

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
BENEFICIAL USE FIELD REPORT

A. GENERAL INFORMATION

Permit No: 72-16772

Exam Date: 07/22/2020

1. Current Owner:
TRAVIS AND BRENDA BULLOCK
PO BOX 1189
CHALLIS ID 83226
2. Accompanied by: Travis Bullock, permit Holder and Cindy Yenter, IDWR Staff.
Phone No: 208-879-1189
Address: PO BOX 1189
Challis, ID 83226

3. SOURCE:

GROUND WATER

Method of Determination: Aerial Photography and Site Visit and interview with Travis Bullock.

B. OVERLAP REVIEW

1. Other water rights with the same place of use: YES Overlap

Water Right No.	Source	Purpose of Use	Basis
Permit 72-16699	Ground Water	Irrigation, Domestic, Stockwater	Permit

Comments: Permit 72-16772 and 72-16699 list the same place of use for the above uses, (see narrative).

2. Other water rights with the same point-of-diversion: YES Overlap

Water Right No.	Source	Purpose of Use	Basis
Permit 72-16699	Ground Water	Irrigation, Domestic, Stockwater	Permit

Comments: Permit 72-16772 and 72-16699 list both points of diversion on the permits, (see narrative).

C. DIVERSION AND DELIVERY SYSTEM

1. **LOCATION OF POINT(S) OF DIVERSION:**

GROUND WATER SE¼ NW¼, Sec. 10, Twp 14N, Rge 19E, B.M. CUSTER County

Method of Determination: Aerial Photography and Site Visit and interview with Travis Bullock.

PLACE OF USE: HEATING

[illegible]

PLACE OF USE: DOMESTIC

[illegible]

PLACE OF USE: IRRIGATION

Twp	Rng	Sec	NE				NW				SW				SE				Totals
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
14N	19E	10			8.0					15.0									23.0

Total Acres: 23.0

PLACE OF USE: STOCKWATER

Twp	Rng	Sec	NE				NW				SW				SE				Totals
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
14N	19E	10			X														

Method of Determination: Aerial Photography and Site Visit and interview with Travis Bullock.

3.

Delivery System Diagram Attached (required). Indicate all major components and distances between components.
 _____ Indicate weir size/pipe as applicable.

Map Attached Showing Location(s) of point(s) of diversion and place(s) of use (required). Scale must be
 _____ 1:24,000 or greater.

_____ Aerial Photo Attached (required for irrigation of 10+ acres).

_____ Photo of Diversion and System Attached

4.

Well or Diversion ID No.*	Motor Make	Hp	Motor Serial No.	Pump Make	Pump Serial No. or Discharge Size
D0051559	Pumpen	15	N/A	Submersible	N/A

D. FLOW MEASUREMENTS

None taken.

E. FLOW CALCULATIONS

☒ Additional Computation Sheets Attached

Theoretical yield: $Q = \frac{8.8 \times (HP) \times (EFF)}{H}$

Where: HP = 15 HP (acquired from applicant)

EFF = Pump Efficiency = 70% (assumed)

H = Total Dynamic Head = (total lift) + (2.31 x operating pressure). Total lift was estimated at 60 ft based on water level from well driller's report. Operating pressure estimated at 35 psi based on pressure gauge on system.

$$(8.8) \times (15 \text{ hp}) \times 70\% = 92.4 = 0.65 \text{ cfs,}$$

$$60 + (35 \times 2.31) = 140.85$$

Irrigation: 23 acres x 0.02 cfs/a = 0.46 cfs. **Recommend 0.46 cfs**

Stockwater: **Recommend amount of 0.04 cfs (domestic permitted amount)**

Domestic: **Recommend permitted amount of 0.04 cfs**

Heating: See Calculation Sheets and Recommended amounts

The applicant stated that the well was not capable of producing enough water for Irrigation and other uses at the same time. Therefore: **I recommend the allowed 0.02 cfs/acre, 0.46 cfs as a combined total flow for all uses.**

F. VOLUME CALCULATIONS

✓ Additional Computation Sheets Attached

1. Volume Calculations for irrigation:

$$V_{I.R.} = (\text{Acres Irrigated}) \times (\text{Irrigation Requirement}) = 23 \text{ A} \times 3.5 \text{ af Ir} = 80.5 \text{ AF}$$

$$V_{D.R.} = [\text{Diversion Rate (cfs)}] \times (\text{Days in Irrigation season}) \times 1.9835 = 0.46 \text{ cfs} \times 183 \text{ days} \times 1.9835 = 82.2 \text{ AF}$$

$$V = \text{Smaller of } V_{I.R.} \text{ and } V_{D.R.} = 80.5 \text{ AF}$$

2. Volume Calculations for Other Uses:

Domestic use for dog kennel only, year round

$$\text{Diversion rate } 0.04 \text{ cfs (permitted rate)} \times 30 \text{ minutes} = (1800 \text{ seconds} \times 0.04 \text{ cfs}) = 72 \text{ ft}^3 \times 365 \text{ days} = 26,280 \text{ ft}^3$$

$$26,280 \text{ ft}^3 / \text{year} \div 43,560 \text{ ft}^3 = 0.6 \text{ AF}$$

Stockwater use for 50 head of horses 4 pigs, and 12 chicken, year round

$$50 \text{ horses} \times 12 \text{ gpd/head} \times 365 \text{ days} = 219,000 \text{ g} \div 325,850 \text{ gal/acre-ft} = 0.67$$

$$4 \text{ pigs} \times 4 \text{ gpd/head} \times 365 = 5840 \div 325,850 \text{ gal/acre-ft} = 0.02 \text{ (rounded)*}$$

$$12 \text{ chickens} \times 0.06 \text{ gpd/head} = 0.72 \div 325,850 \text{ gal/acre-ft} = 0.01* \text{ (rounded)}$$

$$0.67 + 0.02 + 0.01 = 0.7 \text{ AF}$$

Heating volume totaling 28.4 AF, see attached sheets

G. NARRATIVE/REMARKS/COMMENTS

In 2006 Travis and Brenda Bullock filed an application for permit, 72-16699, to drill a new well for domestic, stockwater, and irrigation uses for a new home being built, for their livestock and to irrigate the property. The existing well served a mobile home on the property, but is not sufficient to cover the additional uses. When they drilled a new well they hit hot water. In order to use the hot water they filed a new permit, 72-16772, for various beneficial uses for the hot water. Both permits listed two wells (the original well and the hot well). Because of circumstances beyond their control, they filed a request for extension of time on both permits before the proof due dates of each permit. The statement of completion for permit 72-16699 was filed in 2017 and permit 72-16772 statement of completion was filed in 2019.

The field exam for permit 72-16772 was conducted on July 22, 2020 with permit holder Travis Bullock and Cindy Yenter, IDWR watermaster for District 170 present. Cindy and I met with Mr. Bullock to discuss the development of his permit. We reviewed the various proposed uses listed on his permit and we discovered that a number of uses were not developed and will be dropped from the permit at licensing. The following uses that were not developed are, Irrigation Storage, Irrigation from Storage, Diversion to Storage, Recreation, Fish Propagation and Commercial use. Mr. Bullock showed us around his property to verify what was developed and the points of diversion.

Mr. Bullock explained that the recent earthquakes had damaged his system under ground and production from the well has decreased. Mr. Bullock also stated that because of the earthquakes he had to install a smaller 7.5 hp pump because the original 15 hp pump would draw the well down and suck air and sand. Mr. Bullock indicated that a main line from the well runs to the home for an in-floor heating system. The main line splits before going into the home and conveys hot water to dog kennels, the green house, and stockwater tank. A separate pipe also runs from the well to a main line with risers for his wheel lines, hand lines and a drip system for irrigation. As the well production decreased Mr. Bullock had to change his types of irrigation from 2 wheel lines and 5 hand lines to the 2 wheel lines to a drip system for irrigation. Mr. Bullock verified the acres he was irrigating, the location of green house, dog kennels, stockwater tank and the well on an ArcMap aerial photo. A flow meter was installed but was not working on the day of the field exam. Photos were taken of the place of use.

Permit 72-16772 list two ground water wells as points of diversion, a hot water well and a cold water well. During the exam it was determined that each well is its own separate system, therefore this permit is for the hot water well and the beneficial uses developed from the hot water well. The cold water well will be dropped as a point of diversion from this permit at licensing. The cold water well and its developed uses will be covered under permit 72-16699.

The following beneficial uses were developed under this permit. Irrigation for 23 acres, Heating for a 6,480 ft² home (includes garage) and a 768 ft² greenhouse, and Domestic use for dog kennels

The recommended flow and volume for each of the uses are as follows:

Irrigation of 23 acres, rate: 0.46 cfs, volume: 80.5 af, (see calculations).

Heating for the Home & Greenhouse, rate: 0.20 cfs, volume of: 28.4 af, (see attached calculations sheets).

Domestic* rate: 0.04 cfs, volume: 0.6 af, (see calculations).

Stockwater ** rate: 0.04 cfs, volume: 0.7 af, (see calculations).

*Domestic volume for Permit 72-16772 and Permit 72-16699, for a dog kennel, rate: 0.04 cfs permitted amount, volume of 0.6 af (see volume calculations above)

**Stockwater use is being added to the license to more accurately describe the actual water use. Stockwater could be considered a portion of the permitted domestic use pursuant to 42-111 therefore a licensing amendment is not required.

Have conditions of permit approval been met? ☐ Yes ☐ No

H. RECOMMENDATIONS

1. Recommended Amounts

<u>Beneficial Use</u>	<u>Period of Use</u>	<u>Rate of Diversion</u>	<u>Annual Volume</u>
HEATING	01/01 to 12/31	0.20 CFS	28.4 AF
DOMESTIC	01/01 to 12/31	0.04 CFS	0.6 AF
STOCKWATER	01/01 to 12/31	0.04 CFS	0.7 AF
IRRIGATION	04/15 to 10/15	0.46 CFS	80.5 AF

Recommended Amounts:

Totals:

0.46 CFS

110.2 AF

2. Recommended Amendments

☐ Change P.D. as reflected above ☐ Add P.D. as reflected above ☒ None

☐ Change P.U. as reflected above ☐ Add P.U. as reflected above ☒ None

I. AUTHENTICATION

Benny Walker - Water Resource Agent, Senior

Field Examiner's Name Benny Walker Date 9/30/20

Reviewer _____ Date _____

Permit 72-16772



Hot water: well used for, heating, irrigation, stockwater, and domestic uses.

Note: the excavated area around the well was due to repairs that were needed as a result of the earth quakes.



Above: Inside view of the meter and the pipe connected to the well head

Below: Main line and risers used to irrigate from the hot water well



Permit 72-16699



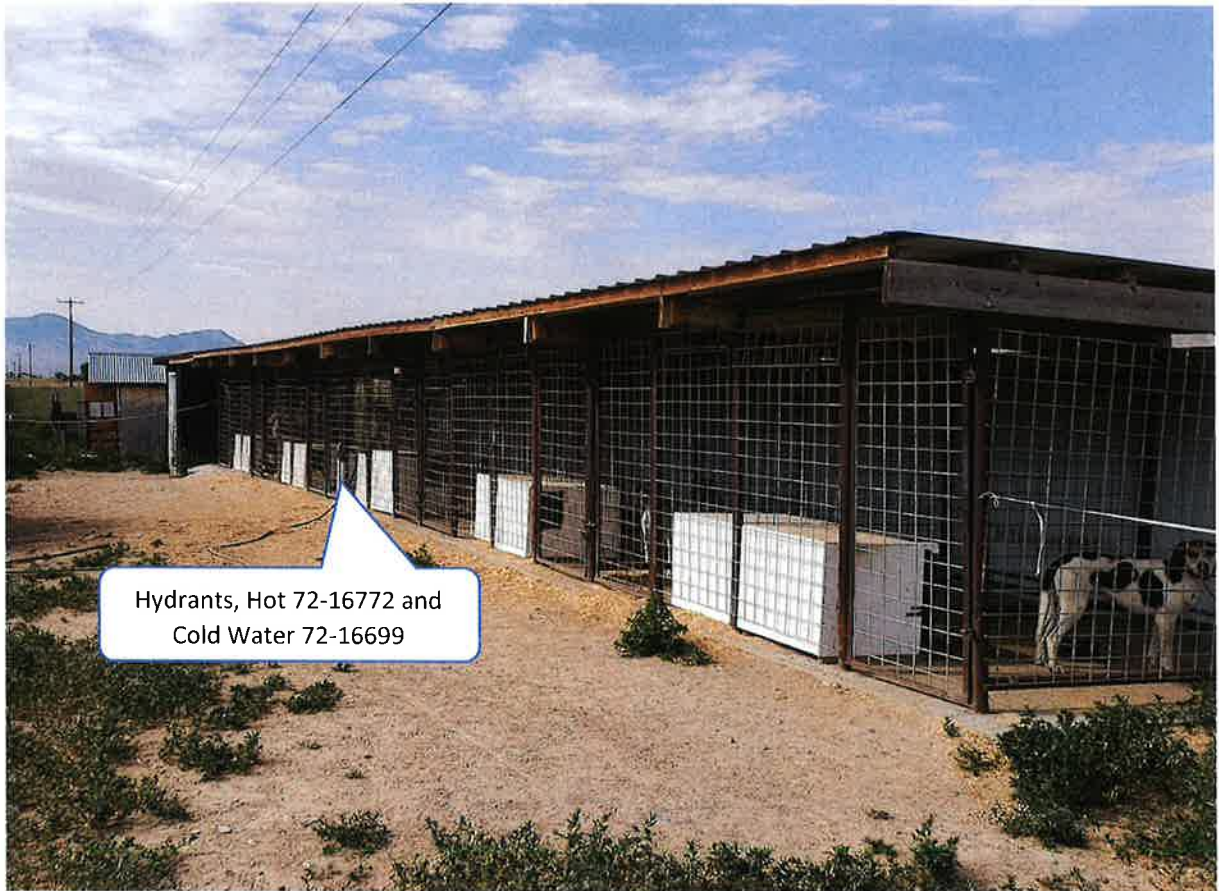
Heating for 6480 ft² home and garage from hot water well



View of the back of the home looking east

Field Exam 72-16772

Permit 72-16772



Hydrants, Hot 72-16772 and
Cold Water 72-16699

Above: Dog kennels with two hydrants, hot and cold water

Below: Stockwater tank with two hydrants, hot 72-16772 and cold water 72-16699



Field Exam 72-16772

Permit 72-16772



Greenhouse



Hot water tank,
radiant heating
72-16772
Cold water, drip
irrigation system
72-16699

**Field Exam
72-16772**

Permit 72-16772



Above: Stockwater, horses and irrigation

Below: Stockwater, pig pen and irrigation



Field Exam 72-16772

State of Idaho
Department of Water Resources
Attachment to Water Right License
72-16772

This map depicts the IRRIGATION place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.

19E



-  Point of Diversion
-  Place Of Use Boundary
-  Townships
-  PLS Sections
-  Quarter Quarters

0 0.04 0.08 0.16 Miles



State of Idaho
Department of Water Resources

Attachment to Water Right License
72-16772

This map depicts the DOMESTIC place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.



-  Point of Diversion
-  Place Of Use Boundary
-  Townships
-  PLS Sections
-  Quarter Quarters

0 0.035 0.07 0.14 Miles



State of Idaho
Department of Water Resources

Attachment to Water Right License

72-16772

This map depicts the HEATING place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.



-  Point of Diversion
-  Place Of Use Boundary
-  Townships
-  PLS Sections
-  Quarter Quarters

0 0.035 0.07 0.14 Miles



State of Idaho
Department of Water Resources

Attachment to Water Right License

72-16772

This map depicts the STOCKWATER place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.

19E

14N



- Point of Diversion
- Place Of Use Boundary
- Townships
- PLS Sections
- Quarter Quarters

0 0.035 0.07 0.14 Miles



IDAHO DEPARTMENT OF WATER RESOURCES WELL DRILLER'S REPORT

1. WELL TAG NO. D 0051559

Drilling Permit No. **851376**

Water right or injection well # **72-16699/application 904384**

2. OWNER

Name **Travis Bullock**

Address **PO Box 1188**

City **Challis**

State **ID**

Zip **83226**

3. WELL LOCATION:

Twp. **14** North ☒ or South ☐ Rge. **19** East ☒ or West ☐

Sec. **10** 1/4 **se** 1/4 **nw** 1/4
10 acres 40 acres 160 acres

Gov't Lot

County **Custer**

Lat. **44 ° 33' 33N** (Deg. and Decimal minutes)

Long. **114 ° 12' 19W** (Deg. and Decimal minutes)

Address of Well Site **127 Stephens Rd**

City **Challis**

(Show at least one of road, distance to road or landmark)

Lot. Blk. Sub. Name

4. USE:

☐ Domestic ☐ Municipal ☐ Monitor ☒ Irrigation ☐ Thermal ☐ Injection
☐ Other

5. TYPE OF WORK check all that apply

(Replacement etc.)

☒ New Well ☐ Replacement well ☐ Modify existing well
☐ Abandonment ☐ Other

6. DRILL METHOD:

☒ Air Rotary ☐ Mud Rotary ☐ Cable ☐ Other

7. SEALING PROCEDURES

Seal material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method/procedure
 bentonite 	 0 	 20 	 750 	 overbore
 grout/cement 	 150 	 240 		 grout pump

8. CASING/LINER:

Diameter (nominal)	From (ft)	To (ft)	Gauge/Schedule	Material	Casing	Liner	Threaded	Welded
 8 	 +1 	 180 	 .250 	 steel 	☒	☐	☐	☒
 6 	 +1 	 240 	 .250 	 steel 	☒	☐	☐	☒

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s)

9. PERFORATIONS/SCREENS:

Perforations ☐ Y ☒ N Method

Manufactured screen ☐ Y ☒ N Type

Method of installation

From (ft)	To (ft)	Slot size	Number/ft	Diameter (nominal)	Material	Gauge or Schedule

Length of Headpipe

Length of Tailpipe

Packer ☐ Y ☐ N Type

10. FILTER PACK:

Filter Material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method

11. FLOWING ARTESIAN:

Flowing Artesian? ☐ Y ☒ N Artesian Pressure (PSIG)

Describe control device

12. STATIC WATER LEVEL and WELL TESTS:

Depth first water encountered (ft) **60** Static water level (ft) **18**

Water temp. (°F) **97 degrees** Bottom hole temp. (°F) **97 degrees**

Describe access port **sanitary well seal**

Well test:

Drawdown (feet)	Discharge or yield (gpm)	Test duration (minutes)
324	100	8 hours

Test method:

Pump	Bailer	Air	Flowing artesian
☐	☐	☒	☐

Water Quality test or comments:

13. LITHOLOGIC LOG and/or repairs or abandonment:

Bore Dia. (in)	From (ft)	To (ft)	Remarks, lithology or description of repairs or abandonment, water temp.	Water	
				Y	N
12	0	2	top soil		x
	2	20	brown clay rock		x
8	20	30	boulders		x
	30	50	brown shale clay		x
	50	60	brown shale		x
	60	95	brown clay wet	x	
	95	130	broken shale		x
	130	178	tan clay hard		x
	178	220	grey hard rock		x
	220	235	brown red rock		x
	235	250	dark brown hard rock		x
	250	260	brown hard rock	x	
	260	324	grey hard rock		x

RECEIVED

JUL 08 2008

DEPT. OF WATER RESOURCES
SOUTHERN REGION

Completed Depth (Measurable)

324'

Date: Started **5/13/2008**

Completed **6/23/2008**

14. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name **Harber Drilling Inc**

Co. No. **430**

*Principal Driller **Alan Harber**

Date **6/27/2008**

*Driller

Date **6/27/08**

*Operator II

Date

Operator I

Date **6/27/2008**

* Signature of Principal Driller and rig operator are required.



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REPRINT
Customer Copy

Number	129203
Date	09/09/09
Page	1

Ship To: TEMP	H & D STEEL c/o MOLE HIGH OUTFITTERS 127 STEPHENS RD. CAHLIS, ID 83226	Bill To: 9994	CASH SALES ASHLAND ASHLAND , OH 44805
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Reference #	Ordered	Requested	Ship	Terms	Wh	Freight	Ship Via
	08/24/09	ASAP	20	NET 10TH	04	PREPAID	NONE

Ln	Item Description	Ordered	Ship	Back	UM	Weight	Lot
9	63 6T15-115 15 HP, 115 GPM PUMPF Price: 1705.560 EA	1			EA	217.0	NONSKE
10							
11	ORDERED FROM						
12	P.E. MYERS PO #22586						

RETAIL
19274.03

PAID
 CEN 3125 9-9-09

PLUS FREIGHT
AND UPS CHARGE
TOTAL 9187.00

PD CK NO 3125
98808.41

TOTAL 9187.00 PLUS FREIGHT 378.37

Extension Tot: 1705.56 (Less Tax + Frt) Total Weight: 217.0

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Number 228095

Date 09/09/09

Page 1

Ship To: TEMP	H & D STEEL c/o MILE HIGH OUTFITTERS 127 STEPHENS RD. CABILLIS, ID 83226	Est. No. 99974	CASH SALES ASHLAND ASHLAND , OH 44805
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Reference #	Ordered	Requested	SSP	Terms	WA	Freight	Ship Via
	08/13/09	ASAP	20	NET 10TH	04	PREPAID	NONE

Ln	Item	Description	Ordered	Ship	Back	UM	Weight	Loc
1	63	6HIT2-15-1 15HP 230V 1PH MOTOR Price: 1175.230 EA	1			EA	154.0	NONSTK
2	64	U17-1286R TRANSDUCER Price: 108.110 EA	1			EA	1.0	NONSTK
3	64	U18-1595 50' TRANSDUCER CABLE Price: 92.270 EA	1			EA	1.0	NONSTK
4	63	PPC5-2-88A-1 PENTEK CONTROLLER Price: 4616.200 EA	1			EA	53.0	NONSTK
5	63	KLC45BE 230V FILTER Price: 811.300 EA	1			EA	18.0	NONSTK
6								
7								
8		PLEASE ORDER FROM F.E. MYERS						

PAID
CR NO 3126
9-9-09

PLUS FREIGHT

Extension Tot:

6803.11

(Less Tax + Frt)

Total Weight:

227.0

DUAL VOLTAGE SUBMERSIBLE MOTOR HITACHI

TYPE	VCTI	H.P.	15	15	15	15	15
FORM	KK	VOLTS	460/230	380	380	400	415
PHASE	3	HERTZ	60	60	50	50	50
POLES	2	min ⁻¹	3450	3400	2830	2840	2850
RATING	S1	AMP'S	21/42	28	25	25	25
TEMP. RISE	80 K	CODE	K	F	H	J	K
AMB. TEMP.	35°C	S.F.	1.15	1.0	1.0	1.0	1.0
DATE	6.11	S.F.A.	23/46				
		MFG. NO.					625838F

Hitachi Industrial Equipment
Systems Co., Ltd.

HD200000

RP14N19E101211 Property Detail

Taxes, Levies and Assessments for 2019			
Land and Property Ownership - Physical Address: 127 STEPHENS RD (zip code 83226)			
Mailing Address: BULLOCK, TRAVIS & BULLOCK, BRENDA PO BOX 1189 CHALLIS, ID 83226 Deeds (Last Deed Date: 06/14/2002) 225039 224611-13 212205 193880 Legal Description: TRACT 03-39 SEC 10 T14N R19E Tax Code Area: 110000 Classes (Last appraised in 2018) RURAL RES TR 1.000 AC \$ 14,750 RURAL RES TR 14.010 AC \$ 39,610 RURAL IMP ON AG \$ 14,620 BLDG RES TR \$ 228,640		Taxes for 2019 ASSESSED VALUE : \$ 298,020 TAX AND SPECIAL CHARGES: \$ 819.66 Taxing Districts Levy STATE 0.000000000 COUNTY 0.002351898 SCHL 181 LEVY 0.000000000 SCHL 181 TORT 0.000011493 SCHL 181 BOND 0.000000000 SCHL 181 PLANT 0.000081404 SCHL 181 SPLMT 0.000651231 CHALLIS CEM 0.000162214 NO. CUSTER FIRE 0.000486277 N. C. HOSP 0.000266616	
This information is provided as a courtesy to our taxpayers. If this parcel has changed code areas, or been split or combined with another parcel, the tax and assessment data shown may not apply or be current. For more information, please contact the appropriate county office.			
Improvement R03 Residential Dwelling			
Year Built : 2004 Total : 5248 sq. ft. Last Appraised : 2018 Stories : 3 Bedrooms : 4 Bathrooms : 2 (Click on photo to enlarge)			
Other Improvements			
R02 02 POLEBLDG 1372 sq. ft. R02 03 POLEBLDG 160 sq. ft. R02 04 GRNHSEFS 736 sq. ft. R03 G01 ATTGAR 1232 sq. ft.			

Method	#1	Chose a house efficiency factor (.28 - Best, .44 Better, .67 Average, 1.11 Poor)	1.11	BTU/hr ft ² - °F
	#1	Design temperature (Twin Falls = 73)	90	°F
	1&2	Area of heated space	768	ft ²
	#1	Single story = 1 Two story = 0.80	1	
	1&2	Geothermal source temperature	97	°F
	1&2	System Temperature, Home = 70 Greenhouse = 60	60	°F
	1&2	Degree Days (see degree days tab)	9,292	°F
	1&2	Greenhouse empirical correction factor, greenhouse = 0.85, other = 0	0.85	
		Heat load (pick value from table below)	76,723	BTU/hr

Heat load in BTU/hr				
Method	#1	Mathematically calculated	76,723	BTU/hr
	#2	Well Insulated	19,440	BTU/hr
		Normally Insulated	30,101	BTU/hr
		Older Homes	44,094	BTU/hr
		Double Poly	65,775	BTU/hr
		Single Poly	111,849	BTU/hr
		Fiberglass	123,618	BTU/hr
		Glass	151,406	BTU/hr

Volume of water required for heating	5.9	afa
--------------------------------------	-----	-----

Calculated value	Answer	Input value	Constant
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Heat Load

Explanation	BTU/hr required	House efficiency facto	Design terr	Area of live	Two story l
Additional info		.28 - Best, .44 Better, Twin falls i			If not a twc
units	BTU/hr	BTU/hr ft ² - °F	°F	ft ²	0.8
symbol	E	e	ΔT	A	0.8
Value	76723.2	1.11	90	768	
	$E = e \times \Delta T \times A \times 0.8 = 76723.2 \text{ BTU/hr}$				
	99.9 BTU/ft ² hr				

Temperature Drop Across System

Explanation	Temperature drop ac	Geothermal source te	Temperatu
Additional info		Temperature of water	Commonly
units	°F	°F	°F
symbol	ΔT _s	S	t
Value	11.1	97	60
	$\Delta T_s = 0.3 \times (S - t) = 11.1 \text{ °F}$		

* Estimating a Flow Rate for Geothermal Heating

Explanation	Flow Rate	System heat load	Temperatu	Caution: This calculation should not be used to design a geothermal heating system, but will give an indication of the approximate flow needed for a geothermal resource when applying for a water right. Value should not be used for licensing. An actual measurement from the system should be taken.
Additional info		See Heat Load Calcul	See Temp	
units	gpm	BTU/hr	°F	
symbol	W	Q	ΔT _s	
Value	13.8	76723.2	11.1	
	$W = Q / (500 \times \Delta T_s) = 13.8 \text{ gpm}$			

Peak heat required per square foot of floor area

Design temperature difference (inside design)		90
x	y	
84	184	197 BTU/hr
104	186	161 BTU/hr
110	178	146 BTU/hr
124	118	86 BTU/hr
116	74	57 BTU/hr
124	54	39 BTU/hr
128	36	25 BTU/hr

Emperical correction factor for heating effect vs. 65°F degree days

Degree Days	9292		
Degree days (x)	Factor $C_d + \sigma$	Factor C_d	Factor $C_d - \sigma$
0	1.2	0.86	0.51
5000	0.83	0.59	0.36
9000	0.92	0.66	0.4
y intercept for valu	0.71	0.51	0.31
If 0-5000 then	0.36		
If 5000-9000 then	0.67		
	0.67		
If greenhouse 0.85	0.85	0.85	

* Annual water requirement for geothermal heating

Explanation	Volume of Geotherm	Peak heating load	Annual he	Conversion	Emperical	Design temperatur	Correction fact	Constant	Temperature loss across system
Additional info			See table for degree d	Use 0.85 for greenhouses,				Units conversion factor	
units	afa	BTU/day	°F	hr/day	°F			BTU/af - °F	°F
symbol	V	HL	DD	24 C _D	ΔT ₁	k	C	ΔT ₂	
Value	5.9	76723.0	9292	24	0.85	90	0.9	2720000	11.1
	$V = (HL \times DD \times 24 \times C_D) / (\Delta T_1 \times k \times C \times \Delta T_2) = 5.9$								

Method	#1	Chose a house efficiency factor (.28 - Best, .44 Better, .67 Average, 1.11 Poor)	0.67	BTU/hr ft ² - °F
	#1	Design temperature (Twin Falls = 73)	90	°F
	1&2	Area of heated space	6,480	ft ²
	#1	Single story = 1 Two story = 0.80	0.8	
	1&2	Geothermal source temperature	97	°F
	1&2	System Temperature, Home = 70 Greenhouse = 60	70	°F
	1&2	Degree Days (see degree days tab)	8,196	°F
	1&2	Greenhouse empirical correction factor, greenhouse = 0.85, other = 0	0	
		Heat load (pick value from table below)	312,595	BTU/hr

Heat load in BTU/hr		
Method	#1	Mathematically calculated
	#2	Well Insulated
		Normally Insulated
		Older Homes
		Double Poly
		Single Poly
		Fiberglass
		Glass

Volume of water required for heating	22.5	afa
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Calculated value	Answer	Input value	Constant
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Heat Load

Explanation	BTU/hr required	House efficiency factor	Design temperature	Area of live	Two story home
Additional info		.28 - Best, .44 Better, .67 Average	Twin falls is 73		If not a two story
units	BTU/hr	BTU/hr ft ² - °F	°F	ft ²	0.8
symbol	E	e	ΔT	A	0.8
Value	312595.2	0.67	90	6480	0.8
$E = e \times \Delta T \times A \times 0.8 = 312595.2 \text{ BTU/hr}$					
48.2 BTU/ft ² hr					

Temperature Drop Across System

Explanation	Temperature drop across system	Geothermal source temperature	Temperature required
Additional info		Temperature of water from well	Commonly assumed
units	°F	°F	°F
symbol	ΔT _s	S	t
Value	8.1	97	70
$\Delta T_s = 0.3 \times (S - t) = 8.1 \text{ °F}$			

* Estimating a Flow Rate for Geothermal Heating

Explanation	Flow Rate	System heat load	Temperature drop	Caution: This calculation should not be used to design a geothermal heating system, but will give an indication of the approximate flow needed for a geothermal resource when applying for a water right. Value should not be used for licensing. An actual measurement from the system should be taken.
Additional info		See Heat Load Calculation	See Temperature Drop	
units	gpm	BTU/hr	°F	
symbol	W	Q	ΔT _s	
Value	77.2	312595.2	8.1	
$W = Q / (500 \times \Delta T_s) = 77.2 \text{ gpm}$				

Peak heat required per square foot of floor area

	Design temperature difference (inside design temp - outside design temp)		90
	x	y	
Glass	84	184	197 BTU/hr
Fiberglass	104	186	161 BTU/hr
Single Poly	110	178	146 BTU/hr
Double Poly	124	118	86 BTU/hr
Older Homes	116	74	57 BTU/hr
Normally Insulated	124	54	39 BTU/hr
Well Insulated	128	36	25 BTU/hr

Empirical correction factor for heating effect vs. 65°F degree days

Degree Days	8196		
Degree days (x)	Factor $C_d + \sigma$	Factor C_d	Factor $C_d - \sigma$
0	1.2	0.86	0.51
5000	0.83	0.59	0.36
9000	0.92	0.66	0.4
y intercept for value	0.71	0.51	0.31
If 0-5000 then	0.42		
If 5000-9000 then	0.65		
	0.65		
If greenhouse 0.85	0	0.65	

* Annual water requirement for geothermal heating

Explanation	Volume of Geothermal water required	Peak heating load	Annual heating degree days	Conversion factor	Empirical correction factor	Design temperature	Correction factor	Constant	Temperature loss across system
Additional info			See table for degree days	Use 0.85 for greenhouses,				Units conversion factor	
units	afa	BTU/day	°F	hr/day		°F		BTU/af - °F	°F
symbol	V	HL	DD	24 C _D	ΔT ₁	k	C	ΔT ₂	
Value	22.5	312595.0	8196	24	0.65	90	0.9	2720000	8.1
$V = (HL \times DD \times 24 \times C_D) / (\Delta T_1 \times k \times C \times \Delta T_2) = 22.5$									