

# Ethanol Plant Suitability Study For Calhoun County, Iowa

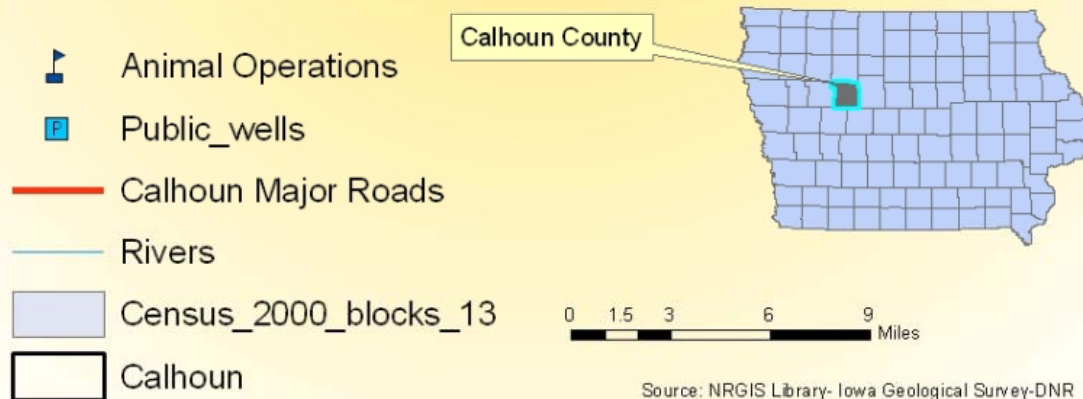
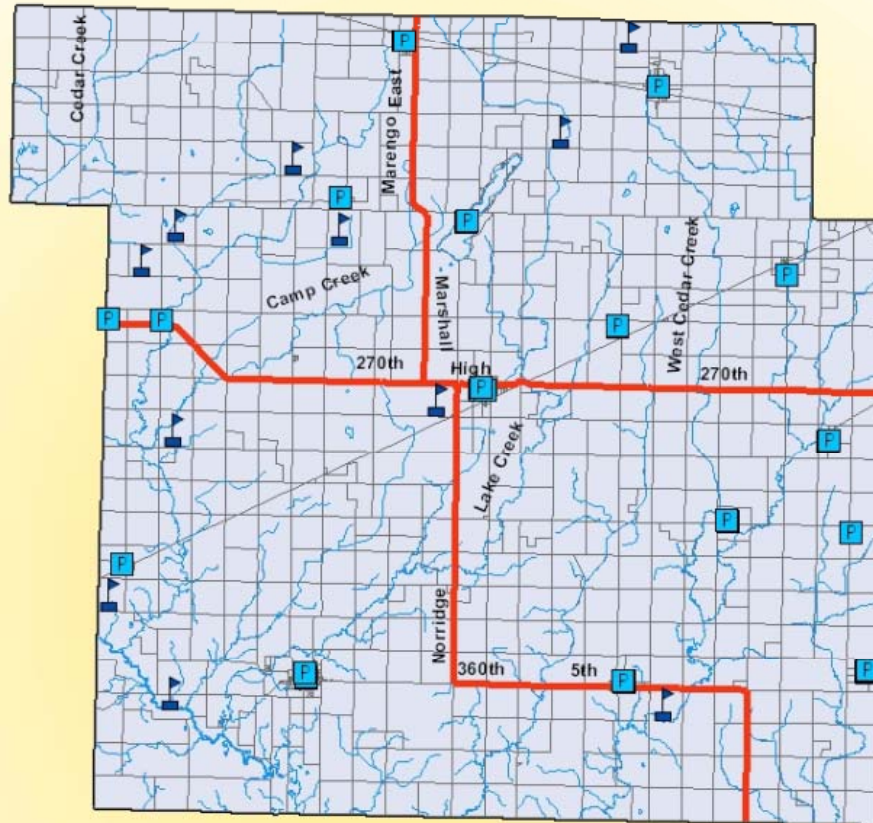
H. Gunsu Gemesi John Hammerly, Jin Zhang,  
LA 567

Advanced GIS Landscape Modeling

Dr. Paul Anderson

Fall, 2007

# Study Area Calhoun County



# Data Sources

- The Natural Resources Geographic System (NRGIS) Library
- Iowa State GIS Server

# Spatial Questions

- What **are the suitable** areas in Calhoun county which will have minimum environmental impacts for ethanol plant construction?
- What **are the suitable** areas in Calhoun county that will minimize economic costs of the ethanol plant?

# Objectives

## Minimize Environmental impact

- Avoid soil erosion
- Avoid flooding Areas
- Avoid areas where the risk of ground water contamination high
- Avoid prime farmland areas

# Minimize Economic Cost

- Close to water source (wells)
- Near animal feeding operations
- Close to major roads
- In suitable slope range
- Easy access to groundwater reserves
  1. Water table dept
  2. Groundwater formation

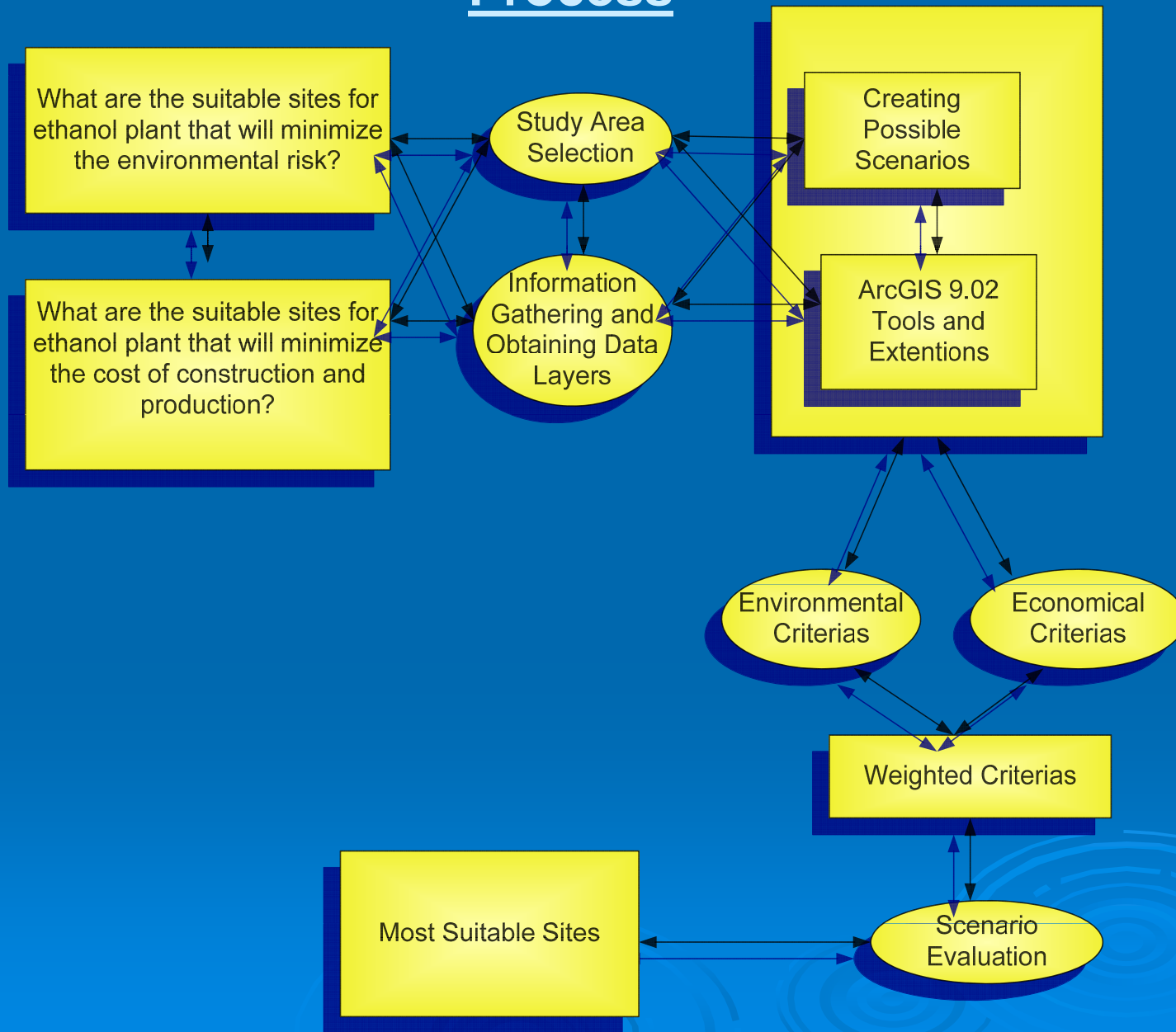
# Environmental Factors

Goals	Weight	Objectives	Map layer	High suitability	Moderate suitability	Low suitability
Minimize environmental impact   100%	20%	<u>Avoid soil erosion</u>	HEL	3	2	1
	35%	<u>Avoid flooding Areas</u>	Flooding	None	Rare, Occasional	Frequent, Common, Pond
	25%	<u>Avoid high vulnerable ground water areas</u>	Ground Water	Bedrock	Alluvial	Open water
	20%	<u>Avoid prime farmland</u>	USDA prime farmland	L	S	P, P2, P3, P5

# Economical Factors

Minimize Economic Cost   100%	15%	<u>High ground water availability</u>	Potential metric	50 - 130	130-200	>200
	15%	<u>High ground water availability</u>	Ground Water	Open Water	Alluvial	Bedrock
	15%	<u>Near Water Source</u>	Public Wells	<1 mile	1-3 miles	>3 miles
	25%	<u>Near animal feeding operations</u>	CAFO	<2 miles	2 - 4 miles	>4 miles
	20%	<u>Near Roads</u>	Roads	<2 miles	2-4 miles	>4 miles
	10%	<u>Build on suitable slopes</u>	slope	0-4%	4-12%	12 - 48%

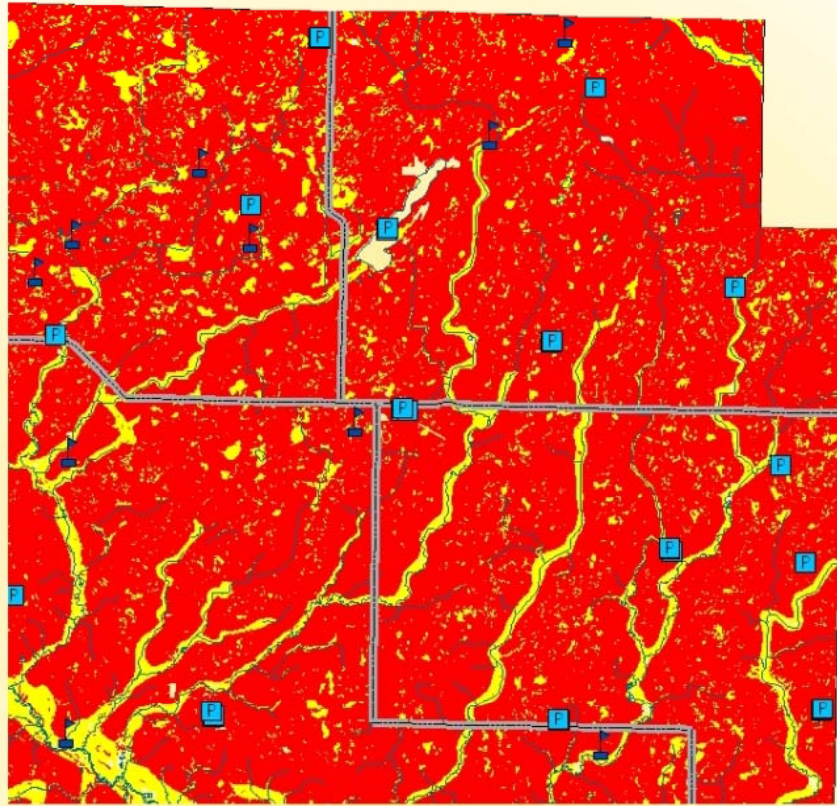
# Process



# Scenarios

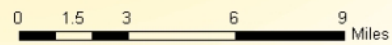
- **Scenario 1 Separate Evaluation**
  - Environmental effect: 100%
  - Economic cost: 100%
- **Scenario 2 Environmental emphasis**
  - Environmental effect: 75%
  - Economic cost: 25%
- **Scenario 3 Economic emphasis**
  - Economic cost : 75%
  - Environmental effect: 25%

## Suitability Evaluation Considering Environmental Factors



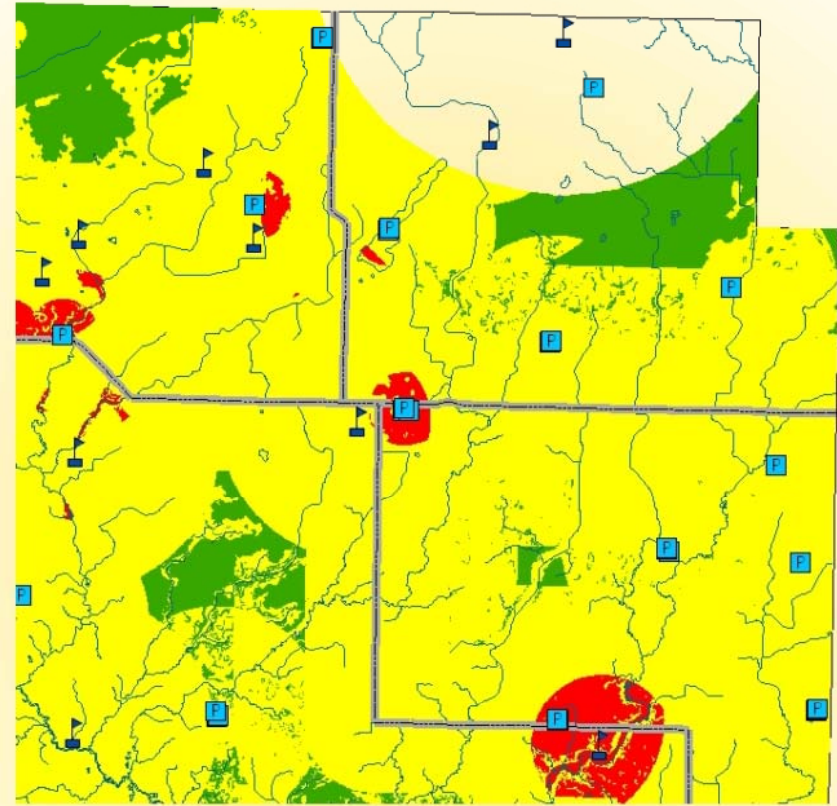
### Suitability Evaluation

- Public\_wells
- Calhoun Major Roads
- Rivers
- Calhoun
- Animal Operations
- Low
- Average
- High



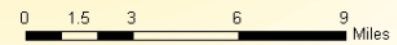
Source: NRGIS Library- Iowa Geological Surv

## Suitability Evaluation Considering Economical Factors



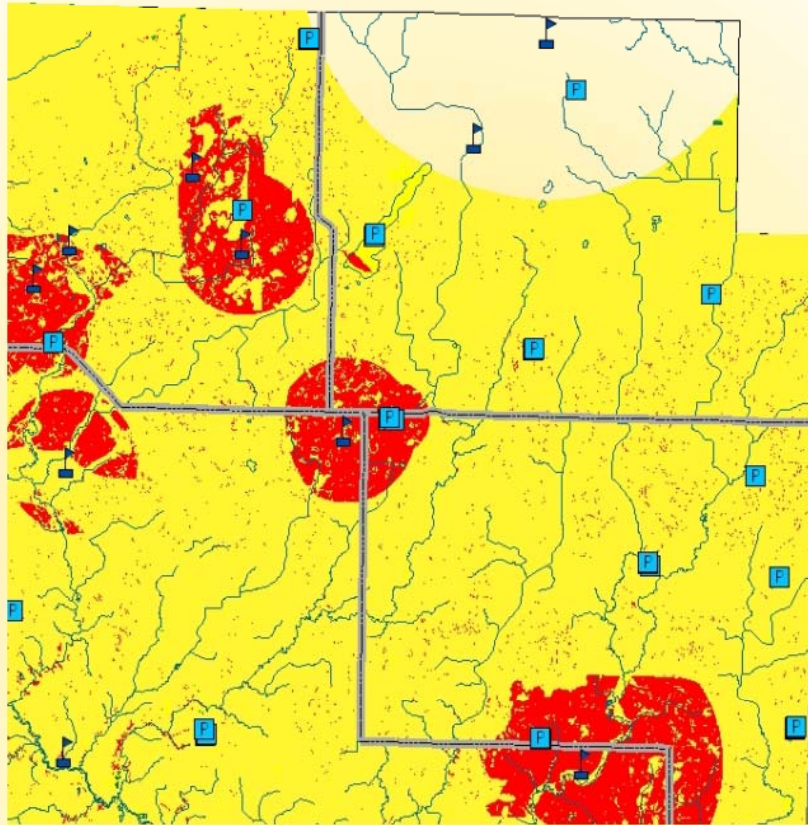
### Suitability Evaluation

- Public\_wells
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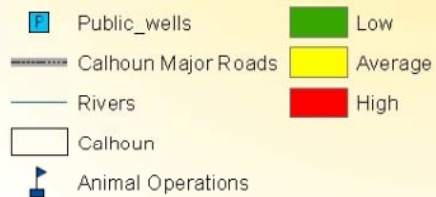


Source: NRGIS Library- Iowa Geological Survey-DNR

## Suitability Evaluation Emphasis on Environmental Factors

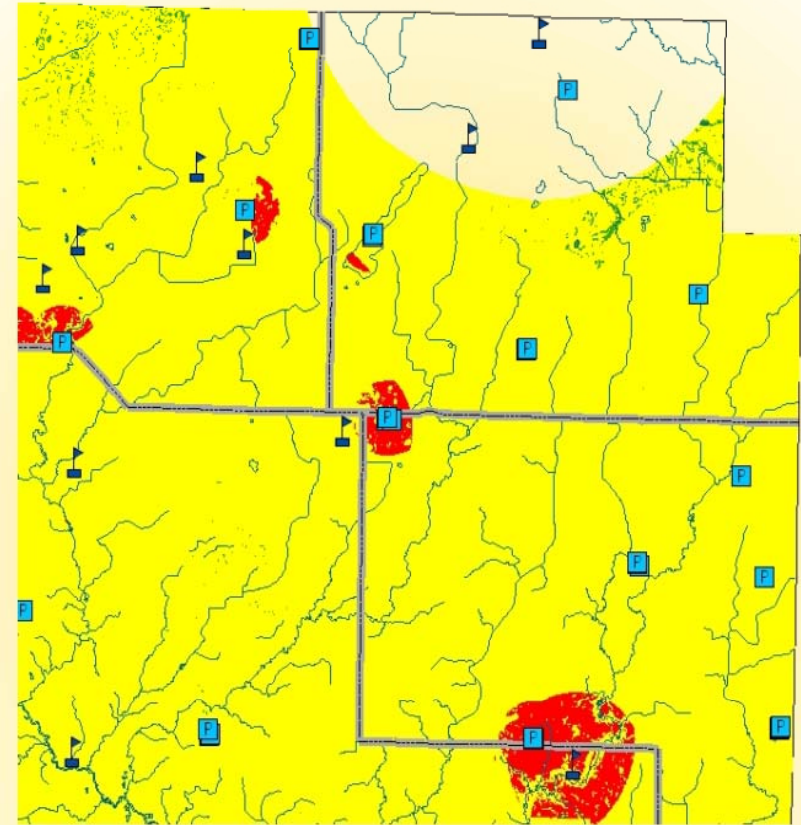


### Suitability Evaluation

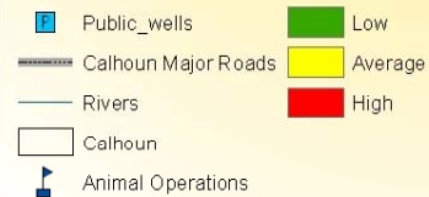


Source: NRGIS Library- Iowa Geological Survey-DNR

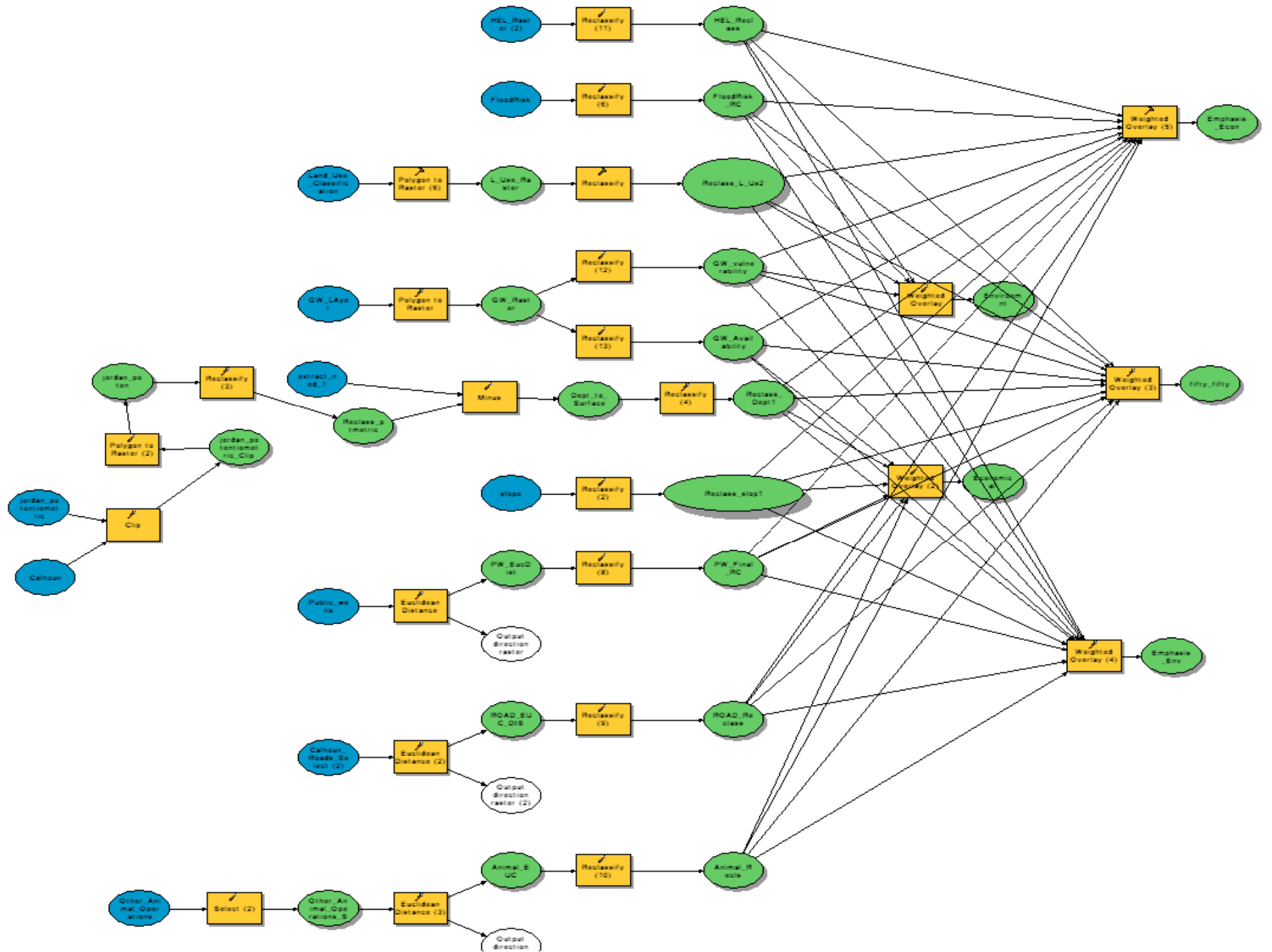
## Suitability Evaluation Emphasis on Economical Factors



### Suitability Evaluation



Source: NRGIS Library- Iowa Geological Survey-DNR

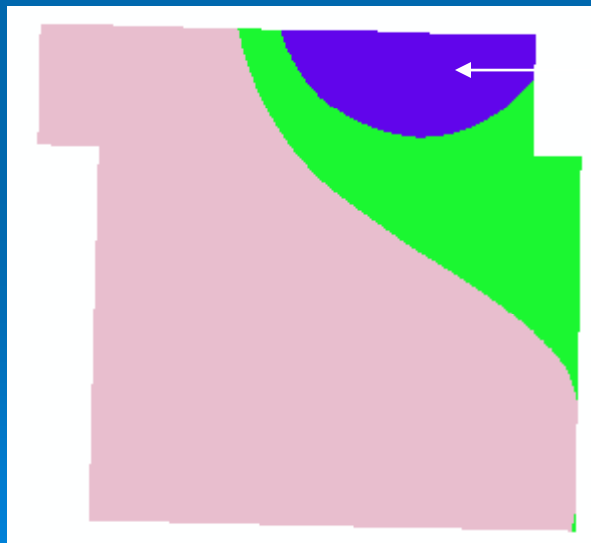


# Limitations

- Data Source

  - Old data

- Missing data



Manson Anomaly

Mason Impact Structure is known as very complex geological structure, data source gives out no contour value.

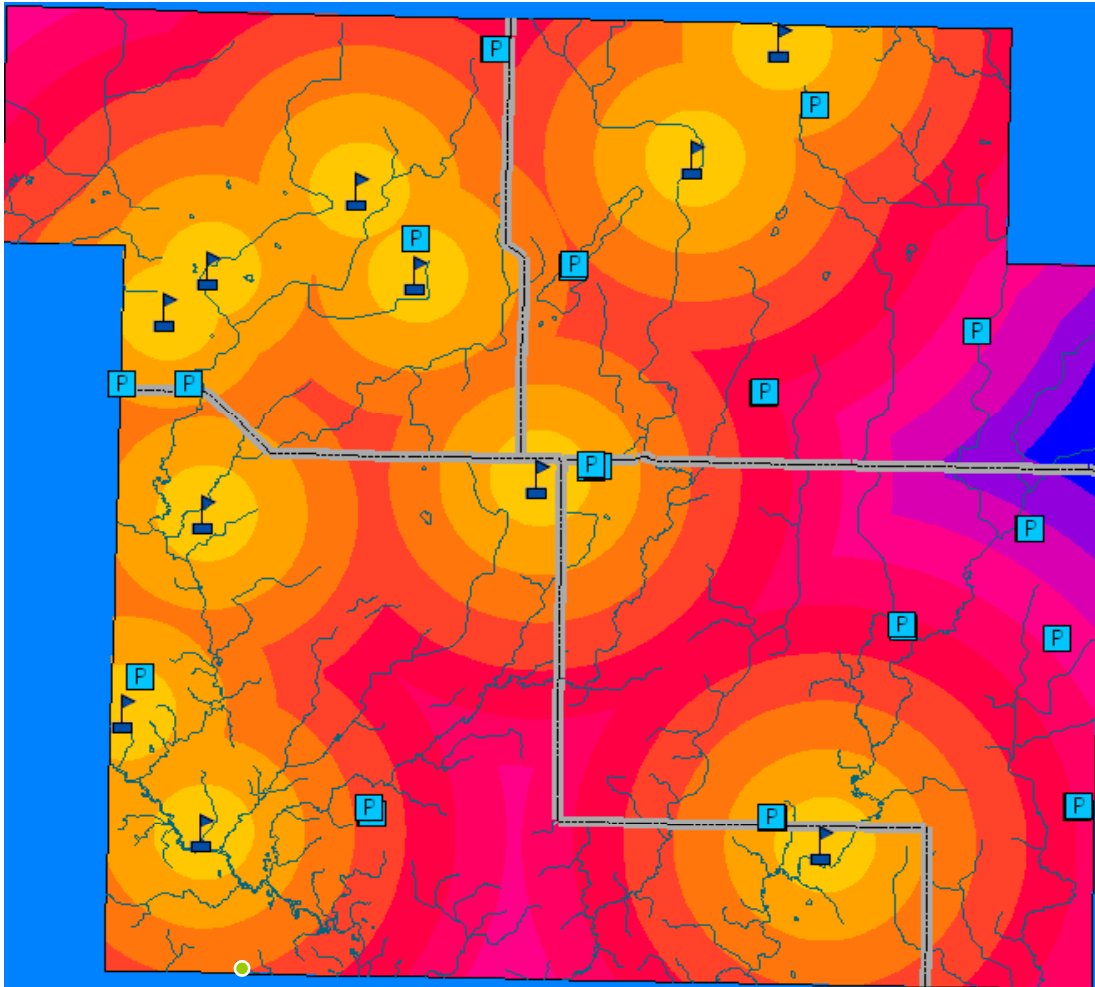
# Conclusion

- The maps emphasizing environmental and economic factors together, exhibit similar regional patterns, but differ slightly in areas within region.
- When the both environmental and economical factors taken in to consideration separately, the area suitability pattern changes drastically

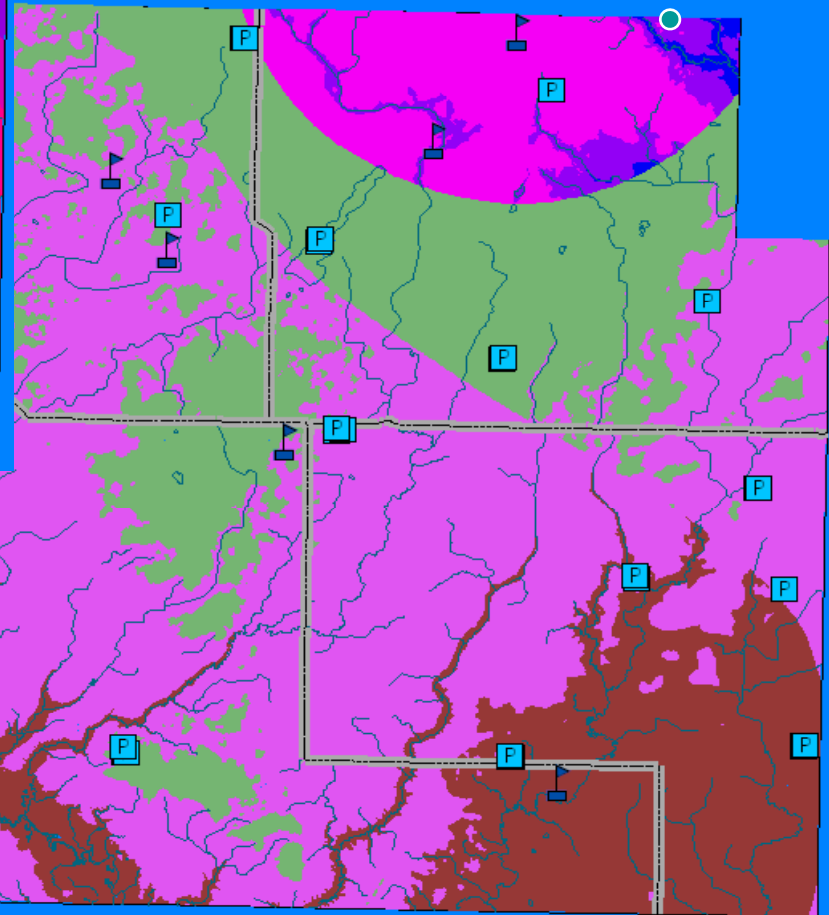
# References

- Landscape Suitability Analysis, Murphy 2005
- Cross-disciplinary approach could give the state an edge, Hunter 2006
- Constraints on the Location of Ethanol Production in the Corn Belt, Eathington & Swenson 2007
- Learning ArcGIS Spatial Analyst, ESRI Training and Education, 2007

Thank you for your attention!!!!  
Questions???



Dept of Water  
Tables to the  
Surface



Animal Operations  
Euclidean Distance  
Calculation



Location: \\Delphi\la567\groups\Project2\Jin John Gunsu\SuitabilityLocation.mdb\Environment

Stylesheet: FGDC ESRI

SuitabilityLocation.mdb

- EconomicalFactors
  - Calhoun\_Roads\_Select
  - Other\_Animal\_Operations\_Sele
  - Public\_wells
- EnvironmentalFactors
  - Calhoun
  - Calhoun\_Soil
  - GW\_LAyer
  - HEL
  - Rivers
- Animal\_EUC
- Animal\_Recls
- Dept\_to\_Surface
- Depthtosurface
- Econ\_Weighted
- Economical
- Emphasis\_Econ
- Emphasis\_Env
- Envir\_Weight
- Envir\_Weighted
- Environment
- Environmnt
- Equal\_weight
- fifty\_fifty
- FloodRisk\_RC
- GW\_Availability
- GW\_Raster
- GW\_vulnerability
- GWAccessibility
- HEL\_RAS
- HEL\_Raster
- HEL\_Reclass
- jordan\_poten

Contents Preview Metadata

Name	Type
Rivers	Personal Geodatabase Feature C
HEL	Personal Geodatabase Feature C
GW_LAyer	Personal Geodatabase Feature C
Calhoun_Soil	Personal Geodatabase Feature C
Calhoun	Personal Geodatabase Feature C

Personal Geo-database

# Scenario 2

## Environmental emphasized

Goals	Weight	Objectives	Map layer	High suitability	Moderate suitability	Low suitability
Minimize environmental impact  75%	16%	<b><u>Avoid soil erosion</u></b>	HEL	3	2	1
	28%	<b><u>Avoid flooding Areas</u></b>	Flooding	None	Rare, Occasional	Frequent, Common, Pond
	16%	<b><u>Avoid high vulnerable ground water areas</u></b>	Ground Water	Bedrock	Alluvial	Open water
	15%	<b><u>Avoid prime farmland</u></b>	USDA prime farmland	L	S	P, P2, P3, P5
Minimize Economic Cost  25%	4%	<b><u>High ground water availability</u></b>	Potential metric	50 - 130	130-200	>200
	4%	<b><u>High ground water availability</u></b>	Ground Water	Open Water	Alluvial	Bedrock
	3%	<b><u>Near Water Source</u></b>	Public Wells	<1 mile	1-3 miles	>3 miles
	6%	<b><u>Near animal feeding operations</u></b>	CAFO	<2 miles	2 - 4 miles	>4 miles
	5%	<b><u>Near Roads</u></b>	Roads	<2 miles	2-4 miles	>4 miles
	3%	<b><u>Build on suitable slopes</u></b>	slope	0-4%	4-12%	12 - 48%

# Scenario 3

## Economic emphasized

Goals	Weight	Objectives	Map layer	High suitability	Moderate suitability	Low suitability
Minimize environmental impact	3%	<b><u>Avoid soil erosion</u></b>	HEL	3	2	1
	10%	<b><u>Avoid flooding Areas</u></b>	Flooding	None	Rare, Occasional	Frequent, Common, Pond
	7%	<b><u>Avoid high vulnerable ground water areas</u></b>	Ground Water	Bedrock	Alluvial	Open water
	5%	<b><u>Avoid prime farmland</u></b>	USDA prime farmland	L	S	P, P2, P3, P5
Minimize Economic Cost	18%	<b><u>High ground water availability</u></b>	Potential metric	50 - 130	130-200	>200
	11%	<b><u>High ground water availability</u></b>	Ground Water	Open Water	Alluvial	Bedrock
	18%	<b><u>Near Water Source</u></b>	Public Wells	<1 mile	1-3 miles	>3 miles
	10%	<b><u>Near animal feeding operations</u></b>	CAFO	<2 miles	2 - 4 miles	>4 miles
	10%	<b><u>Near Roads</u></b>	Roads	<2 miles	2-4 miles	>4 miles
	8%	<b><u>Build on suitable slopes</u></b>	slope	0-4%	4-12%	12 - 48%