State of Oregon
Oregon Department of Geology and Mineral Industries
Brad Avy, State Geologist
www.OregonGeology.org

BASE FLOOD ELEVATION DETERMINATION BF-15-02

BASE FLOOD ELEVATION DETERMINATION FOR REACHES OF FRAZIER CREEK AND MOUNTAIN VIEW CREEK, BENTON COUNTY, OREGON

by Jed T. Roberts[1] and Matt C. Williams[1]

2015

[1]Oregon Department of Geology and Mineral Industries, 800 NE Oregon Street, Suite 965, Portland, OR 97232

DISCLAIMER

The Oregon Department of Geology and Mineral Industries is not liable for any claimed damage from the use of this information. The Federal Emergency Management Agency may, at any time in the future, revise the Base Flood Elevations for this study area. This study and Base Flood Elevation determination does not supersede any existing or future detailed analyses or determination performed by a licensed professional engineer. This analysis and mapping does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size.

Oregon Department of Geology and Mineral Industries Base Flood Elevation Determination BF-15-02
Published in conformance with ORS 516.030

This report was prepared by the Oregon Department of Geology and Mineral Industries for Louis J. Di Meglio, Architect, in fulfillment of the Base Flood Elevation Determination Service Agreement made effective July 16, 2015.

For copies of this publication or other information about Oregon's geology and natural resources, contact:

For additional information:
Administrative Offices
800 NE Oregon Street, Suite 965
Portland, OR 97232
Telephone (971) 673-1555
Fax (971) 673-1562
http://www.oregongeology.org
http://www.oregon.gov/DOGAMI/

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

STUDY BACKGROUND

This study was conducted under a Base Flood Elevation Determination Service agreement dated July 16, 2015, between the Oregon Department of Geology and Mineral Industries (DOGAMI) and Louis J. Di Meglio, Architect. The purpose of this study was to develop 1% annual chance (100-year) water surface elevations, also known as Base Flood Elevations (BFEs), for a reach of Frazier and Mountain View creeks in Benton County, Oregon, just north of Corvallis.

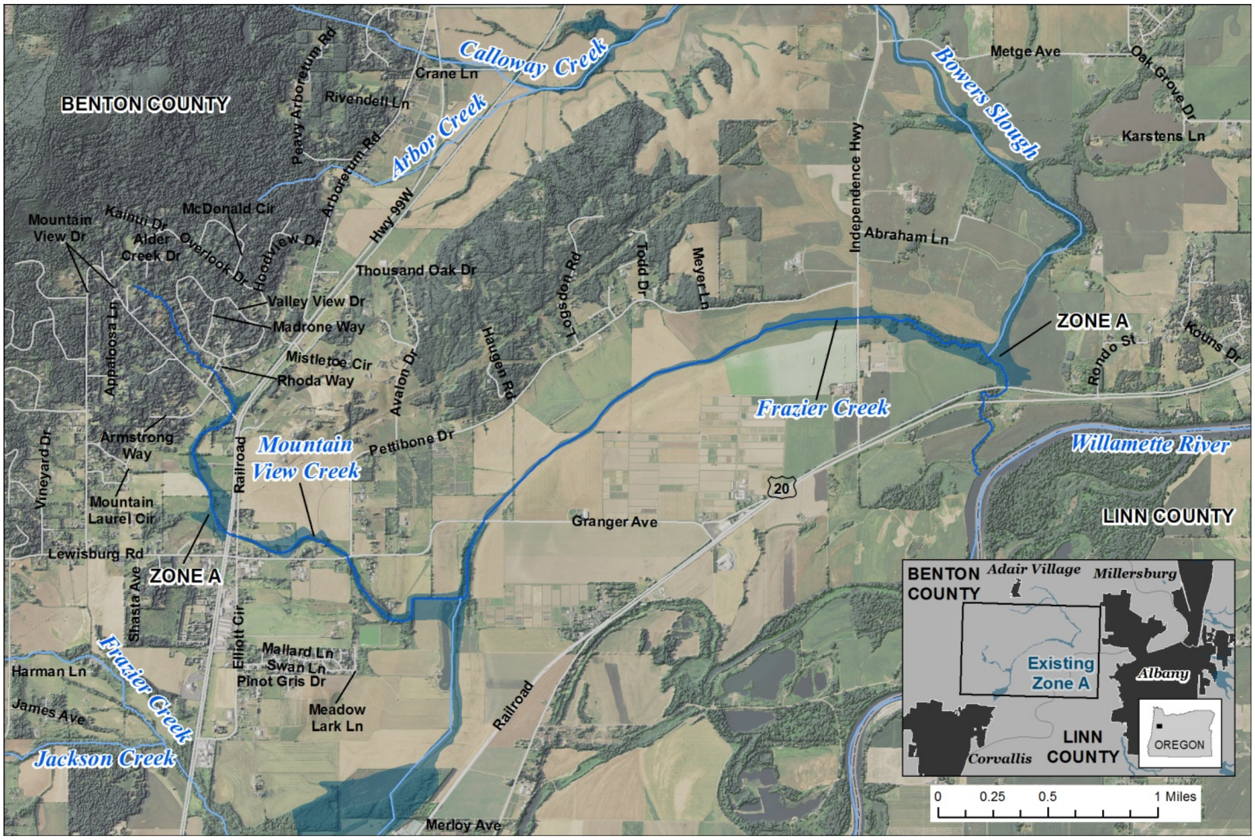
BFEs are determined primarily for administration of the National Flood Insurance Program (NFIP). The Federal Emergency Management Agency (FEMA) oversees the NFIP and issues Flood Insurance Rate Maps (FIRMs) that depict Special Flood Hazard Areas (SFHAs) within which flood insurance for structures is typically required. SFHAs are mapped by *detailed* or *approximate* methods:

- *Detailed analyses* are performed for streams in urban or suburban settings, and SFHAs mapped with this approach are designated as Zone AE, Zone AO, or Zone AH. The analyses incorporate field survey and flood frequency data into a hydraulic model. The resulting BFEs are mapped onto best available topographic data.
- *Approximate analyses* are performed for streams in rural areas, and SFHAs mapped with this approach are designated as Zone A. Unlike detailed analyses, the approximate analysis does not produce BFEs. Instead, this latter method has historically involved engineering judgment of hydraulics and hydrology to map SFHAs onto U.S. Geological Survey (USGS) topographic sheets.

The approximate analysis approach was used to map SFHAs that are shown on the currently effective FIRM for Frazier Creek and Mountain View Creek (Figure 1).

DOGAMI has partnered with FEMA through its Cooperating Technical Partner program to improve FIRMs by introducing high-resolution lidar (light detection and ranging) topographic data. As part of this effort DOGAMI has developed a FEMA-approved computer model-based approach to produce BFEs using lidar in areas designated approximate, enabling the Zone A SFHAs to be revised and updated. This same approach was applied for the current study to produce BFEs in an area where FEMA has not yet funded a lidar-based FIRM revision.

Figure 1. Zone A Special Flood Hazard Area mapped by FEMA in 2011.

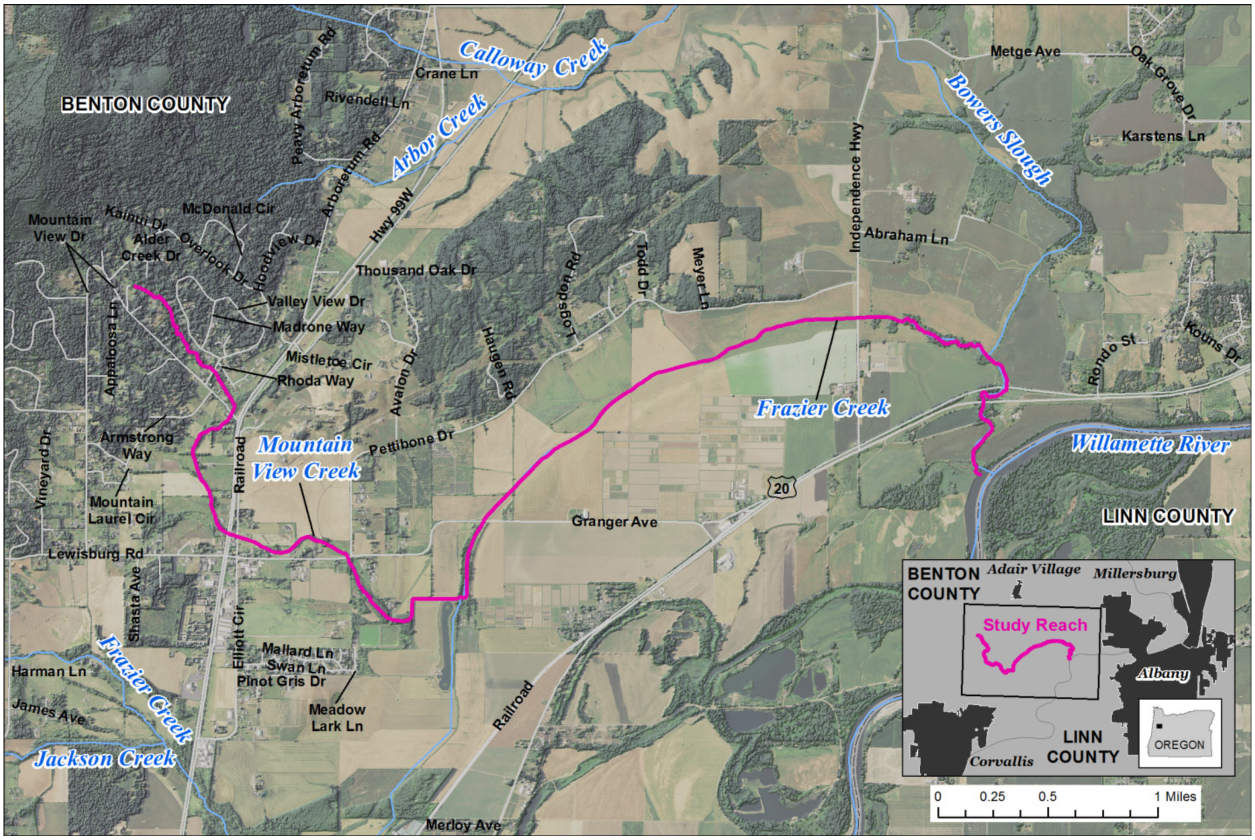


PHYSICAL SETTING

Frazier Creek drains a 28.6 square-mile watershed within the central Willamette River Basin and is a tributary to the Willamette River. Its confluence is located upstream of river mile 122 of the Willamette River. Mountain View Creek is a tributary to Frazier Creek, draining 11.9 square miles. The watershed drains the eastern front of the Oregon Coast Range, dropping into the Crescent Valley north of Corvallis, and finally converging with the Willamette Valley geologic floodplain (Figure 2). It is characterized by steep forested uplands in the northwest and flat agricultural lowlands in the east. Mean annual precipitation in the watershed ranges from approximately 40 to 60 inches per year. Flows do not appear to be regulated by dams or other hydraulic structures.

Frazier Creek and Mountain View Creek appear to have been relatively stable in their planform configurations throughout recent history. The lower portion of Frazier Creek occupies an ancient abandoned side channel of the Willamette River and is susceptible to substantial backwater flooding from the Willamette.

Figure 2. Location of study reach.



HYDROLOGIC ANALYSIS METHODS

Nine discharge locations were identified for this study. Locations were selected at the downstream terminus of the study reach and upstream based on a minimum drainage area reduction of 1 square mile (Figure 3).

100-year peak discharges were calculated using a regional regression equation developed by the Oregon Water Resource Department (OWRD) and the USGS (Cooper, 2005). OWRD and USGS divided western Oregon into three hydrologic regions with separate regression equations. The watersheds upstream of the discharge locations fall completely within Region 2B. For these ungaged locations the 100-year peak discharge is given by the equation:

$$Q_{100} = 31.85\, Area^{0.9114}\, Slope^{0.4501}\, I24\text{-}2^{0.6252}$$

where

Q_{100} = the 100-year (1% annual chance) peak discharge, in cubic feet per second,
Area = the drainage area of the watershed, in square miles,
Slope = the mean watershed slope, in degrees, and
$I24\text{-}2$ = the 2-year (50% annual chance) 24-hour precipitation intensity, in inches.

Basin characteristics were determined using the USGS StreamStats for Oregon web tool (http://water.usgs.gov/osw/streamstats/oregon.html, USGS, 2015). The resulting 100-year peak discharges are listed in Table 1.

Figure 3. Discharge locations.

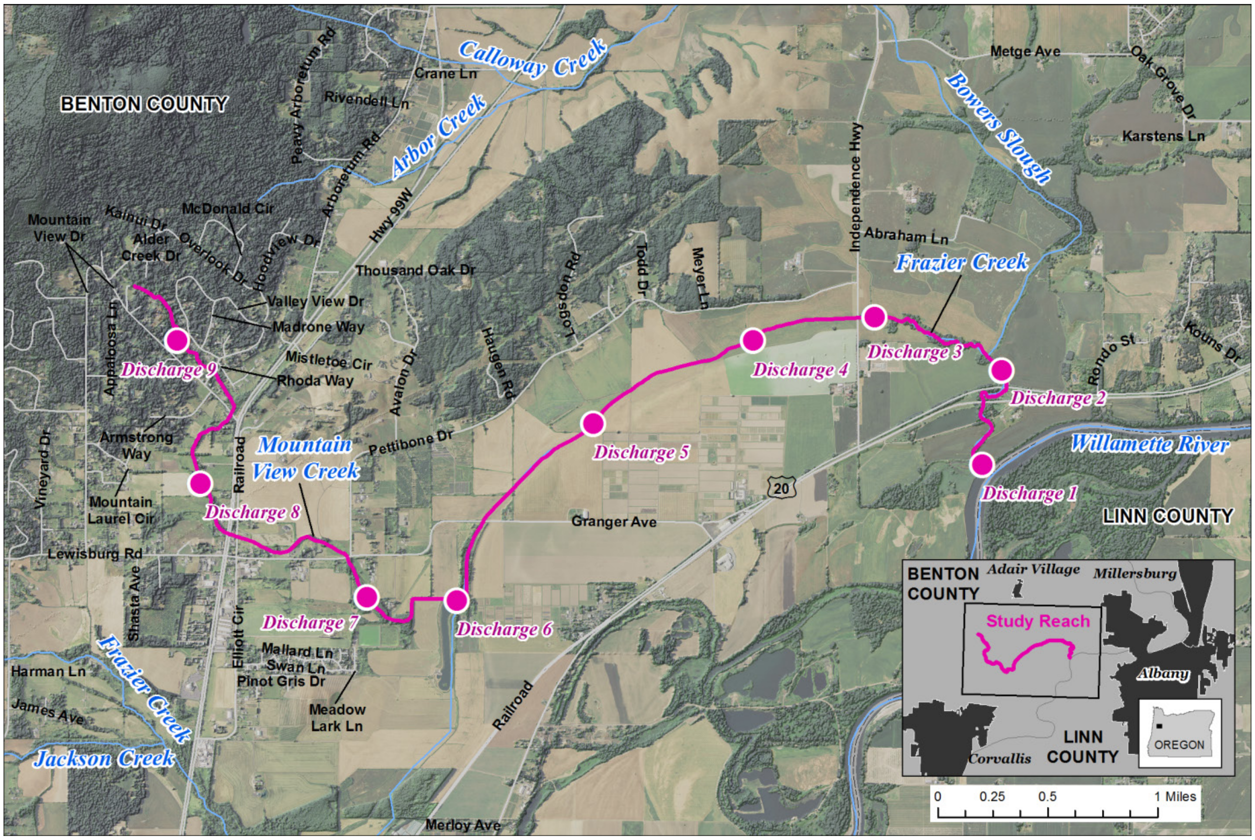


Table 1. Summary of 100-year flood discharges.

Discharge Location	Drainage Area (sq. mi.)	Mean Watershed Slope (deg.)	2-year 24-hour Precipitation Intensity (in.)	100-Year Peak Discharge (cfs)
Discharge Location #1	28.60	5.37	2.10	2,270
Discharge Location #2	27.60	5.40	2.10	2,220
Discharge Location #3	15.10	6.17	2.10	1,360
Discharge Location #4	14.10	6.31	2.11	1,300
Discharge Location #5	13.20	6.43	2.11	1,230
Discharge Location #6	11.90	6.85	2.13	1,160
Discharge Location #7	3.50	7.26	2.09	386
Discharge Location #8	2.03	9.09	2.12	259
Discharge Location #9	1.18	11.2	2.14	182

cfs is cubic feet per second.

HYDRAULIC ANALYSIS METHODS

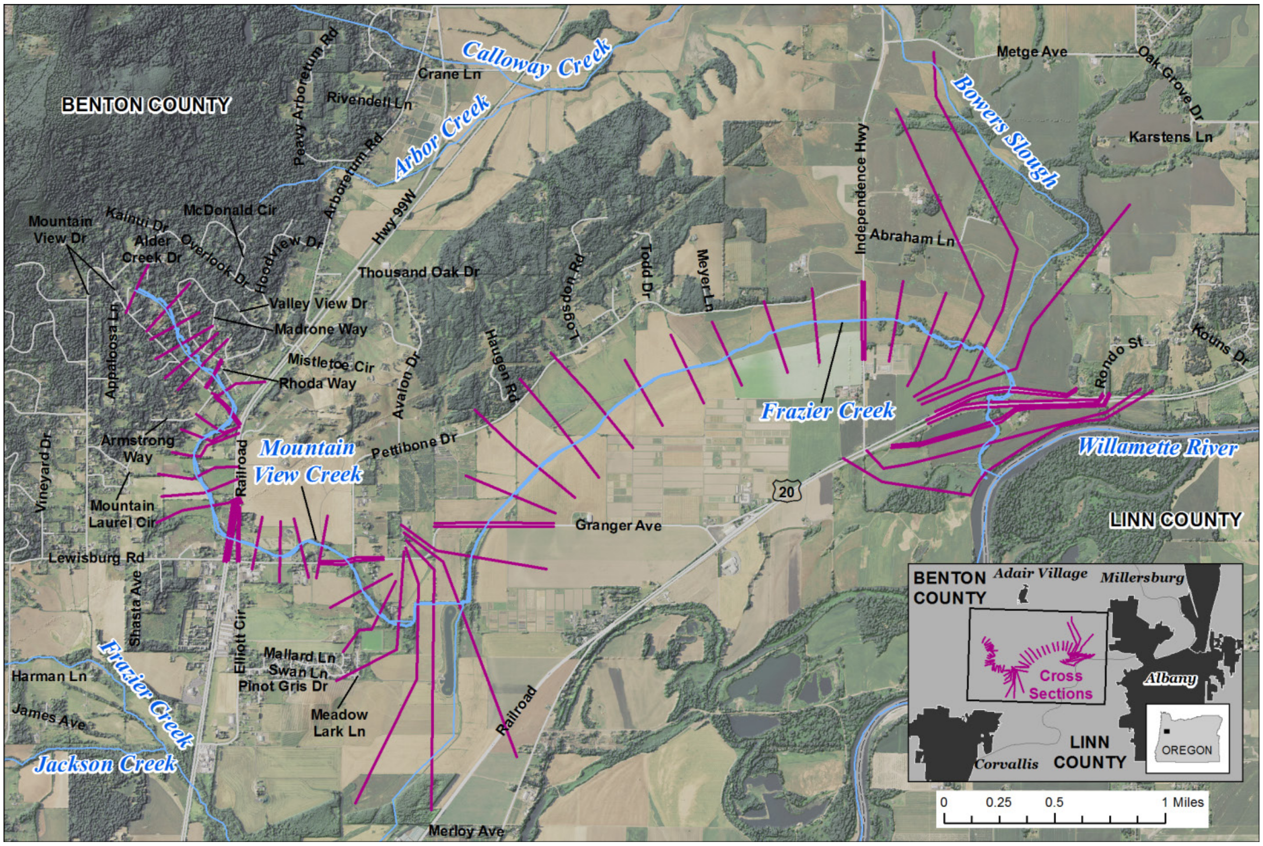
To produce simulated water surface elevations of the 100-year peak discharge, a steady flow hydraulic model was developed using the Hydrologic Engineering Center River Analysis System (HEC-RAS 4.1) produced by the U.S. Army Corps of Engineers (Brunner, 2010). Geometric input data were developed using the Esri ArcGIS© for Desktop Advanced 10.2.2 software package, the Esri 3D Analyst™ and Spatial Analyst™ extensions, and the HEC-GeoRAS 10.2 add-on produced by USACE (Ackerman, 2011).

Geometric data layers, including stream centerline, flowpaths, bank stations, and cross-sections, were digitized from a hillshade raster derived from a 3-foot resolution lidar digital elevation model (DEM). The lidar DEM was derived from ground classified points with an average density of 0.16 per square foot. The vertical accuracy for the lidar acquisition area is ± 0.13 feet on flat surfaces. Lidar acquisition for the study area took place on September 14, 2008 (DOGAMI, 2010).

Sixty-three (63) cross-sections were placed along the study reach, perpendicular to the stream centerline (Figure 4). The downstream reach boundary condition was defined as known water surface elevations from BFEs published by FEMA (2011).

Manning's roughness coefficients were determined for the study area overbank areas using the 2011 National Land Cover Dataset (Jin and others, 2013). Land cover types were assigned a coefficient from land descriptions provided in Chow (1959). Overbank coefficients were found to range from 0.011 to 0.15 throughout the study area. Channel coefficients varied due to changing roughness characteristics observed along the study reach, which reflects steep uplands in the upper reach and confined agricultural channels in the lower reach.

Figure 4. Location of cross-sections used for hydraulic analysis.



SUMMARY OF RESULTS

The results of hydraulic modeling show that BFEs range from 210.9 feet (NAVD88) at the downstream terminus of the study reach to 390.3 feet (NAVD88) at the upstream terminus. Table 2 shows BFEs at cross-sections selected approximately every river mile (Appendix A) throughout the study reach.

Table 2. Summary of 100-year flood elevations.

Reference Cross-Section[1]	Location Description	BFE (ft. NAVD88[2])
FMVC-1	Mouth of Frazier Creek	210.9
FMVC -2	Frazier Creek, 1,700 feet downstream of Independence Highway	210.9
FMVC -3	Frazier Creek, 3,400 feet upstream of Independence Highway	211.0
FMVC -4	Frazier Creek, 1,800 feet downstream of Granger Avenue	212.9
FMVC -5	Just upstream of confluence of Mountain View Creek and Frazier Creek	214.3
FMVC -6	Mountain View Creek, 800 feet downstream of Granger Avenue	223.0
FMVC -7	Mountain View Creek, 800 feet downstream of Highway 99W	236.6
FMVC -8	Mountain View Creek, 1,800 feet upstream of Highway 99W	255.3
FMVC -9	Mountain View Creek, 400 feet upstream of NW Churchill Way	292.3
FMVC -10	Mountain View Creek, 2,800 feet upstream of NW Churchill Way	390.3

[1]See Appendix A for map of reference cross-sections.

[2]North American Vertical Datum of 1988.

REFERENCES

Ackerman, C. T., 2011, HEC-GeoRAS GIS tools for support of HEC-RAS using ArcGIS© user's manual version 4.3.93: Davis, Calif., U.S. Army Corps of Engineers, Hydrologic Engineering Center, CPD-83, 244 p. http://www.hec.usace.army.mil/software/hec-georas/documentation/HEC-GeoRAS_43_Users_Manual.pdf

Brunner, G. W., 2010, HEC-RAS River Analysis System User's Manual, version 4.1: Davis, Calif., U.S. Army Corps of Engineers, Hydrologic Engineering Center, CPD-68, 790 p. http://www.hec.usace.army.mil/software/hec-ras/documentation/HEC-RAS_4.1_Users_Manual.pdf

Chow, V. T., 1959, Open-channel hydraulics: New York, McGraw-Hill, 680 p.

Cooper, R. M., 2005, Estimation of peak discharges for rural, unregulated streams in western Oregon: U.S. Geological Survey Scientific Investigations Report 2005-5116, 134 p. http://pubs.usgs.gov/sir/2005/5116/

Federal Emergency Management Agency (FEMA), 2011, Flood insurance study for Benton County and incorporated areas: Washington, D.C., FEMA Flood Insurance Study 41003CV000A, 71 p. http://www.oregonriskmap.com/index.php/mappingtools/all-downloads/pdf/203-benton-co-fis/file

Jin, S., Yang, L., Danielson, P., Homer, C., Fry, J., and Xian, G, 2013, A comprehensive change detection method for updating the National Land Cover Database to circa 2011: Remote Sensing of Environment, v. 132, 159–175. DOI: 10.1016/j.rse.2013.01.012

Oregon Department of Geology and Mineral Industries (DOGAMI), 2010, Central Willamette Valley lidar data: Lidar Data Quadrangle LDQ-44123F2-Lewisburg.

APPENDIX A: MAP OF HYDRAULIC ANALYSIS RESULTS

Attached to this report is a map depicting the hydraulic analysis results of the 100-year peak discharge for the study reaches of Frazier Creek and Mountain View Creek.

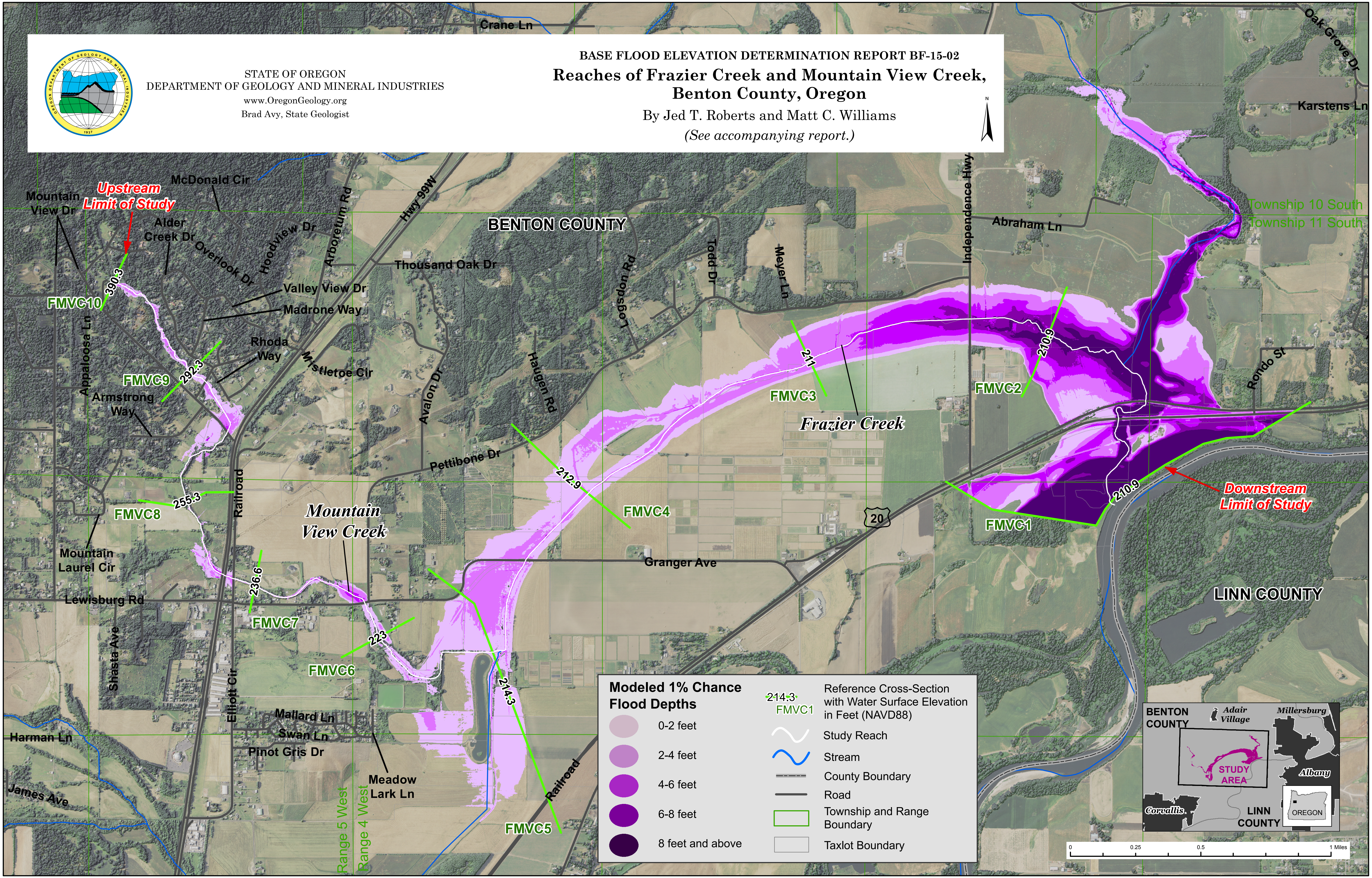
STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
www.OregonGeology.org
Brad Avy, State Geologist

BASE FLOOD ELEVATION DETERMINATION REPORT BF-15-02

Reaches of Frazier Creek and Mountain View Creek, Benton County, Oregon

By Jed T. Roberts and Matt C. Williams

(See accompanying report.)



APPENDIX B: HYDRAULIC ANALYSIS DATA PACKAGE

Attached to this report is a data package containing the input and output datasets used to perform this study. It includes:

- HEC-RAS 4.1 model
- HEC-GeoRAS 10.2 input geometry data in GIS format
    - Cross-sections
    - Stream centerlines
    - Flowpaths
    - Bridges
- HEC-GeoRAS 10.1 output data in GIS format
    - 100-year flood zone
    - 100-year water surface elevation grid
    - 100-year depth grid
    - Cross-sections with computed 100-year water surface elevations
- 3-foot resolution lidar DEM in GIS format
- Study reach output data in GIS format
    - 100-year flood zone
    - 100-year water surface elevation grid
    - 100-year depth grid
- Hydrologic data table