Integrating Wet Areas Mapping with NetMap's Virtual Watershed to Support Spatially Explicit Riparian Zone Delineation and Management in Alberta

For Alberta Environment and Sustainable Resource Development

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Two main objectives:

Build a seamless, routed stream network across WAM tiles

Apply a process based, riparian zone delineation tool

Riparian Processes

- Depth to water (WAM)
- Floodplains
- In-stream wood recruitment
- Current vegetation shade effects on thermal energy to streams

Add Environmental Settings (not included)

- Channel types
- Habitat (fish) potential
- Hillslope erosion potential
- Channel migration
- Thermal refugia
- Tributary confluence zones
- Wildfire risk
- Climate change

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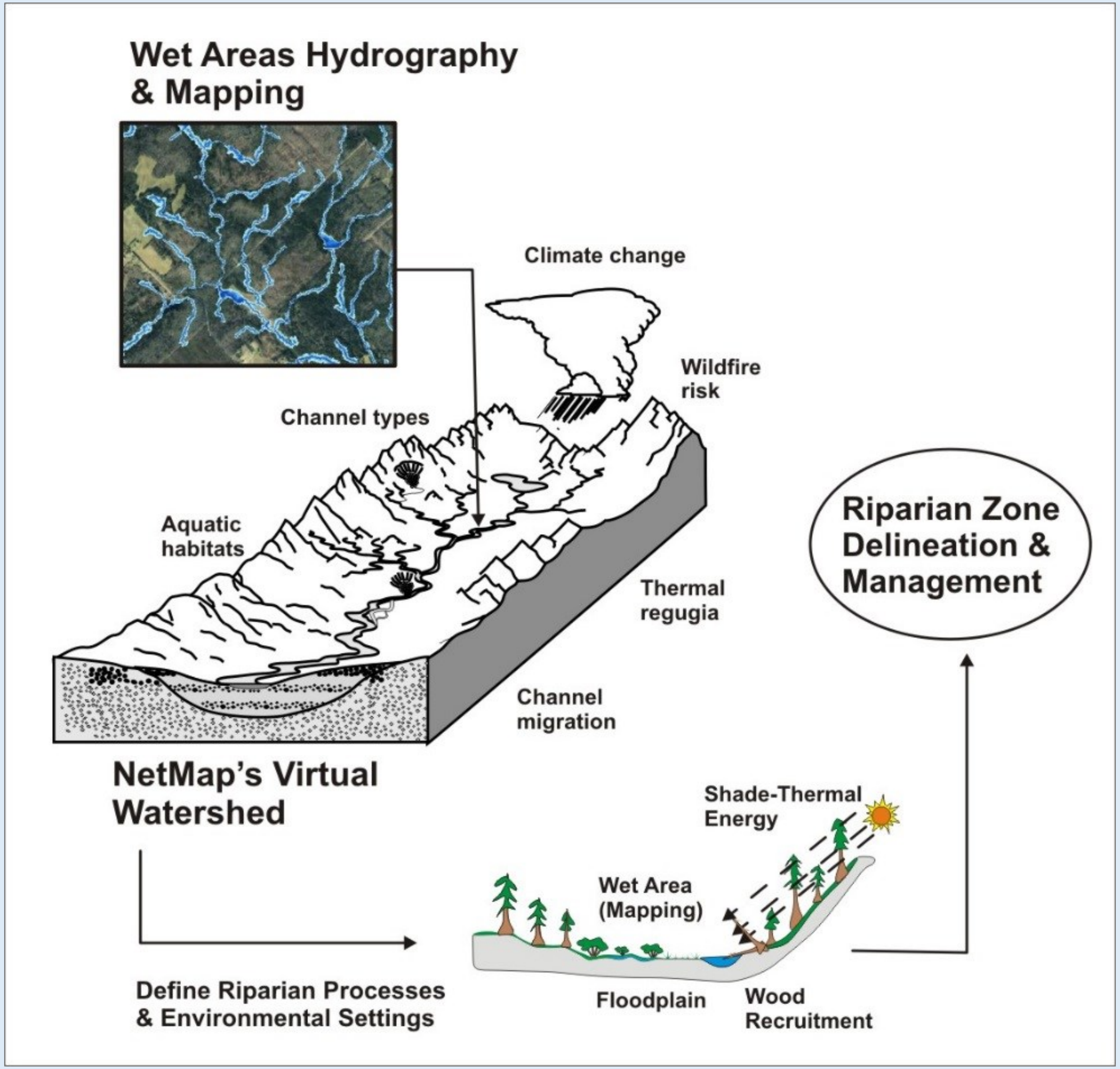
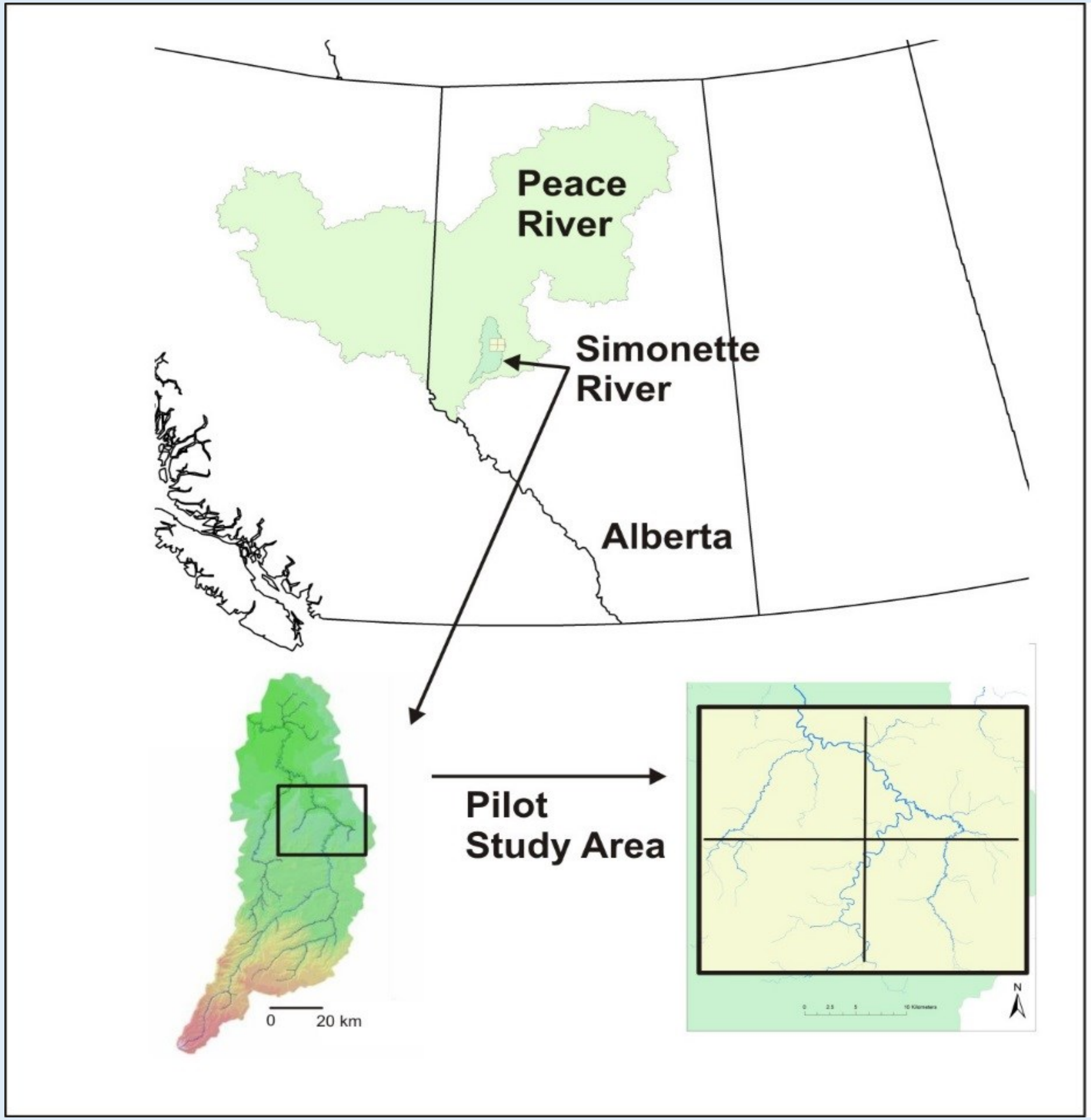
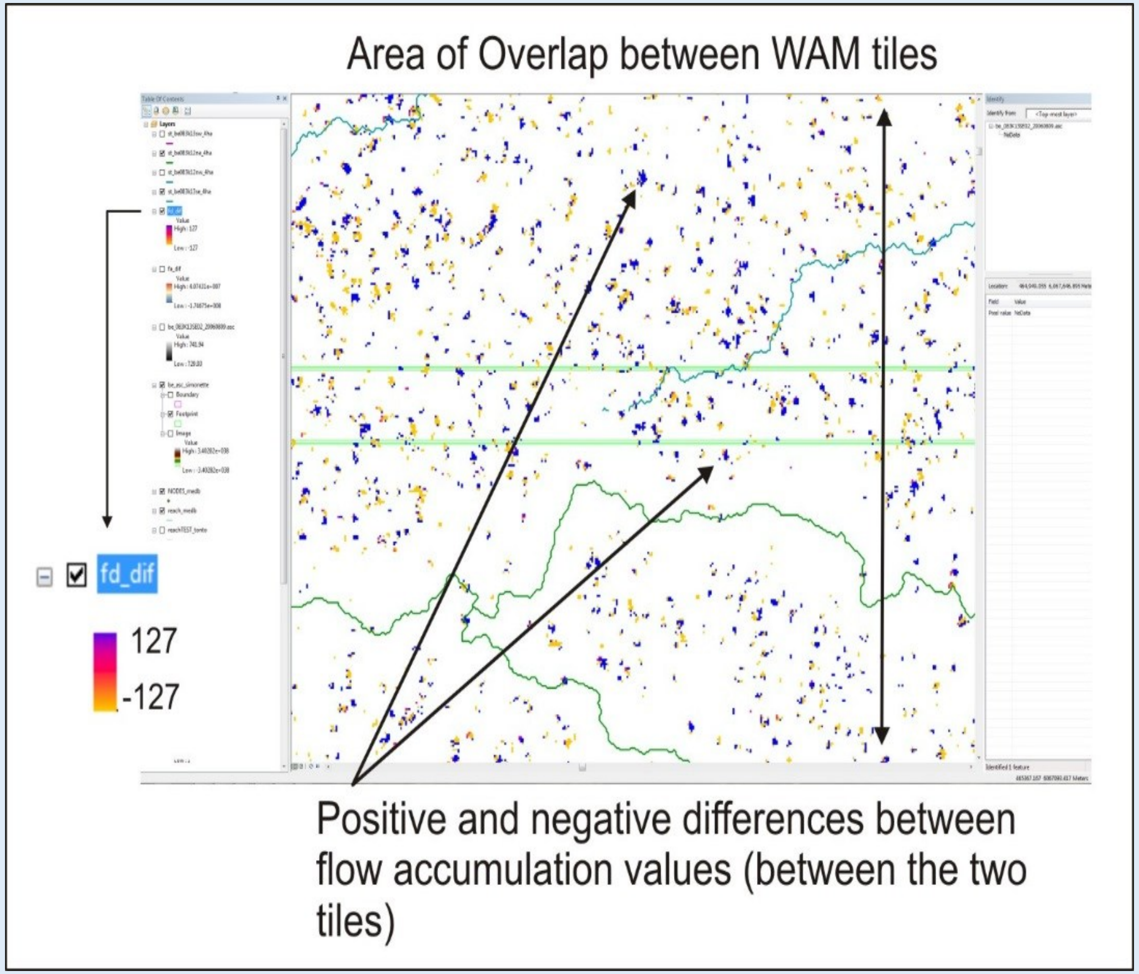
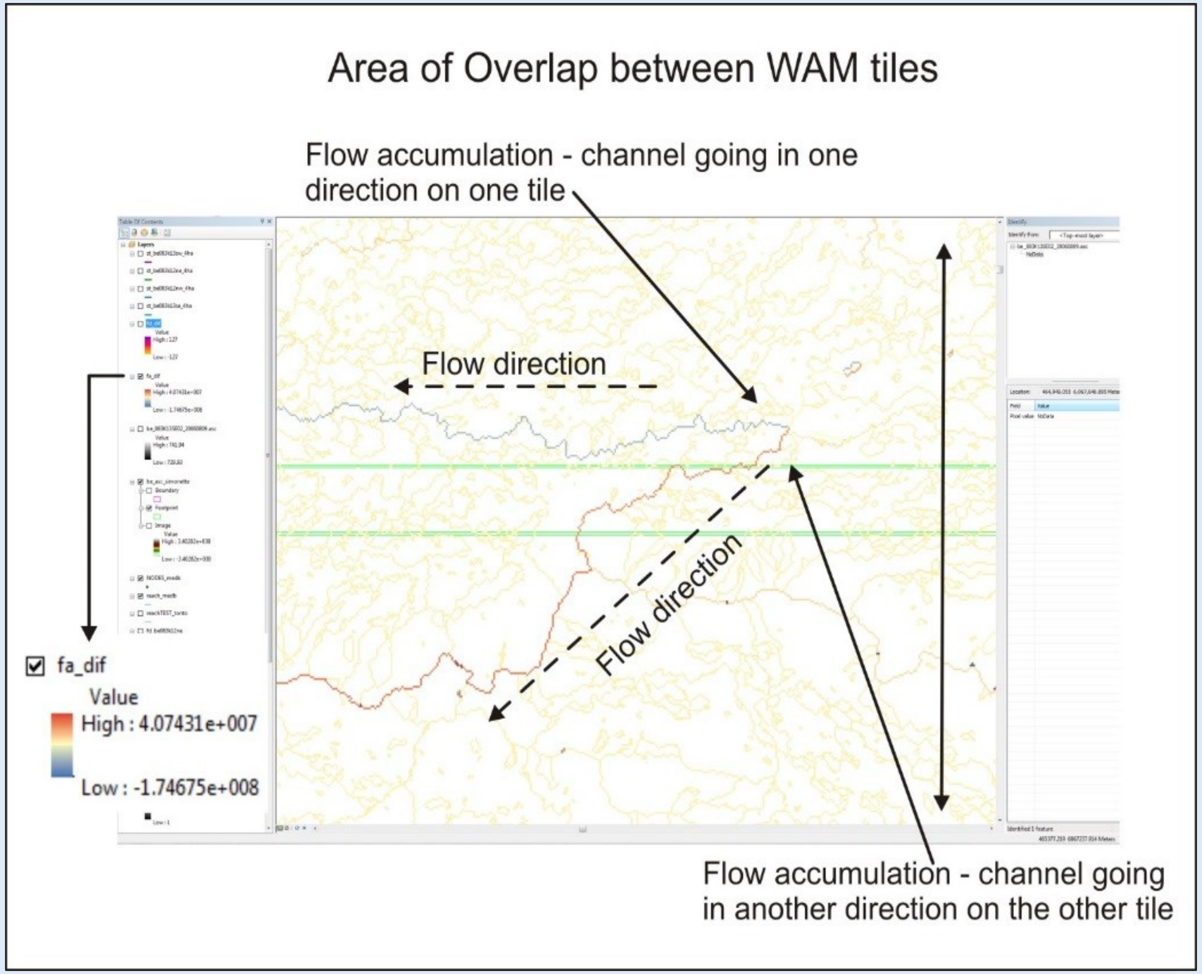
Conceptual Framework

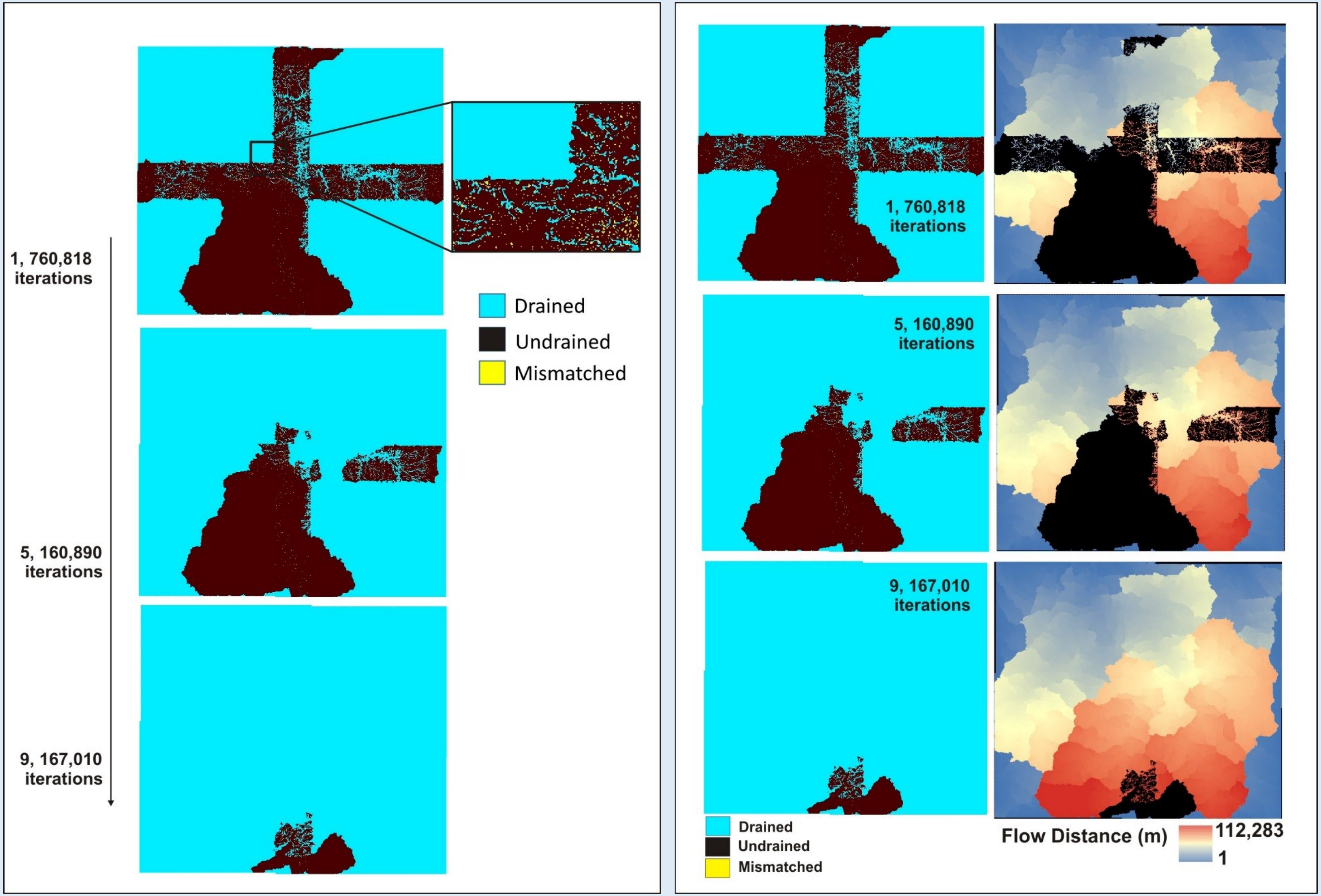


Project Area

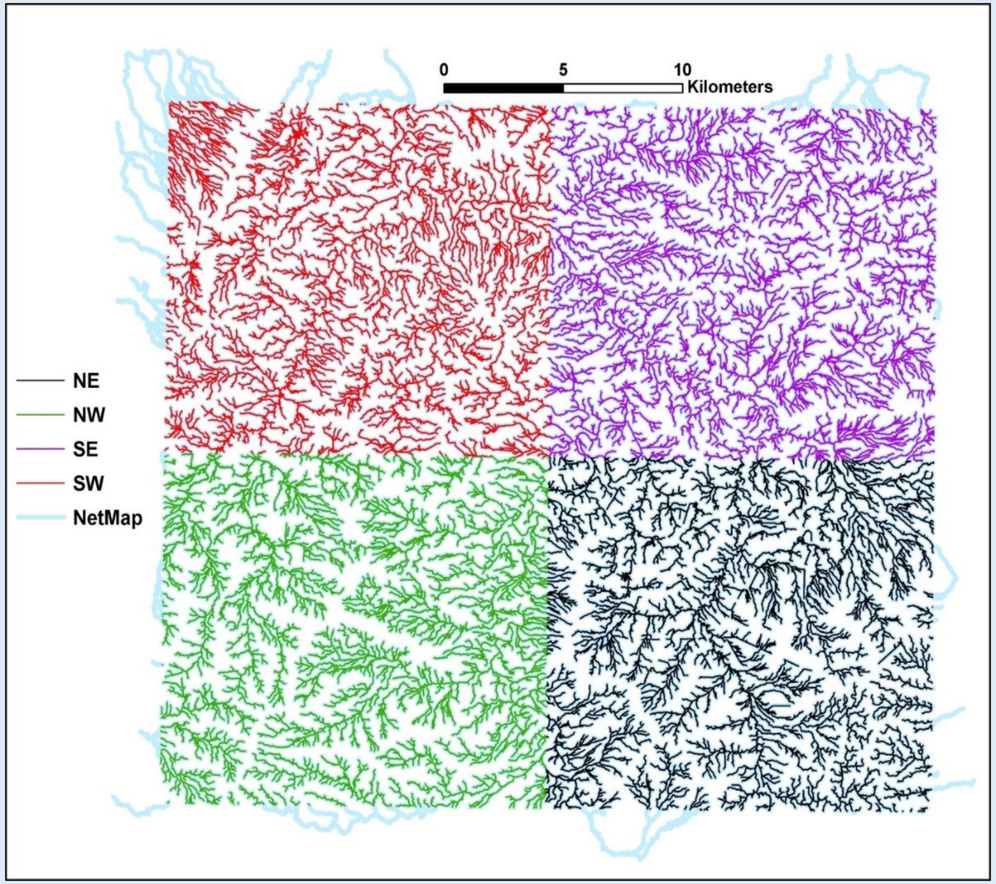



Area of Overlap between WAM tiles
fd_dif
127
-127
Positive and negative differences between flow accumulation values (between the two tiles)

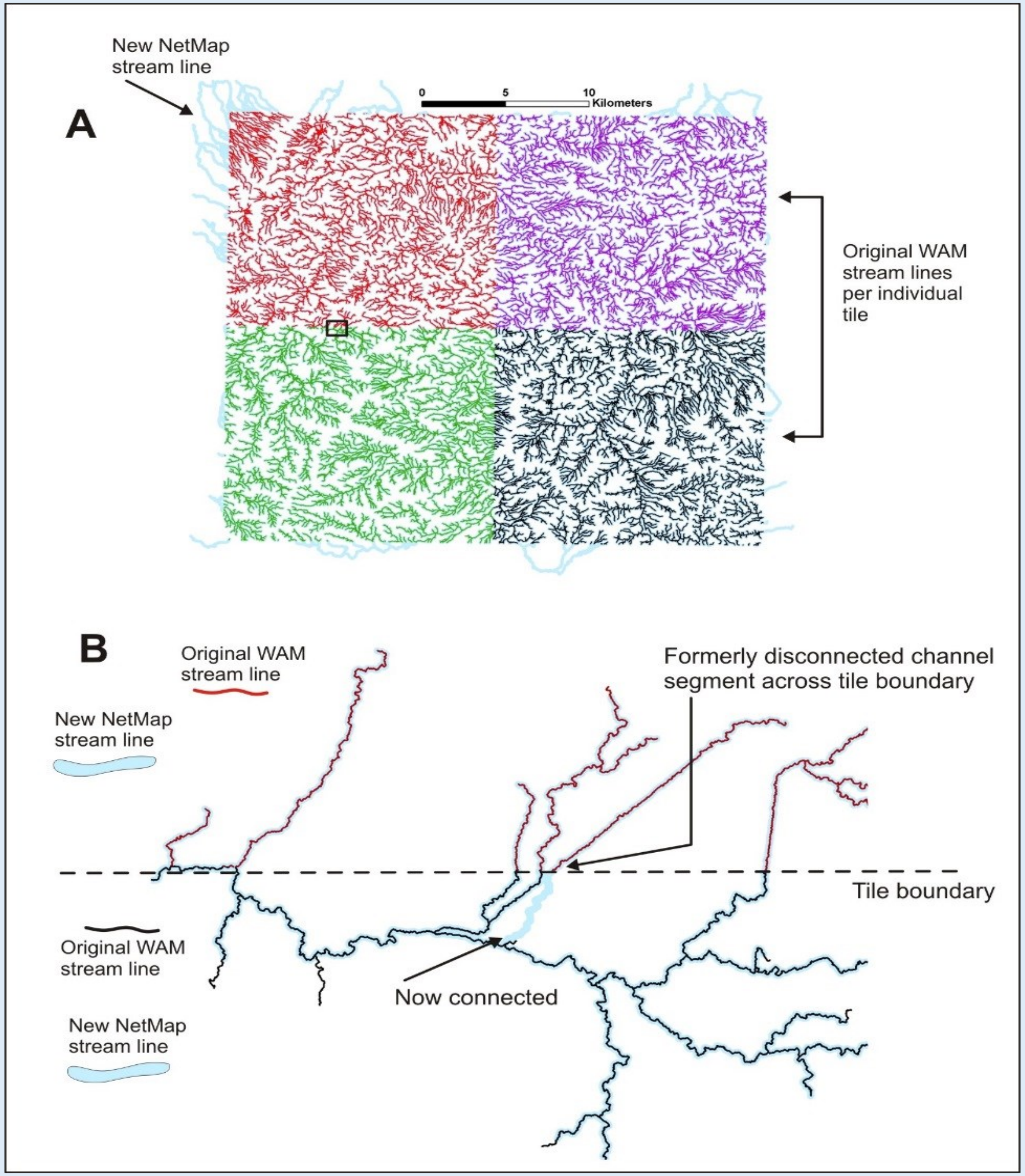

Area of Overlap between WAM tiles
Flow accumulation - channel going in one direction on one tile
Flow direction
Flow direction
fa_dif
Value
High : 4.07431e+007
Low : -1.74675e+008
Flow accumulation - channel going in another direction on the other tile



1, 760,818 iterations
5, 160,890 iterations
9, 167,010 iterations
Drained
Undrained
Mismatched
1, 760,818 iterations
5, 160,890 iterations
9, 167,010 iterations
Drained
Undrained
Mismatched
Flow Distance (m)
112,283
1



0
5
10
Kilometers
NE
NW
SE
SW
NetMap



New NetMap stream line
A
0
5
10
Kilometers
Original WAM stream lines per individual tile
B
Original WAM stream line
New NetMap stream line
Formerly disconnected channel segment across tile boundary
Tile boundary
Original WAM stream line
Now connected
New NetMap stream line

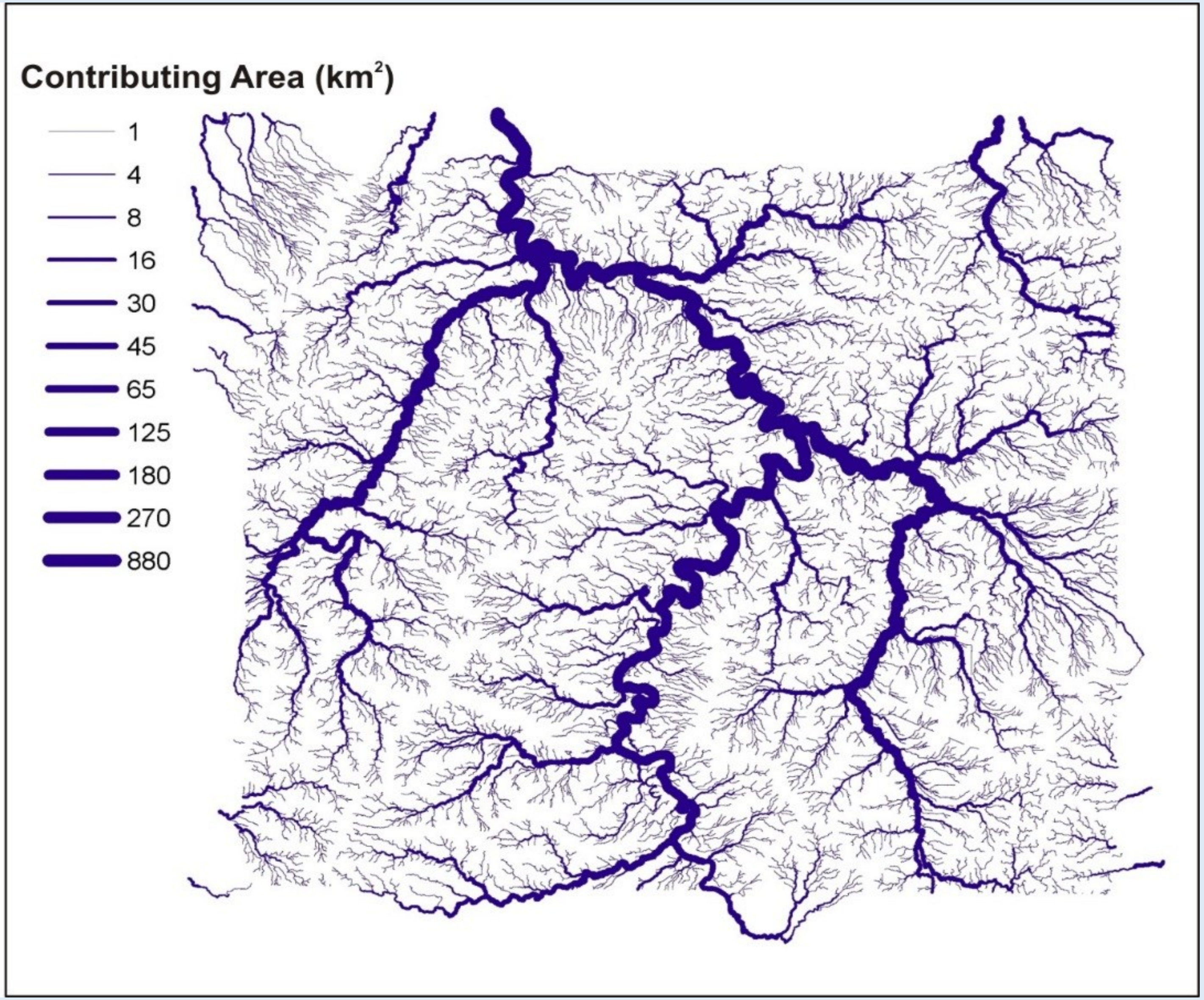

Contributing Area (km²)
1
4
8
16
30
45
65
125
180
270
880

Figure 12. The Integrated WAM-NetMap node based synthetic stream layer with drainage wings.

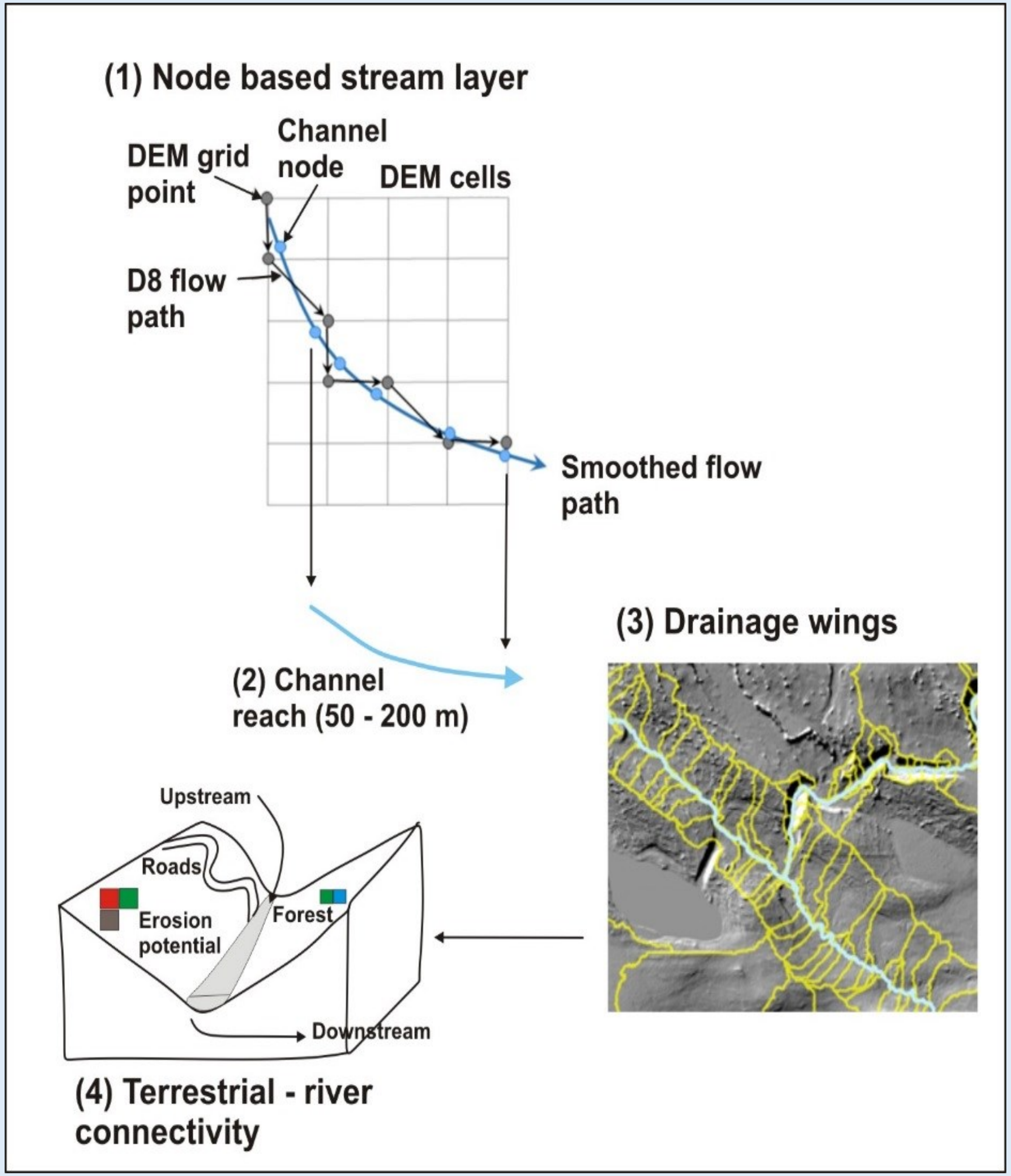


Figure 15. Sinuosity of the stream lines in the Integrated WAM-NetMap is significantly greater than natural river channels in the study area.

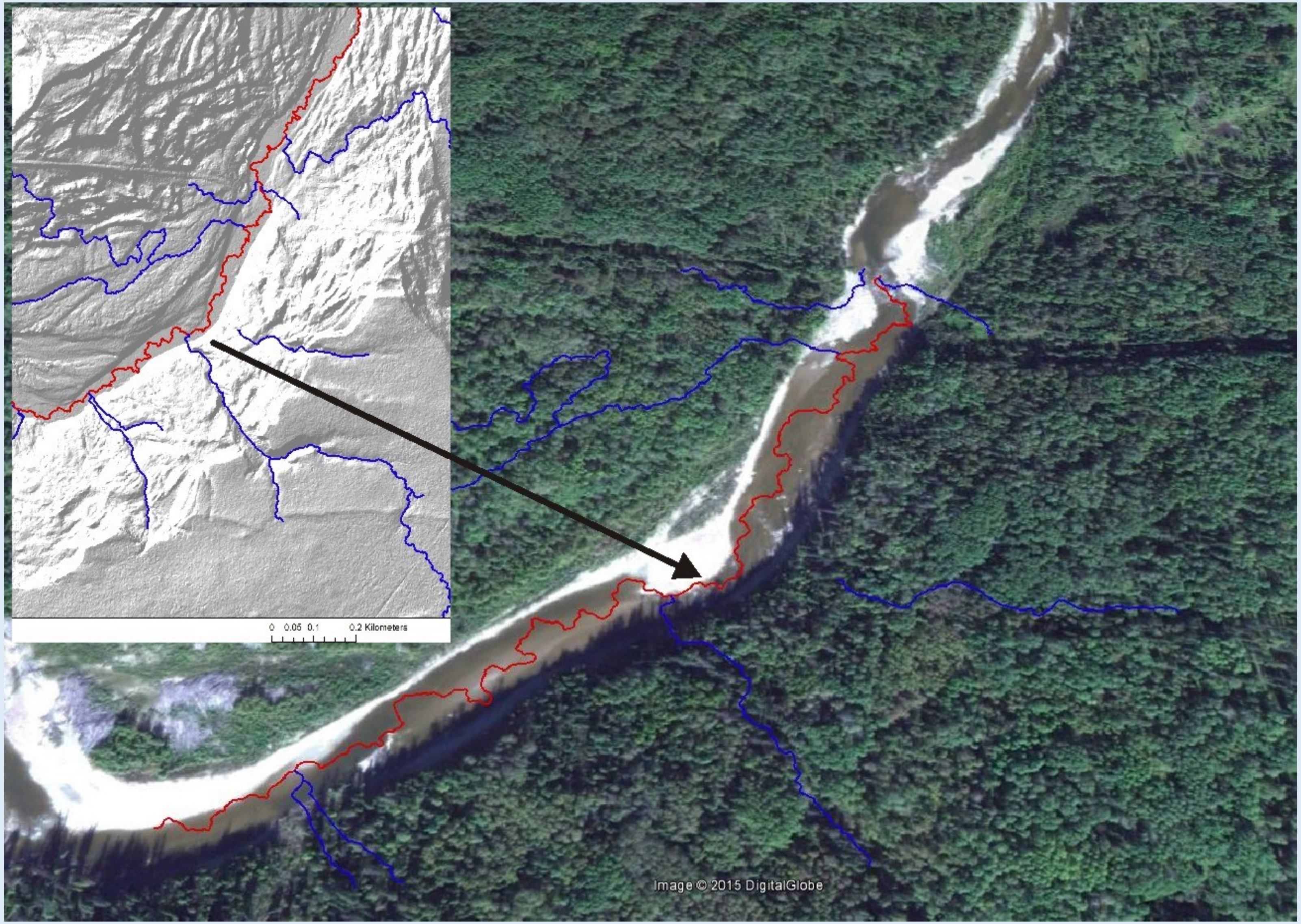


Table 1. List of attributes contained within the Integrated WAM-NetMap to support spatially explicit riparian zone delineation and environmental settings.

Riparian Process/Delineation Parameters (units)	Environmental Settings Parameters (units)
Synthetic Stream Layer (Integrated WAM-NetMap)	Channel Classification (types)*
Depth to Water (WAM, in meters)	Stream order (Strahler 1952)
Drainage area (km^2)	Channel confinement (LL^{-1})
Elevation (m)	Entrenchment ratio (LL^{-1})*
Gradient (LL^{-1})	Hillslope erosion potential (GEP)
Azimuth (0 – 360^o)	Sinuosity (LL^{-1})
Bankfull width (m)	Tributary confluence effects (P)
Bankfull depth (m)	Thermal refugia (watt-hours/m^2 or indexed by contributing area)
Valley Elevations/Floodplain width (n=5, m)	Channel Migration Zone (m)*
Topography (slope, curvature, distance to stream)	Maximum downstream gradient (LL^{-1})
Mean annual flow (m^3s^{-1})	Aquatic (Fish) Habitats*
Mean annual precipitation (m)	Mean annual flow (m^3s^{-1})
Thermal Energy to Channels (Bare Earth, watt-hours /m^2)	Summer habitat volume (m^3)*
Current Shade (tree height and basal area)	Wildfire risk**
In-stream wood recruitment (tree height, stand density, diameter classes)	Climate change forecasts**
Riparian vegetation (basal area, average tree height, average stand density, quadratic mean diameter)	

Figure 13. An illustration of valley floor mapping in the Integrated WAM-NetMap.

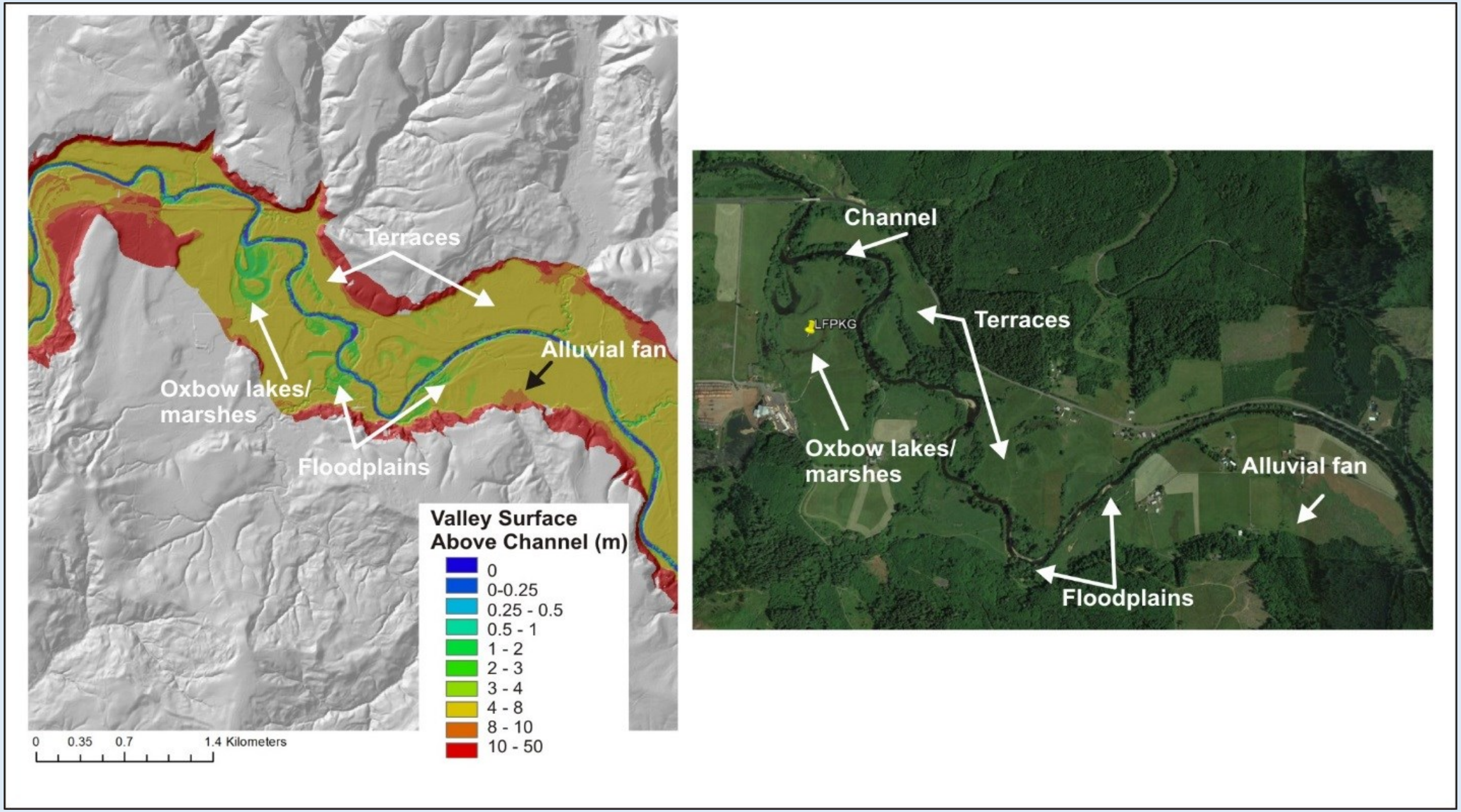


Figure 17. An example of two different types of valley floor and floodplain mapping in the Simonette River basin.

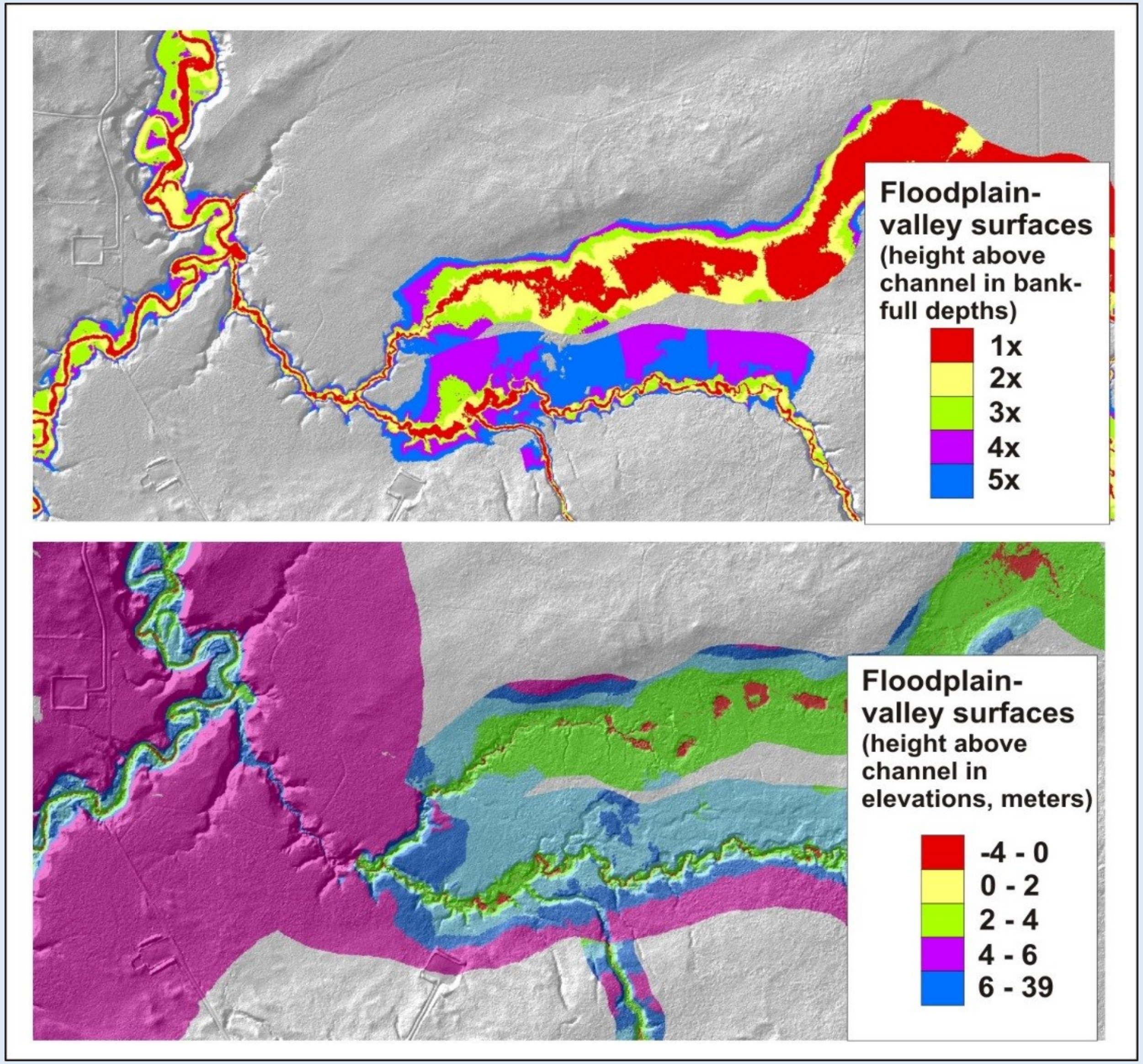


Figure 16. The WAM depth to water in the Simonette River pilot project area compared to floodplain mapping.

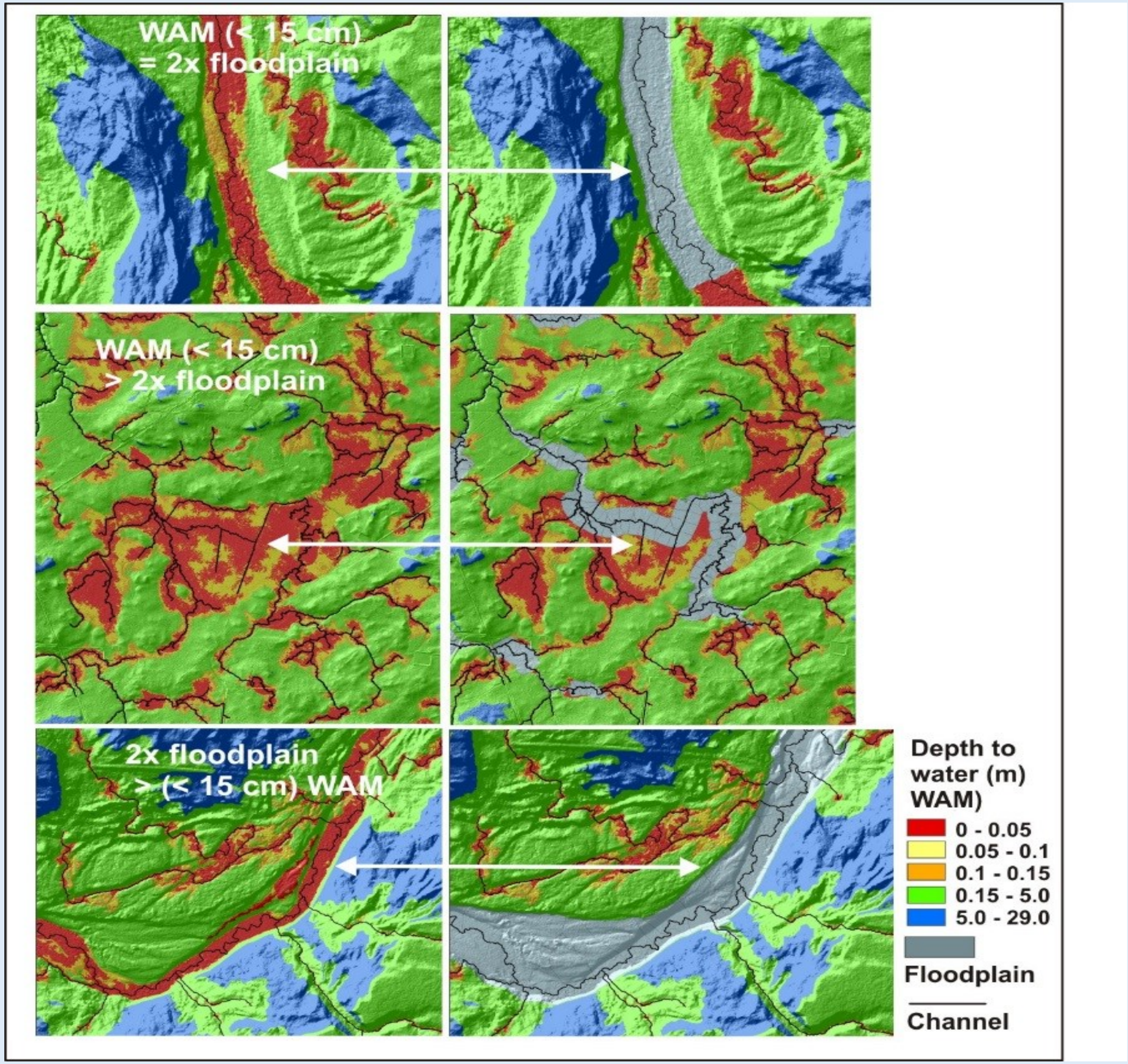
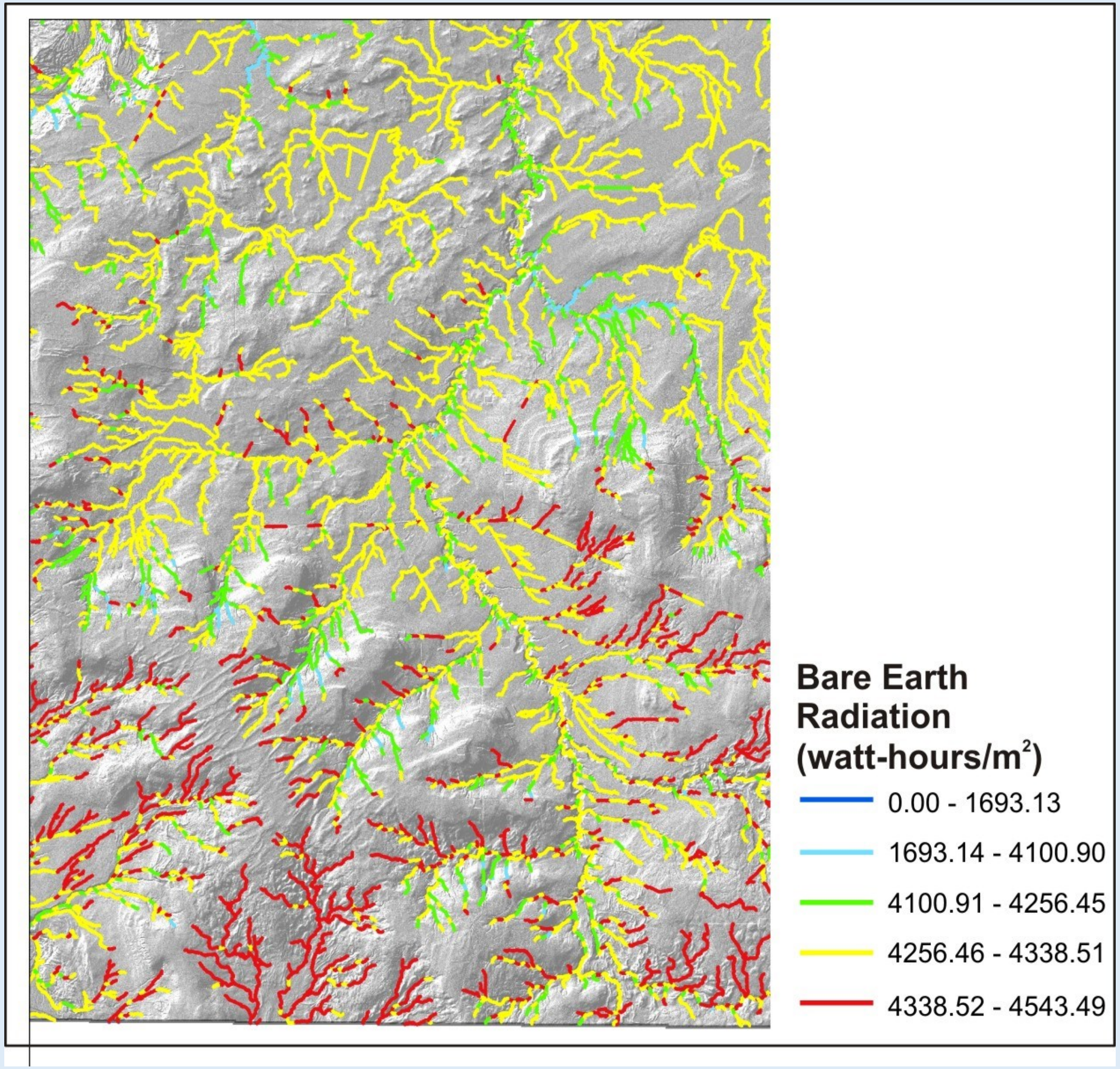


Figure 19. Bare earth radiation loading to streams in the Simonette River

- -latitude
- -solar angle
- -topographic shading
- -stream width
- -stream azimuth
- -vegetation height
- -vegetation width
- -vegetation density



Shade model (Groom et al. 2011)
uses basal area and tree height

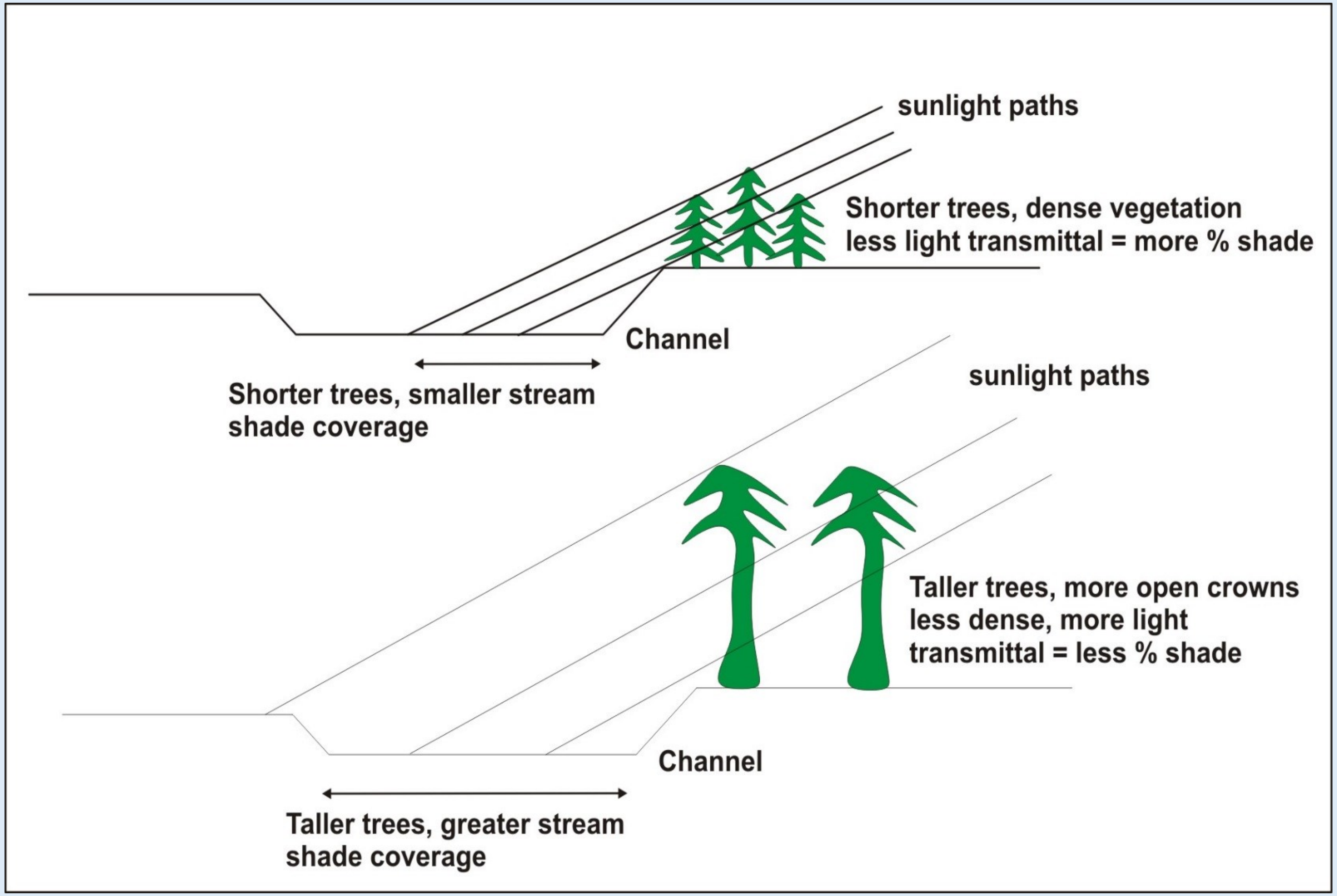
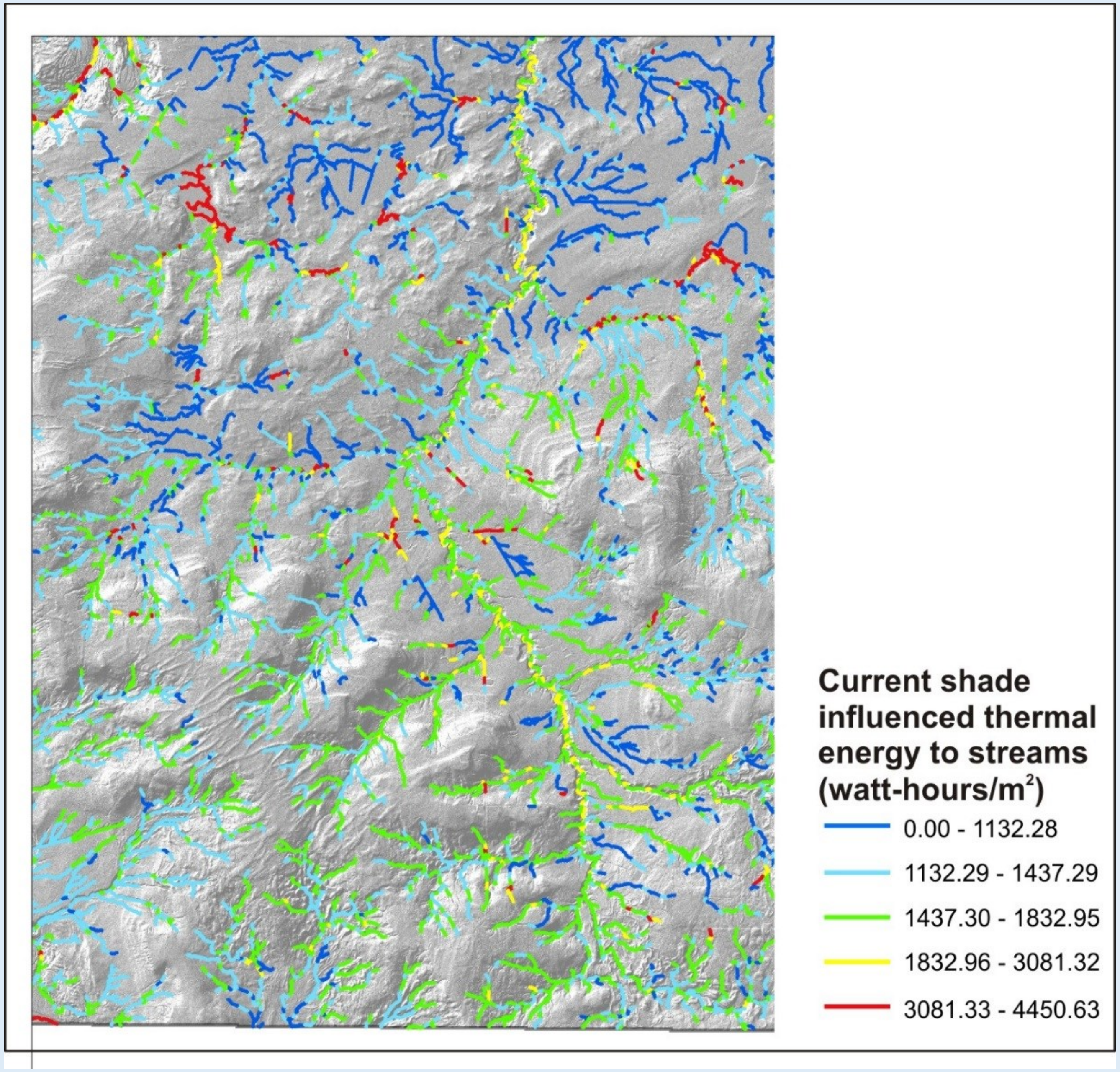
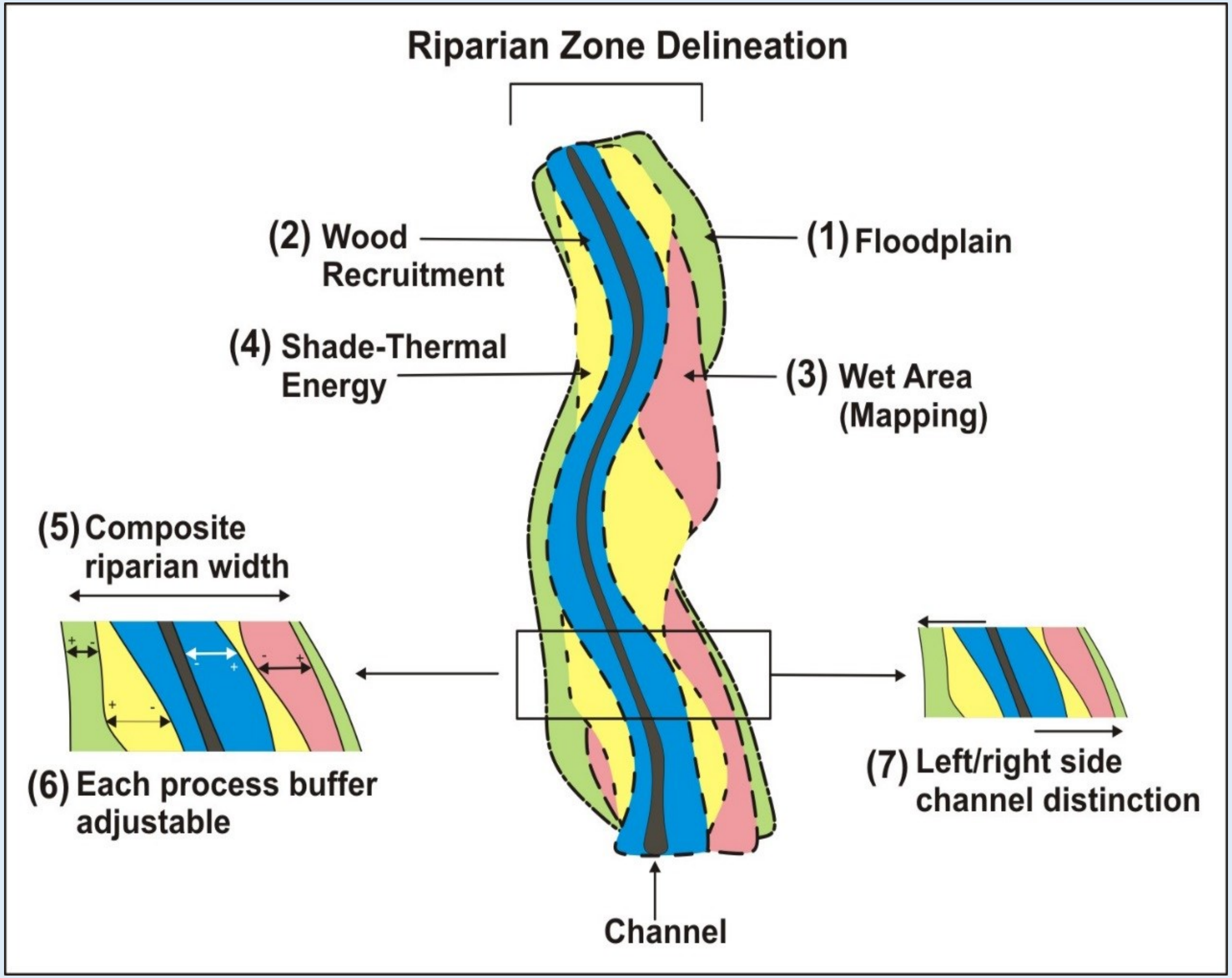
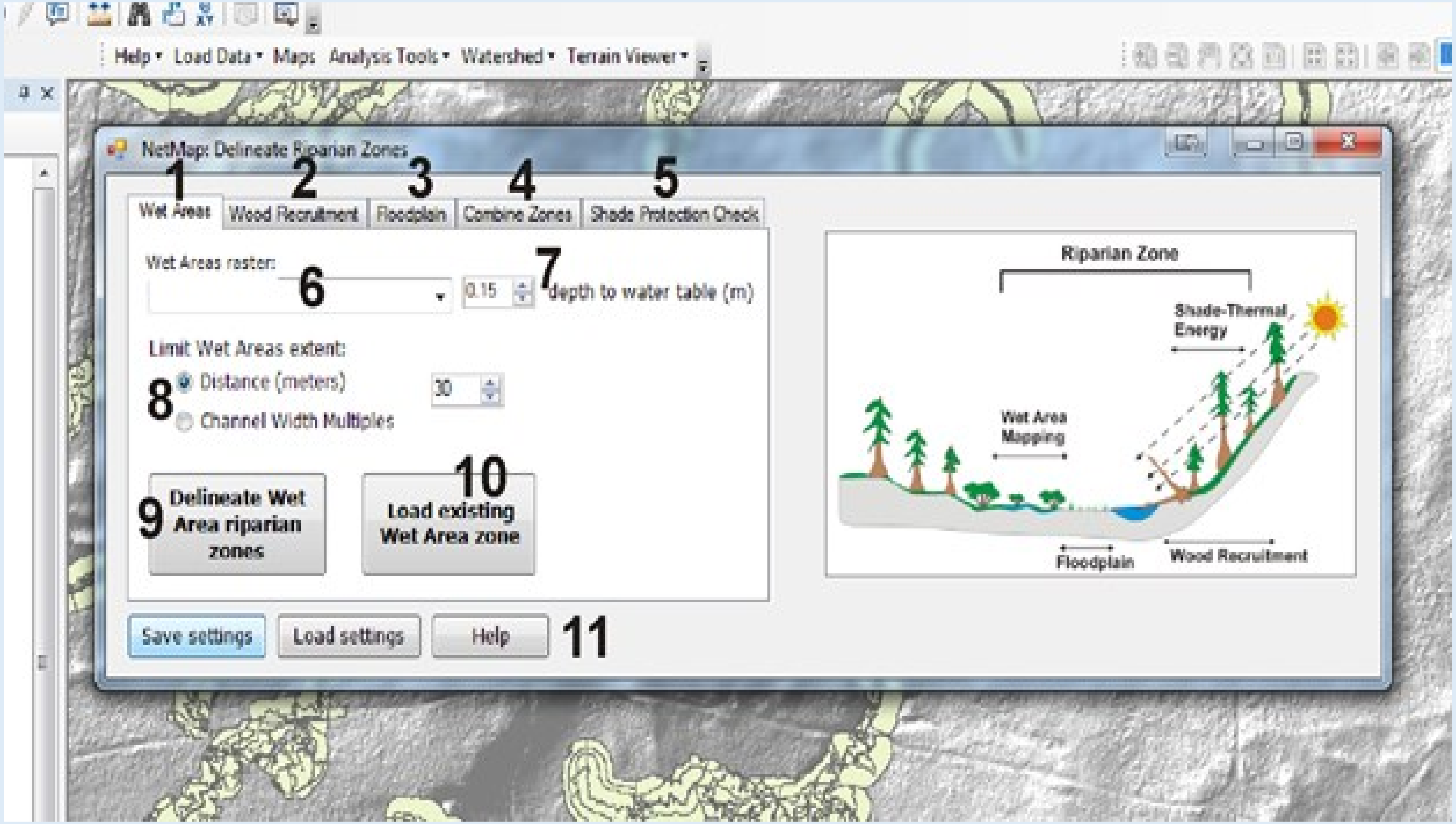


Figure 20. Current streamside shade influenced thermal energy to streams using basal area and tree height.

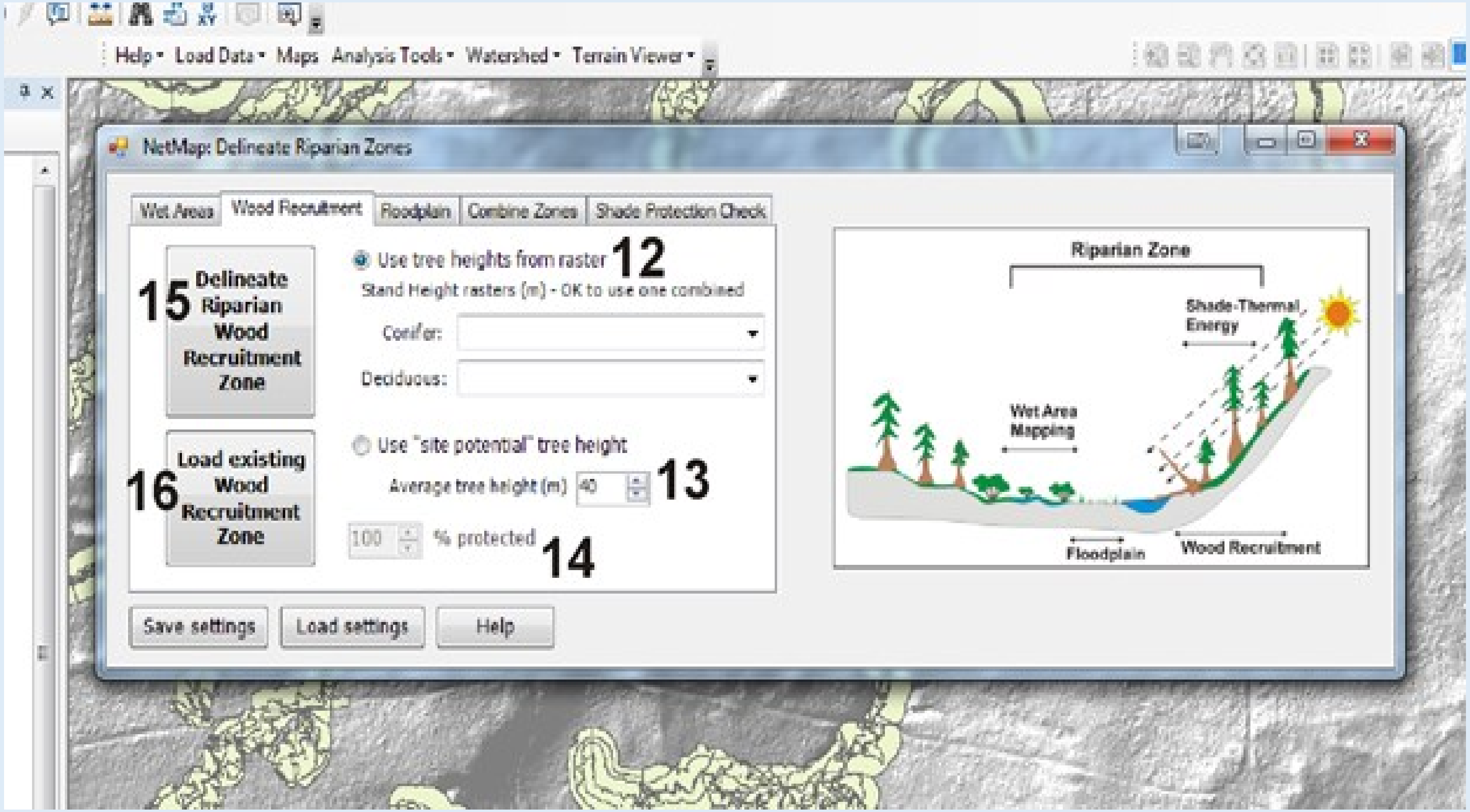


Spatially explicit, variable width riparian zone delineation model

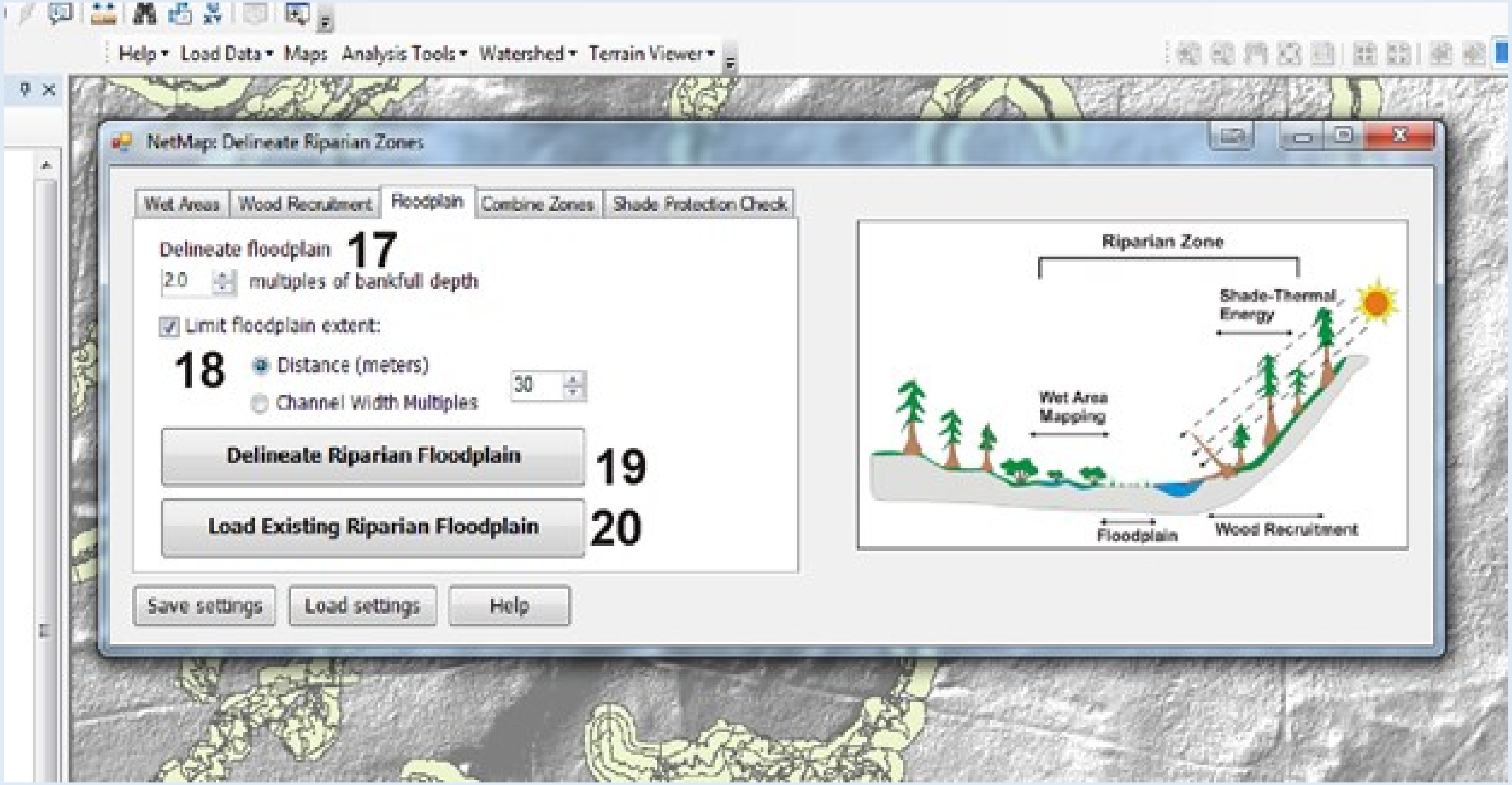


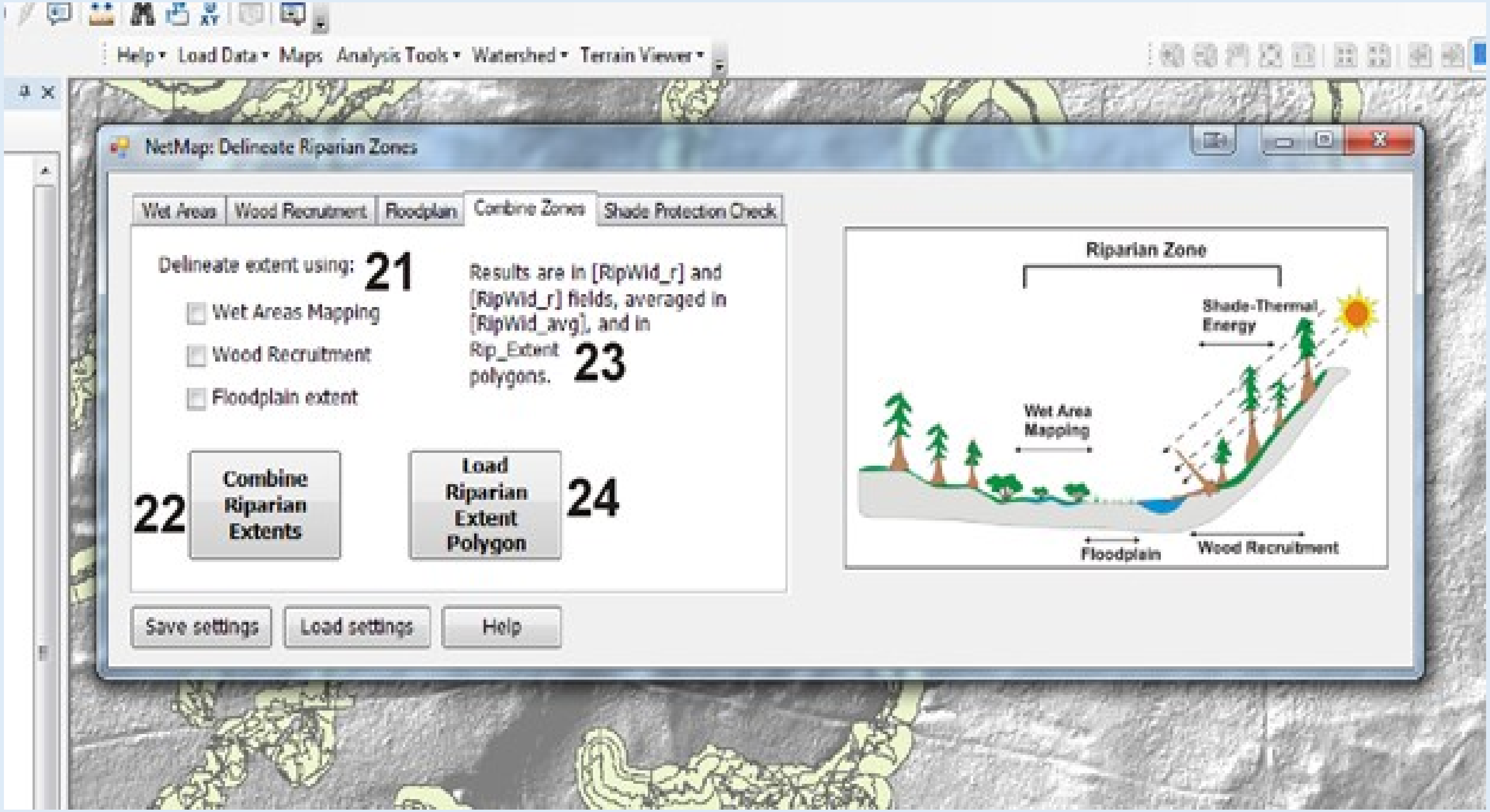


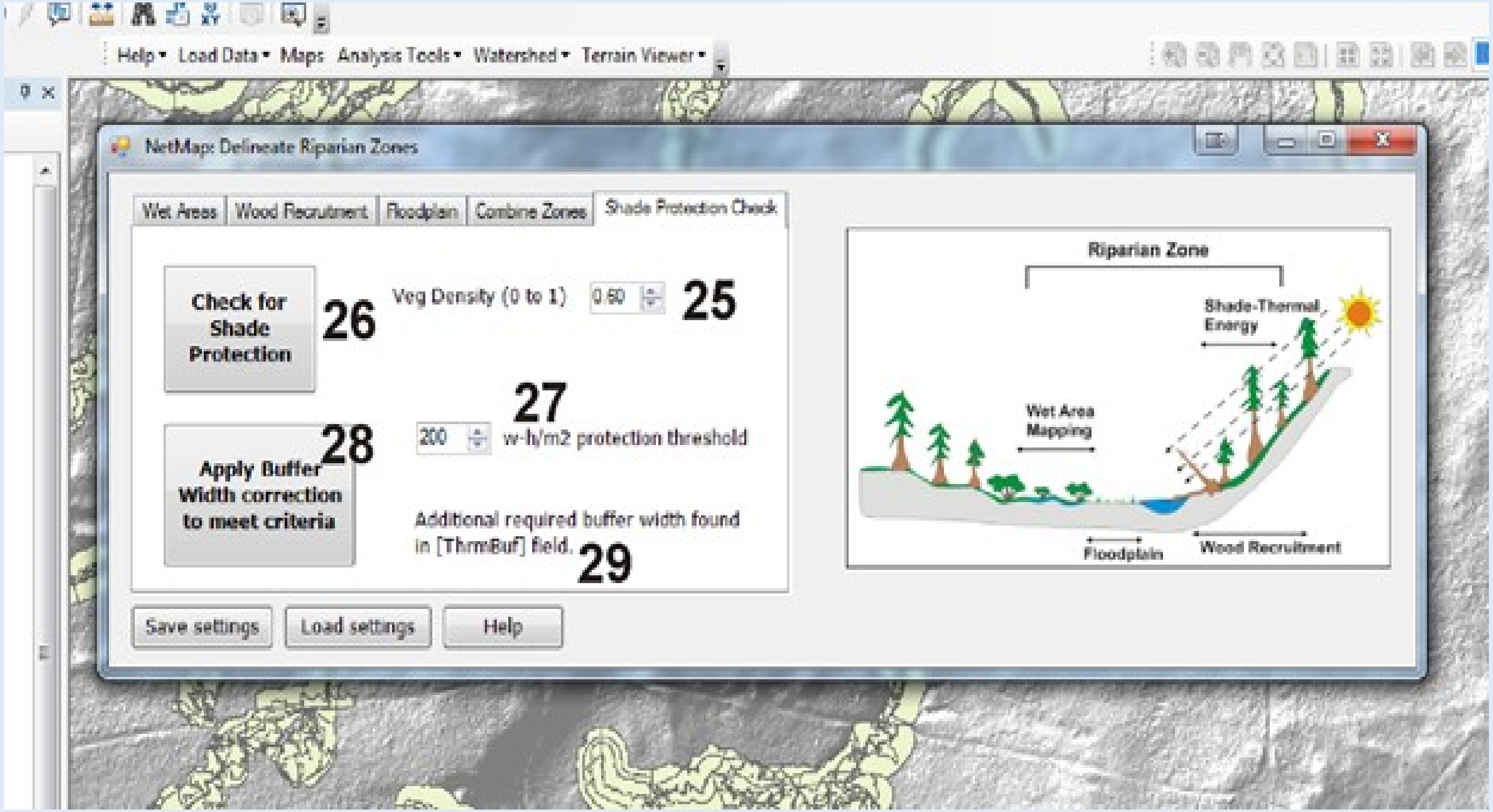
Help Load Data Maps Analysis Tools Watershed Terrain Viewer
NetMap: Delineate Riparian Zones
1
2
3
4
5
Wet Areas
Wood Recruitment
Floodplain
Combine Zones
Shade Protection Check
Wet Areas raster:
6
0.15
7
depth to water table (m)
Limit Wet Areas extent:
8
Distance (meters)
Channel Width Multiples
30
9
Delineate Wet Area riparian zones
10
Load existing Wet Area zone
Save settings
Load settings
Help
11
Riparian Zone
Shade-Thermal Energy
Wet Area Mapping
Floodplain
Wood Recruitment



Help
Load Data
Maps
Analysis Tools
Watershed
Terrain Viewer
NetMap: Delineate Riparian Zones
Wet Areas
Wood Recruitment
Floodplain
Combine Zones
Shade Protection Check
15
Delineate Riparian Wood Recruitment Zone
Use tree heights from raster
12
Stand Height rasters (m) - OK to use one combined
Conifer:
Deciduous:
Use "site potential" tree height
16
Load existing Wood Recruitment Zone
Average tree height (m)
40
13
100
% protected
14
Save settings
Load settings
Help
Riparian Zone
Shade-Thermal Energy
Wet Area Mapping
Floodplain
Wood Recruitment


Help
Load Data
Maps
Analysis Tools
Watershed
Terrain Viewer
NetMap: Delineate Riparian Zones
Wet Areas
Wood Recruitment
Floodplain
Combine Zones
Shade Protection Check
Delineate floodplain
17
2.0
multiples of bankfull depth
Limit floodplain extent:
18
Distance (meters)
Channel Width Multiples
30
Delineate Riparian Floodplain
19
Load Existing Riparian Floodplain
20
Save settings
Load settings
Help
Riparian Zone
Shade-Thermal Energy
Wet Area Mapping
Floodplain
Wood Recruitment


Help Load Data Maps Analysis Tools Watershed Terrain Viewer
NetMap: Delineate Riparian Zones
Wet Areas
Wood Recruitment
Floodplain
Combine Zones
Shade Protection Check
Delineate extent using:
21
Wet Areas Mapping
Wood Recruitment
Floodplain extent
Results are in [RipWid_r] and [RipWid_r] fields, averaged in [RipWid_avg], and in Rip_Extent polygons.
23
22
Combine Riparian Extents
Load Riparian Extent Polygon
24
Save settings
Load settings
Help
Riparian Zone
Shade-Thermal Energy
Wet Area Mapping
Floodplain
Wood Recruitment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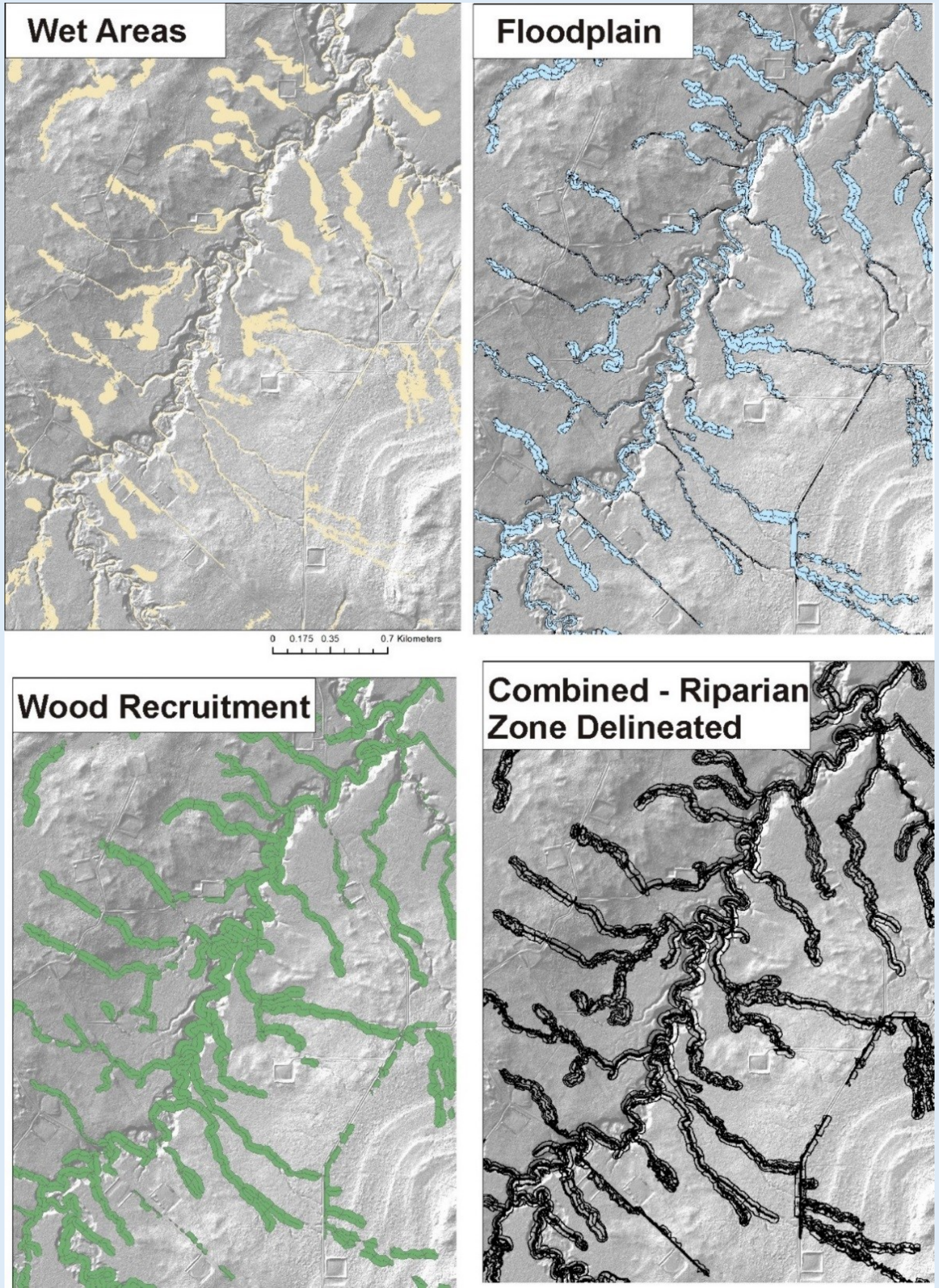
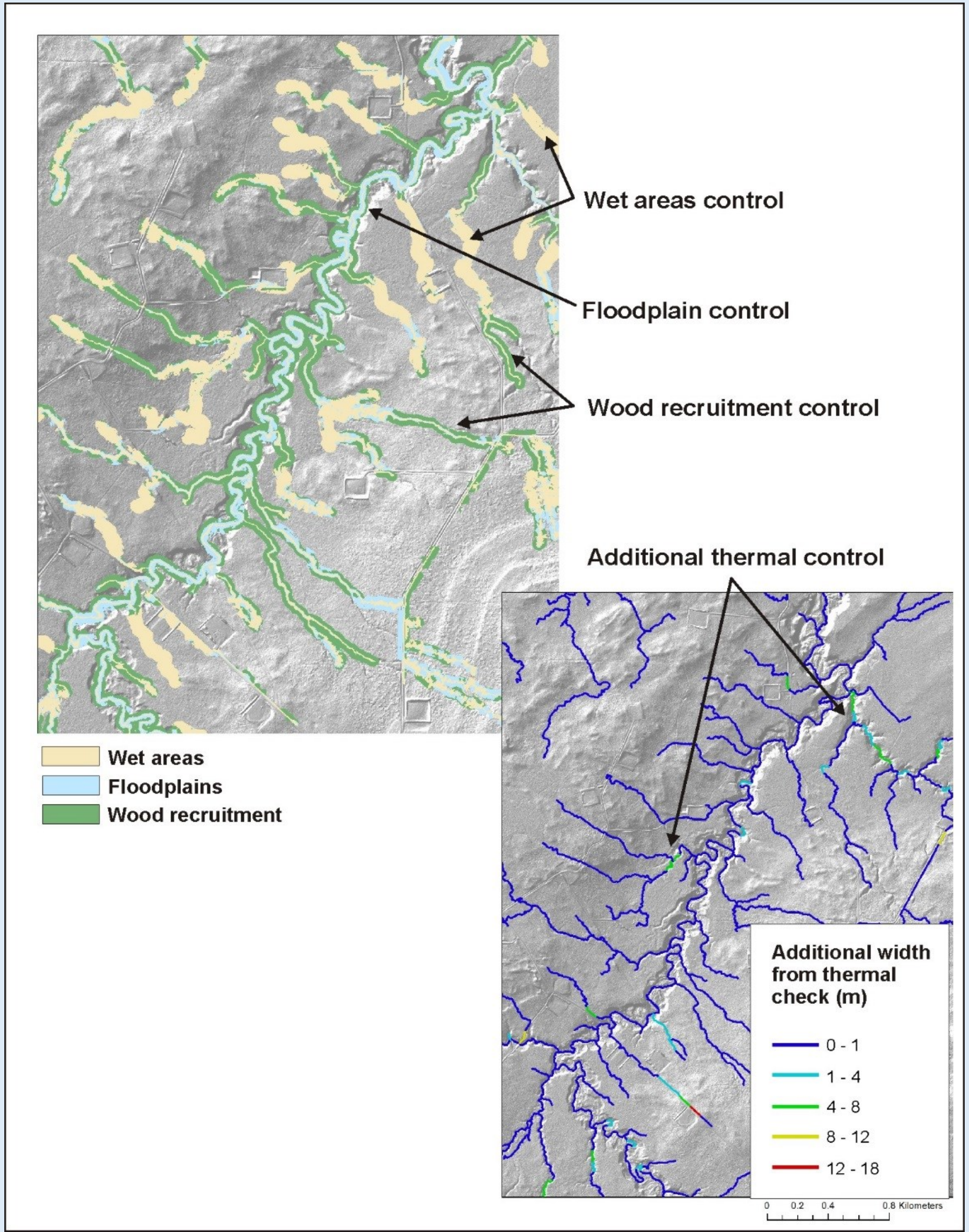
Load Data
Maps
Analysis Tools
Watershed
Terrain Viewer
NetMap: Delineate Riparian Zones
Wet Areas
Wood Recruitment
Floodplain
Combine Zones
Shade Protection Check
Check for Shade Protection
26
Veg Density (0 to 1)
0.60
25
27
Apply Buffer Width correction to meet criteria
28
200
w-h/m2 protection threshold
Additional required buffer width found in [ThrmBuf] field.
29
Save settings
Load settings
Help
Riparian Zone
Shade-Thermal Energy
Wet Area Mapping
Floodplain
Wood Recruitment


Wet Areas
Floodplain
0 0.175 0.35 0.7 Kilometers
Wood Recruitment
Combined - Riparian Zone Delineated


Wet areas control
Floodplain control
Wood recruitment control
Additional thermal control
Wet areas
Floodplains
Wood recruitment
Additional width from thermal check (m)
0 - 1
1 - 4
4 - 8
8 - 12
12 - 18
0 0.2 0.4 0.8 Kilometers

Predicted Spatial Variability in Delineated Riparian Zone in the Simonette basin