

WA

RECEIVED
APR 18 2011
DEPARTMENT OF
WATER RESOURCES

April 15, 2011

Michele Edl
Idaho Department of Water Resources
322 East Front Street
PO Box 83720
Boise, Idaho 83720-0098

Re: Permit 37-8388-SDRTR Additional Information Request

Dear Ms. Edl:

You indicated that the field exam and supporting data submitted on July 7, 2008 were adequate to provide proof of existence and maybe proof of system capacity for the geothermal system. The field exam report lists the pumping rate for the system as 206 gpm based on the installed magnetic flowmeter that the discharge is sustainable, and the temperature is sustainable. This data defines the system capacity and proof of existence and there should be no question about those elements of the proof. Apparently you still have concerns about the beneficial use of the geothermal water.

The field examination was conducted in late June of 2008. The system was in place but there was minimal space heating and no snowmelting happening at the time of the exam. No recent snowfall had occurred in June prior to the exam date. At the time of the beneficial use field exam, no residents were present and no persons were using the recreational pool. The Department has recognized on past geothermal beneficial use exams that snowmelting as a beneficial use has occurred and could be recognized on the license if the snowmelting facilities and piping are in place and the system has been used for the purpose of melting snow. The Department has not required that the exam somehow be conducted on the worst-case design day so that the actual usage could be measured as your letter of March 4, 2011 seems to indicate. The Department has recognized that the beneficial uses had occurred, and then accepted a calculation of what the diversion rate requirement and annual volume requirement are for each. This is the way it is with any field exam. For an irrigation permit, for example, the examiner does not do the exam on the exact day when the peak crop water demand happens to occur. Nor is he expected to monitor the diversion for an entire season and then only license what was actually diverted in that year. In fact, it is entirely possible that the examiner might do the exam during a year when the farmer is growing peas and hardly running his system at all.

Similarly, as with the exam for Permit 37-8388, the exam for the multiple-use geothermal system was conducted during a period when space heating requirements were not maximum, no snowmelting was taking place, and there was no occupancy of the recreational pool and pool temperature maintenance was not mandated. The examiner is charged with:



Hydraulics

Hydrology

Water Resources

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

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

2016 NORTH
WASHINGTON
STREET • SUITE 4

TWIN FALLS,
IDAHO 83301

208•736•8543

FAX: 736•8506

1. Documenting the system
2. Measuring the system capacity
3. Determining the beneficial uses which have been developed
4. Estimating the diversion rate and annual volume requirement for each beneficial use

Additional analyses have been made relative to water requirements for each beneficial use, which may be helpful in your further evaluation.

Space heating

The instantaneous flow rate requirement for space heating was estimated using IDWR's worksheet. This worksheet implements an algorithm based on temperature differential and efficiency factors which is a standard, recognized approach to estimating heat requirements for space heating. IDWR has used or recognized this approach numerous times. An inside temperature of 72F was assumed, and the outside temperature was assumed to be -1.7F which is the 80% exceedance level for minimum daily temperature at Hailey. Utilization of the Hailey meteorological data is conservative since the Warfield Hot Springs on Warm Springs Creek is at a considerably higher elevation than the Hailey gage and temperatures will be significantly lower. The Hailey site was used because it had the best historical data set.

The analysis using the IDWR worksheet shows a flow rate of 47.7 gpm of geothermal water at 115.5°F for heating of the 12,000 sq ft home.

The annual volume for space heating was calculated assuming 273 heating days per year (September through May) and applying the calculated rate to this period. This results in an annual volume of 57.6 acre-ft.

The hot water source is also utilized to heat hot water for domestic use in the residence. Water at 115.5°F is utilized in heat exchangers to boost water temperature in the two (2) hot water heater(s) in the residence. The required discharge and/or annual volume of geothermal water use for hot water heating is not measured and cannot be determined with available data. The estimated flow requirement of 47.7 gpm for space heating within the residence is therefore conservative and does not include discharge for hot water heating.

Snowmelting

Instantaneous flow for snowmelting was calculated using procedures outlined in Lund¹, which are based on ASHRAE guidance. Parameters needed for the procedures to calculate required flow rate are snowmelting area, water

¹ Lund, John W. (2000). Pavement Snow Melting. Geo-Heat Center, Oregon Institute of Technology.

temperature, air temperature, relative humidity, rate of snowfall, and wind speed. The following parameters were utilized for this analysis:

- Air temperature – 80% exceedance level for daily minimum at Hailey station.
- Wind speed – average January speed at the Hailey airport (4.1 mph). No local wind data is available.
- Relative humidity – average January value of 63% at Boise. No local humidity data.

Rate of snowfall –an exponential distribution was fit to the 24-hour snowfall depth at Hailey, the 90% exceedance value was selected, and it was assumed that that depth fell in a short duration (4 hours). It was also assumed that the snow density is 0.1 which resulted in a calculated water equivalent of 0.17 in/hr.

Analysis using the Lund (2000) procedure shows a flow requirement of 404 gpm for snow melting using first use geothermal water. If second-use water after space heating is utilized (48 gpm at 102.5F), then the flow requirement is 375 gpm of first-use water. However, actual amount licensed would be limited by the system capacity of 206 gpm or 0.46 cfs.

Annual volume calculation for snowmelting was made based on the fact that the snowmelting system will operate at a fixed flow rate; i.e. the system cannot feasibly be adjusted to exactly match the heat requirement of each of the many snowstorms that will occur over a given year. Instead, the system will likely be turned on whenever snowmelting is required, and turned off whenever the snowfall ceases or snowmelting is no longer required. Given this method of operation, the annual volume that should be licensed is best calculated by estimating a conservatively high number of days each year that the system will be operated.

The number of days of snowfall for November through March has been recorded at the NRCS SNOTEL sites at Hyndman, Dollarhide Summit, and Chocolate Gulch, located 16.9 miles, 9.4 miles, and 9.4 miles, respectively, from the project site. This data was analyzed and a frequency analysis performed. The data sets exhibited a probability distribution with bi-modal characteristics and could not be fitted with a standard probability distribution; therefore frequencies were determined by the plotting position method. The data and analysis is attached and the results shown in the following table:

	Hyndman	Dollarhide Summit	Chocolate Gulch
Mean	49.0	64.2	46.5
Standard deviation	10.1	12.8	9.8
Exceedance probability:			
0.5	51	61	47
0.75	58	74	55
0.8	59	76	56
0.9	62	82	57
0.95	63	85	58

The 90% level was selected as a reasonable criterion to ensure that the annual licensed volume is sufficient. The project site is similar in elevation to the Chocolate Gulch snow survey site, but is orographically similar to the Dollarhide Summit site. Therefore, the average of these two sites (70 days) was assumed to best represent conditions at the project site. The Hyndman site was not used due to its distance from the project.

Although the snowmelting system requires 404 gpm (see above), the actual amount licensed would be limited to 206 gpm based on system capacity. This rate operated over 70 days per year yields an annual volume of 63.7 acre-feet.

Recreational Spa

The instantaneous requirement for the spa was calculated using the GeoHeat Center's tool for open water heat requirement. The climatic inputs described above were used for this calculation and the analysis is attached.

To calculate annual diversion requirement, a monthly analysis was performed using average monthly climate parameters of temperature, humidity, and wind speed. Something more conservative than the average could be used to account for colder years, but a sensitivity analysis showed there was not much difference on an annual basis. Again, the met data used was from the Hailey station.

The analysis indicates that maintenance of a desired 100°F minimum pond temperature during the winter will require 18.6 gpm using first use geothermal water (115.5°F). If second-use water after space heating is used (48 gpm at 102.5°F), the water must be supplemented with 11 gpm of first-use water to maintain the pond temperature, for a total of 59 gpm.

The annual diversion volume to be licensed is the amount needed on an annual basis to maintain the target pond temperature of 100°F under assumed climatic conditions. It is assumed that the flow to the pond will be regulated in order to maintain the pond temperature near this target value.

To make this calculation, a monthly analysis of pond heat losses and flow requirement was made using average values of temperature, relative humidity, and wind speed at the Hailey 3NNW station. Since the licensed diversion

volume must be large enough to cover years with demand higher than average, an argument could be made for using something more conservative than average monthly climatic data. However, a cursory sensitivity analysis with the heat loss calculations shows that the heat balance can be maintained even under more extreme conditions with only 2 to 3 degrees drop in pond temperature, which cannot be discerned by a human swimmer. Therefore, the use of average values is reasonable. The calculations are attached.

Temperature data was obtained from the Western Regional Climate Center (WRCC) for the NWS station Hailey 3NNW. Data on wind speed is also compiled by WRCC but reflects data collected at the Hailey airport AWOS station. Relative humidity data for a long period of record at Hailey was not found; however, average monthly data from the NCDC for Boise was assumed to be applicable to Hailey. The pond heat loss calculation is very insensitive to humidity level, so the lack of site-specific data is not crucial.

The total annual volume requirement for the pond is 29.1 acre feet.

Possible Usage Scenarios and Recommended License Amounts

The distribution piping in the system is configured such that first-use water may be diverted to any use. Second-use water after space heating can also be diverted to snowmelting or the pond. Second-use water after snowmelting or the pond cannot be re-used, as this would require re-pumping the water back into the system. Thus, there are three possible arrangements or scenarios for usage of the geothermal water. These scenarios are diagrammatically shown on the attached sheets. The total flow requirement does not vary significantly between the scenarios, and in every case is greater than the available system capacity. Therefore, permit 37-8388 should be licensed for the system capacity.

The snowmelting should be licensed for the full capacity (206 gpm or 0.46 cfs), while the heating use should be licensed for the maximum flow rate required to heat the residence (48 gpm or 0.11 cfs). The pond recreational use should be licensed for the maximum requirement assuming second-use water is utilized as the primary source (59 gpm or 0.13 cfs). The total flow rate should be limited to the system capacity (0.46 cfs). Annual volumes should be licensed according to the volume calculations described above for each use.

Recommended license amounts:

Use	Period	Div Rate	Div Vol
Heating (space)	1/1 to 12/31	0.11 cfs	57.6 afa
Heating (snowmelting)	1/1 to 12/31	0.46 cfs	63.7 afa
Recreation	1/1 to 12/31	0.13 cfs	29.1 afa
TOTAL		0.46 cfs	150.4 afa

I submitted, at Pam Skaggs request, an estimate of actual measured geothermal water use based on operator monthly flow data which showed that the annual volume of use for the period prior to August 208 was 246.5 acre feet. This measured volume reflects actual system use but exceeds the volume estimated from the above analysis. However, if you believe the measured volume is a more accurate depiction of beneficial use, the data is available.

At this point I am somewhat at a loss as to what information to provide since there are apparently no published IDWR criteria for beneficial use for the types of uses identified for this permit. Your letter appears to suggest or perhaps require that the applicant measure the water use in the wintertime, when the temperature is equal to -1.7F, during a snowstorm equivalent to the design storm described above, and when the pool is being used. If this is the requirement it will be impossible to schedule such an event, especially since the winter has terminated. If the additional information included with this report is not adequate, I will need explicit definition of the type and extent of data which you require to satisfy the beneficial use evaluation.

Please respond as soon as possible. I believe the above information should be adequate to process this field exam.

Cordially,


Charles E. Brockway, Ph.D., P.E.

Enc.

Cc: James P. Speck, Atty.
Jeff Peppersack
Gary Spackman

Enclosures

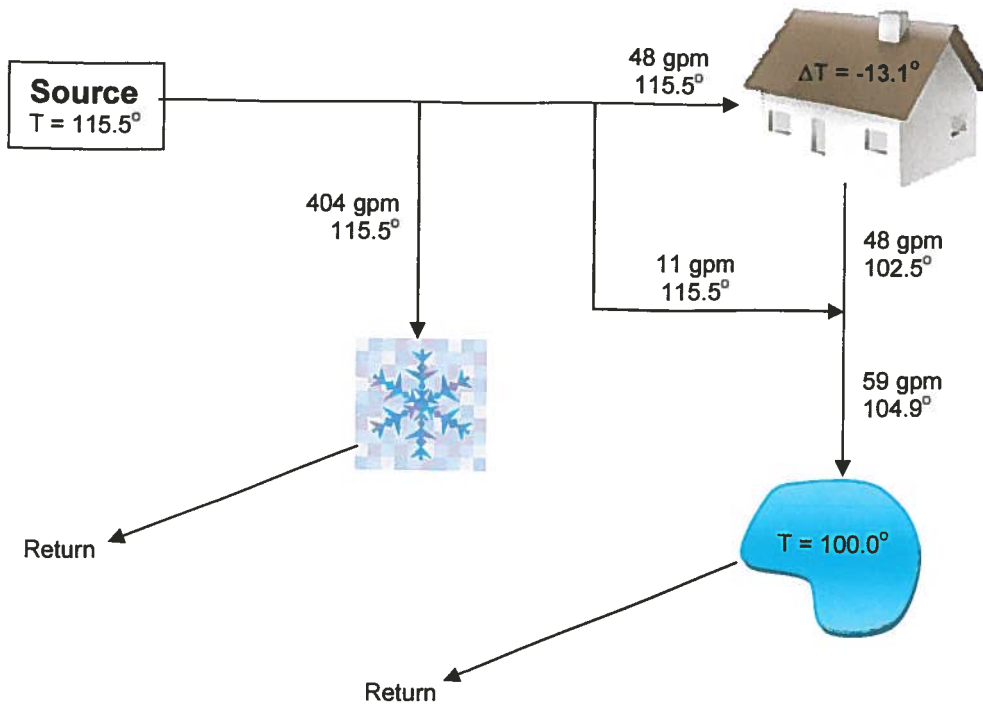


SCENARIO 1

First-use water for snowmelting and space heating

Second-use water for pond, augmented by first-use to maintain temperature

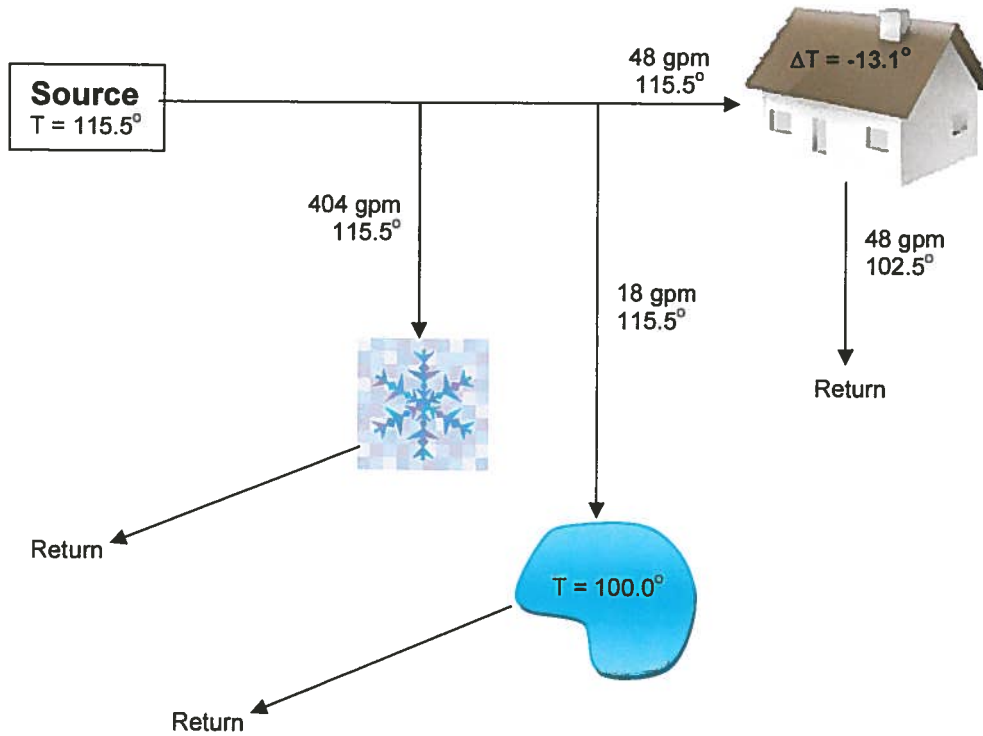
Total flow requirement from source = 463 gpm



SCENARIO 2

First-use water for snowmelting, space heating, and pond

Total flow requirement from source = 470 gpm

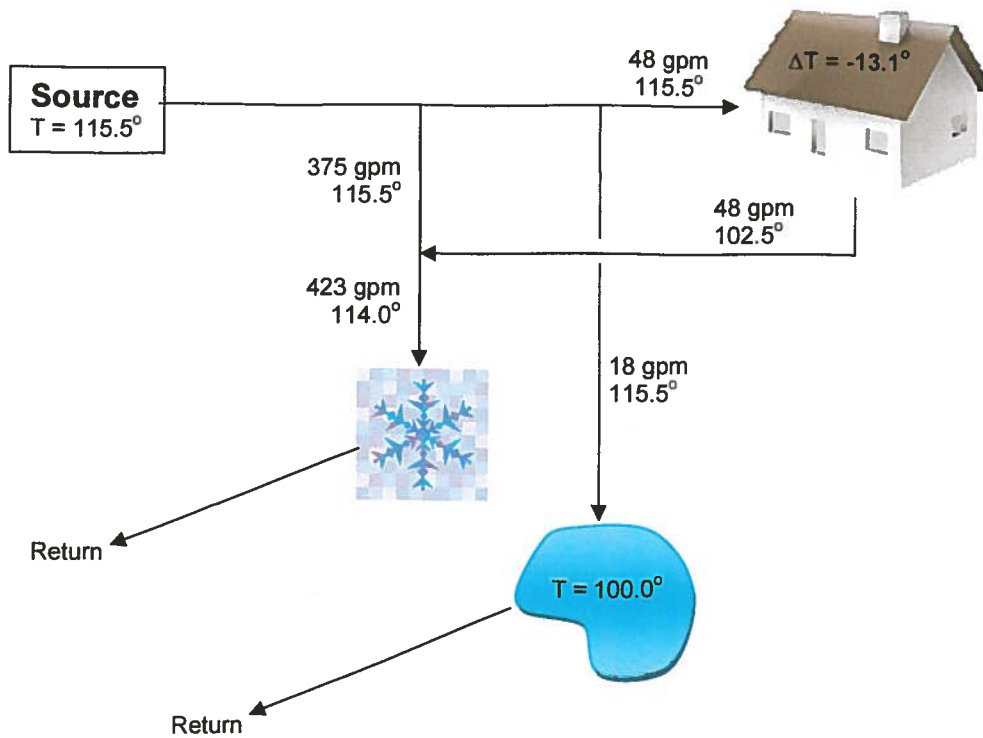


SCENARIO 3

First-use water for space heating and pond

First-use water for snowmelting, augmented by second-use water from space heating

Total flow requirement from source = 442 gpm



RESIDENTIAL SPACE HEATING/COOLING REQUIREMENTS FOR COLD OR GEOTHERMAL SOURCES

Worksheet created by Cindy Hodges, 11/93.

Data entered by: C.E. Brockway Robbins Residence-Warfield Hot Springs Blaine County Revised 3/24/2011

Exam Date: 06/27/08 Main House 10000 sq ft

File No: 485-02-3008 Office 0 sq ft

Computations for: Heating Managers Hou 2000 sq ft

Employees Hou 0 sq ft

Mill Office 0 sq ft

Total 12000 sq ft

REQUIRED DATA:

Area of livable floor space, ft2 (A)

12000

2 story? (N=1, Y=2)

2

House efficiency factor (e) *

0.44

Inside design temperature (Ti)

72

Average outside temperature (To) **

-1.7

Source temperature, degrees F (S)

115.5

Heating/cooling days per season (D)

273

Hours/day system operates (H)

24

CALCULATED DATA:

DESIGN HEAT LOAD (BTU/hr required)

Formula: $E = [e \times (T_i - T_o)] \times A$

Applies factor of 0.8 for two-story dwelling

E = 311,309 BTU/hour

TEMPERATURE DROP ACROSS SYSTEM

Formula: $T_s = 0.3 \times [S - T_i]$

Ts = 13.05 degrees F

* e values are as follows:

0.28 Best energy efficiency - extra insulation, caulked and

weathersripped, with storm windows and doors

0.44 Better energy efficiency - standard insulation, caulked and

weathersripped, with storm windows and/or doors

0.67 Average residence - standard insulation, no weatherproofing

but with storm windows or double panes

1.11 Poor energy efficiency - minimal insulation, no weatherproofing

or storm windows (older homes, shops or greenhouses)

** Suggested average outside temperatures:

WINTER

4 deg F Boise

6 deg F Grand View

-8 deg F Cascade

SUMMER

80 deg F Boise

90 deg F Grand View

70 deg F Cascade

FLOW RATE REQUIRED (at given source temperature)

Formula: $Q = E / (500 \times T_s) \times 448.8$

Q = 0.11 cfs

47.7 gpm

DIVERTED VOLUME OVER SEASON

Formula: $V_{div} = Q \times D \times H / 24 \times 1.9835$

Vdiv = 57.6 AFA

ROBBINS TRUST ROADWAY SNOW MELTING WITH GEOTHERMAL WATER

Lund, John W. (2000). Pavement Snow Melting. Geo-Heat Center Bulletin.
Assumes direct-use hydronic method, buried pipelines.
Met data from Hailey station

SCENARIO: FIRST USE OF GEOTHERMAL WATER

DESIGN CONDITION:

Parameter	Value	Units
Total area	22,956	ft2 Based on snowmelting area .shp file
Rate of snowfall	0.17	inches of water equivalent per hour
Air temperature	-1.6	F
Wind speed	4.1	mph
Water film temperature	33	F
Ratio of snow-free area to total	1	
Resource temperature	115.5	F
Effluent temperature	85	F
Road pavement heat loss	20%	

CALCULATIONS:

Parameter	Value	Units
Vapor pressure of air	0.06	in Hg
Heat of vaporization at film temp	1075.5	Btu/lb
Sensible heat	14.9	Btu/hr/ft2
Heat of fusion	126.8	Btu/hr/ft2
Heat of evaporation	18.6	Btu/hr/ft2
Heat transfer (conv. & radiation)	54.2	Btu/hr/ft2
Unit heat required at road surface	214.5	Btu/hr/ft2
Unit heat required from pipes	268.1	Btu/hr/ft2
Total heat required	6155379	Btu/hr
Flow rate required	404	gpm
	0.90	cfs
Snow melt System Operation	150.0	days
Snow melt System Operation	8.0	hours/day
Diversion Volume required	89.2	afa
Formula: $V_{div} = Q \times D \times H/24 \times 1.9835$		

SCENARIO: SECOND USE OF GEOTHERMAL WATER

DESIGN CONDITION:

Parameter	Value	Units
Total area	22,956	ft2 Based on snowmelting area .shp file
Rate of snowfall	0.17	inches of water equivalent per hour
Air temperature	-1.7	F
Wind speed	4.1	mph
Water film temperature	33	F
Ratio of snow-free area	1	
Resource temperature	102.5	F
Effluent temperature	85	F
Road pavement heat loss	20%	

CALCULATIONS:

Parameter	Value	Units
Vapor pressure of air	0.06	in Hg
Heat of vaporization at	1075.5	Btu/lb
Sensible heat	14.9	Btu/hr/ft2
Heat of fusion	126.8	Btu/hr/ft2
Heat of evaporation	18.7	Btu/hr/ft2
Heat transfer (conv. &	54.4	Btu/hr/ft2
Unit heat required at r	214.7	Btu/hr/ft2
Unit heat required from	268.4	Btu/hr/ft2
Total heat required	6162035	Btu/hr
Flow rate required	704	gpm
	1.57	cfs
Snow melt System Op	150.0	days
Snow melt System Op	8.0	hours/day
Diversion Volume req	155.6	afa
Formula: $V_{div} = Q \times D \times H/24 \times 1.9835$		

ROBBINS RESIDENCE-WARFIELD HOT SPRINGS
OPEN POND HEAT LOSS CALCULATION - PEAK FLOW REQUIREMENT

Permit 37-8388

OIT Geohat Center Tools

CEB As-Built Conditions

Assumes first use of geothermal water

FIRST USE WATER

Parameter	Value Units	Assumptions / Remarks
1. Resource temp	115.5 F	Measured mixed temperature 10/13/09
2. Length	24 ft	Pond length avg
3. Width	12 ft	Pond width avg
4. Water temp in pond	100 F	Desired temperature for hot tub(Owner data)
5. Wind velocity	4.1 mph	Average January wind speed at Hailey
6. Air temp	-1.7 F	80% exceedance minimum temp at Hailey
7. Cover thickness	0 in	No pond cover
8. Cover "k"	0.4 btu in/hr sqft F	Value irrelevant since thickness = 0
9. Relative humidity	65 %	Average January humidity at Boise
10. Calculated water vap pres	0.982 psia	
1. Evaporative Loss	68501 btu/hr	237.8 btu/hr sqft
2. Convective Loss	43472 btu/hr	150.9 btu/hr sqft
3. Radiant Loss	25273 btu/hr	87.8 btu/hr sqft
4. Conductive Loss	6742 btu/hr	23.4 btu/hr sqft
5. Total Loss	143987 btu/hr	500.0 btu/hr sqft
6. Required flow rate	18.6 gpm	

ha	1.484215	Pond surface area	288 ft2
x/k	0		0.01 acres
p. press	0.020		
area	288		
surf temp	100		
U	1.484215		

SECOND USE WATER

Parameter	Value Units	Assumptions / Remarks
1. Resource temp	102.5 F	Estimated avg second use after space heat
2. Length	24 ft	Pond length avg
3. Width	12 ft	Pond width avg
4. Water temp in pond	100 F	Desired Minimum temperature (Owner data)
5. Wind velocity	4.1 mph	Average January wind speed at Hailey
6. Air temp	-1.7 F	80% exceedance minimum temp at Hailey
7. Cover thickness	0 in	No pond cover
8. Cover "k"	0.4 btu in/hr sqft F	Value irrelevant since thickness = 0
9. Relative humidity	65 %	Average January humidity at Boise
10. Calculated water vap pres	0.982 psia	
1. Evaporative Loss	68501 btu/hr	237.8 btu/hr sqft
2. Convective Loss	43472 btu/hr	150.9 btu/hr sqft
3. Radiant Loss	25273 btu/hr	87.8 btu/hr sqft
4. Conductive Loss	6742 btu/hr	23.4 btu/hr sqft
5. Total Loss	143987 btu/hr	500.0 btu/hr sqft
6. Required flow rate	115.2 gpm	

ha	1.484215	Pond surface area	288 ft2
x/k	0		0.01 acres
p. press	0.020		
area	288		
surf temp	100		
U	1.484215		

STATISTICAL ANALYSIS OF NUMBER OF DAYS OF SNOWFALL, NOVEMBER - MARCH
NRCS SNOTEL SITES

Brockway Engineering 4/15/11

Water Year	No. Days Snowfall		
	Hyndman	Dollarhide	Chocolate
1982		85	
1983		90	
1984		64	
1985		58	
1986		76	
1987		53	
1988		66	
1989	63	70	
1990	39	55	
1991	39	51	
1992	46	53	
1993	61	46	
1994	38	45	30
1995	64	84	60
1996	58	71	55
1997	59	81	56
1998	40	62	46
1999	62	75	54
2000	53	47	37
2001	35	59	34
2002	42	59	42
2003	51	60	47
2004	46	60	44
2005	32	47	30
2006	55	78	56
2007	41	58	45
2008	54	71	57
2009	52	74	51
2010	41	58	40

STATISTICS:

	Hyndman	Dollarhide	Chocolate
Mean	49.0	64.2	46.5
Std dev	10.1	12.8	9.8
Ex prob:			
0.5	51	61	47
0.75	58	74	55
0.8	59	76	56
0.9	62	82	57
0.95	63	85	58

ROBBINS TRUST, PERMIT 37-8388
OPEN POND HEAT LOSS - MONTHLY & ANNUAL VOLUME REQUIREMENT

OIT Geoheat Center Tools
As-Built Conditions

Average climatic conditions

Resource temperature 115.5 F

Target pond temperature 100 F

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	16.5	2.3
February	28	4.6	24.1	68	17.2	2.1
March	31	5.9	31.0	58	19.5	2.7
April	30	6.7	42.6	52	19.6	2.6
May	31	7.6	51.7	49	19.9	2.7
June	30	7.7	58.8	47	18.8	2.5
July	31	8.1	67.5	38	18.2	2.5
August	31	7.9	66.0	38	18.1	2.5
September	30	7.5	56.7	45	18.9	2.5
October	31	6.4	46.5	52	18.4	2.5
November	30	4.5	33.0	67	15.9	2.1
December	31	3.9	22.3	74	15.6	2.1
TOTAL						29.1

(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 Boise

(4) Heat balance calc from OIT GeoHeat Center tool [gpm]