

An aerial photograph of a landscape with various land cover types, including green fields, brown patches, and some buildings. Overlaid on the map are several concentric, irregular contour lines in red, purple, blue, and cyan. These lines represent different levels of Potential Cumulative Impact (PCI). A small green square is located at the top center of the map, within the innermost contour lines.

PCI

Potential Cumulative Impact

Developing a multi-scale, spatially explicit estimator of the impacts of land cover change on aquatic resources.

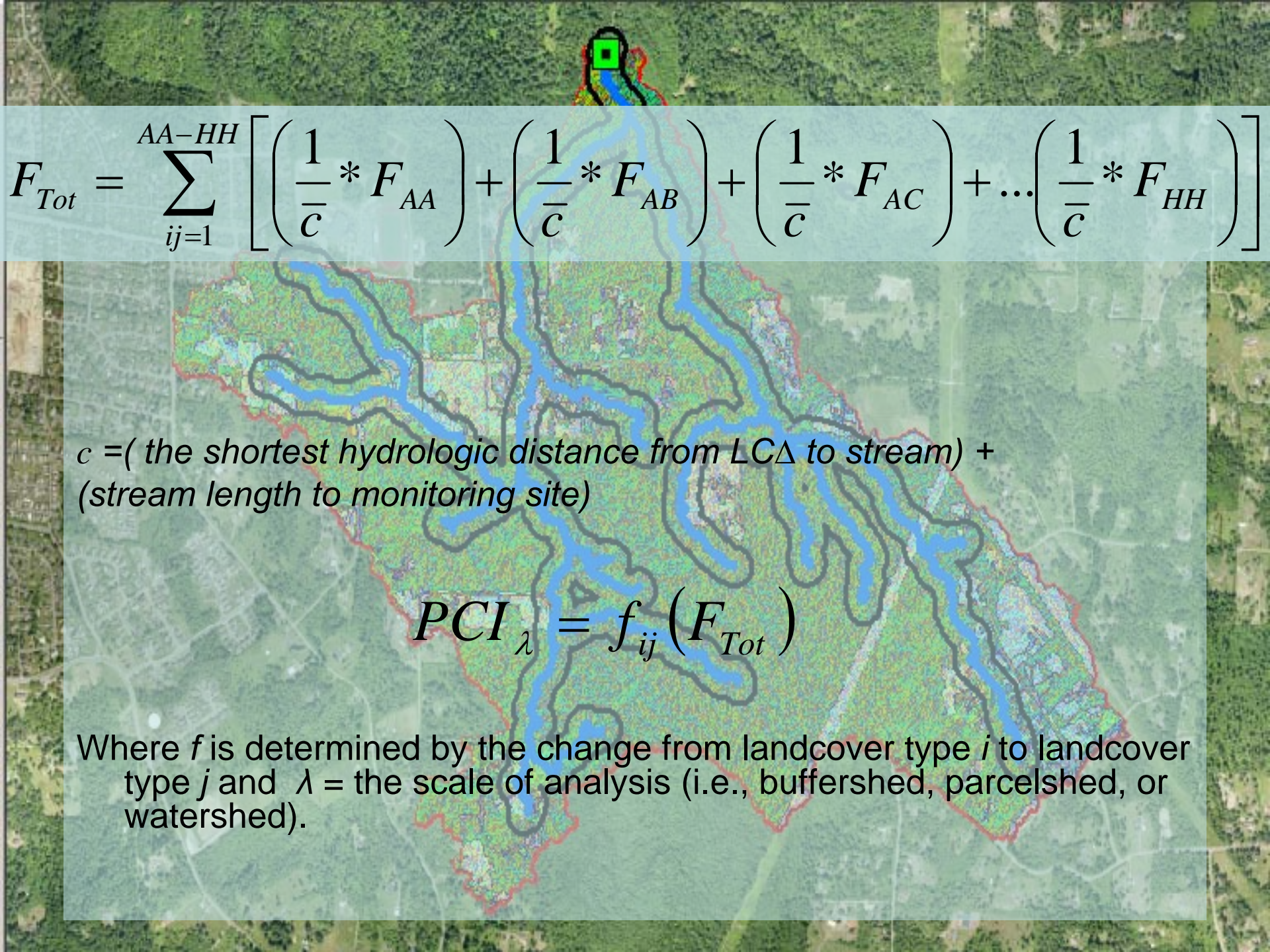
WOW is this complicated!

Types of Resolution

- **Spatial**
6ft grids, buffershed, parcelshed, watershed
- **Temporal**
2005, 2007, 2009, 2010, 2012
- **Radiometric**
 8^1 (each year), 8^2 (each pair of years), 8^{5+n} (study duration – including n years of historical landscape reconstruction)
- **Phenomenological**
 - Benthos (e.g., BIBI), hydrology, stream geomorphology, water chemistry, landcover

		A	B	C	D	E	F	G	H
		Tree	Shrub	Herb	Building	Paved	Unpaved	Water	Wetland
A	Tree								
B	Shrub								
C	Herb								
D	Building								
E	Paved								
F	Unpaved								
G	Water								
H	Wetland								

		A	B	C	D	E	F	G	H
		Tree	Shrub	Herb	Building	Paved	Unpaved	Water	Wetland
A	Tree		AB	AC	AD	AE	AF	AG	AH
B	Shrub	BA		BC	BD	BE	BF	BG	BH
C	Herb	CA	CB		CD	CE	CF	CG	CH
D	Building	DA	DB	DC		DE	DF	DG	DH
E	Paved	EA	EB	EC	ED		EF	EG	EH
F	Unpaved	FA	FB	FC	FD	FE		FG	FH
G	Water	GA	GB	GC	GD	GE	GF		GH
H	Wetland	HA	HB	HC	HD	HE	HF	HG	



$$F_{Tot} = \sum_{ij=1}^{AA-HH} \left[\left(\frac{1}{\bar{c}} * F_{AA} \right) + \left(\frac{1}{\bar{c}} * F_{AB} \right) + \left(\frac{1}{\bar{c}} * F_{AC} \right) + \dots \left(\frac{1}{\bar{c}} * F_{HH} \right) \right]$$

$c =$ (the shortest hydrologic distance from $LC\Delta$ to stream) +
 (stream length to monitoring site)

$$PCI_{\lambda} = f_{ij} (F_{Tot})$$

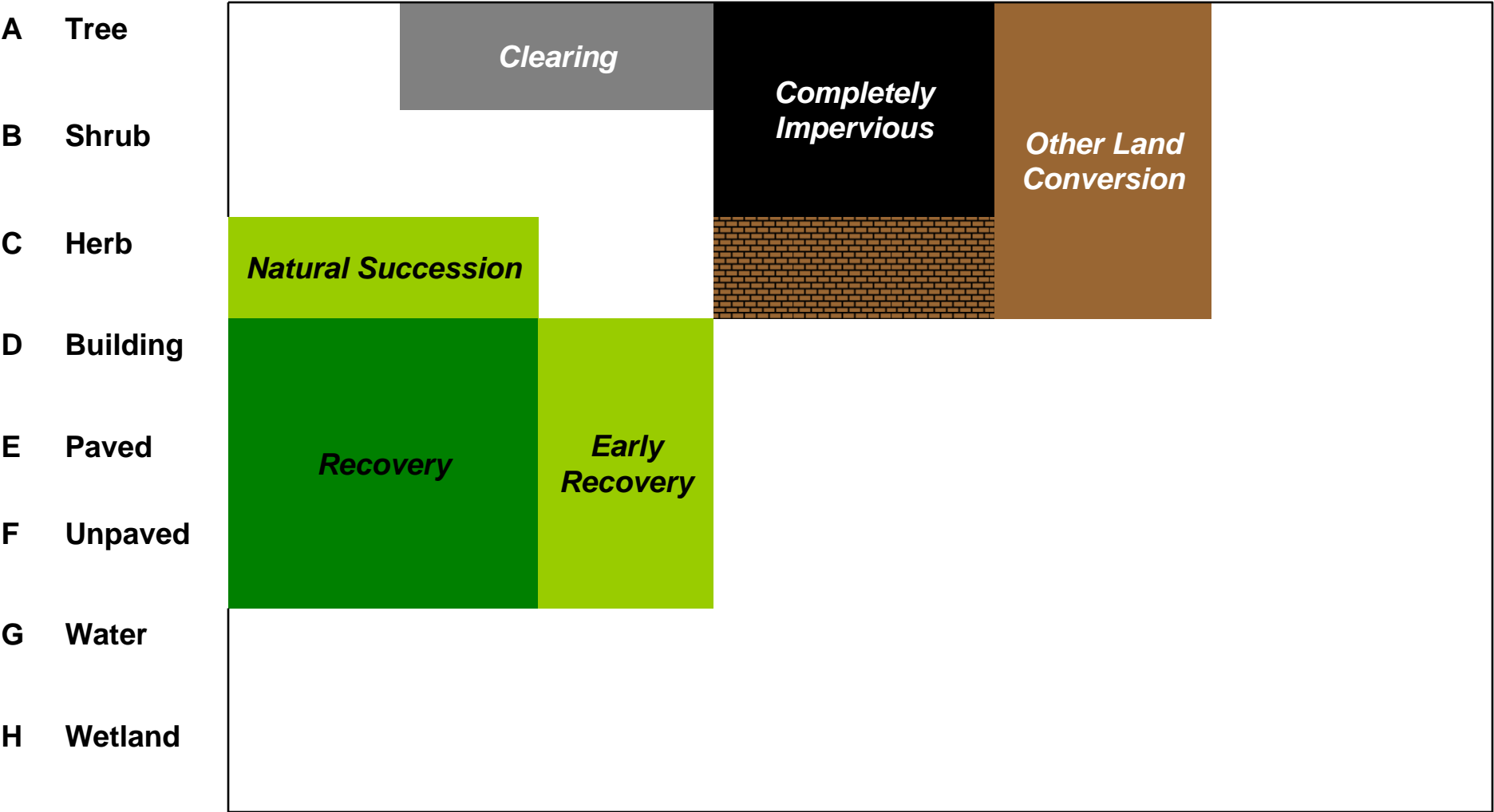
Where f is determined by the change from landcover type i to landcover type j and λ = the scale of analysis (i.e., buffershed, parcelshed, or watershed).

		A	B	C	D	E	F	G	H
		Tree	Shrub	Herb	Building	Paved	Unpaved	Water	Wetland
A	Tree		AB	AC	AD	AE	AF		
B	Shrub	BA		BC	BD	BE	BF		
C	Herb	CA			CD	CE	CF		
D	Building	DA	DB	DC					
E	Paved	EA	EB	EC					
F	Unpaved	FA	FB	FC					
G	Water								
H	Wetland								

A	B	C	D	E	F	G	H
Tree	Shrub	Herb	Building	Paved	Unpaved	Water	Wetland

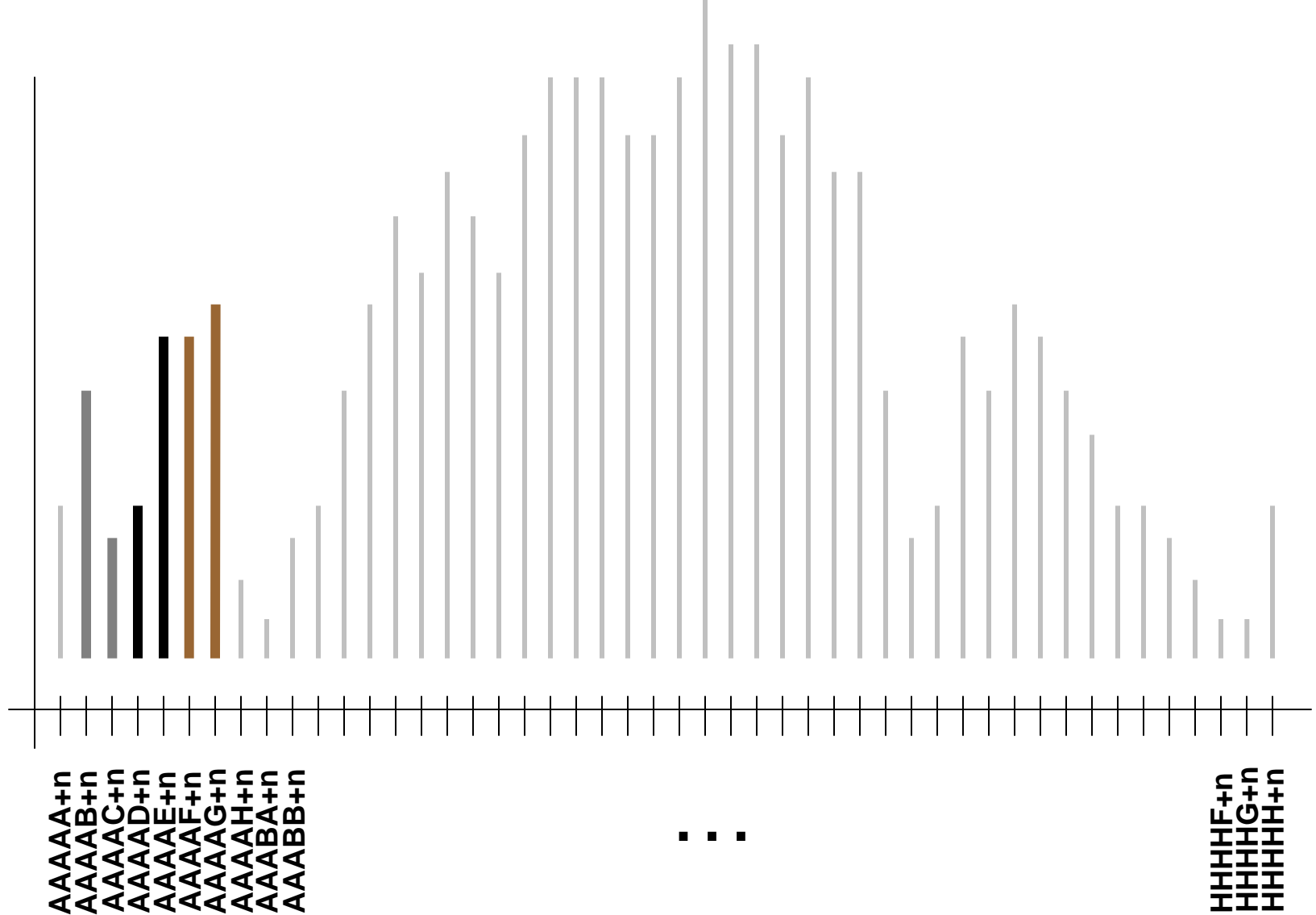
A	Tree		AB	AC	AD	AE	AF	
B	Shrub				BD	BE	BF	
C	Herb	CA	CB		CD	CE	CF	
D	Building	DA	DB	DC				
E	Paved	EA	EB	EC				
F	Unpaved	FA	FB	FC				
G	Water							
H	Wetland							

A	B	C	D	E	F	G	H
Tree	Shrub	Herb	Building	Paved	Unpaved	Water	Wetland

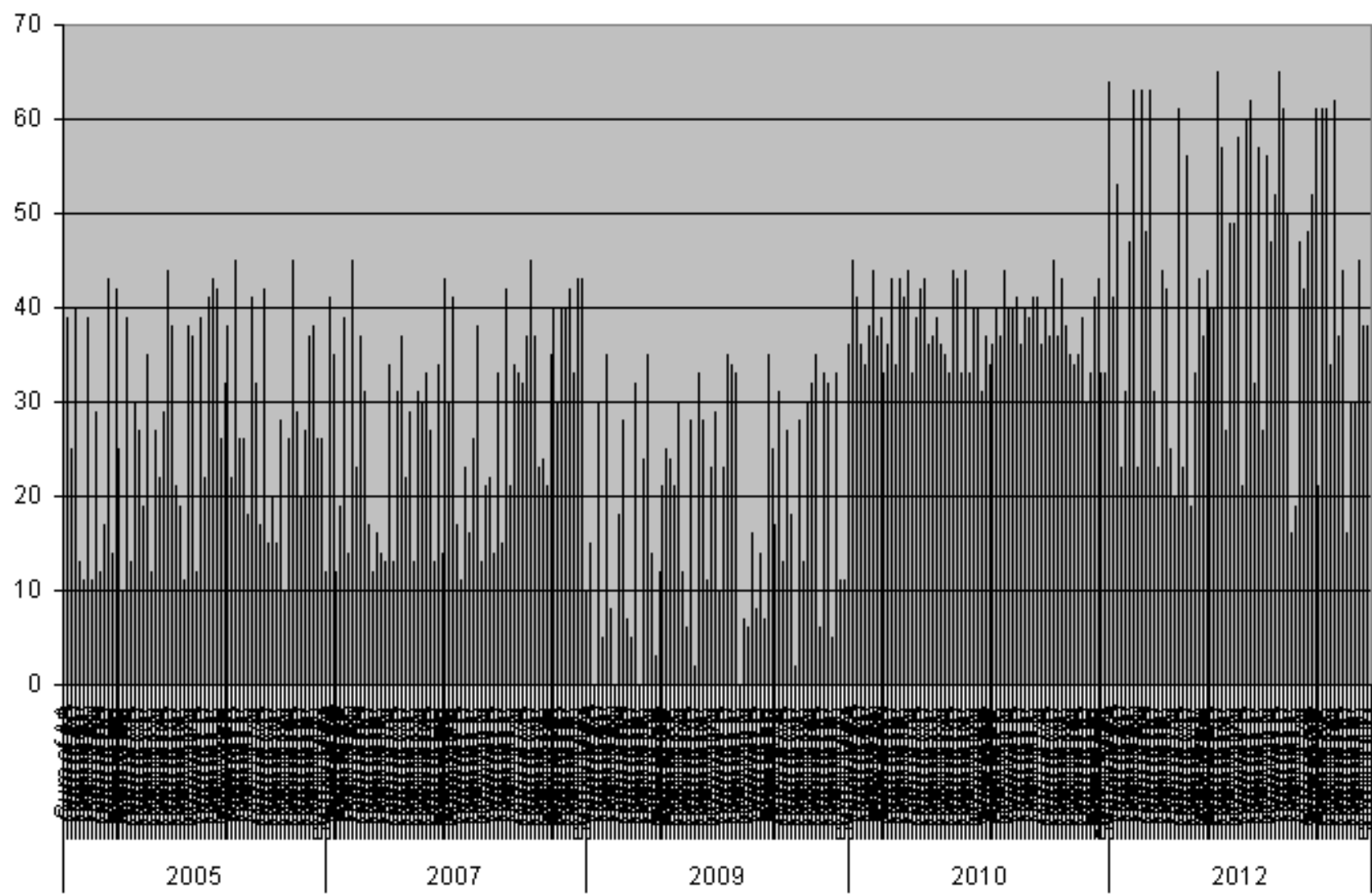


		A	B	C	D	E	F	G	H
		Tree	Shrub	Herb	Building	Paved	Unpaved	Water	Wetland
A	Tree		AB	AC	AD	AE	AF	AG	AH
B	Shrub	BA		BC	BD	BE	BF	BG	BH
C	Herb	CA	CB		CD	CE	CF	CG	CH
D	Building	DA	DB	DC		DE	DF	DG	DH
E	Paved	EA	EB	EC	ED		EF	EG	EH
F	Unpaved	FA	FB	FC	FD	FE		FG	FH
G	Water	GA	GB	GC	GD	GE	GF		GH
H	Wetland	HA	HB	HC	HD	HE	HF	HG	

f



These $5+n$ codes represent the legacy of each grid cell across 5 possible temporal states plus n historical states. There are 8^{5+n} possibilities for each gridcell.



An aerial photograph of a forested area. A green square marker is located at the top center. From this marker, two lines (one cyan and one blue) extend downwards, following a path through the trees. A red line outlines a larger, irregular area that encompasses the path and extends to the right. The background is a dense green forest.

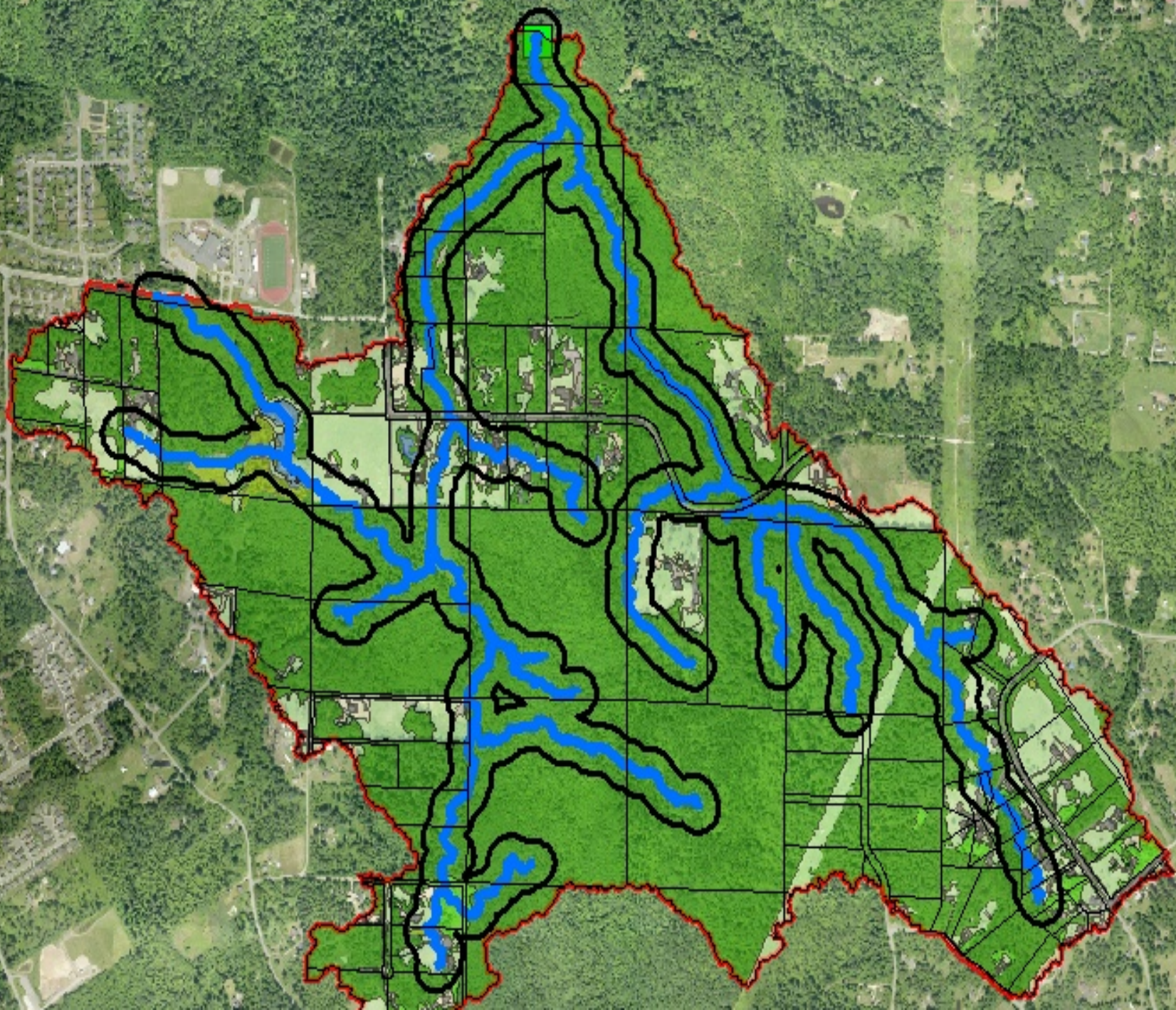
CAUTION

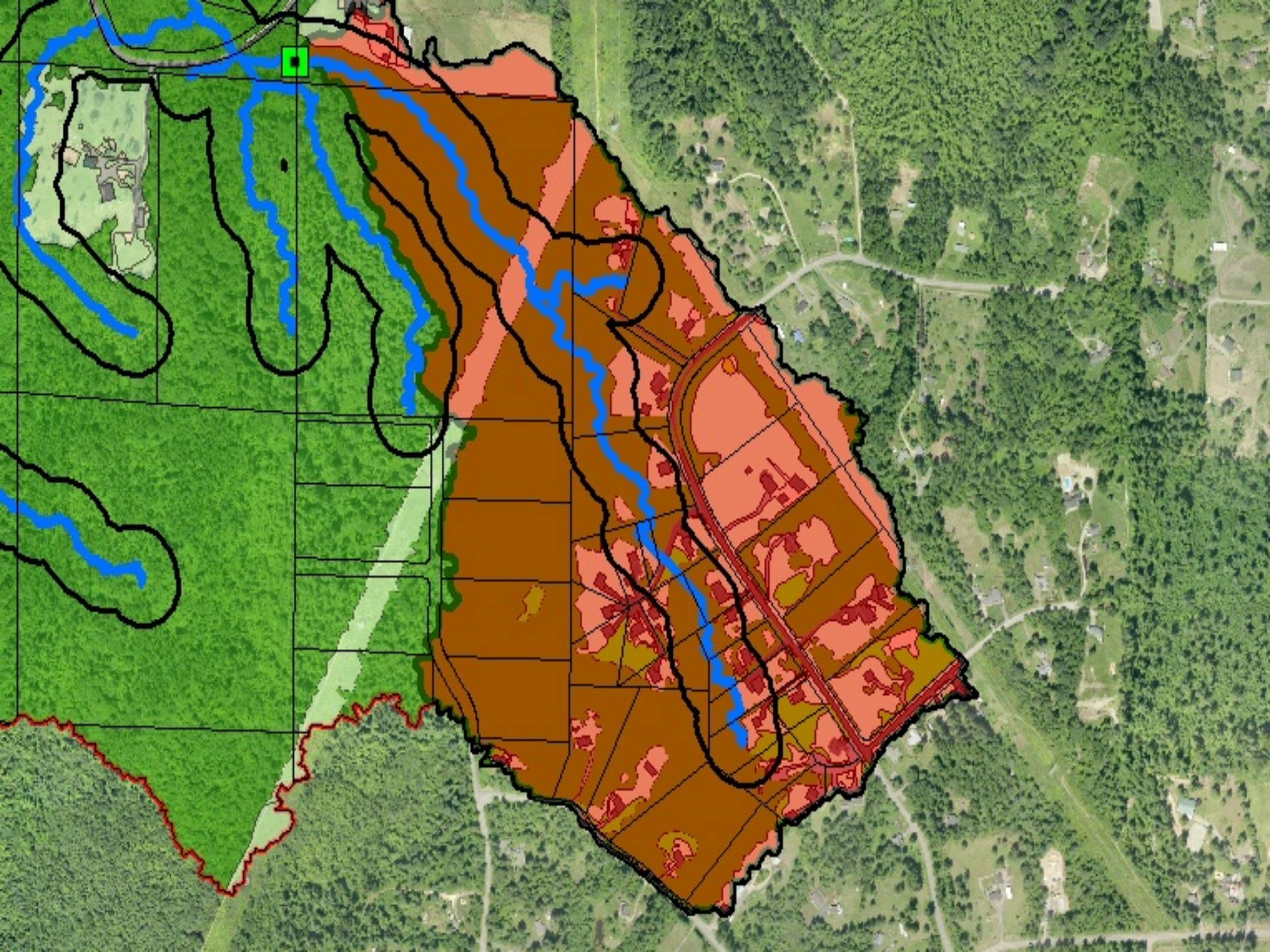
SPATIALLY

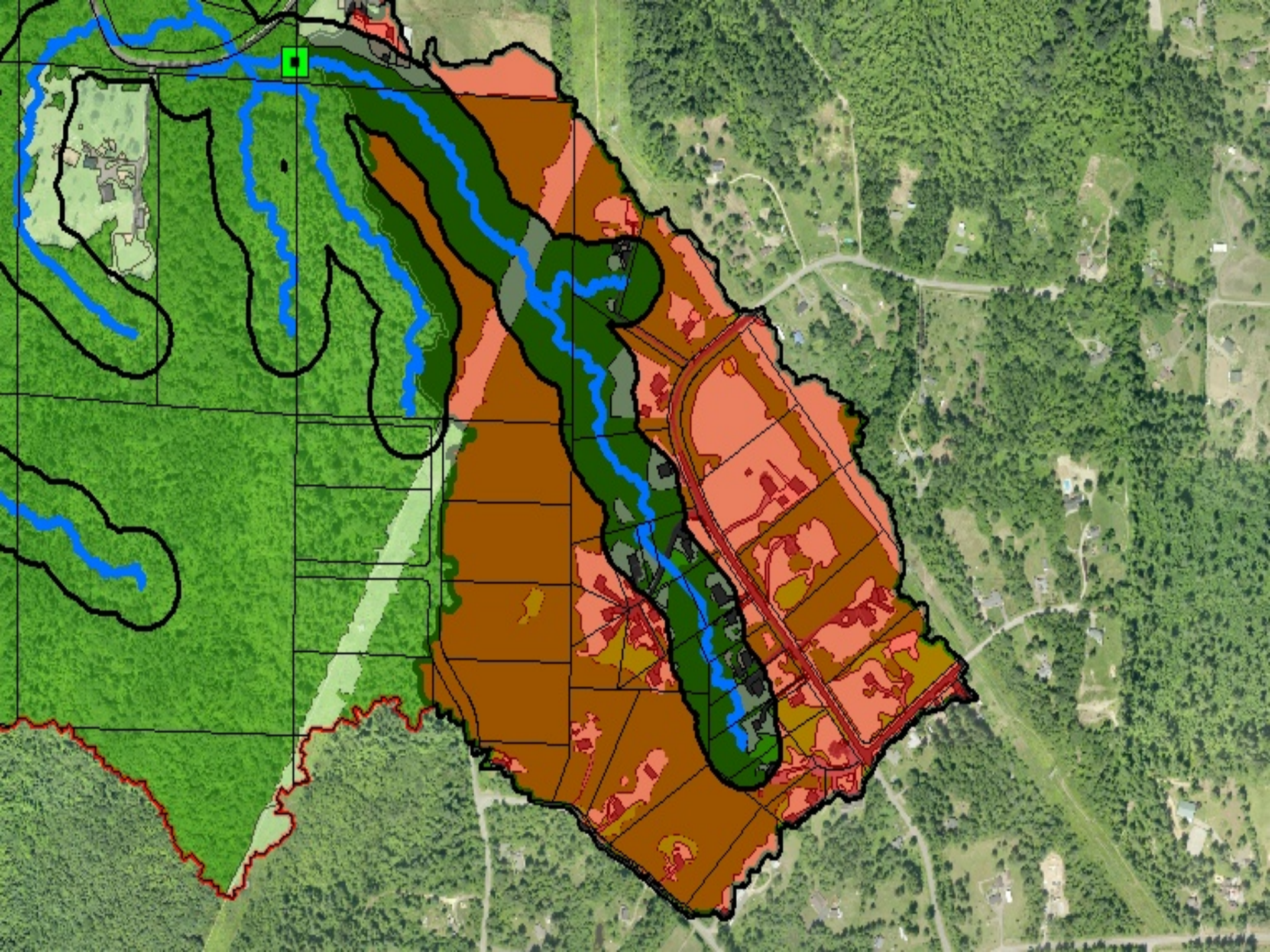
EXPLICIT CONTENT

Spatially Explicit Analysis

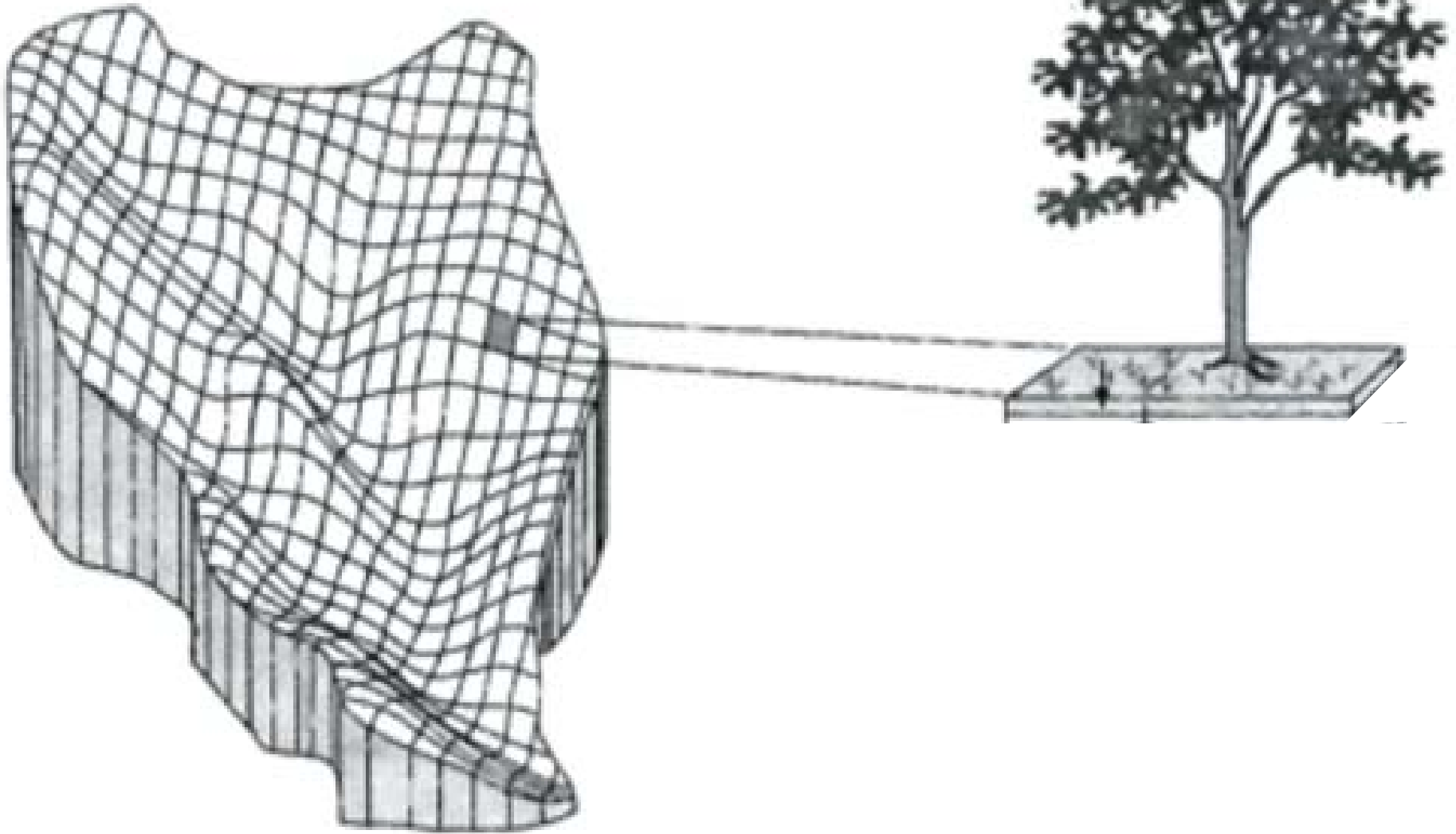
- Three scales of analysis
 - Watershed
 - Parcelshed
 - Buffershed
- Three measures of connectivity
 - Euclidian distance from the sampling location
 - Euclidian distance from stream network
 - Hydrologic distance from sampling location





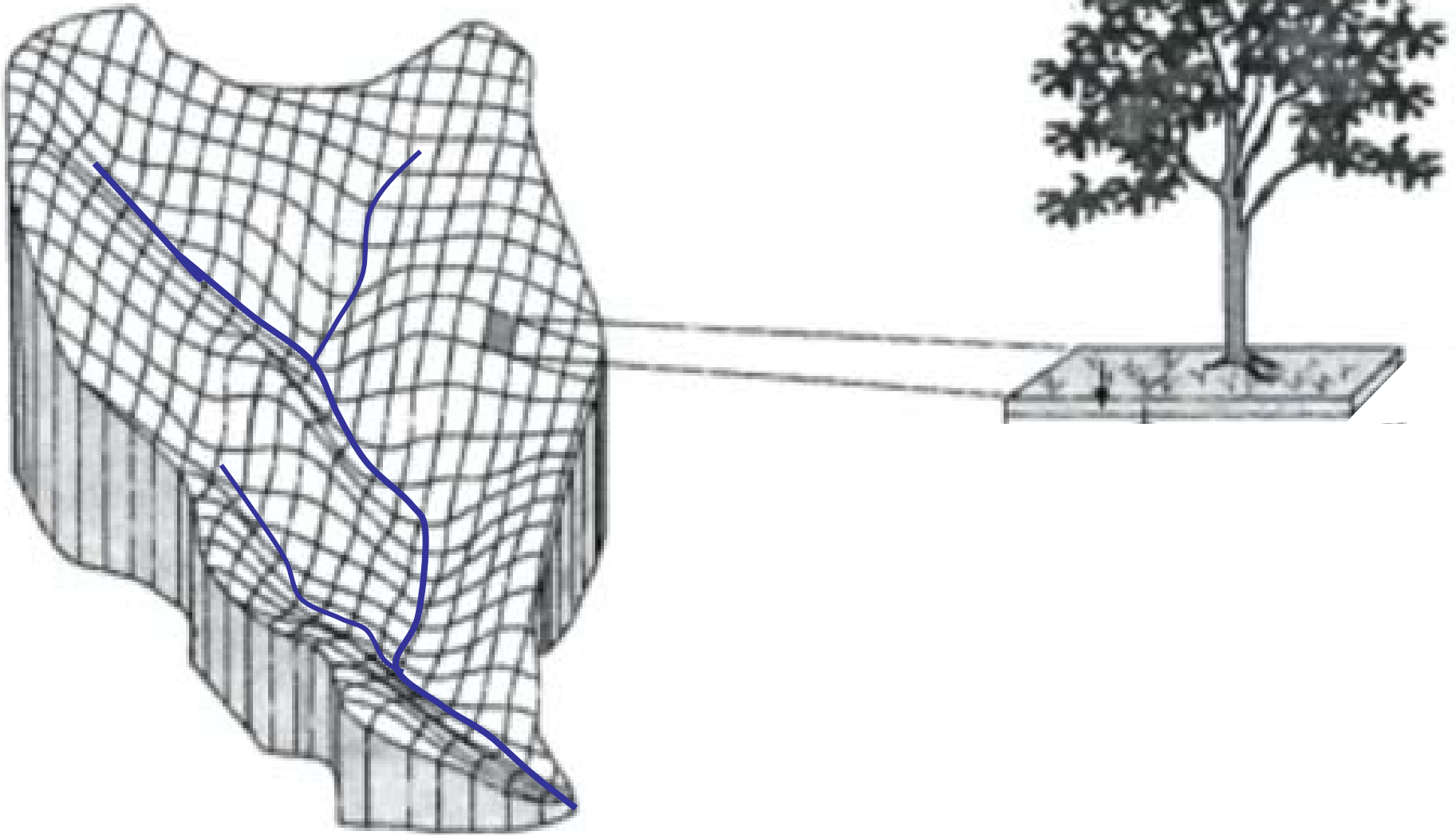


Shortest Euclidean Distance



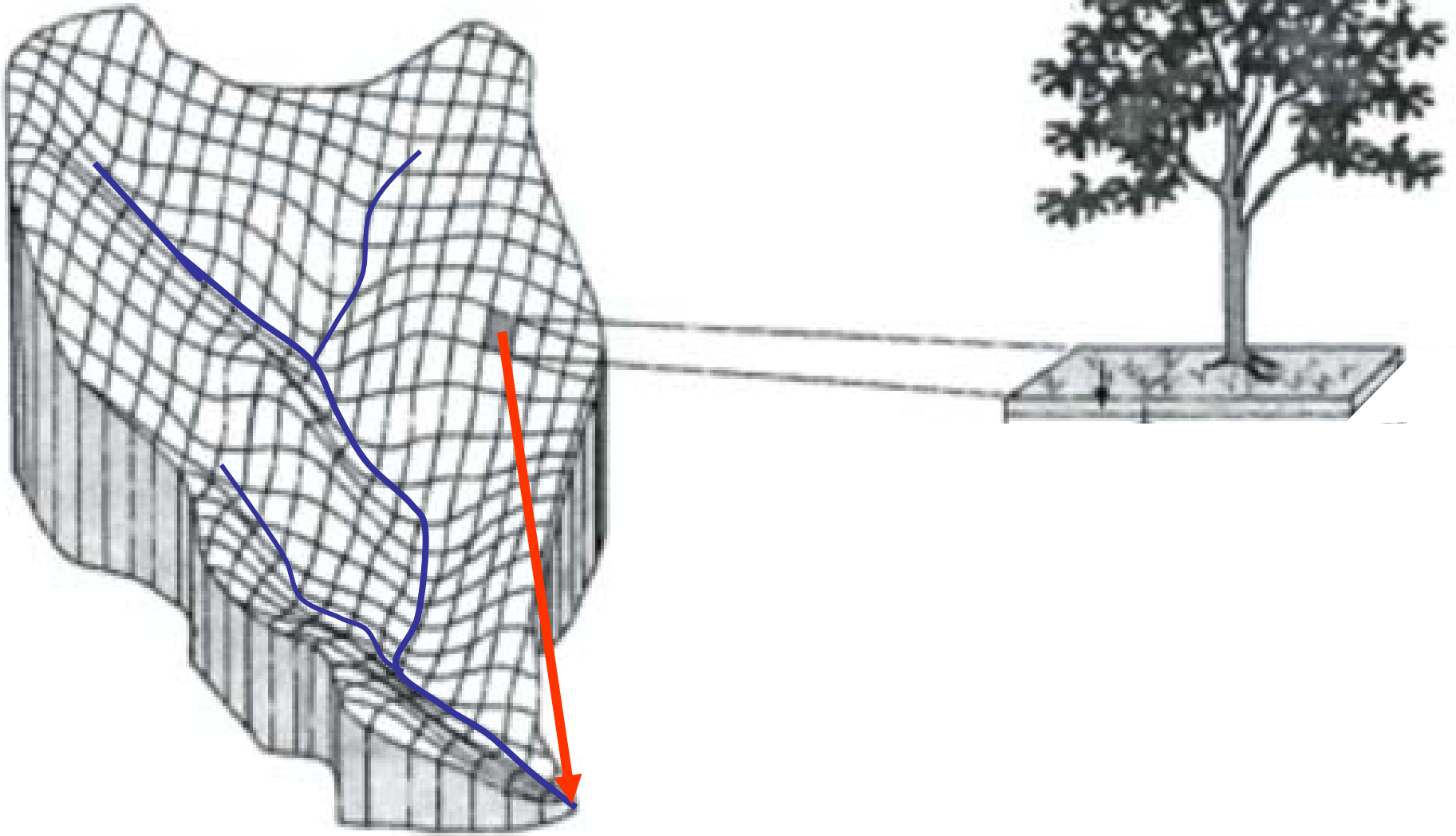
From: Wigmosta et al., (1994)

Shortest Euclidean Distance

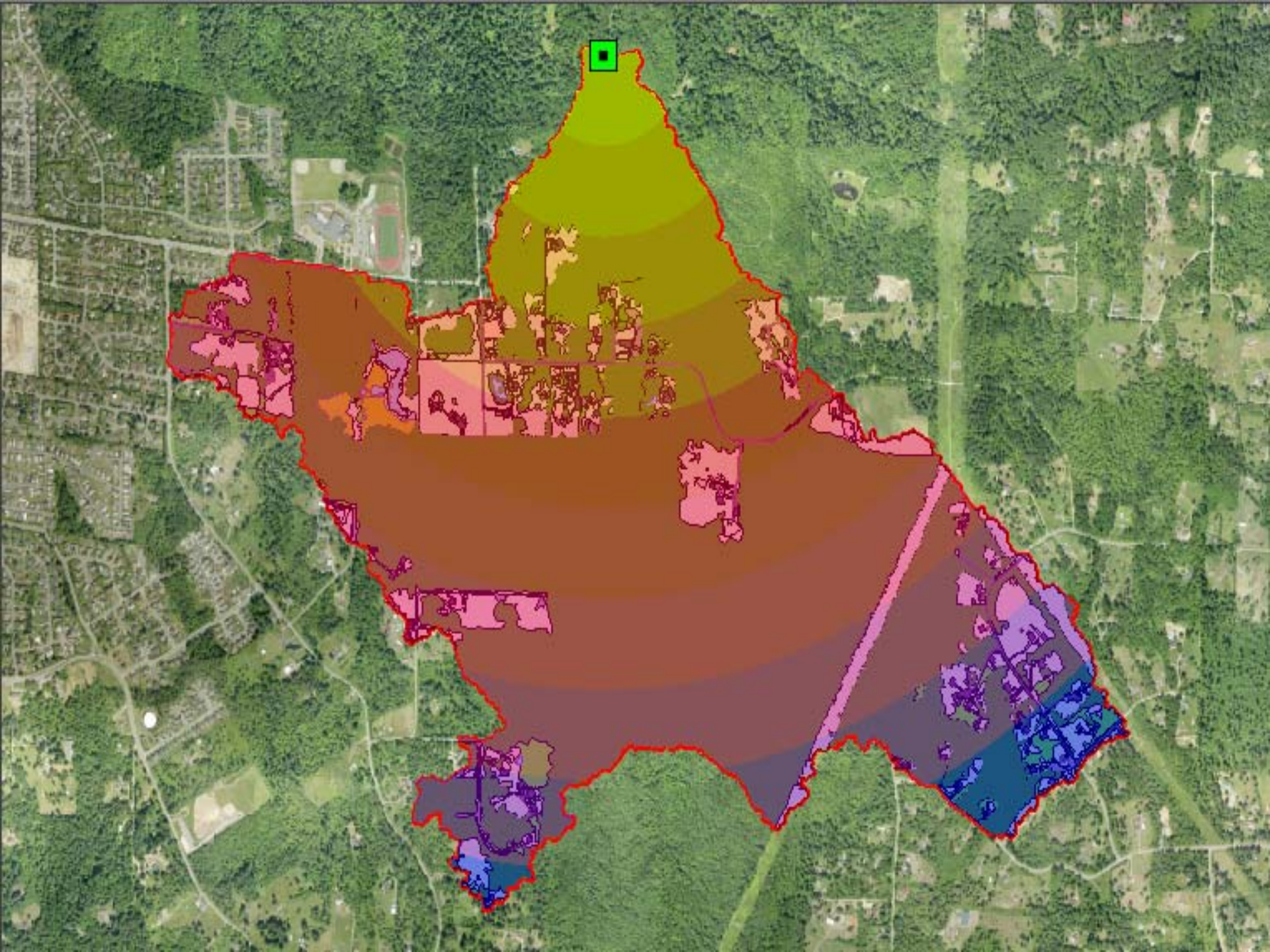


From: Wigmosta et al., (1994)

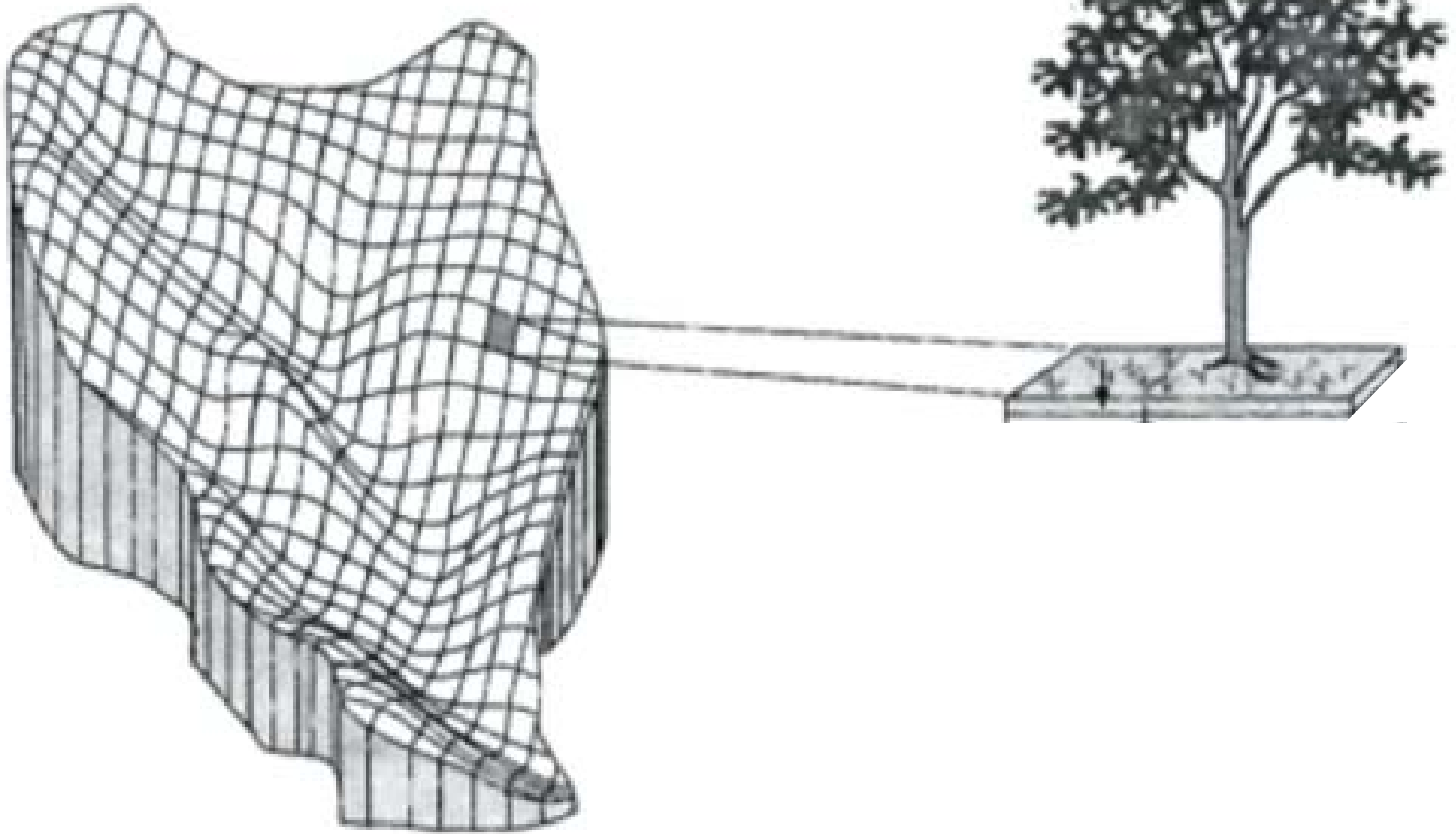
Shortest Euclidean Distance



From: Wigmosta et al., (1994)

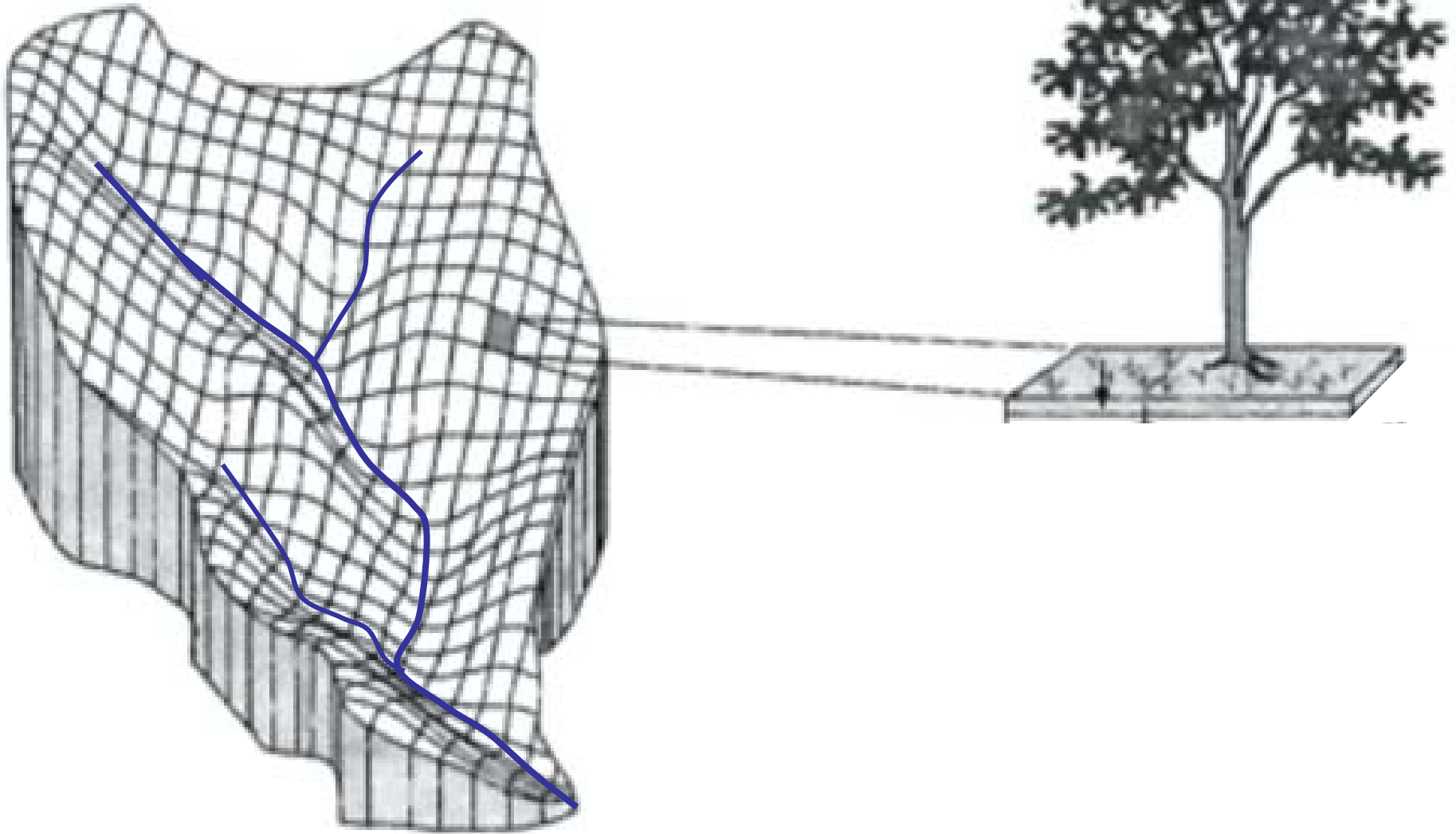


Shortest Distance to Stream



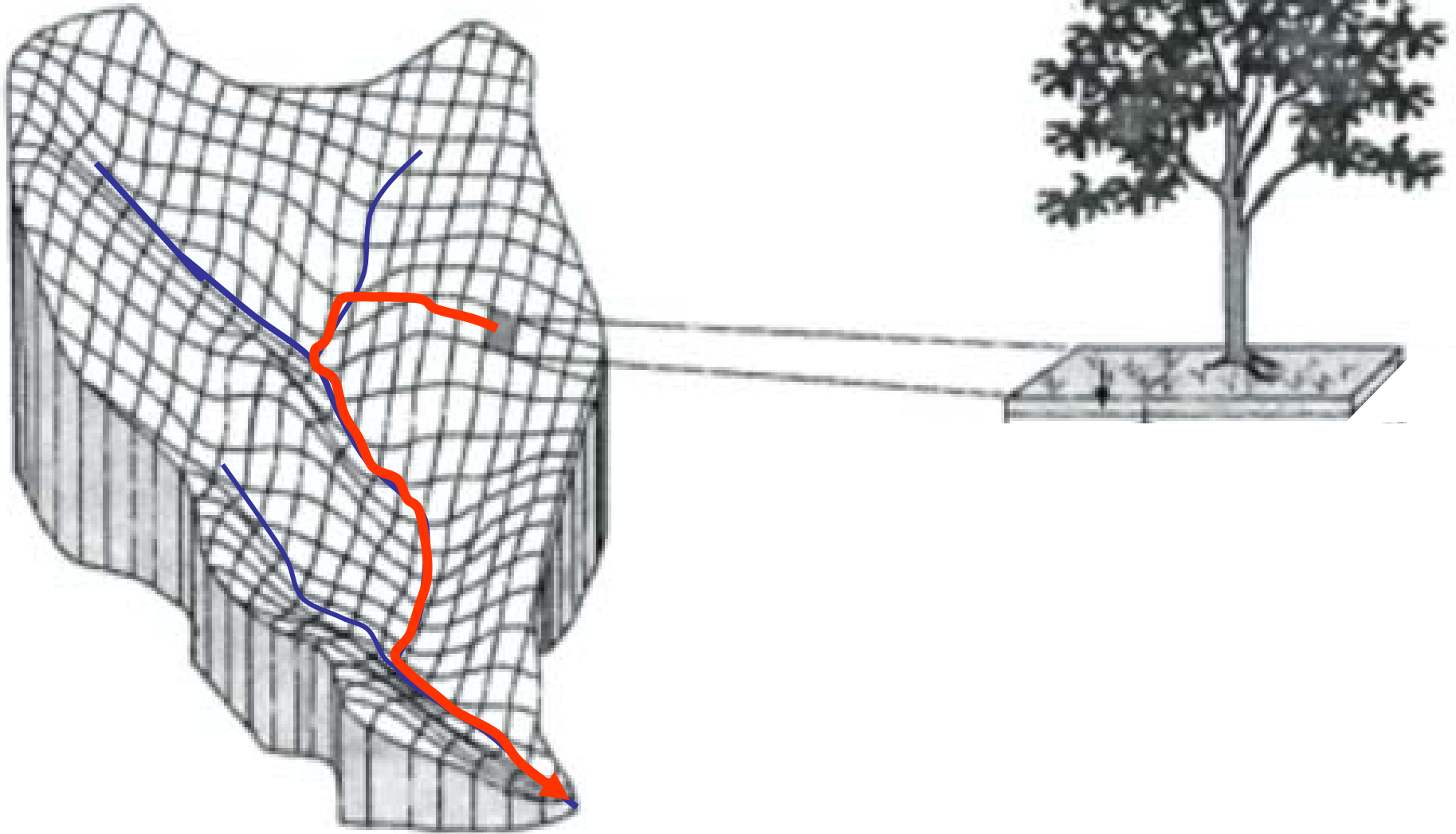
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Shortest Distance to Stream



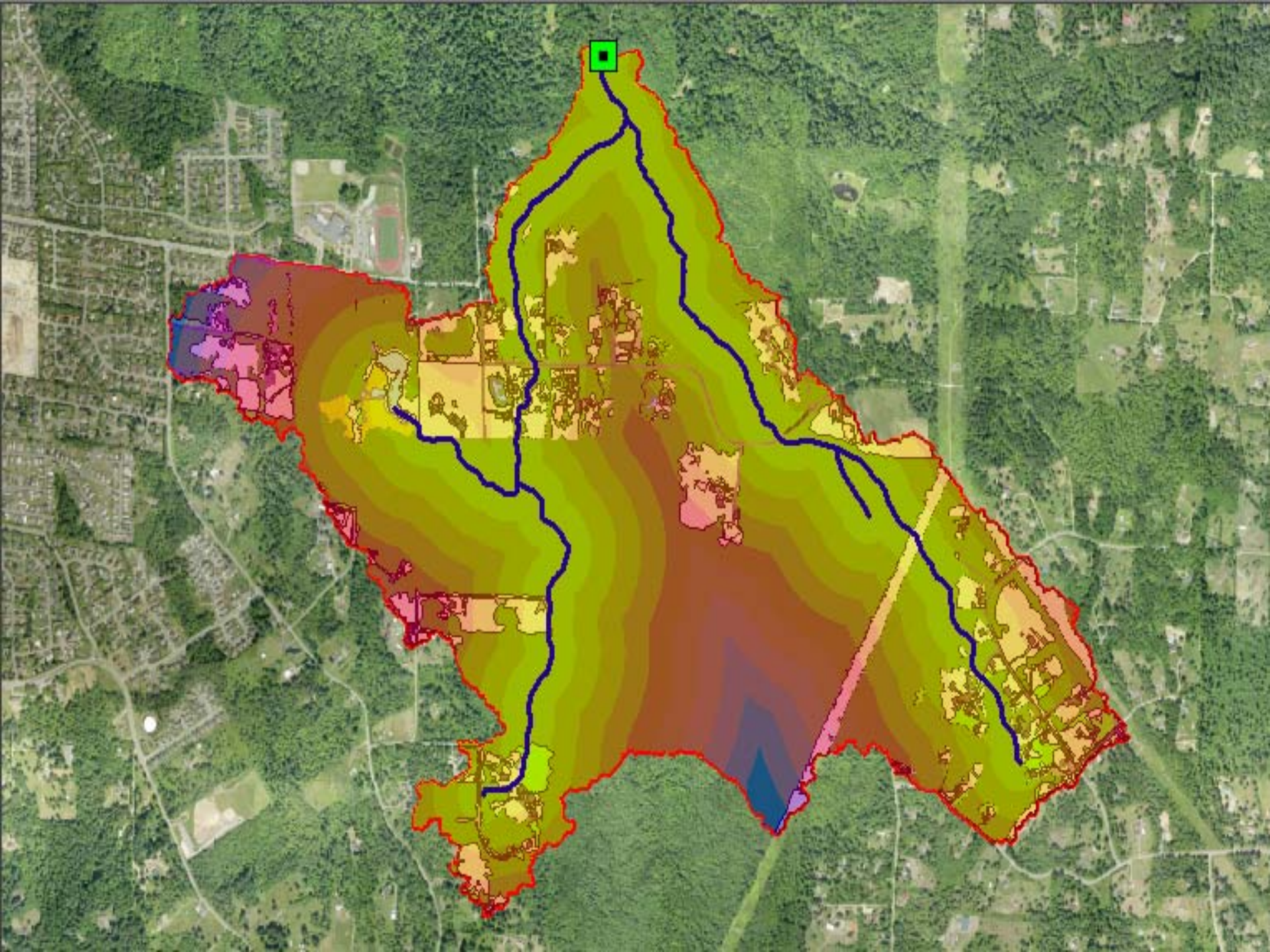
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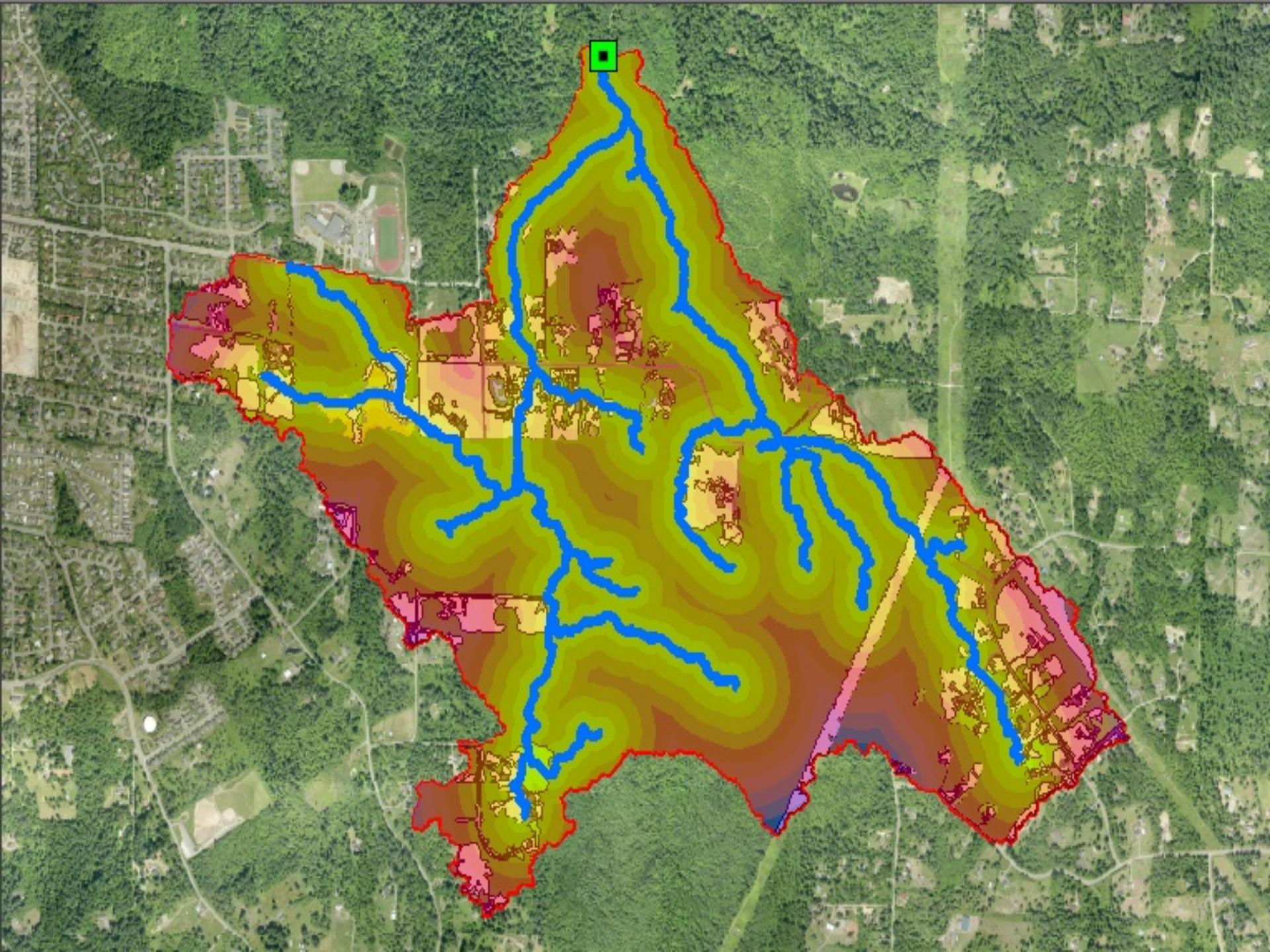
Shortest Distance to Stream



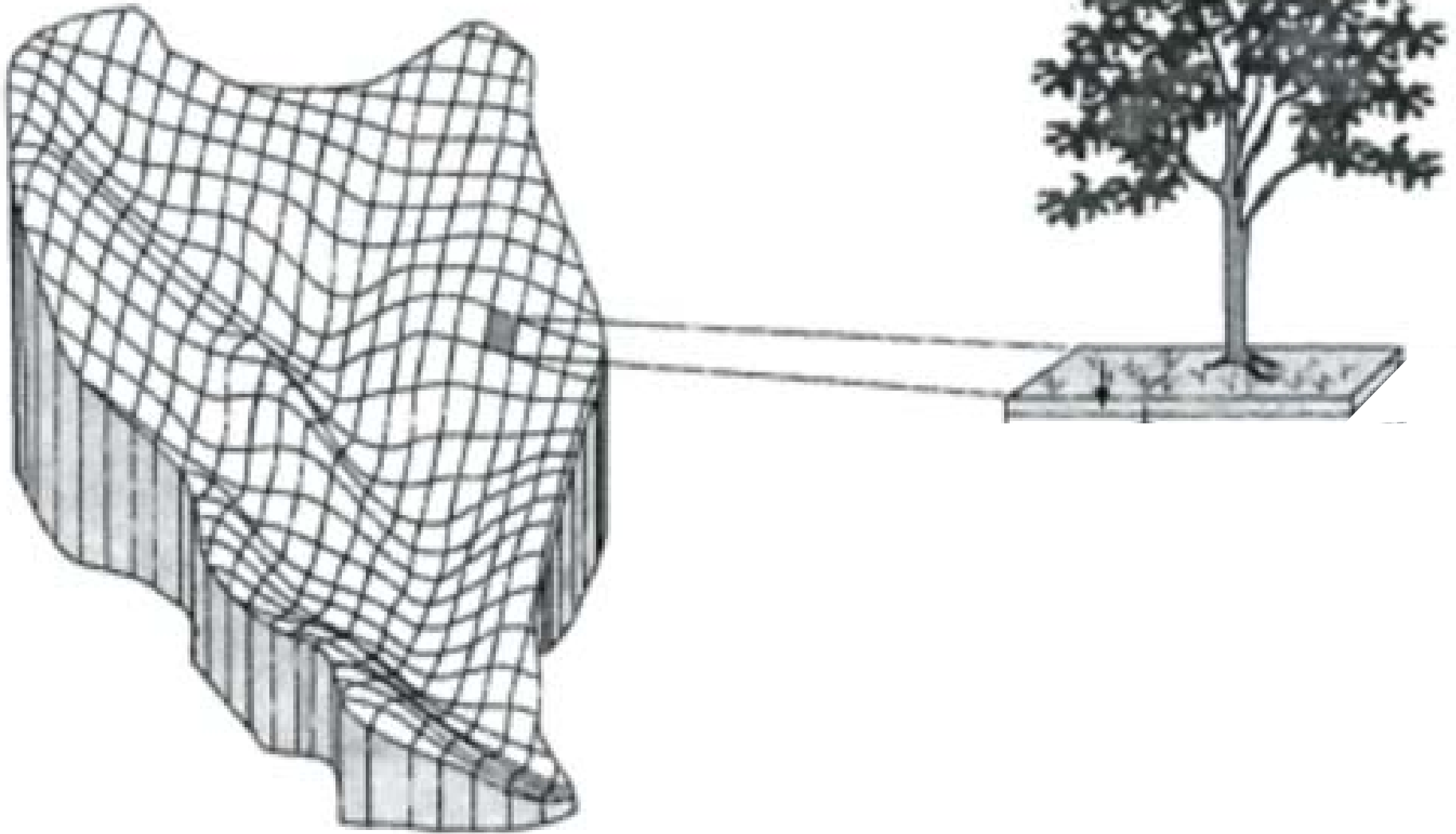
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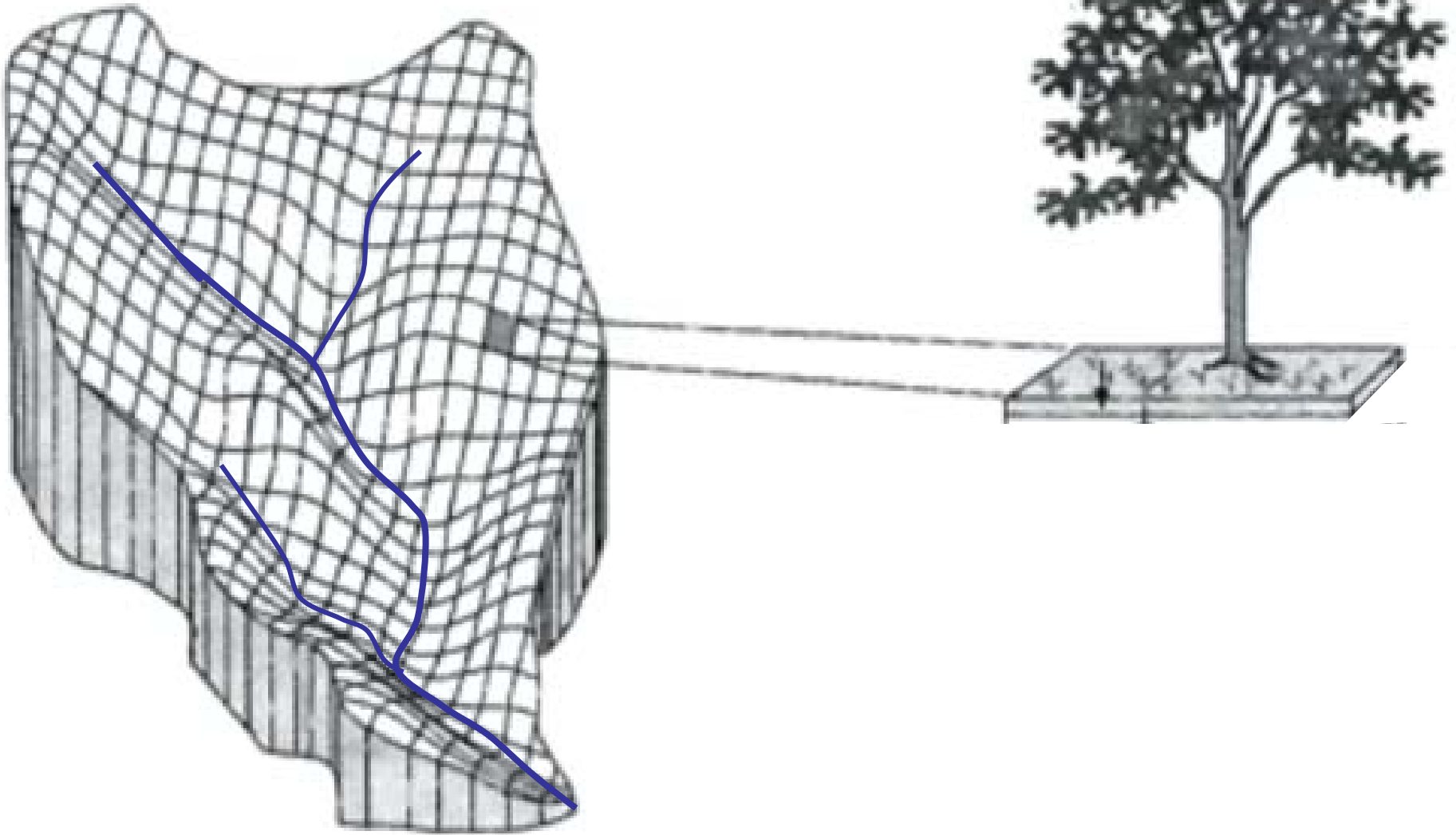


Shortest Hydrologic Connectivity



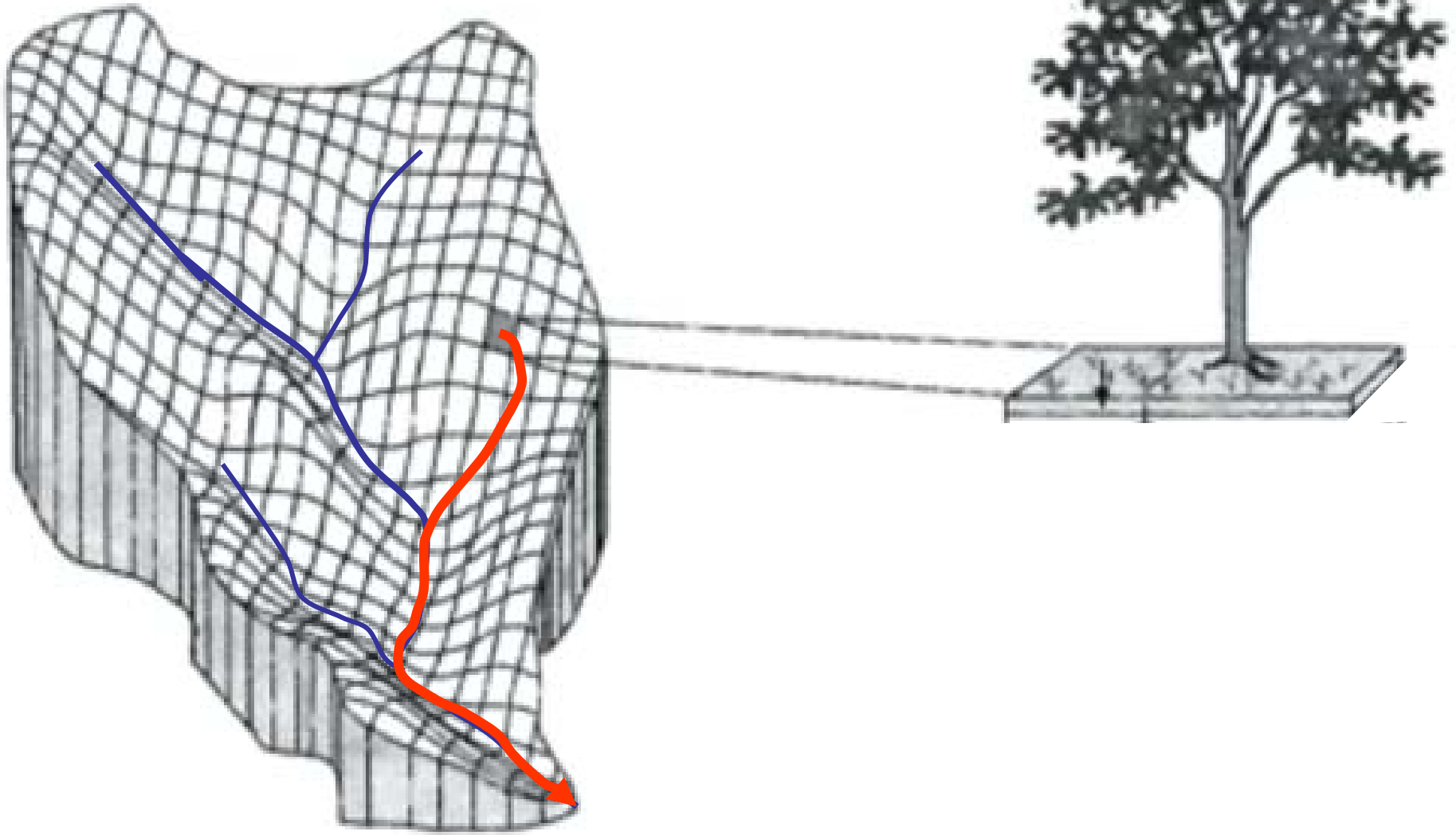
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Shortest Hydrologic Connectivity



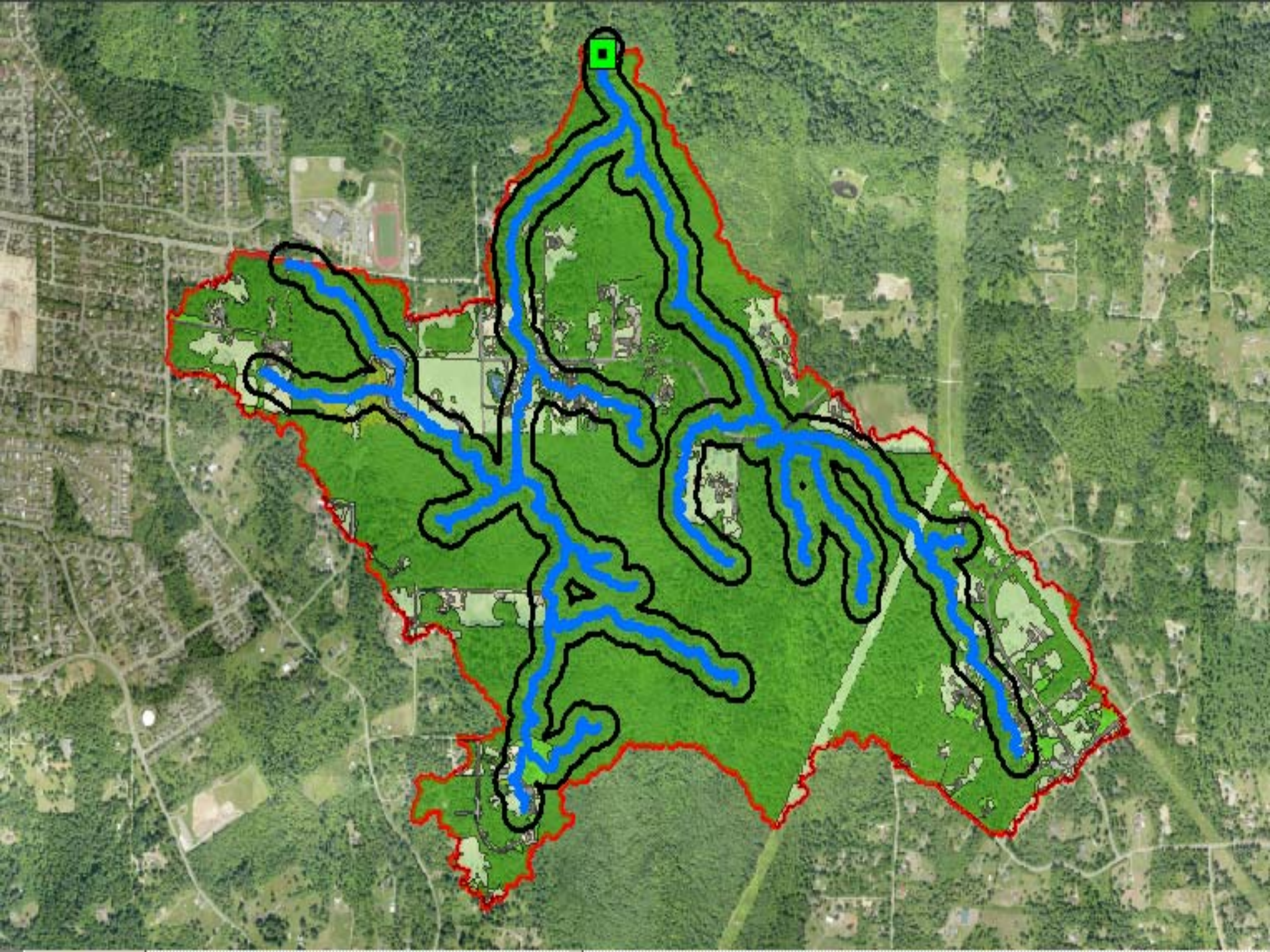
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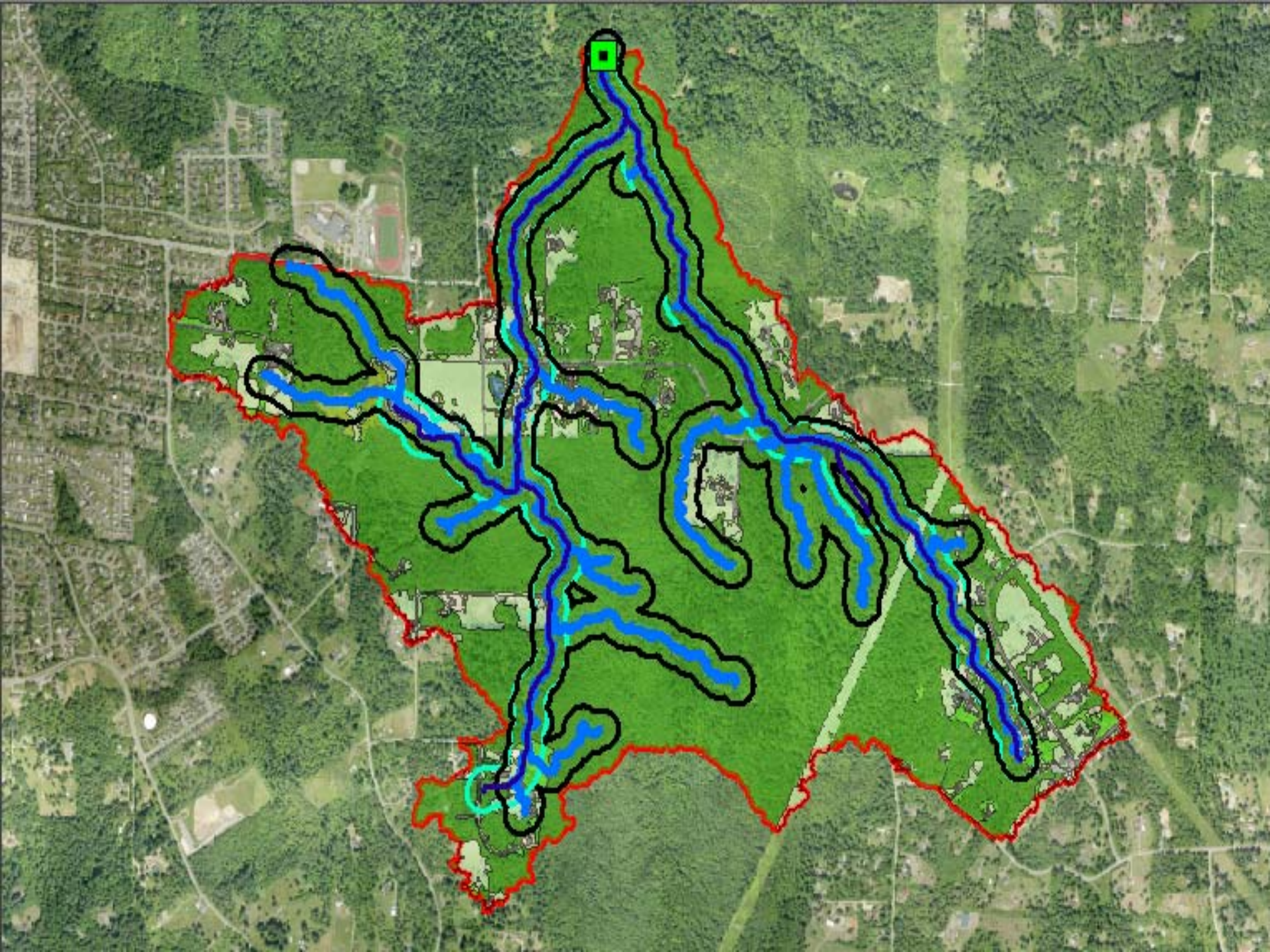
Shortest Hydrologic Connectivity



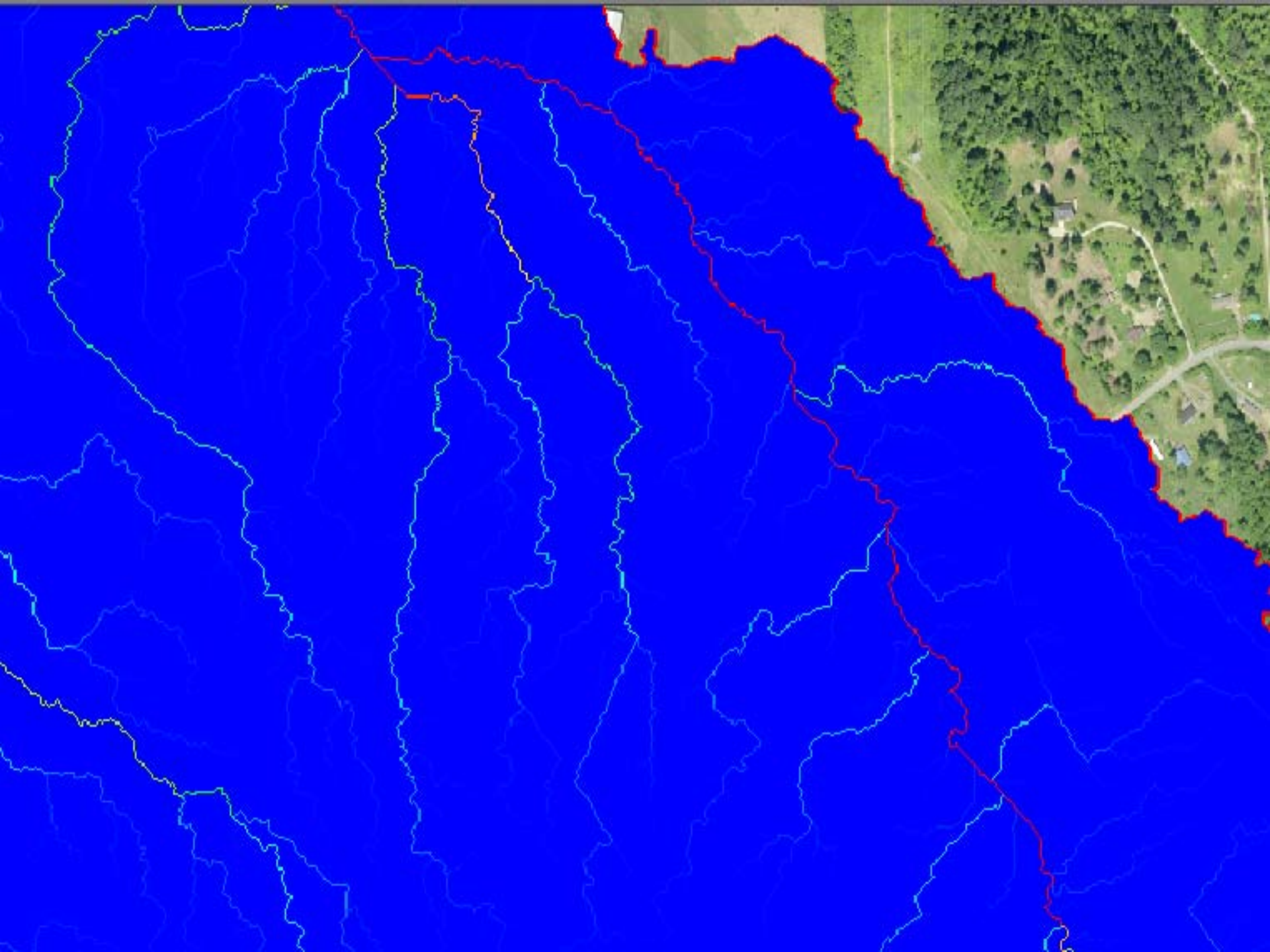
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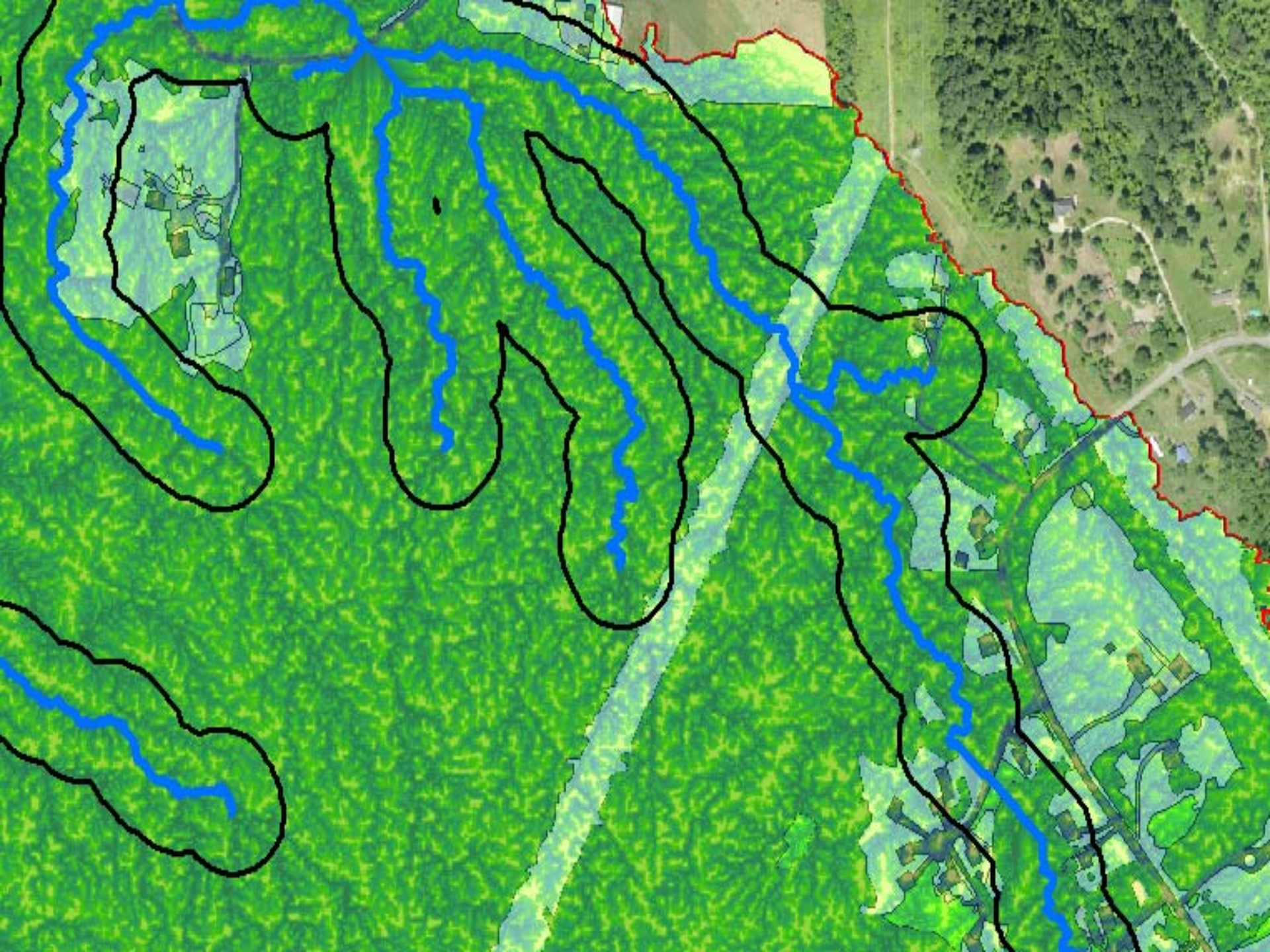


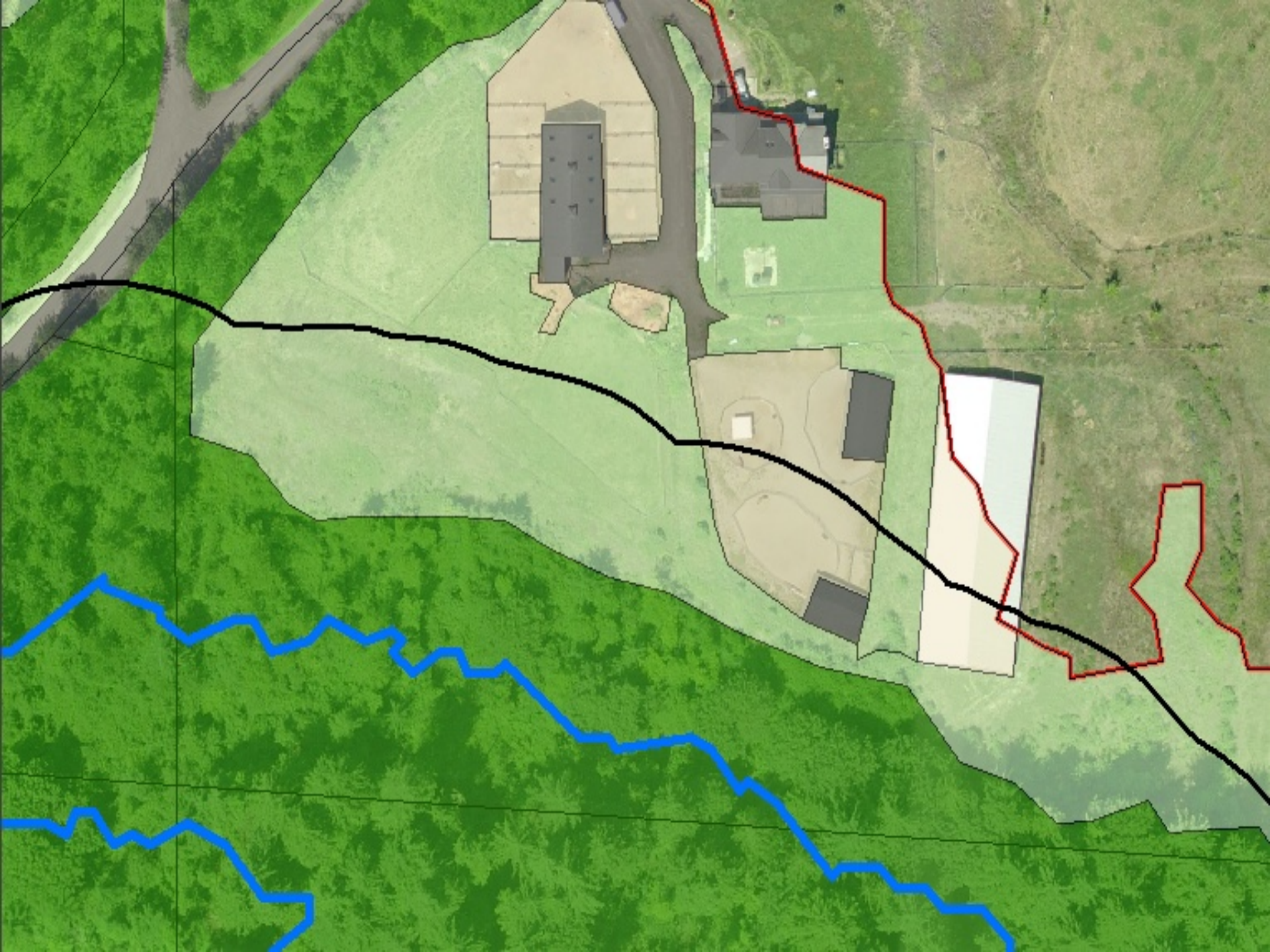






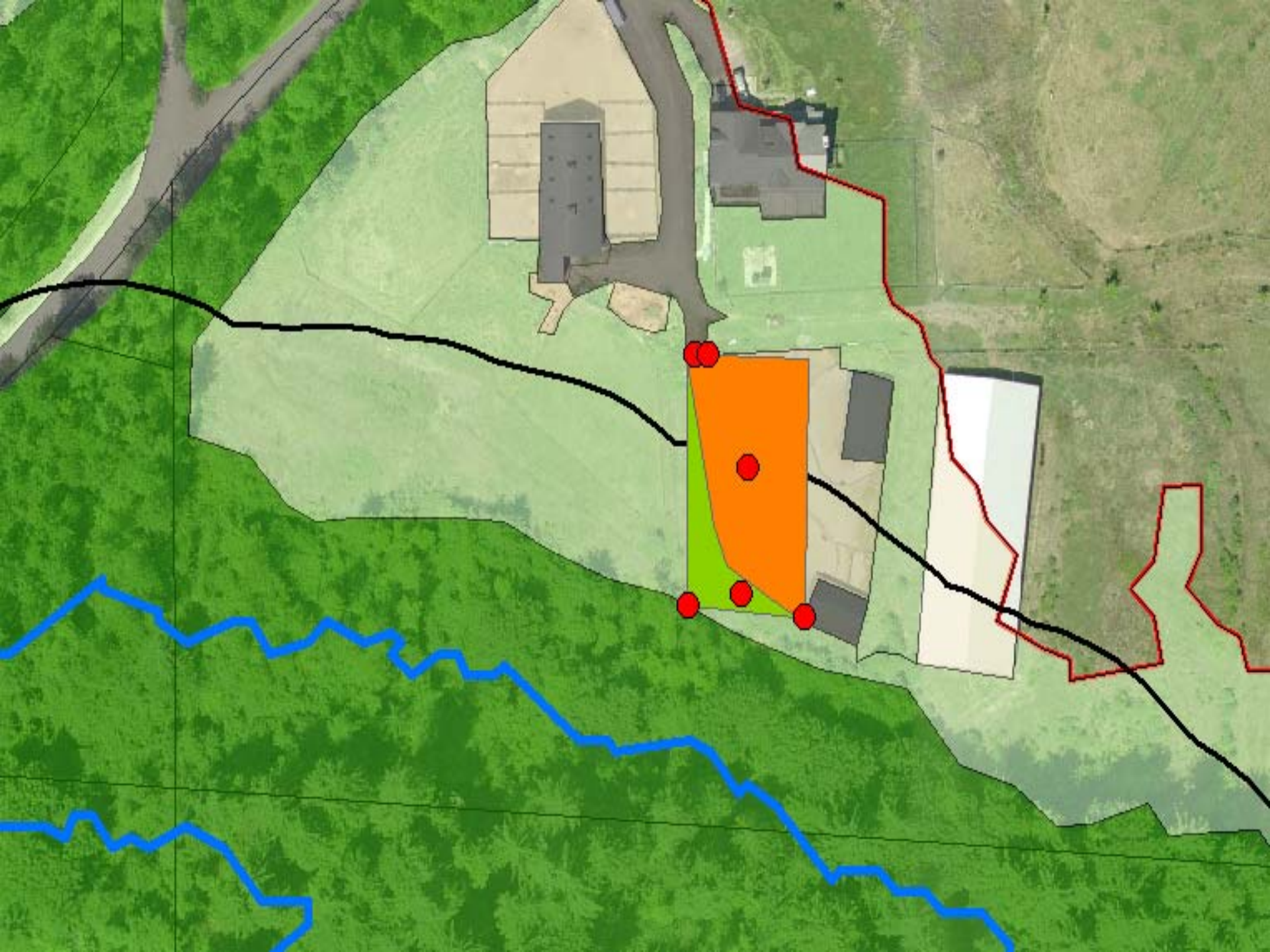




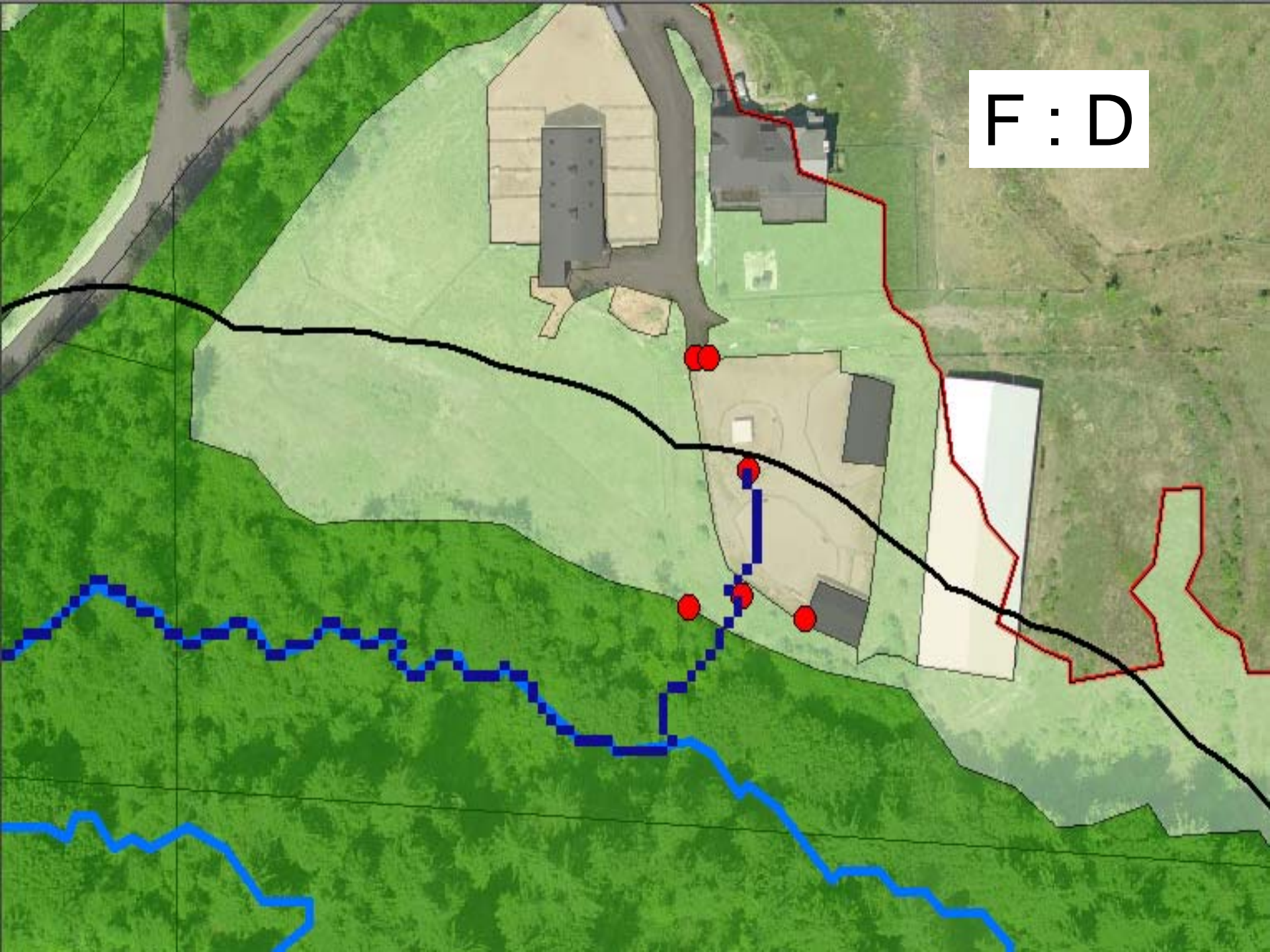




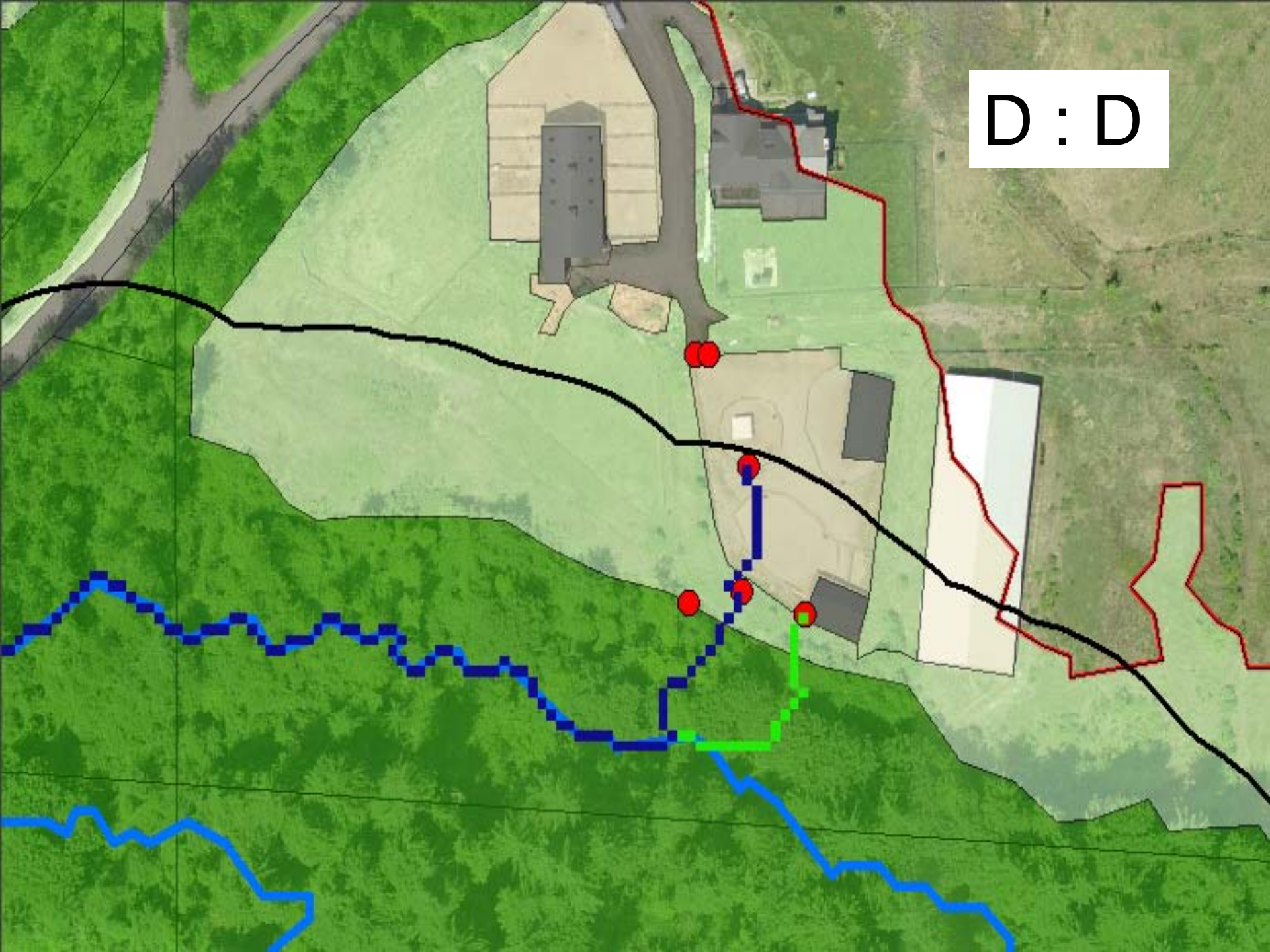




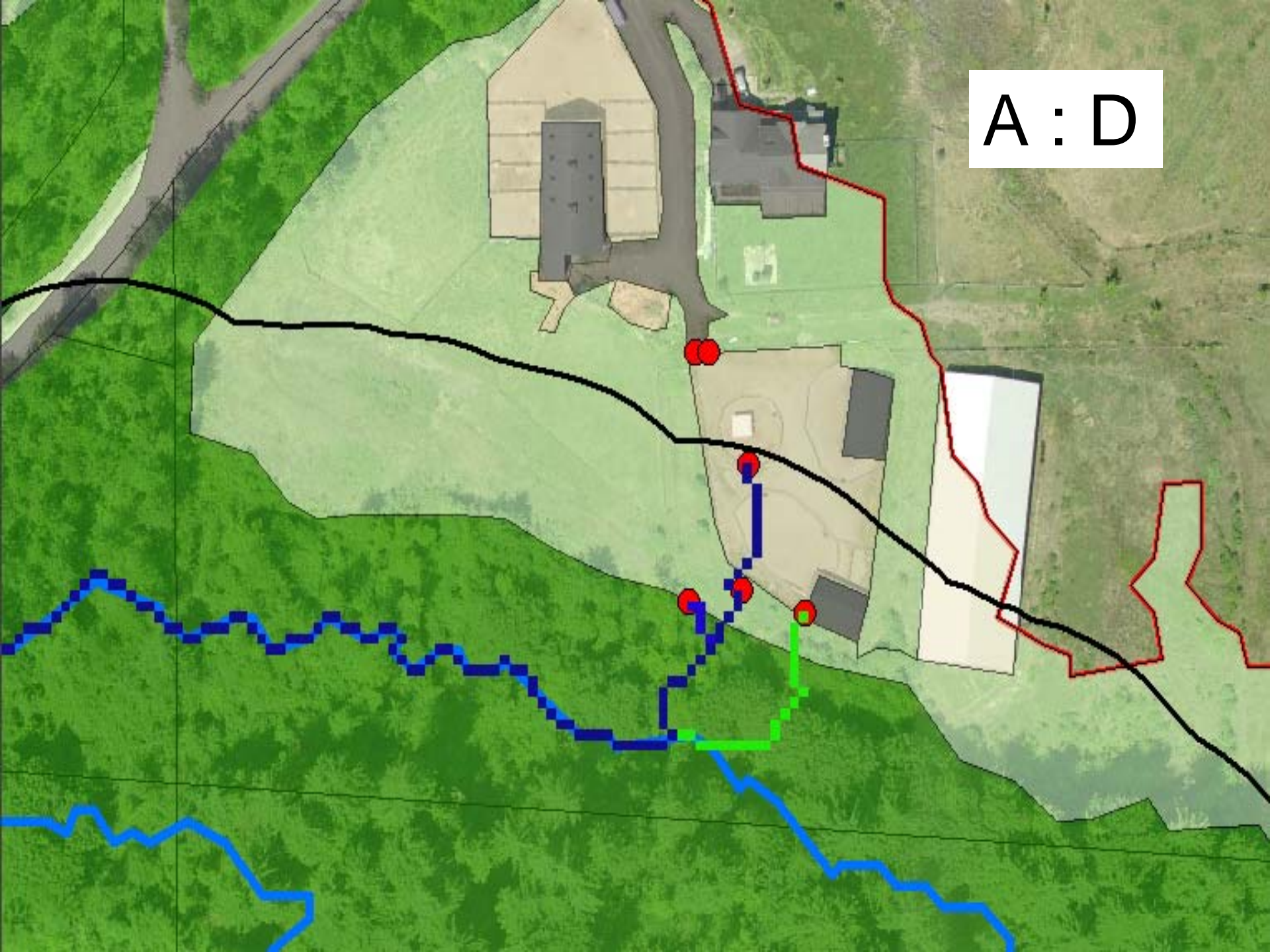
F : D



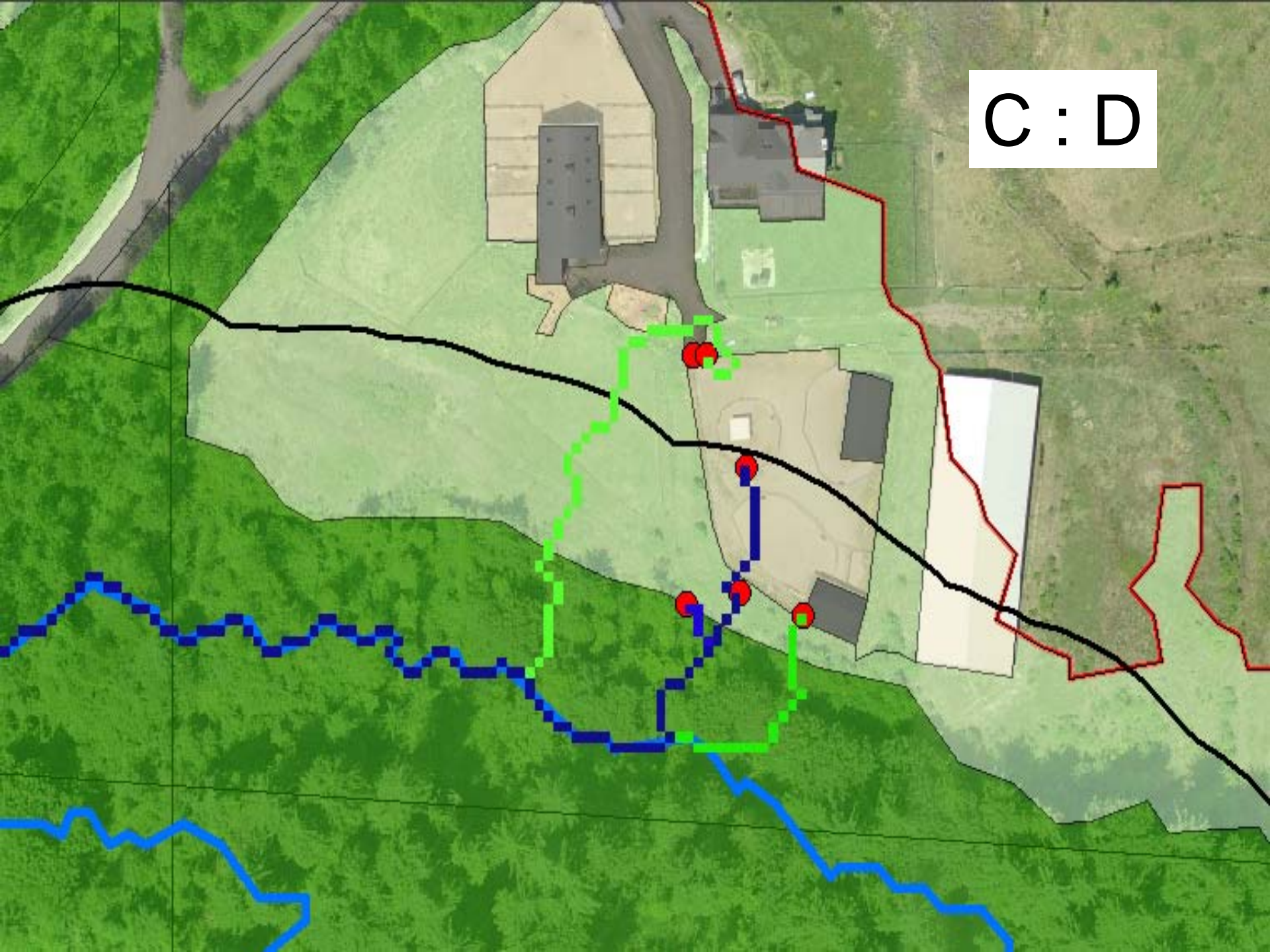
D : D



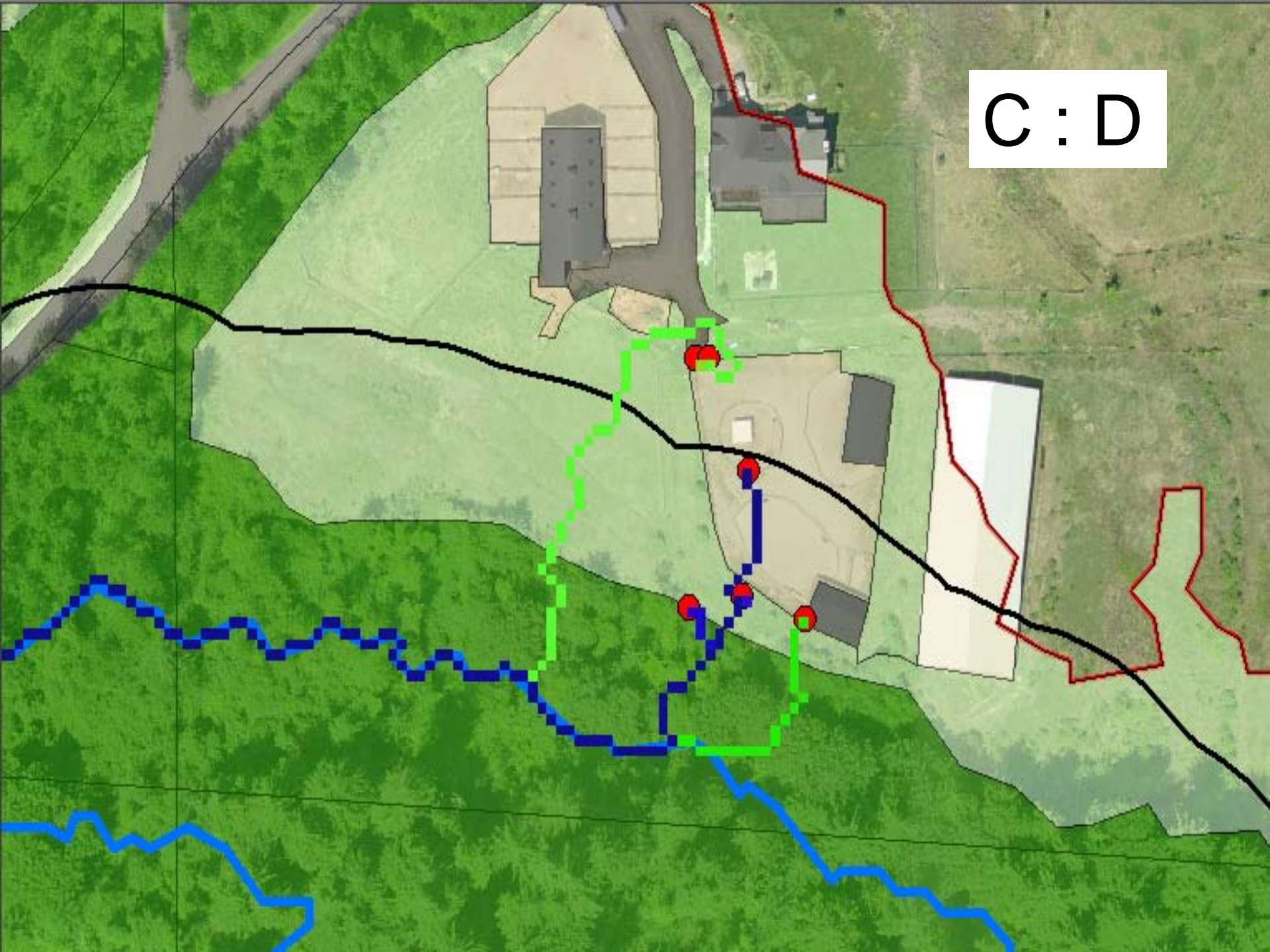
A : D



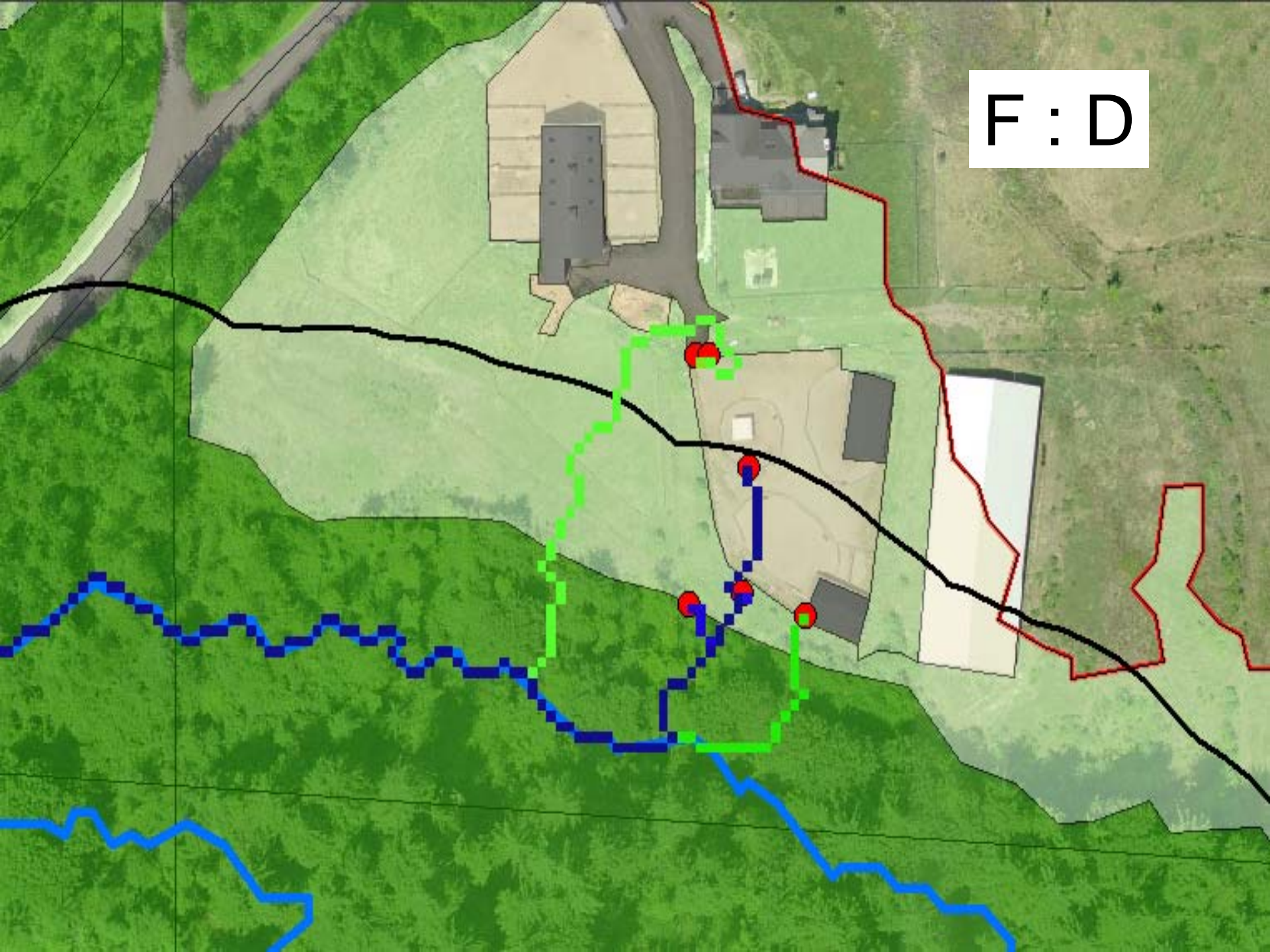
C : D



C : D



F : D



An aerial photograph of a landscape with a green-shaded watershed boundary. A network of blue lines represents a stream system within the watershed. A red line outlines the entire watershed area. A green square marker is located at the top of the watershed, near a stream head. A semi-transparent grey rectangle is overlaid on the center of the image, containing text.

**So – How will this improve the
state of our knowledge?**

Watershed

Parcelshed

Buffershed

Response Variable



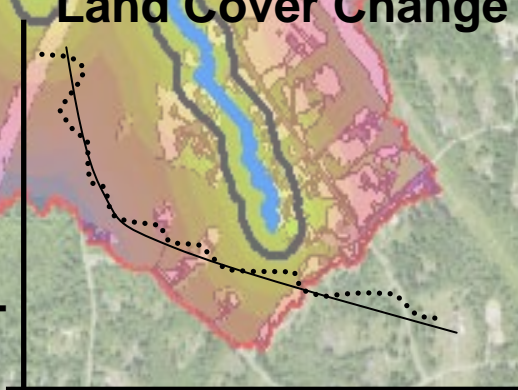
Univariate Analysis of Land Cover Change

Response Variable

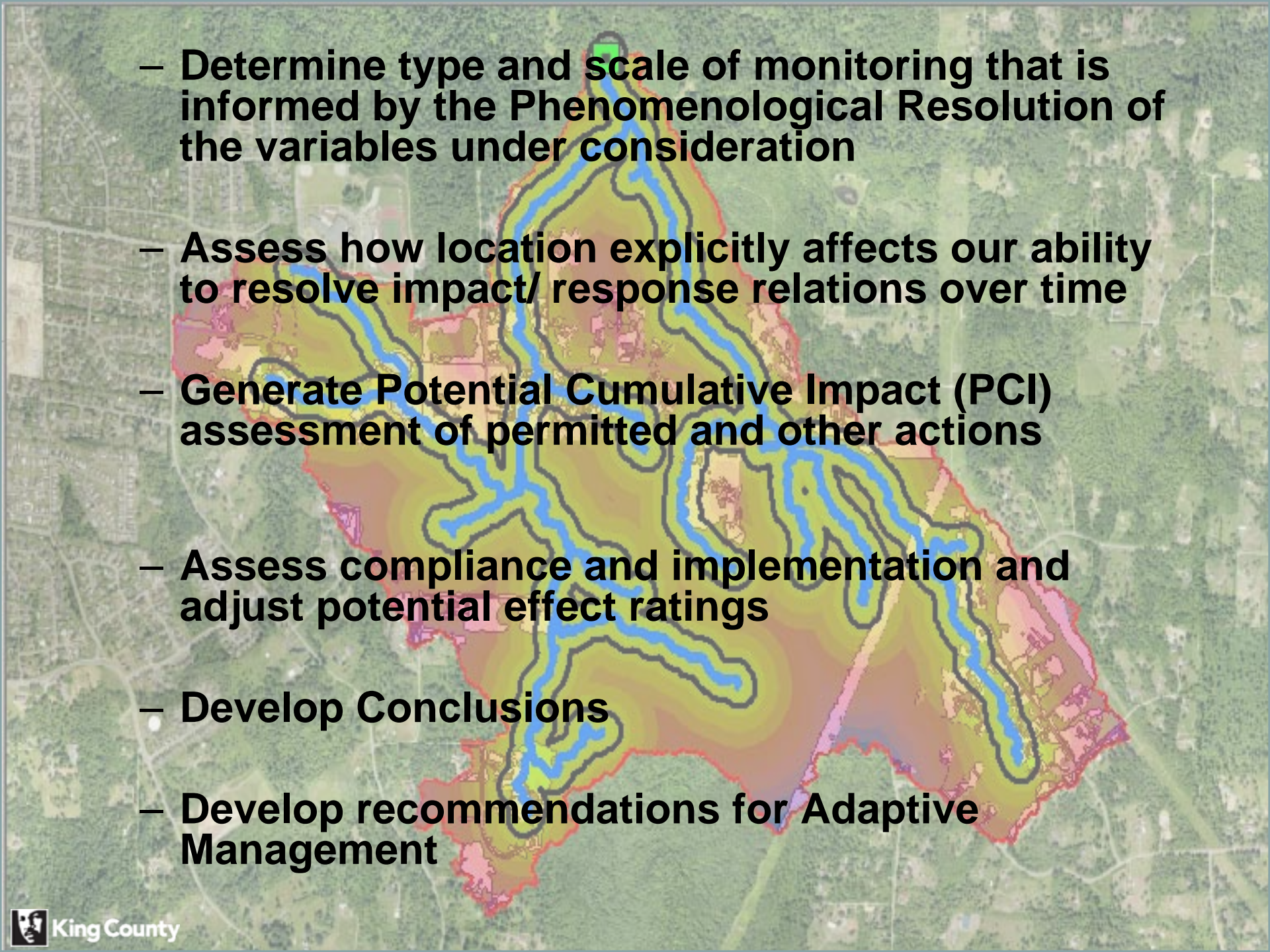


Scaled Analysis of Land Cover Change

Response Variable



Connectivity-Weighted Land Cover Change

- 
- An aerial photograph of a landscape, likely a watershed, with various colored overlays. A blue line network represents water bodies or channels. A yellow-green area covers a large central portion, possibly indicating a specific land use or impact zone. A red line outlines a larger area, and a pinkish-purple area is visible on the right side. The text is overlaid on the left side of the map.
- Determine type and scale of monitoring that is informed by the Phenomenological Resolution of the variables under consideration
 - Assess how location explicitly affects our ability to resolve impact/ response relations over time
 - Generate Potential Cumulative Impact (PCI) assessment of permitted and other actions
 - Assess compliance and implementation and adjust potential effect ratings
 - Develop Conclusions
 - Develop recommendations for Adaptive Management

An aerial photograph of a landscape, likely a watershed, with a green square marker at the top center. The map shows a network of blue lines representing water bodies or streams, surrounded by yellow and green areas, possibly indicating different land use or elevation zones. The background is a detailed aerial view of the terrain.

Acknowledgements

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