Evaluation of groundwater and phosphorus transport in fractured altered wetland soils

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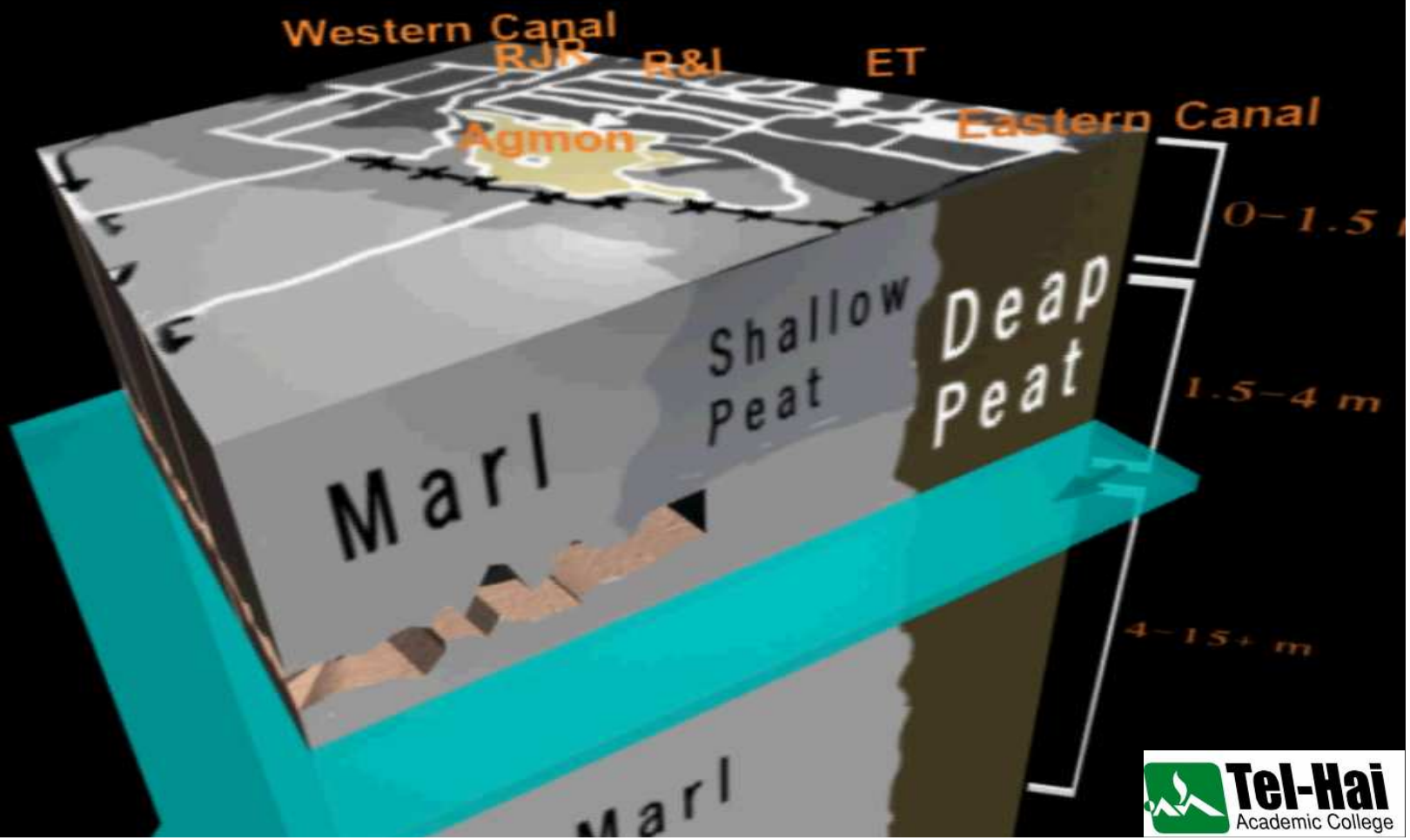


Lake Kinneret basin

P and nutrient transport from The Hula Valley

The Hula Valley is an agricultural area located upstream of lake Kinneret which supplies 30% of Israels portable water

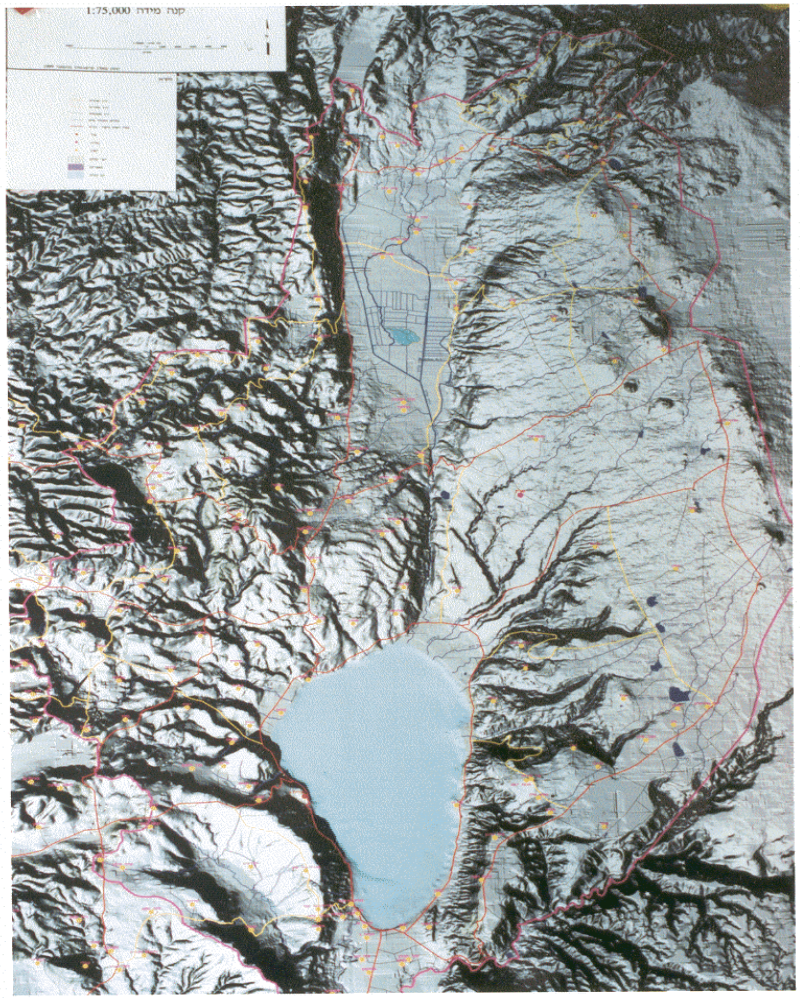
The Hula Swamps were drained during the 50's. The valley was re-flooded in the early 90's as part of a large remediation project.

In the late 90's P loads from the Hula valley to the Jordan River (JR) were increased.

Near surface groundwater in agricultural fields leads to P release to pore water.

Up to date no transport mechanism was envisioned to explain P, N & S transport from these East Mediterranean altered wetland soils to the JR.

P and nutrient transport from The Hula Valley

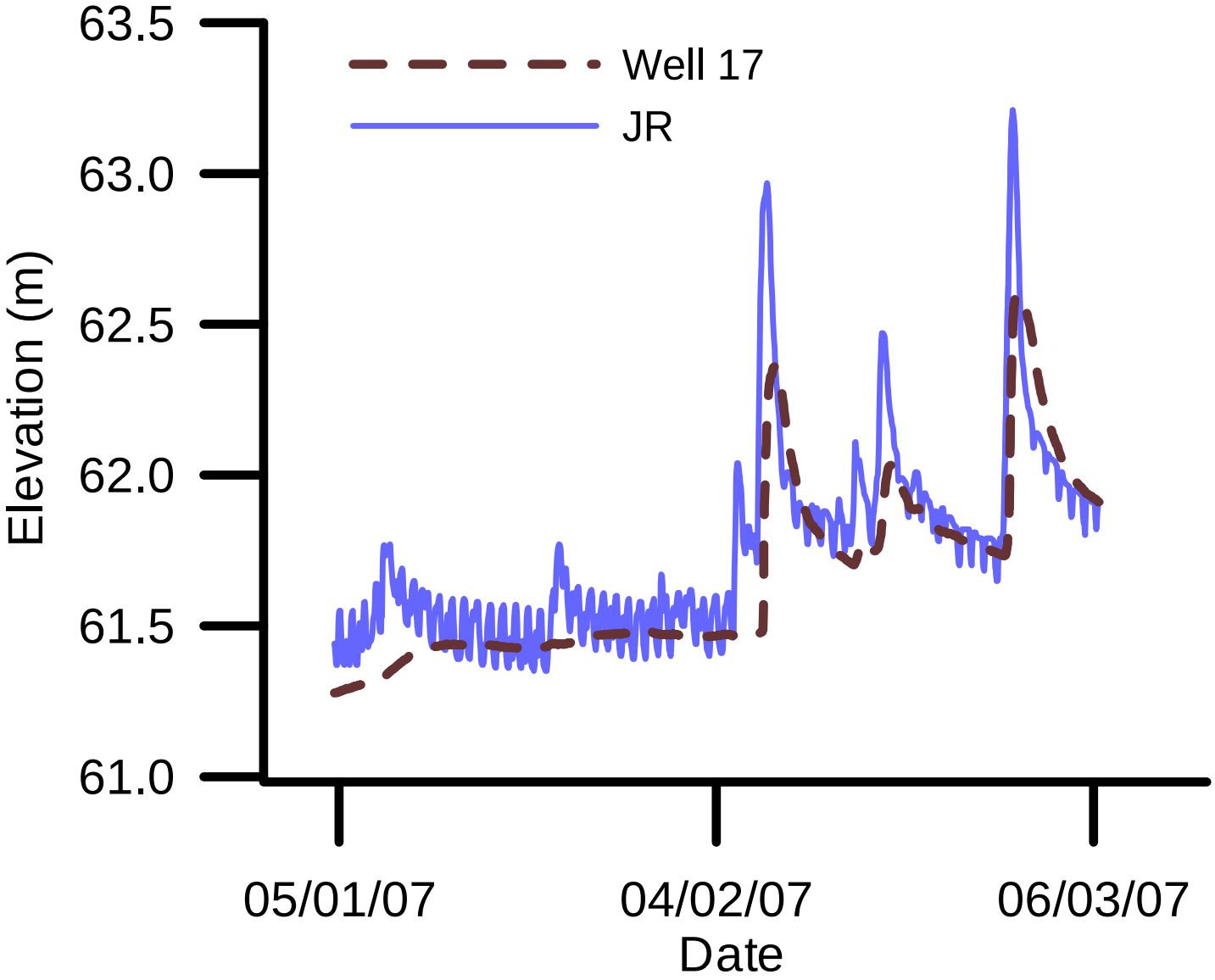


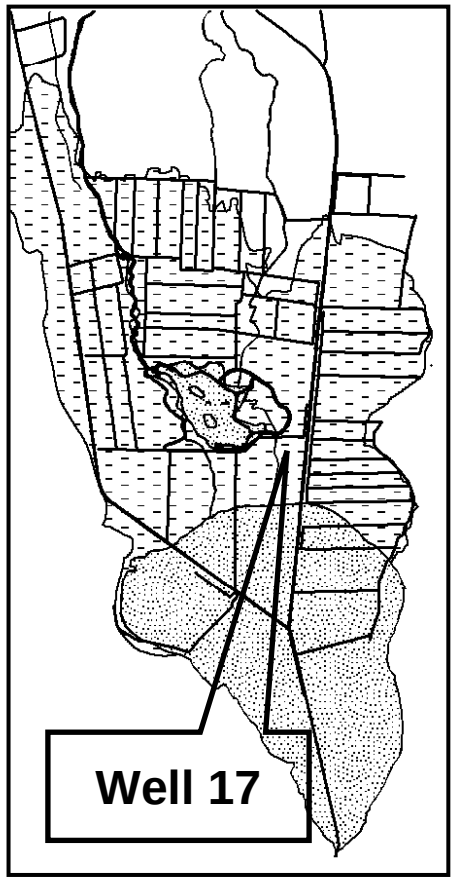
Annual average of 410 MCM are flowing in the outlet of the Hula Valley, from which only 5% are precipitation over the Valley.

The Valley area is 175 km^2, which are 11% of the JR basin.

No surface flow occurs in the valley and still the valley contributes 30% (24 ton) of the total P and 60% (9600 ton) of the total S which are transported at the valley outlet.

Hydrological connectivity of the JR to the agricultural fields





Flowing water in the Hula's soils

Large field Experiment for Evaluating Water and solute transport in the Hula's Soils

Hypothesis

P and other nutrients transport in these soils is driven by water fluctuations in the drainage canal. Most of the transport from the field occurs through cracks flow which can facilitate both soluble and particulate transport.

Large field Experiment for Evaluating Water and solute transport in the Hula's Soils

Experiment Stages:

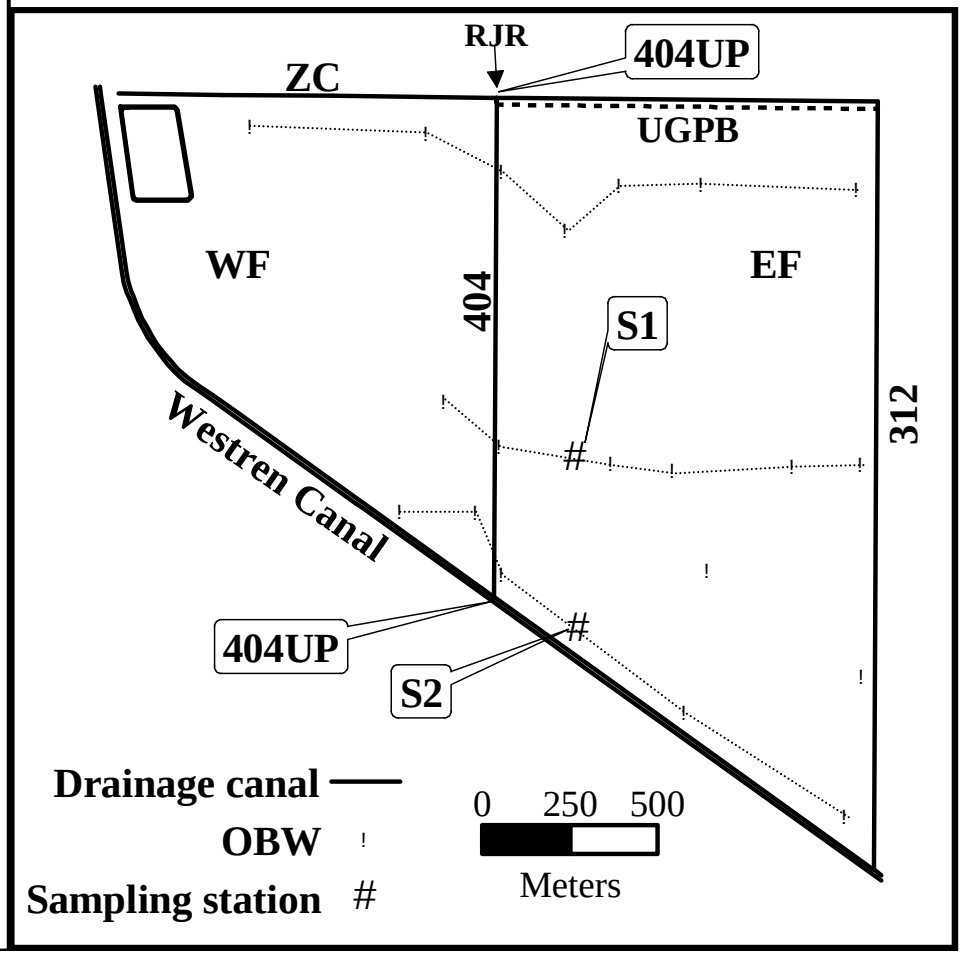
Raising stage – lasted 28 days.

We closed the outlet of 404 canal and water flowed from the canal to the fields.

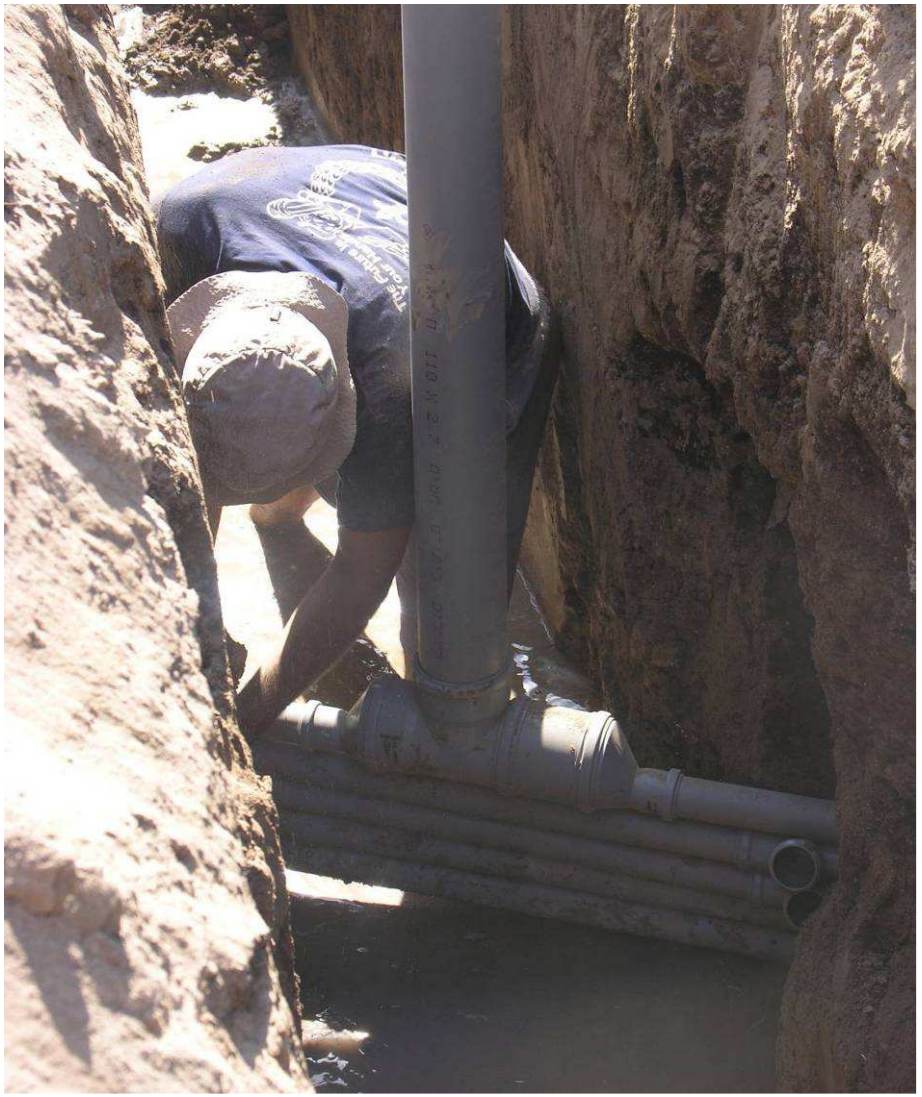
Drainage stage – lasted 5 days.

We lowered the water level in the canal by opening the canal outlet. During this stage we closed the inlet of the canal and only drainage water was flowing in the canal.

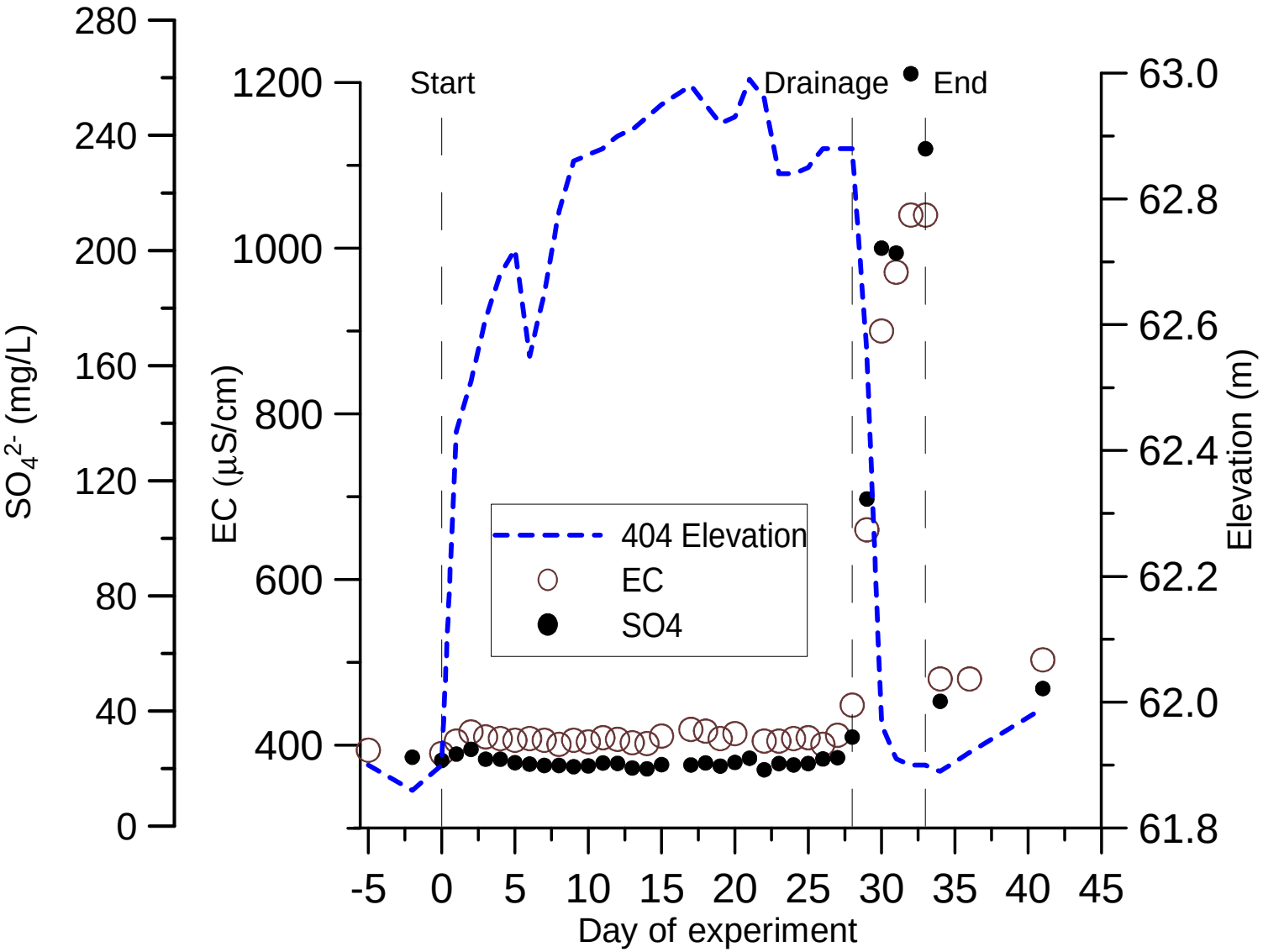
During the experiment we sampled water in OBW, 404 Canal, Differential Sampling Stations, & Cracks.



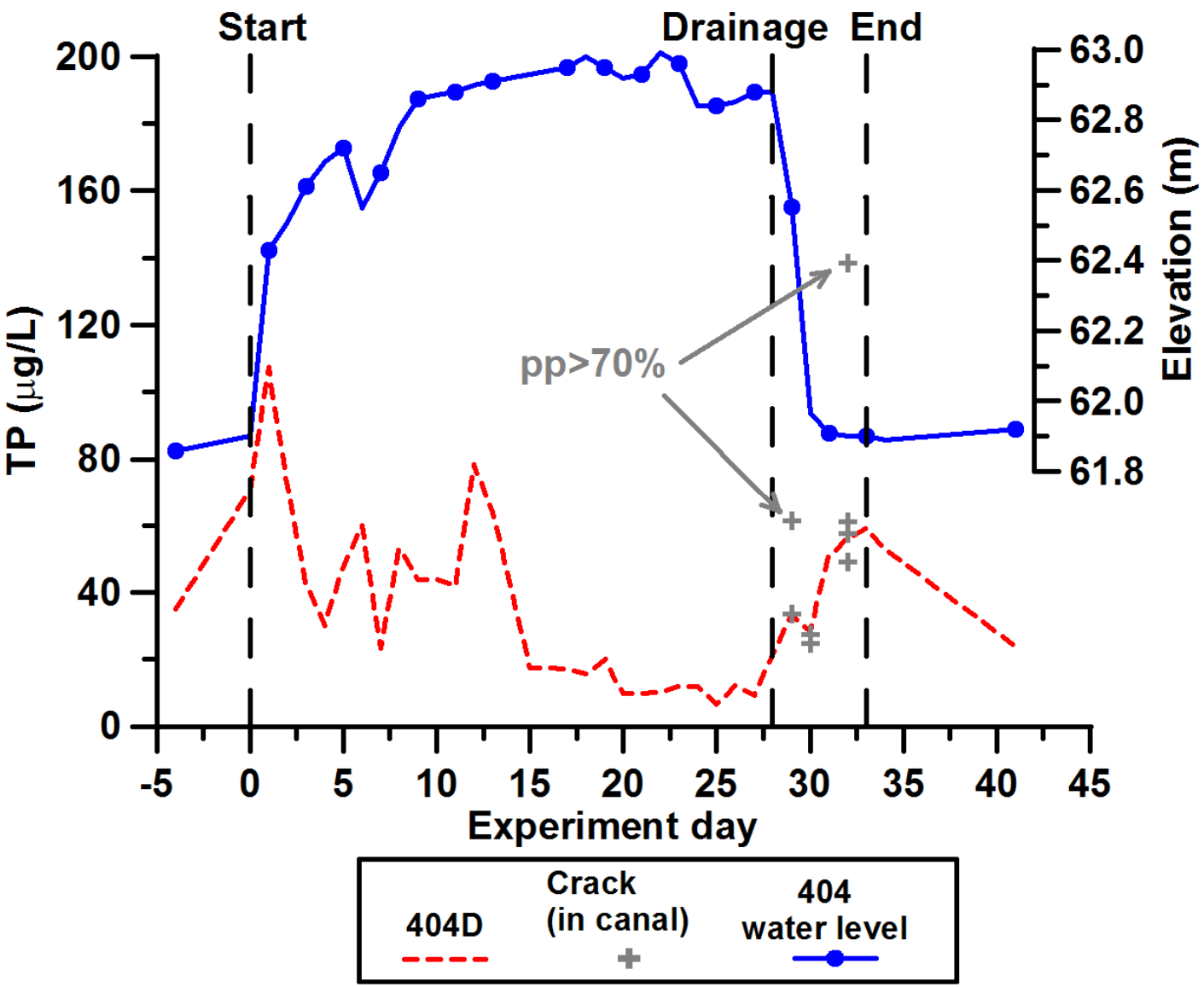
Differential Sampling Stations



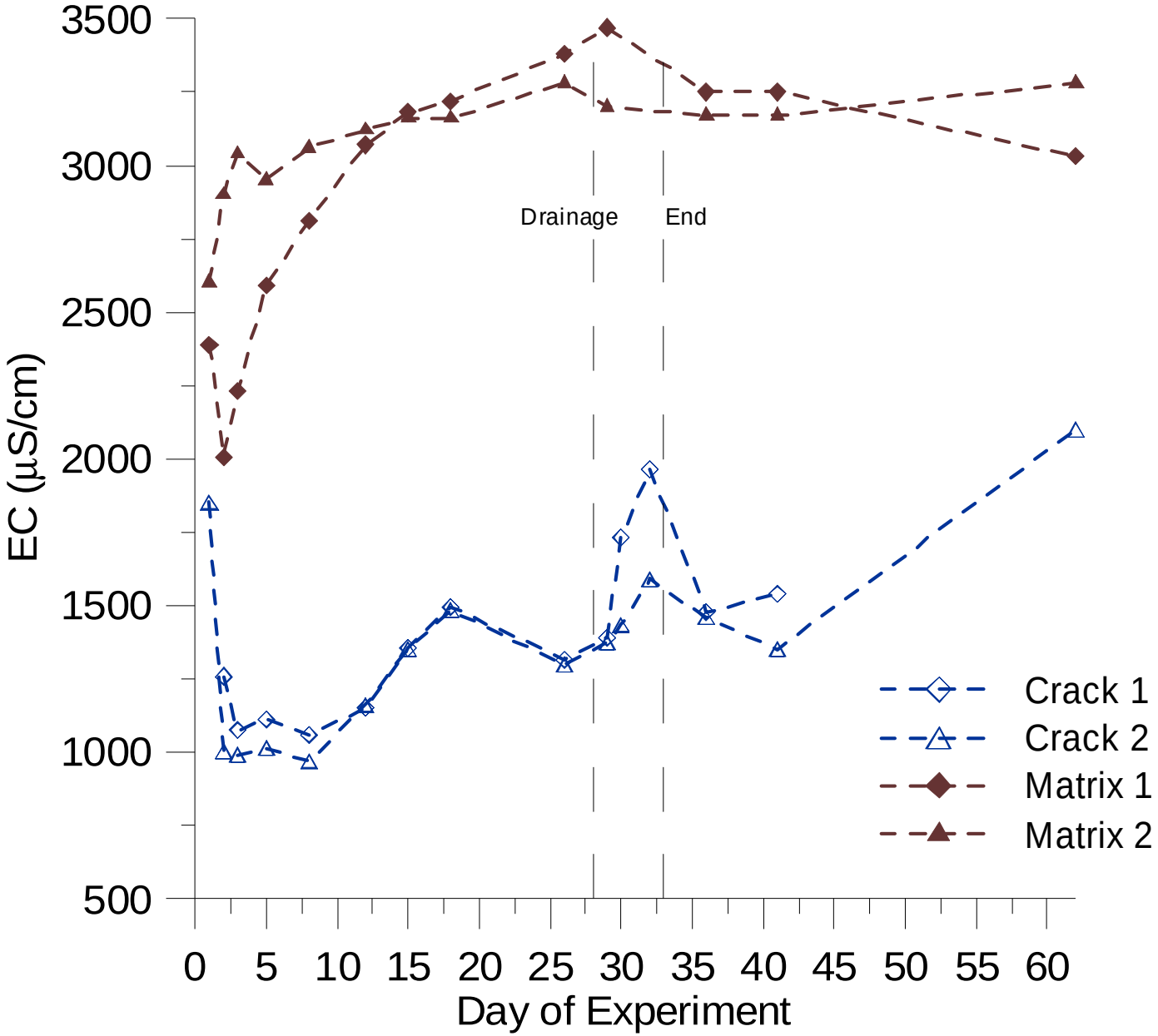
EC and Water level in 404 Canal



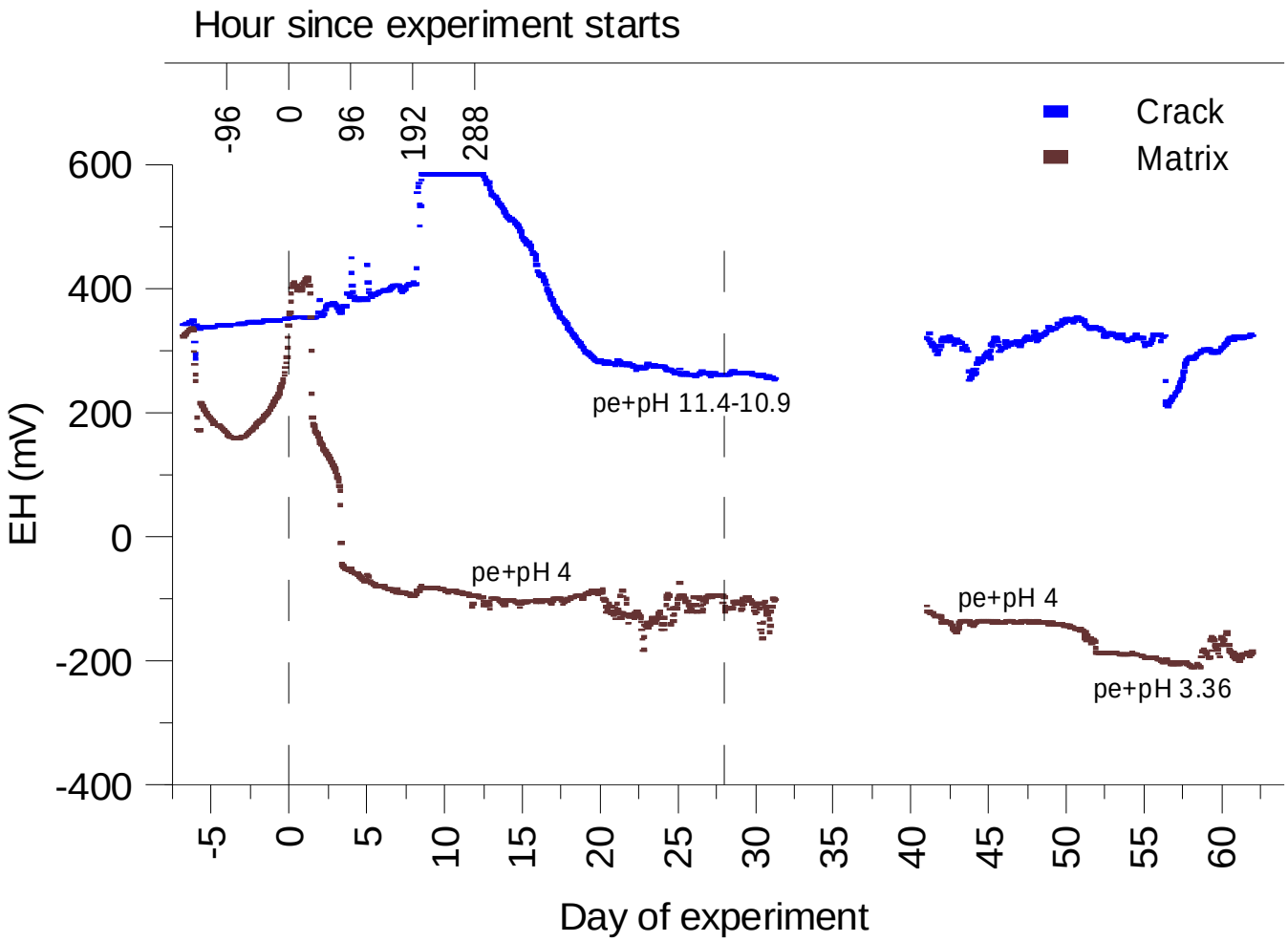
Total P in Canal 404



EC in the Sampling Station



E_H –Matrix vs. Cracks (Sampling Station)

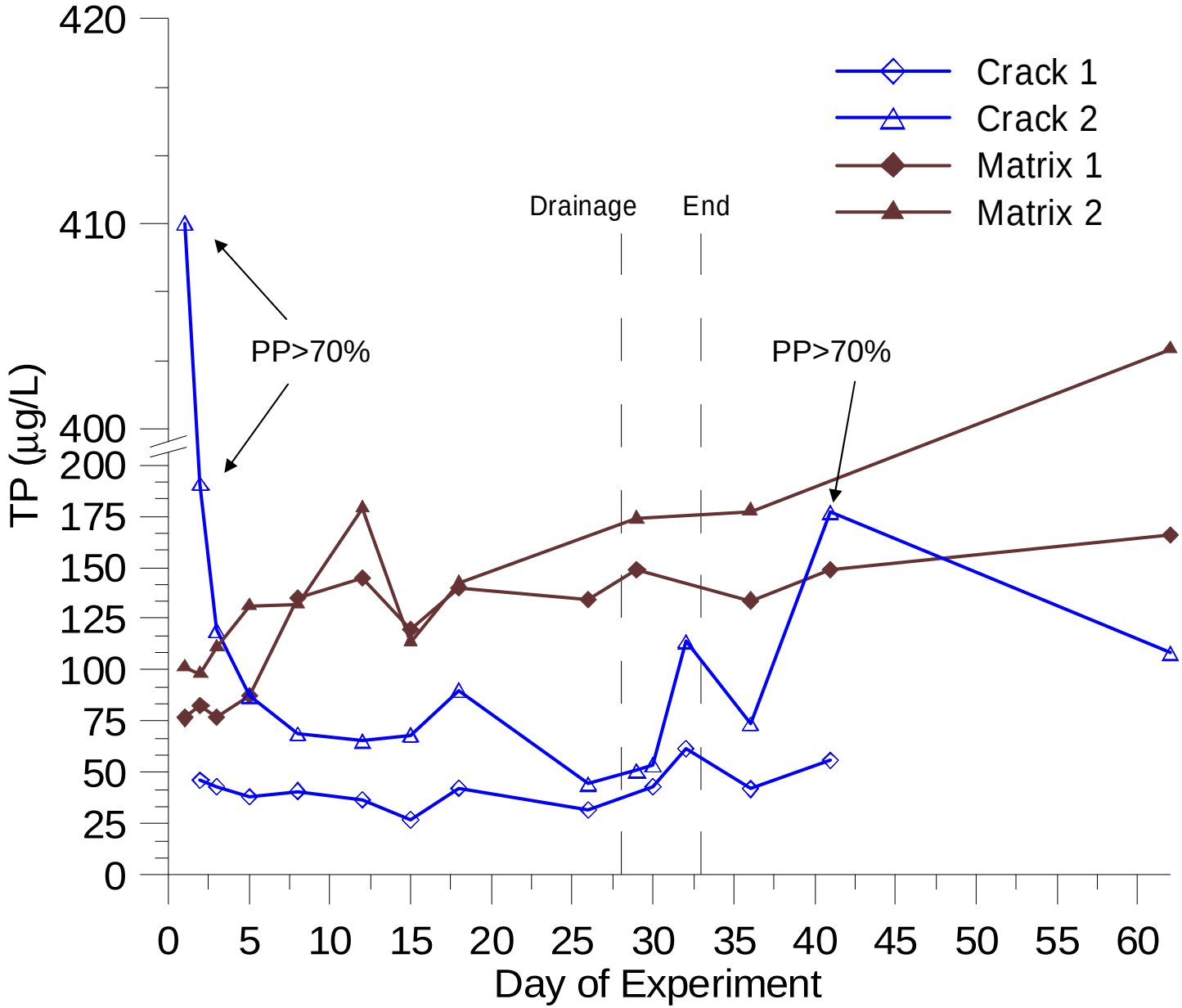


Absorbed P *

Cracks	18.21 mg/kg
Matrix	1.12 mg/kg

*NaOH Extraction
Preliminary results

Total P in the sampling station

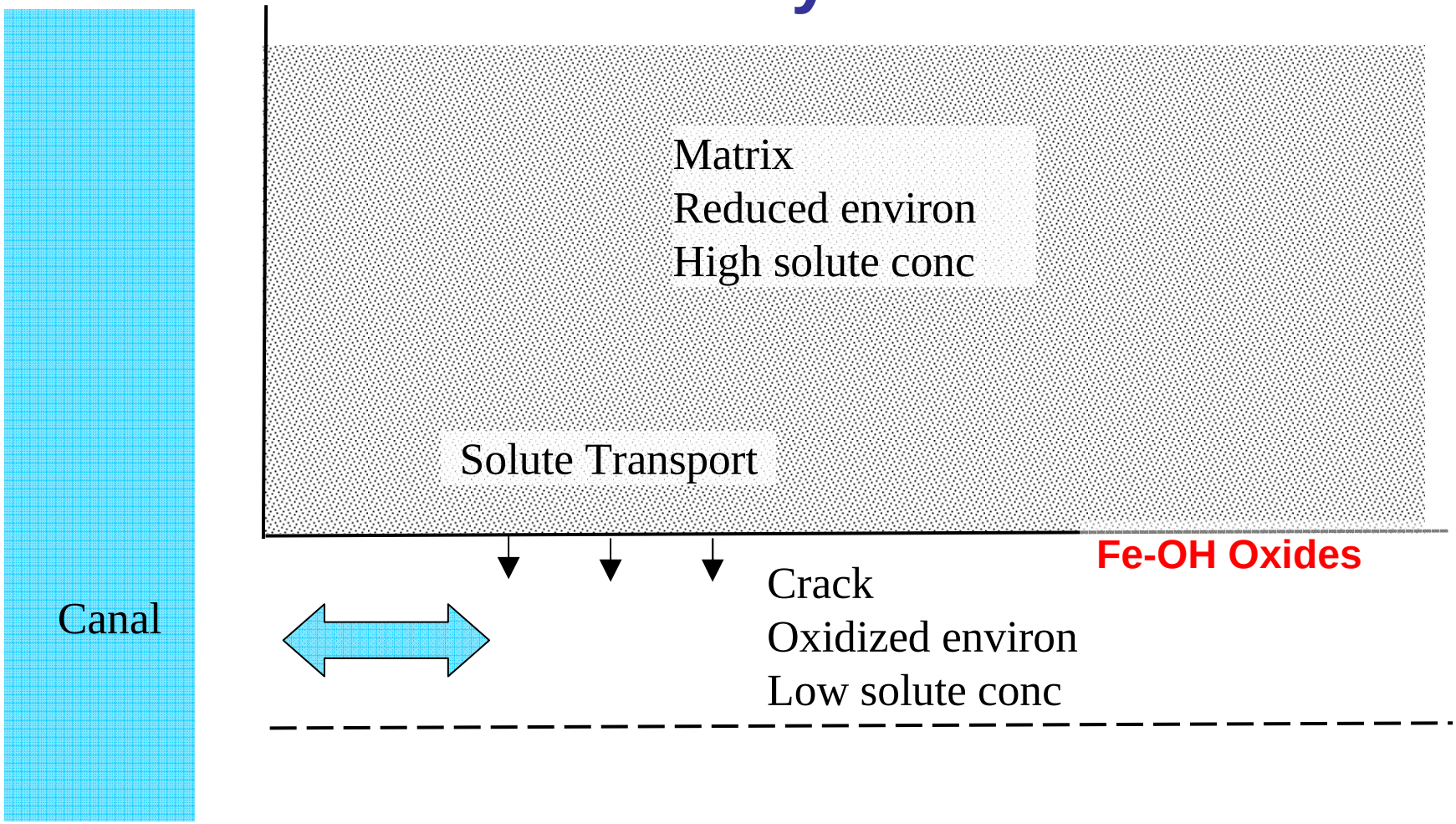


Nutrient Loads

TP(kg)		SO_4(kg)		Water discharge (m^3)	
daily	**total**	**daily**	**total**		
0.128	**0.64**	**740**	**3700**	24,500	

$$Q_f = Q_{404up} - Q_{404D} - \Delta Q_S$$

Nutrient transport from soils to waterways



vertical P mobility from pore water to floodwater (above-ground water) is limited by the oxidized layer in the floodwater-soil contact zone (Young and Ross 2001).

Summary & Conclusions

- Good hydrological connectivity exists between the fields and the waterways.
- Rapid water level rise during high discharge periods in the JR could drive significant flow into the fields. During the river recession, water would flow from the fields to the river.
- On the basis of Sulfate behavior we expecting significant loads during high discharge periods.
- P is adsorbed on the Fe mineral in the cracks faces, thus significant transport is expected only as particulate fraction.
- Attention has to be paid to cracks waters when evaluating nutrient transport in this altered wetland.