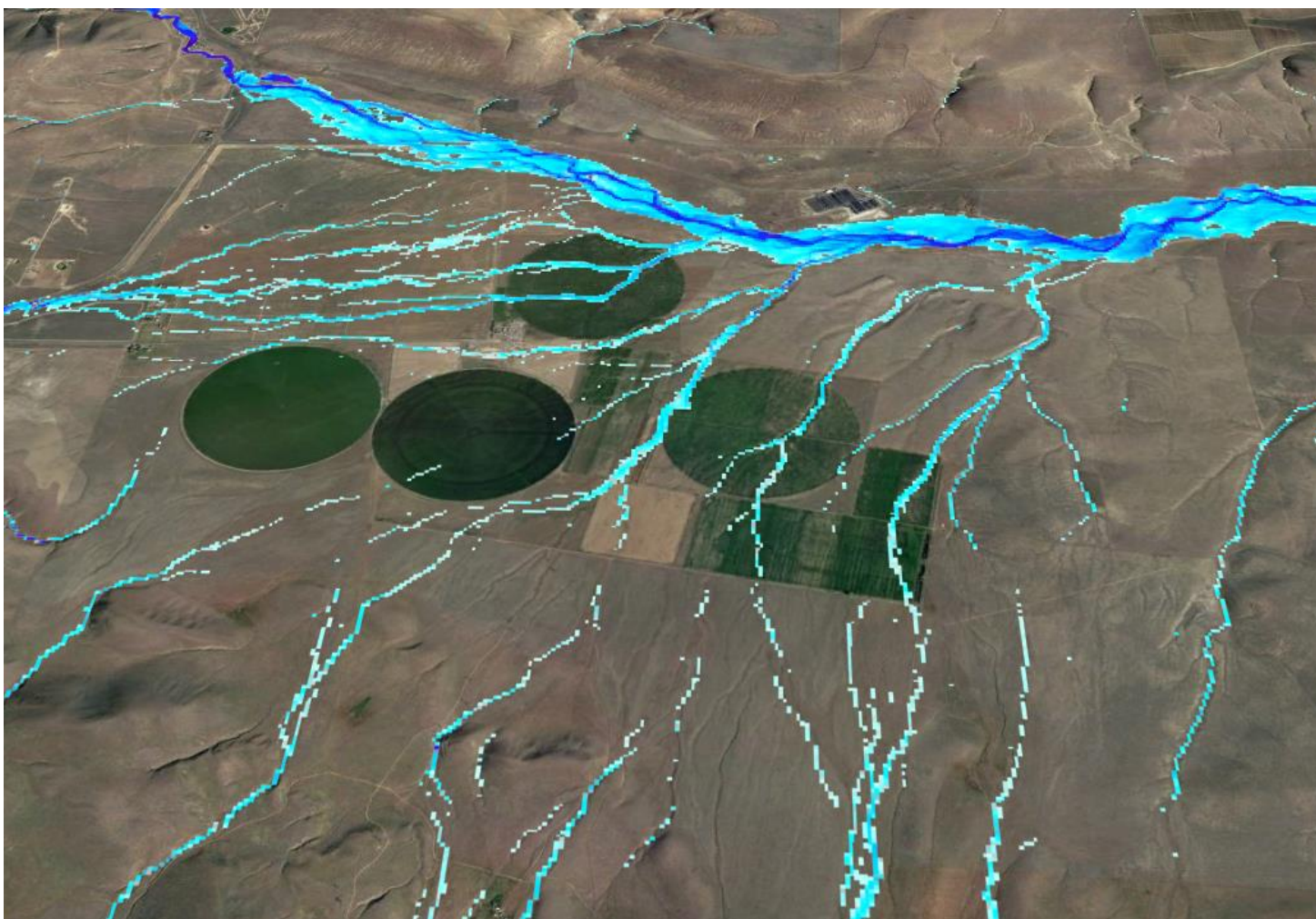


ATTACHMENT K: PRELIMINARY HYDROLOGY REPORT



PRELIMINARY HYDROLOGY STUDY

Wautoma Solar Project

Benton County, Washington

DECEMBER 9, 2021

PREPARED FOR:

INNERGEX

PREPARED BY:

Westwood

Preliminary Hydrology Study

Wautoma Solar Project

Benton County, Washington

Prepared For:

Innergex Renewable Energy
1225, rue Saint-Charles Ouest
10e étage, Longueuil (Québec) J4K 0B9

Prepared By:

Westwood
12701 Whitewater Drive, Suite 300
Minnetonka, MN 55343
(952) 937-5150

Project Number: R0033629.00
Date: December 9, 2021

Table of Contents

| | |
|---|-----------|
| Executive Summary | 3 |
| 1.0 Data Sources | 4 |
| 2.0 Coordinate System | 4 |
| 3.0 Existing Conditions | 5 |
| 3.1 Project Location | 5 |
| 3.2 Watershed Hydrology | 5 |
| 3.3 Onsite Conditions | 5 |
| 3.4 FEMA Flood Zones | 5 |
| 4.0 Proposed Conditions | 6 |
| 4.1 Proposed Conditions | 6 |
| 4.2 Post-Construction Stormwater Management | 6 |
| 5.0 FLO-2D Modeling | 6 |
| 5.1 FLO-2D Modeling Overview | 6 |
| 5.2 Elevation Data | 6 |
| 5.3 Watershed Soils and Land Cover | 7 |
| 5.4 Precipitation | 7 |
| 6.0 Flood Analysis Results | 7 |
| 6.1 Existing Conditions Flood Analysis | 7 |
| 6.2 Scour | 8 |
| 7.0 Recommendations | 8 |
| 8.0 Next Steps | 9 |
| 9.0 Included Output Files | 10 |
| 10.0 References Cited | 11 |

Tables

| | |
|--|---|
| Table 1 – Data Sources | 4 |
| Table 2 – Coordinate System Used | 4 |
| Table 3 – Flood Depths Onsite | 8 |

Exhibits

| |
|---|
| Exhibit 1: Location Map |
| Exhibit 2: Base Hydrologic Map |
| Exhibit 3: Soils Map |
| Exhibit 4: Landcover Map |
| Exhibit 5: Curve Number and Topographic Source Map |
| Exhibit 6: 100-Year Max Flood Depth Map |
| Exhibit 6a: 100-Year Max Flood Depth Project Area Map |
| Exhibit 7: 100-Year Peak Velocity Map |
| Exhibit 7a: 100-Year Peak Velocity Project Area Map |
| Exhibit 8: 100-Year Scour Map |

Appendices

| |
|--|
| Appendix A: NOAA Atlas 2 Precipitation Data |
| Appendix B: Curve Number Table |
| Appendix C: FEMA Flood Insurance Rate Map (FIRM) |

Executive Summary

The purpose of this study is to analyze and review the existing hydrology of the Wautoma Solar Project (Project or Site) and any impacts that the hydrology may play in the design of the proposed solar array. This report was prepared to be used by the Project team in the design and layout of the Project and not intended for submittal to reviewing agencies for stormwater permitting.

The Site is proposed on approximately 4,875 acres and is located approximately 30 miles northwest of the city of Richland in Benton County, Washington. The Site is located on varying terrain that generally slopes to the north in the southern portion and east in the northern portion. The modeled watershed area encompasses approximately 101 square miles and generally slopes east.

The analysis shows low to moderate water depths and velocities (Exhibits 6 through 7A) across the majority of the site. Higher flood depths exist within Dry Creek and its surrounding areas located within and adjacent to the site. Minimal scour is expected onsite except within and adjacent to Dry Creek.

Based on experience with similar projects, the majority of the site is suitable for the planned development by avoiding or designing to areas of high flood depths.

1.0 Data Sources

Table 1 – Data Sources

| Task | Format | Source | Use |
|-----------------------------|--------------------|---------------------------|-------------------------|
| Elevation | 1-meter LiDAR data | USGS | FLO-2D Model Elevations |
| | 10-meter DEM data | USGS | |
| Crop Data | Shapefile | USDA 2013 Crop Data Layer | Landcover |
| Soils | Shapefile | USGS SSURGO Dataset | Curve Numbers |
| Precipitation | PDF File | Atlas 2 | Design Storms |
| HUC-12 Drainage Boundary | Shapefile | USGS | Define Model Extents |
| Site Boundary | KMZ | Innergex Renewable Energy | Define Model Extents |
| 2014 Aerial Photography | ArcGIS Map Service | USDA FSA | Reference |
| FEMA Flood Zones | PDF | FEMA | Reference |
| Culvert Locating and Sizing | Aerial Imagery | Google Earth | Culvert Modeling |

2.0 Coordinate System

Table 2 – Coordinate System Used

| | |
|--------------|-------------------------------|
| Projection | State Plane Coordinate System |
| Zone | Washington South (FIPS 4602) |
| Datum | NAD83 |
| Planar Units | Feet (U.S. Survey) |

3.0 Existing Conditions

3.1 Project Location

The Site is approximately 4,875 acres and is located within Benton County, Washington (Exhibit 1). The Project Site is located approximately 30 miles northwest of Richland, Washington, which is the closest city to the Project (Exhibit 1).

3.2 Watershed Hydrology

The modeled watershed area encompasses approximately 101 square miles that generally slopes to the east following Dry Creek. Dry Creek is a non-perennial stream that flows east through the northern portion of the Site and through the central portion of the modeled watershed.

3.3 Onsite Conditions

The Project is located within the valley that contains Dry Creek. The southern portion of the Site drains north along several concentrated flow paths towards Dry Creek. The northern portion of the Site drains east following Dry Creek. A small part of the eastern portion of the Project drains east. In general, the Site is on semi-flat terrain with slopes of less than 3%, although there are locations where the slopes reach roughly 10%.

US Fish and Wildlife Service National Wetlands Inventory (NWI Wetlands) provides information on the distribution of US wetlands and are shown in Exhibit 2. The NWI Wetlands dataset is not all-inclusive and other wetlands not shown may exist. The landcover on the Project area is primarily shrubland, pasture, and cropland (Exhibit 4), and the soils onsite primarily belong to Hydrologic Soil Groups A and B (Exhibit 3). Typically, A soils are Sands and B soils are Silty Sands.

The main potential hydrologic issues on Site are flooding and erosive velocities.

3.4 FEMA Flood Zones

FEMA has completed a study to determine flood hazards for part of the selected location; the Project area is covered by Flood Insurance Rate Map (FIRM) panels 5302370125B and 5302370250B (Appendix C). FIRM 5302370125B has been digitized and the flood zones can be seen in Exhibits 2 and 6-8. The flood hazards for the area within FIRM 5302370250B have not been studied. The Project contains areas of FEMA Zone A flood hazards surrounding Dry Creek (Exhibits 2 and 6-8). A FEMA Zone A flood hazard is a 100-year flood hazard with no defined base flood elevations. No preliminary or pending FEMA changes are proposed within the Project area.

4.0 Proposed Conditions

4.1 Proposed Conditions

The majority of the proposed solar facility will consist of above ground mounted solar modules. A climate-specific grass seed mix should be planted below the modules and would make up the majority of the land cover. A small amount of impervious surface will be added from the gravel access roads and electrical equipment pads. The Project should be designed to minimize grading and maintain existing drainage patterns. A flood analysis of pre-development and post development depths will need to be completed once civil design is finalized for permitting purposes.

4.2 Post-Construction Stormwater Management

Benton County has adopted the Washington Department of Ecology Stormwater Management Manual for Eastern Washington (SWMMEW) as their basis of design and review. In compliance with SWMMEW, the proposed development will require storage onsite for any increase in runoff for the 100-year, 24-hour storm. The basin design for any required storage will also follow the requirements outlined in the SWMMEW. As the project design advances, the post-construction stormwater management should be reviewed in further detail with the County Engineer.

5.0 FLO-2D Modeling

5.1 FLO-2D Modeling Overview

FLO-2D is a physical process model that routes rainfall runoff and flood hydrographs over flow surfaces or in channels using the dynamic wave approximation to the momentum equation. FLO-2D offers advantages over 1-D models and unit hydrograph methods by allowing for breakout flows and visualization of flows across a potential site. The primary inputs are a DTM (elevation data), curve numbers, and precipitation. No culverts were included in the model; all roadways and berms were assumed to overtop.

A FLO-2D model with 50-foot grid cells was utilized to model the watershed within and directly impacting the Site.

5.2 Elevation Data

The elevation data input into the FLO-2D model was a blend of 1-meter LiDAR data from USGS and 10-meter DEM data from USGS (Exhibit 5). The 1-meter LiDAR data was used for topographic coverage of the eastern portion of the modeled watershed, including onsite areas, and the 10-meter DEM data was used for topographic coverage of the western portion of the contributing watershed.

(Exhibit 5). This data was incorporated into the DTM using the export to XYZ function in Global Mapper. These XYZ files are read directly into FLO-2D.

5.3 Watershed Soils and Land Cover

USDA-NRCS SSURGO soil data provides soil types within the Project boundary and full coverage of the contributing watershed. Soils are primarily classified as Hydrologic Soil Groups A and B within the Project boundary (Exhibit 3). Land cover was obtained from the USDA 2013 Crop Data Layer. Exhibit 4 displays the land cover classes for the entire watershed. Curve numbers were applied to each grid cell in the FLO-2D model based on intersecting the grid with the curve numbers (Exhibit 5).

5.4 Precipitation

Precipitation data was downloaded from NOAA Atlas 2 (Appendix A) and used for the FLO-2D analysis for the 100-Year, 24-Hour storm event. Using the 100-Year rainfall depth of 2.29 inches for this location allows for the best initial analysis in order to determine the worst areas of flooding and erosion. Rainfall inputs were distributed based on a SCS Type II distribution pattern.

6.0 Flood Analysis Results

6.1 Existing Conditions Flood Analysis

The analysis shows low to moderate water depths and velocities (Exhibits 6 through 7A) across the majority of the Site. During a 100-year storm, the flood depths across the majority of the Project area are less than 0.5 feet with velocities less than 1 foot/second, with the exception of within and adjacent to Dry Creek where the depths can reach as high as 6 feet. Several concentrated flow paths in the southern portion of the Site have higher flood depths but are generally less than 2.5 feet. See Table 3 below for a breakdown of flood depths within the Project.

Table 3 – Flood Depths Onsite

| Peak Flow Depth (ft) | Percentage of Project Area |
|----------------------|----------------------------|
| 0.00 - 0.49 | 89.6% |
| 0.50 - 1.00 | 4.6% |
| 1.01 - 1.50 | 2.4% |
| 1.51 - 2.00 | 1.4% |
| 2.01 - 2.50 | 0.7% |
| 2.51 - 3.00 | 0.5% |
| 3.01 - 4.00 | 0.6% |
| 4.01 - 6.00 | 0.2% |
| 6.01+ | 0.0% |

See Exhibits 6 through 7A for areas within the Project with higher flood depths and velocities.

6.2 Scour

Minimal scour is expected onsite except within and adjacent to Dry Creek (Exhibit 8). The scour depths calculated for this project are based on HEC-18 Pier Scour Equations of a 6-inch-wide pile perpendicular to flow. Scour calculations consist of local scour only with unarmored soils and pile bases to provide the conservative local scour results. These scour results do not account for general, rill, or gully scour.

7.0 Recommendations

Based on experience on similar projects, the Site is suitable for the planned development and hydrologic concerns can be addressed by either avoiding areas of high flood depths or through detailed engineering design.

8.0 Next Steps

1. Final engineering design should account for the flood depths and velocities presented in Exhibits 6-7A.
2. Facilities to be elevated 1' above the 100-year, 24-hour peak flood elevations.
3. Proposed facilities should avoid FEMA Flood Zones located onsite.
4. Stormwater management should be revisited to ensure the final design meets the local and state requirements.

9.0 Included Output Files

1. Shapefile of 100-Year Rain Event Flow Depth
2021-11-24_Wautoma_100YearFlowDepth.shp
Attribute "ID" = Grid Cell Number
Attribute "VAR" = Max Flow Depth (Feet)
2. KMZ of 100-Year Rain Event Flow Depth
2021-11-24_Wautoma_100YearFlowDepth.kmz
Overlay in Google Earth for graphical representation.
3. Shapefile of 100-Year Rain Event Velocity
2021-11-24_Wautoma_100YearVelocity.shp
Attribute "ID" = Grid Cell Number
Attribute "VAR" = Max Velocity (Feet)
4. KMZ of 100-Year Rain Event Velocity
2021-11-24_Wautoma_100YearVelocity.kmz
Overlay in Google Earth for graphical representation.

KMZ Legend

Depth (FT)



KMZ Legend

Velocity (FPS)



10.0 References Cited

National Engineering Handbook, Part 630 Hydrology. Chapter 9 Hydrologic Soil-Cover Complexes. USDA. NRCS. 210-VI-NEH, July 2004

USDA Geospatial Data Gateway, 10-meter DEM, Elevation data, Accessed December 2021, from <https://datagateway.nrcs.usda.gov/>

The National Map, 1-meter DEM, Elevation data, Accessed December 2021, from <https://viewer.nationalmap.gov/basic/>

Web soil survey. Retrieved December 2021, from <https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

NOAA Atlas 2 Precipitation Frequency Estimates. Retrieved December 2021, from <https://www.nws.noaa.gov/oh/hdsc/noaaatlas2.htm>

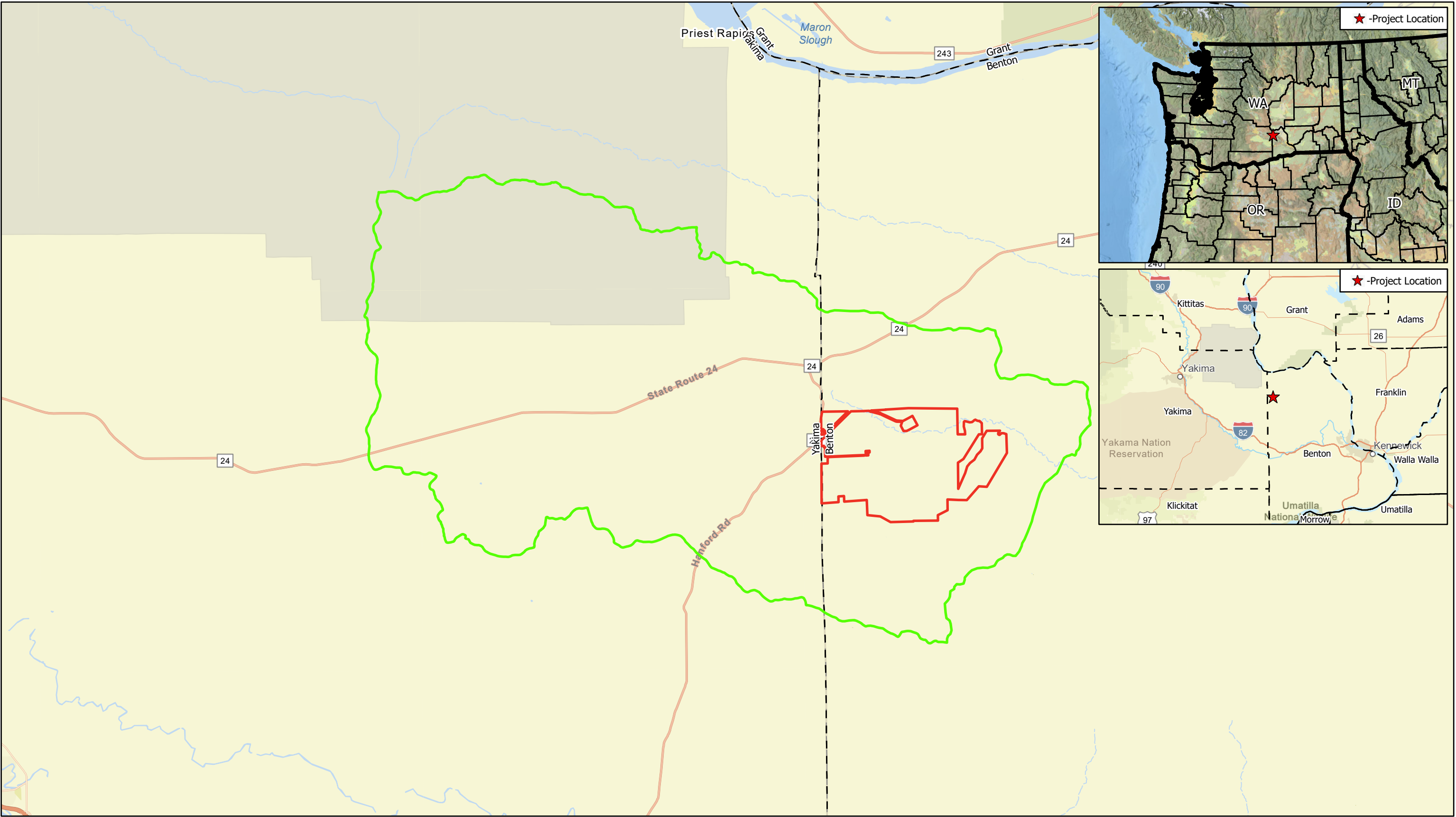
USGS. USGS water resources: About USGS water resources. Retrieved December 2021, from <https://water.usgs.gov/GIS/huc.html>

USDA 2013 Crop Data Layer, Landcover data, retrieved December 2021, from https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

FEMA Flood Insurance Rate Maps, retrieved December 2021, from <https://msc.fema.gov/portal/advanceSearch#searchresultsanchor>

The background of the entire page is a dark red color with a complex pattern of lighter red, wavy contour lines, resembling a topographic map. A dashed red line runs diagonally from the top center towards the bottom left. An 'X' mark is located in the middle-left area, and a solid red dot is positioned further down the dashed line.


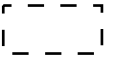

Exhibits



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Westwood
Toll Free (888) 937-5150 westwoodps.com

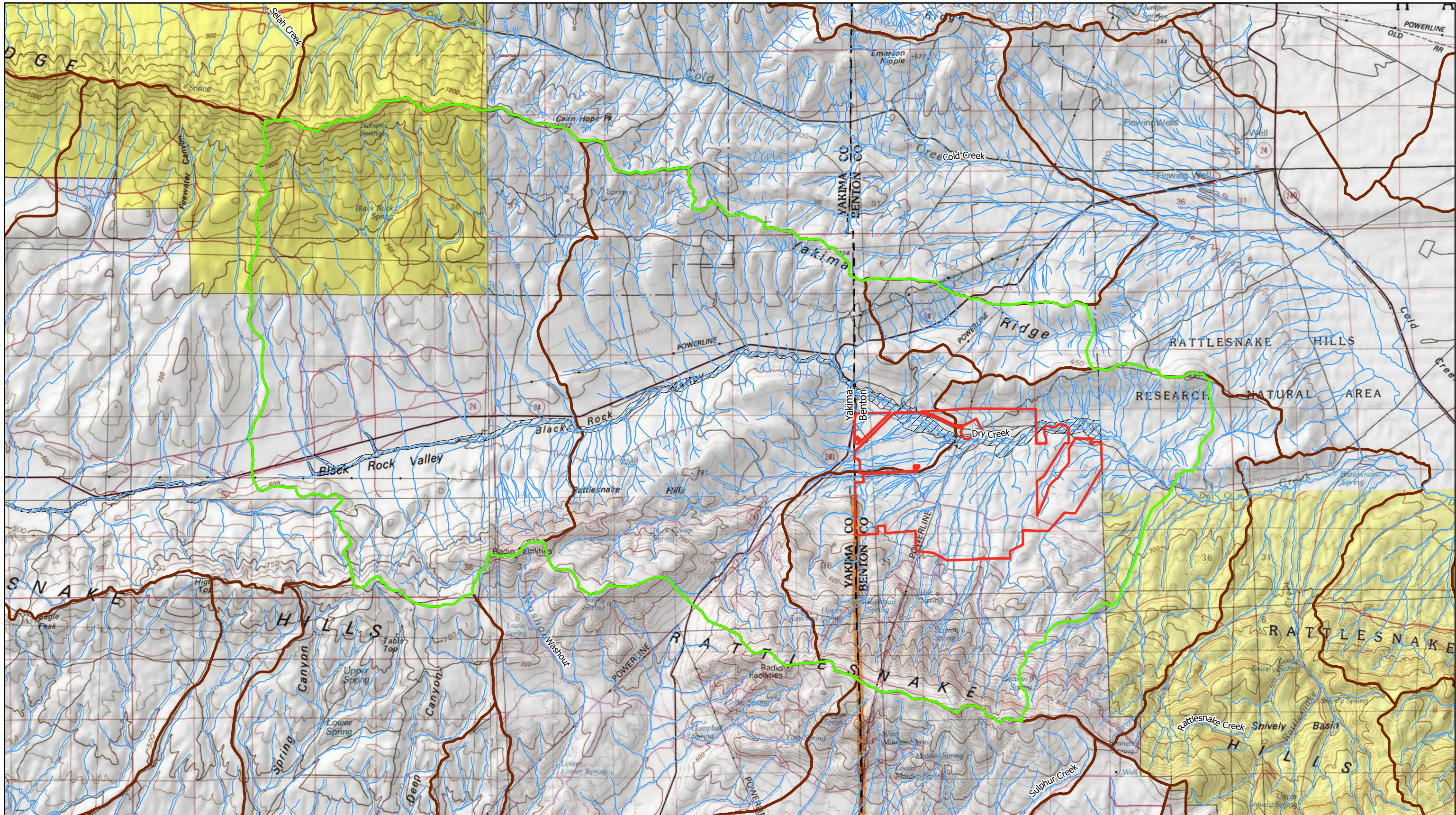
Legend

-  Project Boundary
-  County Boundary
-  FLO-2D Boundary



Wautoma Solar Project
Benton County, Washington

Exhibit 1: Location Map
December 7, 2021










Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

Westwood

Toll Free (888) 937-5150 westwoodps.com

Legend

- | | | |
|--|---|--|
|  Project Boundary |  HUC 12 Boundary |  NHD Flowline |
|  FLO-2D Boundary |  FEMA Zone A* | |
|  County Boundary |  NWI Wetlands | |



0 1.5 Miles

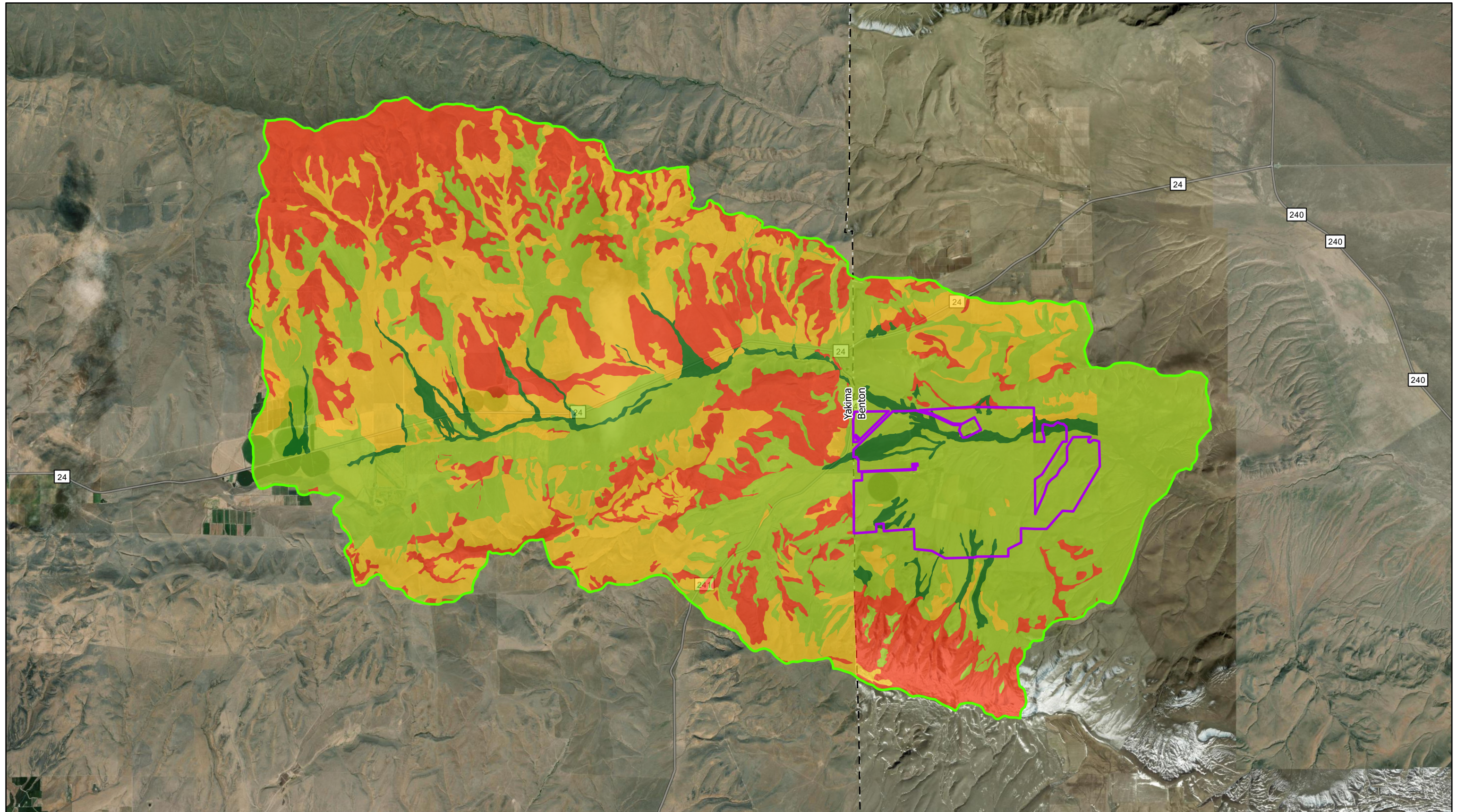
Wautoma Solar Project

Benton County, Washington

Exhibit 2: Base Map

December 8, 2021

*FEMA Data not available for the southern portion of the site




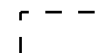
Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

Westwood
Toll Free (888) 937-5150 westwoodps.com

Legend

 Project Boundary

 FLO-2D Boundary

 County Boundary

Hydrologic Soil Group

 A

 B

 C

 D



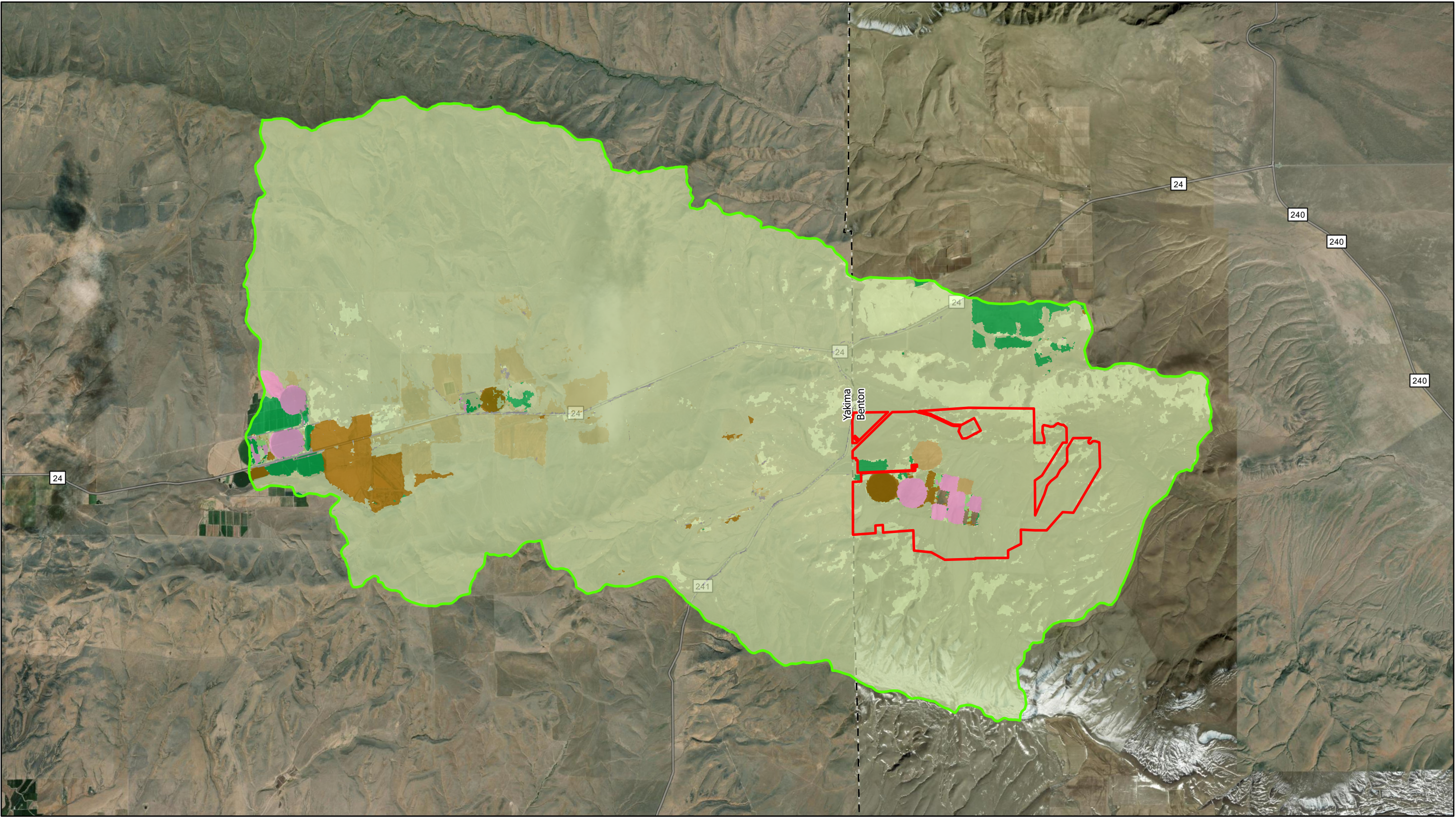
0  1.5 Miles

Wautoma Solar Project

Benton County, Washington

Exhibit 3: Soils Map

December 8, 2021



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Westwood

Toll Free (888) 937-5150 westwoodps.com

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary

Landcover

- Alfalfa
- Developed
- Forest

- Fallow/Idle Cropland
- Other Cropland
- Grassland/Pasture
- Other Hay/Non Alfalfa

- Shrubland
- Spring Wheat
- Winter Wheat



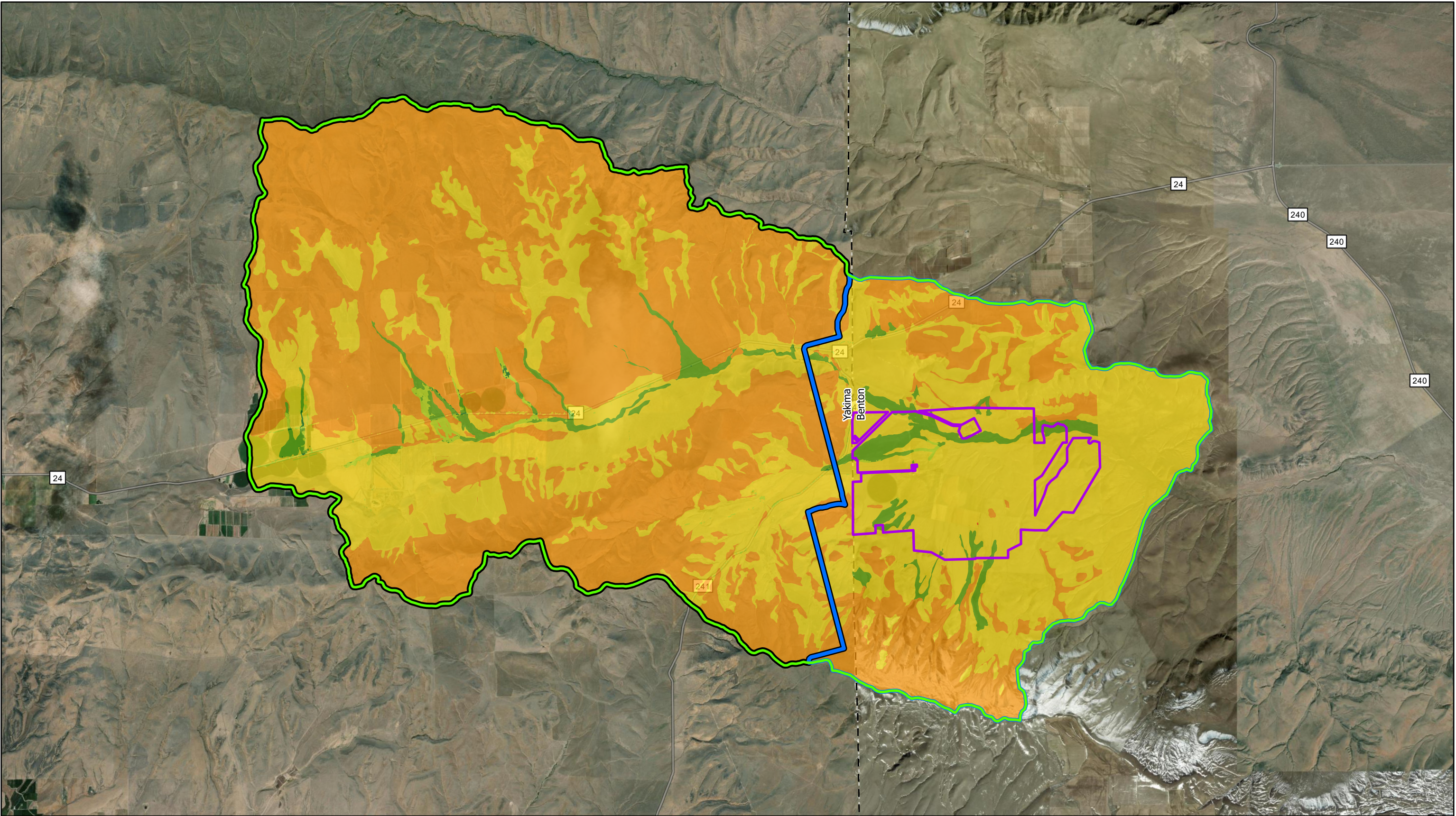
0 1.5 Miles

Wautoma Solar Project

Benton County, Washington

Exhibit 4: Landcover Map












December 8, 2021



Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

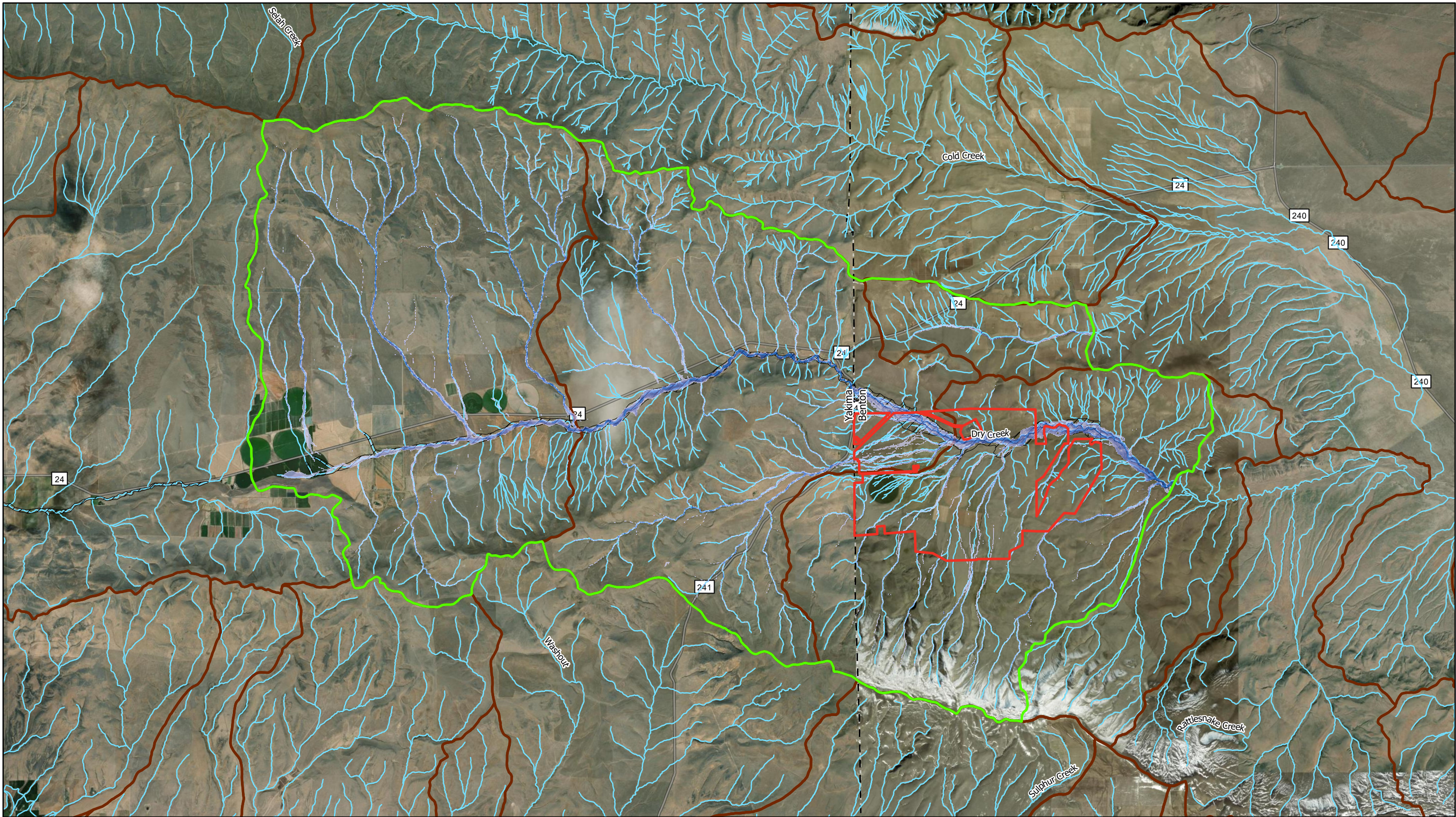
Westwood
Toll Free (888) 937-5150 westwoodps.com

Legend

- | | | | |
|--|--|---|---|
|  Project Boundary |  1-Meter Extents | Curve Number |  70 - 79 |
|  FLO-2D Boundary |  10-Meter Extents | |  80 - 89 |
|  County Boundary | | |  90 - 99 |
| | | |  60 - 69 |
| | |  40 - 49 | |
| | |  50 - 59 | |



Wautoma Solar Project
Benton County, Washington
**Exhibit 5: Curve Number and
Topographic Source Map**
December 8, 2021



Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

Westwood

Toll Free (888) 937-5150 westwoodps.com

Legend

- | | | | |
|------------------|-----------------------------|-------------|-------------|
| Project Boundary | FEMA Zone A* | 1.01 - 1.50 | 3.01 - 4.00 |
| FLO-2D Boundary | NHD Flowline | 1.51 - 2.00 | 4.01 - 6.00 |
| County Boundary | Peak Flow Depth (ft) | 2.01 - 2.50 | 6.01 + |
| HUC 12 Boundary | 0.50 - 1.00 | 2.51 - 3.00 | |



0 1.5 Miles

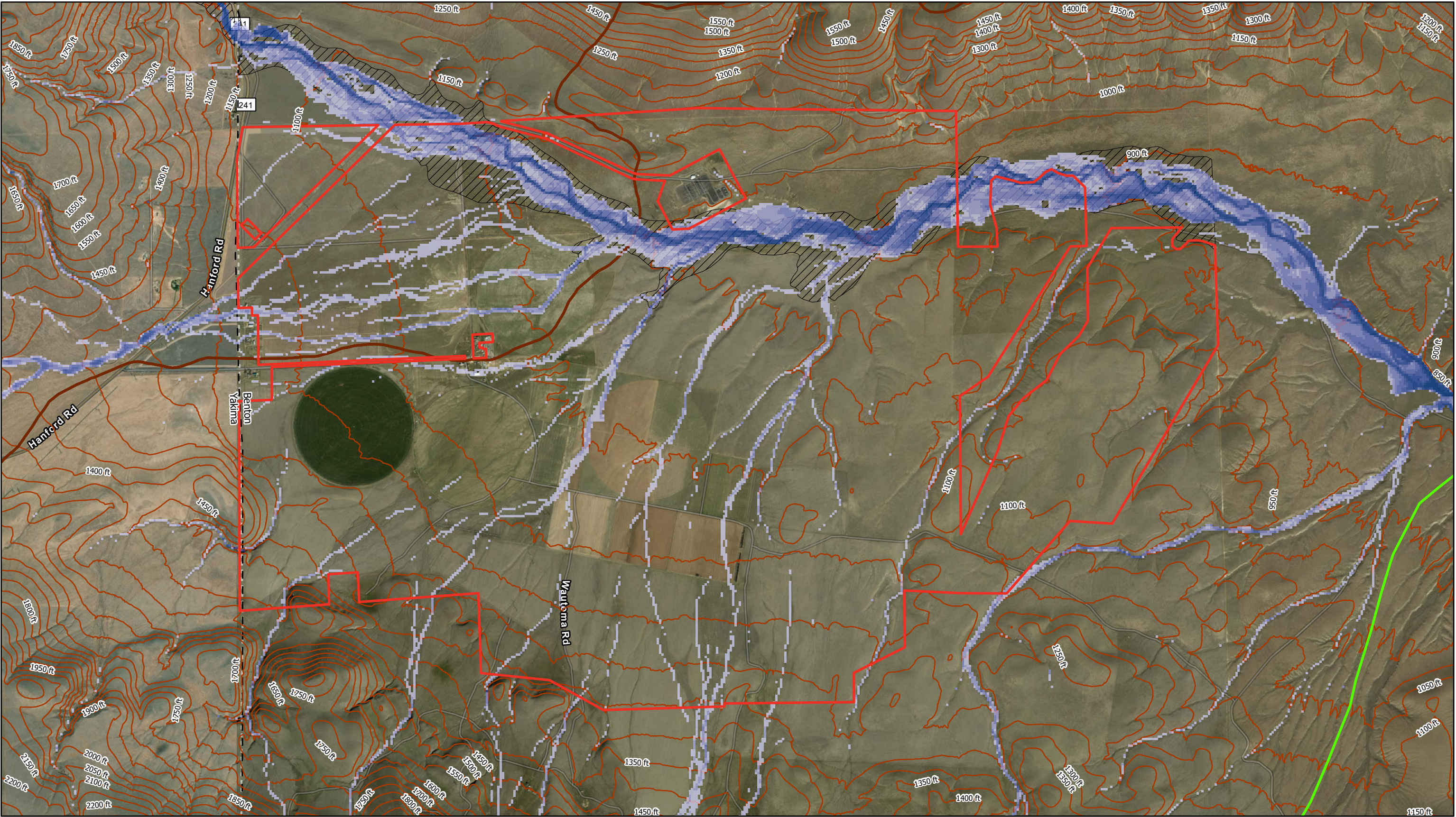
Wautoma Solar Project

Benton County, Washington

Exhibit 6: 100-Year
Max Flood Depth Map

December 9, 2021

*FEMA Data not available for the southern portion of the site



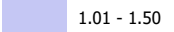
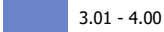
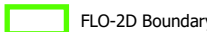

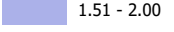


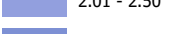


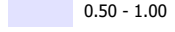



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Westwood

Toll Free (888) 937-5150 westwoodps.com

Legend

- | | | | |
|--|--|---|---|
|  Project Boundary |  FEMA Zone A* |  1.01 - 1.50 |  3.01 - 4.00 |
|  FLO-2D Boundary |  50' Contours |  1.51 - 2.00 |  4.01 - 6.00 |
|  County Boundary | Peak Flow Depth (ft) |  2.01 - 2.50 |  6.01 + |
|  HUC 12 Boundary |  0.50 - 1.00 |  2.51 - 3.00 | |

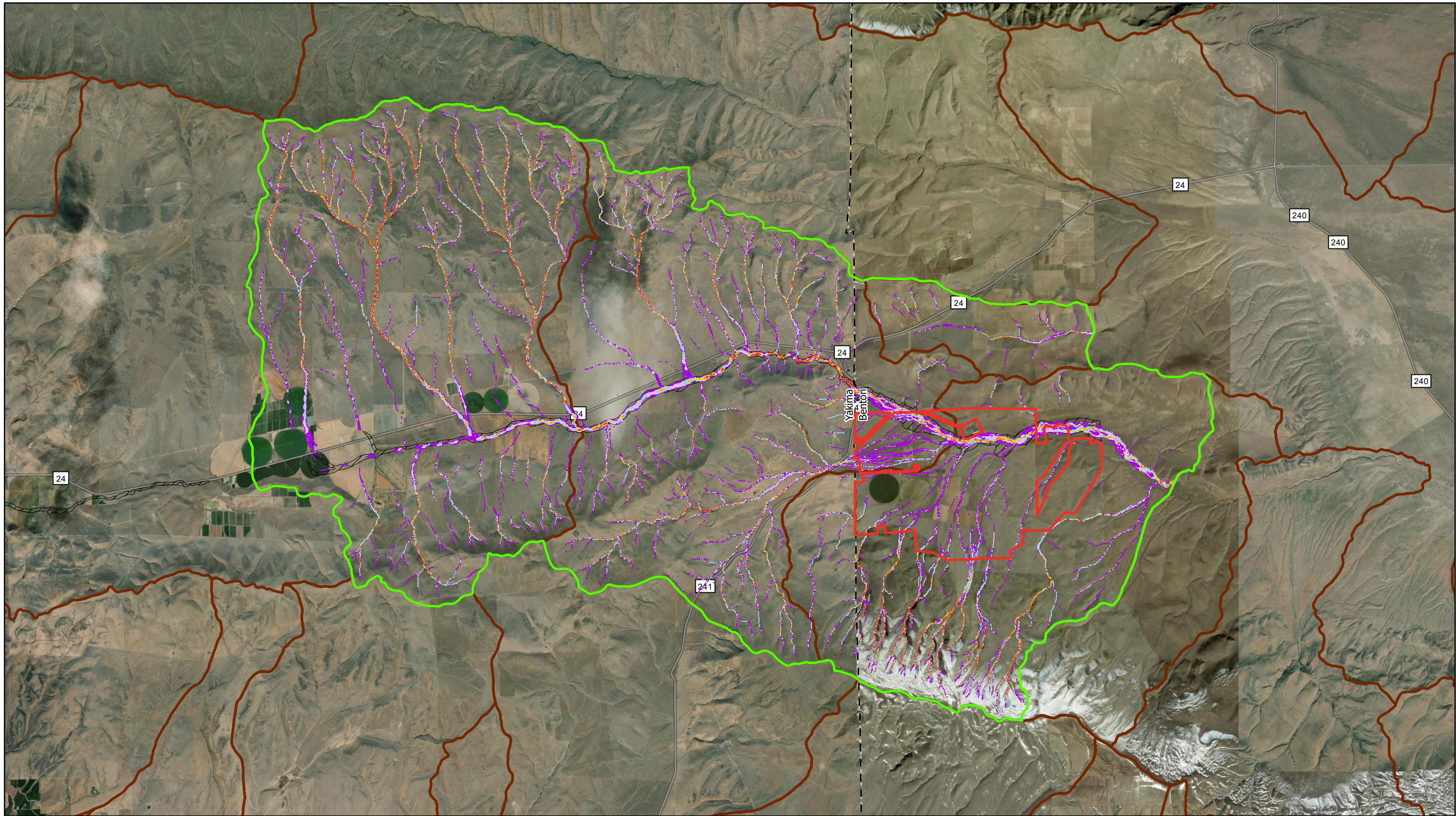
*FEMA Data not available for the southern portion of the site

Wautoma Solar Project

Benton County, Washington

Exhibit 6A: 100-Year Max Flood
Depth Project Area Map

December 9, 2021



Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

Westwood
Toll Free (888) 937-5150 westwoodps.com

Legend

- | | |
|------------------|-----------------|
| Project Boundary | HUC 12 Boundary |
| FLO-2D Boundary | FEMA Zone A* |
| County Boundary | |

Peak Velocity (fps)

- | | |
|-------------|-------------|
| 1.00 - 1.50 | 2.51 - 3.00 |
| 1.51 - 2.00 | 3.01 - 4.00 |
| 2.01 - 2.50 | 4.01 + |

*FEMA Data not available for the southern portion of the site



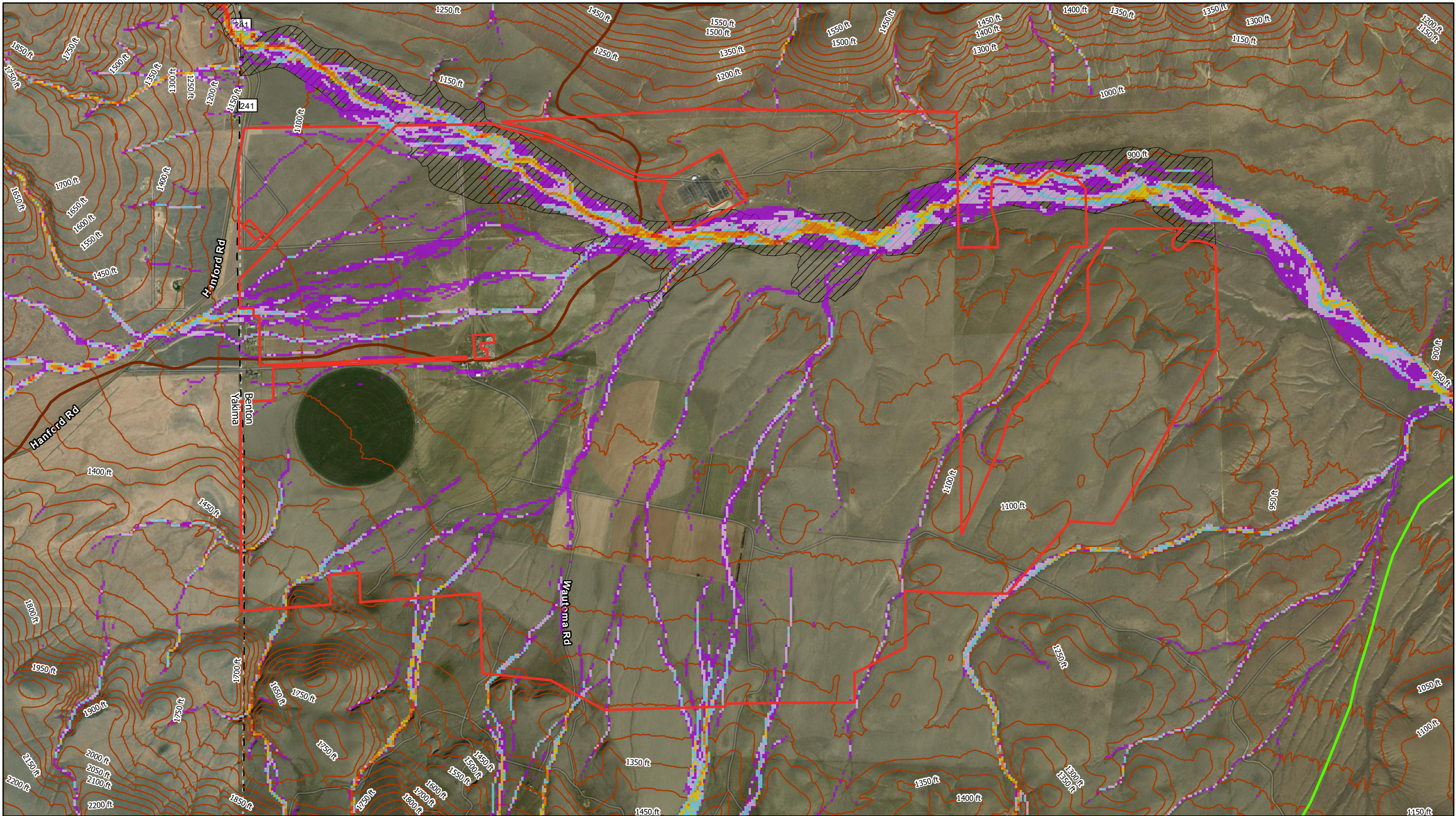
0 1.5 Miles

Wautoma Solar Project

Benton County, Washington

**Exhibit 7: 100-Year
Peak Velocity Map**

December 9, 2021



Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

Westwood

Toll Free (888) 937-5150 westwoodps.com

Legend

- | | | | |
|------------------|-----------------|----------------------------|-------------|
| Project Boundary | HUC 12 Boundary | Peak Velocity (fps) | 2.51 - 3.00 |
| FLO-2D Boundary | FEMA Zone A* | | 3.01 - 4.00 |
| County Boundary | 50' Contours | | 4.01 + |
| | | | 1.00 - 1.50 |
| | | 1.51 - 2.00 | 2.01 - 2.50 |

*FEMA Data not available for the southern portion of the site



0 2,000 Feet

Wautoma Solar Project

Benton County, Washington

Exhibit 7A: 100-Year Peak
Velocity Project Area Map







December 9, 2021





Data Source(s): Westwood (2021); Esri WMS
Basemap Imagery (Accessed 2021); USGS
(2021); FEMA (2021); USDA (2021)

Westwood
Toll Free (888) 937-5150 westwoodps.com

Legend

- | | |
|--|---|
|  Project Boundary |  HUC 12 Boundary |
|  FLO-2D Boundary |  FEMA Zone A* |
|  County Boundary |  50' Contours |

Scour (ft)

- | |
|---|
|  1.00 - 1.50 |
|  1.51 - 2.00 |

 2.01 +

*FEMA Data not available for the southern portion of the site



0 2,000 Feet

Wautoma Solar Project

Benton County, Washington

Exhibit 8: 100-Year Scour Map
December 9, 2021



Appendix A

Atlas 2 Rainfall Data

Precipitation Frequency Data Output

NOAA Atlas 2

Washington 46.59017908°N 120.04977851°W
Site-specific Estimates

| Map | Precipitation (inches) | Precipitation Intensity (in/hr) |
|------------------|---------------------------|------------------------------------|
| 2-year 6-hour | 0.68 | 0.11 |
| 2-year 24-hour | 1.04 | 0.04 |
| 100-year 6-hour | 1.48 | 0.25 |
| 100-year 24-hour | 2.29 | 0.10 |

[Go to PFDS](#)
[Go to NA2](#)

Hydrometeorological Design Studies Center - NOAA/National Weather Service
1325 East-West Highway - Silver Spring, MD 20910 - (301) 713-1669
Mon Nov 22 15:08:51 2021



Appendix B

Curve Number Table

Table 2. Semi-Arid Curve Numbers (adapted from NEH 630)

| Class | Value | Classification Description | Curve Number | | | | |
|--------------------|-------|---|--------------|----|----|----|-----|
| | | | Soil Type* | | | | |
| | | | A | B | C | D | W |
| Water | 11 | Open Water - areas of open water, generally with less than 25% cover of vegetation or soil. | 98 | 98 | 98 | 98 | 100 |
| | 12 | Perennial Ice/Snow - areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover. | 98 | 98 | 98 | 98 | 100 |
| Developed | 21 | Developed, Open Space - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. | 46 | 65 | 77 | 82 | 100 |
| | 22 | Developed, Low Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units. | 61 | 75 | 83 | 87 | 100 |
| | 23 | Developed, Medium Intensity – areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units. | 77 | 85 | 90 | 95 | 100 |
| | 24 | Developed High Intensity -highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover. | 89 | 92 | 94 | 95 | 100 |
| Barren | 31 | Barren Land (Rock/Sand/Clay) - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover. | 77 | 86 | 91 | 94 | 100 |
| Forest | 41 | Deciduous Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change. | 43 | 55 | 70 | 77 | 100 |
| | 42 | Evergreen Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage. | 43 | 55 | 70 | 77 | 100 |
| | 43 | Mixed Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover. | 43 | 55 | 70 | 77 | 100 |
| Shrubland | 51 | Dwarf Scrub - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation. | 55 | 71 | 81 | 89 | 100 |
| | 52 | Shrub/Scrub - areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions. | 55 | 71 | 81 | 89 | 100 |
| Herbaceous | 71 | Grassland/Herbaceous - areas dominated by graminoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing. | 55 | 71 | 81 | 89 | 100 |
| | 72 | Sedge/Herbaceous - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra. | 55 | 71 | 81 | 89 | 100 |
| | 73 | Lichens - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation. | 55 | 71 | 81 | 89 | 100 |
| | 74 | Moss - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation. | 55 | 71 | 81 | 89 | 100 |
| Planted/Cultivated | 81 | Pasture/Hay – areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation. | 55 | 71 | 81 | 89 | 100 |
| | 82 | Cultivated Crops – areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled. | 67 | 78 | 85 | 89 | 100 |
| | 83 | Small Grains | 63 | 75 | 83 | 87 | 100 |
| Wetlands | 91 | Woody Wetlands - areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water. | 45 | 66 | 77 | 83 | 100 |
| | 92 | Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water. | 45 | 66 | 77 | 83 | 100 |

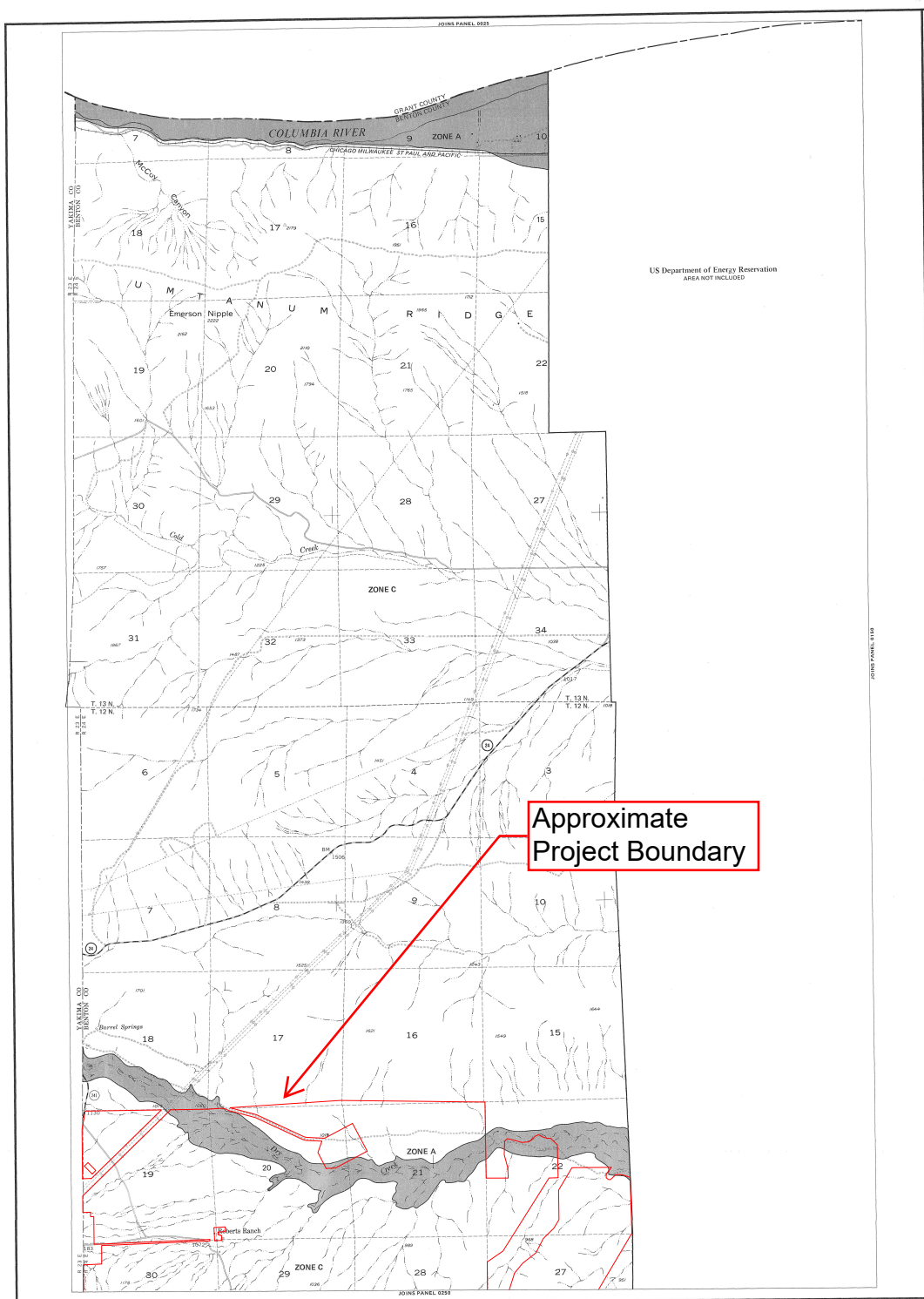
*A/D, B/D and C/D soils lumped as D soils, W denotes water

**Curve Numbers for NLCD Codes 41-43 have been increased from 30 to 43 as many of these areas are partially grazed Woods-grass combination.

The background of the entire page is a dark red topographic map. It features intricate, swirling contour lines in a lighter red shade. A dashed red line runs diagonally from the top left towards the bottom center. Along this line, there is a solid red dot in the lower half and a red 'X' mark in the upper half.

Appendix C

FEMA FIRM Panels



KEY TO MAP

| | |
|-------------------------|----------------|
| 500-Year Flood Boundary | ZONE B |
| 100-Year Flood Boundary | ZONE A1 |
| Zone Designations* | ZONE A5 |
| 100-Year Flood Boundary | ZONE B |

Base Flood Elevation Line With Elevation In Feet**

Base Flood Elevation In Feet Where Unlabeled Within Zone**

Elevation Referenced Mark

Zone D Boundary

River Mile

**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 less than one (1) foot and there (1) foot average depths of inundation are shown, but no flood hazard factors are determined. |
| AH | Areas of 100-year shallow flooding where depths are less than one (1) foot and there (1) foot average depths of inundation are shown, but no flood hazard factors are determined. |
| A1/A30 | Areas of 100-year flood; base flood elevations and flood hazard factors determined. |
| A30 | Areas of 100-year flood to be protected by flood protection systems; base flood elevations and flood hazard factors not determined. |
| B | Areas between limits of the 100-year flood and 500-year flood, or 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 uncontrolled, not 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.

INITIAL IDENTIFICATION:
AUGUST 9, 1977

FLOOD HAZARD BOUNDARY MAP REVISIONS:

FLOOD INSURANCE RATE MAP EFFECTIVE:
JULY 19, 1982

FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when structural criteria apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6626.

APPROXIMATE SCALE
2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

BENTON COUNTY, WASHINGTON
(UNINCORPORATED AREAS)

PANEL 125 OF 1075
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
530237 0125 B

EFFECTIVE DATE:
JULY 19, 1982

Federal Emergency Management Agency