Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Nikolski Village Drinking Water System, Umnak Island, Alaska

PWSID # 260278.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1456
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.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for Nikolski Village Source of Public Drinking Water, Umnak Island, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Nikolski Village has one Public Water system (PWS) that consists of a man-made spring with an underground dam. The system (PWS No. 260278.001) has been used as a drinking water source since it was installed in the mid to late 1970's. ADEC records indicate this system is classified as groundwater under the influence of surface water.

The spring is a Class A (community and non-transient non-community) water system located near the northwestern corner of Umnak Lake in Nikolski, Alaska. Available records indicate that drinking water is stored in a 50,000-gallon storage tank, and treated with calcium hypochlorite. This system operates year round and serves approximately 44 residents through twenty-five service connections. The spring received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produce a **Very Medium** rating for the natural susceptibility of the spring.

Identified potential and current sources of contaminants for the public drinking water source include: livestock pastures, a large-capacity septic system, a landfill, aboveground fuel tanks, a petroleum product bulk station/terminal, and roads. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

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

PUBLIC DRINKING WATER SYSTEM

The Nikolski Village spring is a Class A (community/non-transient/non-community) public water system. The system is located near the northwestern corner of Umnak Lake in Nikolski,, Alaska (Sec. 4, T84S, R136W, Seward Meridian; see Map A of Appendix A). Nikolski is located on Nikolski Bay, off of the southwest end of Umnak Island. It lies 116 air miles west of Unalaska, and 900 air miles from Anchorage. The community has a population of 41 (ADCED, 2003). Average annual precipitation in Nikolski is 21 inches, with 41 inches of snowfall. Temperatures range from 11 to 65°F.

The community of Nikolski obtains their water supply from a community spring that is influenced by surface water. Residences are connected to a piped water system and utilize individual septic systems. Nikolski receives electrical power from the Umnak Power Company. Power generating facilities are fueled by diesel (ADCED, 2003).

According to information supplied by ADEC for the Nikolski Village PWS, the spring and underground dam are in an unconfined aquifer. The spring is not located within a floodplain.

Information acquired from a July 2001 sanitary survey for the public water system indicated that the land surface was sloped away from the spring outlet/intake. Generally, land surfaces that slope away from the spring outlet/inlet promote surface water drainage, which reduces potential of contaminant.

Umnak Island lies in the eastern Aleutian Islands and is bounded on the north by the Bering Sea and on the south by the Pacific Ocean. Umnak Island, like nearly all of the islands of the Aleutian arc, rests on a flat-topped submarine ridge, the Aleutian ridge.

The Island is divided into northeastern and southwestern parts at the narrow isthmus where Inanudak Bay makes a deep reentrant into the northwest coast. The two parts of Umnak Island have marked differences in topography. Southwester

Umnak Island is much more rugged, with two large volcanic mountains rising to nearly 7,000 feet. Okmok Volcano, a low shield-like volcano, almost wholly occupies northeastern Umnak Island less than 3,500 feet in altitude. Southwestern Umnak Island contains the glaciated volcanic mountains, Recheschnoi and Vsevidof, in the northern part and the Nikolski plain in the south part. The Nikolski plain is a rolling surface with a relief of a few hundred feet. Small lakes, less than a mile long, abound on the surface of the plain.

The surficial deposits on Umnak Island are comprised of till, glacial outwash, beach deposits, dune sand, talus, and alluvium (Byers, 1959).

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 spring.

The most probable area for contamination to reach the drinking water spring is the area that contributes water to the spring, 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 spring, 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 Nikolski Village 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 springs 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 springs, as well as the three protection area zones for groundwater under the influence of surface water, 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
E	Areas within 1000-ft of lakes or streams
F	Areas within 1-mile of lakes or streams
G	The watershed boundary

The DWPA for the Nikolski Village PWS was determined using an analytical calculation and includes Zone A (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 Nikolski Village DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

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

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

RANKING OF CONTAMINANT RISKS

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

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

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well. Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE DRINKING WATER SYSTEM

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

- Natural susceptibility, and
- Contaminant risks.

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Spring Outlet/Intake' to contamination by looking at the construction of the spring 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 spring. 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 spring and the aquifer.

Susceptibility of the Spring Outlet/Intake (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 Spring)
(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 Nikolski Village's water system 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 this PWS.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Spring	5	Low
Susceptibility of the Aquifer	19	High
Natural Susceptibility	24	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	50	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	75	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	75	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	75	High
Synthetic Organic Chemicals	75	High
Other Organic Chemicals	75	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of a landfill and a large capacity septic system in Zone A (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, 2003). 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 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 spring, the overall vulnerability of the spring to contamination is **High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of a landfill and a large capacity septic system 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 spring indicates that nitrates have not been detected

in recent sampling events. 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).

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the spring, the overall vulnerability of the spring 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 a landfill and a petroleum product bulk station/terminal in Zone A. Several other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

Detectable concentrations of trihalomethanes were reported in sampling events for this public water system. However, the detectible concentrations of trihalomethanes reported in 2003 were well below the MCL of 0.08 mg/L. Trihalomethanes are considered byproducts of the water treatment process and are not from the source waters. Since the reported concentration of TTHM's in recent sampling events did not exceed the applicable MCLs, risk points were not retained (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

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.

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

Heavy Metals, Cyanide and Other Inorganic Chemicals

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

Based on review of recent sampling records for this public water system, high levels of copper have been detected in recent sampling events, and have exceeded the MCL of 1.3 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentration of copper in a recent sampling event is not likely to be representative of source water conditions. This analyte is likely attributed to either the water treatment process or water distribution network.

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the spring, the overall vulnerability of the spring to contamination is **High**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfill in Zone A. Several 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 Nikolski Village (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 spring, the overall vulnerability of the spring 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 landfill in Zone A. 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 Nikolski Village (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 spring, the overall vulnerability of the spring 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 Nikolski to protect public health. It is anticipated that Source Water

Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

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Byers, Jr., F.M. 1959, Geology of Umnak Island and Bogoslof Islands, Aleutian Islands, Alaska, USGS Bulletin 1028-L, prepared in cooperation with the Office Chief of Engineers, U.S. Army.

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APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

APPENDIX B

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

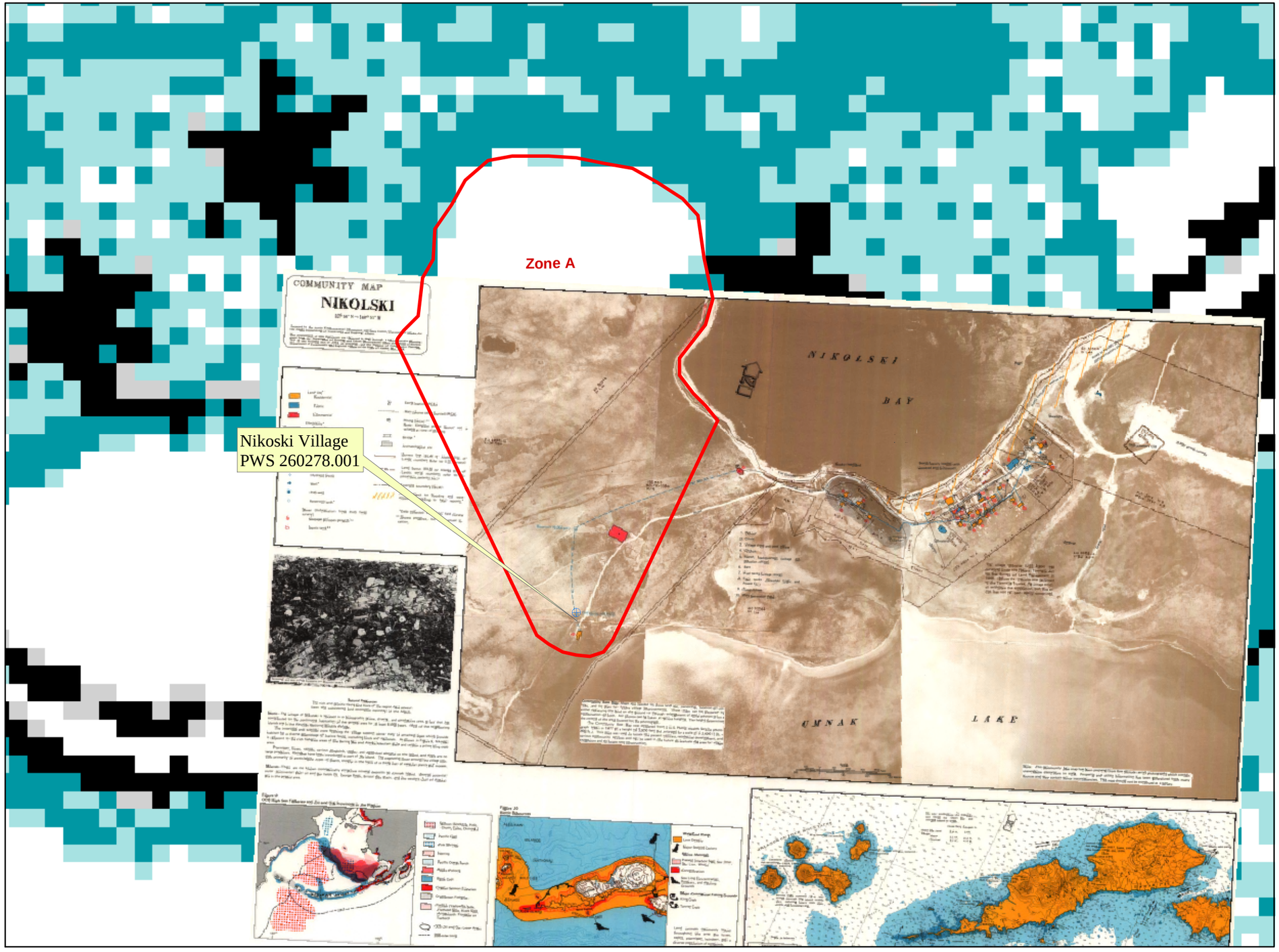
APPENDIX C

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 #260278.001 Nikoski Village



LEGEND

Public Water System Well

Groundwater Protection Zones

Zone A – Several Months Travel Time or Watershed Boundary

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

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 0.05 0.1 0.2 0.3 0.4 Miles

Nikolski Village
PWS 260278.001
Appendix A Map A

Table 1

Contaminant Source Inventory for ***Nikolski Village***

PWSID 260278.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Livestock pastures	A08	A08-01	A	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	C	
Landfills (municipal; Class III)	D51	D51-01	A	C	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	
Petroleum product bulk station/terminals	X11	X11-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A

Table 2

Contaminant Source Inventory and Risk Ranking for Nikolski Village
Sources of Bacteria and Viruses

PWSID 260278.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Livestock pastures	A08	A08-01	A	Medium	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	
Landfills (municipal; Class III)	D51	D51-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 3

Contaminant Source Inventory and Risk Ranking for Nikolski Village
Sources of Nitrates/Nitrites

PWSID 260278.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Livestock pastures	A08	A08-01	A	Medium	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	
Landfills (municipal; Class III)	D51	D51-01	A	Very High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 4

Contaminant Source Inventory and Risk Ranking for Nikolski Village
Sources of Volatile Organic Chemicals

PWSID 260278.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Landfills (municipal; Class III)	D51	D51-01	A	High	C	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 5

Contaminant Source Inventory and Risk Ranking for Nikolski Village

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 260278.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Landfills (municipal; Class III)	D51	D51-01	A	High	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 6

Contaminant Source Inventory and Risk Ranking for Nikolski Village
Sources of Synthetic Organic Chemicals

PWSID 260278.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Livestock pastures	A08	A08-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Landfills (municipal; Class III)	D51	D51-01	A	Very High	C	
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	

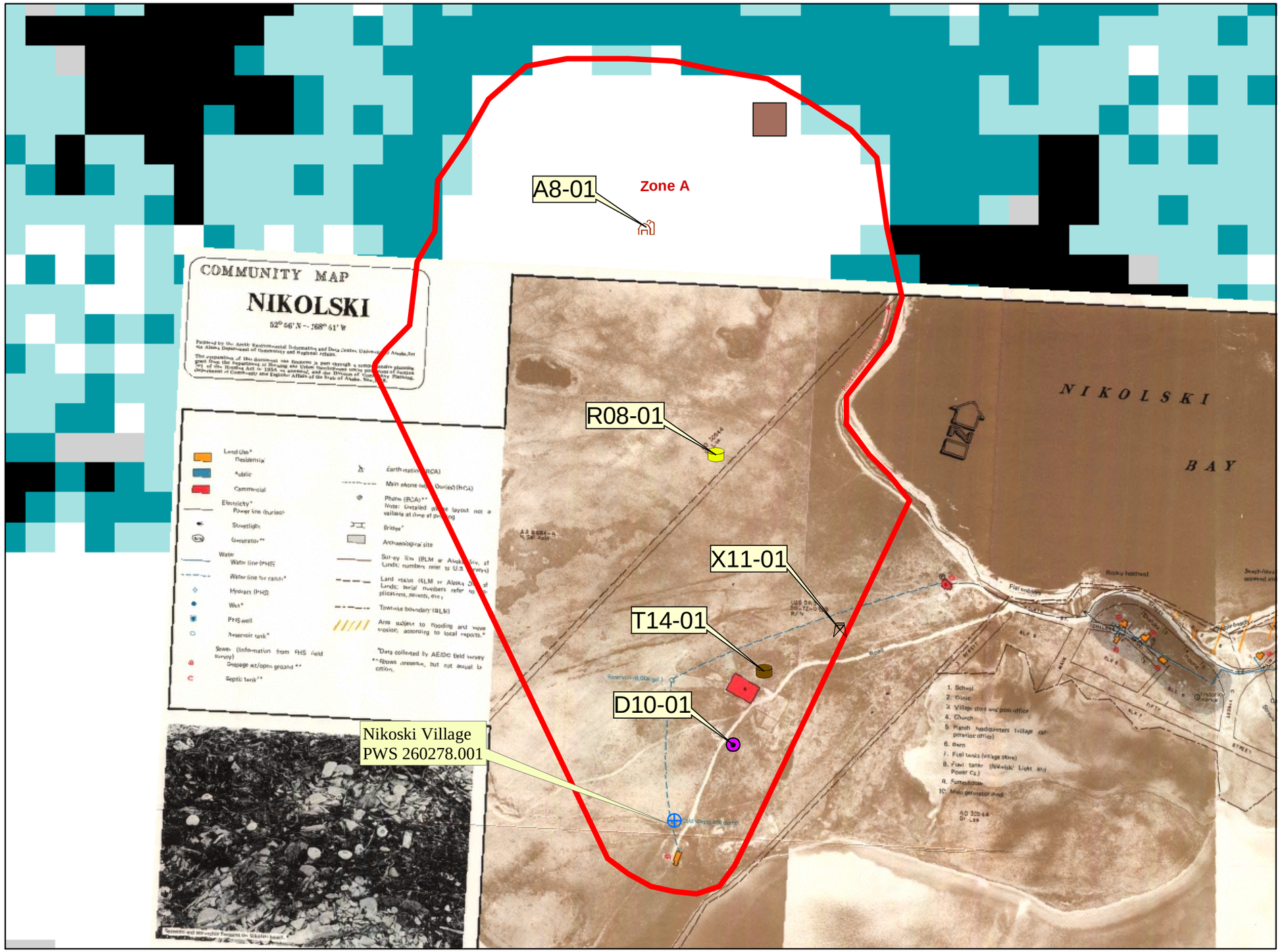
Table 7

Contaminant Source Inventory and Risk Ranking for Nikolski Village
Sources of Other Organic Chemicals

PWSID 260278.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	
Landfills (municipal; Class III)	D51	D51-01	A	Very High	C	
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Public Water Well System for PWS #260278.001 Nikoski Village
Showing Potential and Existing Sources of Contamination



LEGEND

Public Water System Well

Groundwater Protection Zones

Zone A – Several Months Travel Time or Watershed Boundary

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

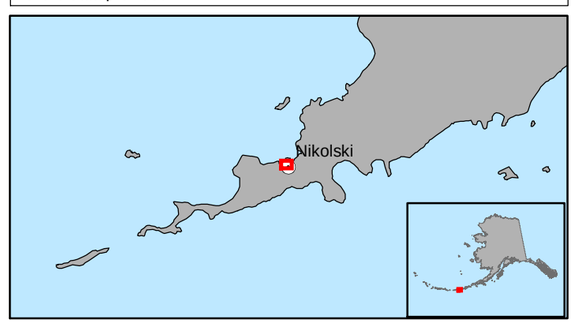
Existing or Potential Contaminant Sources

- Livestock pastures (A8)
- Injection Wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)
- Tanks, heating oil, residential (aboveground) (R08)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Petroleum product bulk station/terminals (X11)
- Landfills (Municipal, Class III) (D51)

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

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

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



0 0.03 0.06 0.12 0.18 0.24 Miles

Nikolski Village
PWS 260278.001
Appendix C Map C

Chart 1. Susceptibility of the spring outlet/intake -Nikolski Village (260278.001)

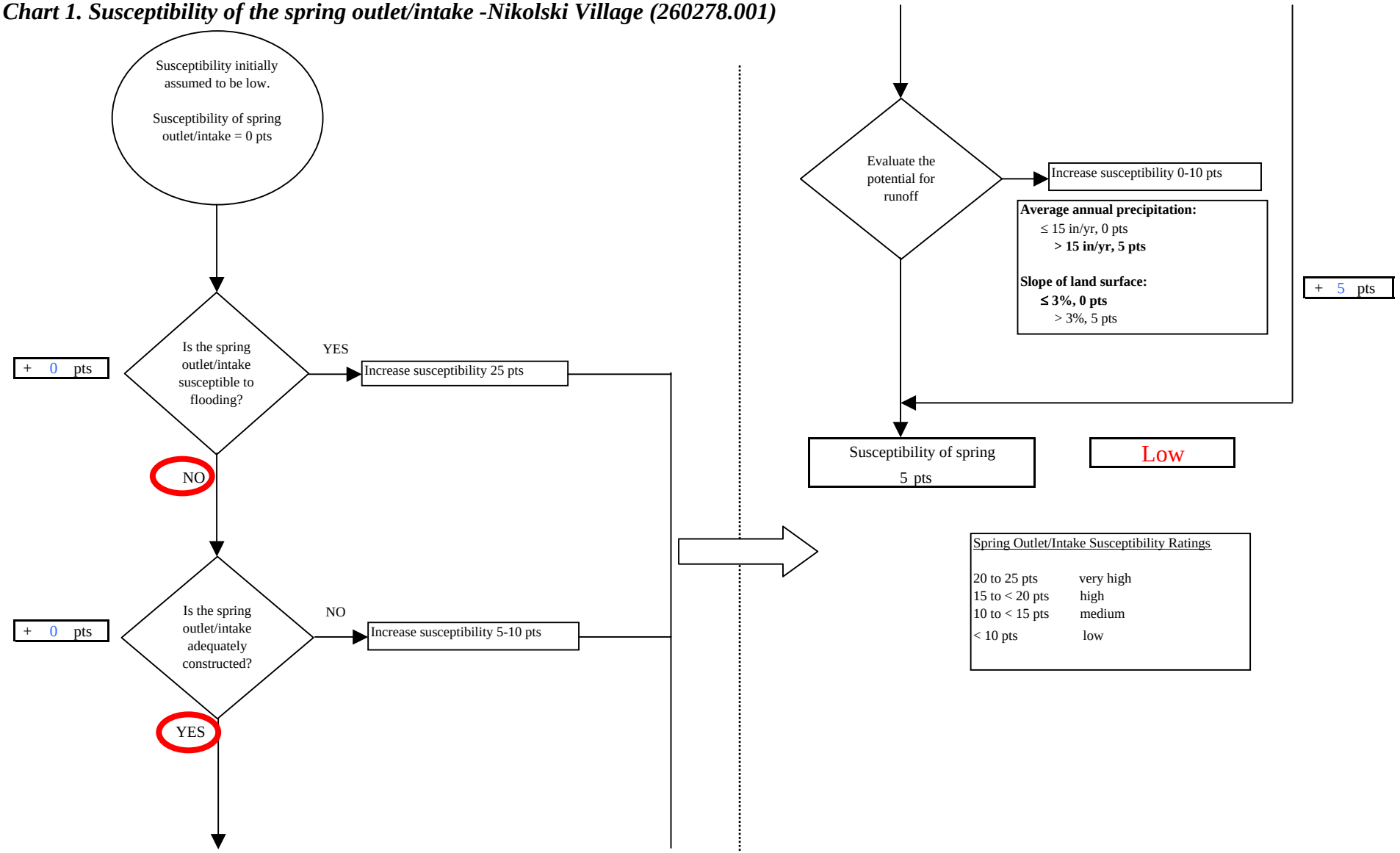


Chart 2. Susceptibility of the aquifer - Nikolski Village (260278.001)

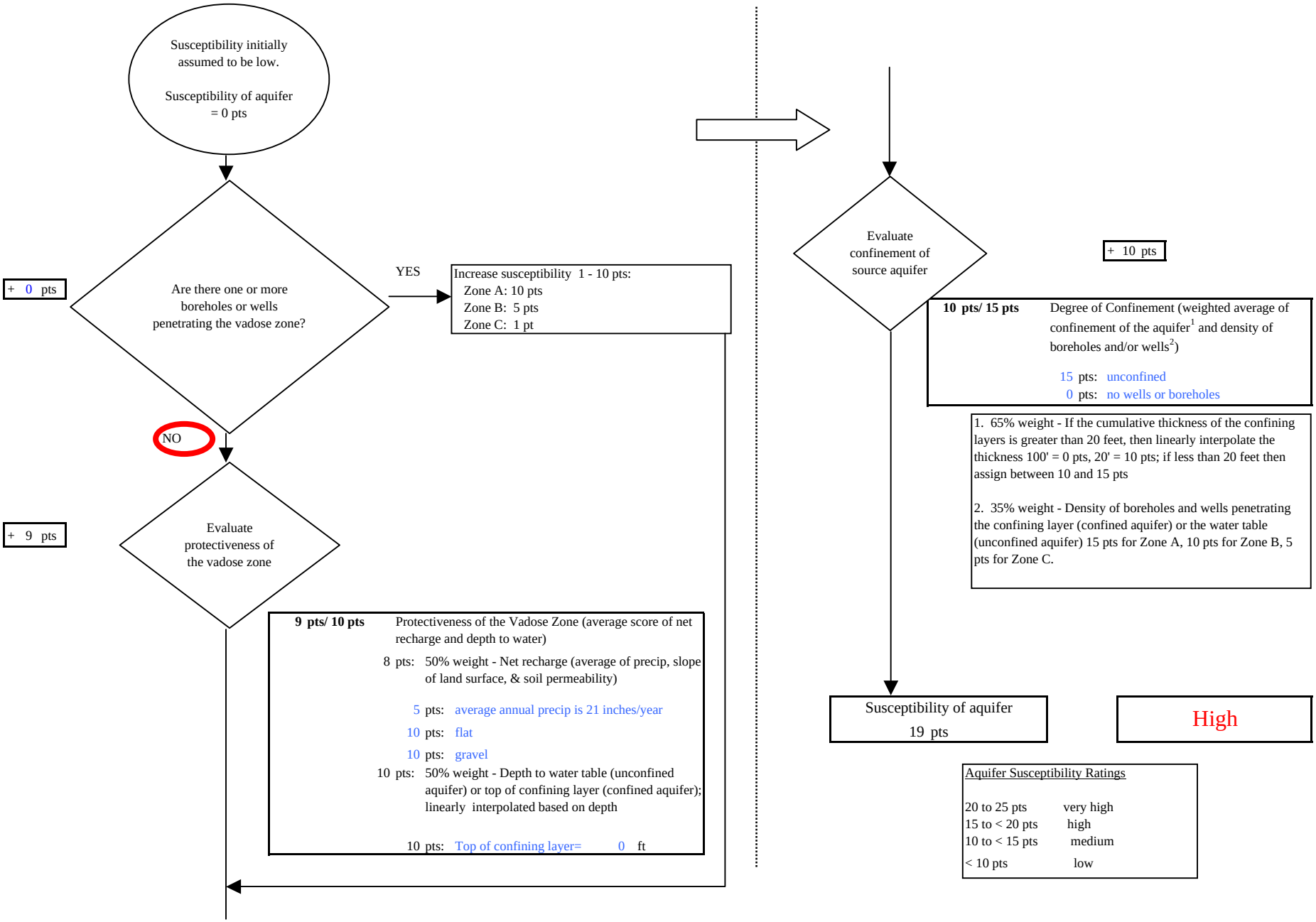
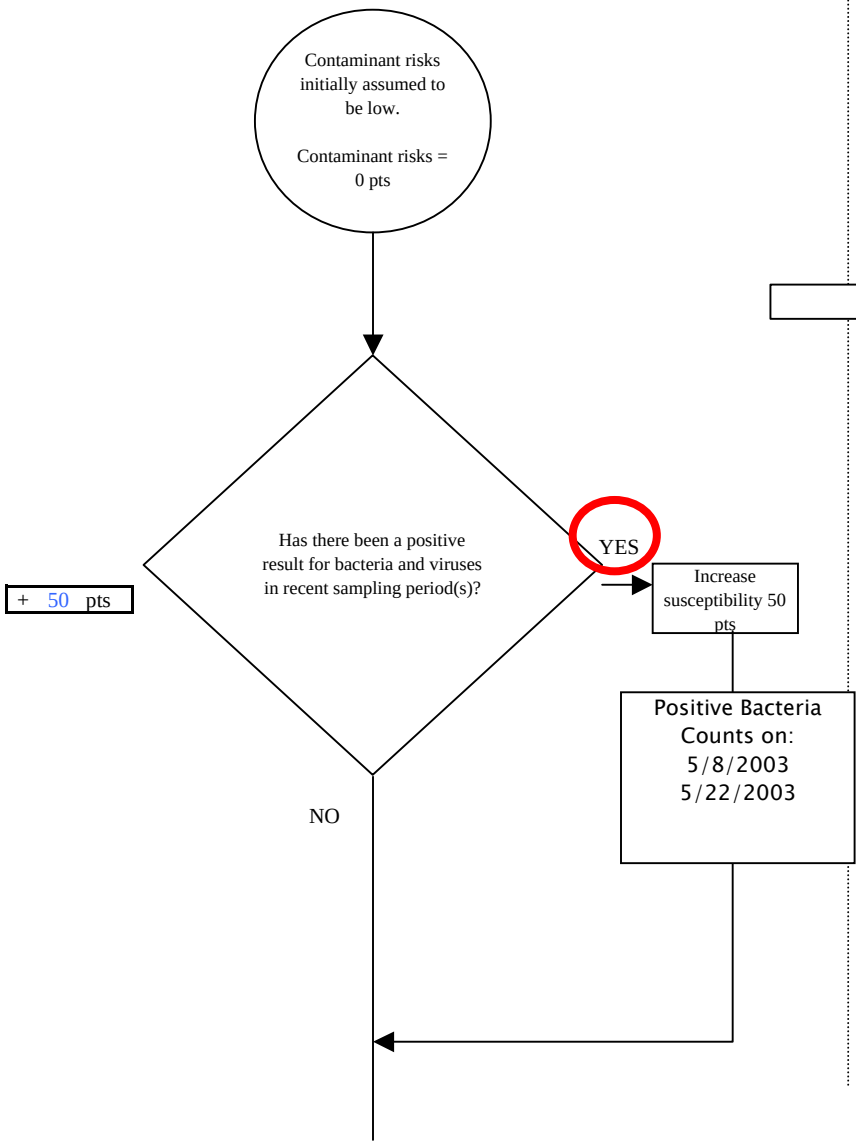
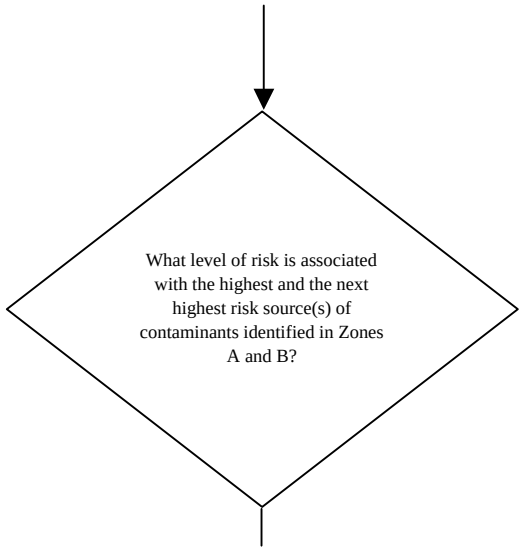


Chart 3. Contaminant risks for Nikolski Village (260278.001) - Bacteria & Viruses





+ 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)	2	0	2
Medium(s)	1	0	1
Low(s)	1	0	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 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 Nikolski Village (260278.001) - Bacteria & Viruses

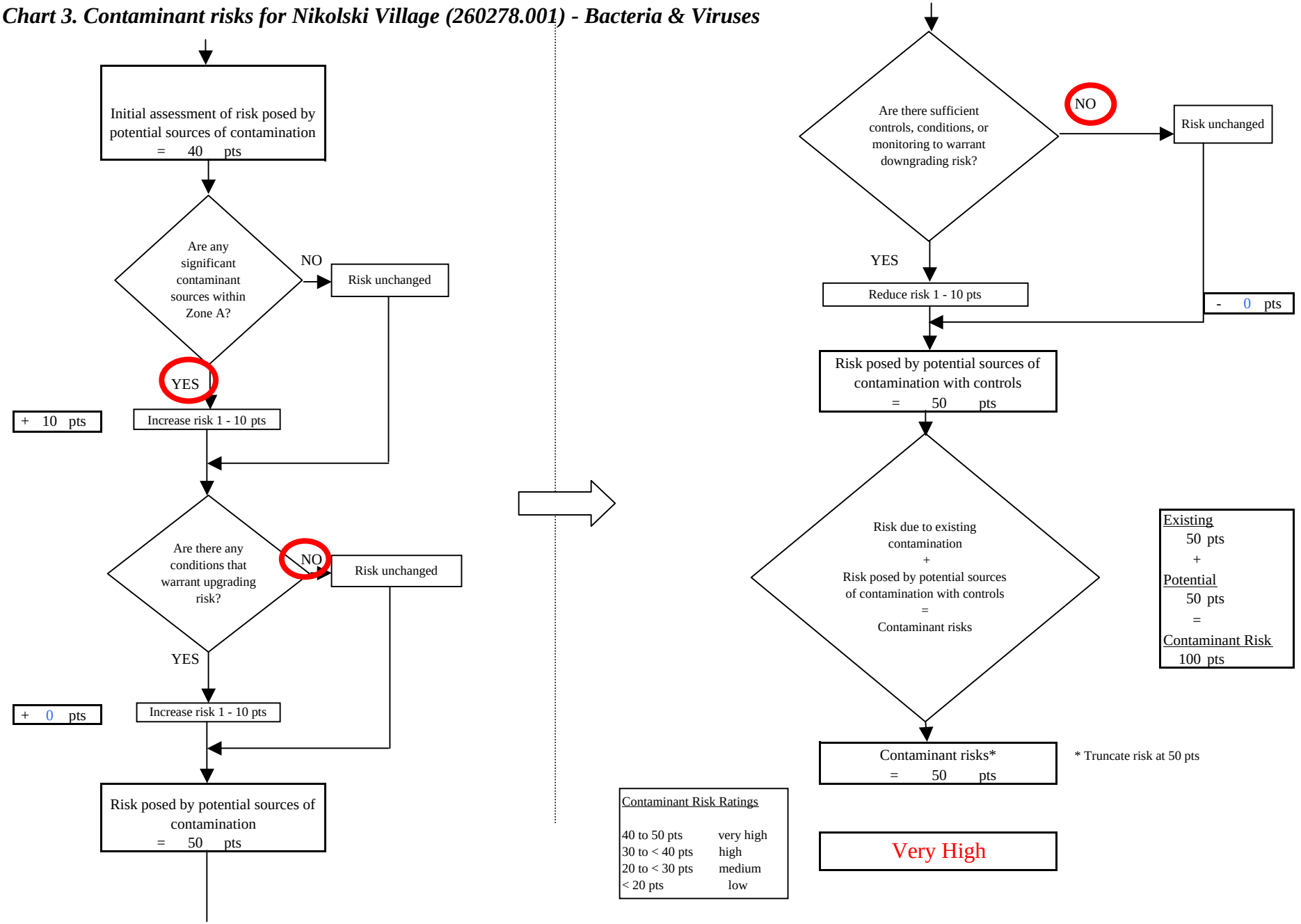


Chart 4. Vulnerability analysis for Nikolski Village (260278.001) - Bacteria & Viruses

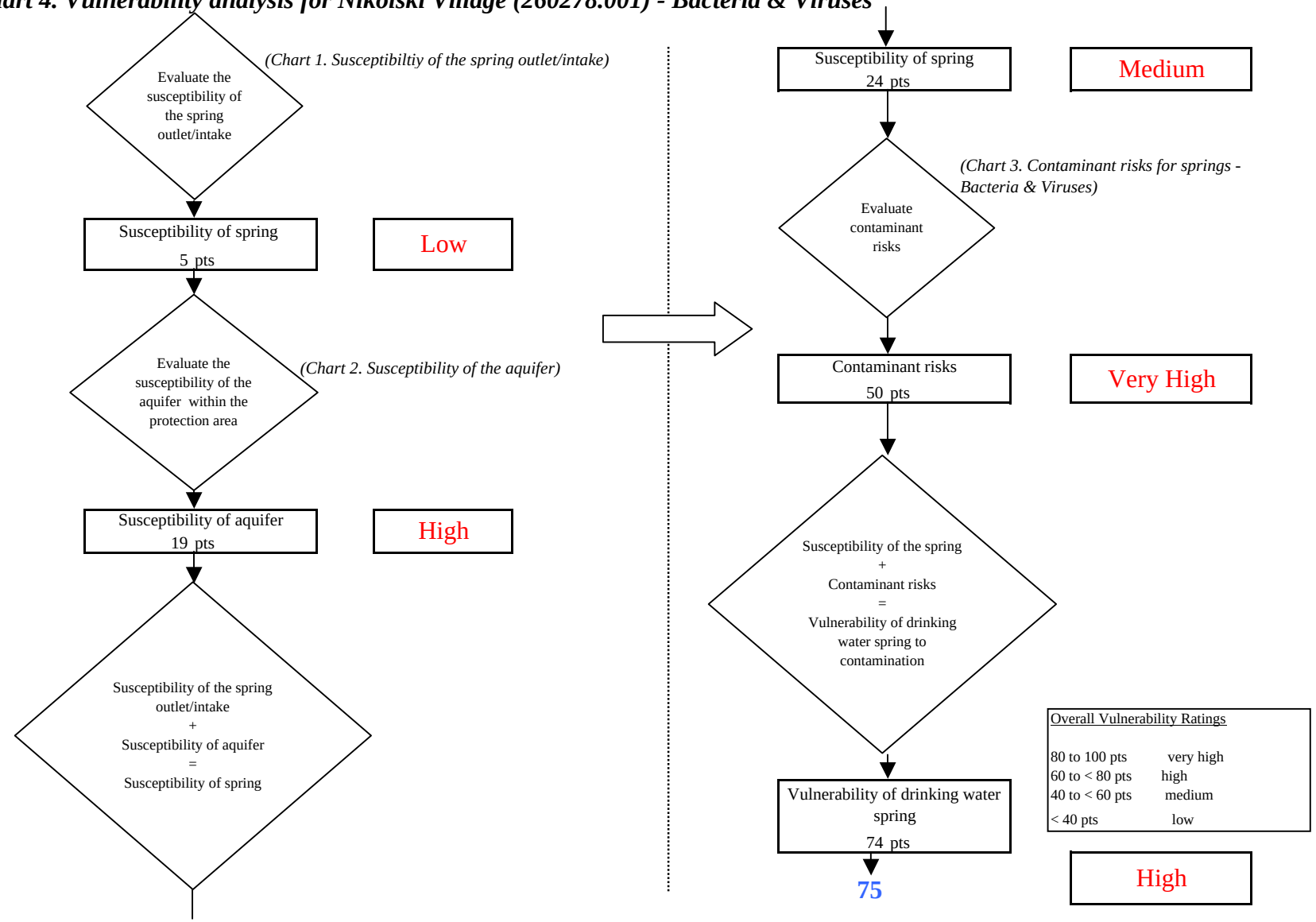


Chart 5. Contaminant risks for Nikolski Village (260278.001) - Nitrates and Nitrites

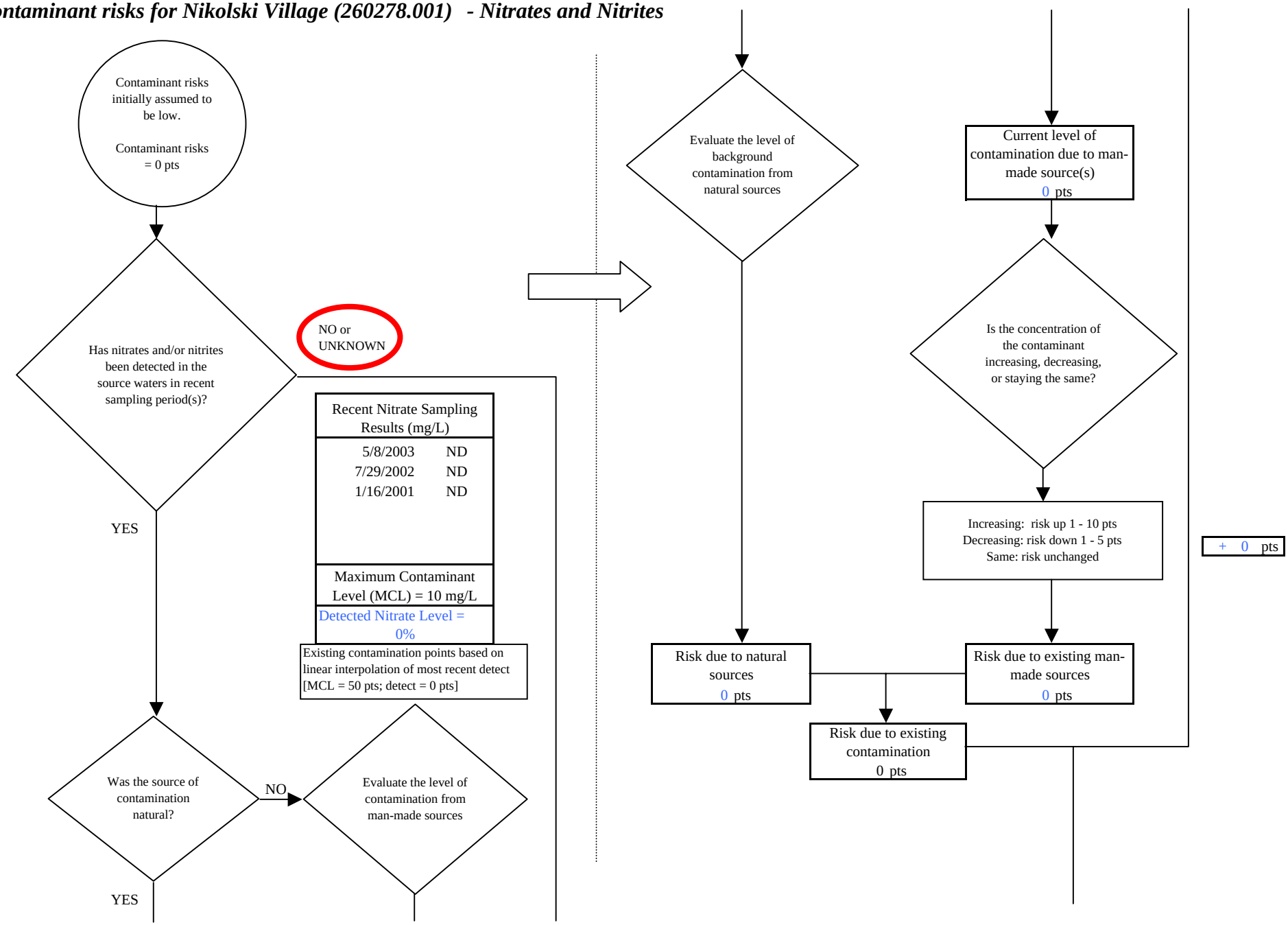


Chart 5. Contaminant risks for Nikolski Village (260278.001) - Nitrates and Nitrites

+ 40 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A and B? (see Risk Matrix below)

Initial assessment of risk posed by potential sources of contamination = 40 pts

Are any significant sources in Zone A?

NO → Risk unchanged → + 10 pts

YES → Increase risk 1 - 10 pts

Risk Levels for Contaminant Sources identified in Zones A and B

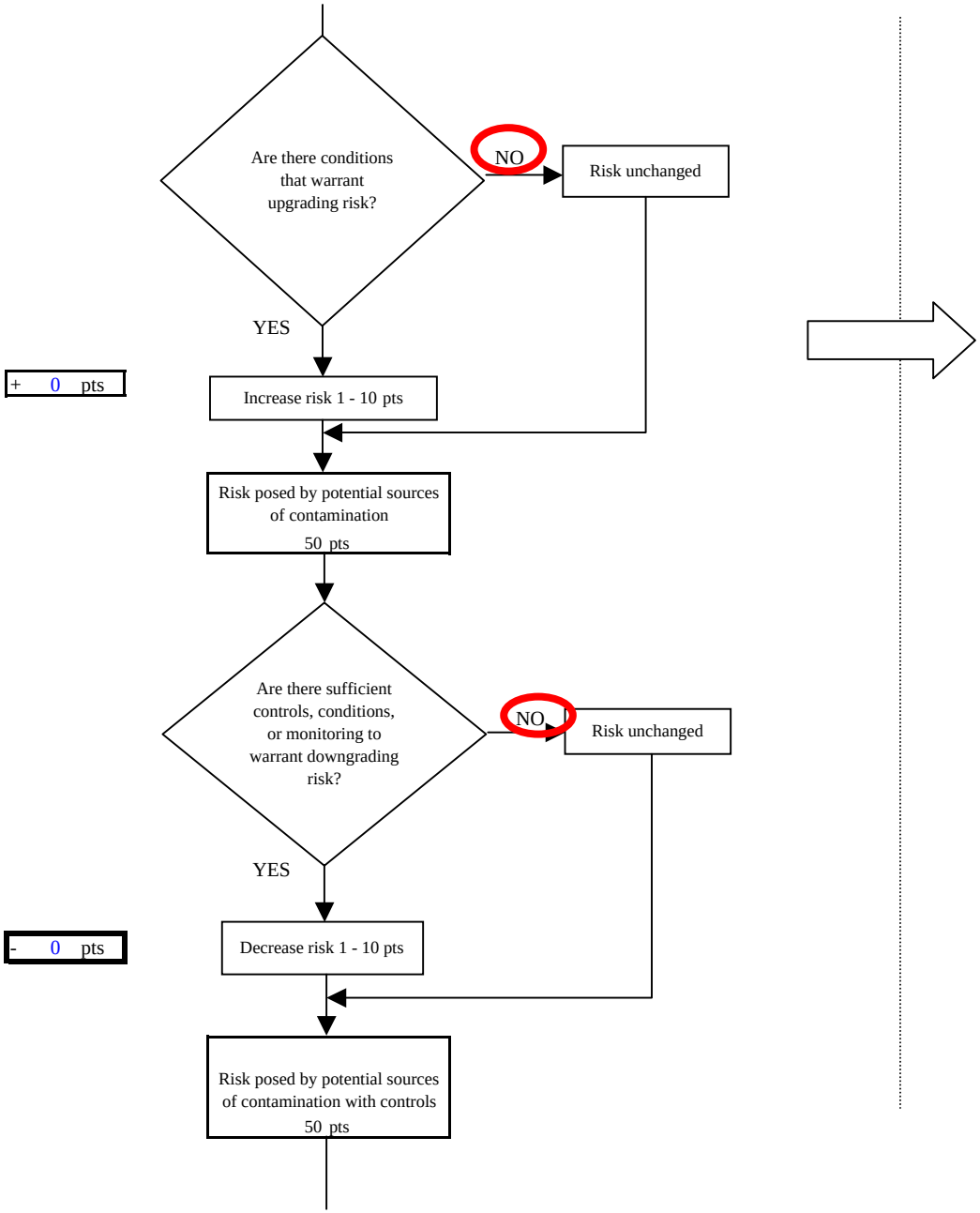
	Zone A	Zone B	Total
Very Highs(s)	1	0	1
High(s)	1	0	1
Medium(s)	1	0	1
Low(s)	1	0	1

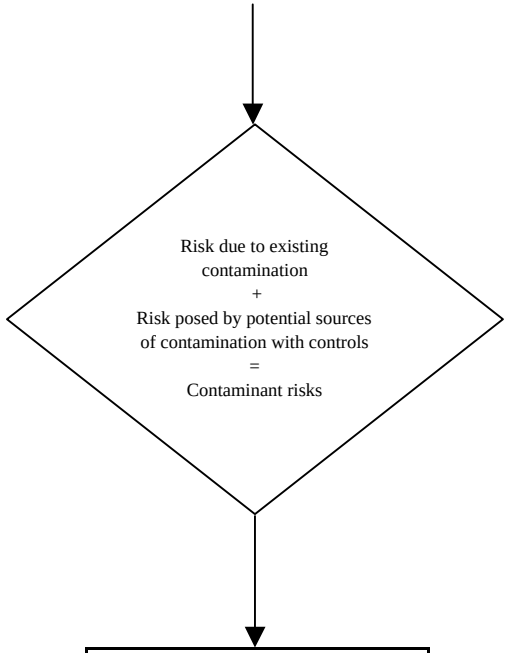
	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source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

Matrix Score 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 5. Contaminant risks for Nikolski Village (260278.001) - Nitrates and Nitrites





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

Contaminant risks*
= 50 pts

*Truncate risk at 50 pts

Very High

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 6. Vulnerability analysis for Nikolski Village (260278.001) - Nitrates and Nitrites

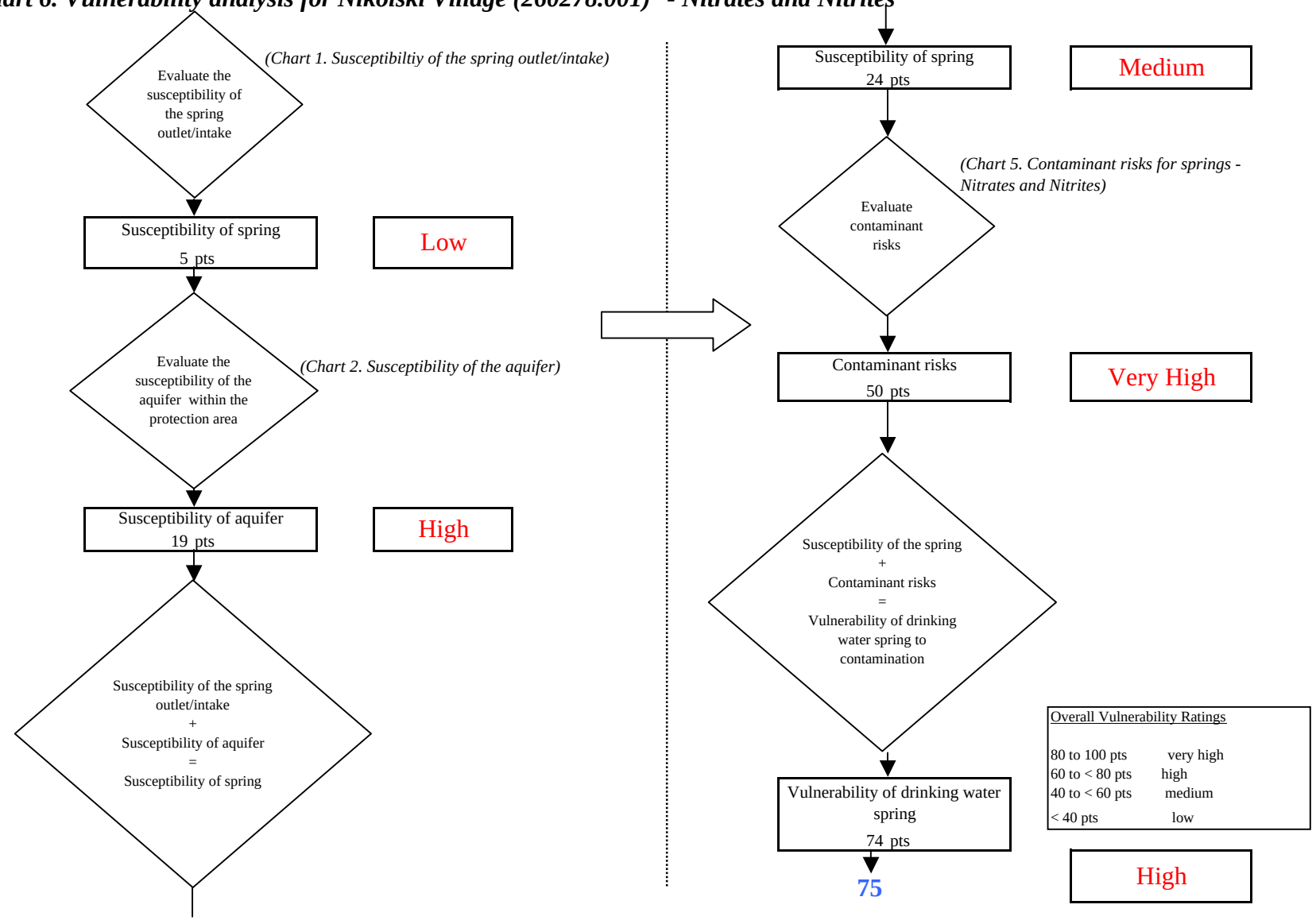


Chart 7. Contaminant risks for Nikolski Village (260278.001) - Volatile Organic Chemicals

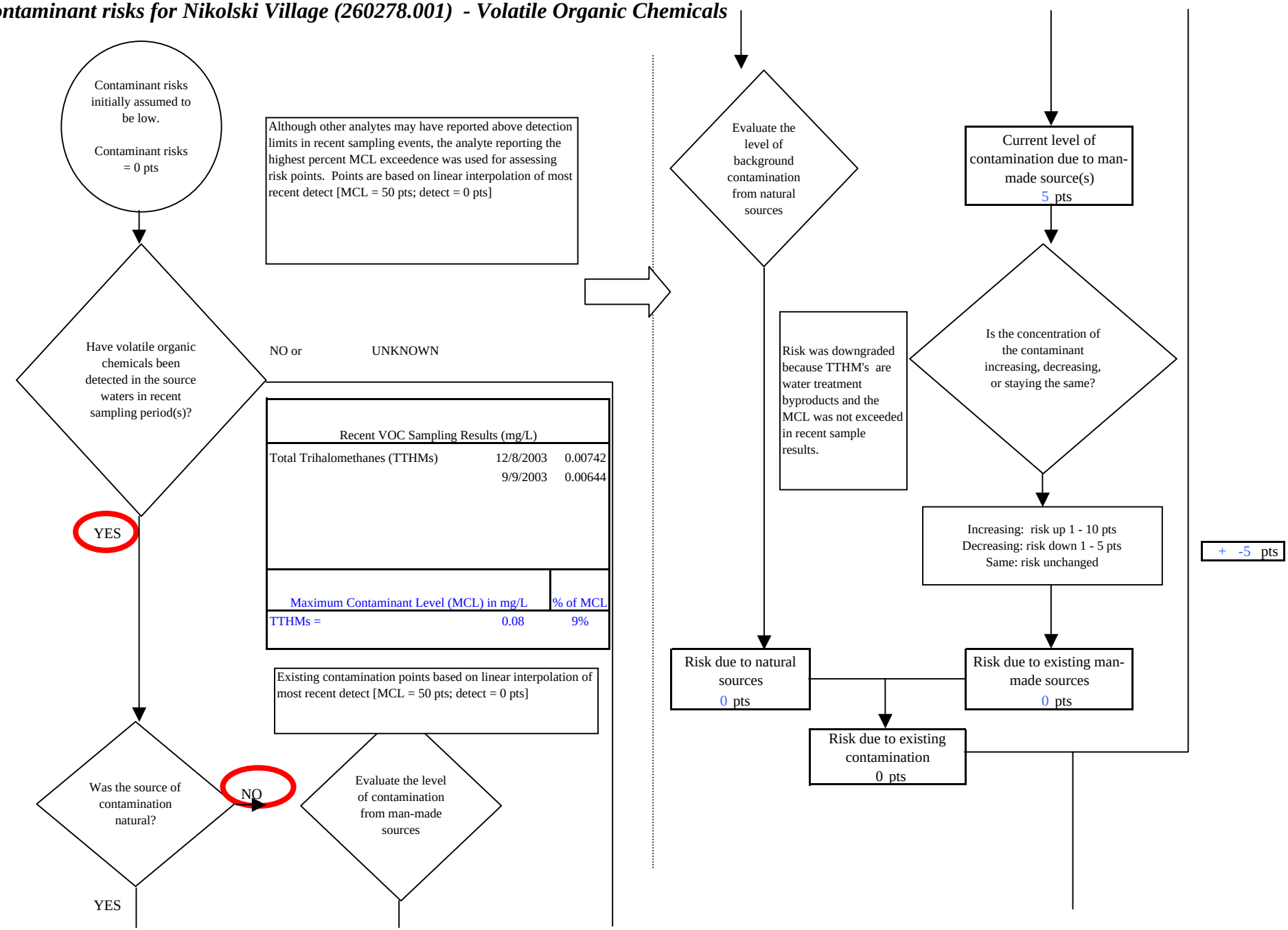
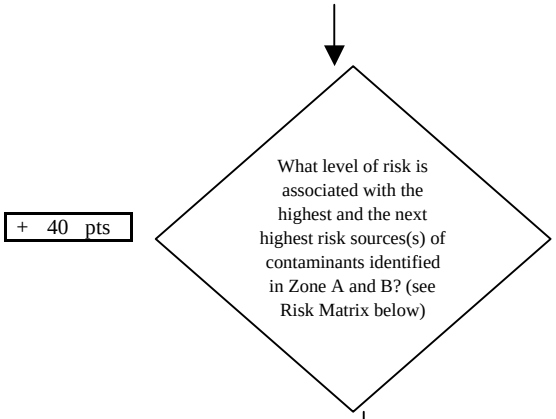


Chart 7. Contaminant risks for Nikolski Village (260278.001) - Volatile Organic Chemicals



+ 40 pts

Risk Levels for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	1	0	1
High(s)	1	0	1
Medium(s)	1	0	1
Low(s)	3	0	3

	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.

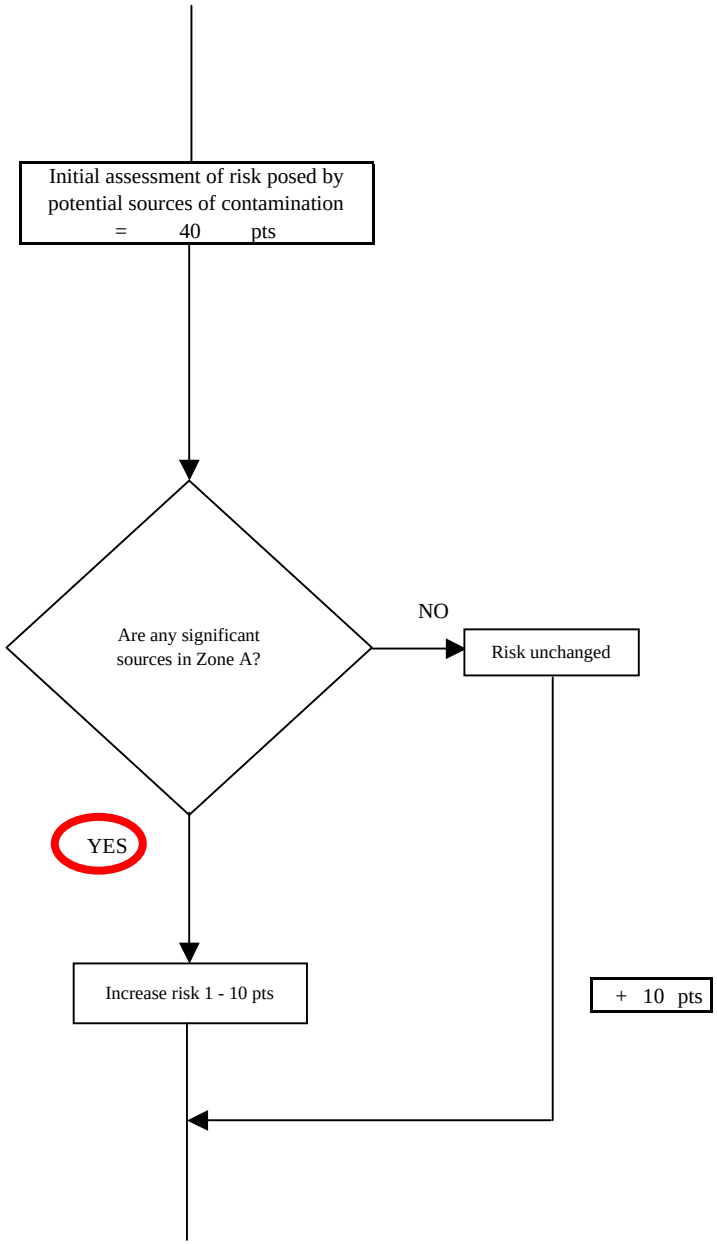
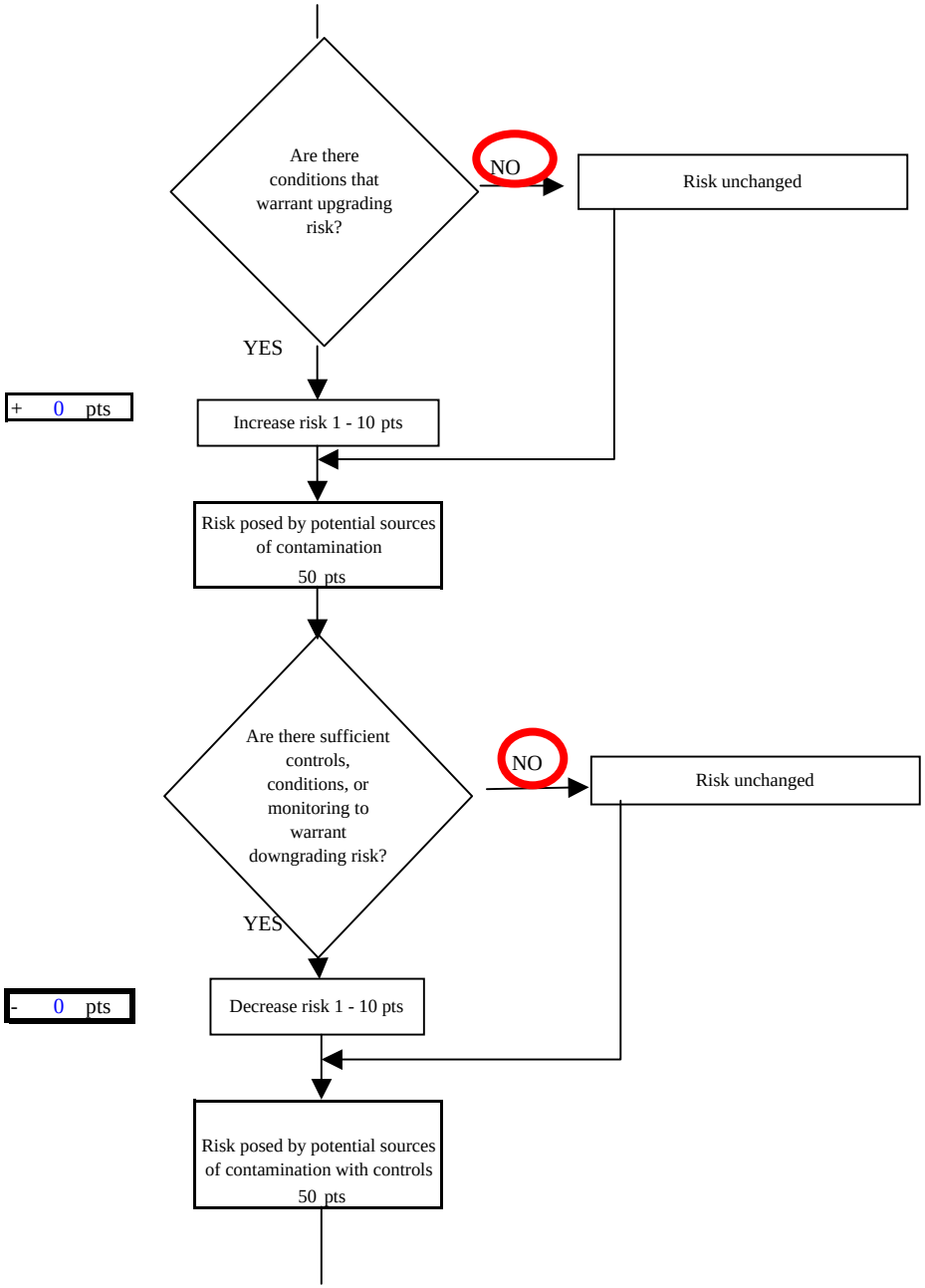
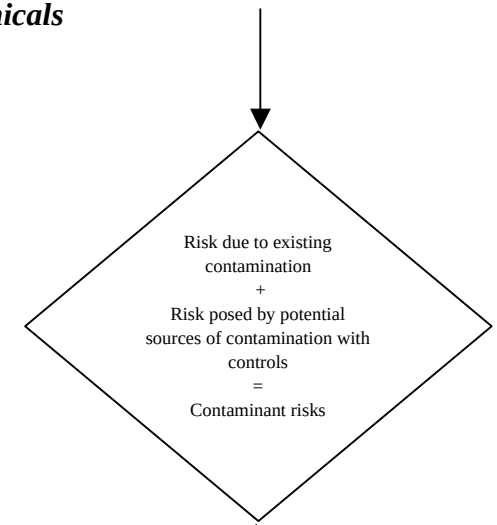


Chart 7. Contaminant risks for Nikolski Village (260278.001) - Volatile Organic Chemicals





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

Contaminant risks*
= 50 pts

*Truncate risk at 50 pts

Very High

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 8. Vulnerability analysis for Nikolski Village (260278.001) - Volatile Organic Chemicals

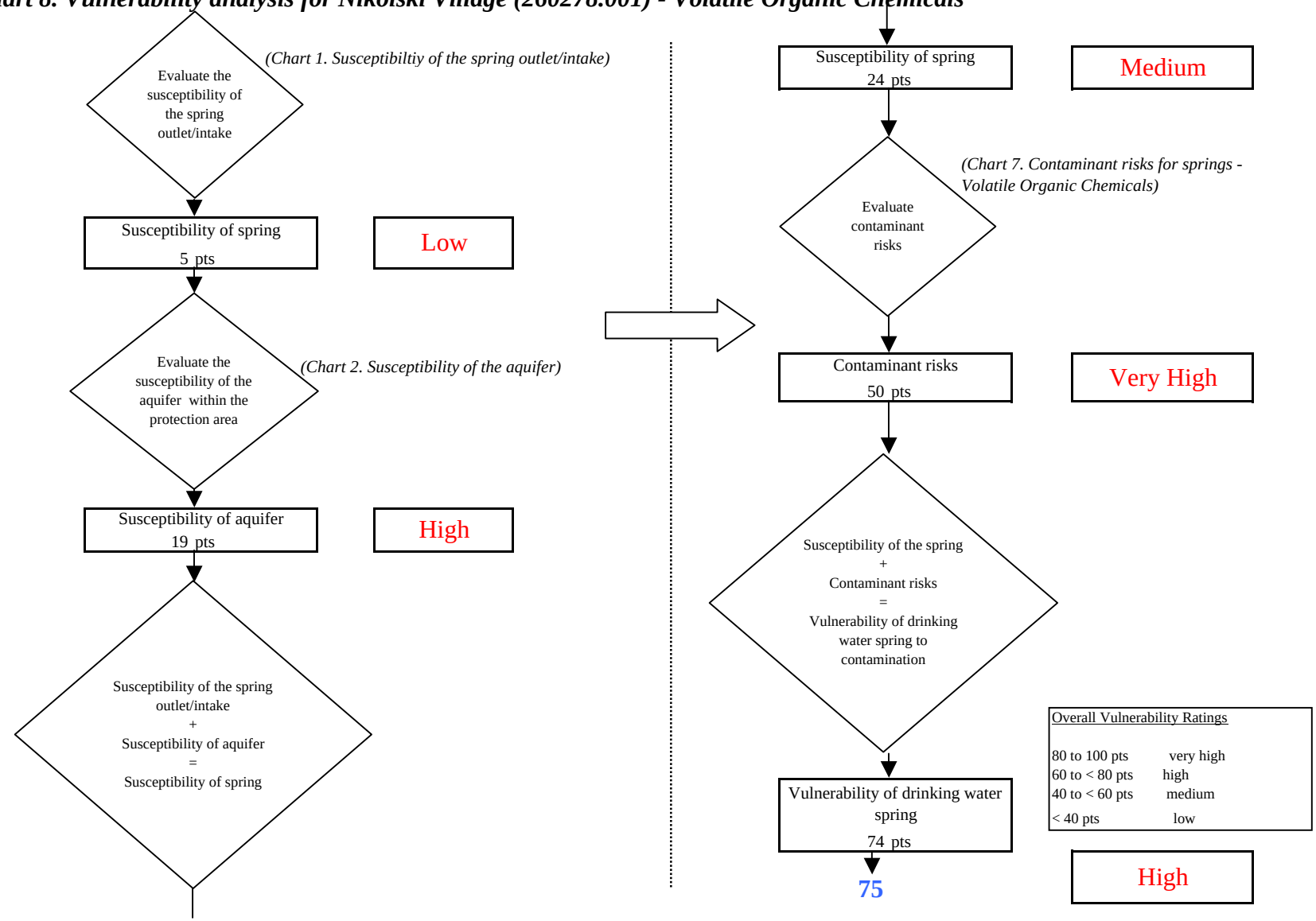


Chart 9. Contaminant risks for Nikolski Village (260278.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

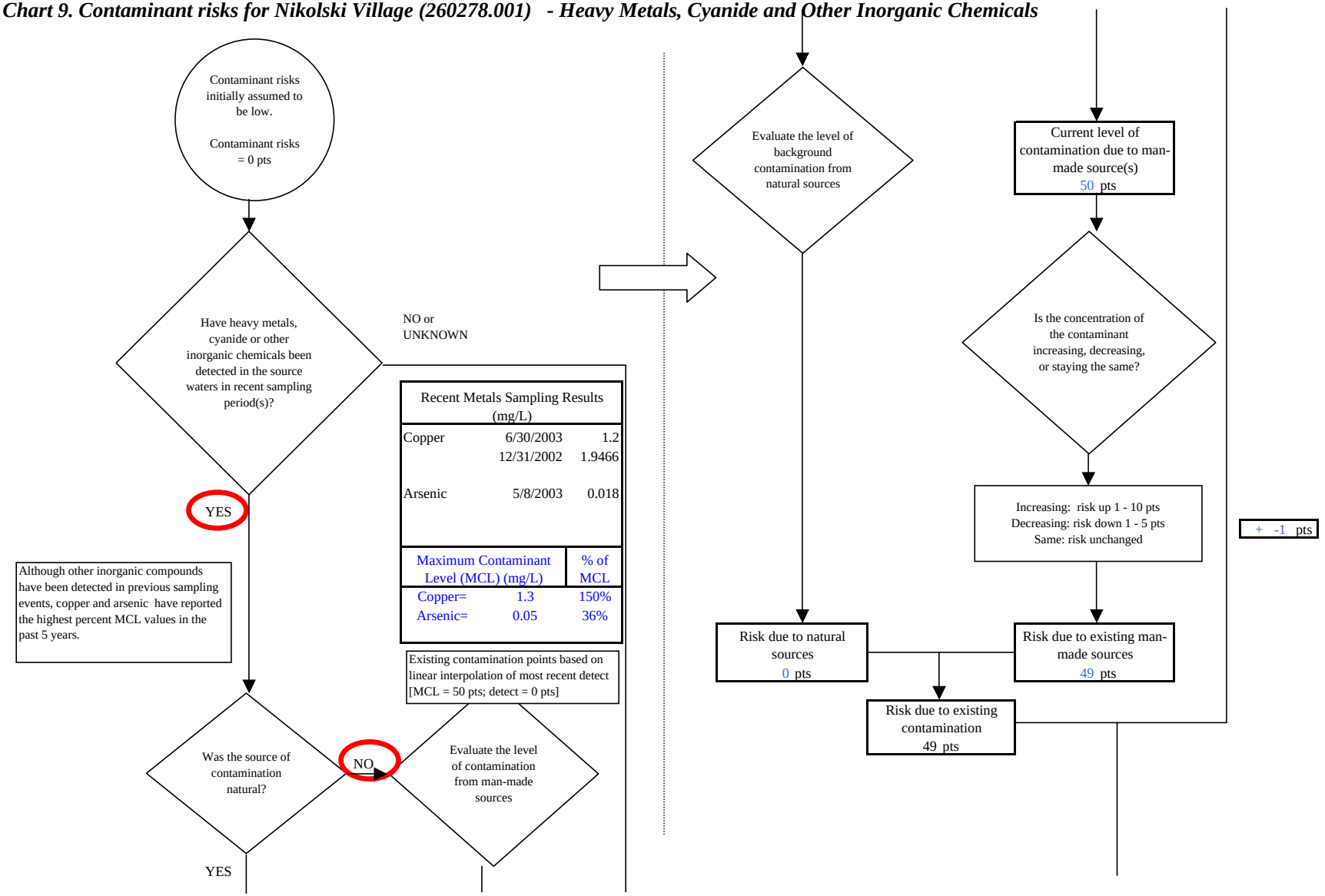
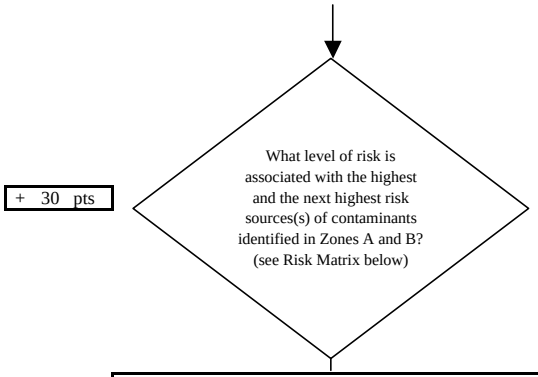


Chart 9. Contaminant risks for Nikolski Village (260278.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 30 pts

Risk Levels 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)	4	0	4

	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.

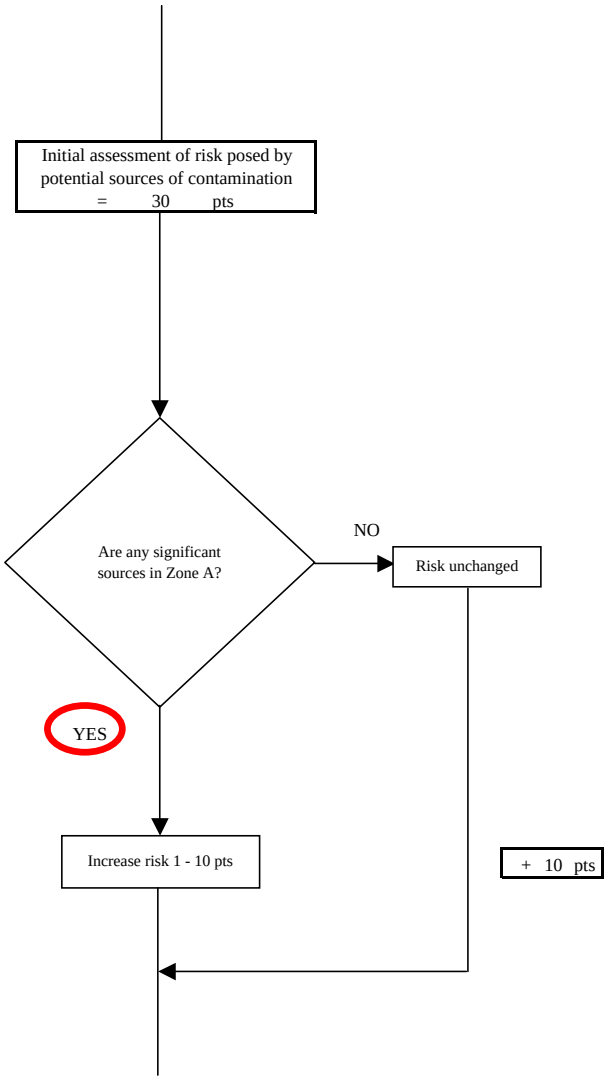


Chart 9. Contaminant risks for Nikolski Village (260278.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

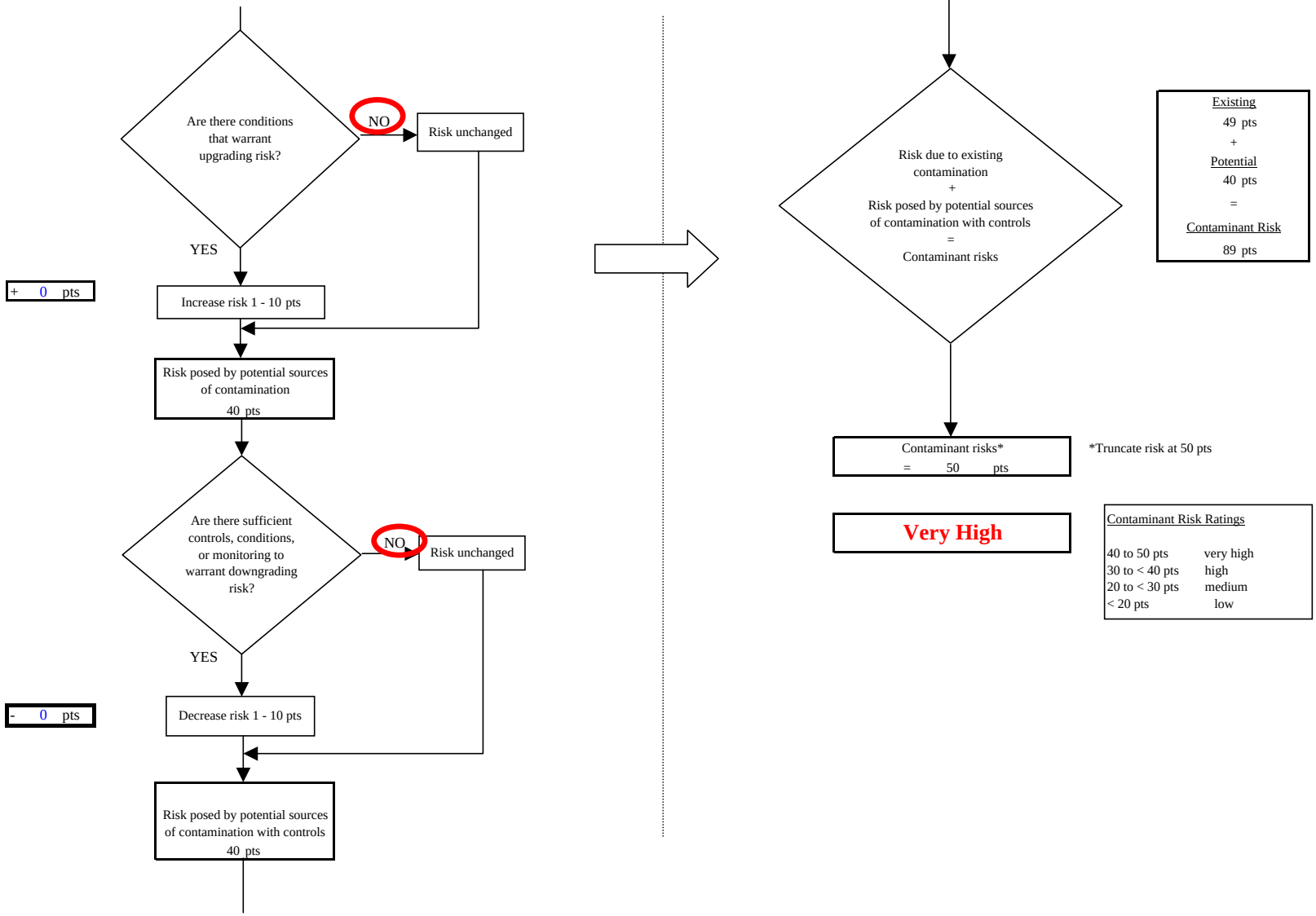


Chart 10. Vulnerability analysis for Nikolski Village (260278.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

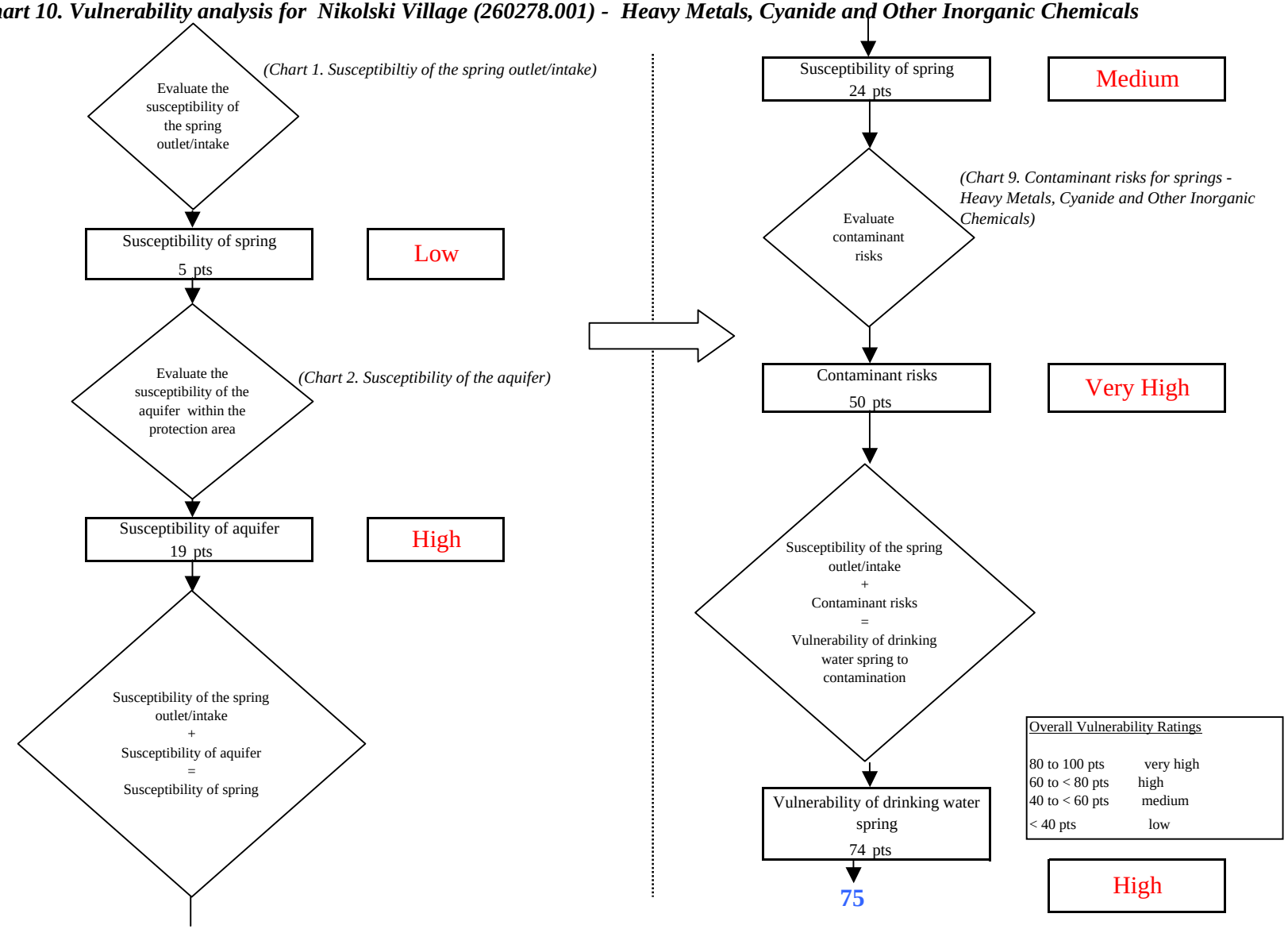


Chart 11. Contaminant risks for Nikolski Village (260278.001) - Synthetic Organic Chemicals

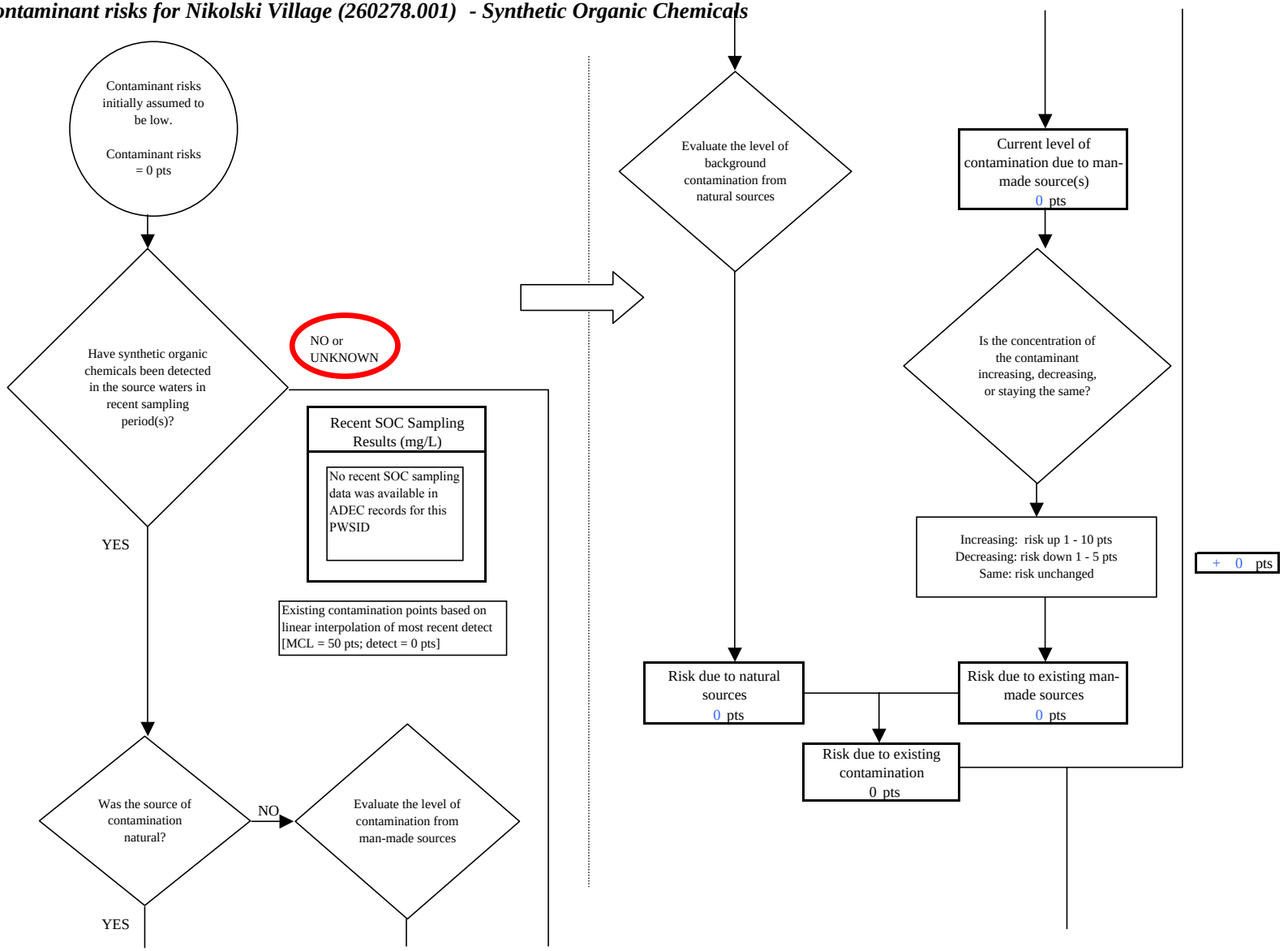
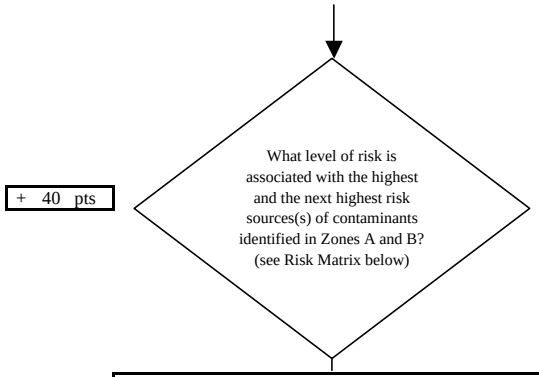


Chart 11. Contaminant risks for Nikolski Village (260278.001) - Synthetic Organic Chemicals



+ 40 pts

Risk Levels for Contaminant Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	1	0	1
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	0	3

	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.

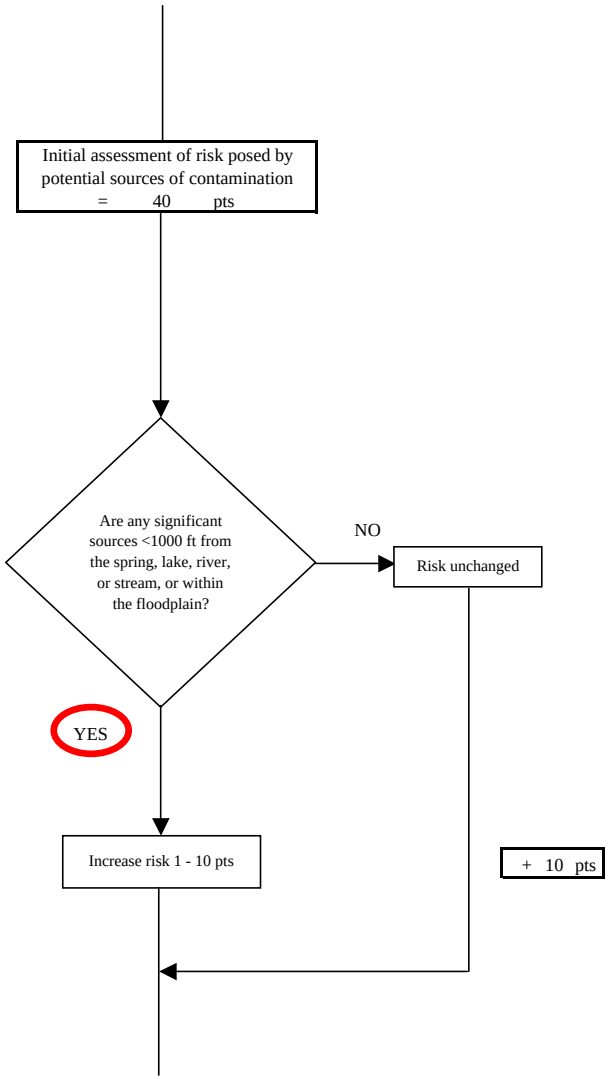


Chart 11. Contaminant risks for Nikolski Village (260278.001) - Synthetic Organic Chemicals

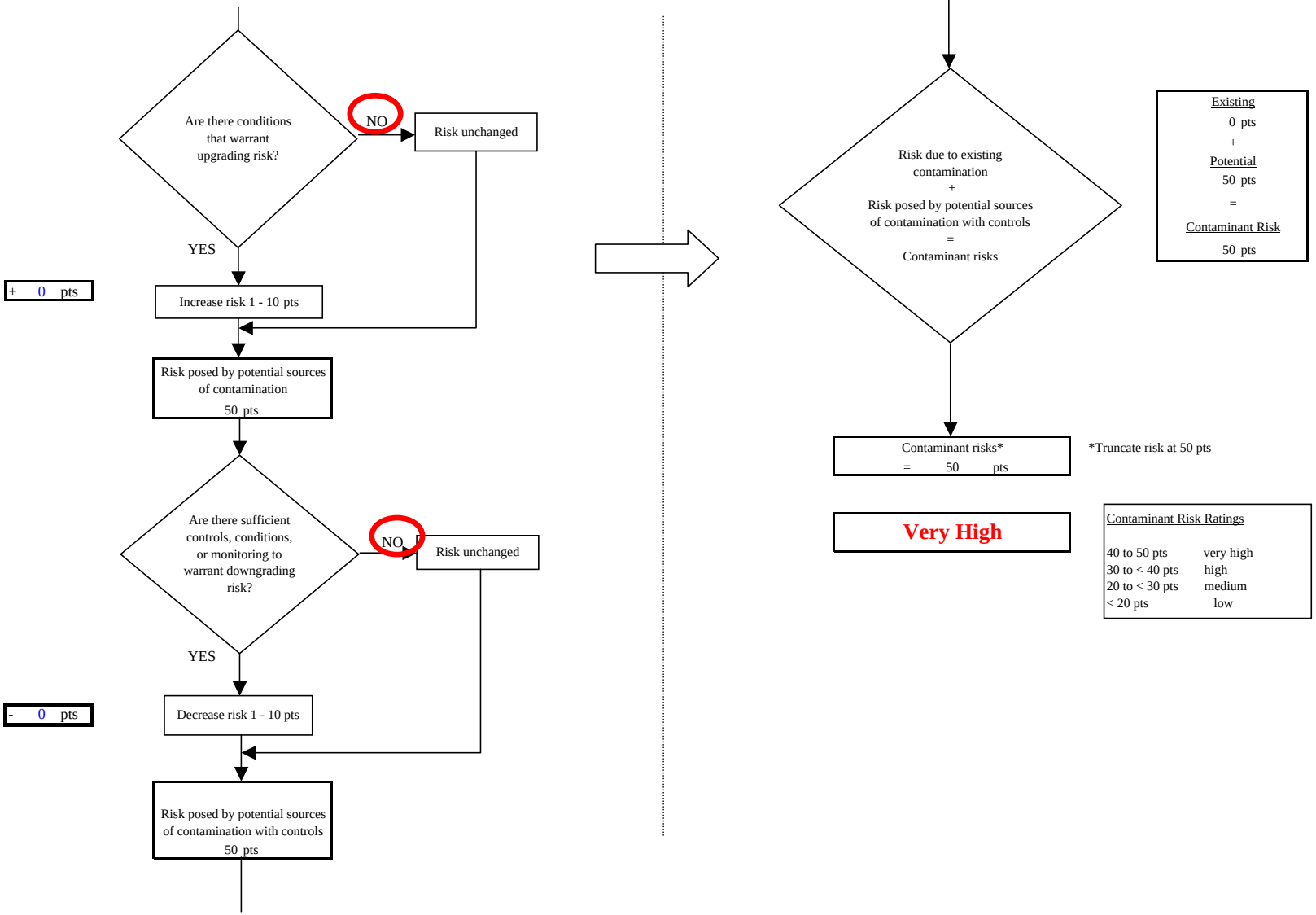


Chart 12. Vulnerability analysis for Nikolski Village (260278.001) - Synthetic Organic Chemicals

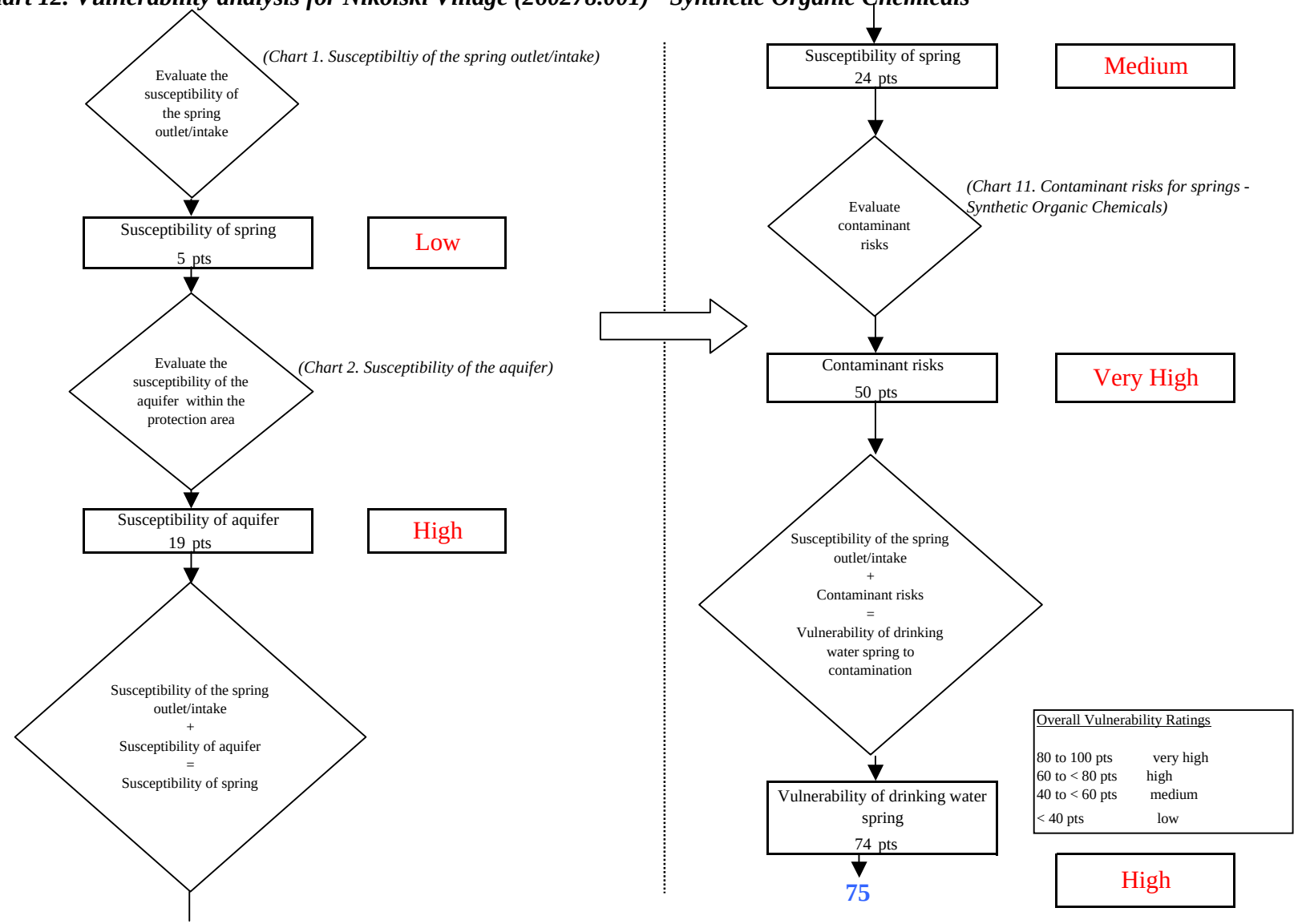


Chart 13. Contaminant risks for Nikolski Village (260278.001) - Other Organic Chemicals

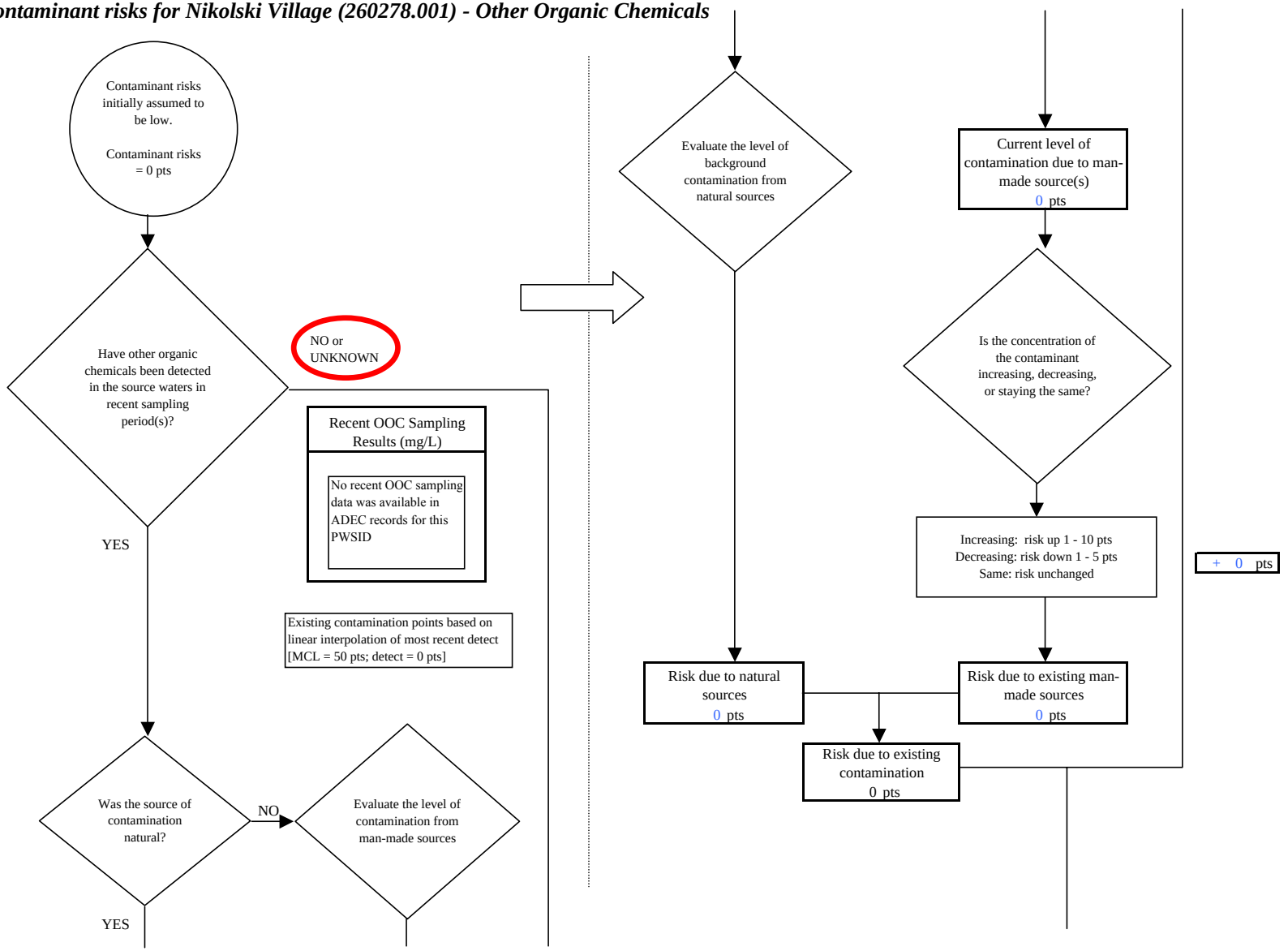
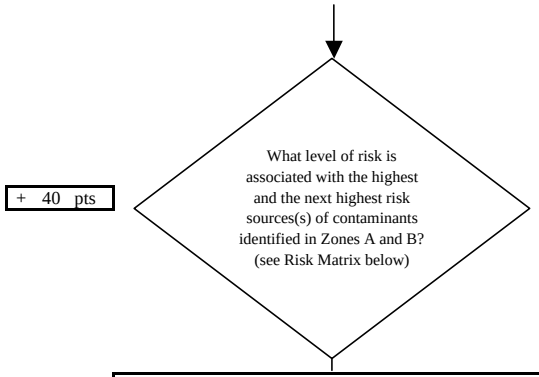


Chart 13. Contaminant risks for Nikolski Village (260278.001) - Other Organic Chemicals



+ 40 pts

Risk Levels for Contaminant Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	1	0	1
High(s)	1	0	1
Medium(s)	0	0	0
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.

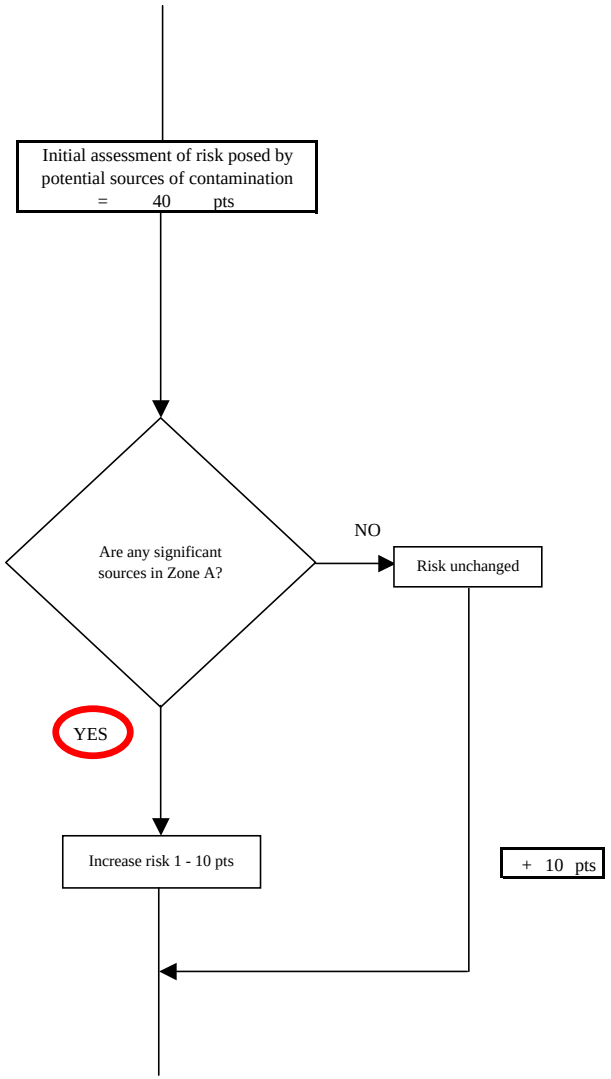


Chart 13. Contaminant risks for Nikolski Village (260278.001) - Other Organic Chemicals

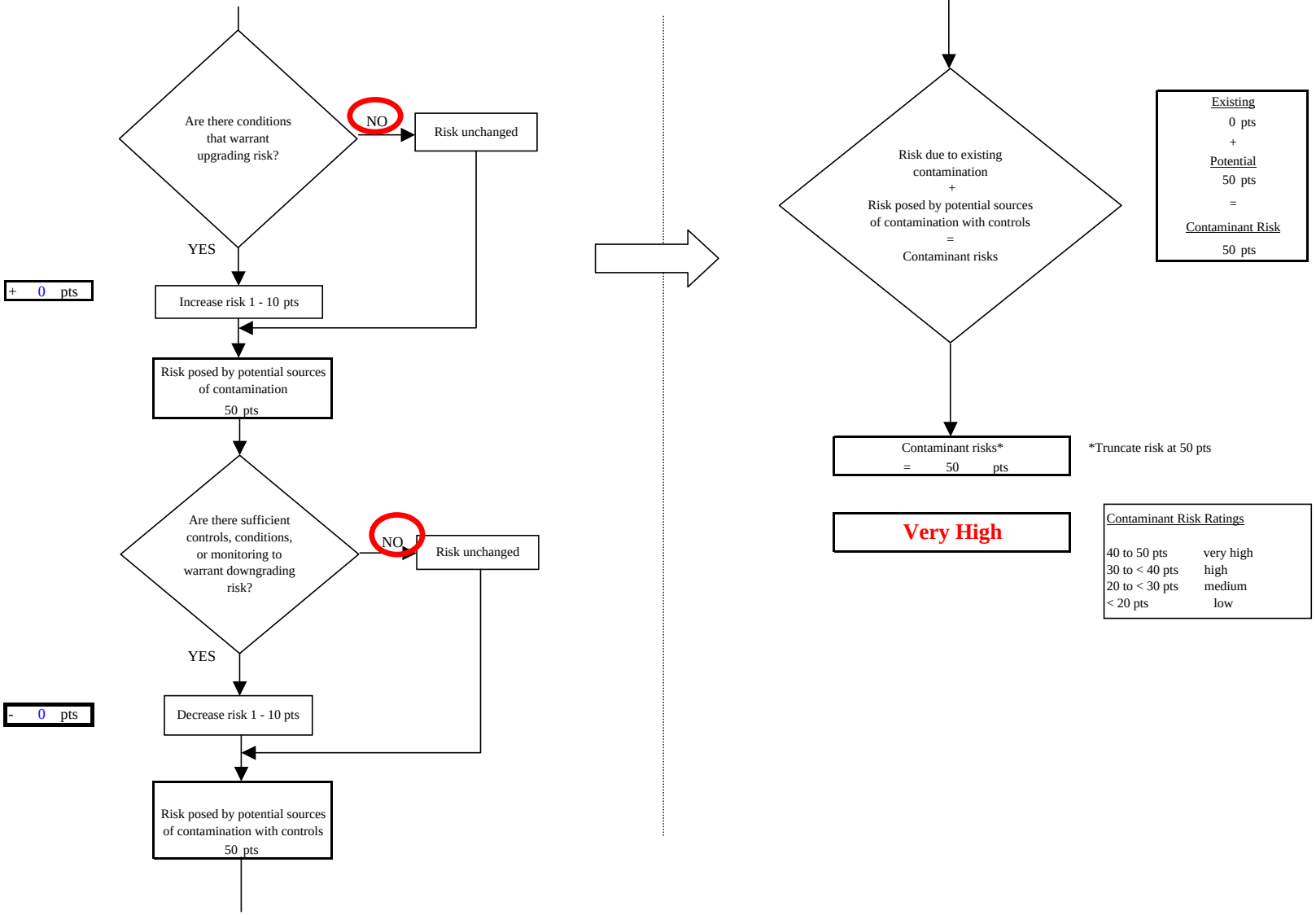


Chart 14. Vulnerability analysis for Nikolski Village (260278.001) - Other Organic Chemicals