

State of Idaho
Department of Water Resources
Water Right License

WATER RIGHT NO. 45-07746

Priority: May 09, 2000

Maximum Diversion Rate: 2.90 CFS
Maximum Diversion Volume: 9.5 AF

It is hereby certified that HEIDI F MATTHEWS
And

E EUGENE MATTHEWS
1249 S HWY 27

OAKLEY ID 83346

has complied with the terms and conditions of the permit, issued pursuant to Application for Permit dated April 13, 2000; and has submitted Proof of Beneficial Use on November 27, 2002. An examination confirms water is diverted from:

SOURCE

SPRING CREEK
MILL CREEK

Tributary: MILL CREEK
BIRCH CREEK

and a water right has been established as follows:

<u>BENEFICIAL USE</u>	<u>PERIOD OF USE</u>	<u>DIVERSION RATE</u>	<u>ANNUAL DIVERSION VOLUME</u>
DIVERSION TO STORAGE	03/15 to 11/15	2.90 CFS	
IRRIGATION STORAGE	01/01 to 12/31		9.5 AF
IRRIGATION FROM STORAGE	03/15 to 11/15		9.5 AF

LOCATION OF POINT(S) OF DIVERSION:

MILL CREEK	SE1/4NE1/4	Sec. 10,	Twp 14S,	Rge 23E, B.M.	CASSIA County
SPRING CREEK	SW1/4SE1/4	Sec. 3,	Twp 14S,	Rge 23E, B.M.	CASSIA County

PLACE OF USE: IRRIGATION STORAGE

Twp Rge Sec	NE				NW				SW				SE				Totals
	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
13S 23E 28															X		
14S 23E 3														X			

Total Acres: 684

PLACE OF USE: IRRIGATION FROM STORAGE

Twp Rge Sec	NE				NW				SW				SE				Totals
	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
13S 23E 20				32.0								35.0	32.0	35.0	32.0		166.0
13S 23E 21						40.0			40.0	40.0							120.0
13S 23E 28		34.0	33.0		33.0	11.0	5.5	34.0	38.0	29.0	35.0	35.0		36.0			323.5
13S 23E 29	4.4	35.0	39.0	38.0	34.0			35.0	35.0				40.0	36.0			296.4

Total Acres: 905.9

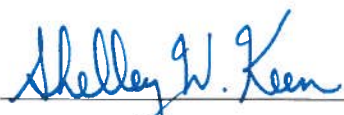
State of Idaho
Department of Water Resources
Water Right License
WATER RIGHT NO. 45-07746

CONDITIONS OF APPROVAL

1. The issuance of this right does not grant any right-of-way or easement across the land of another.
2. Use of water under this right will be regulated by a watermaster with responsibility for the distribution of water among appropriators within a water district. At the time of this approval, this water right is within State Water District No. 45A.
3. The right holder shall maintain a measuring device and lockable controlling works of a type approved by the Department in a manner that will provide the watermaster suitable control of the diversions.
4. This right is for the use of trust water, and it is subject to review 20 years after the date of permit approval to re-evaluate the availability of trust water for the authorized use and to re-evaluate the public interest criteria for reallocating trust water.
5. When the minimum stream flow water rights in the Snake River at Murphy Gage are not being satisfied, the right holder shall cease diverting water for the consumptive uses authorized by this right.
6. Rights 45-577A, 45-577B, 45-578A, 45-578B, 45-579A, 45-579B, 45-580A, 45-580B, 45-586, 45-587, 45-588, 45-600, 45-7746, 45-12927, 45-12929, and 45-14216 when combined shall not exceed a total diversion rate of 6.93 cfs.
7. Rights 45-577A, 45-577B, 45-578A, 45-578B, 45-579A, 45-579B, 45-580A, 45-580B, 45-586, 45-587, 45-588, 45-600, 45-24405, 45-2406, 45-2661, 45-7746, 45-12927, 45-12928, 45-12929, 45-12930, and 45-14216 when combined shall not exceed the irrigation of 527.2 acres.
8. This right is limited to the irrigation of 527.2 acres within the authorized place of use in a single irrigation season.
9. The two (2) ponds established by the storage of water under this right shall not exceed a total capacity of 9.5 acre-feet or a total surface area of 2.5 acres.

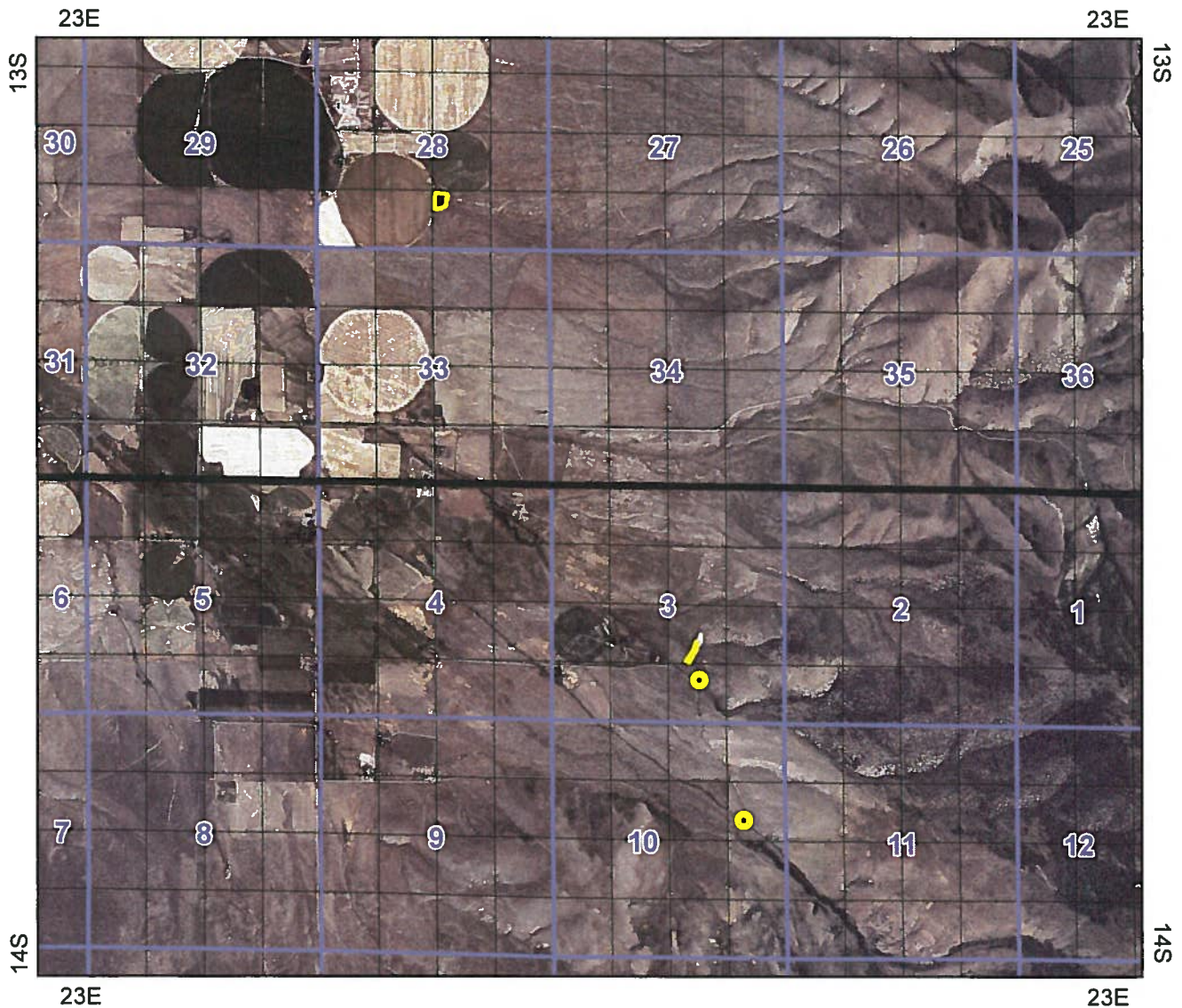
This license is issued pursuant to the provisions of Section 42-219, Idaho Code. The water right confirmed by this license is subject to all prior water rights and shall be used in accordance with Idaho law and applicable rules of the Department of Water Resources.

Signed this 18th day of November, 2015.


for GARY SPACKMAN
Director

State of Idaho
Department of Water Resources
Attachment to Water Right License
45-7746

This map depicts the IRRIGATION STORAGE 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.

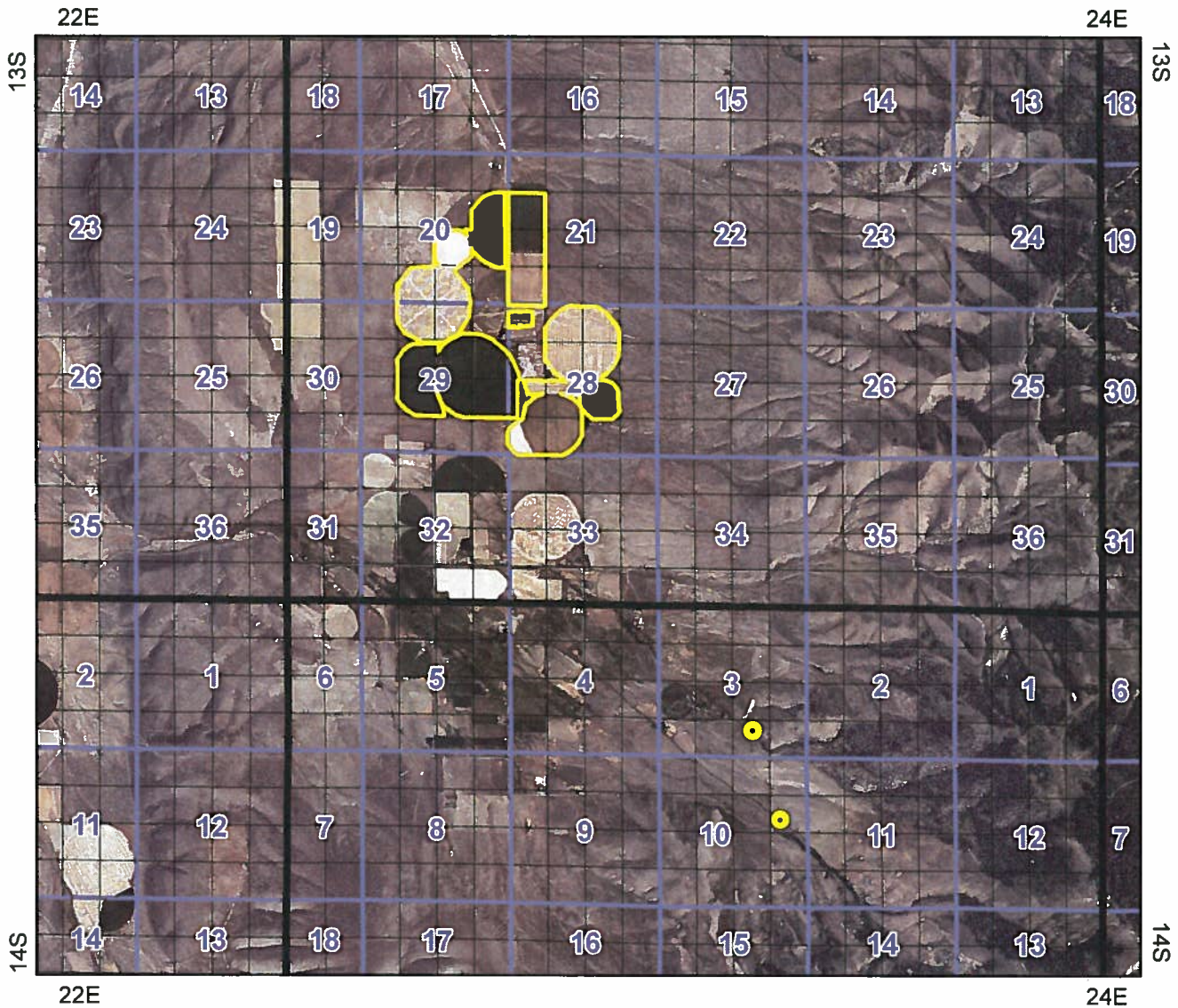


-  Point of Diversion
-  Place Of Use Boundary
-  Townships
-  PLS Sections



State of Idaho
Department of Water Resources
Attachment to Water Right License
45-7746

This map depicts the IRRIGATION FROM STORAGE 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

0 0.75 1.5 3 Miles





State of Idaho

DEPARTMENT OF WATER RESOURCES

322 East Front Street • P.O. Box 83720 • Boise, Idaho 83720-0098

Phone: (208) 287-4800 • Fax: (208) 287-6700 • Website: www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

GARY SPACKMAN
Director

November 19, 2015

HEIDI F MATTHEWS
E EUGENE MATTHEWS
1249 S HWY 27
OAKLEY ID 83346

RE: License No. 45-7746

Issuance of License

Dear Water Right Holder(s):

The Department of Water Resources has issued the enclosed Water Right License confirming that a water right has been established in accordance with your permit. Please be sure to thoroughly review the conditions of approval and remarks listed on your license. Also enclosed is a copy of the approved application for amendment.

The license is a PRELIMINARY ORDER issued by the Department pursuant to section 67-5243, Idaho Code. It can and will become a final order without further action by the Department unless a party petitions for reconsideration or files an exception and/or brief within fourteen (14) days of the service date as described in the enclosed information sheet.

Please note that water right owners are required to report any change of water right ownership and/or mailing address to the Department within 120 days of the change. Failure to report these changes could result in a \$100 late filing fee. Contact any office of the Department or visit the Department's homepage on the Internet to obtain the proper forms and instructions.

If you have any questions, please contact me at 208-287-4951.

Sincerely,

Pamela Skaggs
Water Rights Supervisor

Enclosure(s)

c: METROPOLITAN LIFE INSURANCE CO
WATER DISTRICT #45A

CERTIFICATE OF SERVICE

I hereby certify that on November 20, 2015, I mailed a true and correct copy, postage prepaid, of the foregoing PRELIMINARY ORDER (Approved License) to the person(s) listed below:

RE: WATER RIGHT NO.

45-7746

**E EUGENE MATTHEWS
1249 S HWY 27
OAKLEY ID 83346**

**HEIDI F MATTHEWS
1249 S HWY 27
OAKLEY ID 83346**

**METROPOLITAN LIFE INSURANCE CO
10801 MASTIN BLVD STE 930
OVERLAND PARK KS 66210**

**WATER DISTRICT #45A
DANIELLE HELMS
2110 S 50 E
OAKLEY ID 83346**



**Darla Block
Technical Records Specialist**

EXPLANATORY INFORMATION TO ACCOMPANY A PRELIMINARY ORDER

(To be used in connection with actions when a hearing was not held)

(Required by Rule of Procedure 730.02)

The accompanying order or approved document is a "Preliminary Order" issued by the department pursuant to section 67-5243, Idaho Code. It can and will become a final order without further action of the Department of Water Resources ("department") unless a party petitions for reconsideration, files an exception and brief, or requests a hearing as further described below:

PETITION FOR RECONSIDERATION

Any party may file a petition for reconsideration of a preliminary order with the department within fourteen (14) days of the service date of this order. **Note: the petition must be received by the department within this fourteen (14) day period.** The department will act on a petition for reconsideration within twenty-one (21) days of its receipt, or the petition will be considered denied by operation of law. See Section 67-5243(3) Idaho Code.

EXCEPTIONS AND BRIEFS

Within fourteen (14) days after: (a) the service date of a preliminary order, (b) the service date of a denial of a petition for reconsideration from this preliminary order, or (c) the failure within twenty-one (21) days to grant or deny a petition for reconsideration from this preliminary order, any party may in writing support or take exceptions to any part of a preliminary order and may file briefs in support of the party's position on any issue in the proceeding with the Director. Otherwise, this preliminary order will become a final order of the agency.

REQUEST FOR HEARING

Unless a right to a hearing before the Department or the Water Resource Board is otherwise provided by statute, any person aggrieved by any final decision, determination, order or action of the Director of the Department and who has not previously been afforded an opportunity for a hearing on the matter may request a hearing pursuant to section 42-1701A(3), Idaho Code. A written petition contesting the action of the Director and requesting a hearing shall be filed within fifteen (15) days after receipt of the denial or conditional approval.

ORAL ARGUMENT

If the Director grants a petition to review the preliminary order, the Director shall allow all parties an opportunity to file briefs in support of or taking exceptions to the preliminary order and may schedule oral argument in the matter before issuing a final order. If oral arguments are to be heard, the Director will within a reasonable time period notify each party of the place, date and hour for the argument of the case. Unless the Director orders otherwise, all oral arguments will be heard in Boise, Idaho.

CERTIFICATE OF SERVICE

All exceptions, briefs, requests for oral argument and any other matters filed with the Director in connection with the preliminary order shall be served on all other parties to the proceedings in accordance with IDAPA Rules 37.01.01302 and 37.01.01303 (Rules of Procedure 302 and 303).

FINAL ORDER

The Director will issue a final order within fifty-six (56) days of receipt of the written briefs, oral argument or response to briefs, whichever is later, unless waived by the parties or for good cause shown. The Director may remand the matter for further evidentiary hearings if further factual development of the record is necessary before issuing a final order. The department will serve a copy of the final order on all parties of record.

Section 67-5246(5), Idaho Code, provides as follows:

Unless a different date is stated in a final order, the order is effective fourteen (14) days after its service date if a party has not filed a petition for reconsideration. If a party has filed a petition for reconsideration with the agency head, the final order becomes effective when:

- (a) The petition for reconsideration is disposed of; or
- (b) The petition is deemed denied because the agency head did not dispose of the petition within twenty-one (21) days.

APPEAL OF FINAL ORDER TO DISTRICT COURT

Pursuant to sections 67-5270 and 67-5272, Idaho Code, if this preliminary order becomes final, any party aggrieved by the final order or orders previously issued in this case may appeal the final order and all previously issued orders in this case to district court by filing a petition in the district court of the county in which:

- i. A hearing was held,
- ii. The final agency action was taken,
- iii. The party seeking review of the order resides, or
- iv. The real property or personal property that was the subject of the agency action is located.

The appeal must be filed within twenty-eight (28) days of this preliminary order becoming final. See section 67-5273, Idaho Code. The filing of an appeal to district court does not itself stay the effectiveness or enforcement of the order under appeal.

RECEIVED

NOV 18 2015

DEPARTMENT OF
WATER RESOURCES

Page 1

State of Idaho
Department of Water Resources
APPLICATION FOR AMENDMENT

(For Licensing Purposes)

WATER RIGHT NO. 45-07746

Date of Priority: May 09, 2000

Maximum Diversion Rate: 2.90 CFS
Maximum Diversion Volume: 9.5 AF

Comes now HEIDI F MATTHEWS

And

E EUGENE MATTHEWS

1249 S HWY 27

OAKLEY ID 83346

and represents to the Director of the Idaho Department of Water Resources that he is the owner and holder of Permit to Appropriate the Public Waters of the State of Idaho No. 45-07746, and requests that the permit be changed as follows:

Source: SPRING CREEK
MILL CREEK

Tributary: MILL CREEK
BIRCH CREEK

BENEFICIAL USE	PERIOD OF USE	RATE OF DIVERSION	ANNUAL VOLUME
DIVERSION TO STORAGE	03/15 to 11/15	2.90 CFS	
IRRIGATION STORAGE	01/01 to 12/31		9.5 AF
IRRIGATION FROM STORAGE	03/15 to 11/15		9.5 AF

LOCATION OF POINT(S) OF DIVERSION:

MILL CREEK SE1/4NE1/4 Sec. 10, Twp 14S, Rge 23E, B.M. CASSIA County
SPRING CREEK SW1/4SE1/4 Sec. 3, Twp 14S, Rge 23E, B.M. CASSIA County

PLACE OF USE: IRRIGATION STORAGE

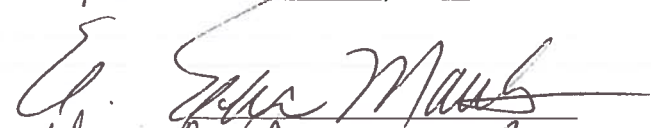
Twp	Rge	Sec	NE				NW				SW				SE				Totals
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
13S	23E	28															X		
14S	23E	3																	

PLACE OF USE: IRRIGATION FROM STORAGE

Twp	Rge	Sec	NE				NW				SW				SE				Totals
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
13S	23E	20				32.0								35.0	32.0	35.0	32.0		166.0
13S	23E	21						40.0			40.0	40.0							120.0
13S	23E	28		34.0	33.0		33.0	11.0	5.5	34.0	38.0	29.0	35.0	35.0		36.0			323.5
13S	23E	29	4.4	35.0	39.0	38.0	34.0			35.0	35.0				40.0	36.0			296.4

Total Acres: 905.9

Permit holder asserts that no one will be injured by such change and that such change will be made at permit holder's own risk. Signed this 10th day of November, 2015.


(Signature)
Heidi F. Matthews

State of Idaho
Department of Water Resources
APPLICATION FOR AMENDMENT
(For Licensing Purposes)
WATER RIGHT NO. 45-07746

FOR DEPARTMENT USE ONLY

Preliminary check by _____ Fee = 100⁰⁰ Received by DJ # C101230 Date 11-18-15

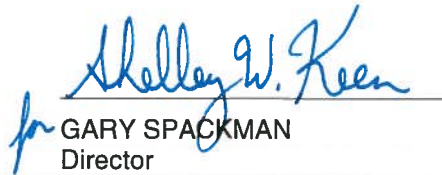
ACTION OF THE DEPARTMENT OF WATER RESOURCES

I, GARY SPACKMAN, of the Department of Water Resources hereby approve the above Application for Amendment for Permit No. 45-07746 with the following:

CONDITIONS OF APPROVAL

1. The issuance of this right does not grant any right-of-way or easement across the land of another.
2. Use of water under this right will be regulated by a watermaster with responsibility for the distribution of water among appropriators within a water district. At the time of this approval, this water right is within State Water District No. 45A.
3. The right holder shall maintain a measuring device and lockable controlling works of a type approved by the Department in a manner that will provide the watermaster suitable control of the diversions.
4. This right is for the use of trust water, and it is subject to review 20 years after the date of permit approval to re-evaluate the availability of trust water for the authorized use and to re-evaluate the public interest criteria for reallocating trust water.
5. When the minimum stream flow water rights in the Snake River at Murphy Gage are not being satisfied, the right holder shall cease diverting water for the consumptive uses authorized by this right.
6. Rights 45-577A, 45-577B, 45-578A, 45-578B, 45-579A, 45-579B, 45-580A, 45-580B, 45-586, 45-587, 45-588, 45-600, 45-7746, 45-12927, 45-12929, and 45-14216 when combined shall not exceed a total diversion rate of 6.93 cfs.
7. Rights 45-577A, 45-577B, 45-578A, 45-578B, 45-579A, 45-579B, 45-580A, 45-580B, 45-586, 45-587, 45-588, 45-600, 45-24405, 45-2406, 45-2661, 45-7746, 45-12927, 45-12928, 45-12929, 45-12930, and 45-14216 when combined shall not exceed the irrigation of 527.2 acres.
8. This right is limited to the irrigation of 527.2 acres within the authorized place of use in a single irrigation season.
9. The two (2) ponds established by the storage of water under this right shall not exceed a total capacity of 9.5 acre-feet or a total surface area of 2.5 acres.

Witness my hand this 18th day of November, 2015.


for GARY SPACKMAN
Director



State of Idaho

DEPARTMENT OF WATER RESOURCES

322 East Front Street • P.O. Box 83720 • Boise, Idaho 83720-0098

Phone: (208) 287-4800 • Fax: (208) 287-6700 • Website: www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

GARY SPACKMAN
Director

October 22, 2015

HIEDI F AND E EUGENE MATHEWS
1249 S HWY 27
OAKLEY ID 83346

RE: Water Right Permit No. 45-7746

Dear Permit Holders:

In the final review before issuing the license for this permit, it was discovered that the Department of Water Resources is reviewing the permit referenced above prior to issuing a water right license. By issuing a license, the Department confirms the extent of development that has been established in compliance with the terms of the permit. The examiner who verified your water use reported that certain elements of the permit have been developed differently than described on your permit. Changes that do not increase the authorized use of water under the permit can be requested and approved in accordance with Section 42-211, Idaho Code. Before a license can be issued, your permit must be amended to depict your water use as it was actually developed.

This permit limited the acres irrigated to the lands already irrigated under your existing surface water rights. The permit was filed before the Snake River Basin Adjudication Court decreed your existing surface water rights. During the review of this permit during the licensing process, it was determined that the total acres that could be irrigated are the 527.2 acres allowed by your decreed surface water rights. The decreed water rights are within a permissible place of use of 905.9 acres, so this permit should be limited to the 527.2 acres within the 905.9 acre permissible place of use allowed by your existing decrees. In order to accomplish this task, we will need the permit amended to correct the place of use allowed to be considered.

The enclosed Application for Amendment form depicts the elements of the water right as they will appear on the license when it is issued. Please review the amendment form carefully. If you concur with the information presented, please sign the form and return it with the \$100.00 filing fee by November 6, 2015.

If you have any questions, please don't hesitate to contact me.

Sincerely,

Daniel A. Nelson
Staff Hydrologist
Planning Bureau
Idaho Department of Water Resources
Telephone # (208) 287-4856
Email – dan.nelson@idwr.idaho.gov

MEMORANDUM

TO: Water Right File 45-7746

FROM: Daniel Nelson – Staff Hydrologist

DATE: October 19, 2015

SUBJECT: Licensing Review of Water Right 45-7746

This is the licensing review of the field exam submitted by Sandy Hemenway formerly in our state office. The field exam was done in 2012. Ms. Hemenway reported that 904.8 acres were irrigated with a diversion to storage rate of 2.90 cfs for the irrigation use, and 9.5 af for the irrigation storage and irrigation from storage uses. There are a couple of issues that need to be addressed. Each will be addressed below:

History:

This permit was issued to cover 2 small ponds that are used to regulate the water flows from Spring Creek and Mill Creek. The water is diverted from the two creeks and diverted into the southern and smaller pond where water is either stored or sent down 2-12 inch pipelines to the northern and larger pond. There is a ground water well that sits at the base of the southern smaller pond that uses the same pipeline that sends water to the larger northern pond. The northern pond is the main regulation pond, where several water sources are collected and pumped out to the various pivots and irrigation system for the farm.

This permit was allowed to be processed in a moratorium area in 2000 due to the ponds being in place prior to 1987. Therefore, this permit only deals with the storage of the ponds and the use out of the ponds. The permit clearly states that this permit does not authorize additional lands to be irrigated. The property has numerous water rights from Spring Creek, Mill Creek, Spring, Bedeke Spring, and ground water. All of these rights were decreed in the Snake River Basin Adjudication (SRBA) with a limitation of 527.2 acres being irrigated. This permit did allow an additional 2.90 cfs to be diverted to fill the ponds during flood water events. It would take less than 2 days to deliver the 9.5 af allowed by this permit at a diversion rate of 2.90 cfs ($9.5 \text{ af} / [2.90 \text{ cfs} \times 1.9835] = 1.65 \text{ days}$).

The permit allows a total of 9.5 af of water for irrigation from storage. The minimum consumptive use in this area is generally around 2 af per acre and the maximum headgate requirement for this area is 4 af per acre. Using these numbers, the 9.5 af could irrigation 4.8 acres ($9.5 \text{ af} / 2 \text{ af/ac} = 4.75 \text{ acres}$) to 2.4 acres ($9.5 \text{ af} / 4 \text{ af/ac} = 2.375 \text{ acres}$). It is clear from these numbers that these ponds are simple regulation ponds used to smooth out water level fluctuations in the pond when needed. The water stored is used for irrigation, however, there is no way to determine the actual number of acres this water right serves.

Storage and Volume:

Ms. Hemenway used current aerial photos (2004 and after) to determine the size of the ponds. However, this permit was issued per pre-1987 development. The ponds have changed since 1987, so we need to establish the volume of the ponds as they were developed prior to 1987, since the permit was issued based on pre 1987 development. However, a review of the 1987 aerial photos shows the ponds have been modified and reduced in size since 1987. In 1987, the southern pond had a surface area of 1.1 acres, and in 2004 the surface area was determined to be 0.7 acres. The 1987 northern pond has a 1987 surface area of 3.6 acres, and in 2004 the surface area was reduced to 1.8 acres. The ponds are in the same 40 acre tracts and have been reduced in size since 1987 therefore, it is reasonable to use the current pond areas when creating the shape files for the water right licenses.

Ms. Hemenway stated that the ponds had an average depth of 4 feet, which puts the pond volume for the two ponds slightly over the maximum amount we can allow in the permit. Per a review of the aerial photos, it doesn't appear as though they fill these ponds on a consistent basis, so I feel it is reasonable to limit them to the 9.5 af. The ponds in 1987 appear to have held a great deal more water than the two ponds currently being used.

Acres:

Ms. Hemenway used the current shape file in the database to determine the number of acres for this permit. However, she counted the acres designated by the shape file and the rounding that occurred when you bring those acres into workflow. The permit specifically states that this permit doesn't allow irrigation of additional acres. Therefore, the license should reflect the acres designated by the decreed water rights. The irrigation from storage on this permit should be limited to the 527.2 acres allowed to be irrigated from the surface water sources within the 905.9 acre permissible place of use determined in the SRBA water rights. 9.5 af of water clearly cannot supply any significant irrigation water to the entire 527.2 acres of ground, but it will be blended in with the existing irrigation rights from Spring Creek and Mill Creek. The shape file for this permit will reflect the shape file created in the SRBA. Therefore, an X35 condition will be required to limit water rights 45-577A, 45-577B, 45-578A, 45-578B, 45-579A, 45-579B, 45-580A, 45-580B, 45-586, 45-587, 45-588, 45-600, 45-24405, 45-2406, 45-2661, 45-7746, 45-12927, 45-12928, 45-12929, 45-12930, and 45-14216 to 527.2 acres.

Points of Diversion:

The permit shows 2 points of diversion for this system. Ms. Hemenway designated the same 2 points of diversion. The points of diversion designated by Ms. Hemenway were included on the list of points of diversion allowed under the overlapping water rights. Therefore, the points of diversion appear to be correct.

Diversion Rate:

I was unable to re-create the flow rates calculated by Ms. Hemenway from the measurements she describes in her field report. Therefore, I used the measurements that Ms. Hemenway supplied in her field report, and used the standard weir formulas for the measurement points shown in the pictures by Ms. Hemenway. The information that Ms. Hemenway supplied suggests that diversions may have diverted up to 8.49 cfs sometime in the past. At the time of the field examination, the diversion rate measured by Ms. Hemenway was approximately 1.70 cfs.

This permit was approved based on pre-1987 development, and there is nothing in the field exam that shows diversions to the system prior to 1987. I spoke with the watermaster Daniel Helms about possible measurement records, and she told me she doesn't have any past records. I reviewed the records back to 1977, and couldn't find any actual flow measurements except for the 2005 season. In the 2005 season, the permit holder only diverted a maximum of 1.80 cfs, which is very close to what I calculated being measured at the time of the field exam. I calculated the flow rate at the time of the field exam at 1.70 cfs. Please see the attached spreadsheet with my calculations.

There is a statement in the permit that the adjudication review for this farm could determine the maximum flow rate for this permit. However, after reviewing the adjudication files, the adjudication referred back to a water right transfer review and limited the decreed water rights based on the transfer. Therefore, there isn't any information available to determine what was diverted through this system prior to 1987.

Without daily measurement data, determining the maximum flow for this system is very difficult. A review of the water rights in the water district and on Mill Creek and Spring Creek show that this permit is the most junior water right in the district. Therefore, this right can only be used if all of the existing water rights on the creek have been fully satisfied. Add into the equation that at a diversion rate of 2.90 cfs, the two ponds could be filled in less than 48 hours, this diversion rate does not seem unreasonable.

The permit has a condition that limits the flow from the surface water sources to 6.00 cfs. However, the surface water rights for this farm were decreed with a combined limitation of 6.83 cfs. Therefore, we cannot limit this permit to the 6.00 cfs when combined with other sources, since it would limit the diversion rate from the other water rights. Therefore, an X35 condition will be required to limit water rights 45-577A, 45-577B, 45-578A, 45-578B, 45-579A, 45-579B, 45-580A, 45-580B, 45-586, 45-587, 45-588, 45-600, 45-7746, 45-12927, 45-12929, and 45-14216 to 6.83 cfs.

Overlapping Water Rights:

I have attached a spreadsheet to this memo showing the overlapping water rights. All of the water rights for this farm are limited to a maximum of 527.2 acres of irrigation. The maximum allowable flow rate from Spring Creek and Mill Creek and all of the surface water sources is 3.10 cfs. The water rights on the ground water wells add an additional 4.36 cfs to the farm, but when combined with the surface water rights, they are limited to the 527.2 acres of irrigation.

As discussed above, this permit when combined with the other rights for this farm should also be limited to 527.2 acres. The 9.5 af of water can only supply enough water to irrigate 2 to 5 acres of irrigation.

Conditions:

Condition 1 (004) were carried over to licensing. Condition 6 (R04) was replaced with R05 as is standard. Condition 2 (051) was changed to condition 933 as is standard, and condition 934 was added since this is a consumptive use not required to be mitigated. Condition 3 (074) was dropped at licensing, since the lands irrigated were limited to the lands allowed in the SRBA decrees. Condition 4 (18B) was dropped, since the field examiner stated dam did not qualify for dam safety regulation requirements. Condition 7 (01J) was changed to condition R43 as per standard. Condition 5 (X35) was maintained but altered to limit the diversion rate for the surface water rights to the amount decreed of 6.93 cfs, and a second X35 condition was added to limit the acres irrigated under all of the decreed water right on this farm to 527.2 acres. Condition X27 was added to limit the water use to the 527.2 acres within the 905.9 acre permissible place of use. Condition 220 should also be added to the license to limit the amount of water that can be stored and diverted to 9.5 af of storage and 2.5 acres of pond surface area.

Overlap Review permit 45-7746

45-577A	10 acres
45-578A	
45-579A	
45-580A	
45-600	

45-577B	2.72 cfs 150 acres
45-578B	
45-580B	

45-577A	238 acres
45-577B	
45-578A	
45-578B	
45-579A	
45-579B	
45-580A	
45-580B	
45-600	
45-2405	
45-12927	
45-12928	

45-12927 is an enlargement of other rights in this table. 78 acre limit.

45-577A	3.1 cfs 160 acres
45-577B	
45-578A	
45-578B	
45-579A	
45-579B	
45-580A	
45-580B	
45-600	

45-577A	3.1 cfs 238 acres
45-577B	
45-578A	
45-578B	
45-579A	
45-579B	
45-580A	
45-580B	
45-600	
45-12927	

45-577A	6.93 cfs 527.2 acres
45-577B	
45-578A	
45-578B	
45-579A	
45-579B	
45-580A	
45-580B	
45-586	
45-587	
45-588	
45-600	
45-12927	
45-12929	
45-14216	

45-577A	527.2 acres
45-577B	
45-578A	
45-578B	
45-579A	
45-579B	
45-580A	
45-580B	
45-586	
45-587	
45-588	
45-600	
45-12927	
45-12928	
45-12929	
45-14216	
45-2405	
45-2406	
45-2661	
45-12930	

45-586	166.2 acres
45-587	
45-588	

45-586	3.83 cfs 289.2 acres
45-587	
45-588	
45-12929	
45-14216	

45-12929 is an enlargement of other rights in this table. 123 acre limit.

45-12928	4.56 cfs 527.2 acres
45-2405	
45-2406	
45-2661	
45-12930	

Water Right	Source
45-577A	Spring Creek and Mill Creek
45-577B	Spring Creek and Mill Creek
45-578A	Spring Creek and Mill Creek
45-578B	Spring Creek and Mill Creek
45-579A	Spring Creek and Mill Creek
45-579B	Spring Creek and Mill Creek
45-580A	Spring Creek and Mill Creek
45-580B	Spring Creek and Mill Creek
45-586	Spring Creek and Mill Creek
45-587	Spring Creek and Mill Creek
45-588	Spring Creek and Mill Creek
45-600	Spring
45-12927	Spring Creek, Mill Creek and Spring
45-12928	Ground Water
45-12929	Spring Creek, Mill Creek and Bedeke Spring
45-14216	Bedeke Spring
45-2405	Ground Water
45-2406	Ground Water
45-2661	Ground Water
45-12930	Ground Water

Source Limits =

Spring Creek and Mill Creek = 3.10 cfs

Spring Creek, Mill Creek, Spring, and Bedeke Spring = 6.93 cfs

Surface water per acre = $6.93 \text{ cfs} / 527.2 \text{ acres} = 0.013144 \text{ cfs/acre}$

Ground Water = 4.56 cfs

Ground Water per acre = $4.56 \text{ cfs} / 527.2 \text{ acres} = 0.008645 \text{ cfs/acre}$

Total existing water = $11.49 \text{ cfs} = 11.49 \text{ cfs} / 527.2 \text{ acres} = 0.0218 \text{ cfs/acre}$

This permit can add up to an additional 2.90 cfs. However, this diversion rate is only allowed to fill the existing pond and not to be used for direct irrigation of the property. The ponds are limited to a maximum volume of 9.5 af, therefore, this diversion rate will only in place a very short period of time.

$9.5 \text{ af of maximum volume allowed} / (2.90 \text{ cfs diversion rate} \times 1.9835 \text{ conversion factor}) = 1.65 \text{ days to supply the } 9.5 \text{ af of water.}$

With the short duration of fill time, this diversion rate will be relatively minimal.

Permit 45-7746 Flow Measurements by Dan Nelson

Spring Creek Cipoletti Weir -- POD A0009763 -- 52 inches wide -- 2 to 7 inches in height.

Conversion from inches to feet = inches / 12 = feet

Inches	Feet
52	4.33
2	0.17
7	0.58

Cipoletti Weir Formula = $3.367 \times \text{Weir Length} \times \text{Depth of Water}^{1.5}$

Weir Length	Water Height	Flow In cfs
4.33	0.17	0.99
4.33	0.58	6.50

Mill Creek -- 2X4 Dam -- POD A0018552 -- 47 inches wide -- 2 to 4 inches in height.

Conversion from inches to feet = inches / 12 = feet

Inches	Feet
47	3.92
2	0.17
4	0.33

Dam Formula = $2.64 \times \text{Weir Length} \times \text{Depth of Water}^{1.5}$

Weir Length	Water Height	Flow In cfs
3.92	0.17	0.70
3.92	0.33	1.99

Combined Flow Rate Spring Creek and Mill Creek

Source	Minimum	Maximum	Average
Spring Creek	0.99	6.50	3.75
Mill Creek	0.70	1.99	1.35
Total	1.70	8.49	5.09

Existing rights allow = 3.1 cfs
Permit Allows = 2.9 cfs
Total = 6.00 cfs

The existing rights and the permit allow a total of 6.00 cfs to be diverted. According to the field examiner's measurements, between 1.70 cfs and 8.49 cfs have been diverted from Spring Creek and Mill Creek. Therefore, there should be adequate water to allow this permit to be licensed at the full rate of 2.90 cfs if all other factors comply with that diversion rate.

Please Note: I was not able to recreate the flow calculations done by the field examiner. The field examiner also stated the two 12 inch pipelines could run up to 7.86 cfs, but dependent of the velocity, two 12 inch pipelines could run up to 39.06 cfs for steel and 17.83 cfs for schedule 80 PVC. Therefore, I re-calculated the flow measurements using the Bureau of Reclamation Water Measurement Manual and the Mechanical Engineers' Handbook (copies of the handbook are included with this spreadsheet.

Mechanical Engineers' Handbook

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nozzle. In case of such a nozzle the coefficient 0.91 means that 17.2 percent of the head is "lost," *i.e.*, used up in overcoming friction.

Venturi Meter. This device was invented by Clemens Herschel in 1887, and named after Venturi, who observed the principle in 1791. The general formula of this useful flow meter is discussed on p. 238. Referring to Fig. 8, the practical formula connecting the measured difference of pressure heads, $H_1 - H_2 = h$, with the mean velocity of flow in the throat is the same as the nozzle formula on p. 213. For coefficients, see p. 2081.

The nominal size of a Venturi meter is that of the pipe line in which it is to be placed. The throat diameter usually is made some size between 0.25 and 0.75 of the upstream diameter, depending on the rate of flow to be expected and on the pressure in the line. The throat velocity with the low rates of flow should be great enough so that the difference of pressure heads (often called the **Venturi difference**) will cause a measurable indication on the register or gage, but should not be so great as to cause the throat pressure to drop below atmospheric, lest there be trouble with air leaking into the gage and register connections. The upstream convergence angle of a Venturi meter may be from 25 to 30 deg. but the downstream divergence angle should not be greater than $7\frac{1}{2}$ deg. The pressure connections usually are made to **ring piezometers**, consisting of circumferential passageways communicating to the interior of the meter by four or more small holes equally spaced around the pipe. The object is to assure the obtaining of the average pressure by avoiding dependence on a single piezometer hole subject to possible local disturbances. The ring piezometers are cast as part of the meter tube. The meters are usually made of cast iron and in several sections, bolted together. The throat is bronze-lined, very accurately bored to size and very smoothly finished. Venturi meters have been made of concrete and wood staves, the throats being lathe-finished bronze castings.

For the loss of head caused by the presence of a Venturi meter in a pipe line, see p. 2081.

Flow over Dams and Weirs

Weirs. A weir is a bulkhead or dam over which water flows, or a notch in the top of such a structure through which water flows. An orifice becomes a weir if the water surface upstream falls below its top edge. The velocity of approach is sometimes considerable, as for a low dam in a river at floodtime, or it may be practically negligible, as for a small notch in the side of a large tank.

The theoretical discharge over a weir of width l is $Q = \frac{2}{3}C_d l h \sqrt{2gh}$. This is two-thirds of the theoretical discharge through a rectangular orifice l ft long and h ft high under a head h . The actual discharge is $Q = 3.33lh^{3/2}$, as determined for sharp-crested weirs by Francis, who found an experimental discharge coefficient of 0.62. Multiplying this by $\frac{2}{3}\sqrt{2g}$ yields the value 3.33. This numerical constant contains g in ft-sec units, and Q is therefore in cu ft per sec and l and h are in ft.

By a sharp crest is meant one with a sharp upstream corner, so that full contraction is developed. The crest itself may have considerable thickness (but see under broad flat crests p. 246) and is frequently made of a steel plate or angle planed off and sometimes beveled on the downstream side to give a top flat portion from $\frac{1}{16}$ to $\frac{1}{2}$ in. wide.

Accuracy of Francis Formula. This formula is very widely used by engineers. It is reliable within from 1 to 3 percent for heads above 0.3 ft, provided (1) the weir bulkhead has a vertical upstream face and occupies the full width of the channel, (2) the crest is level, (3) the channel of approach is deep (*i.e.*, the weir bulkhead is high, so that the velocity of approach is small—see below for corrections), (4) there is free access of the air to the space below the falling sheet of water (*i.e.*, between it and the downstream face of the weir), (5) the head is measured a distance upstream from the weir of at least four times the head, (6) the side walls extend downstream from the weir (above the crest level) to prevent a lateral spreading as the water passes over the crest, and (7) due precautions in measuring are taken.

For very low heads, Francis formula results for discharge must be increased 1(3) percent when $h = 0.2$ ft, and 4(7) percent when $h = 0.1$ ft, the low values for a strictly

sharp crest piece with extremely smooth upstream face, the high values for ordinary iron plate with machine-planed top but somewhat corroded.

Effects of Errors or Uncertainties. A small percentage error in head causes $1\frac{1}{2}$ times that error in discharge. Conversely, the allowable percentage error in head is two-thirds that in discharge. Considerable errors in the measured head may be made by careless methods of referencing the crest level to the head gage scale, and by assuming that a non-level crest is level without knowing the average level. The mean level of the water surface must be measured, not the crests of the small waves or surges existing in all flowing water. Rounding the upstream corner of the crest increases the discharge especially at low heads. Roughness of the upstream vertical face of the weir has the same effect.

For a rectangular notch with vertical sharp-edged ends, contraction occurs at the ends as well as at the crest, and the discharge is reduced approximately as though the length of the weir were decreased by $0.1h$ for each end contraction. Hence, the Francis formula for a sharp-crested weir with two end contractions is

$$Q = 3.33(l - 0.2h)h^{3/2}$$

This formula must not be used unless l is at least $2 \times h$.

See Cone, Flow through Weir Notches (rectangular, triangular, Cipolletti, circular) with Thin Edges and Full Contractions, *Jour. Agr. Research*, U.S. Dept. Agriculture, 5, No. 23, 1916; and a variety of weir-notch data by Pardoe in his discussion of Precise Weir Measurements, *Trans. ASCE*, 93, 1929.

Cipolletti Trapezoidal Weir. Cipolletti found that a trapezoidal notch with end slopes 1 horizontal to 4 vertical (Fig. 15) just compensated for the reduction due to

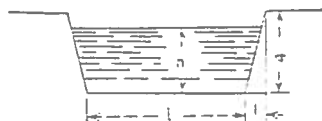


FIG. 15. Cipolletti weir.



FIG. 16. Triangular-notch weir.

end contraction in a rectangular notch of the same crest length, and, accordingly, the simple Francis formula, $Q = 3.33lh^{3/2}$, may be used for such a trapezoidal notch. The crest length l must be at least $2 \times h$, and the crest should be 2 or 3 $\times h$ above the bottom of the channel of approach to avoid a velocity-of-approach correction. The Cipolletti weir has become popular in the Western states for measuring irrigation water.

Triangular Notch. There are certain advantages in the triangular notch for measuring discharges that vary from a moderate maximum to a very small minimum, e.g., 1 gpm, and where about the same degree of precision is desired whether the discharge is high or low. The formula for a sharp-edged notch (Fig. 16) is $Q = C \sqrt{1.49} \tan(\alpha/2) h^2 \sqrt{2gh}$, where α is the notch angle and h is the head above the vertex. The discharge coefficient C has a value from 0.58 to 0.59, based on experiments at Cornell University, with heads up to 3 ft and vertex angles of 28, 60, 90, and 120 deg. The average coefficient 0.58 was found for the 60 and 90 deg weirs, and 0.59 for the 28 and 120 deg weirs. These results are close to those of Cone *loc. cit.*. Prof. Thomson found for 90 deg, 0.60, and for 127 deg, 0.62, with heads 0.2 to 0.3 ft.

The inverted notch, with discharge proportional to head, allows very simple regulating and recording devices to be used with it. It is constructed with curved sides such that the width of notch above the straight level crest decreases just enough to keep the discharge proportional to the head. The rate of flow is given by the formula, $Q = C \times 1.57 \sqrt{2gl} \sqrt{h}h$, where Q is in cu ft per sec, l and h are notch width and head, respectively, in ft. With $C = 0.60$, this becomes $Q = 7.55 (l \sqrt{h}h)$. The product $l \sqrt{h}$ is constant, and this gives the relation for the curves of the sides. Starting with some desired or convenient head for a value of the discharge, say near the probable maximum to be expected, the value of the notch width at that height above

the crest is calculated from the above formula for Q . These values of width and head give the constant value $l\sqrt{h}$. It is not necessary to continue the side curves of the notch closer to the crest than about $1\frac{1}{2}$ to $1\frac{3}{4}$ in. (depending on the range of heads); they may terminate in short verticals to the crest. The ratio of the discharge shut off by reason of such an abrupt termination of the curves to the full opening discharge (if it could be secured) is $0.64\sqrt{h_1/h}$, where h_1 is the height of the end verticals and h is the head of water. For values of $h/h_1 = 400, 100, 25$, and 10 , respectively, the percentage reductions in discharge are 3, 6, 13, and 20. Unless the notch curves are accurately constructed, large errors in estimated discharge are to be expected. For results of tests see *Eng. News*, Nov. 25, 1915.

Velocity-of-approach effects, causing a greater discharge than from a deep quiet pool with the same head, have been variously expressed in the formulas adopted by different engineers. The Bazin and Rehbock formulas avoid the direct use of $v^2/2g$, where v is the mean velocity through the cross section of the channel of approach upstream from the weir, where the head is measured. They provide for the changes in the discharge coefficient by expressions involving both the head and height of weir, but on the assumption that the distribution of velocities in the channel of approach is fairly uniform. The Fteley and Stearns and the Hamilton Smith formulas add $a(v^2/2g)$ to the observed (static) head, each using a constant value for a (1.5 and $1\frac{1}{3}$, respectively, for weirs without end contractions), thus also assuming fixed natural velocity distribution, yet recognizing that the flow-assisting velocities near the surface of the channel of approach are usually greater than those near the bottom.

Recent experimental evidence favors the Rehbock formula as probably the best of the rigid type of weir formulas for normal, or fairly uniform, velocity distribution in the upstream channel. This is for sharp-crested weirs without end contraction:

$$Q = \left(0.605 + \frac{1}{320h - 3} + \frac{0.08h}{d_0}\right) \frac{2}{3} Lh \sqrt{2gh} \quad (\text{ft-sec units})$$

$$= \left(3.234 + \frac{5.347}{320h - 3} + 0.428 \frac{h}{d_0}\right) Lh^{3/2}$$

where d_0 is the height of weir or the depth of water at zero head. (See Precise Weir Measurements and discussions, *Trans. ASCE*, 93, 1929.) Although this is not strictly correct dimensionally, it gives values agreeing within less than 1 percent with experiments on weirs from 0.2 to 4 ft in height with heads from 0.1 to 2 ft subject to the ratio h/d_0 not exceeding 4. For any particular weir and head, the discharge by this formula may be found readily by multiplying the discharge by the ratio of the parenthesis value to the 0.623 corresponding to the Francis formula (p. 244). Thus for a head of 1.605 ft on a weir 3 ft high the parenthesis value is $0.605 + 0.0020 + 0.0428 = 0.650$. This is 4.3 percent greater than 0.623, and the 6.77 cfs per ft for the head 1.605 ft is to be increased by this percentage, making it 7.06 cfs per ft of weir crest.

Flow of water over dams varies from about 20 percent less to 20 percent more than for a sharp crest of the same length and with the same head. For broad flat-crested dams, the flat top wider than the head, the coefficient 2.64, instead of Francis's 3.33, applies, or, with sufficient accuracy, the discharge is 80 percent of that given by the Francis formula. If the upstream corner is rounded, the discharge may be greater. Dams with steeply sloping upstream faces (about 1 to 1) may have coefficients nearly as high as 4, as will also a thin vertical bulkhead with a rounded upstream corner (radius = 2 to 8 in. = thickness of bulkhead). A very gradually sloping approach, e.g., 5 horizontal to 1 vertical, or a rounding crest of large radius introduces an appreciable friction effect, and the discharge may be no greater than for a sharp-crested weir. Non-vertical upstream faces on sharp-crested dams increase the discharge if inclined downstream and decrease it if inclined upstream, the coefficient being 3.10 for a 1 to 1 upstream and 3.73 for a 2 horizontal to 1 vertical downstream inclination, coefficients for intermediate inclinations being between these values. If air is not allowed free access under the falling sheet of water at the crest, the discharge over any narrow-top weir or dam is increased, but is also made less certain due to

the tendency of the partial vacuum so formed to break at intervals and cause pulsating flow.

Submerged weirs and dams, where the water surface downstream from the dam is at a higher level than the crest, do not show much reduction in discharge, as compared with the unsubmerged condition, until the downstream head, or backwater, is nearly one-half the upstream head above the crest. This is especially true for broad-crested dams, whether flat or rounded or with easy upstream sloping faces, since in these cases there is a considerable surface drop to the water and a decided increase in velocity even before the water leaves the crest. This condition remains practically unchanged with submergence until the downstream backwater head is over half the upstream head, *i.e.* high enough to smother the flow.

For experimental results on weirs, see Horton, "Weir Experiments, Coefficients and Formulas," U.S. Geol. Survey, W. S. & I. Paper 200.

Flow of Liquids in Pipes

In any pipe or conduit through which a fluid is flowing, there is a continuous loss of head and of pressure. Figure 17 shows a portion of a pipe line through which fluid is being forced uphill from *A* toward *B*. With no flow, *i.e.*, only static fluid pressure, the head at *B* should be *h* ft less than at *A*. But, owing to the flow, there is loss of head along the pipe and the head at *B* is (*h* - *h_f*) ft less than at *A*, where *h_f* designates the friction head between *A* and *B*. At the same time, the heads at both *A* and *B* are less than with the no-flow condition because of the loss of head up-stream from *A*.

The loss of head or friction head depends on (1) the kind of fluid flowing, especially its viscosity; (2) the velocity of the fluid; (3) the size (*e.g.*, hydraulic radius) of the pipe or conduit; (4) the roughness of the interior surface; and (5) the length. Pressure has practically no effect on the loss of head because the viscosity of liquids and gases varies only slightly with pressure within the range ordinarily occurring in practice. The pressure drop due to friction, $p_f = h_f \rho g$, depends on the density and, therefore, for gases, on the pressure in the pipe. The friction head is measured in feet or centimeters of the liquid or gas flowing and is given in general by the

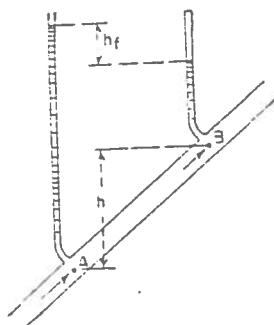


FIG. 17

Darcy equation, $h_f = f \frac{L}{4m} \frac{V^2}{2g}$, in which *f* is known as the pipe friction factor and is dimensionless; *L* is the length of pipe; *m* is the hydraulic radius defined as the ratio of cross-sectional area *A* divided by the wetted perimeter *P*, or $m = A/P$; *V* is the velocity; and *g* is the acceleration of gravity. This equation is applicable for either metric or English units, as long as the quantities are consistently expressed in length-time units.

Darcy's equation in the above form is valid for any shape of cross section. For circular pipes the value of $m = \pi d^2 / 4\pi d$, so that $4m = d$. The pipe friction formula

thus assumes its more familiar form, $h_f = f \frac{L}{D} \frac{V^2}{2g}$. The equation applies regardless of the internal state of motion, whether laminar or turbulent. The internal flow conditions, however, determine the value of the friction factor *f*, which can in general be expressed as a function of the ratio of inertial to viscous forces *R*, known as Reynolds number, and of the so-called relative roughness ϵ/d . The length ϵ is a length characterizing the hydraulically effective roughness of any pipe surface and is derived from experiment. Thus $f = \phi(R, \epsilon/d)$. The practical application of Darcy's formula for the determination of head losses therefore requires knowledge concerning this function.

Laminar Flow. If the forced movement of fluid through a filled pipe occurs as a telescopic sliding of adjacent concentric layers of fluid without transverse mixing, the resistance to this type of motion is due entirely to molecular forces. In long straight

- Home
- Acoustics
- Air Psychrometrics
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- Electrical
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- HVAC Systems
- Hydraulics and Pneumatics

PVC Pipes - Friction Loss and Flow Velocity - Schedule 80

Water flow in thermoplastic PVC and CPVC pipes Schedule 80 - friction loss (ft/100 ft, psi/100 ft) and flow velocities at dimensions from 1/2 inch to 16 inches

Sponsored Links

Friction loss and flow velocity in PVC and CPVC pipes Schedule 80 with water can be found in the table below. The table may be also be used for pipes in other thermoplastic materials where the inner diameter corresponds to [PVC Pipe Schedule 80](#)

- 1 ft (foot) = 0.3048 m
- 1 ft/s = 0.3048 m/s
- 1 gal (US)/min = $6.30888 \times 10^{-5} \text{ m}^3/\text{s}$ = 0.0227 m³/h = 0.0631 dm³(liter)/s = $2.228 \times 10^{-3} \text{ ft}^3/\text{s}$ = 0.1337 ft³/min
- 1 psi/100 ft = 2.3 ftH₂O/100 ft = 2288 mmH₂O/100 ft = 22.46 kPa/100 m

Note! Velocity should in general not exceed 5 feet per second to avoid damaging noise and wear and tear of pipes and fittings.

12 inches				
Volume Flow (gal/min)	Volume Flow (gal/hr)	Velocity (ft/sec)	Friction Head (ft/100ft)	Friction Loss (psi/100 ft)
350	21000	1.1	0.04	0.02
400	24000	1.3	0.05	0.02
450	27000	1.4	0.06	0.03
500	30000	1.6	0.07	0.03
750	45000	2.4	0.2	0.07
1000	60000	3.2	0.3	0.1
1250	75000	4.0	0.4	0.2
1500	90000	4.8	0.6	0.2
2000	120000	6.4	0.9	0.4
2500	150000	8.0	1.4	0.6
3000	180000	9.6	2.0	0.9
3500	210000	11.2	2.7	1.2
4000	240000	12.8	3.4	1.5

Pressure Ratings of Steel Pipe

Based on ASTM A53 Grade B or A106 Grade B Seamless
ANSI B31.1, 1977 with allowances for connections and fittings
reduces these working pressures approx. 25%

PIPE		PRESSURE-PSI		WATER HAMMER FACTOR	PIPE		PRESSURE-PSI		WATER HAMMER FACTOR
NOM. SIZE INCHES	SCH. NO.	WORKING	BURST		NOM. SIZE INCHES	SCH. NO.	WORKING	BURST	
1/8	40	3500	20,200		2½	160	4200	15,700	5.43
1/8	80	4800	28,000		2½	XXS	6900	23,000	7.82
1/4	40	2100	19,500		3	40	1600	7,400	2.60
1/4	80	4350	26,400		3	80	2600	10,300	2.92
3/8	40	1700	16,200		3	160	4100	15,000	3.56
3/8	80	3800	22,500		3	XXS	6100	20,500	4.64
1/2	40	2300	15,600	63.4	3½	40	1500	6,800	1.94
1/2	80	4100	21,000		3½	80	2400	9,500	2.17
1/2	160	7300	26,700		4	40	1400	6,300	1.51
1/2	XXS	12300	42,100		4	80	2300	9,000	1.67
3/4	40	2000	12,900	36.1	4	160	4000	14,200	2.08
3/4	80	3500	17,600	44.5	4	XXS	5300	18,000	2.47
3/4	169	8500	25,000		5	40	1300	5,500	.960
3/4	XXS	10000	35,000		5	80	2090	8,100	1.06
1	40	2100	12,100	22.3	5	160	3850	13,500	1.32
1	80	3500	15,900	26.8	5	XXS	4780	16,200	1.49
1	160	5700	22,300	36.9	6	40	1210	5,100	.666
1	XXS	9500	32,700	68.3	6	80	2070	7,800	.738
1½	40	1800	10,100	12.9	6	160	3760	13,000	.912
1½	80	3000	13,900	15.0	6	XXS	4660	15,000	1.02
1½	160	4400	18,100	18.2	8	40	1100	4,500	.385
1½	XXS	7900	27,700	30.5	8	80	1870	6,900	.422
1½	40	1700	9,100	9.46	8	160	3700	12,600	.529
1½	80	2800	12,600	10.9	8	XXS	3560	12,200	.519
1½	160	4500	17,700	13.7	10	40	1030	4,100	.244
1½	XXS	7200	25,300	20.3	10	*80	1800	6,600	
2	40	1500	7,800	5.74	10	160	3740	12,500	.340
2	80	2500	11,000	6.52	10	XXS	3300	11,200	
2	160	4600	17,500	8.60	12	@40	1000	3,800	
2	XXS	6300	22,100	10.9	12	**80	1800	6,500	
2½	40	1900	8,500	4.02	12	160	3700	12,300	.239
2½	80	2800	11,500	4.54	12	XXS	2700	9,400	

The allowable pressures were calculated by the formula in the Code for Pressure Piping, ASA B31.1-1955, Section 3, par. 324(a),

$$P = \frac{25(t-C)}{D-2y(t-C)}$$

where P = allowable pressure in lb per sq in. (gauge)
S = allowable working stress in lb per sq in.
D = outside diameter in inches
t = design thickness in inches, or 12 1/2% less than the nominal thickness shown in the table
C = allowance in inches for corrosion and/or mechanical strength (C=0.05" has been used above for all pipe sizes)
y = a coefficient having values for ferritic steels, as follows:

0.4 up to and including 900°F
0.5 for 950°F
0.7 for 1000°F and above

The allowable working stresses were obtained from the Code for Pressure Piping, ASA B31.1.1-1955, Table 12.

Hydraulic machinery piping is not covered by the Code for Pressure Piping, but it is current practice to use stresses comparable with those given for Refinery and Oil Transportation Piping, Div. A. The allowable working

pressures at 100°F tabulated above accordingly may be used, provided that water hammer or shock conditions are considered by reducing these values by the product of the flow rate in gallons per minute and the Water Hammer Factor tabulated above.

Thus if the flow rate is 100 gpm in a 2" extra strong line, the shock pressure created by water hammer is 100 x 6.52 = 652 lbs. per sq. in.; by deducting this from the value of 2500 lb per sq in. shown in the table the allowable static working pressure is found to be 1848 lb per sq in.

Burst pressures for pipe were calculated using formula

$$P = \frac{25t}{OD}$$

Where P = internal burst pressure, psig
S = allowable stress (60,000 psi)
OD = outside diameter of tube in inches
t = nominal wall thickness

NOTES: *Not extra strong. Schedule 60 is extra strong in this size.

** Not extra strong. Extra strong does not have a schedule number in this size! (ID of 12" XS is 11.75 inches)

@ Not standard weight. Standard weight does not have a schedule number in this size! (ID of 12" Standard is 12.00 Inches).

Steel Pipe - Size, Schedule and Flow Rates

Standard Pipe - Schedule 40

PIPE SIZE	OD	WALL	ID	INT AREA	WT/ FT	GPM @ 2 FPS	GPM @ 5 FPS	GPM @ 10 FPS	GPM @ 15 FPS	GPM @ 20 FPS	GPM @ 25 FPS
1/8	.405	.068	.269	.057	.245	.35	.89	1.8	2.7	3.5	4.4
1/4	.540	.088	.364	.104	.425	.65	1.6	3.2	4.9	6.5	8.1
3/8	.675	.091	.493	.191	.567	1.2	3.0	6.0	9.0	12.0	15.0
1/2	.840	.109	.622	.304	.852	1.9	4.8	9.5	12.0	19.0	23.8
3/4	1.050	.113	.824	.533	1.132	3.3	8.4	16.7	25.1	33.4	41.8
1	1.315	.133	1.049	.864	1.679	5.4	13.5	27.0	40.6	54.1	67.7
1 1/4	1.660	.140	1.380	1.495	2.273	9.4	23.4	46.8	70.3	93.7	117
1 1/2	1.900	.145	1.610	2.036	2.718	12.7	31.9	63.7	95.6	127	159
2	2.375	.154	2.057	3.356	3.653	21.0	52.5	105	157	210	263
2 1/2	2.875	.203	2.469	4.788	5.793	30.0	75.0	150	225	300	375
3	3.500	.216	3.068	7.393	7.575	46.3	116	232	347	463	579
3 1/2	4.000	.226	3.548	9.886	9.109	61.9	155	310	465	619	774
4	4.500	.237	4.026	12.73	10.79	79.7	199	399	598	797	997
4 1/2	5.000	.247	4.506	15.95	12.54	99.9	250	499	749	998	1249
5	5.563	.258	5.047	20.01	14.62	125	313	627	940	1253	1567
6	6.625	.280	6.065	28.89	18.97	181	452	904	1357	1810	2262
7	7.625	.301	7.023	38.74	23.54	243	607	1213	1820	2427	3033
8	8.625	.322	7.981	50.03	28.55	313	783	1567	2350	3134	3917
10	10.75	.365	10.02	78.85	40.48	494	1235	2470	3705	4940	6175
12	12.75	.406	11.94	111.9	53.56	701	1753	3506	5259	7012	8765

Extra Strong Pipe - XS - Schedule 80

WALL	ID	INT AREA	WT/ FT	GPM @ 2 FPS	GPM @ 5 FPS	GPM @ 10 FPS	GPM @ 15 FPS	GPM @ 20 FPS	GPM @ 25 FPS	PIPE SIZE
.085	.215	.036	.314	.23	.57	1.1	1.7	2.3	2.8	1/8
.119	.302	.072	.535	.45	1.1	2.2	3.4	4.5	5.6	1/4
.126	.423	.141	.738	.88	2.2	4.4	6.6	8.8	11.0	3/8
.147	.546	.234	1.087	1.5	3.7	7.3	11.0	14.7	18.3	1/2
.154	.742	.433	1.473	2.7	6.8	13.6	20.3	27.1	33.9	3/4
.179	.957	.719	2.171	4.5	11.3	22.5	33.8	45.0	56.3	1
.191	1.278	1.283	2.996	8.0	20.0	40.1	60.2	80.3	100	1 1/4
.200	1.500	1.767	3.631	11.1	27.7	55.3	83.0	110	138	1 1/2
.218	1.939	2.953	5.022	18.5	46.2	92.5	139	185	231	2
.276	2.323	4.238	7.661	26.5	66.4	133	199	265	332	2 1/2
.300	2.900	6.605	10.25	41.4	103	207	310	414	517	3
.318	3.364	8.888	12.50	55.7	139	278	418	557	696	3 1/2
.337	3.826	11.50	14.98	72.0	180	360	540	720	900	4
.355	4.290	14.45	17.61	90.5	226	453	679	905	1132	4 1/2
.375	4.813	18.19	20.78	114	285	570	855	1140	1425	5
.432	5.761	26.07	28.57	163	408	816	1225	1633	2041	6
.500	6.625	34.47	38.05	216	540	1080	1620	2160	2699	7
.500	7.625	45.66	43.39	286	715	1430	2145	2861	3575	8
.594	9.562	71.81	64.40	450	1125	2249	3374	4498	5623	10
.688	11.37	101.61	88.57	636	1591	3182	4774	6365	7956	12

Schedule 160 Pipe

PIPE SIZE	OD	WALL	ID	INT AREA	WT/ FT	GPM @ 2 FPS	GPM @ 5 FPS	GPM @ 10 FPS	GPM @ 15 FPS	GPM @ 20 FPS	GPM @ 25 FPS
1/2	.840	.187	.466	1.71	1.310	1.07	2.67	5.34	8.01	10.7	13.4
3/4	1.050	.218	.587	.271	1.940	1.70	4.24	8.49	12.7	17.0	21.2
1"	1.315	.250	.815	.522	2.850	3.27	8.17	16.3	24.5	32.7	40.8
1 1/4	1.660	.250	1.160	1.060	3.764	6.62	16.6	33.1	49.7	66.2	82.8
1 1/2	1.900	.281	1.338	1.410	4.862	8.81	22.0	44.0	66.1	88.1	110
2	2.375	.343	1.689	2.241	7.450	14.0	35.1	70.2	105	140	175
2 1/2	2.875	.375	2.125	3.542	10.01	22.2	55.5	111	167	222	278
3	3.500	.437	2.626	5.416	14.30	33.9	84.8	170	254	339	424
4	4.500	.531	3.438	9.283	22.52	58.2	145	291	436	582	727
5	5.563	.625	4.313	14.61	33.0	91.5	229	458	686	915	1144
6	6.625	.718	5.189	21.15	45.30	132	331	662	994	1325	1656
8	8.625	.906	6.813	36.44	74.70	230	571	1142	1713	2384	2855
10	10.75	1.125	8.500	56.75	115.84	355	889	1777	2666	3555	4443
12	12.75	1.312	10.126	80.53	160.33	504	1261	2523	3784	5045	6306

Double Extra Strong Pipe

WALL	ID	INT AREA	WT/ FT	GPM @ 2 FPS	GPM @ 5 FPS	GPM @ 10 FPS	GPM @ 15 FPS	GPM @ 20 FPS	GPM @ 25 FPS	PIPE SIZE
.294	.252	.050	1.714	.32	.79	1.6	2.4	3.1	3.9	1/2
.308	.434	.148	2.440	.93	2.3	4.6	6.9	9.2	11.6	3/4
.358	.598	.282	3.659	1.8	4.4	8.8	13.3	17.7	22.1	1"
.382	.896	.630	5.214	4.0	9.0	18.0	27.0	36.0	45.0	1 1/4
.400	1.100	.950	6.408	6.0	14.9	29.8	44.6	59.5	74.4	1 1/2
.436	1.503	1.774	9.029	11.1	27.9	55.6	83.4	111	139	2
.552	1.771	2.463	13.70	15.4	38.6	77.1	116	154	193	2 1/2
.600	2.300	4.154	18.58	26.0	65.1	130	195	260	325	3
.674	3.152	7.803	27.54	48.9	122	244	367	488	611	4
.750	4.063	12.97	38.55	81.2	203	406	609	812	1015	5
.864	4.997	18.83	53.16	118	295	590	885	1180	1475	6
.875	6.875	37.12	72.42	233	581	1163	1744	2325	2907	8
1.000	8.750	60.13	104.1	377	942	1883	2825	3767	4709	10
1.000	10.75	90.76	125.5	569	1421	2843	4264	5686	7107	12

184 inches / 52% Stream / 14% Total

184 inches / 52% Stream / 14% Total

[illegible]

MEMORANDUM

TO: Water Right File 45-7746

FROM: Daniel Nelson – Staff Hydrologist

DATE: October 19, 2015

SUBJECT: Telephone Conversation with Daniel Helms Watermaster 45A

I spoke with Daniel Helms, the watermaster for water district 45A, concerning water right 45-7746. I asked if she had any records concerning water right permit 45-7746 or the delivery of water to the headgate for these permits. She told me that she just started as watermaster, and doesn't have any of the old watermaster records. She told me that the permit was only in use during high water.

Nelson, Dan

From: Nelson, Dan
Sent: Tuesday, September 22, 2015 3:28 PM
To: 'ASKCRAIG3@YAHOO.COM'
Subject: Question on Water Delivery

Ms. Smith and Ms. Helms;

I am reviewing a water right file for permit 75-7746. I am wondering if you have any delivery records showing the delivery of water under this permit? The specific years that I am looking for is from 2000 to 2002, but I will accept any records of deliver for this permit. This permit is owned by Anderson Farms (Heidi and Eugene Mathews). This permit allows water to be diverted from Mill Creek and Spring Creek for storage in two small irrigation ponds.

I would appreciate any records that you may have on this permit. I reviewed the records submitted to the Department, and they did not mention this permit specifically.

Thank you,

Daniel Nelson
Staff Hydrologist
Idaho Department of Water Resources
Telephone (208) 287-4856
Fax (208) 287-6700 (attn: Dan Nelson)