

# GROUNDWATER POLLUTION POTENTIAL OF BARRON COUNTY, WISCONSIN

Alexander Zaporozec

1987

**Sources of data**  
Barron County lies within the boundaries of two major hydrogeologic districts of Wisconsin: a small part of the northeastern area is within the Lake Superior district, and the remainder of the county lies within the west-central drift/Paleozoic district (Zaporozec and Cotter, 1985). Most of the county is covered by glacial till and by thick sequences of outwash sand and gravel, which are the major source of groundwater in Barron County (see Barron County Atlas plates, *Physical Setting and Hydrogeology of Barron County, Wisconsin*). Surface geology was mapped by M.D. Johnson during 1981-83 (Johnson, 1986); his map served as a basis for delineating hydrogeologic settings in Barron County.

Local officials can use the map to aid in determining whether or where they should study potential groundwater problems more closely. The vulnerability map can be combined with land-use maps, groundwater-quality data, and pollution-source inventory to direct available resources to the most critical areas. Such maps and information are only supplemental tools in a groundwater protection program; pollution control efforts should be concentrated on regulating land uses and on checking pollution at the source.

## How to read the map

The DRASTIC system provides the user with information about the hydrogeologic setting of an area and its pollution potential. (See Table 2) The symbols found on the map look like this:  
7Ba1 -- defines the hydrogeologic setting  
196 -- defines the index of the relative pollution potential of the groundwater in the setting.

- A. Hydrogeologic setting
1. The first number (7) refers to the major groundwater region in which the hydrogeologic setting is located, as defined by Aller and others (1985).
  2. The letter or letters (Ba) define the hydrogeologic setting in more detail.
  3. The last number (1) describes a certain set of factors that are unique to the setting. When factors, such as depth to water, change enough to warrant a different index but not significantly to change the hydrogeologic setting, a new set of unique characteristics is generated and another number (2) is assigned.

- B. Index  
This number represents a relative measure of groundwater pollution potential. The ranges are shown on the map legend. The darker hues indicate greater vulnerability of groundwater to pollution.

The index has been calculated as follows:  
1. Each factor has been weighted with respect to each other and assigned a number from 1 to 5 (see table 1A).  
2. Each factor has been divided into ranges or descriptive terms and assigned associated rating factors from 1 to 10 (tables 1B-1H).  
3. The numerical value for each factor has been calculated by multiplying weight and rating.  
4. The individual numerical values have been summed to obtain the DRASTIC index.  
The higher the index, the greater the potential for pollution. Index values range from 80 to 196 in Barron County. The numerical values are relative and have no differential meaning. They are of value only with respect to other numbers generated by the same DRASTIC system and are designed for ready comparison of one setting to another.

## References

- Aller, L., Bennett, T., Lehr, J.H., and Petty, R.J., 1985, DRASTIC: A standardized system for evaluating ground water pollution potential using hydrogeologic settings. U.S. Environmental Protection Agency Report 600/2-85-018, 163 p.  
Bell, E.A. and Hindall, S.M., 1975, The availability of ground water for irrigation in the Rice Lake-Eau Claire area, Wisconsin. Wisconsin Geological and Natural History Survey Information Circular 31, 65 p.  
Johnson, M.D., 1986, Pleistocene geology of Barron County, Wisconsin. Wisconsin Geological and Natural History Survey Information Circular 55, plate 1 (scale 1:100,000).  
Zaporozec, A. and Cotter, R.D., 1985, Major ground-water flows for irrigation in the Rice Lake-Eau Claire area, Wisconsin. Wisconsin Geological and Natural History Survey Educational Series 28, 20 p.

Table 1. Weights, ranges, and ratings for DRASTIC factors (from Aller and others, 1985)

A. Assigned weights for DRASTIC factors			E. Ranges and ratings for soil media		
Factor (units)	Weight		Range	Rating	
Depth to water table (ft)	5		Thin or absent	10	
Net recharge (in.)	4		Gravel	10	
Aquifer media	3		Sand	9	
Soil media	2		Shrinking and/or aggregated clay	7	
Topography (% of slope)	1		Sandy loam	6	
Impact of the vadose (unsaturated) zone	5		Loam	5	
Hydraulic conductivity of the aquifer (gallons per day per ft <sup>2</sup> ) (gpd/ft <sup>2</sup> )	3		Silty loam	4	
			Clay loam	3	
			Muck*	2	
			Nonshrinking and nonaggregated clay	1	
B. Ranges and ratings for depth to water			F. Ranges and ratings for topography		
Range (feet)	Rating		Range (% of slope)	Rating	
0-5	10		0-2	10	
6-10	8		2-5	9	
20-50*	4		6-12	5	
50-100*	3		12-18	3	
100+	2		18+	1	
C. Ranges and ratings for net recharge			G. Ranges and ratings for impact of vadose (unsaturated) zone media		
Range (in.)	Rating		Range	Rating	Typical rating
0-2	1		Silt/clay	1-2	1
0-4	3		Shale	2-5	3
4-7	6		Limestone	2-7	5
7-10	8		Sandstone	4-8	6
10+	9		Bedded limestone, sandstone, shale	4-8	6
			Sand and gravel with significant silt and clay	4-8	6
			Metamorphic/igneous	2-8	4
			Sand and gravel	6-9	8
			Basalt	2-10	9
			Karst limestone	8-10	10
D. Ranges and ratings for aquifer media			H. Ranges and ratings for hydraulic conductivity		
Range	Rating	Typical rating	Range (gpd/ft <sup>2</sup> )	Rating	
Massive	1-3	2	1-100	1	
Metamorphic/igneous	2-5	3	100-300	2	
Weathered metamorphic/igneous	3-5	4	300-700	4	
Thin-bedded sandstone, limestone, shale sequences	5-9	6	700-1000	6	
Massive sandstone	4-9	6	1000-2000	8	
Massive limestone	4-9	6	2000+	10	
Fractured dolomite*	8	8			
Sand and gravel	6-9	8			
Basalt	2-10	9			
Karst limestone	9-10	10			
* modified					

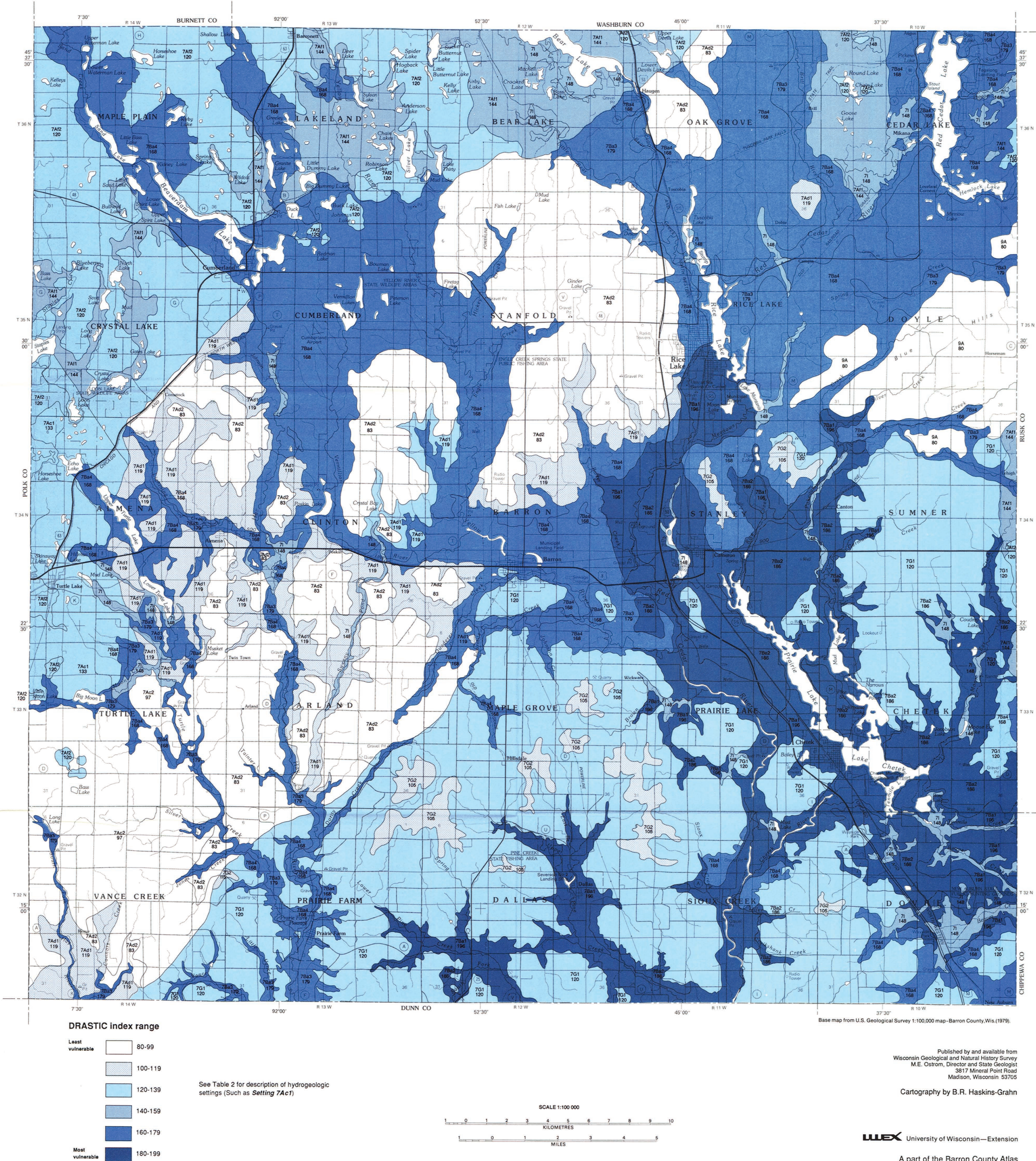


Table 2. Hydrogeologic settings and relative pollution potential index charts for Barron County, Wisconsin (based on DRASTIC)

Tect-central drift/Paleozoic district						Setting 7Ba1 Outwash						
<p>This hydrogeologic setting is characterized by rolling to hilly topography and dolomite bedrock covered by till and meltwater-stream sediment that vary in thickness. Although groundwater occurs in the glacial deposits and the underlying dolomite, the dolomite serves as the principal aquifer. The till serves as a source of recharge for the underlying dolomite. Although precipitation is abundant in most of the area, recharge is moderate to moderately low because of the relatively low permeability. Depth to water table is variable; it depends partly on the thickness of the glacial till but typically is moderately deep to deep.</p>						Factor	Range	Weight	Rating	Number		
						Depth to water	<20 ft	5	6*	30		
						Net recharge	7-10 in.	4	8*	32		
						Aquifer media	Sand & gravel	3	9	27		
						Soil media	Sandy loam	2	6	12		
						Topography	0-2%	1	10	10		
						Unsaturated zone	Sand & gravel	5	9	45		
						Hydraulic cond.	2000+ gpd/ft <sup>2</sup>	3	10	30		
						DRASTIC index					196	
						Setting 7Ac1 Mixed glacial deposits over dolomite						
Factor	Range	Weight	Rating	Number	Factor	Range	Weight	Rating	Number			
Depth to water	20-50+ ft	5	6*	30	Depth to water	20-50 ft	5	6*	30			
Net recharge	4-7 in.	4	8	24	Net recharge	7-10 in.	4	8	32			
Aquifer media	Fract. dolomite	3	8*	24	Aquifer media	Sand & gravel	3	9	27			
Soil media	Sandy loam	2	6	12	Soil media	Sandy loam	2	6	12			
Topography	6-12%	1	5	5	Topography	0-2%	1	10	10			
Unsaturated zone	Silt/sand/clay	5	4	20	Unsaturated zone	Sand & gravel	5	9	45			
Hydraulic cond.	700-1000 gpd/ft <sup>2</sup>	3	6	18	Hydraulic cond.	2000+ gpd/ft <sup>2</sup>	3	10	30			
DRASTIC index					133	DRASTIC index					186	
Setting 7Ac2 Glacial till over dolomite						Setting 7Ba3 Outwash						
Factor	Range	Weight	Rating	Number	Factor	Range	Weight	Rating	Number			
Depth to water	50-100 ft	5	3*	15	Depth to water	<20 ft	5	8*	40			
Net recharge	2-4 in.	4	3	12	Net recharge	7-10 in.	4	8	32			
Aquifer media	Fract. dolomite	3	8*	24	Aquifer media	Sand & gravel	3	8	24			
Soil media	Silty loam	2	4	8	Soil media	Silty loam	2	4	8			
Topography	6-12%	1	5	5	Topography	0-2%	1	10	10			
Unsaturated zone	Silt/sand/clay	5	3*	15	Unsaturated zone	Sand & gravel	5	7	35			
Hydraulic cond.	700-1000 gpd/ft <sup>2</sup>	3	6	18	Hydraulic cond.	2000+ gpd/ft <sup>2</sup>	3	10	30			
DRASTIC index					97	DRASTIC index					179	
* modified						DRASTIC index						179
(7Ad) Mixed glacial deposits over sandstone						Setting 7Ba4 Outwash						
<p>This hydrogeologic setting is characterized by rolling topography and relatively flat-lying sandstone bedrock that is covered by till of varying thickness. The till consists chiefly of unsorted deposits that may be covered by less or interbedded locally with glacial deposits and the underlying dolomite. Although groundwater occurs in the glacial deposits and in the underlying bedrock, the sand and gravel interbedded within till is the principal aquifer. The till serves as a source of recharge to the underlying bedrock. Although precipitation is abundant in most of the area, recharge is moderate to moderately low because of the till and silts, which are typically loamy and silty. Depth to water table is extremely variable, depending partly on the thickness of the till and ranges between 20 and 120 ft.</p>						Factor	Range	Weight	Rating	Number		
						Depth to water	20-50 ft	5	6*	30		
						Net recharge	4-7 in.	4	6	24		
						Aquifer media	Sand & gravel	3	7	21		
						Soil media	Silty loam	2	4	8		
						Topography	6-12%	1	9	9		
						Unsaturated zone	Silt/sand/clay	5	3*	15		
						Hydraulic cond.	300-700 gpd/ft <sup>2</sup>	3	4	12		
						DRASTIC index					119	
						Setting 7Ae1 Glacial till over sandstone						
Factor	Range	Weight	Rating	Number	Factor	Range	Weight	Rating	Number			
Depth to water	50-100+ ft	5	2*	10	Depth to water	20-100 ft	5	4*	20			
Net recharge	2-4 in.	4	3	12	Net recharge	4-7 in.	4	6	24			
Aquifer media	Sand & gravel	3	7	21	Aquifer media	Sandstone	3	6	18			
Soil media	Silty loam	2	4	8	Soil media	Till or absent	2	10	20			
Topography	6-12%	1	5	5	Topography	1-12%	1	5	5			
Unsaturated zone	Silt/sand/clay	5	3*	15	Unsaturated zone	Sandstone	5	6	30			
Hydraulic cond.	300-700 gpd/ft <sup>2</sup>	3	4	12	Hydraulic cond.	1-100 gpd/ft <sup>2</sup>	3	1	3			
DRASTIC index					120	DRASTIC index					120	
* modified						DRASTIC index						83
(7Af) Mixed glacial deposits (new setting)						Setting 7Ge2 Thin till over sandstone						
<p>This hydrogeologic setting is characterized by rolling topography and mixed glacial deposits and meltwater-stream sediments of varying thickness that overlie relatively flat-lying sandstone bedrock. Groundwater occurs in the sand and gravel interbedded within glacial till or deposited in streambeds, glacial channels and in the narrow rills around ice-walled lakes. The centers of ice-walled lakes are composed of fine-grained clay, silt, and sand. Glacial deposits contain a typical hummocky topography; isolated knobs or small hills are separated by depressions that are now filled with marshes and lakes. Precipitation is abundant throughout most of the area, and recharge is moderate to high. Water levels vary, but are usually moderately steep.</p>						Factor	Range	Weight	Rating	Number		
						Depth to water	20-50 ft	5	6*	30		
						Net recharge	4-7 in.	4	6	24		
						Aquifer media	Sand & gravel	3	7	21		
						Soil media	Sandy loam	2	6	12		
						Topography	6-12%	1	5	5		
						Unsaturated zone	Silt/sand/clay	5	3*	15		
						Hydraulic cond.	300-700 gpd/ft <sup>2</sup>	3	4	12		
						DRASTIC index					83	
						* modified						DRASTIC index
(7Ai) Swamp/marsh (modified setting)						Setting 7H1 Swamp/marsh						
<p>This hydrogeologic setting is characterized by low topography, high water levels, and high organic silt and clay deposits overlain by glacial sediment (not differentiated on the map). The wetlands are shown on the map. These wetlands also occur along the courses of other floodplains and in upland areas as a result of the vertically restricted drainage. Recharge is moderate in most areas due to restriction by clayey silts. These deposits are not aquifers. Water levels are very shallow.</p>						Factor	Range	Weight	Rating	Number		
						Depth to water	100-150 ft	5	1	5		
						Net recharge	4-7 in.	4	6	24		
						Aquifer media	Sandstone	3	6	18		
						Soil media	Silty loam	2	10	20		
						Topography	Muck/deep	2	2	2		
						Unsaturated zone	Sandstone	5	6	30		
						Hydraulic cond.	300-700 gpd/ft <sup>2</sup>	3	1	3		
						DRASTIC index					105	
						* modified						DRASTIC index
(7I) Swamp/marsh (modified setting)						Setting 7I1 Swamp/marsh						
<p>This hydrogeologic setting is characterized by low topography, high water levels, and high organic silt and clay deposits overlain by glacial sediment (not differentiated on the map). The wetlands are shown on the map. These wetlands also occur along the courses of other floodplains and in upland areas as a result of the vertically restricted drainage. Recharge is moderate in most areas due to restriction by clayey silts. These deposits are not aquifers. Water levels are very shallow.</p>						Factor	Range	Weight	Rating	Number		
						Depth to water	0-5 ft	5	10	50		
						Net recharge	4-7 in.	4	6	24		
						Aquifer media	Sand & gravel	3	8	24		
						Soil media	Muck/deep	2	2	2		
						Topography	0-2%	1	10	10		
						Unsaturated zone	Sandstone	5	6	30		
						Hydraulic cond.	100-300 gpd/ft <sup>2</sup>	3	2	6		
						DRASTIC index					148	
						* modified						DRASTIC index
Lake Superior district						Setting 9A1 Mountain slopes						
(9A) Mountain slopes						Setting 9A1 Mountain slopes						
<p>This hydrogeologic setting is characterized by moderately steep to steep slopes of the Blue Hills, a thin silt or glacial till cover, and fractured Precambrian bedrock. Groundwater is obtained primarily from the fractures in the Precambrian quartzite. The fractures provide localized sources of groundwater, and the yields are typically small. Although precipitation is abundant due to the steeper slopes, thin soil cover, and small storage capacity of the fractures, runoff is significant and groundwater recharge is moderately low. Water levels are extremely variable but are commonly deep.</p>						Factor	Range	Weight	Rating	Number		
						Depth to water	50-100+ ft	5	2*	10		
						Net recharge	2-4 in.	4	3	12		
						Aquifer media	Quartzite	3	4	12		
						Soil media	Till or absent	2	10	20		
						Topography	12-18%	3	3	3		
						Unsaturated zone	Quartzite	5	4	20		
						Hydraulic cond.	1-100 gpd/ft <sup>2</sup>	3	1	3		
						DRASTIC index					80	
						* modified						DRASTIC index