

# Scoping-Level Evaluation of Everglades Water Quality Compliance Using a Central Flow-Way Hydrated With Lake Okeechobee Water

by

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# Introduction

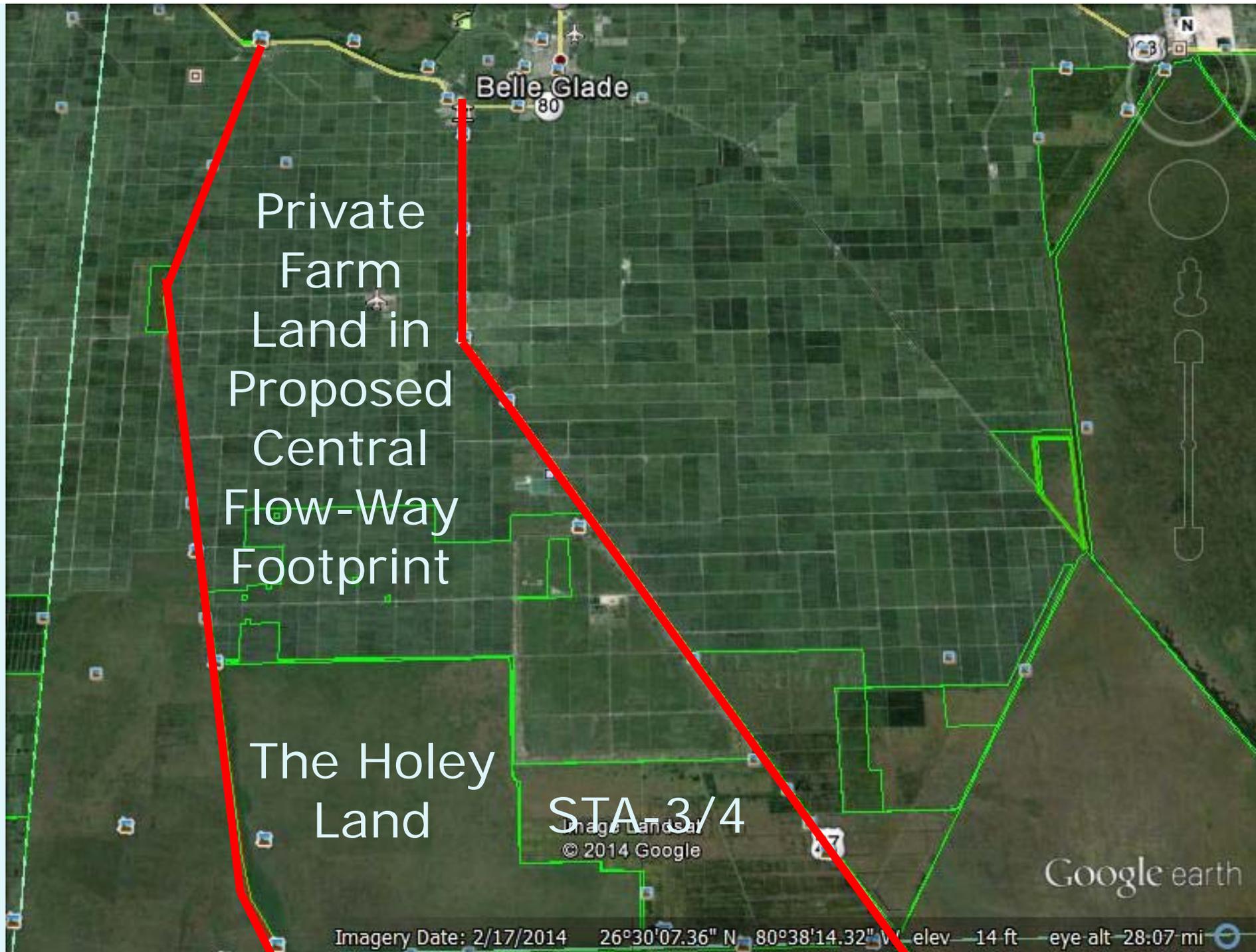
## Need

- CEPP only increases treated flow to Everglades ~0.25M ac-ft/yr by 2030
- CEPP is under-designed to treat high TP in EAA runoff to its 10 ppb WQS
  - Mitsch et al. (2014)
- CFW with a storage reservoir is a viable alternative to CEPP
  - U of FL Water Institute Report (2015)

# Introduction

## Proposed CFW Project Elements

- ~150K acres south of EAA land
- 2/3 in private lands
- ~\$1.1B for new lands at fair value
- ~\$0.9B for infrastructure per scale-up of \$120M FEB C with same aspect
- Lake O. gravity- & pump-flow to CFW
- Eastern and Western Flow Paths stay



# Introduction

## Myths

- No gravity-flow from Lake Okeechobee to Everglades per EAA peat subsidence
- Not enough water due to ET losses
- Cannot meet NPDES TP WQS at inflow to Everglades without reservoir assist
- High flow diversions will be greater than for Flow Equalization Basin-assisted STAs
- Cannot meet TP WQBELs after Lake O. resuspension events

# Introduction

## Issues

- CFW opponents accept the myths or reject as financially or politically infeasible.
- CFW proponents fall into two camps:
  - CEPP/CERP is not necessary or sufficient, but CFW is, so do CFW now for fast, effective relief
  - CEPP/CERP is necessary but not sufficient, so do CFW after CEPP

# Introduction

## Myths

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# Introduction

## Approach

- Adapt scoping-level water quality model used by SFWMD to size the original STAs for removing TP in EAA runoff down to its 10 ppb WQS.
- Design CFW to remove TP in Lake O. water via sheetflow through wetland plant communities adapted to high, medium, and low TP concentrations.

# Scoping-Level Water Quality Model

## Model Equations from Walker (1995)

$$dQ/dA = p - e$$

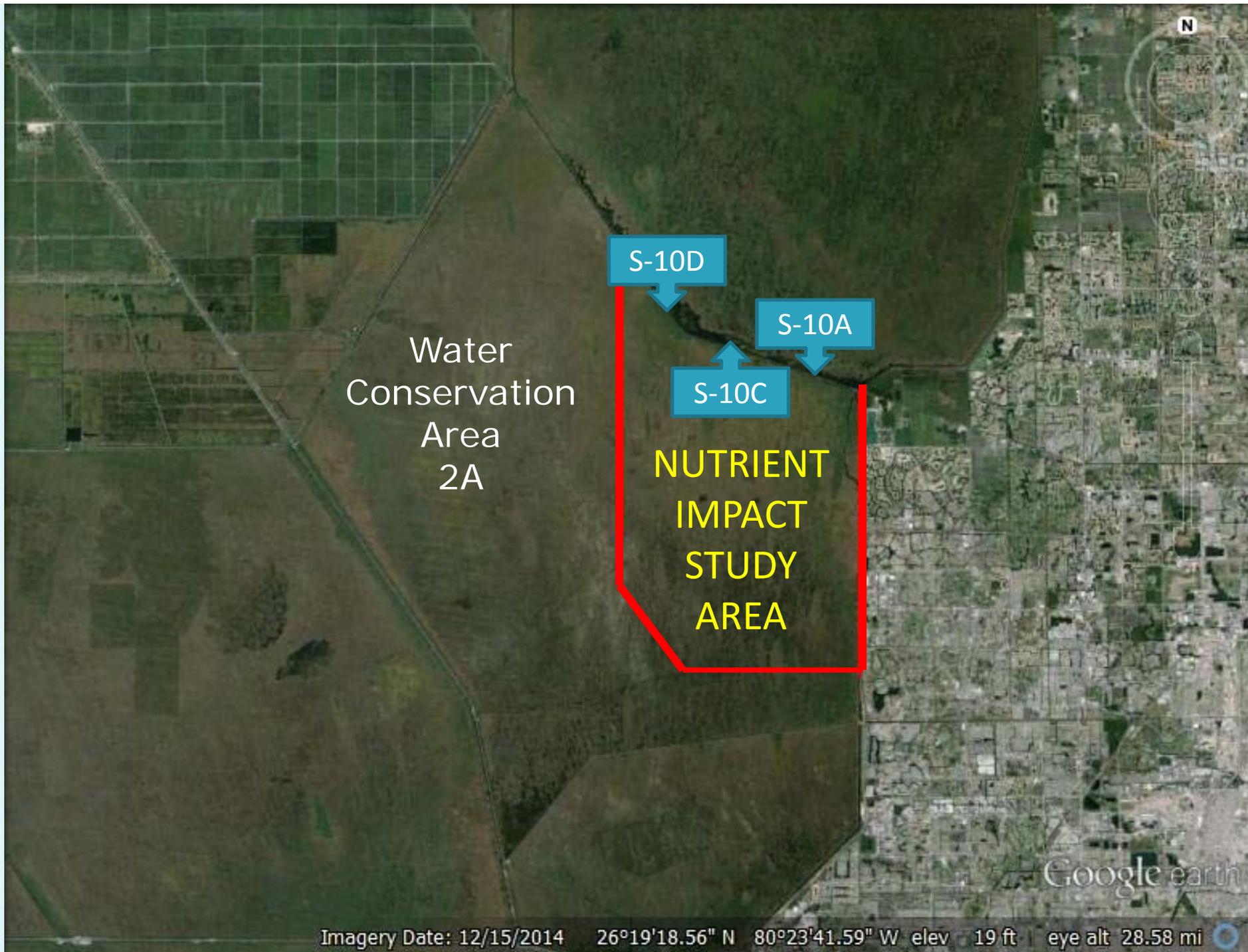
$$d(QC)/dA = p \times C_p - K_e \times F_w \times C$$

$$Q = Q_0 + (p - e) \times A$$

$$C = (C_0 - p \times C_p / g) [1 + (p - e) A / Q_0] - (g / (p - e)) + p \times C_p / g$$

$$g = K_e \times F_w + (p - e)$$

$$S = K_e \times F_w \times C$$



Water  
Conservation  
Area  
2A

S-10D

S-10A

S-10C

**NUTRIENT  
IMPACT  
STUDY  
AREA**

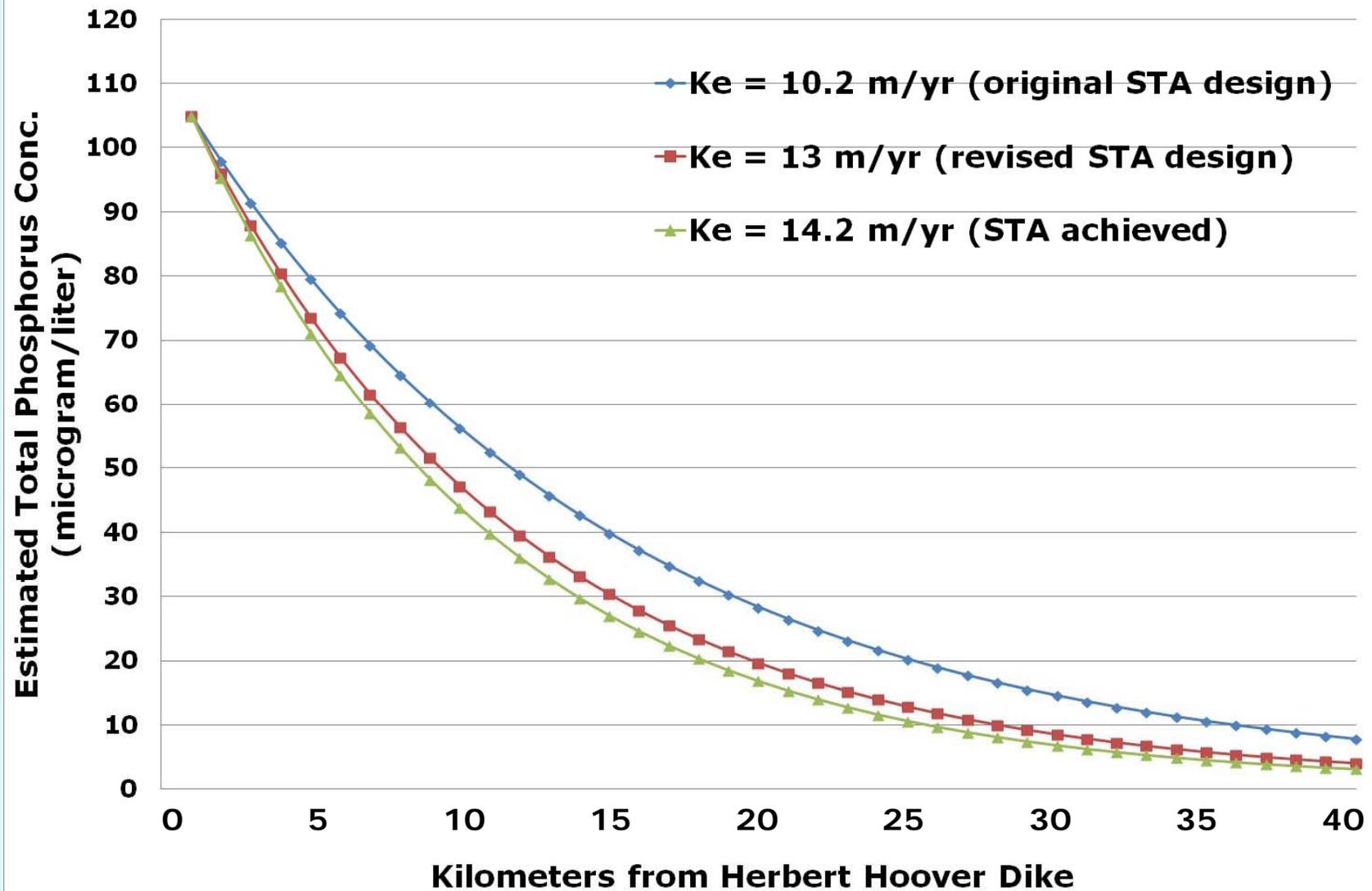
Google earth

# Scoping-Level Water Quality Model

## Model Parameters

$p$	= Rainfall ( $m/yr$ )	1.16
$e$	= Evapotranspiration ( $m/yr$ )	1.38
$F_w$	= Wet Period Fraction (unitless)	0.95
$Q_o$	= S10A+C+D Flow ( $hm^3/yr$ )	2160
$C_o$	= S10A+C+D Inflow Conc. (ppb)	105
$F_w$	= Width of Flow Path (km)	10.5
$C_p$	= Rainfall P Conc. (ppb)	12
$K_e$	= TP settling rate ( $m/yr$ )	10.2, 13, 14.2

## Steady-State TP Settling Model for STA Design: Proposed Flow-Way from Hoover Dike to WCA-3A



# CFW Scoping-Level Exercise

## Key Findings

- The CFW alternative that channels 1.75M acre-ft per year of Lake Okeechobee water to the Everglades is likely to meet the TP target there.
- A reservoir is not necessary to attain the TP WQS in the impounded Everglades at WCA-3A if Lake Okeechobee releases are controlled.

# CFW Scoping-Level Exercise

## Key Conclusions

- Unofficial EPA variances can suspend WQSs but not downstream impacts.
- A reservoir-assisted CFW is more likely to meet Everglades water quantity, quality, routing, and timing restoration objectives than CEPP.
- Where there is public will, the politics and financing will follow.

# CFW Scoping-Level Exercise

## Key Recommendations

- Expedite optimization of design and operation of the reservoir-assisted CFW using an EPA-approved dynamic water quantity-quality model.
- Use Amendment 1 restoration funds to buy CFW footprint lands and pay for new infrastructure.

# References

- Walker, Jr., W.W. 1995. Design basis for Stormwater Treatment Areas. Water Resources Bulletin. 31(4): 671-685  
<http://h2o.wwwalker.net/pdf/stadesign.pdf>
- Mitsch, W., et al. 2014. Protecting the Florida Everglades Wetlands with Wetlands .... Ecol. Eng. in press.  
[http://www.researchgate.net/publication/268804293\\_Protecting\\_the\\_Florida\\_Everglades\\_wetlands\\_with\\_wetlands\\_Can\\_stormwater\\_phosphorus\\_be\\_reduced\\_to\\_oligotrophic\\_conditions](http://www.researchgate.net/publication/268804293_Protecting_the_Florida_Everglades_wetlands_with_wetlands_Can_stormwater_phosphorus_be_reduced_to_oligotrophic_conditions)

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- University of Florida Water Institute Report to Florida Legislature on Moving Water South. March 2015:
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- Everglades Restoration Website:
  - <http://www.evergladesrestoration.gov/>

# References

- SFWMD Ecosystem Restoration Reports:
  - <http://my.sfwmd.gov/portal/page/portal/xweb%20about%20us/agency%20reports>
- Corps Ecosystem Restoration Websites:
  - <http://www.saj.usace.army.mil/Missions/Environmental/EcosystemRestoration.aspx>
  - <http://www.saj.usace.army.mil/Media/NewsReleases/tabid/6071/Article/494080/2014-everglades-system-status-report-available-online.aspx>

# References

- USGS Websites:
  - <http://soundwaves.usgs.gov/2011/11/research.html>
  - <http://sofia.usgs.gov/>
- NRC Biennial Reports 1-5 on Progress for Everglades Restoration:
  - <http://dels.nas.edu/Report/Progress-Toward-Restoring-Everglades/18809>

# References

- Greater Everglades Ecosystem Restoration (GEER) Conference Website:
  - <http://sofia.usgs.gov/geer/>
- RECOVER Team Poster:
  - [http://www.conference.ifas.ufl.edu/GEER2010/Poster%20PDFs/Burns\\_General%20RECOVER%20Poster.pdf](http://www.conference.ifas.ufl.edu/GEER2010/Poster%20PDFs/Burns_General%20RECOVER%20Poster.pdf)
- RECOVER CERP Performance Measures:
  - [http://141.232.10.32/pm/recover/eval\\_team\\_perf\\_measures.aspx](http://141.232.10.32/pm/recover/eval_team_perf_measures.aspx)

# References

- EPA Water Quality Standards Regulations

<http://water.epa.gov/scitech/swguidance/standards/wqsregs.cfm>

- EPA Water Quality Criteria

<http://water.epa.gov/scitech/swguidance/standards/criteria/>

# Abbreviation Key

- Corps or USACE: U.S. Army Corps of Engineers Jacksonville District Office
- C&SF Project: Central & Southern Florida Project for flood control and water supply
- SFWMD or District: South Florida Water Management District operates C&SF Project for the Corps in 16-county area from Orlando to the Florida Keys
- FDEP: Florida Dept. of Environmental Protection
- WRDA: Water Resources Development Act

# Abbreviation Key

- WQSs: the Water Quality Standards issued to implement Clean Water Act (CWA) Section 303(c) for a particular fresh or salt water body or portion thereof consists of:
  - a set of applicable narrative “free from” conditions and numerical values to protect its highest attainable uses as a drinking water supply, sport or commercial fishery, or agricultural or industrial conveyance
  - or the already attained water quality better than the minimum per the anti-degradation provision.

# Abbreviation Key

- WQC: Narrative Water Quality Criteria  
The waters shall be virtually free from:
  - oils of natural or unnatural origin in unnatural amounts with a visible sheen
  - putrefying matter in noxious amounts
  - pathogens in disease-causing amounts
  - nutrients in eutrophy-causing amounts
  - toxic substances in toxic amounts

# Abbreviation Key

- **WQC: Numerical Water Quality Criteria**  
The sets of concentrations of an element or compound in fresh and salt water not to be exceeded by the specified magnitude, duration, and frequency at the specified compliance points required to protect:
  - aquatic life from short-term and long-term exposures living or foraging in or transiting those waters; and
  - human health from drinking, contacting, or eating fish or shellfish harvested recreationally or commercially from those waters.

# Abbreviation Key

- TP: Total Phosphorus includes all inorganic and organic dissolved, colloidal, and particle forms present in unfiltered samples collected, digested and analyzed using EPA- and FDEP-approved methods.
- TP WQS: The concentration of TP in surface water that will not cause or contribute to an algae bloom  $\geq 20$  ug/L in chlorophyll-a equivalents more frequently than once-in-three-years.
- TP WQS for the Everglades: 10 ppb

# Abbreviation Key

- CERP: Comprehensive Everglades Restoration Plan prepared and approved by Corps and SFWMD per WRDA 1996 and adopted by Congress in WRDA 2000.
- CEPP: Central Everglades Planning Project prepared by same agencies per WRDA 2010 to expedite attaining central Everglades water quantity, quality, routing, and timing restoration objectives approved by SFWMD in 2013 and the Corps in 2014.

# Abbreviation Key

- TMDL: Total Maximum Daily Load required by CWA Section 303(d)(1)(C).
- NPDES: wastewater discharge permits are issued by EPA or delegated states under the National Pollutant Discharge Elimination System per CWA Section 402
- TBELs: Technology-Based Effluent Limits routinely achievable for each industrial category.
- WQBELs: Water Quality-Based Effluent Limits to attain WQS at compliance points

# Abbreviation Key

- EAA: Everglades Agricultural Area ~1,000 sq. mi. of drained floodplain peat soil south and east of Lake Okeechobee dike
- STA: Stormwater Treatment Area is an engineered wetland to treat EAA runoff
- FEB: a load-leveling Flow Equalization Basin is a shallow reservoir that stores for later treatment some EAA stormwater runoff pulses that would otherwise be treated less efficiently by STAs or have to be diverted to prevent system blow-out.

# Abbreviation Key

- FSP: CEPP's not yet Congress-adopted Final Selected Plan that assumes as a given the water quality acceptable to EPA Region 4, as codified in the Everglades TP TMDL and Watershed Plan, FEB-assisted STA NPDES permit WQBELs, and compliance points and schedules.
- CFW: the Central Flow-Way alternative to CEPP that sheetflows water directly from Lake Okeechobee south to the Everglades between Miami & North New River Canals

# Short History of CFW

## Short History of the CFW

- 1955: USACE Original CFW Plan 6
- 1971: Repair of Everglades Basin
- 1981: Marshall Plan
- 1993: Science Subgroup Report
- 1994: USACE Recon Restudy
- 2000: GEER Conference
- 2003-06: NRC Biennial Reports
- 2007: Everglades Coalition Action Plan

# Short History of CFW

- 2007: Dennis Duke, Corps-Jacksonville, to NRC: Restore Sheet Flow by 2020
- 2009: River of Grass Initiative (ROGI) rates high Marshall Plan Element 6 (MPE6)
- 2010: NRC Biennial Report supports ROGI
- 2012-14: CEPP process rates low MPE6
- 2015: UF Water Institute Expert Panel finds CEPP not sufficient and highlights but does not adopt ROGI MPE6 vs. CEPP+