Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Echo Bay Bible Camp, Juneau, Alaska PWSID #110106

DRINKING WATER PROTECTION PROGRAM REPORT NO. 700

Alaska Department of Environmental Conservation

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Echo Bay Bible Camp
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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 Echo Bay Bible Camp, Juneau, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Echo Bay Bible Camp is a Class B (transient/non-community) water system consisting of three wells. The Echo Bay Bible Camp is located at Mile 40 of the Juneau Veterans' Memorial Highway, northwest of Juneau, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Echo Bay Bible Camp public drinking water source include: livestock pastures, stables and corrals; laundromat, septic system; above ground diesel tank; water supply wells; and underground metals mining. 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 Echo Bay Bible Camp received a vulnerability rating of **High** for bacteria and viruses; **High** for nitrates and nitrites, and **Medium** for volatile organic chemicals.

ECHO BAY BIBLE CAMP PUBLIC DRINKING WATER SYSTEM

Echo Bay Bible Camp public water system is a Class B (transient/non-community) water system. The system consists of three wells northwest west of Juneau, Alaska. Juneau is the states third largest city, situated in the heart of the Tongass National Forest in Southeast Alaska's panhandle. The population of Juneau is approximately 31,000.

Downtown Juneau averages about 92 inches of precipitation per year, while 10 miles northwest at the airport averages about 54 inches per year; with an annual average of approximately 101 inches of snow. The groundwater aquifers underlying the area are recharged through the infiltration of precipitation and surface water. Groundwater aquifers in the region generally occur in the fractured bedrock and unconsolidated sediments deposited by glaciers and/or rivers.

The Juneau area topography is near sea level along the Gastineau Channel.

According to a Sanitary Survey dated July 15, 1998, is unknown when Well No. 1 was installed, this well consists of 4-inch diameter casing and is 25 feet below ground surface. It is assumed that the well screen is 10 feet. Well No. 2 was installed in 1998 and consists of 4-inch diameter casing, and is 25 feet below the ground surface. It is assumed that the length of the well screen for Well No. 2 is 10 feet. A third well is reportedly located at the camp, but no information is available.

The Sanitary Survey indicates that the land surface is appropriately sloped away from both wells, providing adequate surface water drainage. Notes indicate that Well No. 1 was to have a cement pad installed around the well in 1998. It is unknown if the wells are grouted 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 60 residents and 120 non-residents through the service connection.

ECHO BAY BIBLE CAMP 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 attribute 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).

Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DPWA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPAs 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 Echo Bay Bible Camp extends southeast of the well. 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 Echo Bay Bible Camp 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 ECHO BAY BIBLE CAMP 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

The wells for Echo Bay Bible Camp are 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 Echo Bay Bible Camp

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	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	40	Very High
Nitrates and/or Nitrites	45	Very High
Volatile Organic Chemicals	25	Medium

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	70	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	55	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with the reported detection of bacteria and viruses in past water samples from the livestock pastures, stables and corrals; laundromat, and septic system exhibiting the greatest risk (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. Bacteria and viruses sampling data indicated there were no recent sample results. 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 the livestock pastures, stables and corrals; Laundromat; and 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).

Sampling history for Echo Ranch Bible Camp wells indicate that nitrates have been detected in the water, but only in very low concentrations (most recently at 0.11 mg/L on 6/12/2002) or 11% 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 **Medium** with the laundromat, septic system; above ground diesel tank and closed tank; and underground metals mining creating the only known risks 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 Echo Bay Bible Camp for volatile organic chemicals. 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 **Medium**.

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King, P.B., compiler, 1969, Tectonic map of North America: US Geological Survey Map, (scale 1:5,000,000) 2 sheets.

Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL: http://www.epa.gov/safewater/mcl.html.

APPENDIX A

Echo Bay Bible Camp
Drinking Water Protection Area Location Map
(Map 1)

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Echo Bay Bible Camp (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 110106.001***

Echo Bay Bible Camp

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Livestock pastures	A08	A08-1	A	2	Southeast of well
Livestock stables/corrals	A09	A09-1	A	2	South of well
Laundromats without dry cleaning	C22	C22-1	A	2	East of well
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D101	A	2	Northeast of well
Tanks, diesel (above ground)	T06	T06-1	A	2	Northeast of well
Closed tanks, diesel (above ground)	T07	T07-1	A	2	Above ground diesel tank in Zone A
Water supply wells	W09	W09-1-3	A	2	Three wells for Echo Bay Bible Camp
Metals mining, underground (active or inactive?)	E05	E05-1-2	E	3	Two mining claims in Zone E
Metals mining, underground (active or inactive?)	E05	E05-2-7	F	3	Five mining claims in Zone F
Metals mining, underground (active or inactive?)	E05	E05-8	G	3	Mining claim in Zone G

Contaminant Source Inventory and Risk Ranking for

Table 2 ***PWSID 110106.001***

Echo Bay Bible Camp

Sources of Bacteria and Viruses

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Livestock pastures	A08	A08-1	A	Medium	2	Southeast of well
Livestock stables/corrals	A09	A09-1	A	Medium	2	South of well
Laundromats without dry cleaning	C22	C22-1	A	Low	2	East of well
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D101	A	High	2	Northeast of well

Contaminant Source Inventory and Risk Ranking for

Table 3 ***PWSID 110106.001***

Echo Bay Bible Camp

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Livestock pastures	A08	A08-1	A	Medium	2	Southeast of well
Livestock stables/corrals	A09	A09-1	A	Medium	2	South of well
Laundromats without dry cleaning	C22	C22-1	A	Low	2	East of well
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D101	A	High	2	Northeast of well

Contaminant Source Inventory and Risk Ranking for

Table 4 ***PWSID 110106.001***

Echo Bay Bible Camp

Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-1	A	Low	2	East of well
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D101	A	Low	2	Northeast of well
Tanks, diesel (above ground)	T06	T06-1	A	Medium	2	Northeast of well
Closed tanks, diesel (above ground)	T07	T07-1	A	Medium	2	Above ground diesel tank in Zone A
Metals mining, underground (active or inactive?)	E05	E05-1-2	E	Medium	3	Two mining claims in Zone E
Metals mining, underground (active or inactive?)	E05	E05-2-7	F	Medium	3	Five mining claims in Zone F
Metals mining, underground (active or inactive?)	E05	E05-8	G	Medium	3	Mining claim in Zone G

APPENDIX C

Echo Bay Bible Camp
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2 and 3)

APPENDIX D

Vulnerability Analysis for Echo Bay Bible Camp Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Echo Bay Bible Camp

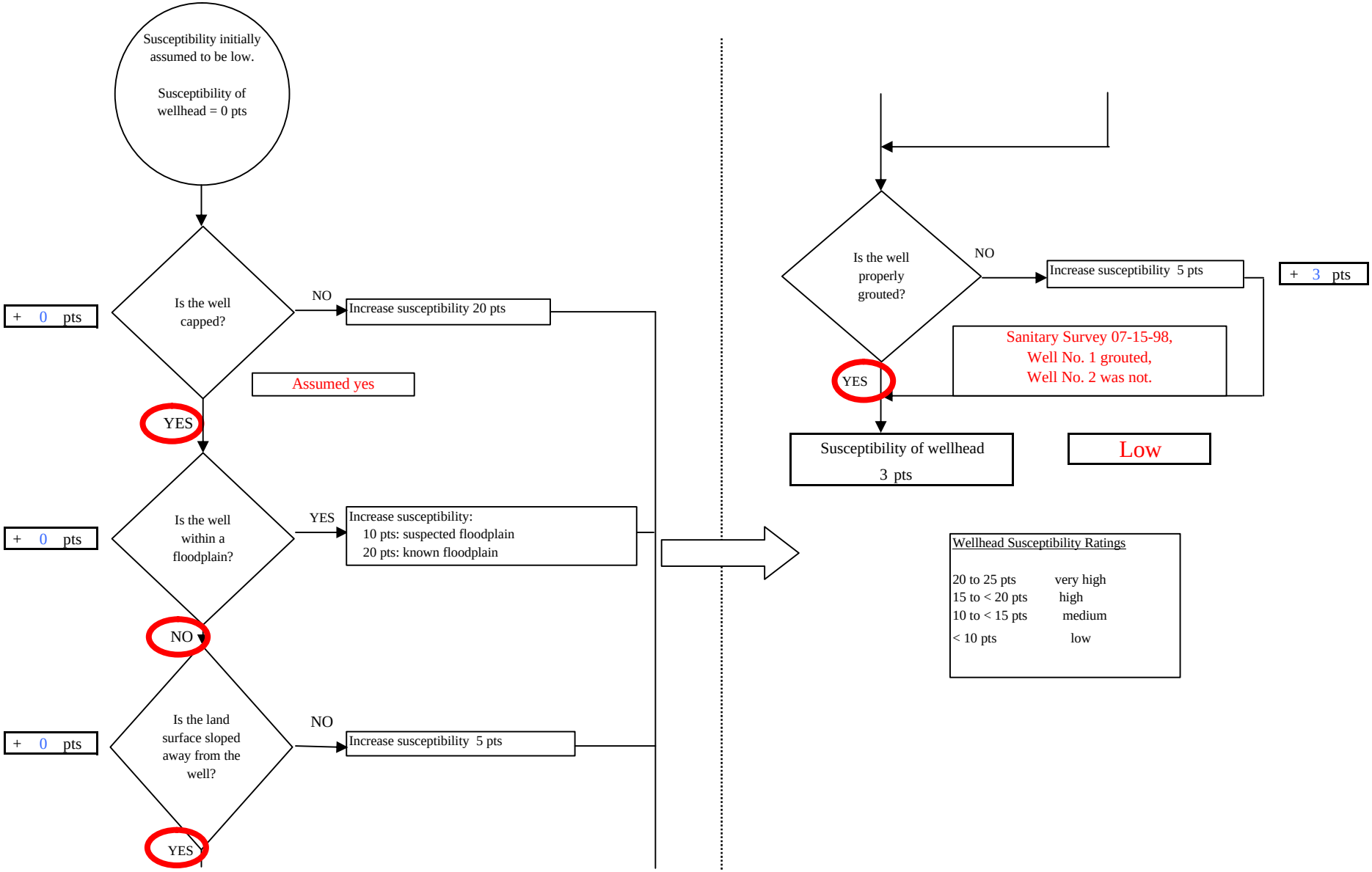


Chart 2. Susceptibility of the aquifer - Echo Bay Bible Camp

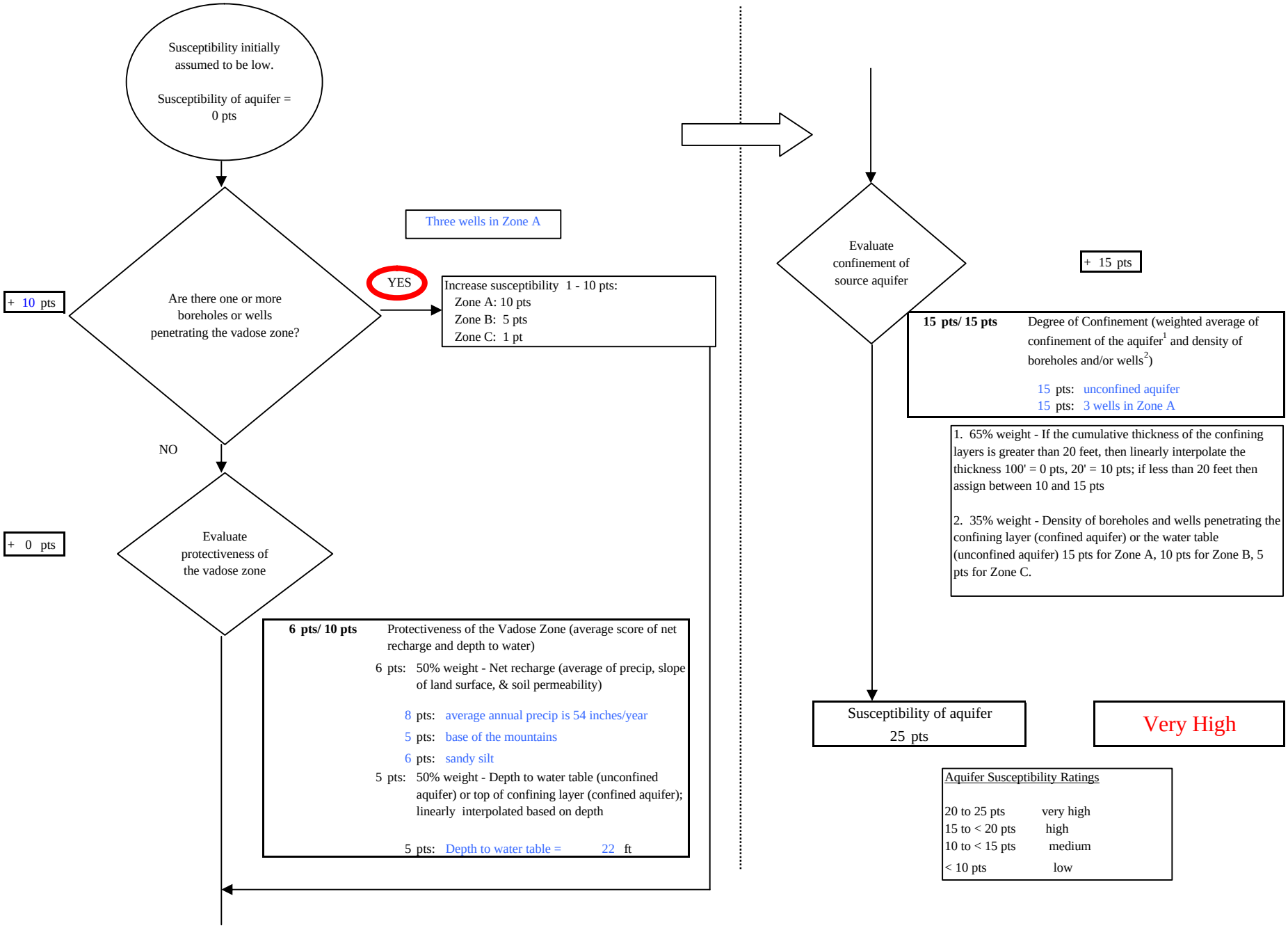
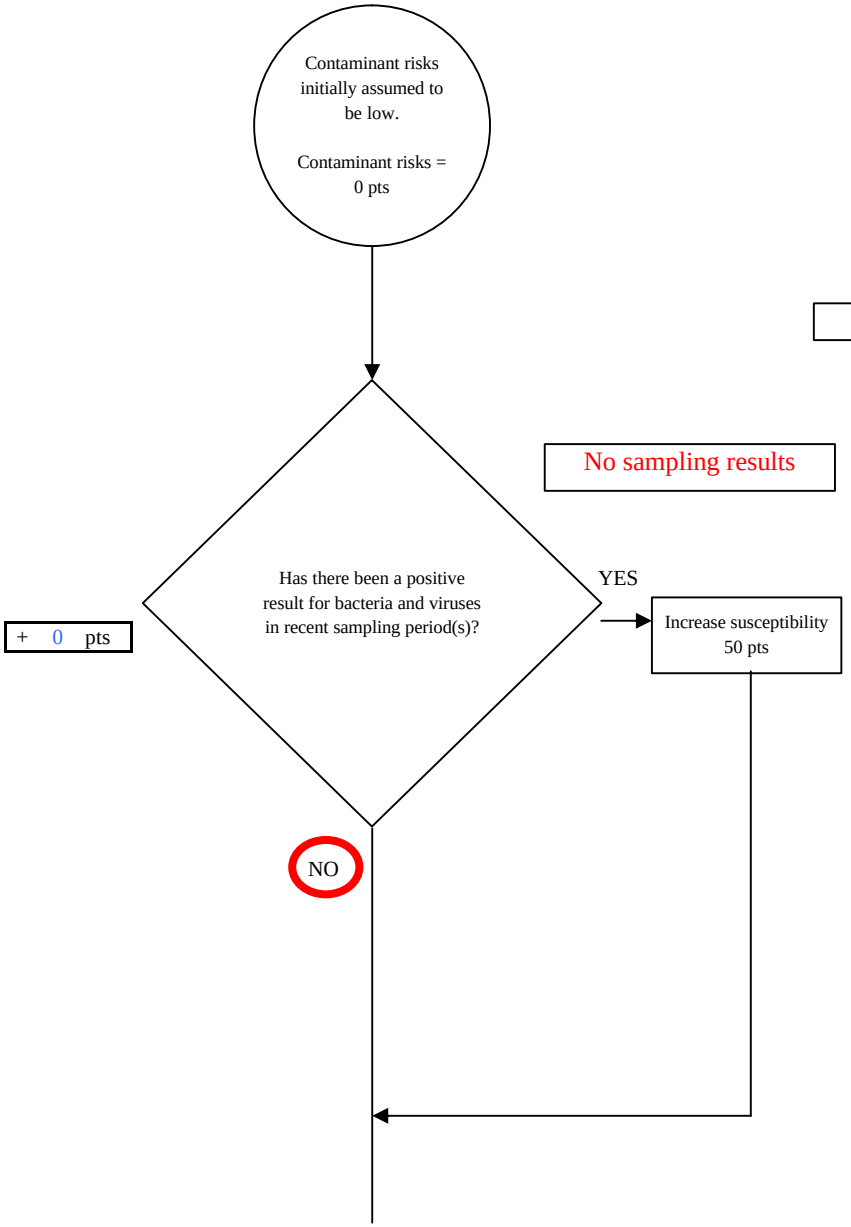
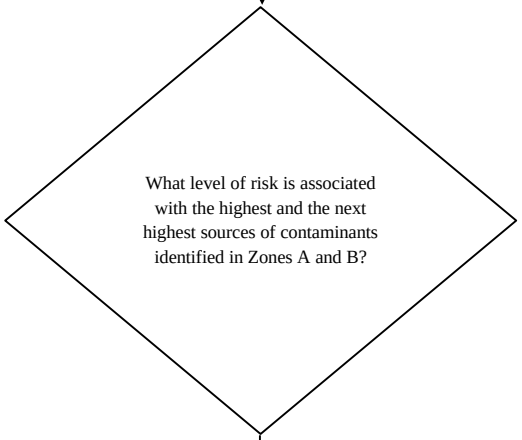


Chart 3. Contaminant risks for Echo Bay Bible Camp - Bacteria & Viruses





+ 30 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)	1	0	1
Medium(s)	2	0	2
Low(s)	1	0	1

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 Echo Bay Bible Camp - Bacteria & Viruses

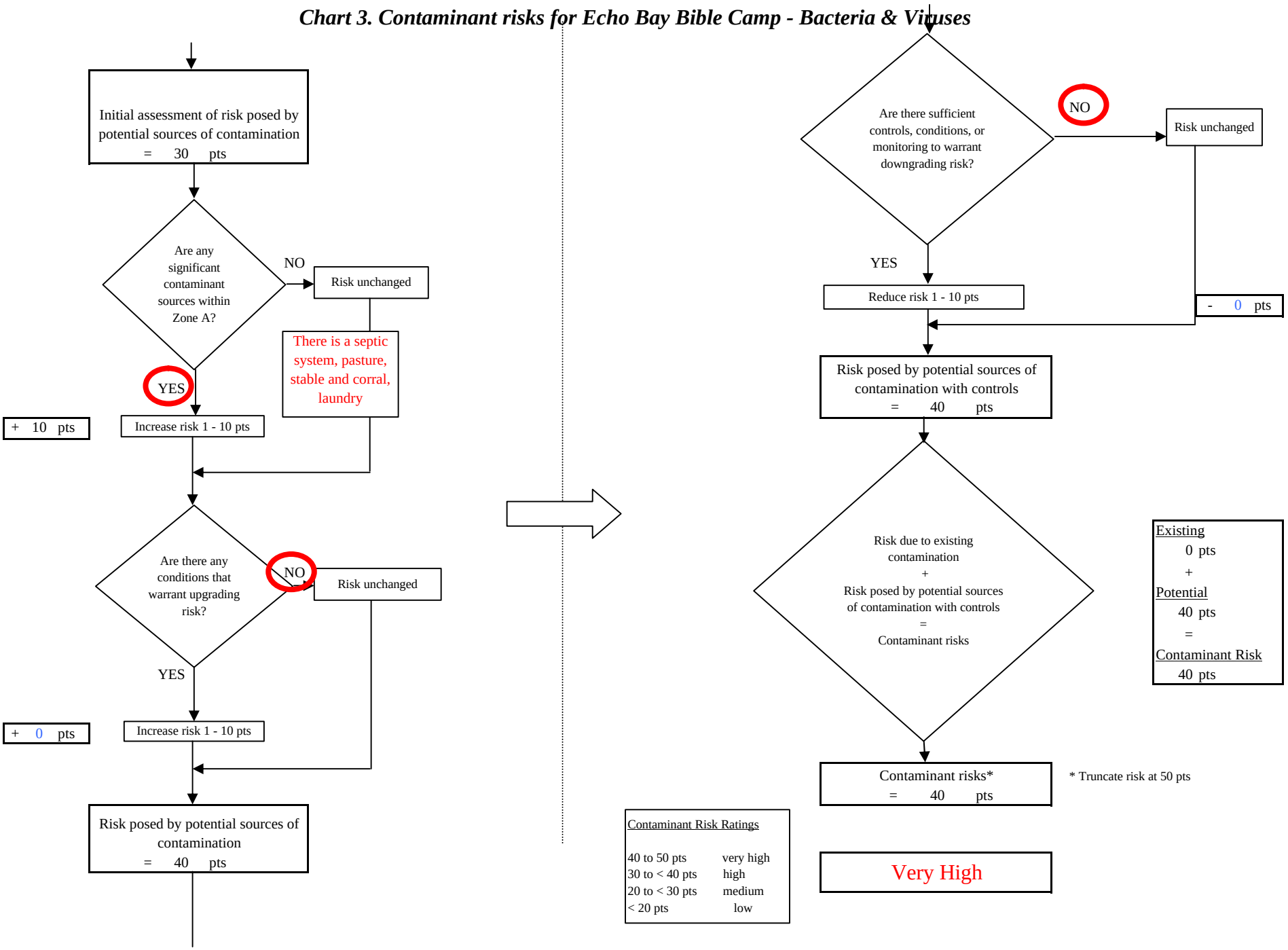


Chart 4. Vulnerability analysis for Echo Bay Bible Camp - Bacteria & Viruses

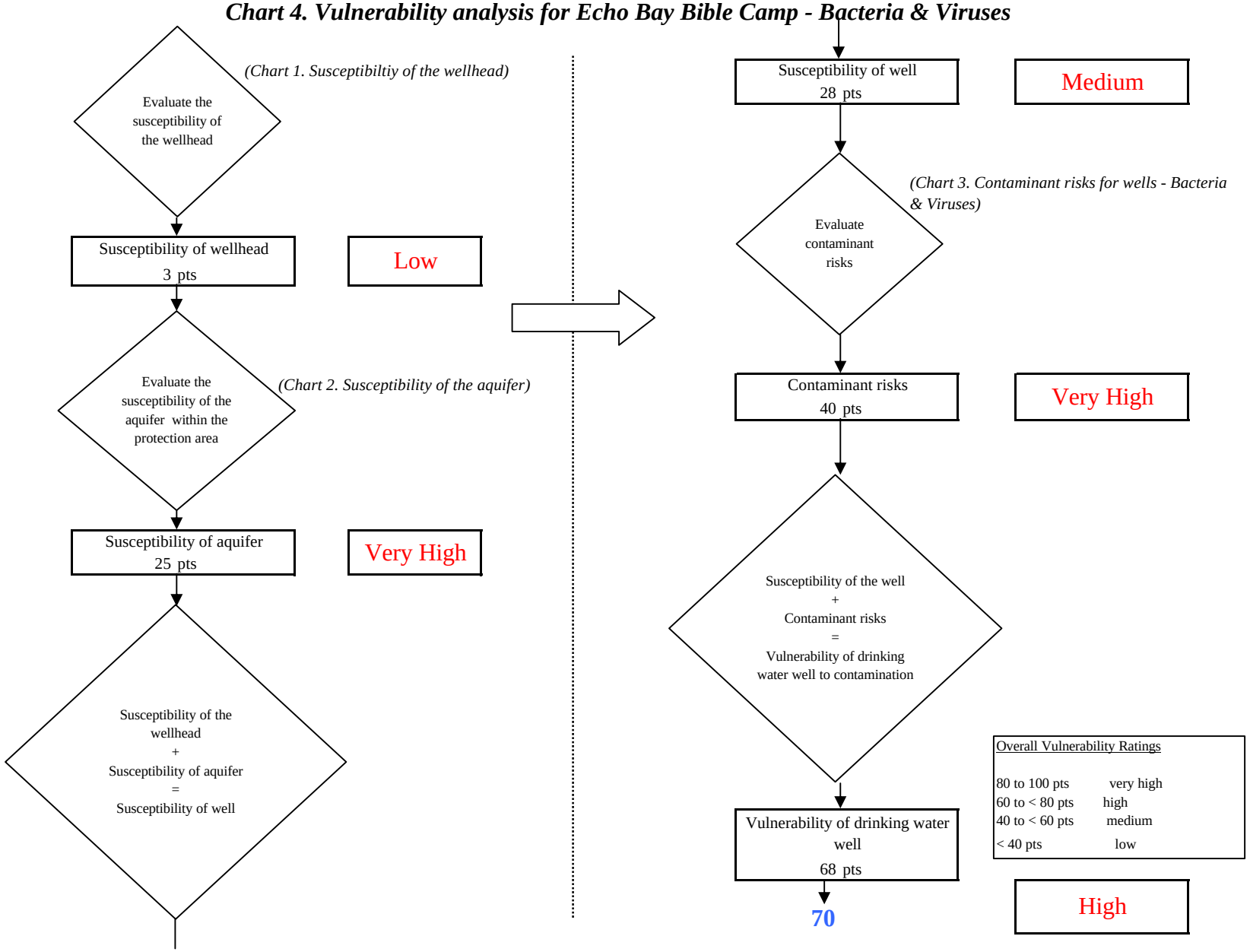


Chart 5. Contaminant risks for Echo Bay Bible Camp - Nitrates and Nitrites

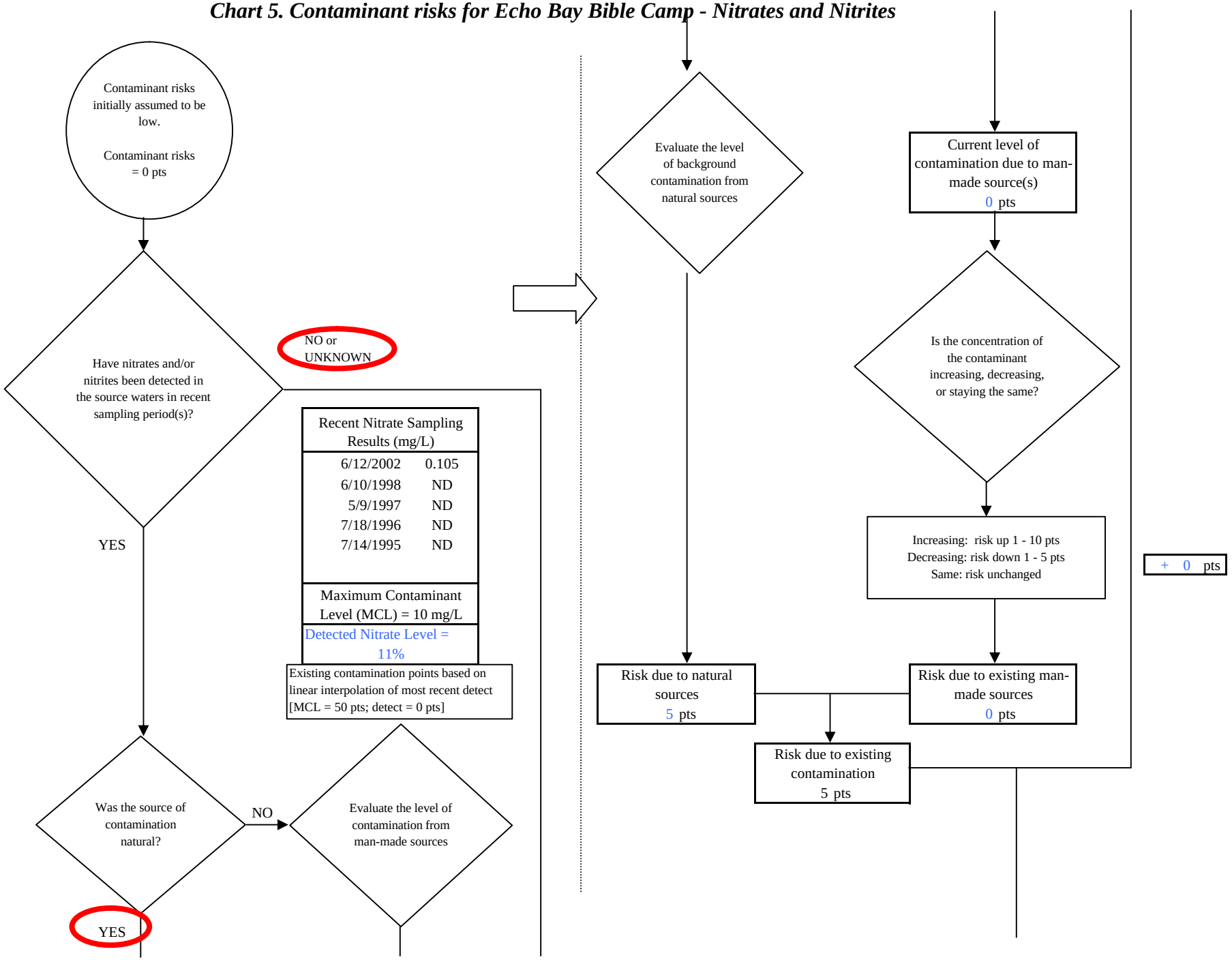


Chart 5. Contaminant risks for Echo Bay Bible Camp - Nitrates and Nitrites

+ 30 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)	1	0	1
Medium(s)	2	0	2
Low(s)	1	0	1

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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, sewerline, 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 = 30 pts

Is the source aquifer fractured rock or karst?

YES

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

YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 5. Contaminant risks for Echo Bay Bible Camp - Nitrates and Nitrites

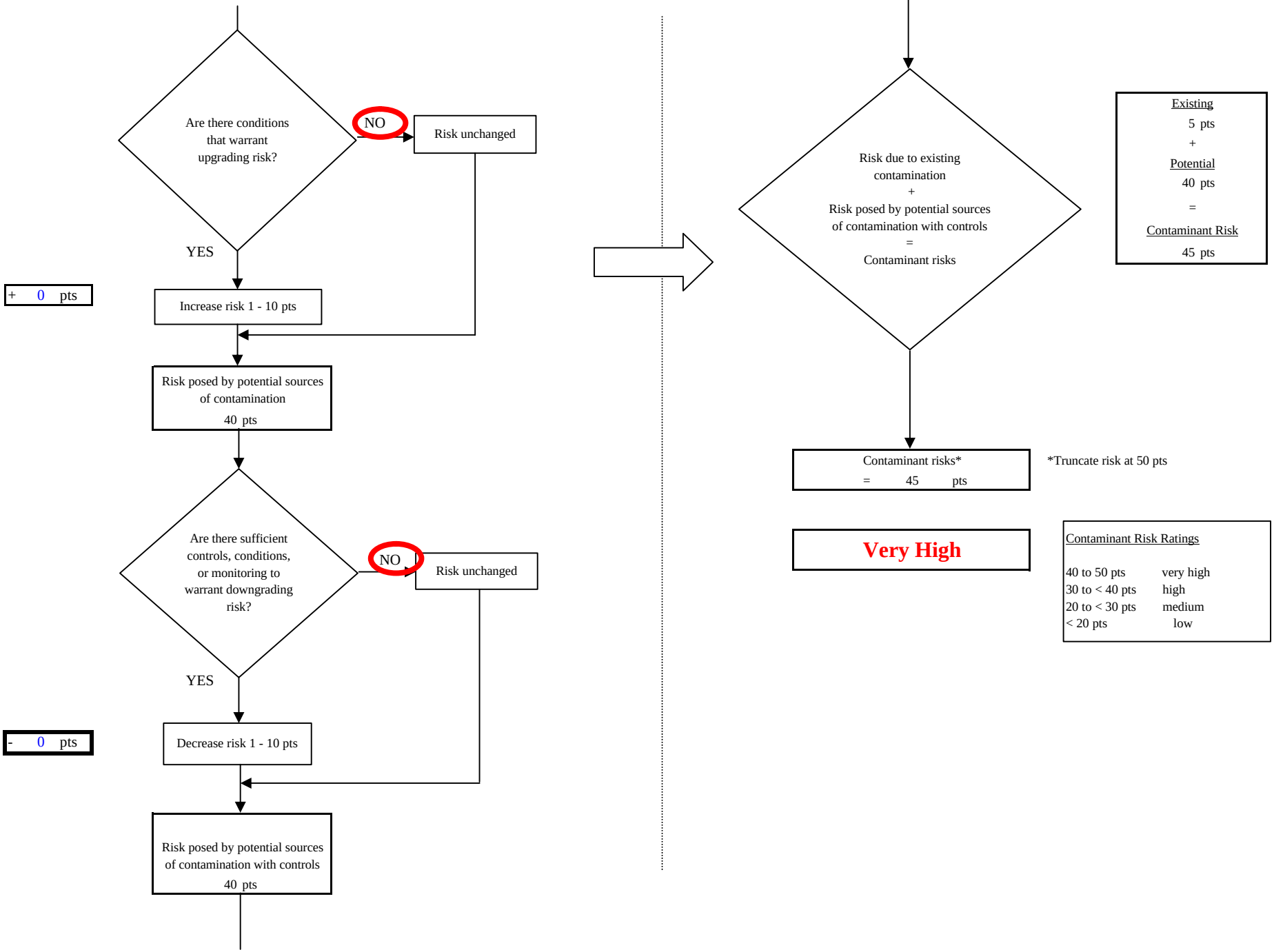


Chart 6. Vulnerability analysis for Echo Bay Bible Camp - Nitrates and Nitrites

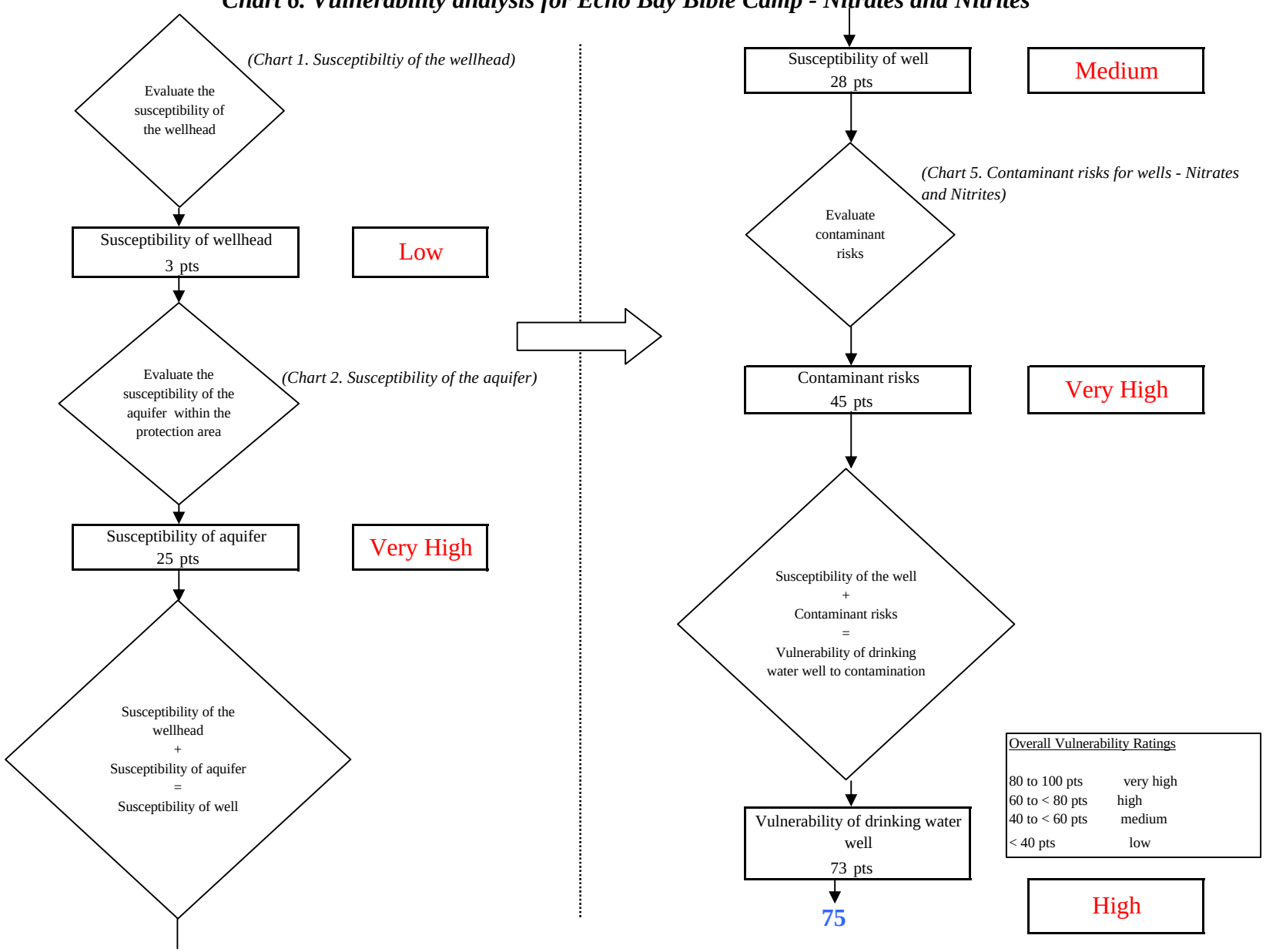


Chart 7. Contaminant risks for Echo Bay Bible Camp - Volatile Organic Chemicals

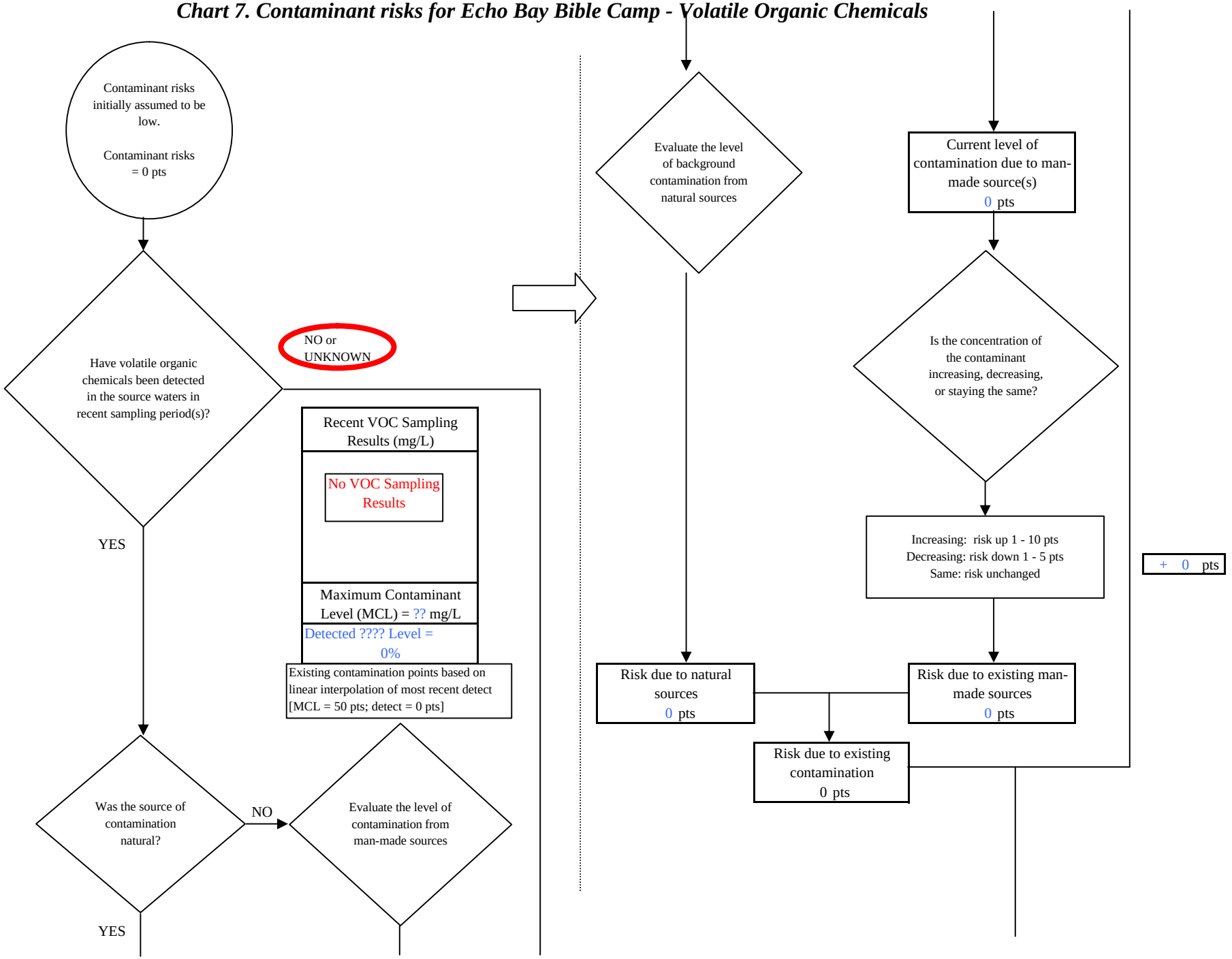


Chart 7. Contaminant risks for Echo Bay Bible Camp - Volatile Organic Chemicals

+ 20 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)	2	0	2
Low(s)	2	0	2

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 20

Note: Septic systems, sewerline, 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 = 20 pts

Is the source aquifer fractured rock or karst?

YES

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

YES

Increase risk 1 - 10 pts

+ 5 pts

Chart 7. Contaminant risks for Echo Bay Bible Camp - Volatile Organic Chemicals

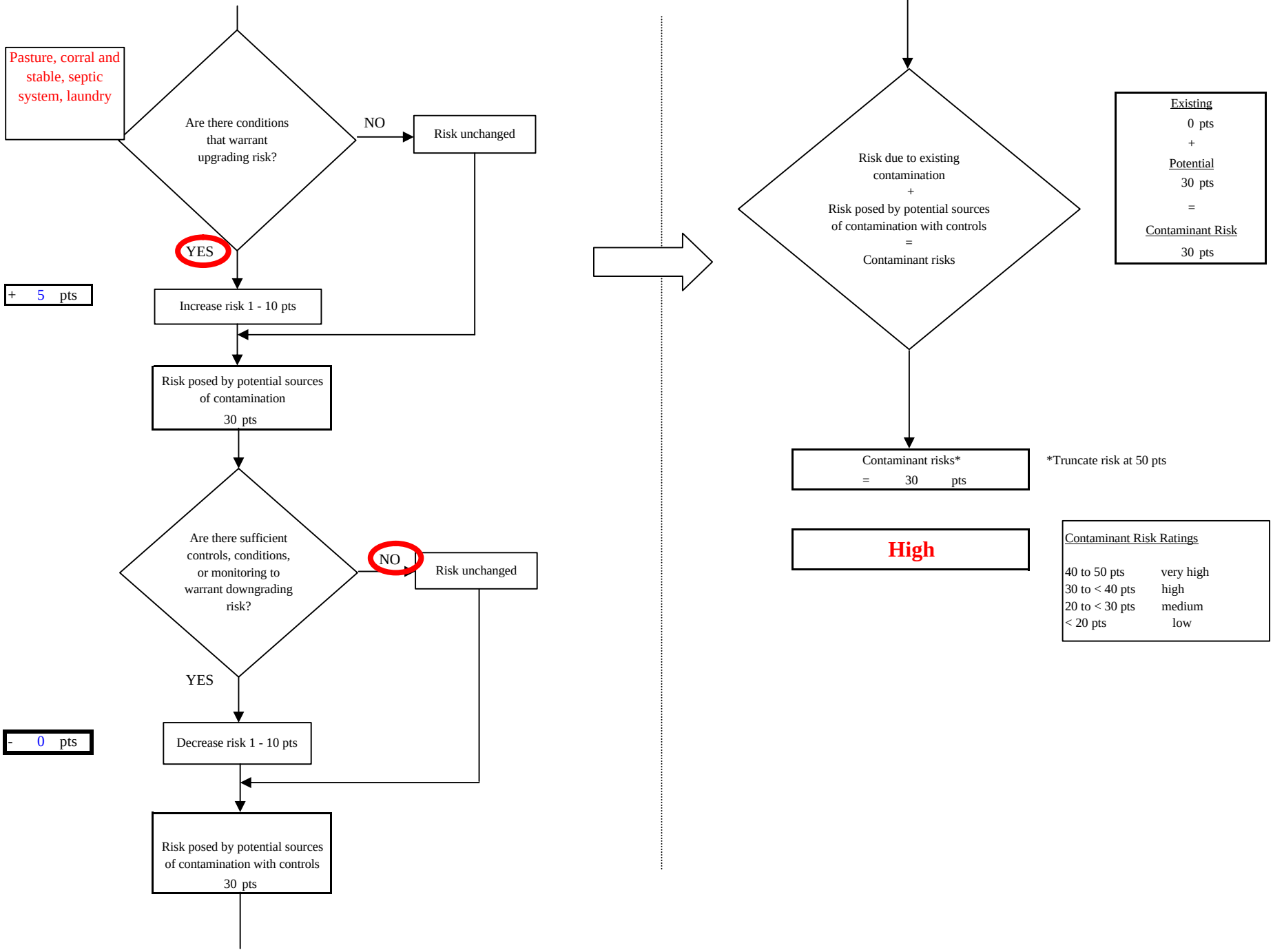


Chart 8. Vulnerability analysis for Echo Bay Bible Camp - Volatile Organic Chemicals