Technical Memorandum

From: Surface Water Availability Resource Assessment Team – Yi Zhang
To: Regional Planning Councils, EPD Planning Team, Planning Contractors, File
Date: July 16, 2010

Subject: Summary Future (2050) Resource Assessment in Apalachicola – Chattahoochee – Flint (ACF) River Basins

Introduction

The purpose of this memorandum is to summarize the results of future Resource Assessment in the ACF Basins with projected 2050 water use conditions. The projected water use conditions (including municipal, industrial, thermal energy, and agricultural) were provided by EPD Planning Team in May 2010.

We used Hec-5 model in both Current Resource Assessment and 2050 Future Resource Assessment. The objective of 2050 Future Resource Assessment is to provide Regional Planning Councils and their Planning Contractors a starting point in assessing whether available resource can meet both the off-stream and instream needs into the forecast future. If available resource cannot satisfy the needs, then Best Management Practices (BMP's) will have to be considered to satisfy the needs.

Model Settings and Key Assumptions

The ACF Basin model contains 6 Planning Nodes and corresponding sub-basins (or 15 Basic Nodes and corresponding Local Drainage Areas). (See Figure 1.)

The hydrological conditions incorporated in the model include unimpaired incremental flow on daily basis for the period between 1939 and 2007. The flow data have been incorporated at all 15 Basic Nodes.

Forecast annual average withdrawal and discharge of each Sub-basin has been temporally distributed to monthly values according to intra-annual patterns of current conditions. The Sub-basins are the finest spatial resolution in the planning models. The water use data do not reflect any single individual facilities, existing or planned.

There are not additional Management Practices (MP's) beyond those that have been reflected by Current Resource Assessments or by forecast 2050 demands. The amount of storage for each Sub-basin remains the same as in Current Resource Assessment. All of the storage volume has been aggregated at the Sub-basin level. The storage information incorporated in the model does not reflect the site or size of any single reservoir.

We assumed continued operation of the ACF system per the Army Corps of Engineers' Revised Interim Operation Plan (RIOP), as we have modeled under Current Resource Assessment.

In unregulated portion of the basin, Flow Regime is defined by the State's Interim Instream Flow Protection Policy, which calls for the protection of monthly 7Q10 or natural inflow, whichever is lower. In the ACF Basins, this applies to the Montezuma and Bainbridge Nodes.

In regulated portion of the basin, Flow Regime is limited to locations where an explicit flow requirement is specified by the Army Corps of Engineers, Tennessee Valley Authority, or Federal Energy Regulatory Commission (FERC). In the ACF Basins, this applies to the Whitesburg, Columbus, Columbia, and Jim Woodruff Nodes.

Summary of Results

Montezuma Planning Node:

With projected 2050 water use and no additional MP's, there is almost no gap between simulated flow and Flow Regime. The percentage of time when there is a flow shortage is almost 0%, with an average shortfall of 1 cfs.

There is no shortage in meeting water demand in this Sub-basin, as shown by Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled 20100521-SWP-2050-NMP-ACF-Montezuma-YiZhang.xls.

Table 1. Summary of Montezuma Node

	Length of Shortfall(% of time)	Average Shortfall (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current	0.01%	1 0.6 mgd	3421 2211 mgd	1 61 mgd	593 383 mgd
2050	0.01%	1 0.6 mgd	3409 2203 mgd	1 0.6 mgd	593 383 mgd

Bainbridge Planning Node:

With projected 2050 water use and no additional MP's, we do see a significant gap between the simulated flow and the flow regime at this node as shown in Table 2. The percent of time when there is a flow shortage is 13%, with an average shortfall of 355 cfs. Under 2050 forecast water demand, both length and depth of the gap are almost the same as those of current Resource Assessment. This is because total consumptive water use above Bainbridge node under forecasted 2050 demand (annual average 327 cfs) is very close to that under current demand condition (annual average 378 cfs). This is due to increased return rate under 2050 demand condition although the withdrawals also increase.

There is no shortage in meeting water demand in this Sub-basin, as shown by Figures “TS-Consumptive” and “Gap-Dem” in the attached file titled 20100521-SWP-2050-NMP-ACF-Bainbridge-YiZhang.xls.

Table 2. Summary of Bainbridge Node

	Length of Shortfall(% of time)	Average Shortfall (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current	13%	352 227 mgd	7910 5113 mgd	1376 890 mgd	2506 1620 mgd
2050	13%	355 229 mgd	7904 5108 mgd	1295 837 mgd	2506 1620 mgd

<u>Whitesburg Planning Node:</u>

With projected 2050 water use and no additional MP’s, our model was able to meet all consumptive water demand in this Sub-basin, as shown by Table 3 as well as by Figures “TS-Consumptive” and “Gap-Dem” in the attached file titled 20100521-SWP-2050-NMP-ACF-Whitesburg-YiZhang.xls. However, this is not to assume that increased water use directly from Lake Lanier, is authorized by owners and operators of the project. If any planning activity is based on this assumption, then the planners need to confirm the assumption with the project owners. The portion of demand increase that comes directly from the federal storage reservoir is therefore considered potential gaps, unless and until appropriate authorization is granted.

There is no shortage in meeting at-site flow requirements, such as minimum flow requirement at Buford Dam and flow requirement (750 cfs) at Atlanta.

Table 3. Summary of gap at Whitesburg Node

	Demand Shortage (cfs)	At-site Flow Requirement Shortage (cfs)	Minimum Reservoir Conservation Storage (acre-feet)	Minimum Percentage Reservoir Conservation Storage	Basin-wide Flow Requirement Shortage
Current	0	0	540,021	50%	None
2050	0	0	424,998	39%	None

There is still39% water of conservation storage remaining in Lake Lanier. The reservoir storage is generally lower than modeled under current demand conditions, because of increased demand in this Sub-basin. However, the reservoir storage modeled was far from depletion.

Columbus Planning Node:

With projected 2050 water use and no additional MP's, our model was able to meet all consumptive water demand in this Sub-basin, as shown by Table 4 as well as Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled 20100521-SWP-2050-NMP-ACF-Columbus-YiZhang.xls. However, this is not to assume that increased water use directly from Lake Lanier, is authorized by owners and operators of the project. If any planning activity is based on this assumption, then the planners need to confirm the assumption with the project owners. The portion of demand increase that comes directly from the federal storage reservoir is therefore considered potential gaps, unless and until appropriate authorization is granted.

There is no shortage in meeting at-site flow requirements, such as minimum flow requirement at West Point Dam.

Table 4. Summary of gap at Columbus Node

	Demand Shortage (cfs)	At-site Flow Requirement Shortage (cfs)	Minimum Reservoir Conservation Storage (acre-feet)	Minimum Percentage Reservoir Conservation Storage	Basin-wide Flow Requirement Shortage
Current	0	0	14,310	5%	None
2050	0	0	14,269	5%	None

Going through the most critical drought on record, there is about 5% water of conservation storage remaining in West Point reservoir, which is about the same as that under current demand condition although total consumptive use in 2050 is somewhat higher than that under current demand condition in this Sub-basin, as shown by Figure "TS-Consumptive" in the attached file titled 20100521-SWP-2050-NMP-ACF-Columbus-YiZhang.xls. Increased consumptive demand directly taken from West Point Lake is assumed to be a potential gap, unless and until appropriately authorized.

Columbia Planning Node:

With projected 2050 water use and no additional MP's, there is no shortage in meeting water demand in this Sub-basin, as shown by Table 5 and by Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled 20100521-SWP-2050-NMP-ACF-Columbia-YiZhang.xls. There is no at-site flow requirements.

Table 5. Summary of gap at Columbia Node

	Demand Shortage (cfs)	At-site Flow Requirement Shortage (cfs)	Minimum Reservoir Conservation Storage (acre-feet)	Minimum Percentage Reservoir Conservation Storage	Basin-wide Flow Requirement Shortage
Current	0	0	41,076	17%	None
2050	0	0	45,770	19%	None

There is about 19% water of conservation storage remaining in W.F. George reservoir, which is slightly higher than that under current demand condition.

Jim Woodruff Planning Node:

With projected 2050 water use and no additional MP's, there is no shortage in our model meeting water demand in this Sub-basin, as shown by Table 6 and by Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled 20100521-SWP-2050-NMP-ACF-Woodruff-YiZhang.xls. There is also no shortage in meeting basin-wide flow requirement at Chattahoochee gage as shown by Figures "Fut-TS" in the attached file titled 20100521-SWP-2050-NMP-ACF-Woodruff-YiZhang.xls. However, any increased water demand from all federal storage projects are considered potential gaps, unless and until such increase is appropriately authorized.

Table 6. Summary of gap at Jim Woodruff Node

	Demand Shortage (cfs)	At-site Flow Requirement Shortage (cfs)	Minimum Composite Conservation Storage (acre-feet)	Minimum Percentage Composite Conservation Storage	Basin-wide Flow Requirement Shortage
Current	0	0	652,974 at Buford, WP, & WFG	40% at Buford, WP, & WFG	None
2050	0	0	565,765 at Buford, WP, & WFG	35% at Buford, WP, & WFG	None

There is about 35% water of conservation storage remaining in composite storage of Buford, West Point and W.F. George reservoirs, which is little smaller than that under current demand condition. This is because the consumptive water use during drought period under forecasted 2050 condition is larger than that under current demand condition in Chattahoochee basin, therefore more storage is needed to meet this increased consumptive demand.

Note: At semi-regulated Planning Nodes where there are no explicit flow requirements, we do not have a flow regime to measure stream flow against.

Detailed Results

We provide detailed modeling results of each Planning Node in a summary MS Excel file. There are multiple figures in each file. The purposes of these figures are listed in Table 7 below:

Table 7. Metrics in Detailed Evaluation of Modeling Results

Variable Evaluated	Figure Tabs	Purpose of figures
Demand	TS-Consumptive	Time series of Consumptive Demand
	Gap-Dem	Time series of demand shortages or the "Onion" for current and future demands
Storage	TS-Stor	Time series of storage remaining with bottom of pool
	POR (stor)	Exceedance of POR storage remaining with bottom of pool
Stream Flow Time Series	Nat-TS	Unimpaired natural flow time series
	Nat,FR-TS	Unimpaired plus adjusted flow regime
	FR-TS	Adjusted flow regime
	Cur-TS	Adjusted flow regime and current assessment flow
	Fut-TS	Adjusted flow regime and forecasted assessment flow
	Cur,Fut TS	Comparison of current and future flows
	Fut,Nat TS	Comparison of unimpaired natural and future flows
Flow Regime Shortage	Gap-FR	Flow regime shortage or "Onion" for current and future demands
Stream Flow Exceedance	POR-(Nat)	Exceedance of natural, current and future flows
	Jan (cur)	January Monthly Exceedance of natural, current, future flows and Adjusted Flow regimes
	Feb (cur) through Dec (cur)	February through December Monthly Exceedance of natural, current, future flows and Adjusted Flow regimes

Table 8. Planning Node and corresponding summary MS Excel file List.

Planning Node	Summary MS Excel File
Montezuma	20100521-SWP-2050-NMP-ACF-Montezuma-YiZhang.xls
Bainbridge	20100521-SWP-2050-NMP-ACF-Bainbridge-YiZhang.xls
Whitesburg	20100521-SWP-2050-NMP-ACF-Whitesburg-YiZhang.xls
Columbus	20100521-SWP-2050-NMP-ACF-Columbus-YiZhang.xls
Columbia	20100521-SWP-2050-NMP-ACF-Columbia-YiZhang.xls
Woodruff	20100521-SWP-2050-NMP-ACF-Woodruff-YiZhang.xls

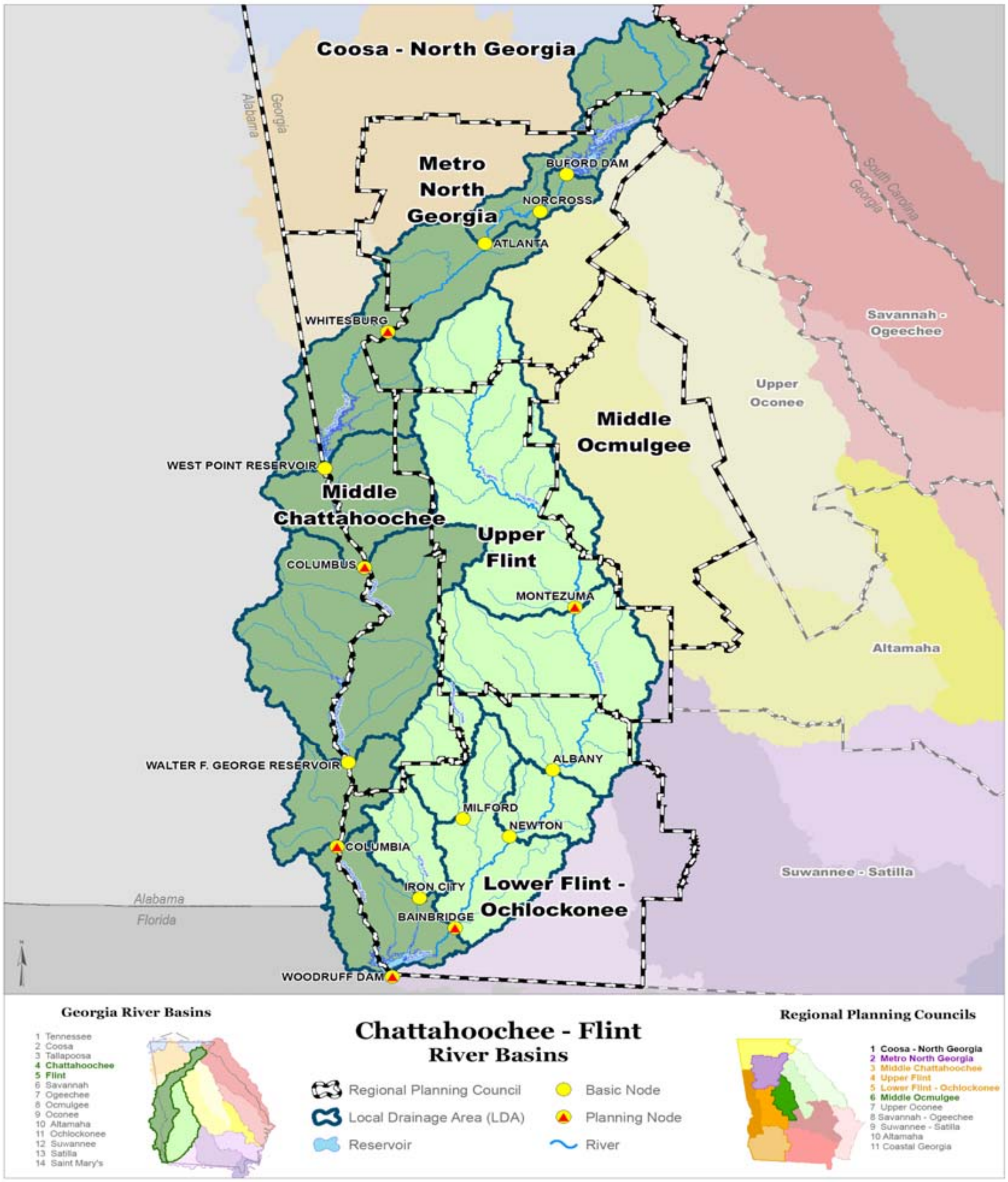

Figure 1. The Chattahoochee – Flint River Basins

Technical Memorandum

From: Surface Water Availability Resource Assessment Team – Menghong Wen
To: Regional Planning Councils, EPD Planning Team, Planning Contractors, File
Date: July 14, 2010

Subject: Summary Future (2050) Resource Assessment in Ochlocknee, Suwannee, Satilla and St. Mary's (OSSS) River Basins

Introduction

The purpose of this memorandum is to summarize the results of future Resource Assessment in the OSSS Basins with projected 2050 water use conditions. The projected water use conditions (including municipal, industrial, thermal energy, and agricultural) were provided by EPD Planning Team in May 2010 and revised in June 2010.

We used River Basin Planning Tool (RBPT) in both Current Resource Assessment and 2050 Future Resource Assessment. The objective of 2050 Future Resource Assessment is to provide Regional Planning Councils and their Planning Contractors a starting point in assessing whether available resource can meet both the off-stream and instream needs into the forecast future. If available resource cannot satisfy the needs, then Best Management Practices (BMP's) will have to be considered to satisfy the needs.

Model Settings and Key Assumptions

The OSSS includes 7 Basins and the model contains 8 Planning Nodes with their corresponding sub-basins (or 15 Basic Nodes and corresponding Local Drainage Areas). (See Figure 1.)

The hydrological conditions incorporated in the model include unimpaired incremental flow on daily basis for the period between 1939 and 2007. The flow data have been incorporated at all 14 Basic Nodes.

Forecast annual average withdrawal and discharge of each Sub-basin has been temporally distributed to monthly values according to intra-annual patterns of current conditions. At places where no current patterns exist, a uniform distribution is adopted. The Sub-basins are the finest spatial resolution in the planning models. The water use data do not reflect any single individual facilities, existing or planned.

There are not additional Management Practices (MP's) beyond those that have been reflected by Current Resource Assessments or by forecast 2050 demands. There is no flow regulating storage projects in these basins. Therefore, these basins are all unregulated basins.

In unregulated basins, Flow Regime is defined by the State's Interim Instream Flow Protection Policy, which calls for the protection of monthly 7Q10 or natural inflow, whichever is lower. In the OSSS Basins, this applies to all planning nodes.

Summary of Results

Atkinson Planning Node:

With projected 2050 water use and no additional MP's, we see a small gap between the needed withdrawal and the modeled withdrawal at this node. The situation is the same for the current water use scenario. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Atkinson. For 2050 scenario, the percentage of time when there is a demand shortage is less than 1%, with an average shortfall of 9 cfs.

A similar gap in stream flow can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 7%. The average shortage is 29 cfs. (See Tables 1(a) and 1(b).) The length and depth of the Flow Regime gap under forecast 2050 water use show better stream flow conditions than the scenario of current condition. This is because there is less consumptive water use in the sub-basin than the current condition.

Table 1 (a). Summary of Atkinson Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfal (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Correspon ding Flow Regime (cfs)
Current Demand	11%	26	2257	63	73
2050 Forecasted Demand	7%	29	2269	54	70

Table 1 (b). Summary of Atkinson Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfall (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	11%	17	1458	41	47
2050 Forecasted Demand	7%	19	1466	35	45

Concord Planning Node:

With projected 2050 water use and no additional MP's, we see a gap between the needed withdrawal and the modeled withdrawal at this node. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Concord. For projected 2050 water use, the percentage of time when there is a demand shortage is 3%, with an average shortfall of 20 cfs.

A similar gap in stream flow can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 10%. The average shortage is 37 cfs. (See Tables 2(a) and 2(b).) The length of Flow Regime shortfall under 2050 water use scenario is worse in stream condition. This is because of the water use is higher under the 2050 conditions than under current conditions.

Table 2(a). Summary of Concord Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfall (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	9%	26	1107	60	68
2050 Forecasted Demand	10%	37	1100	86	97.35

Table 2(b). Summary of Concord Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfal (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	9%	17	715	39	44
2050 Forecasted Demand	10%	24	711	55	63

<u>Statenville Planning Node:</u>

With projected 2050 water use and no additional MP's, we see a significant gap between the needed withdrawal and the modeled withdrawal at this node. (The situation is the same for the current water use scenario but the gap is smaller.) See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Statenville. The percentage of time when there is a demand shortage is 6%, with an average shortfall of 30 cfs.

A significant gap in stream flow can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 19% (19.3%). The average shortage is 44 cfs. (See Tables 3(a) and 3(b).) The length of Flow Regime shortfall under 2050 water use scenario is a little bit less than under the current water use (19.7%). However, the depth of the gap is larger. For the summer months, forecasted 2050 consumptive water uses are higher than the current condition but less in spring and winter.

Table 3(a). Summary of Statenville Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfal (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	20%	31	1060	92	95
2050 Forecasted Demand	19%	44	1054	82	84

Table 3(b). Summary of Statenville Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfal (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	20%	20	685	59	61
2050 Forecasted Demand	19%	28	681	53	54

<u>Jennings Planning Node:</u>

With projected 2050 water use and no additional MP's, we see no gap between the needed withdrawal and the modeled withdrawal at this node. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Jennings.

However, gap in stream flows can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 14%. The average shortage is 40 cfs (See Tables 4(a) and 4(b).). We see the same length of shortfall, but the depth of the gap is larger than the current condition.

The immediate upstream node Statenville is also a Planning Node. The stream flow at Jennings Node is to a very large extent affected by the Flow Regime shortfalls at the Statenville Node.

Table 4(a). Summary of Jennings Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfal (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	14%	34	1387	97	120
2050 Forecasted Demand	14%	40	1387	128	141

Table 4(b). Summary of Jennings Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfall (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	14%	22	896	63	78
2050 Forecasted Demand	14%	26	896	83	91

Pinetta Planning Node:

With projected 2050 water use and no additional MP's, we see a small gap between the needed withdrawal and the modeled withdrawal at this node. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Pinetta. The percentage of time when there is a demand shortage is 1%, with an average shortfall of 26 cfs.

A gap in stream flow can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 12%. The average shortage is 67 cfs. (See Tables 5(a) and 5(b).) We see that both the length of shortfall and the depth of the gap are larger for the 2050 future forecasted water use than those of current condition scenario.

Table 5(a). Summary of Pinetta Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfall (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	11%	43	1714	100	132
2050 Forecasted Demand	12%	67	1703	136	155

Table 5(b). Summary of Pinetta Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfal (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	11%	28	1108	65	85
2050 Forecasted Demand	12%	43	1100	88	100

Quincy Planning Node:

With projected 2050 water use and no additional MP's, there is a gap between available resource and the combined off-stream and instream needs. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Quincy. The percentage of time when there is a demand shortage is 2%, with an average shortfall of 4 cfs.

A significant gap in stream flow can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 11%. The average shortage is 8 cfs. (See Tables 6(a) and 6(b).)

Table 6(a). Summary of Quincy Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfal (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	5%	5	264	11	11
2050 Forecasted Demand	11%	8	257	20	20

Table 6(b). Summary of Quincy Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfal (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	5%	3	171	7	7
2050 Forecasted Demand	11%	5	166	13	13

<u>Fargo Planning Node:</u>

With projected 2050 water use and no additional MP's, there is a very small gap between available resource and the combined off-stream and instream needs. Actually, Fargo's demand is very small (less than 1 cfs) but the flows in the stream can also be low at times. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Fargo. The percentage of time when there is a demand shortage is 1%, with an average shortfall of 0.2 cfs. Anyway, the number is not very meaningful for a frequently nearly dry stream.

Gaps in stream flow exist. It can be observed with Figure "Fut-TS." Modeled flow (blue) is below Flow Regime (red) for extended period under 2007 hydrological conditions. For the entire period of record, the percentage of time when there is a shortage to Flow Regime is 1%. The average shortage is 0.4 cfs. (See Tables 7(a) and 7(b).)

Table 7(a). Summary of Fargo Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfal (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	3%	0.3	959	1	1
2050 Forecasted Demand	1%	0.4	959	1	9

Table 7(b). Summary of Fargo Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfall (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	3%	0	620	0	1
2050 Forecasted Demand	1%	0	620	0	6

<u>Gross Planning Node:</u>

There is no water use but very small Municipal discharges projected for 2050. Therefore, there is no gap in combined off-stream and instream needs. See Figures "TS-Consumptive" and "Gap-Dem" in the attached file titled OSSS-2050-Gross.

There is no gap in stream flow. (See Figure "Fut-TS." and Tables 8(a) and 8(b).)

Table 8(a). Summary of Gross Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfall (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	0%	0	1240	0	N/A
2050 Forecasted Demand	0%	0	1240	0	N/A

Table 8(b). Summary of Gross Node (MGD)

Scenario	Length of Shortfall (% of time)	Average Shortfall (MGD)	Long-term Average Flow (MGD)	Maximum Shortfall (MGD)	Corresponding Flow Regime (MGD)
Current Demand	0%	0	801	0	N/A
2050 Forecasted Demand	0%	0	801	0	N/A

Detailed Results

We provide detailed modeling results of each Planning Node in a summary MS Excel file. There are multiple figures in each file. The purposes of these figures are listed in Table 9 below:

Table 9. Metrics in Detailed Evaluation of Modeling Results

Variable Evaluated	Figure Tabs	Purpose of figures
Demand	TS-Consumptive	Time series of consumptive water use for both current and 2050 conditions
	Gap-Dem	Time series of demand shortages or the "Onion" for current and future demands
Storage	TS-Stor	Time series of storage remaining with bottom of pool
	POR (stor)	Exceedance of POR storage remaining with bottom of pool
Stream Flow Time Series	Nat-TS	Unimpaired natural flow time series
	Nat,FR-TS	Unimpaired plus adjusted flow regime
	FR-TS	Adjusted flow regime
	Cur-TS	Adjusted flow regime and current assessment flow
	Fut-TS	Adjusted flow regime and forecasted assessment flow
	Cur,Fut TS	Comparison of current and future modeled flows
	Fut,Nat TS	Comparison of unimpaired natural and future modeled flows
Flow Regime Shortage	Gap-FR	Flow regime shortage or "Onion" for current and future demands
Stream Flow Exceedance	POR-(Nat)	Exceedance of natural, current and future flows
	Jan (cur)	January Monthly Exceedance of natural, current, future flows and Adjusted Flow regimes
	Feb (cur) through Dec (cur)	February through December Monthly Exceedance of natural, current, future flows and Adjusted Flow regimes

Table 10. File Names for the Model Results Analyses for Nodes

Node Name	File Name
Atkinson	20100714-SWP-2050-NMP-OSSS-Atkinson-menghongwen
Concord	20100714-SWP-2050-NMP-OSSS-Concord-menghongwen
Statenville	20100714-SWP-2050-NMP-OSSS-Statenville-menghongwen
Jennings	20100714-SWP-2050-NMP-OSSS-Jennings-menghongwen
Pinetta	20100714-SWP-2050-NMP-OSSS-Pinetta-menghongwen
Quincy	20100714-SWP-2050-NMP-OSSS-Quincy-menghongwen
Fargo	20100714-SWP-2050-NMP-OSSS-Fargo-menghongwen
Gross	20100714-SWP-2050-NMP-OSSS-Gross-menghongwen

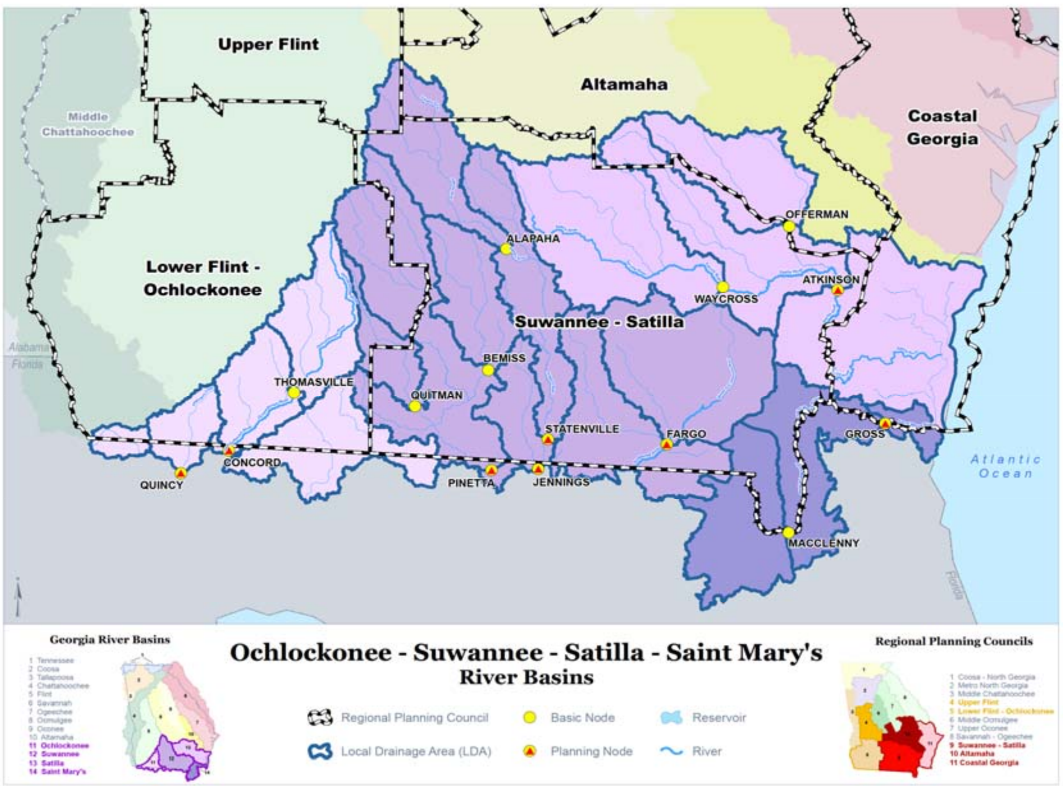

Figure 1. The Ochlockonee, Suwannee, Satilla and St. Mary’s (OSSS) River Basins