

Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Chatanika Lodge Drinking Water System,
Fairbanks area, Alaska
PWSID # 310138

DRINKING WATER PROTECTION PROGRAM REPORT Report 680
Alaska Department of Environmental Conservation

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The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Source Water Assessment for Chatanika Lodge Source of Public Drinking Water, Fairbanks Area, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Chatanika Lodge is a Class B (transient/non-community) water system consisting of one well on the Steese Highway approximately 20 miles northeast of Fairbanks, Alaska. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Very High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Chatanika Lodge public drinking water source include: a large capacity septic system, a fuel tank, and inactive placer mining. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Combining the natural susceptibility of the well with the contaminant risk, the public water sources for Chatanika Lodge received a vulnerability rating of **High** for bacteria and viruses and nitrates and/or nitrites, and a **Medium** for volatile organic chemicals.

CHATANIKA LODGE PUBLIC DRINKING WATER SYSTEM

Chatanika Lodge public water system is a Class B (transient/non-community) water system. The system consists of one well on the northeast side of the Steese Highway approximately 20 miles northeast of Fairbanks, Alaska near the community of Chatanika (T3N, R1E, Section 2) (See Map 1 of Appendix A). Fairbanks and its surrounding communities are located in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include: College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The majority of residents the Fairbanks area have individual wells and septic systems, and the remainder haul water (ADCED, 2002). Heating oil (stored in both above and below ground 275 to 500-gallon tanks) is used for heating homes and buildings. Refuse is

transported to the Fairbanks North Star Borough landfill.

The Fairbanks area includes two distinct topographic areas: the floodplain of the Tanana River and the Chena River, and the uplands north of this floodplain. This water system is located in the uplands at an elevation of approximately 800 feet above sea level.

According to the well log for this water system, the depth of the well is 150 feet below the ground surface, and is screened in bedrock (schist). Bedrock in this area is predominantly a metamorphosed marine mud deposit, called a pelitic schist. The schist is locally intruded by granitic rocks – granite and quartz diorite. Groundwater in the bedrock is principally contained in fractures. The water wells in this area with the greatest well recharge appear to be in quartz veins, quartzite, and siliceous schist (Nelson, 1978).

Groundwater in the uplands is recharged by local precipitation. Outflow of ground water in the uplands primarily occurs two ways. In areas under artesian pressure (pressure caused by overlying permafrost), water can flow to the surface through thawed conduits within the permafrost. Otherwise groundwater will flow under the permafrost (if present) and out to the groundwater beneath the adjacent flood plain or creek valley (Nelson, 1978).

The Sanitary Survey (8/12/98) for the water system indicates the land surface is appropriately sloped away from the well providing adequate surface water drainage. It is unknown whether a sanitary seal has been installed on the well. The well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves approximately 3 residents and 150 non-residents through one service connections.

CHATANIKA LODGE DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely

pathways for surface contamination to reach the groundwater. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the drinking water protection area. Because releases of contaminants within the protection area are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

An outline of the immediate watershed was used to determine the size and shape of the protection area for Chatanika Lodge. Available geology was also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The protection areas established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the protection area. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources (*Jokela et. al., 1991*).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. time-of-travel
B	Less than the 2 year time-of-travel
C	Less Than the 5 year time-of-travel
D	Less than the 10 year time-of-travel

The DWPA for Chatanika Lodge is limited by its immediate watershed and includes only Zone A (See Map 1 of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of

contamination within the Chatanika Lodge DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals

The sources are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a “potential” or “existing” source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only “Very High” and “High” rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

VULNERABILITY OF CHATANIKA LODGE DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and
- Contaminant risks.

Appendix D contains eight charts, which together form the ‘Vulnerability Analysis’ for a source water assessment for a public drinking water source. Chart 1 analyzes the ‘Susceptibility of the Wellhead’ to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the ‘Susceptibility of the Aquifer’ to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes ‘Contaminant Risks’ for the drinking water source with respect to bacteria and viruses. The ‘Contaminant Risks’ portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the ‘Vulnerability Analysis for Bacteria and Viruses’. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

$$\begin{aligned}
 & \text{Susceptibility of the Wellhead (0 – 25 Points)} \\
 & \quad \text{(Chart 1 of Appendix D)} \\
 & \quad + \\
 & \text{Susceptibility of the Aquifer (0 – 25 Points)} \\
 & \quad \text{(Chart 2 of Appendix D)} \\
 & \quad = \\
 & \text{Natural Susceptibility (Susceptibility of the Well)} \\
 & \quad \text{(0 – 50 Points)}
 \end{aligned}$$

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The well for the AK Division of Parks – Upper Chatanika River is completed in an unconfined aquifer. Because unconfined aquifers are recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for Chatanika Lodge.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	20	Very High
Susceptibility of the Aquifer	23	Very High
Natural Susceptibility	43	Very High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	35	High
Nitrates and/or Nitrites	35	High
Volatile Organic Chemicals	12	Low

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

$$\begin{aligned}
 & \text{Natural Susceptibility (0 – 50 points)} \\
 & \quad + \\
 & \text{Contaminant Risks (0 – 50 points)} \\
 & \quad = \\
 & \text{Vulnerability of the} \\
 & \text{Drinking Water Source to Contamination (0 – 100).}
 \end{aligned}$$

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings	
80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the three categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	55	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is high with the large capacity septic system representing the risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Large capacity septic systems, designated a type of Class V Injection well by the Environmental Protection Agency (EPA), differ from residential septic systems in that they serve multiple dwellings, businesses, or communities.

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Chatanika Lodge. After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is high with the large capacity septic system representing the risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrates are very mobile, moving at approximately the same rate as water. Sampling history for Chatanika Lodge well indicates that nitrates have not been detected in the water during recent sampling history. After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is low with the fuel storage tank creating the risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

The drinking water at Chatanika Lodge has not been sampled for Volatile Organic Chemicals recently. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

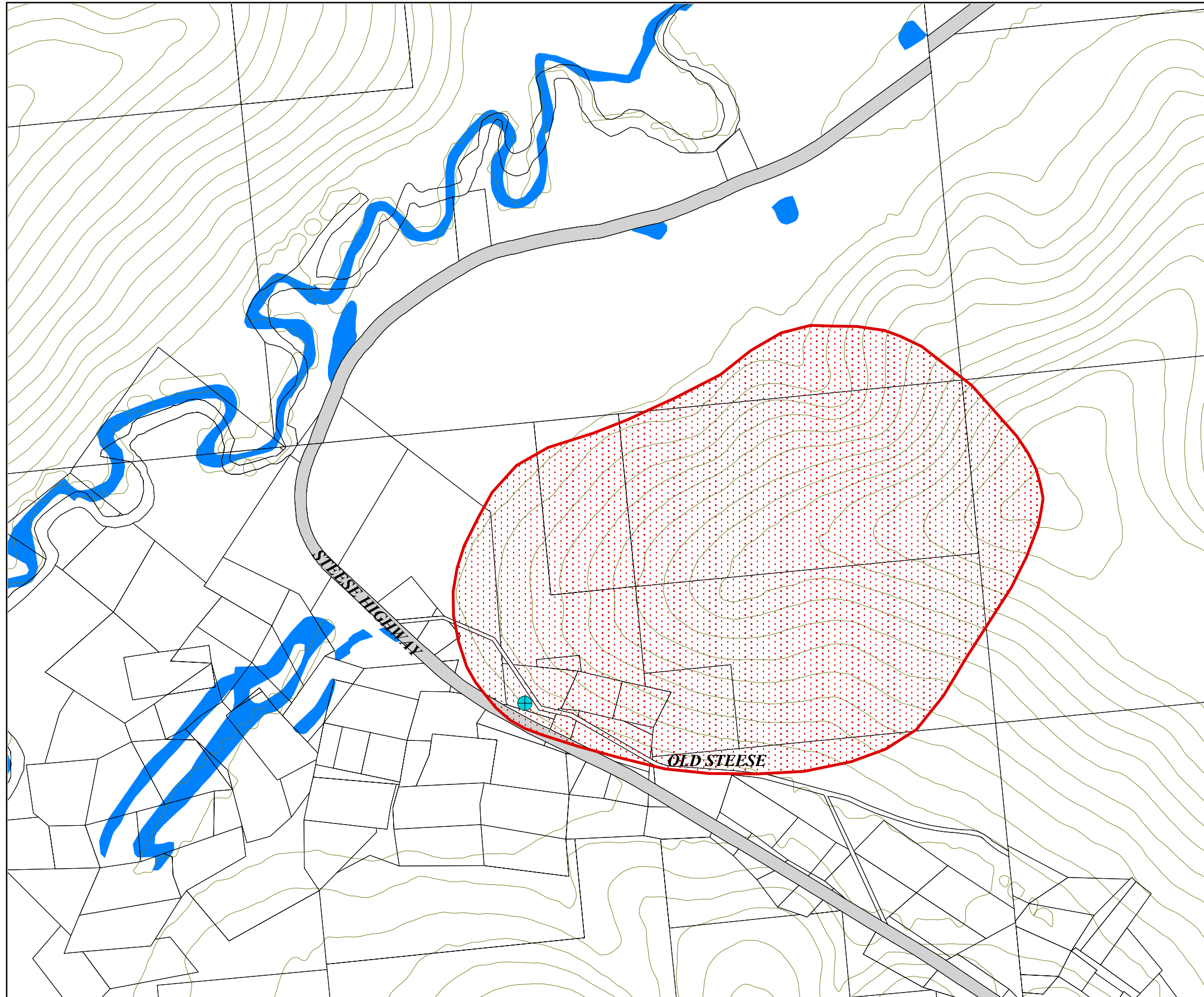
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
APPENDIX A

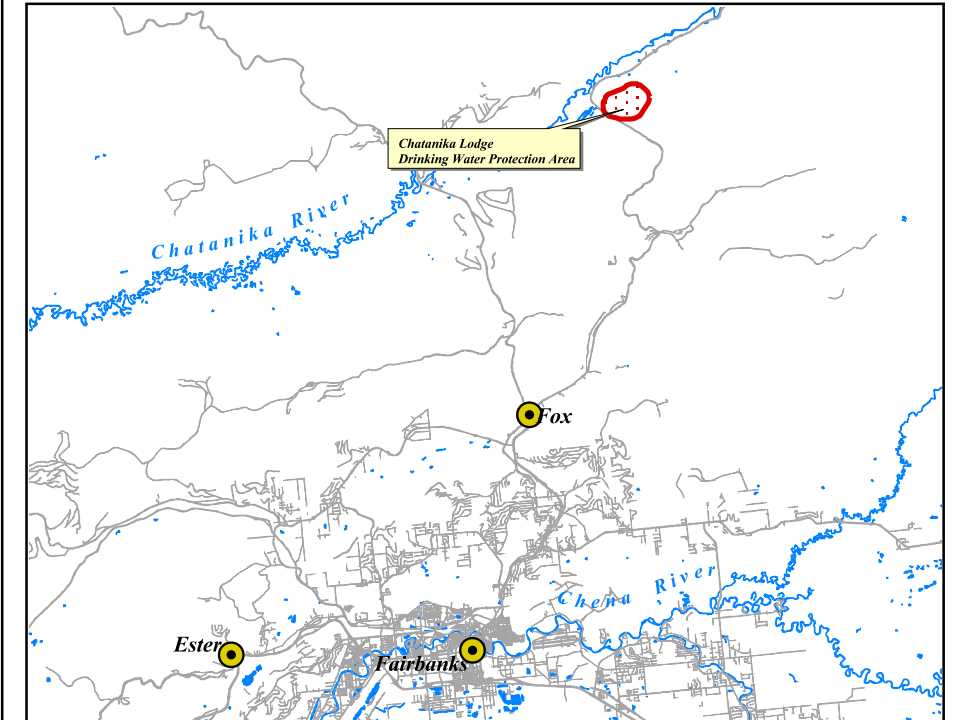
Chatanika Lodge Drinking Water Protection Area Location Map (Map 1)

Chatanika Lodge Drinking Water Protection Area



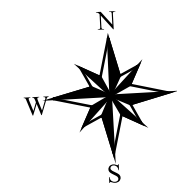
Legend

-  Chatanika Lodge Well
-  Zone A Protection Area
-  Several Months Travel Time
-  Parcels
-  Roads
-  Elevation Contours (20 meters)
-  Rivers and Streams



1 0 1 Miles

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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Chatanika Lodge (Tables 1-4)

Table 1

**Contaminant Source Inventory for
Chatanika Lodge**

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Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	Septic system for Chatanika Lodge
Metals mining, placer (inactive)	E04	E04-1	A	2	Placer mining along Cleary Creek
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	2	Fuel tank for Chatanika Lodge

Table 2

*Contaminant Source Inventory and Risk Ranking for
Chatanika Lodge
Sources of Bacteria and Viruses*

PWSID 310138.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	Septic system for Chatanika Lodge

Table 3

*Contaminant Source Inventory and Risk Ranking for
Chatanika Lodge
Sources of Nitrates/Nitrites*

PWSID 310138.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	Septic system for Chatanika Lodge

Table 4

*Contaminant Source Inventory and Risk Ranking for
Chatanika Lodge
Sources of Volatile Organic Chemicals*

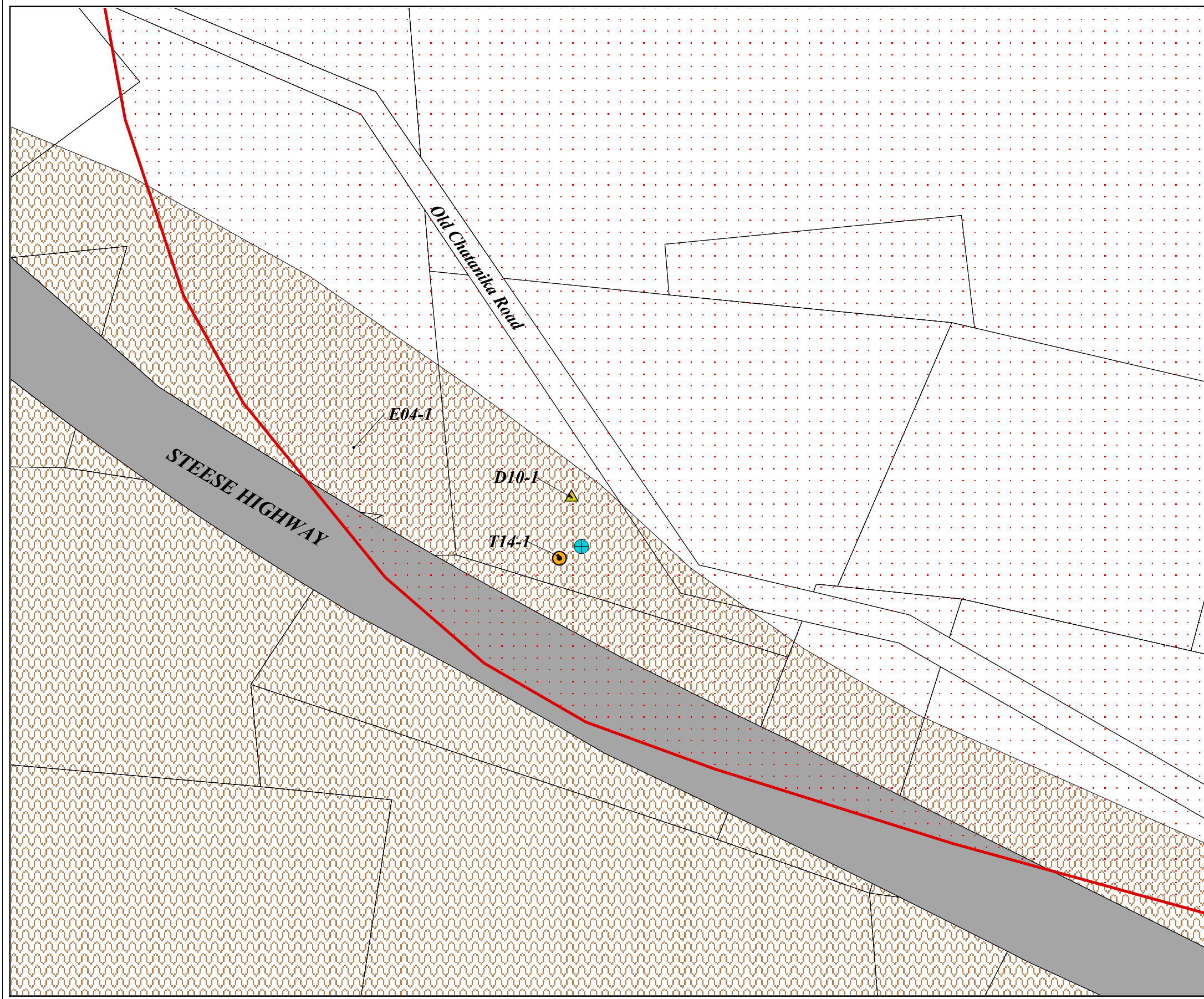
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<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	Septic system for Chatanika Lodge
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	Low	2	Fuel tank for Chatanika Lodge

APPENDIX C

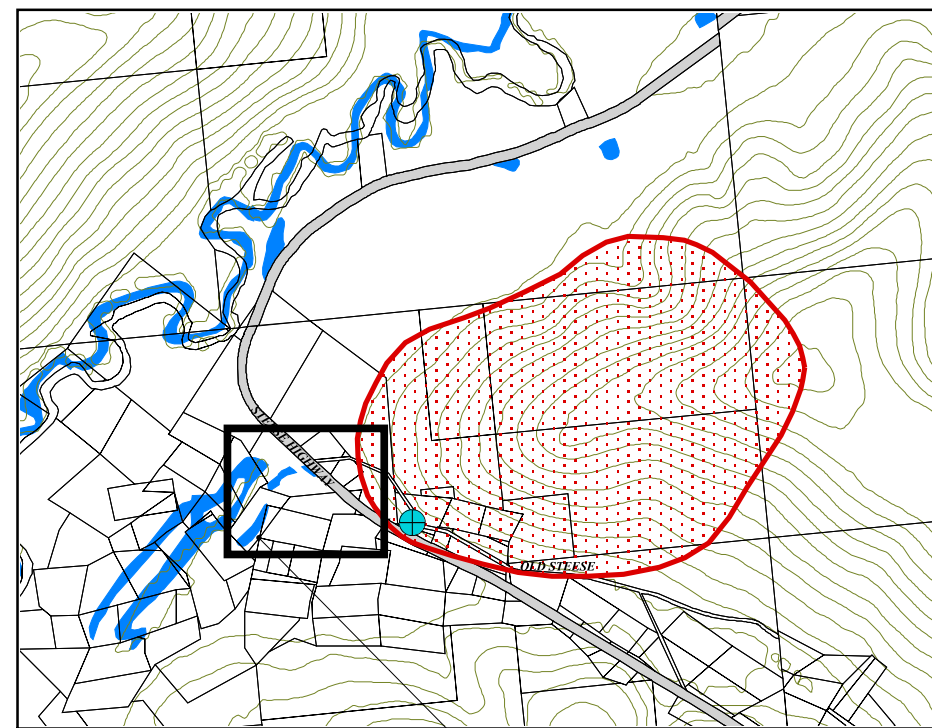
Chatanika Lodge Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)

Chatanika Lodge Drinking Water Protection Area with Potential & Existing Contaminant Sources

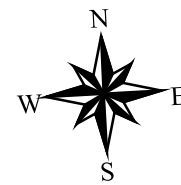


Legend

- Chatanika Lodge Well
- Zone A Protection Area**
- Several Months Travel Time
- Parcels
- Roads
- Contaminant Sources**
- Large Capacity Septic Systems (D10)
- Above Ground Fuel Tank (R07)
- Inactive placer mining (E04)



Area of Map



Map 2

500 0 500 1000 Feet

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APPENDIX D

Vulnerability Analysis for Chatanika Lodge Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Chatanika Lodge

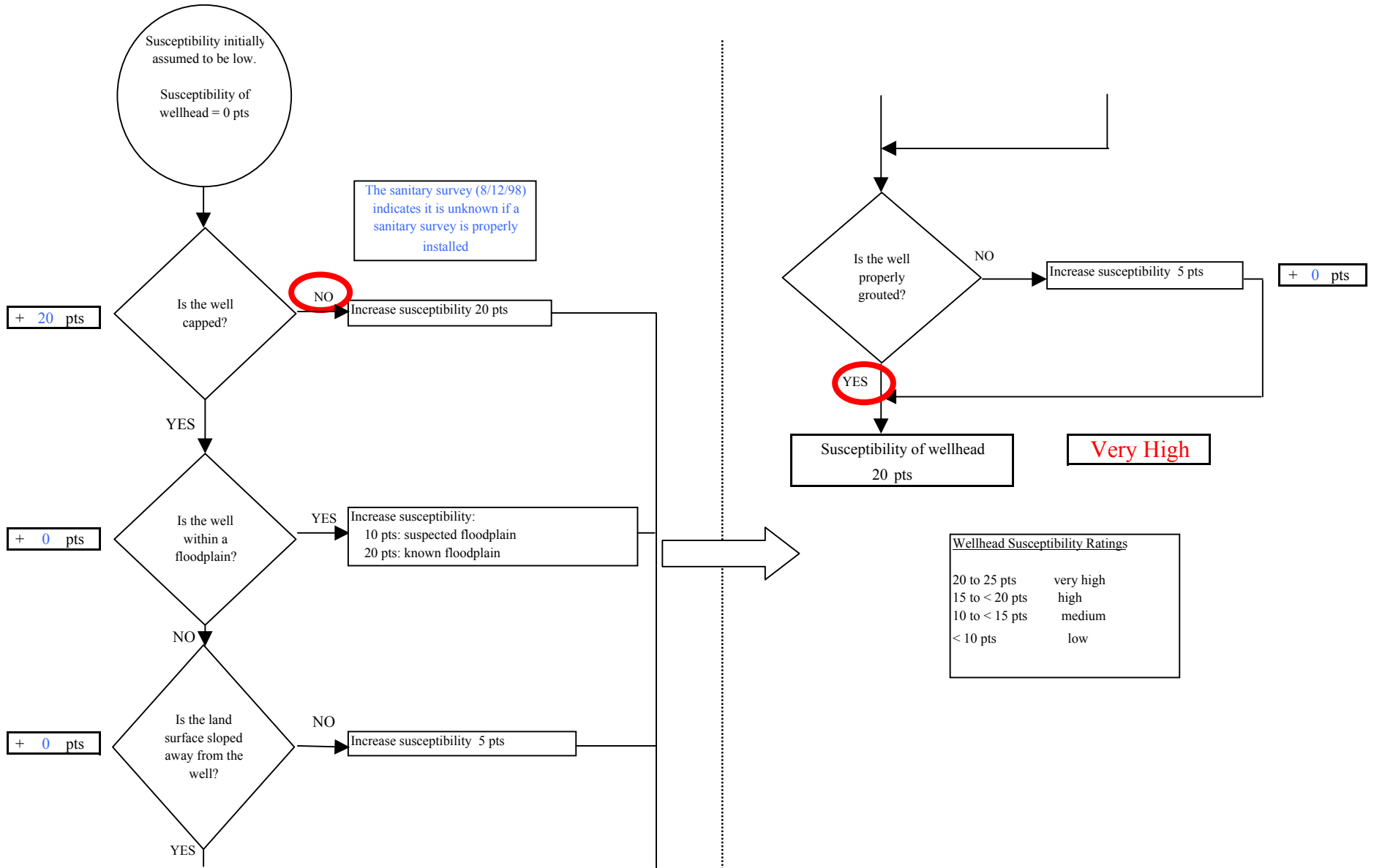


Chart 2. Susceptibility of the aquifer - Chatanika Lodge

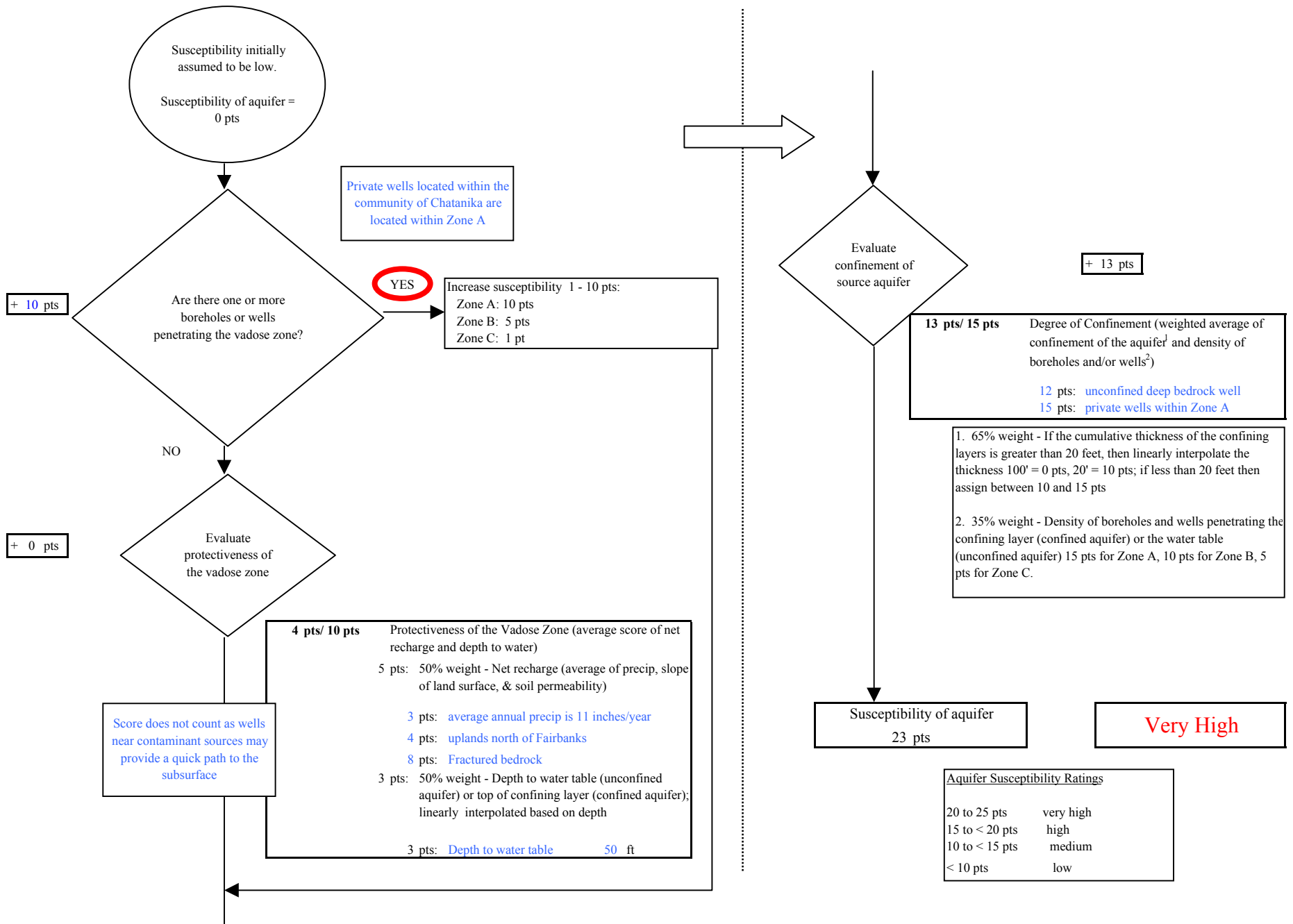
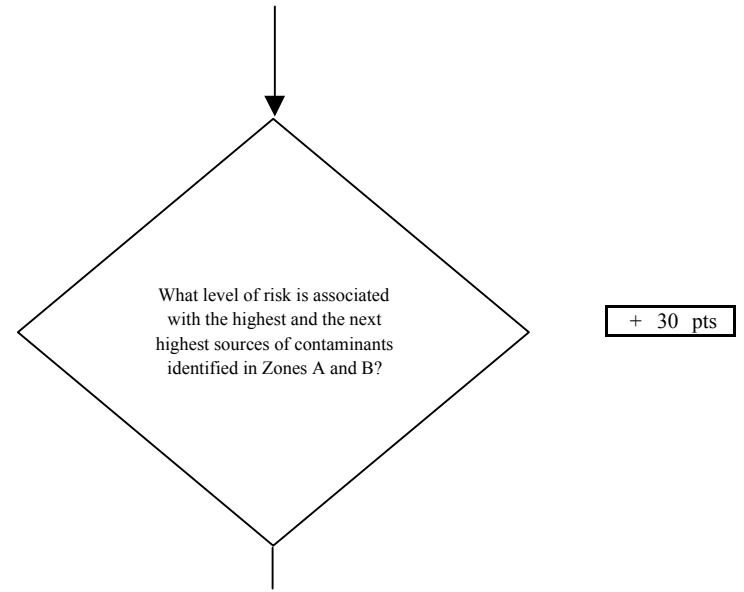
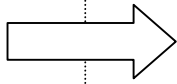
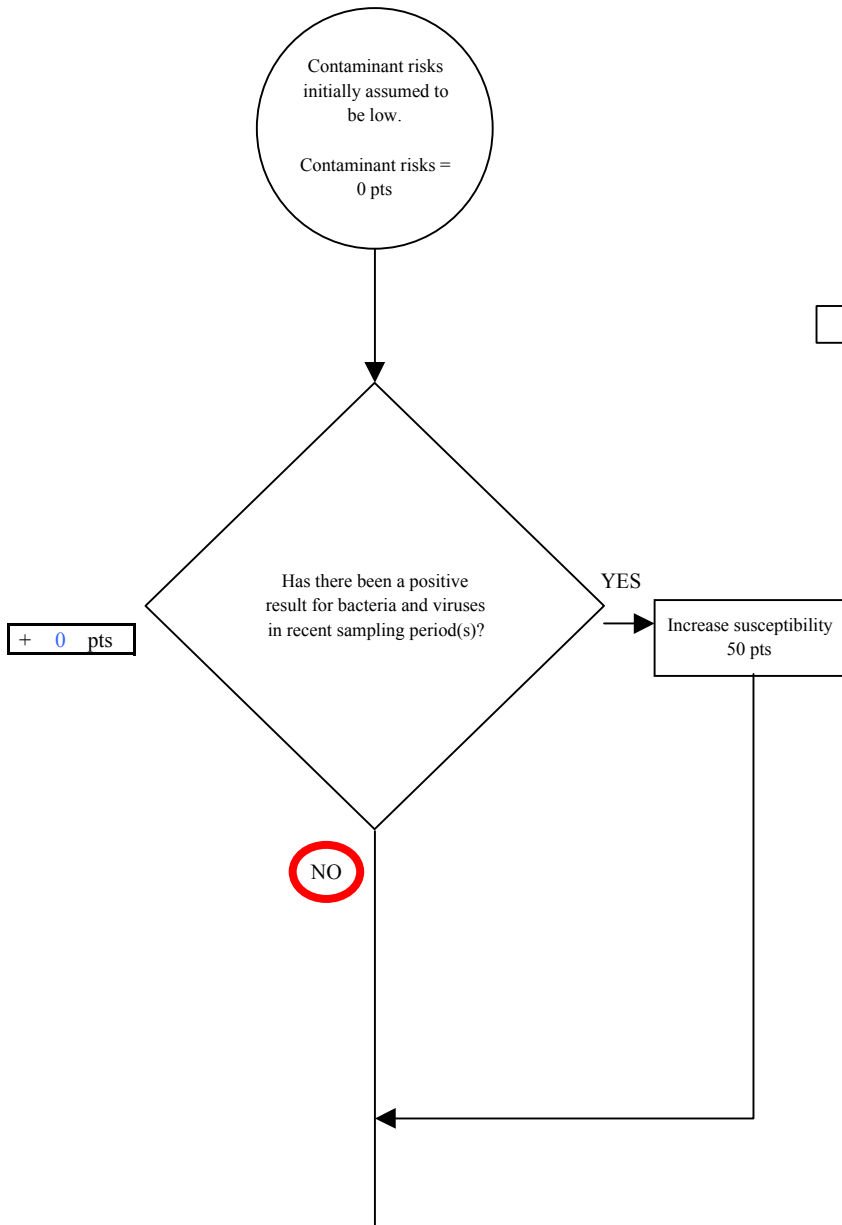


Chart 3. Contaminant risks for Chatanika Lodge - Bacteria & Viruses



Risk Rankings for Contaminant Sources Identified in Zones A and B			
	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	0	0	0

	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 30

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

Chart 3. Contaminant risks for Chatanika Lodge - Bacteria & Viruses

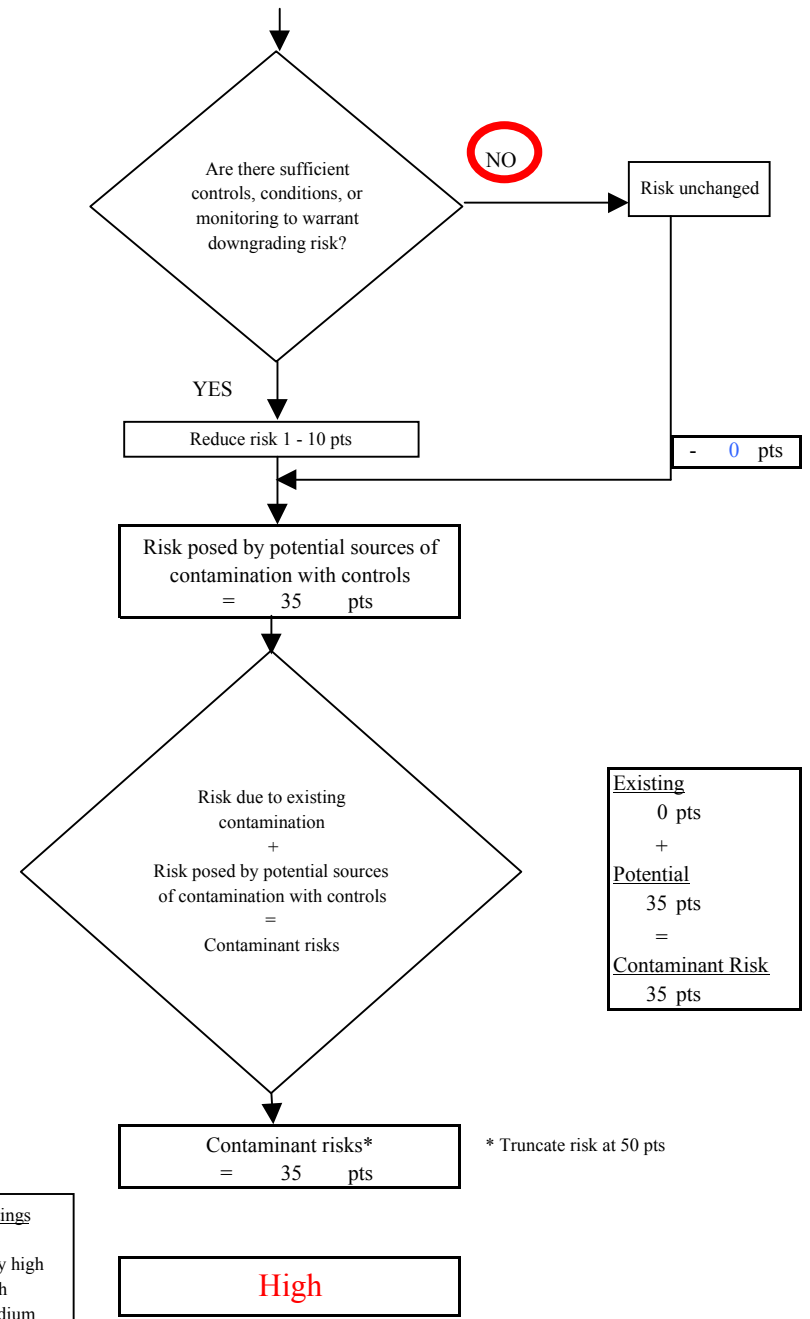
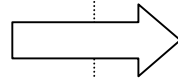
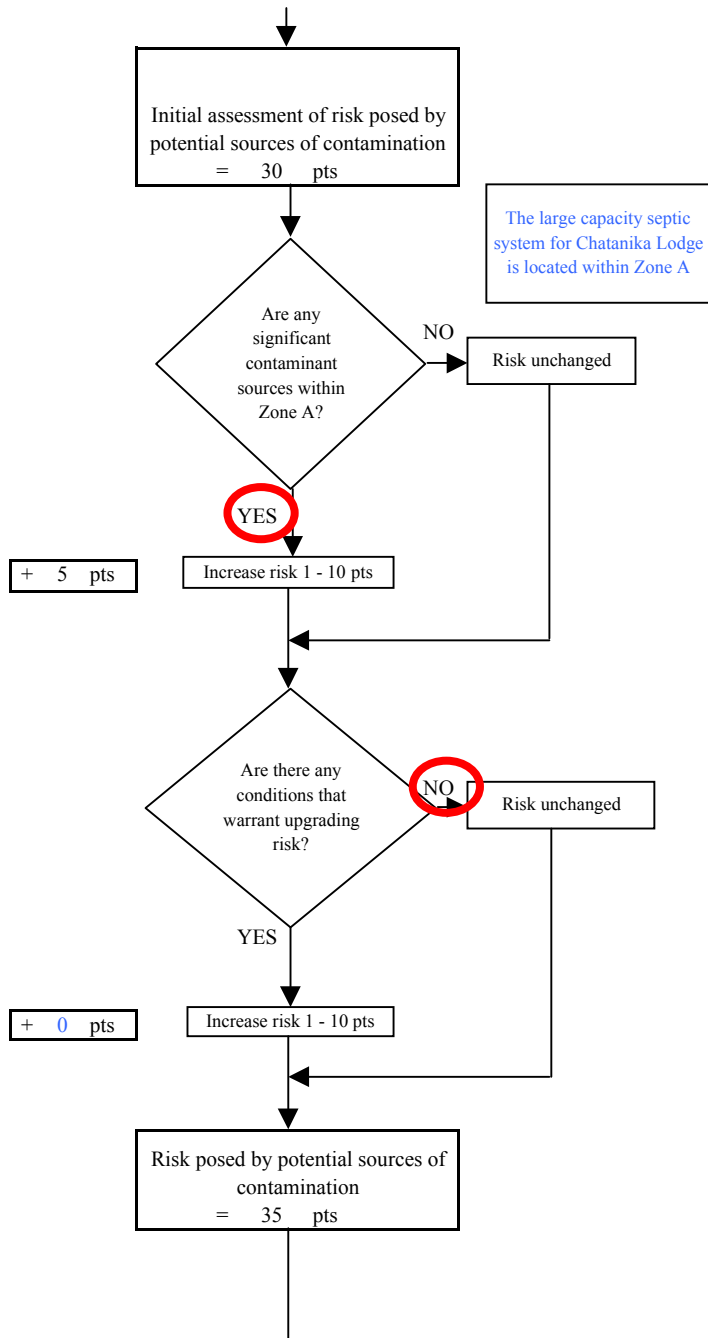


Chart 4. Vulnerability analysis for Chatanika Lodge - Bacteria & Viruses

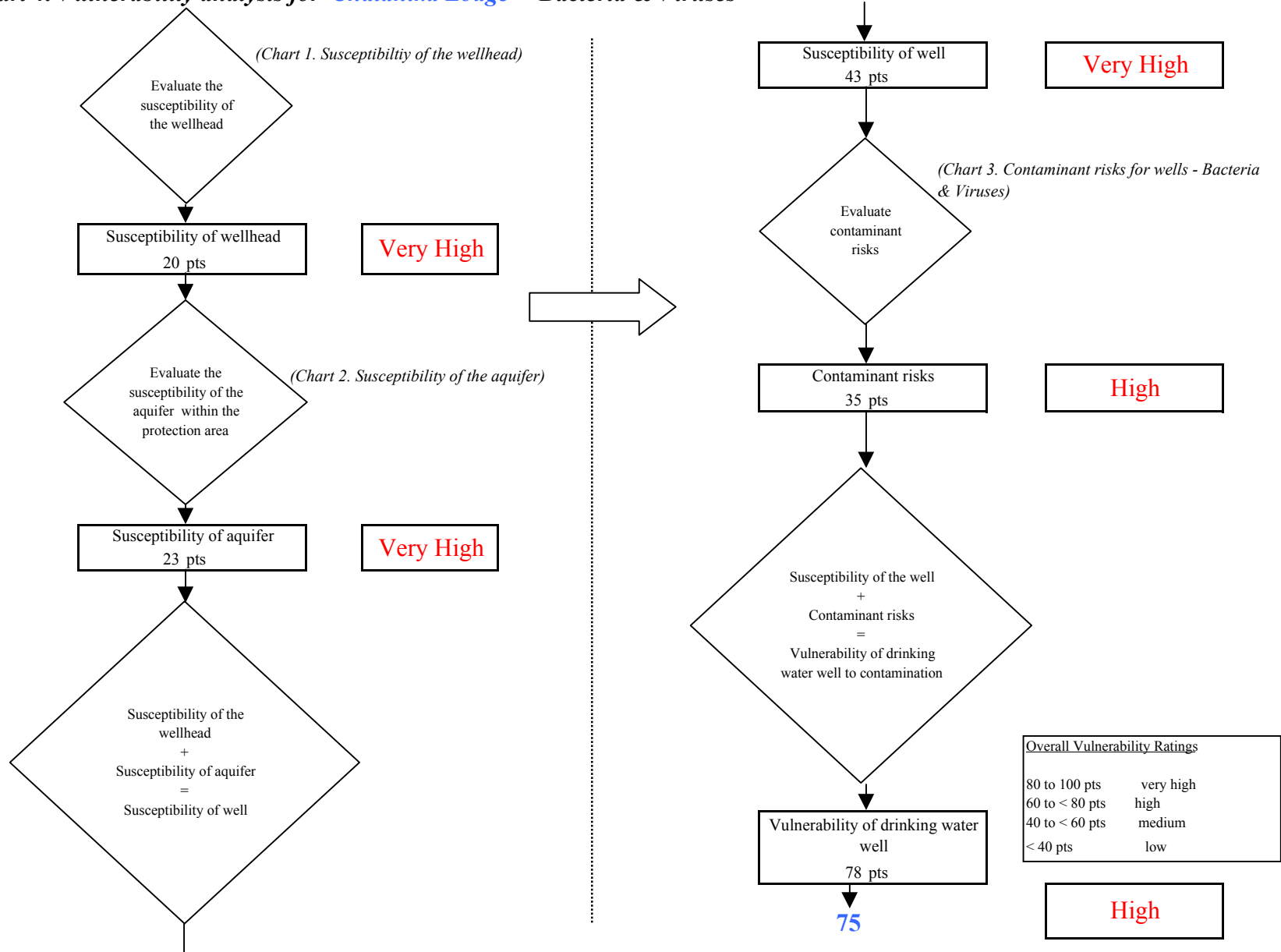


Chart 5. Contaminant risks for *Chatanika Lodge* - Nitrates and Nitrites

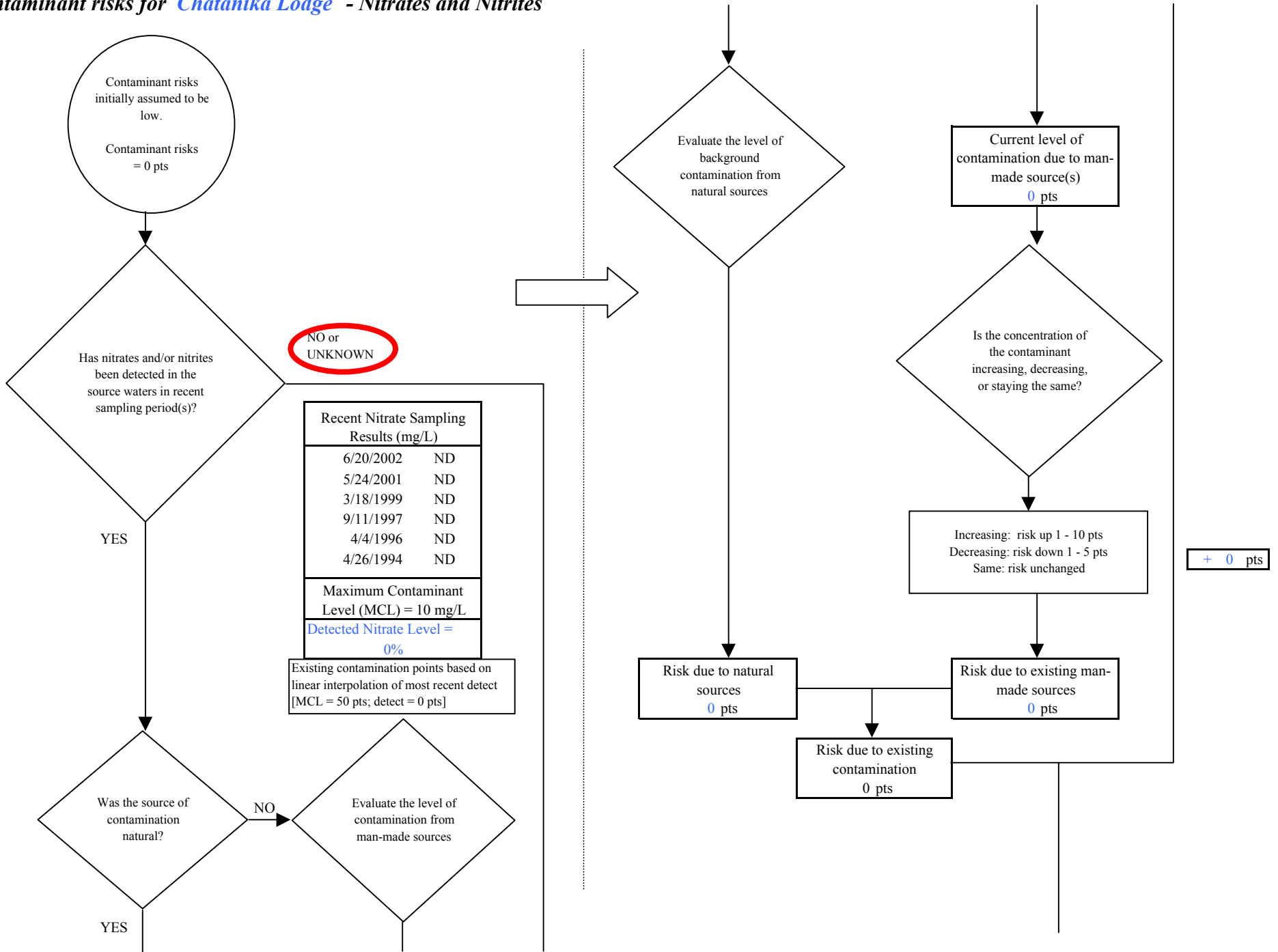
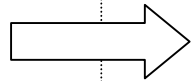
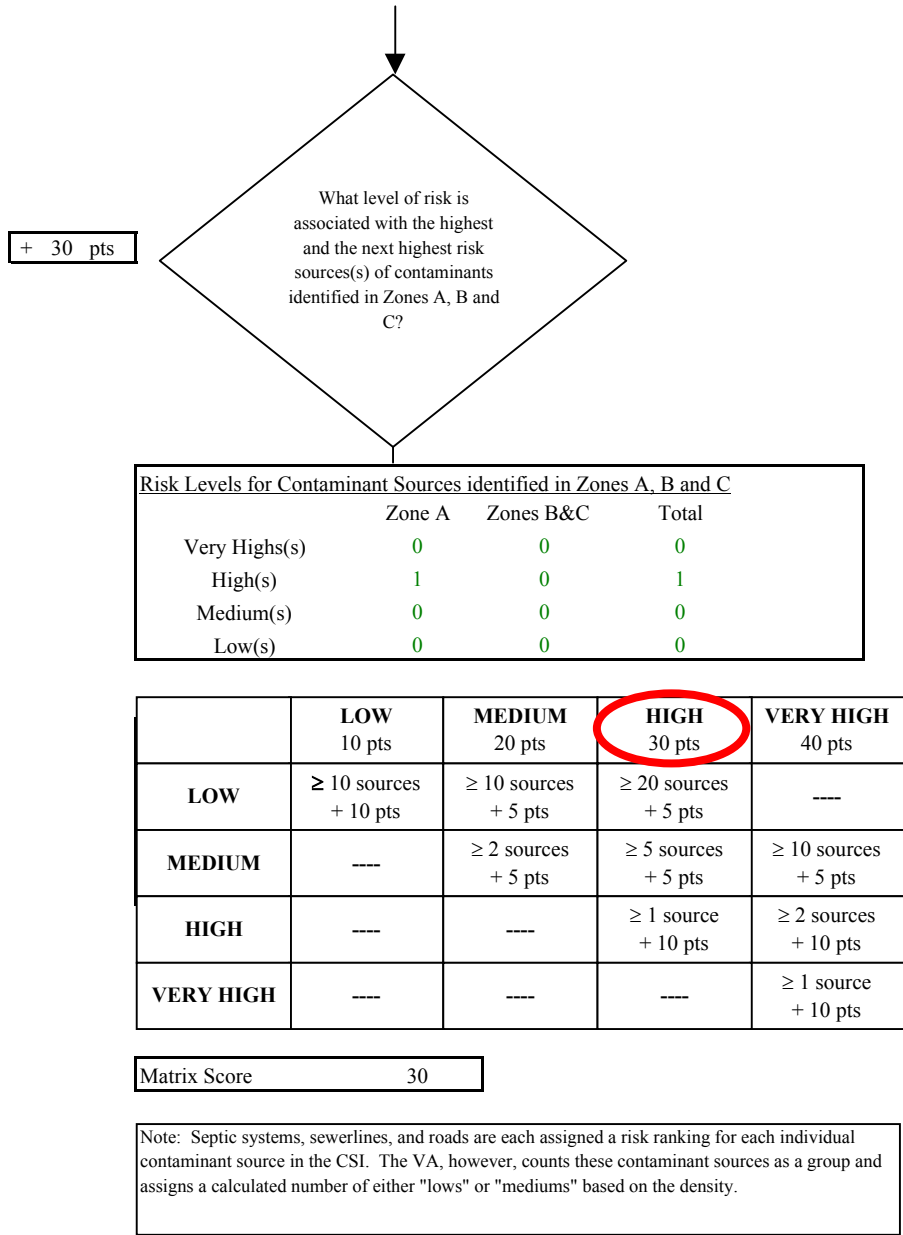


Chart 5. Contaminant risks for Chatanika Lodge - Nitrates and Nitrites



The large capacity septic system for Chatanika Lodge is located within Zone A

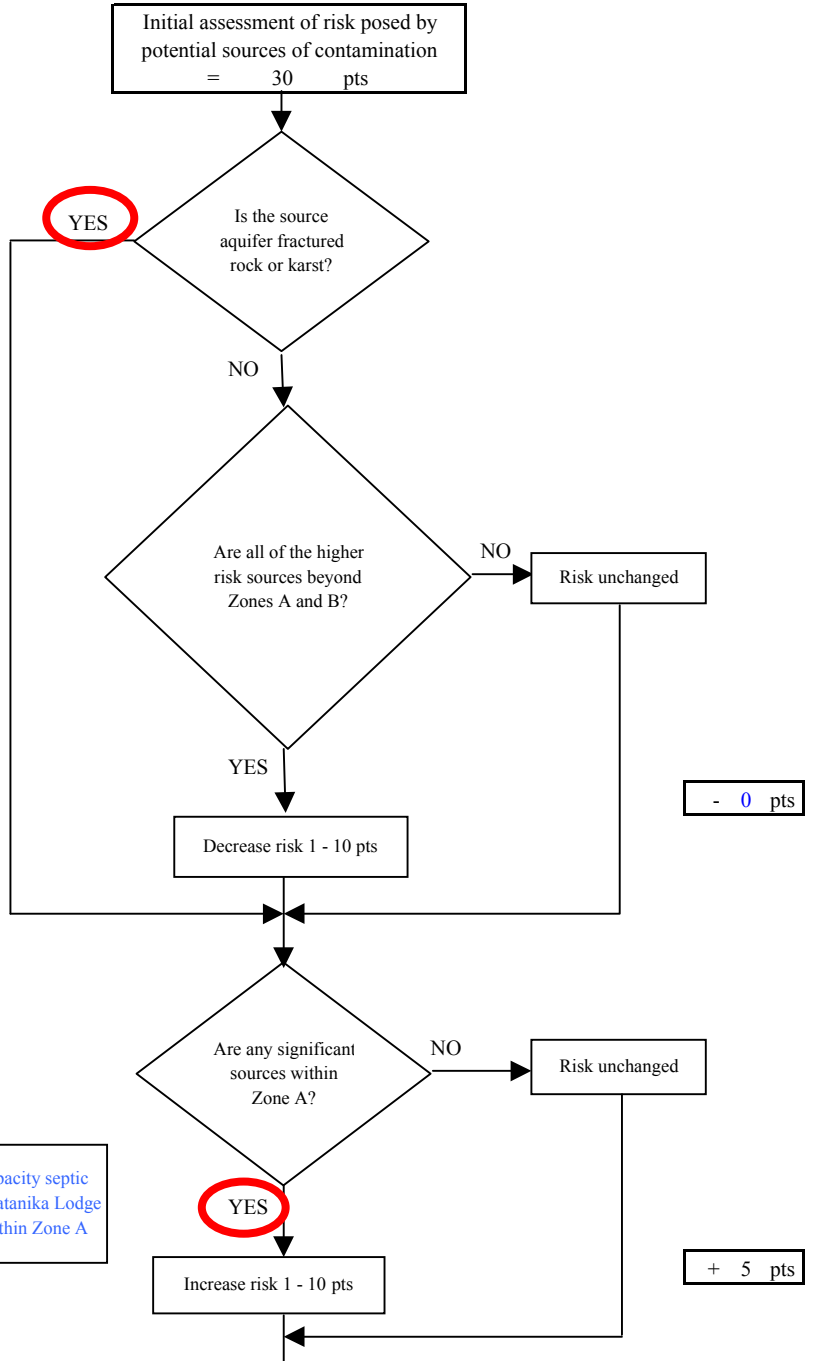


Chart 5. Contaminant risks for Chatanika Lodge - Nitrates and Nitrites

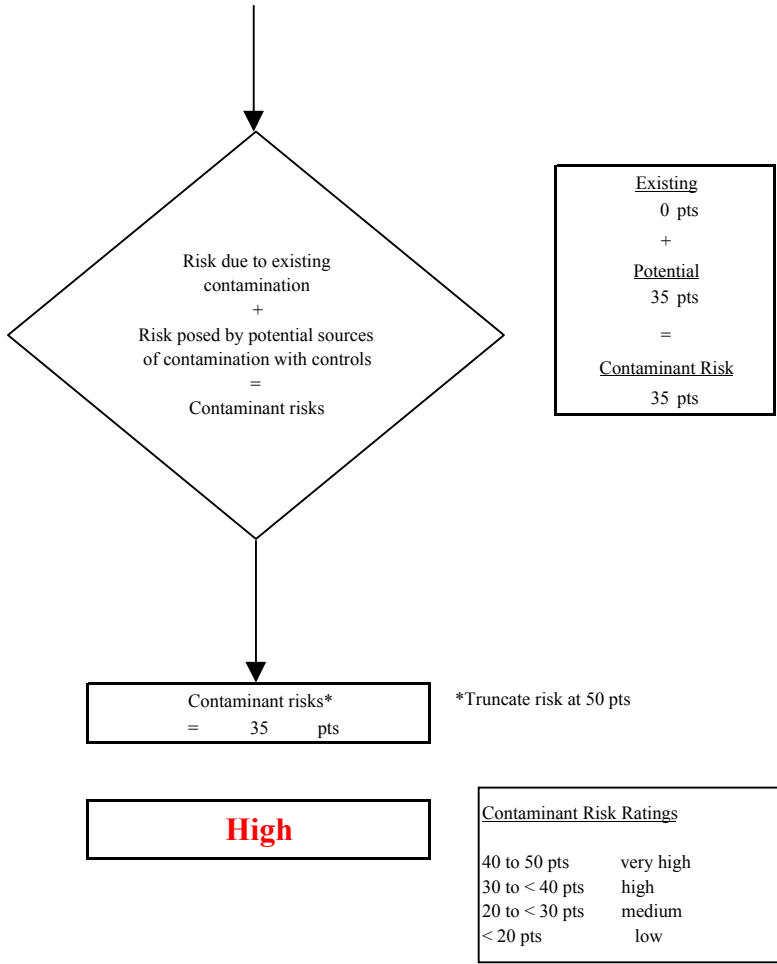
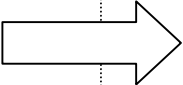
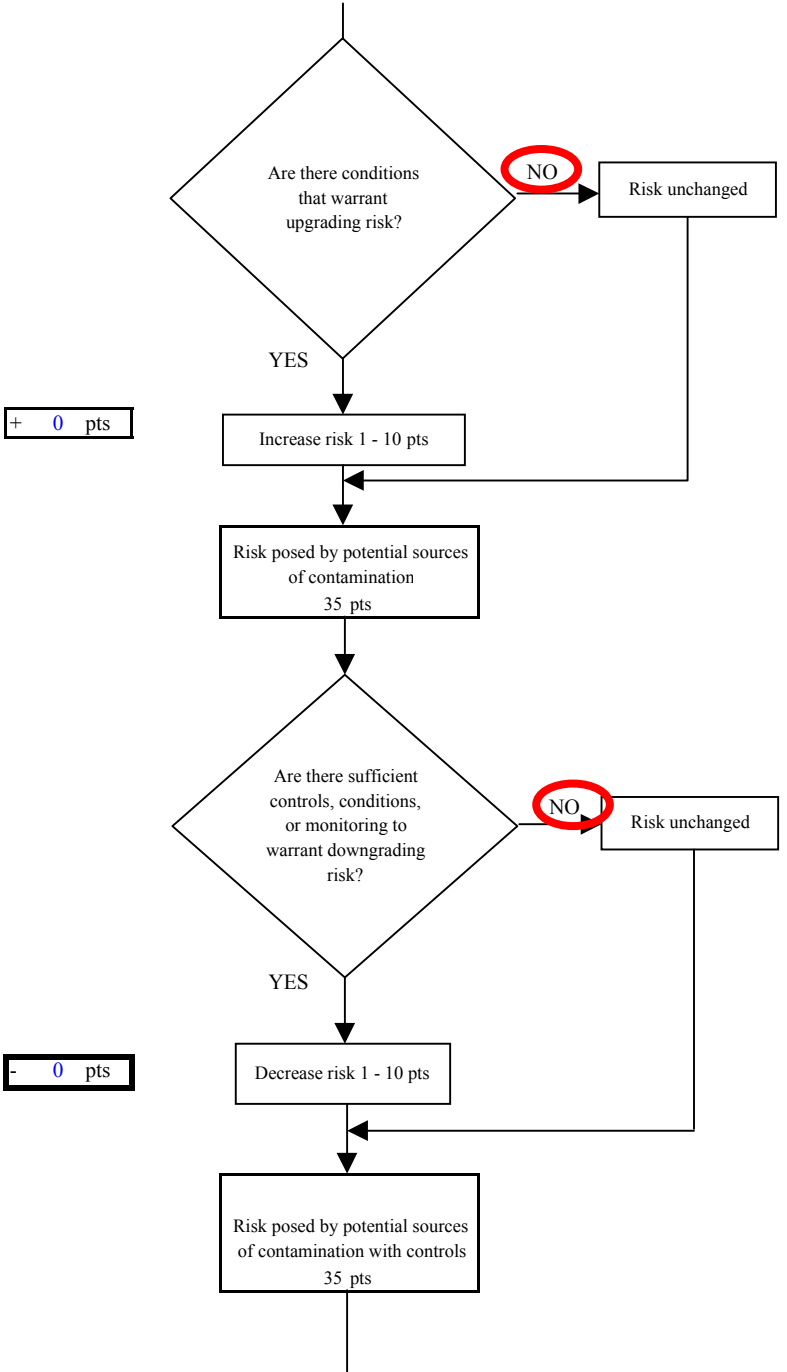


Chart 6. Vulnerability analysis for Chatanika Lodge - Nitrates and Nitrites

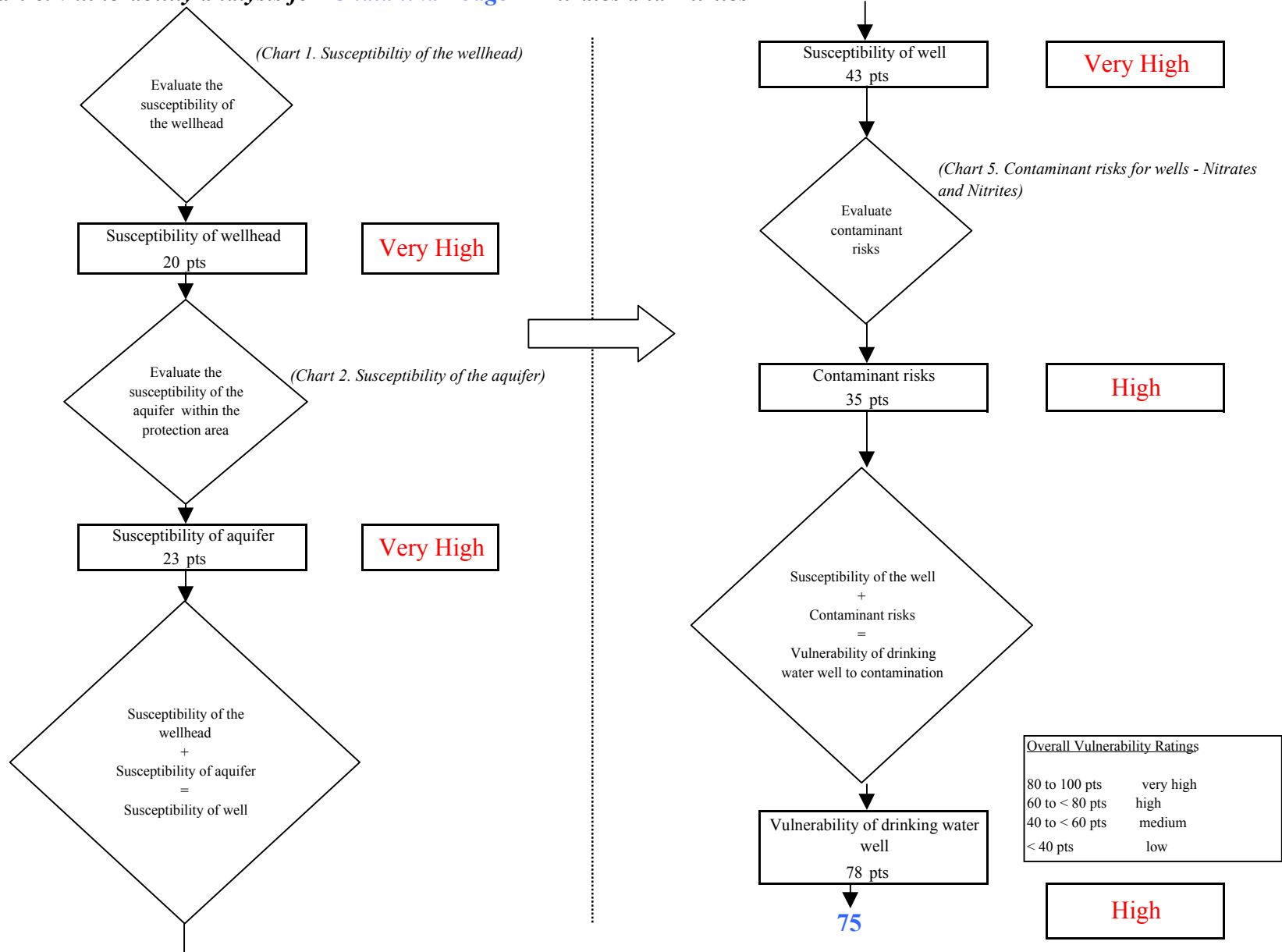


Chart 7. Contaminant risks for *Chatanika Lodge* - Volatile Organic Chemicals

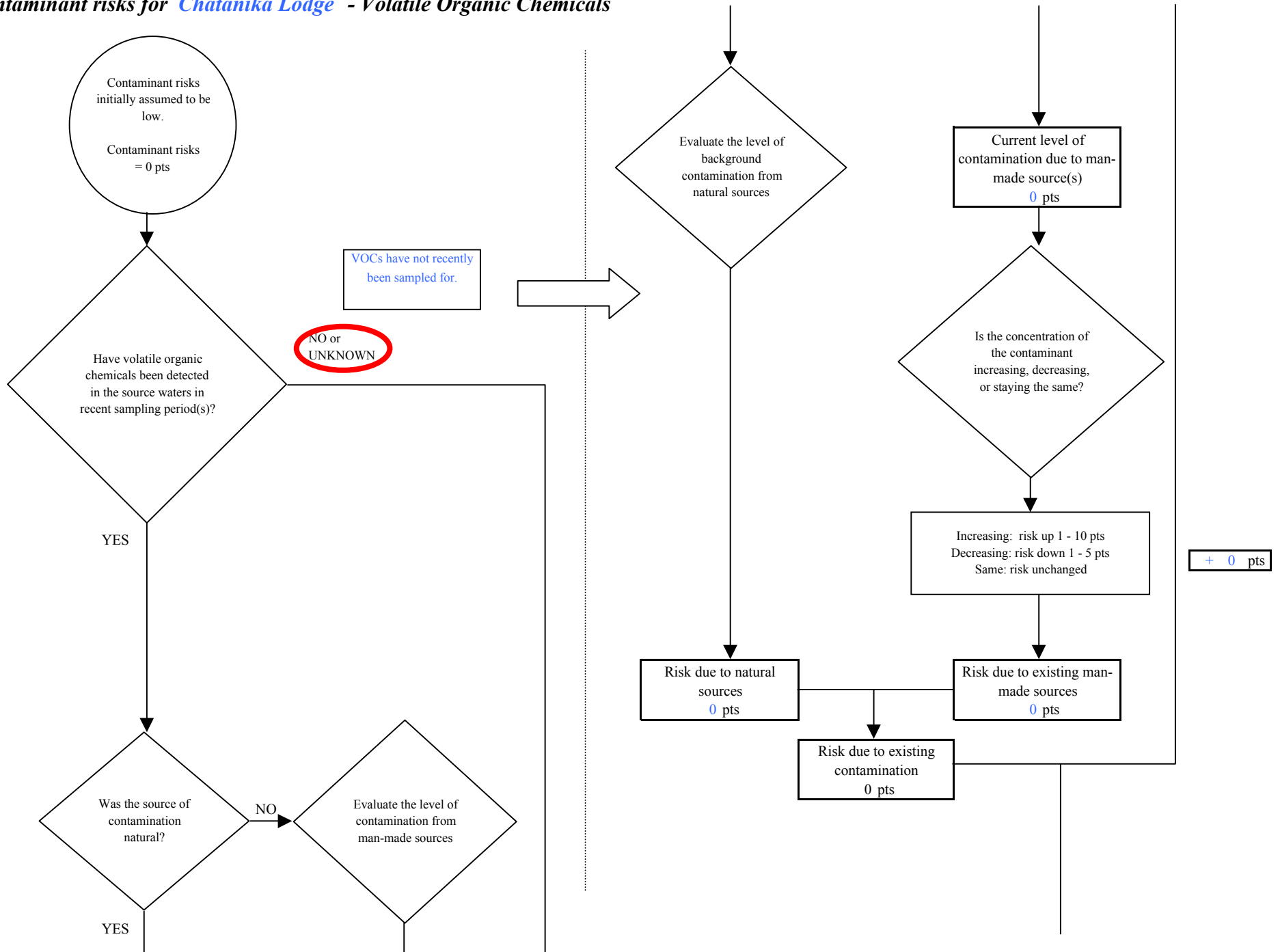


Chart 7. Contaminant risks for Chatanika Lodge - Volatile Organic Chemicals

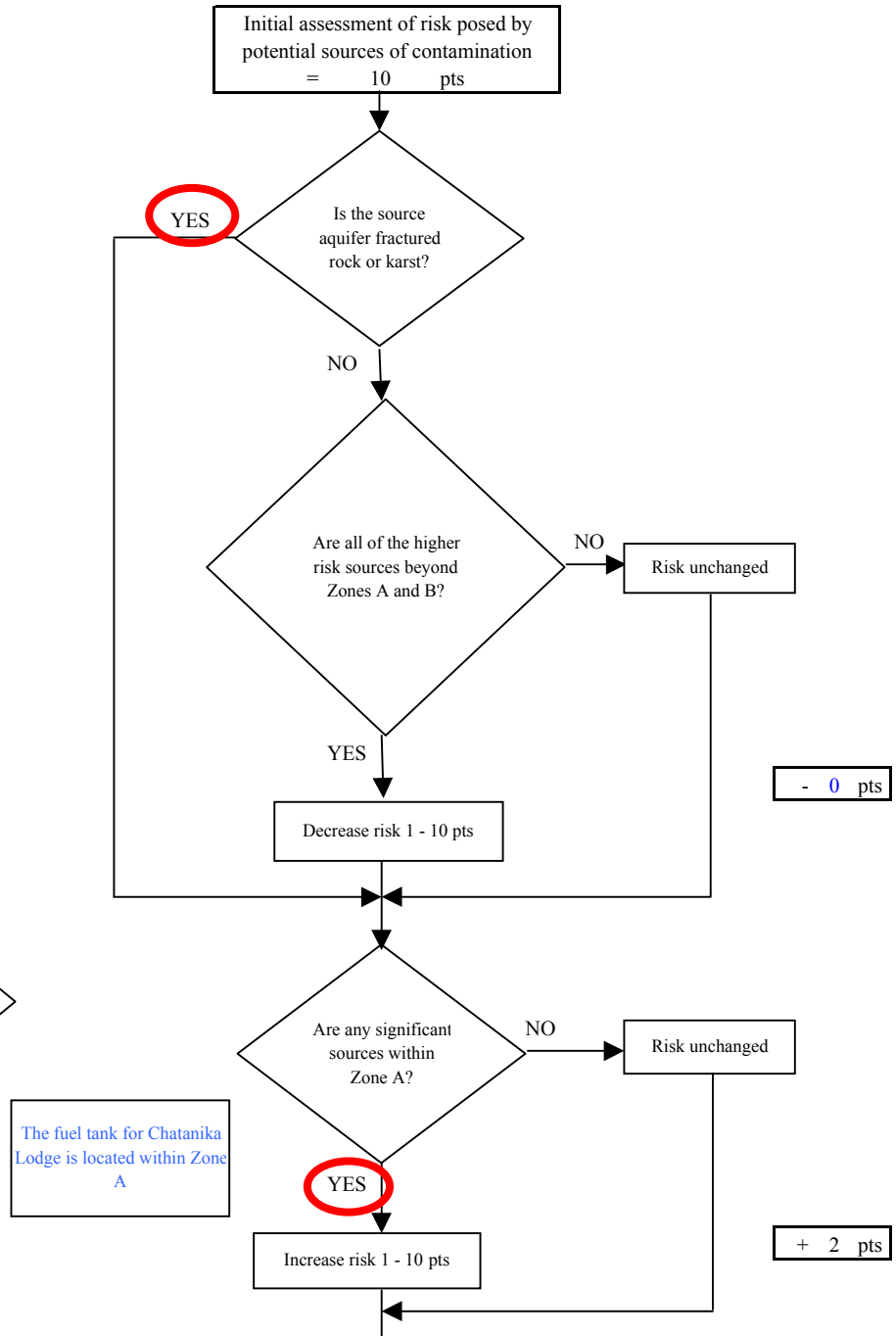
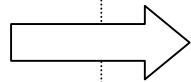
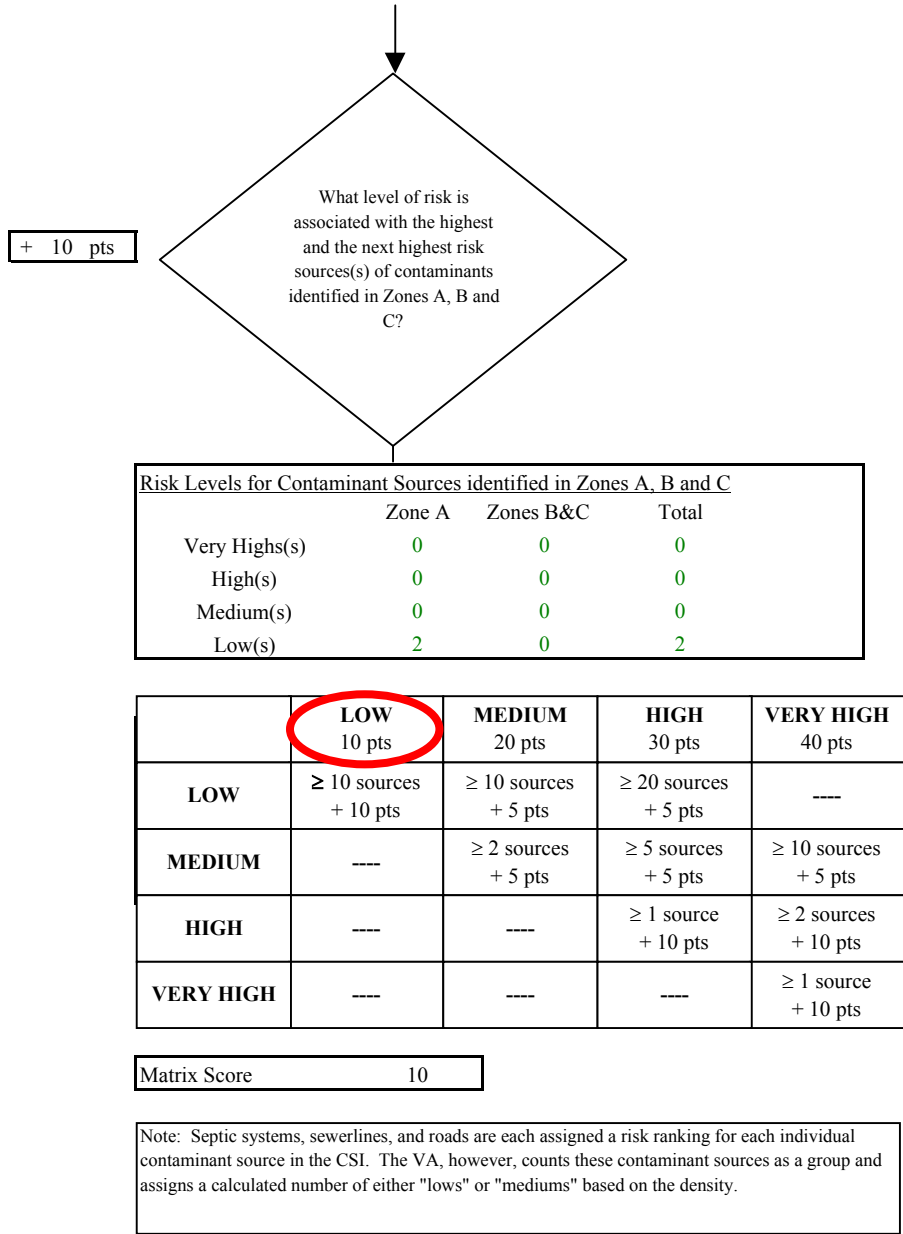


Chart 7. Contaminant risks for Chatanika Lodge - Volatile Organic Chemicals

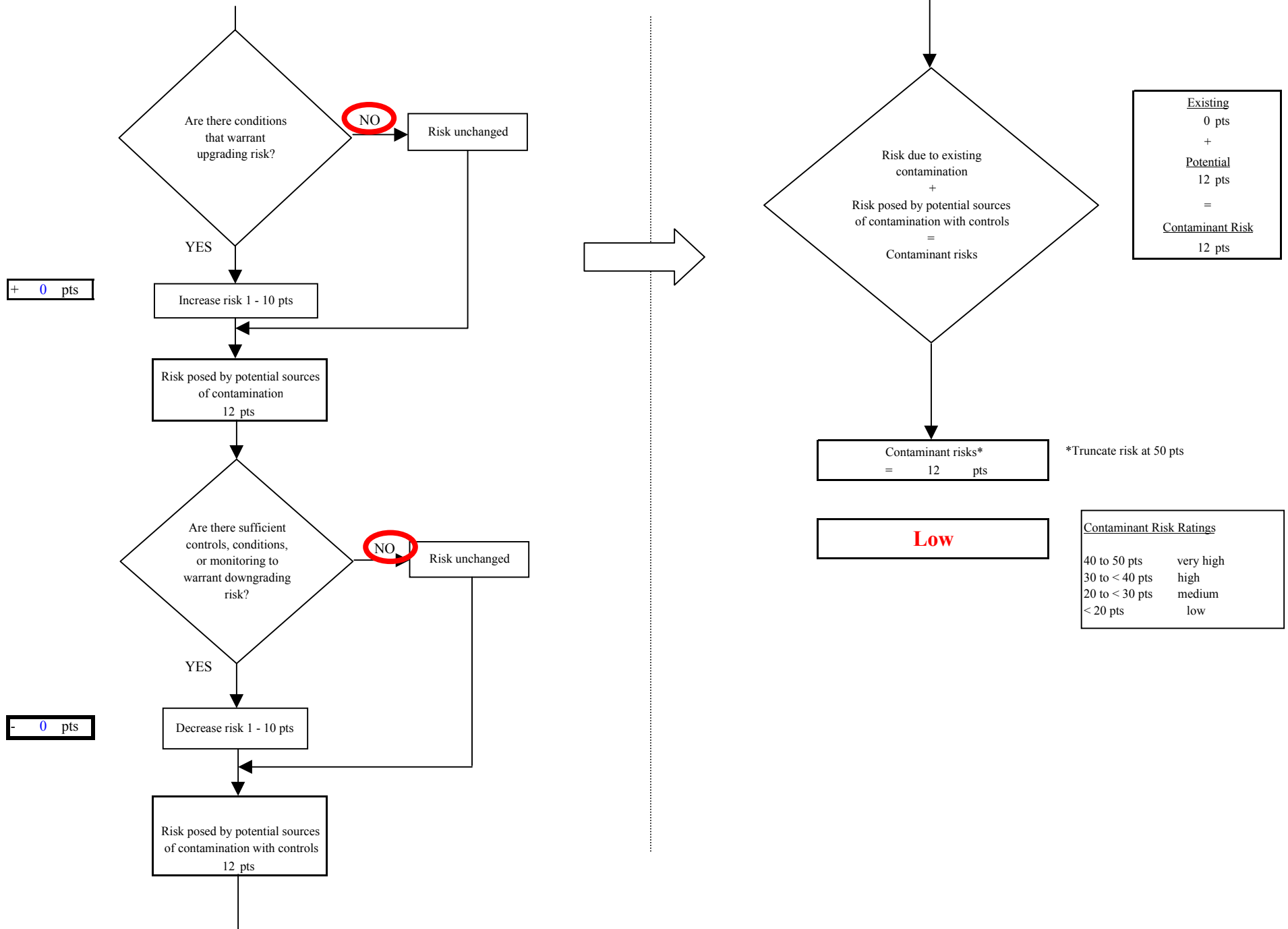


Chart 8. Vulnerability analysis for Chatanika Lodge - Volatile Organic Chemicals

