Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Anyaraqmuite Office Building Drinking Water System, Aniak, Alaska

PWSID # 271554.001

March 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1223
Alaska Department of Environmental Conservation

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DRINKING WATER PROTECTION PROGRAM REPORT 1223

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 Anyaraqmuite Office Building Source of Public Drinking Water, Aniak, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Anyaraqmuite Office Building has one Public Water System (PWS) well. The well (PWSID# 271554.001) is said to have been drilled around 1985 and has presumably been used as a drinking water source since that time.

The well is a Class B (transient/non-community) water system located approximately 0.5 miles northwest of the Aniak Airport in Aniak, Alaska. Available records indicate that there is no secondary storage of drinking water, other than the pressure tank, and the untreated drinking water source is derived directly from the wellhead. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produce a **Very High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the primary public drinking water source include: domestic wastewater collection systems, aboveground fuel tanks, water supply wells, electric power generation facilities, firehouses, an airport, an ADEC recognized contaminated site, a motor/motor vehicle repair shop, and a medical/veterinary facility. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the water well received a vulnerability rating of **High** for the bacteria and viruses, a vulnerability rating of **Very High** for nitrates and nitrites, and a vulnerability rating of **Very High** for volatile organic chemicals contaminant categories.

ANYARAQMUITE OFFICE BUILDING PUBLIC DRINKING WATER SYSTEM

The Anyaraqmuite Office Building water well is a Class B (transient/non-community) public water system located 0.5 miles northwest of the Aniak Airport in Aniak, Alaska (Sec. 11, T17N, R57W, Seward Meridian; see Map A of Appendix A). Aniak is located on the south bank of the Kuskokwim River in the Yukon-Kuskokwim Delta. The village is located about 92 miles northeast of Bethel and 317 miles west of Anchorage. The community has a population of 539 (ADCED, 2003). The Anyaraqmuite Office Building has a serves non-resident population of approximately 35 people. Average annual precipitation in Aniak is 19 inches, including approximately 60 inches of snowfall. Temperatures can be as extreme as -55 to 87°F.

The community of Aniak gets most of their water supply from individual wells. Most households are served by the piped sewage collection system and the remaining households either have individual septic tanks or pit privies (ADCED, 2003). Aniak receives electrical power from the Aniak Light and Power Company. Power generating facilities are fueled by diesel (ADCED, 2003).

According to information supplied by ADEC for the Anyaraqmuite Office Building PWS, the depth of the primary water well is 47.5 feet below the ground surface. Based on available information, it is assumed the well is in an unconfined aquifer and is not screened. Unconfined aquifers are more susceptible to groundwater impacts resulting from the downward migration of surface contaminants. The well is located in a floodplain.

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

Aniak is located on a flat former floodplain of the Kuskokwim River and the topographic relief in the area is less than 20 feet. Soils information is limited. Generally, the soils consist of sandy silt overlying sand and fine gravels. Aniak is located in an area that is considered a discontinuous permafrost zone and the permafrost masses are small, thin and

generally isolated (U.S. Department of Health and Human Services, et. al, 1983).

ANYARAQMUITE OFFICE BUILDING 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 Anyaraqmuite Office Building PWS. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (Freeze and Cherry, 1979). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

The protection areas established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

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 Anyaraqmuite Office Building 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 Anyaraqmuite Office Building DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses,
- Nitrates and/or nitrites,
- Volatile organic chemicals.

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

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Rankings include:

- Low,
- Medium,
- High, and
- Very High.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of

contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

VULNERABILITY OF THE ANYARAQMUIT OFFICE BUILDING DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility, and
- Contaminant risks.

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The Anyaraqmuite Office Building's water well is in an unconfined aquifer. Unconfined aquifers are more susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the Susceptibility scores and ratings for both wells in this PWS.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	50	Very High

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

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

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

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	25	Medium
Nitrates and/or Nitrites	35	High
Volatile Organic Chemicals	42	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:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

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

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	75	High
Nitrates and Nitrites	85	Very High
Volatile Organic Chemicals	90	Very High

Bacteria and Viruses

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

No positive bacteria counts were 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 **High**. The risk to this source of public drinking water is primarily attributed to the presence of domestic wastewater collection systems in Zone A (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that nitrates have been detected in recent sampling events. However, the reported concentrations of nitrates do not exceed the maximum contaminant level (MCL) of 10 mg/L. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L; therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources. After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Very High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of an airport in Zone B and an ADEC recognized contaminated site in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

No recent sampling data was available in ADEC records for the Anyaraqmuite Office Building (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 **Very High**.

Using the Source Water Assessment

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

REFERENCES

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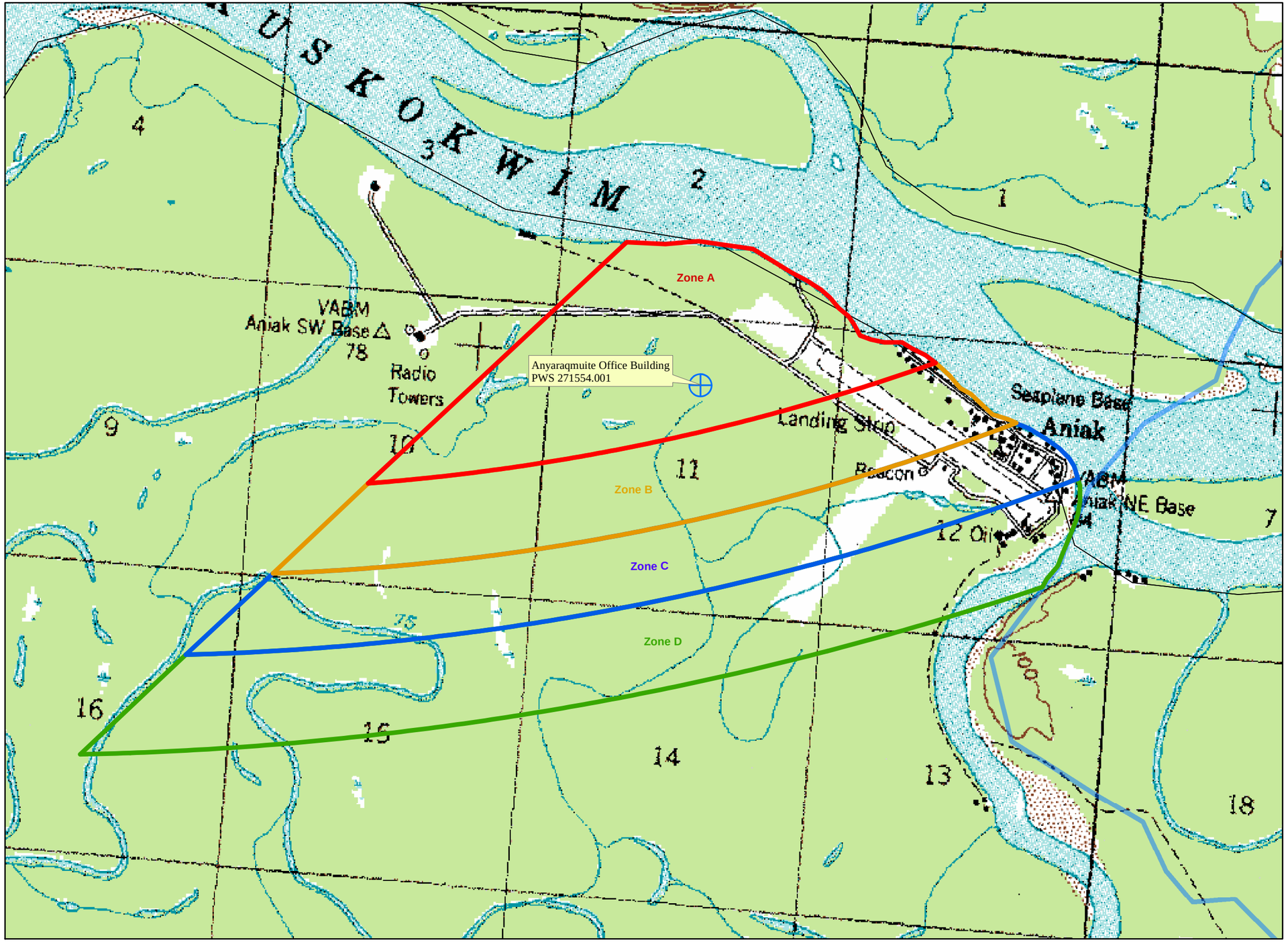
APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #271554.001 Anyaraqmuite Office Building



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)
- Road Ferry Crossing

Groundwater Protection Zones

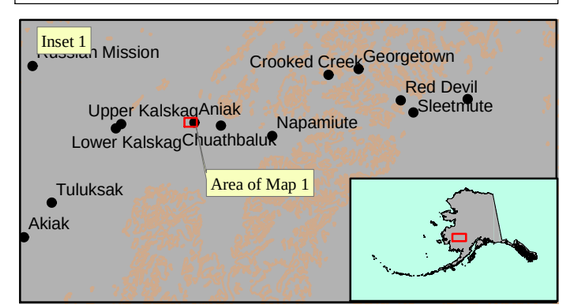
- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time or Watershed Boundary

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

All other data:
United States Geological Survey (USGS)

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

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



0 0.25 0.5 1 1.5 2 Miles

Anyaraqmuite Office Building
PWS 271554.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Rankings (Tables 1-4)

Table 1

Contaminant Source Inventory for ***Anyaraqmuite Office Building***

PWSID 271554.00

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stati	D01	D01-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	Offices
Water supply wells	W09	W09-02	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	B	C	Power Generation Facility
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	B	C	Power Generation Facility
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	B	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	B	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	B	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	B	C	Telephone
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	B	C	Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	B	C	Fire Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	B	C	Library
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	B	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	B	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	B	C	Satellite
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	B	C	School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-17	B	C	School
Water supply wells	W09	W09-02	B	C	
Airports	X14	X14-01	B	C	Airport
Electric power generation (fossil fuels)	X36	X36-01	B	C	Power Generation Facility
Electric power generation (fossil fuels)	X36	X36-02	B	C	Power Generation Facility
Firehouses	X38	X38-01	B	C	Fire Station

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-18	C	C	Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-19	C	C	Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-20	C	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-21	C	C	School
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	C	C	Mark Air Facility - Aniak Airport. ADEC RecKey#1992250119301. Ac site with high priority. Soil contaminated with hydrocarbons.
Water supply wells	W09	W09-03	C	C	
Water supply wells	W09	W09-04	C	C	
Motor /motor vehicle repair shops	C31	C31-01	D	C	Service/Maintenance Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-22	D	C	Hospital/Clinic/ER
Tanks, heating oil, nonresidential (aboveground)	T14	T14-23	D	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-24	D	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-25	D	C	Police Station
Medical/veterinary facilities (doctor or dentist offices, hospitals nursing homes)	X40	X40-01	D	C	Hospital/Clinic/ER

Table 2

Contaminant Source Inventory and Risk Ranking for Anyaraqmuite Office Building Sources of Bacteria and Viruses

PWSID 271554.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	

Table 3

Contaminant Source Inventory and Risk Ranking for Anyaraqmuite Office Building Sources of Nitrates/Nitrites

PWSID 271554.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	
Airports	X14	X14-01	B	Low	C	Airport

Table 4

Contaminant Source Inventory and Risk Ranking for Anyaraqmuite Office Building Sources of Volatile Organic Chemicals

PWSID 271554.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	B	Low	C	Power Generation Facility
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	B	Low	C	Power Generation Facility
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	B	Low	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	B	Low	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	B	Low	C	Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	B	Low	C	Telephone
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	B	Low	C	Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	B	Low	C	Fire Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	B	Low	C	Library
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	B	Low	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-14	B	Low	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-15	B	Low	C	Satellite
Tanks, heating oil, nonresidential (aboveground)	T14	T14-16	B	Low	C	School
Tanks, heating oil, nonresidential (aboveground)	T14	T14-17	B	Low	C	School
Airports	X14	X14-01	B	High	C	Airport
Electric power generation (fossil fuels)	X36	X36-01	B	Medium	C	Power Generation Facility
Electric power generation (fossil fuels)	X36	X36-02	B	Medium	C	Power Generation Facility
Firehouses	X38	X38-01	B	Low	C	Fire Station
Tanks, heating oil, nonresidential (aboveground)	T14	T14-18	C	Low	C	Church

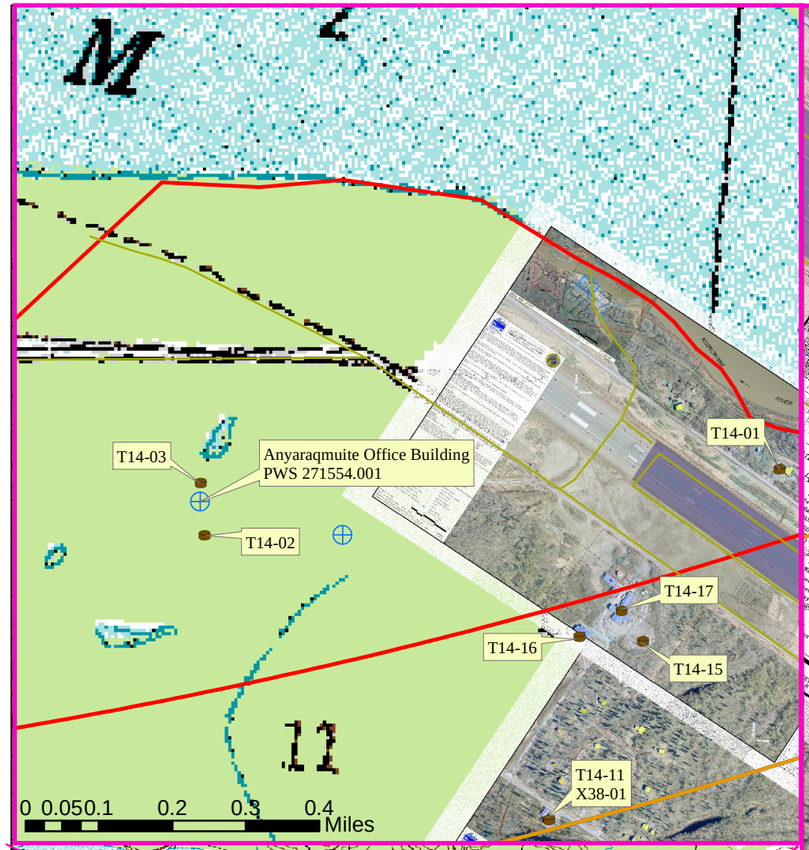
Contaminant Source Inventory and Risk Ranking for Anyaraqmuite Office Building Sources of Volatile Organic Chemicals

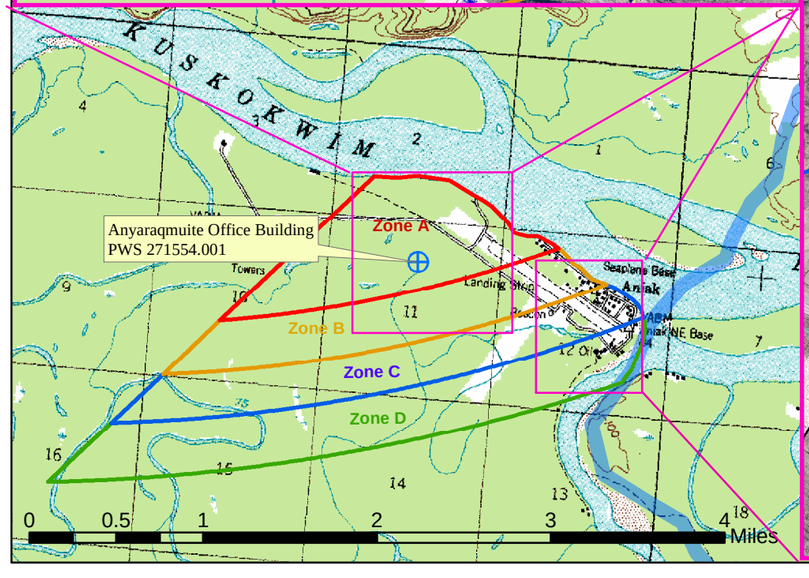
Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-19	C	Low	C	Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-20	C	Low	C	Offices
Tanks, heating oil, nonresidential (aboveground)	T14	T14-21	C	Low	C	School
Contaminated sites, DEC recognized, non-Superfun non-RCRA	U04	U04-01	C	High	C	Mark Air Facility - Aniak Airport. ADEC RecKey#1992250119301. Act site with high priority. Soil contaminated with hydrocarbons.

APPENDIX C

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

Public Water Well System for PWS #271554.001 Anyaraqmuite Office Building
Showing Potential and Existng Sources of Contamination





LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)
- Road Ferry Crossing

Groundwater Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time or Watershed Boundary

Existing or Potential Contaminant Sources

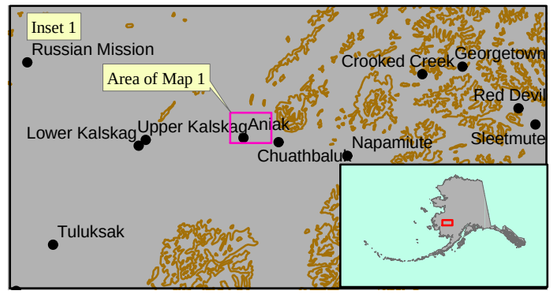
- Motor Vehicle Repair Shops (C31)
- Tanks, Heating Oil, Nonresidential (aboveground) (T14)
- Electrical Power Generation (fossil fuels) (X36)
- Firehouses (X38)
- Medical/Veterinary Facilities (X40)
- Airports/Landing Strips (X14)

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

All other data:
United States Geological Survey (USGS)

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

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



Anyaraqmuite Office Building
PWS 271554.001

Appendix C Map C

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - Anyaraqmuite Office Building (PWS No. 271554.001)

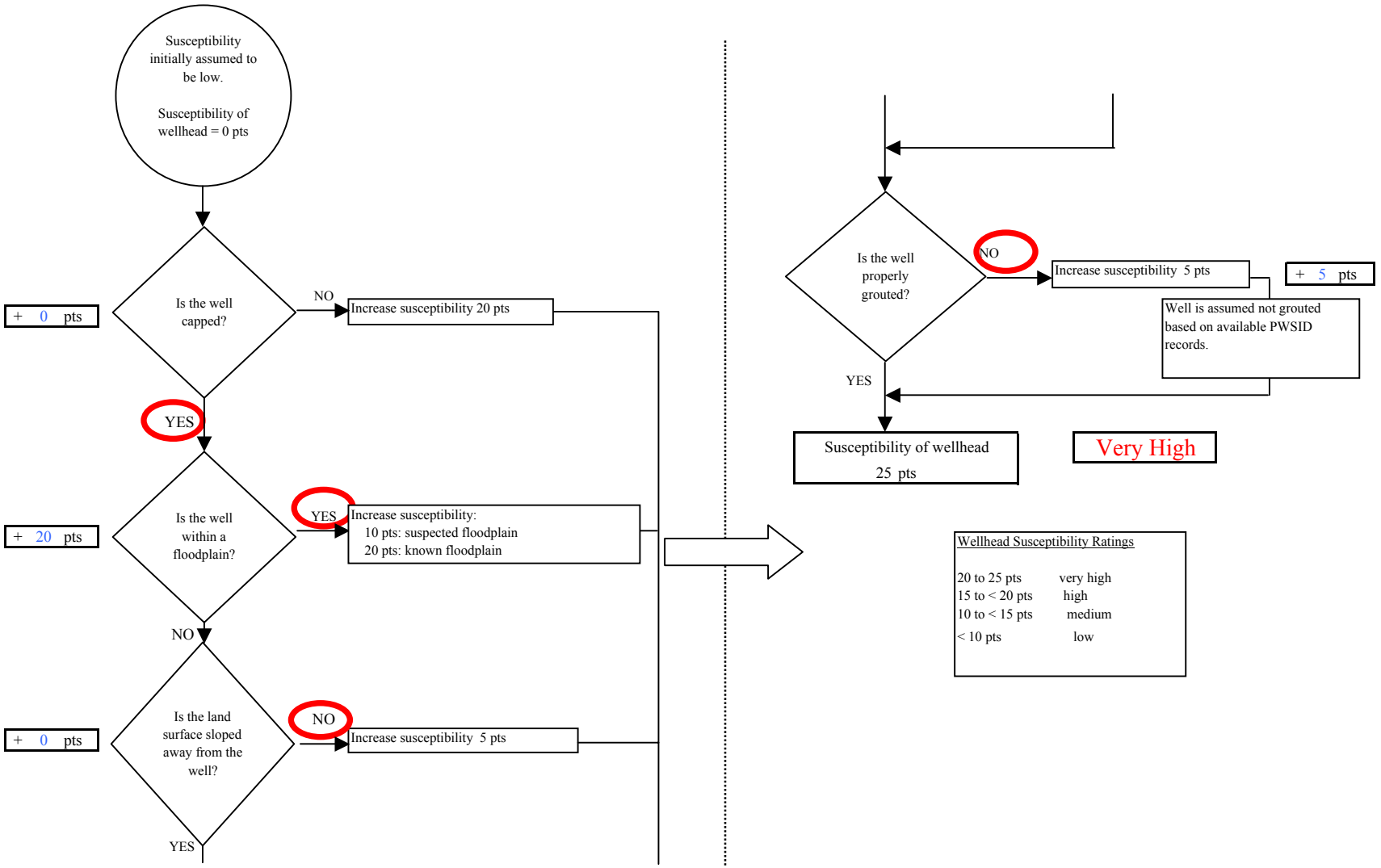


Chart 2. Susceptibility of the aquifer Anyaraqmuite Office Building (PWS No. 271554.001)

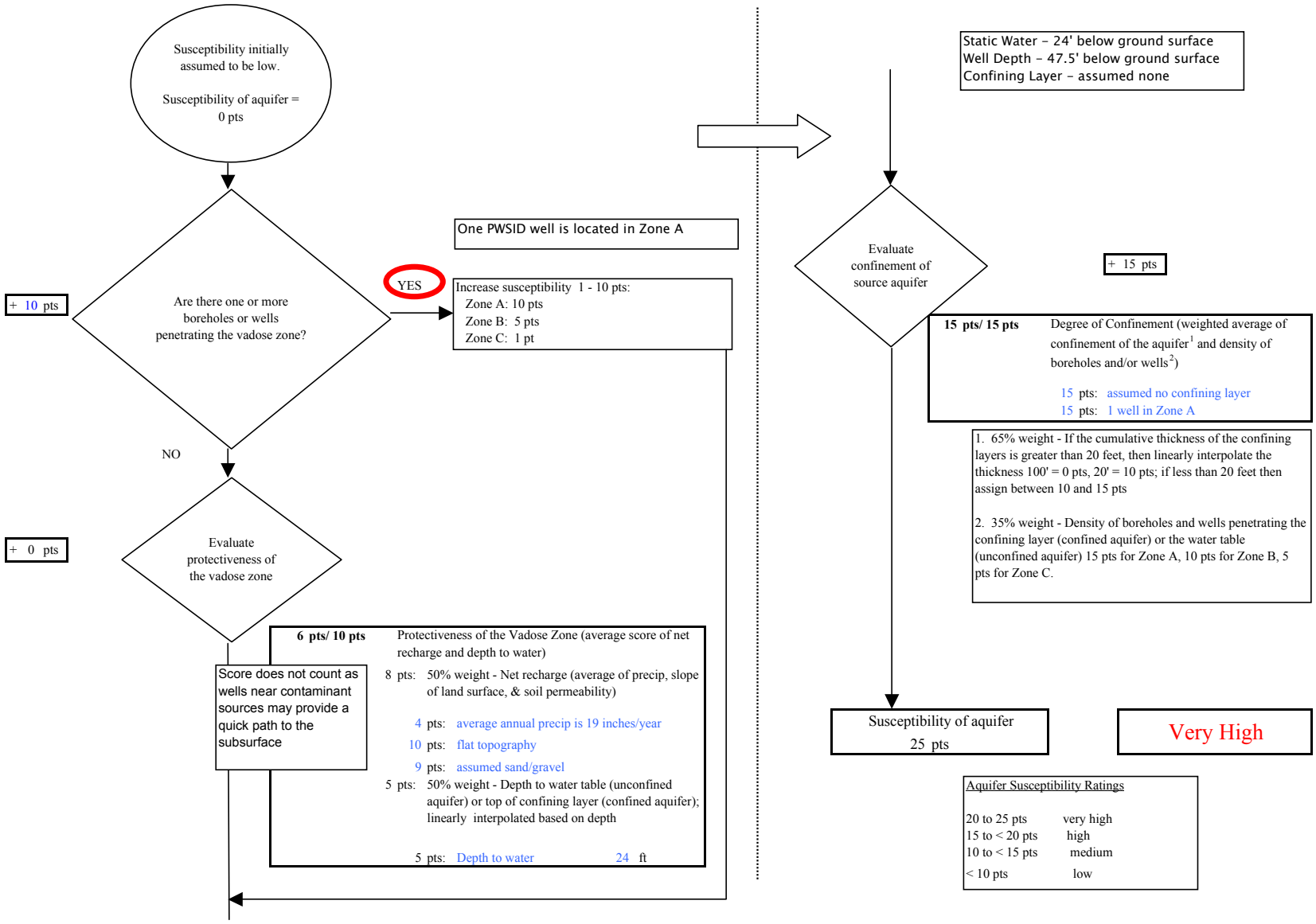
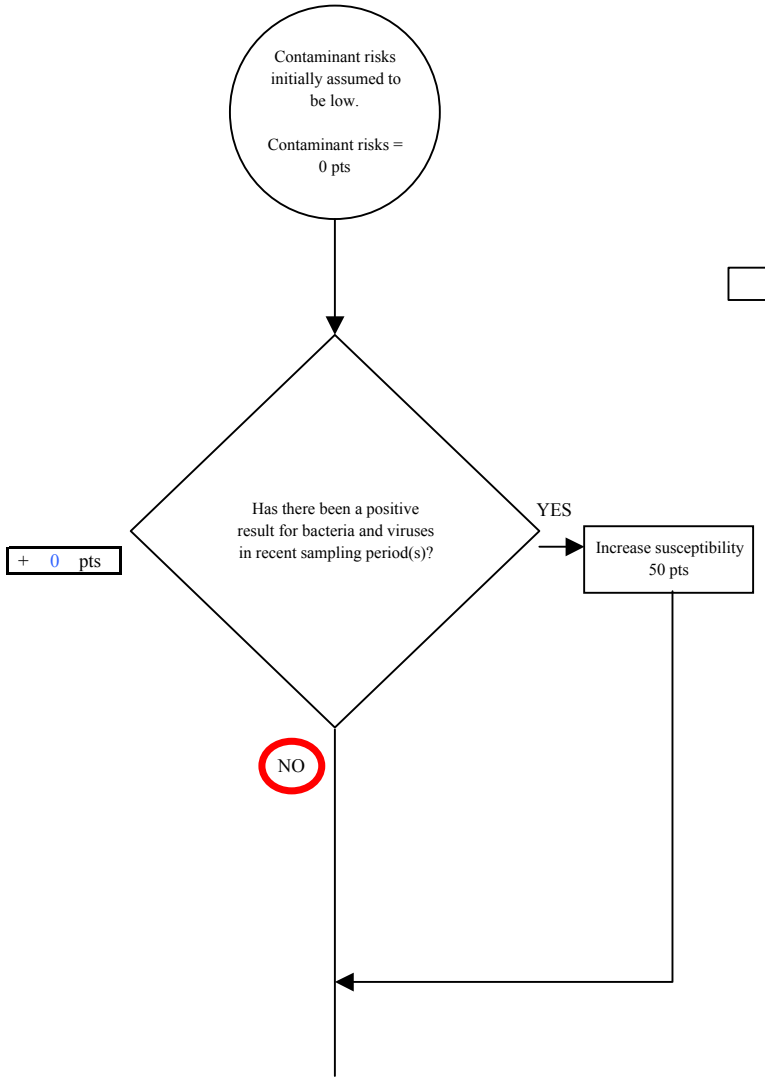
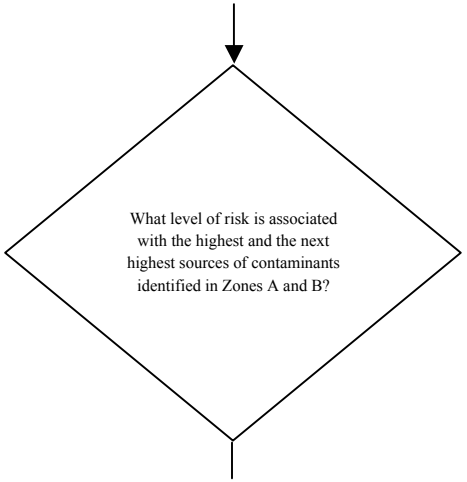


Chart 3. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Bacteria & Viruses





+ 20 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)	0	0	0
Medium(s)	1	0	1
Low(s)	0	0	0

	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 3. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Bacteria & Viruses

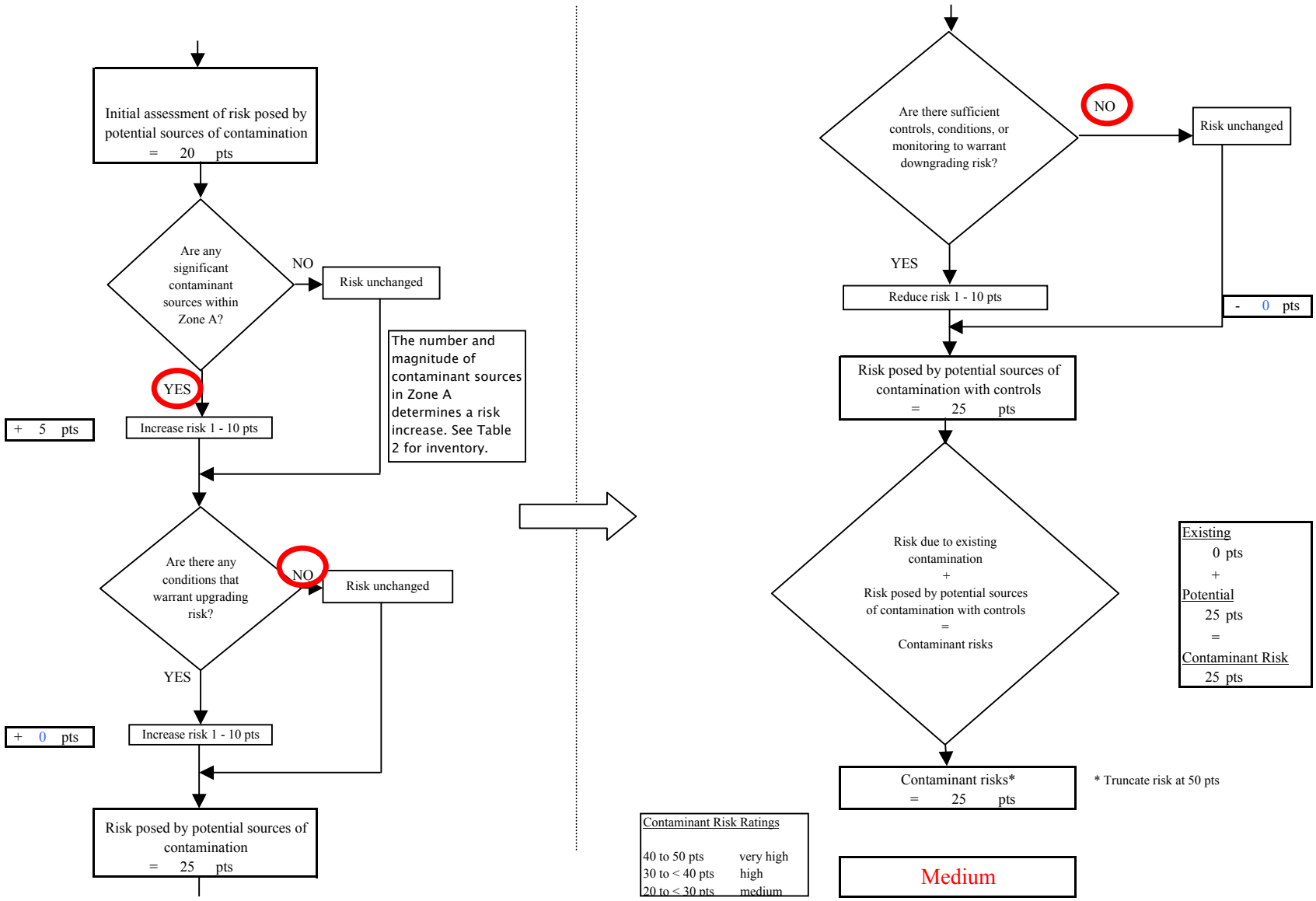


Chart 4. Vulnerability analysis for Anyaraqmuite Office Building (PWS No. 271554.001) - Bacteria & Viruses

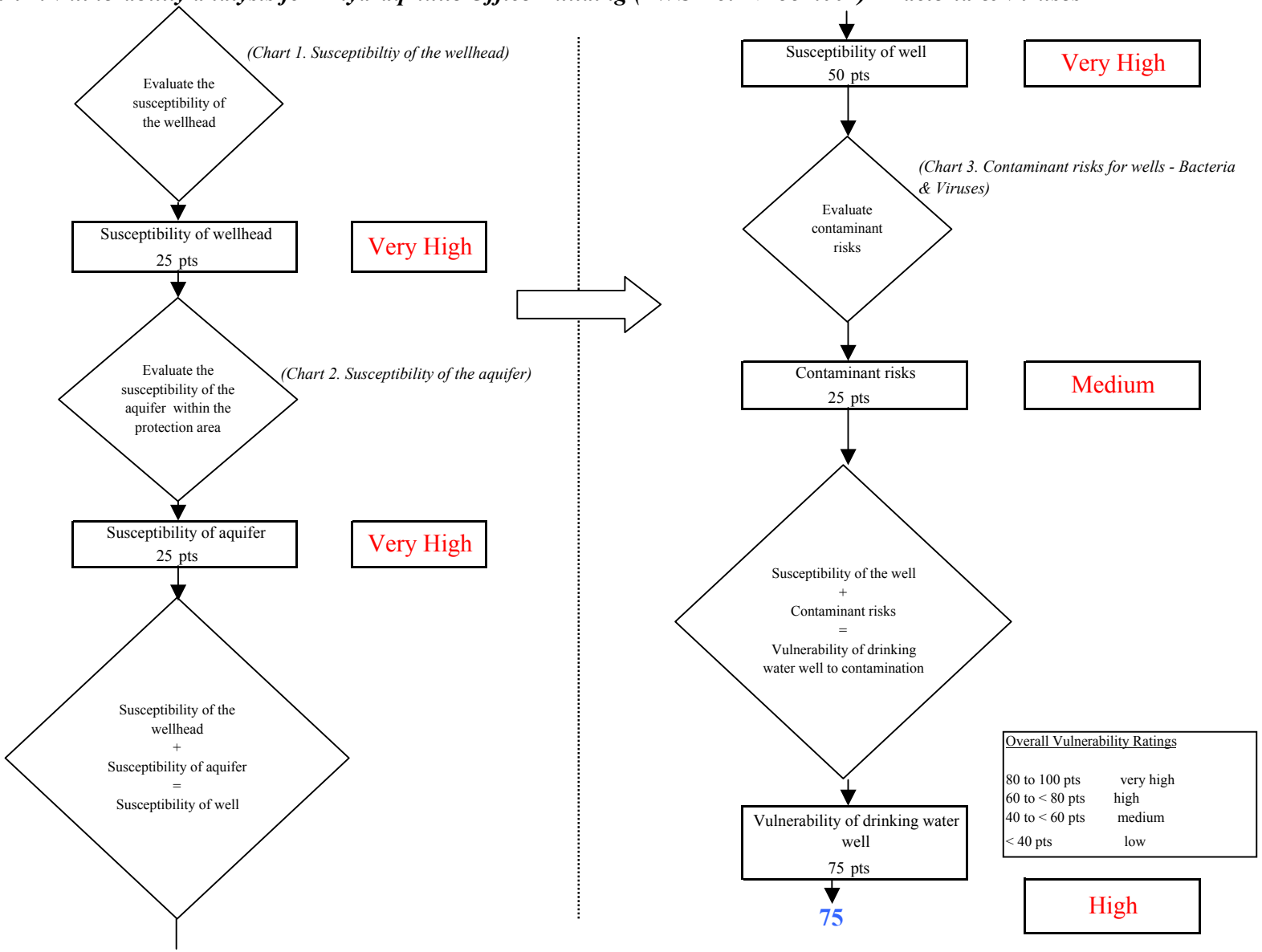


Chart 5. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Nitrates and Nitrites

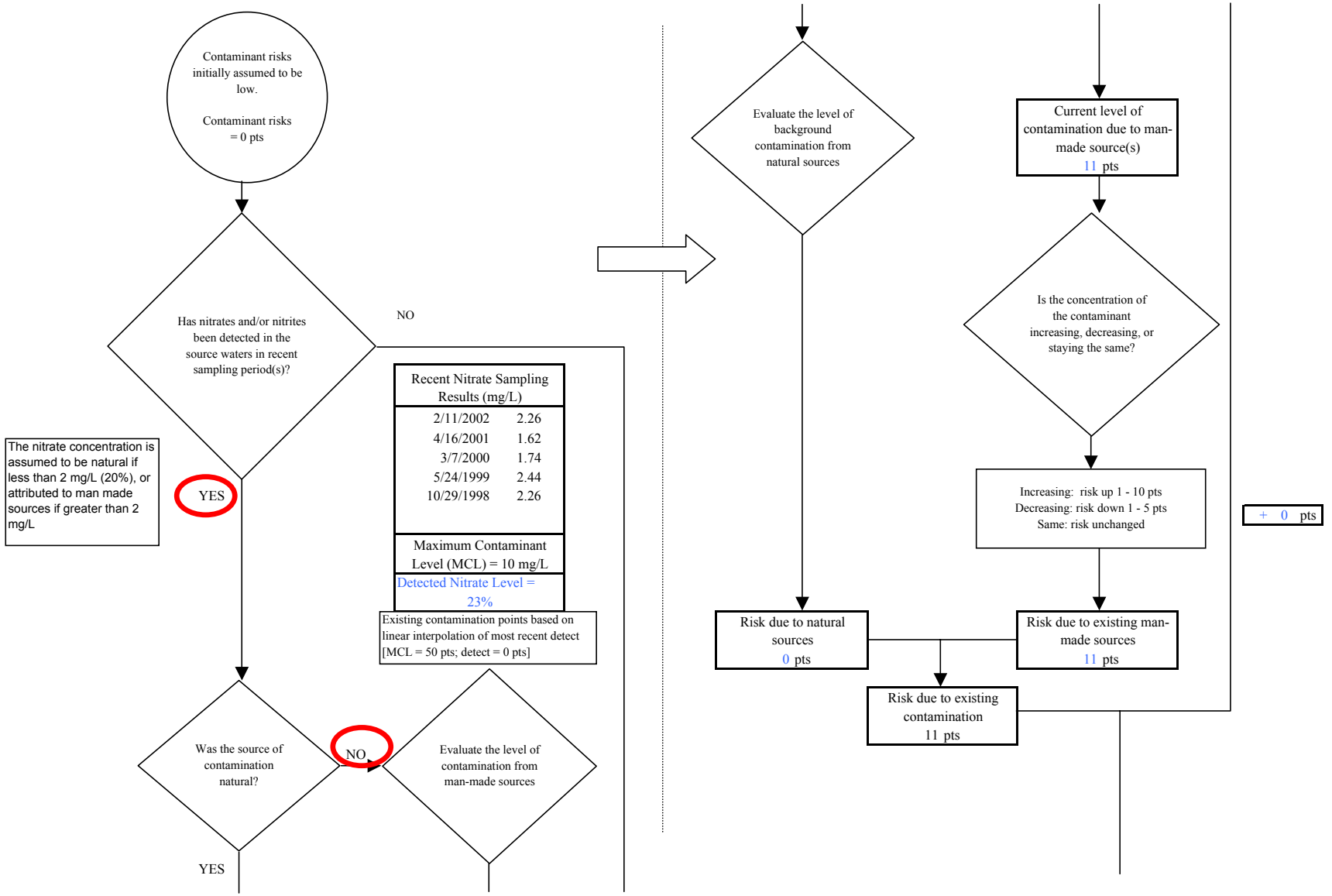
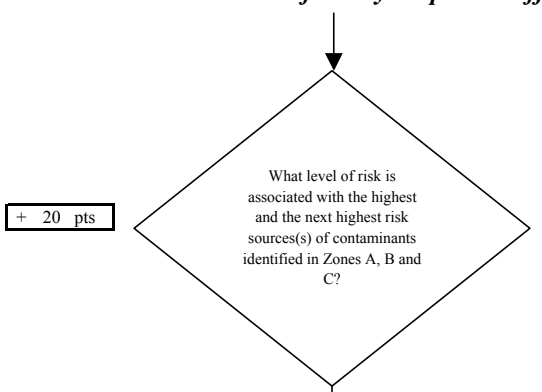


Chart 5. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Nitrates and Nitrites



+ 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)	1	0	1
Low(s)	0	1	1

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

Matrix Score 20

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

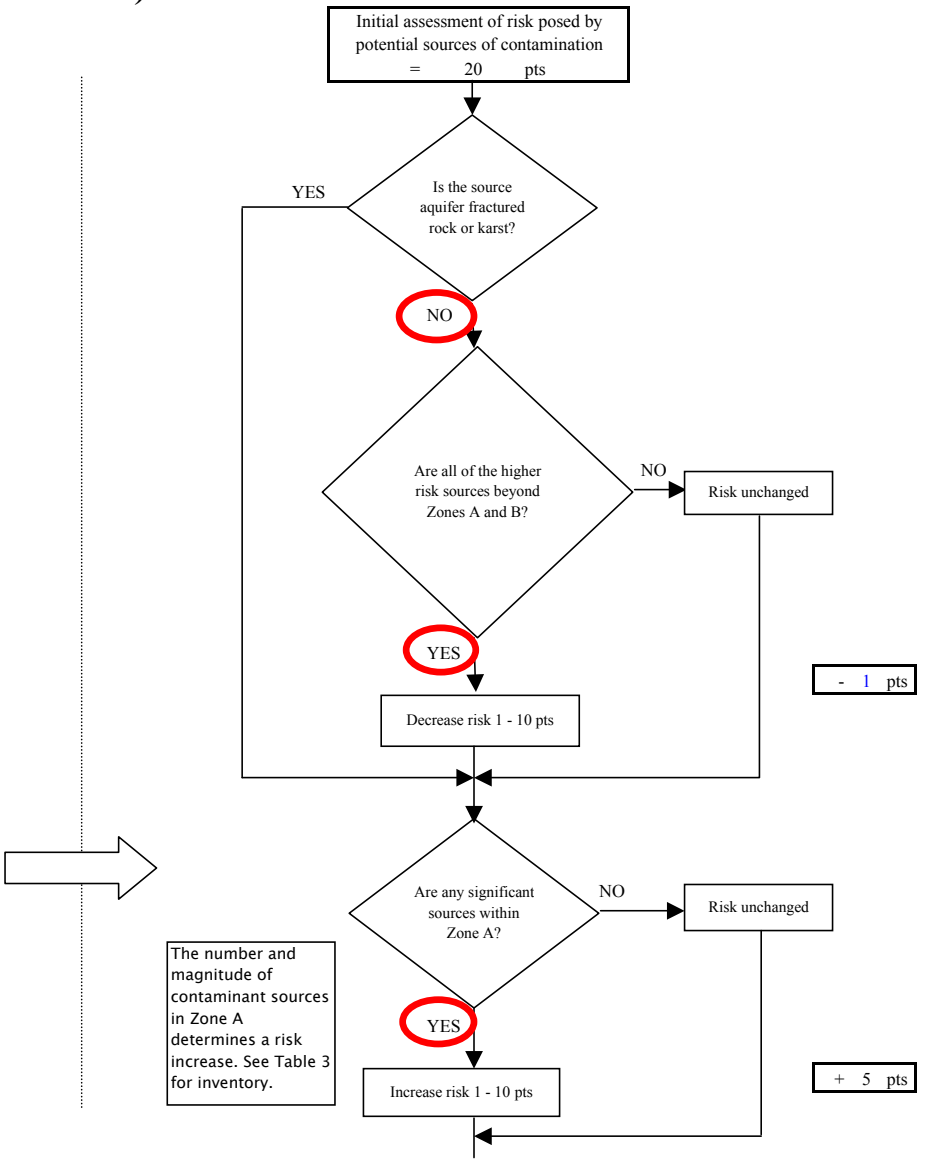


Chart 5. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Nitrates and Nitrites

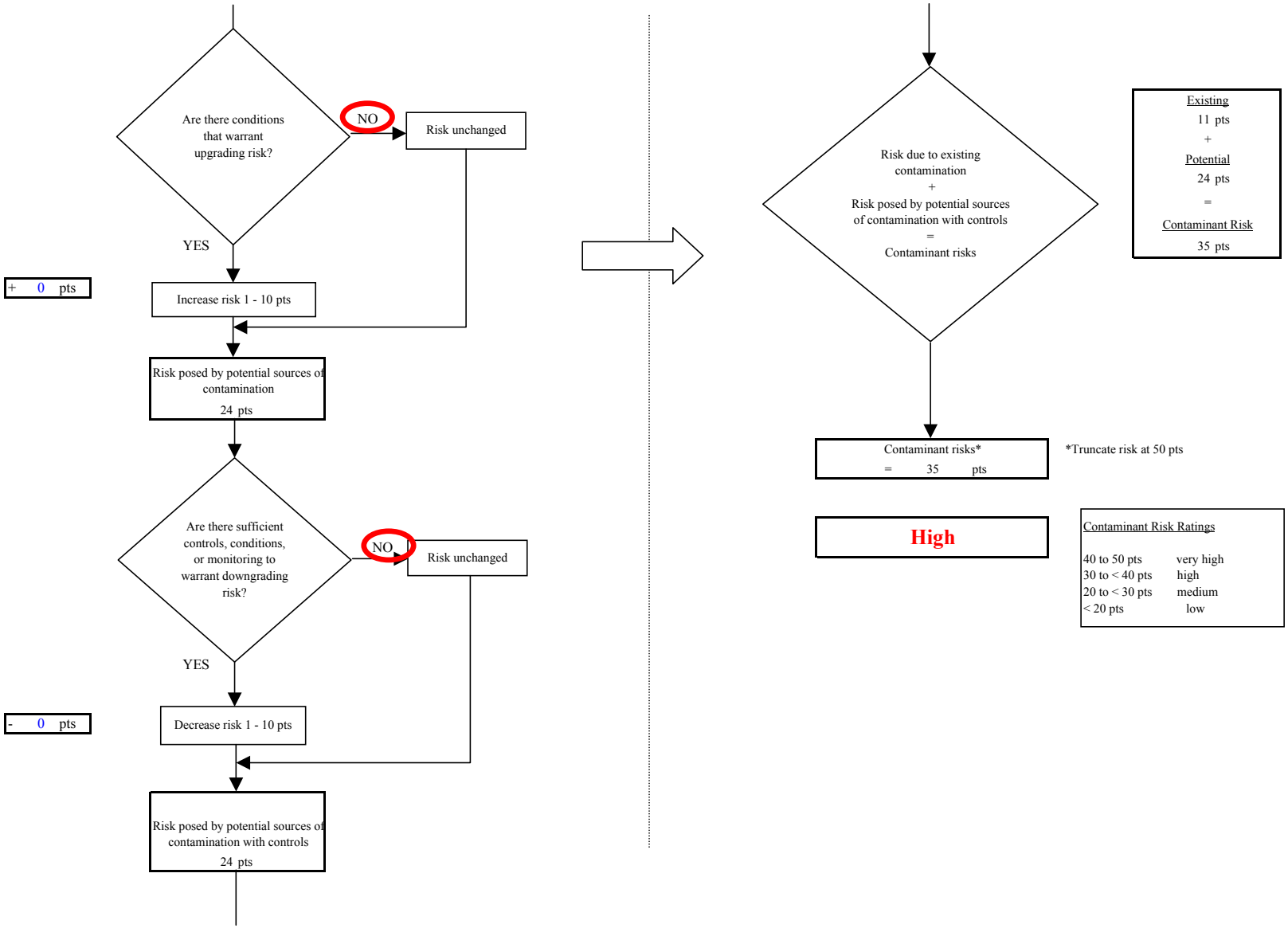


Chart 6. Vulnerability analysis for Anyaraqmuite Office Building (PWS No. 271554.001) - Nitrates and Nitrites

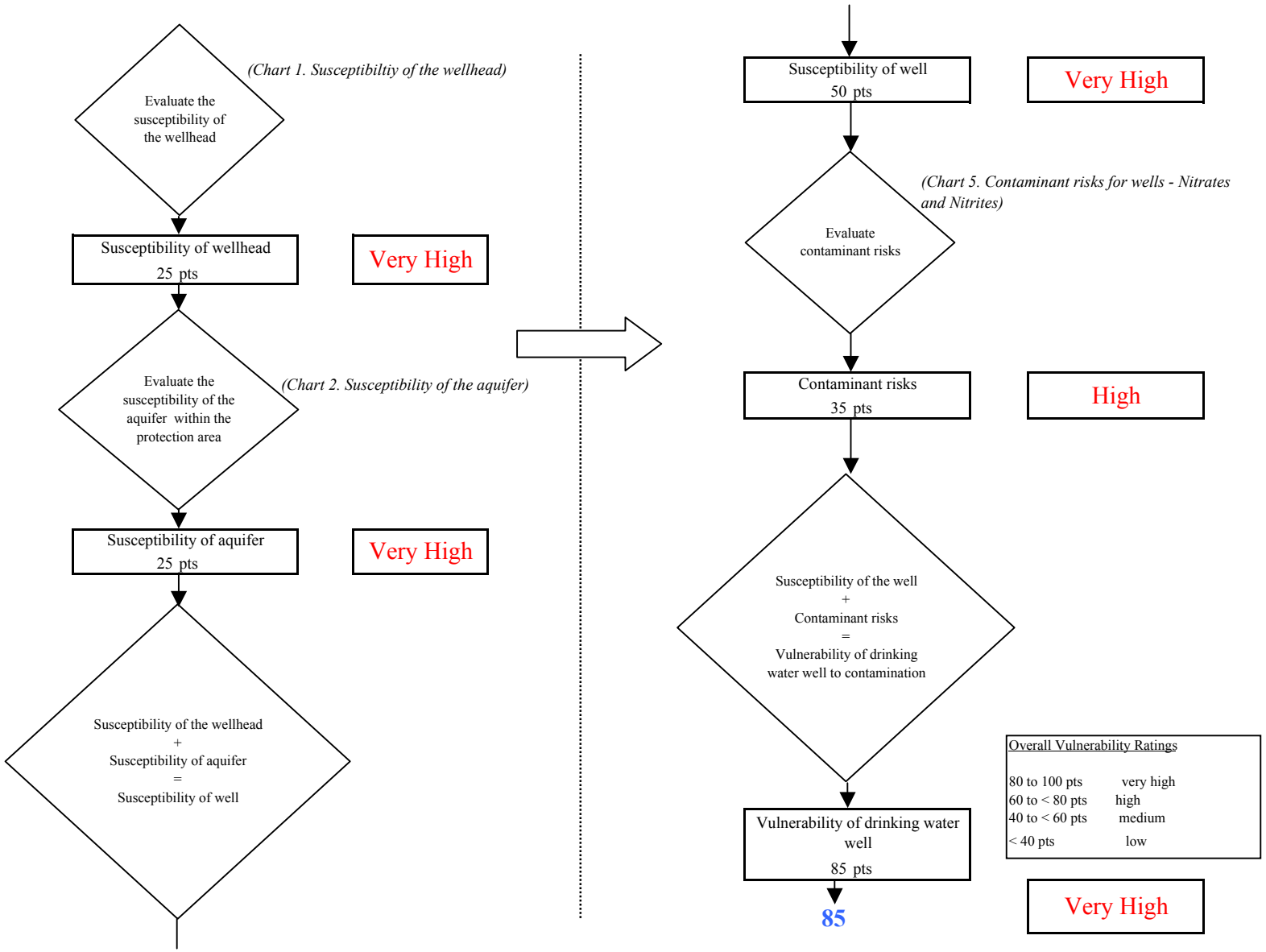


Chart 7. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Volatile Organic Chemicals

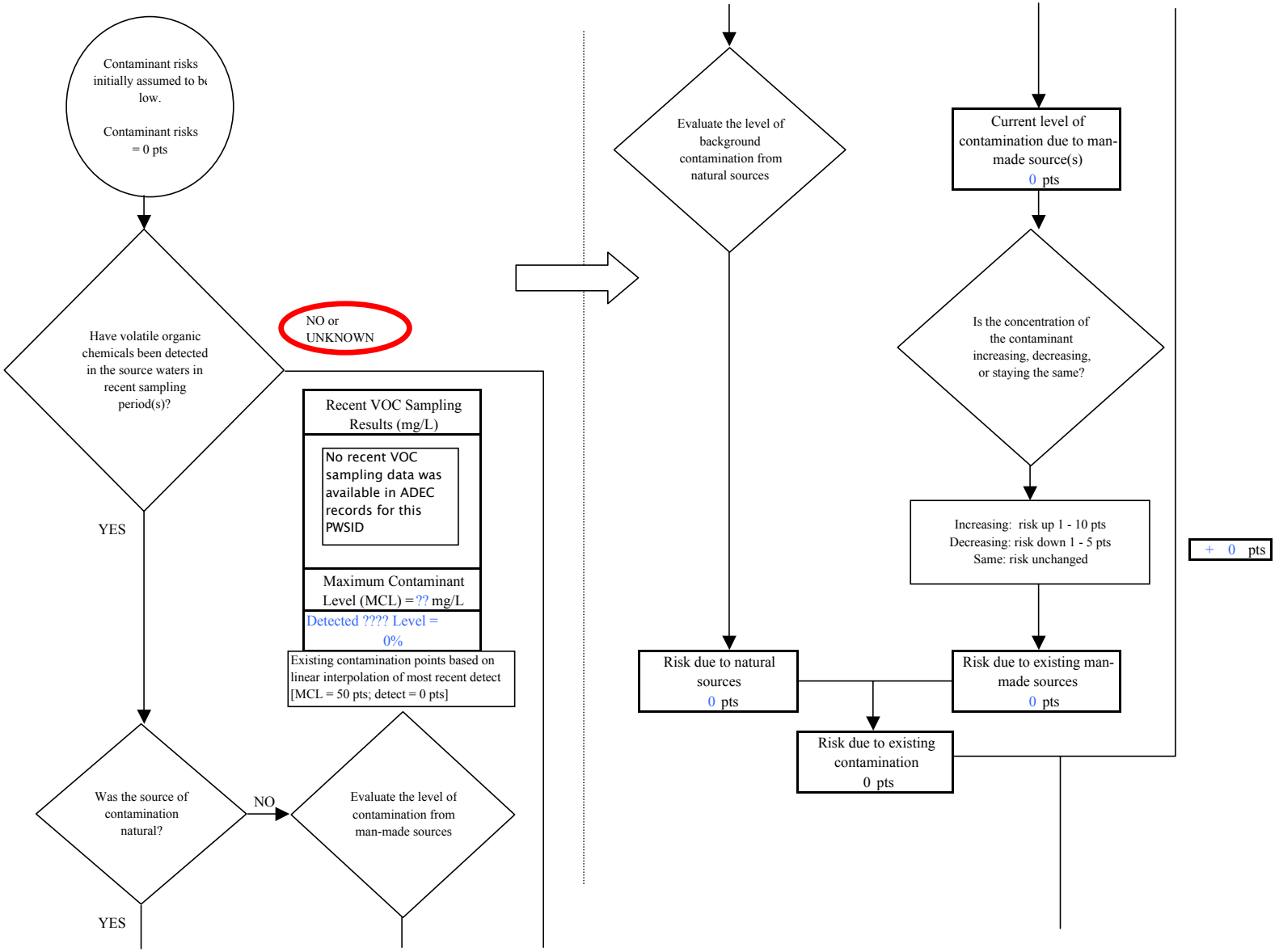


Chart 7. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Volatile Organic Chemicals

+ 40 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	2	2
Medium(s)	0	2	2
Low(s)	4	19	23

	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 40

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individua 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 = 40 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

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 4 for inventory.

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 7. Contaminant risks for Anyaraqmuite Office Building (PWS No. 271554.001) - Volatile Organic Chemicals

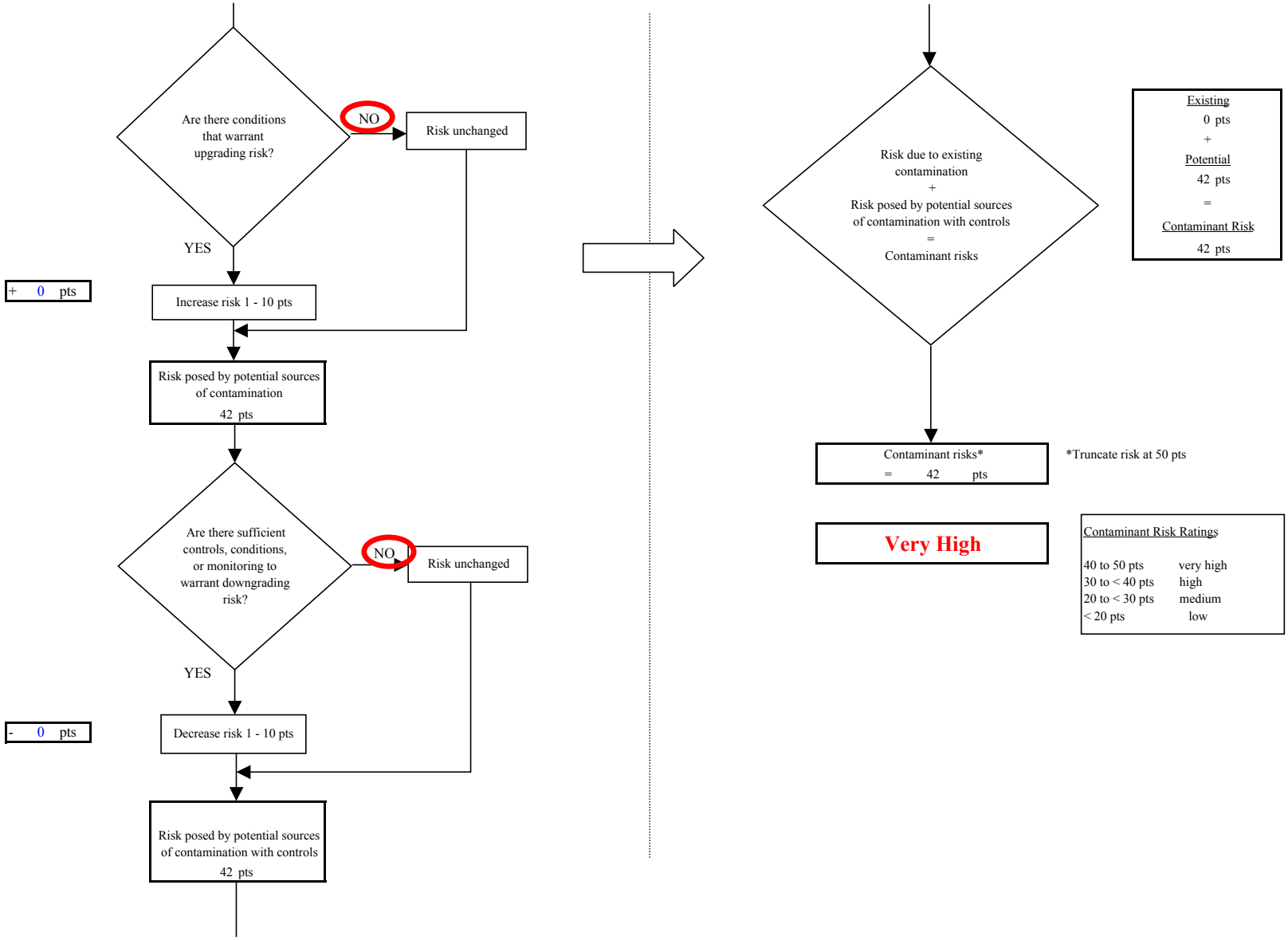


Chart 8. Vulnerability analysis for Anyaraqmuite Office Building (PWS No. 271554.001) - Volatile Organic Chemicals