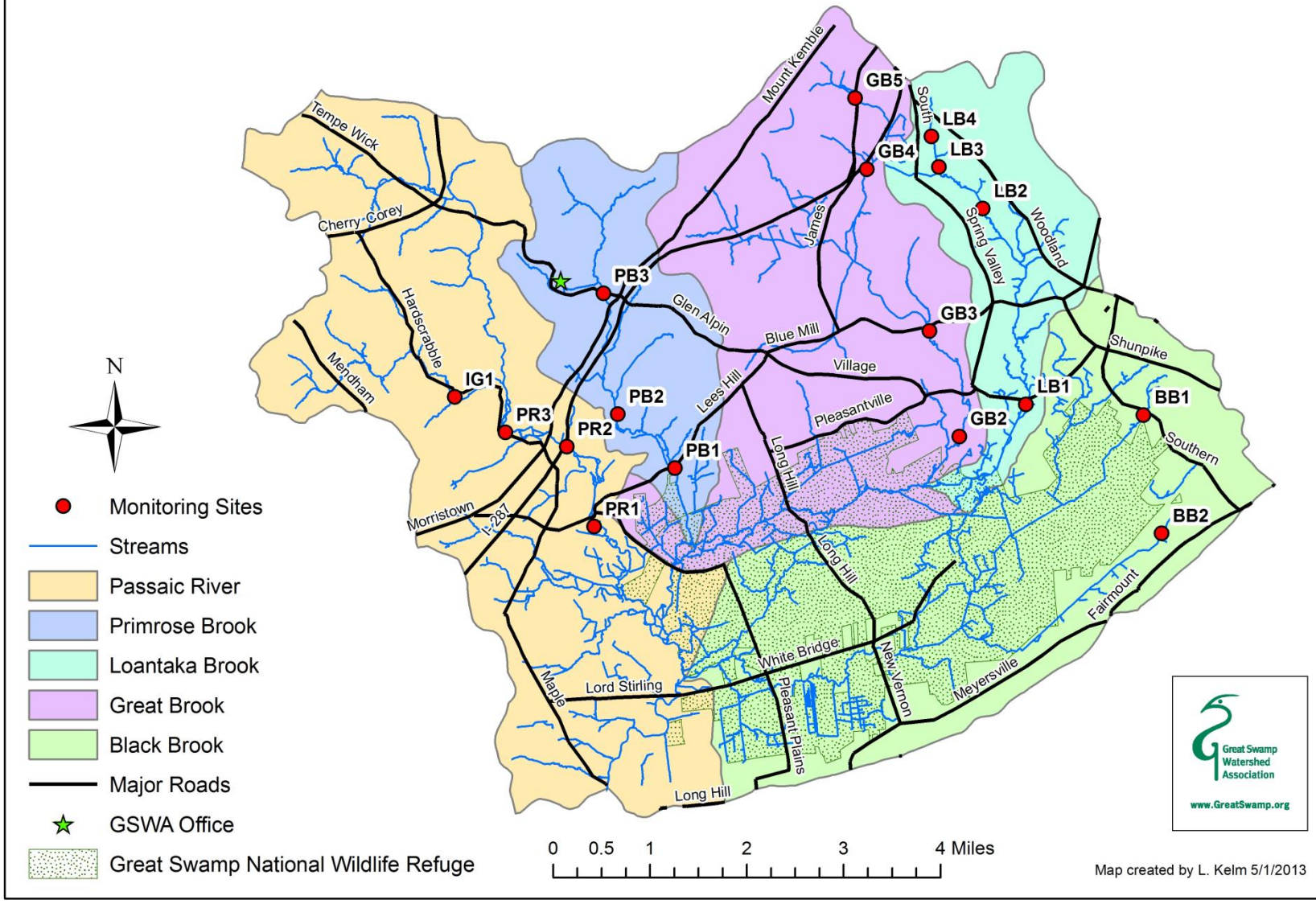
*Macroinvertebrate Communities of the Great Swamp Watershed

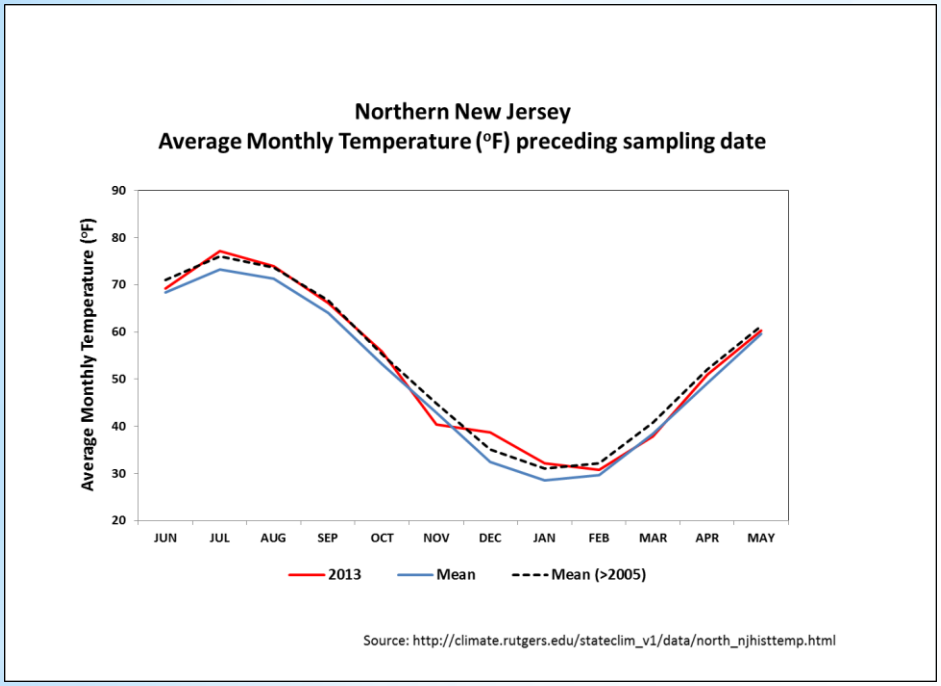
2013

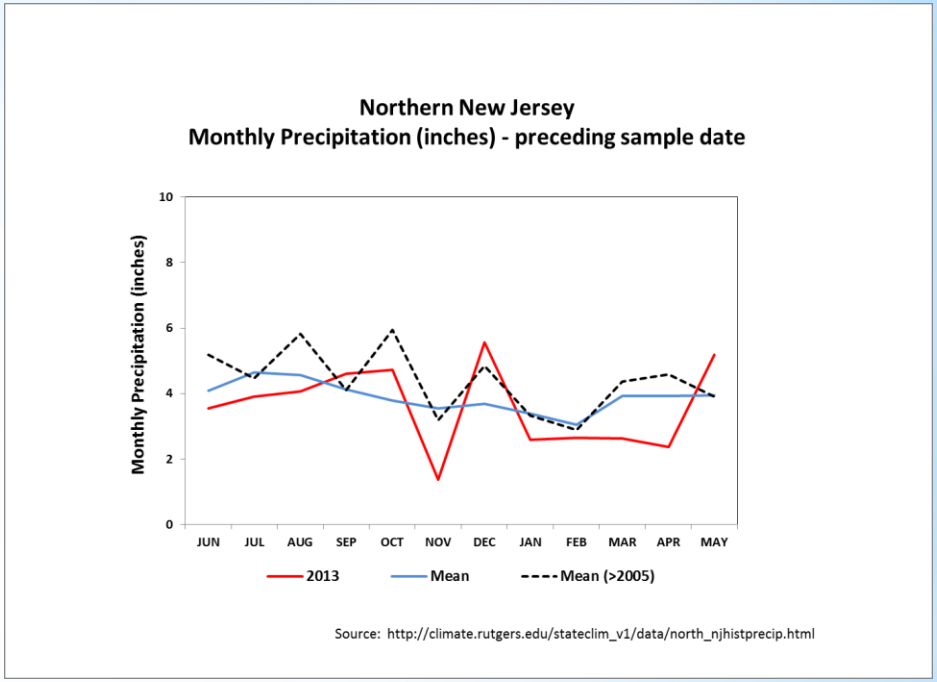
Lee Pollock

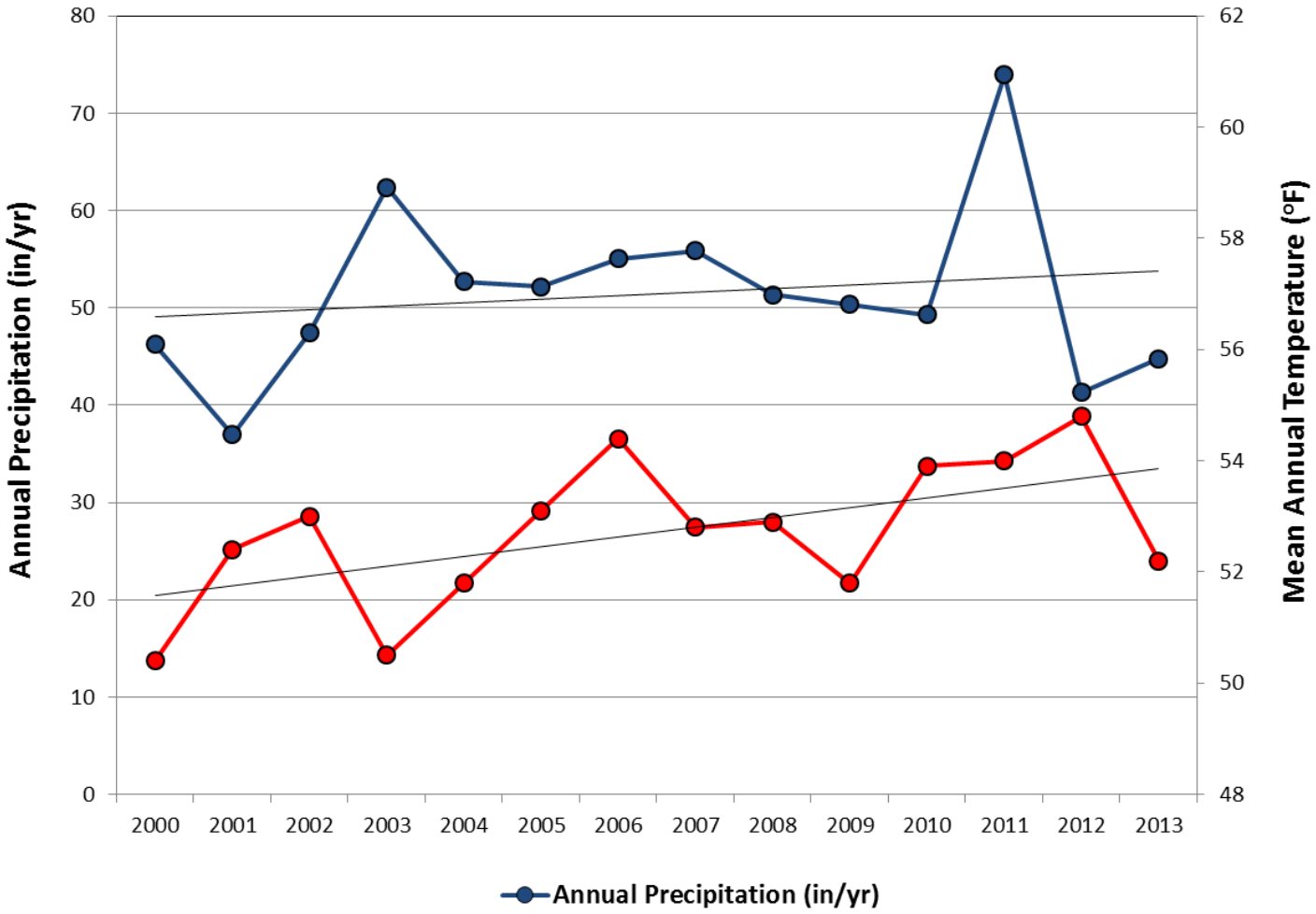
Professor Emeritus
Drew University

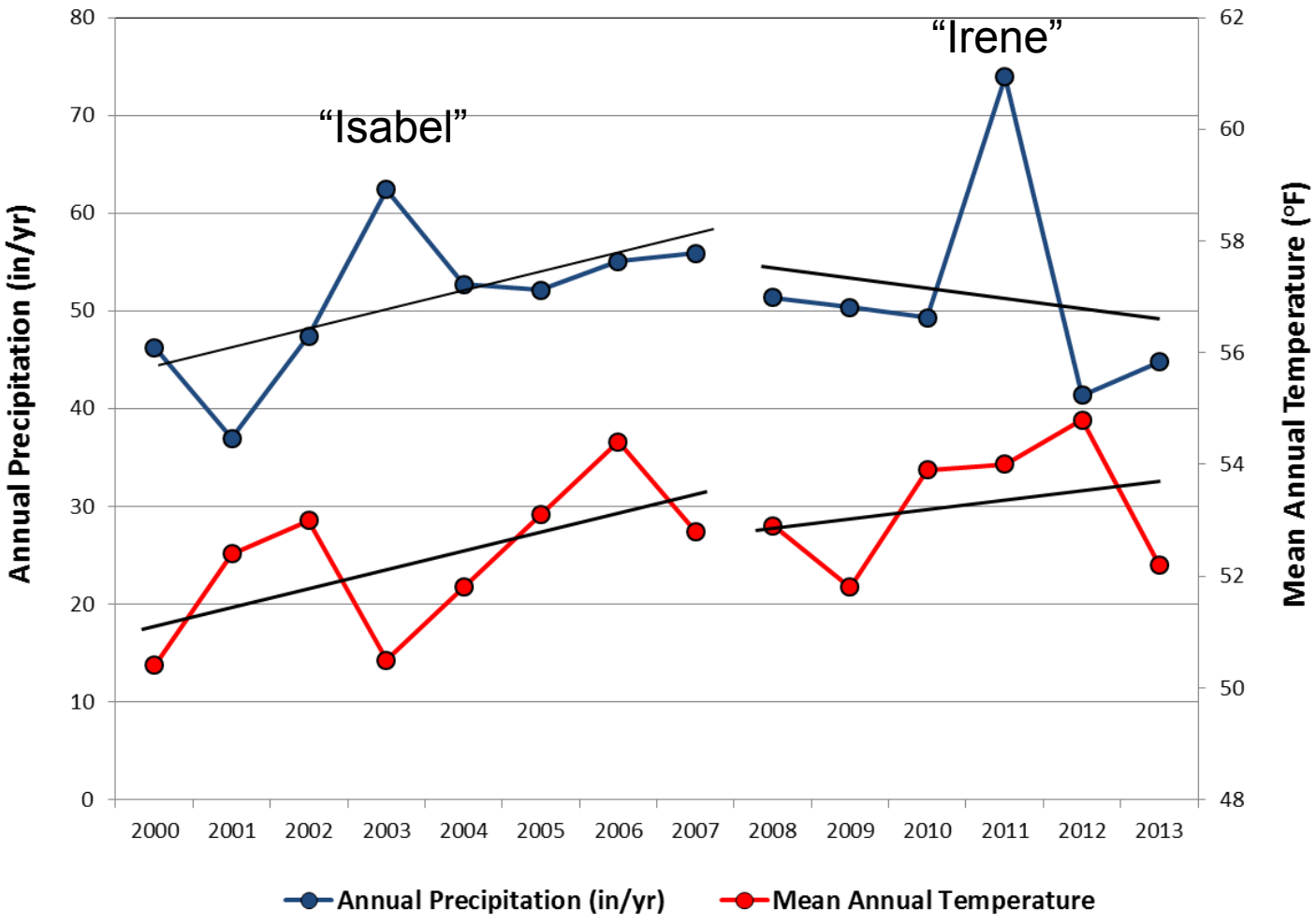
Macroinvertebrate Monitoring Sites in the Great Swamp Watershed




Northern New Jersey
Average Monthly Temperature (°F) preceding sampling date
Average Monthly Temperature (°F)
90
80
70
60
50
40
30
20
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
2013
Mean
Mean (>2005)
Source: http://climate.rutgers.edu/stateclim_v1/data/north_njhisttemp.html


Northern New Jersey
Monthly Precipitation (inches) - preceding sample date
Monthly Precipitation (inches)
10
8
6
4
2
0
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
2013
Mean
Mean (>2005)
Source: http://climate.rutgers.edu/stateclim_v1/data/north_njhistprecip.html


Northern New Jersey
Annual Climate Values
Annual Precipitation (in/yr)
Mean Annual Temperature (°F)
80
70
60
50
40
30
20
10
0
62
60
58
56
54
52
50
48
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Annual Precipitation (in/yr)


Northern New Jersey
Annual Climate Values
"Isabel"
"Irene"
Annual Precipitation (in/yr)
Mean Annual Temperature (°F)
80
70
60
50
40
30
20
10
0
62
60
58
56
54
52
50
48
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Annual Precipitation (in/yr)
Mean Annual Temperature

Great Swamp Watershed, May 16, 2013. Habitat Assessment

*** Average, 2000-2008 ** Determined once**

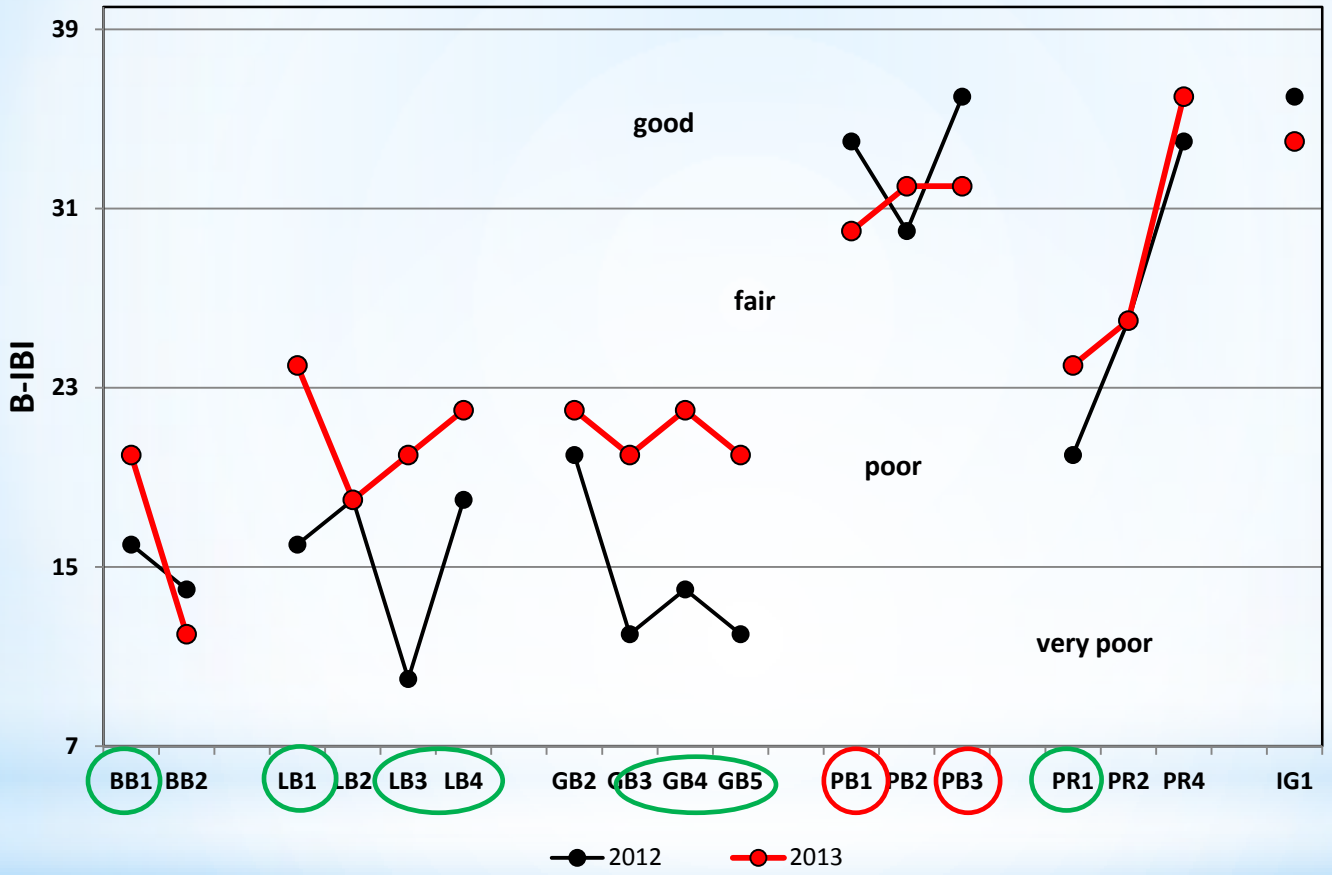
	B-IBI	temp	TDS	DO	pH	Turbidity	total	HabValue2	
BB1	20	15.0	631	7.49	8.48	1.06	78	28	**BB1**
BB2	12	15.1	343.7	6.81	8.53	4.52	67	24	**BB2**
LB1	24	14.8	569	6.94	7.90	5.97	81	29	**LB1**
LB2	18	17.4	708	9.24	7.83	4.29	94	32	**LB2**
LB3	20	17.7	752	7.83	7.08	1.59	90	33	**LB3**
LB4	22	15.7	1013	8.89	7.83	5.47	59	21	**LB4**
GB2	22	14.1	293.8	8.39	8.29	5.05	78	31	**GB2**
GB3	20	14.7	308	8.59	7.96	6.45	136	70	**GB3**
GB4	22	16.7	568	7.48	7.57	2.67	83	40	**GB4**
GB5	20	21.9	487	8.61	7.76	11.60	98	47	**GB5**
PB1	30	17.0	171.4	9.48	7.67	1.88	124	59	**PB1**
PB2	32	17.4	176.1	9.05	7.61	2.06	134	56	**PB2**
PB3	32	17.1	97.8	9.75	7.76	1.84	155	76	**PB3**
PR1	24	18.8	199.7	10.1	7.51	2.96	119	50	**PR1**
PR2	26	17.1	187.9	10	7.62	2.67	82	24	**PR2**
PR3	36	17.1	148.8	10.02	7.41	1.09	154	78	**PR3**
IG1	34	16.9	156.7	9.86	7.49	1.05	158	83	**IG1**

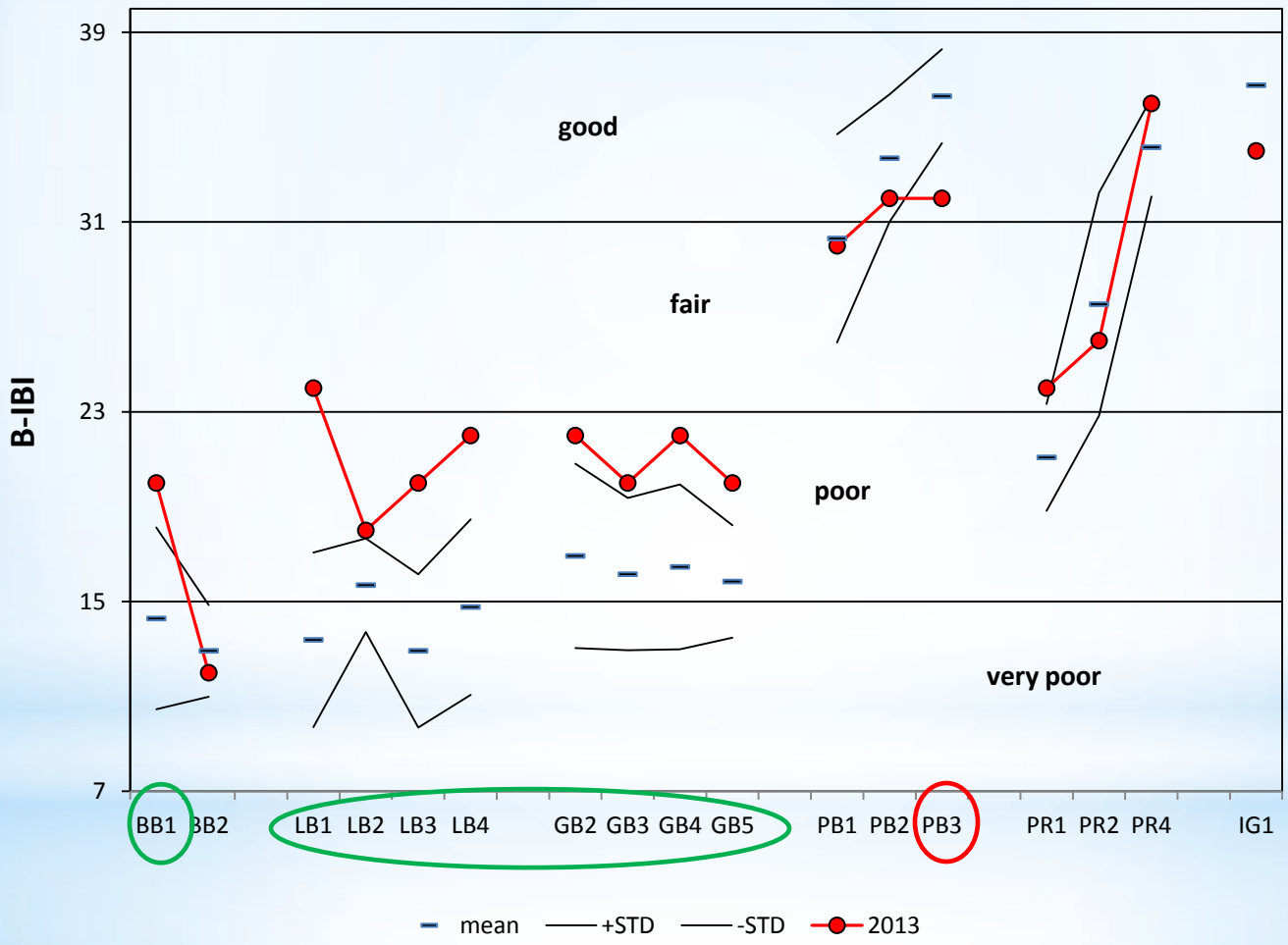
- Macroinvertebrates (MIVs)
  - Direct, integrative measure of water quality
  - Provide historical information
  - Can be used to identify impairment sources
  - Both broad dispersal as adults and limited mobility as nymphs/larvae
  - Normally abundant
  - Easy & inexpensive to sample and identify

Calculating the Benthic Index of Biological Integrity B-IBI

	BB1		RB1		Scoring Table		
	2008	2007	2008	2007	1	3	5
Dominance	0.485	0.724	0.310	0.590	>.75	.75-.5	<.5
Taxa	33	21	31	26	<12	12-20	>20
%Predators	0.051	0.008	0.138	0.067	<.025	.025-.1	>.1
Ind Intolerant	3	3	3	6	<2	2-4	>4
#Ephem	4	3	4	6	<2	2-5	>5
#Trich	6	4	9	5	<2	2-5	>5
#Plec	1	0	2	3	<2	2-4	>4
Ind Tolerant	3	3	2	2	>4	4-2	<2
					High		Low
					Stress Level		
B-IBI Scores							
Dominance	***5***	3	**5**	3			
Taxa	5	5	5	5			
%Predators	***3***	1	***5***	3			
Ind Intolerant	3	3	3	5			
#Ephem	3	3	3	5			
#Trich	***5***	3	***5***	3			
#Plec	1	1	3	3			
Ind Tolerant	3	3	3	3			
B-IBI Total	**28**	**22**	**32**	**30**			
	BB1		RB1				

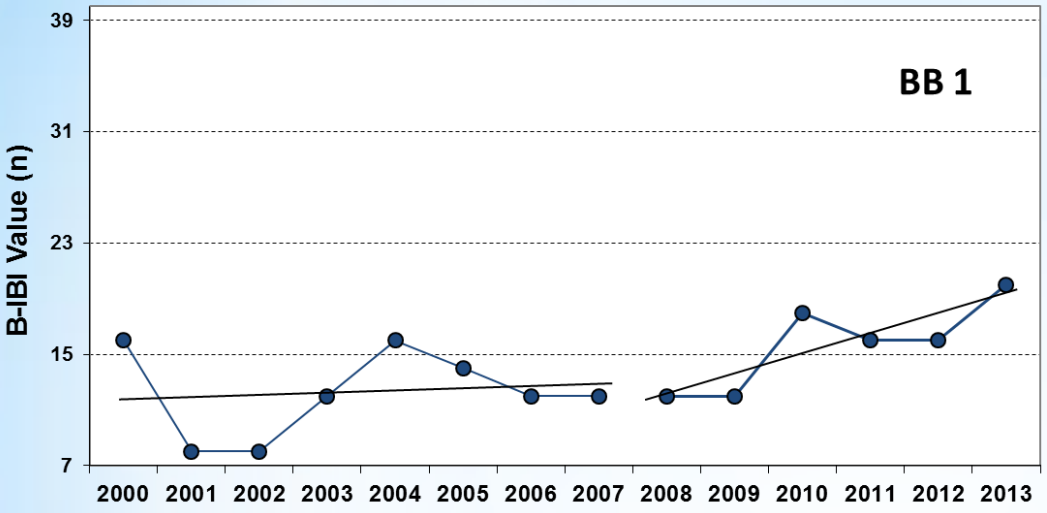
E P T


39
31
23
15
7
B-IBI
good
fair
poor
very poor
BB1
BB2
LB1
LB2
LB3
LB4
GB2
GB3
GB4
GB5
PB1
PB2
PB3
PR1
PR2
PR4
IG1
2012
2013


B-IBI
39
31
23
15
7
good
fair
poor
very poor
BB1
BB2
LB1
LB2
LB3
LB4
GB2
GB3
GB4
GB5
PB1
PB2
PB3
PR1
PR2
PR4
IG1
mean
+STD
-STD
2013

Southern Boulevard, Chatham Township
Golf course; heavily traveled roadway

*BB 1

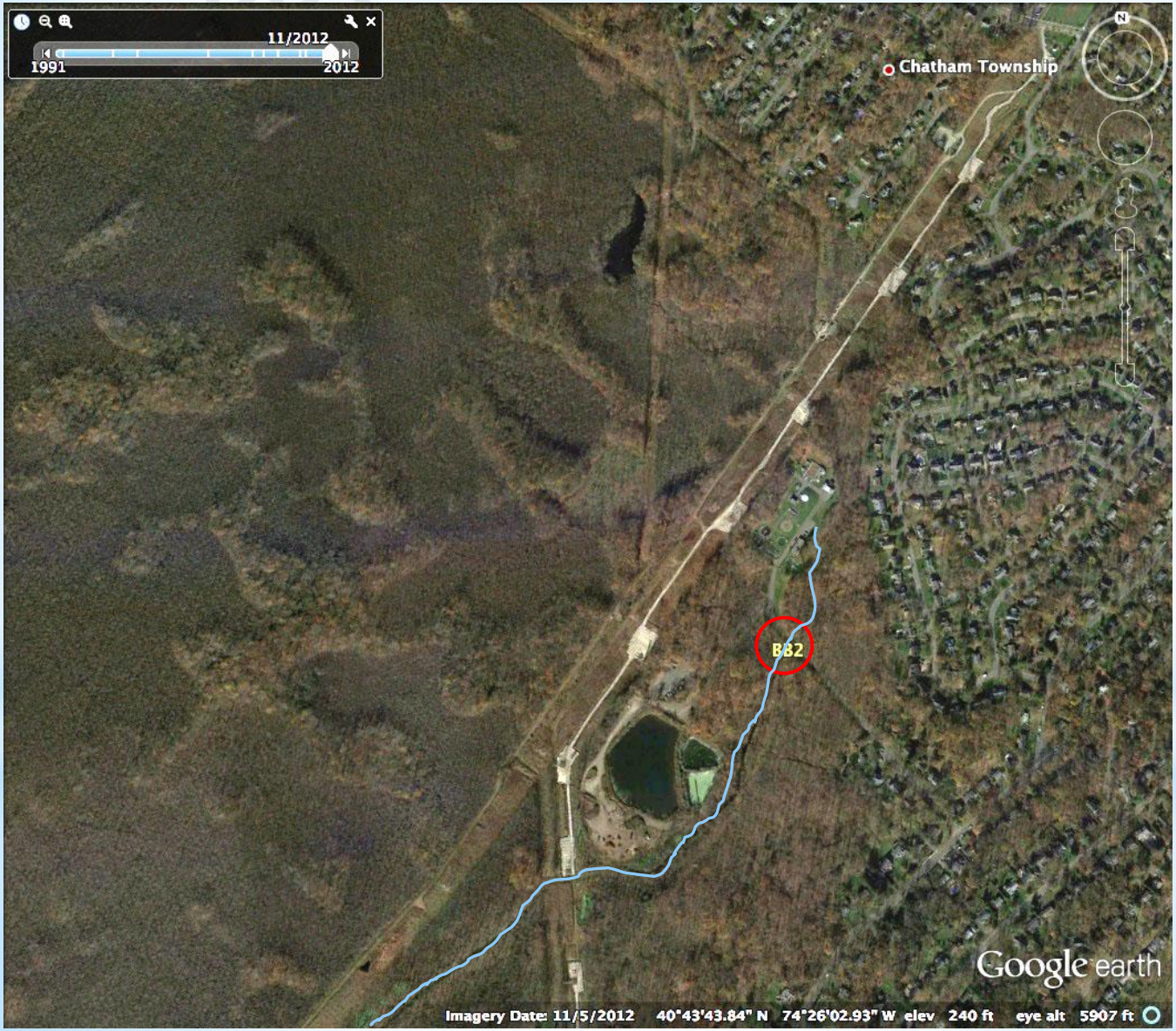


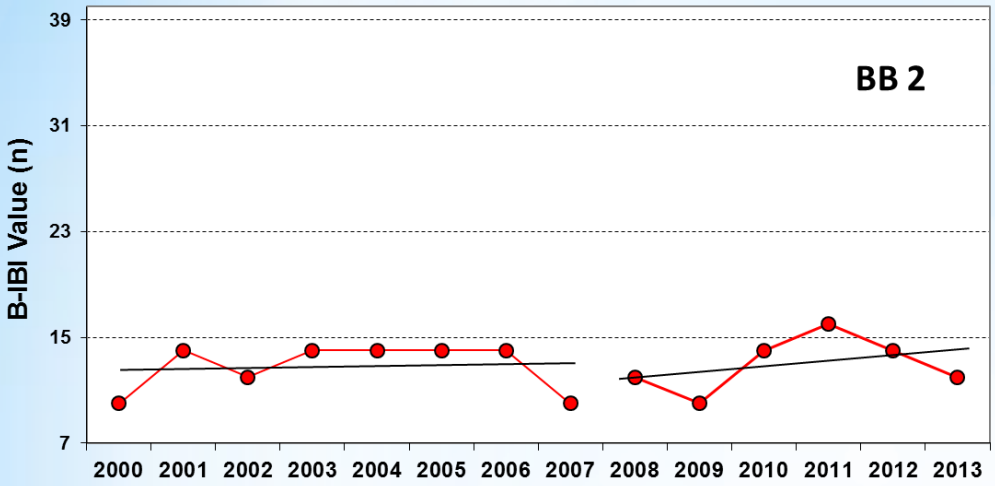
*BB 1

Small, slow flow
High temperature,
oil films
2013 – high TDS (>NJS);
hydropsychid dominance down

*BB2

Drainage channel, STP





Good

Fair

Poor

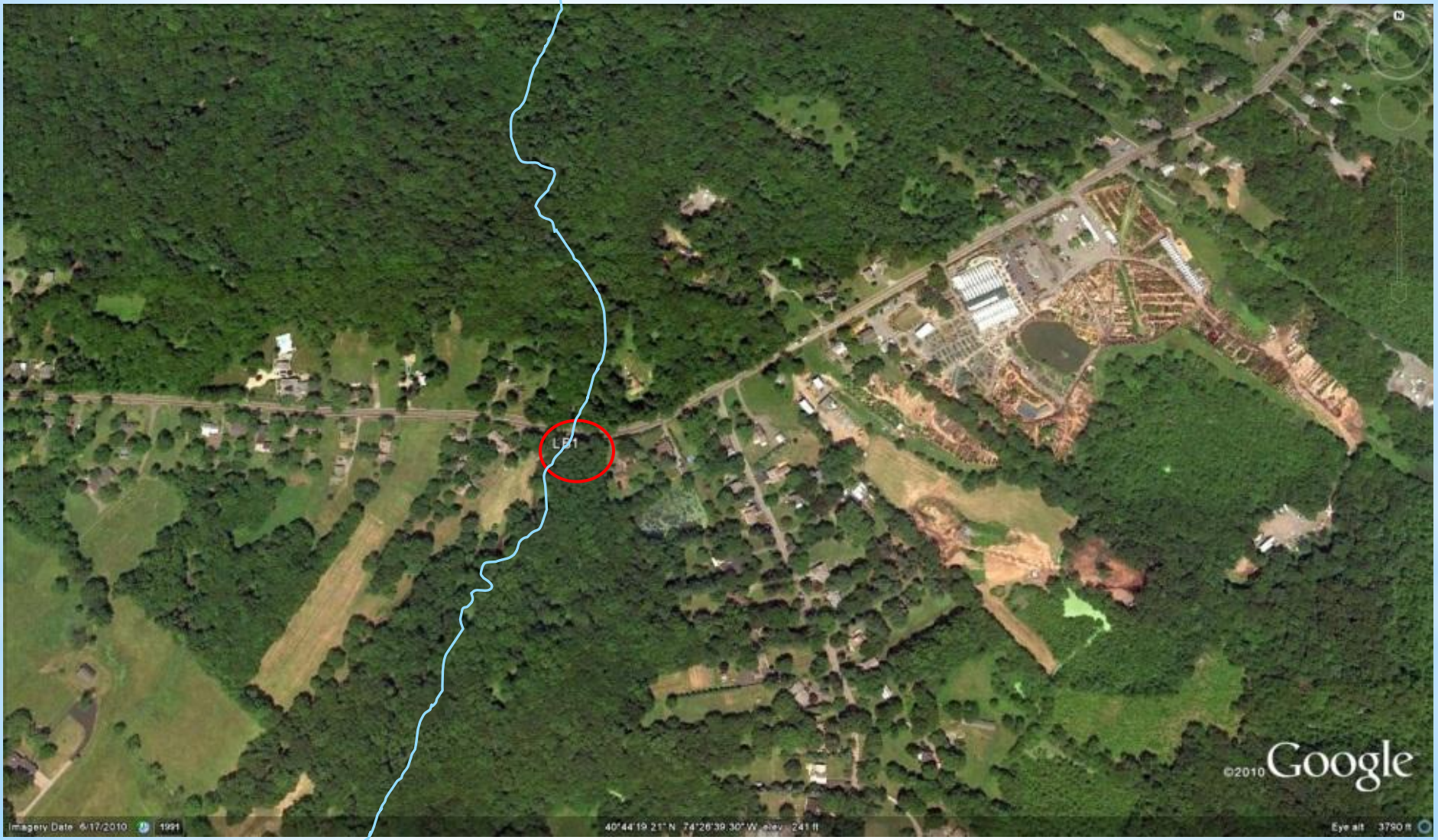
Very Poor

*BB2

Sandy, poor substrate

2013 - high pH
To be dropped?

GSWA monitoring site



*LB1

Limited substrate

High turbidity, sediments

Diluted but high TDS (>NJS)

2013 higher TAXA, esp chironomids

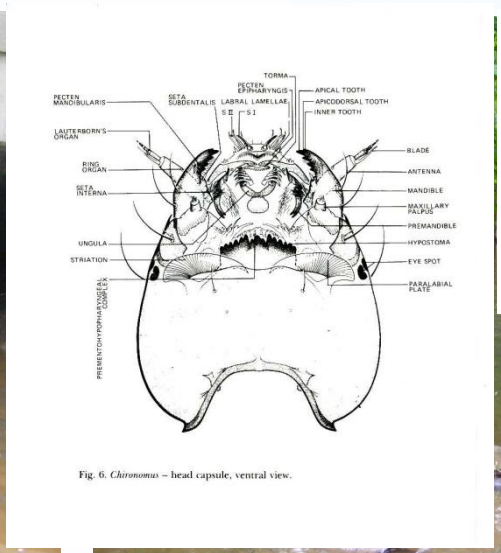
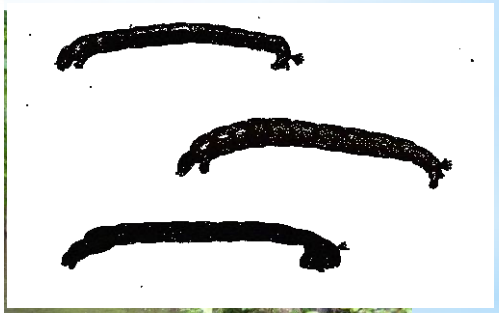
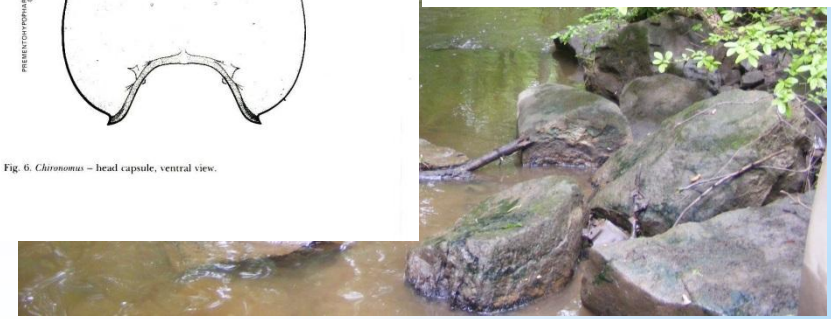
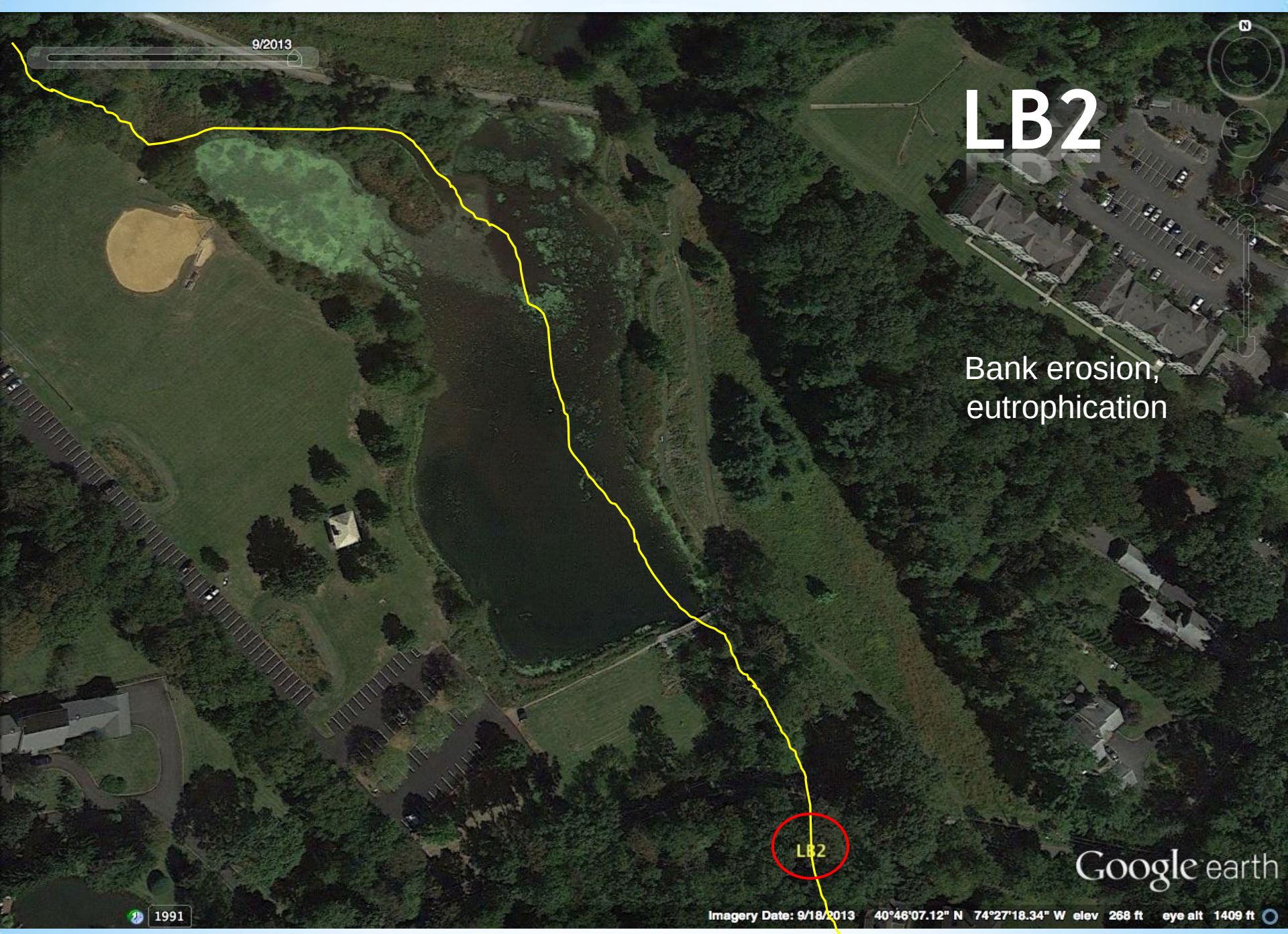
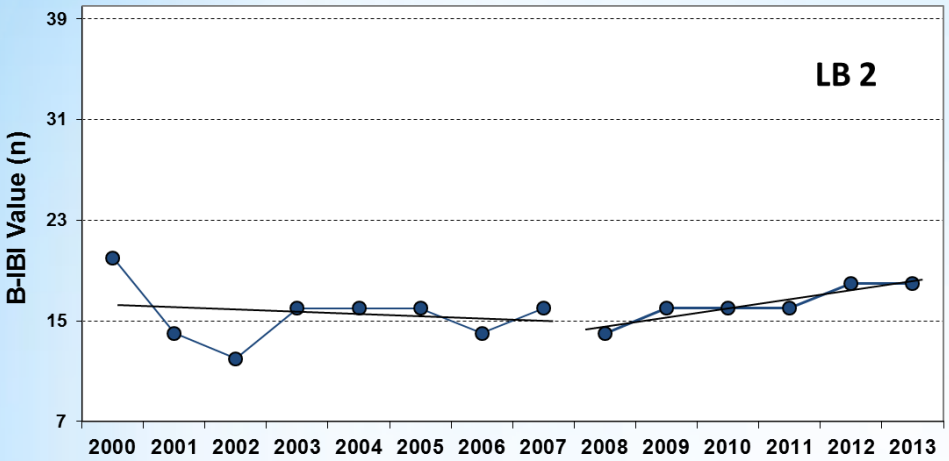


Fig. 6. *Chironomus* – head capsule, ventral view.






9/2013
LB2
Bank erosion, eutrophication
LB2
Google earth
1991
Imagery Date: 9/18/2013 40°46'07.12" N 74°27'18.34" W elev 268 ft eye alt 1409 ft

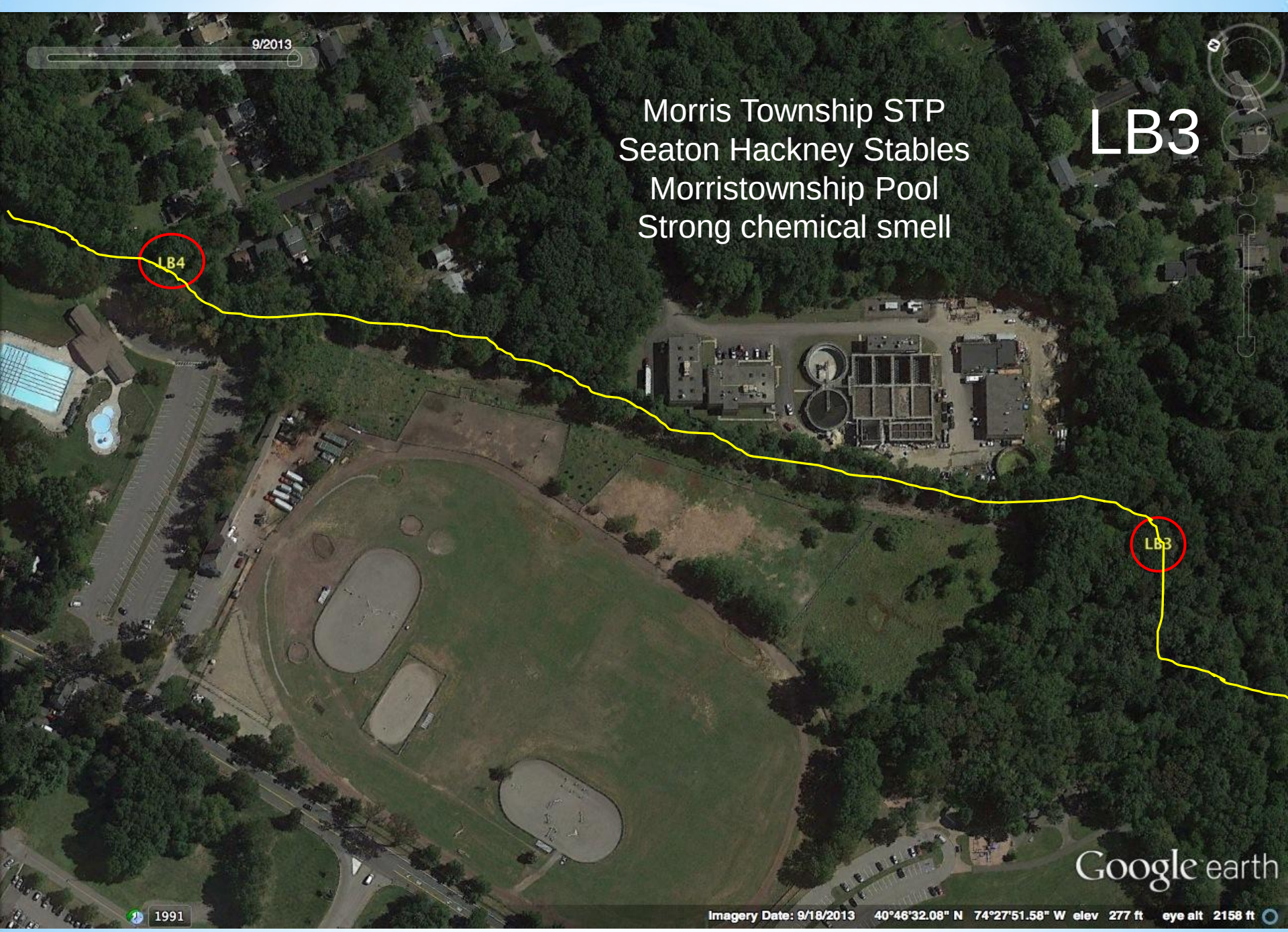


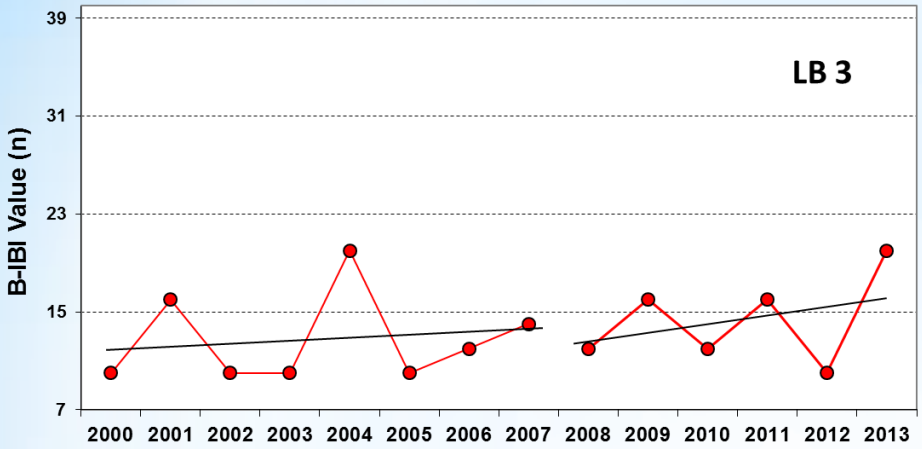
*LB2

Higher temperature

low DO, detritus

High TDS >NJS, chemical smell


9/2013
Morris Township STP
Seaton Hackney Stables
Morristownship Pool
Strong chemical smell
LB3
LB4
LB3
Google earth
1991
Imagery Date: 9/18/2013 40°46'32.08" N 74°27'51.58" W elev 277 ft eye alt 2158 ft



*LB3

Very limited substrate - shifting sands

TDS = 752 mg/L; >>NJS

2013: Taxa up; oligochaete dominance down

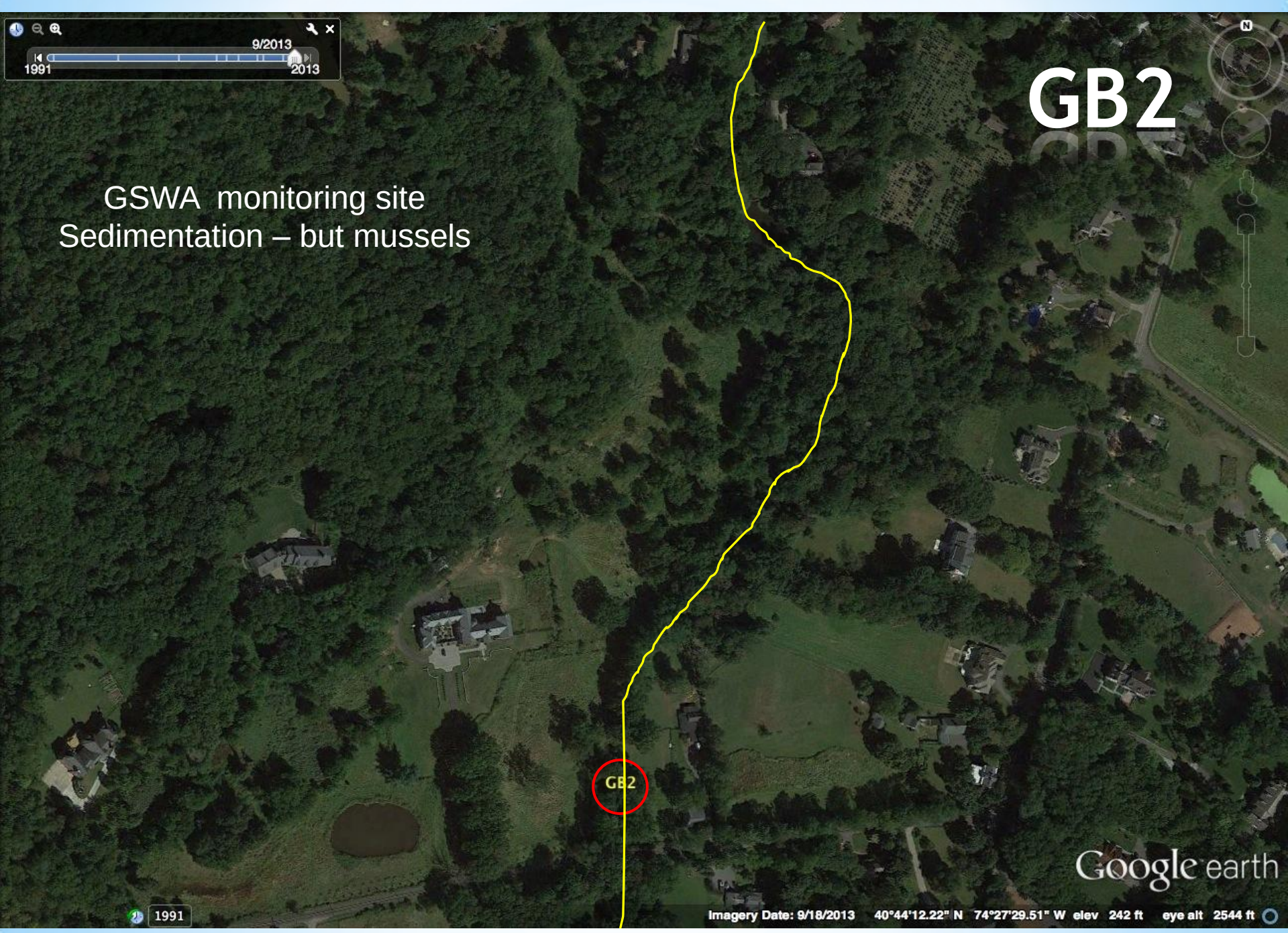
Fanok Road municipal pool
Channelized ditch

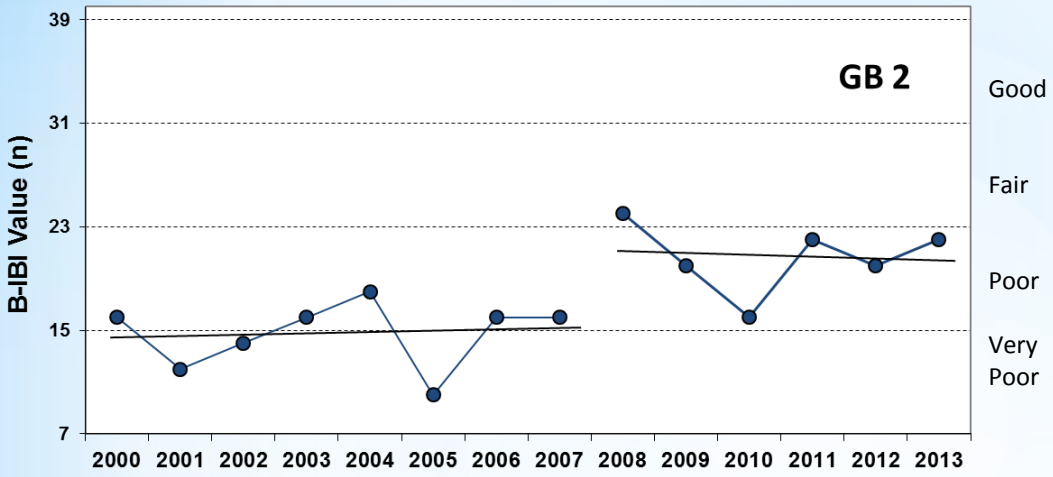
*LB4

Little MIV substrate

TDS = 1013 mg/L, >>NJS

2013: Taxa doubled,
13 chironomid types


9/2013
1991
2013
GB2
GSWA monitoring site
Sedimentation – but mussels
GB2
1991
Google earth
Imagery Date: 9/18/2013 40°44'12.22" N 74°27'29.51" W elev 242 ft eye alt 2544 ft



*GB2

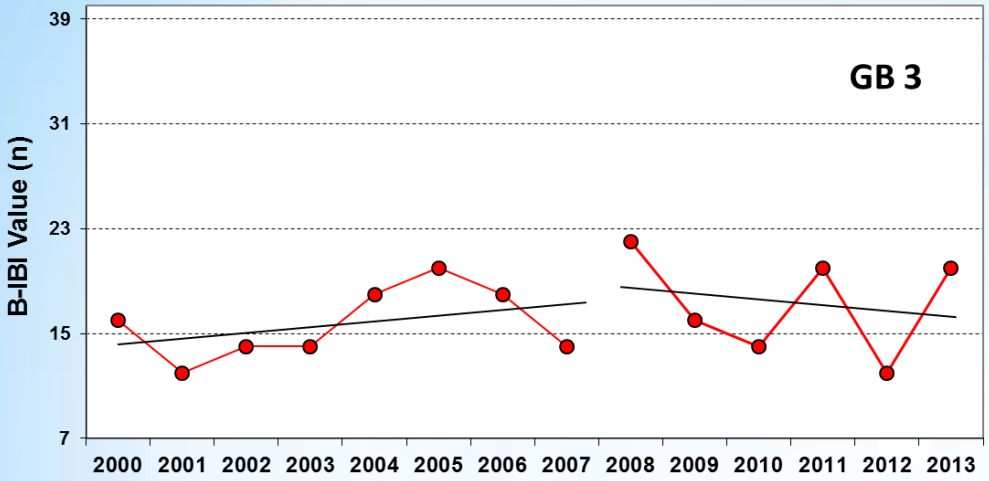
Poor substrate diversity

,

High turbidity –
silt bar expanding

Mussel bed


9/2013
GB3
Below Silver Lake
Agricultural land
GB3
Google earth
1991
Imagery Date: 9/18/2013 40°45'04.16" N 74°28'09.51" W elev 266 ft eye alt 2761 ft



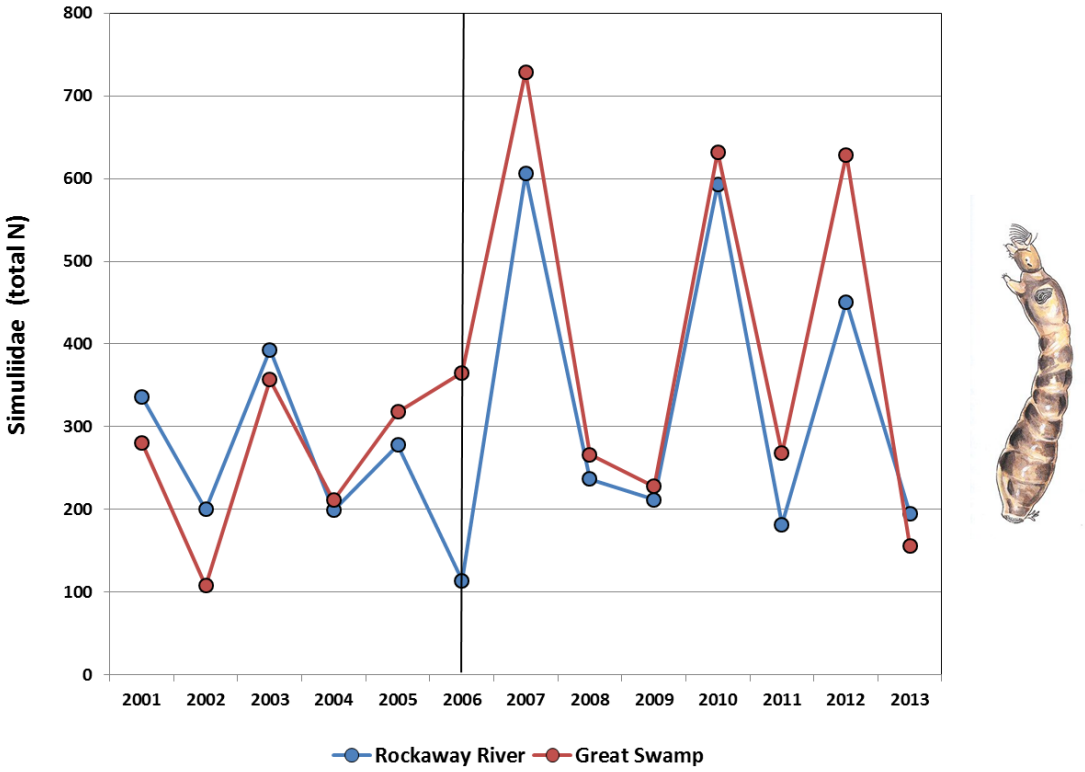
*GB3

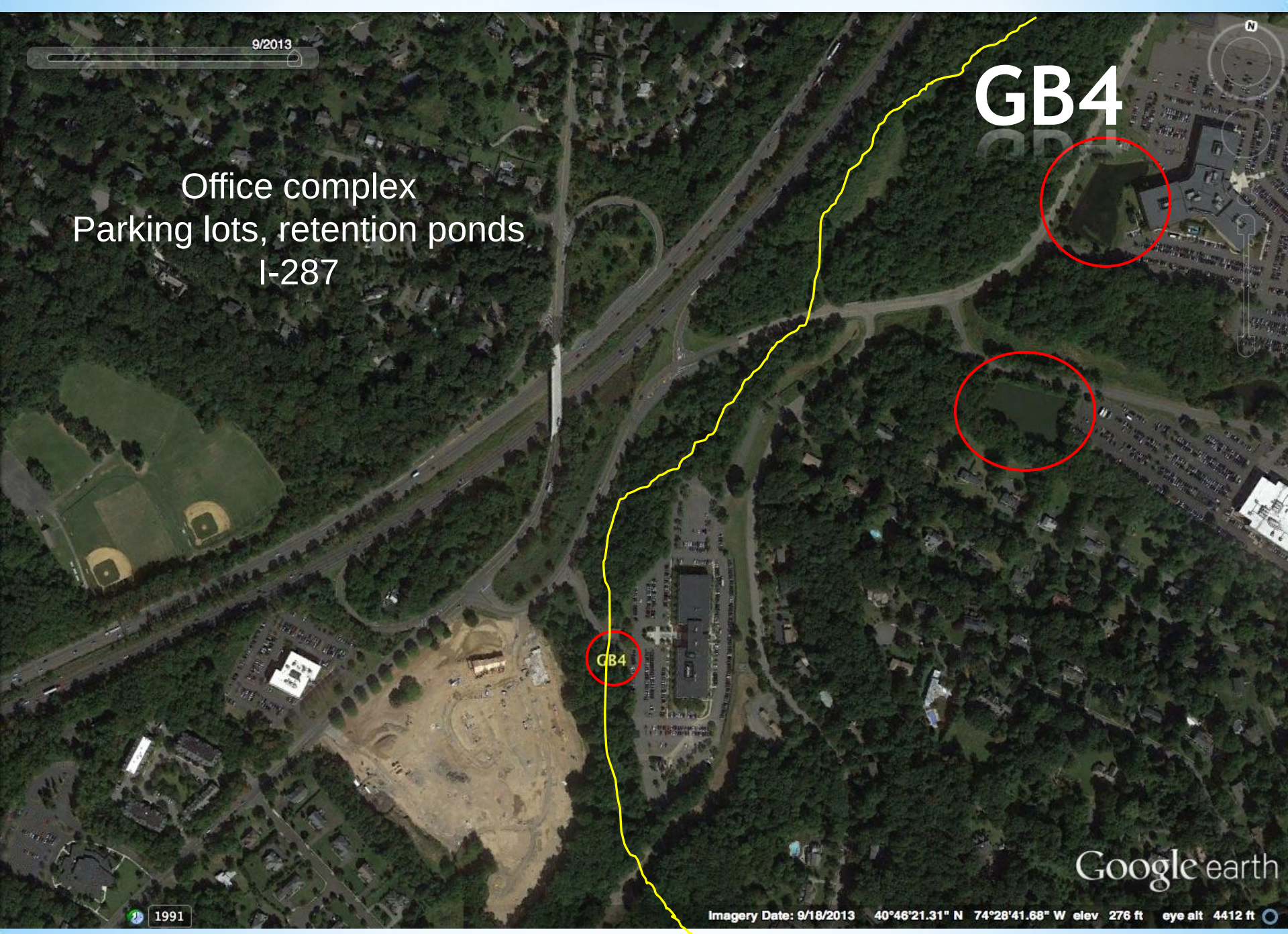
Good substrate

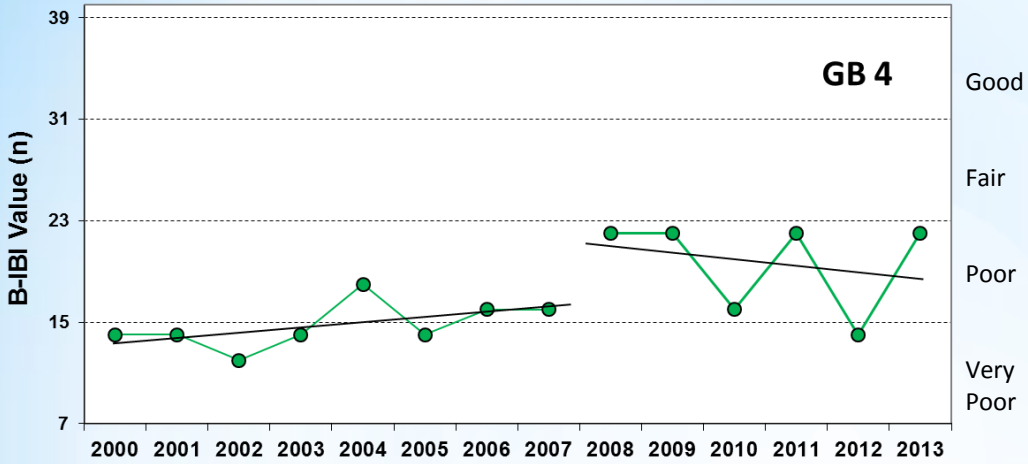
High temperature
Very high turbidity – silt & debris

2013 – TAXA, mayflies higher, dominance down

Simuliidae - blackfly larvae




9/2013
GB4
Office complex
Parking lots, retention ponds
I-287
GB4
Google earth
1991
Imagery Date: 9/18/2013 40°46'21.31" N 74°28'41.68" W elev 276 ft eye alt 4412 ft

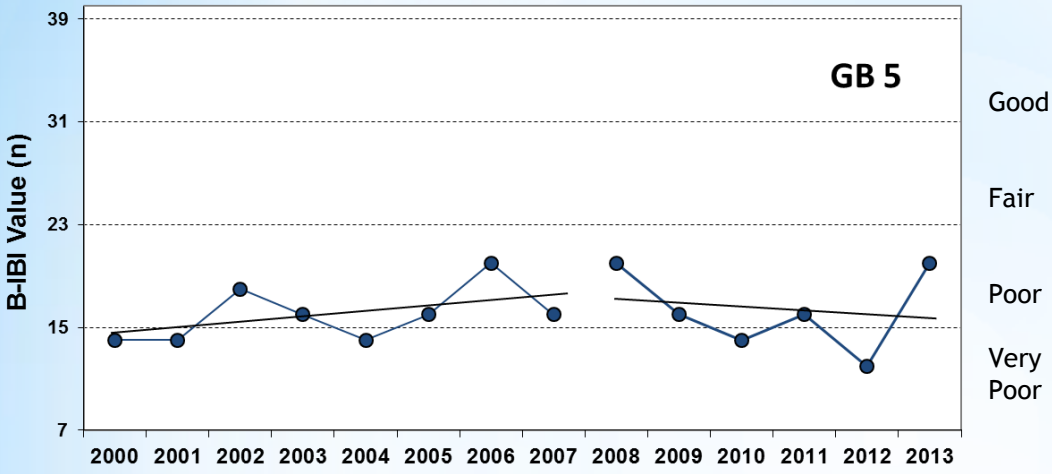


*GB4

Poor substrate,
High TDS & silt

2013: TAXA up,
Blackflies down

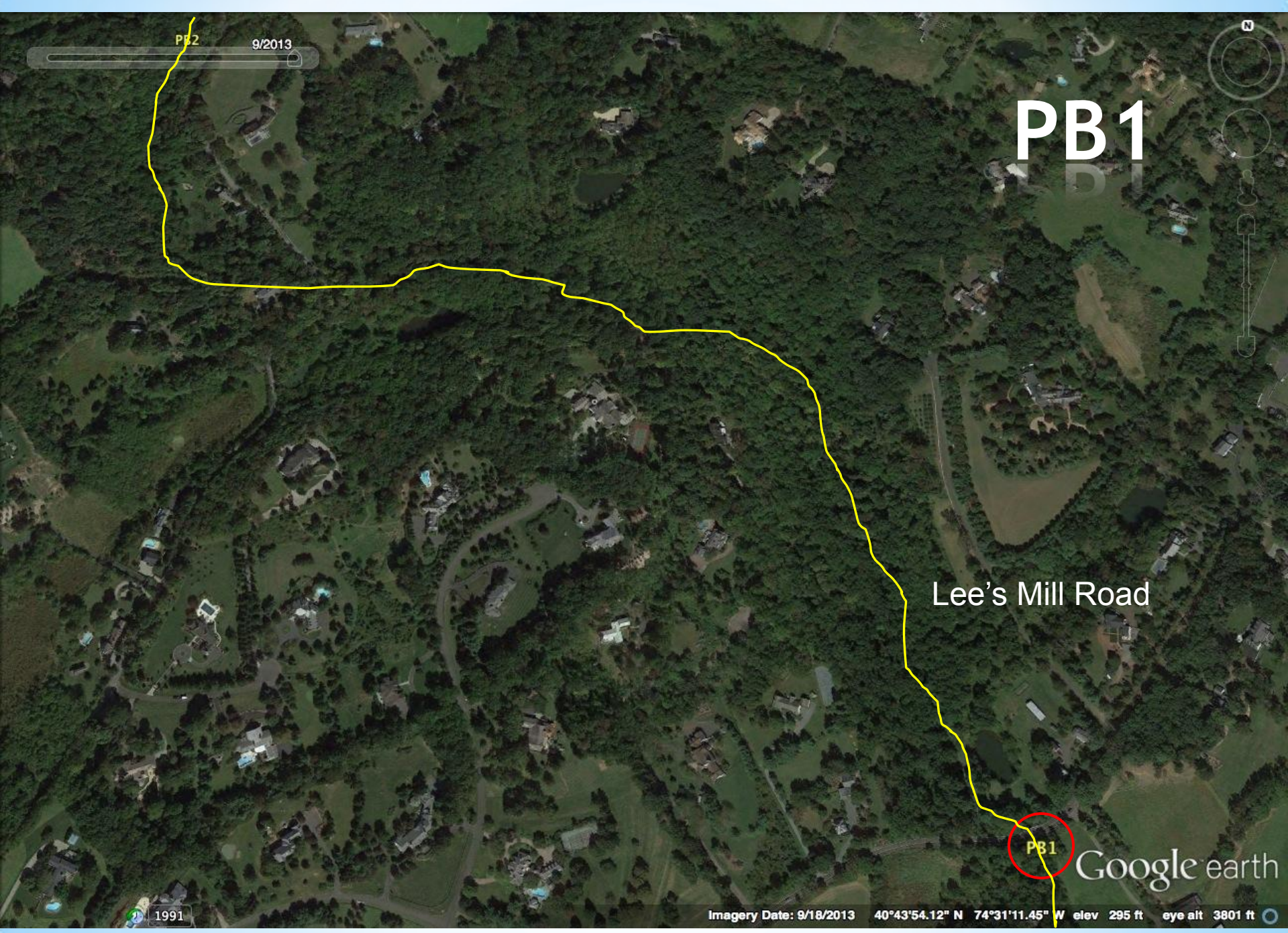

9/2013
GB5
James Street, Footes Pond
Eutrophic, silty
Golf course upstream
GB5
Google earth
1991
Imagery Date: 9/18/2013 40°47'06.84" N 74°28'59.48" W elev 300 ft eye alt 2501 ft

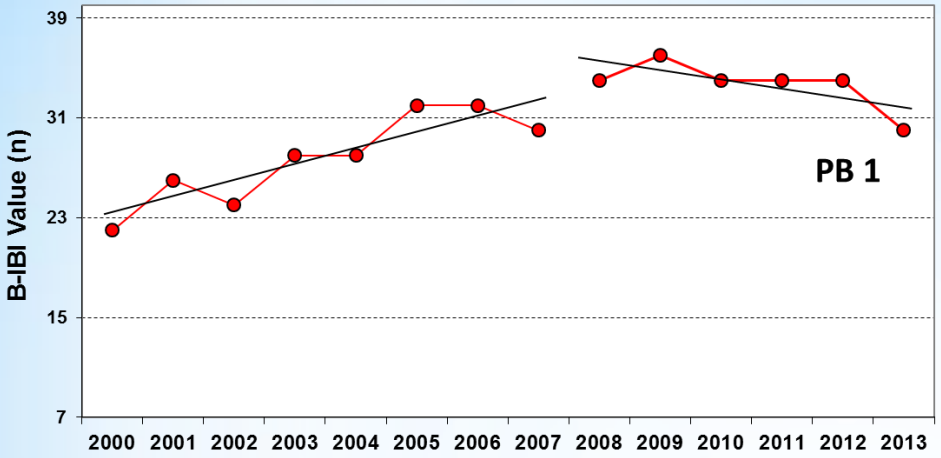


*GB5

Temperature high,
Low DO,
Thick silt & algae cover substrate

2013 – TAXA up
Blackflies down

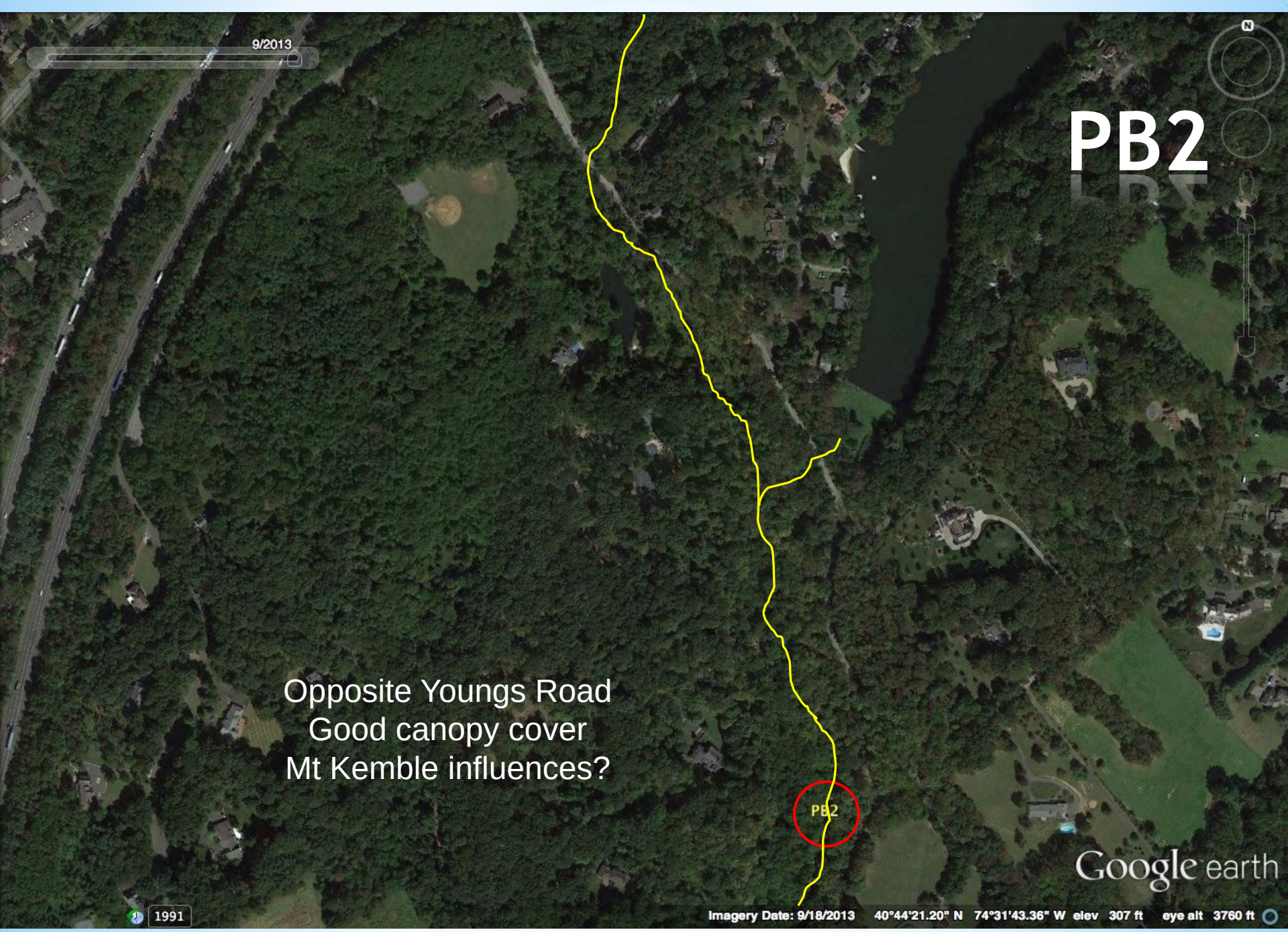

PB2
9/2013
PB1
Lee's Mill Road
PB1
Google earth
1991
Imagery Date: 9/18/2013 40°43'54.12" N 74°31'11.45" W elev 295 ft eye alt 3801 ft

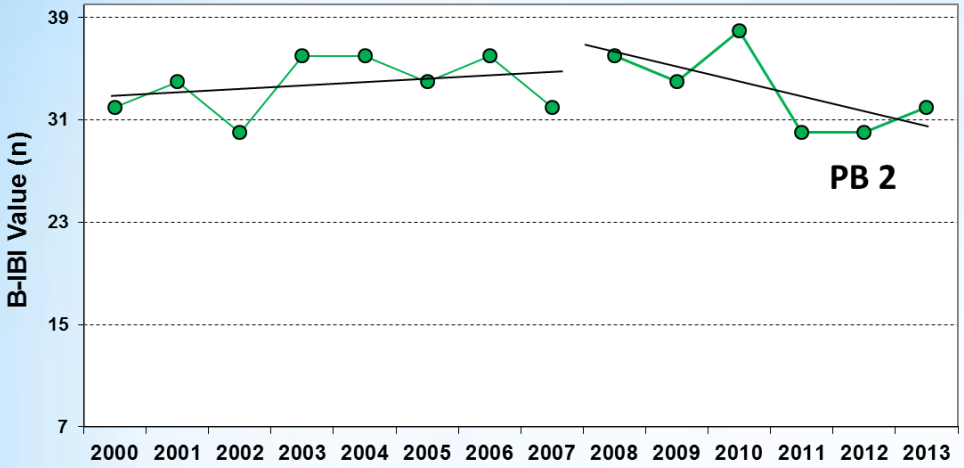


*PB1

Good substrate
Some sedimentation

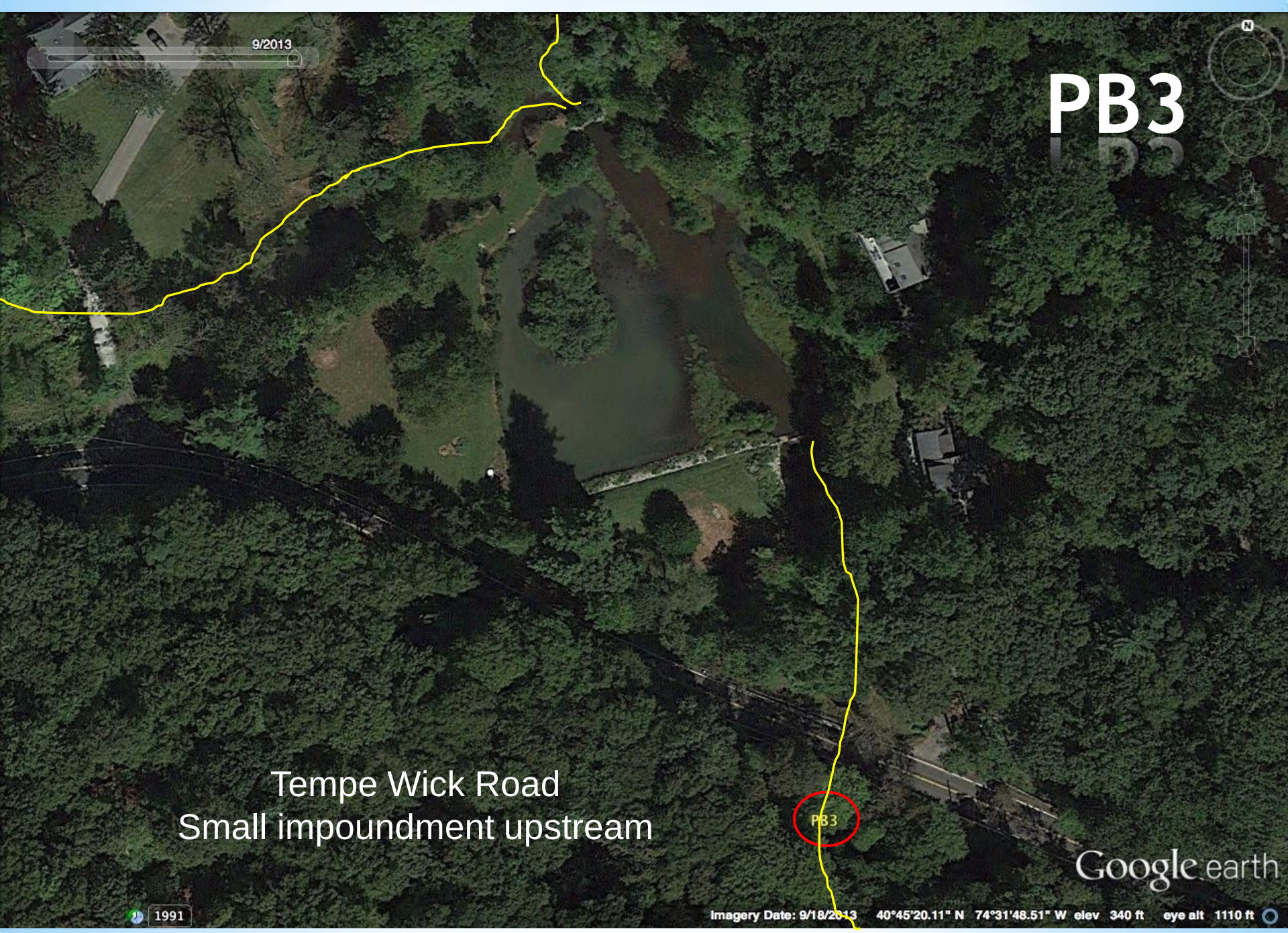
2013 – stoneflies & caddisflies down

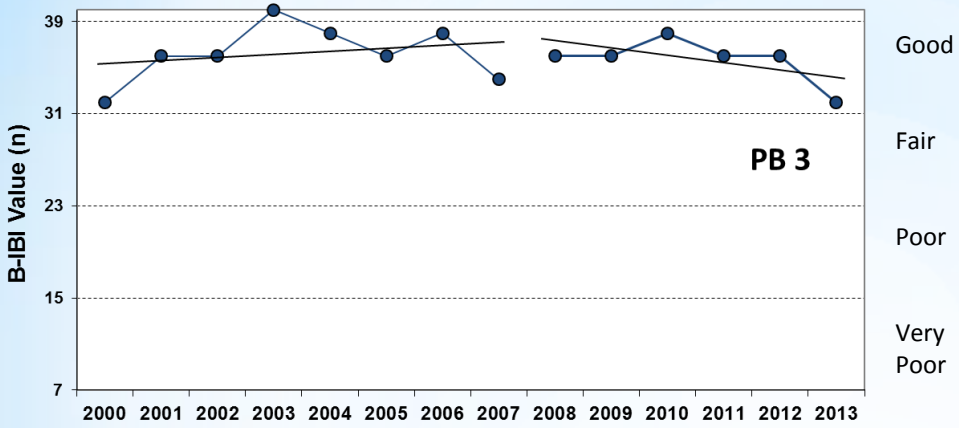

9/2013
PB2
Opposite Youngs Road
Good canopy cover
Mt Kemble influences?
PB2
Google earth
1991
Imagery Date: 9/18/2013 40°44'21.20" N 74°31'43.36" W elev 307 ft eye alt 3760 ft



*PB2

2013 – higher TAXA, more caddisflies

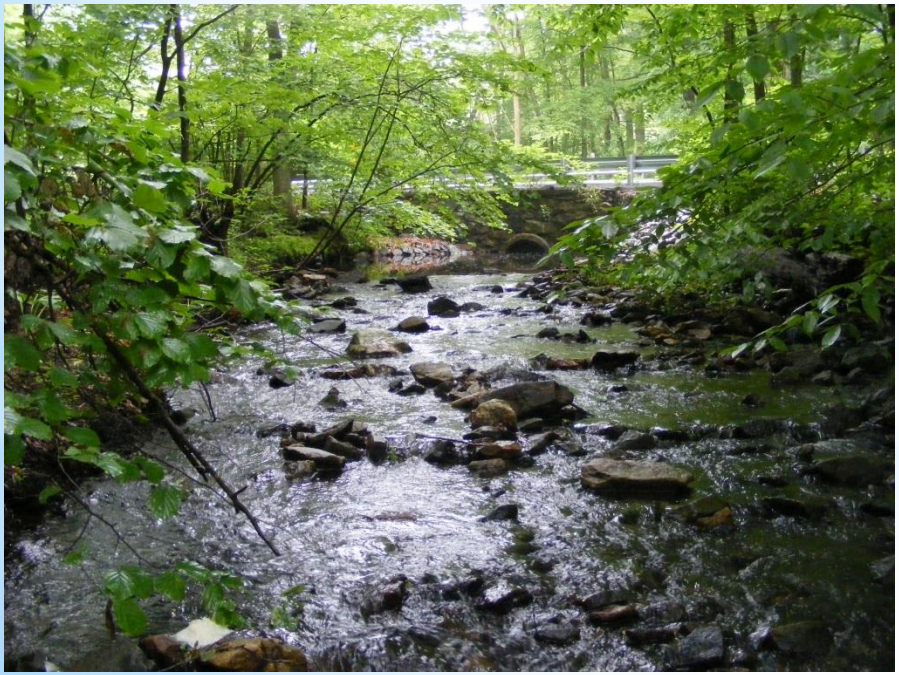

9/2013
PB3
Tempe Wick Road
Small impoundment upstream
PB3
Google earth
1991
Imagery Date: 9/18/2013 40°45'20.11" N 74°31'48.51" W elev 340 ft eye alt 1110 ft

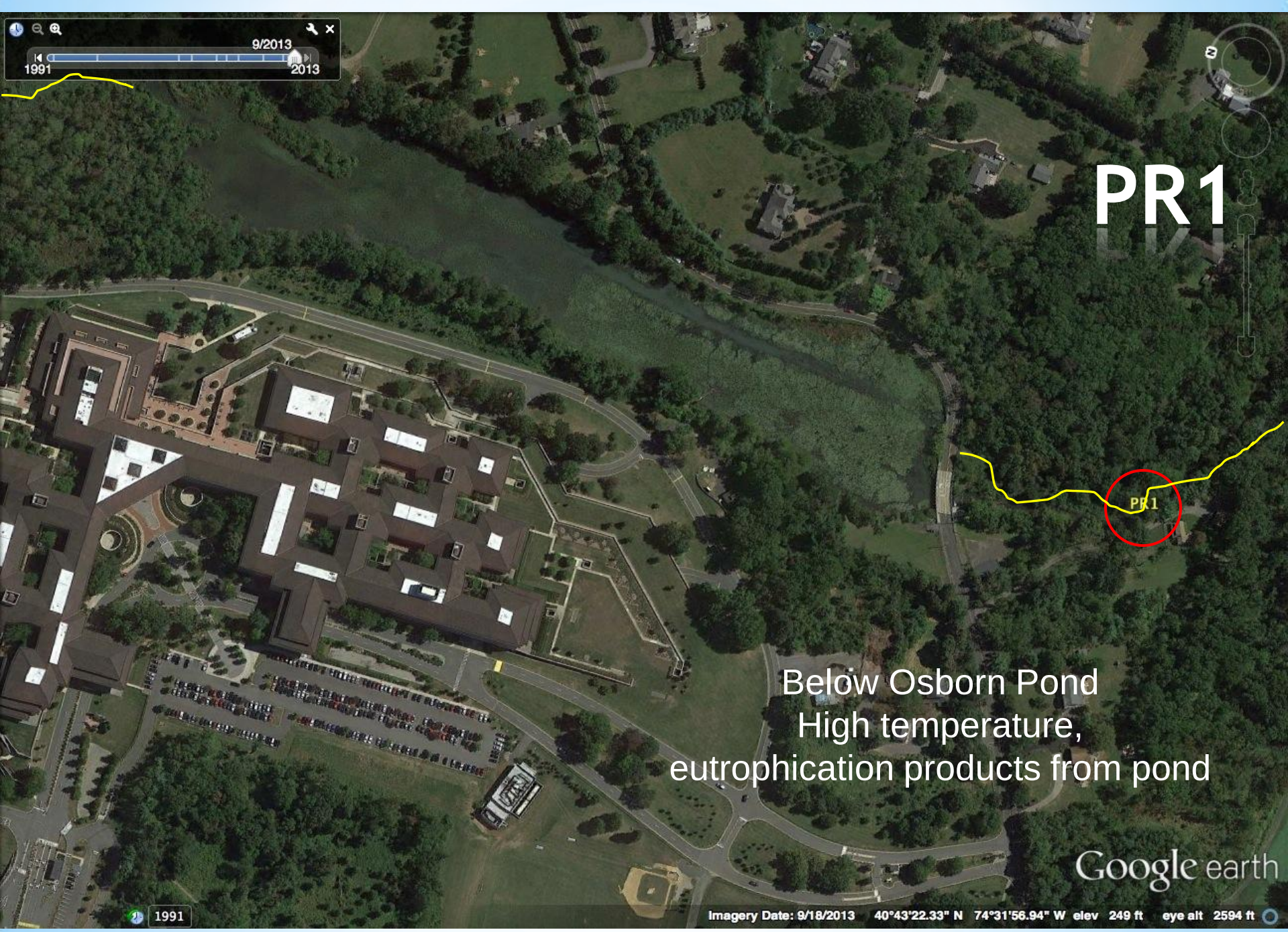


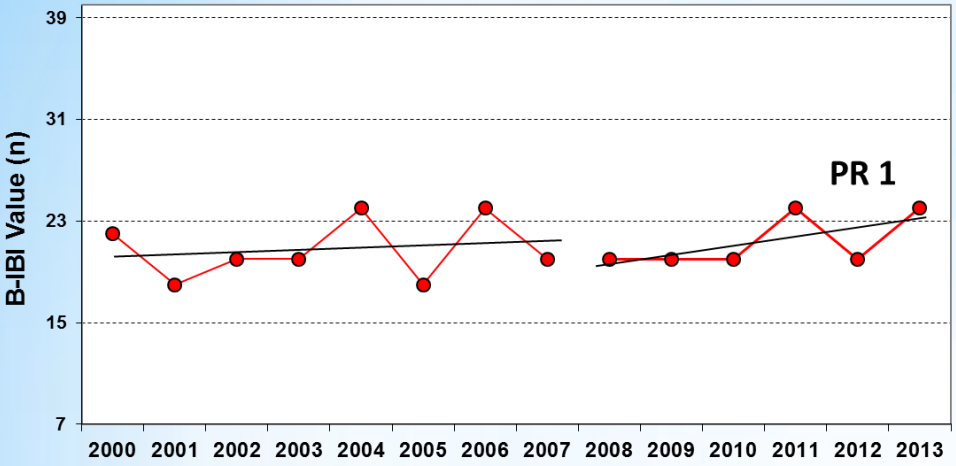
*PB3

Ideal MIV habitat - Despite heavily traveled roadway

2013 – TAXA drop
Fewer E, P, Ts … why??




9/2013
1991
2013
PR1
PR1
Below Osborn Pond
High temperature,
eutrophication products from pond
Google earth
1991
Imagery Date: 9/18/2013 40°43'22.33" N 74°31'56.94" W elev 249 ft eye alt 2594 ft



Good

Fair

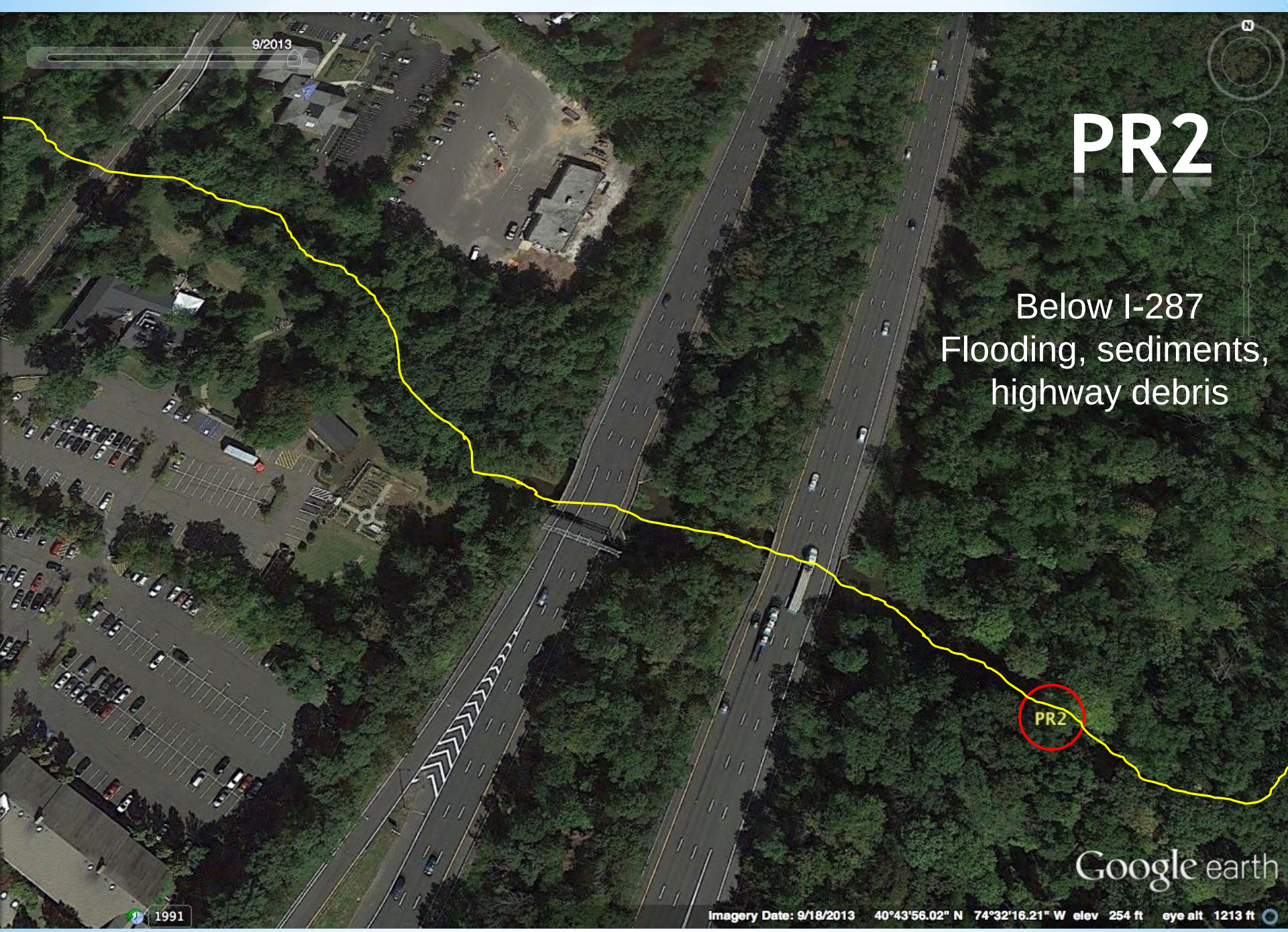
Poor

Very Poor

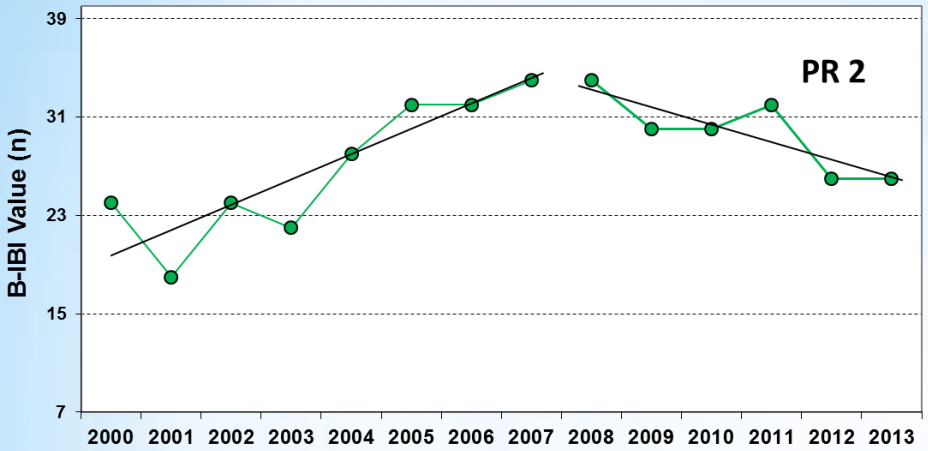
*PR1

Limited substrate

2013 – TAXA up esp. mayflies, hydropsychid dominance down


9/2013
PR2
Below I-287
Flooding, sediments,
highway debris
PR2
Google earth
1991
Imagery Date: 9/18/2013 40°43'56.02" N 74°32'16.21" W elev 254 ft eye alt 1213 ft

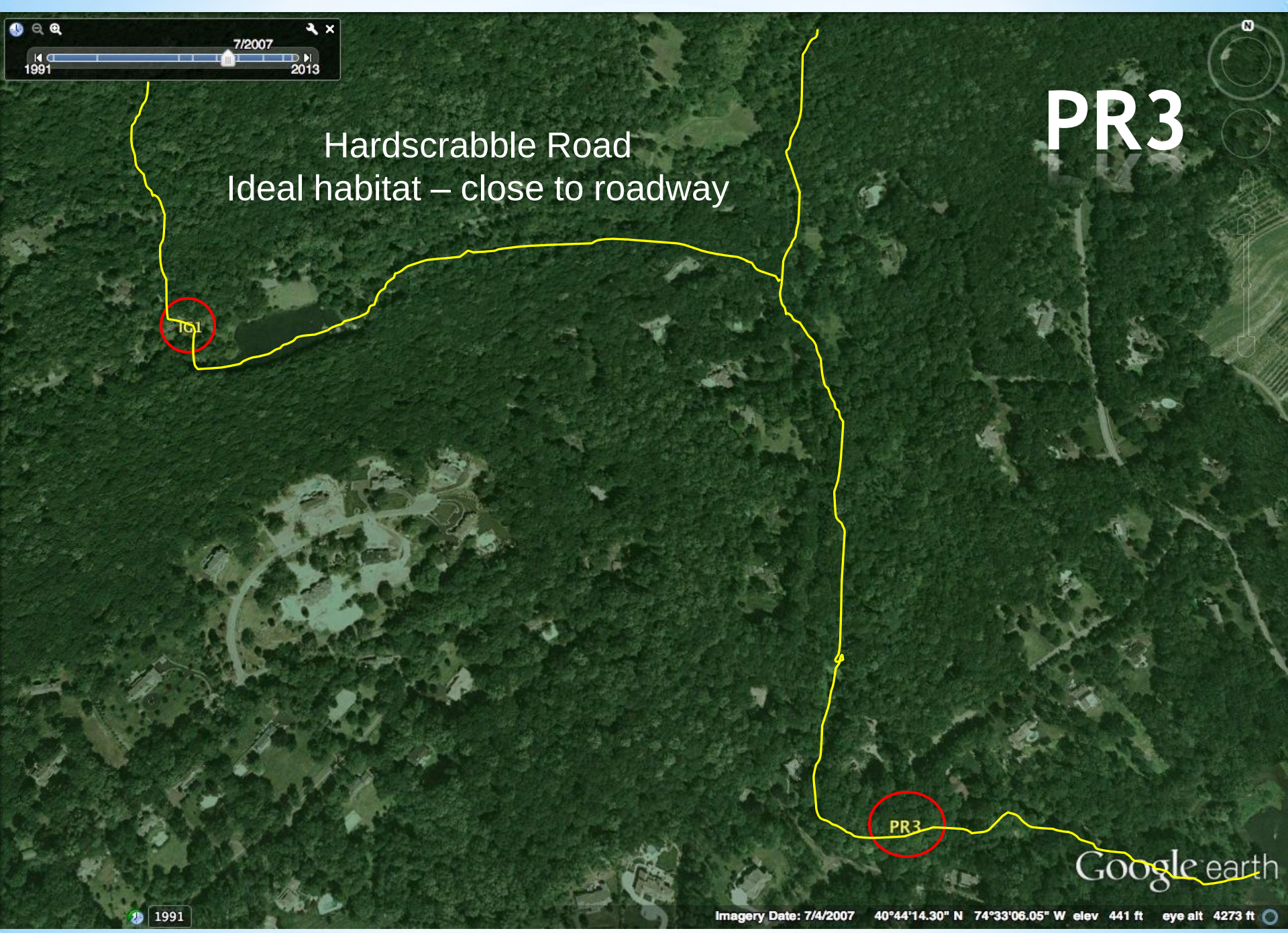
Original PR2 site
Destroyed by Hurricane Irene

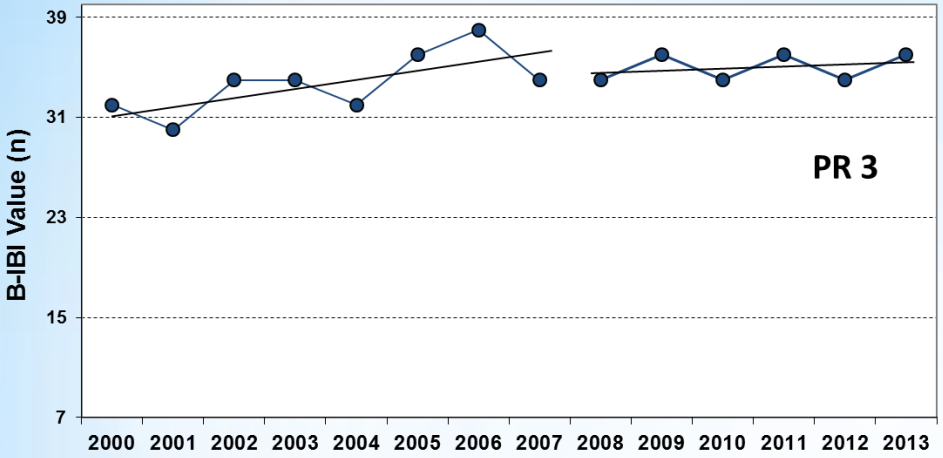


* new PR2

New, much poorer site downstream. F

2012+13 vs 2011: fewer mayflies, caddisflies


7/2007
1991
2013
PR3
Hardscrabble Road
Ideal habitat – close to roadway
TG1
PR3
Google earth
1991
Imagery Date: 7/4/2007 40°44'14.30" N 74°33'06.05" W elev 441 ft eye alt 4273 ft



Good

Fair

Poor

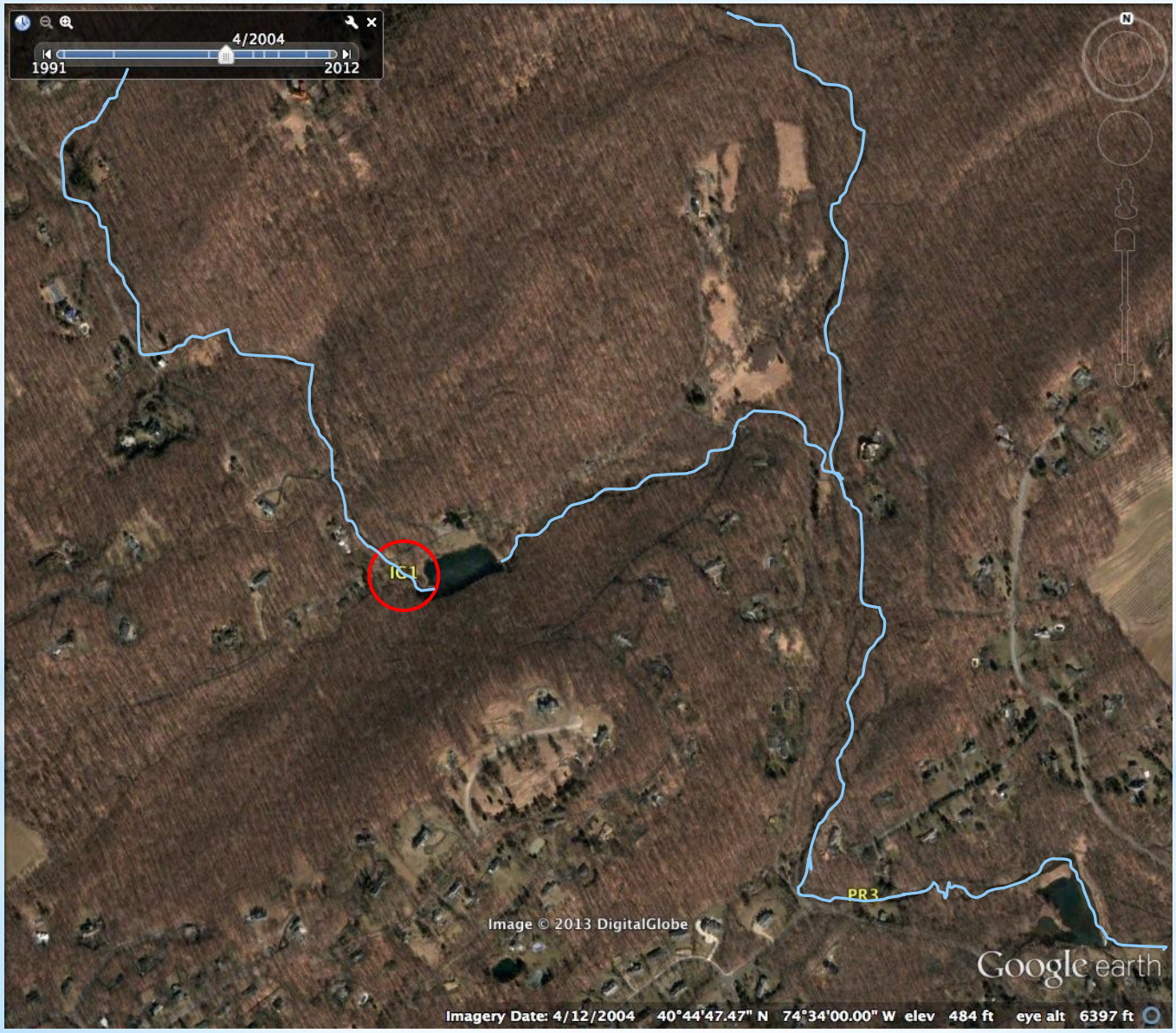
Very Poor

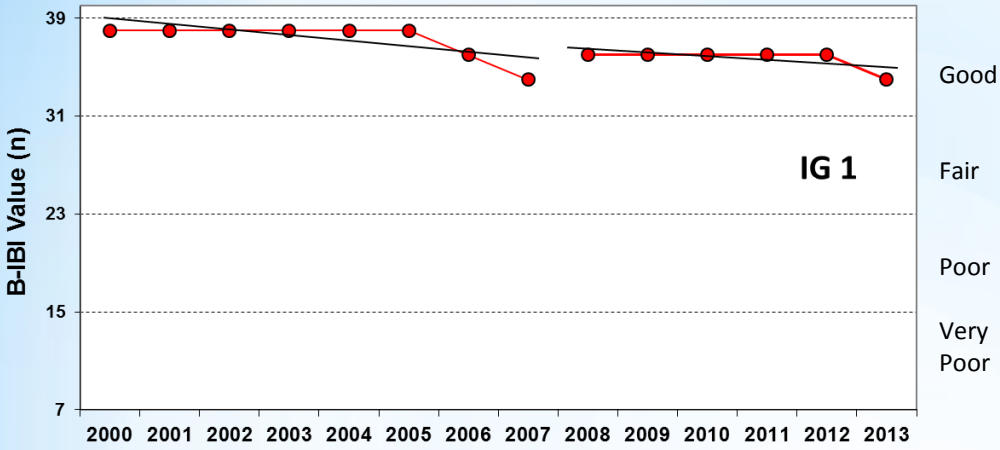
*PR3

High MIV diversity; low density

2013: mayflies up

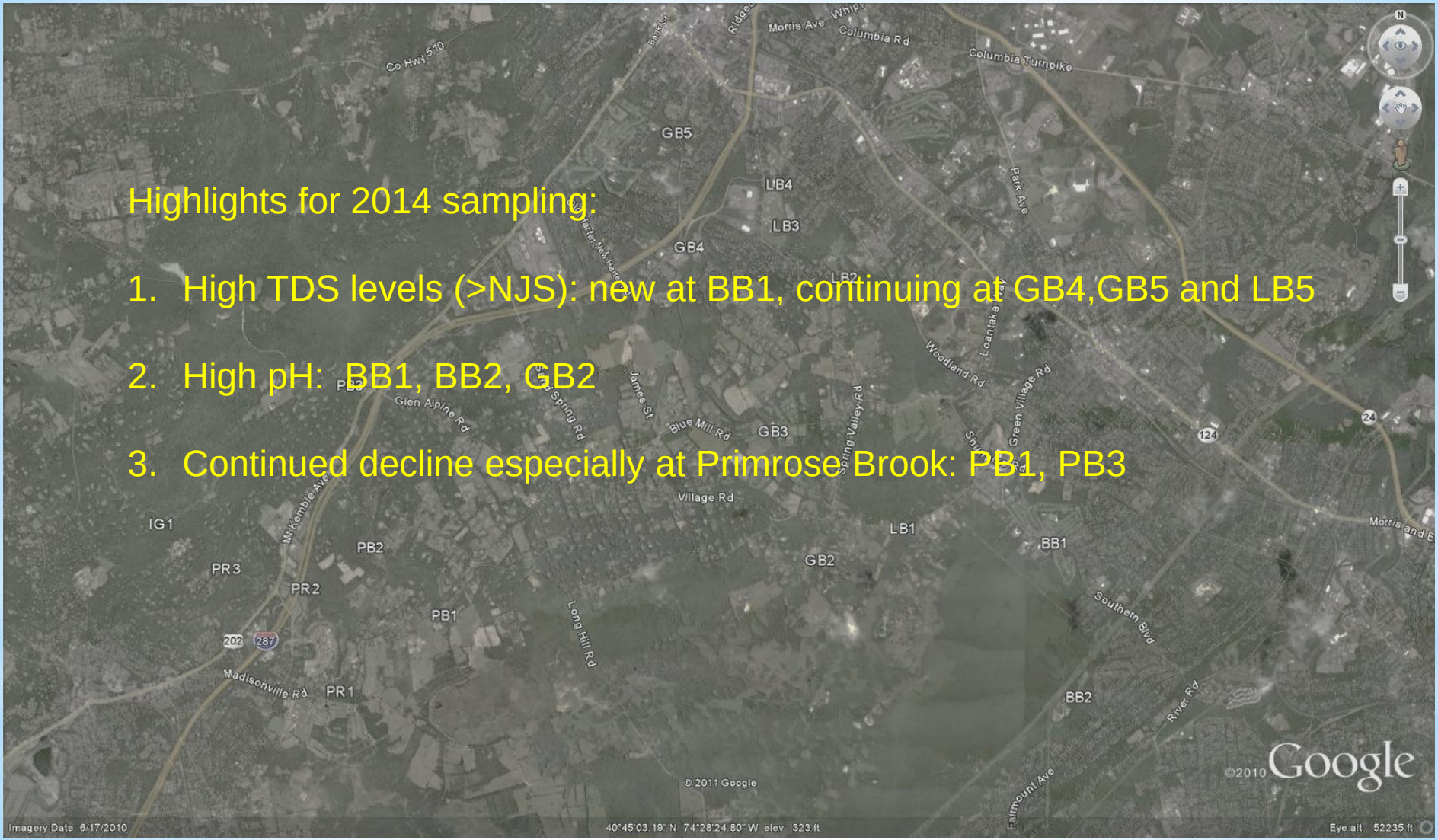
Upper Passaic tributary
"Reference" site

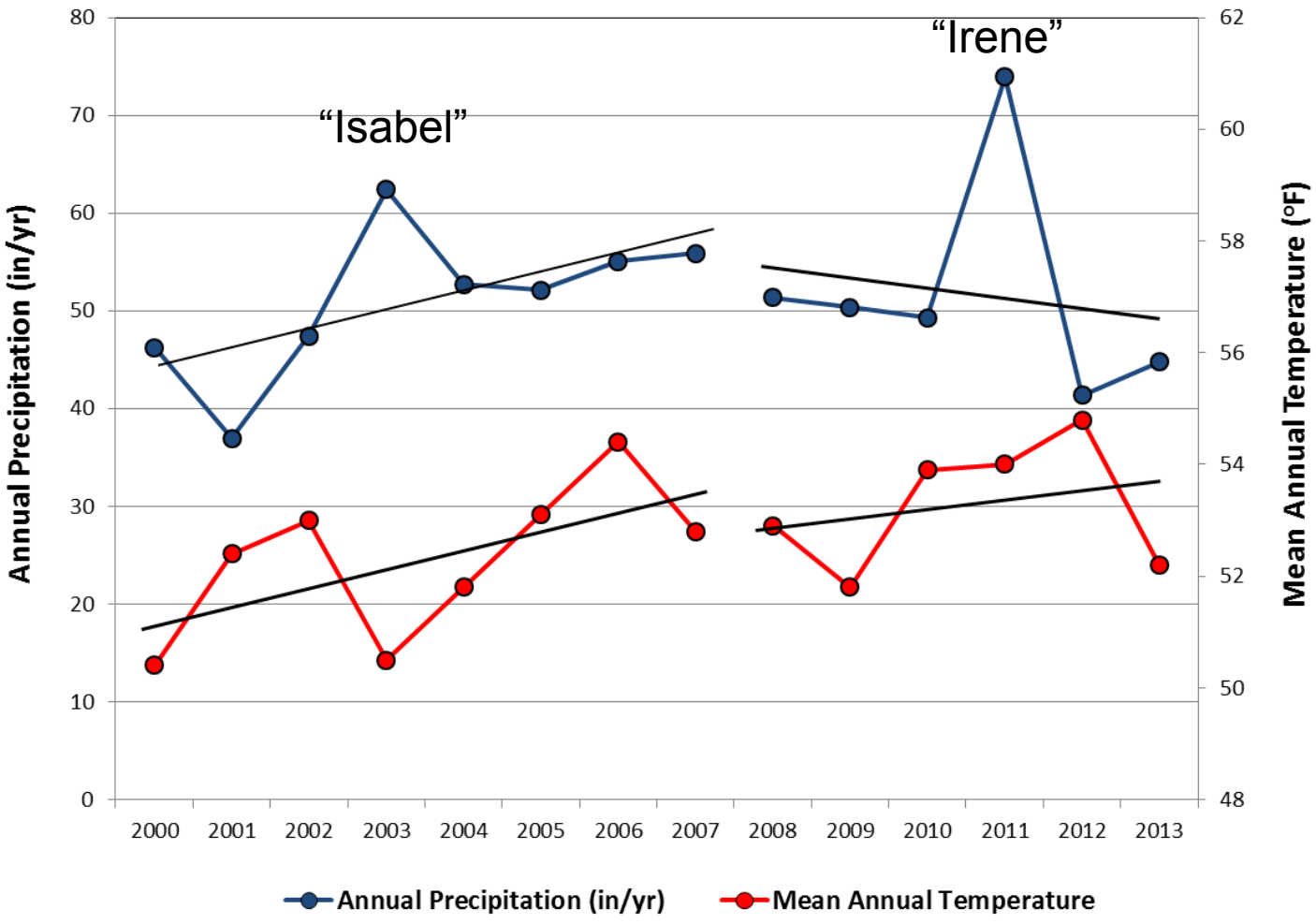




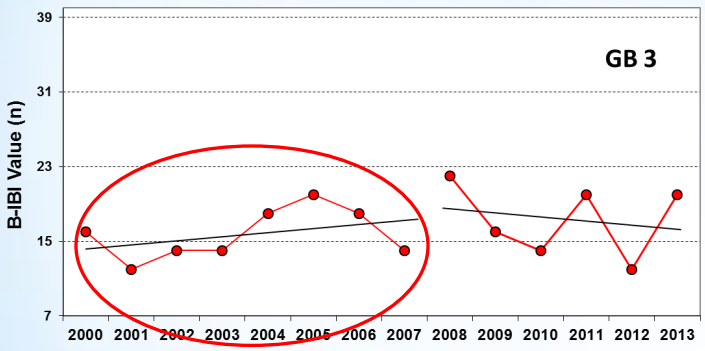
*IG1

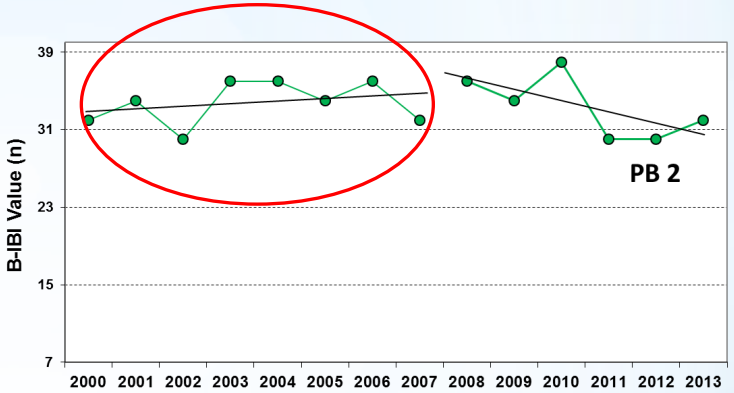
Great habitat


Highlights for 2014 sampling:
1. High TDS levels (>NJS): new at BB1, continuing at GB4,GB5 and LB5
2. High pH: BB1, BB2, GB2
3. Continued decline especially at Primrose Brook: PB1, PB3
Co Hwy 510
Morris Ave
Columbia Rd
Columbia Turnpike
GB5
LB4
LB3
GB4
LB2
Park Ave
Glen Alpine Rd
James St
Blue Mill Rd
GB3
Spring Valley Rd
Woodland Rd
Green Village Rd
Village Rd
IG1
Mt Kemble Ave
PB2
PR3
PR2
PB1
LB1
BB1
GB2
Long Hill Rd
Southern Blvd
202
287
Madisonville Rd
PR1
BB2
River Rd
Fairmount Ave
© 2011 Google
©2010 Google
Imagery Date: 6/17/2010
40°45'03.19" N 74°28'24.80" W elev 323 ft
Eye alt 52235 ft

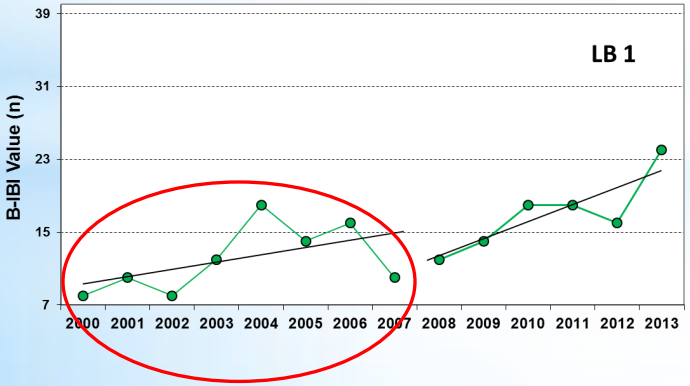

Northern New Jersey
Annual Climate Values
"Isabel"
"Irene"
Annual Precipitation (in/yr)
Mean Annual Temperature (°F)
80
70
60
50
40
30
20
10
0
62
60
58
56
54
52
50
48
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Annual Precipitation (in/yr)
Mean Annual Temperature

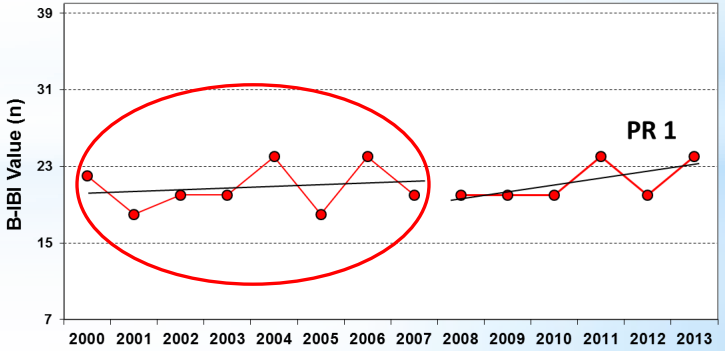
Great Brook (GB2, GB3, GB4, GB5), Primrose Brook (PB1, PB2, PB3)



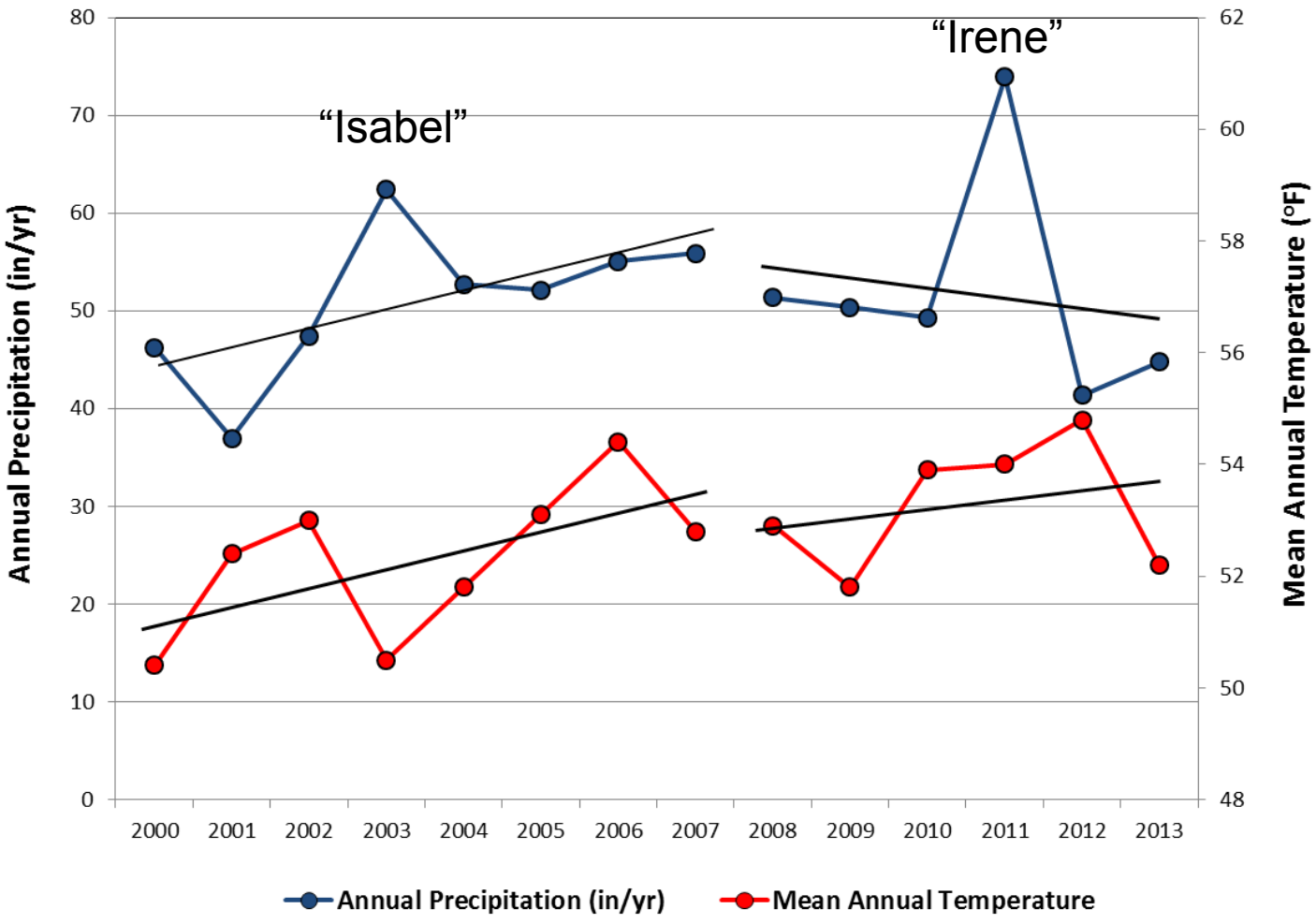


Black Brook (BB1, BB2), Loantaka Brook (LB1, LB2, LB3, LB4),
Passaic River (PR1, (PR2), PR3)





Same pattern, all sites, both GS & RR watersheds: regional cause?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2000
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2008
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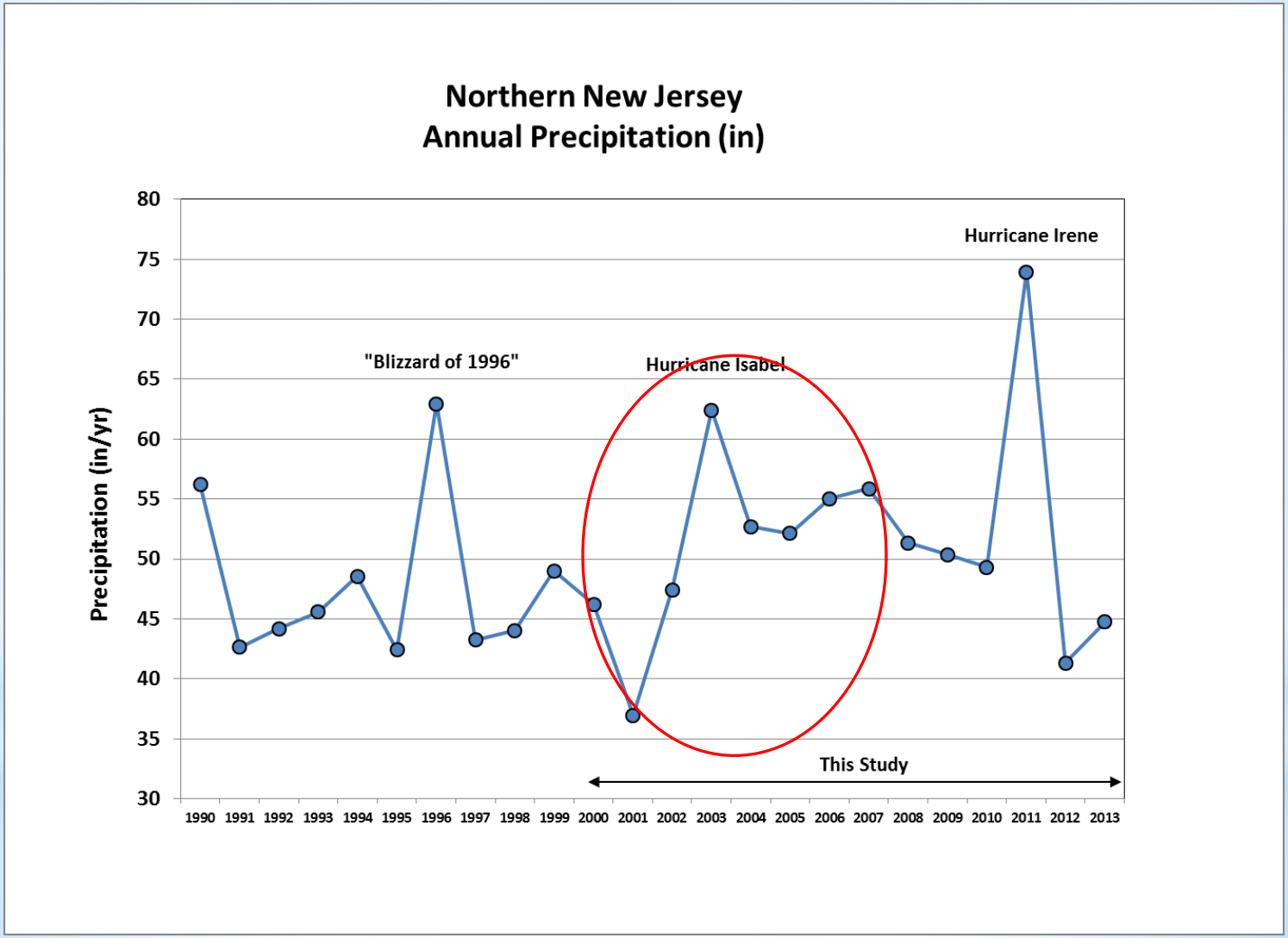
2010
2011
2012
2013
Annual Precipitation (in/yr)
Mean Annual Temperature

* Both Groups Increase in B-IBI score, 2001-2007

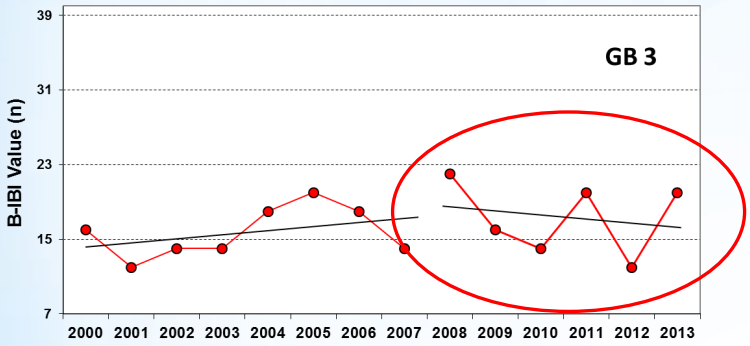


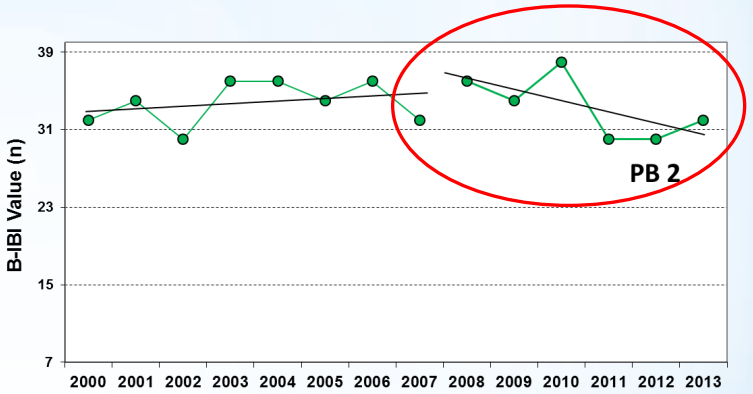
* Increased Precipitation

- Less danger of stagnation or drying up during low-water periods
- More water, faster flow, lower temperature, higher DO levels
- More water, faster flow, better flushing of sediment-space-clogging silt
- More water, better dilution of potentially stress-producing contaminants
- More precipitation through surroundings, more allochothonous organic detritus rinsed in for MIV food
- More precipitation, perhaps improving survival/reproduction of terrestrial life history stages?

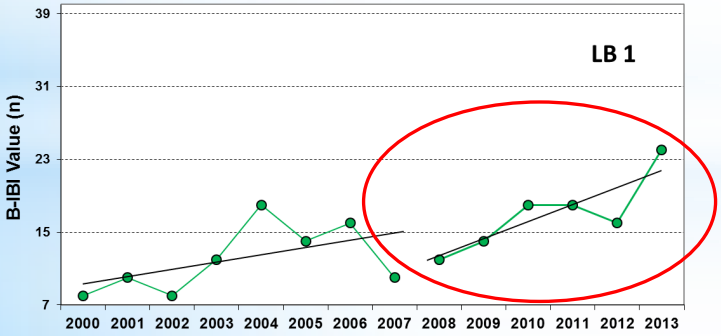
Community Quality (B-IBI) Patterns

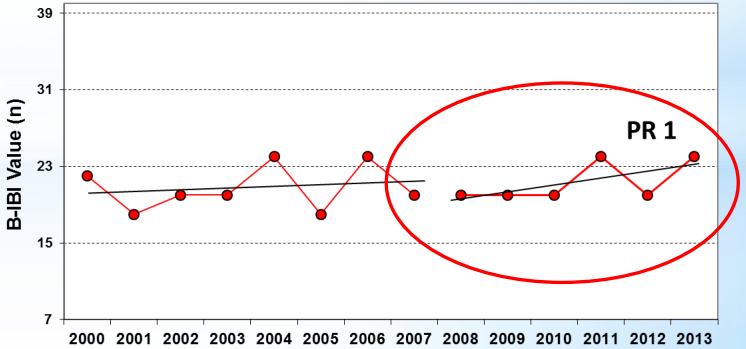
Group I Pattern: Great Brook (GB2, GB3, GB4, GB5), Primrose Brook (PB1, PB2, PB3)





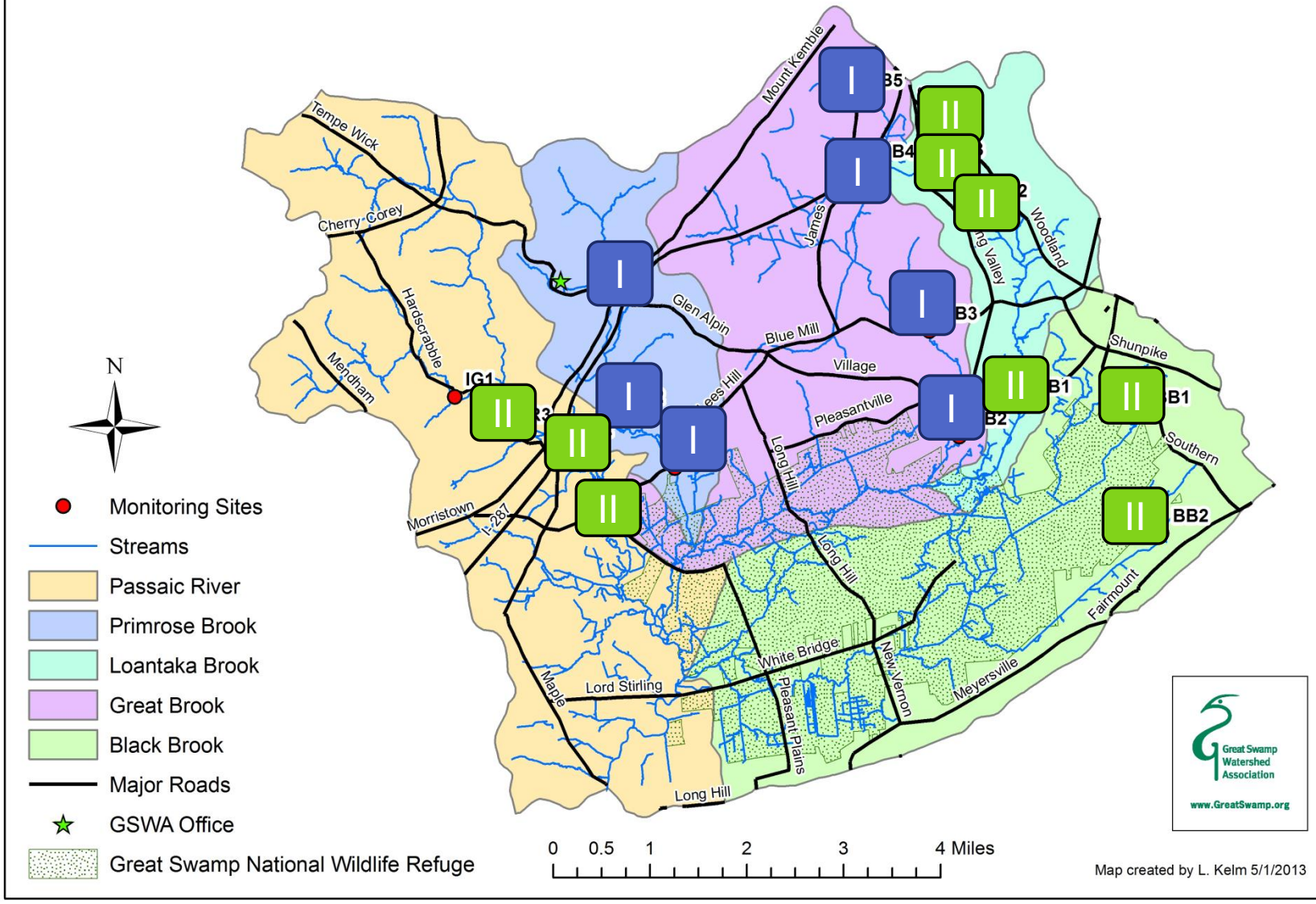
Group II Pattern: Black Brook (BB1, BB2), Loantaka Brook (LB1, LB2, LB3, LB4), Passaic River (PR1, (PR2), PR3)





Patterns differ within each watershed: stream-based cause(s)?

Macroinvertebrate Monitoring Sites in the Great Swamp Watershed



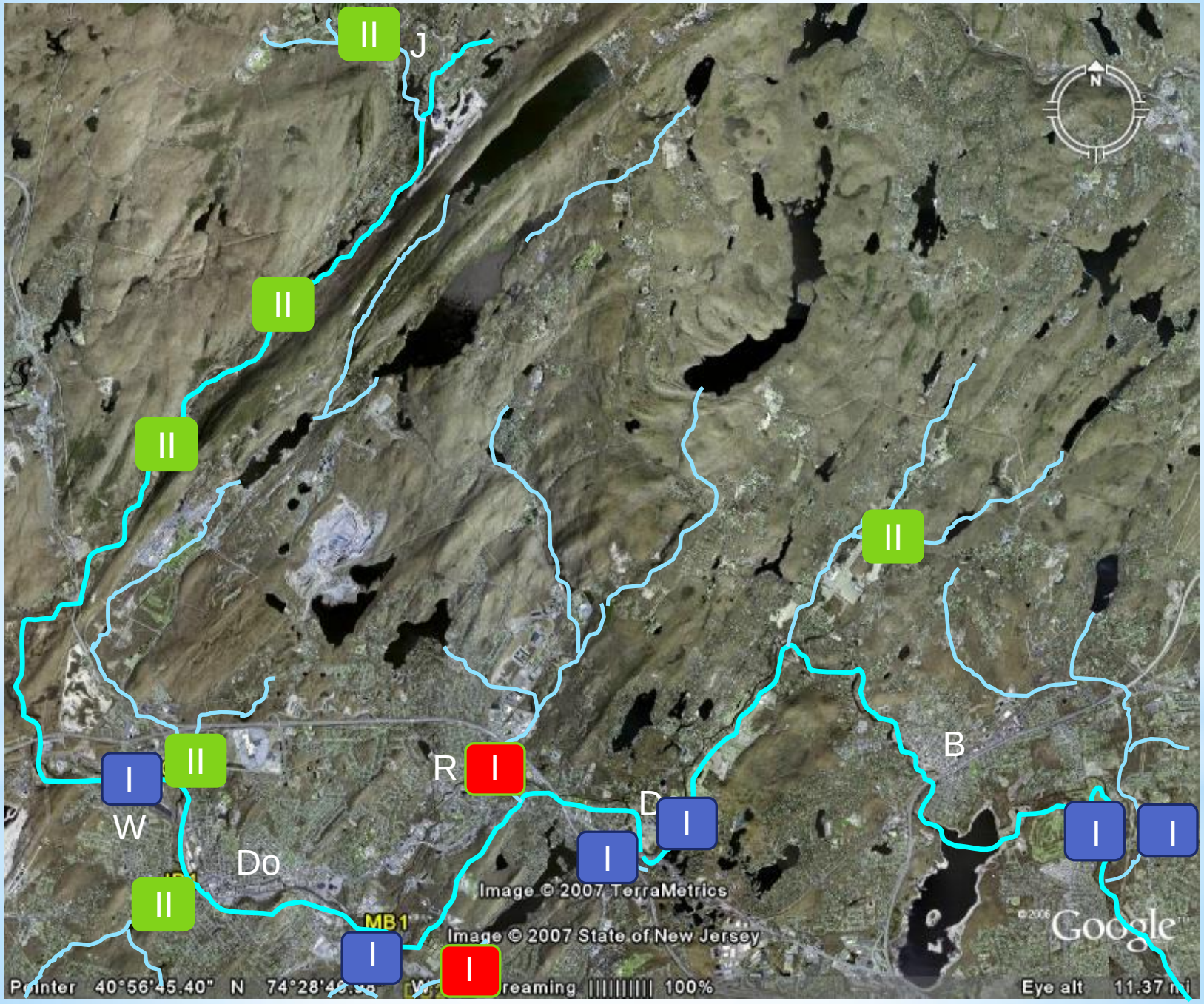

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Image © 2007 State of New Jersey
Google
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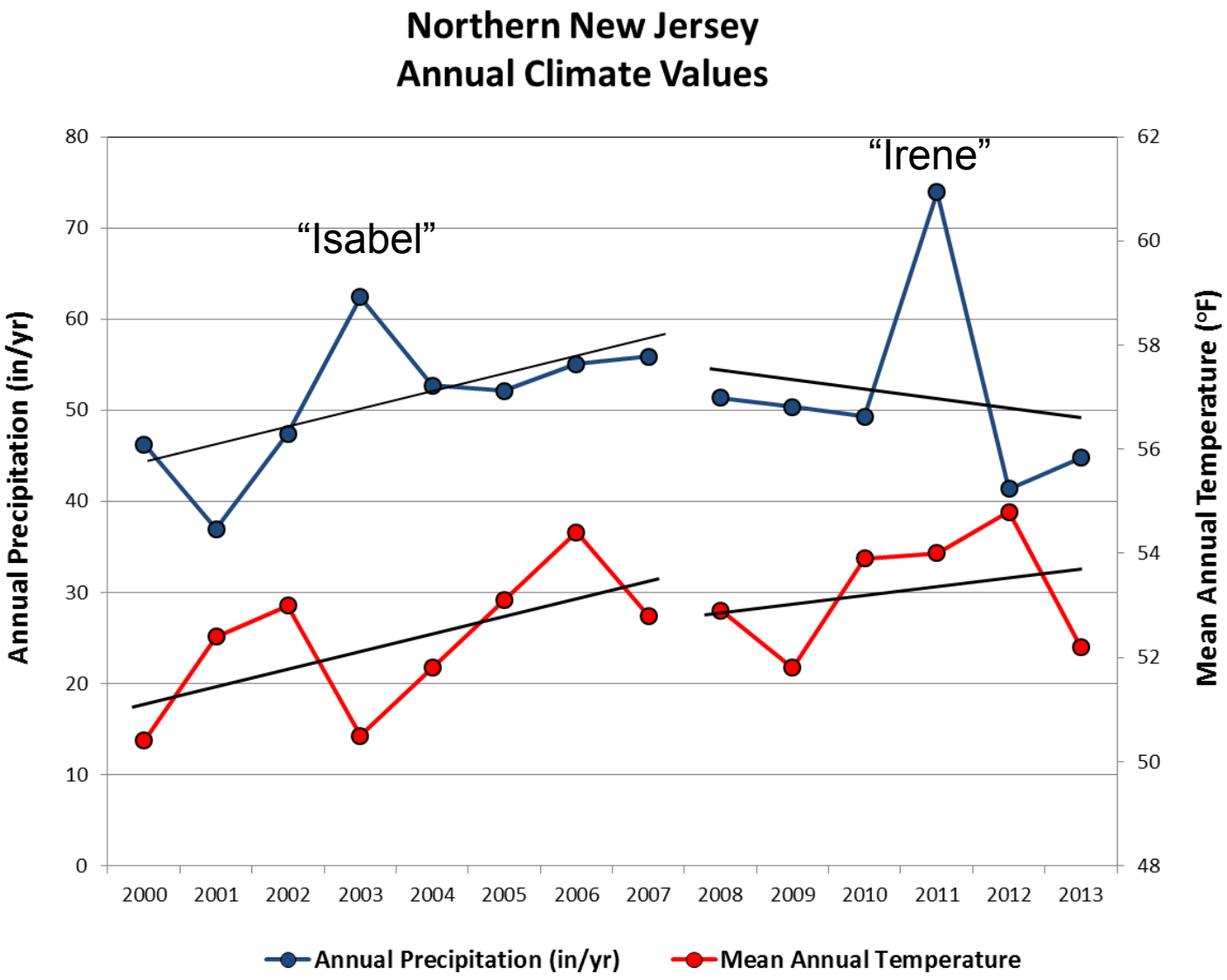
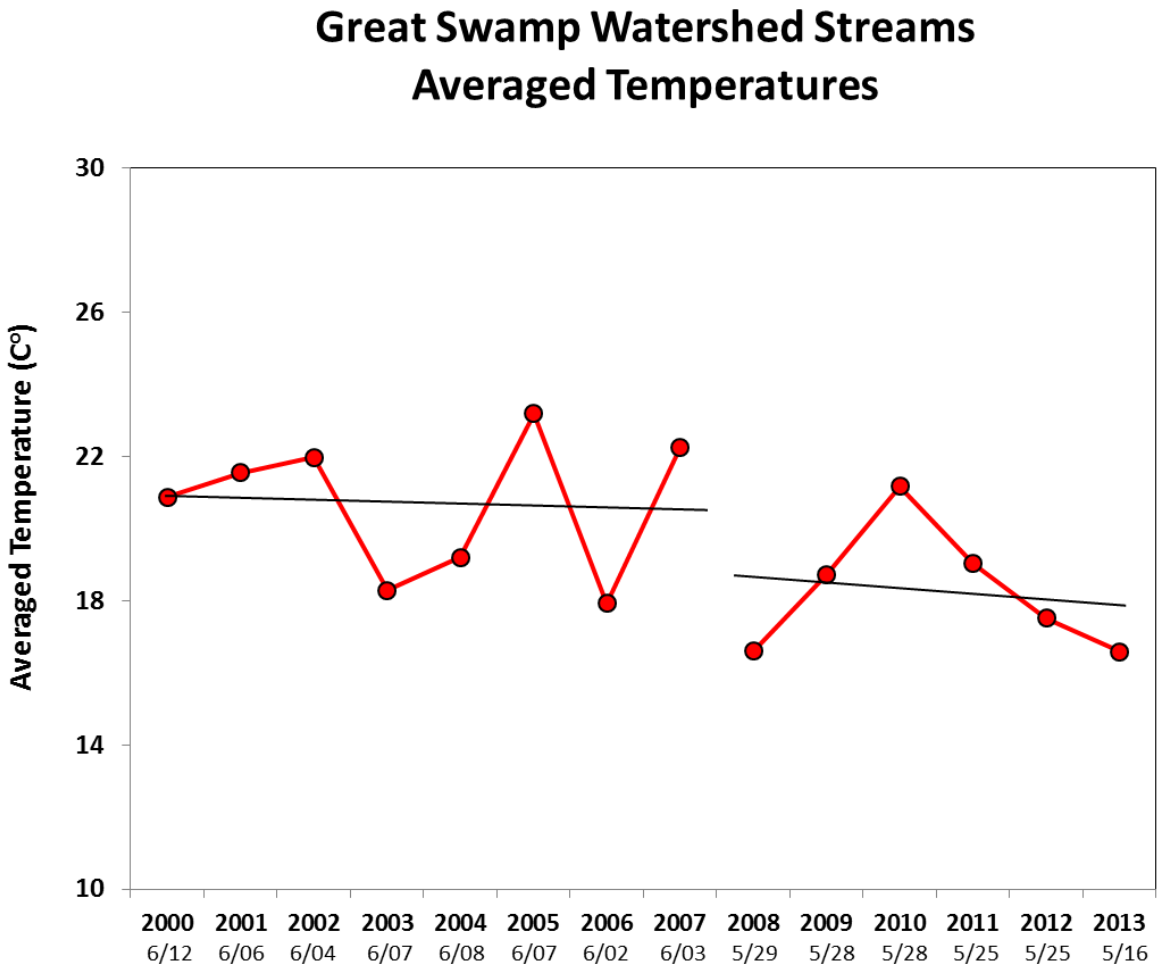


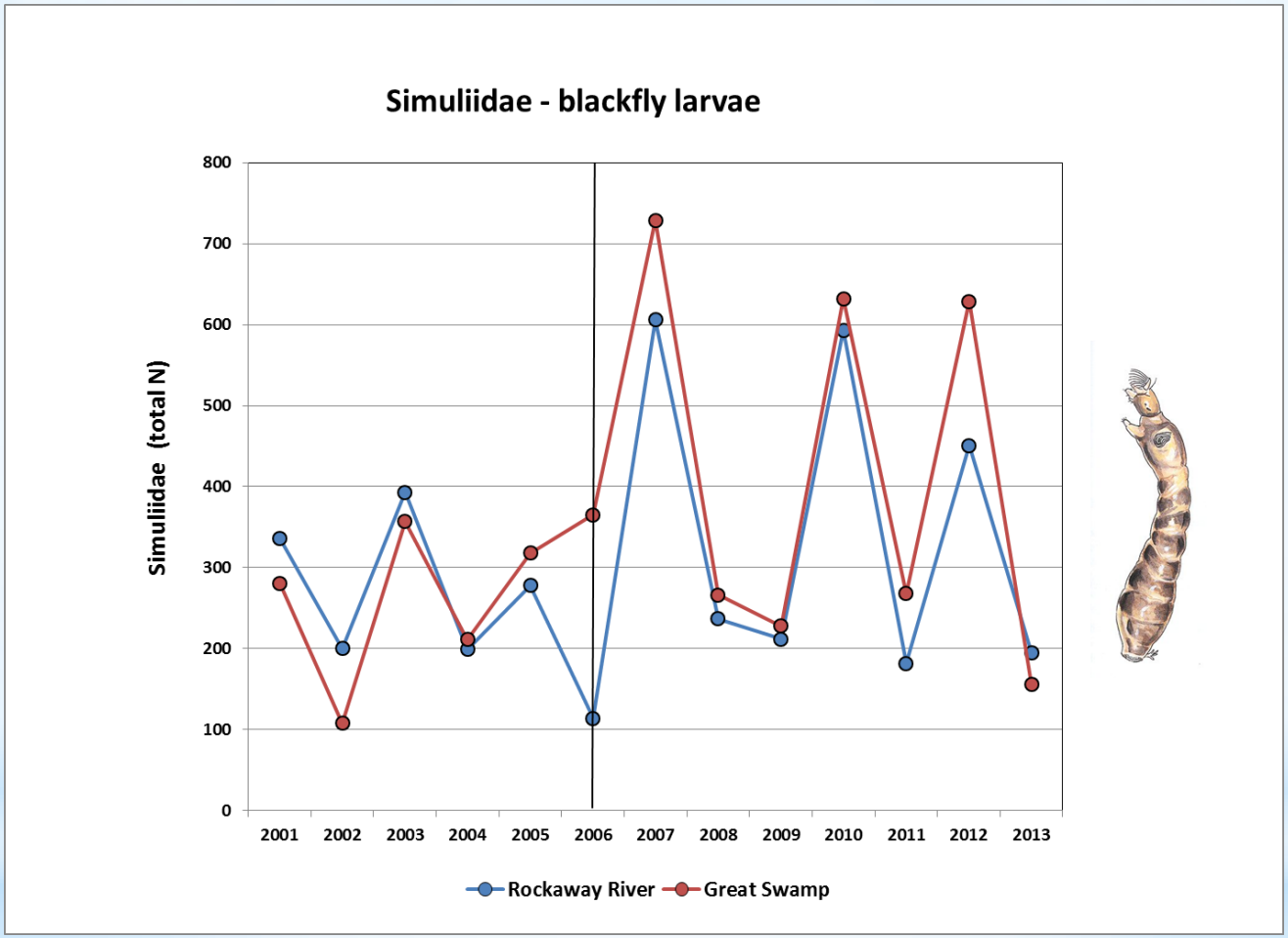
-declining precipitation: more stress, lower B-IBI (Group I?)

- Increasing temperature, lower DO: more stress, lower B-IBI (Group I?)

Earlier sampling dates,
lower temperature



- Lower temperatures, higher DO: less stress, higher B-IBI (Group II?)



- earlier dates, catch different points in life cycle timing
- pre-emergence “sample flooding”/ post-emergence diversity “expansion”
- especially problematic with blackflies

2000-2007: increasing community quality – all sites, both watersheds

Regional influence: increasing post-drought precipitation?

2008-2013: Group I decreasing; Group II increasing – streamwide not regional? a mix?

Climate influences:

- decreasing precipitation – negative effect?
- increasing temperatures – negative effect?
- yet Group II community scores increase?

Earlier sample date influences:

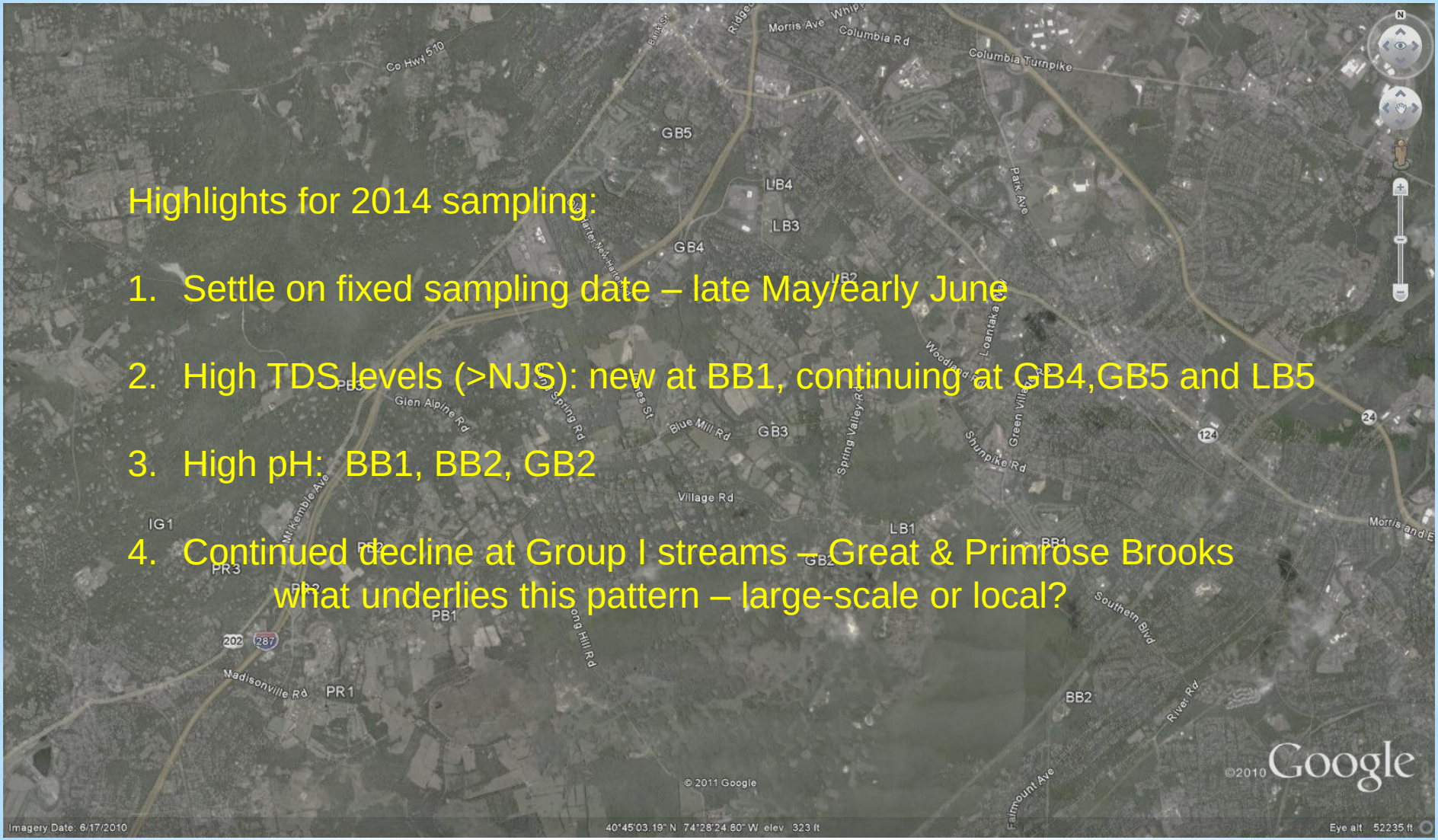
- earlier sample dates – pre- or post-emergence "boom or bust"
- earlier sample dates - colder temperatures – positive?
- colder temperatures – higher DO – positive

Watershed influences:

- Group types differ in adjacent subwatersheds (GSwamp)?
- Group I (declines) – less stress, GS; more stress, RR?
- Group II (increases) – more stress, GS; less stress, RR?

On-going concern:

Are Group I 2008-2013 declines by larger-scale (e.g., climate) or by local-scale issues?



Highlights for 2014 sampling:

1. Settle on fixed sampling date – late May/early June
2. High TDS levels (>NJS): new at BB1, continuing at GB4,GB5 and LB5
3. High pH: BB1, BB2, GB2
4. Continued decline at Group I streams – Great & Primrose Brooks
   what underlies this pattern – large-scale or local?