North Palm Beach Groundwater Model
Alternative Modeling Results

South Florida Water Management District
May 9, 2018

U.S.ARMY

Outline

- Performance Measure Graphics Overview
- Alternative Results
  - Difference Maps
  - Select Graphics from:
    - WRAP Stage Duration Curves
    - Reservoir Hydrographs
    - Structure Flow Graphics
  - Lainhart Targets

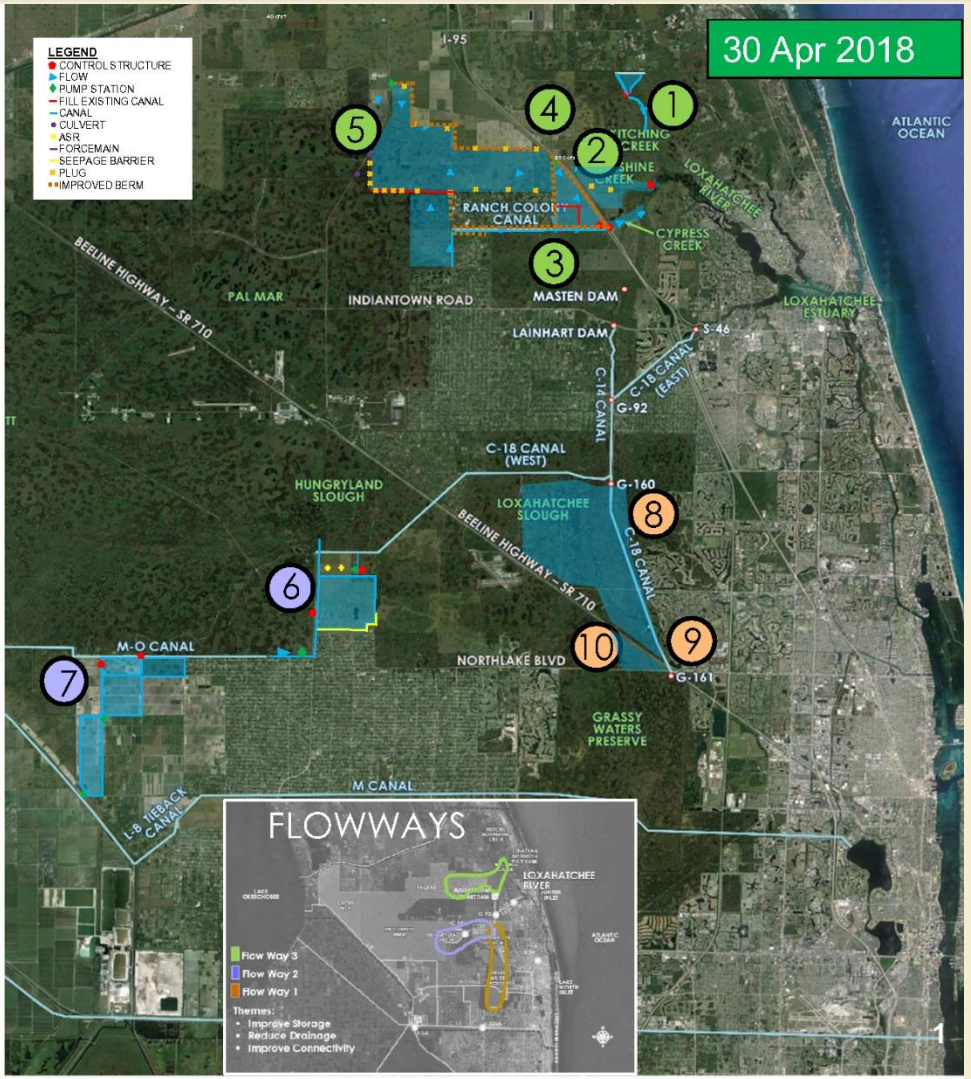
Performance Graphic Overview

- 2 Performance Measure Graphic Sets
  - PM Set #1 – 2014 Base (2014B) and 2070 Future Without Project Conditions (2070FWO)
  - PM Set #5 – 2070FWO with Alternatives 2, 5, 10, and 13
- 11 Different Data Types with 700+ graphics per Performance Measure Graphic Set

Alternative 2 Project Features

ALTERNATIVE 2

1. Kitching Creek (Hydration)
   Spreader canal; weir/plug (Jenkins Ditch)
2. Moonshine Creek (MC) & Gulfstream East (GE) (Restoration): Connect HSLCD ditch to MC; clear MC vegetation; weir in Hobe Grove Ditch; regrade adjacent area to historic topography
3. Cypress Creek Canal (CCC) (Reduce Over-drainage): Replace CCC weir to raise control elevation, raise berm at Ranch Colony; automate twin 84" culverts;
4. Gulfstream West (Restoration & Reduce over-drainage): Partial backfill & relocate southern end of HSLCD canal; small pump, construct flow through marsh to attenuate flows
5. Palmar East (Restoration & Connectivity)
   Plug ditches; remove pipes; improve northern berm; construct western berm; improve eastern berm; pumps at Thomas Farm to redirect drainage to GW flow- through marsh via north Nine Gems canal
6. C-18W Reservoir (7,200 ac/ft & 2 ASR wells): Above-ground reservoir; inflow pump; discharge structure; seepage control; M-O Canal connector and pump
7. L-8 Basin Shallow Storage (4,300 ac/ft; includes pumps & channels)
8. G-160 Structure (Reduce Over-drainage): improve hydroperiod in Loxahatchee Slough
9. G-161 Structure (Connectivity): GWP water to Loxahatchee Slough
10. GWP Triangle (Connectivity)

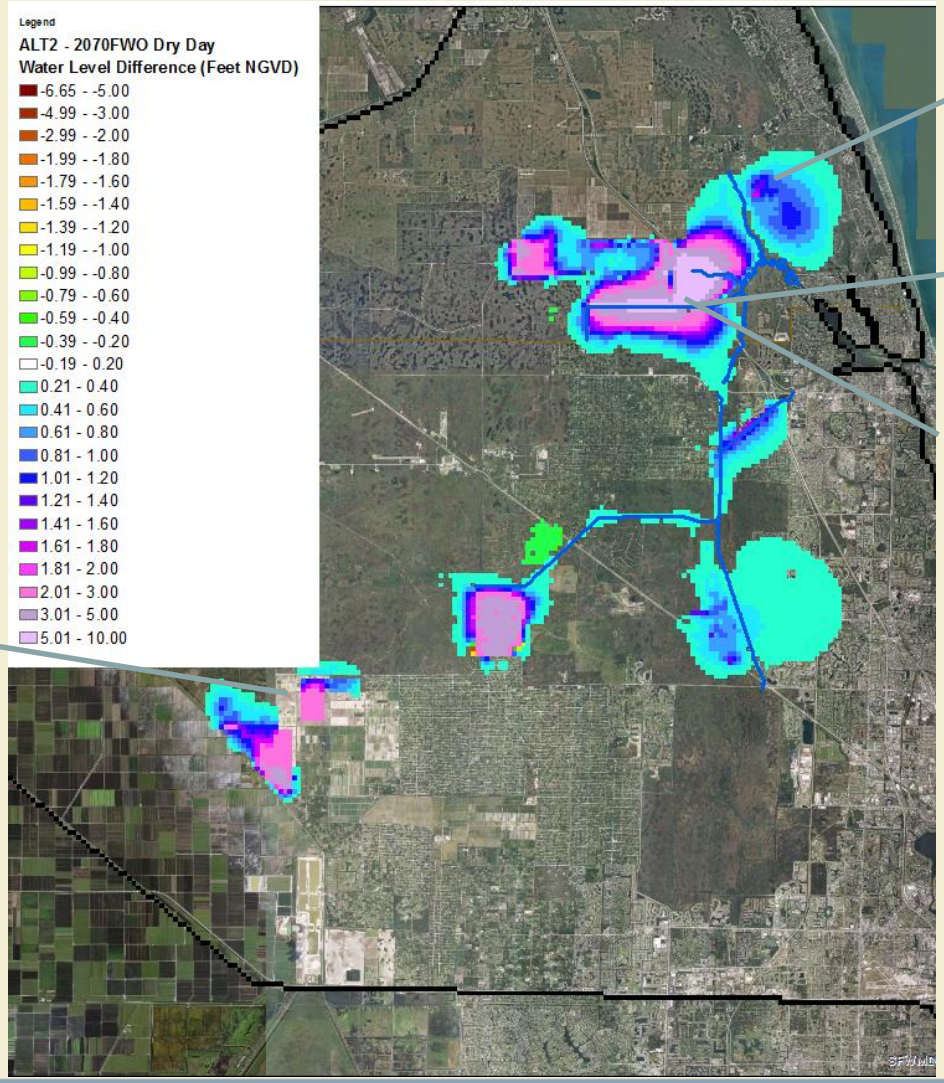


Alternative 5

Alternative 10

Alternative 13

Alternative 2 – 2070FWO Water Level Difference Map (Dry Day)



Jenkins Ditch

Flow Through Marsh Outflows

PM-2.2A

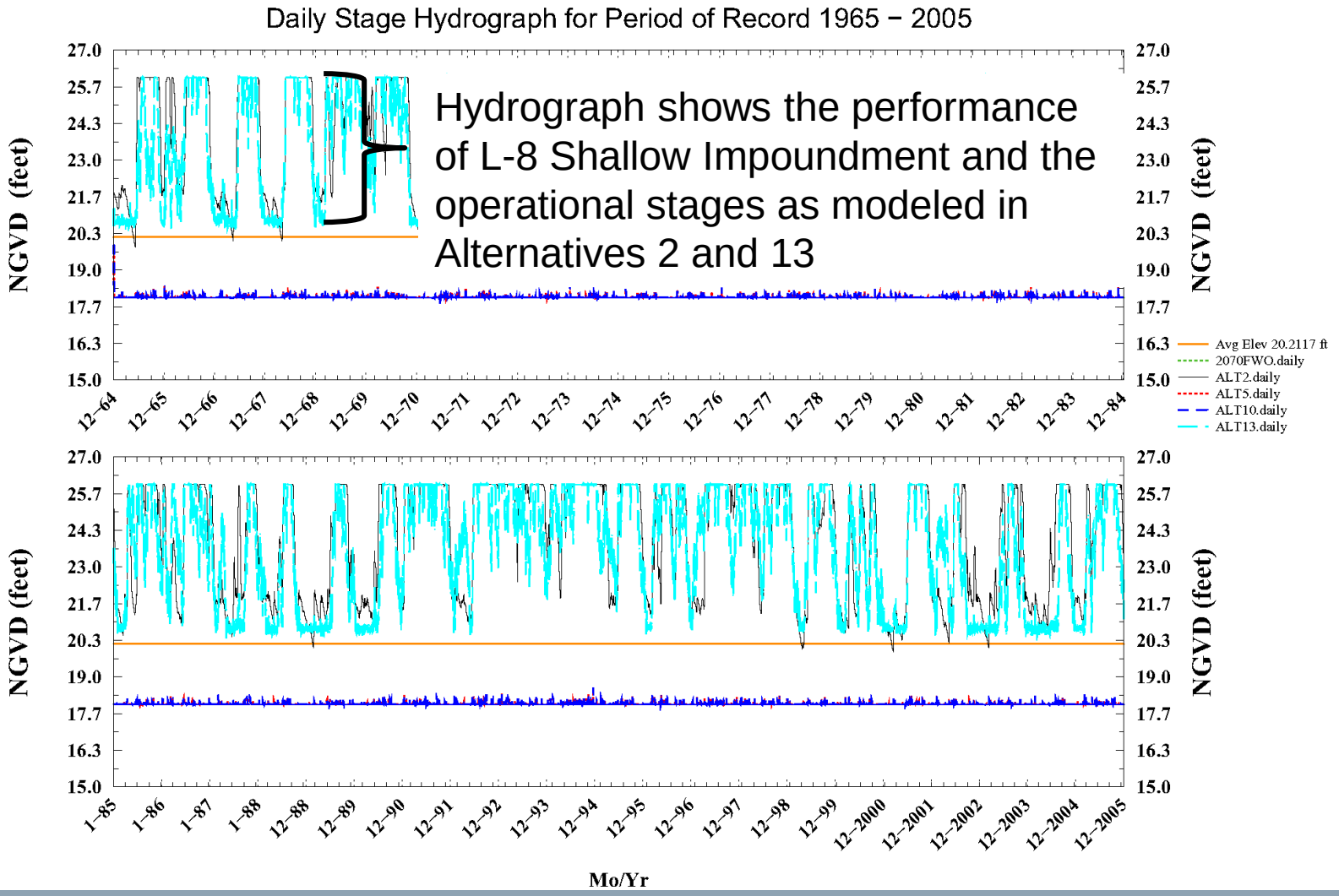
L-8 Shallow Impoundment

[Alternative 5]

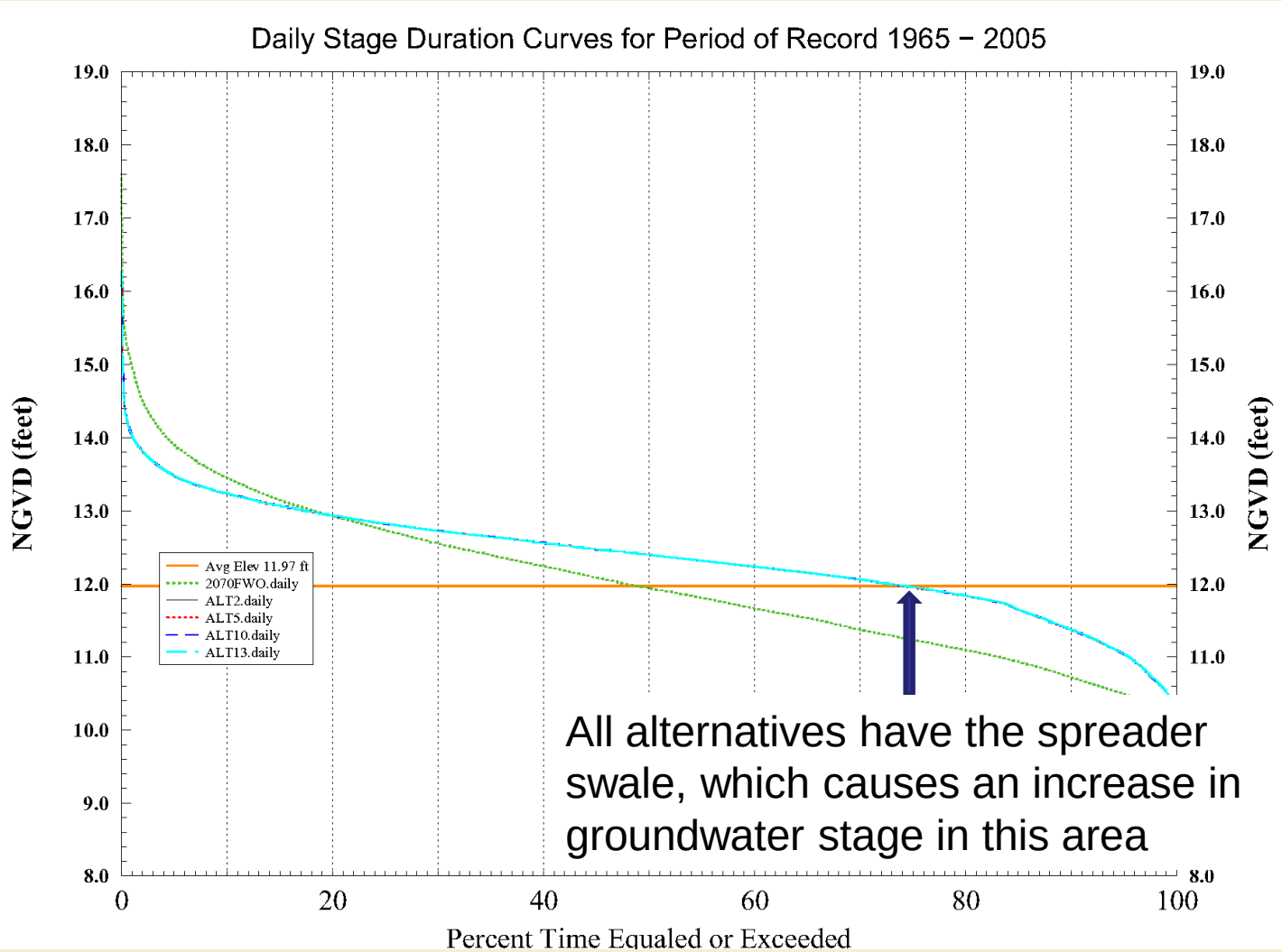
[Alternative 10]

[Alternative 13]

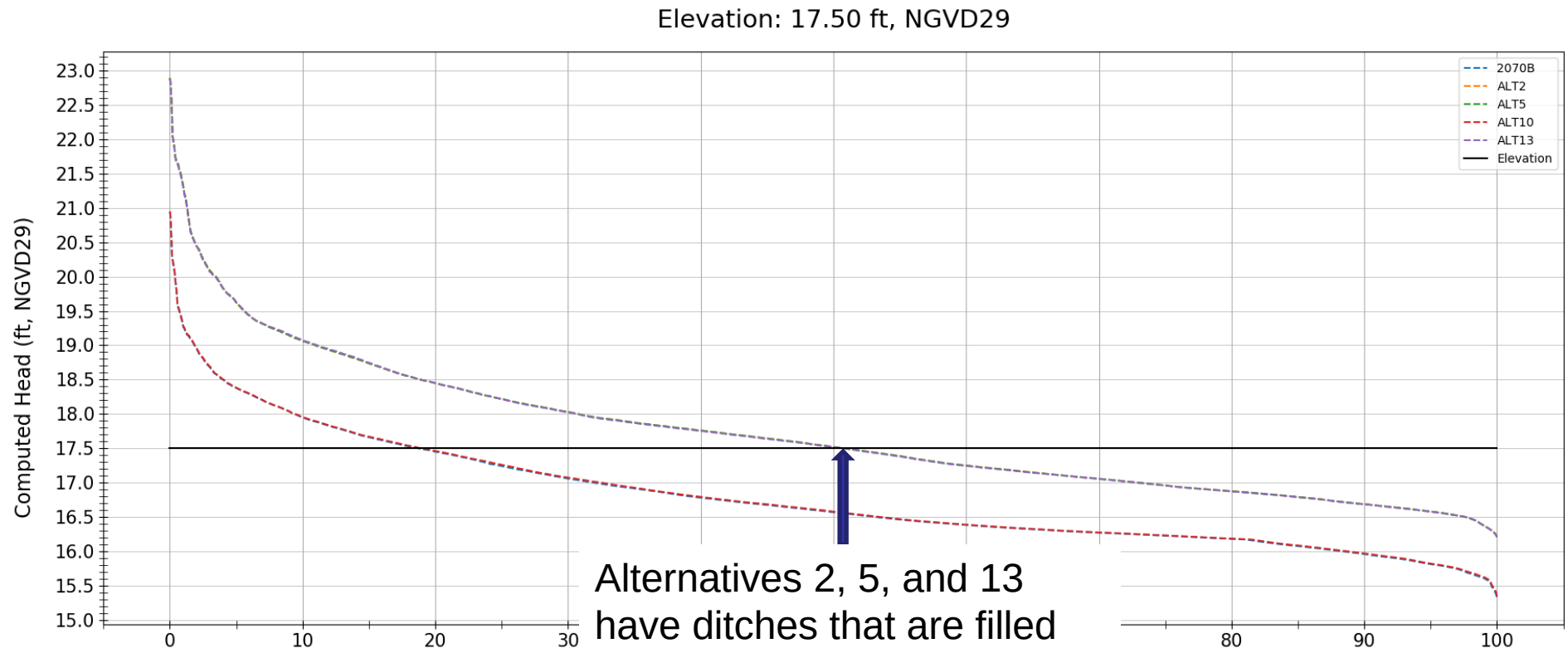
L-8 Shallow Impoundment



Jenkins Ditch

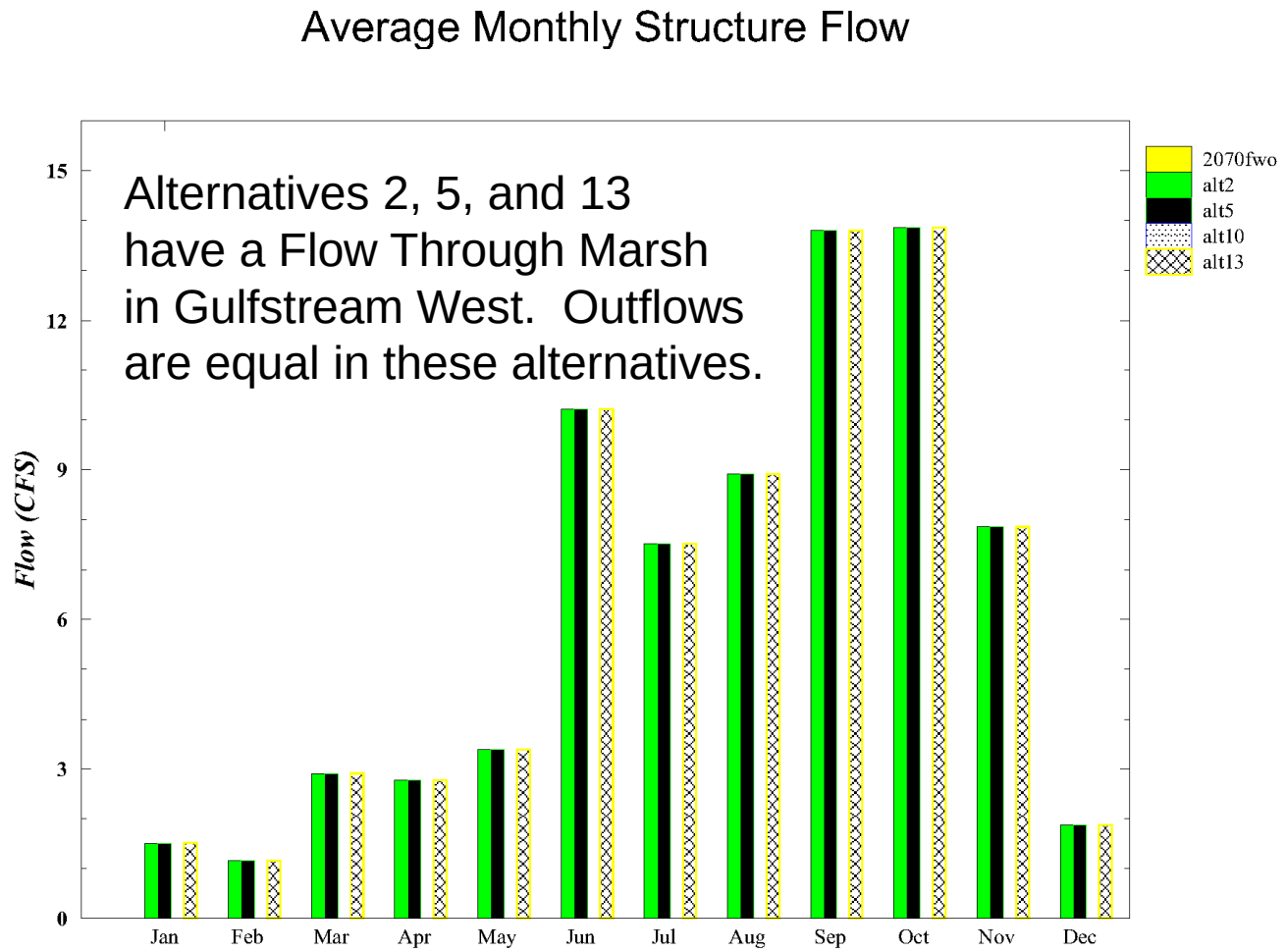


PM-2.2A (Eastern Nine Gems)



Alternatives 2, 5, and 13 have ditches that are filled in PalMar, resulting in higher groundwater stages

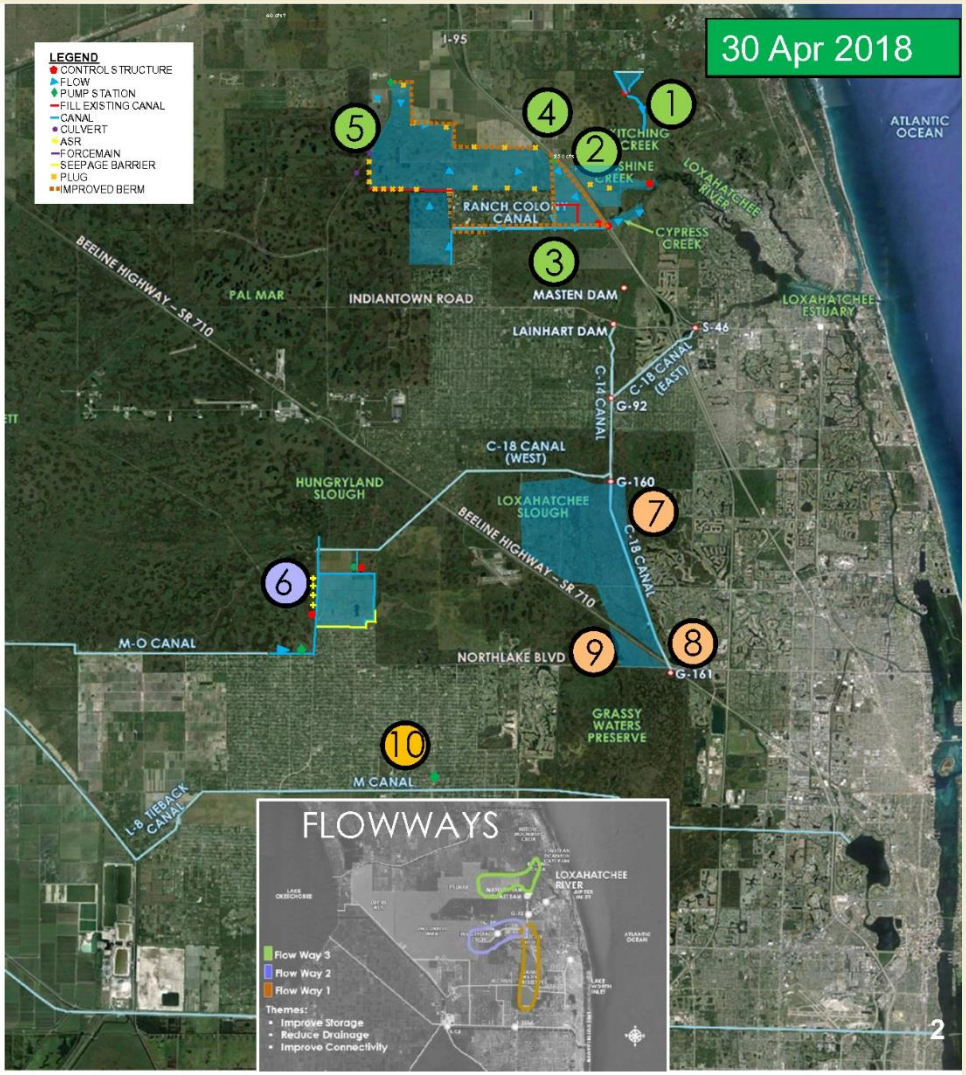
Flow Through Marsh Outflows



Alternative 5 Project Features

ALTERNATIVE 5

1. Kitching Creek (Hydration): Spreader canal; weir/plug (Jenkins Ditch)
2. Moonshine Creek (MC) & Gulfstream East (GE) (Restoration): Connect HSLCD ditch to MC; clear MC vegetation; weir in Hobe Grove Ditch; regrade adjacent area to historic topography
3. Cypress Creek Canal (CCC) (Reduce Over-drainage): Replace CCC weir to raise control elevation; raise berm at Ranch Colony; automate twin 84" culverts;
4. Gulfstream West (Restoration & Reduce Over-drainage): Partial backfill & relocate southern end of HSLCD canal; small pump; construct flow through marsh to attenuate flow
5. Palmar East (Restoration & Connectivity) Plug ditches; remove pipes; improve northern berm; construct western berm; improve eastern berm; pumps at Thomas Farm; redirect drainage to GW flow-through marsh via north Nine Gems canal
6. C-18W Reservoir (9,500 ac/ft & 4 ASR Wells): Above-ground reservoir; inflow pump; discharge structure; seepage control; M-O Canal Connector and pump
7. G-160 Structure (Reduce Over-drainage): Improve hydroperiod in Loxahatchee Slough
8. G-161 Structure (Connectivity): GWP water to Loxahatchee Slough
9. GWP Triangle (Connectivity)
10. M-1 Pump Station (Conveyance): Deliver Lower M-1 Basin water to M-Canal, GWP, and G-161

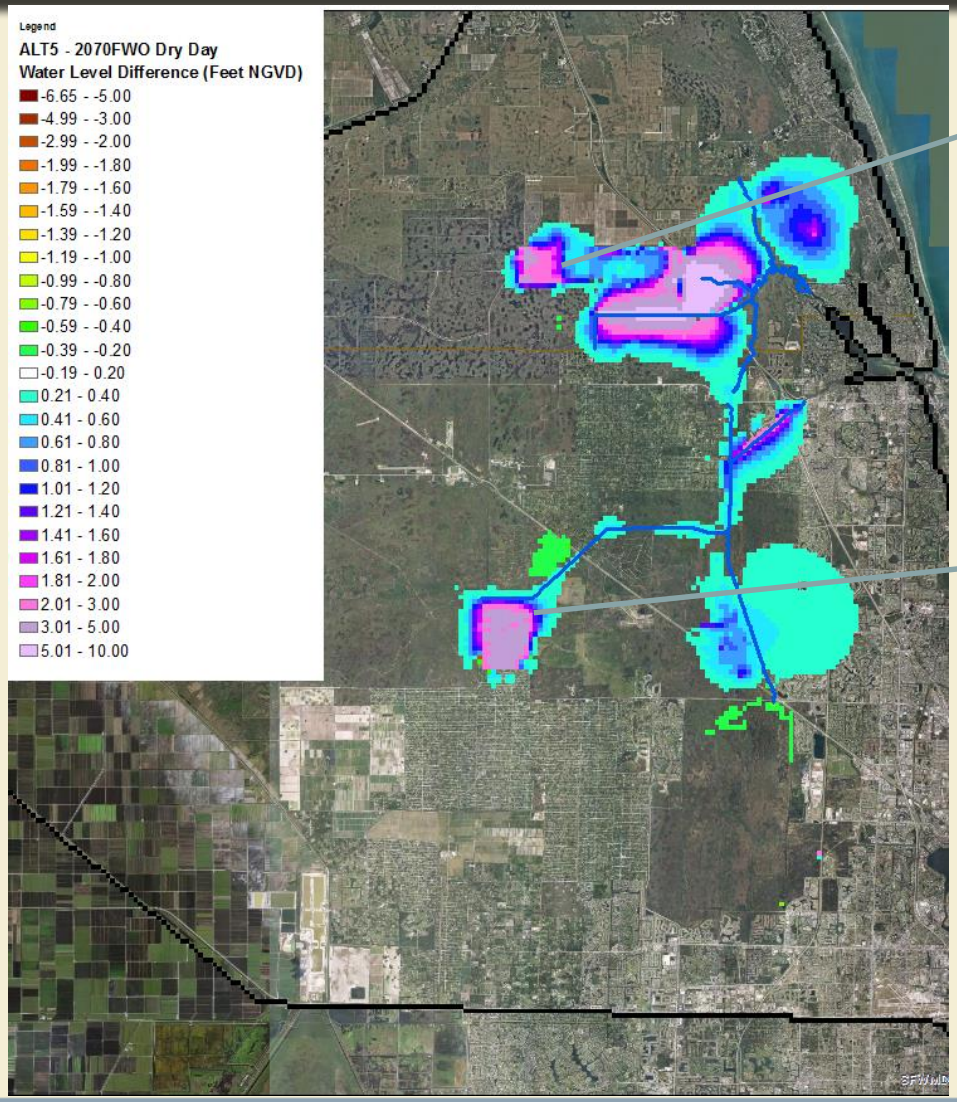


Alternative 2

Alternative 10

Alternative 13

Alternative 5 – 2070FWO Water Level Difference Map (Dry Day)



PM-11.2

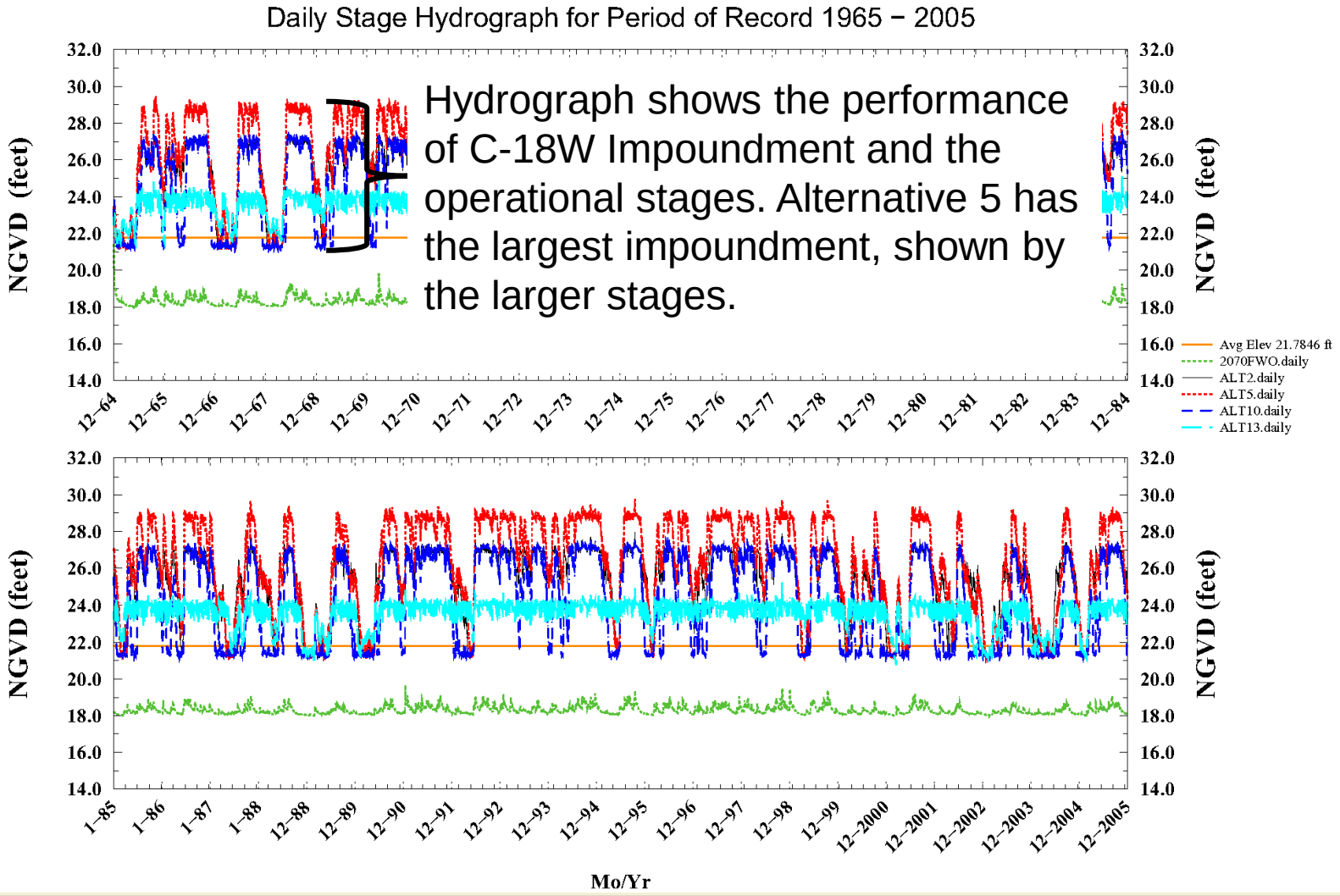
C-18W Impoundment

Alternative 2

Alternative 10

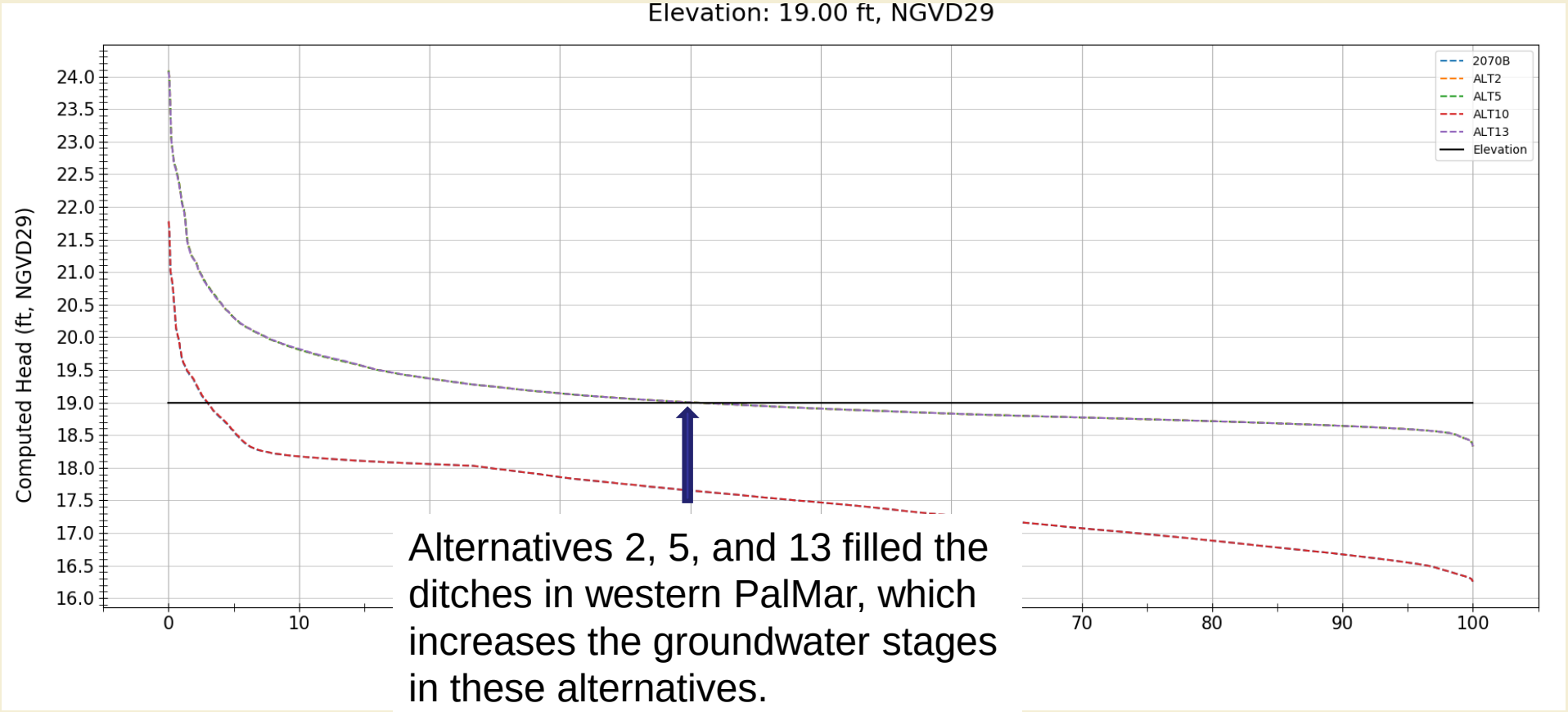
Alternative 13

C-18W Impoundment



Hydrograph shows the performance of C-18W Impoundment and the operational stages. Alternative 5 has the largest impoundment, shown by the larger stages.

PM-11.2 (Western Nine Gems)

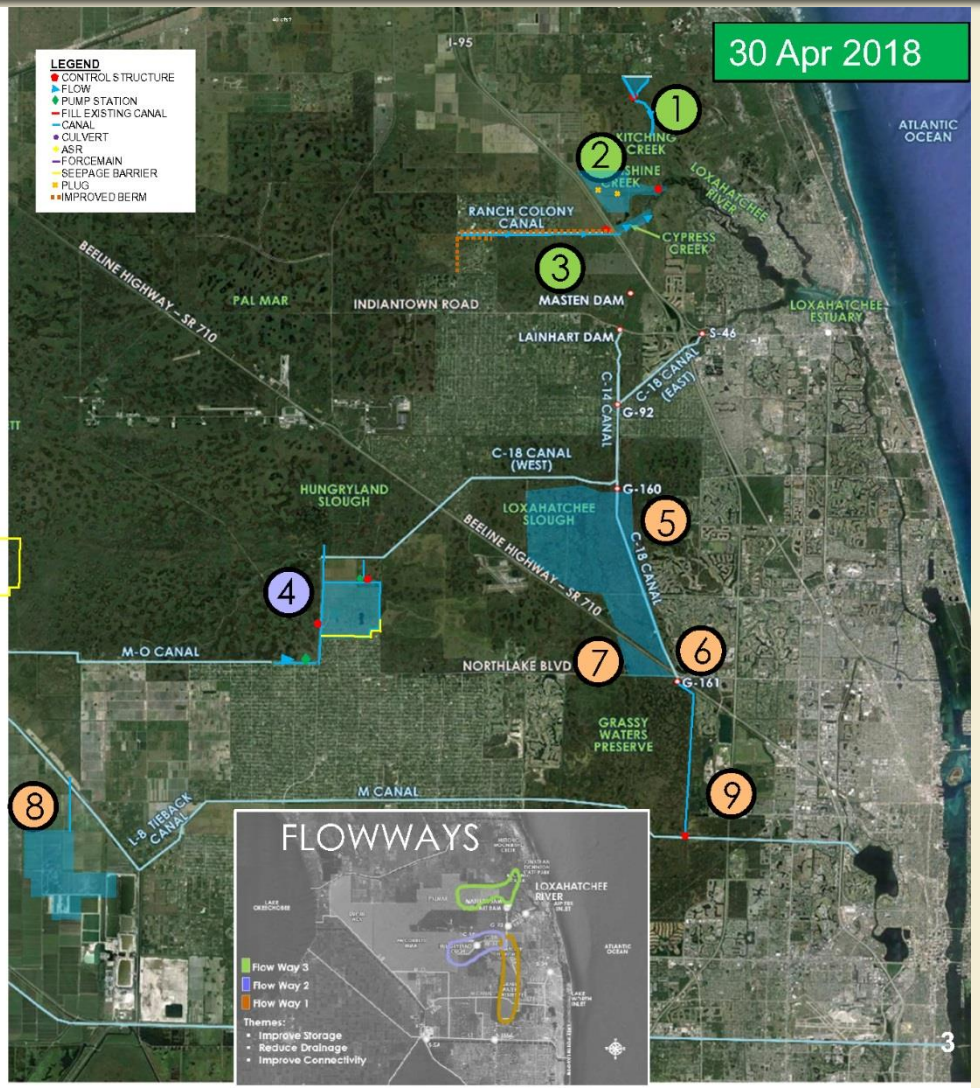


Alternatives 2, 5, and 13 filled the ditches in western PalMar, which increases the groundwater stages in these alternatives.

Alternative 10 Project Features

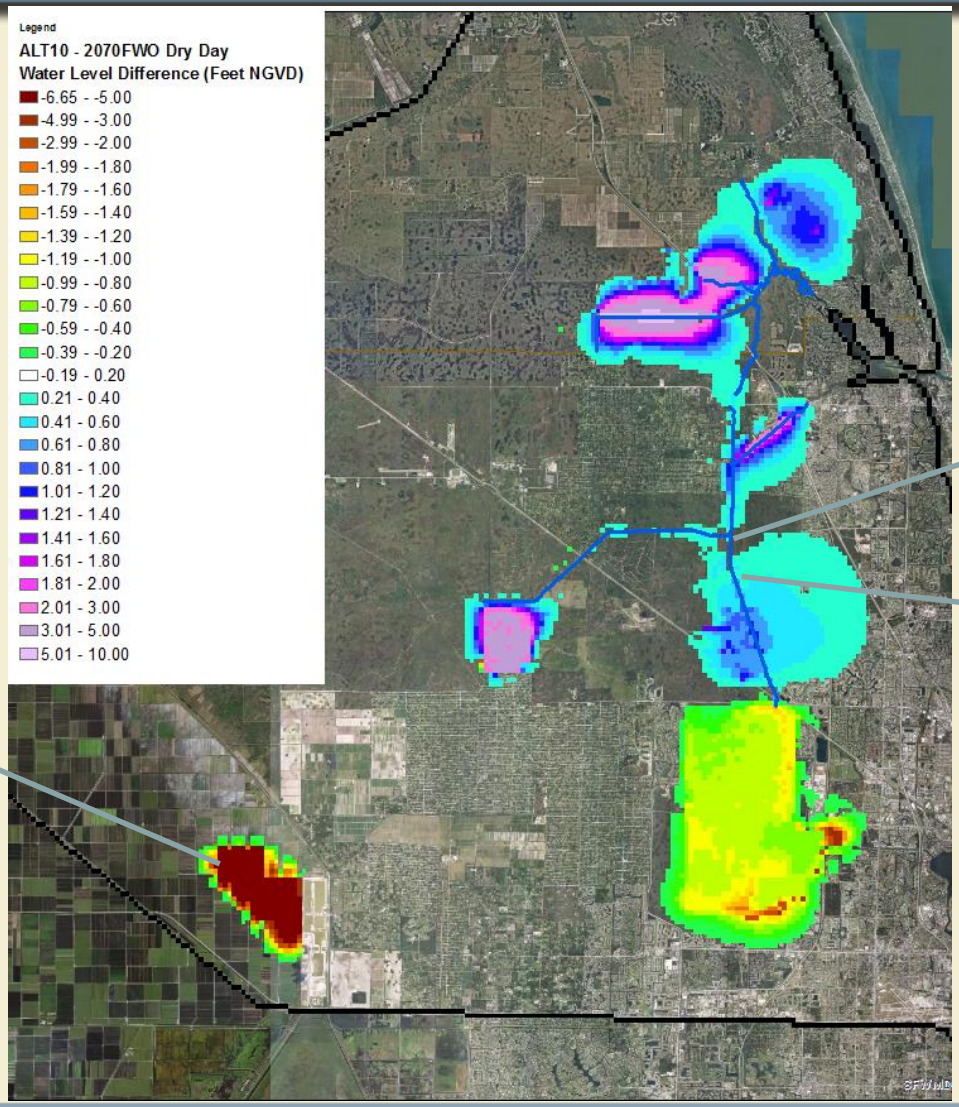
ALTERNATIVE 10

1. Kitching Creek (Hydration): Spreader canal; weir/plug (Jenkins Ditch)
2. Moonshine Creek (MC) & Gulfstream East (GE) (Restoration): Connect HSLCD ditch to MC; clear MC vegetation; weir in Hobe Grove Ditch; regrade adjacent area to historic topography
3. Cypress Creek Canal (CCC) (Reduce Over-drainage): Replace CCC weir; raise berm at Ranch Colony; automate twin 84" Culverts
4. C-18W Reservoir (7,200 ac/ft): Above-ground reservoir; inflow pump; discharge structure; seepage control; M-O Canal Connector and pump
5. G-160 Structure (Reduce Over-drainage): improve hydroperiod in Loxahatchee Slough
6. G-161 Structure (Connectivity): GWP water to Loxahatchee Slough
7. GWP Triangle (Connectivity)
8. C-51 Deep Reservoir (Storage): 44,000 ac/ft; includes pump & channels
9. Force Main (Conveyance): Pump and pipeline through Grassy Waters Preserve to connect M-Canal to G-161



Alternative 2
Alternative 5
Alternative 13

Alternative 10 – 2070FWO Water Level Difference Map (Dry Day)



G-160 Flows

LS-6A

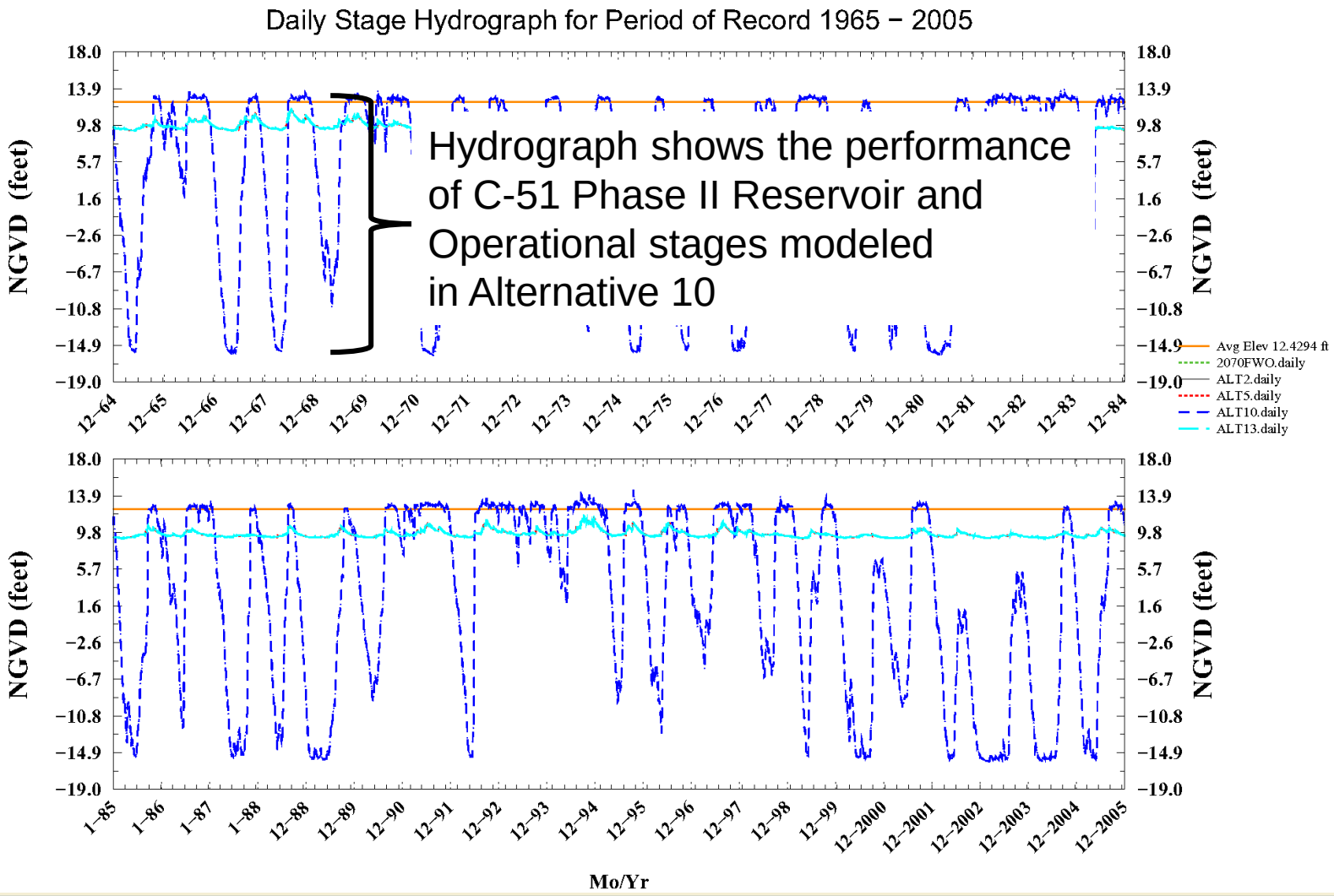
C-51 Phase II Reservoir

Alternative 2

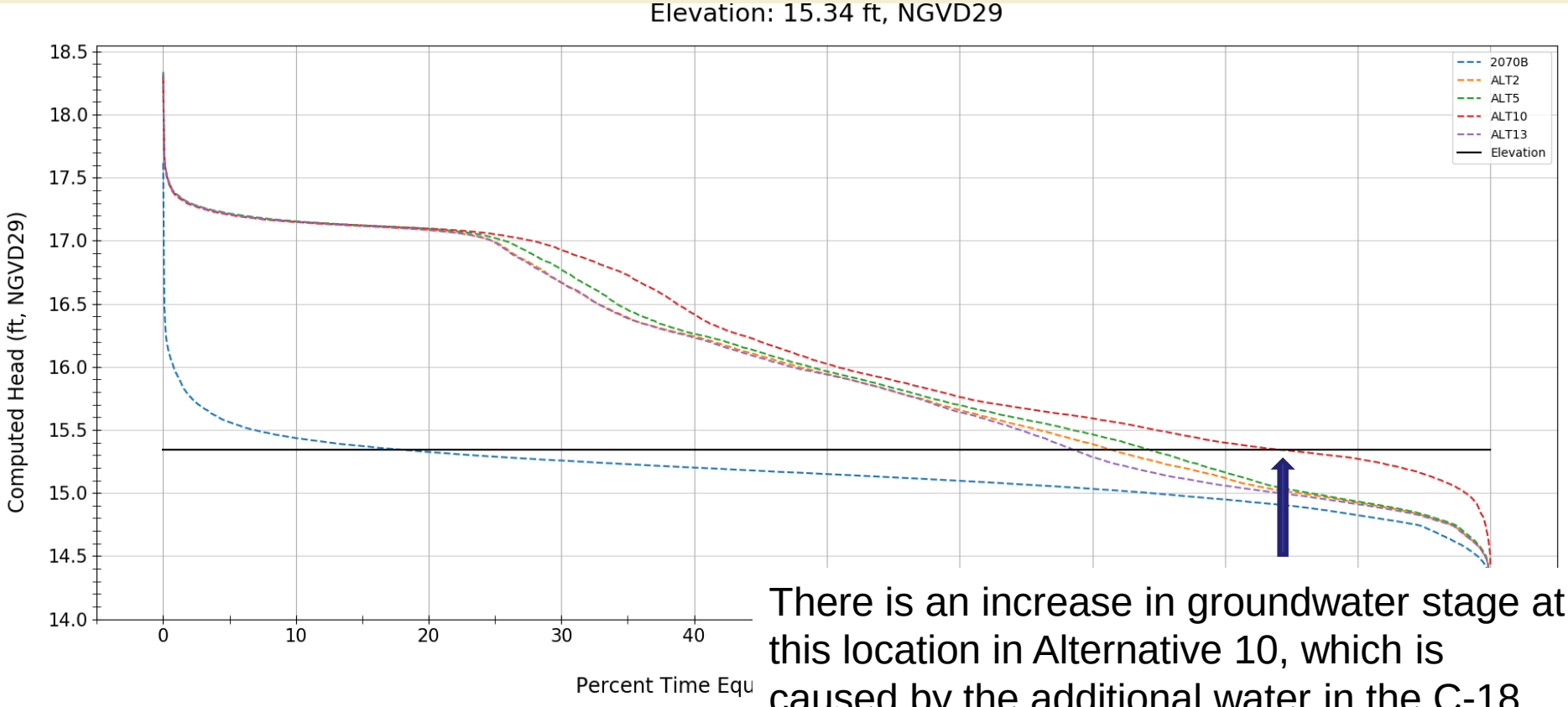
Alternative 5

Alternative 13

C-51 Phase II Reservoir



LS-6A (Eastern Loxahatchee Slough)

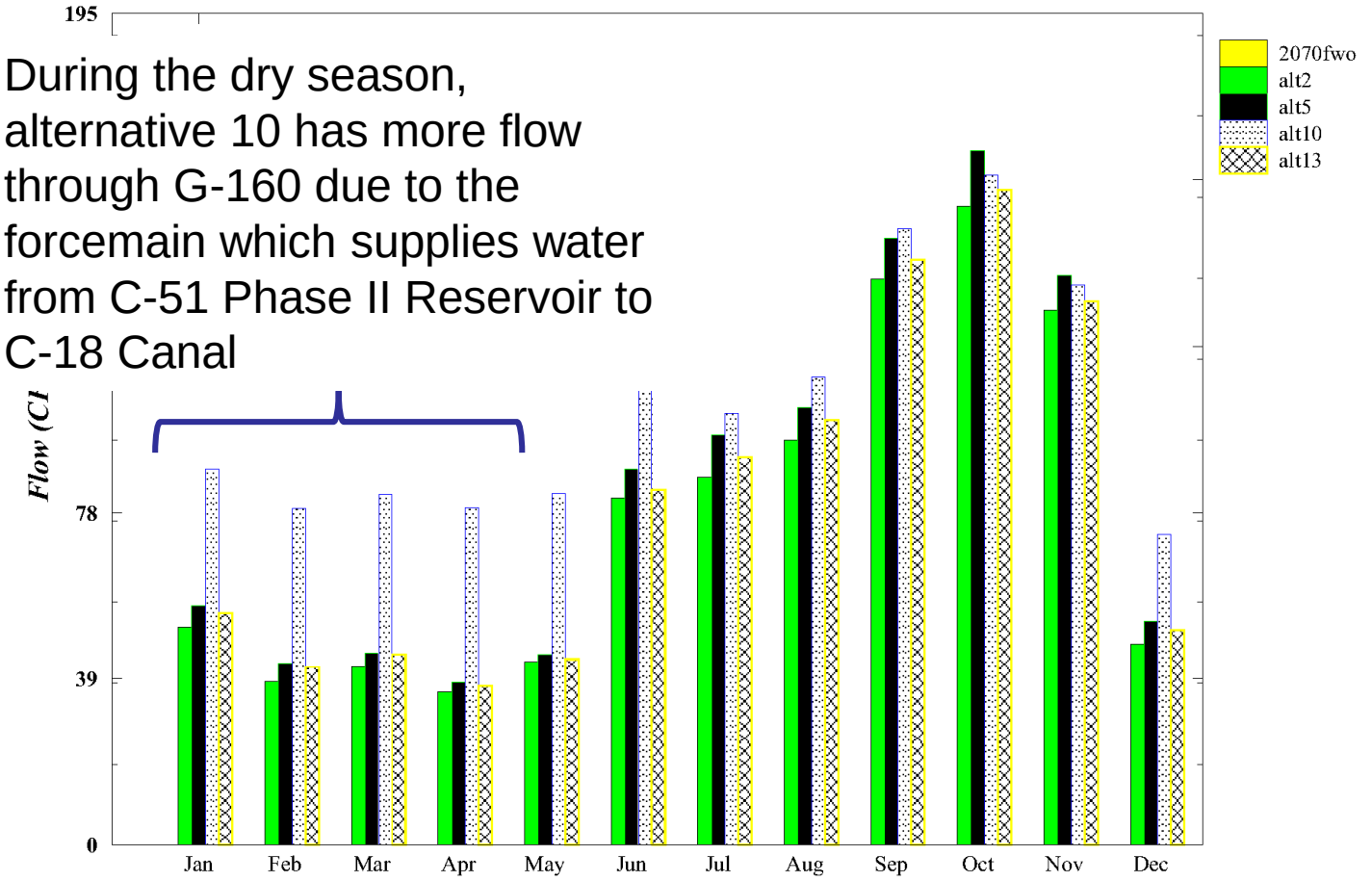


There is an increase in groundwater stage at this location in Alternative 10, which is caused by the additional water in the C-18 Canal from the forcemain

G-160

Average Monthly Structure Flow

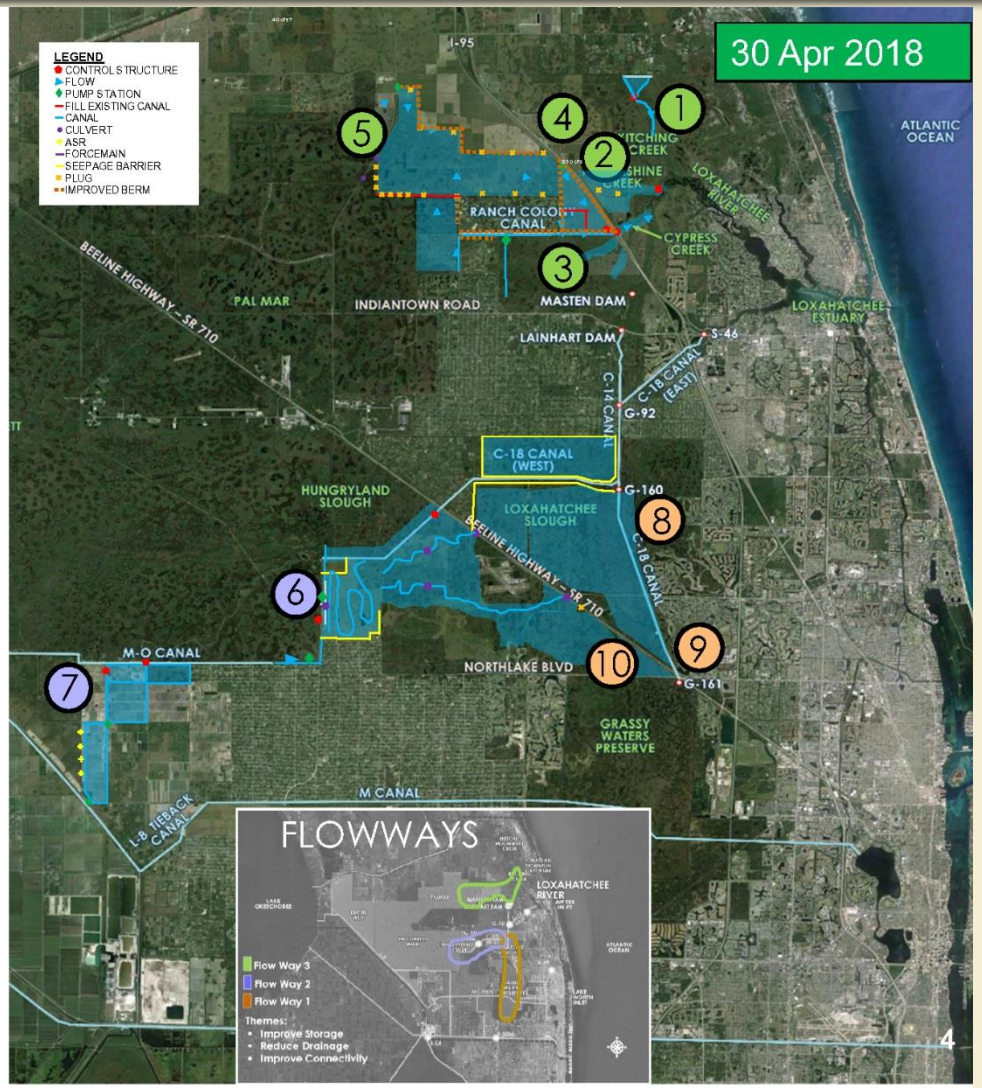
During the dry season, alternative 10 has more flow through G-160 due to the forcemain which supplies water from C-51 Phase II Reservoir to C-18 Canal



Alternative 13 Project Features

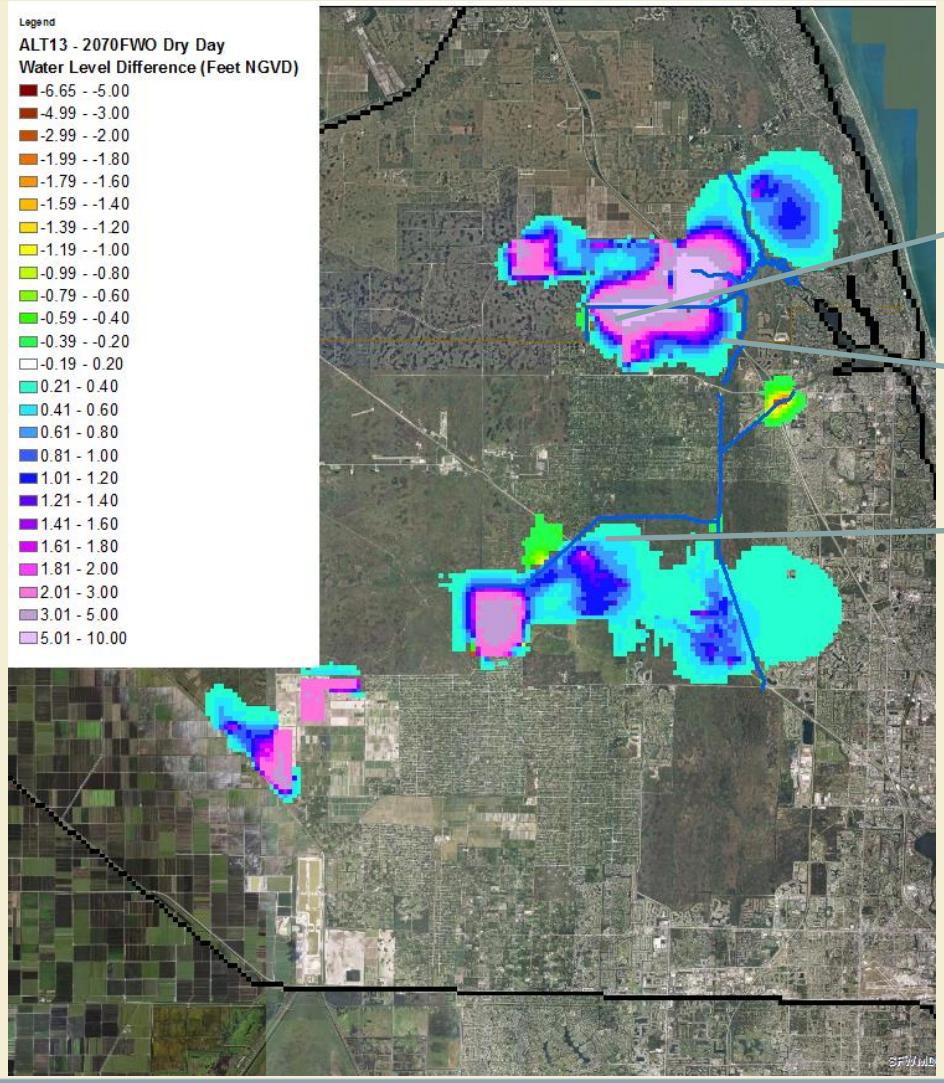
ALTERNATIVE 13

1. Kitching Creek (Hydration): Spreader canal; weir/plug (Jenkins Ditch)
2. Moonshine Creek (MC) & Gulfstream East (GE) (Restoration): Connect HSLCD ditch to MC; clear MC vegetation; weir in Hobe Grove Ditch; regrade adjacent area to historic topography
3. Cypress Creek Canal (CCC) (Reduce Over-drainage): Replace CCC weir; raise berm at Ranch Colony; automate twin 84" culverts; pump and spreader swale; regrade CC southern forks
4. Gulfstream West (Restoration & Reduce Over-drainage): Partial backfill & relocate southern end of HSLCD canal; small pump; construct flow through marsh to attenuate flow
5. Palmar East (Restoration & Connectivity): Plug ditches; remove pipes; improve northern berm; construct western berm; improve eastern berm; pumps at Thomas Farm to redirect drainage to GW flow through marsh via north Nine Gems canal
6. Natural Storage C-18W (Basin Restoration): Restore natural topography; seepage barriers; culverts for Beeline Hwy; backfill interior canals south of C-18W Canal; pump station at Mecca; flow-paths through Mecca & Avenir; M-O Canal connector & pump
7. L-8 Basin Shallow Storage (6,500 ac/ft & 4 ASR wells); includes pumps & channels
8. G-160 Structure (Reduce Over-drainage): improve Hydroperiod in Loxahatchee Slough
9. G-161 Structure (Connectivity): GWP water to Loxahatchee Slough
10. GWP Triangle (Connectivity)



Alternative 2
Alternative 5
Alternative 10

Alternative 13 – 2070 FWO Water Level Difference Map (Dry Day)



Cypress Creek Spreader North

Shiloh

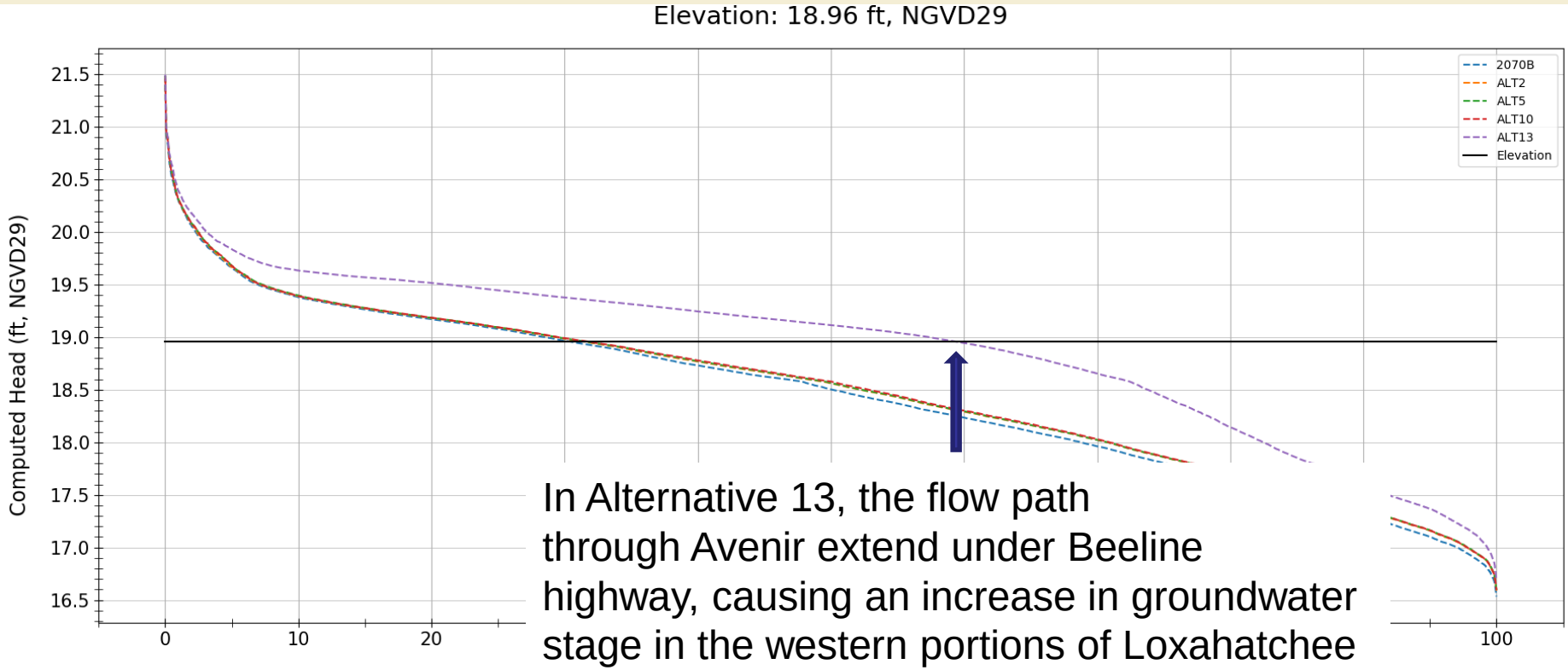
LS-3.2

[Alternative 2](#)

[Alternative 5](#)

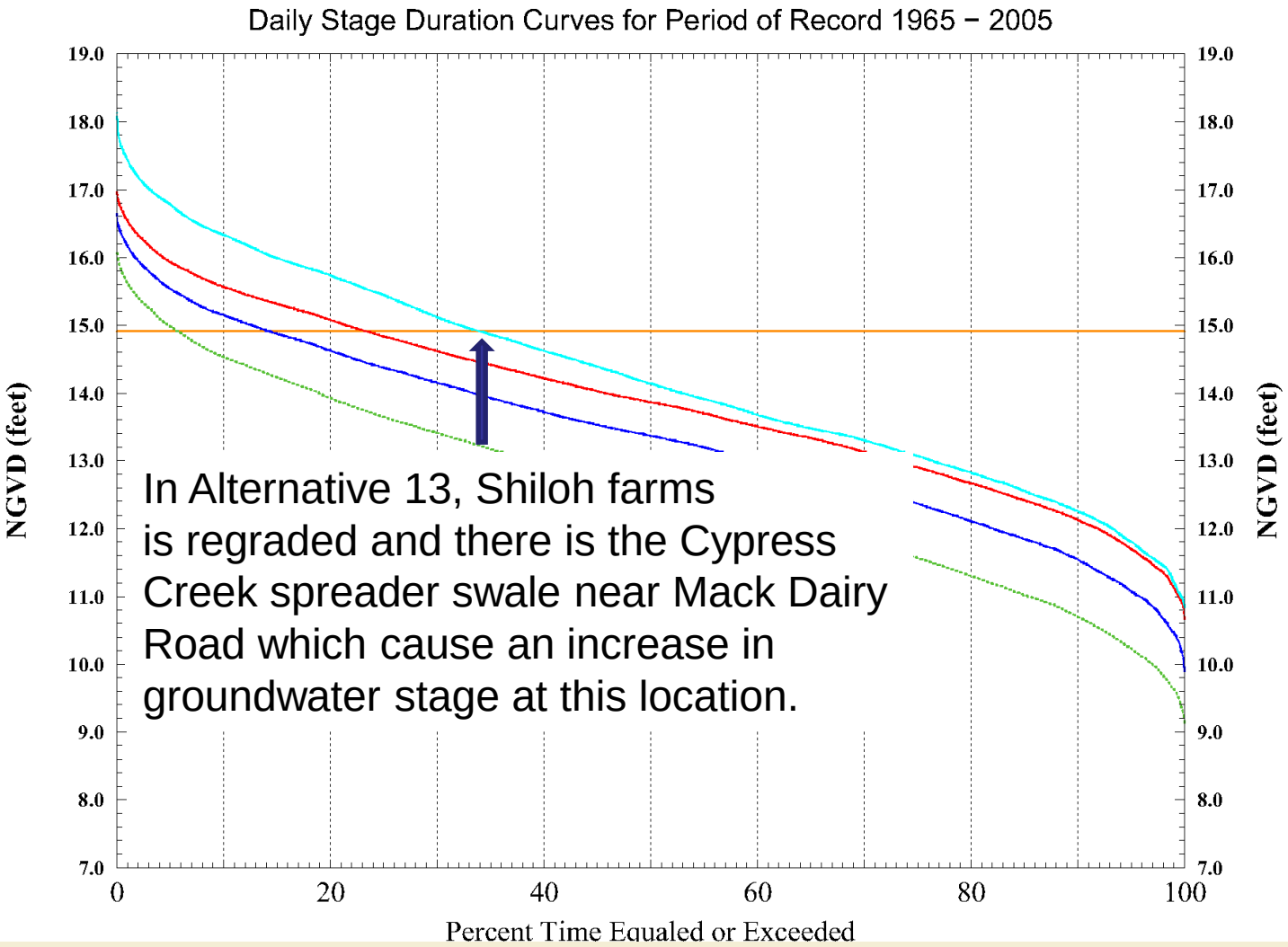
[Alternative 10](#)

LS-3.2 (Western Loxahatchee Slough)

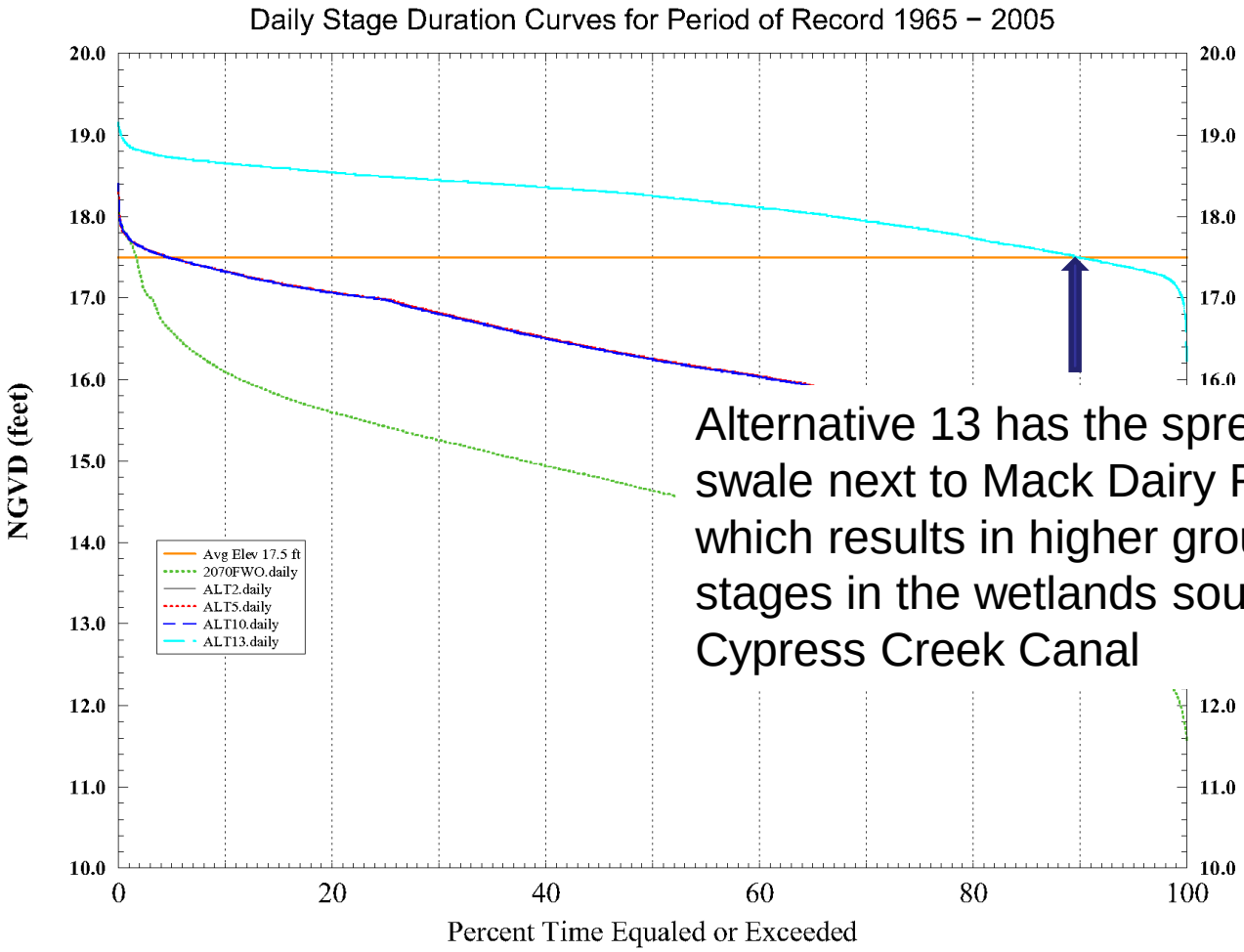


In Alternative 13, the flow path through Avenir extend under Beeline highway, causing an increase in groundwater stage in the western portions of Loxahatchee Slough.

Shiloh

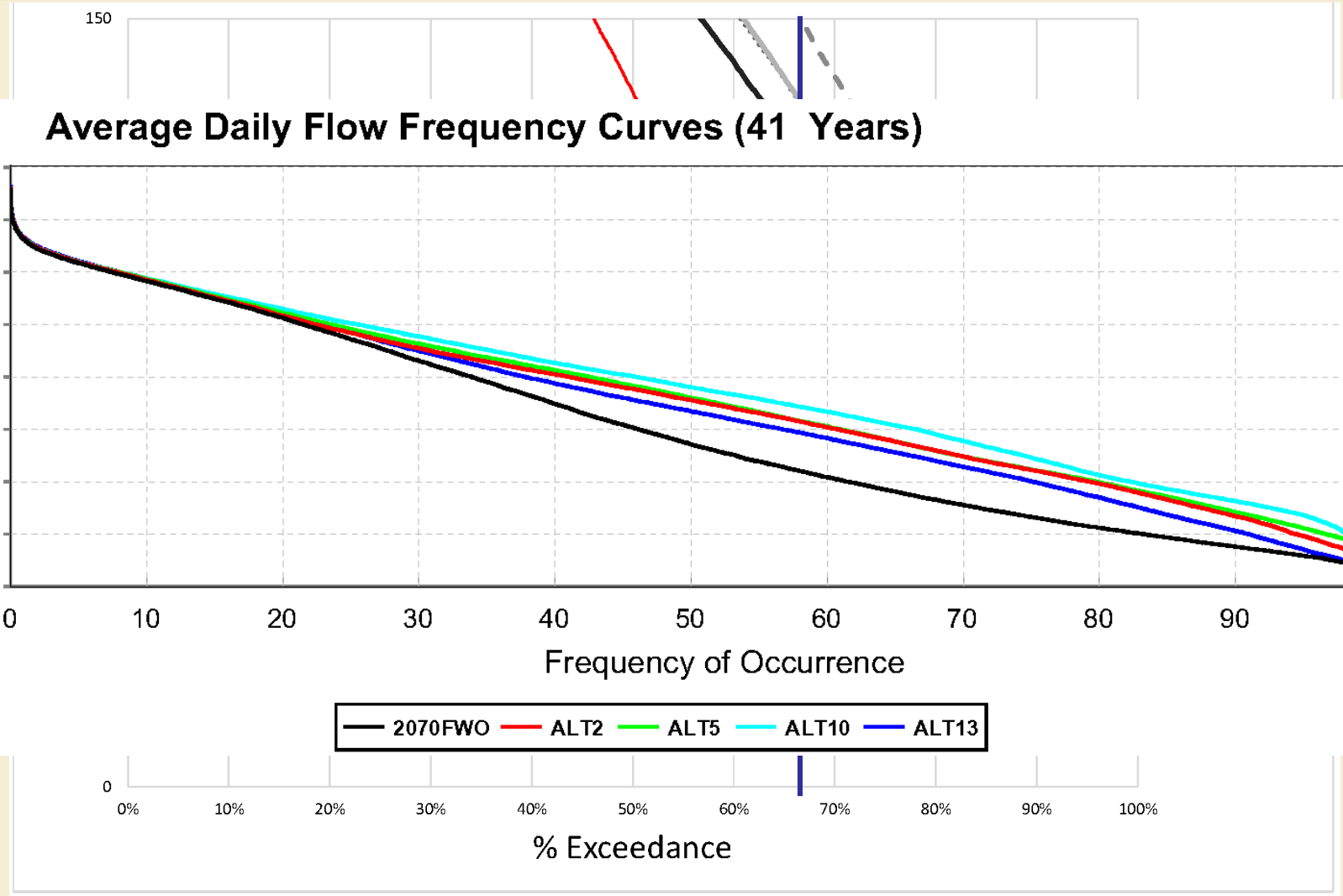

Daily Stage Duration Curves for Period of Record 1965 – 2005
NGVD (feet)
NGVD (feet)
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
0
20
40
60
80
100
Percent Time Equaled or Exceeded
In Alternative 13, Shiloh farms is regraded and there is the Cypress Creek spreader swale near Mack Dairy Road which cause an increase in groundwater stage at this location.

Cypress Creek Spreader North



Alternative 13 has the spreader swale next to Mack Dairy Road, which results in higher groundwater stages in the wetlands south of Cypress Creek Canal

Lainhart Flows



Lainhart Wet Season Target Comparison

	2014B	2070 FWO	Alt 2	Alt 5	Alt 10	Alt 13
Percent Met	**76%**	**78%**	**98%**	**98%**	**100%**	**98%**
Years the target was not met	1977	1977	2000	2000		2000
	1979 – 1980	1980				
	1987 – 1989	1987 - 1989				
	2000	2000				
	2002 - 2004	2002 - 2004				

Wet Season Target Criteria: Daily Flow > 110 cfs for at least 120 days from June 1 – November 30.

Lainhart Dry Season Target Comparison

	2014B	2070 FWO	Alt 2	Alt 5	Alt 10	Alt 13
Percent Met	65%	65%	87%	91%	95%	80%

4% difference

Dry Season Target:
30 Day Rolling Average greater than 68 cfs from December 1 – May 31
Percentages reflect the average over the 41-year period of record

Questions?