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Form No. 652 06/2013

PETITION TO CREATE A STREAM DEPLETION ZONE	For Department Use Only
This form may be filed by a municipality, county, conservation district, or local water quality district formed under Title 7, chapter 13, part 45; or by the owners of at least 15% of the flow rate of the surface water rights in the proposed STREAM DEPLETION ZONE. An incomplete or non-qualifying petition will be returned.	Basin 76H 30102741
	Date/Time Rec'd 5/15/15 2:39
	Fee Received $750
	Check No. 2138
	Payor Leonard J Sherven
A fee of **$750** must accompany this petition. Petitioners must also pay reasonable costs of giving notice, holding the hearing, conducting investigations, and making records pursuant to § 85-2-380, MCA.	Deposit No. MSS 1528875
	Received By ae
	Refund $
	Date
Make checks payable to "DNRC"	Def Letter Sent

CONTACT NAME Randy Overton
MAILING ADDRESS 175 Hutton Ranch Rd Suite 103
CITY Kalispell STATE Montana ZIP 59901
WORK PHONE (406) 871-1095 HOME PHONE ______ CELL PHONE ______

1. Definition: "STREAM DEPLETION ZONE" means an area where hydrogeologic modeling concludes that as a result of a ground water withdrawal, the surface water would be depleted by a rate equal to at least 30% of the ground water withdrawn within 30 days after the first day a well or developed spring is pumped at a rate of 35 gallons a minute.

2. Pursuant to § 85-2-306(3)(a)(iv) MCA, the maximum flow rate for all groundwater appropriations that meet exceptions to the permit requirements in § 85-2-306 and are located within a STREAM DEPLETION ZONE is 20 gallons per minute and the maximum volume is 2 acre-feet per year.

3. § 85-2-380 MCA requires that this petition must allege certain facts showing that the following situations exist:

   A. The proposed STREAM DEPLETION ZONE lies within a basin closed pursuant to 85-2-319, 85-2-321, 85-2-330, 85-2-336, 85-2-341, 85-2-343, or 85-2-344.

   B. There exists a hydrogeologic assessment for the area where the STREAM DEPLETION ZONE is proposed that was conducted by either the ground water investigation program established by 85-2-525 or by a hydrogeologist or a qualified licensed professional engineer.

WATER SOURCE

May 15, 2015

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MISSOULA REGIONAL OFFICE

Jim Nave
Montana DNRC Water Resources Division
P.O. Box 5004
Missoula, MT 59806

Re: Stream Depletion Zone Petition

Dear Jim:

Enclosed is a Stream Depletion Petition prepared on behalf of petitioners Jeffery and Nancy Ince, Leonard Skarvan, and J.H. Tenzer, pursuant to the requirements of 85-2-380 MCA. The petition area covers the confluence of the North Fork Rye Creek with Rye Creek, extending up both drainages.

We understand that this is the first Stream Depletion Zone (SDZ) petition that is being submitted to the DNRC, therefore we sent a draft copy to Tim Davis in Helena so that the staff could take a preliminary look at the petition to confirm that the content and form was appropriate.

The groundwater modeling conducted followed the same approach that the Montana Bureau of Mines and Geology employed in some of their SDZ demonstration documents. Since the petition is surrounded on three sides by federal lands the petition area is limited to privately held land. The three petitioners hold 95% of the surface water rights in the petition area.

The enclosed petition documents include Form 652 with the petitioners signatures and the technical report describing the groundwater modeling effort, the results, and mapping of the stream depletion zone; the $750.00 fee is enclosed as well.

Finally, 85-2-380 MCA requires that the hydrogeologic assessment/modeling for the petition be conducted by a hydrogeologist of qualified licensed professional engineer. For the last 41 years I have been working as a hydrogeologist on water supply, hazardous waste, and mining projects. My groundwater modeling experience began in 1980 when I worked for the U.S. Dept. of the Interior. Over the years I have worked on groundwater projects throughout the US, with the last 8 years focused in Montana.

WATER SOURCE

If you have any questions or would like additional information, please feel free to contact me at any time.

SIncerely,

Randy Overton
Principal Hydrogeologist
(406) 871-1095
randy@watersource-llc.com

4. Attach all supporting information including hydrologic analysis prepared by a hydrogeologist, a qualified scientist, or a qualified licensed professional engineer. Hydrologic analysis must include:
   a. The name and address of all water right owners who may be affected.
   b. A 1:24,000-scale U.S. Geological Survey topographic map, or one of similar size, scale and detail. In addition to the information provided on the USGS map, the map must also show the following:
      i. north direction;
      ii. township and range numbers
      iii. section corners and numbers
      iv. accurate outline of the proposed STREAM DEPLETION ZONE
      v. location of any known groundwater recording equipment
      vi. location of any known surface water recording equipment
      vii. points of diversion for all groundwater users, including wells and developed springs.

SIGNATURES OF AGENCY OR DISTRICT REPRESENTATIVE

If submitted by a municipality, county, conservation district, or local water quality district formed under Title 7, chapter 13, part 45 the representative(s) must sign here.

Printed Name ____________________________ Signature ______________________________

Printed Name ____________________________ Signature ______________________________

Send the form to your local Water Resources Regional Office

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****If submitted by petitioning water right holders, please fill out Attachment 1.***

ATTACHMENT 1: SIGNATURES OF PETITIONING WATER RIGHT HOLDERS

Must be signed by the owners of at least 15% of the flow rate of the surface water rights in the proposed STREAM DEPLETION ZONE. Attach additional sheets if necessary.

WE THE UNDERSIGNED WATER RIGHT HOLDERS PETITION THE DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION FOR A STREAM DEPLETION ZONE IN ACCORDANCE WITH § 85-2-380, MCA AND THIS PETITION.

Printed Name	/ Signature
1. Jeffery Ince	/
Mailing Address P.O. Box 875, Darby, MT 59829	Phone (406) 821-2226
2. Nancy Ince	/
Mailing Address P.O. Box 875, Darby, MT 59829	Phone (406) 821-2226
3. Leonard Skarvan	/
Mailing Address P.O. Box 875, Darby, MT 59829	Phone (406) 821-2226
4. J.H. Tenzer	/
Mailing Address P.O. Box 1089, Darby, MT 59829	Phone (406) 821-1040
5.	/
Mailing Address	Phone
6.	/
Mailing Address	Phone
7.	/
Mailing Address	Phone
8.	/
Mailing Address	Phone
9.	/
Mailing Address	Phone
10.	/
Mailing Address	Phone
11.	/
Mailing Address	Phone
12.	/
Mailing Address	Phone
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Mailing Address	Phone
15.	/
Mailing Address	Phone
16.	/
Mailing Address	Phone
17.	/
Mailing Address	Phone

WATER SOURCE

Groundwater Model Determination of Extent of Stream Depletion in Rye Creek - North Fork Rye Creek Drainages

Stream Depletion Zone Petition for Ince/Skarvan/Tenzer

Prepared for Petitioners:
Jeffery and Nancy Ince
Leonard Skarvan
J.H. Tenzer

May 15, 2015

Randall J Overton
Principal Hydrogeologist
Water Source, LLC

Table of Contents

1.0 Introduction

Jeffery and Nancy Ince, Leonard Skarvan, and J.H. Tenzer hold 95 percent of surface water right 76H-150386-00 with points of diversion at the confluence of the North Fork Rye Creek with Rye Creek and on the North Fork Rye Creek; Rye Creek discharges to the Bitterroot River. The Bitterroot River watershed is a closed basin pursuant to 85-2-344 MCA. The Inces, Skarvan, and Tenzer are petitioning the Montana DNRC to create a Stream Depletion Zone (SDZ) pursuant to 85-2-380 MCA.

Water right 76H-150386-00 has an April 1, 1887 enforceable priority date. The petitioners water rights account for 95% of the surface water rights within the proposed Stream Depletion Zone (SDZ). The proposed SDZ surrounds the confluence of Rye Creek and North Fork Rye Creek, extending downstream a short distance on Rye Creek, and upstream on both Rye Creek and North Fork Rye Creek.

The intent of petitioning for designation of a stream depletion zone along upper Rye Creek and the North Fork Rye Creek is to protect existing irrigation water rights. Surface water and groundwater are hydraulically connected in the vicinity of the Rye Creek - North Fork Rye Creek confluence. The use of water from shallow ponds, pits, and shallow large diameter wells, are increasingly diverting surface water from the North Fork Rye Creek and Rye Creek.

The upper Rye Creek watershed includes the main stem Rye Creek and the North Fork Rye Creek; the greater Rye Creek watershed discharges to the Bitterroot River between Conner and Darby. Figure 1 shows the location of the petition area. The geomorphic and hydrogeologic character of the stream system changes between the Rye Creek and North Fork Rye Creek confluence and the downstream end of Rye Creek near the confluence with the Bitterroot River. The elevational difference from the confluence of Rye Creek and the North Fork Rye Creek down to the downstream end of Rye Creek at the Bitterroot River is 250 feet drop over a 4.75 mile distance, and the alluvial sediments and groundwater are directly linked to the Bitterroot River and alluvium. Groundwater near the Rye Creek confluence with the Bitterroot River is hydraulically consistent with the alluvial aquifer of the river. The shallow groundwater between the upper Rye Creek watershed at the North Fork Rye Creek is separated from the Bitterroot alluvium due to elevational differences, distance, and multiple bedrock intrusions that effectively separate shallow groundwater along the Rye Creek corridor into discontinuous occurrences.
The bedrock underlying the upper Rye Creek watershed is generally granite and related bedrock, with some volcanic intrusives and Belt Supergroup rocks; mostly the underlying bedrock is mapped as granite, and augen gneiss (See: Preliminary Geologic Map of the Nez Perce 30 x 60 Quadrangle, Preliminary Geologic Map of the Hamilton 30 x 60 Quadrangle, Geologic Map of the Dillion 1° x 2° Quadrangle).

The geologic history of the area included a significant amount a tectonic activity, igneous intrusions creating the Idaho Batholith, and the development of the Rocky Mountain trench. The end result is the current geologic structure underlying the Rye Creek watershed where there has been significant faulting and movement of bedrock elements and subsequent erosion. During drier periods colluvial deposits have tended to encroached on valley floors becoming thicker towards the mountain block where the sediments originated from, resulting in the current landforms we view today.

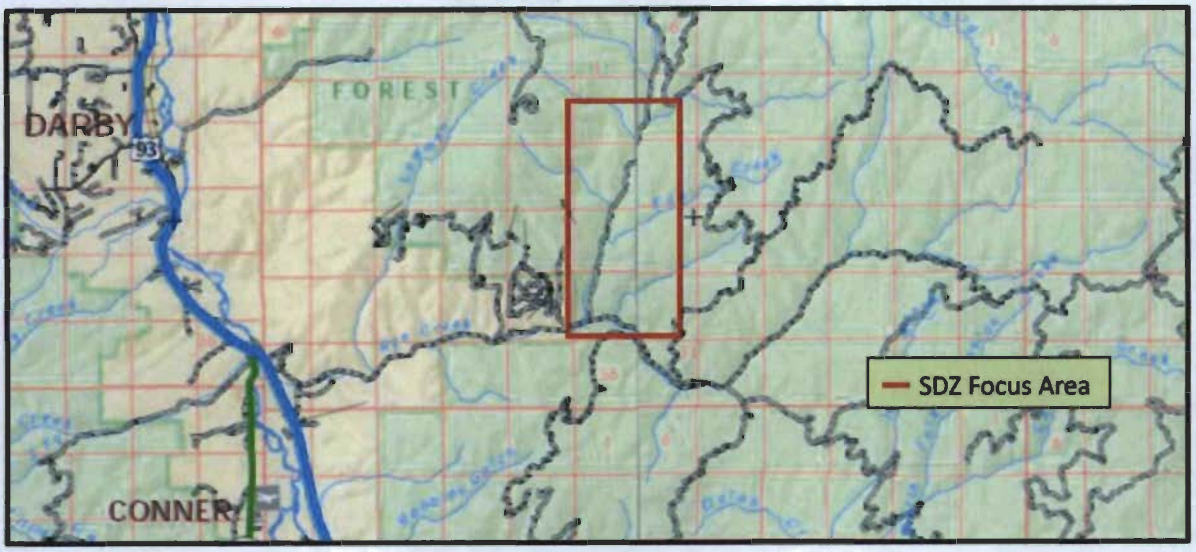


Figure 1

The canyon and valley floor of Rye Creek and the North Fork Rye Creek vary in form largely in response to slope and width of the canyon/valley floor. The basic structure is alluvial and colluvial sediments occupy the valley and canyon floors and are bound and underlain by bedrock. The faulting and movement of the bedrock units resulted in fracturing of the rock altering the hydraulic fabric of the rock such that hydraulic characterizes are elevated, but variable, where faulting and fracture swarms occur. The thickness of the canyon and valley sedimentary fills over which the streams flow are variable with occasional rock outcrops at the stream bottoms penetrating and limiting the continuity of the alluvium. The intervening fills between rock outcrops can be relatively thin to thick, on the order of 200 feet or more. Where thicker sediments exist buried paleochannels occur, occupied by higher hydraulic conductivity sands and gravels that are surrounded by lower hydraulic conductivity sediments. In some areas relatively thin layers or sheet deposits of moderate hydraulic conductivity sediments can occur. In short, the canyon and valley floor deposits are complex interbedded interfluve deposits that are similar to deposits that occupy many steeper alluvial valley floors. The principal differences within the Rye Creek system are the steeper canyon segments are likely dominated by coarser sediments.

In general, the bedrock adjacent to the streams are more fractured with higher hydraulic conductivity than the majority of bedrock within the watershed. The distribution of hydraulic conductivity in the bedrock is higher in the soil mantel and regolith, with decreasing hydraulic conductivity with depth and as the frequency of fractures and fracture aperture decreases. The principal deviation from the general case is periodic zones of faulting and the associated fracture swarms that may accompany the fault zones. The expected trend is that fracture system hydraulic conductivity also declines with depth, but mostly remaining higher than surrounding rock.

Figure 2 outlines the upper Rye Creek and North Fork Rye Creek watershed, which is a bit over 30,000 acres, and is located on the east side of the southern Bitterroot Valley. The watershed elevation ranges from about 4,200 feet msl downstream of the confluence of Rye Creek and North Fork Rye Creek, up to the highest point of 7,400 feet msl in the Rye Creek headwaters.

The primary source of water in the watershed is from snowmelt providing direct runoff in the spring, and recharge to groundwater that is released to streams throughout the year; secondary sources of water are from occasional thunderstorm activity in the summers. The more intense summer time storms also provide direct runoff, but most summer precipitation infiltrates the soils and regolith, which is then followed by a few days of elevated stream flow as the shallow water in the regolith discharges to streams. The majority of groundwater is stored in the upper 100 to 500 feet of bedrock.

2.0 The Model Structure

ModFlow 2005 was used to develop a model of the watershed using the USGS ModelMuse GUI. ModelMuse employs a object orientated method for assigning model parameters and where model packages are operational. Key elements of the model structure and implementation are shown in Figure 3 and described below. The illustrated model elements are, the model top elevation (color coded surface), stream segments, riparian zones with high evaportraspiration straddling the streams, and a zone where the alluvium has higher hydraulic conductivity.

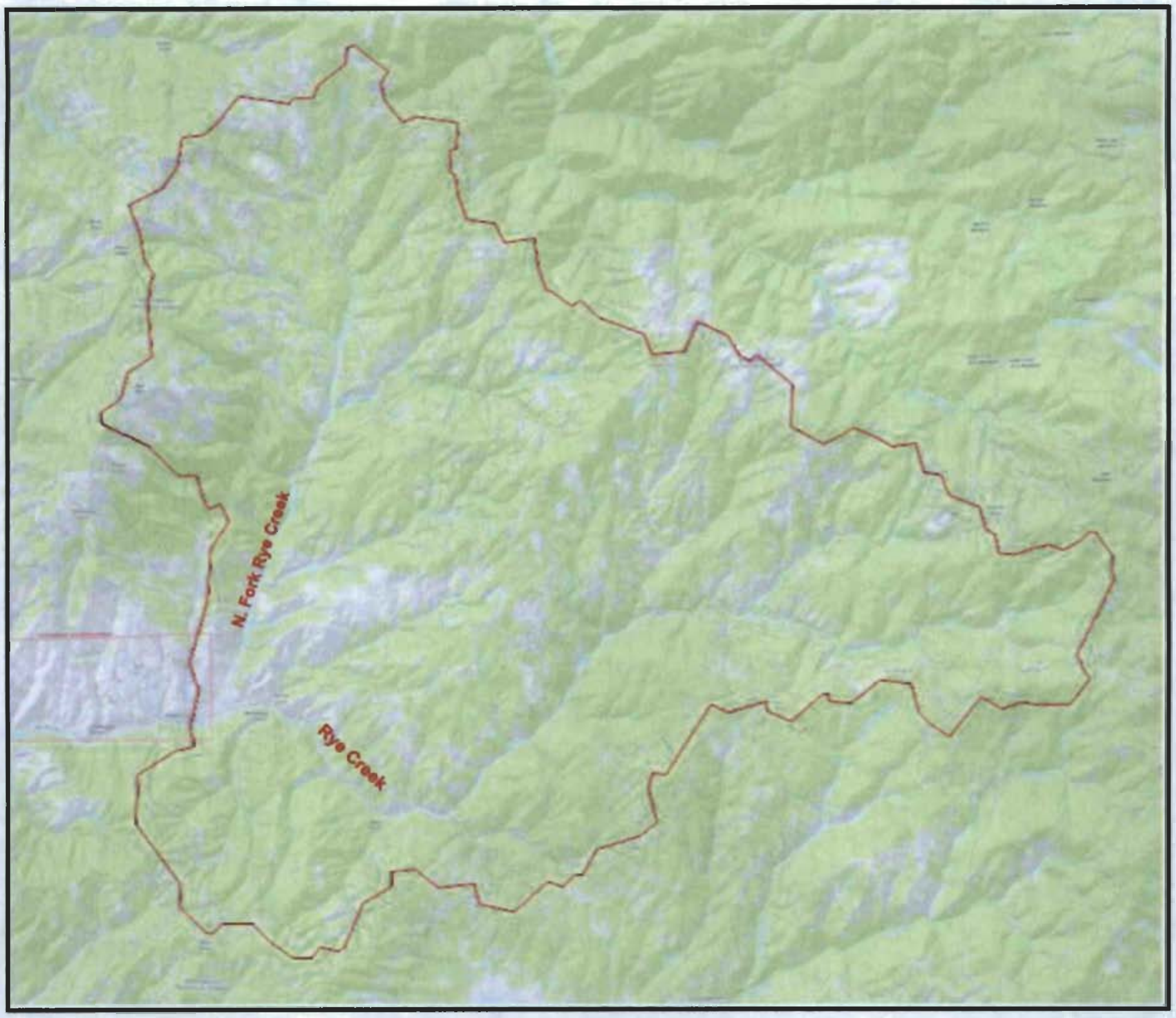


Figure 2

2.1 Model Grid

A uniform model grid using 500 feet by 500 feet grid cells was employed. The grid is 115 (easting) by 96 (northing) cells; each cell covers 5.74 acres. There are 5 layers in the model, each being 100 feet thick and using the same grid configuration.

2.2 Elevation Model

The model top surface was derived from a modified USGS DEM data set, and is a subdued expression of the land surface. The initial model top surface was used as the reference elevation data set for the initial head used in the model.

2.3 Model Layers

The model is structured with 5 layers, each being 100 feet thick. The top and bottom of each layer is set relative to the model top elevation. The top layer (L1) and second layer (L2) were set as convertible layers so that dewatering and rewetting could be handled appropriately by the model. The upper 100 feet (L1) is the most complex in terms of variable conditions that needed to be accommodated with one set of values. As a general approach, the model hydraulic conductivity and storage terms were set to progressively lower values with depth. Table 1 summarizes the hydraulic parameter values used in the model.

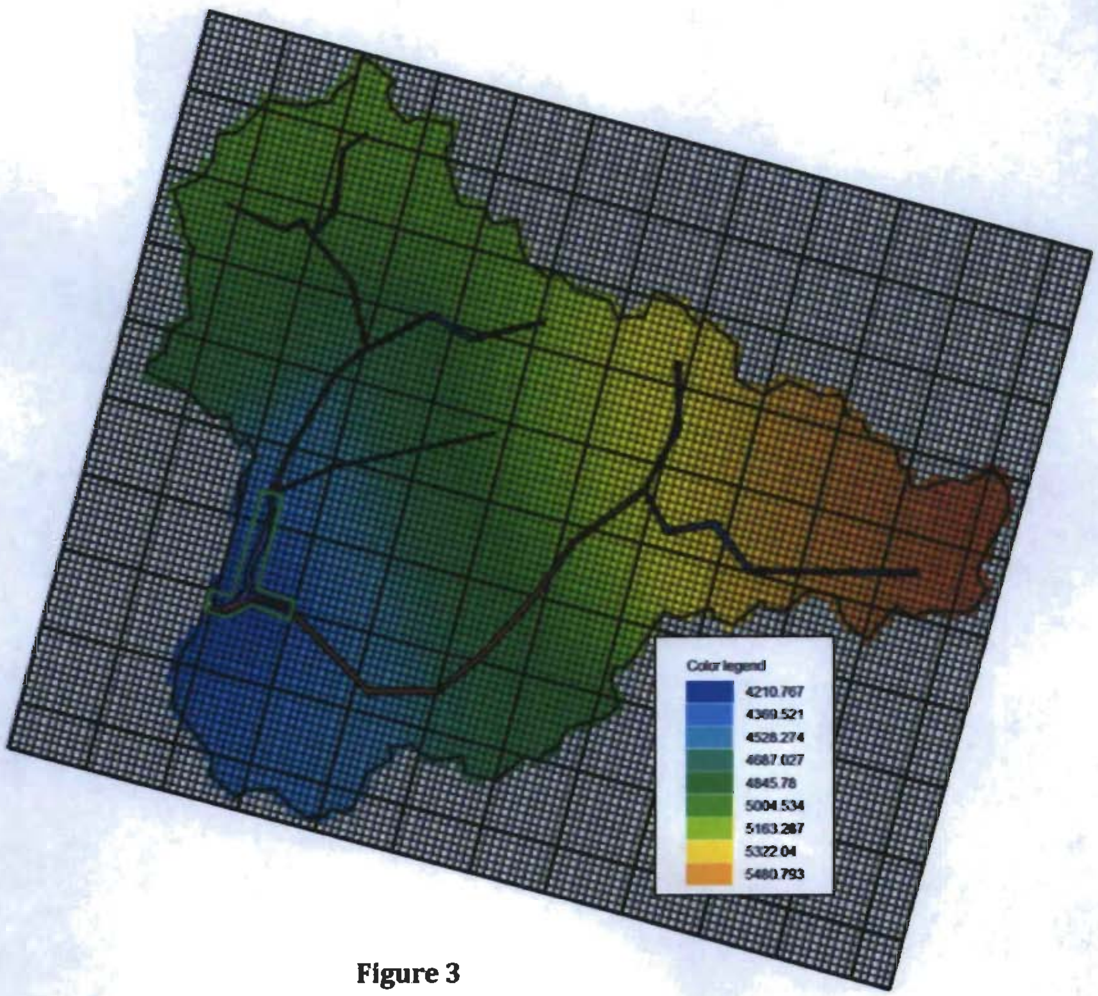


Figure 3

The top layer, L1, needed to accommodate a variety of conditions over generally steep terrain. Because of the difficult of establishing a reasonable operating model over the complex terrain the hydraulic conductivity for the top layer was set as an average of the expected conditions with the upper 100 feet. Splitting the top layer into separate layers with varying hydraulic parameters was avoided because of the complexity of resolving numerical solutions for thin layers in steep terrain. Thin layers with higher hydraulic conductivity would lead to frequent dewatered conditions, which in turn would require short time steps to achieve numeric stability. Based on field conditions, the upper several feet of the surface, whether steeper mountain sides, slopes covered with colluvium, or valley bottom, are all expected to have the highest hydraulic conductivity within the layer.

The hydraulic conductivity of the L1 layer bedrock will also vary depending upon the degree of fracturing, especially associated with fracture swarms and faulting. The hydraulic conductivity in the L1 near surface could vary from ≈150 ft/day for cleaner sand and gravels and some regolith, down to perhaps 0.1 ft/day for lightly fractured bedrock at greater depth within the layer. Two sets of L1 hydraulic conductivities were used for distinctly different settings. For the majority of the modeled area a hydraulic conductivity of 0.4 ft/day was estimated. For some areas within the valley/canyon floor near the confluence of Rye Creek and North Fork Rye Creek the bedrock is more fractured and thicker sand and gravel deposits are more frequent. In this second zone within the L1 layer, the hydraulic conductivity was estimated at 19.30 ft/day. The storage term for L1 was set as 0.02, also reflecting the range of conditions within the upper 100 feet, from unconfined in the near surface to weakly confined behavior at depth.

The hydraulic parameters used for the deeper layers, L2 - L5, were treated in a simpler and more uniform fashion.

Table 1

Hydraulic Conductivity and Storage Parameter Values						
Layer		Kx ft/d	Ky ft/d	Kz ft/d	Sy	Ss
L1	0' - 100'	0.4	0.4	0.04	0.02	0.02
L1 alluvium		19.3	19.3	1.93	0.02	0.02
L2	100' - 200'	0.05	0.05	0.005	0.001	0.001
L3	200' - 300'	0.01	0.01	0.001	0.0005	0.0005
L4	300' - 400'	0.005	0.005	0.0005	0.0001	0.0001
L5	400' - 500'	0.001	0.001	0.0001	0.0001	0.0001

2.4 Recharge

Recharge is the source of water for the model rather than using constant head boundaries. Recharge within the model is based on 30 year precipitation and temperature averages as obtained from PRIZM (*PRISM Climate Group at Oregon State University*). A modified Thornthwaite-Mather soil water balance model was used to estimate the recharge and the timing of recharge for the modeled area (*SWB – A modified Thornthwaite-Mather Soil Water Balance code for estimating groundwater recharge: U.S. Geological Survey Techniques and Methods 6-A31*). The Thornthwaite-Mather method accounts for precipitation, snowmelt, runoff, evapotranspiration, changes in soil water storage, with excess water available as groundwater recharge. The Thornthwaite-Mather model also accounts for the timing and rate of recharge.

Once the net infiltration available for recharge was mapped spatially and in time, the data was averaged within three categories of high, medium, and low recharge, with a large area where no net infiltration occurs. As would be expected the high recharge coincided with the higher elevations where the greatest snow pack develops, and with the least recharge occurring in the lower elevations. In the lower elevation there is a significant area where there was little to no recharge because the potential ET is high enough that all infiltration is removed by ET. Based on the distribution in the low recharge area the low recharge occurrence was consolidated in area somewhat. The recharge in each category (high, medium, low) was averaged over each area and the recharge was split up into two week time periods until the all the recharge water was applied. The timing of the recharge in each category varied somewhat over the time periods. Table 2 shows the time periods in days relative to January 1 along with the daily recharge rate per square foot used in the ModFlow model.

Table 2

Recharge by Infiltration Rate, Area, and Volume				
Cumulative Rate	Recharge Time Period by Days	Daily Recharge Rate in Feet	Net Recharge Volumes Ac/Ft	Recharge Area in Acres
0"	-	0.0	0.0	2,537.12
0" - 2"	120 - 135	0.003385211	249.15	4,906.55
	135 - 151	0.006873006	539.56	
2" - 4"	120 - 135	0.010496402	1,104.50	7,015.10
	135 - 151	0.010496402	1,178.13	
4"-14"	120 -135	0.007293424	1,748.23	15,979.94
	135 -151	0.014587397	3,729.69	
	151 -166	0.010874984	2,606.72	
Totals			11,155.96	30,438.71

2.5 Streams

Streams draining the largest subwatersheds with the modeled area were established in the model using the Stream Flow Routing (SFR) package; smaller tributaries to these streams were not included. The SFR package was preferred over the STR package because of the GAGE option to output stream segment discharges for last and/or all stream reaches within the stream segment as an adjunct file. The GAGE option has been useful when exploring stream reaches and segments that would be affected by well pumping.

The general performance and behavior of streams within the greater watershed was of interest, but a particular interest was to examine stream discharge out of the model from the exit stream reach, the stream segment/reach gain or loss of water, and the differences between when pumping was or was not conducted. These interests also influenced the choices within the SFR package.

Early in the process the choice of setting and stream channel characteristics were explored. The stage calculation (ICALC) choices did not appear to make significant difference in outcomes, but did significantly increase output file sizes and increased execution times (convergence). When using a more complex channel form, calculated stream stages were somewhat higher but overall stream leakage (±) was about the same. Consequently, a simple specified stage approach proved to be most efficient.

The streambed has been observed to have a clogged layer and therefore the hydraulic conductivity of the streambed was adjusted to account for clogging. The hydraulic conductivity of the clogged layer was set by formula to be 20% of the L1 hydraulic conductivity and the thickness of the clogged layer set at 0.5 feet. Stream widths varied from 10 to 15 feet in width depending upon location in the model. The established stage was set at one foot and simple reservoir routing was employed from in each reach to accumulate and pass flows through the system.

In order control files size and processing time the GAGE option was set to record the last reach only in each stream segment. However, flow and stream leakage information for each reach is also included in the stream listing file.

For purposes of the SDZ determination, depletion of water from a stream is estimated by comparing the result of two identical models where the only difference is turning on a pumped well in one model but not the other. The stream depletion is evident when there is a difference in volume of stream leakage between the two models. We compared the stream leakage values for a reference case (non-pumping) with the pumped well case and found that the difference between stream leakage values for a reference time step also matched the difference between the last or exit stream segment gage values as well.

2.4 Riparian Zone Evapotranspiration

Evapotranspiration (ET) was handled in two ways within the model. As previously described in the Recharge discussion, ET was deducted from the general recharge water budget when net recharge was determined. However, in riparian zones adjacent to drainages, shallow groundwater is still available for plants throughout the growing season, and ET in those areas can be significant. Therefore, in the stream corridors the Evapotranspiration package (EVT) was used. The key purpose of using the EVT package was to simply remove water from the system. Because not every tributary to the larger drainages were included as separate stream segments, the size (width) of the EVT areas were increased along the simulated streams to account for additional upland riparian zone ET.

The EVT package timing is based on ET starting in mid-April of each year and continuing for 4.6 months into September of the year. The ET rate was set as a constant rate of 0.02 $ft/day/ft^2$, and based on a reference ET surface elevation equal to the initial head, with an extinction depth of 10 feet.

3.0 Model Calibration

Traditional data presumed to be available for model calibration includes significant potentiometric data sets from wells that are ideally scattered across the modeled area along with long term stream gauging data. Such information does not exist in the Rye Creek watershed. However, limited and alternate data are available. Limited stream gauging on the North Fork Rye Creek was conducted beginning from just prior to, through the end of, irrigation season during 2013. Other types of information used include the headwater extent of the onset of intermittent discharge to streams, the seasonal decline in elevation for the point where discharge onset occurs, and the headwater extent of shallow groundwater supported riparian vegetation.

The model was adjusted so that stream flows in the lower portion of the North Fork Rye Creek approximated flows measured during stream gauging in the spring of 2013 year. Data collected in the spring of 2013 at two locations along the lower North Fork Rye Creek were used as reference flows for calibration purposes and compared to the GAGE data for the outlet of the North Fork Rye Creek segment at the confluence with Rye Creek. Stream gauging was conducted at the first and fourth bridges that cross the North Fork Rye Creek in mid-March and May of 2013. Mid-March gauging was conducted just before the onset of increased flows associated with snowmelt, and May gauging was conducted during the declining limb of the spring runoff. Table 4 summarizes the data.

Table 4

Rye Creek and N. Fork Rye Creek Flows in CFS				
Dates	N Fork Rye Creek 1475' upstream Field Measurement	N Fork Rye Creek 3300' upstream Field Measurement	N Fork Rye Creek Confluence GAGE File Data	Main Rye Creek Confluence GAGE File Data
Feb 26	-	-	4.8	2.4
Mar 14	3.7	4.5	14.2	9.0
Mar 31	-	-	17.2	12.8
May 8	11.3	12.5	7.1	4.1

field measurements collected in 2013

Since water in the model is based on 30 year average temperature and precipitation data from the PRIZM data, the predicted recharge/runoff/discharge will reflect average conditions and does not include the variability that occurs from year to year. The 2013 gauging data suggests recharge/runoff began a bit later than would occur in a true average year, but the magnitude of the recharge/discharge event matches fairly well. The data measured during the 2013 season suggests the runoff season began 2 to 3 weeks earlier than that suggested by the PRIZM average. The gauging data also compares well with the predicted stream flows, and is certainly well within range of normal year to year variability.

The annual rise and fall of groundwater elevations in terrain where higher levels of recharge occur was predicted to be in the range of 100 to 200 feet, which appears to compliment the extent of the seasonal increase in elevation of the onset of flow in intermittent headwater drainages. Data from one shallow piezometer placed 100 feet from North Fork Rye Creek indicates that close to the stream the groundwater only rises and falls by 1.0 to 1.5 feet over the year, comparable to the model prediction of 1.0 to 0.5 feet per year.

With the lack of potentiometric data points scattered over the watershed, the beginning potentiometric surface was estimated with a process of equating the surface with the DEM data for the watershed, using an average recharge values, and running a steady state solution. Trial and error ultimately produced an acceptable beginning condition from which transient simulations could begin.

Parameter adjustment and iterative model runs continued until the model performed with reasonable seasonal variation in stream flows, and with multiple year simulations closely repeating each other using an initial head feedback mechanism. As mentioned earlier the most dramatic rise and fall of groundwater levels was in the higher terrain, and in the low terrain adjacent to North Fork Rye Creek the range over the course of the year was about 1.0 to 0.5 feet.

4.0 Determining the Stream Depletion Zone

Once a the base or reference model was completed (without an operating well), the reference model was run once for a comparative or reference case. The reference case was compared to reparative model runs where an operating well was simulated in differing cells. The process was repeated by beginning with a copy of the first reference model, moving the well to a new cell, and rerunning the model. After each run the results of the model with pumping was compared to the reference case results. The flow chart in Figure 4 outlines the process for determining if depletion of a stream was occurring by pumping a well in a specific cell in the model.

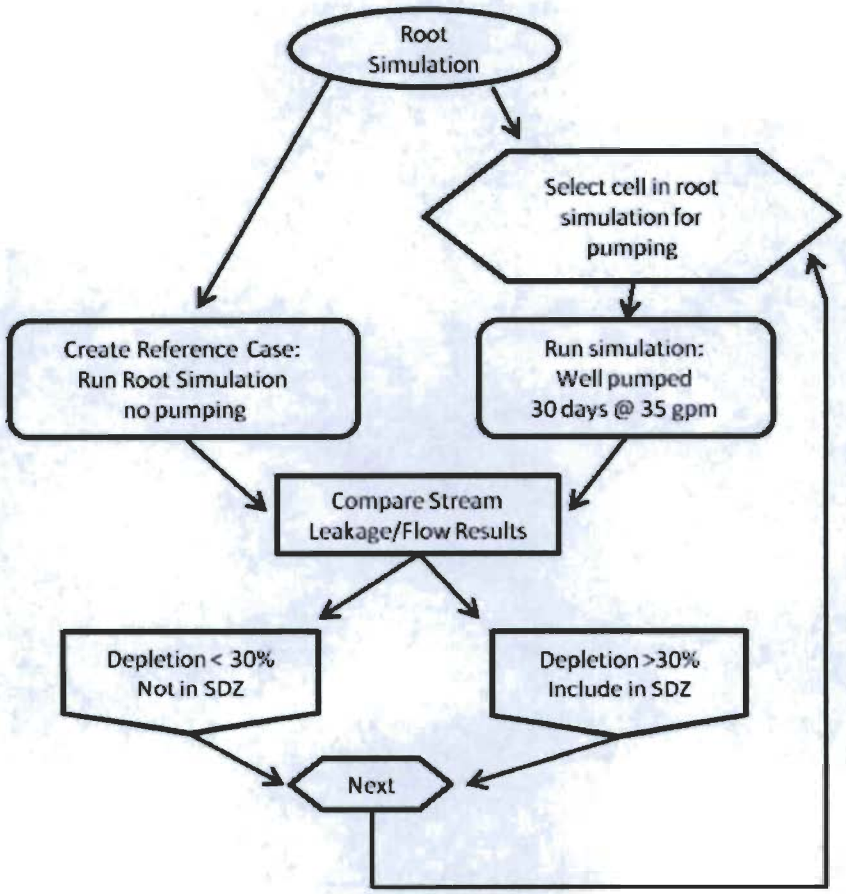


Figure 4

As previously discussed, the difference in the result of the stream segment discharging from the model was always equivalent to the difference between the stream leakage values reported in the model results. Since extracting stream discharge values from GAGE files was faster than using stream leakage values from LST files, the stream discharge value differences were used. The discharge differences were compared to the daily pumped volume/rate for the last model time step that included pumping. The pumping schedule in the model was set at 35 gpm for 30 days (6737.9679 ft^3/day) in the last time period of the model run. The last time step in the time period was 7.7134 days and the reported discharge/leakage is the average daily volume/rate. If the difference between pumped and reference case stream flow/leakage was greater than 30% of the daily pumping rate or 10.5 gpm (2021.39 ft^3/day), the cell where the well was located was included within the stream depletion zone.

The MNW2 well package was used in the model because it was more flexible than the WELL package as MNW2 allows definable well parameters. All wells were set as pumping only from the L1 layer because the history of wells in the mountainous terrain of the area indicated that most wells were 100 feet in depth or less. In cases where wells are deeper they tend to stop when they hit the first producing set of fractures within the bedrock. Wells completed in colluvial/alluvial settings are frequently less than 100 feet in depth and may include screened sections, perforated casing, or simply be cased as an open bottom well. Bedrock wells typically include a surface casing with an open hole completion and a plastic liner. The simulated wells were set as 8" diameter boreholes with a 6" positive skin to account for borehole sidewall fracturing in the shallow bedrock and the influence of well development.

5.0 The Results

The reference case model was used as the beginning point for determining specific stream depletion rates from a single well at a specific location or model cell.

After the reference case simulation was run, determining the extent of the stream depletion zone is a simple methodical process. A series of model runs are conducted by simply moving the pumped well location from cell to cell (see Figure 4 flow chart) and the model is rerun. The difference in results between the reference case and the pumped version are recorded. After repeated runs with different well locations patterns begin to emerge. Keeping in mind that the watershed is relatively steep terrain, the performance of well close to a stream will behave differently than if the well is located at some distance from a stream and perhaps on top of a ridge. Overall a pattern of a relatively narrow stream depletion zone straddling streams emerged. The SDZ varied from about 1,500 to 2,500 feet in width. In areas where tributaries joined, the SDZ would tend to be wider. Figure 5 shows the cells used for the well locations in the iterative process outlined in Figure 4.

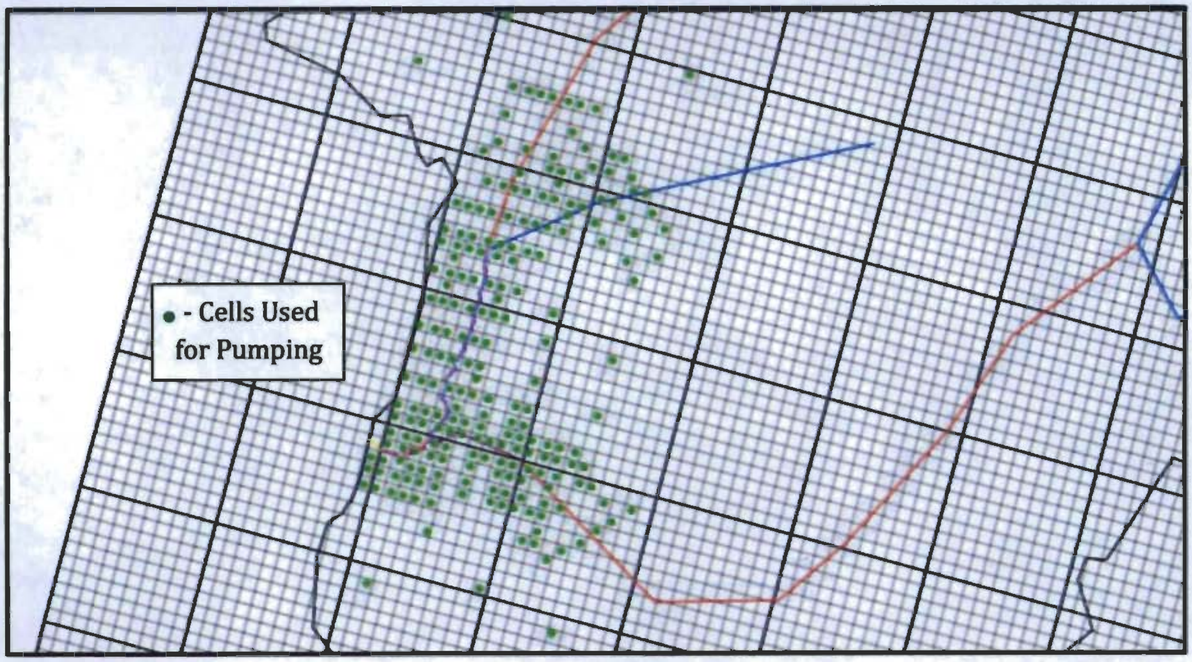
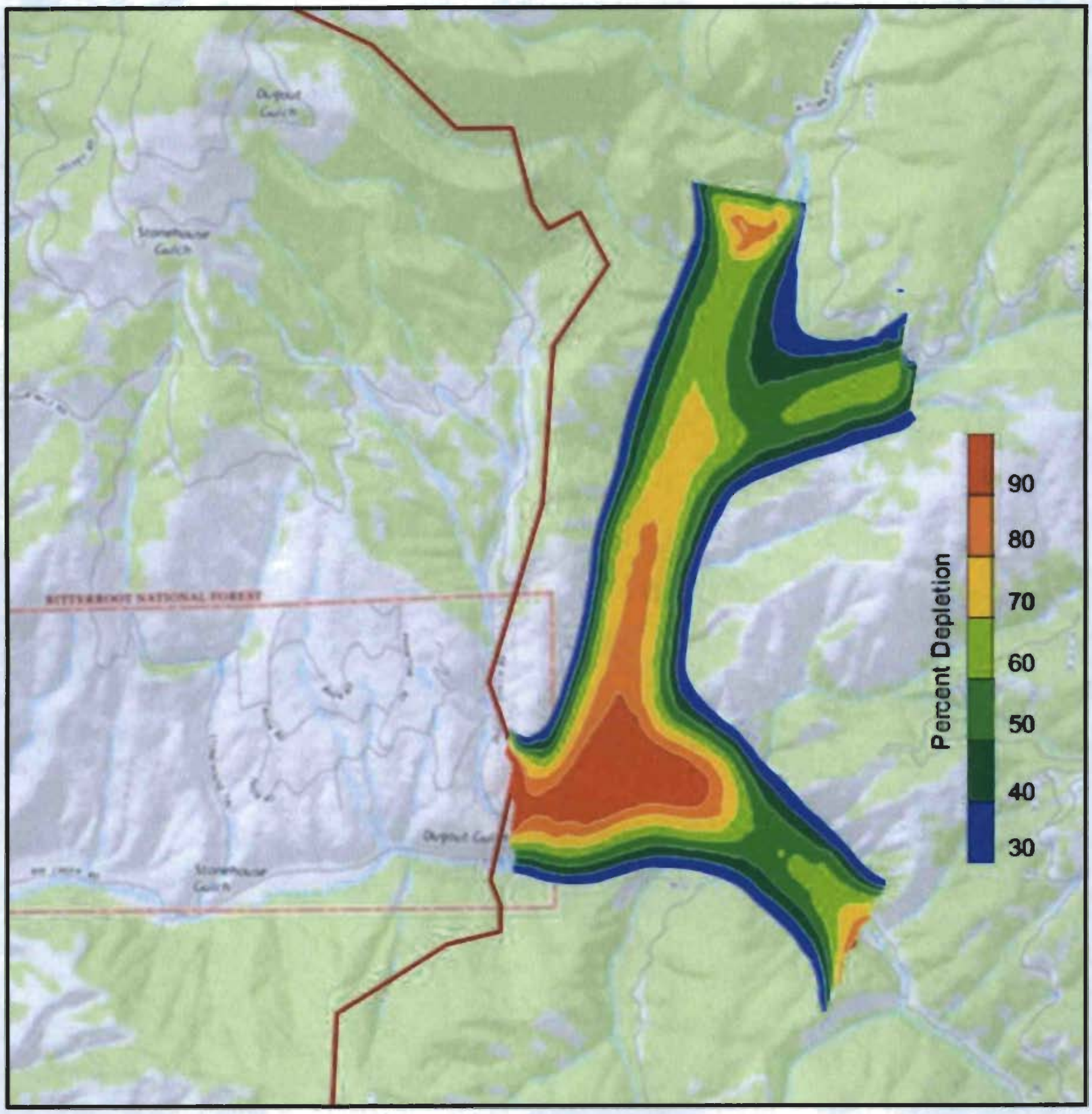


Figure 5

Once a clear pattern emerged the choice of cells within which the well was placed was altered. Initially every cell adjacent to and intersected by the stream was used for well placement, with adjacent second and third tier cells located away from the streams also utilized. Once the depletion percentage dropped below 30% subsequent wells at distance from the stream were not included in the test. Occasional upland cells were tested to confirm that at distance from the streams, depletions would not exceed 30% depletion. After the first 50 pumped cells, the near stream pattern of depletion became evident and the choice of cells used for pumping was adjusted to cells in every other row or column in the model grid that were perpendicular to the stream. Testing was extending into upland areas until the 30% SDZ limit was reached. Figure 5 illustrates the portion of the model grid with the cells used for the pumped well marked. Figure 6 is a mapping of the modeled stream depletion rates showing the depletion rates from 100% down to the 30% limit.

Appendix A contains a table listing the of results of 226 model runs. In each model run the pumped well was moved to a new cell. The results included in the Appendix A table include pumped well location by grid column and row, daily exit stream flow volume/rate, the daily depletion volume, and the percent stream depletion.



Percent Depletion
90
80
70
60
50
40
30
BITTERROOT NATIONAL FOREST

Figure 6

7.0 Proposed Stream Depletion Zone Limits

The focus in identifying the stream depletion zone was on the lower extent of the watershed where privately held lands and irrigation is concentrated. The majority of the watershed is Federally held land managed by the U.S. Forest Service, therefore, the proposed SDZ is limited to areas dominated by privately held lands.

Figure 7 illustrates the outline of the proposed SDZ and also shows the locations of existing groundwater diversion points within the SDZ. Table 5 lists the latitude and longitude of the SDZ corner points; the coordinates were taken from points on Google Earth and it is based on a WGS 84 projection. Figure 8 shows an overlay of the proposed SDZ on a Montana Cadastral map that shows the location of privately held lands and federal lands (green shading).

Table 6 lists provides a list of all of the surface and groundwater rights holders that may be affected by the proposed stream depletion zone. The ownerships are based on the names and adresses as listed on abstracts obtained from the Montana DNRC.

Table 5

SDZ Corner Point Coordinates		
Point #	Latitude	Longitude
1	45.981671	-114.0473332
2	45.981709	-114.040702
3	45.995759	-114.036002
4	45.995755	-114.024326
5	45.983794	-114.027975
6	45.980678	-114.021766
7	45.974022	-114.026802
8	45.974038	-114.043876

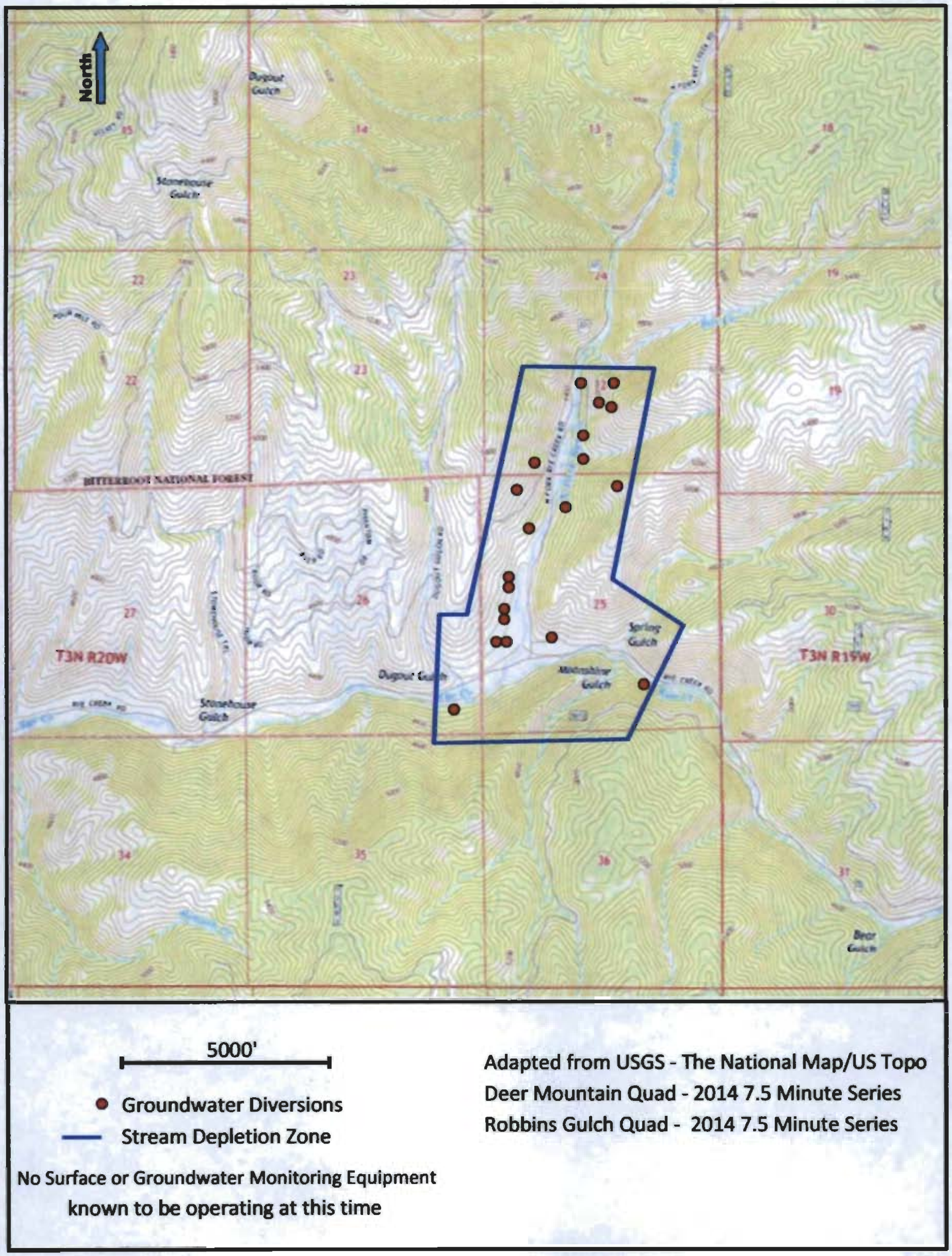

North
Dugout Gulch
Stonehouse Gulch
Bitterroot National Forest
T3N R20W
T3N R19W
Dugout Gulch
Stonehouse Gulch
Spring Gulch
Moonshine Gulch
Bear Gulch
5000'
Groundwater Diversions
Stream Depletion Zone
No Surface or Groundwater Monitoring Equipment
known to be operating at this time
Adapted from USGS - The National Map/US Topo
Deer Mountain Quad - 2014 7.5 Minute Series
Robbins Gulch Quad - 2014 7.5 Minute Series

Figure 7

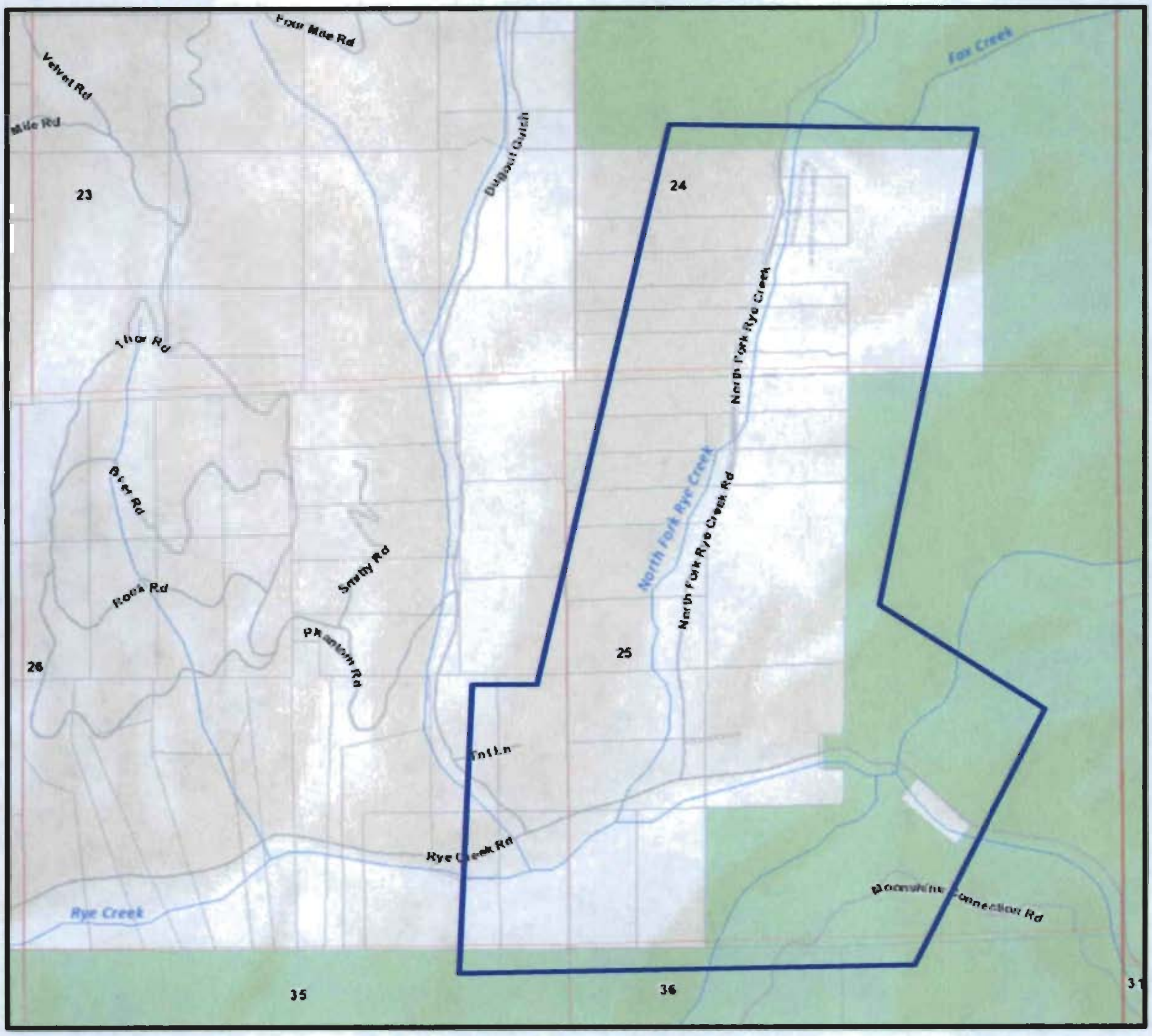

Velvet Rd
Dugout Gulch
Fox Creek
23
24
North Fork Rye Creek
North Fork Rye Creek Rd
25
26
Rye Creek Rd
Rye Creek
Connection Rd
35
36

Figure 8

Table 6

Groundwater Source

76H 102442 00
GALE DODD
124 TAILGATE LN
HAMILTON, MT 59840

RHONDA DODD
124 TAILGATE LN
HAMILTON, MT 59840

RICHARD BEAUDIN
PO BOX 1155
DARBY, MT 59829

MARY BEAUDIN
PO BOX 1155
DARBY, MT 59829

76H 102441 00
GALE DODD
124 TAILGATE LN
HAMILTON, MT 59840

RHONDA DODD
124 TAILGATE LN
HAMILTON, MT 59840

RICHARD BEAUDIN
PO BOX 1155
DARBY, MT 59829

MARY BEAUDIN
PO BOX 1155
DARBY, MT 59829

76H 106368-00
PATRICIA EVANS
PO BOX 1168
DARBY, MT 59829

MELISSA D BRYANT
PO BOX 1168
DARBY, MT 59829

76H 107624 00
CATHY USHER
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

DAVID BERNARD
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

DANIEL BERNARD
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

CARMA HARREL
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

76H 25707 00
CATHY USHER
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

DAVID BERNARD
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

DANIEL BERNARD
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

CARMA HARREL
66826 BISHOP CREEK RD
DEER ISLAND, OR 97054-9520

76H 30020567
JANICE RIKUSTAD
PO BOX 322
DARBY, MT 59829

76H 92116 00
RICHARD BEAUDIN
PO BOX 1155
DARBY, MT 59829

MARY BEAUDIN
PO BOX 1155
DARBY, MT 59829

76H 108063 00
EDWARD J LESKY
PO BOX 1257
DARBY, MT 59829

76H 114427 00
JEFFREY L INCE
PO BOX 875
DARBY, MT 59829

NANCY LS INCE
PO BOX 875
DARBY, MT 59829

76H 114428 00
JEFFREY L INCE
PO BOX 875
DARBY, MT 59829

NANCY LS INCE
PO BOX 875
DARBY, MT 59829

76H 30008777
JUSTIN L BOCIEK
4284 N FORK RYE CREEK RD
DARBY, MT 59829-9704

76H 30019729
PAMELA ASLINGER
PO BOX 1311
KENNEBUNKPORT, ME 04046

76H 30041801
TOM JOLLEY
4323 N FORK RYE CREEK RD
DARBY, MT 59829

KELLY JOLLEY
4323 N FORK RYE CREEK RD
DARBY, MT 59829

76H 30041802
TOM JOLLEY
4323 N FORK RYE CREEK RD
DARBY, MT 59829

KELLY JOLLEY
4323 N FORK RYE CREEK RD
DARBY, MT 59829

76H 30045989
MARY BETH GORACKE
140 LORD LN
CONNER, MT 59827

LYLE E GORACKE
140 LORD LN

CONNER, MT 59827

76H 30051565
TOM JOLLEY
4323 N FORK RYE CREEK RD
DARBY, MT 59829

KELLY JOLLEY
4323 N FORK RYE CREEK RD
DARBY, MT 59829

76H 30070904
LEONARD J SKARVAN
PO BOX 875
DARBY, MT 59829

NANCY LS INCE
PO BOX 875
DARBY, MT 59829

76H 71325 00
SKALKAHO RYE RANCH
PO BOX 203
DARBY, MT 59829

76H 92095 00
STEVEN J REEVES
PO BOX 339
DARBY, MT 59829

VIVIAN K REEVES
PO BOX 339
DARBY, MT 59829

76H 81772 00
BENJAMIN G TAYLOR
JEFF HANCOCK
1720 OLD STAGE RD
COLORADO SPRINGS, CO 80906

Surface Water

76H 70445 00
PAMELA ASLINGER
PO BOX 1311
KENNEBUNKPORT, ME 04046

76H 148214 00

SKALKAHO RYE RANCH
PO BOX 203
DARBY, MT 59829

76H 50471 00
USA (DEPT OF AGRICULTURE FOREST SERVICE)
% JED SIMON
MISSOULA, MT 59807-7669

76H 50496 00
USA (DEPT OF AGRICULTURE FOREST SERVICE)
% JED SIMON
MISSOULA, MT 59807-7669

76H 50475 00
USA (DEPT OF AGRICULTURE FOREST SERVICE)
% JED SIMON
MISSOULA, MT 59807-7669

76H 150386 00
ROBERT F RECHT
1811 GREENACRES RD
GREENACRES, WA 99016-8500

SHARON L RECHT
PO BOX 444
MURRAY, ID 83874

JEFFREY W HANCOCK
210 EVERGREEN DR
BOISE, ID 83716

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DARBY, MT 59829

NANCY LS INCE
PO BOX 875
DARBY, MT 59829

J H TENZER
PO BOX 1089
DARBY, MT 59829

AHLGREN ELIZABETH A TRUST
27821 W LAKEVIEW DR N
LAKE BARRINGTON, IL 60084-2312

LEONARD J SKARVAN
PO BOX 875
DARBY, MT 59829

NANCY LS INCE
PO BOX 875
DARBY, MT 59829

Appendix A

X	Y	Column	Row	Exit Stream Segment Flow ft^3 (ref. flow 960069.12)	ft^3/day depletion	Percent Depletion	Depletion Fraction
815500.3	676843.3	16	45	960058.88	10.24	0.15	0.0015
813722.6	662813.3	20	73	953420.62	6648.50	98.67	0.9867
813590.2	662331.2	20	74	954688.94	5380.18	79.85	0.7985
813457.8	661849	20	75	957169.31	2899.81	43.04	0.4304
813325.5	661366.8	20	76	958601.25	1467.87	21.79	0.2179
814337.1	663163.1	21	72	953332.38	6736.74	99.98	0.9998
814204.7	662680.9	21	73	953395.75	6673.37	99.04	0.9904
814469.5	663645.3	21	71	953404.44	6664.68	98.91	0.9891
814072.4	662198.8	21	74	956748.12	3321.00	49.29	0.4929
813940	661716.6	21	75	957346.81	2722.31	40.40	0.4040
814601.8	664127.4	21	70	957889.25	2179.87	32.35	0.3235
814734.2	664609.6	21	69	958209.75	1859.37	27.60	0.2760
813807.6	661234.5	21	76	958390.19	1678.93	24.92	0.2492
815263.7	666538.2	21	65	958561.25	1507.87	22.38	0.2238
814999	665573.9	21	67	958627.62	1441.50	21.39	0.2139
816719.8	671842	21	54	958638.12	1431.00	21.24	0.2124
815528.4	667502.5	21	63	958880.31	1188.81	17.64	0.1764
816455	670877.7	21	56	958930.25	1138.87	16.90	0.1690
816322.7	670395.5	21	57	958994.88	1074.24	15.94	0.1594
815793.2	668466.9	21	61	959113.00	956.12	14.19	0.1419
816057.9	669431.2	21	59	959382.75	686.37	10.19	0.1019
818970.1	680038.7	21	37	960017.00	52.12	0.77	0.0077
814819.3	663030.7	22	72	953331.19	6737.93	100.00	1.0000
814686.9	662548.6	22	73	953334.94	6734.18	99.94	0.9994
815084	663995.1	22	70	953427.75	6641.37	98.57	0.9857
814951.6	663512.9	22	71	953427.75	6641.37	98.57	0.9857
815216.4	664477.2	22	69	953896.38	6172.74	91.61	0.9161
815481.1	665441.5	22	67	954509.25	5559.87	82.52	0.8252
814554.5	662066.4	22	74	955173.44	4895.68	72.66	0.7266
816540.1	669298.8	22	59	955483.81	4585.31	68.05	0.6805
814422.2	661584.3	22	75	956914.00	3155.12	46.83	0.4683
815745.9	666405.9	22	65	957580.69	2488.43	36.93	0.3693
817201.9	671709.6	22	54	957764.38	2304.74	34.21	0.3421
816010.6	667370.2	22	63	958029.31	2039.81	30.27	0.3027
817466.7	672673.9	22	52	958247.88	1821.24	27.03	0.2703
816937.2	670745.3	22	56	958263.00	1806.12	26.81	0.2681
816672.5	669781	22	58	958321.62	1747.50	25.94	0.2594
814289.8	661102.1	22	76	958373.19	1695.93	25.17	0.2517
816275.3	668334.5	22	61	958443.62	1625.50	24.12	0.2412
817731.4	673638.2	22	50	958724.75	1344.37	19.95	0.1995
816804.8	670263.1	22	57	958819.50	1249.62	18.55	0.1855
813495.6	658209.1	22	82	960051.75	17.37	0.26	0.0026
815433.8	663380.5	23	71	953332.44	6736.68	99.98	0.9998

X	Y	Column	Row	Exit Stream Segment Flow ft^3 (ref. flow 960069.12)	ft^3/day depletion	Percent Depletion	Depletion Fraction
815301.4	662898.4	23	72	953332.50	6736.62	99.98	0.9998
815566.2	663862.7	23	70	953374.75	6694.37	99.35	0.9935
815698.5	664344.8	23	69	953386.56	6682.56	99.18	0.9918
815963.3	665309.2	23	67	953407.94	6661.18	98.86	0.9886
815169.1	662416.2	23	73	953415.56	6653.56	98.75	0.9875
816228	666273.5	23	65	953417.81	6651.31	98.71	0.9871
816492.8	667237.8	23	63	953433.38	6635.74	98.48	0.9848
816757.5	668202.1	23	61	953448.69	6620.43	98.26	0.9826
817022.2	669166.4	23	59	953465.88	6603.24	98.00	0.9800
817287	670130.8	23	57	953478.75	6590.37	97.81	0.9781
815036.7	661934	23	74	955305.38	4763.74	70.70	0.7070
817684.1	671577.2	23	54	956778.62	3290.50	48.84	0.4884
817948.8	672541.6	23	52	956982.12	3087.00	45.82	0.4582
814904.3	661451.9	23	75	957011.31	3057.81	45.38	0.4538
818345.9	673988	23	49	957865.38	2203.74	32.71	0.3271
817419.4	670612.9	23	56	957895.25	2173.87	32.26	0.3226
818610.7	674952.4	23	47	958419.75	1649.37	24.48	0.2448
814771.9	660969.7	23	76	958454.75	1614.37	23.96	0.2396
818875.4	675916.7	23	45	958898.12	1171.00	17.38	0.1738
816180.7	664212.5	24	69	953331.20	6737.92	100.00	1.0000
816048.3	663730.3	24	70	953331.38	6737.74	100.00	1.0000
816710.2	666141.1	24	65	953332.50	6736.62	99.98	0.9998
816445.4	665176.8	24	67	953332.56	6736.56	99.98	0.9998
815916	663248.2	24	71	953333.12	6736.00	99.97	0.9997
817239.7	668069.7	24	61	953333.50	6735.62	99.97	0.9997
817769.1	669998.4	24	57	953333.62	6735.50	99.96	0.9996
816974.9	667105.4	24	63	953333.88	6735.24	99.96	0.9996
817504.4	669034.1	24	59	953372.50	6696.62	99.39	0.9939
815783.6	662766	24	72	953399.56	6669.56	98.98	0.9898
815651.2	662283.8	24	73	953511.00	6558.12	97.33	0.9733
817901.5	670480.5	24	56	953796.75	6272.37	93.09	0.9309
818166.3	671444.9	24	54	954896.38	5172.74	76.77	0.7677
818431	672409.2	24	52	955305.00	4764.12	70.71	0.7071
815518.8	661801.7	24	74	956986.38	3082.74	45.75	0.4575
819092.8	674820	24	47	957171.75	2897.37	43.00	0.4300
815386.5	661319.5	24	75	957273.88	2795.24	41.48	0.4148
819357.6	675784.3	24	45	957925.62	2143.50	31.81	0.3181
815254.1	660837.4	24	76	958630.31	1438.81	21.35	0.2135
816530.5	663597.9	25	70	953331.20	6737.92	100.00	1.0000
817986.6	668901.7	25	59	953332.25	6736.87	99.98	0.9998
817457.1	666973.1	25	63	953332.62	6736.50	99.98	0.9998
816662.9	664080.1	25	69	953333.69	6735.43	99.96	0.9996
816398.1	663115.8	25	71	953333.75	6735.37	99.96	0.9996

X	Y	Column	Row	Exit Stream Segment Flow ft^3 (ref. flow 960069.12)	ft^3/day depletion	Percent Depletion	Depletion Fraction
817721.8	667937.4	25	61	953355.38	6713.74	99.64	0.9964
816795.2	664562.3	25	68	953361.44	6707.68	99.55	0.9955
818251.3	669866	25	57	953366.12	6703.00	99.48	0.9948
816927.6	665044.4	25	67	953381.12	6688.00	99.26	0.9926
817192.3	666008.7	25	65	953392.81	6676.31	99.08	0.9908
816265.7	662633.6	25	72	953421.81	6647.31	98.65	0.9865
819310.3	673723.3	25	49	953984.75	6084.37	90.30	0.9030
819045.5	672759	25	51	954226.75	5842.37	86.71	0.8671
818648.4	671312.5	25	54	954938.12	5131.00	76.15	0.7615
818913.2	672276.8	25	52	954970.88	5098.24	75.66	0.7566
818383.7	670348.2	25	56	956062.88	4006.24	59.46	0.5946
819839.7	675651.9	25	45	956327.88	3741.24	55.52	0.5552
816001	661669.3	25	74	956971.50	3097.62	45.97	0.4597
816133.4	662151.5	25	73	957205.44	2863.68	42.50	0.4250
815868.6	661187.1	25	75	957908.69	2160.43	32.06	0.3206
815736.3	660705	25	76	958935.94	1133.18	16.82	0.1682
817012.6	663465.6	26	70	953332.00	6737.12	99.99	0.9999
817145	663947.7	26	69	953362.81	6706.31	99.53	0.9953
818865.8	670215.8	26	56	953762.88	6306.24	93.59	0.9359
820321.9	675519.6	26	45	953826.88	6242.24	92.64	0.9264
820057.2	674555.2	26	47	954321.12	5748.00	85.31	0.8531
819130.6	671180.1	26	54	954925.12	5144.00	76.34	0.7634
819395.3	672144.4	26	52	956448.75	3620.37	53.73	0.5373
818468.7	668769.3	26	59	957431.25	2637.87	39.15	0.3915
817674.5	665876.4	26	65	957952.25	2116.87	31.42	0.3142
818204	667805	26	61	958018.75	2050.37	30.43	0.3043
817409.8	664912	26	67	958022.94	2046.18	30.37	0.3037
817939.2	666840.7	26	63	958147.12	1922.00	28.52	0.2852
818733.5	669733.6	26	57	958377.75	1691.37	25.10	0.2510
818336.4	668287.2	26	60	958411.00	1658.12	24.61	0.2461
817494.8	663333.2	27	70	953332.50	6736.62	99.98	0.9998
817627.2	663815.4	27	69	953385.12	6684.00	99.20	0.9920
817362.4	662851	27	71	953397.19	6671.93	99.02	0.9902
819612.7	671047.8	27	54	953671.38	6397.74	94.95	0.9495
817759.5	664297.5	27	68	954189.88	5879.24	87.26	0.8726
820804.1	675387.2	27	45	955216.00	4853.12	72.03	0.7203
817230.1	662368.9	27	72	956192.19	3876.93	57.54	0.5754
820274.6	673458.6	27	49	956515.88	3553.24	52.73	0.5273
820142.2	672976.4	27	50	956843.12	3226.00	47.88	0.4788
817097.7	661886.7	27	73	957110.75	2958.37	43.91	0.4391
819877.5	672012.1	27	52	957261.88	2807.24	41.66	0.4166
816965.3	661404.6	27	74	957893.88	2175.24	32.28	0.3228
819348	670083.4	27	56	957896.38	2172.74	32.25	0.3225

X	Y	Column	Row	Exit Stream Segment Flow ft^3 (ref. flow 960069.12)	ft^3/day depletion	Percent Depletion	Depletion Fraction
817891.9	664779.7	27	67	958287.62	1781.50	26.44	0.2644
818950.9	668637	27	59	958536.88	1532.24	22.74	0.2274
818156.7	665744	27	65	958560.25	1508.87	22.39	0.2239
816833	660922.4	27	75	958823.69	1245.43	18.48	0.1848
818686.1	667672.6	27	61	959321.25	747.87	11.10	0.1110
817977	663200.8	28	70	953333.38	6735.74	99.97	0.9997
818109.3	663683	28	69	953404.62	6664.50	98.91	0.9891
820094.9	670915.4	28	54	954817.25	5251.87	77.94	0.7794
821286.2	675254.8	28	45	956956.12	3113.00	46.20	0.4620
821021.5	674290.5	28	47	957456.00	2613.12	38.78	0.3878
820492	672361.9	28	51	957514.00	2555.12	37.92	0.3792
820624.4	672844	28	50	957568.88	2500.24	37.11	0.3711
820359.6	671879.7	28	52	958388.38	1680.74	24.94	0.2494
819830.2	669951.1	28	56	959286.88	782.24	11.61	0.1161
818459.1	663068.5	29	70	953333.62	6735.50	99.96	0.9996
818326.8	662586.3	29	71	953420.12	6649.00	98.68	0.9868
818591.5	663550.6	29	69	953430.12	6639.00	98.53	0.9853
820709.4	671265.2	29	53	953631.12	6438.00	95.55	0.9555
818194.4	662104.1	29	72	955234.19	4834.93	71.76	0.7176
818723.9	664032.8	29	68	955717.12	4352.00	64.59	0.6459
820841.8	671747.3	29	52	956602.88	3466.24	51.44	0.5144
818062	661622	29	73	957112.38	2956.74	43.88	0.4388
818856.2	664514.9	29	67	958159.62	1909.50	28.34	0.2834
821768.4	675122.5	29	45	958209.88	1859.24	27.59	0.2759
821371.3	673676	29	48	958224.75	1844.37	27.37	0.2737
817929.6	661139.8	29	74	958237.31	1831.81	27.19	0.2719
820577.1	670783	29	54	958502.75	1566.37	23.25	0.2325
818941.3	662936.1	30	70	953334.62	6734.50	99.95	0.9995
818808.9	662453.9	30	71	953425.69	6643.43	98.60	0.9860
819073.7	663418.2	30	69	953464.00	6605.12	98.03	0.9803
821324	671615	30	52	953791.38	6277.74	93.17	0.9317
818676.5	661971.8	30	72	955351.44	4717.68	70.02	0.7002
818544.2	661489.6	30	73	956969.38	3099.74	46.00	0.4600
819206	663900.4	30	68	957489.12	2580.00	38.29	0.3829
821721.1	673061.4	30	49	957867.50	2201.62	32.67	0.3267
818411.8	661007.4	30	74	958171.75	1897.37	28.16	0.2816
819338.4	664382.6	30	67	958598.88	1470.24	21.82	0.2182
820000.2	666793.4	30	62	959612.62	456.50	6.78	0.0678
819603.1	665346.9	30	65	960011.06	58.06	0.86	0.0086
820265	667757.7	30	60	960027.12	42.00	0.62	0.0062
817617.6	658114.5	30	80	960029.88	39.24	0.58	0.0058
821938.5	671964.8	31	51	955155.25	4913.87	72.93	0.7293
819158.7	661839.4	31	72	956526.62	3542.50	52.58	0.5258

X	Y	Column	Row	Exit Stream Segment Flow ft^3 (ref. flow 960069.12)	ft^3/day depletion	Percent Depletion	Depletion Fraction
819291.1	662321.6	31	71	956719.81	3349.31	49.71	0.4971
819026.3	661357.2	31	73	956824.31	3244.81	48.16	0.4816
819423.4	662803.7	31	70	957681.06	2388.06	35.44	0.3544
821673.7	671000.4	31	53	957715.38	2353.74	34.93	0.3493
818894	660875.1	31	74	957936.88	2132.24	31.65	0.3165
822203.2	672929.1	31	49	957968.62	2100.50	31.17	0.3117
819555.8	663285.9	31	69	958140.31	1928.81	28.63	0.2863
822335.6	673411.2	31	48	958613.12	1456.00	21.61	0.2161
822420.6	671832.4	32	51	953788.12	6281.00	93.22	0.9322
819640.9	661707	32	72	955745.25	4323.87	64.17	0.6417
819773.2	662189.2	32	71	956735.88	3333.24	49.47	0.4947
820038	663153.5	32	69	957161.62	2907.50	43.15	0.4315
819905.6	662671.3	32	70	957450.12	2619.00	38.87	0.3887
819376.1	660742.7	32	74	957486.88	2582.24	38.32	0.3832
822817.8	673278.9	32	48	958211.75	1857.37	27.57	0.2757
822023.5	670385.9	32	54	958752.12	1317.00	19.55	0.1955
819111.4	659778.4	32	76	959170.38	898.74	13.34	0.1334
823035.2	672182.2	33	50	953609.75	6459.37	95.87	0.9587
820123	661574.7	33	72	955538.31	4530.81	67.24	0.6724
819990.7	661092.5	33	73	955538.81	4530.31	67.24	0.6724
820255.4	662056.8	33	71	955797.88	4271.24	63.39	0.6339
819858.3	660610.3	33	74	956824.00	3245.12	48.16	0.4816
820387.8	662539	33	70	957190.25	2878.87	42.73	0.4273
823167.5	672664.3	33	49	957227.00	2842.12	42.18	0.4218
819725.9	660128.2	33	75	958001.00	2068.12	30.69	0.3069
820520.1	663021.1	33	69	958498.38	1570.74	23.31	0.2331
822770.4	671217.9	33	52	958740.75	1328.37	19.71	0.1971
819593.5	659646	33	76	958848.81	1220.31	18.11	0.1811
823517.3	672049.8	34	50	954447.12	5622.00	83.44	0.8344
820472.8	660960.1	34	73	955441.56	4627.56	68.68	0.6868
820869.9	662406.6	34	70	958436.12	1633.00	24.24	0.2424
823120.2	670603.3	34	53	958591.00	1478.12	21.94	0.2194
819943.3	659031.5	34	77	959104.94	964.18	14.31	0.1431
822855.5	669639	34	55	959474.25	594.87	8.83	0.0883
820955	660827.8	35	73	954944.62	5124.50	76.05	0.7605
821219.7	661792.1	35	71	957585.50	2483.62	36.86	0.3686
820557.9	659381.3	35	76	957785.56	2283.56	33.89	0.3389
823867.1	671435.3	35	51	957817.38	2251.74	33.42	0.3342
821352.1	662274.2	35	70	958795.62	1273.50	18.90	0.1890
823205.3	669024.5	35	56	959830.88	238.24	3.54	0.0354
825190.8	676256.9	35	41	959878.50	190.62	2.83	0.0283
821881.6	664202.9	35	66	959879.00	190.12	2.82	0.0282
822411	666131.5	35	62	960044.25	24.87	0.37	0.0037

X	Y	Column	Row	Exit Stream Segment Flow ft^3 (ref. flow 960069.12)	ft^3/day depletion	Percent Depletion	Depletion Fraction
821304.8	660213.2	36	74	955501.00	4568.12	67.80	0.6780
821172.4	659731.1	36	75	955808.75	4260.37	63.23	0.6323
821701.9	661659.7	36	71	958353.12	1716.00	25.47	0.2547
824216.9	670820.7	36	52	958375.50	1693.62	25.14	0.2514
823952.2	669856.4	36	54	959483.62	585.50	8.69	0.0869
820245.8	656355.9	36	82	959986.50	82.62	1.23	0.0123
821654.6	659598.7	37	75	954778.00	5291.12	78.53	0.7853
821786.9	660080.9	37	74	955416.62	4652.50	69.05	0.6905
822051.7	661045.2	37	72	958168.62	1900.50	28.21	0.2821
822401.5	660430.6	38	73	957983.25	2085.87	30.96	0.3096
823016	660780.4	39	72	958814.75	1254.37	18.62	0.1862

**BEFORE THE DEPARTMENT OF
NATURAL RESOURCES AND CONSERVATION
OF THE STATE OF MONTANA**

* * * * * * *

PETITION TO CREATE A STREAM DEPLETION ZONE NO. 76H 30102741 BY JEFFERY INCE, NANCY INCE, LEONARD SKARAVAN AND J.H. TENZER)))	**DETERMINATION TO PROCEED WITH RULEMAKING ON PETITION TO CREATE A STREAM DEPLETION ZONE IN MODIFIED FORM**

* * * * * * *

On May 15, 2015, Randy Overton of Water Source, LLC submitted Petition to Create A Stream Depletion Zone No. 76H 30102741 to the Missoula Water Resources Office of the Department of Natural Resources and Conservation (Department or DNRC) for the designation of a Stream Depletion Zone. The petition was submitted on behalf of Jeffery and Nancy Ince, Leonard Skaravan and J.H.Tenzer.

The Petitioner proposes to establish the stream depletion zone at the confluence of Rye Creek and the North Fork of Rye Creek. The proposed stream depletion zone includes private subdivided parcels along Rye Creek and North Fork Rye Creek upstream of their confluence and for a short distance downstream on Rye Creek. Rye Creek is a tributary of the Bitterroot River in the southern portion of the basin approximately 10 miles east-southeast of the Town of Darby. The objective of the stream depletion zone is to restrict future groundwater withdrawals and use that are exempt from permitting per §85-2-306 (3)(a)(iii), MCA, in order to protect existing surface water rights in Rye Creek and the North Fork of Rye Creek.

The Petition was determined to be correct and complete as of July 29, 2015. On (pending), the department informed the Petitioner that it would proceed under § 85-2-380(2)(b), which allows the department to initiate rulemaking to establish a stream depletion zone upon receipt of a petition signed by the owners of at least 15% of the flow rate of the surface water rights in the area estimated to be affected.

Department Hydrogeologist Russell Levens was assigned by the department to review the information provided in the Petition and issued a memorandum of his findings and opinions. See attached Department memorandum from Russell Levens to Jim Nave dated July 29, 2015.

A "stream depletion zone" means an area where hydrogeologic modeling concludes that as a result of a ground water withdrawal, the surface water would be depleted by a rate equal to at least 30% of the ground water withdrawn within 30 days after the first day a well or developed spring is pumped at a rate of 35 gallons per minute. 85-2-102(23), MCA.

Pursuant to 85-2-380, MCA, the department is authorized to initiate rulemaking to establish a stream depletion zone upon satisfaction of the following statutory requirements:

> (1) Notwithstanding the provisions of subsection (2), the department may establish a stream depletion zone by rule if:
> (a) the stream depletion zone lies within a basin closed pursuant to 85-2-319, 85-2-321, 85-2-330, 85-2-336, 85-2-341, 85-2-343, or 85-2-344; and
> (b) there exists a hydrogeologic assessment for the area where the stream depletion zone is proposed that was conducted by either the ground water investigation program established by 85-2-525 or by a hydrogeologist or a qualified licensed professional engineer.
> (2) If the provisions of subsection (1) are met, the department shall initiate rulemaking to establish a stream depletion zone upon receipt of a petition signed by:
> (a) a municipality, county, conservation district, or local water quality district formed under Title 7, chapter 13, part 45; or
> (b) the owners of at least 15% of the flow rate of the surface water rights in the area estimated to be affected, the boundary of which cannot exceed the boundaries of the drainage subdivisions established by the office of water data coordination, Unites States geological survey, and used by the water court.
>
> (3) The department shall provide notice of the rulemaking by first-class mail to any appropriator of water who, according to the records of the department, may be affected by the proposed stream depletion zone.
> (4) In establishing rules related to stream depletion zones, the department shall consult with the ground water investigation program and the ground water assessment steering committee established by 2-15-1523.

Establishment of a stream depletion zone limits the exception to the permit requirements provided for by 85-2-306(3), MCA, providing in relevant part:

> (3)(a) Outside the boundaries of a controlled ground water area, a permit is not required before appropriating ground water by means of well or developed spring:

. . .

(iv) when the appropriation is within a stream depletion zone, is 20 gallons a minute or less, and does not exceed 2 acre-feet per year, except that a combined appropriation from the same source by two or more wells or developed springs exceeding this limitation requires a permit.

FINDINGS

The North Fork of Rye Creek and Rye Creek are located within the boundaries of the Bitterroot River subbasin temporary closure pursuant to §85-2-344, MCA, and satisfies the requirement of 85-2-380(1)(b), MCA.

Included with the petition is a hydrogeologic assessment titled Groundwater Model Determination of Extent of Stream Depletion in Rye Creek – North Fork Rye Creek Drainages (Hydrologic Assessment). The Hydrogeologic Assessment was prepared by hydrogeologist Randy Overton of Water Source, LLC, of Kalispell, Montana. The Hydrologic Assessment included with the Petition was prepared by a hydrologist as required by 85-2-380(1)(b).

There are three water rights for surface water diverted out of North Fork Rye Creek or Rye Creek, including the petitioner's statement of claim 76H 150386-00, within the proposed stream depletion zone with a total combined flow rate of 823.55 gpm. The petitioners own all but approximately 1.2 acres of the 24.5 acres listed as the place of use for statement of claim number 76H 150386-00. The flow rate listed for 76H 150386-00 is 583.44 gpm, which equals 23.81 gpm per acre for the claim. The petitioner's portion of the flow rate would be 559.06 gpm based on a pro-rata share of the water right (24.5 acres – 1.02 acres = 23.48 acres x 23.81 gpm/acre = 559.06 gpm). The petitioner's own more than 15% of the flow rate of the surface water rights in the area estimated to be affected and satisfies the requirements of 85-2-380(2)(b), MCA.

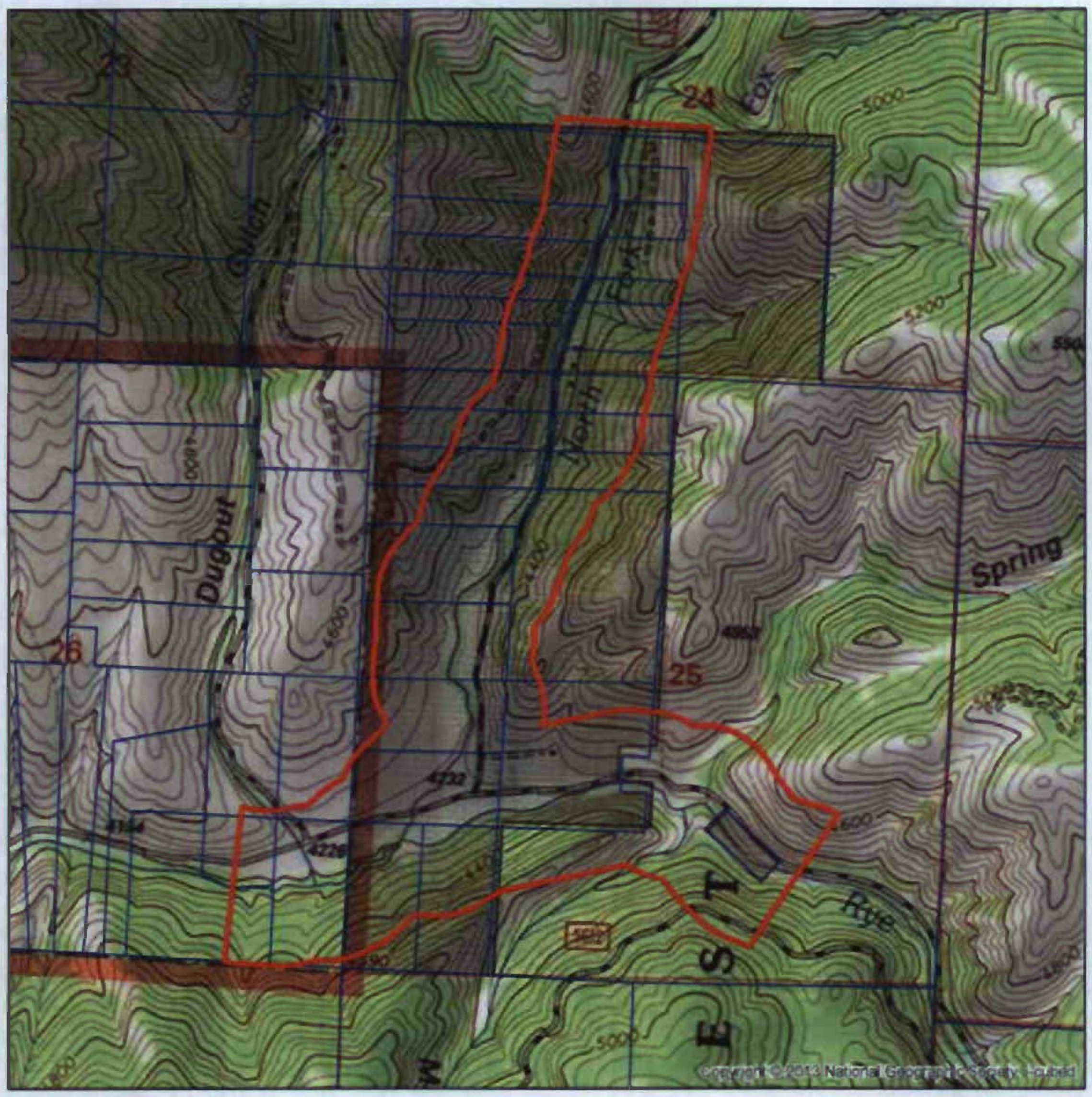
The Hyrdogeologic Assessment utilizes the numerical groundwater flow model MODLFOW 2005 in conjunction with the ModelMuse graphical user interface. The model contains 5 layers each with 115 cells measuring 500 feet by 500 feet that are used to represent alluvial and bedrock aquifers. Model input parameter values are based on typical values for lithologies, sediment grain size and bedrock fracturing, and professional judgement. The upstream and downstream extents of the proposed stream depletion zone were determined by the petitioner. According to the petitioner the focus of the stream depletion zone is the lower portion of the basin that is dominated by privately held land. The upstream boundaries coincide with the transition from privately held land to lands owned by the United States Forest Service. The lower downstream boundary of the proposed stream depletion zone is located just west of the property boundary of petitioner J.H. Tenzer. Although the entire lower reach of Rye Creek west of petitioner J.H. Tenzer's property boundary is within privately held land, the petitioners did not propose to include any of the western, lower reaches of Rye Creek in the proposed stream depletion zone. Water Source, LLC states that the width of the stream depletion zone they calculated varied from 1,500 to 2,500 feet from the streambed based on their model. A map of the proposed streamside depletion zone was included with the Hydrogeologic Assessment. The mapped stream depletion zone provided by the petitioner has a width of 4,000 feet and is not supported by the calculations in the petitioner's Hydrogeologic Assessment.

Department hydrogeologist Russell Levens calculated a stream depletion zone using the Well Pumping Depletion Model. The department's modeling shows that 30% of the diverted volume would be depleted within 30 days of pumping groundwater at 35 gpm in an area that is located within 700 feet from the either side of the streambed. Based on the findings of Department hydrogeologist Russell Levens the department determines that it will proceed with rulemaking with a modified stream depletion zone with boundaries of a width of 700 feet on either side of the North Fork of Rye Creek and Rye Creek. The area within the modified boundaries of the stream depletion zone satisfy the requirements of 85-2-102(23), MCA.

The modified North Fork Rye Creek and Rye Creek stream depletion zone means an area of approximately 378.66 acres or 0.59 square miles located approximately 10 miles southeast of the Town of Darby, Montana in Ravalli County. Beginning approximately 0.13 miles west of the intersection of Dugout Gulch Road and Rye Creek Road in the SE1/4 of Section 26, Township 03N, Range 20W, the stream depletion zone extends 700 feet on either side of Rye Creek eastward to the intersection of Rye Creek and North Fork Rye Creek roads. From the intersection of North Fork Rye Creek and Rye Creek roads the stream depletion zone extends 700 feet on either side of Rye Creek approximately 0.63 miles east on Rye Creek Road, terminating on United Stated Forest Service property in the SE1/4 of Section 25, Township 03N, Range 20W. Extending 700 feet on either side of the North Fork of Rye Creek the stream depletion zone extends approximately 1.21 miles north on North Fork Rye Creek Road from its intersection with Rye Creek Road to its terminus on United States Forest Service property in the

S2 of Section 24, Township 03N, Range 20W. The legal land descriptions are in the following table:

Quarter Section	Section	Township	Range
SESE	26	3 North	20 West
S1/2	25	3 North	20 West
NW	25	3 North	20 West
S1/2	24	3 North	20 West



Proposed Stream Depletion Zone

Department Hydrogeologist, Russell Levens, consulted with Andy Bobst from the Montana Bureau of Mines and Geology Groundwater Investigation Program, satisfying the requirements of 85-2-380(4), MCA.

RULEMAKING TIMELINE

The Department will provide the petitioners with a draft copy of the rule with this determination to proceed. The Petitioner has until October 16, 2015 to provide any comments. The Department will then finalize the rules and proceed with formal rulemaking proceedings in accordance with Title 2, Chapter 4, part 3, MCA. Any comments provided on the draft rule does not preclude the petitioner from submitting comments during the comment period provided for in the formal proceedings.

Per 85-2-306(3)(iv) MCA, if the proposed rule is adopted by the State of Montana, groundwater appropriations within the stream depletion zone exceeding 20 gallons per minute and/or 2 acre-feet a year require a permit.

Please contact the Missoula Regional Office at 542-5889 if you have any questions.

DATED this 2nd day of October, 2015.

Jim Nave, Regional Manager
Missoula Regional Office
Department of Natural Resources and Conservation

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

STEVE BULLOCK
GOVERNOR

DIRECTOR'S OFFICE (406) 444-2074
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STATE OF MONTANA

WATER RESOURCES DIVISION (406) 444-6601
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PO BOX 201601
HELENA, MONTANA 59620-1601

To: Jim Nave, Regional Manager
Missoula Water Resource Office

From: Russell Levens, Groundwater Hydrologist
Water Management Bureau

Date: July 29, 2015

RE: Proposed Rye Creek – North Fork Rye Creek Stream Depletion Zone

Introduction

The purpose of this report is to review a petition by Jeffery and Nancy Ince, and Leonard Skarvan requesting that the Department of Natural Resources and Conservation (DNRC) establish a Stream Depletion Zone (SDZ) in Ravalli County pursuant to §85-2-380, MCA. The proposed SDZ is along Rye Creek which is a tributary of the Bitterroot River and North Fork Rye Creek approximately 10 miles east-southeast of the Town of Darby. The proposed SDZ includes private subdivided parcels along Rye Creek and North Fork Rye Creek upstream of their confluence and for a short distance downstream on Rye Creek. The stated purpose of the petition is to protect existing irrigation water rights.

The following is a summary of the statutory provisions regarding stream depletion zones.

Definition: "stream depletion zone" means an area where hydrogeologic modeling concludes that as a result of a ground water withdrawal, the surface water would be depleted by a rate equal to at least 30% of the ground water withdrawn within 30 days after the first day a well or developed spring is pumped at a rate of 35 gallons a minute.

Provisions: Pursuant to § 85-2-306(3)(a)(iv) MCA, the maximum flow rate for all groundwater appropriations that meet exceptions to the permit requirements in § 85-2-306 and are located within a stream depletion zone is 20 gallons per minute and the maximum volume is 2 acre-feet per year.

Who May Petition: A petition for a stream depletion zone may be filed by a municipality, county, conservation district, or local water quality district formed under Title 7, chapter 13, part 45; or by the owners of at least 15% of the flow rate of the surface water rights in the proposed stream depletion zone.

Petition Requirements: § 85-2-380 MCA requires that a petition must allege certain facts showing that the following situations exist:

- The proposed stream depletion zone lies within a basin closed pursuant to 85-2-319, 85-2-321, 85-2-330, 85-2-336, 85-2-341, 85-2-343, or 85-2-344.
- There exists a hydrogeologic assessment for the area where the stream depletion zone is proposed that was conducted by either the ground water investigation program established by 85-2-525 or by a hydrogeologist or a qualified licensed professional engineer.

The following review addresses whether an adequate hydrogeologic assessment exists for the area where the Rye Creek – North Fork Rye Creek SDZ is proposed and whether the stream depletion zone meets the definition. An alternative SDZ also is delineated.

Hydrogeologic Assessment

The petition includes a hydrogeologic assessment for the area in a report by Water Source, LLC entitled Groundwater Model Determination of Extent of Stream Depletion in Rye Creek – North Fork Rye Creek Drainages. Water Source, LLC presents a conceptual model of surface water and groundwater conditions in the watershed and a proposed stream depletion zone boundary. The report contains a description of the geomorphic and hydrographic character of the surface water network from the upper Rye Creek watershed including the main stem Rye Creek and the North Fork Rye Creek downstream to the confluence of Rye Creek with the Bitterroot River between the towns of Conner and Darby. It includes information on the lithology and structure of bedrock in the watershed, the occurrence and continuity of alluvial sediments along stream channels, and the hydraulic connection between groundwater and surface water.

The proposed stream depletion zone boundary is based on modeling by Water Source, LLC using the U.S. Geological Survey numerical groundwater flow model MODFLOW 2005 in conjunction with the ModelMuse graphical user interface. The model contains 5 layers each with 115 cells measuring 500 feet by 500 feet that are used to represent alluvial and bedrock aquifers. No aquifer tests were conducted. Instead, model input parameter values are based on typical values for lithologies, sediment grain size and bedrock fracturing, and professional judgment. The input values of hydraulic conductivity, the fundamental measure of the ease water flows through an aquifer, are 19.3 ft/day for alluvium and highly fractured bedrock along the valley floor and 0.4 ft/day for bedrock over the majority of the remainder of the model area. The higher hydraulic conductivity value corresponds to the low end of typical values for sand and gravel aquifers (Table 1) and appears to be reasonable. The value used for the majority of the bedrock aquifer is in the middle of the typical range for fractured bedrock Freeze and Cherry, 1979).

Table 1. Hydraulic conductivity values for modeling return flows (after Bear, 1972).

Unconsolidated Sediment	Hydraulic Conductivity (ft/day)
Well Sorted Sand or Sand and Gravel	10 – 1,000
Very Fine Sand, Silt, Loess, Loam	0.001 - 1
Unweathered Clay	0.0000001 – 0.0001

Input values for specific yield, the measure of the amount of water released from storage by drainage in an unconfined aquifer, are 0.02 for the majority of layer 1 of the model. This value is appropriate for bedrock; however, is low for more porous alluvial aquifers or highly fractured bedrock. For comparison, DNRC assumes a value of 0.1 for evaluation of stream depletion for beneficial use applications for groundwater.

Water Source, LLC acknowledges that detailed groundwater level and stream gaging data would be desirable to better calibrate their numerical model. In lieu of those data, they calibrate their model by adjusting model parameters so stream flows in the model approximated stream flows measured during 2013. Although not specifically stated, recharge apparently was the parameter primarily adjusted during calibration.

Water Source, LLC states that the width of the SDZ they calculated varied from 1,500 to 2,500 feet; however, they propose a 4,000 + wide SDZ in their Figure 7. I consulted with Andy Bobst from the Montana Bureau of Mines and Geology (MBMG) Ground Water Investigation Program on evaluation of the proposed SDZ using the model provided by Water Source, LLC and the SDZ tool developed by MBMG (Bobst and Fleener, 2014). Output from the SDZ tool indicates that depletion equal to 30 percent of pumping in 30 days would not occur beyond 500-feet from Rye Creek or North Fork Rye Creek. Andy Bobst also commented on the relatively large size of the cells used in the Water Source, LLC.

Discussion

The design of the Water Source, LLC model, calibration decisions, and modeling results are reasonable; however, they are not unique and the 500 feet by 500 feet grid cell size is much too coarse to adequately model the dimensions of a SDZ. Furthermore, the proposed SDZ does not appear to be supported by the model. Therefore, absent a more detailed numerical model and additional work delineating the SDZ, a simple analytical model with simpler assumptions will provide a more reliable delineation of a SDZ along Rye Creek. The Well Pumping Depletion Model (WPDM), a spreadsheet adaptation of the analytical stream depletion model by Schroeder (1987), is used here to propose an alternate SDZ boundary. In contrast to a numerical model, WPDM calculates steam depletion for uniform properties and simple aquifer boundaries. WPDM cannot represent the complex alluvial / bedrock aquifers in the Rye Creek watershed in detail; however, the simpler conceptual model corresponds to the level of knowledge of the aquifers and their connection to surface water. Modeling using WPDM was conducted with the following inputs:

- Hydrualic conductivity = 19.3 feet/day
- Aquifer thickness = 40 feet (from well logs)
- Specific yield = 0.1
- Aquifer width = 2,000 feet on each side of Rye Creek and North Fork Rye Creek.
- Pumping rate = 35 gallons per minute

The WPDM model calculates that surface water would be depleted by a rate equal to 30% of the groundwater withdrawn within 30 days within 700 feet of Rye Creek and North Fork Rye Creek (Figure 1). For comparison, the SDZ determined by using the SDZ tool with the model construct provided by Water Source, LLC does not extend outside the 500 feet by 500 feet cells that represent streams.

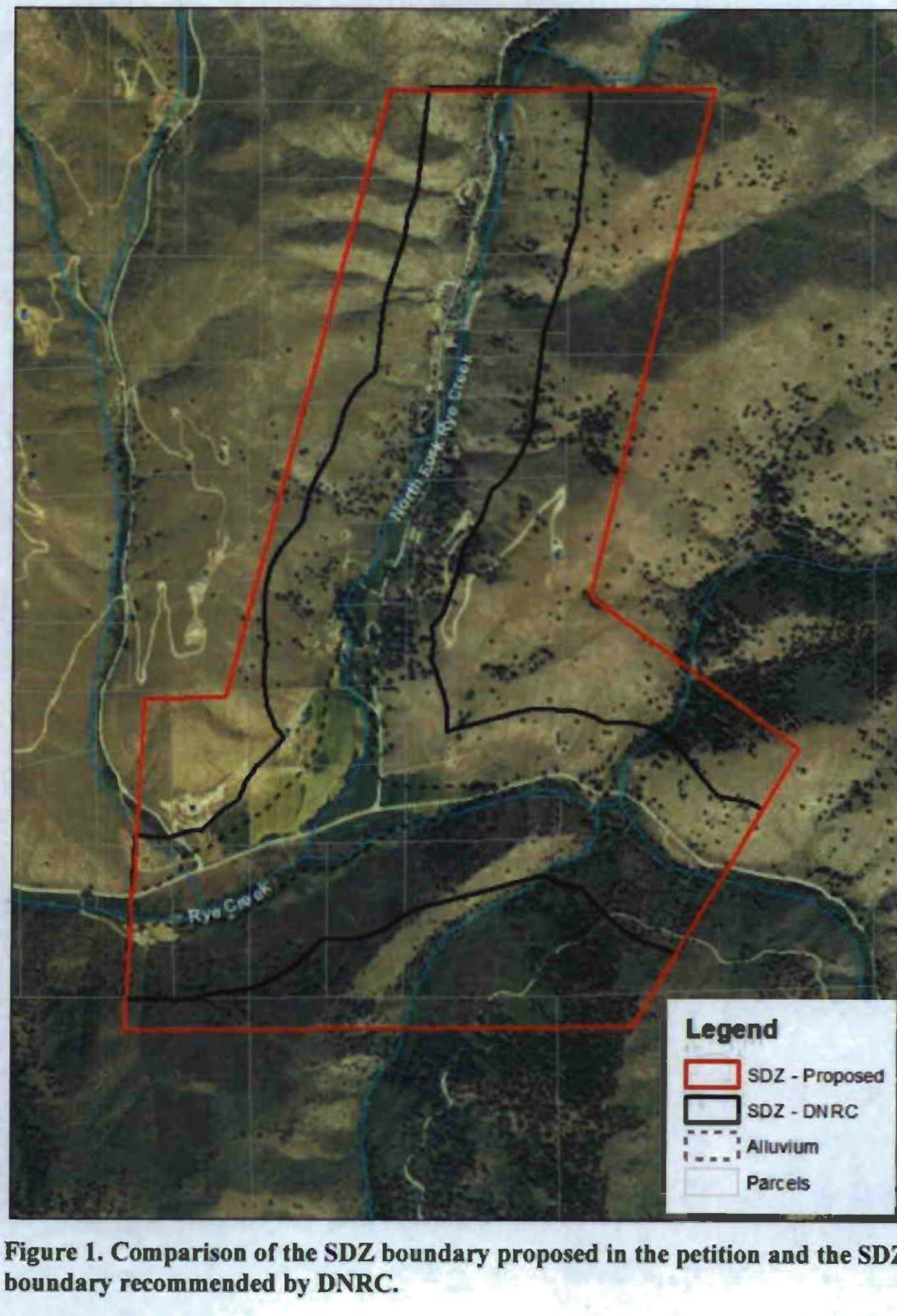

Figure 1. Comparison of the SDZ boundary proposed in the petition and the SDZ boundary recommended by DNRC.

Conclusion and Recommendation

Overall, the numerical model presented with the subject petition is a reasonable representation of the groundwater conditions in the watershed; however, the model is not unique and is too coarse for use in delineating a credible SDZ. The numerical model could be improved by reducing the cell size near surface waters to 50 feet by 50 feet and by collecting detailed groundwater level and stream flow data. Refining the detail of the model is relatively easy and a reasonable undertaking; however, the level of effort to collect data necessary to improve model calibration would be considerable. Modeling using WPDM provides an alternative approach that parallels our level of knowledge of the hydrogeology of the Rye Creek watershed. Therefore, a SDZ extending 700 feet on either side of Rye Creek and North Fork Rye Creek depicted in Figure 1 is more defensible than the propose SDZ boundary.

References

Bobst, A., and Fleener, S., 2014, A MODFLOW tool to define boundaries of a stream depletion zone: Montana Bureau of Mines and Geology Open-File Report 655, 24 p.

Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Englewood Cliffs, NJ, Prentice-Hall, 604 p.

Schroeder, D.R., 1987. "Analytical Stream Depletion Model." Office of the State Engineer, Colorado Division of Water Resources, Ground Water Software Publication No. 1.

Nave, Jim

From: randy@watersource-llc.com
Sent: Thursday, October 08, 2015 11:23 AM
To: Levens, Russell; Nave, Jim
Cc: chillipepy@aol.com
Subject: Comments on proposed Rye Crk SDZ No. 76H 30102741

Russ & Jim:

These three comments on the proposed Stream Depletion Zone for petitioners Ince, Skarvan, and Tenzer are editorial in nature.

1) The name of Leonard Skarvan in the notice document is spelled as "Skaravan" with an extra letter "a" in it, correct spelling is "Skarvan".

2) In the Russ Levens memo and in the notice document the model used was ModFlow-NWT not ModFlow 2005. ModFlow-NWT is more recent version of ModFlow that handles cell rewetting better than ModFlow 2005 and is better suited for steep terrain.

2) In the notice document and Russ's memo the model is described as having 115 cells. The model grid is 115 rows X 96 columns which probably where the 115 value came from. The number of cells in the active modeled area is actually a bit over 5,303 cells.

Thanks for your consideration

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