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Hydraulics

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Water Resources

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**DEPARTMENT OF
WATER RESOURCES**

November 23, 2010

Mr. Jeff Peppersack
Idaho Department of Water Resources
322 East Front Street
PO Box 83720
Boise, Idaho 83720-0098

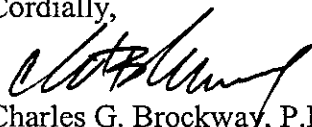
Re: Mitigation Plan for Permit 37-8205
Project No. 337-07-2000

Dear Jeff:

Enclosed is a proposed mitigation plan for potential consumptive use under permit 37-8205. In brief, the plan involves reduction of the pond heat load to reduce the increased consumptive use to roughly one-third of the original plan, and assertion of mitigation credit for reduction of evaporative and evapotranspirative area compared to the original reservoir footprint. The plan includes revised recommendations for licensing amounts based on the reduced water requirements.

Please review the plan and let me know as soon as possible whether this will meet with the Department's approval so that the permit can be licensed.

Cordially,


Charles G. Brockway, P.E.

CHARLES E.
BROCKWAY,
PH.D., P.E.

CHARLES G.
BROCKWAY,
PH.D., P.E.

Enc.

Cc: Donna Kelsey
Ed Lawson

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IDAHO 83301

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NOV 24 2010

DEPARTMENT OF
WATER RESOURCES

**Proposed Mitigation Plan for Pond Evaporation
Sun Valley Land & Minerals
Permit 37-8205**

Brockway Engineering, PLLC
November 23, 2010



Overview

Development of the heated pond under permit 37-8205 will result in evaporative losses above those that would occur naturally as a cold water pond authorized by water rights from Deer Creek. The methodology for calculating the additional losses is described in the Technical Memorandum dated December 30, 2009. It was determined that the additional annual evaporation induced by maintain a year-round temperature of 85 degrees in the pond would be 13.62 af/ac/yr, or 15.9 ac-ft/year on the 1.17-acre pond.

After consultation with Jeff Peppersack of IDWR, it was determined that the only potential mitigation sources are 1) retirement of irrigated acreage under 37-22128, and 2) possible credit for reduction of water surface area that has occurred due to the reconfiguration of the Clarendon Reservoir from a single reservoir to several smaller ponds. The permittee does not wish to retire irrigated acres. Therefore, the proposed mitigation plan involves a credit for reservoir surface area reduction, in combination with a plan to reduce the heat load of the pond and correspondingly reduce the required evaporation mitigation.

This mitigation plan contains the following components:

1. A calculation of reservoir water surface area reduction and evaporation reduction compared to historical conditions.
2. A reduced heat load for the pond to lower the evaporative losses to a level where the available mitigation is sufficient.
3. A calculation of the peak flow rate and annual volume requirement for the reduced heat load condition.
4. Recommendations for licensing amounts.

Reservoir Water Surface Area Reduction

An analysis was made of the current reservoir surface in comparison with historical aerial photos. Reduction of surface area has occurred by two modes: placement of embankments to separate the discrete ponds, and reduction of backwater in the southwest portion of the old reservoir footprint. It is fortunate that an aerial flight and topographic mapping was performed in May 2000 in preparation for the pond construction. This flight resulted in a detailed map with 1-foot topographic contours. This allowed an accurate delineation of the full-pool contour which was estimated to be 5631 feet based on on-ground survey shots performed by Galena Engineering and Alpine Enterprises prior to the deconstruction of the original dam. The 5631-foot contour is shown on the attached map and has an area of 14.0 acres. This contour is overlain

on the 1980 aerial photo to illustrate historic conditions. From this photo is clear that the full pool contour enclosed both an evaporating free water surface and an evapotranspiring area in the backwater.

Another source of information on historic water surface area is the USGS quadrangle map, which has a date of 1967. The outline of the reservoir from the USGS map is overlain on the aerial photo, but appears to be unreasonable as it includes an extended backwater area up Deer Creek which does not appear to have ever existed. Therefore, the USGS delineation was discounted.

The current pond area is relatively certain and is delineated on the 2009 aerial photo to be 11.8 acres. Compared to the original surface area of 14.0 acres, the evaporative or evapotranspirative area reduction is estimated to be 2.2 acres. From Allen & Brockway (2009), the annual evaporation from shallow ponds is 782 mm or 2.57 ac-ft/acre. Thus, a reduction of 2.2 acres should provide 5.65 ac-ft annual for mitigation purposes.

Reduction of Pond Heat Load to Meet Mitigation Volume

Is it proposed to create a 25'x25' heated "plunge" area at the existing terrace. This area would be maintained at 85°F year-round utilizing existing 2" feeder pipes as shown on the diagram. These pipes have valves enabling regulation of the flow to maintain the desired temperature.

Rather than maintaining the main pond at a temperature of 85°F year-round as originally contemplated, it is proposed to reduce the average pond temperature to a maximum of 66°F, and vary the flow rate pumped from the wells to the pond accordingly. This can be easily accomplished with the existing valving. It is proposed to monitor the pond temperature at four (4) locations; the average of these four measurements would be the parameter which cannot exceed 66°F.

The proposed pond configuration is illustrated on the attached diagram.

Calculations of evaporation for the proposed configuration are shown on the attached spreadsheets. These calculations follow the methodology outlined in the December 30, 2009 technical memo submitted to IDWR as additional information for this permit. For the heated plunge and semi-heated main pond, the total annual evaporation is 8.90 ac-ft/year. If the same pond area were not heated, the annual evaporation would be 3.48 ac-ft/year. This difference of 5.42 ac-ft/year is less than the available mitigation volume outlined above.

Flow and Volume Requirements for Heated Pond

With the reduced heat load of the pond, the required flow rate and annual volume that can be beneficially used will be reduced accordingly. The amounts that should be licensed will decrease from those calculated for the original beneficial use examination.

Peak flow and monthly volume calculations are provided on the attached spreadsheets. These calculations follow the same methodology as those in the original beneficial use examination. The following results were obtained:

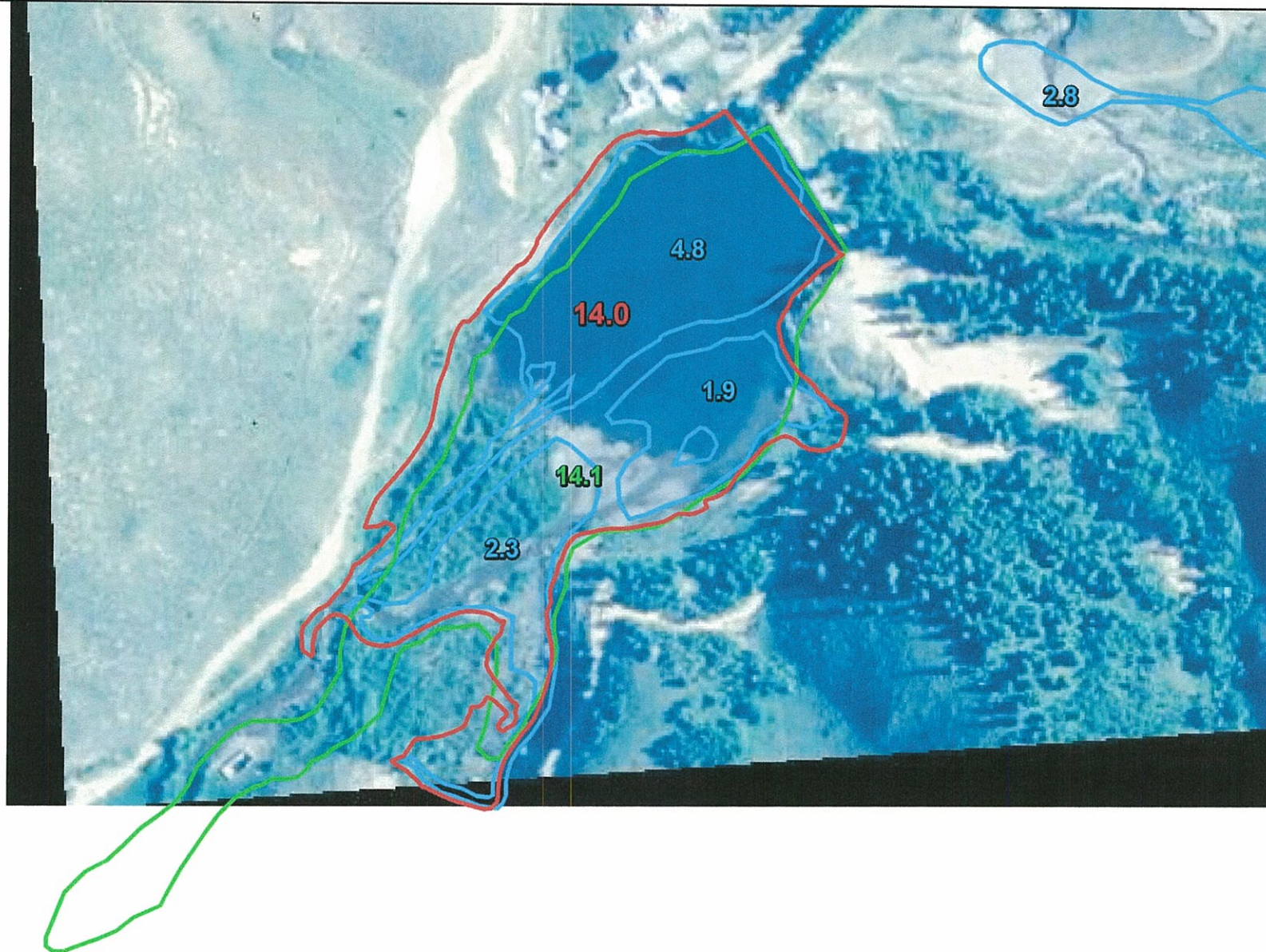
Peak flow requirement	293 gpm (0.65 cfs)
Annual volume requirement	278.9 ac-ft

Revised Licensing Recommendations

For licensing purposes, the flow and volume requirements for residential and snowmelting purposes have not changed, but the flow and volume for heating of the pond/spa should reflect the above amounts. The recommended amounts to be licensed are as follows:

	Div. Rate	Ann. Volume
Heating (residential)	0.032 cfs	17.4 afa
Heating (snowmelting)	0.81 cfs	104.7 afa
Recreation or Heating (pond / spa)	0.65 cfs	278.9 afa
<u>TOTAL</u>	<u>1.49 cfs</u>	<u>401.0 afa</u>

Whereas the total diversion rate was previously limited by the instantaneous well output, the total is now limited by the sum of the three beneficial uses.



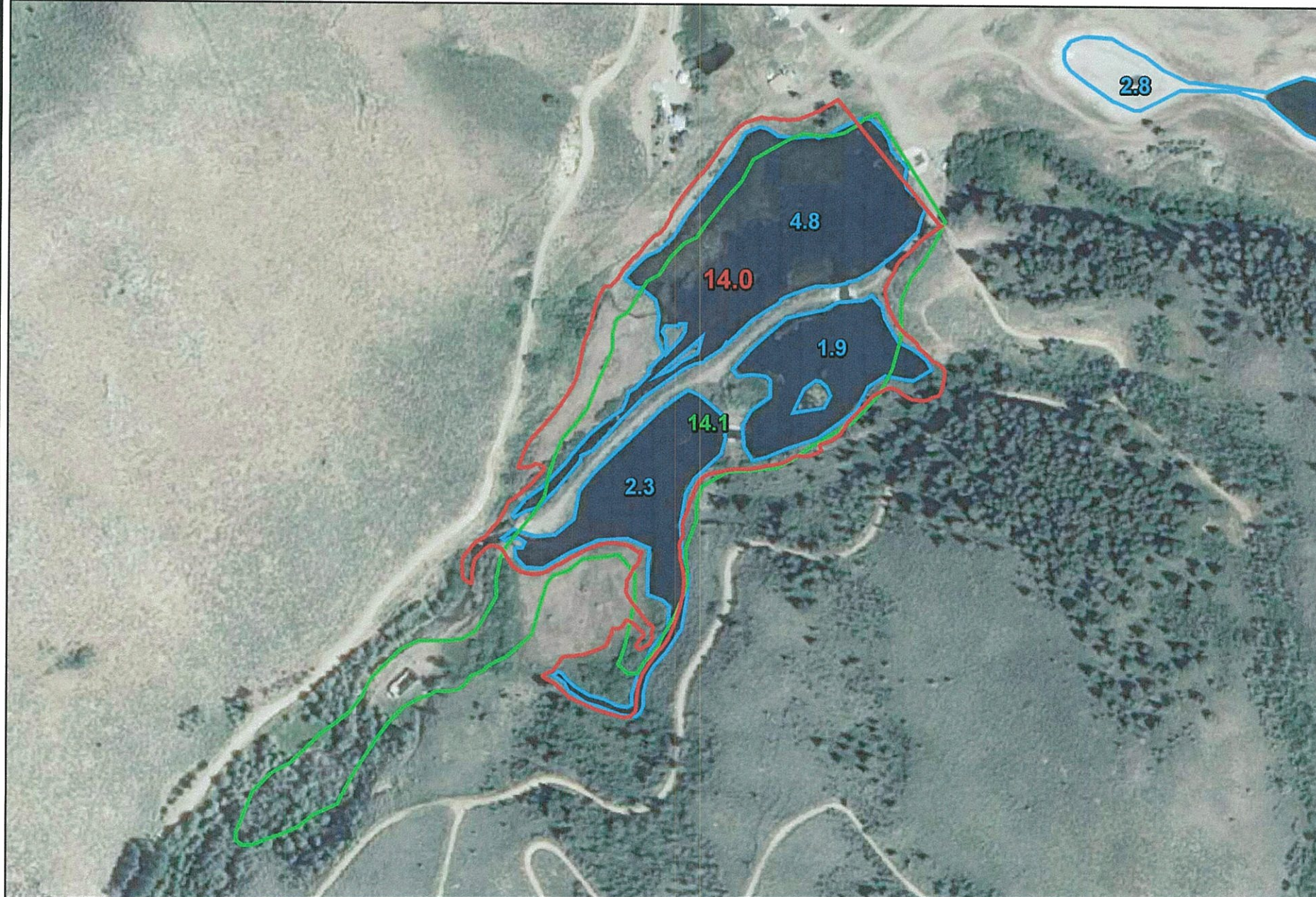
1 inch equals 300 feet

**SUN VALLEY LAND & MINERALS
HISTORIC RESERVOIR AREAS
FSA 1980 AERIAL PHOTOGRAPH**

BROCKWAY ENGINEERING, PLLC.
ALR - JULY 1, 2010

Legend

- 5631' CONTOUR MAY 2000
- USGS Quad Reservoir
- Current Ponds



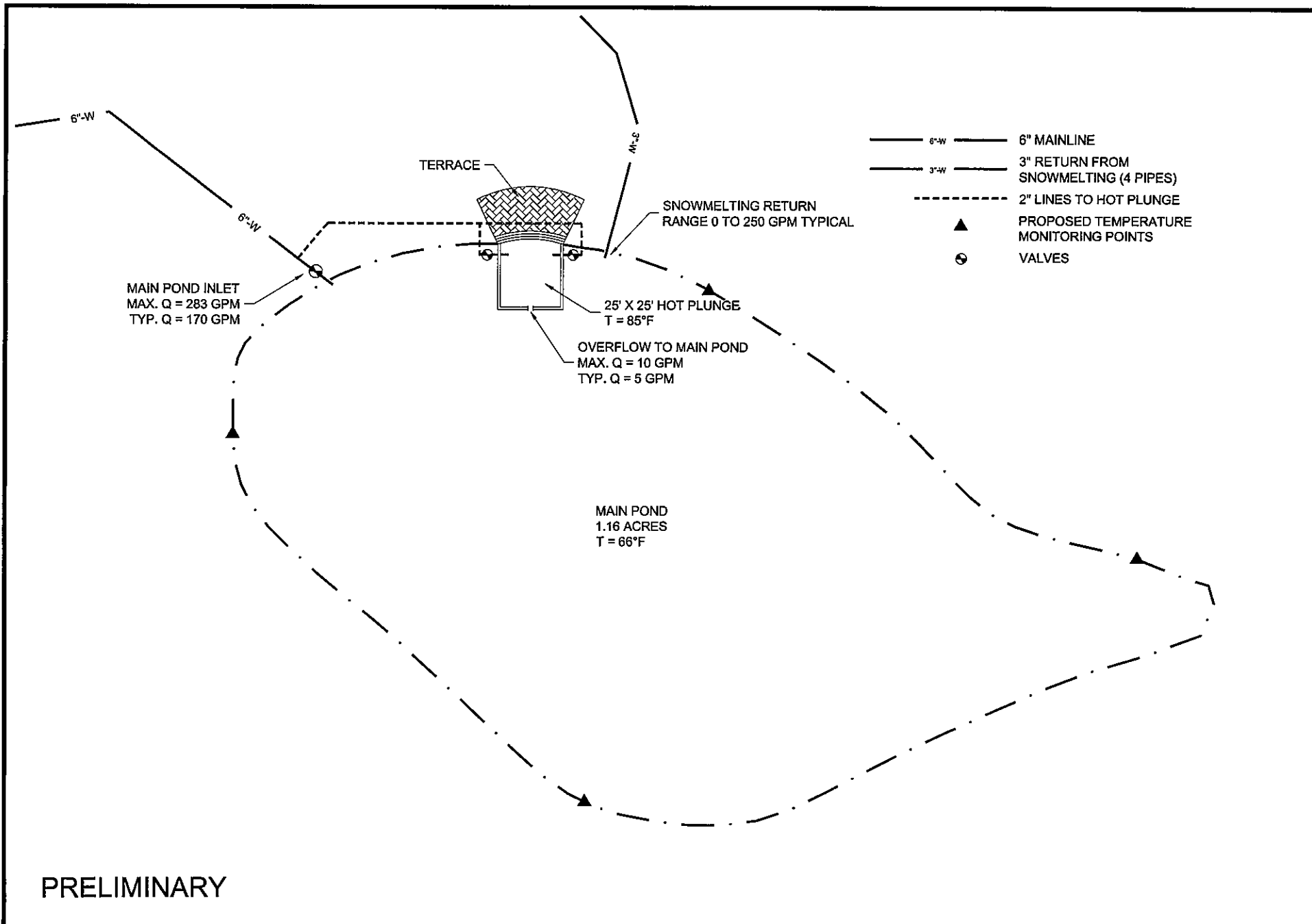
1 inch equals 300 feet

**SUN VALLEY LAND & MINERALS
HISTORIC RESERVOIR AREAS
NAIP 2009 AERIAL**

BROCKWAY ENGINEERING, PLLC.
ALR - JULY 1, 2010

Legend

- 5631' CONTOUR MAY 2000
- USGS Quad Reservoir
- Current Ponds



PRELIMINARY

THIS DRAWING HAS BEEN PREPARED BY BROCKWAY ENGINEERING, PLLC FOR A SPECIFIC PROJECT TAKING INTO ACCOUNT THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH BROCKWAY ENGINEERING & THE CLIENT IS GRANTED.				DESIGNED BY	BROCKWAY ENGINEERING, PLLC HYDRAULICS - HYDROLOGY - WATER RESOURCES 2016 NORTH WASHINGTON, SUITE 4 TWIN FALLS, ID 83301 (208) 736-8543	SUN VALLEY LAND & MINERALS WATER RIGHT 37-8205 PROPOSED MITIGATION PLAN FOR POND EVAPORATION	PROJECT #	
				CGB			337-07-2000	
				DRAFTED BY			DWG#	REV
				CGB			1	△
A	ISSUED FOR REVIEW	11/15/2010						
REV	DESCRIPTION	DATE	APPR. BY					

EVAPORATIVE LOSS IN OUTDOOR POOL - NATURAL COLD WATER CONDITIONS

Four applicable methods as compiled by Helfrich et al. (1982), reported and discussed in Bras (1990)
CGB 12/7/09

Pond temperature

9999 deg C (9999 = natural flow temp)

a 2500 J/g

a,b are coeffs in Le equation:

es = saturation vapor pressure at pond surface temperature

b 2.386 J/g-C

Le = a - bT

ea = vapor pressure of ambient air

rho 1.00E+06 g/m^3

rho = density of water

Month	Days	Avg air temp [C]	Avg RH (%)	Avg Wind (m/s)	Pond sfc temp [C]	Le [J/g]	es (mb)	ea (mb)	Est. pond temp (natural flow)	
									F	C
January	31	-7.1	74	1.8	4.4	2489	8.4	2.6	40	4.4
February	28	-4.4	68	2.1	4.4	2489	8.4	3.0	40	4.4
March	31	-0.6	58	2.6	4.4	2489	8.4	3.4	40	4.4
April	30	5.9	52	3.0	7.2	2483	10.2	4.8	45	7.2
May	31	10.9	49	3.4	10.0	2476	12.3	6.4	50	10.0
June	30	14.9	47	3.4	12.8	2470	14.8	7.9	55	12.8
July	31	19.7	38	3.6	15.6	2463	17.7	8.6	60	15.6
August	31	18.9	38	3.5	15.6	2463	17.7	8.3	60	15.6
September	30	13.7	45	3.4	12.8	2470	14.8	7.0	55	12.8
October	31	8.1	52	2.9	7.2	2483	10.2	5.6	45	7.2
November	30	0.6	67	2.0	4.4	2489	8.4	4.2	40	4.4
December	31	-5.4	74	1.7	4.4	2489	8.4	3.0	40	4.4

Month	Kohler (1954)				Meyer (1942)				Brady et al. (1969)				Ryan and Harleman (1973)				Average [in]
	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	
January	39.6	1.59E-08	0.05	1.68	68.7	2.76E-08	0.09	2.91	49.2	1.98E-08	0.07	2.08	32.7	1.31E-08	0.04	1.39	2.01
February	41.8	1.68E-08	0.06	1.60	67.3	2.71E-08	0.09	2.58	48.6	1.95E-08	0.07	1.86	34.6	1.39E-08	0.05	1.32	1.84
March	49.7	2.00E-08	0.07	2.11	68.9	2.77E-08	0.09	2.92	51.8	2.08E-08	0.07	2.19	41.1	1.65E-08	0.06	1.74	2.24
April	60.6	2.44E-08	0.08	2.49	78.2	3.15E-08	0.11	3.22	61.0	2.46E-08	0.08	2.51	50.1	2.02E-08	0.07	2.06	2.57
May	74.9	3.02E-08	0.10	3.19	90.4	3.65E-08	0.12	3.85	73.8	2.98E-08	0.10	3.14	61.9	2.50E-08	0.09	2.64	3.20
June	89.0	3.60E-08	0.12	3.68	106.7	4.32E-08	0.15	4.41	87.6	3.55E-08	0.12	3.62	73.6	2.98E-08	0.10	3.04	3.69
July	123.0	5.00E-08	0.17	5.27	143.8	5.84E-08	0.20	6.16	120.7	4.90E-08	0.17	5.17	101.7	4.13E-08	0.14	4.35	5.24
August	124.3	5.05E-08	0.17	5.32	147.1	5.97E-08	0.20	6.30	122.1	4.96E-08	0.17	5.23	102.8	4.17E-08	0.14	4.40	5.31
September	97.8	3.96E-08	0.13	4.04	118.9	4.81E-08	0.16	4.91	96.5	3.91E-08	0.13	3.99	80.9	3.27E-08	0.11	3.34	4.07
October	49.7	2.00E-08	0.07	2.11	65.8	2.65E-08	0.09	2.79	50.5	2.04E-08	0.07	2.15	41.1	1.66E-08	0.06	1.75	2.20
November	31.4	1.26E-08	0.04	1.29	51.4	2.06E-08	0.07	2.11	37.0	1.49E-08	0.05	1.52	26.0	1.04E-08	0.04	1.07	1.49
December	35.3	1.42E-08	0.05	1.49	63.3	2.54E-08	0.09	2.68	45.2	1.82E-08	0.06	1.92	29.1	1.17E-08	0.04	1.23	1.83
	Total			34.27	Total			44.82	Total			35.38	Total			28.33	35.70

Average evaporation from the four methods: 35.70 inches

April - October 26.28
November - March 9.42

EVAPORATIVE LOSS IN HEATED OUTDOOR POOL - PROPOSED CONDITIONS, 66 DEGREES F

Four applicable methods as compiled by Helfrich et al. (1982), reported and discussed in Bras (1990)
CGB 12/7/09

Pond temperature 66 deg F = 18.89 deg C (9999 = same as air)
a 2500 J/g a,b are coeffs in Le equation:
b 2.386 J/g-C Le = a - bT
rho 1.00E+06 g/m^3 rho = density of water
es = saturation vapor pressure at pond surface temperature
ea = vapor pressure of ambient air

Month	Days	Avg air temp [C]	Avg RH (%)	Avg Wind (m/s)	Pond sfc temp [C]	Le [J/g]	es (mb)	ea (mb)
January	31	-7.1	74	1.8	18.9	2455	21.8	2.6
February	28	-4.4	68	2.1	18.9	2455	21.8	3.0
March	31	-0.6	58	2.6	18.9	2455	21.8	3.4
April	30	5.9	52	3.0	18.9	2455	21.8	4.8
May	31	10.9	49	3.4	18.9	2455	21.8	6.4
June	30	14.9	47	3.4	18.9	2455	21.8	7.9
July	31	19.7	38	3.6	18.9	2455	21.8	8.6
August	31	18.9	38	3.5	18.9	2455	21.8	8.3
September	30	13.7	45	3.4	18.9	2455	21.8	7.0
October	31	8.1	52	2.9	18.9	2455	21.8	5.6
November	30	0.6	67	2.0	18.9	2455	21.8	4.2
December	31	-5.4	74	1.7	18.9	2455	21.8	3.0

Month	Kohler (1954)				Meyer (1942)				Brady et al. (1969)				Ryan and Harleman (1973)				Increase from natural	
	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Average [in]	natural [in]
January	131.8	5.37E-08	0.18	5.66	228.8	9.32E-08	0.32	9.83	163.9	6.68E-08	0.23	7.04	108.9	4.44E-08	0.15	4.68	6.80	4.79
February	145.3	5.92E-08	0.20	5.64	234.1	9.54E-08	0.32	9.08	169.0	6.89E-08	0.23	6.56	120.1	4.89E-08	0.17	4.66	6.48	4.64
March	182.4	7.43E-08	0.25	7.84	252.7	1.03E-07	0.35	10.86	190.1	7.75E-08	0.26	8.17	150.8	6.14E-08	0.21	6.48	8.33	6.10
April	191.4	7.79E-08	0.27	7.95	246.9	1.01E-07	0.34	10.26	192.4	7.84E-08	0.27	8.00	158.2	6.44E-08	0.22	6.58	8.20	5.63
May	196.3	8.00E-08	0.27	8.43	236.9	9.65E-08	0.33	10.18	193.5	7.88E-08	0.27	8.31	162.3	6.61E-08	0.22	6.97	8.47	5.27
June	180.0	7.33E-08	0.25	7.48	215.8	8.79E-08	0.30	8.97	177.2	7.22E-08	0.25	7.37	148.8	6.06E-08	0.21	6.19	7.50	3.81
July	179.3	7.30E-08	0.25	7.70	209.5	8.53E-08	0.29	9.00	175.9	7.17E-08	0.24	7.56	148.2	6.04E-08	0.21	6.37	7.66	2.42
August	179.2	7.30E-08	0.25	7.70	212.0	8.64E-08	0.29	9.11	176.0	7.17E-08	0.24	7.56	148.1	6.03E-08	0.21	6.36	7.68	2.37
September	186.5	7.60E-08	0.26	7.75	226.6	9.23E-08	0.31	9.42	184.0	7.50E-08	0.25	7.65	154.2	6.28E-08	0.21	6.41	7.81	3.74
October	174.6	7.11E-08	0.24	7.50	230.9	9.41E-08	0.32	9.92	177.5	7.23E-08	0.25	7.63	144.3	5.88E-08	0.20	6.20	7.81	5.61
November	132.7	5.40E-08	0.18	5.51	216.8	8.83E-08	0.30	9.01	156.2	6.36E-08	0.22	6.49	109.7	4.47E-08	0.15	4.56	6.39	4.90
December	123.0	5.01E-08	0.17	5.28	220.8	8.99E-08	0.31	9.48	157.8	6.43E-08	0.22	6.78	101.7	4.14E-08	0.14	4.37	6.48	4.65
	Total			84.45	Total			115.11	Total			89.11	Total			69.81	89.62	53.92

Average evaporation from the four methods: 89.62 inches

April - October 55.13 28.85
November - March 34.49 25.08

EVAPORATIVE LOSS IN HEATED OUTDOOR POOL - PROPOSED CONDITIONS, 85 DEGREES F

Four applicable methods as compiled by Helfrich et al. (1982), reported and discussed in Bras (1990)
CGB 12/7/09

Pond temperature 85 deg F = 29.44 deg C (9999 = same as air)
a 2500 J/g a,b are coeffs in Le equation:
b 2.386 J/g-C Le = a - bT
rho 1.00E+06 g/m^3 rho = density of water
es = saturation vapor pressure at pond surface temperature
ea = vapor pressure of ambient air

Month	Days	Avg air temp [C]	Avg RH (%)	Avg Wind (m/s)	Pond sfc temp [C]	Le [J/g]	es (mb)	ea (mb)
January	31	-7.1	74	1.8	29.4	2430	41.1	2.6
February	28	-4.4	68	2.1	29.4	2430	41.1	3.0
March	31	-0.6	58	2.6	29.4	2430	41.1	3.4
April	30	5.9	52	3.0	29.4	2430	41.1	4.8
May	31	10.9	49	3.4	29.4	2430	41.1	6.4
June	30	14.9	47	3.4	29.4	2430	41.1	7.9
July	31	19.7	38	3.6	29.4	2430	41.1	8.6
August	31	18.9	38	3.5	29.4	2430	41.1	8.3
September	30	13.7	45	3.4	29.4	2430	41.1	7.0
October	31	8.1	52	2.9	29.4	2430	41.1	5.6
November	30	0.6	67	2.0	29.4	2430	41.1	4.2
December	31	-5.4	74	1.7	29.4	2430	41.1	3.0

	Kohler (1954)				Meyer (1942)				Brady et al. (1969)				Ryan and Harleman (1973)				Increase from				
Month	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Average [in]	natural [in]			
January	264.1	1.09E-07	0.37	11.46	458.6	1.89E-07	0.64	19.90	328.4	1.35E-07	0.46	14.25	218.4	8.99E-08	0.31	9.48	13.77	11.76			
February	293.8	1.21E-07	0.41	11.52	473.3	1.95E-07	0.66	18.55	341.8	1.41E-07	0.48	13.40	242.9	1.00E-07	0.34	9.52	13.25	11.41			
March	372.9	1.53E-07	0.52	16.18	516.6	2.13E-07	0.72	22.42	388.6	1.60E-07	0.54	16.87	308.2	1.27E-07	0.43	13.38	17.21	14.97			
April	407.6	1.68E-07	0.57	17.12	525.9	2.16E-07	0.74	22.09	410.0	1.69E-07	0.57	17.22	337.0	1.39E-07	0.47	14.15	17.64	15.07			
May	441.6	1.82E-07	0.62	19.17	532.9	2.19E-07	0.75	23.13	435.2	1.79E-07	0.61	18.89	365.1	1.50E-07	0.51	15.84	19.26	16.05			
June	428.6	1.76E-07	0.60	18.00	513.7	2.11E-07	0.72	21.58	421.8	1.74E-07	0.59	17.72	354.3	1.46E-07	0.50	14.88	18.04	14.36			
July	440.8	1.81E-07	0.62	19.13	515.0	2.12E-07	0.72	22.35	432.5	1.78E-07	0.61	18.77	364.4	1.50E-07	0.51	15.81	19.02	13.78			
August	434.2	1.79E-07	0.61	18.84	513.7	2.11E-07	0.72	22.30	426.6	1.76E-07	0.60	18.51	358.9	1.48E-07	0.50	15.58	18.81	13.50			
September	428.6	1.76E-07	0.60	18.00	520.7	2.14E-07	0.73	21.87	423.0	1.74E-07	0.59	17.76	354.3	1.46E-07	0.50	14.88	18.13	14.06			
October	381.2	1.57E-07	0.53	16.54	504.3	2.08E-07	0.71	21.88	387.6	1.60E-07	0.54	16.82	315.1	1.30E-07	0.44	13.67	17.23	15.03			
November	277.9	1.14E-07	0.39	11.67	454.1	1.87E-07	0.64	19.07	327.3	1.35E-07	0.46	13.75	229.8	9.46E-08	0.32	9.65	13.53	12.04			
December	248.9	1.02E-07	0.35	10.80	446.8	1.84E-07	0.63	19.39	319.4	1.31E-07	0.45	13.86	205.7	8.47E-08	0.29	8.93	13.25	11.41			
Total				188.44	Total				254.53	Total				197.82	Total				155.77	199.14	163.44

Average evaporation from the four methods: 199.14 inches

April - October 128.13 101.85
November - March 71.01 61.59

SUN VALLEY LAND & MINERALS**PERMIT 37-8295 MITIGATION PLAN - SUMMARY OF POND EVAPORATION CALCULATIONS**

Brockway Engineering 11/16/2010

HEATED POND

	Area [acres]	Evap [in/yr]	Evap [ac-ft/yr]
Heated plunge area 25'x25' at 85 deg F	0.01	199.1	0.24
Main pond at 66 deg F	1.16	89.6	8.66

Total evaporation - heated pond **8.90**

NATURAL COLD WATER POND

Natural cold water evaporation	35.70 in/year
Area of pond	1.17 acres
Total evaporation - cold water pond	3.48 ac-ft/yr

Increase in evaporation **5.42 ac-ft/yr**

SUN VALLEY LAND & MINERALS**OPEN POND HEAT LOSS CALCULATION - PEAK FLOW REQUIREMENT**

Permit 37-8205

OIT Geoheat Center Tools

CGB 11/16/2010 - Reduced Heat Load for Mitigation Plan

SEMI-HEATED MAIN POND - 66 DEGREES F

Parameter	Value Units	Assumptions / Remarks
1. Resource temp	124.7 F	Measured mixed temperature 10/13/09
2. Length	370 ft	Pond length avg
3. Width	138 ft	Pond width avg
4. Water temp in pond	66 F	Pleasant temperature for bathing/swimming
5. Wind velocity	4.1 mph	Average January wind speed at Hailey
6. Air temp	-1.7 F	80% exceedance minimum temp at Hailey
9. Relative humidity	65 %	Average January humidity at Boise
7. Cover thickness	0 in	No pond cover
8. Cover "k"	0.4 btu in/hr sqft F	Value irrelevant since thickness = 0
10. Calculated water vap pres	0.308 psia	
1. Evaporative Loss	2377423 btu/hr	46.6 btu/hr sqft
2. Convective Loss	3147943 btu/hr	61.7 btu/hr sqft
3. Radiant Loss	2679809 btu/hr	52.5 btu/hr sqft
4. Conductive Loss	107360 btu/hr	2.1 btu/hr sqft
5. Total Loss	8312535 btu/hr	162.8 btu/hr sqft
6. Required flow rate	283.2 gpm	

ha	0.910662	Pond surface area	51060 ft2
x/k	0		1.17 acres
p. press	0.020		
area	51060		
surf temp	66		
U	0.910662		

Total - plunge and pond 293.3

SUN VALLEY LAND & MINERALS**OPEN POND HEAT LOSS CALCULATION - PEAK FLOW REQUIREMENT**

Permit 37-8205

OIT Geoheat Center Tools

CGB 11/16/2010 - Reduced Heat Load for Mitigation Plan

HEATED "PLUNGE" AREA - 85 DEGREES F

Parameter	Value	Units	Assumptions / Remarks
1. Resource temp	124.7	F	Measured mixed temperature 10/13/09
2. Length	25	ft	Pond length avg
3. Width	25	ft	Pond width avg
4. Water temp in pond	85	F	Pleasant temperature for bathing/swimming
5. Wind velocity	4.1	mph	Average January wind speed at Hailey
6. Air temp	-1.7	F	80% exceedance minimum temp at Hailey
9. Relative humidity	65	%	Average January humidity at Boise
7. Cover thickness	0	in	No pond cover
8. Cover "k"	0.4	btu in/hr sqft F	Value irrelevant since thickness = 0
10. Calculated water vap pres	0.589	psia	
1. Evaporative Loss	78014	btu/hr	124.8 btu/hr sqft
2. Convective Loss	69446	btu/hr	111.1 btu/hr sqft
3. Radiant Loss	44609	btu/hr	71.4 btu/hr sqft
4. Conductive Loss	8066	btu/hr	12.9 btu/hr sqft
5. Total Loss	200135	btu/hr	320.2 btu/hr sqft
6. Required flow rate	10.1	gpm	

ha	1.281578	Pond surface area	625 ft2
x/k	0		0.01 acres
p. press	0.020		
area	625		
surf temp	85		
U	1.281578		

SUN VALLEY LAND & MINERALS**OPEN POND HEAT LOSS - MONTHLY & ANNUAL VOLUME REQUIREMENT****Permit 37-8205****OIT Geoheat Center Tools****CGB 11/16/2010 - Reduced Heat Load for Mitigation Plan**

Average climatic conditions

Resource temperature 124.7 F

Target pond temperature: 66F (main pond), 85F (plunge)

Month	No. Days	Wind Speed (1)	Air Temp (2)	Relative Humid (3)	Average flow requirement (4)	Volume (ac-ft)
January	31	4.1	19.3	74	225.4	30.9
February	28	4.6	24.1	68	223.8	27.7
March	31	5.9	31.0	58	232.9	31.9
April	30	6.7	42.6	52	199.3	26.4
May	31	7.6	51.7	49	167.7	23.0
June	30	7.7	58.8	47	129.3	17.1
July	31	8.1	67.5	38	90.2	12.4
August	31	7.9	66.0	38	97.3	13.3
September	30	7.5	56.7	45	141.7	18.8
October	31	6.4	46.5	52	174.1	23.9
November	30	4.5	33.0	67	187.7	24.9
December	31	3.9	22.3	74	209.0	28.6
TOTAL						278.9

(1) Average monthly wind speed at Hailey airport AWOS [mph]

(2) Average monthly temperature at Hailey NWS [degrees F]

(3) Average monthly relative humidity at Hailey airport for 1/1/2007 - 10/13/2009 [%]

(4) Estimated by OIT GeoHeat Center tool [gpm]