Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for
USFS Porcupine Creek #1
Drinking Water System,
Hope, Alaska
PWSID # 240422
June 2003

DRINKING WATER PROTECTION PROGRAM REPORT # 600
Alaska Department of Environmental Conservation

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By Ecology & Environment, Inc.

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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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APPENDICES

Source Water Assessment for USFS Porcupine Creek #1 Source of Public Drinking Water, Hope, Alaska

By Ecology & Environment, Inc.

Drinking Water Protection Program
Alaska Department of Environmental Conservation

Executive Summary

USFS Porcupine Creek #1 is a Class B (transient/non-community) water system consisting of one well in Hope, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium.** Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for USFS Porcupine Creek #1 public drinking water source include: a road and a campground. 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 source for USFS Porcupine Creek #1 received a vulnerability rating of **Low** for bacteria and viruses, **Low** for nitrates and nitrites, and **Low** for volatile organic chemicals.

Introduction

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system. Ecology and Environment, Inc. has been contracted to perform these assessments under the supervision of ADEC.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

Description of the Hope Area

Location

The Hope area is located on the northern end of the Kenai Peninsula at approximately mile 16 of the Hope Highway, which leads northwest along the south side of the Turnagain Arm of Cook Inlet. The Hope intersection is at mile 56.7 of the Seward Highway. The community of Hope is located near the mouth of Resurrection Creek (see Inset of Map 1 of Appendix A).

Precipitation

The Hope area averages about 22.5 inches of precipitation per year, with approximately 89.5 inches of snowfall (ACRC 2002).

Topography and Drainage

Hope lies in the Resurrection Creek valley, which cuts through the steeply rising peaks of the Kenai Mountains. Most of the homes and businesses are located at the mouth of Resurrection Creek or on the gentler slopes at the base of the mountains. Numerous small creeks provide drainage off the hills into Resurrection Creek, which flows into Turnagain Arm.

Groundwater Use

There is no municipal water supply. Approximately one-fourth of homes uses individual water wells and septic tank systems, and is fully plumbed. The school operates its own well water system. Many homes in this area are used only seasonally (ADCED 2002).

Geology and Soils

Bedrock in the Kenai Mountains comprises slates and graywackes of the Cretaceous-age Valdez Group.

Surface sediments in the glaciated valleys are predominantly poorly-sorted sand and gravel of glacial origin, which may have been reworked by post-glacial stream action.

USFS Porcupine Creek #1 Public Drinking Water System

USFS Porcupine Creek #1 is a Class B (transient/non-community) water system. The system consists of one well located at mile 17.8 of the Hope Highway.

The well was installed with a sanitary seal July 8, 1965 to a total depth of 115 feet. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The site is properly drained and grouted. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters. The well operates from May 31 to September 30 and serves approximately 0 residents to 50 non-residents.

USFS Porcupine Creek #1 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. Some areas are more likely to allow contamination to reach the well than others. 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 a release of contaminants within the DWPA is 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 this aquifer were derived from Freeze and Cherry (1979), Glass (1996), and from a review of well logs in the area found in the Alaska Department of Natural Resources and United States Geological Survey databases. 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 Water Systems for additional information).

The DWPAs established for wells by the ADEC are 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 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 DWPA zones and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance to the 2-year 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

As an example, water moving through the aquifer in Zone B will most likely reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

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 USFS Porcupine Creek #1 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 water system assessments, three categories of drinking water contaminants were inventoried. They include:

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

Inventoried potential sources of contamination within the drinking water protection area were associated with residential and light industrial type activities. The sources are displayed on Map 2 of Appendix C and summarized in the tables in Appendix B.

Ranking of Contaminant Risks

Once the potential and existing sources of contamination have been identified, they are sorted and ranked 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. Further, contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well. 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 USFS Porcupine Creek #1 Drinking Water Source

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 achieved by analyzing 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

The well for USFS Porcupine Creek #1 is completed in an unconfined aquifer. Because unconfined aquifers are recharged by surface water and precipitation that migrates downward from the sruface, contaminants at the surface have the potential to impact this aquifer adversely. Table 2 shows the Susceptibility scores and ratings for USFS Porcupine Creek #1 (see Charts 1 and 2).

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	17	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 or 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 (see Charts 3, 5, and 7).

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	16	Low
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 (see Charts 4, 6, and 8).

Table 4. Overall Vulnerability to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	30	Low
Nitrates and Nitrites	30	Low
Volatile Organic Chemicals	30	Low

Bacteria and Viruses
The contaminant risk for bacteria and viruses is Low, with the campground and campground road representing the greatest risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination by bacteria and viruses is Low.

Nitrates and Nitrites
The contaminant risk for nitrates and nitrites is Low with the campground and campground road representing the highest 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.

The last five years' sampling history for USFS Porcupine Creek #1 public water source indicates the most recent concentration detected was 0.846 mg/L on 6/21/01, which represents 8.0% of the Maximum Contaminant Level (MCL). While nitrates and nitrites can occur naturally in groundwater, a level of 20% of the MCL or more is considered to be due to manmade sources. Water with levels of nitrates and nitrites below 100% of the MCL is considered safe to drink by ADEC. 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 Low.

Volatile Organic Chemicals
The contaminant risk for volatile organic chemicals is Low with the campground and campground road representing the highest risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Residents in the area typically heat their homes with various types of on-site fuel sources, including propane and heating oil stored in aboveground or underground storage tanks. Although this report does not address heating oil tanks (unless their location is known), they can pose a risk of volatile organic chemical contamination to drinking water sources. The most

common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Secondary containment around the tank and regular system maintenance can help prevent many of these harmful fuel leaks and help protect the drinking water supply.

Class B water systems generally are not required to test for volatile organic chemicals. After combining the potential 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.

References Cited

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Alaska Department of Community and Economic Development (ADCED), 2002, Alaska Community Database [WWW database]. URL http://www.dced.state.ak.us/cbd/commdb/CF_BLOCK.cfm

Freeze, R.A. and Cherry, J.A., 1979, *Groundwater*, Upper Saddle River, NJ: Prentice Hall, Inc.

Glass, R.L., 1996, Ground-water conditions and quality in the western part of Kenai Peninsula, southcentral Alaska, Prepared in cooperation with the Alaska Department of Natural Resources, Kenai Peninsula Borough, Kenai Soil and Water Conservation District, U.S. Geological Survey, Anchorage, AK, and Branch of Information Services, Denver, CO.

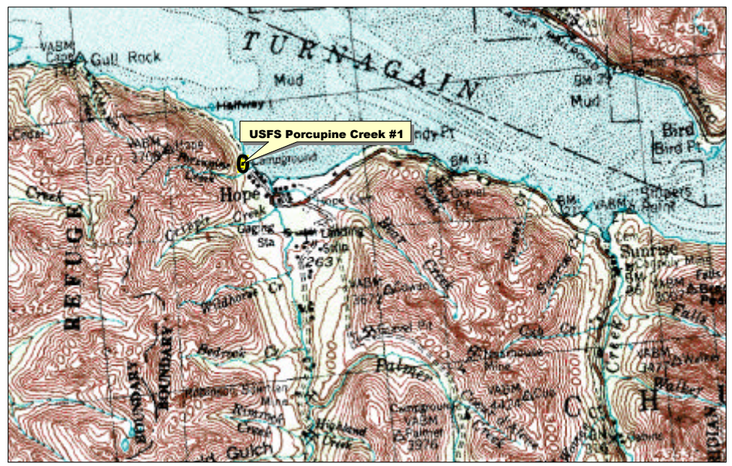
APPENDIX A

USFS Porcupine Creek #1
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Area for USFS Porcupine Creek Campground #1

0 USFS Porcupine Creek Campground Well
Zone A (Few Months Travel Time)

N
W E
S



2000 0 2000 4000 6000 Feet

PWSID 240422.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for USFS Porcupine Creek #1 (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 240422.001***

USFS Porcupine Creek #1

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	A	Campground roads	2	
Campgrounds and RV Parks	X35	X35-1	A	Porcupine Creek Campground	2	

Table 2

Contaminant Source Inventory and Risk Ranking for USFS Porcupine Creek #1 Sources of Bacteria and Viruses

PWSID 240422.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	A	Low	Campground roads	2	
Campgrounds and RV Parks	X35	X35-1	A	Low	Porcupine Creek Campground	2	

Table 3

Contaminant Source Inventory and Risk Ranking for USFS Porcupine Creek #1 Sources of Nitrates/Nitrites

PWSID 240422.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	A	Low	Campground roads	2	
Campgrounds and RV Parks	X35	X35-1	A	Low	Porcupine Creek Campground	2	

Table 4

Contaminant Source Inventory and Risk Ranking for USFS Porcupine Creek #1 Sources of Volatile Organic Chemicals

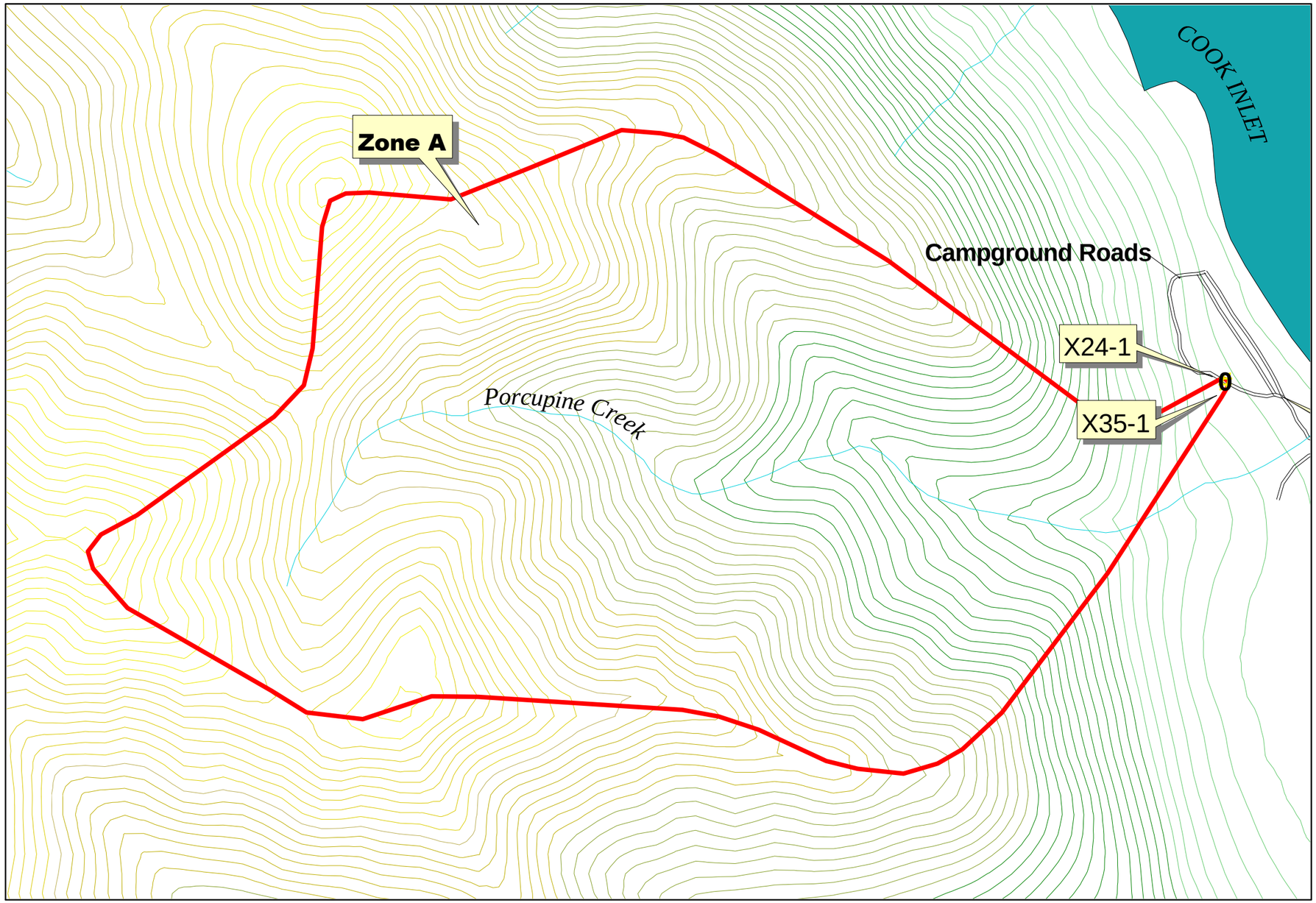
PWSID 240422.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	A	Low	Campground roads	2	
Campgrounds and RV Parks	X35	X35-1	A	Low	Porcupine Creek Campground	2	

APPENDIX C

USFS Porcupine Creek #1
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Drinking Water Protection Area for USFS Porcupine Creek Campground #1 and Potential and Existing Sources of Contamination



0 USFS Porcupine Creek Campground Well

Zone A (Few Months Travel Time)

Campground Roads

N
W E
S

0.5 0 0.5 1 Miles

PWSID 240422.001

Map 2

APPENDIX D

Vulnerability Analysis for USFS Porcupine Creek #1 Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - USFS Porcupine Creek #1

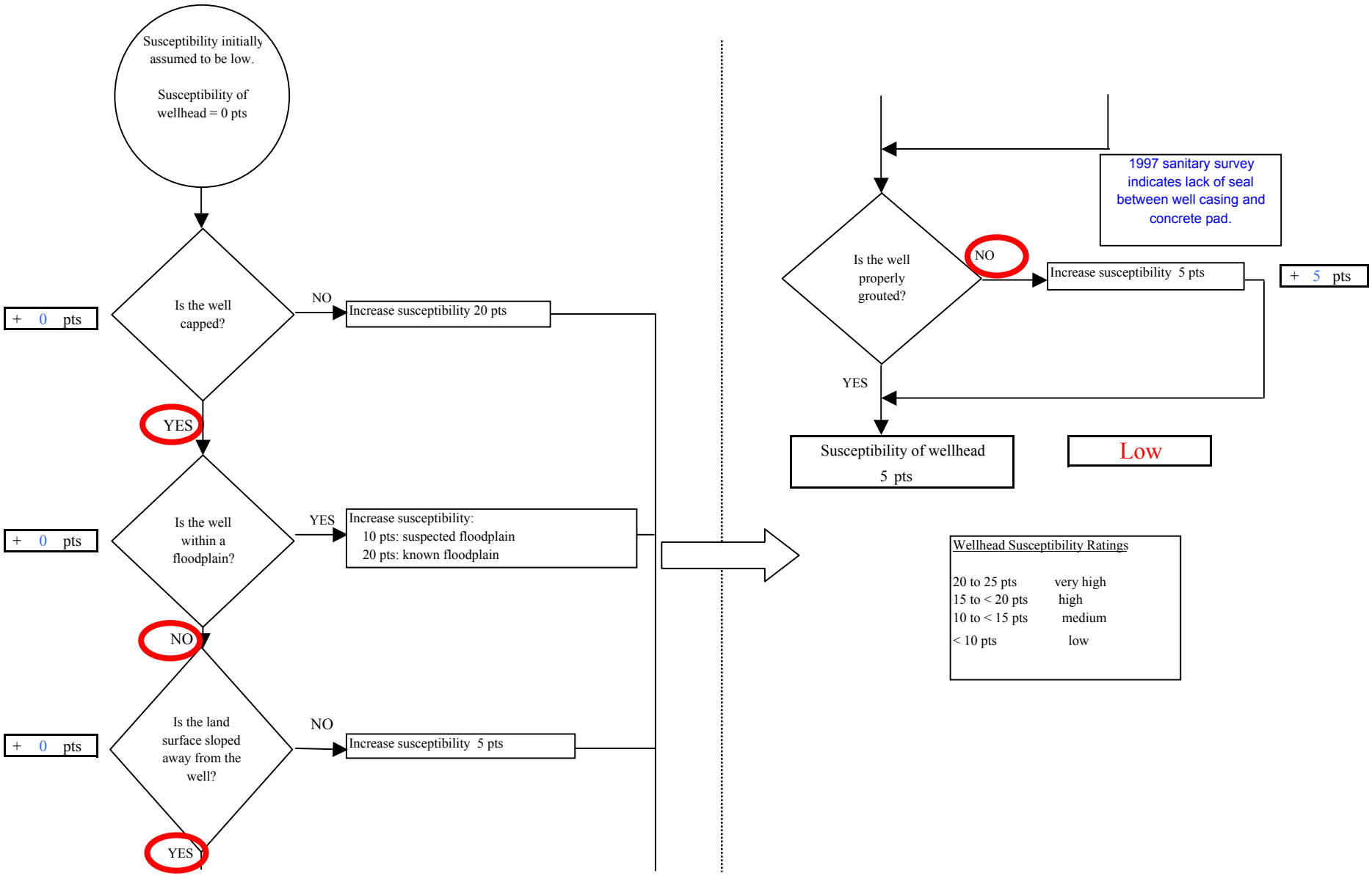


Chart 2. Susceptibility of the aquifer - USFS Porcupine Creek #1

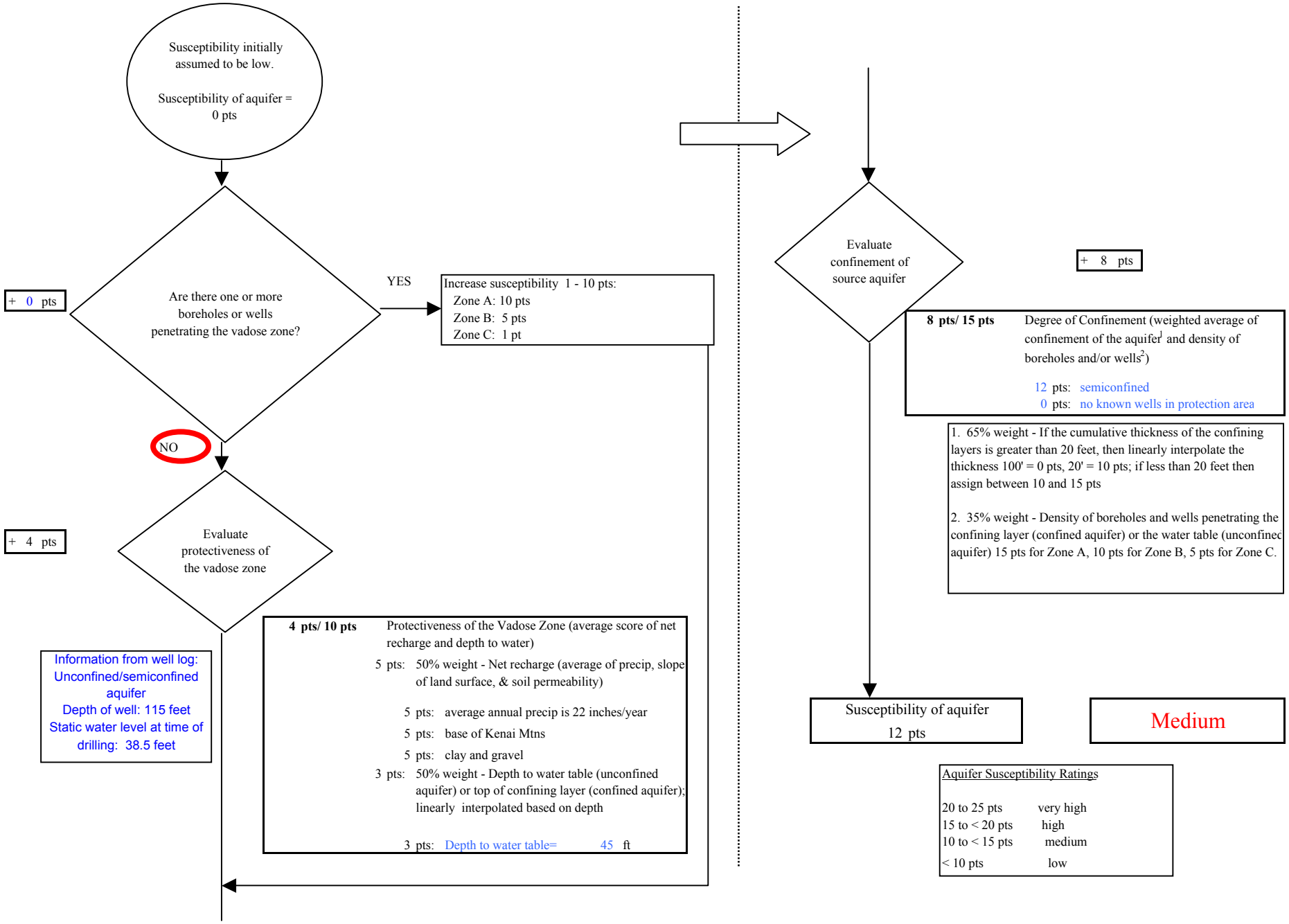
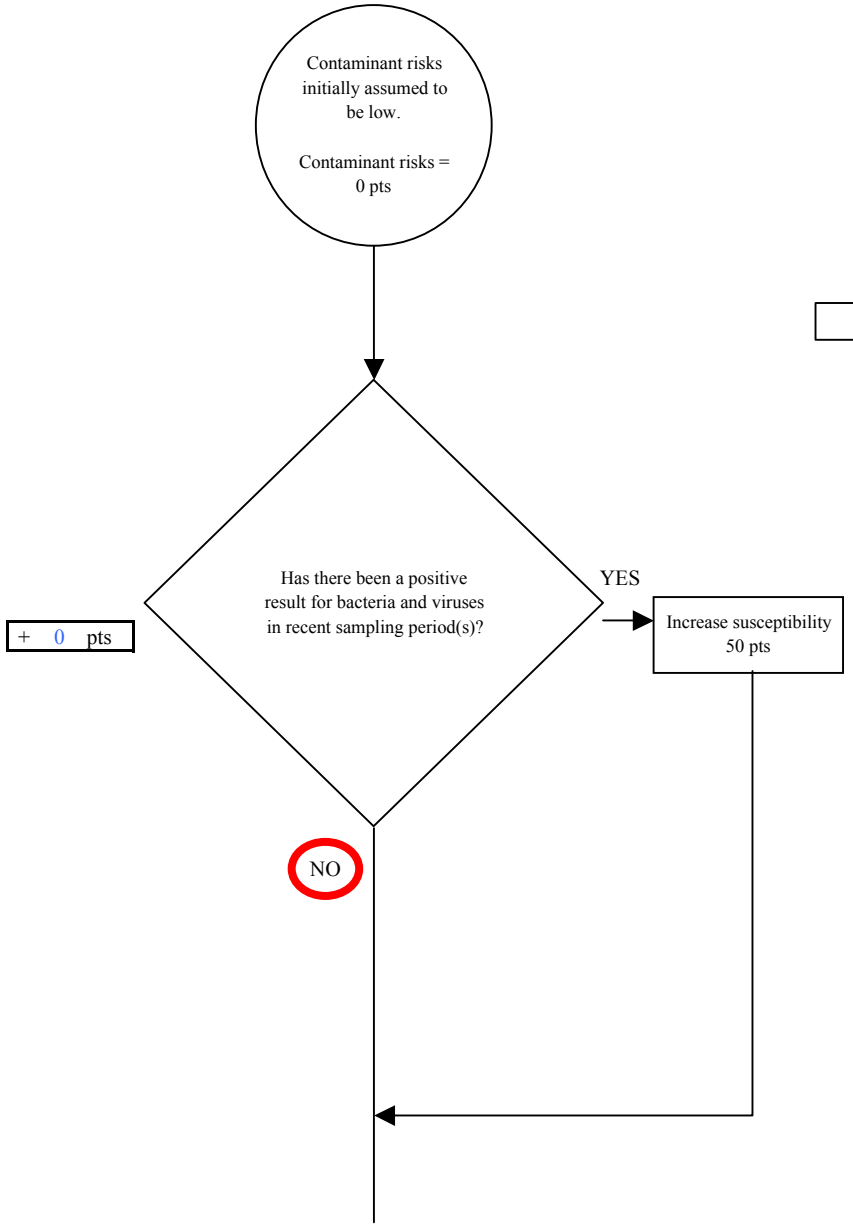
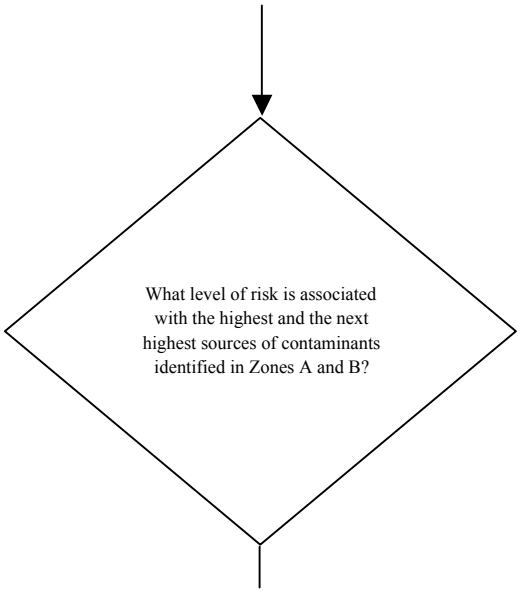


Chart 3. Contaminant risks for USFS Porcupine Creek #1 - Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	0	2

	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 10

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 USFS Porcupine Creek #1 - Bacteria & Viruses

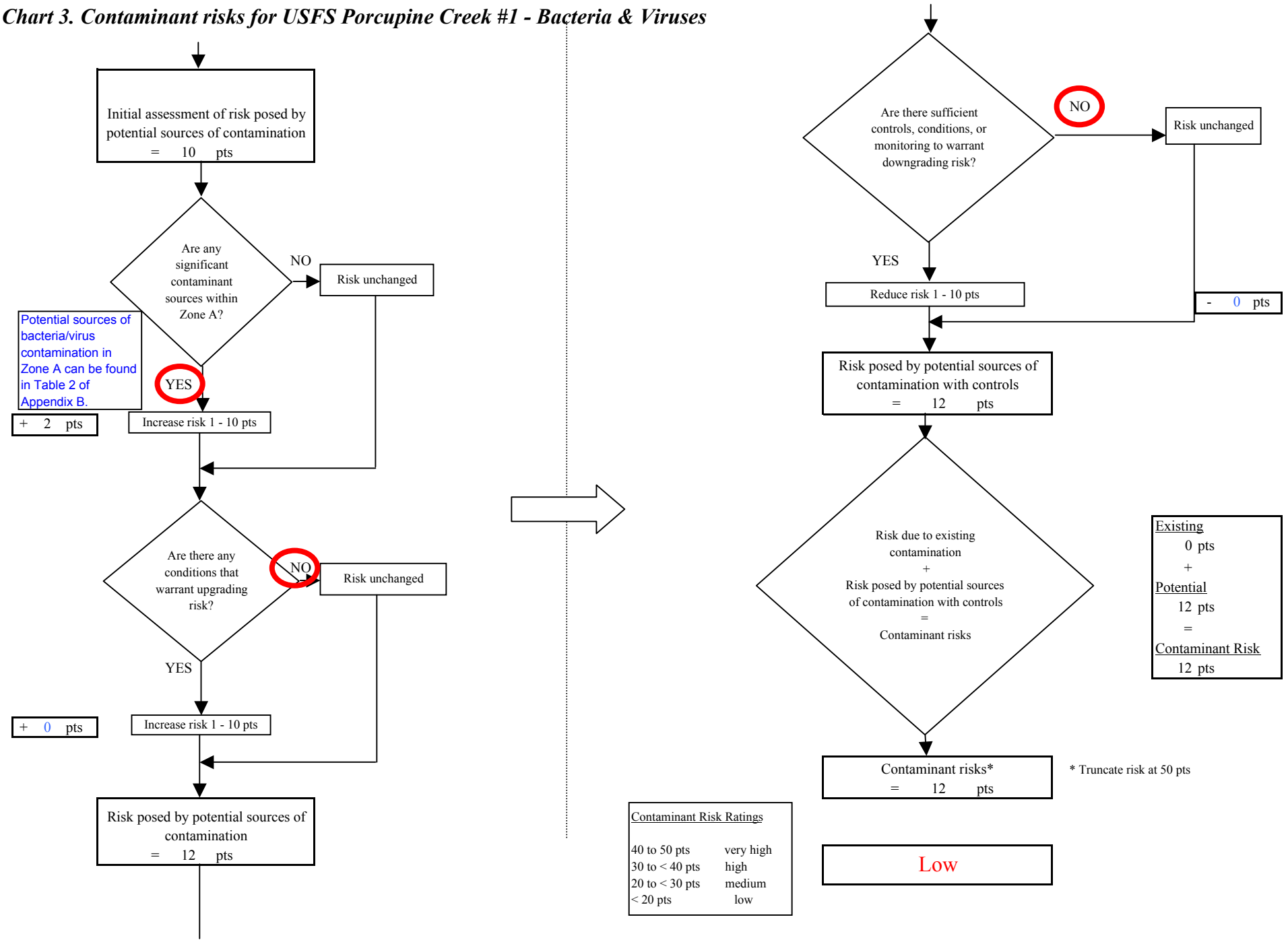


Chart 4. Vulnerability analysis for USFS Porcupine Creek #1 - Bacteria & Viruses

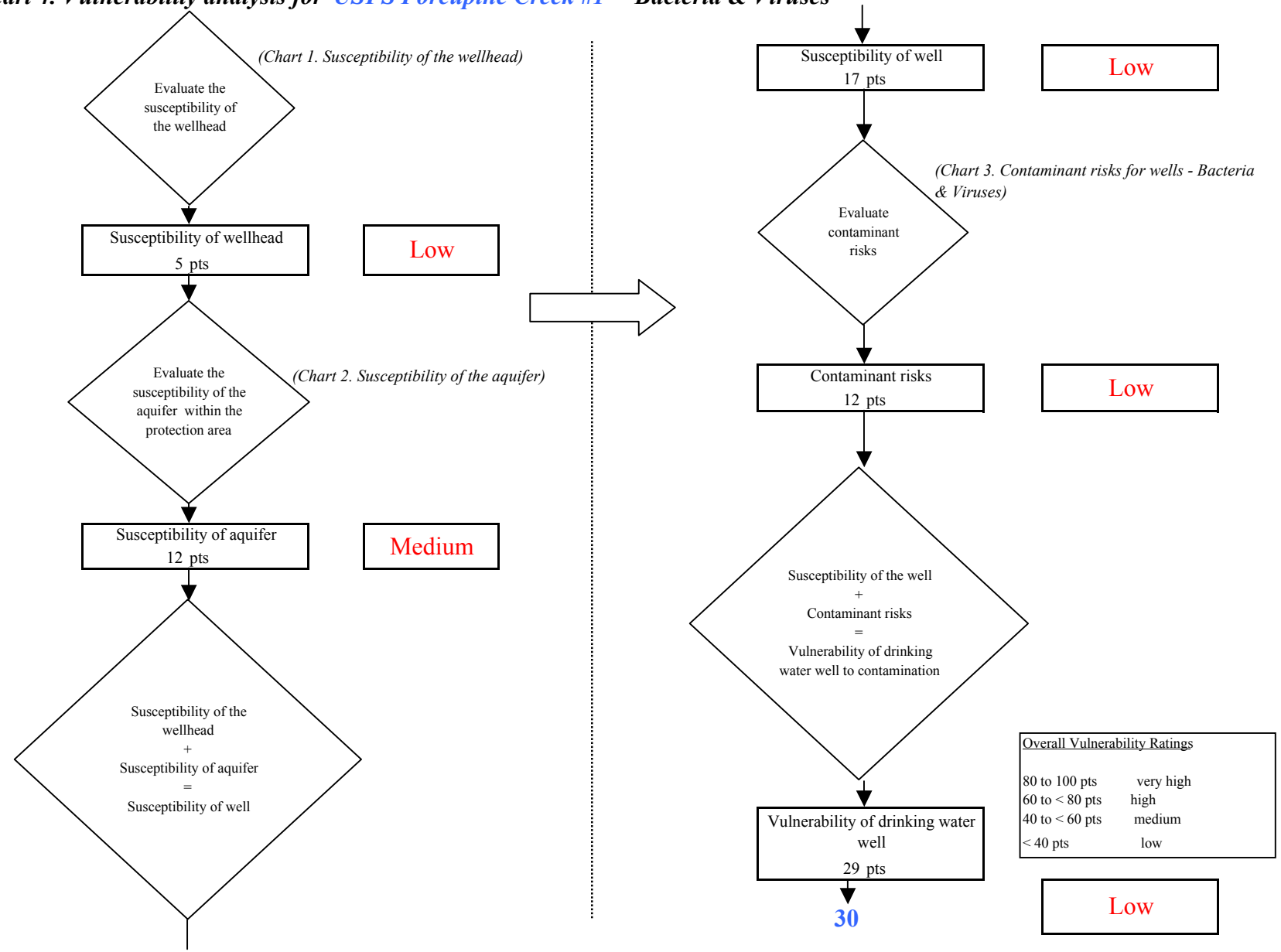


Chart 5. Contaminant risks for USFS Porcupine Creek #1 - Nitrates and Nitrites

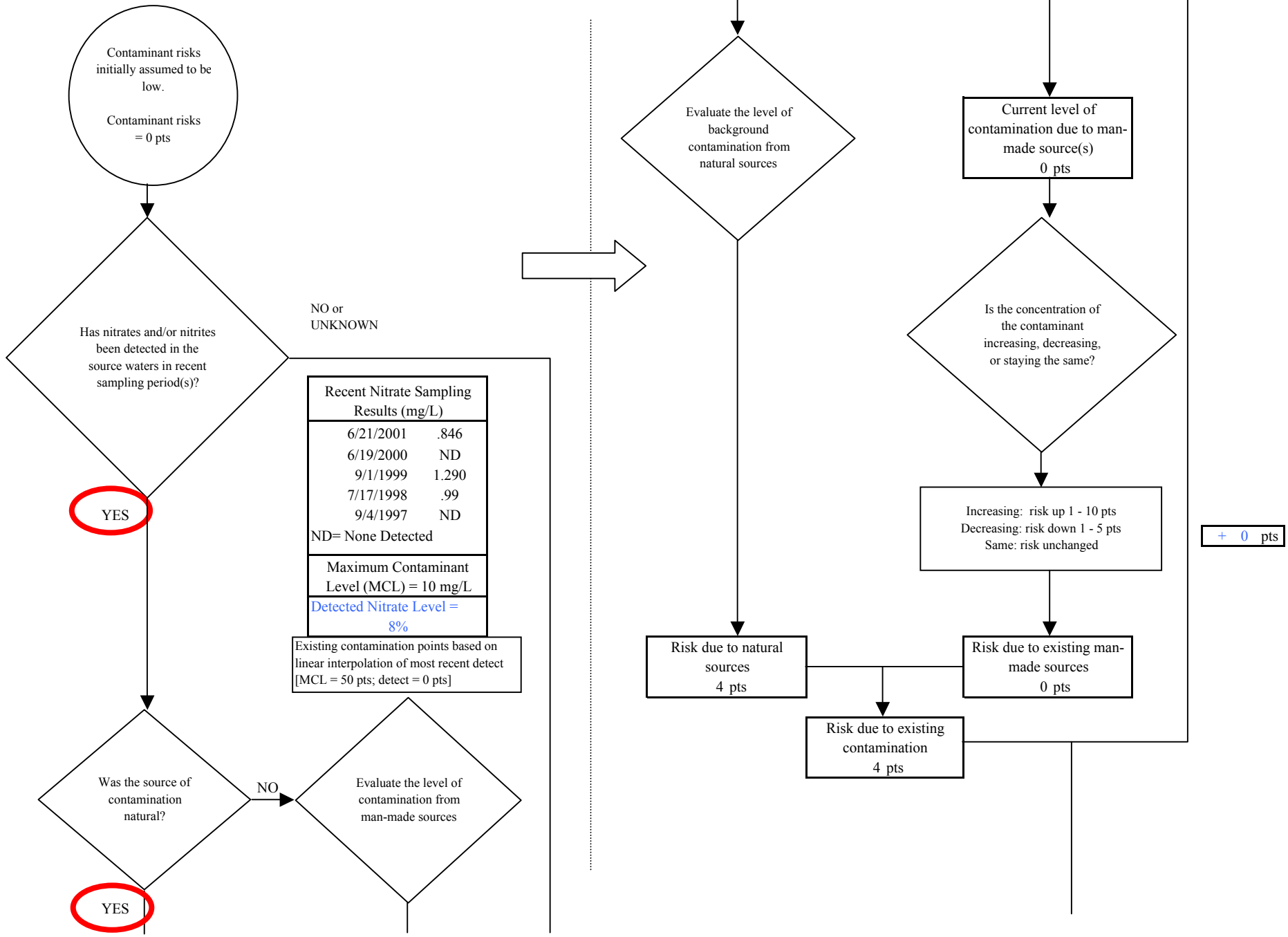


Chart 5. Contaminant risks for USFS Porcupine Creek #1 - Nitrates and Nitrites

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	0	2

	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 10

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.

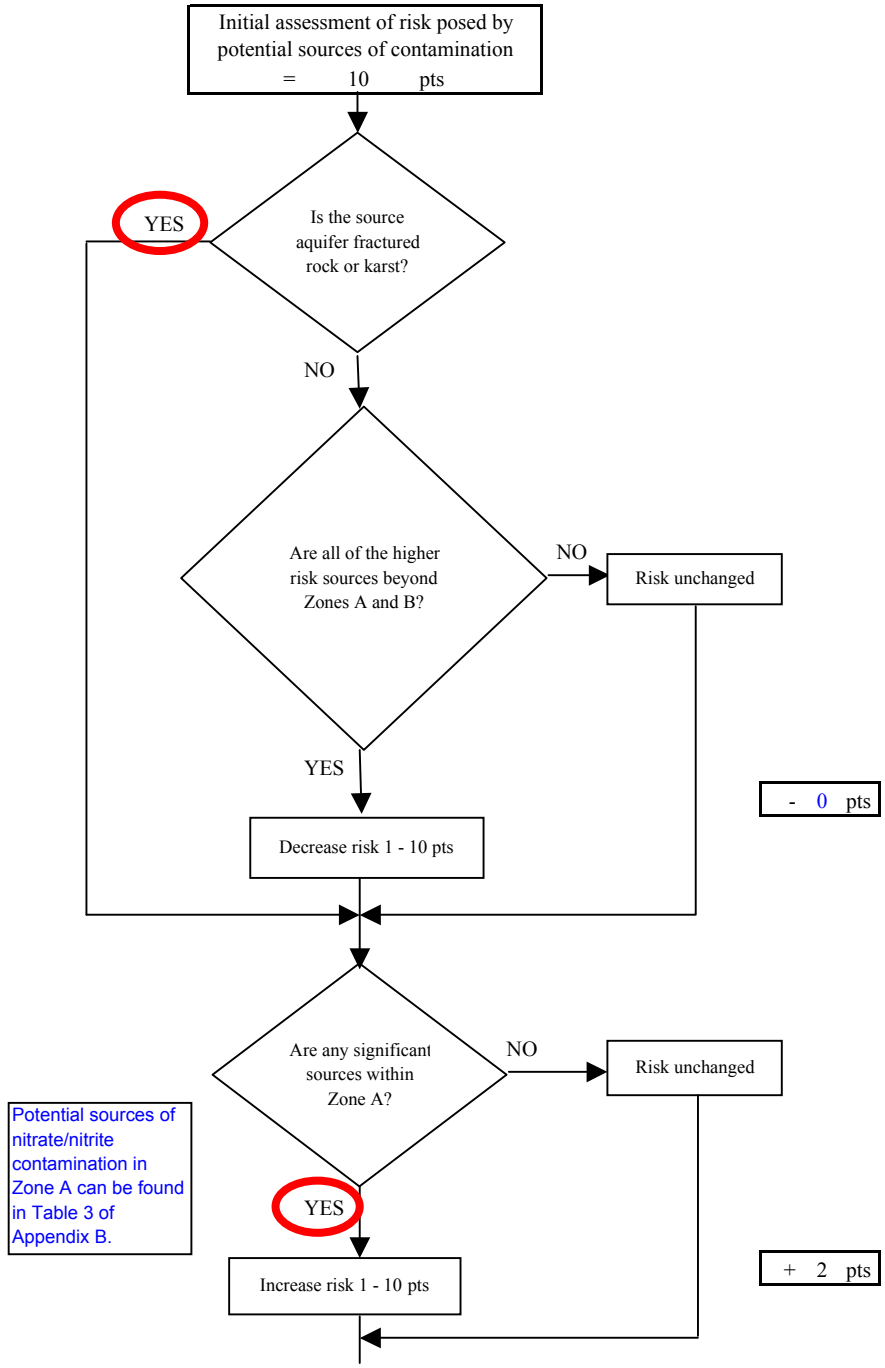


Chart 5. Contaminant risks for USFS Porcupine Creek #1 - Nitrates and Nitrites

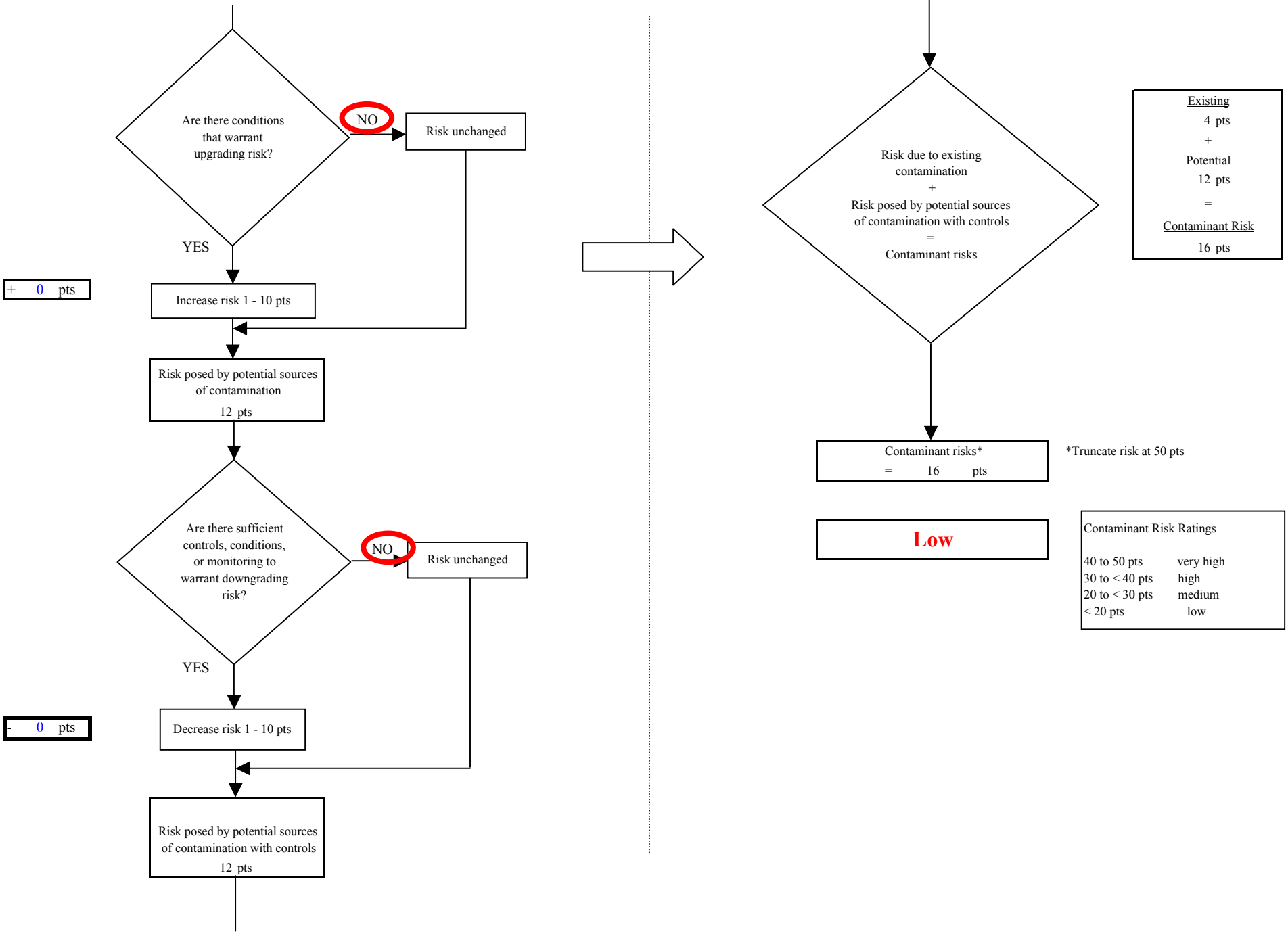


Chart 6. Vulnerability analysis for USFS Porcupine Creek #1 - Nitrates and Nitrites

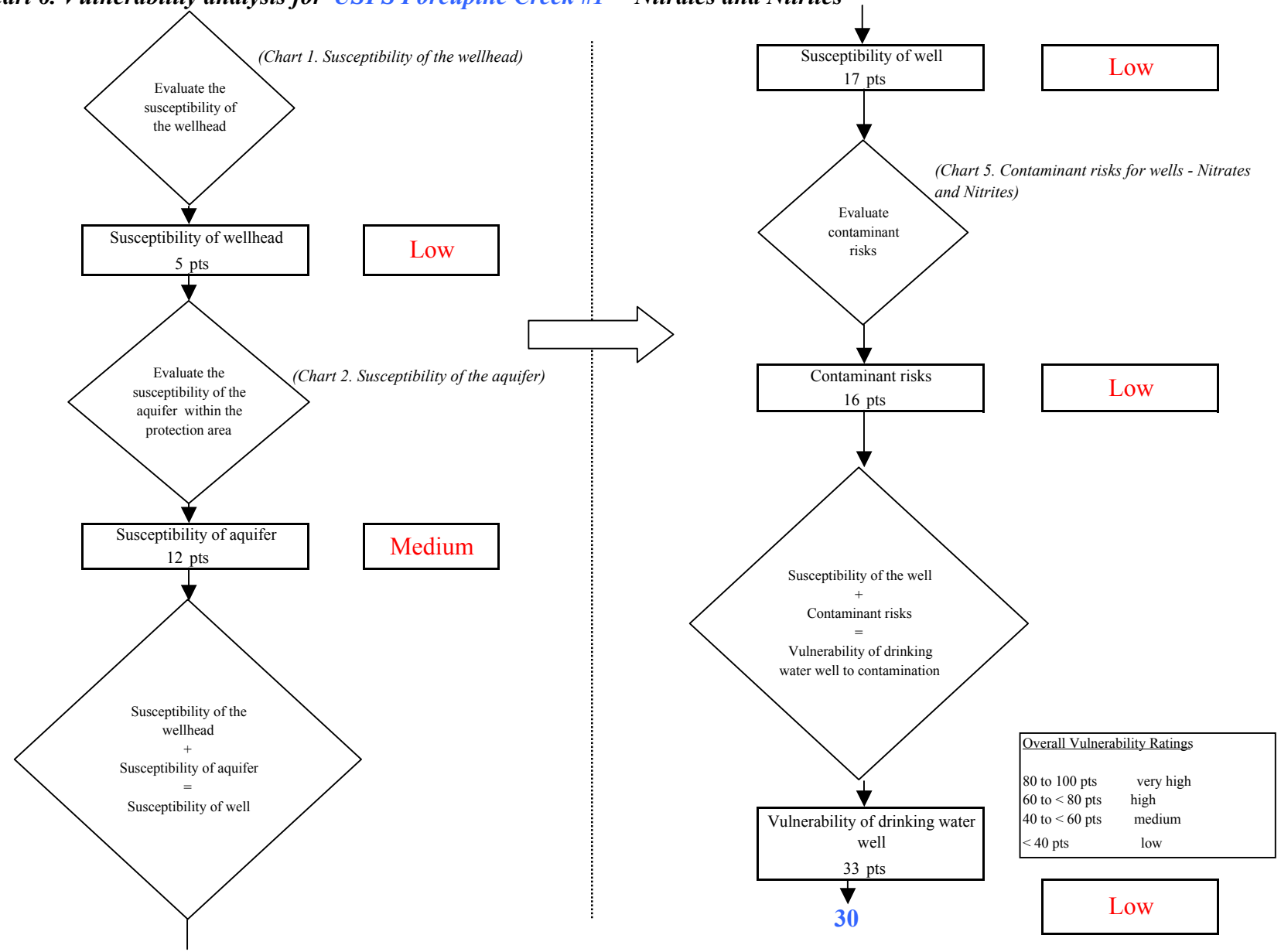


Chart 7. Contaminant risks for USFS Porcupine Creek #1 - Volatile Organic Chemicals

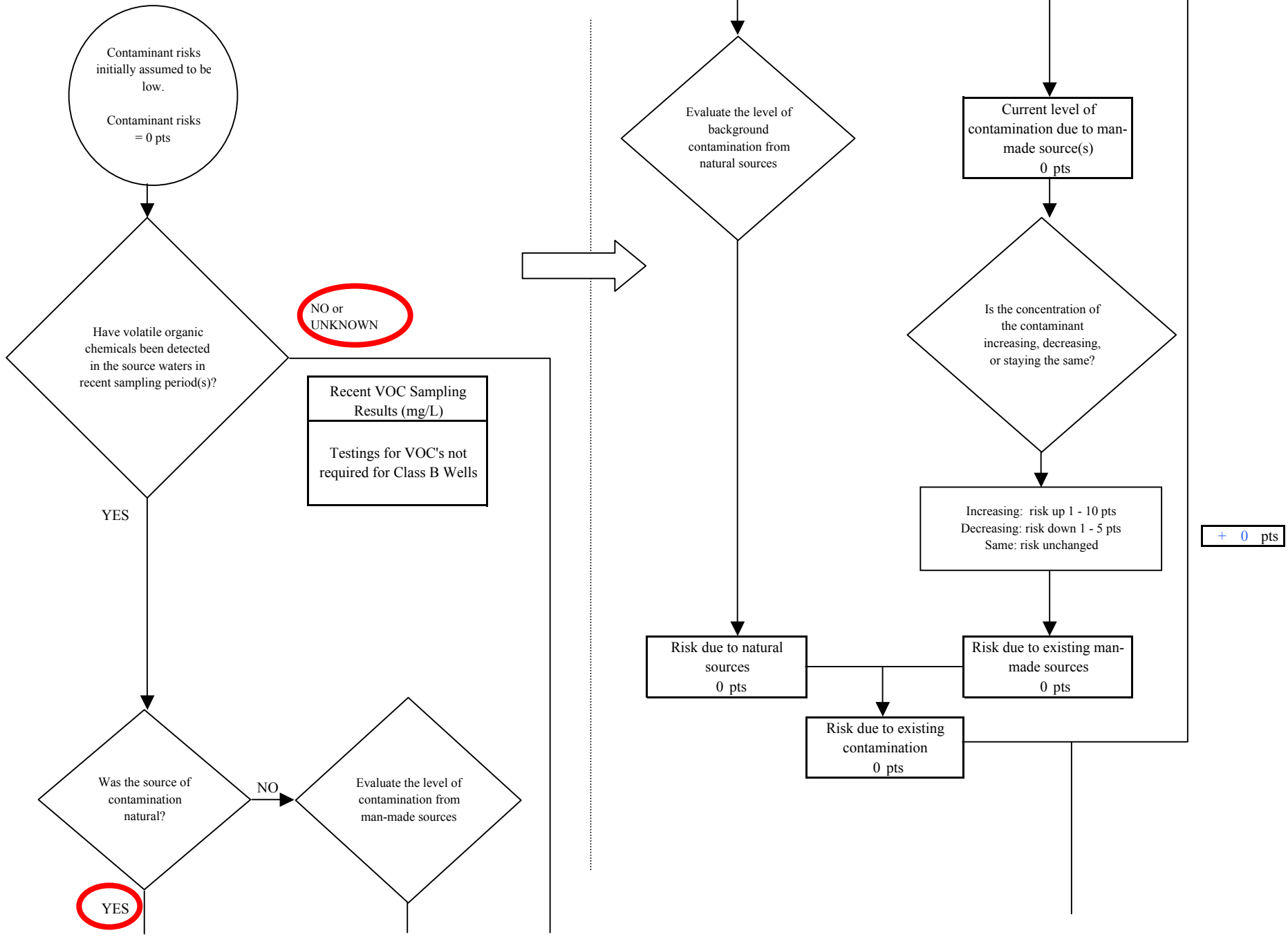


Chart 7. Contaminant risks for USFS Porcupine Creek #1 - Volatile Organic Chemicals

+ 10 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	0	2

	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 10

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.

Initial assessment of risk posed by potential sources of contamination = 10 pts

YES

Is the source aquifer fractured rock or karst?

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

Potential sources of volatile organic chemical contamination in Zone A can be found in Table 4 of Appendix B.

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for USFS Porcupine Creek #1 - Volatile Organic Chemicals

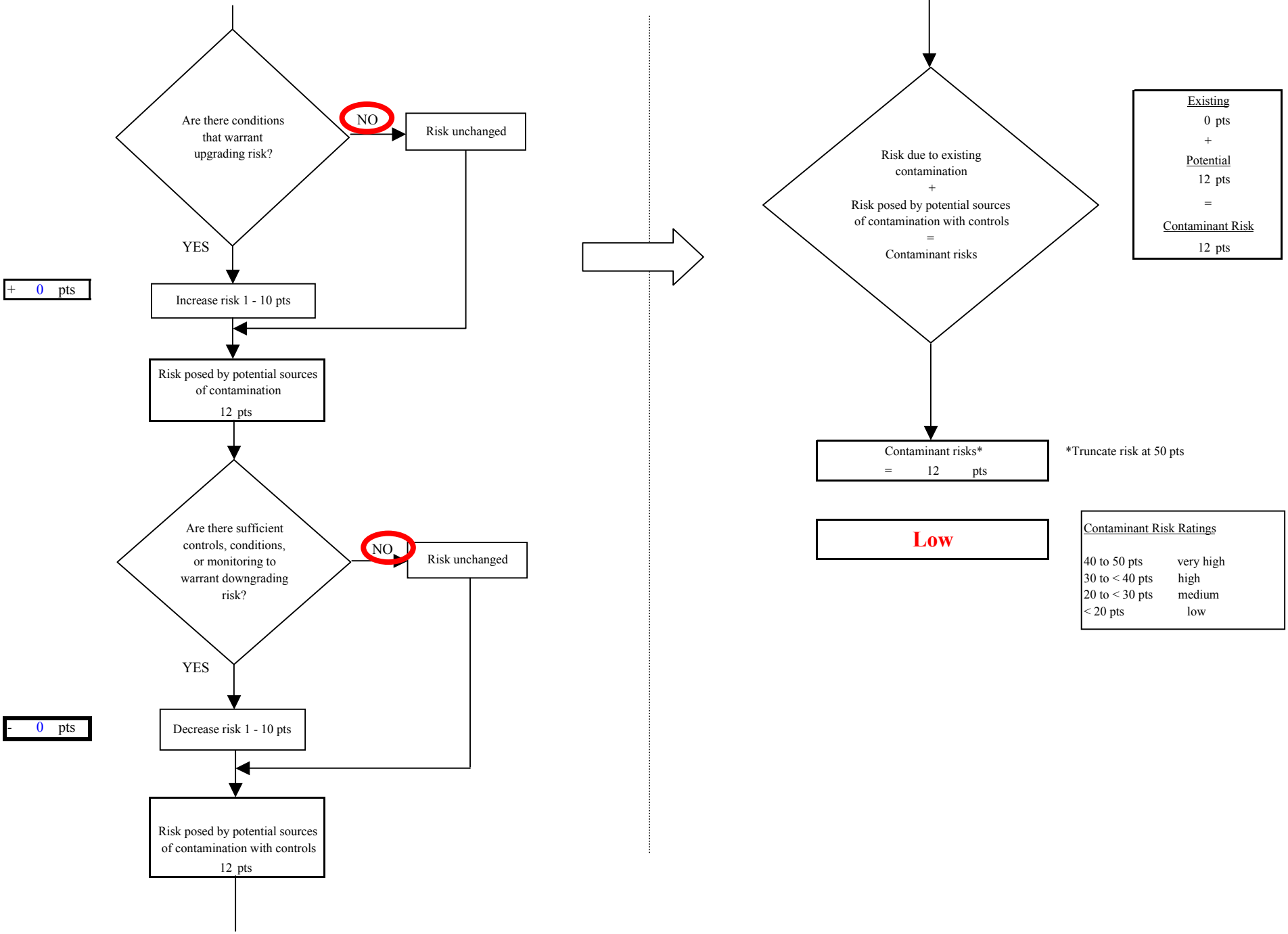


Chart 8. Vulnerability analysis for USFS Porcupine Creek #1 - Volatile Organic Chemicals