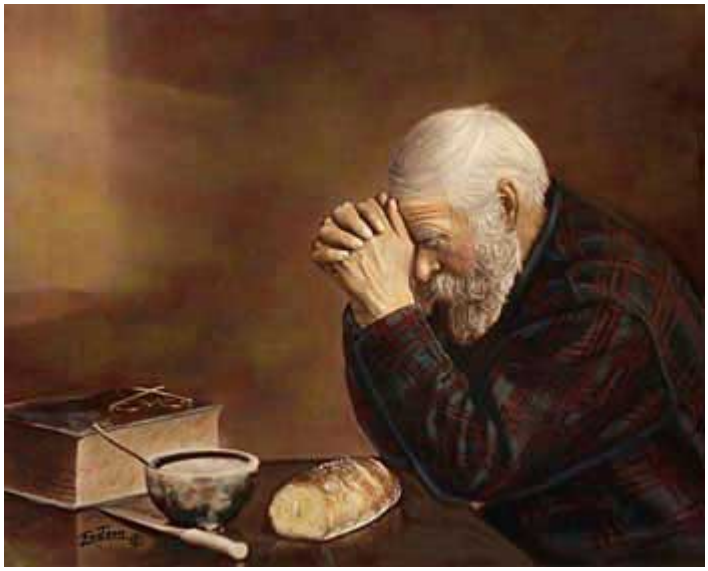
CITY OF BOVEY



Home of the Picture "GRACE"

Wellhead Protection Plan
Part 1

Wellhead Protection Plan

Part I

Wellhead Protection Area Delineation
Drinking Water Supply Management Area Delineation
Well and Aquifer Vulnerability Assessment

For

The City of Bovey

February 8, 2007

James F. Walsh

Minnesota Department of Health

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Glossary of Terms

Assimilative Capacity. The ability of the saturated or unsaturated zones of a formation to attenuate the concentrations of contaminants to acceptable levels before they reach the well (U.S. EPA, June 1987). An assimilative capacity boundary can be any combination of 1) surface and subsurface geologic materials, and 2) groundwater flow paths that prevent contaminants from reaching a public water supply well at levels that present a risk to human health.

Capture Zone. The subsurface area surrounding a well or well field that supplies a public water supply system through which water is likely to move toward and reach the well. The capture zone and the surface water contribution area, when needed, comprise the wellhead protection area (WHPA).

Conjunctive Delineation. A WHPA that is defined by two components, consisting of 1) the capture zone for a well that is based on generating flow pathlines within the subsurface area(s) of contribution, and 2) a surface area that may contribute recharge to the capture zone.

Drinking Water Supply Management Area (DWSMA). The area delineated using identifiable land marks, defined in this report, that reflects the scientifically calculated wellhead protection area boundaries as closely as possible (Minnesota Rules 4720.5100, subpart 13).

Source Water Protection Area (SWPA). A source water assessment includes a description of 1) the area to be protected, 2) potential contamination sources that may impact the source of drinking water, and 3) the susceptibility of the public water supply to potential contamination sources. For the purposes of this delineation report, the SWPA and the DWSMA are the same.

Wellhead Protection Area (WHPA). The surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field (Minnesota Statutes, part 103I.005, subdivision 24).

Introduction

This report documents the technical information necessary to prepare Part I of a wellhead protection plan that will help ensure an adequate and safe drinking water supply for the city of Bovey, public water supply identification number 1310003. It documents the delineation of the wellhead protection area (WHPA), the drinking water supply management area (DWSMA), and the vulnerability assessments for the public water supply well and DWSMA. An updated source water assessment with a new protection area (SWPA) also is included. Definitions explaining the differences between the terms WHPA, DWSMA, and SWPA are provided in the "Glossary of Terms" at the beginning of this report.

The delineation was performed in accordance with Minnesota Rules 4720.5100-4720.5590 for preparing and implementing wellhead protection plans for public water supply wells. The Minnesota Department of Health (MDH) administers these rules and the results described in this report reflect those of the MDH to 1) identify the capture zones for delineation of the WHPA, and 2) prepare well and DWSMA vulnerability assessments. Also, this report presents the findings of the public water supplier to identify the boundaries of the DWSMA.

The public water supplier operates a single well, termed Well No. 1 (Unique No. 228834). The well is located in Section 32 of Township 56 North, Range 24 West in Itasca County. Table 1 in Appendix I presents some of the key information about this well that affects its vulnerability assessment.

The WHPA for Well No. 1 (Unique No. 228834) was determined using a computer model to simulate groundwater flow towards it. The DWSMA boundaries were determined using U.S. Public Land Survey boundaries, city streets, and roads. Figure 1 shows the boundaries for the WHPA and the DWSMA.

Source Water Assessment

The MDH is required under Section 1453 of the 1996 Amendments to the federal Safe Drinking Water Act to prepare source water assessments for all public water supply systems. Congress intends that assessments should be used to educate public water suppliers and the customers they serve about the source of their drinking water and potential contaminants that may affect people's health. The following Source Water Assessment for the public water supplier contains the information specified in Minnesota's source water assessment program description.

Source Water Assessment for
The City of Bovey

Public Water Supplier ID Number: 1310003

Water Supplier Contact: Mike Bibitch
218-245-1633
Bovey, MN 55709

MDH Contact: Beth Kluthe
Minnesota Department of Health
218-755-6315
705 Fifth Street, Suite A
Bemidji, MN 56601
beth.kluthe@health.state.mn.us

Status of the Source Water Protection Plan –

The Minnesota Department of Health has approved the 1) delineation of the wellhead protection area, 2) delineation of the drinking water supply management area, and 3) assessments of well and aquifer vulnerability. The public water supplier is proceeding with the development of the remainder of the wellhead protection plan.

Source Water Protection Area - See Figure 1.

Description of the Source Water - The water supply for the city of Bovey comes from a sand and gravel aquifer that exhibits confined hydraulic conditions at the city well. The aquifer is about 50 feet thick and is covered by 30-40 feet of clay rich till. Generally, groundwater moves in a southwesterly direction in the wellhead protection area, although the flow directions are variable and influenced by the water level within the Canisteo Mine Pit.

Table 2
Well Used by the Public Water Supplier

Well No.	Unique No.	Well Use	Aquifer Type	Well Depth (ft)	Well Sensitivity	Aquifer Sensitivity
1	228834	Primary	Sand and Gravel	92	High	Moderate

Aquifer Sensitivity - The sensitivity of the aquifer used by the public water supplier is variable throughout the drinking water supply management area. It ranges from highly sensitive where the aquifer is exposed at the land surface, such as around the Canisteo Mine Pit, to moderately sensitive where covered by till. Existing data suggest that the overlying till is leaky. A tritium sample taken from city Well 1 (228834) on February 10, 2004, showed 18.3 tritium units, indicating that most of the water pumped by the well entered the ground within the last 50 years.

Well Construction Assessment - Existing construction information for Well 1 (228834) suggests that grout was not drawn into the annular space of the well casing as it was driven, as is currently required by the State Well Code. This factor could provide a pathway for near-surface contamination to enter the source water. However, it is also possible that the limited annular space created during cable tool well construction may have become sealed due to swelling of clay minerals present in the surficial till.

Susceptibility of the Source Water to Contamination - The source water used by the public water supplier is considered susceptible to potential sources of contamination principally because of the geologic setting, although the construction of Well 1 (228834) may also provide an avenue for contamination. The land uses within the drinking water supply management area may potentially contribute contaminants that may present a health concern to the users of the public water supply.

Contaminants of Concern - Routine water testing from Bovey Well 1 (228834) has shown that it has generally been free from contaminants and meets all potability standards of the federal Safe Drinking Water Act. However, the well is considered susceptible to contamination from a variety of sources. These include contaminants that may persist in groundwater for long periods of time and which are not susceptible to retardation or removal by movement through fine-grained sediment.

Delineation of the Wellhead Protection Area

Physical Setting

The City of Bovey is located in Itasca County near the western end of the Mesabi Iron Range. The town is surrounded by features associated with a nearly 100-year old history of iron mining, which ceased in this area in the mid-1980's (Jones, 2002). These features include tailings ponds, waste rock stockpiles, and, most prominently, the Canisteo Mine Pit lake (Figure 2). The Canisteo Mine Pit lake is situated approximately 2,400 feet north of Well 1 (228834). It has an average depth of approximately 100 feet, but is up to 300 feet in depth locally. It is nearly five miles in length, averages approximately 0.5 miles in width, and was created when water levels rose following the cessation of mining at a series of closely-spaced, abandoned natural ore mine pits.

Assessment of Data Elements

This section documents how the data elements specified under Minnesota Rules 4720.5400 were used to describe the physical environment.

Soils: The aquifer used by the city of Bovey is buried beneath a layer of till, except where exposed locally along the margins of the Canisteo Mine Pit lake. As a result, soils maps are not useful for delineating its boundaries. However, the Itasca County soils survey (Nyberg, 1987) was useful for assessing the vulnerability of the aquifer.

Precipitation: The mean annual precipitation for the area is 27.54 inches (Minnesota State Climatologist, 2001). Jones (2002) derived estimates of groundwater recharge for the area using stream-hydrograph analysis methods on daily streamflow records for the Prairie River near the city of Taconite for the 1968-1982 time period. These recharge estimates were used in the WHPA delineation.

Geology: Figures 2 and 3 show the distribution of the aquifer and its stratigraphic relationships with adjacent geologic materials. They were prepared using existing geologic maps (Jennings and Reynolds, 2005) and well record data that is contained in the County Well Index database. A complete listing of the geological maps and studies that were used to further define local hydrogeologic conditions is provided in the section of this report entitled "Selected References."

The natural landscape of the Bovey area was strongly affected by late-Pleistocene glaciation. Although the town of Bovey is situated on relatively flat ground, the surrounding area consists of an irregular topography of small hills and depressions (Figures 2 and 3). This distribution of landforms is attributed to rapidly shifting depositional environments commonly found near the margins of glacial ice, probably of the Koochiching lobe (Jennings and Reynolds, 2005). Dominant glacial landforms in the Bovey area include Trout Lake, attributed to a subglacial drainage feature known as a tunnel valley, and the irregular hills adjacent to and west of Trout Lake, indicative of ice contact deposits (Jennings and Reynolds, 2005).

Although surficial materials in the Coleraine area near Bovey are dominated by sediments of the Koochiching lobe, interpretations are complicated by apparent admixture with sediments of the Rainy lobe. This was probably caused by collapse of both units related to late melting of buried

ice (Jennings and Reynolds, 2005). The total thickness of glacial sediments in the Bovey area is on the order of 160 feet. Generally, drift thickens to the south and thins to the north, approaching zero along the crest of the Giants Range, a linear ridge composed of Archean granitic and metasedimentary rocks that trends northeast to southwest (Jones, 2002). It is located north of the Canisteo Mine Pit.

Winter (1971) identified three major morainal till units and associated glaciofluvial outwash deposits in this general area, but only two appear to occur in Bovey. These are the upper surficial and middle boulder till units (Jones, 2002). The surficial till is brown in color, sandy, silty, and calcareous and is generally less than 30 feet thick in this area (Jones, 2002). The boulder till ranges widely in color from gray to yellow, consists of sands and silts with abundant cobbles and boulders, and is generally less than 50 feet thick (Winter, 1971). Glaciofluvial outwash deposits lie stratigraphically between the surficial and boulder tills, and often lie between the boulder till and deeper tills or bedrock (Winter, 1973a). Those that occur between the surficial and boulder tills are the thickest and most continuous outwash deposits in the Bovey area. They are often greater than 50 feet thick, and sometimes exceed 100 feet in portions of buried valleys (Winter, 1973a). These outwash deposits consist of fine-grained sands throughout much of the study area. However, they are highly transmissive, coarse-grained sands, gravels and boulders occurring within buried valleys and at other locations where the bedrock surface is low (Jones, 2002). These deposits form the aquifer that is tapped by the Bovey city well.

The uppermost bedrock beneath the city of Bovey consists of the Virginia Formation, a Paleoproterozoic package of argillites, siltstones and greywackes (Jones, 2002). This unit thins to the north so that the uppermost bedrock present within the Canisteo Mine Pit is the Biwabik Iron Formation (Jirsa and others, 2005).

Groundwater Quantity and Quality: The Minnesota Department of Natural Resources permits high-capacity wells and documents their pumping volumes in the State Water Use Database (SWUDs). It is important to identify other high-capacity wells in the vicinity of the Bovey well because they may affect the boundary of the capture zone in the WHPA. The only high-capacity wells identified within two miles of the Bovey well are the municipal wells for Coleraine and Taconite. The Taconite city wells are completed in the Biwabik Iron Formation and are unlikely to constitute a flow boundary to the Bovey well. The Coleraine municipal wells are completed in the same aquifer as Bovey Well 1 (228834) and, therefore, may constitute a flow boundary.

Water quality information on the Bovey city well was obtained from MDH records, as well as published data (Cotter and others, 1965). These data show that significant changes have occurred in the chemical makeup of the city water over time (Figures 4 and 5). The earliest data for the Bovey well date to 1957 and 1971, at which time the Canisteo Pit was dewatered. Chloride and sulfate values recorded from that time period show values of 3.5-5.0 mg/l and 50-68 mg/l, respectively. Follow-up sampling conducted in 2004 showed markedly different results. The chloride and sulfate values for the Bovey city well had risen to 32-34 mg/l and 160-190 mg/l, respectively. This may be attributed to changing groundwater flow patterns in the area related to rising Canisteo Mine Pit water levels, as described below.

When the Canisteo Mine Pit was dewatered, it functioned as a drain, collecting groundwater from surrounding aquifers in addition to precipitation and surface water runoff. At its lowest levels, the dry pit floor would have been approximately 200 feet below the level of Trout Lake.

As a result, groundwater flow in the Bovey area would have been directed from Trout Lake towards the Canisteo Pit. It is likely that the Bovey municipal well would have captured some water from Trout Lake during this time. This theory is supported by 1) water level observations of the lake and the city well noted in Cotter and others (1965), and 2) historic water chemistry data from Trout Lake and the municipal wells of Bovey and Coleraine. Trout Lake water quality data were obtained from published data (Cotter and others, 1965) and compared with sampling conducted in 2004 in support of this delineation. The chloride and sulfate results from Trout Lake were consistent over this time period, with values of 5.9-6.2 mg/l and 39-52 mg/l, respectively. These values are very similar to those observed from early samples taken from the Bovey and Coleraine municipal wells. Note that the 2004 sample results for the Coleraine city wells suggest that they were still capturing some Trout Lake water at that time (Figure 5).

As the Canisteo Pit water level has risen since the cessation of mining, now exceeding that of Trout Lake by 20 feet, the groundwater flow dynamic in the Bovey area has changed. Water level data now suggest that groundwater is flowing from the Canisteo Pit towards Trout Lake, at least locally (Jones, 2002). Because of this change in groundwater gradient, the capture area for the Bovey city well has likely shifted from a southerly direction to more northeasterly. Stable isotope data obtained on samples from the Bovey city well in 2004 show no significant evidence of evaporated surface water, indicating that any capture of Trout Lake water had ceased and that Canisteo Pit water had not yet arrived (Figure 6).

The elevated levels of chloride and sulfate observed in the 2004 samples from the Bovey city well likely reflect ambient water quality in the aquifer within the current northeasterly capture area. Elevated chloride is likely related to road de-icing salt, although fertilizer and wastewater are other possible sources. Elevated sulfate is generally related to naturally-occurring minerals, although wastewater is a possible source. Common mineral sources include gypsum, a soluble calcium sulfate mineral that occurs in minor amounts in some rocks, or the oxidation of sulfide-bearing minerals such as pyrite. Gypsum is not known to occur in the Biwabik Iron Formation or associated Precambrian rocks of the Bovey area, although it could be present in minor amounts in glacial drift.

Pyrite is known to occur at some locations within the Biwabik Iron Formation, the Virginia Formation, and the Cretaceous Coleraine Formation. It is possible that some of the waste rock stockpiles in the Bovey area contain pyrite, and result in localized occurrences of sulfate-rich groundwater. Evidence for this comes from water quality sampling conducted in 2004 on a ditch that drains into the north side of Trout Lake. The ditch originates at a wetland located at the toe of a waste rock stockpile along the south shore of the Canisteo Pit north of Coleraine (Figure 2). The chloride and sulfate values determined for the ditch water were 69 mg/l and 210 mg/l, respectively, similar to values currently seen from the Bovey city well (Figure 5). Note that the sulfate and chloride values noted for the Canisteo Pit in 2004 were significantly lower than those observed at the Bovey well, further suggesting that water from the pit had not yet reached the city well.

Hydrogeological Setting

In the geographic area that includes the WHPA, the aquifer from which the city well pumps has the following characteristics:

- It is composed of sand and gravel and is 30 to 50 feet thick;
- It exhibits a porosity that is estimated to be 25%;
- It exhibits a base elevation of approximately 1,216 feet above sea level at the city well and probably rises to the north, consistent with the bedrock surface;
- It exhibits a stratigraphic top elevation of approximately 1,269 feet above sea level at the city well and probably rises to the north, consistent with the bedrock surface;
- It exhibits a wide range of aquifer transmissivity, as described below, and these zones of differing transmissivity may constitute flow boundaries. An attempt has been made to subdivide the aquifer into zones of differing transmissivity based on existing geologic mapping and aquifer test data (Figure 8).

The ambient flow field in the aquifer upgradient of the city well is currently oriented westerly to southerly (from approximately 180 to 280 degrees), with an average hydraulic gradient of approximately 0.008 (Figure 7).

The aquifer generally exhibits confined hydraulic conditions. This was determined by comparing the static water level measurements from wells completed in the aquifer with its stratigraphic top (Figure 3). In most instances, the static water levels occur in the till that commonly overlies the aquifer. However, the aquifer is unconfined where it is intersected by the Canisteo Mine Pit and at some other locations where ice contact deposits are prevalent, particularly around Trout Lake (Figures 2 and 3).

The Minnesota Department of Natural Resources (DNR) has developed a procedure for determining geologic sensitivity at well sites (DNR, 1991). The Bovey city well exhibits a geologic sensitivity rating of moderate using the DNR criteria.

Criteria Used to Delineate the Wellhead Protection Area

The criteria for delineating the WHPA, as required in Minnesota Rules 4720.5510, were addressed as follows.

Time of Travel - A 10-year time of travel was used to characterize groundwater movement in the aquifer and the pumping of the water supply well. Also, a one-year time of travel was used to define the emergency response area (ERA), as specified under Minnesota Rules 4720.5250. The 1- and 10-year capture zone boundaries are shown in Figure 1.

Daily Volume of Water Pumped - Information provided by the city of Bovey was used to determine the maximum discharge from their well. The results are presented in the following table. The daily volume of discharge used as an input parameter in the model was calculated by dividing the greatest annual pumping volume by 365 days.

Table 3
Annual Volume of Water Discharged From Bovey Water Supply Well

Well No.	Unique No.	2001	2002	2003	2004	2005	Future Pumping
1	228834	26,800,000	20,900,000	**35,391,000**	29,673,000	32,178,000	

(Expressed as gallons. Bolding indicates greatest annual pumping volume.)

The values shown in Table 3 are the total number of gallons pumped annually by the Bovey city well and reported to the Minnesota Department of Natural Resources under Groundwater Appropriations Permit No. 842085. The city of Bovey indicates that it intends to pump approximately the same amounts of water during the next five years. As a result, the maximum amount of annual pumping, shown in bold above, was used to express the daily volume of water pumped from the city well.

The maximum annual volume pumped by Bovey Well 1 (228834) over the 2001-2005 time period was incorporated as a daily volume in the groundwater flow model used to designate the capture zone for the well. For delineation purposes, the following pumping rate was applied to the well in the groundwater flow model. The rate selected is consistent with WHP rule requirements because the maximum volume is used.

Table 4
Pumping Rate Used for WHPA Delineation

Well Number	Equivalent Annual Volume (gallons)	Model Input (cubic meter/day)
1	35,391,000	367

Groundwater Flow Field - The groundwater flow field was determined by compiling static water level elevations from 1) wells that are completed in the same aquifer used by the city of Bovey, and 2) fully-penetrating surface water features such as the Canisteo Mine Pit lake and Trout Lake (Figure 7). The ambient flow field in the aquifer upgradient of the city well is oriented westerly to southerly (from 180 to 280 degrees) with an average hydraulic gradient of approximately 0.008.

Aquifer Transmissivity - The transmissivity of the aquifer used by Bovey Well 1 (228834) was estimated from 1) single well aquifer tests on monitoring wells conducted as part of USGS Water Resources Investigations Report 02-4198 (Jones, 2002), and 2) specific capacity data from the Bovey and Coleraine city wells, including other wells completed in the same formation (Figure 8). The specific capacity data were corrected for partial penetration, assuming an aquifer thickness of 50 feet using the method described in Appendix III.

These results suggest an aquifer transmissivity that ranges from approximately 220 ft^2/day to 6,800 ft^2/day. The wide range in transmissivity probably reflects variations in aquifer grain size, and possibly differences in well development. The low end of the range is representative of data from Jones (2002). The upper value represents the geometric mean from the specific capacity data for the five wells that were pumped in excess of 50 gallons per minute for at least two hours. The geometric mean of the entire 14-well data set is 1,480 ft^2/day.

The groundwater flow model developed for this area by Jones (2002) utilized relatively low values of aquifer hydraulic conductivity to achieve calibration for the aquifer used by Bovey. Those values spanned from 13.1 ft/day to 32.8 ft/day, which yield aquifer transmissivity values of approximately 650 ft^2/day in the area of the Bovey city well. However, based on the specific capacity data set, an aquifer transmissivity value of 6,800 ft^2/day is considered representative of the area around the Bovey city well. Apparently the aquifer consists of narrow, high transmissivity zones within a broader, moderate transmissivity domain. The high transmissivity regions probably correspond with glacial drainage pathways where coarse sediment was locally deposited. As indicated by Jones (2002), the Bovey-Coleraine aquifer generally consists of fine sand, but coarse sand and gravel are present locally, generally in low spots on the bedrock surface. Figure 8 shows a possible channel configuration that accommodates most of the high transmissivity wells analyzed for this study, and aligns with 1) a bedrock valley of Jirsa (2005), and 2) an exposure of potential aquifer material in a wall of the Canisteo Mine Pit mapped by Jennings and Reynolds (2005). This channel morphology was used in the model simulations used to delineate the WHPA. This method of determining transmissivity meets the requirements of Minnesota Rules 4720.5510, subpart 6. The aquifer test plan was approved by MDH on November 9, 2006.

Flow Boundaries - The following conditions define the extent to which flow boundaries must be considered:

The aquifer used by the city of Bovey appears to be laterally persistent except where it was removed within the Canisteo Mine Pit. However, it does appear to vary widely in transmissivity, and boundaries to groundwater flow undoubtedly occur where significant contrasts are found. In addition, the overlying and underlying tills that are generally present serve to retard vertical movement of groundwater into or out of the aquifer and constitute flow boundaries.

The aquifer generally exhibits confined hydraulic conditions in the vicinity of the city well. However, the aquifer is unconfined where it is intersected by the Canisteo Mine Pit and at some other locations where ice contact deposits are prevalent, particularly around Trout Lake (Figures 2 and 3). These fully-penetrating hydraulic features constitute hydrologic flow boundaries.

The State Water Use Data System maintained by the DNR was accessed and identified the following high-capacity wells, in addition to that operated by the city of Bovey, that may impact the delineation of the WHPA:

* City of Coleraine Wells 1 and 4 (241430 and 110457, respectively)

Method Used to Delineate the Wellhead Protection Area - The WHPA for Bovey Well 1 (228834) was delineated using the three-dimensional, numerical groundwater flow model Modflow 2000, along with Modpath particle tracking software. These programs were accessed using the GMS modeling software, Version 6.0. This program is capable of simulating complex hydrologic scenarios, such as spatial variability in aquifer recharge and geology, including the presence of flow boundaries. The model input and solution files are on file at the MDH and available upon request.

Groundwater Flow Model Used to Define the Well Capture Zones - The groundwater flow model used to delineate the WHPA for Bovey was derived from an existing regional model of the Canisteo Mine Pit area (Jones, 2002). The model simulates flow in the complete glacial drift package, plus the uppermost bedrock. Because the original model consists of a relatively coarse (100 m) uniform grid, it was deemed necessary to create a subset of the model with a grid that was refined based on the locations of the pumping wells in the Bovey area. The local model used for WHPA delineation was extracted from the regional model using the telescopic refinement process in GMS (Figure 9). In this process, boundary conditions and hydraulic properties assigned to individual cells in the original three-dimensional model are exported to two-dimensional scatter points. Following creation of the new, refined grid for the local model, grid cells are re-populated with the original boundary conditions and hydraulic properties via interpolation from the two-dimensional data sets. Finally, constant head boundary conditions are applied along the boundaries of the model. It should be noted that the grid for the local model was oriented in such a way that at least two of the four local model boundaries approximately parallel potentiometric contours from the original model, therefore satisfying constant head conditions at those boundaries.

Glaciofluvial sediments, such as those tapped by the Bovey city well, are predominantly represented in two layers of the model (Layers 2 and 4). Layer 2 represents the aquifer utilized by the cities of Bovey and Coleraine. Glacial clays and till are present in three layers of the model (Layers 1, 3 and 5). Layer 6 represents uppermost bedrock. The geometry of these bodies was determined from surficial geologic maps and well record data. The porosity of the aquifer material was set at 0.25, typical of a sand aquifer (Fetter, 1988). The hydraulic conductivity and recharge values assigned to these units are shown in Table 5.

In addition to the grid refinement, the local model used to delineate the Bovey WHPA differs from the regional model of Jones (2002) in that 1) the hydraulic conductivity of the Bovey-Coleraine aquifer was increased within the outwash channel, as shown in Figure 8, and 2) the conductance of the Trout Lake bed material was increased from 0.02 m^2/d/m to 1.0 m^2/d/m. The latter change was implemented to allow a better fit to the chemical and isotopic data obtained from the Coleraine city wells, as described in the section of this report dealing with model calibration.

Table 5
Parameters Used for WHP Area Delineation

		Hydraulic Conductivity (ft/day)	
Type of Simulated Cell	**Recharge (ft/day)**	**Calibrated Values from Regional Model**	**Values Used to Create WHPA**
Glaciofluvial Sediments	1.1×10^{-3}	13.1 – 32.8	13.1 - 136
Glacial Tills	3.9×10^{-6}	7.0×10^{-2}	7.0×10^{-2}
Bedrock	2.3×10^{-4}	7.0×10^{-3}	7.0×10^{-3}
Canisteo Mine Pit	1.4×10^{-3}	3.28×10^{4}	3.28×10^{4}

Lakes and perennial wetlands are represented in the model as general head boundaries. The most locally significant of these is Trout Lake. The water level elevation at this lake has ranged from 1,283.9 to 1,290.1 feet above sea level over the period from 1911 to present, and most recent readings place the level at approximately 1,288 feet. An hydraulic conductivity of 0.07 ft/day and a vertical thickness of 3.28 ft were used in calculating the conductance in these cells. The thickness value is an estimate of Jones (2002), whereas the hydraulic conductivity was derived from single well hydraulic tests (Jones, 2002) and values determined for lake-bed material at Shingobee Lake (Kishel and Gerla, 2002).

Perennial streams and rivers not simulated as part of the wetlands were simulated using the river module. The same hydraulic conductivity and bed thickness values applied to wetlands and lakes noted above were applied to the river segments. River stage values were assumed to be 6.56 feet above the altitude of the riverbed (Jones, 2002).

Recharge was applied to the surficial layer of the model using a specified flux boundary. Initial recharge rates were proportioned based on results from stream hydrograph analyses and geology in the surficial layer of the model. The largest recharge rates were simulated where glaciofluvial sediments were present at the land surface. Smaller rates were applied where clay, till, or bedrock were present at the land surface (Table 5).

The Canisteo Mine Pit was represented in the model as a series of highly conductive, constant head cells. An hydraulic conductivity value of 3,280 ft/day was used for these cells (Table 5). This value was used because it allows water levels in the pit cells to be relatively consistent and to respond similarly to a lake (Jones, 2002). The water level in this pit has varied greatly over the past 100 years in response to mining activities, which ceased in the mid 1980s (Jones, 2002). Since 1989, the water level in the pit has risen from 1,250 feet above sea level to its current elevation of approximately 1,310 feet above sea level (DNR records). For the purposes of the WHPA delineation, Canisteo Pit water levels were simulated at 1,300, 1,310 and 1,320 feet in separate model runs. The 1,300-foot level is consistent with the original model of Jones (2002) and represents the level at which the DNR proposes to control the pit level in the future (Bob Liebfried, personal communication, 2006). The 1,310-foot level represents current conditions (DNR data). The 1,320-foot level represents the approximate overflow elevation for the pit. Given the past rate of the rising water level within the pit, this level could be reached within the next ten years, which is the time period that the city's WHP plan is intended to cover.

The capture zones generated by the model were created by releasing particles from the well and tracing backward. The particles were released at the center of the model cell containing the well, and twenty path lines were generated for each well. The groundwater component of the WHPA for the city of Bovey is a composite of each of the model scenarios shown in Figure 9. Note that some of the particle tracks from the Bovey city well intersect the Canisteo Mine Pit within a 10-year time of travel for both the 1,310-foot and 1,320-foot pit water level simulations. This observation is consistent with the original results presented by Jones (2002), although no time of travel estimates accompanied the flow paths shown in that document.

Results of Model Calibration and Sensitivity Analysis - The local model used for the WHPA delineation was extracted from the original calibrated Canisteo Pit regional model of Jones (2002). As a result, no additional attempts were made to further calibrate the model to hydraulic heads. However, 16 of the 18 monitoring wells from the original model that were located within the boundaries of the local model were used to generate calibration results for the local model runs, where synoptic water level data existed for comparison (Table 6). Water level data for all 16 of the monitoring wells were available from the DNR for 2001 for the 1,300-foot pit level simulation, and from 13 of the wells in 2006 for the 1,310-foot pit level simulations. A representative plot of measured versus simulated water level elevations for the 1,310-foot level simulation is shown in Figure 10, and a plot of model-generated potentiometric contours for Layer 2 versus water level data from wells is shown in Figure 11.

Table 6
Model Calibration Data (all values in meters)

Model Run	Mean Error	Mean Absolute Error	Root Mean Squared Error
Canisteo Pit Level = 1,300 ft	**-0.83**	**4.1**	**5.21**
Canisteo Pit Level = 1,310 ft	**-0.25**	**4.71**	**5.47**

Although no efforts were made to improve the head calibration, the conductance of the Trout Lake bed materials was varied in the local model to better reflect the chemical and isotopic data obtained from the municipal wells of Bovey and Coleraine. Water sampling conducted in 2004 showed that the Coleraine municipal wells were strongly affected by surface water capture. Water from Trout Lake appeared to be a significant component, although the presence of some Canisteo Mine Pit water could not be ruled out. In contrast, the Bovey city well water showed no significant evidence of surface water influence. The local model was calibrated to the 1,300-foot Canisteo Mine Pit level because it most closely simulates the period prior to the 2004 water-sampling episode. The calibration was considered successful when 1) a significant number of particles traced from the Coleraine city wells terminated at, or passed-through, the Trout Lake general head boundary cells, and 2) none of the particles released from the Bovey well passed through Trout Lake or the Canisteo Mine Pit lake within a 3-year time of travel. This time of travel criterion was selected because it represents the elapsed time between the dates when the Canisteo Mine Pit water level was simulated (2001) and the sampling was conducted (2004).

In his sensitivity analysis of the regional model, Jones (2002) varied horizontal hydraulic conductivity by 0.2-10 times the calibrated values, vertical hydraulic conductivity by 0.1-10 times the calibrated values, and recharge by 0.5-1.5 times the calibrated values. He found that the regional model was most sensitive to changes in horizontal hydraulic conductivity and much less sensitive to changes in vertical hydraulic conductivity and recharge. When varied over the ranges described above, maximum water level differences from the calibrated model, as observed at all monitoring wells, ranged from -21.13 to +59.91 feet for horizontal hydraulic conductivity, -17.29 to +21.69 feet for vertical hydraulic conductivity, and -10.93 to +9.28 feet for recharge.

Conjunctive Delineation - As noted above, some of the particle tracks from the Bovey city well intersect the Canisteo Mine Pit within a 10-year time of travel for the 1,310-foot and 1,320-foot pit water level simulations (Figure 10). As a result, this feature must be considered to be a component of the city's WHPA unless an assimilative capacity boundary can be established (see glossary of terms). At this point, data are insufficient to establish an assimilative capacity boundary for the Canisteo Mine Pit. Existing chemical data appear limited to a relatively narrow range of parameters, leaving many parameters on the National Primary Drinking Water Standards list uncharacterized at this time. Any attempt to establish the basis for an assimilative capacity boundary would need to factor the modeled travel time from the pit to the well, which is believed to range from a minimum of 5 years at a pit water level of 1,320 feet, to at least 8 years when assuming a pit water level of 1,310 feet.

Figure 12 depicts the final WHPA for the city of Bovey. This area was determined by merging 1) the 10-year time of travel groundwater capture zones for the city well, and 2) the surface watershed area for the Canisteo Mine Pit lake, as determined by the DNR (Bob Liebfried, personal communication, 2006).

Uncertainty Analysis - A primary source of uncertainty in the WHPA delineation is the actual three-dimensional geometry of the coarse-grained outwash channel that is thought to provide a high transmissivity pathway for groundwater flow between the Bovey city well and both the Canisteo Mine Pit and Trout Lake. The boundaries of this feature have a significant impact on the groundwater capture zone for the Bovey city well. In addition, the transmissivity of this feature could be more accurately quantified to provide greater confidence in the model output. The following section describes steps that could be taken to provide a greater degree of certainty in the modeled capture zone.

Recommendations for Future Data Collection

1) Enhancing the Understanding of Local Hydrogeologic Conditions.

Subsurface Geology -

Every five years, the city of Bovey should work with the MDH so that the locations of new wells constructed within one mile of the city's well field can be verified and accurate elevations obtained. This information will help address uncertainties related to 1) the areal extent, thickness, and compositional variability of the Bovey-Coleraine aquifer, and 2) the distribution of hydraulic head in this aquifer.

Aquifer Transmissivity -

The transmissivity of the Bovey-Coleraine aquifer in the vicinity of the Bovey municipal well was estimated from specific capacity data. Such estimates tend to be less accurate than those determined from aquifer test data. In order to confirm that the estimates derived from specific capacity tests are appropriate for the area around the city well, it would be helpful if the city were able to conduct an appropriate aquifer test. Such a test would benefit from an observation well that is located within relatively close proximity to the city well. The MDH can work with the city to design a proper aquifer test that provides drawdown and recovery data from both the pumping well and the observation well.

2) Surface Water/Groundwater Exchange.

Chemical and Isotopic Data -

Groundwater modeling results suggest that the Bovey city well is likely to capture water a significant amount of water from the Canisteo Mine Pit within the next ten years, assuming the water level in the pit remains at or exceeds current levels. The MDH recommends that the city initiate an annual program of water sampling from their well in order to track such changes. The results will help to validate the groundwater model and refine resulting capture zones in the future. To support the proposed sampling program, the MDH will assist with the selection of sampling points and analytical parameters. The city will be responsible for most of the sampling, but the MDH will pay for the analyses using funding that it has dedicated for this work. There would be no cost to the city for these analyses and related MDH staff time.

3) Water Use and Water Level Considerations.

Revisions to the WHPA -

The following water use factors should be monitored to determine if a revision of the WHPA or DWSMA is required: 1) the installation of any new high-capacity wells within 1.5 miles of the city well field, 2) increased discharge from the city wells over the values used in this report, and 3) changes in water levels at the Canisteo Mine Pit lake and Trout Lake. The third point refers to the fact that the groundwater gradient in the Bovey and Coleraine areas is largely set by the water level elevations of these two water bodies. If the water level of Trout Lake is maintained around current levels and the Canisteo Mine Pit level is dropped to 1,300 feet or less, then it is unlikely that the Bovey city well will capture Canisteo Mine Pit water within a 10-year time of travel, based on current data. If such a scenario were to be maintained for at least a 10-year time period, then the Canisteo Mine Pit and its surface watershed could be removed from the city of Bovey WHPA.

Delineation of the Drinking Water Supply Management Area

Method Used to Designate the Drinking Water Supply Management Area – The Drinking Water Supply Management Area (DWSMA) was determined by overlaying the WHPA on a map of area roads, railroads, and public land survey boundaries, using a geographic information system to select the closest such feature. This area was then reviewed and modified by staff from the city of Bovey and the MDH.

Assessment of Well Vulnerability

This part documents the vulnerability of the wells used by the public water supplier and is required under Minnesota Rules 4720.5210. The protocol for determining well vulnerability is defined in the MDH document entitled Methodology for Phasing Wells into Minnesota's Wellhead Protection Program (1993), which was approved by the U.S. Environmental Protection Agency as part of its review of Minnesota's wellhead protection program description. The MDH uses the protocol to maintain a database defining the potential vulnerability of community and noncommunity public water supply wells. A score is calculated for each well using 1) construction criteria defined in the State Well Code, 2) geologic sensitivity, and 3) the results of water quality monitoring conducted by the MDH. A numeric score is assigned to each well based on the results of the three areas of evaluation. A cutoff score is used to define wells that are most likely to be vulnerable based on their construction, geologic setting, and sampling history. The printouts of the vulnerability ratings for the city well are presented in Appendix I.

The results of the well vulnerability assessments suggest that the well used by the city of Bovey is potentially vulnerable to contamination. This conclusion is based primarily on a water sample collected from the city well on February 10, 2004, that contained tritium at 18.3 tritium units, indicating the predominance of young (post-1954) water in the sample. An additional factor is that the well does not meet current State Well Code standards for construction.

Vulnerability Assessment for the Drinking Water Supply Management Area

The aquifer used by the Bovey city well was evaluated for its vulnerability to contamination throughout the extent of the DWSMA on the basis of 1) surficial geologic and soils maps, 2) geologic logs from wells in the area, and 3) the chemical and isotopic data noted above.

The Itasca County Soil Survey includes an assessment of the geologic sensitivity at the water table based on the criteria of the DNR (1991). The geologic sensitivity ratings within the Bovey DWSMA range from very high to low (Figure 13). These ratings correlate strongly with the surficial geologic mapping of Jennings and Reynolds (2005). Geologic sensitivity ratings of very high or high correspond to the occurrence of relatively coarse sediments associated with glacial outwash or ice contact deposits. These are most prevalent around Trout Lake, which has been interpreted to be the remnant of a sub-glacial drainage feature (Jennings and Reynolds, 2005). Very high geologic sensitivity ratings are also assigned within the Canisteo Mine Pit

lake, where till that originally overlay the city's aquifer has been removed by mining. Geologic sensitivity ratings of moderate and low are assigned where the soil has a relatively high clay or loam content, suggesting that till was the parent material. These areas are strongly correlated with those areas mapped as Koochiching lobe till by Jennings and Reynolds (2005).

The geologic sensitivity ratings described above were compared with those determined from the geologic logs for wells located within and immediately adjacent to the city's DWSMA (Figure 13). In general, a strong correlation was noted between the two data sources. Wells located adjacent to Trout Lake generally show vulnerability ratings of high to moderate, whereas those located away from the lake and associated ice-contact deposits generally show ratings of moderate to low. Although a very low rating is documented at some wells, this amount of geologic protection appears to be very localized.

The chemical and isotopic data for the Bovey and Coleraine city wells suggest that, even where the geologic sensitivity rating for the aquifer is low to moderate, it is characterized by the presence of young water that is elevated in chloride. As a result, the overlying till cover is considered to be leaky. Those areas determined to exhibit a low geologic sensitivity rating were increased to a vulnerability rating of moderate to reflect the leaky nature of the till. Finally, mapped areas smaller than approximately 10-acres in size were incorporated within the surrounding mapped area to avoid small slivers of land that would be difficult to identify and manage.

In summary, the vulnerability of the Bovey-Coleraine aquifer ranges from moderate to very high. Within areas rated as moderate, the time required for water moving vertically from the land surface to reach the aquifer is probably on the order of several years to decades (DNR, 1991). Within areas rated as very high or high, water from the land surface can probably reach the aquifer in weeks to years.

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Kishel, H.F., and Gerla, P.J. (2002), *Effects of small-scale hydraulic variation on ground-water discharge to Shingobee Lake, Minnesota*, University of North Dakota, Department of Geology web page; URL http://www.geology.und.nodak.edu/gerla/home/cur_res.html.

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Winter, T.C. (1971), *Sequence of glaciation in the Mesabi-Vermillion Iron Range area, northeastern Minnesota*, U.S. Geological Survey Professional Paper 750-C, p. C82-C88.

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Appendix I

Municipal Well Information

Table 1
Municipal Water Supply Well Information
Bovey, Minnesota

Local Well Name	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Well Vulnerability	Aquifer
1	228834	P	16	74	92	1953	Vulnerable	QBAA

Note: 1. Primary (P) or Emergency backup (E) well

625 Robert St. N. St. Paul MN 55155
P.O. Box 64975 St. Paul MN 55164 - 0975

MINNESOTA DEPARTMENT OF HEALTH
SECTION OF DRINKING WATER PROTECTION
SWP Vulnerability Rating

PWSID: 1310003
SYSTEM NAME: Bovey
WELL NAME: Well #1

TIER: 3
WHP RANK:
UNIQUE WELL #: 00228834

COUNTY: Itasca | TOWNSHIP NUMBER: 56 | RANGE: 24 W | SECTION: 32 | QUARTERS: BDA

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Quaternary Buried Unconfined	
DNR Geologic Sensitivity Rating	:	Medium	25
L Score	:	2	
Geologic Data From	:	Well Record	
Year Constructed	:	1953	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	74	10
Well Depth	:	92	
Casing grouted into borehole?		Unknown	0
Cement grout between casings?		Not applicable	0
All casings extend to land surface?		Yes	0
Gravel - packed casings?		Unknown	0
Wood or masonry casing?		No	0
Holes or cracks in casing?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	650	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	1.3	10
Maximum tritium detected	:	18.3 02/10/2004	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		55
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
NITRATE DATA FROM PWSD 1989, 11/71 SAMPLE

Appendix II

Figures Used In This Report

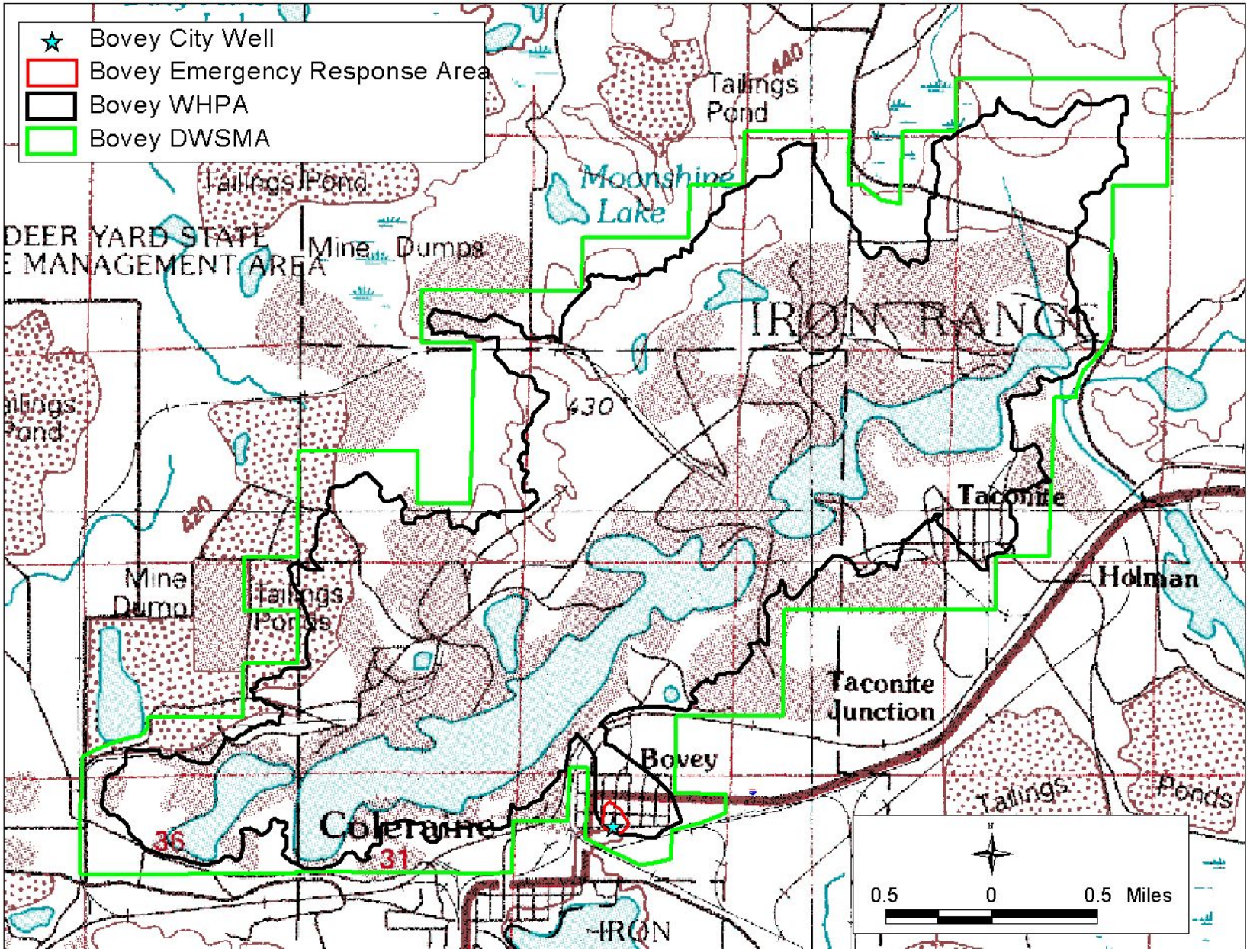

Figure 1. Wellhead protection area (WHPA), drinking water supply management area (DWSMA) and emergency response area (ERA) for the city of Bovey.

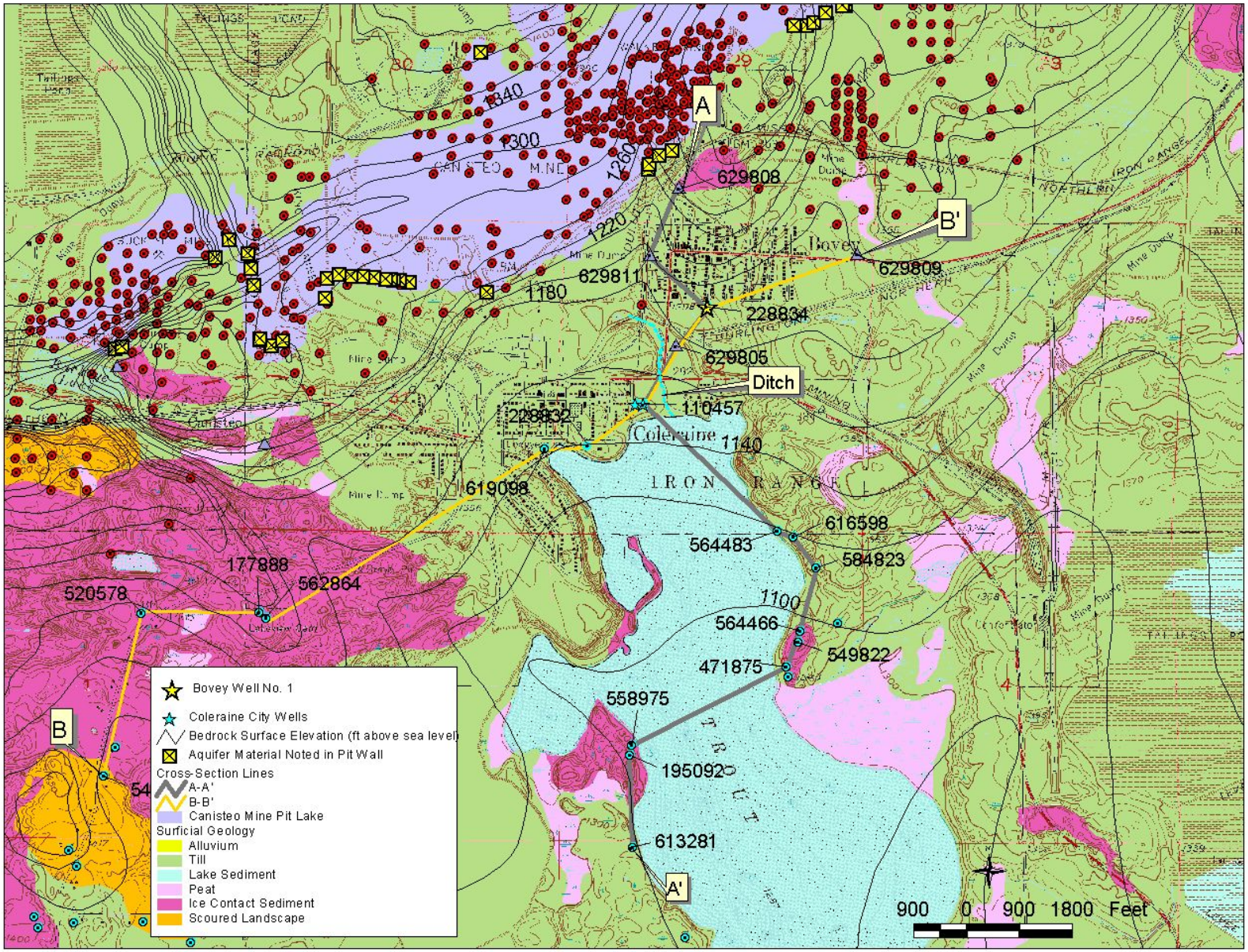

Figure 2. Surficial geology of the Bovey area (Jennings and Reynolds, 2005).

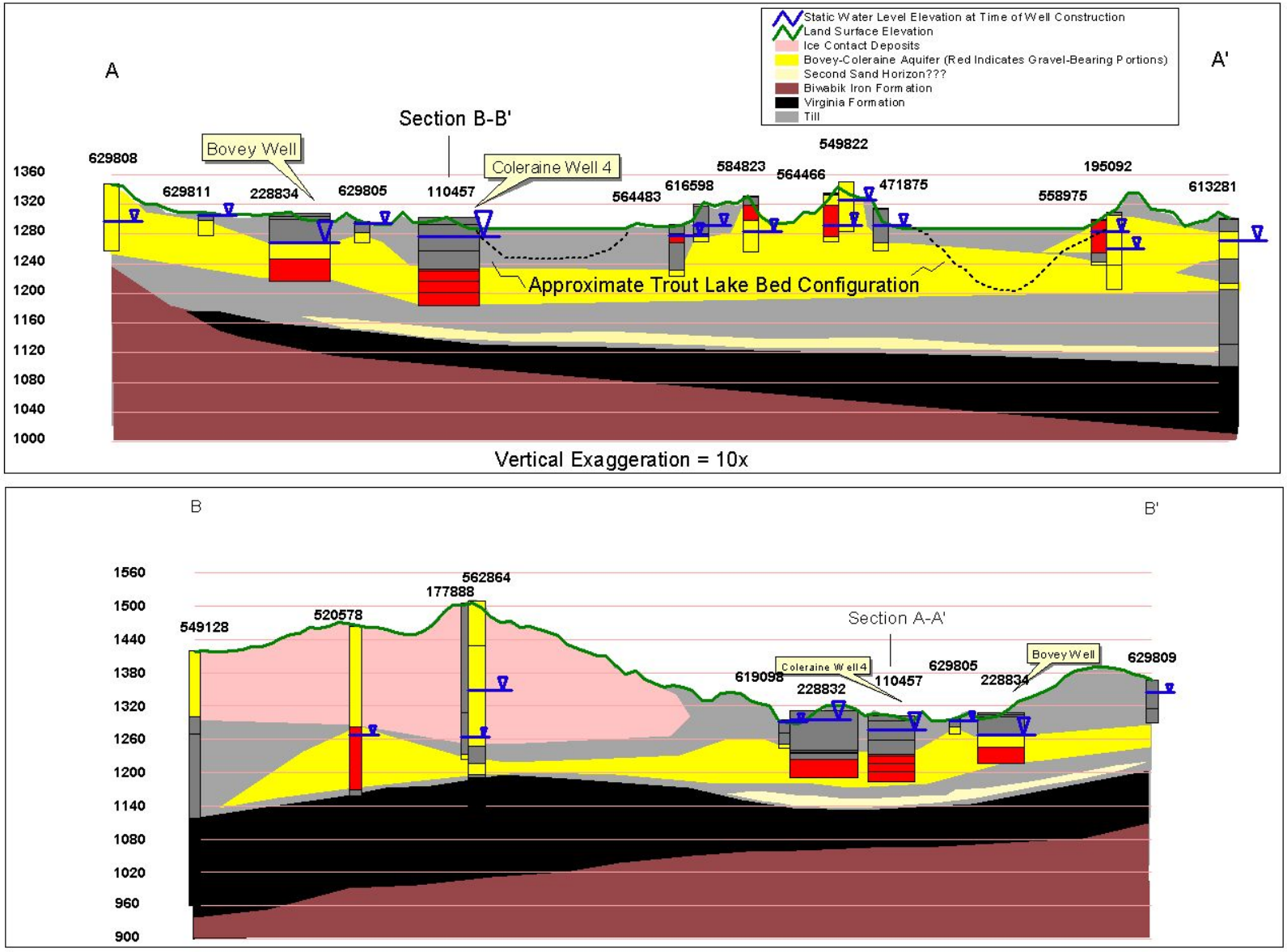

Figure 3. Geologic cross-sections through the Bovey area.

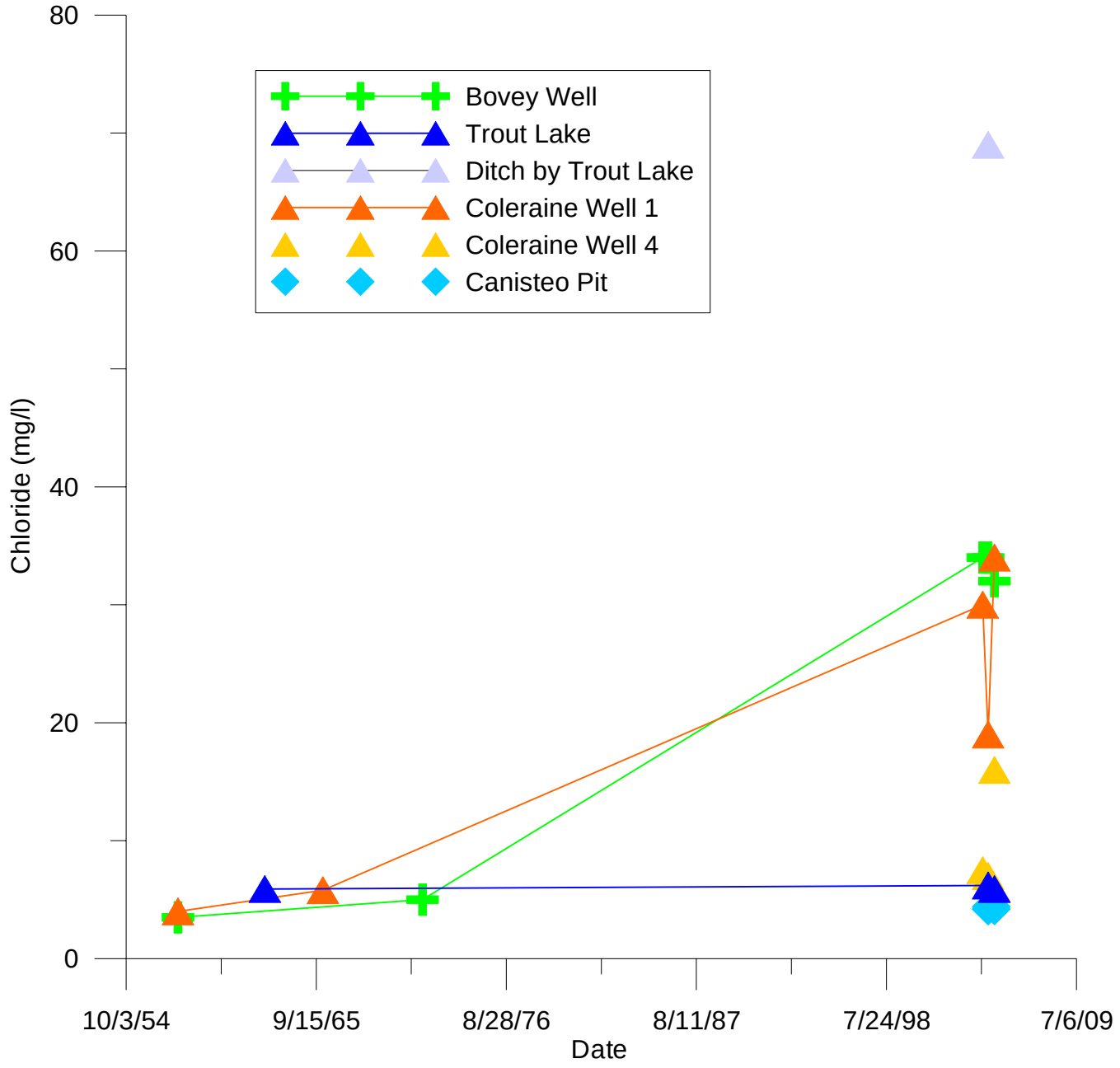

Figure 4. Chloride data through time.

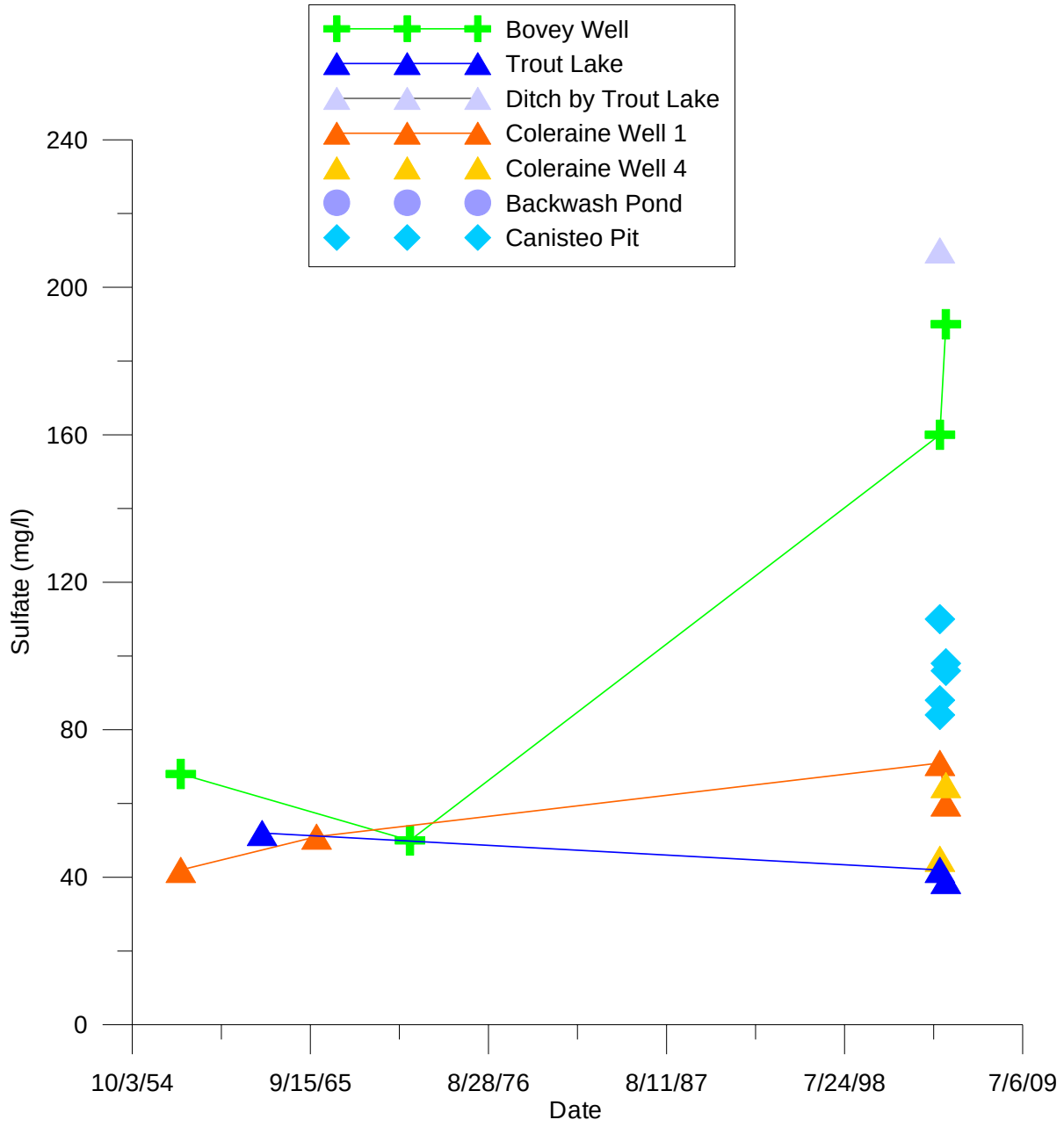

Figure 5. Sulfate data through time.

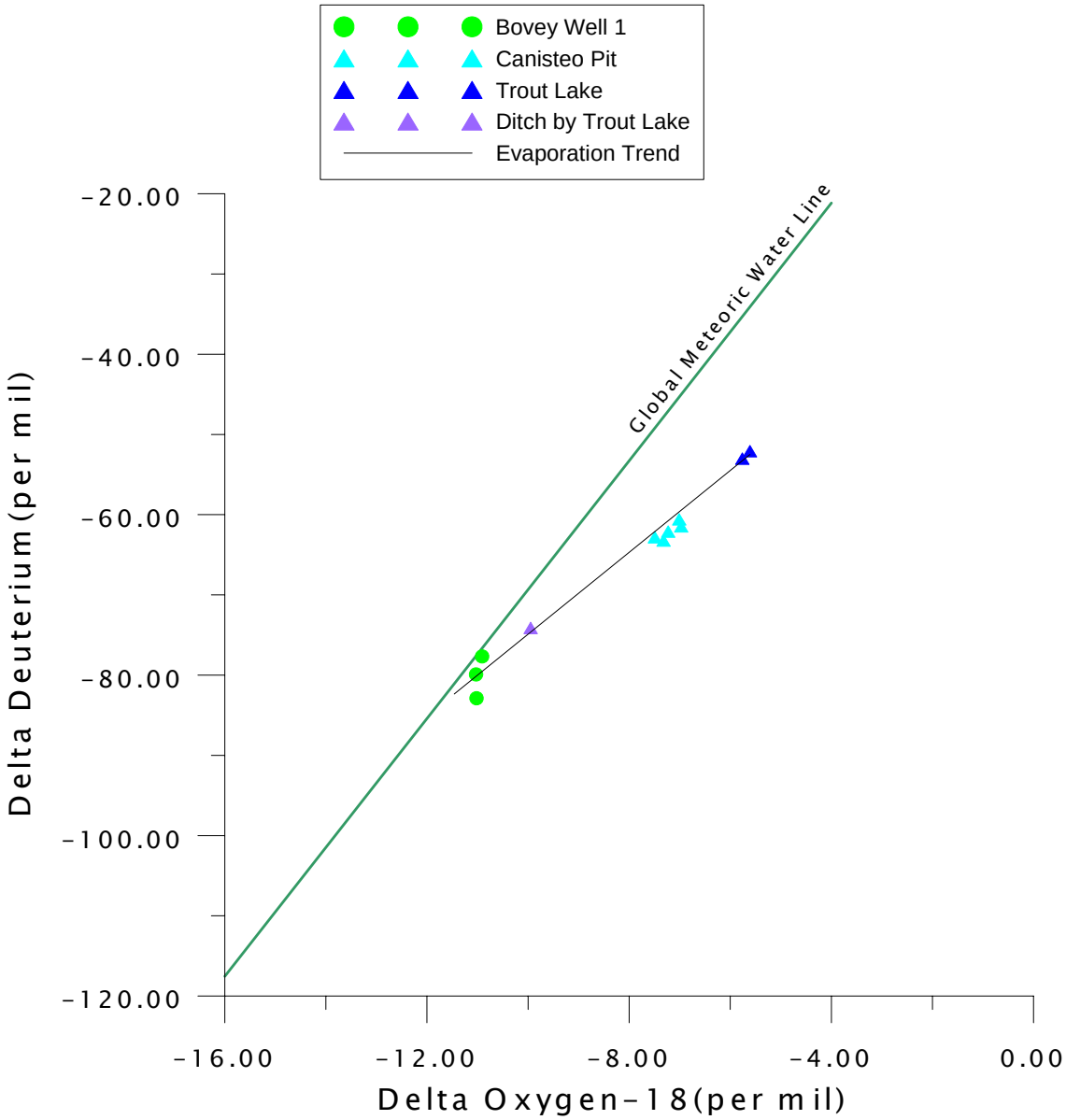

Figure 6. Stable isotopes of water.

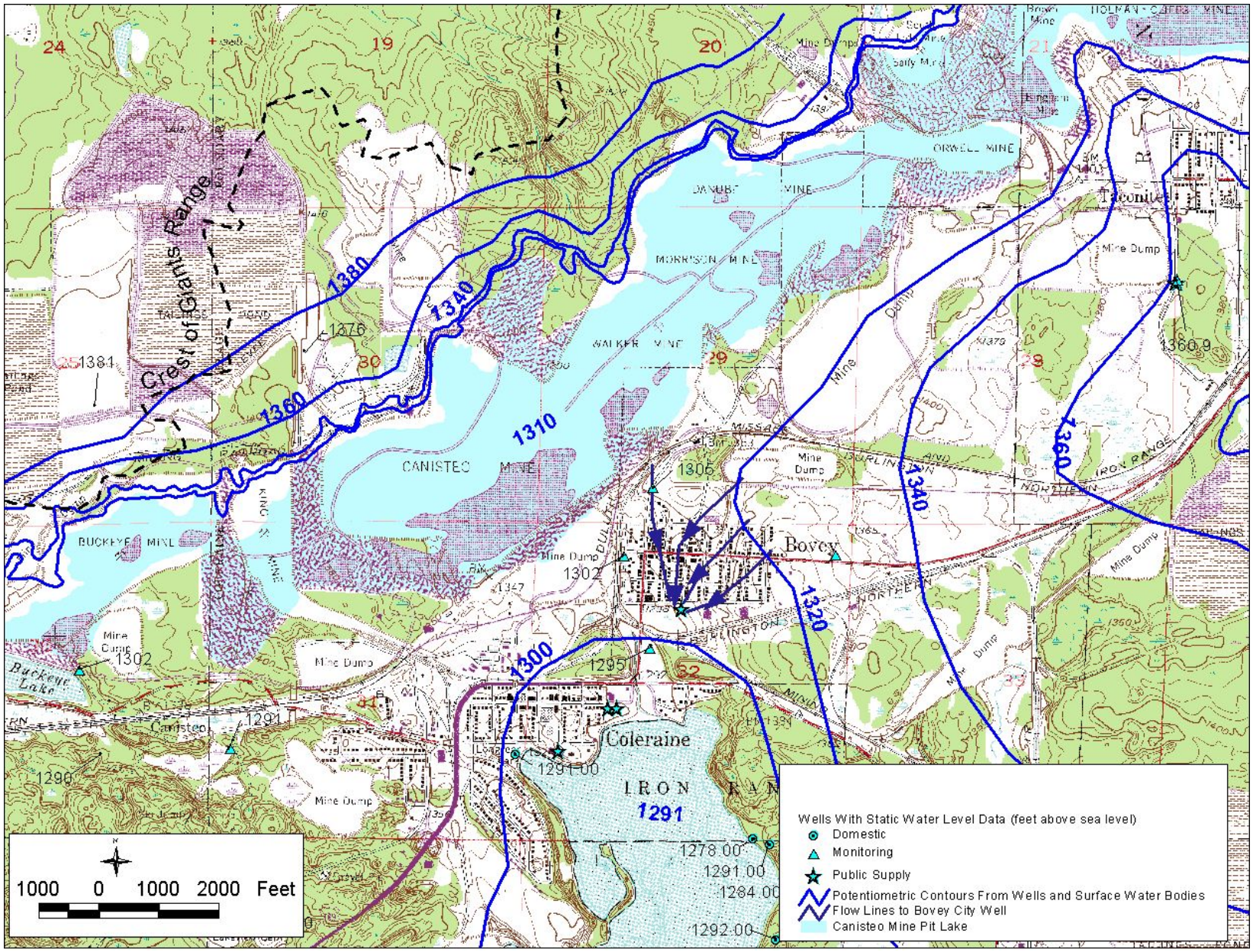

Figure 7. Groundwater flow direction in the Bovey area in 2006.

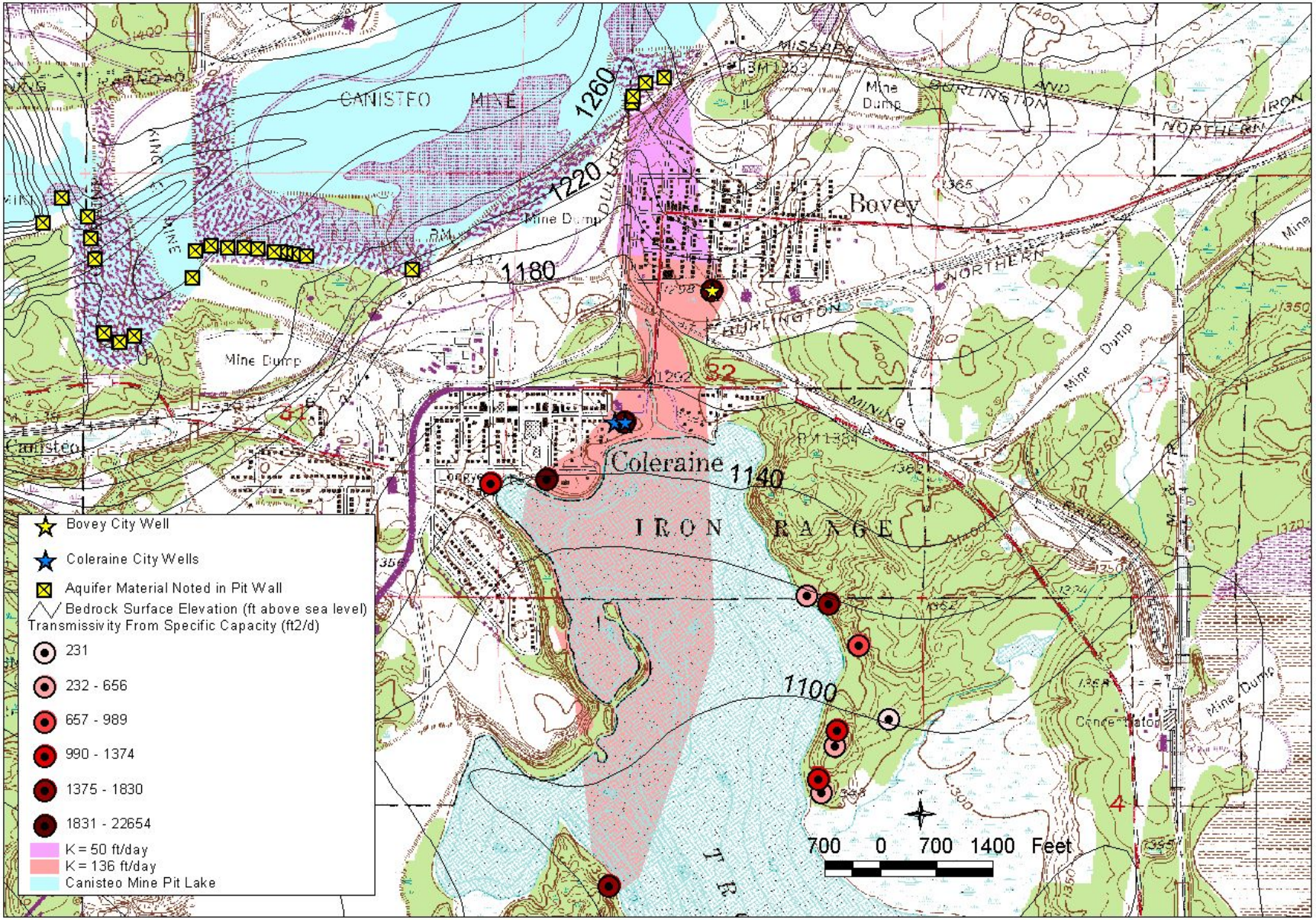

Figure 8. Distribution of transmissivity.

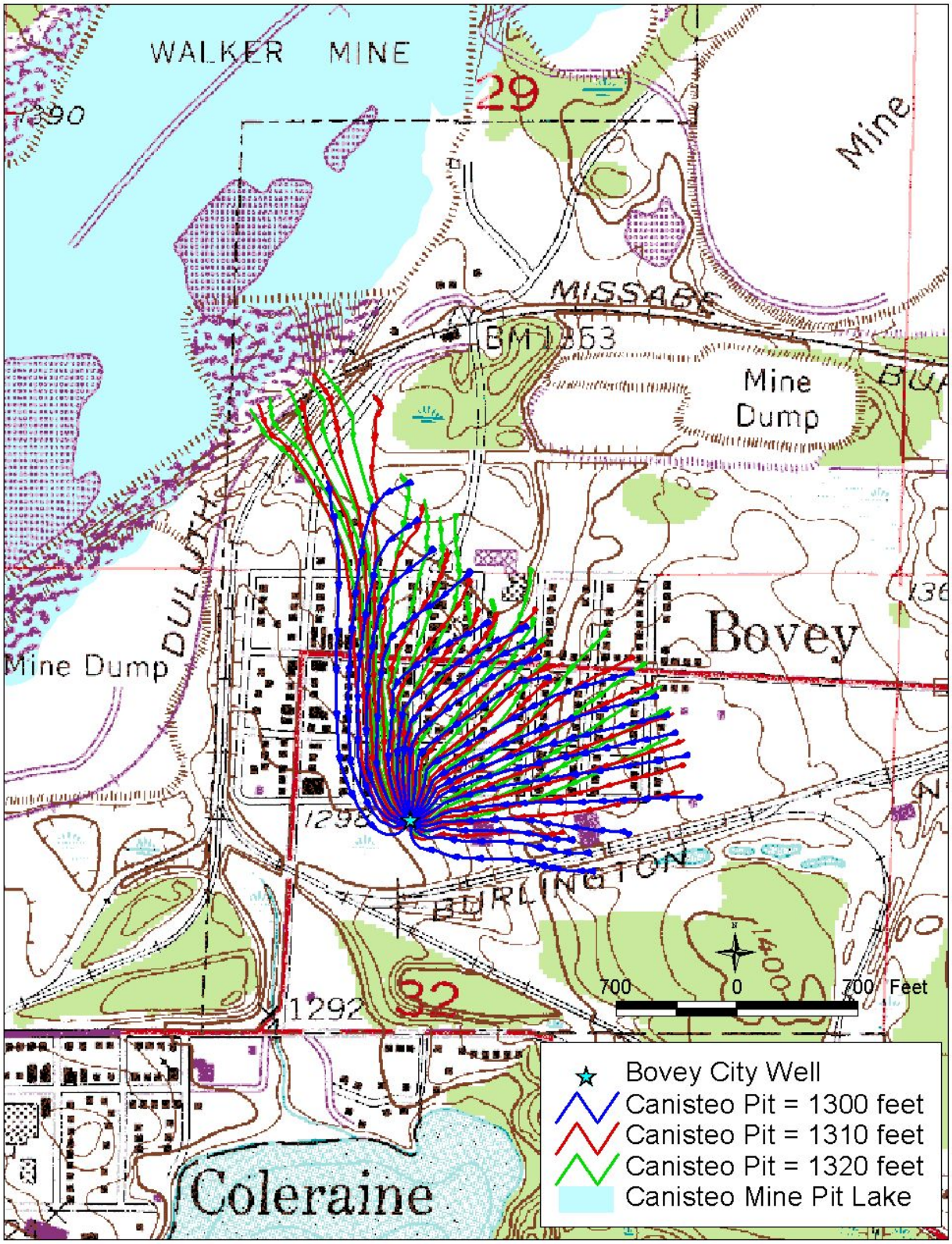

Figure 9. Ten-year time of travel particle traces. Tick marks are shown at each one-year travel time.

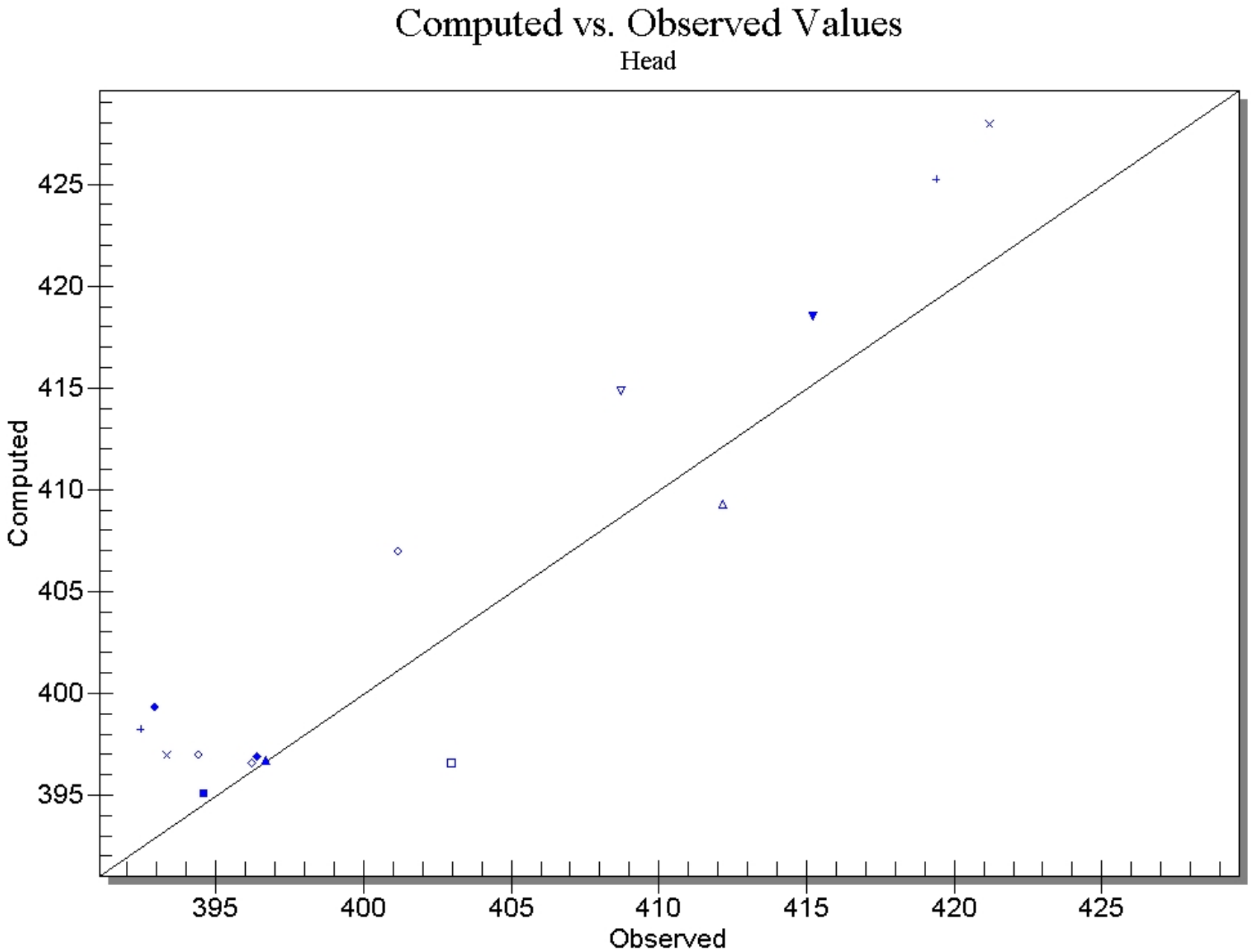

Figure 10. Graphical view of comparison between measured and modeled heads.

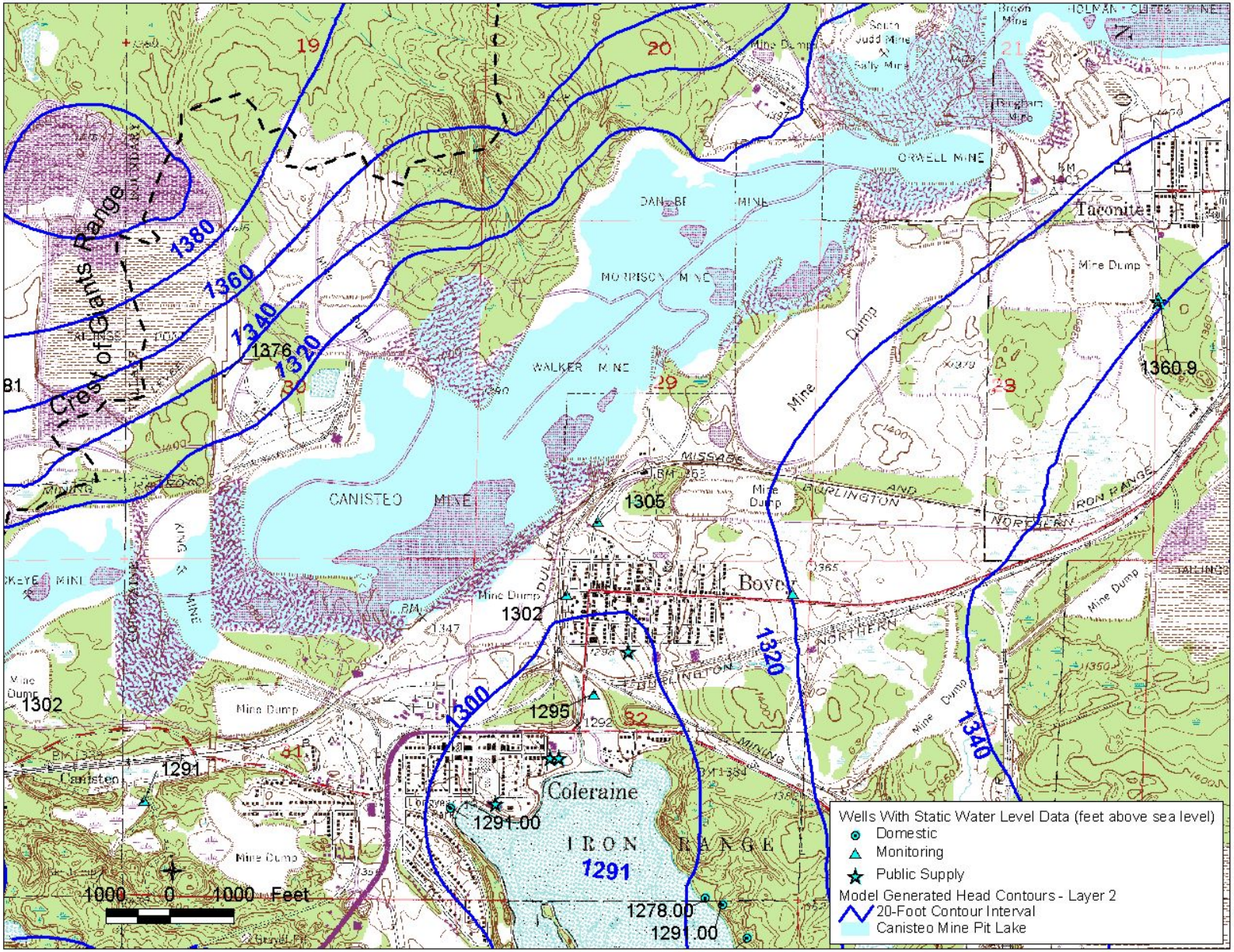

Figure 11. Map view of comparison between measured and modeled heads.

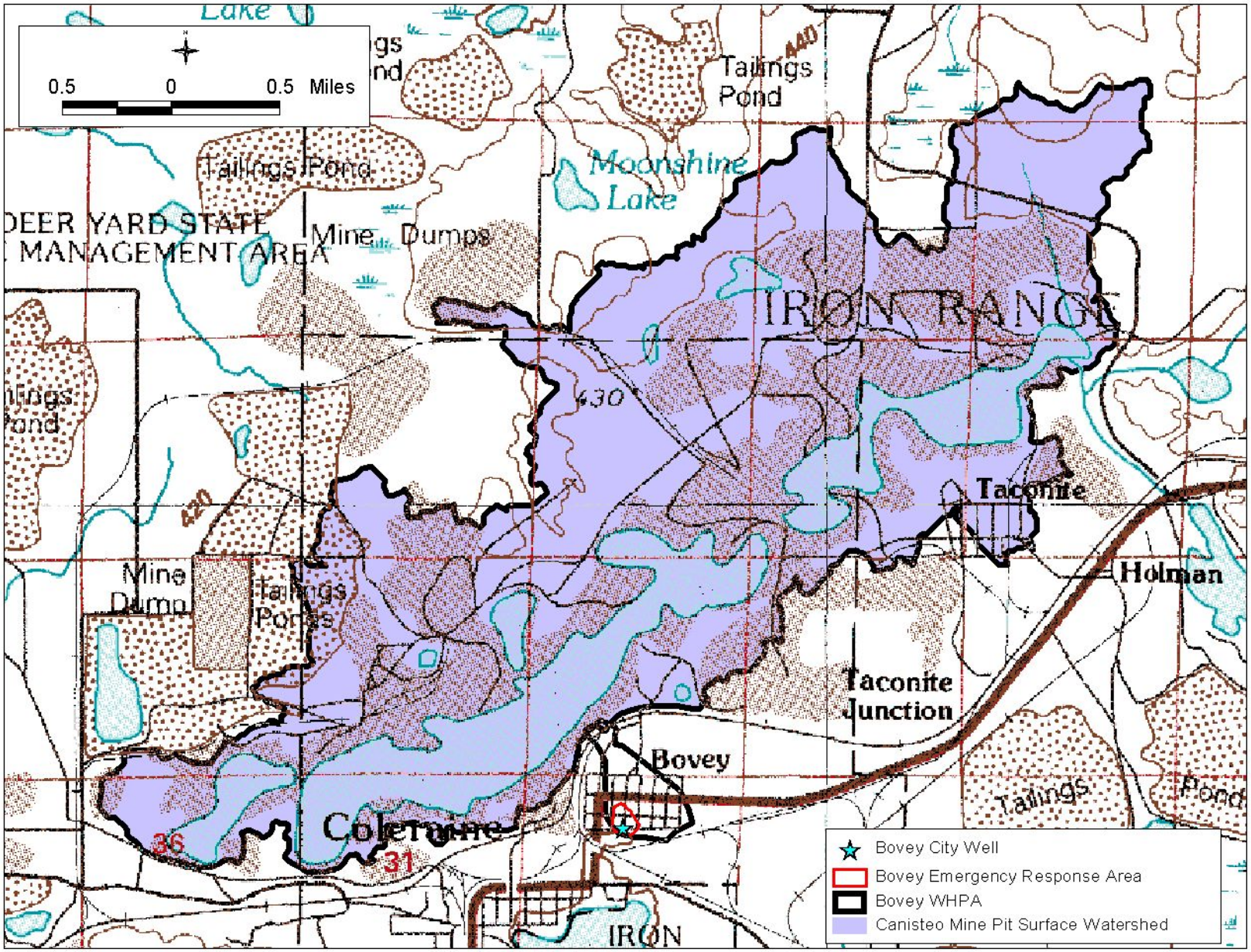

Figure 12. Conjunctive delineation for city of Bovey WHPA.

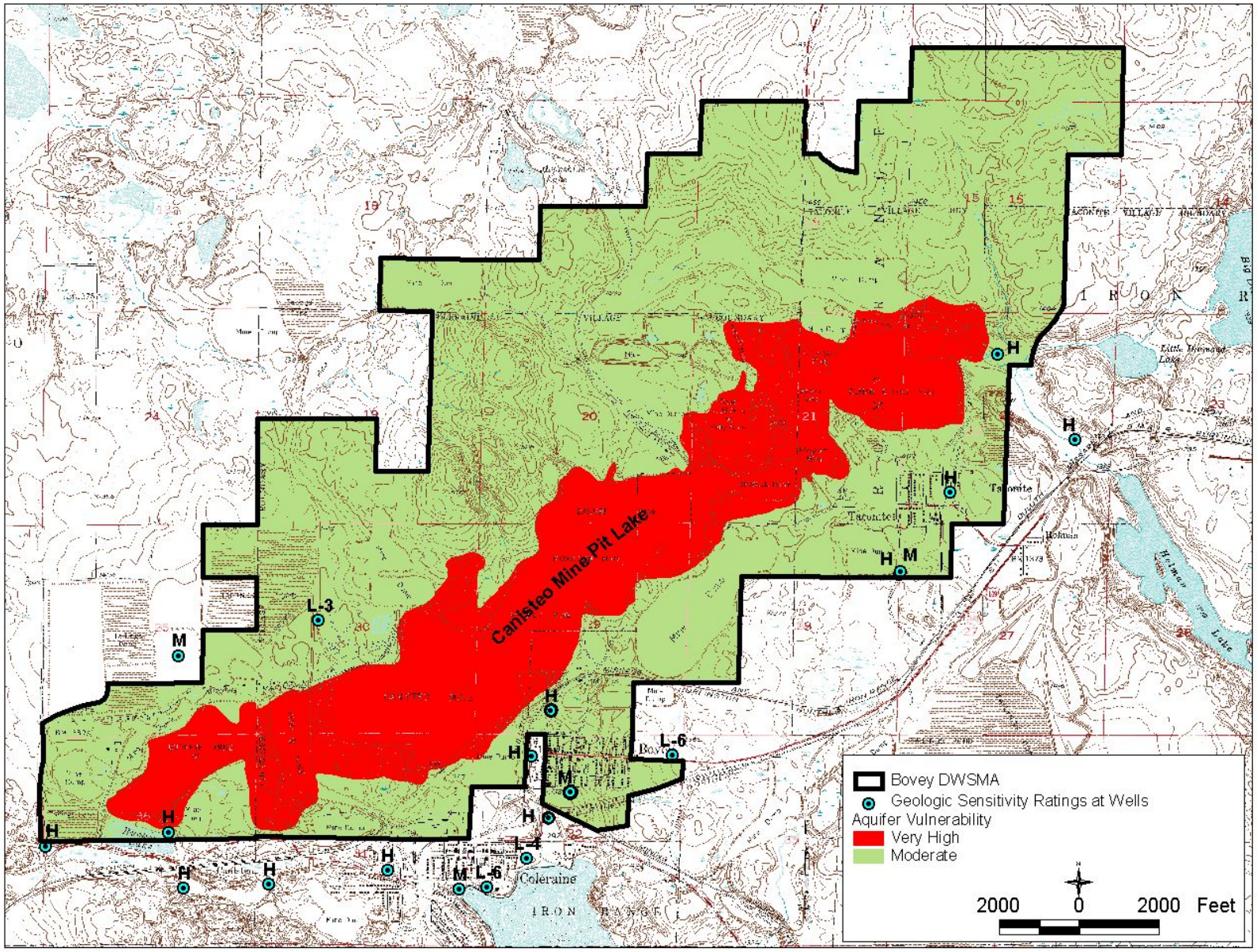

Figure 13. Vulnerability of the aquifer used by the city of Bovey throughout the DWSMA.

Appendix III

Method Used to Estimate Transmissivity from Specific Capacity

Method Used to Estimate Transmissivity

The method used to estimate transmissivity from specific capacity data is similar to that of Bradbury and Rotheschild, 1985, and Mace (2000) but with some differences. The method is described in some detail here.

Starting with a rearrangement of Sternberg's (1973) equation that relates specific capacity (Sc) to transmissivity (T), the duration of pumping (t) the well radius (r_w)and storativity (S) for a partially penetrating well:

$$Sc = \frac{4\pi T}{\left[\ln\left(\frac{2.25\,T\,t}{r_w^{\,2}\,S}\right) + 2\,s_p\right]} \qquad \textbf{1}$$

where s_p is the partial penetration factor defined base on the physical properties of the well and aquifer, L is the length of the screen portion of the aquifer and H is the aquifer thickness Brons and Marting (1961):

$$s_p = \frac{1-\left(L/H\right)}{\left(L/H\right)} - \left[\ln\left(H/r_w\right) - G\left(L/H\right)\right] \qquad \textbf{2}$$

Where the function G is approximated by Bradbury and Rothschild (1985) using the following polynomial with 0.992 correlation coefficient:

$$G\left(L/H\right) = 2.948 - 7.363\left(L/H\right) + 11.447\left(L/H\right)^2 - 4.675\left(L/H\right)^3 \qquad \textbf{3}$$

Rearranging Equation 1 to solve for transmissivity and substituting for Sc in terms of the discharge of the well (Q) and the observed draw down at tine t (s), Sc=Q/s:

$$T = \frac{Q}{4\pi s}\left[\ln\left(\frac{2.25\,T\,t}{r_w^{\,2}\,S}\right)\right] + \frac{Q\,s_p}{2\pi s} \qquad \textbf{4}$$

The second term in Equation 4 was solved directly from the draw down, discharge, well construction, and aquifer thickness information. The first term was solved iteratively with assumed values of storativity for confined (0.001) and unconfined (0.075) conditions.

References:

Bradbury, K.R., and Rothschild, E.R. (1985), *A computerized technique for estimating the hydraulic conductivity of aquifers from specific capacity data,* Ground Water, Vol. 23, No. 2, p. 240-246.

Brons, F., and Marting, V.E. (1961), *The effect of restricted fluid entry on well productivity,* Journal of Petroleum Technology, Vol. 13, No. 2, p. 172-174.

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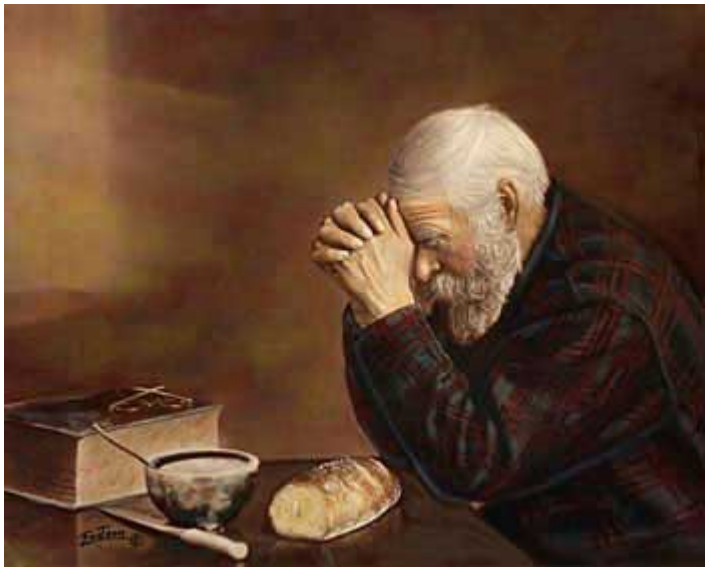
CITY OF BOVEY



Home of the Picture "GRACE"

Wellhead Protection Plan
Part 2

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PUBLIC WATER SUPPLY PROFILE

PUBLIC WATER SUPPLY

NAME: City of Bovey

ADDRESS: PO Box 399

Bovey, MN 55709

TELEPHONE NUMBER: 218-245-1633

WELLHEAD PROTECTION MANAGER

NAME: Kevin Odden, Water Supertindent

ADDRESS: P.O. Box 399
Bovey, MN 55709

TELEPHONE NUMBER: 218-245-2572

CONSULTANT/TECHNICAL ASSISTANCE

NAME: AC Analytical & Consulting, LLC

ADDRESS: PO Box 248
Bemidji MN 56601

TELEPHONE NUMBER: 218-243-3328

DOCUMENTATION LIST

STEP	DATE PERFORMED
Part I Approval Notice Received from MDH	**July 2, 2007**
Scoping 2 Meeting Held (4720.5349, subp. 1)	**October 5, 2007**
Scoping Decision Notice Received (4720.5340, subp. 2)	**November 1, 2007**
Remaining Portion of Plan Submitted to Local Units of Government (LUGs) (4720.5350, subp. 1 & 2)	**January 10, 2011**
Review Received From Local Units of Government (4720.5350, subp. 2)	**March 16, 2011**
Review Considered (4720.5350, subp. 3)	**March 16, 2011**
Public Hearing Conducted (4720.5350, subp. 4)	**March 16,2011**
Remaining Portion WHP Plan Submitted (4720.5360, subp. 1)	**April 26, 2011**
Approved Review Notice Received	**July 27, 2011**

PART 2 EXECUTIVE SUMMARY

This portion of the wellhead protection (WHP) Plan for the City of Bovey includes:

- the results of the Potential Contaminant Source Inventory,
- the Potential Contaminant Source Management Strategy,
- the Emergency/Alternative Water Supply Contingency Plan, and
- the Wellhead Protection Program Evaluation Plan.

Part 1 of the wellhead protection plan presented the 1) delineation of the wellhead protection area (WHPA) and the drinking water supply management area (DWSMA) and 2) the vulnerability assessments for the City's well and the aquifer within the DWSMA. The City manages one well for the Public Water Supply (PWS) (Unique well number 228834). The Plan was submitted to the Minnesota Department of Health (MDH) and approved July 2, 2007. The boundaries of the DWSMA are shown in Figure 1.

The **vulnerability assessment for the aquifer within the DWSMA** was performed using available information and indicates that the aquifer used by the City is considered to have a mixed vulnerability to contamination. Rising water levels in the Canisteo Mine Pit have altered the flow path of water that feeds the public water supply well. As water levels continue to rise, increasing amounts of pit water will feed the municipal well. Thus, creating a large area of open water that is very highly vulnerable to contamination and has a high impact upon the public water supply well. The majority of the landmass within the DWSMA is rated as low-moderate vulnerability due to the clay-rich confining layer that lies over the aquifer used by the City. MDH computer modeling revealed characteristics that are termed 'leaky confining layer' which constitutes some areas receiving vertical recharge more rapidly from the surface than other areas. This is confirmed by the presence of tritium in the municipal well of 18.3 tritium units. Therefore, some areas of high vulnerability exist on the landmass contained within the DWSMA mainly due to erosion or glacial scouring of the clay-rich confining layer. Consequently, the principal potential sources of contamination to the aquifer are other wells that reach or penetrate the aquifer the public water supply is using for a drinking water source, chemical and petroleum storage tanks, shallow disposal wells, leaking underground storage tanks, pipelines, other potential contamination sites such as superfund sites or solid waste management sites, spills and chemical storage and preparation areas. This information was presented to Bovey city staff during the Second Scoping meeting held with the MDH, October 5, 2007, when the necessary requirements for the content of Part 2 were outlined and discussed in detail.

Based on the review of construction records and vulnerability assessment for the City of Bovey well found in Part 1 of the WHP Plan, Well 1 is vulnerable to contamination since it is unclear if the annular space between the outer and inner casings was properly grouted.

The information and data contained in Chapters 1-4 of this part of the WHP Plan (hereafter referred to as the Plan) support the approaches taken to address potential contamination sources that have been identified as possibly affecting the aquifer used by the public water supply. The primary concern at this time is rising water level in the Canisteo Mine Pit. This presents several problems: some residents have water in the basements, continual altering of the hydraulic characteristics of the aquifer, potential flooding that would make contaminant migration to the city well a greater possibility through existing wells or possible unknown abandoned wells, and a greater influence from a large body of water upon the aquifer that if contaminated in any of a multitude of ways would directly impact the city well. The reader is encouraged to concentrate attention on Chapters 1-4 in order to better understand why a particular management strategy is included in Chapter 5.

In Chapter 1, the required data elements indicated by MDH in the Scoping 2 Decision Notice are addressed. Pertinent data elements include information about the geology, water quality and water quantity. The data elements and information supplied in Part 1 of the WHP Plan are based on the assessment that the aquifer providing drinking water for this City has a moderate-high vulnerability to contamination from land uses, such as other wells that penetrate the same aquifer and land uses that either store liquids in tanks or dispose of liquids below the land surface.

Chapter 2 addresses the possible impacts that changes in the physical environment, land use, and water resources have on the public water supply. There are no anticipated changes within the next ten-year period, when this Plan is to be updated, above the Canisteo Mine Pit issue and an average five-percent increase used for city growth. The City of Bovey has evaluated the support necessary to implement its wellhead protection plan.

The problems and opportunities concerning land use issues relating to the aquifer, well water, and the DWSMA and those issues identified at public meetings, are addressed in Chapter 3. The mixed vulnerability status of the aquifer and the good quality of water currently produced by the City well constitutes these major concerns to be addressed by this plan: 1) the rising water level in the Canisteo Mine Pit, 2) other wells located within the DWSMA that could become pathways for contamination to enter the aquifer of which none are presently known to exist; 3) the pumping effects of high-capacity wells that may alter the boundaries of the delineated WHPA, reduce the hydraulic head in the aquifer, or cause the movement of contamination toward public water supply; 4) registered underground or above-ground storage tanks that may release contaminants into groundwater 5) shallow disposal-type wells and 6) potential of a hazardous spill along major corridors through the DWSMA.

The drinking water protection goals that the public water supplier (PWS) would like to achieve with this Plan are listed in Chapter 4. In essence, the PWS would like to 1) maintain or improve on the current drinking water quality, 2) increase public awareness of groundwater protection issues, 3) protect the aquifer, and 4) continue to collect data to supplement the existing geologic and hydrogeologic knowledge of the area, confirming where all wells and contamination sources are located within the DWSMA and support efforts in WHP planning.

The objectives and action plans for managing potential sources of contamination are contained in Chapter 5. Actions aimed toward educating the general public about groundwater issues, gathering information about other wells, and collecting data relevant to wellhead protection planning are the general focus.

Chapter 6 contains a guide to evaluate the implementation of the identified management strategies of Chapter 5. The wellhead protection program for the City of Bovey will be evaluated on an annual basis prior to the City's budgeting process.

An emergency/contingency plan is included to address the possibility that the water supply system is interrupted due to either emergency situations or drought. Chapter 7 contains details about the water supply distribution system, emergency contact numbers, equipment listings as well as other information to assist the City of Bovey in responding quickly and effectively in emergency situations.

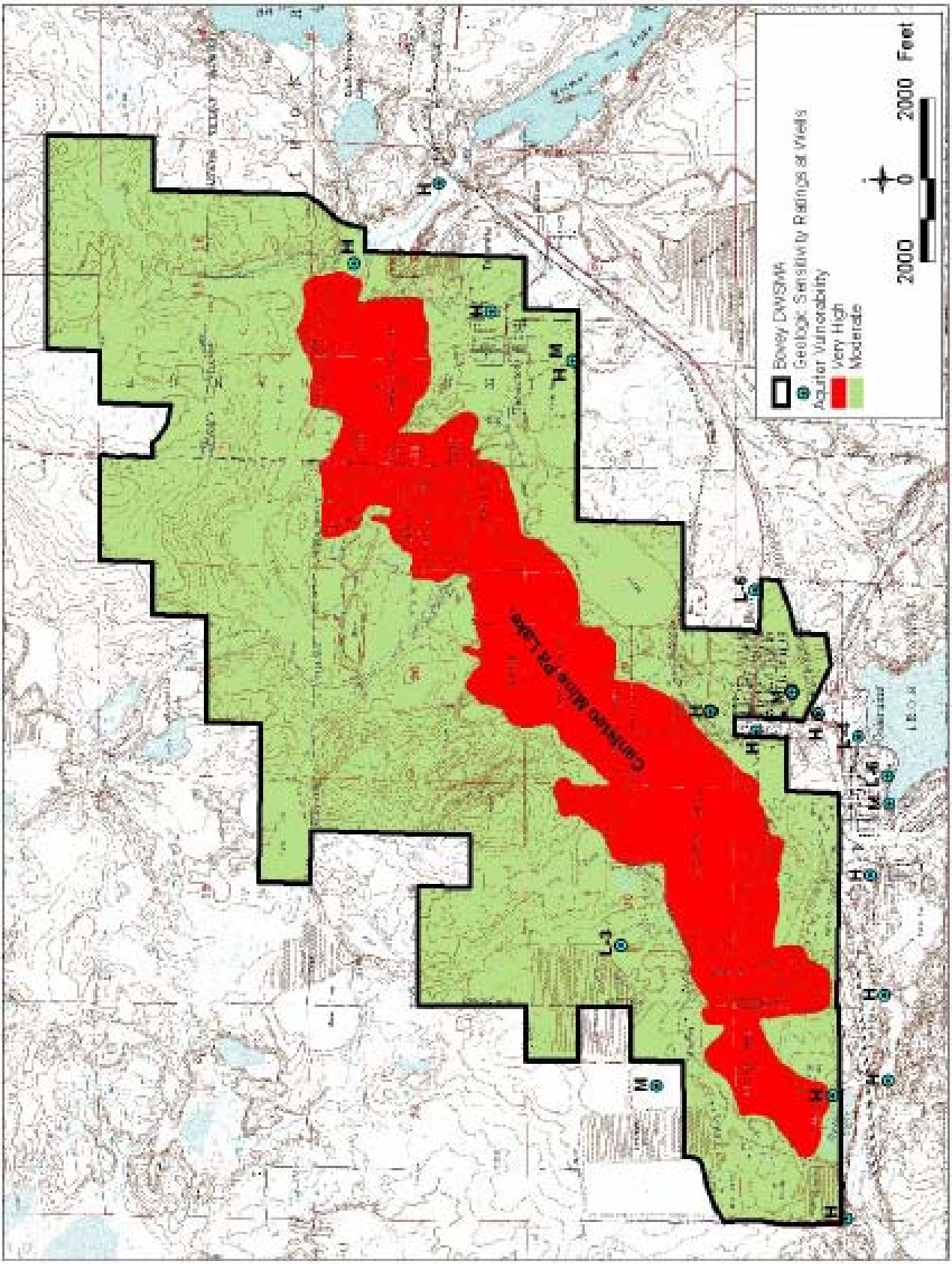


Figure 1: Vulnerability of the City of Bovey Drinking Water Supply Management Area.

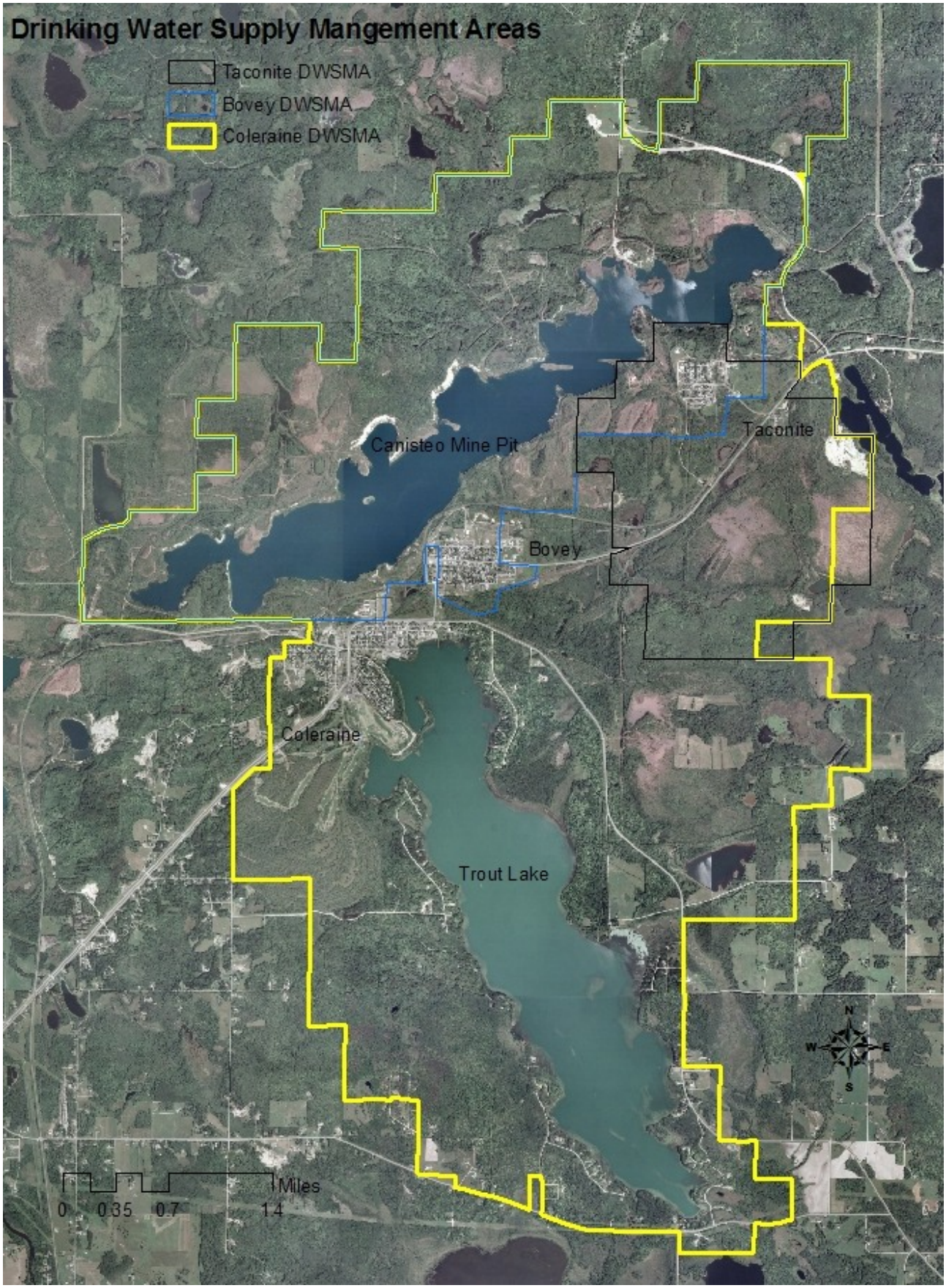


Figure 2: Bovey, Coleraine and Taconite's Drinking Water Supply Management Areas.

CHAPTER ONE

DATA ELEMENTS, ASSESSMENT (4720.5200)

INTRODUCTION: Part 1 of the Wellhead Protection Plan (WHPP) determined that the Drinking Water Supply Management Area (DWSMA) for the City of Bovey has a mixed vulnerability to contamination (Figure 1). The City manages one primary well for the Public Water Supply (PWS), Well No. 1 (228834). This is a unique situation for two reasons: 1) the rising water level in the Canisteo Mine Pit has altered aquifer characteristics and the capture zone for the municipal well. As water level rises, it appears the PWS will be comprised of increasing amounts of pit water; thus, creating a large area of open water that is very highly vulnerable to contamination and 2) three Public Water Suppliers (Bovey, Coleraine and Taconite) are located on the southern border of the Canisteo Mine Pit. The large areal extent of these cities Wellhead Protection Areas (WHPA) determined in Part 1 of the WHPP results in Bovey's WHPA overlapping with the city of Taconite's WHPA and being completely enclosed in the city of Coleraine's WHPA (Figure 2). The cities have agreed to monitor and resolve any potential contaminant issues within their respective city jurisdictional boundaries which is the majority of issues within the cities respective DWSMA. The cities will work collaboratively to resolve issues in overlapping DWSMA boundaries.

The land mass within Bovey's Drinking Water Supply Management Area (DWSMA) varies from low to moderate vulnerability where sufficient thickness of clay-rich glacial till overlies the aquifer to high vulnerability where the glacial till has eroded or been scoured by glacial activity. Therefore, land activities in these areas require evaluation since they have the potential of affecting the water quality.

I. REQUIRED DATA ELEMENTS

A. Physical Environment Data Elements

1. Precipitation – Average annual precipitation over the last five years is 27.5 inches per year.

   Tritium is the result of nuclear testing that occurred in the early 1950's. Isotopic analysis in 2004 revealed 18.3 Tritium Units (TU) present in the PWS. This concentration of tritium shows that the water is 'young water' or water that has entered the aquifer after the nuclear testing in the early 1950's. Although Part 1 of the Plan states that the aquifer is overlain with 30-40 ft. of clay-rich till, the aquifer is considered leaky due to the concentration of tritium found in Well 1. Therefore, we must assume that areas exist where the infiltration of precipitation along with potential contaminants can reach the aquifer within years to decades.

   Table 1: Five-year historical average rainfall is 27.5 inches per year. Data gathered from the gauging station at Bovey-Coleraine-Taconite Waster Water Treatment Plant.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2005	1.66	0.49	1.18	1.36	4.97	4.79	0.82	1.58	5.06	2.99	3.25	0.99	29.1
2006	0.49	1.17	2.15	1.14	3.39	3.15	3.15	2.96	2.66	1.62	1.32	1.52	24.7
2007	0.18	0.80	2.56	2.53	2.20	3.10	1.48	1.09	6.94	4.68	0.39	1.50	27.5
2008	0.19	0.43	0.63	5.05	2.95	3.66	2.95	1.01	4.55	2.72	1.08	1.77	27.0
2009	0.70	0.89	4.17	1.22	1.91	3.06	5.73	4.58	0.32	4.33	1.09	1.16	29.2

2. Geology – The general geology of the Bovey area as described in Part 1 of the WHP Plan is summarized in the following paragraphs:

The City of Bovey's public water supply lies on somewhat level ground between the Canisteo Mine Pit and Trout Lake. Glaciofluvial outwash, deposits sorted by glacial melting, primarily fine sand intermixed with coarse sand, gravel and boulders with an average thickness of 50 feet comprise the aquifer used by the cities of Bovey and Coleraine for their public water supply. The aquifer is sandwiched between two major tills from the late Pleistocene glaciations, the surficial till above and the boulder till below. Groundwater flow is variable due to the rising water levels in the Canisteo Mine Pit, but is considered westerly to southerly at this time.

Trout Lake is considered a glacial tunnel valley, a subglacial drainage feature, and probably influenced the aquifer during the dewatering of the mine by presenting a more northerly groundwater flow pattern at that time. Irregular hills are adjacent to Trout Lake to the west and are characteristic of ice margin contact deposits. Glacial drift thickens to the south and thins to the north approaching bedrock near the Giants Range north of the Canisteo Mine Pit

3. Soils – Soils play an important role in contaminant attenuation and slowing the infiltration of harmful contaminants into an aquifer. Cross sections shown in Part 1 of the Plan show a 30-40 feet sandy-clay cap overlies the aquifer. The predominant soil types in this area are Nashwauk and Warba both are fine-sandy loams that are deep, well-drained and have a moderate to moderately-slow permeability (Exhibit 1). Although the soils have a moderate ability to attenuate certain contaminants, the rapid infiltration rate could override the soils retention capacity in the advent of a large volume contaminant influx.

Udorthents and Sickens are scattered throughout the DWSMA in varying size. These areas are remnants of mining operations such as pits or piles and comprise a large area to the northeast between Bovey and Taconite and on the north side of the Canisteo Mine Pit. Although difficult to assign regular soil properties to these series due to the high variability of the mining operations that created the features, it is assumed that the areas south of the pit are resting on the Warba soil series that is a clay-rich sandy loam with good retention capacity. North of the pit are other large areas of dumps and tailing piles that most likely rest on Nashwauk soil series that have similar retention capacities. It is assumed that the waste piles do not present an immediate threat to the aquifer.

Complications result when the top sand-clay loam and the underlying clay-till soil parent material are removed, exposing more vulnerable soil layers below, such as around the Canisteo Mine Pit. These edge areas of the pit are considered highly vulnerable and contaminants entering these areas could reach the aquifer in a short period of time, months to years.

4. Water Resources -- This data element applies as it relates to future groundwater uses that may influence the ability of the aquifer to yield water to the public water supply. Increased water usage may result in a reduction of aquifer yield or increase the likelihood that contaminants of human or natural origin may affect the quality of drinking water.

At this time the aquifer used for the Public Water Supply (PWS) has sufficient volume to maintain present day usage. Recharge is predominantly from infiltration into the leaky-confined aquifer and groundwater flow from the Canisteo Mine Pit with Trout Lake serving as a possible discharge area. Flow direction is westerly to southerly.

B. Land Use Data Elements

1. Land Use – The City of Bovey lies in the southeastern part of Itasca County. A growing community, primarily commercial along 2nd Street and 2nd Avenue, the growth is perceived to continue at a moderate rate. Major transportation corridors within the DWSMA are U.S. Highway 169, County Roads 10 and 61 are all on the southern border, and a railway that lies between the city and the mine pit to the north. The Duluth Missabi Iron Range railway is not in use at this time since it runs parallel to the mine pit and lies close enough in places that the eroding walls of the pit are considered unstable enough to allow transport of any kind.

A large portion of the DWSMA encompasses the Canisteo Mine Pit with most of the adjoining land immediately around the pit and most of the northern landmass belonging to mining companies. The City has limited authority for landuse controls in this area.

The City of Bovey has business districts along the corridor of old U.S. Highway 169, (2nd Avenue) from the south entrance with more business zoning in this area presently proposed, and Main Street to the east exit. Inter-mixed areas of Business-Residential exist, however the majority of the remaining city limits are classified as residential (Exhibit 2). Bovey administers land use controls within its boundaries. No comprehensive land use plan is available. However, the Minnesota Department of Health (MDH) has supplied a landuse map (Exhibit 3).

Due to the information contained in Part 1, which indicates that the public water supply (PWS) has a mixed vulnerability, low to very high for certain land use activities, an inventory of other wells that reach or penetrate the aquifer the public water supply is using for a drinking water source, chemical and petroleum storage tanks, shallow disposal wells, leaking underground storage tanks, pipelines, other potential contamination sites such as superfund sites or solid waste management sites, spills and chemical storage and preparation areas located within the DWSMA is required.

The City of Bovey staff and a MDH representative conducted a potential contaminant source inventory (PCSI). A spreadsheet and map of potential contaminants identified in the DWSMA are presented in the Appendix as Exhibit 4.

The City owns the land where Well 1 is located. Elevating water levels in the Canisteo Mine Pit have altered the flow direction and characteristics of the aquifer used by the City for a PWS. Isotopic analyses indicate that with rising water levels, increased amounts of pit water will be incorporated into the water supply. Removal of soils and clay-rich till through the mining process and now the erosion along the edges of the pit lake due to wave-action and sloughing, constitutes this area receiving a very-high vulnerability status and is a focus for potential contaminants entering the aquifer.

Nine LUST sites were identified within the DWSMA (Exhibit 4). Four remain active and two have an unknown status. All other LUST sites are conditionally closed.

A community wastewater-lift station is within the one-year travel time region of the PWS well. The lift station serves the cities of Bovey, Coleraine and Taconite and discharges into the wastewater treatment plant ½ mile east of Coleraine. There is a bypass that diverts the wastewater in cases of emergency into a drainage ditch and eventually discharging into Trout Lake.

No private wells were inventoried within the DWSMA. Plan implementation will include a continued search for wells that have the potential to pose a threat. There are 3 PWS wells, 2 monitoring wells, 8 observation and 7 unclassified wells placed to monitor the increasing water levels from the Canisteo Mine Pit. Although soils in the area and the 30-40 foot clay-rich till cap over the aquifer have a reasonably high capacity of retention for contaminants, it is assumed from Part 1 of the Plan, the leaky-confined conditions the aquifer displays, that areas exist within the DWSMA where till is thin and the ability for contaminant retention is reduced.

The inventory found 27 RST's and UST's within Bovey's DWSMA (12 are in Taconite's DWSMA and are Taconite's responsibility to monitor and address), 8 active and 18 abandoned or removed and 1 inactive. As previously stated, contaminant retention is considered reasonably high but areas exist that may lack this ability. Large volumes of petroleum-based products or chemicals released into these areas could reach the aquifer in a relatively short time span.

There are no old municipal wells for the City of Bovey. Records dating back to 1939 establish that Bovey received water from Coleraine's Well 1 that was drilled in 1917. It is assumed that this was the situation when the well was first drilled also. The City will continue to investigate the possibility of former municipal wells or pump houses for surface water usage, and attempt to locate sites if discovered. Taconite's 2 PWS wells are also the original wells

Land use and management of the Inner Wellhead Management Zone (IWMZ or 200' radius around the City of Bovey's Public Water Supply Well) were discussed and considered in the development of this plan. This is done to identify the highest priority issues with the most immediate consequences or impact upon the public water supply well. The City with assistance from the MDH has updated the IWMZ forms as part of plan preparation (Exhibit 5).

Land uses in the IWMZ of the Bovey DWSMA were also considered. City staff will continue to monitor changes within the IWMZ as part of plan implementation. This information is used to support the development of Chapter 7 of this plan, which details an emergency / conservation plan for the City.

2. Public Utility Services -- Records of well construction and maintenance apply to this portion of the plan due to the information provided about the wells and the quality and quantity of the water supplying this City. City Well 1 was cable tool/bored and gravel-packed in 1953. It is plausible that the clay-rich till has swelled enough to form an impenetrable area around the casing, however, since the well was not grouted according to present day requirements it is considered highly vulnerable to contamination. The city of Taconite also has PWS wells within the DWSMA but they are finished in the Biwabik formation and not considered a threat to aquifer flow boundaries, characteristics or potential contamination.

C. Water Quantity Data Elements

1. Surface Water Quantity -- Part 1 of the Plan determined there is a hydraulic connection between the surface water bodies of the Canisteo Mine Pit and Trout Lake with the aquifer used by the City. It is assumed, based on subsurface formation gradient, that prior to the mining activity that started in the early 1900's, groundwater flow was to the southeast through the glacial tunnel valley and towards Trout Lake. Several mining companies were involved in a variety of extractions and dewatering was eventually necessary to keep the mines operable.

This created a depressional low in the area and a local aquifer discharge point. The aquifer flow was likely influenced by Trout Lake during this time with the flow direction reverting to a more northerly direction. Once mining and dewatering ceased in the mid-1980's, local aquifers and precipitation increased water levels in the pit by as much 70 feet per year initially raising pit water levels to the point they are presently at, 20 feet above Trout Lake. In the absence of the depressional discharge point and the increased hydraulic head presented by the high water levels in the pit, local aquifer flow changed to a westerly and southerly direction, again highly influenced by local water bodies. No designated floodplain presently exist within the DWSMA. Due to the rising water level in the Canisteo Mine Pit, several basements in the town have flooding problems and the City is exploring the possibility of designating this area as a floodplain.

2. Groundwater Quantity -- Groundwater levels are adequate for the amounts that the City of Bovey currently is permitted for under the groundwater appropriations program that is administered by the Minnesota Department of Natural Resources (DNR). There is currently two other high-capacity well within the DWSMA (Taconite PWS Wells 1 & 2) and two other high-capacity wells within one mile (Coleraine PWS Wells 1 and 4). The Coleraine municipal wells are considered to be in the same aquifer that Bovey uses for the PWS. There are no known water use conflicts. At this time, there appears to be sufficient groundwater quantity, based upon the existing pumping capacity.

D. Water Quality Data Elements

1. Surface Water Quality – The aquifer is influenced to some extent by two large water bodies on either side of the City, Trout Lake to the south and the Canisteo Mine Pit to the north. According to Part 1 of the Plan the pit is the primary influence at this time. Trout Lake influenced the aquifer to some extent prior to dewatering of the mine being stopped. Neither surface water body contains contamination presently that would be a threat to the PWS.

2. Groundwater Quality -- Existing information consists of isotopic and chemical analyses and indicates that the aquifer used by the City of Bovey is predominantly recharged by precipitation infiltrating through the leaky-confining layer and influenced to some degree by the Canisteo Mine Pit and Trout Lake. Tests conducted by MDH have revealed tritium values of 18.3 Tritium Units (TU) for Well 1 indicating the main component recharging the aquifer used by the City of Bovey is 'young water' (water that infiltrated after the 1950's atomic testing) and therefore the aquifer may be directly impacted by land use activities.

Changes in the general chemistry of the well water may indicate that the aquifer is receiving recharge from different pathways, such as improperly constructed or sealed wells or through different geological materials. An annual program of water sampling should be conducted to monitor changes in ionic and isotopic composition to gain a better understanding of local groundwater flow and the capture zone for the PWS well.

II. ASSESSMENT OF DATA ELEMENTS

A. Use of the Well -- General information describing this public water supply system is presented in the Source Water Assessment (SWA) found in Part 1of this Plan. The City of Bovey has no residential meters or commercial meters. Connor Jasper Middle School is the only metered facility and is not billed by usage. The public school is the only high water usage customer at around 600,000 gallons per year. The average annual water usage for the City over the last five years is 31.8 million gallons per year.

B. Wellhead Protection Area Delineation Criteria -- See Part 1 of this Plan for documentation regarding how the following delineation criteria were applied to determining the boundaries of the WHPA:

1. Time of Travel – 10 years
2. Flow Boundaries – geologic information
3. Daily Volume – provided by the City of Bovey
4. Ground Water Flow Field – static water levels and local surface water bodies
5. Aquifer Transmissivity – USGS single aquifer tests and specific capacity tests of Bovey and Coleraine PWS wells

C. Quality and Quantity of Water Supplying the Public Water Supply Well -- Water quality monitoring results indicate no evidence of contamination from 1) human-origin, such as fuel and fuel break-down products, pesticides, or commercial fertilizer, or 2) naturally-occurring contaminants such as arsenic and boron. At this time problems with water quality are not an issue, as the City of Bovey has enjoyed water quality that meets standards in the Federal Safe Drinking Water Act (Exhibit 6).

D. The Land and Groundwater Uses in the DWSMA -- Proactive management of existing wells or unsealed or unused wells if discovered and storage tanks are of immediate concern due to the mixed low to very high vulnerability rating of the aquifer. Improperly constructed, unsealed or unused wells may provide a direct route for contaminants to reach the aquifer used by the City.

The City has conducted a thorough inventory of LUST sites and registered storage tanks throughout the DWSMA. Abandoned wells, transportation corridors and tanks are a primary focus of existing potential contamination routes for the City. The management strategies selected and documented in Chapter 5 of this Plan will focus on activities that have the most potential to impact the aquifer used for the PWS.

Land use within the DWSMA is limited due to much of the available land being owned by mining companies. Increased water level in the Canisteo Mine Pit is a unique problem where flooding not only presents a monetary loss for the residents and the City but also increases the chance for contaminants entering existing wells or unknown abandoned well sites and eventually the aquifer. The city limits are contained within the DWSMA. No shallow disposal wells were identified by the City of Bovey staff within the DWSMA.

CHAPTER TWO

IMPACT OF CHANGES ON PUBLIC WATER SUPPLY WELLS (4720.5220)

I. CHANGES IDENTIFIED IN:

A. Physical Environment -- Large-scale changes in the physical environment within the DWSMA are not anticipated during the 10-year period that this Plan is in effect other than resolution to the increased water levels in the Canisteo Mine Pit. Rising water levels to the point that flooding occurs presents several possible contamination problems. Other than the increasing water levels, the geologic conditions that protect the water supply are such that changes in the physical environment should have little to no effect on the aquifer. However, direct routes through these geologic conditions, or the confining layer over the city wells (e.g. unidentified abandoned wells and / or underground storage tanks) could potentially impact the aquifer and groundwater quality.

B. Land Use -- Anticipated changes of land use in the City of Bovey DWSMA will most likely consist of isolated new residential development in areas of the newly proposed zoning areas to the north and east parts of the City. Potential for some commercial development along U.S. Highway 169 and 2nd Avenue, governed by the availability of land. The City manages growth and development through local land use controls. Future residential and commercial growth will be considered in relationship to the impact on the public water supply wells and aquifer. Presently, the City of Bovey requires new property owners to hook up to municipal sewer (Ordinance 10-0224) and is exploring the requirement of hook up to municipal water also. This action lessens the likelihood of new wells being installed in the community that may serve as an entry point for contaminants. Constructing additional wells into the aquifer may increase the points of entry, alter the WHPA, or draw naturally-occurring or human-caused contaminants towards the PWS wells.

The City will monitor for any changes in land use within the IWMZ in relation to issues presented in Chapter 1 of this Plan. All properties within the DWSMA follow Itasca County Ordinances that apply to shoreline and septic systems.

C. Surface Water -- There is a direct hydraulic influence from both the Canisteo Mine Pit and Trout Lake, individually or in conjunction depending upon water levels of each water body. Therefore, any changes to the conditions of surface waters may have an impact on the quality or quantity of the public water supply.

D. Groundwater -- The public water supply well has historically provided groundwater of excellent quality and quantity. The City will monitor high water usage sources to alleviate impacts on the public water supply.

II. IMPACT OF CHANGES

A. Expected Changes in Water Use -- The City does not anticipate that its water use will increase by more than five-percent during the first five years that this Plan is in effect. The PWS will re-evaluate its water-use patterns for the second five-year interval as part of its comprehensive planning activities and incorporate the results into future revisions of this Plan.

B. Influence of Existing Water and Land Government Programs and Regulation – Recognizing that the State Well Code has sole authority in permitting wells, there may be existing land use ordinances by the City of Bovey and Itasca County that could be revised in the future to address new private wells, storage tanks or shallow disposal wells within the DWSMA. However, there is no discussion, or intention at this time of requiring additional regulation related to managing wells or storage tanks within the DWSMA. The City has identified the sealing of unused/unsealed wells as a priority item in the past and will continue to address these issues as they are identified within the DWSMA. The City conveys the importance of the state mandated controls pertaining to abandoned wells. The Itasca SWCD has been supportive of the Wellhead Protection Plan and manages state funds for the sealing of abandoned wells within Wellhead Protection Areas (WHPA) on a priority basis.

The City does not presently have natural or manmade stormwater ponds but is exploring dredging west of 2nd Avenue to create one. Stormwater ponds are important and serve as a sink for urban runoff allowing access fertilizers and pesticides to be absorbed by aquatic plants.

The City of Bovey is reliant on the Minnesota Pollution Control Agency's authority for the permitting of above and below-ground storage tanks. Currently, no Class V Wells or Shallow Disposal Wells were identified within the DWSMA.

C. Administrative, Technical, and Financial Considerations -- The City of Bovey staff were active in the process of developing this Plan. Many of the activities during the planning process have been accomplished through efforts of this group, with assistance from studies provided by other units of government. For this Plan to be effective:

1. The City will need to raise public awareness of the issues affecting the quality and quantity of its drinking water supply through public educational programs.
2. Administrative duties will remain with the Wellhead Protection Manager who will report to the City Council, coordinate implementation of wellhead protection management action plans, and conduct regular meetings.
3. Implementation of Well Head Protection activities will be supported by existing and future dollars from the City's general operating fund. Other sources of funding or in-kind services to achieve the goals in Chapter 4 include 1) the Board of Water and Soil Resources (BWSR) cost-share programs, 2) the Local County Water Management Program with funds from BWSR and Itasca County as administered by the Itasca SWCD to assist the City of Bovey with future inventory, mapping, classification, and tracking of all wells in the DWSMA; 3) the State Well Code administered by MDH for sealing abandoned wells, constructing new wells, and setting the requirements for well sealing if this becomes necessary; 4) the MDH Plan Implementation Grant specifically designated to aid cities in the implementation process; and 5) the Local County Water Management Program through the Itasca SWCD and the Itasca County Environmental Services Department will provide technical assistance in well sealing and private septic system management,
4. The costs of implementing Wellhead Protection activities will be reviewed annually prior to the City's budgeting process to determine whether the estimated costs match 1) the scope of the management practices identified in this part of the Plan, 2) the actual costs to monitor changes in the status of the wells. If necessary the City of Bovey will work with the MDH to adjust the plan implementation schedule and to determine the availability of state or federal funding for offsetting increased costs to plan implementation.

CHAPTER THREE

ISSUES, PROBLEMS, AND OPPORTUNITIES (4720.5230)

I. LAND USE ISSUES, PROBLEMS, AND OPPORTUNITIES RELATED TO:

A. The Aquifer – The mixed vulnerability (low-moderate to very high) assigned to the aquifer used as the source of the City of Bovey's water supply, should be relatively unaffected by land use activities with the exception of the potential contaminants investigated as part of this Plan.

B. The Well Water -- The potential contaminant source inventory performed by City staff and MDH representative indicated the types of wells, tanks and other sources of concern Exhibit 4. City staff has investigated historical records, will continue to research but has not identified any old abandoned wells. An interconnect between the City of Bovey and the City of Coleraine's public water supplies exists and is used as a backup in case of emergency.

The placement of additional high-capacity wells, increased pumping from existing wells, or significant changes in current groundwater appropriations within the DWSMA may have an impact on 1) groundwater availability to all users, 2) increased risk that contamination may enter the part of the aquifer used by the public water supply wells, or 3) change the delineated WHPA and DWSMA boundaries. The City of Bovey will work with the DNR and MDH to become aware of any proposed high-capacity well within the DWSMA. The City will work with the well owner to minimize or eliminate potential impacts to the public water supply.

C. Underground and Above-Ground Storage Tanks –Two LUST sites remain active with one monitoring well in place. The City will conduct a complete inventory and verify all tanks as part of Plan implementation.

The City had a cross-connection with the creamery. Local residents knowledge of this is as follows: the creamery was located on the west side of 2nd Ave. between 3rd St. and 4th St. and adjacent to Enstrom's Studio and the King Lumber Co. The creamery was dismantled in the mid 1960's. In 1999 a new water main was installed down 2nd Ave. from 2nd St. to 4th St. and new services were installed. So if the cross connection had existed at the time the new water main was installed it was not reconnected as only existing structures were connected and 1 stub was put in for the empty lot for future connection should the lot be sold and a structure erected on that lot. The assumption is that when the creamery was dismantled, the well would have been disconnected and capped but nobody can verify this. If the connection is found in the future it will be disconnected.

While the MPCA requires permits for above and below ground tanks in excess of 1,100 gallons, the City of Bovey will review their role towards ensuring that any new businesses comply with existing regulations and if local requirements for sitting large capacity tanks are adequate to protect local drinking water supplies.

D. Shallow Disposal Wells – The City of Bovey staff considered the potential locations of shallow disposal wells (Class V Wells). There are no indications that these types of wells would exist since municipal sewer has always been available and required (Ordinance 10-0224). Management strategies regarding shallow disposal wells and reporting requirements are presented in Chapter 5 of this plan.

E. The Drinking Water Supply Management Area -- A primary concern expressed by the City of Bovey is resolution to the increasing water levels in the Canisteo Mine Pit. Appropriations of $3.5 million have been secured, but no resolution has been enacted at this time. Rising water levels continue to erode shoreline due to wave action and sloughing. Water levels are rising approximately 2 feet per year and have now reached a point above the bedrock and are wearing away the softer parent material and soils that contain the water body. Some basements in the City are now consistently wet. If allowed to reach flood stage, wells within this area are jeopardized. Since they may be completed within the same aquifer the City is utilizing, contamination of the municipal water supply could occur. Residents that have endured repeated basement flooding and associated problems with mold, mildew and water damage to personal property have served a class action lawsuit against the state. The City of Bovey has backed the residents on this issue and the floodplain classification, and is presently attempting to persuade the City of Coleraine to back these issues also to pressure the state for a resolution. Any resolution should consider the three cities impacted by this issue and place a high priority on protecting the public water supply's located within this region.

Another concern brought up by the MDH hydrogeologist as a direct result of periodic water analyses monitoring, is the rising levels of sulfate in the cities of Bovey and Coleraine PWS wells. Historical levels dating back to 1957 show sulfate levels ranging from 42 milligrams per liter (mg/L) to 68 mg/L. Analyses completed in 2009 show these levels now range from 100 mg/L to 200 mg/L with one reading from the Dump Station at 503 mg/L. Since the Canisteo Mine Pit historically has been below 100 mg/L and flow has been established to be coming from that direction, the increase in sulfates in the PWS wells is suspected to be coming from somewhere between the pit and the wells. The suspected area of concern is the US Steel Dump II. Although no toxic effect is related to higher sulfate levels, it does generate taste and odor effects that could be unpleasant to consumers and problematic for the cities. Management strategies to confirm the source of the sulfate and present a resolution to increasing levels is presented in Chapter 5 of this Plan.

Other focal points are to ensure consistent and long-term management of water wells, environmental bore holes, and observation wells within the DWSMA. A cooperative effort has been verbally agreed upon between the two cities of Bovey and Coleraine to manage potential contaminants within their jurisdictional boundaries where the DWSMA's are overlapped or encompassed within the other city's DWSMA. The City has limited legal capabilities to regulate well construction and sealing in the DWSMA. Second, changes in land use that increase pumping of the aquifer used by the City's well need to be assessed for the possible impacts on water availability and quality. Finally, the City has no regulatory authority over water appropriations and must rely on the State of Minnesota to address issues and concerns related to pumping.

F. Providing Funds to Conduct Requirements of the Well Head Protection Plan- The City understands the importance of providing good quality and quantities of water for consumption and strives to maintain present conditions. Cities already face obstacles in balancing budgets. Staff time and incidental costs of this un-funded mandate adds a financial burden to an already stressed budget. The City will apply for the MDH Implementation Grant to offset the costs.

II. IDENTIFICATION OF:

A. Problems and Opportunities Disclosed at Public Meetings and in Written Comments -- At the beginning of the planning process other Local Units of Government

(LUGs) were identified and informed that the City was beginning the wellhead protection planning process. (See Exhibit 7 for a list of LUGs.) Each unit of government was also sent a copy of the City's delineated WHPA and DWSMA and vulnerability assessment for the wells and DWSMA. To date, no comments from the LUGs have been received.

B. Data Elements -- The state's Wellhead Protection Rule requires that existing information be utilized in developing the initial Wellhead Protection Plan. Much of the data collected and utilized to delineate the City's WHPA and DWSMA and to determine the vulnerability of the aquifer to possible contamination comes from small-scale, or regional studies. There is a limited amount of subsurface information available to define local groundwater flow conditions and the groundwater chemistry of the aquifer within the DWSMA. The direction of groundwater flow was evaluated to address concerns that the current amount of subsurface information does not permit an unquestioned determination of local groundwater flow conditions toward the City's water supply wells. As a result, delineation of the WHPA represents a composite of capture zones generated by varying aquifer properties, within limits determined by MDH.

The City of Bovey plans to utilize public education opportunities, both existing and proposed, to address potential contamination of the aquifer. Additionally, the City will work in cooperation with the BWSR, the Local Water Plan through the Itasca SWCD, and the Itasca County Environmental Service Department (ESD) to utilize the well sealing cost-share program. The City will set a high priority on well sealing for existing wells that are unused or are not properly maintained if discovered.

Based upon the uncertainties associated with the aquifer as described in Part I of the WHP Plan, the City will continue to focus its data collection efforts on the following activities throughout the ten-year life of this plan:

1. Every 5 years, work with MDH so that new well locations within 1 mile of the City's wellfield can be verified and accurate elevations obtained. This information will help address uncertainties related to 1)the areal extent, thickness and compositional varability of the Bovey-Coleraine aquifer, and 2) the distribution of hydraulic head in this aquifer.
2. Work with MDH to determine the feasibility of performing an aquifer test utilizing the observation well that is within close proximity to the City well.
3. Inform MDH when any of the City wells are repaired so that information regarding well construction, static water level, and pumping capacity can be verified or updated;
4. The City and MDH will inform each other of additional high capacity wells that are to be constructed within the DWSMA or within 1.5 miles of the City well. MDH will determine with the DNR whether the applicant for a water appropriations permit needs to conduct an aquifer test to evaluate the long-term pumping impacts on the City water supply wells;
5. Initiate an annual program of water sampling to help validate the groundwater model and refine resulting capture zones. MDH will assist with the selection of sampling points and analytical parameters.
6. Inform MDH of any wells that are to be properly sealed within the DWSMA so that the Minnesota Geological Survey can be notified and determine whether it can run a borehole geophysical survey of the well;
7. Inform MDH if the City is considering the construction of a new water supply well so that MDH can determine whether any potential sites for the new well present concerns over well interference or the movement of existing contamination plumes toward existing municipal or private water supply wells;

C. **Status and Adequacy of Official Controls, Plans, and Other Local, State, and Federal Programs on Water Use and Land Use** -- There are many tools available to the regulating agencies that may be used to achieve the wellhead protection planning goals identified by the wellhead planning team. State and local governmental units, such as MDH, Itasca County and the DNR, regulate:

Table 1: Official controls, plans and other Local, State and Federal Programs

Government Unit	Type of Program	Brief Program Description
MN Dept. of Health (MDH)	State Well Code Wellhead Protection Program	MDH has sole authority over the construction of new wells and offers technical assistance for sealing unused, unsealed wells. In addition, MDH administers the Safe Drinking Water Act. MDH has staff that will assist the city with identifying technical or financial support that other governmental agencies can provide to assist with managing potential contamination sources.
MN Dept. of Natural Resources (DNR)	Water Appropriation Permits	DNR can require that anyone requesting an increase in existing permitted appropriations or to pump groundwater must address concerns of the impacts to drinking water if these concerns are included in a WHP plan.
MN Pollution Control Agency (MPCA)	Storage Tank Program Stormwater Program	MPCA administers the programs dealing with storage tank regulations and stormwater management.
Environment Protection Agency (EPA)	Shallow Disposal Well Program	EPA has the regulatory authority over Class V Injection Wells or also known as Shallow Disposal Wells.
Itasca County Environmental Services Office	Household Hazardous Waste Collection. Land-use and Water Planning Individual Sewage Treatment Systems (ISTS)	Provides education to landowners and a semi-annual collection program for disposing of household hazardous waste. "Clean Shop" mandatory biannual business hazardous waste collection. Establishes countywide goals and priorities towards protecting water resources. Permitting is under Itasca County authority

City staff recommends that no additional regulations be imposed at this time and are confident that local issues may be adequately addressed through existing processes. Processes include public education, adoption of best management practices for different types of wells, tank maintenance, water conservation and good communication with other landowners within the DWSMA.

CHAPTER FOUR
WELLHEAD PROTECTION GOALS (4720.5240)

The City of Bovey's public water supply is considered to have a mixed vulnerability to contamination (low to moderate on the landmass and high to very high around the water bodies) due to the rising water levels in the Canisteo Mine Pit, the presence of tritium and the leaky-confined conditions of the aquifer, supports that substantial surface vertical recharge is occurring. The overall goal of this WHP Plan is to a) prevent contamination of the aquifer from existing known sources and all other potential contaminant sources described within this document and, b) cooperatively manage the aquifer to assure a sustainable potable water supply for all users.

The City has enjoyed a sufficient and safe water supply in the past and proposes, through the implementation of this WHP Plan, to further protect water quality and quantity.

The City identified the following goals to be achieved with the action items contained in this Plan:

A. Maintain or improve on the current level of water quality that meets or exceeds all state and federal standards.
B. Educate public officials, landowners and the general public about the importance of wellhead protection in order to protect the public water supply.
C. Provide ongoing collection of data to support future wellhead protection efforts.
D. Ensure protection of the City's aquifer
E. Maintain water quality and integrity of the public water supply well.

CHAPTER FIVE

OBJECTIVES AND PLANS OF ACTION (4720.5250)

ESTABLISHING PRIORITIES -- The aquifer providing water to the public water supply system has been identified to have a mixed vulnerability to contamination from land use activities (low-moderate to very high). A number of factors must be considered when WHP measures are selected and prioritized (part 4720.5250, subpart 3). Such factors include:

- Contamination of the public water supply wells by substances that exceed federal drinking water standards
- Quantifiable levels of contamination resulting from human activity
- The location of potential contaminant sources relative to the wells.
- The number of each potential contaminant sources identified and the nature of the potential contaminant associated with each source
- The capability of the geologic material to absorb a contaminant
- The effectiveness of existing controls
- The time required to get cooperation from other agencies and cooperators
- The resources needed: staff, money, time, legal, technical

Based upon these factors, the staff will concentrate management efforts on the following categories and subsequent strategies to create awareness about groundwater protection and help prevent future contamination of the aquifer:

A. WHP Education & Awareness:

B. Canisteo Mine Pit increased Water Level and Runoff Problems

C. Individual Landowner Management Practices:

1. **Private Well Management**
2. **High Capacity Well Management**
3. **Class V Wells and Other Unknown Potential Contaminants**
4. **Tanks (Registered Storage Tank-RST, Leaky Underground Storage Tank-LUST)**
5. **Hazardous Waster Generators (HWG), Voluntary Investigative Cleanup (VIC)**

D. Transportation Corridor & Spills:

E. Inner Wellhead Management Zone Activities & Old Municipal Wells:

F. Data Collection:

G. Wellhead Protection Recognition and Planning:

H. Plan Evaluation and Reporting

A. WHP EDUCATION & AWARENESS:

Objective A-1. Create awareness and general knowledge about the importance of WHP in the City of Bovey DWSMA and surrounding community. Establish a public education program through personal communication and mailings to educate citizens on how land use activities affect groundwater quality and the Public Water Supply (PWS) Wells.

Implementation Action Items															
					Implementation Time Frame										
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action A-1a	Collect and assemble a comprehensive packet of "fact sheets" from existing materials addressing a variety of land use BMP's pertaining to PCSI and WHP education. Most of these fact sheets are already in print and can be obtained through the County, MDH, MPCA, MDA, Extension or County Offices as noted below. Additional information is available on the MRWA website. The packets will be made available at City Hall and used at fairs and county festivals. They will contain information on: • Importance of well sealing and cost share funding available for sealing wells (MDH, MRWA, St. Louis SWCD) © • Proper well maintenance for private wells (MDH, MRWA) © • Best Management Practices for Private Fuel-Oil and Commercial Storage Tanks (MPCA Tank Unit) © • Information on Class V Wells (MDH, MRWA) © Check for updated and/or new information at least every 3 years.	High	City Staff ® Cooperators are noted behind fact sheet listing	Initially $100 and Staff Time Updating $50 plus Staff Time		X			X			X		
Action A-1b	Develop and submit a newsletter or article to be published in the Scenic Range News Forum or local newsletters explaining the WHP efforts for providing good quality water for consumers, how consumers can obtain further information such as collected in Action A-1a, and progress / results of implementing the goals of this Plan.	High	City Staff ® City Staff©	Staff Time	X			X			X			
Action A-1c	Determine interest from local civic groups and schools in water and wastewater treatment plant tours. If interest exists use this opportunity to provide information on the WHP efforts of preserving the good quality water consumers now enjoy. Provide handouts developed in Action A-1a and explain areas where the general public can help in WHP efforts. If positive feedback and tours are a success, continue on a yearly basis. Otherwise, try again within a few years to determine if a better result can be achieved.	Medium	City Staff ® Public Works® Civic Grps© Public School©	Staff Time			X				X			

Objective A-2. Develop long-term educational tools to reach a greater percentage of the public and provide a wide array of available information. Periodically update the information to reflect progress in WHP efforts and show continued commitment to providing good quality water to consumers.

Implementation Action Items															
Action	Description	Priority (H, M,L)	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action A-2a	Contact the Bovey Public School to see if they would be interested in participating in a local youth education days, water festival or if they would like to have city staff conduct classroom presentations addressing groundwater issues. If the school is interested, then MRWA educational materials (Groundwater Model, Enviroscape etc…) could be utilized at the water festivals or classroom presentations. If initial response is positive, evaluate the probability of continuing on a regular basis. Otherwise, attempt the goal again in a few years for possible personnel or interest changes	High	City Staff ® Public School© MRWA©	Staff Time		X				X				
Action A-2b	Explore developing a City webpage and include information explaining the WHPA, DWSMA and WHP efforts and ways that the community can help protect the municipal water supply. Provide website addresses where interested parties can find more information and / or a direct link to sites such as MRWA, MDH, BWSR, etc.	Medium	Private Consultant©	$500 plus Staff Time				X				X		
Action A-2c	Obtain a video on WHP from MDH or MRWA to be shown to local government, groups of property owners and / or on the Public Access Channel. Repeat every 4 years.	Medium	City Staff ® MDH & MRWA©	$100			X				X			
Action A-2d	Contact MDH requesting a large printout of the DWSMA for display purposes at City Hall, local events and other areas that residents visit frequently.	Medium	City Staff ® MDH©	Staff Time	X									

B. CANISTEO MINE PIT INCREASED WATER LEVEL and RUNOFF PROBLEMS

Objective B-1. Explore available options to increase pressure on State Agencies so a final resolution on rising water levels can be approved and implemented prior to increased associated problems.

Implementation Action Items															
Action	Description	Priority (H, M,L)	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action B-1a	Send an Official Letter to appropriate state agencies and the MnDNR along with a map and explanation of the WHPP. Explain the importance that this issue is resolved in order to protect the municipal supply and wastewater treatment facilities of three financially strapped cities. Request that the issue be resolved and implemented as expeditiously as possible.	High	Mayor, City Council & Staff ® MDH, MnDNR©	Staff Time	X									
Action B-1b	Due to overlapping and completely enclosed WHPA's between the three municipalities affected by the Canisteo Mine Pit (Bovey, Coleraine and Taconite), a collaborative effort must be pursued to ensure authority for handling potential contaminant sources (PCS) within these areas. A yearly meeting between the City's of Bovey and Coleraine will be held in the fourth quarter to access implementation progress and prepare for submission of the annual update to MDH.	High	WHP Manager ® WHP Teams of Coleraine & Taconite ©	Staff Time	X	X	X	X	X	X	X	X	X	X
Action B-1c	Contact the MnDNR and request a map showing the location of all observation wells installed to monitor rising water levels in the Canisteo Mine Pit. Once received verify the present PCSI well inventory to ensure that wells were not counted twice from the different databases utilized to construct the inventory. All observation and monitoring wells should be verified within the first 3 years from Plan adoption.	High	WHP Manager ® WHP Teams of Coleraine & Taconite ©	Staff Time	X	X	X							

Objective B-2. Work with MDH to determine the source and possible resolution to the increased sulfate levels in the PWS well.

Implementation Action Items														
Action	Description	Priority (H, M,L)	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action B-2a	Work with MDH to develop a sampling procedure for the City well, the US Steel Dump II site, monitoring well and pond, and drainages leading towards the City well for monitoring the increase in sulfate. MDH has available funds for chemical analyses within WHPA's. Use the results to determine, to the best of available information, the source of the sulfate.	High	City Staff ® MDH, US Steel ©	Staff Time for sample collection	X	X	X							
Action B-2b	Apply for and utilize the available MDH Implementation grant, MDH competitive grant or other available funding to alleviate the source of the increasing sulfate concentration. Contact and work with owners of mining company land to resolve the problem of increasing sulfate levels. Thus, retaining the present condition of the drinking water for consumers.	High	City Staff ® MDH, US Steel ©	Staff Time +/- $10,000					X	X	X	X	X	X

C: INDIVIDUAL LANDOWNER MANAGEMENT PRACTICES:

C-1. PRIVATE WELL MANAGEMENT

Objective C-1: Educate and promote proper well management in the DWSMA. Identify new wells that may be constructed within the DWSMA or existing wells that have not been identified at this time. Promote proper well management and sealing of wells not in use.

Implementation Action Items															
Action	Description	Priority (H, M,L)	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action C-1a	The City of Bovey will promote the sealing of abandoned wells through Public Service Announcements and distribution of educational items compiled in Objective A to the public at local events related to WHP initiatives. Materials should include how to visually identify a possible abandoned well. The City will share the contact information of agencies providing cost share funding options (Itasca SWCD, Itasca County ESO, BWSR) to any property owner that discovers an abandoned well.	High	City Staff ® Itasca Co. © Itasca SWCD©	$100 plus Staff Time	X	X	X	X	X	X	X	X	X	X
Action C-1b	The City will continually attempt to locate existing wells in the DWSMA. This will be accomplished through direct contact with landowners, reviewing water connection information, utilizing the County Well Index, MDH well permitting authorities and through visual observation as City Staff periodically travels through the DWSMA.	High	WHP Manager® Landowner© Itasca SWCD©	Staff Time	X	X	X	X	X	X	X	X	X	X
Action C-1c	Well Management informational materials will be made available at City Hall promoting proper maintenance and management of existing wells. Presently no private wells have been inventoried. If Action C-1b results in well(s) being discovered, the owner should be informed of the risks to the PWS and be encouraged to follow good management practices. A high priority should be given to wells known to be developed in the aquifer used by the City.	High	City Staff ® MDH © Itasca SWCD© Private well owners ©	$50 plus Staff Time	X	X	X	X	X	X	X	X	X	X

C-2. HIGH CAPACITY WELL MANAGEMENT:

OBJECTIVE C-2: Identify any new high capacity wells that are proposed in the DWSMA so their impact on the public water supply wells can be determined.

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action C-2a	Collaborate with the MDH Source Water Protection Unit in the identification of new high-capacity wells that are proposed for construction within 1.5 miles of the DWSMA. The WHP Manager will alert the MDH Source Water Protection Unit upon learning about the construction or use of a high capacity well in or near the DWSMA. Potential impacts will be evaluated by MDH. On-going as information surfaces and investigated thoroughly every 5 years.	High	WHP Managers® MDH® Itasca Co. © Itasca SWCD ©	Staff Time					X					
Action C-2b	If a high capacity well is identified within the DWSMA the wellhead protection manager will contact the well owner and provide them a map of the DWSMA and discuss the possible impact the high capacity well might have on the City of Bovey's drinking water supply.	High	WHP Managers MDH © Private well owners ©	Staff Time	X	X	X	X	X	X	X	X	X	X

C-3. CLASS V WELLS (SHALLOW DISPOSAL SYSTEM) and Other Unknown Potential Contaminants:

OBJECTIVE C-3: Create awareness among commercial enterprises, local automotive shops, or garages about what a Class V well is and Federal EPA registration, permitting and reporting requirements for Class V Wells. Establish contingency fund for unknown contaminants.

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action C-3a	Send fact sheets (assembled in A-1a above via mail or personal contact) concerning definition and problems with Class V wells to any new business (automobile repair, garages, maintenance building, etc.) within the DWSMA. In the event a Class V well is identified the wellhead manager will work cooperatively with MDH to determine the status of the shallow disposal system and what reporting steps may be needed to register the Class V well with EPA, reporting forms are available at: www.epa.gov/safewater/uic/7520s.html).	HIgh	City Staff ® MDH © EPA ©	Staff Time		X			X			X		
Action C-3b	In the event a Class V well is identified, provide contact information to the landowner on available technical services thru MNTAP to assess management and / or disposal alternatives (MNTAP's web site is: http://www.mntap.umn.edu/). Any actions taken will be summarized and submitted to MDH in 2017.	Low	City Staff ® MDH © MnTAP©	Staff Time								X		
Action C-3c	Within the first two years after Plan adoption contact the present owners of the property where the old train roundhouse existed. There was the possibility of a water tower, a Class V pit or containment and other contamination in the area. Determine resident knowledge of any former cleanup efforts and if any known problems exist today that require addressing for eliminating contaminant migration.	High	City Staff ® Property Owner©	Staff Time	X	X								
Action C-3d	It is always difficult to foresee or plan for the future. If a critical issue or potential contaminant threat becomes an issue in the future, the city will promptly take actions to prevent this contaminant source from polluting their drinking water supply. Contact and work with the appropriate agency to resolve and remediate potential contaminant problems. Apply for MDH grant or other available funding sources in the advent that contaminants, unknown at this time, pose a threat to the public water supply.	High	City Staff ® MDH © MnTAP© EPA © PCA©	Staff Time		X	X	X	X	X	X	X	X	X

C4. TANK MANAGEMENT: Registered Storage Tanks (RST) and Leaky Underground Storage Tanks (LUST) sites.

OBJECTIVE C-4: Create awareness about WHP efforts and activities for any new business owners with above and below ground tanks.

Implementation Action Items															
					Implementation Time Frame										
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action C-4a	Provide information from A1 above to existing and any new business that would require a registered storage tank (RST) describing what the WHPA is and the resulting impact from a major leak. Information on tank monitoring and management is available through the MPCA tank unit. Provide information regarding proper containment areas for above and below-ground tanks, spill response and clean-up. Repeat in 4 years.	High	City Staff ® MPCA© MRWA©	Staff Time			X				X			
Action C-4b	Send a formal letter to MPCA with a map and listing of Active LUST sites requesting that the City of Bovey be informed of any status change at the site and updated once the site is completely closed.	High	Mayor City Staff ® MPCA©	Staff Time	X									
Action C-4c	Within the first three years from Plan adoption, utilize available MDH grant implementation or other competitive funding to aid in the removal of empty UST at the Post Office. It is listed as a LUST site that is closed; however, city staff state that a tank still exists at the site.	High	City Staff ® MDH MPCA©	Staff Time $5000	X	X	X							
Action C-4d	Within the first five years of Plan implementation, contact all property owners listed in Appendix that have tanks and verify what tanks are presently there and which ones remain active. There is some differences between the PCA site and the PCSI generated by MDH and these require resolution.	High	City Staff ® MDH MPCA©	Staff Time	X	X	X	X	X					

C-5. HAZARDOUS WASTE GENERATORS (HWG), VOLUNTARY INVESTIGATIVE CLEANUP (VIC):

OBJECTIVE C-5: Verify amounts of potentially hazardous substance produced and ensure that waste is disposed of properly. Ensure that VIC site is moving forward with the cleanup, what the they are cleaning up and status.

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action C-5a	Send a letter to the two HWG permit holders that have an unknown status requesting verification of the permit status and description of potential contaminant generated as well as amounts. Send a brief explanation of the WHP Plan efforts to reduce the threat to the PWS so they are aware.	High	WHP Managers® Mayor® NRRI © ISD #316 ©	Staff Time					X					
Action C-5b	Request the status of cleanup on the VIC site at NRRI Coleraine Minerals Research. Send a brief explanation of the WHP Plan efforts to reduce the threat to the PWS so they are aware of the City's concern. If VIC is ongoing, request to be updated on a yearly basis.	High	WHP Managers MDH © Private well owners ©	Staff Time			X							

D. TRANSPORATION CORRIDOR & SPILLS:

OBJECTIVE D-1: Create awareness about the WHP area along transportation corridors. Protect the groundwater and public water supply wells from possible contamination from accidental spills along roads and right of ways. Inform local emergency responders about the location of the DWSMA and WHP efforts.

Implementation Action Items														
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action D-1a	Work with the cities of Coleraine and Taconite to purchase and install perimeter signs on major roadways State Hwy 169, County Road 61 and County Road 10 establishing a visual border to the shared DWSMA's.	High	Water Superintendent ® City Staff of cities ©	$250 plus Staff Time		X								
Action D1-b	Through direct correspondence with the County Emergency Manager, Local Fire Department, MPCA, and local first responders alert them to the location of the DWSMA by providing them a map and informing them of City of Bovey's WHP efforts. Request that strong consideration be given to the WHP area when responding to a spill. Contact every two years to ensure continued support.	High	WHP Manager ® Local Fire Dept., ©Co. Emergency Manager©, MPCA Spill Units©	Staff Time	X		X		X		X		X	

E. INNER WELLHEAD MANAGEMENT ZONE ACTIVITIES & OLD MUNICIPAL WELLS:

OBJECTIVE E-1: Effectively manage the IWMZ (200' radius around public water supply well) to reduce the likelihood of contaminants from entering the well at a level to cause human health impacts.

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2018	Update Plan
Action E-1a	Assist MDH staff in completing the IWMZ forms for the public water supply wells every five years.	High	MDH ® City Staff ©	Staff Time					X					X
Action E-1b	City staff will continue to monitor setbacks for any new potential sources of contamination located within the IWMZ.	High	WHP Manager ® City staff ©	Staff Time	X	X	X	X	X	X	X	X	X	X
Action E-1c	City staff will develop wellhead protection measures to address any new potential contaminant sources identified in future IWMZ inventories/surveys.	High	City Staff ®	Staff Time	X	X	X	X	X	X	X	X	X	X
Action E-1d	Implement the WHP Measures identified in the IWMZ Inventory.	High	City Staff ®	Staff Time	X	X	X	X	X	X	X	X	X	X

OBJECTIVE E-2: Work with the MDH to ensure that all old municipal wells are properly sealed.

Implementation Action Items														
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action E-2a	At this time, there appears to not be any old municipal wells. The City of Bovey was reliant upon the City of Coleraine for there public water supply from as far back as records go, up until 1953 when Bovey drilled their own municipal well. If more information comes forth in the future that suggests a location may be identified, the City will work to find the exact location with the help of MDH, and ensure that any sealing or containment is completed.	HIgh	WHP Manager ® MDH ©	Staff Time	X	X	X	X	X	X	X	X	X	X

F. DATA COLLECTION:

OBJECTIVE F-1: Gather additional information from new wells drilled in the area in order to gain further knowledge of the City's aquifer characteristics.

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action F-1a	Every five years, the City of Bovey should work with MDH so that locations of new wells constructed within one mile of the City's well field can be verified and accurate elevations obtained. This information will help address uncertainties related to 1) areal extent, thickness and compositional variability of the City's aquifer and 2) the distribution of hydraulic head in this particular aquifer.	High	WHP Manager ® Itasca SWCD © MDH ©	Staff Time					X					X
Action F-1b	Work with MDH to determine the feasibility of conducting an aquifer test utilizing the observation well that is within close proximity to the City well. If the test is deemed feasible, determine the cost of such test and explore funding to carry out. This will provide a better estimate of aquifer transmissivity.	High	WHP Manager ® MDH ©	Staff Time			X					X		
Action F-1c	Initiate an annual program of water sampling to help validate the ground water model and refine resulting capture zones. MDH will assist with the selection of sampling points and analytical parameters. The City will be responsible for most of the sampling, but the MDH will pay for the analyses using available funds. Apply for grants that would support the collection and analyses to ensure no loss of funding in the future.		WHP Manager ® MDH ©	Staff Time	X	X	X	X	X	X	X	X	X	X
Action F-1d	Contact and collaborate with the MDH Source Water Protection Unit Hydrogeologist when conducting any future pump tests, test drillings, or studies that may benefit WHP efforts and local geologic knowledge. This is continual as new sources of information develop; however, any future projects that may provide additional information should be thoroughly evaluated periodically.	High	WHP Manager ® MDH ©	Staff Time					X					X
Action F-1e	Monitor to determine if a revision of the WHPA or DWSMA may be required. This may be necessary if any of the following occur: 1) the installation of any new high-capacity wells within 1.5 miles of the city well field, or 2) an increased discharge from the city wells over the values used in this report occurs. On-going and evaluated thoroughly in conjunction with strategy C-3a.	High	WHP Manager ® MDH ©	Staff Time					X					X

G. WELLHEAD PROTECTION RECOGNITION & PLANNING:

OBJECTIVE G-1: Identify Wellhead Protection and the delineations completed (WHPA, DWSMA) in future revisions to local landuse and resource planning / documents. Consideration should be given to how future land uses or changes may impact local groundwater resources and the City of Bovey's public water supply

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action G-1a	Request that the City Council review present Ordinances 10-0224, future Ordinances and Planning documents, and include emphasis of the importance of the WHP Plan. Thus, attaining recognition of efforts to protect the City of Bovey's public water supply. Evaluate every 5 years to ensure WHP efforts are taken into consideration in the development of new regulations.	High	WHP Manager ® City Council© Elected Official©	Staff Time	X					X				
Action G-1b	Request that the WHPA and DWSMA be identified in the Itasca County Comprehensive Local Water Management Plan, Itasca County Ordinances: 1) Shoreland Management, 2) Sewage Treatment Systems and 3) Subdivision Controls and in other local landuse planning documents such as comprehensive plans as developed or available. Applicable protection strategies and ways to protect groundwater resources as identified in this plan may also be considered. Evaluate every 5 years to ensure WHP efforts are taken into consideration in the development of new regulations	High	WHP Manager ® Itasca ESO © Itasca SWCD © Water Planner© Elected Official ©	Staff Time					X					

H. EVALUATION AND REPORTING:

OBJECTIVE H-1: Implementation of the WHP Plan requires regular assessment to determine the effectiveness of present management strategies, available funds to conduct the implementation and strategies that may need revision to produce the desired result.

Implementation Action Items															
Action	Description	Priority	Responsible Party ® & Cooperators ©	Cost	Implementation Time Frame									
					2011	2012	2013	2014	2015	2016	2017	2018	2019	Update Plan
Action H-1a	The WHP manager will report to the City Council prior to the budgeting process, conveying the effectiveness of present management strategies and any concerns of funding, revisions or implementation problems with the WHP Plan. Brief the Council on projects for the up coming year and any perceived problems with implementation.	High	WHP Manager ® City Council©	Staff Time	X	X	X	X	X	X	X	X	X	X
Action H-1b	The WHP managers will make an annual written report to the governing authority regarding progress in implementing the wellhead protection management objectives of this Plan. The annual reports will be compiled and used to review the overall progress in implementing source management strategies when the City's wellhead protection plan is updated in 10 years. A copy of the report will be sent to the Minnesota Department of Health Source Water Protection Unit in St. Paul and another copy will be placed in the City's Wellhead Protection file.	High	WHP Manager ® MDH SWPU©	Staff Time	X	X	X	X	X	X	X	X	X	X
Action H-1c	Due to overlapping and encompassed DWSMA's, City Staff from Bovey and Coleraine will cooperatively conduct a self-assessment of their Plans, including effectiveness of the management strategies, progress of implementation and any new concerns or problems every quarter (2.5 years) that the Plans are in effect. The assessment meeting will be documented by each respective city's WHP Manager and included in their WHP Plan file to be utilized by MDH in their periodic overall assessment of the WHP Plan implementation.	High	City Staff ® MDH ©	Staff Time			December			June		December		

CHAPTER SIX
EVALUATION PROGRAM (4720.5270)

The success of the wellhead protection management program must be evaluated in order to determine whether the plan is actually accomplishing what the City of Bovey set out to do. The activities listed 1-5 below will be implemented in order to:

- Track the implementation of the objectives identified in Chapter 5 of this Plan;
- Determine the effectiveness of specific management strategies regarding the protection of the public water supply;
- Identify possible changes to these strategies which may improve their effectiveness; and
- Determine the adequacy of financial resources and staff availability to carry out the management strategies planned for the coming year.

1) The City will continue to cooperate with MDH in the annual monitoring of the water supply to determine whether the management strategies are having a positive effect and to identify water quality problems that may arise.
2) City staff, the governing authority, and the WHP manager will travel through the drinking water supply management area on a regular basis to identify any changes in land use or potential contaminant source management practices that may adversely impact the public water supply.
3) The City staff will meet on an as-needed basis, with a minimum of one annual meeting, to review the results of each strategy implemented during the previous plan year, identify and discuss whether modifications are needed for those strategies, and additional strategies for the coming year.
4) The City staff will conduct a self-assessment of the WHP Plan Implementation process quarterly (every 2.5 years the Plan is in effect), document the assessment and include it in the WHP Plan file.
5) The wellhead protection plan manager will make an annual written report to the governing authority regarding progress in implementing the wellhead protection management objectives of this Plan. The annual reports will be compiled and used to review the overall progress in implementing source management strategies when the City's wellhead protection plan is updated in 10 years. A copy of the report will be sent to the Minnesota Department of Health Source Water Protection Unit in St. Paul and another copy will be placed in the City's Wellhead Protection file.

CHAPTER SEVEN

WATER SUPPLY CONTINGENCY PLAN (4720.5280)

WATER SUPPLY CONTINGENCY PLAN
City of Bovey

Table of Contents

Annual Plan Review

Date Reviewed	*Reviewer*	*Comments*

Plan Distribution

Person	*Organization*	*Plan Location*
Kevin Odden	Water Superintendent	City Hall / Water Plant

Prepared By: _____

Date Approved: _____

A. PURPOSE

The purpose of this Contingency Plan is to establish, provide and keep updated, certain emergency response procedures and information for the City of Bovey that may become vital in the event of a partial or total loss of public water supply services.

B. PUBLIC WATER SUPPLY CHARACTERISTICS

1. Current Supply Source - The City obtains their water supply from one municipal well. Well 1 is cased to a depth of 97 feet. Additional information concerning the public water supply is described below.

	Well Number 1
Unique Well #	228834
Supply Source	Sand / Gravel
Well Depth (ft.)	97
Well Diameter (in.)	16
Well Capacity (gpm)	450

2. Treatment - The City of Bovey uses fluoride and gravity sand filtration for iron and manganese removal at the Water Treatment Plant.

3. Storage and Distribution - The City has one elevated tower with a capacity of 125,000 gallons. The majority of the water distribution system is looped, with no dead ends. The water system contains all other necessary valving and piping with all connections metered.

4. Maps/Plans - Maps of the water distribution, sanitary sewer, stormwater systems and valving are in the process of being updated. Only hand drawn maps located at City Hall are presently available for the new additions. Once updated, printouts will be added to the Plans folder.

C. PRIORITY OF WATER USERS DURING WATER SUPPLY EMERGENCY

Table C-1 - Water Use Priority Grouping

Priority Group and Rank	Maximum Daily Use (gpd)	Minimum Daily Use (gpd)
Residential--#1	92,000	63,000 With schools operating
Institutional--#2	3,000	1,500
Commercial--#3	4,000	2,000

Triggers for implementing water supply reduction/allocation procedures:

- Water exceeds State Safe Drinking Water Standards
- Water demand increase or treatment / storage capacity reduction
- Main system break or production loss

In the event of a major system disruption, failure or an emergency, conservation procedures will be enacted by the Water Superintendent.

D. ALTERNATIVE WATER SUPPLY OPTIONS

1. Surface water sources and treatment needs: Canisteo Mine Pit and Trout Lake are a possible sources of surface water. Volume is dependent upon available pump and treatment capacity.

The Minnesota National Guard may be able to provide emergency treatment of surface water for human consumption. In the event of a significant water disruption emergency such as a catastrophic event, the following procedure is recommended:

- Contact the County Sheriff (218) 327-7470 or 911 to request assistance from the Minnesota National Guard.
- Sheriff will contact the Minnesota National Guard, Division of Emergency Management, State Duty Officer (800) 422-0798; and Community Support Group at (651) 282-4013 to request assistance for the City of Bovey.
- The Minnesota National Guard can provide a portable Reverse Osmosis Water Purification System (ROWPU) capable of supplying 900 gph or 15 gpm.

2. Bottled water supplies, delivery and distribution. Large quantities of bottled water or distributors in the Bovey area include:

Culligan Water Conditioning in Grand Rapids, MN	218-326-9060
Ecowater in Grand Rapids, MN	218-327-1144
Rapids Beverage in Grand Rapids, MN	218-326-8369

3. System interconnects with other water supplies. The City of Bovey currently has one interconnect with the City of Coleraine that could supply up to 360,000 gallons per day in an emergency.

4. New well. No new wells are planned at this time.

5. Emergency or backup wells. The City of Bovey is supplied by one main well (Well 1) and no emergency backup wells. The interconnect with Coleraine is used in emergencies.

6. Emergency treatment of water system. The City does not presently have a backup generator for use during a power failure. Coleraine does and can feed the City of Bovey via the interconnect.

7. Source Management (blending). The City has only one municipal well.

E. INVENTORY OF AVAILABLE EMERGENCY EQUIPMENT AND MATERIALS

Table E-1 contains a list of services, equipment and supplies that are available to the City of Bovey to respond to a disruption in the water system. It is believed that the items contained in Table E-1 would be adequate to respond to most (if not all) water system emergencies.

Table E-1 Emergency Equipment & Materials Contacts

Description	Owner	Telephone	Location	Acquisition Time
Well Repair	Thein Well	800-850-8000	Spicer, MN	6 hours
Pump Repair	Motor Shop	218-326-4091	Grand Rapids, MN	½ hour
Electrician	Terry Burke	218-245-1930	Bovey, MN	½ hour
Plumber	Heisel Brothers	218-741-8381	Virginia, MN	½ hour
Backhoe / Excavator	Casper Construction	218-326-9637	Grand Rapids, MN	1 hour
Chemical Feed	Hawkins Chem.	715-392-5121	Superior, WI	1 hour
Meter Repair	Servocal Instruments	888-390-7919	Shakopee, MN	3 hours

Generator	None	Presently	Available	
Valves	Vessco Inc.	800-722-7868	Eden Prairie, MN	5 hours
Pipe & Fittings	Heisel Brothers	218-741-8381	Virginia, MN	½ hour

F. EMERGENCY IDENTIFICATION PROCEDURES

Table F-1 Procedural Operations

Incident	Response Procedure and Comments
Identify Disruption	Person identifying disruption contacts Water Superintendent
Notify Response Coordinator	Water Superintendent notifies Emergency Management Officer or Alternate
Identify Incident Direction and Control	Water Superintendent and Emergency Management Officer or Alternate assesses situation and determine incident direction and control, begin solving problem
Identify Internal Communication	Water Superintendent contacts City Hall and / or City Clerk to inform of situation
Inform Public	Public relations personnel contacts appropriate organizations to inform public of problem
Assess Incident on Continual Basis	Water Superintendent or Alternate continues to monitor/solve problem
Assess Contamination Disruption	Water Superintendent or Alternate and MDH determines if water supply is contaminated. Monitor/solve problem as needed
Assess Mechanical Disruption	Water Superintendent or Alternate assesses mechanical disruption. Monitor and solve disruption as needed.
Provide Alternate Water Supply	If needed, alternate water supply is located and provided
Impose Water Use Restrictions	If needed, Water Superintendent, City Clerk and/or Mayor may impose water use restrictions.

G. NOTIFICATION PROCEDURES

1. Agency Notification

Table G-1 contains the names and telephone numbers for contacts at various local and state agencies that may be notified in the event of a public water supply system emergency. Based on the nature of the emergency and the information available, various representatives from this listing will be selected by the response coordinator to be part of the ***emergency oversight committee,*** which will then meet throughout the duration of the emergency to aid in decision-making and positive outcomes.

Table G-1. Agency Emergency Contact Listing

Personnel	Name	Home Telephone	Work Telephone
Public Works Foreman	Kevin Odden	218-245-1555	218-245-2572
Mayor/Board Chair	Deborah Trboyevich	218-245-1955	218-326-1247
Council Members	Robert Tok	218-245-3402	
Council Members	Stacy Grosse	218-259-6756	
Council Members	Harriet Pavlica	218-245-2016	
Council Members	Robert Stein	218-245-1633	
Emergency Management Officer	Kris Christians	218-256-9133	
Alt. Emerg. Mgmt Off.	Dan Dotlich	218-245-2588	
State Incident Duty Officer	MN Duty Officer		800-422-0798
Fire Chief	Dan Dotlich	218-245-2588	
Sheriff	Vic Williams		911
Police Chief	Bill Hollom	218-326-3053	218-245-2590
Water Superintendent	Kevin Odden	218-245-1555	218-245-2572
Water Operator	Kevin Odden	218-245-1555	218-245-2572
School Superintendent	Mark Adams		218-245-1566
Ambulance	Meds 1		911
Hospital	Grand Itasca Hospital		218-326-3401
Doctor or Medical Facility	Grand Itasca Clinic		218-326-5000
Power Company	Minnesota Power		800-307-6937
Highway Department	Itasca Co. Highway Dept.		218-327-2853
Telephone Company	Qwest		800-223-7508
Neighboring Water System	City of Coleraine		218-245-2112
MRWA Technical Advisor	Aaron Meyer		320-808-7293
MRWA Technical Services	Mike Roers		320-760-5886
MRWA Circuit Rider Contact	Mike Roers		320-760-5886
MDH District Engineer	Mike Luhrsen		218-723-4642
MDH Source Water Protection	Beth Kluthe		218-308-2115

2. Critical Response Personnel

Table G-2 Critical Response Personnel

Title	Name	Response Assignment
Emergency Management Officer (EMO)	Kris Christians	Coordinate actions to address emergency
Alternate EMO	Dan Dotlich	Coordinate actions to address emergency
Water Operator	Kevin Odden	Direct or contact firms to resolve issue
Alternate Water Operator	Brian McCartney	Direct or contact firms to resolve issue
Public Relations	Bev Dahlgren	Contact media to inform citizens/businesses of emergency
Alternate Public Relations	Vern Hawkinson	Contact media to inform citizens/businesses of emergency
Public Health/Medical	City Fire Dept., Meds One Ambulance Service, City Police Dept. & Itasca Co Sheriff's Dept., Grand Itasca Clinic & Hospital	Assist City as needed to address emergency
Alternate Public Health/Medical	Same as above.	Assist City as needed to address emergency

3. Public Information Plan
   a) Public relations center and primary spokesperson:

Name: Bev Dahlgren
Title: City Clerk
Address: City Hall
Phone: 218-245-1633

Public information center location during an emergency is: Bovey City Hall

Times the center is available are: Regular business hours and open as needed in the event of an emergency.

Alternate Information Center Location Site: The Bovey Fire Hall 502 2nd Street will be used as an alternate meeting site.

   b) Information checklist to be conveyed to the public and media:
      - Name of water system:
      - Contaminant of concern and date:
      - Source of contamination:
      - Public health hazard:
      - Steps the public can take:
      - Steps the water system is taking:
      - Other information:

   c) Media contacts

Media	Name	Telephone	Location
Newspaper	Scenic Range News Forum	218-245-1422	314 2nd St. Bovey, MN
Television	WDIO TV	218-727-6864	10 Observation Rd Duluth MN
Radio	KOZY Radio	218-999-5669	507 11th St. Grand Rapids MN

H. MITIGATION AND CONSERVATION PLAN

1. Mitigation

   a. Infrastructure maintenance/upgrades/maps:

      The City water system is flushed two times per year. No new water lines were installed within the last year. Current infrastructure maps are available at City Hall.

   b. Regular inspection of tower, well(s), pump house:

      All of these items are inspected daily. The well house and chemical rooms have keyed entries and are locked. The water tower and ground storage unit are inspected and cleaned by Maguire Iron, every 3 years.

   c. Staff emergency training:

      Staff receive training through Minnesota Rural Water Association.

   d. System security analysis:

All facilities are locked and have keyed entries.

e. Site new backup well(s):

The City of Bovey has no backup well and none are being planned.

f. System valving to isolate problems:

The water system is adequately valved to isolate problems.

g. Sanitation procedures for construction/repairs:

All disinfecting procedures are performed per State specifications.

2. Conservation

a. Water meters:
No meters are installed.

b. Public education:
The City publishes the Consumer Confidence Report in the Scenic Range News Forum and a copy is available at City Hall.

c. Rate structure:

ADOPTED ON MARCH 24, 2010

REGULAR MONTHLY RATES

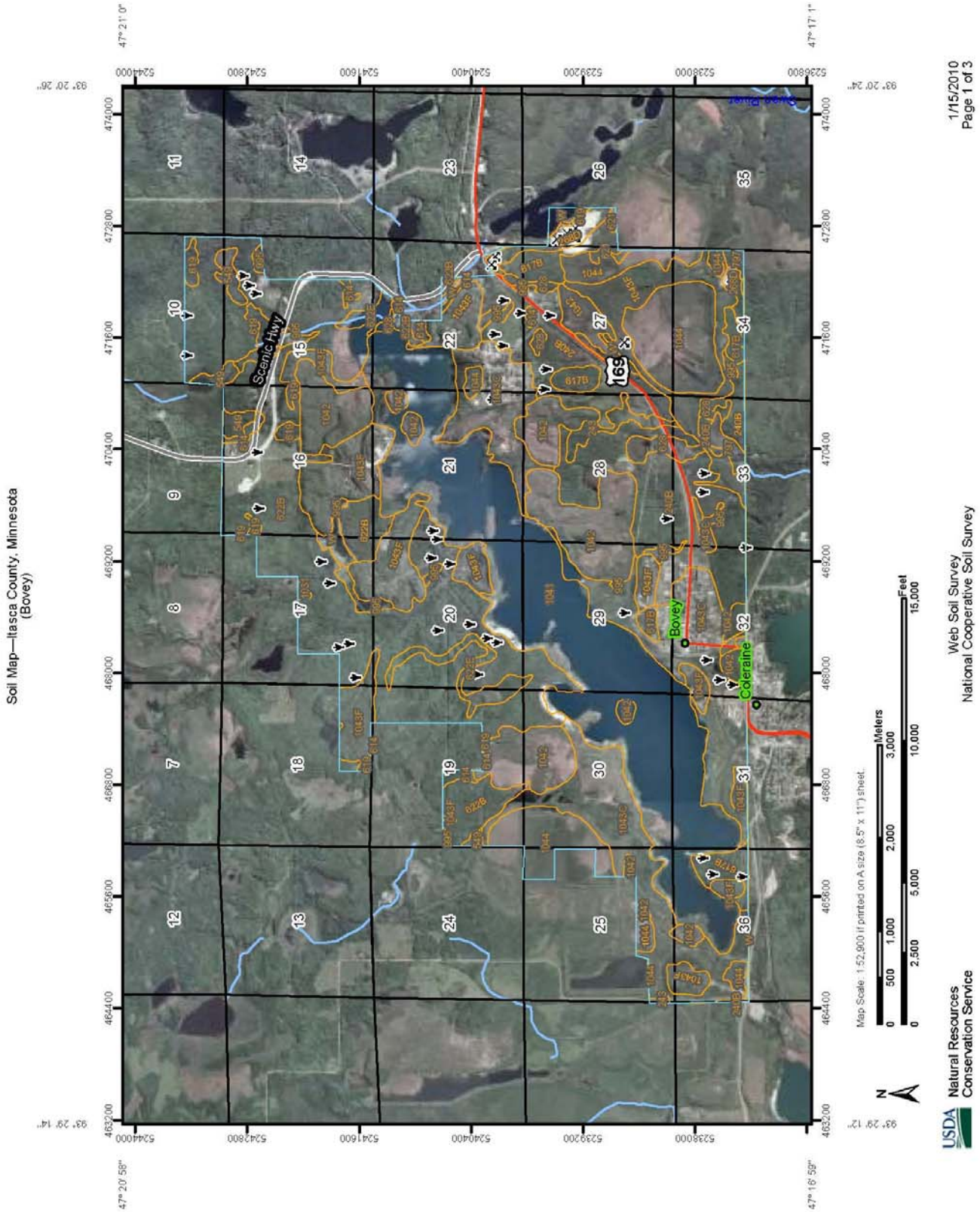
WATER RATE	$29.00
WASTEWATER TREATMENT	$38.50
GARBAGE	$19.13
STREET LIGHTS	$5.50
SOLID WASTE TAX	$1.87

ADDITIONAL FEE'S

WATER CONNECTION FEE	$25.00
WATER DISCONNECT FEE	$25.00
SEWER VARIANCE FEE/MONTH	$2.00
SEWER SURCHARGE FEE/MONTH	$100.00
SEWER COMPLIANCE CERTIFICATE FEE	$25.00
PU ACCOUNT DELINQUENCY FEE/MONTH	$5.00

APPENDIX

EXHIBIT 1: Soils for City of Bovey DWSMA from USDA website



Map Unit Legend

Itasca County, Minnesota (MN061)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
240B	Warba fine sandy loam, 1 to 8 percent slopes	819.6	10.0%
243	Stuntz very fine sandy loam	52.1	0.6%
268D	Cromwell fine sandy loam, 10 to 25 percent slopes	74.9	0.9%
549	Greenwood peat	66.8	0.8%
614	Blackhoof muck	52.5	0.6%
617B	Goodland silt loam, 1 to 10 percent slopes	191.3	2.3%
619	Keewatin silt loam	82.8	1.0%
621	Morph very fine sandy loam	13.5	0.2%
622B	Nashwauk fine sandy loam, 1 to 10 percent slopes	1,763.3	21.4%
622E	Nashwauk fine sandy loam, 12 to 35 percent slopes	98.4	1.2%
628	Talmoon silt loam	81.7	1.0%
797	Mooselake and Lupton mucky peats	36.6	0.4%
995	Borosaprists, depressional	82.1	1.0%
1031	Histosols, ponded	4.2	0.1%
1041	Pits, mine	1,558.9	19.0%
1042	Dumps, mine	748.5	9.1%
1043C	Udorthents, nearly level to rolling	1,039.8	12.6%
1043F	Udorthents, very steep	885.9	10.8%
1044	Slickens	512.1	6.2%
W	Water	62.0	0.8%
Totals for Area of Interest		**8,225.3**	**100.0%**

Exhibit 1.1: From: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed [1/16/2010]

EXHIBIT 2: City of Bovey Existing and Proposed Zoning

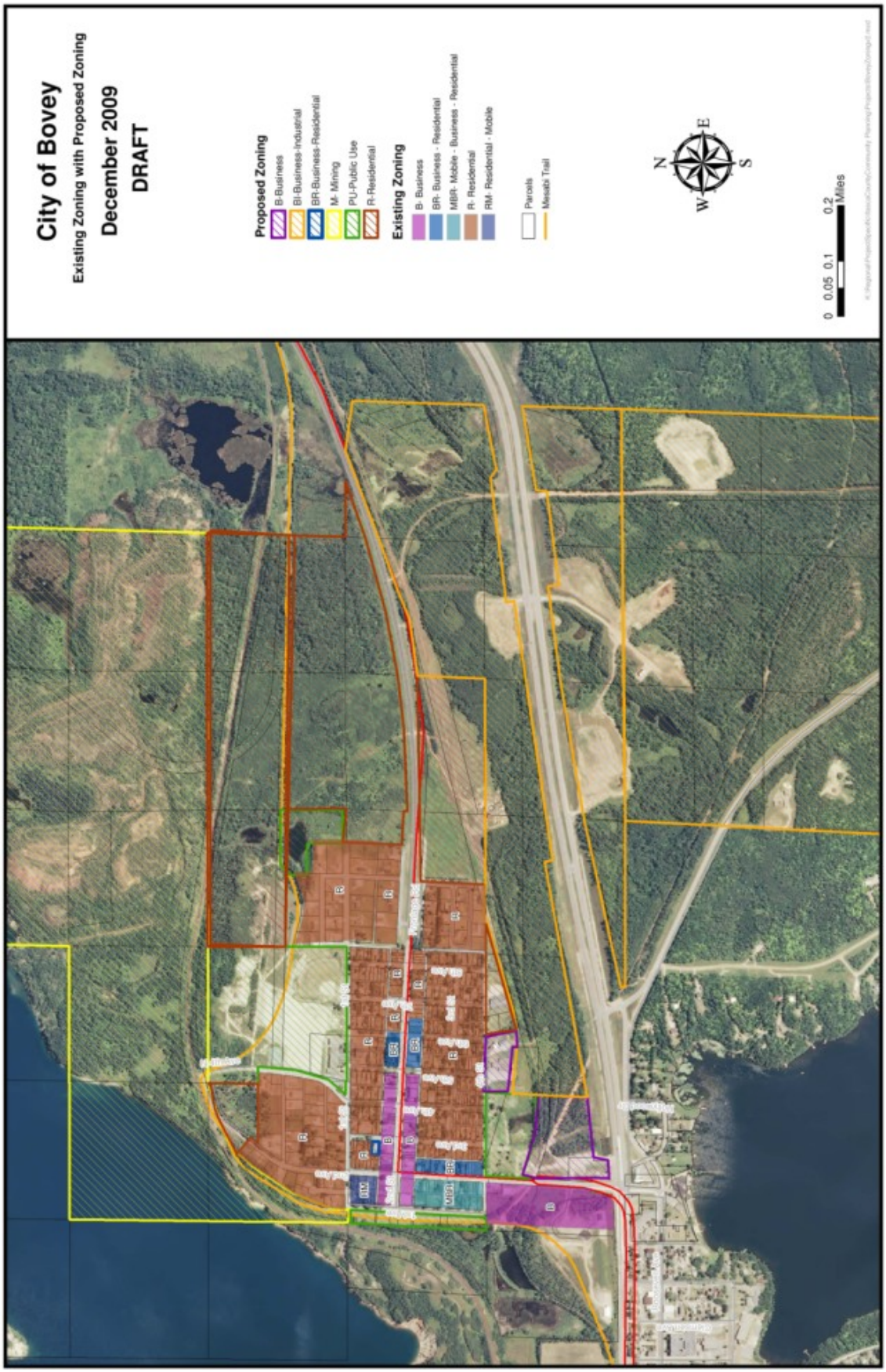


EXHIBIT 3: Landuse Map and Table

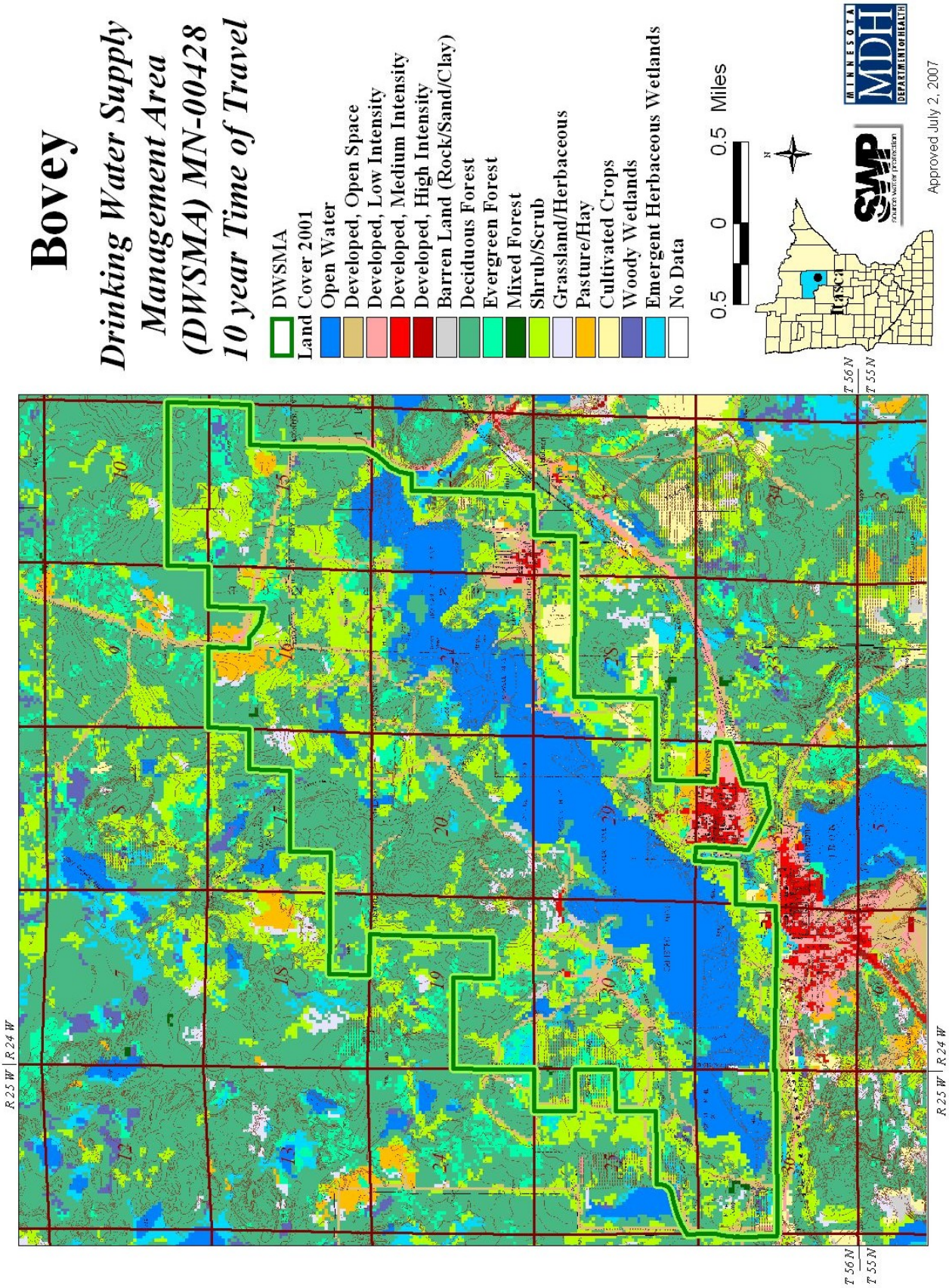


Exhibit 3.1: Landuse Statistics Table

Bovey DWSMA (MN-00428) 2001 Land Cover Statistics

LAND COVER	ACRES	PERCENT	YEAR
Open Water	1,391.26	22.41	2001
Developed, Open Space	351.65	5.66	2001
Developed, Low Intensity	98.16	1.58	2001
Developed, Medium Intensity	61.88	1.00	2001
Developed, High Intensity	7.79	0.13	2001
Barren Land (Rock/Sand/Clay)	11.80	0.19	2001
Deciduous Forest	2,313.81	37.27	2001
Evergreen Forest	297.57	4.79	2001
Mixed Forest	5.12	0.08	2001
Shrub/Scrub	1,298.67	20.92	2001
Grassland/Herbaceous	74.56	1.20	2001
Pasture/Hay	83.90	1.35	2001
Cultivated Crops	60.54	0.98	2001
Woody Wetlands	34.50	0.56	2001
Emergent Herbaceous Wetlands	117.29	1.89	2001
Total	6,208.49	100.00	2001

These statistics are geographically derived from the 2001 National Land Use/Land Cover dataset. They may not reflect current conditions and are only an approximation of land cover.

Exhibit 4: Bovey PCSI Map of entire DWSMA

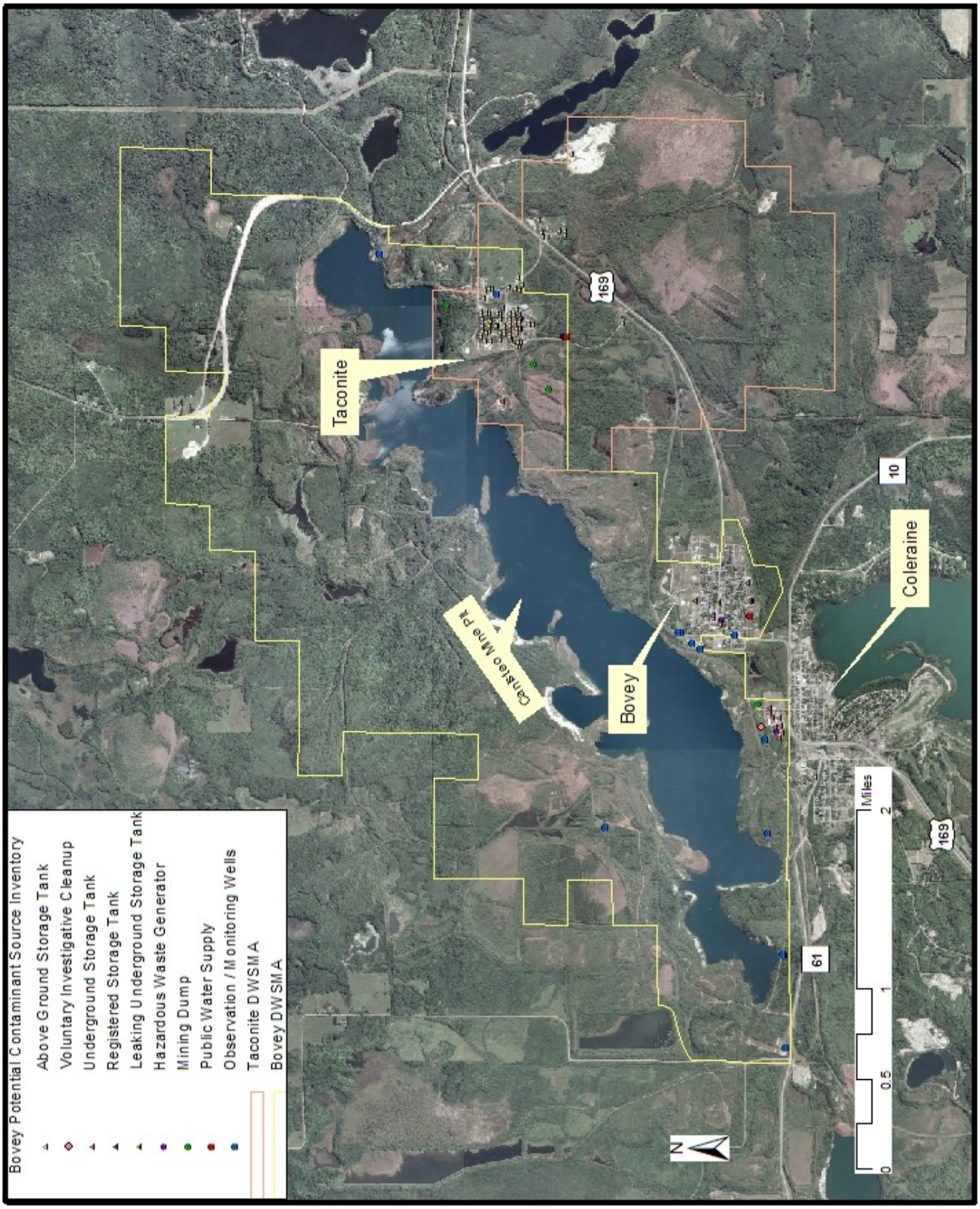


Exhibit 4.1: Bovey Area Responsibility for PCSI in Bovey DWSMA

Exhibit 4.2: Taconite Area Responsibility for PCSI in Bovey DWSMA

EXHIBIT 4.3: Potential Contaminent Source Inventory (PCSI) Tables

Revised Oct. 29, 2014

Leaking Underground Storage Tanks (LUST)

MDH ID	PCA ID	Name	Address	Status	Comments
27838	12701	Bob's Country Market	100 2nd Street	Removed	Property owner verified that tanks were removed
30972		Bovey Post Office	500 2nd Street	Removed	Underground Radar verified no tank exists.
60354	71	Bovey Spur (Holiday #570)	2nd St. & 4th Ave.	Inactive	Tanks in place. Property owned by Itasca County.
43997	15150	Connor Jasper Middle School	108 6th Ave.	Inactive	School is closed. Owned by private developer. Tank never did leak. Leak was from piping in the boiler room and fuel oil went down floor drain into sewer. Unknown if UST is still in
30974	10309	R.M. Townhouses (Itasca Oil Co.)	201 3rd Ave.	Removed	Tanks were removed during construction of townhomes.
92213	4940	ISD #316 Bus Garage	401 5th Ave.	Removed	ISD #316 staff verified tank was removed.
10128	17803	Dixon Football Field	Gayley Ave. & Hwy 169 Coleraine	Removed	ISD #316 staff verified tank was removed.
60399	3102	NRRI Minerals	1 Gayley Ave. Coleraine	Removed	Company staff verified tank was removed.
14418	4321	Taconite City Garage	34 Hodgins Ave. Taconite	Removed	Taconite City staff verified that tank was removed.

Registered Storage Tanks (RST) and Underground Storage Tanks (UST)

MDH ID	PCA ID	Name	Address	Status	Comments
14518	15398	Taconite Community Bldg	26 Haynes St So	Inactive	Scheduled for removal in 2015
43997	10562	Connor Jasper Middle School	108 6th Ave	Inactive	Unknown if UST still in place.
10128	10557	Dixon Football Field	Gayley Ave & Hwy 169	Removed	ISD #316 staff verified tank was removed.
10131	10560	Mount Olive Lutheran Church	620 4th St	Inactive	Unknown if UST still in place.
10142	10571	NRRI Laboratory	1 Gayley Ave	Removed	Company staff verified tanks were removed.
7509		Rhude & Fryberger Inc.	605 W 37th St Hibbing	Removed	Taconite City staff verified tanks were removed.
30974	19259	Robert Miller Townhouses	201 3rd Ave	Removed	Tanks were removed during construction of townhomes.
14418	15292	Taconite City Garage	34 Hodgins Ave Taconite	Removed	Taconite City staff verified tanks were removed.
60354	11280	Bovey Spur	2nd St & 4th Ave	Inactive	Ownership is with Itasca County. UST's in place.
1047308		Eric Troumbly	71 Hodgins Ave Taconite	Inactive	Tank is still in place.
1044042		Iron Range Township		Removed	Taconite City staff verified tanks were removed.
		Joe Camilli (Trailer Lot)	20 Nelson St S Taconite	Inactive	Unknown if UST is in place.
	10564 *	Spartan Transportation	401 5th Ave	Active	1-10K diesel & 1-1K gas UST's are in use.

* PCA ID for this location in this table was listed as 13902 which is the Itasca County Dist #3 garage which is located 20 miles north of Bovey. PCA location for Spartan Transportation has been updated with the proper number.

EXHIBIT 4.3: Potential Contaminant Source Inventory (PCSI) Tables

Leaking Underground Storage Tanks (LUST)

MDH ID	PCA ID	Name	Address	Status	Comments
27838	12701	Bob's County Market	100 2nd Street	XC	
30972		Bovey Post Office	500 2nd Street	XC	Closed, tank in place
60354	71	Bovey Spur (Holiday #570)	2nd St & 4th Ave	Active	PCA site shows XC 9-26-08
43997	15150	Connor-Jasper Middle School	108 6th Ave	Unk	Fuel oil went down drain into sewer system
30974	10309	R.M. Townhouse(Itasca Oil Co.)	201 3rd Ave	Active	
92213	4940	ISD #316 Bus Garage	401 5th Ave	XC	
10128	17803	Dixon Football Field	Gayley Ave & Hwy 169	Unk	
60399	3102	NRRI Minerals	1 Gayley Ave	Active	
14418	4321	Taconite City Garage	34 Hodgins Ave	Active	

XC- Conditionally Closed, Unk- Unknown

Registered Storage Tanks (RST) Underground Storage Tanks (UST)

MDH ID	PCA ID	Name	Address	Status	Comments
14518	15398	Taconite Community Bldg	26 Haynes St So	Active	1-7K Fuel oil tank
43997	10562	ConnerJasper Middle School	108 6th Ave	Active	1-10K Fuel oil tank
10128	10557	Dixon Football Field	Gayley Ave/Hwy 169	Removed	1.5K UST Fuel oil removed
10131	10560	Mount Olive Lutheran Church	620 4th St	Active	1-10K Fuel oil
10142	10571	NRRI Laboratory	1 Gayley Ave	Active	(1-10Kgas,2-10K 1-12K 1-1K fuel oil, & 1K / 500gal other) All Removed
7509		Rhunde & Fryberger Inc	605 W 37thSt Hibbing	Unkown	2-10K & 3-1K All Removed
30974	19259	Robert Miller Townhouse	201 3rd Ave Bovey	Unknown	** PCA states (formerly Itasca Oil, All removed)
14418	15292	Taconite City Garage	34 Hodgins Ave	Unknown	** PCA states(500 gal gas UST, removed)
60354	11280	Bovey Spur	2nd St & 4th Ave	Active	2-10K&2-4K Removed, 1-550 gal fuel oil Active
1047308		Eric Troumbly	71 Hodgins Ave Tac.	Active	265 gal private fuel oil storage tank
1044042		Iron Range Twp		Active	1-1K gas & 2 fuel oil, all UST and Active
		Joe Camilli (Trailer Lot)	20 Nelson St S Tacon	Inactive	Gasoline
*	13902	Spartan Transportation (formerly ISD # 316 Bus Garage)	401 5th Ave	Active	City staff confirmed 1-10K diesel & 1-1K gas Active

***** City staff verified after PCSI was finalized by MDH, update when Plan is updated.

****** PCA site differs from finalized PCSI from MDH. Part of implementation is to verify tanks and include in update.

Wells within DWSMA (A-Active, U-Unknown)

Bovey 1	PWS		Bovey	55709	31 WEL	A
Bovey, City Of	Unclassified	Observation well	Bovey	55709	31 WEL	A
City Of Bovey	Unclassified	Observation well	Bovey	55709	31 WEL	A
City Of Bovey	Unclassified	Observation well	Bovey	55709	31 WEL	A
City Of Bovey	Unclassified	Observation well	Bovey	55709	31 WEL	A
City Of Bovey	Unclassified	Observation well	Bovey	55709	31 WEL	A
Dnr	Unclassified		Bovey	55786	31 WEL	A
DNR Monitoring Well	Institution		Bovey	55709	31 WEL	U
DNR Monitoring Well	Unclassified		Grand Rapids	55744	31 WEL	A
DNR Monitoring Well	Unclassified		Grand Rapids	55744	31 WEL	U
DNR Monitoring Well	Institution		Bovey	55709	31 WEL	U
DNR Observation Well	Institution	Observation well	Taconite	55786	31 WEL	A
DNR Observation Well	Unclassified	Observation well	Taconite	55786	31 WEL	A
DNR Observation Well	Unclassified	Observation well	Taconite	55786	31 WEL	A
Itasca Company	Unclassified	Monitoring well	Bovey	55709	31 WEL	A
Mining Exploration Bore Hole	Unclassified		Bovey	55709	31 WEL	U
Mw-1	Unclassified		Bovey	55709	31 WEL	U
Taconite No 1	PWS		Taconite	55786	31 WEL	A
Taconite No.2	PWS		Taconite	55786	31 WEL	A
	Unclassified		Grand Rapids	55744	31 WEL	U

Miscellaneous Potential Contaminants

Connor-Jasper Middle School	Institution	108 6th Av	Bovey	55709	31 ARP	U
Taconite I Dump	Dump	SW portion of Taconite	Taconite	55786	31 DMP	U
Taconite II Dump	Dump	West of Taconite	Taconite	55786	31 DMP	U
Taconite III Dump	Dump	In Taconite	Taconite	55786	31 DMP	U
Us Steel Dump II	Unclassified	.5 mile NE of Coleraine	Coleraine	55722	31 DMP	U
Bovey City Hall	Institution	402 2nd St.	Bovey	55709	31 HSTS	
Good Time Pizza	Food services	314 2nd St	Bovey	55709	31 HWGP	I
Good Time Pizza	Food services	314 2nd St	Bovey	55709	31 HWGP	I
NRRI Lab	Unclassified	One Gayley Ave	Coleraine	55722	31 HWGP	U
ISD # 316 Bus Garage	Institution	401 5th Ave	Bovey	55709	31 HWGP	U
NRRI Lab	Unclassified	1 Gayley Avenue	Coleraine	55722	31 NFRAP	U
Bovey WTP	PWS	Po Box 399	Bovey	55709	31 NPDES	U
NRRI Lab	Unclassified	One Gayley Ave.	Coleraine	55722	31 NPDES	A
NRRI Lab	Unclassified	1 Gayley Avenue	Coleraine	55722	31 VIC	U

ARP- Air Release Permit, DMP- Dump Site, HSTS- Historical Site, HWGP- Hazardous Waste Generator Permit, NFRAP- No further remedial action planned, NPDES- National Pollutant Discharge Elimination System, VIC- Voluntary Investigative Cleanup. U-Unknown, I-Inactive, A-Active

Exhibit 5: IWMZ Forms and Management Strategies

MINNESOTA MDH DEPARTMENT of HEALTH

Environmental Health Division
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) - POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1310003	**COMMUNITY**
NAME	Bovey	
ADDRESS	Bovey Water Superintendent, P.O. Box 399, Bovey, MN 557090399	

FACILITY (WELL) INFORMATION

NAME	Well #1	**IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?**
FACILITY ID	S01	☐ YES (Please attach a copy)
UNIQUE WELL NO.	228834	☐ NO ☐ UNDETERMINED
COUNTY	Itasca	

PWS ID / FACILITY ID	1310003 S01	**UNIQUE WELL NO.**	228834

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
Agricultural Related							
*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well[2] (Class V well - illegal[3])	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		
SSTS Related							
AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well)[2]	50/300/150[4]	50/300/150[4]	100/600/300[4]	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		N		
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal)[2]	75	75	150	N		

3/22/2010 1

PWS ID / FACILITY ID	1310003 S01	UNIQUE WELL NO.	228834

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
MVW	Motor vehicle waste disposal (Class V well - illegal)[2]	illegal	illegal		N		
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		N		
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	125	Y
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		
Land Application							
SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
Solid Waste Related							
COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		
Storm Water Related							
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well[2] (Class V well - illegal[3])	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		
Wells and Borings							
*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		N		
UUW	Unused, unsealed well or boring	50	50		N		
General							
*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		N		
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well)[2]	illegal[3]	illegal[3]		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		
OH1	Ordinary high water level of a stream, river, pond, lake, reservoir, or drainage ditch (holds water six months or more)	50	35		N		

PWS ID / FACILITY ID	1310003 S01	UNIQUE WELL NO.	228834

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
*PP1	Petroleum buried piping	50	50		N		
*PP2	Petroleum or crude oil pipeline to a refinery or distribution center	100	100		N		
PT1	Petroleum tank or container, 1100 gal. or more, without safeguards	150	150		N		
PT2	Petroleum tank or container, 1100 gal. or more, with safeguards	100	100		N		
PT3	Petroleum tank or container, buried, between 56 and 1100 gal.	50	50		N		
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		Y	185	Y
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		Y	195	Y
PU1	Pit or unfilled space more than four feet in depth	20	20		N		
PC1	Pollutant or contaminant that may drain into the soil	50	50	100	N		
SP1	Swimming pool, in-ground	20	20		N		
*VH1	Vertical heat exchanger, horizontal piping conforming to rule	50	10		N		
*VH2	Vertical heat exchanger (vertical) piping, conforming to rule	50	35		N		
*WR1	Wastewater rapid infiltration basin, municipal or industrial	300	300	600	N		
*WA1	Wastewater spray irrigation area, municipal or industrial	150	150	300	N		
*WS1	Wastewater stabilization pond, industrial	150	150	300	N		
*WS2	Wastewater stabilization pond, municipal, 500 or more gal./acre/day of leakage	300	300	600	N		
*WS3	Wastewater stabilization pond, municipal, less than 500 gal./acre/day of leakage	150	150	300	N		
*WT1	Wastewater treatment unit tanks, vessels and components (Package plant)	100	100		N		
*WT2	Water treatment backwash disposal area	50	50	100	Y	155	Y
Additional Sources (If there is more than one source listed above, please indicate here).							
Potential Contamination Sources and Codes Based on Previous Versions of this Form							
	none found within 200' of this well.						

* New potential contaminant source.

[1] A sensitive well has less than 50 feet of watertight casing, and which is not cased below a confining layer or confining materials of at least 10' in thickness.

[2] These sources, known as Class V underground injection wells, are regulated by the federal U.S. Environmental Protection Agency.

[3] These sources are classified as illegal by Minnesota Rules, Chapter 4725.

[4] Isolation distance is determined by average flow per day or if a facility handles infectious or pathological wastes.

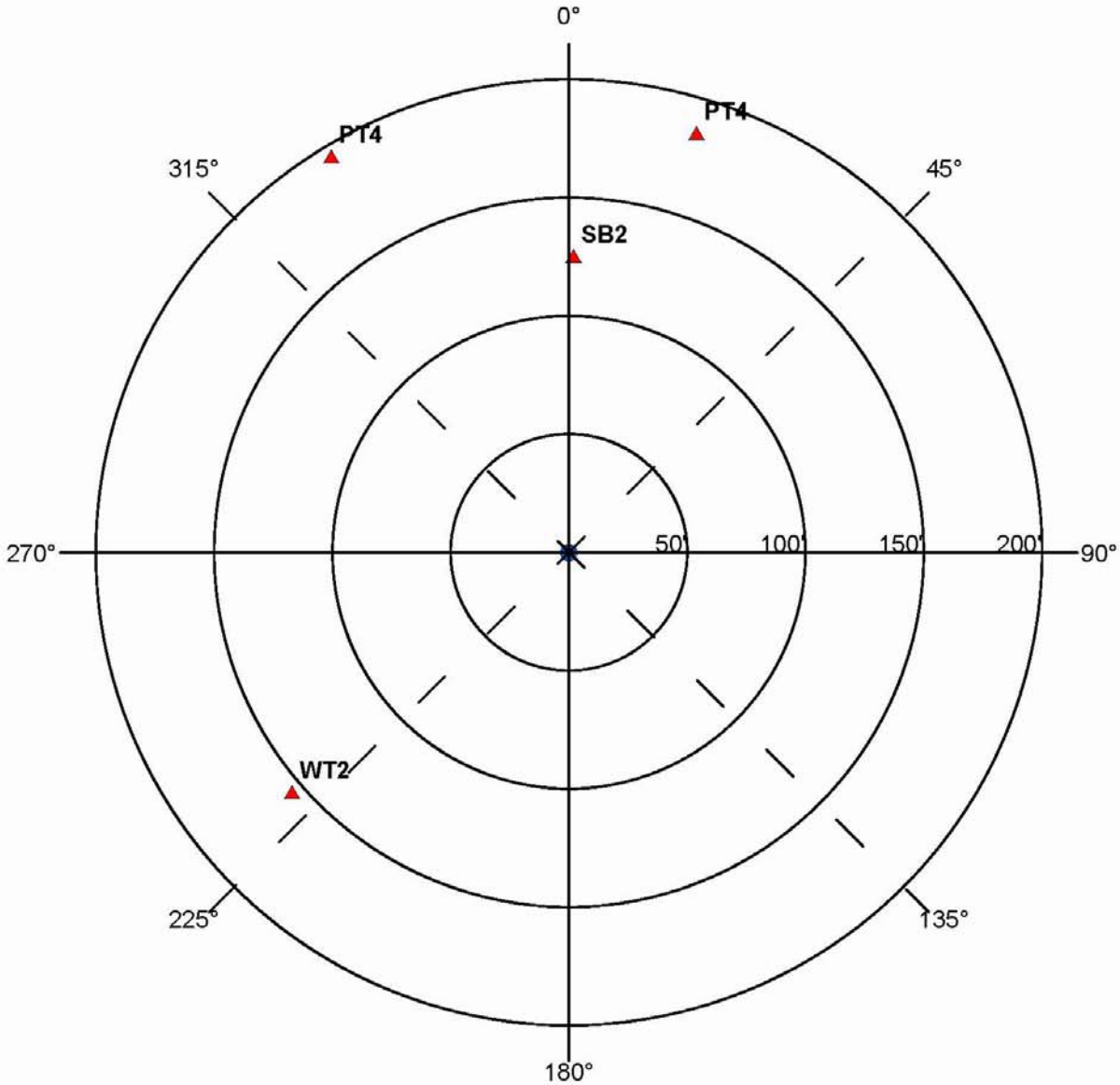
[5] A community public water-supply well must be a minimum of 50 feet from a petroleum tank or container, unless the tank or container is used for emergency pumping and is located in a room or building separate from the community well; and is of double-wall construction with leak detection between walls; or is protected with secondary containment.

This form is based on the new isolation distances in Minnesota Rules, Chapter 4725, related to wells and borings adopted August 4, 2008, and Minnesota Rules, Chapter 4720, related to wellhead protection.

PWS ID / FACILITY ID	1310003 S01	UNIQUE WELL NO.	228834

SETBACK DISTANCES	All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



Were the isolation distances maintained for the new sources of contamination?	(Y)	N	N/A
Is the system monitoring existing nonconforming sources of contamination?	Y	N	(N/A)

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR	Kluthe, Beth	DATE	12 - 2 - 2009

PWS ID / FACILITY ID	1310003 S01	UNIQUE WELL NO.	228834

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Explore opportunities to remove the private inactive fuel tank located northwest of the city well.		
Contact the property owner northeast of the city well to discuss proper tank management and wellhead protection. Encourage the conversion to natural gas and removal of fuel tank.		
Tanks and secondary containments should be inspected on a regular basis for leak or spill detection. See: www.pca.state.mn.us/about/whotocall.html#hotlines for information, or call the Minnesota Pollution Control Agency at 1-800-657-3864.		

COMMENTS

9/7/2003 - Location for PCSI Type ETL (bearing = 0, distance = 0 , inventory date: 12/9/1998) could not be determined.
9/7/2003 - Location for PCSI Type GSP (bearing = 0, distance = 80 , inventory date: 12/9/1998) could not be determined.
9/7/2003 - Location for PCSI Type SBM (bearing = 0, distance = 90 , inventory date: 12/9/1998) could not be determined.
9/7/2003 - Location for PCSI Type PLE (bearing = 0, distance = 0 , inventory date: 12/9/1998) could not be determined.

For further information, please contact:

Minnesota Department of Health
Drinking Water Protection Section
Source Water Protection Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975

Section Receptionist: 651-201-4700
Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000

EXHIBIT 6: Consumer Confidence Report
City of Bovey
2008 Drinking Water Report

The City of Bovey is issuing the results of monitoring done on its drinking water for the period from January 1 to December 31, 2008. The purpose of this report is to advance consumers' understanding of drinking water and heighten awareness of the need to protect precious water resources.

Source of Water

The City of Bovey provides drinking water to its residents from a groundwater source: a 92-foot-deep well that draws water from the Quaternary Buried Unconfined aquifer.

The water provided to customers may meet drinking water standards, but the Minnesota Department of Health has also made a determination as to how vulnerable the source of water may be to future contamination incidents. If you wish to obtain the entire source water assessment regarding your drinking water, please call 651-201-4700 or 1-800-818-9318 (and press 5) during normal business hours. Also, you can view it on line at www.health.state.mn.us/divs/eh/water/swp/swa.

Call 218-245-2572 if you have questions about the City of Bovey drinking water or would like information about opportunities for public participation in decisions that may affect the quality of the water.

Results of Monitoring

No contaminants were detected at levels that violated federal drinking water standards. However, some contaminants were detected in trace amounts that were below legal limits. The table that follows shows the contaminants that were detected in trace amounts last year. (Some contaminants are sampled less frequently than once a year; as a result, not all contaminants were sampled for in 2008. If any of these contaminants were detected the last time they were sampled for, they are included in the table along with the date that the detection occurred.)

Key to abbreviations:
MCLG—Maximum Contaminant Level Goal: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

MCL—Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

AL—Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirement which a water system must follow.

90th Percentile Level—This is the value obtained after disregarding 10 percent of the samples taken that had the highest levels. (For example, in a situation in which 10 samples were taken, the 90th percentile level is determined by disregarding the highest result, which represents 10 percent of the samples.) Note: In situations in which only 5 samples are taken, the average of the two with the highest levels is taken to determine the 90th percentile level.

pCi/l─PicoCuries per liter (a measure of radioactivity).

ppb─Parts per billion, which can also be expressed as micrograms per liter (µg/l).

ppm─Parts per million, which can also be expressed as milligrams per liter (mg/l).

N/A─Not Applicable (does not apply).

Contaminant (units)	MCLG	MCL	Level Found		Typical Source of Contaminant
			Range (2008)	Average /Result*	
Fluoride (ppm)	4	4	.73-1.1	.85	State of Minnesota requires all municipal water systems to add fluoride to the drinking water to promote strong teeth; Erosion of natural deposits; Discharge from fertilizer and aluminum factories.
Nitrate (as Nitrogen) (ppm)	10	10	N/A	.39	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.

Contaminant (units)	Level Found		Typical Source of Contaminant
	Range (2008)	Average/ Result*	
Radon (pCi/l) (11/28/2005)	N/A	153	Erosion of natural deposits.

*This is the value used to determine compliance with federal standards. It sometimes is the highest value detected and sometimes is an average of all the detected values. If it is an average, it may contain sampling results from the previous year.

Radon is a radioactive gas which is naturally occurring in some groundwater. It poses a lung cancer risk when gas is released from water into air (as occurs during showering, bathing, or washing dishes or clothes) and a stomach cancer risk when it is ingested. Because radon in indoor air poses a much greater health risk than radon in drinking water, an Alternative Maximum Contaminant Level (AMCL) of 4,000 picoCuries per liter may apply in states that

have adopted an Indoor Air Program, which compels citizens, homeowners, schools, and communities to reduce the radon threat from indoor air. For states without such a program, the Maximum Contaminant Level (MCL) of 300 pCi/l may apply. Minnesota plans to adopt an Indoor Air Program once the Radon Rule is finalized.

Contaminant (units)	MCLG	AL	90% Level	# sites over AL	Typical Source of Contaminant
Copper (ppm)	N/A	1.3	.34	0 out of 10	Corrosion of household plumbing systems; Erosion of natural deposits.

Contaminant (units)	MCLG	AL	90% Level	# sites over AL	Typical Source of Contaminant
Lead (ppb)	N/A	15	2	0 out of 10	Corrosion of household plumbing systems; Erosion of natural deposits.

If present, infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. City of Bovey is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

Some contaminants do not have Maximum Contaminant Levels established for them. These unregulated contaminants are assessed using state standards known as health risk limits to determine if they pose a threat to human health. If unacceptable levels of an unregulated contaminant are found, the response is the same as if an MCL has been exceeded; the water system must inform its customers and take other corrective actions. In the table that follows are the unregulated contaminants that were detected:

Contaminant (units)	Level Found		Typical Source of Contaminant
	Range (2008)	Average/ Result	
Sodium (ppm) (11/28/2005)	N/A	14	Erosion of natural deposits.
Sulfate (ppm) (11/28/2005)	N/A	156	Erosion of natural deposits.

Compliance with National Primary Drinking Water Regulations

During the year, we failed to take a sample and/or submit information on Total Coliform Bacteria during the required testing period(s) of October 1, 2008 to December 31, 2008. Because we did not monitor or failed to monitor completely during the compliance period(s), we did not know whether Total Coliform Bacteria were present in your drinking water, and we are unable to tell you whether your health was at risk during that time.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.

Radioactive contaminants, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the U. S. Environmental Protection Agency (EPA) prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Food and Drug Administration regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium are available from the Safe Drinking Water Hotline at 1-800-426-4791.

Exhibit 7: List of Local Units of Government

Itasca County Board, Chairperson

Iron Range Township Board, Chairperson

Arbo Township Board, Chairperson

City of Coleraine, Mayor

City of Taconite, Mayor

Arrowhead Regional Development Commission, Executive Director