Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for the Venetie Drinking Water System, Venetie, Alaska

PWSID # 300248.002

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1317
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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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Venetie Public Water System has one Public Water System (PWS) well. The well (PWS No. 300248.002) has been used as a drinking water source since it was drilled in December of 2003.

The well is a Class A (community and non-transient non-community) water system located approximately one-half mile southwest of the village of Venetie, Alaska. The 1999 sanitary survey indicates that there is a storage capacity of 428,000 gallons and that the water is chlorinated. This system operates year round and serves approximately 200 residents and 10 non-residents through 2 service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very 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: fuel tanks, landfills, a sewage lagoon, motor vehicle repair shops and bulk fuel facilities. A detailed inventory can be found in Table 1 of Appendix B. These identified potential and existing sources of contamination are considered 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 well received a vulnerability rating of **High** for 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.

PUBLIC DRINKING WATER SYSTEM

The Venetie Public Water System well is a Class A (community/non-transient/non-community) public water system. The system is approximately one-half mile southwest of the village of Venetie, Alaska (Sec. 10, T025N, R006E, Fairbanks Meridian, see Map A of Appendix A). Venetie is situated on the north bank of the Chandalar River. The community has a population of 199. Average annual precipitation in Venetie is 6.58 inches, including approximately 43.4 inches of snowfall. Temperatures can be as extreme as -60 to 97°F (ADCED, 2003).

The residents of Venetie haul all of their water supply from the community well after it is treated. Most households use honeybuckets (ADCED, 2003). Venetie receives electrical power from Venetie Village Electric; power-generating facilities are combined diesel and solar powered. Refuse is hauled by individuals to the Village Council operated landfill (ADCED, 2003).

According to information supplied by ADEC for the Venetie PWS, the depth of the well is 30 feet below the ground surface. Based on available well is screened and completed in a confined aquifer. The well is not located within a floodplain.

Information acquired from the May 1999 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 grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

Venetie lies on the northeast bank of the Chandalar River, near the base of the southern foothills of the Brooks Range. Gravelly glacial outwash from this range forms an alluvial fan underlying the area of the village. It is situated in the lowland area known as the Yukon Flats (Duane Miller & Associates, 2003).

On the northeast bank, the river has cut the alluvial deposits to form steep bluffs, rising 30 to 40 feet above the floodplain to a generally flat terrace. This terrace, on which the current Village is located, is uniformly composed of alluvial sand and gravel with varying amounts of silt. The granular material is overlain by 3 to 5 feet of eolian (wind blown) silt and

a thin organic mat (Duane Miller & Associates, 2003).

It its natural state, the entire area away from the river was probably underlain by permafrost; however, continued human activity and fires have altered the surface cover and caused significant permafrost degradation (Duane Miller & Associates, 2003).

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 Venetie 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 Venetie 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 Venetie PWS 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, and
- 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 7 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 Venetie PWS water well is completed 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	0	Low
Susceptibility of the Aquifer	22	Very High
Natural Susceptibility	22	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	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	45	Very High
Synthetic Organic Chemicals	50	Very High
Other Organic Chemicals	50	Very High

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

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

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed the presence of a sewage lagoon and two landfills located in Zones A and B. Numerous other potential contaminant sources are also found within the protection area (see Table 2 – Appendix B).

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination.

Positive bacteria counts have not 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 is primarily attributed to the presence of two landfills and a sewage lagoon located in Zones A and B. Numerous other potential contaminant sources are also found within the protection area (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 they did not exceed the MCL of 10mg/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 bulk fuel facilities and a landfill located in Zones A and B. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Detectable concentrations of xylenes and trihalomethanes were reported in sampling events for this public water system. However, the detectible concentrations of the analytes reported were well below their respective MCL's of 10 mg/L and 0.08 mg/L (See Chart 7 - Contaminant Risks for Volatile Organic Compounds in Appendix D).

A xylene is any of a group of very similar organic compounds. They are clear liquids with a sweet odor. The greatest use of xylenes is as a solvent which is much safer than benzene. Other uses include: in gasoline as part of the BTX component (benzene-toluene-xylene); Xylene mixtures are used to make phthalate plasticizers, polyester fiber, film and fabricated items. Short-term: EPA has found xylenes to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: disturbances of cognitive abilities, balance, and coordination. Long-term: Xylenes has the potential to cause the following effects from a lifetime exposure at levels above the MCL: damage to the central nervous system, liver and kidneys (EPA, 2002).

Trihalomethanes are considered byproducts of the water treatment process and are likely not representative of source water conditions. Since the reported concentration of TTHM's in recent sampling events did not exceed the applicable MCL, risk points were not retained.

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

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **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 two landfills in Zone B (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of copper and low levels of lead have been detected in recent sampling history, but have not exceeded their respective MCLs of 1.3 mg/L and 0.015 mg/L (see Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper and lead in recent sampling events are not likely to be representative of source water conditions. The presence of these analytes is likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on their presence.

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 **Very High**. The risk is primarily attributed to the landfills located in Zone B. 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 Venetie Public Water System (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 **High**.

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfills located in Zone B. Several 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 Venetie Public Water System (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 community of Venetie to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm

Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL http://www.state.ak.us/dec/dspar/csites/cs_search.htm

Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp

Duane Miller & Associates, dated August 13, 2003. Information from a Geotechnical Consultation, AEA Fuel System, Venetie, Alaska.

Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

United States Environmental Protection Agency (EPA, Office of Water). 2001, July 23. Retrieved February 2002 [WWW document]. http://www.epa.gov/safewater/ars/ars_rule_factsheet.html

APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

APPENDIX B

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

APPENDIX C

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

APPENDIX D

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

Public Water Well System for PWS # 300248.001 Venetie Water System

ZONE D

ZONE C

ZONE B

ZONE A

Venetie Water System
PWS 300248.001

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)
- Road Ferry Crossing

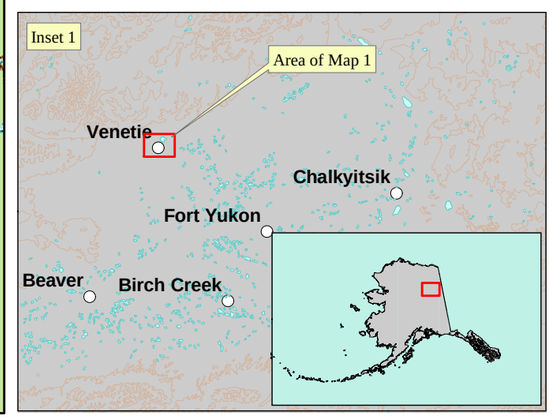
Groundwater Protection Zones

- Zone A - Several Months Travel Time
- Zone B - Two Years Travel Time
- Zone C - Five Years Travel Time
- Zone D - Ten 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.



0 0.4 0.8 1.6 2.4 3.2 Miles

Venetie Water System
PWS 300248.001
Appendix A Map A

Table 1

Contaminant Source Inventory for ***Venetie Water System***

PWSID 300248.00

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	C	Water Treatment at Washeteria
Motor /motor vehicle repair shops	C31	C31-01	A	C	School Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	C	Sewage Lagoon
Tanks, diesel (above ground)	T06	T06-01	A	C	School Generator
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Power Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	C	Radio Transmitter
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	C	Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	C	Shitzu Sarah Frank Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	C	Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	C	VENETIE SCHOOL; John Fredson School
Petroleum product bulk station/terminals	X11	X11-01	A	C	School Tank Farm
Petroleum product bulk station/terminals	X11	X11-02	A	C	Village Tank Farm
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1 - 20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	C	School Tank Farm
Electric power generation (fossil fuels)	X36	X36-01	A	C	Power Plant
Landfills (municipal; Class III)	D51	D51-01	B	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	C	Landfill/Incinerator
Tanks, diesel (above ground)	T06	T06-02	B	C	Generator at Council Office
Tanks, diesel (above ground)	T06	T06-03	B	C	Generator at Village Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	B	C	PHS Clinic

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	B	C	Village Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	B	C	Mission Service-Episcopal
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	B	C	Tribal Village Council Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	B	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	B	C	ARCS
Cemeteries	X01	X01-01	B	C	Cemetery
Municipal or city parks (with green areas)	X04	X04-01	B	C	Community Gardens
Petroleum product bulk station/terminals	X11	X11-03	B	C	Village Council Tank Farm
Airports	X14	X14-01	B	C	Former Airstrip
Airports	X14	X14-01	B	C	VENETIE LANDING STRIP
Pipelines (oil and gas)	X28	X28-02	B	C	Airport Header
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-01	B	C	PHS Clinic

Table 2

Contaminant Source Inventory and Risk Ranking for Venetie Water System
Sources of Bacteria and Viruses

PWSID 300248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	Water Treatment at Washeteria
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	Sewage Lagoon
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	High	C	Landfill/Incinerator
Municipal or city parks (with green areas)	X04	X04-01	B	Medium	C	Community Gardens
Medical/veterinary facilities (doctor or dentist offic hospitals, nursing homes)	X40	X40-01	B	Medium	C	PHS Clinic

Table 3

Contaminant Source Inventory and Risk Ranking for Venetie Water System
Sources of Nitrates/Nitrites

PWSID 300248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	Water Treatment at Washeteria
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	High	C	Sewage Lagoon
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	Very High	C	Landfill/Incinerator
Cemeteries	X01	X01-01	B	Medium	C	Cemetery
Municipal or city parks (with green areas)	X04	X04-01	B	Medium	C	Community Gardens
Airports	X14	X14-01	B	Low	C	Former Airstrip
Airports	X14	X14-01	B	Low	C	VENETIE LANDING STRIP
Medical/veterinary facilities (doctor or dentist offic hospitals, nursing homes)	X40	X40-01	B	Low	C	PHS Clinic

Table 4

Contaminant Source Inventory and Risk Ranking for Venetie Water System

Sources of Volatile Organic Chemicals

PWSID 300248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Laundromats without dry cleaning	C22	C22-01	A	Low	C	Water Treatment at Washeteria
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	School Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Tanks, diesel (above ground)	T06	T06-01	A	Medium	C	School Generator
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Power Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Radio Transmitter
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	Shitzu Sarah Frank Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	VENETIE SCHOOL; John Fredson School
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	School Tank Farm
Petroleum product bulk station/terminals	X11	X11-02	A	Very High	C	Village Tank Farm
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Medium	C	School Tank Farm
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	Power Plant
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	High	C	Landfill/Incinerator
Tanks, diesel (above ground)	T06	T06-02	B	Medium	C	Generator at Council Office
Tanks, diesel (above ground)	T06	T06-03	B	Medium	C	Generator at Village Store

Table 4 (continued)

Contaminant Source Inventory and Risk Ranking for Venetie Water System

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	T14-08	B	Low	C	PHS Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	B	Low	C	Village Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	B	Low	C	Mission Service-Episcopal
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	B	Low	C	Tribal Village Council Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	B	Low	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	B	Low	C	ARCS
Petroleum product bulk station/terminals	X11	X11-03	B	Very High	C	Village Council Tank Farm
Airports	X14	X14-01	B	High	C	Former Airstrip
Airports	X14	X14-01	B	High	C	VENETIE LANDING STRIP
Pipelines (oil and gas)	X28	X28-02	B	Medium	C	Airport Header
Medical/veterinary facilities (doctor or dentist offic hospitals, nursing homes)	X40	X40-01	B	Low	C	PHS Clinic

Table 5

Contaminant Source Inventory and Risk Ranking for Venetie Water System

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 300248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	School Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Power Plant
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Low	C	Radio Transmitter
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Low	C	Teachers Quarters
Tanks, heating oil, nonresidential (aboveground)	T14	T14-04	A	Low	C	Church
Tanks, heating oil, nonresidential (aboveground)	T14	T14-05	A	Low	C	Shitzu Sarah Frank Community Hall
Tanks, heating oil, nonresidential (aboveground)	T14	T14-06	A	Low	C	Shop
Tanks, heating oil, nonresidential (aboveground)	T14	T14-07	A	Low	C	VENETIE SCHOOL; John Fredson School
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	School Tank Farm
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	Village Tank Farm
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Low	C	School Tank Farm
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	Power Plant
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	High	C	Landfill/Incinerator
Tanks, heating oil, nonresidential (aboveground)	T14	T14-08	B	Low	C	PHS Clinic
Tanks, heating oil, nonresidential (aboveground)	T14	T14-09	B	Low	C	Village Store
Tanks, heating oil, nonresidential (aboveground)	T14	T14-10	B	Low	C	Mission Service-Episcopal
Tanks, heating oil, nonresidential (aboveground)	T14	T14-11	B	Low	C	Tribal Village Council Office

Contaminant Source Inventory and Risk Ranking for Venetie Water System

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-12	B	Low	C	Post Office
Tanks, heating oil, nonresidential (aboveground)	T14	T14-13	B	Low	C	ARCS
Cemeteries	X01	X01-01	B	Low	C	Cemetery
Municipal or city parks (with green areas)	X04	X04-01	B	Low	C	Community Gardens
Petroleum product bulk station/terminals	X11	X11-03	B	Low	C	Village Council Tank Farm
Airports	X14	X14-01	B	Low	C	VENETIE LANDING STRIP
Airports	X14	X14-01	B	Low	C	Former Airstrip
Pipelines (oil and gas)	X28	X28-02	B	Low	C	Airport Header
Medical/veterinary facilities (doctor or dentist offic hospitals, nursing homes)	X40	X40-01	B	Low	C	PHS Clinic

Table 6

Contaminant Source Inventory and Risk Ranking for Venetie Water System
Sources of Synthetic Organic Chemicals

PWSID 300248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	School Tank Farm
Petroleum product bulk station/terminals	X11	X11-02	A	Low	C	Village Tank Farm
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	Very High	C	Landfill/Incinerator
Cemeteries	X01	X01-01	B	Medium	C	Cemetery
Municipal or city parks (with green areas)	X04	X04-01	B	Low	C	Community Gardens
Petroleum product bulk station/terminals	X11	X11-03	B	Low	C	Village Council Tank Farm
Airports	X14	X14-01	B	Medium	C	Former Airstrip
Airports	X14	X14-01	B	Medium	C	VENETIE LANDING STRIP
Medical/veterinary facilities (doctor or dentist offic hospitals, nursing homes)	X40	X40-01	B	Low	C	PHS Clinic

Table 7

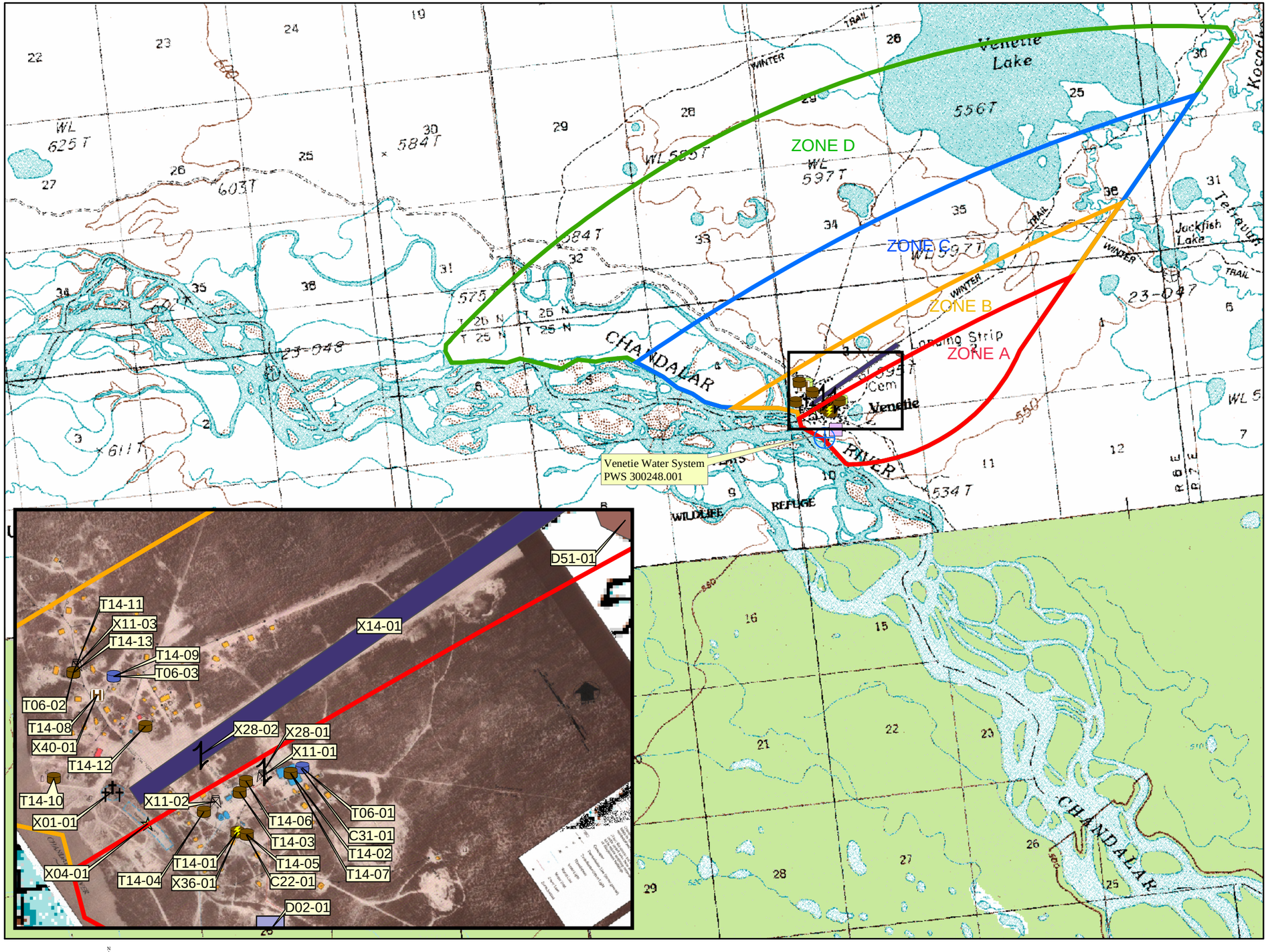
Contaminant Source Inventory and Risk Ranking for Venetie Water System

Sources of Other Organic Chemicals

PWSID 300248.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	School Shop
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	A	Low	C	Sewage Lagoon
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	School Tank Farm
Petroleum product bulk station/terminals	X11	X11-02	A	High	C	Village Tank Farm
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1 - 20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	High	C	School Tank Farm
Electric power generation (fossil fuels)	X36	X36-01	A	High	C	Power Plant
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Venetie
Landfills (municipal; Class III)	D51	D51-02	B	Very High	C	Landfill/Incinerator
Petroleum product bulk station/terminals	X11	X11-03	B	High	C	Village Council Tank Farm
Airports	X14	X14-01	B	Medium	C	VENETIE LANDING STRIP
Airports	X14	X14-01	B	Medium	C	Former Airstrip
Pipelines (oil and gas)	X28	X28-02	B	High	C	Airport Header

Public Water Well System for PWS # 300248.001 Venetie Water System
Sources of Existing or Potential Contamination



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Aqueduct or Pipeline
- Lake or Pond
- Glacier
- Contours

Transportation

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

Groundwater Protection Zones

- Zone A - Several Months Travel Time
- Zone B - Two Years Travel Time
- Zone C - Five Years Travel Time
- Zone D - Ten Years Travel Time

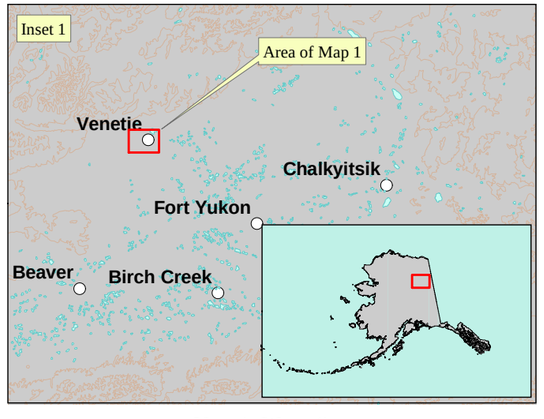
Existing or Potential Contaminant Sources

- Laundromat without dry cleaning (C22)
- Motor/motor vehicle repair facilities (C31)
- Tanks, diesel (aboveground) (T06)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Cemetery (X01)
- Municipal or city parks (X04)
- Petroleum product bulk station/terminals (X11)
- Pipeline, oil or gas (X28)
- Electric power generation (X36)
- Medical/veterinary facility (doctor, dentist, nursing home) (X40)
- Domestic Wastewater Treatment pond or lagoon (D02)
- Landfill, municipal, Class III (D51)
- Airport or landing strip (X14)

Data Sources:
- Contaminant Sources, Public Water System Wells, Contours Alaska Department of Environmental Conservation (ADEC)
- Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
- United States Geological Survey (USGS)
- Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

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



0 0.4 0.8 1.6 2.4 3.2 Miles

Venetie Water System
PWS 300248.001
Appendix C Map C

Chart 1. Susceptibility of the wellhead - Venetie Water System (PWS No. 300248.001)

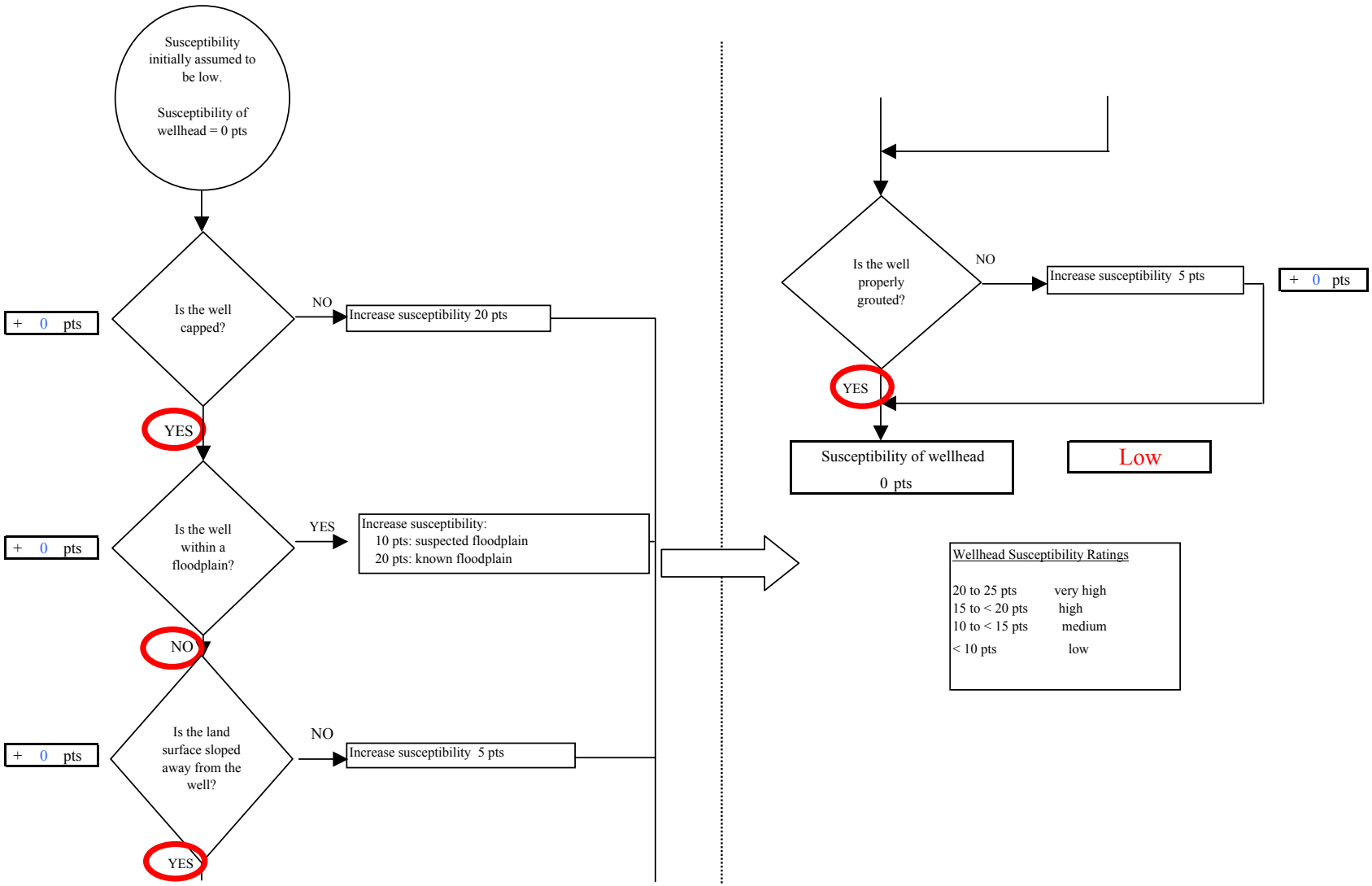


Chart 2. Susceptibility of the aquifer Venetie Water System (PWS No. 300248.001)

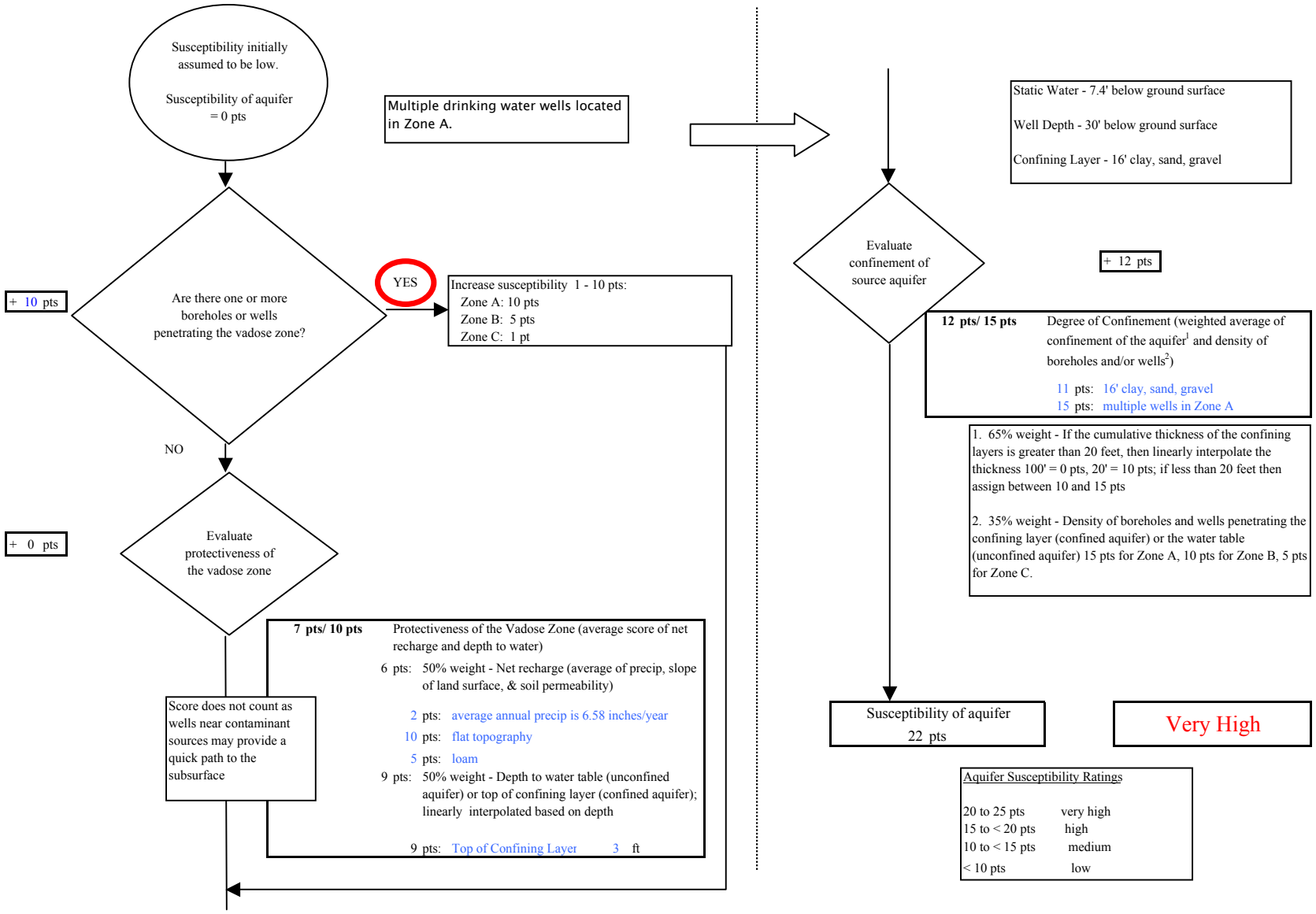
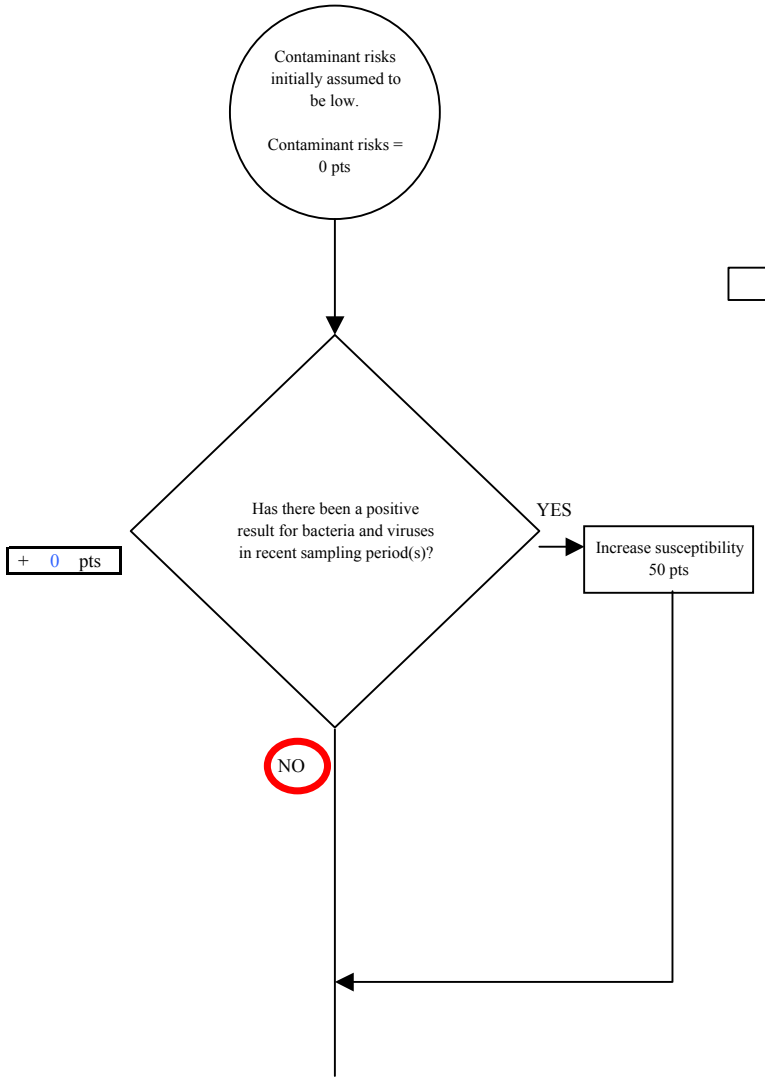
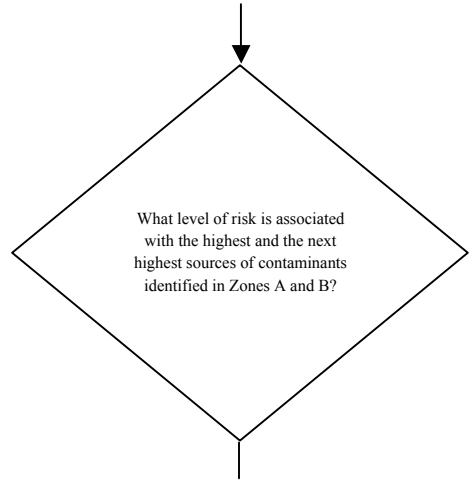


Chart 3. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Bacteria & Viruses





+ 40 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	2	3
Medium(s)	0	2	2
Low(s)	2	0	2

	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 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 Venetie Water System (PWS No. 300248.001) - Bacteria & Viruses

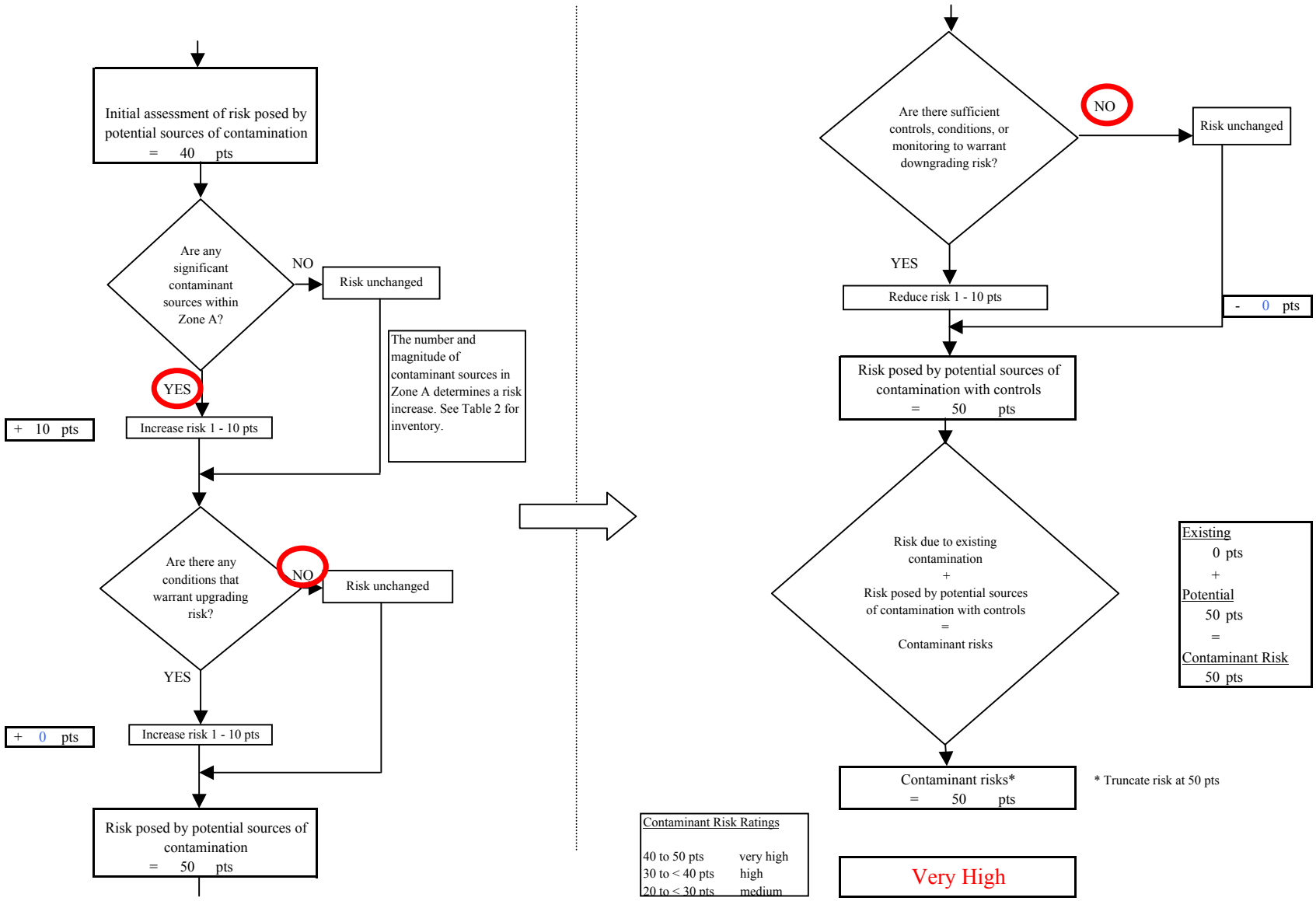


Chart 4. Vulnerability analysis for Venetie Water System (PWS No. 300248.001) - Bacteria & Viruses

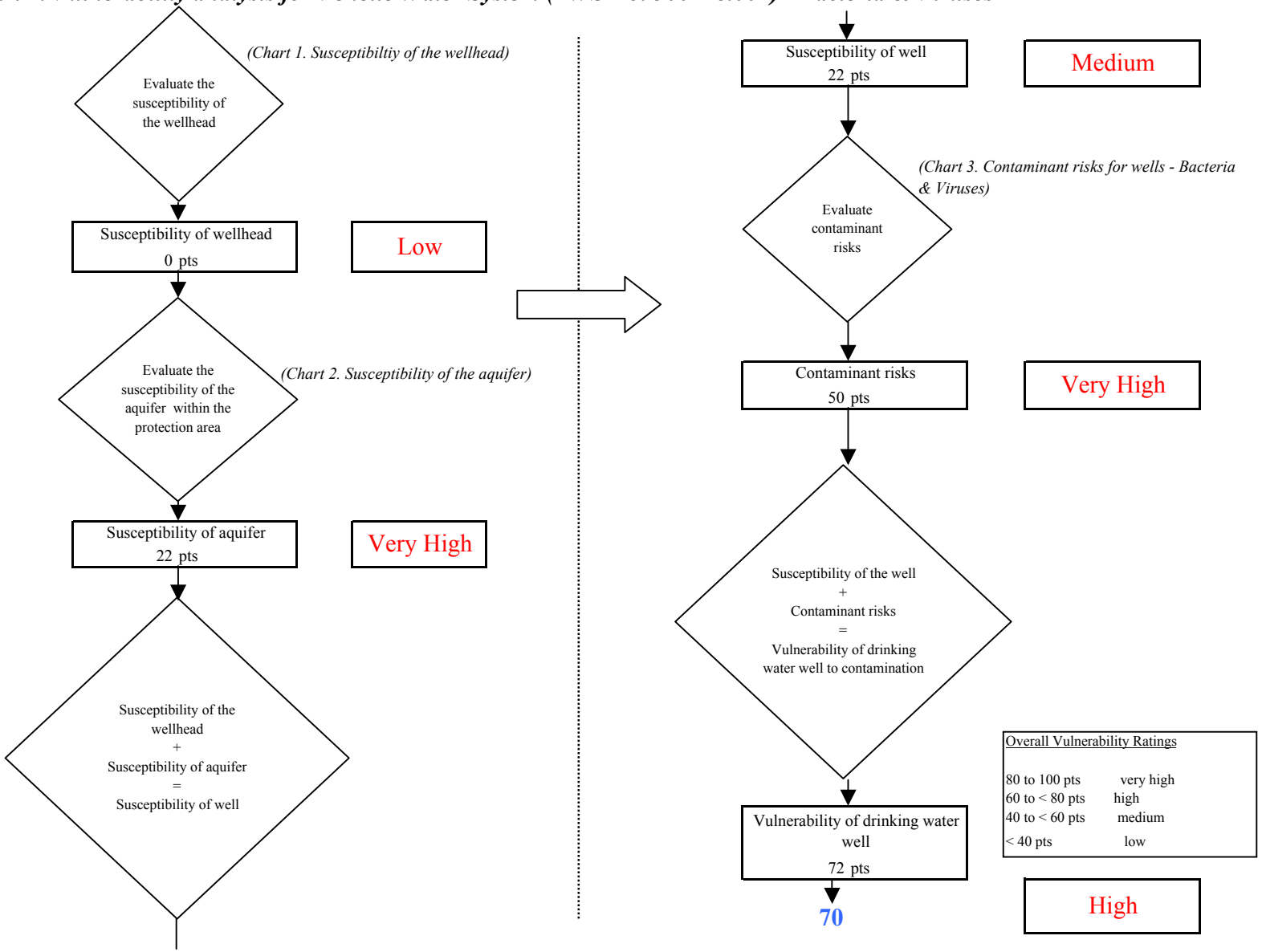


Chart 5. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Nitrates and Nitrites

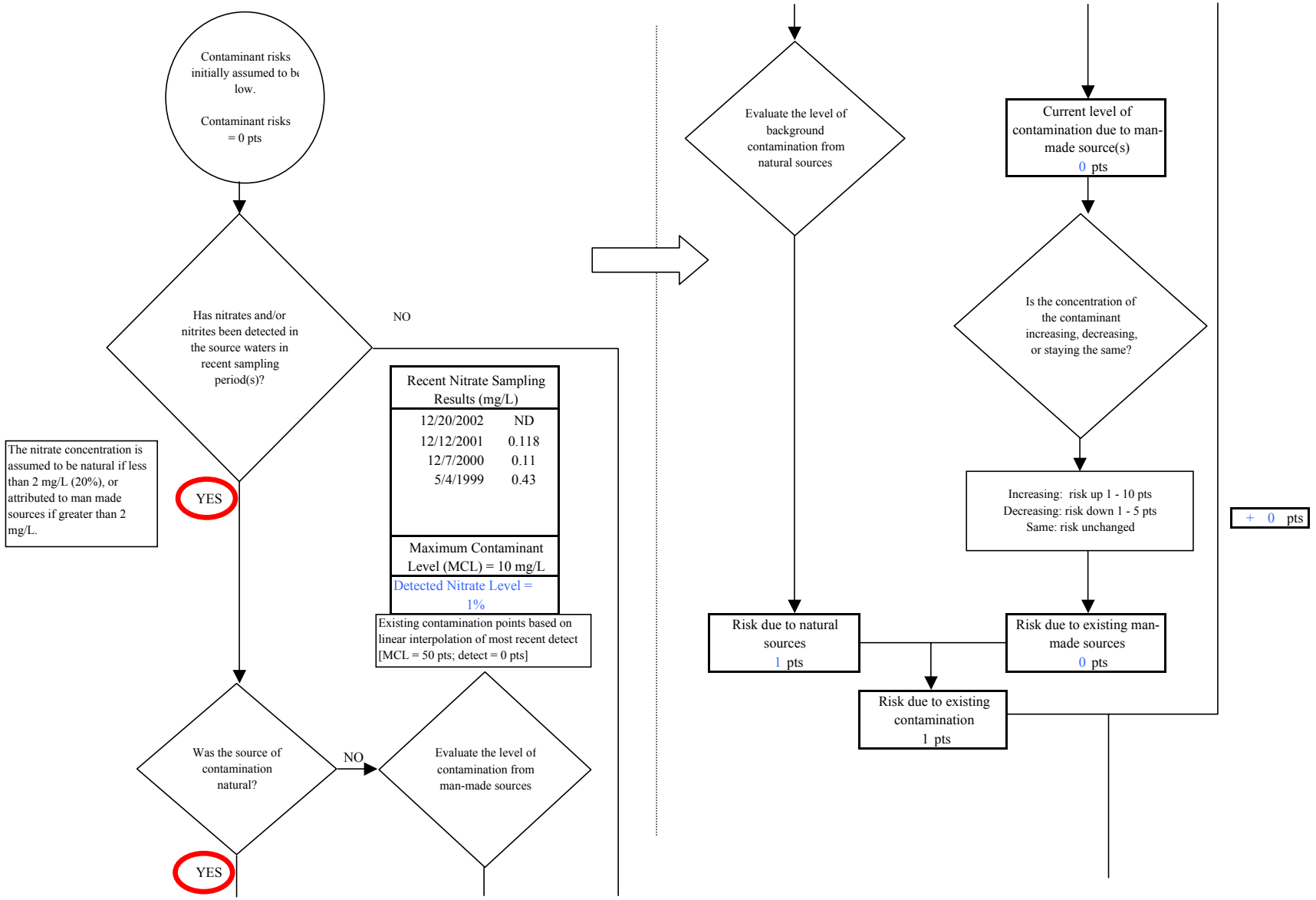
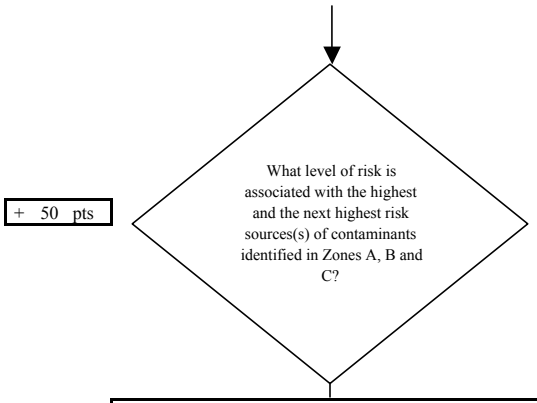


Chart 5. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Nitrates and Nitrites



+ 50 pts

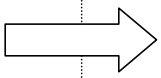
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	2	2
High(s)	1	0	1
Medium(s)	0	2	2
Low(s)	2	3	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 50

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.



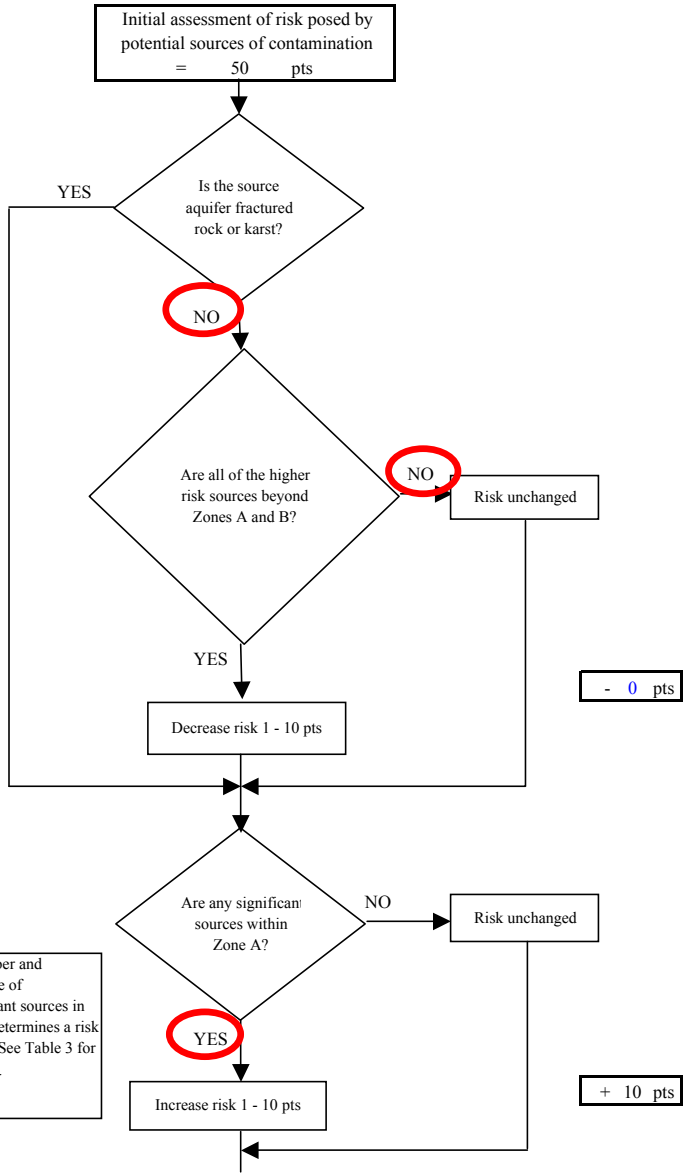


Chart 5. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Nitrates and Nitrites

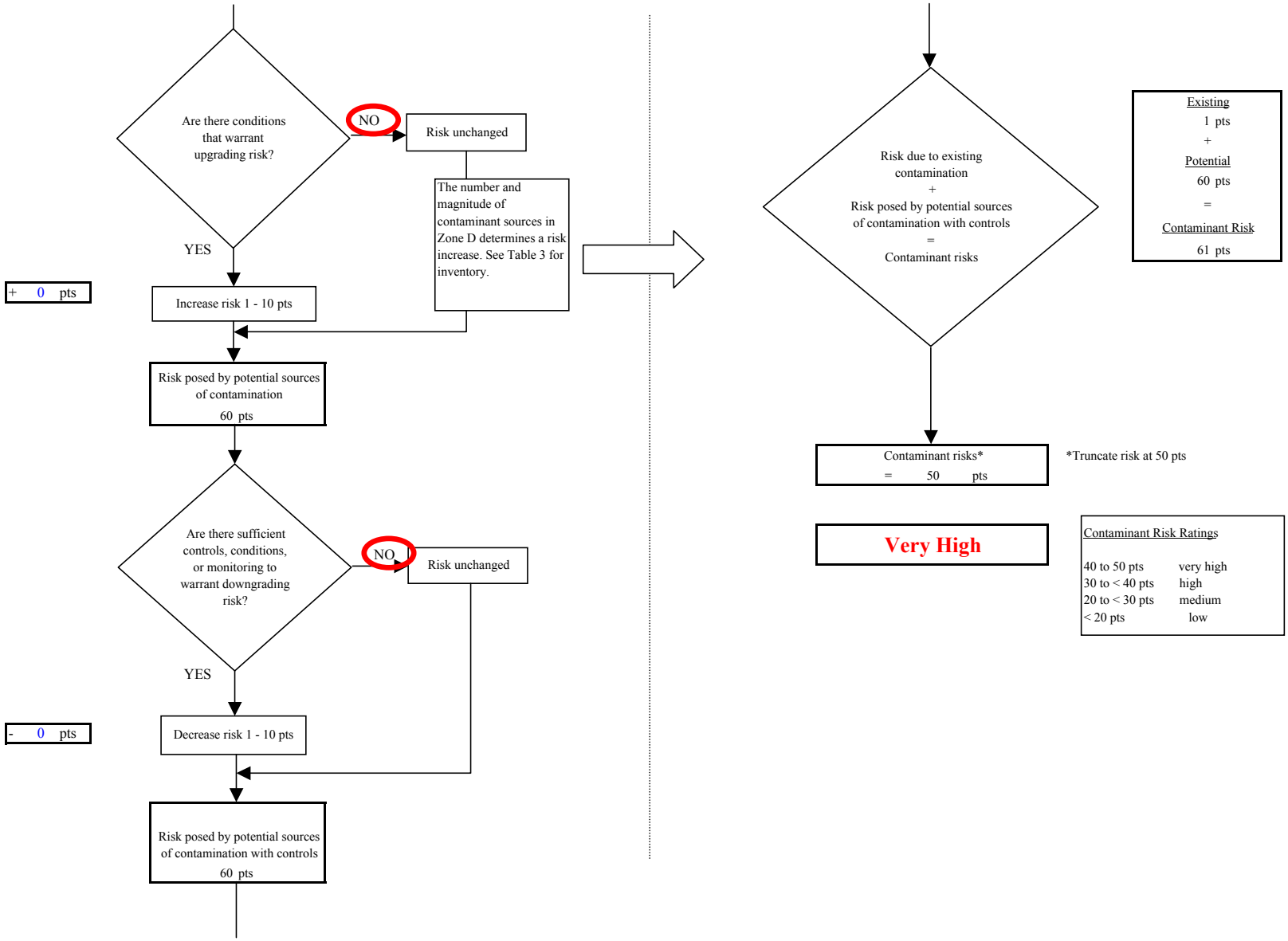


Chart 6. Vulnerability analysis for Venetie Water System (PWS No. 300248.001) - Nitrates and Nitrites

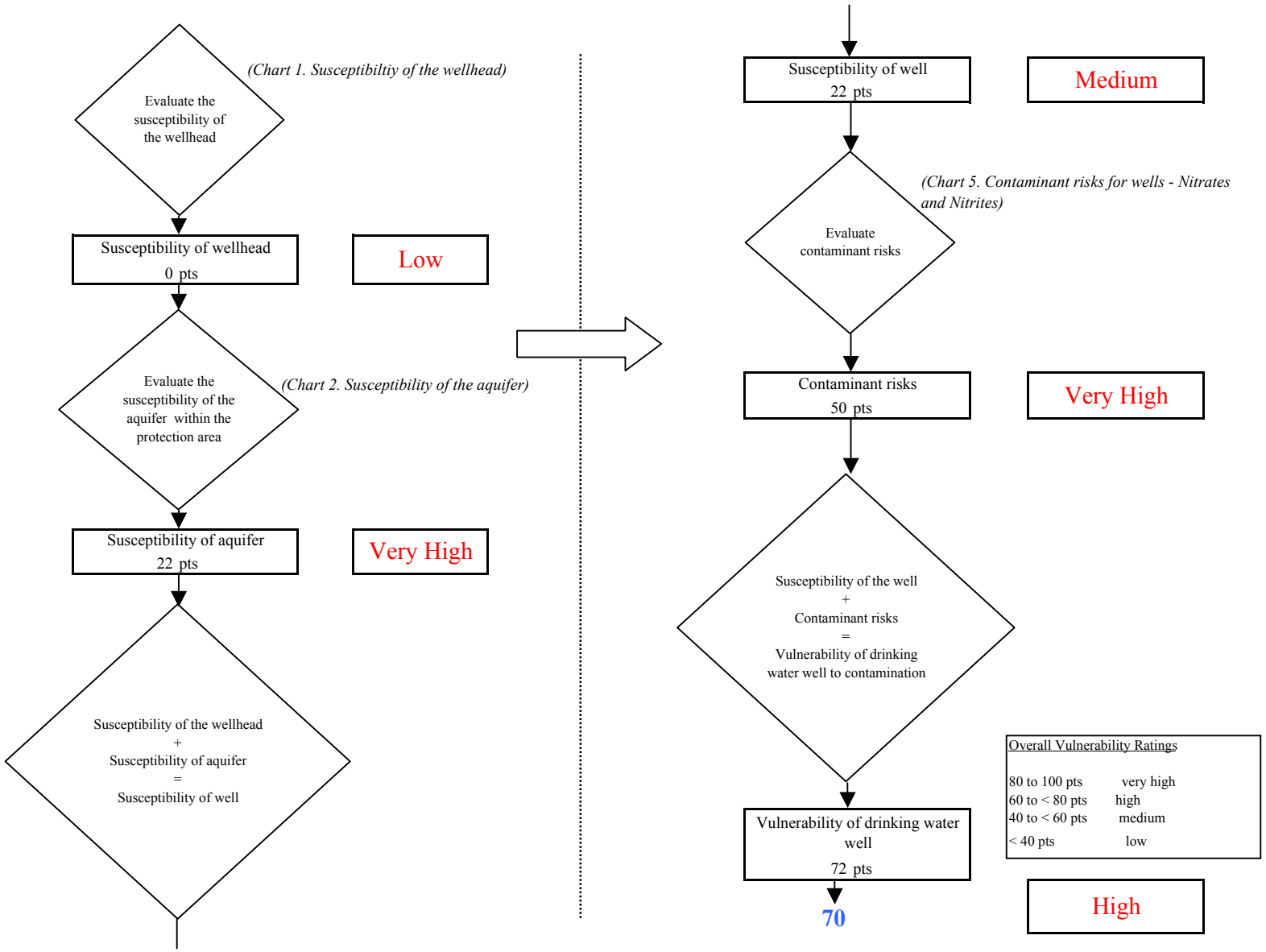


Chart 7. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Volatile Organic Chemicals

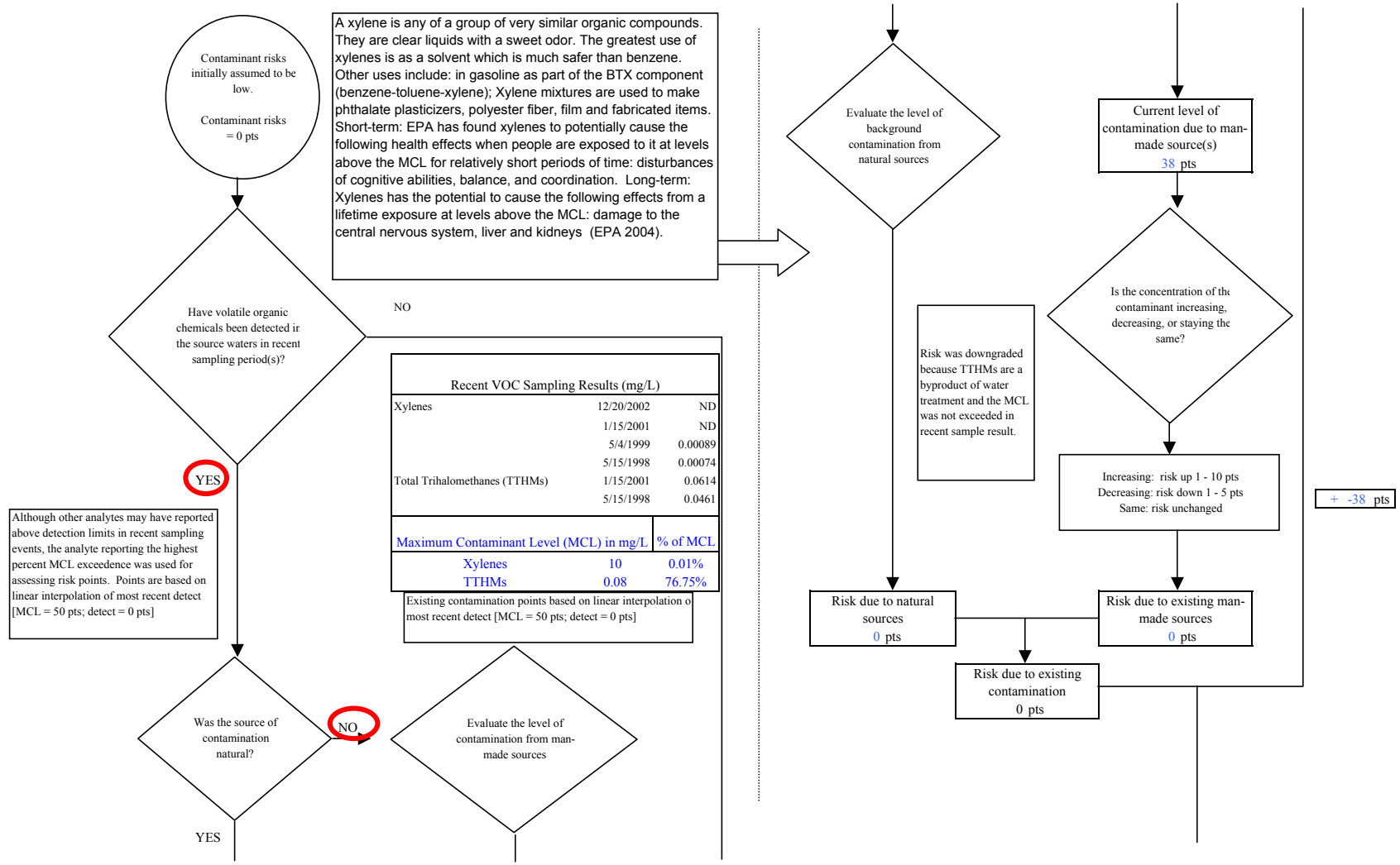
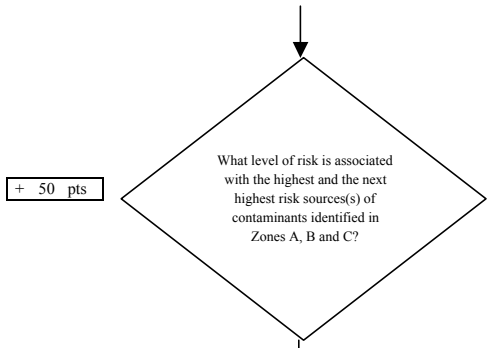


Chart 7. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Volatile Organic Chemicals



+ 50 pts

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

	Zone A	Zones B&C	Total
Very Highs(s)	2	1	3
High(s)	0	4	4
Medium(s)	4	3	7
Low(s)	10	7	17

	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 50

Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in tl 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.

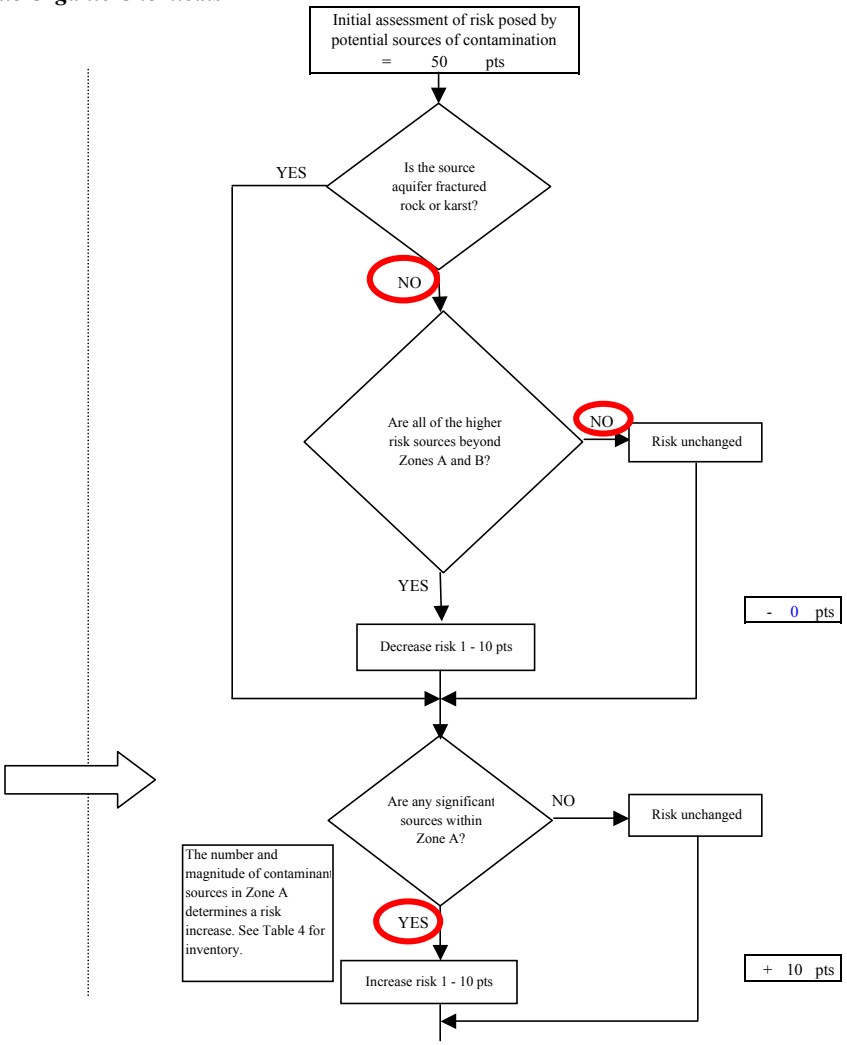


Chart 7. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Volatile Organic Chemicals

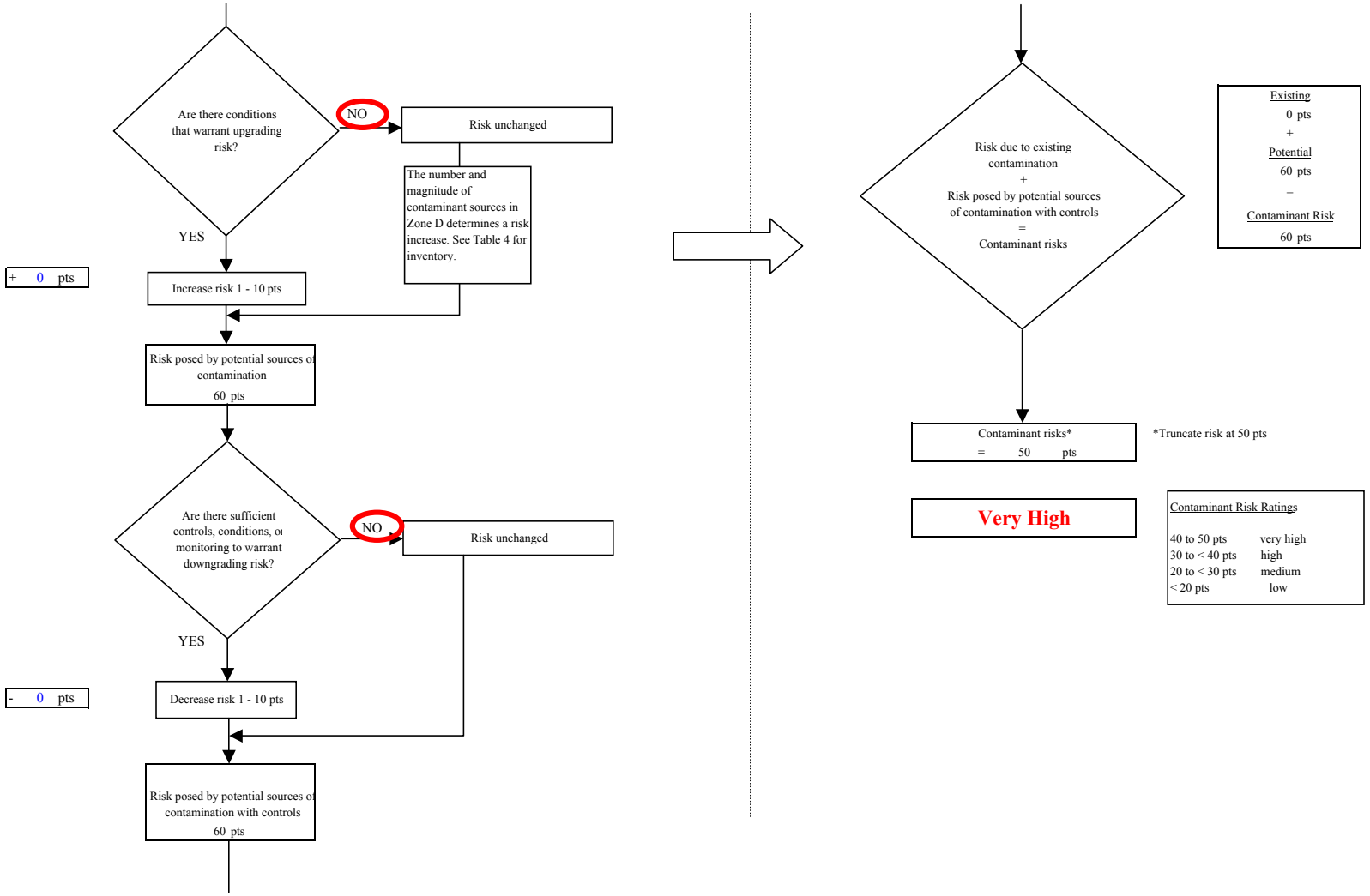


Chart 8. Vulnerability analysis for Venetie Water System (PWS No. 300248.001) - Volatile Organic Chemicals

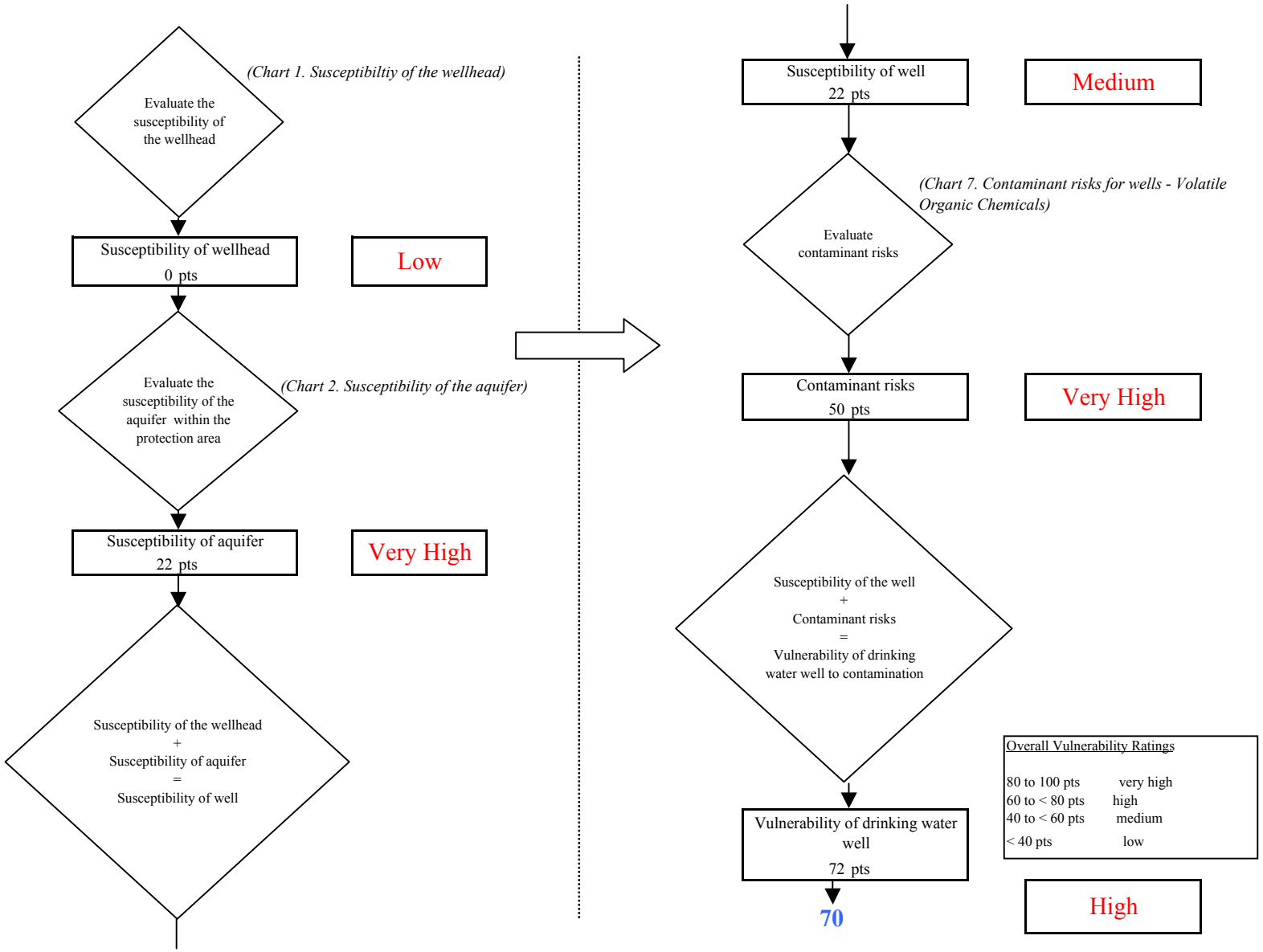


Chart 9. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

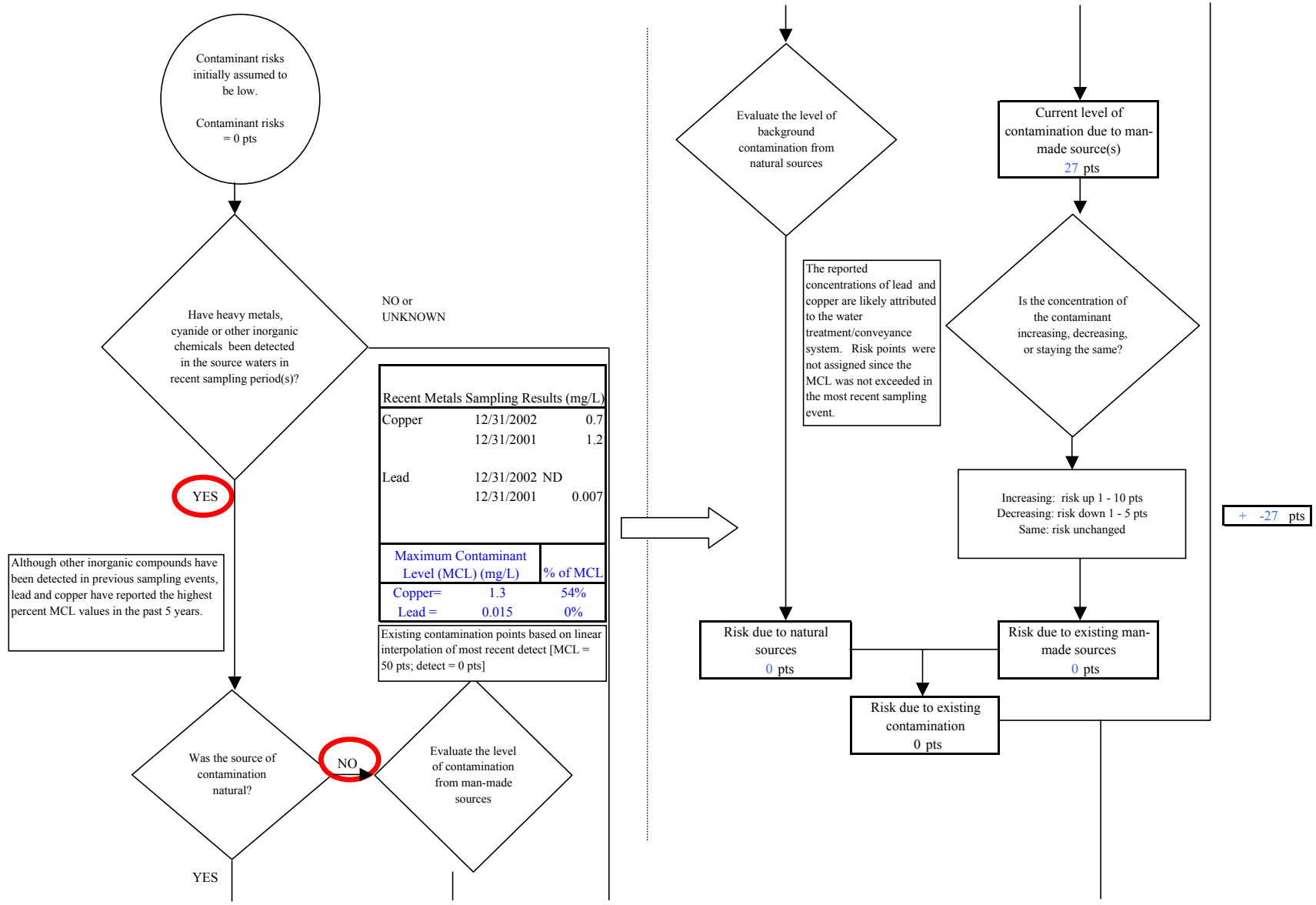
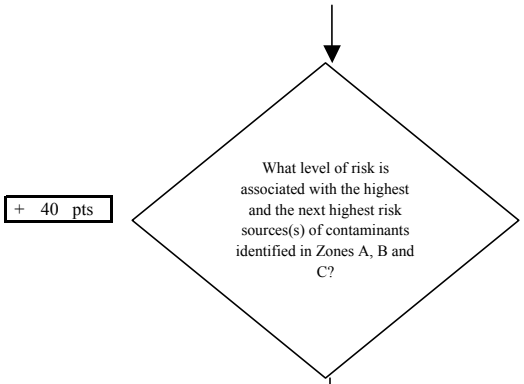


Chart 9. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 40 pts

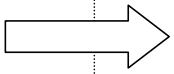
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	2	2
Medium(s)	2	0	2
Low(s)	12	13	25

	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 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.



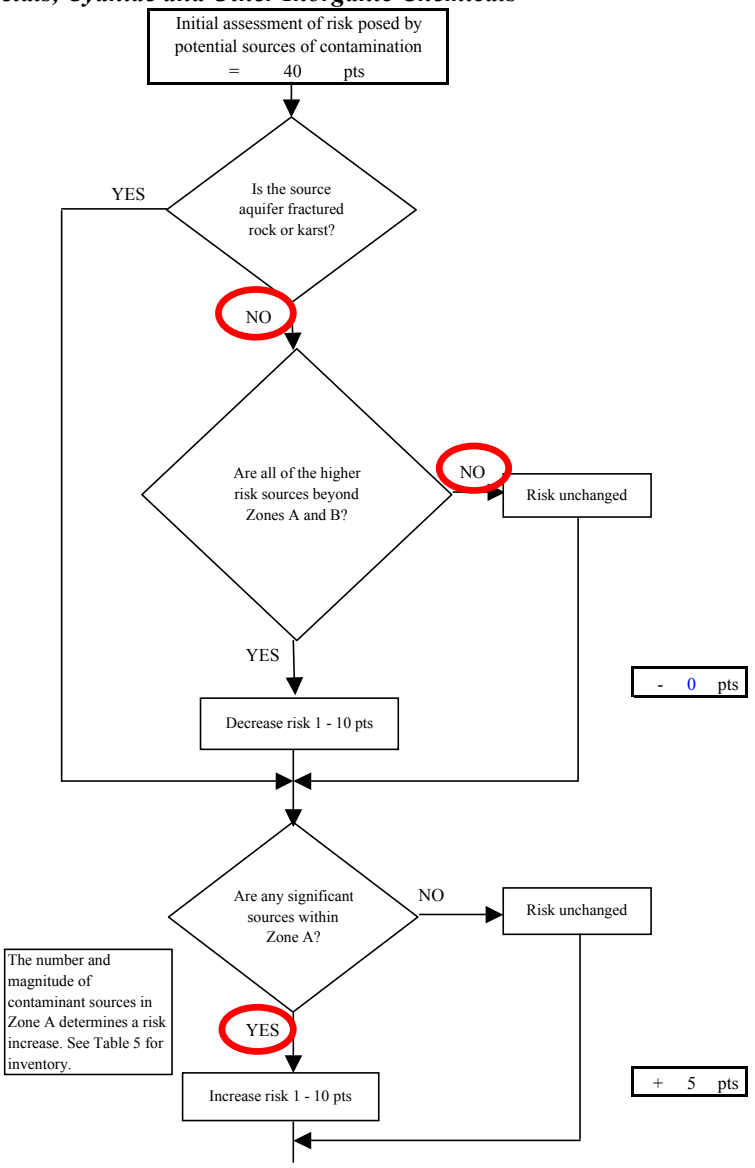


Chart 9. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

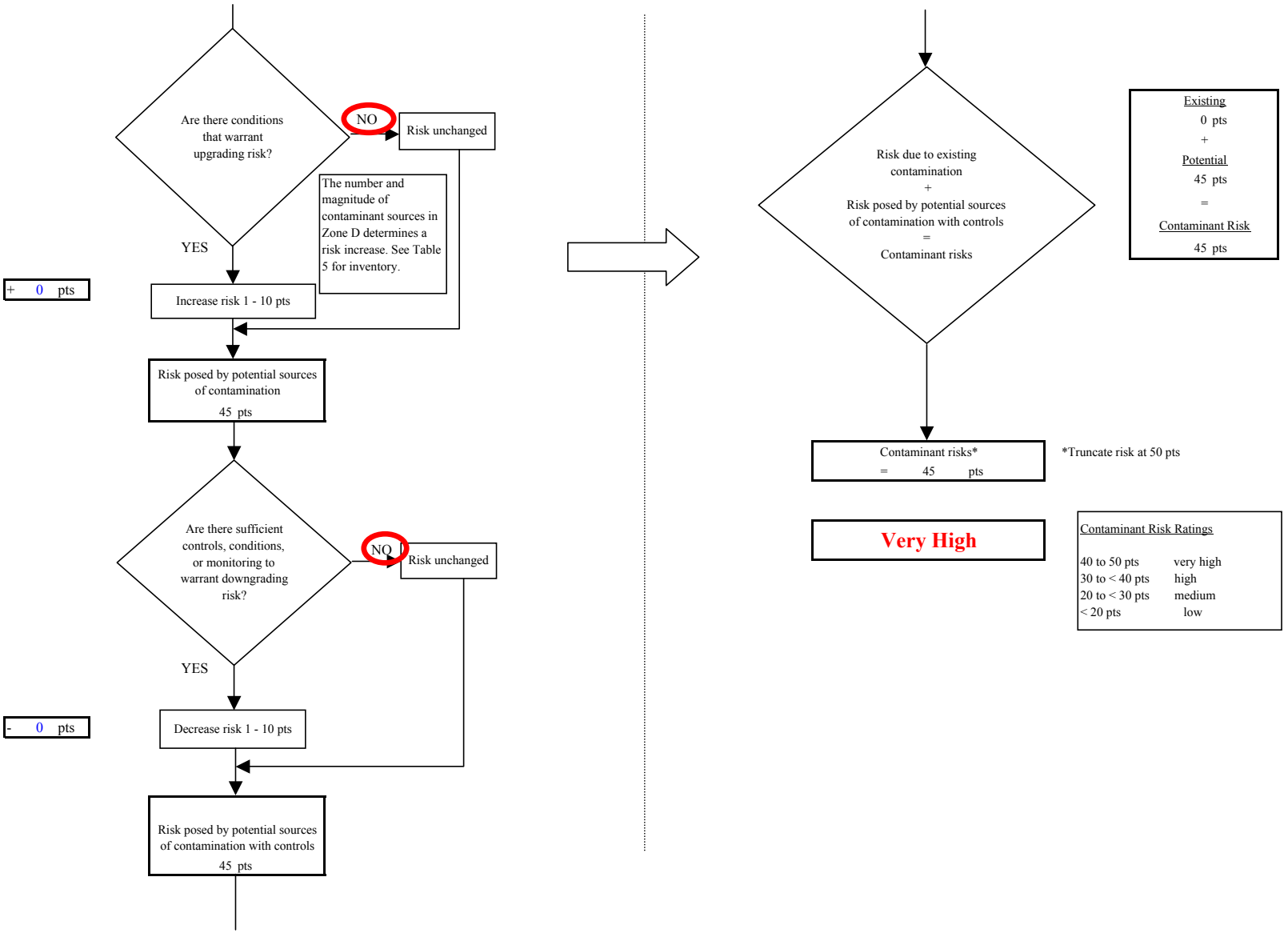


Chart 10. Vulnerability analysis for Venetie Water System (PWS No. 300248.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

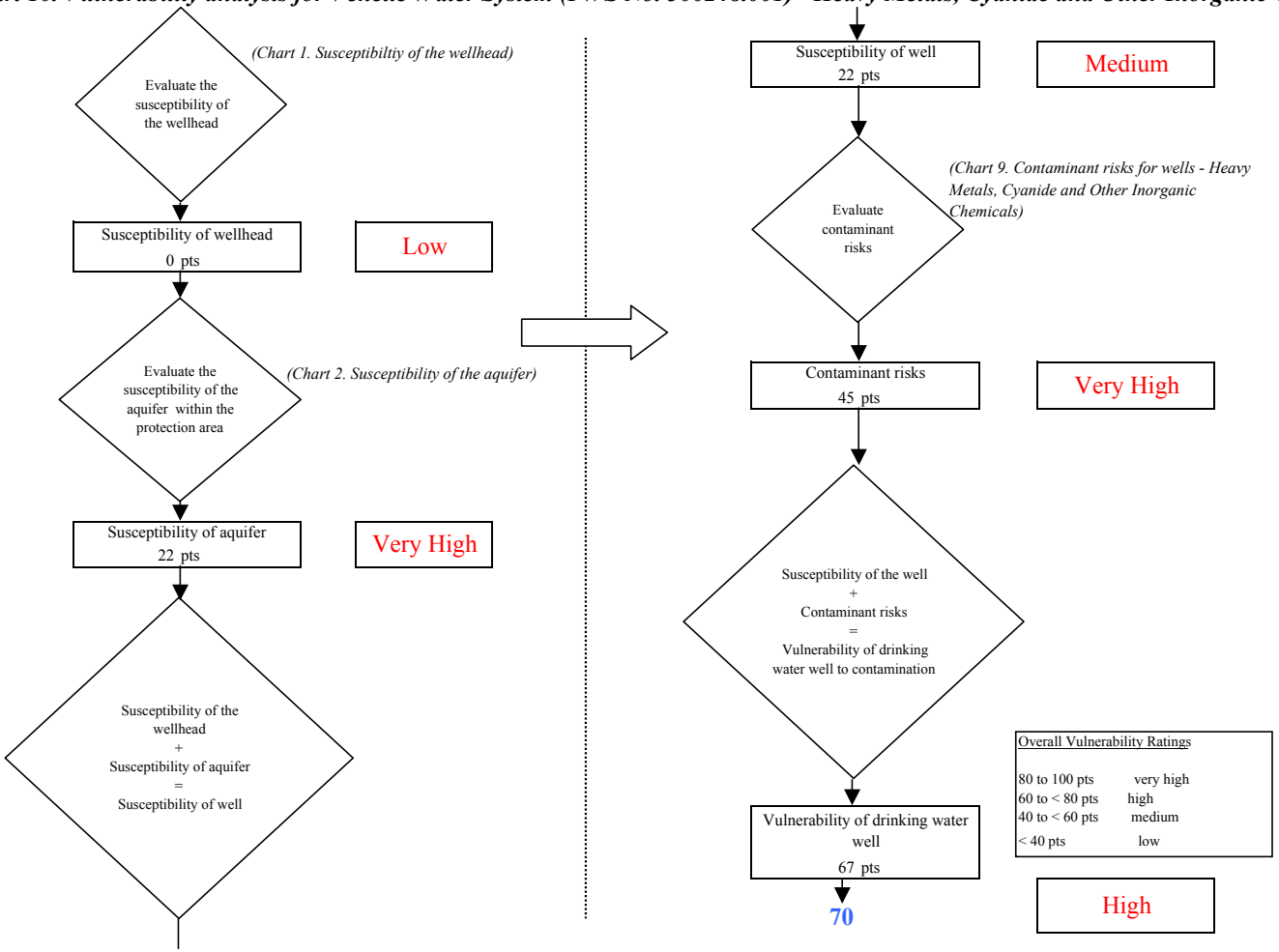


Chart 11. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Synthetic Organic Chemicals

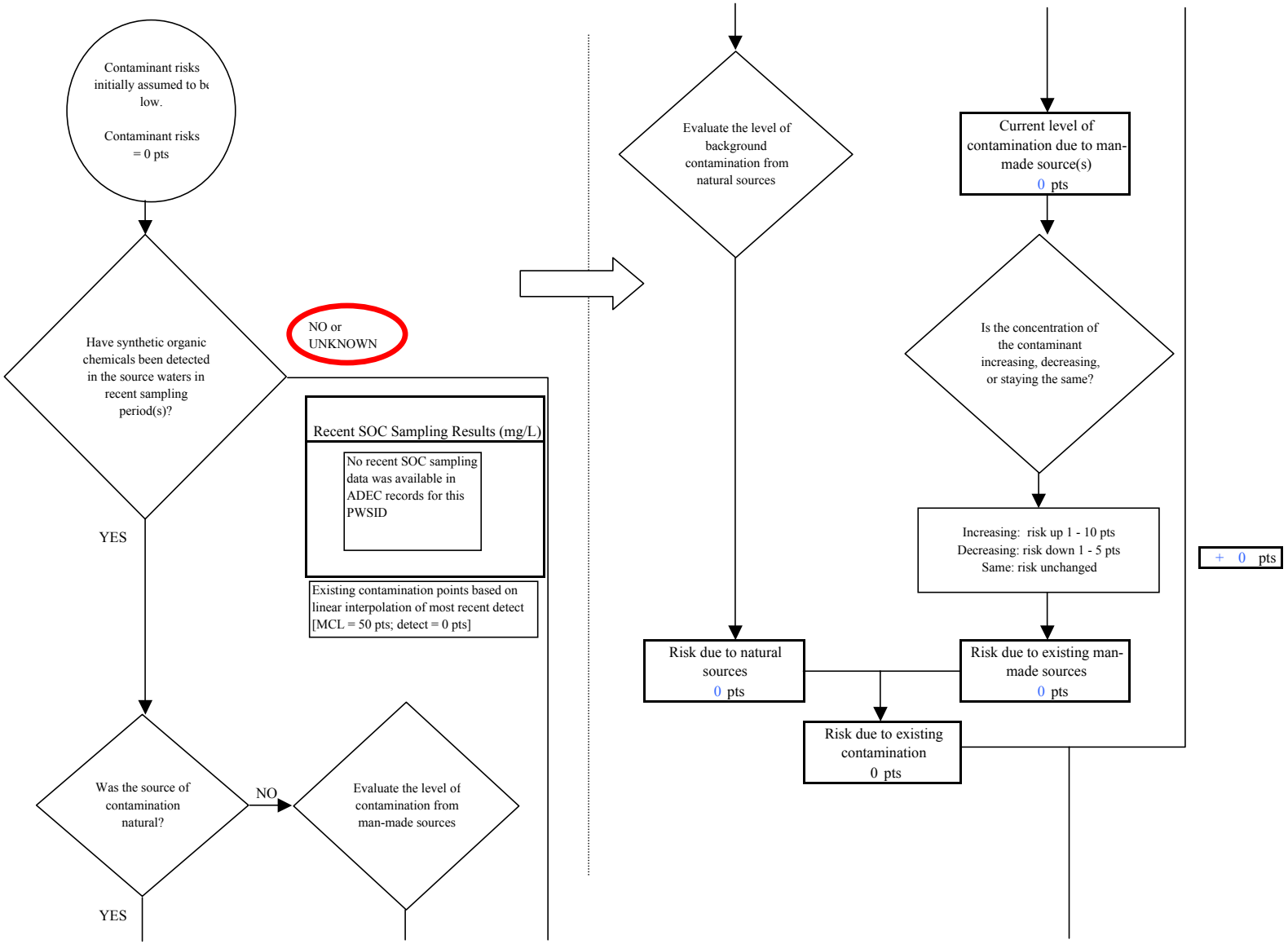
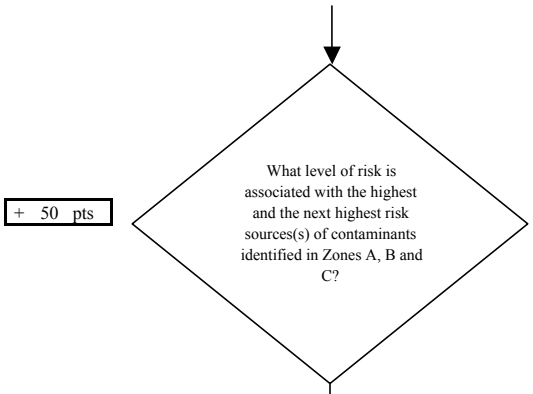


Chart 11. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Synthetic Organic Chemicals



+ 50 pts

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	2	2
High(s)	0	0	0
Medium(s)	0	3	3
Low(s)	3	3	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 50

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.

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.

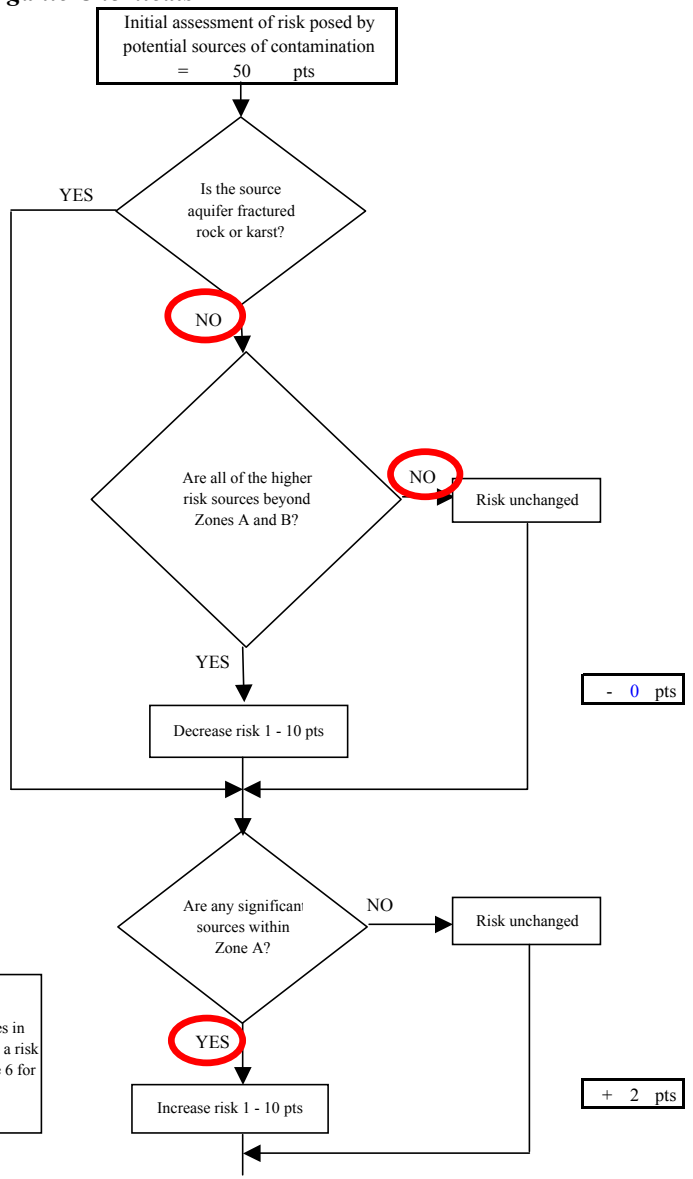


Chart 11. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Synthetic Organic Chemicals

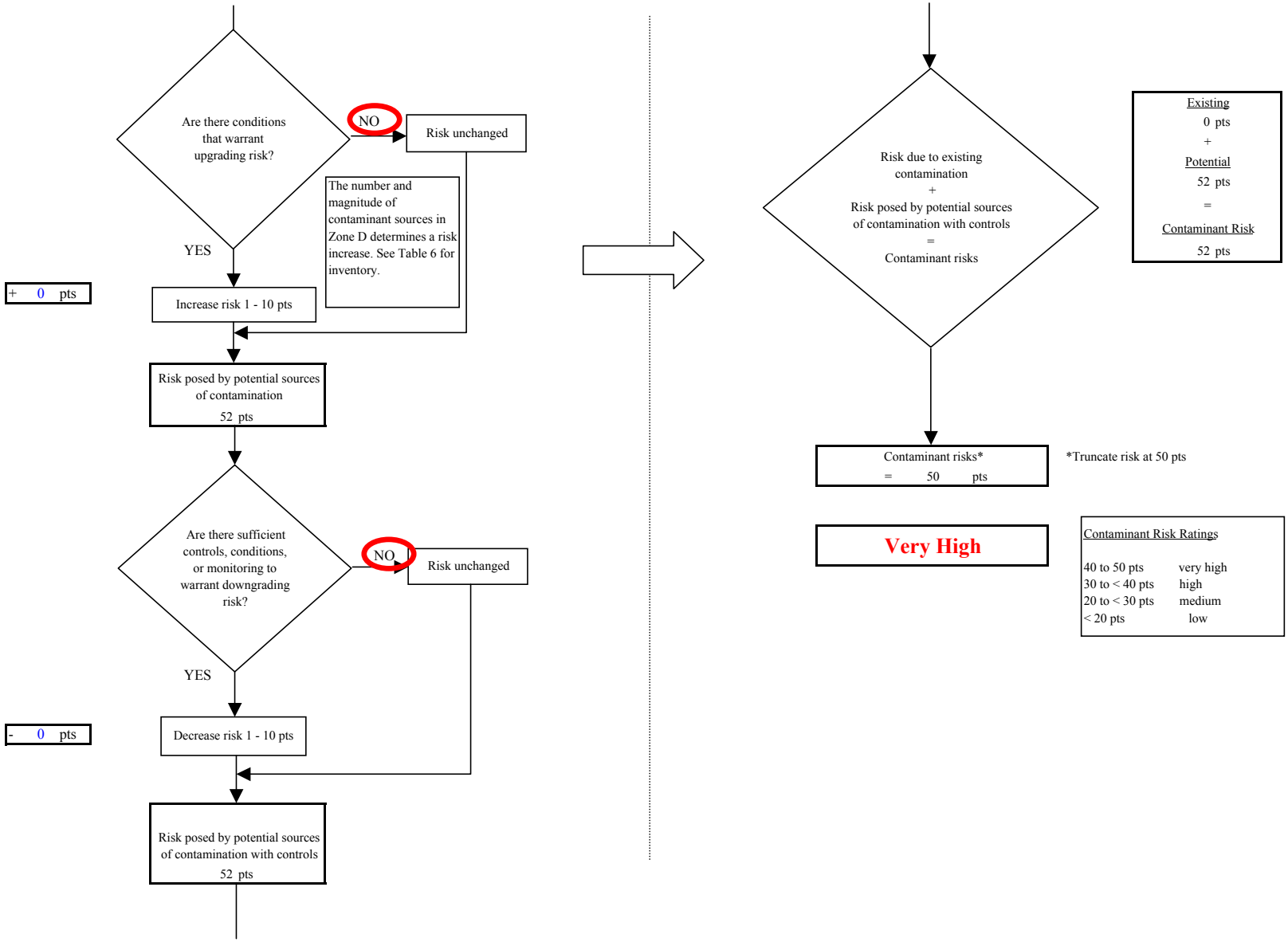


Chart 12. Vulnerability analysis for Venetie Water System (PWS No. 300248.001) - Synthetic Organic Chemicals

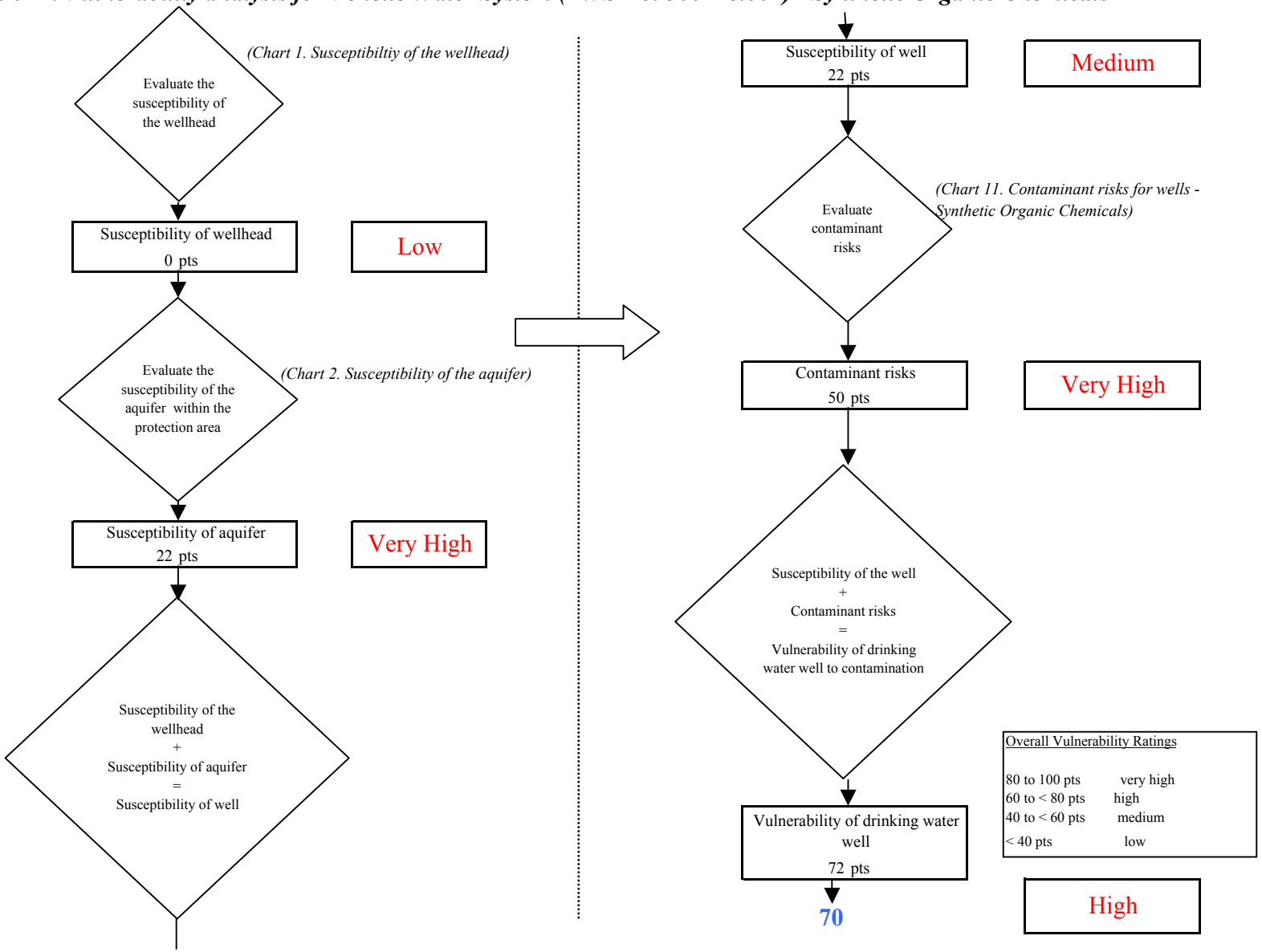


Chart 13. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Other Organic Chemicals

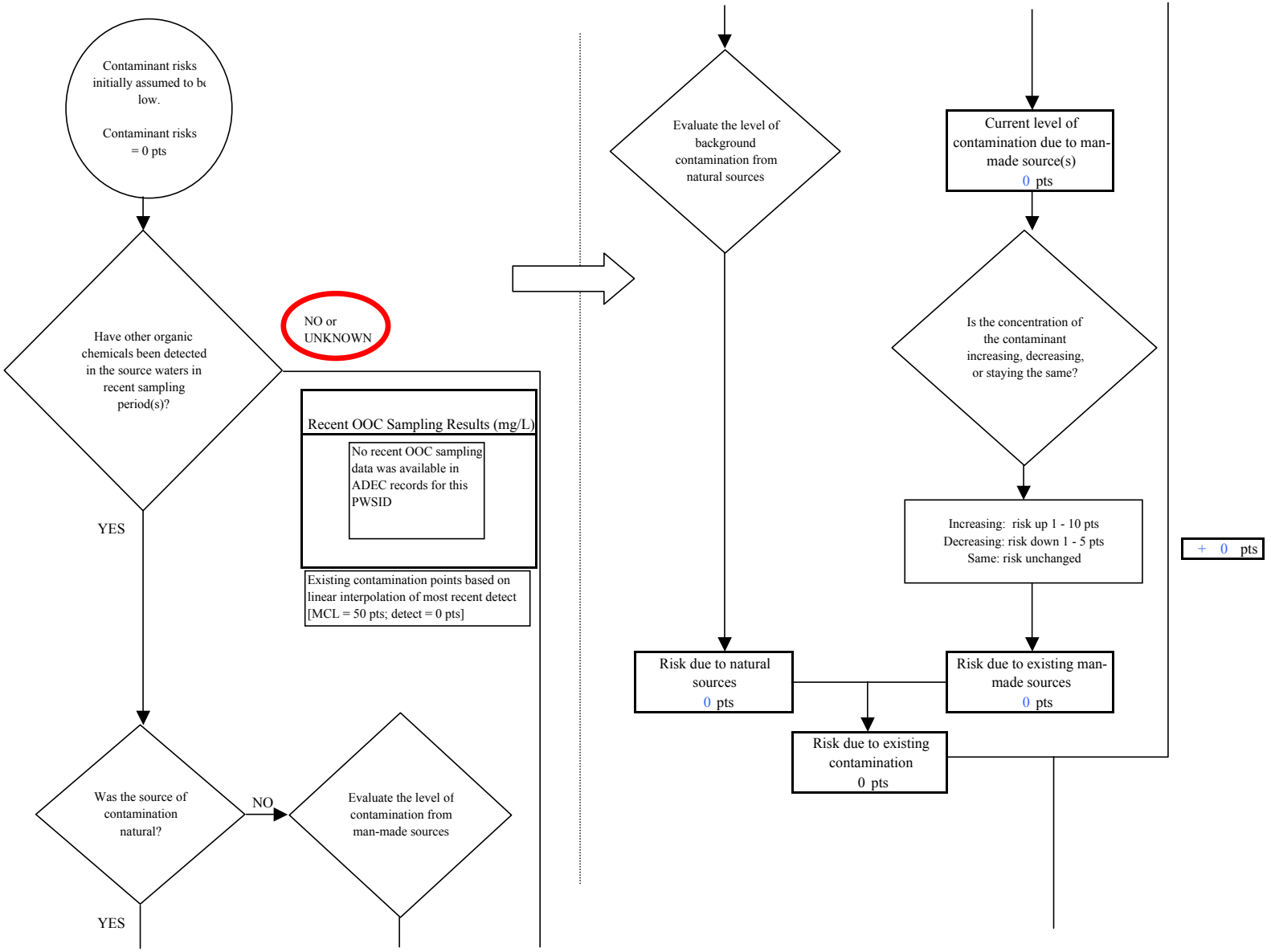
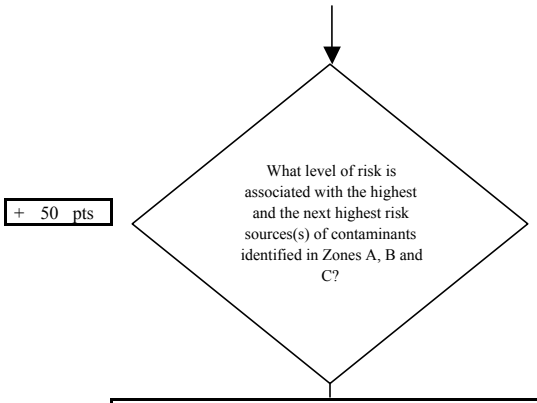


Chart 13. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Other Organic Chemicals



+ 50 pts

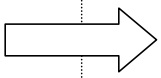
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	2	2
High(s)	4	2	6
Medium(s)	1	2	3
Low(s)	2	0	2

	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 50

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.



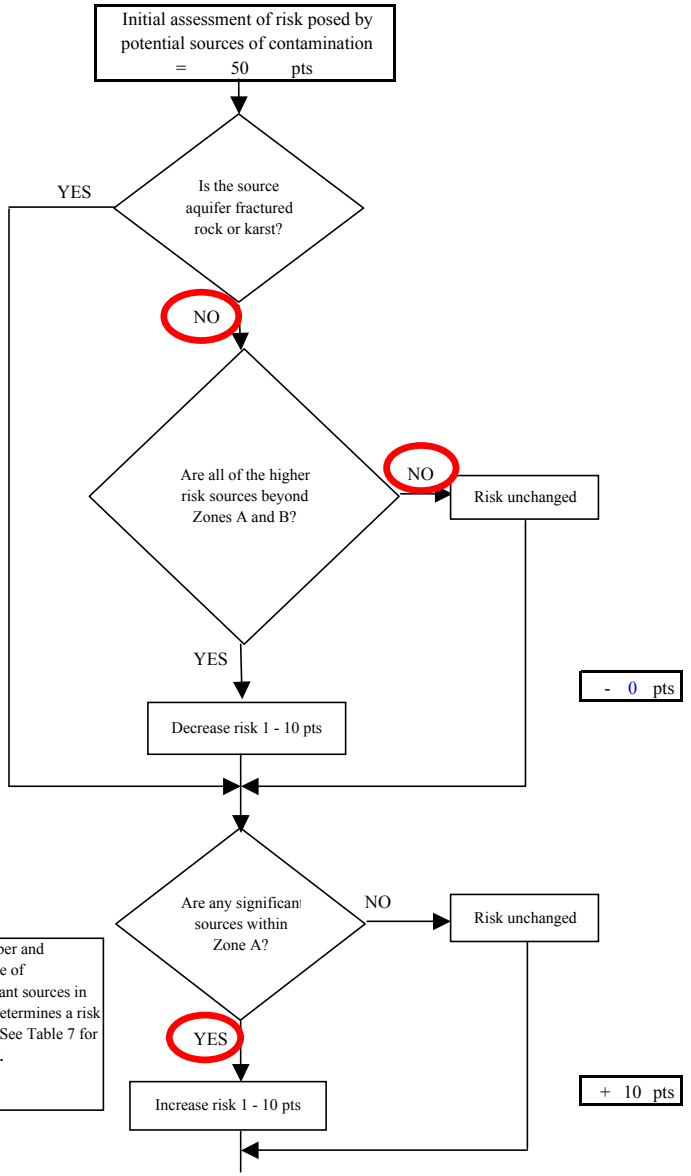


Chart 13. Contaminant risks for Venetie Water System (PWS No. 300248.001) - Other Organic Chemicals

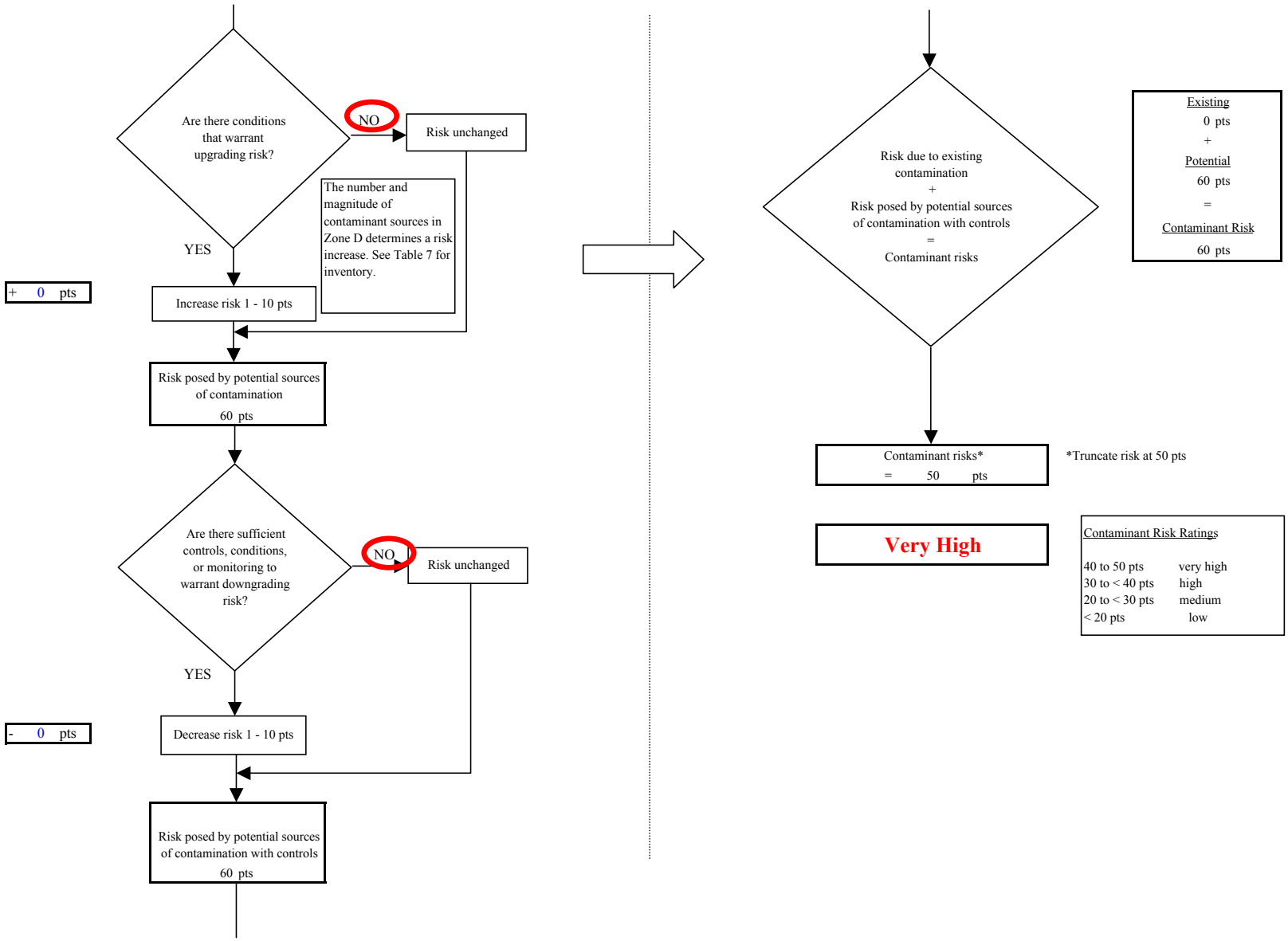


Chart 14. Vulnerability analysis for Venetie Water System (PWS No. 300248.001) - Other Organic Chemicals