

MEMORANDUM

TO: Danielle Favreau

FROM: Daniel Nelson – Staff Hydrologist

DATE: November 26, 2013, 2013

SUBJECT: Licensing Review of Water Right 57-7687

I was asked to run the Department's Pond Spreadsheet on this pond. The Bureau of Land Management (BLM) representative informed us that the pond has an average depth of 3.5 feet and our GIS information shows the pond at 0.2 acres of surface area. With this information the pond capacity is 0.7 acre feet, and the evaporation for this pond is 0.3 acre feet for a total of 1.2 acre feet of total storage requirement. This is an onstream pond, so no seepage amounts were calculated into the equations.

A new permit will need to be filed by the Bureau of Land Management for the remainder of the storage for this pond, or they will not be able to storage more than the 0.3 acre feet of water allowed by the permit. The pond surface area is 0.2 acres, so they are allowed to fill the pond to a maximum depth of 1.5 feet ($0.3 \text{ acre feet} / .02 \text{ acres} = 1.5 \text{ feet}$).

TOTAL STORAGE

FILE NUMBER	57-7687
REVIEWER	Dan Nelson
DATE	11/26/2013

This spreadsheet has been designed by Idaho Department of Water Resources to estimate the total seepage, evaporation and fill capacity required for a pond

Surface Area (in Acres)	0.2	"Surface Area" is automatically carried over from the "Seepage Loss Sheet"
Average Pond Depth (in feet)	3.5	"Average Pond Depth" depicts the actual depth of the pond either measured or estimated. Note: If you know the maximum depth and not the average depth, the field examiner's handbook suggests multiplying the maximum depth by 0.4 to get the average depth, or you can use any method that you know the capacity, divide the capacity by surface area and enter the average pond depth in the space above.
Pond Capacity (in acre feet)	0.7	

Volume Needed Above Initial Fill to Fulfill From Storage Needs- "Multiple Fills" (in acre feet)	0	The "Volume Needed Above Initial Fill" is the acre-feet of water required to meet <i>from storage</i> component if the <i>from storage</i> component exceeds a one time fill. This section should not include the amount of water needed to fill the pond initially or the amount of water needed to maintain the pond level due to evaporation or seepage. For example: if a pond has a capacity of 5 acre feet and 2.5 acre feet of seepage and evaporation, but the pond is used for irrigation that requires 10 acre feet of from storage for the irrigation use, then you would insert 5 acre feet into this location (10 acre feet needed - 5 acre feet from the initial fill = 5 acre feet of additional storage needed). PLEASE NOTE: You must have a " <u>From Storage</u> " component exceeding the initial fill on the permit to include a volume in this space.
Estimated Seepage Loss (in acre feet)	0.00	The "Estimated Seepage Loss" is automatically carried over from the Seepage Loss Sheet
Estimated Evaporation Loss (in acre feet)	0.55	The "Estimated Evaporation Loss" is automatically carried over from the Evaporation Loss Sheet
Total Volume Required (in acre feet)	1.2	"The Total Volume Required" is calculated by adding the Pond Capacity, Multiple Fills, Seepage Loss, and Evaporation Loss amounts to determine the total amount of storage required.

Flow Rate into Pond (in cfs)	1.00	The "Flow Rate" Into the Pond depicts the actual flow either measured or estimated into the pond.
Highest Daily Evaporation Rate From Evaporation Tab. (in mm/day)	5.05	This number is automatically selected by picking the highest recorded number in the "Precipitation Deficit Table".
Maximum Required Daily Maintenance Volume (in acre feet per day)	0.00	"Maximum Required Daily Maintenance Volume" is the maximum volume of water needed on any given day during the year, and is calculated by adding the highest daily evaporation loss to the average daily seepage loss in acre feet. The average daily seepage loss is calculated by dividing the "Estimated Seepage Loss" by 365 days. This is acceptable, since the seepage rate shouldn't vary throughout the season unless the pond completely freezes over during the winter months. The highest daily evaporation loss is calculated by dividing the Highest Daily Evaporation Rate by the 304.8 conversion factor and multiplying this number by the pond surface area to attain a combined daily acre feet requirement.
Minimum Maintenance Flow (in cfs)	0.00	The "Minimum Maintenance Flow" is the minimum amount of flow required to maintain the level of the pond. This number is determined by dividing the "Maximum Required Daily Maintenance Volume" by 1.9835. This flow can be used to determine if the flow rate into the pond is adequate to maintain the pond level.
Days Required to Fill the Pond	0	The "Days Required to Fill the Pond" is calculated by dividing the "Pond Capacity" by the "Flow Rate" minus "Minimum Maintenance Flow" multiplied by 1.9835. This section will assist you in determining if the flow rate being diverted to the pond is adequate to fill the pond while maintaining the pond level. The length of time to fill the pond will help determine if the flow rate is adequate for the size of pond being proposed. This number should be between 1 and 365 days for a project to be successful.
Days Required to Fill the Pond at 13,000 gallons per day	19	The "Days Required to Fill the Pond at 13,000 gallons per day" is calculated converting the "Pond Capacity" and the "Maximum Daily Maintenance Volume" to gallons. The "Pond Capacity" is then divided by 13,000 gallons minus the "Maximum Daily Maintenance Volume" in gallons to determine the number of days to fill pond. This number should be between 1 and 365 if this pond is to be described as a domestic use.

User Input
Calculated value
Formula Explanations

Evaporation Loss Calculation

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This spreadsheet has been designed by Idaho Department of Water Resources to estimate the annual evaporation losses from a pond.

The acronyms used on the Kimberly Research Center website are defined below:

P = Precipitation
ET= Evapotranspiration
P _d = Precipitation deficit
P _d =ET-P

USING THIS SPREADSHEET

To ascertain the evaporation from a pond, you will need to go to the Kimberley Research Center website. The link is found below. This web site provides the Precipitation Deficit for the area where the pond is located. The Precipitation Deficit is the total amount of free pan evaporation minus the precipitation for a given area, which gives the total amount of evaporative losses incurred by the pond. There are several weather sites that are used, and the entire state is pretty much covered. IDWR staff can find the nearest site using Arc Map. The shape file containing the sites can be found at X:/Spatial/Climate/ETIdahostations.shp.

User Input

Calculated value

Formula Explanations

Found at: <http://www.kimberly.uidaho.edu/ETIdaho/online.php>

Precipitation Deficit

Station: Twin Falls 2 NNE (NWS -- 109294)

Month	mm/day ¹	Days per month	mm/Month
Jan	0.00	31	0.00
Feb	0.59	28	16.52
March	1.62	31	50.22
April	2.87	30	86.10
May	3.50	31	108.50
June	4.28	30	128.40
July	5.05	31	156.55
August	4.18	31	129.58
September	2.82	30	84.60
October	1.81	31	56.11
November	0.48	30	14.40
December	0.00	31	0.00

PLEASE NOTE: We cannot use the season average, because there are several areas in Northern Idaho with a negative Precipitation Deficit. Therefore, we must enter each monthly deficit, and enter in a zero (0) for each negative month. The reason for this is that precipitation can only offset evaporation to the extent of the evaporation.

Please enter the daily average Precipitation Deficit as shown in the example below.

Although it has sometimes been useful to consider wintertime evaporation to be zero, Allen and Robison (2007, p. 169) noted, "Evaporation during nongrowing (wintertime) periods varies widely"

¹Negative monthly mean values should be entered in the above table as "0".

Total mm/year = **830.98**

$[(\text{mm/yr}) \div (\text{convert to feet})] \times (\text{Surface area of pond, in acres}) = \text{Evaporation Loss in Acre Feet}$

(**830.98**) $\div$ (**304.8**) $\times$ (**0.20**) = (**0.5 AFA**)

Surface Area of Pond is automatically Carried over from the Seepage Loss Sheet.

SEEPAGE CALCULATIONS

This spreadsheet has been designed by Idaho Department of Water Resources to estimate the total annual seepage losses from a pond.

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User Input
Calculated value
Formula Explanations

INPUTS

SQ. FT. Calculator
Pond Surface area in acres
0.2

POND SURFACE AREA (SQ. FT.)	8712
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SUGGESTED SEEPAGE RATE (FT/DAY)	0.0000
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Use the table below to find the "SUGGESTED SEEPAGE RATES".

FORMULA: (Surface Area X Seepage Rate) / 7.48 = Gallons Per Day loss

CONVERT TO GPD	0	GPD
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TOTAL SEEPAGE LOSS (AFA)	0.0	AFA
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SUGGESTED SEEPAGE RATES FOR DIFFERENT SOIL TYPES:
GW, GP, GM, GC, SW, SP and SM (silty sand, sand silt mixtures and gravel mixtures) = 0.20 ft per day
OL and ML (inorganic silts - very fine sands, silty, or clayey fine sands) = 0.016 ft per day
SC (clayey sands, sand clay mixtures) = 0.007 ft per day
CL (Low to medium plasticity clays) = 0.003 ft per day
MH, OH, PT and CH (high plasticity clays) = 0.0003 ft per day
LINED PONDS (liners can be chemical, fabric, or bentonite) = 0 ft per day
Ponds Intercepting Groundwater (excavated ponds filled with shallow Ground Water) = 0 ft per day

PLEASE NOTE: The initial basis for the Suggested Seepage Rates in the table above is found on Page 16 of Seepage from Fish Ponds, Bulletin 599, August 1989 Alabama Agricultural experiment Station, Auburn University, Auburn University Alabama. If you don't know the soil type, please refer to the map provided at X:\Spatial\Soils\USCS\PondSoils.lyr. Use "0" if the ponds intersect the water table.

ET_{Idaho} 2012 -- Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho

Please send suggestions for improving this site to robison at kimberly dot uidaho dot edu Copyright 2012, University of Idaho.

Grand View (NWS -- 103760)

Statistics based on thirty year normal spans 1940 to 2008 years

For a different land cover or crop click on the above link.

You can highlight this table and copy via the clipboard to a Microsoft Excel or OpenOffice spreadsheet to plot or otherwise work with this data.

Open water - shallow systems (ponds, streams)															
Precipitation Deficit (Click here for a graph)															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Growing Season ^a	Non Growing Season ^b	Annual
Mean ^j	mm/day												mm		
Monthly ^c	0.08	0.59	1.62	2.87	3.50	4.28	5.05	4.18	2.82	1.81	0.48	0.02	819	0	819
15-Day Moving Average ^d	0.09	0.52	1.63	2.91	3.54	4.28	5.09	4.16	2.73	1.88	0.44	0.05			
7-Day Moving Average ^e	0.10	0.58	1.61	2.86	3.51	4.28	5.07	4.17	2.79	1.83	0.44	0.05			
3-Day Moving Average ^f	0.09	0.60	1.63	2.87	3.49	4.29	5.06	4.18	2.81	1.81	0.47	0.03			
Standard Deviation ^k	mm/day												mm		
Monthly ^c	0.56	0.53	1.07	0.69	1.35	0.80	0.78	0.75	0.73	0.83	0.50	0.73	95	0	95
15-Day Moving Average ^d	0.56	0.71	1.02	0.83	1.21	1.03	0.68	0.69	1.02	0.74	0.66	0.64			
7-Day Moving Average ^e	0.80	0.91	1.20	1.22	1.64	1.36	0.88	0.89	1.25	1.04	0.87	0.82			
3-Day Moving Average ^f	1.15	1.22	1.57	1.68	2.17	1.79	1.21	1.19	1.60	1.34	1.18	1.13			
20% Exceedance ^l	mm/day												mm		
Monthly ^c	0.15	0.95	2.18	3.54	4.34	4.96	5.61	4.61	3.32	2.29	0.88	0.40	860	0	860
15-Day Moving Average ^d	0.54	1.34	2.73	4.04	4.85	5.38	5.87	4.95	3.77	2.80	1.17	0.60			
7-Day Moving Average ^e	0.78	1.84	3.29	4.71	5.61	5.95	6.16	5.22	4.19	3.05	1.67	0.88			
3-Day Moving Average ^f	0.98	2.17	3.95	5.24	6.18	6.56	6.61	5.66	4.70	3.57	1.95	1.09			