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STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

DEPARTMENT OF WATER RESOURCES

BENEFICIAL USE FIELD REPORT

A. GENERAL INFORMATION

Permit No.: 01-10542

1. Owner: BRP, Inc.

Phone No.: (208) 529-9891

Current Address: P.O. Box 1768, Idaho Falls, ID 83403

2. Accompanied by: Doyle Beck

Exam Date: 9/4/2009

Address: Same

Phone No.: Same

Relationship to Permit Holder: Owner

3. Source: Snake River tributary to Columbia River

B. OVERLAP REVIEW

1. Other water rights with the same place of use: 01-7103

2. Other water rights with the same point of diversion: 01-7103

C. DIVERSION AND DELIVERY SYSTEM

1. Point(s) of Diversion:

[illegible]

2. **Place(s) of Use:**

Indicate Method of Determination: Aerial mapping

[illegible]

3. **Delivery System Diagram:** Indicate all major components and distances between components. Indicate weir size/ ditch size/ pipe i.d. as applicable.

See Attached Grid sheet

- ☒ Copy of USGS Quadrangle attached showing location(s) of point(s) of diversion and place(s) of use (*required*).
☒ Aerial photo attached (*required for irrigation of 10+ acres*).
☒ Photo of diversion and system attached.

4.

Well or Diversion Identification No.*	Motor Make	Hp	Motor Serial No.	Pump Make	Pump Serial No. or Discharge Size
N/A					

D. FLOW MEASUREMENTS

1.

Measurement Equipment	Type	Make	Model No.	Serial No.	Size	Calibration
Current meter	Pygmy	n/a	n/a		n/a	New 9-09

2. Measurements: See attached narrative
- _____
- _____
- _____

E. NARRATIVE / REMARKS / COMMENTS

See attached narrative

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

F. FLOW CALCULATIONS

☒ Additional Computation Sheets Attached

Measured Method: See narrative

G. VOLUME CALCULATIONS

1. Volume Calculations for Irrigation:

$V_{I.R.} = (\text{Acres Irrigated}) \times (\text{Irrigation Requirement}) =$ _____

$V_{D.R.} = [\text{Diversion Rate (cfs)}] \times (\text{Days in Irrigation Season}) \times 1.9835 =$ _____

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

2. Volume Calculations for Other Uses:

Continuous flow: 25.8 cfs x 365 days x 1.9835 = 18,679 ac-ft

H. RECOMMENDATIONS

1. Recommended Amounts

Beneficial Use	Period of Use		Rate of Diversion Q (cfs)	Annual Volume V (afa)
	From	To		
<u>Recreation</u>	<u>1/1</u>	<u>12/31</u>	<u>25.8</u>	<u>18,679</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
TOTALS:			_____	_____

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 ☐ Other

I. AUTHENTICATION

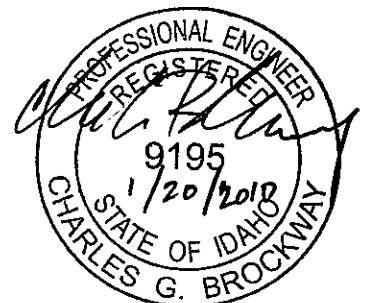
Field Examiner's Name: Charles G. Brockway

Date: 1/20/2010

Reviewer: _____

Date: _____

SEAL



Beneficial Use Exam Narrative
Water Right 01-10542
BRP, Inc.

C. G. Brockway, P.E.
January 20, 2010

A beneficial use field exam was conducted for permit 01-10542. The exam took place on September 4, 2009. Doyle Beck, the president of BRP, Inc. was on-site to explain the diversion system and assist with measurements.

This permit authorizes diversion of 25.8 cfs of water from the Snake River for non-consumptive purposes in Gem Lake Harbor, south of Idaho Falls. Gem Lake Harbor is the remnant of an old gravel pit which is located directly adjacent to the river on the east side, and naturally fills with water. A subdivision has been platted around the harbor, which is used for recreational purposes including boating. This waterway was the subject of permit 01-7103, which was recently licensed for 1.0 cfs. Since the harbor naturally fills, IDWR has determined in the course of evaluating permit 01-7103 that no additional consumptive use would occur due to the diversion of water under either 01-7103 or 01-10542. Both of these rights authorize "flow through" water only, and no storage is authorized.

Diversion is accomplished via a 42" Waterman C-10 canal gate mounted on a concrete headwall. A 40-foot length of 36-inch reinforced concrete pipe discharges to the harbor. The diversion is located within the pool created by Gem State Dam 3.2 miles downstream. The type and diameter of pipe was verified in the field, and the inside diameter confirmed to be exactly 36 inches. Return to the Snake River is uncontrolled and occurs approximately 0.7 miles downstream of the diversion.

The water surface is nearly flat, and the flow velocity very low. The water depth is affected both by the amount of flow diverted to the waterway, and also by backwater from the Snake River at the return flow point.

Operationally, the headgate remains open at all times, and the flow rate entering the waterway is governed by the water level in the river at the headgate and the backwater level. The river level is regulated to some extent by Gem State Dam, but does fluctuate over a range of approximately 2 feet based on water marks on the concrete headwall.

The diversion rate can be accurately measured by current meter only at a box culvert bridge located 0.25 miles downstream from the inlet. At all other points, the waterway is much too wide, deep, and slow to allow a current meter measurement. At the box culvert, the flow is restricted to a width of 16 feet, and velocities are large enough to be measured with a pygmy meter.

Due to the extremely low slope of the water surface, there is no opportunity at any point to install a measuring device such as a flume or weir. It was determined in the course of

applying for permit 01-10542 that a rating could be developed for the diversion culvert based on the head drop across the culvert. A theoretical curve was developed, which was to be checked with discharge measurements. This approach requires two staff gauges set at exactly the same elevation, one upstream in the pool above the headgate, and one downstream just below the outlet of the concrete pipe.

At the time of the exam, the downstream gauge had been installed on a steel post and appears to be adequately stable. On the upstream side, a steel post was driven into the channel bottom, and a gauge set precisely using an automatic level. The water surface difference at this time was 0.08 feet. Both gauges are Type C devices.

The discharge was measured once prior to the permit issuance, and once during the beneficial use exam. Field notes for these measurements are attached. The quality rating for both measurements was good to excellent, and the measurements should be accurate to within 5% or better. On 9/4/09 an attempt was made to current meter the velocity distribution in the outlet of the concrete pipe. This approach yielded a flow rate about 9% greater, but the accuracy is suspect. The following table shows the discharge measurements, along with river levels at the headgate and the river discharge and stage at an upstream USGS gauge.

Date	Discharge (cfs)	Avg. Velocity (ft/s)	River level from top of headwall (ft)	Culvert dH (feet)	Snake River flow (cfs)*	Snake River stage (ft)*
6/21/07	10.63	0.21	3.71	0.14 Surveyed	5260	6.66
9/4/09	9.46	0.19	3.74	0.08 Surveyed and gauge set	4730	6.46

* USGS gauge 13060000

Data from the USGS streamflow gauge 13060000, located 5.0 miles downstream of Gem Lake Harbor, indicates that the daily flow for the 20-year period from 1990 through 2009 had a mean of 5573 cfs, a median of 4310 cfs, and a standard deviation of 4555 cfs. Thus, the 6/21/07 and 9/4/09 measurements were made during a period of approximately average flow in the river, and the capacity of the headgate and culvert would be greater at higher river stage. See attached plot.

A memo contained in the 01-10542 file by Brockway Engineering dated 8/10/2007 explains the development of the theoretical rating curve for the culvert with the headgate fully open. The curve is based on the assumption that the flow rate varies with the square root of the head differential, as predicted by the Darcy-Weisbach friction equation and the orifice equation. Therefore,

$$Q = KH^{1/2}$$

The value of K was determined to be 28.41 based on the 6/21/07 measurement, and the theoretical curve was extended to predict a maximum capacity. When the river discharge increases, the water level at the headgate will increase, which tends to increase the head differential and discharge across the culvert. At the same time the backwater effect from the river at the return point will increase the level in the harbor and tend to decrease the discharge. Based on "normal" high water marks on the concrete headwall and on the box culvert, a reasonable maximum estimate of the head differential was 0.89 feet, corresponding to a system capacity of 26.8 cfs (see the 8/10/2007 memo). The 9/4/09 flow measurement does not disconfirm the theoretical curve, and in fact may indicate a slightly higher K value and therefore a higher diversion capacity at high levels in the Snake River.

The attached plot shows the theoretical curve and the two measurements of diversion rate & head differential made to date. Because the two measurements were made during below-average conditions in the river, the theoretical curve could be better confirmed with at least two additional points: one with a head differential between 0.3 and 0.5, and one with a head differential greater than 0.6, or when the river discharge is above 11,000 cfs which is the 90th percentile daily value. These two points should then be used to adjust the curve to develop a final rating curve. If needed, Brockway Engineering intends to obtain the additional flow measurements in the spring of 2010 or when river levels are at appropriate levels.

In summary, the analysis indicates that the system capacity is at least equal to the diversion rate of 26.8 cfs allowed under 1-7103 and 1-10542. Actual diversion rates at the headgate since permit 1-10542 was approved in 2007 have not been systematically recorded. However, both 2008 and 2009 were very high water years. The peak daily discharge in the Snake River near Shelley was 18,600 cfs in 2008 (97th percentile) and 26,700 cfs in 2009 (>99th percentile). During these two events, river stage at the Gem Lake headgate likely equaled, or perhaps exceeded, the high water marks used for the system capacity determination. Therefore, it is highly likely that the system actually diverted at least 26.8 cfs during the permit period.

The annual volume diverted under this right will vary each year depending on the hydrograph of the river stage at the headgate. No data is available on historic stage at this location – which is regulated by Gem State Dam – that could be used to estimate a stage hydrograph. Stage data is available at the nearest upstream USGS gauge (Snake River at Eagle Rock), but the river level at the headgate is tightly controlled by Gem State Dam, reducing the range considerably. The range of stage at the Eagle Rock gauge and the Shelley gauge has typically been 5 to 6 feet, but water marks on the headwall at the diversion indicate a range less than 2 feet. For example, between the two known data points on 6/21/07 and 9/4/09, the stage at the USGS gauges varied by about 0.35 feet while the river level at the headgate varied by just 0.03 feet.

A conservative approach would be to license the water right for a volume assuming the diversion rate of 25.8 cfs flows continuously for 365 days per year. This would equate to 18,679 ac-ft. There would be no adverse impact of licensing the right for this volume, since it is a flow-through right with no consumptive component. The additional data to be collected in the spring of 2009 may provide information on range of levels that could be used to refine the diversion volume number.

If IDWR will accept the theoretical rating curve as presented in this report, the water right should be licensed immediately. If it is determined that additional data are needed, IDWR should defer final licensing of water right 01-10542 until the additional data described above can be collected, analyzed, and a final rating curve determined.

CURRENT METER CALCULATIONS

Brockway Engineering, PLLC

LOCATION:	Gem Lake Harbor- upstream side of only bridge.	TIME START:	~ 1:00 PM
DATE:	6/21/2007	TIME END:	~ 3:30 PM
HYDROGRAPHER:	ZL	GAUGE START:	-
METER:	Pygmy	GAUGE END:	-
MEASUREMENT NO.:	1 of 1		
REMARKS:	Current metering was done on upstream edge of bridge.		

STAFF GAUGE READING (ft): none
TIME OF STAFF GAUGE READING: N/A

SECT.	DIST. DEPTH		REV	REV	TIME	ANG.	V1	V2	V	BuRec method:		
										SECT.	DELTA	SUM Q
			.6-.2	.8	SEC	CORR.				AREA	Q	
1-Wall	0.43	1.50	0	3	50	1.000	0.00	0.06	0.03	0.49	0.01	0.00
2	1.00	2.40	1	8	50	1.000	0.02	0.16	0.09	1.88	0.17	0.17
3	2.00	2.80	4	13	50	1.000	0.08	0.26	0.17	2.80	0.48	0.65
4	3.00	2.70	5	13	50	1.000	0.10	0.26	0.18	2.70	0.49	1.13
5	4.00	3.20	11	15	50	1.000	0.22	0.30	0.26	3.20	0.83	1.96
6	5.00	3.30	11	17	50	1.000	0.22	0.34	0.28	3.30	0.92	2.89
7	6.00	3.30	7	14	50	1.000	0.14	0.28	0.21	3.30	0.69	3.58
8	7.00	3.30	13	19	50	1.000	0.26	0.38	0.32	3.30	1.06	4.64
9	8.00	3.35	13	17	50	1.000	0.26	0.34	0.30	3.35	1.01	5.64
10	9.00	3.35	6	14	50	1.000	0.12	0.28	0.20	3.35	0.67	6.31
11	10.00	3.35	12	16	50	1.000	0.24	0.32	0.28	3.35	0.94	7.25
12	11.00	3.35	12	17	50	1.000	0.24	0.34	0.29	3.35	0.97	8.22
13	12.00	3.35	5	16	50	1.000	0.10	0.32	0.21	3.35	0.70	8.92
14	13.00	3.40	2	16	50	1.000	0.04	0.32	0.18	3.40	0.61	9.54
15	14.00	3.20	0	13	50	1.000	0.00	0.26	0.13	3.20	0.42	9.95
16	15.00	3.10	0	12	50	1.000	0.00	0.24	0.12	3.10	0.37	10.32
17	16.00	2.85	1	11	50	1.000	0.02	0.22	0.12	2.19	0.26	10.59
18-Wall	16.54	1.45	2	4	50	1.000	0.04	0.08	0.06	0.49	0.03	10.62

AVG. VEL.	0.21	FPS
AREA	50.11	SQ FT
TOTAL DISCHARGE	10.63	CFS

*CALIBRATION		
FOR N(REV/T)<	0.68 V=	1.00 *N+
FOR N(REV/T)>	0.68 V=	1.00 *N+

CURRENT METER CALCULATIONS

Brockway Engineering, PLLC

LOCATION: Gem Lake diversion at box culvert bridge
 DATE: 9/4/2009
 HYDROGRAPHER: CGB
 METER: Pygmy
 MEASUREMENT NO.: 1
 REMARKS:

TIME START: 10:50 AM
 TIME END: 11:40 AM
 GAUGE START:
 GAUGE END:

											BuRec method:		
SECT.	DIST.	DEPTH	REV .6-.2	TIME SEC	REV .8	TIME SEC	ANG. CORR.	V1	V2	V SECT.	DELTA AREA	DELTA Q	SUM Q
1-Wall	3.00	2.70	0	50	0	50	1.00	0.00	0.00	0.00	1.39	0.00	0.00
2	4.00	2.98	3	50	4	50	1.00	0.06	0.08	0.07	2.98	0.21	0.21
3	5.00	3.04	2	50	13	50	1.00	0.04	0.26	0.15	3.04	0.46	0.66
4	6.00	3.23	4	50	13	50	1.00	0.08	0.26	0.17	3.23	0.55	1.21
5	7.00	3.27	5	50	16	50	1.00	0.10	0.32	0.21	3.27	0.69	1.90
6	8.00	3.25	7	56.4	14	51.6	1.00	0.12	0.27	0.20	3.25	0.64	2.54
7	9.00	3.27	11	53.4	16	52.4	1.00	0.21	0.31	0.26	3.27	0.84	3.38
8	10.00	3.20	15	52.6	16	52.5	1.00	0.29	0.30	0.29	3.20	0.94	4.32
9	11.00	3.28	9	50.9	15	52.6	1.00	0.18	0.29	0.23	3.28	0.76	5.08
10	12.00	3.26	6	53.6	17	52.2	1.00	0.11	0.33	0.22	3.26	0.71	5.79
11	13.00	3.25	5	58	14	52.2	1.00	0.09	0.27	0.18	3.25	0.58	6.37
12	14.00	3.25	5	56.8	15	50	1.00	0.09	0.30	0.19	3.25	0.63	7.00
13	15.00	3.19	6	54.6	15	51.1	1.00	0.11	0.29	0.20	3.19	0.64	7.64
14	16.00	2.95	12	52.8	15	50.4	1.00	0.23	0.30	0.26	2.95	0.77	8.42
15	17.00	2.75	10	51	15	51.8	1.00	0.20	0.29	0.24	2.75	0.67	9.09
16	18.00	2.63	5	58.9	10	53.6	1.00	0.08	0.19	0.14	2.76	0.37	9.46
17-Wall	19.10	2.52	0	50	0	50	1.00	0.00	0.00	0.00	1.40	0.00	9.46

AVG. VEL. 0.19 FPS
 AREA 49.72 SQ FT
 DISCHARGE 9.46 CFS

*CALIBRATION
 FOR N(REV/T)< 0.68 V= 1.00 *N+ 0
 FOR N(REV/T)> 0.68 V= 1.00 *N+ 0

DISC GAGE MEASUREMENT - CURRENT METER

Client: <u>Doyle Beck - Buckco Construction</u>			Project: <u>Green Lake Harbor</u>			
Party: <u>2L</u>			Meter:			
Location: <u>Upstream side of bridge abutment - see pics</u>						
Location (numeric)		Meter Code	Date	Gage Start	Gage End	
<u>1 / Bridge</u>		<u>2</u>	<u>6/21/07</u>			
Sec. #	Distance (ft)	Depth (ft)	Rev. 6 or 2	Rev. 0.8	Time (sec)	Angle Correction
1	<u>0.43</u>				<u>50</u>	
2	<u>0.50</u>	<u>1.5'</u>	<u>0</u>	<u>3</u>		
3	<u>1.00'</u>	<u>2.4'</u>	<u>1</u>	<u>8</u>		
4	<u>2.0'</u>	<u>2.80'</u>	<u>4</u>	<u>13</u>		
5	<u>3.0'</u>	<u>2.70'</u>	<u>5</u>	<u>13</u>		
6	<u>4.0'</u>	<u>3.20'</u>	<u>11</u>	<u>15</u>		
7	<u>5.0'</u>	<u>3.30'</u>	<u>11</u>	<u>17</u>		
8	<u>6.0'</u>	<u>3.30'</u>	<u>7</u>	<u>14</u>		<u>Rock?</u>
9	<u>7.0'</u>	<u>3.30'</u>	<u>13</u>	<u>19</u>		
10	<u>8.0'</u>	<u>3.35'</u>	<u>13</u>	<u>17</u>		
11	<u>9.0'</u>	<u>3.35'</u>	<u>6</u>	<u>14</u>	<u>upstream wind</u>	
12	<u>10.0'</u>	<u>3.35'</u>	<u>12</u>	<u>16</u>		
13	<u>11.0'</u>	<u>3.35'</u>	<u>12</u>	<u>17</u>		
14	<u>12.0'</u>	<u>3.35'</u>	<u>5</u>	<u>16</u>	<u>2 times @ same loc.</u>	
15	<u>13.0'</u>	<u>3.40'</u>	<u>2</u>	<u>16</u>		
16	<u>14.0'</u>	<u>3.20'</u>	<u>0</u>	<u>13</u>		
17	<u>15.0'</u>	<u>3.10'</u>	<u>0</u>	<u>12</u>		
18	<u>16.0'</u>	<u>2.85'</u>	<u>1</u>	<u>11</u>		
19	<u>16.45'</u>	<u>1.45'</u>	<u>2</u>	<u>4</u>		
20	<u>16.54'</u>					
21						
22						
23						
24						
25						

Meter Codes: 1 = TYPE AA, 2 = PYGMY, 3 = OTT 47966

Remarks:

2L Bridge

RP Bridge

90

92

94

96

7

0

FIELD RECORD FORM

Page of



BROCKWAY
ENGINEERING
P.L.L.C.

Hydraulics
—
Hydrology
—
Water Resources

2016 NORTH WASHINGTON STREET • SUITE 4
TWIN FALLS, IDAHO 83301
208 • 736 • 8543 FAX 736 • 8506

Client: BRP / BCLCO

Project:

Location: Gem Lake division

Date: 9/4/09

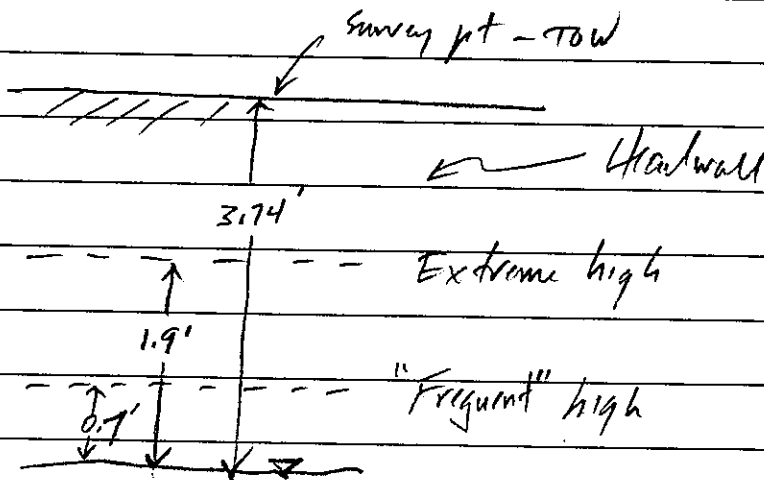
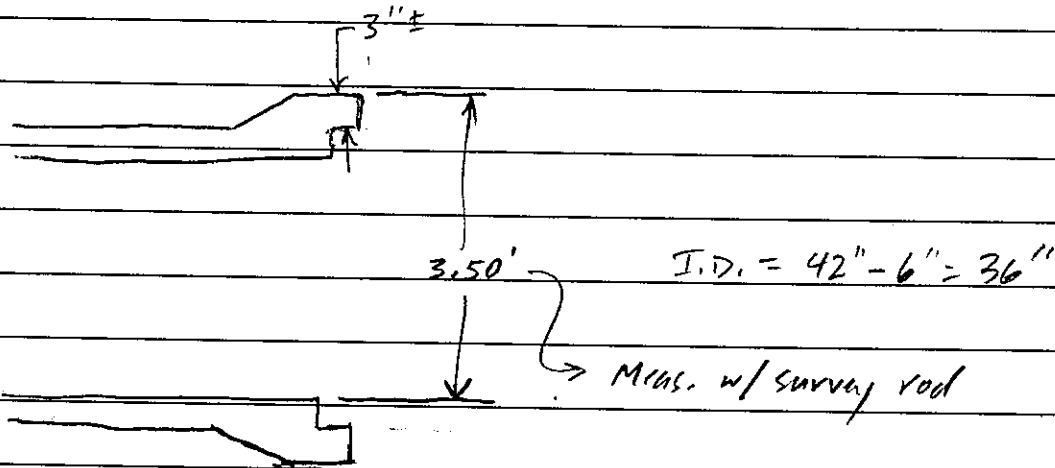
Logged by: OLB

Weather:

Time

FIELD NOTES – DESCRIPTION OF WORK

Headgate is 42" waterman C-10 to a 36" concrete bell & spigot pipe. Bell end faces downstream, disch. to pond:



Culvert Rating Table

PRELIMINARY

Brockway Engineering, PLLC 11/17/09

LOCATION / OWNER:

Gem Lake Harbor - Diversion Culvert
BRP, Inc.

Water Rights 01-10542 and 01-7103

DATE OF TABLE:

11/17/2009

DESCRIPTION:

Concrete headwall, 42" C-10 gate, 40-foot steel pipe culvert, 36" diameter.
Inlet flush with headwall, outlet projecting through fill, both ends submerged.
Rating equation is based on head differential across culvert, submerged conditions, and headgate fully open.

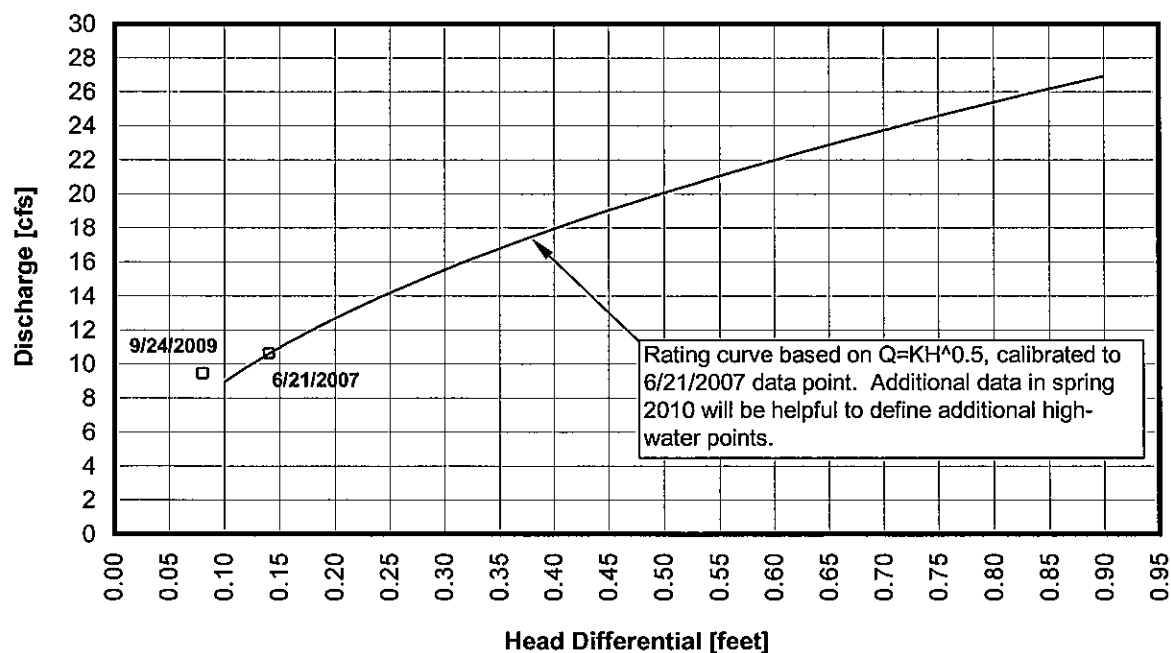
EQUATION:

$Q = K \Delta H^{(1/2)}$, where K = total head loss coefficient.
K = 28.41, calibrated with measured flow and head, agrees w/ theoretical.
Rating should be considered preliminary until additional measurements taken.
See Brockway Engineering memo dated 8/10/07 in 01-10542 file.

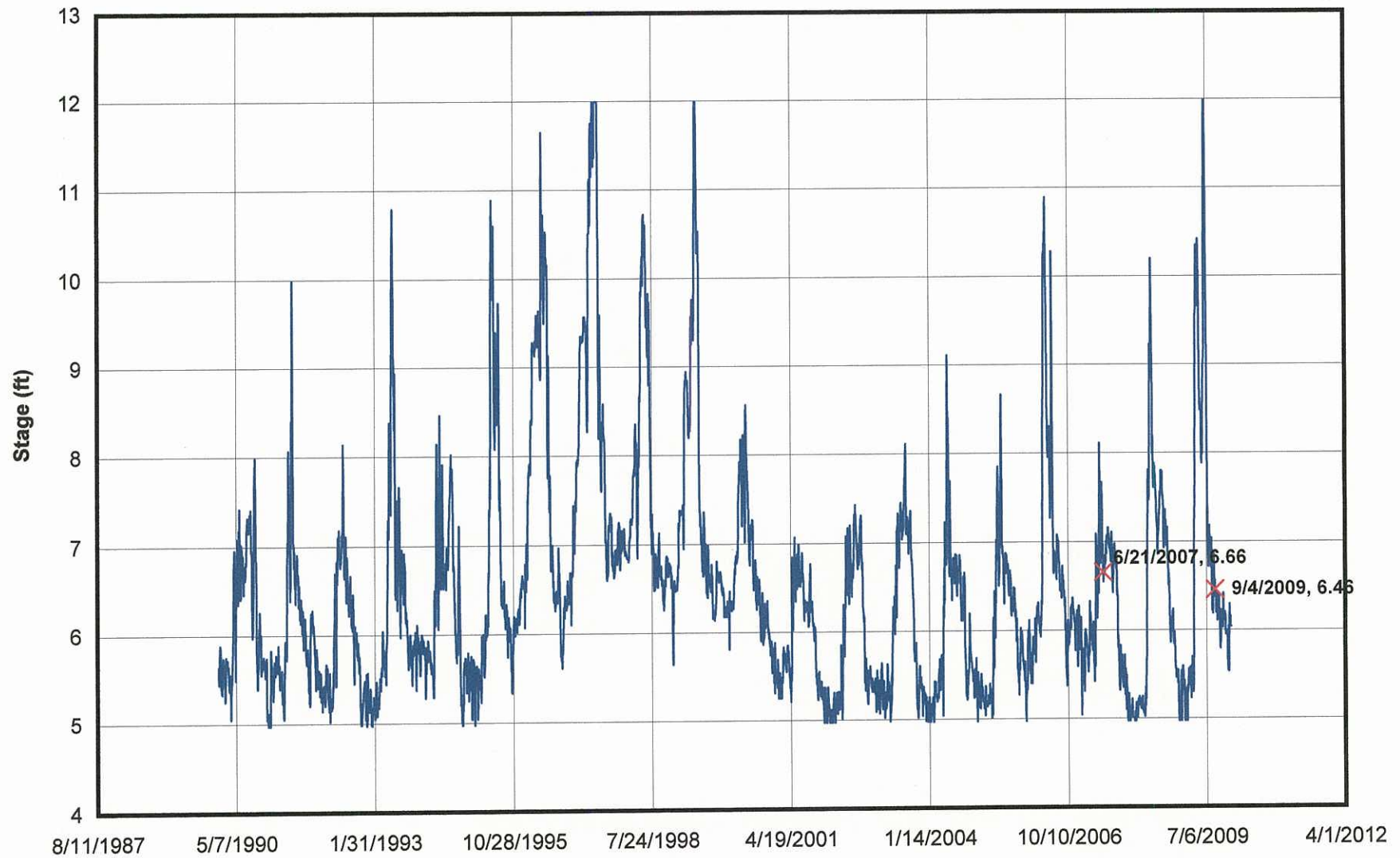
DISCHARGE IN CUBIC FEET PER SECOND

Note: Valid only for submerged conditions and headgate fully open

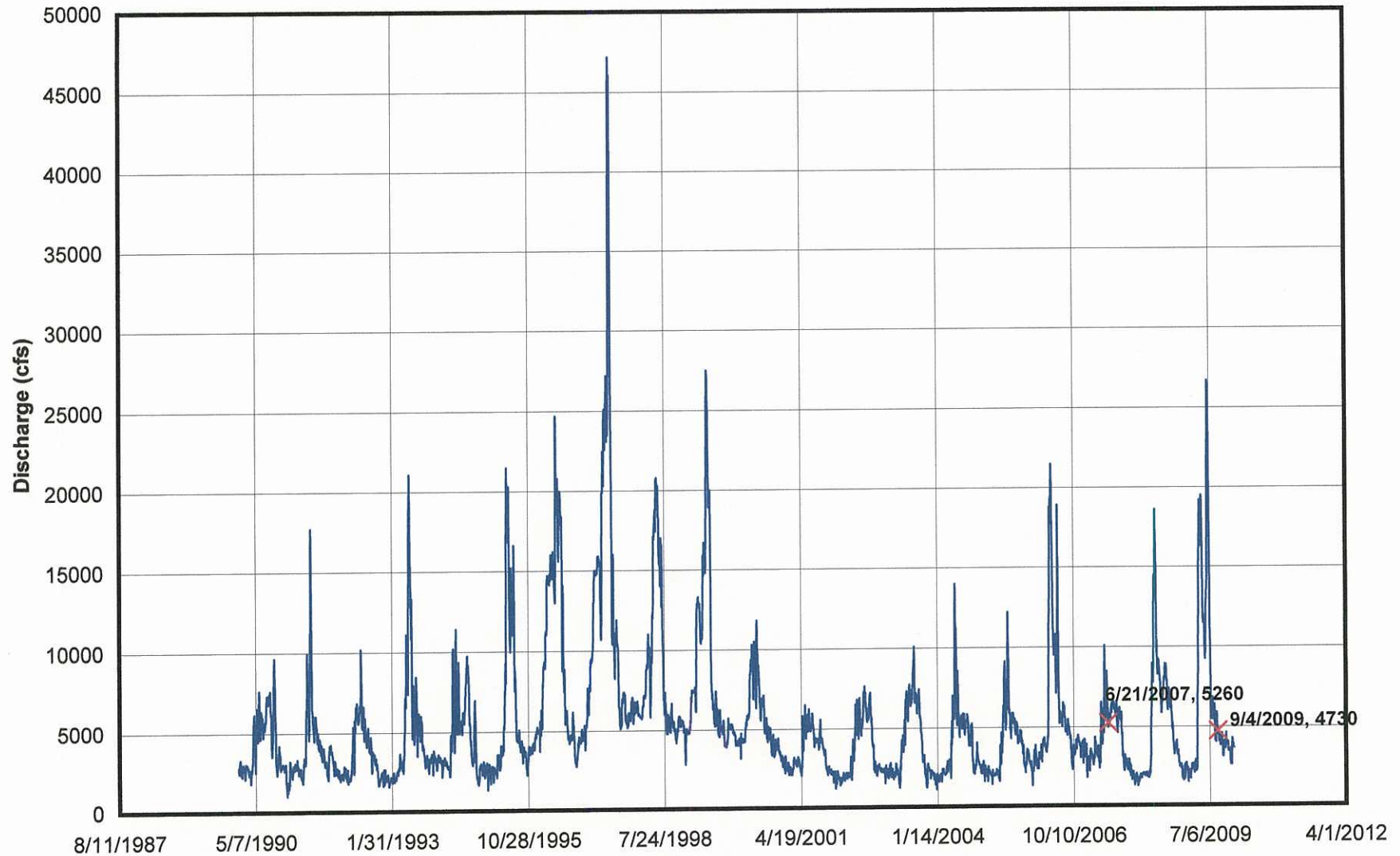
ΔH [feet]	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.1	9.0	9.4	9.8	10.2	10.6	11.0	11.4	11.7	12.1	12.4
0.2	12.7	13.0	13.3	13.6	13.9	14.2	14.5	14.8	15.0	15.3
0.3	15.6	15.8	16.1	16.3	16.6	16.8	17.0	17.3	17.5	17.7
0.4	18.0	18.2	18.4	18.6	18.8	19.1	19.3	19.5	19.7	19.9
0.5	20.1	20.3	20.5	20.7	20.9	21.1	21.3	21.4	21.6	21.8
0.6	22.0	22.2	22.4	22.5	22.7	22.9	23.1	23.3	23.4	23.6
0.7	23.8	23.9	24.1	24.3	24.4	24.6	24.8	24.9	25.1	25.3
0.8	25.4	25.6	25.7	25.9	26.0	26.2	26.3	26.5	26.7	26.8



Snake River nr Shelley - Daily Stage



Snake River nr Shelley - Daily Flow



BRP, INC.
PERMIT 01-10542
T.02N R.37E SEC. 34, 35
2004 NAIP AERIAL PHOTO

Legend

- Point of Diversion
- sections

Beneficial Use Exam – Permit 1-10542



River side of diversion – 42" canal gate on concrete headwall



Staff gauge on river side

(Note: steel post could not be driven plumb due to rocks in channel; however gauge was set plumb)



Outlet of 36" reinforced concrete pipe



Staff gauge downstream of concrete pipe culvert

Beneficial Use Exam – Permit 1-10542



View of Gem Lake Harbor looking downstream from diversion area



Upstream side of box culvert bridge – measuring point

Beneficial Use Exam – Permit 1-10542



Gem Lake Harbor looking northeast from return point



Return point to Snake River (flow entering from lower right)