

Shark River Slough Water Quality Compliance Evaluation Updated

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Main take away for WY2021

• Regional drivers

- Miami and L67A canals continue to deliver elevated total phosphorus levels towards the Park
- TP flow-weighted mean concentrations are increasing as inputs to the western boundary of WCA3A
- Flow vectors from RSM modeling indicate:
 - eastern WCA3A inputs terminate at the S333 complex and S12D
 - Northwestern WCA3A inputs terminate at S12B and S12C
 - Western WCA3A inputs terminate at S12A

• Local drivers

- When S333_H stage was below 9.2 ft
 - S333s, S12C, and S12D TP concentration ≥ 12 ppb
 - 53% of S333N flow
 - 42% of S333+S333N flow
 - 42% of $S12s+S333s+S355s+(\min(S356, S335))$ combined flow
- Further below 9.2 ft the higher the TP concentration

Regional Drivers

Hydrodynamic

WY2021 spatial flow-weighted mean total phosphorus concentrations

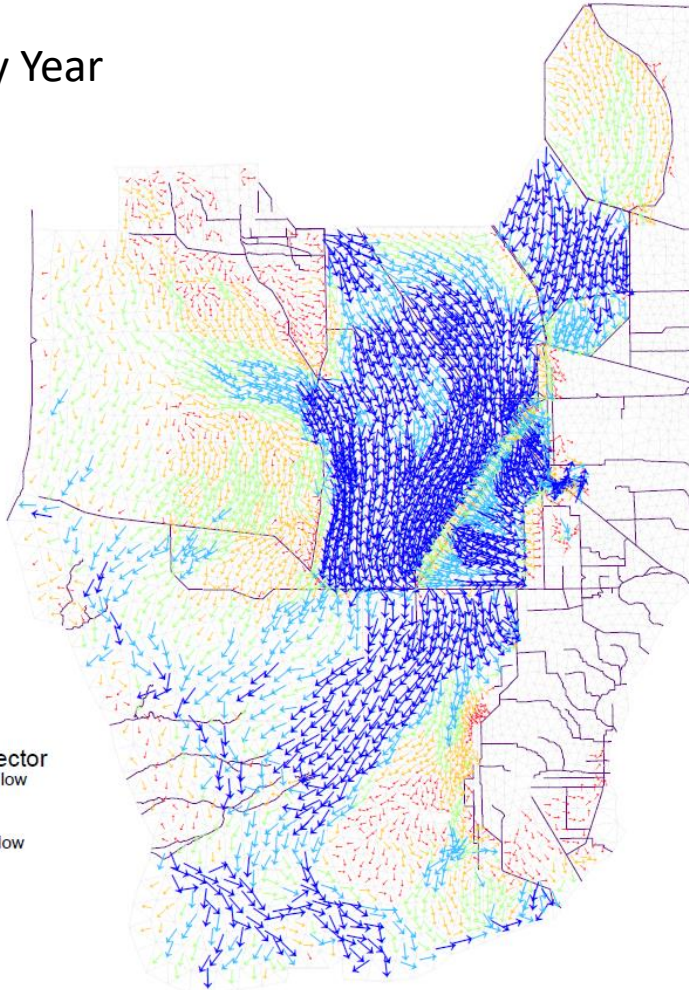
Trends: WY2010 – WY2021; WY = October – September

Regional drivers

Dominant flow patterns based on COP
AltQ in dry, normal, and wet years

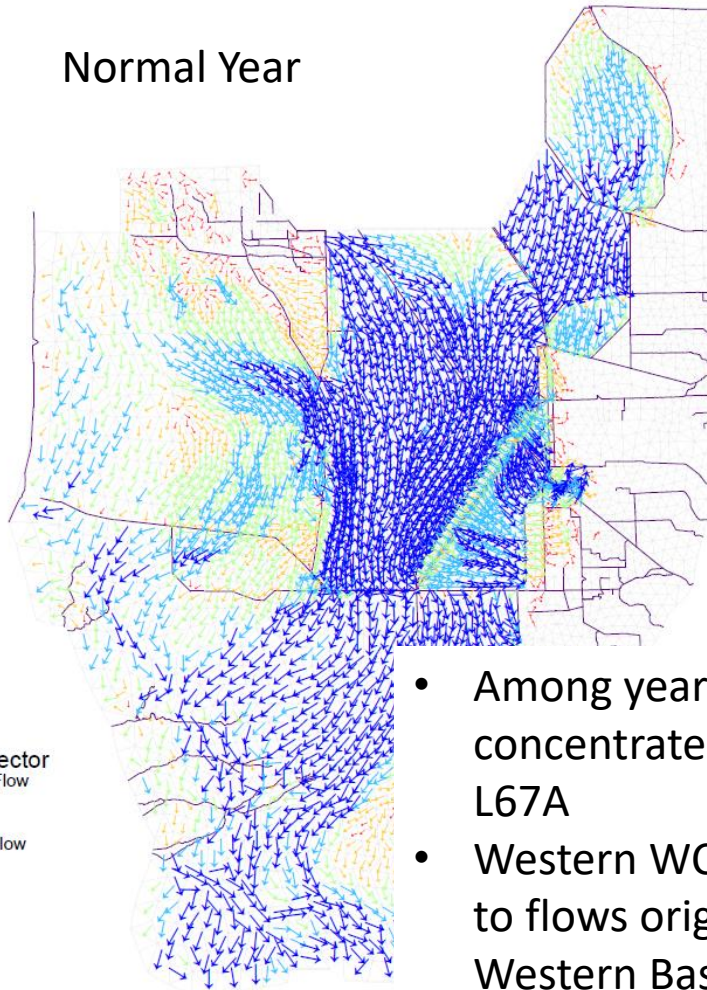
Annual Average Overland Vector
1993

Dry Year



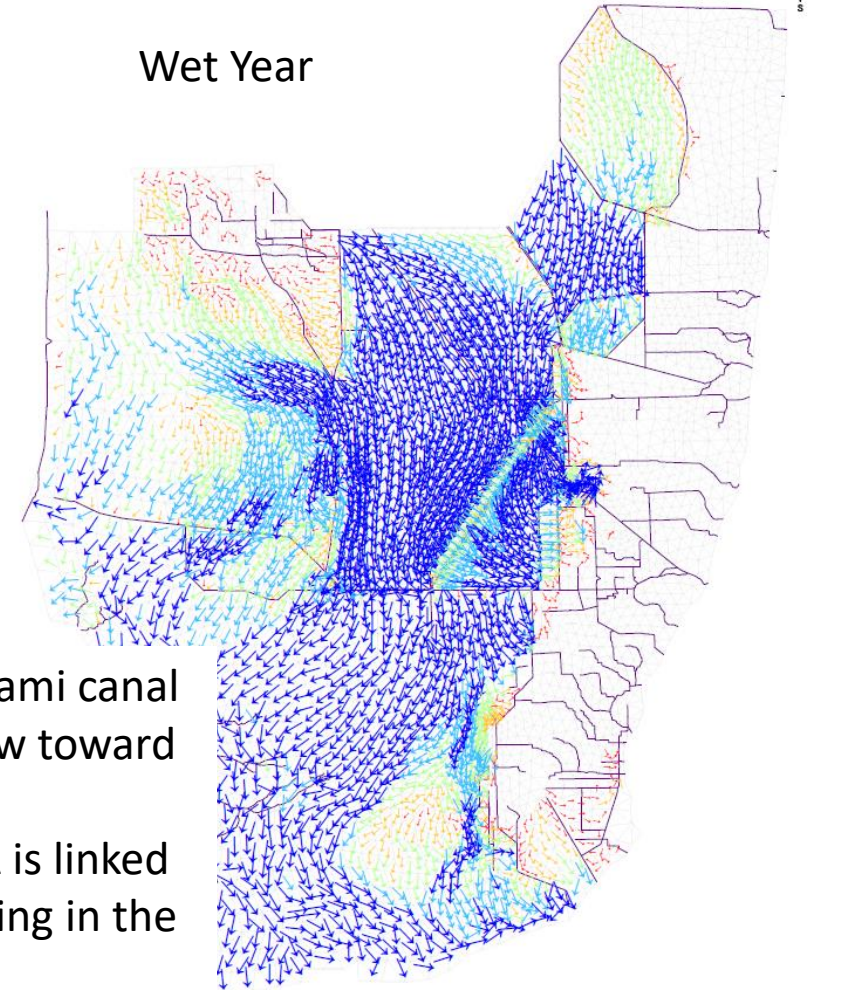
Annual Average Overland Vector
1994

Normal Year

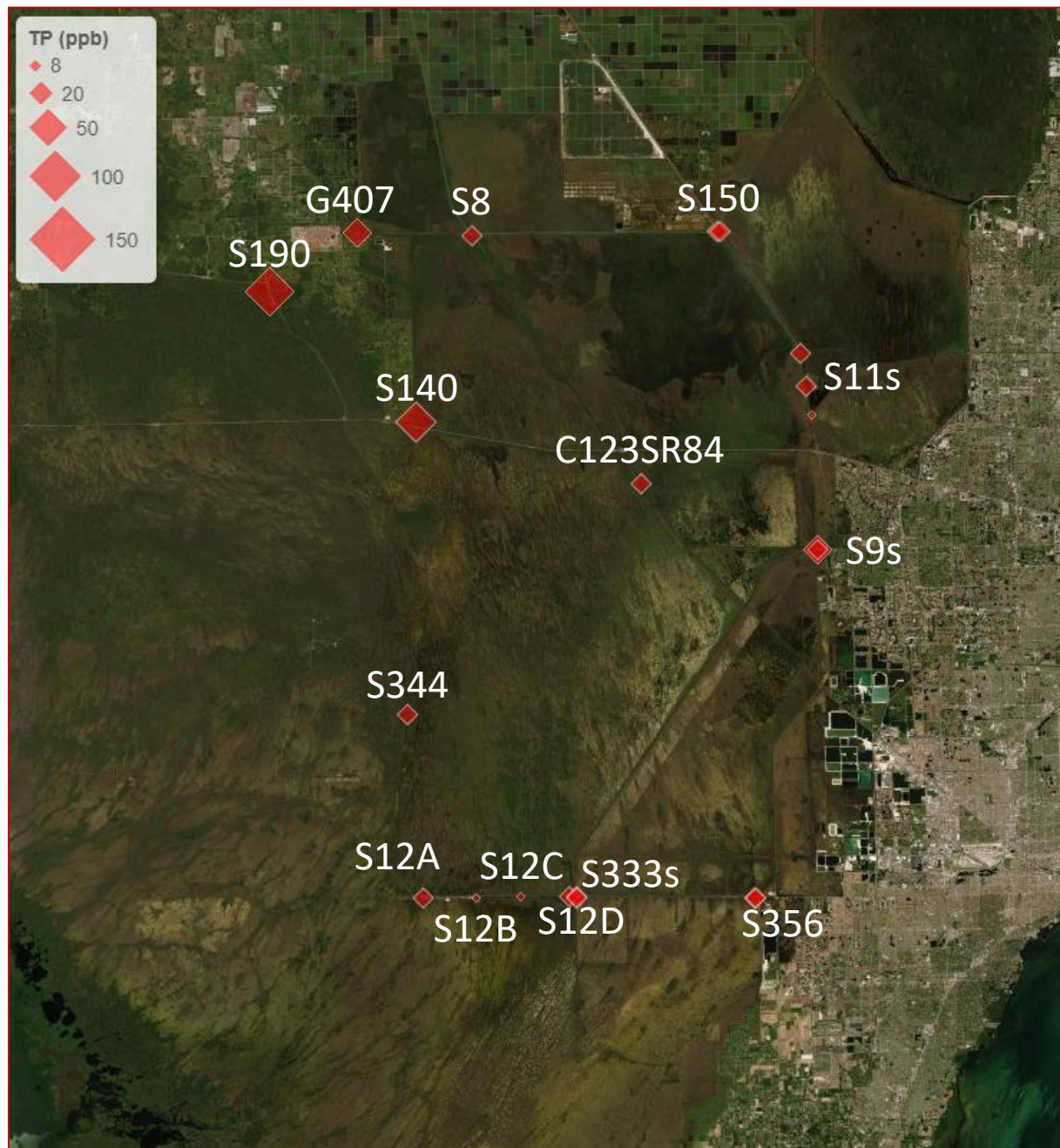


Annual Average Overland Vector
1995

Wet Year



- Among years Miami canal concentrates flow toward L67A
- Western WCA3A is linked to flows originating in the Western Basins



WY2021 – TP FWM concentrations

Station	DBKey	Flow (ac-ft)	Load (kg)	FWM (ppb)
G407	91192	14.6	0.8	47.3
S190	91428	97,178.3	15,582.7	130.0
S140	91384	131,284.8	11,781.7	72.8
S344	91504	47,351.5	629.8	10.8
S8	15040	387,889.7	8,035.3	16.8
S150	15041	8,603.3	163.4	15.4
S11C	15260	250,002.6	2,663.8	8.6
S11B	15259	304,185.1	3,120.9	8.3
S11A	15258	315,869.8	2,946.6	7.6
C123SR84	91500	59,445.6	1,028.6	14
S9	K5483	244,954.5	7,212.9	23.9
S9A	91692	37,049.1	884.2	19.3
S12A	01313	186,811.4	3,253.0	14.1
S12B	00610	189,547.8	1,187.3	5.1
S12C	00621	310,505.7	2,142.9	5.6
S12D	01310	493,747.8	4,991.2	8.2
S333	91487	179,938.5	2,475.7	11.1
S333N	40371	309,444.9	7,386.7	19.4
S356	64136	170,717.8	1,804.9	8.6

- Daily grab samples interpolated; auto samples extend max 10 days; auto samples primary
- Daily loads calculated
- Loads and flows summed to WY
- FWM calculated from WY loads and flows

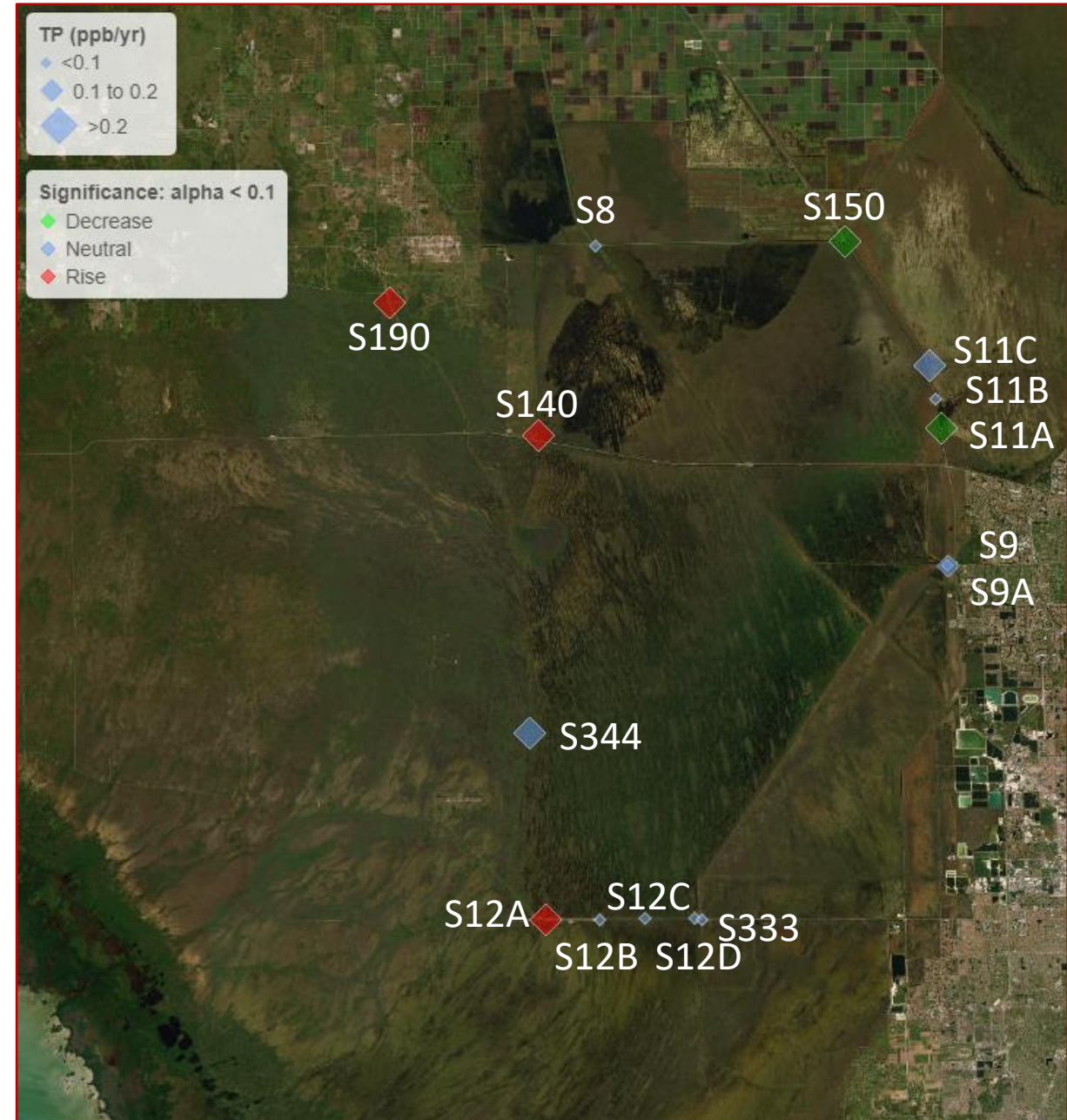


Seasonal Kendall Trends



Station	Tau Trend Strength	Slope (ppb/yr)	p-value
S11A	-0.312	-0.288	0.0186
S11B	-0.048	-0.03422	0.7198
S11C	-0.232	-0.2029	0.1024
S12A	0.239	0.2209	0.0996
S12B	-0.088	-0.06049	0.4576
S12C	-0.078	-0.07043	0.4777
S12D	-0.044	-0.03341	0.6324
S140	0.239	1.4	0.0424
S150	-0.368	-0.3334	0.0211
S190	0.311	2.359	0.0208
S333	0.05	0.0729	0.4694
S344	0.214	0.4055	0.2797
S8	-0.062	-0.09972	0.633
S9	0.076	0.05943	0.356
S9A	0.149	0.1162	0.1856

- WY2010-WY2021
- Based on monthly flow-weighted mean concentration for available data across the period of record
- Some records are imperfect, but the test is robust for missing data
- S11B, S11C, S150, S344 begin after Oct 2009, but include more than 10 years of data (limiting test assumption)
- Evaluated with USGS Kendall.exe Seasonal Kendall package





Local Drivers

Water levels - magnitude below 9.2 ft

Flow conditions – flow rates and volumes under 9.2 ft stage

Water quality response – Total suspended solids and total phosphorus under 9.2 ft stage

Appendix A compliance

• Shark River Slough Compliance since WY2006

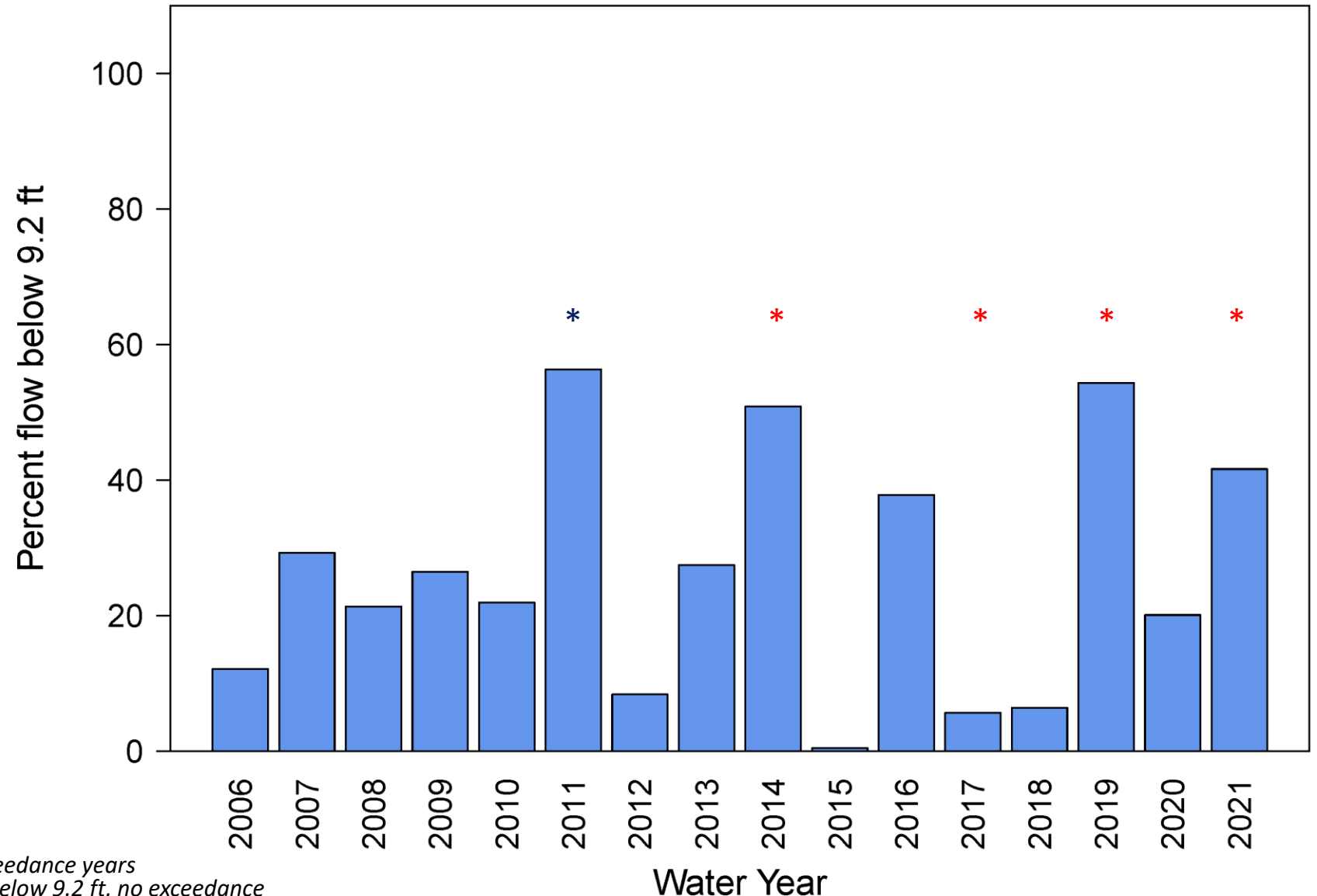
Percent S333s water delivered below 9.2 ft at S333 headwater

Compliant:

- WY2013: 27%
- WY2015: 1%
- WY2016: 38%
- WY2018: 6%
- WY2011: 56% - S333 routed around SRS

Failed compliance:

- WY2014: 51%
- WY2017: 6%; drought
- WY2019: 54%
- WY2021: 42%



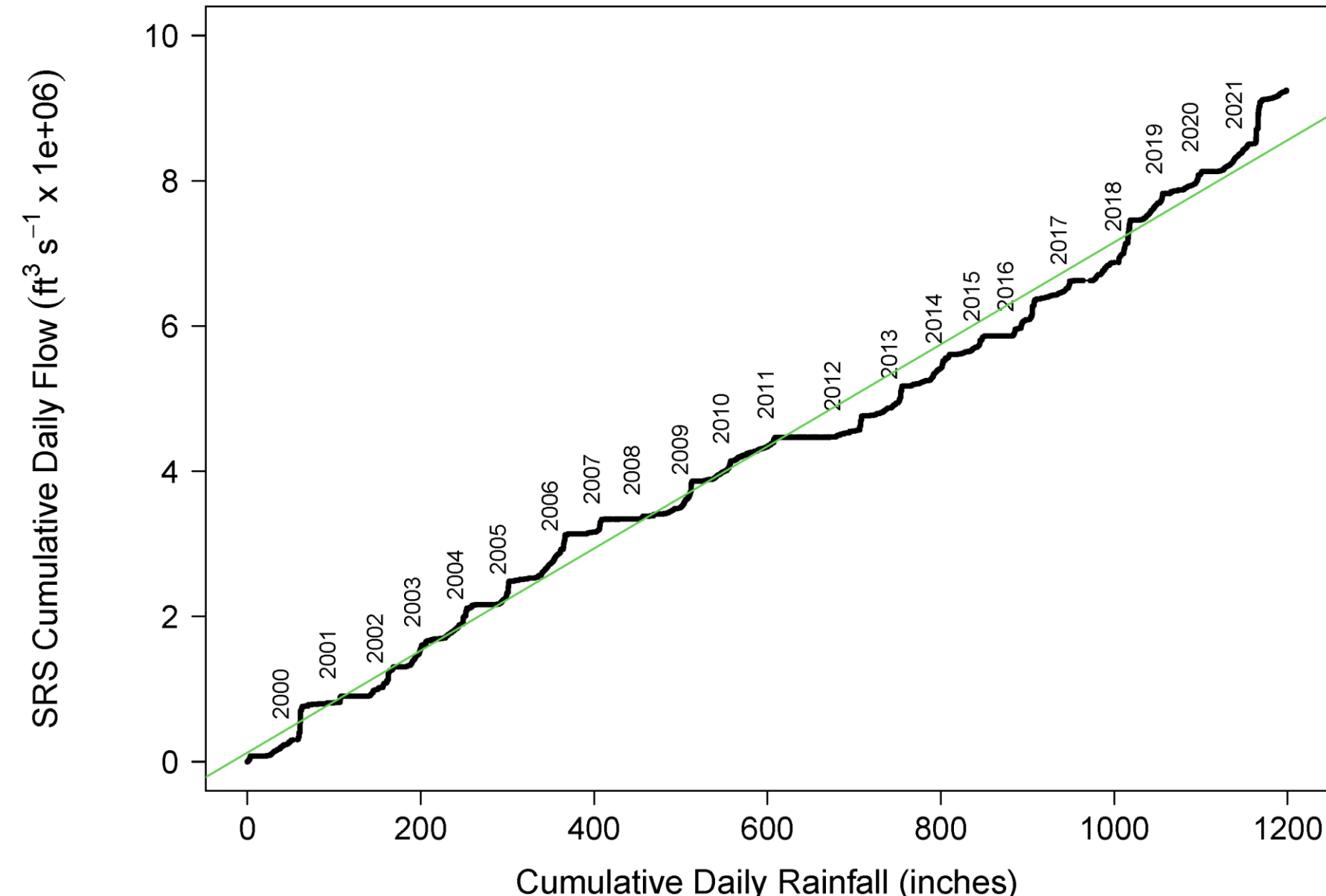
Updated`

* Recent exceedance years

* High flow below 9.2 ft, no exceedance

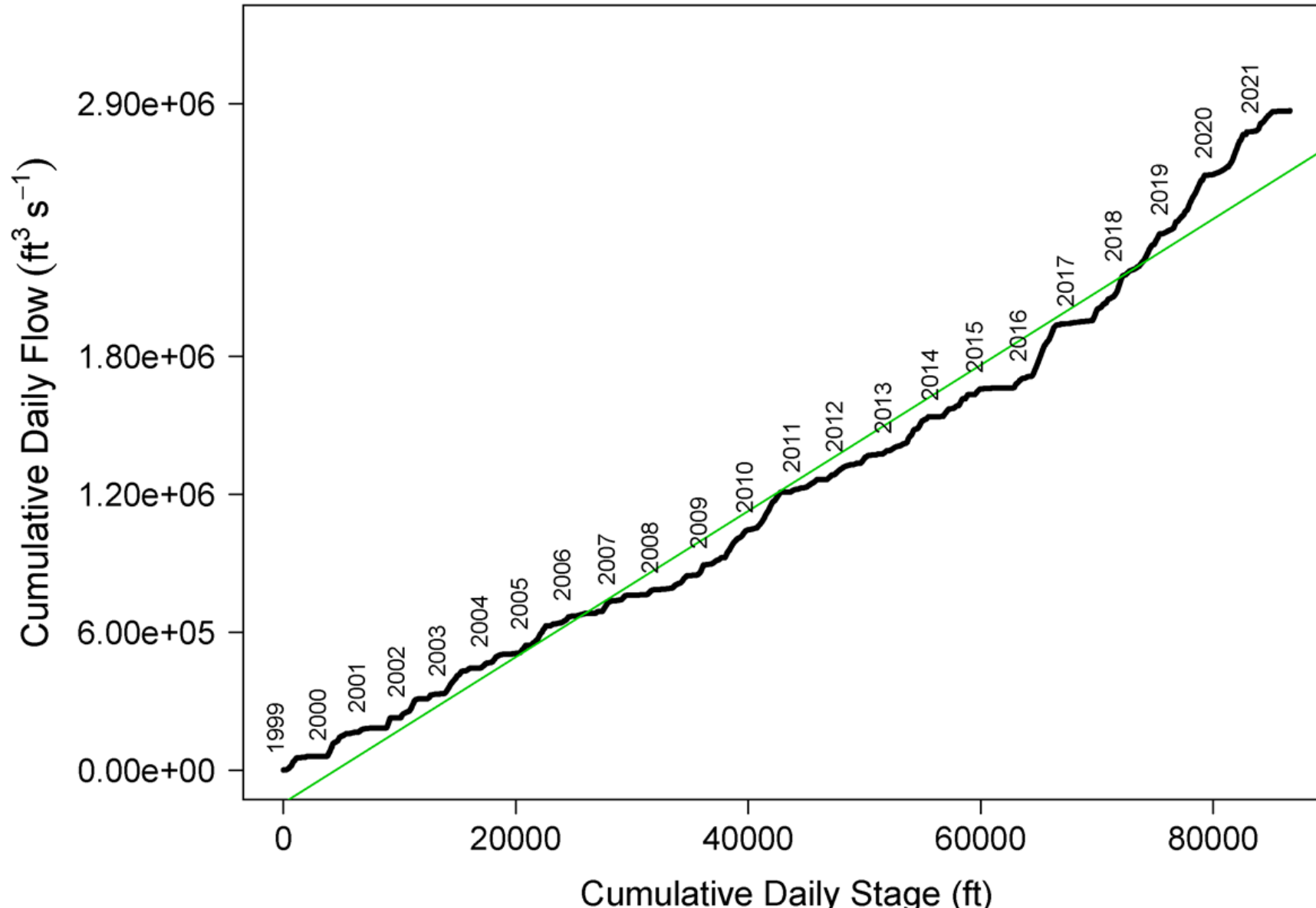


Hydrologic conditions



- Daily rain to WCA3A outpaced SRS daily flows in drought periods:
 - WY2007 – WY2008;
WY2011 - WY2012
- Daily flows to SRS outpaced rainfall in WY2021

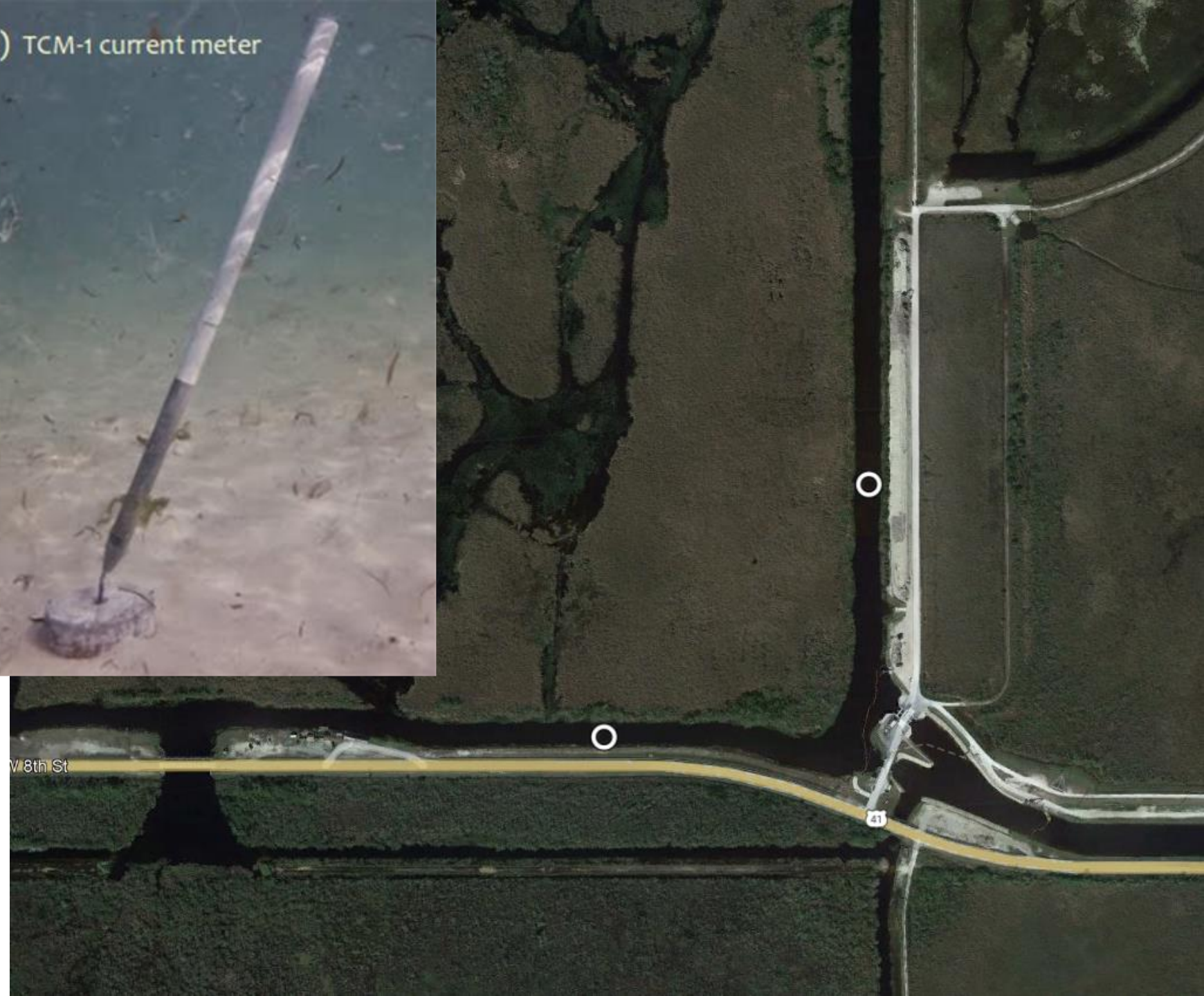
Hydrologic conditions



- Daily flows to SRS out paced daily stage at S333 in WY2021
- Coupled with increased flows relative to rain management operations had a strong influence on water delivered to SRS in WY2021

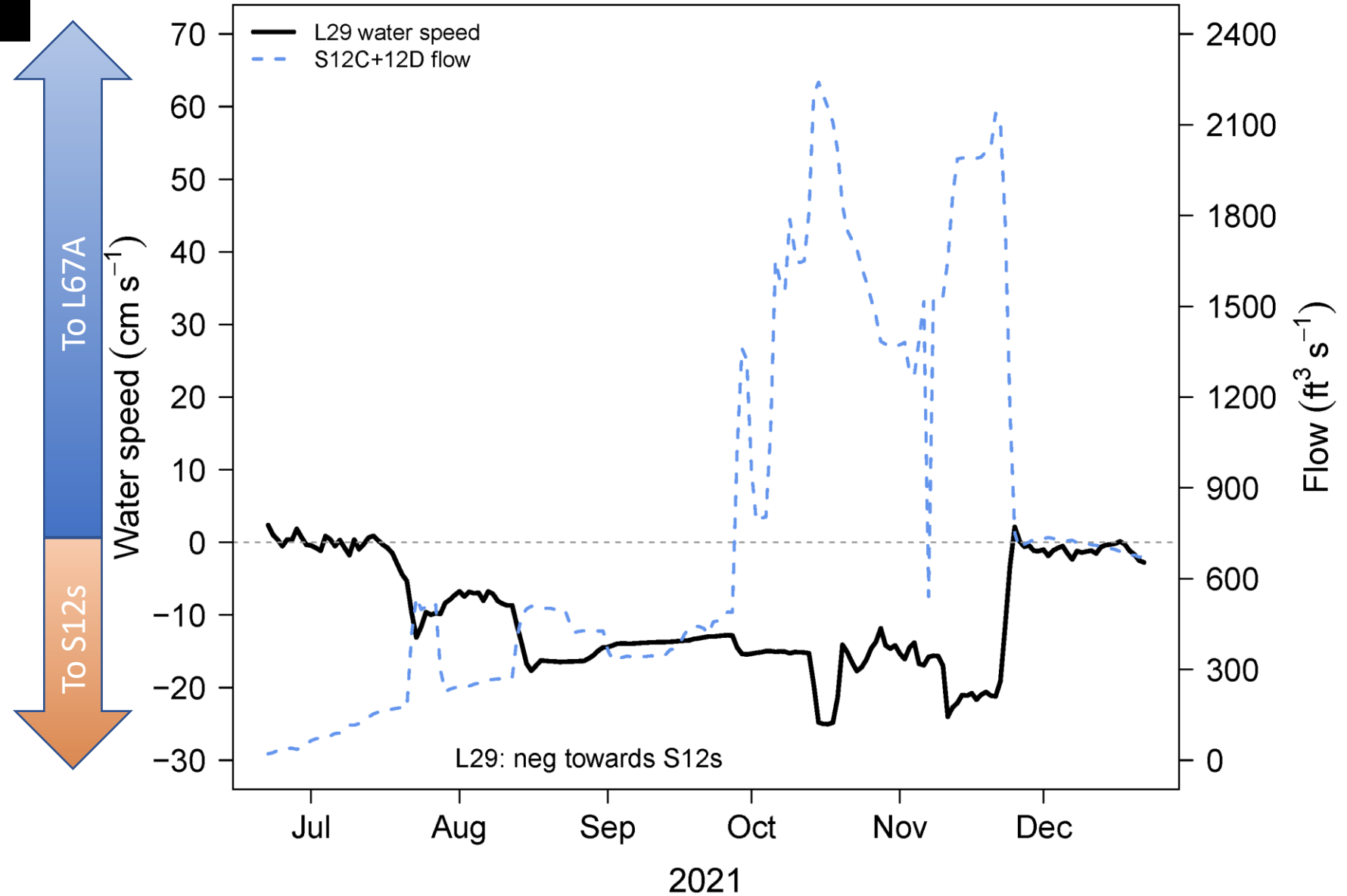
Flow dynamics

- Tilt Current Meter situated 1000 ft upstream of S333 on L67A and L29 canals
- Collected data from Jun 22 – Dec 22, 2021



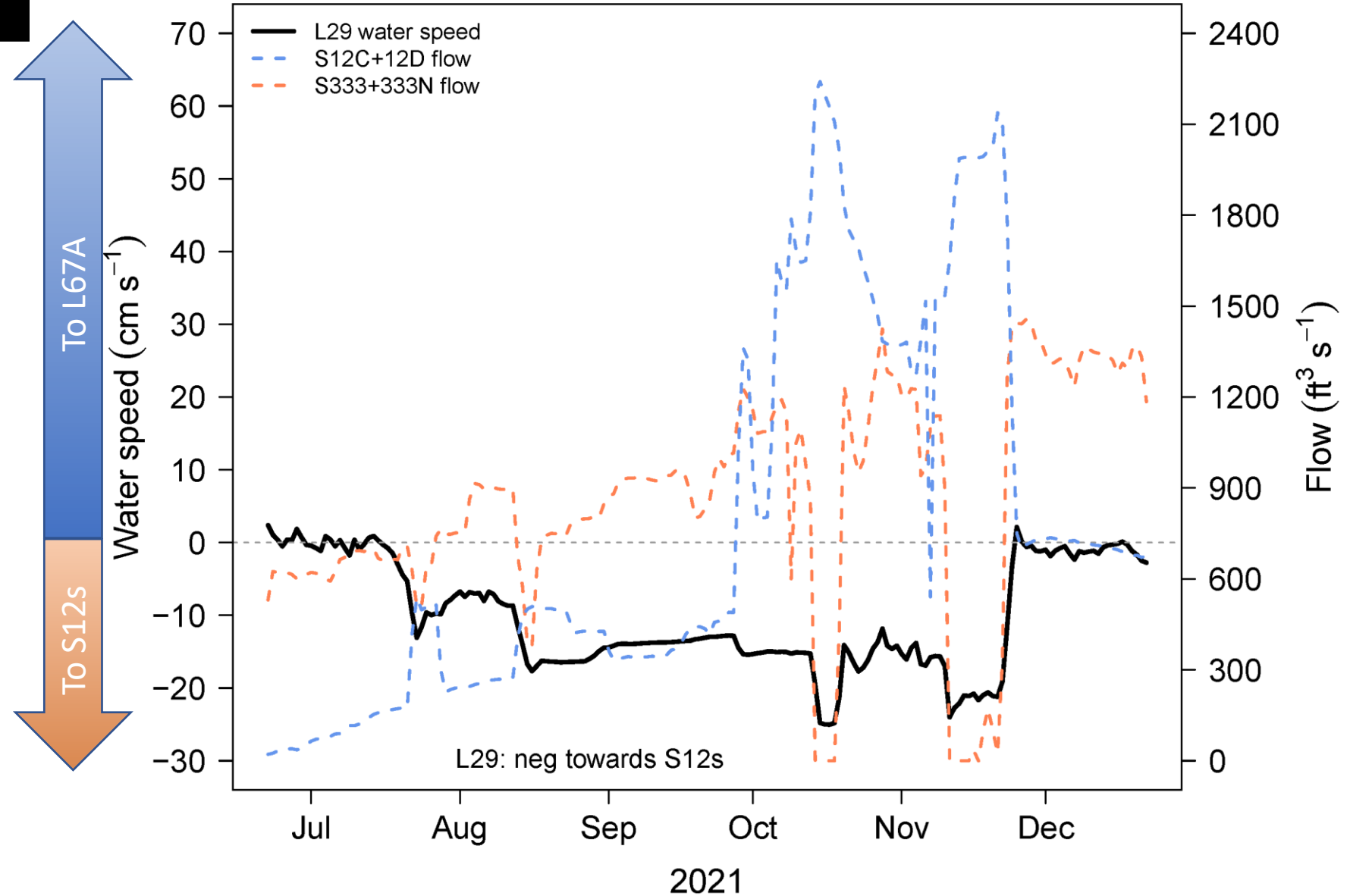
Flow dynamics

- Tilt Current Meter readings (L29) indicates that for most available period flows moved from L67A towards the S12s even when the S333 complex was open
- TCM readings show correlation with S12D and S12C flows



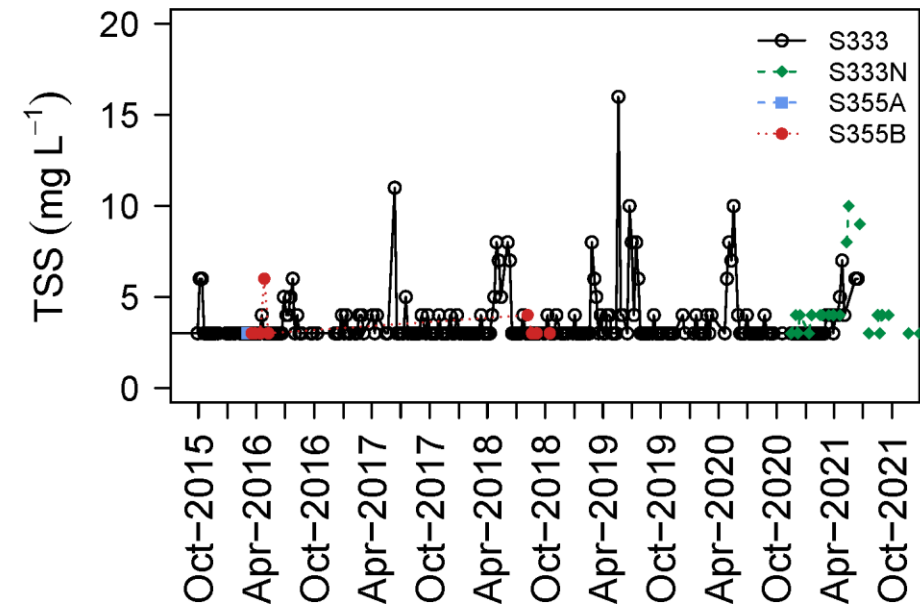
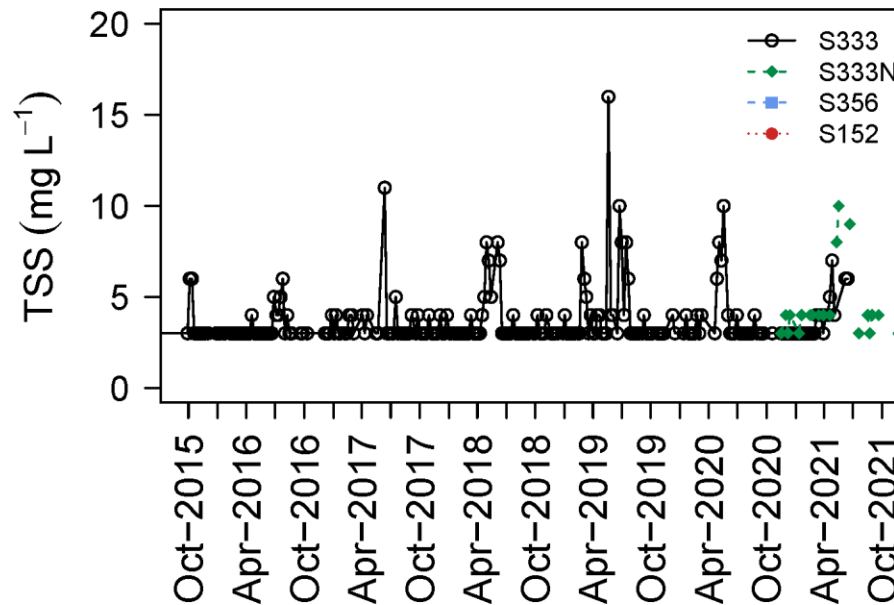
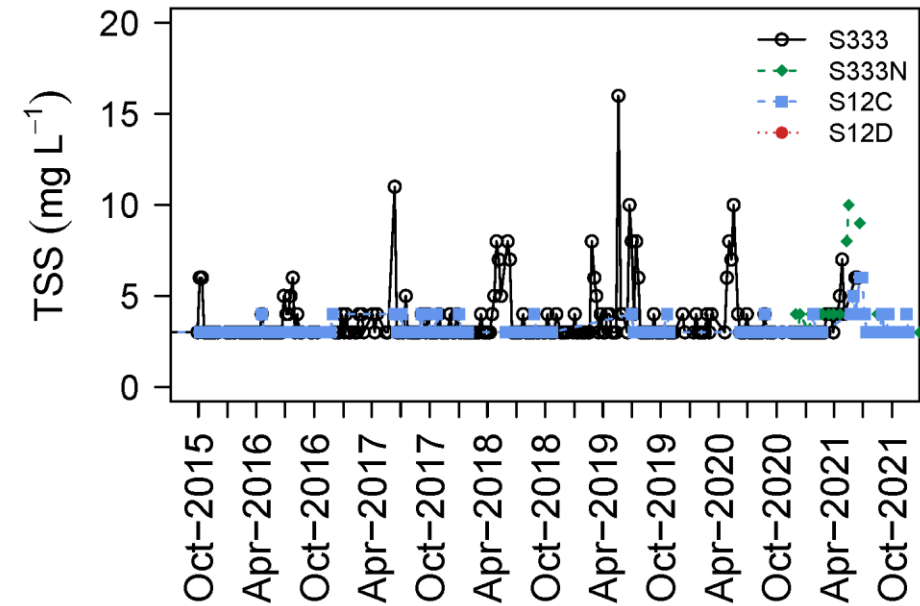
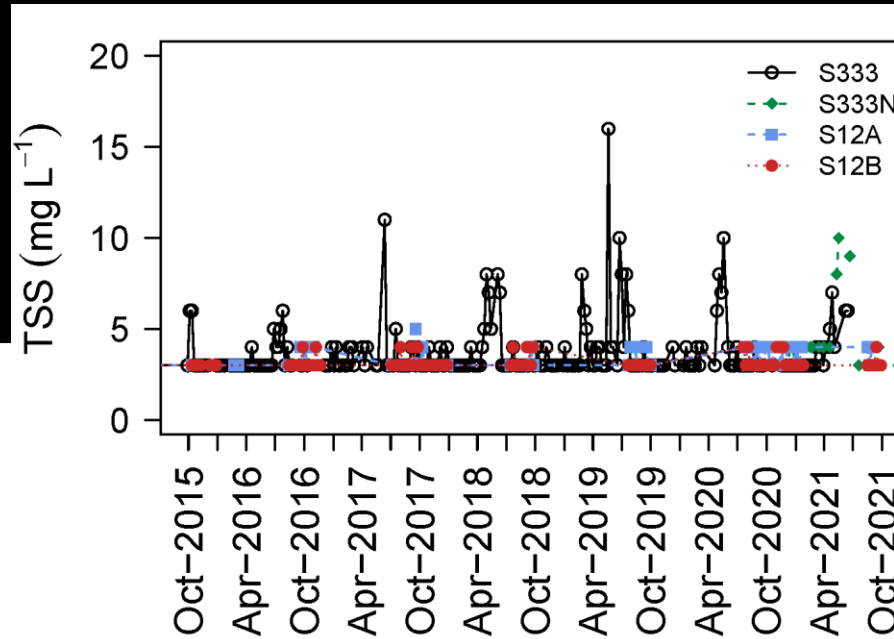
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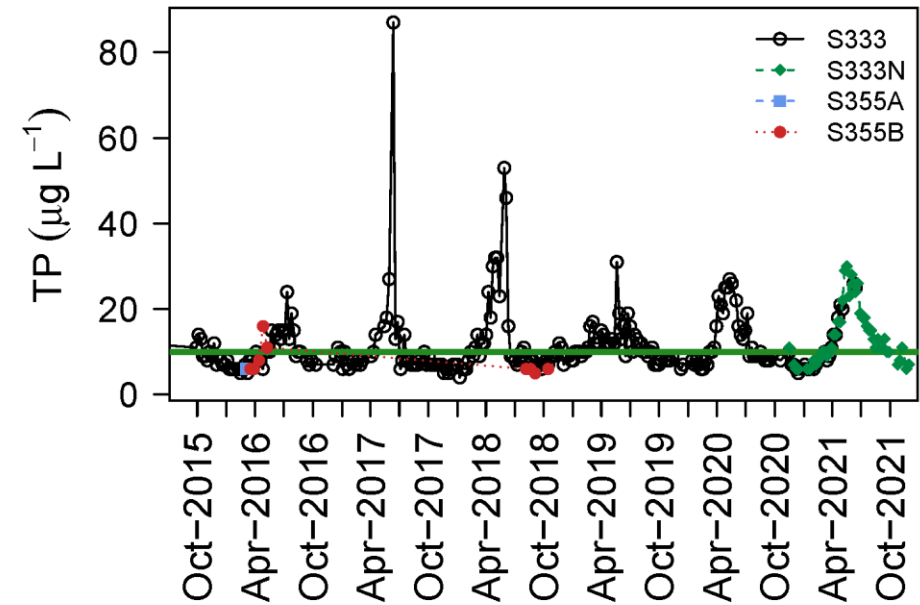
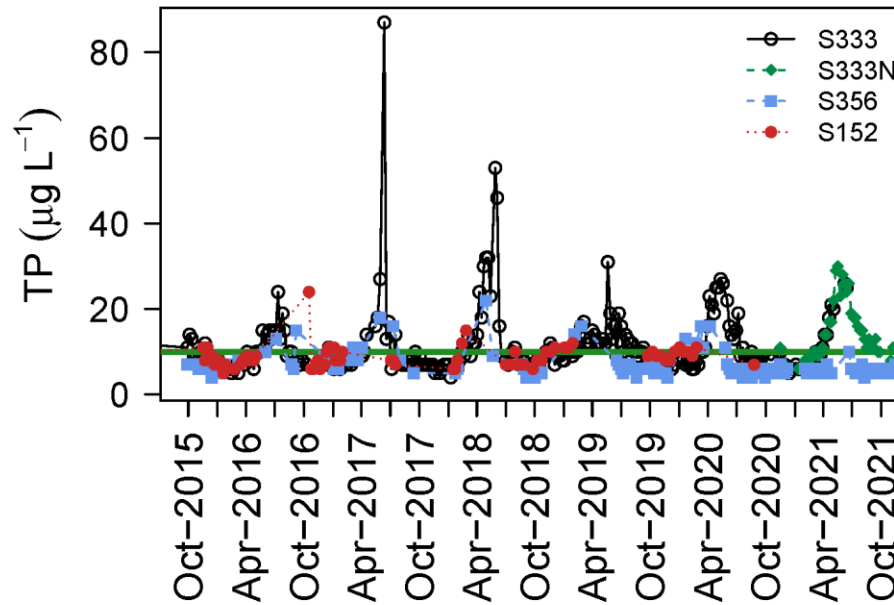
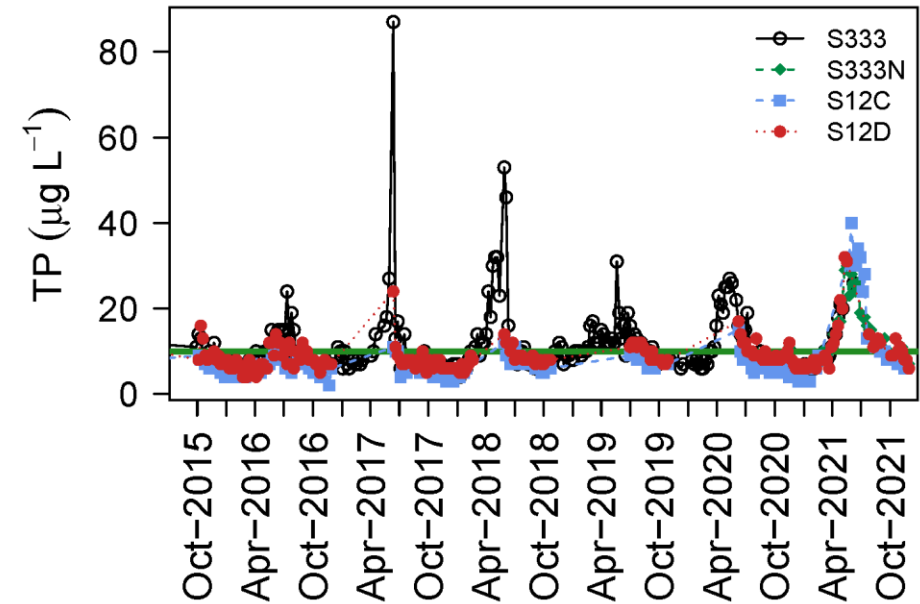
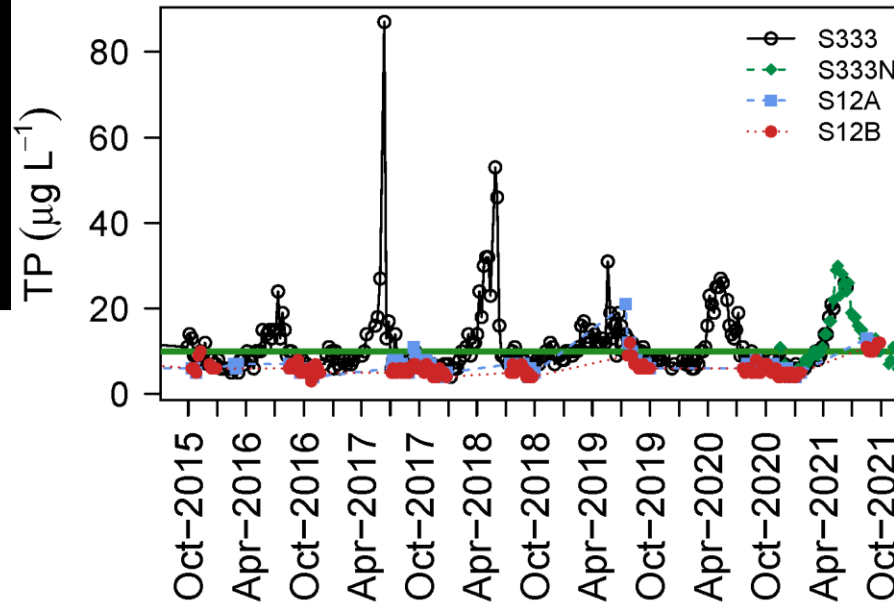
TSS and hydrologic nexus

- **TSS concentrations when flowing**
- S12C consistently above MDL in Jun 2021
- Concentrations at S333 and S333N increase above MDL during low water events



TP and hydrologic nexus

- **TP concentration when flowing**
- S12C and S12D increased above S333 and S333N concentration from May 24 – Jul 12 2021
- Some flow during this time was delivered to the S12C and S12D due to hydrologic restriction on flow through the S333s and construction activity (old Tamiami Trail removal)



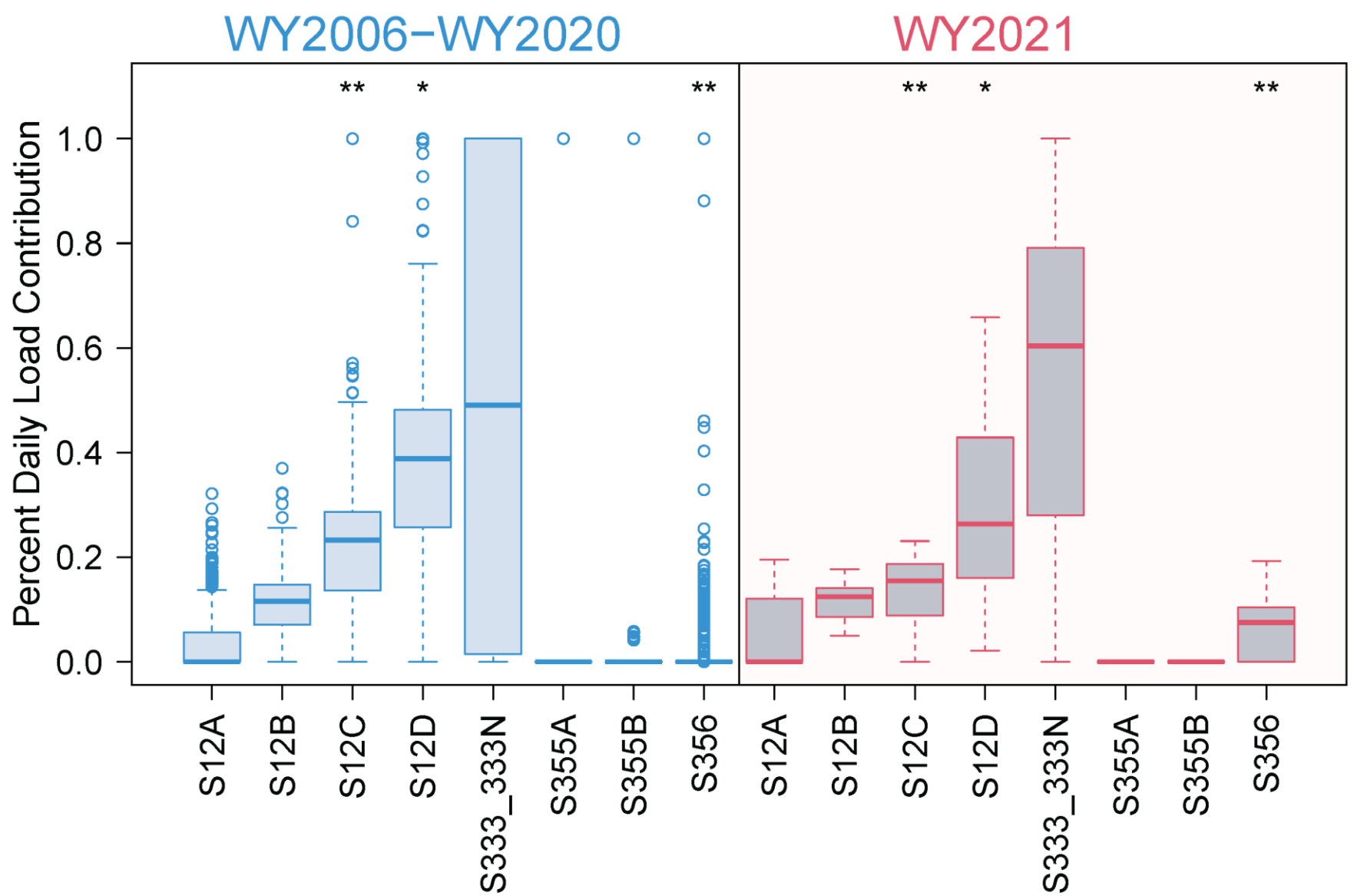
Structure
contribution to event
total phosphorus
load

Daily calculation:
S12s + [S333 + S355A +
S355B + minimum (S356,
S335) - S334]

$Load_{Qi*Ci} = \sum Q_{S,i} * C_{S,i}$
S = structure
i = day

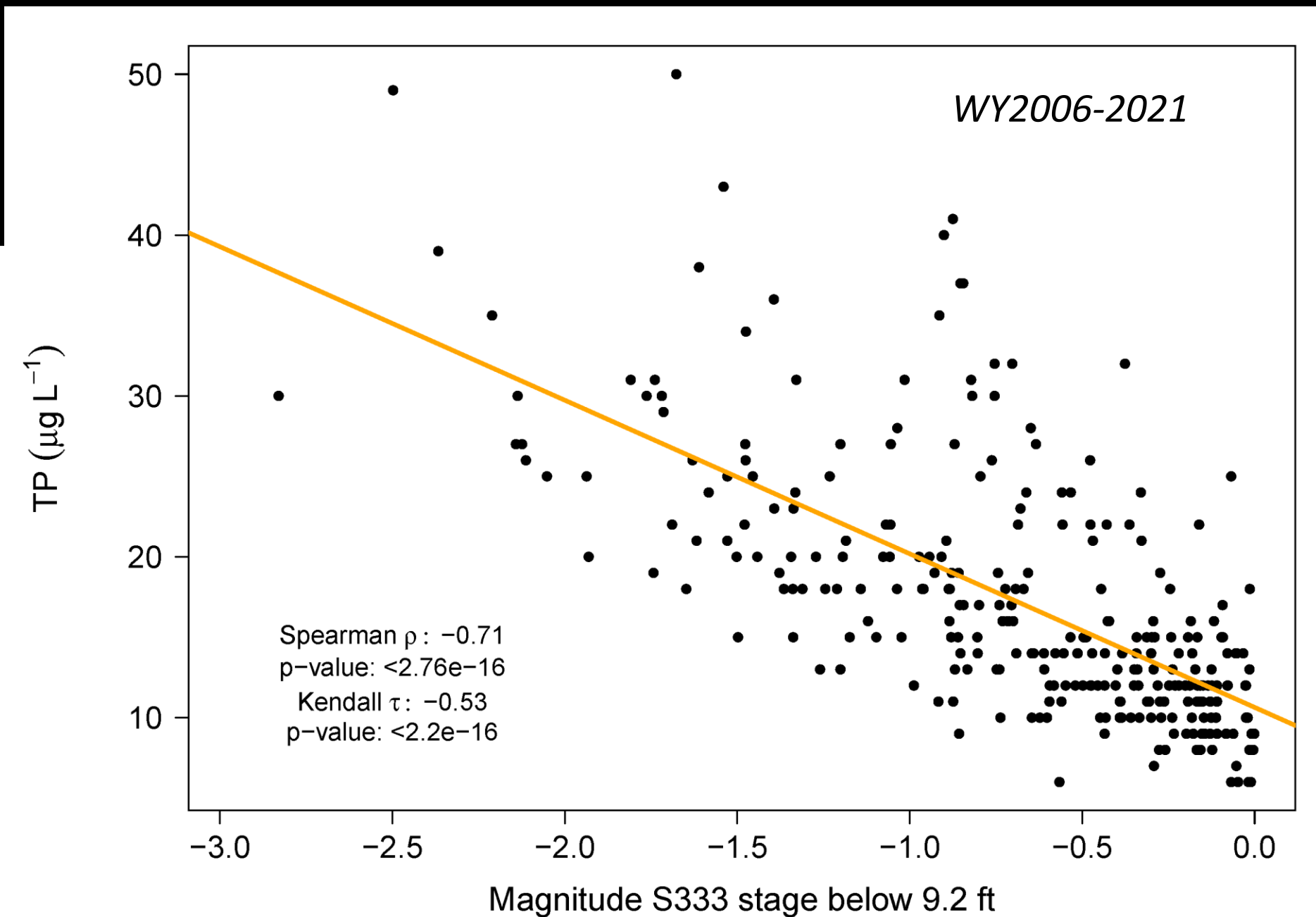
Daily Contribution =
 $load_{S,i} / Load_{Qi*Ci}$

Q = flow
C = concentration



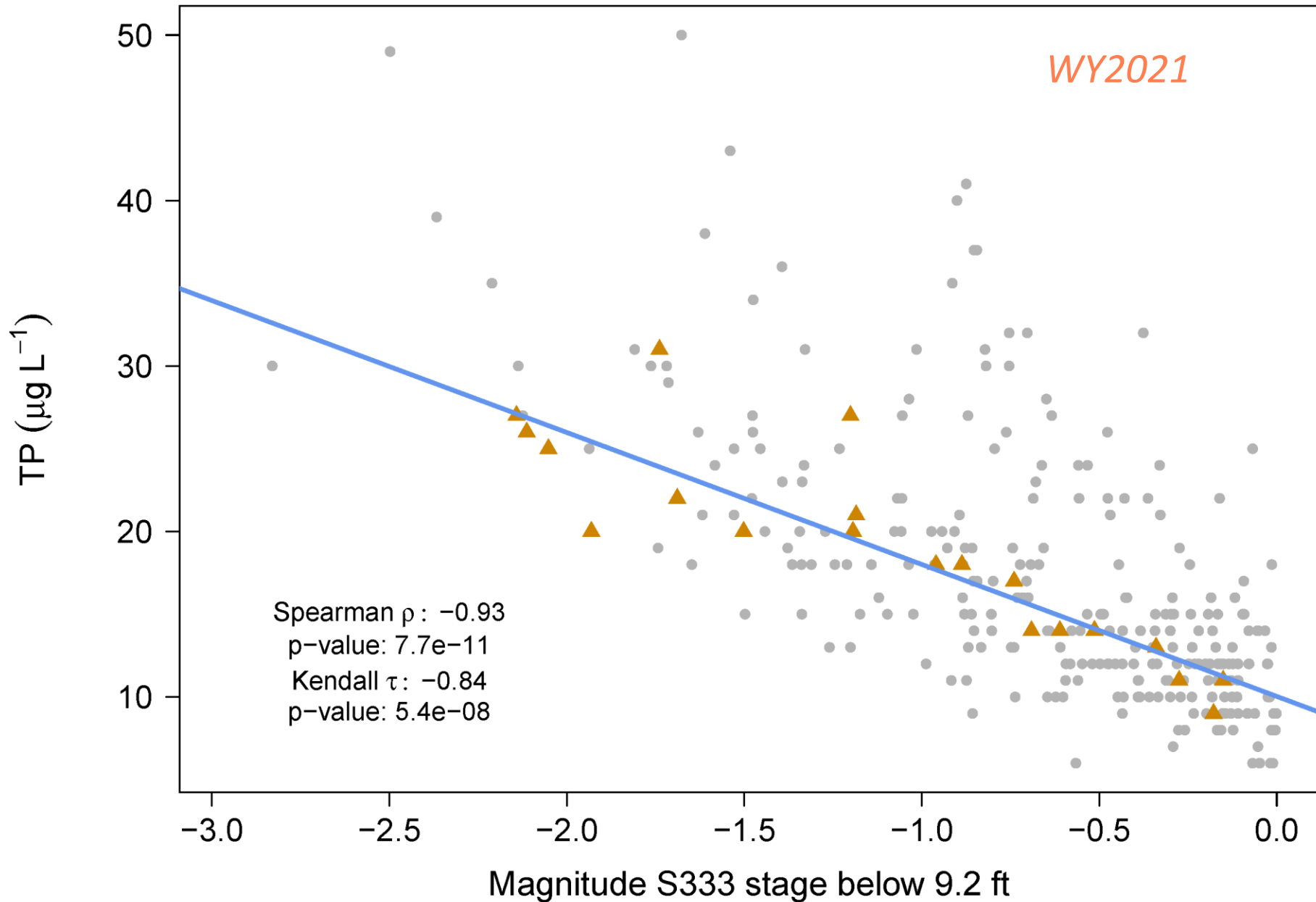
TP and hydrologic nexus

Magnitude of stage (difference between observed S333 stage and 9.2 ft) below 9.2 ft is related to increasing TP



TP and hydrologic nexus

Magnitude of stage (difference between observed S333 stage and 9.2 ft) below 9.2 ft is related to increasing TP



Summary



- WY2021 compliance for Shark River Slough
 - Regional
 - Miami canal and S9 are still delivering elevated levels of TP concentrations to the Shark River Slough
 - TP flow-weighted mean concentrations are increasing as inputs to the western WCA3A boundary
 - Flow vectors indicate WCA3A input connectivity to Shark River Slough inflows
 - Local
 - TP concentration at S12D and S333s began above 8 ppb
 - More than 40% of the annual flow occurred under 9.2 ft at S333 headwater
 - Most past years a larger fraction of this water was routed to South Dade or not delivered
 - WY2021 much of this water was incorporated in compliance determination
 - TP concentrations at S12C, S12D, and S333s were ≥ 12 ppb
 - Dominant contributor to Shark River Slough total loads remains S333 complex
 - Related to low water stage operations
 - Relative to long-term record S12C and S12D WY2021 contributions were reduced

The Ask

- Continue implementing long-term solutions (e.g., Restoration Strategies)
- Continue the Sediment Characterization and Hydrodynamic studies to inform paths forward
- Evaluate water quality Adaptive Management strategies within CEPP 1.0