Model Application Report for Loxahatchee River Watershed Restoration Project

September 2018

Jefferson Giddings and Anushi Obeysekera

South Florida Water Management District | 3301 Gun Club Road | West Palm Beach, FL 33406

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ASR	aquifer storage and recovery
cfs	cubic feet per second
ECB	Existing Condition (base case)
FEB	flow equalization basin
FWO	Future Without Project (base case)
HSLCD	Hobe – St. Lucie Control District
ITID	Indian Trail Improvement District
LECSR-NP	Lower East Coast Subregional Model – North Palm
NGVD29	National Geodetic Vertical Datum of 1929
SFWMD	South Florida Water Management District
USACE	United States Army Corps of Engineers
WRAP	Wetland Rapid Assessment Procedure

INTRODUCTION

South Florida Water Management District (SFWMD) and United States Army Corps of Engineers (USACE) groundwater modeling staff used the Lower East Coast Subregional Model – North Palm version (LECSR-NP) to simulate two base case conditions and four project alternative conditions for the Loxahatchee River Watershed Restoration Project, part of the Comprehensive Everglades Restoration Plan (CERP).

The LECSR-NP uses the United States Geological Survey groundwater modeling code MODFLOW. To simulate surface water processes, several additional packages were implemented in the code to allow for routing of overland flow in wetland systems and to simulate canal structure operations and weir flow equations. A further discussion of the packages and the calibration of the LECSR-NP can be found in Obeysekera et al. (2018).

The LECSR-NP is a three-dimensional numerical model consisting of 704-foot × 704-foot cells (approximately 11 acres) with 3 vertical layers, 292 rows, and 408 columns covering portions of southern Martin County and northern Palm Beach County, Florida. The model simulation period is 14,975 days (41 years) and includes rainfall, evapotranspiration, infiltration, runoff, groundwater withdrawals, canal operations, land use, and other factors affecting surface and groundwater flow in South Florida. Output from the model includes daily structure flow, groundwater/surface levels, and numerous water budget flow terms (e.g., groundwater seepage into the Loxahatchee River). **Figure 1** provides an illustration of the active model area, which is the general location of the Loxahatchee River Watershed Restoration Project.

This model application report provides a general understanding of the performance of the various alternatives compared to the base case conditions and to each other. The modeling effort generated 1,500 graphics, figures, and tables which are used by various project review teams to fully understand the model results. The following discussion of the results is geared towards identifying the primary graphics that illustrate the benefits associated with a specific alternative or major component and provide a general understanding of the overall performance of the features under consideration.

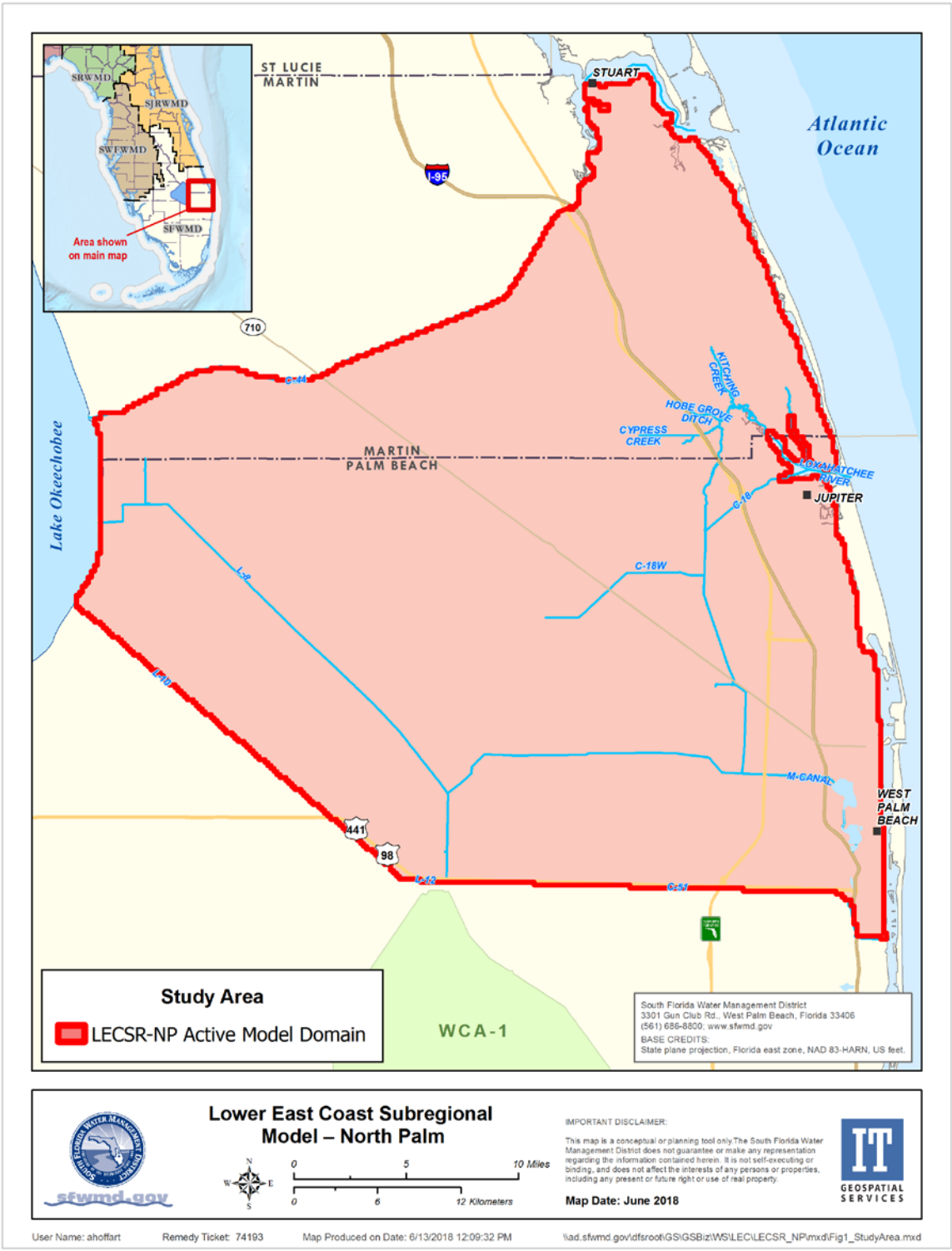


Figure 1. Boundaries of the LECSR-NP active model domain.

SIMULATION OF BASE CASES AND ALTERNATIVES

The plan simulates a 2014 Existing Condition base case (ECB) and a 2070 Future Without Project base case (FWO). Four additional alternatives were simulated: Alternative 2 (Alt 2), Alternative 5 (Alt 5), Alternative 10 (Alt 10), and Alternative 13 (Alt 13). The numbering scheme and gaps reflect the previously considered alternatives that were not selected to be simulated. The two base cases and four alternatives were simulated with a period of record from January 1, 1965 through December 31, 2005 (41 years). Historical climate conditions were used for the simulation period, and permitted allocations were used for the demands for all public water supply utilities. Tidal conditions were modeled using historical conditions. Canal stages for Lake Okeechobee and the L-8, C-44, and C-51 canals were obtained from the South Florida Water Management Model, which also provided flows from the Control 2 structure along the M-Canal to the City of West Palm Beach. **Table 1** identifies the key land acquisition or construction components associated with each alternative. A more detailed discussion can be found in the Loxahatchee River Watershed Restoration Project Modeling Assumptions Table (**Appendix A**). The key features include various combinations of two above-ground reservoirs and an in-ground storage feature, four new or modified control structures, three separate wetland restoration areas, and numerous smaller features designed to work together and improve flow to the Loxahatchee River or enhance wetland hydroperiods.

Table 1. Major land acquisition and/or construction features in each simulation.

Feature	Alt 2	Alt 5	Alt 10	Alt 13
G-160 and G-161 structures	Yes	Yes	Yes	Yes
Cypress Creek and Hobe Grove Ditch weir replacement	Yes	Yes	Yes	Yes
Kitching Creek, Moonshine Creek and Gulfstream East wetland restoration	Yes	Yes	Yes	Yes
Nine Gems and Gulfstream West wetland restoration	Yes	Yes		Yes
C-18W Impoundment	Yes	Yes	Yes	
L-8 Shallow Impoundment	Yes			Yes
C-51 Phase II Impoundment			Yes	
C-18W natural storage				Yes

General Features of the Base Cases and Alternatives

The ECB and FWO include most features currently operating, with some exceptions. Existing features that are not simulated in either base case are the G-160 and G-161 structures and the project culverts along the southern leg of the C-18 Canal. Features simulated in the ECB include the recent modifications to the G-92 structure, the North Lake Boulevard weir, wetland improvement areas constructed by Palm Beach County, regional system deliveries to the City of West Palm Beach, the east Corbett weir, and the existing canal operations for the SFWMD canals, local water control districts (298 Districts), and local developments. The main change from existing conditions not presently observed is the public water supply utility demand, which is based on SFWMD-permitted allocation, not on recently observed use. The FWO includes all ECB assumptions, except the L-8 Flow Equalization Basin (FEB) is assumed to be operational and receiving water from beyond the L-8 Basin. In addition, the FWO includes the recent proposal for the Avenir property, which creates two wetland areas in the northern portion of the property and an urban development in the southern section of the property. All alternatives include the components of the FWO assumptions unless otherwise specified.

The Alternative 2 components and general schematic are shown in **Figure 2**. The main features include the following:

1. Kitching Creek spreader swale along the northern edge of Jonathan Dickinson State Park, which is designed to distribute flow coming into Kitching Creek across the northern wetlands.

2. The Moonshine Creek and Gulfstream East restoration, which includes raising the Hobe Grove Ditch weir to an elevation of 7.5 feet National Geodetic Vertical Datum of 1929 (NGVD29) and removing all infrastructure in the Gulfstream East grove area except for the Hobe – St. Lucie Control District (HSLCD) discharge canal.

3. Replacement of and increase in the control elevation of the Cypress Creek Canal weir to 9.0 feet NGVD29.

4. The Gulfstream West restoration, which removes all infrastructure in the Gulfstream West grove and replaces it with a flow-through marsh system.

5. The Pal Mar East restoration, which involves removing all interior ditches and a section of the main southern canal on the Nine Gems property. In addition, Thomas Farms runoff is routed east through the HSLCD Unit 2 canal system.

6. The C-18W Impoundment, which was constructed as a reservoir to provide environmental deliveries to the Loxahatchee River via Lainhart Dam. The impoundment has a capacity of 7,200 acre-feet and receives direct runoff from the Indian Trail Improvement District (ITID) upper basin and inflows from the L-8 Shallow Impoundment and aquifer storage and recovery (ASR) system. The ASR system consists of 2 ASR wells with inflow and outflow capacity limited to 15 cubic feet per second (cfs).

7. The L-8 Shallow Impoundment, a 4,500-acre reservoir that receives runoff from the L-8 Basin via the L-8 Canal. The L-8 Shallow Impoundment provides water to the C-18W Impoundment when needed. Construction and operation of the G-160 and G-161 structures is included. The G-160 structure is operational and maintains a dry season control of 15.5 feet NGVD29 and a wet season control of 16.9 feet NGVD29.

8. The G-160 structure, which supplies environmental deliveries to the Loxahatchee River.

9. The G-161 structure, which can supply up to 20 cfs from Grassy Waters Preserve if the stage within the preserve is greater than 18.4 feet NGVD29 and other conditions, as outlined in **Appendix A**, are met.

10. Grassy Waters Preserve triangle, which primarily receives water from the Northlake weir.

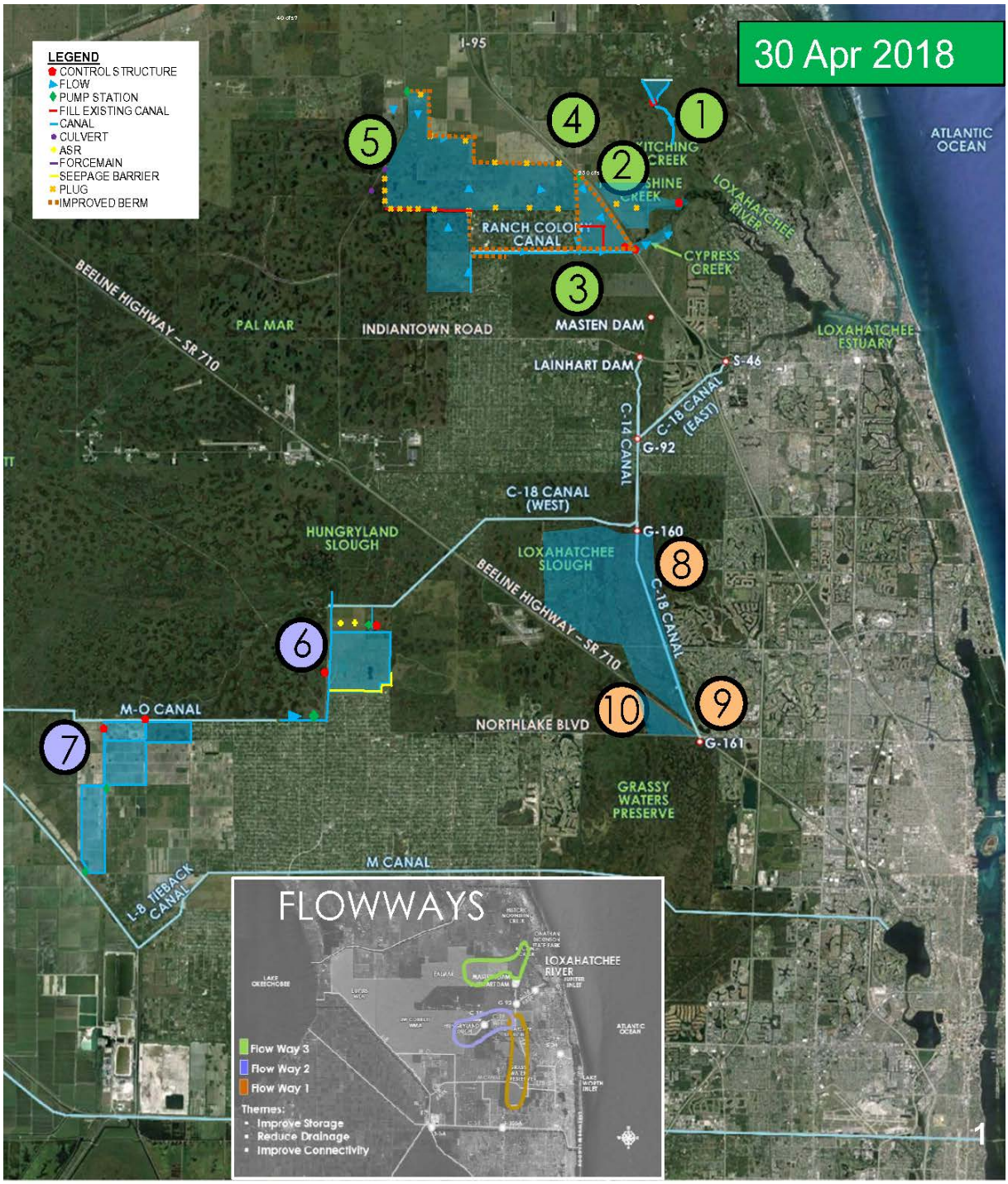


Figure 2. Alt 2 components.

The Alternative 5 components and general schematic are shown in **Figure 3**. The main features include the following:

1. Kitching Creek spreader swale along the northern edge of Jonathan Dickinson State Park, which is designed to distribute flow coming into Kitching Creek across the northern wetlands.

2. The Moonshine Creek and Gulfstream East restoration, which includes raising the Hobe Grove Ditch weir to an elevation of 7.5 feet NGVD29 and removes all infrastructure in the Gulfstream East grove.

3. Replacement of and increase in the control elevation of the Cypress Creek Canal weir to 9.0 feet NGVD29.

4. The Gulfstream West restoration, which removes all infrastructure in the Gulfstream West grove and replaces it with a flow-through marsh system.

5. The Pal Mar East restoration, which involves removing all interior ditches and a section of the main southern canal on the Nine Gems property. In addition, Thomas Farms runoff is routed east through the HSLCD Unit 2 canal system.

6. The C-18W Impoundment, which was constructed as a reservoir to provide environmental deliveries to the Loxahatchee River via Lainhart Dam. The impoundment has a capacity of 9,500 acre-feet and receives runoff from ITID's upper basin and includes an ASR system. The ASR system consists of 4 ASR wells with a total inflow and outflow capacity of 30 cfs. Construction and operation of the G-160 and G-161 structures are included. The G-160 structure is operational and maintains a dry season control of 15.5 feet NGVD29 and a wet season control of 16.9 feet NGVD29.

7. The G-160 structure, which supplies environmental deliveries to the Loxahatchee River.

8. The G-161 structure, which can supply up to 50 cfs from Grassy Waters Preserve if the stage within the preserve is greater than 18.4 feet NGVD29 and other conditions, as outlined in **Appendix A**, are met.

9. Grassy Waters Preserve triangle, which primarily receives water from the Northlake weir.

10. The M-1 pump station, which delivers ITID lower basin water to the M-Canal to augment Grassy Water Preserve when G-161 is operating and to reduce reliance on the regional system.

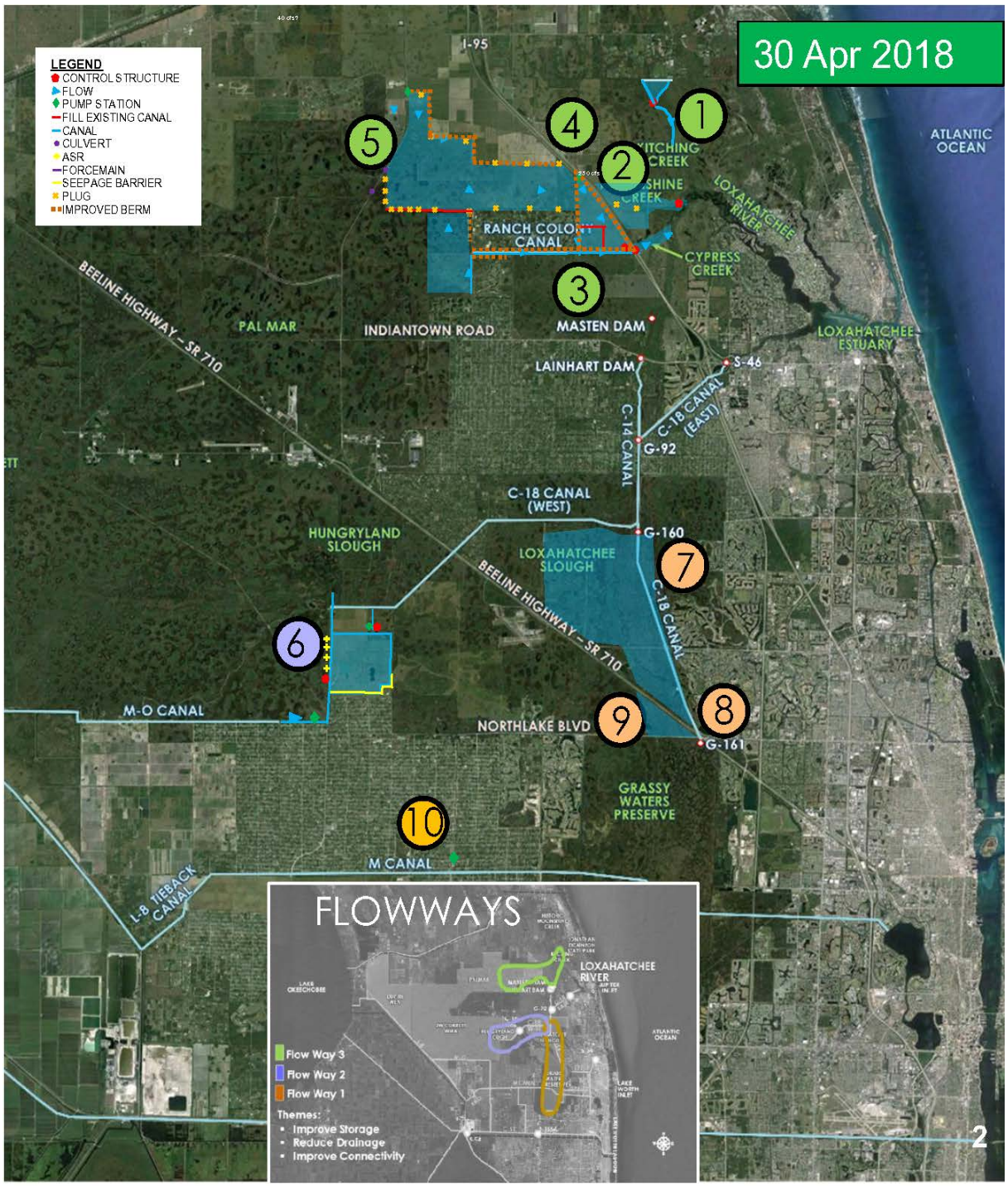


Figure 3. Alt 5 components.

The Alternative 10 components and general schematic are shown in **Figure 4**. The main features include the following:

1. Kitching Creek spreader swale along the northern edge of Jonathan Dickinson State Park, which is designed to distribute flow coming into Kitching Creek across the northern wetlands.

2. The Moonshine Creek and Gulfstream East restoration, which includes raising the Hobe Grove Ditch weir to an elevation of 7.5 feet NGVD29 and removing all infrastructure in the Gulfstream East grove.

3. Replacement of and increase in the control elevation of the Cypress Creek Canal weir to 9.0 feet NGVD29.

4. The C-18W Impoundment, which was constructed as a reservoir to provide environmental deliveries to the Loxahatchee River via Lainhart Dam. The capacity of the impoundment is 7,200 acre-feet, and it receives runoff from ITID's lower basin. Construction and operation of the G-160 and G-161 structures is included. The G-160 structure is operational and maintains a dry season control of 15.5 feet NGVD29 and a wet season control of 16.9 feet NGVD29.

5. The G-160 structure, which supplies environmental deliveries to the Loxahatchee River.

6. The G-161 structure, which can supply up to 50 cfs from the C-51 Phase II Reservoir via a force main from the M-Canal to the G-161 structure if specific conditions, as outlined in **Appendix A**, are met.

7. Grassy Waters Preserve triangle, which primarily receives water from the Northlake weir.

8. The C-51 Phase II in-ground reservoir has a capacity of approximately 44,000 acre-feet and is located in the Everglades Agricultural Area. The reservoir receives runoff from the western L-8 Basin and ITID, and its flood control capacity has been increased to 1,100 cfs. The reservoir was designed to minimize the use of regional system water by the City of West Palm Beach and to provide direct flows, via a force main, to G-161 to meet the wet and dry season targets in the Loxahatchee River.

9. The 50 cfs force main, which supplies water from the C-51 Phase II Reservoir to G-161 via the M-Canal and Grassy Waters Preserve.

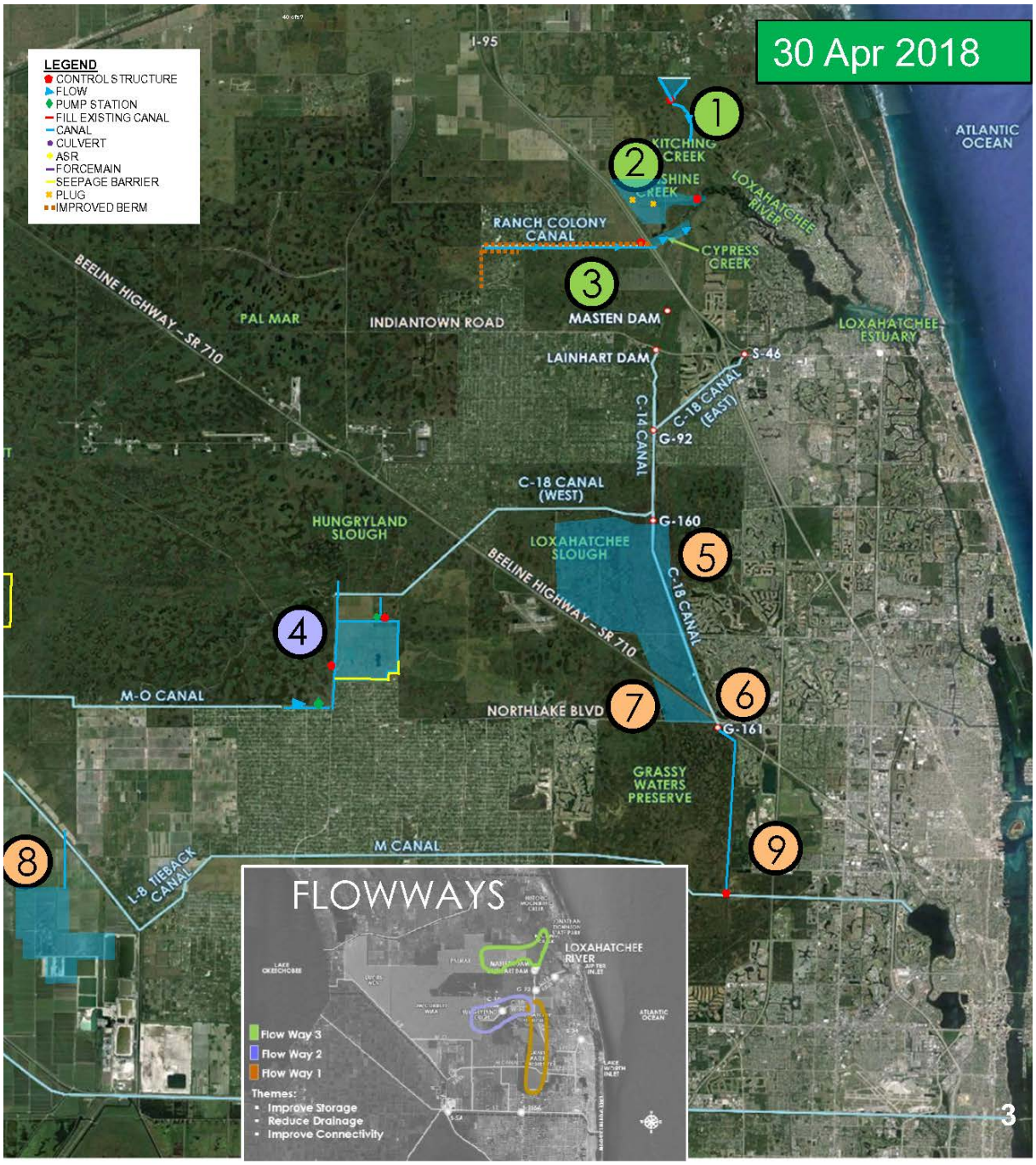


Figure 4. Alt 10 components.

The Alternative 13 components and general schematic are shown in **Figure 5**. The main features include the following:

1. Kitching Creek spreader swale along the northern edge of Jonathan Dickinson State Park, which is designed to distribute flow coming into Kitching Creek across the northern wetlands.

2. The Moonshine Creek and Gulfstream East restoration, which includes raising the Hobe Grove Ditch weir to an elevation of 7.5 feet NGVD29 and removes all infrastructure in the Gulfstream East grove.

3. Replacement of and increase in the control elevation of the Cypress Creek Canal weir to 9.0 feet NGVD29, including a spreader swale to hydrate the Cypress Creek wetland areas south of the Cypress Creek Canal.

4. The Gulfstream West restoration, which removes all infrastructure in the Gulfstream West grove and replaces it with a flow-through marsh system.

5. The Pal Mar East restoration, which involves removing all interior ditches and a section of the main southern canal on the Nine Gems property. In addition, Thomas Farms runoff is routed east through the HSLCD Unit 2 canal system.

6. The C-18W natural storage feature, which is a proposed wetland restoration feature that takes water from the L-8 Shallow Impoundment and spreads it from the C-18W Impoundment area eastward to the western portion of Loxahatchee Slough.

7. The L-8 Shallow Impoundment, an approximately 5,500-acre reservoir that receives runoff from the ITID upper basin via the M-O Canal. The impoundment provides water to the C-18W natural storage area when needed. Construction and operation of the G-160 and G-161 structures is included. The G-160 structure is operational and maintains a dry season control of 15.5 feet NGVD29 and a wet season control of 16.9 feet NGVD29.

8. The G-160 structure, which supplies environmental deliveries to the Loxahatchee River.

9. The G-161 structure, which can supply up to 20 cfs from Grassy Waters Preserve if the stage within the preserve is greater than 18.4 feet NGVD29 and other conditions, as outlined in **Appendix A**, are met.

10. Grassy Waters Preserve triangle, which primarily receives water from the Northlake weir.

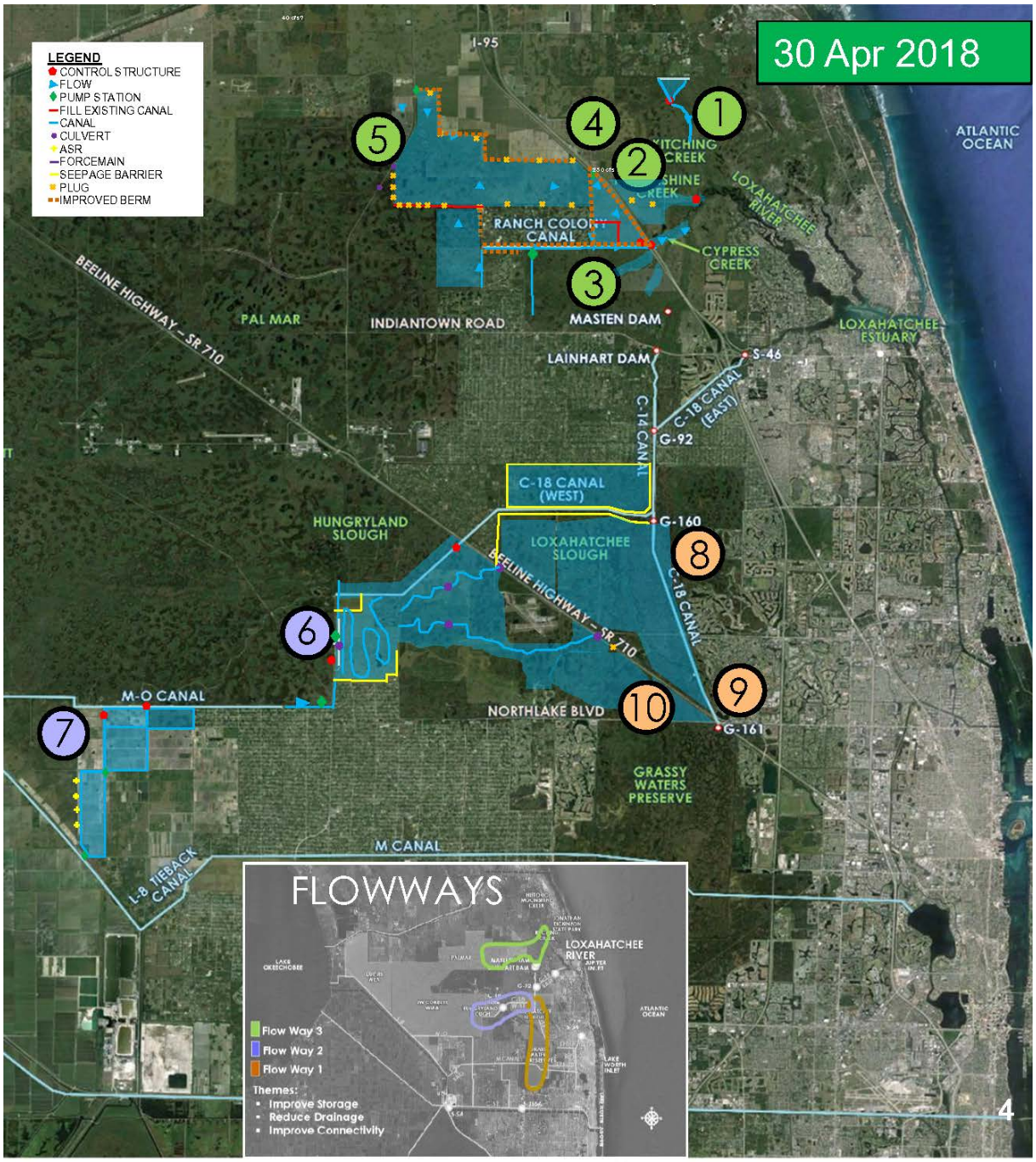


Figure 5. Alt 13 components.

Aids for Interpretation of Performance Measure Graphics

Performance measure graphics visually and graphically display results of the various model runs. Approximately 1,500 graphics were produced to evaluate model performance and conduct comparative analysis on the project features simulated in the various alternatives. A subset of the graphics, including difference maps, stage duration curves, stage hydrographs, flow duration curves, and flow bar graphs, will be used to highlight performance of project features in specific alternatives.

Difference maps highlight the change in water levels between two model runs. Difference maps display snapshots of water levels on a specific day, mainly the driest day, the average day, and the wettest day within the 41-year period of record. All difference maps represent a given model run compared to the future without project base. **Figure 6** shows the legend for the difference maps. When analyzing difference maps, colors ranging from green to red represent a drier condition compared to the FWO, with green being slightly drier and red being substantially drier. Colors ranging from light blue to purple represent a wetter condition compared to the FWO, with light blue being slightly wetter and purple being substantially wetter.

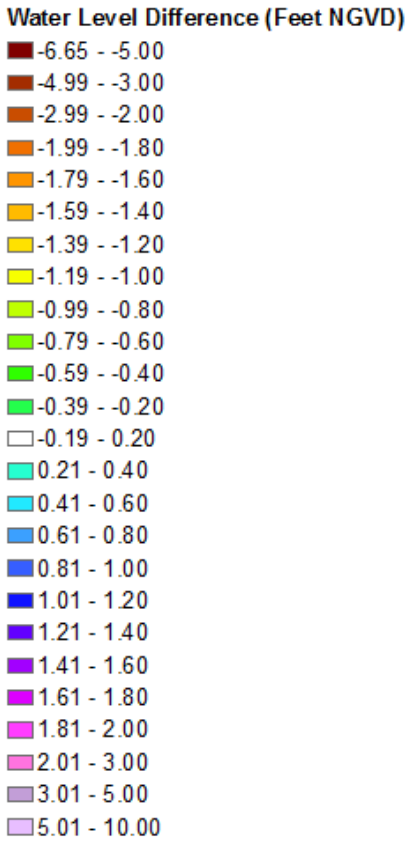


Figure 6. Difference map legend.

Stage duration curves and hydrographs can be used to analyze the hydroperiod for wetland and non-wetland areas. **Figure 7** shows the location of the Wetland Rapid Assessment Procedure (WRAP) cells, and **Figure 8** shows the location of the other indicators. Both sets of locations have corresponding stage duration curves and hydrographs, which show stage variations for each depicted model run. The stage duration curves and hydrographs also show the average model cell topography, except for duration curves for the reservoirs. **Figure 9** shows the locations of the stage duration curves for the reservoirs, where the topography value is an average value across the model cells within the footprint of the impoundment. Stage

duration curves indicate the percent of time a specific location is inundated as well as the range of water levels for the given site. Hydrographs show the stage trends over the 41-year period of record.

Flow graphics are produced for primary structures and for inflows and outflows from project features. Flow duration curves can be used to determine differences in the percent of time various alternatives produce a specific flow. Several bar charts were produced for flows that highlight differences in average monthly and annual flow as well as differences in dry season and wet season flow. These graphics can be used to analyze the performance of project features as simulated in the alternatives, especially where there are differences in operational conditions.

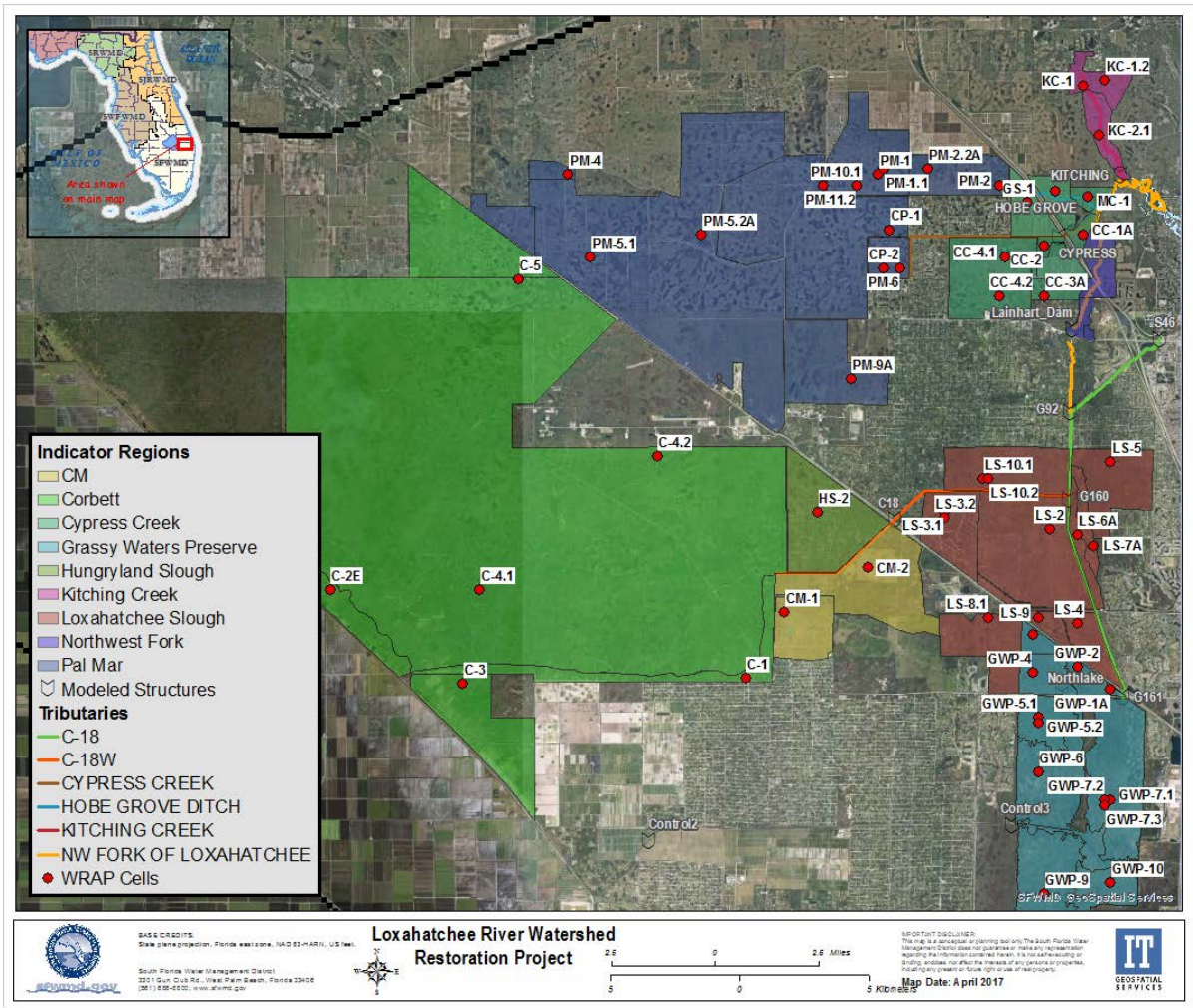


Figure 7. WRAP Cell locations.

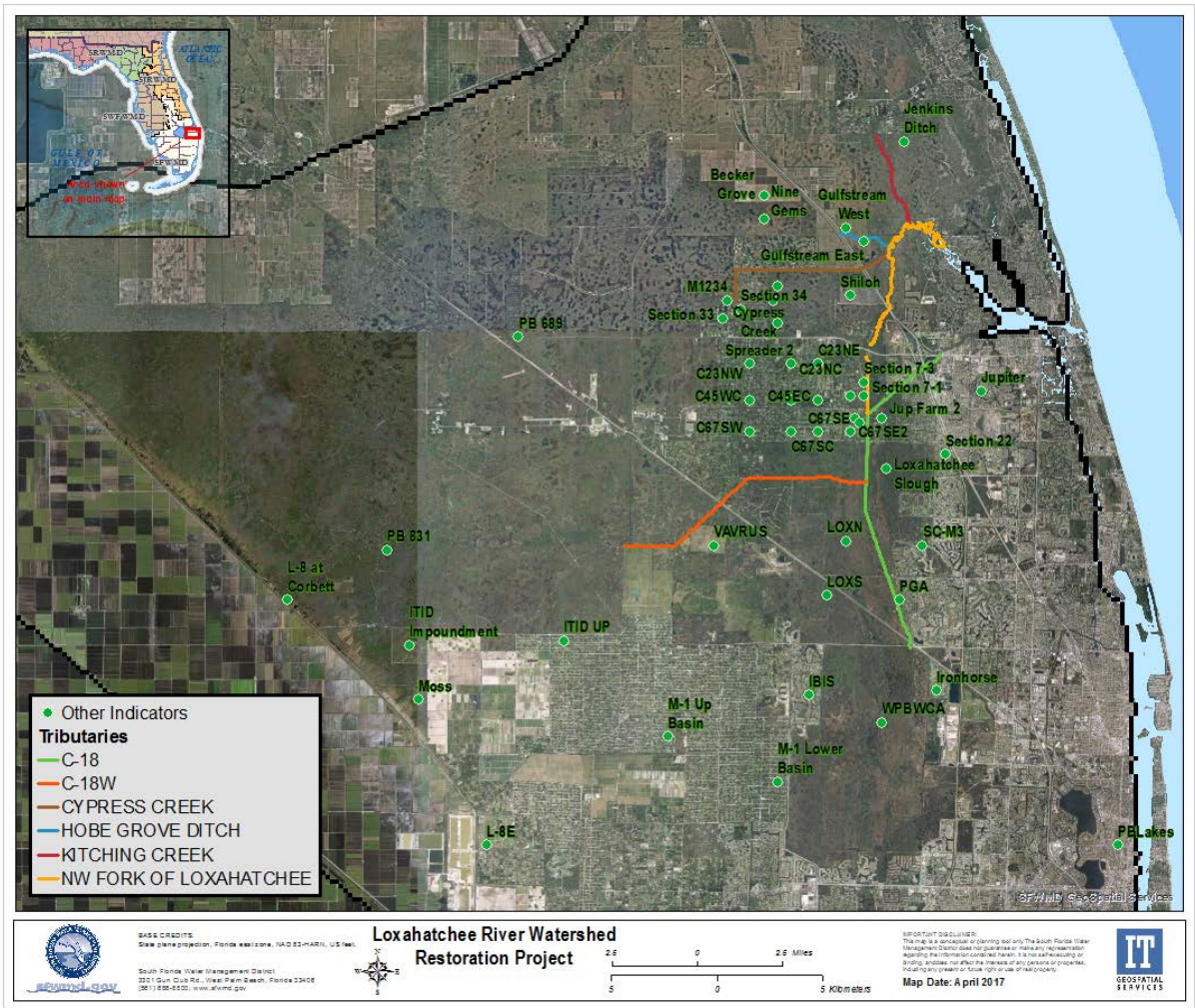


Figure 8. Other indicator locations.

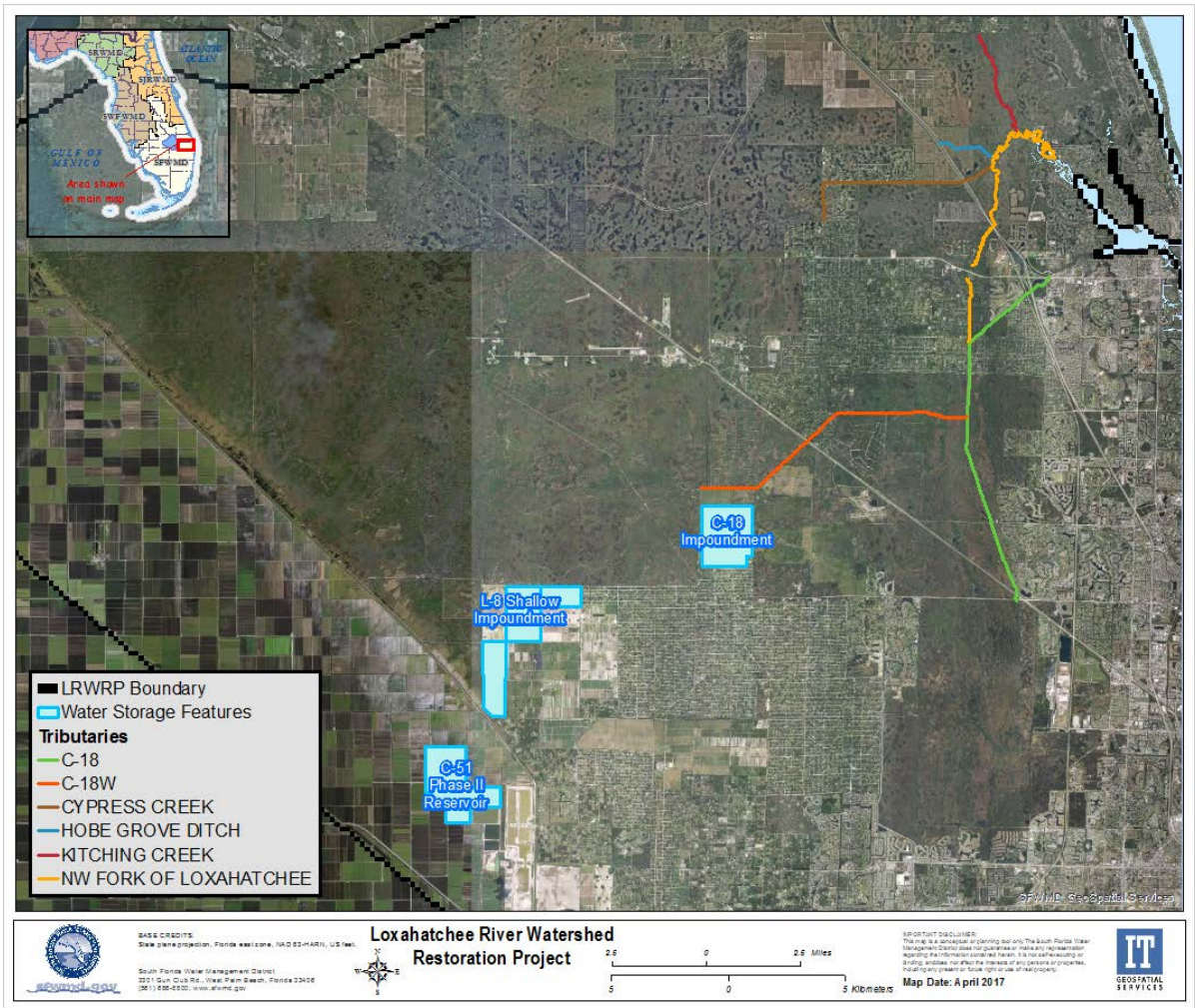


Figure 9. Water storage feature locations.

Comparison of Existing Condition and Future Without Base Cases

The following graphs illustrate the difference between the ECB and FWO.

Figure 10 shows the difference in water levels for a dry season day between the ECB and FWO. The primary differences occur near the Avenir development and at the L-8 FEB. The blue and pink colors indicate FWO water levels are lower than ECB water levels. The large pink area in the lower left is the L-8 FEB, which is operational in the FWO and can pull water below -30 feet NGVD29 to provide water to the stormwater treatment areas. The smaller blue area is the proposed urban development at the Avenir property. The green areas are higher water levels in the FWO because they are wetland mitigation areas to be constructed by Avenir. They are operational in the model and a change in the direction of runoff from the property.

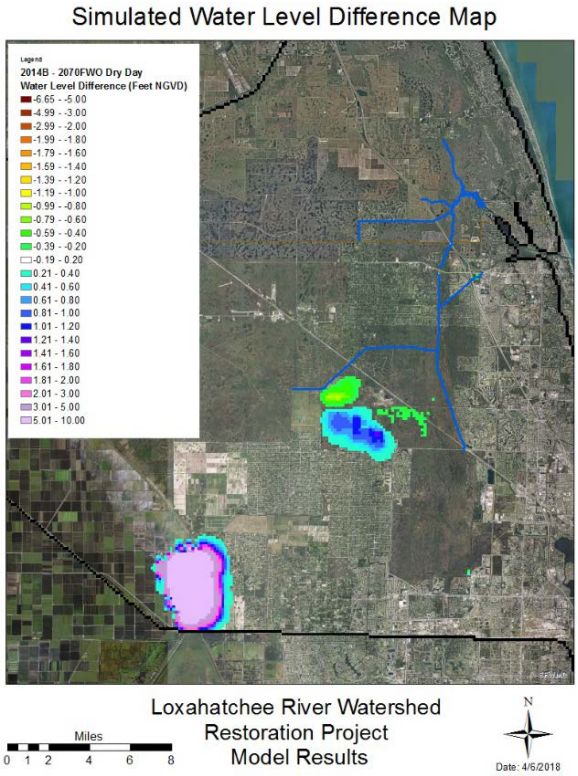


Figure 10. ECB – FWO stage difference.

Figure 11 is the stage duration curve for Wrap Cell CM-2 (location shown in **Figure 7**). This cell is in the proposed northern Avenir wetland mitigation area. The figure indicates this area can expect to see slightly dry conditions during wet periods and slightly wetter conditions during dry periods as a result of constructing the mitigation area.

Figure 12 is the stage duration curve for Wrap Cell LS-9 in the southwestern portion of Loxahatchee Slough (location shown in **Figure 7**). At this site, water levels are slightly higher in the FWO for the entire period of record. This is a result of the redirection of discharge from the Avenir property. The construction of the proposed development at Avenir results in a greater volume of runoff moving to the east and discharging into the southern leg of the C-18 Canal, when historically some of this water would have moved north and discharged into the western leg of the C-18 Canal. Little change occurs elsewhere across the study area between the two base cases.

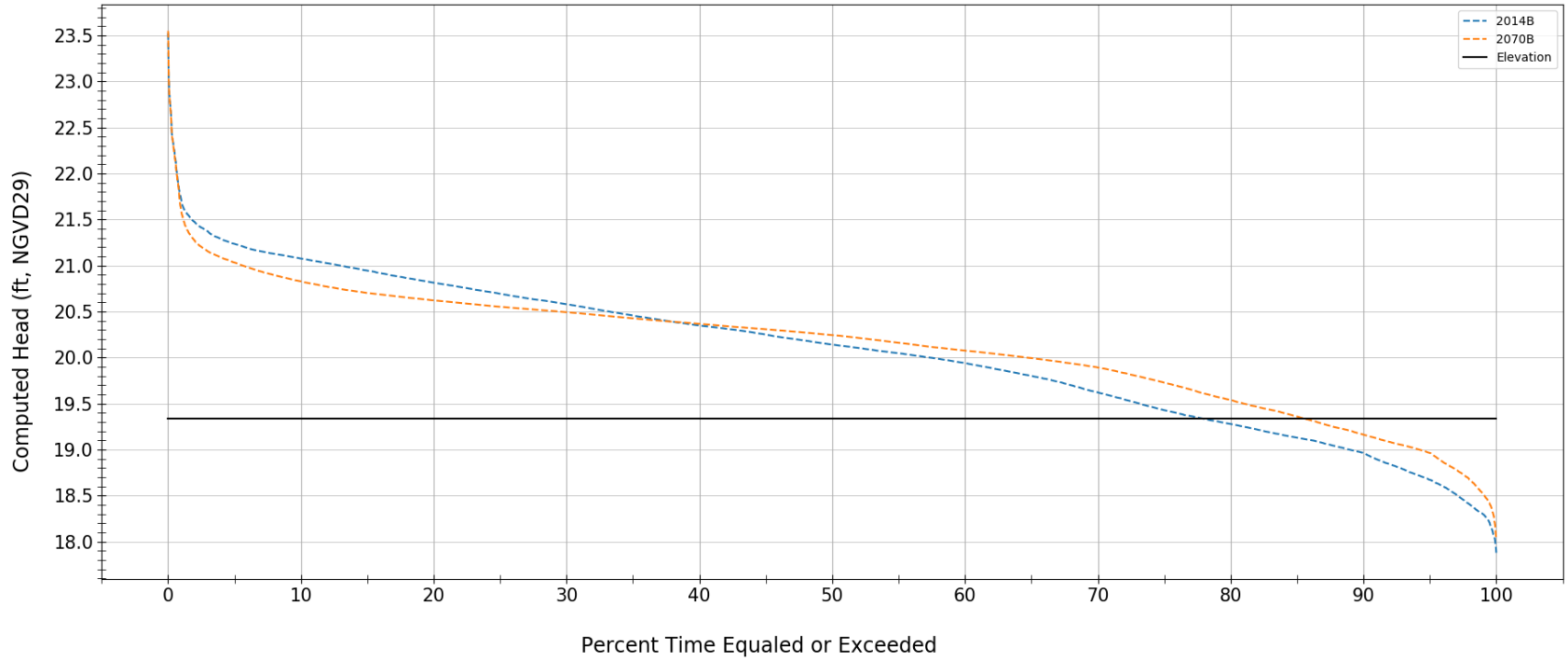


Figure 11. Wrap Cell CM-2 stage duration curve.

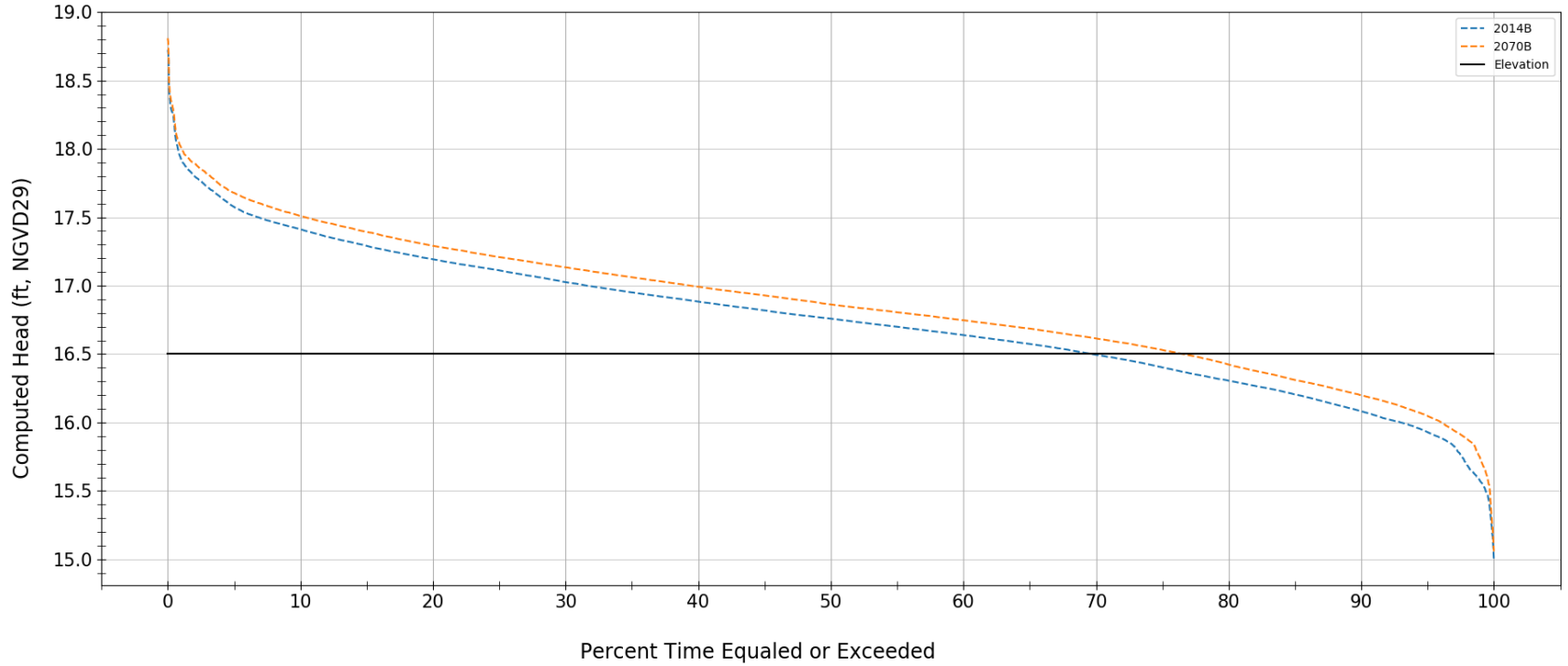


Figure 12. WRAP Cell LS-9 stage duration curve.

ALTERNATIVE 2 PERFORMANCE

The following graphs illustrate the differences between Alternative 2 and the FWO.

Figure 13 shows the difference in water levels for a dry season day between Alternative 2 and the FWO. The L-8 Shallow Impoundment and the C-18W Impoundment are noticeable (i.e., higher stages) on the left side of the figure. Water levels in the southern area of Loxahatchee Slough also show higher stages due to construction of the G-160 structure. The combination of the Gulfstream West, Pal Mar East, and Moonshine Creek/Gulfstream East restorations; the Cypress Creek weir; and the Kitching Creek spreader swale associated with Flow-way 3 is evident (i.e., higher stages) across this region.

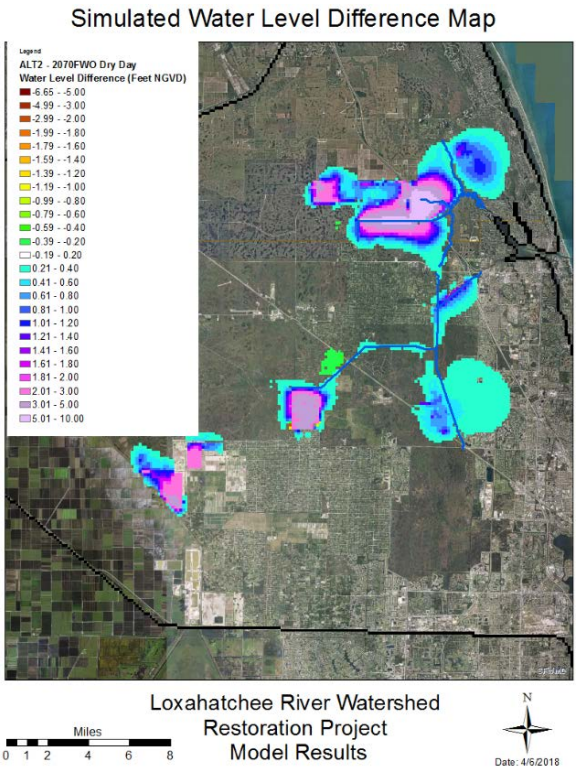


Figure 13. Alt 2 – FWO stage difference.

Figure 14 shows the daily stage hydrograph within the L-8 Shallow Impoundment (location shown in **Figure 9**). The graphic shows the impoundment has stages between 19.0 and 25.7 feet NGVD29 in Alternative 2. The average ground elevation within the impoundment is 20.3 feet NGVD29, indicating there are times when the impoundment is dry. Alternative 2 also has a smaller C-18W Impoundment with two ASR wells. **Figure 15** shows the ASR recharge and recovery volumes. The combined inflow and outflow capacity of the two wells is 15 cfs, and the wells provide water to the C-18W Canal during the dry season when water may not be available in the C-18W Impoundment.

Figure 16 shows the results of creating a flow through marsh system in Flow-way 3. The outflows from the flow-through marsh show the amount of water that is leaving the marsh and entering Cypress Creek. Additional changes in Flow-way 3 include restoration within Pal Mar and removal of existing drainage canals. The results of this project feature are shown in **Figure 17**, which depicts the stage duration curve for WRAP cell PM-11.2 (location shown in **Figure 7**). The graphic indicates the removal of the drainage canals results in a 2-foot increase in groundwater stages.

Figure 18 shows the changes in groundwater stages at Jenkins Ditch (location shown in **Figure 8**) due to the spreader canal near Jenkins Ditch and Kitching Creek. The results indicate that during high-intensity events, the groundwater stage is lower in the alternatives; however, during drier times, the groundwater stage is higher by approximately 0.5 feet.

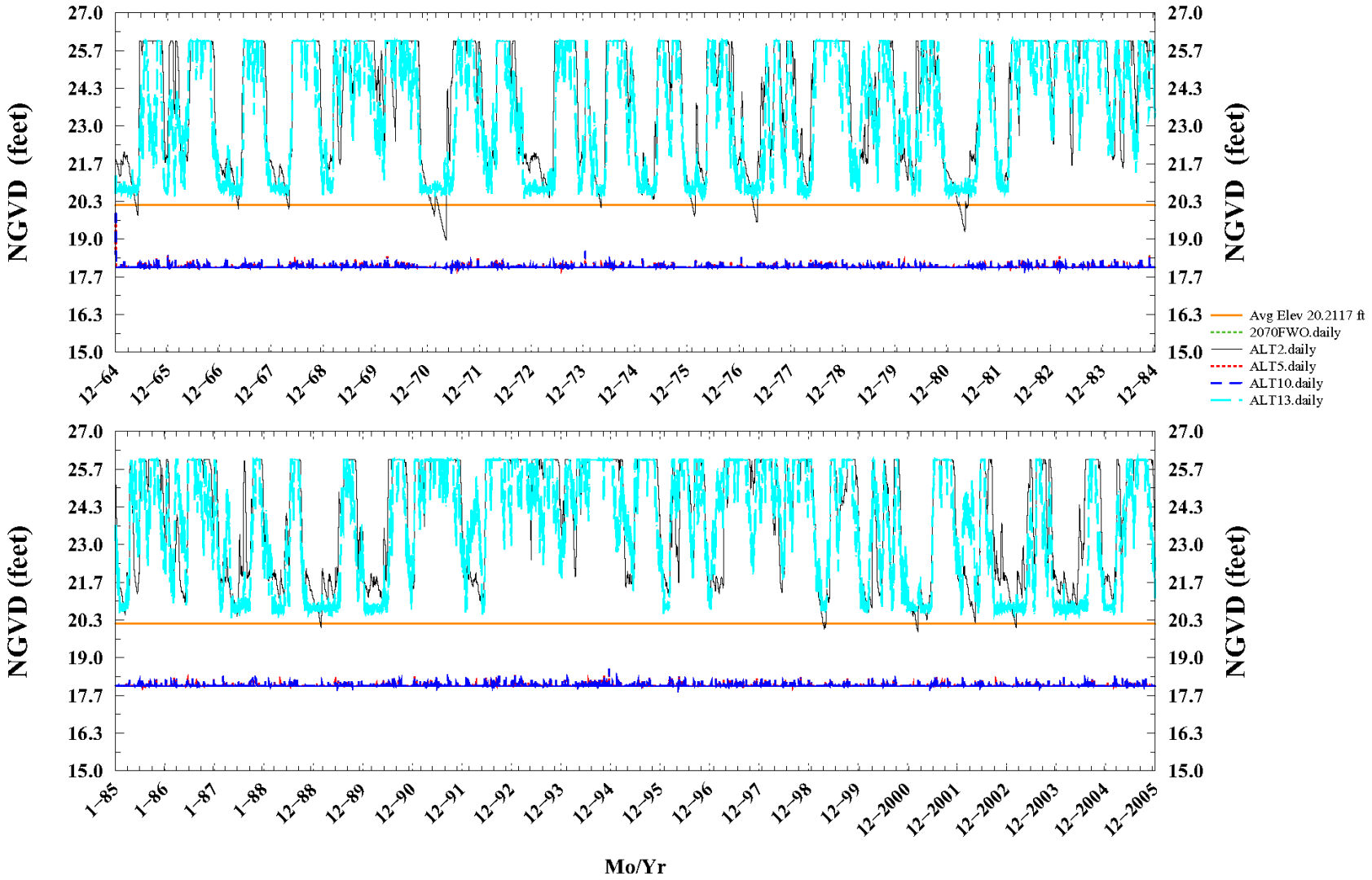
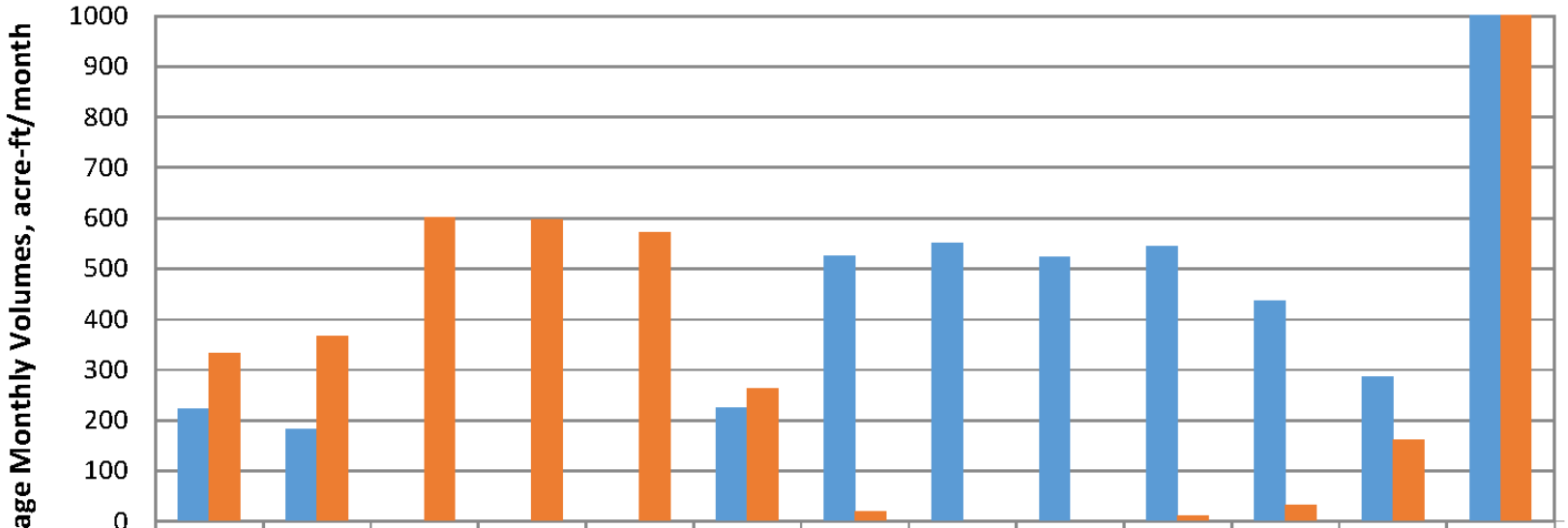


Figure 14. Stage hydrograph for the L-8 Shallow Impoundment.



Month:	1	2	3	4	5	6	7	8	9	10	11	12	Avg. annual total
ASR Recharge	223	182	-	-	-	225	525	550	524	544	436	287	3,496
ASR Recovery	334	366	600	596	572	262	19	-	0	12	32	161	2,955

Figure 15. ASR recharge and recovery flows in Alt 2.

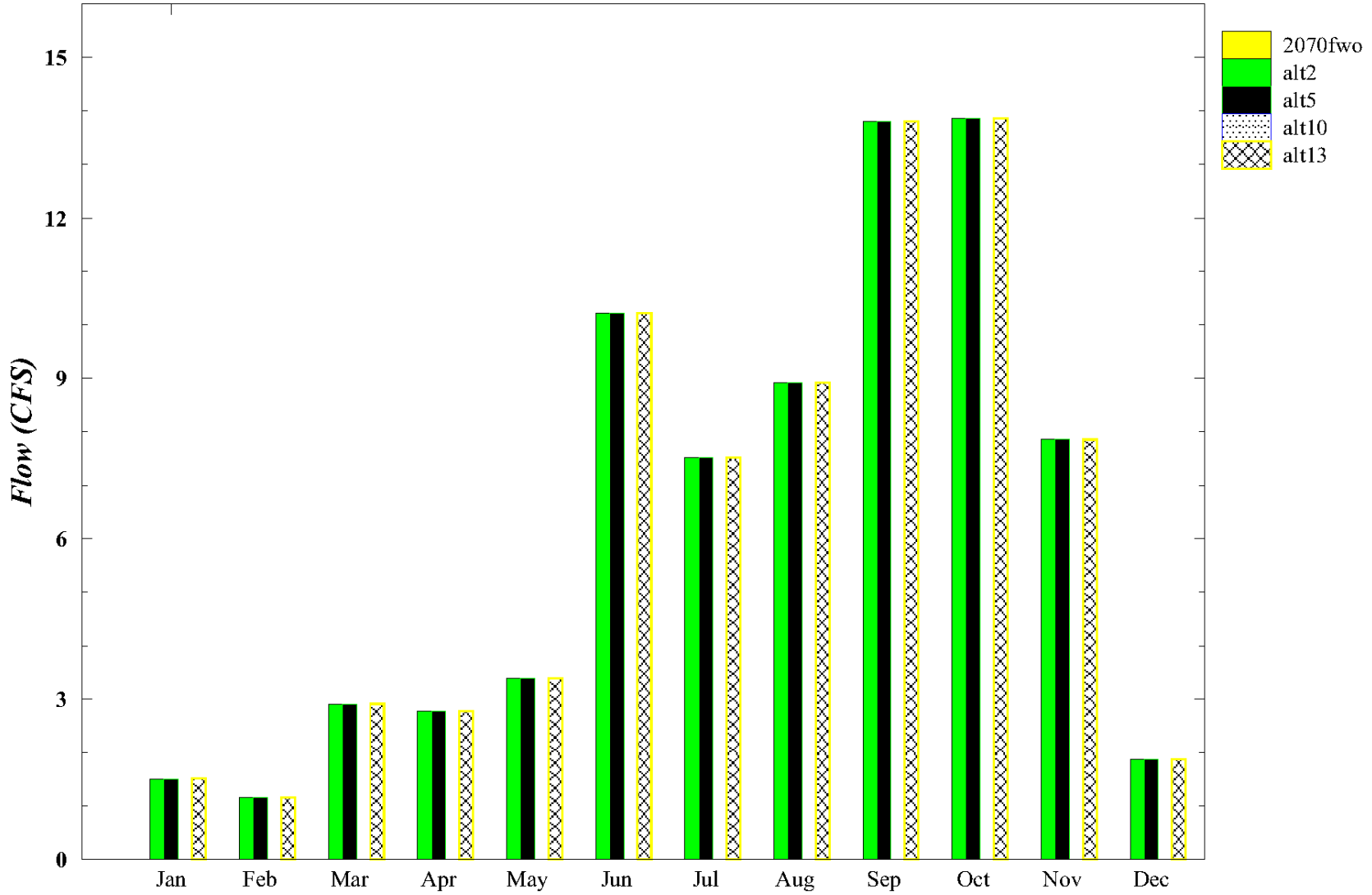


Figure 16. Average monthly structure flow for flow-through marsh outflows.

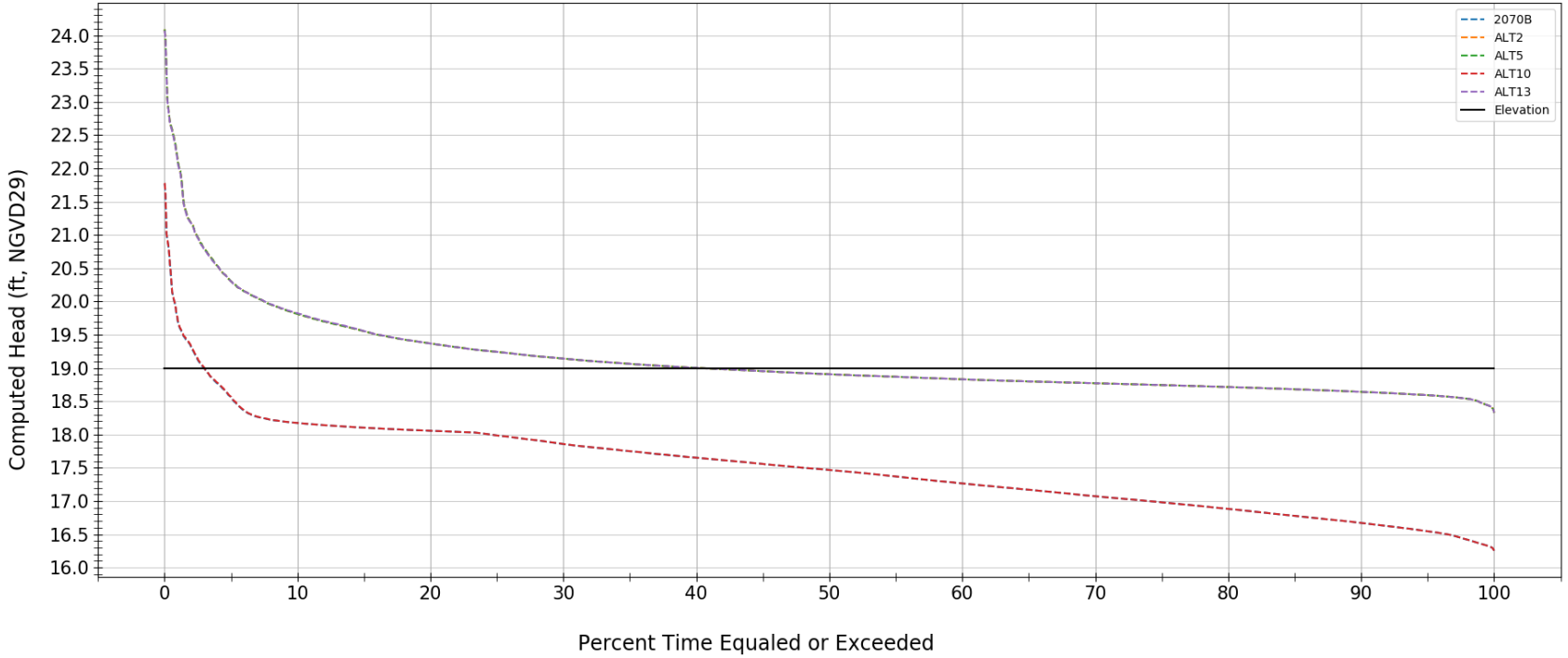


Figure 17. Duration curve for WRAP Cell PM-11.2.

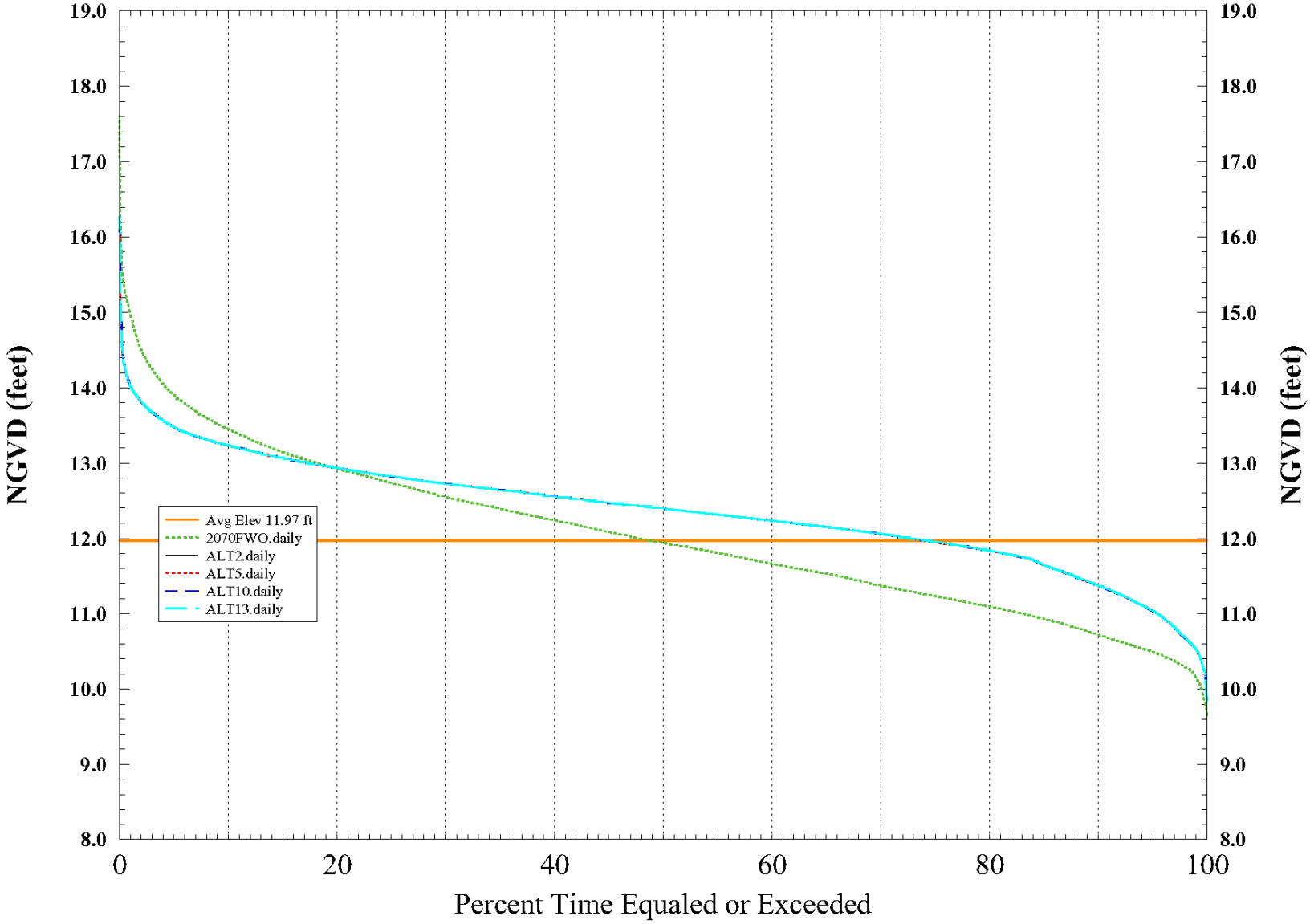


Figure 18. Stage duration curve for Jenkins Ditch.

ALTERNATIVE 5 PERFORMANCE

The following graphs illustrate the differences between Alternative 5 and the FWO.

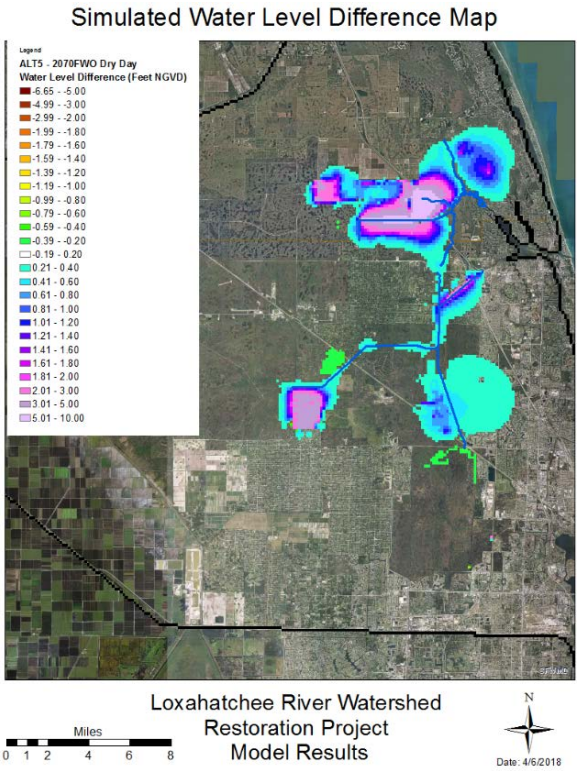


Figure 19. Alt 5 – FWO difference.

Figure 19 shows the difference in water levels for a dry season day between Alternative 5 and the FWO. The C-18W Impoundment is noticeable on the left side of the figure. Water levels in the southern area of Loxahatchee Slough show higher stages due to construction of the G-160 structure. The combination of the Gulfstream West, Pal Mar East, and Moonshine Creek/Gulfstream East restorations; the Cypress Creek weir; and the Kitching Creek spreader swale associated with Flow-way 3 is evident in the northern portion of the figure. A noticeable increase in groundwater stages occurs across this region. Alternatives 2 and 5 have similar difference maps except for the L-8 Shallow Impoundment.

Figure 20 shows the daily stage hydrograph for the C-18W Impoundment (location shown in **Figure 9**). Alternative 5 has a larger impoundment; therefore, the stage within the impoundment can go higher than the stage in the other alternatives. **Figure 21** shows the average monthly outflows from C-18W Impoundment where Alternative 5 has higher outflows than the other alternatives. During the wet season, this is due to the water injected into the ASR wells; during the dry season, this is due to the water available to send to the C-18W Canal. **Figure 22** shows the ASR recharge and recovery flows in Alternative 5. This alternative has four ASR wells adjacent to the C-18W Impoundment with a combined inflow and outflow capacity of 30 cfs. **Figure 22** indicates recovery occurs during the dry season, which typically is when the Loxahatchee River needs water, and ASR recharge occurs during the wet season when there is water available in the C-18W Impoundment.

Figure 23 shows the average monthly flows through the G-161 structure. Per the project assumptions table (**Appendix A**), up to 50 cfs can be sent from Grassy Waters Preserve to the C-18 Canal through G-161 in Alternative 5. Although **Figure 23** indicates the average amount of water through G-161 does not approach 50 cfs, the amount of water is greater than the other alternatives, which can only send a maximum of 20 cfs through G-161. The G-161 operational conditions depend on 1) makeup water being available within the L-8 Basin runoff or ITID lower basin water through the M-1 pump station, 2) stage constraints in Grassy Waters Preserve, and 3) G-160 wet and dry season control elevations.

Changes shown in **Figure 19** within Flow-way 3 can be seen in **Figures 16** to **18**, which were discussed earlier. Project and modeling assumptions for these features are simulated the same in Alternative 5 as in Alternative 2; thus, model performance in the two alternatives is the same.

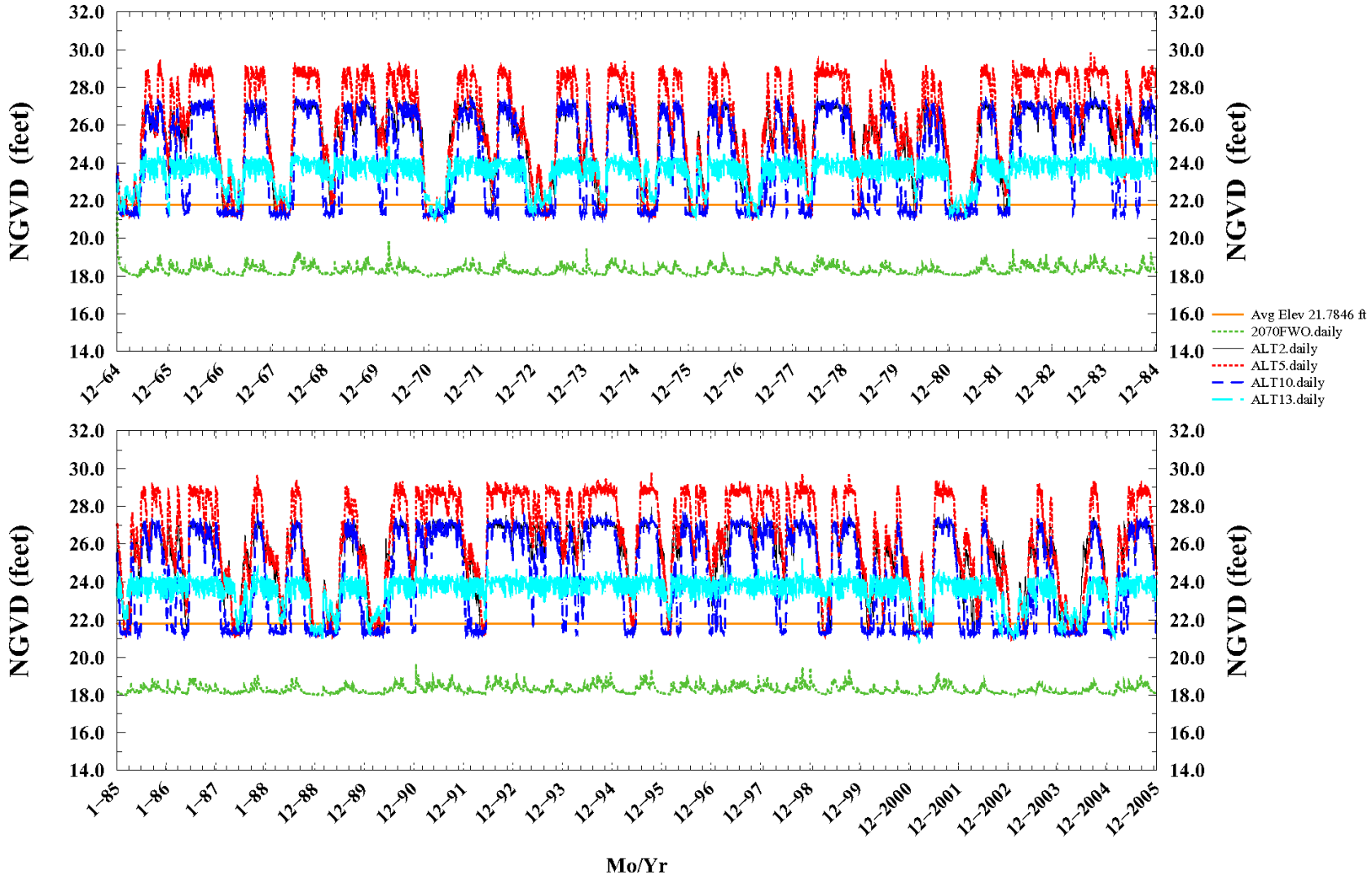


Figure 20. Stage hydrograph for the C-18W Impoundment.

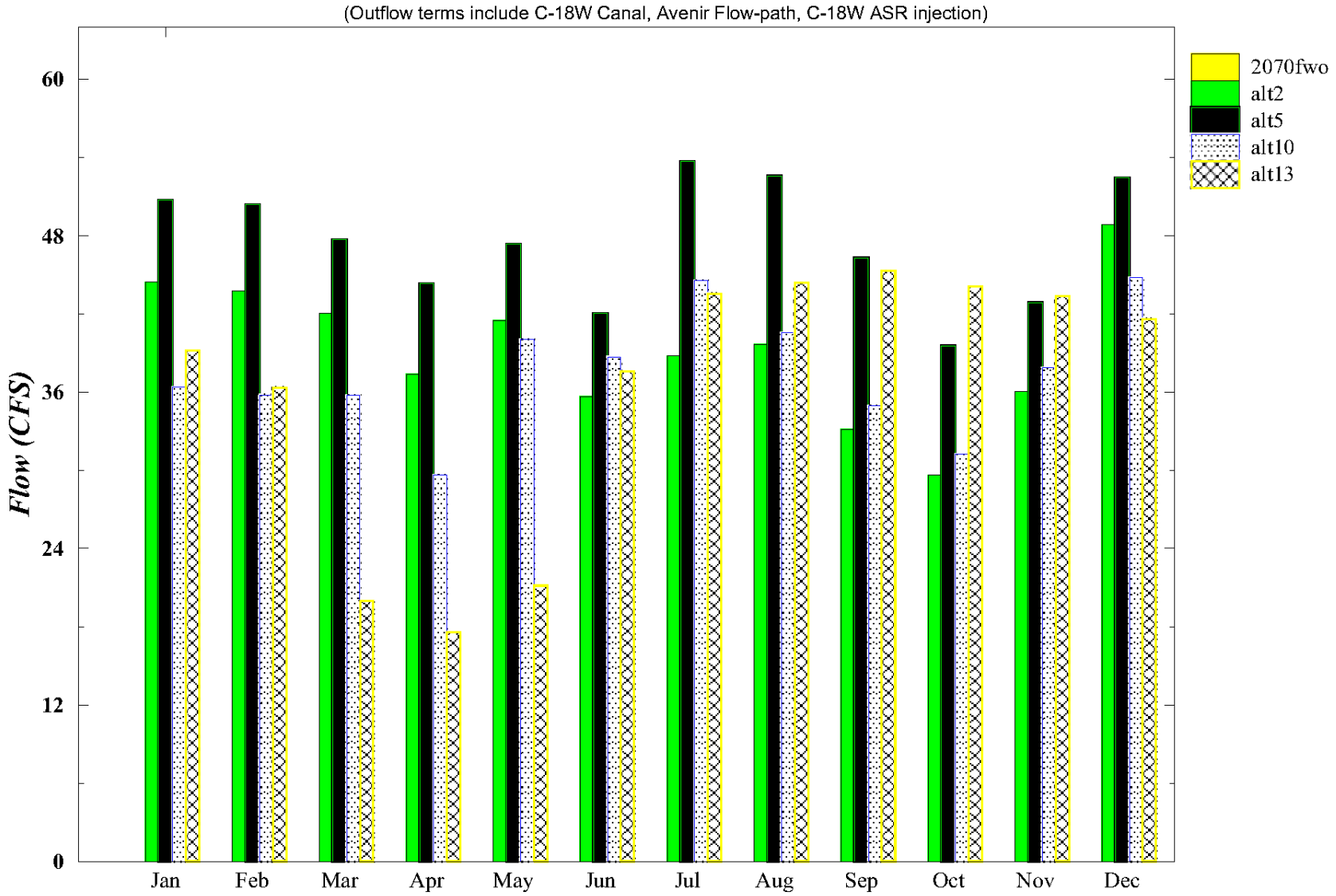
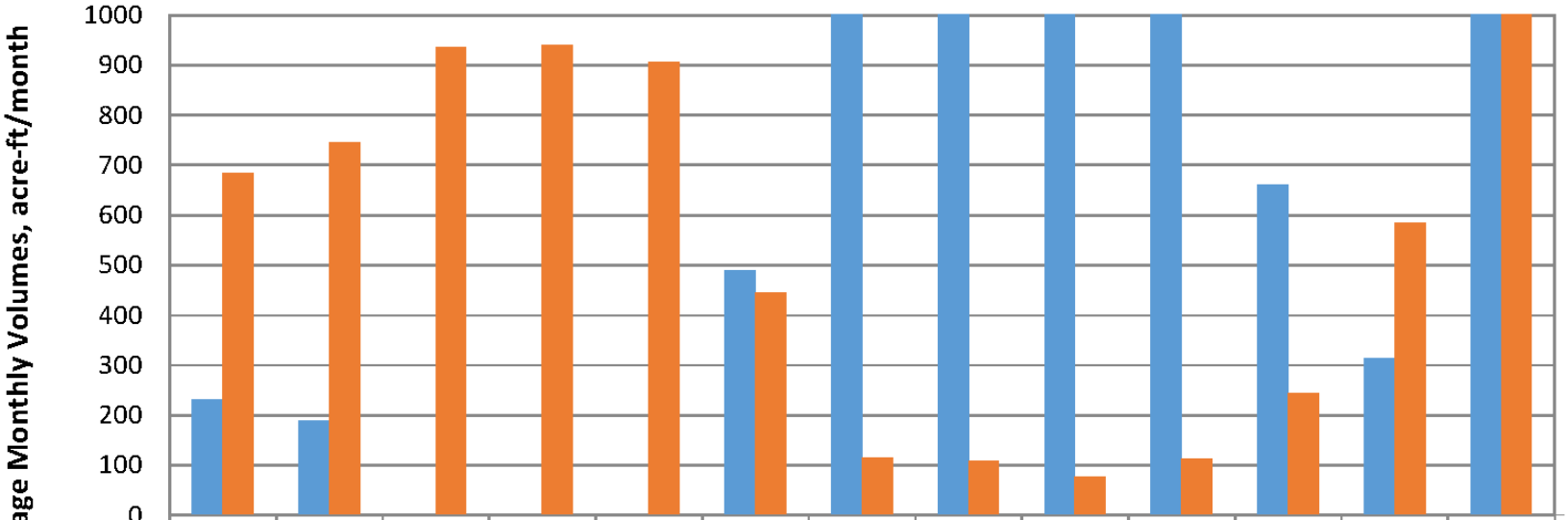


Figure 21. Average monthly structure flow for the C-18W Impoundment total outflow.



Month:	1	2	3	4	5	6	7	8	9	10	11	12	Avg. annual total
ASR Recharge	231	189	-	-	-	489	1,235	1,121	1,060	1,002	660	313	6,302
ASR Recovery	683	745	936	940	906	446	114	109	77	113	244	584	5,897

Figure 22. ASR recharge and recovery flows for Alt 5.

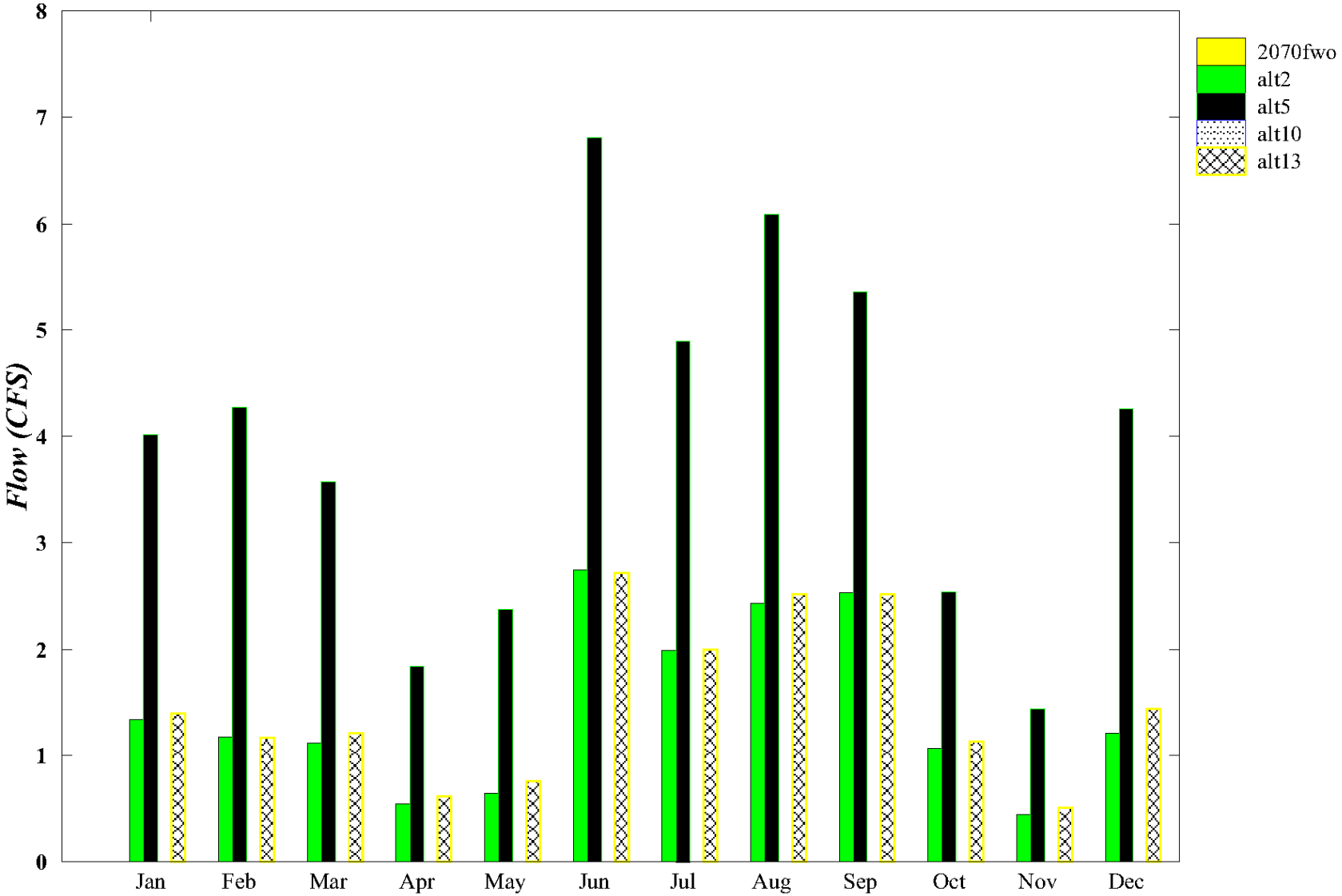


Figure 23. Average monthly structure flow for G-161.

ALTERNATIVE 10 PERFORMANCE

The following graphs illustrate the differences between Alternative 10 and the FWO.

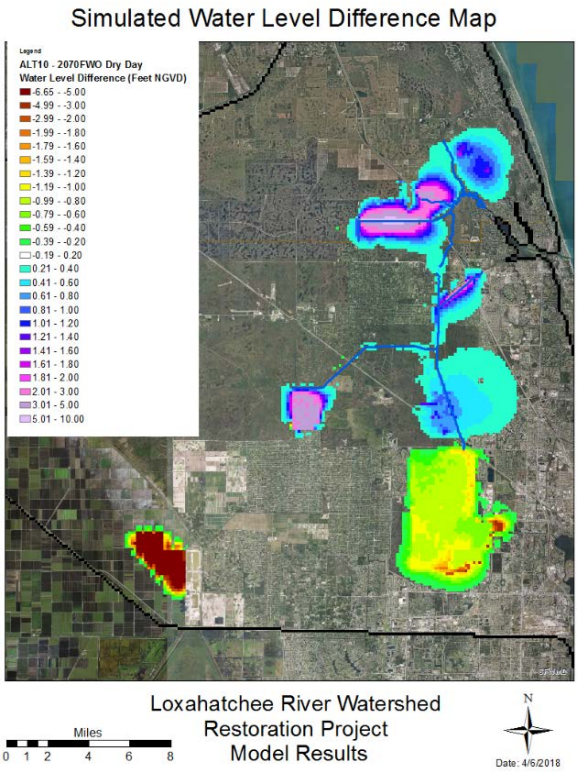


Figure 24. Alt 10 – FWO difference.

Figure 24 shows the difference in water levels for a dry season day between Alternative 10 and the FWO. The C-51 Phase II Reservoir and the C-18W Impoundment are noticeable on the left side of the figure. The C-51 Phase II Reservoir is red, indicating lower stages because of water being conveyed from the reservoir to Grassy Waters Preserve via the M-Canal. Water levels in the southern area of Loxahatchee Slough have higher stages due to construction of the G-160 structure. This area appears slightly wetter than the other alternative primarily because of force main operations. Flow-way 3 is less wet than the other alternatives because it only includes the Moonshine Creek/Gulfstream East restoration, the Kitching Creek spreader swale, and the Cypress Creek weir. The slightly dry conditions (yellow) in Grassy Waters Preserve is primarily the result of decreasing the control elevation of the M-Canal within the preserve.

Figure 25 shows the daily stage hydrograph for the C-51 Phase II Reservoir (location shown in **Figure 9**). The graphic clearly shows the reservoir is an in-ground feature with stages ranging between -15 and 12.5 feet NGVD29. One of the key features of the C-51 Phase II Reservoir is that it supplies flow to the C-18 Canal via a force main. **Figure 26** shows the average monthly flow to the force main. During the dry season, the average flow is greater than 20 cfs, which is critical because the dry season is when the Loxahatchee River needs water the most. Once water enters the C-18 Canal, it moves towards Lainhart Dam, which increases groundwater stages in Loxahatchee Slough along the canal. This is represented in **Figure 27**, which shows the stage duration curve of WRAP cell LS-6A (location shown in **Figure 7**). This cell is just east of the C-18 Canal, and there are times when the groundwater stage is approximately 0.5 feet higher in Alternative 10 than the other alternatives.

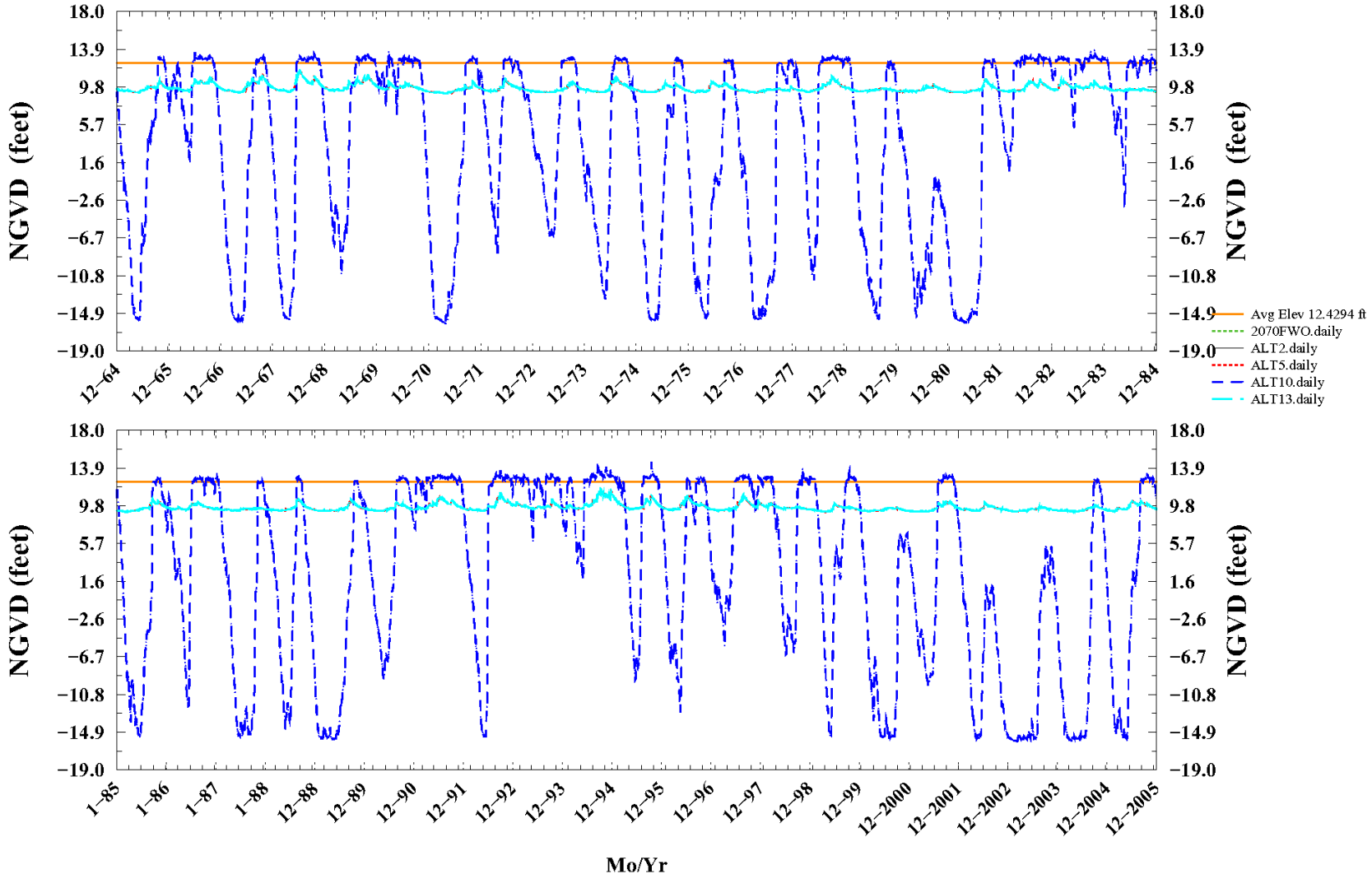


Figure 25. Stage hydrograph for the C-51 Phase II Reservoir.

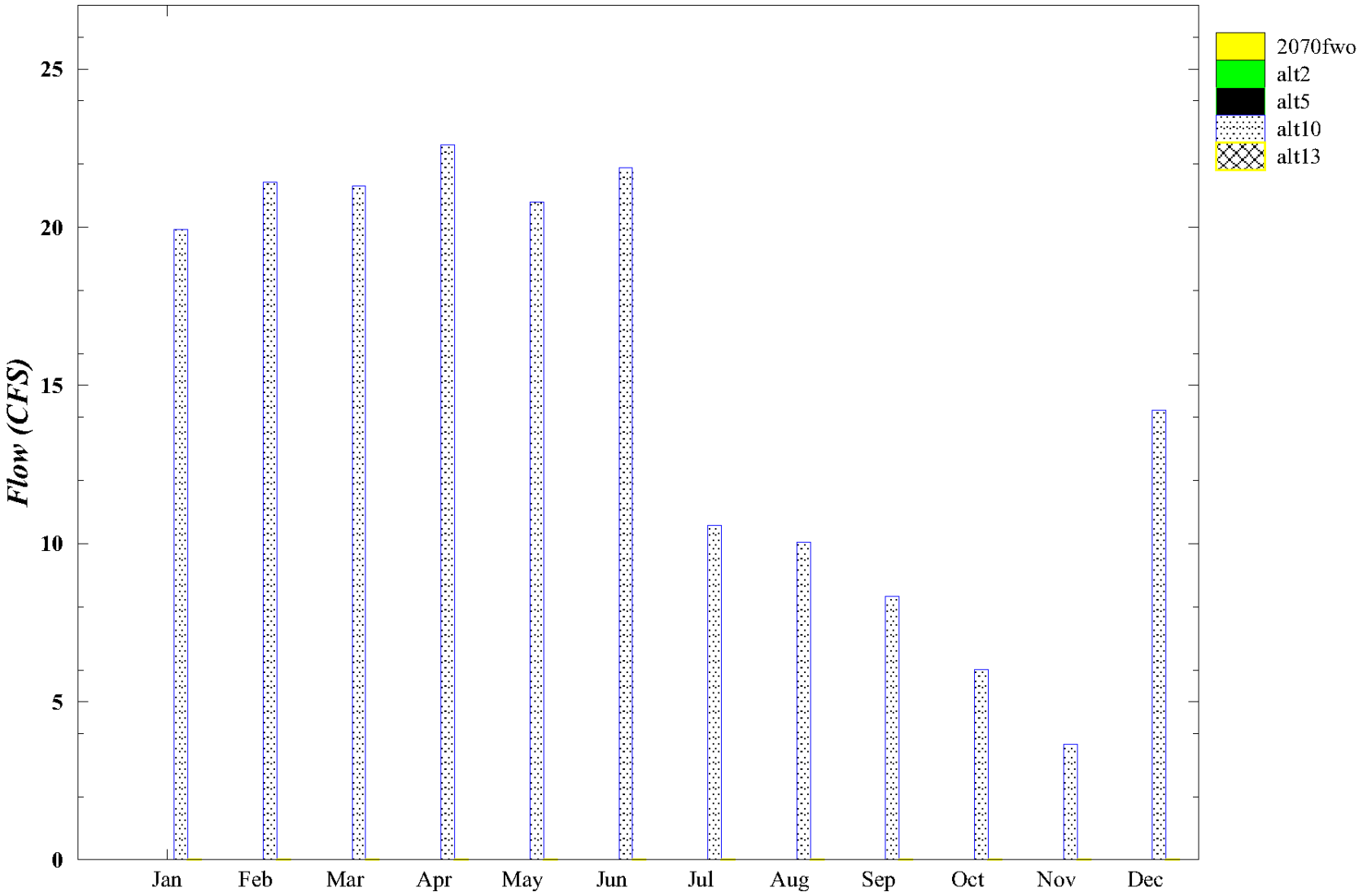


Figure 26. Average monthly structure flow to the force main from the C-51 Phase II Reservoir.

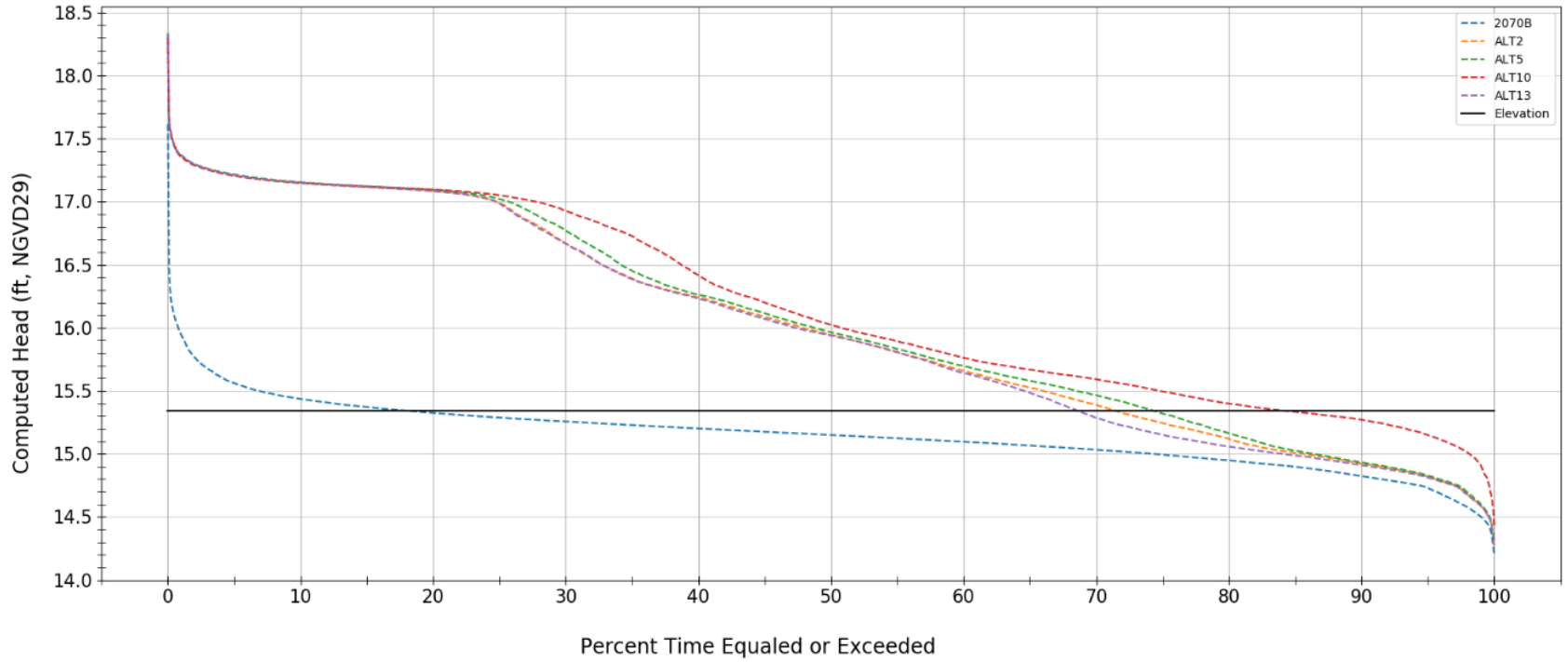


Figure 27. Stage duration curve for WRAP Cell LS-6A.

ALTERNATIVE 13 PERFORMANCE

The following graphs illustrate the differences between Alternative 13 and the FWO.

Figure 28 shows the difference in water levels for a dry season day between Alternative 13 and the FWO. The L-8 Shallow Impoundment and the C-18W natural storage feature are noticeable on the left side of the figure. Of note are the wetter conditions across the entire southern portion of Loxahatchee Slough because of C-18 W natural storage feature operations. Water levels in the southern area of Loxahatchee Slough also show higher stages due to construction of the G-160 structure. The combination of the Gulfstream West, Pal Mar East, and Moonshine Creek/Gulfstream East restorations; the Cypress Creek weir; and the Kitching Creek spreader swale associated with Flow-way 3 are evident (i.e., have higher stages) in the northern portion of the figure. There is a change in the southern portion of Flow-way 3 compared to Alternatives 2 and 5, in that this area is wetter due to Cypress Creek spreader swale operations.

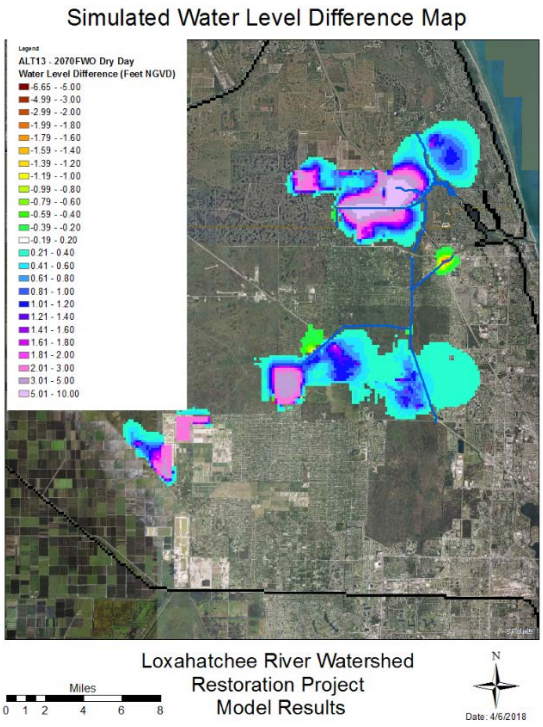
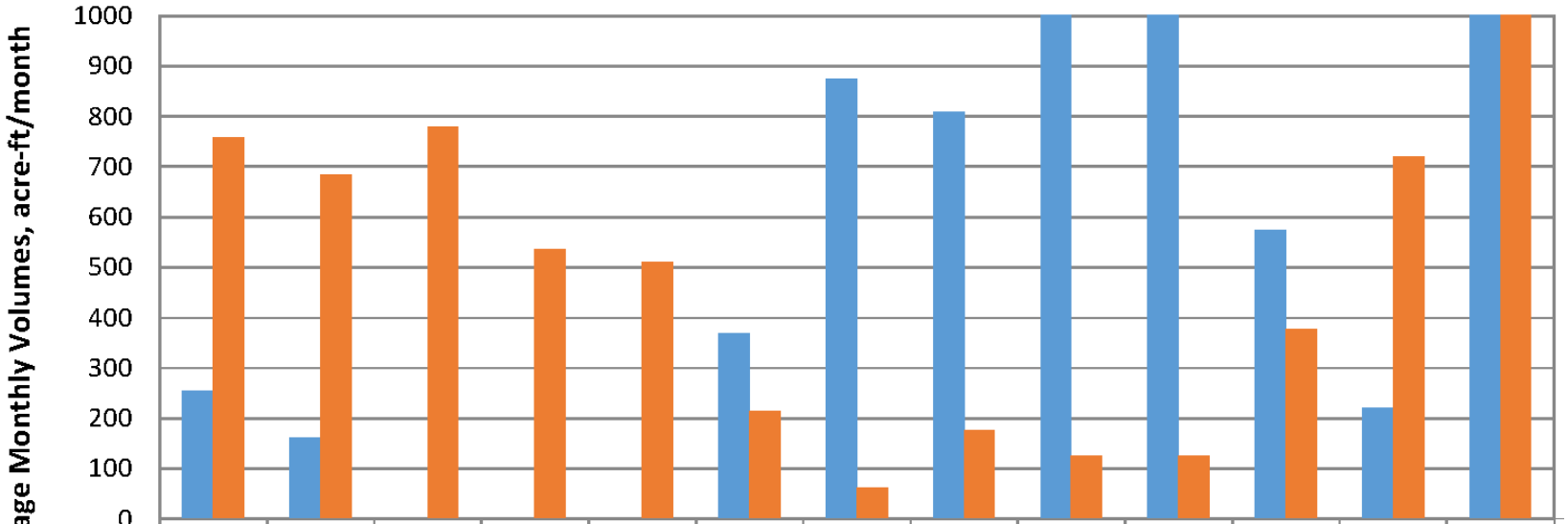


Figure 28. Alt 13 – FWO difference.

Figure 14, discussed previously, shows the stages within the L-8 Shallow Impoundment (location shown in **Figure 9**). The stage within the impoundment ranges from 20.5 to 25.7 feet NGVD29. Compared to Alternative 2, the L-8 Shallow Impoundment never appears to run out of water in Alternative 13 due to the ASR system at the L-8 Shallow Impoundment. The ASR system consists of four wells with a combined inflow and outflow capacity of 30 cfs. **Figure 29** shows the ASR recovery and recharge flows for the system. During the dry season when the impoundment may have less water, the ASR wells are in the recovery stage, which keeps the impoundment from going dry.

The L-8 Shallow Impoundment sends water to the C-18W natural storage feature. A project feature unique to Alternative 13 is the flow path from the natural storage feature to Avenir. **Figure 30** shows the average monthly flows to Avenir from the C-18W natural storage feature. Water is not sent to Avenir between March and May, but during the rest of the year, average flow is between 15 and 20 cfs. This improves the hydroperiod of the wetlands within the western portion of Loxahatchee Slough (**Figures 31** and **32**). **Figure 31** shows the duration curve for WRAP Cell LS-3.2 (location shown in **Figure 7**), in the western portion of Loxahatchee Slough east of Beeline Highway. **Figure 31** shows there usually is an approximately 0.5-foot increase in the groundwater stage. **Figure 32** shows the duration curve for VAVRUS (location shown in **Figure 8**), near the Avenir development. There is an approximately 0.5-foot increase in groundwater stage in this area as well.

Within Flow-way 3, Alternative 13 has the same project features as Alternatives 2 and 5 as well as some additional features. Performance in locations shown in **Figures 16** to **18** are the same for all three alternatives; however, because of the addition of the Cypress Creek spreader swale and the regrading of Shiloh Farms, there are some increases in hydroperiods within the southern portion of Flow-way 3. **Figure 33** shows a 1-foot increase in groundwater stage at the Shiloh Farms regrading area (location shown in **Figure 8**). **Figure 34** shows a 1.5-foot increase in stage at Cypress Creek Spreader North, just east of the Cypress Creek spreader swale (location shown in **Figure 8**).



Month:	1	2	3	4	5	6	7	8	9	10	11	12	Avg. annual total
ASR Recharge	255	160	-	-	-	368	874	808	1,015	1,108	574	220	5,382
ASR Recovery	758	683	779	536	511	213	63	176	126	124	378	720	5,067

Figure 29. ASR recharge and recovery flows for Alt 13.

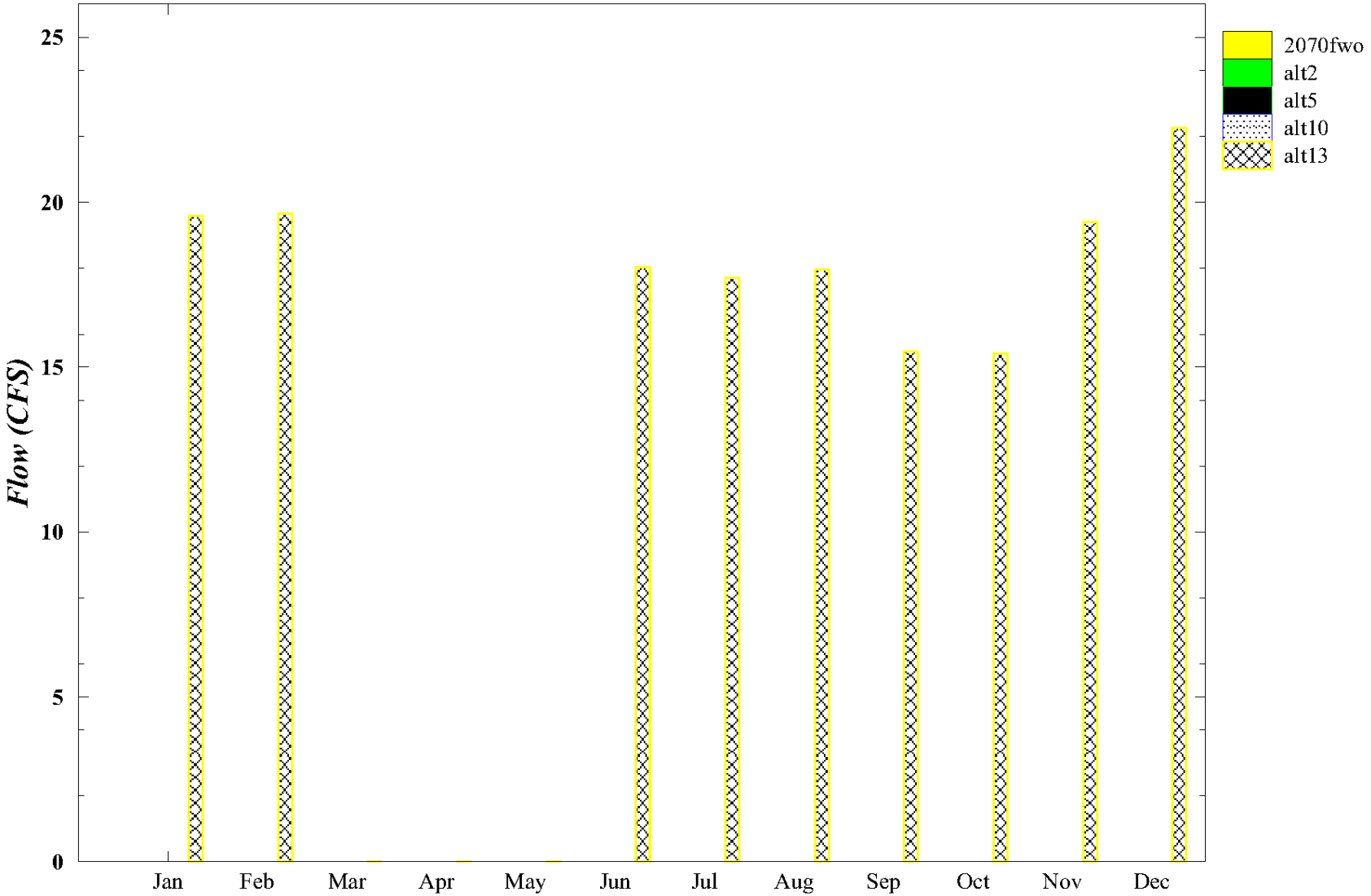


Figure 30. Average monthly structure flow from the C-18W natural storage feature to Avenir.

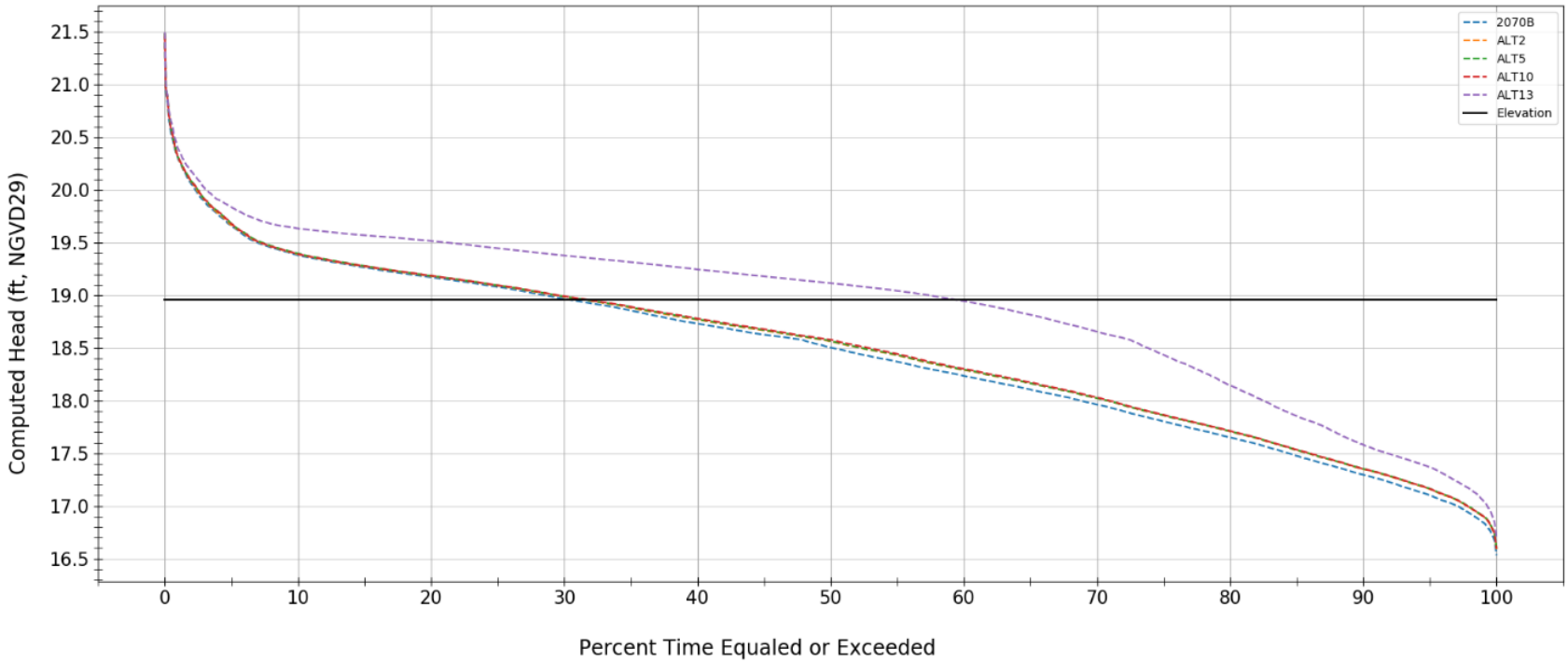


Figure 31. Stage duration curve for WRAP Cell LS-3.2.

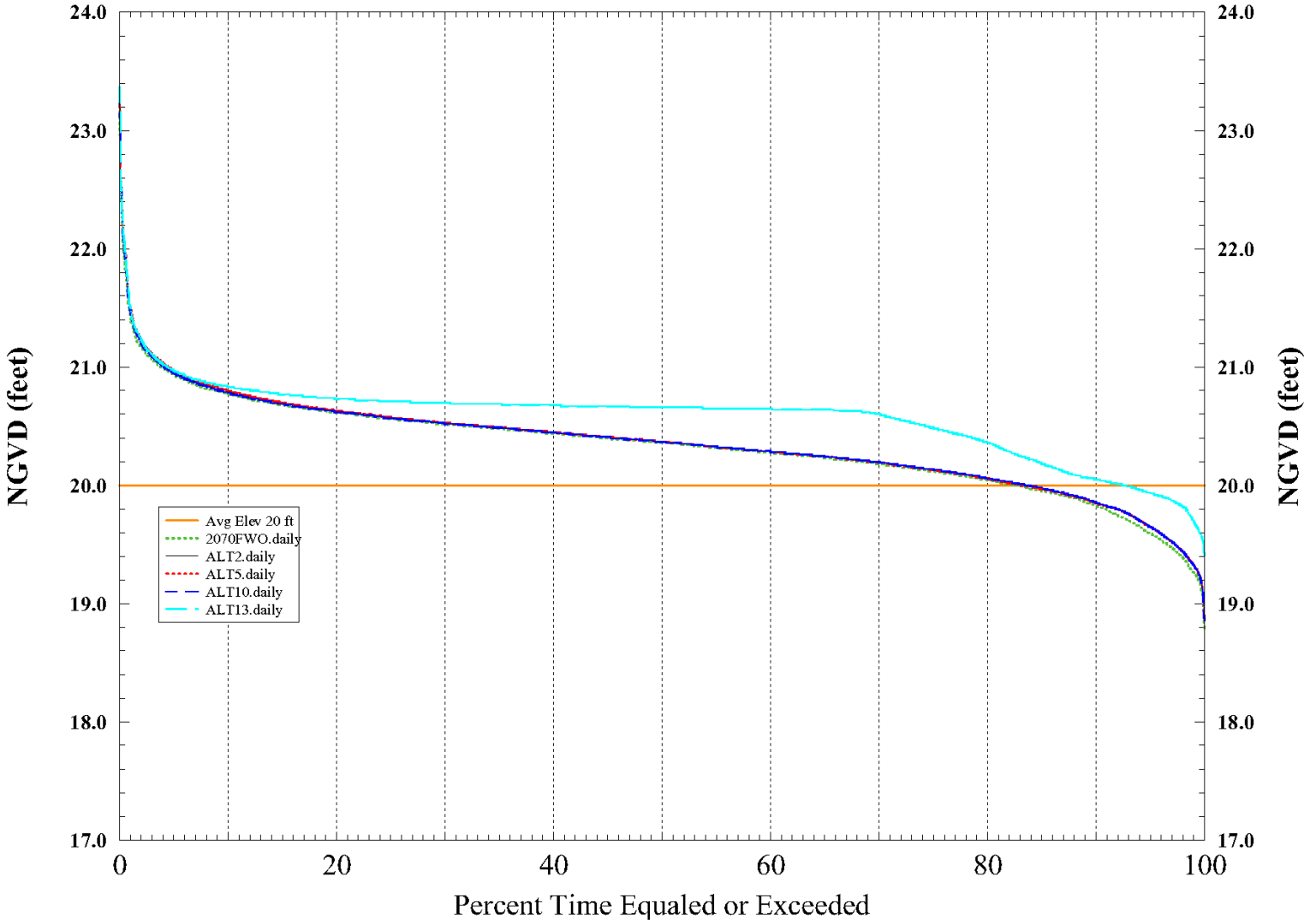


Figure 32. Stage duration curve for VAVRUS.

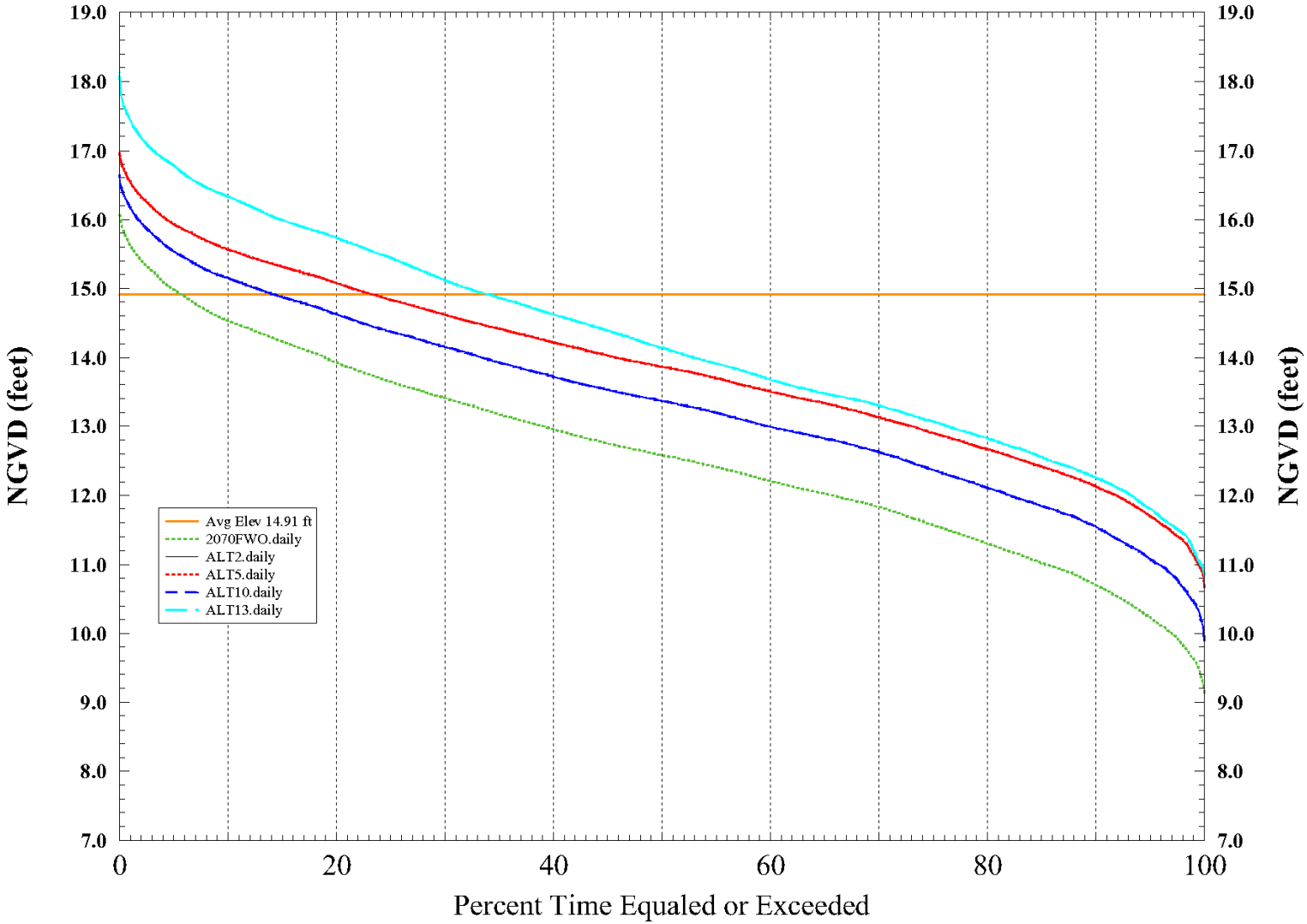


Figure 33. Stage duration curve for Shiloh.

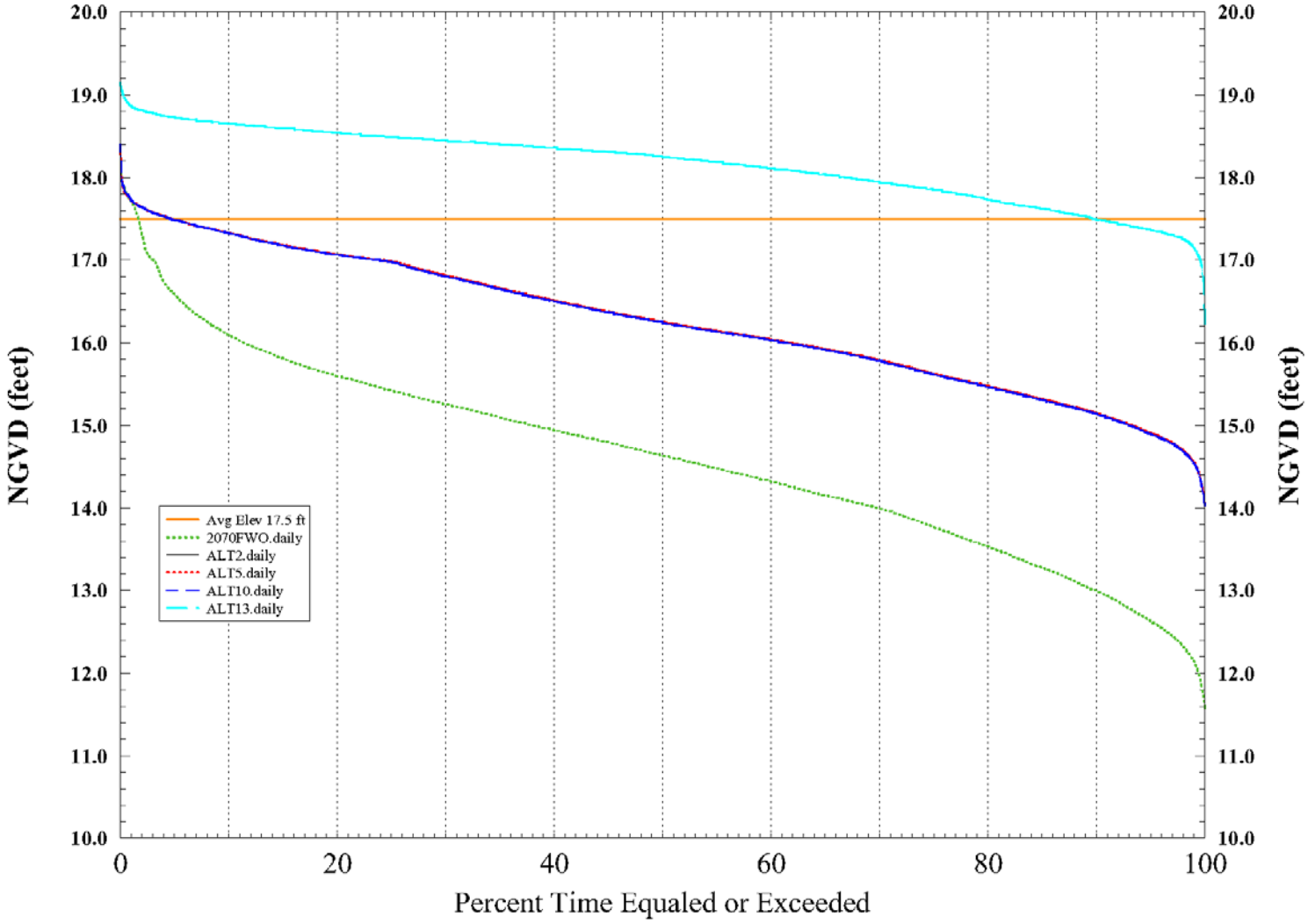


Figure 34. Stage duration curve for Cypress Creek Spreader North.

PERFORMANCE AT PRIMARY STRUCTURES

Figure 35 shows the flow duration curve for the C-18 weir. Based on the graphic, Alternative 5 and Alternative 10 appear to send the most water over the weir, which is due to the outflow capacity of the C-18W Impoundment. **Figure 36** shows the comparison of average monthly flows at the C-18 weir. Based on the graphic, on average over the period of record, Alternative 5 performs better than Alternative 10 during the dry season, and Alternative 10 performs better than Alternative 5 during the wet season. This is due to the ASR operations in Alternative 5. During the dry season, the ASR wells are used to augment flow to the C-18 West Canal, and during the wet season the C-18W Impoundment is injecting water into the ASR wells in addition to the water that is being delivered to the C-18 West Canal.

G-160 is a project feature that allows water to flow from the southern portion of the C-18 Canal north towards G-92. In the model alternatives, G-160 operational protocol does not change. **Figure 37** shows the average monthly structure flow for G-160. Typically, Alternative 10 sends more water through G-160 than the other alternatives. This is due to the force main that bypasses Grassy Waters Preserve and directly sends water into the C-18 Canal at G-161. On average, in October and November, Alternative 5 sends more water through G-160 than the other alternatives. This is because Alternative 5 allows 50 cfs to pass through G-161 into the C-18 Canal compared to Alternatives 2 and 13, which only allow 20 cfs through G-161. Additionally, there is another source of water into Grassy Waters Preserve due to the M-1 – M-Canal pump station. **Figure 38** shows the annual dry season average flows through G-160. During the dry season, when it is critical to move water through the C-18 Canal over Lainhart Dam, Alternative 10 performs better than the other alternatives. Again, this is due to the availability of water in the C-51 Phase II Reservoir to send via the force main into the C-18 Canal.

One of the major objectives of the project is to restore wet and dry season flows to the Northwest Fork of the Loxahatchee River, especially through Lainhart Dam. **Figure 39** shows the performance for each alternative relative to the 2070 FWO. The objective is to maintain flows at the dam of approximately 68 cfs during the dry season and approximately 110 cfs during the wet season. As shown in **Figure 39**, Alternative 10 achieves this more often than the other alternatives. Alternative 10 appears to perform better because of force main operation and the C-51 Phase II Reservoir. Alternatives 2 and 5 are relatively close, but Alternative 5 tends to perform better during the dry season, mainly because of the ASR facility on the western leg of the C-18 Canal. Alternative 13 underperforms compared to the others because the objective of this alternative is designed focused on wetland restoration and not specifically river needs. **Figure 40** shows the flow duration curve for Lainhart Dam for flows under 150 cfs, highlighting the performance of the alternatives for the lowest flows, which typically occur during the dry season. **Figure 40** further emphasizes the performance of Alternative 10.

Table 2 shows the percent of time the wet season and dry season Lainhart targets are met for each of the model runs. The wet season target is 110 cfs daily for at least 120 days between June 1 and November 30. The wet season percentage is the percent the target was met over the 41-year period of record. The dry season target is a mean monthly flow greater than 68 cfs from December 1 of the preceding year through May 31 of the current year. The dry season percentage is the average percent the target was met over the 41-year period of record. **Table 2** shows Alternative 10 performs better than Alternative 5 by 2 percent in the wet season and 4 percent in the dry season. Alternatives 2 and 5 perform the same in the wet season, but during the dry season, Alternative 5 performs better than Alternative 2 by 4 percent. Key features in each alternative, such as the force main in Alternative 10 and the ASR wells in Alternative 5, allow for these alternatives to perform better than the other alternatives.

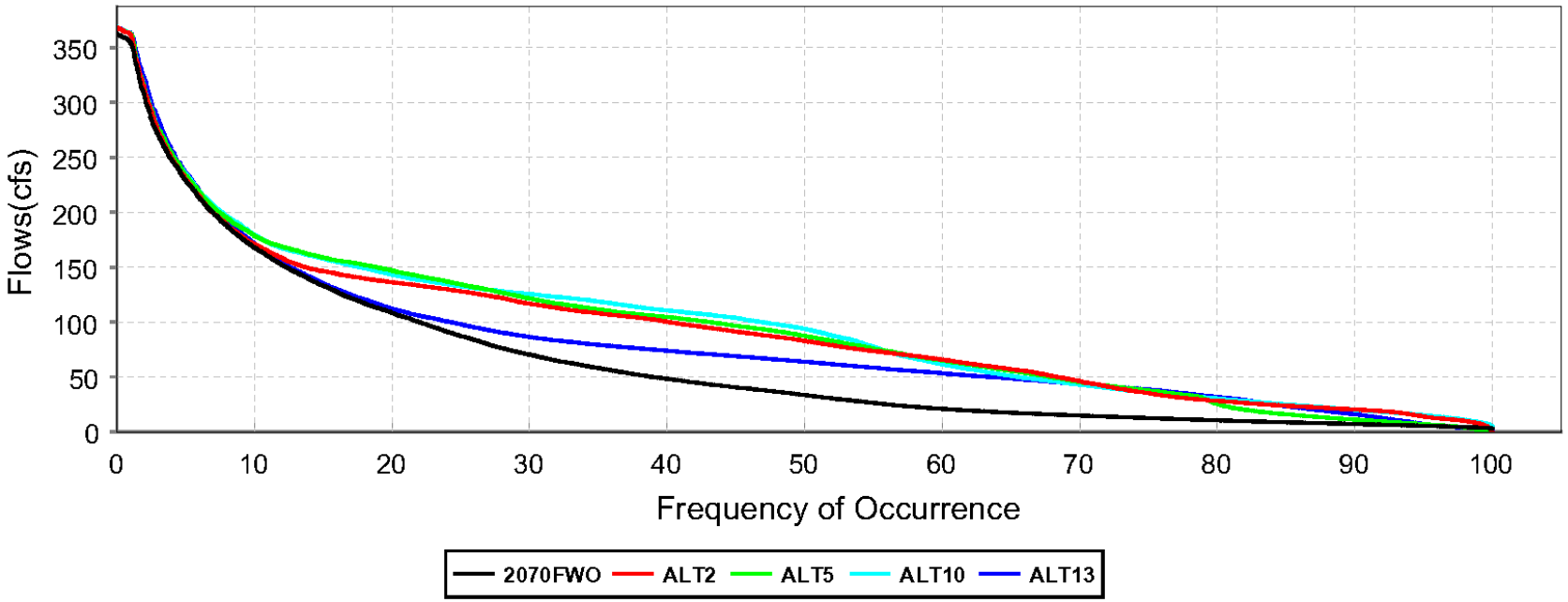


Figure 35. Average daily flow frequency curve for the C-18 weir.

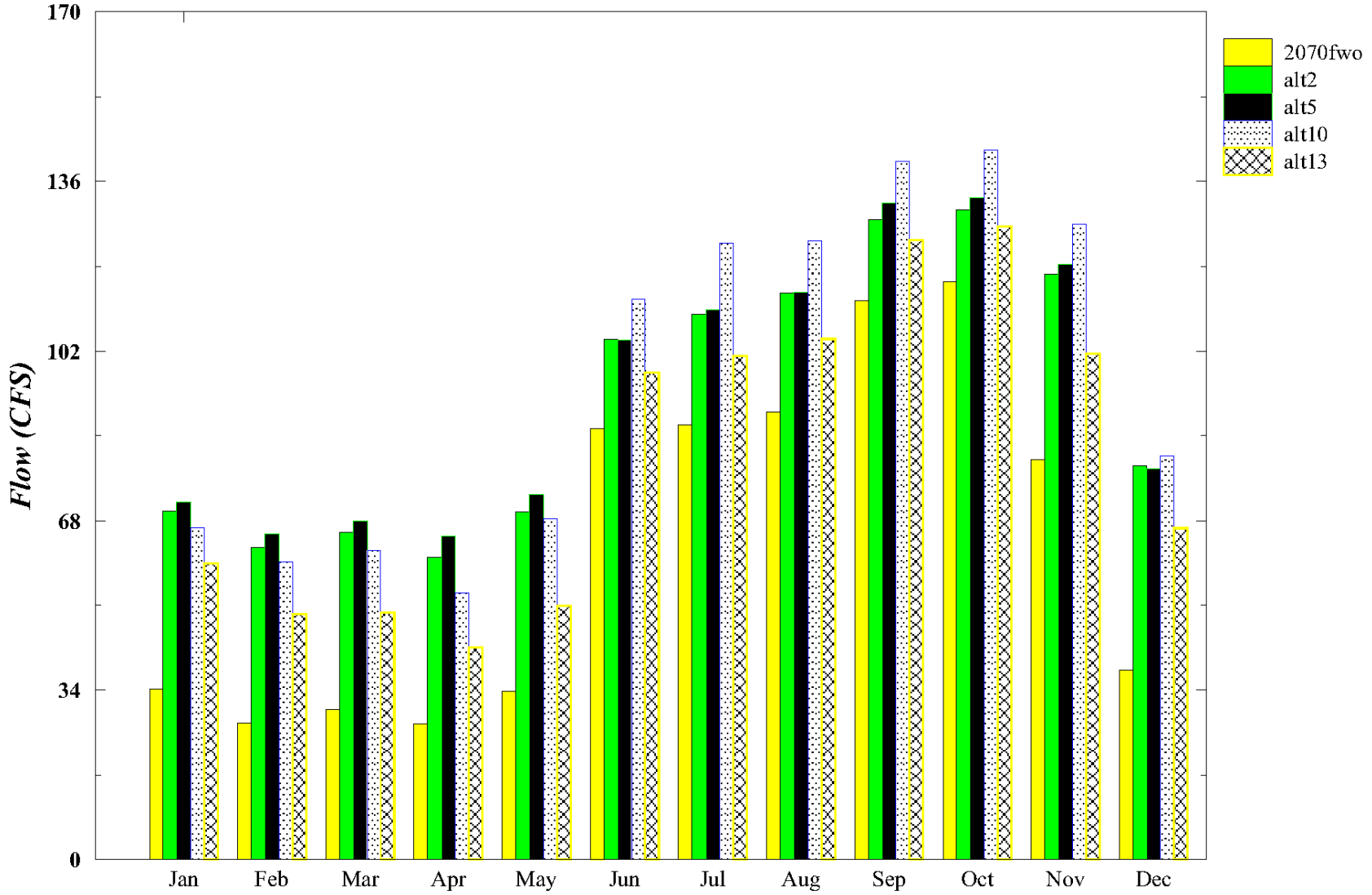


Figure 36. Average monthly flow at the C-18 weir.

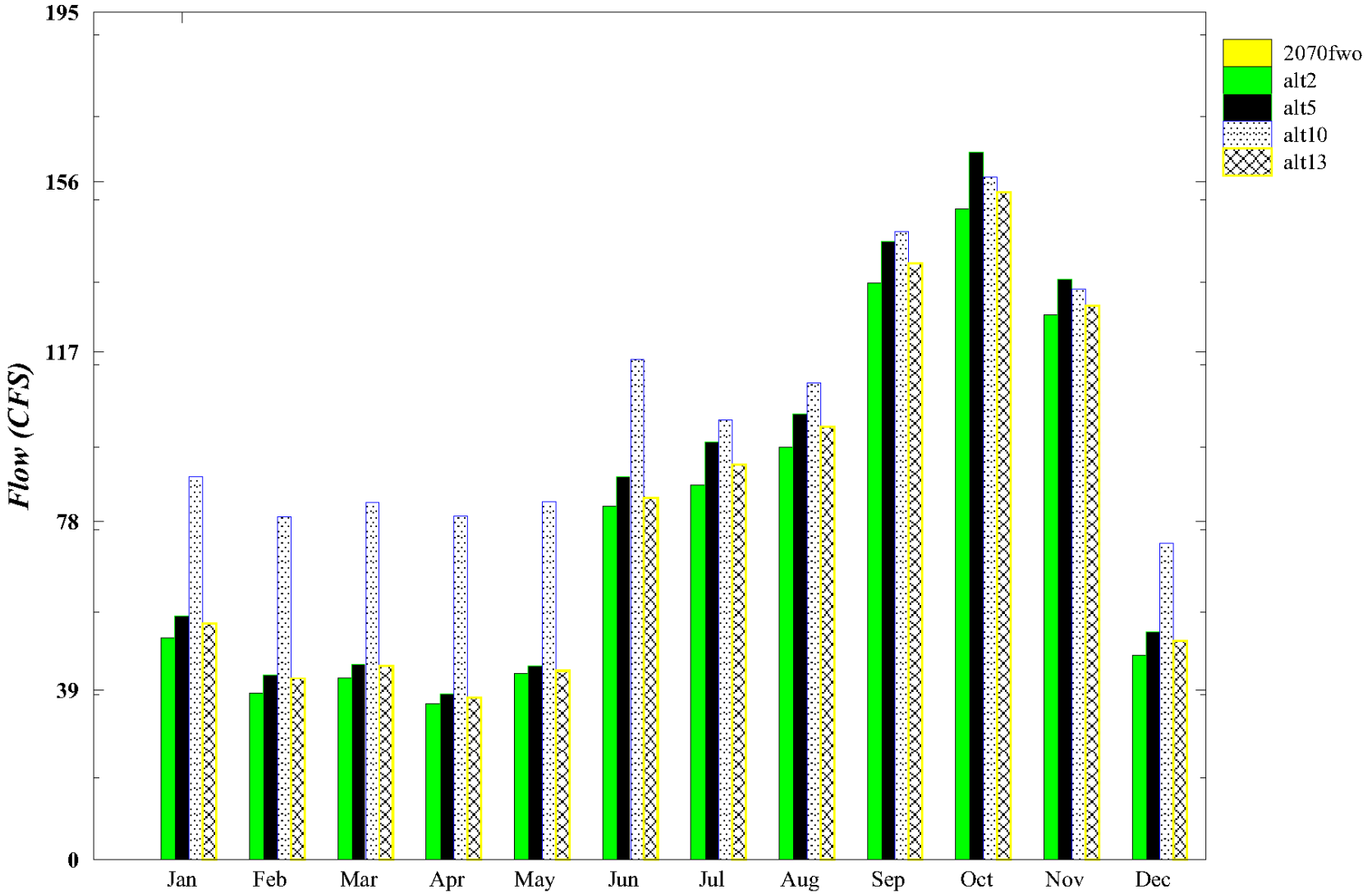


Figure 37. Average monthly structure flow for G-160.

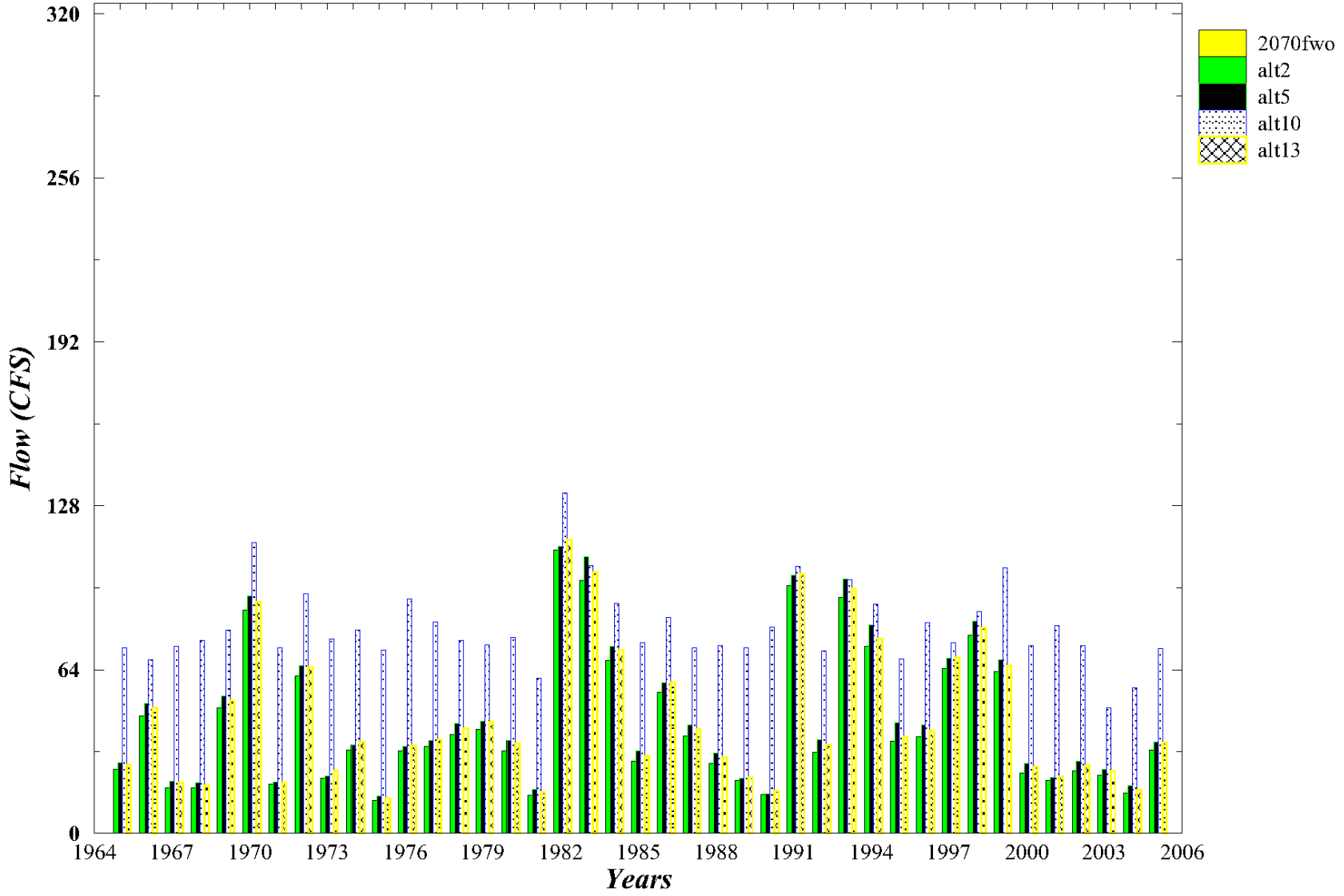


Figure 38. Annual dry season structure flow for G-160.

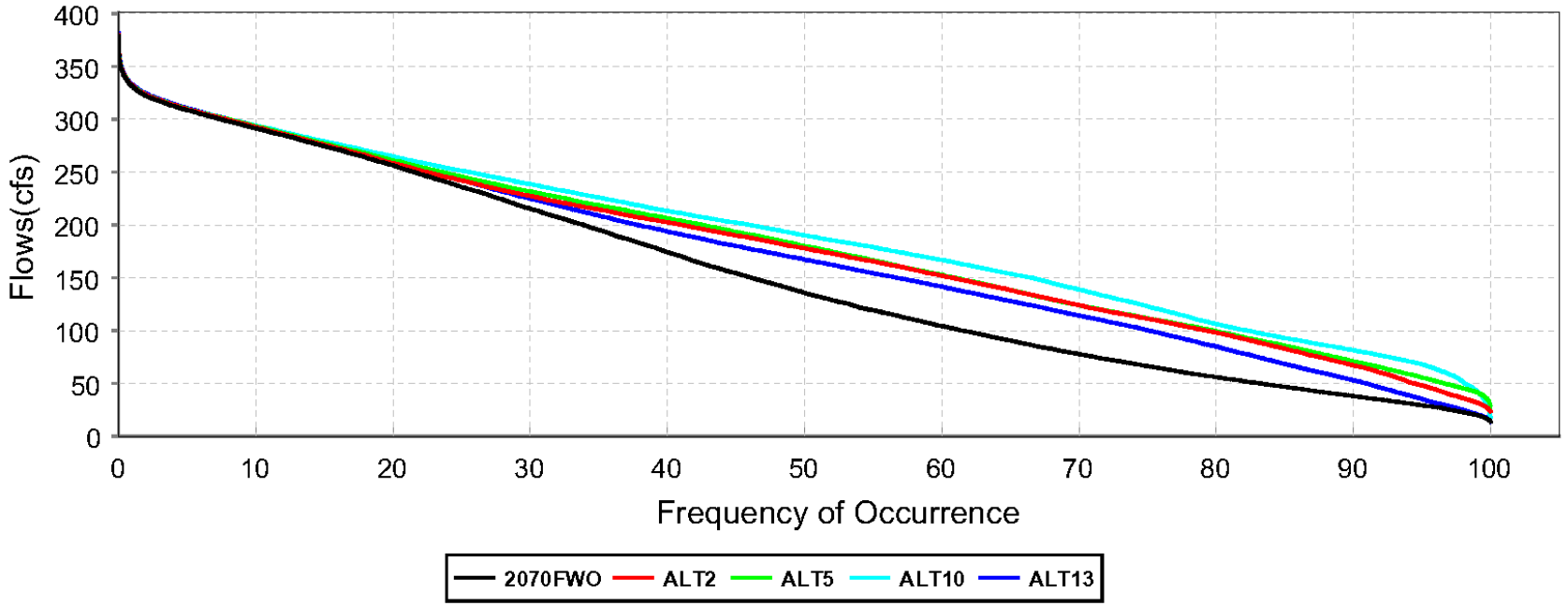


Figure 39. Average daily flow duration curve at Lainhart Dam.

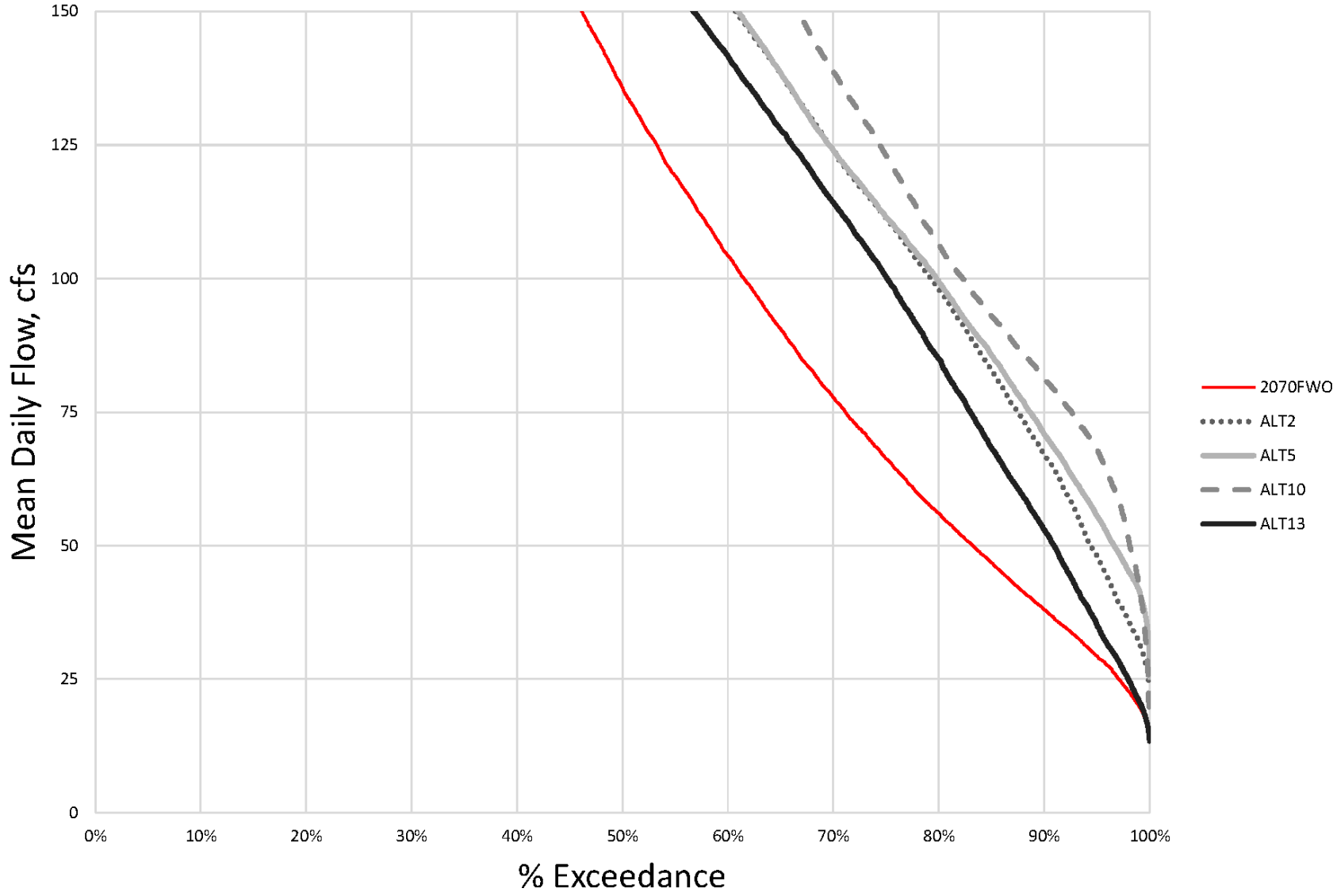


Figure 40. Average daily flow duration curve at Lainhart Dam, specifically for flows less than 150 cfs.

Table 2. Percentage of time Lainhart Dam wet season and dry season targets are met.

Season	ECB	FWO	Alt 2	Alt 5	Alt 10	Alt 13
Wet	76%	78%	98%	98%	100%	98%
Dry	65%	65%	87%	91%	95%	80%

ECB = Existing Condition base case; FWO = Future Without Project base case.

Figure 41 shows the average daily contribution for Lainhart Dam, Cypress Creek, Hobe Grove Ditch, and Kitching Creek to the Northwest Fork of the Loxahatchee River. Comparing the various alternatives, Alternative 10 produces more flow at Lainhart Dam than the other alternatives. At Cypress Creek, Alternative 10 also produces more flow over the weir. The lower flow over the weir in the other alternatives is due to the increased natural extent of wetlands and the improved hydrology and hydroperiods within Flow-way 3. Alternatives 2 and 5 have the same project features, while Alternative 13 has additional features, with the regrading of Shiloh Farms and the Cypress Creek spreader swale. Alternative 10 has limited project features in Flow-way 3; therefore, the flow in Hobe Grove Ditch is lower in Alternative 10 compared to other alternatives. The spreader swale at Jenkins Ditch slightly lowers the flow through Kitching Creek. This project feature is common to all alternatives; thus, all the alternatives have similar flow through Kitching Creek. The improved hydrology and hydroperiods in this area is a desired objective of the project, and with that objective in mind, Alternative 13 appears to perform better than the other alternatives in Flow-way 3.

Water Budgets

Water budget schematics were created for the L-8 Basin, C-18 Basin, Flow-way 3, and Grassy Waters Preserve. Schematics include annual and seasonal average summaries for each basin. Water budget schematics were created using MODFLOW groundwater terminology to identify inflows and outflows for each basin. Change in storage is provided along with the calculated residual, or error term. Basin budgets for each model run are provided in **Appendix B**. Inflow and outflow terms vary by basin and alternative, depending on how various project features were simulated. Inflow values are shown in blue, and outflow values are shown in green. The change in storage is shown in red, and the residual value is highlighted in pink. Structure flows, contained in yellow boxes, are shown on the schematic but are not part of the water budget equation. All terms are given in thousands of acre-feet. Overall, the water budgets indicate the model is performing reasonably well and the residual values are small for each simulated base case and alternative.

CONCLUSIONS

Overall, the model is reasonably simulating the proposed project features. Changes in structure flows and groundwater stages generally are consistent with what would be expected. Review and analysis of the performance measure graphics, tables, and water budgets show the model is performing as expected, indicating there are not any substantial errors in the model application. Due to the iterative nature required to construct the project features, numerous sensitivity runs were conducted to ensure any assumptions made for modeling purposes aligned with the Project Delivery Team's intended use of the features. Once project and model assumptions were finalized, no attempt was made to further improve or optimize the performance of any specific feature. Areas of potential improvement may include additional ASR wells, adjusting the capacity of the force main, refined operation of the ASR facilities, and better regulation of water released from the impoundments for wetland period hydration and associated dry season drawdowns. However, it is unclear if these potential plan enhancements would improve the opportunity for meeting dry season flow targets in the Loxahatchee River.

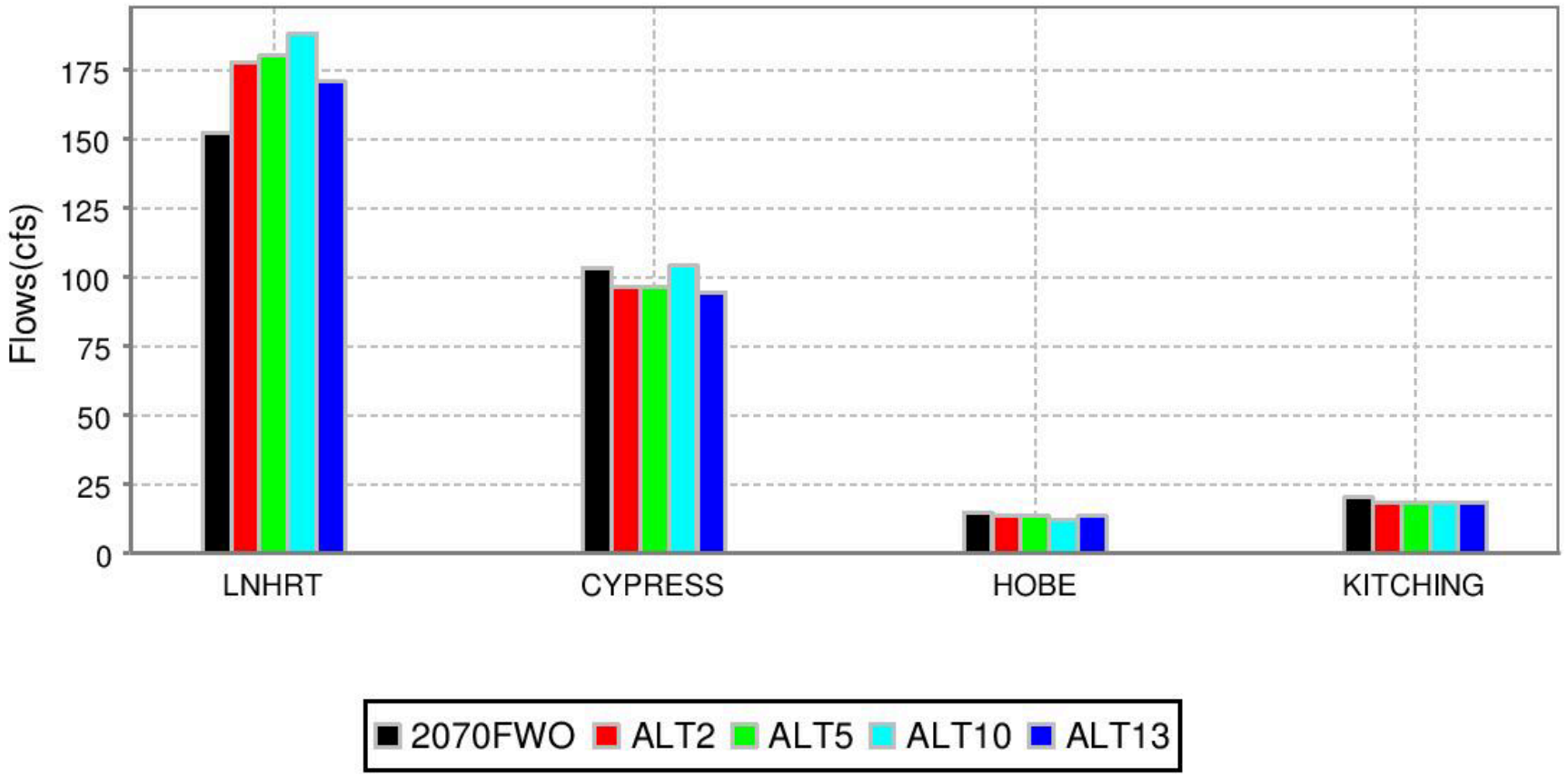


Figure 41. Average daily contribution from Lainhart Dam, Cypress Creek, Hobe Grove Ditch, and Kitching Creek to the Northwest Fork of the Loxahatchee River.

LITERATURE CITED

Obeysekera, A., J. Giddings, and U. Bandara. 2018. Model Calibration Report for the Lower East Coast Subregional Model – North Palm Version. South Florida Water Management District, West Palm Beach, FL.

APPENDIX A – PROJECT AND MODELING ASSUMPTIONS TABLE

ECB

	A	B	C
1	**No.**	**System Operations and Uses**	
2		**General Description/Project Assumptions: ECB**	**Model Assumptions: ECB**
3	1	**Project Location**	
4		The project area lies within northern Palm Beach County and southern Martin County with a focus on the Loxahatchee River watershed. Because of future proposals for the interconnection of the Loxahatchee River watershed with other features of the regional system, the study area extends from the C-51 Canal in Palm Beach County to the south to approximately Bridge Road in Martin County and the C-44 canal in the north. The eastern boundary is the Intracoastal Waterway (ICW) and the western boundary is the L-8 Canal.	The active model boundary covers the entire LRWRP area. It stretches from Lake Okeechobee on the west to the Intracoastal waterway on the east. The southern boundary is the C-51 and the L-10/L-12 canals and the northern boundary is the C-44 canal. The 41-year period of simulation is from the beginning of 1965 through the end of 2005.
5	2	**Regional System**	
6		Lake Okeechobee water is routed to the L-8 Tieback and through the M-Canal to the Grassy Waters Preserve (WPB Water Catchment Area) (GWP) for water supply. Regional water is also withdrawn from the M-Canal for irrigation purposes by existing permitted users. Regional water is brought in from the C-44 canal to irrigate the permitted groves in the northern portion of the study area.	LECSR-NP does not simulate regional water management and relies on the SFWMM run for internal boundary conditions for the L-8, C-51 and C-44 canal stages, as well as flows from the regional system to the M-Canal to supply the City of West Palm Beach. Regional system flows through the M-canal Control 2 pump station supplied by the SFWMM are reduced by 7 percent to account for seepage losses between Control 2 and Control 3 on the M-Canal because the model places this water directly into the M-Canal in the Grassy Water Preserve (GWP).
7	2a	**Flowway Concepts and Operational Priorities between FW1 and FW 2 for Restoration Source Water**	
8		Flowway concepts do not exist in the base case beyond existing canal configurations and structures	Not Applicable in ECB
9		**Description of FW1** - Flowway 1 delivers water via the L-8 canal to GWP and the City of WPB for PWS. G-161 does not exist in the ECB and therefore FW1 does not deliver water to the river in the base condition.	Not Applicable in ECB
10		**Description of FW2** - FW2 Delivers water via the C-18 W canal and G-92 to the Loxahatchee River	Not Applicable in ECB
11	3	**L-8 Basin and/or C-51 Storage**	
12		The areas that contribute flows to the L-8 Basin include Corbett, Dupuis, ITID (upper basin- see below for restrictions), GL Homes/Cypress Groves, agricultural areas	Runoff available in the L-8 Basin is calculated for the West Corbett, Dupuis, Cypress Groves and adjacent agricultural areas including the northwestern portion of the EAA from the Et-Recharge program. Additional inflow to the basin occurs, utilizing the RDF package, for the drainage canals located parallel to the L-8 canal on the western and southern side of Dupuis and Corbett areas. Additional water is available as seepage into the L-8 canal itself which is simulated as a river and obtains it's daily stage from the SFWMM run. Some of the runoff is lost from the basin to provide irrigation to the eastern portion of the EAA and the agricultural areas in the ITID area.

ECB

	A	B	C
13		**L-8 FEB** - L-8 FEB exists as a mined area, however its operation is not included in the base conditions or the alternatives. L-8 FEB water source is S-5A basin and C-51W via S-5A complex which is outside model boundary.	L-8 FEB is fully mined and is not operational and simulated as a lake in the existing condition.
14		**C-51 Reservoir Phase 1:** C-51 Phase I is a mined area, however, its operation is not included in the base conditions or the alternatives. C-51 Phase 1 water source is western C-51 basin via the L-8 FEB.	The C-51 Phase 1 reservoir is simulated as a non-operational, fully mined site.
15		**The C-51 Reservoir Phase II** storage is not operable and does not provide water deliveries to the LRWRP project or elsewhere. This exists as a partially mined site of approximately 158 acres.	The C-51 Reservoir Phase II storage is simulated as a non-operational, partially mined site.
16		**L-8 Basin Shallow Storage** facility is not constructed and the existing agricultural land use is assumed	Not Applicable to ECB
17		**ASR @ L-8 Shallow Impoundment** is neither constructed or operational	Not Applicable to ECB
18	4	**M-Canal Conveyance Improvements**	
19		**Control 2 Pump Station (WPB #2)** pump station has 4 pumps with 75 cfs capacity each, for a total capacity of 300 cfs. However M-Canal conveyance limitations are 225cfs. There is no real estate to improve M-Canal conveyance.	The new 300 cfs pump station is completed but is restricted to a maximum rate of 225 cfs because of canal limitations. Flows through Control 2 are derived from the SFWMM run and simulated in the model using the diversion package.
20		**M-1 (Lower ITID) to M-Canal Pump station** is not constructed	Not applicable to ECB
21	5	**Grassy Waters Preserve (WPB Catchment Area) Deliveries**	
22		CWPB desired operation: GWP stage is between 18.4 and 19.2 (permit is 17.6 - 19.2) NGVD. M-Canal maintained 0.2-0.3 feet below GWP to facilitate flow into the canal. Based on WPB Consumptive Use Permit pumping at control 2 ceases when Clear Lake is >12.5 ft. NGVD	The M-Canal is maintained at a maximum stage of 18.9 ft. NGVD. Regional system inflows are not provided to the M-Canal when stages are above 18.9 ft NGVD, in GWP, using the diversion package. Water supply for the City of West Palm Beach out of the M-Canal are simulated using the well package with withdrawal points along the M-Canal within Grassy Waters Preserve.
23		**Replacement Water** . Replacement water is associated with water removed from GWP at G-161 to compensate for seepage losses from pumping at Control 2, and is not included in the ECB	Not Applicable in ECB.
24	6	**Loxahatchee Slough Area**	
25		**Northlake Bridge:** Improvements to pass 100 cfs at Northlake bridge, draining north at 19.2 ft. NGVD	If stages in northern GWP are greater than 19.2 ft. NGVD, water is diverted north across Northlake Blvd using the diversion package
26		**Beeline Hwy Bridge:** New bridge is constructed on Beeline and there are no flow restrictions	The Beeline Highway bridge is indirectly modeled by allowing runoff west of the bridge to pass into the southern portion of the slough without restrictions.
27		**G-161** is constructed but is not operational	Not applicable to ECB
28		**G-160** is constructed but is not operational	Not applicable to ECB
29		**Shallow seepage Barriers** in Lox Slough at C-18 Canal and around Luckey Tract are not present	Not applicable to ECB
30	7	**C-18W Storage**	
31		**The C-18W Storage** is neither constructed nor operable and does not provide water deliveries to the LRWRP project	Not applicable to ECB

ECB

	A	B	C
32		**Aquifer Storage and Recovery (ASR) @ C-18W** Impoundment is not implemented	Not applicable to ECB
33		**East Corbett Weir** A 140' weir at elevation 21.5' NGVD is located at the eastern side of Corbett west of the C-18W Impoundment.	The weir is simulated at an elevation of 21.5' NGVD. The Corbett weir is a sheet pile weir located in a heavily vegetated area which restricts flow. For simplification purposes, maximum flow over the weir is restricted to 50 cfs. It is simulated with the RDF package and discharges into the C-18 canal upstream of the C-18 weir. Water flows over the weir, across a road and into a ditch which connects to the extreme western end of the C-18W canal.
34		**MO Connector Canal and pump station.** This feature is neither constructed nor operable	Not applicable to ECB
35		**Beeline Culverts north and south of North County Airport** These culverts under Beeline are neither constructed nor operable	Not applicable to ECB
36		**Seepage barriers** around Avenir natural area and Gun Range are not constructed	Not applicable to ECB
37		**Vavrus/Avenir**: The former Vavrus ranch exists as an area with significant ditching and drainage to the C-18 W Canal, with a control elevation of 18.3' NGVD	The Vavrus/Avenir property is assumed to be undeveloped, except for existing fields, for the ECB. Existing on-site ditches discharge into the C-18 canal upstream of the C-18 weir at an elevation of 18.4 feet using the RDF package.
38		**NPBC Airport.** NPBC Airport is gravity drained with a control of 18' NGVD. Sweetbay natural Area is controlled at 20.25' NGVD, and drains through CSX ditch south.	Runoff from the airport drains east towards the southern leg of the C-18 Canal.
39	8	**C-18 Weir, G-92 and Lainhart Dam**	
40		**C-18 Weir** This is an existing weir located just east of Beeline Hwy on the C-18 Canal, which has a crest elevation of 17.6' NGVD.	Flows over the C-18 weir are governed by the weir equation at steps of approximately 0.2 feet intervals using the rdf package. Flows into the west leg of the C-18 canal occur as runoff or base flow from eastern Corbett, Hungryland, Pratt and Whitney, Mecca and Avenir using a combination of the RDF and diversion packages.

ECB

	A	B	C
41		**C-18 Canal operation**s are as follows: The minimum flow delivered to the NW Fork is 35 cfs. If flows at the Lainhart Dam fall below 35 cfs, up to 50 cfs is sent through G-92 to maintain 35 cfs flow (if water is available) Use as-built design with maximum capacity of 400 cfs at G-92. G-92 discharges to the NW Fork of the Loxahatchee River when C-18 is above 13.0 feet NGVD. When C-18 exceeds 14.5 feet NGVD, up to 400 cfs is sent north over G-92. If C-18 is between 13.0 and 14.5 feet NGVD and Lainhart Dam flows exceed 50 cfs from Jupiter Farms runoff, then G-92 flow is zero. If C-18 exceeds 15.0 ft. NGVD, S-46 opens and discharges up to 4,000 cfs to the SW Fork of the Loxahatchee River. When C-14 is above 13.5 ft., excess flow (up to 400 cfs) from SIRWCD is directed back into C-18, through G-92 and discharged out S-46.	The C-18 canal operations are simulated as follows: S-46 discharges in excess of 2000 cfs, depending upon slough water levels and runoff volumes when C-18 water levels exceed 14.9 feet NGVD. Flows through G-92 to the Loxahatchee river are simulated using a combination of both the diversion and the rdf packages and can be head or flow dependent . In general up to approximately 140 cfs can pass through the G-92 structure towards the Lainhart Dam when the C-18 canal stage is below 14.5 feet plus an additional 90 cfs when the C-18 stages are above 14.5 feet and the S-46 structure is not opened.
42	9	**SIRWCD and Jupiter Farms**	
43		**Jupiter Farms** Jupiter Farms is a development in the SIRWCD that drains into the C-14 Canal just north of G-92. SIRWCD control structures at Jupiter Farm are constructed; discharges into and out of Jupiter Farms canals are controlled. This raises the levels of the canals and holds water back from discharging to the C-14 canal	Jupiter farms is simulated as distinct basins. The north-western most portion is simulated using the rdf package at 15.5 feet. The western basin and central basins are simulated using the rdf package with controls of 15, 14.5 feet respectively. The eastern portion of Canal 2 and Section 18 are simulated using the rdf package at 13 feet. The basin, which is their C-14 canal and feeder canals receives the runoff and base flows from the other three basins and discharges over Lainhart dam using the drain package at an elevation of approximately 10.7 feet NGVD. The basin is located east of the C-18 Canal and discharges downstream of the S-46 structure using the drain package with control elevation of 14 feet. Runoff from the basin, using the ET-recharge program is directly put into the basin at the rdf cells using the diversion package.
44	10	**Loxahatchee Tributaries (Kitching, Wilson and the North Fork)**	
45		**Kitching Creek, Wilson Creek and the North Fork** are unregulated. Kitching Creek is an existing upland/wetland mosaic community	Flows into Kitching creek occur as runoff from the northern urban and agricultural operations using the diversion package. Kitching creek proper is simulated with the drain package in the non-tidal reaches and with the river package for the tidal areas. Wilson creek and the North Fork are also simulated using a combination of the river, drain and general head boundaries.
46	10a	**Southern Martin County Properties**	

ECB

	A	B	C
47		**Hobe St. Lucie Conservancy District (HSLCD)** has three discharge structures. One discharges to the South Fork of the St. Lucie River, the second discharges to the Cypress Creek Canal and the third discharges to the Hobe Grove Ditch. Cypress Creek Canal and Hobe Grove Ditch both discharge to the Loxahatchee River.	HSLCD is simulated using the drain package The: Unit 1 South Fork Structure is outside the area of concern, Unit 2 Cypress Creek structure is simulated at 2 ft. NGVD and Unit 3 Hobe Grove Ditch Structure at 11.0 ft. NGVD. Individual canal and farm operations within this area are discussed in the individual project descriptions.
48		**Cypress Creek Canal**: This canal provides drainage for Palmar/Culpepper (including Nine Gems), Ranch Colony communities, the Gulfstream West property, and HSLCD. The existing Cypress Creek structure has a control elevation of 2.0' NGVD	Cypress Creek canal upstream of the dilapidated control structure is maintained at an elevation of 2 feet NGVD from the structure located just west of the Turnpike westward to the Culpepper property using the drain package for the canal itself. Runoff from the urban basins, the western Grove, Palmar, Unit 2, Nine Gems, Thomas Farms and the Cypress Creek natural area are simulated using the diversion package with flows determined from the Et-Recharge program. Groundwater base flows from these areas are also simulated using the drain package discussed below.
49		**Nine Gems (Palmar East) Properties** (lateral and southern canals) exist. Existing drainage is assumed for the southern Nine Gems Canal and lateral drainage canals, as well as for the HSLCD drainage canal.	The entire Palmar property including the primary southern canal and the laterals are all controlled at 16.0 feet NGVD and simulated as a drain. Runoff from the basin is calculated using the ET-Recharge program and introduced back into the model using the diversion package.
50		**Palmar West of Pratt Whitney Road**. Drainage ditches exist, but are not connected. Flow to the east is via culverts under Pratt Whitney Road.	Runoff from the Palmar area, calculated from the Et-Recharge program are simulated using the diversion package and is assumed to discharge into the Cypress Creek Canal in the general area of the twin 84 inch culverts and other culverts in the area. The Pine Glades area east of Pratt Whitney Road also discharges to the Cypress Creek Canal using the diversion package and also has a seepage barrier simulated along the southeastern portion.
51		**Thomas Farms (TF)** TF drains via gravity through an existing culvert under Pratt-Whitney Road, and through the southern Nine Gems canal. The property just north of TF drains (by gravity) into HSLCD canal on north side of Nine Gems	Thomas Farms drains in two directions the northern area is simulated with drains at a control elevation of 12.0 feet NGVD and is considered part of HSLCD Unit 2. The southern area is controlled at 16 feet NGVD and is also simulated as drains and discharges southeastward into the Nine Gems property. Runoff from the property is introduced back into the model using the diversion package.
52		**Hobe St. Lucie Conservancy District Unit 2:** This is an existing agricultural area planted in sugar cane. The property drains through 3-84" culverts, with an invert of 7.7' NGVD and a control elevation of 12.0' NGVD. These culverts drain into the HSL Bypass canal that currently runs through the Gulfstream west property. Permit allocated drainage is 4"/day	Unit 2 is simulated with a control elevation of 12.0 feet NGVD using the drain package. Runoff from the property drains directly into the Cypress Creek canal using the diversion package.

ECB

	A	B	C
53		**Nine Gems (Palmar East) Properties** (northern boundary canal and berm) North end of Nine Gems Wetlands drain north to HSL canal (invert at wetland bottom)	The entire Palmar property including the primary northern and southern canals as well as the laterals are generally controlled at 16.0 feet NGVD and simulated as a drain. Runoff from the basin is calculated using the ET-Recharge program and introduced back into the model using the diversion package.
54		**Gulfstream West Property:** This is a fallow Citrus Grove of ~700 acres. It is located adjacent to and west of the Turnpike and I-95). It drains to Cypress Creek.	Gulfstream West is controlled at an elevation of 8 feet NGVD using the drain package. Runoff drains directly into the Cypress Creek canal via the diversion package.
55		**Moonshine Creek and Eastern Gulfstream Property.** Hobe Grove Ditch is regulated based upon existing control. Gulfstream East property (~450 acres) is a fallow citrus grove located east of I-95 and FL Turnpike. MS Creek is disconnected from historic flow by Hobe Grove Ditch and is unconnected to the ditch	Hobe Grove Ditch structure is controlled at 2 feet NGVD from the Eastern Gulfstream property to were it intersects the Loxahatchee River proper. The Eastern Gulfstream property is simulated using the drain package with elevation ranging from 11.5 to 12 NGVD for the perimeter canal to 6.0 feet NGVD in the agricultural areas. Runoff, using the ET-Recharge program is discharged to the southern end of the Unit 3 canal which then discharges directly into the Hobe-Grove ditch.
56		**Culpepper Property:** Existing elevation of the southern 2/3 of the west Ranch Colony berm (along east Culpepper Property line) is 24.5 ft. NGVD. Existing fixed crested weir twin 84" culverts are set at 17.6 ft. NGVD and the southern Culpepper Culverts (WCS-2, (48" CMP), WCS-3 (60" CMP) and Jupiter Grade Structure (48" CMP) are set at 19.1, 17.6 and 18.5 feet NGVD, respectively). These are wet season control.	The Culpepper culverts are simulated as follows. Because of the size of the model grid the twin 84's and WCS-2 are simulated at 17.6 feet NGVD. WCS-3 is simulated separately but also at 17.6 feet NGVD. The Jupiter grade culvert is also simulated in the model at 18.5 feet NGVD.
57		**Cypress Creek and Shiloh Farms Property (spreader swale, pump station and pepper farm regrade)** 2-66" RCP culverts with risers exist at Gulfstream Road and drainage is per existing permit. The spreader swale, pump station and pepper farm regrade are not implemented.	Small culverts underneath Gulfstream road are not directly simulated in the model. The model assumes overland flow across the road. Improvements to this area are not included in the existing conditions.
58		Spreader Swale on Cypress Creek Property is not present	Not applicable to ECB
59		**Ranch Colony and other Development Communities**. The following control levels are used for the RC communities: Ranch Colony & Colony Park- 14.5' NGVD, RCII - 15.5' NGVD, the Links 17.0' NGVD, Old Trail - 16.0' NGVD	The control elevations for these small parcels are simulated in the model using the drain package at the elevations specified.
60	11	**Indian Trail Improvement District (ITID) M-1 Basins**	

ECB

	A	B	C
61		ITID is allowed 274 cfs peak discharge for flood protection to the L-8 Canal (equivalent to 1/4 in/day). However, most discharges (up to 750 cfs) occur via the M-1 Canal to C-51 unless C-51 stages restrict such flows as specified in ITID permit and MOU. S-155A restrictions are when stages are within 1/2' of 13.5' west and 11.7' east design storm stage of C-51 . ITID's total discharge capacity is 1,800 cfs which is comprised of the 1,100 cfs to the impoundment (and subsequently to the L-8) and up to 750 cfs south via gravity when capacity and conditions allow. For modeling purposes, M-1 Upper and Lower Basins to discharge up to 750 cfs to the C-51, with no flow to L-8.	Maximum discharge from ITID is limited to 750 cfs for the upper and lower basins using the rdf package. Flow in the south portion of ITID, south of the lower basin, is simulated using the drain package.
62		ITID 's peak allowable discharge historically was to L-8 with subsequent discharges to the S-5A complex and Lake Okeechobee at C-10A as conditions allow. However the majority of ITID discharges are now sent by gravity to the C-51.	ITID flows head south to the C-51 canal.
63		The impoundment is not operated consistent with Line 62 above.	ITID impoundments are not simulated as a storage facility in the model.
64		M1 Upper Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr, Nov-Dec) and 16.0 NGVD in the wet season (May-October) M-1 Lower Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr., Nov-Dec) and 15.0 in the wet season (May-Oct)	Control elevations in the upper and lower basins of ITID are controlled using the rdf package at the elevations specified for each basin.
65	12	**Other Related Project Structures - these are outside LECsR-NP model boundary)**	
66		S-155A is constructed and operational. Portion of L-8 discharges to S-155A and out S-155 to Lake Worth Lagoon. All C-51 eastern Basin water discharges at S-155	Stages at S-155 and S-155A are boundary conditions along the southern edge of the model. Stages for these canals are obtained from the SFWMM run.
67		STA-1E and STA-1West are constructed and operational	STA-1E and STA-1W are outside the active model domain and are not simulated.
68	13	**Pumping and Water Restriction Areas**	

ECB

	A	B	C
69		Public Water Supply (PWS) wellfield withdrawals are based on permitted allocations at the end of each utility's consumptive use permit.	Public Water Supply (PWS) wellfield withdrawals from the surficial aquifer system (SAS) are simulated using the permitted allocations. In the case of West Palm Beach, the city's surface water withdrawals are represented in the model as SAS withdrawals from the M-Canal within the Grassy Waters area.
70		PWS in the study area includes Martin County Utilities (Tropical Farms), SMRU, Stuart, Palm Beach County (System 8), Jupiter, Seacoast, Tequesta, West Palm Beach and Riviera Beach.	Coastal well triggers are used to simulate water shortages when the potential for salt water intrusion exists into localized areas. Due to recent modifications made by the utilities several now partially rely upon the Floridan aquifer to meet their demands. This results a significant reduction in the threat of localized salt water intrusion in a number of coastal areas of the model domain and was implemented through the SFWMD permitting process. However, the Palm Beach County area still undergoes water shortage restrictions when the SFWMD regional system is threatened due to low Lake Okeechobee stages. Lake Okeechobee lake triggers are obtained from the SFWMM model and occurred in Nov. 72; Nov.76; Nov.77; Nov. & Dec. 81; Jan. & Feb. 82; Dec. 89; Feb. 90; Dec. 90; Jan. 91; Dec. 00; Jan. and Feb. 01. When a water shortage is triggered it generally stays into effect through the dry season, beginning in the month it is triggered. Lake Okeechobee water restrictions are not implemented in Martin County.
71			
72		NOTE:	
73		Note: The LECSR is a robust and complex regional to sub-regional scale model. Due to the scale of the model, it is frequently necessary to implement approximations for system infrastructure and operations that will, in general, simulate the intent and result of the desired project features while not matching the exact system behavior.	
74			

2070B

	A	B	C
1	**No.**	**System Operations and Uses**	
2		**General Description - Project Assumptions: FWO**	**Model Assumptions: FWO**
3	1	**Project Location**	
4		The project area lies within northern Palm Beach County and southern Martin County with a focus on the Loxahatchee River watershed. Because of future proposals for the interconnection of the Loxahatchee River watershed with other features of the regional system, the study area extends from the C-51 Canal in Palm Beach County to the south to approximately Bridge Road in Martin County and the C-44 canal in the north. The eastern boundary is the Intracoastal Waterway (ICW) and the western boundary is the L-8 Canal	Same as ECB.
5	2	**Regional System**	
6		Lake Okeechobee water is routed to the L-8 Tieback and through the M-Canal to the Grassy Waters Preserve (WPB Water Catchment Area) (GWP) for water supply. Regional water is also withdrawn from the M-Canal for irrigation purposes by existing permitted users. Regional water is brought in from the C-44 canal to irrigate the permitted groves in the northern portion of the study area.	Same as ECB.
7	2a	**Flowway Concepts and Operational Priorities between FW1 and FW 2 for Restoration Source Water**	
8		Flowway concepts do not exist in the base case beyond existing canal configurations and structures	Same as ECB.
9		**Description of FW1** - Flowway 1 delivers water via the L-8 canal to GWP and the City of WPB for PWS. G-161 does not exist in the ECB and therefore FW1 does not deliver water to the river.	Same as ECB.
10		**Description of FW2** - FW2 Delivers water via the C-18 W canal and G-92 to the Loxahatchee River	Same as ECB.
11	3	**L-8 Basin and/or C-51 Storage**	
12		The areas that contribute flows to the L-8 Basin include Corbett, Dupuis, ITID (upper basin- see Item 11 below for restrictions), GL Homes/Cypress Groves, agricultural areas	Same as ECB.
13		**L-8 FEB:** Stages for L-8 FEB are input for the FWO and Alternatives based on output from the Restoration Strategies DMSTA 2012 Project modeling. The project assumes that L-8 FEB water source is S-5A basin and C-51W via S-5A complex which is outside the LECsR model boundary.	Simulation of stages within the L-8 FEB are obtained from the Restoration Strategies DMSTA 2012 Project modeling. Water levels within the facility can vary from approximately 13 feet NGVD to -40 feet NGVD.
14		**C-51 Phase 1:** C-51 Phase I is a mined area, however, its operation is not included in the base conditions or the alternatives. C-51 Ph. 1 water source is western C-51 basin via the L-8 FEB (project assumption, but do not model)	Same as ECB.
15		**The C-51 Reservoir Phase II** storage is not operable and does not provide water deliveries to the LRWRP project or elsewhere. The site is fully mined over a 1,600 acre footprint to -18.6 ft. NGVD.	Same as ECB.
16		**L-8 Basin Shallow Storage** facility is not constructed and the existing agricultural land use is assumed.	Same as ECB.
17		**ASR @ L-8 Shallow Impoundment** is not constructed	Same as ECB.
18	4	**M-Canal Conveyance Improvements**	
19		**Control 2 Pump Station (WPB #2)** pump station has 4 pumps with 75 cfs capacity each, for a total capacity of 300 cfs. However M-Canal conveyance limitations are 225cfs. There is no real estate to improve M-Canal conveyance.	Same as ECB.
20		**M-1 (Lower ITID) to M-Canal Pump station** is not constructed	Same as ECB.
21	5	**Grassy Waters Preserve (WPB Catchment Area) Deliveries**	

2070B

	A	B	C
22		**GWP operation**: GWP stage is between 18.4 and 19.2 (permit is 17.6 - 19.2) NGVD. M-Canal maintained 0.2-0.3 feet below GWP to facilitate flow into the canal. Based on WPB Consumptive Use Permit pumping at control 2 ceases when Clear Lake is >12.5 ft. NGVD	Same as ECB.
23		**Replacement Water** . Replacement water is associated with water removed from GWP at G-161 to compensate for seepage losses from pumping at Control 2, and is not included in the FWO	Same as ECB.
24	6	**Loxahatchee Slough Area**	
25		**Northlake Bridge**: Improvements to pass 100 cfs at Northlake bridge, draining north at 19.2 ft NGVD	Same as ECB.
26		**Beeline Hwy Bridge**: New bridge is constructed on Beeline and there are no flow restrictions	Same as ECB.
27		**G-161** G-161 is constructed but is not operational	Same as ECB.
28		**G-160** G-160 is constructed but is not operational	Same as ECB.
29		**Shallow seepage Barriers** in Lox Slough at C-18 Canal and around Luckey Tract are not present	Same as ECB.
30	7	**C-18W Storage**	
31		**C-18W Storage** This feature is neither constructed nor operable and does not provide water deliveries to the LRWRP project	Same as ECB.
32		**Aquifer Storage and Recovery (ASR) @ C-18W Impoundment** is not implemented	Same as ECB.
33		**East Corbett Weir** A 140' weir at elevation 21.5' NGVD is located at the eastern side of Corbett west of the C-18W Impoundment.	Same as ECB.
34		**MO Connector Canal and pump station** is neither constructed nor operable	Same as ECB.
35		**Beeline Culverts north and south of North County Airport** New culverts under Beeline are neither constructed nor operable	Same as ECB.
36		**Seepage barriers** around natural area and Gun Range are not constructed	Same as ECB.
37		**Vavrus/Avenir**: The conceptual design for the Avenir development is incorporated. The development has a pumped drainage system, with basin controls ranging from 18-18.5' NGVD; onsite lakes controlled at 18-21', neighboring natural preservation is 18.5' -20.5' NGVD. Agricultural drainage ditches within the natural area are assumed to be filled to facilitate rainfall driven restoration. Discussion on FAA constraints may change FWO Avenir assumptions.	For the FWO condition, Avenir/Vavrus is assumed to be developed based upon existing plans. It is simulated as five distinct basins. The northern basin is a wetland restoration area with a control elevation of 20.5 feet NGVD and the existing agricultural ditches are filled. This northern wetland basin discharges to the C-18 canal upstream of the weir. The northeast corner of the property is a separate wetland restoration basin and is smaller than the northern wetland basin with a control elevation of 18.5 feet NGVD. It discharges east underneath the Beeline Highway into the Lox Slough and the southern C-18 canal leg. The southwest basin, Basin 3, is a wetland urban mix with a general control elevation of 20.0 feet. This basin discharges into Basin 1. Basin 1 is located in the south east corner of the property and is urban with a control elevation of 18.0 feet NGVD. This basin discharges into the smaller northeastern wetland Basin. Basin 2 is an urban basin located in the middle of the property immediately south of the main wetland restoration basin. It has a control elevation of 18.5 feet NGVD and discharges northward into the main wetland restoration area. See attached map for Avenir modeling assumptions.

	A	B	C
38		NPBC Airport . NPBC Airport is gravity drained with a control of 18' NGVD. Sweetbay natural Area is controlled at 20.25' NGVD, and drains through CSX ditch south. Assumption pending discussion on FAA constraints of not attracting hazardous wildlife related to traffic safety. Does expansion of runway need to be considered?	Same as ECB.
39	8	**C-18 Weir, G-92 and Lainhart Dam**	
40		**C-18 Weir:** This is the existing weir located just east of Beeline Hwy on the C-18 Canal, which has a crest elevation of 17.6' NGVD	Same as ECB.
41		**C-18 Canal operation**s are as follows: The minimum flow delivered to the NW Fork is 35cfs. If flows at the Lainhart Dam fall below 35 cfs, up to 50 cfs is sent through G-92 to maintain 35cfs flow (if water is available) Use as-built design with maximum capacity of 400 cfs at G-92. G-92 discharges to the NW Fork of the Loxahatchee River when C-18 is above 13.0 feet NGVD. When C-18 exceeds 14.5 feet NGVD, up to 400 cfs is sent north over G-92. If C-18 is between 13.0 and 14.5 feet NGVD and Lainhart Dam flows exceed 50 cfs from Jupiter Farms runoff, then G-92 flow is zero. If C-18 exceeds 15.0 ft. NGVD, S-46 opens and discharges up to 4,000 cfs to the SW Fork of the Loxahatchee River. When C-14 is above 13.5 ft., excess flow (up to 400 cfs) from SIRWCD is directed back into C-18, through G-92 and discharged out S-46.	Same as ECB.
42	9	**SIRWCD and Jupiter Farms**	
43		**Jupiter Farms** is a development in the SIRWCD that drains into the C-14 Canal just north of G-92. SIRWCD control structures at Jupiter Farm are constructed; discharges into and out of Jupiter Farms canals are controlled. This raises the levels of the canals and holds water back from discharging to the C-14 canal.	Same as ECB.
44	10	**Loxahatchee Tributaries (Kitching, Wilson and the North Fork)**	
45		**Wilson Creek and the North Fork** are unregulated **Kitching Creek** is an existing upland/wetland mosaic community	Same as ECB.
46	10a	**Southern Martin County Properties**	
47		**Hobe St. Lucie Conservancy District (HSLCD)** has three discharge structures. One discharges to the South Fork of the St. Lucie River, the second discharges to the Cypress Creek Canal and the third discharges to the Hobe Grove Ditch. Cypress Creek Canal and Hobe Grove Ditch both discharge to the Loxahatchee River.	Same as ECB.
48		**Cypress Creek Canal.** This canal provides drainage for Palmar/Culpepper (including Nine gems), Ranch Colony communities, the Gulfstream West property, and HSLCD. The existing Cypress Creek structure has a control elevation of 2.0' NGVD	Same as ECB.
49		**Nine Gems (Palmar East) Properties** (lateral and southern canals) exist. Existing drainage is assumed for the southern Nine Gems Canal and lateral drainage canals, as well as for the HSLCD drainage canal.	Same as ECB.

2070B

	A	B	C
50		**Palmar West of Pratt Whitney Road.** Drainage ditches exist, but are not connected. Flow to the east is via culverts under Pratt Whitney Road.	Same as ECB.
51		**Thomas Farms (TF)** TF drains via gravity through an existing culvert under Pratt-Whitney Road, and through southern Nine Gems canal. The property just north of TF drains (by gravity) into HSLCD canal on north side of Nine Gems	Same as ECB.
52		**Hobe St. Lucie Conservancy District Unit 2** is an existing agricultural area planted in sugar cane. The property drains through 3-84" culverts, with an invert of 7.7' NGVD and a control elevation of 12.0' NGVD. These culverts drain into the HSL Bypass canal that currently runs through the Gulfstream west property. Permit allocated drainage is 4"/day	Same as ECB.
53		**Nine Gems (Palmar East) Properties** (northern boundary canal and berm) North end of Nine Gems Wetlands drain north to HSL canal (invert at wetland bottom)	Same as ECB.
54		**Gulfstream West Property** is a fallow Citrus Grove of ~ 700 acres. It is located adjacent to and west of I-95/Turnpike). It drains to Cypress Creek.	Same as ECB.
55		**Moonshine Creek and Eastern Gulfstream Property.** Hobe Grove Ditch is regulated based upon existing control. Gulfstream East property (~450 acres) is a fallow citrus grove located east of I-95 and FL Turnpike. MS Creek is disconnected from historic flow by Hobe Grove Ditch and is unconnected to the ditch	Same as ECB.
56		**Culpepper Property:** Existing elevation of the southern 2/3 of the west Ranch Colony berm (along east Culpepper Property line) is 24.5 ft. NGVD. Existing fixed crested weir twin 84" culverts are set at 17.6 ft. NGVD and the southern Culpepper Culverts (WCS-2, (48" CMP), WCS-3 (60" CMP) and Jupiter Grade Structure (48" CMP) are set at 19.1, 17.6 and 18.5 feet NGVD, respectively). These are wet season control.	Same as ECB.
57		**Cypress Creek and Shiloh Farms Property** 2-66" RCP culverts with risers exist at Gulfstream Road and drainage is per existing permit	Same as ECB.
58		Spreader Swale on Cypress Creek Property is not present	Same as ECB.
59		**Ranch Colony and other Development Communities**. The following control levels are used for the RC communities: Ranch Colony & Colony Park- 14.5' NGVD, RCII - 15.5' NGVD, the Links 17.0' NGVD, Old Trail - 16.0' NGVD	Same as ECB.
60	11	**Indian Trail Improvement District (ITID) M-1 Basins**	

2070B

	A	B	C
61		ITID is allowed 274 cfs peak discharge for flood protection to the L-8 Canal (equivalent to 1/4 in/day). However, most discharges (up to 750 cfs) occur via the M-1 Canal to C-51 unless C-51 stages restrict such flows as specified in ITID permit and MOU. S-155A restrictions are when stages are within 1/2' of 13.5' west and 11.7' east. ITID's total discharge capacity is 1,800 cfs which is comprised of the 1,100 cfs to the impoundment (and subsequently to the L-8) and up to 750 cfs south via gravity when capacity and conditions allow. For modeling purposes, M-1 Upper and Lower Basins are assumed discharge up to 750cfs to the C-51, with no flow to L-8. (Assume ITID is not in the L-8 budget).	Same as ECB.
62		ITID 's peak allowable discharge historically was to L-8 with subsequent discharges to the S-5A complex and Lake Okeechobee at C-10A as conditions allow. However the majority of ITID discharges are sent by gravity to the C-51.	Same as ECB.
63		The impoundment is not operated, consistent with the modeling assumption in Line 62 above.	Same as ECB.
64		M1 Upper Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr, Nov-Dec) and 16.0 NGVD in the wet season (May-October) M-1 Lower Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr., Nov-Dec) and 15.0 in the wet season (May-Oct)	Same as ECB.
65	12	**Other Related Project Structures - these are outside LECsR-NP model boundary)**	
66		S-155A is constructed and operational. Portion of L-8 discharges to S-155A and out S-155 to Lake Worth Lagoon. All C-51 eastern Basin water discharges at S-155	Same as ECB.
67		STA-1E and STA-1West are constructed and operational	Same as ECB.
68	13	**Pumping and Water Restriction Areas**	
69		Public Water Supply (PWS) wellfield withdrawals are based on permitted allocations at the end of each utility's consumptive use permit.	Same as ECB.
70		PWS in the study area includes Martin County Utilities (Tropical Farms), SMRU, Stuart, Palm Beach County (System 8), Jupiter, Seacoast, Tequesta, West Palm Beach and Riviera Beach.	Same as ECB.
71			
72			

Alt 2

	A	B	C
1	**No.**	**System Operations and Uses**	
2		**General Description/Project Assumptions: Alternative 2**	**Model Assumptions: Alternative 2**
3	1	**Project Location**	
4		The project area lies within northern Palm Beach County and southern Martin County with a focus on the Loxahatchee River watershed. Because of future proposals for the interconnection of the Loxahatchee River watershed with other features of the regional system, the study area extends from the C-51 Canal in Palm Beach County to the south to approximately Bridge Road in Martin County and the C-44 canal in the north. The eastern boundary is the Intracoastal Waterway (ICW) and the western boundary is the L-8 Canal	Same as ECB
5	2	**Regional System**	
6		Lake Okeechobee water is routed to the L-8 Tieback and through the M-Canal to the Grassy Waters Preserve (WPB Water Catchment Area) (GWP) for water supply. Regional water is also withdrawn from the M-Canal for irrigation purposes by existing permitted users. Regional water is brought in from the C-44 canal to irrigate the permitted groves in the northern portion of the study area.	Same as ECB
7	2a	**Flowway Concepts and Operational Priorities between FW1 and FW2 for Restoration Source Water**	
8		The first priority water source for deliveries to Loxahatchee Slough and River is FW2 to meet restoration targets. FW1 deliveries can supplement up to 20 cfs through G-161 when there is available water in L-8 Canal and Grassy Water Preserve wet and dry stages (as specified on Item 5 below) are met, and is subject to replacement ratio (1.4:1). Flows through G-161 are assumed to come from GWP.	See individual project descriptions below
9	Beth modified 9/6/2017	**Description of Flowway 1**: In this alternative, Flowway 1 consists primarily of G-161, which can divert water from GWP, when conditions allow, into the C-18 canal and then to NW Fork of the Loxahatchee River via G-92 and Lainhart Dam. Flow to the City WPB for water supply, utilizing the Control 2 PS and the M-Canal continue. Source water is primarily L-8 basin, and Lake Okeechobee.	See individual project descriptions below
10		**Description of Flowway 2:** Flowway 2 provides a path to route water eastward down the M-O Canal, via the L-8 Shallow Impoundment and from the C-18W Impoundment to the C-18W canal to G-92 and the NW Fork of the Loxahatchee River. The flowway 2 design consists of storage within the L-8 Basin (L-8 Shallow Impoundment) or within the C-18W Impoundment. A new canal connects the M-O canal to the C-18W Impoundment.	See individual project descriptions below
11	3	**L-8 Basin and/or C-51 Storage**	
12		The areas that contribute flows to the L-8 Basin include Corbett, Dupuis, ITID (upper basin- see Items below for restrictions), GL Homes/Cypress Groves, agricultural areas	Same as ECB
13		**L-8 FEB** - L-8 FEB exists as a mined area, however its operation is not included in the base conditions or the alternatives. L-8 FEB water source is S-5A basin and C-51W via S-5A complex which is outside model boundary (project assumption but do not model)	Same as FWO
14		**C-51 Phase 1:** C-51 Phase I is a mined area, however, its operation is not included in the base conditions or the alternatives. C-51 Ph. 1 water source is western C-51 basin via the L-8 FEB	Same as ECB

Alt 2

	A	B	C
15		**The C-51 Reservoir Phase II** storage is not operable and does not provide water deliveries to the LRWRP project or elsewhere. The site is fully mined over a 1,600 acre footprint to -18.6 ft. NGVD.	Same as ECB
16		**L-8 Basin shallow storage:** This facility is operable. It has a capacity of 4,300 acre feet on 1,500 acres. Cell inflow is from the L-8 canal via a 200 cfs pump station. Outflow to M-O Canal is 100 cfs when Mecca Impoundment has capacity and ITID stages allow. (Outflow is controlled by ITID M-O pump Station, if ITID 1,100 PS is operating, discharge from L-8 Basin shallow storage cannot occur.)	The L-8 Shallow Reservoir is simulated as an above ground reservoir in the wetlands package. Due to grid size the reservoir footprint in the model may be different. Maximum capacity of the reservoir is approximately 4,500 acre-feet volume. Inflows and outflows from the reservoir use the rdf/diversion package. Inflow into L-8 Shallow Storage is from L-8 Basin up to 200 cfs, and outflow is to C-18 Impoundment up to 100 cfs.
17		**ASR @ L-8 Shallow Impoundment** is not constructed.	Same as ECB
18	4	**M-Canal Conveyance Improvements**	
19		**Control 2 Pump Station (WPB #2)** This facility has a pumping capacity of 165 cfs and 2 additional pumps for a total capacity of 300 cfs. The M-canal capacity is assumed to be up to 225 cfs	Same as ECB
20		**M-1 to M-Canal Pump station** is not constructed	Same as ECB
21	5	**Grassy Waters Preserve (WPB Catchment Area) Deliveries**	
22		**GWP Operation:** CWPB desired operation: GWP stage is between 18.4 and 19.2 (permit is 17.6 - 19.2) NGVD. M-Canal maintained 0.2-0.3 feet below GWP to reduce flow into preserve. Based on WPB Consumptive Use Permit pumping at Control 2 ceases when Clear Lake is >12.5 ft. NGVD **Alternative 2** delivers up to 20 cfs via G-161 when GWP stage is above 18.4 ft. NGVD. M-Canal is maintained at 18.9 ft. NGVD.	Same as ECB except G-161, see discussion below.
23		**Replacement water** is provided at a 1.4:1 ratio for water released from GWP at G-161 for River restoration. This water is provided from available L-8 basin flows.	Replacement water is incorporated in the volume of water moved in to GWP. No regional water can be used for replacement water. Replacement water supplied to GWP for G-161 operations is restricted by the available L-8 Basin runoff. G-161 operations can only occur when an equivalent volume of water is available in the L-8 Basin runoff for that day plus the 40 percent loss. For example, if G-161 moves 20 cfs north, then 28 cfs needs to be available in L-8 Basin runoff on that day which then would be placed into the M-Canal in GWP using either the diversion or rdf package.
24	6	**Loxahatchee Slough Area**	
25		**Northlake Bridge**. Improvements to pass 100 cfs at Northlake bridge, draining north at 19.2 ft. NGVD	Same as ECB
26		**Beeline Bridge**: New bridge is constructed on Beeline and there are no flow restrictions	Same as ECB
27		**G-161:** G-161 is constructed and operational. G-161 is not operated for flood control releases. Provide up to 20 cfs, discharging directly to C-18 canal to support flows to the NW Fork of the Loxahatchee River. Triangle stage to be controlled by G-160 operation.	Up to 20 cfs can move from the northern area of GWP into the C-18 canal south of the G-160 structure if northern GWP is above 18.4 feet NGVD. Water only moves into the C-18 canal south leg when stages are below G-160 wet/dry seasonal control elevations described in the section below and if replacement water is available as discussed above. Water is moved through G-161 using the diversion package.

Alt 2

	A	B	C
28		**G-160:** G-160 is constructed and operational and has a maximum capacity of 2000 cfs (for flood control). The structure is operated to benefit Loxahatchee Slough. Open when slough stage is at or greater than 15.5 ft. NGVD in middle of dry season, gradually rising to 17.5 ft. NGVD in wet season. Assume no boards at PC-13 and PC-15. Seasonal Operation schedule is as follows: - December to April: Gate opens at 16.2 ft. NGVD and closes at 15.5 ft. NGVD - November and May gate opens at 17.1 ft. NGVD and closes at 16.2 ft. NGVD - June to October (wet season); gate opens at 17.5 ft. NGVD and closes at 17.1 ft. NGVD. No water is released at G-161 when G-160 is above seasonal stage. G-160 allowable discharge Is up to 150 cfs for environmental deliveries, and to maintain flood control capability as necessary for non-environmental deliveries.	During extreme flood events, excess of 2500 cfs passes from upstream of G-160 to downstream of G-160 when stages exceed 16.2 feet in the dry season and 17.1 feet during the wet season using the rdf package. Normal wet season and dry season releases of up to 150 cfs occurs when the dry season stage exceeds 15.5 feet NGVD and the wet season stage exceeds 16.9 feet NGVD also using the rdf package. Supplemental water for the Loxahatchee river occurs during the dry season when the G-160 upstream stage is between 15.0 and 15.5 feet NGVD and the down stream stage is below 14.75 feet NGVD at rates up to 50 cfs. During the wet season supplemental water for the Loxahatchee river occurs when the G-160 upstream stage is between 16.0 and 16.5 feet NGVD and the down stream stage is below 14.75 feet NGVD at rates up to 50 cfs. An additional wet season supplemental water release to the river of 100 cfs occurs when the stages are between 16.5 and 16.9 feet NGVD.
29		**Shallow seepage Barriers** in Lox Slough at C-18 Canal and around Luckey Tract are not present	Same as ECB
30	7	**C-18W Storage**	
31		**C-18W Impoundment** This facility is constructed, and has a capacity of 7,200 acre feet on 1,590 acres. The Inflow is up to 300 cfs from pump station on north side and 250 cfs from pump station in the seepage collector canal on the west side. Outflow is up to 200 cfs to the C-18W canal. Inflows to the impoundment are from the C-18W (excess) Up to 300 cfs can be diverted to the impoundment when water is flowing over the C-18W weir and stages in the C-18W leg downstream of the weir are > 13.5'. Water can also be delivered to the impoundment via the 250 cfs seepage pump station, which captures seepage as well as flows from Corbett (over a new operable structure) and from the ITID upper basin and the L-8 Shallow Reservoir via the new M-O Connector PS. Additionally, there are 2 ASR wells co-located with the impoundment. A bentonite seepage barrier is assumed to be installed along south and east margins of impoundment @30ft. depth.	The C-18W Impoundment is simulated as an above ground reservoir using the wetland package. Due to grid size the actual acres covered is slightly less but the volume of 7,200 acre feet is preserved by adjusting the depth of water available in the facility. Water is moved in and out of the impoundment up to the volumes specified using the rdf package. The seepage barrier is simulated by reducing the hydraulic conductivity of the aquifer properties in Layer 1 along the southern and eastern levees. Up to 150 cfs of excess water from the C-18 canal is diverted back into the impoundment when levels exceed 18.6 feet NGVD at the C-18 weir and the reservoir is below 25.6 feet NGVD. Up to 250 cfs can be sent into the impoundment from the western seepage canal, where sources include seepage, outflow from Corbett Weir, ITID Upper Basin and L-8 shallow reservoir. During flood events in the reservoir, up to 300 cfs can be diverted to the C-18 canal to avoid over-topping of the reservoir.
32		**Aquifer Storage and Recovery (ASR) @ C-18W Impoundment**: 2 ASR wells are co-located with the impoundment.	Two ASR wells are simulated. The ASR bubble is directly simulated in an inactive portion area of the model and assumes a 70 percent efficiency. Inflows and outflows from the ASR wells are modeled using the diversion package. Inflow and Outflow capacity is limited to 15 cfs. Outflow from the ASR wells for river needs are assumed to pass through the reservoir in a single day.
33		**Corbett Weir:** Corbett weir is replaced with an operable water control structure, and is operated to control water levels in eastern Corbett between 21.5 to 23.0' NGVD. This culvert discharges into the M-O Connector canal. M-O connector discharges under Seminole Pratt Road to the C-18 W Impoundment seepage canal and water is input into the reservoir with a pump station that has a capacity of up to 250 cfs.	The Corbett weir is simulated at a dry season elevation of 21.5 feet NGVD and a wet season elevation of 23.0 feet NGVD. Water flow over the weir is simulated using the rdf package and is discharged into the C-18 Impoundment, or a combination of into the impoundment or directly to the C-18 canal at rates up to 250 cfs.

Alt 2

	A	B	C
34		**M-O connector canal and Pump Station:** A canal runs on the west side of SPW road up to the Corbett structure (weir), then one set of culverts under road discharging into C-18W seepage collection. An MO Connector pump station has a capacity of 120 cfs. When C-18W Impoundment has available capacity and ITID upper basin is available {i.e. ITID water stages are above wet (16.0 ft. NGVD) or dry season control stage (17.0 ft. NGVD)}, the new M-O connector and Pump Station can send up to 120 cfs to the C-18W Impoundment. Flow from L-8 shallow reservoir will supplement water to C-18W Impoundment (when capacity is available) via new 120cfs M-O pump station if ITID upper basin water is not available.	Water from ITID upper basin or the L-8 Shallow Reservoir moves into the C-18 Impoundment at rates up to 120 cfs using the rdf package. Flow from ITID into the C-18 Impoundment have priority over flows from the L-8 Reservoir to the C-18 Impoundment.
35		**Beeline Culverts north and south of North County Airport**: New Culverts under Beeline are neither constructed nor operable	Same as ECB.
36		**Seepage barriers** around natural area (south side of Avenair) are not constructed. Seepage barriers around the Gun Range are constructed. This is associated with seepage management for the C-18W Reservoir.	Seepage barrier around the Gun Range is simulated by reducing the aquifer properties in Layer 1 along the outside of the Gun Range.
37		**Vavrus/Avenir**: The conceptual design for the Avenir development is incorporated. This includes development at the southern end of the property, with proposed control elevations. The internal ditches on the northern portion are filled to implement a 'rainfall driven' restoration.	Same as FWO.
38		**North County Airport**. This alternative includes the C-18W Impoundment. This reservoir is more than 10,000 feet from the NPBC Airport. NPBC Airport is gravity drained with a control of 18' NGVD. Sweetbay Natural Area is controlled at 20.25' NGVD, and drains through CSX ditch south.	Same as ECB
39	8	**C-18 Weir, G-92 and Lainhart Dam**	
40		**C-18 Weir:** This is the existing weir located just east of Beeline Hwy on the C-18 Canal, which has a crest elevation of 17.6' NGVD	Same as ECB
41		**C-18 Canal Operations:** The flow targets for the NW Fork, from the Loxahatchee River Restoration Plan (2006, updated in 2011), are: -Wet season (June-November: 120 days over 110 cfs at Lainhart (110 -150 cfs). - Dry Season (December - May) 50-90 cfs with 68 cfs monthly mean; for model simplification use daily 68 cfs -Use as-built design with maximum capacity of 400 cfs at G-92. -G-92 discharges to the NW Fork of the Loxahatchee River when C-18 is above 13.0' NGVD. - When C-18 exceeds 14.5' NGVD, up to 400 cfs is sent north over G-92. -If C18 is between 13.0 and 14.5' NGVD and Lainhart Dam Flows exceed 50 cfs from Jupiter Farms runoff, then G-92 flow is zero. If C-18 exceeds 15.0' NGVD, S-46 opens and discharges up to 4,000 cfs to the SW Fork of the Loxahatchee River. When C-14 upstream of Lainhart Dam is above 14.0 feet, excess flow (up to 400 cfs) from SIRWCD is directed back into C-18, through G-92 and discharged out through S-46. **Project water is not delivered to the C-18W canal downstream of the weir when downstream stage is >13.5' NGVD (a flood control constraint.)**	Same as ECB
42	9	**SIRWCD and Jupiter Farms**	

Alt 2

	A	B	C
43		**Jupiter Farms** is a development in the SIRWCD that drains into the C-14 Canal just north of G-92. SIRWCD control structures at Jupiter Farm are constructed; discharges into and out of Jupiter Farms canals are controlled at 13.0 - 14.0 NGVD, draining to C-14 upstream of Lainhart. This raises the levels of the canals and holds water back from discharging to the C-14 canal.	Same as ECB.
44	10	**Loxahatchee Tributaries (Kitching, Wilson and the North Fork)**	
45		**Wilson Creek and the North Fork** are unregulated. **Kitching Creek:** A spreader swale is constructed to the east and west from Jenkins Ditch at the north end of JD Park to distribute flows to historic Kitching Creek channels. A sheetpile weir is constructed in the ditch upstream of the main Kitching Creek channel at elevation 12.0 (NGVD)	A spreader swale is assumed along the northern portion of the Jonathan Dickinson State Park adjacent to Jenkins Ditch. A weir is simulated at the intersection of Jenkins Ditch and historic Kitching Creek with a control elevation of 12.0 feet NGVD. Runoff from the urban areas to the north is distributed within the spreader swale and the ditch upstream of the new weir. When levels exceed the weir elevation it is moved downstream into Kitching Creek.
46	10a	**Southern Martin County Properties**	
47		**Hobe St. Lucie Conservancy District (HSLCD)** has three discharge structures. One discharges to the South Fork of the St. Lucie River, the second discharges to the Cypress Creek Canal and the third discharges to the Hobe Grove Ditch. Cypress Creek Canal and Hobe Grove Ditch both discharge to the Loxahatchee River.	There are no changes to South Fork or Hobe Grove ditch Structures. Control levels are implemented in the simulation. Cypress Creek structure changes below.
48		**Cypress Creek Canal:** A new weir is constructed in the Cypress Creek Canal downstream of the existing location. This weir elevation is set at 9.0 ft. NGVD. Location would also be upstream of the outfall for the flow-through marsh. The dogleg canal in Gulfstream West will be straightened. New weir will be downstream of the straightened dogleg.	The weir is simulated with a control elevation 9.0 feet NGVD using the drain package. The location of the new weir is located just west of the Florida Turnpike in the canal.
49		**Nine Gems (Palmar East) Properties** (lateral and southern canals). The internal drainage canals within Nine Gems are filled and do not drain to offsite canals	Nine Gems drainage canal filling is simulated by setting drain conductance to approximately zero.
50		**Palmar West of Pratt Whitney Road**. (same as FWO) Drainage ditches exist, but are not connected. Flow to the east is via culverts under Pratt Whitney Road.	Same as ECB.
51		**Thomas Farms Drainage** is modified so that all drainage is routed and pumped offsite at the northeast corner of the farm to the HSLCD canal on the north side of 9 Gems. A 40 cfs pump station is used to pump the Thomas Farms water north. Current drainage criteria are assumed	All water from Thomas Farms is diverted to the flow through marsh via HSLCD Unit 2 drainage canals using the diversion package up to 50 cfs.
52		**Hobe St. Lucie Conservancy District Unit 2** is an existing agricultural area planted in sugar cane. The property drains through 3-84" culverts, with an invert of 7.7' NGVD and a control elevation of 12.0' NGVD. HSL Drainage is diverted into the Flow-through Marsh. If the marsh is full, or the discharge from Unit 2 exceeds the capacity of the pump station, overflow is directed to the by-pass . Current drainage criteria are assumed	Same as ECB.
53		**Nine Gems (Palmar East) Properties** (northern boundary canal and berm) Drains/pipes to the northern canal are eliminated. Assume minor berm improvements at the north side of the property	Nine Gems drainage canal filling is simulated by setting drain conductance to approximately zero.

Alt 2

	A	B	C
54		**Gulfstream West Property**. A flow through marsh is constructed on the property located to the west of I-95 and the Turnpike (between Old Trail community and the highway). The control stages within the marsh are between 14.5 to 17.0 feet NGVD (assume average NGVD ground elevation of 15.5) The marsh receives Inflow of up to 250 cfs from new pump station at north end of OC-2. Inflow pumping stops when water elevation = 17.75 NGVD (avg. depth of 3') Outflow is designed to discharge 250 cfs when water depth within the marsh reaches 3 feet. At 1.75 feet of depth, discharge base flow of 30 cfs. *All* discharge from the flow-through marsh is downstream of the new CCC weir. The capacity of an existing by-pass canal is maintained at 450 cfs but relocated to a canal on the west side of the FTM. The FTM is intended to pick up and attenuate HSL Unit 2 and rerouted TF discharge, plus any excess Nine gems sheet flow. Refer to initial stage-discharge relationship and stage-storage relationship (prepared by A. Tancreto, attached), for the discharge structure criteria.	The dog leg at the bottom of the by-pass canal is removed and the by-pass canal is now a north-south canal along the west side of the property with an open connection at the Cypress Creek canal. Runoff from Thomas, the Unit 2 farms and northern Nine Gems is discharged into the flow through marsh at at rate of up to 250 cfs at the northern end of the property. If runoff exceeds 250 cfs the by-pass canal is used to route the excess runoff directly to the Cypress Creek canal. The flow through marsh is located on the old Gulfstream West Grove property. Trees and drainage ditches are filled and existing structures removed. A levee is simulated around the property. Water is brought into the property at rates up to 250 cfs at the northern end when stages are below 17.75. Water is released at the south end of the property directly into the Cypress Creek canal. Water is released at the south end at 30 cfs when stages in the marsh exceed 16.0 feet NGVD. Discharge out the south end gradually increase to 250 cfs when stages reach 17.75 feet NGVD.
55		**Moonshine Creek and Gulfstream East Property** The Gulfstream East property (450 acre fallow citrus grove) is restored. Existing drainage ditches are filled (to facilitate restoration)is connected to Hobe Grove Ditch, a new weir is installed at the east end of HG Ditch prior to its discharge to the NW Fork. New weir is at elevation 7.5' NGVD (3.5 ft. below control elevation for HSL upstream structure (11' NGVD)	The structure at the east side of the Hobe-Grove ditch is increased to 7.5 feet NGVD. Filling of existing drainage ditches and structures simulated by setting the drain conductance to approximately 0 from the Gulfstream East Grove for restoration purposes. The perimeter ditch operated by Hobe-St. Lucie is not modified.
56		**Culpepper property** Improvements are completed. The northern portion of the Ranch Colony berm is raised to 24.5' NGVD (consistent with the southern 2/3). The ditch between Nine Gems and Culpepper is filled to allow sheet flow from southwest to northeast. Twin 84" culvert operation will change to between 18.5-20.1 ft. NGVD (see schedule attachment). Other identified culverts to maintain operation as in 2014B	The Culpepper culverts are simulated as follows. Because of the size of the model grid the twin 84's and WCS-2 are simulated at 19.1 feet NGVD. WCS-3 is simulated separately but also at 17.6 feet NGVD. The Jupiter grade culvert is also simulated in the model at 18.5 feet NGVD.
57		**Cypress Creek and Shiloh Farms Properties**, 2-66" RCP culverts with risers exist at Gulfstream Road as in 2014B. No changes to these culverts. The pepper field is regraded to facilitate Historic flowways to Cypress Creek.	Same as ECB
58		**Spreader Swale and pump station on Cypress Creek Property near Mack Dairy**: Not included in Alt 2	Same as ECB
59		**Ranch Colony and other Development Communities:** Communities control elevations are: The following control levels are used for the RC communities: Ranch Colony & Colony Park- 14.5' NGVD, RCII - 15.5' NGVD, the Links 17.0' NGVD, Old Trail - 16.0' NGVD	Same as ECB
60	11	**Indian Trail Improvement District (ITID) M-1 Basins**	
61		ITID is allowed 274 cfs peak discharge for flood protection to the L-8 Canal (equivalent to 1/4 in/day). Most discharges occur via the M-1 Canal to C-51 unless C-51 stages restrict such flows as specified in ITID permit and MOU. S-155A restrictions are when stages are within 1/2' of 13.5' west and 11.7' east. For modeling purposes, ITID will operate consistent with the FWO, in accordance with permit and agreements, with the project being allowed to take upper basin water in accordance with line 35 via the MO connector and pump. Lower Basin water will be discharged at a rate up to 750 cfs to the C-51 Canal.	Same as ECB

Alt 2

	A	B	C
62		ITID 's peak discharge historically was to L-8 with subsequent discharges to the S-5A complex and Lake Okeechobee at C-10A as conditions allow. However the majority of ITID discharges are sent by gravity to the C-51.	Same as ECB
63		The ITID impoundment is not operated, consistent with the modeling assumption in Line 62 above.	Same as ECB
64		M1 Upper Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr, Nov-Dec) and 16.0 NGVD in the wet season (May-October) M-1 Lower Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr., Nov-Dec) and 15.0 in the wet season (May-Oct); No water is to be moved from ITID to LRWRP project features when stages are below ITID seasonal control elevations. Like project water will be passed through the ITID when stages are above ITID seasonal control elevations. The project can capture excess water when ITID is above the seasonal control level.	Same as ECB
65	12	**Other Related Project Structures - (outside model boundary)**	
66		S-155A is constructed and operational. Portion of L-8 discharges to S-155A and out S-155 to Lake Worth Lagoon. All C-51 eastern Basin water discharges at S-155	Same as ECB
67		STA-1E and STA-1West are constructed and operational	Same as ECB
68	13	**Pumping and Water Restriction Areas**	
69		Public Water Supply (PWS) wellfield withdrawals are based on permitted allocations at the end of each utility's consumptive use permit.	Same as ECB
70		PWS in the study area includes Martin County Utilities (Tropical Farms), SMRU, Stuart, Palm Beach County (System 8), Jupiter, Seacoast, Tequesta, West Palm Beach and Riviera Beach.	Same as ECB
71			
72			
73			
74			

Alternative 5

	A	B	C
1	**No.**	**System Operations and Uses**	
2		**General Description - Project Assumptions: Alternative 5**	**Model Assumptions: Alternative 5**
3	1	**Project Location**	
4		The project area lies within northern Palm Beach County and southern Martin County with a focus on the Loxahatchee River watershed. Because of future proposals for the interconnection of the Loxahatchee River watershed with other features of the regional system, the study area extends from the C-51 Canal in Palm Beach County to the south to approximately Bridge Road in Martin County and the C-44 canal in the north. The eastern boundary is the Intracoastal Waterway (ICW) and the western boundary is the L-8 Canal	Same as ECB
5	2	**Regional System**	
6		Lake Okeechobee water is routed to the L-8 Tieback and through the M-Canal to the Grassy Waters Preserve (WPB Water Catchment Area) (GWP) for water supply. Regional water is also withdrawn from the M-Canal for irrigation purposes by existing permitted users. Regional water is brought in from the C-44 canal to irrigate the permitted groves in the northern portion of the study area.	Same as ECB
7	2a	**Flowway Concepts and Operational Priorities between FW1 and FW2 for Restoration Source Water**	
8		The first priority water source for deliveries to Loxahatchee Slough and River is FW2 to meet restoration targets. FW1 deliveries can supplement when available water in L-8 Canal and Grassy Water Preserve wet and dry stages (as specified on Item 5 below) or M-1 Lower basin water is available and subject to replacement ratio (1.4:1) and up to 50 cfs through G-161. Flows through G-161 are assumed to come from GWP.	See individual project descriptions below
9		**Description of Flowway 1.** Alternative 5 relies minimally on FW1. Existing facilities (Control 2 PS, GWP M-Canal are used to deliver water to the City of WPB for water supply, and up to 50 cfs is delivered to the river via G-161. A 75 cfs pump is available to deliver water from ITID lower M-1 basin directly to the M-Canal for river.	See individual project descriptions below
10		**Description of Flowway 2:** Flowway 2 provides a path to route water eastward down the M-O Canal, via the C-18W Impoundment to the C-18W canal and the NW Fork of the Loxahatchee River. The flowway 2 design consists of either storage within the C-18W Impoundment, which can accept water from several sources, or in 4 ASR wells that are co-located with the impoundment. A new canal (M-O Connector) connects the impoundment to the ITID M-O canal	See individual project descriptions below
11	3	**L-8 Basin and/or C-51 Storage**	

Alternative 5

	A	B	C
12		The areas that contribute flows to the L-8 Basin include Corbett, Dupuis, ITID (upper basin- see Item 11 below for restrictions), GL Homes/Cypress Groves, agricultural areas	Same as ECB
13		**L-8 FEB:** Stages for L-8 FEB are input for the FWO and Alternatives based on output from the Restoration Strategies DMSTA 2012 Project modeling. The project assumes that L-8 FEB water source is S-5A basin and C-51W via S-5A complex which is outside the LECsR model boundary.	Same as FWO
14		**C-51 Phase 1:** C-51 Phase I is a mined area, however, its operation is not included in the base conditions or the alternatives. C-51 Ph. 1 water source is western C-51 basin via the L-8 FEB.	Same as ECB
15		**The C-51 Reservoir Phase II** storage is not operable and does not provide water deliveries to the LRWRP project or elsewhere. The site is fully mined over a 1,600 acre footprint to -18.6 ft. NGVD.	Same as ECB
16		**L-8 Basin Shallow Storage** facility is not constructed and the existing agricultural land use is assumed.	Same as ECB
17		**ASR @ L-8 Shallow Impoundment** is not constructed	Same as ECB
18	4	**M-Canal Conveyance Improvements**	
19		**Control 2 Pump Station (WPB #2)** has a pumping capacity of 165 cfs and 2 additional pumps for a total capacity of 300 cfs. The M-canal capacity is assumed to be up to 225 cfs	Same as ECB
20		**M-1 to M-Canal Pump Station**: A 75 cfs pump station is constructed to deliver up to 75 cfs to the M-canal from **ITID lower M-1 Basin** when stage conditions allow. (M-1 Basin stages are 17.0 ft. NGVD dry season and 15.0 Ft. NGVD wet season).	Up to 75 cfs is simulated using the rdf package by moving the water from the ITID lower basin directly into the M-Canal downstream of Control 2, beyond the canal segment where flow is limited to 225 cfs. Water is used to offset G-161 plus replacement water flows for Grassy Waters. If G-161 flow is not needed, water is used to reduce regional system demands.
21	5	**Grassy Waters Preserve (WPB Catchment Area) Deliveries**	
22		**GWP Operation:** CWPB desired operation: GWP stage is between 18.4 and 19.2 (permit is 17.6 - 19.2) NGVD. M-Canal maintained .02-.03 feet below GWP to reduce flow into preserve. Based on WPB Consumptive Use Permit pumping at control 2 ceases when Clear Lake is >12.5 ft. NGVD Delivery of up to 50 cfs via G-161 when GWP stage is above 18.4' NGVD. M- Canal is maintained at 18.9 ft. NGVD. Replacement water at 1.4:1 ratio for water removed from GWP at G-161.	Same as ECB except G-161, see discussion below.
23		**Replacement water** is provided at a 1.4:1 ratio for water released from GWP at G-161 for River restoration. This water is provided from available L-8 basin flows, and M-1 to M-Canal pump station	Same as Alt 2.
24	6	**Loxahatchee Slough Area**	

Alternative 5

	A	B	C
25		**Northlake Bridge:** Improvements to pass 100 cfs at Northlake bridge, draining north at 19.2 ft. NGVD	Same as ECB
26		**Beeline Bridge:** New bridge is constructed on Beeline and there are no flow restrictions	Same as ECB.
27		**G-161**: G-161 is constructed and operational. Provide up to 50 cfs, discharging directly to C-18 to support flows to the NW Fork of the Loxahatchee River. Triangle stage to be controlled by G-160 operation	Up to 50 cfs can move from the northern area of GWP into the C-18 canal south of the G-160 structure if northern GWP is above 18.4 feet NGVD. Water only moves into the C-18 canal south leg when stages are below G-160 wet/dry seasonal control elevation and if replacement water is available as discussed above. Water is moved through G-161 using the diversion package.
28		**G-160:** G-160 is constructed and operational and has a maximum capacity of 2000 cfs (for flood control). The structure is operated to benefit Loxahatchee Slough. Open when slough stage is at or greater than 15.5 ft. NGVD in middle of dry season, gradually rising to 17.5 ft. NGVD in wet season. Assume no boards at PC-13 and PC-15. Seasonal Operation schedule is as follows: - December to April: Gate opens at 16.2 ft. NGVD and closes at 15.5 ft. NGVD - November and May gate opens at 17.1 ft. NGVD and closes at 16.2 ft. NGVD - June to October (wet season); gate opens at 17.5 ft. NGVD and closes at 17.1 ft. NGVD. No water is released at G-161 when G-160 is above seasonal stage. G-160 allowable discharge Is up to 150 cfs for environmental deliveries, and to maintain flood control capability as necessary for non-environmental deliveries.	Same as Alt 2
29		**Seepage Barrier** in Lox Slough/Luckey Tract. Seepage Barrier is not present.	Same as ECB.
30	7	**C-18W Storage**	

Alternative 5

	A	B	C
31		**C-18W Storage**: This impoundment is constructed, and has a capacity of 9,500 acre feet on 1,590 acres. Inflow is up to 300 cfs from pump station on north side and 250 cfs from pump station in the seepage collector canal on the west side. Outflow is up to 200 cfs to the C-18W canal. Inflows to the impoundment are from the C-18W (excess), Corbett (over weir) and ITID upper basin. (Volumes are model caps, demand is triggered by river). Bentonite seepage barrier along south and east margins of the impoundment at 30 ft. deep. 4 ASR wells are co-located with the impoundment.	The C-18W Impoundment is simulated as an above ground reservoir using the wetland package. Due to grid size the actual acres covered is slightly less but the volume of 9,500 acre feet is preserved by adjusting the depth of water available in the facility. Water is moved in and out of the impoundment up to the volumes specified using the rdf package. The seepage barrier is simulated by reducing the hydraulic conductivity of the aquifer properties in Layer 1 along the southern and eastern levees. Up to 150 cfs of excess water from the C-18 canal is diverted back into the impoundment when levels exceed 18.6 feet NGVD at the C-18 weir and the reservoir is below 26.5 feet NGVD. Up to 250 cfs can be sent into the impoundment from the western seepage canal, where sources include seepage, outflow from Corbett Weir, ITID Upper Basin and ASR. During flood events in the reservoir, up to 300 cfs can be diverted to the C-18 canal to avoid over-topping of the reservoir.
32		**Aquifer Storage and Recovery (ASR) @ C-18W Impoundment**: 4 ASR wells are co-located with the impoundment.	4 ASR wells are simulated. The ASR bubble is directly simulated in an inactive portion area of the model and assumes a 70 percent efficiency. Inflows and outflows from the ASR wells are modeled using the diversion package. Inflow and outflow capacities are limited to 30 cfs. Outflow from the ASR wells for river needs are assumed to pass through the reservoir in a single day.
33		**Corbett Weir:** Corbett weir is replaced with an operable water control structure, and is operated to control water levels in eastern Corbett between 21.5 to 23.0' NGVD. This culvert discharges into the M-O Connector canal. M-O connector discharges under Seminole Pratt Road to the C-18 W Impoundment seepage canal and water is input into the reservoir with a pump station that has a capacity of up to 250 cfs.	Same as Alt 2.
34		**M-O Connector Canal and Pump station:** A canal is constructed on the west side of SPW road up to the Corbett structure, then one set of culverts under road discharging into Mecca seepage collection. The MO Connector pump station has a capacity of 205 cfs. The M-O connector can be used to deliver water from the ITID upper basin if the stages are above wet (16.0 ft. NGVD) or dry season control stage (17.0 ft. NGVD) for the basin	Water from ITID upper basin moves into the C-18 Impoundment at rates up to 205 cfs using the rdf package.
35		**Beeline culverts north and south of North County Airport:** Box culverts are not constructed.	Same as ECB.

Alternative 5

	A	B	C
36		**Gun Range and Natural Area Seepage Barriers** Seepage barriers around the Gun Range are constructed, but not around natural area (south side of Avenir)	Same as Alt 2.
37		**Vavrus/Avenir:** The conceptual design for the Avenir development is incorporated. This includes development at the southern end of the property, with proposed control elevations. The internal ditches on the northern portion are filled to implement a 'rainfall driven' restoration	Same as FWO.
38		**North County Airport**. Alternatives 5 includes the C-18W Reservoir. This reservoir is more than 10,000 feet from the NPBC Airport. NPBC Airport is gravity drained with a control of 18' NGVD. Sweetbay Natural Area is controlled at 20.25' NGVD, and drains south through CSX ditch.	Same as ECB.
39	8	**C-18 Weir, G-92 and Lainhart Dam**	
40		**C-18 Weir:** The C-18 Weir is in its existing location, with a weir crest elevation of 17.6 ft. NGVD	Same as ECB.
41		**C-18 Canal Operations:** The flow targets for the NW Fork, from the Loxahatchee River Restoration Plan (2006, updated in 2011), are: -Wet season (June-November: 120 days over 110 cfs at Lainhart (110 -150 cfs). - Dry Season (December - May) 50-90 cfs with 68 cfs monthly mean; for model simplification use daily 68 cfs -Use as-built design with maximum capacity of 400 cfs at G-92. -G-92 discharges to the NW Fork of the Loxahatchee River when C-18 is above 13.0' NGVD. - When C-18 exceeds 14.5' NGVD, up to 400 cfs is sent north over G-92. -If C18 is between 13.0 and 14.5' NGVD and Lainhart Dam Flows exceed 50 cfs from Jupiter Farms runoff, then G-92 flow is zero. If C-18 exceeds 15.0' NGVD, S-46 opens and discharges up to 4,000 cfs to the SW Fork of the Loxahatchee River. When C-14 upstream of Lainhart Dam is above 14.0 feet, excess flow (up to 400 cfs) from SIRWCD is directed back into C-18, through G-92 and discharged out through S-46. Project water is not delivered to the C-18W canal downstream of the weir when downstream stage is >13.5' NGVD (a flood control constraint.)	Same as ECB.
42	9	**SIRWCD and Jupiter Farms**	

Alternative 5

	A	B	C
43		**Jupiter Farms** is a development in the SIRWCD that drains into the C-14 Canal just north of G-92. SIRWCD control structures at Jupiter Farm are constructed; discharges into and out of Jupiter Farms canals are controlled at 13.0 - 14.0 NGVD, draining to C-14 upstream of Lainhart. This raises the levels of the canals and holds water back from discharging to the C-14 canal.	Same as ECB.
44	10	**Loxahatchee Tributaries (Kitching, Wilson and the North Fork)**	
45		**Wilson Creek and the North Fork** are unregulated. **Kitching Creek:** A spreader swale is constructed to the east and west from Jenkins Ditch at the north end of Jonathan Dickinson State Park to distribute flows to historic Kitching Creek channels. A sheetpile weir is constructed in the ditch upstream of the main Kitching Creek channel at elevation 12.0 (NGVD)	Same as Alt 2.
46	10a	**Southern Martin County Properties**	
47		**Hobe St. Lucie Conservancy District (HSLCD)** has three discharge structures. One discharges to the South Fork of the St. Lucie River, the second discharges to the Cypress Creek Canal and the third discharges to the Hobe Grove Ditch. Cypress Creek Canal and Hobe Grove Ditch both discharge to the Loxahatchee River.	Same as ECB. Cypress Creek structure changes and HSLCD Unit 2 discussed separately below.
48		**Cypress Creek Canal:** A new weir is constructed in the Cypress Creek Canal downstream of the existing location. This weir elevation is set at 9.0 ft. NGVD. Location would also be upstream of the outfall for the flow-through marsh. The dogleg canal in Gulfstream West will be straightened. New weir will be downstream of the straightened dogleg.	Same as Alt 2.
49		**Nine Gems (Palmar East) Properties (lateral and southern canals).** The internal drainage canals within Nine Gems are filled and do not drain to offsite canals	Same as Alt 2.
50		**Palmar West of Pratt Whitney Road**. Drainage ditches exist, but are not connected. Flow to the east is via culverts under Pratt Whitney Road.	Same as ECB.
51		**Thomas Farms Drainage west of Pratt Whitney Road** Thomas Farms Drainage is modified so that all drainage is routed and pumped offsite at the northeast corner of the farm to the HSLCD canal on the north side of Nine Gems. A 40 cfs pump station is used to pump the Thomas Farms water north. Current drainage criteria are assumed.	Same as Alt 2.

Alternative 5

	A	B	C
52		**Hobe St. Lucie Conservancy District Unit 2** This is an existing agricultural area planted in sugar cane. The property drains through 3-84" culverts, with an invert of 7.7' NGVD and a control elevation of 12.0' NGVD. HSL drainage is diverted to the Flow-through Marsh (note: PalMar east will also flow into the Flow-through Marsh). If the marsh is full, or the discharge from Unit 2 exceeds the capacity of the pump station, overflow is directed to the by-pass canal. Current drainage criteria are assumed.	Same as ECB.
53		**Nine Gems (Palmar East) Properties** (northern boundary canal and berm) Alt 5: Drains/pipes to the northern canal are eliminated. Assume minor berm improvements at the north side of the property.	Same as Alt 2.
54		**Gulfstream West Property.** A flow through marsh is constructed on the property located to the west of I-95 and the Turnpike (between Old Trail community and the highway). The control stages within the marsh are between 14.5 to 17.0 feet NGVD (assume average NGVD ground elevation of 15.5) The marsh receives Inflow of up to 250 cfs from new pump station at north end of OC-2. Inflow pumping stops when water elevation = 17.75 NGVD (avg. depth of 3') Outflow is designed to discharge 250 cfs when water depth within the marsh reaches 3 feet. At 1.75 feet of depth, discharge base flow of 30 cfs. *All* discharge from the flow-through marsh is downstream of the new CCC weir. The capacity of an existing by-pass canal is maintained at 450 cfs but relocated to a canal on the west side of the FTM. The FTM is intended to pick up and attenuate HSL Unit 2 and rerouted TF discharge, plus any excess Nine Gems sheet flow. Refer to initial stage-discharge relationship and stage-storage relationship (prepared by A. Tancreto, attached), for the discharge structure criteria.	Same as Alt 2.
55		**Moonshine Creek and Gulfstream East Property** The Gulfstream East property (450 acre fallow citrus grove) is restored. Existing drainage ditches are filled (to facilitate restoration)is connected to Hobe Grove Ditch, a new weir is installed at the east end of HG Ditch prior to its discharge to the NW Fork. New weir is at elevation 7.5' NGVD (3.5 ft. below control elevation for HSL upstream structure (11' NGVD)	Same as Alt 2.

Alternative 5

	A	B	C
56		**Culpepper property** Improvements are completed. The northern portion of the Ranch Colony berm is raised to 24.5' NGVD (consistent with the southern 2/3). The ditch between Nine Gems and Culpepper is filled to allow sheet flow from southwest to northeast. Twin 84" culvert operation will change to between 18.5-20.1 ft. NGVD (see schedule attachment). Other identified culverts to maintain operation as in ECB.	Same as Alt 2.
57		**Cypress Creek and Shiloh Farms Properties:** 2-66" RCP culverts with risers exist at Gulfstream Road as in 2014B. There are no changes to these culverts. Pepper Farm unchanged. (Regrading to facilitate historic flowways through Shiloh Farm is not included in Alt 5.)	Same as ECB
58		**Spreader Swale on Cypress Creek Property** does not exist.	Same as ECB
59		**Ranch Colony and other Development Communities:** Communities control elevations are: The following control levels are used for the RC communities: Ranch Colony & Colony Park- 14.5' NGVD, RCII - 15.5' NGVD, the Links 17.0' NGVD, Old Trail - 16.0' NGVD	Same as ECB
60	11	**Indian Trail Improvement District (ITID) M-1 Basins**	
61		Historically, ITID is allowed 274 cfs peak discharge for flood protection to the L-8 Canal (equivalent to 1/4 in/day). In recent years, most discharges occur via the M-1 Canal to C-51 unless C-51 stages restrict such flows as specified in ITID permit and MOU. S-155A restrictions are when stages are within 1/2' of 13.5' west and 11.7' east.	Same as ECB
62		ITID 's peak discharge historically was to L-8 with subsequent discharges to the S-5A complex and Lake Okeechobee at C-10A as conditions allowed. However the majority of ITID discharges are sent by gravity to the C-51.	Same as ECB.
63		The ITID impoundment is not operated, consistent with the modeling assumption in Line 62 above.	Same as ECB.
64		M1 Upper Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr, Nov-Dec) and 16.0 NGVD in the wet season (May-October) M-1 Lower Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr., Nov-Dec) and 15.0 in the wet season (May-Oct) The project can capture excess water when ITID is above the seasonal control level.	Same as ECB.
65	12	**Other Related Project Structures - (outside model boundary)**	

	A	B	C
66		S-155A is constructed and operational. Portion of L-8 discharges to S-155A and out S-155 to Lake Worth Lagoon. All C-51 eastern Basin water discharges at S-155	Same as ECB.
67		STA-1E and STA-1West are constructed and operational	Same as ECB.
68	13	**Pumping and Water Restriction Areas**	
69		Public Water Supply (PWS) wellfield withdrawals are based on permitted allocations at the end of each utility's consumptive use permit.	Same as ECB
70		PWS in the study area includes Martin County Utilities (Tropical Farms), SMRU, Stuart, Palm Beach County (System 8), Jupiter, Seacoast, Tequesta, West Palm Beach and Riviera Beach.	Same as ECB.

	A	B	C
1	**No.**	**System Operations and Uses**	
2		**General Description/Project Assumptions: Alternatives 10**	**Model Assumptions: Alternative 10**
3	1	**Project Location**	
4		The project area lies within northern Palm Beach County and southern Martin County with a focus on the Loxahatchee River watershed. Because of future proposals for the interconnection of the Loxahatchee River watershed with other features of the regional system, the study area extends from the C-51 Canal in Palm Beach County to the south to approximately Bridge Road in Martin County and the C-44 canal in the north. The eastern boundary is the Intracoastal Waterway (ICW) and the western boundary is the L-8 Canal.	Same as ECB
5	2	**Regional System**	
6		Lake Okeechobee water is NOT routed to the L-8 Tieback and through the M-Canal to the Grassy Waters Preserve (WPB Water Catchment Area) (GWP) for water supply. L-8 Basin runoff is used in Alt 10. L-8 Basin water is withdrawn from the M-Canal for irrigation purposes by existing permitted users. Regional water is brought in from the C-44 canal to irrigate the permitted groves in the northern portion of the study area.	In this alternative, the source of water supply for the City of West Palm Beach is shifted from Lake Okeechobee to L-8 Basin water captured and stored in the C-51 Phase II reservoir. See description in project feature below.
7	2a	**Flowway Concepts and Operational Priorities between FW1 and FW2 for Restoration Source Water**	
8		FW1 is first priority water source for deliveries to Loxahatchee Slough and River if City of WPB is releasing waters for flood control purposes. FW1 and FW2 are not connected in Alt 10. FW1 is constrained by available water in L-8 Canal and Grassy Water Preserve wet and dry stages (as specified on Item 5 below). No G-161 replacement ratio (1.4:1) is assumed due to use of Forcemain. G-161 capacity is up to 50 cfs. Flows through G-161 are assumed to come from the Forcemain, not GWP.	See individual project descriptions below
9		Flowway 1 Delivers L-8 Basin water, to C-51 Phase II Reservoir, L-8 Canal, L-8 Tieback Canal, Control 2 pump station, M- Canal to Forcemain, G-161, to C-18 Canal.	See individual project descriptions below

	A	B	C
10		**Description of Flowway 2:** Alt 10: Flowway 2 design includes the C-18W Reservoir which delivers water to the C-18W canal, C-18 Cana, then to the Northwest Fork of the Loxahatchee River.	See individual project descriptions below
11	3	**L-8 Basin and/or C-51 Storage**	
12		The areas that contribute flows to the L-8 Basin include Corbett, Dupuis, ITID (M-1 upper and lower basins - see Item 11 below for restrictions), GL Homes/Cypress Groves, agricultural areas	Same as ECB with exception of ITID water being available for C-51 Storage
13		**L-8 FEB:** Stages for L-8 FEB are input for the FWO and Alternatives based on output from the Restoration Strategies DMSTA 2012 Project modeling. The project assumes that L-8 FEB water source is S-5A basin and C-51W via S-5A complex which is outside the LECsR model boundary.	Same as FWO.
14		**C-51 Phase 1:** C-51 Phase I is a mined area, however, its operation is not included in the base conditions or the alternatives. C-51 Ph. 1 water source is western C-51 basin via the L-8 FEB (project assumption, but do not model)	Same as ECB
15		**C-51 Reservoir Phase II storage:** This facility is constructed and is operable to provide deliveries to the LRWRP project and water supply to the City of West Palm Beach. Inflow source is the L-8 Canal (Area contributing to this site is L-8 Basin, except for agricultural lands west of S-76) Reservoir discharges are routed to Flowway 1. Available capacity is assumed to be 44,000 acre feet on approximately a 1,600-acre footprint (+ or -) 33.7 feet of storage from ground elevation of 15.1 ft. to -18.6 ft. NGVD. (slope within footprint is assumed to reduce available storage volume).	The C-51 Phase II Reservoir is simulated as a fully mined and operational site using the wetlands package. Due to grid size, the footprint may be different, but the 44,000 acre-feet volume is preserved. Water from the L-8 Basin is moved into and out of the reservoir using a combination of diversion and rdf packages.
16		**L-8 Basin shallow storage** This facility is not included in this alternative.	Same as ECB
17		**ASR @ L-8 Shallow Impoundment** is not constructed.	Same as ECB

	A	B	C
18	4	**M-Canal Conveyance Improvements**	
19		**Control 2 Pump Station (WPB #2)** has a pumping capacity of 165 cfs and 2 additional pumps for a total capacity of 300 cfs	Same as ECB
20		**M-1 to M-Canal Pump station** is not constructed	Same as ECB
21	5	**Grassy Waters Preserve (WPB Catchment Area) Deliveries**	
22		**GWP Operation:** CWPB desired operation: GWP stage is between 18.4 and 19.2 (permit is 17.6 - 19.2) NGVD. M-Canal maintained .02-.03 feet below GWP to reduce flow into preserve. Based on WPB Consumptive Use Permit pumping at control 2 ceases when Clear Lake is >12.5 ft. NGVD Deliveries to G-161 for environmental purposes, of up to 50 cfs, via forcemain. No additional water from GWP for environmental purposes is delivered except volume delivered by force main.	M- Canal is maintained at 18.5 ft. NGVD. See discussion on force main below.
23		**Replacement Water**. Replacement water is no required pursuit to Line 22.	Same as ECB.
24	6	**Loxahatchee Slough Area**	
25		**Northlake Bridge**. Improvements to pass 100 cfs at Northlake bridge, draining north at 19.2 ft. NGVD	Same as ECB.
26		**Beeline Bridge**: New bridge is constructed on Beeline and there are no flow restrictions	Same as ECB.
27		**G-161:** G-161 can discharge up to 50 cfs via the force main.	Forcemain is simulated using the diversion package to deliver 50 cfs of water from C-51 Phase II reservoir to G-161. A transmission loss of 7 percent is also assumed before it reaches the intake.
28		**G-160:** G-160 is constructed and operational and has a maximum capacity of 2000 cfs (for flood control). The structure is operated to benefit Loxahatchee Slough. Open when slough stage is at or greater than 15.5 ft. NGVD in middle of dry season, gradually rising to 17.5 ft. NGVD in wet season. Assume no boards at PC-13 and PC-15. Seasonal Operation schedule is as follows: - December to April: Gate opens at 16.2 ft. NGVD and closes at 15.5 ft. NGVD - November and May gate opens at 17.1 ft. NGVD and closes at 16.2 ft. NGVD - June to October (wet season); gate opens at 17.5 ft. NGVD and closes at 17.1 ft. NGVD. No water is released at G-161 when G-160 is above seasonal stage. G-160 allowable discharge Is up to 150 cfs for environmental deliveries, and to maintain flood control capability as necessary for non-environmental deliveries.	Same as Alt 2.
29		**Shallow Seepage Barriers** in Lox Slough at C-18 Canal and around Luckey Tract are not present	Same as ECB.
30	7	**C-18W Storage**	

	A	B	C
31		**C-18 W Impoundment:** C-18W Impoundment has a capacity of 7,200 acre feet on 1,590 acres. Inflow and outflow are up to 300 cfs from pump station on north side and 250 cfs from pump station in the seepage collector canal on the west side. Outflow is 200 cfs to the C-18W canal (volumes are model caps; demand is triggered by the river). Include a constraint that "if the stage west of the C-18 weir is > 18.0 ft. (or some other stage) direct up to 300 cfs into the reservoir. Intent is to avoid drawdown of wetlands in eastern Corbett and Hungryland Slough. Assume impoundment is 4.5 feet deep on 1,590 acres.	The C-18W Impoundment is simulated as an above ground reservoir using the wetland package. Due to grid size the actual acres covered is slightly less but the volume of 7,200 acre feet is preserved by adjusting the depth of water available in the facility. Water is moved in and out of the impoundment up to the volumes specified using the rdf package. The seepage barrier is simulated by reducing the hydraulic conductivity of the aquifer properties in Layer 1 along the southern and eastern levees. Up to 150 cfs of excess water from the C-18 canal is diverted back into the impoundment when levels exceed 18.6 feet NGVD at the C-18 weir and the reservoir is below 25.6 feet NGVD. Up to 250 cfs can be sent into the impoundment from the western seepage canal, where sources include seepage, outflow from Corbett Weir, and ITID Upper Basin. During flood events in the reservoir, up to 300 cfs can be diverted to the C-18 canal to avoid over-topping of the reservoir.
32		**Aquifer Storage and Recovery (ASR) @ C-18W Impoundment** Aquifer Storage and Recovery (ASR) @ C-18W Impoundment is not implemented.	Same as ECB.
33		**Corbett Weir:** Corbett weir is replaced with an operable water control structure, and is operated to control water levels in eastern Corbett between 21.5 to 23.0' NGVD. This culvert discharges into the M-O Connector canal. M-O connector discharges under Seminole Pratt Road to the C-18 W Impoundment seepage canal and water is input into the reservoir with a pump station that has a capacity of up to 250 cfs.	Same as Alt 2.
34		**MO Connector Canal and Pump Station**: A canal is constructed on the west side of SPW road up to the Corbett structure; One set of culverts is constructed under road discharging into Mecca seepage collection. The MO Connector pump station has a capacity of 200 cfs.	Water from ITID lower basin moves into the C-18 Impoundment at rates up to 175 cfs using the rdf and diversion package. Excess water from the lower basin is routed to the L-8 Canal to supplement the C-51 Phase II inflows if needed.
35		**Beeline Culverts:** Culverts under Beeline are neither constructed nor operable.	Same as ECB
36		**Seepage barriers around Gun Range and Natural Area** **Alternative 10:** - Seepage barriers are constructed around Gun Range, but not around Natural area.	Same as Alt 2.

	A	B	C
37		**Vavrus/Avenir:** The conceptual design for the Avenir development is incorporated. This includes development at the southern end of the property, with proposed control elevations. The internal ditches on the northern portion are filled to implement a 'rainfall driven' restoration. Alt 10 does not include natural flowway across Avenir.	Same as FWO.
38		**North County Airport**. This alternative includes the C-18w Reservoir. This reservoir is more than 10,000 feet from the NPBC Airport . NPBC Airport is gravity drained with a control of 18' NGVD. Sweetbay Natural Area is controlled at 20.25' NGVD, and drains through CSX ditch south.	Same as ECB
39	8	**C-18 Weir, G-92 and Lainhart Dam**	
40		**C-18W Weir** The C-18 Weir is in its existing location, with a weir crest elevation of 17.6 ft. NGVD	Same as ECB
41		**C-18 Canal Operations:** The minimum flow delivered to the NW Fork is based on the initial information from the Loxahatchee River Restoration Plan (2006, updated in 2011), the flow targets are: -Wet season (June-November: 120 days over 110 cfs at Lainhart (110 -150 cfs). - Dry Season (December - May) 50-90 cfs with 68 cfs monthly mean; for model simplification use daily 68 cfs -Use as-built design with maximum capacity of 400 cfs at G-92. -G-92 discharges to the NW Fork of the Loxahatchee River when C-18 is above 13.0' NGVD. - When C-18 exceeds 14.5' NGVD, up to 400 cfs is sent north over G-92. -If C18 is between 13.0 and 14.5' NGVD and Lainhart Dam Flows exceed 50 cfs from Jupiter Farms runoff, then G-92 flow is zero. If C-18 exceeds 15.0' NGVD, S-46 opens and discharges up to 4,000 cfs to the SW Fork of the Loxahatchee River. When Lainhart Dam is above 14.0 feet, excess flow (up to 400 cfs) from SIRWCD is directed back into C-18, through G-92 and discharged out through S-46. Project water is not delivered to the C-18W canal downstream of the weir when downstream stage is >13.5' NGVD (a flood control constraint.)	Same as ECB
42	9	**SIRWCD and Jupiter Farms**	
43		**Jupiter Farms** is a development in the SIRWCD that drains into the C-14 Canal just north of G-92. SIRWCD control structures at Jupiter Farm are constructed; discharges into and out of Jupiter Farms canals are controlled at 13.0 - 14.0 NGVD, draining to C-14 upstream of Lainhart. This raises the levels of the canals and holds water back from discharging to the C-14 canal.	Same as ECB.

	A	B	C
44	10	**Loxahatchee Tributaries (Kitching, Wilson and the North Fork)**	
45		**Wilson Creek and the North Fork** are unregulated. **Kitching Creek:** A spreader swale is constructed to the east and west from Jenkins Ditch at the north end of JD Park to distribute flows to historic Kitching Creek channels. A sheetpile weir is constructed in the ditch upstream of the main Kitching Creek channel at elevation 12.0 (NGVD)	Same as Alt 2.
46	10a	**Southern Martin County Properties**	
47		**Hobe St. Lucie Conservancy District (HSLCD)** has three discharge structures. One discharges to the South Fork of the St. Lucie River, the second discharges to the Cypress Creek Canal and the third discharges to the Hobe Grove Ditch. Cypress Creek Canal and Hobe Grove Ditch both discharge to the Loxahatchee River.	Same as ECB. Cypress Creek structure changes and HSLCD Unit 2 discussed separately below.
48		**Cypress Creek Weir** A new weir is constructed in the Cypress Creek Canal downstream of the existing location. This weir elevation is set at 9.0 ft**.** NGVD	Same as Alt 2.
49		**Nine Gems (Palmar East) Properties** (lateral and southern canals) Existing drainage is assumed for the southern Nine Gems Canal and lateral drainage canals, as well as for the HSLCD drainage canal. Nine Gems (Palmar East) Properties (lateral and southern canals)	Same as ECB.
50		**Palmar west of Pratt Whitney Road**. Drainage ditches exist, but are not connected. Flow to the east is via culverts under west of Pratt Whitney Road	Same as ECB
51		**Thomas Farms Drainage** TF drains via gravity through an existing culvert under Pratt-Whitney Road, and through southern Nine Gems canal. The property just north of TF drains (by gravity) into HSLCD canal on north side of Nine Gems.	Same as ECB.

	A	B	C
52		**Hobe St. Lucie Conservancy District Unit 2** This is an existing agricultural area planted in sugar cane. The property drains through 3-84" culverts, invert of 7.7' NGVD and a control elevation of 12.0' NGVD. No changes to HSL Unit 2.	Same as ECB.
53		**Nine Gems (Palmar East) Properties (northern boundary canal and berm)** There are no changes and these wetlands continue to drain to the northern canal. North end of Nine Gems Wetlands drain north to HSL canal (invert at wetland bottom).	Same as ECB.
54		**Gulfstream West** Gulfstream Property West is an ~700 acre fallow Citrus Gove adjacent to and west of I-95/Turnpike). that drains to Cypress Creek. Flow through marsh is not constructed.	Same as ECB.
55		**Moonshine Creek and Gulfstream East Property** The Gulfstream East property (450 acre fallow citrus grove) is restored. Existing drainage ditches are filled (to facilitate restoration)is connected to Hobe Grove Ditch, a new weir is installed at the east end of HG Ditch prior to its discharge to the NW Fork. New weir is at elevation 7.5' NGVD (3.5 ft. below control elevation for HSL upstream structure (11' NGVD)	Same as Alt 2.
56		**Culpepper Property** The Culpepper property improvements are completed. The northern portion of the Ranch Colony berm is raised to 24.5' NGVD (consistent with the southern 2/3).Twin 84" culvert operation will change to between 18.5-20.1 ft. NGVD (see schedule attachment). Other identified culverts to maintain operation as in ECB.	Same as Alt 2.
57		**Cypress Creek and Shiloh Farms Properties**, 2-66" RCP culverts with risers exist at Gulfstream Road as in 2014B. No changes. Do not include regrading the Shiloh pepper field to facilitate Historic flowways to Cypress Creek.	Same as ECB.
58		**Spreader Swale and pump station on Cypress Creek Property near Mack Dairy:** Spreader swale and pump station are not constructed	Same as ECB.

	A	B	C
59		**Ranch Colony and other Development Communities:** Communities control elevations are: The following control levels are used for the RC communities: Ranch Colony & Colony Park- 14.5' NGVD, RCII - 15.5' NGVD, the Links 17.0' NGVD, Old Trail - 16.0' NGVD	Same as ECB
60	11	**Indian Trail Improvement District (ITID) M-1 Basins**	
61		ITID discharges up to 1,100 cfs to the L-8 Canal via the via the ITID Impoundment. (1100 cfs is roughly equivalent to 1"/day flood protection.) ITID will minimize or eliminate gravity discharges to the C-51.	See below.
62		ITID's peak discharge is to L-8 and to the MO Connector with subsequent discharges to project features if storage is available, or to S-5A complex and Lake Okeechobee at C-10A when project storage is full.	ITID upper basin runoff is directed to the C-51 Phase 2 facility. Excess water from the ITID Upper basin is routed south through the S-5A complex. ITID lower basin water is routed to the C-18 Impoundment at rates up to 200 cfs. Excess water is routed south to the L-8 canal.
63		The ITID impoundment has 1100 cfs capacity with the existing inflow pump and is assumed to have 1100 cfs outflow by gravity.	Total discharge capacity for ITID is increased to 1100 cfs and proportioned based upon basin runoff.
64		M1 Upper Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr, Nov-Dec) and 16.0 NGVD in the wet season (May-October) M-1 Lower Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr., Nov-Dec) and 15.0 in the wet season (May-Oct) No water is to be moved from ITID to LRWRP project features when stages are below ITID seasonal control elevations.	same as ECB
65	12	**Other Related Project Structures - (outside model boundary)**	
66		S-155A is constructed and operational. Portion of L-8 discharges to S-155A and out S-155 to Lake Worth Lagoon. All C-51 eastern Basin water discharges at S-155	Same as ECB
67		STA-1E and STA-1West are constructed and operational	Same as ECB
68	13	**Pumping and Water Restriction Areas**	
69		Public Water Supply (PWS) wellfield withdrawals are based on permitted allocations at the end of each utility's consumptive use permit.	Same as ECB
70		PWS in the study area includes Martin County Utilities (Tropical Farms), SMRU, Stuart, Palm Beach County (System 8), Jupiter, Seacoast, Tequesta, West Palm Beach and Riviera Beach.	Same as ECB
71			
72			
73			
74			

	A	B	C
1	**No.**	**System Operations and Uses**	
2		**General Description/Project Assumptions: Alternative 13**	**Model Assumptions: Alternative 13**
3	1	**Project Location**	
4		The project area lies within northern Palm Beach County and southern Martin County with a focus on the Loxahatchee River watershed. Because of future proposals for the interconnection of the Loxahatchee River watershed with other features of the regional system, the study area extends from the C-51 Canal in Palm Beach County to the south to approximately Bridge Road in Martin County and the C-44 canal in the north. The eastern boundary is the Intracoastal Waterway (ICW) and the western boundary is the L-8 Canal	The active model boundary covers the entire LRWRP area. The 41-year period of simulation is from 1965 to 2005. The LECSR-NP model was calibrated from 2005 through 2014.
5	2	**Regional System**	
6		Lake Okeechobee water is routed to the L-8 Tieback and through the M-Canal to the Grassy Waters Preserve (WPB Water Catchment Area) (GWP) for water supply. Regional water is also withdrawn from the M-Canal for irrigation purposes by existing permitted users. Regional water is brought in from the C-44 canal to irrigate the permitted groves in the northern portion of the study area.	LECSR-NP does not simulate regional water management and relies on the SFWMM run, ECB (which was modified from ECB1.3_CEPP) for internal boundary conditions for L-8, C-51 and C-44 canal stages, as well as flows from the Lake to the M-Canal
7	2a	**Flowway Concepts and Operational Priorities between FW1 and FW2 for Restoration Source Water**	
8		The first priority water source for deliveries to Loxahatchee Slough and River is FW2 to meet restoration targets. FW1 deliveries can supplement when available water in L-8 Canal and Grassy Water Preserve wet and dry stages (as specified on Item 5 below) and subject to replacement ratio (1.4:1) and up to 20 cfs through G-161. Flows through G-161 are assumed to come from GWP.	See individual project descriptions below
9		**Description of Flowway 1**: Flowway 1 primarily consists of G-161, which can divert water from GWP into the C-18 canal and then to NW Fork of the Loxahatchee River via G-92 and Lainhart Dam. Flow to the City WPB for water supply, utilizing the Control 2 PS and the M-Canal continue.	See individual project descriptions below
10		**Description of Flowway 2:** Flowway 2 provides an alternative path to route water eastward down the M-O Canal, via the L-8 Shallow Impoundment and C-18W Impoundment or restoration area to the C-18W canal to the NW Fork of the Loxahatchee River. The flowway 2 design consists of either storage within the L-8 Basin (L-8 Shallow Reservoir and associated 4 ASRs). A new canal along the west side of the Mecca Site would be connected to the M-O canal and then to C-18 via shallow conveyance or via the C-18W natural area.	See individual project descriptions below
11	3	**L-8 Basin and/or C-51 Storage**	
12		The areas that contribute flows to the L-8 Basin include Corbett, Dupuis, ITID (upper basin- see Item 11 below for restrictions), GL Homes/Cypress Groves, agricultural areas	Same as ECB
13		L-8 FEB: Stages for L-8 FEB are input for the FWO and Alternatives based on output from the Restoration Strategies DMSTA 2012 Project modeling. The project assumes that L-8 FEB water source is S-5A basin and C-51W via S-5A complex which is outside the LECsR model boundary.	Same as FWO
14		**C-51 Phase 1:** C-51 Phase I is a mined area, however, its operation is not included in the base conditions or the alternatives. C-51 Ph. 1 water source is western C-51 basin via the L-8 FEB	Same as ECB
15		**The C-51 Reservoir Phase II** storage is not operable and does not provide water deliveries to the LRWRP project or elsewhere. The site is fully mined over a 1,600 acre footprint to -18.6 ft. NGVD.	Same as ECB

	A	B	C
16		**L-8 Basin Shallow Storage** L-8 Basin shallow storage has a capacity of 6,500 acre feet on 1,500 acres. Inflow from L-8 at 200 cfs (PS). Discharge to FW2 only up to 180 cfs for deliveries C-18W Natural Storage area requirements and to flowpaths related to Natural Storage.	The L-8 Shallow Reservoir is simulated as an above ground reservoir in the wetlands package. Due to grid size the footprint in the model may be different, and the reservoir is simulated with a volume of 5,600 acre-feet volume. Inflows and outflows from the reservoir use the rdf/diversion package. Inflow into L-8 Shallow Storage is from ITID up to 200 cfs. Outflow to C-18 Natural Storage up to 180 cfs.
17		**ASR @ L-8 Shallow Impoundment.** 4 ASR wells are co-located with the L-8 Shallow Impoundment.	4 ASR wells are simulated. The ASR bubble is directly simulated in an inactive portion area of the model and assumes a 70 percent efficiency. Inflows and outflows from the ASR wells are modeled using the diversion package. ASR inflow and outflow capacity is 30 cfs.
18	4	**M-Canal Conveyance Improvements**	
19		**Control 2 Pump Station (WPB #2):** West Palm Beach Control #2 pump station has a pumping capacity of 165 cfs for water supply deliveries from the L-8 Canal to the M-Canal. **Control 2 Pump Station (WPB #2)** This facility has a pumping capacity of 165 cfs and 2 additional pumps for a total capacity of 300 cfs. The M-canal capacity is assumed to be up to 225 cfs	Same as ECB
20		**M-1 to M-Canal Pump station** M-1 Canal to M canal connection does not exist	Same as ECB
21	5	**Grassy Waters Preserve (WPB Catchment Area) Deliveries**	
22		CWPB desired operation: GWP stage is between 18.4 and 19.2 (permit is 17.6 - 19.2) NGVD. M-Canal maintained .02-.03 feet below GWP to reduce flow into preserve. Based on WPB Consumptive Use Permit pumping at Control 2 ceases when Clear Lake is >12.5 ft. NGVD Delivery of up to 20 cfs via G-161 when GWP stage is above 18.4 ft. NGVD. M-Canal is maintained at 18.9 ft. NGVD. Replacement water at 1.4:1 ratio for water removed from GWP at G-161.	Same as ECB except G-161, see discussion below.
23		**Replacement water** is provided at a 1.4:1 ratio for water released from GWP at G-161 for River restoration. This water is provided from available L-8 basin flows.	Same as Alt 2.
24	6	**Loxahatchee Slough Area**	
25		**Northlake Bridge**. Improvements to pass 100 cfs at Northlake bridge, draining north at 19.2 ft. NGVD	Same as ECB.
26		**Bee Line Highway Bridge:** New bridge is constructed on Beeline and there are no flow restrictions	Same as ECB
27		**G-161:** G-161 is constructed and operational. Provide up to 20 cfs, discharging directly to C-18 to support flows to the NW Fork of the Loxahatchee River. Triangle stage to be controlled by G-160 operation.	Same as ALT 2.
28		**G-160:** G-160 is constructed and operational and has a maximum capacity of 2000 cfs (for flood control). The structure is operated to benefit Loxahatchee Slough. Open when slough stage is at or greater than 15.5 ft. NGVD in middle of dry season, gradually rising to 17.5 ft. NGVD in wet season. Assume no boards at PC-13 and PC-15. Seasonal Operation schedule is as follows: - December to April: Gate opens at 16.2 ft. NGVD and closes at 15.5 ft. NGVD - November and May gate opens at 17.1 ft. NGVD and closes at 16.2 ft. NGVD - June to October (wet season); gate opens at 17.5 ft. NGVD and closes at 17.1 ft. NGVD. No water is released at G-161 when G-160 is above seasonal stage. G-160 allowable discharge Is up to 150 cfs for environmental deliveries, and to maintain flood control capability as necessary for non-environmental deliveries.	Same as Alt 2.
29		Seepage Barrier in Lox Slough/Luckey Tract (see graphics)	A shallow seepage barrier is simulated around the Luckey Tract and the Lox slough south of the C-18 canal using levees along layer 1 in the wetlands package. (see graphics)

	A	B	C
30	7	**C-18W Storage**	
31		**C-18W Natural Storage:** The former Mecca property is managed as a wetland system, with source water (from the L-8 Shallow impoundment, the Corbett structure and ITID upper basin) along three preferential paths through the property. A 50 cfs flow path links to the C-18W canal for deliveries to the river when stages in the Natural Storage are above 21.5' NGVD. Two smaller flow paths run to the Avenir wetland restoration area with a single 25 cfs pump station moving the water east from the Natural Storage area. Wet season hydroperiod desired stage is 21' NGVD. Water is delivered to the eastern flow paths. Average grade elevation of natural storage site is assumed at 21' NGVD after select regrading of site.	C-18 W Natural Storage wetland feature is simulated as a wetland with a maximum water elevation of 24 feet NGVD. Water is discharged with to the Avenir wetland area if needed or to the C-18 West canal to help meet the Loxahatchee River demands. Inflows can occur from Corbett, the seepage canal and the L-8 Impoundment.
32		**Aquifer Storage and Recovery (ASR) @ C-18W Impoundment.** ASR is not implemented	Same as ECB
33		**Corbett Weir:** Corbett Weir is replaced with an operable water control structure, and is operated to control water levels in eastern Corbett between 21.5 to 23.0' NGVD. This culvert discharges into the M-O Connector canal. M-O connector discharges under Seminole Pratt Road to the existing ditch on west side of Mecca. water is input into the reservoir with a pump station that has a capacity of up to 250 cfs. When transitioning between wet season and dry season elevations, the intent is to bleed down the stage at Corbett Weir to elevation 21.5 over two or three months. When the natural storage system is full and there are big rain events, outflow from Corbett will be sent to the C-18W Canal.	The Corbett weir is simulated at a dry season elevation of 21.5 feet NGVD and a wet season elevation of 23.0 feet NGVD. Water flow over the weir is simulated using the rdf package and is discharged into the C-18 Impoundment at rates up to 250 cfs. The bleed down will be simulated by moving 50 cfs from Corbett into the Natural Storage feature when water levels exceed seasonal stage targets in Corbett and the natural storage area can take it. When stages within Corbett exceed season control elevations and the Natural Storage system is full, outflow from Corbett will be sent to the C-18W Canal.
34		**MO Connector Canal and pump station** The M-O Canal Pump station has a capacity of **180 cfs.** M-O connector canal runs on east side of SPW Road up to the Corbett weir structure, then one set of culverts under road discharging into a spreader canal with preferential flow path to the C-18.	The L-8 Shallow Reservoir moves into the C-18 Impoundment at rates up to 180 cfs using the rdf package. Water from the L-8 Shallow Impoundment moves into the C-18 Impoundment when stages in are below 23.5 feet NGVD.
35		**Beeline Culverts** Box Culverts constructed and operable to provide sheet flow north and south of airport to east side of Beeline. Invert at 19' NGVD for northernmost culvert and 18' NGVD for the southernmost culvert for a flow-through system sized to handle the amount of water input to the west side of Mecca property (up to 250 cfs) Also need to consider culverts under FEC railroad of similar size; potential ditch plugs in FEC drainage ditch at SE corner of Airport to push water north to proposed box culverts; and a ditch plug in large canal on east side of Beeline to keep water from draining south toward PGA Blvd.	Same as ECB
36		**Seepage barriers around Gun Range and Natural Area.** Seepage barriers are not present.	Same as Alt 2.
37		**Vavrus/Avenir:** Conceptual development is in place and wetlands are restored to rainfall driven scenario. Additionally, Wetlands are rehydrated at restored by three preferred flow paths. Two flow paths deliver up to 25 cfs (combined via a single 25 cfs pump station) east from Mecca when Mecca is >21' and Avenir is <20.5', with wetland elevations controlled at 20.7-20.5' NGVD from west to east on north side of the C-18W and 20.5' - 19' NGVD from west to east on the Northern Avenir property and Airport preserves properties. When west edge of Mecca is above 21.5', a preferred flow path delivers up to 50 cfs to the C-18W Canal when Lox River needs water.	Avenir development is modeled the same as FWO. Additionally, when stages in C-18 Natural Storage are above 21 feet NGVD and stages in Avenir are below 20.5 feet NGVD, 25 cfs is sent through the flow paths using the diversion package. Discharge occurs either to the north into the C-18 canal or east into Sweetbay if water levels are below the control elevation.

	A	B	C
38		**NPBC Airport**. NPBC Airport is gravity drained with a control of 18' NGVD. Sweetbay natural Area is controlled at 20.25' NGVD, and drains through CSX ditch south.	Water is brought into the Sweetbay natural area from Avenir via the C-18 Impoundment. Water then discharges northeastward underneath the Beeline Highway and into to western portion of the Loxahatchee slough at rates not to exceed 10 cfs.
39	8	**C-18 Weir, G-92 and Lainhart Dam**	
40		**C-18 Weir:** The C-18 Weir is relocated West of Beeline Hwy and upstream from PC-18A (but as far east as possible) and has a weir crest of 18.5' NGVD.	The C-18 Weir is simulated with a weir crest of 18.5' NGVD using the rdf package. Flows over the C-18 weir are governed by the weir equation at steps of approximately 0.2 feet intervals. Flows into the west leg of the C-18 canal occur as runoff or base flow from eastern Corbett, Hungryland, Pratt and Whitney, Mecca and Avenir using a combination of the RDF and diversion packages. The location of the weir in the model does not change because of the cell size.
41		**C-18 Canal Operations:** The minimum flow delivered to the NW Fork is based on the initial information from the Loxahatchee River Restoration Plan (2006, updated in 2011), the flow targets are: -Wet season (June-November: 120 days over 110 cfs at Lainhart (110 -150 cfs). - Dry Season (December - May) 50-90 cfs with 68 cfs monthly mean; for model simplification use daily 68 cfs -Use as-built design with maximum capacity of 400 cfs at G-92. -G-92 discharges to the NW Fork of the Loxahatchee River when C-18 is above 13.0' NGVD. - When C-18 exceeds 14.5' NGVD, up to 400 cfs is sent north over G-92. -If C18 is between 13.0 and 14.5' NGVD and Lainhart Dam Flows exceed 50 cfs from Jupiter Farms runoff, then G-92 flow is zero. If C-18 exceeds 15.0' NGVD, S-46 opens and discharges up to 4,000 cfs to the SW Fork of the Loxahatchee River. When Lainhart Dam is above 14.0 feet, excess flow (up to 400 cfs) from SIRWCD is directed back into C-18, through g-92 and discharged out through S-46. Project water is not delivered to the C-18W canal downstream of the weir when downstream stage is >13.5' NGVD (a flood control	Same as ECB
42	9	**SIRWCD and Jupiter Farms**	
43		**Jupiter Farms** is a development in the SIRWCD that drains into the C-14 Canal just north of G-92. SIRWCD control structures at Jupiter Farm are constructed; discharges into and out of Jupiter Farms canals are controlled at 13.0 - 14.0 NGVD, draining to C-14 upstream of Lainhart. This raises the levels of the canals and holds water back from discharging to the C-14 canal.	Same as ECB.
44	10	**Loxahatchee Tributaries (Kitching, Wilson and North Fork)**	
45		**Wilson Creek and the North Fork** are unregulated. **Kitching Creek:** A spreader swale is constructed to the east and west from Jenkins Ditch at the north end of JD Park to distribute flows to historic Kitching Creek channels. A sheetpile weir is constructed in the ditch upstream of the main Kitching Creek channel at elevation 12.0 (NGVD)	Same as ALT 2.
46	10a	**Southern Martin County Properties**	
47		**Hobe St. Lucie Conservancy District (HSLCD)** has three discharge structures. One discharges to the South Fork of the St. Lucie River, the second discharges to the Cypress Creek Canal and the third discharges to the Hobe Grove Ditch. Cypress Creek Canal and Hobe Grove Ditch both discharge to the Loxahatchee River.	Same as ECB. Cypress Creek structure changes and HSLCD Unit 2 discussed separately below.
48		**Cypress Creek Canal:** A new weir is constructed in the Cypress Creek Canal downstream of the existing location. This weir elevation is set at 13.0 ft. NGVD. Location would also be upstream of the outfall for the flow-through marsh. The dogleg canal in Gulfstream West will be straightened. New weir will be downstream of the straightened dogleg.	Same as Alt 2.

	A	B	C
49		**Nine Gems (Palmar East) Properties** (lateral and southern canals). The internal drainage canals within Nine Gems are filled and do not drain to offsite canals	Same as Alt 2.
50		**Palmar West of Pratt Whitney Road**. Drainage ditches exist, but are not connected. Flow to the east is via culverts under Pratt Whitney Road.	Same as ECB.
51		**Thomas Farms Drainage** is modified so that all drainage is routed and pumped offsite at the northeast corner of the farm to the HSLCD canal on the north side of 9 Gems. A 40 cfs pump station is used to pump the Thomas Farms water north. Current drainage criteria are assumed	Same as Alt 2.
52		**Hobe St. Lucie Conservancy District Unit 2** is an existing agricultural area planted in sugar cane. The property drains through 3-84" culverts, with an invert of 7.7' NGVD and a control elevation of 12.0' NGVD. HSL Drainage is diverted into the Flow-through Marsh. If the marsh is full, or the discharge from Unit 2 exceeds the capacity of the pump station, overflow is directed to the by-pass. Current drainage criteria are assumed	Same as ECB.
53		**Nine Gems (Palmar East) Properties** (northern boundary canal and berm) Drains/pipes to the northern canal are eliminated. Assume minor berm improvements at the north side of the property	Same as Alt 2.
54		**Gulfstream West Property**. A flow through marsh is constructed on the property located to the west of I-95 and the Turnpike (between Old Trail community and the highway). The control stages within the marsh are between 14.5 to 17.0 feet NGVD (assume average NGVD ground elevation of 15.5) The marsh receives Inflow of up to 250 cfs from new pump station at north end of OC-2. Inflow pumping stops when water elevation = 17.75 NGVD (avg. depth of 3') Outflow is designed to discharge 250 cfs when water depth within the marsh reaches 3 feet. At 1.75 feet of depth, discharge base flow of 30 cfs. *All* discharge from the flow-through marsh is downstream of the new CCC weir. The capacity of an existing by-pass canal is maintained at 450 cfs but relocated to a canal on the west side of the FTM. The FTM is intended to pick up and attenuate HSL Unit 2 and rerouted TF discharge, plus any excess Nine gems sheet flow. Refer to initial stage-discharge relationship and stage-storage relationship (prepared by A. Tancreto, attached), for the discharge structure criteria.	Same as Alt 2.
55		**Moonshine Creek and Gulfstream East Property** The Gulfstream East property (450 acre fallow citrus grove) is restored. Existing drainage ditches are filled (to facilitate restoration)is connected to Hobe Grove Ditch, a new weir is installed at the east end of HG Ditch prior to its discharge to the NW Fork. New weir is at elevation 7.5' NGVD (3.5 ft. below control elevation for HSL upstream structure (11' NGVD)	Same as Alt 2.
56		**Culpepper property** Improvements are completed. The northern portion of the Ranch Colony berm is raised to 24.5' NGVD (consistent with the southern 2/3). The ditch between Nine Gems and Culpepper is filled to allow sheet flow from southwest to northeast. Twin 84" culvert operation will change to between 18.5-20.1 ft. NGVD (see schedule tab). Other identified culverts to maintain operation as in 2014B	Same as Alt 2.
57		**Cypress Creek and Shiloh Farms Properties:** 2-66" RCP culverts with risers exist at Gulfstream Road as in 2014B. There are no changes to these culverts. Pepper Farm Changes Alt 13: Regrade pepper farm to facilitate historic flowways through Shiloh Farm	Groundwater withdrawals at the Shiloh farm are eliminated and the internal canal system at the farm is removed.
58		**Spreader Swale on Cypress Creek Property:** A 50 cfs pump station is used to withdraw water from the Cypress Creek Canal, discharging to a spreader swale on the east side of Mack Dairy Road.	33 cfs pump station and spreader swale is simulated using the diversion package. Water is removed from the Cypress Creek Canal when canal elevation is above 9.1 feet NGVD or higher and routed along the east side of Mack Dairy Road when water levels in the property are below 20.5 feet NGVD .

	A	B	C
59		**Ranch Colony and other Development Communities:** Communities control elevations are: The following control levels are used for the RC communities: Ranch Colony & Colony Park- 14.5' NGVD, RCII - 15.5' NGVD, the Links 17.0' NGVD, Old Trail - 16.0' NGVD	Same as ECB
60	11	**Indian Trail Improvement District (ITID) M-1 Basins**	
61		Historically, ITID is allowed 274 cfs peak discharge for flood protection to the L-8 Canal (equivalent to 1/4 in/day). In recent years, most discharges occur via the M-1 Canal to C-51 unless C-51 stages restrict such flows as specified in ITID permit and MOU. S-155A restrictions are when stages are within 1/2' of 13.5' west and 11.7' east.	Same as ECB
62		ITID 's peak discharge historically was to L-8 with subsequent discharges to the S-5A complex and Lake Okeechobee at C-10A as conditions allowed. However the majority of ITID discharges are sent by gravity to the C-51.	Same as ECB
63		The ITID impoundment is not operated, consistent with the modeling assumption in Line 62 above.	Same as ECB
64		M1 Upper Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr, Nov-Dec) and 16.0 NGVD in the wet season (May-October) M-1 Lower Basin control elevation is 17.0 ft. NGVD in the dry season (Jan-Apr., Nov-Dec) and 15.0 in the wet season (May-Oct) No water is to be moved from ITID to LRWRP project features when stages are below ITID seasonal control elevations. Like project water will be passed through the ITID when stages are above ITID seasonal control elevations. The project can capture excess water when ITID is above the seasonal control level.	Same as ECB
65	12	**Other Related Project Structures - (outside model boundary)**	
66		S-155A is constructed and operational. Portion of L-8 discharges to S-155A and out S-155 to Lake Worth Lagoon. All C-51 eastern Basin water discharges at S-155	Same as ECB
67		STA-1E and STA-1West are constructed and operational	Same as ECB
68	13	**Pumping and Water Restriction Areas**	
69		Public Water Supply (PWS) wellfield withdrawals are based on permitted allocations at the end of each utility's consumptive use permit.	Same as ECB
70		PWS in the study area includes Martin County Utilities (Tropical Farms), SMRU, Stuart, Palm Beach County (System 8), Jupiter, Seacoast, Tequesta, West Palm Beach and Riviera Beach.	Same as ECB
71			
72			
73			

Modeled: Control Elevation in Ft NGVD

Structure	Base Cases	Alternatives
Twin 84	17.6	19.1
WCS-2	17.6	19.1
WCS-3	17.6	17.6
Jupiter Grade	18.5	18.5

Project Assumptions:

Existing Operational Schedule

NAVD	Twin 84 WCS1	North WCS 2	South WCS	Jupiter Grade
Jan	18.1	18.1	16.6	17.5
Feb	18.1	18.1	16.6	17.5
Mar	17.6	17.6	16.1	17
Apr	17.6	17.6	16.1	17
May	17.6	17.6	16.1	17
Jun	17.6	17.6	16.1	17
Jul	17.6	17.6	16.1	17
Aug	17.6	17.6	16.1	17
Sep	18.1	18.1	16.6	17.5
Oct	18.6	18.6	17.1	18
Nov	18.6	18.6	17.1	18
Dec	18.1	18.1	16.6	17.5
Structure invert	16.1	16.1	16.1	17

WCS lower elevation to let water exit out in that area

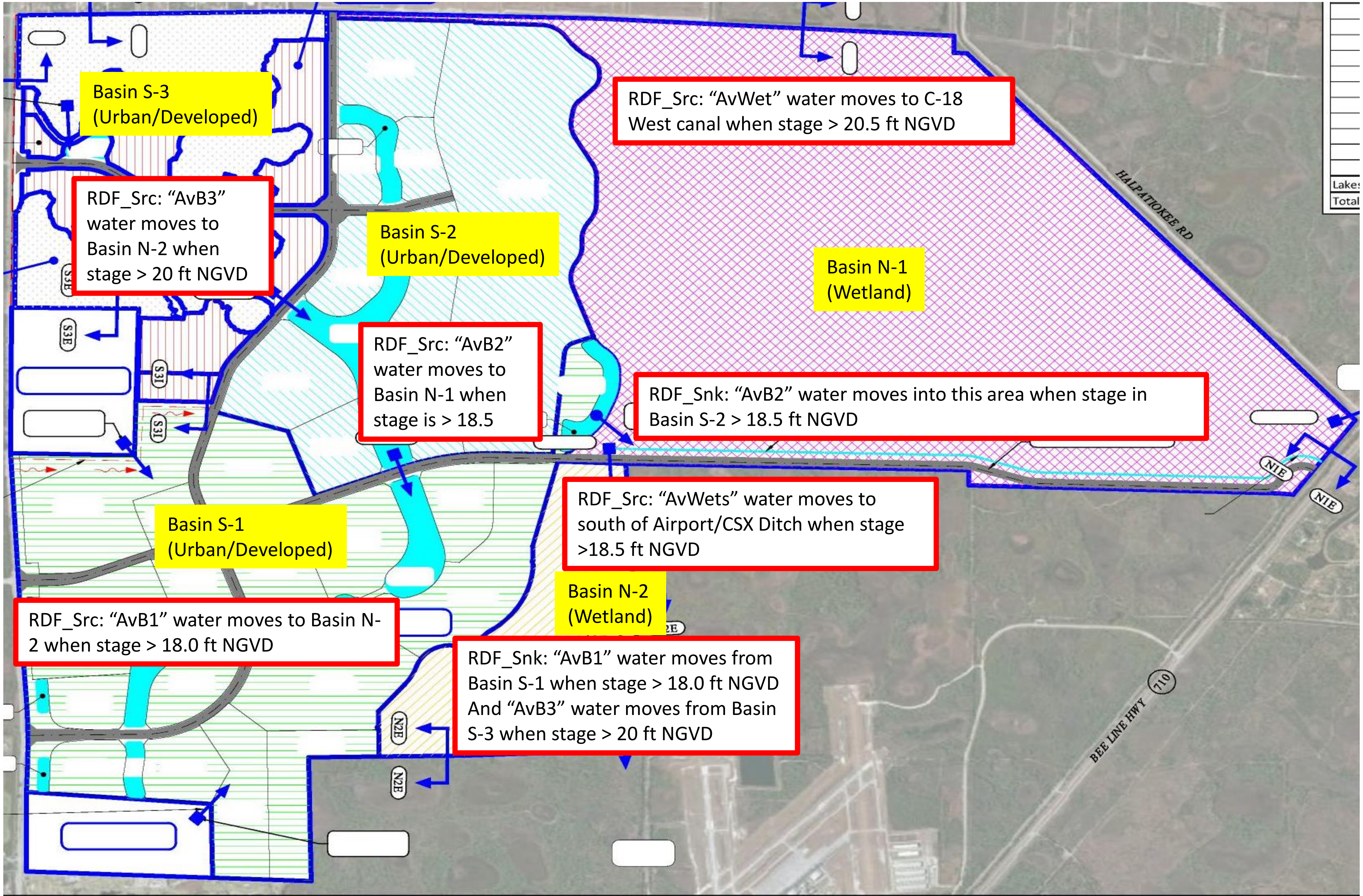
Existing condition maintain

	17.6	17.6	16.1	17
Project condition				
	18.6	18.6	17.1	18

If operational changes are too difficult to model use year round:

	17.6	17.6	16.1	17

Modeling Assumptions for Avenir (Runs: 2070FWO, ALTs 2, 5, and 10)



APPENDIX B – WATER BUDGETS

Water Budgets for Model Runs

South Florida Water Management District
April 5, 2018

Water Budget Terms

Terms	Net File Term	Description
Rivers	LEAK	Inflow or outflow representing baseflow from rivers
Drains	DRAIN	Outflow from basin due to drains
RDF	RDFS	Movement of water due to reinjection drain flow
Diversion	SRC_SNK	Movement of water due to diversions. Runoff from ET-Recharge-Runoff package is added into the Diversions
ΔS	STOR	Change in storage
GW	EAST,WEST,NORTH,SOUTH	Sum of groundwater flow in or out of the basin from each of the faces
Wells	WELLS	Water being removed from basin for irrigation or public water supply uses
ET	ET	ET from saturated zone
Recharge	RECHG	Gross groundwater recharge
Boundary Conditions	HDEND	Movement of water due to head dependent boundary conditions

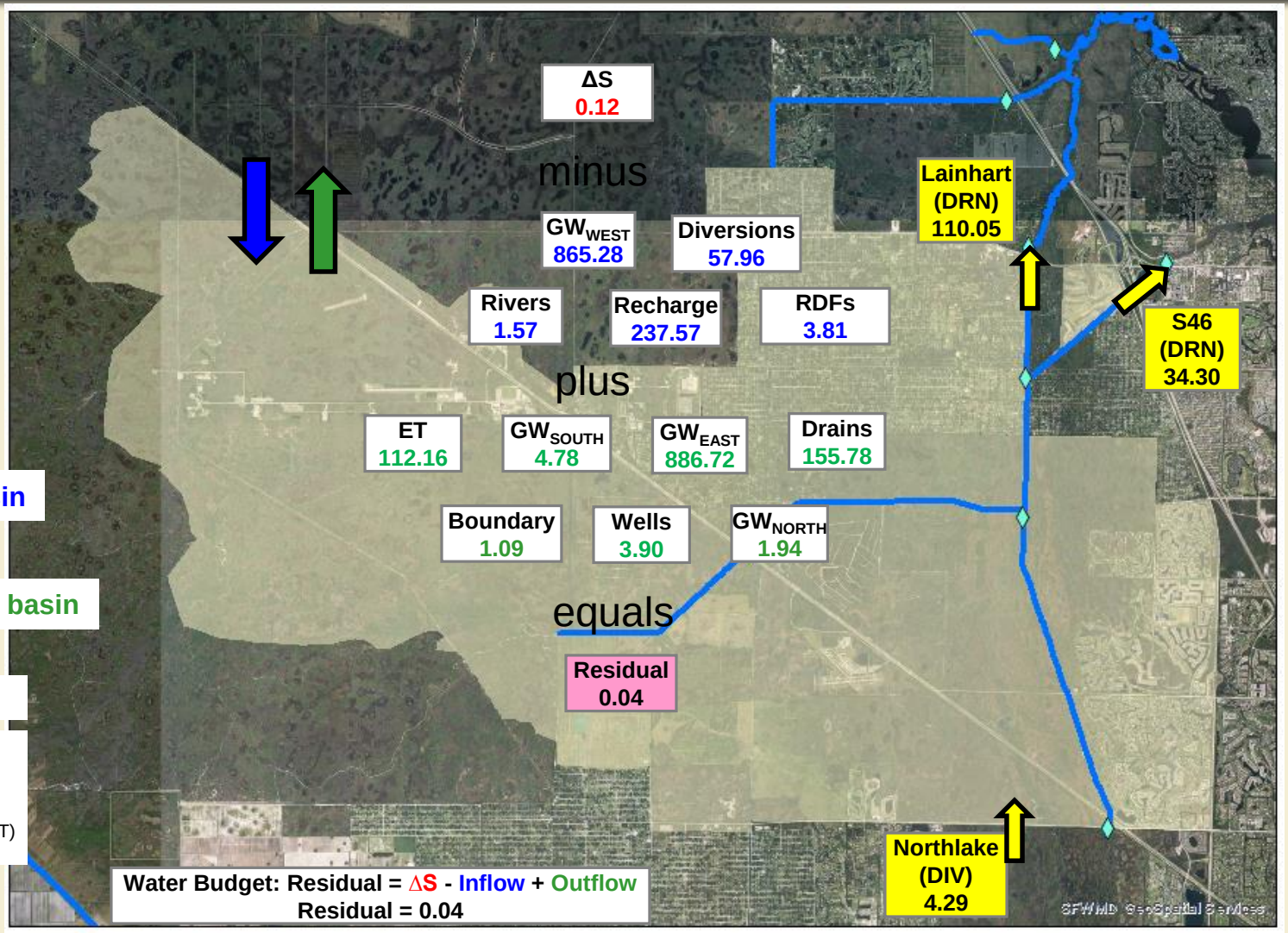
Structure Flow Terms

Structure	Packages Used	Equation
C-18 Weir	RDFS	Q = Rdfs (C18W.NET, AVENIR.NET, ECORB.NET, PRATT.NET)
S-46	Drains	Q = Drn (C18_E.NET)
G-92	RDFS	Q = Rdf (LNHT.NET, JFARM.NET, JFARM1.NET, JFARMP5.NET)
Lainhart	Drains	Q = Drn (LNHT.NET)
G-161	Diversion	Q = DIV (G161_SRC.NET)
G-160	RDFS	Q = RDFS (G160.NET, LOXG160.NET, PGA.NET, OMRSH.NET, MRSLW.NET, EPOINT.NET)
Kitching	Drains	Q = Drn (Kitching.net)
Cypress	Drains	Q = [Drn (FW3.NET) – Drn (GROVE_E.NET)]
Hobe Grove	Drains	Q = Drn (GROVE_E.NET)
L8*	RDF, Rivers, Drains	Q = [Rdf (L8_B.net) + RIV (L8_B.NET) + Drn (L8_B.NET)] + Runoff (Dupuis + Corbett) – [AFSIRS_L8 + AFSIRS_EAA]
Northlake Weir	Diversion	Q = DIV (NLAKE.NET)
Control 2	Diversion	Q = DIV (MCNLNP.NET)
WPB PWS	Well	Q = 50 x (50-00615-W, flow.csv)

* L8 flows are post-processed due to external runoff from Dupuis and West Corbett, and agricultural irrigation demands. Demands are from surface water and are determined by AFSIRS

2014 Existing Condition Base Run

C-18/Jupiter Farms – Annual Average



Inflow to the basin

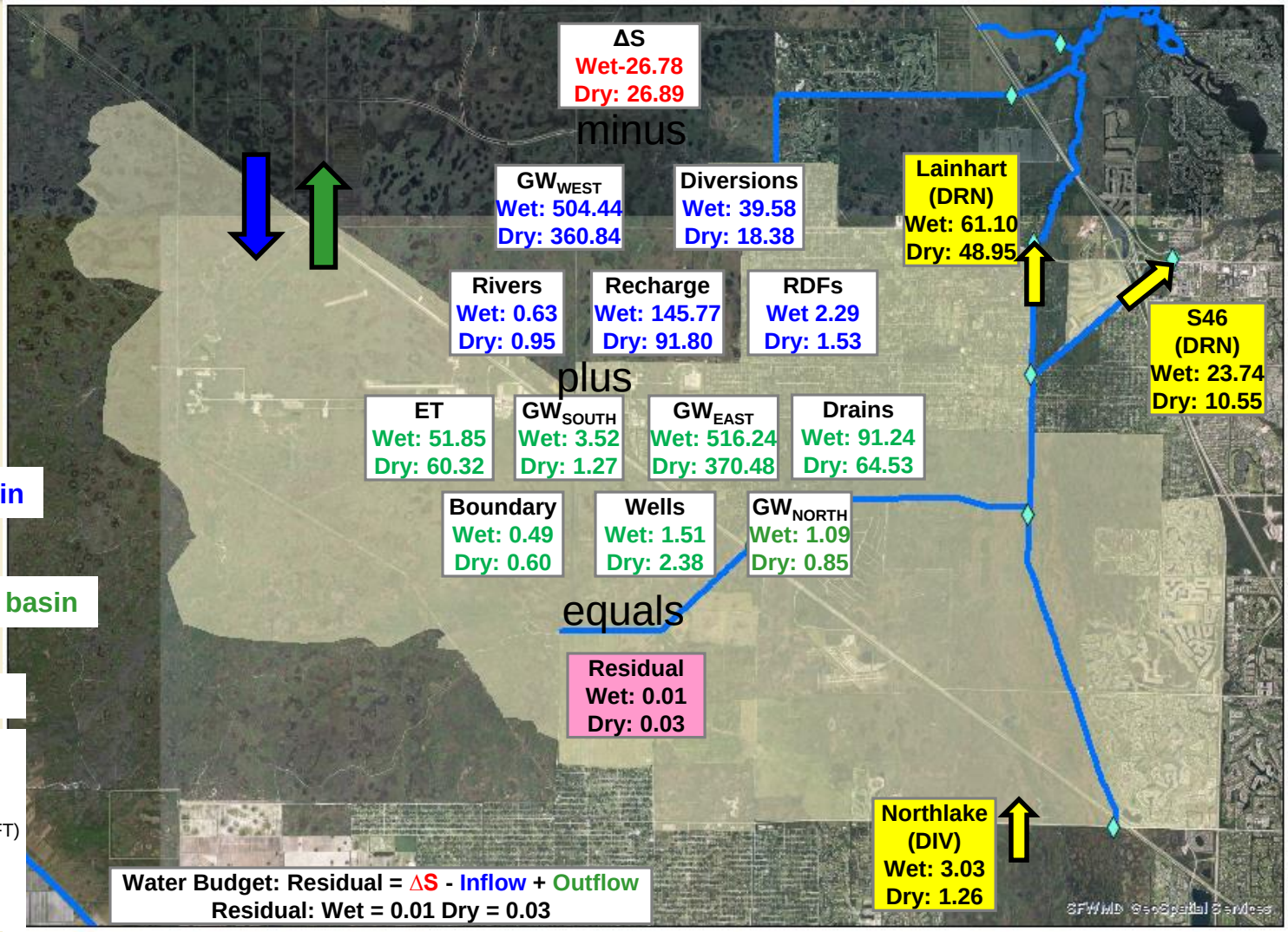
outflow from the basin

C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

C-18/Jupiter Farms – Seasonal Average



Inflow to the basin

outflow from the basin

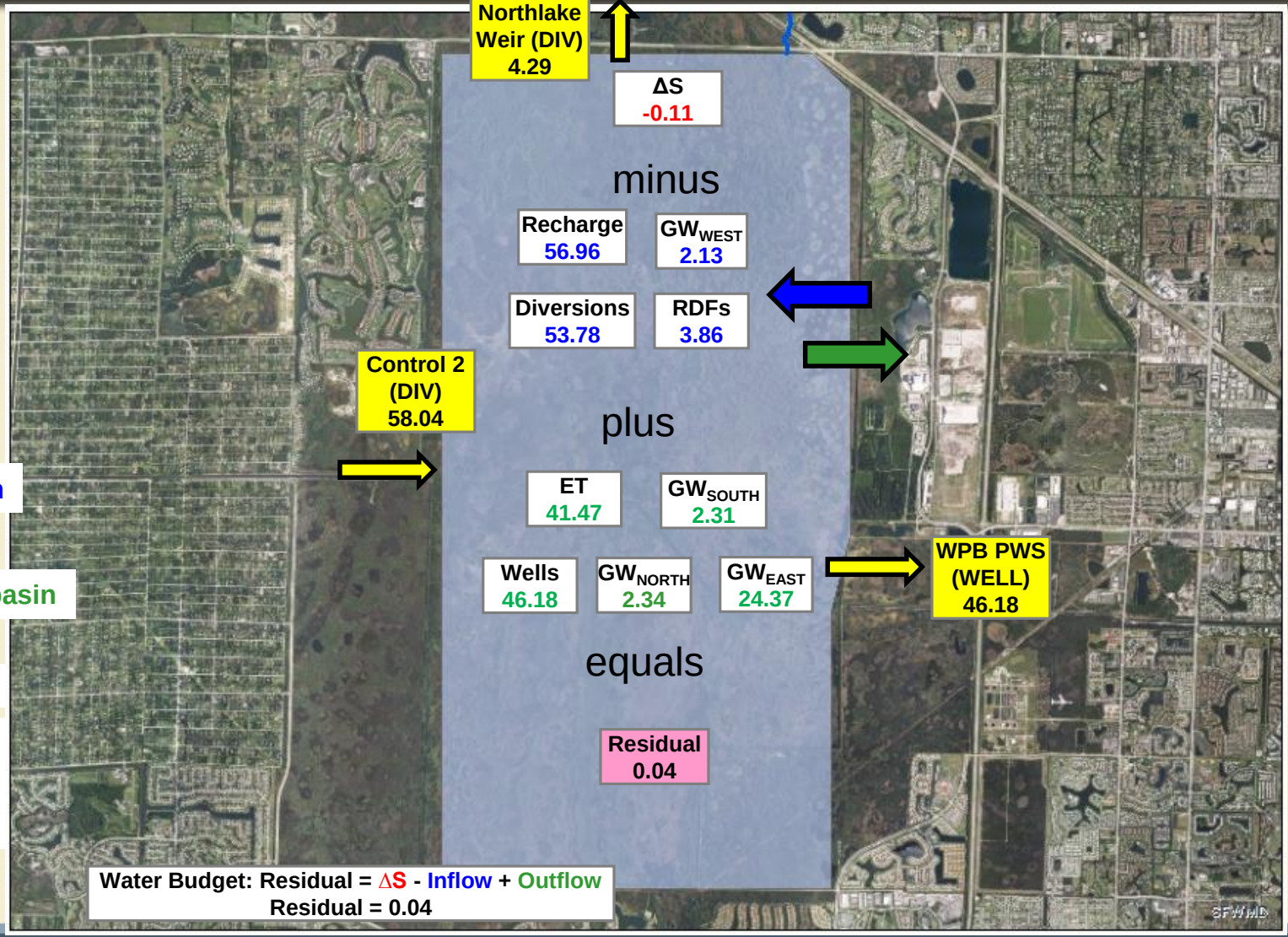
C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Grassy Waters Preserve – Annual Average



Inflow to the basin

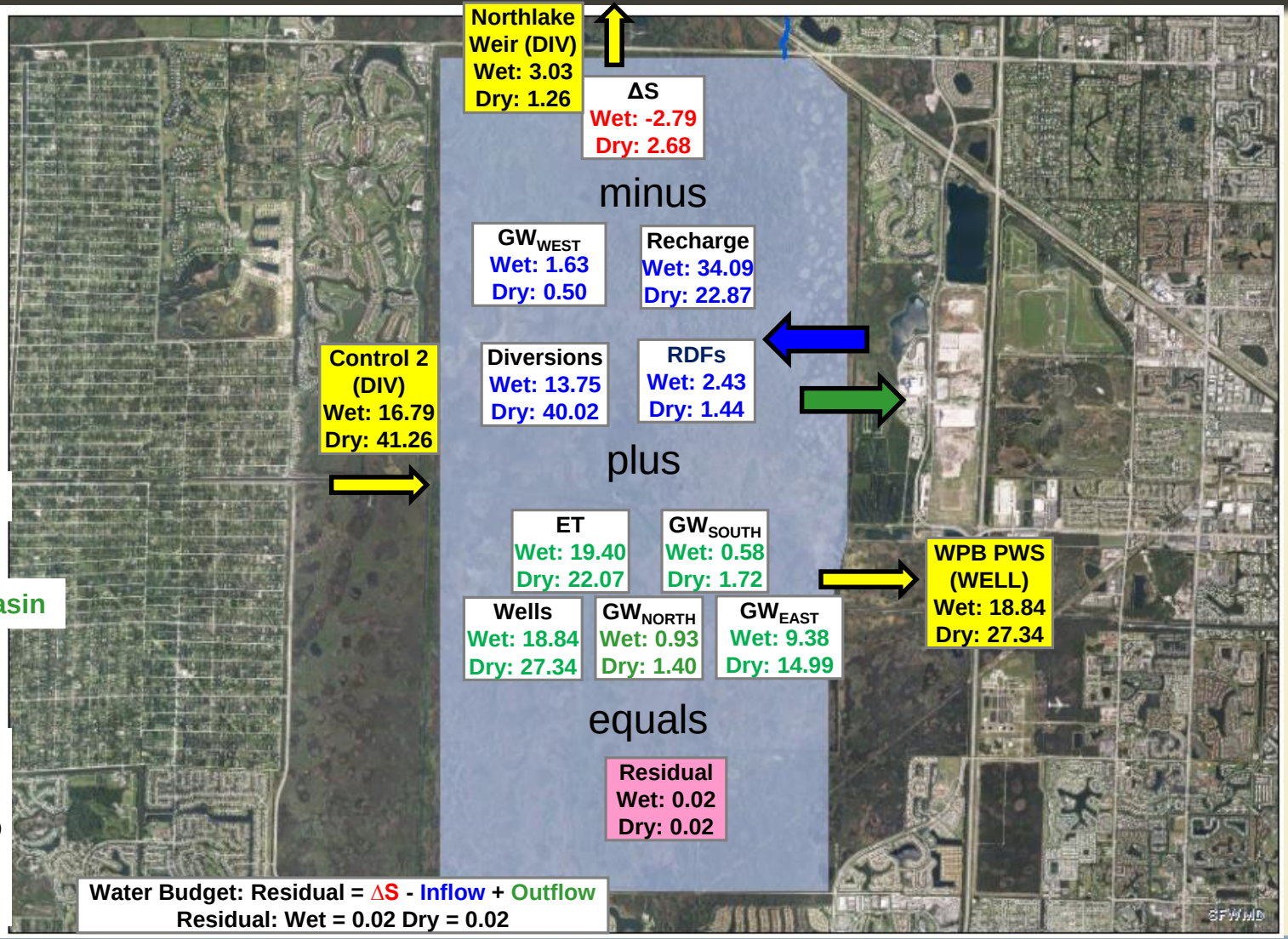
outflow from the basin

Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

Grassy Waters Preserve – Seasonal Average



Inflow to the basin

outflow from the basin

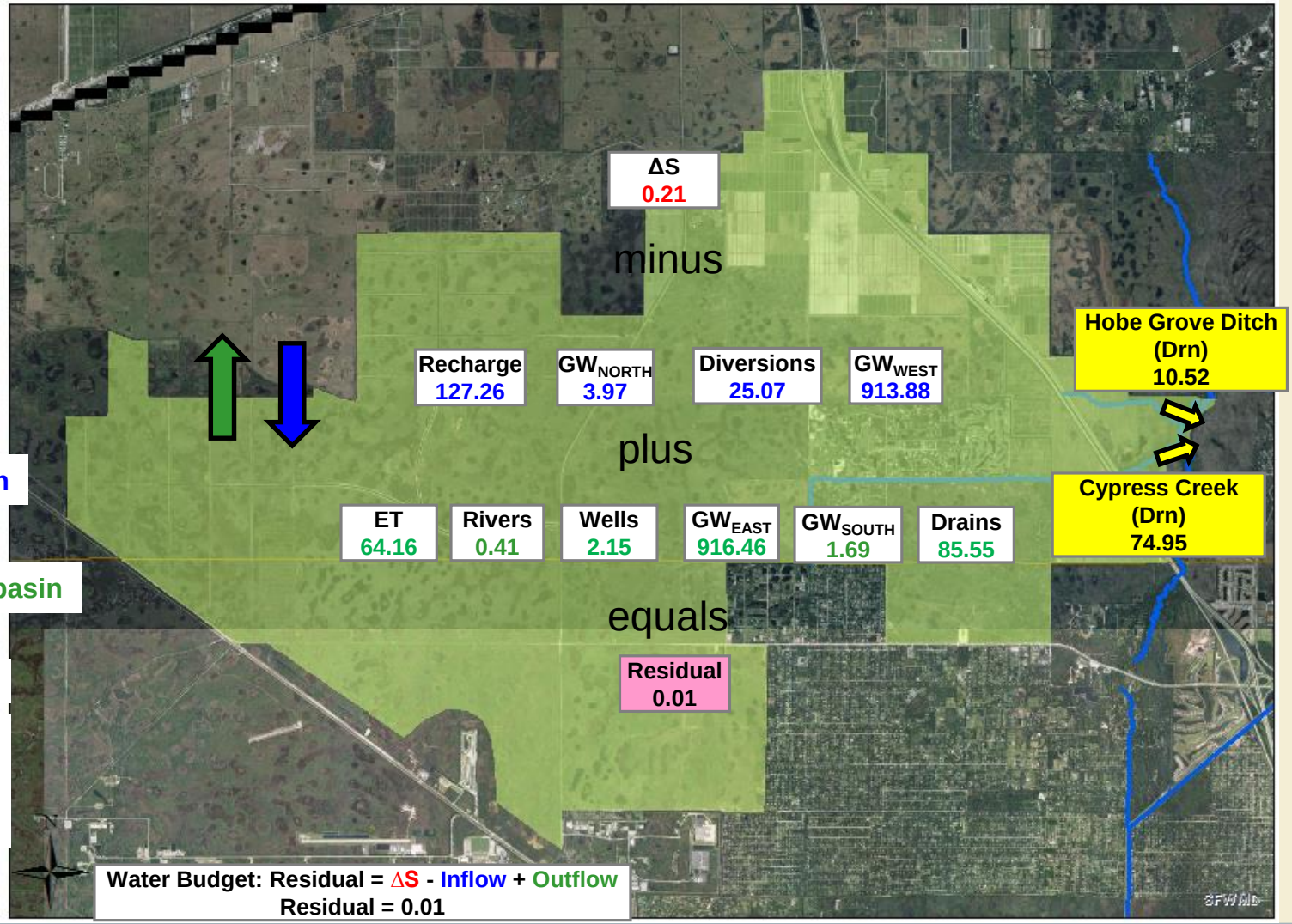
Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Flow Way 3 – Annual Average



Inflow to the basin

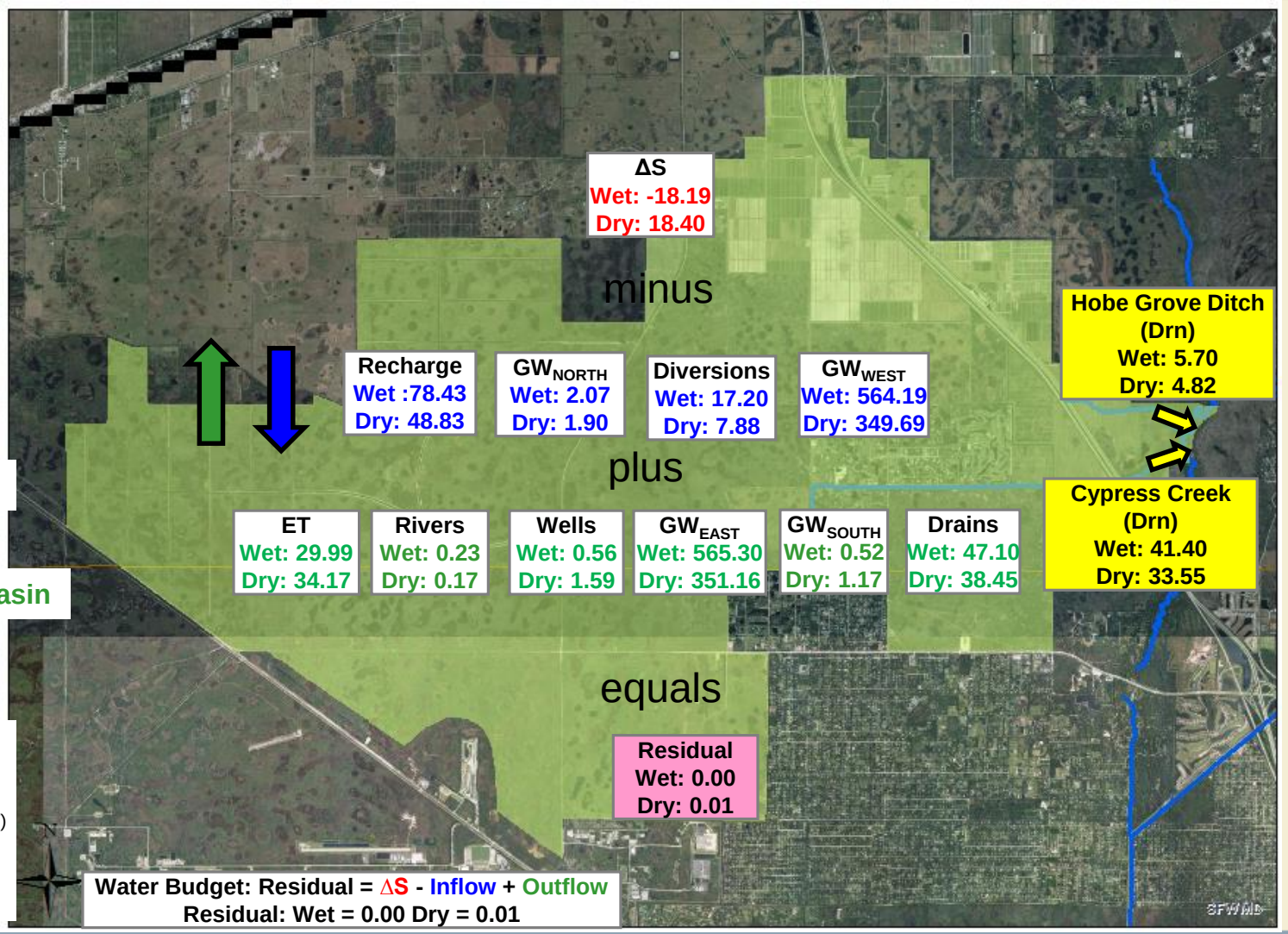
outflow from the basin

Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

Flow Way 3 – Seasonal Average



Inflow to the basin

outflow from the basin

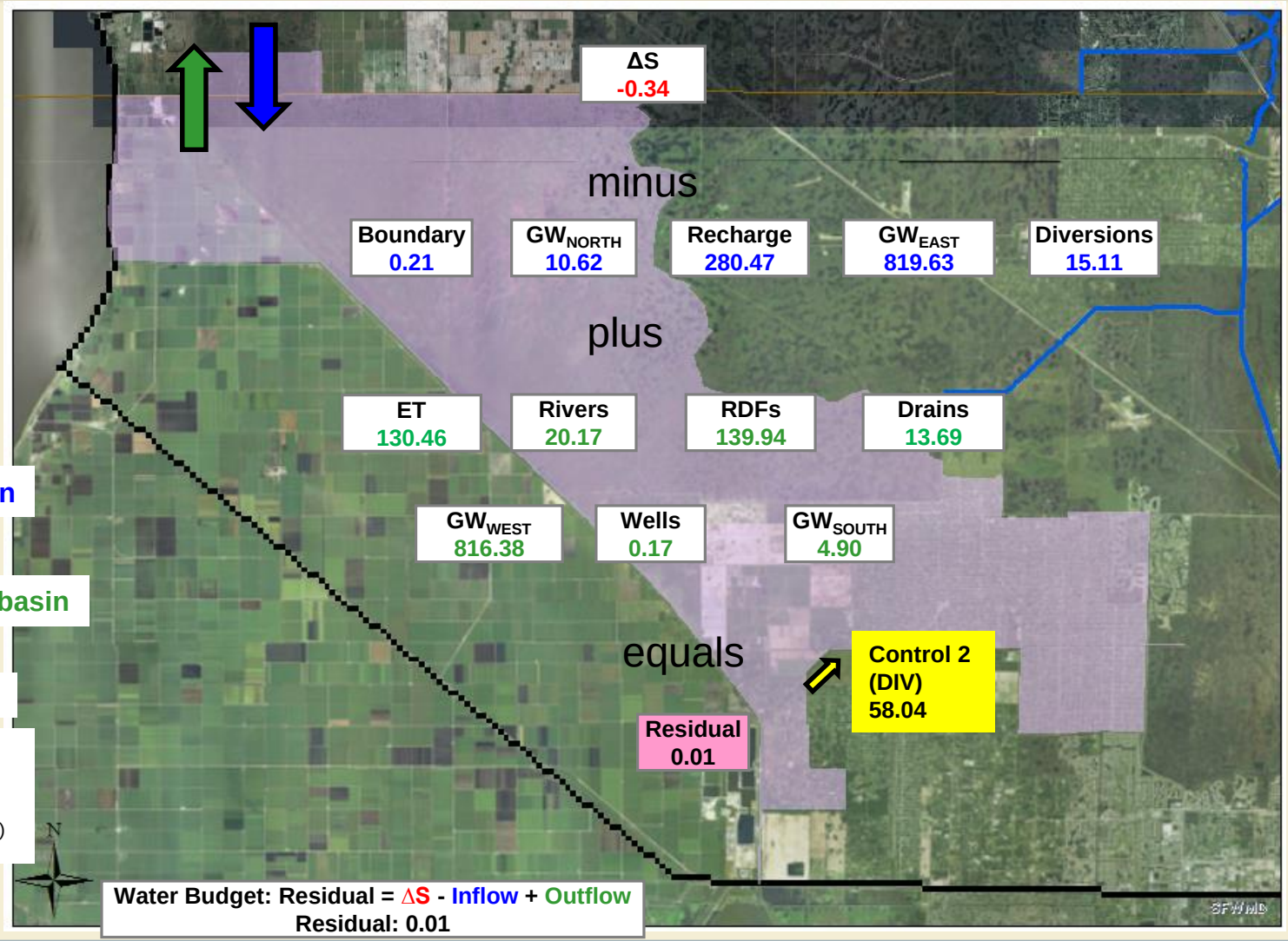
Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

L-8 – Annual Average



Inflow to the basin

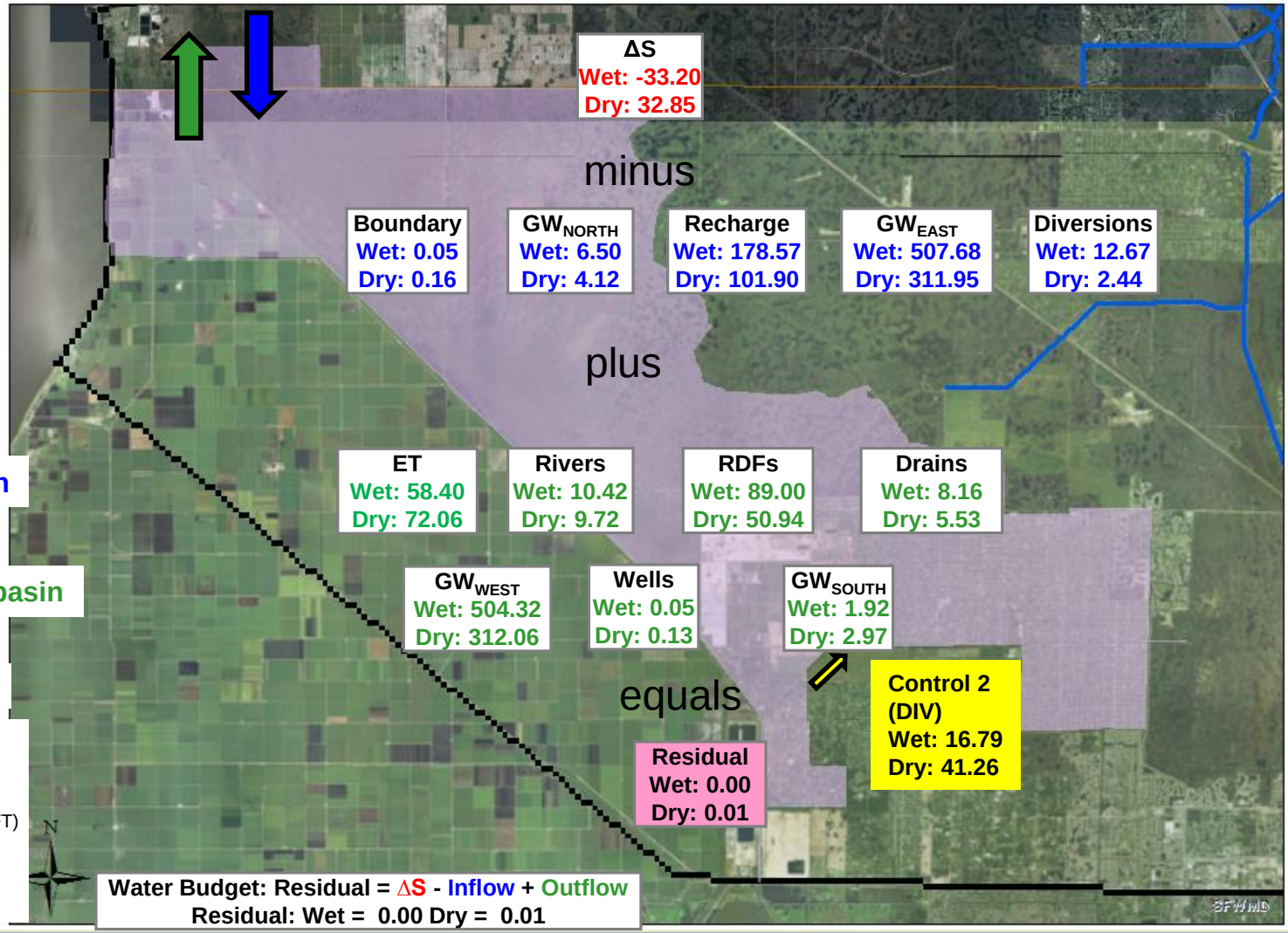
outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

L-8 – Seasonal Average



Inflow to the basin

outflow from the basin

L8
Area= 105096.53 Acres

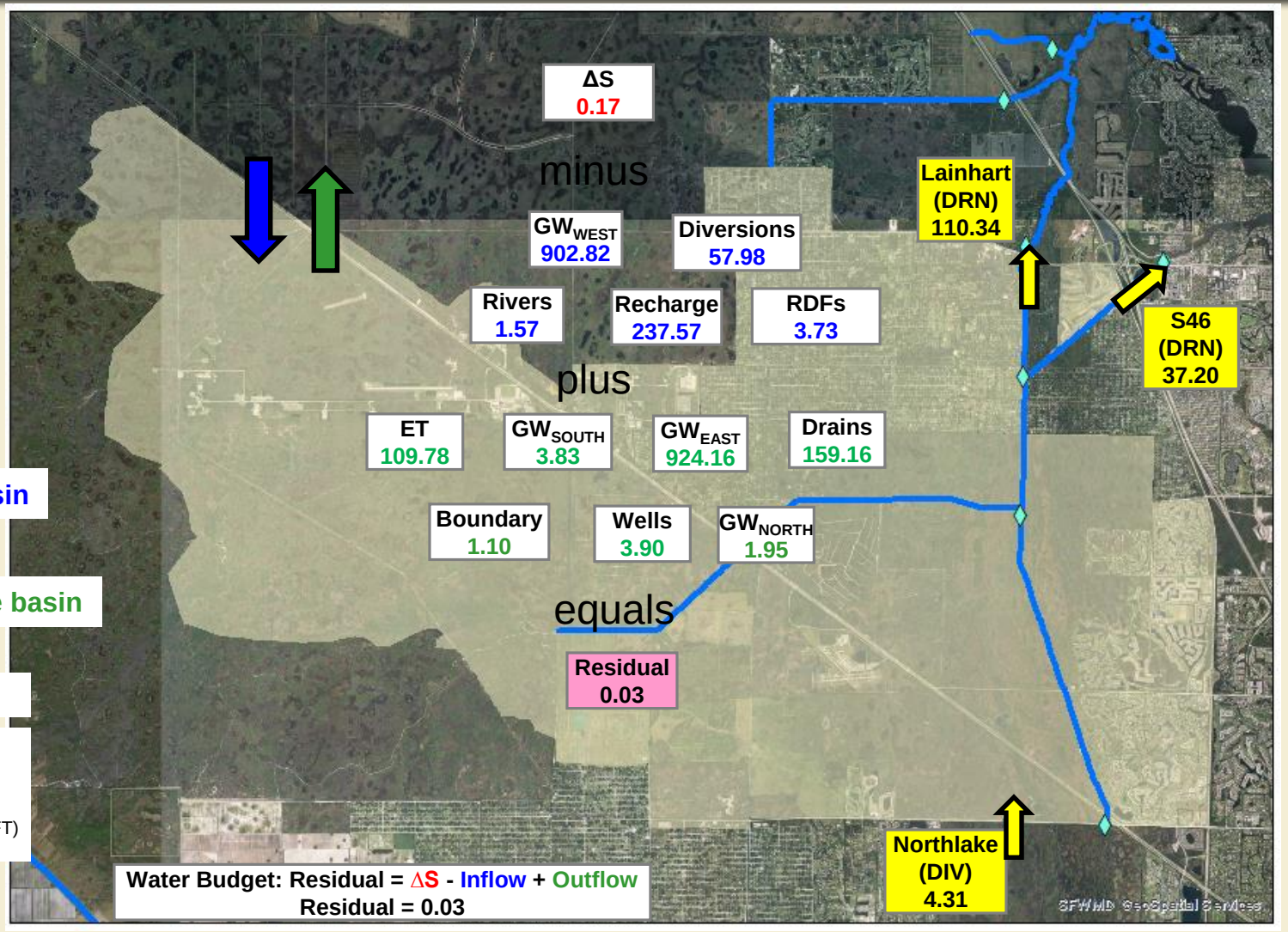
DRAFT
Run Name: 2014 ECB
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

2070 Future Without Project Run

C-18/Jupiter Farms – Annual Average



Inflow to the basin

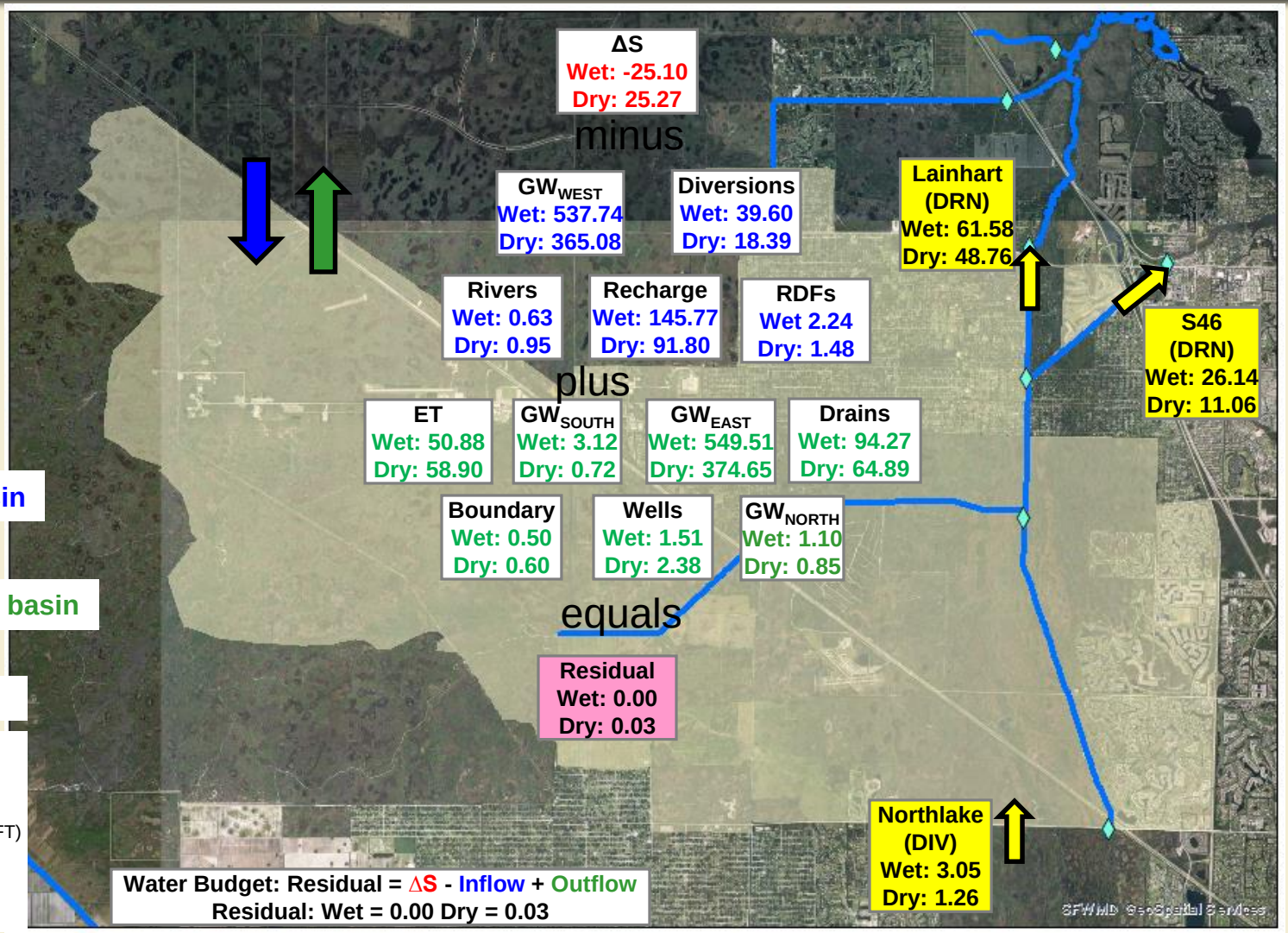
outflow from the basin

C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

C-18/Jupiter Farms – Seasonal Average



Inflow to the basin

outflow from the basin

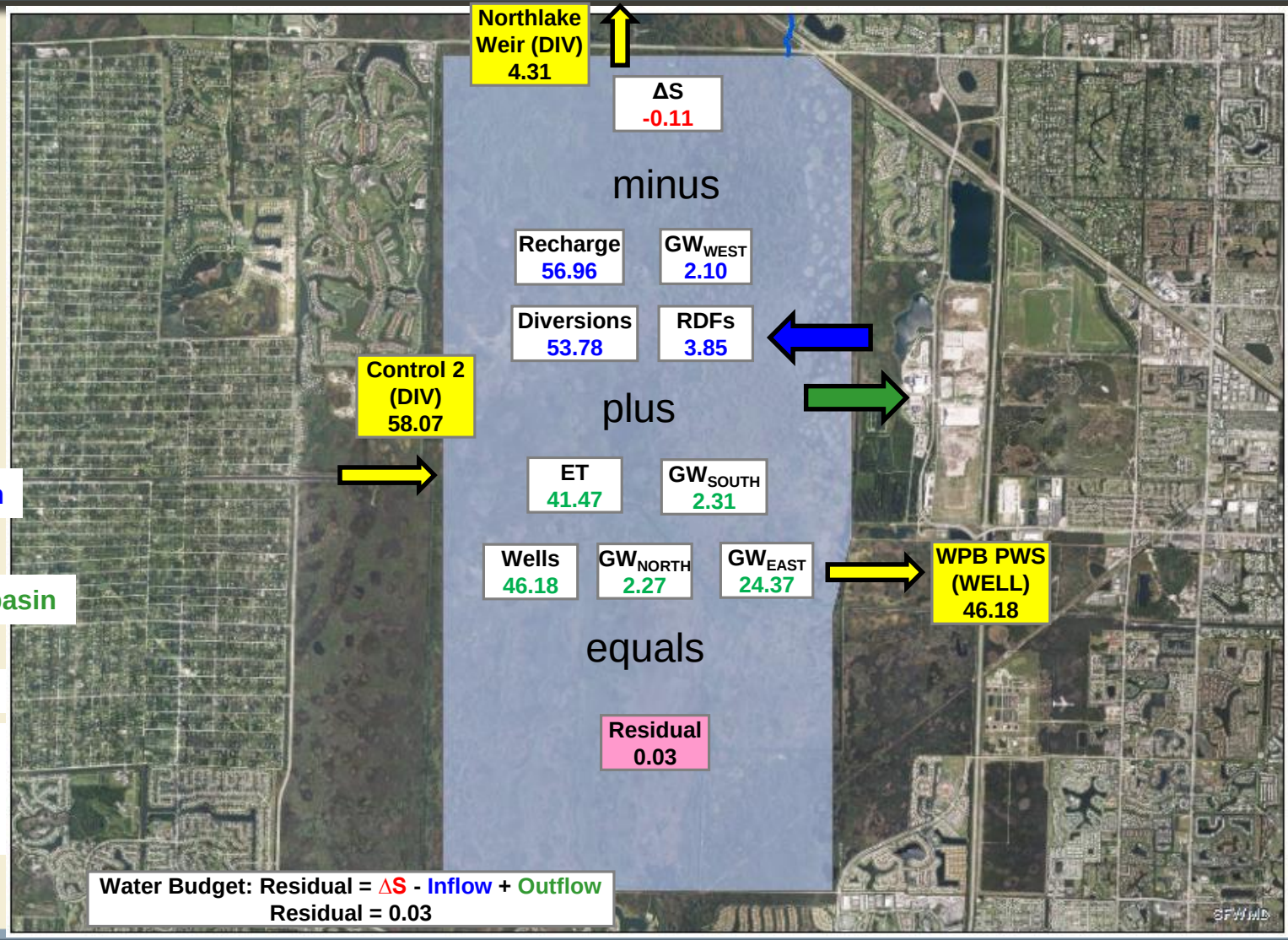
C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Grassy Waters Preserve – Annual Average



Inflow to the basin

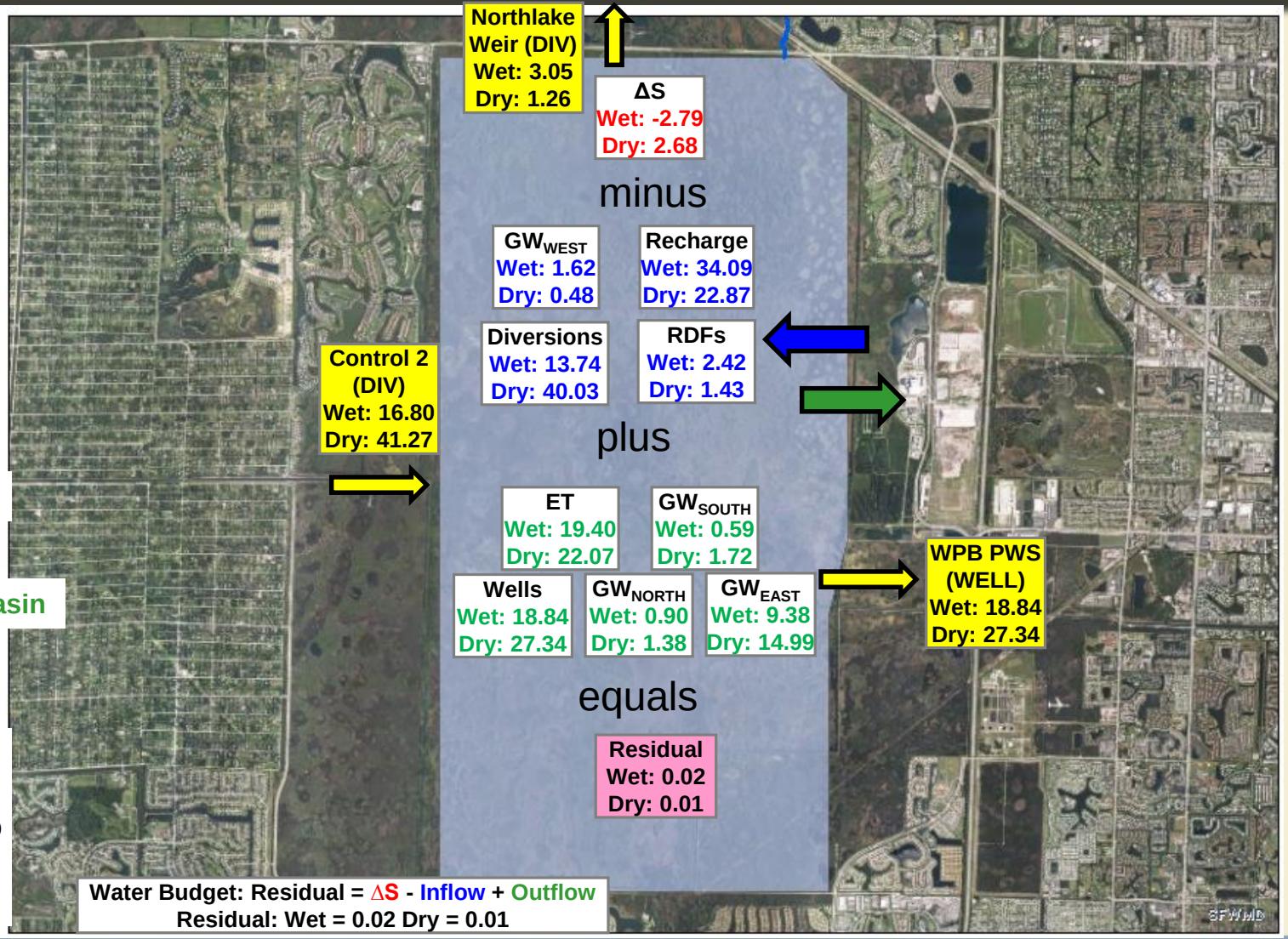
outflow from the basin

Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

Grassy Waters Preserve – Seasonal Average



Inflow to the basin

outflow from the basin

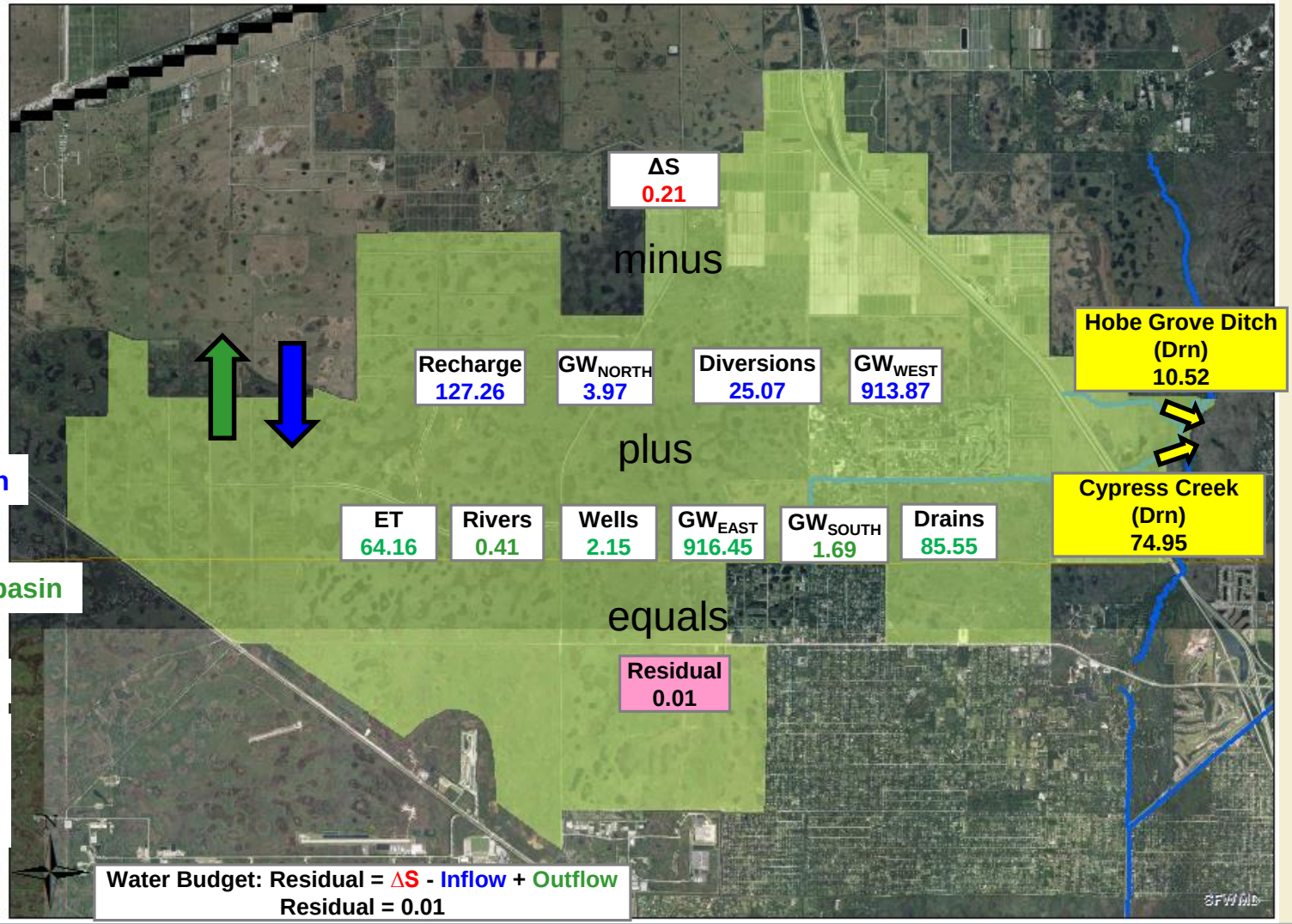
Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Flow Way 3 – Annual Average



Inflow to the basin

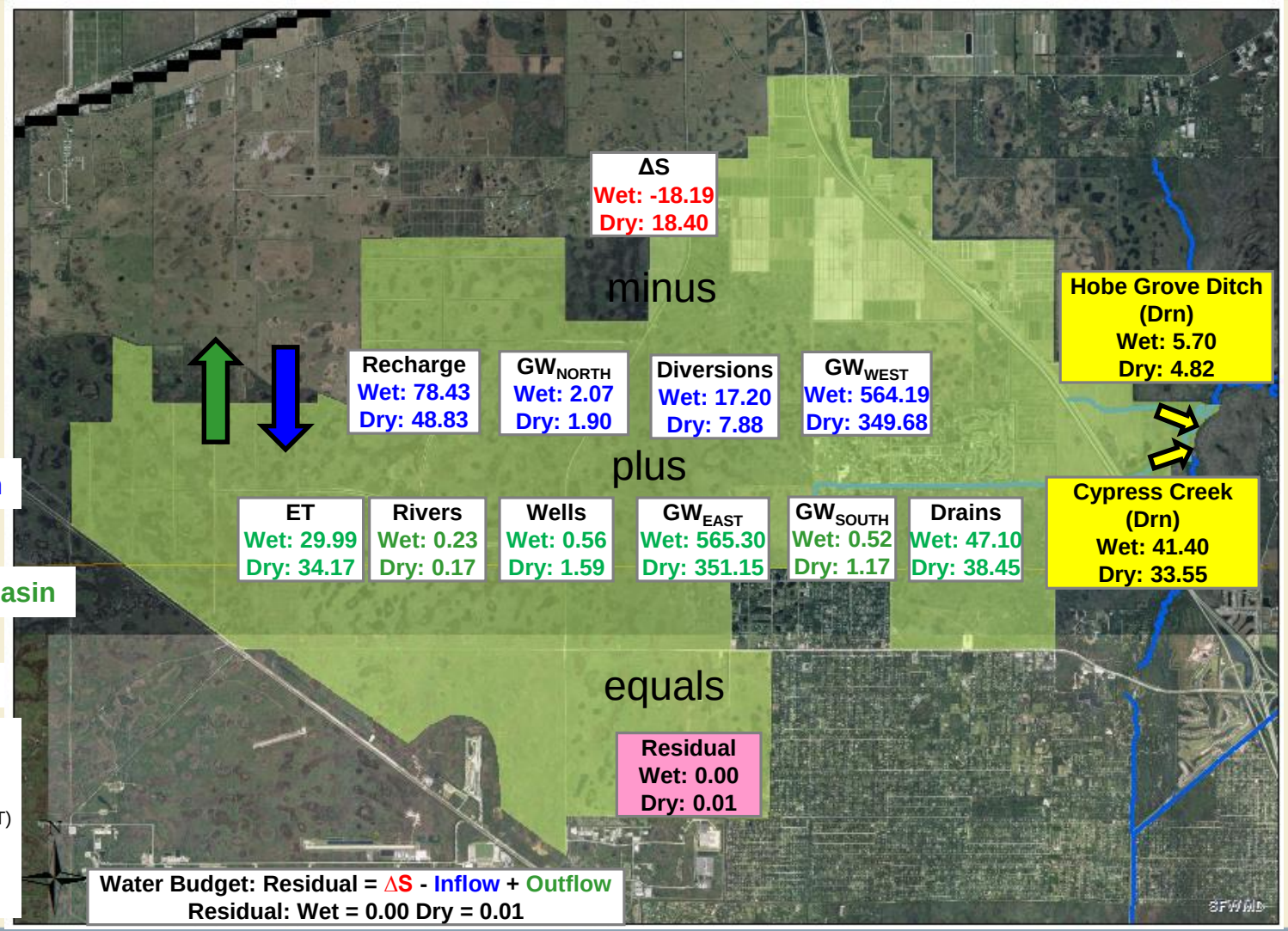
outflow from the basin

Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

Flow Way 3 – Seasonal Average



Inflow to the basin

outflow from the basin

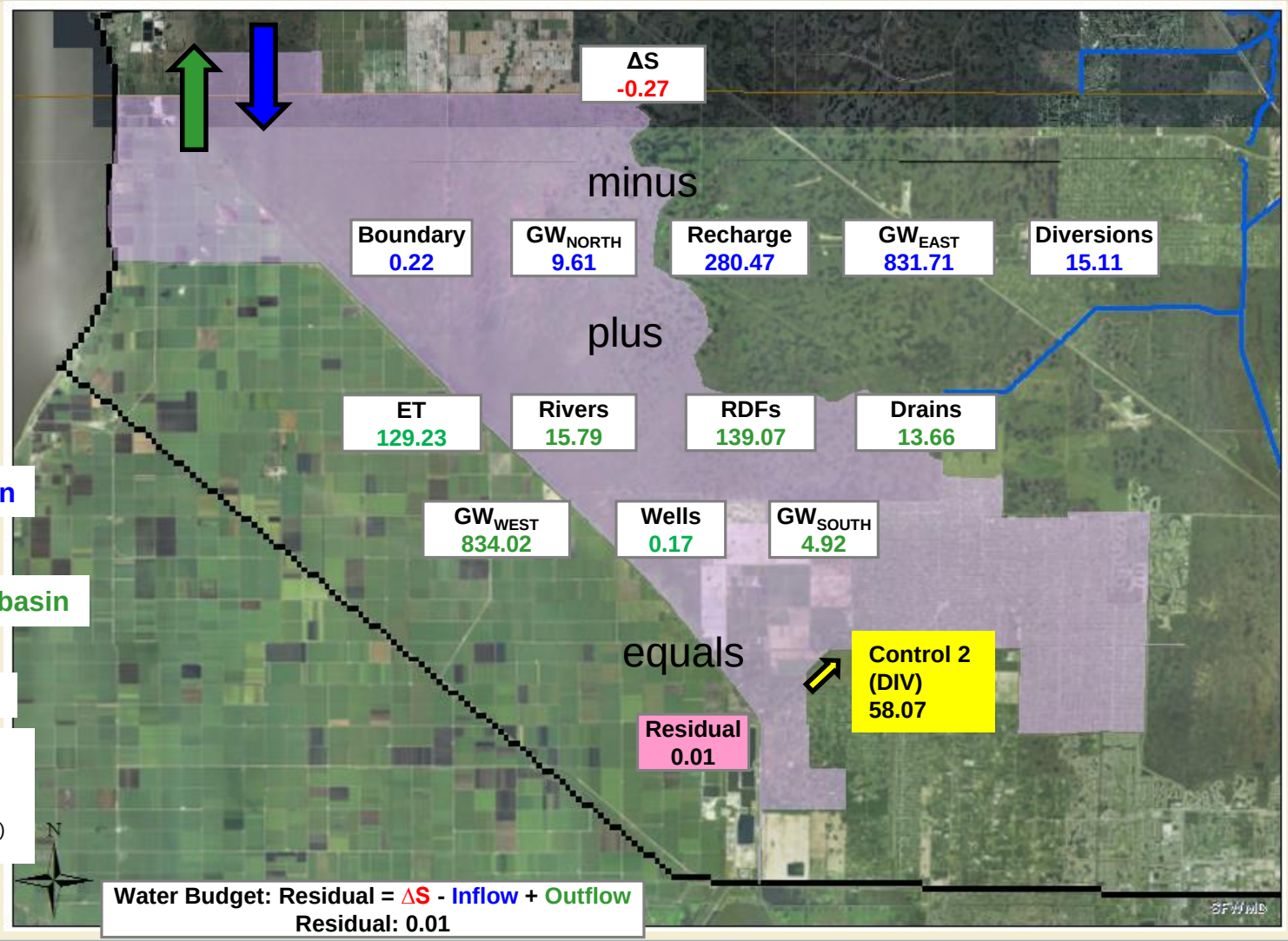
Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

L-8 – Annual Average



Inflow to the basin

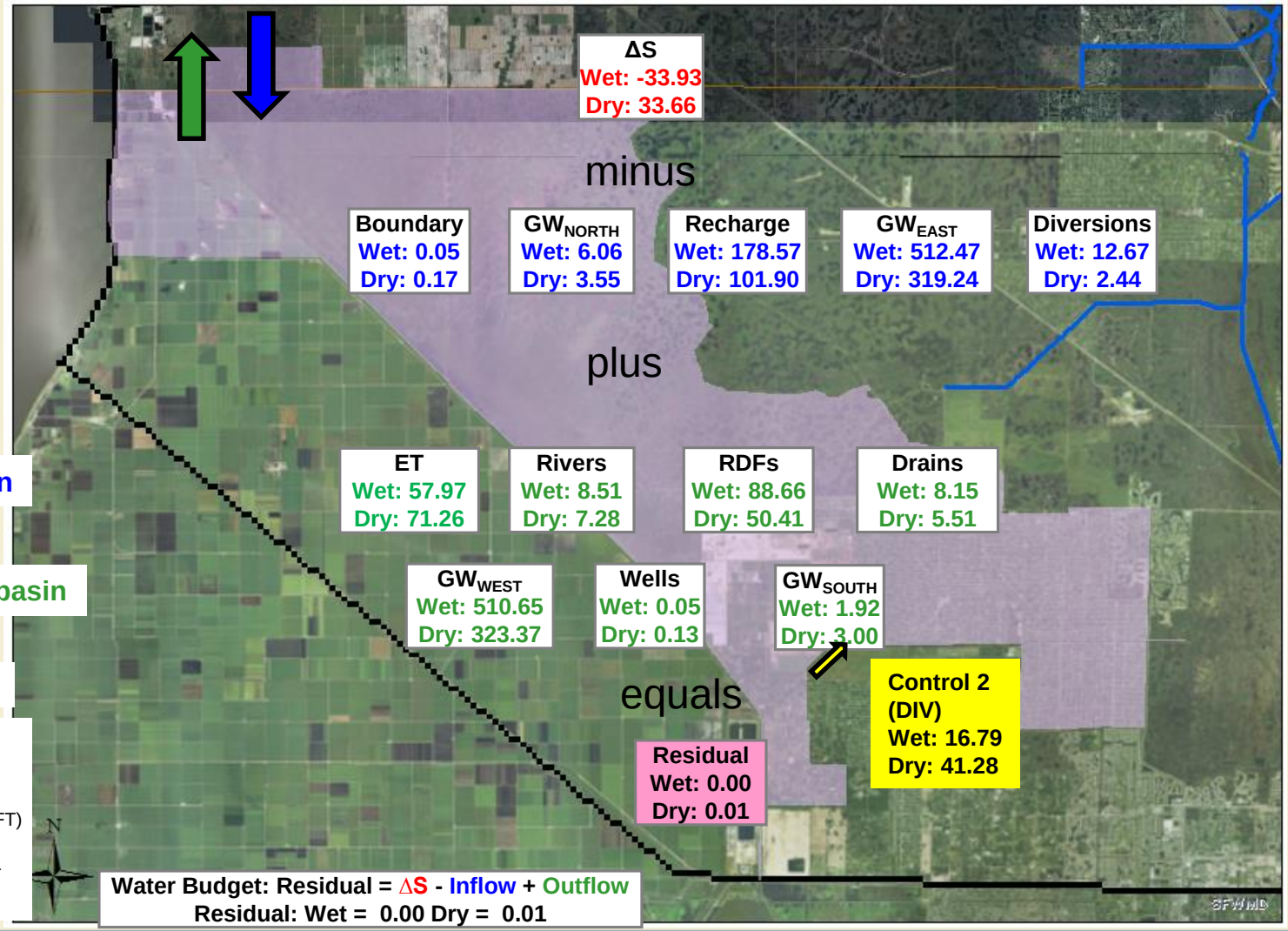
outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Annual Average (KAC-FT)

L-8 – Seasonal Average



Inflow to the basin

outflow from the basin

L8
Area= 105096.53 Acres

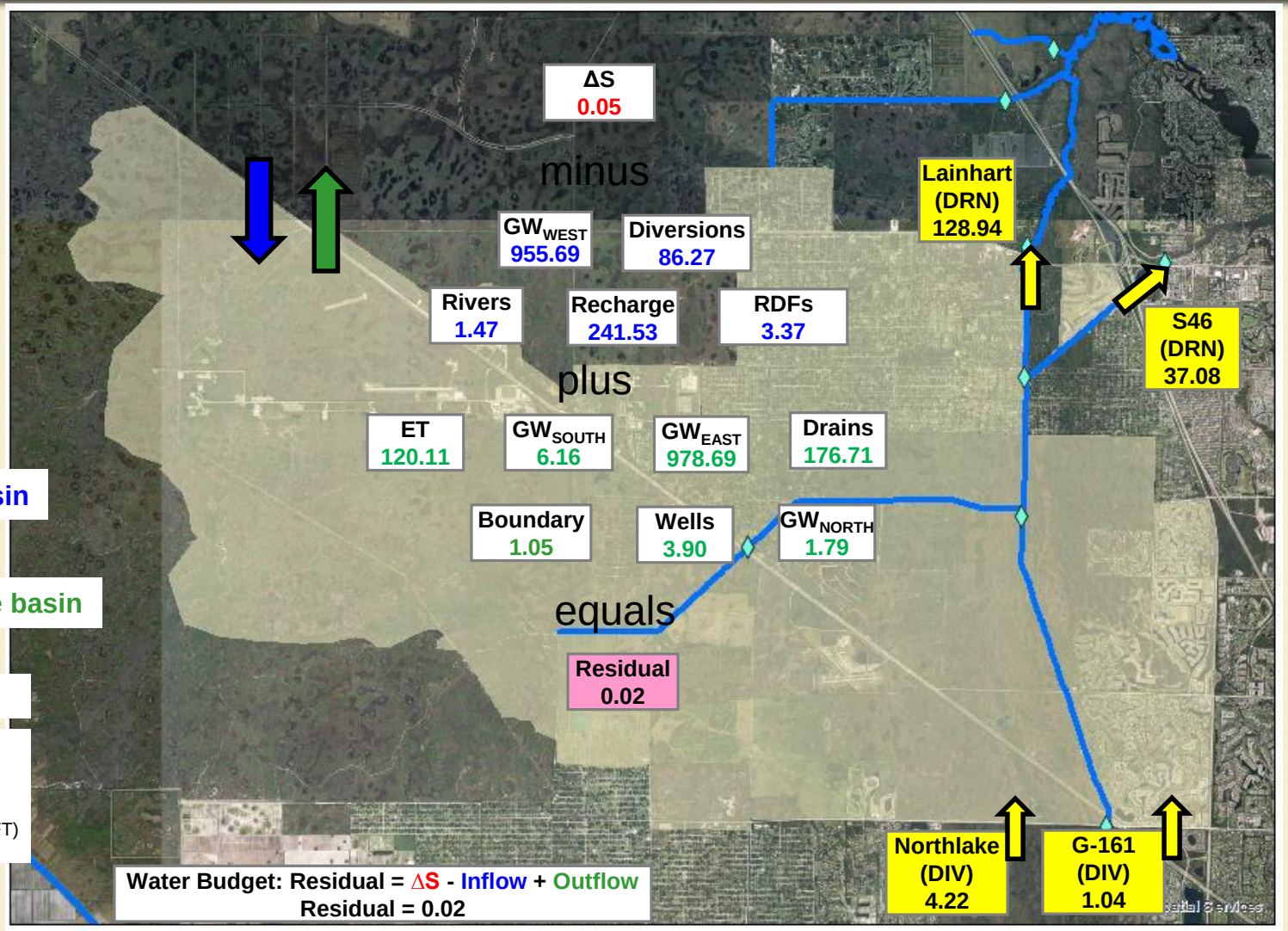
DRAFT
Run Name: 2070 FWO
Run Date: March 29, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Alternative 2 Run

C-18/Jupiter Farms – Annual Average



Inflow to the basin

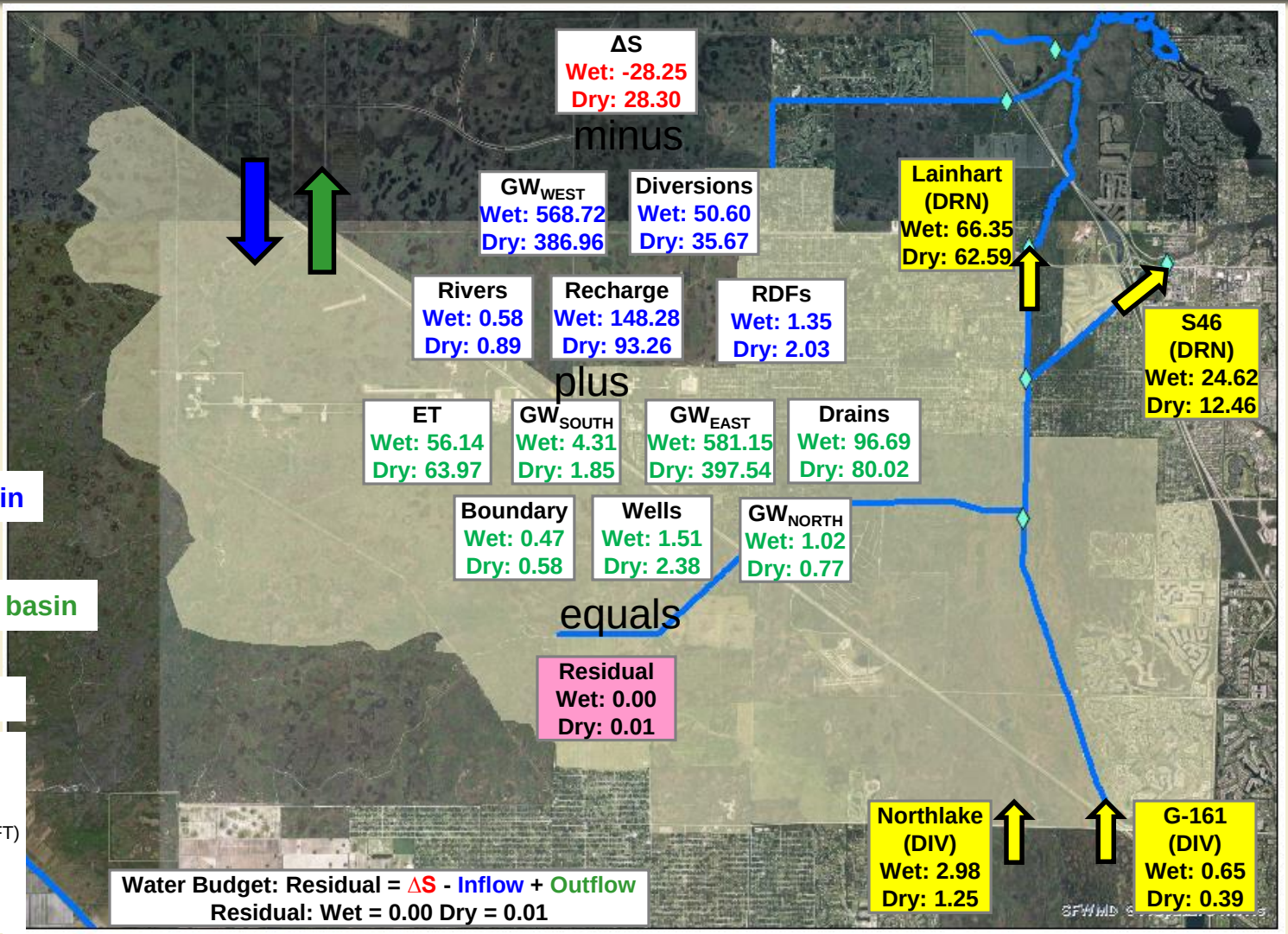
outflow from the basin

C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

C-18/Jupiter Farms – Seasonal Average



Inflow to the basin

outflow from the basin

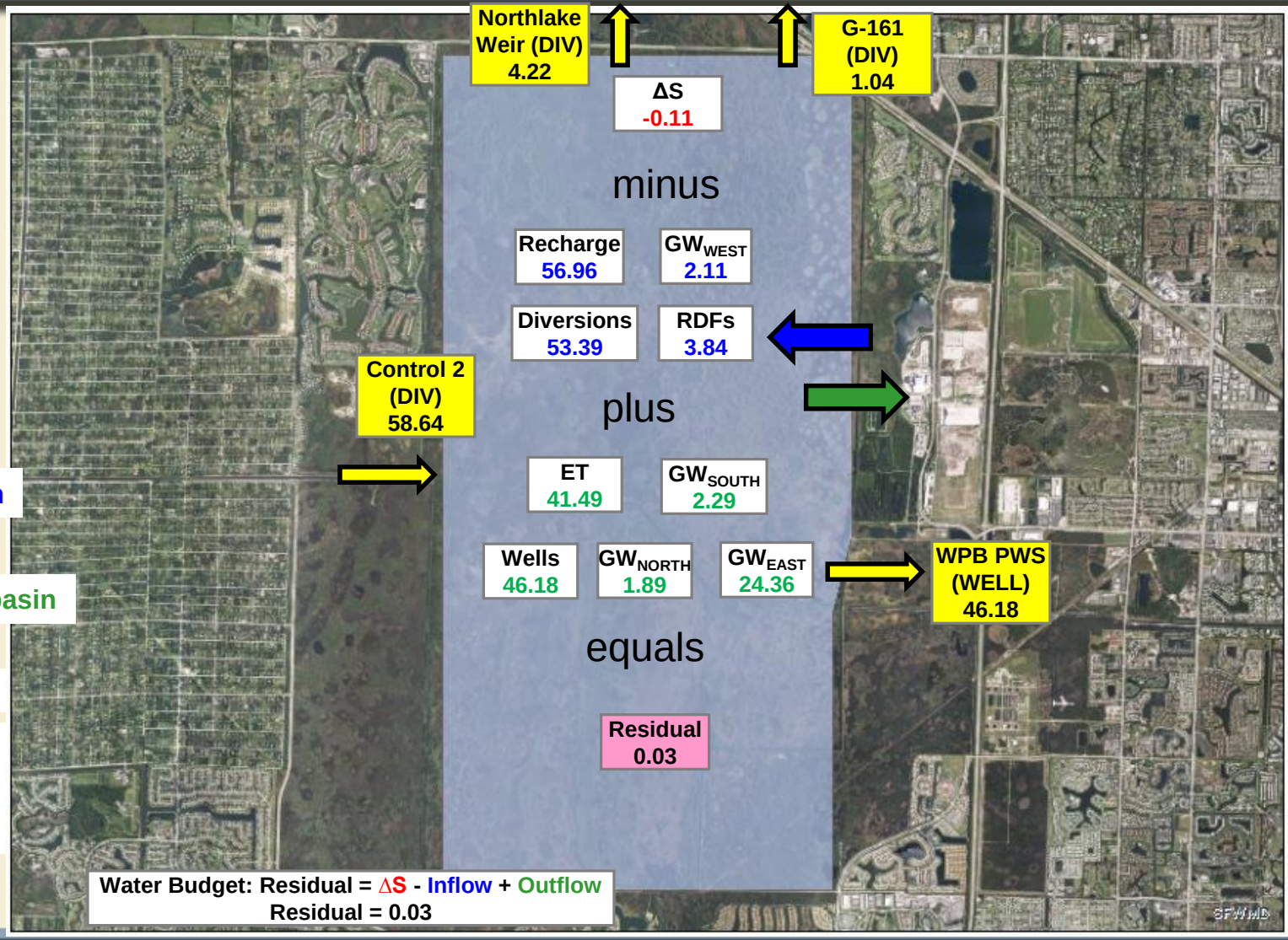
C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Grassy Waters Preserve – Annual Average



Inflow to the basin

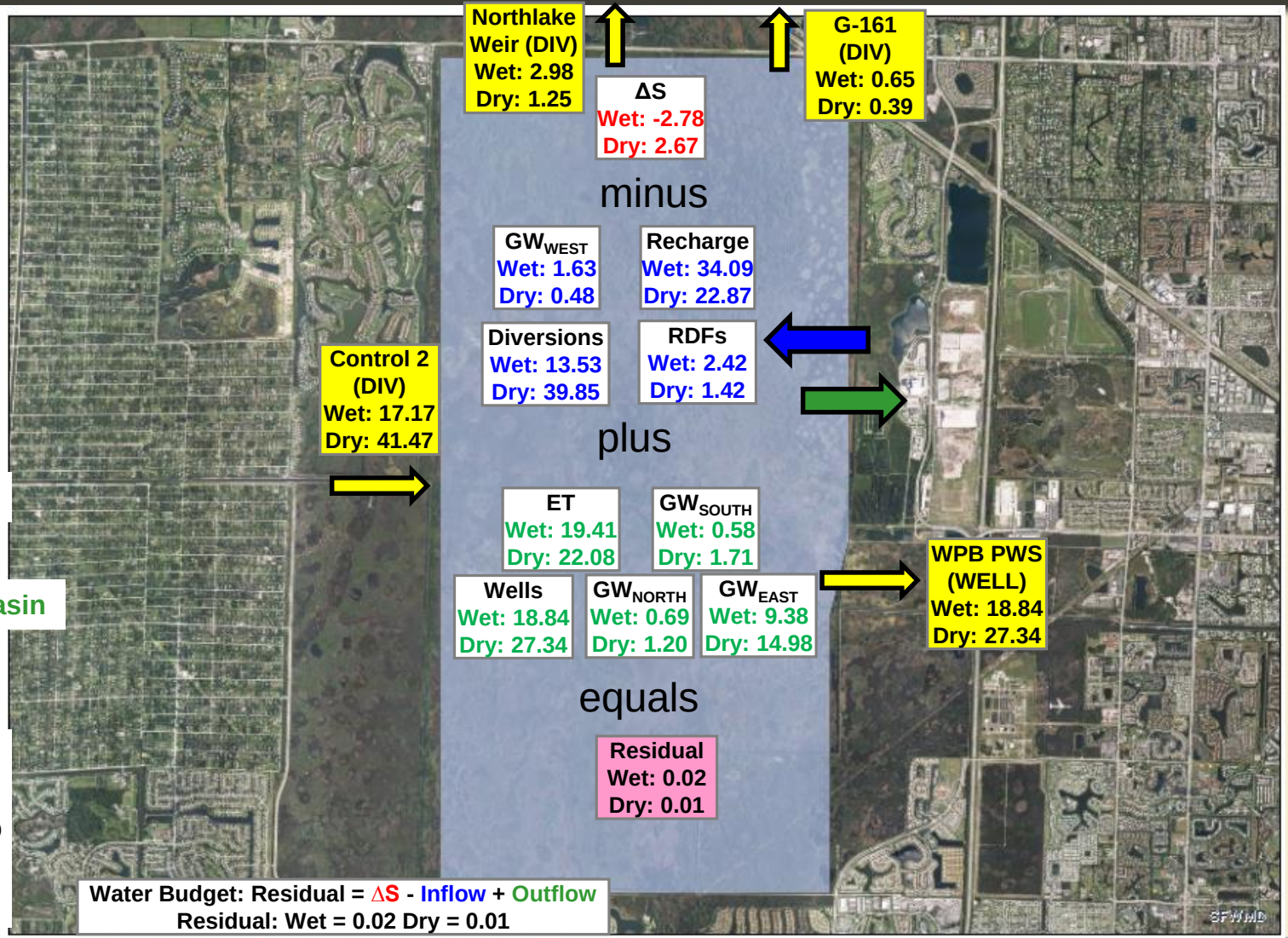
outflow from the basin

Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Grassy Waters Preserve – Seasonal Average



Inflow to the basin

outflow from the basin

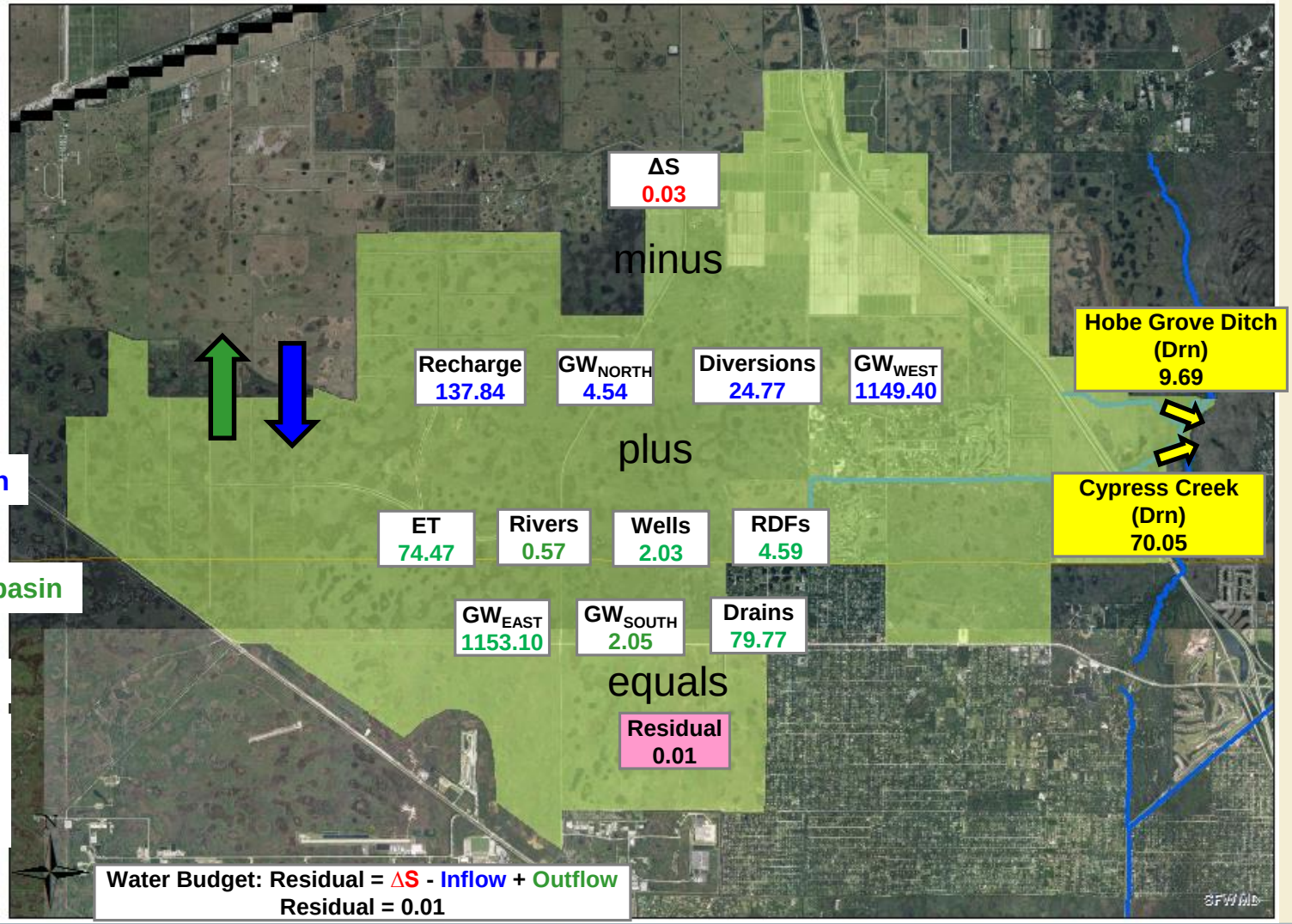
Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31, November 1 – December 31

Flow Way 3 – Annual Average



Inflow to the basin

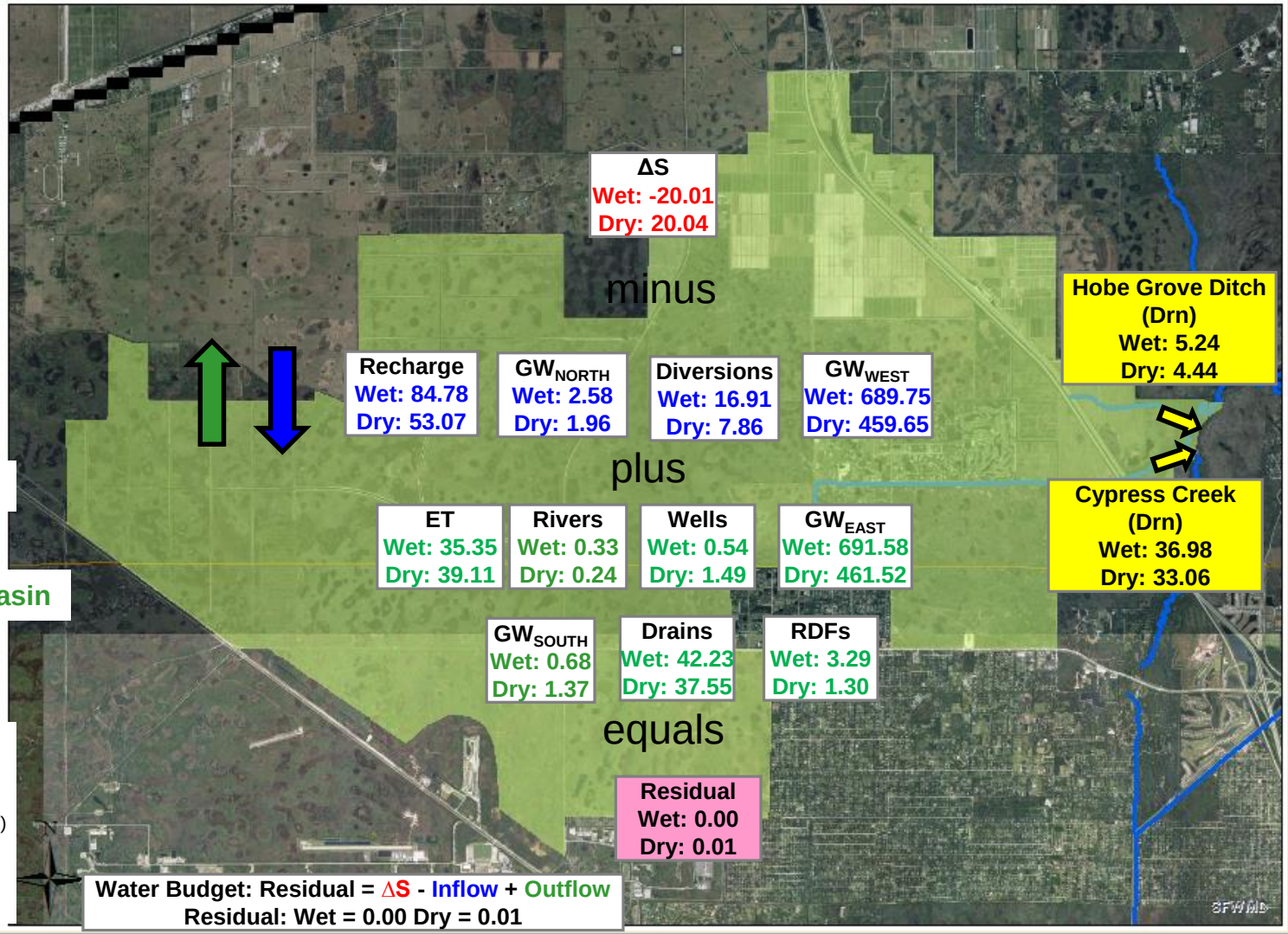
outflow from the basin

Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Flow Way 3 – Seasonal Average



Inflow to the basin

outflow from the basin

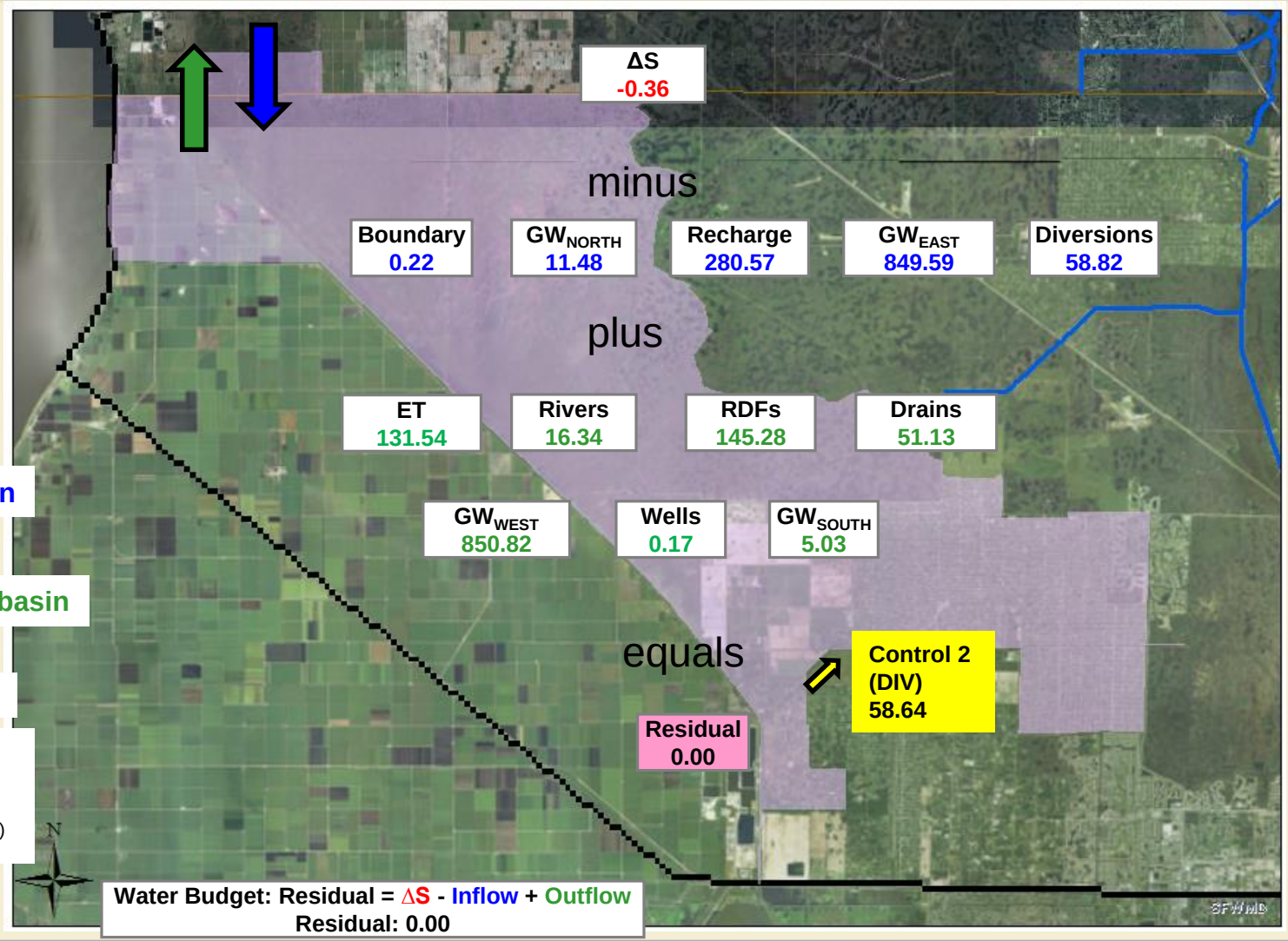
Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

L-8 – Annual Average



Inflow to the basin

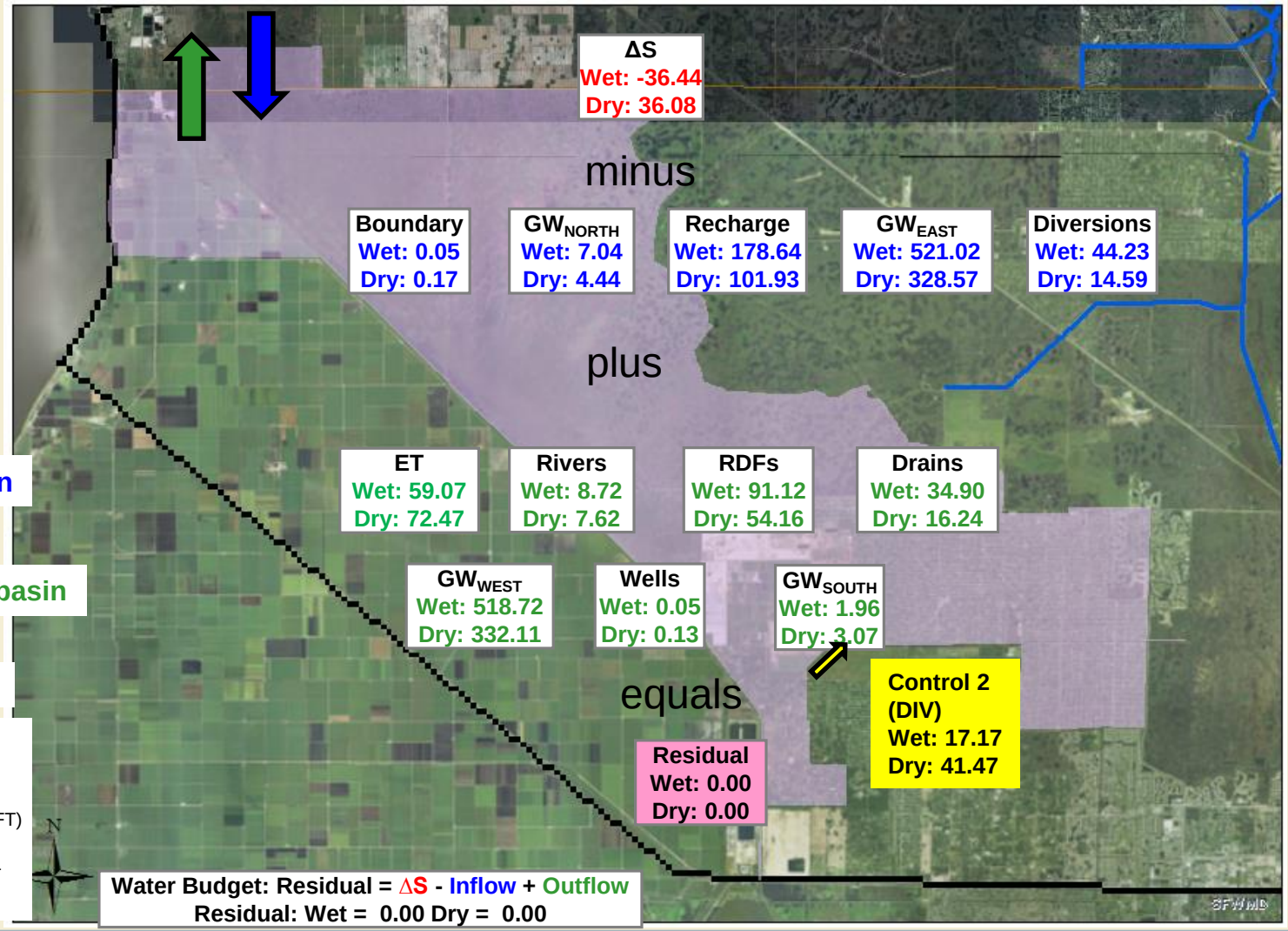
outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

L-8 – Seasonal Average



Inflow to the basin

outflow from the basin

L8
Area= 105096.53 Acres

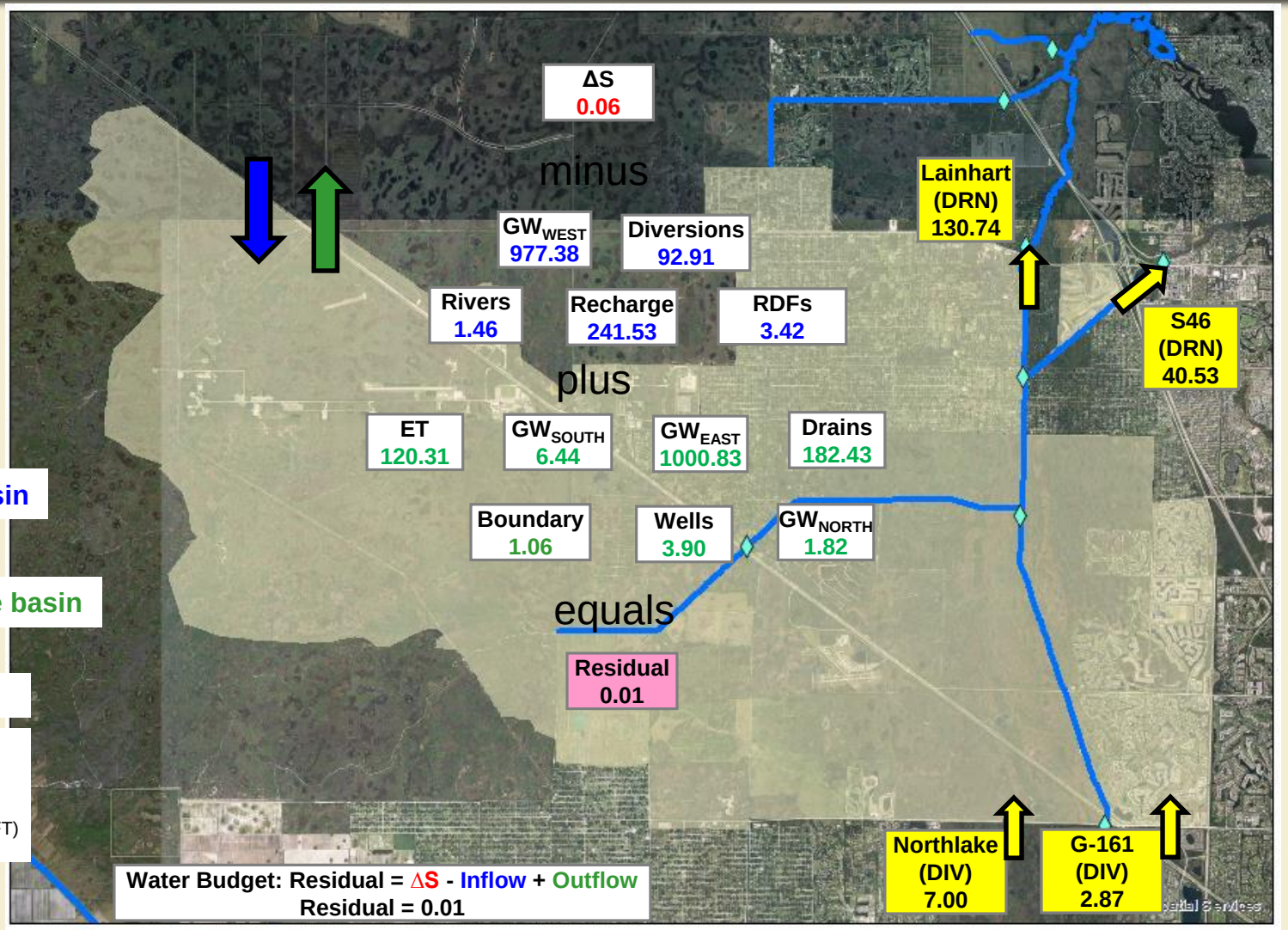
DRAFT
Run Name: Alternative 2
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Alternative 5 Run

C-18/Jupiter Farms – Annual Average



Inflow to the basin

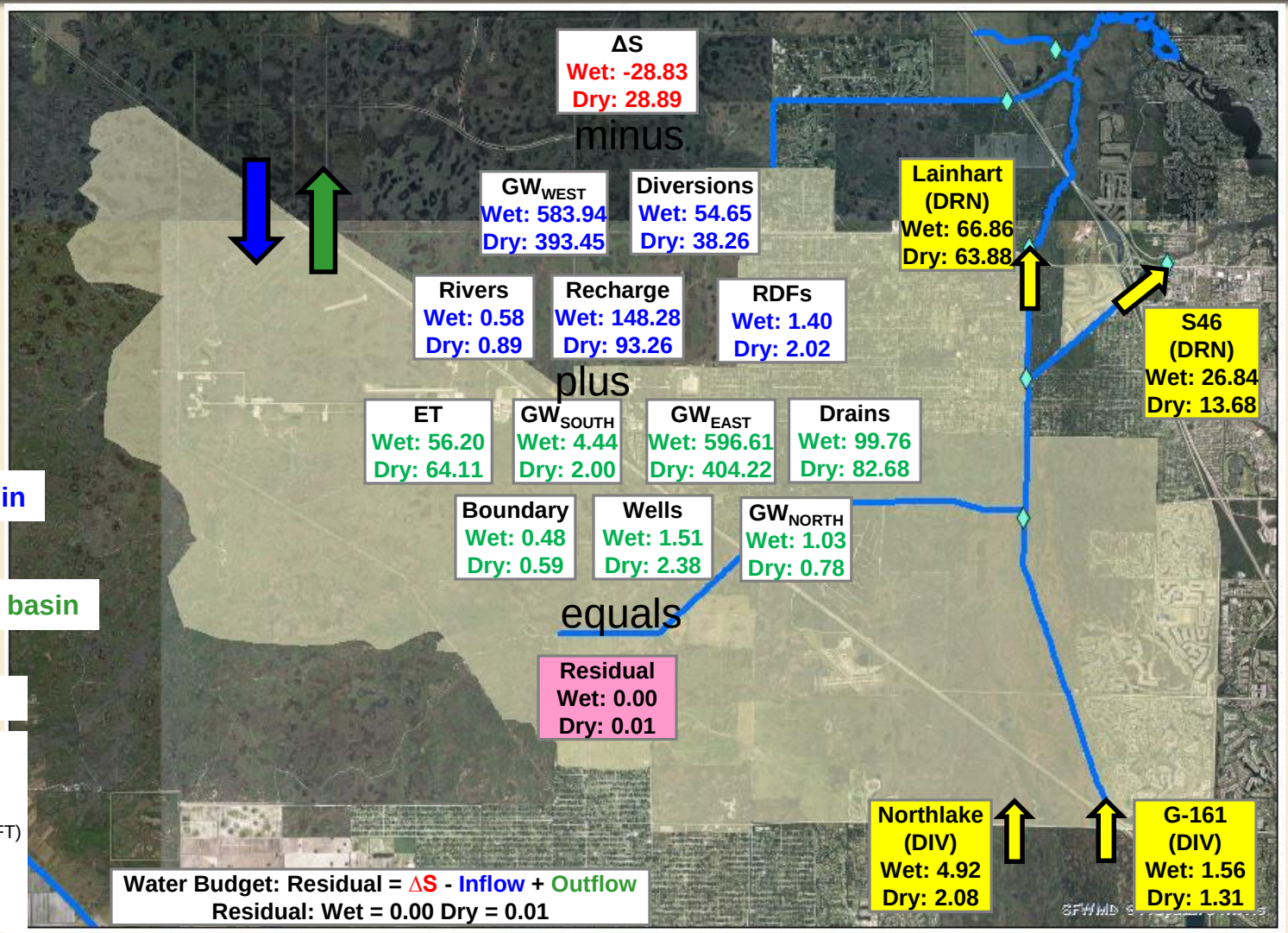
outflow from the basin

C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

C-18/Jupiter Farms – Seasonal Average



Inflow to the basin

outflow from the basin

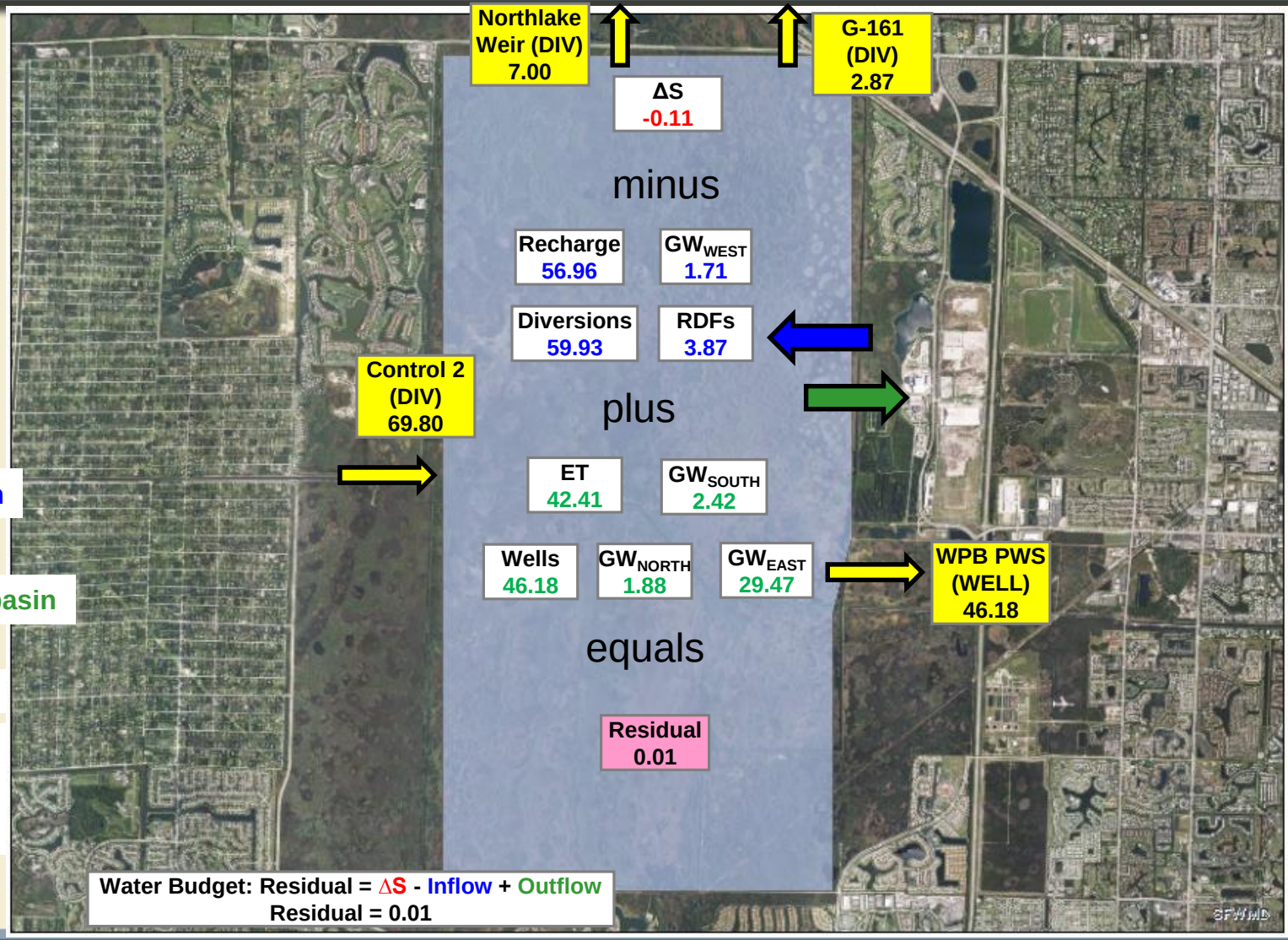
C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Grassy Waters Preserve – Annual Average



Inflow to the basin

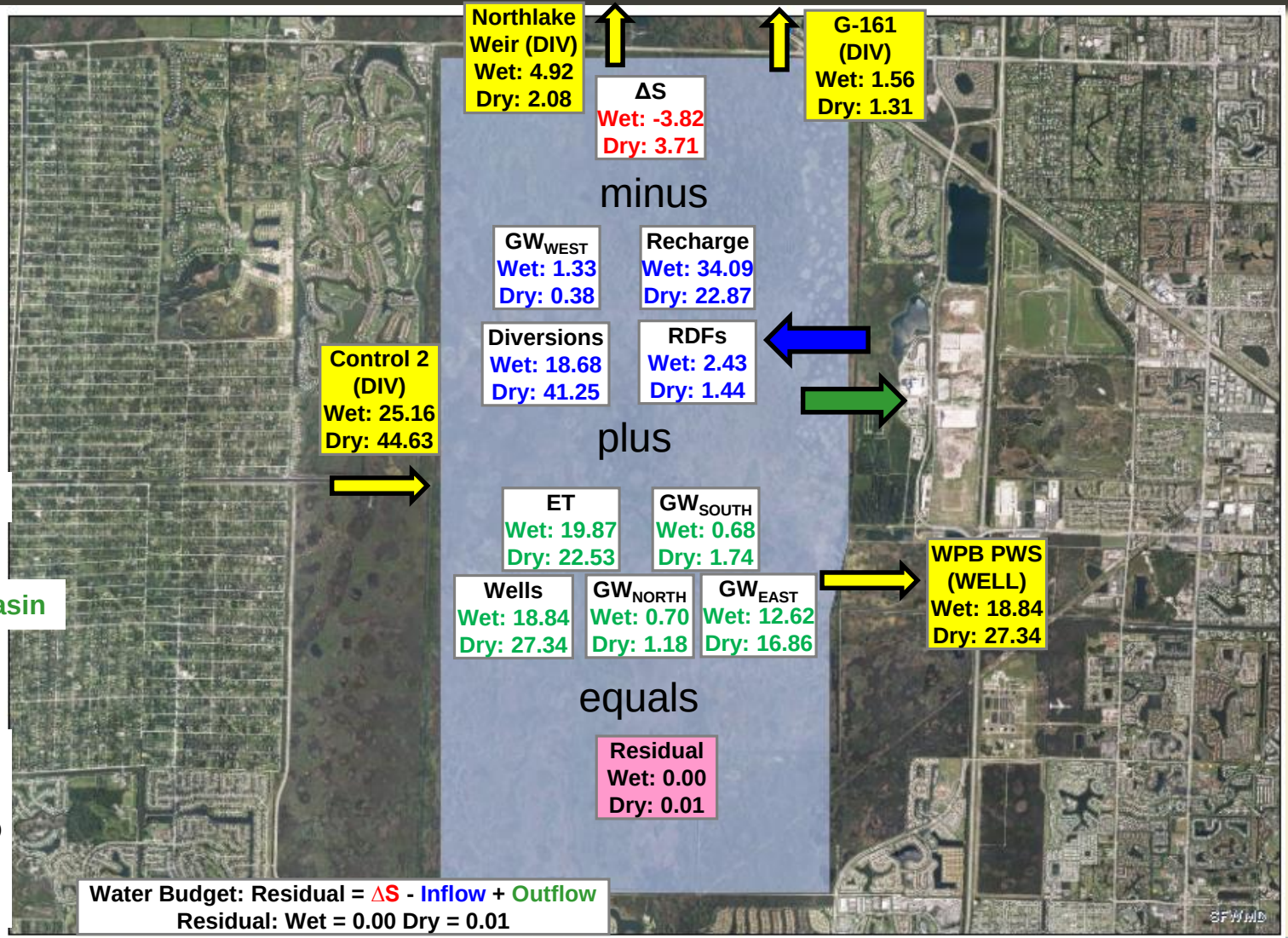
outflow from the basin

Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Grassy Waters Preserve – Seasonal Average



Inflow to the basin

outflow from the basin

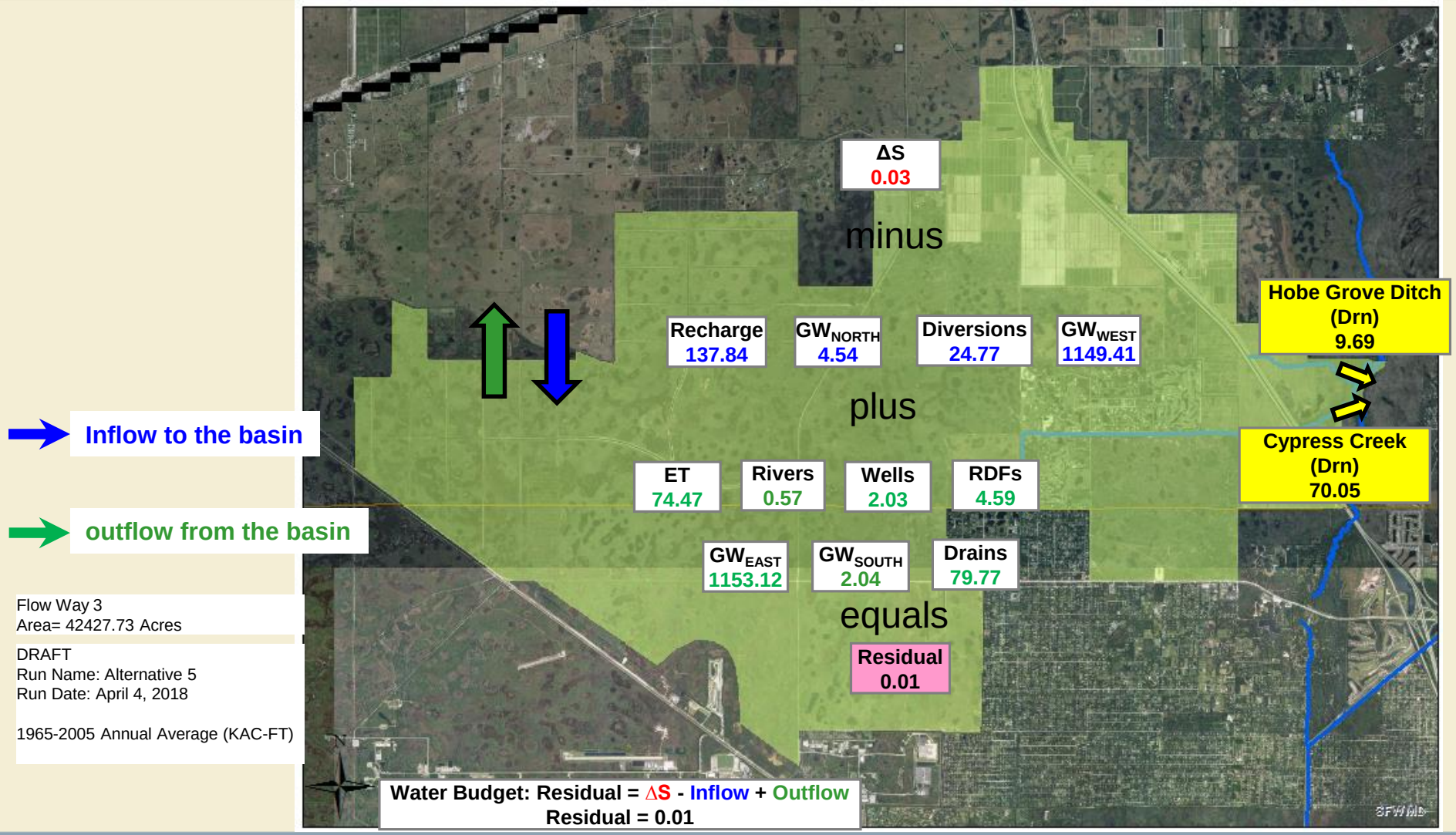
Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

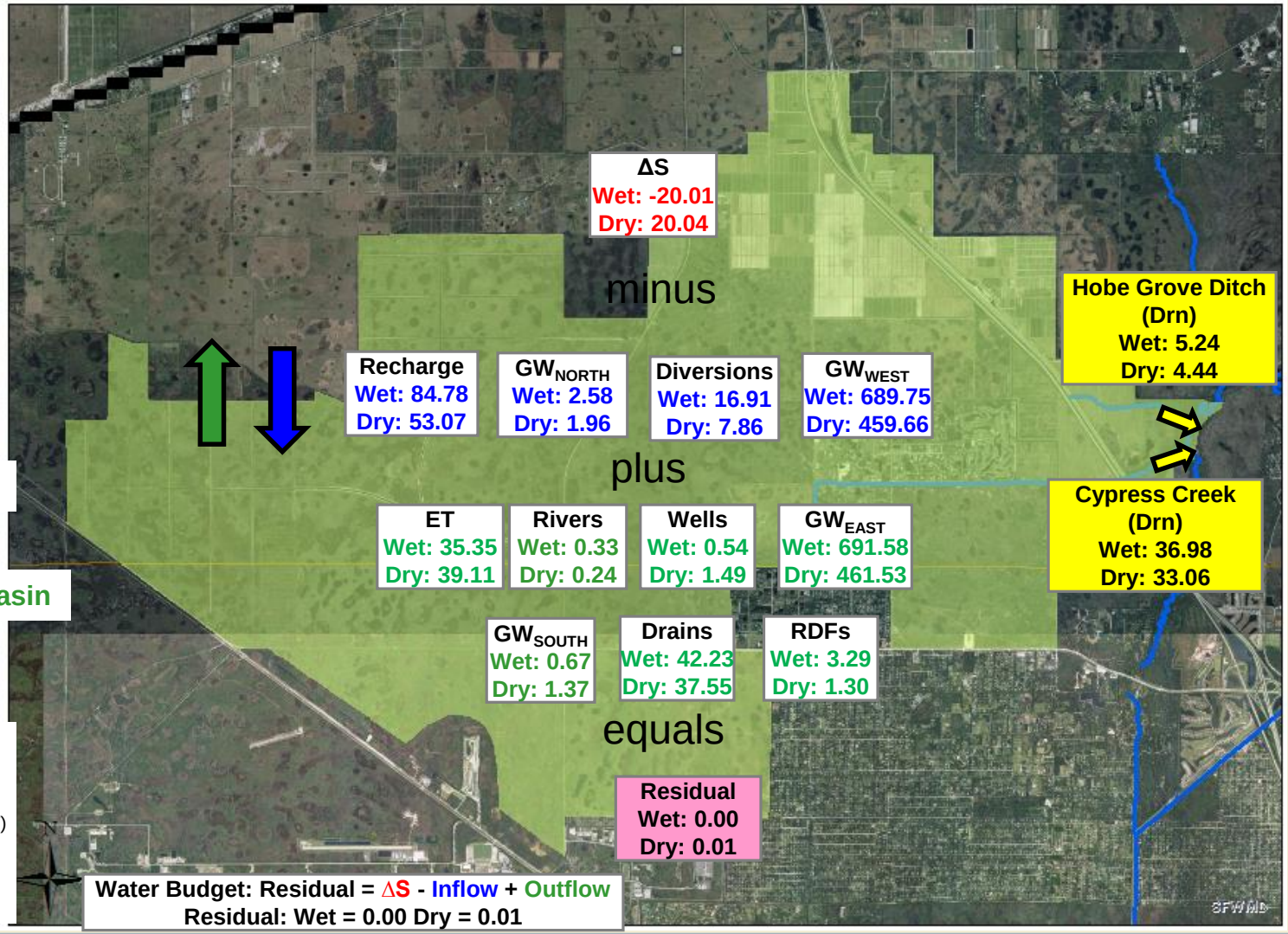
1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Flow Way 3 – Annual Average



Flow Way 3 – Seasonal Average



Inflow to the basin

outflow from the basin

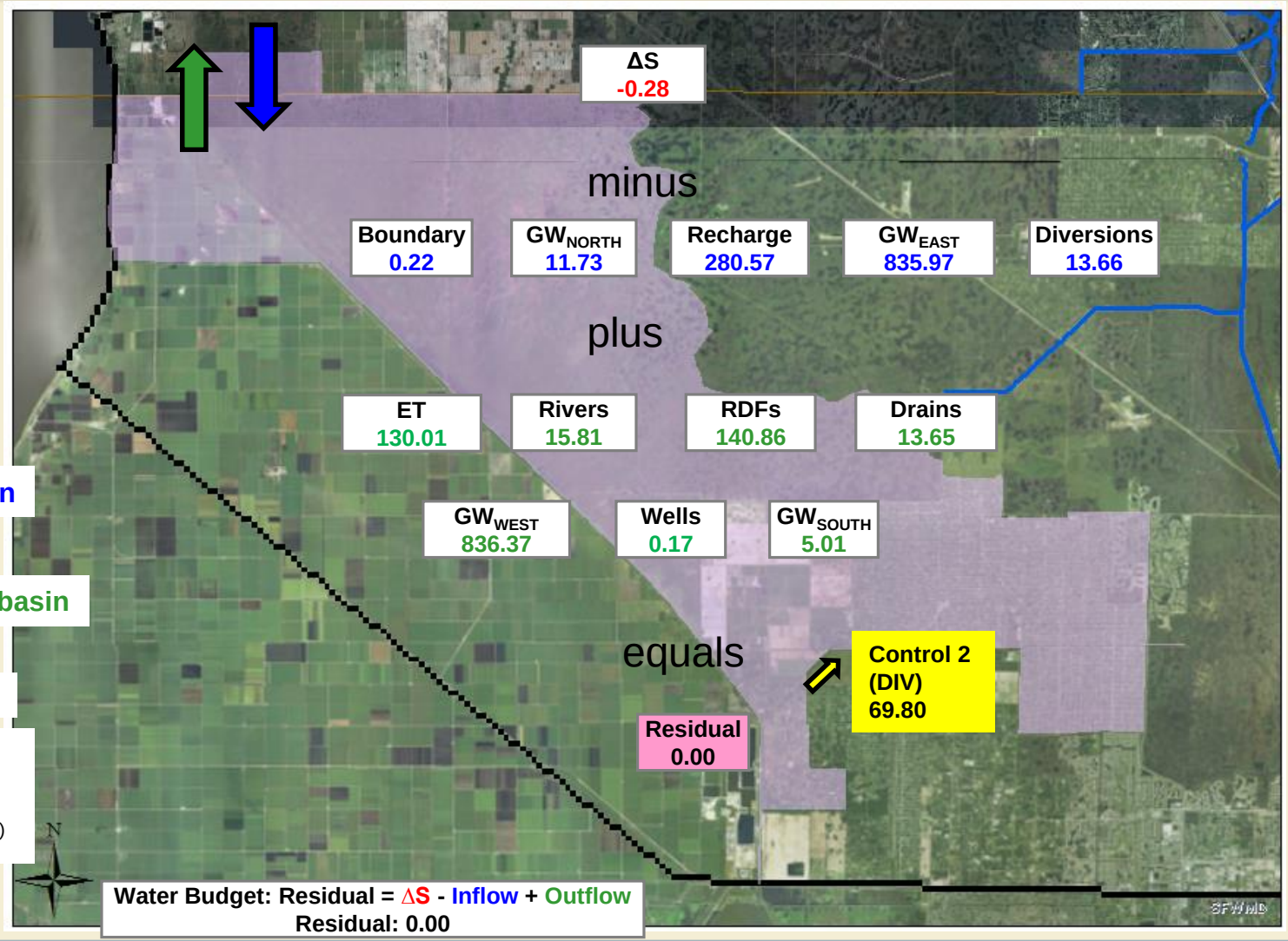
Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

L-8 – Annual Average



Inflow to the basin

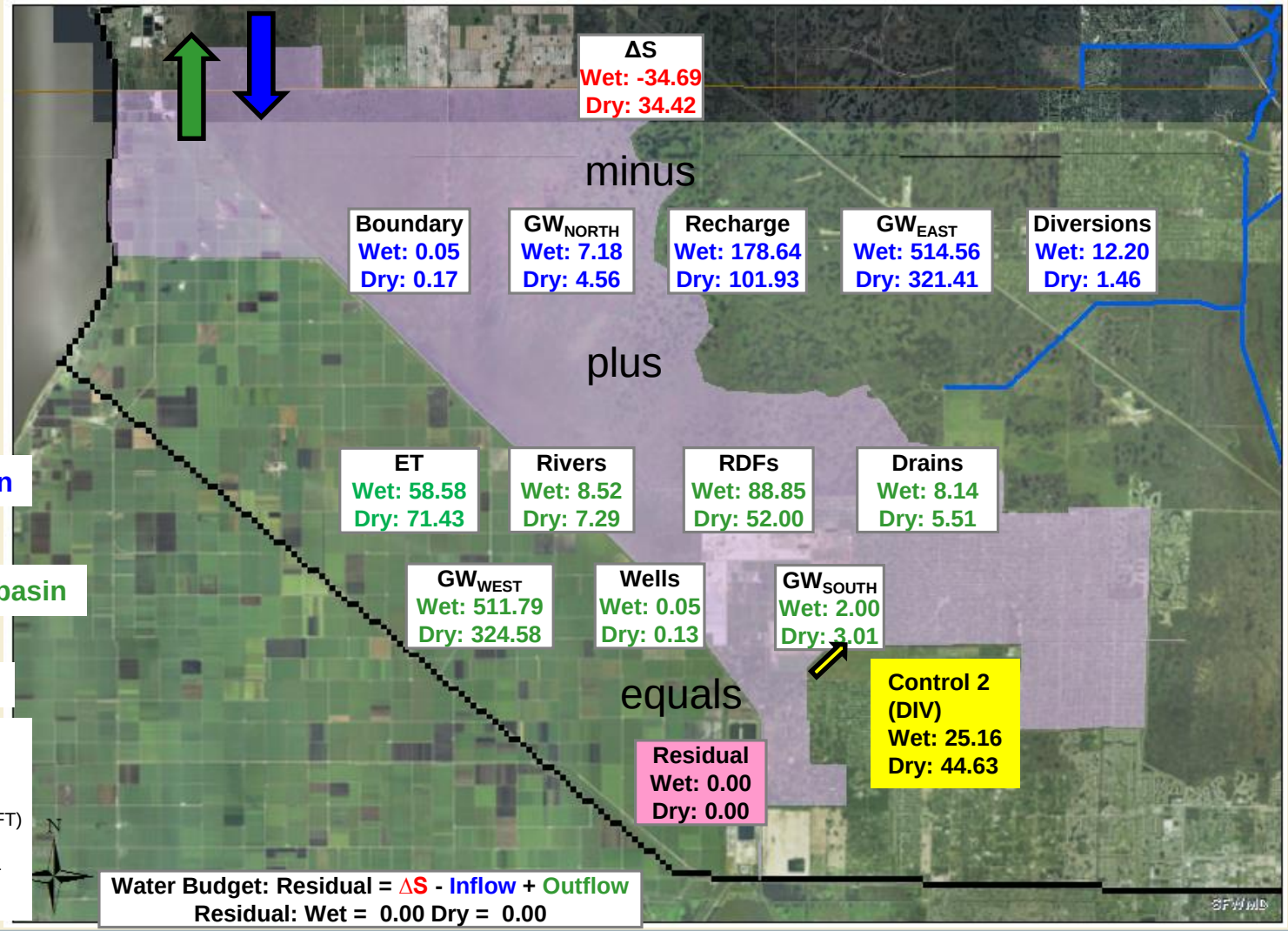
outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

L-8 – Seasonal Average



Inflow to the basin

outflow from the basin

L8
Area= 105096.53 Acres

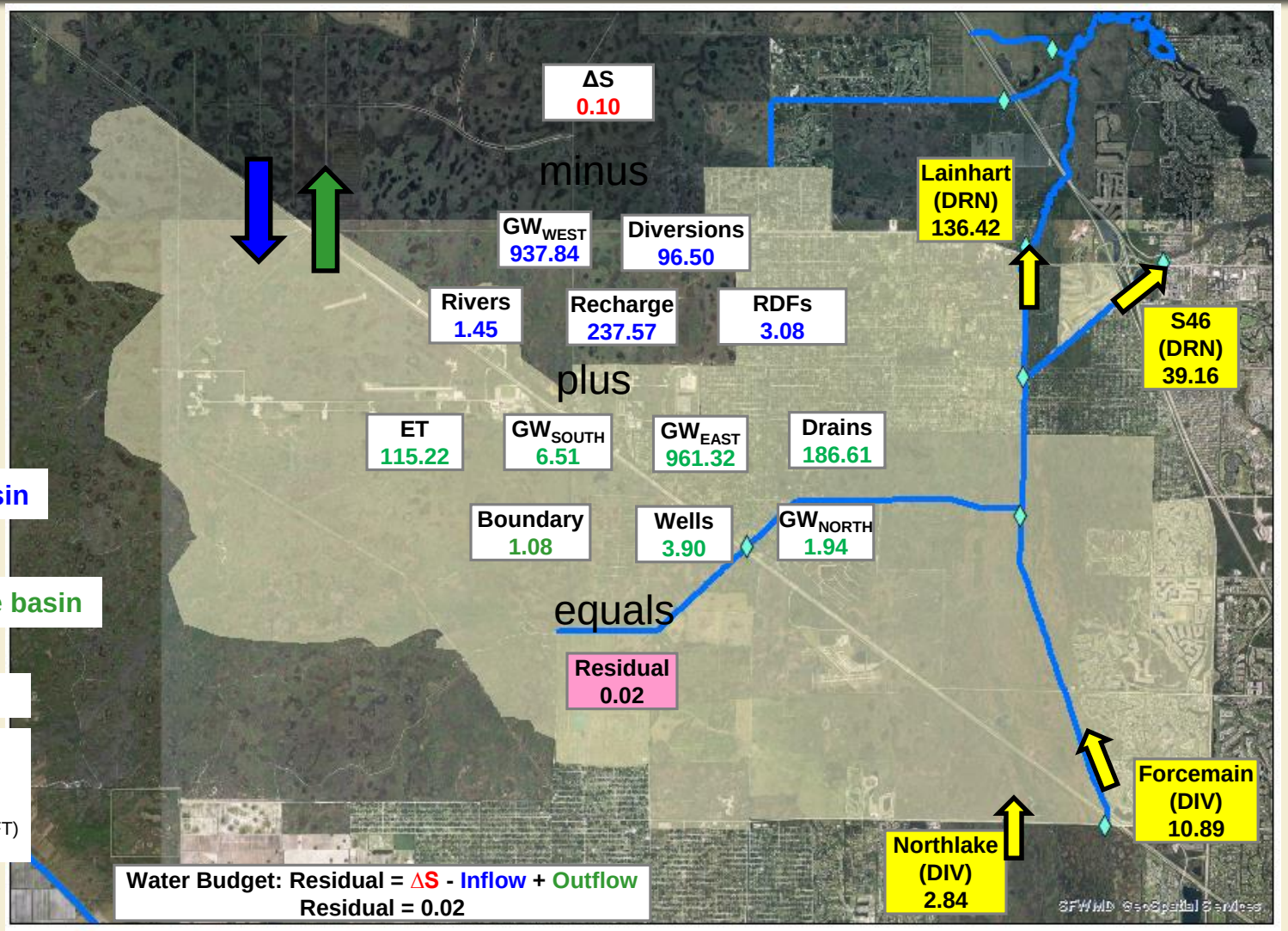
DRAFT
Run Name: Alternative 5
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Alternative 10 Run

C-18/Jupiter Farms – Annual Average



Inflow to the basin

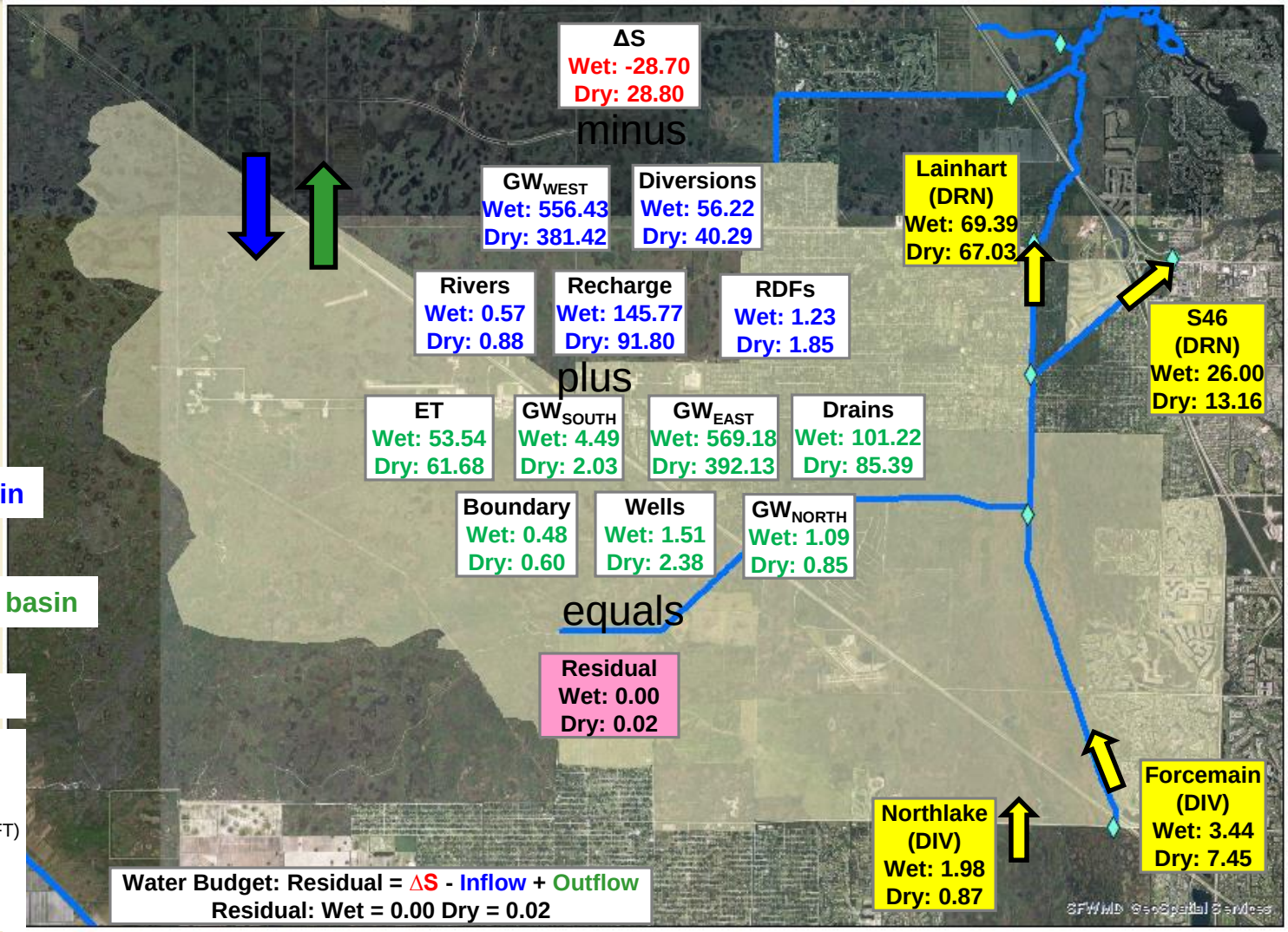
outflow from the basin

C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

C-18/Jupiter Farms – Seasonal Average



Inflow to the basin

outflow from the basin

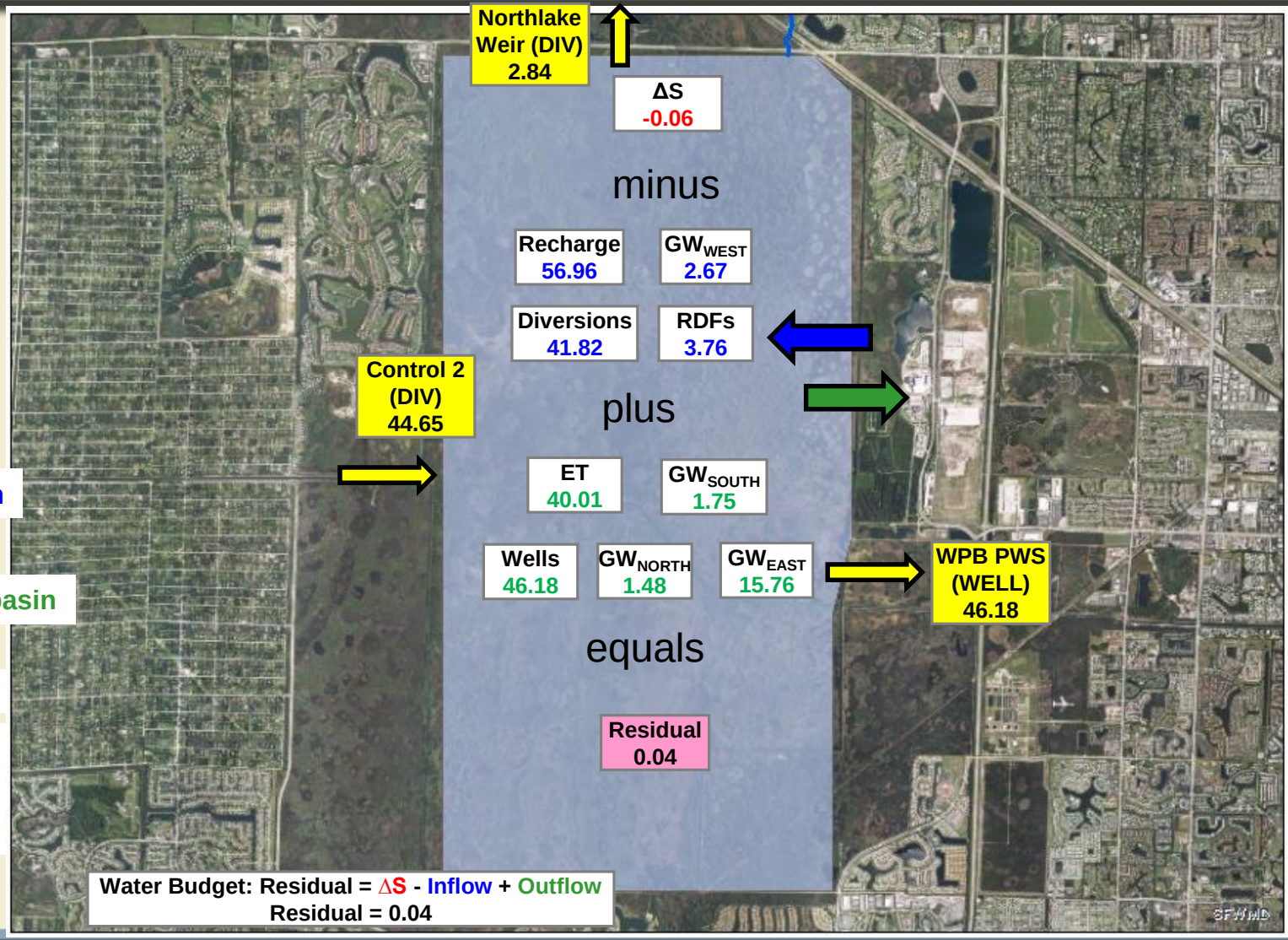
C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Grassy Waters Preserve – Annual Average



Inflow to the basin

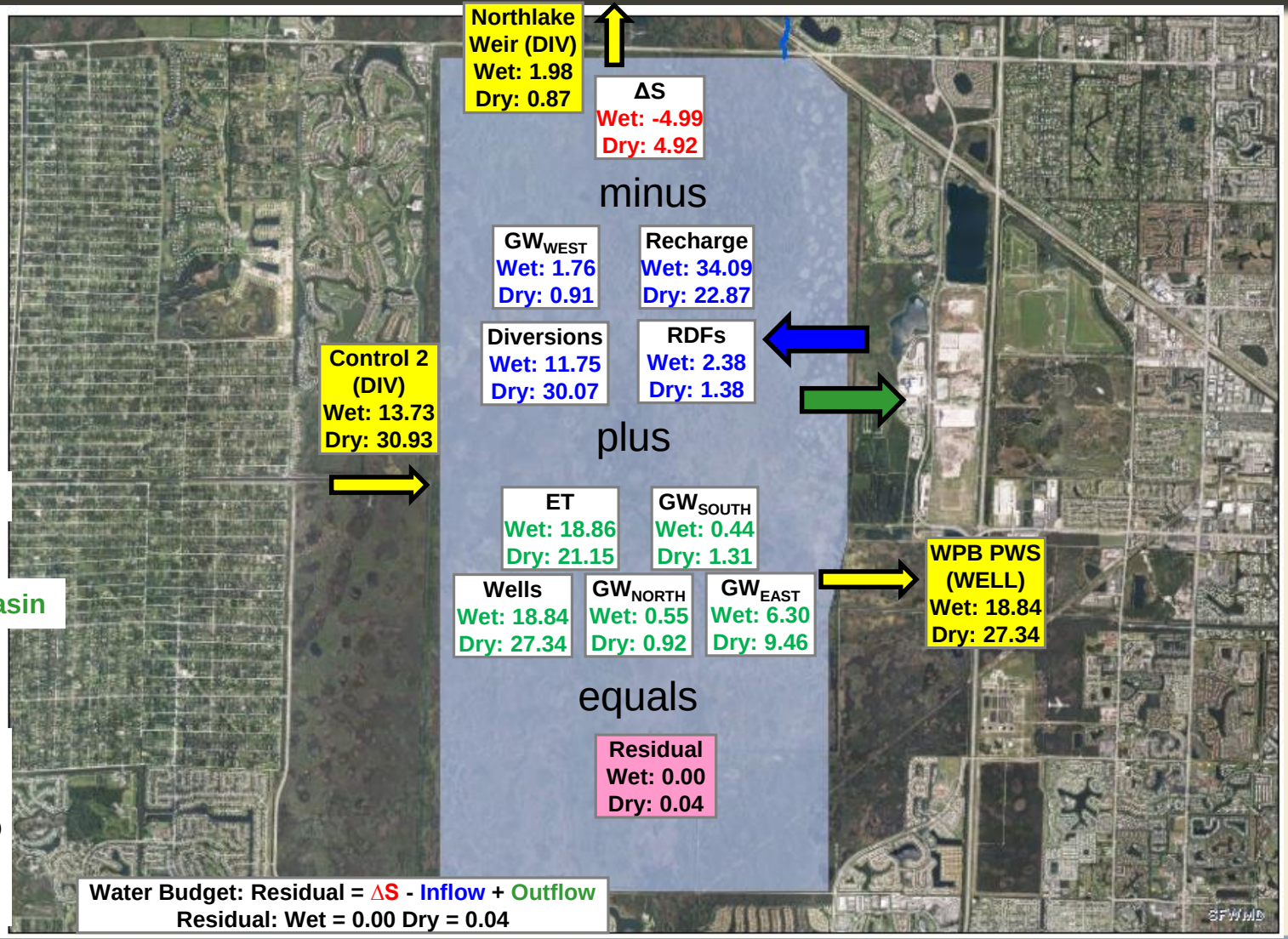
outflow from the basin

Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Grassy Waters Preserve – Seasonal Average



Inflow to the basin

outflow from the basin

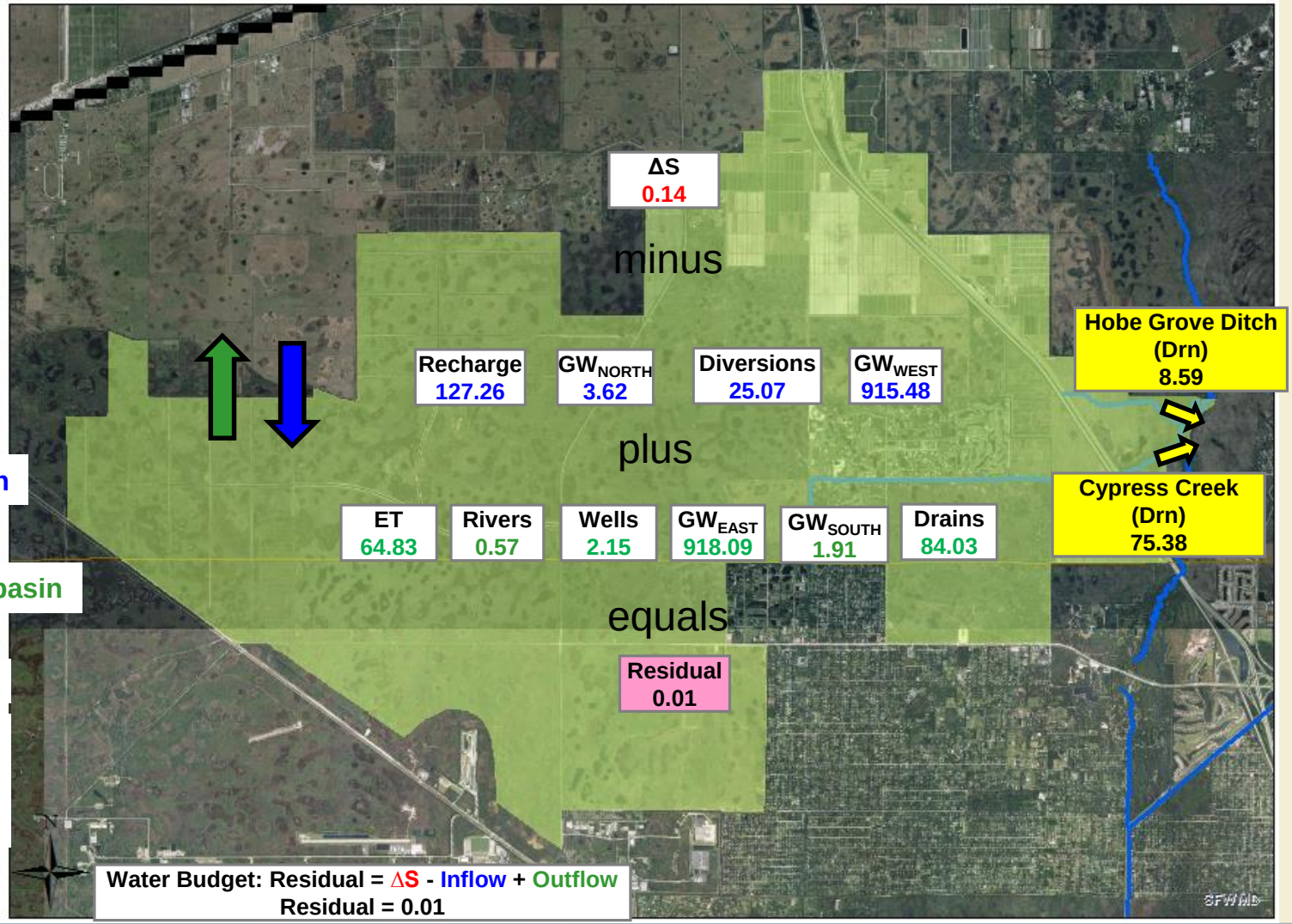
Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Flow Way 3 – Annual Average



Inflow to the basin

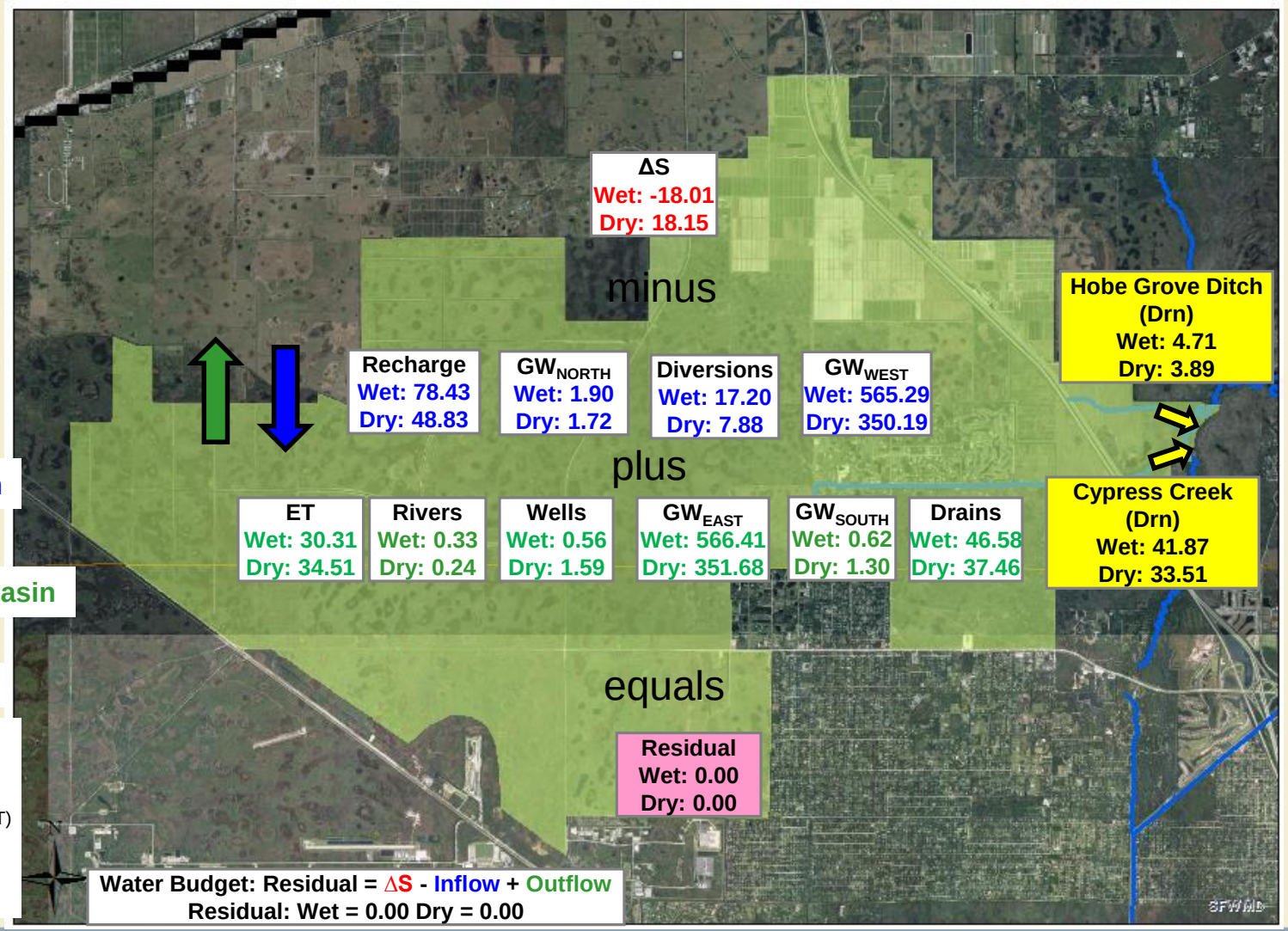
outflow from the basin

Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Flow Way 3 – Seasonal Average



Inflow to the basin

outflow from the basin

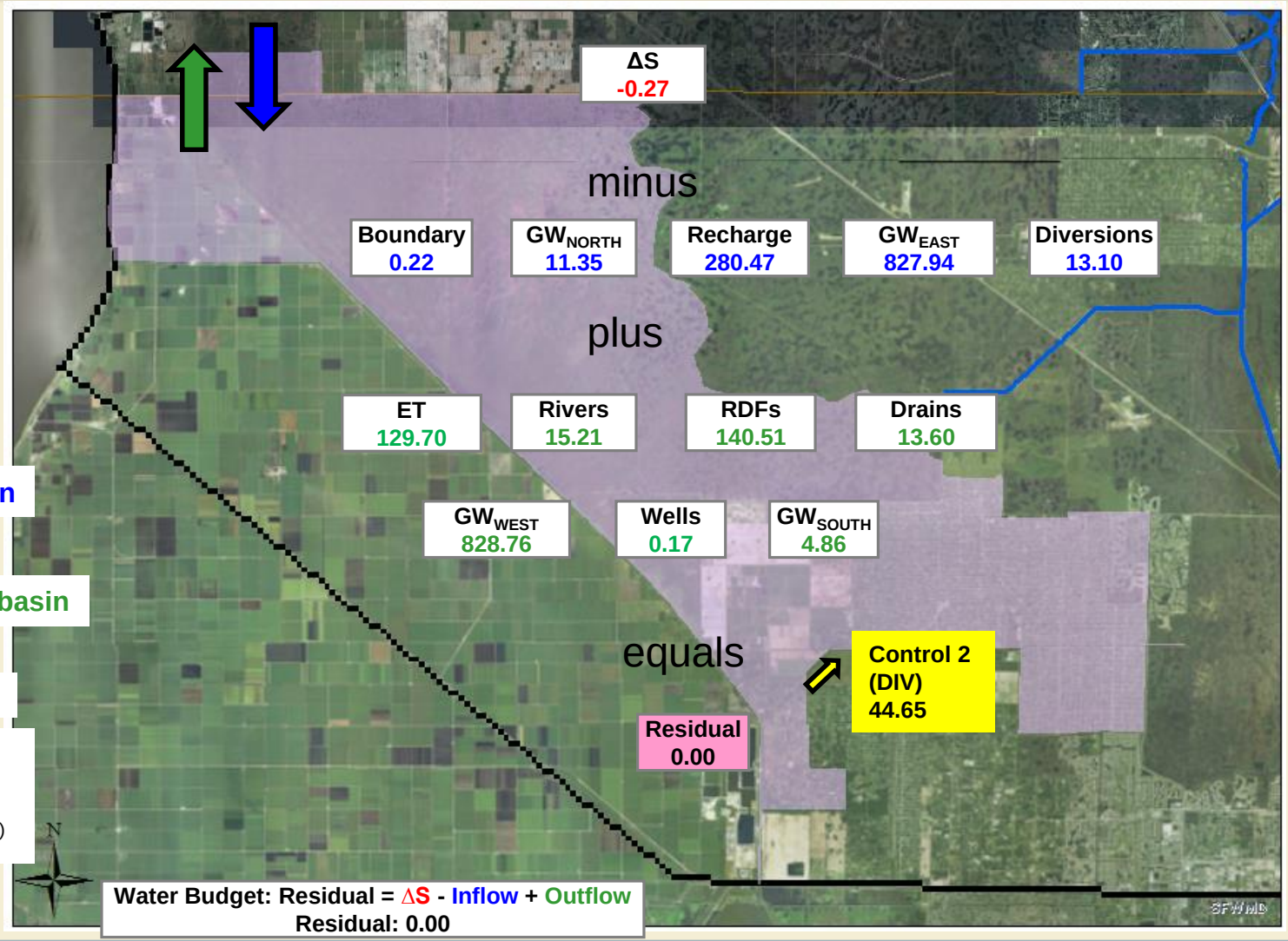
Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

L-8 – Annual Average



Inflow to the basin

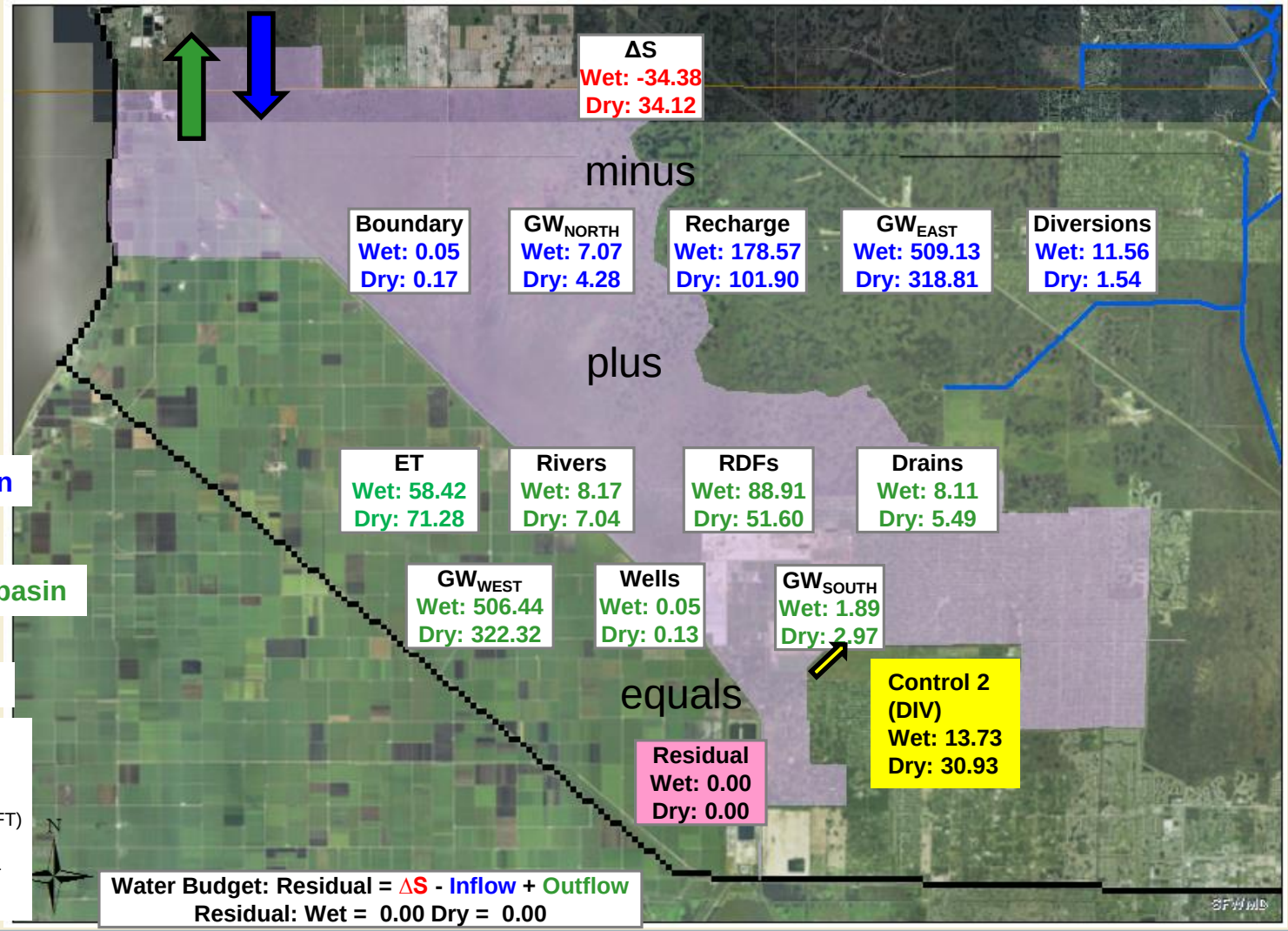
outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

L-8 – Seasonal Average



Inflow to the basin

outflow from the basin

L8
Area= 105096.53 Acres

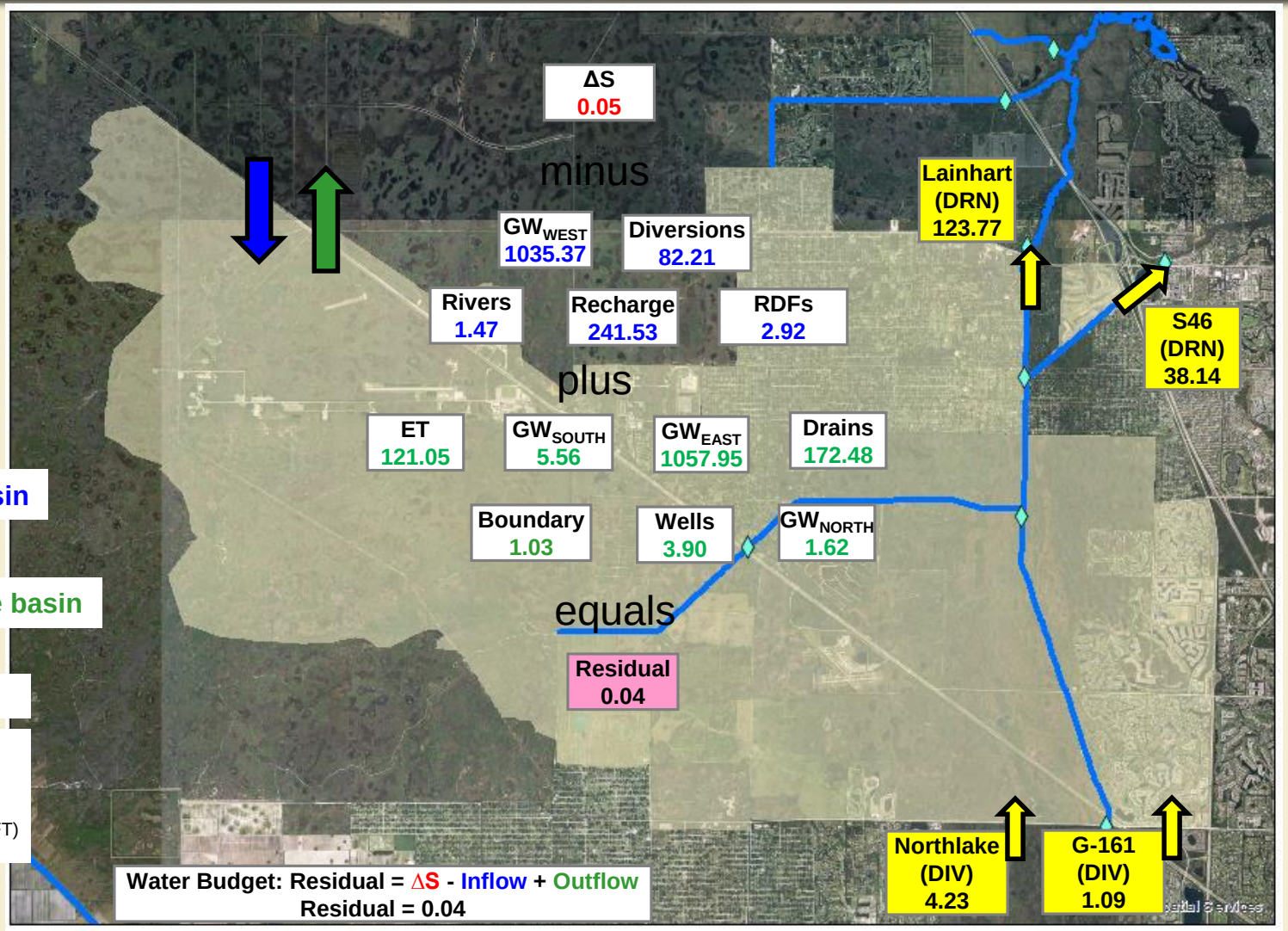
DRAFT
Run Name: Alternative 10
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Alternative 13 Run

C-18/Jupiter Farms – Annual Average



Inflow to the basin

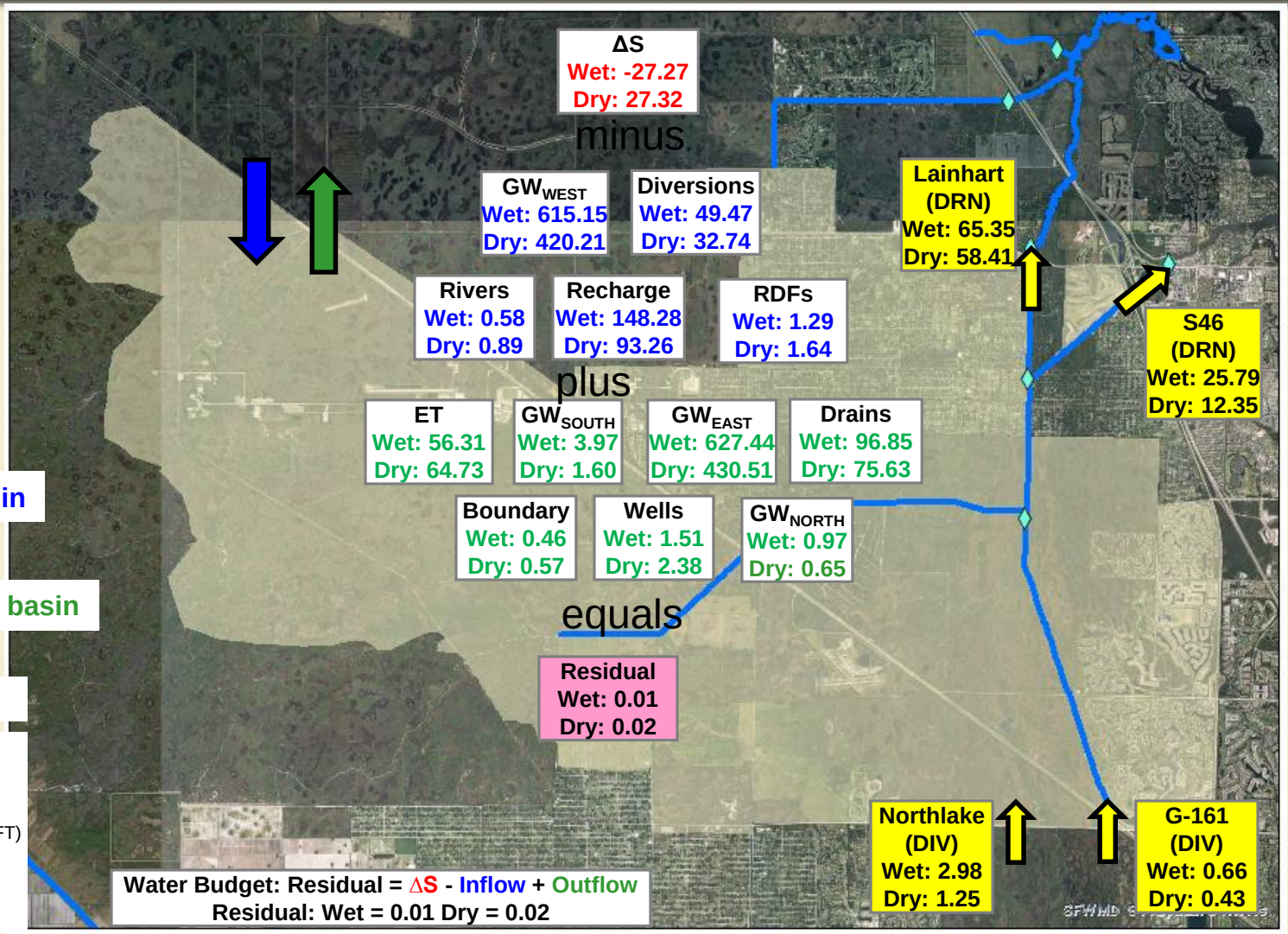
outflow from the basin

C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

C-18/Jupiter Farms – Seasonal Average



Inflow to the basin

outflow from the basin

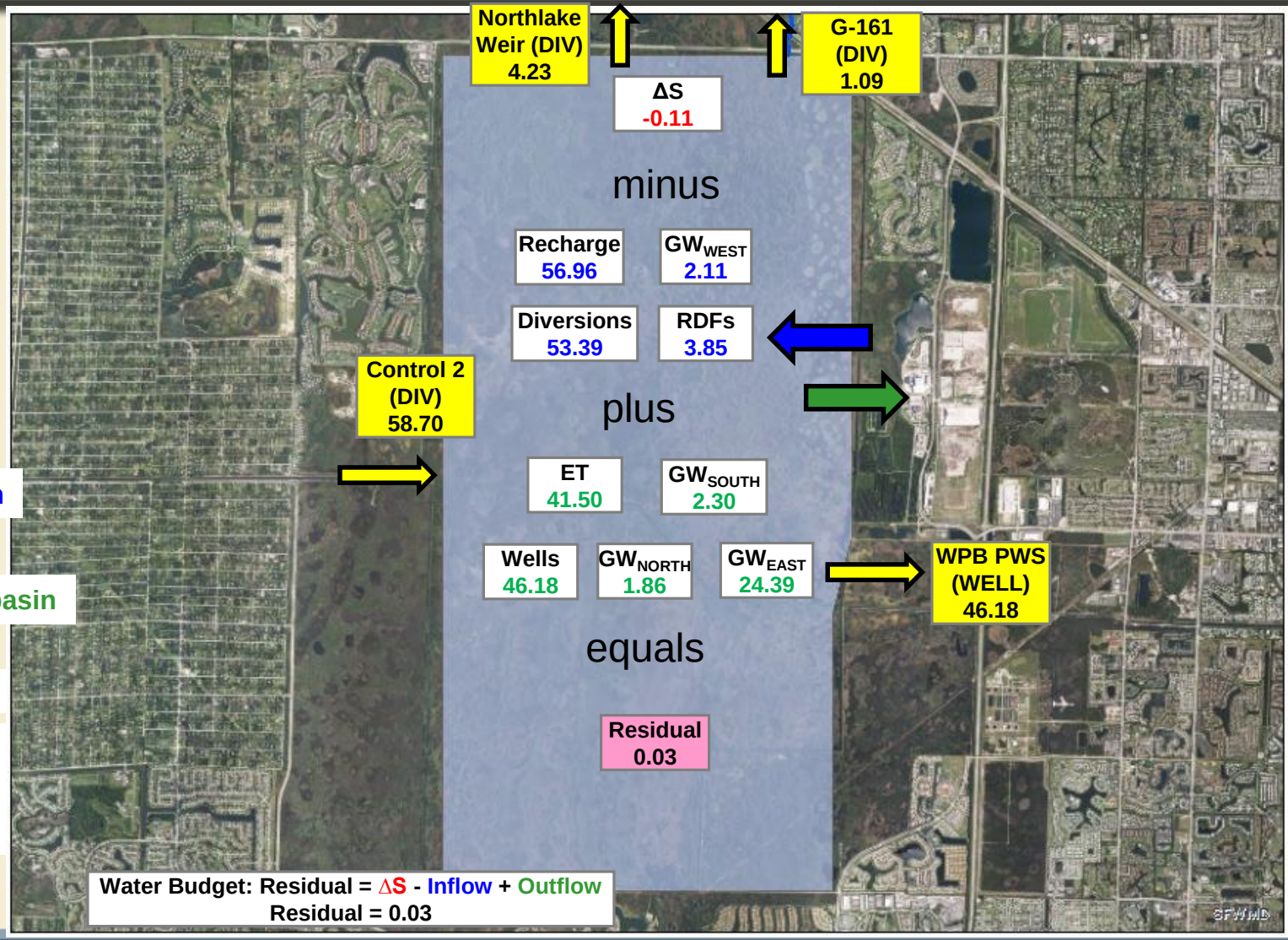
C18/Jupiter Farm
Area= 76868.27 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Grassy Waters Preserve – Annual Average



Inflow to the basin

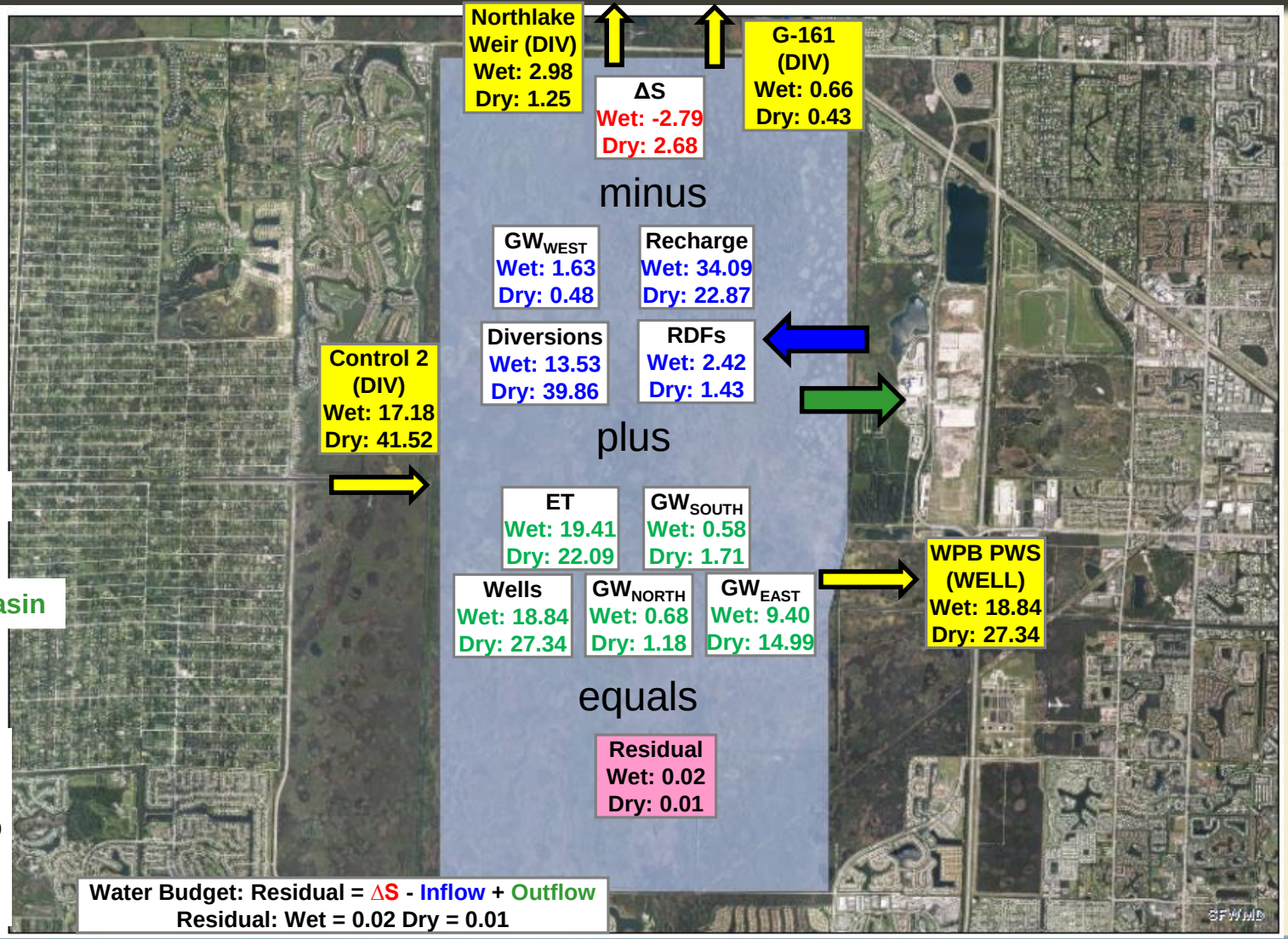
outflow from the basin

Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Grassy Waters Preserve – Seasonal Average



Inflow to the basin

outflow from the basin

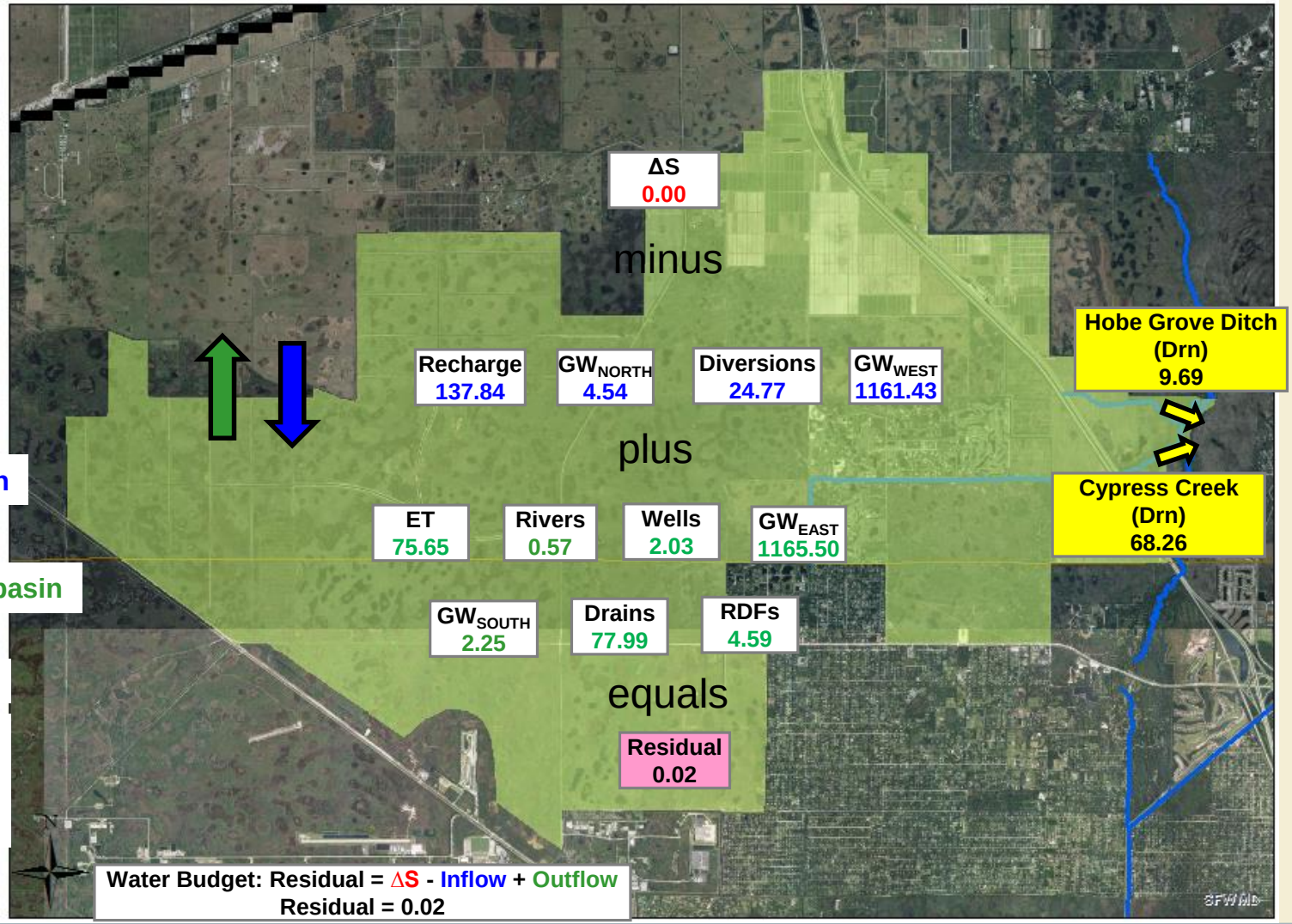
Grassy Waters Preserve
Area= 11104.79 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

Flow Way 3 – Annual Average



Inflow to the basin

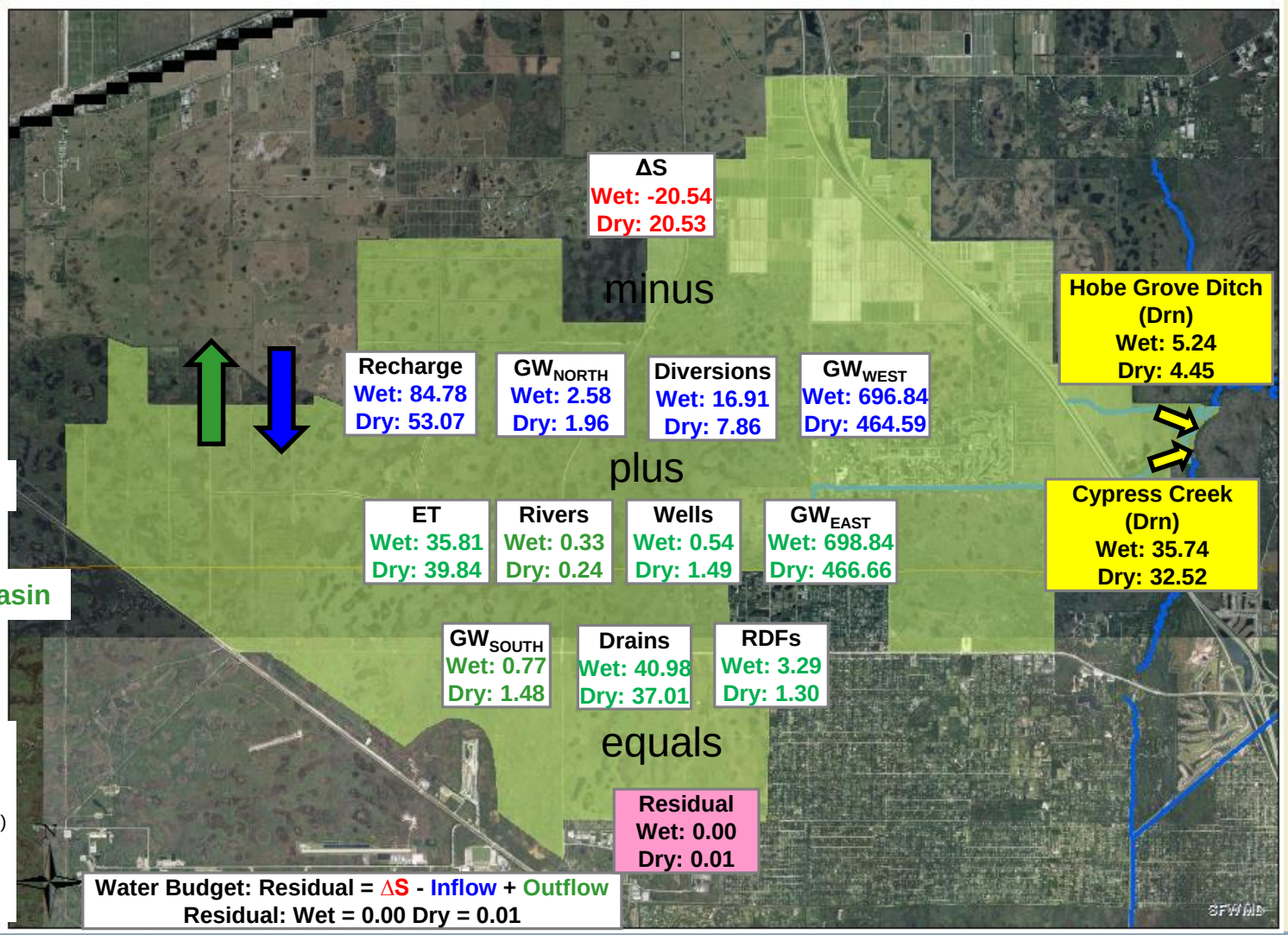
outflow from the basin

Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

Flow Way 3 – Seasonal Average



Inflow to the basin

outflow from the basin

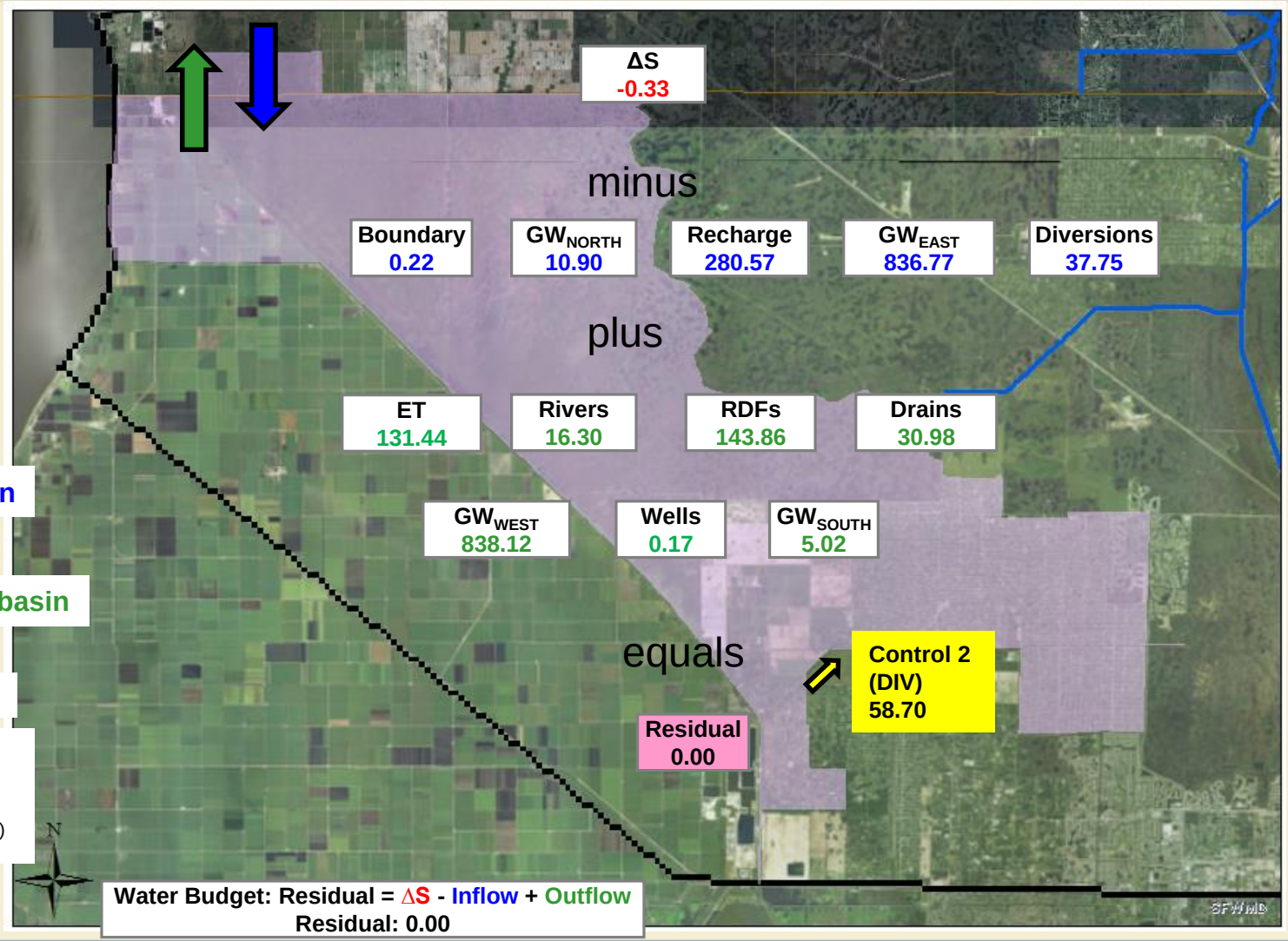
Flow Way 3
Area= 42427.73 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31

L-8 – Annual Average



Inflow to the basin

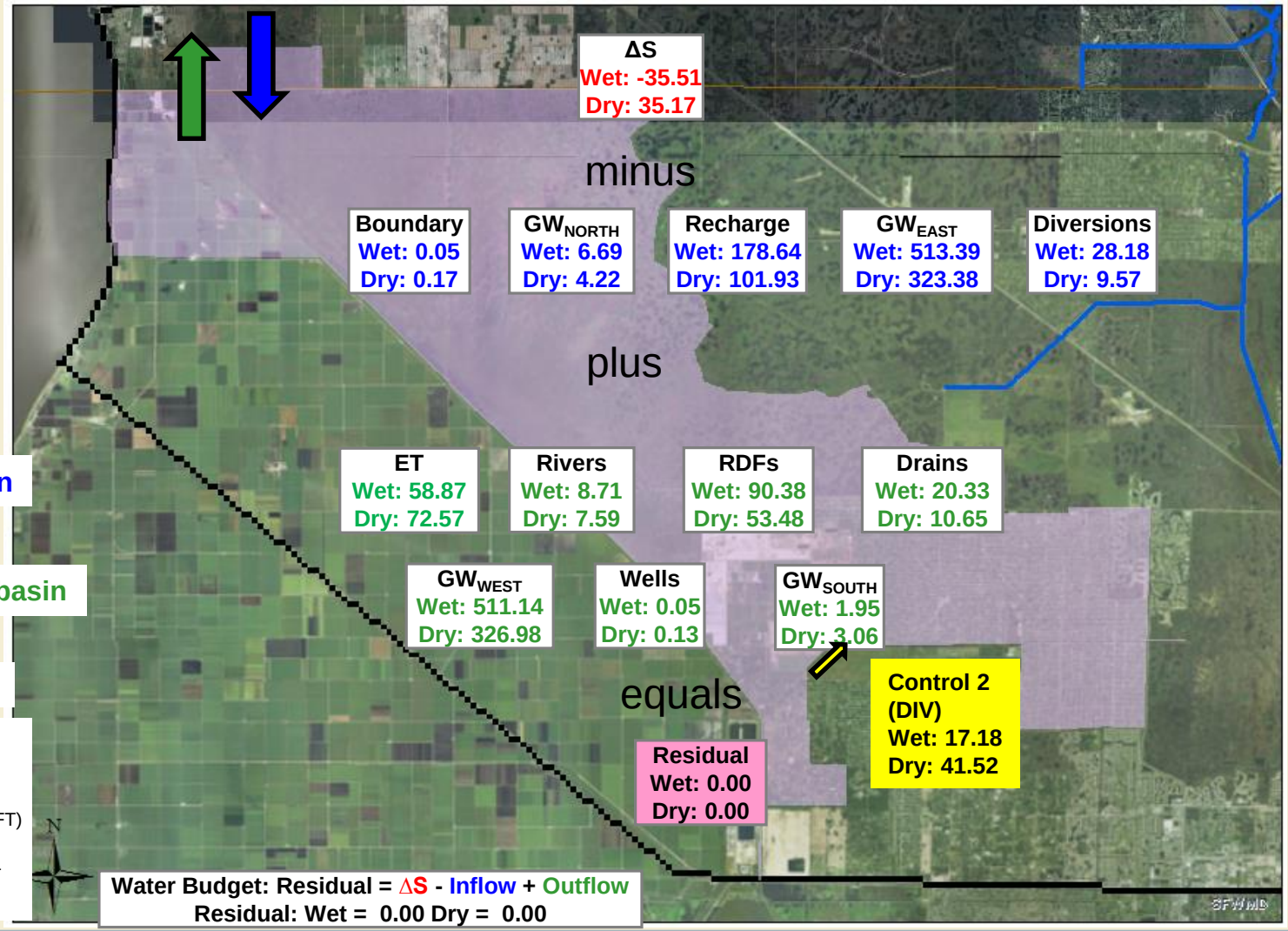
outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Annual Average (KAC-FT)

L-8 – Seasonal Average



Inflow to the basin

outflow from the basin

L8
Area= 105096.53 Acres

DRAFT
Run Name: Alternative 13
Run Date: April 4, 2018

1965-2005 Seasonal Average (KAC-FT)

Wet Season: June 1 – October 31
Dry Season: January 1 – May 31,
November 1 – December 31