ADDRESSING UNIQUE STORAGE CHARACTERISTICS IN THE NORTH BRANCH CHICAGO RIVER WATERSHED USING HEC-RAS

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Project Overview

- 1 of 6 DWPs in various stages of completion
- 4 main reaches modeled
- Existing conditions hydrologic and unsteady hydraulic modeling
- Flood control alternatives hydraulic modeling
- Damage Assessments
- Resulting design and final construction by others

Storage Related Challenges

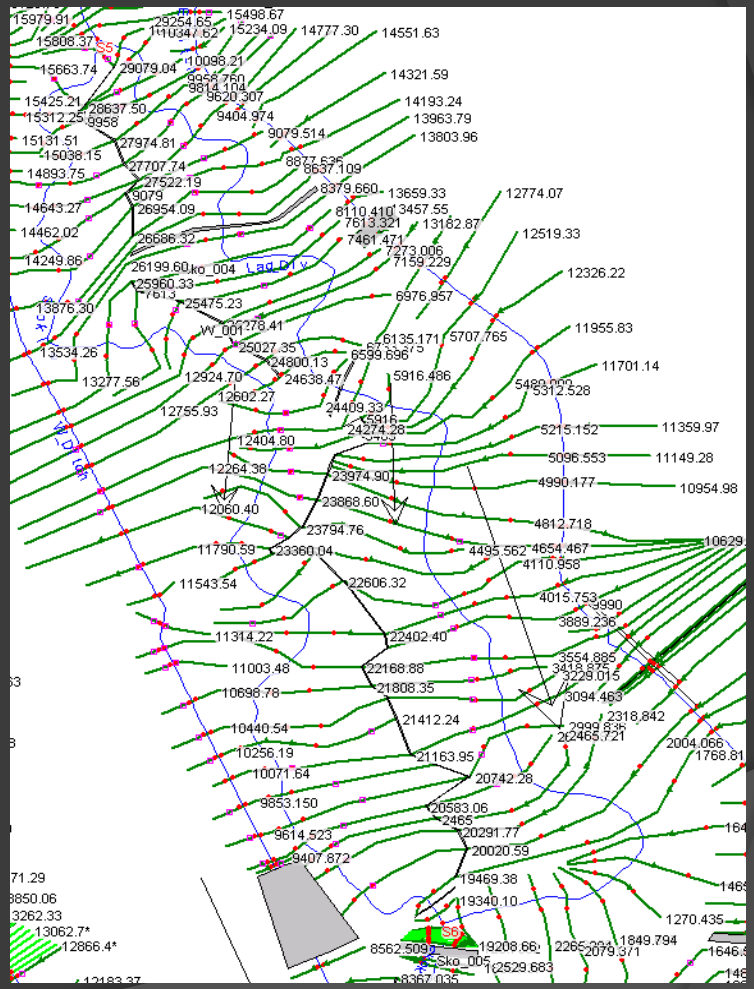
- Balancing stage in split flow reaches along the Skokie River
- Modeling pump operations for the Northbrook Court Reservoir

Skokie River Geometry

- 19 river miles (Skokie River and Tribs)
- Complex reach
- 10 junctions
- 3 split flow reaches
- Several tributary to sub-reach overflow points

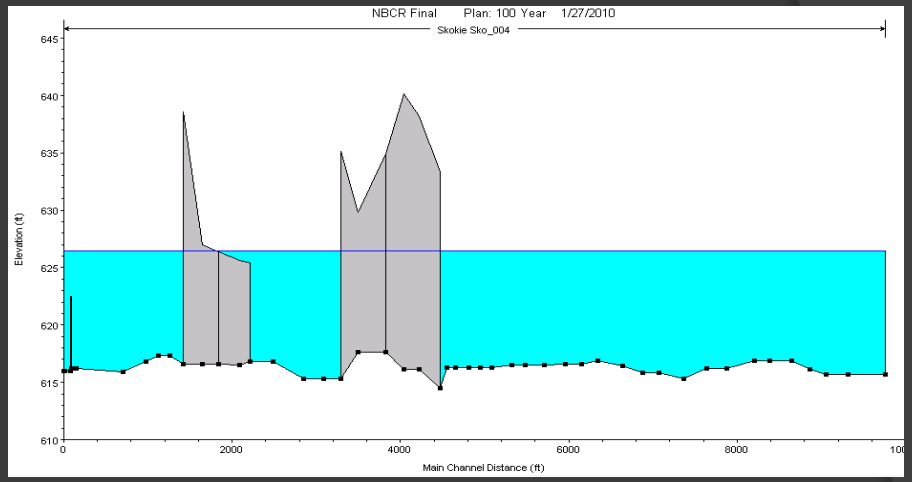
Skokie Lagoons Split Flow Reach

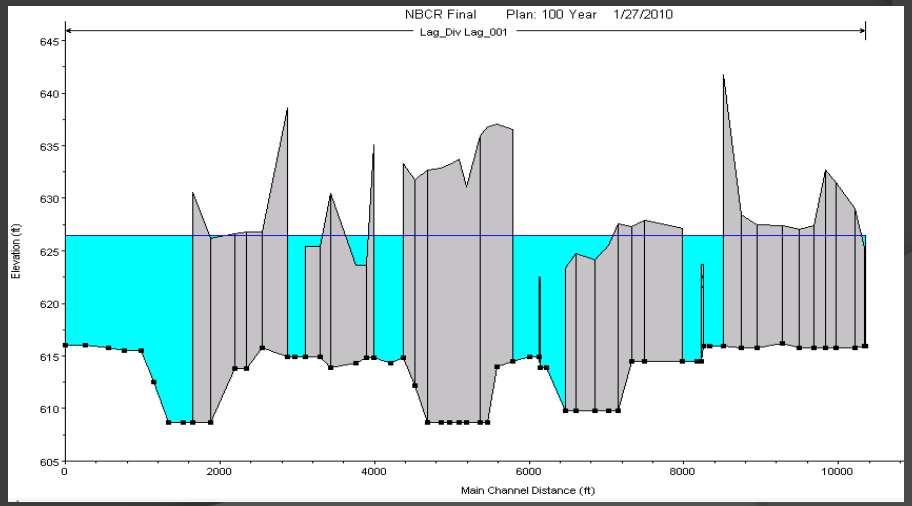
Skokie Lagoons Lateral Weirs



Skokie River & Lagoon Profiles

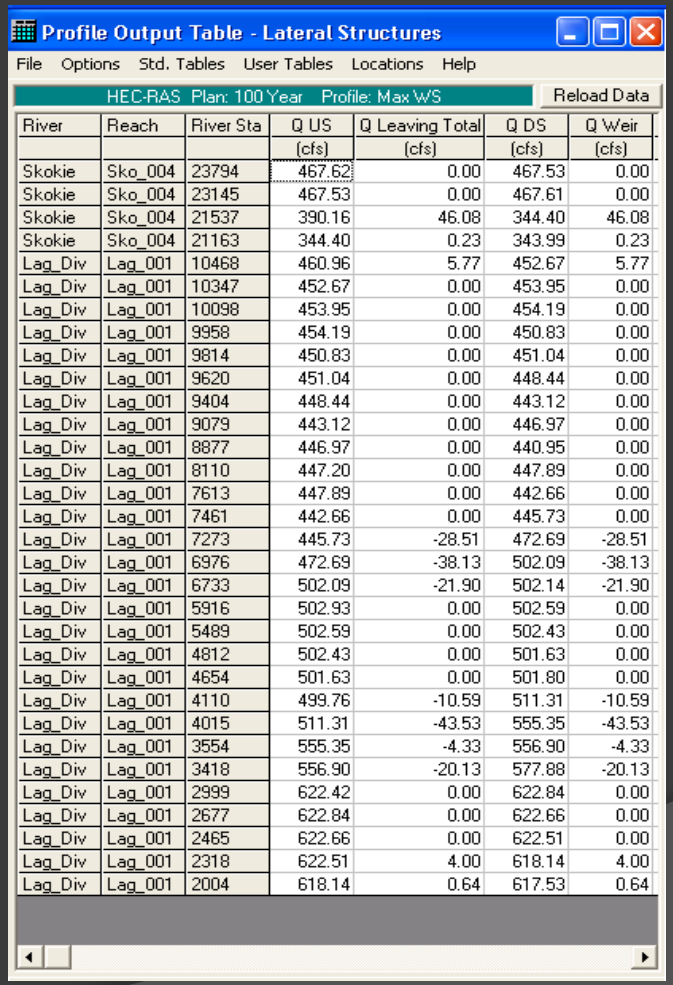
- Gaps in the lateral weirs come from either high points or weirs on the other reach
- 1 ground elevation is taken for each cross section
- WSEL for both reaches = 626.46 (NAVD88)





HEC-RAS Lateral Structure Output

- Lateral Structure output table for both reaches
- Negative flow comes in from the other reach
- At max WSEL, 207cfs flows from Skokie reach to the Lagoon reach (accounting for 25% of the peak flow in the Lagoon)



Profile Output Table - Lateral Structures

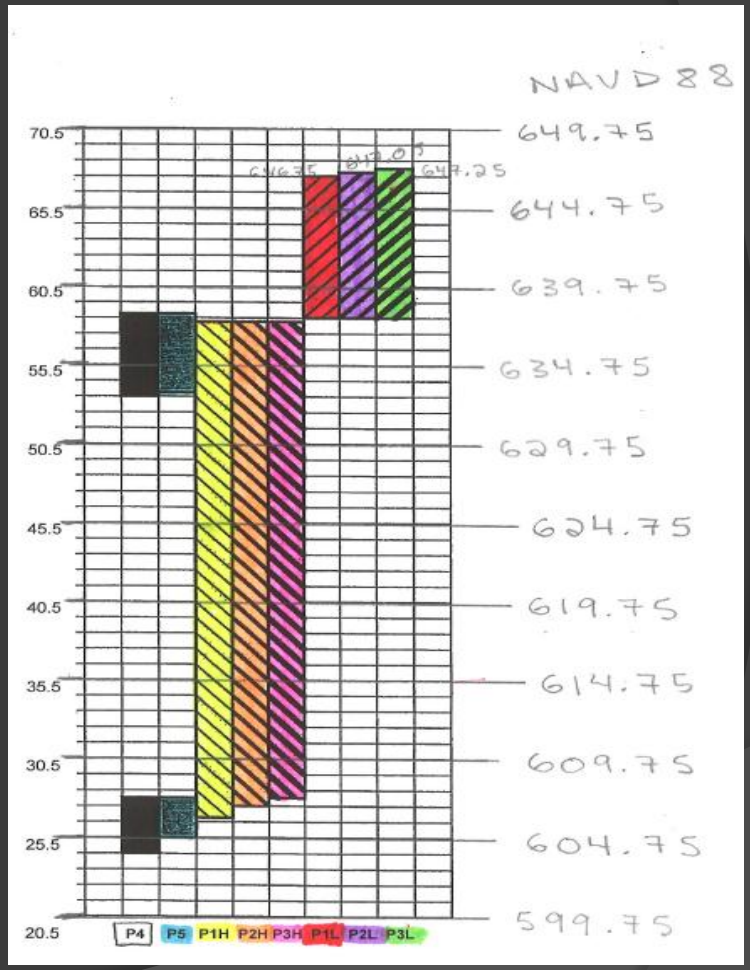
File Options Std. Tables User Tables Locations Help

HEC-RAS Plan: 100 Year Profile: Max WS | Reload Data

River	Reach	River Sta	Q US (cfs)	Q Leaving Total (cfs)	Q DS (cfs)	Q Weir (cfs)
Skokie	Sko_004	23794	467.62	0.00	467.53	0.00
Skokie	Sko_004	23145	467.53	0.00	467.61	0.00
Skokie	Sko_004	21537	390.16	46.08	344.40	46.08
Skokie	Sko_004	21163	344.40	0.23	343.99	0.23
Lag_Div	Lag_001	10468	460.96	5.77	452.67	5.77
Lag_Div	Lag_001	10347	452.67	0.00	453.95	0.00
Lag_Div	Lag_001	10098	453.95	0.00	454.19	0.00
Lag_Div	Lag_001	9958	454.19	0.00	450.83	0.00
Lag_Div	Lag_001	9814	450.83	0.00	451.04	0.00
Lag_Div	Lag_001	9620	451.04	0.00	448.44	0.00
Lag_Div	Lag_001	9404	448.44	0.00	443.12	0.00
Lag_Div	Lag_001	9079	443.12	0.00	446.97	0.00
Lag_Div	Lag_001	8877	446.97	0.00	440.95	0.00
Lag_Div	Lag_001	8110	447.20	0.00	447.89	0.00
Lag_Div	Lag_001	7613	447.89	0.00	442.66	0.00
Lag_Div	Lag_001	7461	442.66	0.00	445.73	0.00
Lag_Div	Lag_001	7273	445.73	-28.51	472.69	-28.51
Lag_Div	Lag_001	6976	472.69	-38.13	502.09	-38.13
Lag_Div	Lag_001	6733	502.09	-21.90	502.14	-21.90
Lag_Div	Lag_001	5916	502.93	0.00	502.59	0.00
Lag_Div	Lag_001	5489	502.59	0.00	502.43	0.00
Lag_Div	Lag_001	4812	502.43	0.00	501.63	0.00
Lag_Div	Lag_001	4654	501.63	0.00	501.80	0.00
Lag_Div	Lag_001	4110	499.76	-10.59	511.31	-10.59
Lag_Div	Lag_001	4015	511.31	-43.53	555.35	-43.53
Lag_Div	Lag_001	3554	555.35	-4.33	556.90	-4.33
Lag_Div	Lag_001	3418	556.90	-20.13	577.88	-20.13
Lag_Div	Lag_001	2999	622.42	0.00	622.84	0.00
Lag_Div	Lag_001	2677	622.84	0.00	622.66	0.00
Lag_Div	Lag_001	2465	622.66	0.00	622.51	0.00
Lag_Div	Lag_001	2318	622.51	4.00	618.14	4.00
Lag_Div	Lag_001	2004	618.14	0.64	617.53	0.64

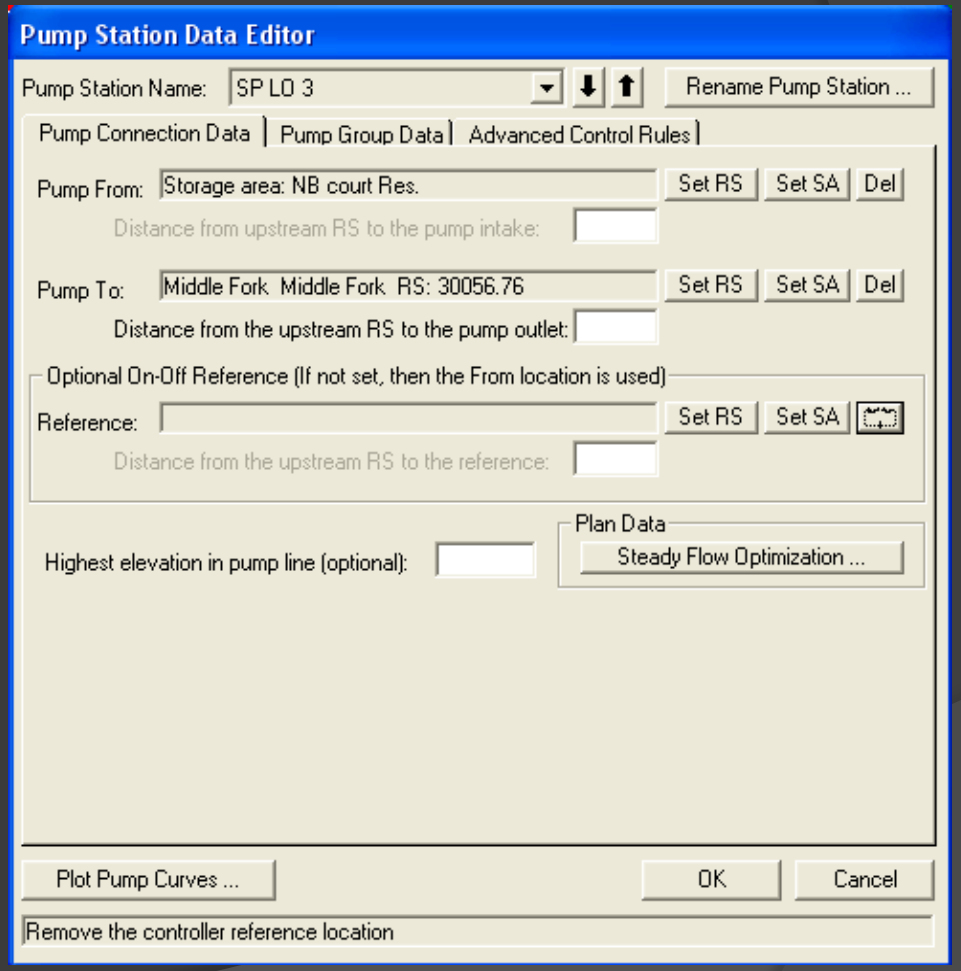
Northbrook Court Reservoir Pumping Operations

- 2 Dry Weather Pumps with one speed, operating over two stage ranges
- 3 Storm Pumps with high and low speed settings, operating over one stage range
- Pumps controlled by reservoir WSEL
- Pump override bubbler located 2.5 miles D/S of reservoir



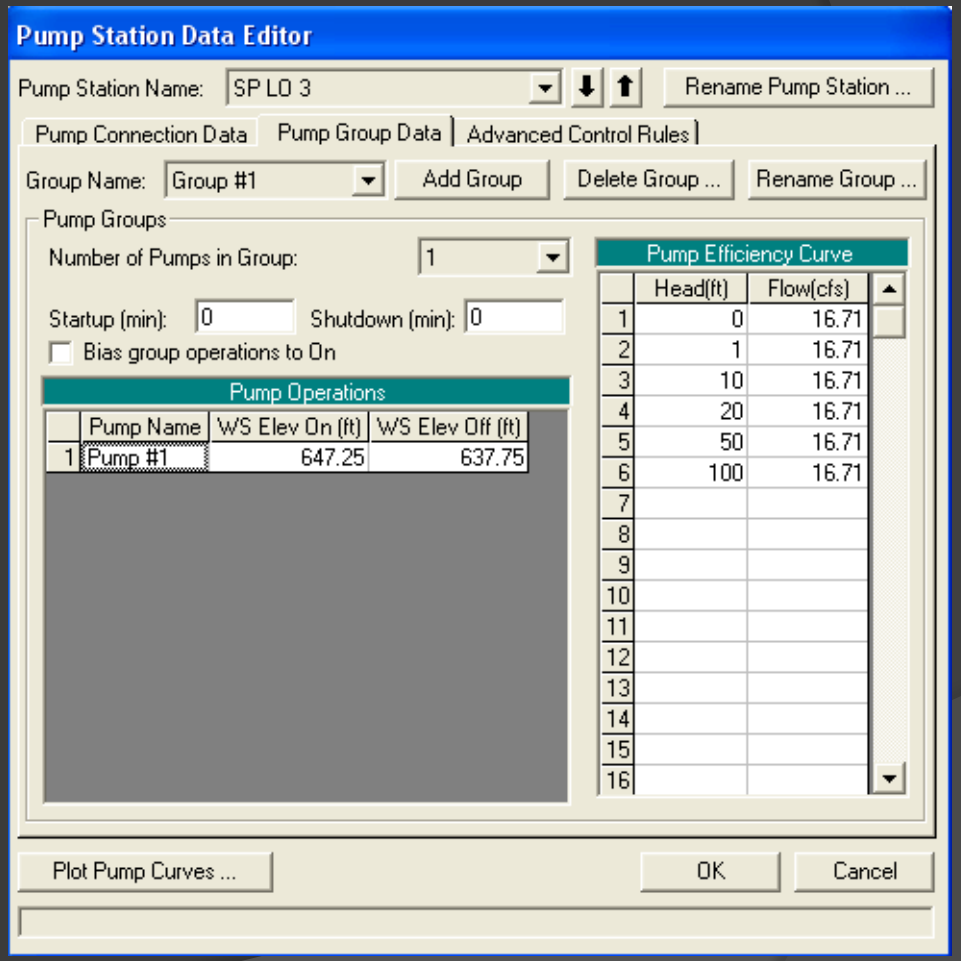
Pump Connection Data

- Each pump setting is input as its own Pump Station
- Pump From
- Pump To
- Optional On-Off Reference not utilized



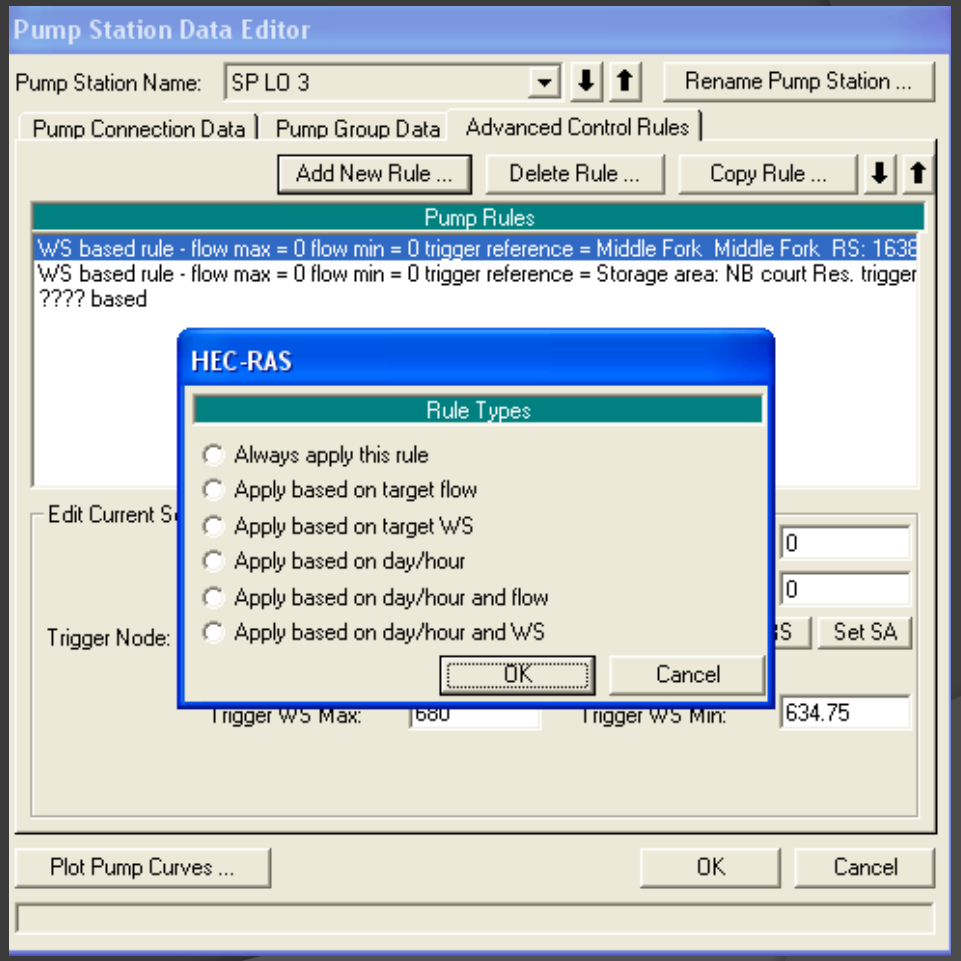
Pump Group Data

- WSEL On
- WSEL Off
- Pump Efficiency
- Scope – General performance



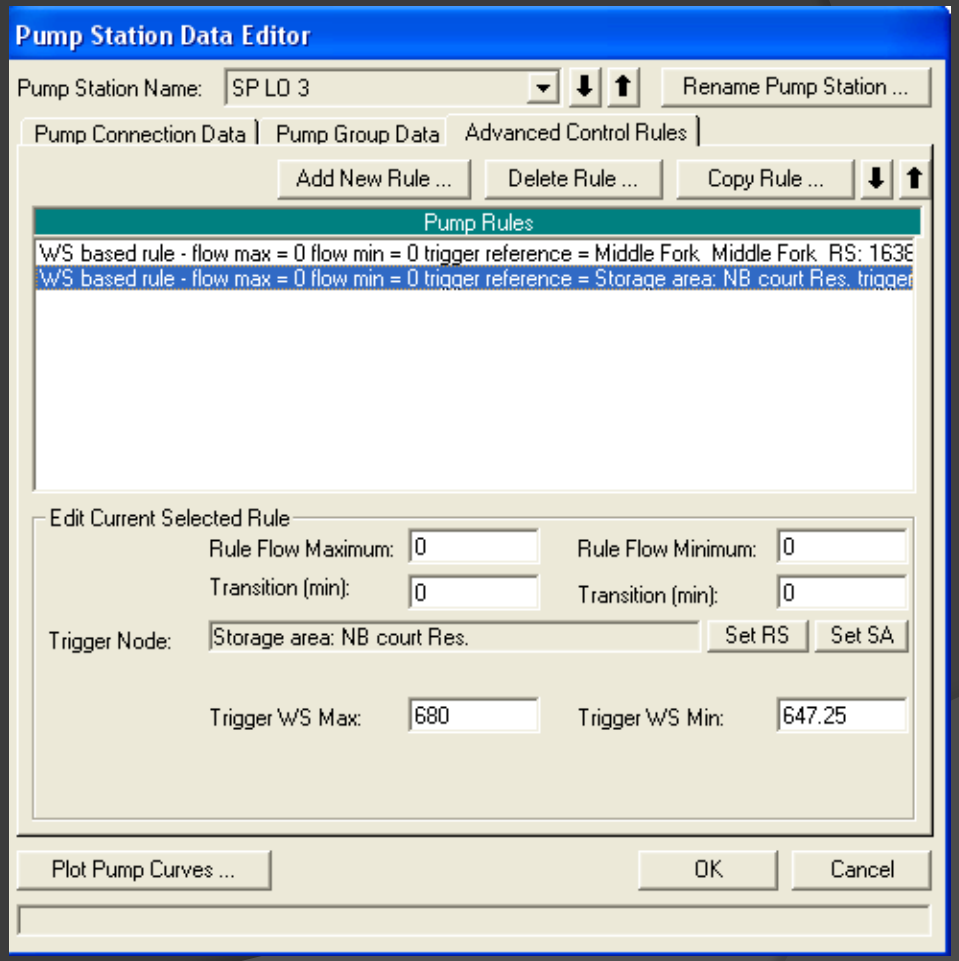
Advanced Control Rules

- New to HEC-RAS 4.0
- Rule Type
- Apply based on target WS



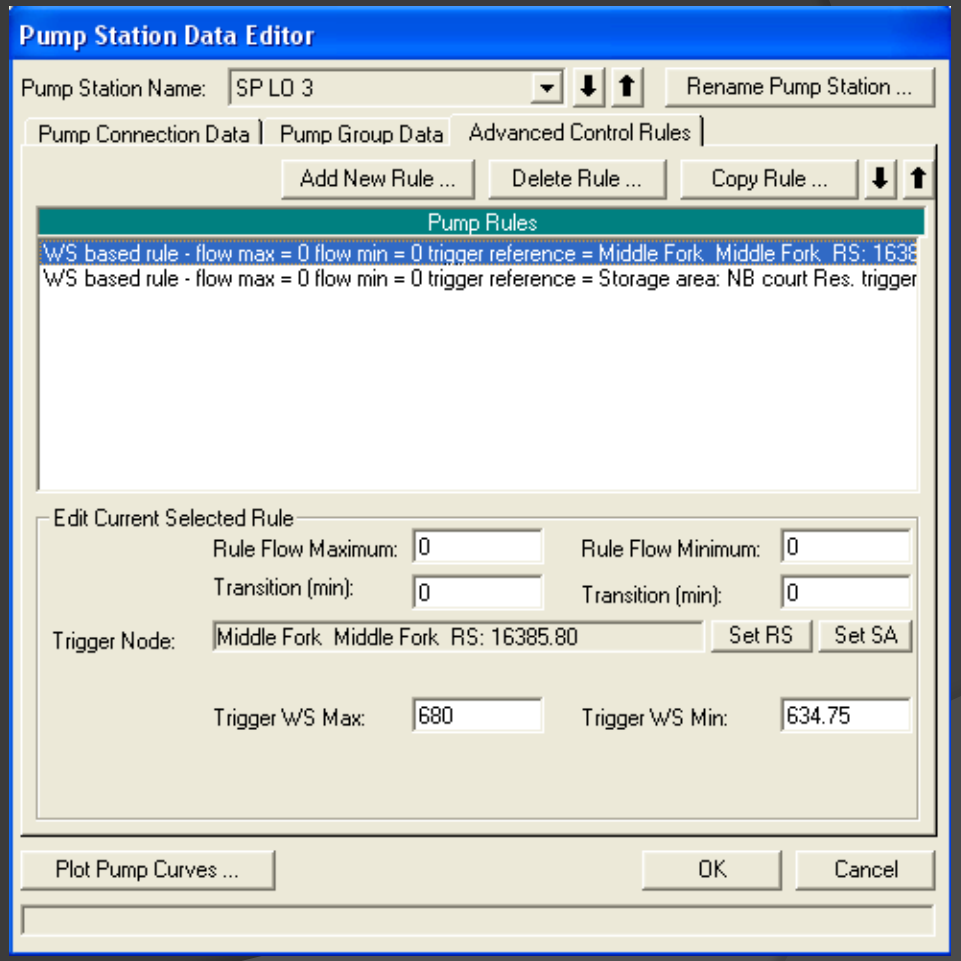
Reservoir WSEL override

- Reservoir set as trigger node
- Rule operates pump while reservoir is falling, not rising
- Rule flow max at 0 shuts pump off
- Trigger WS min is the same as “pump on” elevation set in Pump Group Data



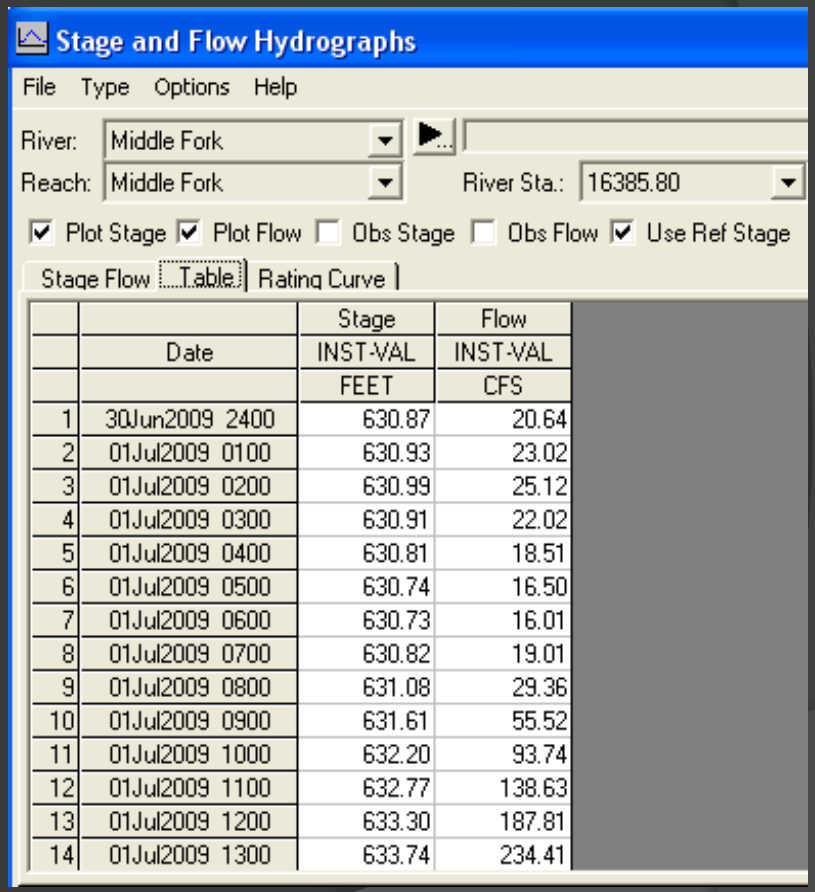
Downstream Bubbler Override

- Trigger node set at bubbler x-section location
- Rule flow max at 0 shuts pump off
- Trigger WS min is at an elevation independent of the reservoir



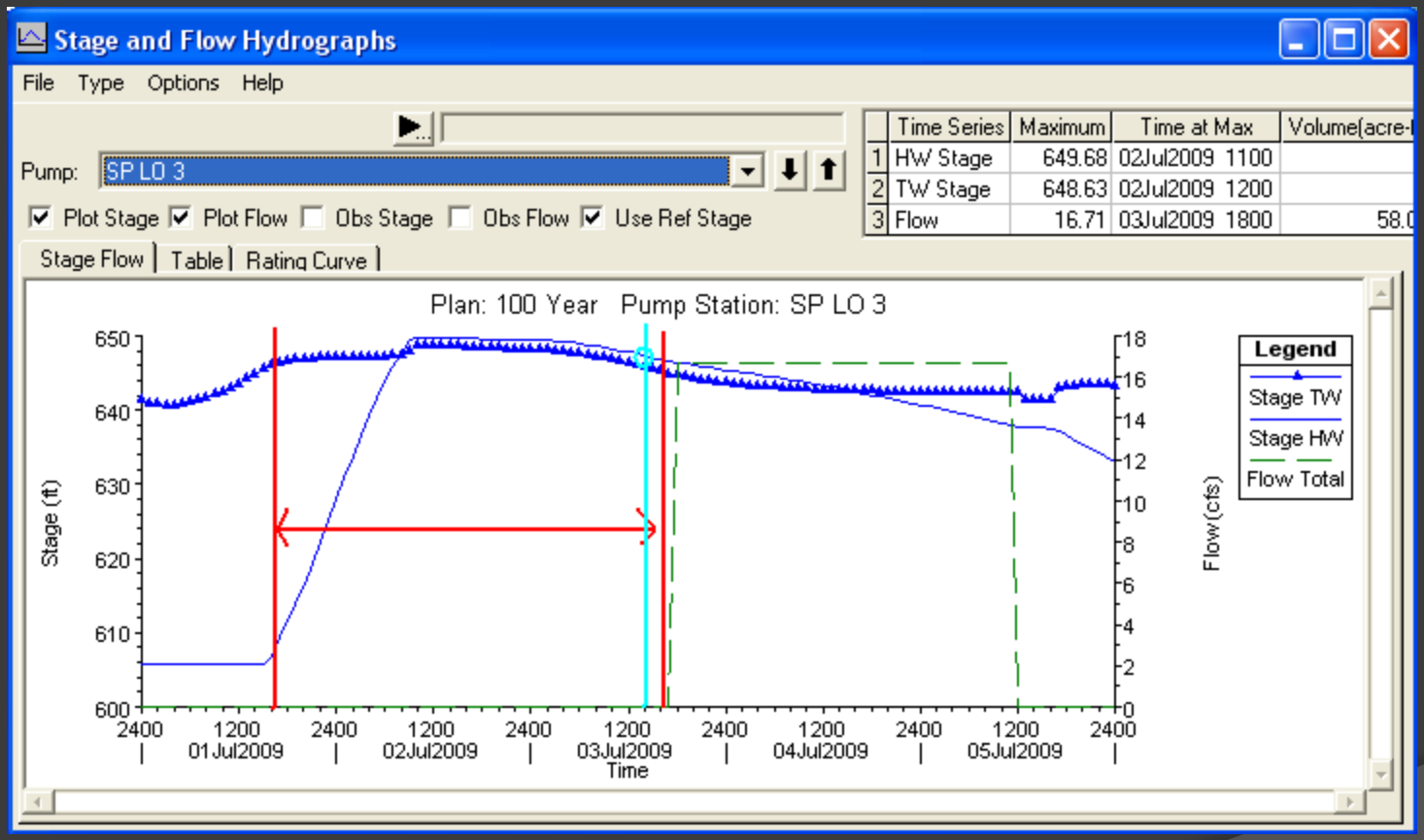
Bubbler Performance Check

- Open Bubbler cross section stage and flow table
- Used excel to determine range of dates that the shutoff should be in effect
- Dates 01 July 1600 to 03 July 1700

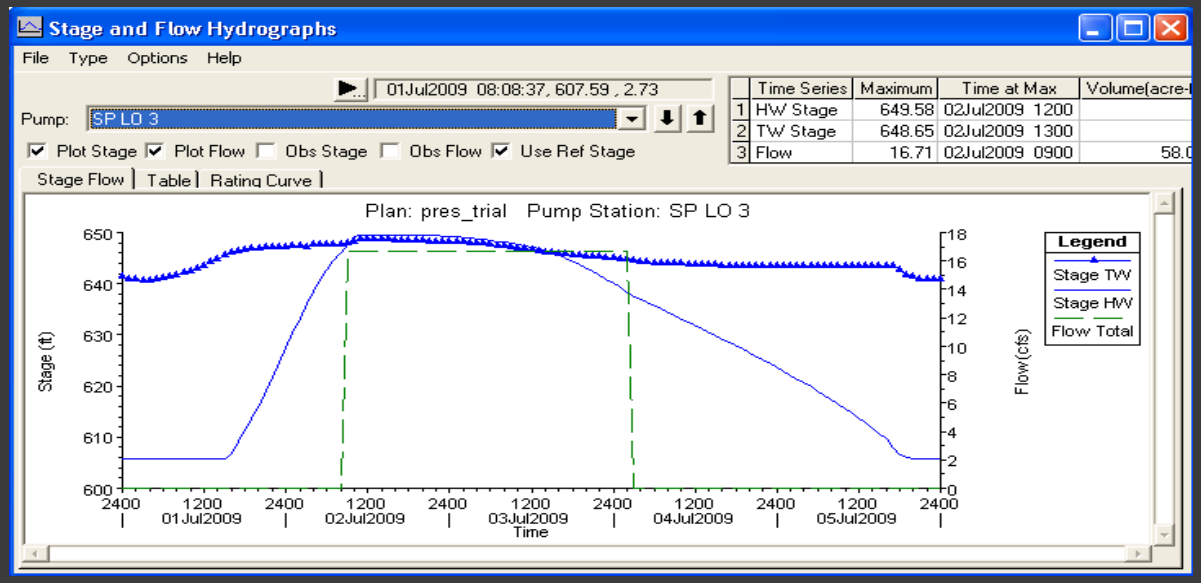


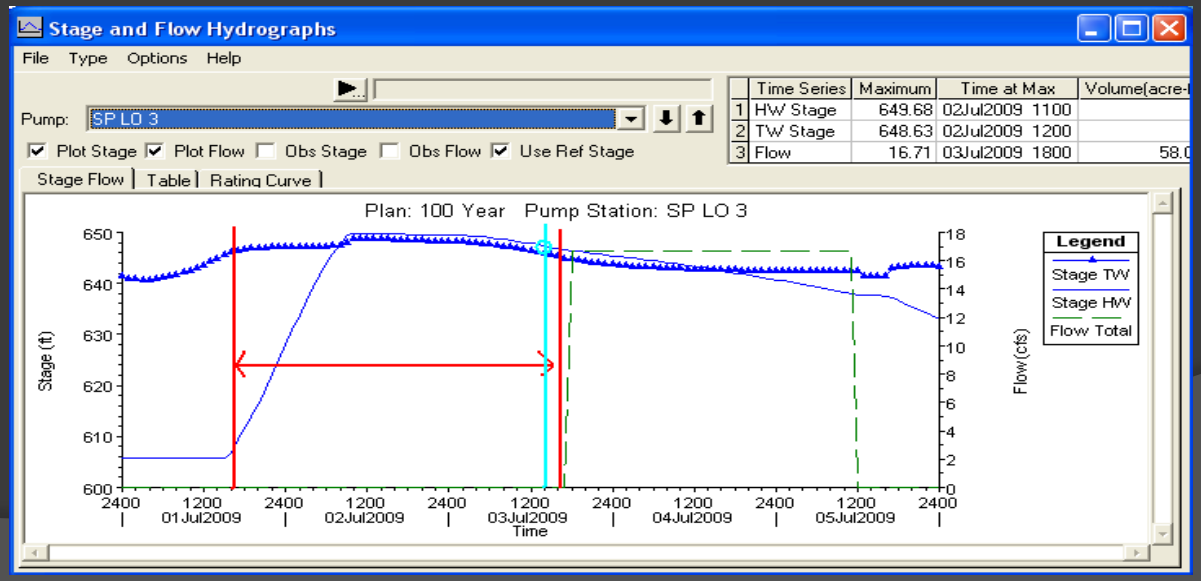
	Date	Stage INST-VAL FEET	Flow INST-VAL CFS
1	30Jun2009 2400	630.87	20.64
2	01Jul2009 0100	630.93	23.02
3	01Jul2009 0200	630.99	25.12
4	01Jul2009 0300	630.91	22.02
5	01Jul2009 0400	630.81	18.51
6	01Jul2009 0500	630.74	16.50
7	01Jul2009 0600	630.73	16.01
8	01Jul2009 0700	630.82	19.01
9	01Jul2009 0800	631.08	29.36
10	01Jul2009 0900	631.61	55.52
11	01Jul2009 1000	632.20	93.74
12	01Jul2009 1100	632.77	138.63
13	01Jul2009 1200	633.30	187.81
14	01Jul2009 1300	633.74	234.41

Bubbler Check - Continued



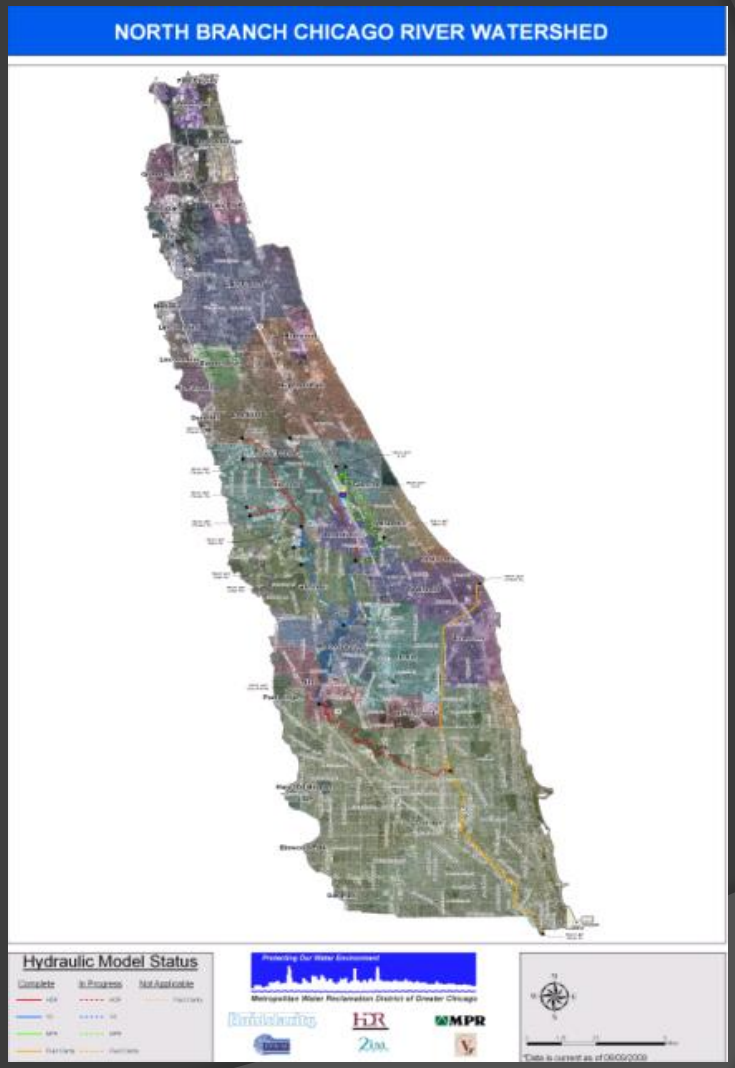
Comparison Without Control Rules





Summary

- Usage of lateral weirs to balance split flow reaches
- Usage of the new advanced pump control rules to manipulate pump operation
- More on NBCR DWP tomorrow during session 3A



Questions?

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