Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for North Pole Christian School Drinking Water System, North Pole, Alaska PWSID 371419

December 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1271
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 North Pole Christian School Source of Public Drinking Water,
North Pole, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the North Pole Christian School to potential contamination. This Class A (community) water system consists of one well on the southeast corner of Newby Road and Silverleaf Avenue in North Pole, Alaska. The well received a natural susceptibility rating of **Medium**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Very High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the North Pole Christian School public water system include: septic systems, residential areas, fuel storage tanks, motor vehicle repair shops and a DEC recognized contaminated site. These 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. Combining the natural susceptibility of the well with the contaminant risk, the public water system for North Pole Christian School received an overall vulnerability rating of **Very High** for bacteria and viruses; a **High** for nitrates and/or nitrites, and volatile organic chemicals, and a **Medium** for heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals and other organic chemicals.

NORTH POLE CHRISTIAN School PUBLIC DRINKING WATER SYSTEM

North Pole Christian School public water system is a Class A (community) water system. The system consists of one well on the southeast corner of Newby Road and Silverleaf Avenue in North Pole, Alaska (T2S, R2E, Section 14) (See Map 1 of Appendix A). North Pole is located southeast of the town of Fairbanks which is located in the Fairbanks North Star Borough near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

North Pole Utilities provides piped water and sewer collection to part of North Pole, other areas use individual wells and septic systems. Electricity for the city is provided by Golden Valley Electric Association. The majority of residents use heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) to heat homes and buildings. Garbage collection services are proved by the city, and refuse is transported to the Fairbanks North Star Borough Class I Landfill on South Cushman Street.

The Fairbanks area includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The North Pole Christian School water system is located in the alluvial plain at an elevation of approximately 530 feet above sea level.

According to the sanitary survey (6/26/03) for this water system, the depth of the well is 40 feet below the ground surface. Most wells in this area are screened in a combination of sand and gravel and it is assumed that this one is also. The alluvial plain consists of alternating layers of silt, sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, T.L. 1958. Geology of the Fairbanks (D-2) Quadrangle, Alaska. USGS). Areas with discontinuous permafrost may locally affect the ground water flow directions.

Primarily the Tanana River, but also the Chena River contribute water to this alluvial aquifer. The Chena River typically only contributes water when its stage is high and the Tanana is low (Nelson, 1978). The Tanana River gets approximately 85% of its water from snowmelt of the Alaska Range and 15% from the Yukon-Tanana uplands (Anderson, 1970).

This system serves approximately 90 non-residents through one service connection.

NORTH POLE CHRISTIAN School DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. 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 capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different ways of calculating the size of capture zones. This assessment uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated in this assessment is only a best guess using the information and resources available to us, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture zone are general for the whole alluvial plain and were obtained from various United State Geological Survey (USGS) reports, well logs in the area, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

The water table in the area of the North Pole Christian School, the area between the Tanana and the Chena Rivers, is primarily influenced by the level of water flow in each river. The capture zones were drawn based on three separate configurations of the water table during various stages of the rivers: a period of high stage in the Chena River (October 14-17, 1986), high stage in the Tanana River (July 16-17, 1987), and low stages in both rivers (March 30-April 3, 1988) (Glass and others, 1996). High water levels in the Chena usually occur in the spring due to runoff from the uplands and in late summer due to rainstorms (Nelson, 1978). The Tanana usually experiences high flow during the hot, dry periods of mid-summer when maximum snowmelt from the Alaska Range occurs (Nelson, 1978). Groundwater in this area generally flows toward the northwest, from the Tanana River to the Chena River, however flow is reversed very near the Chena River during its high stage periods (Glass and others, 1996). These flow reversals are of short duration (i.e. days versus months) and of limited extent, generally within 1000 feet of the river (Nakanishi, et all, 1998).

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into four zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the four 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 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the North Pole Christian School on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program (DWPP) has completed an inventory of potential and existing sources of contamination within the North Pole Christian School protection area. This inventory was completed through a search of agency records and other publicly available information. 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; and
- Other inorganic chemicals.

The sources are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are each 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 combination of toxicity and volume associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

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 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to the six contaminant categories.

VULNERABILITY OF NORTH POLE CHRISTIAN School 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 properties of the aquifer and the presence of other wells or boreholes in the area. 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 the water system's contaminant sample results. Lastly, Chart 4 combines the results of the first three charts to produce 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 wellhead for the North Pole Christian School received a Low Susceptibility rating. The 9/11/00 Sanitary Survey indicates the well is capped with a sanitary seal, the land surface is sloped away from the well; however the well is not grouted. A sanitary seal prevents potential contaminants from entering the well from the inside while sloping the land surface away from the well and grouting help to prevent potential contaminants from traveling down the outside of the well casing.

The aquifer in the area the North Pole Christian School well is completed in received a Very High Susceptibility rating. The highly transmissive aquifer material (sand and gravel) in the area allows contaminants to travel downward from the surface with the precipitation and surface water runoff. The shallow water table allows potential contaminants to come into contact with the water table with little natural filtering where they can disperse quickly. Additionally, wells in the area can provide a quick pathway for contaminants to reach the aquifer. Table 2 summarizes the Susceptibility scores and ratings for North Pole Christian School.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	High

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. 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	37	High
Volatile Organic Chemicals	32	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	20	Medium
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	20	Medium

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

Natural Susceptibility (0 – 50 points)
+
Contaminant Risks (0 – 50 points)
=
Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the 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	80	Very High
Nitrates and/or Nitrites	65	High
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	40	Medium
Other Organic Chemicals	50	Medium

Bacteria and Viruses

The large capacity and residential septic systems in Zone A represents the greatest risk of Bacteria and Viruses to this water system.

A Large Capacity Septic System (Class V Injection well) differs from a residential septic system when it receives sanitary waste from multiple family residences or a non-residential establishment and has the capacity to serve 20 or more persons per day.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coli forms and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Routine sampling detected total coli forms once (detected on 1/15/01 and verified on 1/18/01) within the past 5 years. Fecal coliforms and E. Coli have not been detected.

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 septic systems in Zone A also represent the greatest risk to to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have not been detected in sampling history for the North Pole Christian School well.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Volatile Organic Chemicals

The heating oil tanks represent the greatest risk for volatile organic chemical contamination to the well.

Both underground and above ground heating oil storage tanks are the standard way of heating homes and businesses in the area surrounding Fairbanks. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Regular system maintenance can help prevent many of these harmful fuel leaks.

There is also a DEC-recognized contaminated site (RecKey 1992310907001) located within Zone B of the protection area. Fuel contaminated was discovered beneath a floor drain. Contaminated soils were excavated and the site was closed on 11/20/94.

Ethylbenzene and Styrene have been detected during sampling for Volatile Organic Chemicals, but only in extremely small concentrations with respect to their Maximum Contaminant Levels (MCLs). MCLs are the maximum concentration of a contaminant allowed in drinking water by the Environmental Protection Agency (EPA). Other Volatile Organic Chemicals have not been detected during routine sampling of this water system. 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 motor vehicle repair shops represent the greatest risk to to heavy metals for this source of public drinking water.

Heavy metals were not detected in significant concentration (Fluoride have been detected in small concentrations) during recent sampling.

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 medium.

Synthetic Organic Chemicals

The residential septic systems represent the greatest risk to to synthetic organic chemicals for this source of public drinking water.

Synthetic Organic Chemicals have not been sampled for in this water system.

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 motor vehicle repair shops also represent the greatest risk to to other organic chemicals for this source of public drinking water.

Other Organic Chemicals have not been sampled for in this water system.

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 medium.

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APPENDIX A

North Pole Christian School
Drinking Water Protection Area Location Map
(Map 1)

North Pole

DAWSON ROAD

NEWBY ROAD

NELSON ROAD

LYLE AVENUE

NEW RICHARDSON HIGHWAY

SILVERLEAF AVENUE

SEAVALDRIVE

Zone A

Zone B

LAURENCE ROAD

OLD RICHARDSON HIGHWAY

Zone C

Zone D

EIELSON FARM ROAD

Moose Creek

Map 1: North Pole Christian School Drinking Water Protection Area

PWSID: 371419

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 2,350 4,700 Feet

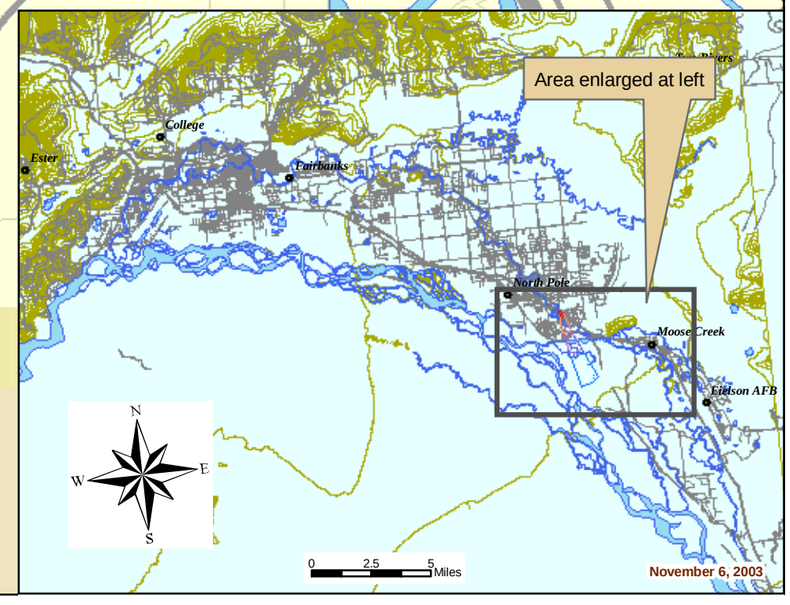
1:32,083

Data Sources:

Parcel, roads - Fairbanks North Star Borough
Water bodies, railroad - Geographic Data Technology
Elevation contours - USGS digital elevation models (DEMs)

Legend

- Zone A *Several months travel time*
- Zone B *Less than 2 years travel time*
- Zone C *Less than 5 years travel time*
- Zone D *Less than 10 years travel time*
- Towns
- Roads
- Surface water
- Parcels
- Railroad



North Pole

DAWSON ROAD

NEWBY ROAD

NELSON ROAD

LYLE AVENUE

NEW RICHARDSON HIGHWAY

SILVERLEAF AVENUE

SEAVALDRIVE

Zone A

Zone B

LAURENCE ROAD

OLD RICHARDSON HIGHWAY

Zone C

Zone D

EIELSON FARM ROAD

Moose Creek

Map 1: North Pole Christian School Drinking Water Protection Area

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0 2,350 4,700 Feet

1:32,083

Data Sources:

Parcel, roads - Fairbanks North Star Borough
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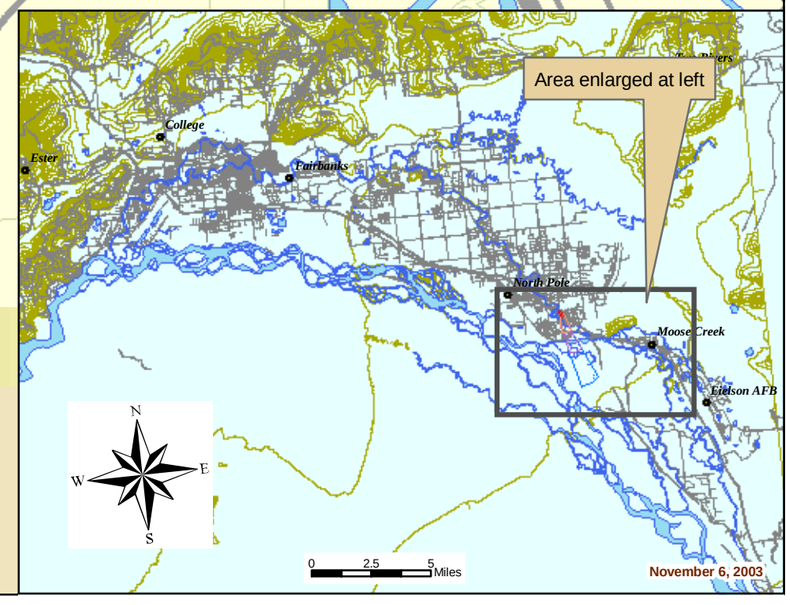
Legend

- Zone A *Several months travel time*
- Zone B *Less than 2 years travel time*
- Zone C *Less than 5 years travel time*
- Zone D *Less than 10 years travel time*
- Towns
- Roads
- Surface water
- Parcels
- Railroad



APPENDIX B

Contaminant Source Inventory and Risk Ranking for North Pole Christian School (Tables 1-7)

Table 1

Contaminant Source Inventory for ***North Pole Christian School***

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	3467 Silverleaf Avenue
Residential Areas	R01		A	2	Estimated 10 acres of residential area
Septic systems (serves one single-family home)	R02		A	2	Assumed 6 septics based on number of parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		A	2	Assumed 7 tanks based on number of parcels designated as residential
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	2	3467 Silverleaf Avenue
Motor /motor vehicle repair shops	C31	C31-1	B	2	2950 Newby Road
Residential Areas	R01		B	2	Estimated 75 acres of residential area
Septic systems (serves one single-family home)	R02		B	2	Assumed 28 septics based on number of parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		B	2	Assumed 28 tanks based on number of parcels designated as residential
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	B	2	2944 Richardson Hwy; Million Subdivision, Lot 4; RecKey 1992310907001
Motor /motor vehicle repair shops	C31	C31-2	C	2	3198 Monkshood Lane
Residential Areas	R01		C	2	Estimated 50 acres of residential area
Septic systems (serves one single-family home)	R02		C	2	Assumed 30 septics based on number of parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		C	2	Assumed 30 tanks based on number of parcels designated as residential

Table 2

Contaminant Source Inventory and Risk Ranking for North Pole Christian School Sources of Bacteria and Viruses

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 6 septics based on number of parcels designated as residential
Residential Areas	R01		A	Low	2	Estimated 10 acres of residential area
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	3467 Silverleaf Avenue
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 28 septics based on number of parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 75 acres of residential area
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 30 septics based on number of parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 50 acres of residential area

Table 3

Contaminant Source Inventory and Risk Ranking for North Pole Christian School Sources of Nitrates/Nitrites

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 10 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 6 septics based on number of parcels designated as residential
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	3467 Silverleaf Avenue
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 28 septics based on number of parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 75 acres of residential area
Residential Areas	R01		C	Low	2	Estimated 50 acres of residential area
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 30 septics based on number of parcels designated as residential

Table 4

Contaminant Source Inventory and Risk Ranking for North Pole Christian School Sources of Volatile Organic Chemicals

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Tanks, heating oil, residential (above ground)	R08		A	Medium	2	Assumed 7 tanks based on number of parcels designated as residential
Residential Areas	R01		A	Low	2	Estimated 10 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 6 septics based on number of parcels designated as residential
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	3467 Silverleaf Avenue
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	Low	2	3467 Silverleaf Avenue
Tanks, heating oil, residential (above ground)	R08		B	Medium	2	Assumed 28 tanks based on number of parcels designated as residential
Residential Areas	R01		B	Low	2	Estimated 75 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 28 septics based on number of parcels designated as residential
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	2950 Newby Road
Tanks, heating oil, residential (above ground)	R08		C	Medium	2	Assumed 30 tanks based on number of parcels designated as residential
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 30 septics based on number of parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 50 acres of residential area
Motor /motor vehicle repair shops	C31	C31-2	C	Medium	2	3198 Monkshood Lane

Table 5

Contaminant Source Inventory and Risk Ranking for North Pole Christian School

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 10 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 6 septics based on number of parcels designated as residential
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	3467 Silverleaf Avenue
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	Low	2	3467 Silverleaf Avenue
Residential Areas	R01		B	Low	2	Estimated 75 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 28 septics based on number of parcels designated as residential
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	2950 Newby Road
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 30 septics based on number of parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 50 acres of residential area
Motor /motor vehicle repair shops	C31	C31-2	C	Medium	2	3198 Monkshood Lane

Table 6

Contaminant Source Inventory and Risk Ranking for North Pole Christian School Sources of Synthetic Organic Chemicals

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 6 septics based on number of parcels designated as residential
Residential Areas	R01		A	Low	2	Estimated 10 acres of residential area
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	3467 Silverleaf Avenue
Residential Areas	R01		B	Low	2	Estimated 75 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 28 septics based on number of parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 50 acres of residential area
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 30 septics based on number of parcels designated as residential

Table 7

Contaminant Source Inventory and Risk Ranking for North Pole Christian School Sources of Other Organic Chemicals

PWSID 371419.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01		A	Low	2	Estimated 10 acres of residential area
Septic systems (serves one single-family home)	R02		A	Low	2	Assumed 6 septics based on number of parcels designated as residential
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	3467 Silverleaf Avenue
Residential Areas	R01		B	Low	2	Estimated 75 acres of residential area
Septic systems (serves one single-family home)	R02		B	Low	2	Assumed 28 septics based on number of parcels designated as residential
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	2950 Newby Road
Septic systems (serves one single-family home)	R02		C	Low	2	Assumed 30 septics based on number of parcels designated as residential
Residential Areas	R01		C	Low	2	Estimated 50 acres of residential area
Motor /motor vehicle repair shops	C31	C31-2	C	Medium	2	3198 Monkshood Lane

APPENDIX C

North Pole Christian School
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

North Pole Christian School well
T16-1
D10-1
U04-1
C31-1
C31-2
Zone A
Zone B
Zone C
SILVERLEAF AVENUE
BIATHALON AVENUE
MARATHON WAY
IRENE MAE STREET
CHRISTIE DRIVE
FROSTY AVENUE
SEAVY DRIVE
CECILE STREET
NELSON ROAD
MANDEVILLE LOOP
ANTON AVENUE
NEWBY ROAD
LAURENCE ROAD
DAWSON ROAD
JOAN AVENUE
MIKE LANE
NEW RICHARDSON HIGHWAY
AMANDA LOOP
ALPINE COURT
HOOVER ROAD
BENTWOOD AVENUE
PROBERT DRIVE
DYKE ROAD
GREENBRIER WAY
MELLOW WOODS DRIVE
TOBACCO ROAD
FOGARTY COURT
ERIN DRIVE
ALASKA RAILROAD
TIMBERBROOK DRIVE
TREATY STREET
ELDERBERRY LANE
FERNWOOD AVENUE
MELLOW WOODS DRIVE
FARRIOR DRIVE
ROSEHIP DRIVE
MOOSEWOOD LANE

Map 2: North Pole Christian School Potential Contaminant Sources

PWSID: 371419

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 400 800 1,600 Feet

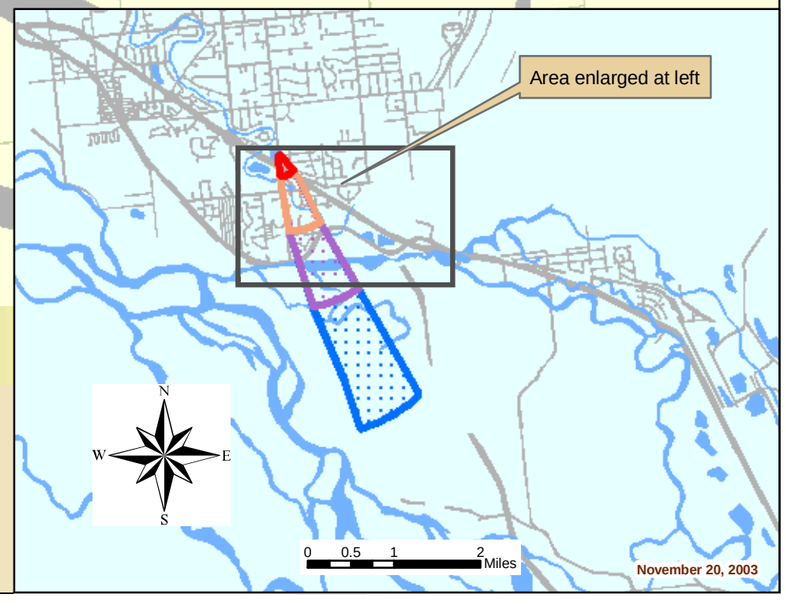
1:9,676

Data Sources:

Parcels, roads - Fairbanks North Star Borough
Water bodies, railroad - Geographic Data Technology
Elevation contours - USGS DEMs

Legend

- C31, Motor vehicle repair shops
- D10, Large capacity septic system
- T16, Heating oil tanks (underground)
- U04, DEC-recognized contaminated sites
- R01, Residential area
- R08, Residential heating oil tanks
- R02, Residential septic systems
- Roads
- Parcels



APPENDIX D

Vulnerability Analysis for North Pole Christian School Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - North Pole Christian School

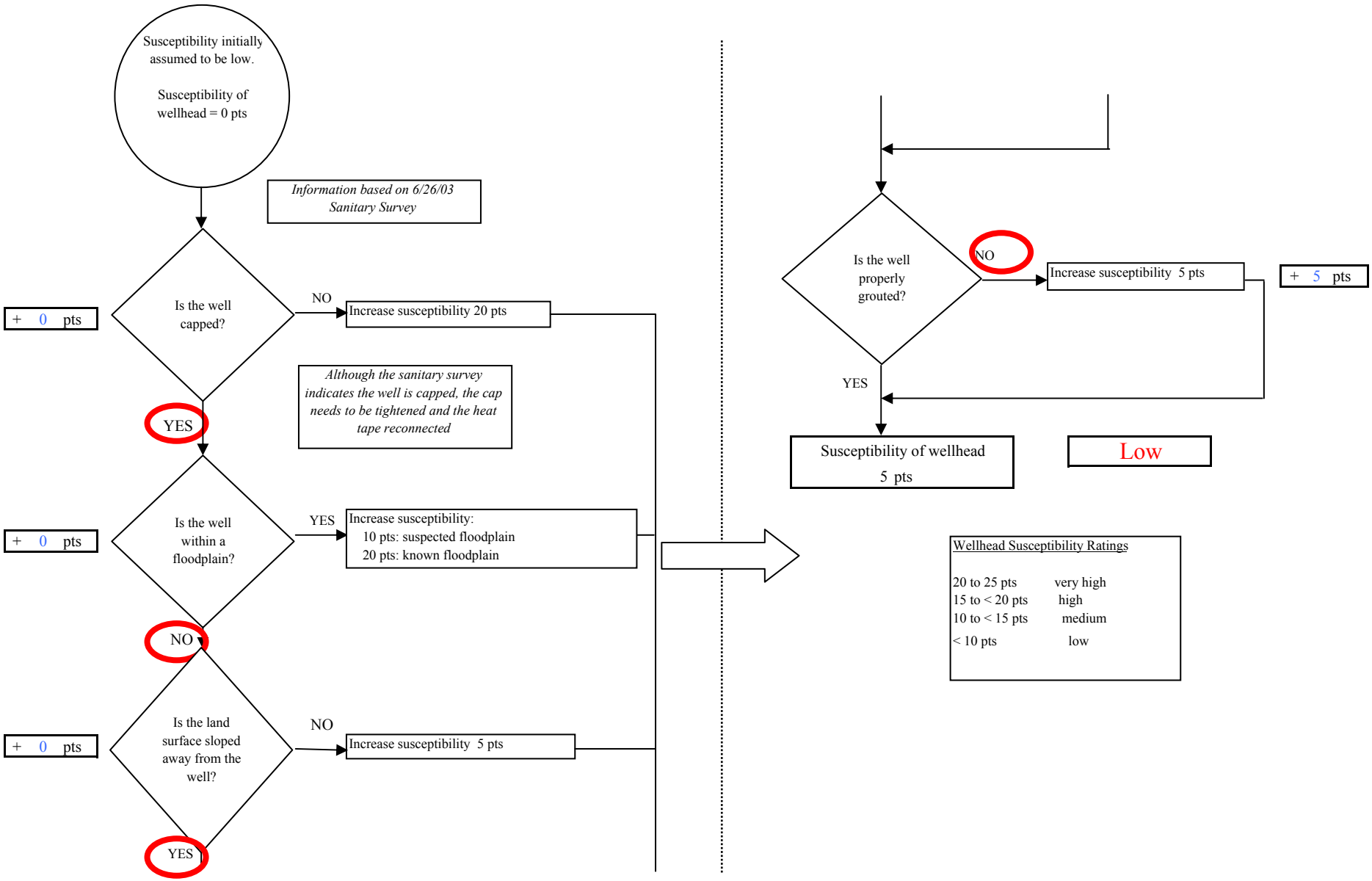


Chart 2. Susceptibility of the aquifer - North Pole Christian School

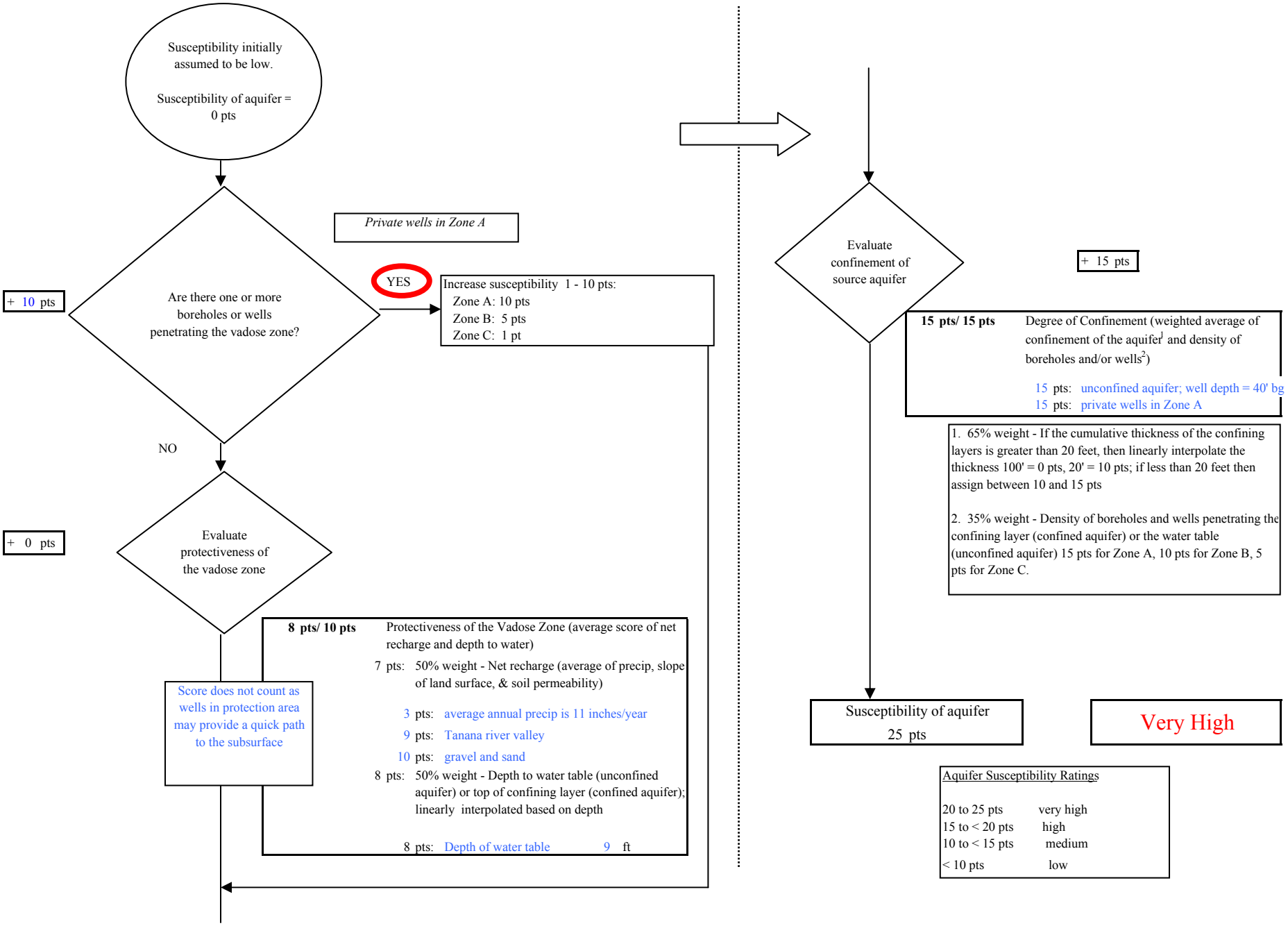
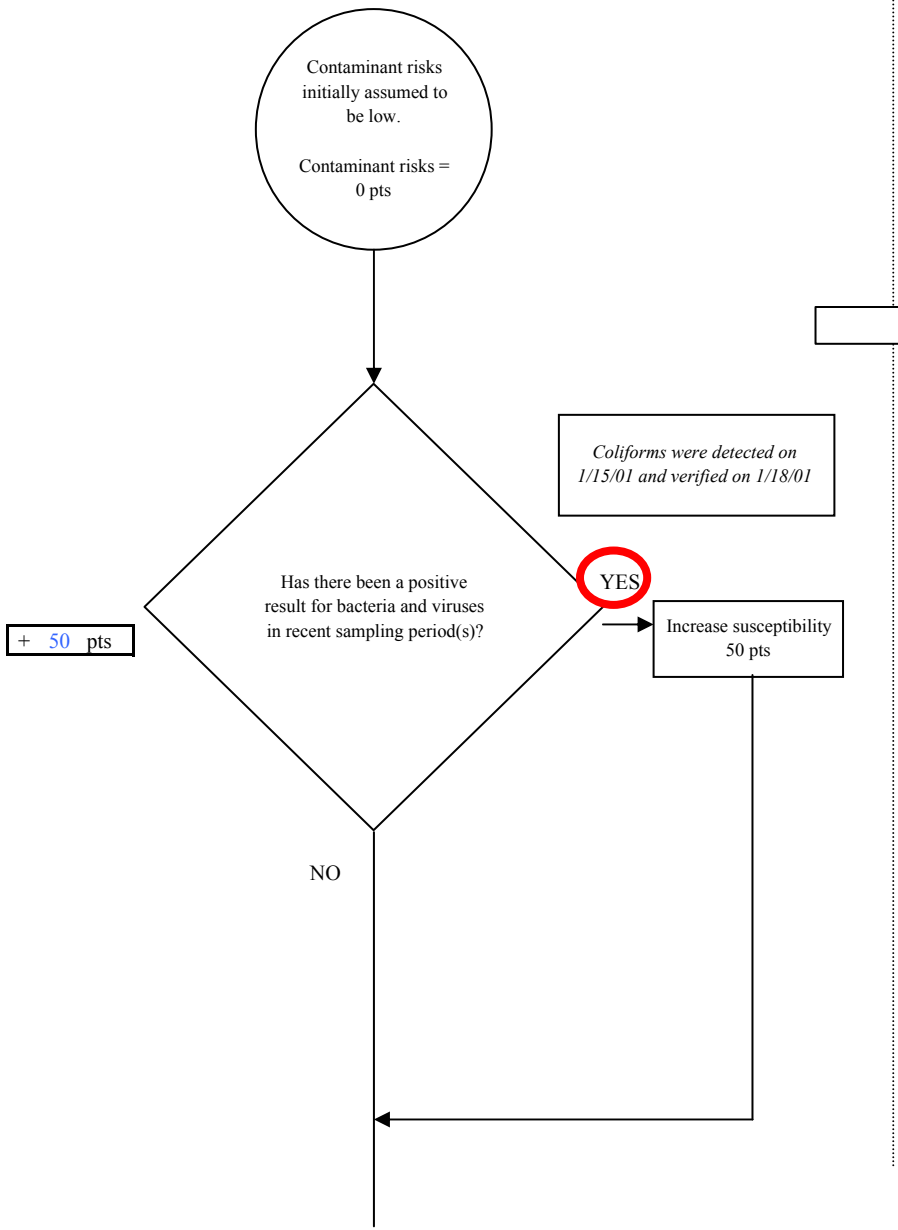
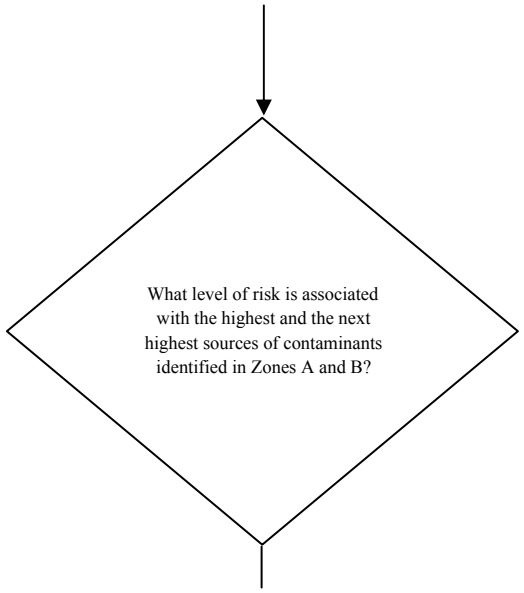


Chart 3. Contaminant risks for North Pole Christian School - Bacteria & Viruses





+ 30 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	7	4	11

	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 3. Contaminant risks for North Pole Christian School - Bacteria & Viruses

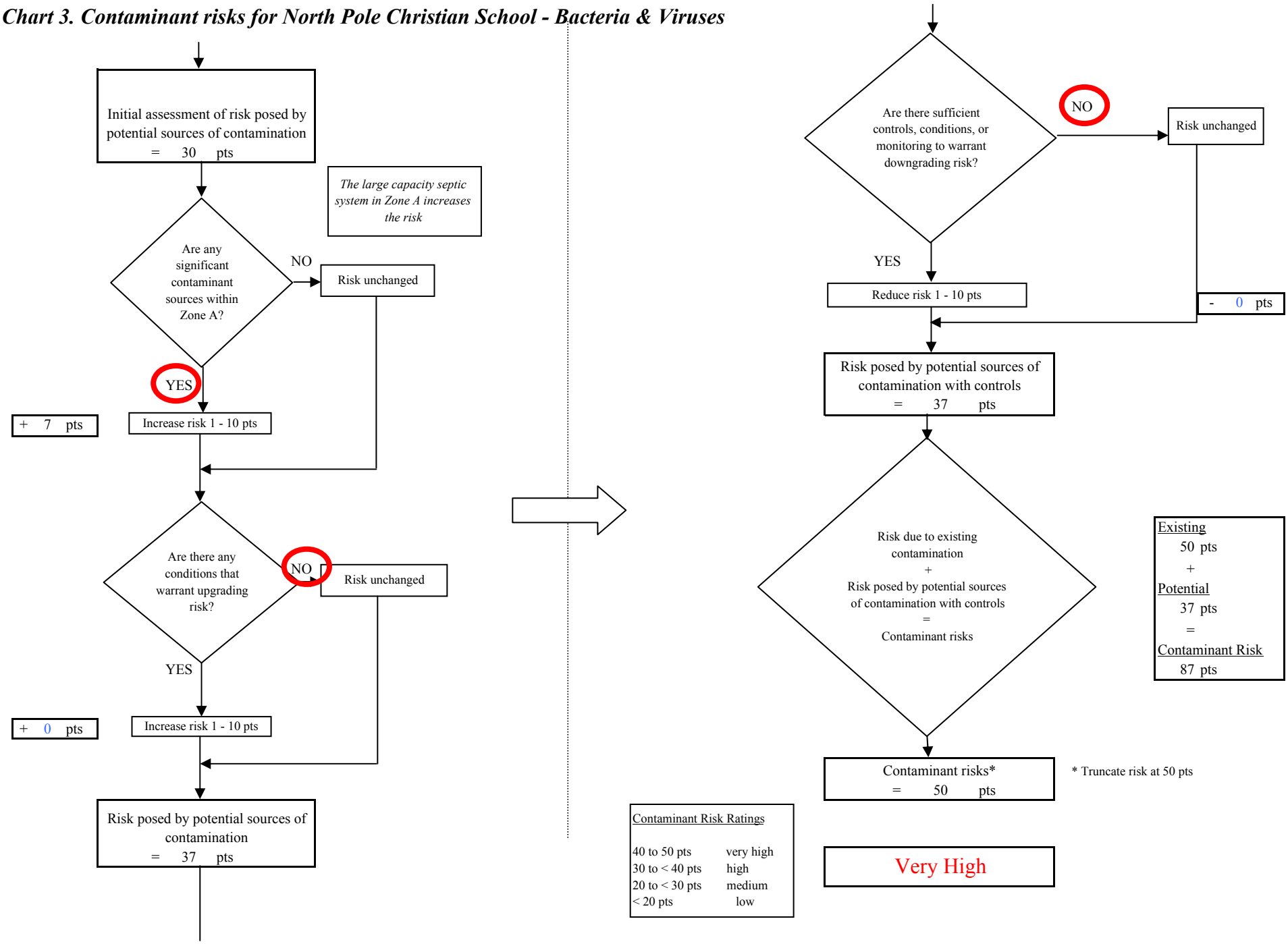


Chart 4. Vulnerability analysis for North Pole Christian School - Bacteria & Viruses

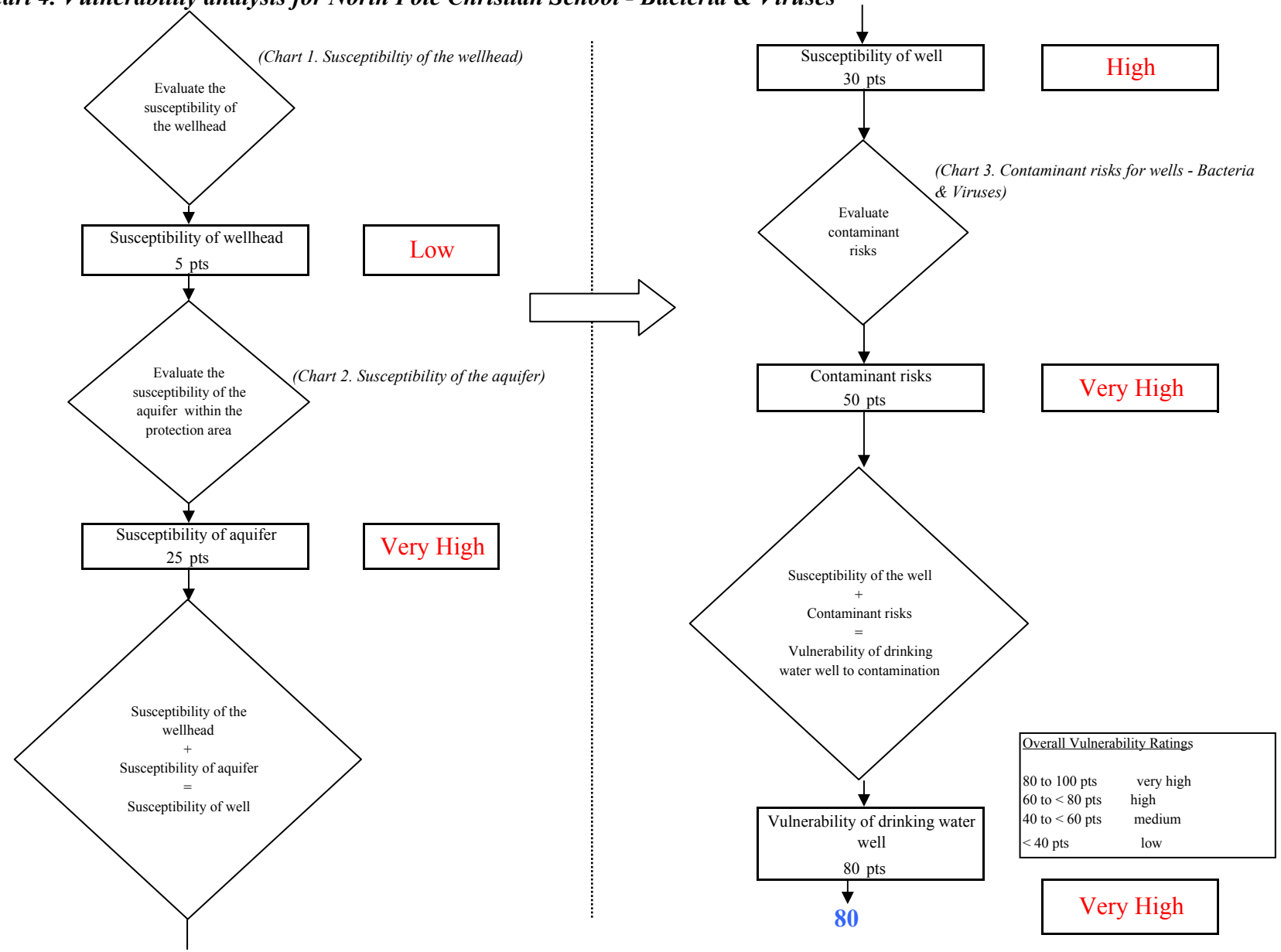


Chart 5. Contaminant risks for North Pole Christian School - Nitrates and Nitrites

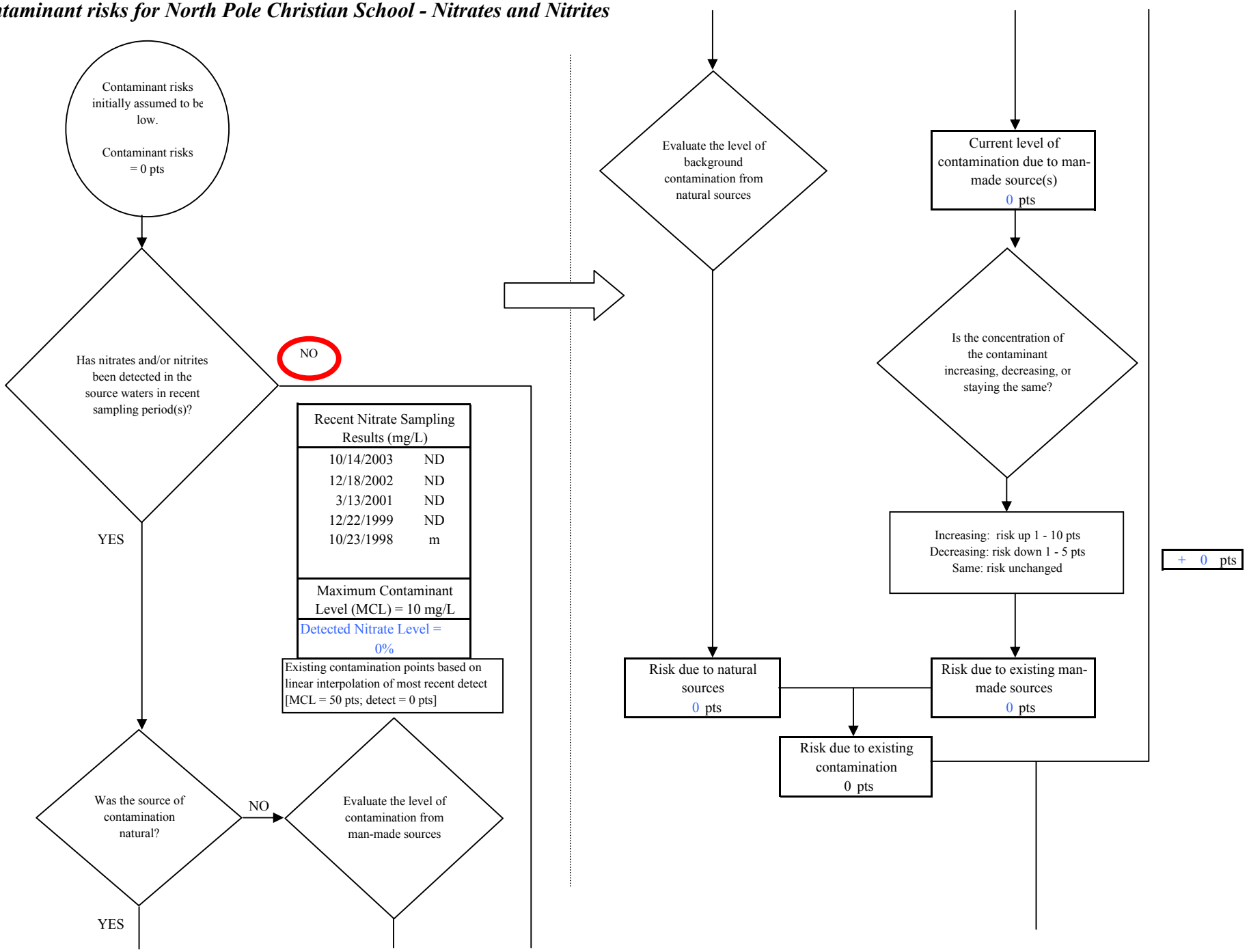


Chart 5. Contaminant risks for North Pole Christian School - Nitrates and Nitrites

+ 30 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	7	8	15

	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.

Initial assessment of risk posed by potential sources of contamination = 30 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 7 pts

The large capacity septic system in Zone A increases the risk

Chart 5. Contaminant risks for North Pole Christian School - Nitrates and Nitrites

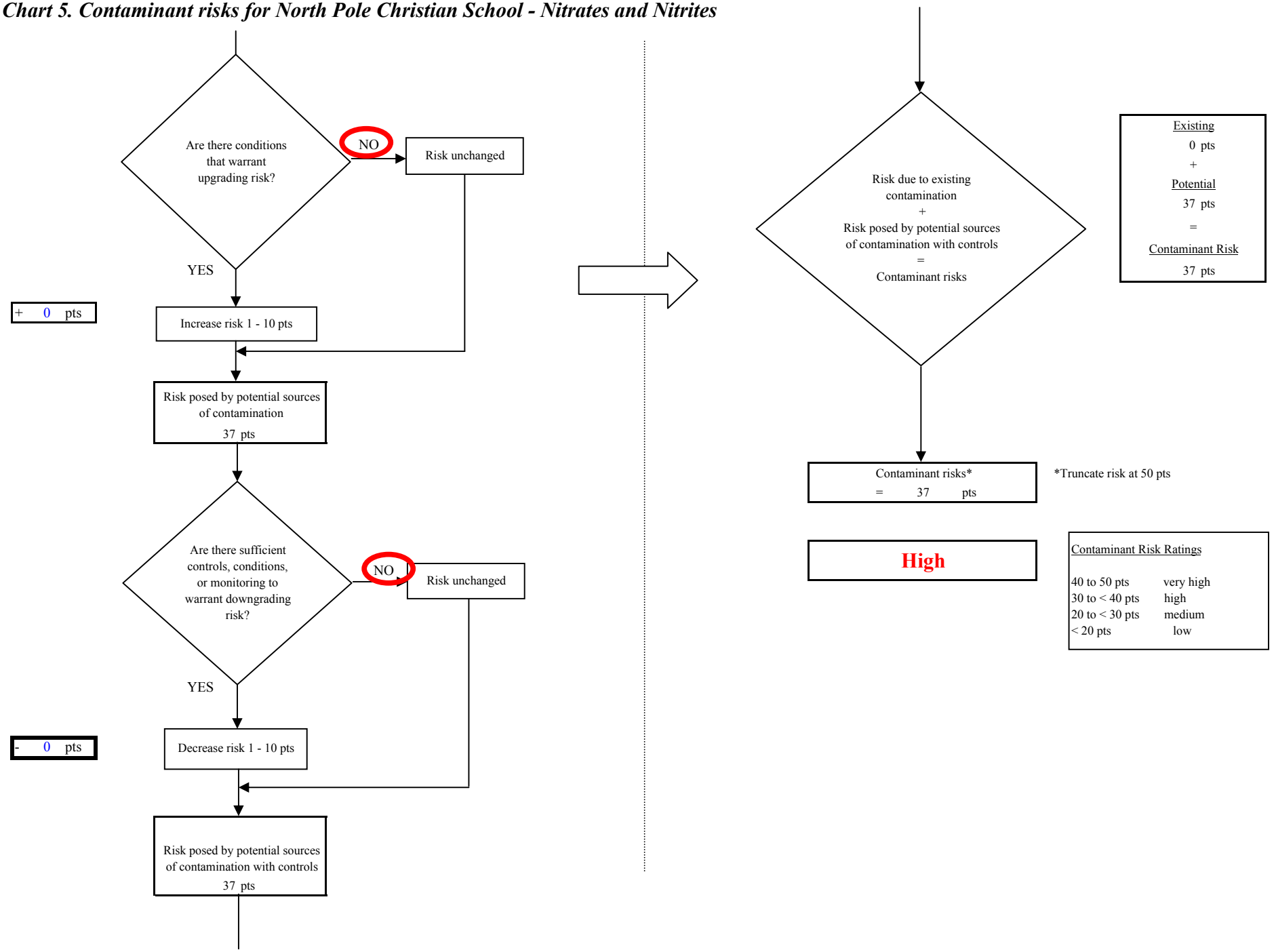


Chart 6. Vulnerability analysis for North Pole Christian School - Nitrates and Nitrites

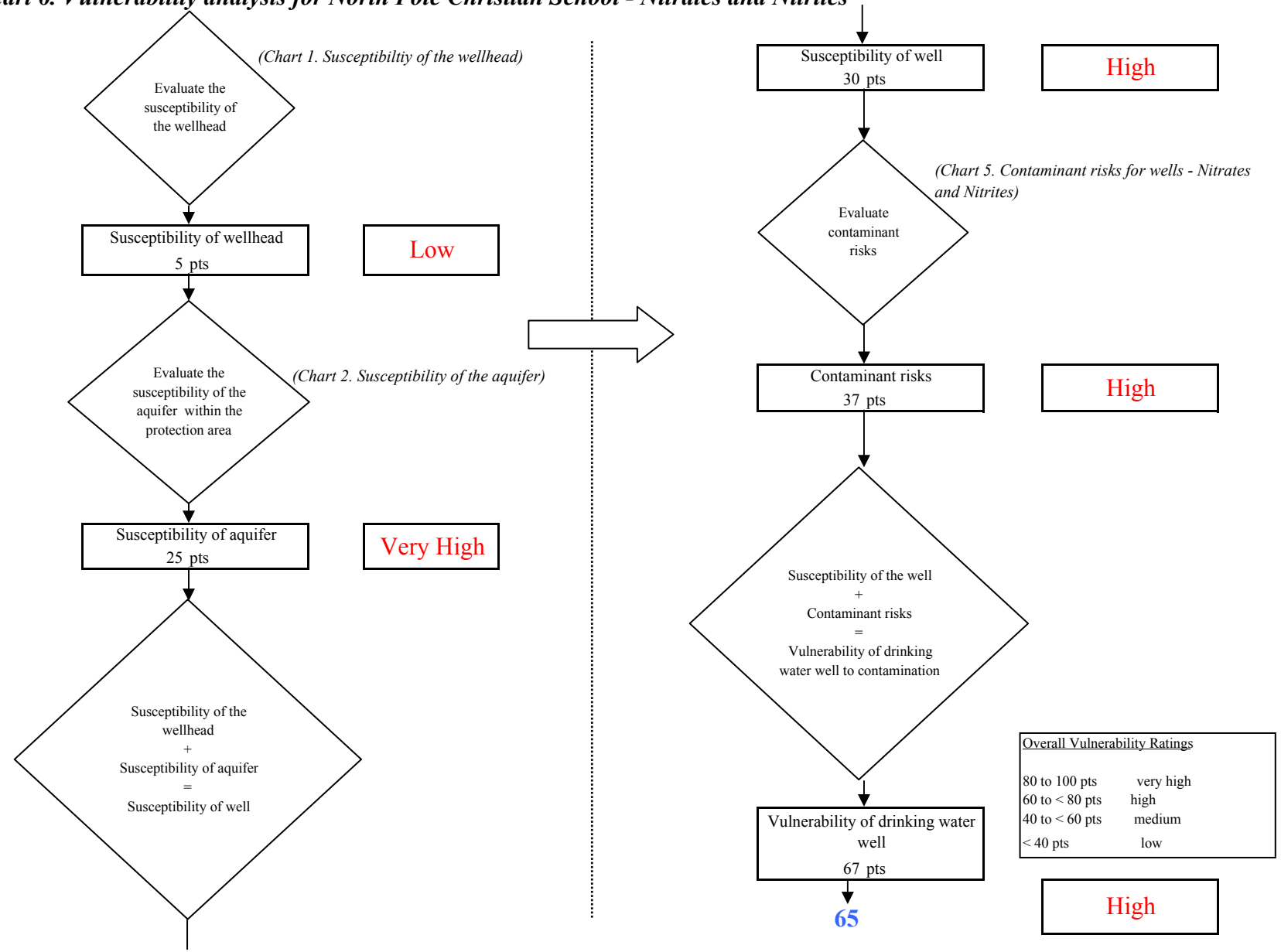


Chart 7. Contaminant risks for North Pole Christian School - Volatile Organic Chemicals

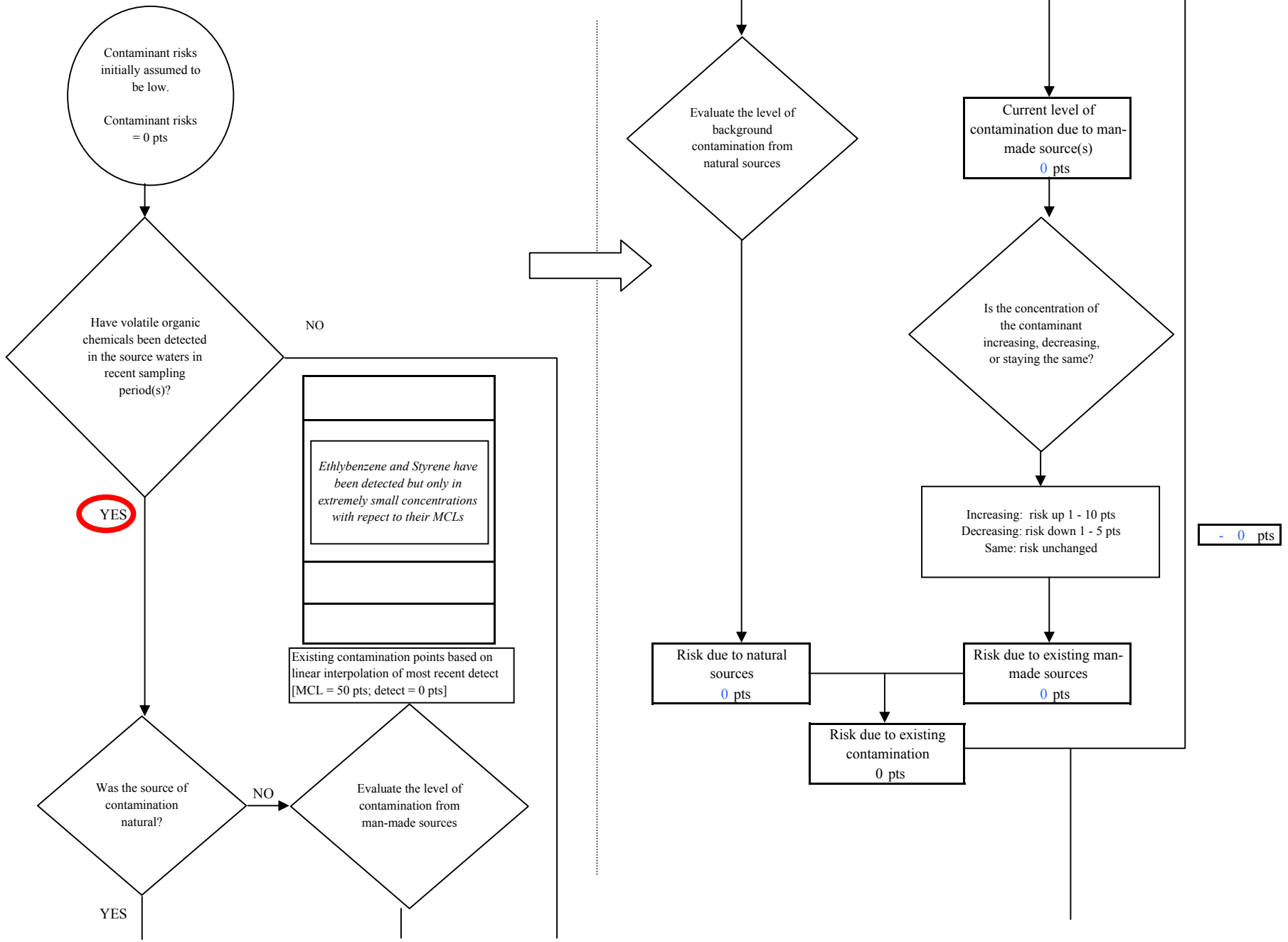
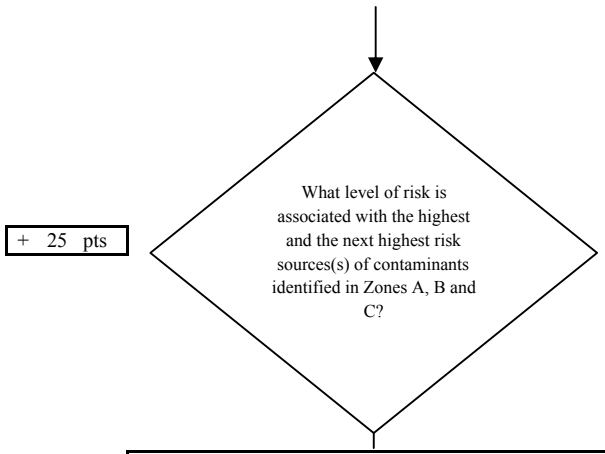


Chart 7. Contaminant risks for North Pole Christian School - Volatile Organic Chemicals



+ 25 pts

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	7	62	69
Low(s)	4	3	7

	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 25

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.

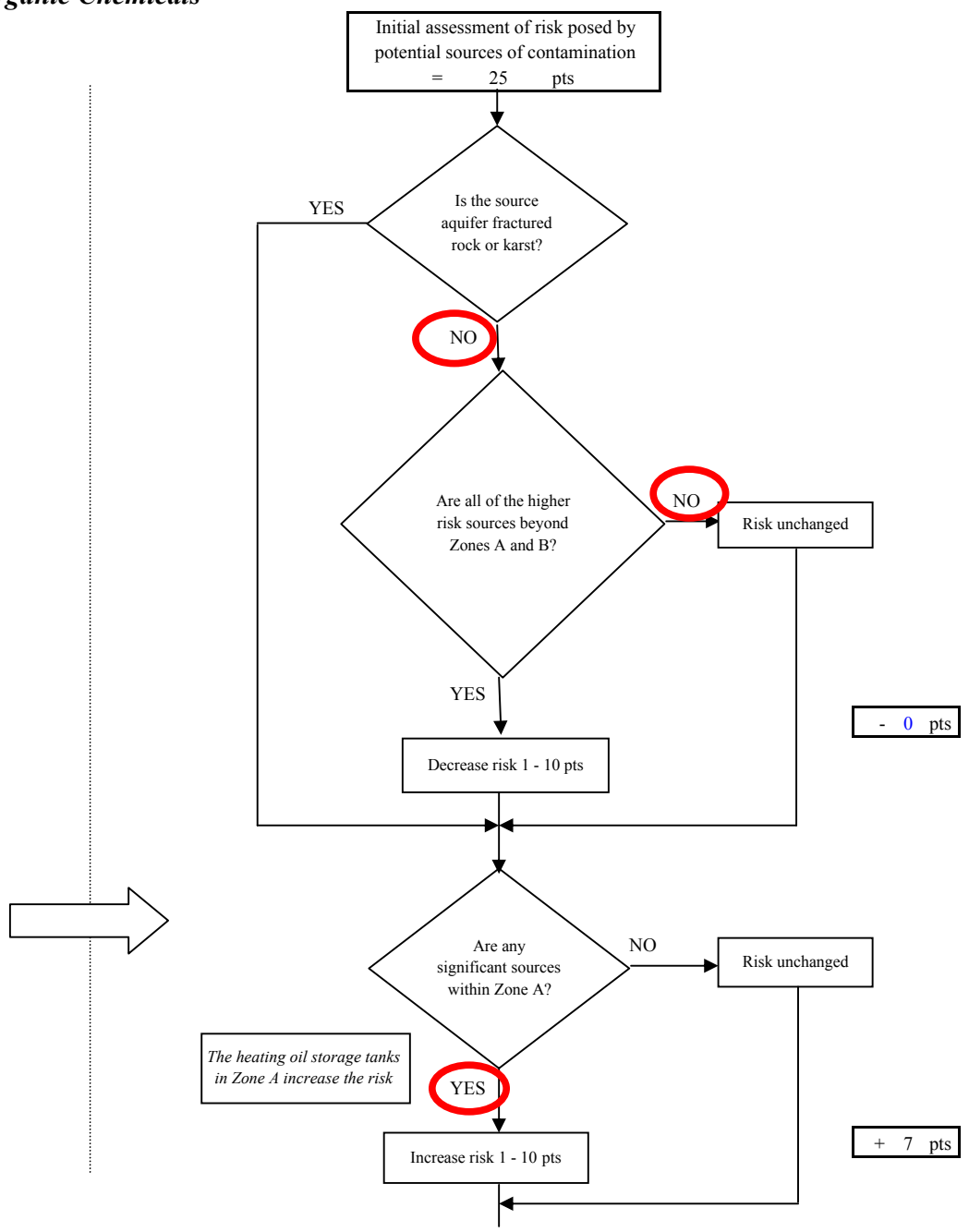


Chart 7. Contaminant risks for North Pole Christian School - Volatile Organic Chemicals

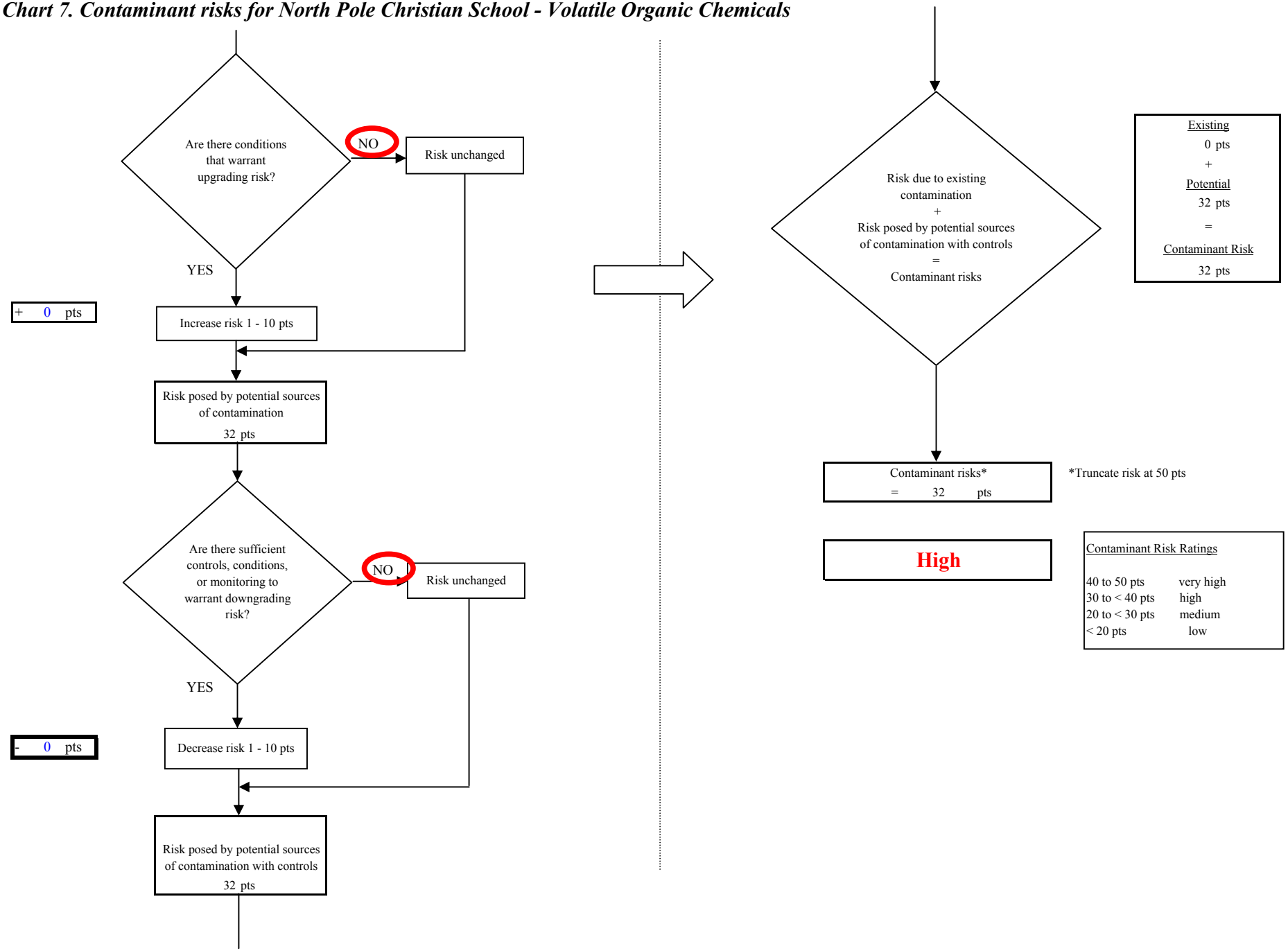


Chart 8. Vulnerability analysis for North Pole Christian School - Volatile Organic Chemicals

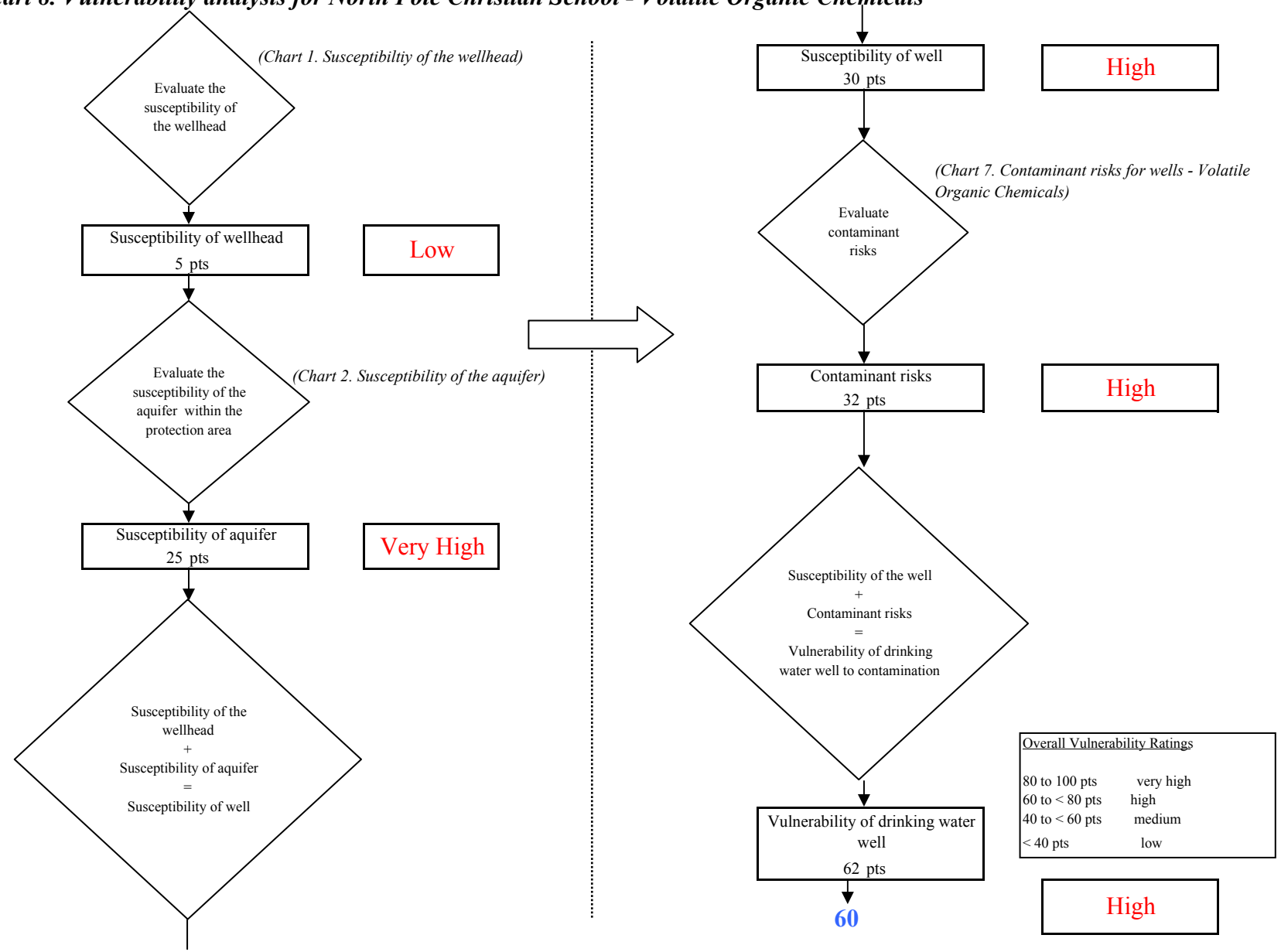


Chart 9. Contaminant risks for North Pole Christian School - Heavy Metals, Cyanide and Other Inorganic Chemicals

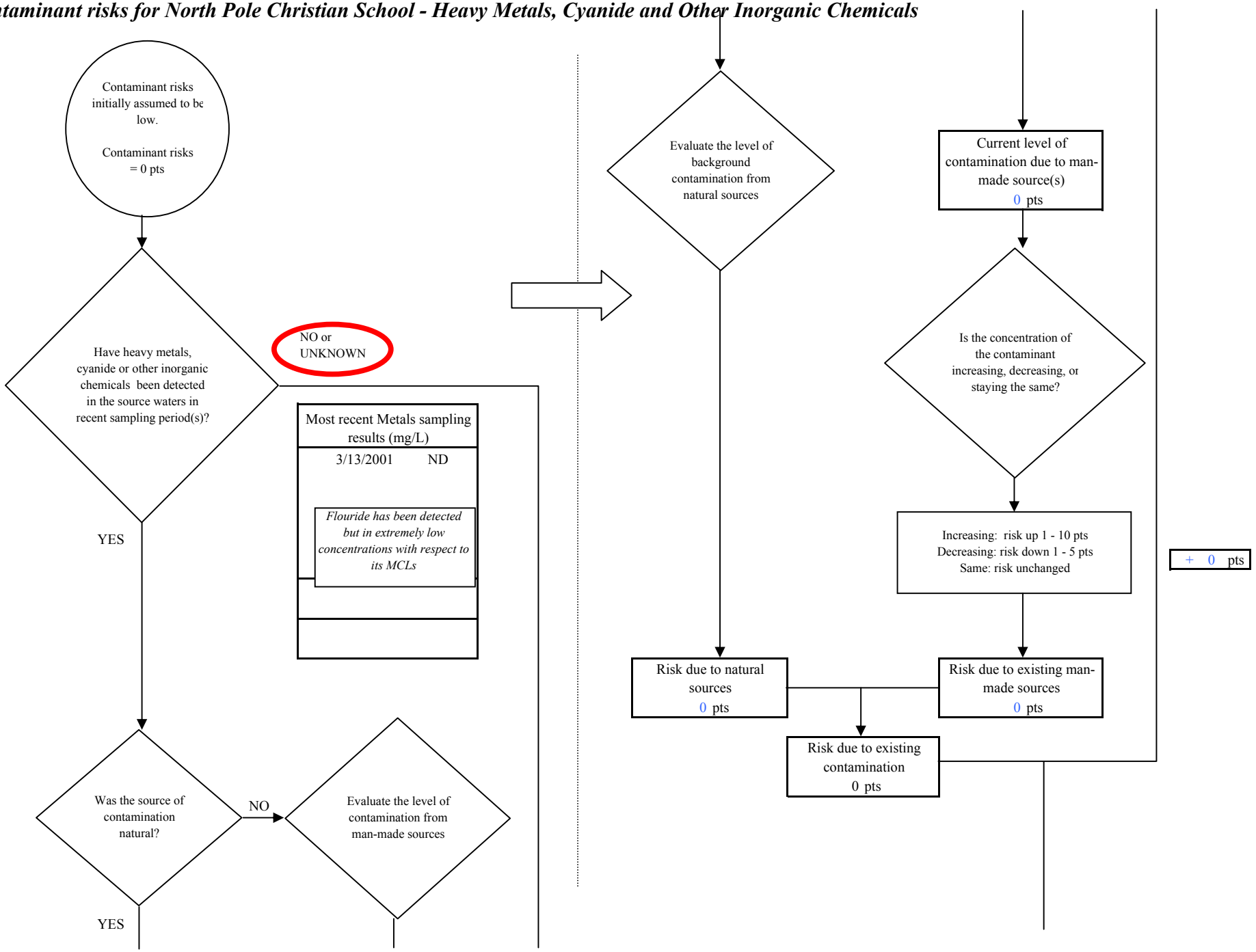
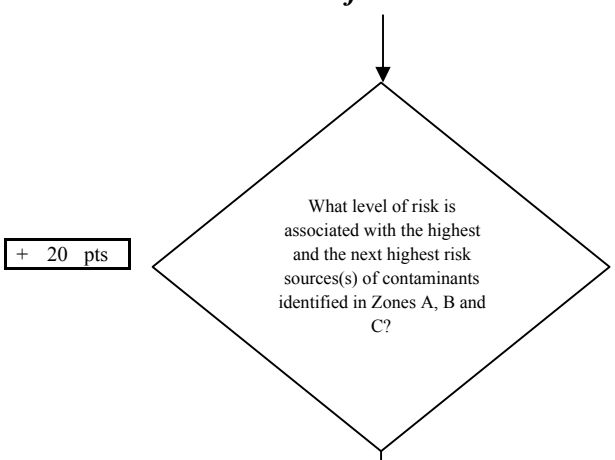


Chart 9. Contaminant risks for North Pole Christian School - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 20 pts

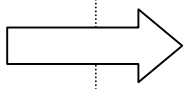
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	2	2
Low(s)	4	2	6

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 20

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.



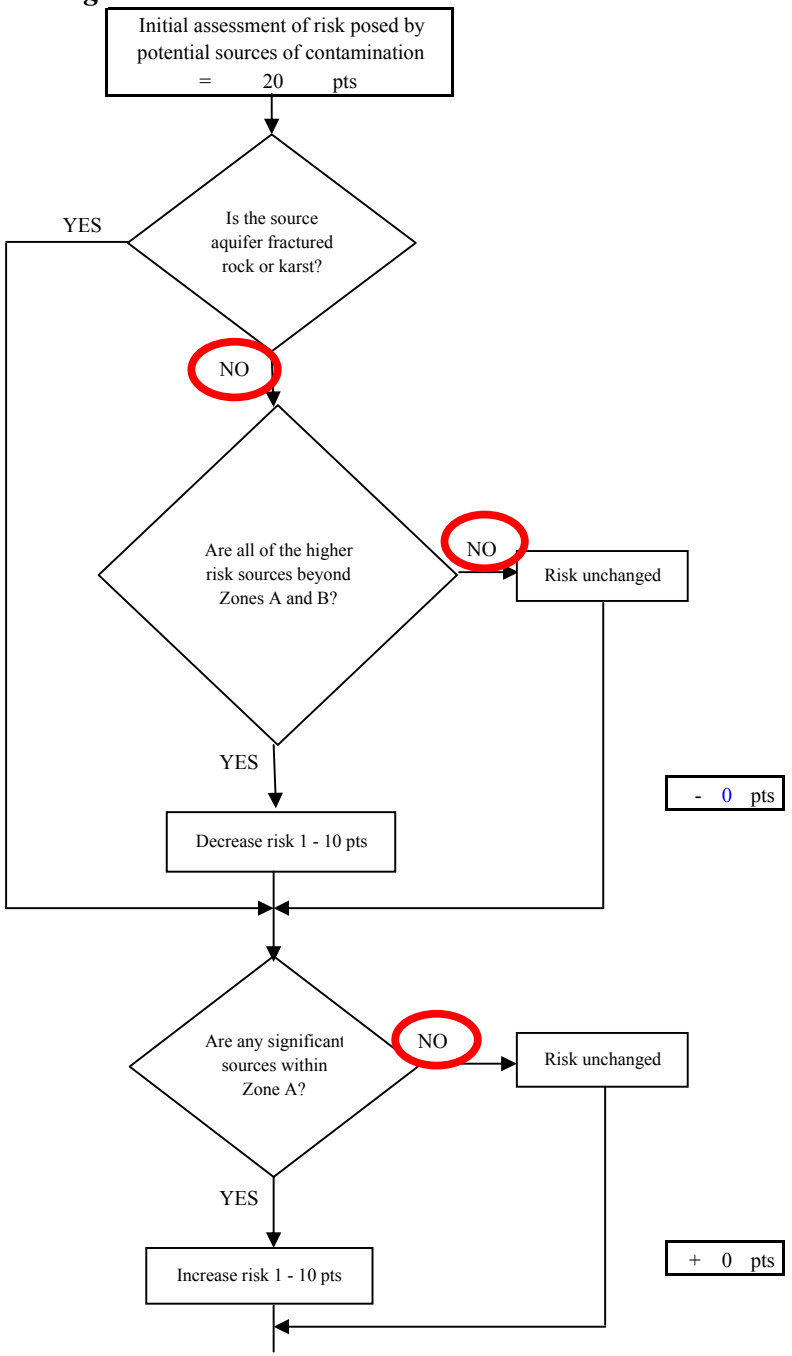


Chart 9. Contaminant risks for North Pole Christian School - Heavy Metals, Cyanide and Other Inorganic Chemicals

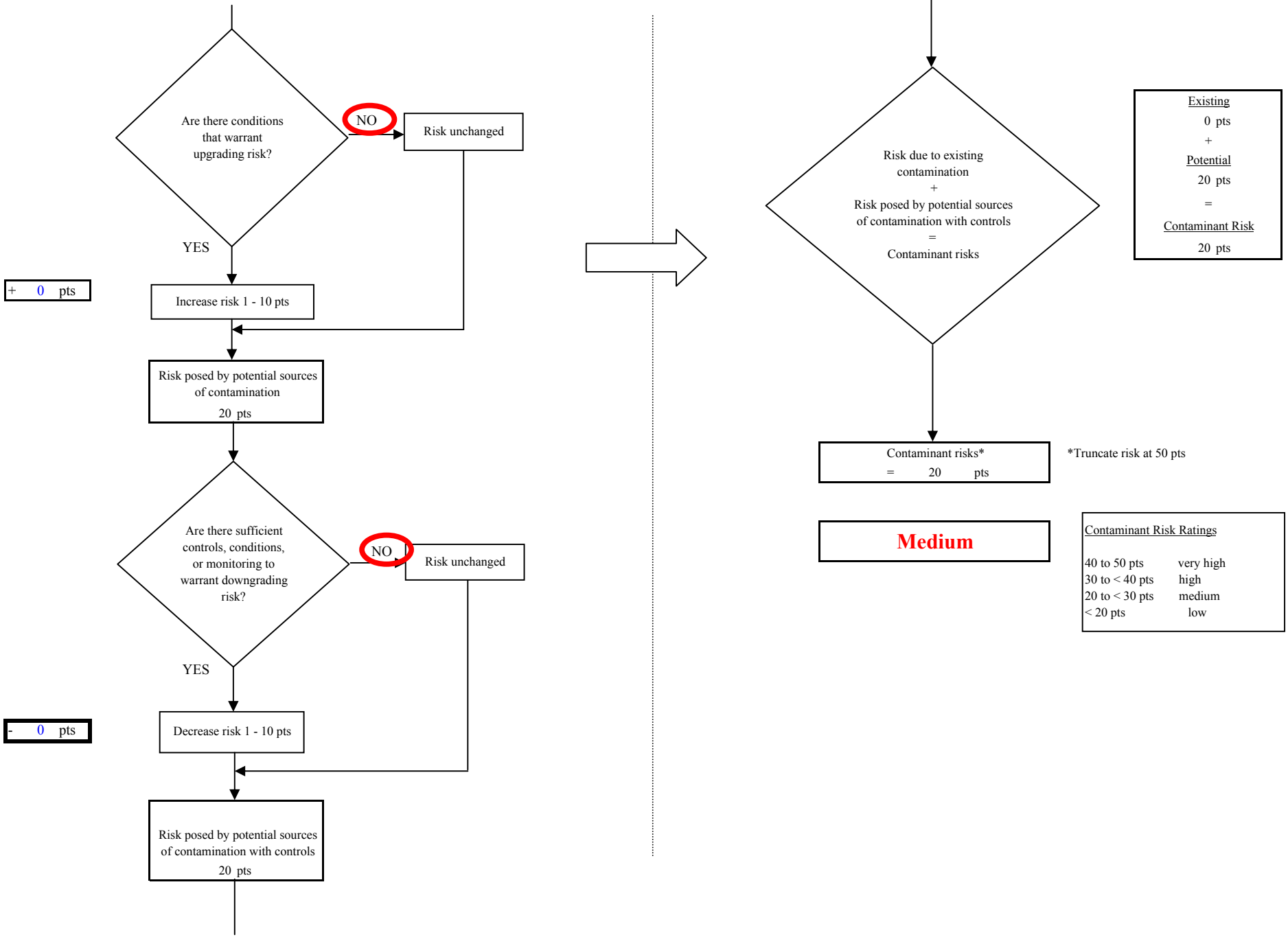


Chart 10. Vulnerability analysis for North Pole Christian School - Heavy Metals, Cyanide and Other Inorganic Chemicals

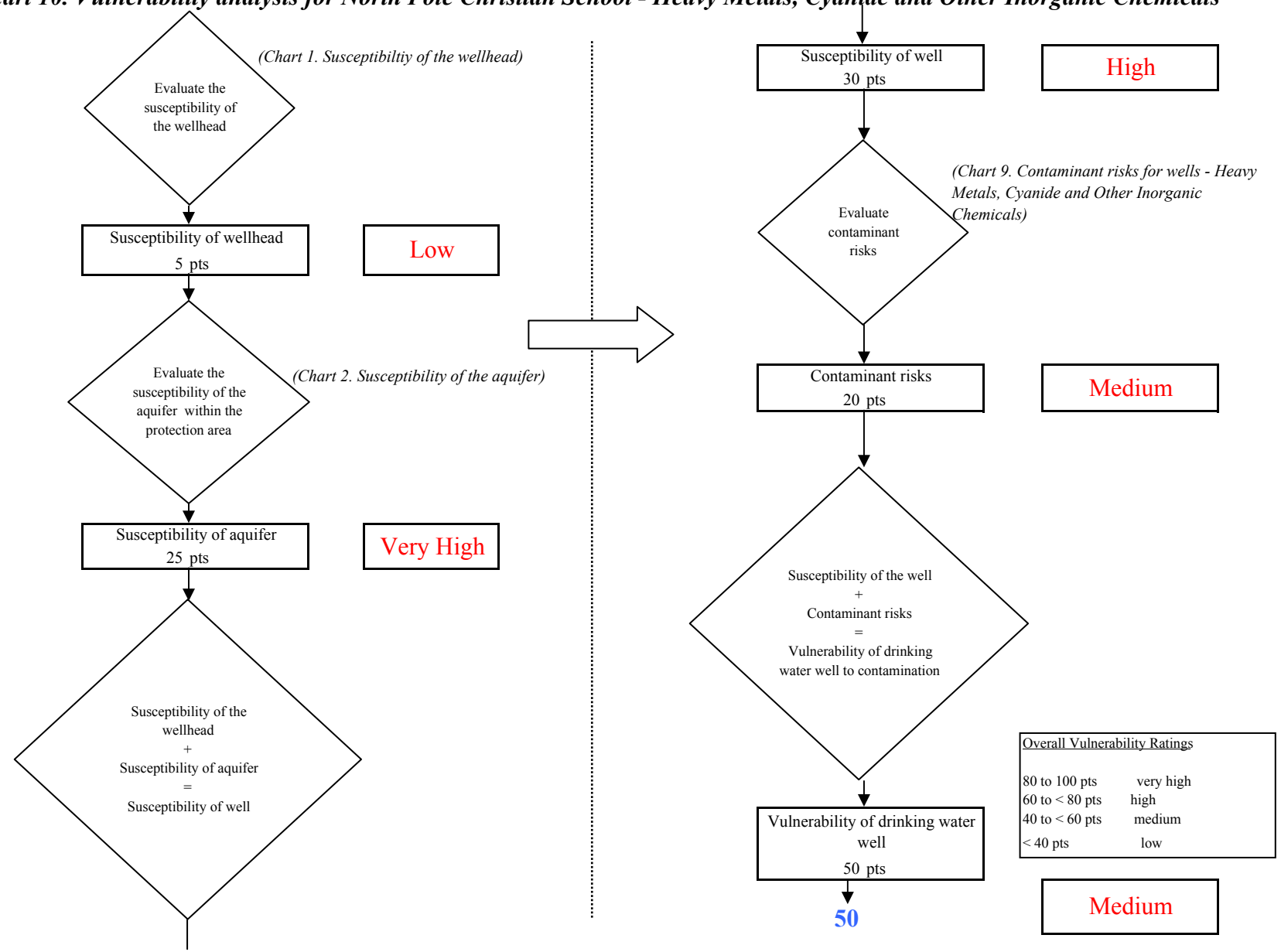


Chart 11. Contaminant risks for North Pole Christian School - Synthetic Organic Chemicals

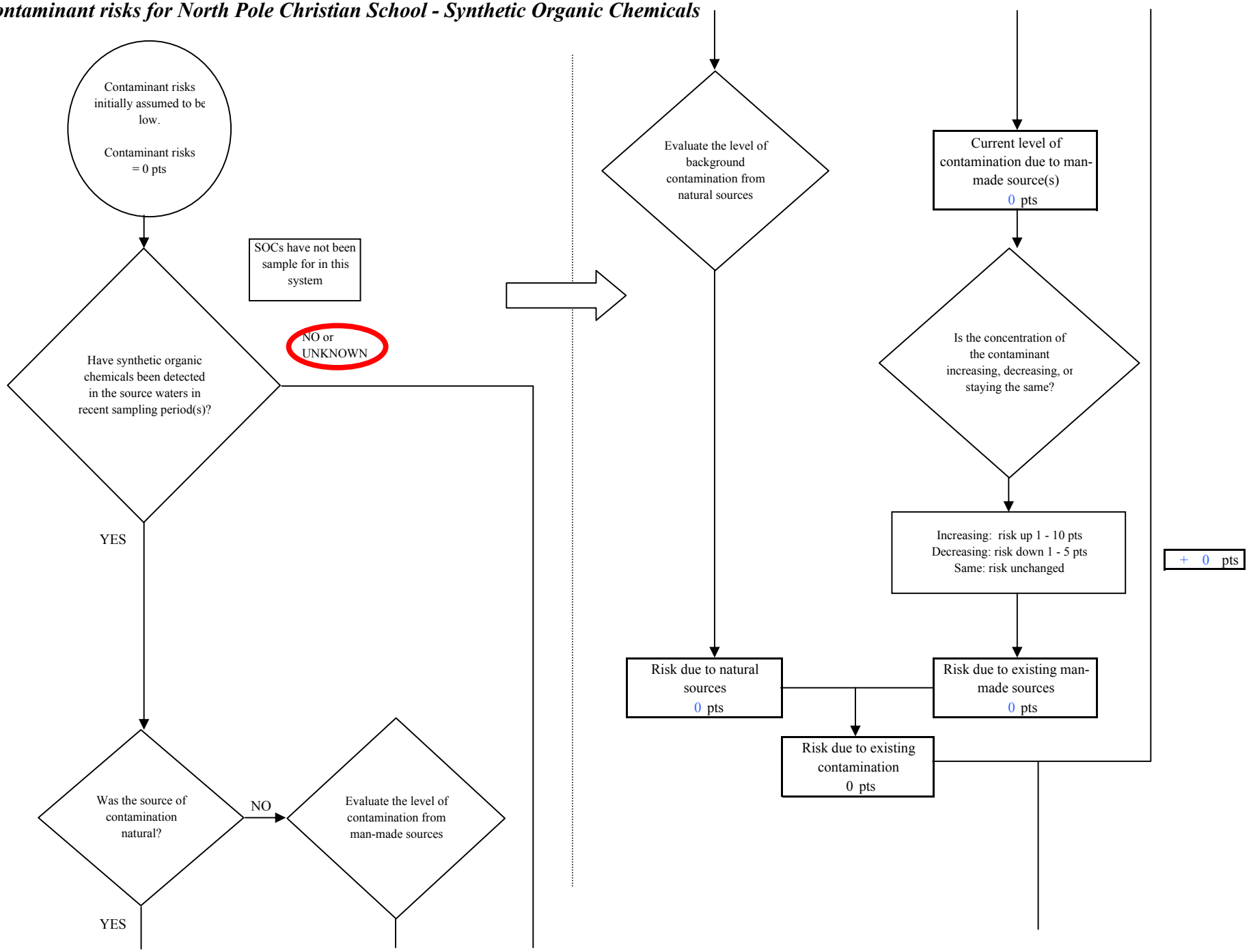


Chart 11. Contaminant risks for North Pole Christian School - Synthetic Organic Chemicals

+ 10 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	2	5

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 10

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 11. Contaminant risks for North Pole Christian School - Synthetic Organic Chemicals

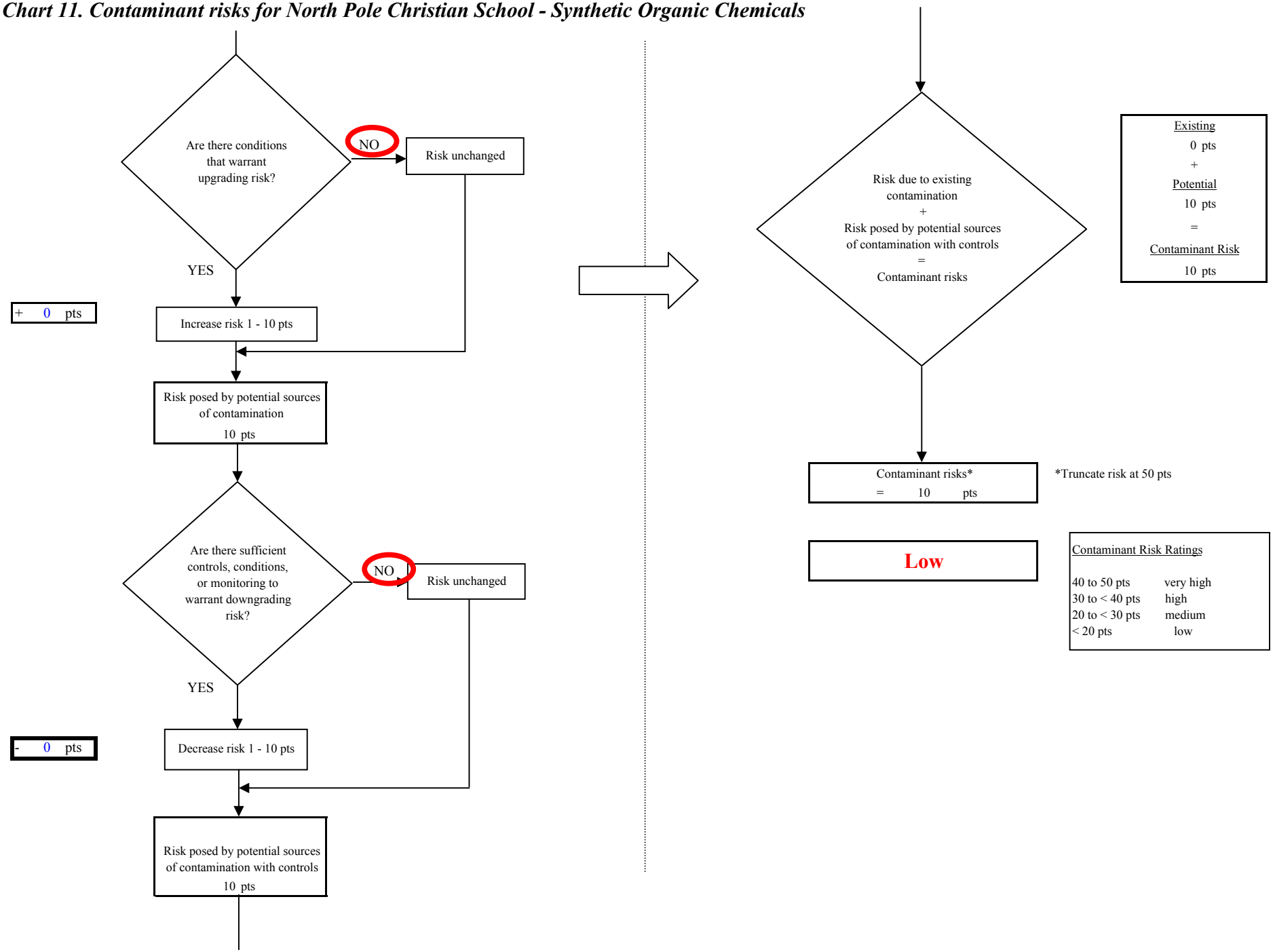


Chart 12. Vulnerability analysis for North Pole Christian School - Synthetic Organic Chemicals

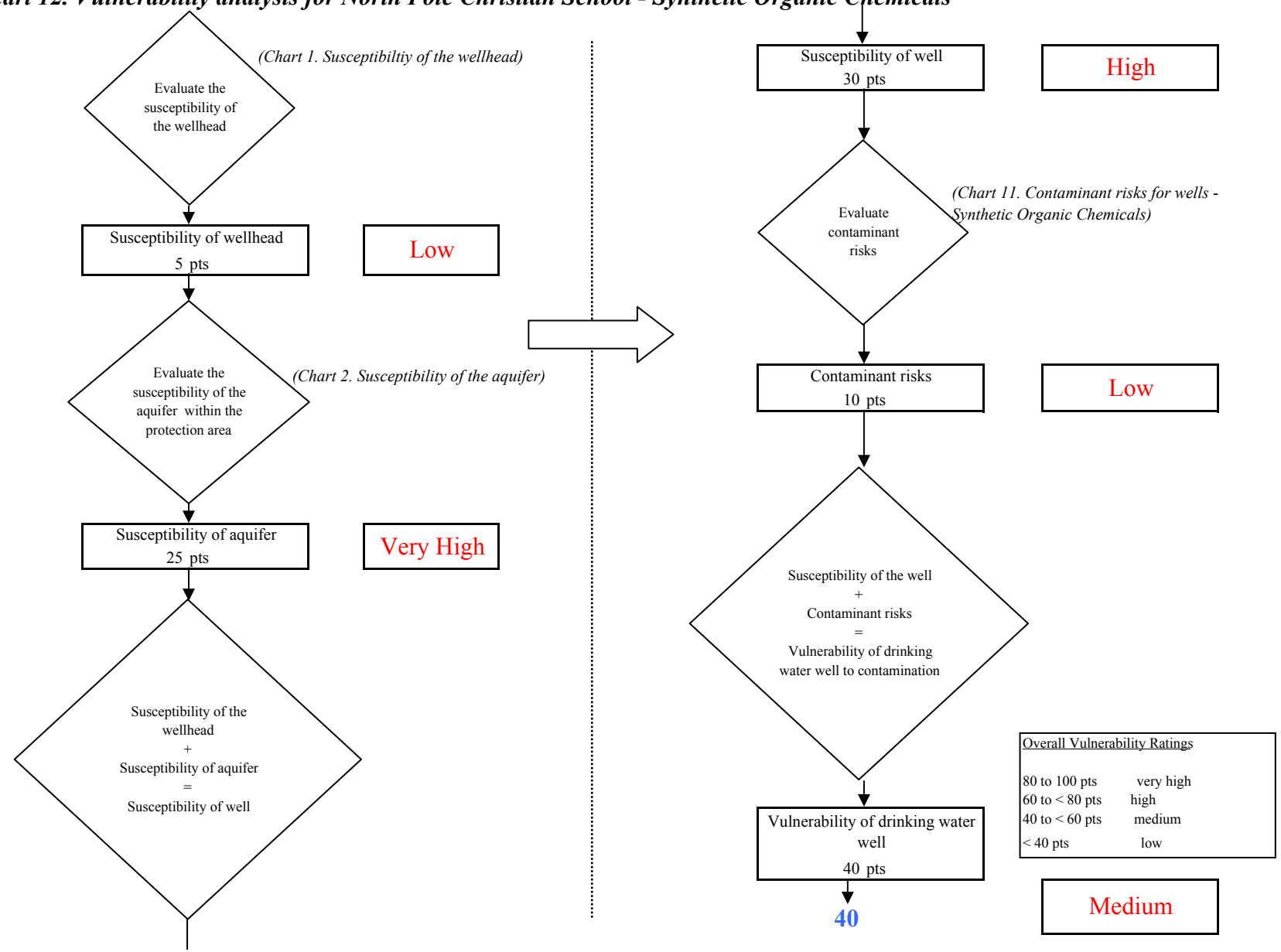


Chart 13. Contaminant risks for North Pole Christian School - Other Organic Chemicals

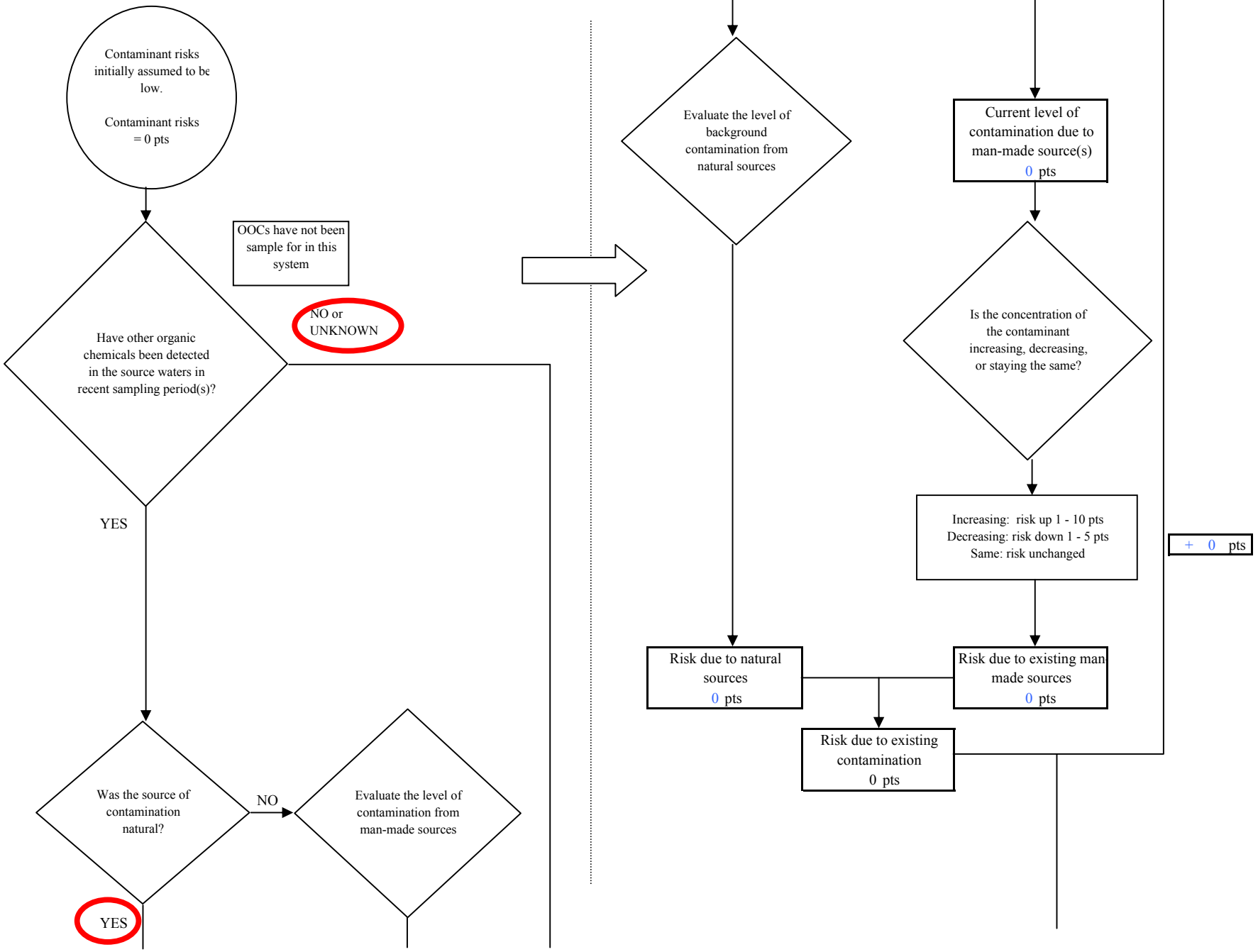


Chart 13. Contaminant risks for North Pole Christian School - Other Organic Chemicals

+ 20 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	2	2
Low(s)	3	2	5

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 20

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

Initial assessment of risk posed by potential sources of contamination = 20 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 0 pts

Chart 13. Contaminant risks for North Pole Christian School - Other Organic Chemicals

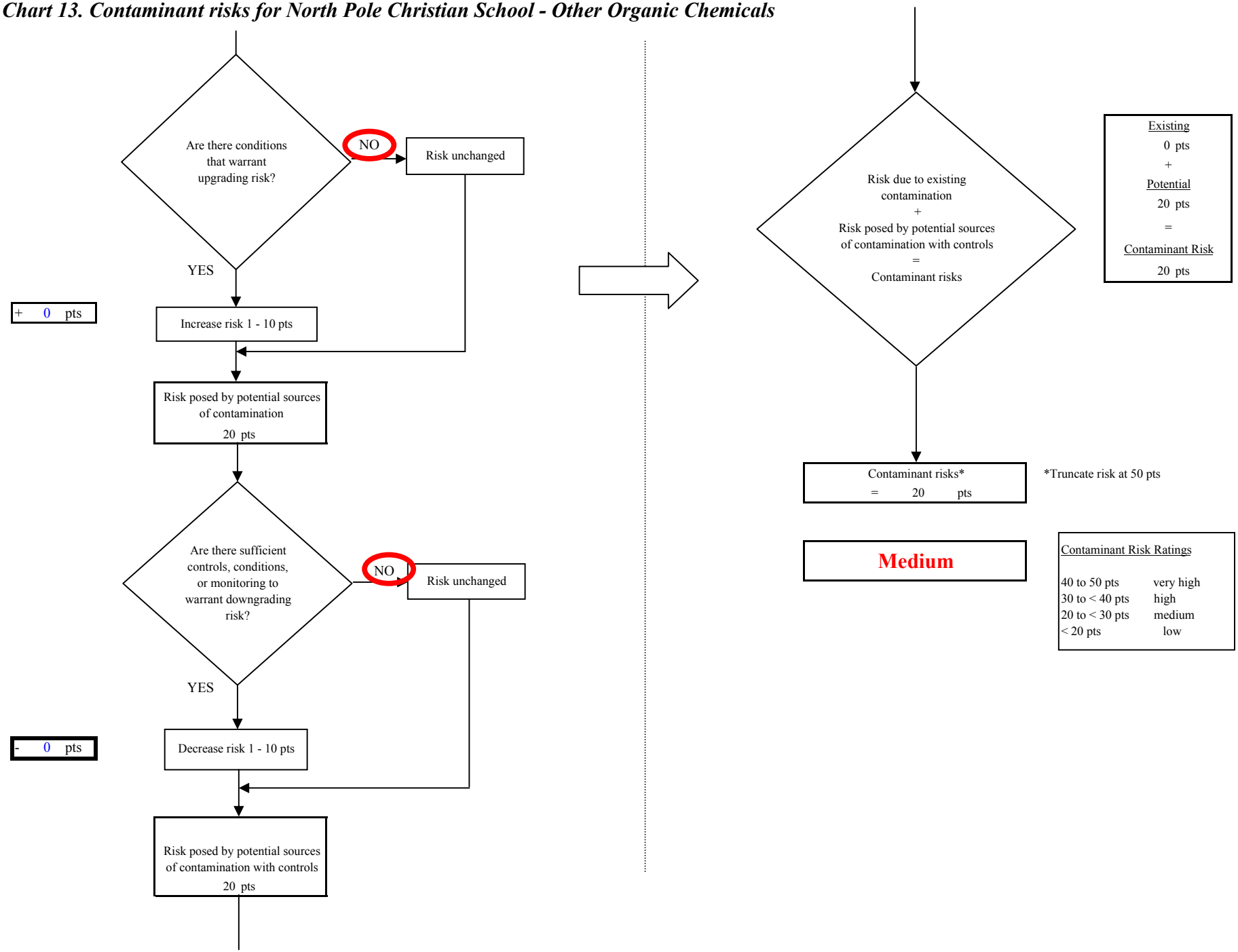


Chart 14. Vulnerability analysis for North Pole Christian School - Other Organic Chemicals