

STA Performance Optimization and Invasive Species Control

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Vegetation Management Goals



- Manage vegetation in the STAs in order to maintain sustainable phosphorus uptake processes and mechanisms
- Increase treatment redundancy and durability
- Increase the genetic and species diversity of beneficial plants for structural stability and P uptake
- Manage invasive/nuisance vegetation to minimize its spread throughout the STAs and downstream, and reduce the impact on desired vegetation and performance.



Everglades Forever Act, 1994



- The "Everglades ecological system is endangered as a result of adverse changes in water quality, and in the quantity, distribution, and timing of flows, and, therefore, must be restored and protected"
- Florida Statute 373.4592



Water Quality Standards



- National Pollutant Discharge Elimination System (NPDES) permit to operate, maintain, and discharge water from the STAs
- EPA-mandated Water Quality Based Effluent Limitation standards (WQBEL).
- Long Term Flow Weighted Mean (LTFWM) of 13 parts per billion Phosphorus

Southern Everglades STAs





WQBEL of 13ppb TP



- 13 ppb is low, rainwater can average10 ppb
- The STAs sequester an average of 1100 metric tons of phosphorus per year
- They have to achieve this while also providing flood control, water supply, public recreation, and endangered species habitat.



Management Conflicts



- Reduce P to 13 ppb
- Flood protection and water supply are a priority
- Treat exotic invasive plants
- Killing plants releases nutrients
- Many herbicides and adjuvants contain P
- What do we do?



Challenges



- Invasive Submerged Aquatic Vegetation (SAV)
- Invasive Emergent Aquatic Vegetation (EAV)
- Invasive Animals, mainly blue tilapia and apple snails
- Water supply and flood control operations often interfere with performance management
- Stakeholder conflicts



Control Invasives and Reduce Nutrient Levels



- Plant the inflow regions in ways that trap and facilitate FAV control
- Increase the cover and diversity of native plants
- Change herbicide application methodologies
- Focus on nutrient reduction, with reduced nutrients the natives often outcompete the invasive species



Invasive SAV Clogging Structures







MINIMIZE IMPACT OF FAV



- Invasive FAV WILL flow into the cells with storm water and agricultural runoff
- The FAV can overshadow desired SAV
- Rafts of FAV can become mobilized and cause damage to EAV, SAV, and structures.
- Rafts of FAV can harbor invasive EAV.
- Excessive or inappropriate herbicide use can impact desired vegetation and fish.



Floating Plant Infestations: A-1 FEB







Aerial Herbicide Application A-1 FEB







FAV Control by Airboat







INVASIVE APPLE SNAILS







INVASIVE APPLE SNAILS (eggs on an invasive grass)





Bioturbation





Invasive Fish, Blue Tilapia







Compartmentalization







Vegetation Conversion to SAV: Emergent Control





Functional Redundancy and Compartmentalization in SAV Cells



- Increase the compartmentalization of the SAV Cells to protect SAV beds from invasive FAV, wind, and wave action
- Where possible maintain a 60:40 SAV:EAV ratio
- Increase the thickness of inflow and downstream vegetation strips to minimize turbidity after SAV die-off events, as well as provide functional treatment redundancy
- Plant the emergent vegetation strips to maximize retention time and contact with the vegetation
- Planting patterns and species choices are guided by the physical characteristics of individual cells



Functional Redundancy: EAV Cells







Revitalization and Rehabilitation



- Periodically revitalize and rejuvenate impacted cells from the effects of normal cyclical declines, the impacts of invasive species, prolonged high water, irresponsible boat traffic and high velocity water movement.
- Stage manipulations and the removal of nuisance vegetation combined with new species/ ecotype introductions through plantings, inoculations, and seeding to increase plant diversity
- Mitigate hydraulic short circuits by degrading levees, constructing levees, and creating, plugging, filling or removing canals as needed.



SAV Harvest and Transport







Conversion: SAV Inoculation



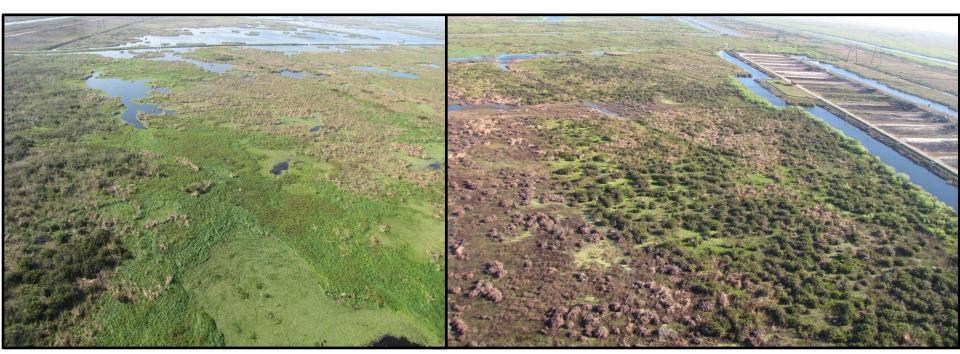




Rehabilitation: STA 1W Cell 1A



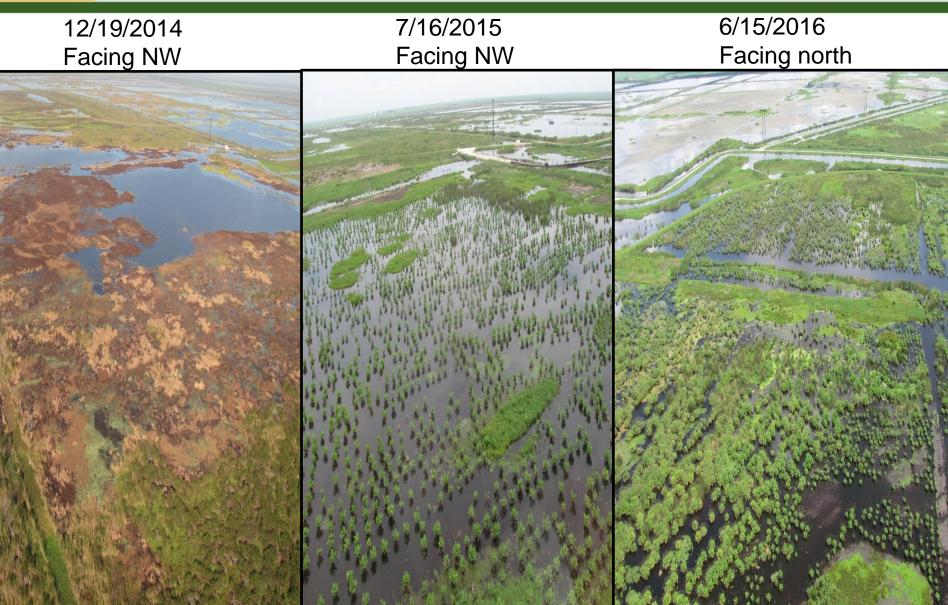






Rehabilitation: STA 1W Cell 1A

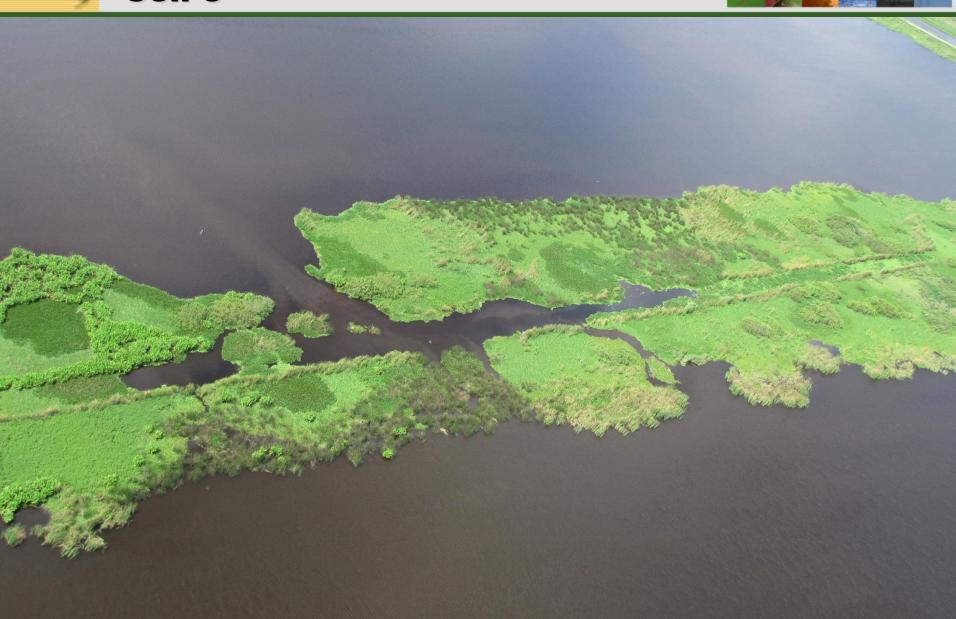






Hydraulic Short Circuit: STA 2 Cell 3







Short Circuit: STA 2 Cell 3





SHORT CIRCUIT REPAIR STA 1E CELL 5







Short Circuit Repairs: STA 3/4







Primrose Willow: STA 5 Cell 4A







Treated Primrose Willow: STA 5 Cell 4A







Cattail Recovery: STA 5 Cell 4 A







QUESTIONS, SUGGESTIONS OR IDEAS?



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Adaptive Vegetation Management Process



- Observe vegetation health and take corrective action as needed
- Proactively manage desired vegetation communities and work to increase cover and health
- Control the growth of species that can negatively impact desired vegetation, performance and interfere with water movement
- Repair and restore cells damaged by natural and anthropogenic causes such as storms, high flows, hunter access, excessive boat traffic, wildlife damage, etc...
- Monitor FAV and nuisance vegetation, plan and schedule appropriate treatments
- Develop novel herbicide applications to increase efficacy and species selectivity



Hydraulic Short Circuit Repairs

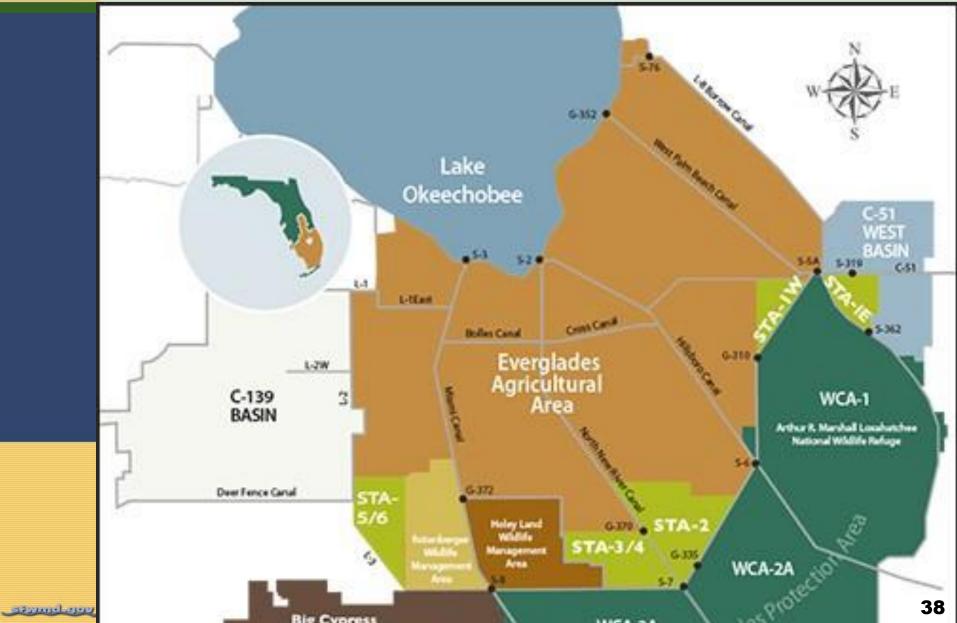






Southern Everglades STAs







STA 1 EAST



-							
ISSUES	ACTIONS	STATUS					
EASTERN FLOW-WAY							
CONVERSION FROM USACE PASTA RESEARCH SITE TO AN ACTIVE FLOWAY IS MOSTLY COMPLETE HEAVY FAV INFLOWS AND INVASIVE PLANTS	ESTABLISH EMERGENT VEGETATION IN CELL 1 AND SAV WITH VEGETATION STRIPS IN CELL2, CONTROL TORPEDO GRASS AN PRIMROSE WILLOW, INOCULATE CELL 2 WITH CHARA AND SOUTHERN NYAD	RESTORATION UNDER WAY, GROW- IN IS PROCEEDING NICELY AND PERFORMANCE IS GOOD. AERIAL TREATMENT FOR TORPEDO GRASS CONTROL AND ADITIONAL INOCULATIONS ARE PLANNED FOR FY 2017					
CENTRAL FLOW-WAY							
HEAVY FAV INFLOWS, EXTENSIVE PRIMROSE WILLOW STANDS POOR TOPOGRAPHY, HYDRAULIC SHORT- CIRCUITING, POOR CATTAIL RECRUITMENT	ESTABLISH THALIA AND BULRUSH STANDS FOR EXPANSION, INCREASE TREATMENT OF PRIMROSE WILLOW, EXPAND PLANTINGS AND SPECIES DIVERSITY	THALIA AND BULRUSH PLANTINGS COMPLETED FOR FY 2017, ADITIONAL EAV AS WELL AS LOTUS AND LILY PLANTINGS SCHEDULED FOR FY 2018					
WESTERN FLOW-WAY							
HEAVY FAV INFLOWS, CELLS 5 AND 7 HAVE HISTORICAL POOR CATTAIL SURVIVAL AND RECRUITMENT, EXCESSIVE FAV INFLOWS, WIDESPREAD SOIL DELAMINATION, HYDRAULIC SHORT CIRCUITS IN CELL 6	TREAT THE FAV AND HYDROCOTYLE BEDS, INCREASE COVER OF EAV IN CELSL 5 AND 7, ESTABLISH WATER LILY, LOTUS AND SAV BEDS IN CELL 6	RESTORATION PLANNED AND UNDERWAY FOR FY 2017 AND 2018					



STA 1 WEST



ISSUES	ACTIONS	STATUS					
NORTHERN FLOW-WAY							
HEAVY FAV INFLOWS, CELL 5A HAS TOPOGRAPHICAL AND HYDRAULIC SHORT CICUITING ISSUES, EXENSIVE BEDS OF FLOATING VEGETATION, EASTERN AND SOUTHERN PORTIONS OF CELL 5B HAVE HAD DECREASING SAV COVER AND INCREASED FLOATING MUCK	ESTABLISH EMERGENT VEGETATION IN CELL 5B AND INCREASE THE NUMBER OF CUTS AT THE INFLOW BERM OF 5A TO BRING WATER INTO THE CELL	RESTORATION UNDER WAY IN CELL 5B, GROW- IN IS PROCEEDING NICELY AND PERFORMANCE IS STILL GOOD. SAV INNOCULATIONS PLANNED FOR SPRING OF 2018 AERIAL TREATMENT OF FLOATING VEGETATION AND EXTENSIVE PLANTING AND SEEDING OF THALIA, LOTUS, NUPHAR AND NYMPHAEA IS PLANNED FOR FY 2018-2019					
EASTERN FLOW-WAY							
HEAVY FAV INFLOWS, EXTENSIVE PRIMROSE WILLOW STANDS, POOR TOPOGRAPHY, HYDRAULIC SHORT- CIRCUITING, POOR CATTAIL RECRUITMENT, MOST OF CELL 1A IS COMPOSED OF FLOATING TUSSOCKS, RECOVERY AND GROW IN FOLOWING THE LEVEE CONSTRUCTION FOR THE WESTERN FLOW-WAY INFLOW CANAL	ESTABLISH THALIA AND BULRUSH STANDS FOR EXPANSION, INCREASE TREATMENT OF PRIMROSE WILLOW, EXPAND PLANTINGS AND SPECIES DIVERSITY, PLANT VEGETATION STRIPS IN CELL 1B AND 3, INCREASE SAV COVERAGE IN CELLS 1B AND 3	THALIA AND BULRUSH PLANTINGS BEGAN IN FY 2015, ADITIONAL EAV AS WELL AS LOTUS AND LILY PLANTINGS SCHEDULED FOR FY 2017-2018 CATTAIL CONVERSION UNDERWAY					

WESTERN FLOW-WAY

HEAVY FAV INFLOWS, CELL 2A HAS TOPOGRAPHICAL ISSUES, POOR CATTAIL SURVIVAL AND RECRUITMENT, EXCESSIVE FAV, AND HYDROCOTYLE BEDS, CELL 2B TREAT THE FAV AND HYDROCOTYLE BEDS, INCREASE COVER OF EAV, WATER LILY, AND LOTUS BEDS IN CELL 2A, INOCULATE SAV IN CELLS 2B AND 4, EXPAND VEGETATION STRIPS IN CELLS 2B AND 4

RESTORATION PLANNED FOR DRY SEASONS OF FY 2017 AND 2018





7		
ISSUES	ACTIONS	STATUS
	FLOW-WAY 1	

OBSERVE. PLANT BULRUSH NYMPHAEA

AND SAWGRASS AS NEEDED, REMOVE THE THE TRAIL TO MINIMISE DAMAGE TO

THE CELL

UNDER OBSERVATION

FLOW-WAY 2 and 3

UNEVEN SAV BEDS, SOME COMPARTMENTS ARE CHARA MONOCULTURES, MULTIPLE SHORT CIRCUITS. DEEP UNVEGETATED REGIONS IN THE NORTH OF BOTH CELLS

Cell 1, SHORT CIRCUITING, THINNING

CATTAIL AND SAWGRASS ALONG WITH

SPREADING INVASIVE PLANTS AT THE

INFLOW AND ALONG THE TRAIL, CHARA

POPULATIONS SEEM REDUCED ALONG

THE TRAIL

GROWTH

LINDERWAY

TRANSPORT SAV FROM DENSE BEDS TO SPARSE AREAS, INTRODUCE SOUTHERN AND SPINY NAIAD INTO COMPARTMENTS

CIRCUITS

WITH ONLY CHARA, REPAIR SHORT

UNVEGETATED REGIONS ARE

UNDERWAY

FLOW-WAY 4

FLOW-WAY 5

HEAVY FAV INFLOWS, CELLS 5 AND 6 BOTH EXPERIENCED SEVERE SOIL **DELAMINATION AND FLOATING CATTAILS** IN THE NORTH ENDS. BOTH ALSO HAVE REGIONS OF DEEP WATER AND

SEDIMENTS UNSUITABLE FOR CATTAIL

CELL 8 CONVERSION PROCESS

ESTABLISH APPROPRIATE EMERGENT VEGETATION IN THE NORTH OF THE

CELLS, AND EXPAND SAV IN THE SOUTH.

RESTORATION UNDER WAY, MORE

WORK IS PLANNED FOR FY 2017, AND 2018 AS THE HEALTH OF THE EMERGENTS INCREASES IN THE NORTH, MORE OF THE SOUTH WILL BE CONVERTED TO SAV.

CELL 3 SAV WORK TO BEGIN WHEN THE

PLANTING TRIALS AND PLANS FOR THE

P FLUX STUDY GROUP IS DONE.

TREATED CATTAIL IS FALLING OUT AND SAV INOCULATIONS HAVE BEEN

CONTINUE CONVERTING TO SAV AND STRENNTHENING THE FAV





STATUS

UNDER WAY, MORE DRY SEASON

THE END OF FY 2018

PLANTING PLANS FOR THE

UNDERWAY

UNVEGETATED REGIONS ARE

TREATMENTS / PLANTINGS PLANNED.

HERBICIDE TREATMENTS PLANNED FOR

		-

ISSUES

FLOW-WAY 1

ACTIONS

WATI

Cell 1A, SHORT CIRCUITING, THINNING CATTAIL IN THE NORTH AND EAST, OPEN WATER AREAS THROUGHOUT THE CELL, DEEP WATER IN THE NORTH PREVIOS REPAIRS DAMAGED AT ALL THE MONITORING SITES

CONTINUE TO EXPAND EAV PLANTINGS
AS APPROPRIATE, REPAIR THE FRONT
END WHEN MONITORING STOPS
CONTINUE TO INCREASE SAV DIVERSITY
AND INCREASE SAWGRASS IN THE
SOUTH END OF CELL 1B

PLANTINGS IN 2A, REPAIR THE FRONT

TRANSPORT SAV FROM DENSE BEDS TO

END WHEN MONITORING STOPS AND

OBSERVE. TREAT FAV AND

HYDROCOTYLE BEDS AS NEEDED

FLOW-WAY 2

UNEVEN EAV IN 2A AND SAV IN 2B, SOME COMPARTMENTS ARE NOT AS THICK AS THEY COULD BE AND SOME STILL HAVE CHARA MONOCULTURES

> SPARSE AREAS, INTRODUCE SOUTHERN AND SPINY NAIAD INTO COMPARTMENTS WITH ONLY CHARA, REPAIR SHORT CIRCUITS

THICKEN VEG STRIPS IN 2B

EXPAND THALIA AND BULRUSH

FLOW-WAY 3

HEAVY FAV INFLOWS, TRAILS MADEPARALLEL TO FLOW FROM INFLOW TO OUTFLOW CANALS

ESTABLISH EMERGENT VEGETATION IN THE NORTH OF THE CELLS AND ALONG THE WESTERN EDGES, EXPAND SAV DIVERSITY AND COVERAGE IN THE SOUTH RESTORATION UNDER WAY, MORE WORK IS PLANNED FOR FY 2018, AS THE HEALTH OF THE EMERGENTS INCREASES IN THE NORTH, MORE OF THE SOUTH WILL BE CONVERTED TO SAV/ MIXED MARSH.







ISSUES

EXTENSIVE PRIMROSE WILLOW AND WILLOW

UNEVEN SAV BEDS. SOME COMPARTMENTS

HEAVY FAV INFLOWS, EXTENSIVE PRIMROSE

HEAVY FAV INFLOWS, EXTENSIVE PRIMROSE

WILLOW AND WILLOW GROWTH IN THE A

HEAVY FAV INFLOWS, EXTENSIVE OPEN

AREAS AND ZONES OF PRIMROSE WILLOW

AND WILLOW GROWTH IN THE A CELL OPEN

CELL OPEN WATER AREAS

WILLOW AND WILLOW GROWTH IN THE A

ARE CHARA MONOCULTURES, MULTIPLE

SHORT CIRCUITS, DEEP UNVEGETATED REGIONS IN THE NORTH OF BOTH CELLS

GROWTH IN THE A CELL, HEAVY FAV

INFLOWS.

CELL

ACTIONS

STATUS

RESTORATION UNDER WAY, MORE WORK IS

RESTORATION UNDER WAY, MORE WORK IS

PLANTINGS COMING ALONG, SAV BECOMING

PLANTINGS COMING ALONG, SAV BECOMING

WELL ESTABLISHED, RESTORATION UNDER

WAY, MORE WORK IS PLANNED FOR FY 2018

FLOW-WAY 1

EXPAND SAV

CELL

CELL

OBSERVE, PLANT CATTAIL, BULRUSH, THALIA HEAVY FAV INFLOWS, EXTENSIVE PRIMROSE

UNDER WAY, 200 ACRES OF PRIMROSE TREATED. BULRUSH AND THALIA PLANTINGS

SEEDING COMPLETE FOR NOW

PLANNED FOR FY 2018

PLANNED FOR FY 2018

WELL ESTABLISHED

WILLOW AND WILLOW GROWTH IN THE A OR SAWGRASS AS NEEDED. CONTINUE TO

UNDER WAY, BULRUSH AND CATTAIL

CELL. DEEP OPEN AREAS

DESIRABLE EMERGENT VEGETATION IN THE

FLOW-WAY 3

REDUCE INVASIVES AND ESTABLISH MORE

A CELL, AND EXPAND SAV IN THE B CELL, ENHANCE VEGETATION STRIPS IN THE B

CONTINUE INCREMENTALLY PLANTING

AERIAL HERBICIDE TREATMENTS AND

SEEDING/ PLANTING OPERATIONS TO BE

EXPAND SAV IN THE B CELL

BULLRUSH AND THALIA IN THE A CELL AS

THE LUDWIGIA IS REMOVED, CATTAIL AND BULRUSH SEEDING IN THE HIGH AREAS.

FLOW-WAY 5

CONDUCTED DURING LOW WATER PERIODS.

DESIRABLE EMERGENT VEGETATION IN THE

FLOW-WAY 4

A CELL. AND EXPAND SAV IN THE B CELL.

ENHANCE VEGETATION STRIPS IN THE B

FLOW-WAY 2

REDUCE INVASIVES AND ESTABLISH MORE