

#### **ENVIRONMENTAL PROTECTION DIVISION**

## Update of the Groundwater Resource Assessment for the Upper Flint Region

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#### **GEORGIA'S AQUIFERS**





# PREVIOUS STATE WATER PLAN REGIONAL AND SUB-REGIONAL MODELS



W S E S 0 20 40

These are the domains of the 2010 State Water Plan regional and sub-regional models; use the same domain for recent models.





#### CDM SMITH REFINED GRID SPACING AND COVERAGE FOR TRANSIENT MODELING OF CLAIBORNE AND CRETACEOUS AQUIFERS



Grid spacing in the original regional model was 5,280 feet (one mile). Grid spacing in the revised model is 1,760 feet (1/3 mile) so that each of the original grid squares is now occupied by nine grid squares  $(3 \times 3 = 9)$ . The grid spacing of 1,760 feet in the revised model is less that the 2,000 feet grid spacing used in the original sub-regional models.

### UPPER FLINT WATER PLANNING REGION



#### SEVEN LAYERS IN THE REGIONAL COASTAL PLAIN STATE WATER PLAN MODEL



#### LAYER 2 FLORIDAN AQUIFER RIVERS AND DRAINS MODELED IN THE UPPER FLINT REGION



The model included depictions of rivers and drains. Rivers (blue) are representative of surface water bodies which remove water from the aquifer and can also add water to the aquifer. Drains (green) are representative of surface water bodies which remove water from the aquifer and don't add water to the aquifer. Most of the Layer 2 wells are near the rivers and drains in the Layer 2 out crop area and therefore pumping of the wells may directly affect surface water flow in the rivers and drains. For this reason increased groundwater withdrawal from the Layer 2 wells was not simulated.



#### LAYER 3 CLAIBORNE AQUIFER RIVERS AND DRAINS MODELED IN THE UPPER FLINT REGION



**Except in Dooly and Crisp** Counties Layer 3 wells are near the rivers and drains in the Layer 3 out crop area and therefore pumping of the wells may directly affect surface water flow in the rivers and drains. For this reason simulation was limited to increased groundwater withdrawals from Layer 3 wells in Dooly and Crisp Counties.



#### LAYER 4 CLAYTON AQUIFER RIVERS AND DRAINS MODELED IN THE UPPER FLINT REGION



Simulation of increased groundwater withdrawal for Layer 4 was not done due to a current Georgia Environmental Protection Division (EPD) moratorium on increased pumping from the Clayton aquifer.



#### LAYER 5 CRETACEOUS AQUIFER RIVERS AND DRAINS MODELED IN THE UPPER FLINT REGION



The Layer 5 wells in Taylor County were near the rivers and drains in the Layer 5 out crop area and therefore pumping of the wells in Taylor County may directly affect surface water flow in the rivers and drains. For this reason simulation was limited to increased groundwater withdrawals from all Layer 5 wells except those in Taylor County.



#### LAYER 6 CRETACEOUS AQUIFER RIVERS AND DRAINS MODELED IN THE UPPER FLINT REGION



None of the Layer 6 wells were near the rivers and drains in the Layer 6 out crop area and therefore pumping of the wells may not directly affect surface water flow in the rivers and drains. For this reason simulation was done of increased groundwater withdrawal from all the Layer 6 wells.

#### TRANSIENT WELL PUMPING IRRIGATION RATES AS PERCENT OF STEADY STATE PUMPING RATE



Transient monthly pumping rate as a percentage of the 100% steady state pumping rate. During the growing season the pumping rates are more than the 100% steady state pumping rate and during the nongrowing season pumping rates are less than the 100% steady state pumping rate

#### ANNUAL PRECIPITATION AND TWO OF THE FOUR YEARS CHOSEN FOR THE TRANSIENT SIMULATIONS



13



#### INPUT TWO YEARS OF LOWER RECHARGE FROM THE CDM SMITH MODEL

SP of Recharge	Row 1/Colunm 1	Stress Period (SP)		Use
from Four Yrs.	Value (ft/day)	Model *.200	Month	Previous
24	0.00008111	1	Dec-19	
25	0.00011738	2	Jan-20	
26	0.00012548	3	Feb-20	
27	0.00005689	4	Mar-20	
28	0.00000000	5	Apr-20	
29	0.00000000	6	May-20	Х
30	0.00000000	7	Jun-20	Х
31	0.00000000	8	Jul-20	Х
32	0.00000000	9	Aug-20	Х
33	0.00000000	10	Sep-20	Х
34	0.00000000	11	Oct-20	Х
35	0.00001402	12	Nov-20	
36	0.00002608	13	Dec-20	
37	0.00004209	14	Jan-21	
38	0.00004434	15	Feb-21	
39	0.00001431	16	Mar-21	
40	0.00000000	17	Apr-21	
41	0.00000000	18	May-21	Х
42	0.00000000	19	Jun-21	Х
43	0.00008221	20	Jul-21	
44	0.00008221	21	Aug-21	Х
45	0.00000000	22	Sep-21	
46	0.00000000	23	Oct-21	Х
47	0.00008686	24	Nov-21	
48	0.00017372	25	Dec-21	

Model incorporated the low recharge rates from years three and four of the CDM Smith calibrated transient model of southwestern Georgia and modifications made to the model by Georgia Environmental Protection Division (EPD) to make the model transient throughout the Georgia Coastal Plain.

#### TAKE A STEADY STATE PUMPING RATE AND DIVIDE IT INTO 25 INCREMENTS REPRESENTING TWO YEARS OF PUMPING

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#### WRITE PUMPING RATES AS SPREADSHEET AND TEXT FILES THAT CAN BE INPUT TO THE MODEL

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	6	Point 1	4/1/2020		0:00:00	-36472.333
	7	Point 1	5/1/2020		0:00:00	-36472.333
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#### UPPER FLINT REGION LAYER 3 CLAIBORNE AQUIFER DRAWDOWN CDM SMITH MODEL BASELINE PUMPING RATES – 25 JULY 2021



By July 2021 (time step 95) when simulated recharge to the aquifer was relatively low and the simulated baseline well pumping rates were relatively high the simulated drawdown was +10 feet (a falling groundwater level) but the +10 feet of simulated drawdown did not occur in an outcrop area of Layer 3 where rivers and drains were located and therefore the simulated drawdown in groundwater levels may not directly affect surface water flows.



#### UPPER FLINT REGION LAYER 5 CRETACEOUS AQUIFER DRAWDOWN CDM SMITH MODEL BASELINE PUMPING RATES – 25 JULY 2021



Simulated drawdown was greater than 30 feet during simulated time step 95 for 31 July 2021 when simulated recharge to the aquifer was relatively low and the simulated baseline well pumping rates were relatively high. Simulated drawdown greater 30 feet occurred in areas of outcrop where Layer 5 rivers and drains are located which means that simulated drawdowns may directly affect surface water flows. The 30 feet of simulated drawdown could cause well pumps which are set within 30 feet of the static water level to go dry.



#### UPPER FLINT REGION LAYER 6 CRETACEOUS AQUIFER DRAWDOWN CDM SMITH MODEL BASELINE PUMPING RATES – 25 JULY 2021



Simulated drawdown was greater than 30 feet during time step 95 for 25 July 2021 when the simulated recharge to the aquifer was relatively low and the simulated baseline well pumping rates were relatively high. Rivers and drains were not located in the outcrop area of Layer 6 and therefore the change in groundwater levels may not directly affect stream flow. The 30 feet of simulated drawdown could cause well pumps which are set within 30 feet of the static water level to go dry. All of the simulated drawdown greater than 30 feet recovered by time step 121 on 1 January 2022.

#### METHODOLOGY USED TO SELECT WELLS FOR SIMULATED INCREASED WITHDRAWAL IN THE UPPER FLINT REGION

Because of the transient simulated drawdowns using the baseline withdrawal rates in the CDM Smith model:

- Don't simulate increased groundwater withdrawal from any well in Layer 2 (Floridan aquifer) due to the wells being located in the outcrop area with rivers and drains
- In Layer 3 (Claiborne aquifer) limit the simulated increased groundwater withdrawal to Dooly and Crisp counties where there are no wells located in the outcrop area with rivers and drains
- Do not simulate increased groundwater withdrawal from Layer 4 (Clayton aquifer) due to the Georgia EPD moratorium on increased pumping from the Clayton aquifer
- Do not simulate increased groundwater withdrawal from Layer 5 (Cretaceous aquifer) due to the simulated baseline drawdown of greater 30 feet in areas of outcrop where Layer 5 rivers and drains are located which means that simulated drawdowns may affect surface water flows .
- In Layer 6 (Cretaceous aquifer) there is no limitation on pumping as there are no wells near rivers and drains in outcrop areas and changing groundwater level will not directly affect stream flow



## UPPER FLINT REGION LAYER 3 CLAIBORNE AQUIFER DRAWDOWN X 1.50 BASELINE PUMPING RATES (+ 12.60 MGD) – 25 JULY 2021



Between January 2020 and July 2021 (time step 95) the simulated drawdown had changed from -10 feet (rising groundwater level) to +10 feet (falling groundwater level). The +10 feet of simulated drawdown in groundwater levels did not occur in outcrop area of Layer 3 where rivers and drains were located and therefore changes in groundwater levels may not directly affect surface water flow.

### UPPER FLINT REGION LAYER 6 CRETACEOUS AQUIFER DRAWDOWN X 1.50 BASELINE PUMPING RATES (+16.80 MGD) – 25 JULY 2021



Drawdown was greater than 30 feet during simulated time step 95 for 25 July 2021 when the modeled recharge rate was low. The drawdown greater 30 feet tended to be larger than it was during simulated time step 36 for July 31 2020. There are no rivers or drains in the outcrop area of Layer 6 and therefore the change in groundwater level may not directly affect stream flow. The 30 feet of simulated drawdown could cause well pumps which are set within 30 feet of the static water level to go dry. All of the simulated drawdown greater than 30 feet recovered by time step 121 on 1 January 2022.



### UPPER FLINT REGION LAYER 3 CLAIBORNE AQUIFER DRAWDOWN X 2.00 BASELINE PUMPING RATES (+25.19 MGD) – 25 JULY 2021



Between January 2020 and July 2021 (time step 95) the simulated drawdown had changed from -10 feet (rising groundwater level) to +10 feet to +20 feet (falling groundwater levels). The +10 feet to +20 of simulated drawdown in groundwater levels did not occur in outcrop area of Layer 3 where rivers and drains were located and therefore changes in groundwater levels may not directly affect surface water flow.

### UPPER FLINT REGION LAYER 6 CRETACEOUS AQUIFER DRAWDOWN X 2.00 BASELINE PUMPING RATES (+33.60 MGD) – 25 JULY 2021



Drawdown was greater than 30 feet during simulated time step 95 for 25 July 2021 when the modeled recharge rate was low. The area of drawdown greater than 30 feet tended to be larger than it was during simulated time step 36 for July 31 2020. There are no rivers or drains in the outcrop area of Layer 6 and therefore the change in groundwater level may not directly affect stream flow. The 30 feet of simulated drawdown could cause well pumps which are set within 30 feet of the static water level to go dry.

### UPPER FLINT REGION LAYER 6 CRETACEOUS AQUIFER DRAWDOWN X 2.00 BASELINE PUMPING RATES (+33.60 MGD) – 1 JANUARY 2022



Most of the simulated drawdown greater than 30 feet has recovered by time step 121 on 1 January 2022. There remained an area of the Upper Flint region in Crisp County where simulated drawdown remained greater than 30 feet by time step 121 on 1 January 2022. This is an area where rivers and drains are not located in the outcrop area of Layer 6 and therefore the change in groundwater level may not affect stream flow. The 30 feet of simulated drawdown could cause well pumps which are set within 30 feet of the static water level to go dry.

#### BRACKISH GROUNDWATER IN THE LOWER UNIT OF THE CRETACEOUS AQUIFER



E X P L A N A T I O N A7CLAY CONTENT GREATER THAN 50 PROCENT A7 ABSENT -1500-5TRUCTURE CONTOUR-Shows altitude of too of quifer A7. Dashed where opposite Datum is mean sea level 250-LINE OF EQUAL CHUBRIDE CONCENTRA-TION, 1976-Dashed where opposimalely located interval 250, 500, and 4000 milligroms per liter • WELL USED FOR GEOLOGIC AND WATER-QUALITY CONTROL

> The lower unit of the Cretaceous aquifer has been mapped to have some brackish groundwater (USGS defines brackish as Total Dissolved Solids (TDS) = 1,000 to 10,000 mg/L) in Crisp County, Georgia (from former GGS Hydrologic Atlas 3, 1980)

# AQUIFERS IN THE UPPER FLINT REGION

- Increased pumping from Layer 2 (Floridan aquifer) may cause drawdowns that extend to rivers and drains in the Layer 2 outcrop area which may decrease surface water flows
- Increased pumping from Layer 4 (Clayton aquifer) is not permitted due to Georgia EPD moratorium on increased pumping from the Clayton aquifer
- Increased pumping from Layer 5 (Cretaceous aquifer) may cause drawdowns that extend to rivers and drains in the Layer 5 outcrop area which may decrease surface water flows



#### INCREASED PUMPING FROM AQUIFERS IN THE UPPER FLINT REGION – WHAT COULD BE DONE

- Could pump up to 12.60 MGD (x 1.50 baseline pumping) to 25.19 MGD (x 2.00 baseline pumping) from two counties in Layer 3 (Claiborne aquifer) possibly without affecting surface water flow
- Could pump up to 16.80 MGD (x 1.50 baseline pumping) to 33.60 MGD (x 2.00 baseline pumping) from all the counties in Layer 6 (Cretaceous aquifer) possibly without affecting surface water flow because there are no rivers and drains in the Layer 6 outcrop area in the Upper Flint region
- The lower unit of the Cretaceous aquifer (Layer 6) has been mapped to have some brackish groundwater that may be captured by increased pumping