



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
LKSD Nunivaarmiut School
Drinking Water System,
Mekoryuk, Alaska

PWSID # 270972.001

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DRINKING WATER PROTECTION PROGRAM REPORT 1112
Alaska Department of Environmental Conservation

Source Water Assessment for LKSD Nunivaarmiut School Drinking Water System Mekoryuk, Alaska

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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 Nunivaarmiut School Source of Public Drinking Water, Mekoryuk, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The LKSD Nunivaarmiut School has one Public Water System (PWS) well. The well (PWS No. 270972.001) has been used as a drinking water source since it was drilled in 1964.

The well is a Class A (community and non-transient non-community) water system located approximately 1,000-feet west of Shoal Bay in Mekoryuk, Alaska. Available records indicate that there is secondary storage of drinking water, with a capacity of 4,500-gallons, and that the drinking water source is treated with sodium hypochlorite. This system operates seasonally and serves approximately 67 residents through three service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produce a **Medium** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: domestic wastewater collection systems, domestic wastewater treatment plant disposal ponds/lagoons, aboveground fuel tanks, wastewater holding tanks, cemeteries, municipal parks, petroleum product bulk stations/terminals, boat yards and marinas, roads, a firehouse, a medical/veterinary facility, motor/motor vehicle repair shops, 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 **High** for bacteria and viruses, nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, and other organic chemicals, and a vulnerability rating of **Medium** for synthetic organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The LKSD Nunivaarmiut School well is a Class A (community/non-transient/non-community) public water system. The system is located approximately 1,000 feet west of Shoal Bay in Mekoryuk, Alaska (Sec. 31, T4N, R97W, Seward Meridian; see Map A of Appendix A). Mekoryuk is located at the mouth of Shoal Bay, on the north shore of Nunivak Island, in the Bering Sea. Nunivak Island lies 30 miles off the coast of Alaska. The community is located 149 air miles west of Bethel and 553 miles west of Anchorage. Mekoryuk has a population of 205 (ADCED, 2003). Average annual precipitation in Mekoryuk is 15 inches, with an annual snowfall of 57 inches. Temperatures range from 48 to 54°F in summer and 37 to 44°F in winter. Temperatures can be as extreme as -48 to 76°F.

The community of Mekoryuk obtains most of their water supply from a community well. Most households are served by a flush/haul system, and the remaining households utilize honey buckets (ADCED, 2003). Mekoryuk receives electrical power from AVEC, a REA Electric Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by the City of Mekoryuk and transported to the landfill (ADCED, 2003).

According to information supplied by ADEC for the LKSD Nunivaarmiut School PWS, the depth of the primary water well is 47 feet below the ground surface, and is screened in a confined aquifer. The well is not located within a floodplain.

Information acquired from 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.

Nunivak Island is situated across Etolin Strait, approximately 23 miles from the mainland of Alaska. The village of Mekoryuk lies on top of 20 to 30 foot sea bluffs overlooking the Bering Sea to the north, and Shoal Bay to the east. Nunivak Island is composed of volcanic rock. The flows are found interlayered with gravels and silts of the Yukon-Kuskokwim Delta unit. Unconsolidated, fine-grained, frozen soils overlie porous, fractured volcanic rock in the Mekoryuk area. Nunivak Island is generally underlain by discontinuous permafrost (R&M Consultants, Inc., 1979).

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 Nunivaarmiut School 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

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 the LKSD Nunivaarmiut School 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 Nunivaarmiut School 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 Nunivaarmiut School 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	5	Low
Susceptibility of the Aquifer	15	High
Natural Susceptibility	20	Medium

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	49	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	35	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:

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

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 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	60	High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide and		
Other Inorganic Chemicals	70	High
Synthetic Organic Chemicals	55	Medium

Other Organic Chemicals 70 High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of a domestic wastewater treatment plant disposal pond/lagoon and a landfill in Zones A and D (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 **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 a domestic wastewater treatment plant disposal pond/lagoon and a landfill in Zones A and D (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 **High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of petroleum product bulk station/terminals and a landfill located in Zones A, B, and D. Numerous other potential contaminant sources are

also found within the protection area (see Table 4 – Appendix B).

All recent sampling data for VOCs were below detection levels for the LKSD Nunivaarmiut School (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 **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 in Zone D. 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 copper have been detected, and have exceeded the MCL of 1.3 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 **High**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **High**. The risk is primarily attributed to the presence of a landfill in Zone D. 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 Nunivaarmiut School (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 **Medium**.

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 stations/terminals and a landfill in Zones A, B, and D. 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 Nunivaarmiut School (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 **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 Nunivaarmiut School and the community of Mekoryuk 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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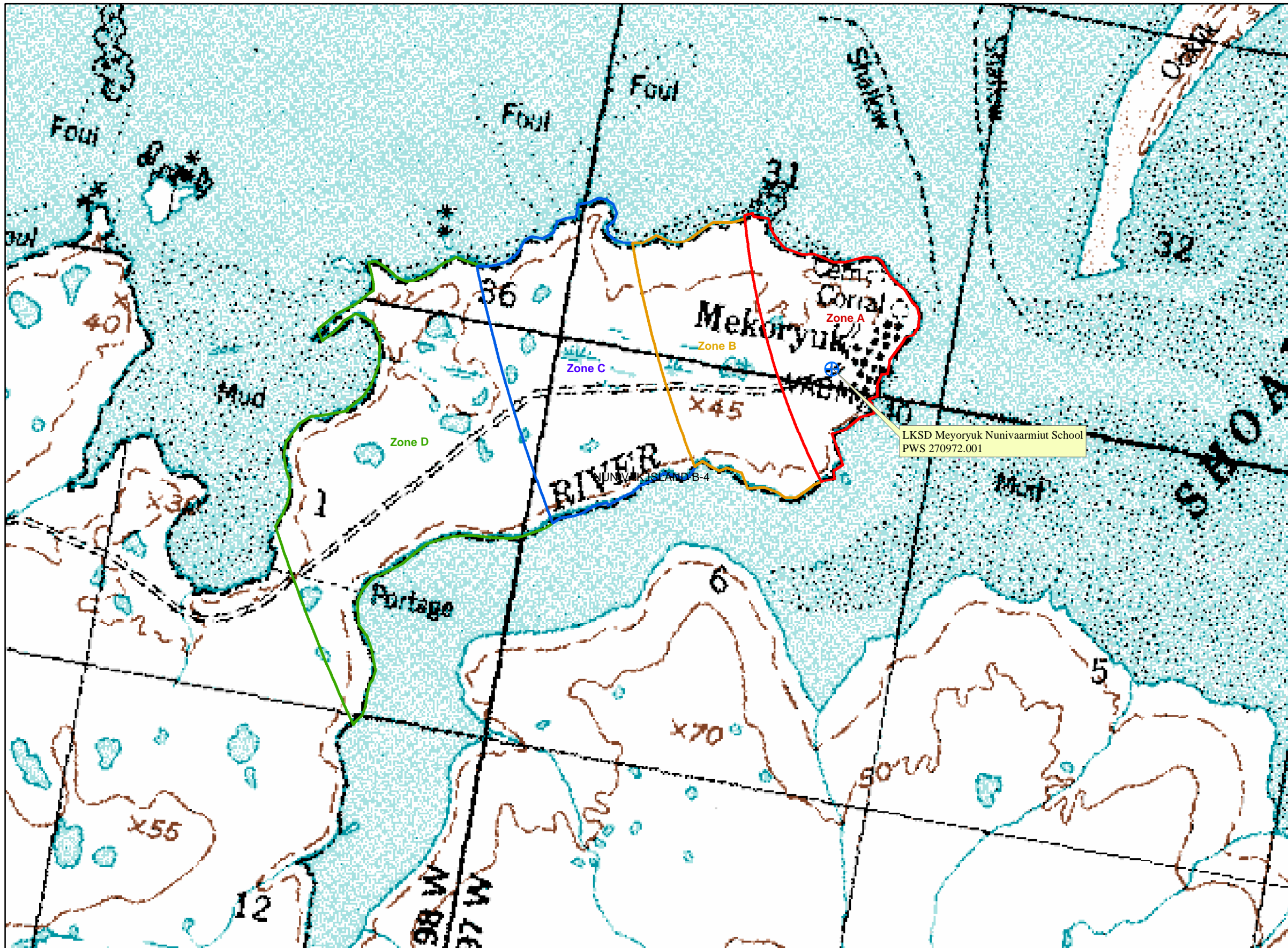
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APPENDIX A

Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWS #270972.001 LKSD Meyoryuk Nunivaarmiut School



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- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

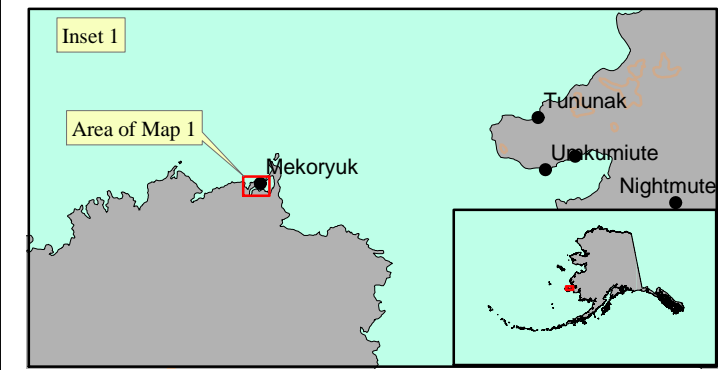
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

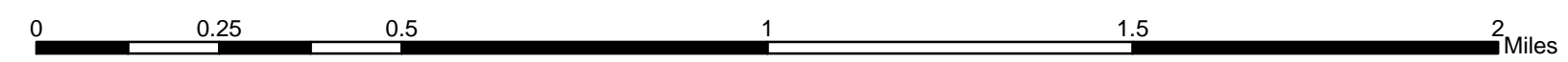
All other data:
United States Geological Survey (USGS)

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.



LKSD Meyoryuk Nunivaarmiut School
PWS 270972.001



APPENDIX B

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

Table 1

**Contaminant Source Inventory for
LKSD Mekoryuk Nunivaarmiut School**

PWSID 270972.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	C	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 55 or less residential heating oil tanks in Zone A
Tanks, diesel (above ground)	T06	T06-01	A	C	BSRP Generator Bldg.
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	AVEC Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	Bering Sea Reindeer Products Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	NIMA Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	C	UUT
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	C	Evangelical Covenant Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	C	Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	C	School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	C	Fire Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	C	National Guard Armory
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	C	BSRP Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	C	IRA Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	C	City Office Complex
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	A	C	NIMA Land Pioneers Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-17	A	C	Police Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-18	A	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-19	A	C	Nuniwaarmiut School
Wastewater Holding Tank	T22	T22-01	A	C	Assume 55 or less wastewater holding tanks 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>
Cemeteries	X01	X01-01	A	C	
Municipal or city parks (with green areas)	X04	X04-01	A	C	
Petroleum product bulk station/terminals	X11	X11-01	A	C	AVEC
Petroleum product bulk station/terminals	X11	X11-02	A	C	BSRP
Petroleum product bulk station/terminals	X11	X11-03	A	C	NIMA
Petroleum product bulk station/terminals	X11	X11-04	A	C	LKSD
Petroleum product bulk station/terminals	X11	X11-05	A	C	Army National Guard
Boat yards and marinas	X15	X15-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Firehouses	X38	X38-01	A	C	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	C	
Motor /motor vehicle repair shops	C31	C31-01	B	C	City Garage
Tanks, heating oil, residential (above ground)	R08	R08-02	B	C	Assume 15 or less residential heating oil tanks in Zone B
Tanks, heating oil, nonresidential (aboveground)	T14	T14-20	B	C	City Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-21	B	C	Satellite
Wastewater Holding Tank	T22	T22-02	B	C	Assume 15 or less wastewater holding tanks in Zone B
Petroleum product bulk station/terminals	X11	X11-06	B	C	City
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Landfills (municipal; Class III)	D51	D51-01	D	C	

Table 2

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School
Sources of Bacteria and Viruses*

PWSID 270972.001

<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	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	
Wastewater Holding Tank	T22	T22-01	A	Low	C	Assume 55 or less wastewater holding tanks in Zone A
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Medium	C	
Wastewater Holding Tank	T22	T22-02	B	Low	C	Assume 15 or less wastewater holding tanks in Zone B
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	D	High	C	

Table 3

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School
Sources of Nitrates/Nitrites*

PWSID 270972.001

<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	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	
Wastewater Holding Tank	T22	T22-01	A	Low	C	Assume 55 or less wastewater holding tanks in Zone A
Cemeteries	X01	X01-01	A	Medium	C	
Municipal or city parks (with green areas)	X04	X04-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	
Wastewater Holding Tank	T22	T22-02	B	Low	C	Assume 15 or less wastewater holding tanks in Zone B
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	D	Very High	C	

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School
Sources of Volatile Organic Chemicals*

PWSID 270972.001

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	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 55 or less residential heating oil tanks in Zone A
Tanks, diesel (above ground)	T06	T06-01	A	Medium	C	BSRP Generator Bldg.
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	AVEC Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	Bering Sea Reindeer Products Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	NIMA Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	UUT
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	Evangelical Covenant Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	Fire Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	Low	C	National Guard Armory
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	Low	C	BSRP Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	Low	C	IRA Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	Low	C	City Office Complex
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	A	Low	C	NIMA Land Pioneers Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-17	A	Low	C	Police Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-18	A	Low	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-19	A	Low	C	Nuniwaarmiut School

Table 4 (continued)

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School
Sources of Volatile Organic Chemicals*

PWSID 270972.001

<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>
Wastewater Holding Tank	T22	T22-01	A	Medium	C	Assume 55 or less wastewater holding tanks in Zone A
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	AVEC
Petroleum product bulk station/terminals	X11	X11-02	A	Very High	C	BSRP
Petroleum product bulk station/terminals	X11	X11-03	A	Very High	C	NIMA
Petroleum product bulk station/terminals	X11	X11-04	A	Very High	C	LKSD
Petroleum product bulk station/terminals	X11	X11-05	A	Very High	C	Army National Guard
Boat yards and marinas	X15	X15-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Firehouses	X38	X38-01	A	Low	C	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	
Motor /motor vehicle repair shops	C31	C31-01	B	Medium	C	City Garage
Tanks, heating oil, residential (above ground)	R08	R08-02	B	Medium	C	Assume 15 or less residential heating oil tanks in Zone B
Tanks, heating oil, nonresidential (aboveground)	T14	T14-20	B	Low	C	City Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-21	B	Low	C	Satellite
Wastewater Holding Tank	T22	T22-02	B	Medium	C	Assume 15 or less wastewater holding tanks in Zone B
Petroleum product bulk station/terminals	X11	X11-06	B	Very High	C	City
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	D	High	C	

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School*

PWSID 270972.001

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>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	AVEC Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	Bering Sea Reindeer Products Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	NIMA Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	UUT
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	A	Low	C	Evangelical Covenant Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	A	Low	C	Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	A	Low	C	School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	A	Low	C	Fire Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	A	Low	C	National Guard Armory
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	A	Low	C	BSRP Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	A	Low	C	IRA Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	A	Low	C	City Office Complex
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	A	Low	C	NIMA Land Pioneers Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-17	A	Low	C	Police Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-18	A	Low	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-19	A	Low	C	Nuniwaarmiut School
Wastewater Holding Tank	T22	T22-01	A	Medium	C	Assume 55 or less wastewater holding tanks in Zone A
Cemeteries	X01	X01-01	A	Low	C	

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School*

PWSID 270972.001

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>
Municipal or city parks (with green areas)	X04	X04-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	AVEC
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	BSRP
Petroleum product bulk station/terminals	X11	X11-03	A	Low	C	NIMA
Petroleum product bulk station/terminals	X11	X11-04	A	Low	C	LKSD
Petroleum product bulk station/terminals	X11	X11-05	A	Low	C	Army National Guard
Boat yards and marinas	X15	X15-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Firehouses	X38	X38-01	A	Low	C	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	
Motor /motor vehicle repair shops	C31	C31-01	B	Medium	C	City Garage
Tanks, heating oil, nonresidential (aboveground)	T14	T14-20	B	Low	C	City Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-21	B	Low	C	Satellite
Wastewater Holding Tank	T22	T22-02	B	Medium	C	Assume 15 or less wastewater holding tanks in Zone B
Petroleum product bulk station/terminals	X11	X11-06	B	Low	C	City
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	D	High	C	

Table 6

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School
Sources of Synthetic Organic Chemicals*

PWSID 270972.001

<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	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Cemeteries	X01	X01-01	A	Medium	C	
Municipal or city parks (with green areas)	X04	X04-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	AVEC
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	BSRP
Petroleum product bulk station/terminals	X11	X11-03	A	Low	C	NIMA
Petroleum product bulk station/terminals	X11	X11-04	A	Low	C	LKSD
Petroleum product bulk station/terminals	X11	X11-05	A	Low	C	Army National Guard
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-06	B	Low	C	City
Landfills (municipal; Class III)	D51	D51-01	D	Very High	C	

*Contaminant Source Inventory and Risk Ranking for
LKSD Mekoryuk Nunivaarmiut School
Sources of Other Organic Chemicals*

PWSID 270972.001

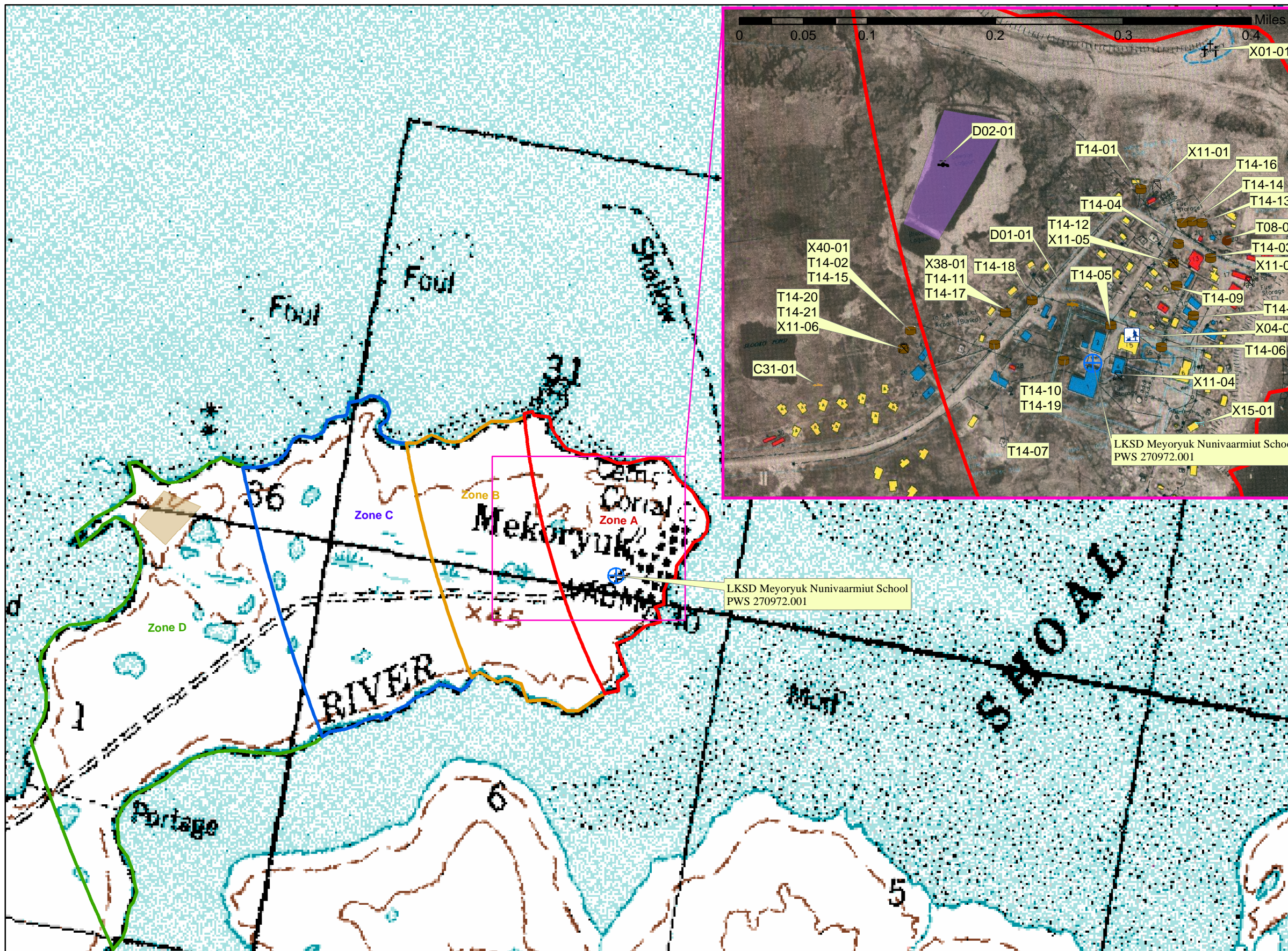
Table 7

<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>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	
Wastewater Holding Tank	T22	T22-01	A	Medium	C	Assume 55 or less wastewater holding tanks in Zone A
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	AVEC
Petroleum product bulk station/terminals	X11	X11-02	A	High	C	BSRP
Petroleum product bulk station/terminals	X11	X11-03	A	High	C	NIMA
Petroleum product bulk station/terminals	X11	X11-04	A	High	C	LKSD
Petroleum product bulk station/terminals	X11	X11-05	A	High	C	Army National Guard
Boat yards and marinas	X15	X15-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Motor /motor vehicle repair shops	C31	C31-01	B	Medium	C	City Garage
Wastewater Holding Tank	T22	T22-02	B	Medium	C	Assume 15 or less wastewater holding tanks in Zone B
Petroleum product bulk station/terminals	X11	X11-06	B	High	C	City
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	D	Very High	C	

APPENDIX C

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

Public Water Well System for PWS #270972.001 LKSD Meyoryuk Nunivaarmiut School
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– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time
- Existing or Potential Contaminant Sources**
- Motor vehicle repair shop (C31)
- Domestic wastewater collection systems (sewer lines) (D01)
- Domestic wastewater treatment plant disposal pond (D02)
- Aboveground diesel tank (T06)
- Nonresidential aboveground heating oil tank (T14)
- Cemetery (X01)
- Municipal park (X04)
- Petroleum product bulk station/terminal (X11)
- Boat yards and marinas (X15)
- Firehouse (X38)
- Medical/veterinary facility (X40)
- Landfill (municipal; Class III) (D51)

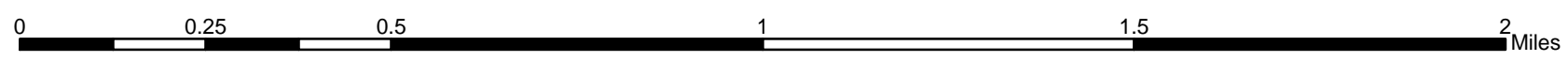
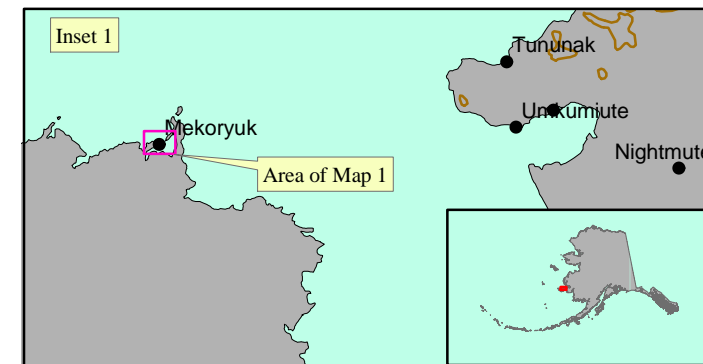
Data Sources:

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

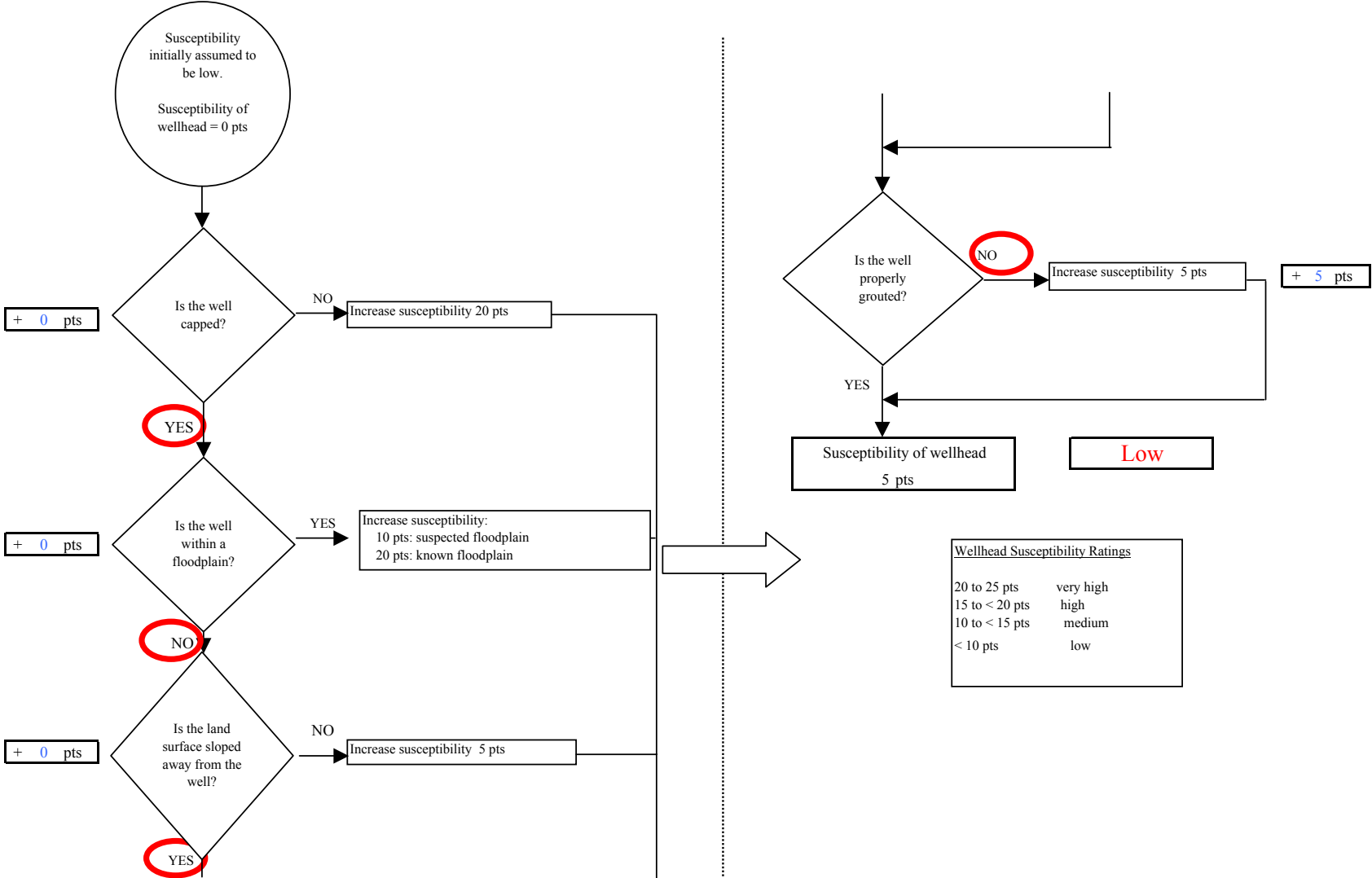
URS Corporation does not guarantee the accuracy or validity of the data provided.



APPENDIX D

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

Chart 1. Susceptibility of the wellhead - LKSD Nunivaarmiut School (PWS No.270972.001)



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 LKSD Nunivaarmiut School (PWS No.270972.001)

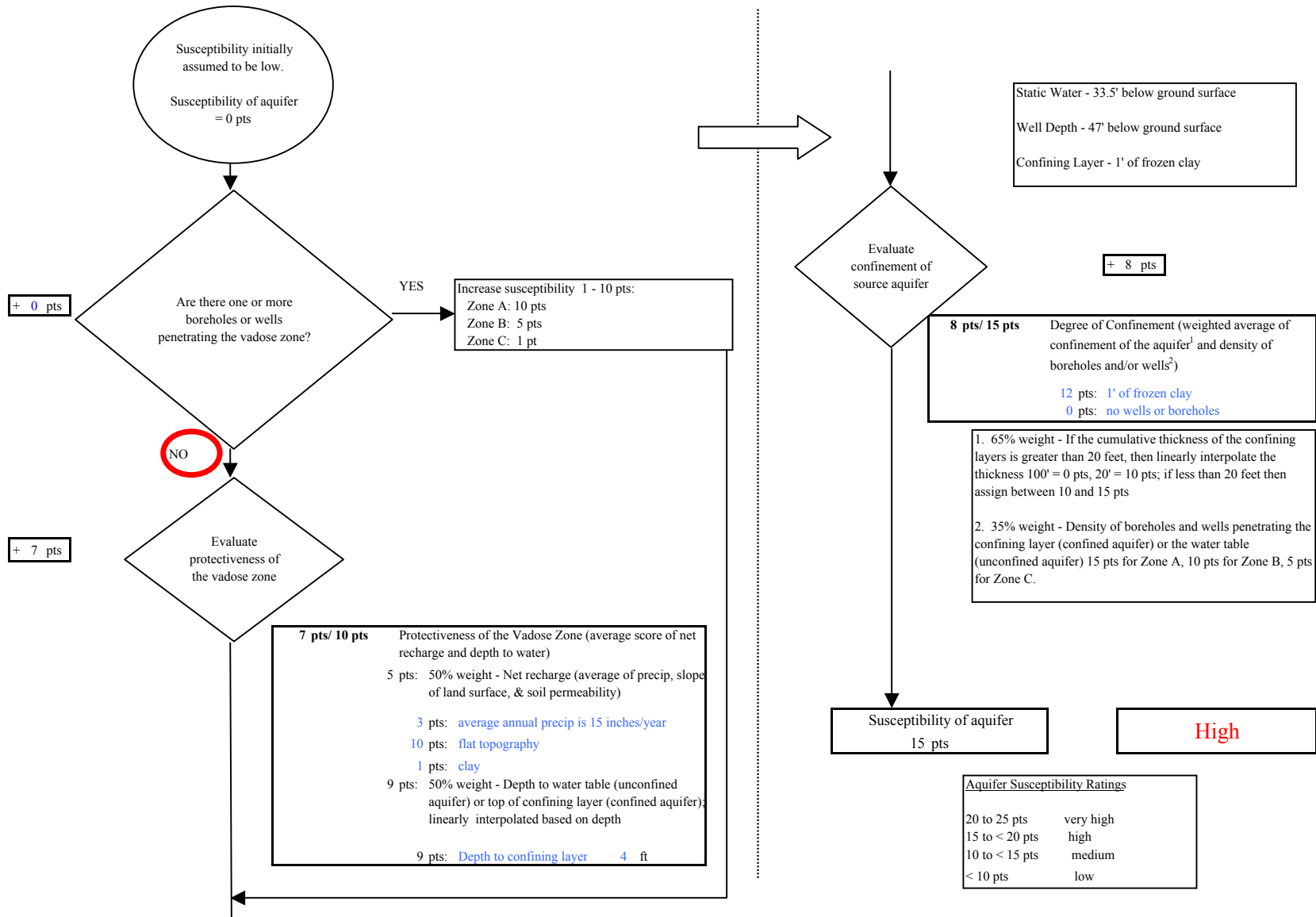


Chart 3. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Bacteria & Viruses

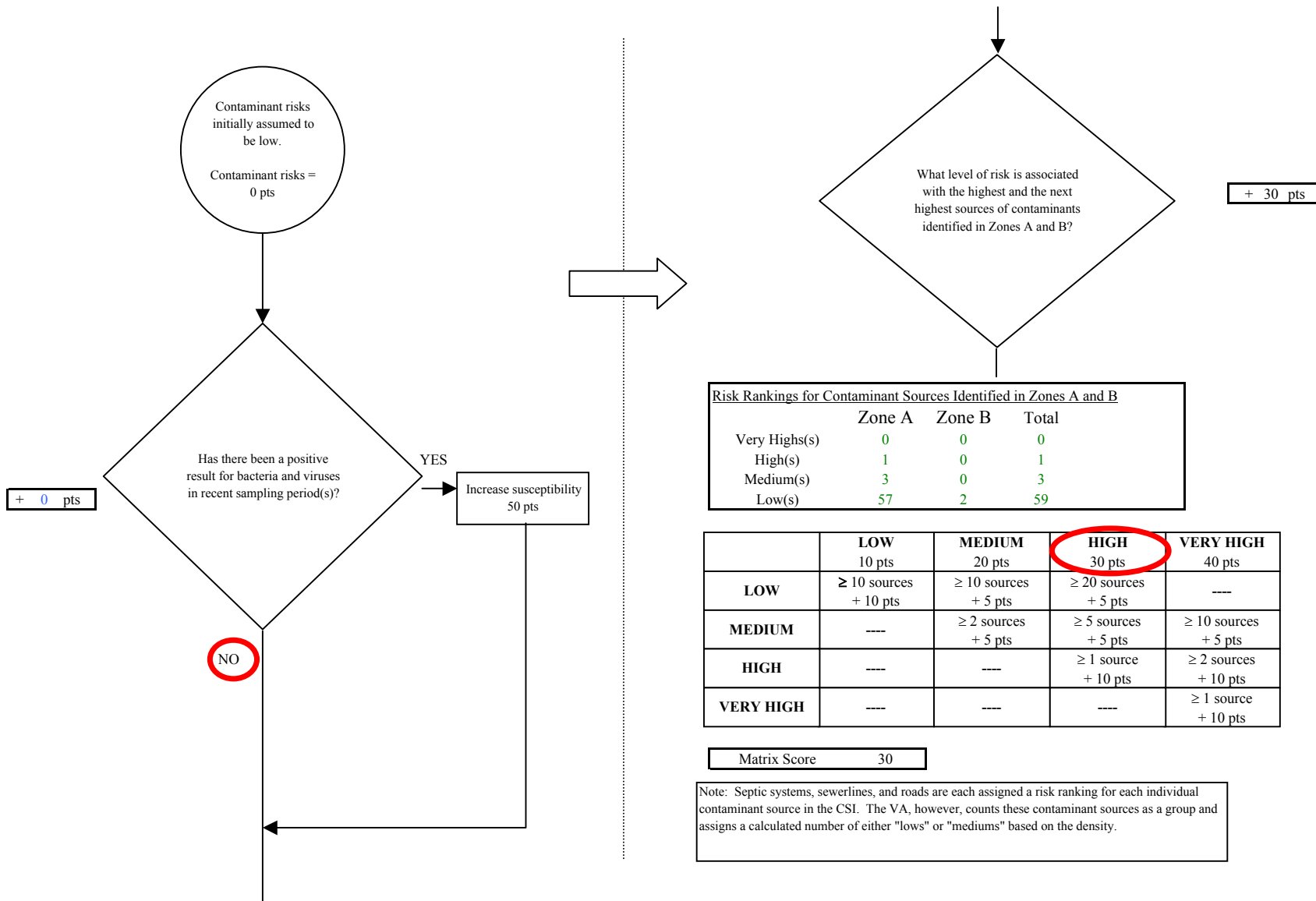
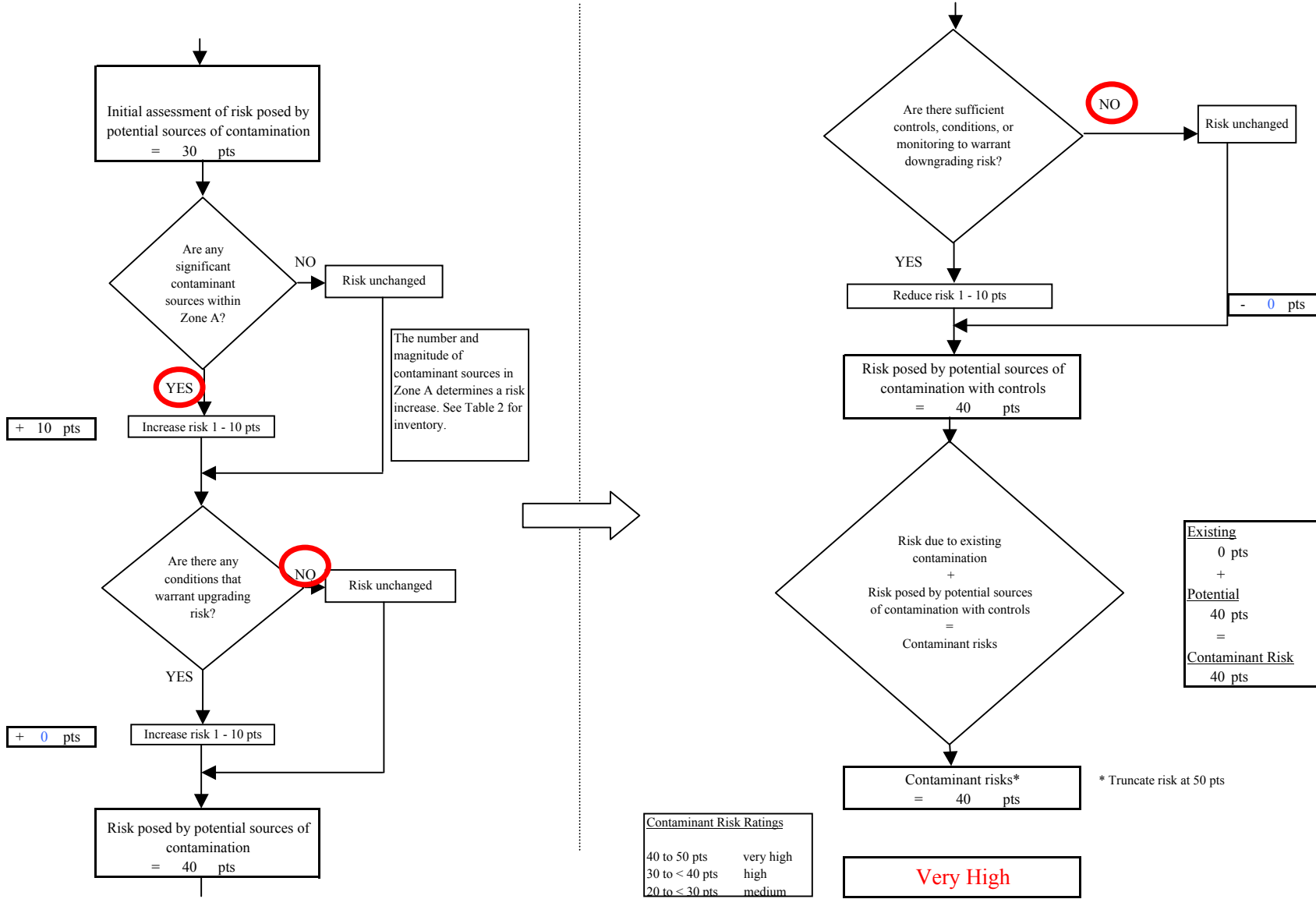


Chart 3. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Bacteria & Viruses



Contaminant Risk Ratings	
40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium

Existing	0 pts
+	
Potential	40 pts
=	
Contaminant Risk	40 pts

Chart 4. Vulnerability analysis for LKSD Nunivaarmiut School (PWS No.270972.001) - Bacteria & Viruses

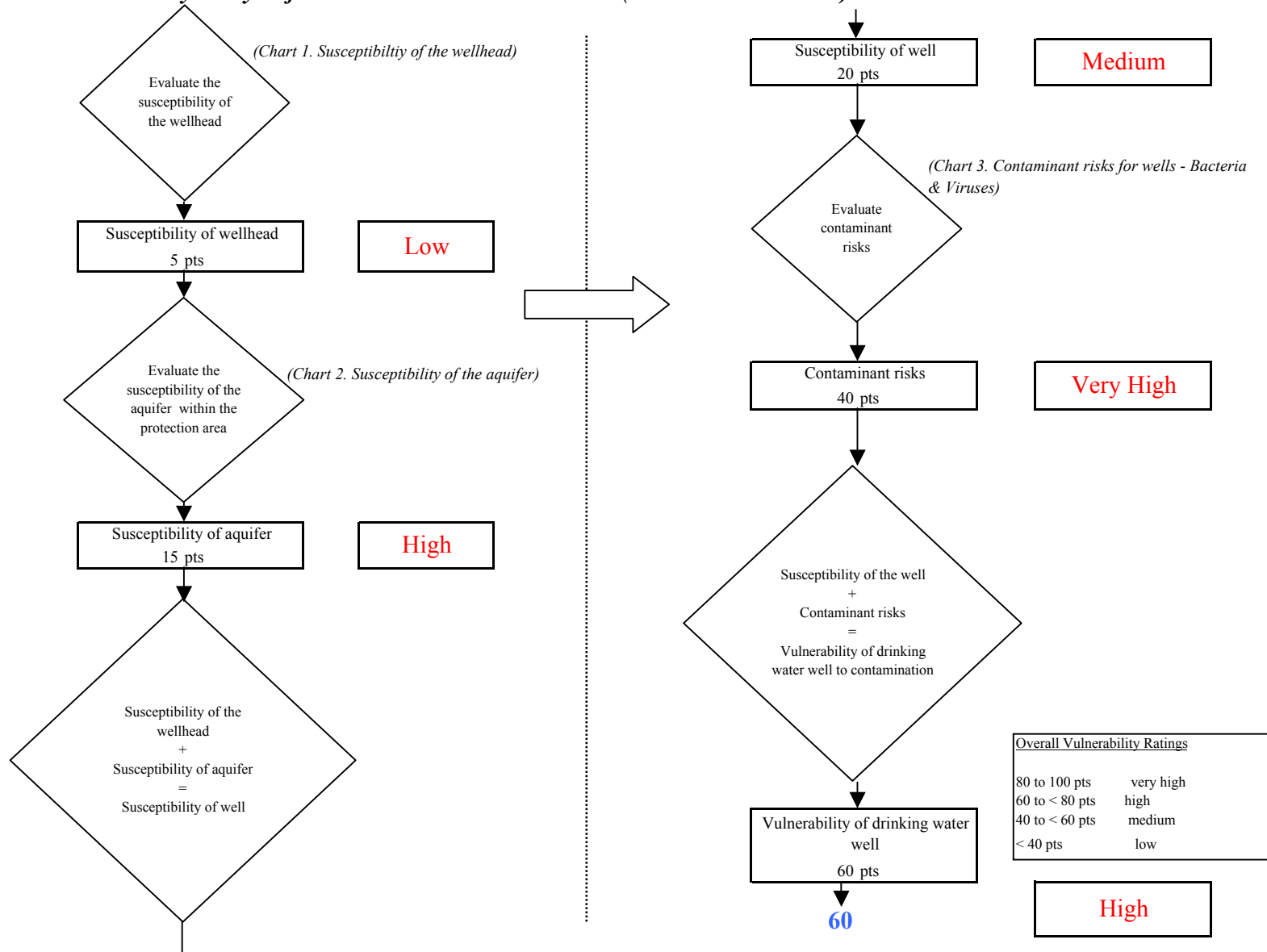


Chart 5. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Nitrates and Nitrites

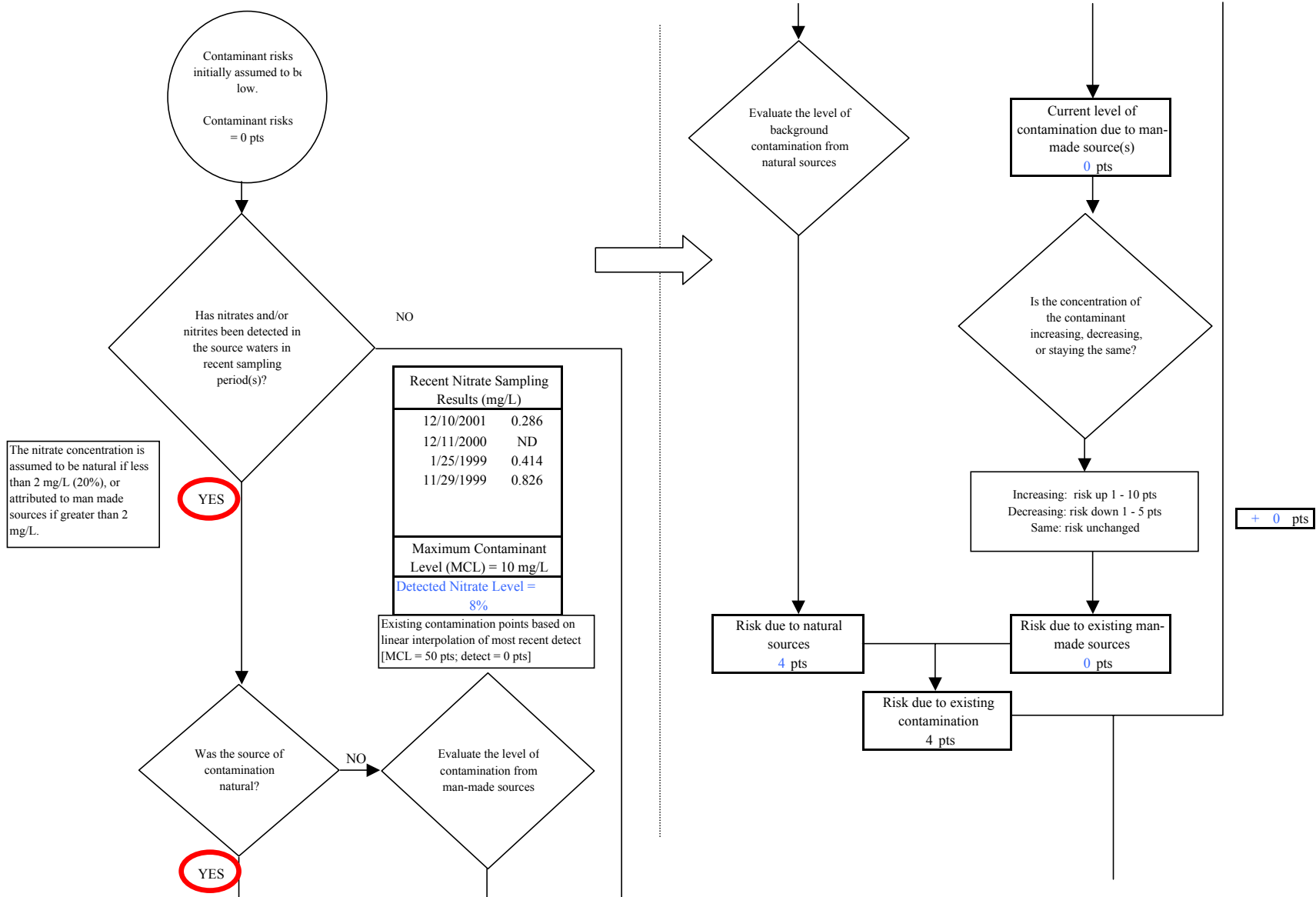
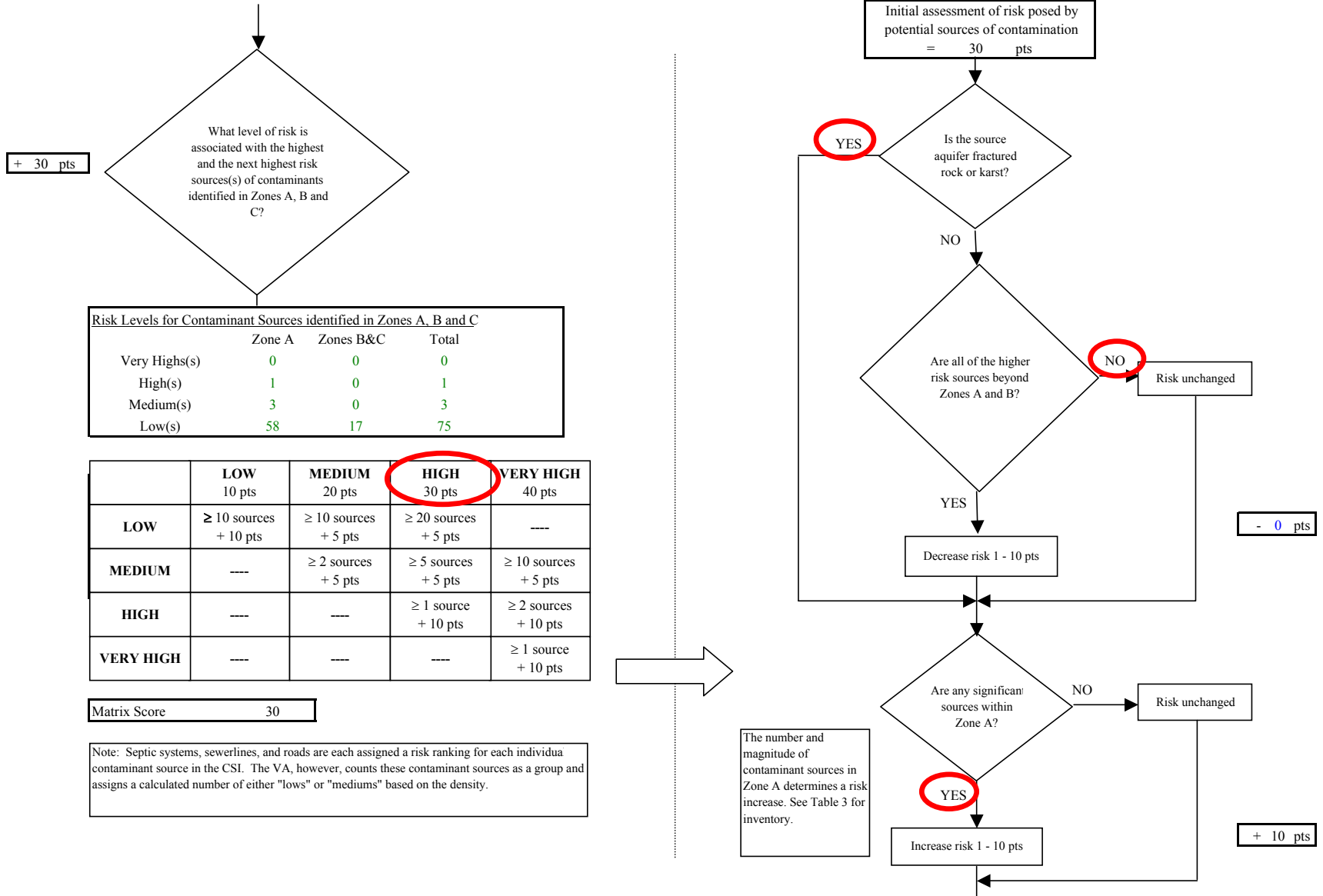


Chart 5. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Nitrates and Nitrites



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?

+ 30 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)	1	0	1
Medium(s)	3	0	3
Low(s)	58	17	75

	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 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 5. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Nitrates and Nitrites

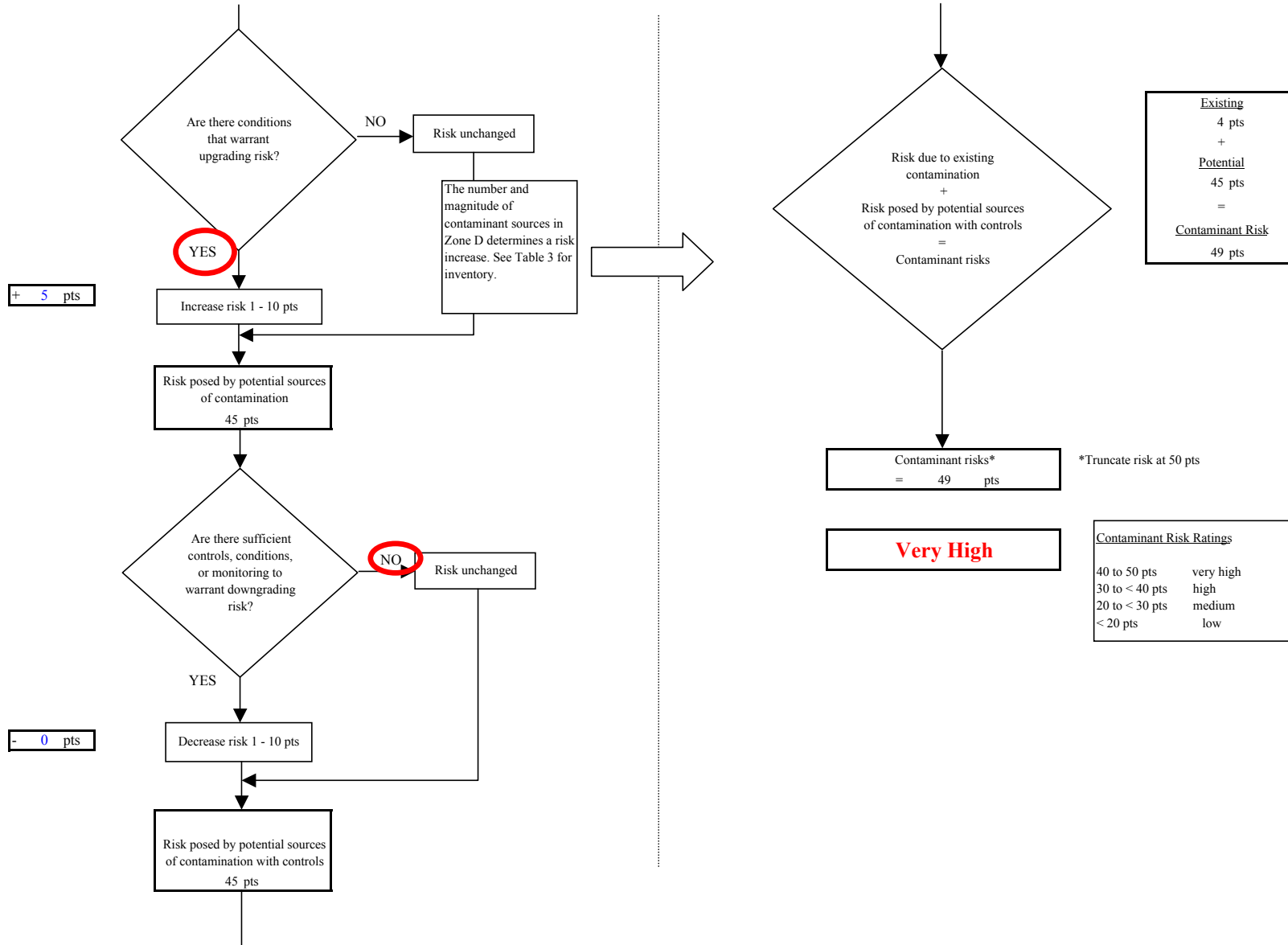


Chart 6. Vulnerability analysis for LKSD Nunivaarmiut School (PWS No.270972.001) - Nitrates and Nitrites

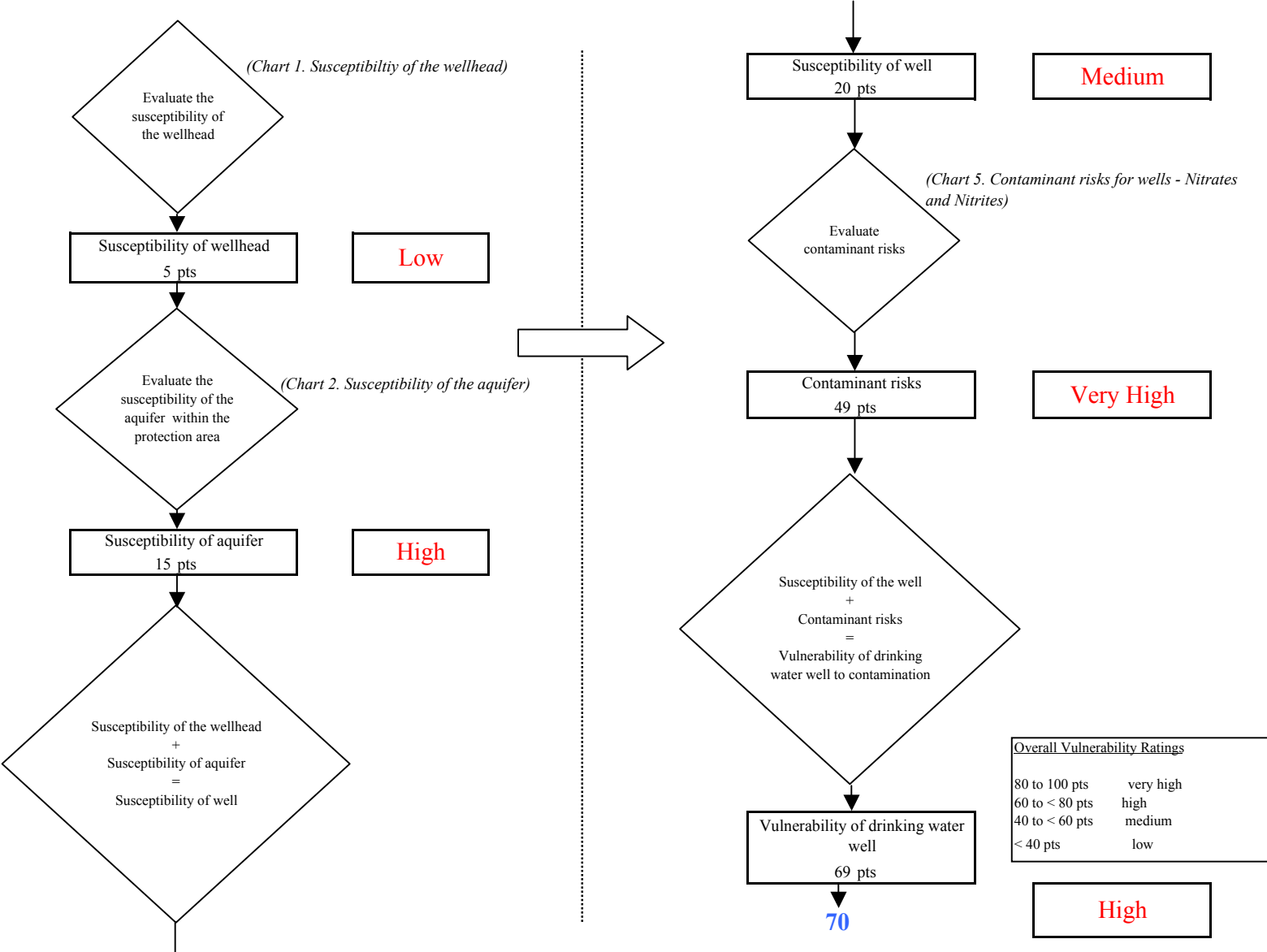


Chart 7. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Volatile Organic Chemicals

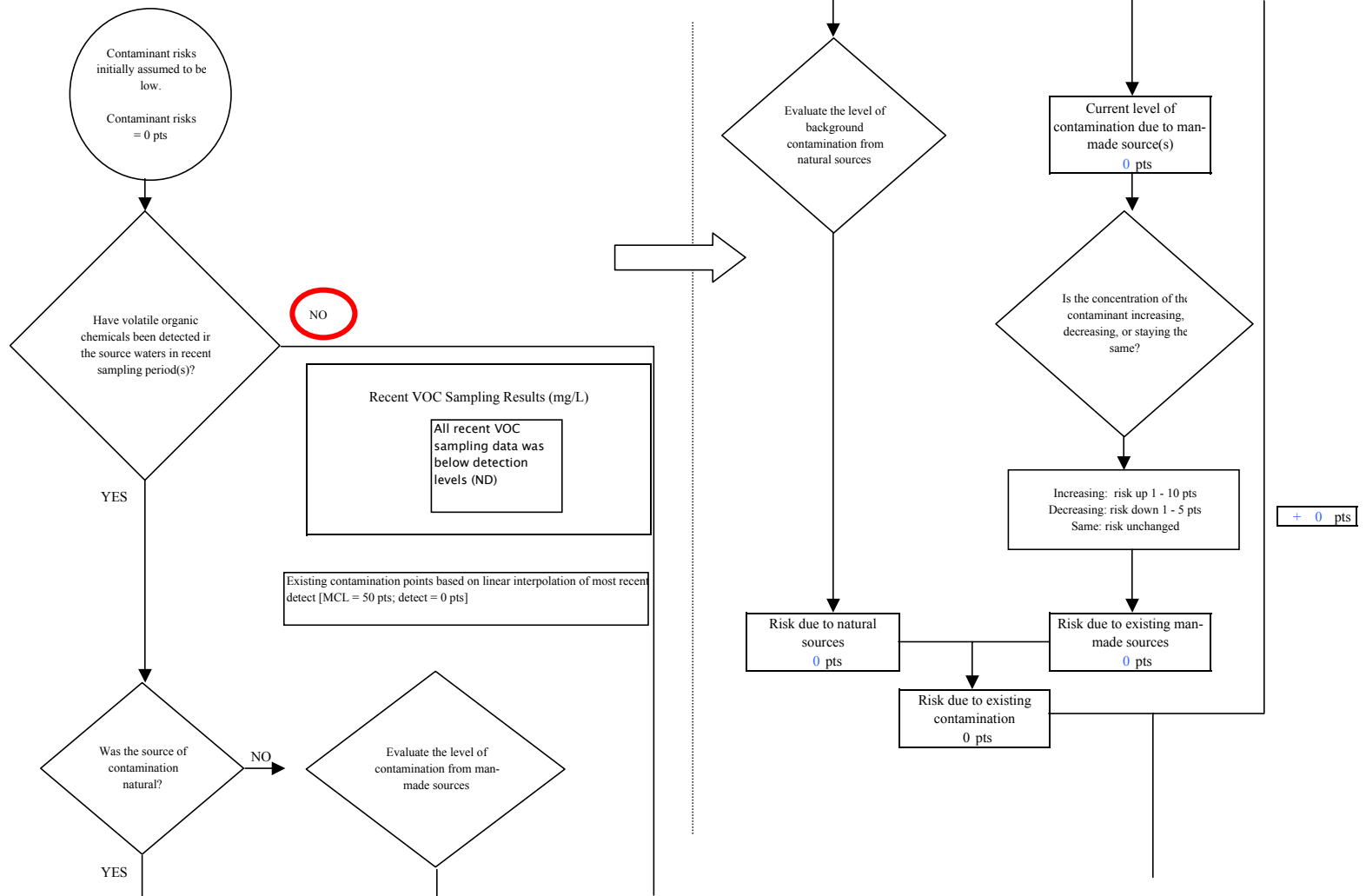


Chart 7. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Volatile Organic Chemicals

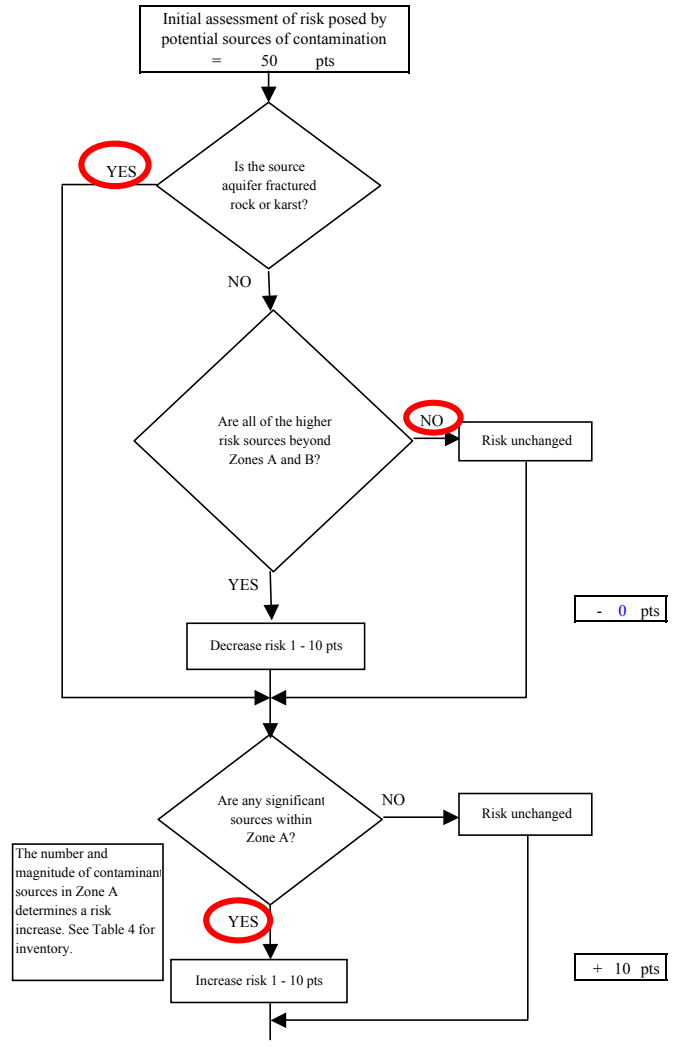
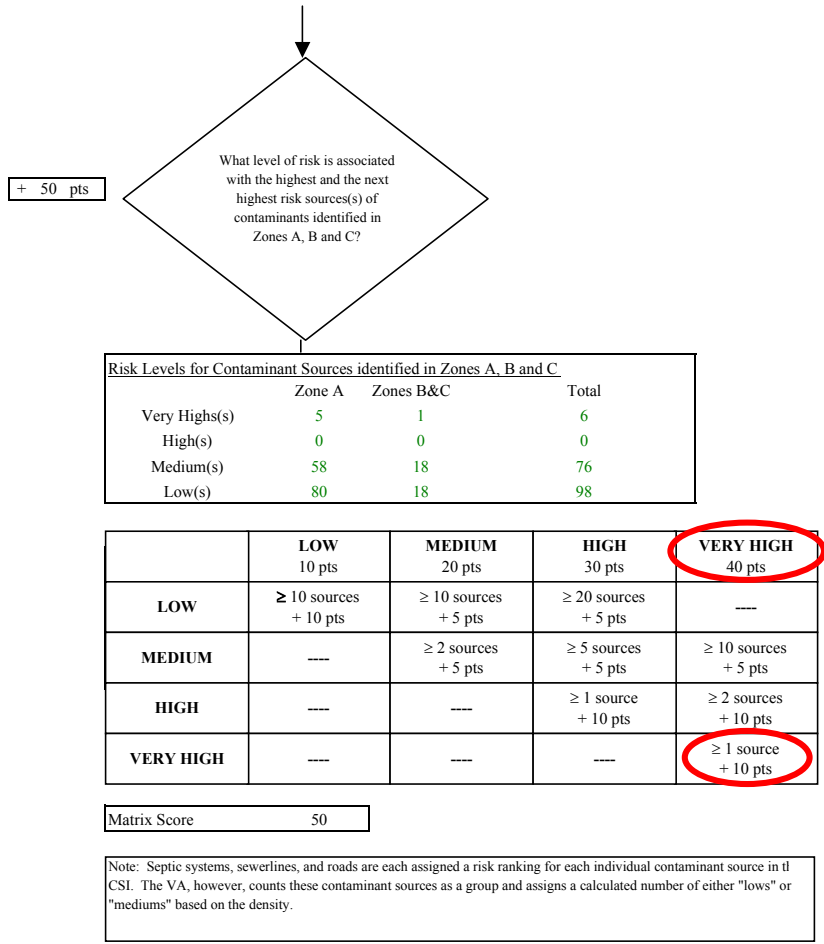


Chart 7. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Volatile Organic Chemicals

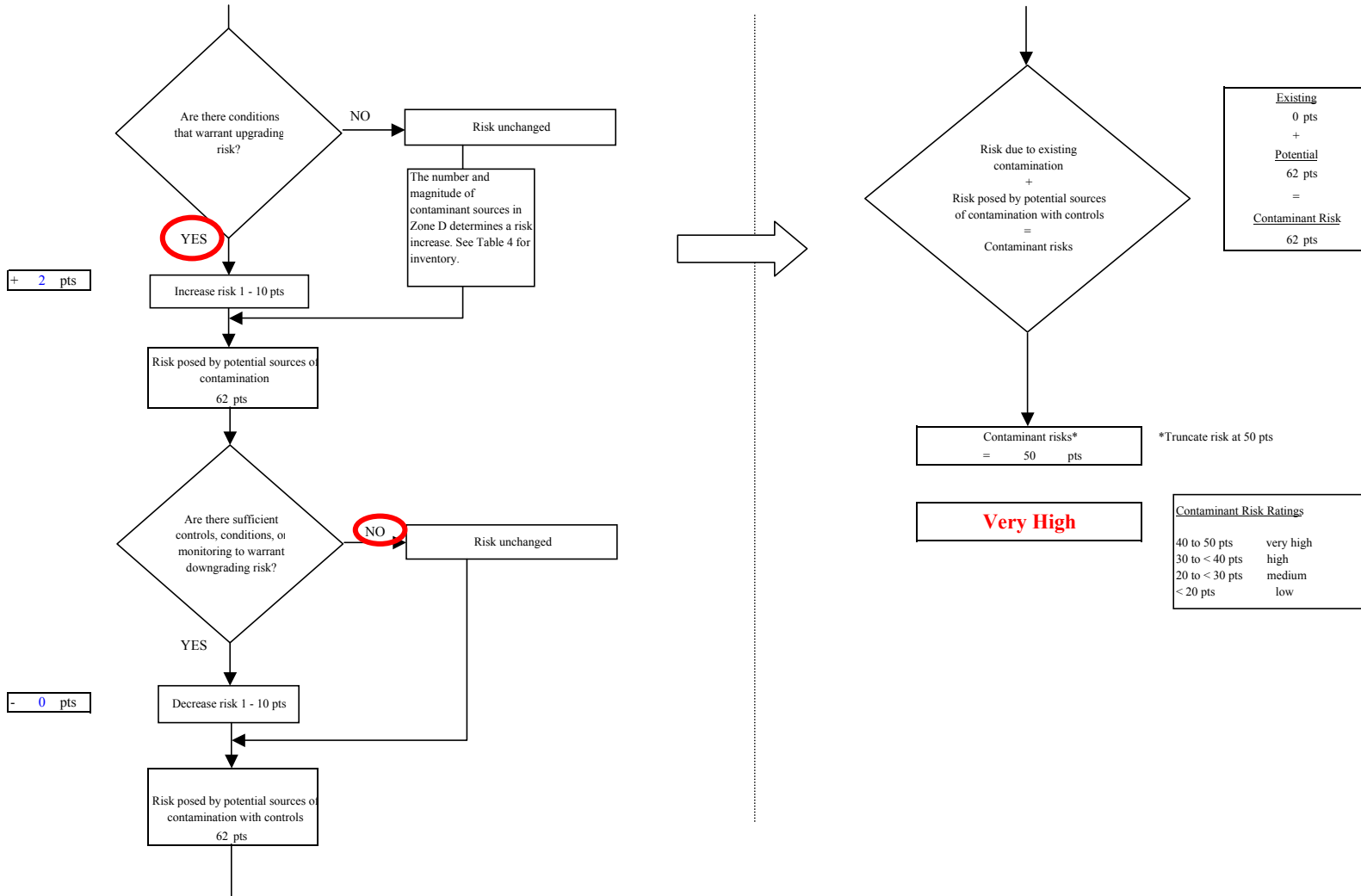


Chart 8. Vulnerability analysis for LKSD Nunivaarmiut School (PWS No.270972.001) - Volatile Organic Chemicals

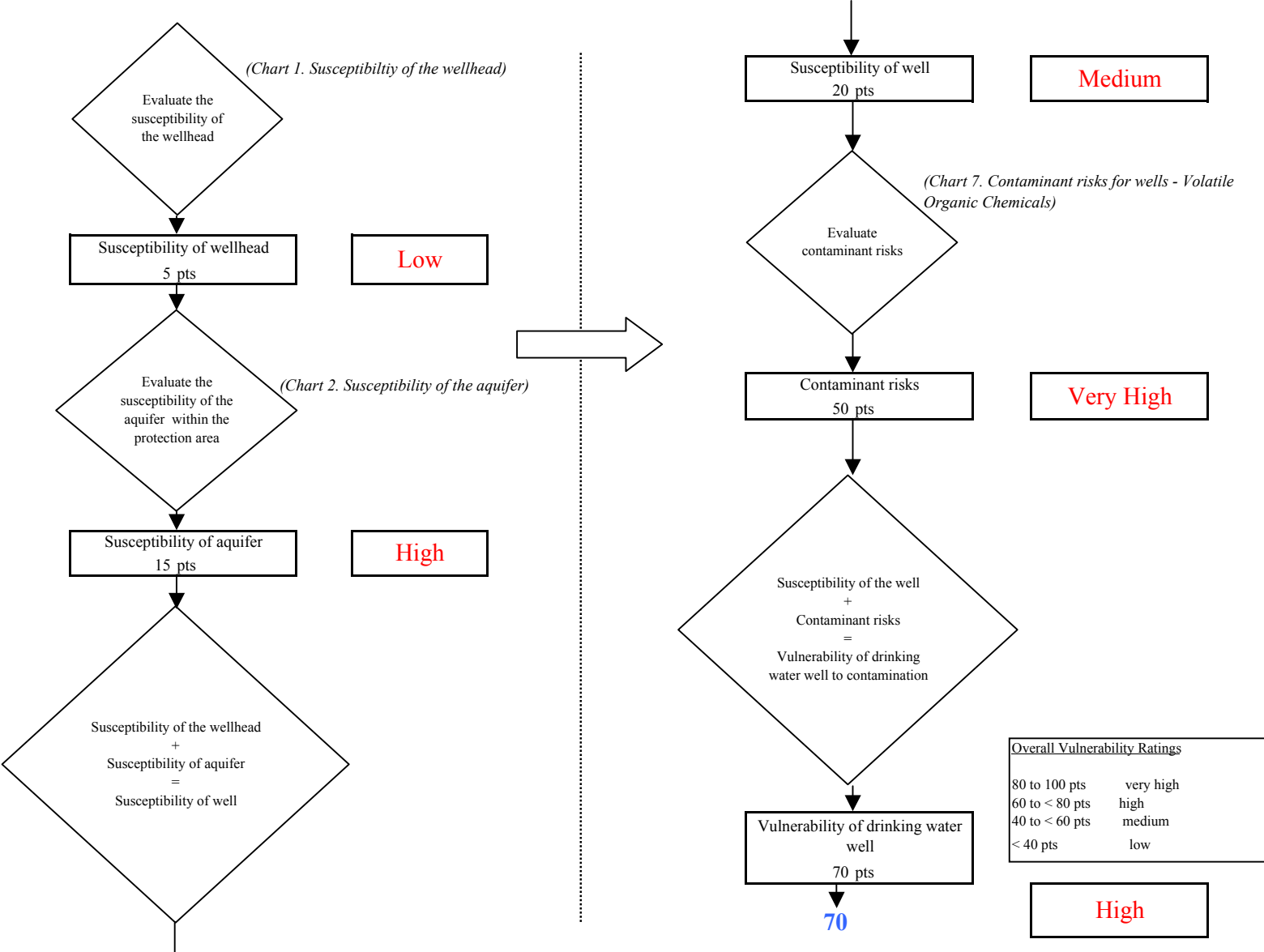


Chart 9. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

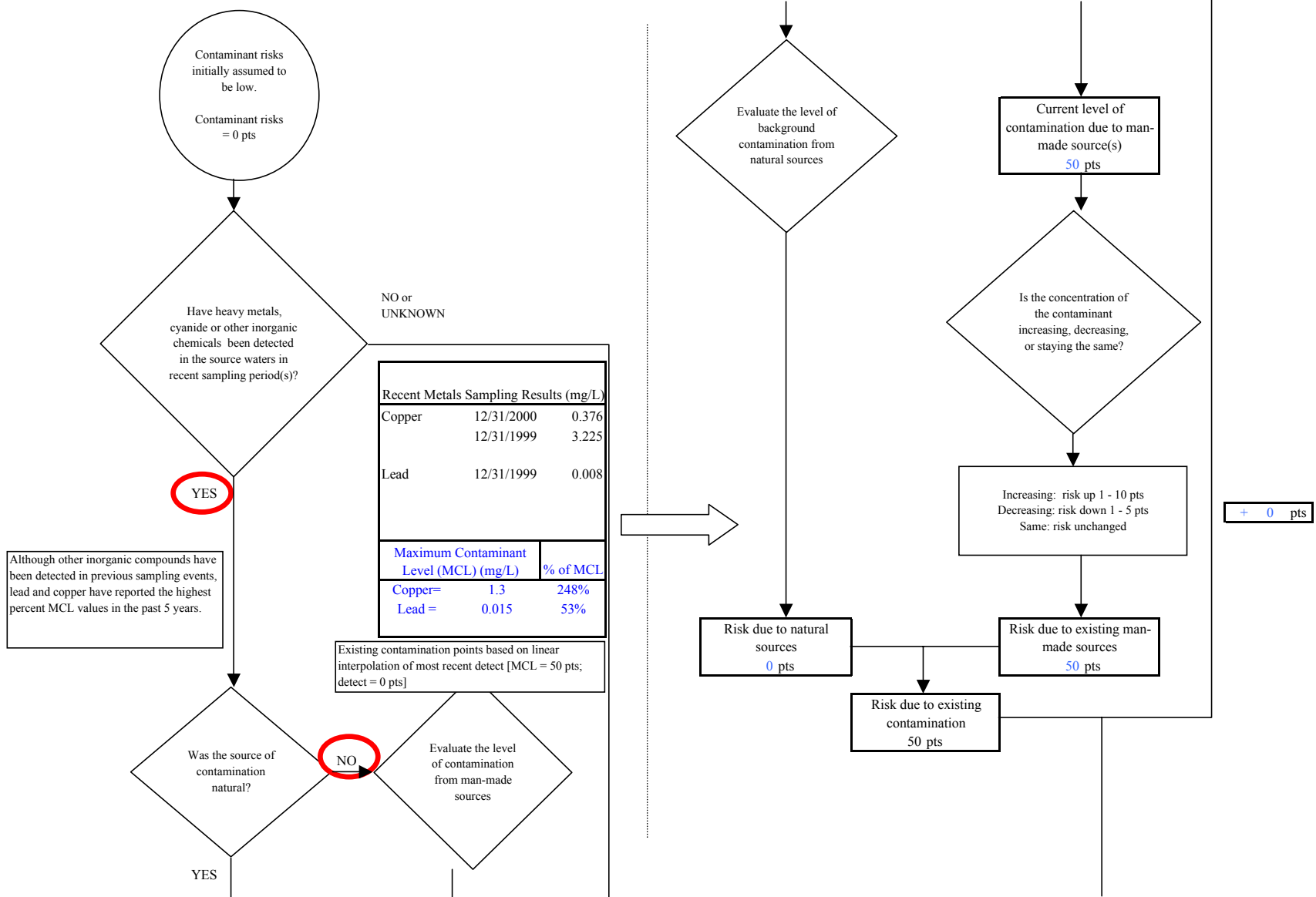


Chart 9. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

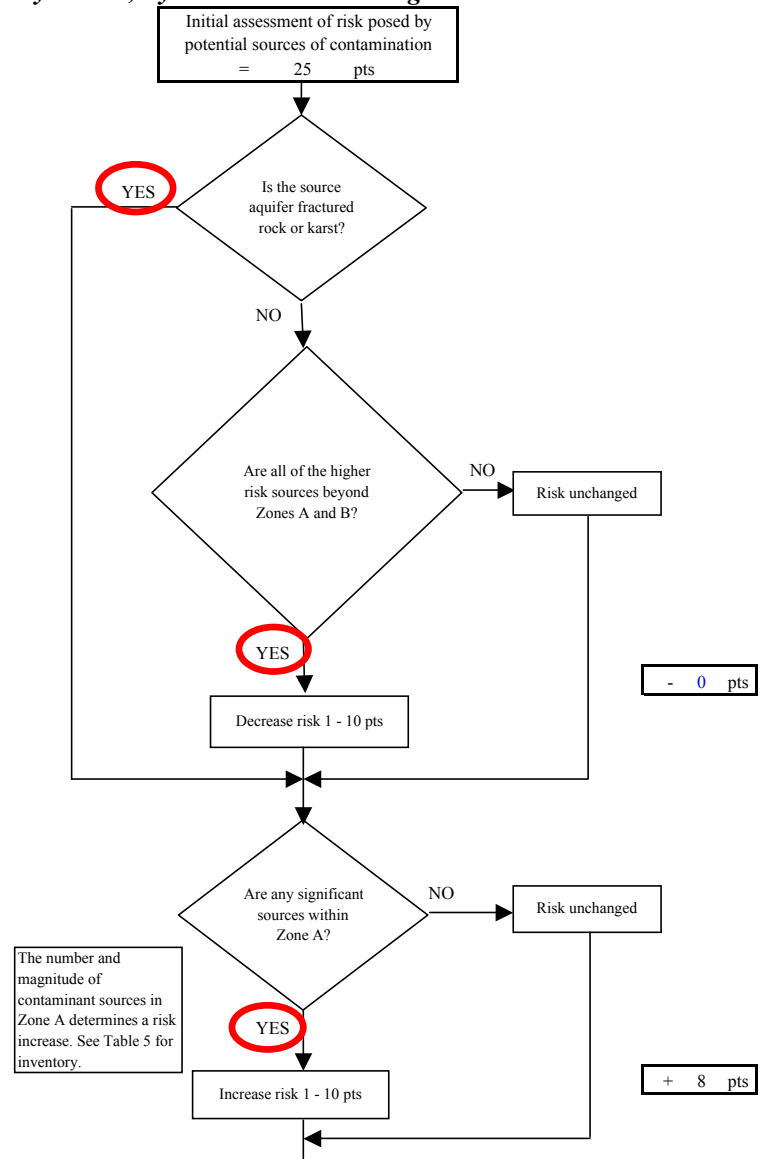
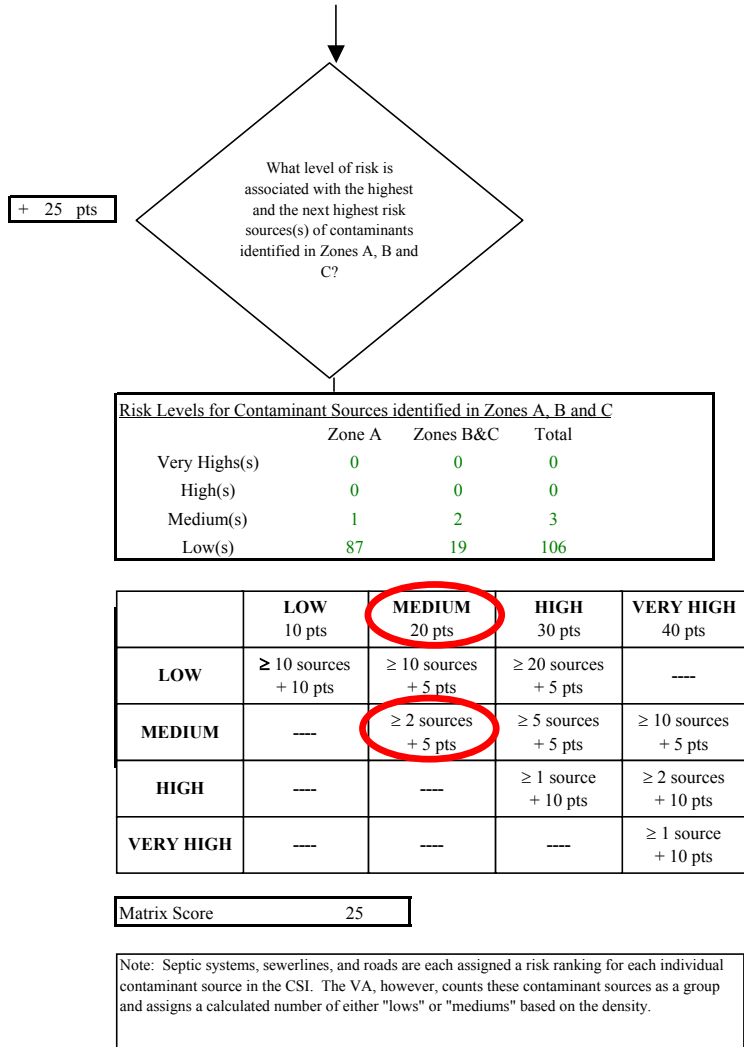


Chart 9. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

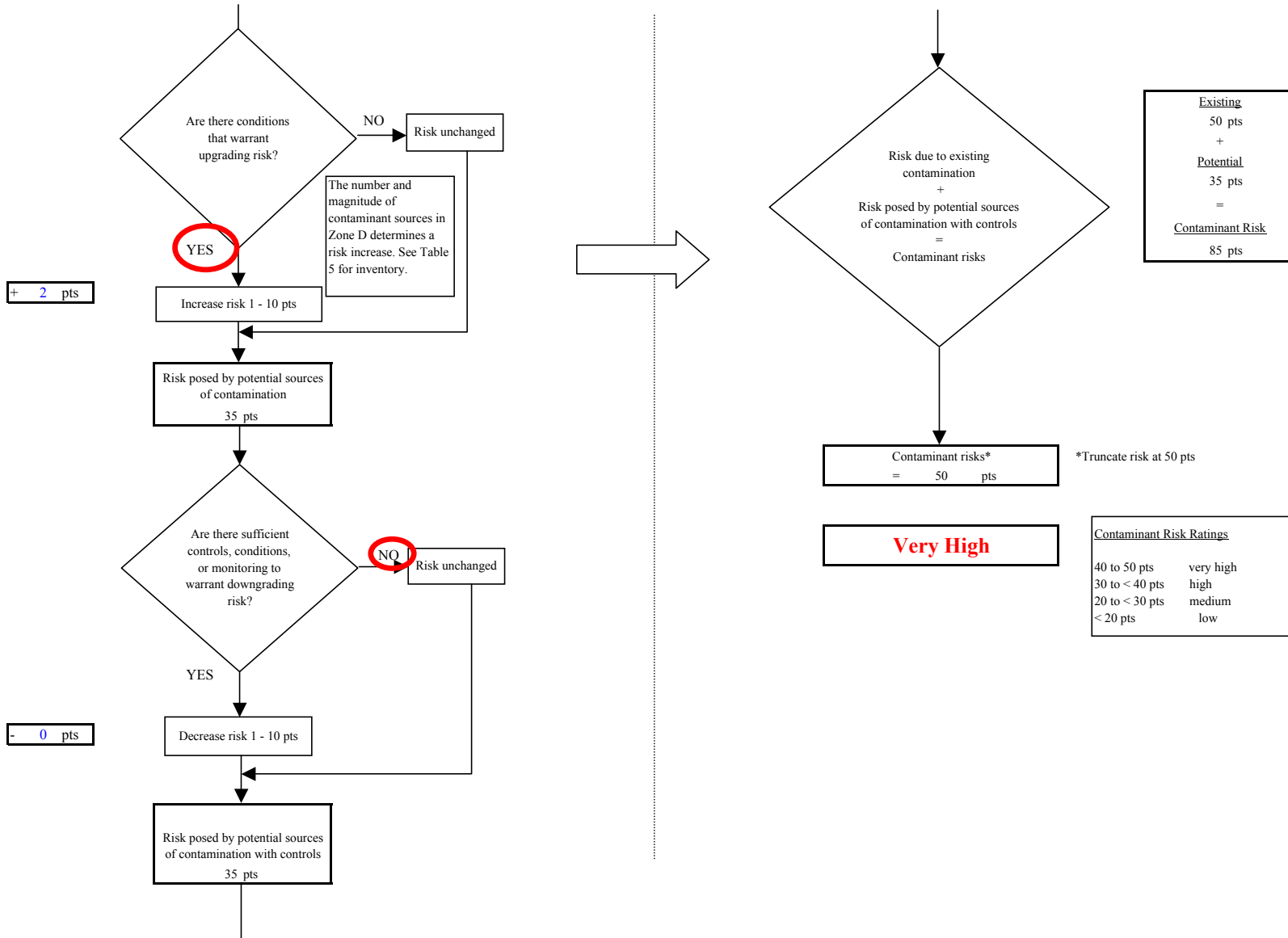


Chart 10. Vulnerability analysis for LKSD Nunivaarmiut School (PWS No.270972.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

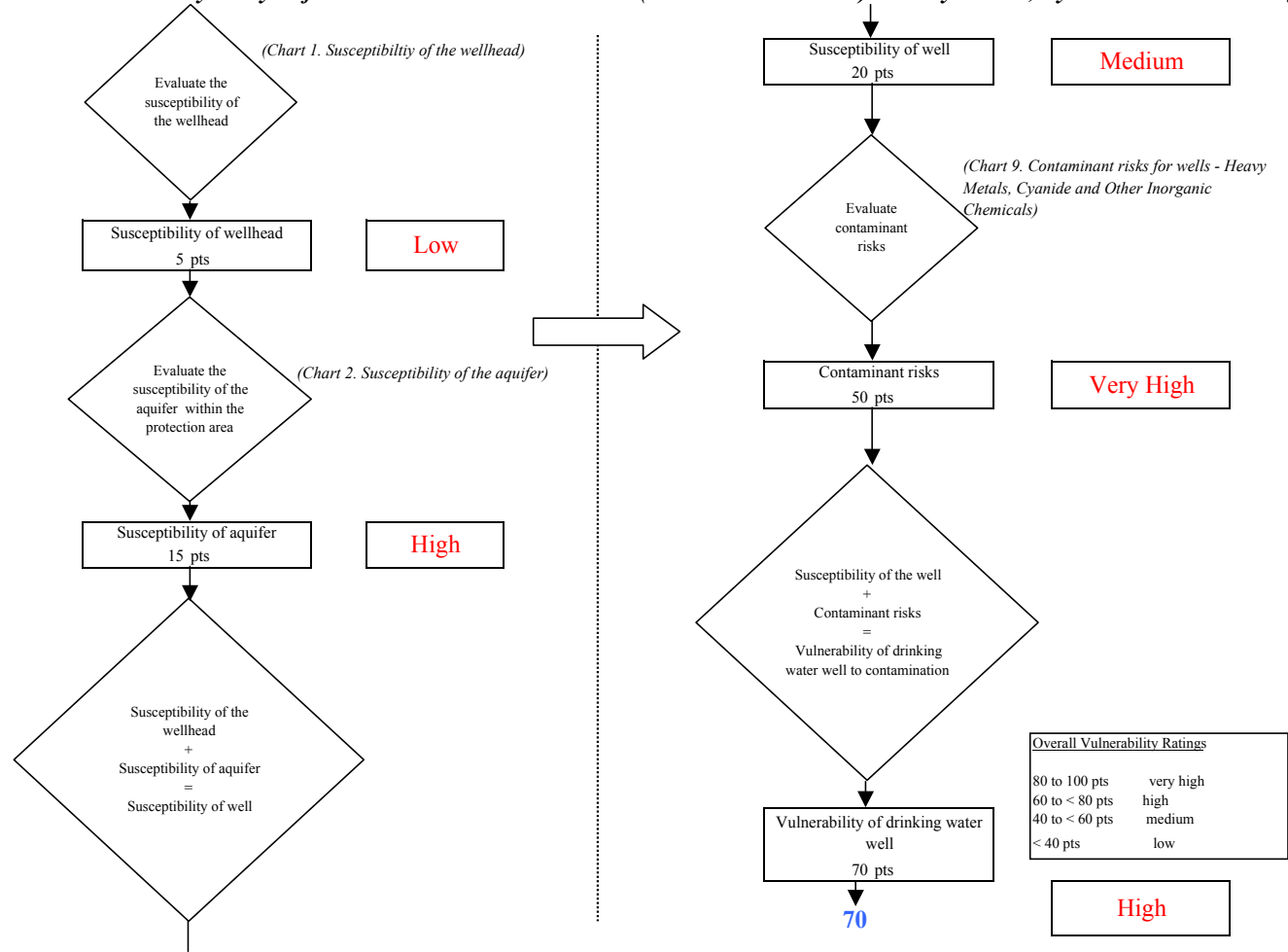


Chart 11. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Synthetic Organic Chemicals

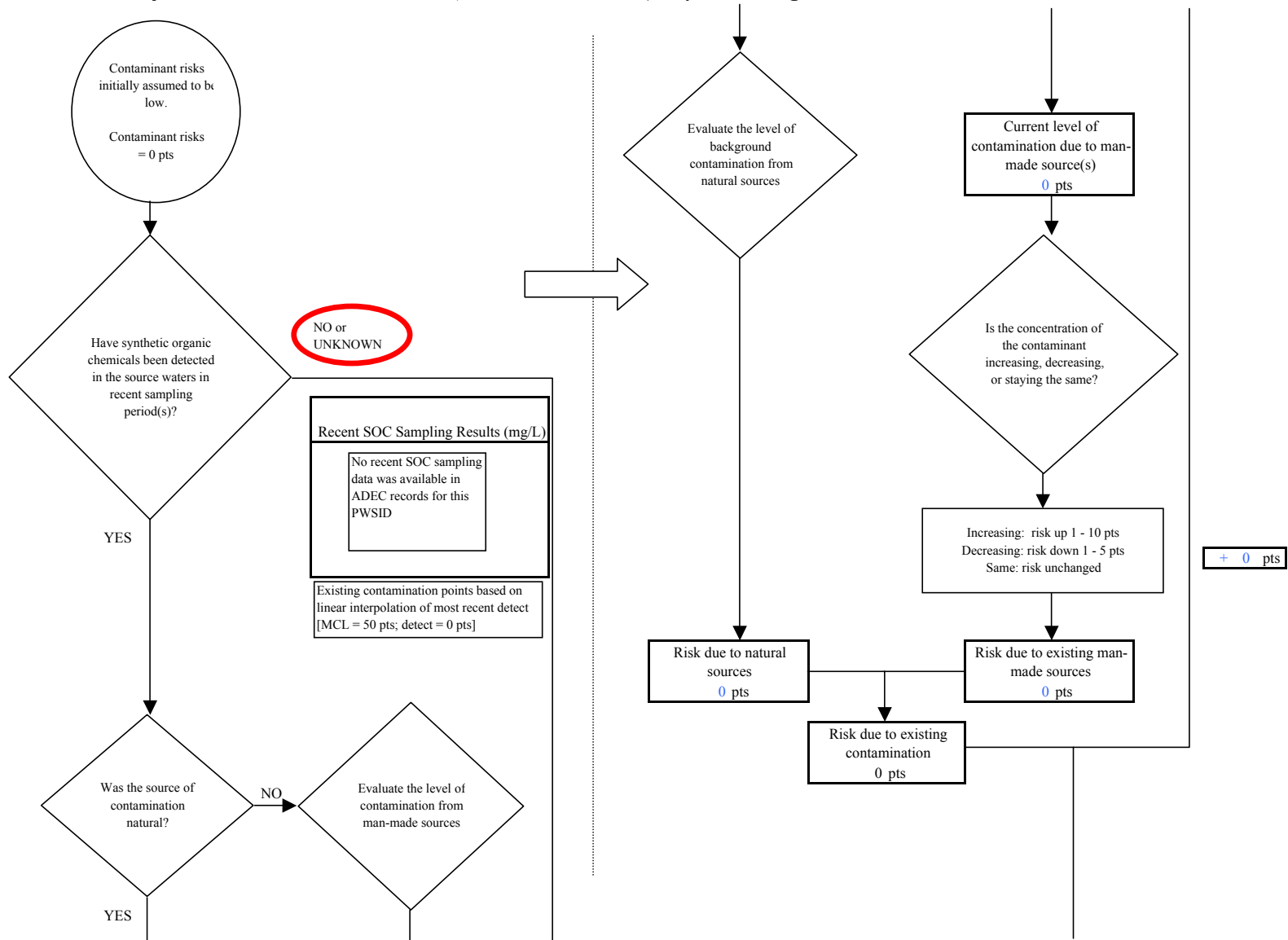


Chart 11. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Synthetic Organic Chemicals

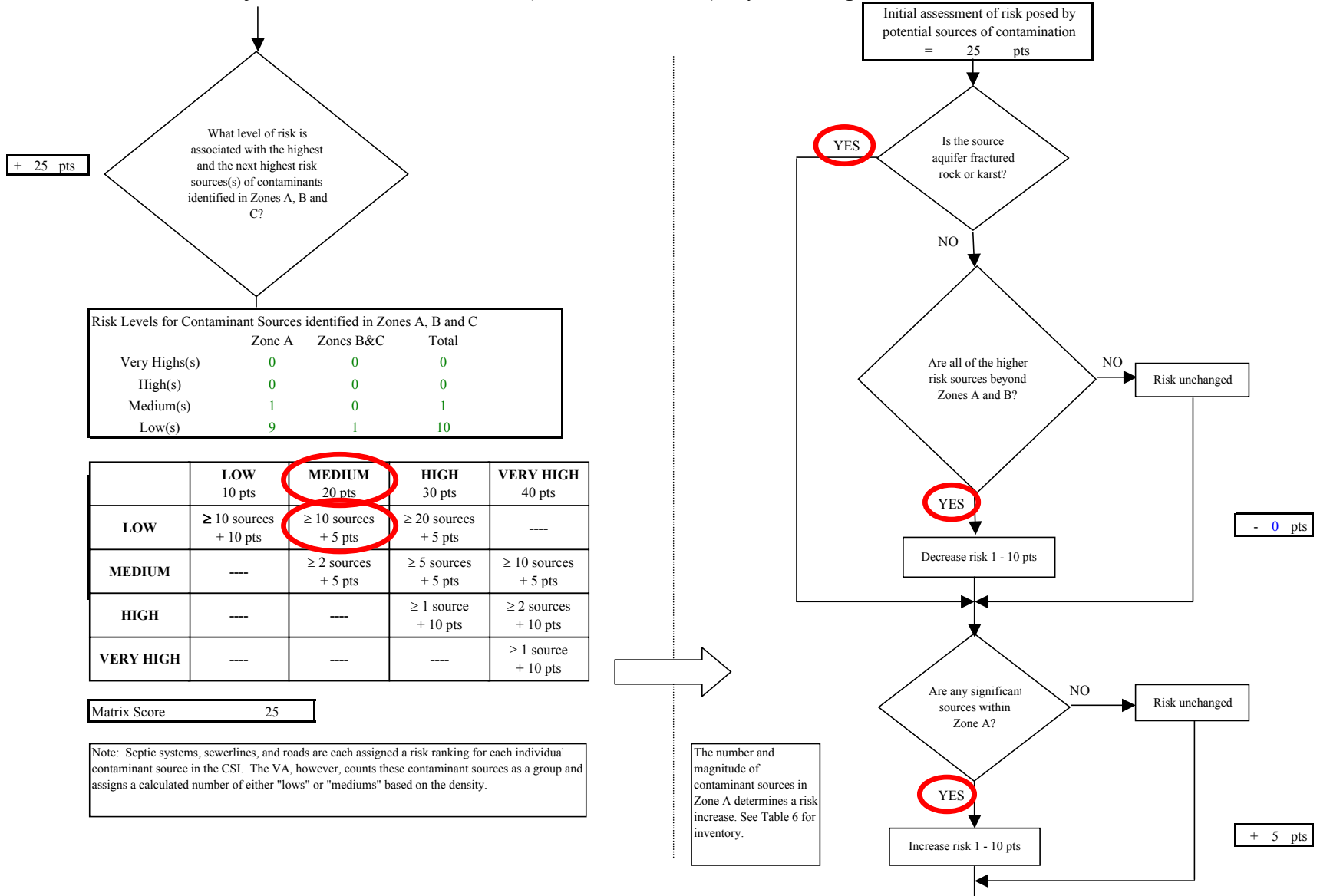


Chart 11. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Synthetic Organic Chemicals

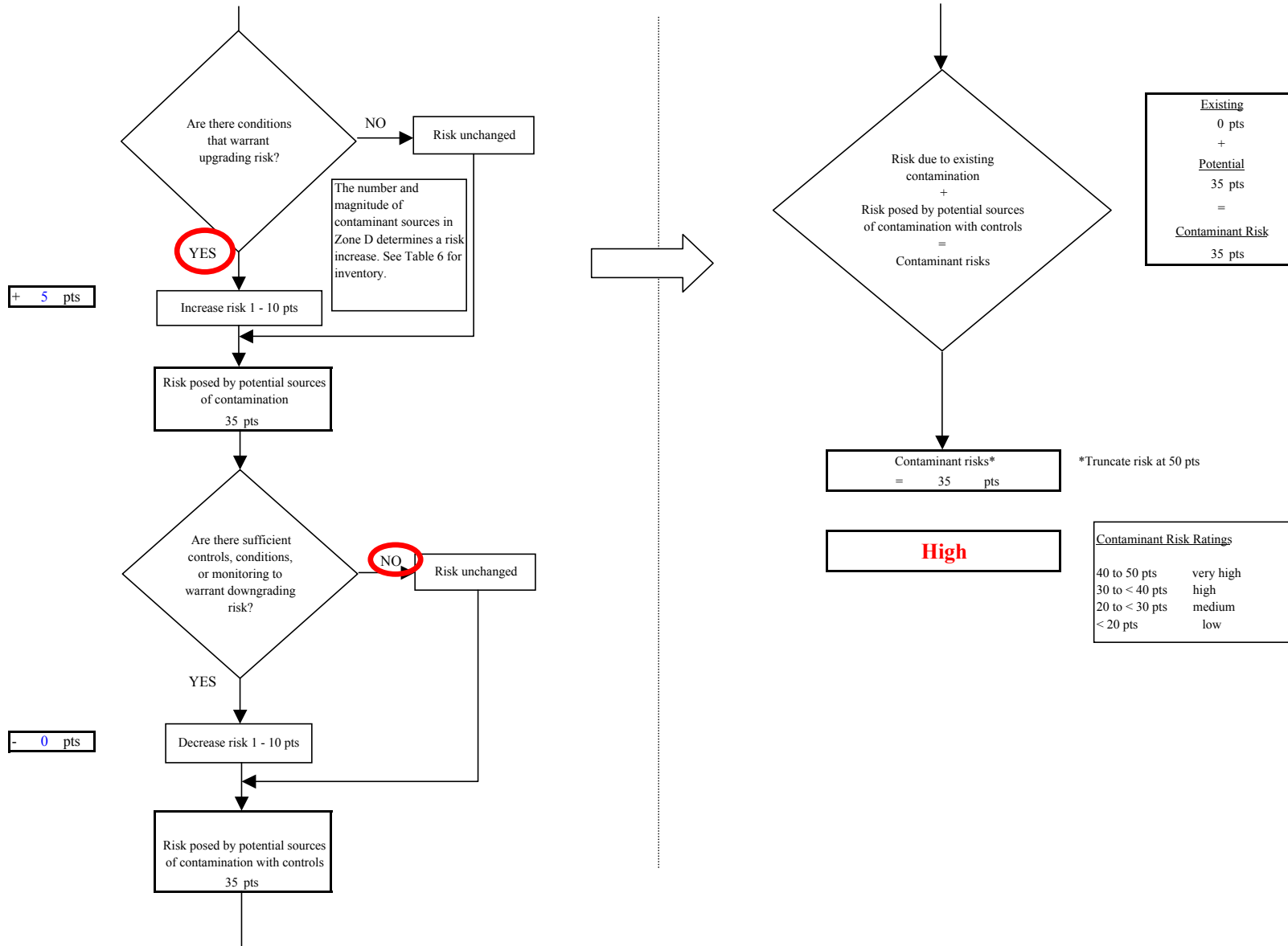


Chart 12. Vulnerability analysis for LKSD Nunivaarmiut School (PWS No.270972.001) - Synthetic Organic Chemicals

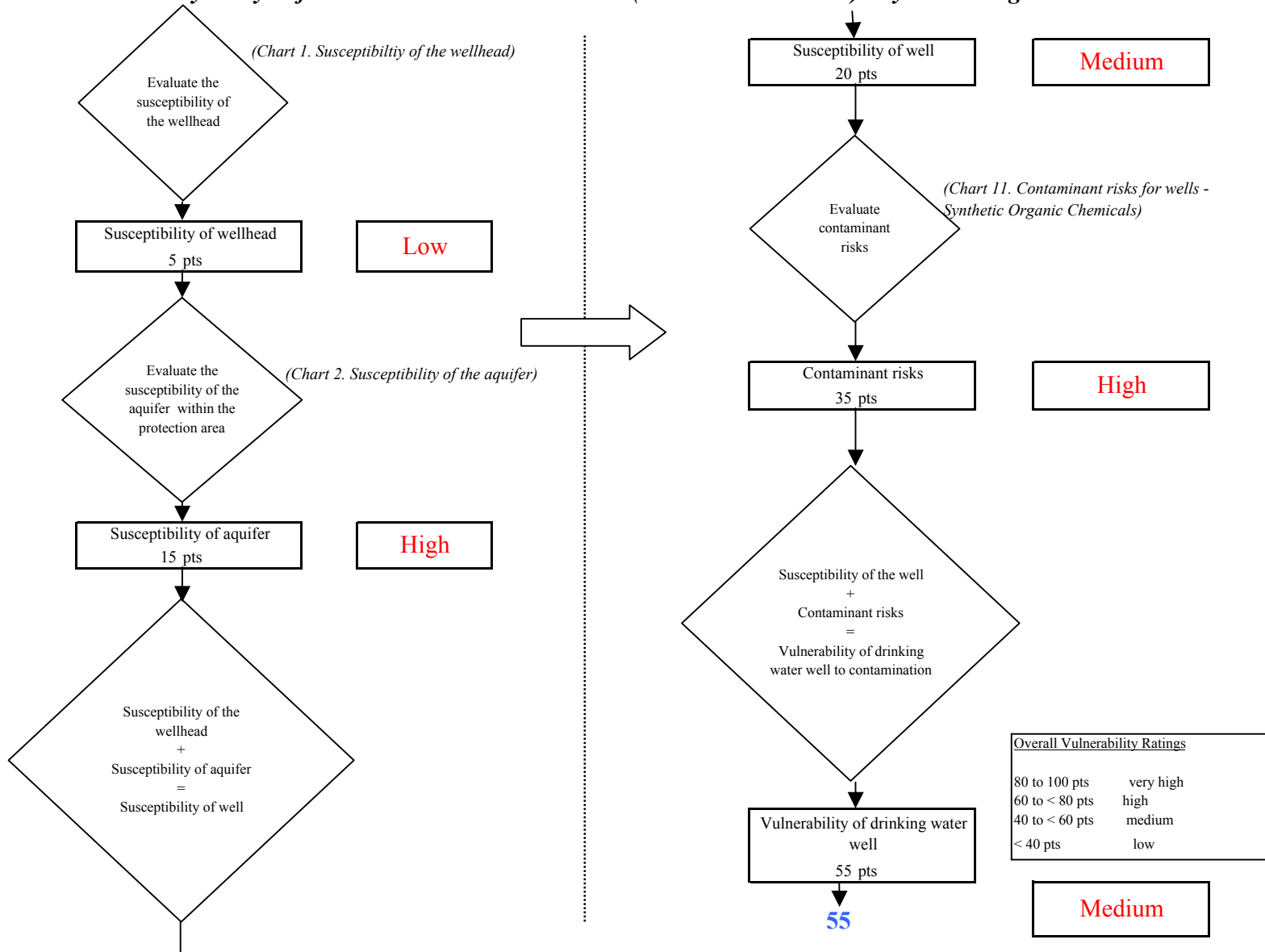


Chart 13. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Other Organic Chemicals

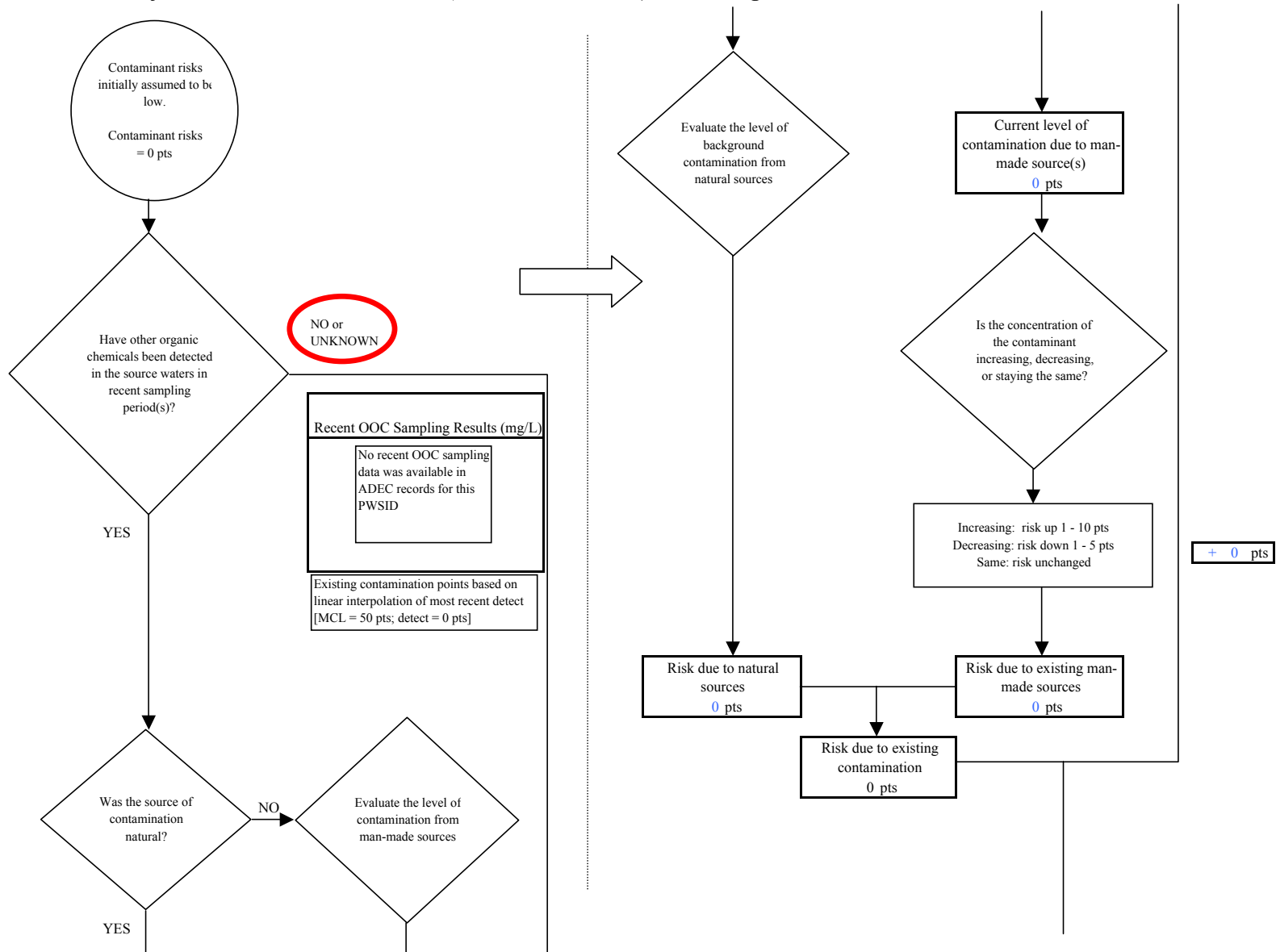


Chart 13. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Other Organic Chemicals

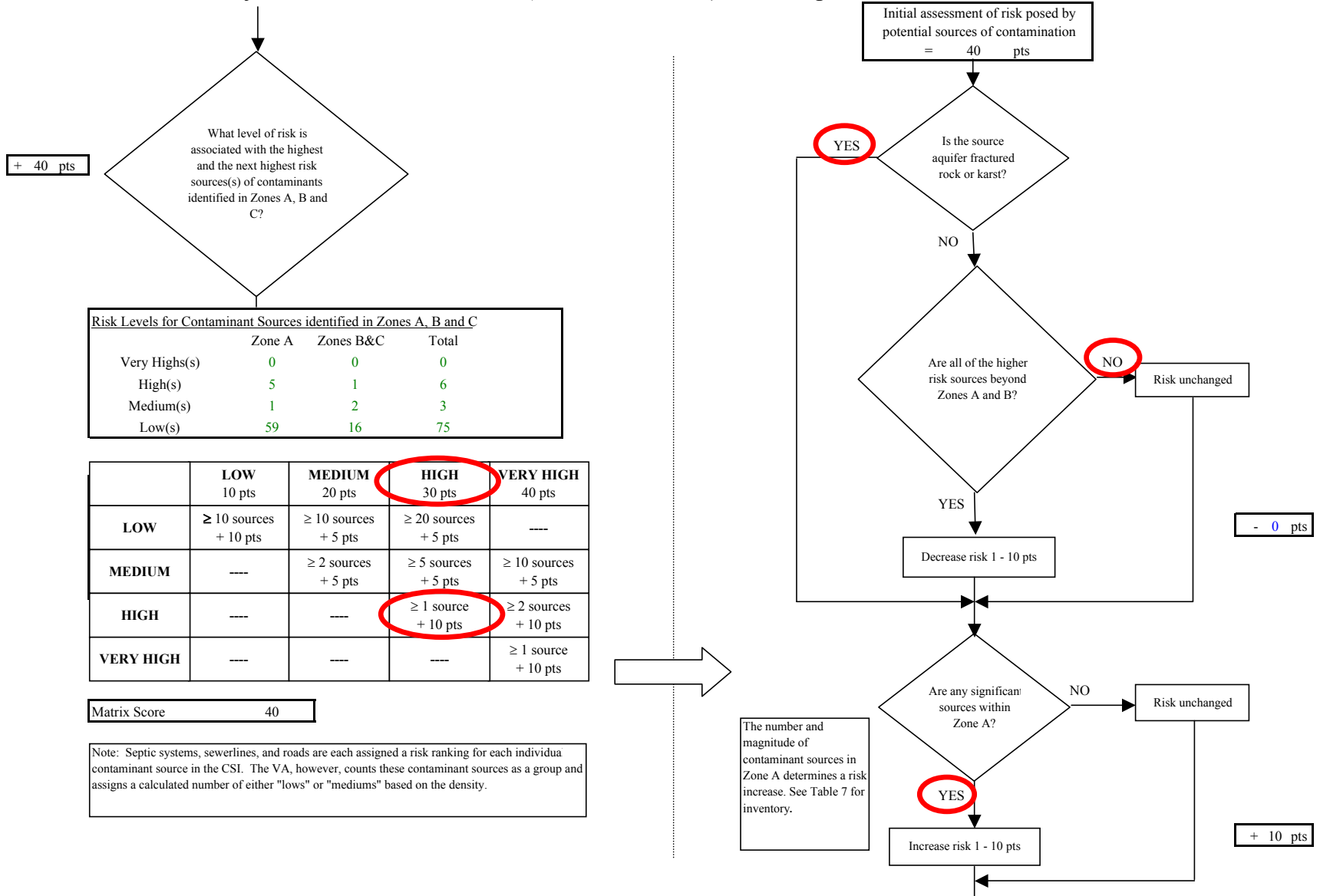


Chart 13. Contaminant risks for LKSD Nunivaarmiut School (PWS No.270972.001) - Other Organic Chemicals

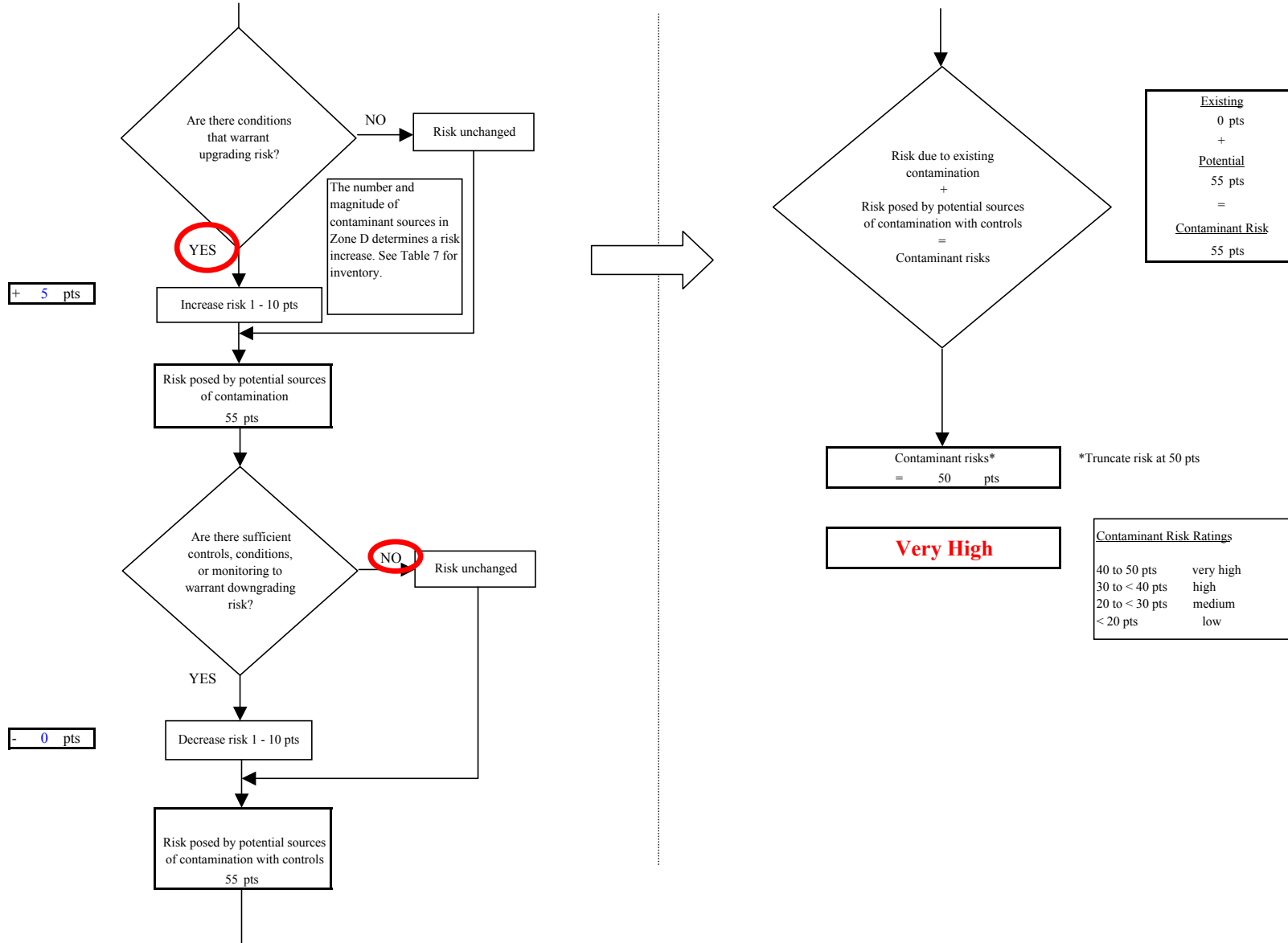


Chart 14. Vulnerability analysis for LKSD Nunivaarmiut School (PWS No.270972.001) - Other Organic Chemicals

