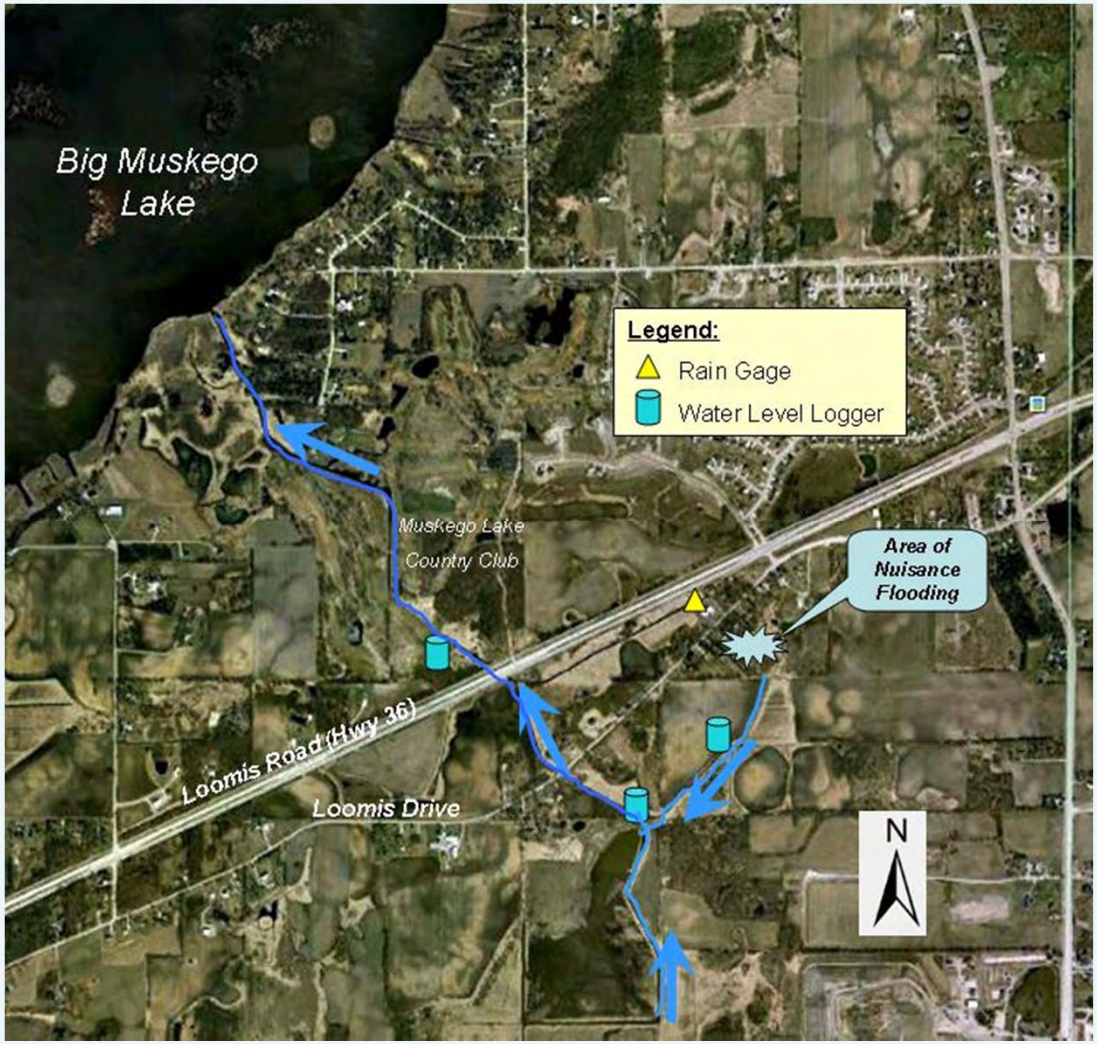
Investigation of Flooding of South Ditch to Big Muskego Lake



CITY OF MUSKEGO

Prepared By:

Concord Ecological Engineering, Inc.

Ruekert·Mielke
engineering solutions for a working world

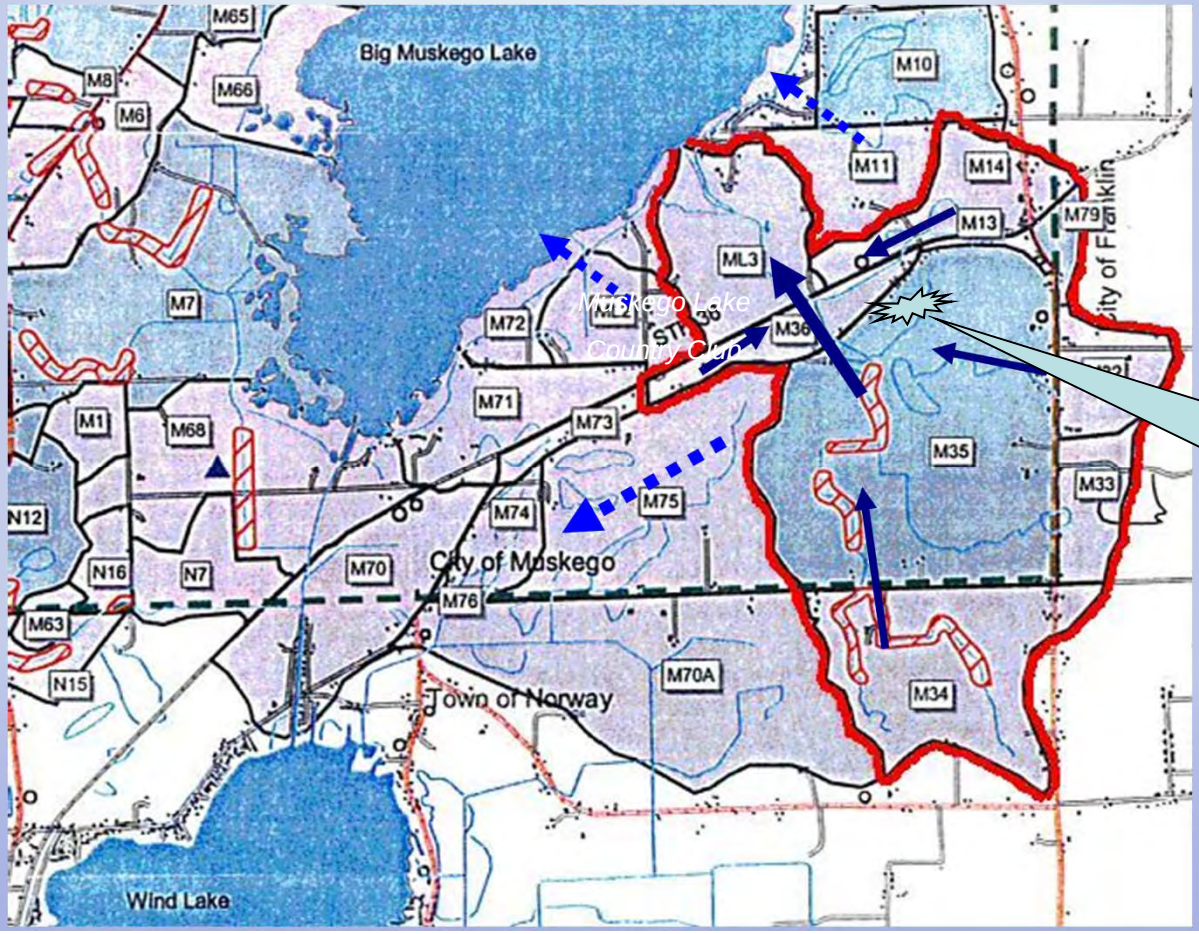
Residents Concerned About “Nuisance” Flooding

City of Muskego
Responded to Concerns

- Geomorphic Assessment
  - Geologic setting
  - History of watershed
  - Condition of stream (ditch)
- Data Collection
  - Rainfall
  - Surface water elevations
- Analysis

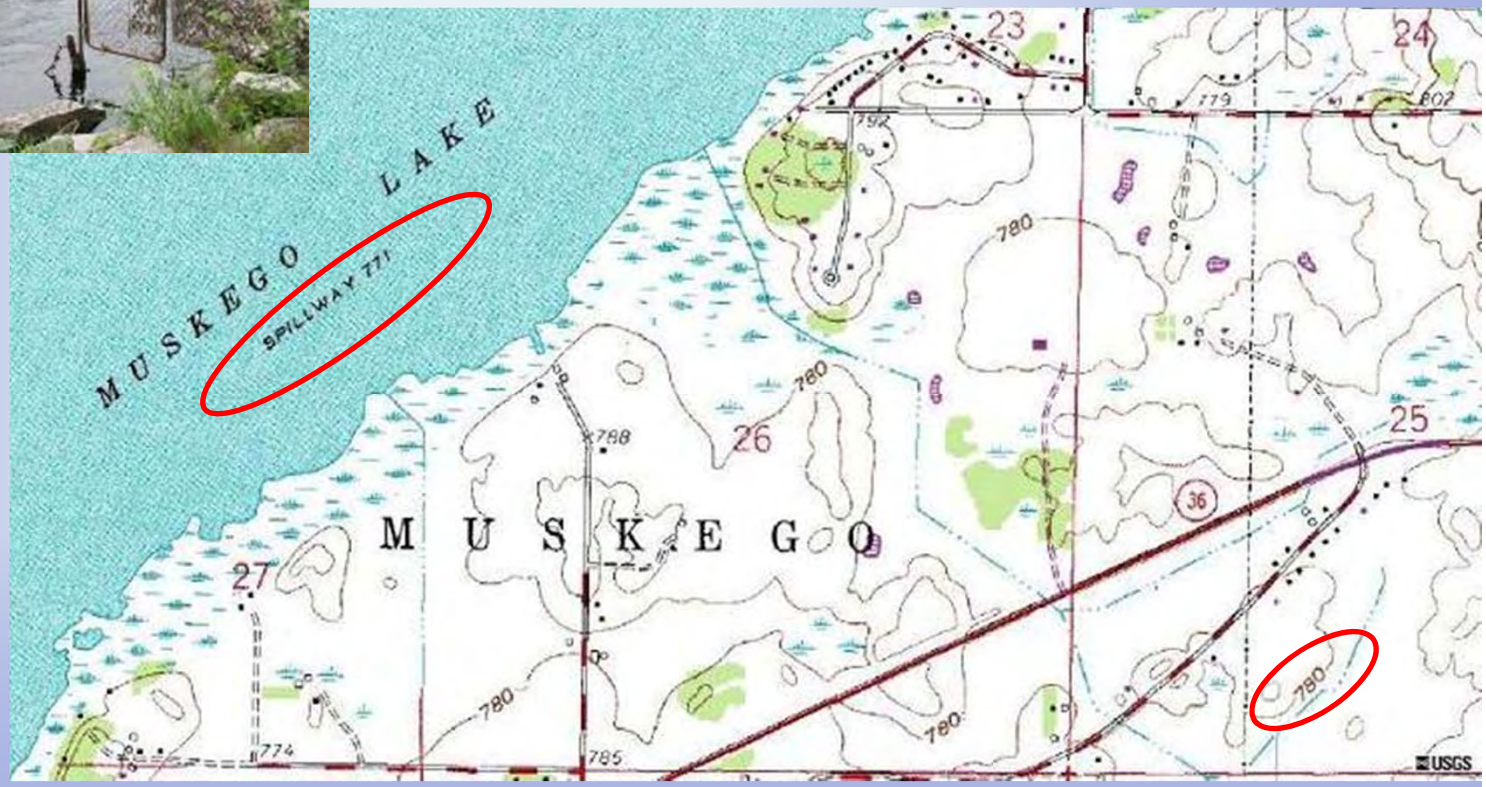
Physical Setting of South Inlet Ditch

- Part of the Fox River System
- The South Inlet Ditch discharges to Big Muskego Lake
  - Controlled by a concrete weir outlet
  - Discharges downstream to Wind Lake



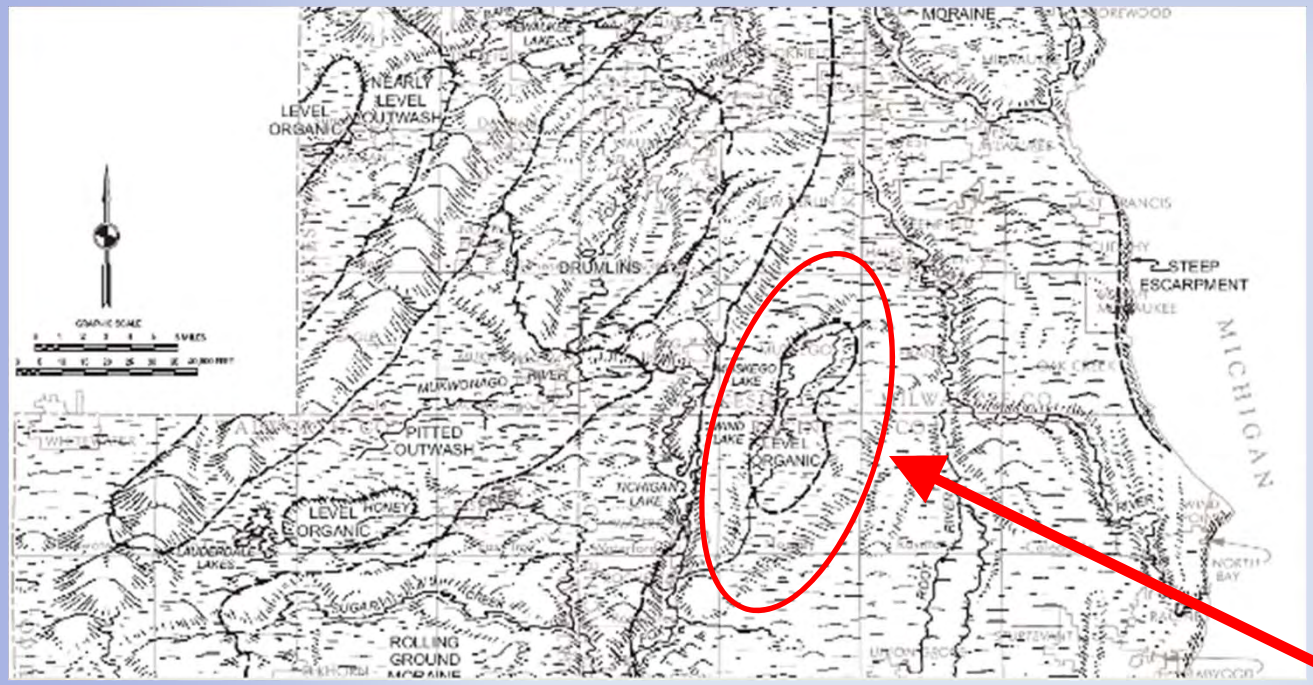
Physical Setting of South Inlet Ditch

Big Muskego Lake Outlet



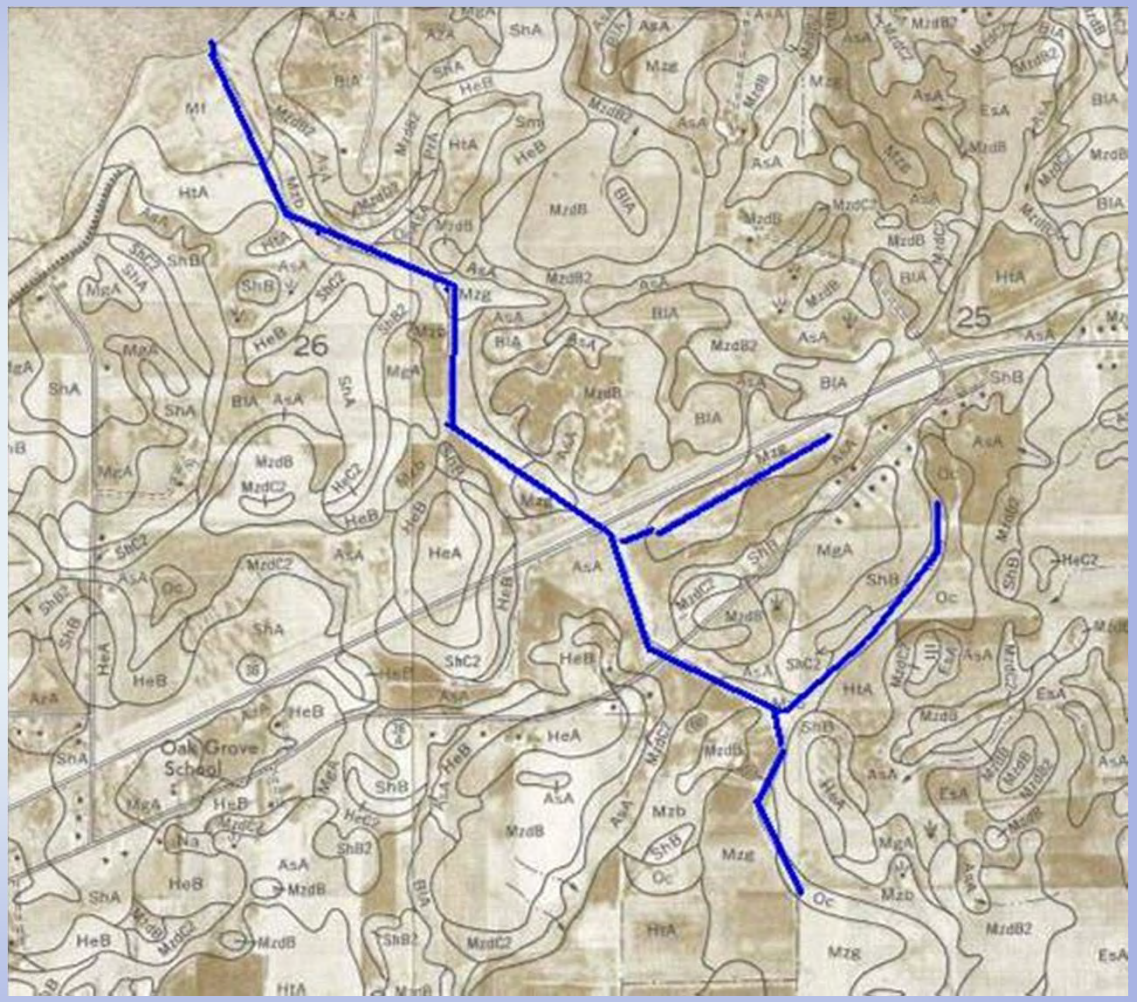
Note only <u>about</u> 9 ft (or less) between the lake and local elevations

Big Muskego Lake is a Remnant of a Historically Larger Lake



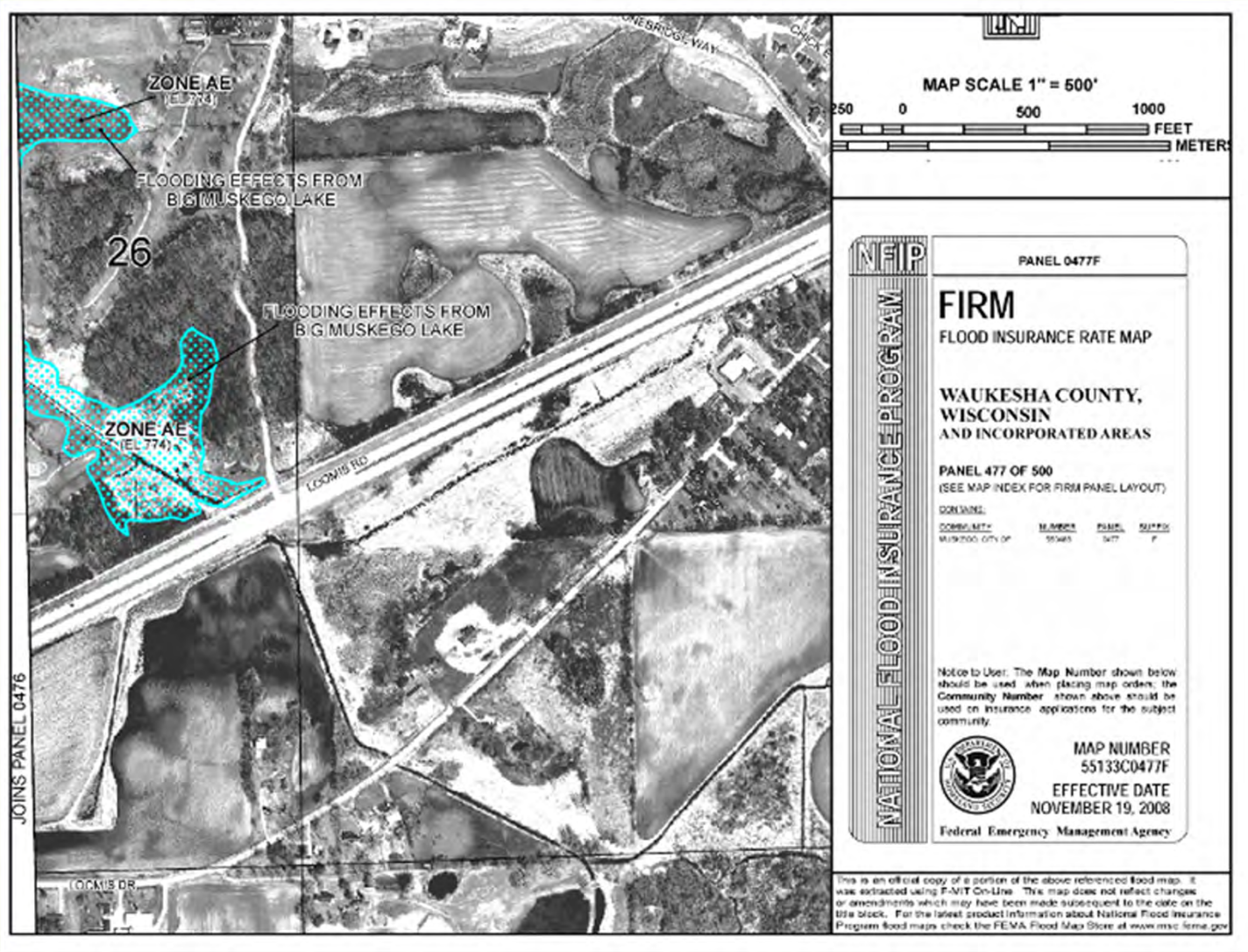
Soils are Consistent with Old Lakebeds

Soils Map Shows *Relatively* Lower Infiltration due to High Water Table or Heavier Soils



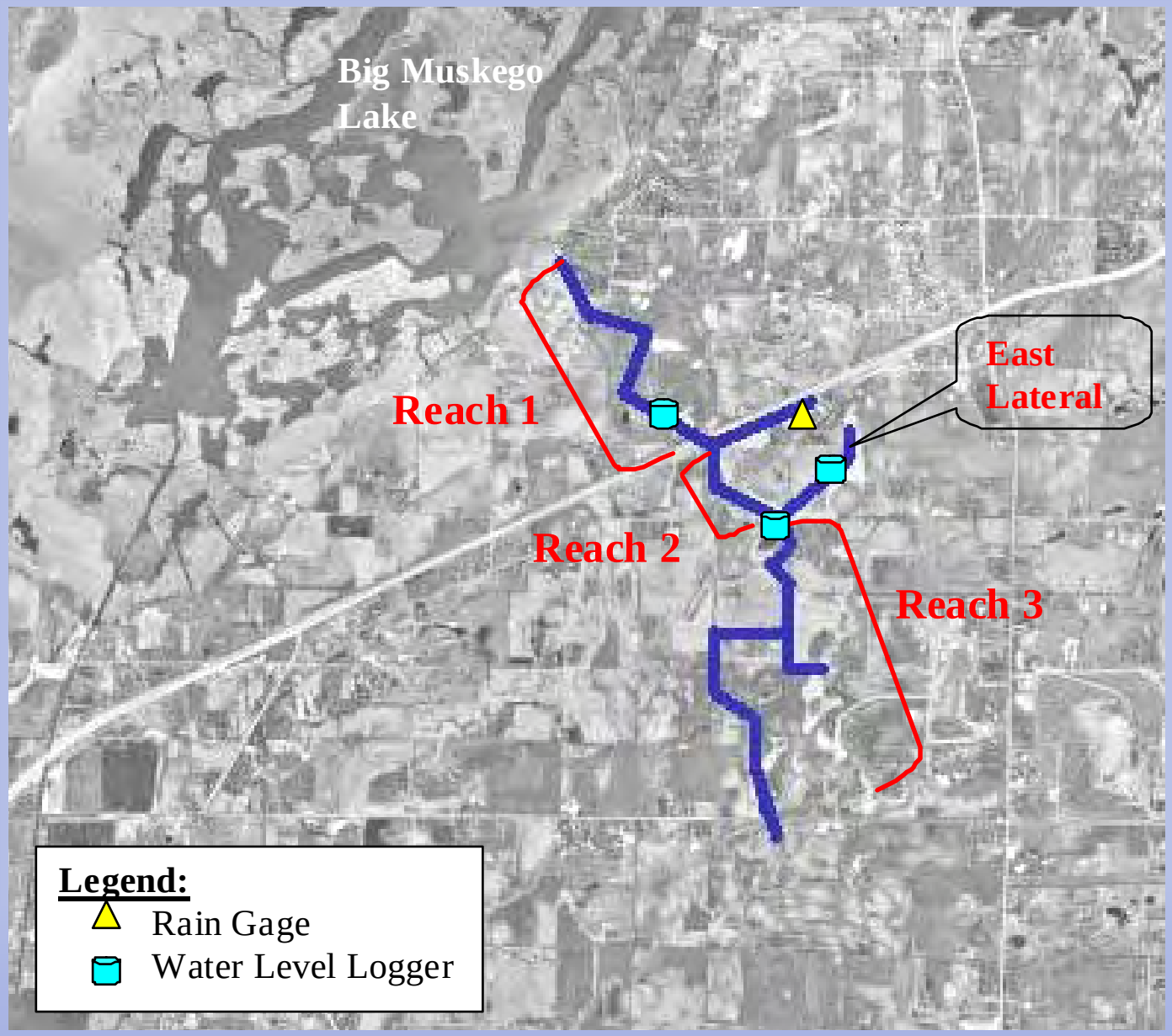
ShB (Saylesville silt loam) "this soil generally remains wet for several days longer in spring and after periods of heavy rainfall than do some well-drained soils"

Detailed Floodplain Mapping Downstream of Loomis Road (elevation 774)

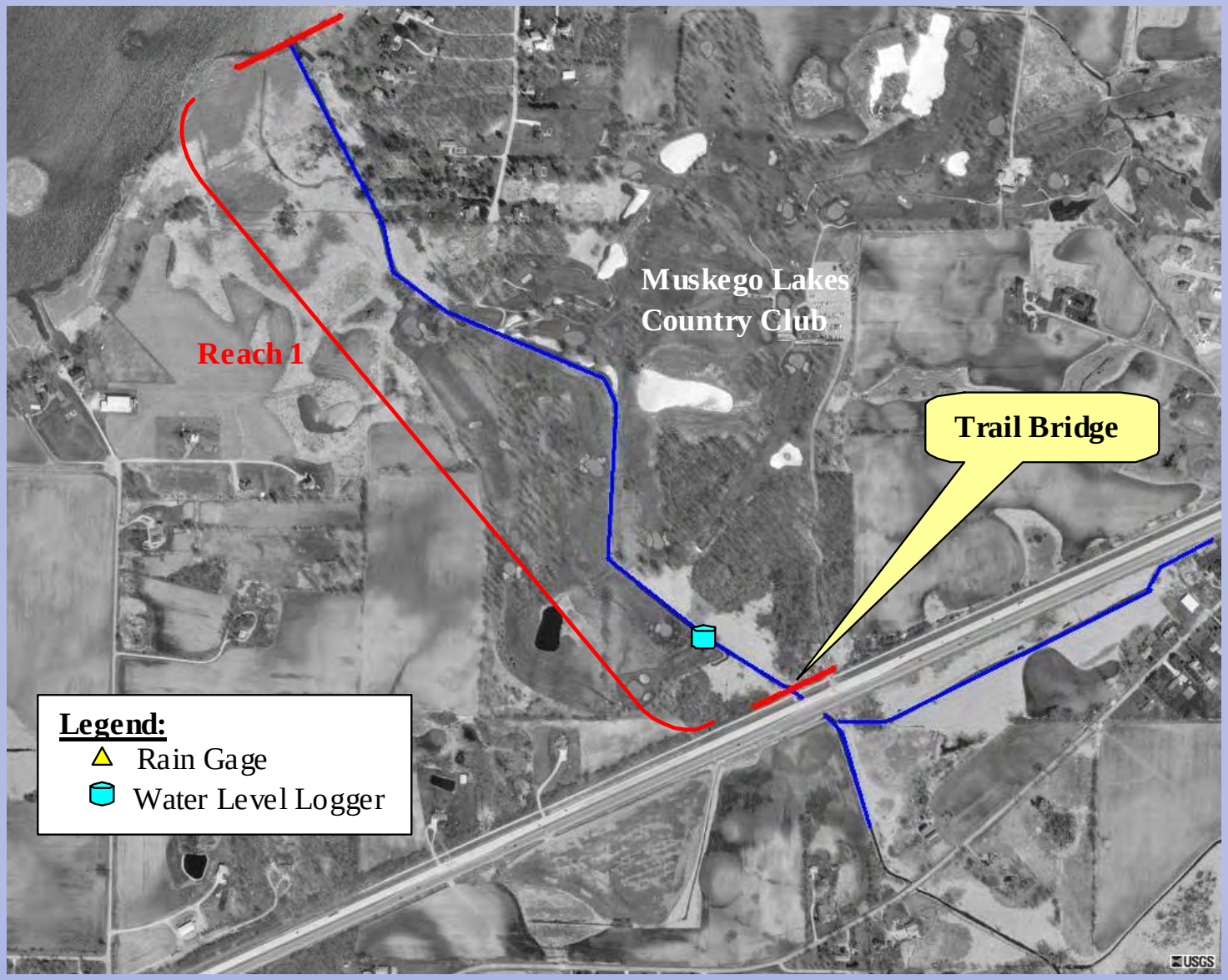


NOTE: Floodplain Mapping is a <u>Zoning</u> Exercise
Unmapped Areas Can Still be Subject to Flooding

Fluvial Geomorphic Assessment (2009)



Reach 1


Muskego Lakes
Country Club
Reach 1
Trail Bridge
Legend:
Rain Gage
Water Level Logger
USGS

Reach 1

Figure 17. Mouth of System at Big Muskego Lake

Figure 18. Upstream of Mouth of System at Big Muskego Lake – Photo taken facing upstream

Figure 19. Downstream of Golf Course – Photo taken facing upstream – note private crossing

Figure 20. Downstream of Golf Course Photo taken facing downstream

Figure 21. Facing downstream from Golf Course Limit (bridge)

Figure 22. Facing upstream from Golf Course Limit (from bridge)

Figure 23. System within Golf Course – facing downstream – note: widened section

Figure 24. System within Golf Course – facing upstream – note: widened section in foreground

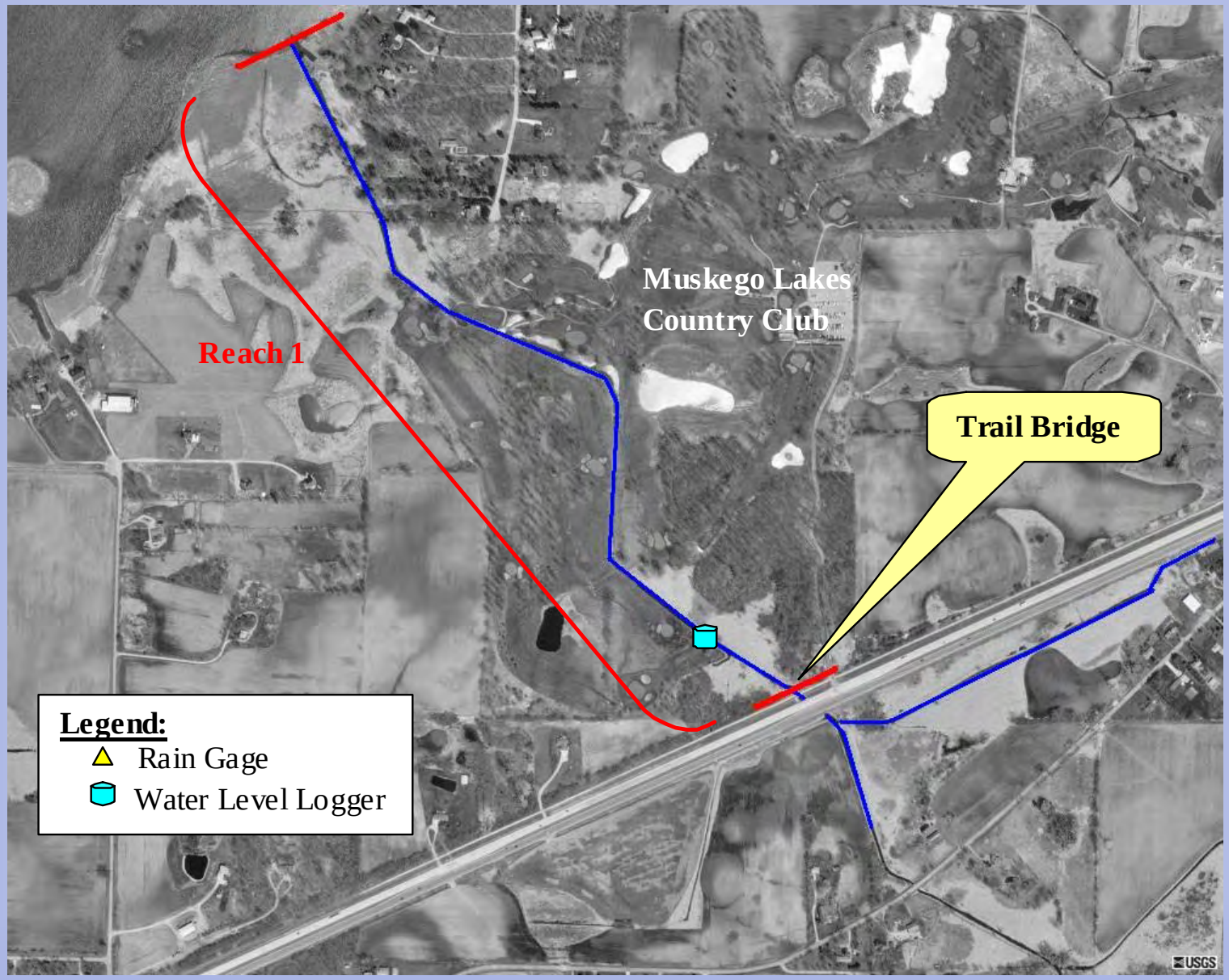
Figure 25. Section within Golf Course *Note straightened section, no ditch spoil, mowed to edge* Photo taken facing upstream

Figure 26. Section within Golf Course *Note: Crossings in background (no real impedance to flow)*Photo taken facing downstream

Figure 27. Facing downstream from the Water Level Data Collector

Figure 28. Facing downstream – Trail bridge in foreground. *Note: low member elevation collected during the site investigation*

Reach 2


Muskego Lakes
Country Club
Reach 1
Trail Bridge
Legend:
Rain Gage
Water Level Logger
USGS

Reach 2

Figure 31. Downstream end of Loomis Road crossing (Hwy 36)

Figure 32. Upstream end of Loomis Road (Hwy 36) crossing

Figure 33. Facing upstream from Loomis Road (Hwy 36) crossing – note the branch to the lateral between old and new Loomis in the background

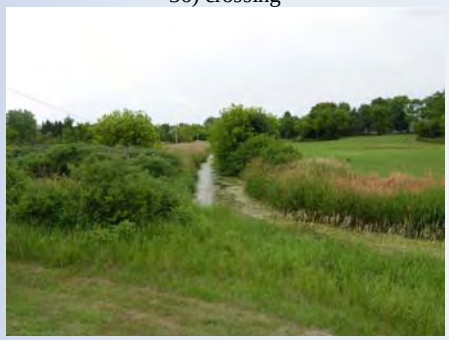


Figure 34. Facing upstream from Loomis Road (Hwy 36) – section between Loomis Drive and Loomis Road (old and new Loomis)

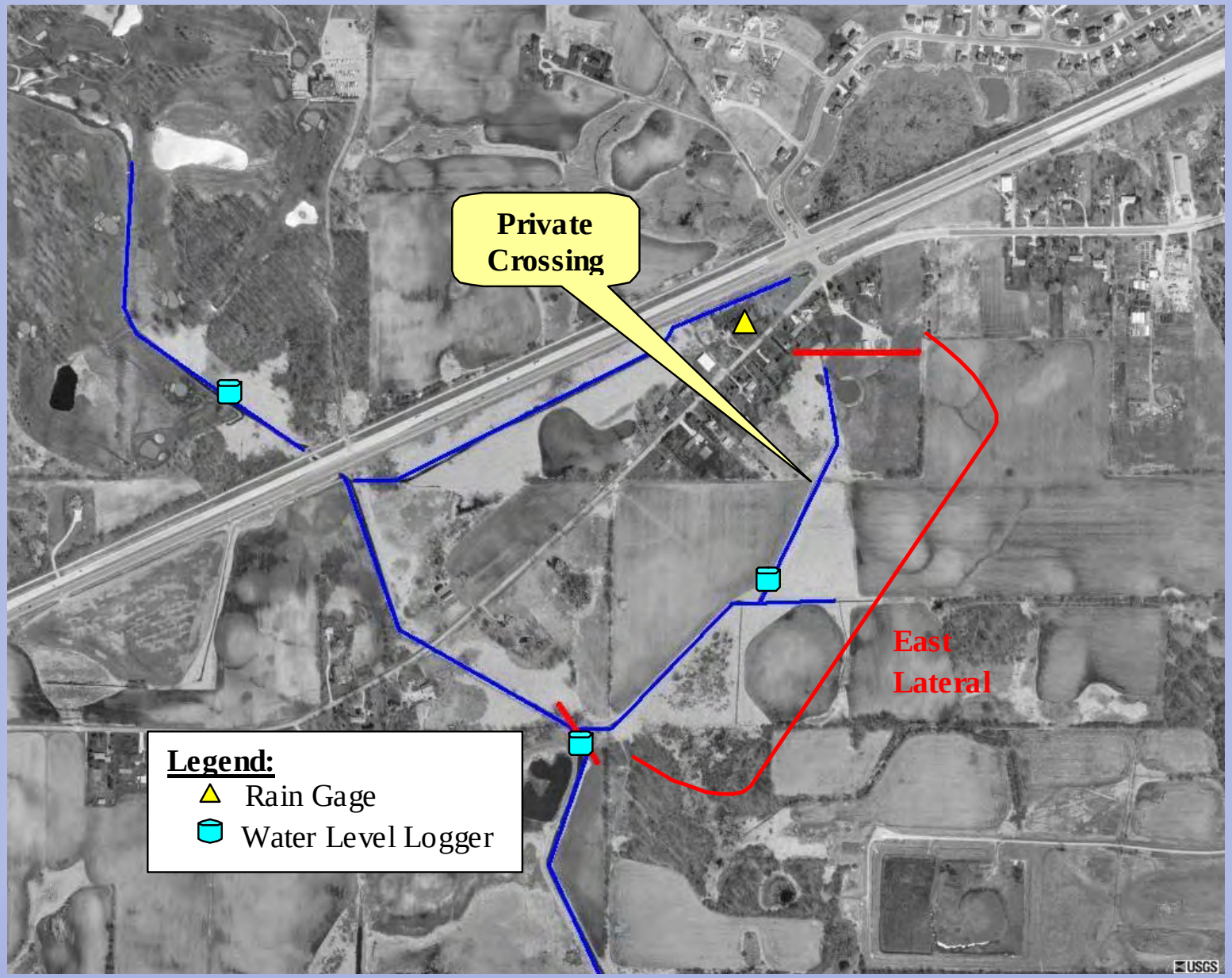
Figure 35. Facing west (downstream) from the Fire Station at Loomis Drive – ditch tributary

Figure 36. Facing downstream from Loomis Drive (old Loomis)

Figure 37. Upstream side of Loomis Drive crossing

Figure 38. Facing upstream from Loomis Drive crossing

East Lateral



East Lateral

Figure 40. Facing downstream near the confluence with the mainstem - note presence of rooted aquatic vegetation and algae

Figure 41. Facing upstream near the confluence with the mainstem – note cornfield in left background

Figure 42. Facing downstream – upstream of confluence with mainstem

Figure 43. Same location as Figure 42 – facing upstream

Figure 44. Facing downstream (west) near water level data logger

Figure 45. Facing east (upstream) of minor eastern lateral near water level data logger

Figure 46. Facing downstream northern minor lateral (from water level data logger to private crossing as shown in Figure 39)

Figure 47. Facing upstream northem minor lateral (from water level data logger to private crossing as shown in Figure 39)

Figure 48. Private crossing in foreground

Figure 49. Private crossing on northern minor lateral of East Lateral (see Figure 39)

Figure 50. Facing upstream from private crossing (northern minor lateral)

Figure 51. Excavated pond at headwater of northern minor lateral

Results of Geomorphic Assessment

- The system has been excavated
- The ditch is flat
- The banks are stable
- There is very little ‘in-stream’ habitat
- There is limited hydraulic resistance
- The ditch is aggradational
  - *it’s size is due to historical excavation activity and not a reflection of ‘natural’ channel forming processes; Hence it is bigger than it needs to be and is filling in …..though <u>very</u> slowly*

Rain Gage and Water Surface Elevation Data Collector Installed

Rain Gage at the Fire Station

Data Collector ***Golf Course***

Data Collector ***'Upstream'***

Data Collector ***Bridge***

What Can We Learn from Data Collection?

- Rainfall
  - ✓Events – flooding can be the result of a large rainfall event…..can learn about the depth and intensity of *events* which can be compared to published values (rainfall frequency curves)
  - ✓Seasonal – flooding can be the result of numerous small events over time…..can learn about how systems operate over time

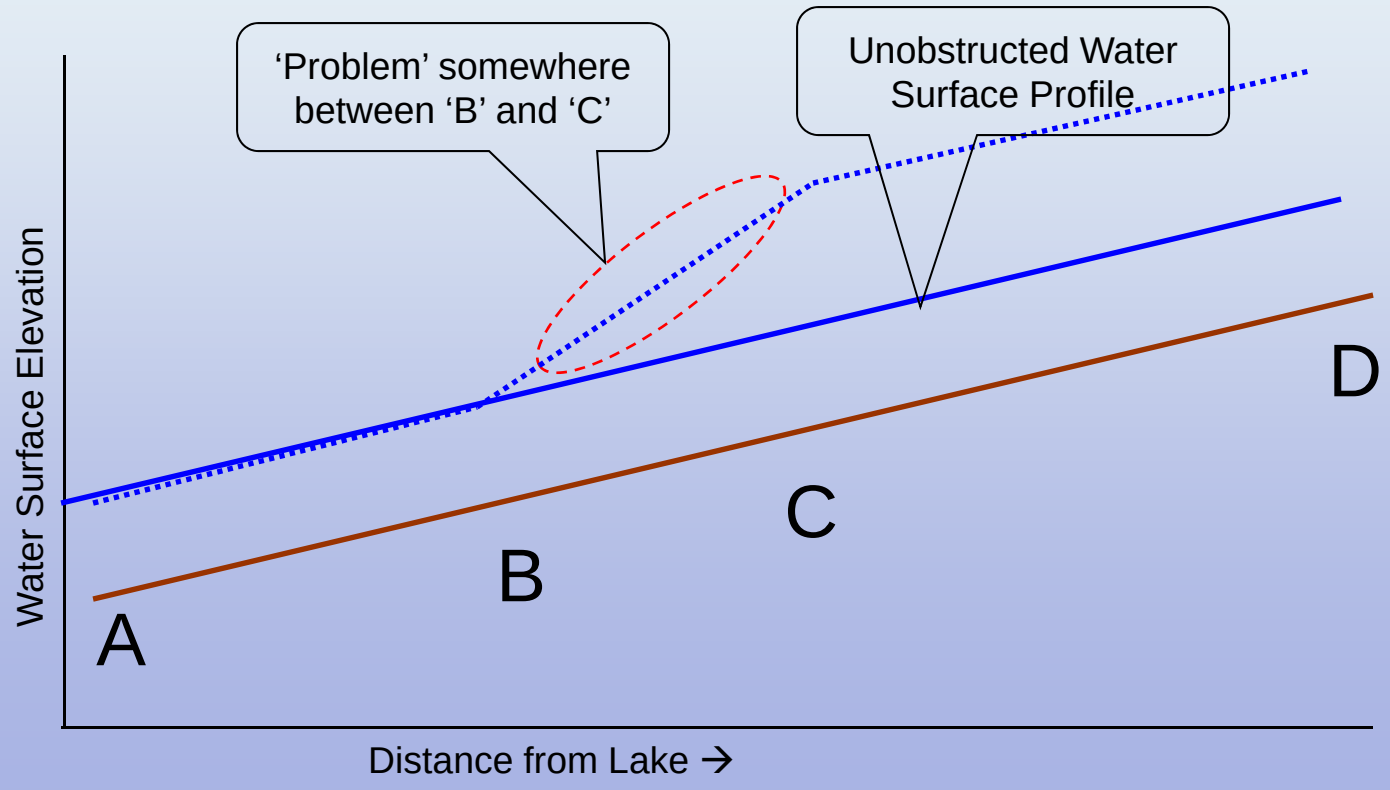
What Can We Learn from Data Collection?

- Water Level Data Logger
  - ✓Elevated flood levels can be due to blockages in system
  - ✓Elevated flood levels can be due to reduced capacity in system (pipe too small)
  - ✓Can learn about the drawdown time / conditions and not just the peak elevations

Elevated Flood Levels

Gage data can show how much / where a blockage or constriction occurs….

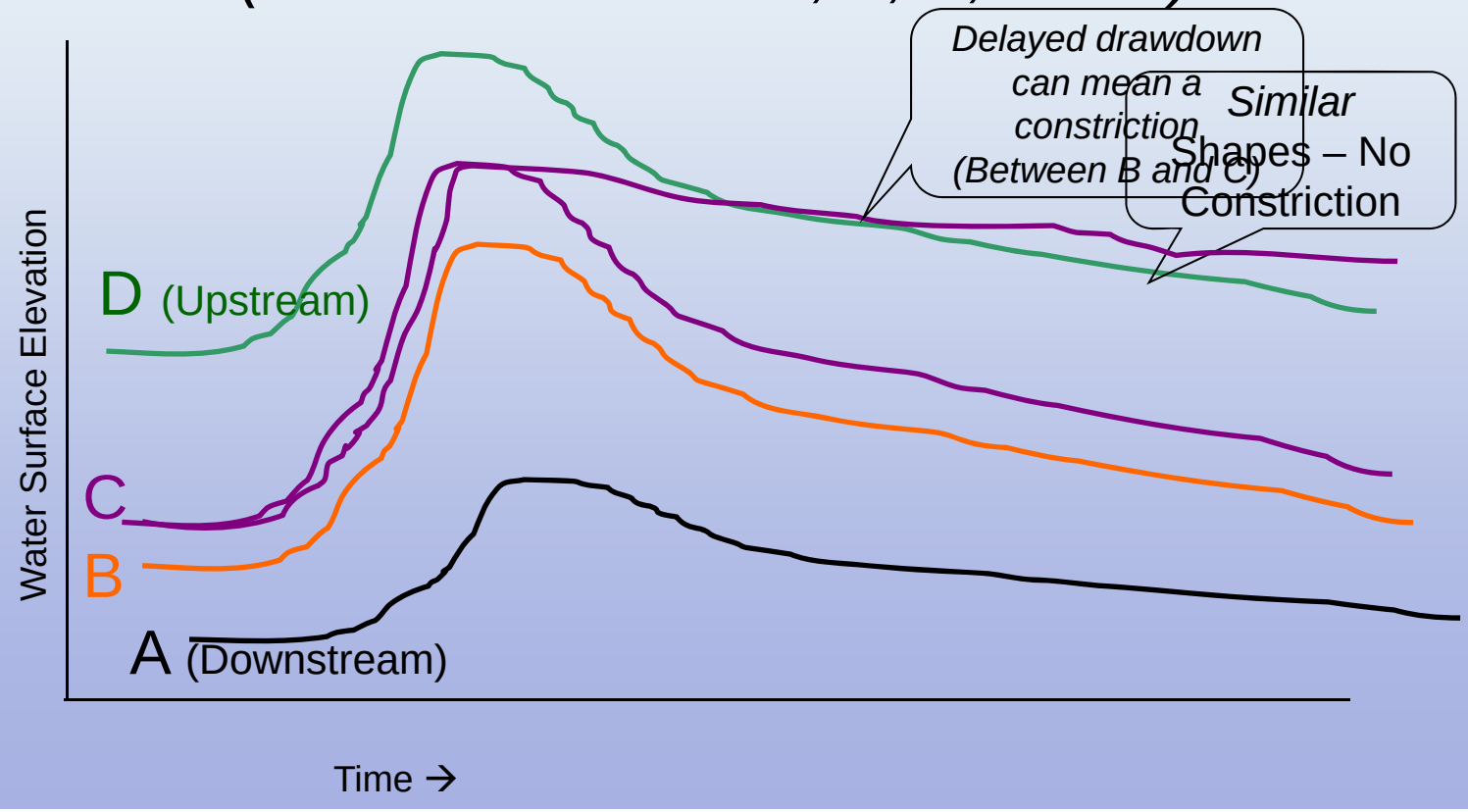
what we look for (measure levels at A, B, C, and D):



Elevated Flood Levels
Delay in Drawdown

If there is a constriction it can also lengthen the time it takes to draw down the water surface elevation

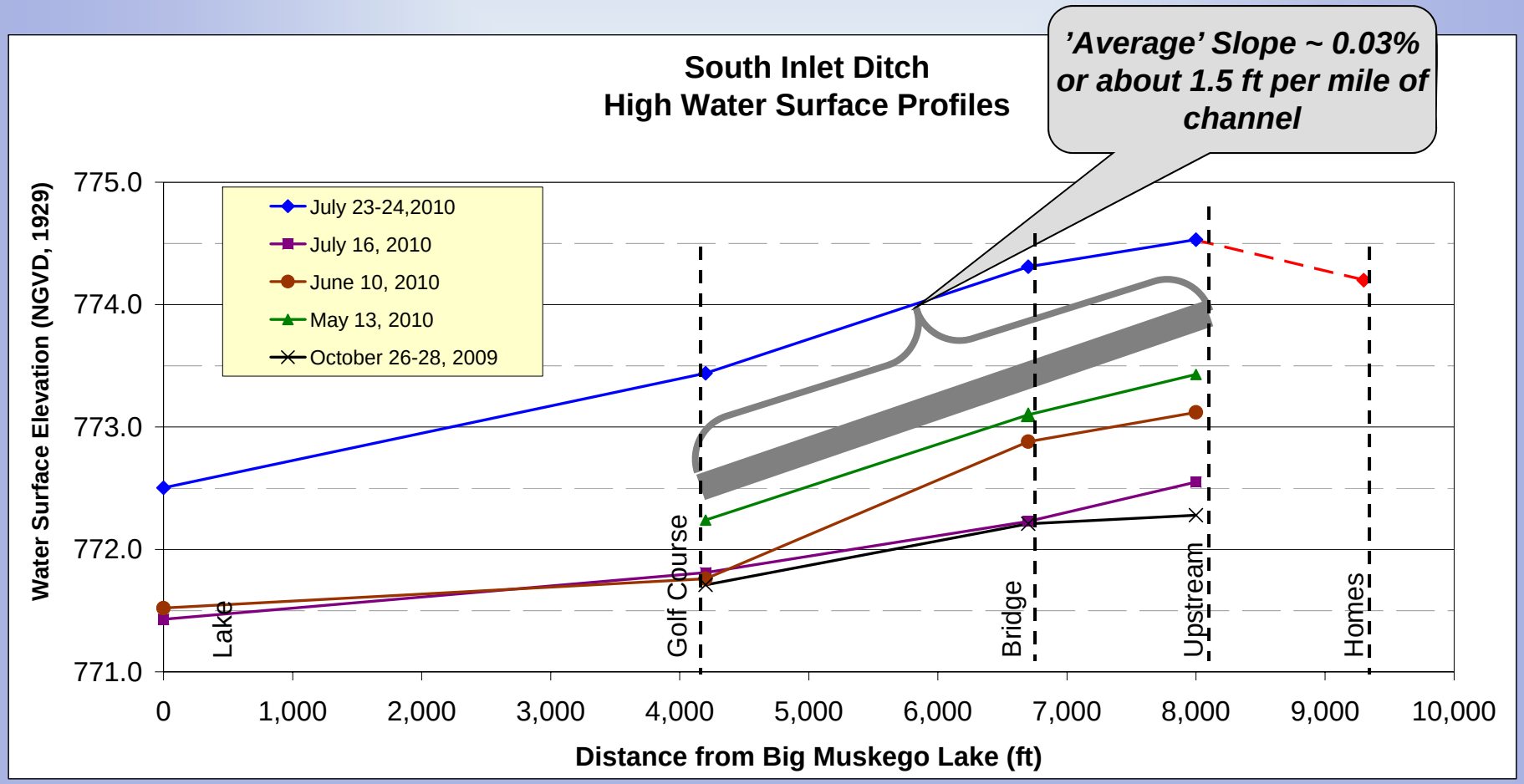
what we look for (measure levels at A, B, C, and D):



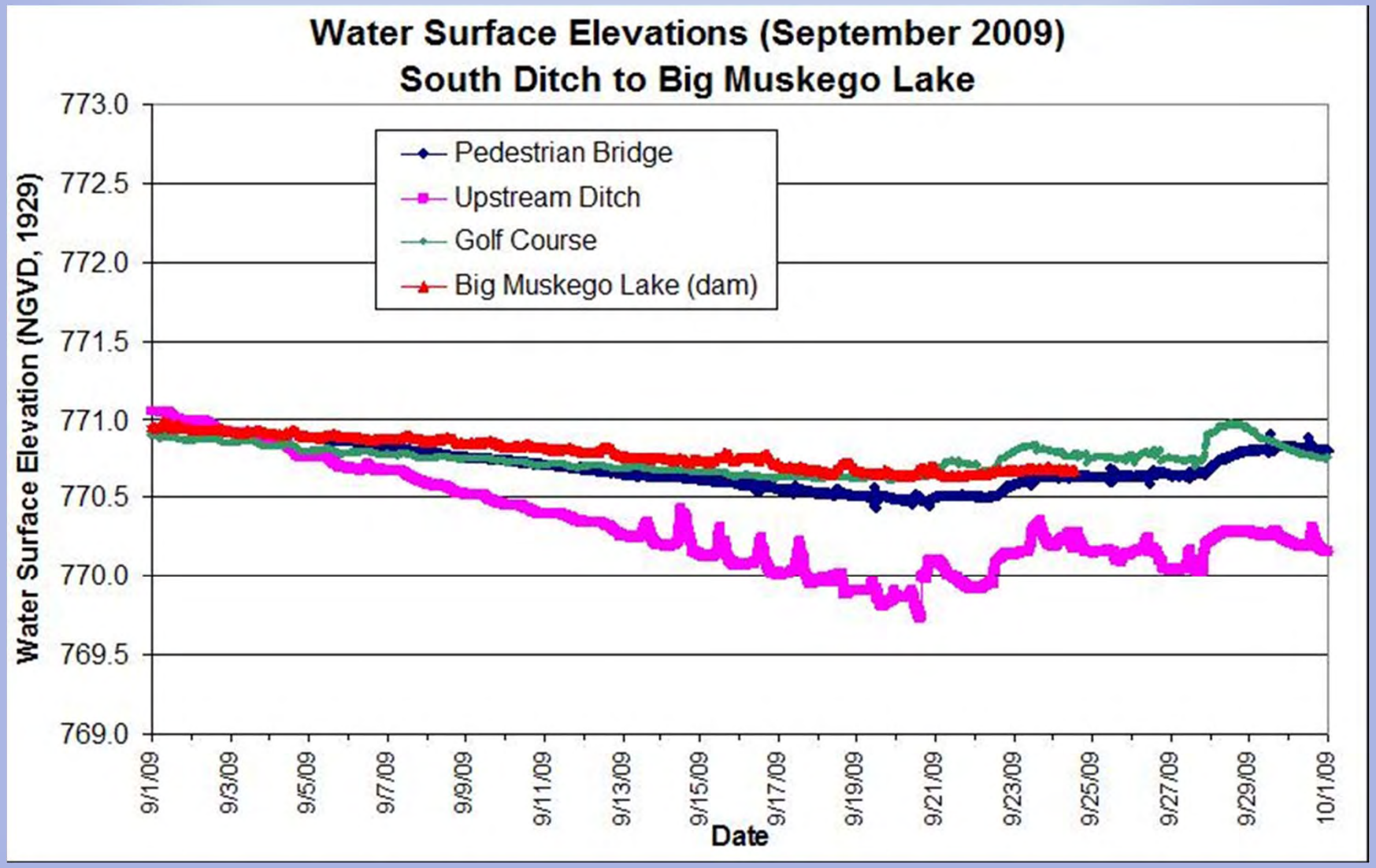
Results – Water Surface Profiles

(Table 3 of the Report)

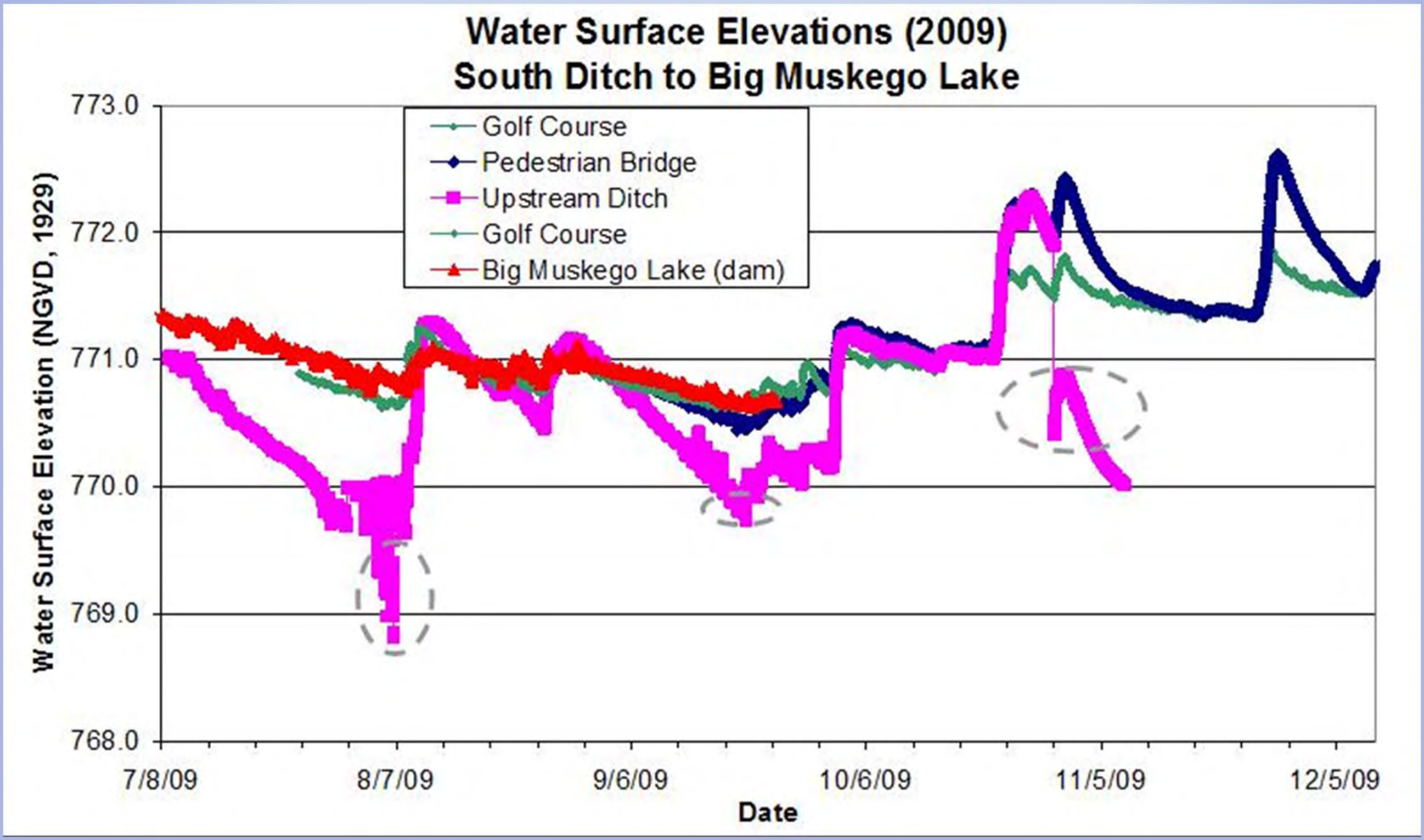
Note: did not have lake elevations for entire study record, and included one water surface elevation at the homes



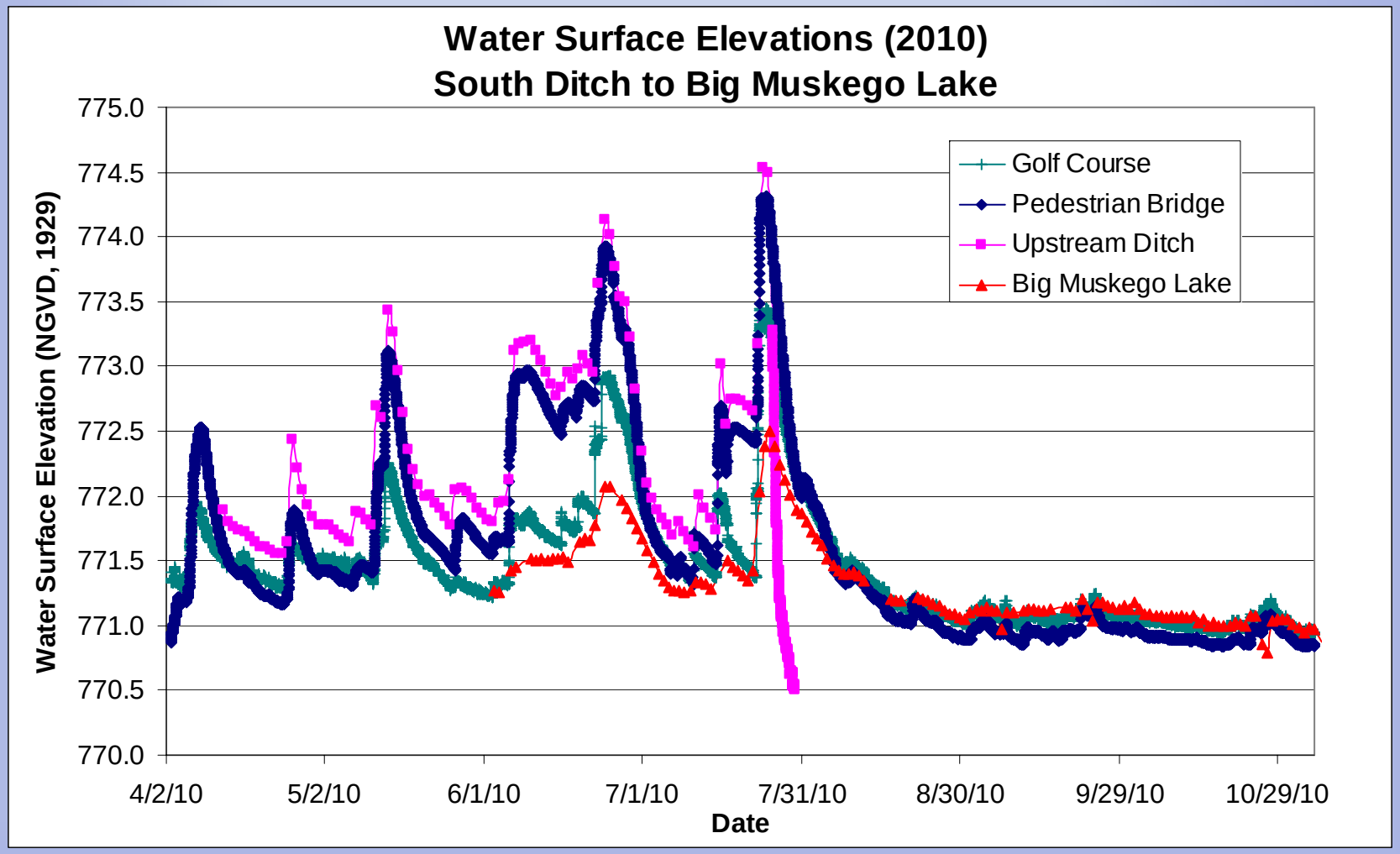
Results – Water Surface Drawdown 2009



Water Surface Elevations
Detail of Portion of 2009



Water Surface Elevations 2010



Water Surface Elevations
High Water Period 2010

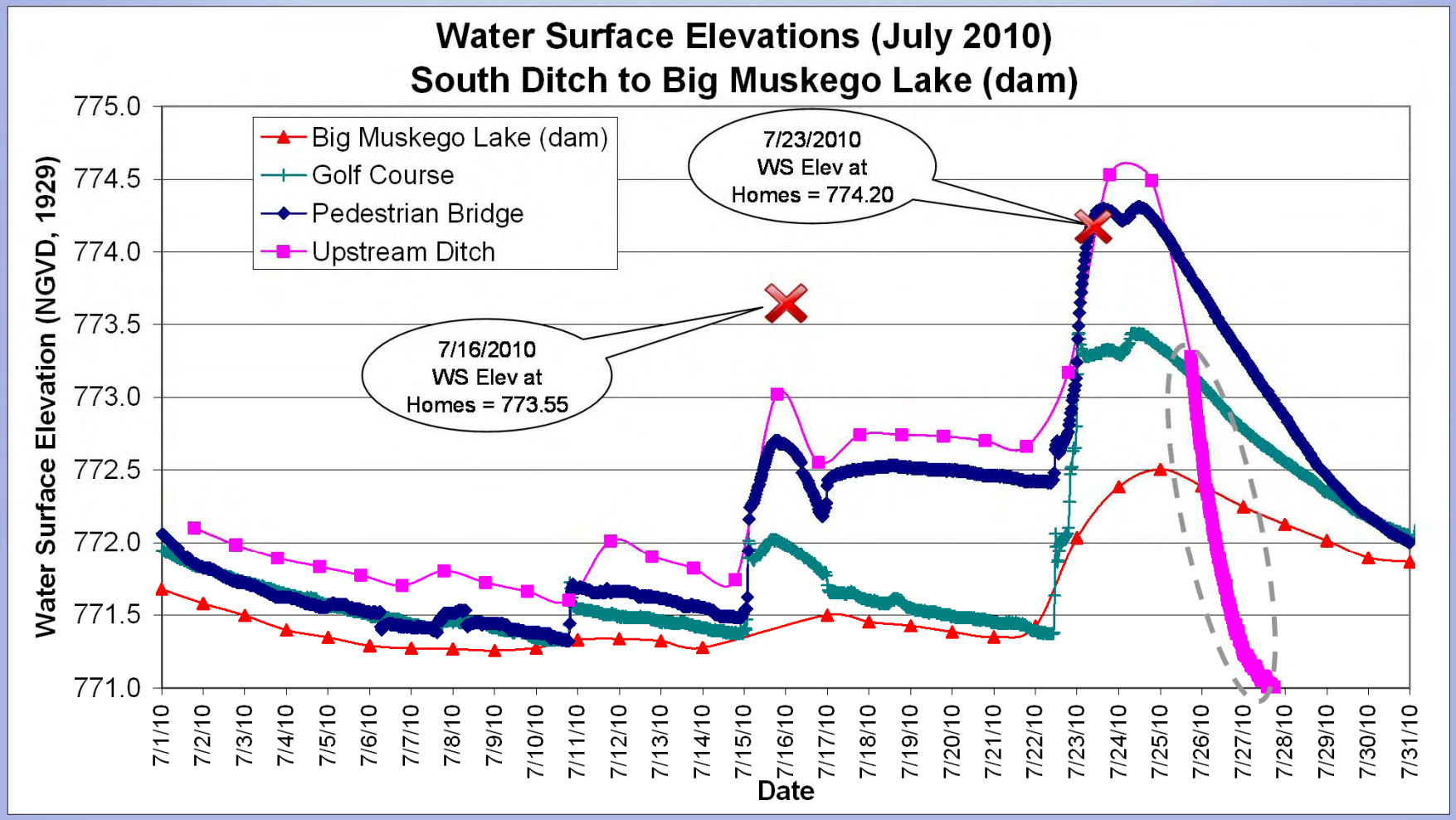
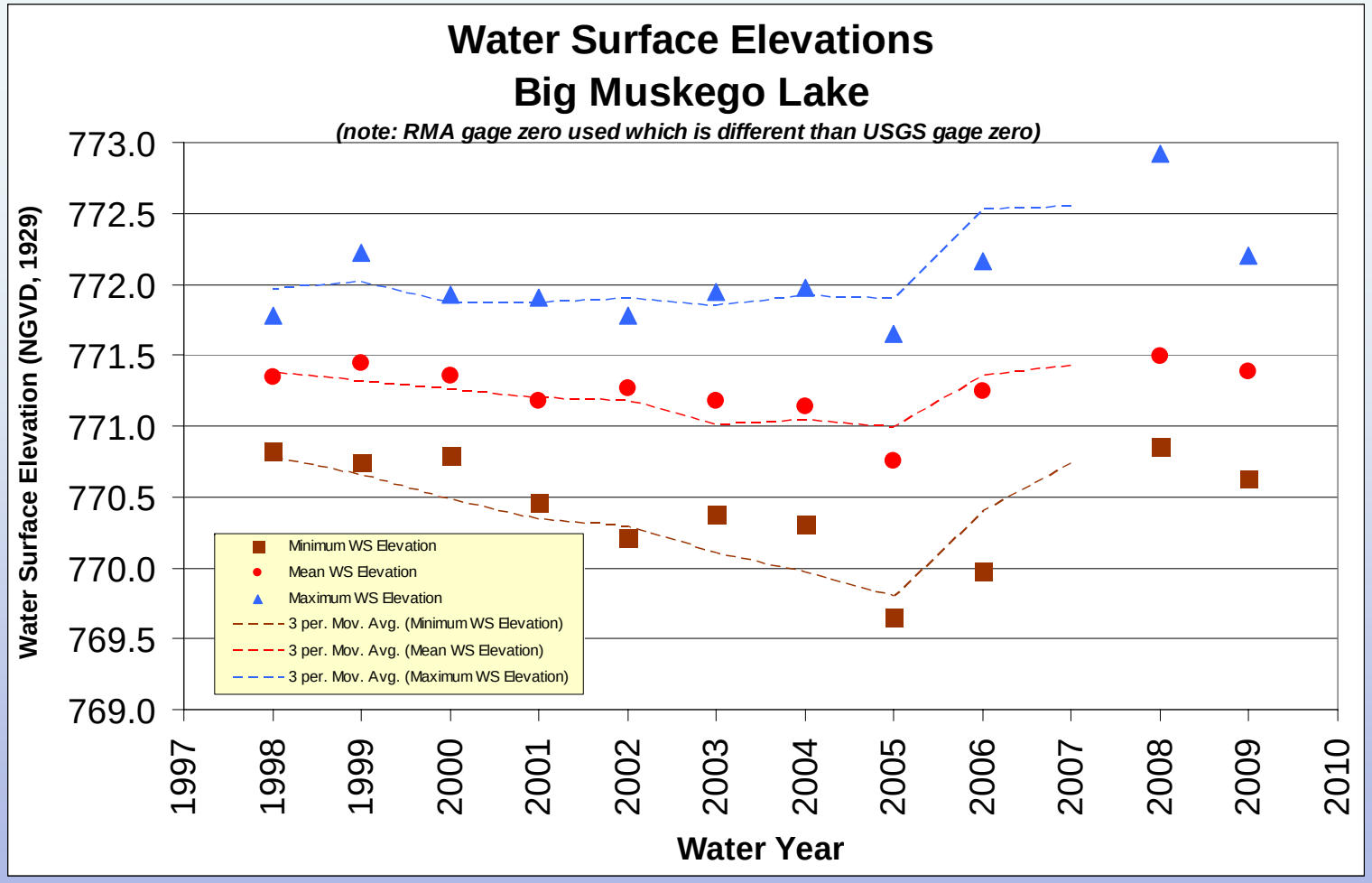


Figure 5. July 2010 Water Surface Elevations (Flood Conditions)

So, Why is there High Water the Last Couple of Years?



At least a partial explanation is that it appears that there has been higher runoff volumes (estimated by the annual mean water surface elevations of Big Muskego Lake)

Conclusions

- Data was collected in a dry and wet period (2009 and 2010).
- The ditch system (and the slope of the water surface profiles are small for dry and wet conditions)
- There does not appear to be major constrictions in the drainage system that elevate the flood elevations or lengthen the drawdown time
- The local field crossing appears to have less capacity than the remainder of the ditch system
- Recent higher annual runoff volumes may provide some explanation for wetter conditions

Recommendations

- Based upon the data collected and analysis, it does not appear that dredging would lower the water surface elevations or decrease the drawdown time for the area of nuisance flooding

- Replacing the downstream field crossing may provide some local benefit

- The City may want to consider continuing to monitor the ditch system to further evaluate its efficiency