Lake Lacawac, Bruce R. Hargreaves, Lehigh University (brh0@lehigh.edu, http://www.lehigh.edu/~brh0) 41°22.5'N 75°17.3'W elevation 428m

18 May 2013, 4:30-6:43pm EDT: platform moved to lake center 3Nov 2012: platform move to dock by 12N

The water level sensor (referenced to dock) settles for several days after moving platform to lake center and thus underestimates water level during this period.

Dec11: Tw12 appears to be failing (drifting upward); need to check or replace when possible

H310 sensor depth & Lake level are based on differential pressure
sensor with ca 0.1mm resolution & vertical position referenced to bottom of lake.
Sensor PSIG converted to depth using density of water at 4oC (1.43321 psi/m)
Lake level is referenced also to lower frame of dock at SE corner (2003-May2005)
(Actual water level at dock varies seasonally with density of water column and hourly from
precip, runoff, evaporation, seepage & outflow. Outflow also varies with status of beaver dam).

5280 ft/mile
1609.3 m/mile

Std pressure at sea level =1 atm=760 mm Hg=29.92" Hg=1013.2 mbars
Std pressure at 428m elevation =724 mm Hg, 29.61 in. Hg, (965.2 mbars)

rain sum (in.) Aug-Sep2011=> 18.26

	Tair avg F	Tair max F	Tair min F		Rain-in	WS-mph	WS max mph				Tw 0.1m F	Tw 0.5m F	Tw 1m F	Tw 2m F	Tw 3m F	Tw 4m F	Tw 5m F	Tw 6m F	Tw 8m F	Tw 10m F	Tw 12m F						
	66.2	84.6	43.2		7.54	4.3	24				73.4	73.1	72.3	68.9	64.0	58.3	51.3	46.0	42.5	42.0	41.8						
Month summa avg Tw	Tair avg-C	Tair Hi-C	Tair Min-C	RHair-%	Rain-mm	WS-m/s	WS Max-m/s	WDIR-deg	Barom-mb	Sum Rad W/m2	Sum PAR uM/m2/s	Tw 0.1m	Tw 0.5m	Tw 1m	Tw 2m	Tw 3m	Tw 4m	Tw 5m	Tw 6m	Tw 8m	Tw11.2m	Tw12.5m	H310_z (m)	Lakelevel-mm (4oC)	cumul. rain-mm	Batt min-V	RH% CR10 enc	RH% MUX enc
13.3	19.0	29.2	6.2	76.8	191.6	1.9	10.9	224.7	963.1	158027554	329	23.0	22.8	22.4	20.5	17.8	14.6	10.7	7.8	5.8	5.5	5.5	11.3	78.4	191.6	12.6	22.6	23.4

month (All)

Data

Location	% records	Date	Day of Yr	Tair avg-C	Tair Hi-C	Tair Min-C	RHair-%	Rain-mm	WS-m/s	WS Max m/s	WDIR-deg	Barom-mb	Sum Rad J/m2	Sum PAR Mol/m2	Tw 0.1m	Tw 0.5m	Tw 1m	Tw 2m	TW3m	TW4m	TW5m	TW6m	TW8m	TW H310-C	TW12m	H310 depth-m (4oC)	Lakelevel-mm (4oC)	cumul. rain-mm	Batt min-V	RH% CR10 enc	RH% MUX enc
ND	100%	6/1/2013	152	24.8	29.2	19.1	79.7	0.0	1.9	7.3	238	964.9	6662846	14	24.57	23.65	20.23	16.70	15.41	13.95	9.76	7.11	5.64	5.4	5.36	11.2	22.0	0.000	12.7	17.6	20.3
ND	100%	6/2/2013	153	24.1	26.2	22.0	84.5	0.5	2.7	8.3	223	960.2	5206799	11	24.63	24.39	21.32	16.98	15.54	13.92	9.80	7.13	5.66	5.4	5.35	11.2	17.5	0.500	12.7	19.0	20.4
ND	100%	6/3/2013	154	18.9	21.6	13.7	88.0	0.1	1.9	6.1	257	961.0	4577524	9	24.05	23.98	23.43	17.22	15.63	13.87	9.87	7.16	5.65	5.4	5.35	11.2	13.9	0.600	12.7	18.0	19.2
ND	100%	6/4/2013	155	13.9	18.9	8.8	72.1	0.0	2.7	8.7	309	966.3	7820209	16	22.37	22.33	22.30	17.62	15.72	13.93	9.86	7.21	5.68	5.4	5.35	11.2	8.3	0.600	12.7	13.6	16.1
ND	100%	6/5/2013	156	15.2	21.4	6.2	67.6	0.0	1.5	6.2	215	969.7	7493673	16	22.14	21.74	21.30	18.24	15.87	13.90	9.97	7.21	5.65	5.5	5.36	11.2	2.5	0.600	12.7	13.3	16.6
ND	100%	6/6/2013	157	15.3	17.9	13.4	85.6	8.2	1.9	7.7	163	966.9	2842729	6	21.44	21.40	21.32	18.69	16.00	13.87	9.95	7.32	5.71	5.5	5.37	11.2	-0.2	8.800	12.7	13.7	15.6
ND	100%	6/7/2013	158	14.3	14.6	13.8	106.3	22.3	2.1	7.2	103	960.2	1028549	2	20.12	20.14	20.13	19.32	16.04	13.91	10.09	7.31	5.74	5.5	5.38	11.2	13.1	31.100	12.6	18.1	19.5
ND	100%	6/8/2013	159	16.3	19.4	13.8	101.3	1.8	2.0	5.8	273	961.0	3606882	8	19.62	19.58	19.54	19.09	16.13	13.95	10.18	7.38	5.69	5.5	5.38	11.2	27.6	32.900	12.6	23.8	22.4
ND	100%	6/9/2013	160	17.3	22.8	11.9	88.9	0.0	1.4	6.8	280	970.0	6782116	14	20.53	20.39	19.90	19.22	16.31	13.98	10.20	7.42	5.71	5.5	5.39	11.2	25.5	32.900	12.7	22.6	20.2
ND	100%	6/10/2013	161	15.9	17.2	14.7	80.7	28.1	1.5	6.2	142	966.7	947561	2	20.72	20.73	20.53	19.37	16.45	13.99	10.24	7.46	5.76	5.5	5.41	11.2	32.7	61.000	12.6	21.7	26.2
ND	100%	6/11/2013	162	18.2	20.8	15.2	100.0	13.7	2.6	10.9	248	956.3	3500892	7	20.24	20.20	20.15	19.47	16.70	14.12	10.45	7.58	5.76	5.5	5.41	11.3	71.3	74.700	12.6	27.0	26.9
ND	100%	6/12/2013	163	17.3	20.8	14.2	92.9	0.0	3.3	10.3	312	959.4	7607789	16	20.27	20.22	20.18	19.76	17.13	14.20	10.55	7.63	5.75	5.5	5.42	11.3	77.4	74.700	12.7	23.5	23.0
ND	100%	6/13/2013	164	14.2	15.9	11.9	104.1	34.2	2.1	8.7	142	953.7	700756	2	20.21	20.21	20.20	19.93	17.84	14.24	10.63	7.68	5.79	5.5	5.43	11.3	89.1	108.900	12.6	20.8	25.0
ND	100%	6/14/2013	165	15.2	20.5	10.4	92.2	5.7	3.1	10.8	235	957.8	5554475	11	19.39	19.36	19.33	19.16	18.19	14.44	10.81	7.82	5.79	5.5	5.44	11.3	130.8	114.600	12.6	25.6	27.7
ND	100%	6/15/2013	166	17.5	22.4	12.9	80.8	0.0	2.0	7.8	293	964.6	7152718	15	20.07	19.99	19.91	19.24	18.42	14.58	10.89	7.88	5.82	5.5	5.44	11.3	136.2	114.600	12.7	21.4	22.4
ND	100%	6/16/2013	167	18.5	22.9	12.3	82.9	0.0	2.2	10.4	257	962.0	4206404	9	20.48	20.44	20.40	19.57	18.47	14.65	10.97	7.86	5.83	5.5	5.44	11.3	133.5	114.600	12.7	20.7	20.8
ND	100%	6/17/2013	168	21.1	25.7	16.7	85.2	0.0	1.8	8.4	264	962.0	7278768	15	21.53	21.40	21.05	20.16	18.47	14.77	10.90	7.92	5.88	5.5	5.46	11.3	129.9	114.600	12.7	23.0	22.5
ND	100%	6/18/2013	169	19.1	24.5	14.0	90.9	0.0	1.4	6.8	211	961.9	4184644	9	22.71	22.45	22.17	20.47	18.47	14.85	10.94	7.91	5.85	5.6	5.47	11.3	125.3	114.600	12.7	21.7	20.8
ND	100%	6/19/2013	170	16.6	20.6	12.4	77.8	0.0	2.0	7.5	200	966.6	7833656	16	22.45	22.39	22.30	20.78	18.52	14.82	10.99	7.96	5.91	5.6	5.47	11.3	120.1	114.600	12.7	20.1	20.6
ND	100%	6/20/2013	171	17.2	23.8	8.4	79.9	0.0	1.2	6.2	245	972.7	7322952	15	23.14	22.70	22.22	21.21	18.63	14.97	11.00	7.97	5.88	5.6	5.48	11.3	113.7	114.600	12.7	18.7	18.9
ND	100%	6/21/2013	172	20.6	24.9	16.4	82.5	0.0	1.5	5.7	240	973.9	5708661	12	23.69	23.21	22.76	21.44	18.70	14.98	11.03	7.97	5.89	5.6	5.49	11.3	107.9	114.600	12.6	21.5	20.3
ND	100%	6/22/2013	173	21.7	26.3	16.3	79.7	0.0	1.9	6.8	228	972.3	6641223	14	23.87	23.77	23.20	21.69	18.75	15.03	11.03	8.00	5.90	5.6	5.50	11.3	102.1	114.600	12.6	22.2	20.4
ND	100%	6/23/2013	174	24.4	28.9	20.0	82.6	0.0	1.9	7.1	225	970.1	7254408	15	25.04	24.78	24.07	22.00	18.89	15.06	11.09	8.02	5.89	5.6	5.50	11.3	96.1	114.600	12.7	24.6	22.4
ND	100%	6/24/2013	175	23.7	29.1	19.3	89.8	2.8	1.8	8.8	248	967.7	6115215	13	26.32	26.16	25.16	22.36	18.97	15.16	11.07	8.06	5.92	5.6	5.51	11.3	90.3	117.400	12.7	25.6	25.1
ND	100%	6/25/2013	176	23.2	27.8	18.7	92.8	0.7	1.9	8.2	249	963.7	6423826	14	26.59	26.45	26.00	22.63	19.09	15.16	11.10	8.09	5.94	5.6	5.54	11.3	86.1	118.100	12.6	26.7	32.7
ND	100%	6/26/2013	177	22.1	25.6	18.9	105.0	0.0	1.8	9.6	268	960.8	4622655	10	26.35	26.28	26.21	22.94	19.13	15.15	11.14	8.09	5.96	5.6	5.53	11.3	80.2	118.100	12.7	27.4	26.4
ND	100%	6/27/2013	178	21.9	26.4	17.5	95.1	24.3	1.4	6.6	166	957.4	5404048	11	26.63	26.42	26.04	23.29	19.23	15.19	11.20	8.13	5.95	5.6	5.55	11.3	77.1	142.400	12.7	27.3	28.1
ND	100%	6/28/2013	179	20.8	24.9	17.8	10.2	22.3	2.0	8.1	249	950.2	5203794	11	26.33	26.23	26.13	23.87	19.44	15.49	11.40	8.25	5.99	5.6	5.60	11.3	110.1	164.700	12.6	29.9	39.6
ND	100%	6/29/2013	180	20.3	24.7	16.5	0.2	0.1	1.6	6.2	239	952.4	5501795	11	26.00	25.91	25.82	24.33	19.55	15.51	11.45	8.29	6.00	5.6	5.59	11.3	116.7	164.800	12.6	29.5	37.4
ND	100%	6/30/2013	181	20.5	25.2	17.4	0.1	26.8	1.0	6.4	198	959.4	2839982	6	25.75	25.61	25.60	24.60	19.68	15.60	11.51	8.36	6.02	5.6	5.58	11.3	124.6	191.600	12.7	29.2	33.6
#N/A	100%	7/1/2013	182	19.5	19.5	19.5	0.1	0.0	0.8	2.0	45	963.2	4	0	25.36	25.34	25.34	24.82	19.59	15.47	11.94	8.15	6.17	5.6	5.59	11.3	147.6	191.600	12.7	31.9	36.3

Lake water & energy budget daily summary from hourly data (negative values: loss from lake; runoff & seepage term is residual after adjusting lake level change for all others)

Ratio of lake watershed to lake area: 2.6176758 Runoff & seepage as % of watershed area precip: 24.1%

																														1.000
																														4.184
Grand sum/avg	19.02	22.99	22.83	22.40	20.52	17.77	14.60	1.7	158027554	-75609	121.8	191.6	120.3	-104.8	-23.0	0.0	Nominal diffuse %R from water=7%	-68048.5	78917.2	155535%		17	#N/A	#N/A		-2.7	#N/A

SumTerrevap2=AirVPD,mbar*WS,m/s*s

<=SCALE ADJ (1.0=no adjustment)

joule/calorie (= joule/degree for 1cm3)

Data

DATE	DayOfYr	AvgTair C	AvgTw 0.1m	AvgTw0.5 m	Avg Tw1m	Avg Tw2m	Avg Tw3m	Avg Tw4m	AvgWS CSI m/s	SumRad J/m2	SumH Evap (*0.9=KJ/m2)	Sum Lk_lvl chg (mm)	SumRain mm	Sum Runoff & seepage, mm	SumLake evap (mm)	Sum Terrevap2	Solar Heat input (absorbed from solar rad), KJ/m2)	Sum H evap (KJ/m^2)	solar heat absorbed - evap loss (kJ/m^2)	% of absorbed solar heat lost via evap	Solar Heat input (absorbed from solar rad), Tw 0-6m)	starting Tw (0-6m)	ending Tw (0-6m)	actual dTw, 0-6m	RESID1: NON-SOLAR FLUX (Heat flux to offset absorbed solar to match dTw)	evap loss (degC 0-6m)	RESID2: NON-SOLAR FLUX to offset absorbed solar to match dTw LESS EVAP (degC 0-6m)
																					4.184	<=CONVERT HEAT TO DEGREES				4.184	slope
																	7%	0.9			6000000	cm3/m2 (for 0-4m integrated depth)				6000000	intercept
																											r2
6/1/2013	152	24.82	24.57	23.65	20.23	16.70	15.41	13.95	1.7	6662846	-1381	-4.260	0.0	-1.1	-1.9	-1.2	6196	-1243	4953	20.1%	0.25	14.81	15.22	0.40	0.15	-0.05	0.20
6/2/2013	153	24.09	24.63	24.39	21.32	16.98	15.54	13.92	2.5	5206799	-1685	-4.199	0.5	-1.3	-2.3	-1.0	4842	-1517	3326	31.3%	0.19	15.22	15.34	0.12	(0.07)	-0.06	(0.01)
6/3/2013	154	18.92	24.05	23.98	23.43	17.22	15.63	13.87	1.7	4577524	-2639	-3.770	0.1	0.3	-3.7	-0.4	4257	-2375	1882	55.8%	0.17	15.34	15.51	0.17	0.00	-0.09	0.10
6/4/2013	155	13.87	22.37	22.33	22.30	17.62	15.72	13.93	2.4	7820209	-5161	-6.770	0.0	1.6	-7.1	-1.1	7273	-4645	2628	63.9%	0.29	15.51	15.36	(0.15)	(0.44)	-0.19	(0.26)
6/5/2013	156	15.21	22.14	21.74	21.30	18.24	15.87	13.90	1.2	7493673	-3195	-4.917	0.0	0.4	-4.4	-0.8	6969	-2875	4094	41.3%	0.28	15.36	15.58	0.22	(0.05)	-0.11	0.06
6/6/2013	157	15.26	21.44	21.40	21.32	18.69	16.00	13.87	1.7	2842729	-2554	4.874	8.2	0.7	-3.5	-0.3	2644	-2299	345	87.0%	0.11	15.58	15.46	(0.12)	(0.22)	-0.09	(0.13)
6/7/2013	158	14.26	20.12	20.14	20.13	19.32	16.04	13.91	1.9	1028549	-1611	21.214	22.3	1.1	-2.2	0.1	957	-1450	-493	151.6%	0.04	15.46	15.53	0.07	0.03	-0.06	0.09
6/8/2013	159	16.26	19.62	19.58	19.54	19.09	16.13	13.95	1.8	3606882	-973	0.835	1.8	0.5	-1.3	0.0	3354	-876	2478	26.1%	0.13	15.53	15.47	(0.06)	(0.19)	-0.03	(0.16)
6/9/2013	160	17.29	20.53	20.39	19.90	19.22	16.31	13.98	1.2	6782116	-1350	-3.023	0.0	-0.6	-1.9	-0.4	6307	-1215	5092	19.3%	0.25	15.47	15.83	0.36	0.11	-0.05	0.16
6/10/2013	161	15.94	20.72	20.73	20.53	19.37	16.45	13.99	1.3	947561	-2256	28.558	28.1	4.3	-3.1	-0.6	881	-2030	-1149	230.4%	0.04	15.83	15.70	(0.13)	(0.17)	-0.08	(0.09)
6/11/2013	162	18.16	20.24	20.20	20.15	19.47	16.70	14.12	2.4	3500892	-805	25.059	13.7	12.7	-1.1	-0.1	3256	-724	2532	22.2%	0.13	15.70	15.83	0.13	(0.00)	-0.03	0.03
6/12/2013	163	17.32	20.27	20.22	20.18	19.76	17.13	14.20	3.0	7607789	-1844	-0.860	0.0	2.1	-2.5	-0.3	7075	-1660	5416	23.5%	0.28	15.83	16.20	0.37	0.09	-0.07	0.16
6/13/2013	164	14.21	20.21	20.21	20.20	19.93	17.84	14.24	1.9	700756	-1756	36.759	34.2	6.5	-2.4	0.1	652	-1580	-928	242.4%	0.03	16.20	15.88	(0.31)	(0.34)	-0.06	(0.28)
6/14/2013	165	15.23	19.39	19.36	19.33	19.16	18.19	14.44	2.9	5554475	-2277	20.853	5.7	24.4	-3.1	-0.5	5166	-2049	3117	39.7%	0.21	15.88	16.05	0.16	(0.04)	-0.08	0.04
6/15/2013	166	17.46	20.07	19.99	19.91	19.24	18.42	14.58	1.7	7152718	-1888	-0.965	0.0	9.3	-2.6	-0.9	6652	-1699	4953	25.5%	0.26	16.05	16.17	0.13	(0.14)	-0.07	(0.07)
6/16/2013	167	18.53	20.48	20.44	20.40	19.57	18.47	14.65	2.0	4206404	-1465	-3.477	0.0	5.5	-2.0	-0.8	3912	-1318	2594	33.7%	0.16	16.17	16.42	0.25	0.09	-0.05	0.15
6/17/2013	168	21.06	21.53	21.40	21.05	20.16	18.47	14.77	1.6	7278768	-1161	-4.231	0.0	3.6	-1.6	-0.9	6769	-1045	5725	15.4%	0.27	16.42	16.89	0.46	0.19	-0.04	0.23
6/18/2013	169	19.09	22.71	22.45	22.17	20.47	18.47	14.85	1.2	4184644	-1465	-4.182	0.0	2.7	-2.0	-0.4	3892	-1319	2573	33.9%	0.16	16.89	16.91	0.03	(0.13)	-0.05	(0.08)
6/19/2013	170	16.65	22.45	22.39	22.30	20.78	18.52	14.82	1.7	7833656	-3348	-6.428	0.0	2.7	-4.6	-0.9	7285	-3013	4272	41.4%	0.29	16.91	17.18	0.27	(0.02)	-0.12	0.10
6/20/2013	171	17.16	23.14	22.70	22.22	21.21	18.63	14.97	1.0	7322952	-2517	-6.174	0.0	0.9	-3.5	-0.7	6810	-2265	4545	33.3%	0.27	17.18	17.33	0.15	(0.12)	-0.09	(0.03)
6/21/2013	172	20.58	23.69	23.21	22.76	21.44	18.70	14.98	1.3	5708661	-1780	-5.407	0.0	0.0	-2.5	-0.5	5309	-1602	3707	30.2%	0.21	17.33	17.42	0.10	(0.11)	-0.06	(0.05)
6/22/2013	173	21.72	23.87	23.77	23.20	21.69	18.75	15.03	1.7	6641223	-1968	-6.083	0.0	-0.3	-2.7	-0.9	6176	-1771	4405	28.7%	0.25	17.42	17.65	0.22	(0.02)	-0.07	0.05
6/23/2013	174	24.44	25.04	24.78	24.07	22.00	18.89	15.06	1.8	7254408	-1598	-6.228	0.0	-0.8	-2.2	-1.1	6747	-1439	5308	21.3%	0.27	17.65	17.98	0.33	0.06	-0.06	0.12
6/24/2013	175	23.69	26.32	26.16	25.16	22.36	18.97	15.16	1.6	6115215	-1857	-3.942	2.8	-1.1	-2.6	-0.7	5687	-1671	4016	29.4%	0.23	17.98	18.15	0.17	(0.06)	-0.07	0.01
6/25/2013	176	23.22	26.59	26.45	26.00	22.63	19.09	15.16	1.7	6423826	-1975	-5.754	0.7	-0.5	-2.7	-0.6	5974	-1778	4197	29.8%	0.24	18.15	18.34	0.19	(0.04)	-0.07	0.03
6/26/2013	177	22.10	26.35	26.28	26.21	22.94	19.13	15.15	1.6	4622655	-1348	-5.579	0.0	-1.7	-1.9	0.2	4299	-1213	3086	28.2%	0.17	18.34	18.45	0.10	(0.07)	-0.05	(0.02)
6/27/2013	178	21.94	26.63	26.42	26.04	23.29	19.23	15.19	1.1	5404048	-1895	20.130	24.3	-0.9	-2.6	-0.2	5026	-1705	3320	33.9%	0.20	18.45	18.79	0.34	0.14	-0.07	0.21
6/28/2013	179	20.83	26.33	26.23	26.13	23.87	19.44	15.49	1.8	5203794	-8079	21.173	22.3	15.9	-11.2	-3.2	4840	-7271	-2432	150.2%	0.19	18.79	18.96	0.17	(0.02)	-0.29	0.27
6/29/2013	180	20.29	26.00	25.91	25.82	24.33	19.55	15.51	1.5	5501795	-7602	-4.861	0.1	11.7	-10.6	-2.9	5117	-6842	-1725	133.7%	0.20	18.96	18.99	0.03	(0.17)	-0.27	0.10
6/30/2013	181	20.46	25.75	25.61	25.60	24.60	19.68	15.60	0.7	2839982	-5958	33.475	26.8	21.8	-8.3	-1.8	2641	-5363	-2721	203.0%	0.11	18.99	18.96	(0.02)	(0.13)	-0.21	0.09
7/1/2013	182	19.55	25.36	25.34	25.34	24.82	19.59	15.47	0.5	4	-219	0.000	0.0	0.0	-0.3	-0.1	0	-197	-197	##########	0.00	18.96	#N/A	#N/A	#N/A	-0.01	#N/A