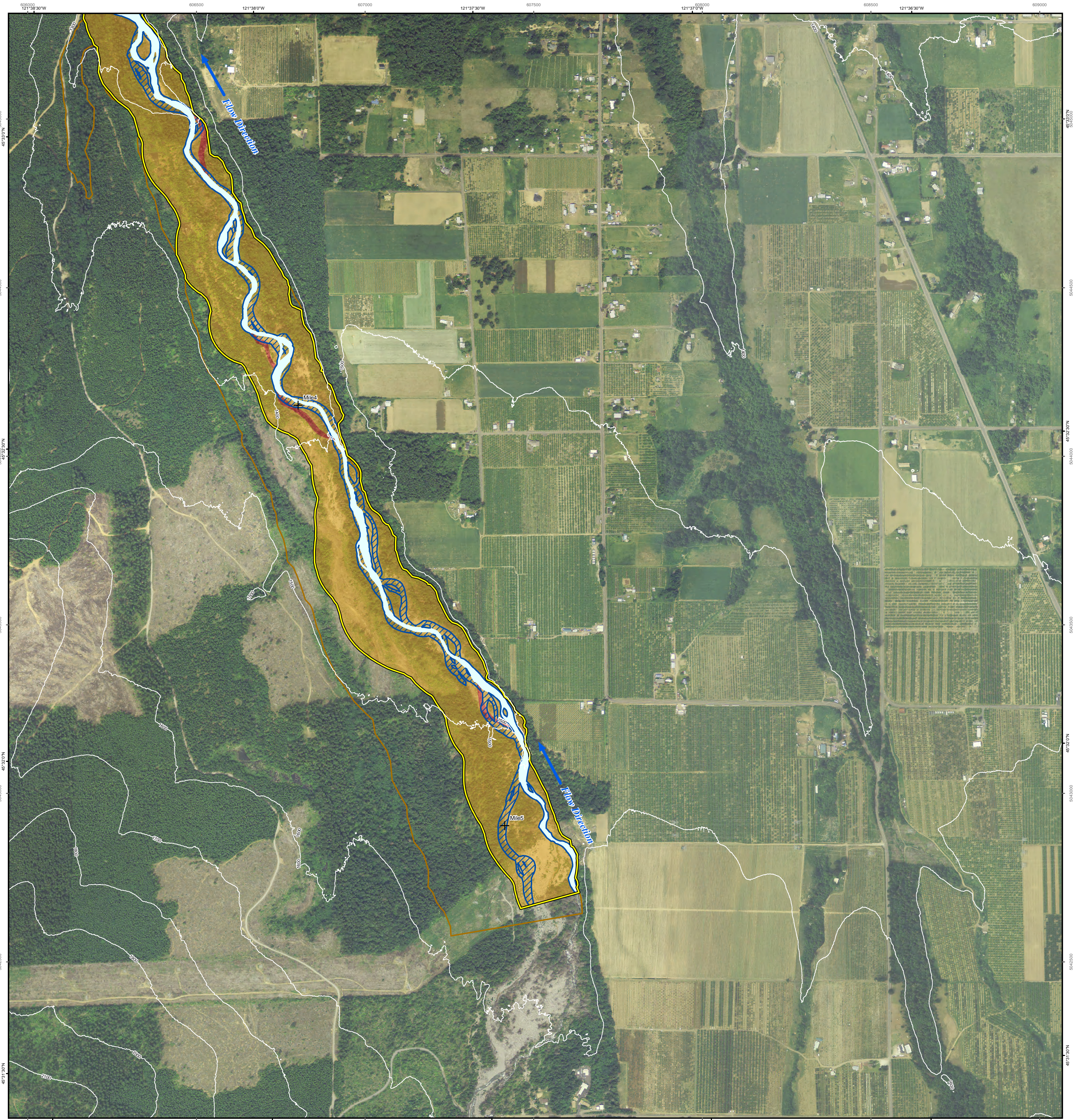
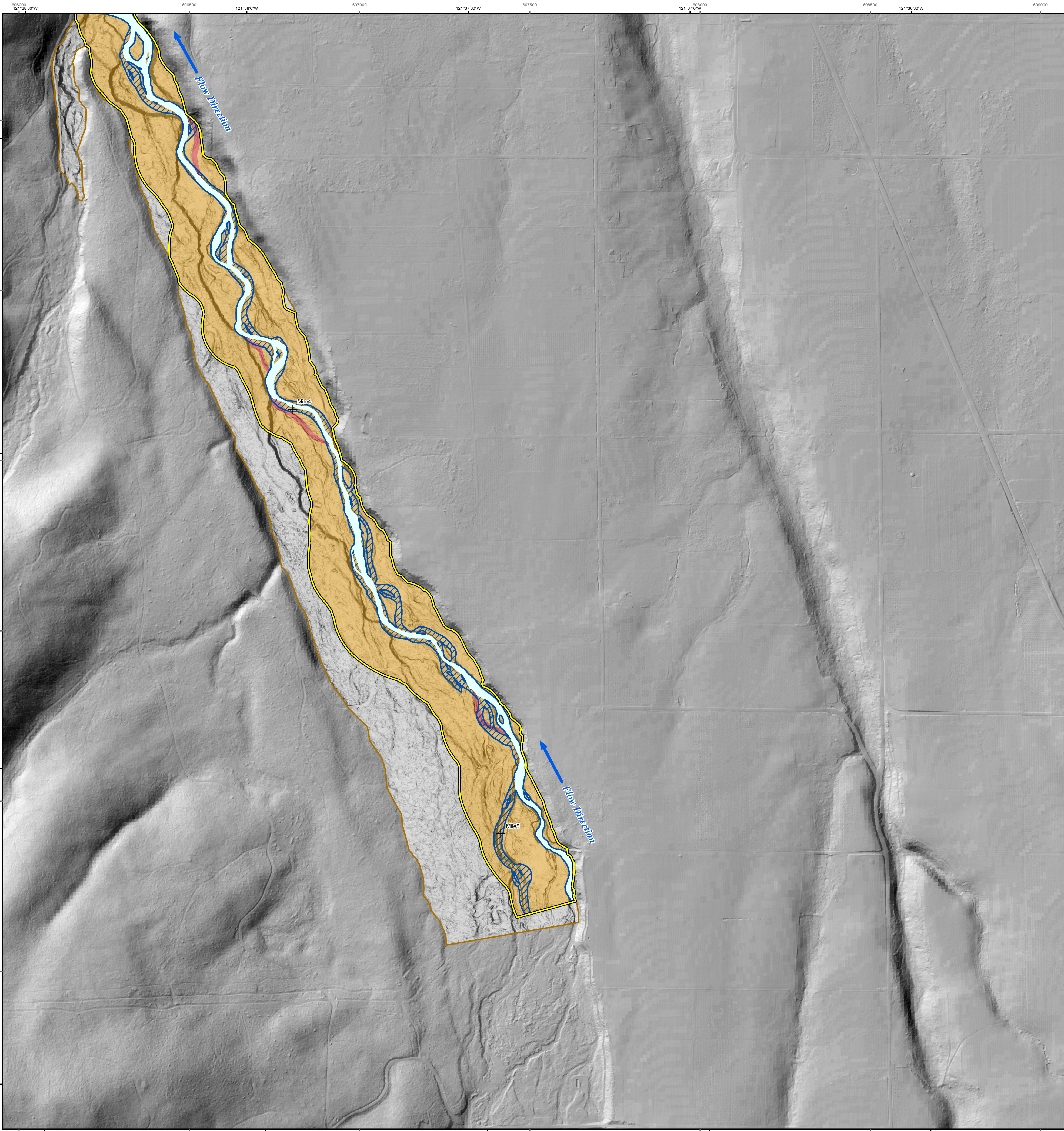


Channel Migration Hazard Map for the Middle Fork Hood River, River Miles 3 through 5, Hood River County, Oregon

2011



EXPLANATION

Conventional flood hazard maps, like the FEMA Flood Insurance Rate Map (FIRM) series, examine only the hazard posed by standing floodwaters on a given floodplain. Damage from bank erosion as river channels naturally migrate may be far greater locally and may occur even in the absence of major flooding. To address this hazard, this channel migration hazard map identifies areas susceptible to future channel movement and erosion. Following the methodology of Rapp and Abbe (2003) and Abbe and others (2008) lidar-derived digital elevation models (DEMs) and aerial photography (see source data) were examined to map the position of the channel over time. Localized erosion rates, potential avulsion sites, areas where erosion may be prevented, and areas where infrastructure is at risk from erosion were identified from these data. The resulting Channel Migration Zone and its subzones (see Figure 1 for generalized representation) host estimates of the likely hazard projected 100 years into the future. The analysis area is mostly within the geologic floodplain of the river, with some exceptions where forecasted erosion boundaries intersect active landslides. In these locations the Channel Migration Zone may include the landslide toe.

The resulting hazard zones are depicted on a lidar-derived base map (left panel) and an orthophoto base map (right panel) at a scale of 1:6,000. The channel hazard map should be used as a guide for local governments, land owners, and infrastructure managers to identify assets potentially at risk and to develop effective mitigation measures.

For more information on methodologies, see English and Coe (2011).

METHODS, COMPONENTS, AND LIMITATIONS OF INTERPRETATION

Channel boundaries were mapped using historical and current aerial photography. Historical aerial photography was rectified using 2005 NAIP aerial photography as a base for georeferencing. The combined extent of mapped channel areas comprises the **Historical Migration Zone (HMZ)**.

Erosion rates are derived by measuring change between serial channel locations (for example 1955 compared to 1970) for channel reaches defined by morphological components such as flow, channel geometry, valley width, vegetation, and development. For each reach, the area difference computed between channels is divided by channel length, then divided by the number of years between channel locations. This is performed for each channel location (1955-1957, 1975, 2005, 2009). Year-to-year erosion rates are averaged to produce a single annual erosion rate for each reach (Figure 2). The erosion rate is multiplied by 100 to produce the distance of erosion over 100 years, and the resulting value is used to buffer the Historical Migration Zone. This buffered region represents the **Erosion Hazard Area (EHA)**.

Avulsion is the natural process by which flow diverts out of an established river channel into a new permanent course on the adjacent floodplain (Slingerland and Smith, 2004). **Avulsion Hazard Zones (AHZ)** are derived by identifying areas susceptible to avulsion such as lateral channels and historical avulsion paths. Morphological evidence such as meander and erosive scarring are also used to define potential avulsion paths. Lidar-derived digital elevation models (DEMs), hillshades, and slope models are used to identify morphologies characteristic of avulsions beneath vegetation.

Disconnected Migration Areas (DMA) are identified as areas behind infrastructure that can potentially prevent channel change. Roads, levees (not overtopped by flood), and areas of permanent development are used to identify areas of disconnection.

The final **Channel Migration Zone (CMZ)** is the collective area of the HMZ, AHZ, and EHA (Figure 1). The DMA represents areas that would be within the CMZ had there not been infrastructure preventing channel migration.

Limitations of this study relate to the accuracy of the historical aerial photography and length of historical record. The rectification process used to co-register individual photos produced accuracies of 9-15 feet (95% confidence). Accuracies vary throughout individual photos and photo areas.

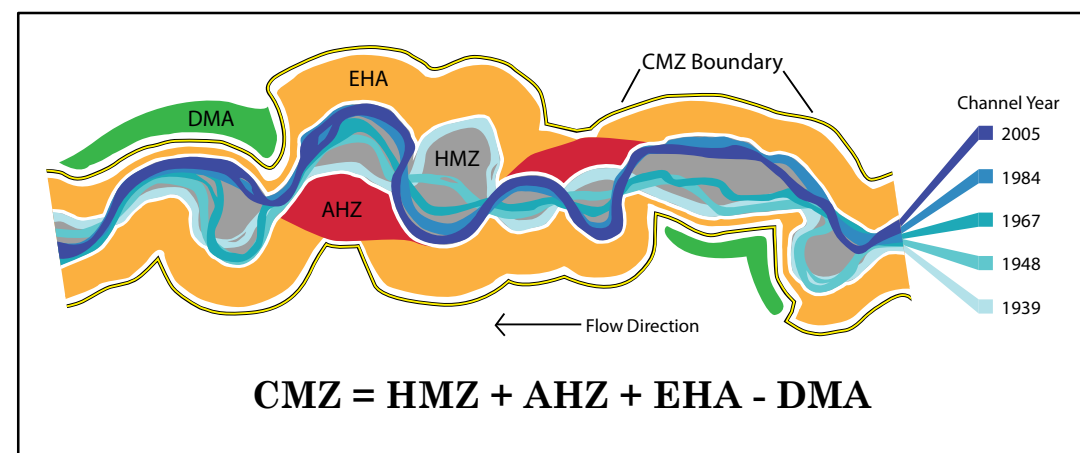


Figure 1. Conceptual graphic of channel migration zone.

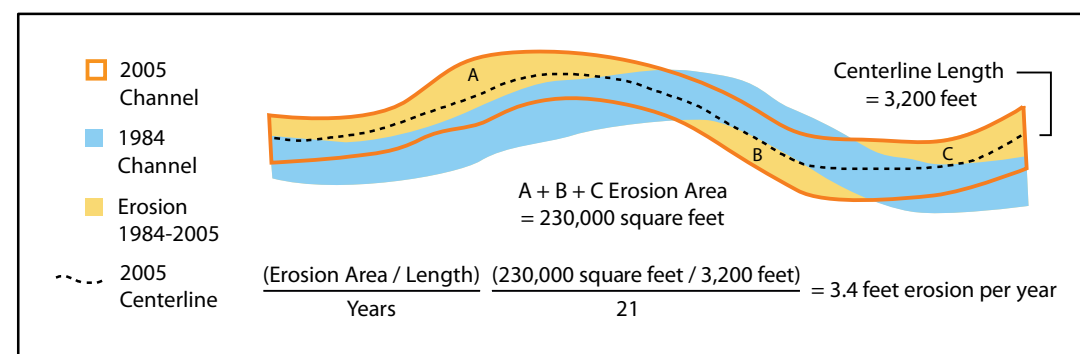


Figure 2. Conceptual graphic of erosion calculation.

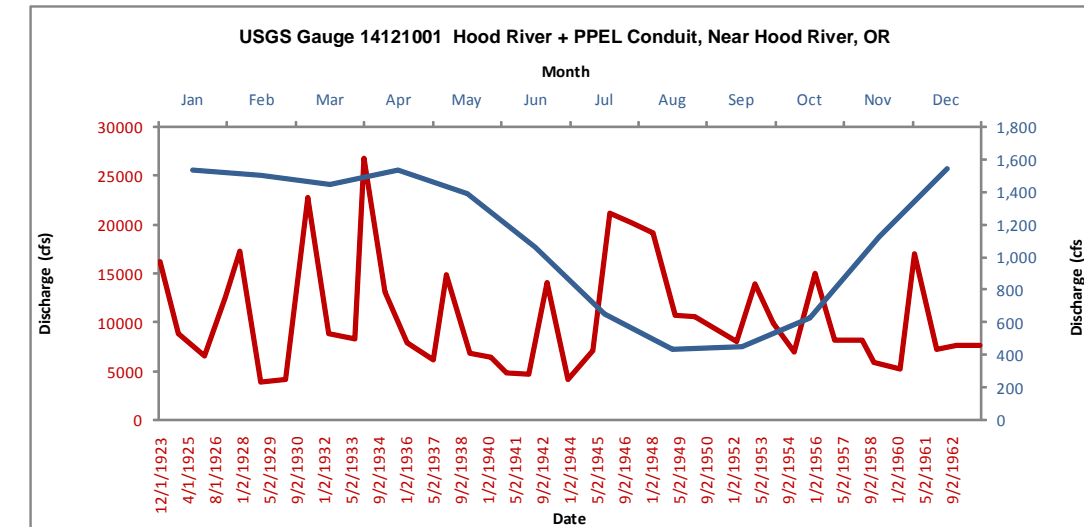


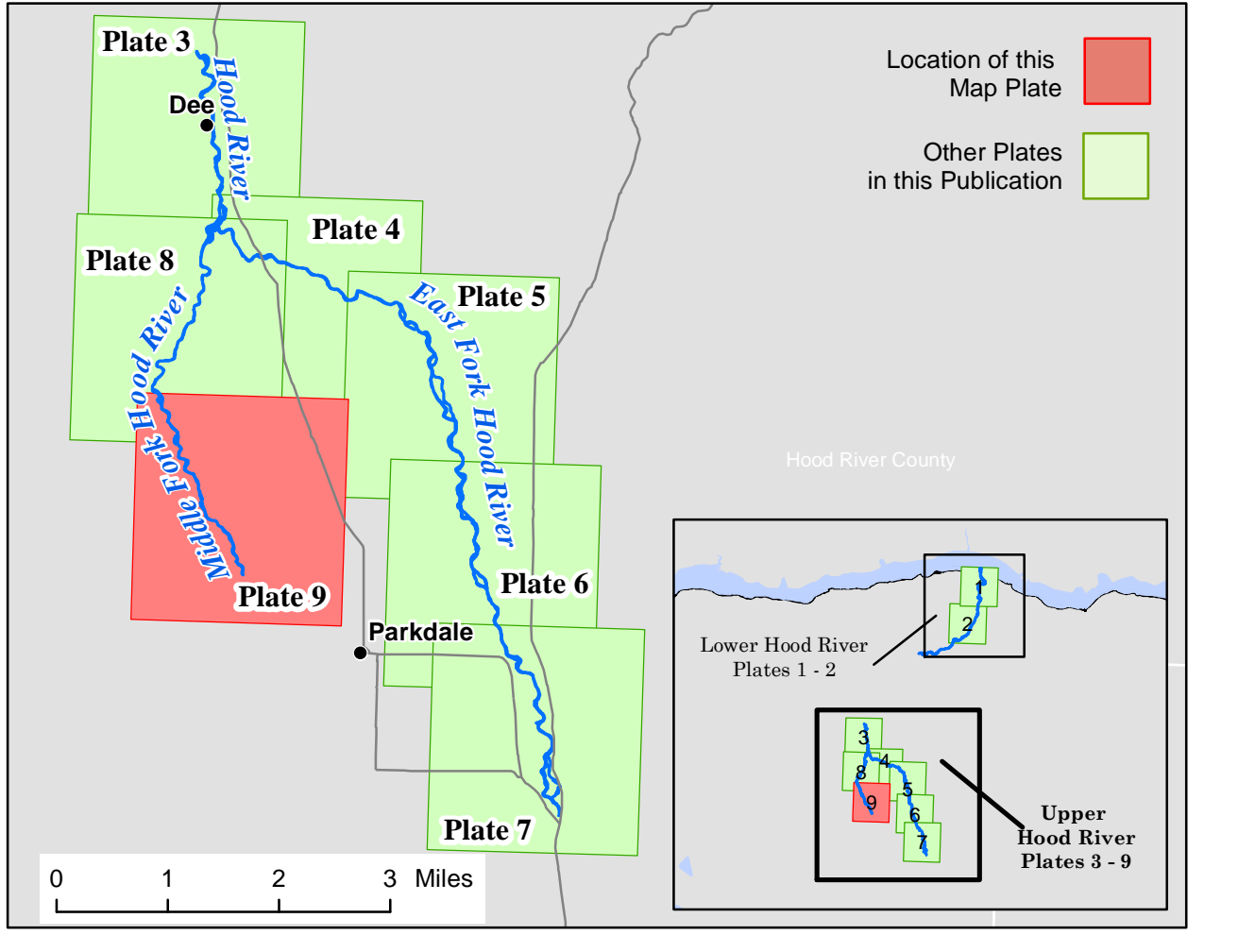
Figure 3. Regional hydrograph for the Hood River, Oregon. This figure depicts historical peak flows (labels and line in blue). The historical flow line displays years in which major flows occurred (e.g., 1933 and 1945), and the annual average monthly flow line depicts seasonal variation in flow typical of a Cascades mountain stream. Flow units are in cubic feet per second (cfs). Although specific values describe flows only at this specific gauge, the shapes and peaks of lines describe the common hydrologic regime of the area.

LEGEND AND DEFINITION OF MAP ELEMENTS

- Channel Migration Zone (CMZ)** – is composed of four subzones within the geologic flood plain (Rapp and Abbe, 2003). These zones include:
 - Historical Migration Zone (HMZ)** – the collective area occupied by the channel during the period 1955 to 2009.
 - Avulsion Hazard Zone (AHZ)** – areas potentially at risk from avulsion (catastrophic development of a new channel or reoccupation of an abandoned channel).
 - Erosion Hazard Area (EHA)** – the area outside the HMZ that is at risk of bank erosion from channel migration during the next 100 years
 - Disconnected Migration Area (DMA)** – the portion of the CMZ where man-made structures physically eliminate channel migration
- Geologic Floodplain** – the area adjacent to a stream or river that has been occupied by and shaped by that river during the past 10,000 to 100,000 years.
- Sandy River Channel (2009)** – the position of the channel in 2009 (shown as a blue zone within the HMZ).
- Elevation Contour** – 100-foot interval contours.
- River Mile** – distance in miles upstream from the river mouth.
- Structural Asset At Risk** – structure that falls within the CMZ.
- Road Asset At Risk** – road that falls within the CMZ.

References:
Abbe, T. B., Clites, P. L., Dalby, C., Locke, B., and Williams, K., 2008, Channel Migration Zonodelineation workshop: interpreting fluvial landscapes: Understanding integration between fluvial geomorphology, hydrology, ecology, sedimentology and hydrology, 5-day short course, Oct. 21-25, 2008, Paradise Valley, Mont.: Estria Environmental Consultants and Northwest Environmental Training Center.
English, J. T., and Coe, D. E., 2011, Channel migration hazard maps, Coos County, Oregon: Oregon Department of Geology and Mineral Industries-Open File Report O-11-05, 18 p.
Rapp, C. F., and Abbe, T. B., 2003, A framework for delineating channel migration zones: Olympia, Wash.: Washington State Department of Ecology Publication 03-06-027, 65 p.
Slingerland, R., and Smith, N. D., 2004, Avulsions and their deposits: Annual Review of Earth and Planetary Sciences, v. 32, p. 257-285.

LOCATION MAP



Acknowledgments:

We thank Ian P. Madin, Chief Scientist, and William J. Barnes, Engineering Geologist, Oregon Department of Geology and Mineral Industries, for their assistance in the review process of this publication.

Software: Esri ArcGIS 10.1, Adobe Creative Suite 5.
Projections: North American Datum 1983, UTM zone 10 north. Grid ticks displayed in latitude and longitude as well as UTM coordinates.
Source data: Lidar data for publication from DOKAMI Lidar Data Quadrangle LIDAR 2010-03-1213-F White Salmon, LIDAR 2010-03-1213-FS Hood River, LIDAR 2010-03-1213-FS Parkdale, LIDAR 2010-03-1213-FS Des. Digital elevation model (DEM) consists of a 3-foot-square elevation grid that was converted into slope and shaded relief images. Orthophotos of Hood River County (1955, 1967, and 1978) are from University of Oregon Map Library and (2005 and 2009) National Agricultural Imagery Program (NAIP).
Disclaimer: This map depicts channel migration zones and associated hazards based on interpretation of aerial photography and lidar elevation data. Migration predictions and hazard areas were created using methods and protocols defined by Rapp and Abbe (2003). This map cannot serve as a substitute for site-specific investigations by qualified practitioners. Site-specific data may yield results that differ from those shown on this map. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or survey purposes. Users of this information should review or consult the primary data and information sources to ascertain the suitability of the information.