

APPENDIX D

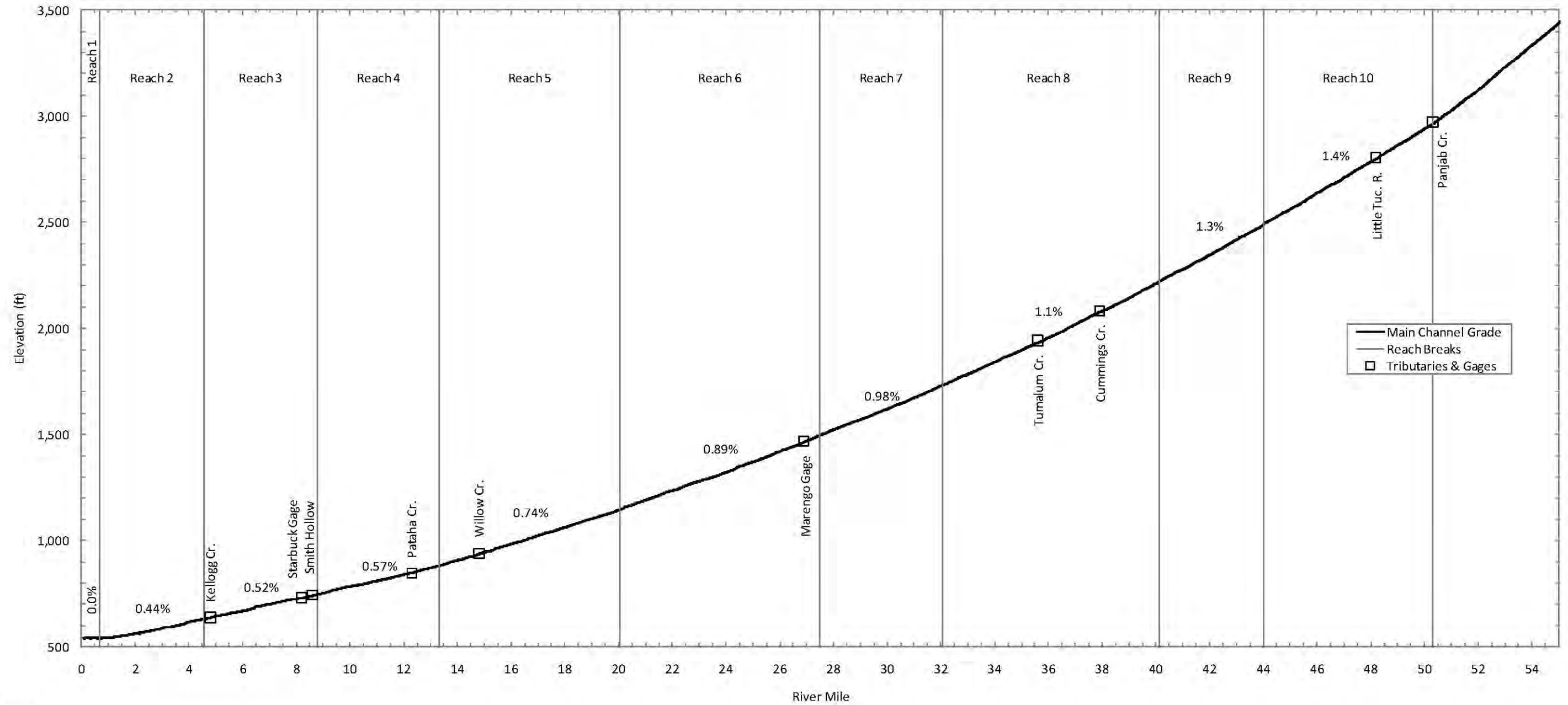
REACH CHARACTERISTICS AND FIGURES

D.1 REACH CHARACTERISTICS AND FIGURES

Reach delineation was based on our site reconnaissance, basin-scale geomorphic analyses, hydraulic model output, sediment mobility results, existing and past river management actions, and hydrography. The following sections describe the analyses performed to estimate characteristics of each reach, including the relative amounts of confinement, valley area, low floodplain, area impacted by human infrastructure, and riparian conditions. Figures D-1a through D-10b display aerial photographs, topographic surfaces, and spatial characteristics and features present within each reach. Spatial analyses were performed in ArcGIS Desktop ArcView 9.3 using the spatial and three-dimensional (3D) analyst extensions. The spatial data sets shown in Table D-1 were used to determine reach characteristics.

D.1.1 Gradient

The average gradient for each reach was calculated by determining the gradient between bare-earth LiDAR elevations at 100-foot intervals along the 2010 mainstem channel alignment. The gradient of the 100-foot intervals were averaged for each reach. The results are presented in Chart D-1 and Table D-2a. The profile of the Tucannon River displays a smooth, concave profile with a steeper gradient near the headwaters that becomes flatter moving closer to the confluence with the Snake River.



Notes:

- 1) Main channel grade elevation based on aerial LiDAR from 2010
- 2) River stationing developed by Anchor QEA (2010) using aerial photography for channel centerline delineation
- 3) For reach information see Section 7 in the main report
- 4) Slope shown for each basin is the average channel slope calculated at 100 ft intervals

Chart D-1
Tucannon River Longitudinal Profile and Reach Extents

D.1.2 Relative Elevation Map

The 2010 bare-earth LiDAR tiles collected by Watershed Sciences (2010) were re-projected and converted to a horizontal datum of Washington State Plane, South Zone (feet) and a vertical datum of North American Vertical Datum (NAVD) 88, feet. The re-projected LiDAR surface was processed using 3D and spatial analyst tools to create a surface relative to the elevation along the 2010 mainstem channel alignment. The elevation values in this surface are converted from actual values to values based on a perpendicular cross-section across the river channel, extending into the floodplain such that the elevations along that line are relative to the elevation of the main channel. The relative elevation map was used for several of the reach characteristic calculations and is shown in the attached figures.

The relative elevation surface is a tool to view relatively high areas and relatively low areas of the floodplain such as side channels, remnant (historic) channel positions, and overbank flow paths. The relative elevation surface also allows us to identify potential disconnected habitats and other opportunities for restoration.

D.1.3 Valley and Low Floodplain Area

From the relative elevation surface, a GIS polygon was created that represented the extent of the surface that was less or equal to 40 feet relative elevation to the main channel. This area was assumed to encompass the Tucannon River valley bottom. Another polygon was created that represented the area of the valley surface that was less or equal to 5 feet in relative elevation to the main channel. This area generally included the lowest areas of the active channel and vegetated floodplain; this was assumed to be the “low” floodplain. The low floodplain is the area that is most frequently connected to the river during flood events. In the Tucannon basin, the low floodplain is typically inundated from the 5- to 10-year flood event. In a majority of the valley, the low floodplain is covered with riparian vegetation. From the calculated low floodplain area, we also determined the amount of low floodplain in each reach per river mile. The area of the valley, low floodplain, acres of low floodplain per river mile, and the percent low floodplain within each reach are shown in Table D-2a.

D.1.4 Percent Confinement

Confining features including levees, road grades, apparent dredge spoils, and other human features were digitized in ArcGIS. Bare-earth LiDAR topography, geologic mapping, and field investigation were used to identify naturally confining features such as alluvial fans and bedrock. Using this information, along with observation of historic channel positions and 2010 aerial imagery, the floodplain was delineated into confined, moderately confined, and unconfined zones that are represented by georeferenced polygon shapefiles in ArcGIS. Confined areas are typically locations of the channel with a narrow floodplain restricted by human features or bedrock, while unconfined areas are typically areas with wide floodplain corridors and an unrestricted channel that is able to migrate freely across the floodplain. Depositional areas, typically associated with unconfined and moderately confined areas, were also identified and mapped from observation of aerial photos and observations in the field.

To determine percent confinement within each reach, a GIS polyline representing the 2010 main channel alignment was segmented by the relative confinement polygons. The lengths of each segment were calculated and compared the total length of the mainstem channel to estimate the percent of the channel length that is confined, moderately confined, and unconfined in each reach. The results of these calculations are presented in Table D-2a and summarized in Chart D-2.

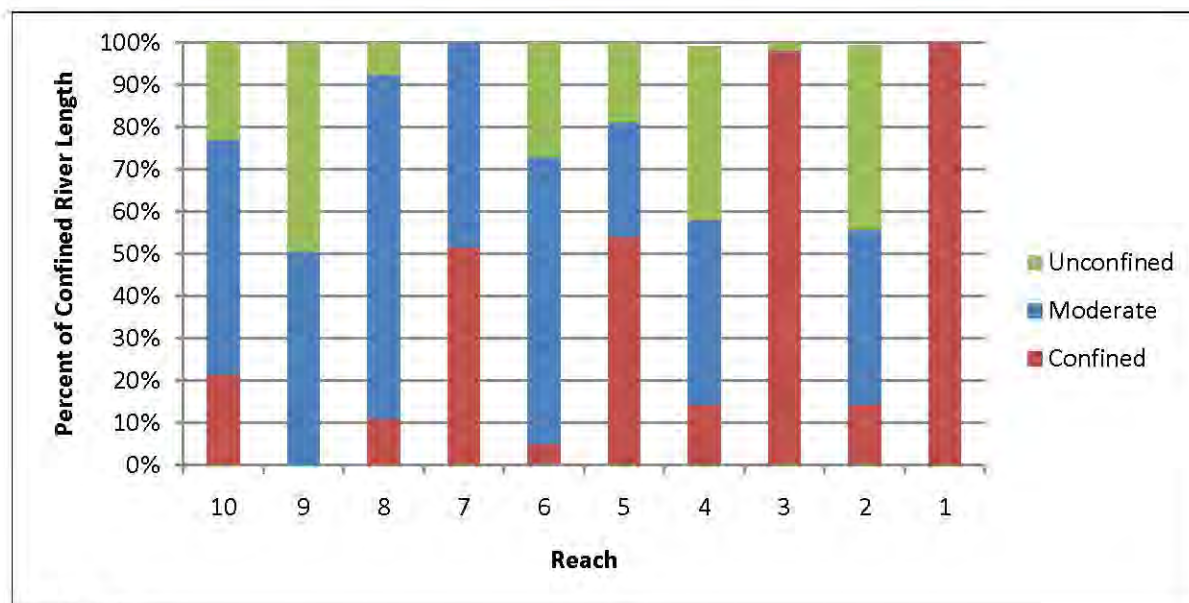


Chart D-2
Percent of Relative Confinement Areas

D.1.5 Percent of Disconnected Low Floodplain

The GIS polyline representing the 2010 main channel alignment was visually segmented where levees or other human features physically separated the main channel from relatively low features of the floodplain. For example, a length of the channel where a levee cuts off the main channel from a remnant meander bend is classified as “disconnected.” The lengths of each segment were calculated and compared the total length of the mainstem channel to estimate the percent of the channel length that is disconnected from the low floodplain by human features (Table D-2b). **The disconnected segments do not include areas where the valley has been graded out and the river channelized against the edge of the valley, or areas where valley bottom is primarily occupied by a man-made lake. The disconnected segments also do not include smaller levees, berms, or side-cast dredge materials that appear to impede channel migration but do allow floodwaters to overtop the banks.** Although these areas have been greatly impacted by anthropogenic activities, they typically do not include opportunities for restoration.

The percent of disconnected channel length was then multiplied by the low floodplain area per river mile. The result of this calculation is a relative number in acres per mile that

represents the amount of disconnected low floodplain that may potentially be re-connected. Chart D-3 compares the percent of disconnected low floodplain (red bar) within each reach to the acres per mile of disconnected low floodplain (green line).

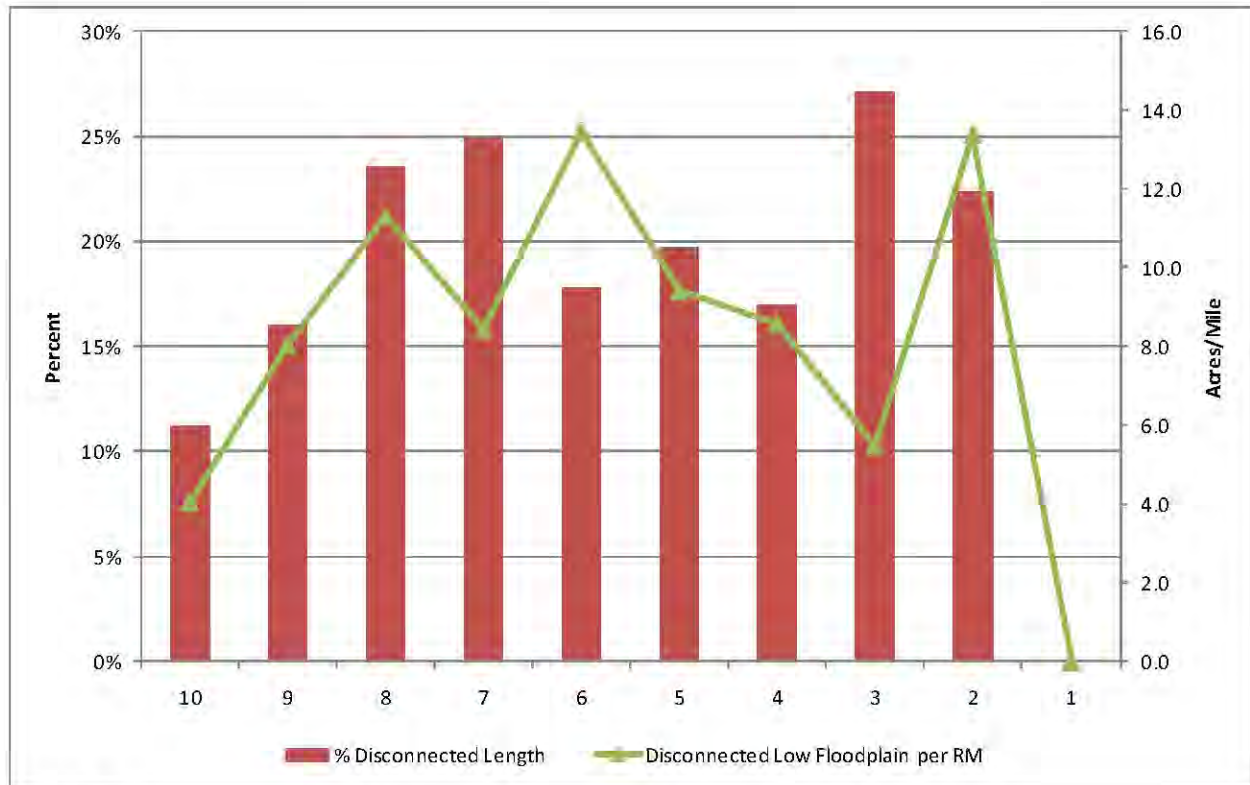


Chart D-3

Percent of the Disconnected Channel Length versus Percent Low Floodplain

D.1.6 Riparian Characteristics

Forest canopy density and height were estimated within the low floodplain areas (areas within 5 feet in elevation relative to the river) for each reach. These areas are typically vegetated and have more frequent connectivity with the channel than the valley area (within 40 feet relative elevation), and were therefore assumed to be representative of the riparian zone. The methodology presented by Crawford (2010) was followed to perform this spatial analysis. LAS (LiDAR point cloud files) points containing the highest hit elevation (i.e., canopy surface) were compared to the total number of LiDAR hits within a specific grid cell size to determine density. The highest hit points were then compared to the bare-earth

LiDAR surface to determine canopy heights. These results are provided in Table D-3a and D-3b, and Chart D-4 summarizes the relative canopy heights. The areas where highest hit points were not provided were assumed to have low-lying vegetation or no vegetation (less than 5 feet) such as road surfaces, grain crops, and grazing pastures. The percent of low floodplain covered with vegetation at least 5 feet in height (black line) is also shown on Chart D-4 for reference.

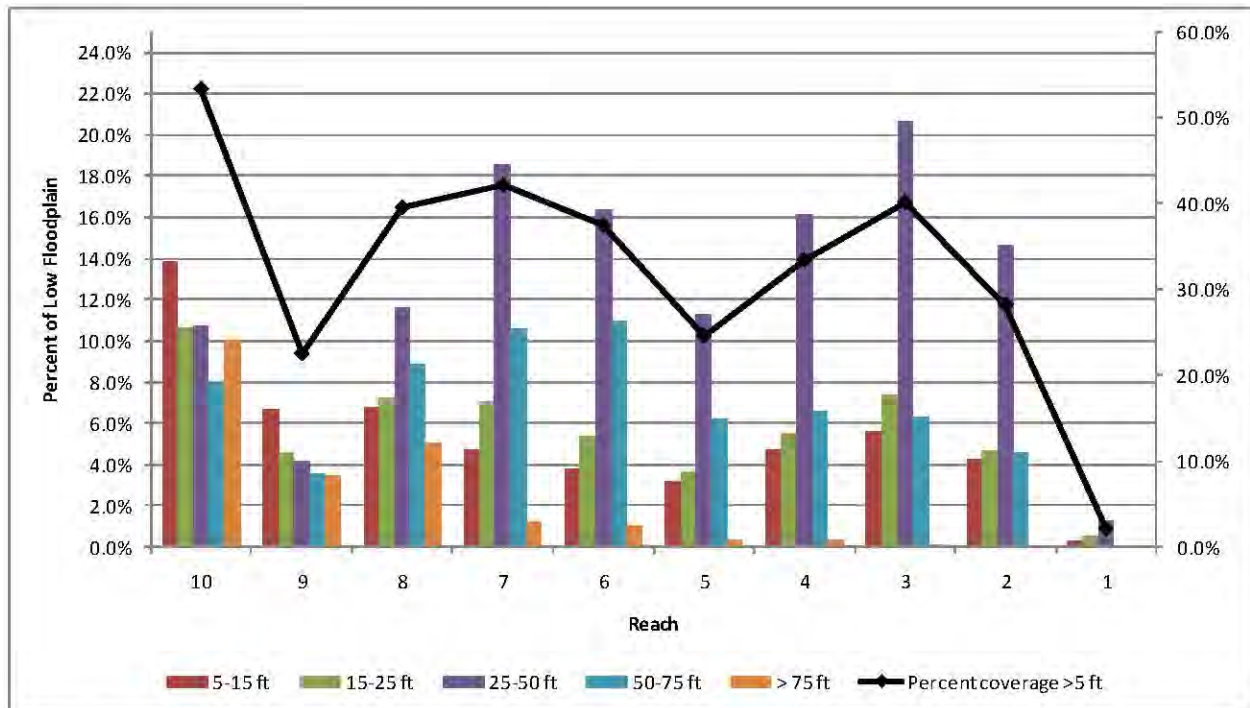


Chart D-4
Percent of Low Floodplain Covered by Canopy Height Categories by Reach

D.2 REFERENCES

Crawford, C. 2010. LiDAR Solutions in ArcGIS. Presentation at the ESRI International User Conference; Technical Workshops.

<http://proceedings.esri.com/dvd/uc/2010/uc-index/uc/workshops/tw_604.pdf>

USGS (U.S. Geological Survey). 2010. Streamstats in Washington.

<<http://water.usgs.gov/osw/streamstats/Washington.html>>

Watershed Sciences. 2010. LiDAR Remote Sensing Data Collection: Tucannon River, Tucannon Headwaters, and Cummings Creek, WA. Prepared for Columbia Conservation District, City of Dayton, CTUIR, and USFS Pomeroy Ranger District.

APPENDIX D

TABLES

Table D-1
Spatial Data Sources Used to Determine Reach Characteristics

Data	Type	Source
2010 LiDAR bare-earth coverage	Raster GRID	Columbia Conservation District (Watershed Sciences 2010)
2010 LiDAR highest hit	LAS (point) files	
2010 orthophotography	Raster (TIFF)	
Drainage basin areas	Polygon	Streamstats (USGS 2010)

Table D-2a
Summary of Reach Characteristics

Reach	River Mile		Length (mi)	Average Gradient (%) ^a	Approx. Drainage Area at Downstream End (mi ²) ^b	Major Tributaries	Valley Area (acres) ^c	Low Floodplain Area (acres) ^d	Percent Low Floodplain	Low Floodplain per River Mile (acres/mi)
	From	To								
10	50.2	44.0	6.2	1.40	87	Little Tucannon River, Panjab Creek	478	224	47%	36.1
9	44.0	40.0	4.0	1.30	95	None	417	201	48%	50.2
8	40.0	32.1	7.9	1.10	144	Tumalum Creek, Cummings Creek	987	379	38%	48.0
7	32.1	27.5	4.6	0.98	159	None	580	156	27%	33.9
6	27.5	20.0	7.5	0.89	178	None	1173	567	48%	75.6
5	20.0	13.2	6.8	0.74	220	Willow Creek	943	325	34%	47.7
4	13.2	8.9	4.3	0.57	410	Pataha Creek	608	217	36%	50.5
3	8.9	4.5	4.4	0.52	490	Kellogg Creek, Smith Hollow	693	89	13%	20.3
2	4.5	0.7	3.8	0.44	503	None	561	227	41%	59.8
1	0.7	0.0	0.7	0.00	503	None	81.4	59 ^h	72%	83.9 ^g

Table D-2b
Summary of Reach Characteristics

Reach	River Mile		Length (mi)	Degree of Confinement, Length (mi) ^e			Degree of Confinement (%)			Disconnected Low Floodplain by River Length (%) ^f		Disconnected Low Floodplain per River Mile (acres/mi) ^h
	From	To		Confined	Moderate	Unconfined	Confined	Moderate	Unconfined	Disconnected	Open	
10	50.2	44.0	6.2	1.5	4.7	0.0	24%	76%	0%	11.2%	88.8%	4.0
9	44.0	40.0	4.0	0	2.0	2.0	0%	51%	50%	16.0%	84.0%	8.0
8	40.0	32.1	7.9	0.9	6.4	0.6	11%	82%	8%	23.5%	76.5%	11.3
7	32.1	27.5	4.6	2.4	2.2	0.0	52%	48%	0%	24.9%	75.1%	8.4
6	27.5	20.0	7.5	0.4	5.1	2.1	5%	68%	28%	17.8%	82.2%	13.5
5	20.0	13.2	6.8	3.7	1.8	1.3	54%	27%	19%	19.7%	80.3%	9.4
4	13.2	8.9	4.3	0.6	1.9	1.8	14%	44%	41%	17.0%	83.0%	8.6
3	8.9	4.5	4.4	4.3	0.0	0.1	98%	0%	3%	27.1%	72.9%	5.5
2	4.5	0.7	3.8	0.5	1.6	1.7	14%	42%	44%	22.3%	77.7%	13.4
1	0.7	0.0	0.7	0.7	0.0	0.0	100%	0%	0%	0.0%	100.0% ^g	0.0

Notes:

- Average gradient calculated from 2010 LiDAR topography.
- Drainage area calculated from USGS Streamstats (2011).
- The area of the reach that is less or equal to 40 feet in elevation relative to the channel, based on relative elevation maps created from 2010 LiDAR.
- The area of the reach that is less or equal to 5 feet in elevation relative to the channel, based on relative elevation maps created from 2010 LiDAR.
- The length the river alignment in the reach that falls within each confinement category.
- Value is approximate and was estimated visually. "Open" includes areas where the floodplain has been graded out and the river channelized against one area of the valley.
- Reach 1 is a highly modified reach; this metric is not necessarily applicable to assessing conditions in this reach.
- The product of low floodplain per river mile and percent disconnected length.

Table D-3a
Riparian Height Calculations by Reach

Reach	River Mile		Length (mi)	Low Floodplain Area (acres) ^a	Height Class (acres)						Height Class (% of Valley)					
	To	From			0-5 ft ^c	5-15 ft	15-25 ft	25-50 ft	50-75 ft	> 75 ft	0-5 ft ^c	5-15 ft	15-25 ft	25-50 ft	50-75 ft	> 75 ft
10	55.0	44.0	11.0	704.3	104.6	31.0	23.8	24.0	17.9	22.4	46.7%	13.9%	10.6%	10.7%	8.0%	10.0%
9	44.0	40.0	4.0	416.6	155.6	13.4	9.2	8.4	7.1	7.0	77.5%	6.7%	4.6%	4.2%	3.5%	3.5%
8	40.0	32.1	7.9	987.1	229.2	25.6	27.2	44.0	33.6	19.2	60.5%	6.8%	7.2%	11.6%	8.9%	5.1%
7	32.1	27.5	4.6	580.2	90.2	7.4	11.0	28.9	16.5	1.9	57.9%	4.7%	7.1%	18.5%	10.6%	1.2%
6	27.5	20.0	7.5	1172.8	354.5	21.5	30.2	92.6	62.0	5.9	62.6%	3.8%	5.3%	16.3%	10.9%	1.0%
5	20.0	13.2	6.8	943.3	244.9	10.3	11.7	36.7	20.1	1.1	75.4%	3.2%	3.6%	11.3%	6.2%	0.3%
4	13.2	8.9	4.3	607.9	144.8	10.3	12.0	35.1	14.4	0.8	66.6%	4.7%	5.5%	16.1%	6.6%	0.4%
3	8.9	4.5	4.4	692.7	53.5	5.0	6.6	18.5	5.6	0.1	59.9%	5.6%	7.4%	20.7%	6.3%	0.1%
2	4.5	0.7	3.8	561.3	163.2	9.7	10.6	33.3	10.4	0.1	71.8%	4.3%	4.7%	14.6%	4.6%	0.0%
1	0.7	0.0	0.7	81.4	57.5	0.2	0.3	0.8	0.0	0.0	97.9%	0.3%	0.5%	1.3%	0.0%	0.0%

Table D-3b
Riparian Density Calculations by Reach

Reach	River Mile		Length (mi)	Low Floodplain Area (acres) ^a	Relative Density of Vegetation by Area (acres) ^b					Relative Density of Vegetation (% of Valley) ^b					Percent Coverage Greater Than 5 feet Height
	To	From			0.0-0.2	0.2-0.4	0.4-0.6	0.6-0.8	0.8-1.0	0.0-0.2	0.2-0.4	0.4-0.6	0.6-0.8	0.8-1.0	
10	55.0	44.0	11.0	704.3	79.4	6.5	0.6	10.8	22.0	35.5%	2.9%	0.3%	4.8%	9.8%	53.3%
9	44.0	40.0	4.0	416.6	40.6	4.3	0.3	0.0	0.0	20.2%	2.1%	0.2%	0.0%	0.0%	22.5%
8	40.0	32.1	7.9	987.1	123.3	25.4	0.8	0.2	0.1	32.5%	6.7%	0.2%	0.0%	0.0%	39.5%
7	32.1	27.5	4.6	580.2	57.6	7.9	0.2	0.0	0.0	37.0%	5.0%	0.1%	0.0%	0.0%	42.1%
6	27.5	20.0	7.5	1172.8	202.5	9.4	0.3	0.0	0.0	35.7%	1.7%	0.0%	0.0%	0.0%	37.4%
5	20.0	13.2	6.8	943.3	76.9	2.8	0.2	0.0	0.1	23.7%	0.9%	0.0%	0.0%	0.0%	24.6%
4	13.2	8.9	4.3	607.9	70.1	2.2	0.2	0.0	0.1	32.3%	1.0%	0.1%	0.0%	0.0%	33.4%
3	8.9	4.5	4.4	692.7	34.7	1.0	0.0	0.0	0.0	38.9%	1.2%	0.0%	0.0%	0.0%	40.1%
2	4.5	0.7	3.8	561.3	62.3	1.6	0.2	0.1	0.0	27.4%	0.7%	0.1%	0.0%	0.0%	28.2%
1	0.7	0.0	0.7	81.4	1.2	0.1	0.0	0.0	0.0	2.0%	0.1%	0.0%	0.0%	0.0%	2.1%

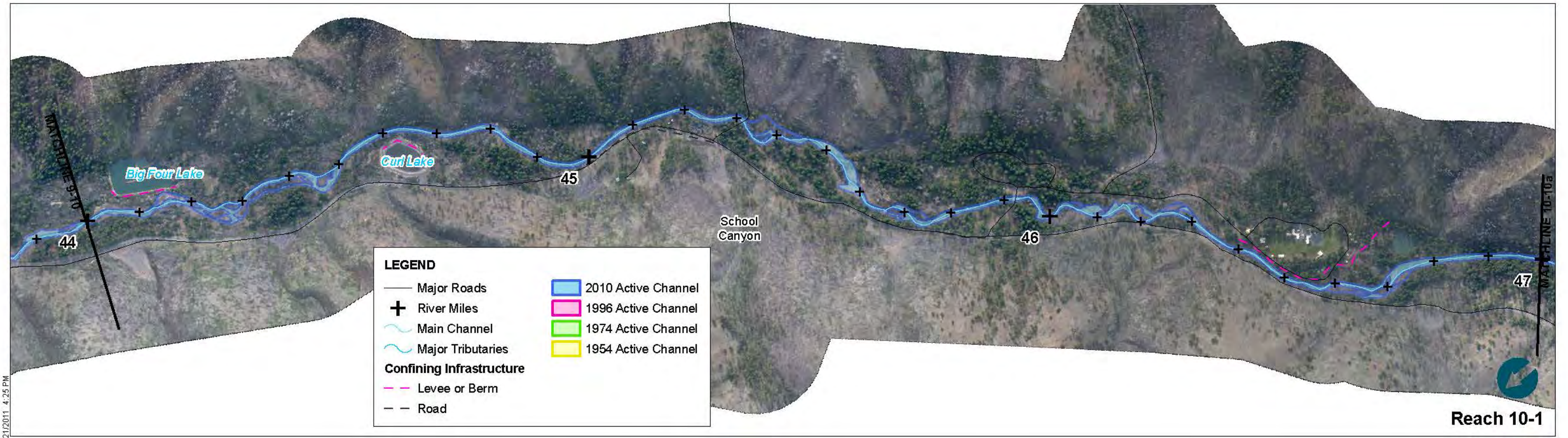
Notes:

- a. The area of the reach that is less than or equal to 40 feet in elevation relative to the channel, based on relative elevation maps created from 2010 LiDAR.
b. Areas of vegetation less than 5 feet tall were excluded from the density data set; does not account for areas with highest hit values equal or close to bare earth.
c. Cells without a highest hit return were assumed to be close to zero and have been added to the 0 to 5-foot category.

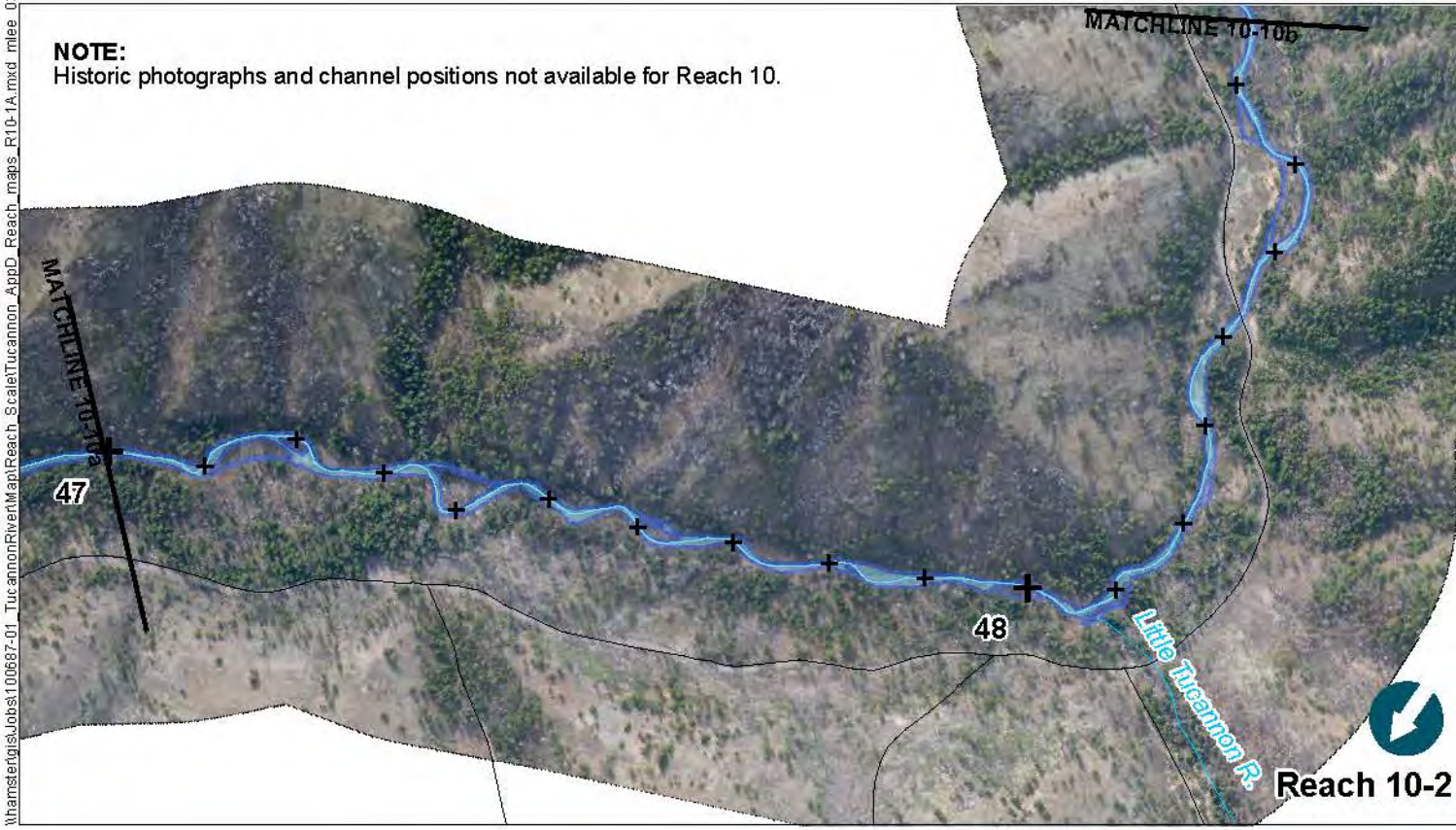
APPENDIX D

FIGURES

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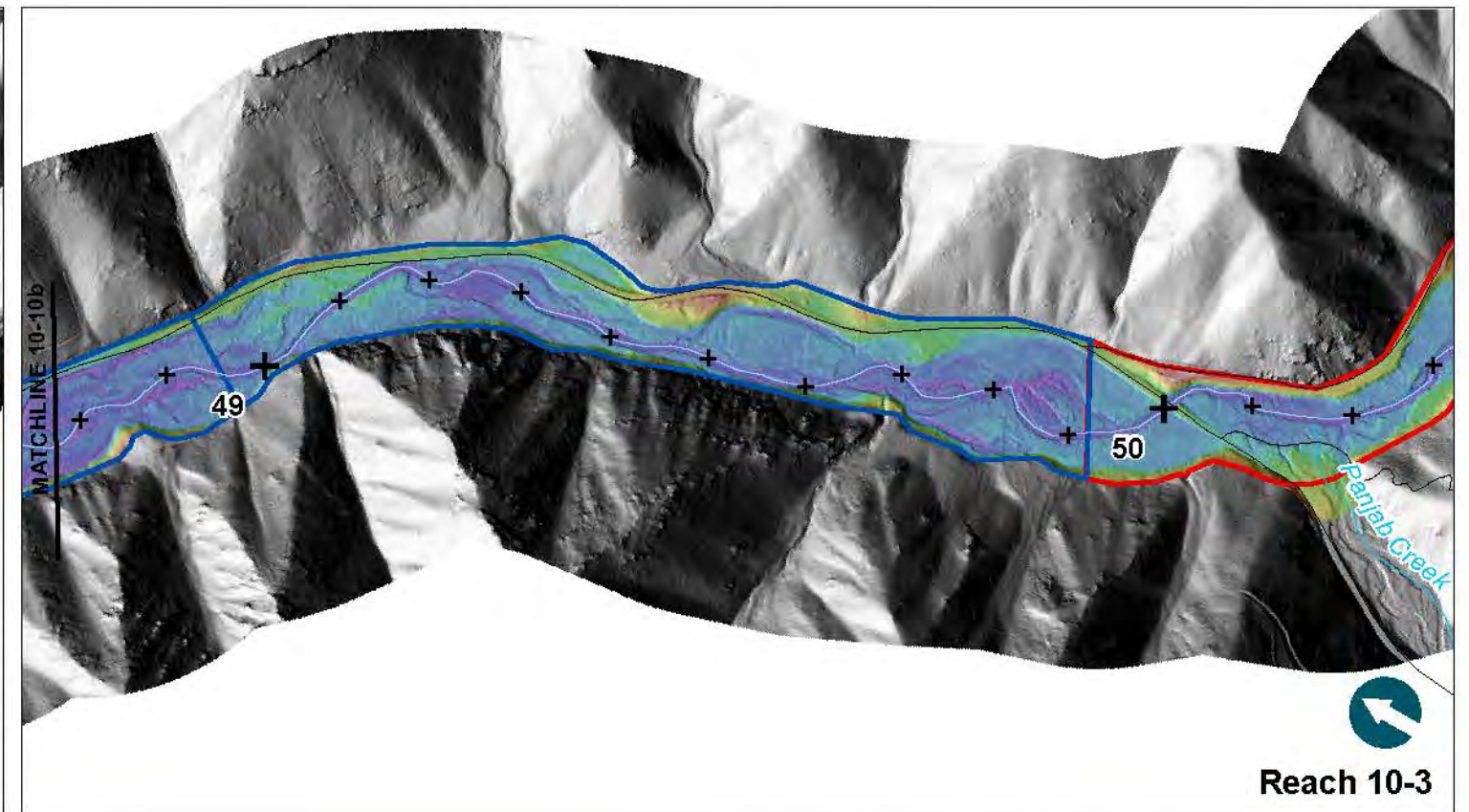
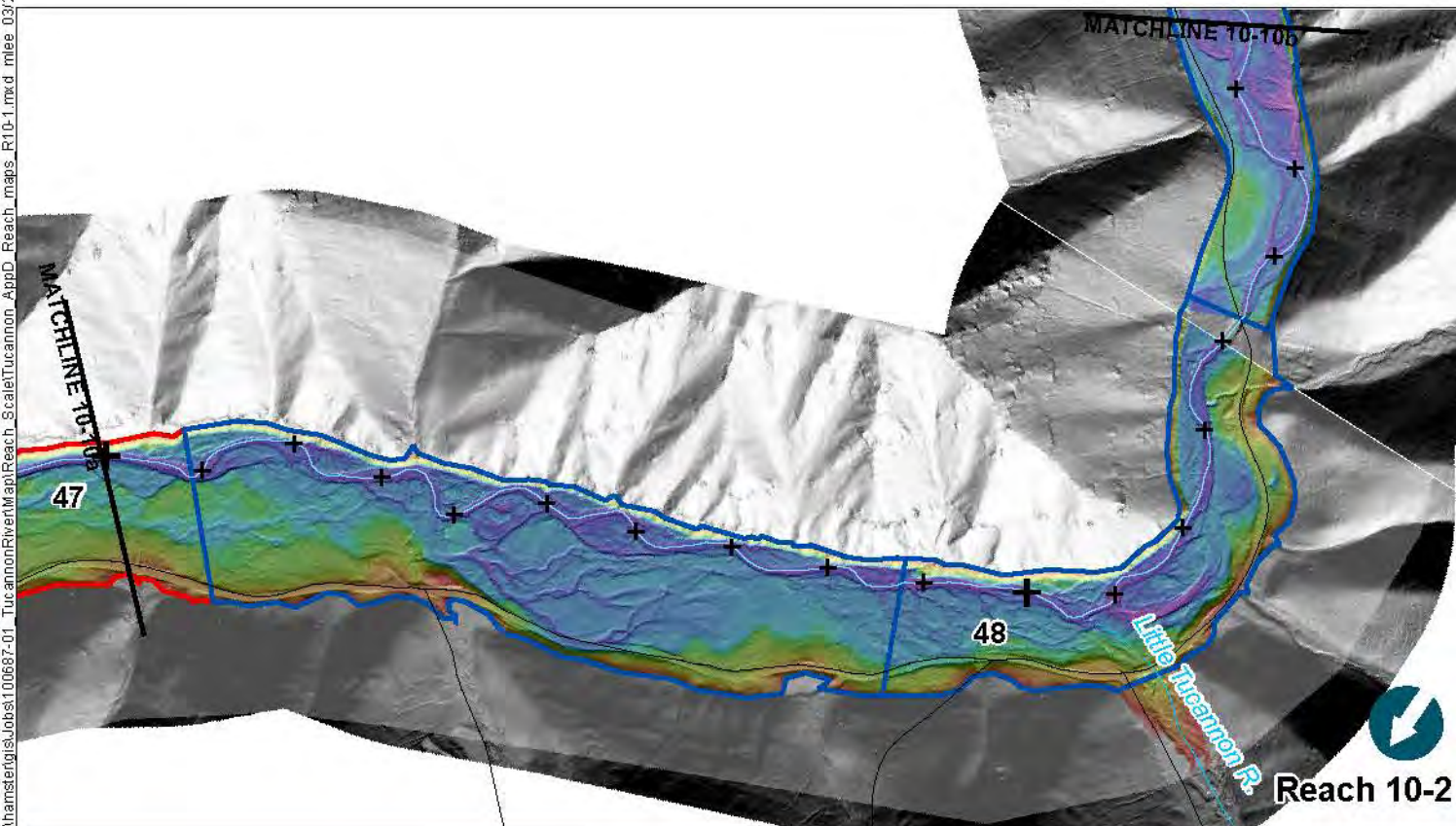
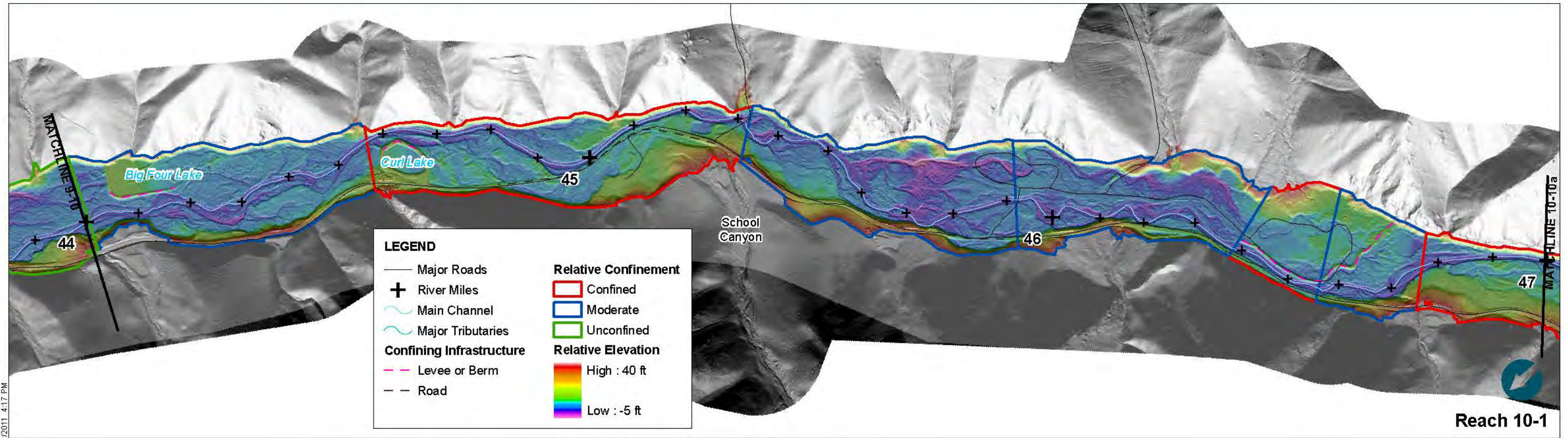
NOTE:
Historic photographs and channel positions not available for Reach 10.



NOTES:
2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.



Figure D-10a
Reach 10 Current Aerial Photo and Historic Active Channel Positions
Tucannon River Geomorphic Assessment and Habitat Restoration Study
Columbia Conservation District



NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

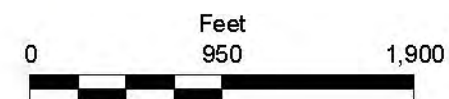
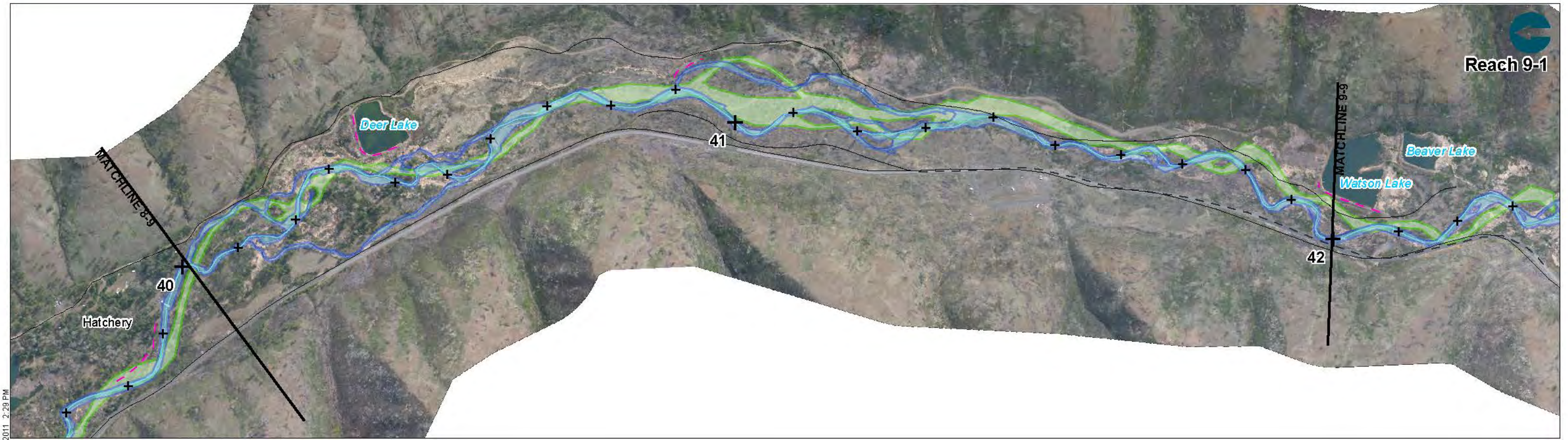


Figure D-10b
 Reach 10 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



LEGEND

- Major Roads
- + River Miles
- Main Channel
- Major Tributaries
- Confining Infrastructure
 - - Levee or Berm
 - - Road
- 2010 Active Channel
- 1996 Active Channel
- 1974 Active Channel
- 1954 Active Channel

NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

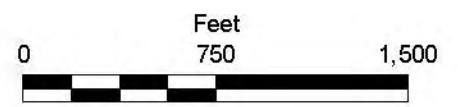
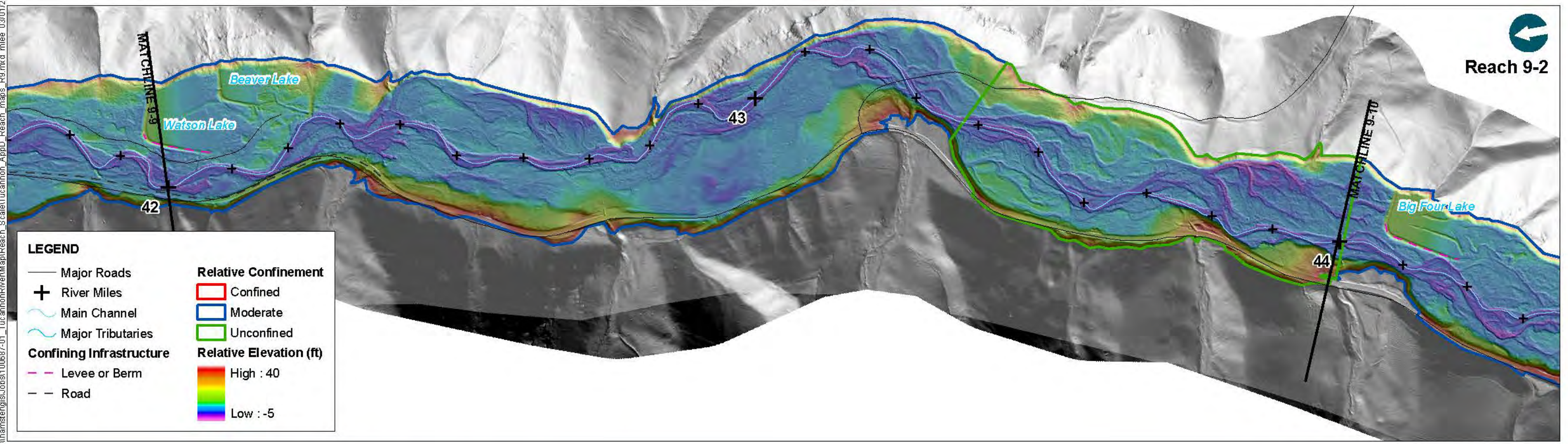
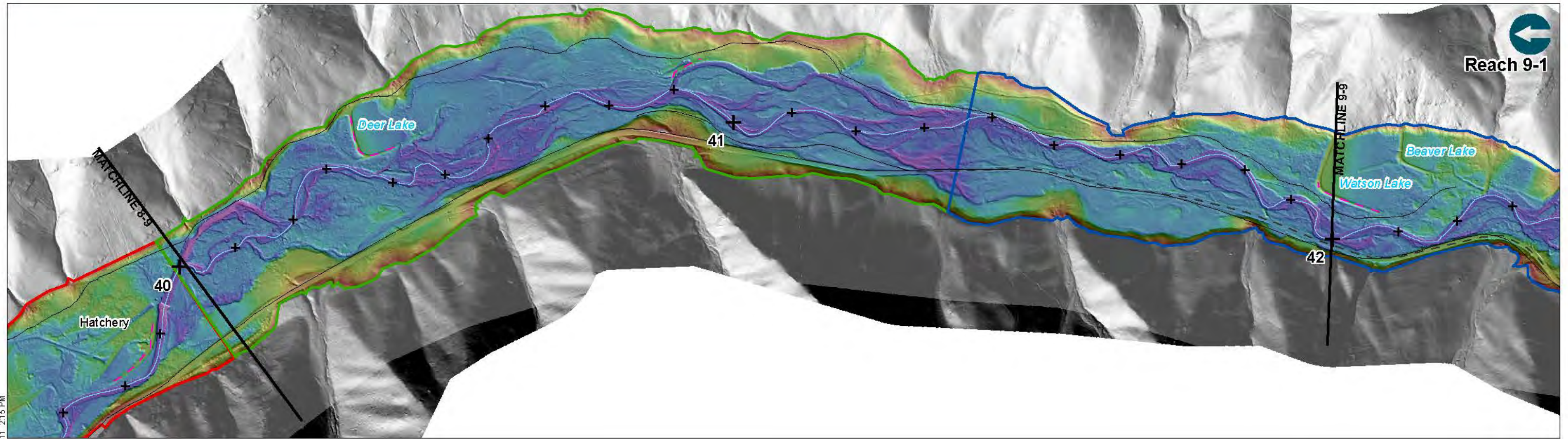


Figure D-9a
 Reach 9 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District

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LEGEND

— Major Roads	Relative Confinement
+ River Miles	▭ Confined
— Main Channel	▭ Moderate
— Major Tributaries	▭ Unconfined
Confining Infrastructure	Relative Elevation (ft)
- - Levee or Berm	High : 40
- - Road	Low : -5

NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

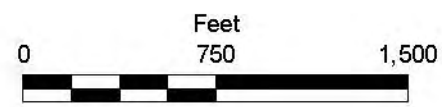
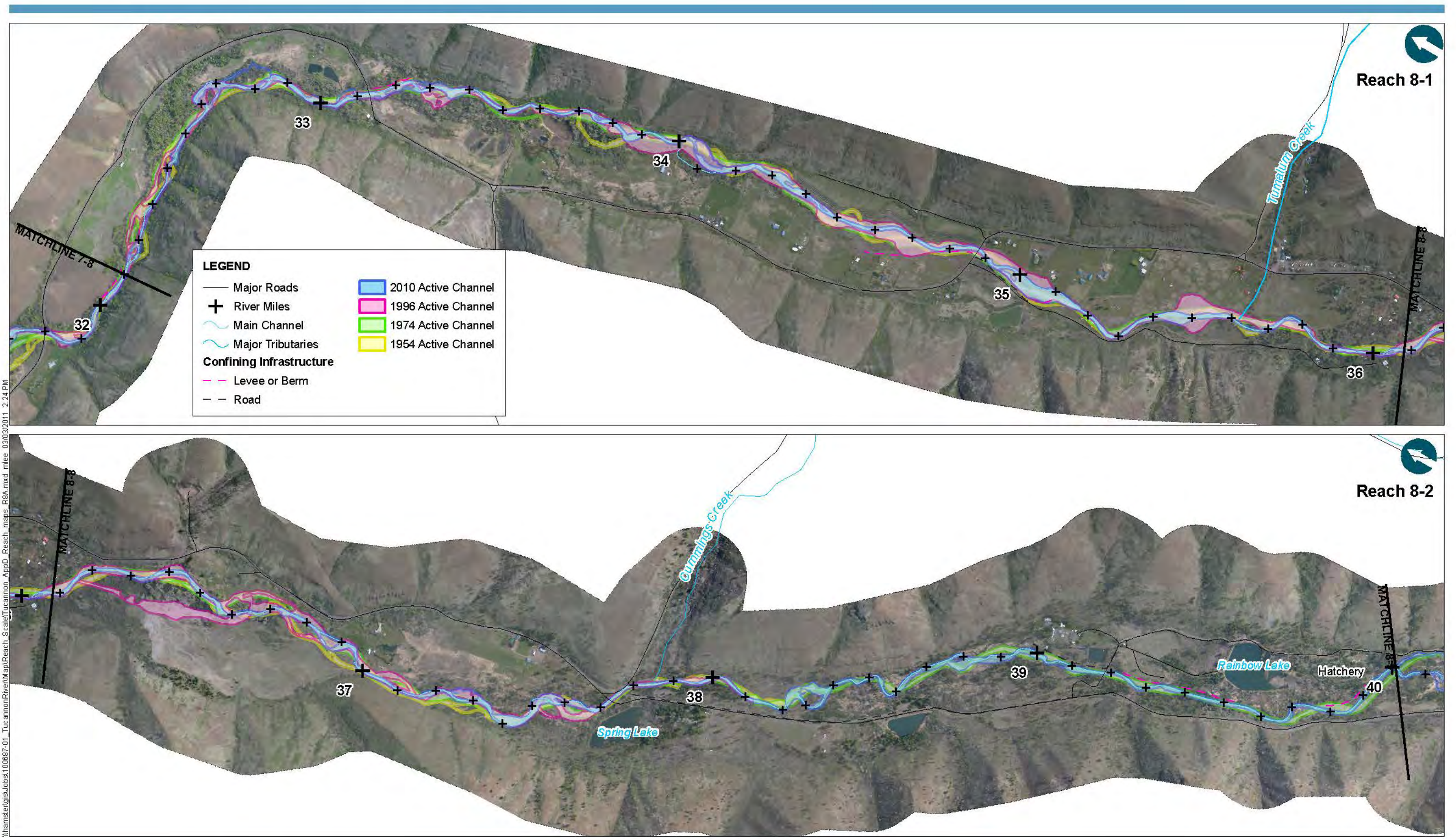


Figure D-9b
 Reach 9 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



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NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

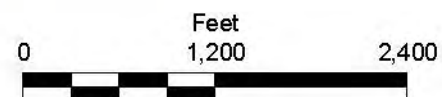
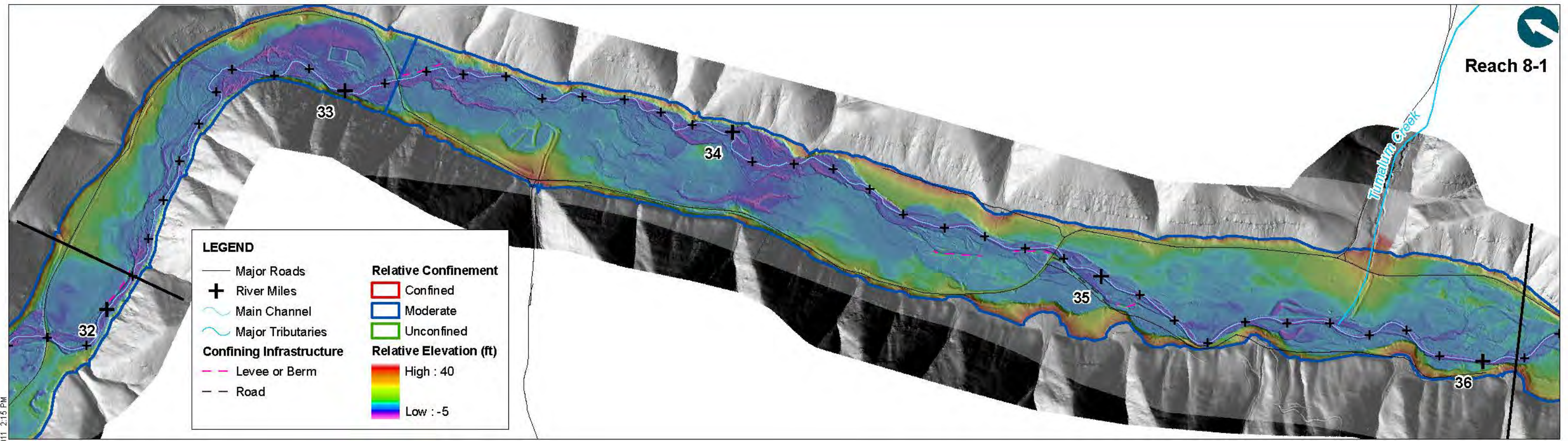
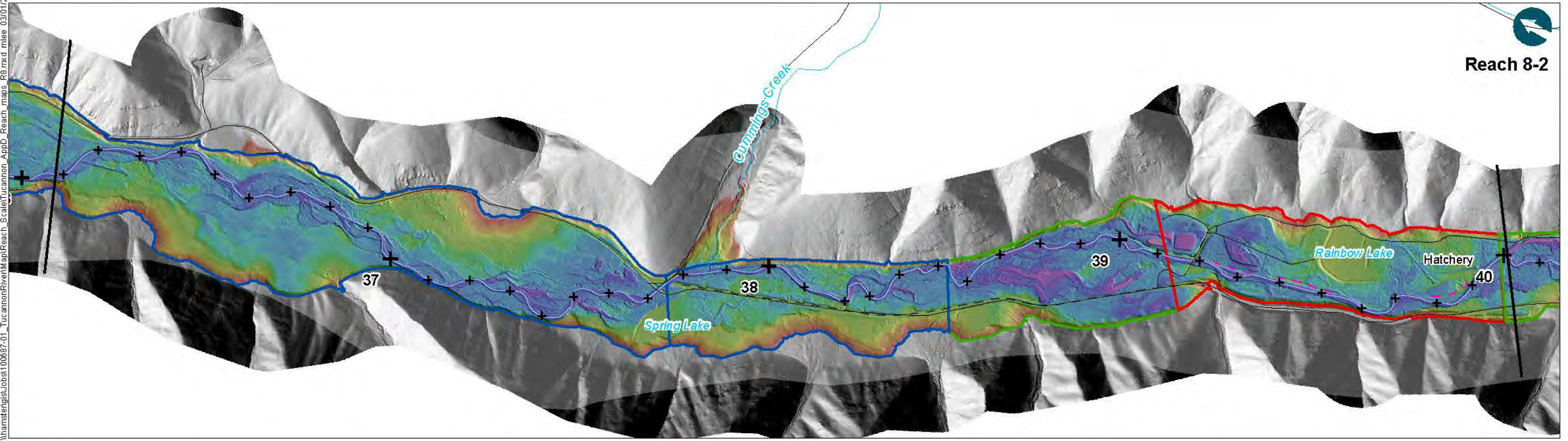


Figure D-8a
 Reach 8 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District

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Reach 8-1



Reach 8-2

NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

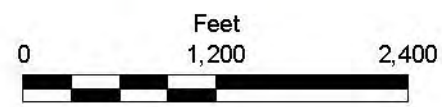
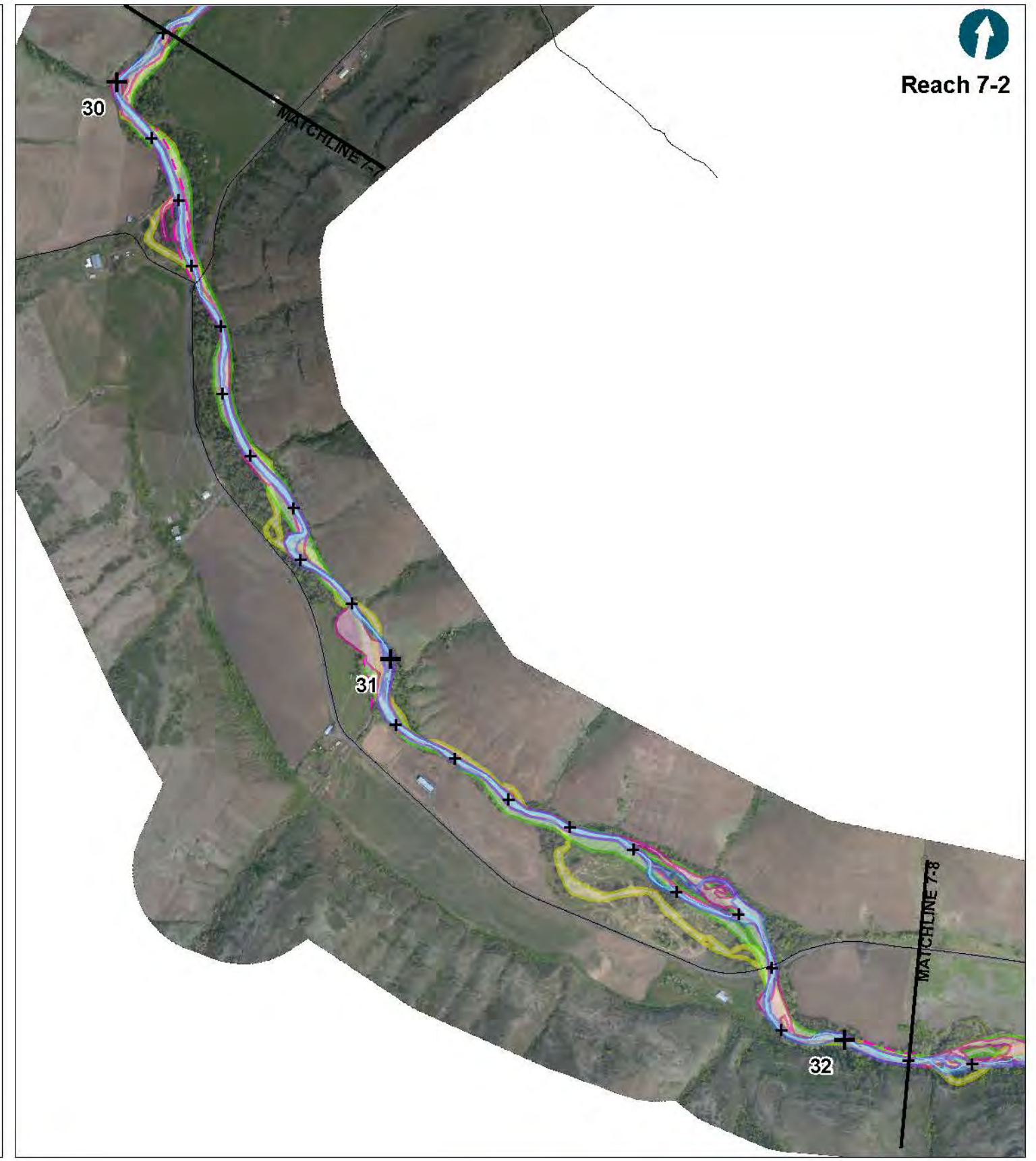
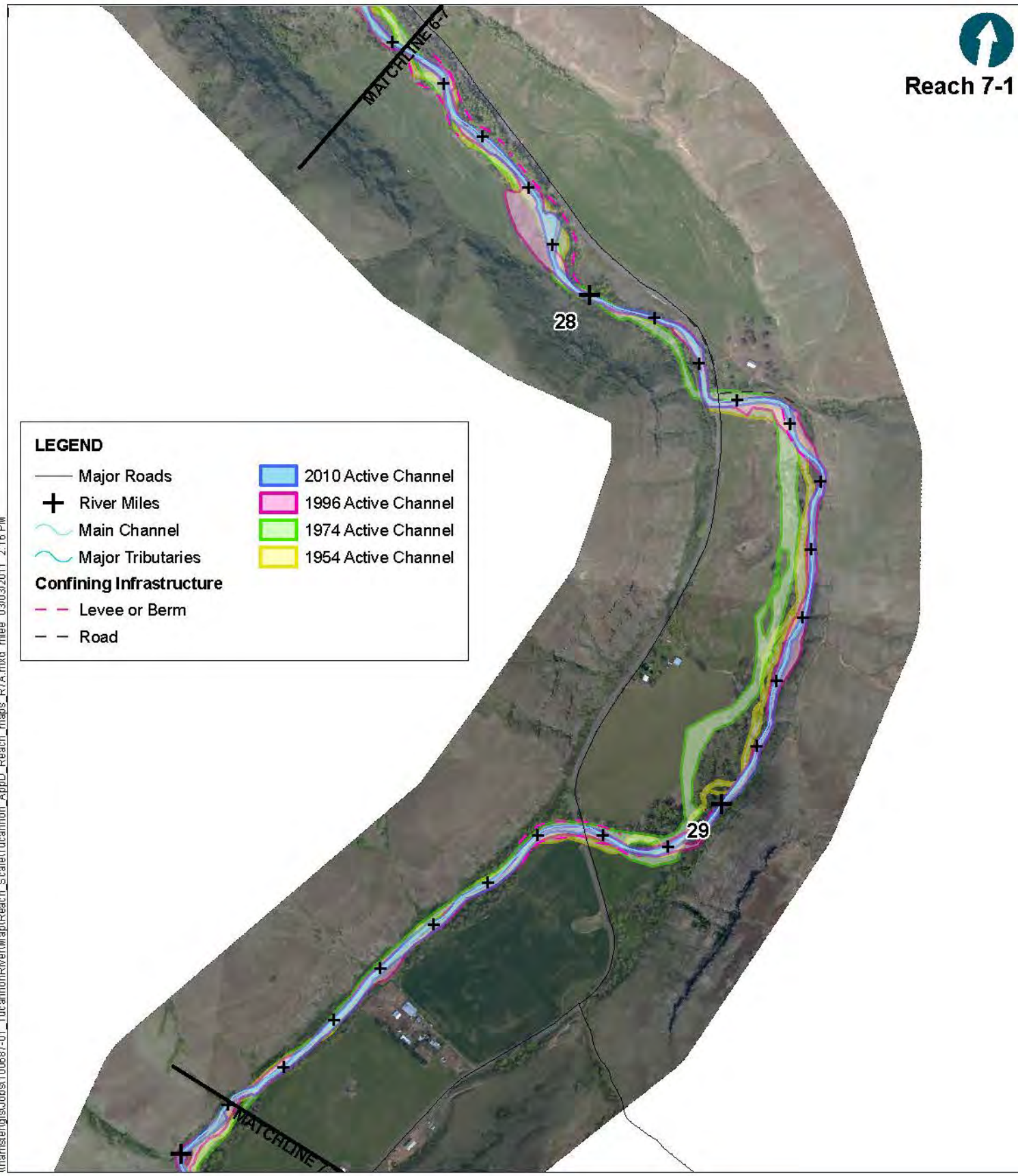


Figure D-8b
 Reach 8 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District

NhamstergisJobs100687-01_TucannonRiverMap\Reach_Scale\Tucannon_AppD_Reach_maps_R7A.mxd mlee 03/03/2011 2:16 PM



NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

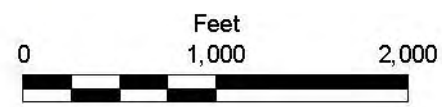
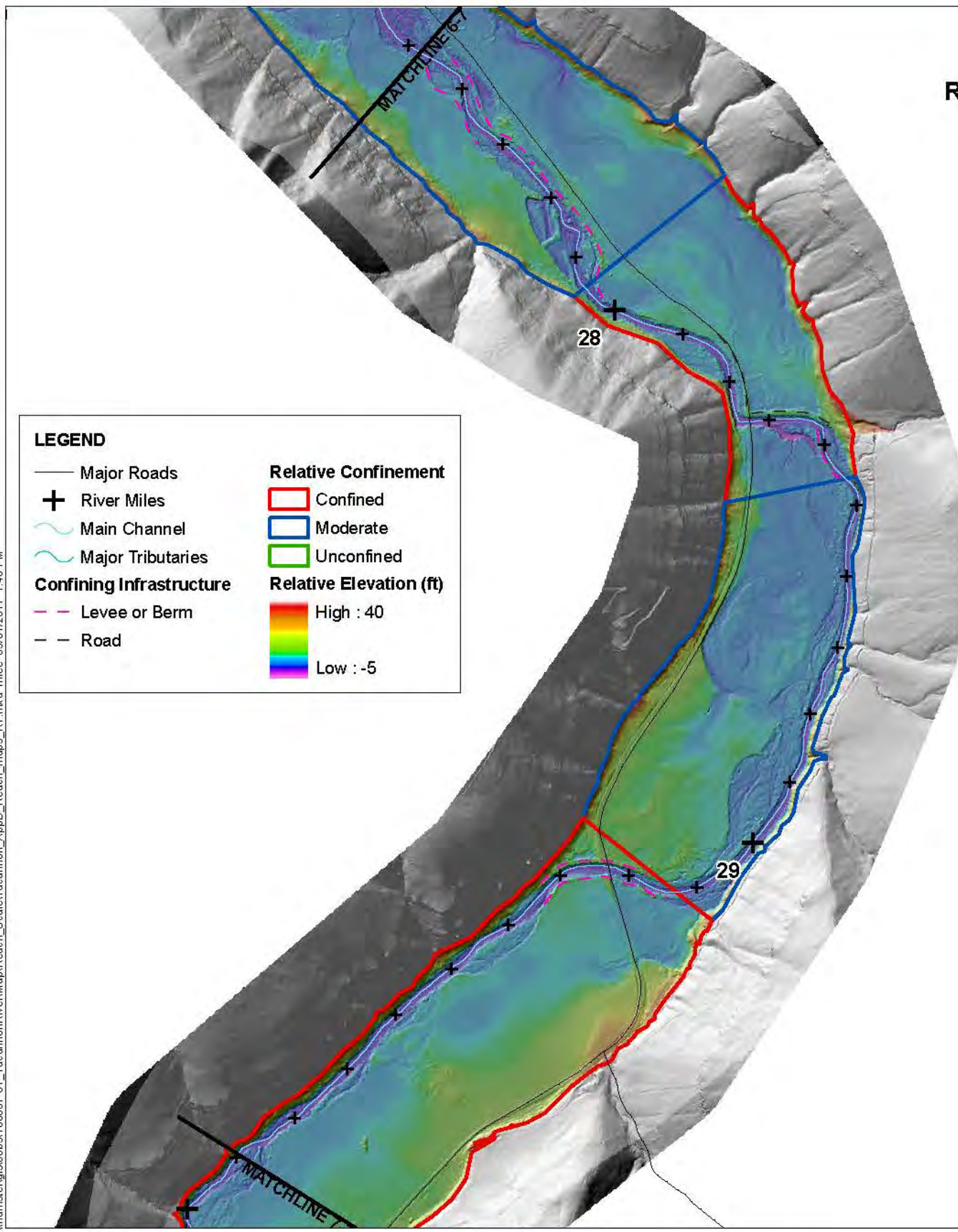
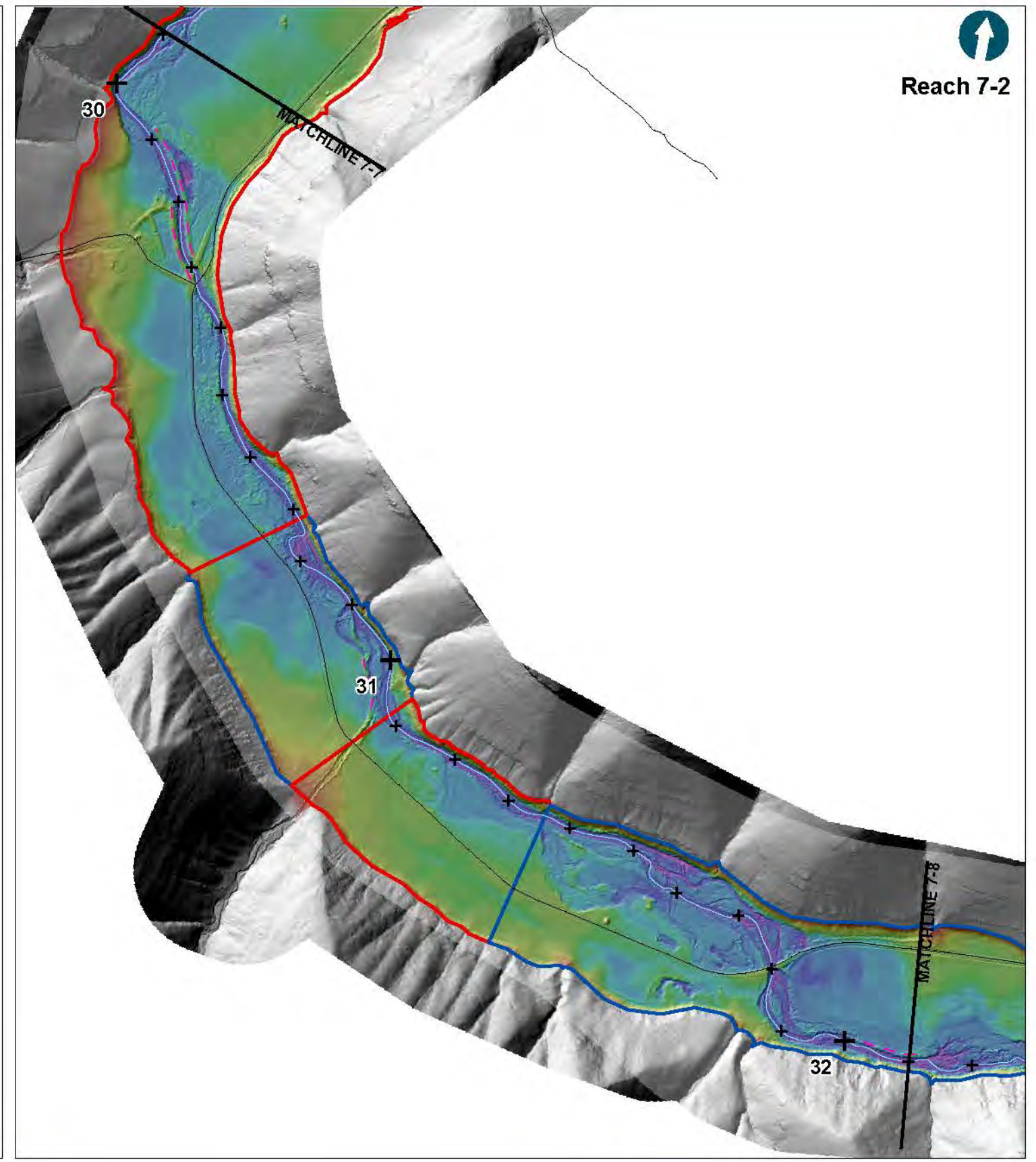


Figure D-7a
 Reach 7 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District

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Reach 7-1



Reach 7-2



NOTES:
Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

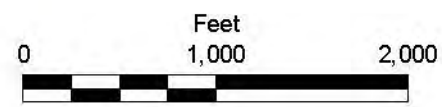
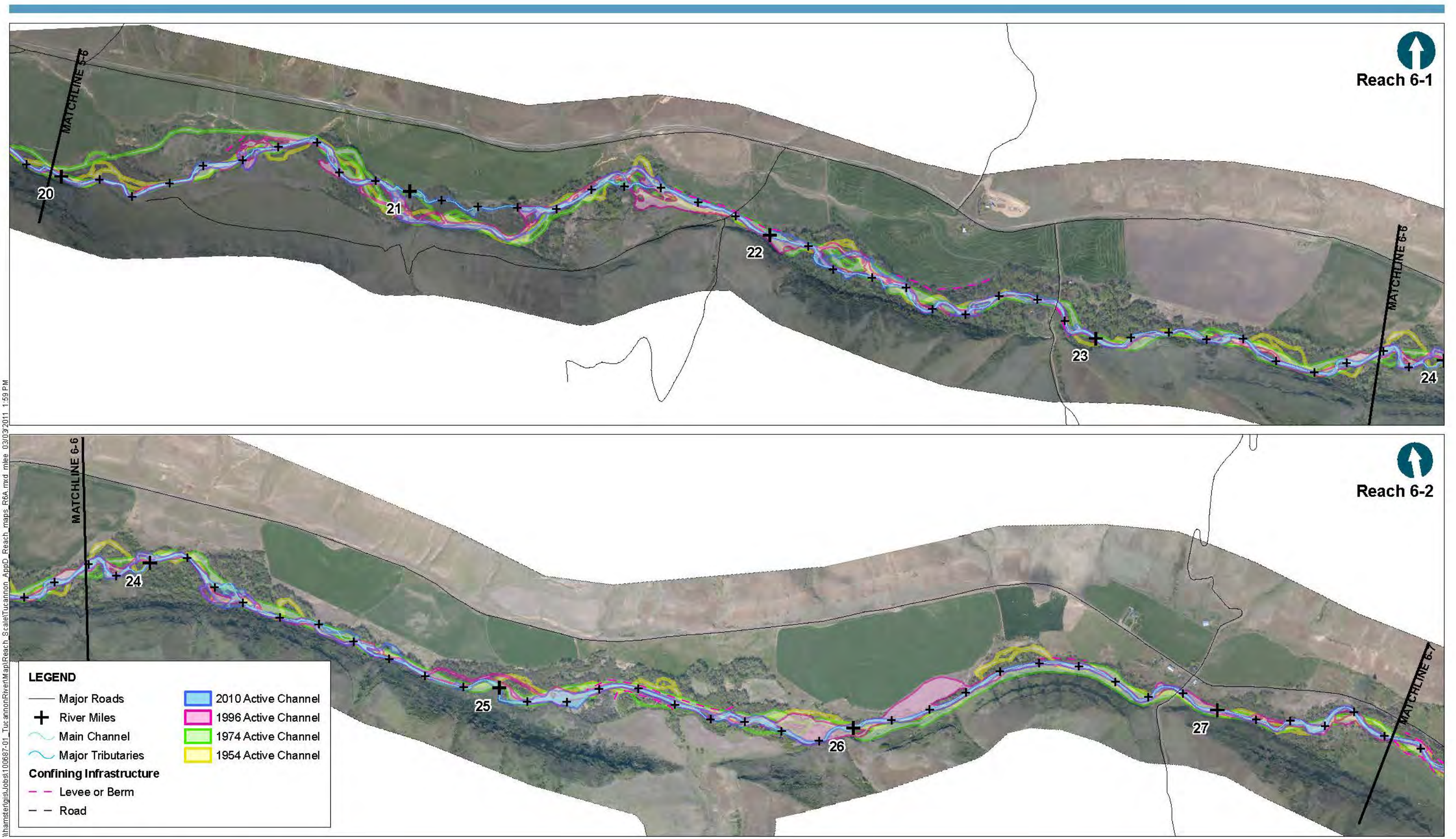


Figure D-7b
Reach 7 Relative Elevation and Topographic Features
Tucannon River Geomorphic Assessment and Habitat Restoration Study
Columbia Conservation District



NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

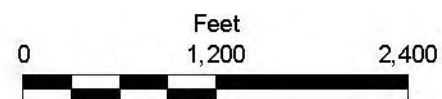
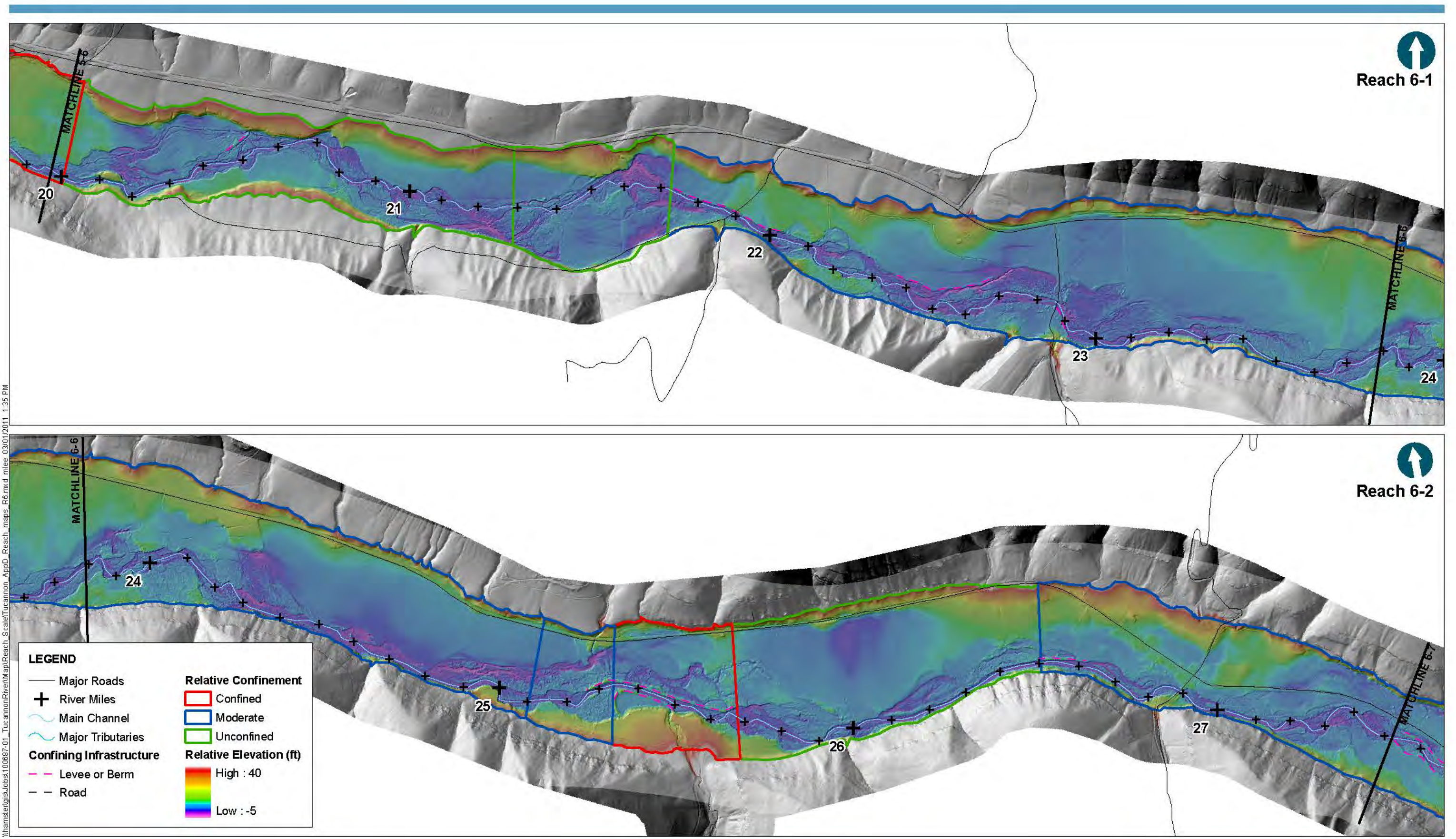


Figure D-6a
 Reach 6 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

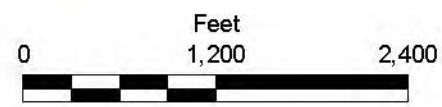
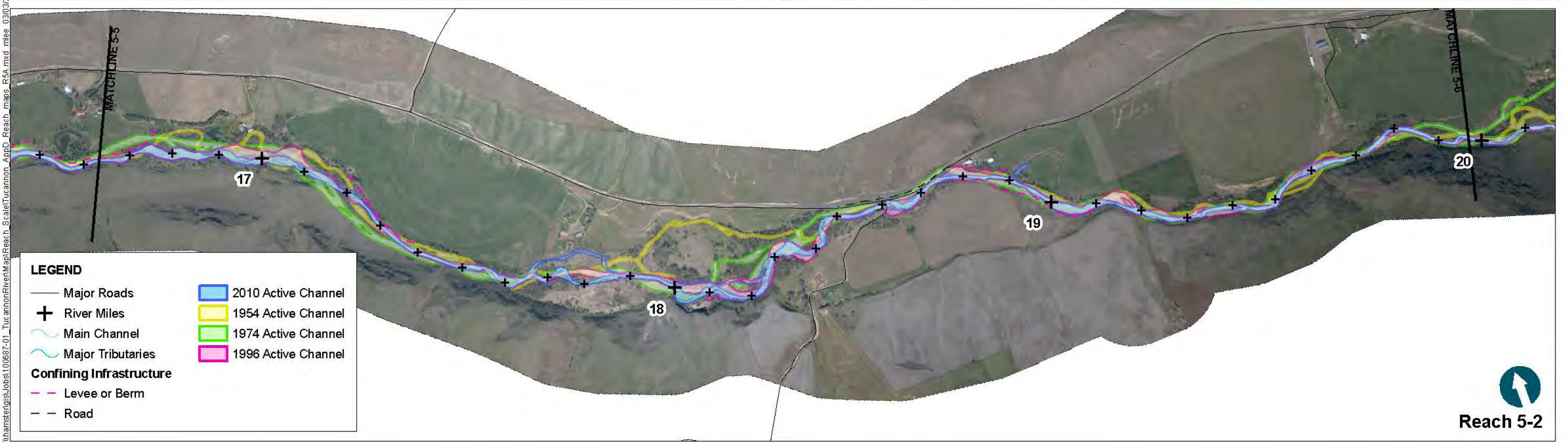
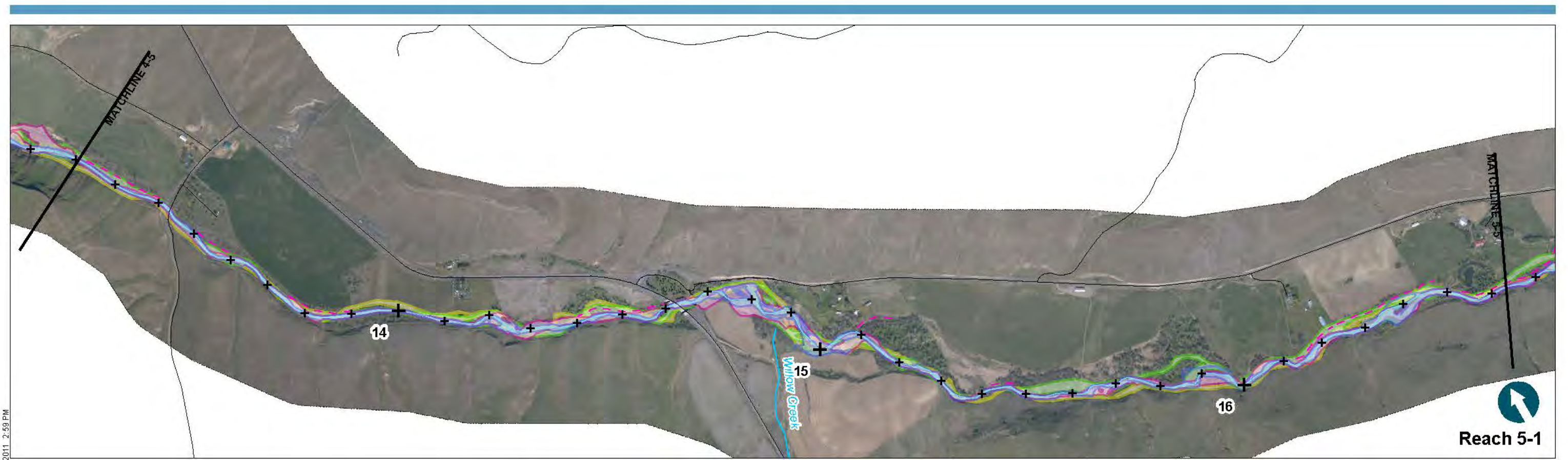


Figure D-6b
 Reach 6 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District

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LEGEND

— Major Roads	2010 Active Channel
+ River Miles	1954 Active Channel
— Main Channel	1974 Active Channel
— Major Tributaries	1996 Active Channel
Confining Infrastructure	
- - Levee or Berm	
- - Road	

NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

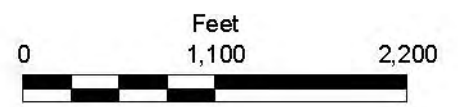
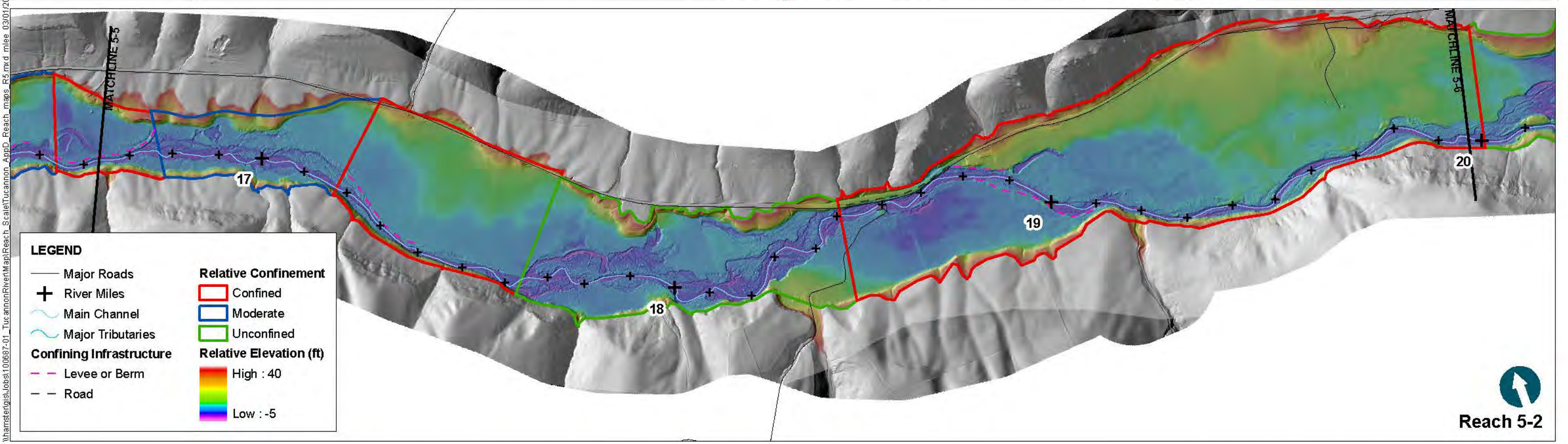
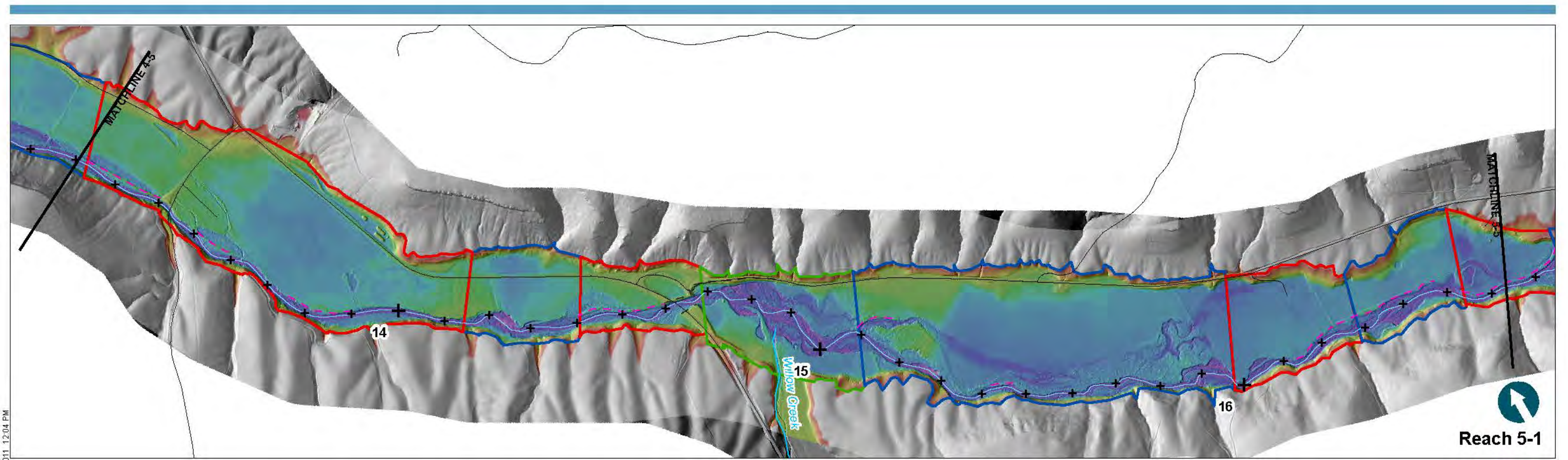


Figure D-5a
 Reach 5 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



LEGEND

- Major Roads
- + River Miles
- ~ Main Channel
- ~ Major Tributaries

Confining Infrastructure

- - Levee or Berm
- - Road

Relative Confinement

- Red outline: Confined
- Blue outline: Moderate
- Green outline: Unconfined

Relative Elevation (ft)

High : 40
Low : -5

NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

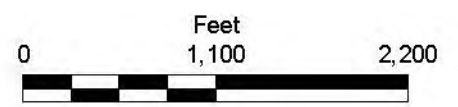
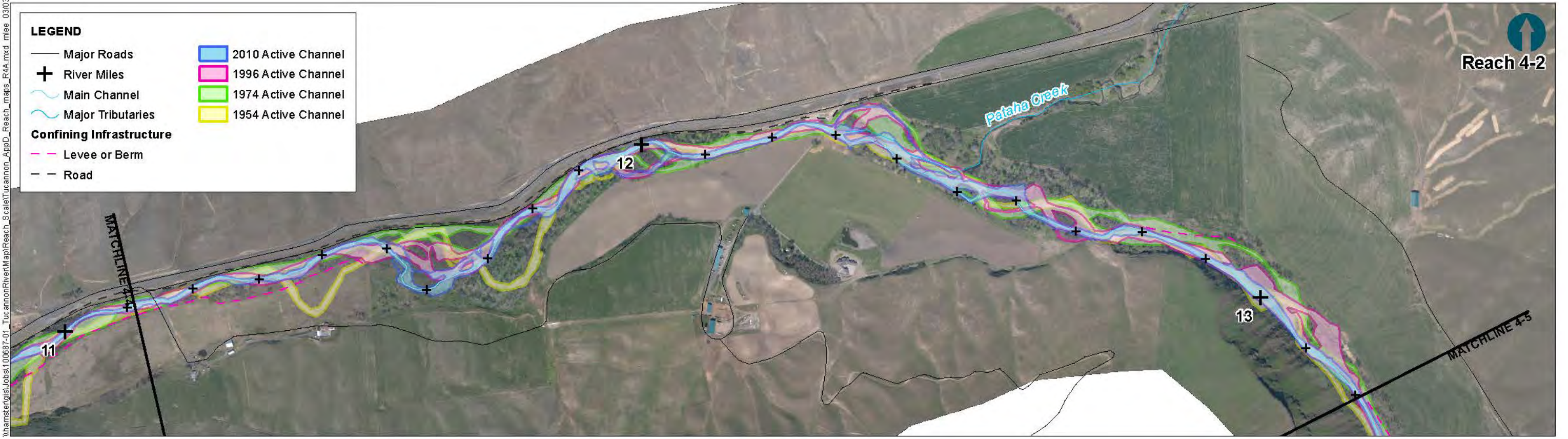
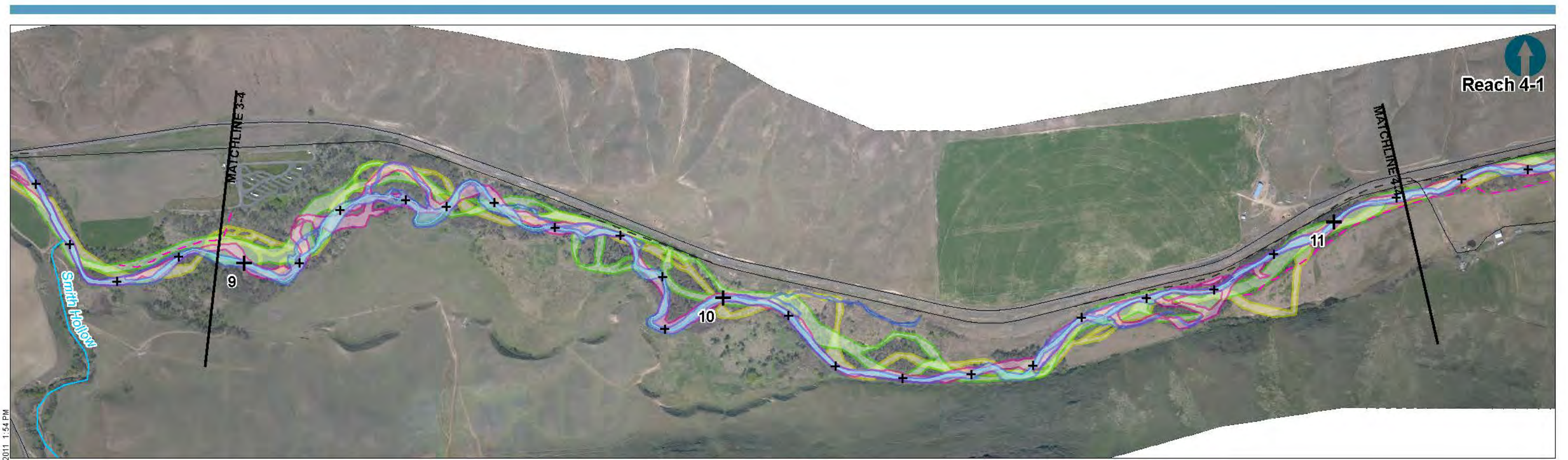


Figure D-5b
 Reach 5 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



LEGEND

- Major Roads
- + River Miles
- Main Channel
- Major Tributaries
- Confining Infrastructure
 - - Levee or Berm
 - - Road
- 2010 Active Channel (Blue)
- 1996 Active Channel (Pink)
- 1974 Active Channel (Green)
- 1954 Active Channel (Yellow)

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NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

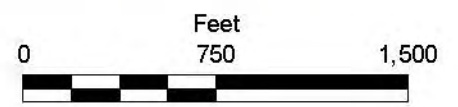
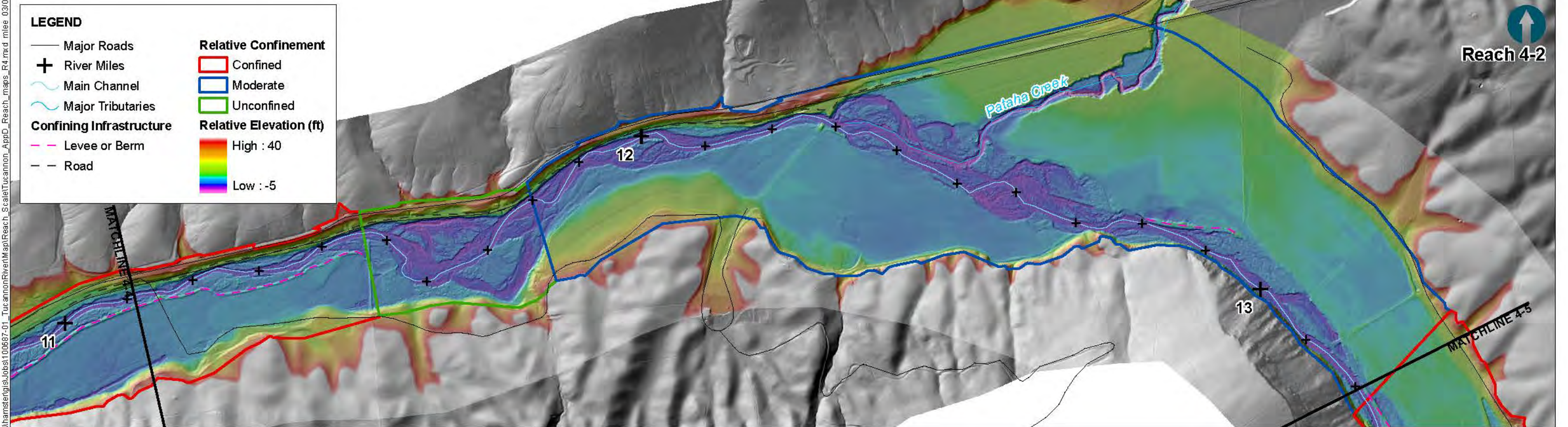
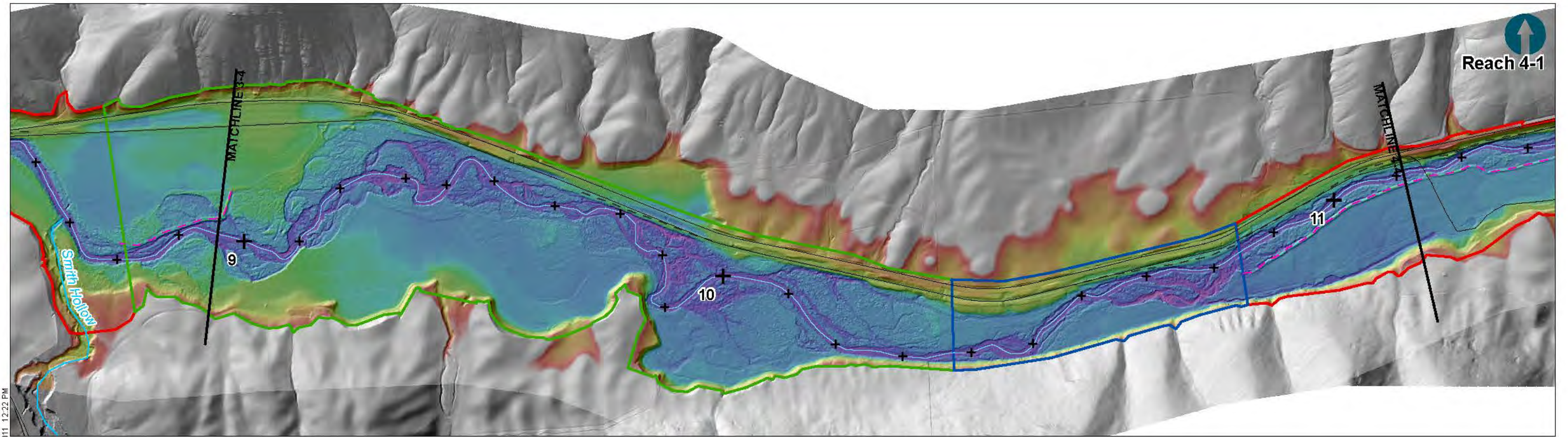


Figure D-4a
 Reach 4 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



LEGEND

— Major Roads	Relative Confinement
+ River Miles	▭ Confined
~ Main Channel	▭ Moderate
~ Major Tributaries	▭ Unconfined
— Confining Infrastructure	Relative Elevation (ft)
- - Levee or Berm	High : 40
- - Road	Low : -5

NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

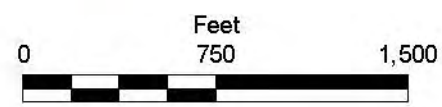
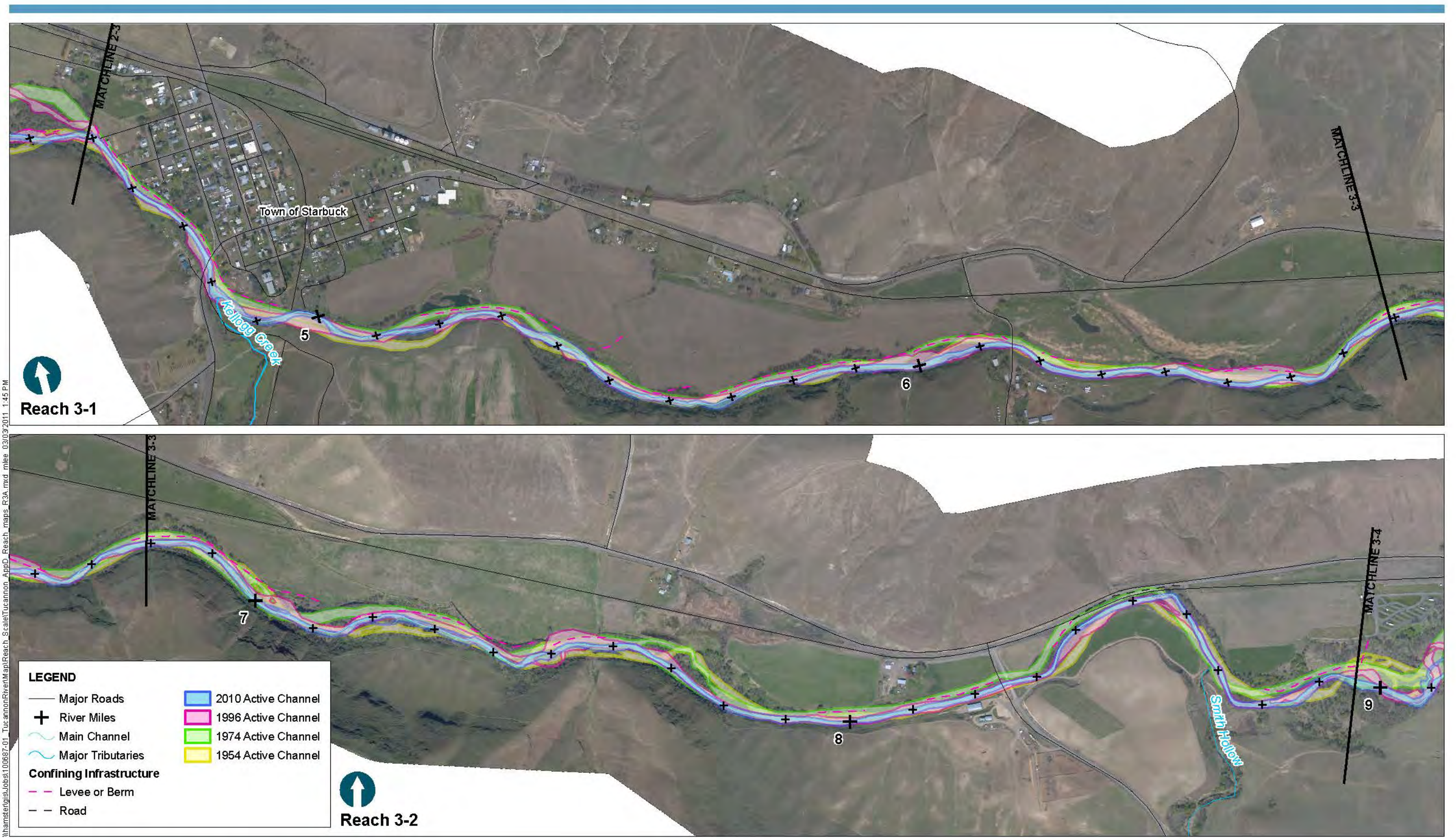


Figure D-4b
 Reach 4 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



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NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

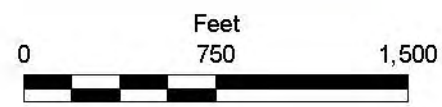
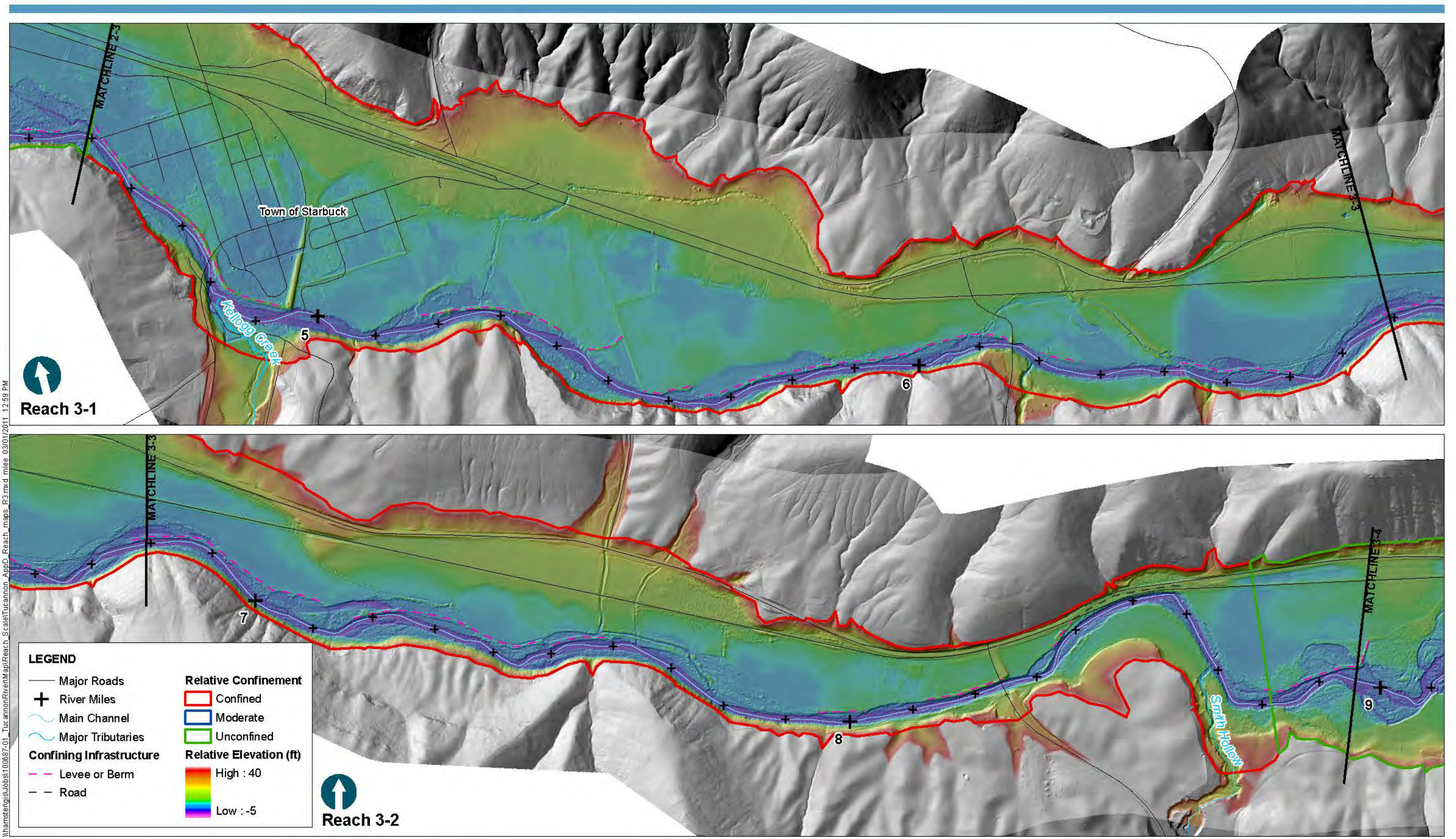
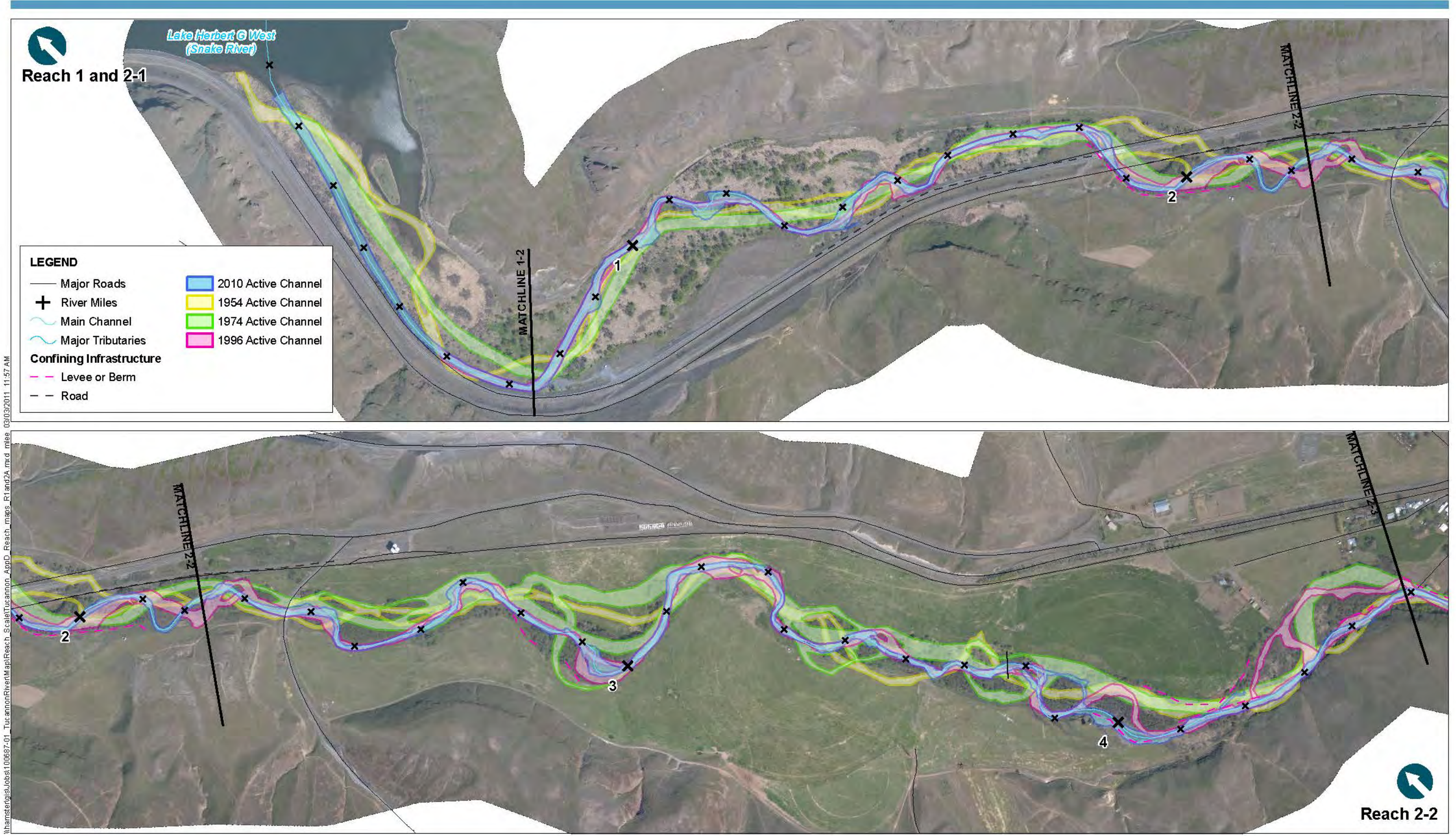


Figure D-3a
 Reach 3 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District





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NOTES:
 2010 orthophotos shown. Georeferenced historic channel patterns are approximate; traced from historic photos obtained from NRCS, USGS, USFS and CCD. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

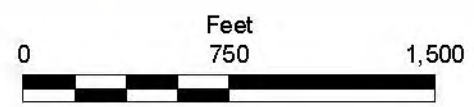
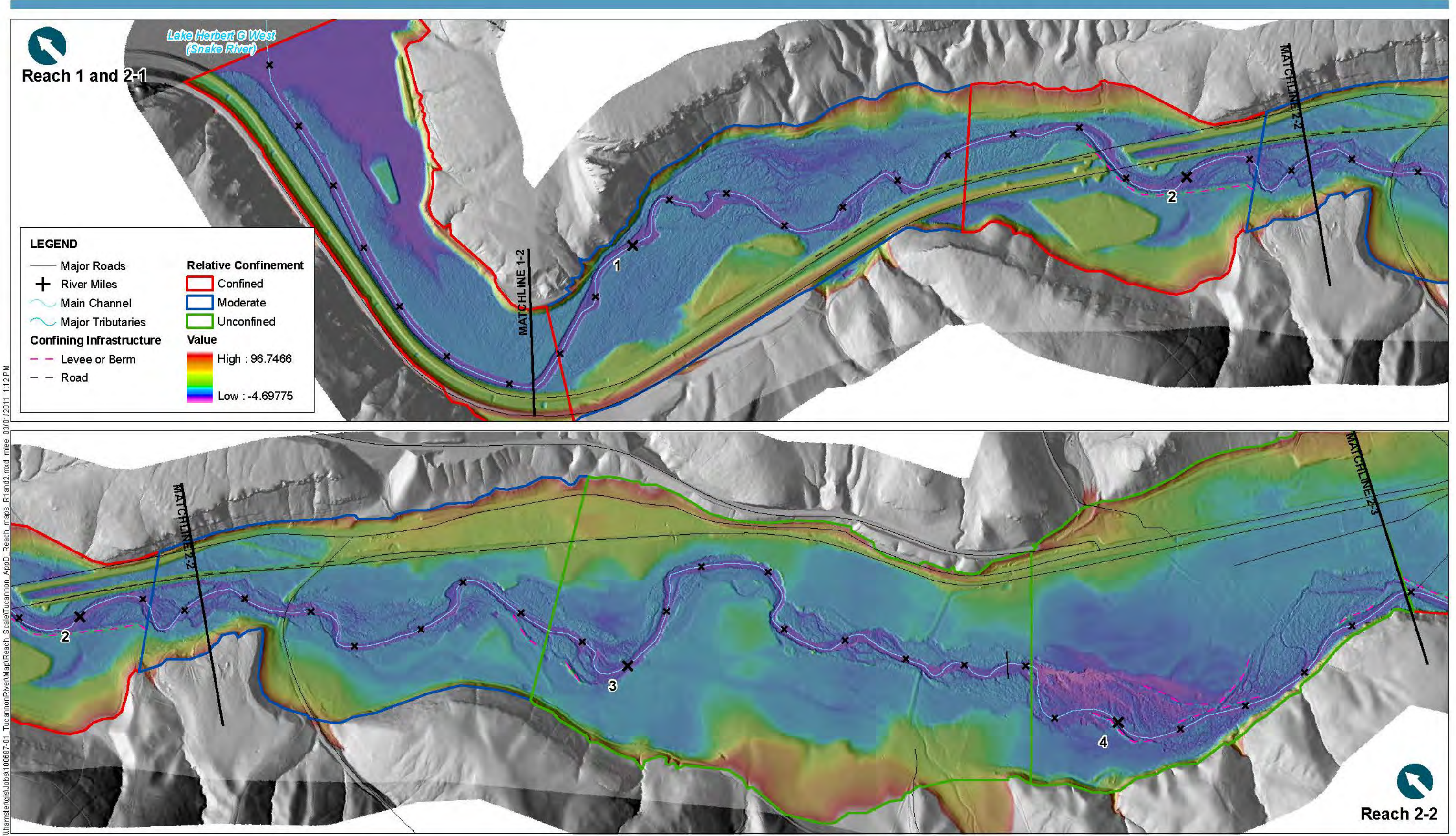


Figure D-1a and D-2a
 Reach 1 and 2 Current Aerial Photo and Historic Active Channel Positions
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District



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NOTES:
 Relative elevation map created from 2010 LiDAR. Roads from WA DNR. Tributary alignments from DOE. Locations of features are approximate. This figure is to be used for conceptual purposes only.

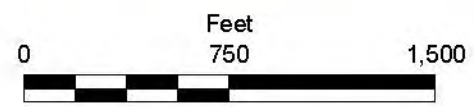


Figure D-1b and D-2b
 Reach 1 and 2 Relative Elevation and Topographic Features
 Tucannon River Geomorphic Assessment and Habitat Restoration Study
 Columbia Conservation District

