



# GA Regional Biophysical Modeling Simple Scenarios

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## GA Regional Modeling Team

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Results represent work in progress and are not yet peer reviewed. They are based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2017-68007-26319. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.



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# Recall: management practices

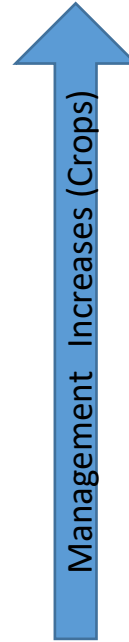
## Current Production Systems

**CROPS** Cotton-cotton-peanut  
Corn-cotton-peanut

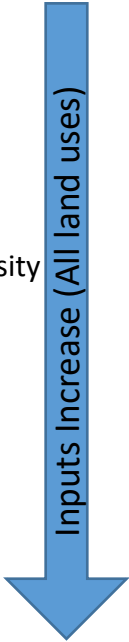
**FORESTS** Longleaf  
Loblolly  
Slash pine

# GEORGIA

## Management System Summaries



	<u>Crop</u>	<u>Forests</u>
<b>MS1</b>	<ul style="list-style-type: none"> <li>SMS based irrigation</li> <li>Lowest fertilization</li> <li>Cover crops</li> <li>Strip tillage</li> </ul>	<ul style="list-style-type: none"> <li>No thinning</li> <li>No fertilization</li> <li>Longer rotation age</li> <li>Lower initial planting density</li> </ul>
<b>MS2</b>	<ul style="list-style-type: none"> <li>Checkbook irrigation</li> <li>Medium N rate</li> <li>No cover crops</li> <li>Conventional tillage</li> </ul>	<ul style="list-style-type: none"> <li>Thinning</li> <li>Medium N rate</li> <li>Medium rotation age</li> </ul>
<b>MS3</b>	<ul style="list-style-type: none"> <li>Least efficient irrigation</li> <li>Highest fertilization</li> <li>No cover crops</li> <li>Conventional tillage</li> </ul>	<ul style="list-style-type: none"> <li>Thinning</li> <li>Highest N rate</li> <li>Shortest rotation age</li> </ul>



These FACETS results represent work in progress and are not suitable for public distribution.

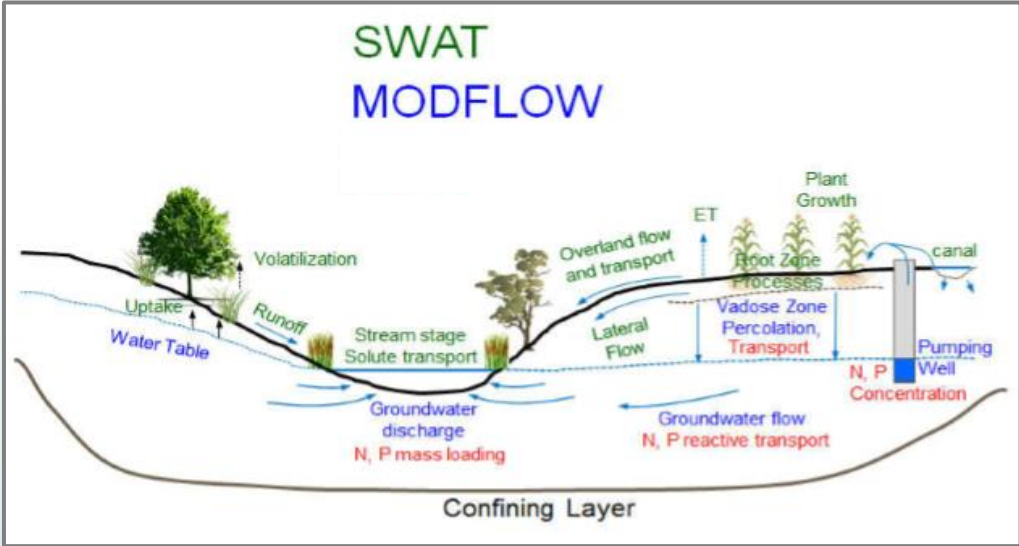


# Georgia – Regional Scale Modeling

Region of interest



Regional Biophysical Modeling Framework



## Soil and Water Assessment Tool (SWAT)

Simulates hydrology and water quality

- Land surface
- Soil
- Surface water

## MODFLOW

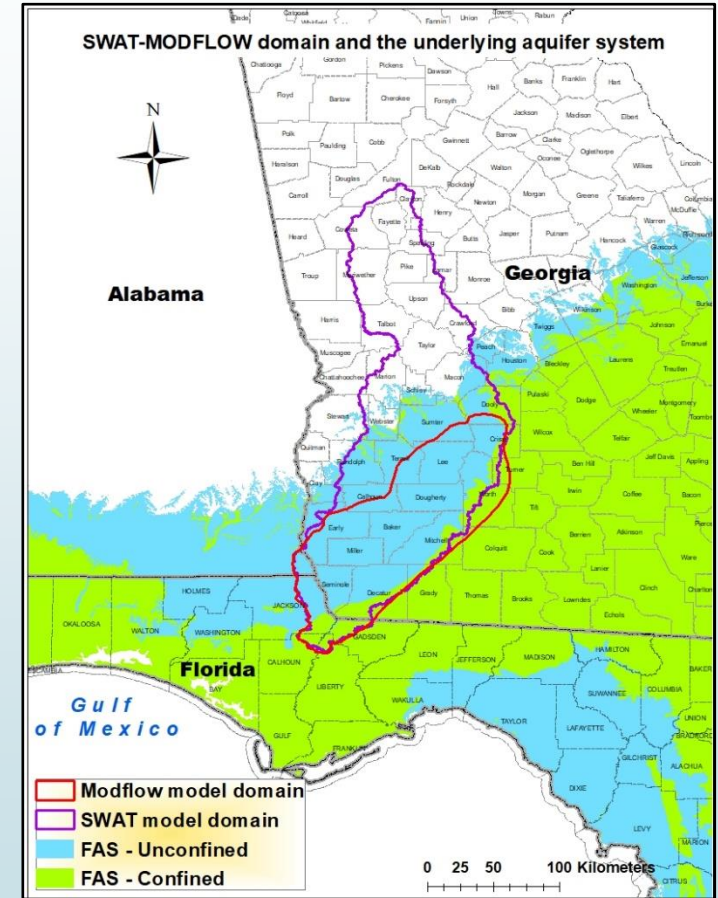
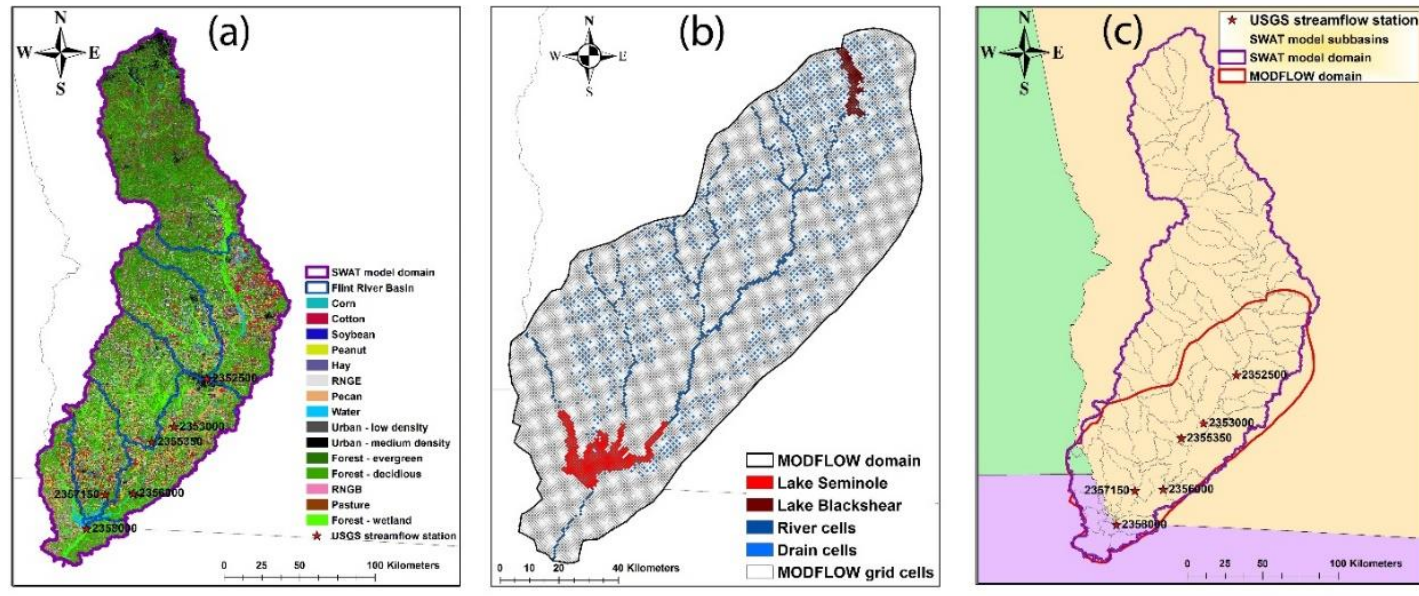
- Groundwater hydrology
- Interaction between ground and surface water

Results represent work in progress and are not yet peer reviewed

# Regional Modeling Domain

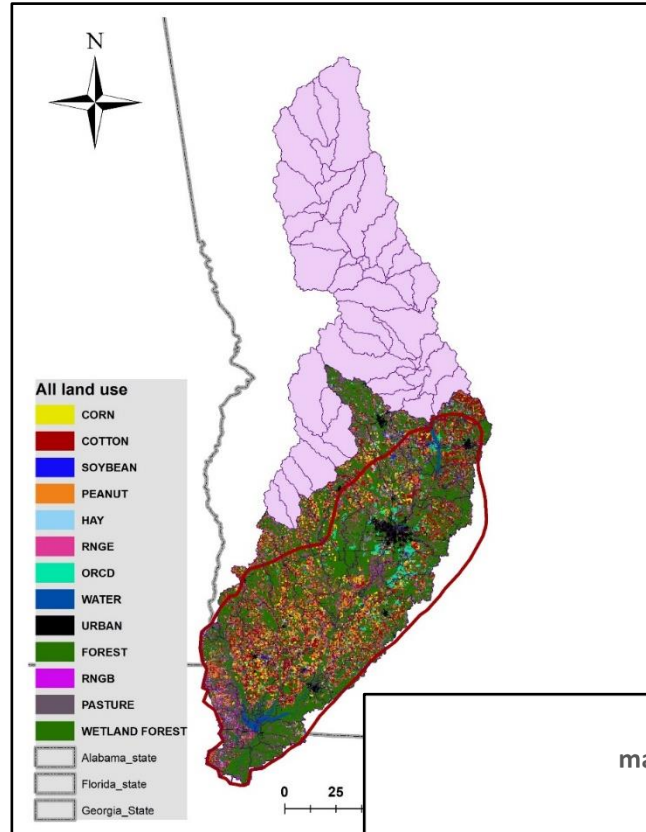
SWAT-MODFLOW model that simulates the surface- and groundwater processes of the lower Flint River Basin.

Spatial extent of the (a) SWAT model (b) the MODFLOW domain (c) the overlap of the SWAT and MODFLOW domain



# Simple scenarios: Development and Evaluation

Land use in the region

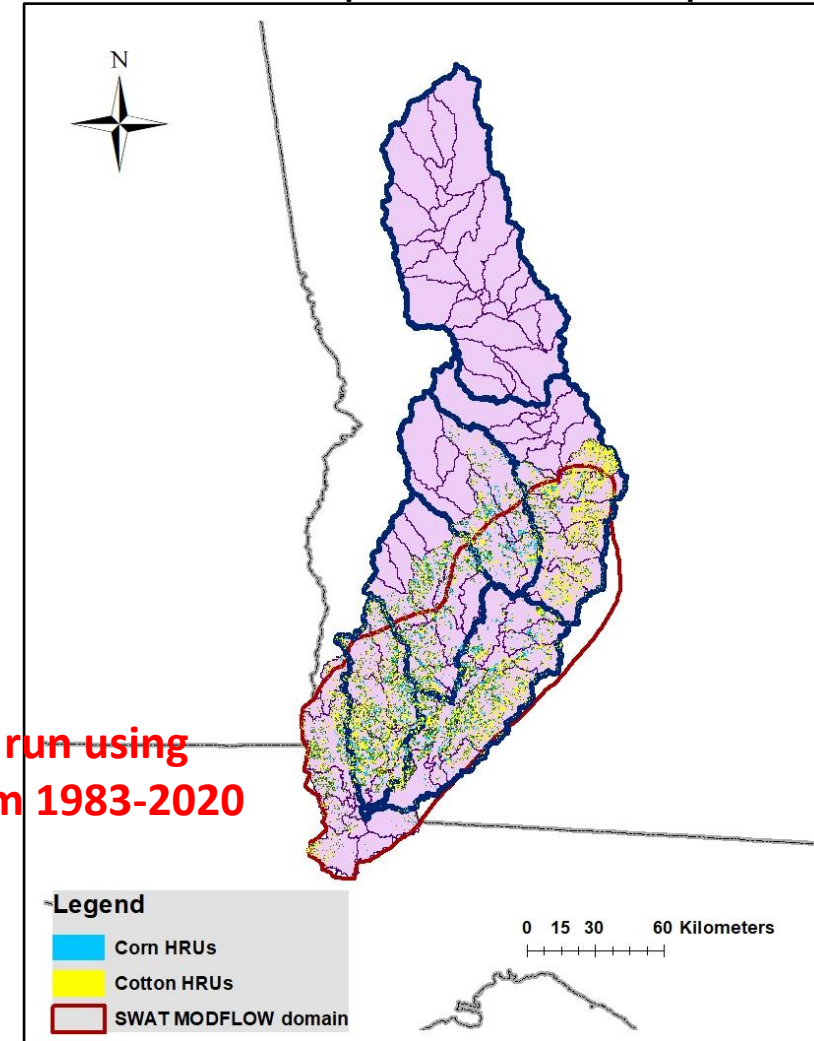


Simple scenarios

Scenario	Land use	Management Systems
<b><u>All Ag MS1</u></b> Row crops: corn-cotton-peanut cotton-cotton-peanut Forest: Loblolly	2011 Land use	All row crops use MS1, Forests MS1
<b><u>All Ag MS2</u></b> Row crops: corn-cotton-peanut cotton-cotton-peanut Forest: Loblolly	2011 Land use	All row crops use MS2, Forests MS1
<b><u>All Ag MS3</u></b> Row crops: corn-cotton-peanut cotton-cotton-peanut Forest: Loblolly	2011 Land use	All row crops use MS3, Forests MS1

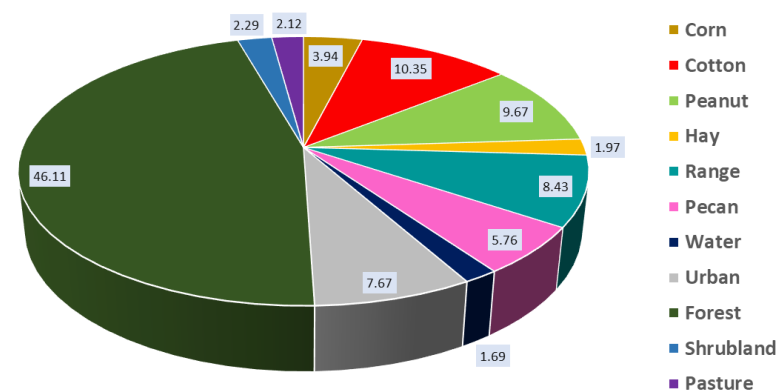
*Note: Hay and pasture is not simulated in GA*

Land use where crop rotations were incorporated

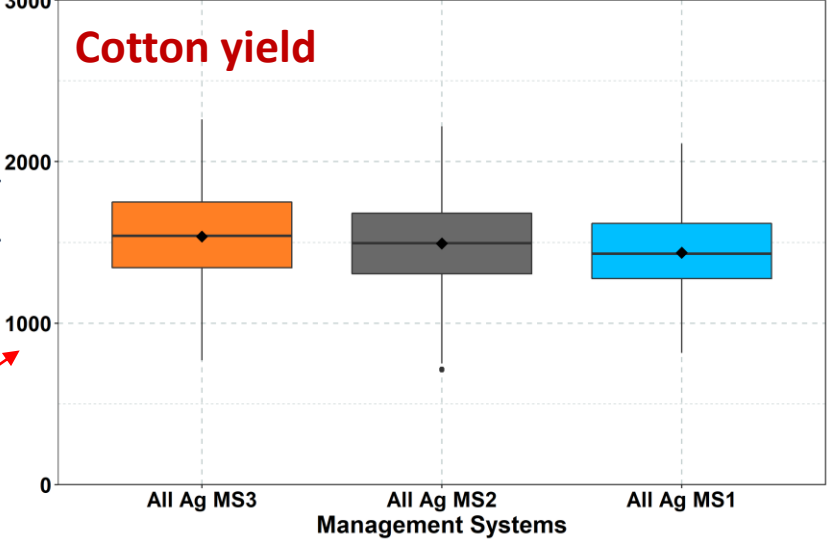
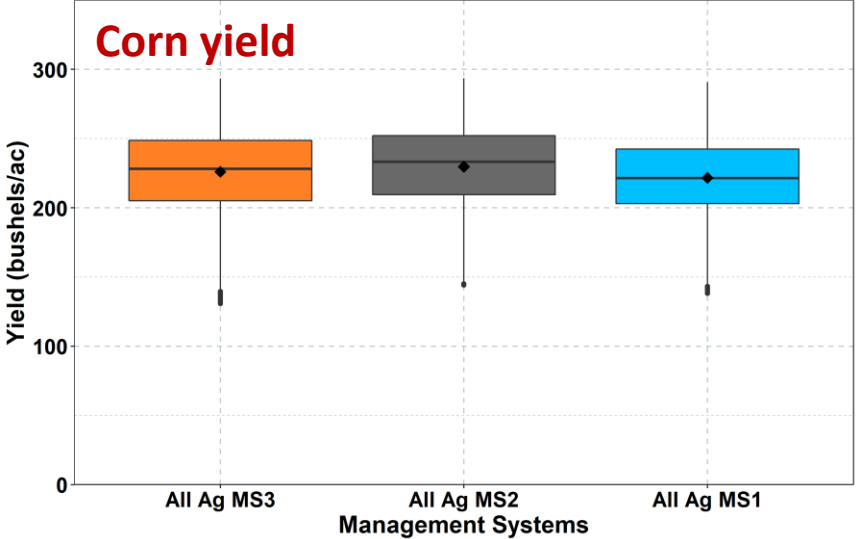


Each scenario was run using historical climate from 1983-2020

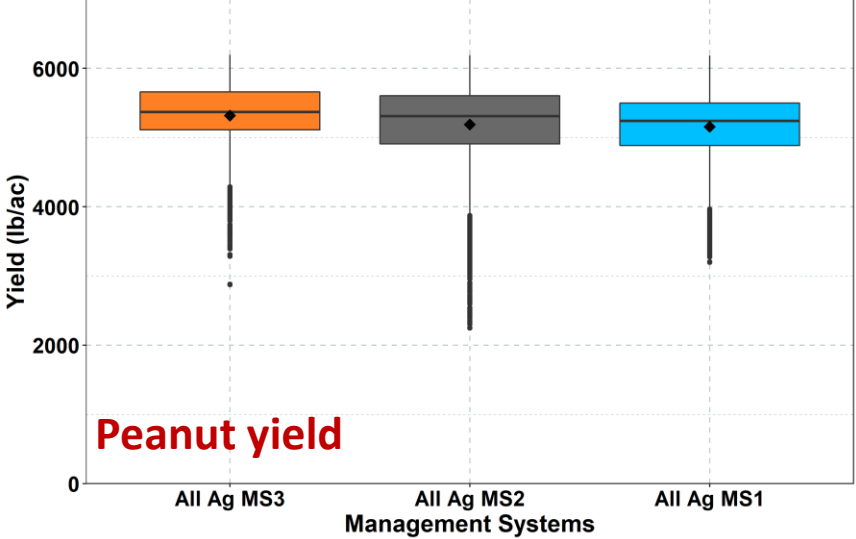
Lower Flint River Basin major land use % distribution



# Findings – Crop Yields



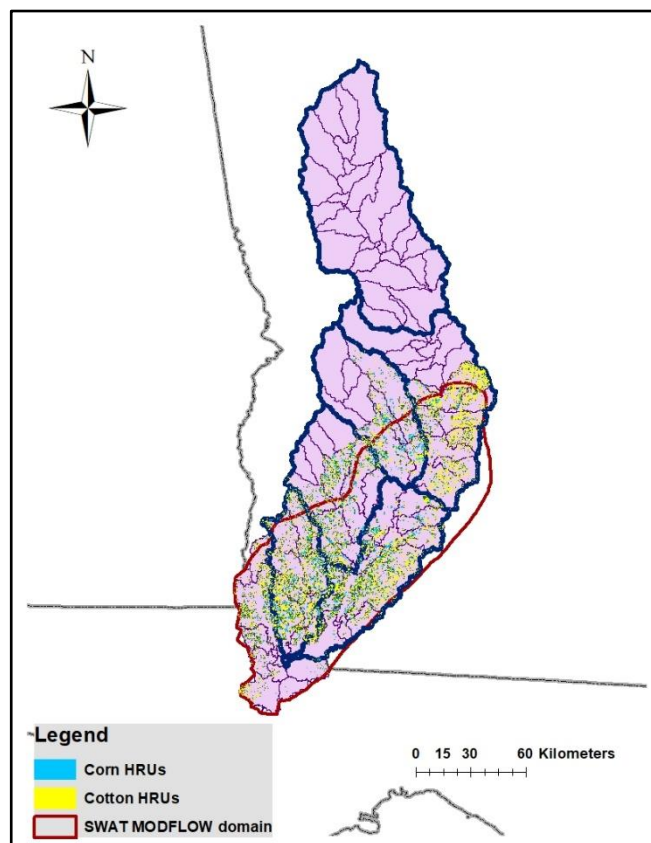
Small but statistically significant differences



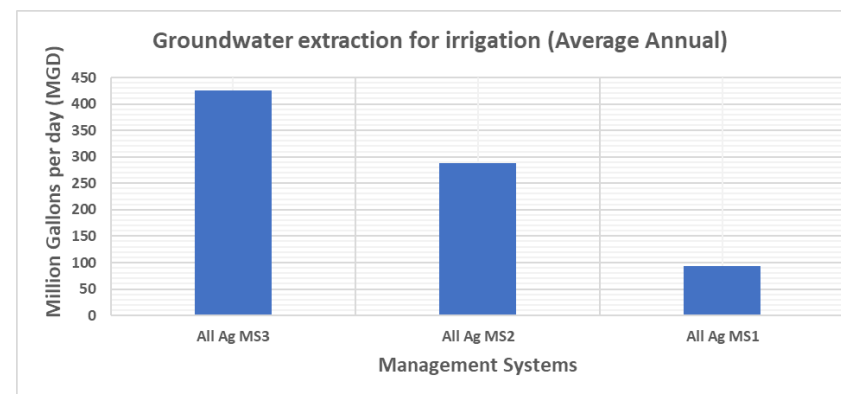
# Findings: Aquifer pumping

These FACETS results represent work in progress and are not suitable for public distribution.

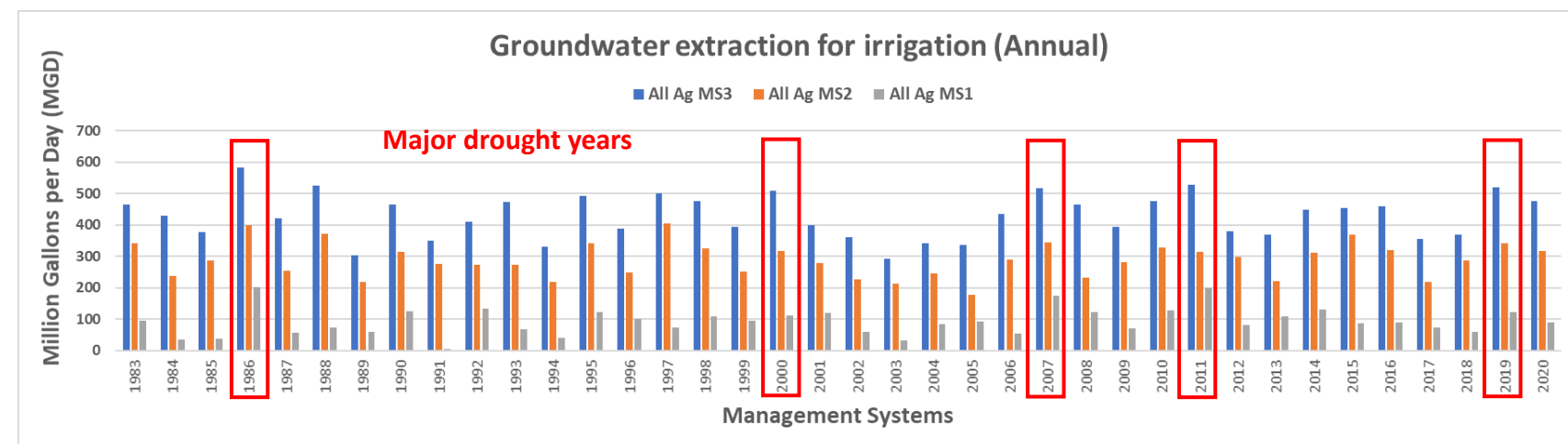
## Irrigated HRUs in the model



## Average annual pumping for irrigation from 1983 - 2020

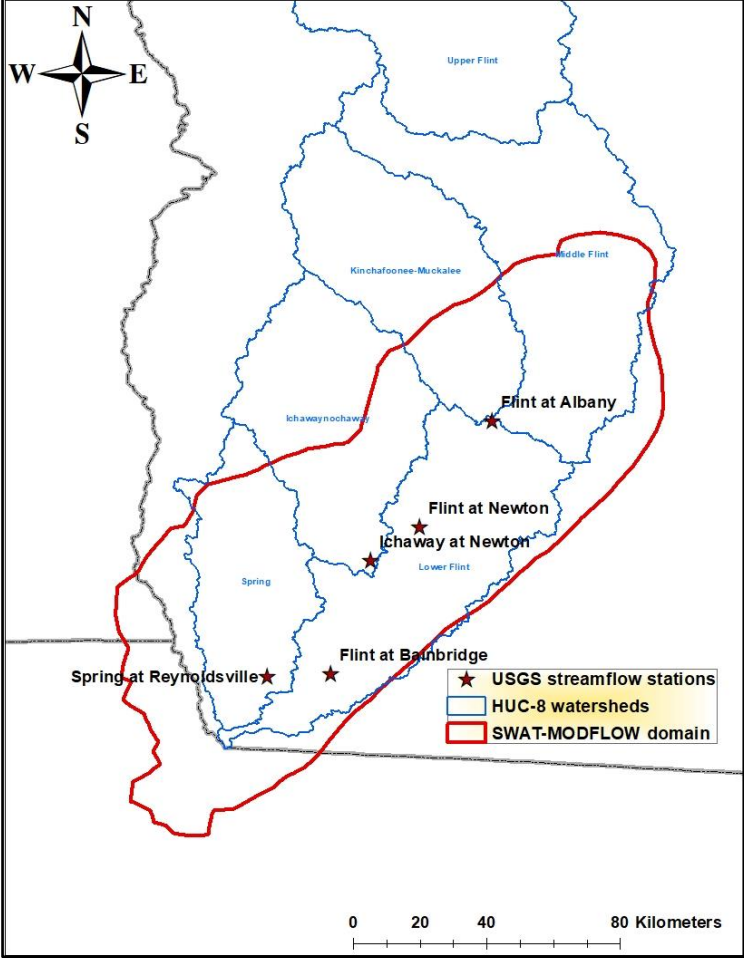


Groundwater pumpage ranged from close to 100 MGD in MS1 to more than 400 MGD in MS3  
Pumpage was over 500 MGD in major drought years in MS3

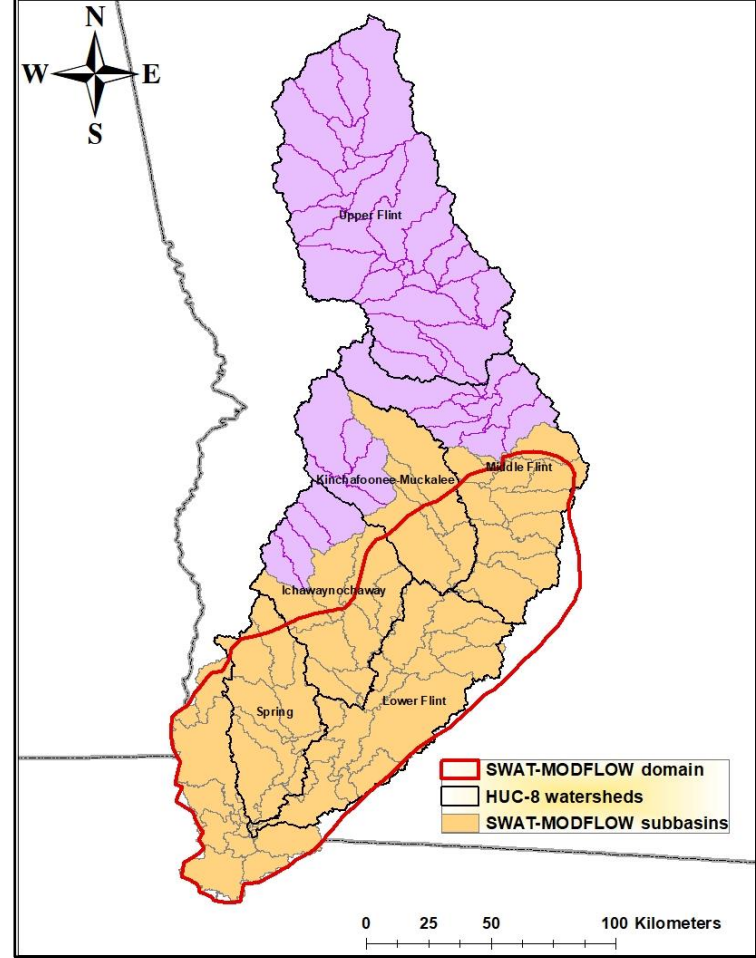


# Approach: Evaluation – Water Quantity

Flow evaluation at important USGS stations



Spatial evaluation

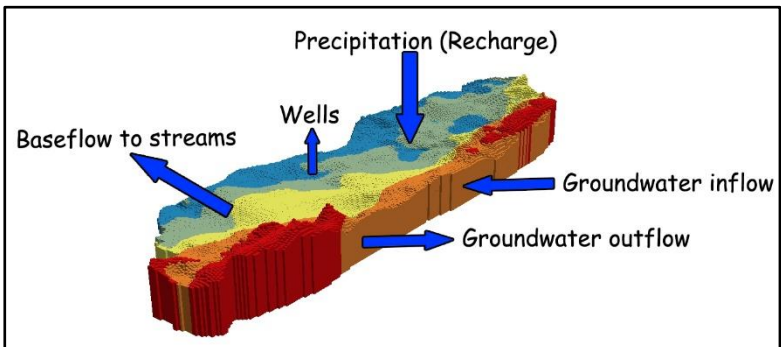




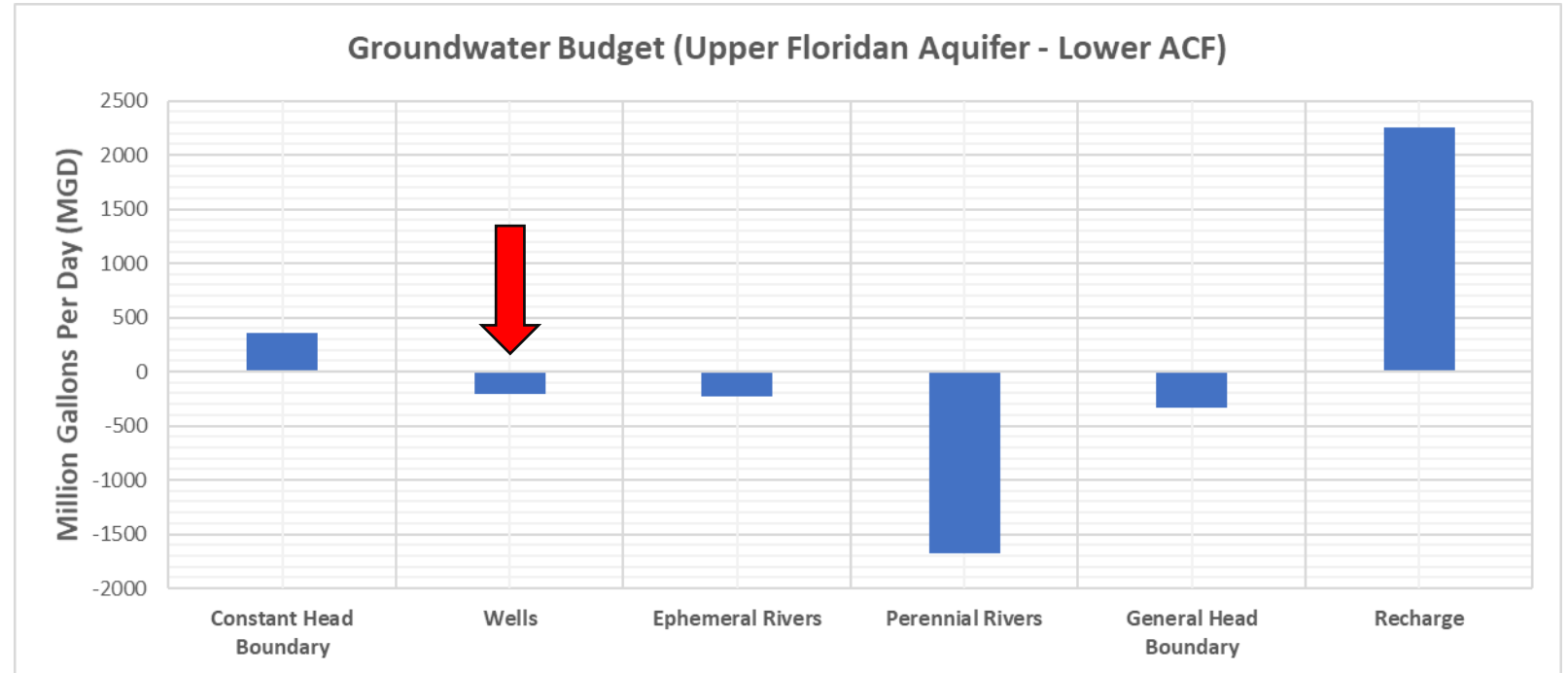
# Understanding - Water Budget

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## Groundwater budget of the aquifer system

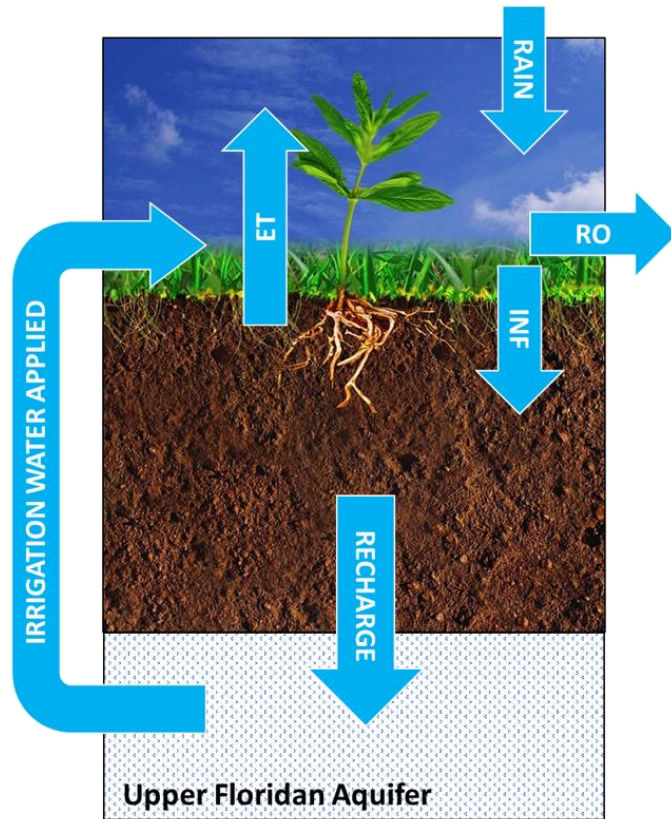


**Important note:** Groundwater pumpage is a small component of the overall water budget

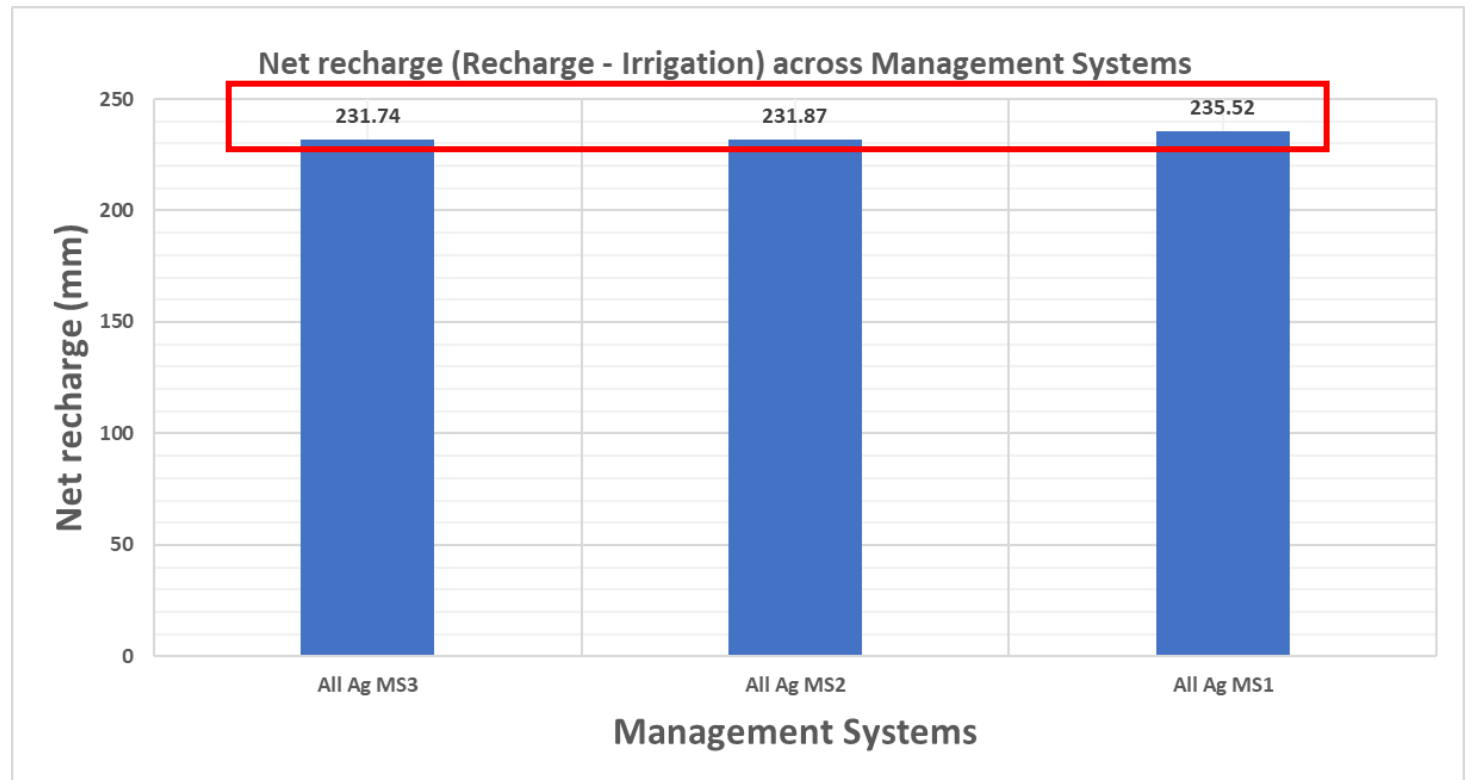


# Findings: Net recharge

Net recharge = Recharge - Irrigation



Annual average net recharge was slightly higher for MS1  
All Ag MS1 has lower irrigation but same precipitation as the other two scenarios



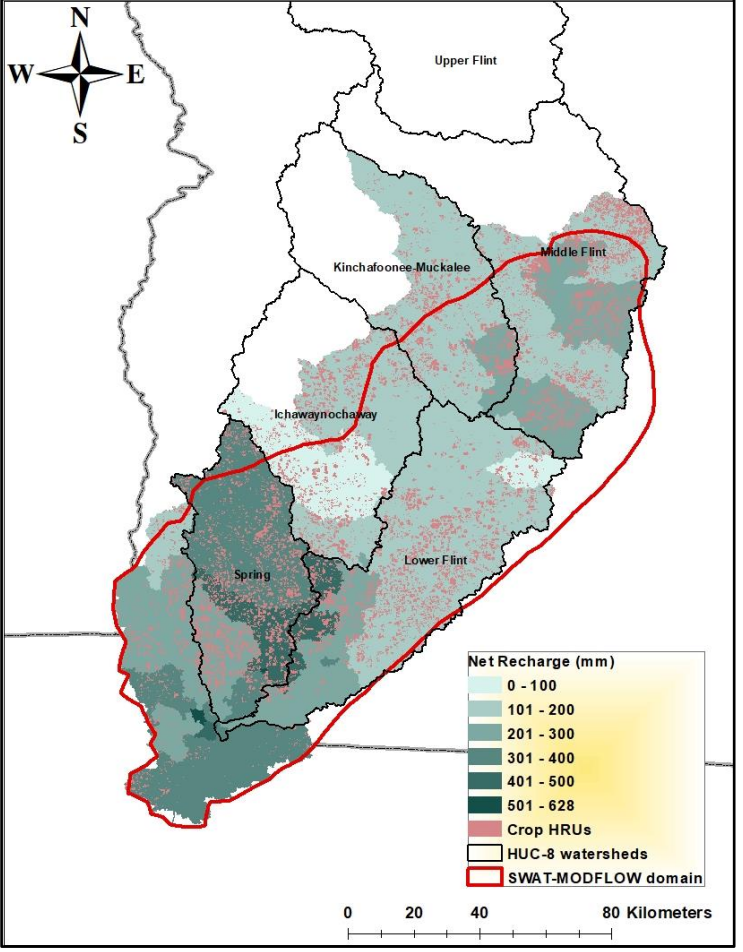
# Findings: Net recharge

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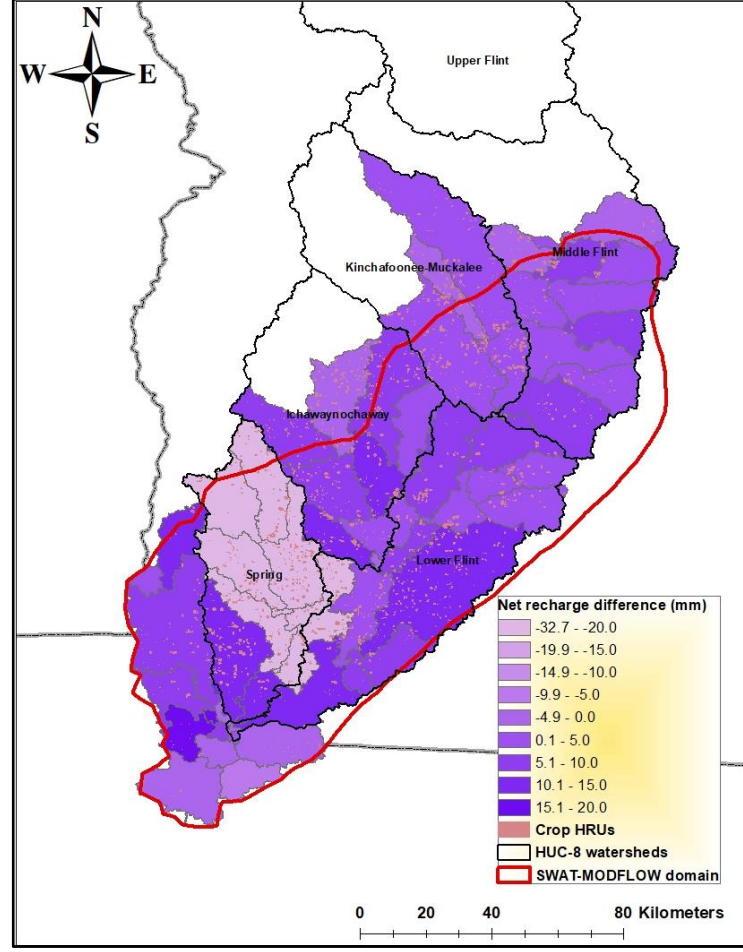
## (Spatial evaluation)

Spring watershed seems to have a different trend than other watersheds in the study region  
The difference, however, is close to or less than an inch across the three Management Systems

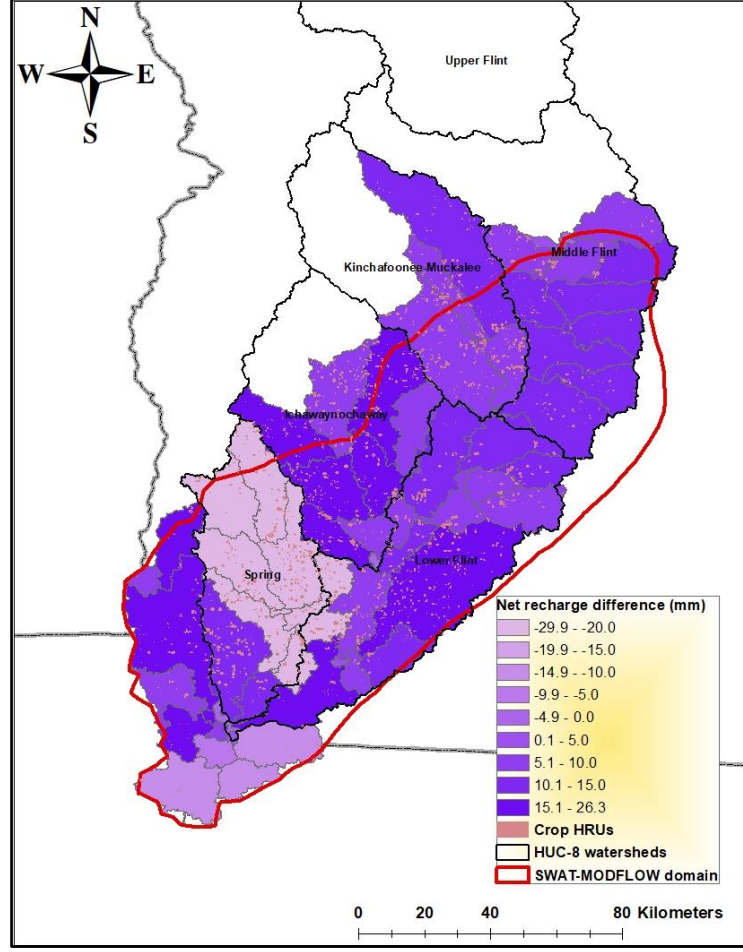
Net recharge (All Ag MS3)



Difference in net recharge (MS2 – MS3)



Difference in net recharge (MS1 – MS3)



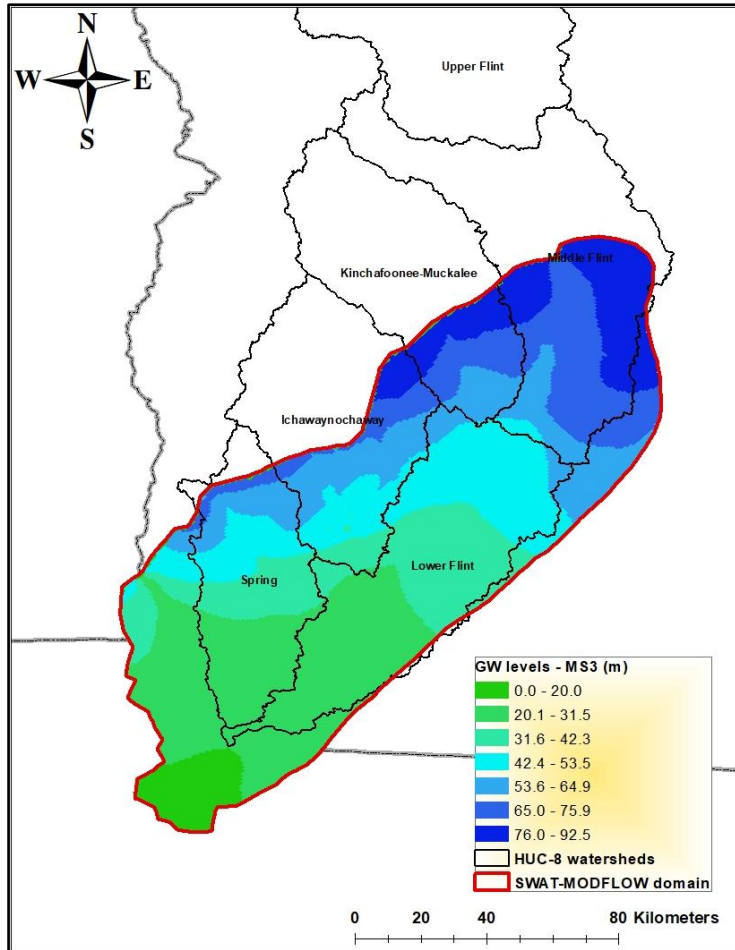
# Findings: GW levels

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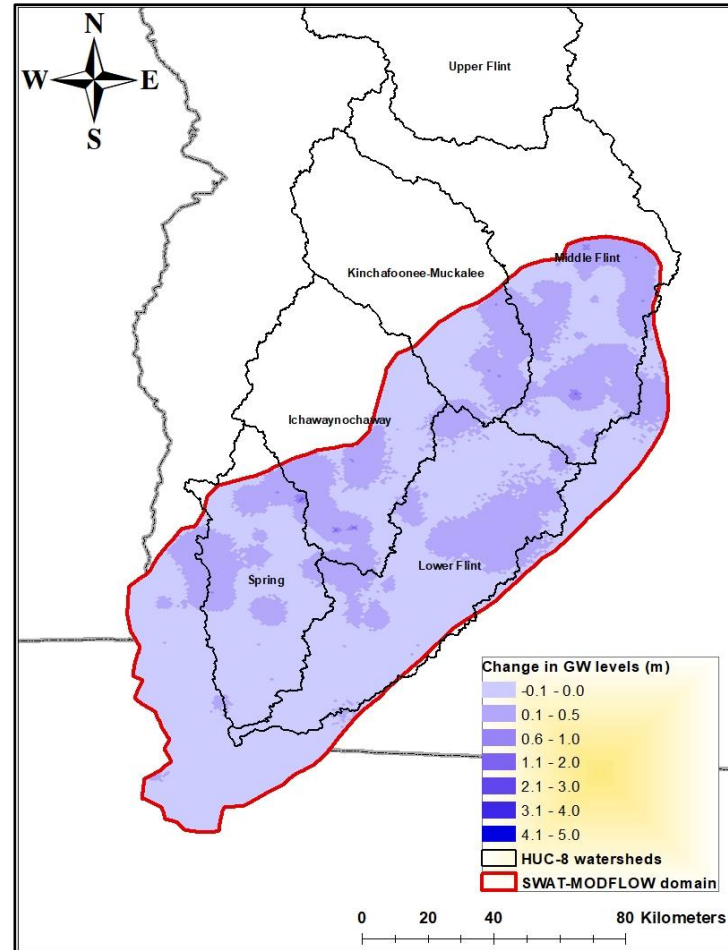
Average annual GW levels were slightly lower for MS2 and MS3 when compared to MS1 GW levels

Certain areas in Spring, Ichawaynochaway, and Middle Flint were identified as sensitive to groundwater pumpage for irrigation

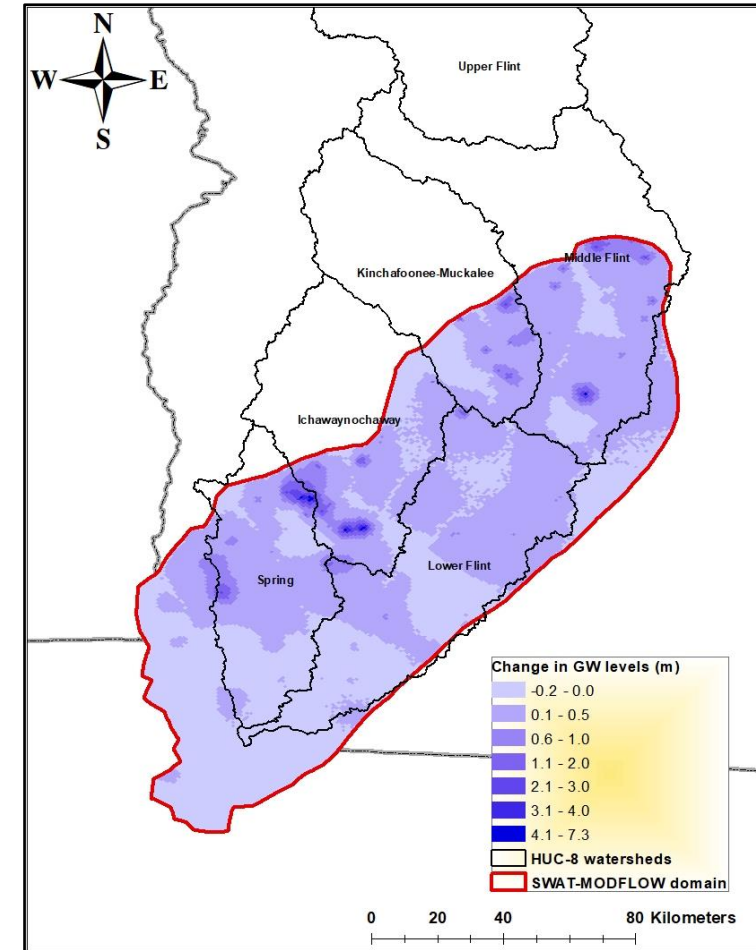
GW levels (All Ag MS3)



Difference in GW levels (MS2 - MS3)



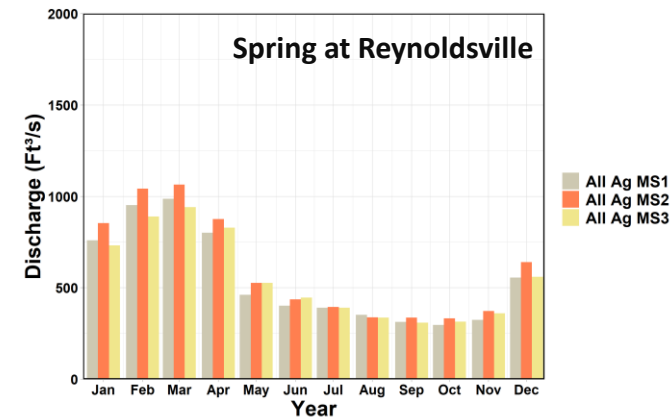
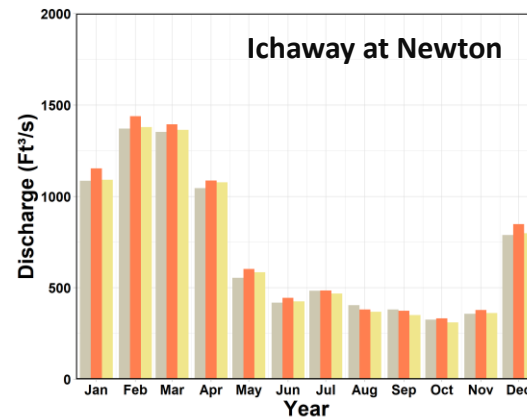
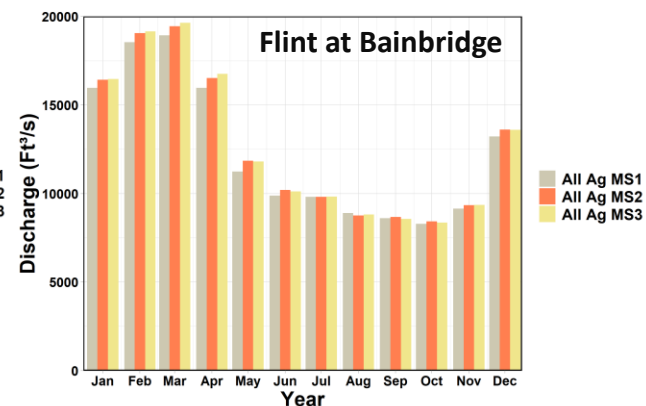
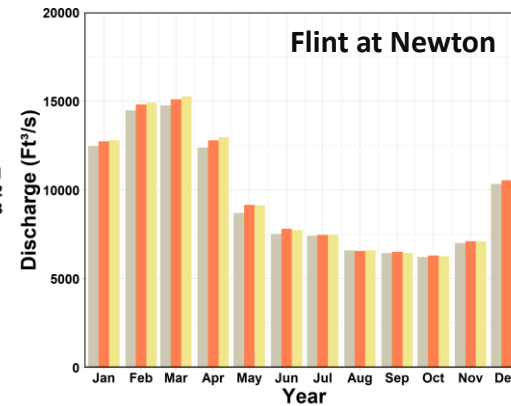
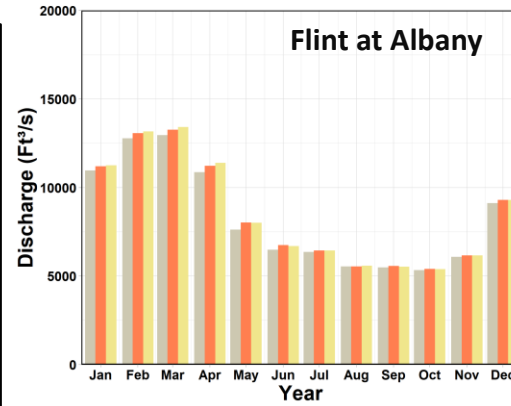
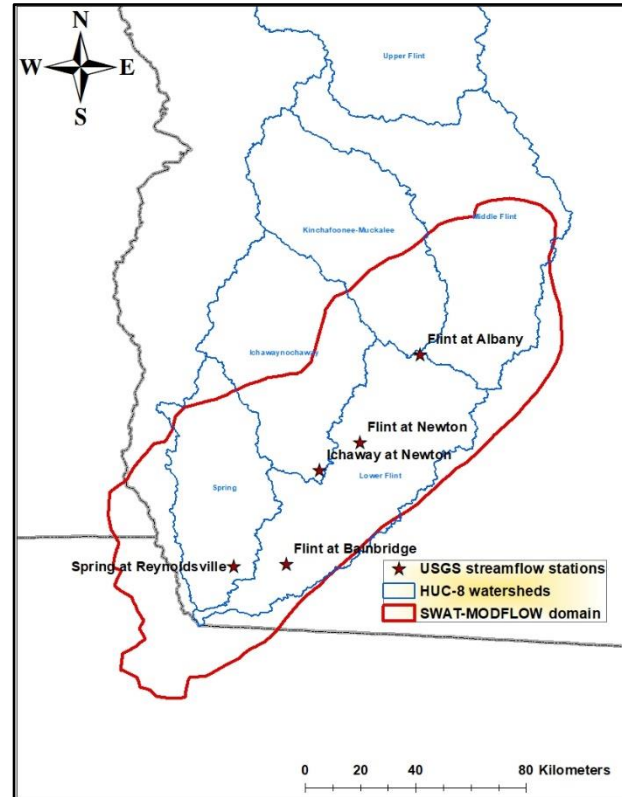
Difference in GW levels (MS1 - MS3)



# Findings: Streamflow

These FACETS results represent work in progress and are not suitable for public distribution.

## Average monthly streamflow

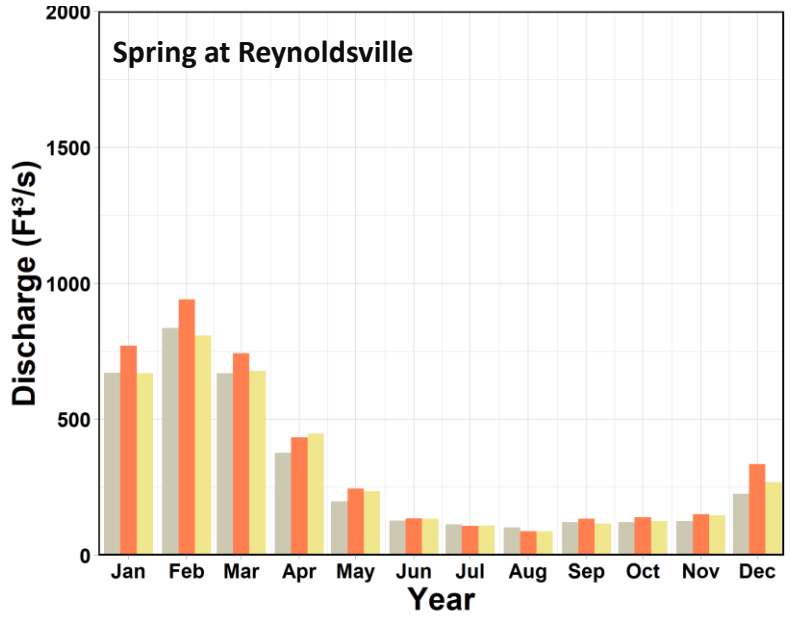
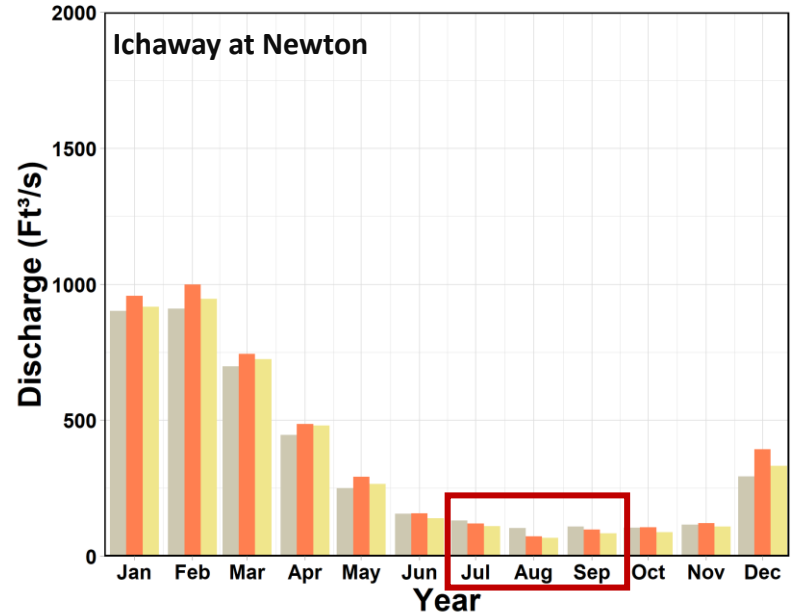
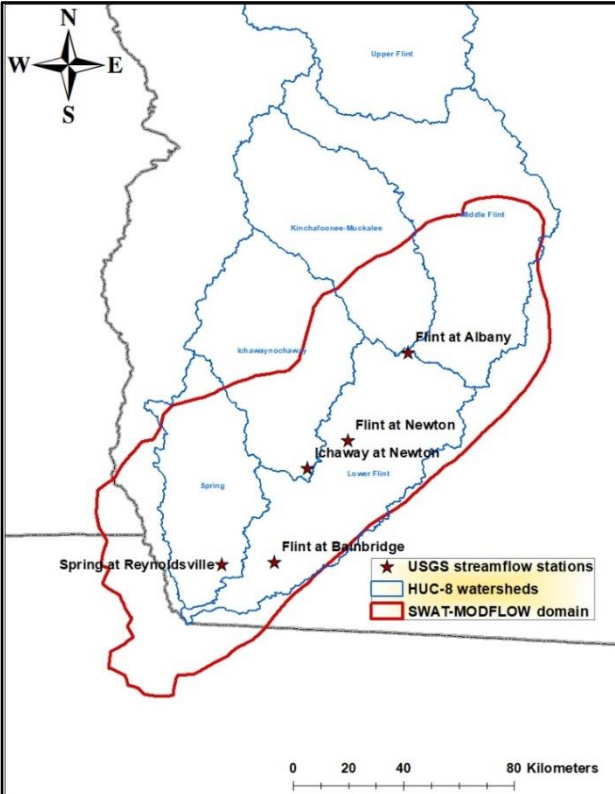


Evaluation of monthly averaged flows (over the whole simulation period) showed similar flows between the three scenarios.

# Findings: Streamflow

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## Evaluating change in flow across Management Systems for drought years

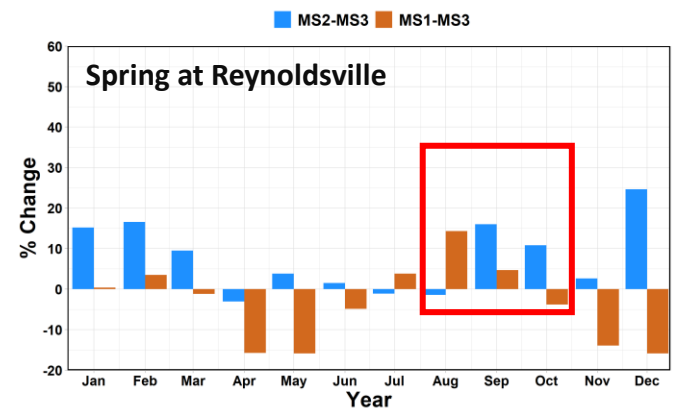
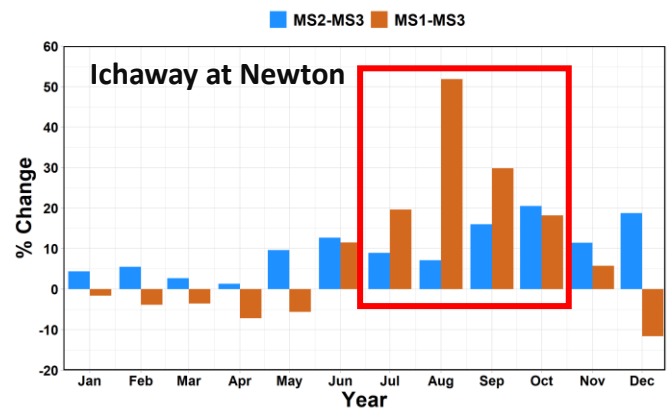
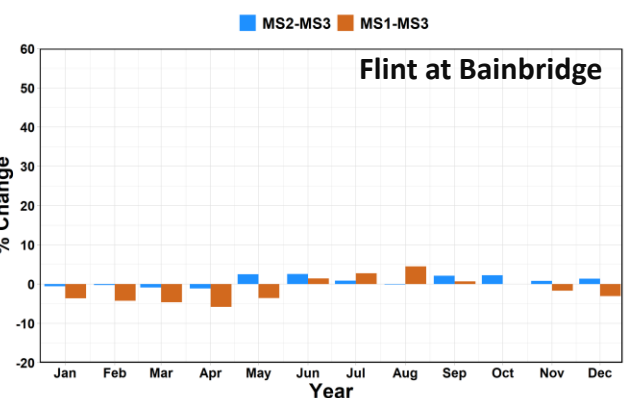
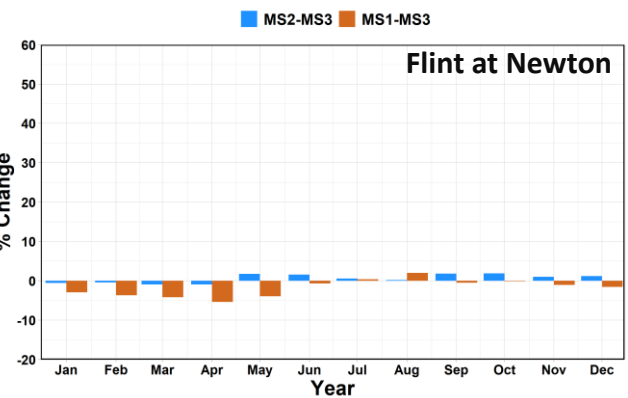
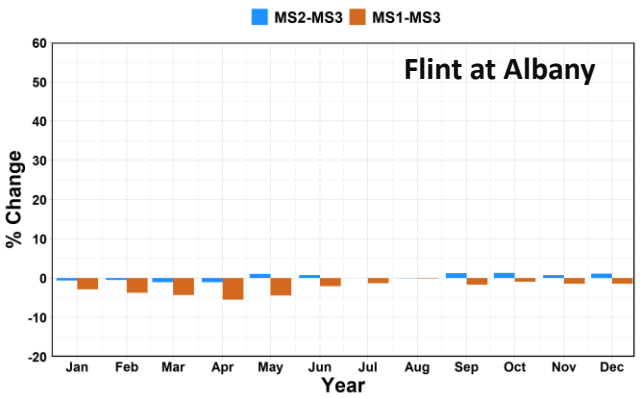
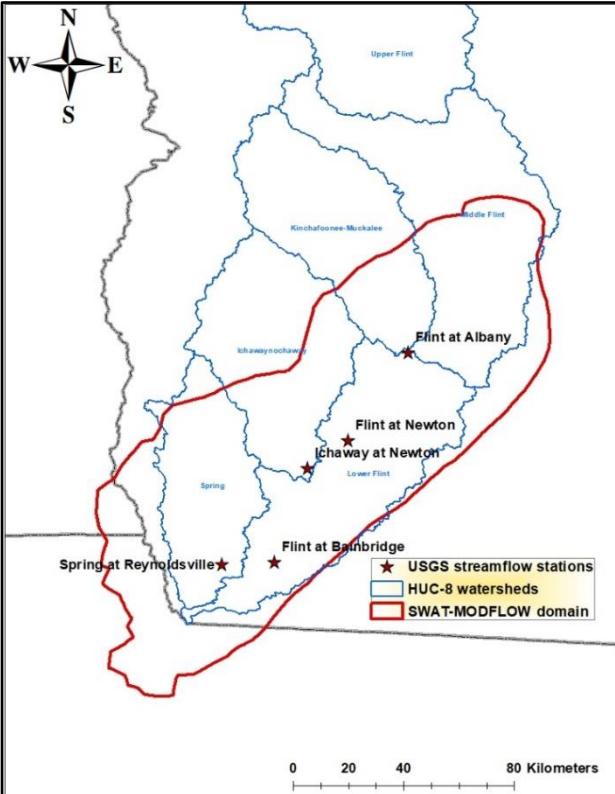


MS1 had higher average monthly streamflow during the drought years – especially at Ichaway at Newton.

# Findings: Streamflow

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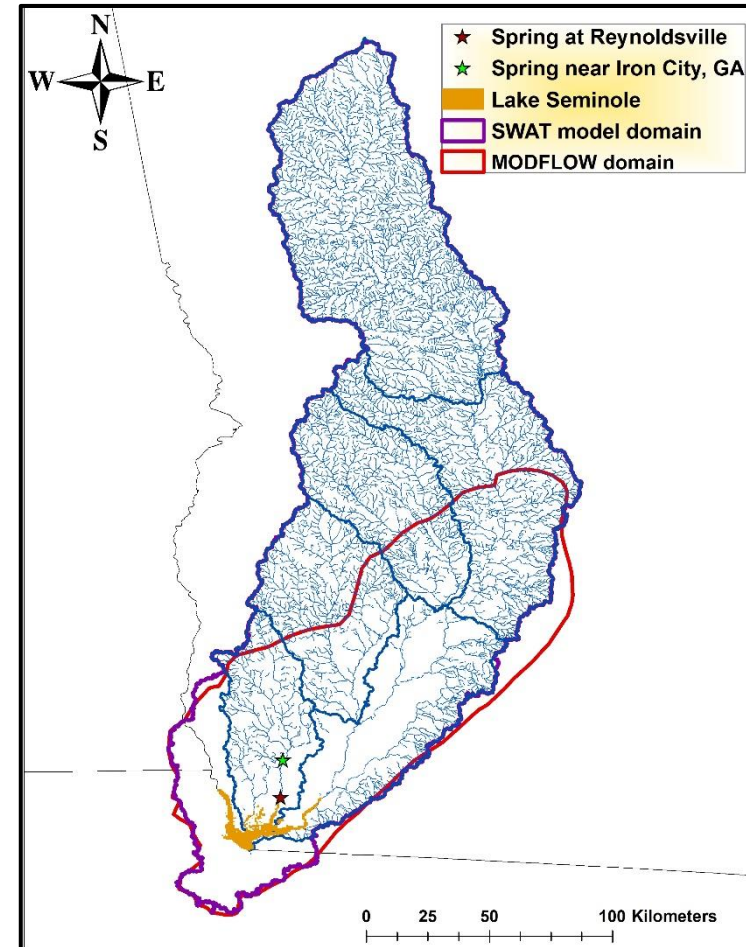
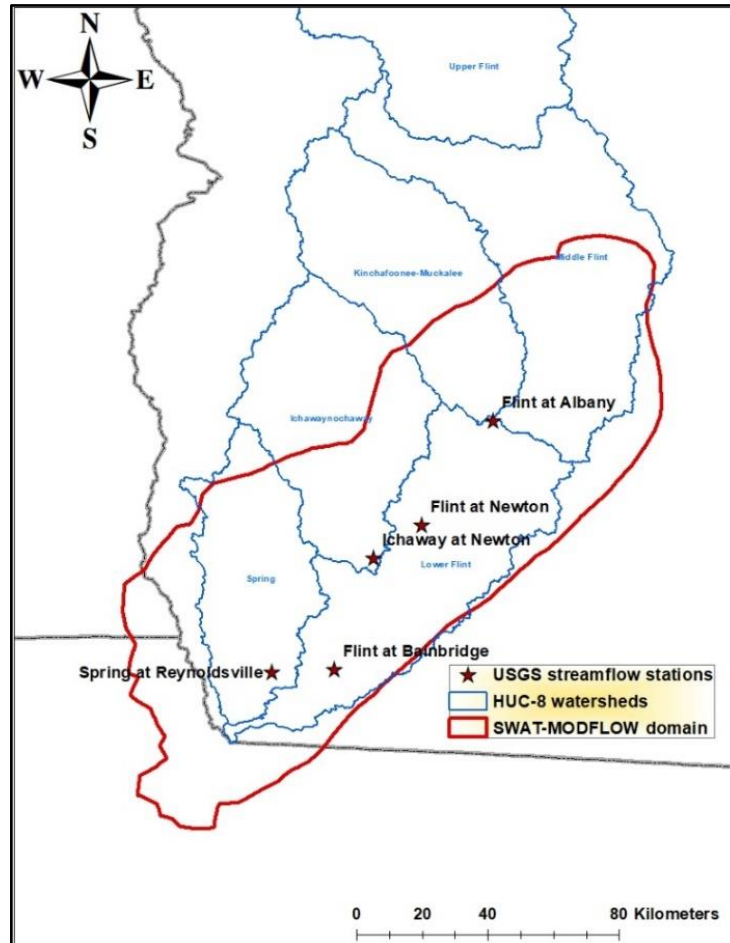
## Evaluating differences in drought years



Evaluation of change in streamflow showed **minimal change along the Flint River** (less than 5%). Increase in streamflow, especially at the end of the growing season, in the tributary streams was predicted when changed from MS3 to MS2 and MS1.

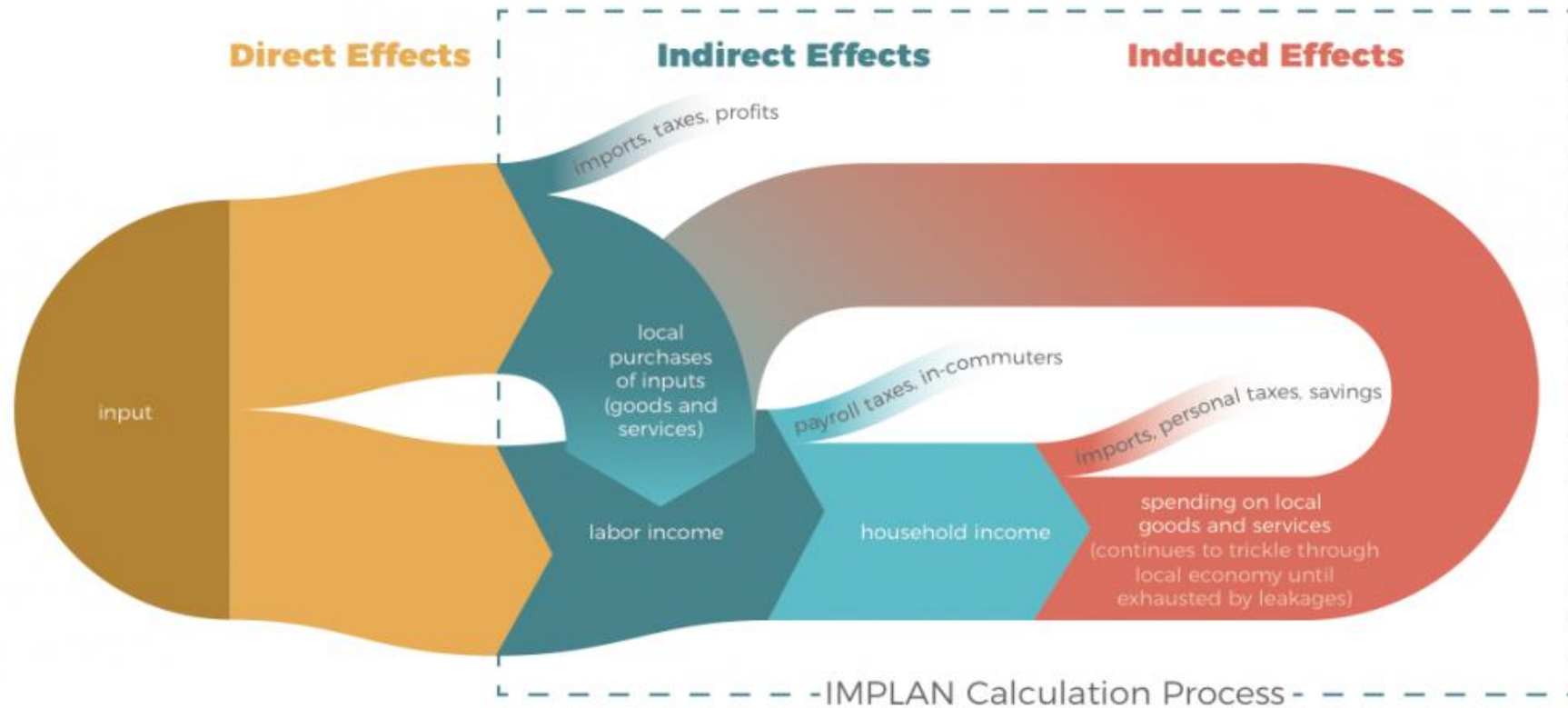
# Improvement to model development based on feedback

## Spring at Reynoldsville station – Lake Seminole impact



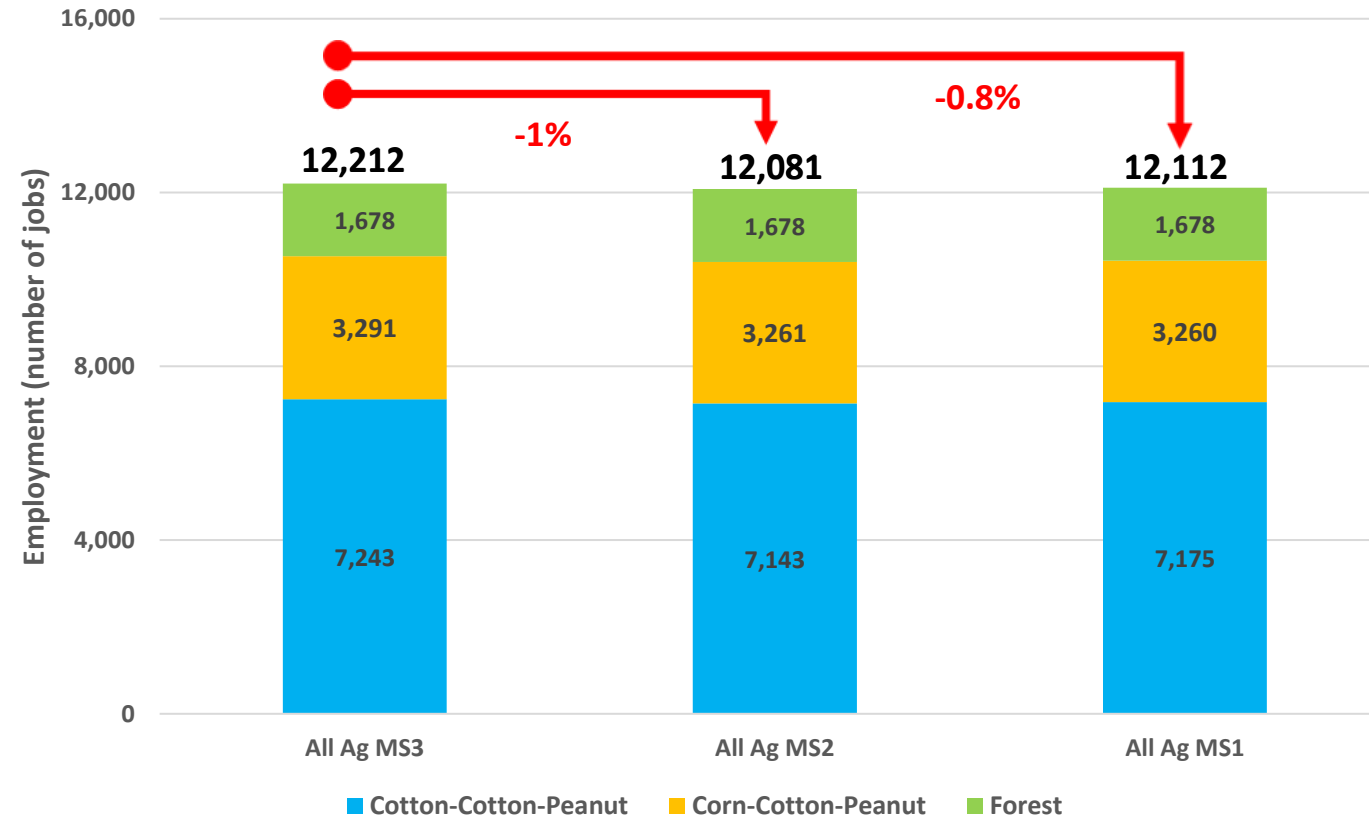


# Economic Modeling Framework -IMPLAN



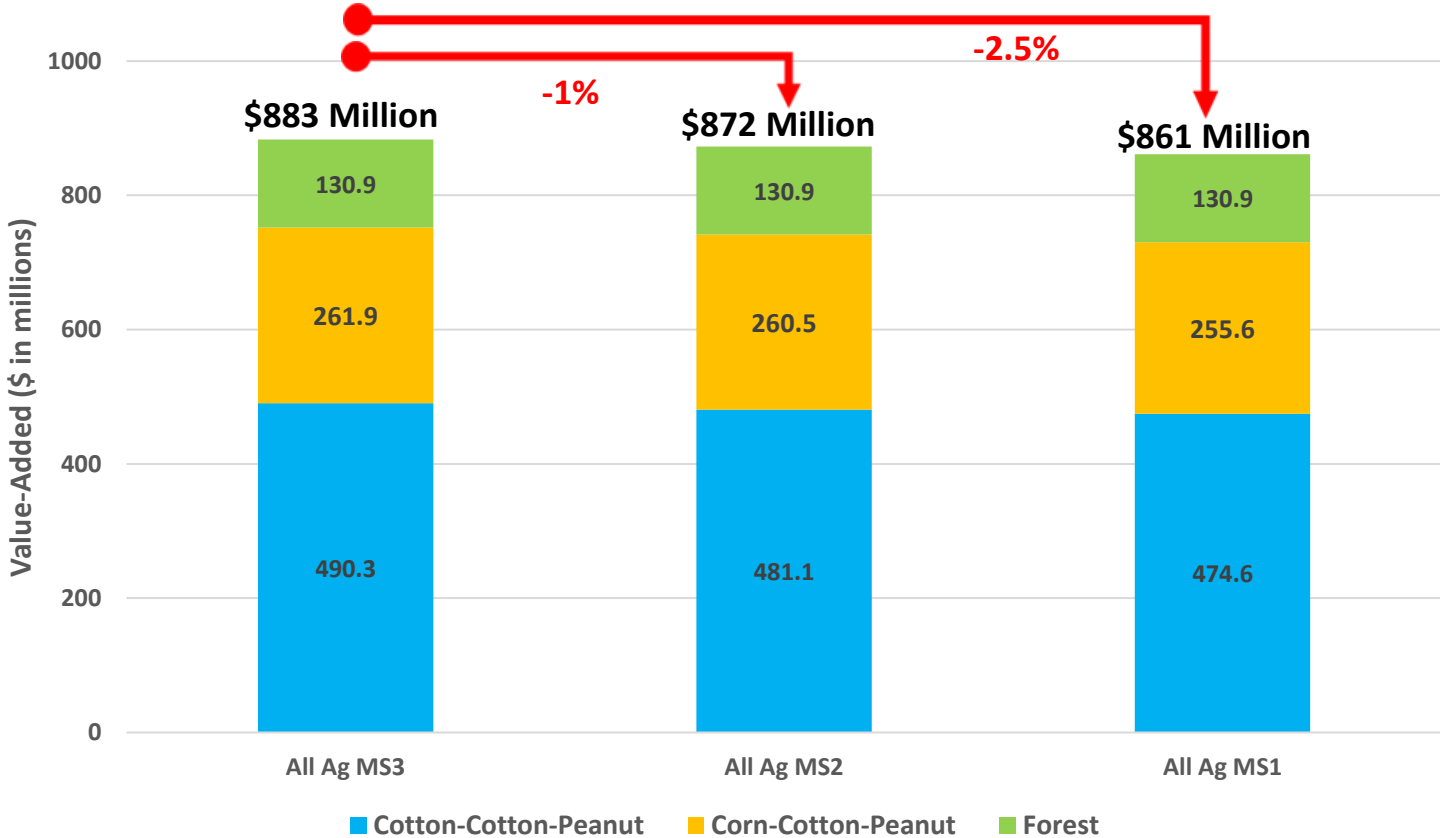
**Figure:** Flowchart showing direct, indirect and induced impacts estimated by IMPLAN within a regional economy

# Georgia Simple Scenarios: Regional Economy (Employment)



- Cotton-Cotton-Peanut rotation showed higher negative impact for change from MS3 to MS2 compared to MS3 to MS1.
- Forest-based contribution estimated only for loblolly pine MS1.

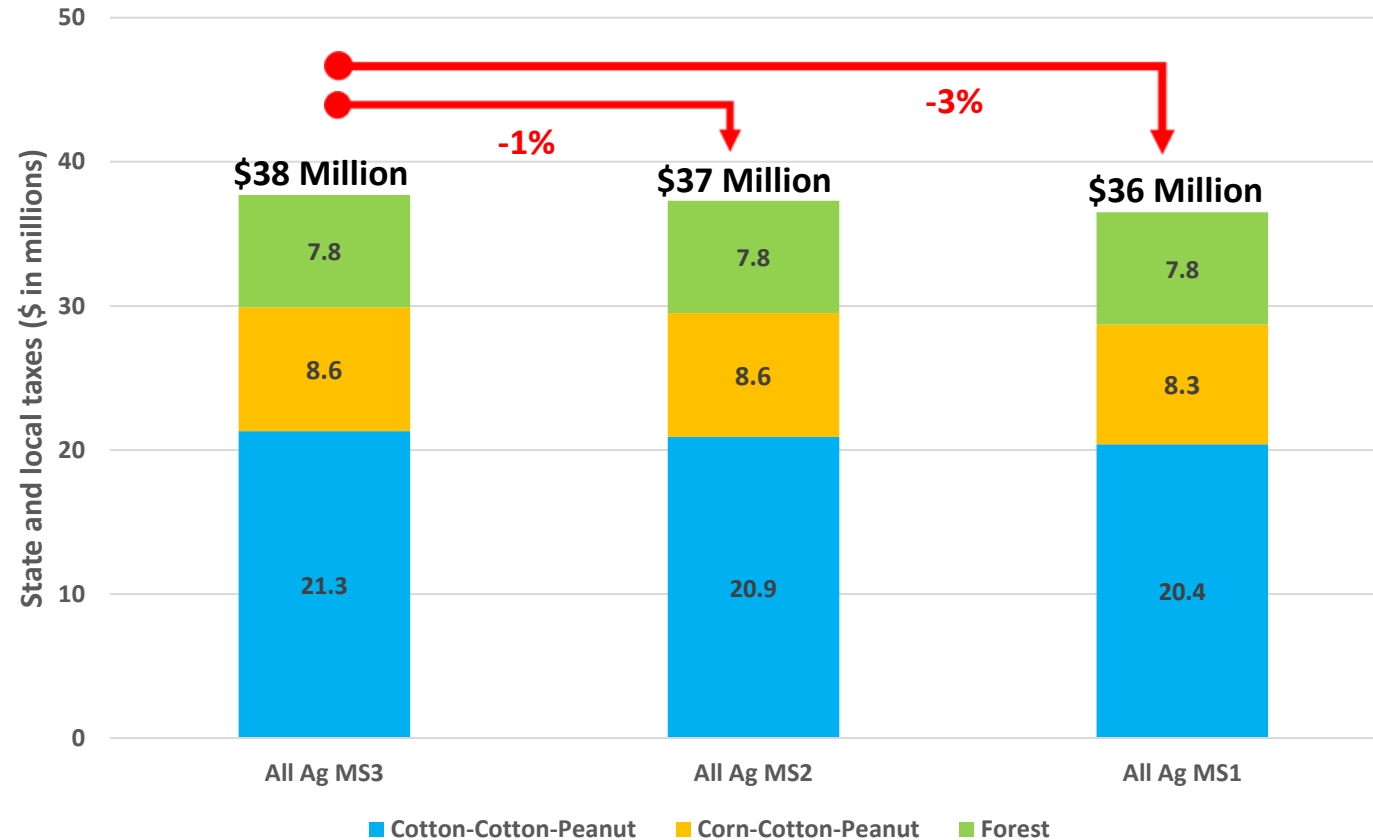
# Georgia Simple Scenarios: Regional Economy (Value-Added)



- Negative impact on value added as production changes from MS3 to MS2 and MS1.
- Forest-based contribution estimated only for loblolly pine MS1.

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# Georgia Simple Scenarios: Regional Economy (State and local taxes)

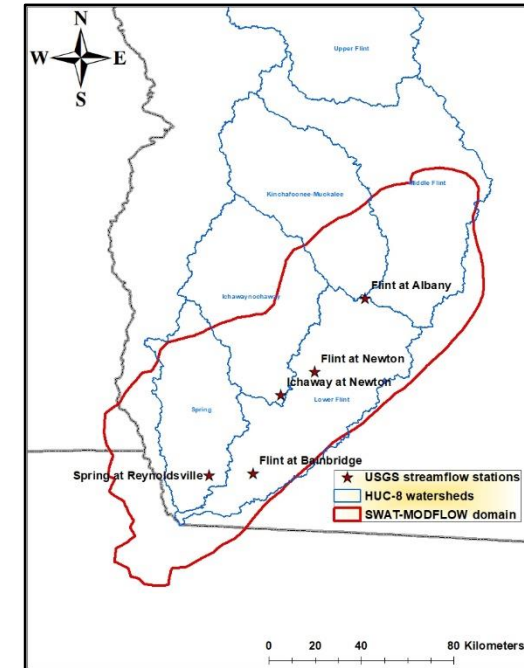


- Negative impact on state and local taxes generation as production changes from MS3 to MS2 and MS1.
- Forest-based contribution estimated only for loblolly pine MS.

# Summary

- **Aquifer Pumping**
  - All Ag MS3 had the highest groundwater pumping for irrigation use.
- **Evaluation of net recharge**
  - showed that there was minimal differences – especially when evaluated for the whole basin.
- **Evaluation of GW levels**
  - showed there was minimal difference between MS3 and MS2.
  - Comparison between MS3 and MS1 identified critical areas for groundwater level reduction.
- **Evaluation of streamflow**
  - showed minimal impact on the Flint River.
  - Impact on streamflow were significant during drought years in the two tributary streams.
- **Economics**
  - Cotton-Cotton-Peanut rotation showed higher negative impact for change from MS3 to MS2 compared to MS3 to MS1.
  - Negative impact on state and local taxes generation as production changes from MS3 to MS2 and MS1.

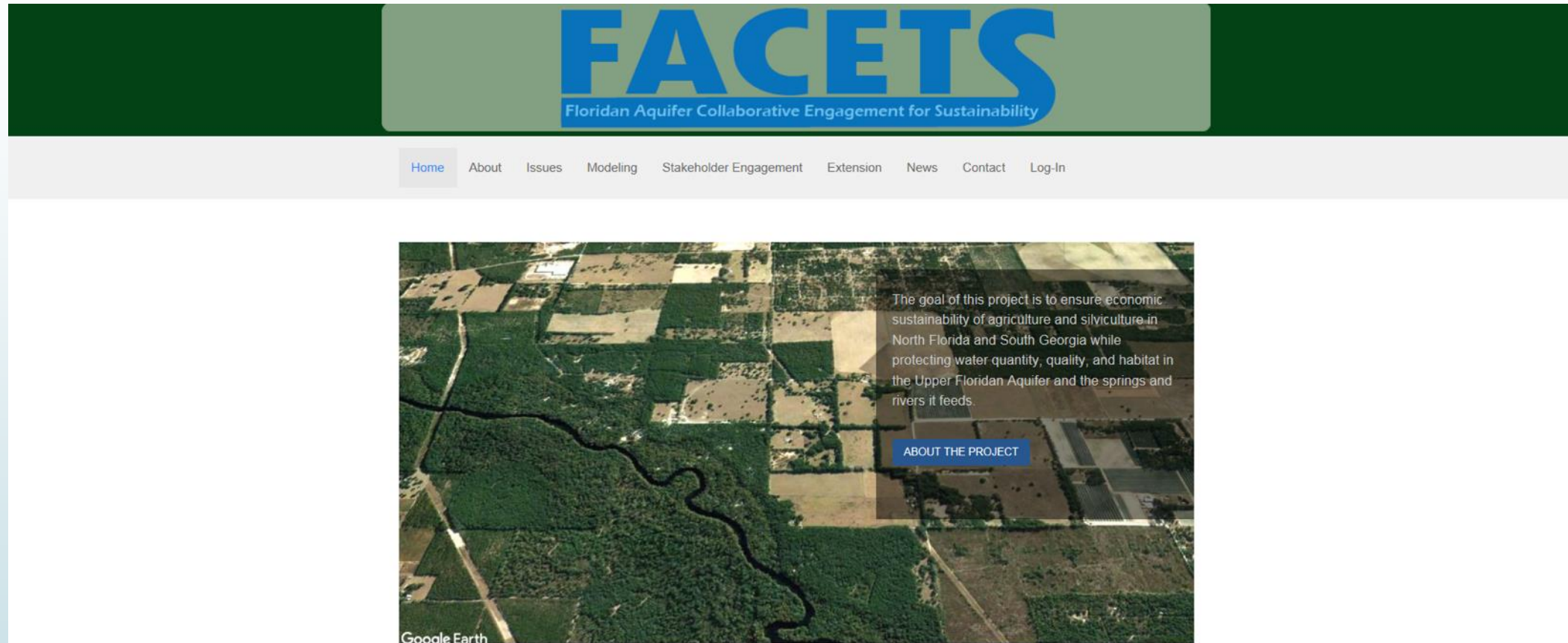
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Simple scenarios

Scenario	Land use	Management Systems
<u>All Ag MS1</u> <b>Row crops:</b> corn-cotton-peanut cotton-cotton-peanut <b>Forest:</b> Loblolly	2011 Land use	All row crops use MS1, Forests MS1
<u>All Ag MS2</u> <b>Row crops:</b> corn-cotton-peanut cotton-cotton-peanut <b>Forest:</b> Loblolly	2011 Land use	All row crops use MS2, Forests MS1
<u>All Ag MS3</u> <b>Row crops:</b> corn-cotton-peanut cotton-cotton-peanut <b>Forest:</b> Loblolly	2011 Land use	All row crops use MS3, Forests MS1

For more information <http://Floridanwater.org>



The screenshot shows the top portion of a website. At the top is a dark green banner with the word "FACETS" in large, bold, blue letters. Below it, in smaller white text, is the full name "Floridan Aquifer Collaborative Engagement for Sustainability". Below the banner is a light gray navigation bar with links for Home, About, Issues, Modeling, Stakeholder Engagement, Extension, News, Contact, and Log-In. The main content area features an aerial photograph of a rural landscape with a river and fields. A semi-transparent text box is overlaid on the right side of the photo, containing project goals and a blue "ABOUT THE PROJECT" button. A "Google Earth" watermark is visible in the bottom left corner of the photo.

The goal of this project is to ensure economic sustainability of agriculture and silviculture in North Florida and South Georgia while protecting water quantity, quality, and habitat in the Upper Floridan Aquifer and the springs and rivers it feeds.

[ABOUT THE PROJECT](#)

The Floridan Aquifer Collaborative Engagement for Sustainability (FACETS) project is a Coordinated Agricultural Project funded by the USDA National Institute of Food and Agriculture. The FACETS project brings scientists and stakeholders together in a participatory process to develop new knowledge needed to explore tradeoffs between the regional agricultural economy and environmental quality; understand changes needed to achieve agricultural water security and environmental protection; and to implement desired changes.