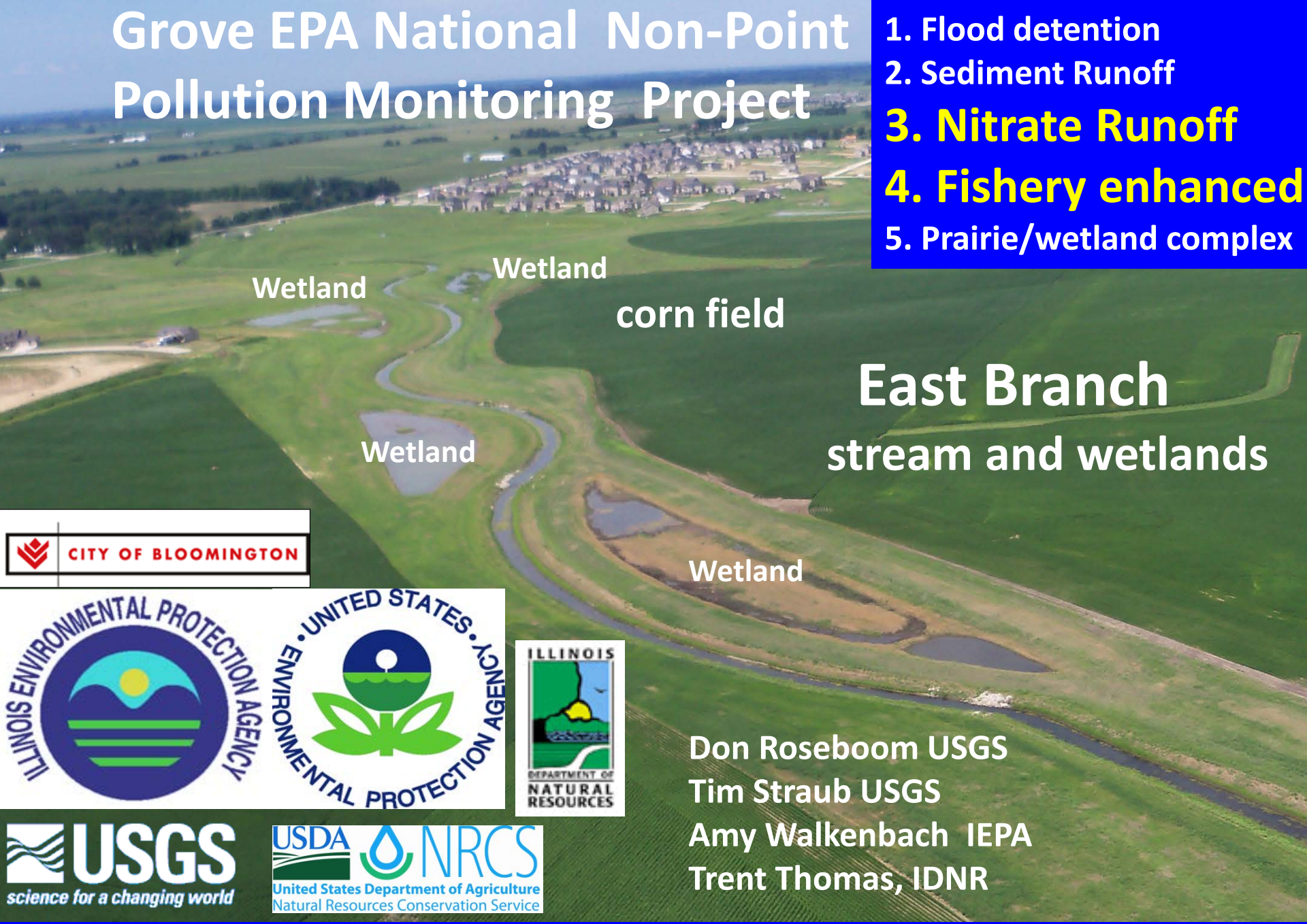
Grove EPA National Non-Point Pollution Monitoring Project

1. Flood detention
2. Sediment Runoff
3. Nitrate Runoff
4. Fishery enhanced
5. Prairie/wetland complex



CITY OF BLOOMINGTON

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

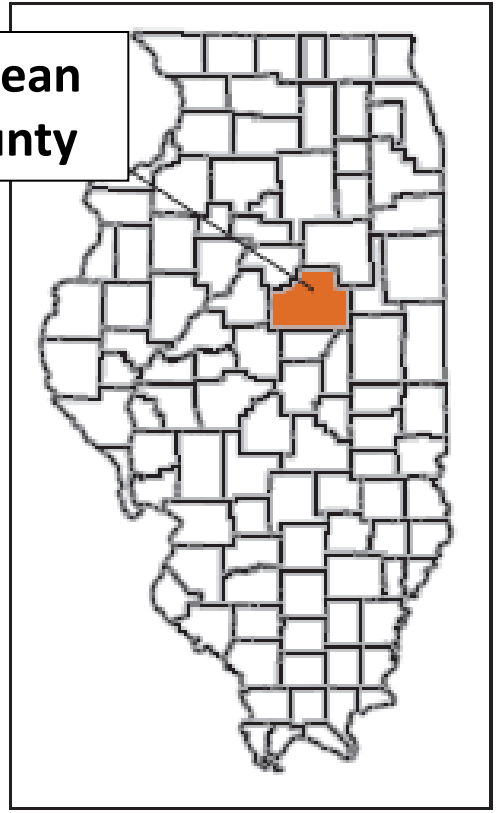
ILLINOIS DEPARTMENT OF NATURAL RESOURCES

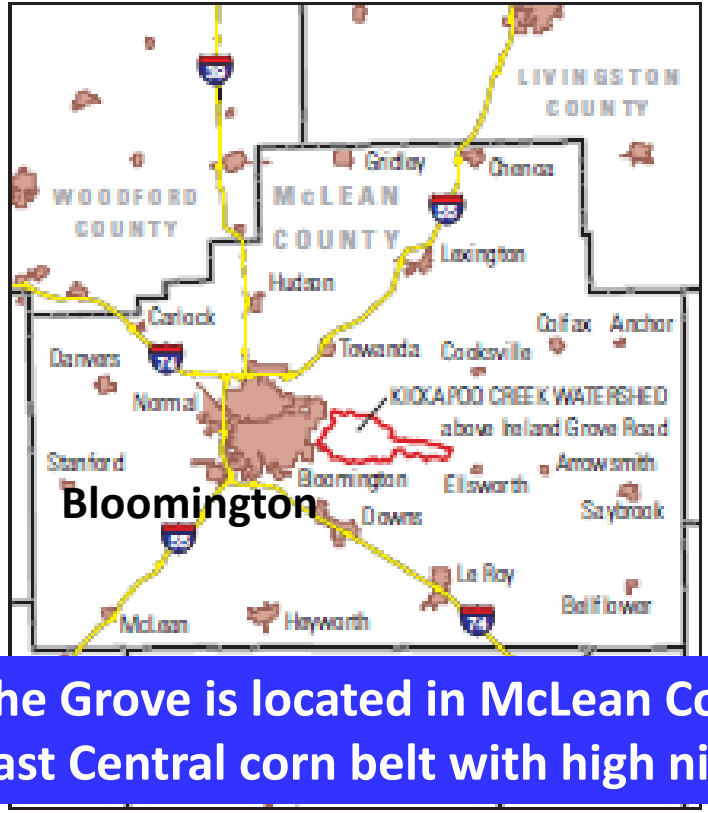
USGS science for a changing world

USDA NRCS United States Department of Agriculture Natural Resources Conservation Service

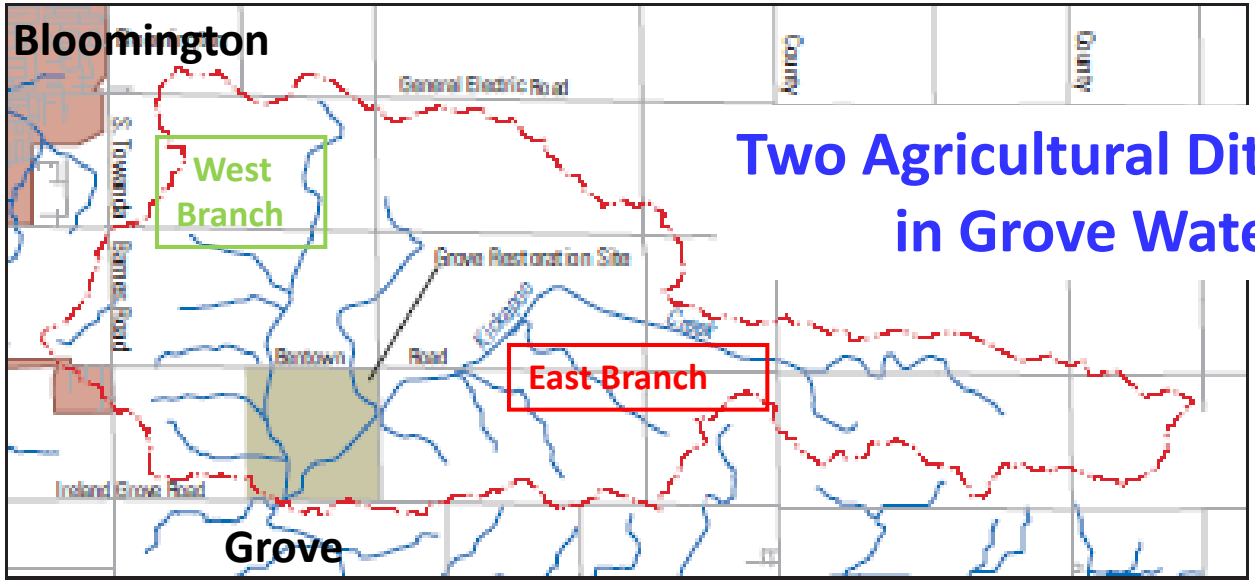
Don Roseboom USGS
Tim Straub USGS
Amy Walkenbach IEPA
Trent Thomas, IDNR

Grove Restorations are funded by city, state, and federal agencies





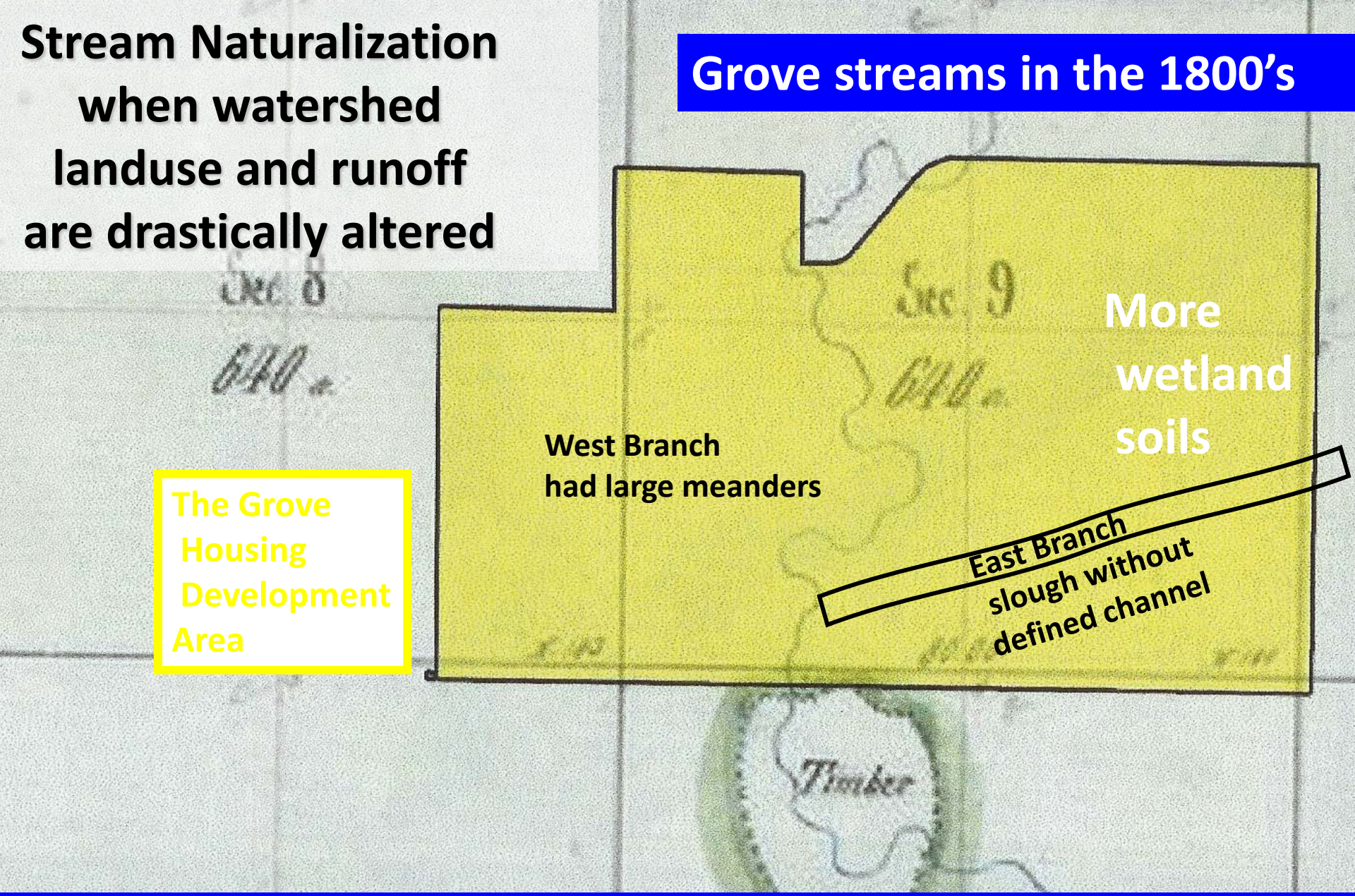
The Grove is located in McLean County, IL
East Central corn belt with high nitrate output



Two Agricultural Ditches in Grove Watershed

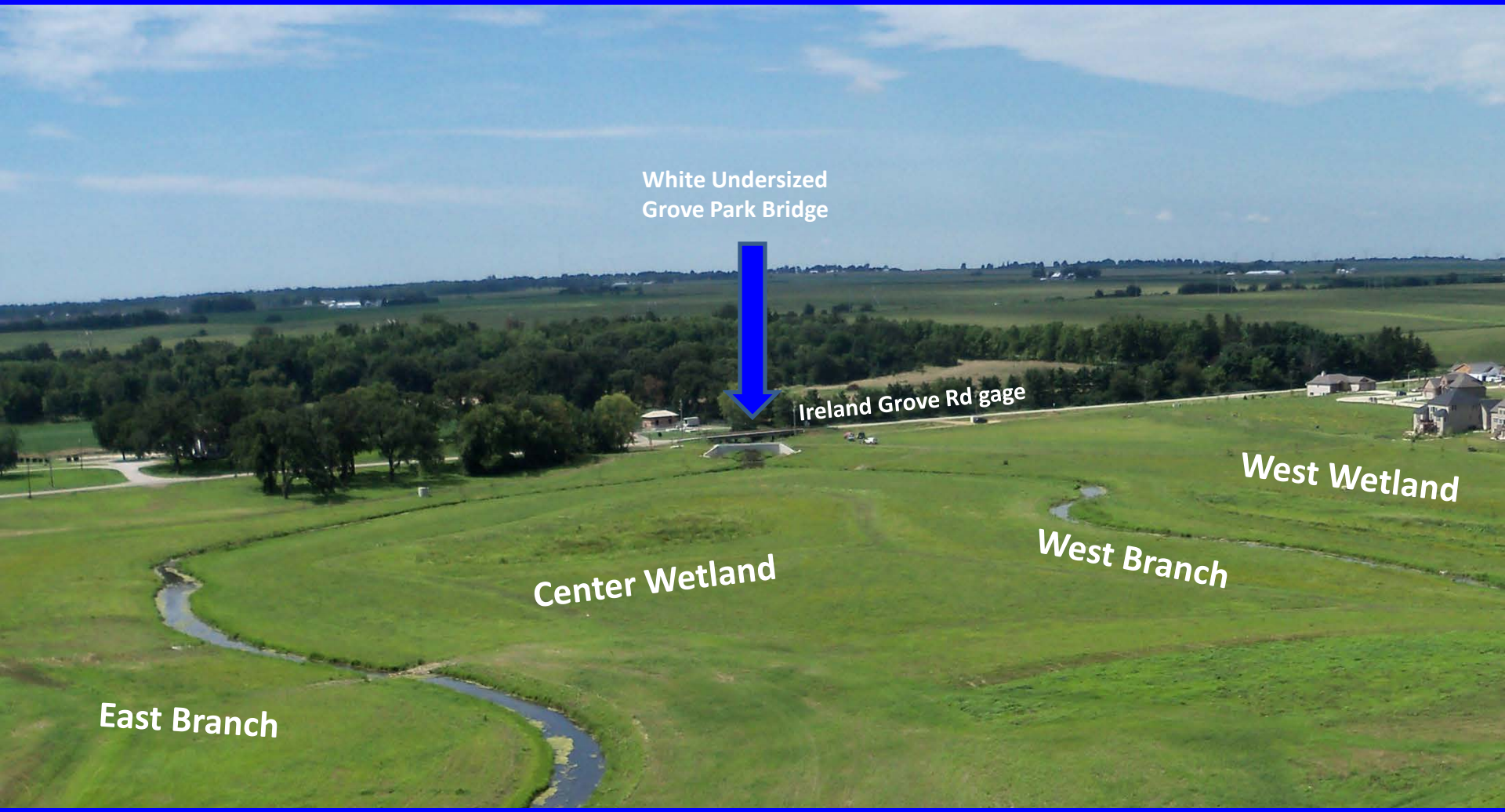
Stream Naturalization when watershed landuse and runoff are drastically altered

Grove streams in the 1800's



The larger East Branch existed as a slough while the steeper West Branch had large stream meanders

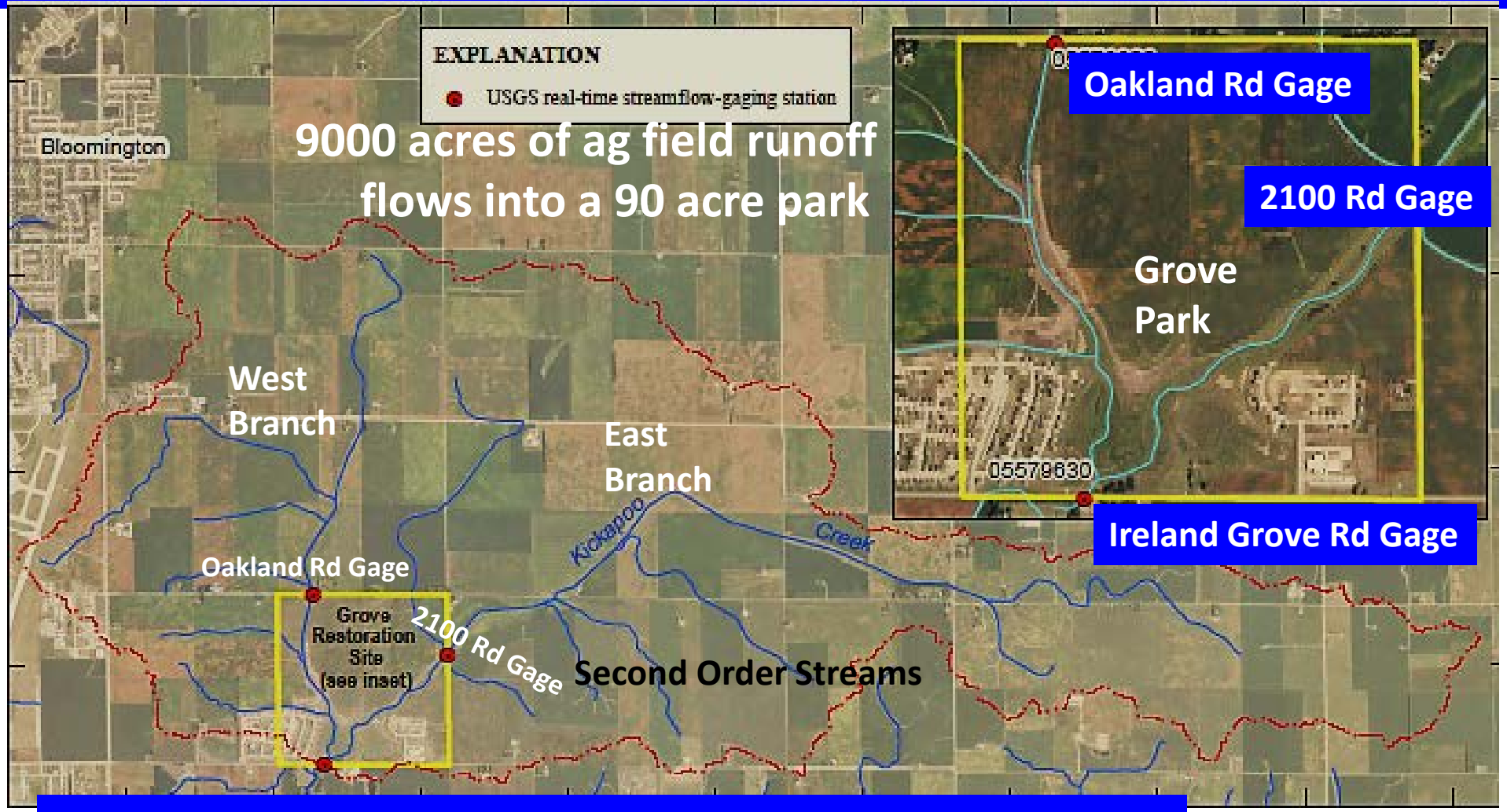
The excavated floodplain in Phase 1 provides the greater floodwater storage but must reduce sedimentation rates



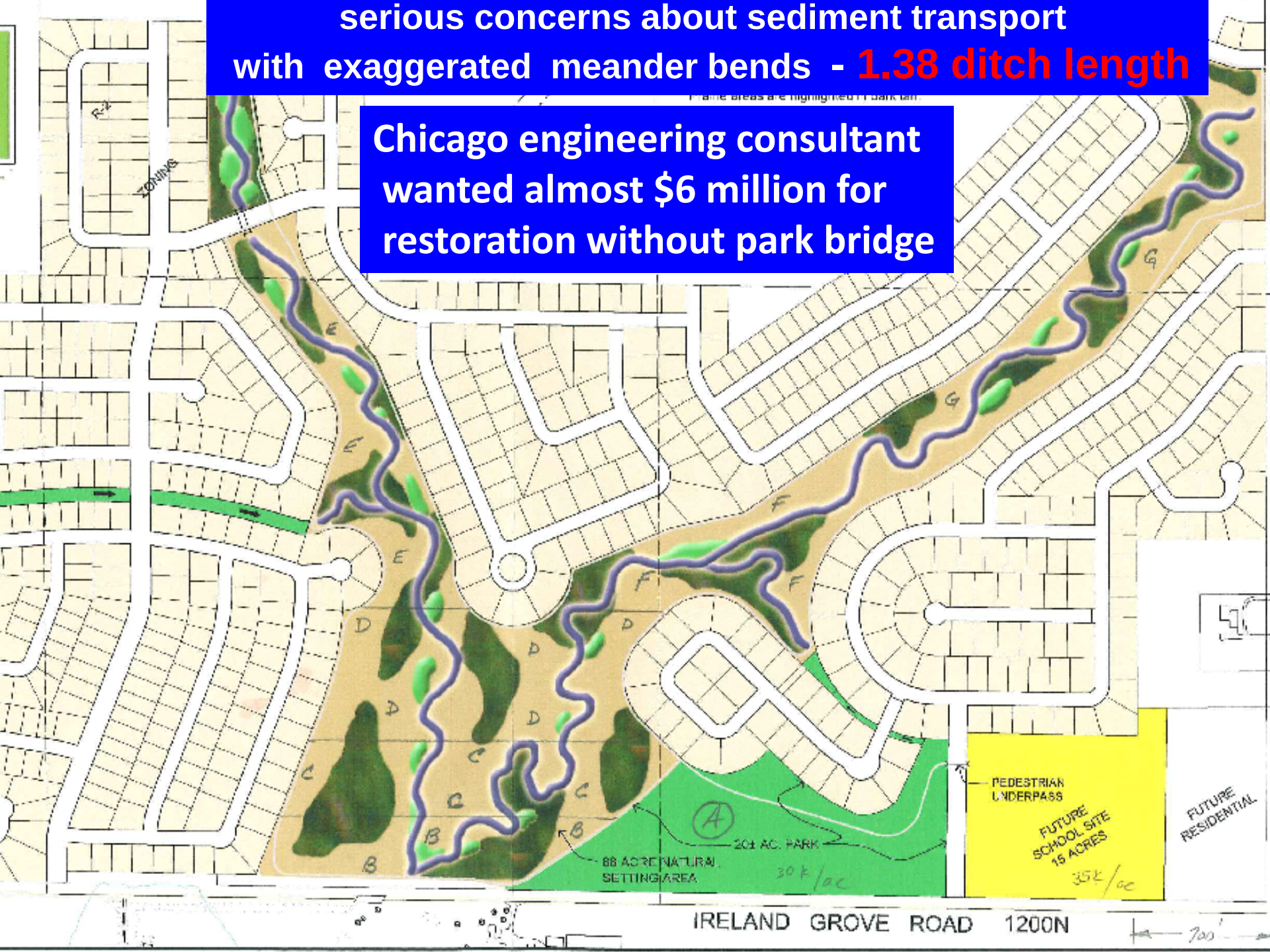
No dam - The undersized Grove Park Bridge increases flood storage during floods greater the 2- yr flood magnitude

The park bridge detained surface runoff and filled the Phase 1 basin with peak stream flow containing 10 mg/l nitrate and 1.5 mg/l total phosphorus while transporting 3,000 tons of sediment

Oakland Rd Gage and 2100 Rd Gage measure sediment and nutrients moving into the Grove from West and East Branch drainage ditches



Ireland Grove Rd Gage measures what leaves the Grove


serious concerns about sediment transport
with exaggerated meander bends - 1.38 ditch length
Chicago engineering consultant
wanted almost $6 million for
restoration without park bridge
ZONING
PEDESTRIAN
UNDERPASS
FUTURE
SCHOOL SITE
15 ACRES
35K/ac
FUTURE
RESIDENTIAL
20± AC. PARK
30K/ac
88 ACRE NATURAL
SETTING AREA
IRELAND GROVE ROAD 1200N

BMP's to improve water quality in the Grove restoration

Streams, Prairie, Wetlands are 5+ years old in Phase 1 and 2.

The stream length is 1.08 X the length of original ag ditches.

Criteria for a more natural stream channel achieved with Newbury rock riffles to scour and maintain pool depth

2. Critical Depth (D_c) = $\{Q^2/(g\ W^2)\}^{1/3}$

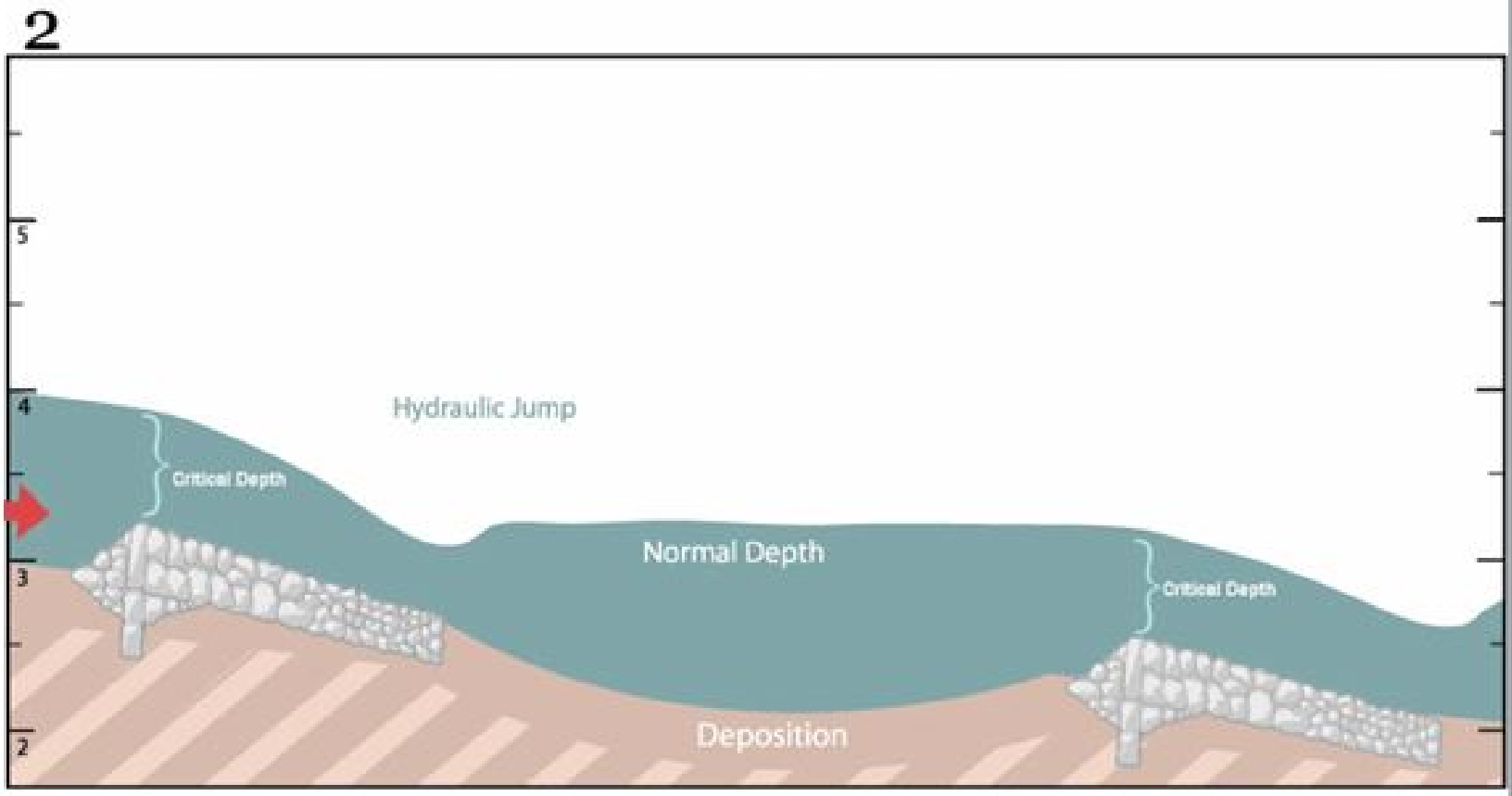
3. Critical Velocity (Vc) = (g Dc) ½

4. Critical Specific Energy = 1.5 Dc

Depth of stream flow varies as velocity increases on backface of riffle

But water level upstream of riffle remains constant

NO Impoundment

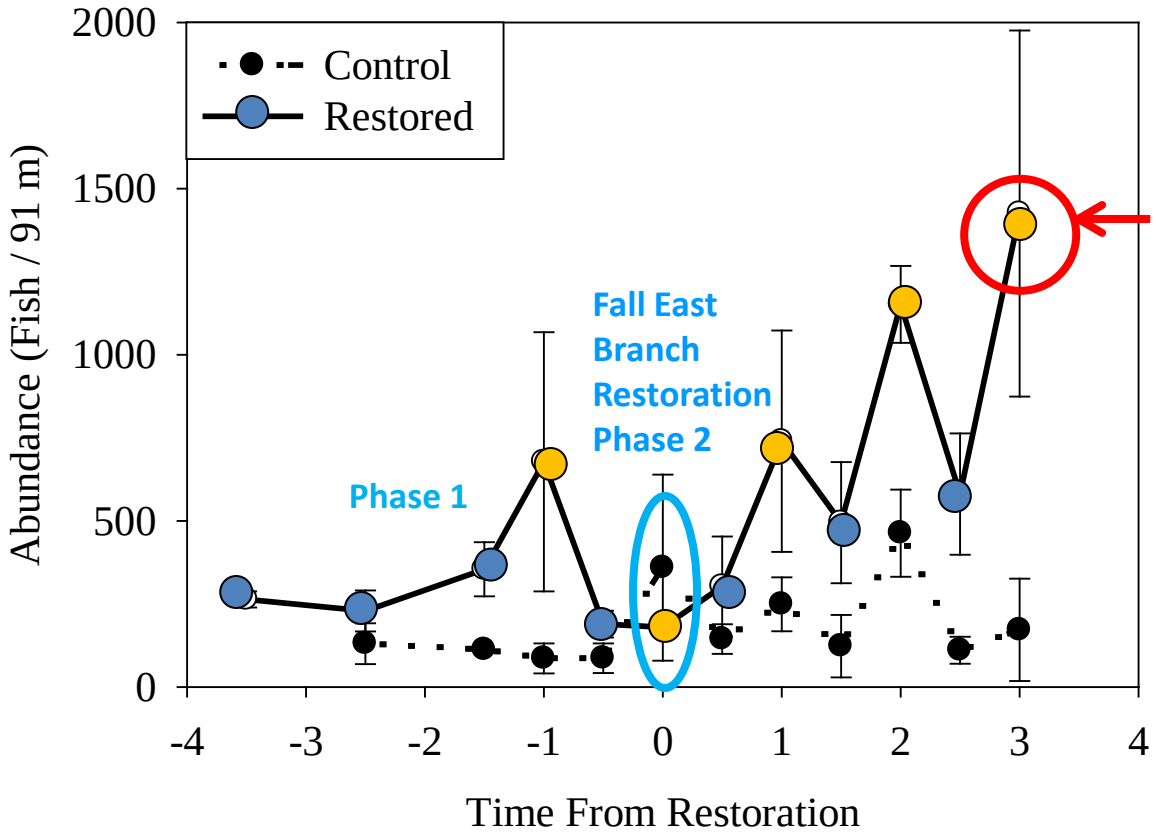


Stream velocity will scour pool and maintain sediment transport since energy line is not decreased

How did stream fisheries and water quality respond to the Grove stream/slough restoration

In 2012 drought, pool water is deeper than staff are tall – stay near banks

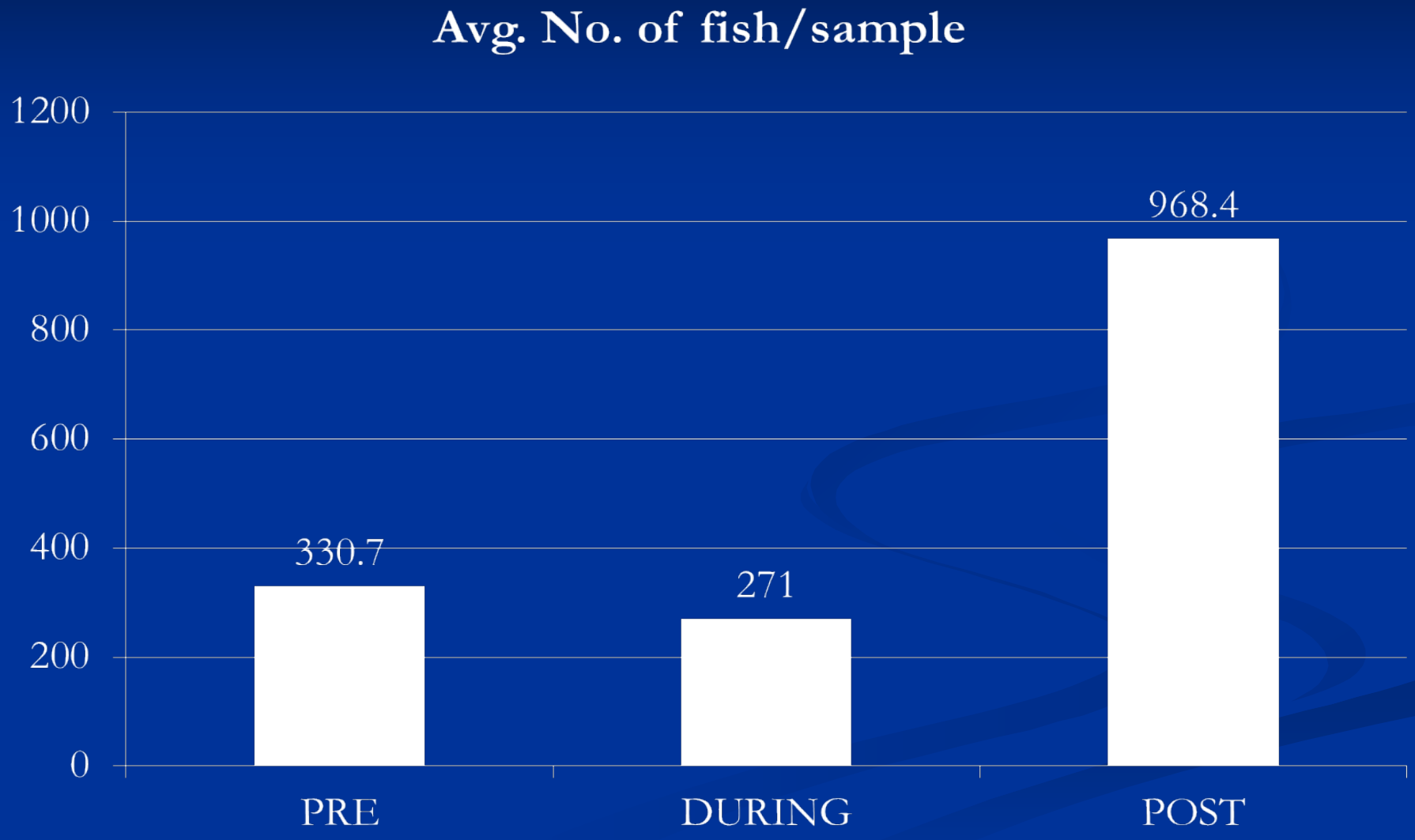
Fish abundance continues to increase after Phase 2 East Branch Restoration



Initial dip in Fall Treatment abundance

Fall samples are consistently higher than Spring samples

Significant increase in fish abundance



Even during 2012 drought, fall fish numbers are high in the upper East Branch fish survey pool below the E8 riffle, low DO-high nitrate

East Branch Upstream Treatment Site

High flows scour deep hole

Bloomington

Standardise Samples by Total
Transform: Square root
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.09

Time
- Pre
- During
- After

Similarity
72

2010
2011
2011
2010
2013
2012
2009
2006
2008
2007
2008
2007
2009
construction

Top 55%
-- Striped Shiner
+ Bluntnose Minnow
+ Green Sunfish
+ Bigmouth Shiner
-- Central Stoneroller
+ Bluegill
-- Johnny Darter

2012 drought did not affect fish in deeper pools

Pre: 12.5 species
303.7 fish

During: 10 species
56 fish

After: 17.8 species
1232.7 fish


The aquatic vegetation in the Grove prairie slough improved water quality and provided plentiful forage

Flows through vegetation as narrow leaf pondweed
increases DO, increases fish forage,
increases water temperature and reduces NO_3,
in the East Branch during normal stream flows

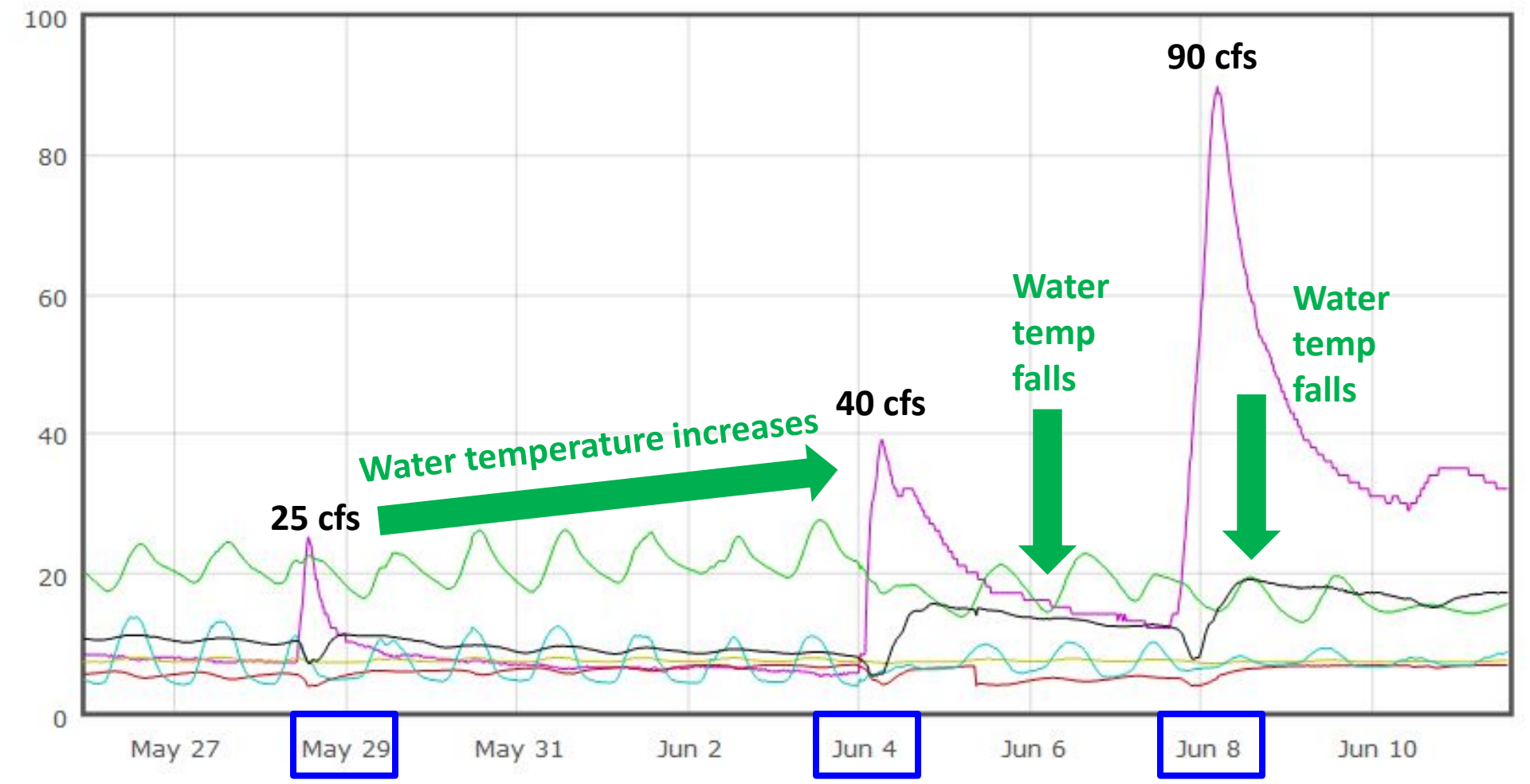
IEPA field staff monitored dissolved oxygen in the Grove during the severe drought in early September 2012

East Branch control and two restoration sites In 2012 drought

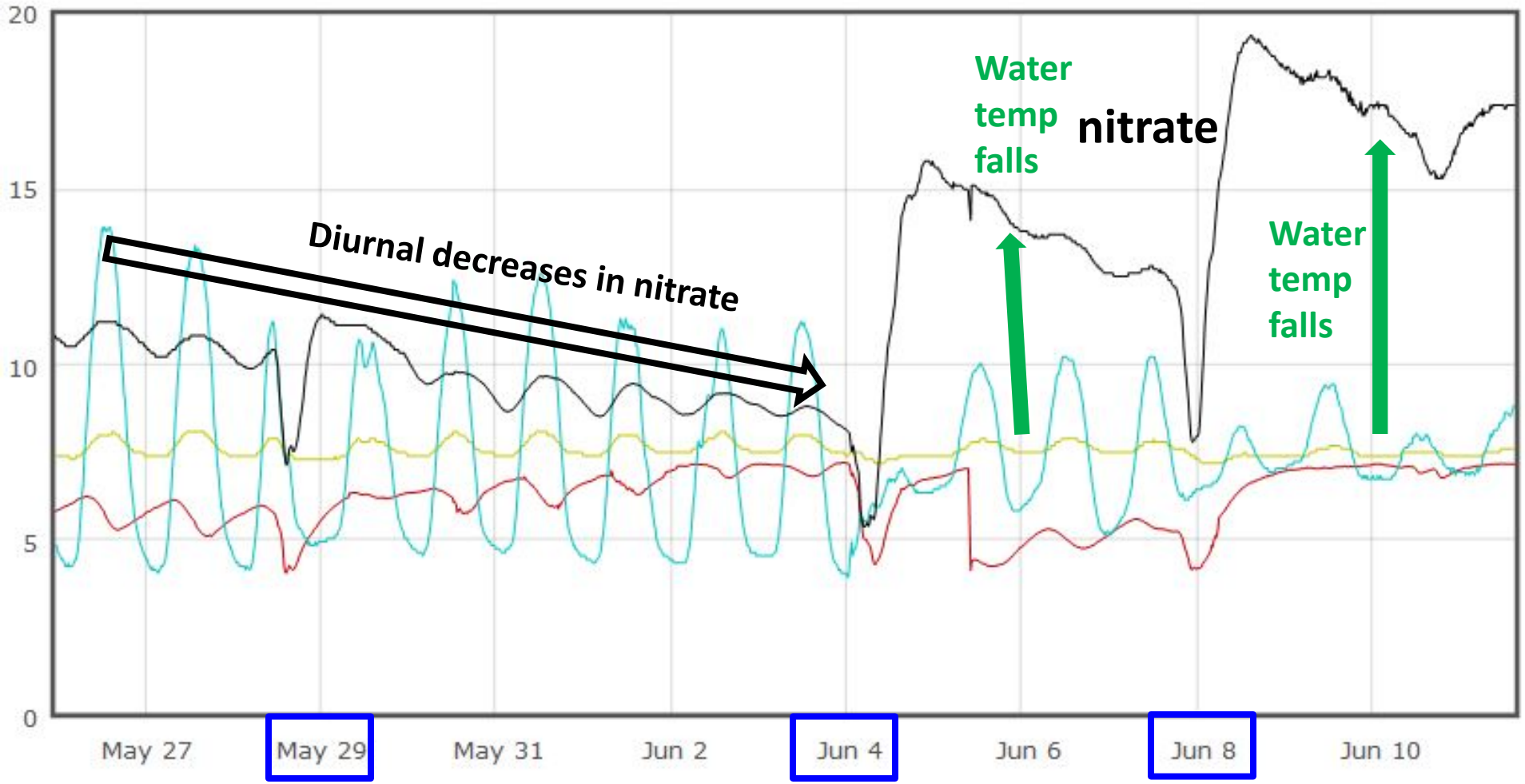
IEPA upstream control
DO – 0.7 mg/l
Hydrogen sulfide odor
Black organic sediment

IEPA at E8 riffle/ pool
East Branch, 2100 Rd
DO – 4.0 mg/l

IEPA at E1 riffle/ pool
DO is 6. 8 mg/l



Ireland Grove Rd WQ oscillations lessens when small rainfalls increase flows slightly, water temperatures fall as runoff increases

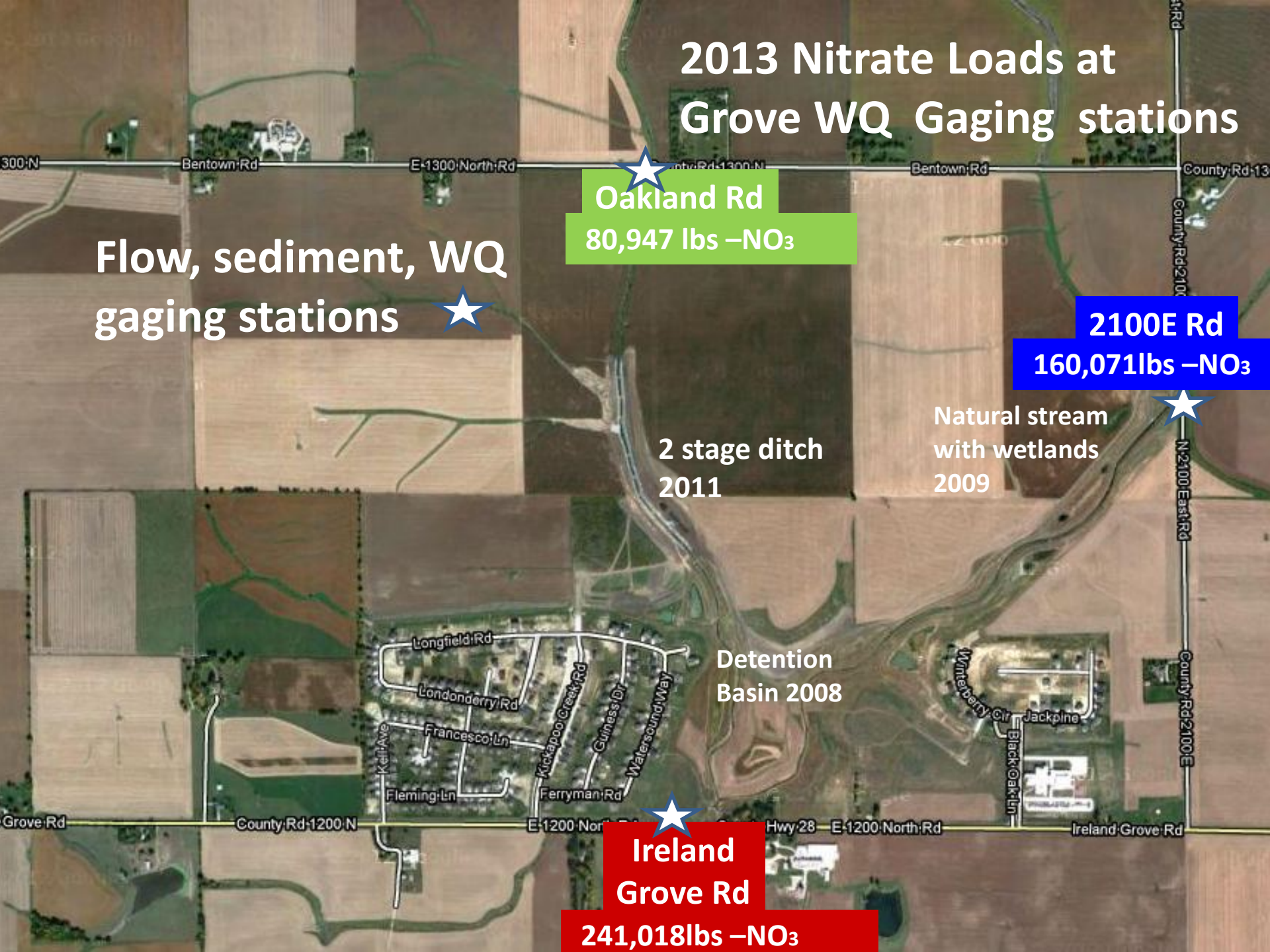


Ireland Grove Rd WQ oscillations

small increases in flow lowers temperatures

reduces DO, pH, and Spec Cond oscillations

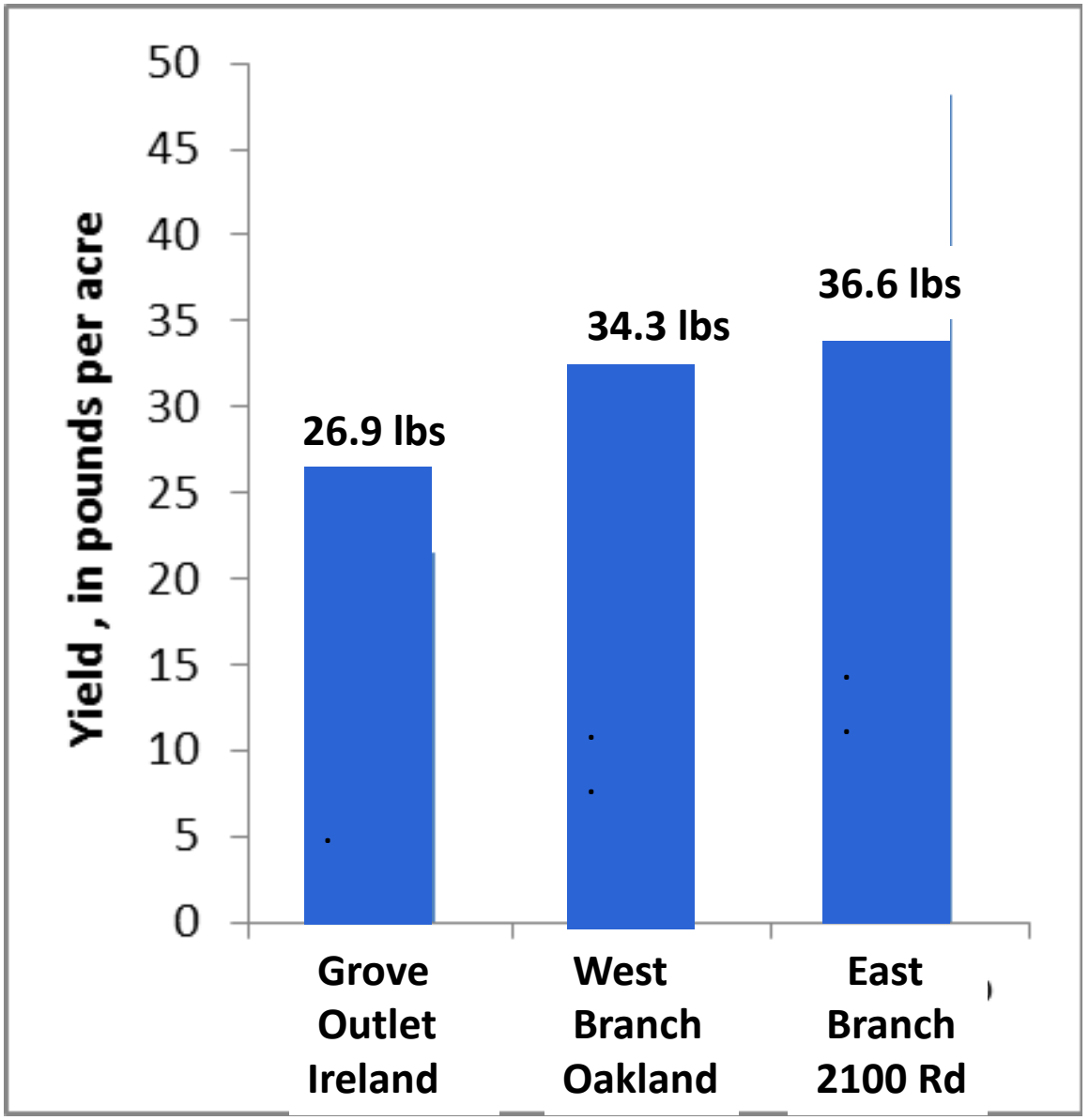
nitrate concentrations rise quickly


2013 Nitrate Loads at Grove WQ Gaging stations
Oakland Rd
80,947 lbs –NO3
Flow, sediment, WQ gaging stations
2100E Rd
160,071lbs –NO3
Natural stream with wetlands 2009
2 stage ditch 2011
Detention Basin 2008
Ireland Grove Rd
241,018lbs –NO3
Bentown Rd
E 1300 North Rd
County Rd 2100 E
Longfield Rd
Londonderry Rd
Francesco Ln
Fleming Ln
Ferryman Rd
Kickapoo Creek Rd
Guinness Dr
Watersound Way
Winterberry Cir
Jackpine
Black Oak Ln
Grove Rd
County Rd 1200 N
E 1200 North Rd
Ireland Grove Rd

2013 Nitrate Yield per Acre For Grove Gages

East Branch and West Branch imported 338,600 lbs NO_3 into Grove Park

The Grove Park exported 255,200 lbs of nitrate –N out of the park

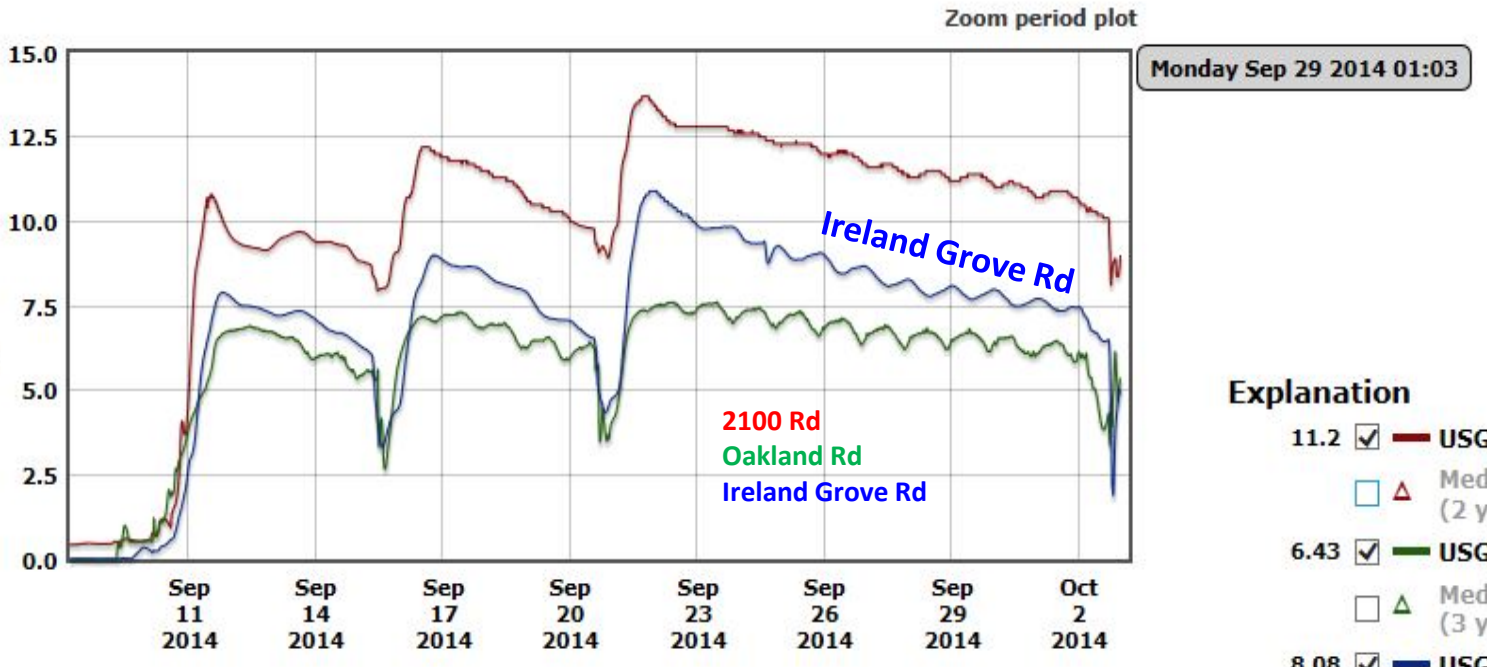


The Grove Park reduced the nitrate load by 24.6 % (83,400 lbs)

2100 Rd USGS 05579610 KICKAPOO CREEK AT 2100E ROAD NEAR BLOOMINGTON, IL
Oakland Rd USGS 05579620 KICKAPOO CREEK TRIBUTARY NEAR BLOOMINGTON, IL
Ireland Grove Rd USGS 05579630 KICKAPOO CREEK NEAR BLOOMINGTON, IL

Nitrate- n

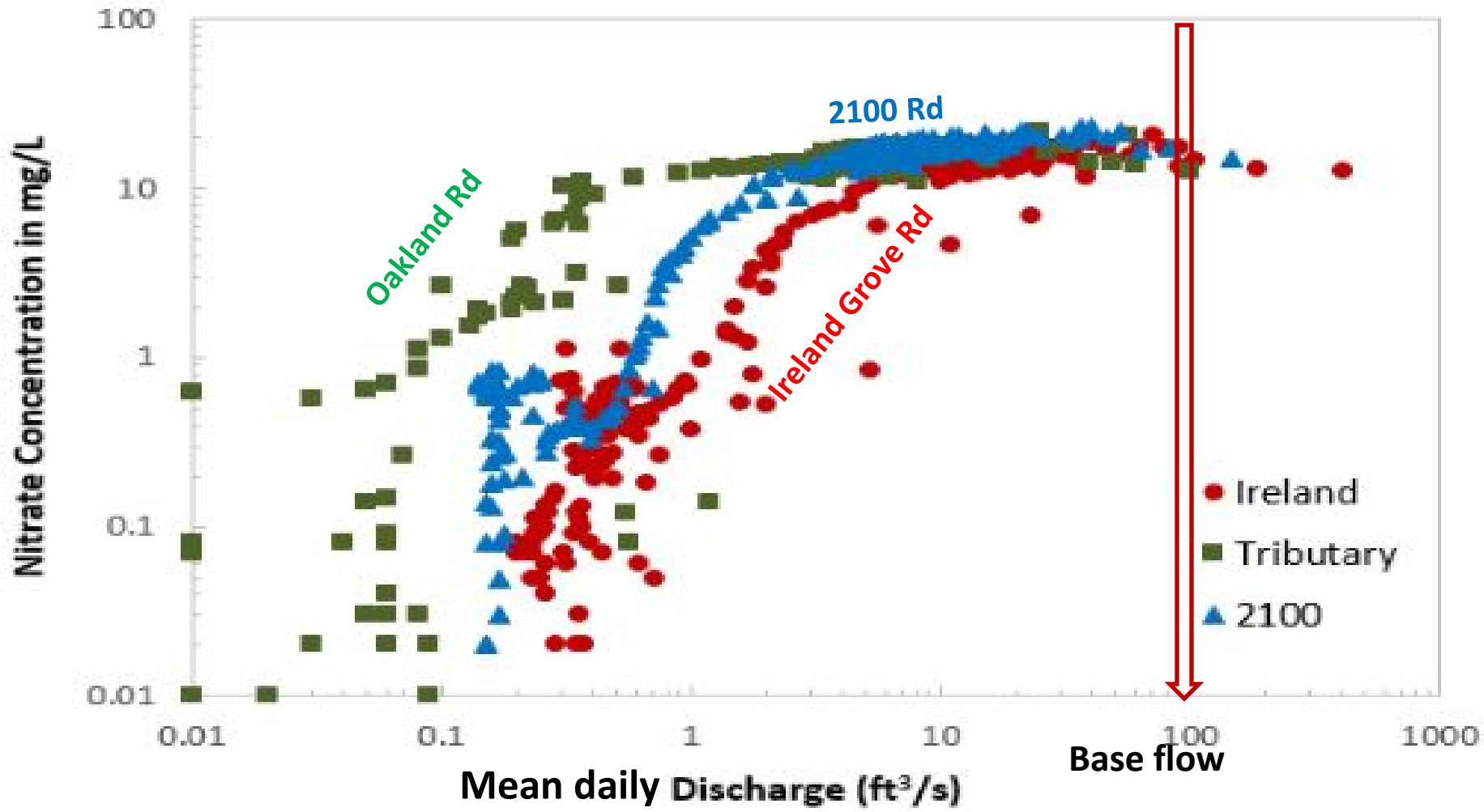
, in situ, milligrams
itrogen



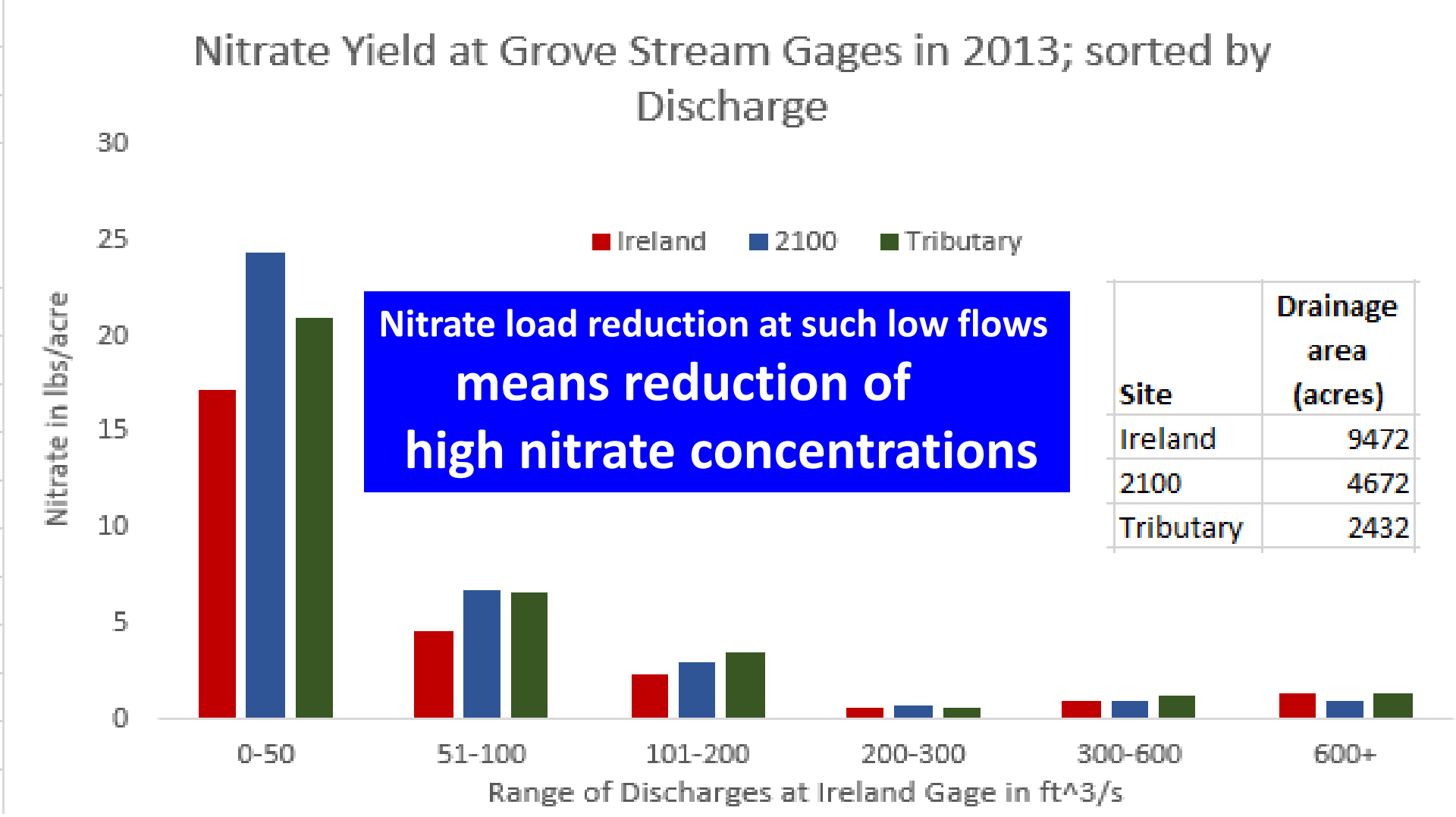
The rate of nitrate reduction is greater in stream flow from Grove restoration (Ireland Grove Rd gage) than

in the rates of nitrate reduction in flows from ag ditches at the 2100 Rd and Oakland Rd gages

Grove Nitrate Transport Curve 2013



Nitrate concentrations at Ireland Grove Rd are lower than nitrate concentrations in the 2 upstream drainage ditches at base flows less than 100 cfs but very few samples above 100 cfs



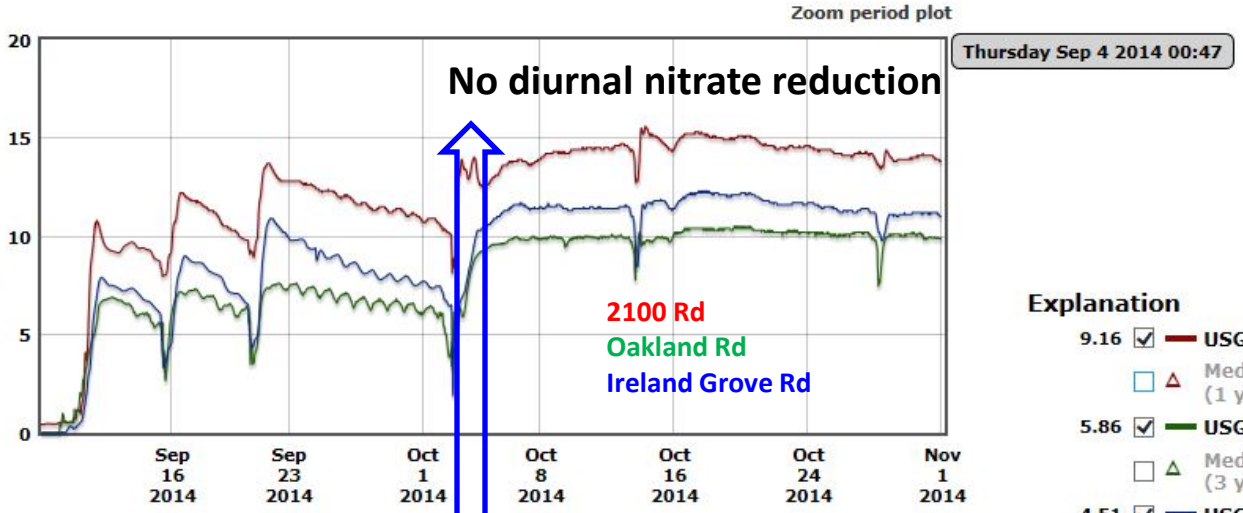
0-100 cfs flows account for 73 percent of the nitrate load and 91 percent of nitrate reduction during 200+ days

2013 fall applications of agricultural lime and potash to fields -- increase specific conductivity in tile flows and stream flows

2100 Rd USGS 05579610 KICKAPOO CREEK AT 2100E ROAD NEAR BLOOMINGTON, IL
Oakland Rd USGS 05579620 KICKAPOO CREEK TRIBUTARY NEAR BLOOMINGTON, IL
Ireland Grove Rd USGS 05579630 KICKAPOO CREEK NEAR BLOOMINGTON, IL

Nitrate

Nitrate plus nitrite, water, in situ, milligrams per liter as nitrogen



2100 Rd USGS 05579610 KICKAPOO CREEK AT 2100E ROAD NEAR BLOOMINGTON, IL
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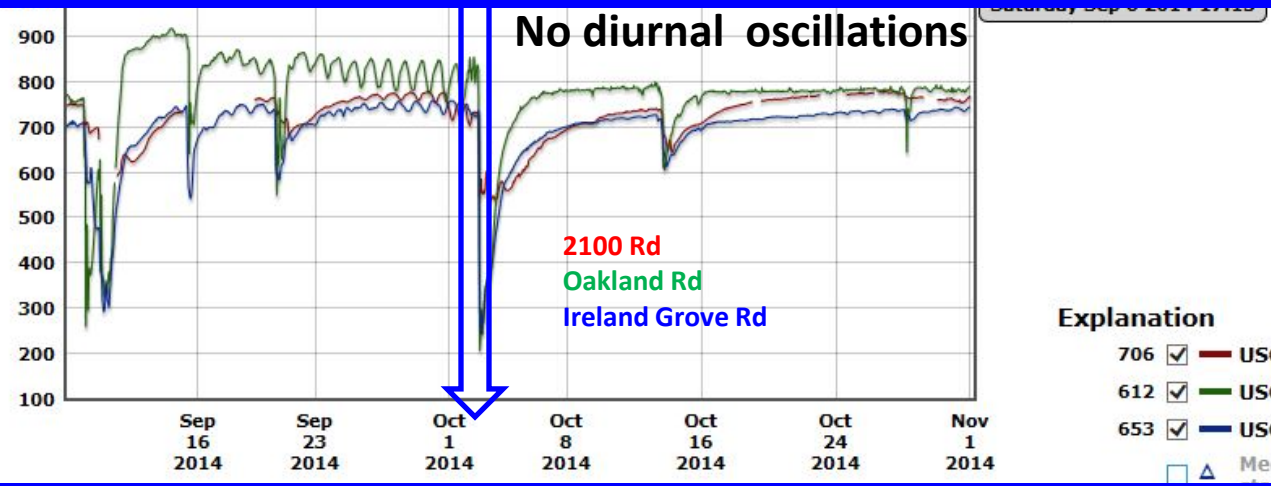
Ireland Grove Rd USGS 05579630 KICKAPOO CREEK NEAR BLOOMINGTON, IL

High nitrate levels in low flows with conductivity of 600-900uSeimens

Specific Conductance

Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius

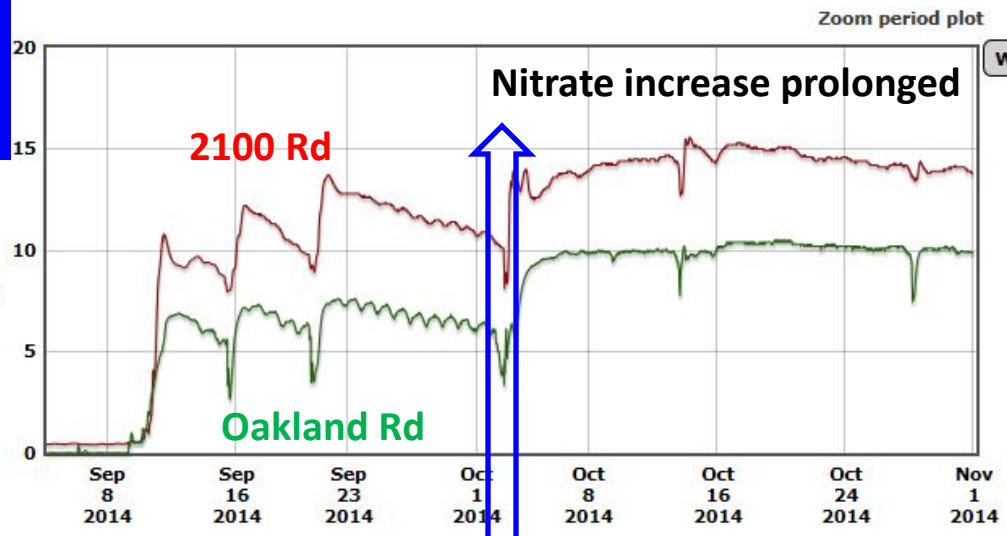


Low base flows have high nitrate concentrations in high specific conductivity waters

Both upstream gages represent WQ diurnal reductions in ag ditches

Nitrate

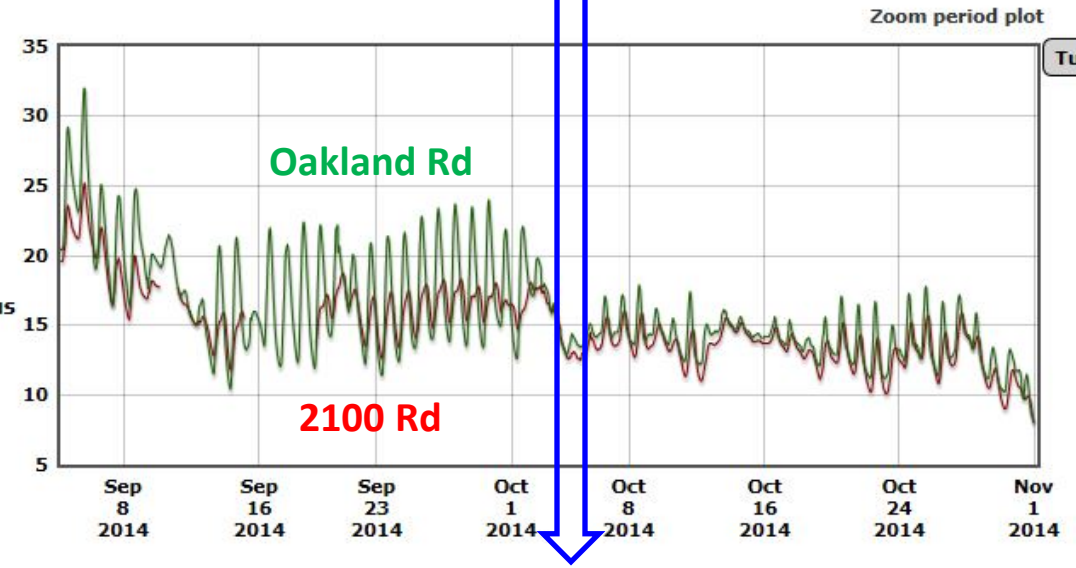
Nitrate plus nitrite, water, in situ, milligrams per liter as nitrogen



Explanati 2100 Rd
USGS 05579610
Median daily sta (1 year)
USGS 05579620
Oakland Rd

2100 Rd USGS 05579610 KICKAPOO CREEK AT 2100E ROAD NEAR BLOOMINGTON, IL
Oakland Rd USGS 05579620 KICKAPOO CREEK TRIBUTARY NEAR BLOOMINGTON, IL

Temperature, water, degrees Celsius



Explanatio 2100 Rd
-- USGS 0557961
14.5 USGS 0557962
Oakland Rd

Greater temperatures oscillations at Oakland Rd than at 2100 Rd results in Greater nitrate oscillations at Oakland Rd gage