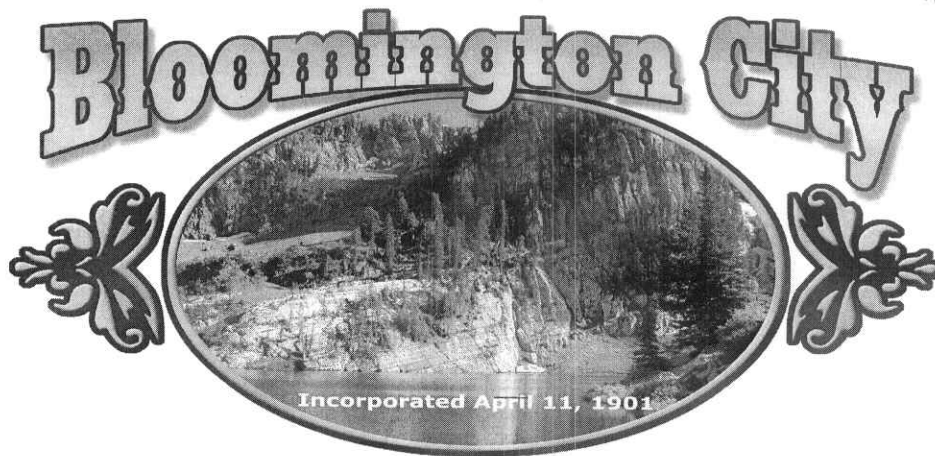


RECEIVED

JAN 15 2008

DEPARTMENT OF
WATER RESOURCES



Bloomington City
P.O. Box 194
Bloomington, Idaho 83223

Mayor Wayne J. Lloyd
City Clerk Winston Hart
208-945-3169 (Voice and Fax)

Council Members:

Ted Stocker
Philip Ward
Stacey Higley

January 4, 2008

Shelly Keen
Idaho Department of Water Resources
P.O. Box 83720
Boise, ID 83720

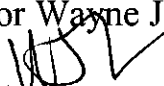
Re: Protest Application #11-7582

The City of Bloomington has secured the hydrogeologist firm of Clearwater Geosciences, LLP to determine the effects of water extraction from the aquifer that feeds the Bloomington City water supply. This courtesy copy of this report is being sent to you to advise you of the ramifications of approval of the Bear Mountain project. The City has retained legal counsel and will vigorously attempt to seek denial of water extraction in areas that will affect our water supply. We therefore seek denial of the application extracting

water from the aquifer adjacent to the spring that the City of Bloomington depends on for water. The application for a test well reference #11-7582, according to our counsel should be terminated because of the negative impact it potentially has on our water source. Other areas should be investigated thus reducing the impact on the aquifer that supports our community's water source. The longevity and quality of life of our community is commensurate with our water supply. We appreciate your review of this protest. Please feel free to contact the city if you have any questions.

Respectfully,

Mayor Wayne J. Lloyd


WJL/wjh

CC: File, Holden, Kidwell, Hahn & Crapo

Attachments: Hydrogeologist Report – Dr. Tom Woods.

HYDROGEOLOGIC ANALYSIS

CITY OF BLOOMINGTON MUNICIPAL SPRING

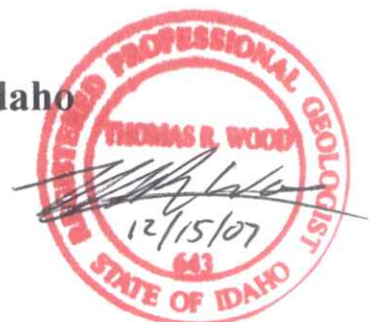
POTENTIAL IMPACTS OF PROPOSED BLACK BEAR MOUNTAIN RESORT

BEAR LAKE COUNTY, IDAHO



Submitted By
Clearwater Geosciences, LLP
For
City of Bloomington, Bear Lake County, Idaho

December 2007





Executive Summary

The city of Bloomington, Idaho requested that Clearwater Geosciences, LLP prepare a hydrogeologic assessment to determine potential impacts to the city's water supply spring from the proposed Black Bear Mountain Resort. This report presents the results of the assessment. The assessment consisted of examining water rights and water use, existing well logs, determining the characteristics of the local aquifers and making aquifer drawdown calculations.

The results indicate that the location of the subdivision wells may have a negative impact on the Bloomington Municipal Spring depending on the location where the wells are drilled within the Black Bear Mountain Development. Wells drilled on the west side of the fault creating the Bloomington Springs are likely to impact the springs. Although Clearwater Geosciences, LLP was not able to obtain drillers logs for test wells drilled or being drilled by the development, the locations for the drilling permits is in an area to the west of the spring-controlling fault. Therefore, if these test wells are eventually made into production wells, aquifer drawdown, caused by pumping, may reduce flow in the Bloomington Municipal Spring.

Introduction

The city of Bloomington, Idaho obtains municipal water from a spring located in the SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 19 of Township 14S, Range 43E in Bear Lake County, Idaho. This spring is in the Bear River Mountain range, approximately 3.5 miles to the west of the city of Bloomington, and at an elevation of about 6400 ft above mean sea level (MSL). The city is at an elevation of about 5968 ft MSL.

The geology and groundwater resources of the Bear Lake region were recently documented in a report by the Idaho Water Resources Research Institute (IWRRI et al., 2005), a division of the Idaho Geological Survey. The Bear River mountain range consists of several distinct stratigraphic units including the Paleozoic carbonate strata of the Bloomington Formation which hosts springs such as the Bloomington Municipal Spring (see Figure 1). The groundwater that feeds the spring is entirely derived from infiltrating snowmelt from higher elevations in this mountain range. The water that issues from the Bloomington Municipal Spring is conveyed eastward, via pipeline, down a canyon to the city of Bloomington, a change in elevation of about 430 ft. The city has a water right, associated with the spring and dating back to 1935, that consists of 5.25 cfs.

IWRRI Study

The Idaho Water Resources Research Institute (IWRRI) supported exploration of rural water supplies in a program entitled "Technical Assistance for Rural Ground Water Development within Idaho." Through this program, the water supplies for the cities of Paris and Bloomington were documented (Wylie et al., 2005). The objectives of that study were to better understand the sources of spring water for these two communities



and to make recommendations for future groundwater extraction strategies, including locations near the communities.

The IWRI analysis included examination of the underlying geology, movement of groundwater, and water chemistry. The analysis hypothesized the nature of Paris and Bloomington springs and explained their similarities and differences. The study also examined three potential subsurface regimes to explore for additional sources of water.

The geology of the Bear River Range consists of inclined limestones, shales, and quartzites. The limestones are located throughout much of the area and are particularly abundant in the higher elevations of the Bear River Range. These transmit much of the annual infiltrating snowmelt. There are less-permeable layers of shale in a formation called the Lead Bell Formation that is downhill from where the snowmelt infiltrates. The study determined that these subsurface features formed and control the springs that supply municipal water.

The authors' conceptual model starts with precipitation as snow falling on higher elevations of the Bear River Range west of Bloomington and Paris. The melted snow enters the subsurface and passes through a series of limestone before exiting springs, including the Bloomington Municipal Spring. The less-permeable shale layers brought to surface by the north-trending Bloomington Thrust fault force groundwater out of the subsurface into springs from the cavernous Bloomington Formation that lies just above the shales and fault. Figure 2 illustrates this concept. In a similar manner, the Paris Spring is recharged from a higher elevation in the Bear River range and receives more snowfall and has a thicker recharge zone than what serves the Bloomington spring. Hence, the Paris spring has a higher and steadier flow.

Below the Lead Bell shale is a quartzite layer called the Brigham Quartzite. This formation is a very hard rock hosting some groundwater that seeps past the shale and fault. Some water remains as groundwater in this lower layer while some discharges as springs from the quartzite and adds to surface waters including the Bloomington and Paris Canyon creeks. In the valley is a geologic layer called the Salt Lake Formation that consists of unconsolidated sediments of clay, sand, gravel and silt.

The report looked at three of these formations and concluded that the most reliable source of future municipal groundwater would be from the Salt Lake Formation toward the center of the valley. There are many high-yielding wells completed in this formation although the recharge mechanism for the formation was not explained in the study. The Bloomington Formation was recommended as it contains several high-yield springs but the permeability is limited to fractures and limestone caverns with little groundwater storage capacity. The Brigham Quartzite formation does contain groundwater but, again, with very limited permeability and, due to the presence of fault systems that bound this formation, it may be cutoff from recharge derived from higher elevation mountains.



In a situation such as this, where permeable rock units overlies much lower permeable rocks, contact springs can form. The lithologic contact between the two rock types is often marked by an obvious line of springs (Fetter, 1988). In this area, the Bloomington Municipal, Jarvis, and Paris springs make a clear northwest-trending line coincident with the surface exposure of the Bloomington Formation. Fault systems can also cause reduction in permeability and force the exit of groundwater from the subsurface.

The IWRRI study also focused on groundwater chemistry and demonstrated that the water sampled from springs in the Bloomington Formation has a very different chemical signature than the water taken from downhill springs exiting the Brigham Quartzite. They concluded that, due to the fault system, the Brigham Quartzite formation is probably disconnected from the recharge sources that supply the Bloomington, Jarvis, and Paris springs.

Clearwater Geosciences, LLP reviewed the IWRRI report and other additional data available for the area and concur with the assessment and conclusions of the report.

Proposed Subdivision and Drilling Activities

The proposed Black Bear Mountain Resort is also shown in Figure 1. This subdivision covers some 2207 acres (3.45 mi²) over five sections (sections 28, 29, and 33-34) of Township 14S, Range 43E and three sections (3, 4, and 9) of Township 15S, Range 43E (personal communication, M. Poulsen, 2007). The configuration of the proposed subdivision that is shown in Figure 1 is only an estimated outline of the subdivision. It covers areas ranging in elevation from about 6200-6800 ft above msl.

Permit applications for well drilling that were filed with the Idaho Department of Water Resources in year 2007 show there were two exploratory test holes planned for this area possibly to support water development for Black Bear Mountain Resort subdivision. The drilling permits indicate that the test holes were to be drilled or have been drilled in the SW ¼ SW ¼ of Section 32, T14S, 43E. This location encompasses a portion of the Bloomington Formation that is, as explained above, the geologic layer that hosts the Bloomington Municipal Spring. Figure 3 shows the locations of the trend of the Bloomington Formation (near the blue fault line), municipal spring, and the 40-acre quarter-quarter section where the test wells were drilled.

The IWRRI study argued that the presence of high-yielding springs, used for municipal water supply, is the result of sharp permeability contrast that occurs along the eastern edge of the Bloomington Formation. The Bloomington Municipal Spring is part of this formation and is at an elevation of about 6400 ft. The two test holes were drilled approximately 2.1 miles south to southeast of the municipal spring at an elevation of approximately 6850 ft or about 450 higher than the spring. The permit applications indicate 1000-ft holes were to be drilled. A 1000-ft hole would place the bottom of the



test hole about 550 ft below the elevation of the Bloomington Municipal Spring and would likely extend across depths at which source water for the municipal spring occurs.

Though official drillers logs have not yet been filed with IDWR, sources familiar with the drilling of the test holes confirmed that there were indeed two test holes drilled in the SW-SW corner of Section 32 in 2007. One hole was drilled to 1000, the other to 1100 ft. One of these holes was pumped at 75-90 gpm. The drilling was reported to be in limestone-like material offering moderate resistance to drill bit advancement (about 160-200 feet/day of drilling); which is softer than what would be expected from the very hard crystalline Brigham quartzite. Water was encountered at 580 ft below land in one hole and at 320 ft in the second hole. Clearwater Geosciences, LLP was not able to obtain further information regarding the test holes, as contractors have one year to file a well drillers log for a newly drilled well.

Impact Analysis

The impact analysis presented in this report estimates the impact of pumping groundwater from the subsurface geologic formation or layer that is in hydraulic communication with the Bloomington Municipal Spring. The analysis relies on estimates of several parameters including the expected water use requirement for the proposed subdivision, the storage and transmissibility of the aquifer, and the degree of hydraulic communication between the subdivision water wells and the municipal spring.

For the subdivision water requirements, a withdrawal rate of 2000-5000 gpm is assumed. This accounts for domestic water requirements of individual homes within the subdivision. Also, the subdivision is being built as a resort community and will likely feature irrigated parks, golf course, lawns and other green areas. As a result, the 2000-5000 gpm estimate is reasonable, although with a large range. Our calculations could be further refined with additional information about the communities water demand.

Estimates of aquifer properties were obtained from pumping tests conducted in the past on a number of wells in the Bear Lake area, both in areas near the springs and down in the valley near the two communities. From 26 wells, a range of transmissivity values was obtained for this area. The transmissivity of an aquifer is a parameter that expresses the aquifer's ability to yield water; it is a function of hydraulic conductivity (basically, permeability) and aquifer thickness. An estimate of 50,000 ft²/day was obtained from the past tests. This value is about the median of the range of values obtained from converting specific capacity (gpd per ft drawdown) from the well pumping tests. The appendix to this report includes tabulation of these calculations.

Storativity is another aquifer parameter; it relates the amount of water released from an aquifer when water is drawn down in a pumped well. A value of 0.001 was used; this value was obtained from literature (Freeze and Cherry, 1979) and is consistent with these groundwater conditions and subsurface materials. The portion of the aquifer in the



hills to the west of Bloomington that was analyzed in this section is part of the Bloomington formation and was assumed to be under confined conditions

With these inputs, a drawdown analysis was performed. The drawdown calculation is an analytical technique based on the mechanics and mathematics of groundwater flow and the impact of withdrawals (Theis, 1935). This type of calculation determines the lowering of the potentiometric surface as a function of radial distance from the pumped well. The potentiometric surface (e.g. water table) represents the driving force that moves groundwater from one location to another, such as to the Bloomington Municipal Spring. This surface is often called the head field and represents a combination of different forms of driving energy such as gravity and pressure. The lowering of this surface can have significant impacts on surface expressions such as lakes, streams, and springs, especially in the latter case since springs can be very dependent on the head of the system. Springs are essentially the intersection of land surface with the water table and are typically not under much pressure; therefore, a few feet decline in the water table can have dramatic effects on the discharge of springs.

Results

The Theis-distance calculation is presented in the appendices. The results were compared to the estimated potentiometric surface map for an area between the SE $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 19 (Bloomington Municipal Spring) and SW $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 32 (Black Bear Mountain Resort test wells). The potentiometric surface map is extracted from a much larger map that is based on a total of 68 well logs found for T14S, R43E and T15S, R43E.

The results of the analytical calculation show that, within two years of pumping at a rate of 2000 gpm in the location of the current test holes, the potentiometric surface would be lowered by nearly 4 feet at a distance of 2.1 miles (i.e., at Bloomington Municipal Spring). Continuous pumping at the higher end of 5000 gpm would lower the surface even more to a total of 10 ft at the spring.

There are several limitations with the analysis that require explanation. The major limitations of the Theis method affecting its application to this problem are that 1) the water table is flat and 2) the aquifer is of infinite areal extent. Nevertheless, the Theis solution is the standard method employed by hydrogeologists to understand potential impacts from groundwater pumping.

First, despite that fact that the water table gradient is steep in this area, the presence of the springs and the proposed pumping locations along the same contour elevation suggests that water table can be treated as flat for this calculation. The potentiometric surface map indicates that the well location in Section 32 and the Bloomington Municipal Spring in Section 19 are along a line that is approximately perpendicular to the direction of groundwater flow and they are cross-gradient from each



other. This means that the cone of depression formed from pumping of the new well can be approximated using the Theis equation.

Second, the Theis-distance analytical technique assumes an aquifer with infinite areal extent; that is, the aquifer is assumed to extend infinitely in all directions. Obviously, this is never the case in any real world situation and this assumption of the Theis solution is always carefully considered. As described above, there is a sharp boundary to aquifer formed by contact of the limestone with shale to the east of Bloomington City Spring. In this area, there is only one-half of an aquifer, thus, the calculations presented above almost certainly under estimate the actual amount of drawdown to be expected from the proposed development.

The analytical technique used here depends on several highly idealized conditions and assumptions. A more thorough, rigorous analysis would require the development and testing of a numerical model which could overcome some of the assumptions and better represent the specific conditions of the study area. However, such a model would require additional field data and more time to prepare.

Conclusion

The results indicate that the location of the subdivision wells may have a negative impact on the Bloomington Municipal Spring depending on where the wells are located within the Black Bear Mountain Development. If water supply wells for this subdivision/resort are drilled on the along the contact of the limestone and shale system that create the Bloomington Spring, then they are likely to impact the springs by reducing flow. If they are drilled downhill to the east of the limestone-shale contact and fault system, they might not impact the spring at all; however, this is not know without more drilling and aquifer testing information.

The locations for the drilling permits is in the area of the proposed development that has the greatest potential to negatively impact the Bloomington Springs (i.e. along the spring controlling geologic trend). If these test wells are eventually made into production wells, aquifer drawdown caused by pumping, is likely to reduce flow in the Bloomington Springs. Other locations within the proposed development to the east are less likely to impact the Bloomington Springs, but without additional information it is difficult to assess.

The hydrogeologic assessment presented here, in conjunction with a detailed investigation by the State of Idaho, suggest that negative impacts to the Bloomington Springs may be significant. Especially when considering where the developer is placing test wells and looking for water. Additional investigations using data from the test wells and better water demand numbers from the development would help refine the calculations presented here.



References

- Fetter, C. W., Applied Hydrogeology, Macmillan Publishing, New York, 1980.
- Freeze, R. A. and J. A. Cherry, Groundwater, Prentice-Hill, Inc., Englewood Cliffs, NJ, 1979.
- Personal communication, Mitch Poulsen, Bear Lake County Planning and Zoning Commission, November, 2007.
- Theis, C. V., The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. Trans. American Geophysical Union, Vol 2., pp. 519-524, 1935.
- Wylie, A. H., B. R. Otto, and M. J. Martin, Hydrogeologic Analysis of the Water Supply for Bloomington and Paris, Bear Lake County, Idaho, Information Circular 58, Idaho Geological Survey, Moscow, Idaho, 2005.



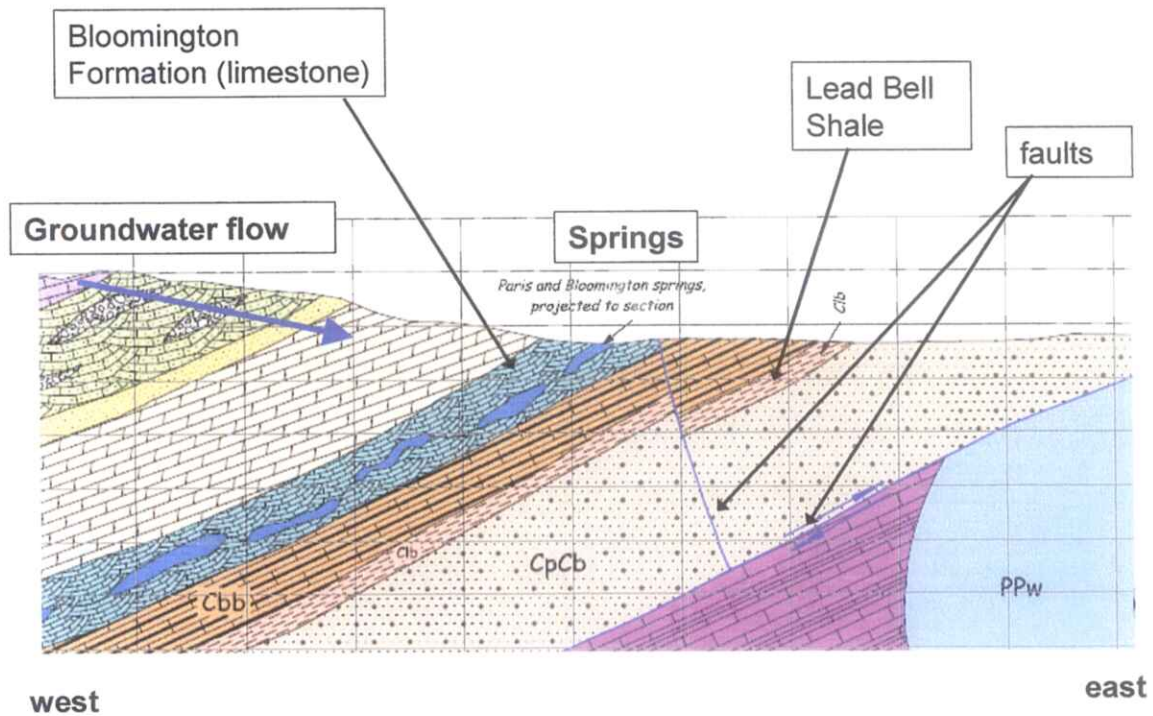


FIGURE 2. Conceptual model cross-section showing more-permeable Bloomington Formation adjacent to downhill, less-permeable rocks (Lead Bell shale) and fracture system. Brigham Quartzite formation (CpCb) also shown downhill of springs (after Oriel and Platt, 1980).

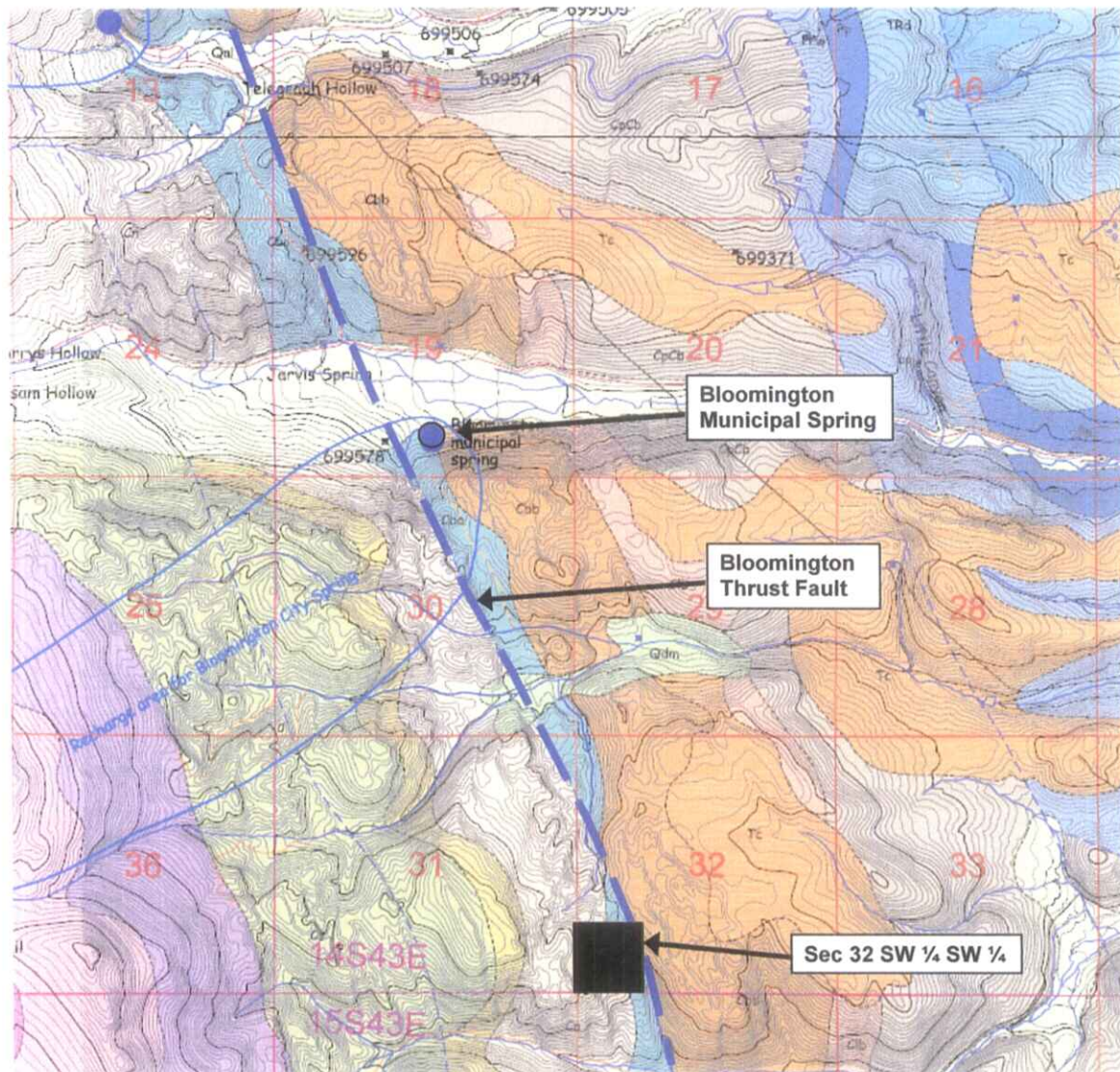


FIGURE 3. Locations of Bloomington Municipal Spring, Black Bear Mountain Resort test hole drilling, and Bloomington Thrust fault. (Modified from Oriel and Platt, 1980)



APPENDIXES

A. Water Table Map and Well Data

B. Transmissivity Calculations and Pump Test Data

C. Theis-Distance Calculations



Appendix A – Water Table Map and Well Data

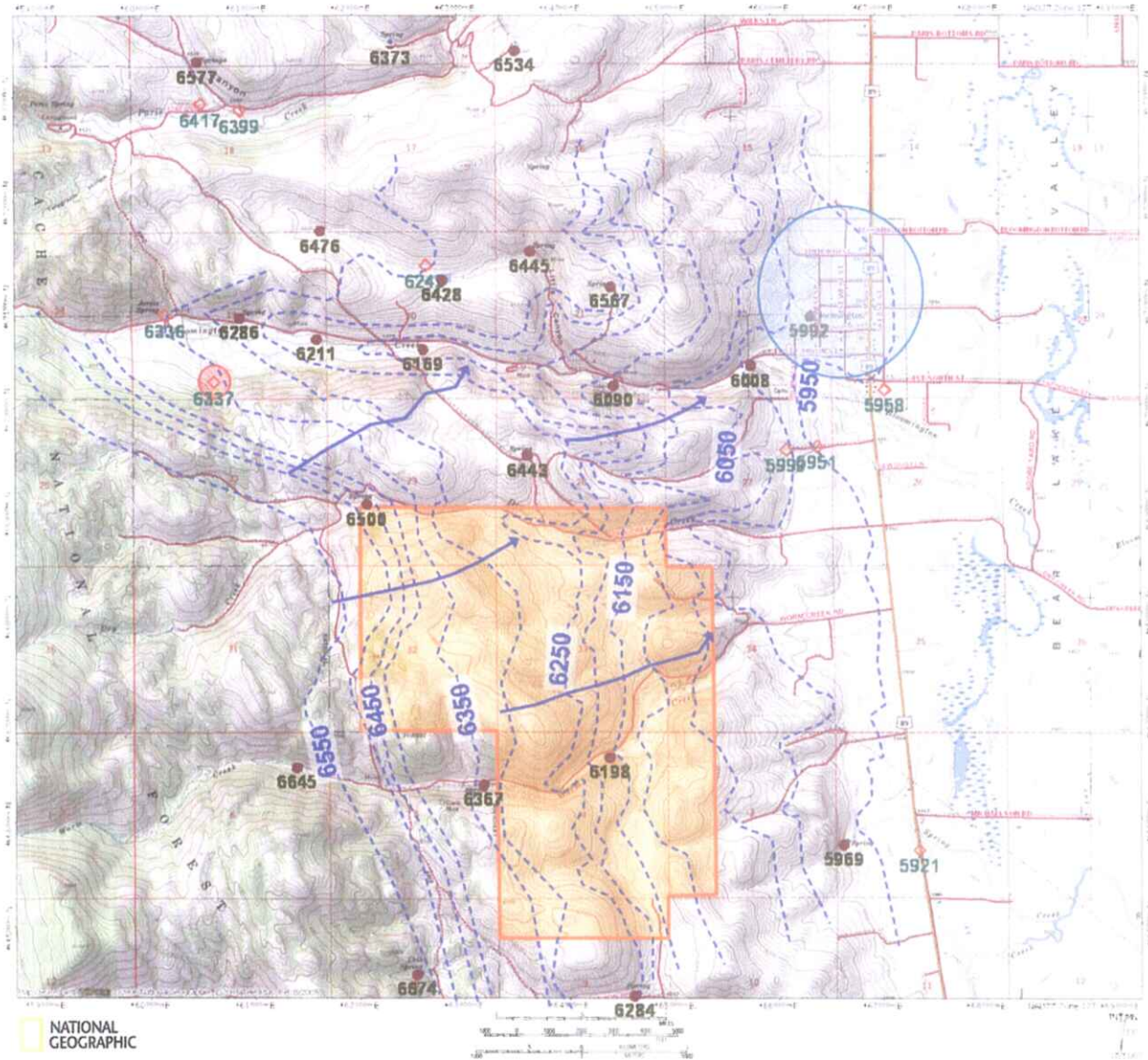


Figure A-1. Detailed water table map (50-ft) contours. Contour values are feet above mean sea level. Arrows indicate general direction of groundwater flow. Large red circle is Bloomington Municipal Spring location, Orange polygon is proposed subdivision.



Table A-1. Well data used to prepare map in Figure A-1.

TWP	RNG	SEC	Tract	Static Water Level	Total Depth	Casing Depth	CSG. DIA.	Construction Date
15S	43E	19	NENE	4	0			11/18/1984
15S	43E	35	SWSE	59	325	319	6	7/11/1990
15S	43E	26	NESW	91	361	345	6	2/21/1994
15S	43E	27	SESE	75	260		6	11/1/2000
15S	43E	14	SWNENE	75	80	80	6	9/16/2002
15S	43E	11	SWSESW	68	160	158	6	9/22/2006
15S	43E	11	SWSESW	117	220	247	6	10/10/2006
15S	43E	23	NWSW	58	301	283	6	1/9/2007
14S	43E	27	SENE	45	180	158	8	10/24/2002
14S	43E	10	NENE	96	285	284	8	1/17/2003
14S	43E	4	SWSE	30	120	60	6	8/30/2003
14S	43E	9	NWSWNE	39	102	97	6	8/26/2004
14S	43E	9	NWSWNE	8	102	79	6	11/11/2006
14S	43E	27	SWNENE	37	128	128	6	12/16/2006
14S	43E	18	SWNE	47	134	113	6	10/20/1994
14S	43E	18	SESW	70	174	145	6	10/26/1994
14S	43E	20	NWNE	218	275	266	6	9/20/1990
14S	43E	24	SWNW	Above Ground Level		30	6	9/9/1997
14S	43E	36	SWNW	70	105	40	6	9/13/1989
15S	43E	1	SWSW	7	210	210	6	6/3/2004
15S	43E	2	SWSE	20	159		6	6/24/2000
15S	43E	13	SESESW	6	75	69	6	5/15/2002
14S	43E	23	SWSE	3	40			12/31/9999



Appendix B -- Transmissivity Estimates

Town-ship	Range	Sec-tion	Tract	Yield gpm	gpd ¹	Draw-down, ft	material pumped ²	Spec Capac ³ gpd/ft	T ⁴ (ft ² /d)
15S	43E	23	NESWNW	42	60480	90	clay, cobbles	672	1.35E+05
15S	43E	14	NENESW	30	43200	51	gravel	847	1.70E+05
15S	43E	26	SESE	30	43200	9		4800	9.65E+05
15S	43E	13	SESESW	15	21600	15	sand, clay	1440	2.89E+05
15S	43E	14	NENESW	20	28800	22	clay	1309	2.63E+05
				30	43200	62	clay	697	1.40E+05
15S	43E	11	SENW	20	28800	12	clay, gravel	2400	4.82E+05
15S	43E	11	SWNE	35	50400	100	sand, clay	504	1.01E+05
15S	43E	23	NWSW	15	21600	90	rock	240	4.82E+04
15S	43E	26	SWSW	20	28800	10	clay, gravel	2880	5.79E+05
15S	43E	11	SWSW	50	72000	74	gravel, sand	973	1.96E+05
15S	43E	11	SWSESW	50	72000	52	gravel	1385	2.78E+05
15S	43E	11	SWSESW	5	7200	123	silt	59	1.18E+04
15S	43E	11	SWSESW	12	17280	25	cobbles	691	1.39E+05
15S	43E	23	NWSW	30	43200	142	clay	304	6.11E+04
15S	43E	14	NENENW	25	36000	59	gravel, sand	610	1.23E+05
14S	43E	18	SWNENE	5	7200	80	cobbles	90	1.81E+04
14S	43E	18	SESWNE	5	7200	100	cobbles	72	1.45E+04
14S	43E	9	SESWNW	40	57600	45	shale	1280	2.57E+05
14S	43E	10	NENENE	35	50400	100	clay	504	1.01E+05
				50	72000	160	clay	450	9.05E+04
				60	86400	250	clay	346	6.95E+04
14S	43E	4	NWNESE	20	28800	15		1920	3.86E+05
				125	180000	130		1385	2.78E+05
14S	43E	9	NWSENW	50	72000	120	shale	600	1.21E+05
14S	43E	9	NESENW	35	50400	50	shale	1008	2.03E+05
14S	43E	23	SWSE	20	28800	12	gravel, clay	2400	4.82E+05
14S	43E	9	NWSWNE	55	79200	40	shale	1980	3.98E+05
14S	43E	9	NWSWNE	30	43200	20	shale	2160	4.34E+05



14S	43E	27	SWNE	18	25920	63	clay	411	8.27E+04
Summary Statistics for Transmissivity Estimates									
							min	59	1.2E+04
							max	4800	9.6E+05
							avg	1147	2.3E+05
							count	30	

¹ yield, converted to gallons per day

² subsurface formation material surrounding open interval of well and pump

³ specific capacity, well yield divided by drawdown

⁴ Transmissivity, ft²/day



Appendix C - Drawdown Calculation

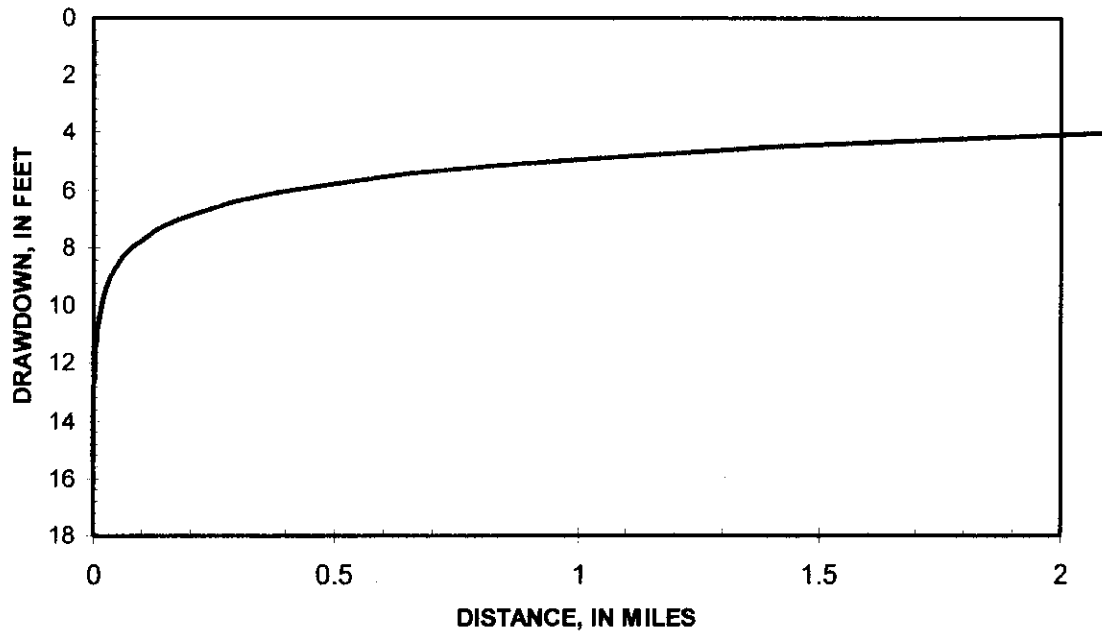


Figure C-1. Drawdown as a function of radial distance under 2000 gpm conditions

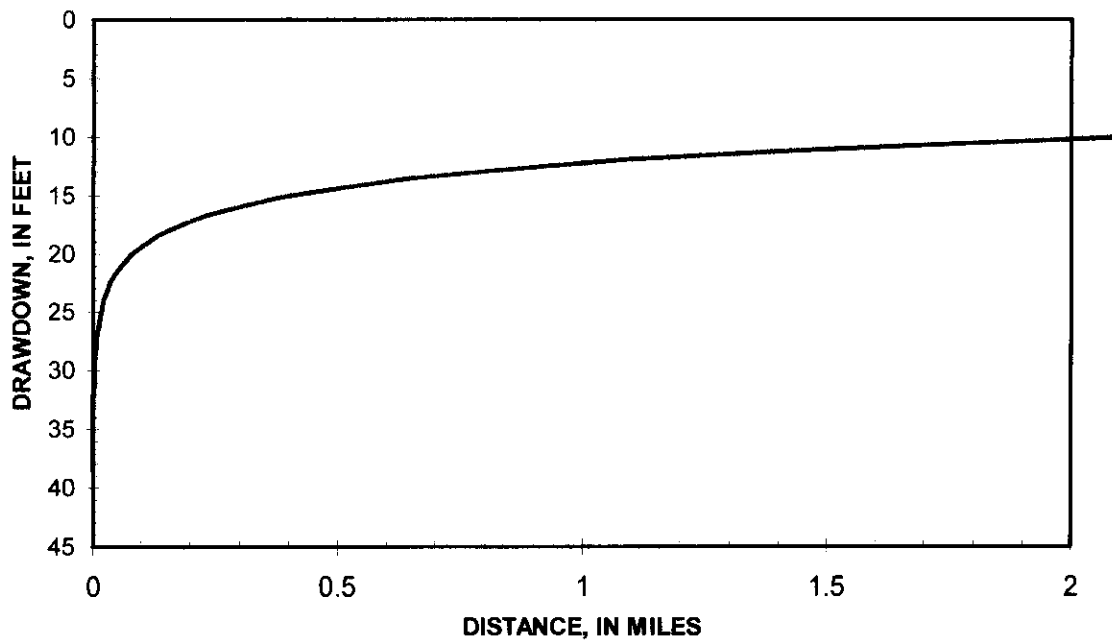




Figure C-2. Drawdown as a function of radial distance under 5000 gpm conditions
Appendix C (continued)

For Figure C-1

Q = 2000 gpm
S = 0.001 d'less
T = 50000 ft²/d
Time = 2 years

Radius, miles	Radius, ft	Drawdown
2.1	11088.0	4.0

For Figure C-2

Q = 5000 gpm
S = 0.001 d'less
T = 50000 ft²/d
Time = 2 years

Radius, miles	Radius, ft	Drawdown
2.1	11088.0	10.0