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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
Bristol Bay Borough Clinic  
Drinking Water System,  
Naknek, Alaska

PWSID # 261981.001  
February 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1191  
Alaska Department of Environmental Conservation

# Source Water Assessment for Bristol Bay Borough Clinic Drinking Water System Naknek, Alaska

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DRINKING WATER PROTECTION PROGRAM REPORT 1191

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 Bristol Bay Borough Clinic Source of Public Drinking Water, Naknek, Alaska

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## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The Bristol Bay Borough Clinic has one Public Water System (PWS) well. The well (PWSID# 261981.001) has been used as a drinking water source since it was drilled in 1982.

The well is a Class B (transient/non-community) water system that is located approximately 200 yards northwest of the Naknek River on School Road in Naknek, Alaska. Available records indicate that there is no secondary storage of drinking water, other than the pressure tank, and the untreated drinking water source is derived directly from the wellhead. This system operates year round and serves approximately 62 non-residents through three service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produce a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the primary public drinking water source include: domestic wastewater collection systems, aboveground fuel tanks, electric power generation, a medical/veterinary facility, water supply wells, and an airport. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the water well received a vulnerability rating of **Low** for the bacteria and viruses, a vulnerability rating of **Low** for nitrates and nitrites, and a vulnerability rating of **Low** for volatile organic chemicals contaminant categories.

### BRISTOL BAY BOROUGH CLINIC PUBLIC DRINKING WATER SYSTEM

The Bristol Bay Borough Dock water well is a Class B (transient/non-community) public water system. The facility is located approximately 200 yards northwest from the Naknek River, along School Road, in Naknek, Alaska (Sec. 2, T17S, R47W, Seward Meridian; see Map A of Appendix A). Naknek is the primary fishery center in Bristol Bay, located about 12 miles northwest of King Salmon and

300 miles southwest of Anchorage. The community has a population of 642 (ADCED, 2003). Average annual precipitation in Naknek is 20 inches, including approximately 45 inches of snowfall. Temperatures range from 42 to 63°F in summer and -4 to 16°F in winter. Temperatures can be as extreme as -46 to 88°F.

The community of Naknek gets most of their water supply from individual wells. Most households are served by the piped sewage collection system operated by the Borough and the remaining households have individual septic tanks (ADCED, 2003). Naknek receives electrical power from the Naknek Electric Association operated by the REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by the Patterson Sanitation Company and trucked to the Borough operated landfill located five miles outside of the community (ADCED, 2003).

According to information supplied by ADEC for the Bristol Bay Borough Clinic PWS, the depth of the primary water well is 132 feet below the ground surface and it is screened in gravel and silty sand in a confined aquifer. Confined aquifers are likely less susceptible to groundwater impacts resulting from the downward migration of surface contaminants. The well is not located in a floodplain.

Information acquired from a September 1998 sanitary survey for the public water system indicated that the land surface is sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces potential of contaminant migration down the well casing annulus. The well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

Naknek is located in an area that has been mapped as being underlain by isolated masses of permafrost; predominantly fine-grained deposits. Permafrost is usually found either at a considerable depth as relict permafrost or near the surface as thin lenses of small extent where ground insulation is high or low. The

terrain in this area consists of low hills with many shallow lakes. The lakes resulted from the delayed melting of buried ice blocks (ADOT&PF, 1982).

**BRISTOL BAY BOROUGH CLINIC  
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 protection area 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 for the Bristol Bay Borough Clinic PWS. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (Freeze and Cherry, 1979). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

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 (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

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**

<b>Zone</b>	<b>Definition</b>
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 the Bristol Bay Borough Clinic PWS was determined using an analytical calculation and includes Zones A, B, C and D (See Map A 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 Bristol Bay Borough Clinic 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 C 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 THE BRISTOL BAY BOROUGH CLINIC 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 Bristol Bay Borough Clinic’s water well is in a confined aquifer. Confined aquifers are less susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the Susceptibility scores and ratings for both wells in this PWS.

**Table 2. Susceptibility**

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	12	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	25	Medium
Nitrates and/or Nitrites	25	Medium
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)

$$\begin{array}{r}
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100)}.
 \end{array}$$

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	35	Low
Nitrates and Nitrites	35	Low
Volatile Organic Chemicals	35	Low

#### **Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Medium**. The risk is primarily attributed to the presence of domestic wastewater collection systems and a medical/veterinary facility in Zone A (see Table 2 – Appendix B).

A positive bacteria count has not been reported in recent (within five years) sampling events. Only a small amount of bacteria and viruses are required to endanger public health.

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 **Low**.

#### **Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Medium**. The risk to this source of public drinking water is attributed to the presence of a domestic wastewater collection systems in Zone A (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that no nitrates have been detected in the water. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Low**.

#### **Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Medium**. The risk is primarily attributed to the presence of an airport in Zone D (see Table 4 – Appendix B).

No recent sampling data was available in ADEC records for the Bristol Bay Borough Clinic (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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 **Low**.

#### **Using the Source Water Assessment**

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the Bristol Bay Borough Clinic and the community of Naknek to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

## REFERENCES

- Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: [http://www.dced.state.ak.us/cbd/commdb/CF\\_COMDB.htm](http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm)
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- United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.



## **APPENDIX A**

### **Drinking Water Protection Area Location Map (Map A)**

## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking (Tables 1-4)**

## **APPENDIX C**

### **Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)**

## **APPENDIX D**

### **Vulnerability Analysis for Public Drinking Water Source (Charts 1-8)**

*Contaminant Source Inventory and Risk Ranking for  
Bristol Bay Borough Clinic  
Sources of Bacteria and Viruses*

*PWSID 261981.001*

*Table 2*

<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>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	Assume 1-10 sewer lines located in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Medium	C	BBB Clinic

**Table 3**

*Contaminant Source Inventory and Risk Ranking for  
Bristol Bay Borough Clinic  
Sources of Nitrates/Nitrites*

**PWSID 261981.001**

<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>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	Assume 1-10 sewer lines located in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	BBB Clinic
Airports	X14	X14-01	D	Low	C	

*Contaminant Source Inventory and Risk Ranking for  
Bristol Bay Borough Clinic  
Sources of Volatile Organic Chemicals*

*PWSID 261981.001*

*Table 4*

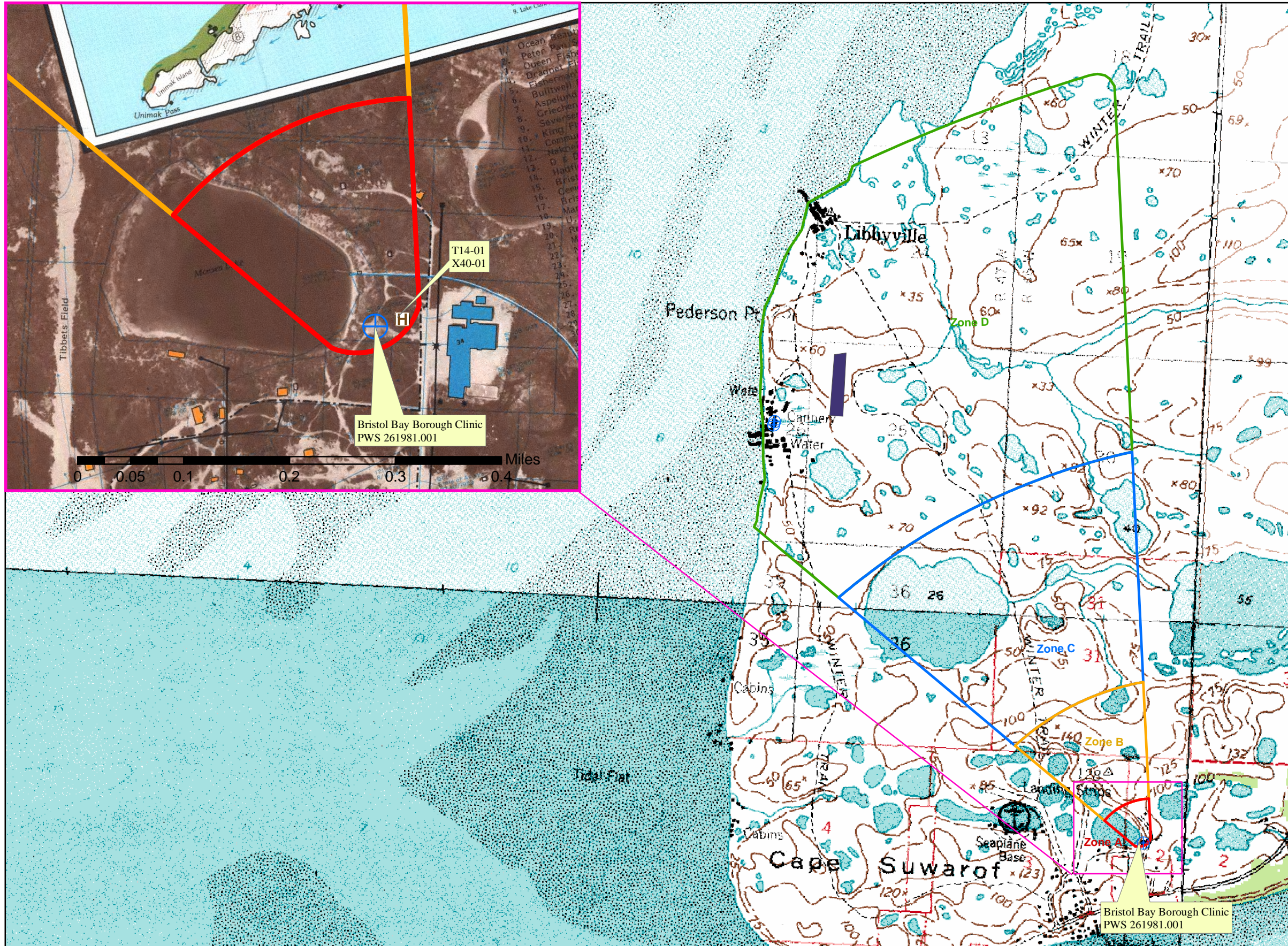
<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	Assume 1-10 sewer lines located in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume residential housing heated by heating oil
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	BBB Clinic
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	BBB Clinic
Airports	X14	X14-01	D	High	C	

## **APPENDIX C**

### **Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)**



**Public Water Well System for PWS #261981.001 Bristol Bay Borough Clinic  
Showing Potential and Existing Sources of Contamination**



**LEGEND**

- Public Water System Well
- Hydrography/Physical**
  - Parcels
  - Stream
  - Lake or Pond
  - Contours
- Transportation**
  - Primary Route (Class 1)
  - Secondary Route (Class 2)
  - Road (Class 3)
  - Road (Class 4)
  - Road (Class 5, Four-wheel drive)
- Groundwater Protection Zones**
  - Zone A Protection Area- Several Months Travel Time
  - Zone B Protection Area- 2 Years Travel Time
  - Zone C Protection Area- 2 Years Travel Time
  - Zone D Protection Area- 10 Years Travel Time
- Existing or Potential Contaminant Sources**
  - Tanks, heating oil, nonresidential (aboveground) (T14)
  - Medical/veterinary facilities (X40)
  - Airports (X14)

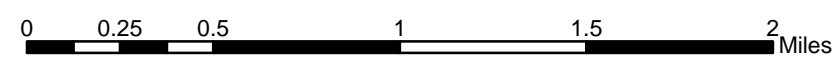
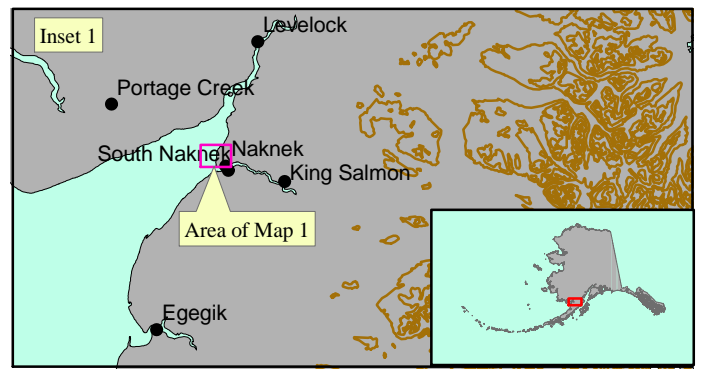
Data Sources:  
Contaminant Sources, Public Water System Wells, Contours  
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:  
United States Geological Survey (USGS)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC

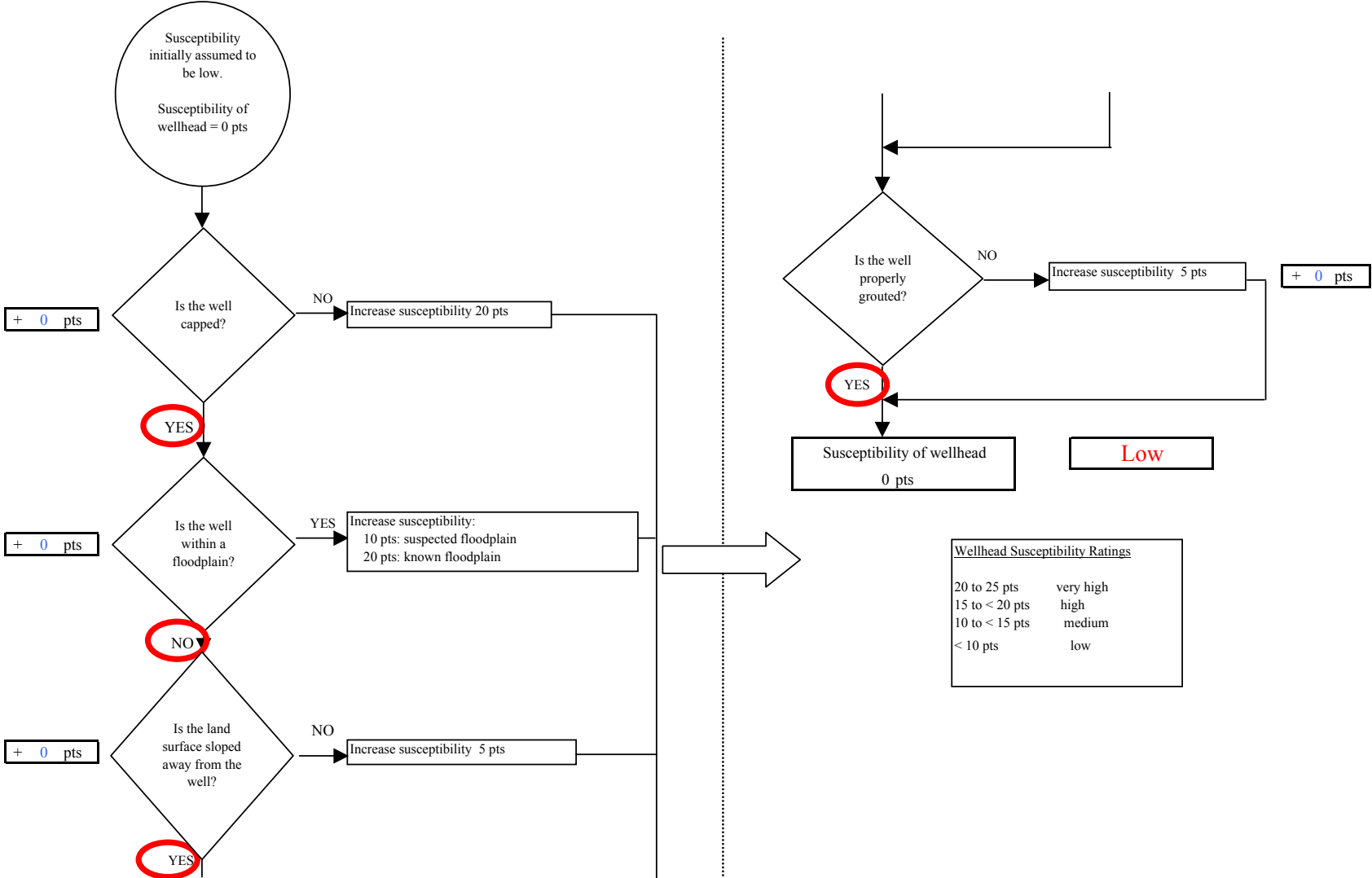
URS Corporation does not guarantee the accuracy or validity of the data provided.



## **APPENDIX D**

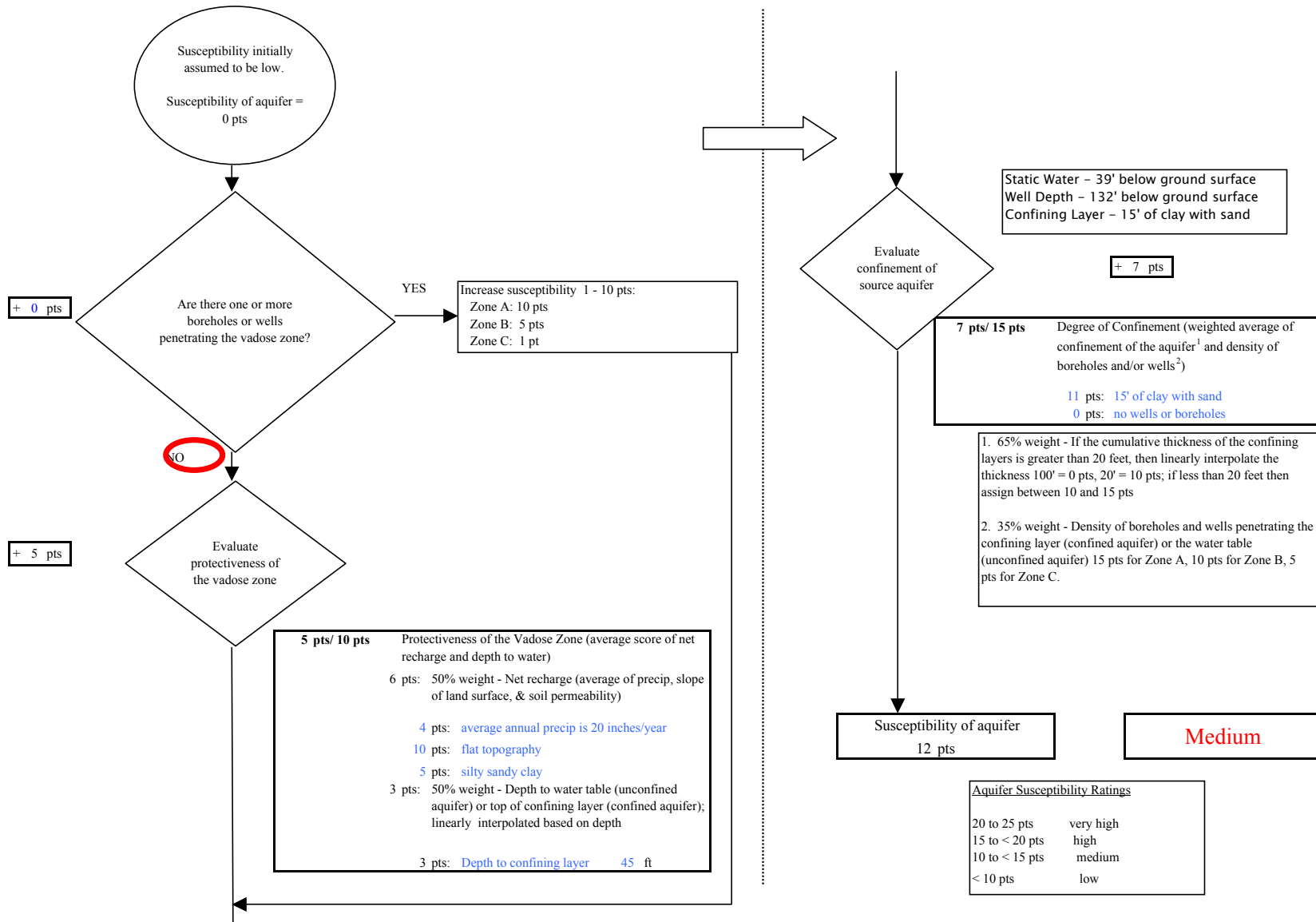
### **Vulnerability Analysis for Public Drinking Water Source (Charts 1-8)**

**Chart 1. Susceptibility of the wellhead - Bristol Bay Borough Clinic (PWS No. 261981.001)**

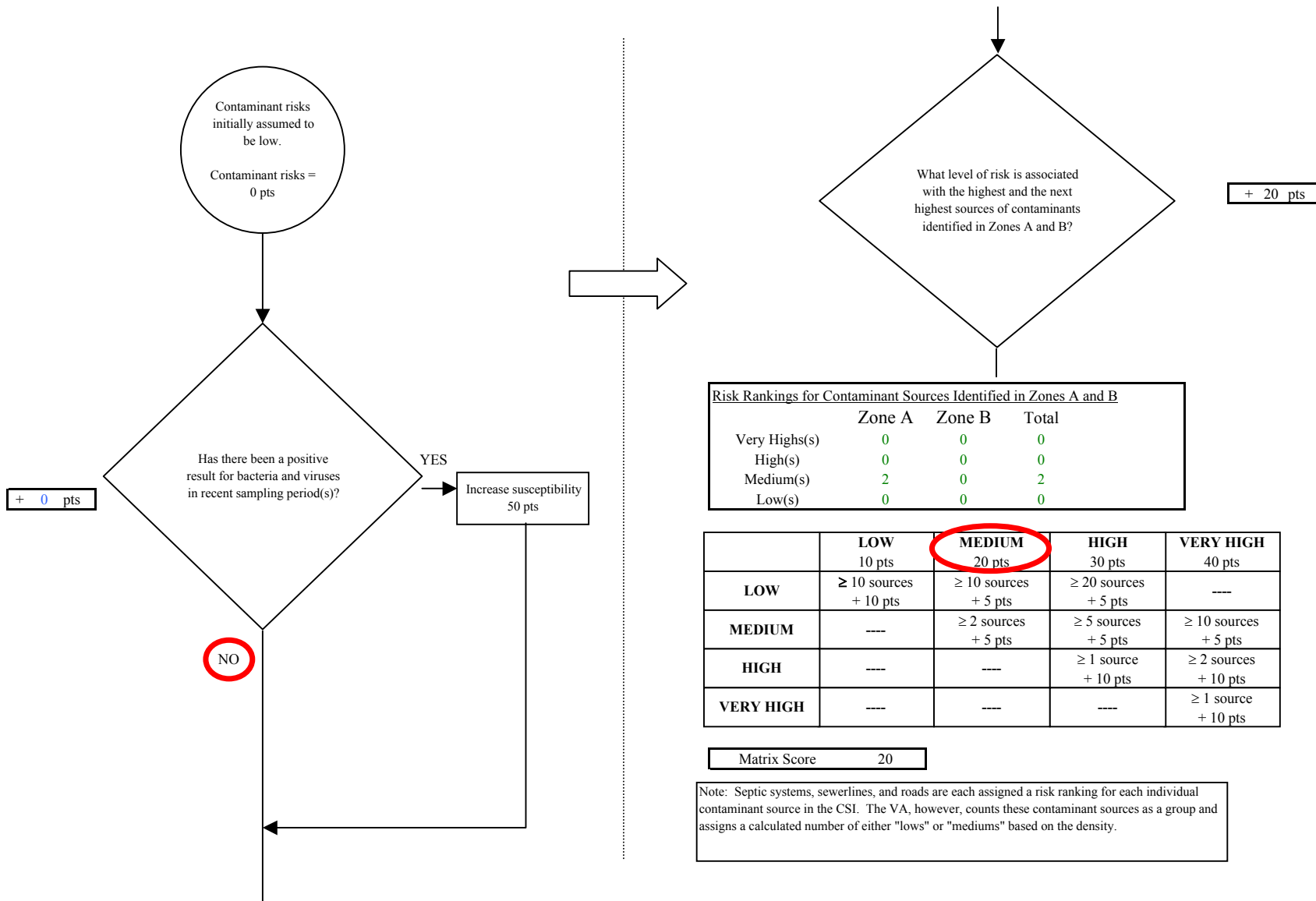


Wellhead Susceptibility Ratings	
20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10 pts	low

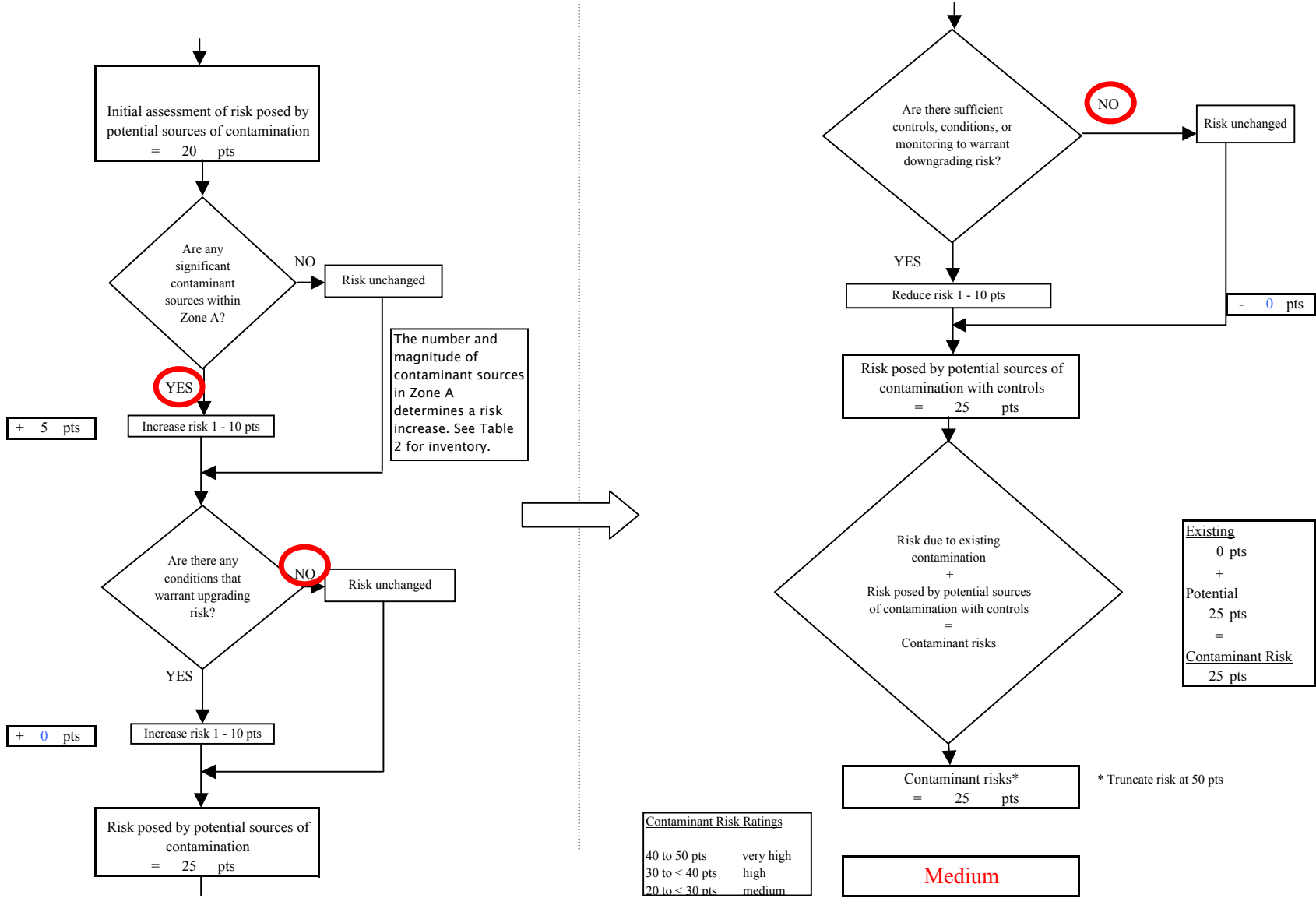
**Chart 2. Susceptibility of the aquifer Bristol Bay Borough Clinic (PWS No. 261981.001)**



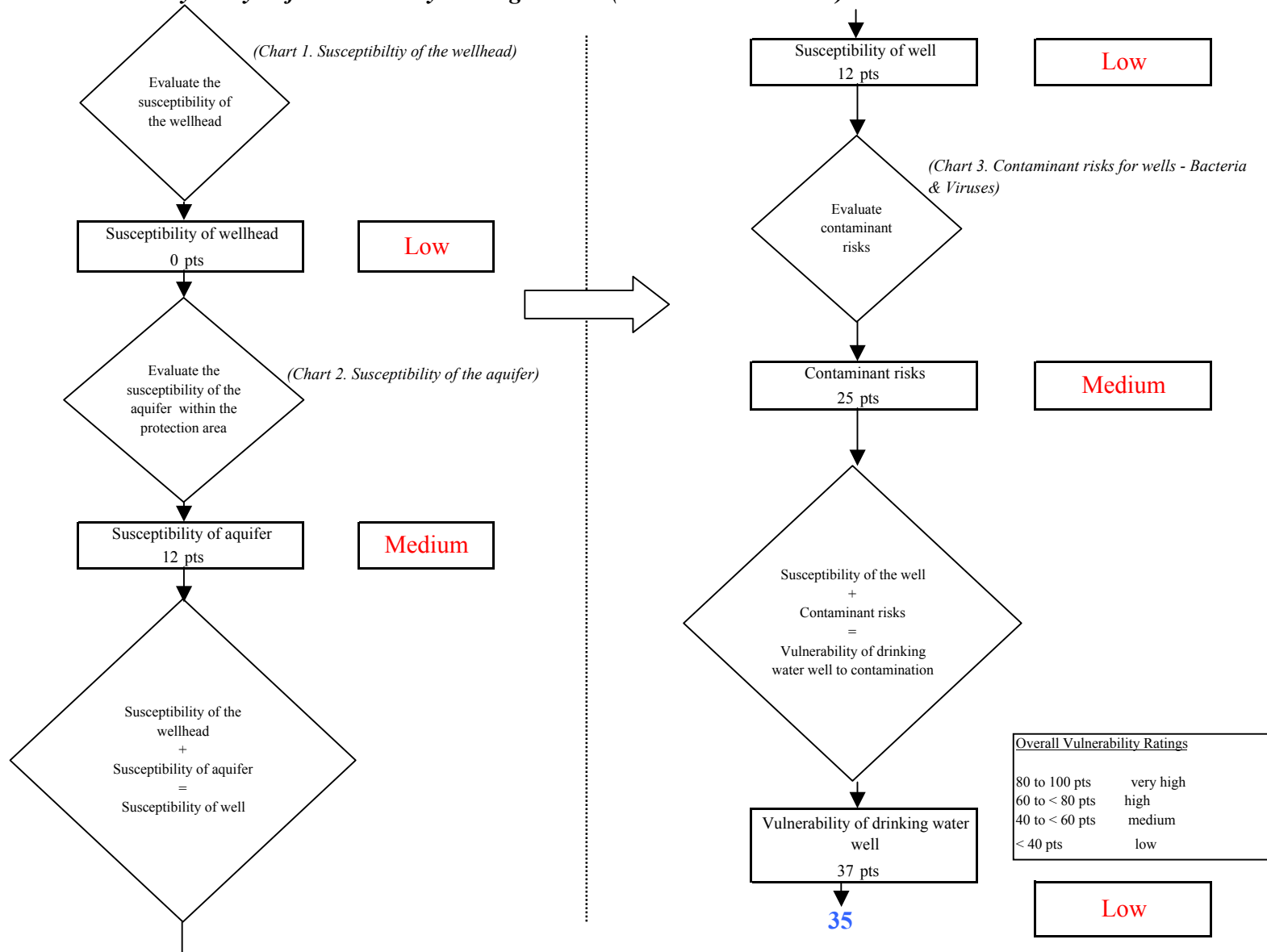
**Chart 3. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Bacteria & Viruses**



**Chart 3. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Bacteria & Viruses**



**Chart 4. Vulnerability analysis for Bristol Bay Borough Clinic (PWS No. 261981.001) - Bacteria & Viruses**



**Chart 5. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Nitrates and Nitrites**

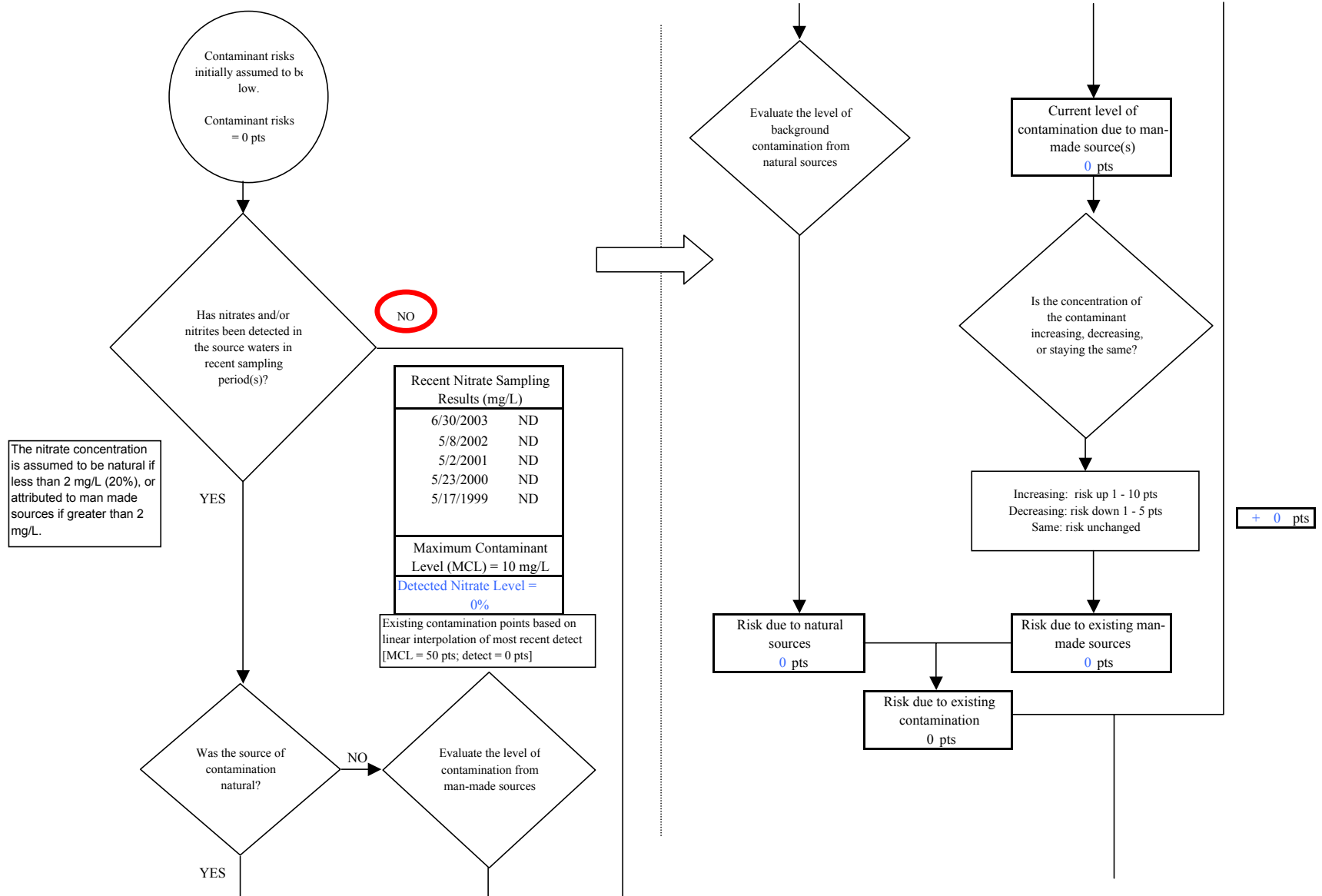
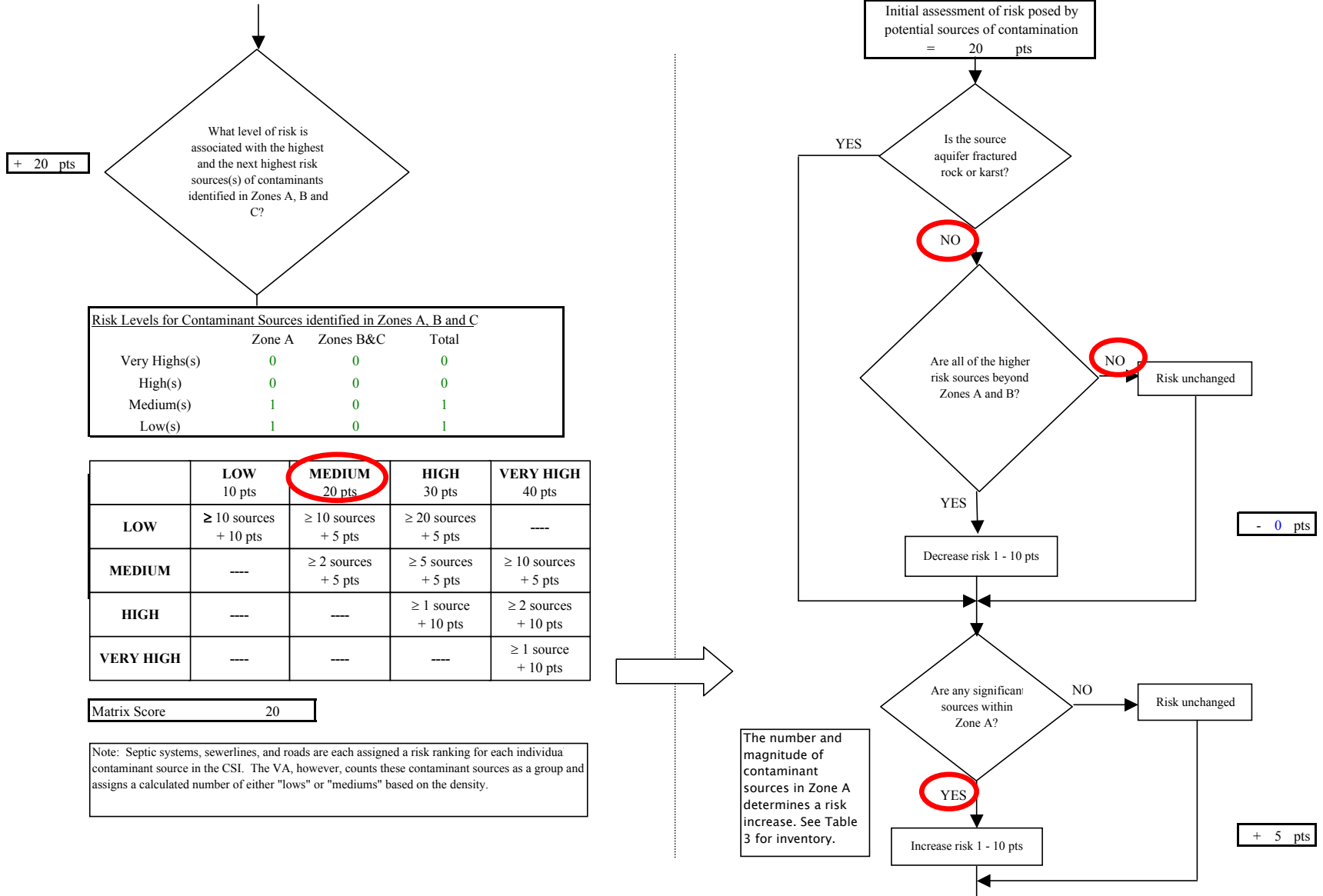




Chart 5. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Nitrates and Nitrites



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?

+ 20 pts

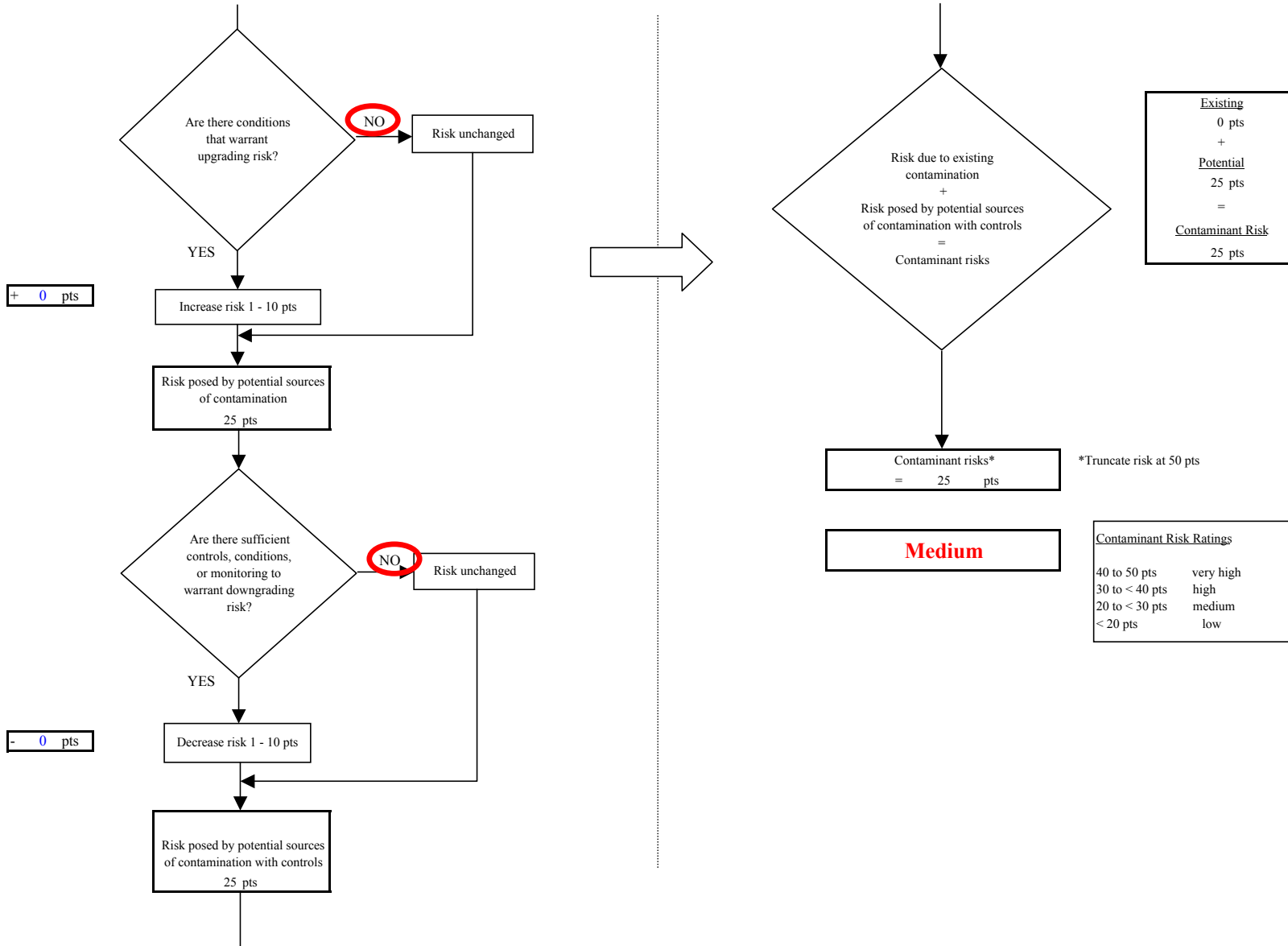
Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	1	0	1

	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 20

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 Bristol Bay Borough Clinic (PWS No. 261981.001) - Nitrates and Nitrites**



**Chart 6. Vulnerability analysis for Bristol Bay Borough Clinic (PWS No. 261981.001) - Nitrates and Nitrites**

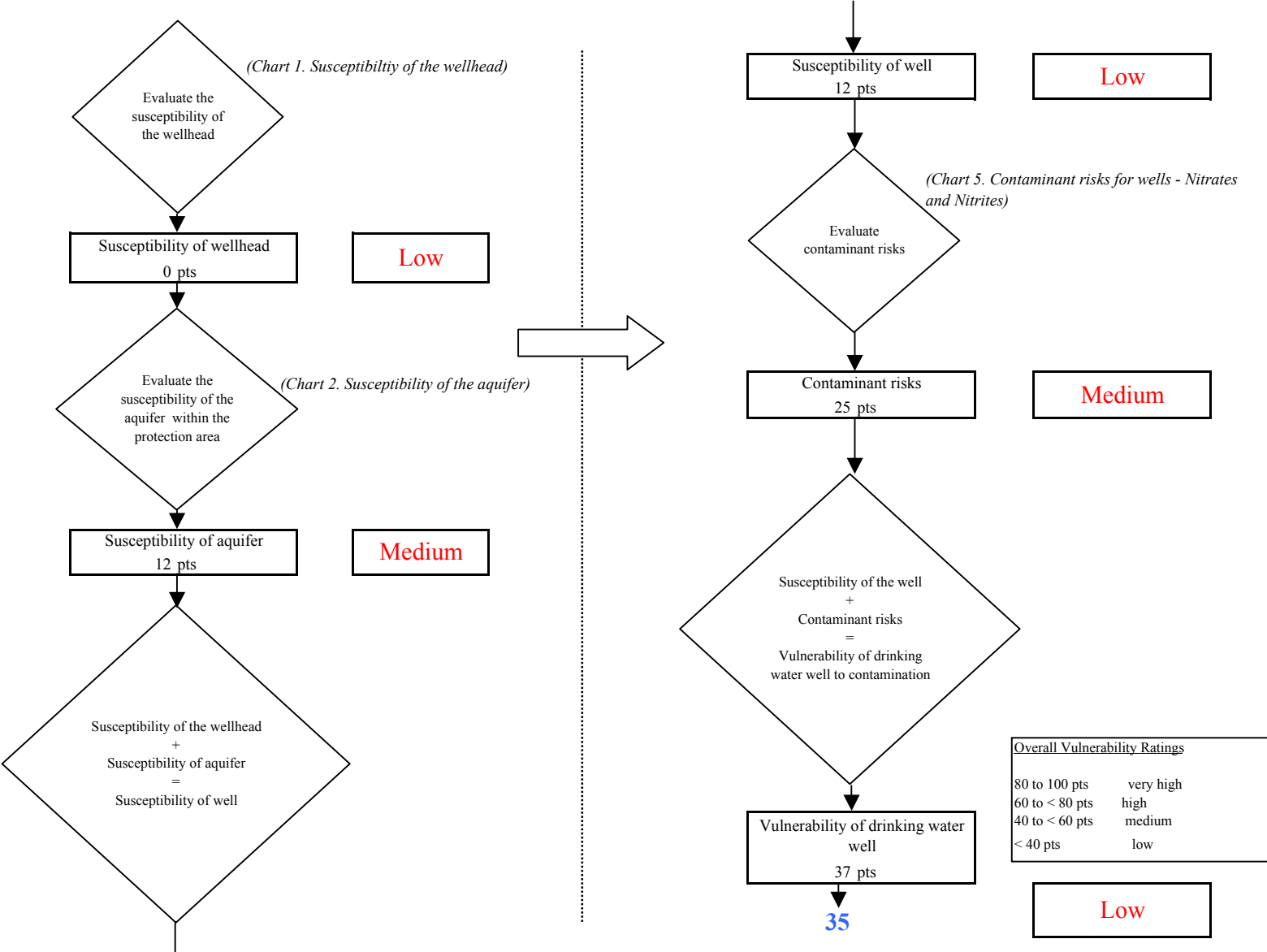
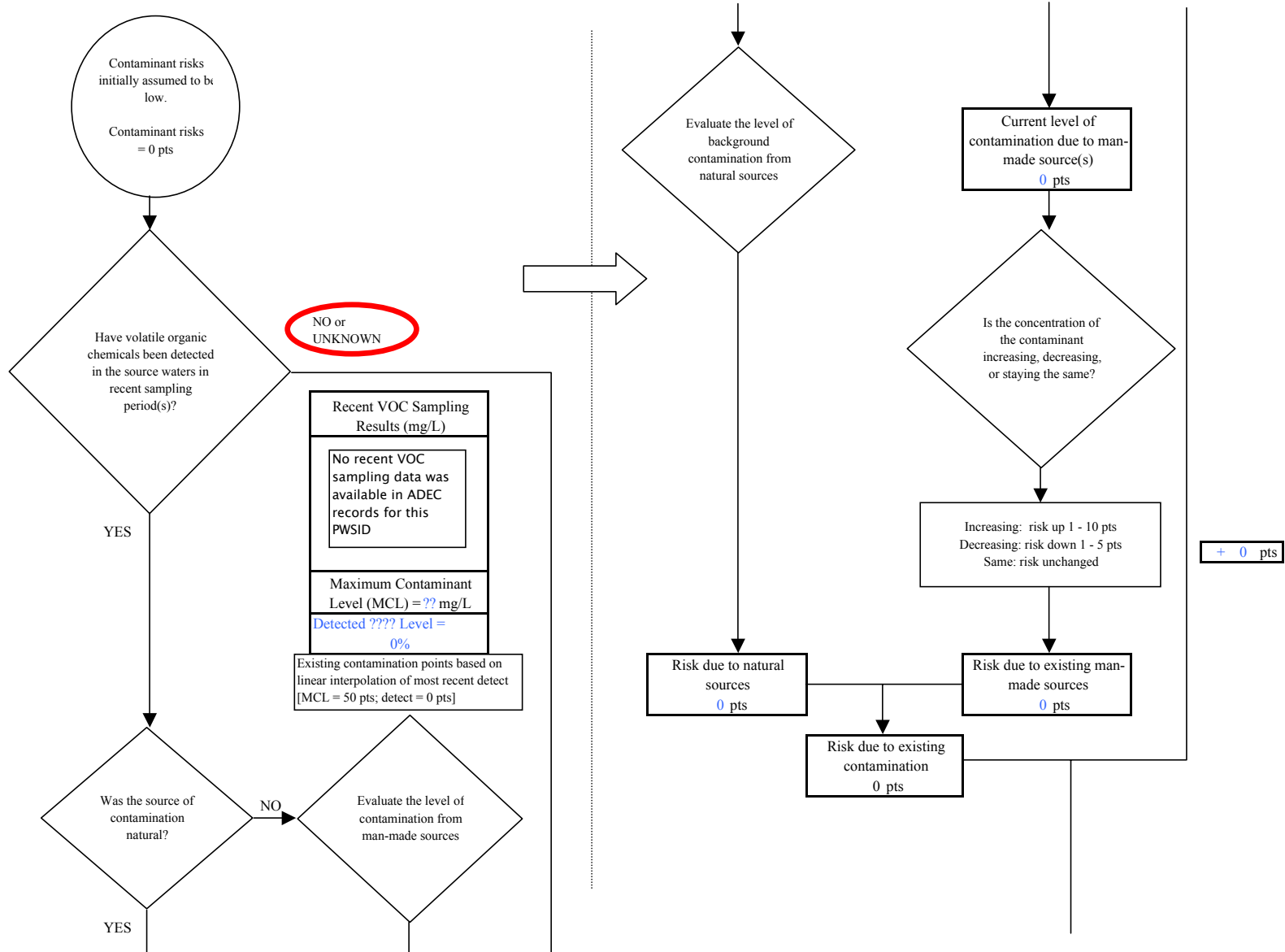
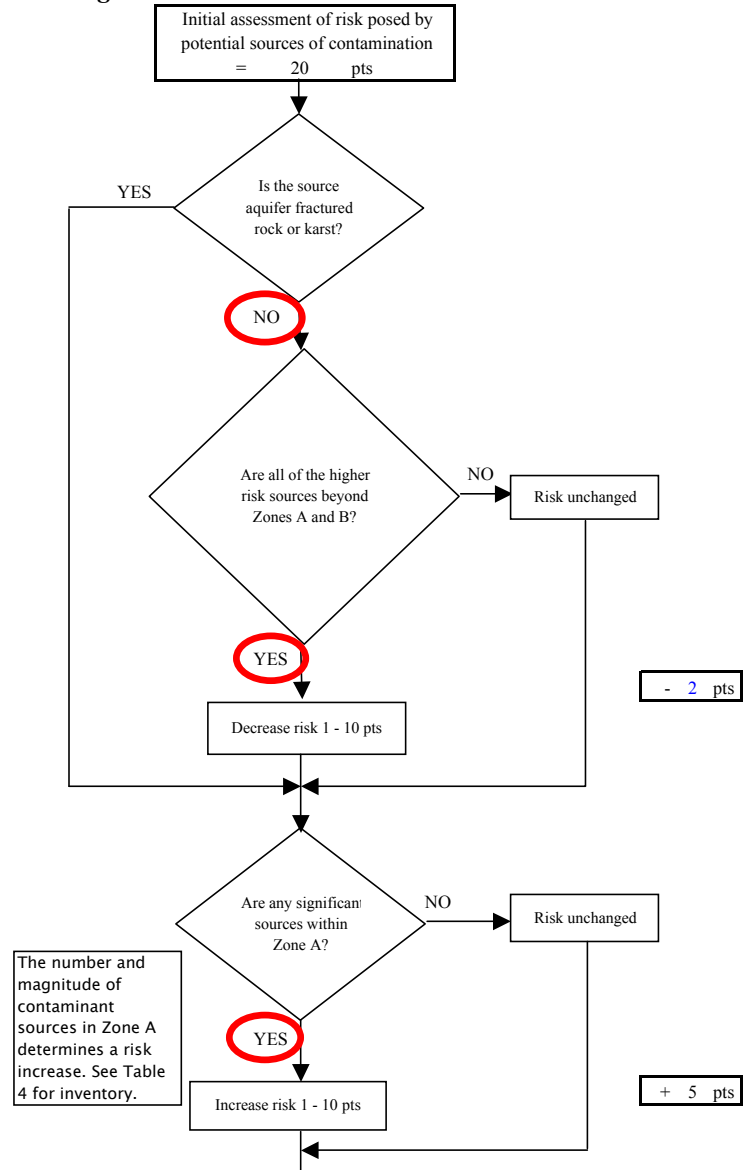
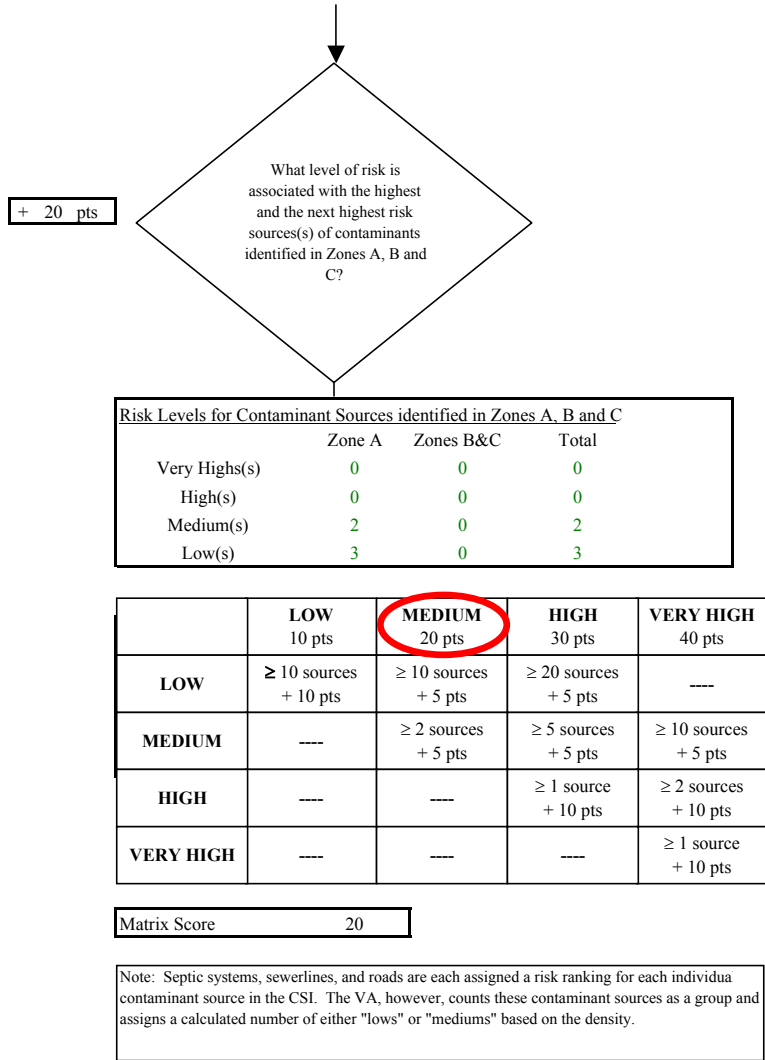


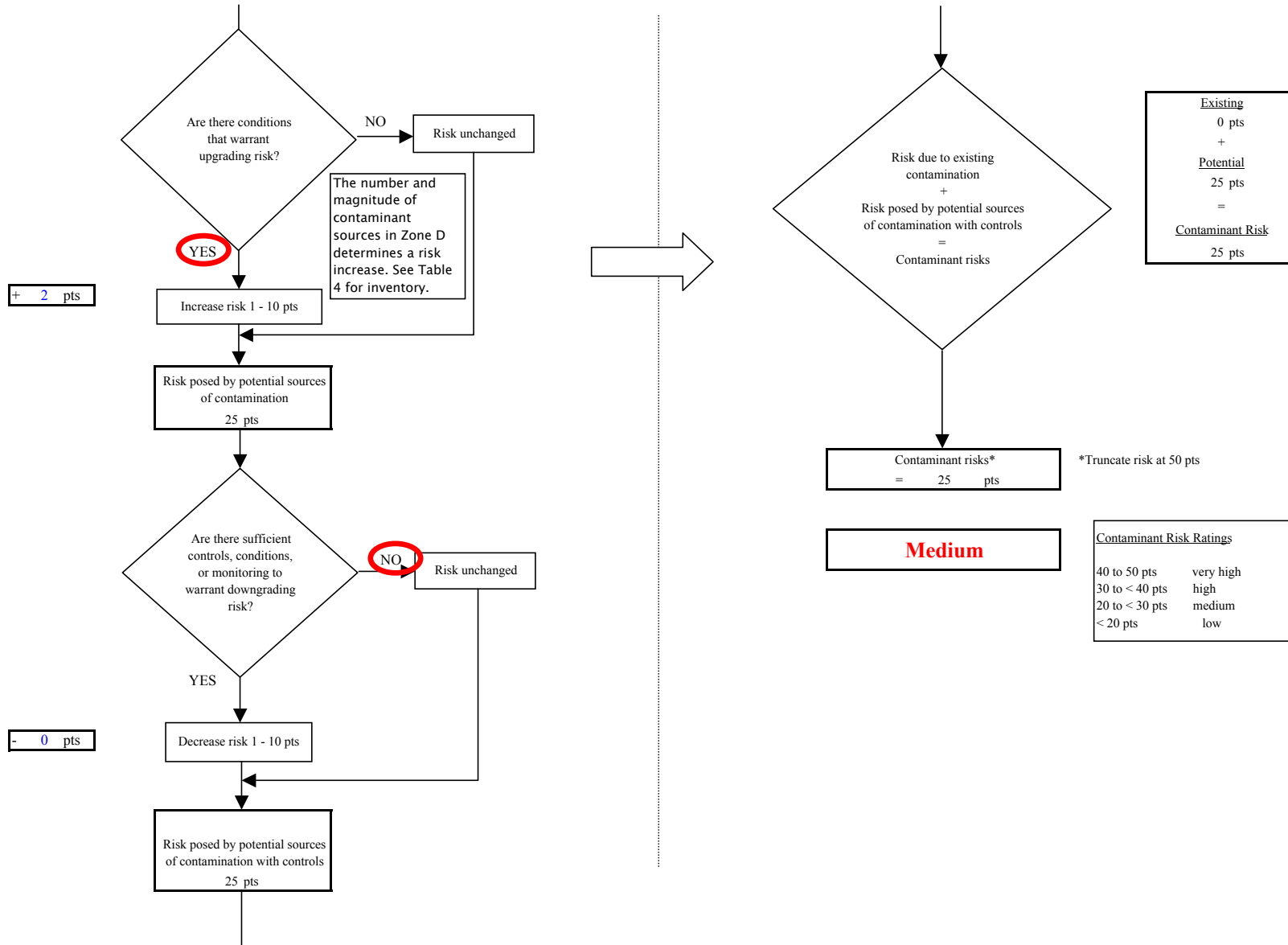
Chart 7. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Volatile Organic Chemicals



**Chart 7. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Volatile Organic Chemicals**



**Chart 7. Contaminant risks for Bristol Bay Borough Clinic (PWS No. 261981.001) - Volatile Organic Chemicals**



**Chart 8. Vulnerability analysis for Bristol Bay Borough Clinic (PWS No. 261981.001) - Volatile Organic Chemicals**

