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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
LKSD Kwethluk High School & Elementary  
Drinking Water System,  
Kwethluk, Alaska

PWSID # 270956.001

April 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1110  
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 LKSD Kwethluk High School & Elementary Source of Public Drinking Water, Kwethluk, Alaska

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## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The LKSD Kwethluk High School & Elementary has one Public Water System (PWS) well. The well (PWS No. 270956.001) has been used as a drinking water source since it was drilled in 1966.

The well is a Class A (community and non-transient non-community) water system located at 101 Village Way in Kwethluk, Alaska. Available records indicate that there is secondary storage of drinking water, with a capacity of 1,500-gallons, and that the drinking water source is treated with calcium hypochlorite. This system operates seasonally and serves approximately 225 non-residents through two service connections. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produce a **Very High** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: Laundromats, motor/motor vehicle repair shops, domestic wastewater treatment plant disposal ponds/lagoons, aboveground fuel tanks, ADEC recognized contaminated sites, petroleum product bulk station/terminals, an airport, boat yards and marinas, roads, electric power generation, firehouses, and a landfill. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

Overall, the water well received a vulnerability rating of **Very High** for the bacteria and viruses, nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

### PUBLIC DRINKING WATER SYSTEM

The LKSD Kwethluk High School & Elementary well is a Class A (community/non-transient/non-community) public water system. The system is located at 101 Village Way in Kwethluk, Alaska (Sec. 5, T8N, R69W, Seward Meridian; see Map A of Appendix A). Kwethluk is located 12 air miles east of Bethel on the Kwethluk River at its junction with the Kuskokwim River. The community has a population of 730 (ADCED, 2003). Average annual precipitation in Kwethluk is 16 inches, including approximately 50 inches of snowfall. Temperatures range from 42 to 62°F in summer and -2 to 19°F in winter. Temperatures can be as extreme as -46 to 86°F.

The community of Kwethluk obtains most of their water supply from community wells. Honeybuckets are hauled to the sewage lagoon (ADCED, 2003). Kwethluk receives electrical power from Kwethluk Inc. Power generating facilities are fueled by diesel. Refuse is collected by the City of Kwethluk and transported to the landfill (ADCED, 2003).

According to information supplied by ADEC for the LKSD Kwethluk High School & Elementary PWS, the depth of the primary water well is 145 feet below the ground surface and is screened in a confined aquifer based on available construction details. The well is located within a floodplain.

Information acquired from a September 1998 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

The topography of the Kwethluk area generally consists of low wetlands with small knolls and numerous small lakes, sloughs, and old river

channels. Kwethluk lies within the floodplain of both the Kwethluk River and the Kuskokwim River. The geology in the area consists of unconsolidated floodplain alluvium, silt deposits, and reworked silt. The materials are generally deposited by water and have been extensively reworked by the shifting currents of the Kuskokwim River, its tributaries, ice jams, and runoff flooding. The community of Kwethluk is located near the southern boundary of the area that is generally accepted to be underlain by continuous permafrost (Dames & Moore, 1997).

**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 LKSD Kwethluk High School & Elementary 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 A 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 LKSD Kwethluk High School & Elementary 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 LKSD Kwethluk High School & Elementary 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 A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses,
- Nitrates and/or nitrites,
- Volatile organic chemicals,
- Heavy metals, cyanide and other inorganic chemicals,
- Synthetic organic chemicals,
- Other 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, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

### VULNERABILITY OF THE 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 fourteen 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. Chart 4 contains the ‘Vulnerability Analysis for Bacteria and Viruses’. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other 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 LKSD Kwethluk High School & Elementary 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 this PWS.

**Table 2. Susceptibility**

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	15	High
Natural Susceptibility	40	Very High

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

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

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

**Table 3. Contaminant Risks**

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	44	Very High
Other Organic Chemicals	50	Very High

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

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

Again, rankings are assigned according to a point score:

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

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

**Table 4. Overall Vulnerability**

Category	Score	Rating
Bacteria and Viruses	90	Very High
Nitrates and Nitrites	90	Very High
Volatile Organic Chemicals	90	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	90	Very High
Synthetic Organic Chemicals	85	Very High
Other Organic Chemicals	90	Very High

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of two domestic wastewater treatment plant disposal ponds/lagoons and a landfill in Zones A and C (see Table 2 – Appendix B).

No positive bacteria counts have been reported in recent (within five years) sampling events (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.

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 **Very High**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of two domestic wastewater treatment plant disposal ponds/lagoons and a landfill in Zones A and C (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 low levels of nitrates have been detected in recent sampling events. However, the reported concentrations of nitrates do not exceed the maximum contaminant level (MCL) of 10 mg/L. 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. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources. 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 **Very High**.

### **Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of an ADEC recognized contaminated site, petroleum product bulk station/terminals, an airport, and a landfill located in Zones A and C. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Detectable concentrations of trihalomethanes were reported in sampling events for this public water system. However, the detectible concentrations of trihalomethanes reported in 2001 were well below the MCL of 0.08 mg/L. Trihalomethanes are considered byproducts of the water treatment process and are not from the source waters. Since the reported concentration of TTHM's in recent sampling events did not exceed the applicable MCLs, risk points were not retained.

Aside from being byproducts of the drinking water treatment process, possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports. See Table 4 in Appendix D for a complete listing.

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 **Very High**.

### **Heavy Metals, Cyanide and Other Inorganic Chemicals**

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfill located in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, high levels of arsenic have been detected in recent sampling history. The arsenic concentrations have exceeded the MCL of 0.05 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall

vulnerability of the well to contamination is **Very High**.

### **Synthetic Organic Chemicals**

The contaminant risk for synthetic organic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfill located in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the LKSD Kwethluk High School & Elementary (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

After combining the contaminant risk for synthetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Very High**.

### **Other Organic Chemicals**

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of petroleum product bulk station/terminals, electric power generation, and a landfill located in Zones A and C. Numerous other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the LKSD Kwethluk High School & Elementary (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

After combining the contaminant risk for other organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Very High**.

### **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 LKSD Kwethluk High School & Elementary and the community of Kwethluk 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.



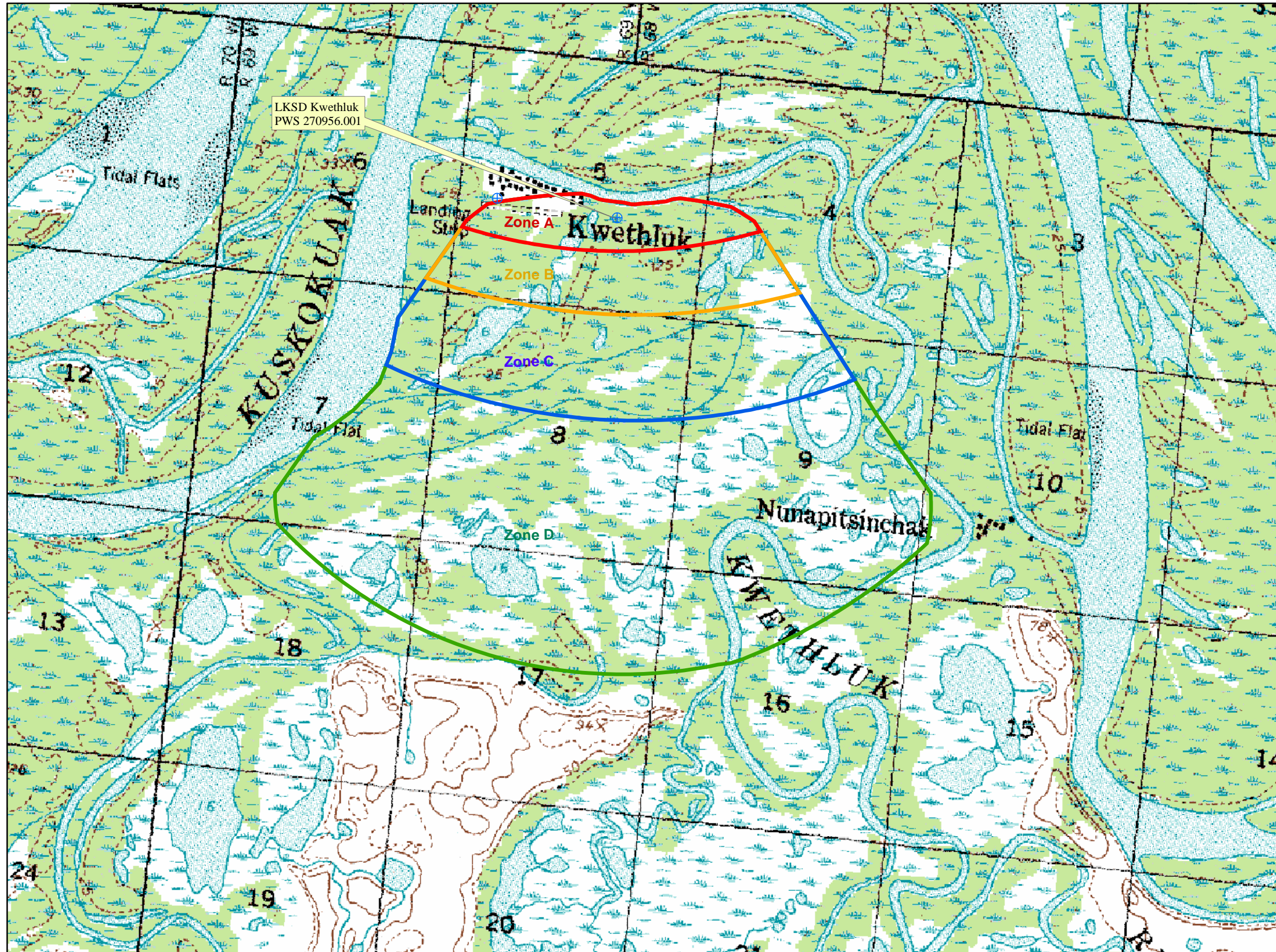
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# **APPENDIX A**

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

Public Water Well System for PWS #270956.001 LKSD Kwethluk

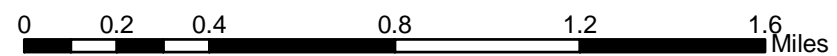
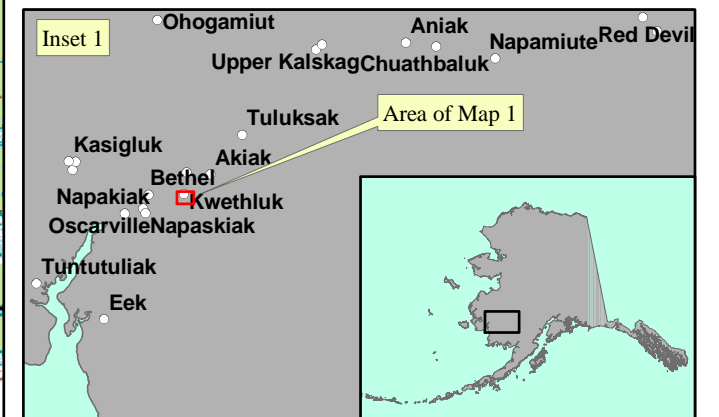


**LEGEND**

- ⊕ Public Water System Well
- Groundwater Protection Zones**
  - Zone A Protection Area- Several Months Travel Time
  - Zone B Protection Area- 2 Years Travel Time
  - Zone C Protection Area- 5 Years Travel Time
  - Zone D Protection Area- 10 Years Travel Time or Watershed Boundary
- Hydrography/Physical**
  - Parcels
  - Stream
  - Lake or Pond
  - Contours

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 A Public Water Systems" published by ADEC

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



## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking (Tables 1-7)**

**Table 1**

**Contaminant Source Inventory for  
LKSD Kwethluk High**

**PWSID 270956.001**

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Laundromats without dry cleaning	C22	C22-01	A	C	
Motor /motor vehicle repair shops	C31	C31-01	A	C	LKSD Kwethluk High School
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	C	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume approximately 40 residential heating oil tanks in Zone A
Tanks, diesel (above ground)	T06	T06-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	AKARNG Kwethluk FSA, RecKey #1997250113601, Status: Active, diesel range organics contamination discovered near footprint of a 3,000-gallon AST
Petroleum product bulk station/terminals	X11	X11-01	A	C	
Petroleum product bulk station/terminals	X11	X11-02	A	C	
Airports	X14	X14-01	A	C	
Boat yards and marinas	X15	X15-01	A	C	Assume 1 boat yard/marina present along river and Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Electric power generation (fossil fuels)	X36	X36-01	A	C	
Firehouses	X38	X38-01	A	C	
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	C	C	
Airports	X14	X14-02	C	C	
Highways and roads, dirt/gravel	X24	X24-03	C	C	Assume 1-20 roads in Zone C

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High  
Sources of Bacteria and Viruses*

*PWSID 270956.001*

*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>
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	C	High	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High  
Sources of Nitrates/Nitrites*

*PWSID 270956.001*

**Table 3**

<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>
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	High	C	
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	C	Very High	C	
Airports	X14	X14-02	C	Low	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C



*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High  
Sources of Volatile Organic Chemicals*

*PWSID 270956.001*

**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>
Laundromats without dry cleaning	C22	C22-01	A	Low	C	
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	LKSD Kwethluk High School
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	Low	C	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume approximately 40 residential heating oil tanks in Zone A
Tanks, diesel (above ground)	T06	T06-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	A	High	C	AKARNG Kwethluk FSA, RecKey #1997250113601, Status: Active, diesel range organics contamination discovered near footprint of a 3,000-gallon A
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	
Petroleum product bulk station/terminals	X11	X11-02	A	Very High	C	
Airports	X14	X14-01	A	High	C	
Boat yards and marinas	X15	X15-01	A	Low	C	Assume 1 boat yard/marina present along river and Zone A

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High  
Sources of Volatile Organic Chemicals*

*PWSID 270956.001*

*Table 4 (continued)*

<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>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	
Firehouses	X38	X38-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	C	High	C	
Airports	X14	X14-02	C	High	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High*

*PWSID 270956.001*

**Table 5**

*Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	LKSD Kwethluk High School
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	A	Low	C	AKARNG Kwethluk FSA, RecKey #1997250113601, Status: Active, diesel range organics contamination discovered near footprint of a 3,000-gallon A
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	
Airports	X14	X14-01	A	Low	C	
Boat yards and marinas	X15	X15-01	A	Low	C	Assume 1 boat yard/marina present along river and Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	
Firehouses	X38	X38-01	A	Low	C	

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High*

*PWSID 270956.001*

*Table 5 (continued)*

*Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

<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>
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	C	High	C	
Airports	X14	X14-02	C	Low	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C

Table 6

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High  
Sources of Synthetic Organic Chemicals*

PWSID 270956.001

<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 treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	Low	C	
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	A	Low	C	AKARNG Kwethluk FSA, RecKey #1997250113601, Status: Active, diesel range organics contamination discovered near footprint of a 3,000-gallon A
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	
Airports	X14	X14-01	A	Medium	C	
Landfills (municipal; Class III)	D51	D51-01	C	Very High	C	
Airports	X14	X14-02	C	Medium	C	

*Contaminant Source Inventory and Risk Ranking for  
LKSD Kwethluk High  
Sources of Other Organic Chemicals*

*PWSID 270956.001*

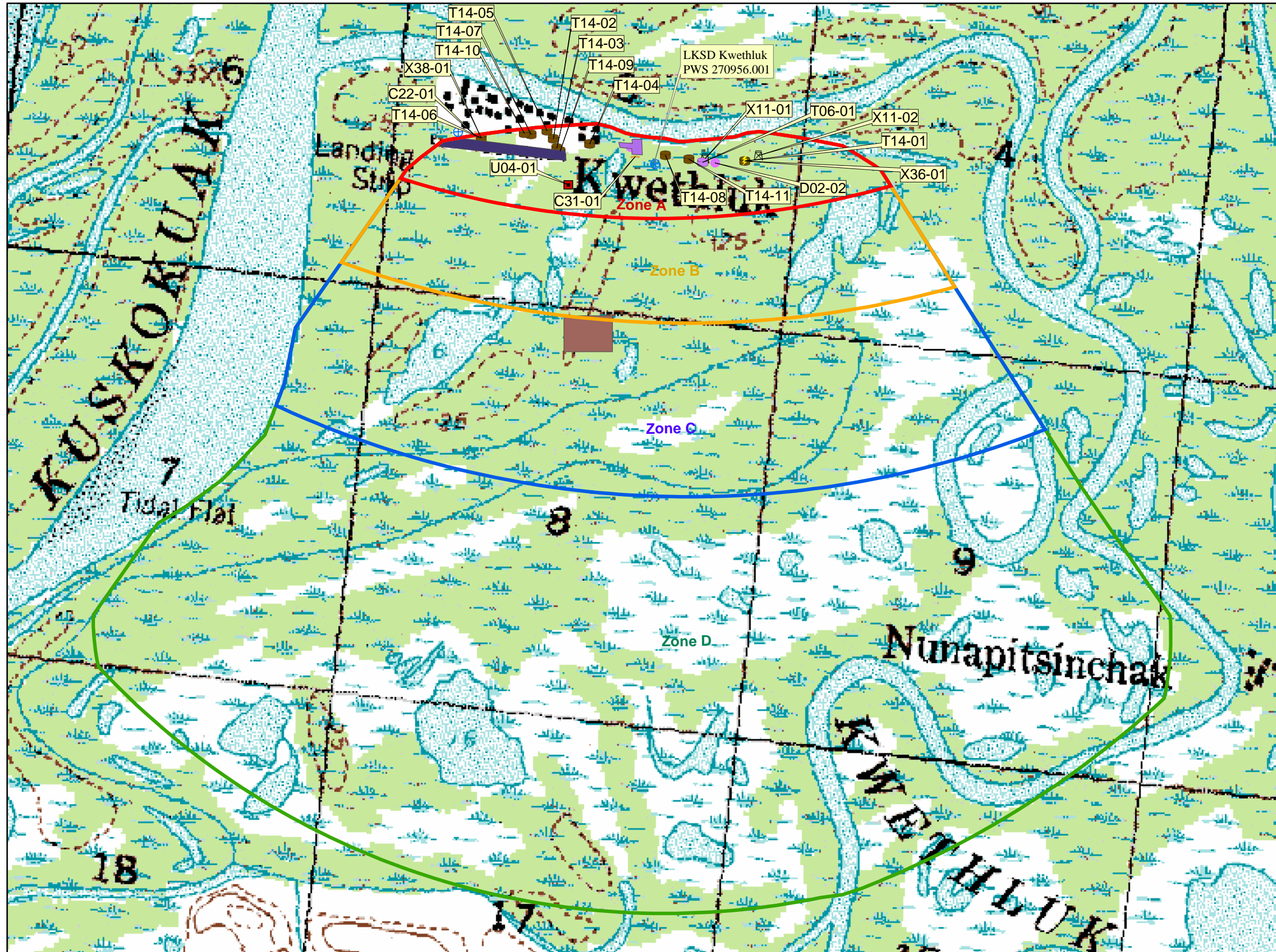
*Table 7*

<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>
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	LKSD Kwethluk High School
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-02	A	Low	C	
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	A	Low	C	AKARNG Kwethluk FSA, RecKey #1997250113601, Status: Active, diesel range organics contamination discovered near footprint of a 3,000-gallon A
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	
Petroleum product bulk station/terminals	X11	X11-02	A	High	C	
Airports	X14	X14-01	A	Medium	C	
Boat yards and marinas	X15	X15-01	A	Low	C	Assume 1 boat yard/marina present along river and Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Electric power generation (fossil fuels)	X36	X36-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	C	Very High	C	
Airports	X14	X14-02	C	Medium	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C

## **APPENDIX C**

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

**Public Water Well System for PWS #270956.001 LKSD Kwethluk**  
**Showing Potential and Existing Sources of Contamination**

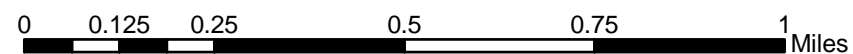


**LEGEND**

- Public Water System Well
- Groundwater Protection Zones**
  - Zone A Protection Area- Several Months Travel Time
  - Zone B Protection Area- 2 Years Travel Time
  - Zone C Protection Area- 5 Years Travel Time
  - Zone D Protection Area- 10 Years Travel Time or Watershed Boundary
- 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)
  - Road Ferry Crossing
- Existing or Potential Contaminant Sources**
  - Laundromats without dry cleaning service (C22)
  - Motor/motor vehicle repair facility (C31)
  - Tanks, diesel (aboveground) (T06)
  - Tanks, heating oil, non-residential (aboveground) (T14)
  - Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
  - Petroleum product bulk station/terminal (X11)
  - Domestic Wastewater Treatment Plant (D02)
  - Landfill, Municipal, Class III (D51)
  - Airport or Landing Strip (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 A Public Water Systems" published by ADEC

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

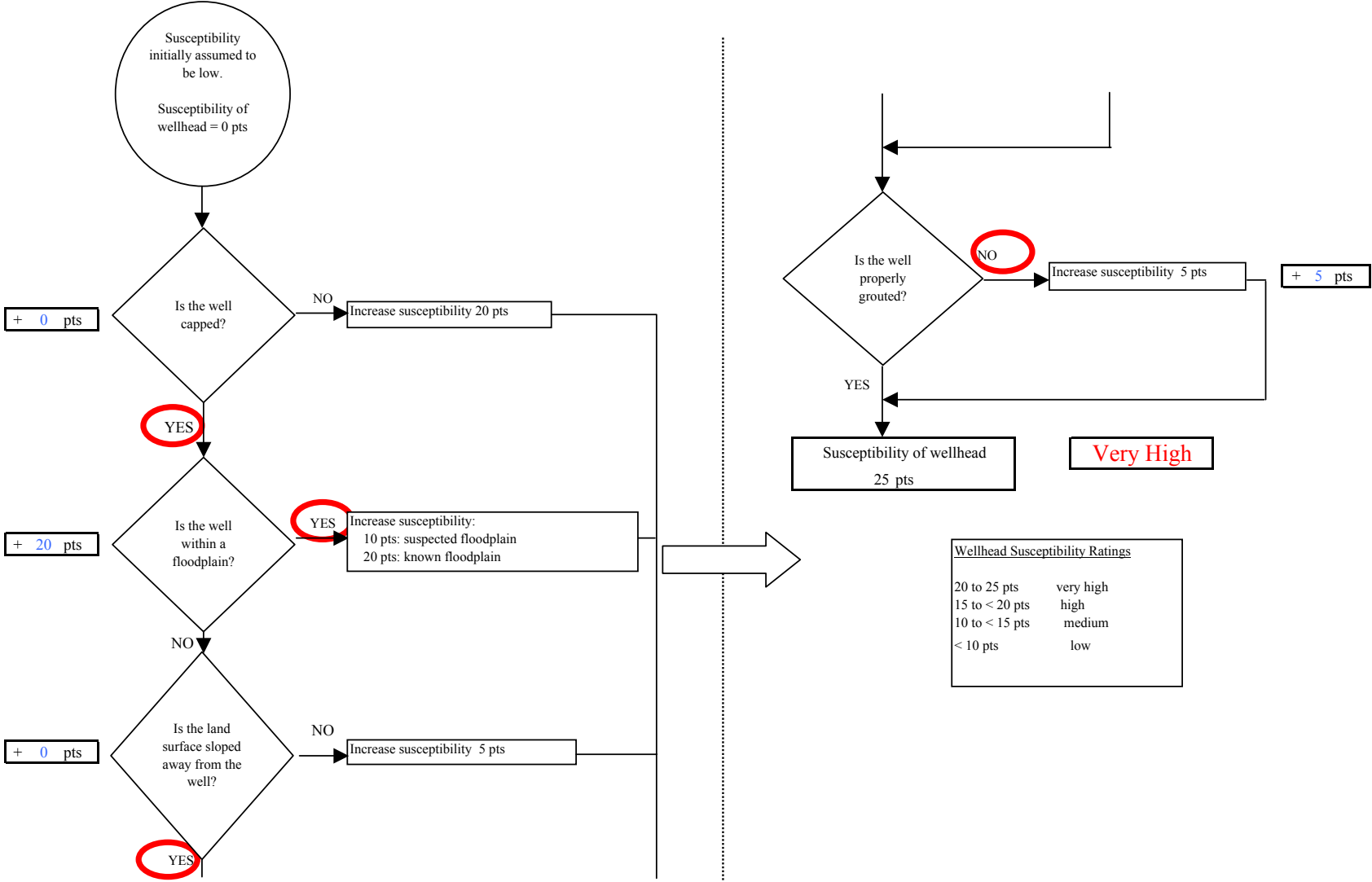




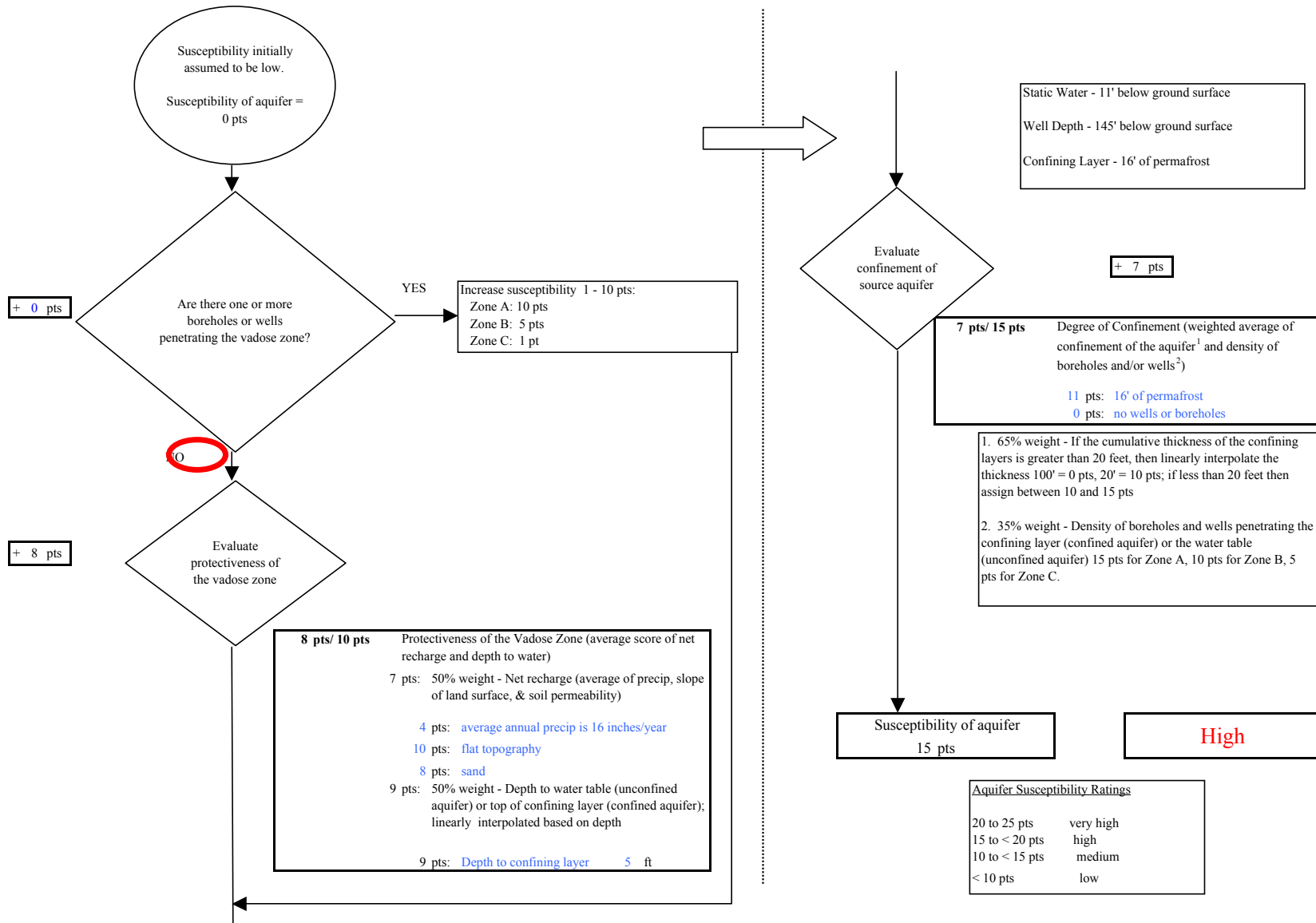
## **APPENDIX D**

### **Vulnerability Analysis for Public Drinking Water Source (Charts 1-14)**

**Chart 1. Susceptibility of the wellhead - LKSD Kwethluk High (PWS No.270956.001)**



**Chart 2. Susceptibility of the aquifer LKSD Kwethluk High (PWS No.270956.001)**



**Chart 3. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Bacteria & Viruses**

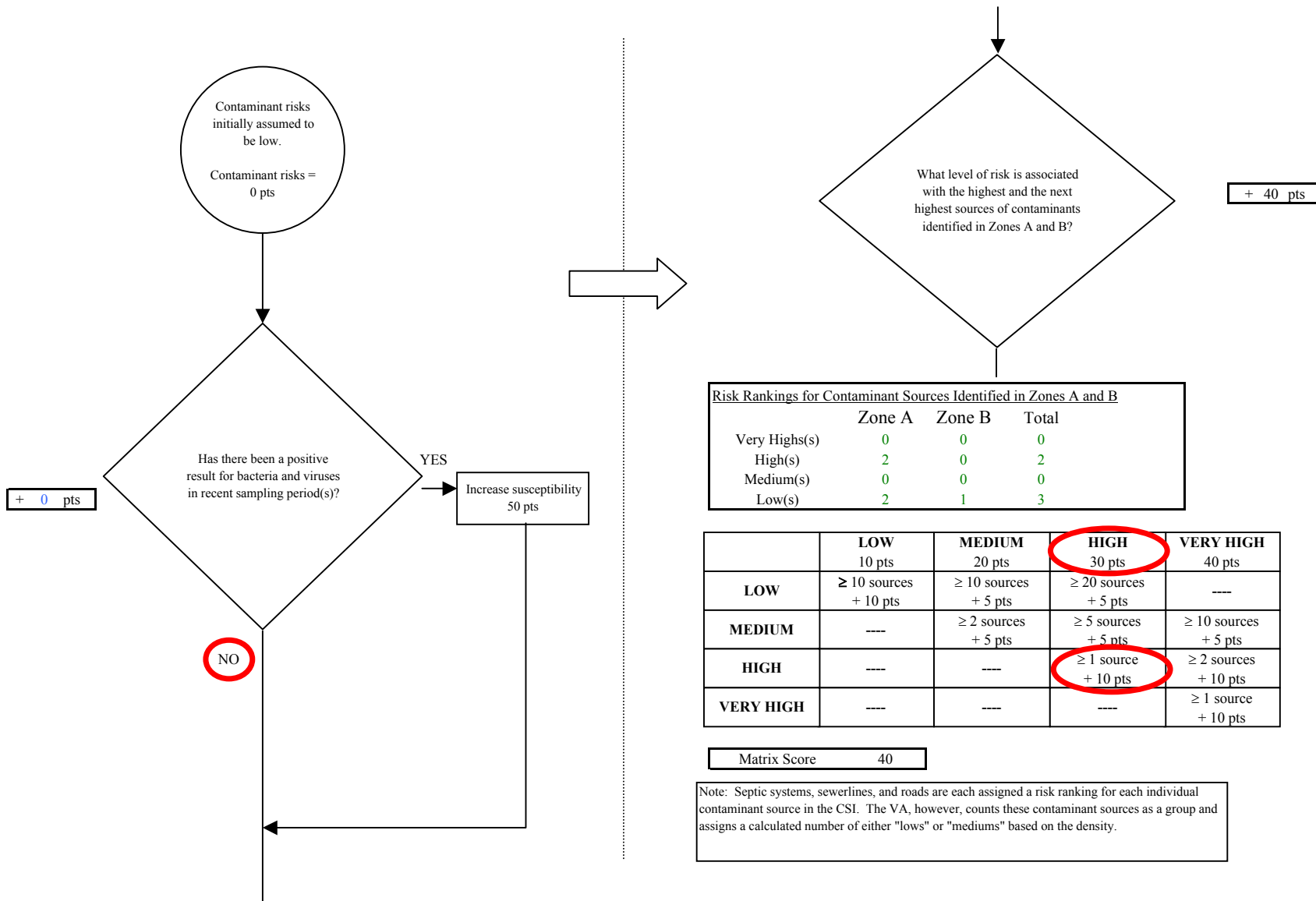
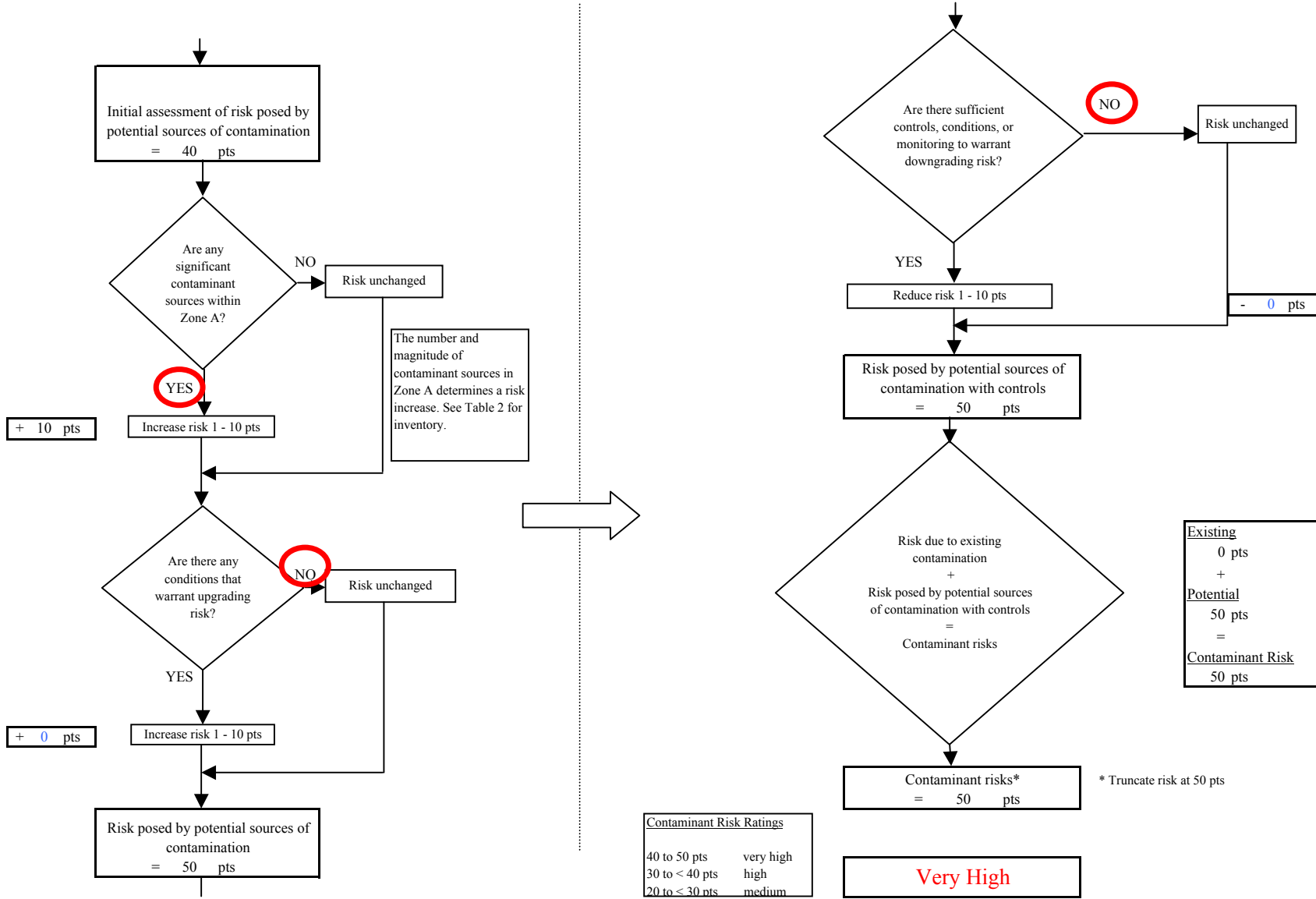
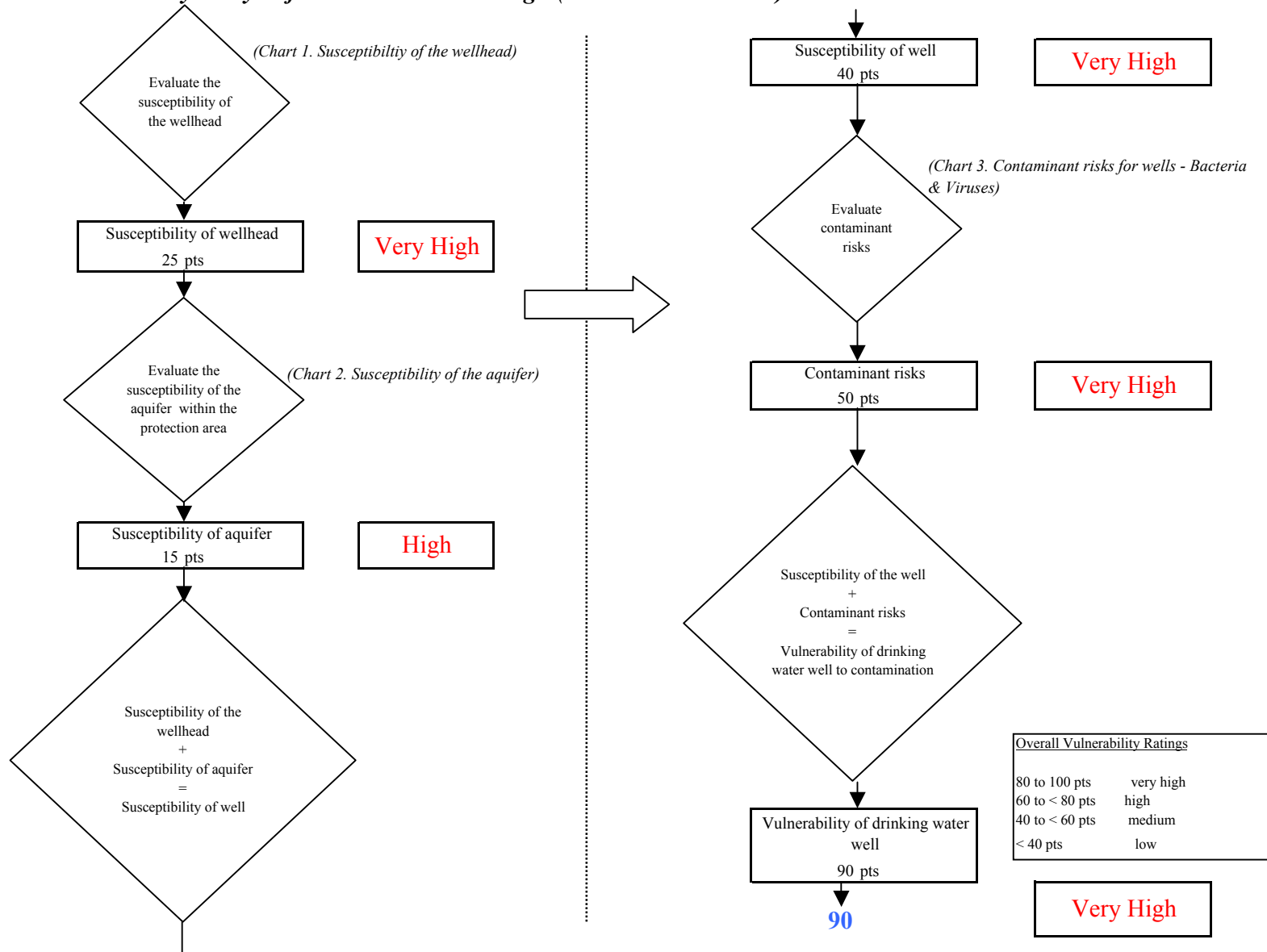


Chart 3. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Bacteria & Viruses



**Chart 4. Vulnerability analysis for LKSD Kwethluk High (PWS No.270956.001) - Bacteria & Viruses**



**Chart 5. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Nitrates and Nitrites**

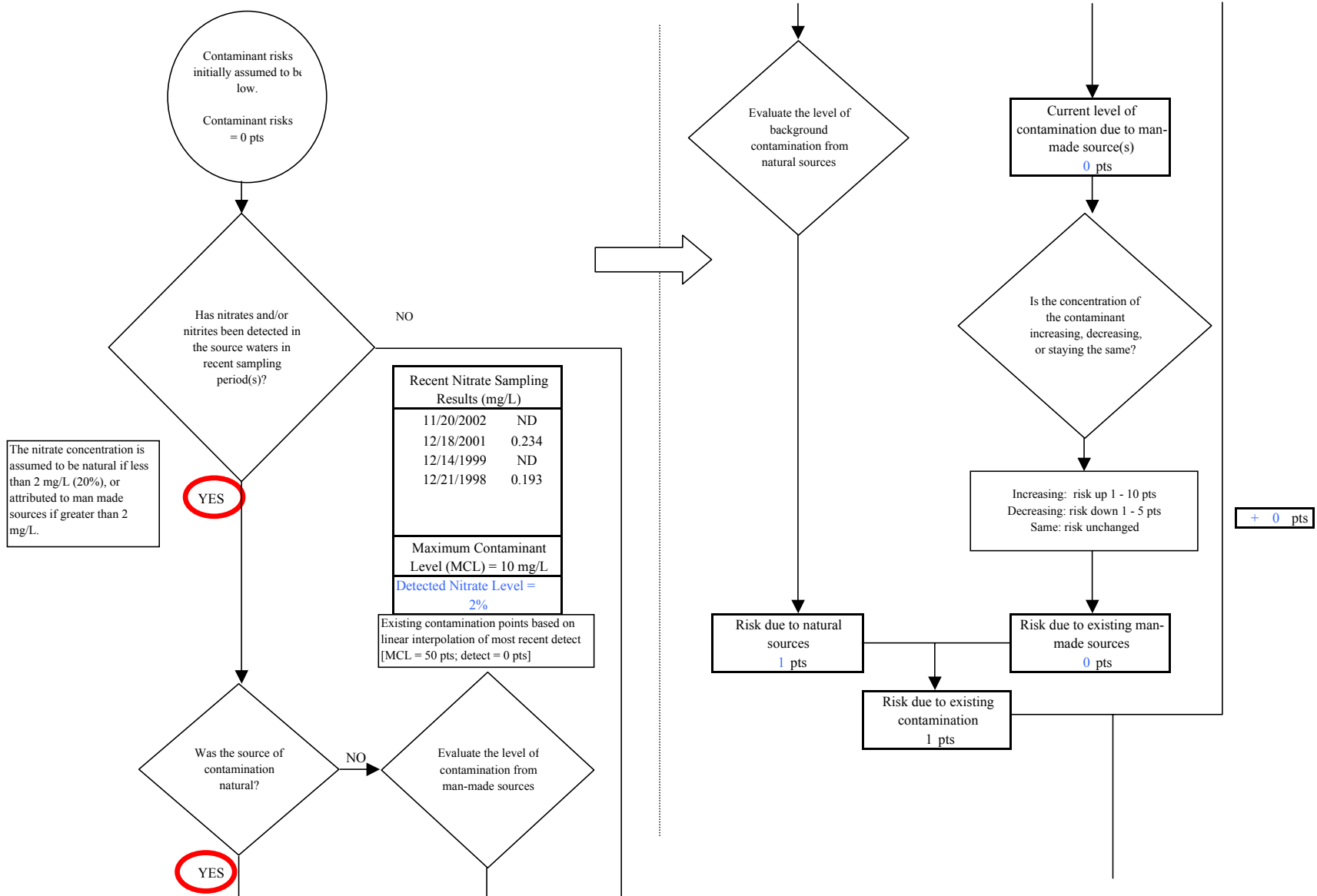
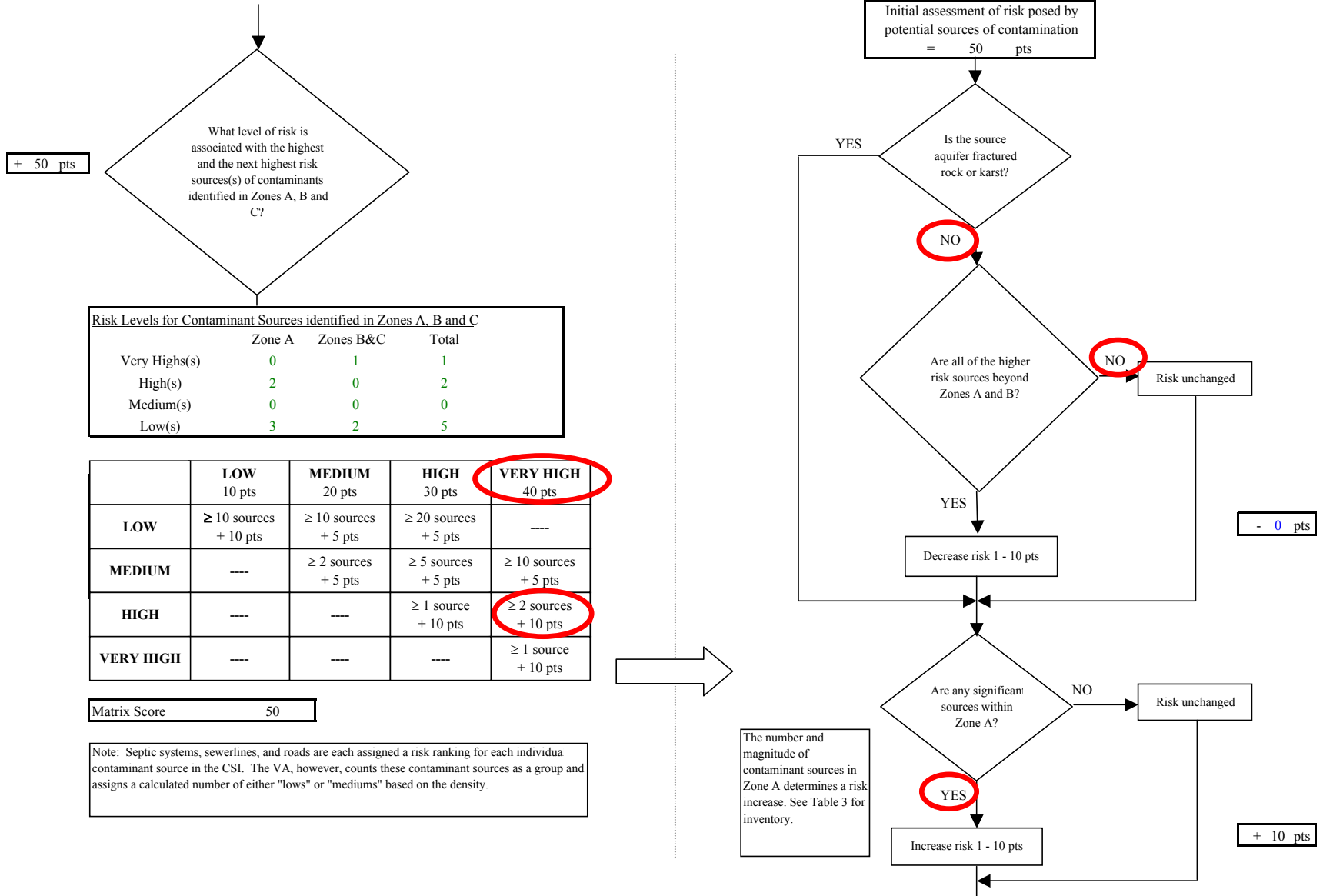
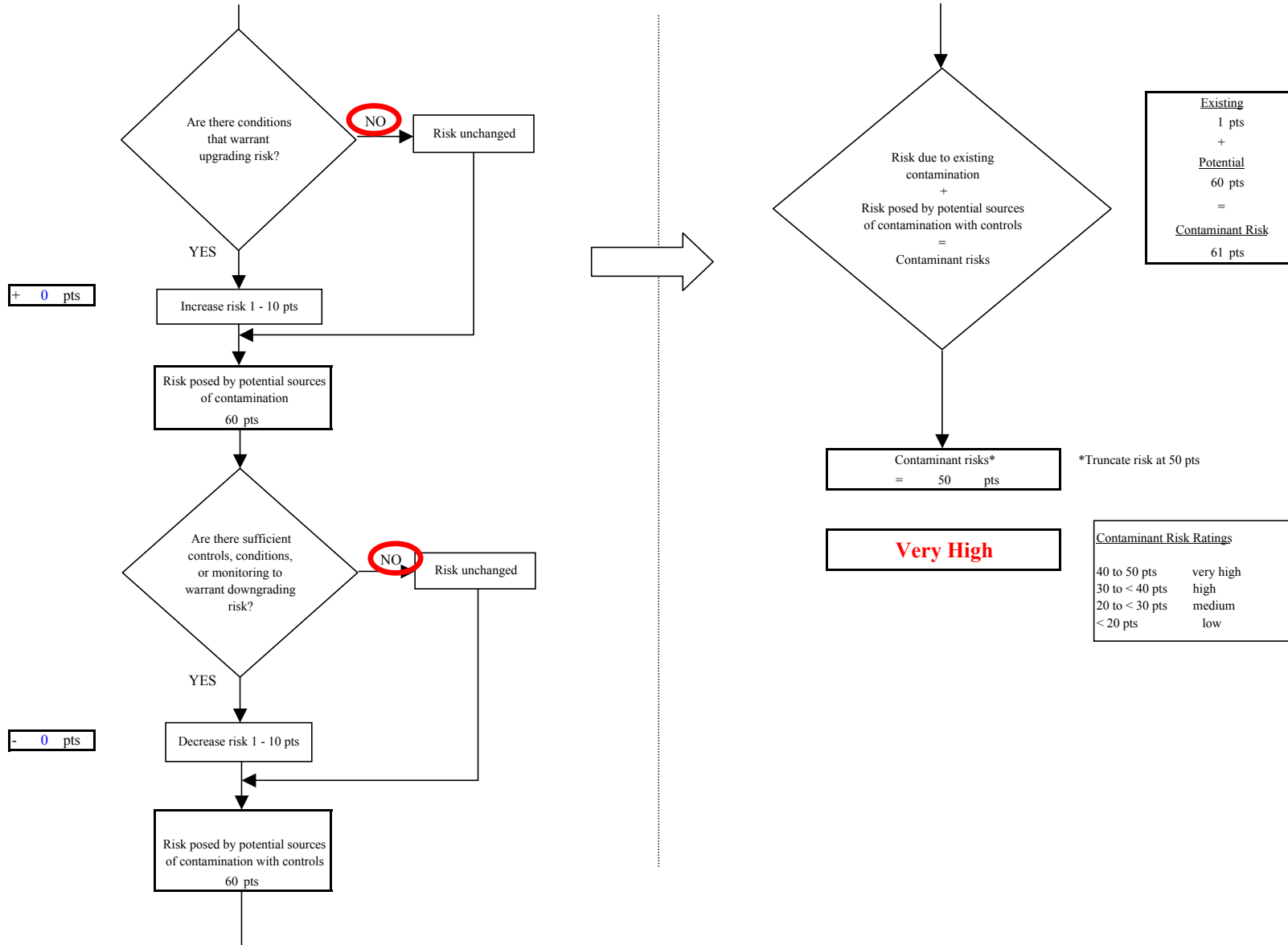


Chart 5. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Nitrates and Nitrites

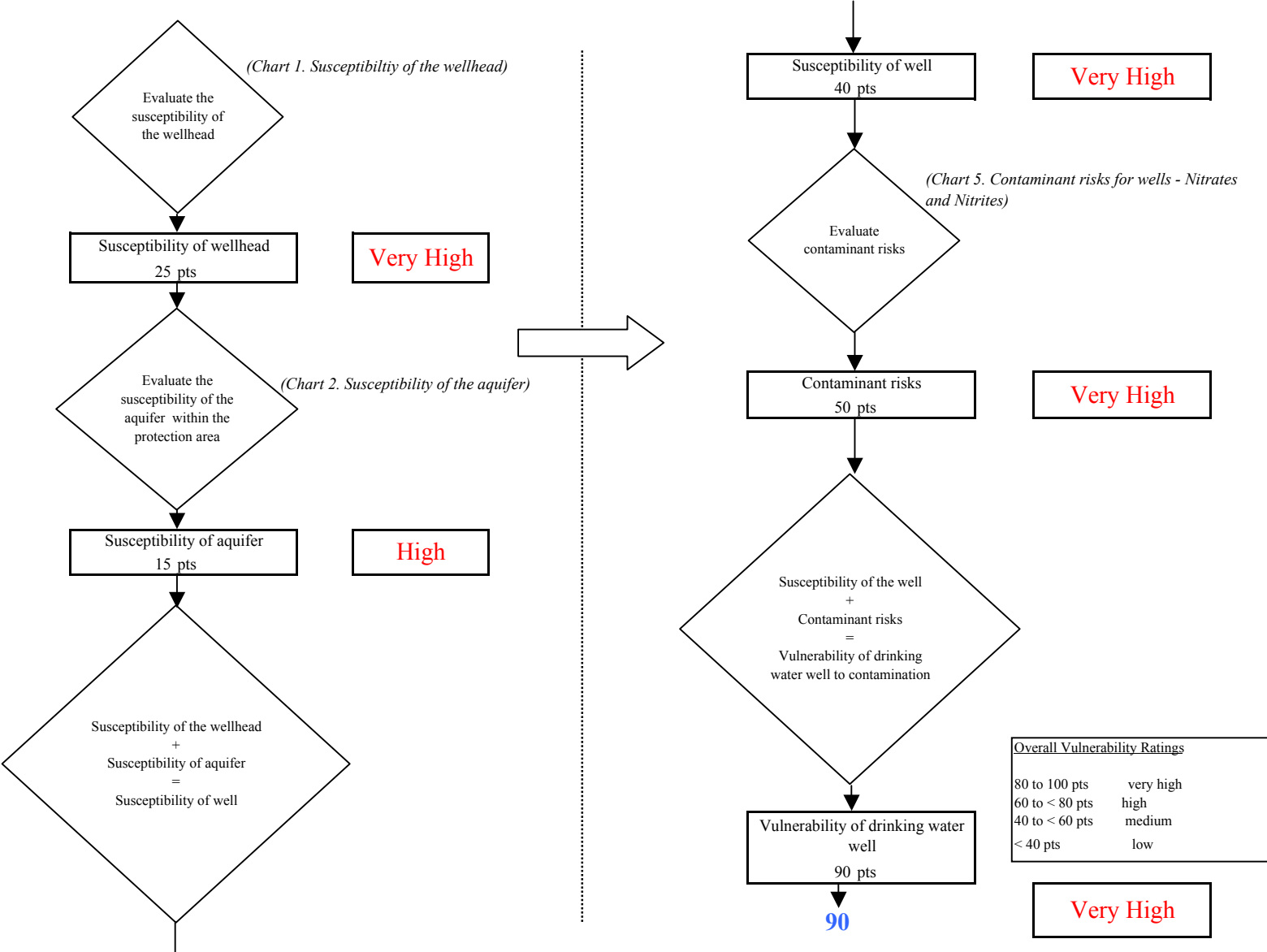




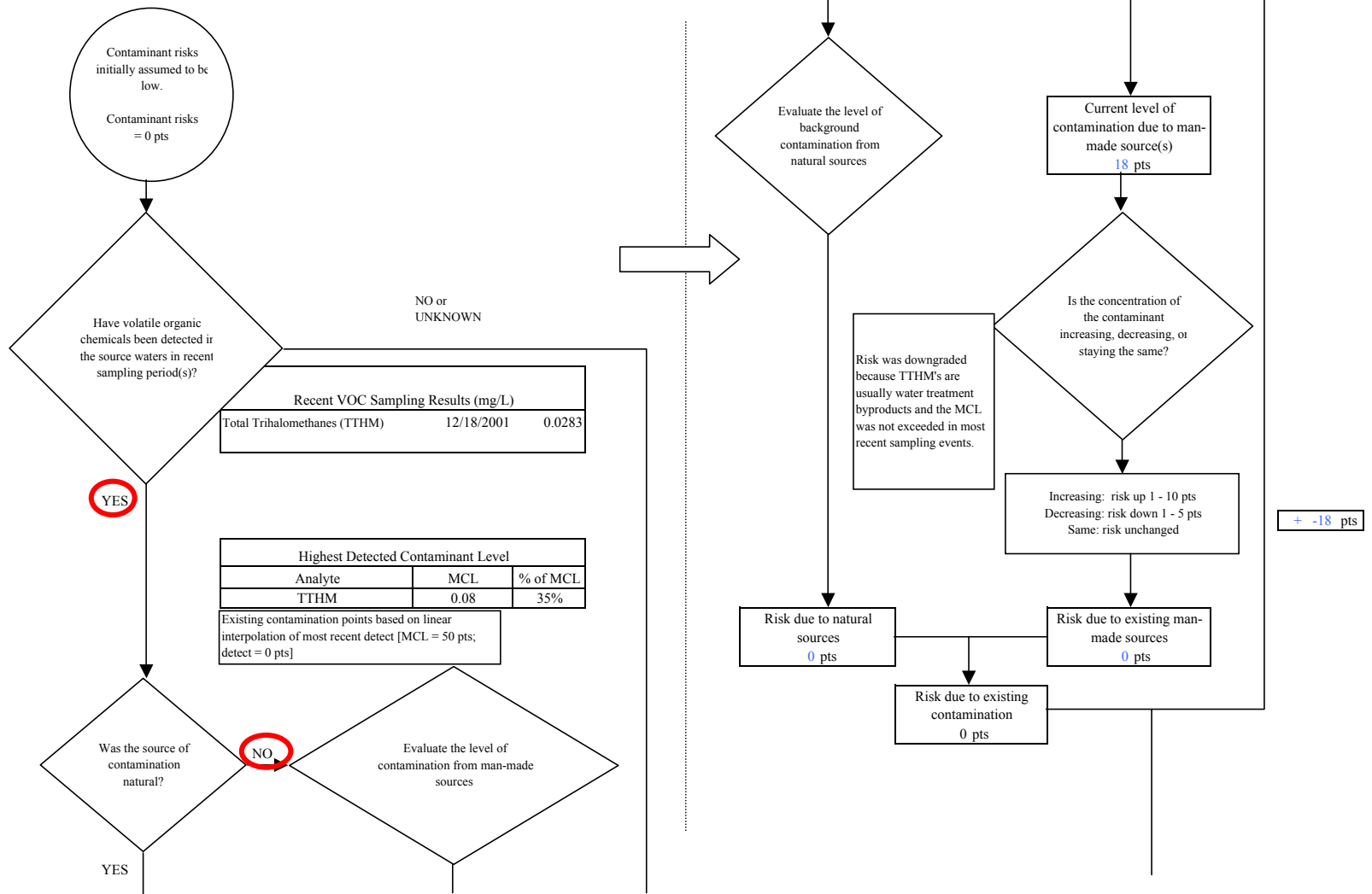
**Chart 5. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Nitrates and Nitrites**



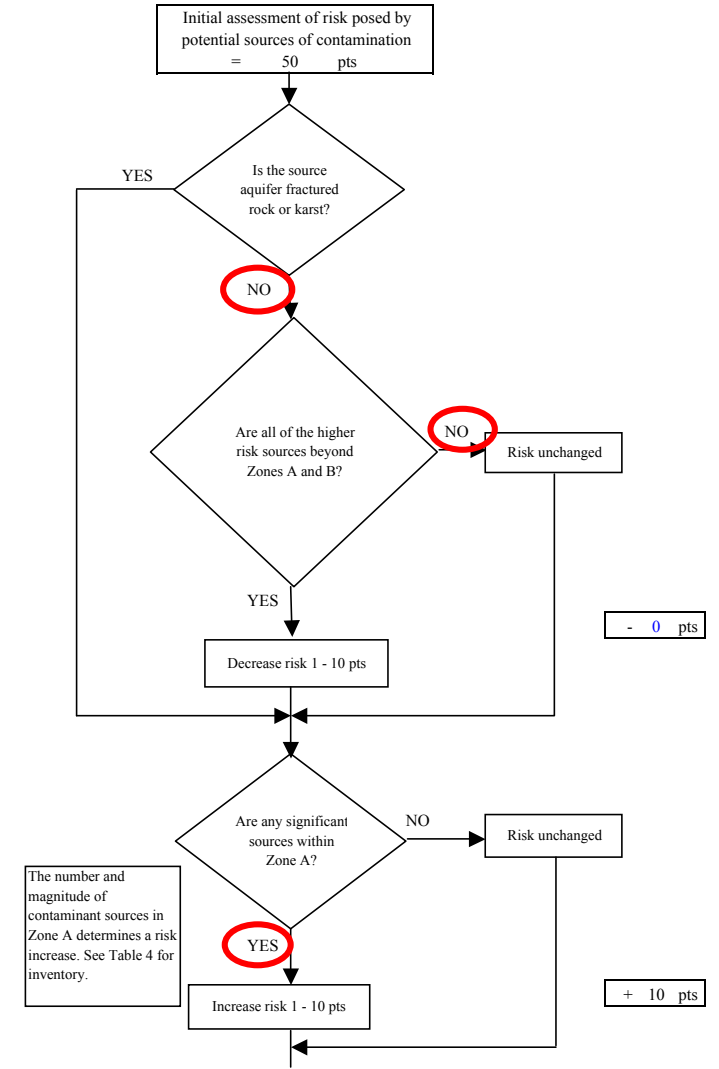
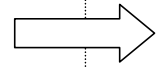
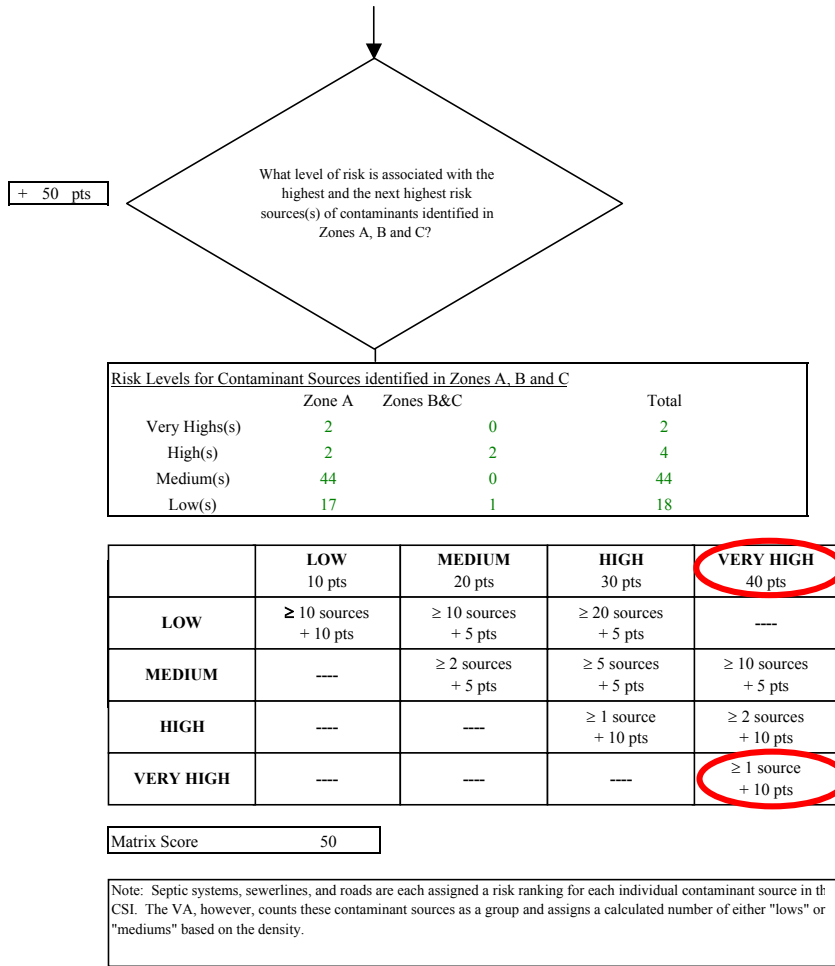
**Chart 6. Vulnerability analysis for LKSD Kwethluk High (PWS No.270956.001) - Nitrates and Nitrites**



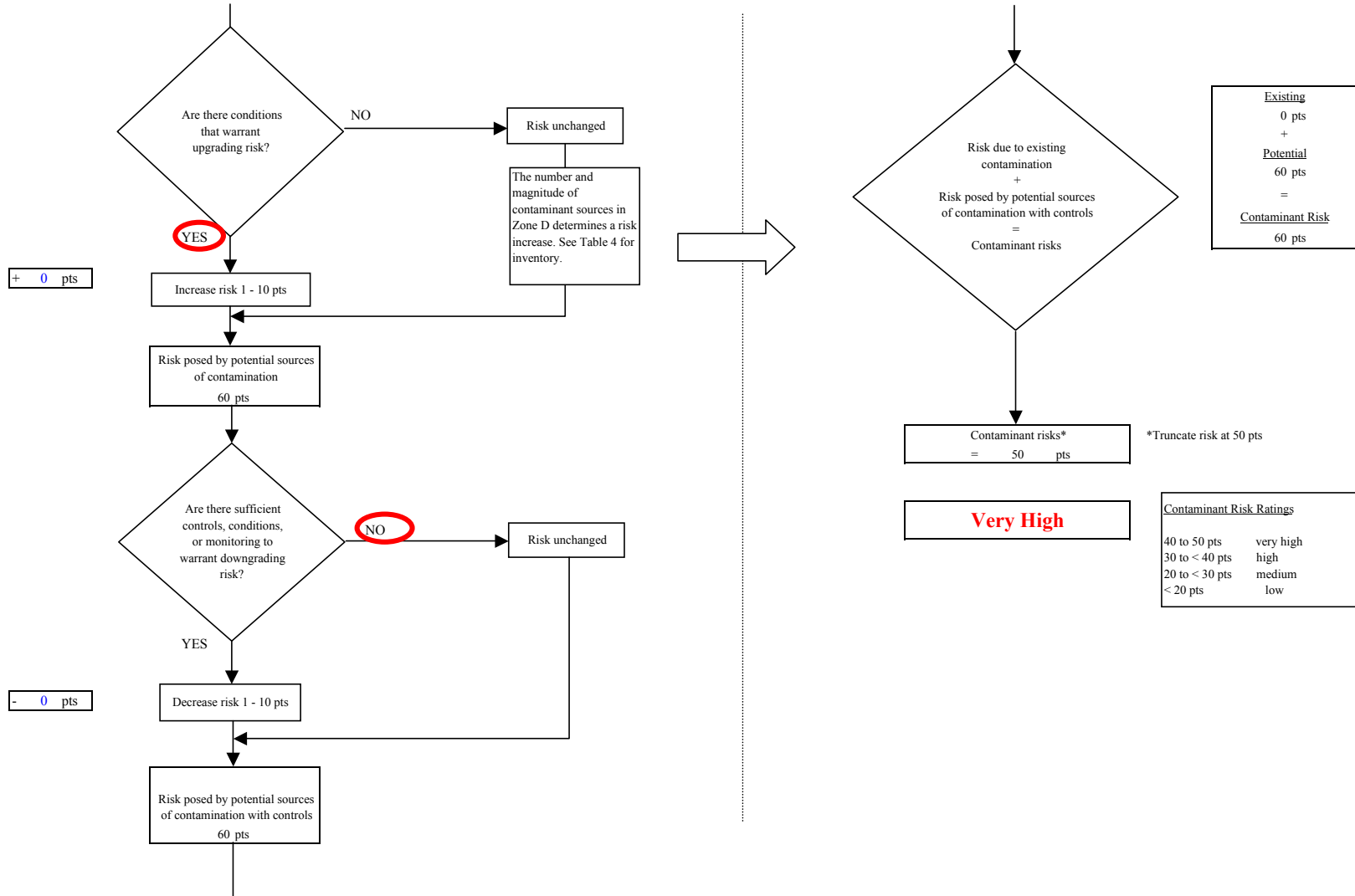
**Chart 7. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Volatile Organic Chemicals**



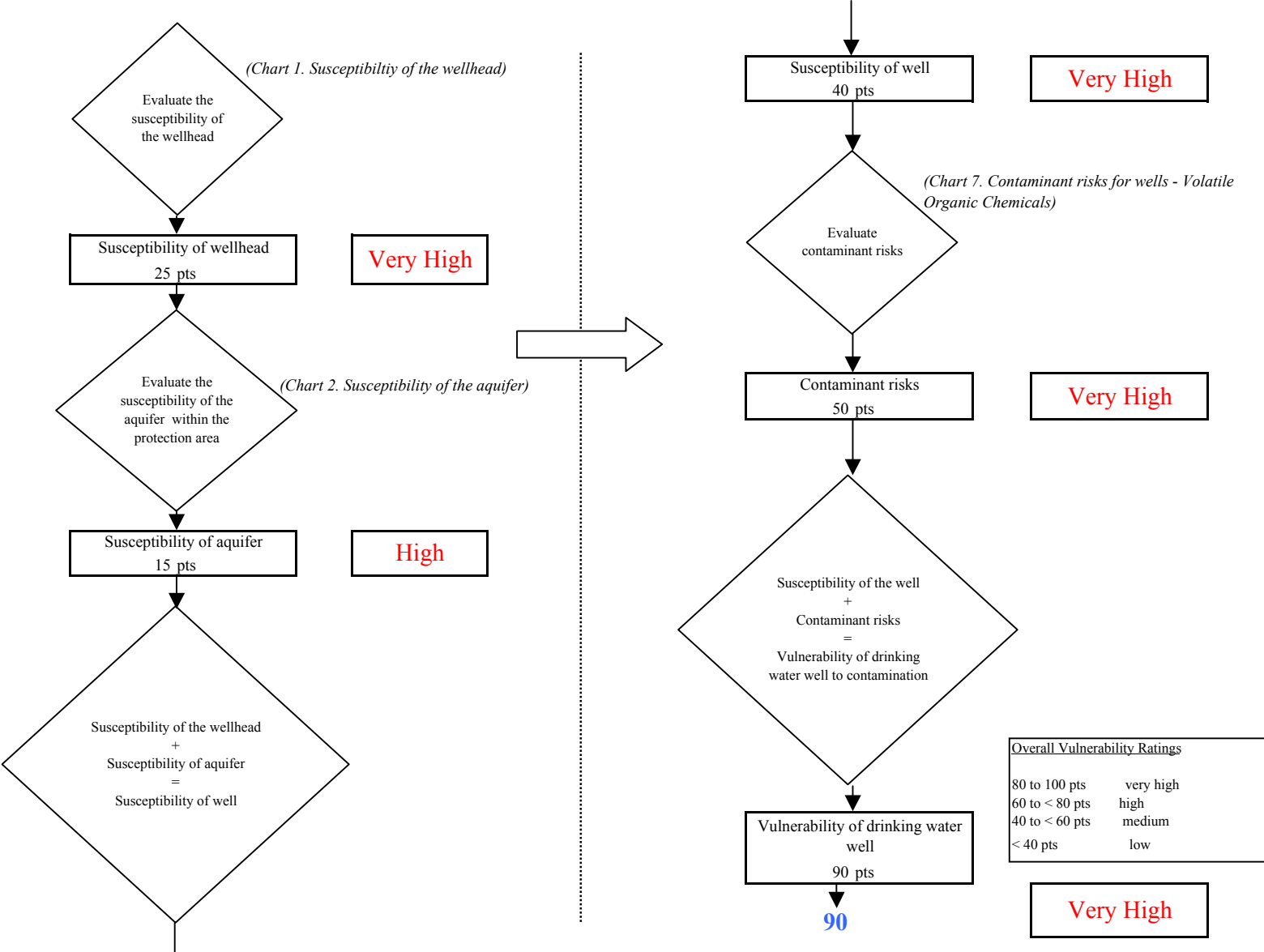
**Chart 7. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Volatile Organic Chemicals**



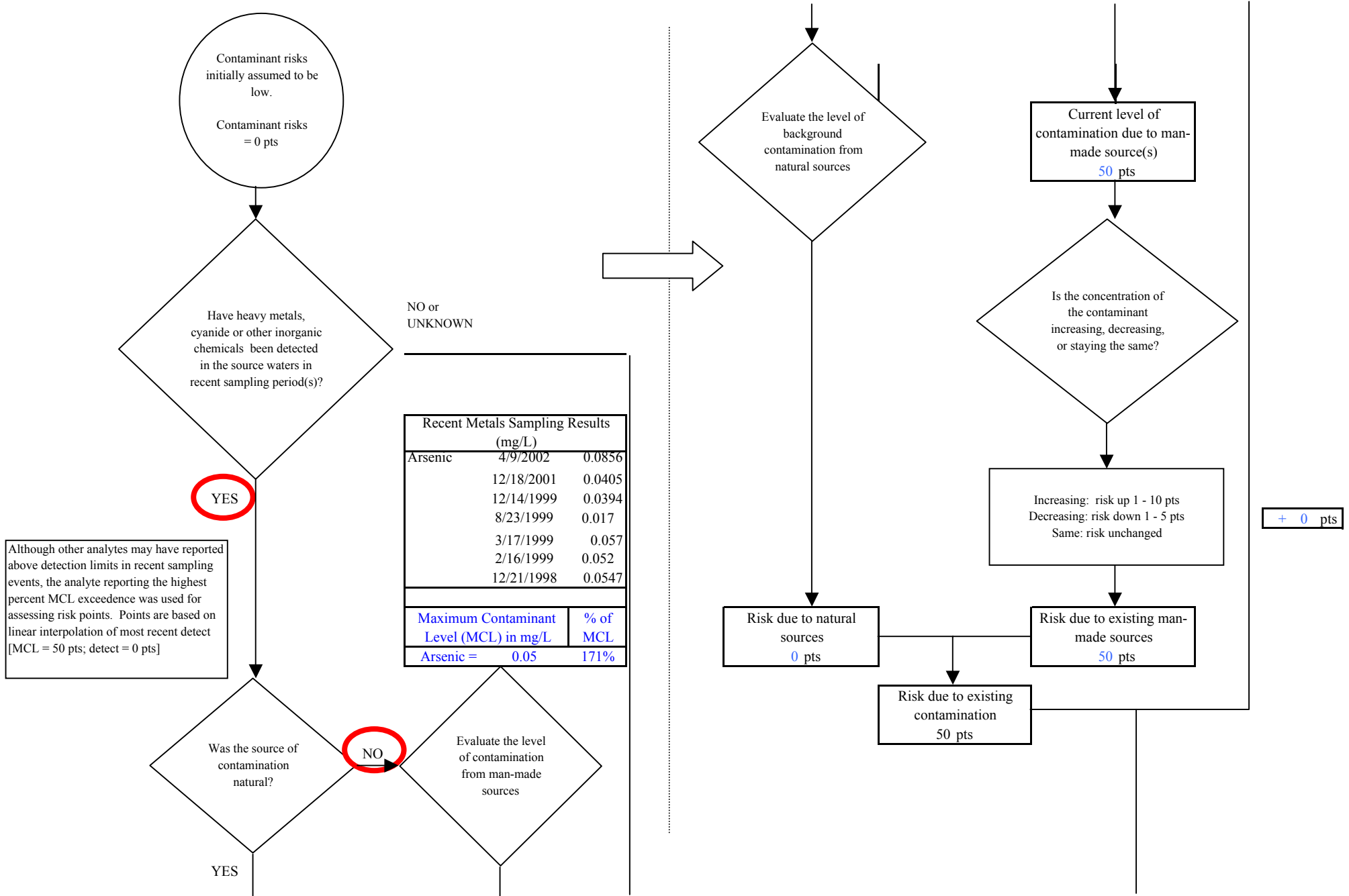
**Chart 7. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Volatile Organic Chemicals**



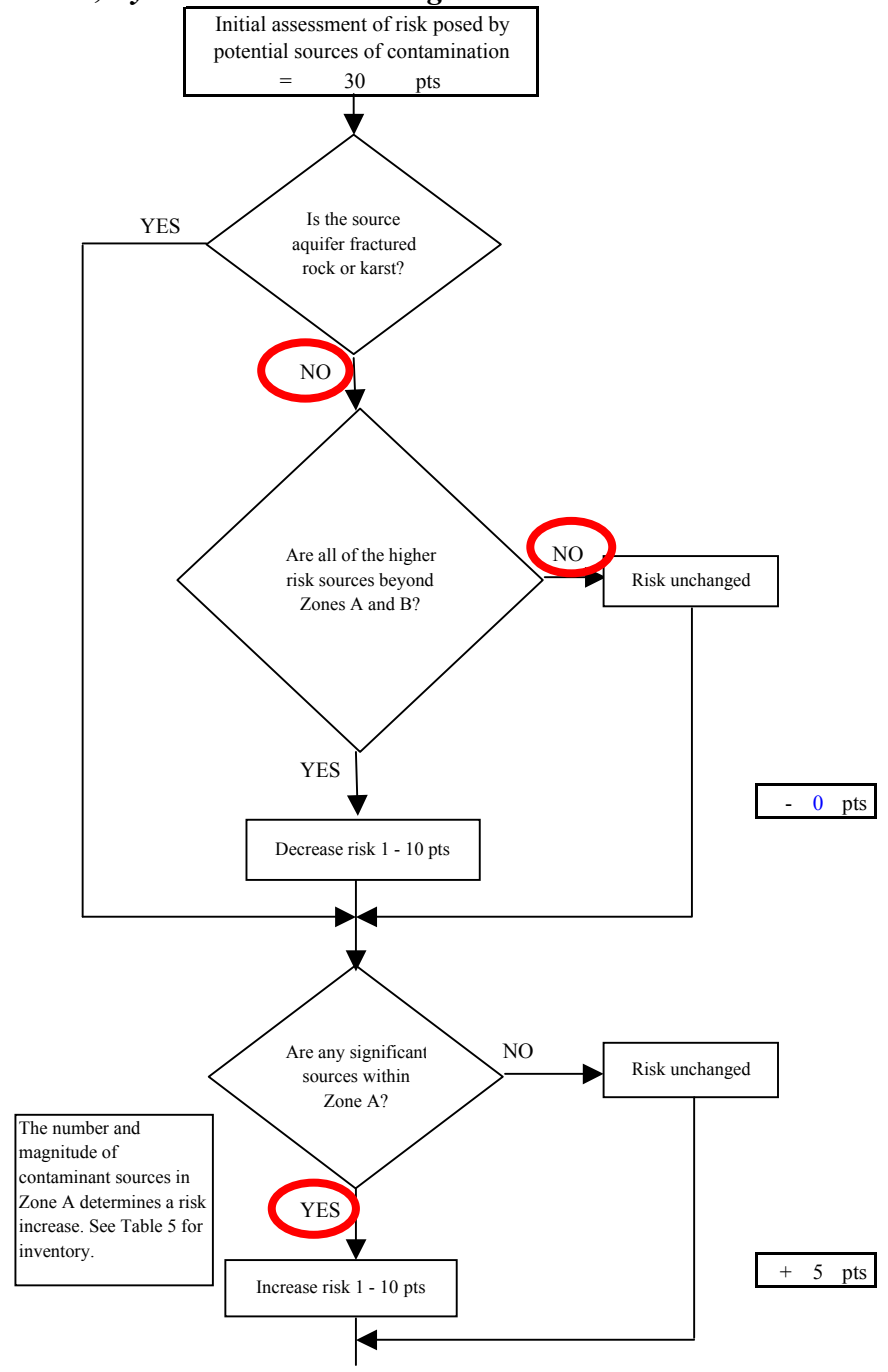
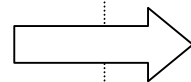
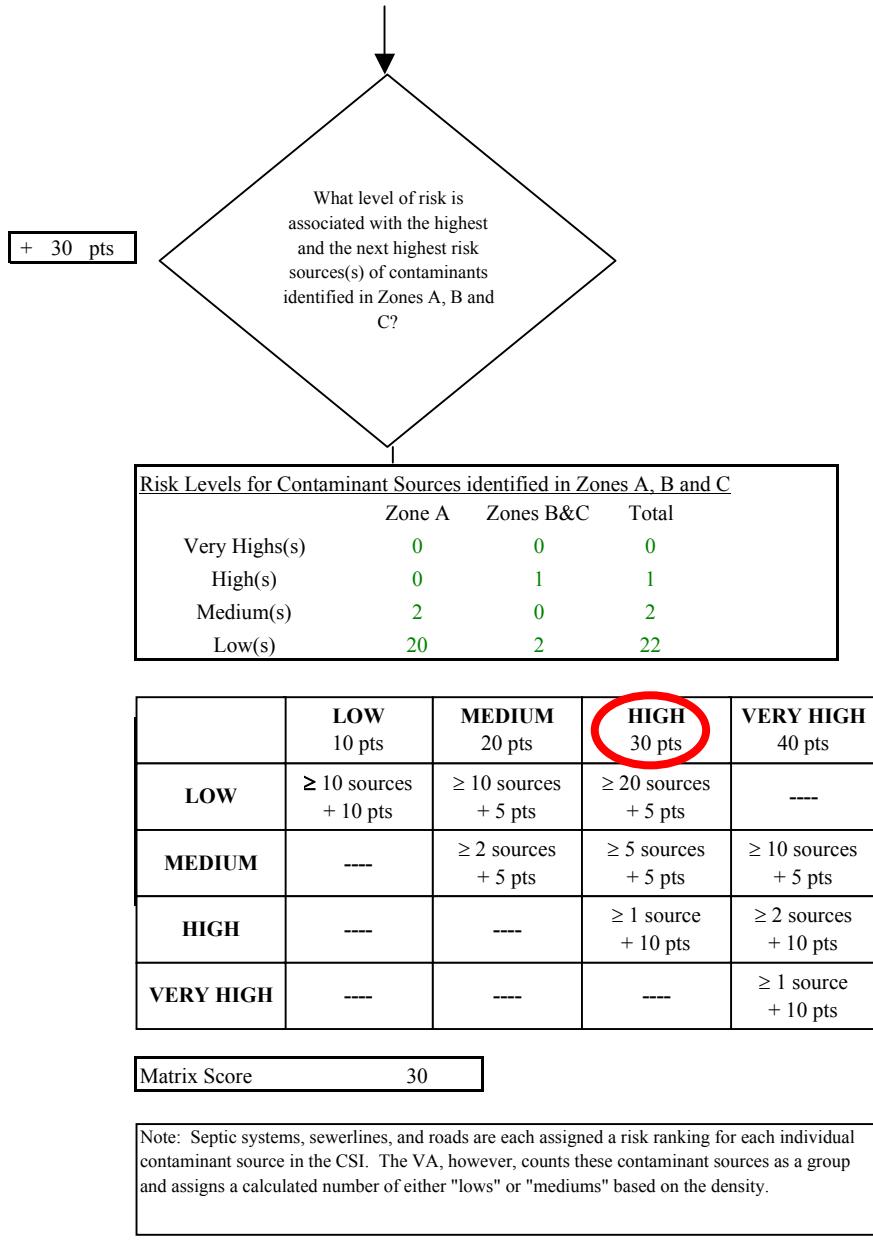
**Chart 8. Vulnerability analysis for LKSD Kwethluk High (PWS No.270956.001) - Volatile Organic Chemicals**



**Chart 9. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**

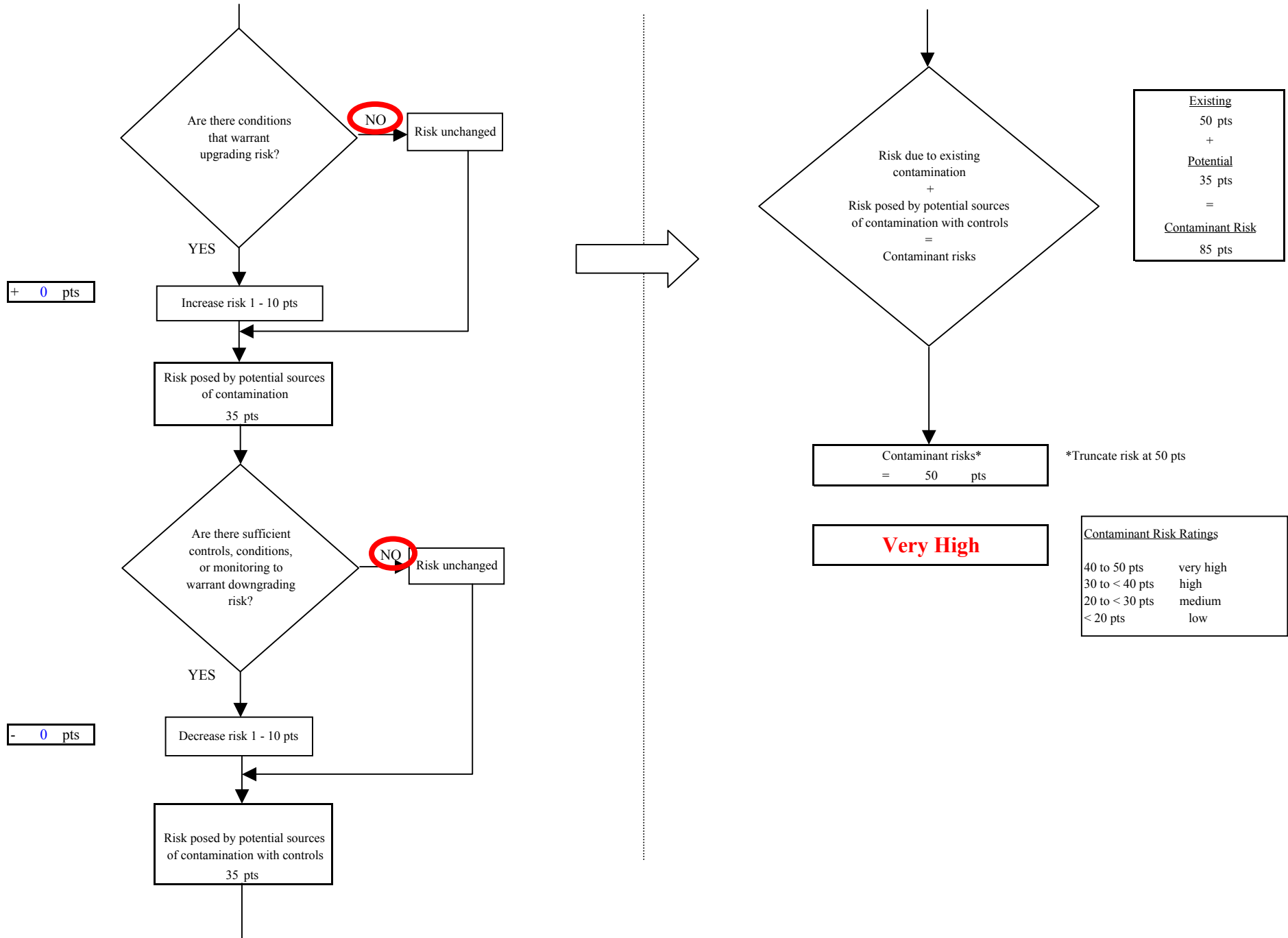


**Chart 9. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**

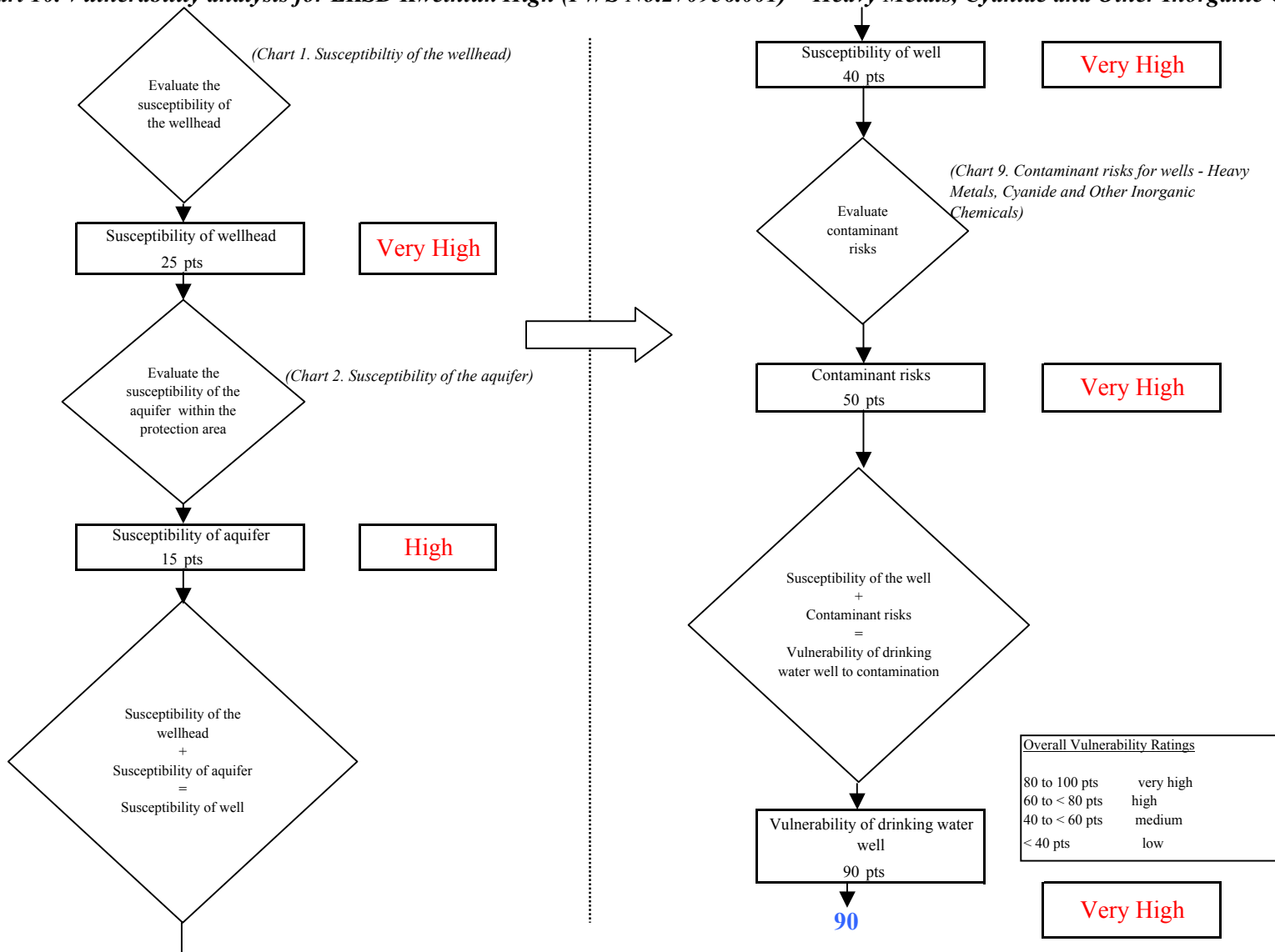




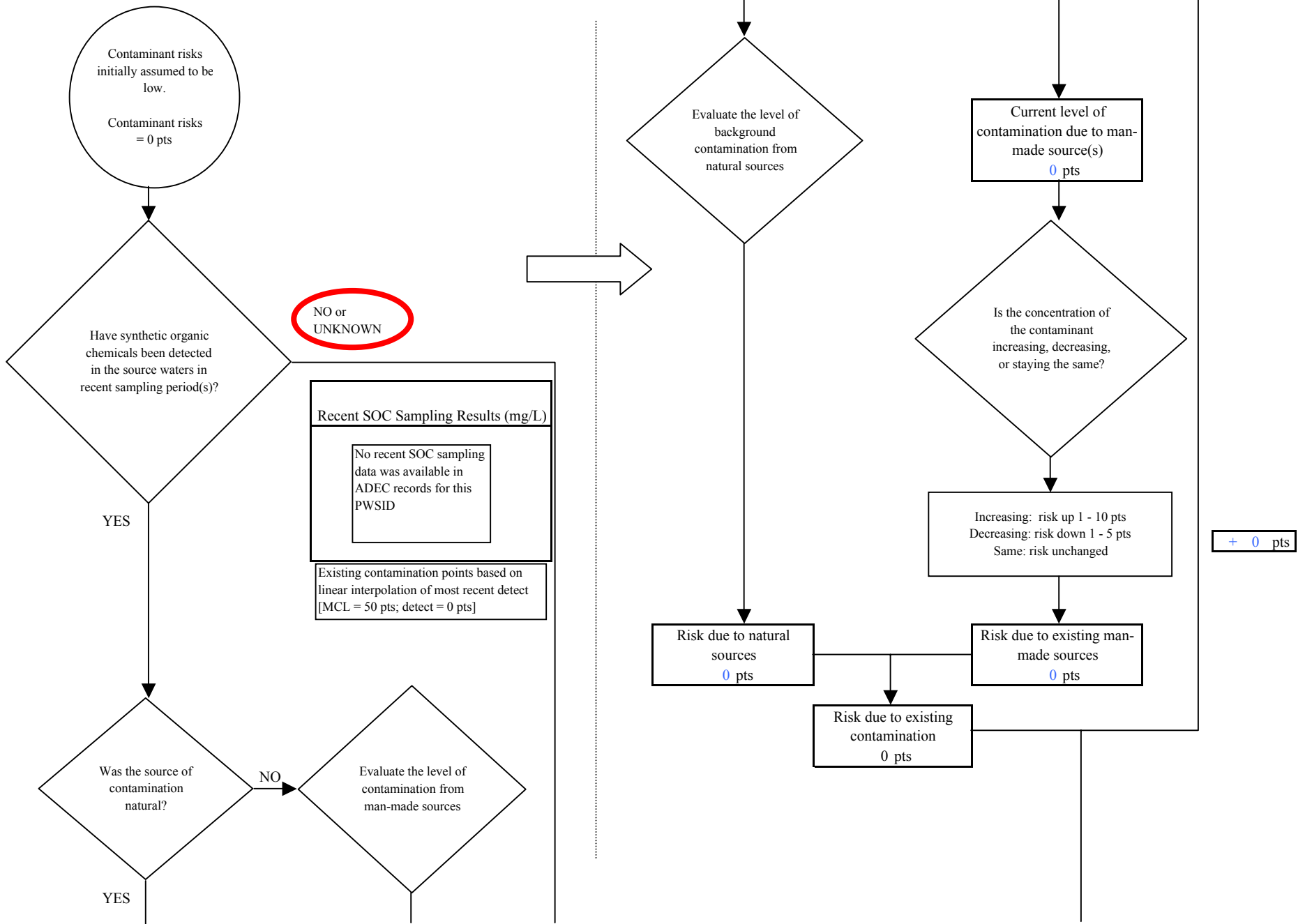
**Chart 9. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



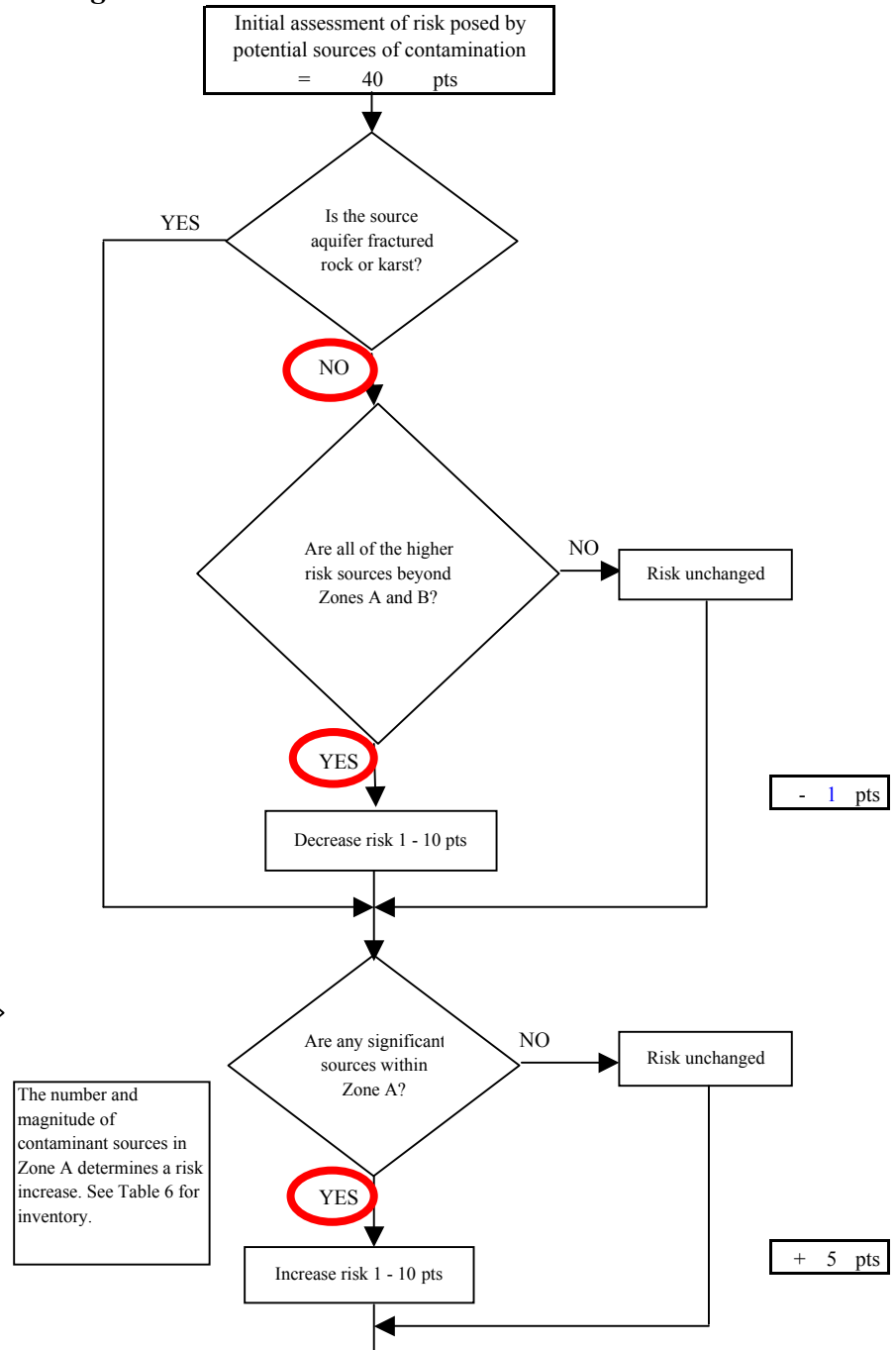
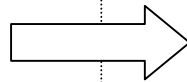
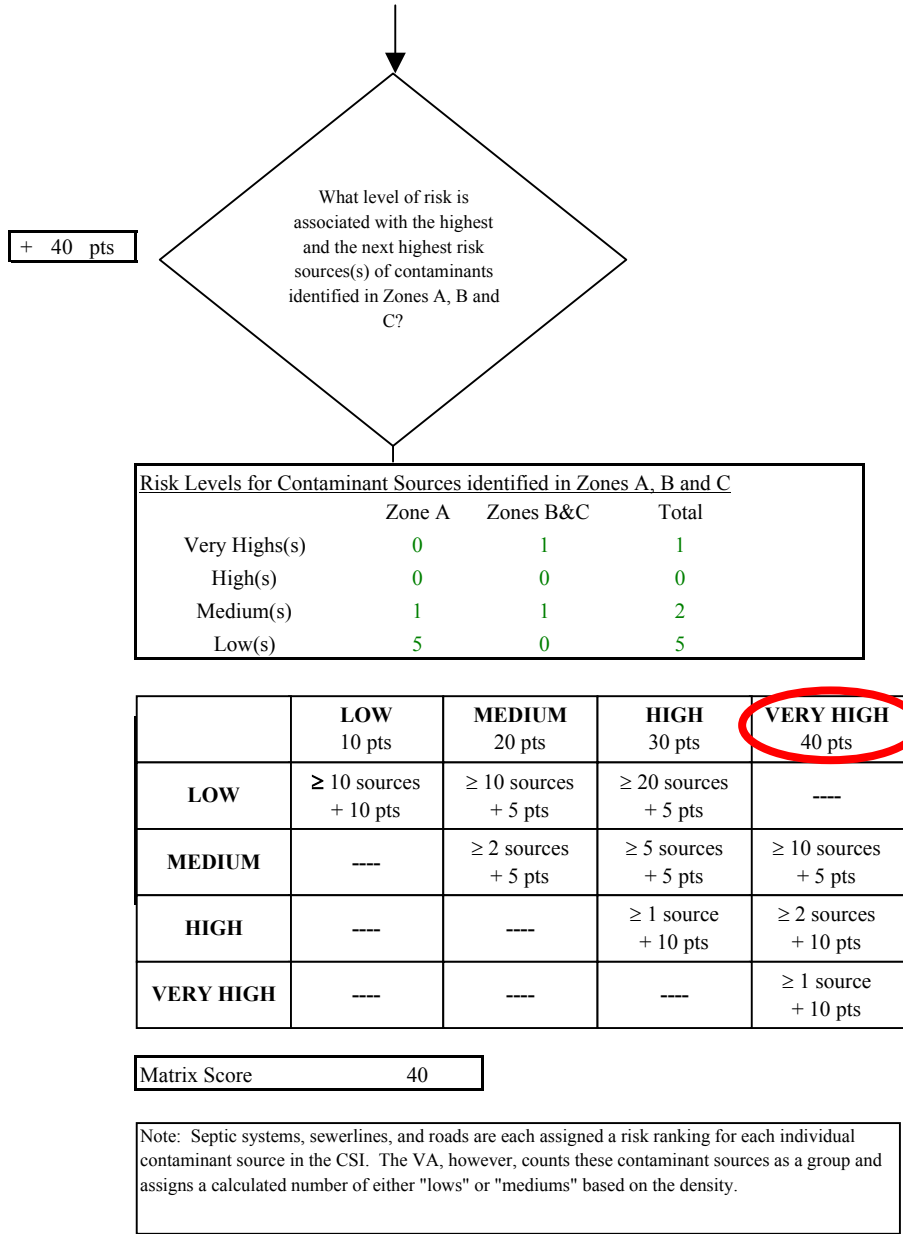
**Chart 10. Vulnerability analysis for LKSD Kwethluk High (PWS No.270956.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



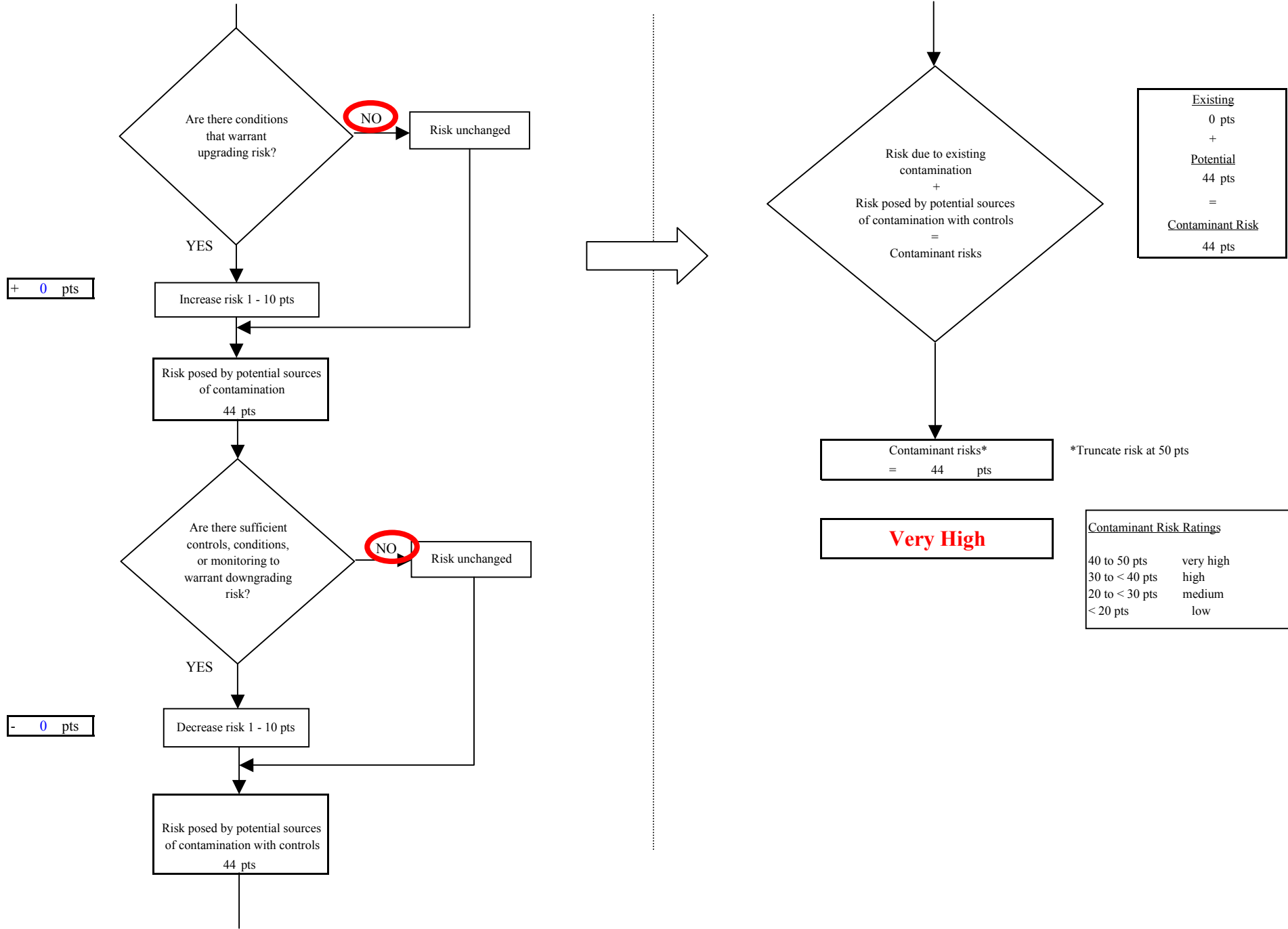
**Chart 11. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Synthetic Organic Chemicals**



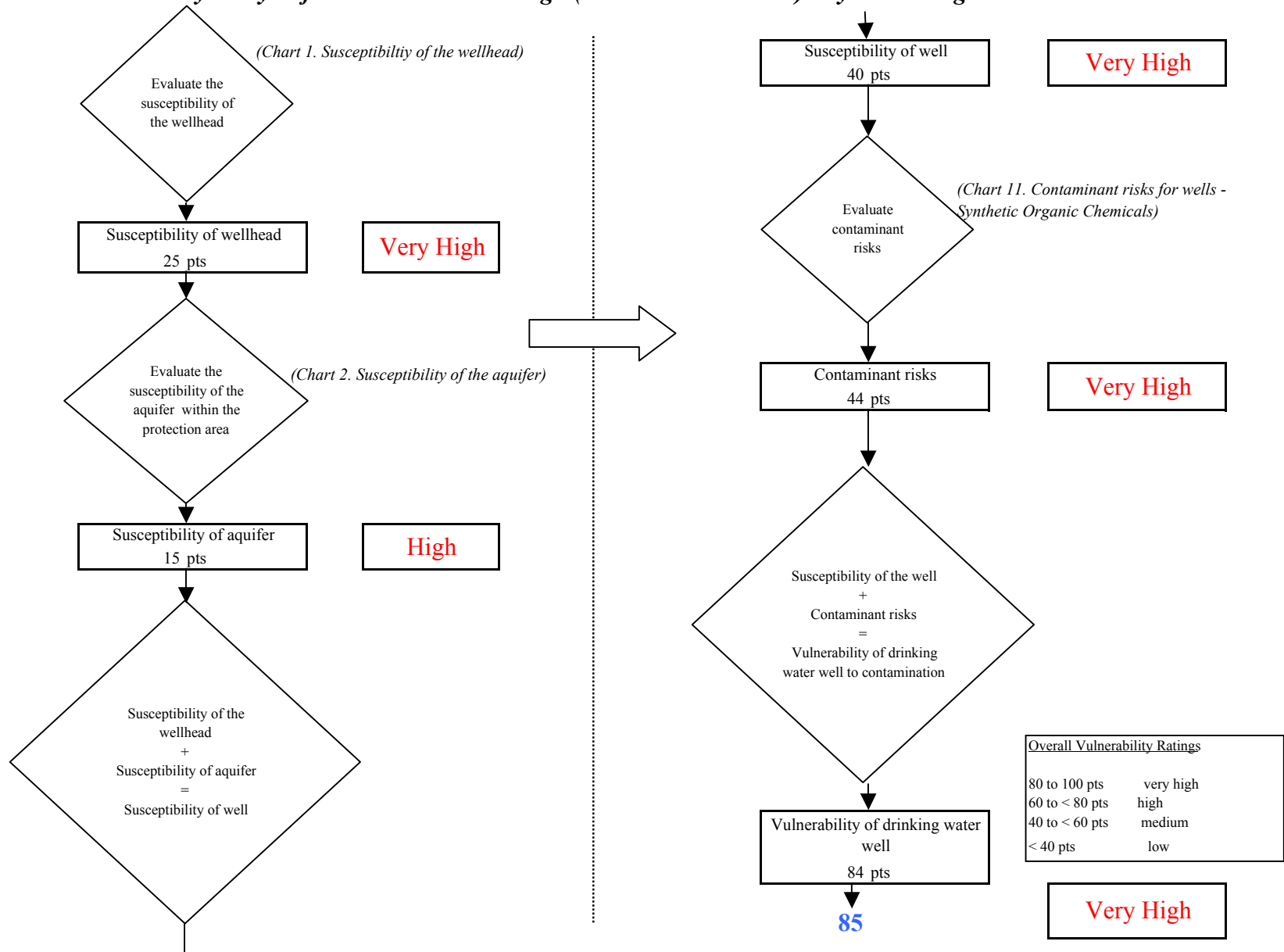
**Chart 11. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Synthetic Organic Chemicals**



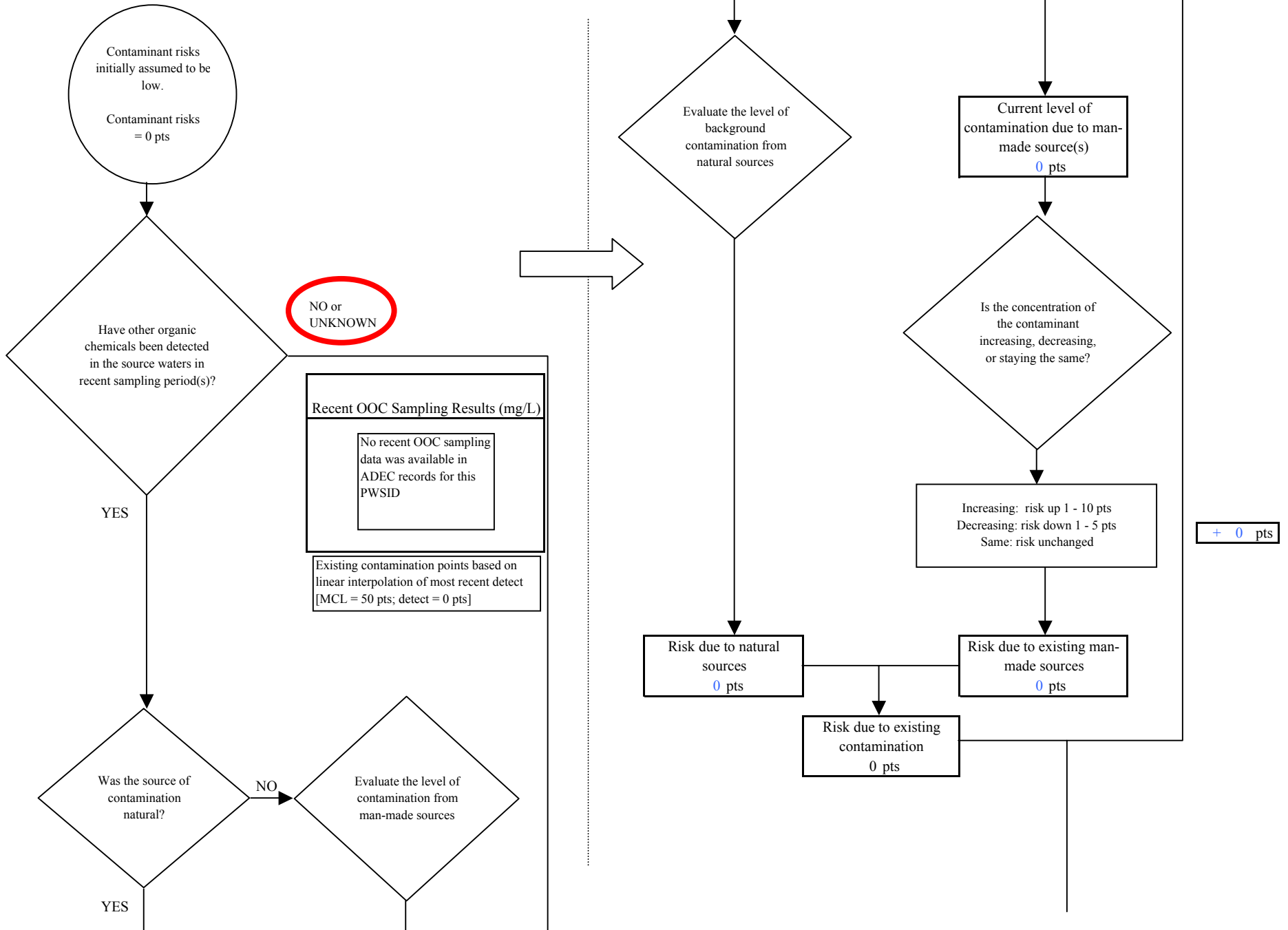
**Chart 11. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Synthetic Organic Chemicals**



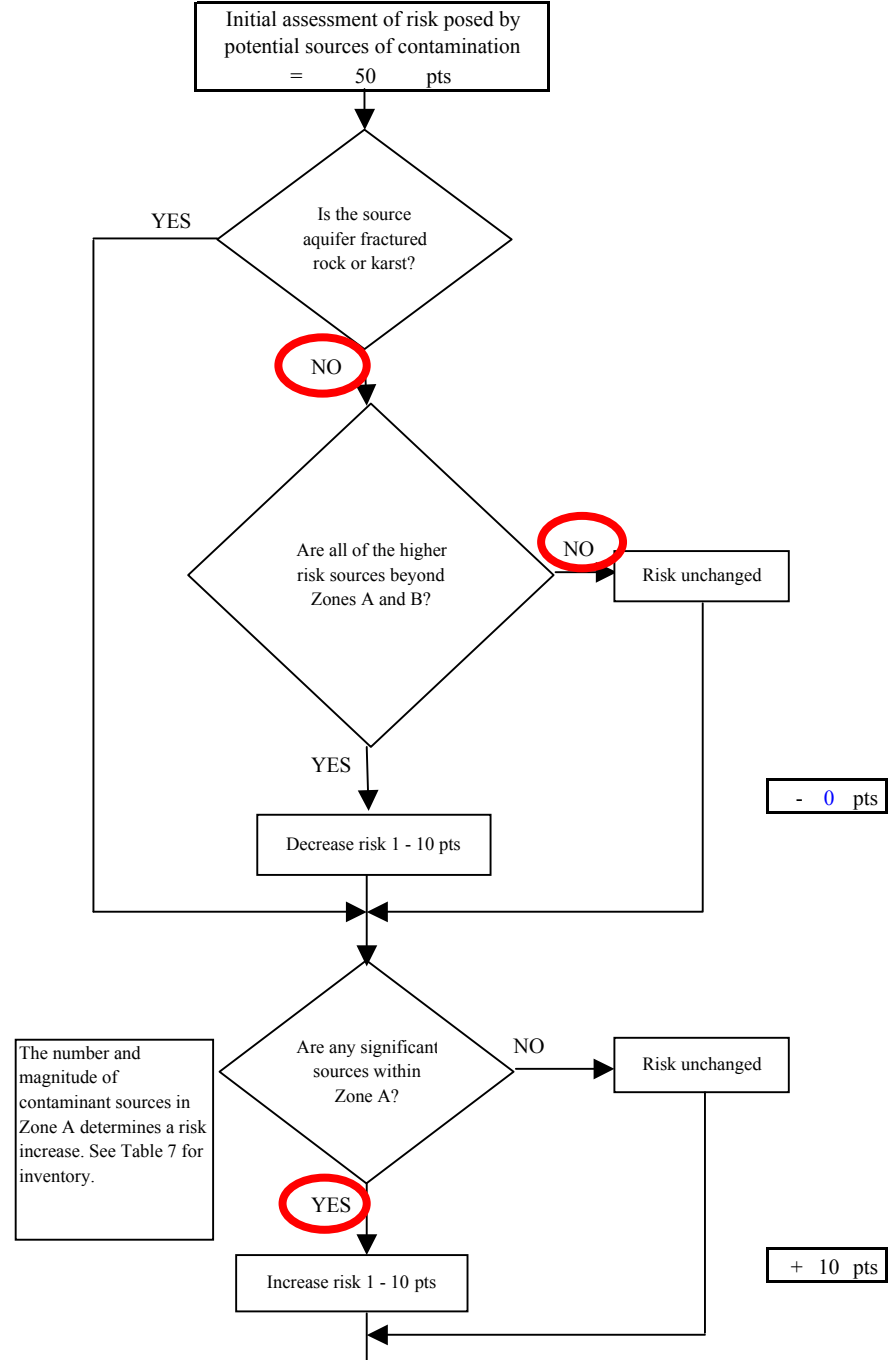
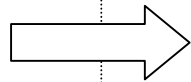
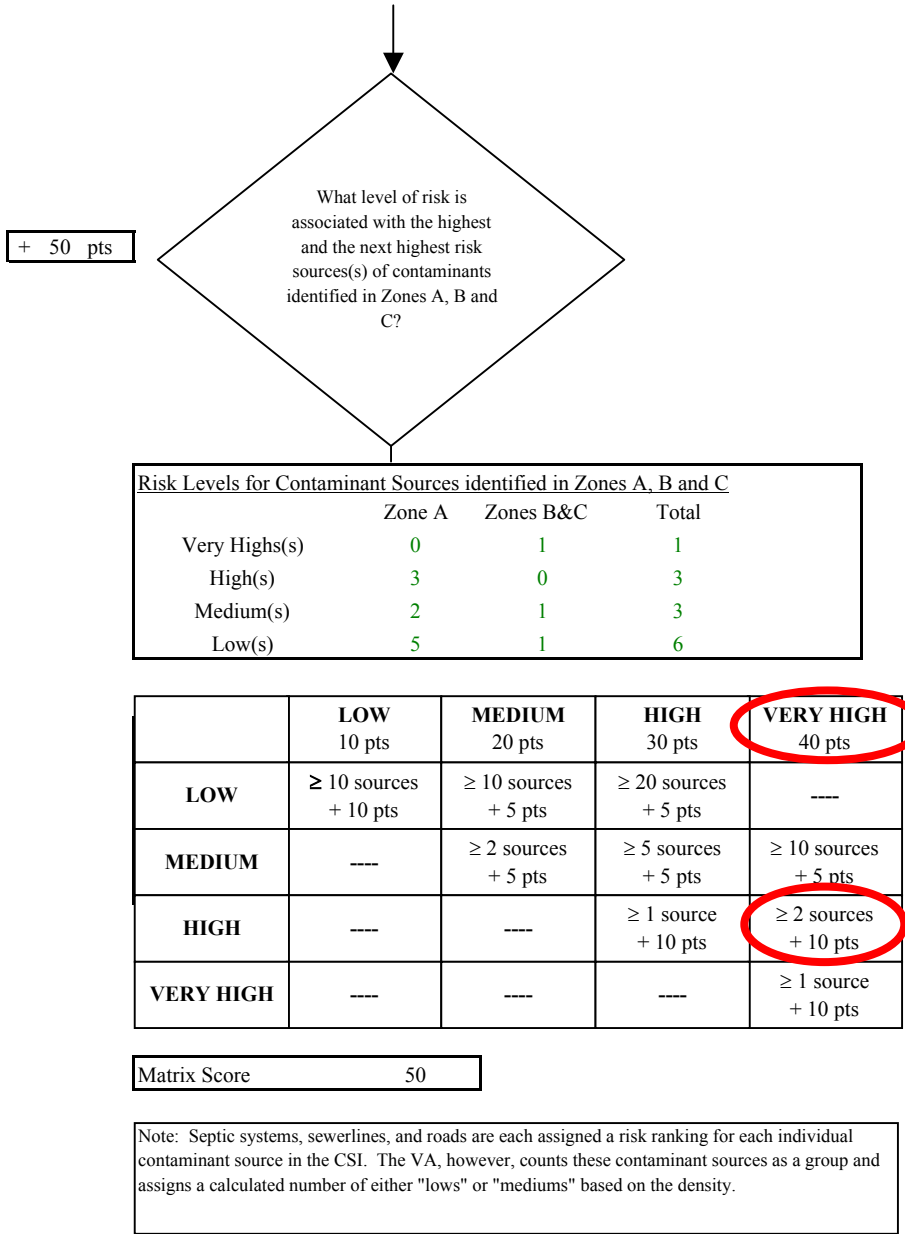
**Chart 12. Vulnerability analysis for LKSD Kwethluk High (PWS No.270956.001) - Synthetic Organic Chemicals**



**Chart 13. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Other Organic Chemicals**

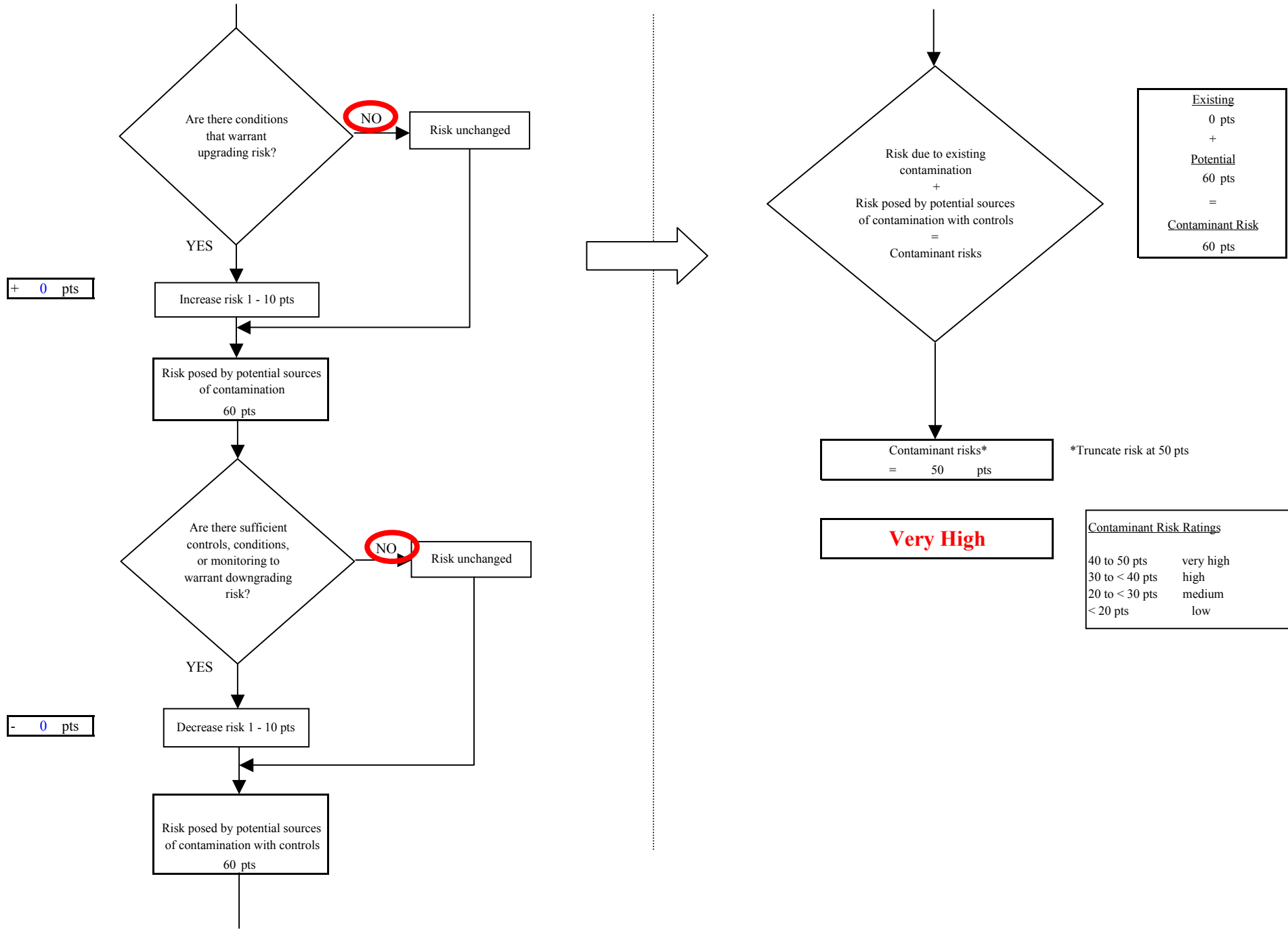


**Chart 13. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Other Organic Chemicals**





**Chart 13. Contaminant risks for LKSD Kwethluk High (PWS No.270956.001) - Other Organic Chemicals**



**Chart 14. Vulnerability analysis for LKSD Kwethluk High (PWS No.270956.001) - Other Organic Chemicals**

