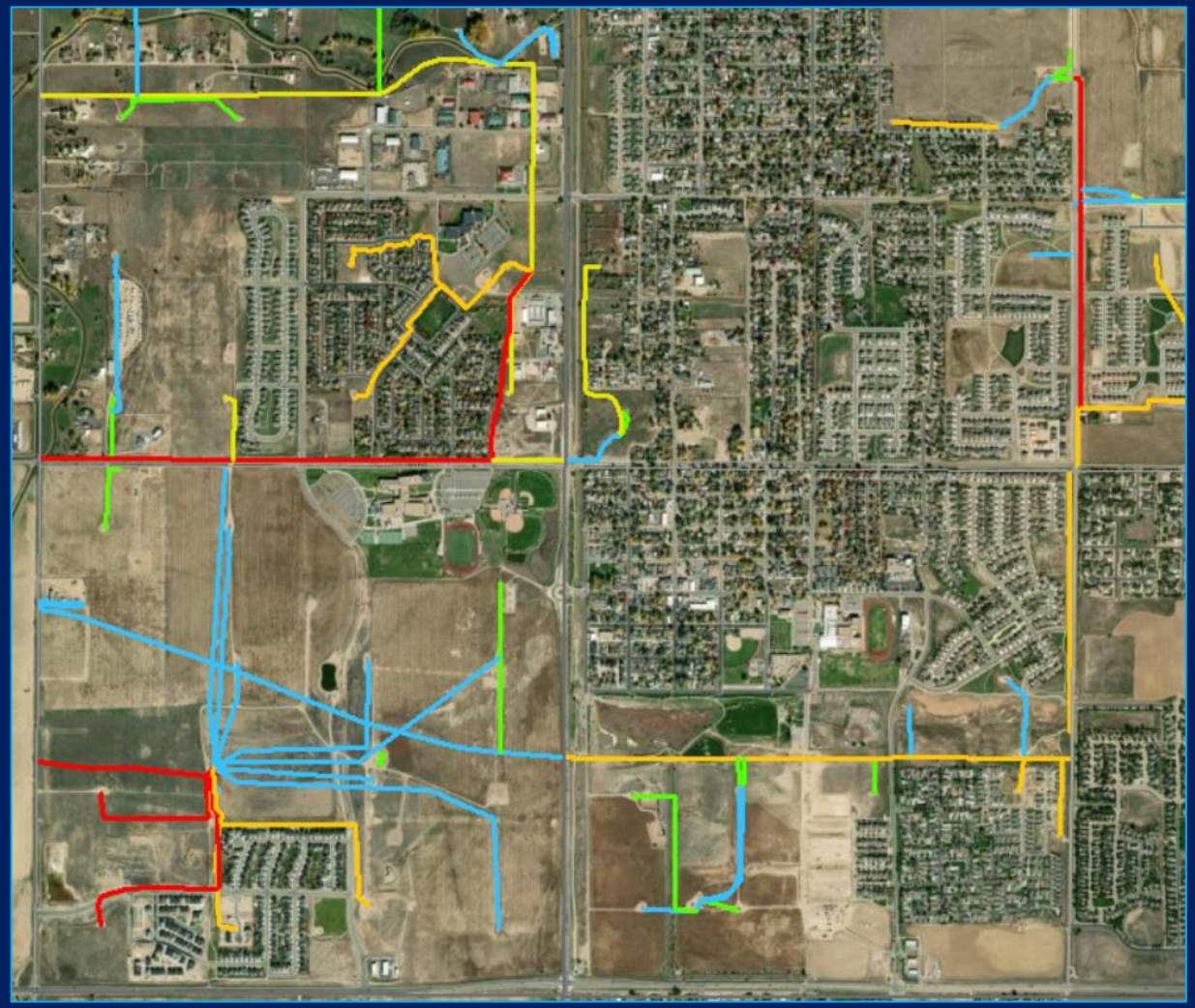
Oil and Gas Flowline Prioritization

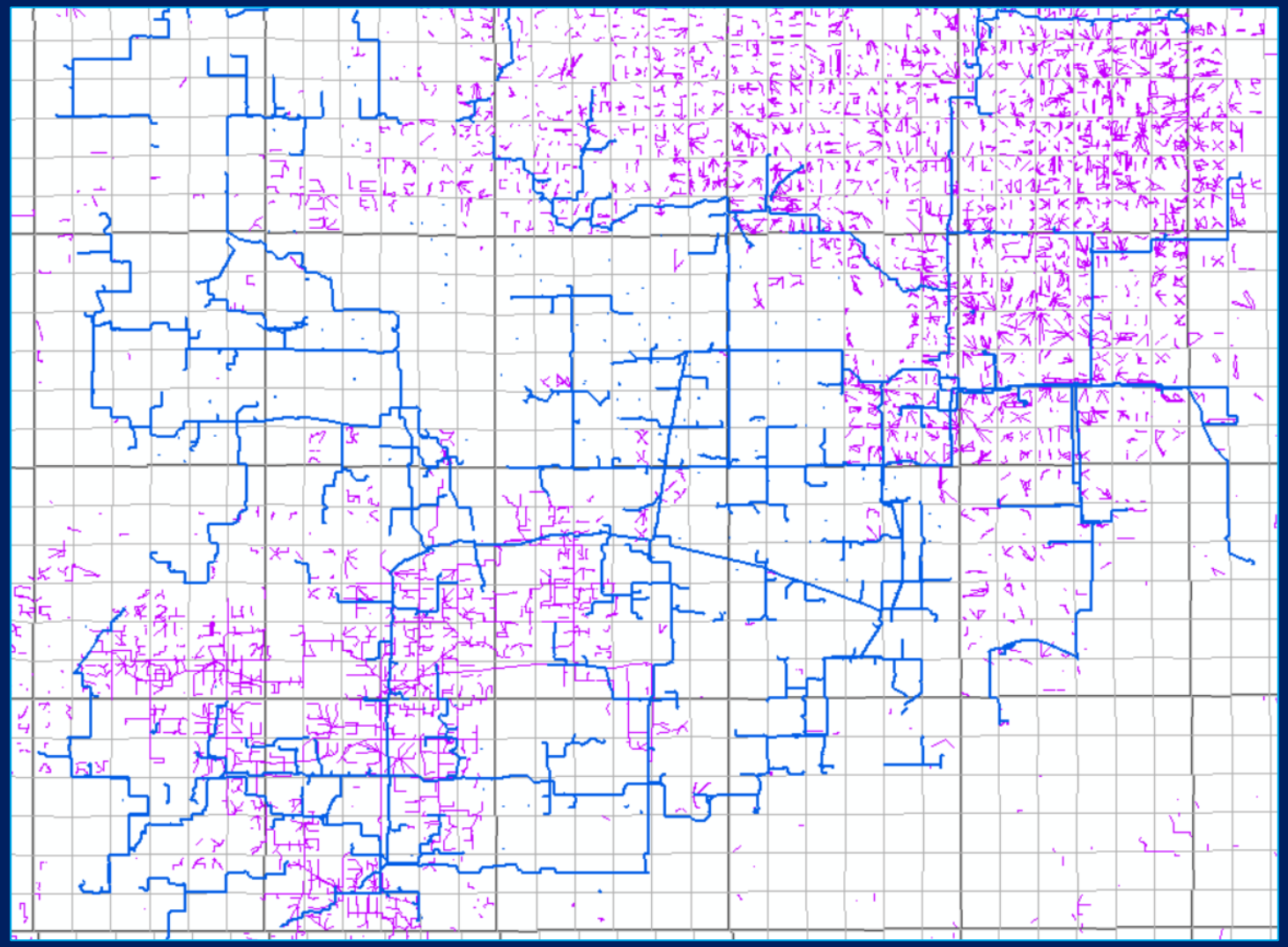
A Geographic Model for Identifying Flowlines that Require Review, Inspection, and/or Testing



GIS Specialist: Jim Milne
Colorado Energy & Carbon Management Commission (ECMC)

Which Flowlines Need ECMC Attention First?

Flowlines located in Geographically Sensitive Areas can be identified using a GIS Model.



Geographic Priority Factors

- Population Density (Buildings)
- Streams, Lakes, Wetlands
- Public Supply Surface Water
- Public Supply Groundwater
- Domestic Water Wells
- Shallow Groundwater
- Soil Classification
- Sensitive Wildlife Habitats

Model Process Steps

Step 1
Assemble Relevant GIS Layers

Step 2
Create GIS Buffers

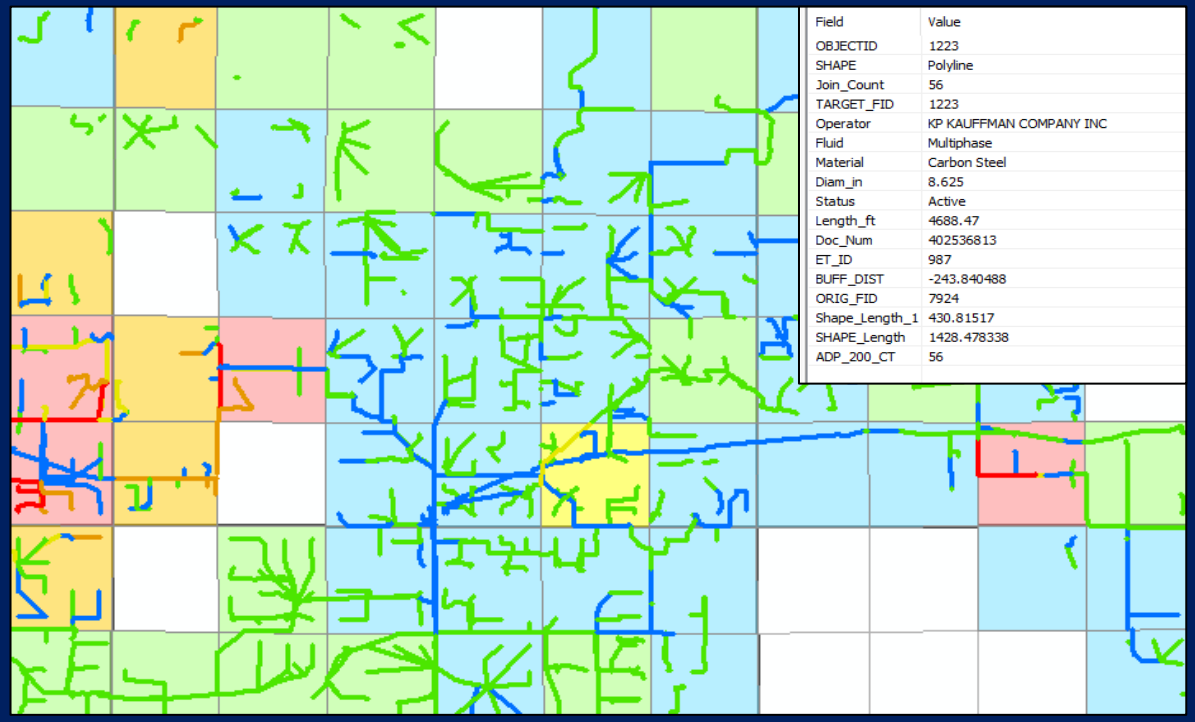
Step 3
Intersect OG Flowlines with GIS Polys and Buffers

Step 4
Transfer GIS Intersect Results to ECMC Database

Step 5
Execute Stored Procedure to Calculate Scores

Geographic Sensitivity Scores in ECMC DB

Step 6
Output Priority Results to Map or Report



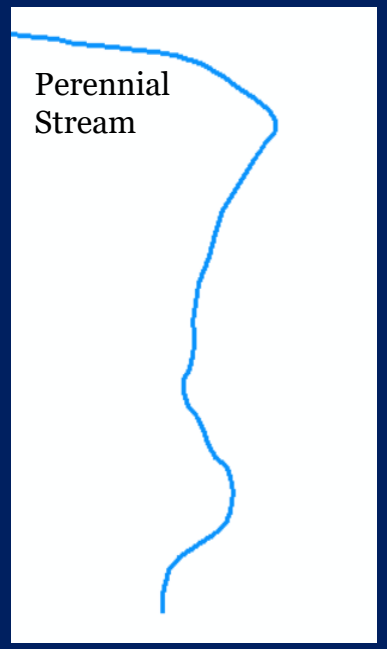
Field	Value
OBJECTID	1223
SHAPE	Polyline
Join_Count	56
TARGET_FID	1223
Operator	KP KAUFFMAN COMPANY INC
Fluid	Multiphase
Material	Carbon Steel
Diam_in	8.625
Status	Active
Length_ft	4688.47
Doc_Num	402536813
ET_ID	987
BUFF_DIST	-243.840488
ORIG_FID	7924
Shape_Length_1	430.81517
SHAPE_Length	1428.478338
ADP_200_CT	56

Assemble GIS Layers

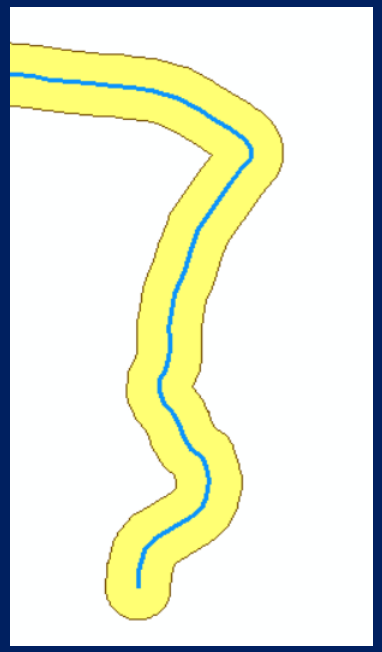
- Need Statewide GIS Layers
- Data will be used as basis for Priority Buffers
- Groups will be used for Scoring

Group	Population	Surface Water	Groundwater
	Building Footprints	Public Water System Surface Water Protection Zones (Rule 411a)	Public Water System Groundwater Protection Zones (Rule 411b)
	Address Points	Rivers & Streams	Domestic Water Wells
	Disproportionately Impacted Communities	Lakes & Wetlands	Springs
	Municipal Boundaries	Flood Plains	Soil Surveys – High Permeability Areas
	School Buildings	Aquatic High Priority Habitat Buffers (Rule 1202c)	CGS Mapped Alluvium (Shallow Groundwater Areas)

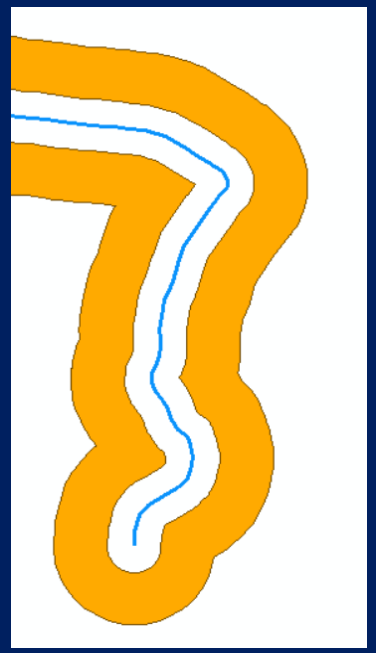
Create Simple Buffers



Stream

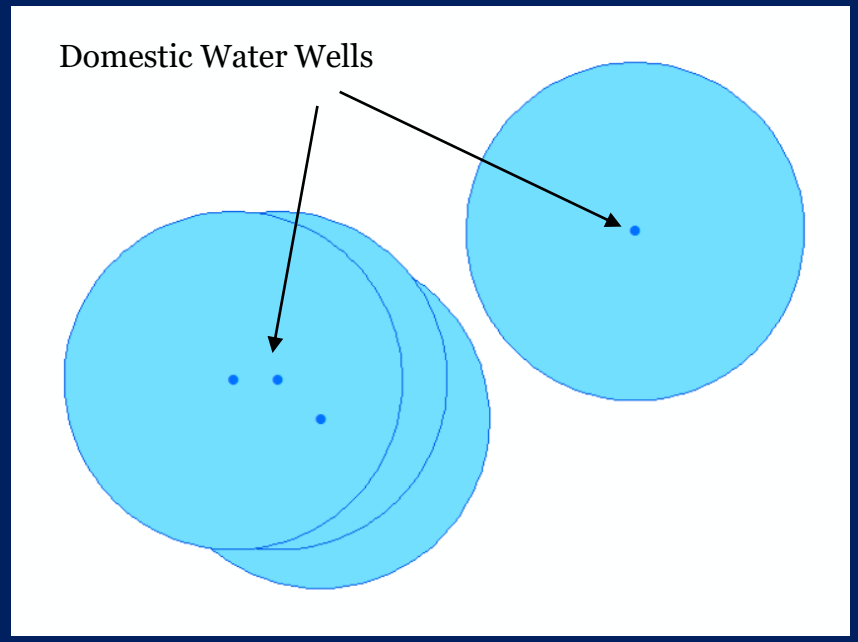


100 ft Buffer



100-300 ft Buffer

Stream Buffers

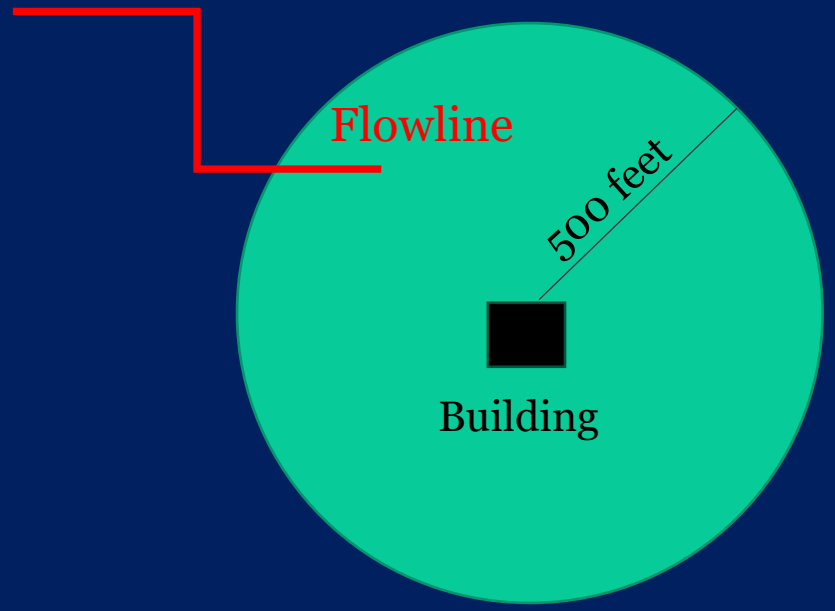


500-foot buffers

Water Well Buffers

Two Basic GIS Intersect Operations

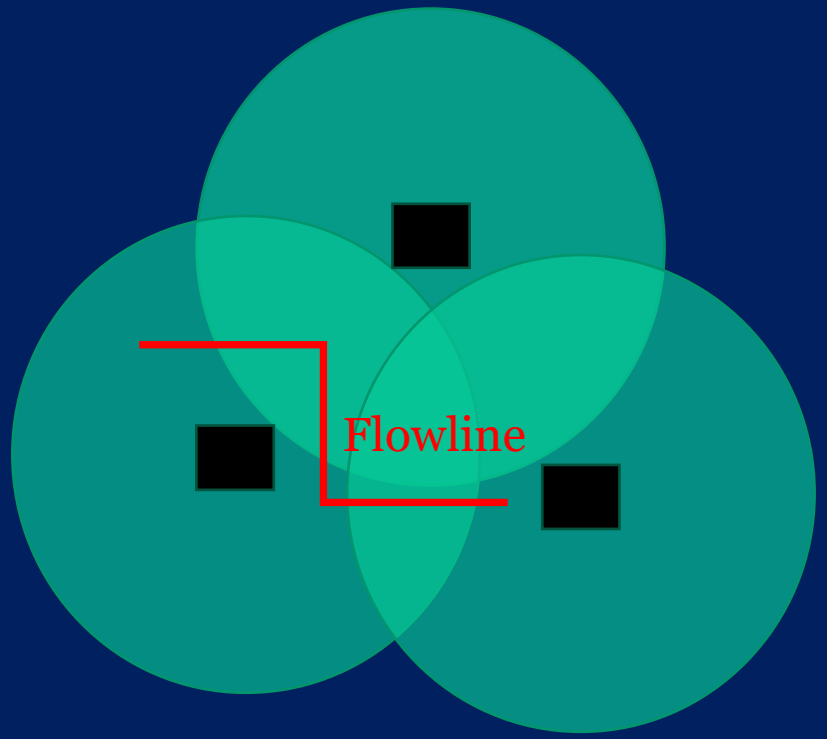
INTERSECT



Is there a Flowline within the 500-foot building footprint buffer?

TRUE or FALSE

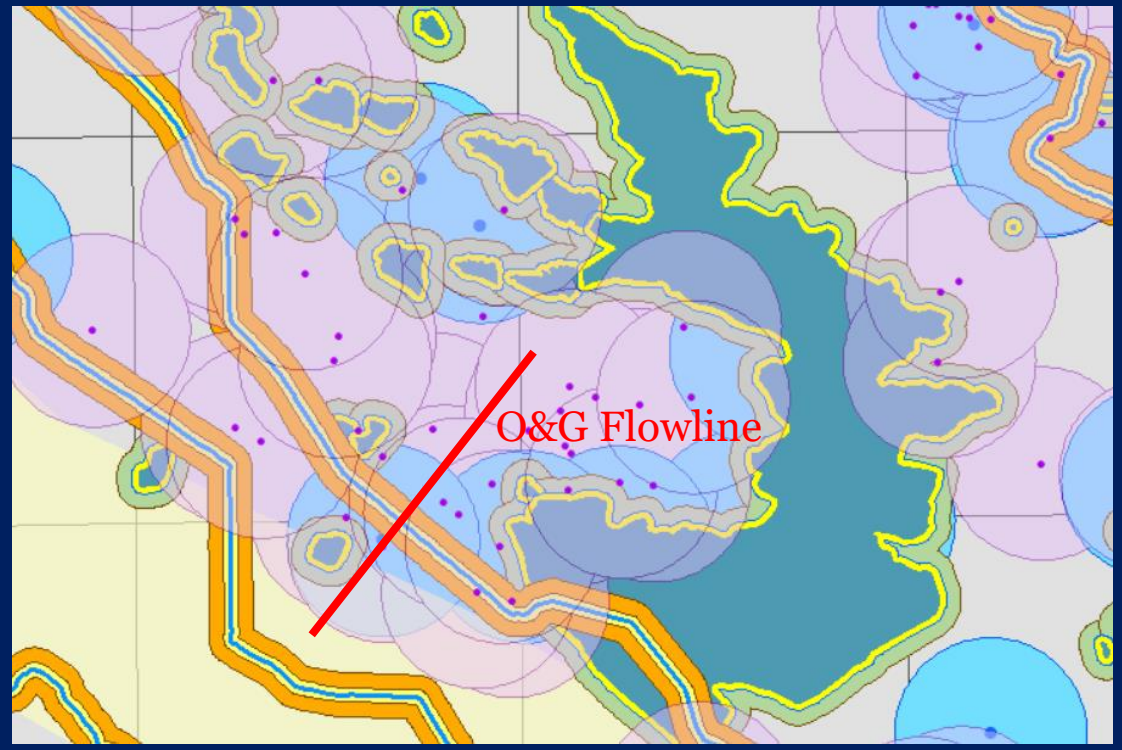
COUNT

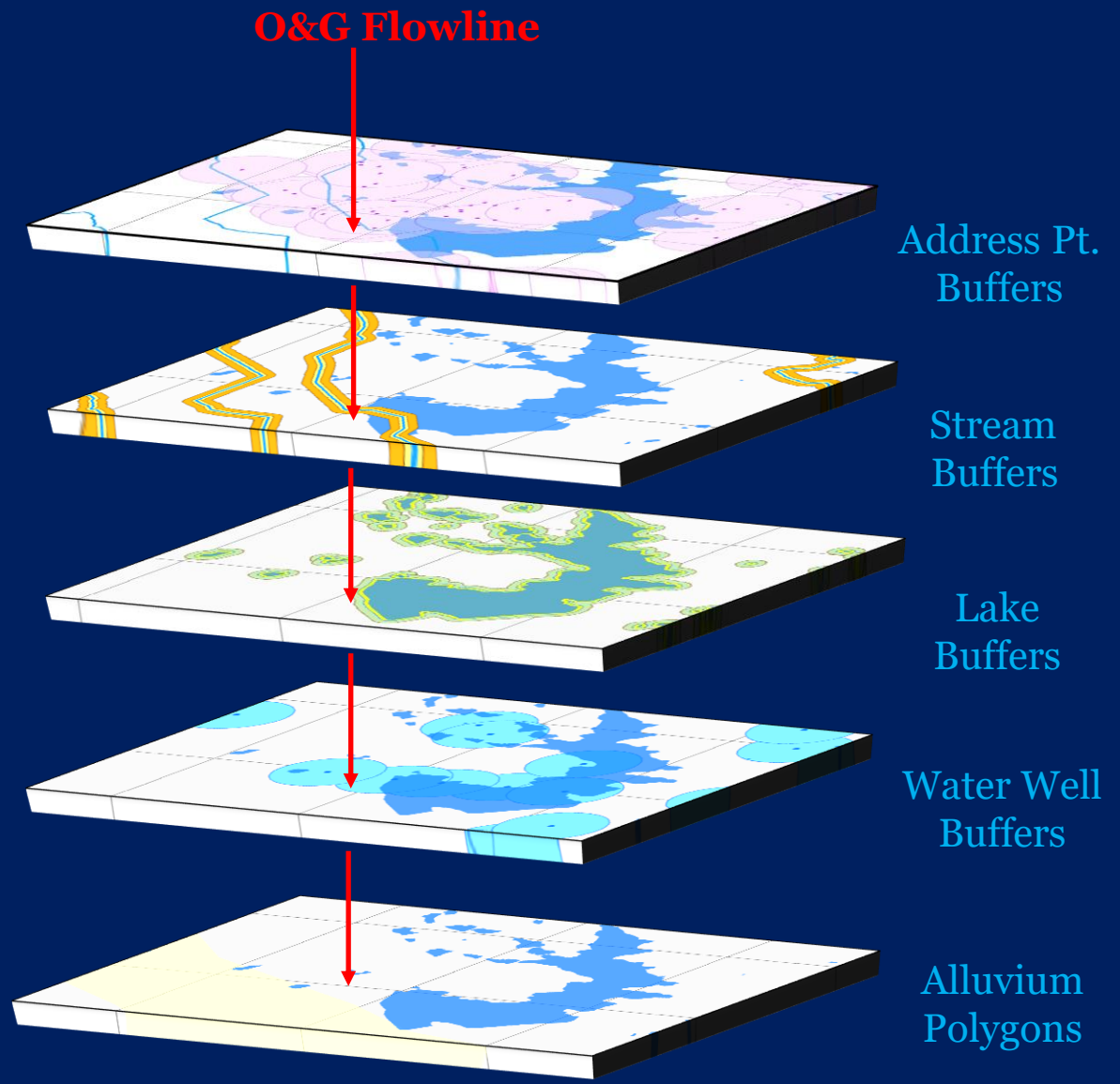


How many 500-foot building footprint buffers intersect a Flowline?

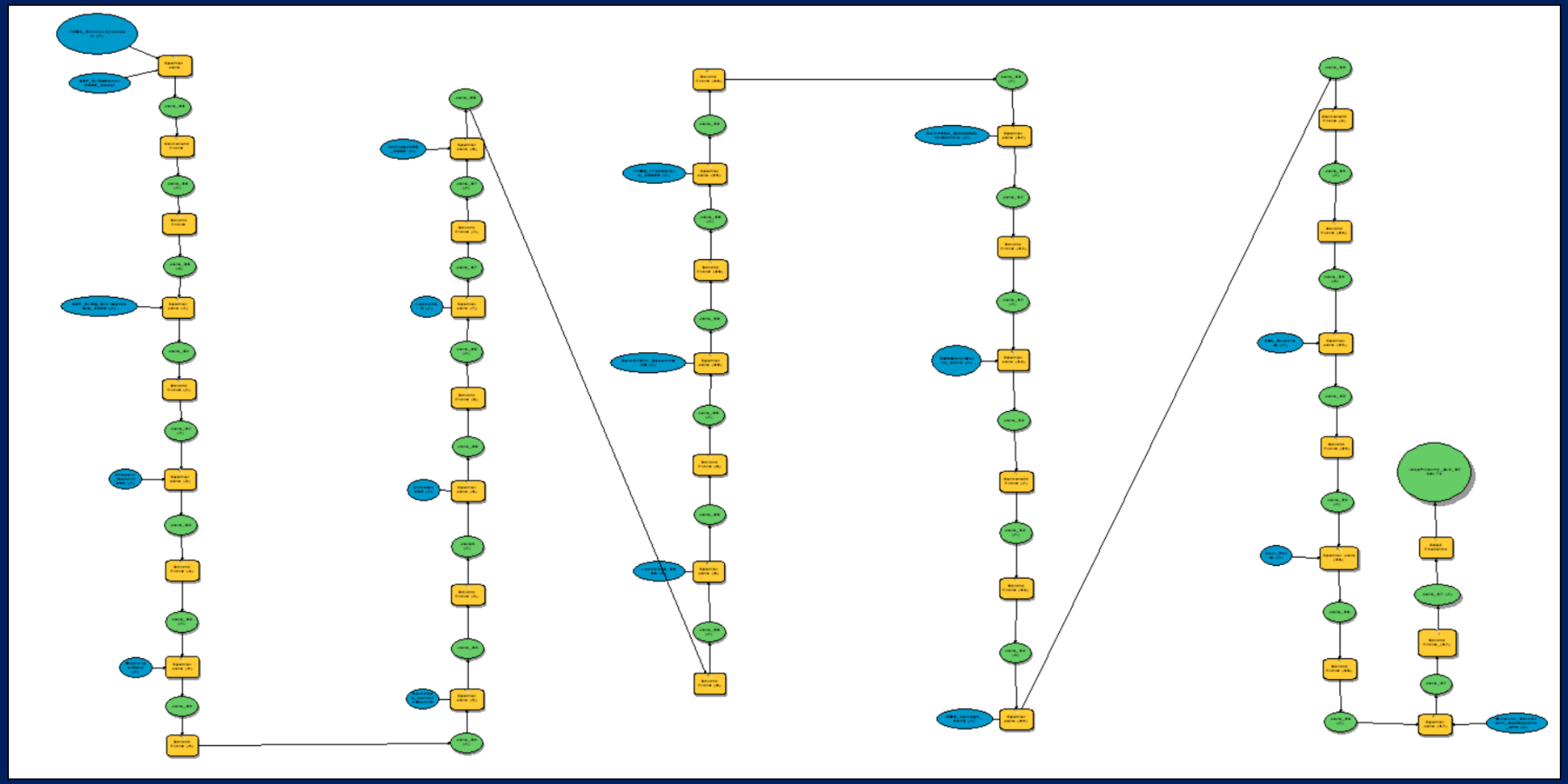
COUNT = 3

Intersect Flowline Polylines with Buffers & Polygons





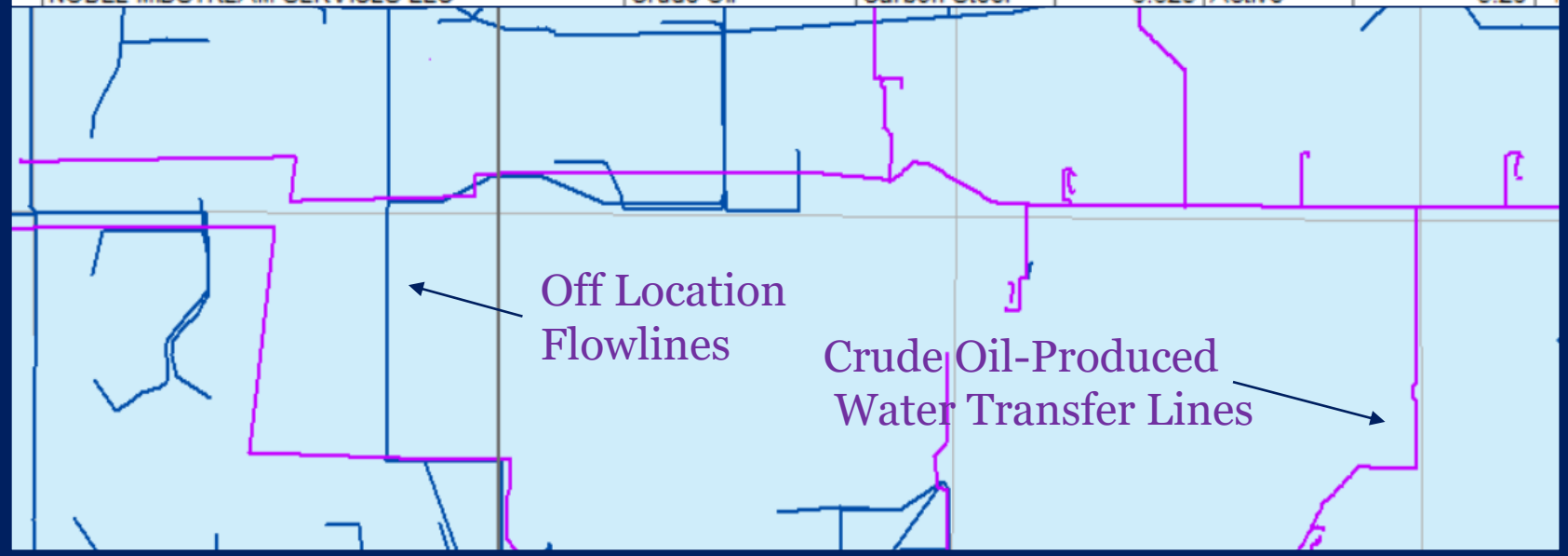
Flowline Intersect Results Obtained from ArcGIS Geoprocessing Model



Working with ECMC Flowline GIS Data

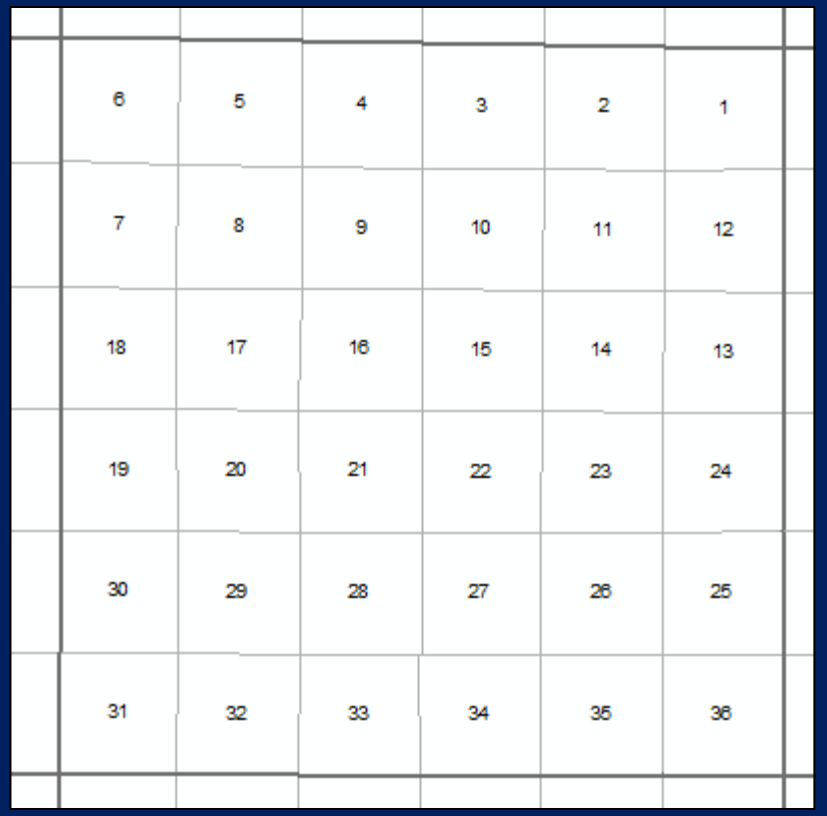
- Submitted by Multiple Operators
- No consistent approach to line geometry
- Very short line segments & very long line segments
- Duplicate Lines
- Incomplete networks with disconnected lines

Operator	Fluid	Material	Diam_in	Status	Length_ft
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	28.95
KERR MCGEE OIL & GAS ONSHORE LP	PRODUCED WATER	Steel	1	ACTIVE	19.74
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	630.42
ANADARKO WATTENBERG OIL COMPLEX LLC	<Null>	<Null>	<Null>	<Null>	0.36
KERR MCGEE OIL & GAS ONSHORE LP	PRODUCED WATER	<Null>	2	ACTIVE	148.9
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	12	ACTIVE	812.63
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	2456.21
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	8	ACTIVE	633.6
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	35.57
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	9.31
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	1020.28
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	6	ACTIVE	90.03
ANADARKO WATTENBERG OIL COMPLEX LLC	OIL (RAW)	STEEL	4	ACTIVE	1.42
NOBLE MIDSTREAM SERVICES LLC	Crude Oil	Carbon Steel	6.625	Active	5.29



Define Geographic Analysis Unit as a Section of Land

- Perform Flowline Analysis based on PLSS Section Grid
- Duplicate Lines and inconsistent line segments not an Issue
- Allow for Sections to be prioritized based on Flowline Intersects within a Section
- All Flowline Intersects with other GIS Layers can be visualized on a map as Priority colors.
- Split Flowlines on Section Lines Prior to GIS Intersect analysis (Flowlines cannot touch Section Lines)



Set Up Flowlines for Section Level Analysis

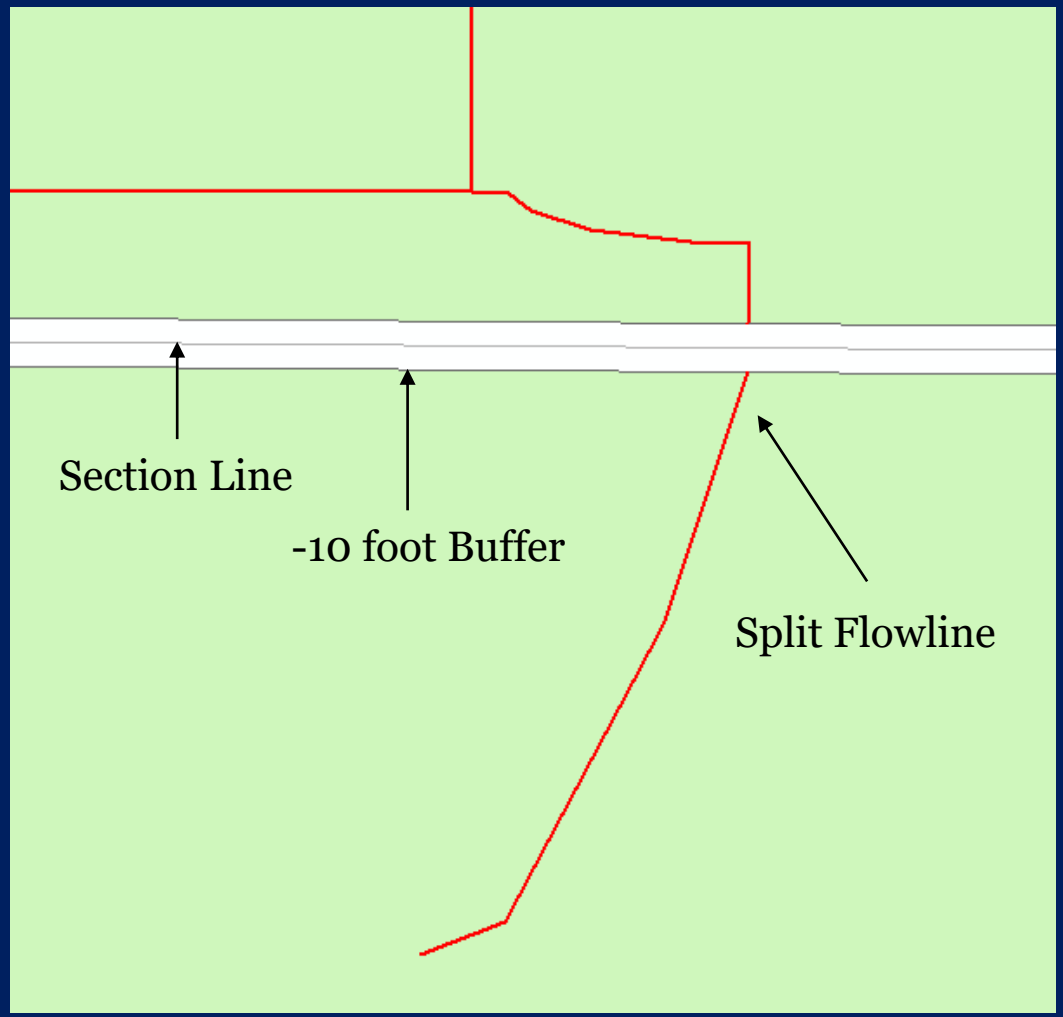
1. Need to Split Flowlines on Section Lines Prior to GIS Intersect analysis (Flowlines cannot touch Section Lines)

2. Set Up Section Grid for Analysis by creating a negative 10-foot buffer layer using the Section Grid

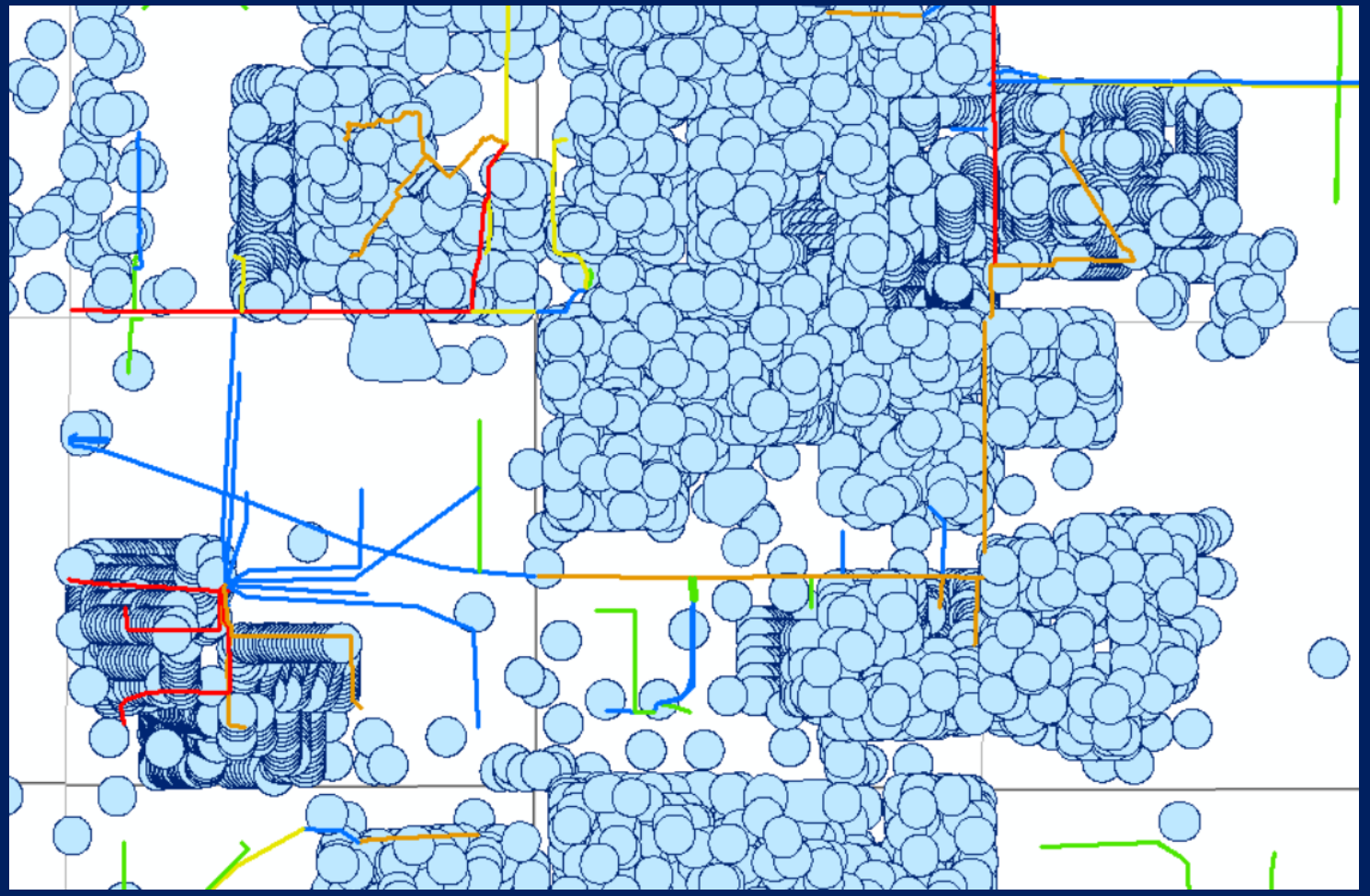
3. Split Flowlines on the -10 foot Section buffer layer

4. Select Flowlines within the -10 foot Section Buffer Layer

5. Save as a new Flowline Layer that is now clipped within the Section Layer



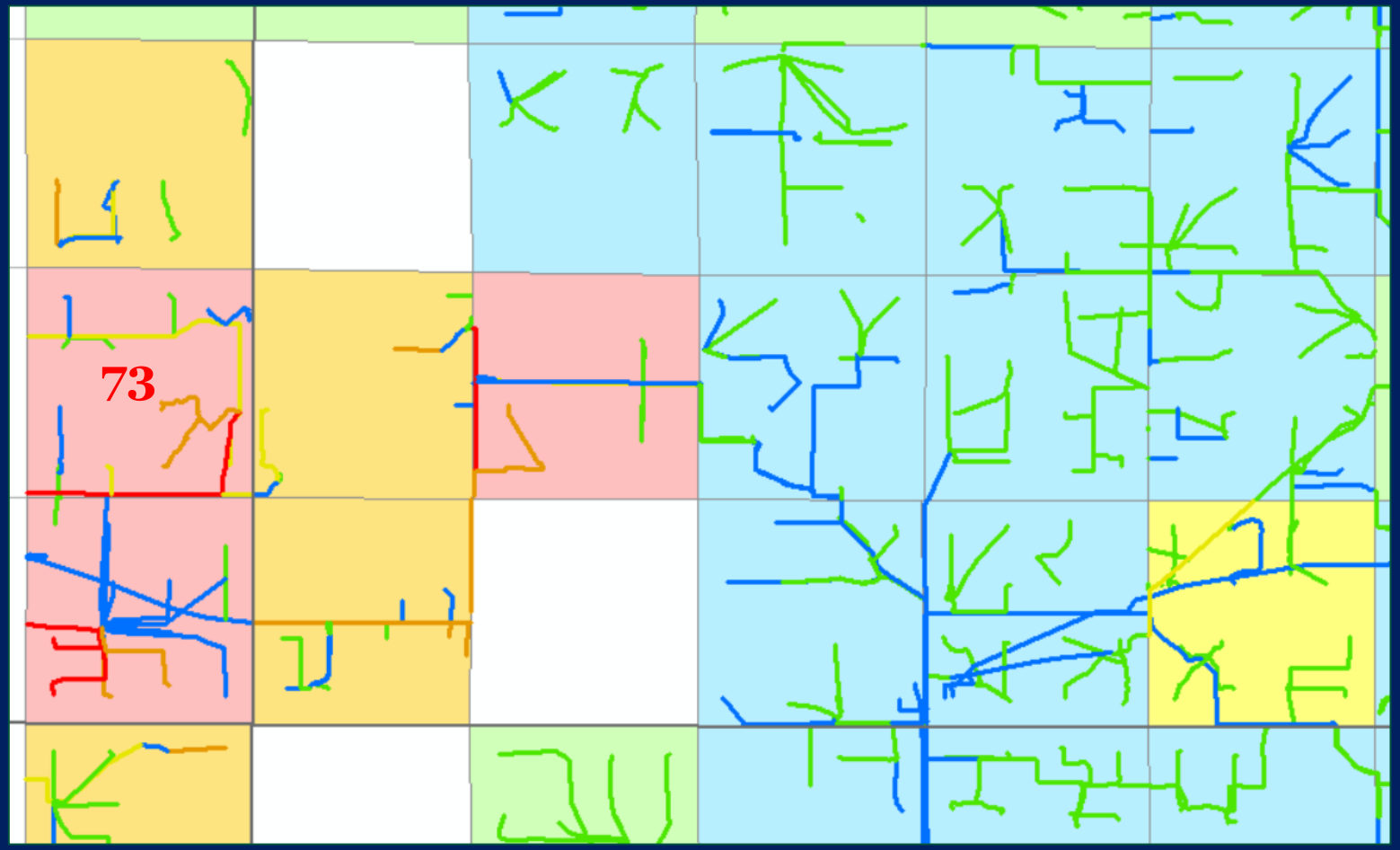
Results of GIS Intersections are written to the Flowline Attribute Table



73 buildings are within 200 feet of this flowline

h	ADP_200_CT
24	73
24	73
32	68
32	68
32	68
78	61
78	61
43	56
38	56
43	56
36	52
36	52
59	46
78	46
78	46
65	46

Transfer Flowline Values to Section Grid for Visualization (Max Value per Section)

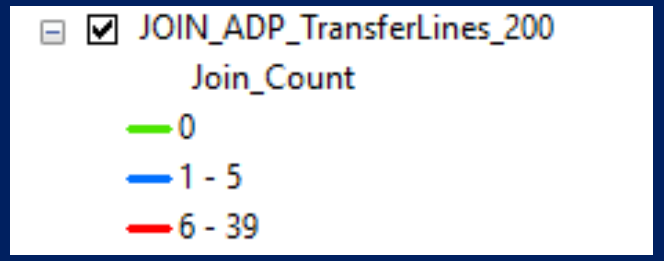


73 buildings are within 200 feet of this flowline

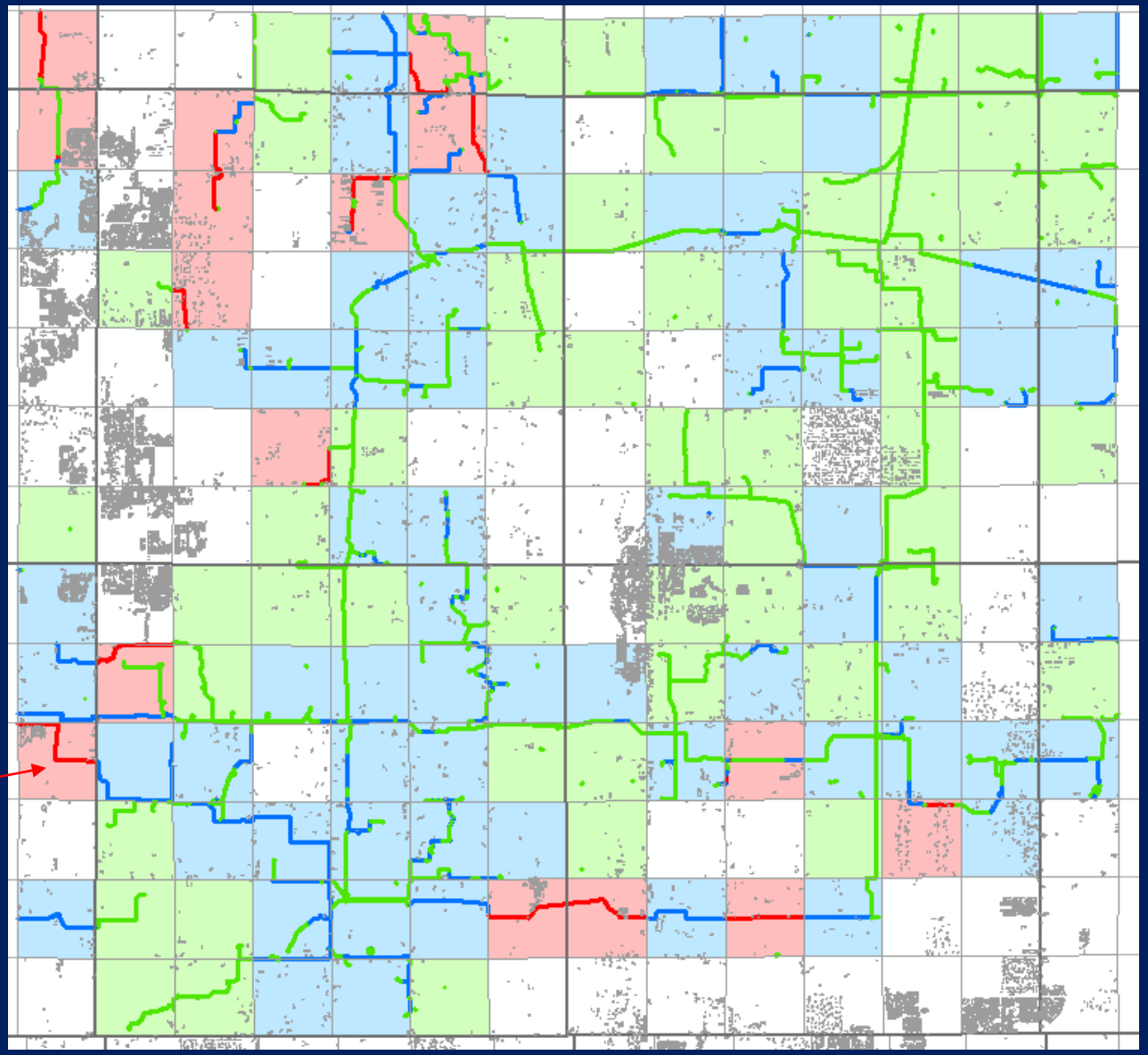
ADP_200_CT
73
73
68
68
68
61
61
56
56
56
52
52
46
46
46
46

Section Grid Results – 200 feet from a Building

Crude Oil – Produced Water Transfer Lines

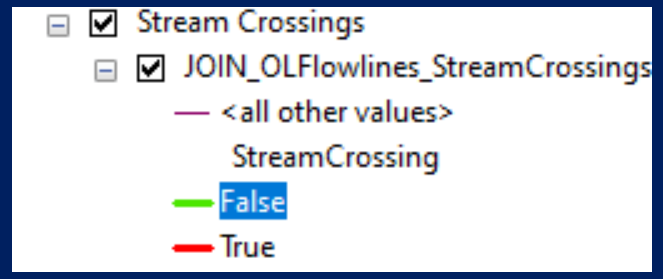


This Section contains a Transfer Line that is within 200 feet of between 6 and 39 Building Footprints

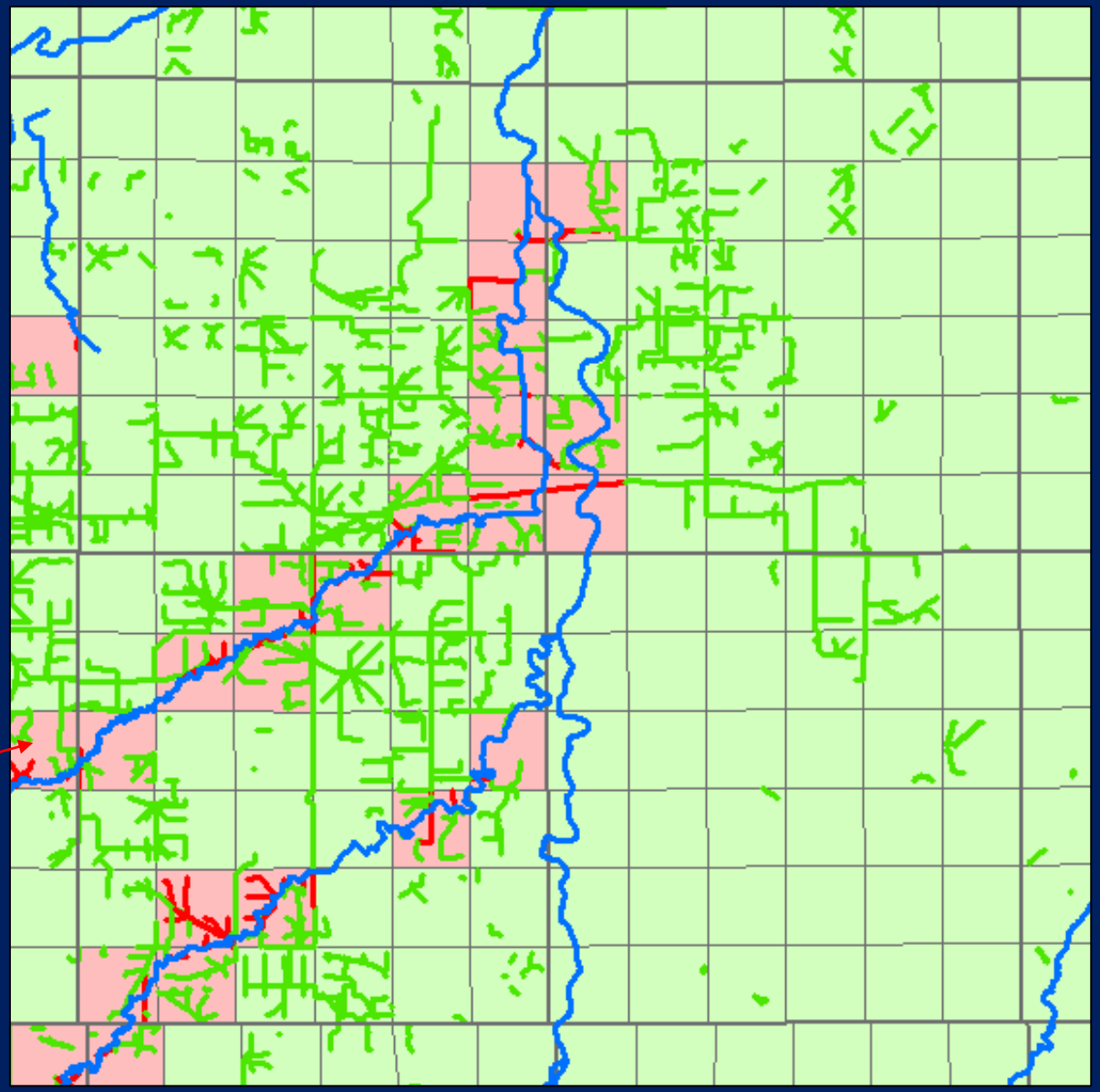


Section Grid Results – Stream Crossings

Off Location Flowlines



This Section contains at least 1 Flowline that crosses a Stream



Scoring & Prioritizing by Groups

Example Scoring Worksheet for Population Group

GROUP	Priority	CRITERIA	DB ABBREVIATION	VALUE 1	SCORE 1	VALUE 2	SCORE 2	VALUE 3	SCORE 3
Population	Priority 1: Score >=20	Count of Address Points or Buildings within 200 feet of a Flowline	ADPBldg_200_CT	>20	20	1-20	5	0	0
	Priority 2: Score = 10 - 19	Count of Address Point or Buildings in Disprortionately Impacted Communities within 200 feet of a Flowline	ADPBldg_200_DIC	>20	10	1-20	5	0	0
	Priority 3: Score = <10	Within 200 feet of a School Bldg	School200	TRUE	10	FALSE	0		
		Within a Municipal Boundary	MunBdry	TRUE	0	FALSE	0	Not Scored-Informational	

- Qualitative Scoring Approach
- Relative scores for criteria based on ECMC Staff field knowledge
- Each Group (Population, Surface Water, Groundwater) scored independently
- Highest Priority Group is promoted to the Overall Geographic Priority

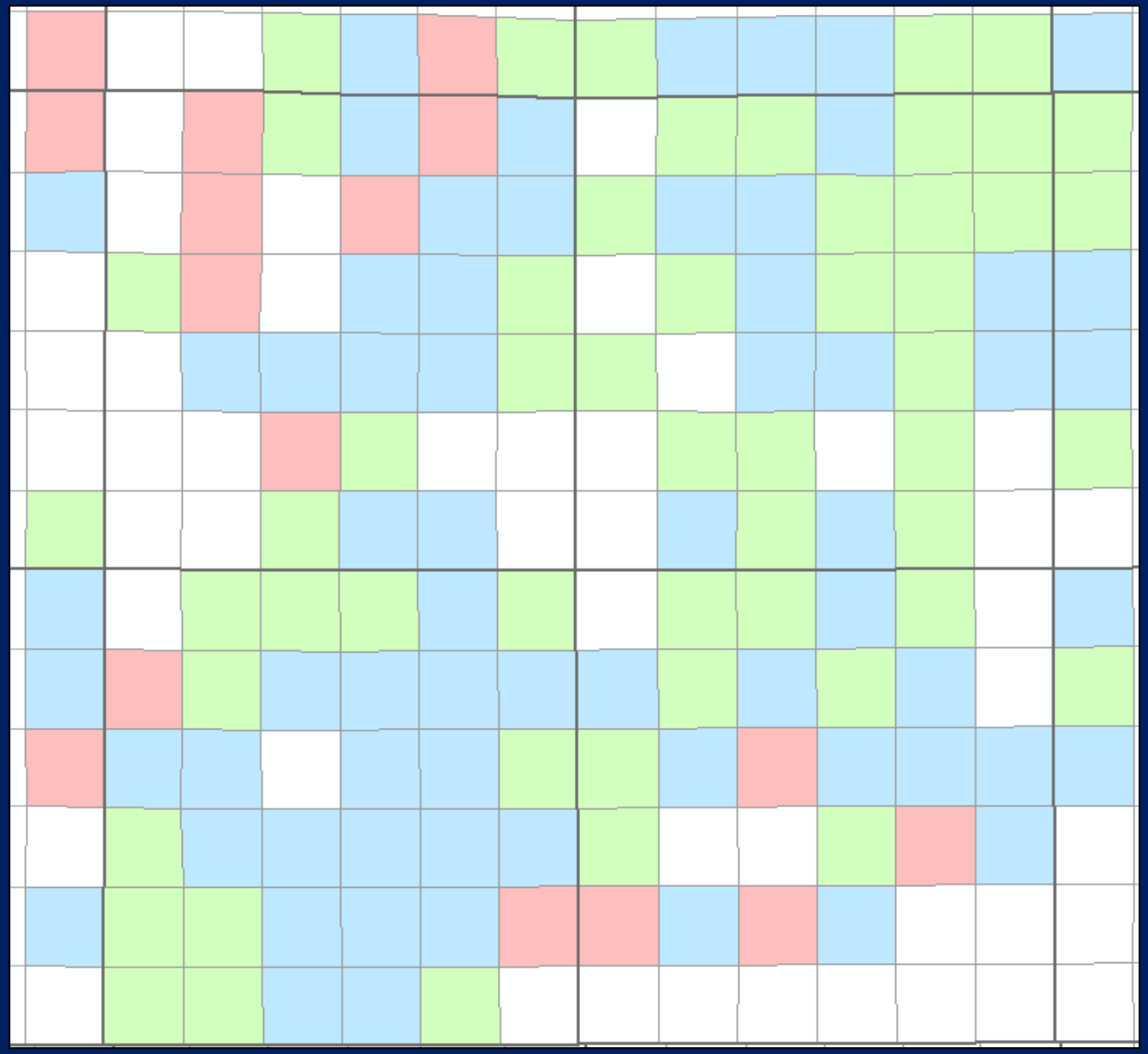
GIS Priority Matrix		Priority Levels		
		Priority 1	Priority 2	Priority 3
Geographic Group	Population	P1	P2	P3
	Surface Water	P1	P2	P3
	Groundwater	P1	P2	P3
	Overall Geographic Priority	GEOGRAPHIC PRIORITY 1, if any of the 3 Groups = P1	GEOGRAPHIC PRIORITY 2, if no P1s and any of the 3 Groups = P2	GEOGRAPHIC PRIORITY 3, if no P1s or P2s and any of the 3 Groups = P3

Overall Geographic Priority by Section

Priority 1 = Red

Priority 2 = Blue

Priority 3 = Green



Questions?

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