Reengineering Monitoring Water Conservation Area 2A (WCA-2A) Pilot Project

Background and Recommendations

October 21, 2008

An Interagency Workshop

Why Reengineer?

- Senior management of multiple agencies requested that staff evaluate the existing monitoring environment and come up with ideas for reducing/controlling costs, while maintaining or increasing information flow

- Current monitoring system has evolved into a conglomeration of networks, not necessarily conducive to answering critical questions for regional environmental management or the most cost-effective or efficient use of resources

Why Reengineer? (cont.)

- SFER Peer Review panel has repeatedly recommended that the regional water quality monitoring in South Florida be better integrated, standardized and routinely optimized

- Reality of decreasing budgets, increasing demand for monitoring, and competition for funding requires a comprehensive review and overhaul in network design and new approaches to monitoring to ensure sustainability

Reengineering Approach

- Select pilot project area (WCA-2A)
- Tabula rasa (wipe the map clean)
- Review mandates/permits (letter and spirit) and determine fundamental management/scientific questions
- Define monitoring objectives and information needs

Reengineering Approach (cont.)

- Design and rebuild the monitoring network to fulfill objectives and information needs:
  - Develop parameter sets based on logistics, utility and justifiable need
  - Develop frequencies that are logical with respect to environmental variability and data needs
  - Rebuild structure and marsh station sets
    - *Evaluate and integrate new technology*
    - *Logistical considerations*
    - *Review historical data*
    - *Prioritize critical stations*
    - *Give preference to stations with history*

Why WCA-2A?

- Smallest major conservation area
- Diversity of environmental attributes
  - Structures
  - Marshes
- Regulated by a diversity of mandates and permits
- Large quantity of historical data
  - Topography
  - Ecology
  - Hydrology
  - Water Quality

Monitoring in WCA-2A Required for:

- Settlement Agreement
- Everglades Forever Act
  - Non Everglades Construction Project (Non-ECP) Permit
  - Stormwater Treatment Area (STA) ECP Permits
- NPDES Permits
- EAA Rule 40E-63
- Total Phosphorus Rule
- Hypothesis-driven research
- Agency's mission

Fundamental Questions
(as indicated by mandates/permits and research)

- What is the status of water quality and associated loads at inflows?
- How has water quality changed in response to altered hydrology and loading?
- As water quality changes, are there associated responses in flora and fauna?
- Can station-scale data be integrated to document landscape-scale patterns?
- As landscape-scale changes occur, how is hydrology altered?
- Are there relationships from monitoring data that can be used as tools or indicators for long-term management?

Monitoring Objectives and Information Needs

- Provide essential data to:
  - understand the system
  - meet regulatory objectives
  - estimate nutrient loads
  - determine station responses
  - develop response indicators
  - discern landscape changes
  - develop management tools

Develop Parameter Set for all Stations (Structures and Marsh)

Considerations:

- Utility
- Justifiable need
- One of the fundamental problems common to failed monitoring programs is the selection of parameters based on ease of measurement, or because they had established protocols, not because they were particularly useful to answering the project questions

  - paraphrased from L. M. Reid, The Epidemiology of Monitoring, 2001, JAWRA 37(4)

- Logistical considerations

Develop Parameter Set for all Stations
(Structures and Marsh)

Considerations (cont.)

- Standardized or variable
  - Standardization of parameter sets eliminates variability between stations and projects easing integration of various monitoring projects AND minimizes sampling errors

Standard Parameter Set

- **Field Measurements**
  - Depth
  - Specific Conductivity
  - Temperature
  - pH
  - DO
- **Nutrients**
  - TPO4
  - TDPO4
  - OPO4
  - TKN
  - TDKN
  - NOx
  - NH4
  - TOC
  - DOC
- **Ions**
  - Ca
  - Mg
  - Na
  - K
  - SO4
  - SiO2
  - Cl
- **Other**
  - TSS
  - Alkalinity
  - Fe (Q)

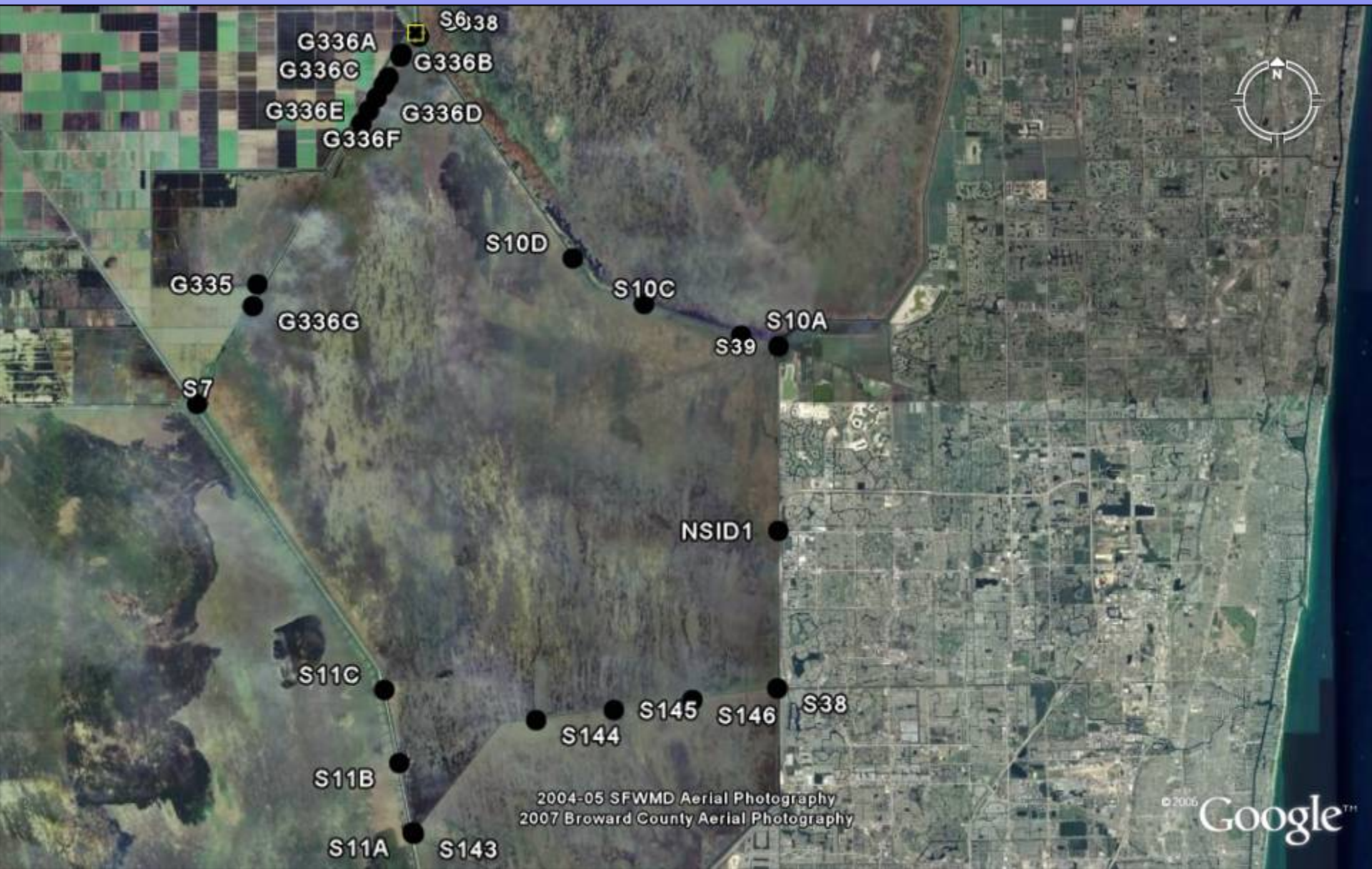
Rebuilding Station Sets Part 1: Structures

- Inflows
  - NSID1
  - S39 and S10s
  - S6 and S336s
  - S7, G371, and S150
- Outflows
  - S11s and S143
  - S144, S145, S146, and S38

<u>Primary Objective of Monitoring</u>

Ensure discharges meet water quality standards and quantify nutrient loads

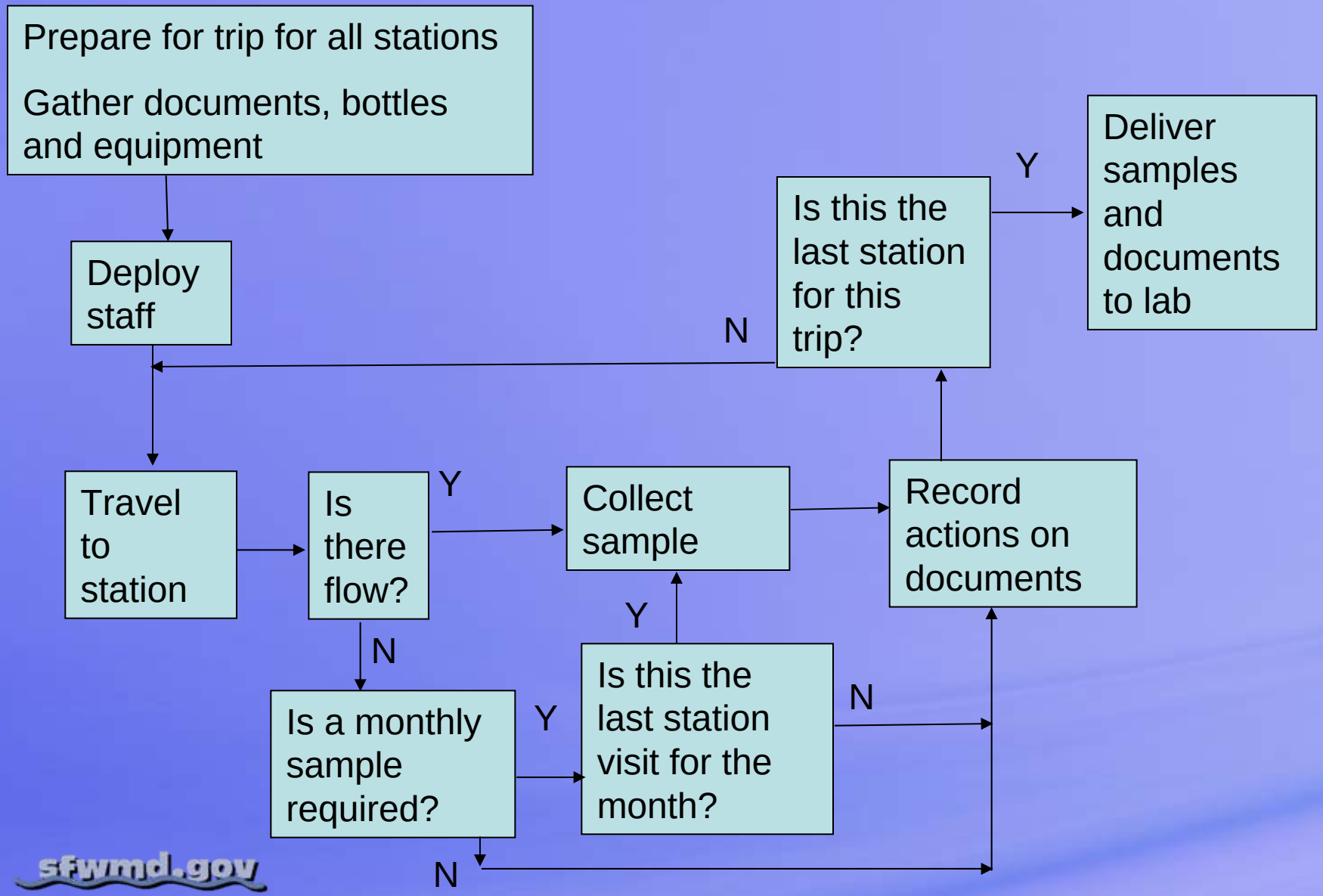
WCA-2A Structures Overview



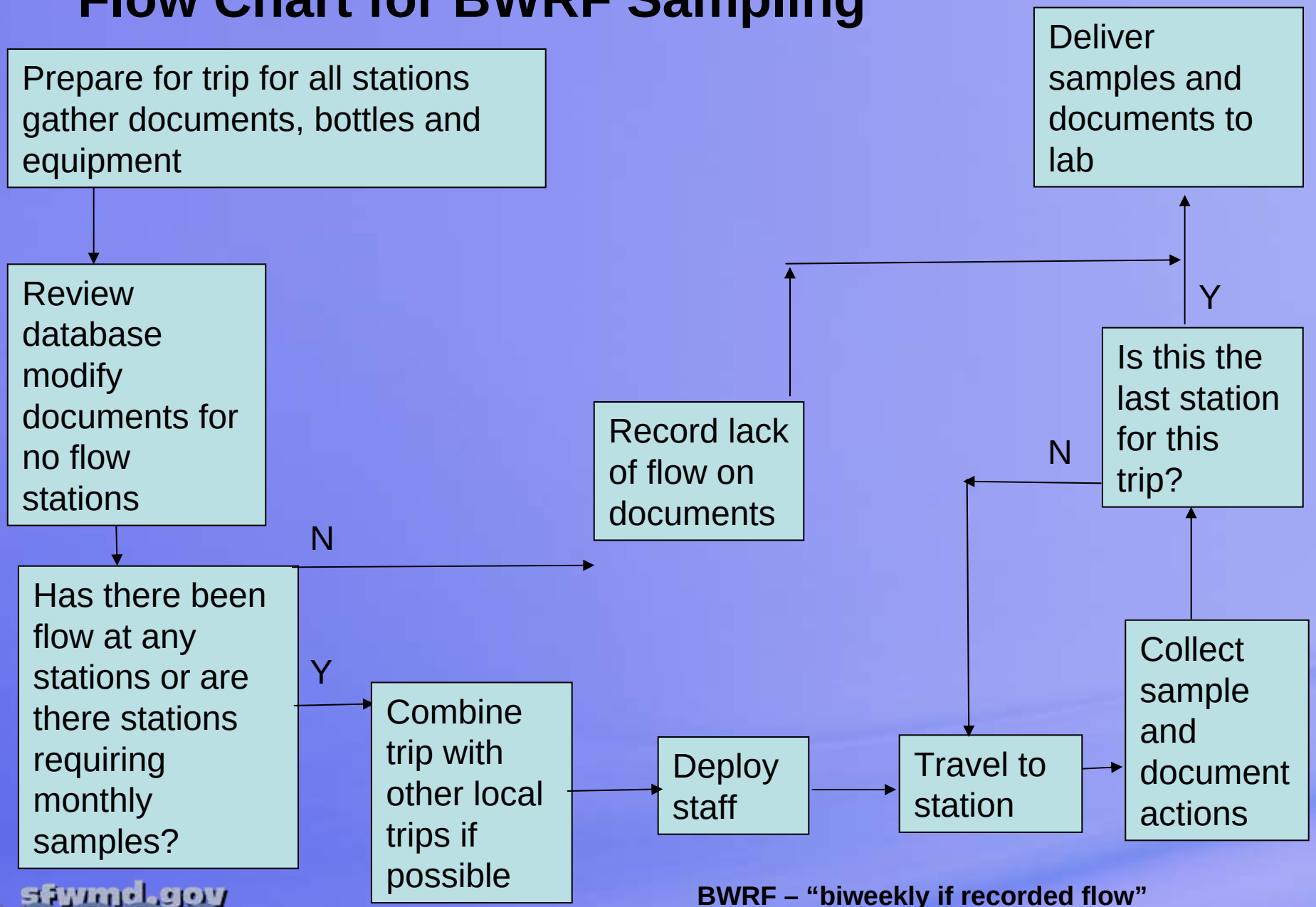
Structure Monitoring

- Currently samples are collected when flow is observed or at monthly defaults
- Suggest changing from direct observation-based collection to telemetry-based collection using electronic databases to screen stations before staff deployment

Flow Chart for Existing Grab Sampling



Flow Chart for BWRF Sampling



BWRF – "biweekly if recorded flow"

For Structures with Recorded Flow (RF)

- On the day of collection,
  - If no flow has occurred in the last two weeks, then the station is not visited
  - If flow has occurred, then the station is visited and samples collected
- At a review frequency of biweekly, this process will actually increase the number of samples collected, but has the potential to decrease the number of station visits

Why Biweekly?

- Considering staff and travel logistics
  - Monthly creates too many stations in too few trips
  - Weekly creates too many trips with too few stations
- Note: Stations with autosamplers will have to be visited and maintained on a weekly basis

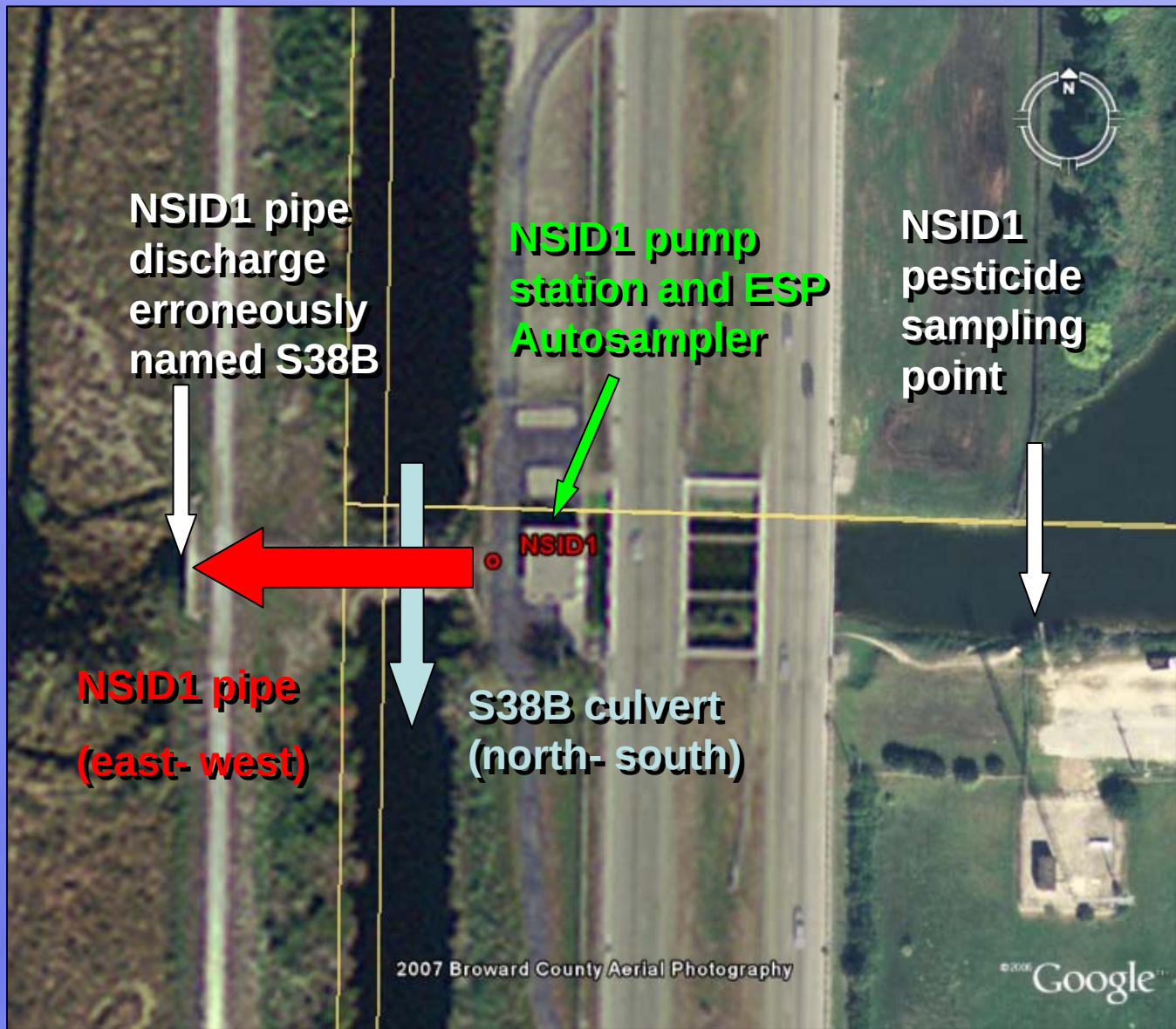
How Will You Discern flow?

- Actual or provisional flow data may not be available in real-time or even within two weeks
- Pumping or structure opening combined with headwater and tailwater readings can be used to determine structure openings and flow
- Positive flow only will trigger a sampling event

A Real-World Example

- Using historical data from 2004
  - S10A and S10C were sampled BWF
    - 52 station visits (52 trips)
    - 13 samples
- If we apply a BWRF protocol
  - 19 station visits (10 trips)
  - 19 samples
- 81% decrease in sampling trips
- 64% decrease in station visits
- 46% increase in data

NSID1 Existing Monitoring



NSID1 Discussion Points

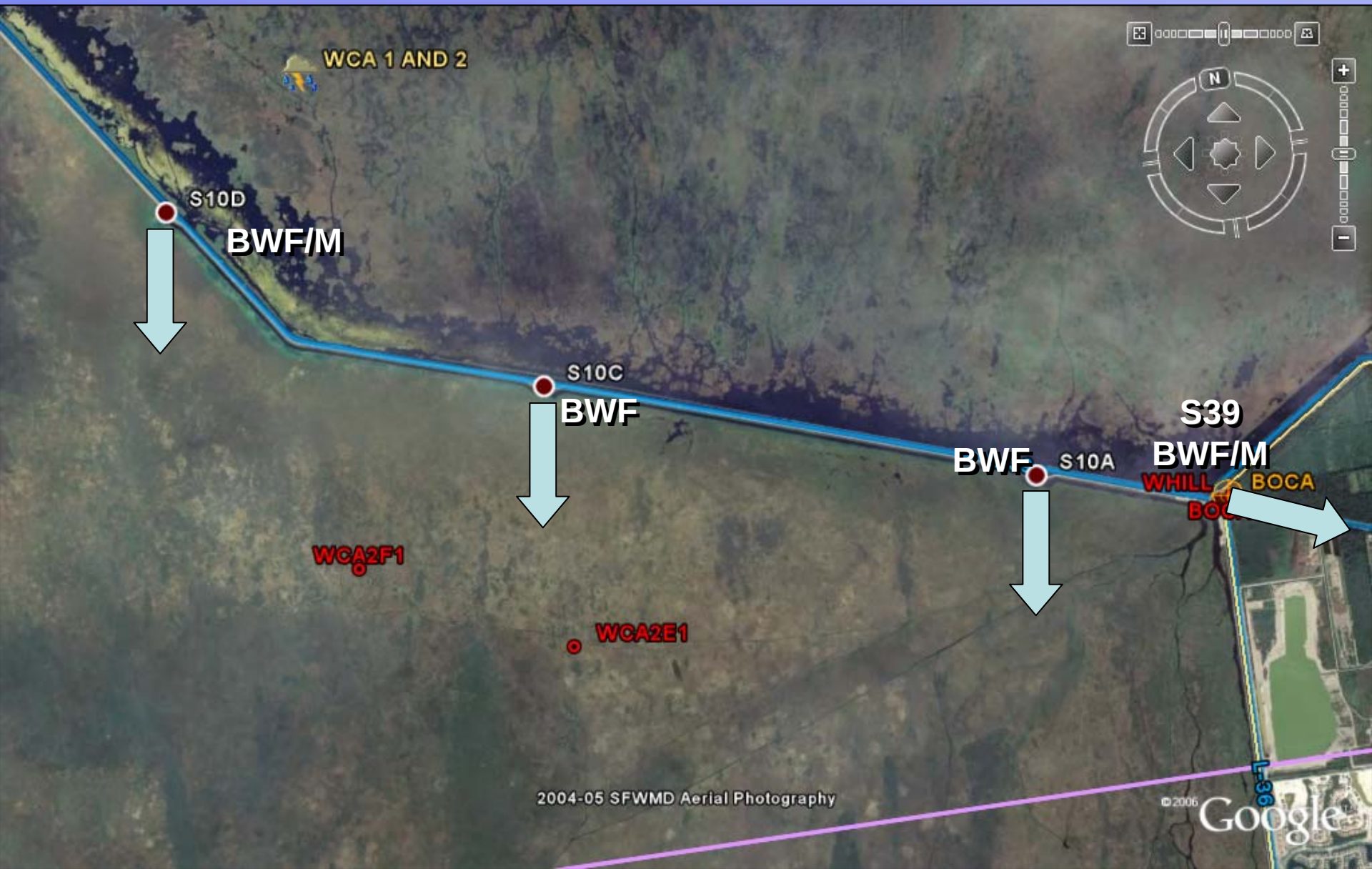
- NSID1 is a minor pump station that occasionally discharges from suburban area into WCA-2A
- Monitoring required by Settlement Agreement; no longer required by Non-ECP Permit or Everglades Stormwater Program
- Grab sample biweekly when flowing from discharge pipe for Settlement Agreement
- Autosampler in pump station for Everglades regulation information need
- Sampling challenges due to configuration of infrastructure

Recommended Actions

- ✓ Relocate grab sample upstream of structure
- ✓ Maintain frequency as "biweekly if flowing" (BWF)
- ✓ Rename station NSID1

NSID1
Proposed Monitoring Locations

S10 Area Existing Monitoring



S10 Discussion Points

- Data associated with flows is needed for calculating loads to WCA-2A
- Data associated with non-flowing conditions is used for modeling
- It has been suggested that failure to collect non-flowing data may compromise estimates of loading because of missing first-flush effect

Flowing vs Non-Flowing Samples and Results

- S10D
  - TP samples collected within 14 days of a flow event (median = 64.5 ug/L) are significantly different and higher than non-flowing samples (43.0) and all samples (47.5)
  - Suggests that going to monitoring within 14 days of a flow event will be closer to peaks than non-flowing data

A Practical Observation on S10 Flows and Sampling

- Sampling of the S10s is not random, sampled on Monday
- Sampling is triggered by observing flow
- S10 flow events are not evenly distributed. Flow events starting on
  - Monday 19%
  - Tuesday 14%
  - Wednesday 14%
  - Thursday 19%
  - Friday 34%
  - Saturday and Sunday 0%

What Does this Mean for Sampling the S10s?

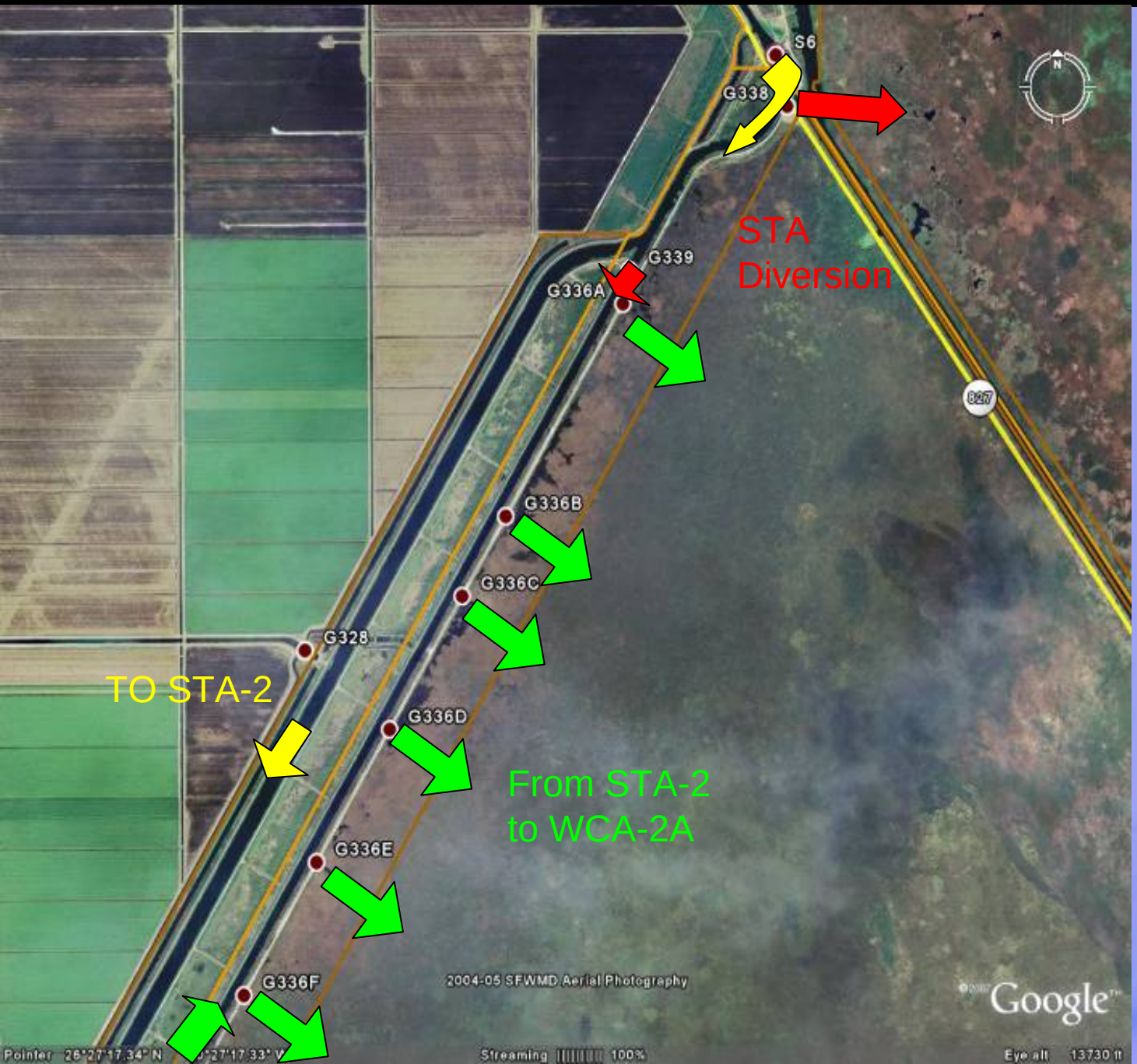
- The chances of actually collecting a sample on the day discharge begins is at best 19%
- 50% of all flows are sampled within 7 days of initiation of discharge
- 20% of all flows are collected between 7 and 14 days of initiation of discharge
- 30% of all flows are not sampled

Recommended Actions

- ✓ Change S39 and S10D from BWF/M to BWRF/M, maintaining two data points of non-flowing data
- ✓ Change S10C and S10A to BWRF

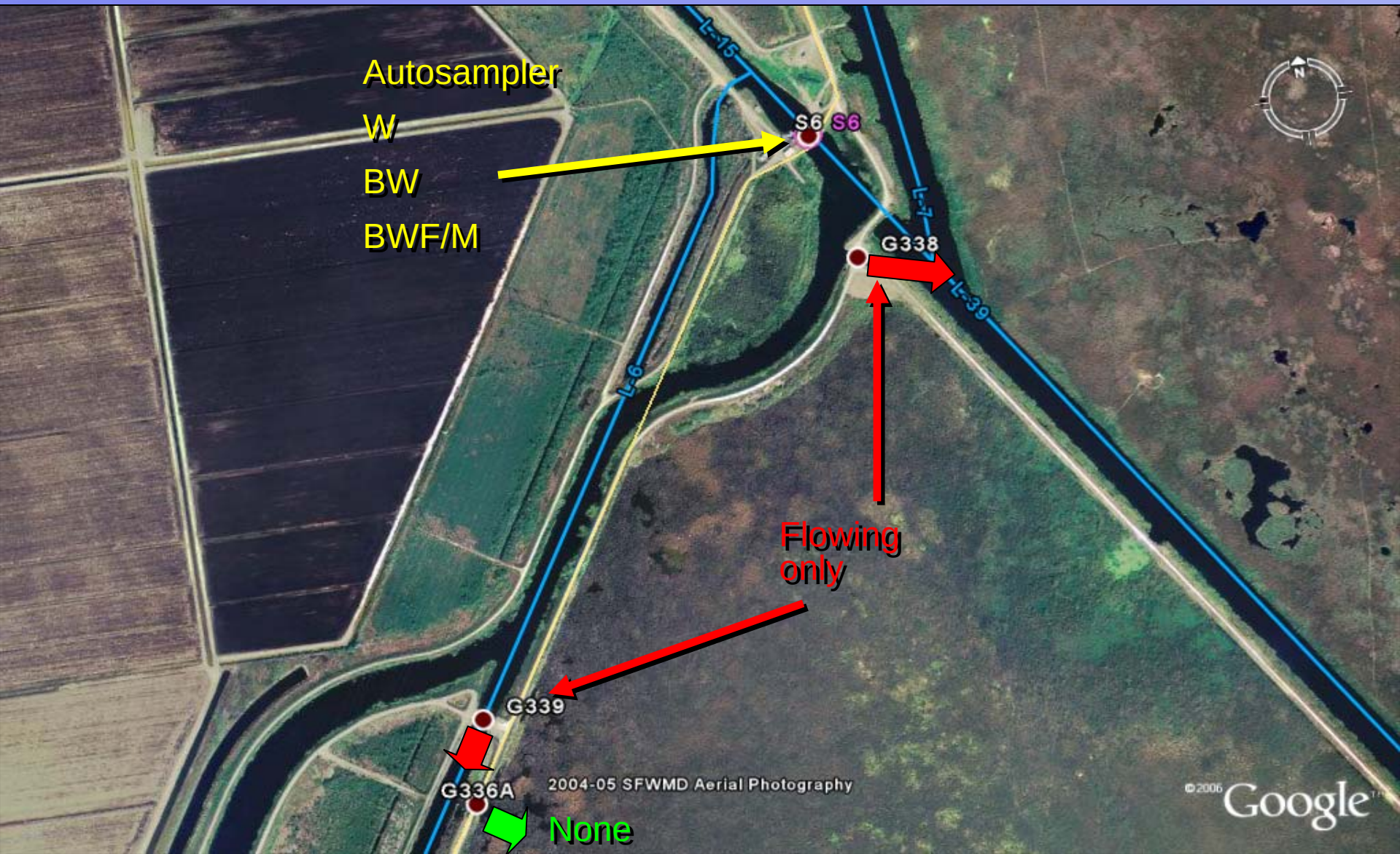
BWF/M – "biweekly if flowing, otherwise monthly"
BWRF/M – "biweekly if recorded flow, otherwise monthly"

S10 Area Proposed Monitoring



S6 Area Overview

S6 Area Existing Monitoring



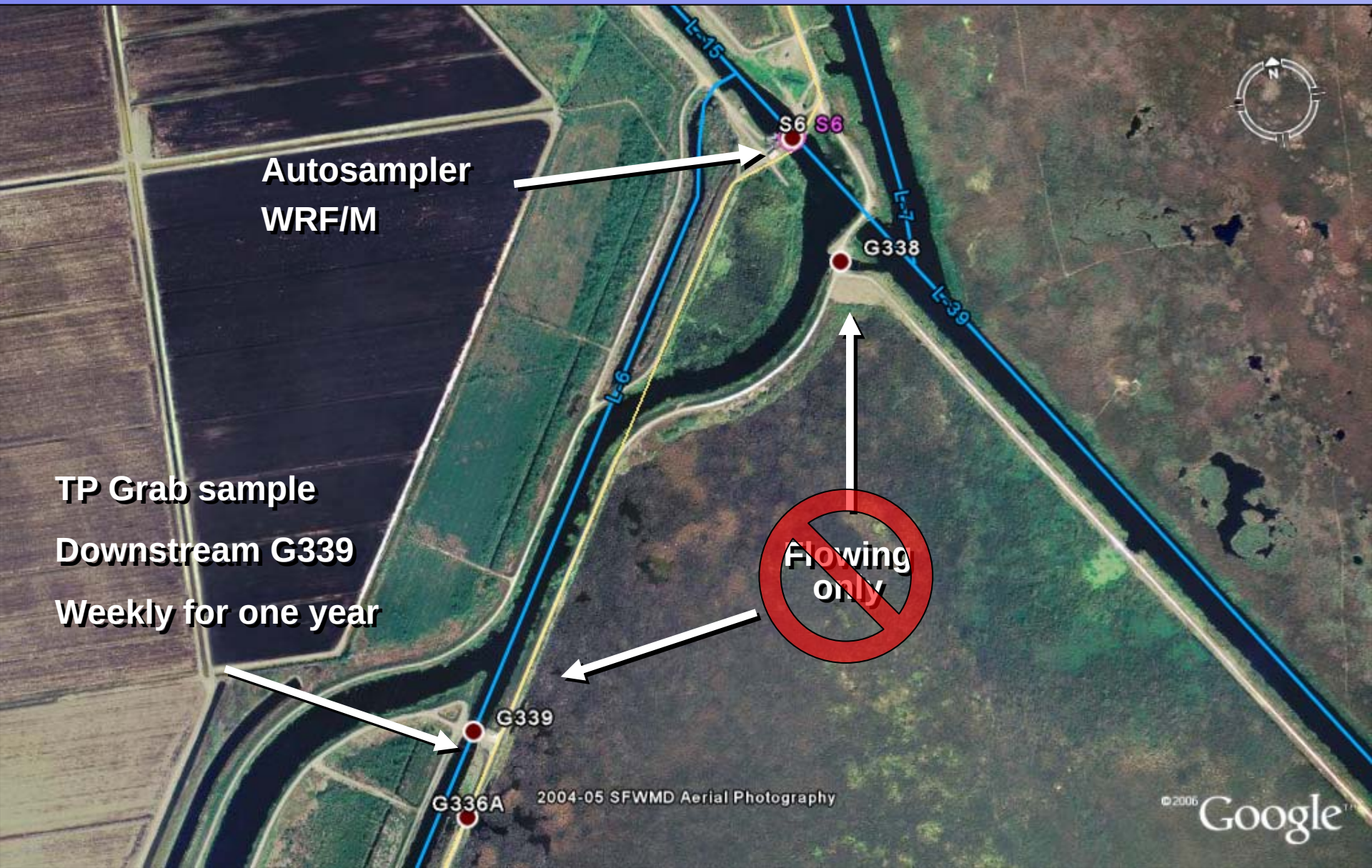
Discussion Points

- Data associated with flows at S6 is needed for calculating loads to STA-2 and Everglades Agricultural Area (EAA) Rule (autosampler required)
- S6 part of CAMB 1991 so Settlement Agreement station, but modified and no longer delivers to Everglades Protection Area (EPA)
- G336s not monitored
- G338 and G339 are monitored only during diversion operations to estimate loads to WCA-1 and WCA-2A for STA-2 permit
- S6 data is highly comparable to G329B (4.5 miles downstream)

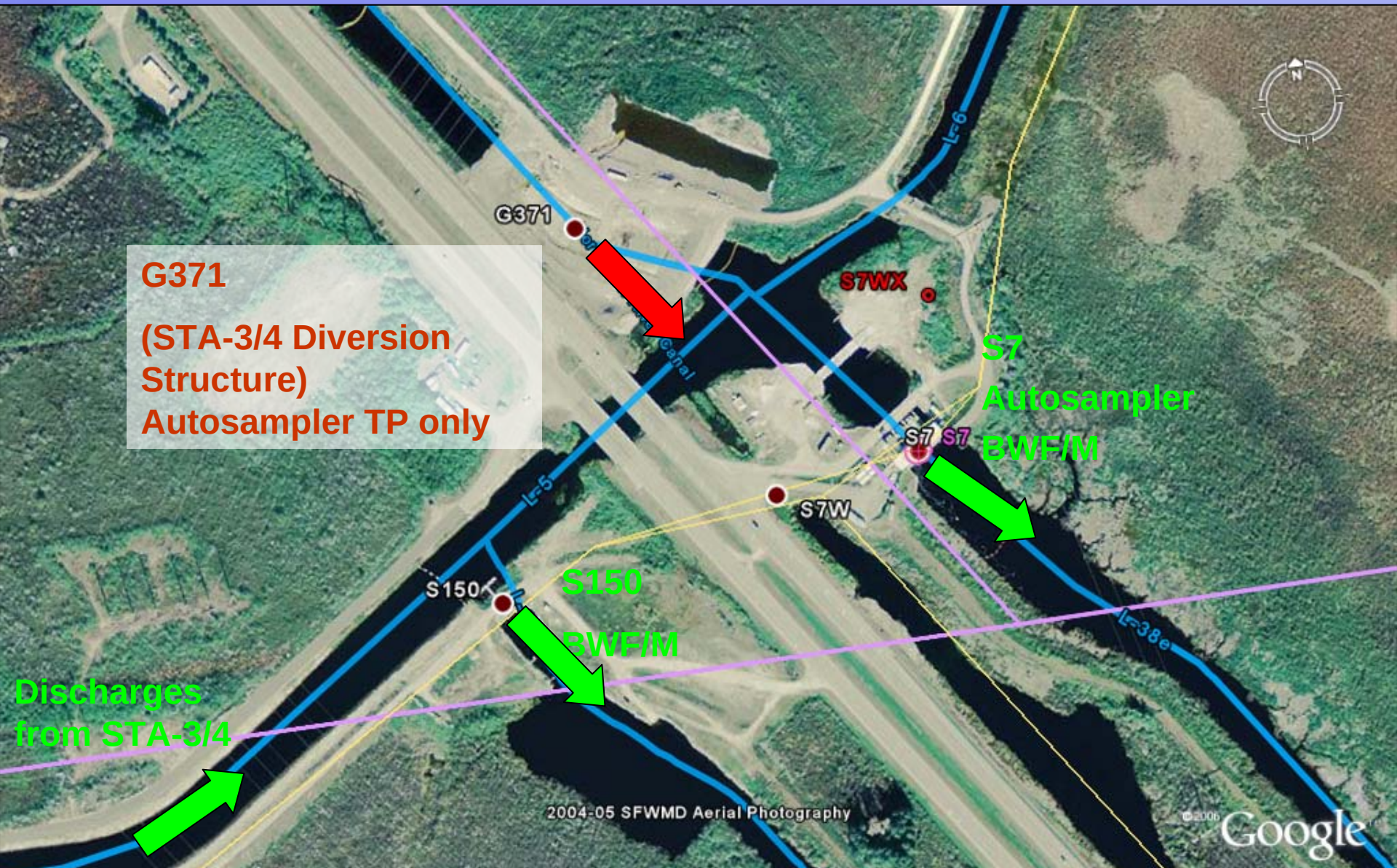
Recommended Actions

- ✓ Retain autosampler
- ✓ Eliminate W, BW, BWF/M monitoring at S6 to standard set WRF/M
- ✓ Cease flow response monitoring requirements at G338 and G339. Loading can be calculated from S6 data (autosampler and grab) and G338/G339 flows
- ✓ Begin sampling G339 on the downstream side for TP only for at least one year, validate that STA-2 discharges are representative of what is reaching G336s

S6 Area Proposed Monitoring



S7 Area Existing Monitoring



S7 Area and STA-3/4 Outflow Autosamplers

Autosamplers monitoring discharges from STA-3/4

Discussion Points

- G371
  - Diversion operations for STA-3/4,
  - EAA Rule autosampler (TP)
- S7 and S150
  - Sourced either from STA-3/4 or G371
  - Flows from STA-3/4 to S7 must pass S150
  - Grabs collected BWF/M
  - S7 autosampler (TP & TN)

- Recently modified infrastructure and drought means little information on how current system functions

S7 TP Data

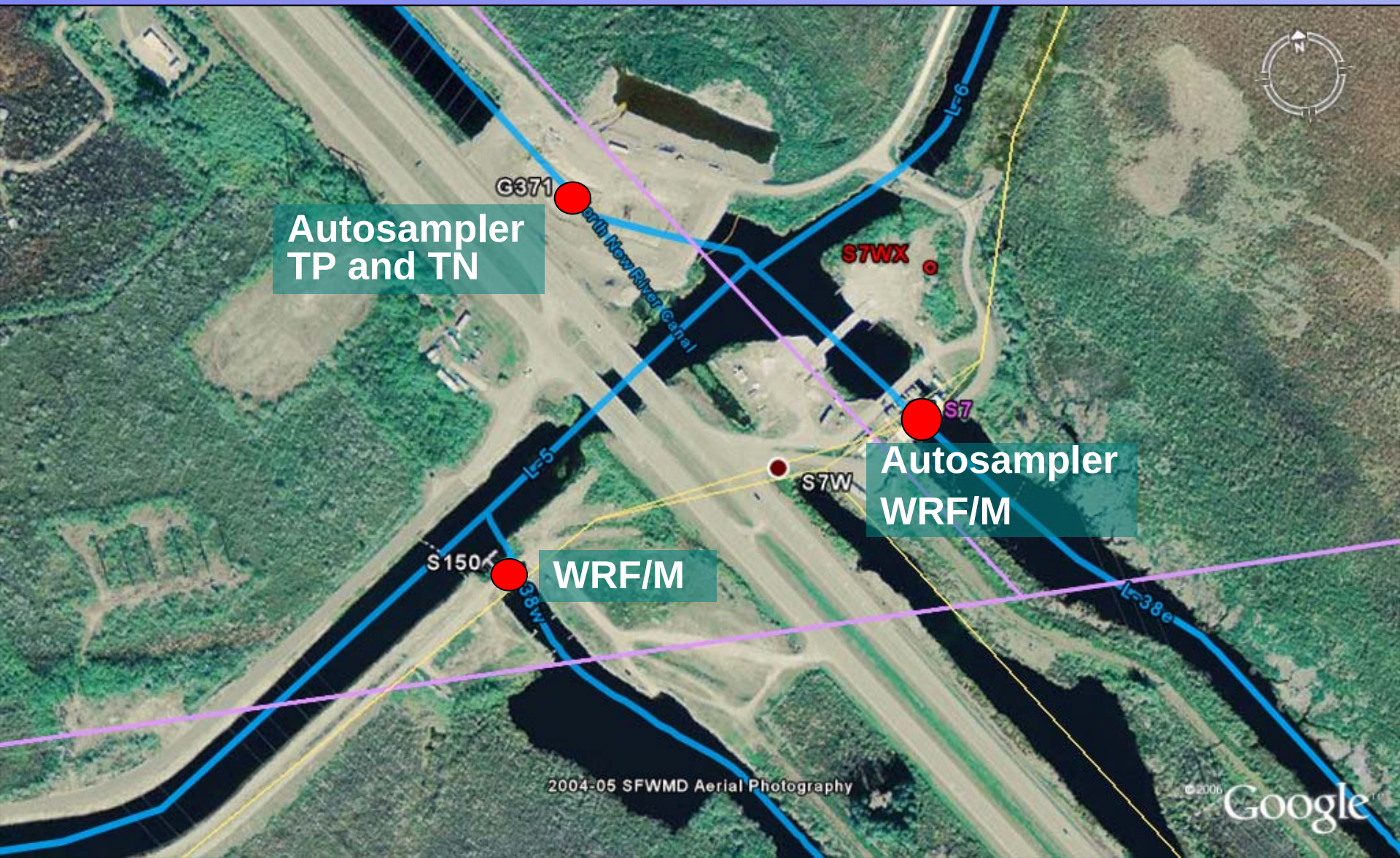
- S7 TP samples collected within 14 days of a flow event (median = 33.0 ug/L) are significantly different and higher than non-flowing samples (25.5) and all samples (29.0)

- Suggests that going to monitoring within 14 days of a flow event will be closer to peaks than non-flowing data

Recommended Actions

- ✓ Add TN to G371 autosampler
- ✓ Retain autosampler at S7
- ✓ Change S7 and S150 to WRF/M
- ✓ Review collected data every two years to see how S7 and S150 compare and how they respond to normal STA operations

S7 Area Proposed Monitoring



S11 Area Existing Monitoring

* Samples are collected at S11A if either S11A or S143 are flowing, otherwise monthly

S11A/S143 Discussion Points

- S11s serve as inflows to WCA-3A
- S11A (BWF) currently serves as a surrogate for S143 which is BWF/M (Non-ECP)
- Average TP during 2000-2006
  - S11C 29 ug/L
  - S11B 22 ug/L
  - S11A 24 ug/L

Recommended Actions

- ✓Maintain monthly events at S11A/S143 and S11C
- ✓Change S11B to BWRF

S11 Area Proposed Monitoring

* Samples are collected at S11A if either S11A or S143 are flowing.

L35B Area Existing Monitoring

* Samples are collected at S145 if either S144, S145, or S146 are flowing.

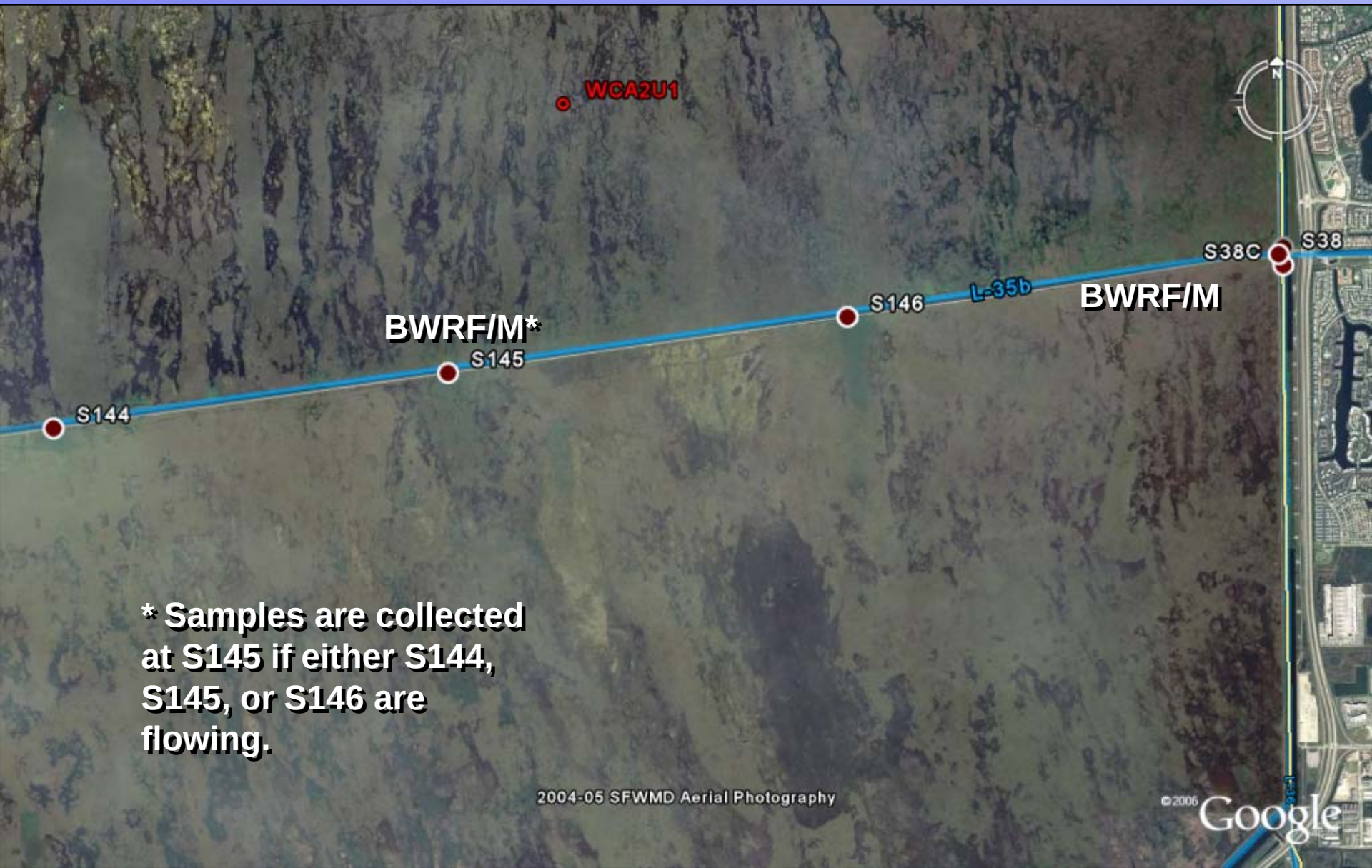
Discussion Points

- S145 serves as a surrogate for S144 and S146
- L-35b levee begins at S38 and ends at S11A
  - one lane with little space for turnaround

Recommended Actions

- ✓ Modify monitoring at S145 to BWRF/M
- ✓ Increase monitoring at S38 to BWRF/M
  - Little affect on costs
  - More water quality data on the south end of WCA-2A
  - May characterize short circuiting along eastern levee

L35B Area Proposed Monitoring



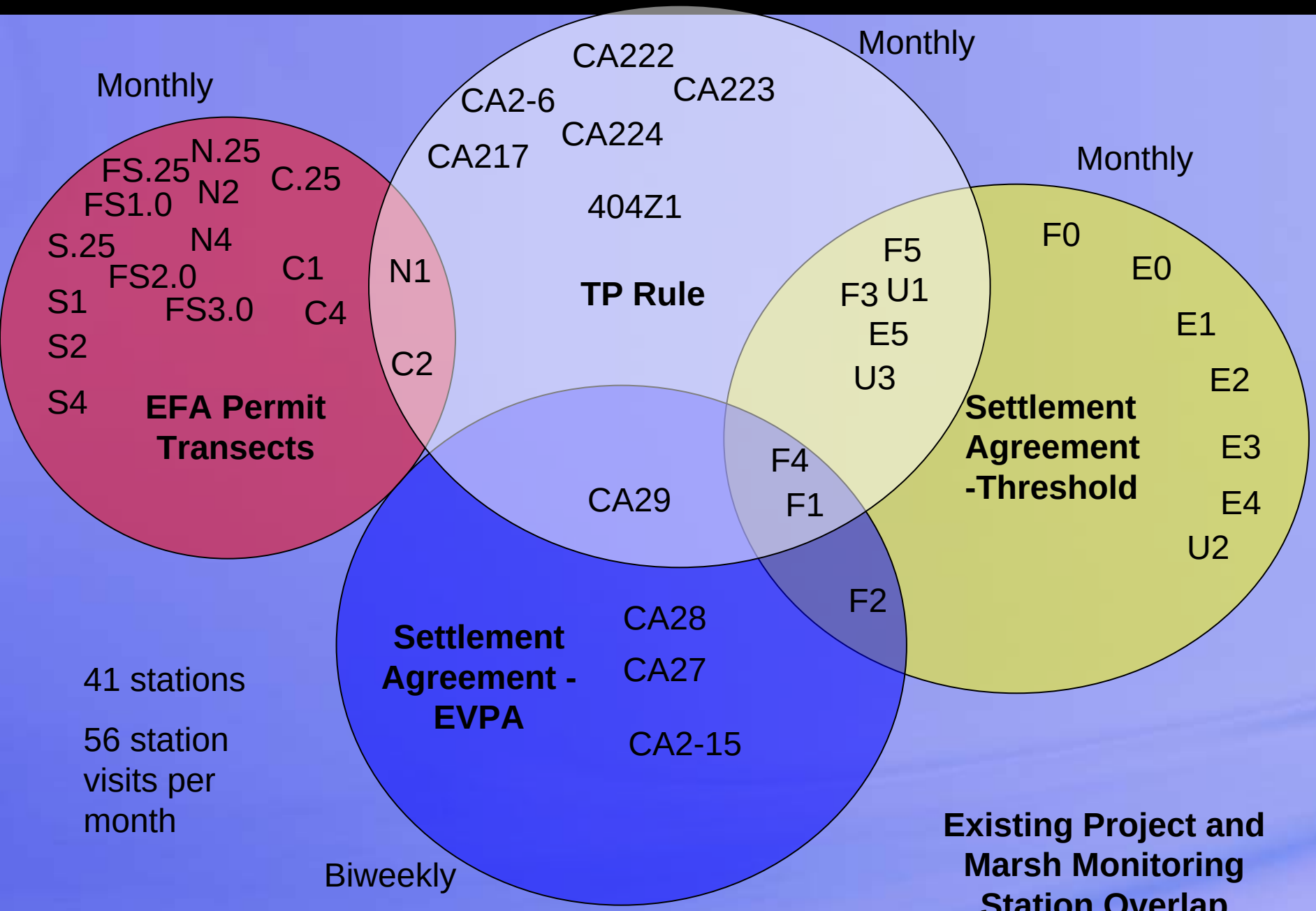
* Samples are collected at S145 if either S144, S145, or S146 are flowing.

Rebuilding Stations Sets Part 2: Marsh

Existing network evolved from:

- Settlement Agreement
  - EVPA (Everglades Protection Area Project) Threshold
- EFA Permits
  - STA-2 and STA-3/4
- Total Phosphorus Rule
- Research Needs

Existing WCA-2A Marsh Monitoring Stations



41 stations

56 station visits per month

Existing Project and Marsh Monitoring Station Overlap Diagram

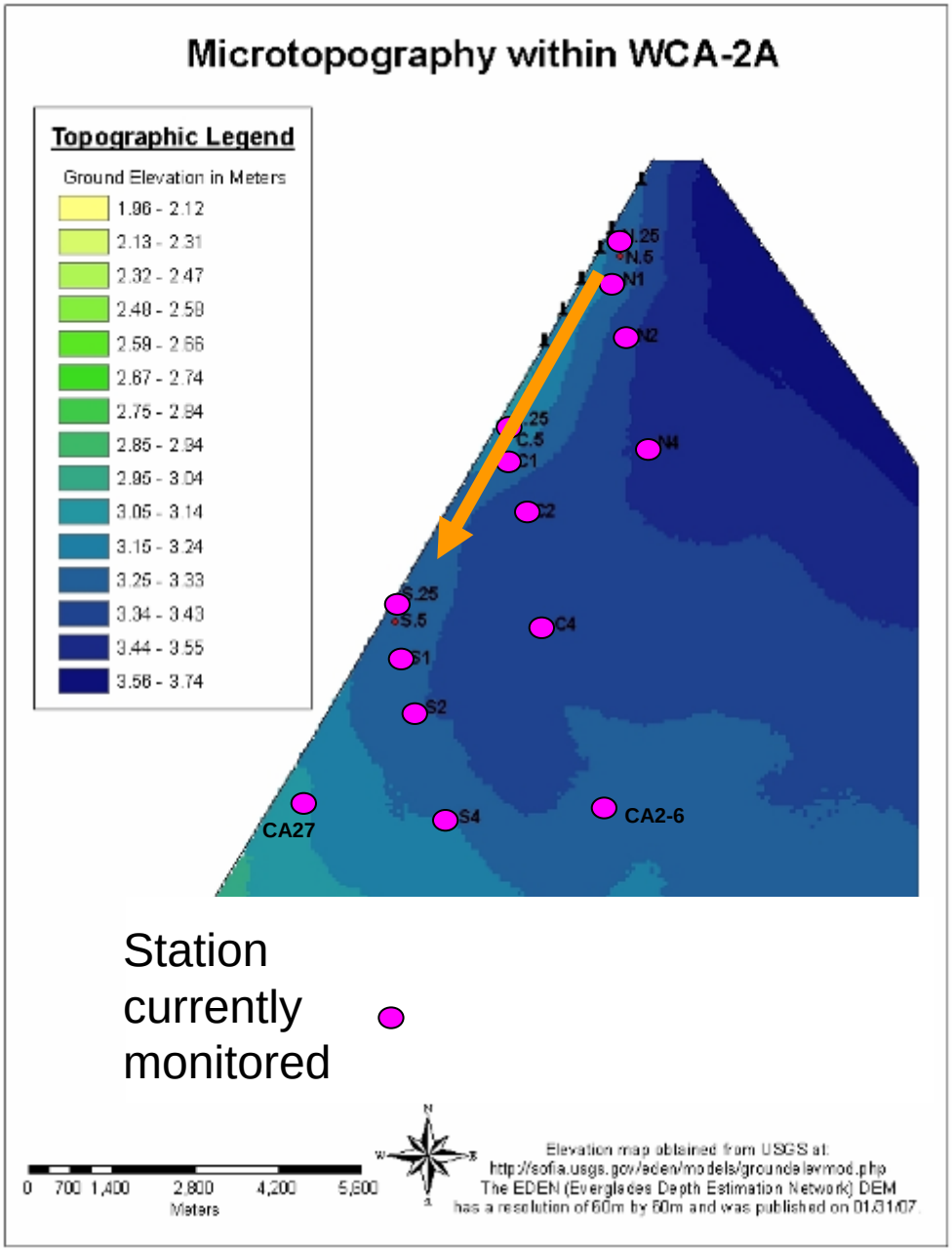
Approach to Reengineering Marsh Stations

- Review mandates, permit, and research information needs
- Review existing stations
  - Analyze and compare data
- Evaluate frequency
- Evaluate utility
- Evaluate logistics
- Propose list
- Discuss with staff
- Repeat

STA-2 Existing Discharge Monitoring Transects

Water was assumed to flow away from the levee; stations were located accordingly

Based on data analysis and topography, water appears to flow southwest, perpendicular to transects



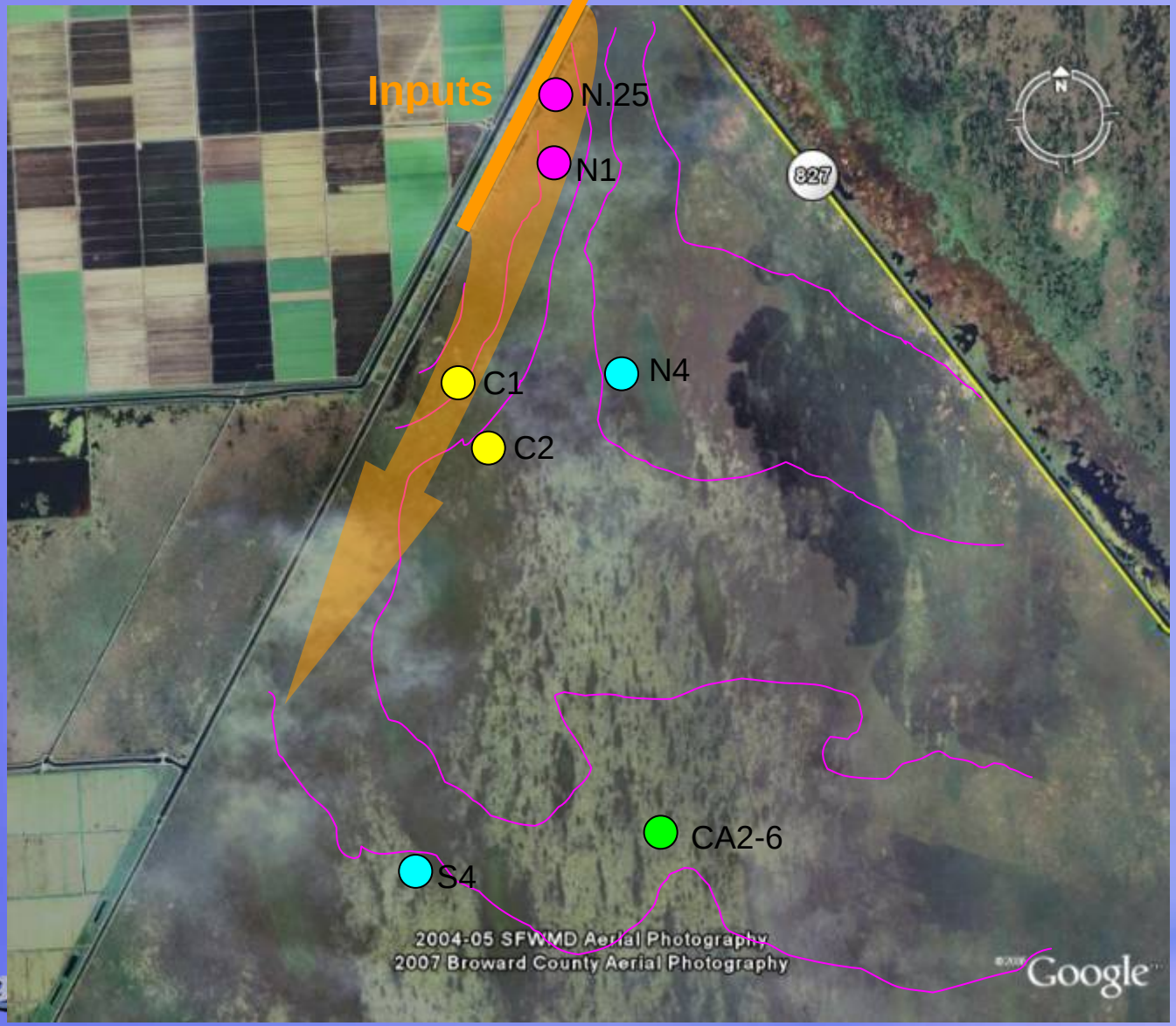
Discussion Points
How Do We Reengineer This Area?

- EFA STA-2
  - N Transect
  - C Transect
  - S Transect
- TP Rule
  - N1 (Impacted)
  - 404C2 (Unimpacted)
  - CA2-6 (Unimpacted)
- Settlement Agreement
  - CA2-6
  - CA27

Proposed Actions

- EFA STA-2
  (Garrett and Ivanoff 2008 recommendations)
  - N.25, N1, N4
  - C1
  - S4
- TP Rule
  - N1 (Impacted)
  - 404C2 (Unimpacted)
  - CA2-6 (Unimpacted)
- Settlement Agreement
  - CA2-6

STA-2 Proposed Discharge Monitoring Transects



CA215 and U3 Existing Monitoring

Discussion Points - CA215 and U3

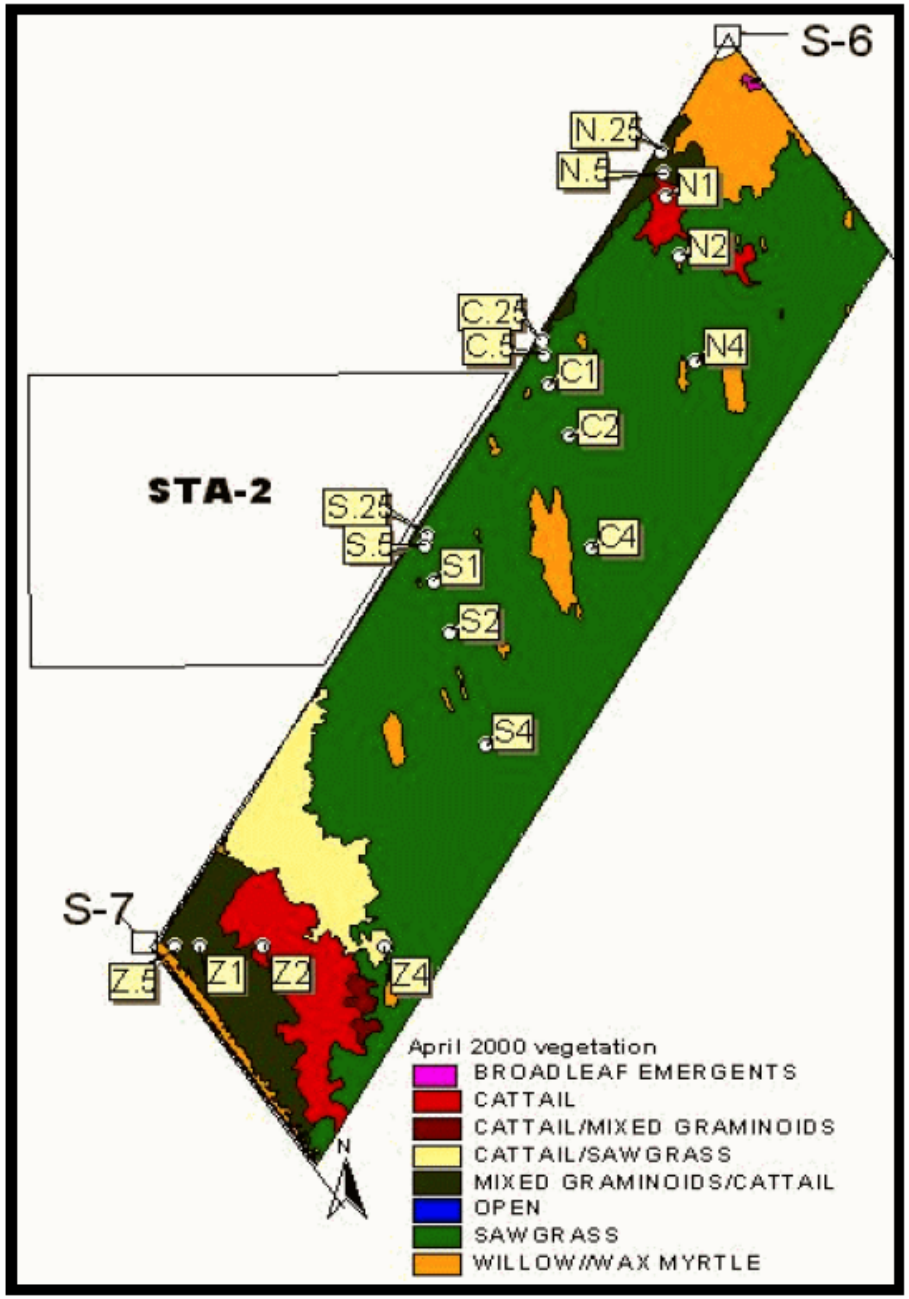
- Intent of both stations was to provide water quality monitoring in the 2-17 stage gage area
- U3 is monitored for Threshold and TP rule
- CA215 is monitored for EVPA
- Water quality results are statistically significantly different
  - TPO4 difference (geomean 5.2 versus 7.6 µg/L)
  - May not be ecologically significant

Recommendation

- Cease all monitoring at CA215

Existing STA-3/4 and STA-2 Discharge Monitoring

Vegetation Map of the WCA-2A Western Marsh



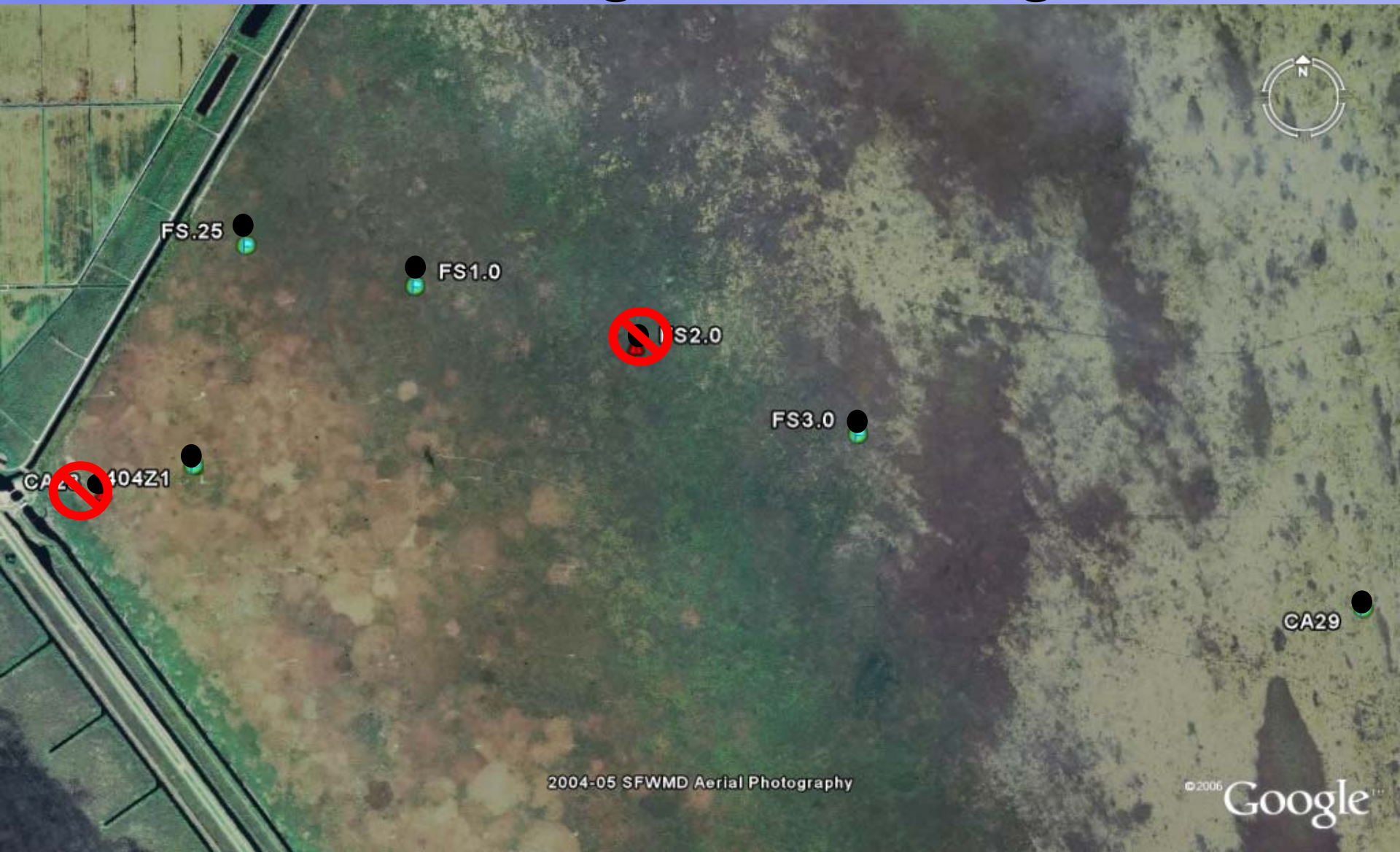
How Do We Reengineer This Area?

- EFA STA-2
  - FS Transect
- TP Rule
  - CA29 (Unimpacted)
  - 404Z1(Impacted)
- Settlement Agreement
  - CA28
  - CA29

Proposed Actions

- EFA STA-2
  (Garrett and Ivanoff 2008 recommendations)
  - FS.25, FS1.0, FS3.0
  - Eliminate FS2.0 as duplicative
- TP Rule
  - 404Z1 (Impacted)
  - CA29 (Unimpacted)
- Settlement Agreement
  - Eliminate CA28 as duplicative of 404Z1
  - CA29

Proposed STA-3/4 and STA-2 Discharge Monitoring



Region Downstream of S7

This area downstream of S7 appears to be insufficiently monitored

Region Downstream of S7 Proposed Monitoring Site

Activation of a new station at an existing stage gauge seems appropriate

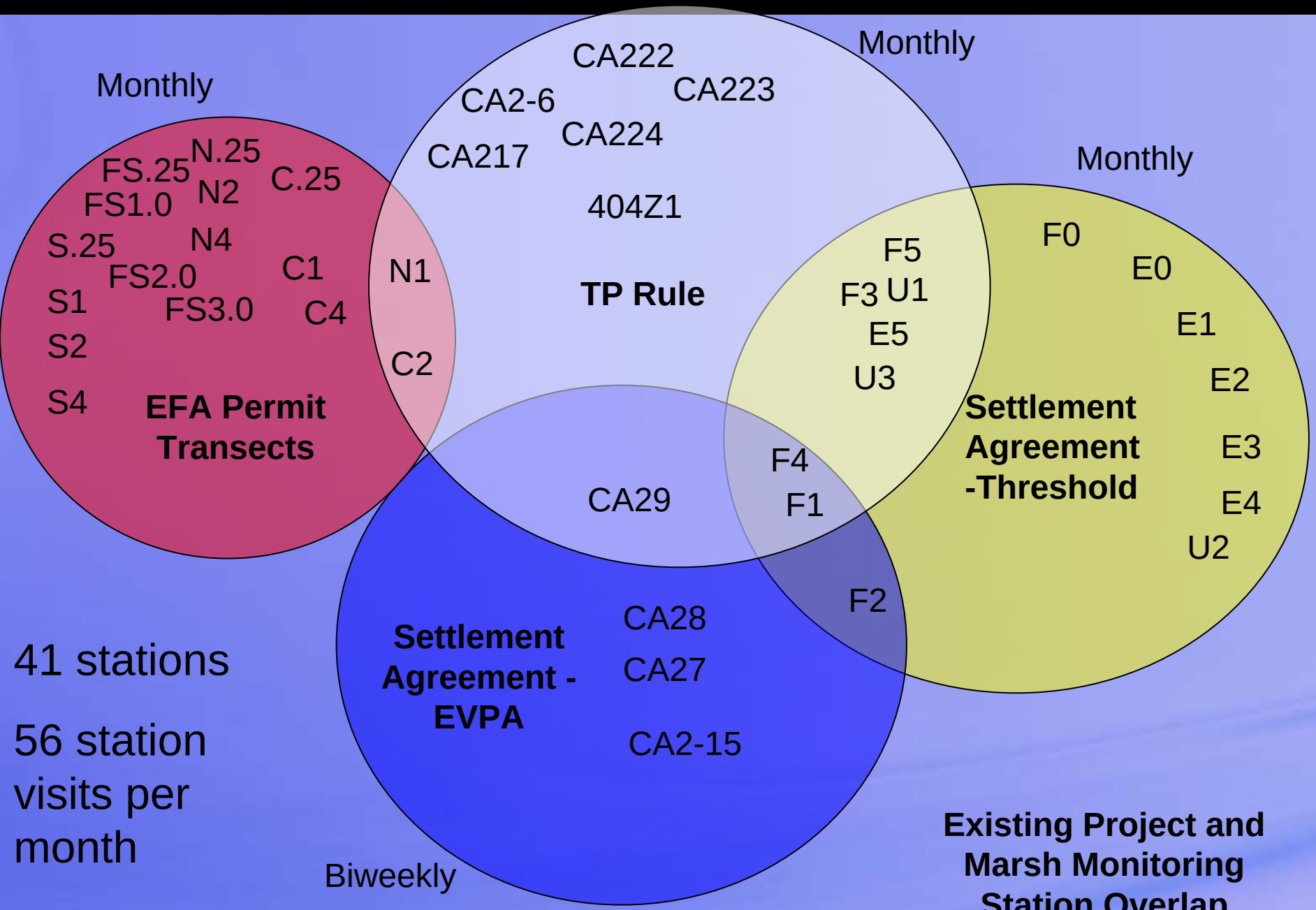
At What Frequency Should Marshes be Monitored?

- Previous analyses have shown that monitoring marshes monthly seems to be optimal for a number of projects
- Recommendation: Modify EVPA stations from biweekly to monthly

EVPA Marsh Monitoring Stations Biweekly to Monthly Frequency

- Standardize all stations to monthly
  - EVPA (7 stations) currently biweekly

Existing WCA-2A Marsh Monitoring Network

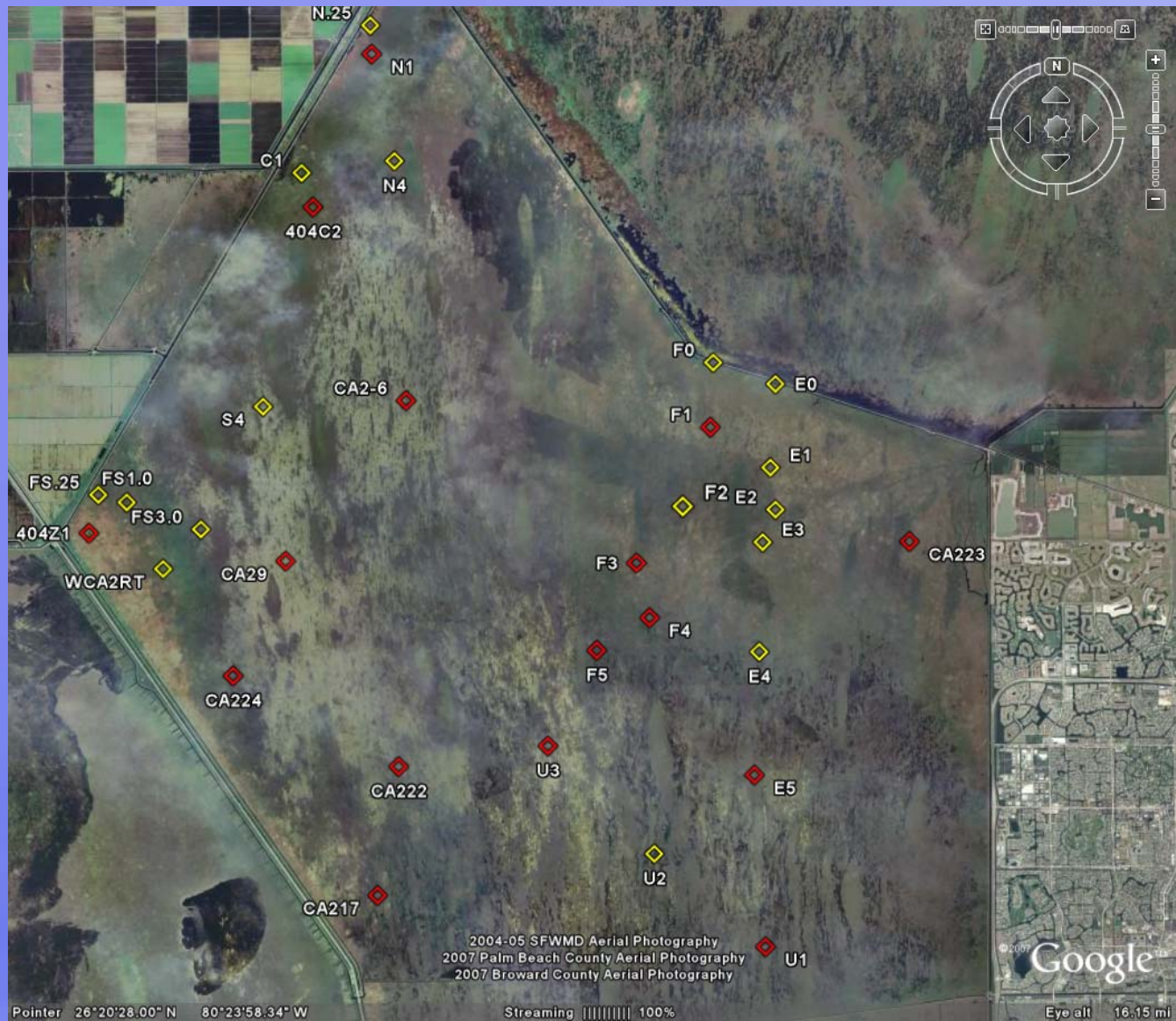


41 stations

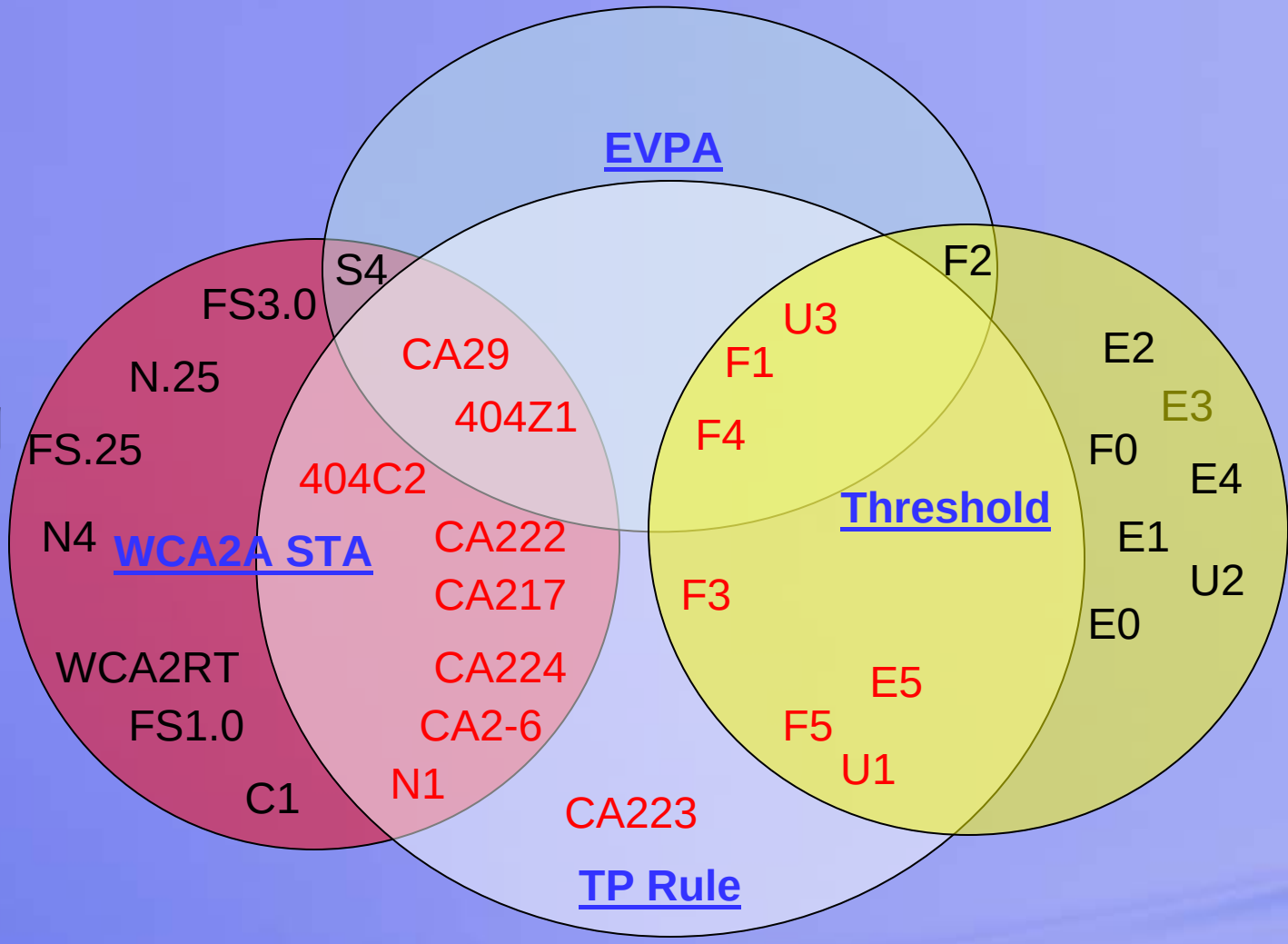
56 station visits per month

Existing Project and Marsh Monitoring Station Overlap Diagram

Proposed WCA-2A Marsh Monitoring Network



Proposed WCA-2A Marsh Monitoring Network



32 Stations

Proposed WCA-2A Integrated Marsh Monitoring

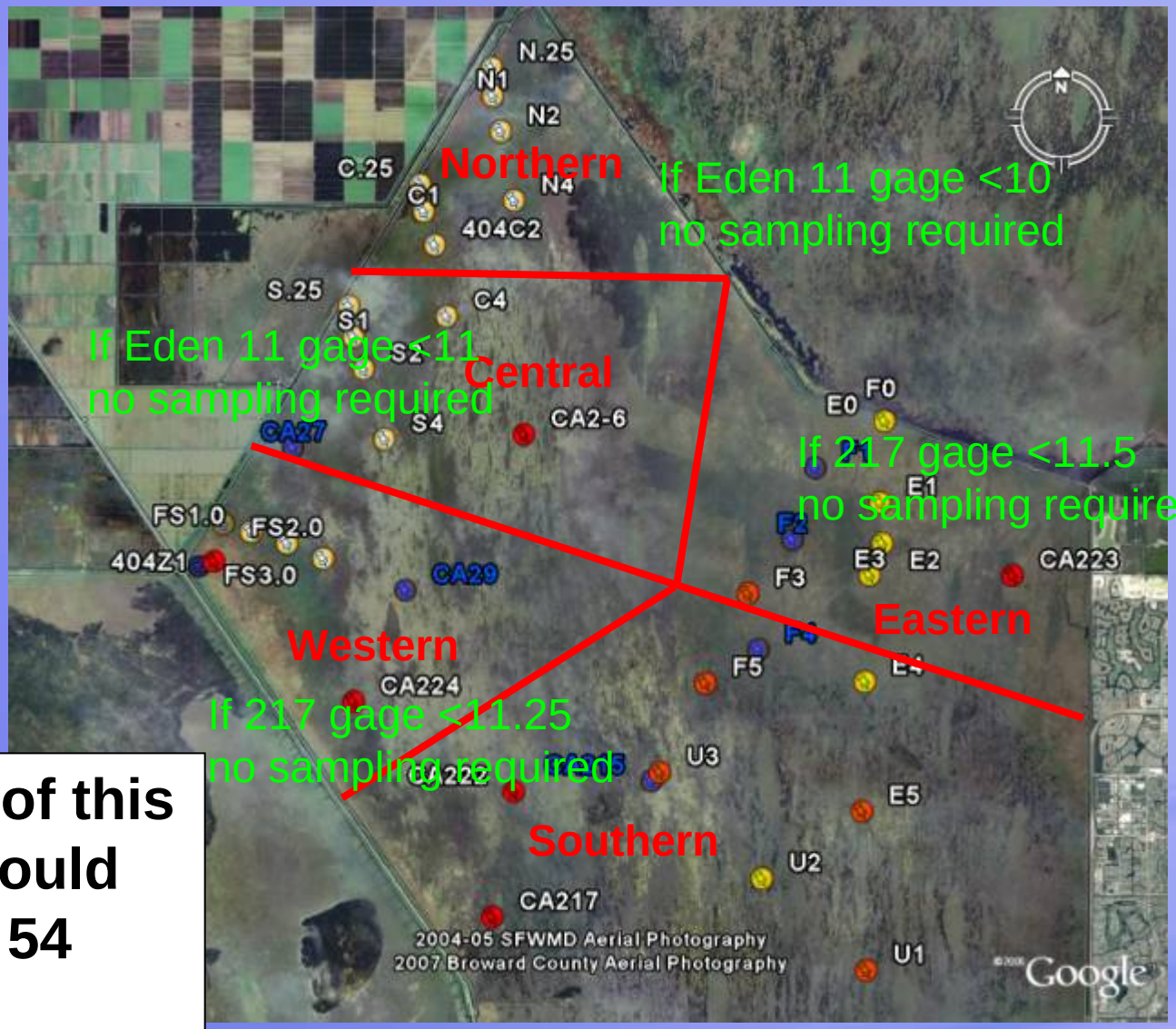
Progress Summary

- Parameter list standardized
- Five structures converted to BWRF/M
- Four structures converted to BWRF
- Three structures converted to WRF/M
- Two structures eliminated
- One structure added on a short term basis
- 15 marsh stations transferred to WQM from Everglades Division eliminating duplicative trips
- Frequency standardized to monthly at seven (7) stations
- Existing stations optimized (10 eliminated)
- New stations added (1)
- No loss of stations for TP Rule or Threshold
- Monthly station visits reduced 43% (56>>32)

What Else Can Be Done to Reengineer Marsh Monitoring?

- Emergency Suspension of Sampling Policy
  - Low Water, Drought and Fire Guidelines
    - If a geographic area is officially closed because of these conditions, then the District will cease monitoring operations in the area
    - The District will develop guidance for relating remote stage readings to water depths and if criteria are met, sampling for a region will be cancelled

Draft Low Water Sampling Suspension Guidelines



Implementation of this policy in 2007 would have eliminated 54 station visits

How Do We Implement?

- Respond to interagency technical input
- TOC approval
  - Modify Settlement Agreement
- FDEP Approval
  - Modify EFA permits
  - Modify Non-ECP permit
- Restructure sampling programs and trips

Implementing Reengineering Changes

- List of changes being proposed:
  - Changes in frequency to incorporate the concept of Recorded Flow
  - Reductions in frequency
  - Elimination of parameters
  - Increases in parameters, no approval needed
  - Increases in frequency, no approval needed

Structure Changes Needing TOC Approval Only

S10A, S10C, S10D, S11B, S11C

- Eliminate Color, NO2, Turbidity

S38B

- Eliminate Color, NO2, Turbidity, Cd, Cu, Zn

Marsh Changes Needing TOC Approval Only

CA28, CA27, CA2-15

- Eliminate all monitoring

F1, F2, F4, and CA29

- Change frequency from biweekly to monthly
- Eliminate Turbidity

Structure Changes Needing TOC and FDEP Approval

Frequency changes at all relevant structures to incorporate RF concept

S11A

- Eliminate Color, NO2, Turbidity

S38, S39

- Eliminate Turbidity

S6, S7

- Eliminate Color, NO2, Turbidity

G338 & G339

- Eliminate all water quality monitoring

Marsh Changes Needing TOC and FDEP Approval

C0.25, C4, N2, S0.25, S1, S2, and FS2.0

- Eliminate all monitoring

A *Win-Win* Scenario

- Recorded flow at structures
  - Reduces station visits and operational efficiencies
  - Retains or increases data
  - Has potential broad application
- Integrated marsh monitoring
  - Reduces stations and increases operational efficiencies
  - Increases and standardizes parameter list, providing more data at key locations

Bottom line: *Generating more essential information for less cost!*

Discussion