

Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
USF&W Tetlin Visitor Center,
Tok, Alaska
PWSID #381341

DRINKING WATER PROTECTION PROGRAM REPORT NO. 924

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 USF&W Tetlin Visitor Center, Tok, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for USF&W Tetlin Visitor Center is a Class B (transient/non-community) water system consisting of one well. The USF&W Tetlin Visitor Center is located at Mile 1,229 of the Alaska Highway, near Tok, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for USF&W Tetlin Visitor Center public drinking water source include a large-capacity septic system; aboveground heating oil tanks; paved highways and roads. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for USF&W Tetlin Visitor Center received a vulnerability rating of **High** for bacteria and viruses and nitrates and nitrites, and **Low** for volatile organic chemicals.

USF&W TETLIN VISITOR CENTER PUBLIC DRINKING WATER SYSTEM

USF&W Tetlin Visitor Center public water system is a Class B (transient/non-community) water system. The system consists of one well at Mile 1,229 of the Alaska Highway, approximately 3½ miles north of U.S. Customs near Tok, Alaska (See Map 1 of Appendix A). Tok is located at the junction of the Alaska Highway and the Tok cutoff to the Glenn Highway, 200 miles southeast of Fairbanks. Tok is called the “Gateway to Alaska” as it is the first major community upon entering Alaska, 93 miles from the Canadian border. The population of Tok is approximately 1,400.

Tok averages about 15 inches of precipitation per year, including 33 inches of snow. Although the quality of the groundwater can vary significantly in a short distance, groundwater supplies are generally abundant in the area.

The area surrounding the facility is flat-lying and located within the floodplain of a creek.

According to a Sanitary Survey dated June 24, 1999, the existing well was installed in 1988 with 6-inch diameter casing to a depth of 406 feet below the ground surface. The length of the well screen is assumed to be 10 feet. The Survey indicates that the land surface is sloped away from the well, providing adequate surface water drainage. Because the well was installed prior to 1992, it is assumed it is not grouted according to ADEC standards. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates from May to September and serves approximately 11,000 non-residents each month through one service connection.

USF&W TETLIN VISITOR CENTER 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 (DWPA). Because releases of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were estimated from information contained in the well logs and/or the Sanitary Survey. Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DWPA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPA's established for wells by the ADEC are usually separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well.

The TOT 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 USF&W Tetlin Visitor Center extends about 0.25 mile north of the well, and includes only Zone A. Because the upland groundwater system may include fractured bedrock, the TOT may be more rapid than predicted. For this reason, the zones related to TOT have been expanded at the upland base. Development in the vicinity of the well is limited to 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 USF&W Tetlin Visitor Center 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 TOT 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 USF&W TETLIN VISITOR CENTER 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.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
Chart 2 of Appendix D)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

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

We assume the well for the USF&W Tetlin Visitor Center 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 the USF&W Tetlin Visitor Center.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	15	High
Natural Susceptibility	20	Low

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	40	Very High
Nitrates and/or Nitrites	50	Very 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:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

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	60	High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	30	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with large-capacity septic systems and paved highways and roads located within Zone A representing the risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Only a small amount of bacteria and viruses are required to endanger public health. Recent sampling events indicated no positive results were detected for bacteria and viruses. However, after combining the contaminant risks with the overall natural susceptibility of the well, the vulnerability of the well to contamination by bacteria and viruses is **High**.

Nitrates and Nitrites

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

Sampling history for The USF&W Tetlin Visitor Center indicates that nitrates have been detected in the water, (most recently at 9.50 mg/L on 5/29/02) or 95% of the Maximum Contaminant Level (MCL). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination by nitrates and nitrites is **High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** with large-capacity septic systems; aboveground heating oil tanks; and paved highways and roads creating the only known risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

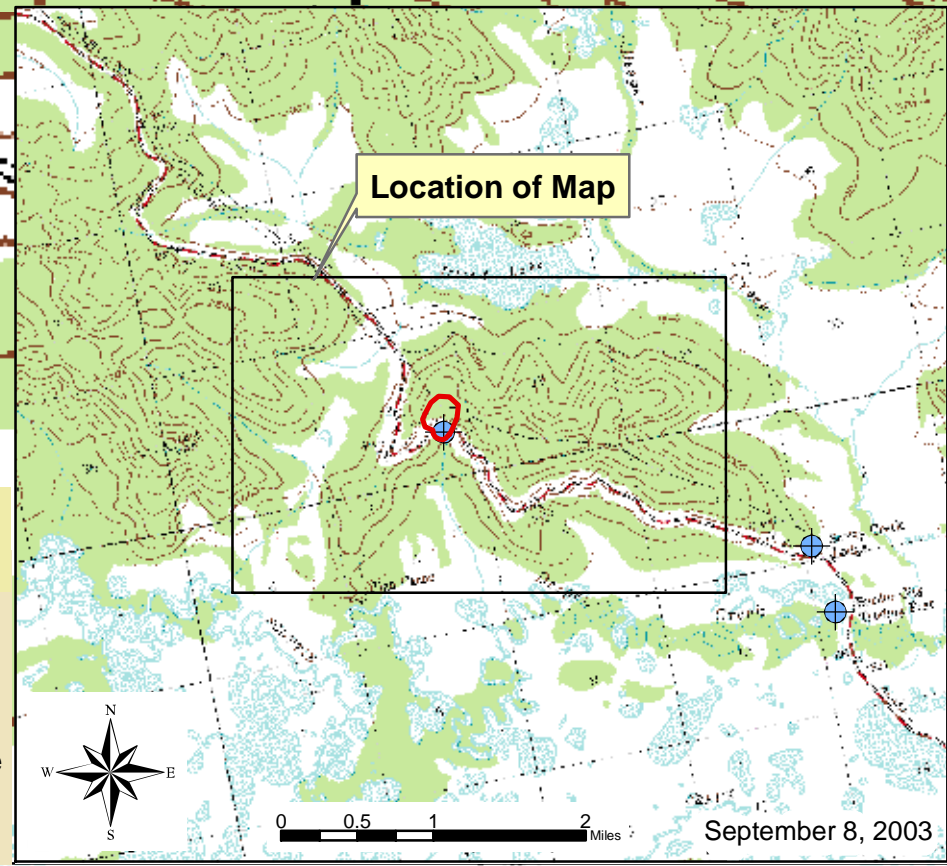
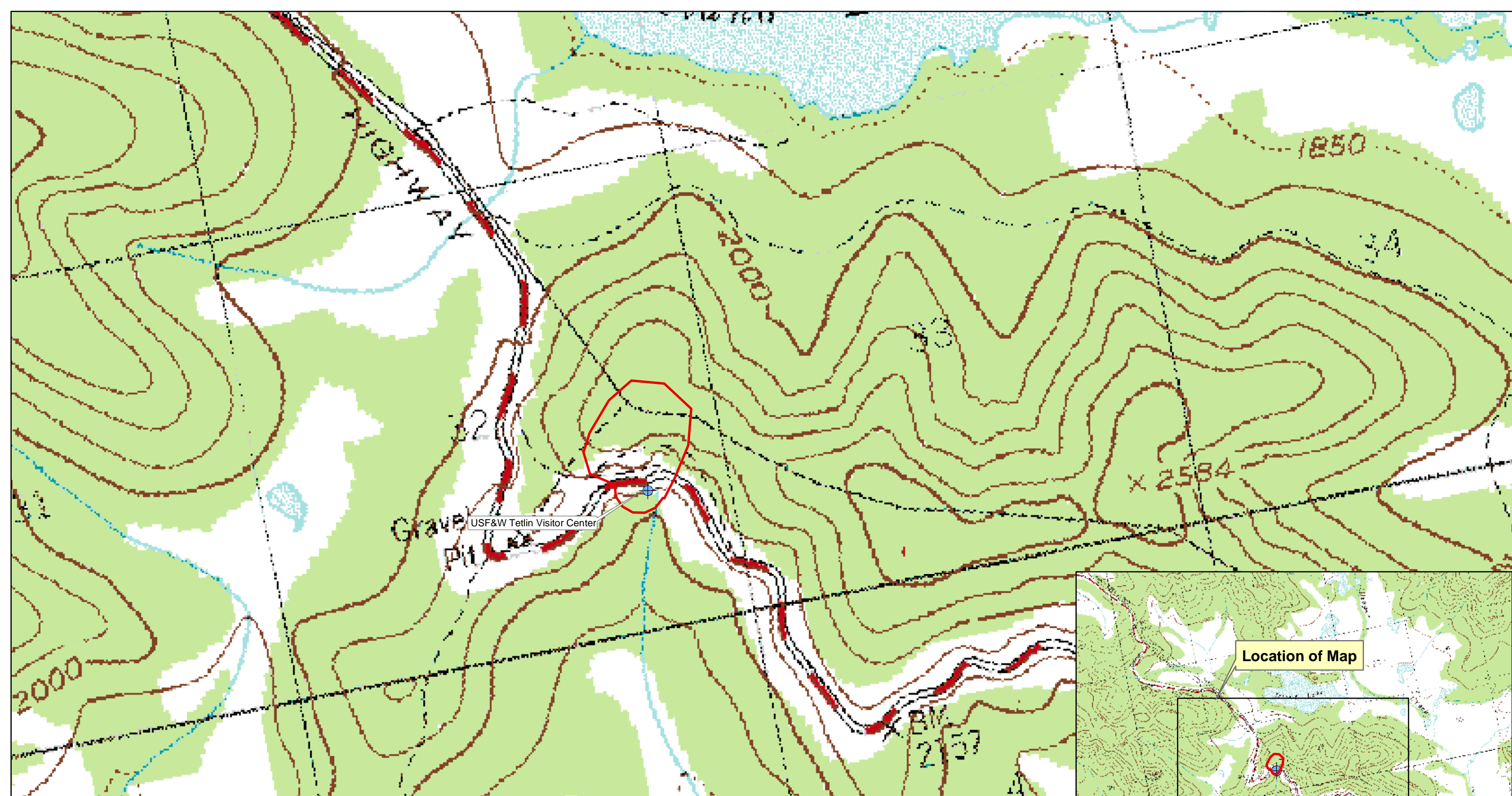
There are no recent sample data available for the drinking water at USF&W Tetlin Visitor Center for volatile organic chemicals. However, after combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination by volatile organic chemicals is **Low**.

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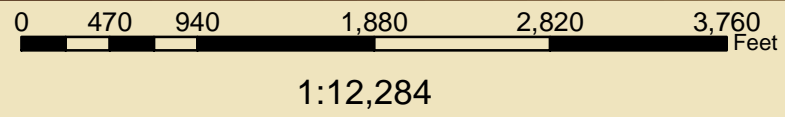
APPENDIX A

USF&W Tetlin Visitor Center Drinking Water Protection Area Location Map (Map 1)



Map 1: USF&W Tetlin Visitor Center Drinking Water Protection Areas

PWSID: 381341.001



Data Sources:
Background image - USGS 1:63,000 mapping

- Legend**
- Public Drinking Water Systems
 - DWPA Zone A**
 Several Months Travel Time
 - DWPA Zone B**
 Less than 2 Years Travel Time
 - DWPA Zone C**
 Less than 5 Years Travel Time
 - DWPA Zone D**
 Less than 10 Years Travel Time

APPENDIX B

USF&W Tetlin Visitor Center (Tables 1-4)

Table 1**Contaminant Source Inventory for
USF&W Tetlin Visitor Center****PWSID 381341.001**

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 USF&W Tetlin Visitor Center
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	2	Heating Oil Tank for USF&W Tetlin Visitor Center
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	2	Alaska Highway

**Contaminant Source Inventory and Risk Ranking for
USF&W Tetlin Visitor Center
Sources of Bacteria and Viruses**

PWSID 381341.001

Table 2

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	Septic System for USF&W Tetlin Visitor Center
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	Alaska Highway

**Contaminant Source Inventory and Risk Ranking for
USF&W Tetlin Visitor Center
Sources of Nitrates/Nitrites**

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Table 3

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	Septic System for USF&W Tetlin Visitor Center
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	Alaska Highway

**Contaminant Source Inventory and Risk Ranking for
USF&W Tetlin Visitor Center
Sources of Volatile Organic Chemicals**

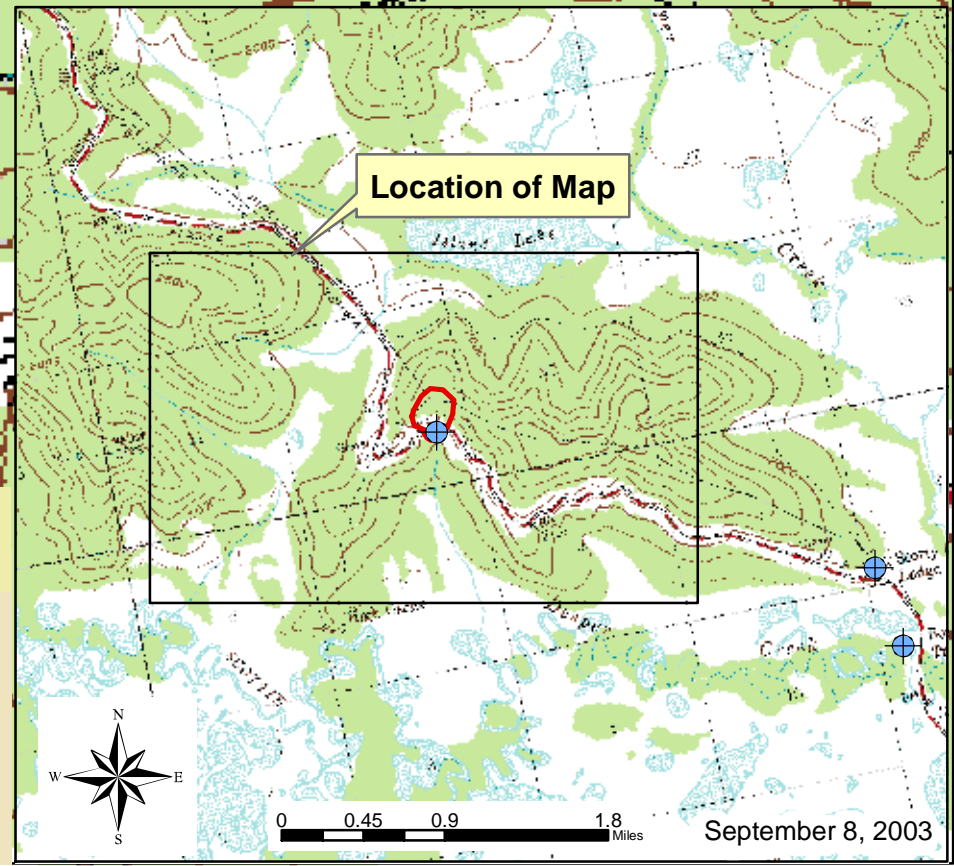
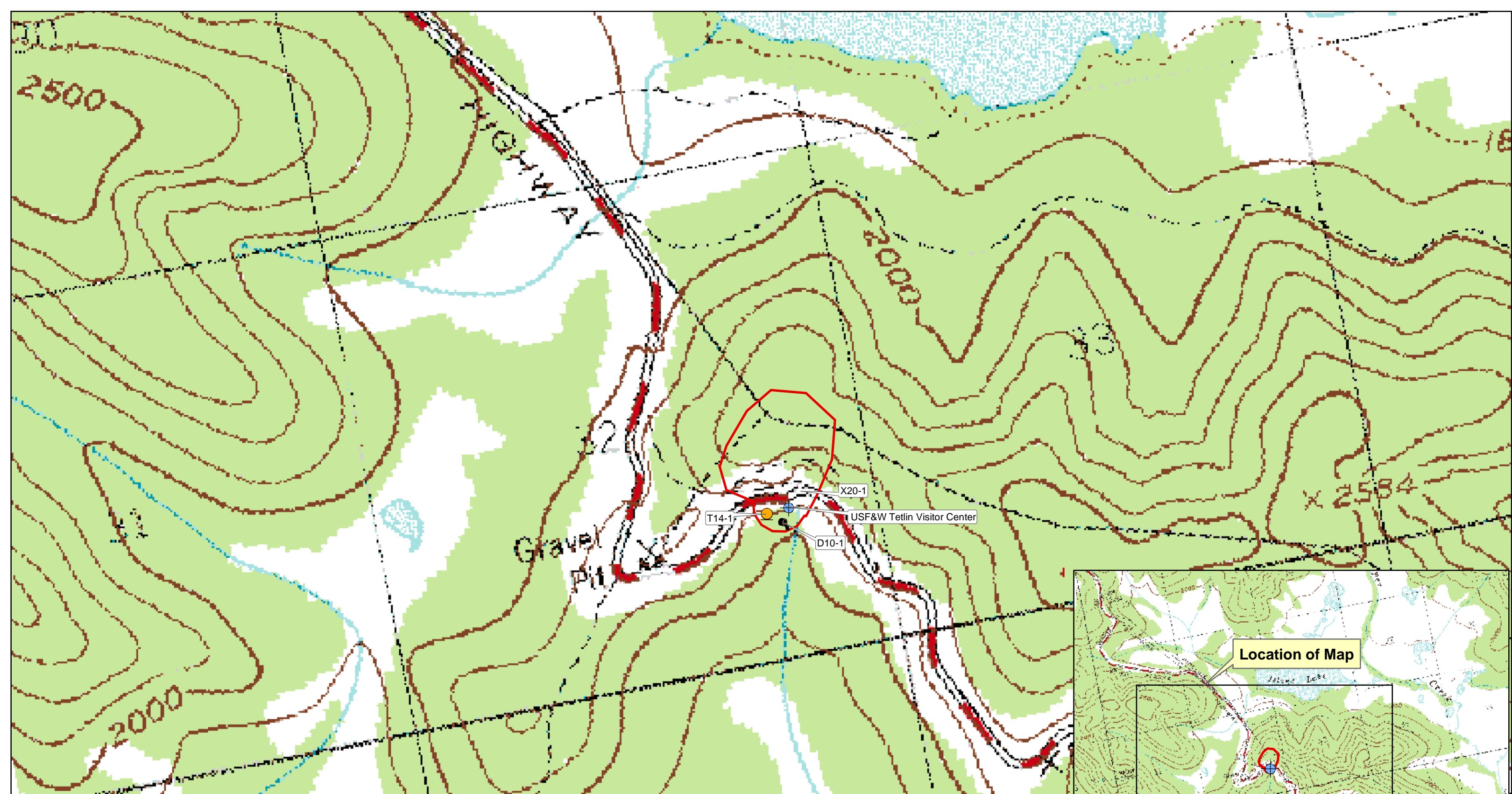
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Table 4

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	Septic System for USF&W Tetlin Visitor Center
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	Low	2	Heating Oil Tank for USF&W Tetlin Visitor Center
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	Alaska Highway

APPENDIX C

USF&W Tetlin Visitor Center Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



Map 2: Drinking Water Protection Areas for USF&W Tetlin Visitor Center and Potential and Existing Sources of Contamination

PWSID: 381341.001



0 380 760 1,520 2,280 3,040 Feet
1:11,441

Data Sources:
Background image - USGS 1:63,000 mapping

- Legend**
- Public Drinking Water Systems
 - DWPP Contaminated Sites**
 - Nonresidential Heating Oil Tank (T14)
 - Large Capacity Septic System (D10)
 - DWPA Zone A**
 - Several Months Travel Time
 - DWPA Zone B**
 - Less than 2 Years Travel Time
 - DWPA Zone C**
 - Less than 5 Years Travel Time
 - DWPA Zone D**
 - Less than 10 Years Travel Time

September 8, 2003

APPENDIX D

**Vulnerability Analysis for USF&W Tetlin Visitor Center
Public Drinking Water Source
(Charts 1-8)**

Chart 1. Susceptibility of the wellhead - USF&W Tetlin Visitor Center

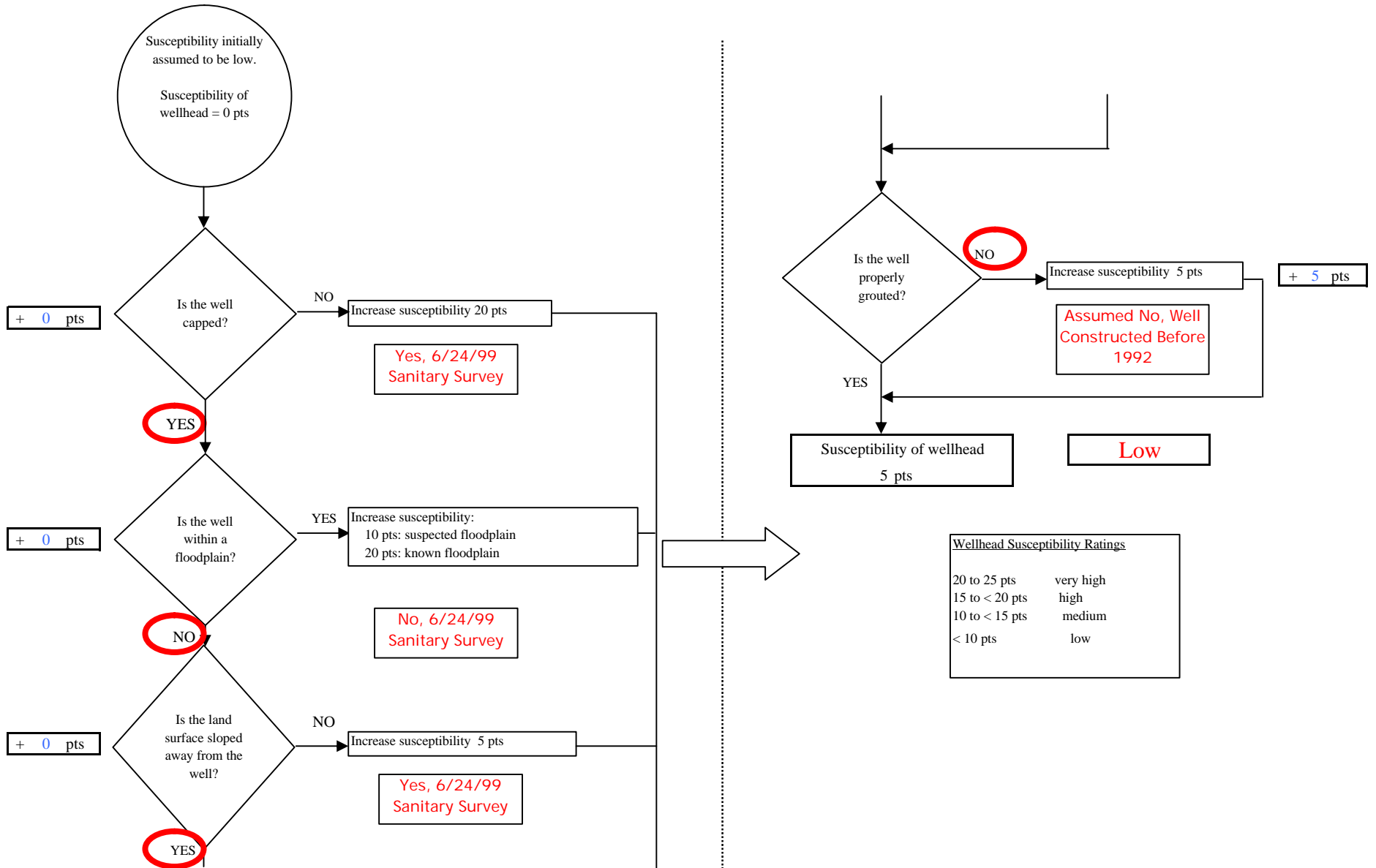


Chart 2. Susceptibility of the aquifer - USF&W Tetlin Visitor Center

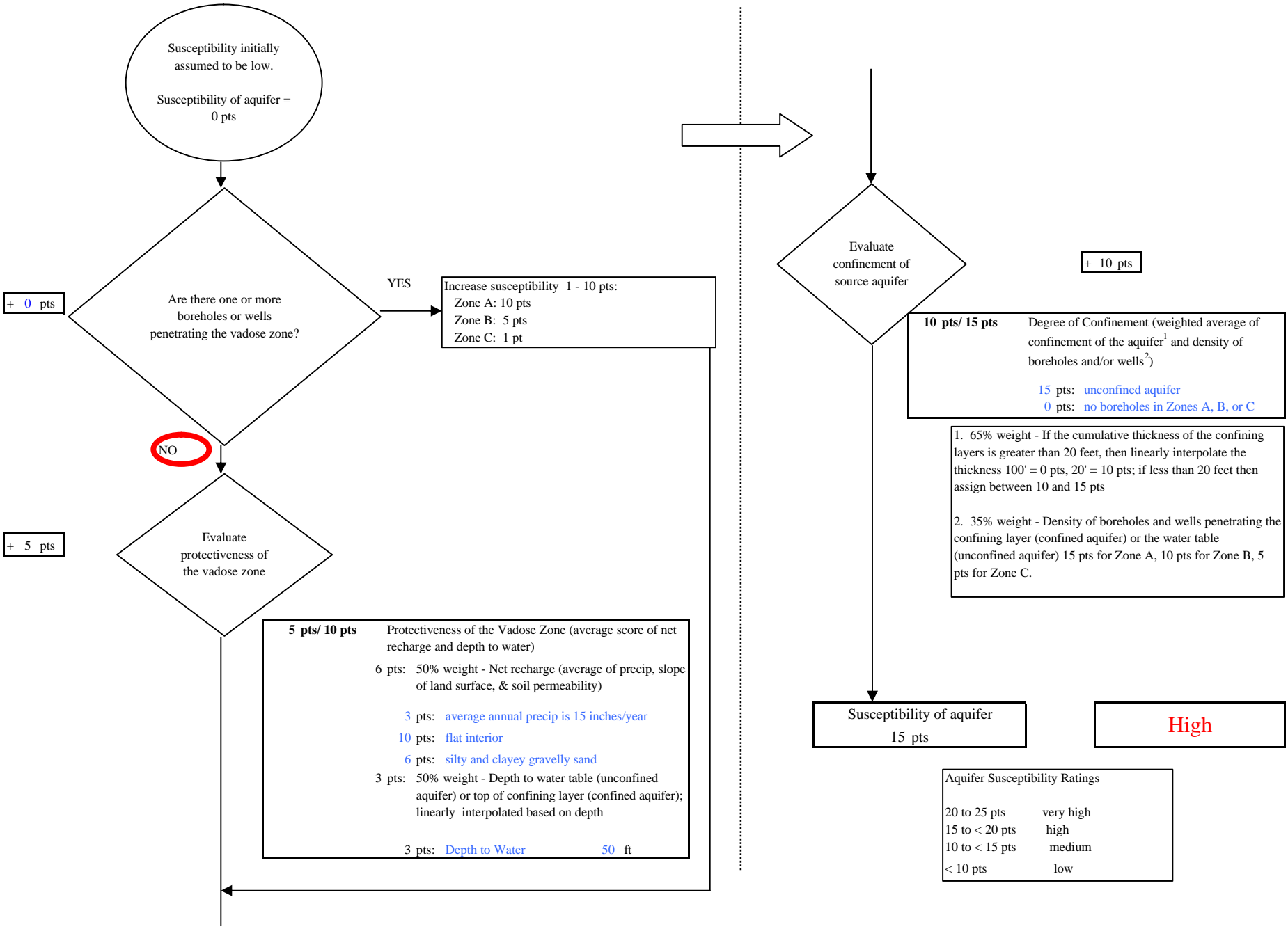


Chart 3. Contaminant risks for USF&W Tetlin Visitor Center - Bacteria & Viruses

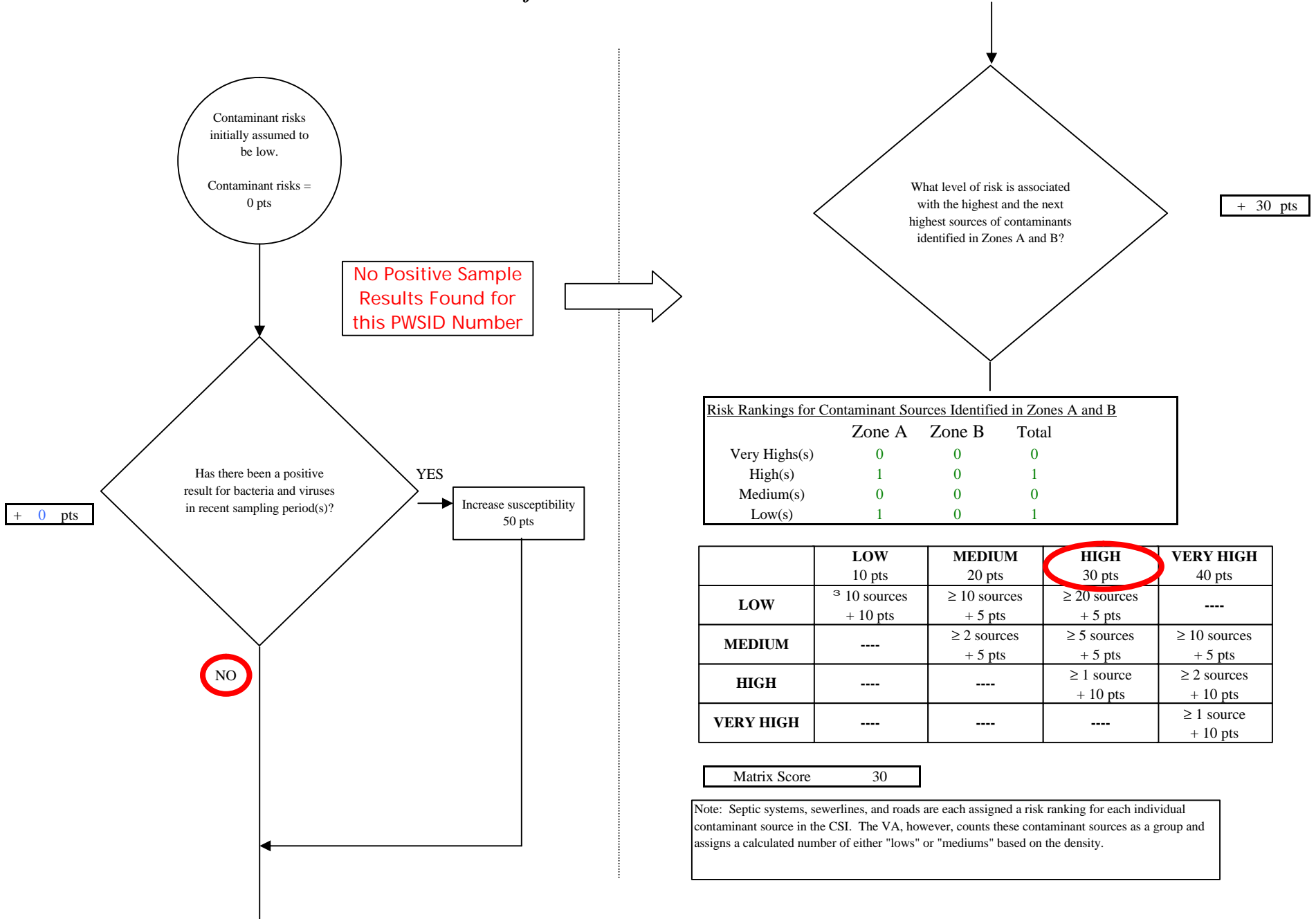


Chart 3. Contaminant risks for USF&W Tetlin Visitor Center - Bacteria & Viruses

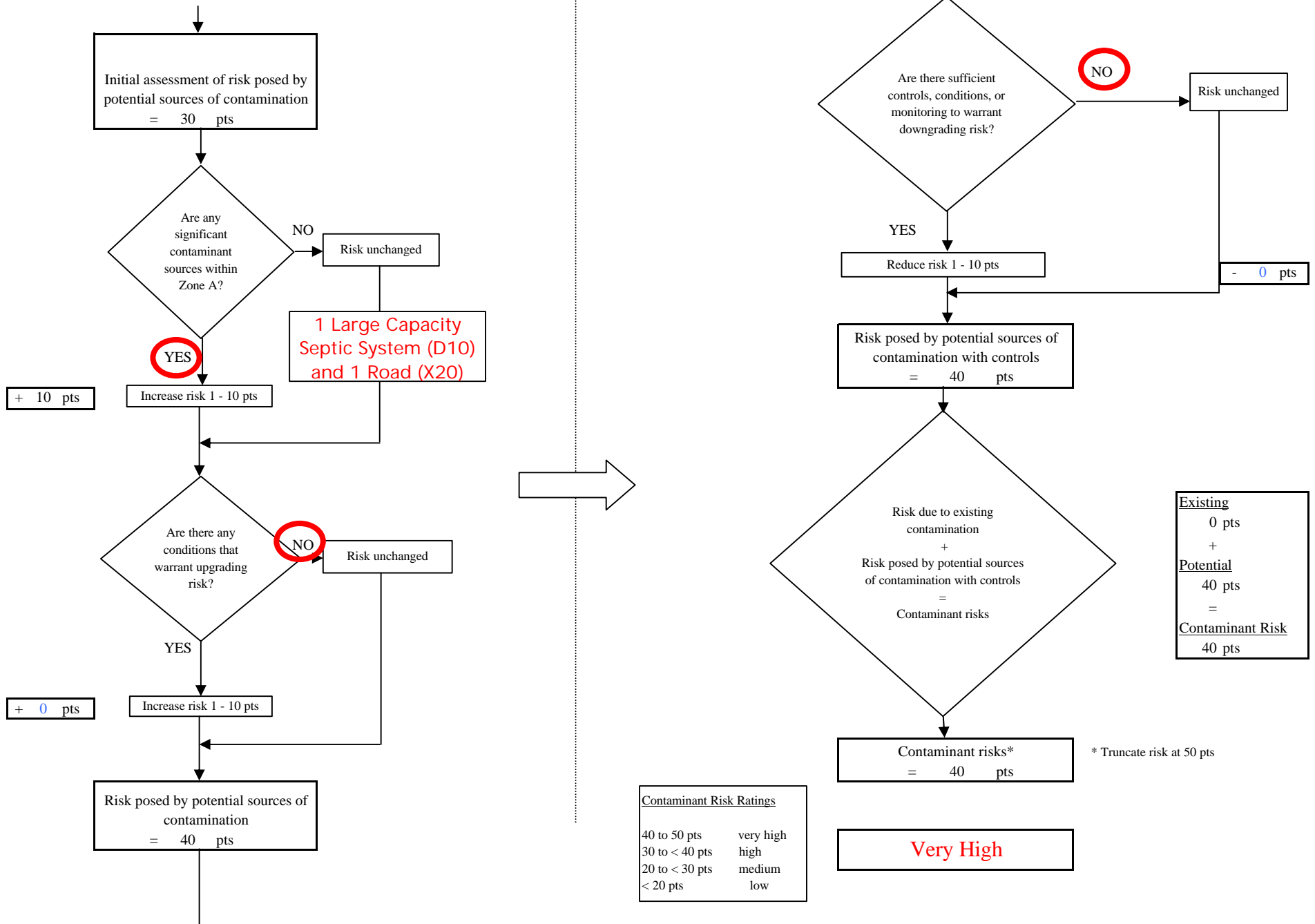


Chart 4. Vulnerability analysis for USF&W Tetlin Visitor Center - Bacteria & Viruses

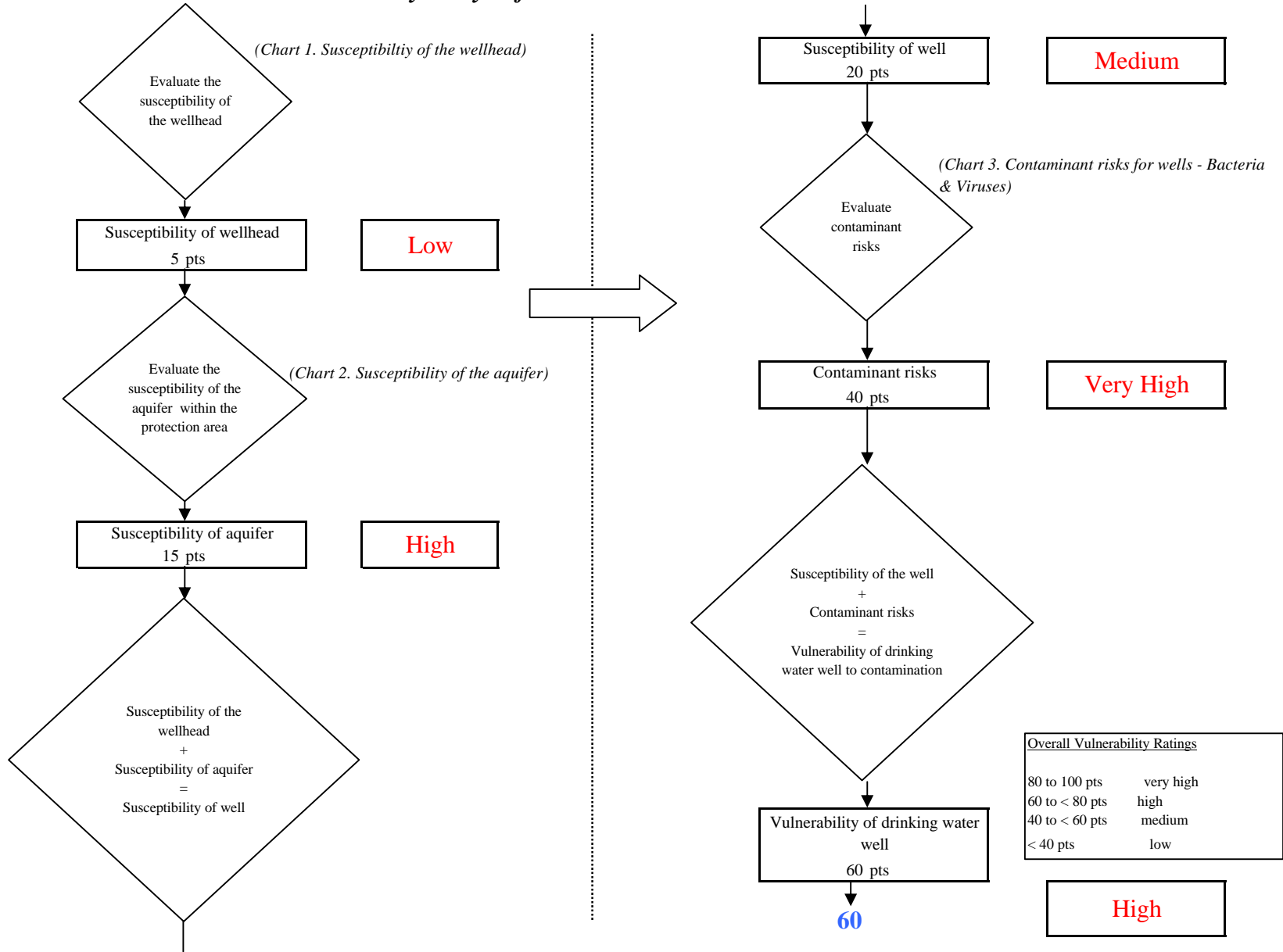


Chart 5. Contaminant risks for USF&W Tetlin Visitor Center - Nitrates and Nitrites

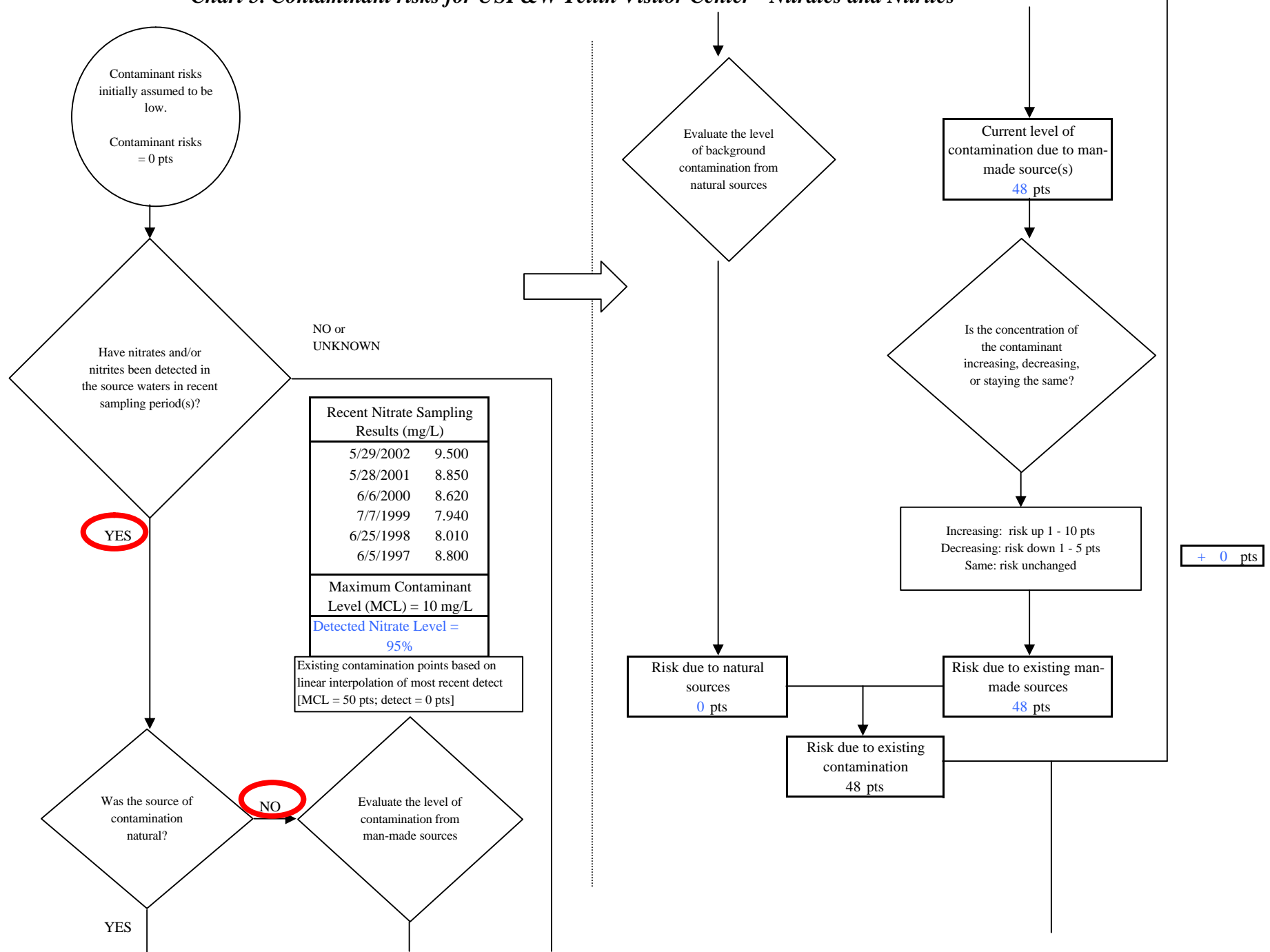


Chart 5. Contaminant risks for USF&W Tetlin Visitor Center - Nitrates and Nitrites

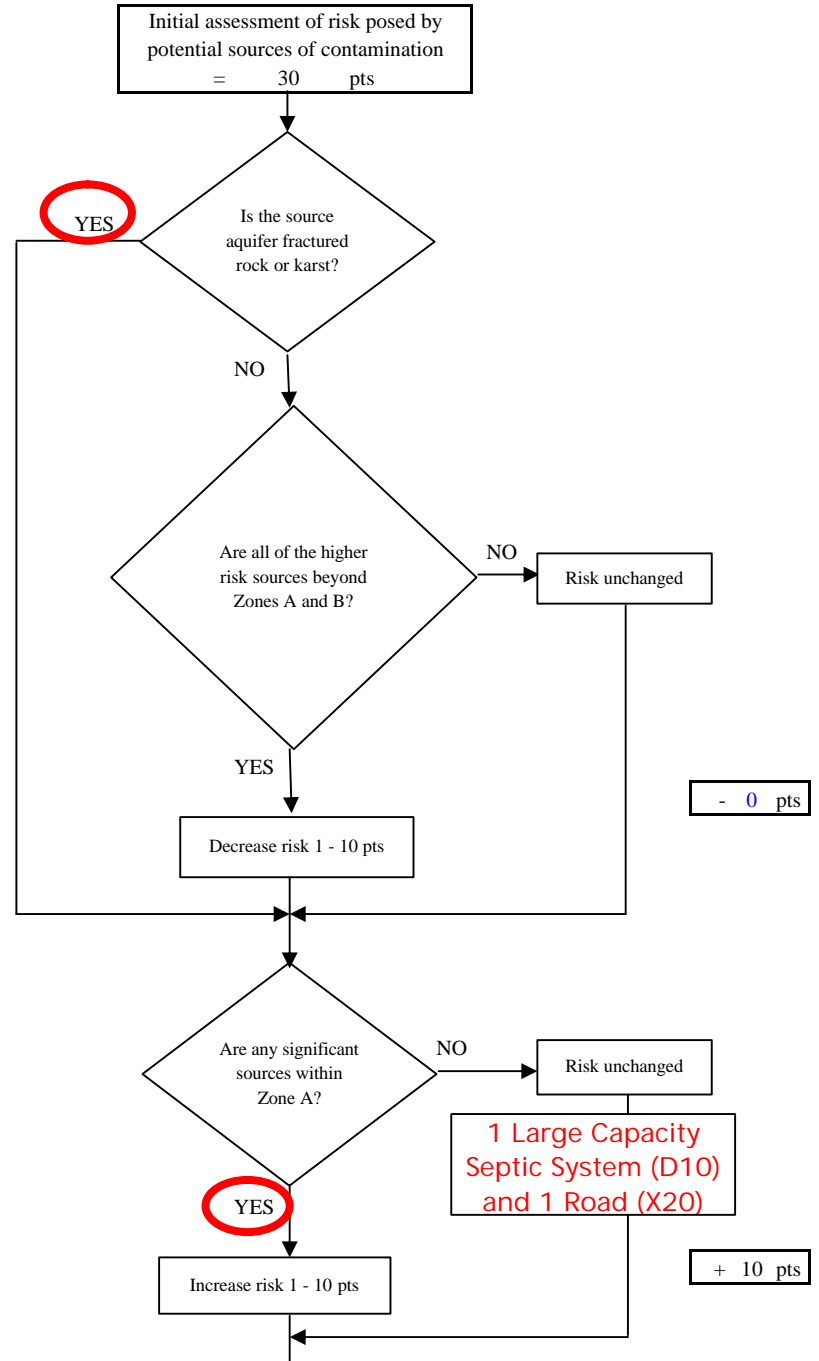
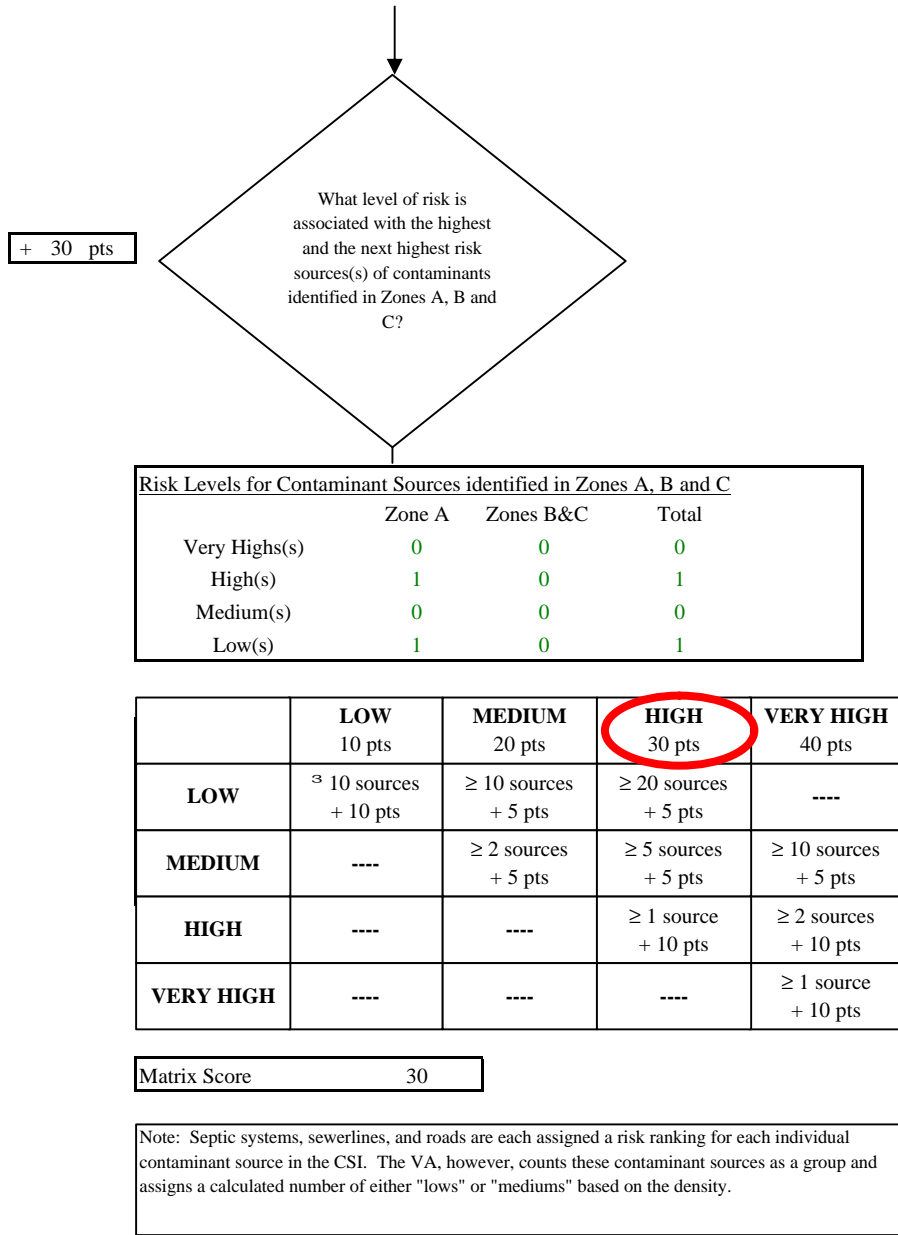


Chart 5. Contaminant risks for USF&W Tetlin Visitor Center - Nitrates and Nitrites

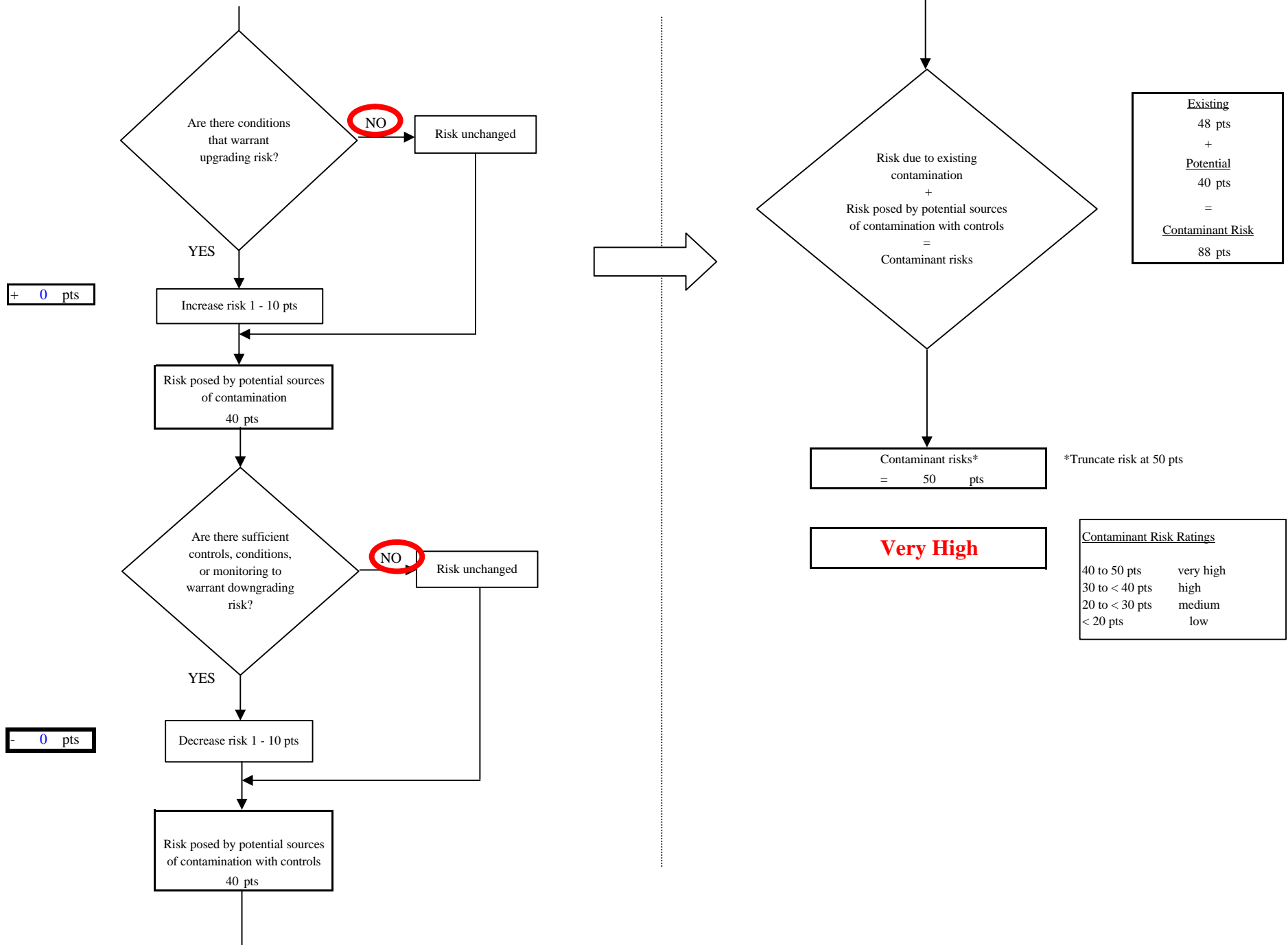


Chart 6. Vulnerability analysis for USF&W Tetlin Visitor Center - Nitrates and Nitrites

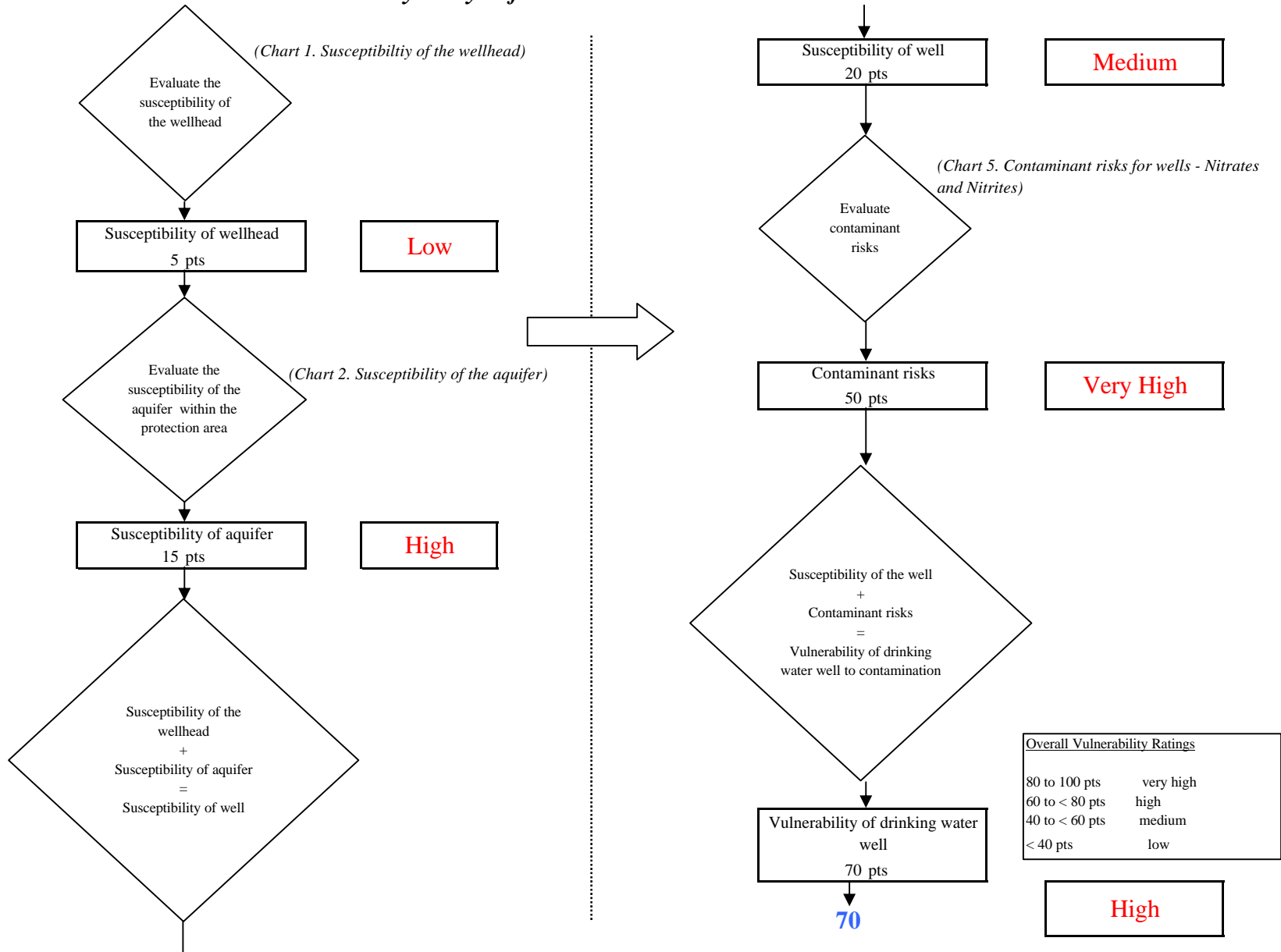


Chart 7. Contaminant risks for USF&W Tetlin Visitor Center - Volatile Organic Chemicals

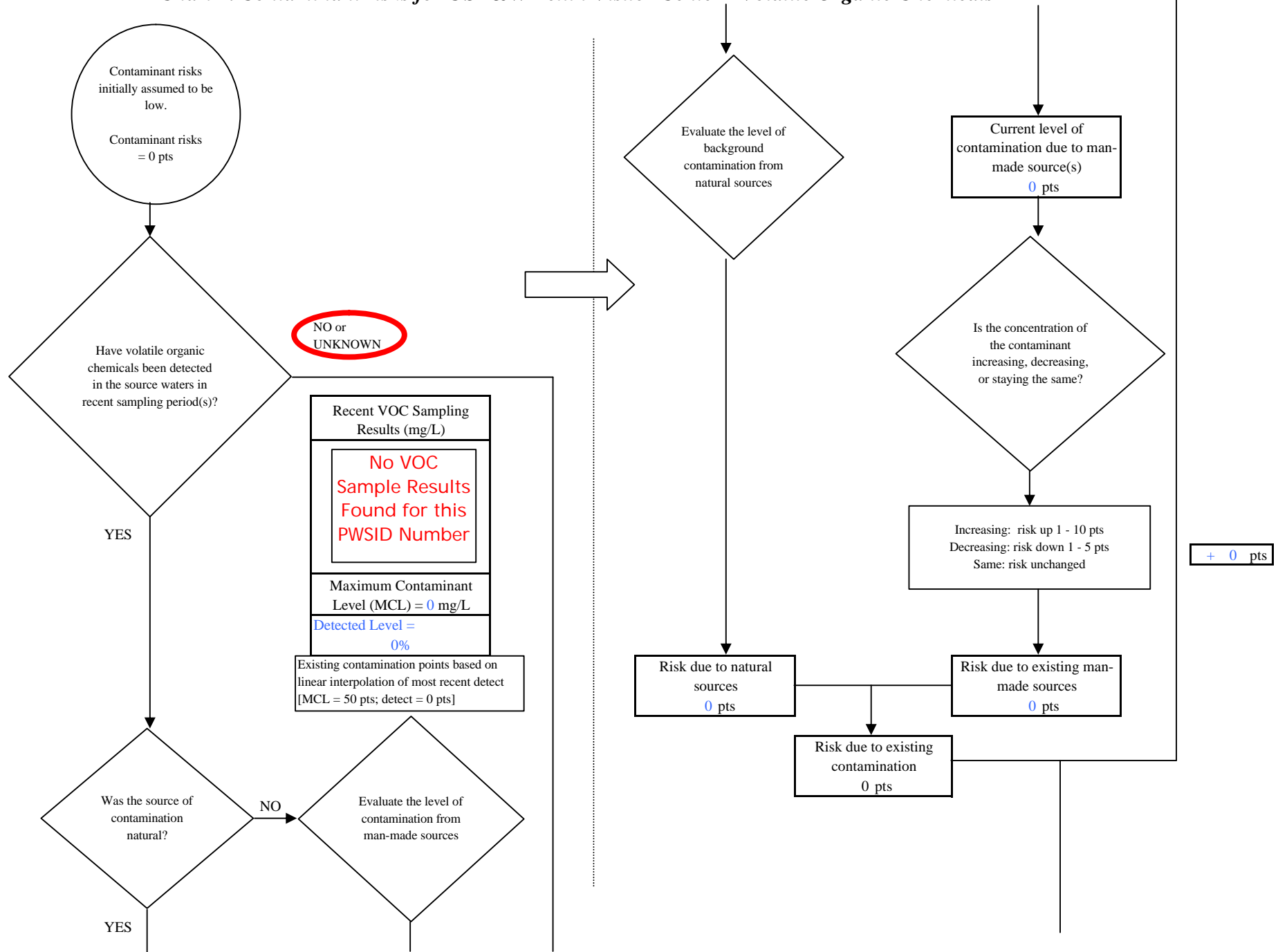


Chart 7. Contaminant risks for USF&W Tetlin Visitor Center - Volatile Organic Chemicals

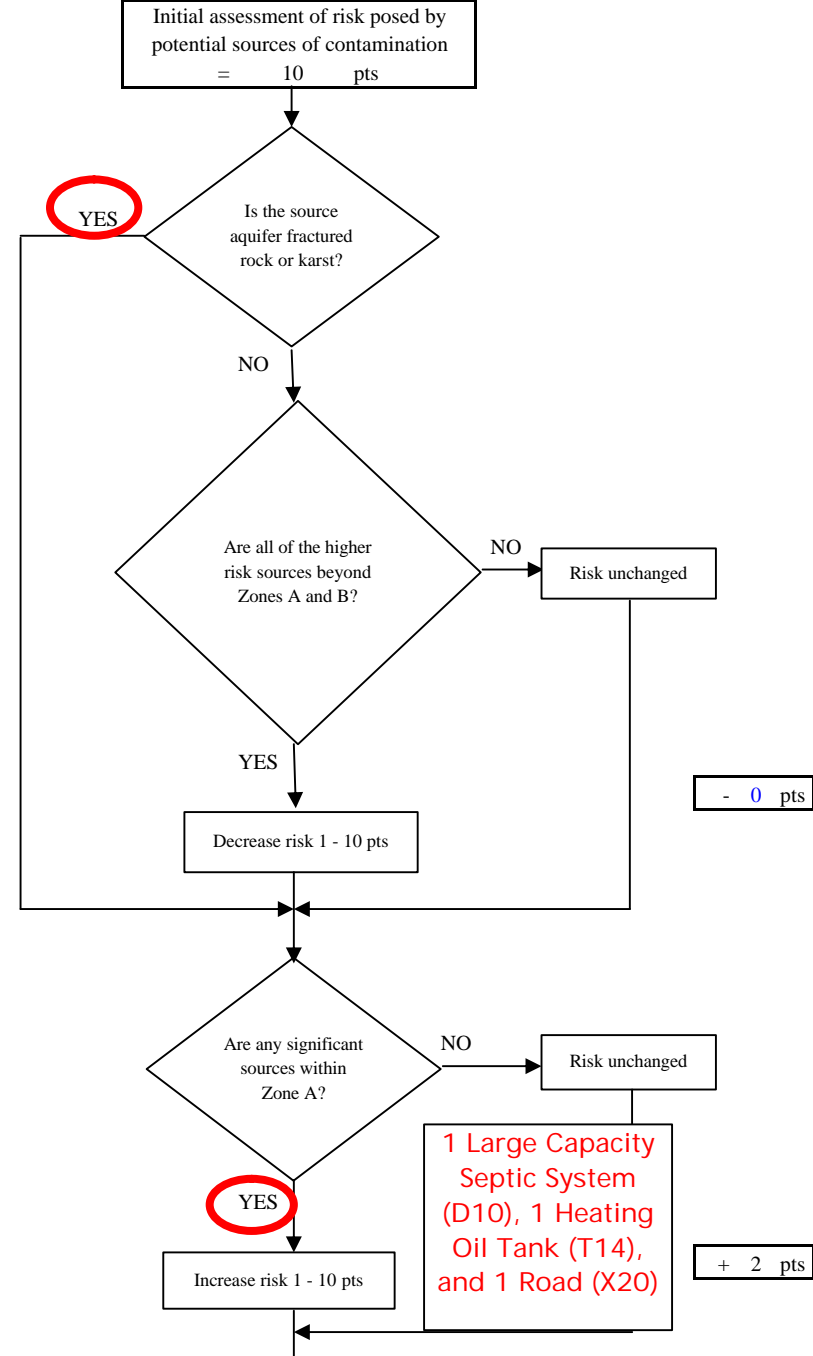
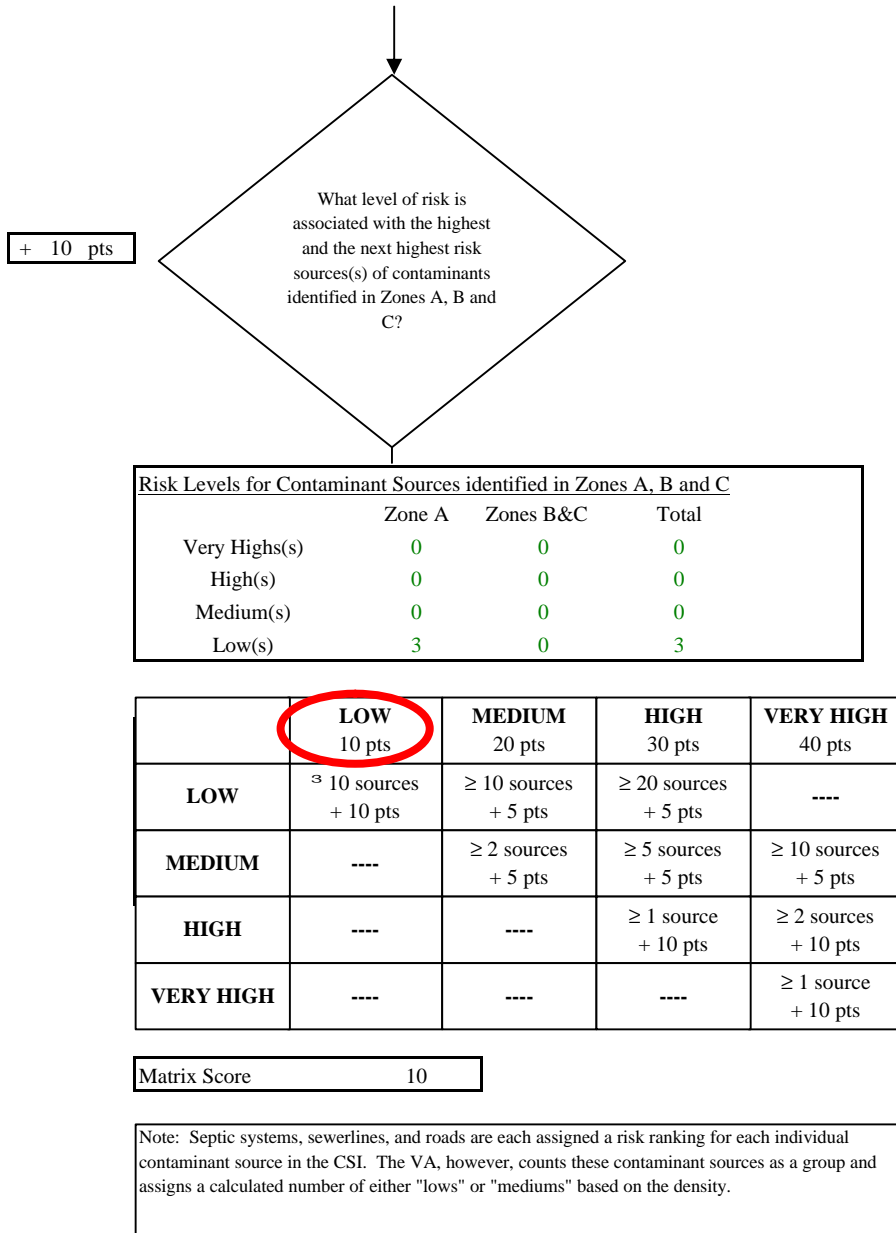


Chart 7. Contaminant risks for USF&W Tetlin Visitor Center - Volatile Organic Chemicals

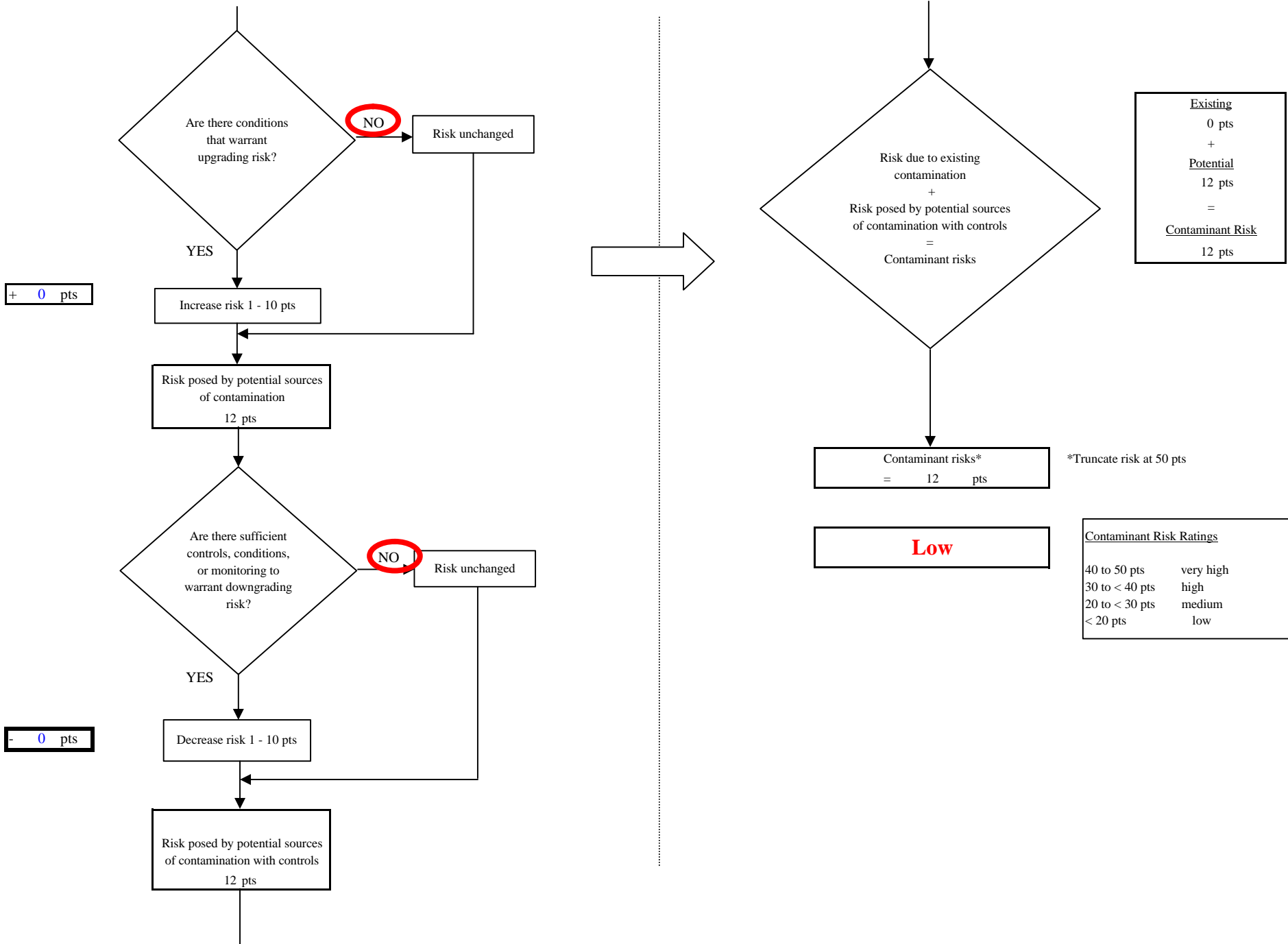


Chart 8. Vulnerability analysis for USF&W Tetlin Visitor Center - Volatile Organic Chemicals

