Public Meeting/Open House
August 2, 2011

EMERGENCY DRAWDOWN OF TWIN LAKES

SD DOT DRAINAGE PERMIT

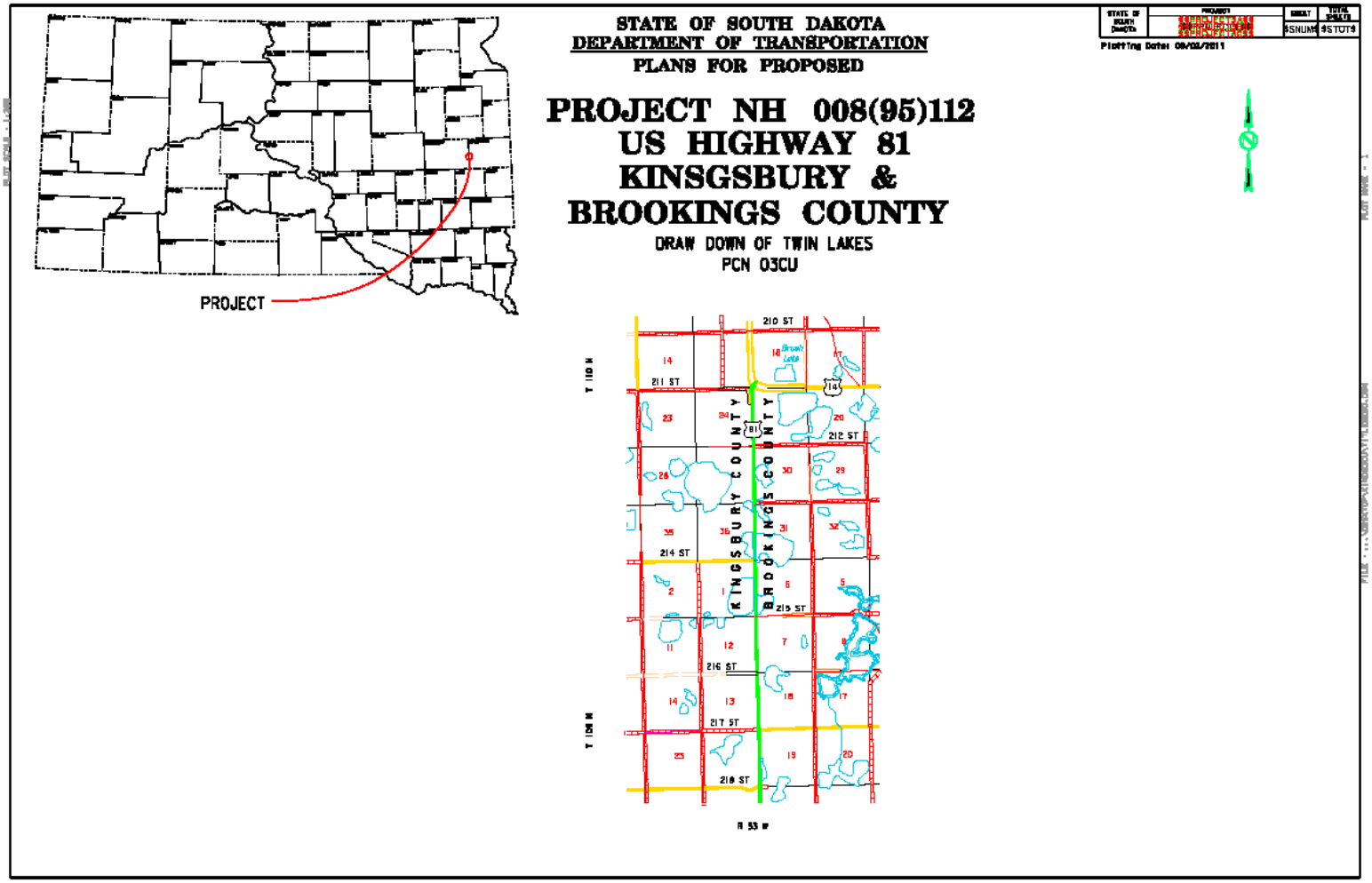
PROJECT NH0081 (95) 112 PCN 03CU
KINGSBURY COUNTY & BROOKINGS COUNTY

US HIGHWAY 81 SOUTH OF US HIGHWAY 14

Temporary Drawdown of Twin Lakes

PROJECT LOCATION

BANNER



VIDEO

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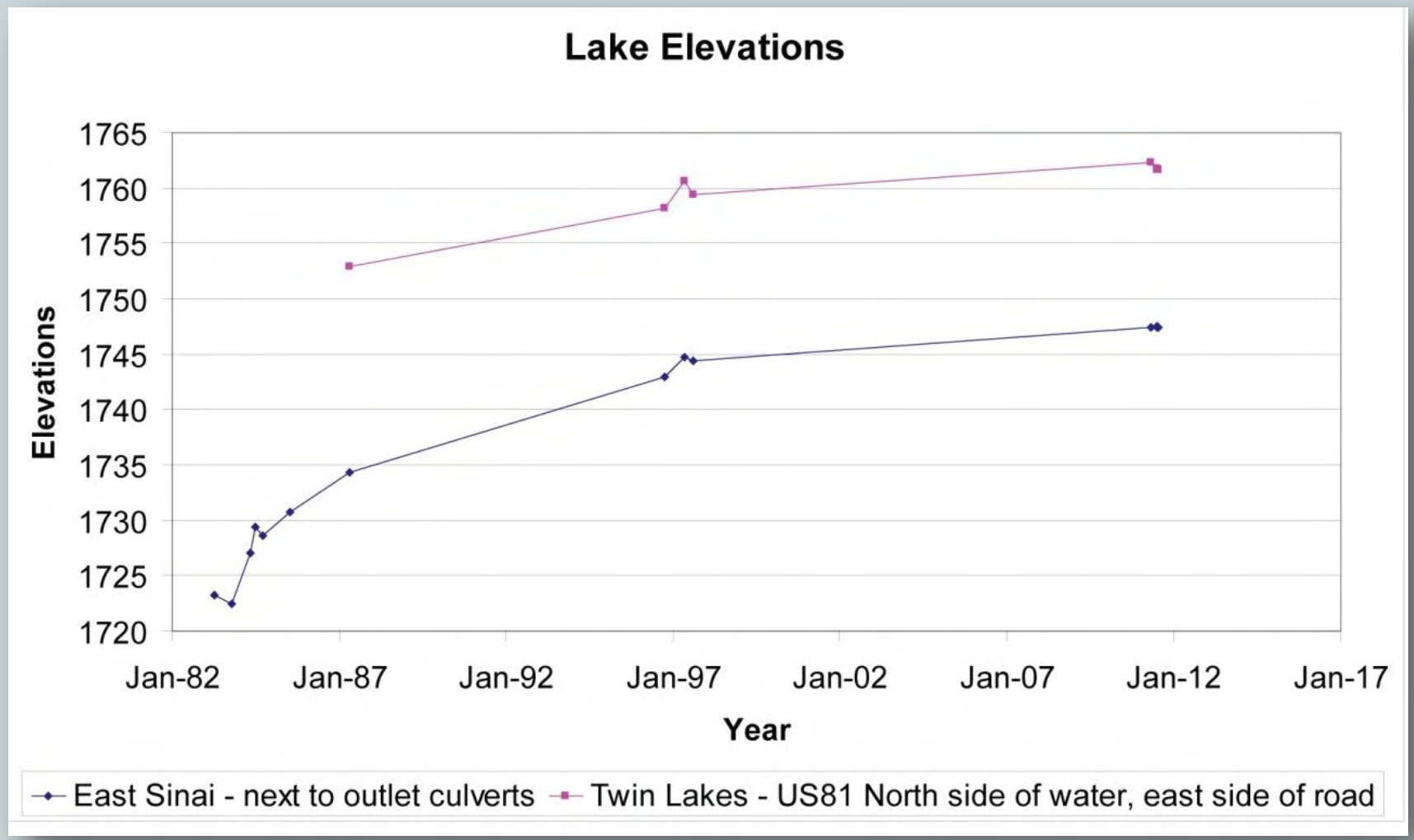
LAKE ELEVATIONS

BANNER



LAKE ELEVATIONS CORRESPONDING OVERFLOW RATES

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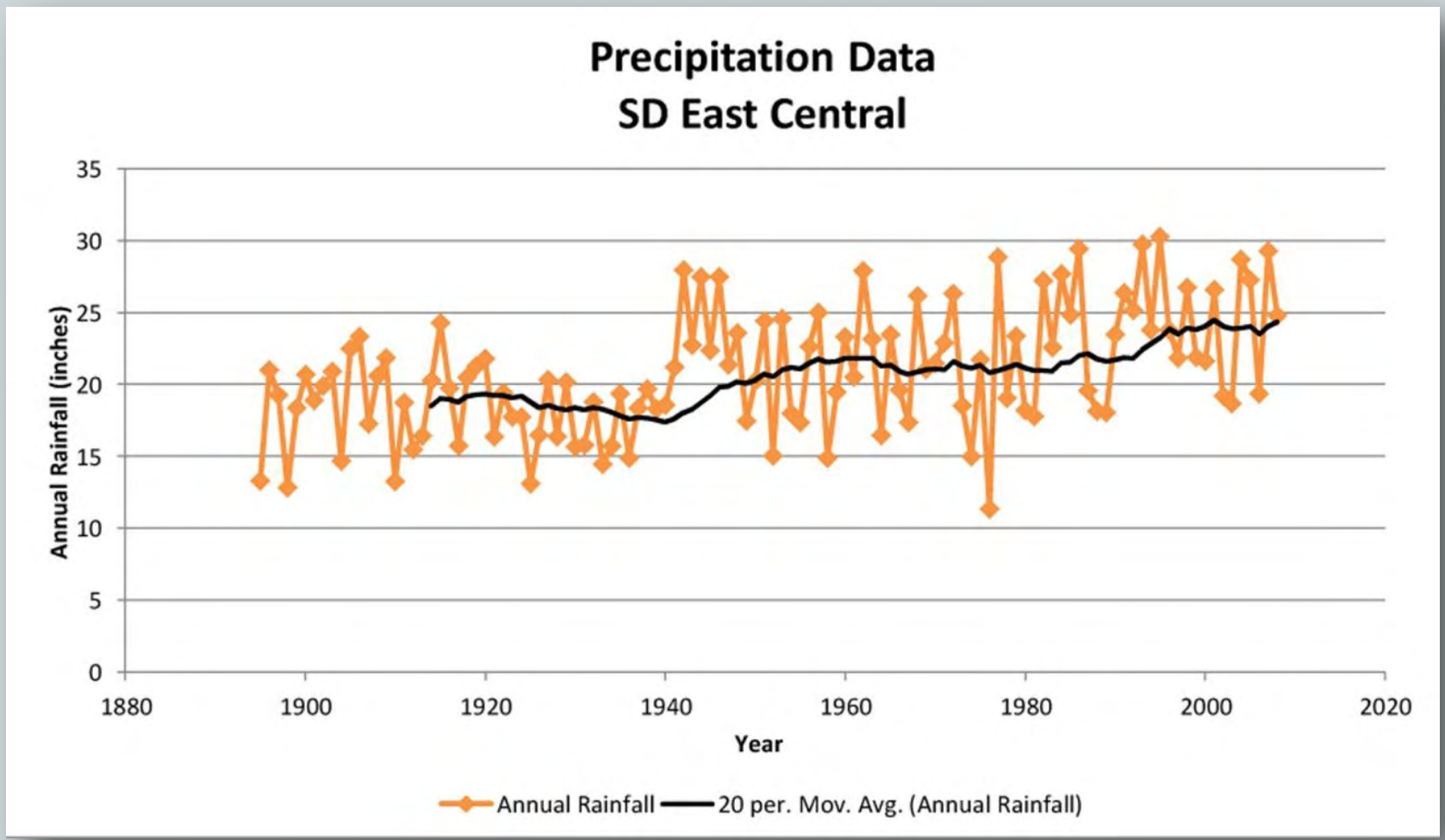
Lake Elevations and Corresponding Overflow Rates					
	Lake Sinai		Twin Lakes		
Date	Flow (cfs)	Water Elevation	Flow (cfs)	Water Elevation	Comments
16-Jun-11					4 culverts installed at outlet to Lake Sinai - CR-11
17-Jun-11	76.11	1748.09			Calc. Elev. based on headwater depth measurement
20-Jun-11	50.00	1747.76			Calc. Elev. based on headwater depth measurement
21-Jun-11	90.00	1748.26			Calc. Elev. based on headwater depth measurement
23-Jun-11	65.08	1747.96			Calculated Elevation Based on measured flow
27-Jun-11	58.00	1747.86			Calculated Elevation Based on measured flow
7-Jul-11	37.86	1747.59	20.48	1762.74	Calculated flow Based on measured Elevation
8-Jul-11	36.43	1747.57	19.39	1762.71	Calculated flow Based on measured Elevation
11-Jul-11	30.36	1747.49	18.46	1762.68	Calculated flow Based on measured Elevation
13-Jul-11	27.50	1747.44	15.70	1762.59	Calculated flow Based on measured Elevation
14-Jul-11	30.78	1747.49	9.50	1762.38	Calculated Elevation Based on measured flow
15-Jul-11	30.71	1747.49	17.85	1762.66	Calculated flow Based on measured Elevation
18-Jul-11	27.50	1747.44	17.23	1762.64	Calculated flow Based on measured Elevation
19-Jul-11	27.30	1747.44	9.17	1762.37	Calculated Elevation Based on measured flow
1-Aug-11	17.29	1747.27	6.51	1762.25	Calculated Elevation Based on measured flow
2-Aug-11			12.01	1762.47	Calculated flow Based on measured Elevation

PRECIPITATION



PRECIPITATION

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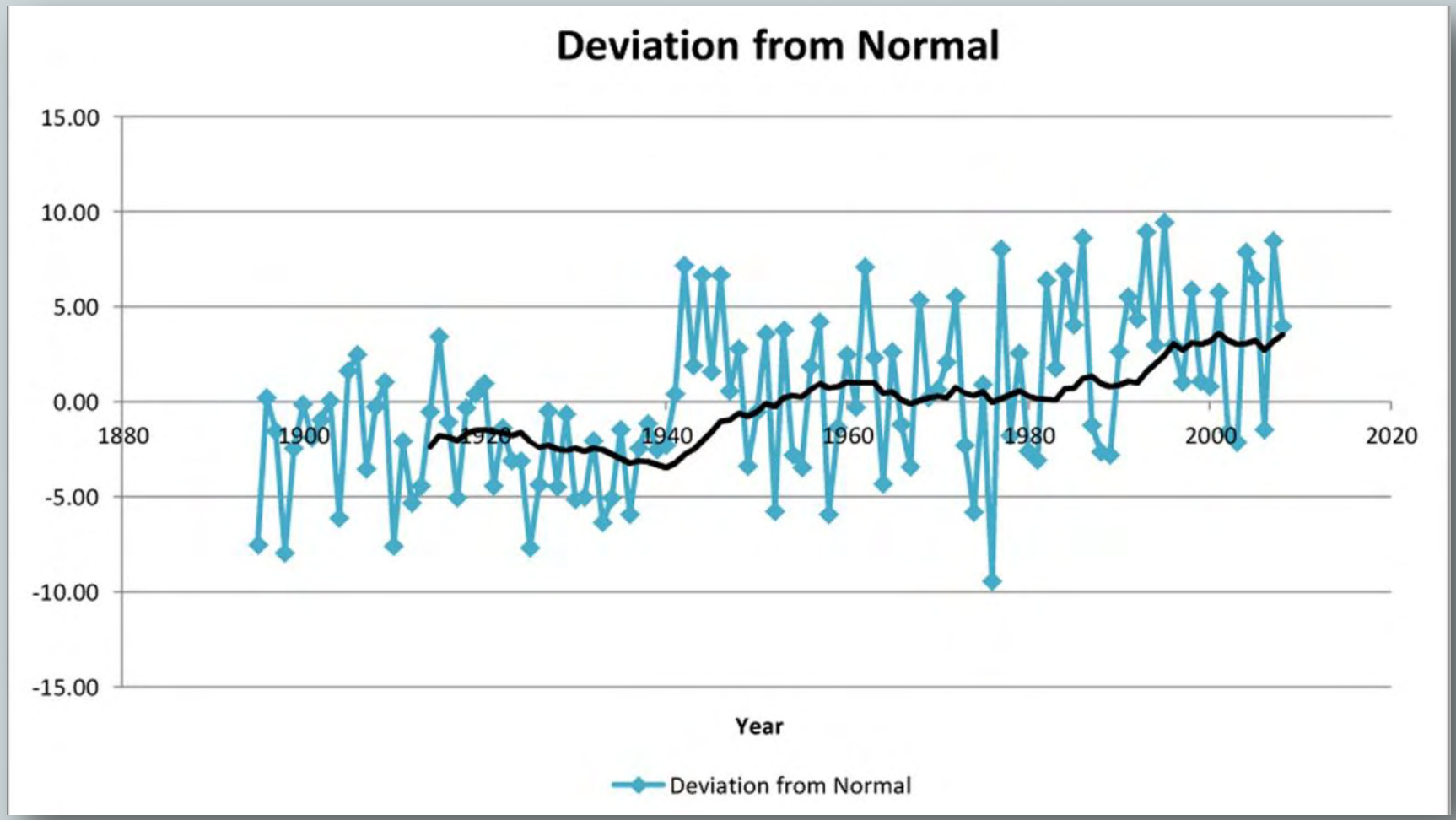

WATERSHED ANALYSIS (SWMM)

BANNER

- Drainage Areas (3 main sub-basins, + downstream)
  - Brush Lake
  - Twin Lakes
  - Lake Sinai
  - Several Downstream of Lake Sinai to Big Sioux River
- Rainfall and Evaporation Information
  - Normal Precipitation
  - Above Normal (2010)
  - Below Normal

WATERSHED ANALYSIS (SWMM)
-CONTINUED

BANNER

- Hydraulics
  - Outlet Structures and Elevations of Lakes
    - Natural Channels, Culverts
  - Areas and Volumes of Lakes
  - Drawdown of Twin Lakes
    - Pumps down to a required elevation (i.e. EL. 1759.0)

WATERSHED ANALYSIS (SWMM)

-CONTINUED

BANNER

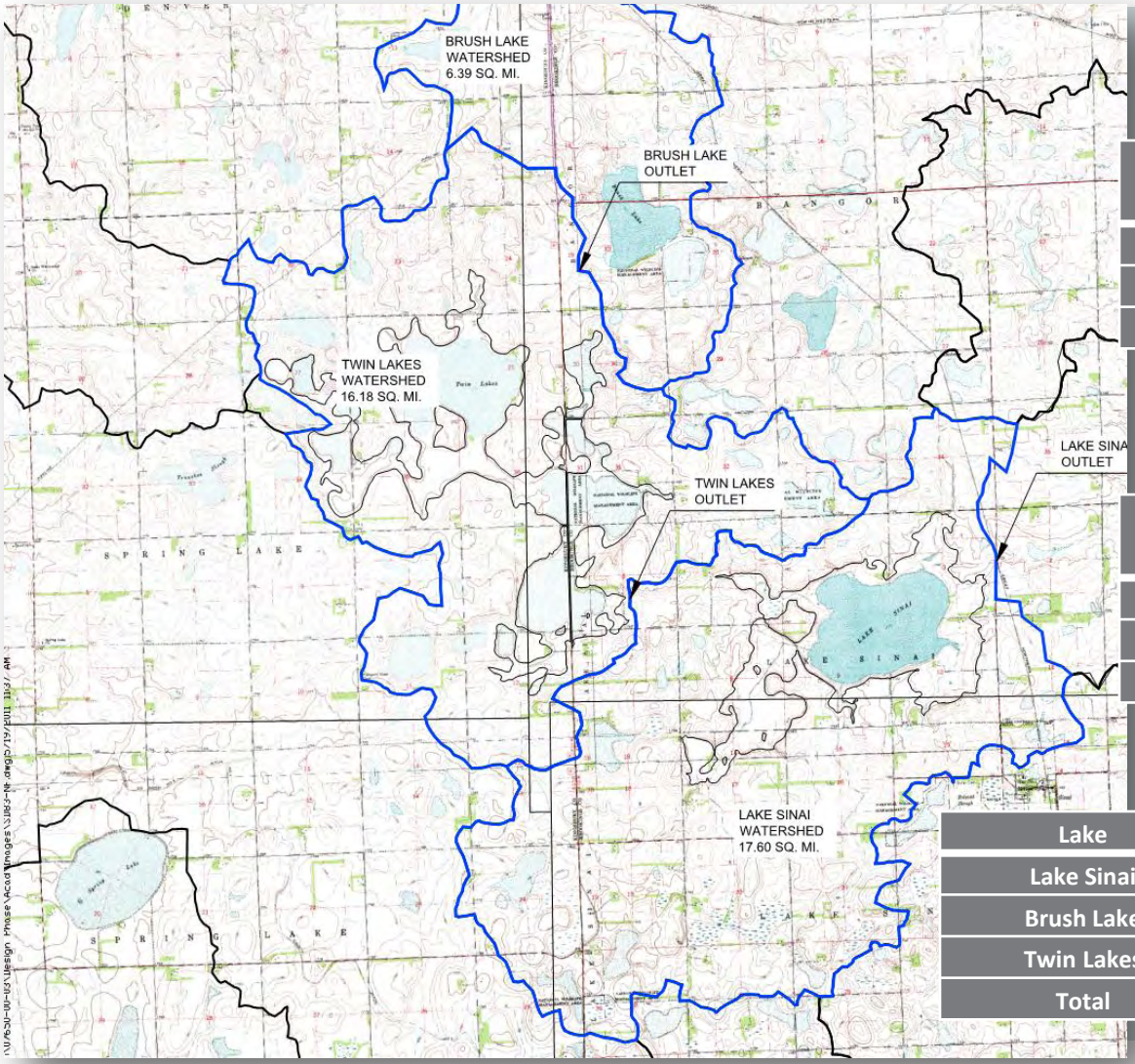

Table 1 - Current Lake Elevations (7/19/2011) (Datum: NAVD88)

Lake	Water Surface Elevation (ft)	Outlet Elevation (ft)
Lake Sinai	1747.4	1746.3
Twin Lakes	1762.4	1761.6
Brush Lake	1767.3	1767.2

Table 2 - Current Lake Areas (4/28/2011) (Datum: NAVD88)

Lake	Lake Area (aces)	Lake Area (sq. mi.)
Twin Lakes	3145	4.9
Lake Sinai	1976	3.1
Brush Lake	541	0.8

Table 3 – Watershed Areas

Lake	Area (ac)	Area (sq.mi.)
Lake Sinai	11262	17.60
Brush Lake	4092	6.39
Twin Lakes	10358	16.18
Total	25712	40.17

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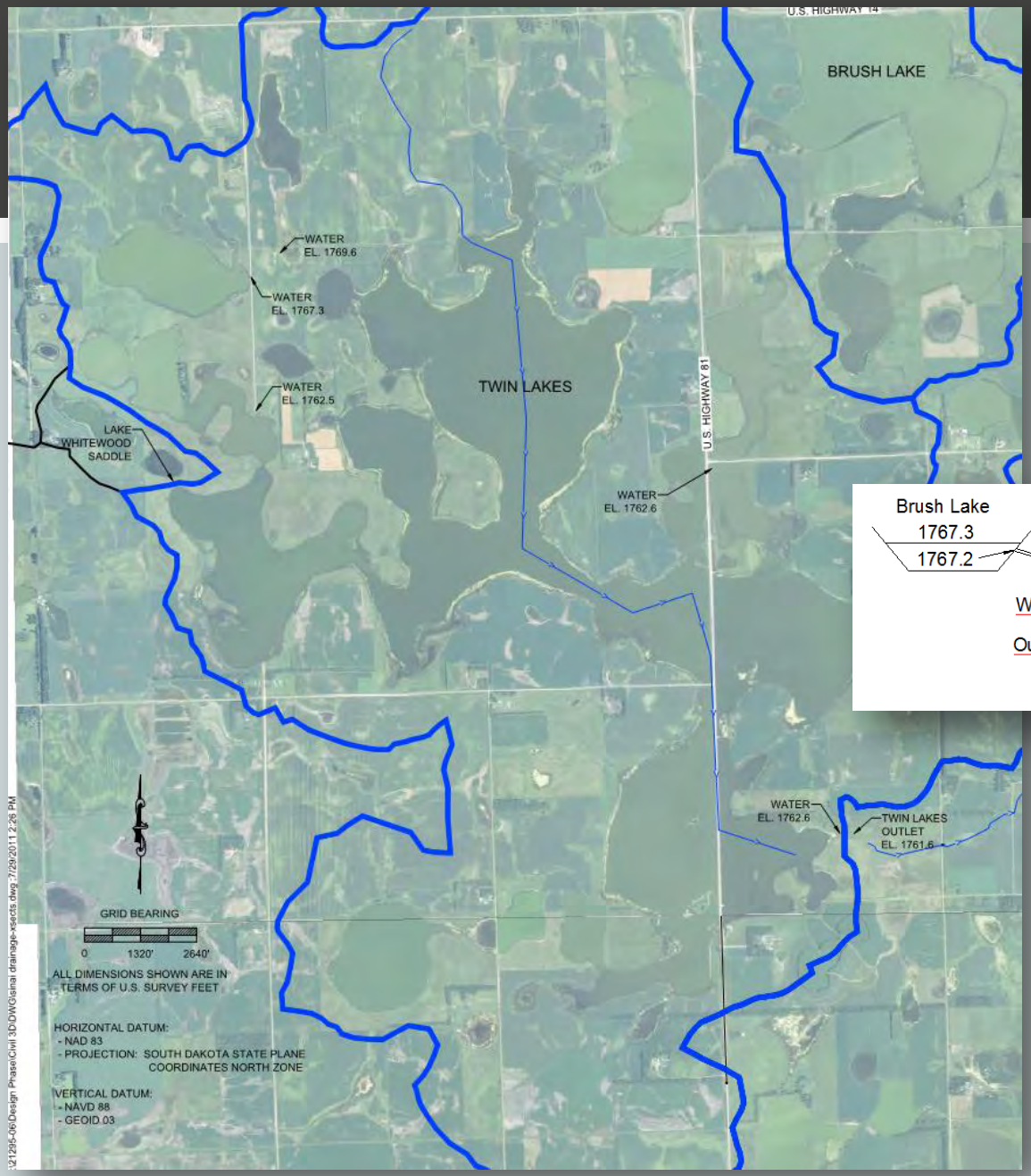
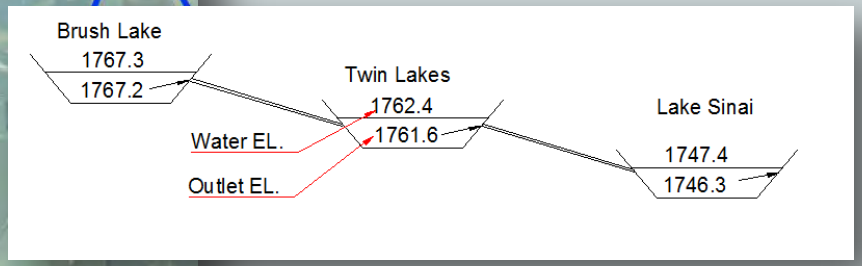

U.S. HIGHWAY 14
BRUSH LAKE
WATER
EL. 1769.6
WATER
EL. 1767.3
WATER
EL. 1762.5
TWIN LAKES
U.S. HIGHWAY 81
LAKE
WHITEWOOD
SADDLE
WATER
EL. 1762.6
WATER
EL. 1762.6
TWIN LAKES
OUTLET
EL. 1761.6
GRID BEARING
0
1320'
2640'
ALL DIMENSIONS SHOWN ARE IN
TERMS OF U.S. SURVEY FEET
HORIZONTAL DATUM:
- NAD 83
- PROJECTION: SOUTH DAKOTA STATE PLANE
COORDINATES NORTH ZONE
VERTICAL DATUM:
- NAVD 88
- GEOID 03


Brush Lake
1767.3
1767.2
Twin Lakes
1762.4
1761.6
Water EL.
Outlet EL.
Lake Sinai
1747.4
1746.3

MODEL PRECIPITATION - 2010 VS. NORMAL
(USING SDSU RAINGAGE NEAR BROOKINGS)

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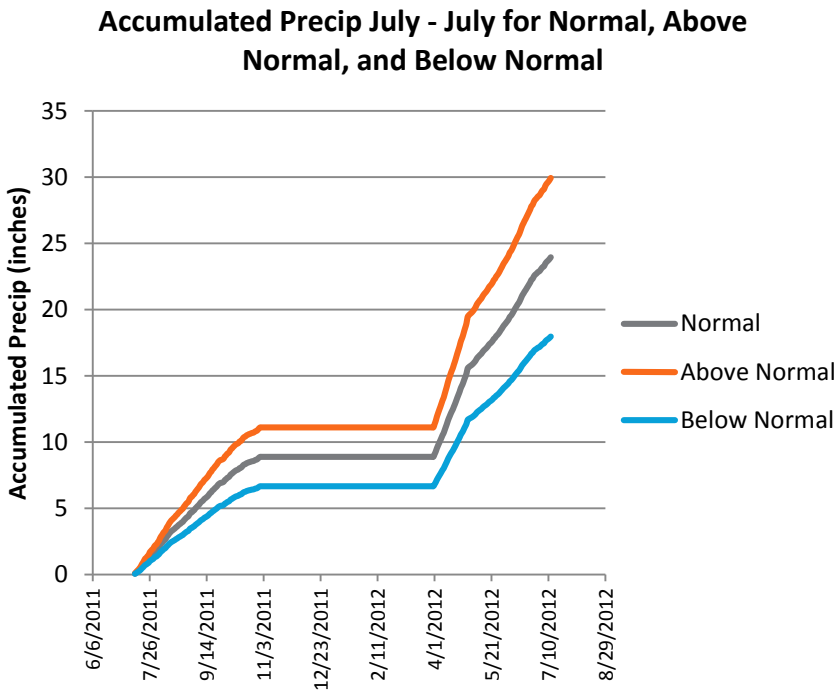

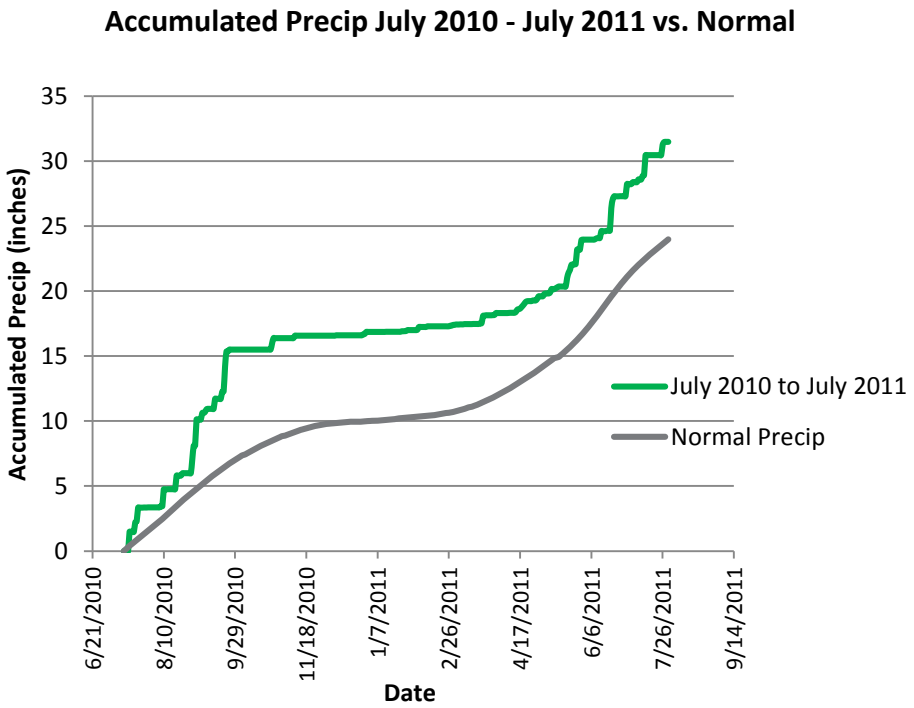

Above Normal Precipitation is 25% more precip and 25% less evaporation than normal
And vice versa for the Below Normal Precipitation

WATERSHED ANALYSIS (SWMM)

- EX. 2YRS OF 2010 PRECIP/EVAP AT 35CFS DRAWDOWN OF TWIN LAKES

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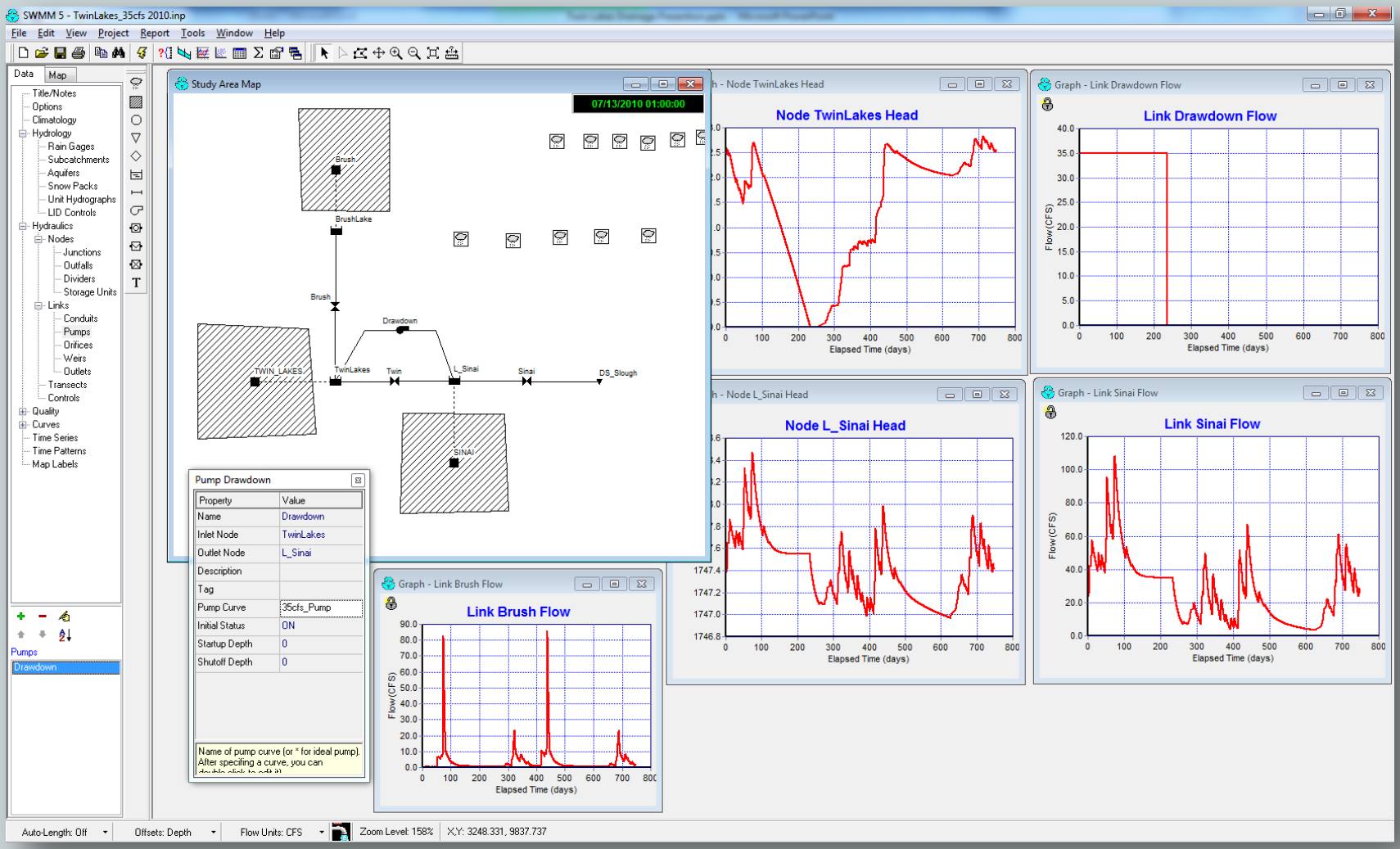
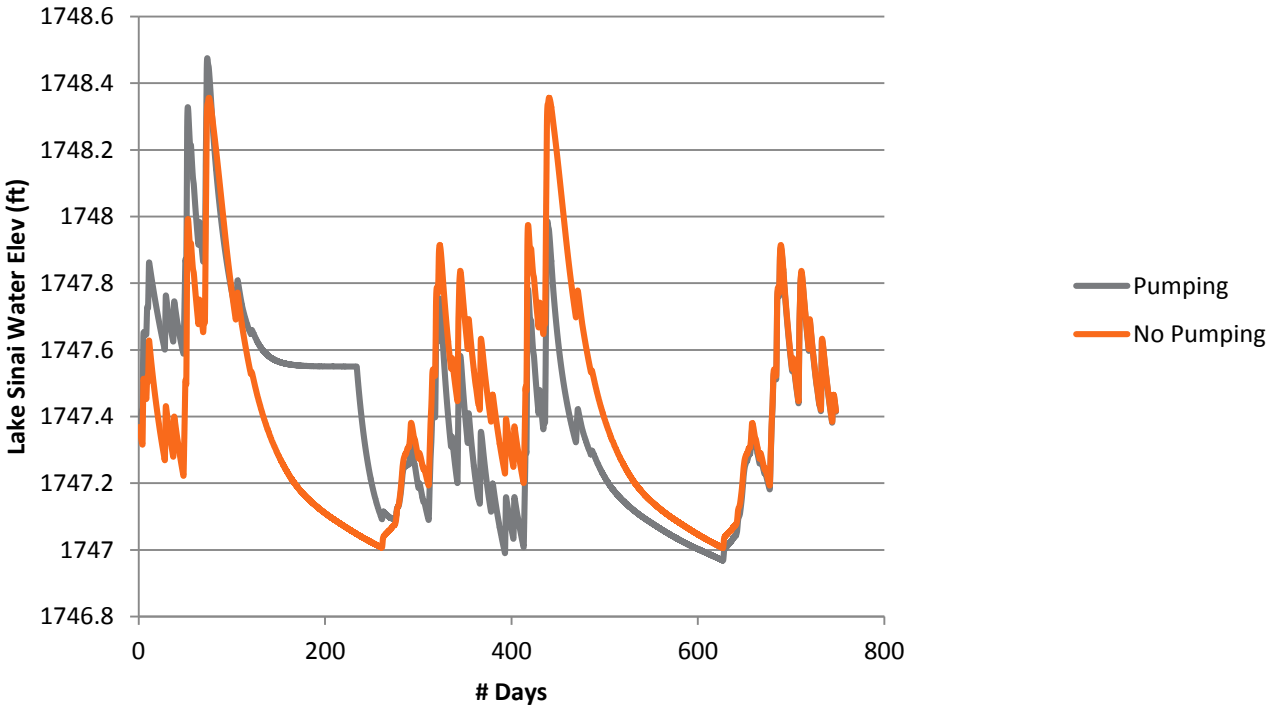


MODEL RESULTS - EXAMPLE



HYDRAULIC ANALYSIS

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- Hydraulic analysis downstream of Twin Lakes
  - Input
    - Cross-sections, buildings elevations surveyed
    - HEC-RAS software (developed by USACE)
    - Once a drawdown rate (pump) has been selected, it will be input into the model
  - Output
    - Determine water depths and widths of discharges
    - Map the inundation levels on surveyed cross sections
      - In between cross sections is estimated

HYDRAULIC ANALYSIS

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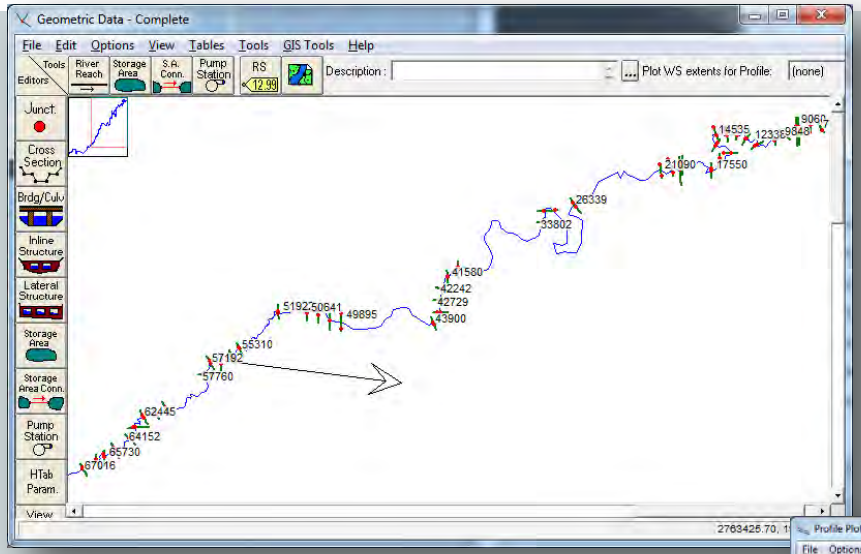
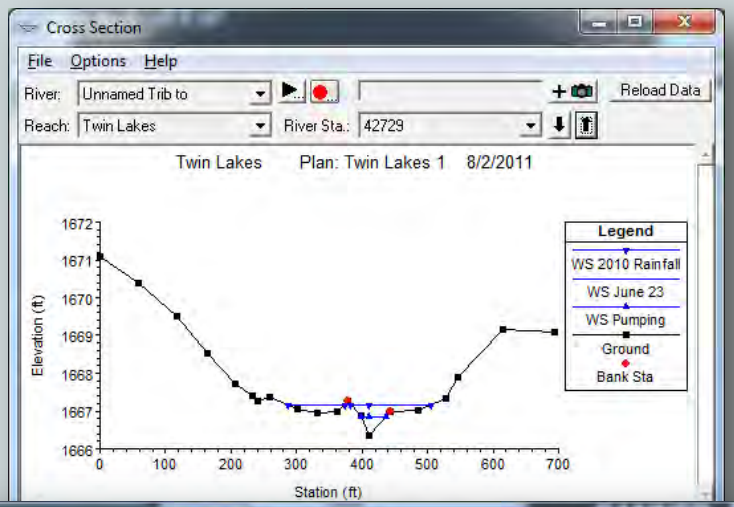
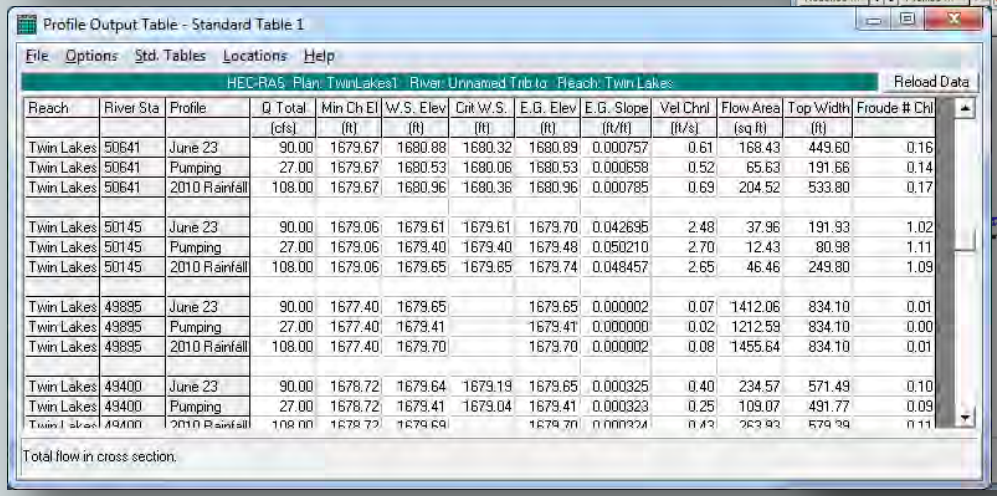
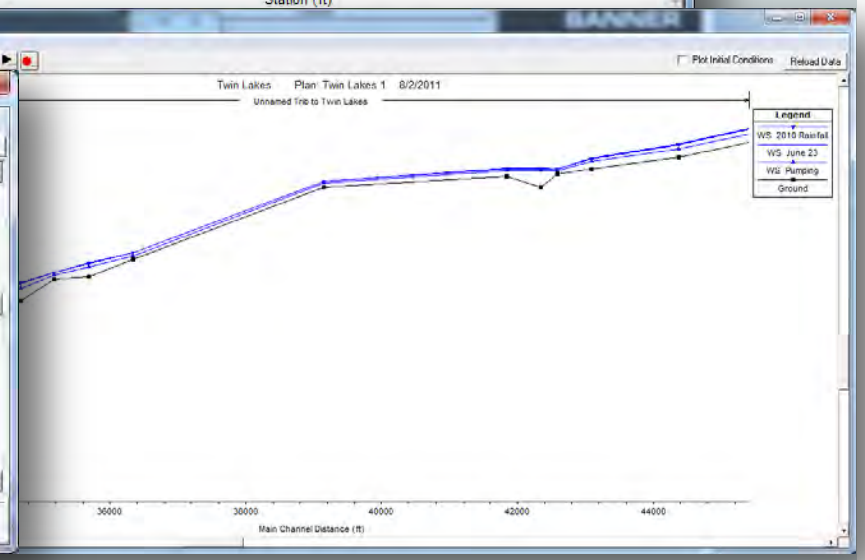
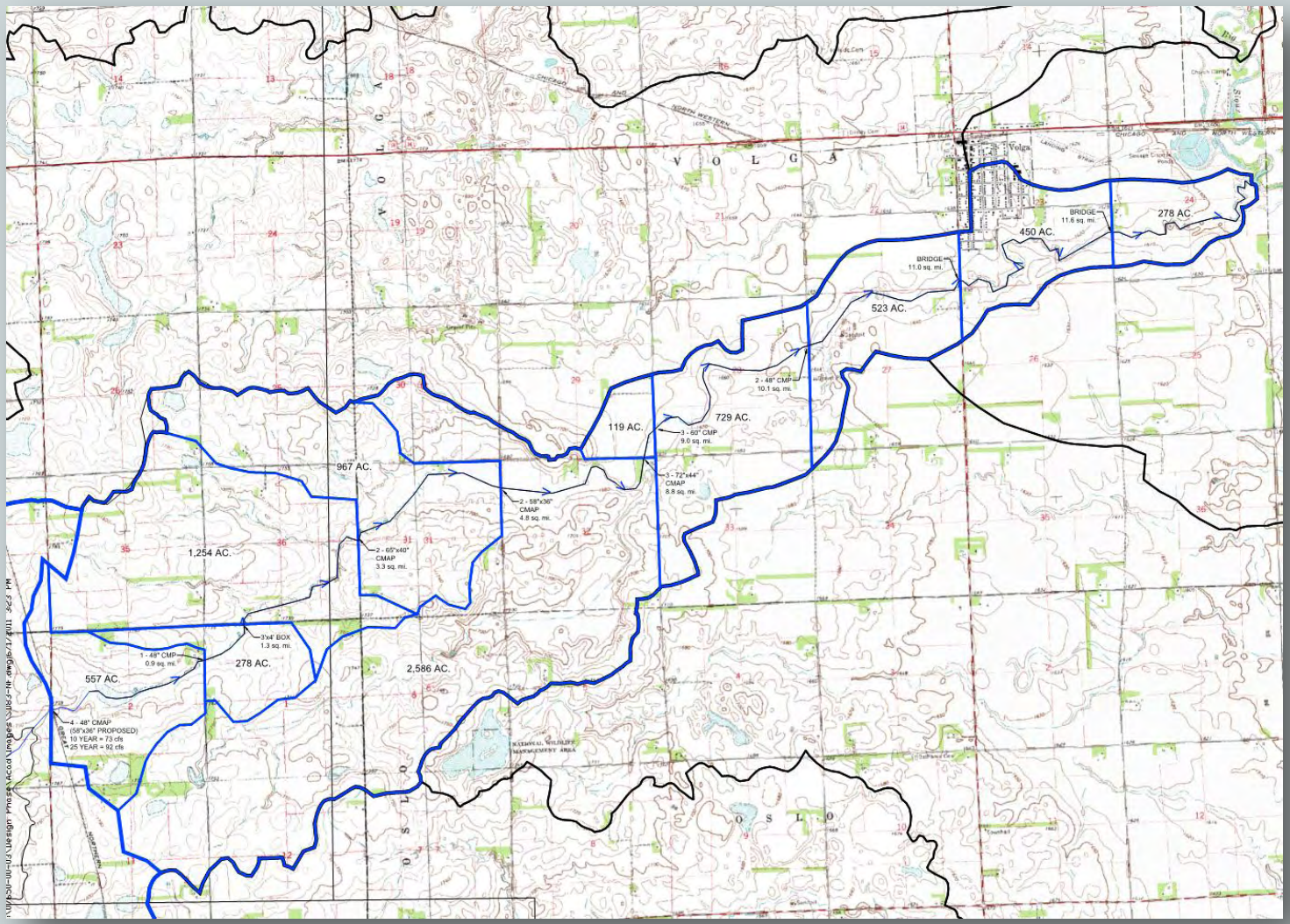






Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Twin Lakes	50641	June 23	90.00	1679.67	1680.88	1680.32	1680.89	0.000757	0.61	168.43	449.60	0.16
Twin Lakes	50641	Pumping	27.00	1679.67	1680.53	1680.06	1680.53	0.000658	0.52	65.63	191.66	0.14
Twin Lakes	50641	2010 Rainfall	108.00	1679.67	1680.96	1680.36	1680.96	0.000785	0.69	204.52	533.80	0.17
Twin Lakes	50145	June 23	90.00	1679.06	1679.61	1679.61	1679.70	0.042695	2.48	37.96	191.93	1.02
Twin Lakes	50145	Pumping	27.00	1679.06	1679.40	1679.40	1679.48	0.050210	2.70	12.43	80.98	1.11
Twin Lakes	50145	2010 Rainfall	108.00	1679.06	1679.65	1679.65	1679.74	0.048457	2.65	46.46	249.80	1.09
Twin Lakes	49895	June 23	90.00	1677.40	1679.65		1679.65	0.000002	0.07	1412.06	834.10	0.01
Twin Lakes	49895	Pumping	27.00	1677.40	1679.41		1679.41	0.000000	0.02	1212.59	834.10	0.00
Twin Lakes	49895	2010 Rainfall	108.00	1677.40	1679.70		1679.70	0.000002	0.08	1455.64	834.10	0.01
Twin Lakes	49400	June 23	90.00	1678.72	1679.64	1679.19	1679.65	0.000325	0.40	234.57	571.49	0.10
Twin Lakes	49400	Pumping	27.00	1678.72	1679.41	1679.04	1679.41	0.000323	0.25	109.07	491.77	0.09
Twin Lakes	49400	2010 Rainfall	108.00	1678.72	1679.69		1679.70	0.000324	0.43	263.93	579.39	0.11



DOWNSTREAM OF LAKE SINAI

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