# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for Kokhanok Water & WW System

Kokhanok, Alaska

PWSID # 263006.001

January 2004

Drinking Water Protection Program Report #1068

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 (EPA), the 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 that 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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# APPENDICES

# Source Water Assessment for the Kokhanok Water & WW System, Kokhanok, Alaska

**Drinking Water Protection Program**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The public water system for Kokhanok, Alaska, is a Class A surface water system that obtains water from the south shore of Lake Iliamna near the head of Kohkanok Bay. Water from the lake is filtered, chlorinated, and piped to a storage tank located southeast of the city on Gobby Hill. The storage tank has an approximate volume of 100,000 gallons.

The Kokhanok protection area is approximately 14 square miles in size and has received a susceptibility rating of **High**. *A rating of High to Very High is typical for all systems with surface water intakes*. Potential and existing sources of the following contaminants were evaluated for the Source Water Assessment: bacteria and viruses, nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, volatile organic chemicals, and other organic chemicals.

Known potential contaminant sources are located within surface water protection area including sewage lagoons, fuel tanks, cemeteries, motor vehicle repair shops, scrap yards, bulk fuel facilities, airports, landfills, power generation facilities, and roads. These sources may affect drinking water at the reservoir and could potentially influence sampling results. Samples were collected from post-treated water. Contaminant sources identified within the surface water protection area for this public water system have been considered in order to provide the most conservative evaluation.

This evaluation included all available water sampling data submitted to the Alaska Department of Environmental Conservation (ADEC) by the system operator. As stated previously, the samples were collected from post-treated water. Vulnerability ratings for the water system have been determined by combining the susceptibility of the surface water source with the contaminant risks. The system received a vulnerability rating of **Medium** bacteria and viruses, a **High** rating for nitrates and nitrites, a **Very High** rating for volatile organic compounds, a **Low** rating for heavy metals, cyanide, and other inorganics, a **Medium** rating for synthetic organic compounds, and a **Very High** rating for other organic compounds.

This assessment 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 City of Kokhanok to protect public health.

## DRINKING WATER SYSTEM AND AREA OVERVIEW

Kokhanok (Sec. 32, T008S, R032W, Seward Meridian) is located on the south shore of Lake Iliamna, approximately 210 miles southwest of Anchorage and approximately 85 miles northeast of King Salmon. Kokhanok has a current population of 174 (ADCED, 2003). Average annual precipitation in Kokhanok is 32 inches annually, including approximately 89 inches of snowfall. Temperatures range from -48 to 84°F. Average summer highs range from 60 to 64°F. Winter highs average 3 to 30°F.

The public water system is a Class A surface water system that operates year-round and obtains water from Lake Iliamna, approximately one half mile southeast of the community. The water is piped to a treatment plant, treated, and then stored in a 100,000-gallon tank on Gobby Hill located southeast of the city. The community operates piped water and sewer systems that serve approximately 35 of 52 households. The remaining households use honeybuckets (ADCED, 2003).

The City of Kokhanok provides local power during summer months; however, electricity is purchased from the school district during the winter. Power generating facilities are fueled by diesel. The Kokhanok Village Council provides refuse collection services (ADCED, 2003).

Information acquired from a June 1998 sanitary survey for the public water system indicated that the surface water intake is adequately constructed. The surface water intake is screened and protected from ice buildup and siltation. No information was available regarding the average daily production of the water system; however, the system is equipped with 2 pumps, each rated for a pumping rate of 35 gallons per minute.

Kokhanok lies between two physiographic areas called the Nushagak-Bristol Bay Lowlands and the Nushagak-Big River Hills (Ottley, 1984). Surficial soils consist primarily of clean, subrounded to rounded, sands, gravelly sand, and sandy gravels. This material is well drained and overlain by a thin layer of organics and silts. The Kokhanok area has been mapped as containing isolated masses of permafrost.

## DRINKING WATER PROTECTION AREA

Identifying the pathways most likely for surface contamination to reach water intake areas is the first step in determining the water system's risk. These pathways are initially determined by looking at the drainage area contributing overland water flow to a surface water source intake. The entire drainage area is also known as the "drinking water protection area." Please refer to pages 10-11 of the "Guidance Manual for Class A Public Water Systems" for additional information.

The protection area established for surface water sources by the ADEC is usually separated into three zones. These zones correspond to the overland-flow distance that water travels to get to the source. The ADEC Drinking Water Protection Program's Technical Advisory Committee developed guidelines for derivation of these zones in 1998. The following is a summary of the three protection area zones:

**Table 1. Definition of Zones**

| Zone | Definition |
|---|---|
| A | Areas within 1000-ft of lakes or streams |
| B | Areas within 1-mile of lakes or streams |
| C | The watershed boundary |

The protection area for the Kokhanok water intake includes each of these Zones (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 Kokhanok surface water protection area. This inventory was completed through a search of agency records and other publicly available information. There is a wide array of potential contamination sources to surface water. These contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For 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.

Numerous contaminant sources were identified in the Kokhanok protection area as displayed on Map C of Appendix C and in Table 1 of Appendix B.

## RANKING OF CONTAMINANT RISKS

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

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

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

The remaining tables 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:

- Surface Water Susceptibility and
- Contaminant risks.

Appendix D contains 13 charts, which together form the 'Vulnerability Analysis' for the public drinking water Source Water Assessment. Chart 1 analyzes the 'Susceptibility of the Surface Water Source' to contamination by looking at the climate, terrain, and intake location. Chart 2 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 intake area. Chart 3 contains the 'Vulnerability Analysis for Bacteria and Viruses,' which is a composite score of the Vulnerability Analysis and the overall Susceptibility. Charts 4 through 13 repeat 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 Surface Water Susceptibility of the source is reached by considering the properties of the water intake and the surrounding area. The derivation of this information is presented below and the data for this source is shown in Chart 1 of Appendix D.

Susceptibility of the Surface Water Source – always considered to be "high" (30 points)

+

Adequate Construction of the Intake (0 – 5 Points)

+

Runoff Potential Within Zone B (0 – 5 Points)

+

Dilution Capacity of the Surface Water (0 – 10 Points)

=

Natural Susceptibility
(0 – 50 Points)

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

| Surface Water Source Susceptibility Ratings | |
|---|---|
| 40 to 50 pts | Very High |
| 30 to < 40 pts | High |

**Table 2. Susceptibility of the Water Source**

| | Score | Rating |
|---|---|---|
| Minimum Allowable Susceptibility | 30 | |
| Intake Construction Adequate | 0 | |
| Runoff Potential | 2 | |
| Dilution Capacity | 5 | |
| ***Overall Susceptibility*** | ***37*** | ***High*** |

For contaminants, risks to a drinking water source depend on the type, number or density, and distribution of the contaminant sources. The Contaminant Risk score has been derived from an examination of existing, and historical contamination sources that have been detected in the protection area 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 the 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. Kokhanok Contaminant Risks**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 12 | Low |
| Nitrates and/or Nitrites | 37 | High |
| Volatile Organic Chemicals | 50 | Very High |
| Heavy Metals, Cyanide, and Other Inorganic Chemicals | 2 | Low |
| Synthetic Organic Chemicals | 5 | Low |
| Other Organic Chemicals | 45 | Very High |

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

Susceptibility of the Surface Water Source

(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 and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Kokhanok Water System Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 50 | Medium |
| Nitrates and Nitrites | 75 | High |
| Volatile Organic Chemicals | 85 | Very High |
| Heavy Metals, Cyanide, and Other Inorganic Chemicals | 35 | Low |
| Synthetic Organic Chemicals | 40 | Medium |
| Other Organic Chemicals | 80 | Very High |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Low**. The contaminant risk for bacteria and viruses is primarily attributed to the presence of roads in Zone A. Other identified contaminant risks include landfills.

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. Typically, coliform detection in raw water samples collected from surface water sources is normal. (See Chart 2 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Only one positive bacteria count was reported in recent (previous 5 years) sampling events. The positive result was reported in 1999; however, the follow-up confirmation sample was negative.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the source, the overall vulnerability of the source to bacteria and virus contamination is considered **Medium**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **High** (See Chart 4 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). The contaminant risk is primarily attributed to multiple risk sources identified in the protection area for this public water system. Indentified sources include roads, landfills, and a wastewater treatment facility. Nitrates are very mobile, moving at approximately the same rate as water.

The Maximum Contaminant Level (MCL) for nitrates is 10 milligrams per liter (mg/L). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects (EPA, 2003).

The recent sampling history for the water source indicates that no detectable concentrations of nitrates have been reported.

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

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Very High** (See Chart 6 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

The contaminant risk is primarily attributed to two bulk fuel facilities identified in the protection area for this public water system.

Detectable concentrations of trihalomethanes were reported in sampling events for this public water system. None of the reported trihalomethane concentrations were reported above the MCL. Trihalomethanes are considered byproducts of the water treatment process and are not from the source waters. Since none of the reported concentrations exceeded applicable MCLs, and the presence of trihalomethanes are not attributed to the source waters, no contaminant risk points were retained. The MCL for total trihalomethanes is 0.08 mg/L.

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the

source, the overall vulnerability of the source to contamination remains **Very High**.

**Heavy Metals, Cyanide, and Other Inorganic Chemicals**

The contaminant risk for heavy metals is **Low**.

Two contaminant sources for heavy metals, cyanide, and other inorganic chemicals were identified in the protection area for this public water system. The contaminant sources consist of two landfills. Based on review of recent sampling records for this public water system, low levels of copper, and lead have been detected. None of these analytes have exceeded their respective MCLs in recent sampling events (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. These two analytes are likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on the presence of these analytes.

After combining the contaminant risk for heavy metals with the natural susceptibility of the source, the overall vulnerability of the well to contamination is **Low**.

**Synthetic Organic Chemicals**

The contaminant risk for synthetic organic chemicals is **Low**. Two contaminant sources for synthetic organic chemicals were identified in the protection area for this public water system. The contaminant sources consist of two landfills.

Review of historical sampling data found no recent sampling results for synthetic organic chemical contaminants.

After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to synthetic organic chemicals of the source is **Medium** (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

**Other Organic Chemicals**

The contaminant risk for other organic chemicals is **Very High**. Several contaminant risks sources for other organic chemicals were identified in Zones B and C of the protection area. The contaminant risk is primarily attributed to five high risk sources located in Zone B (See Table 7 – Appendix B). After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to other organic chemicals of the source is **Very High** (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

Review of the historical sampling data found no recent sampling results for other organic chemicals.

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

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# APPENDIX A

## Drinking Water Protection Area Location Map
## (Map A)

# Public Water System for PWS #263006.001 Kokhanok Water and Wastewater System


## LEGEND

- Public Water System

***Hydrography/Physical***

- Parcels
- Stream
- Lake or Pond
- Contours (approx. 50 ft or as indicated)

***Transportation***

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

***Surface Water Protection Zones***

- Zone A Protection Area– 1000 Feet from Surface Water
- Zone B Protection Area– 1 Mile from Surface Water
- Zone C Protection Area– 10 Miles from Surface Water

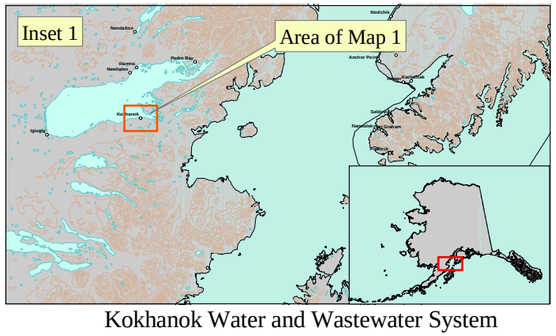
**Data Sources:**
**Contaminant Sources, Public Water System Wells, Contours**
**Alaska Department of Environmental Conservation (ADEC)**

**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.**




Kokhanok Water and Wastewater System
PWS 263006.001
Appendix A Map A

# APPENDIX B

## Contaminant Source Inventory and Risk Rankings (Tables 1-7)

***Table 1***

# *Contaminant Source Inventory for* ***Kokhanok Water & WW System***

***PWSID 263006.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Water supply wells | W09 | W09-01 | A | C | Kokhanok Water and Wastewater System |
| Highways and roads, dirt/gravel | X24 | X24 | A | C | Assumed 1 to 20 dirt/gravel roads located in Zone A |
| Motor /motor vehicle repair shops | C31 | C31-01 | B | C | |
| Domestic wastewater collection systems (sewer lines or lift stations) | D01 | D01-01 | B | C | 35 residential households suspected of having sewer service |
| Domestic wastewater treatment plant disposal ponds/lagoons | D02 | D02-01 | B | C | |
| Scrap, salvage, or junk yards | D59 | D59-01 | B | C | School dump |
| Solid Waste Transfer Facility | D61 | D61-01 | B | C | "slop bucket lake dump" |
| Residential Areas | R01 | R01-01 | B | C | Assumed 59 residential households, total residential area suspected of being less than 50 acres |
| Tanks, fuel, residential (above ground) | R07 | R07-01 | B | C | 54 residents suspected of having above ground fuel tanks |
| Tanks, diesel (above ground) | T06 | T06-01 | B | C | School Generator |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-01 | B | C | School power house |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-02 | B | C | Clinic |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-03 | B | C | Store |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-04 | B | C | Teachers quarters |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-05 | B | C | GCI Earth Station |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-06 | B | C | Saint Peter and Paul Orthodox Church |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-07 | B | C | Fire Station |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-08 | B | C | Village Council Office |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-09 | B | C | Police Station |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-10 | B | C | Post Office |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-11 | B | C | ACS |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-12 | B | C | GCI |
| Tanks, heating oil, nonresidential (aboveground) | T14 | T14-13 | B | C | Kokhanok School |
| Cemeteries | X01 | X01-01 | B | C | Orthodox Church Cemetery |

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Petroleum product bulk station/terminals | X11 | X11-01 | B | C | Fuel Storage Site |
| Petroleum product bulk station/terminals | X11 | X11-02 | B | C | School Fuel Storage |
| Airports | X14 | X14-02 | B | C | Kokhanok Landing Strip |
| Boat yards and marinas | X15 | X15-01 | B | C | Float plane dock |
| Fuel barges (operating in area) | X18 | X18-01 | B | C | Barge, Boat & Floatplane Landing Site |
| Highways and roads, dirt/gravel | X24 | X24 | B | C | Assumed 1 to 50 dirt/gravel roads located in Zone B |
| Electric power generation (fossil fuels) | X36 | X36-01 | B | C | School Power House |
| Firehouses | X38 | X38-01 | B | C | Fire Station |
| Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes) | X40 | X40-01 | B | C | Clinic |
| Landfills (municipal; Class III) | D51 | D51-01 | C | C | Kokhanok Class III Landfill |
| Landfills (municipal; Class III) | D51 | D51-02 | C | C | Old Kokhanok Landfill |
| Airports | X14 | X14-01 | C | C | Landing Strip 07/25 |
| Highways and roads, dirt/gravel | X24 | X24 | C | C | Assumed 1 to 50 dirt/gravel roads located in Zone C |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for Kokhanok Water & WW System Sources of Bacteria and Viruses*

***PWSID 263006.001***

| ***Contaminant Source Type*** | ***Contaminant Source ID*** | ***CS ID tag*** | ***Zone*** | ***Risk Ranking for Analysis*** | ***Map Number*** | ***Comments*** |
|---|---|---|---|---|---|---|
| Highways and roads, dirt/gravel | X24 | X24 | A | Low | C | Assumed 1 to 20 dirt/gravel roads located in Zone A |
| Domestic wastewater treatment plant disposal ponds/lagoons | D02 | D02-01 | B | High | C | |
| Landfills (municipal; Class III) | D51 | D51-01 | C | High | C | Kokhanok Class III Landfill |
| Landfills (municipal; Class III) | D51 | D51-02 | C | High | C | Old Kokhanok Landfill |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for Kokhanok Water & WW System Sources of Nitrates/Nitrites*

***PWSID 263006.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Highways and roads, dirt/gravel | X24 | X24 | A | Low | C | Assumed 1 to 20 dirt/gravel roads located in Zone A |
| Domestic wastewater treatment plant disposal ponds/lagoons | D02 | D02-01 | B | High | C | |
| Landfills (municipal; Class III) | D51 | D51-01 | C | Very High | C | Kokhanok Class III Landfill |
| Landfills (municipal; Class III) | D51 | D51-02 | C | Very High | C | Old Kokhanok Landfill |

***Table 4***

# *Contaminant Source Inventory and Risk Ranking for Kokhanok Water & WW System Sources of Volatile Organic Chemicals*

***PWSID 263006.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Petroleum product bulk station/terminals | X11 | X11-01 | B | Very High | C | Fuel Storage Site |
| Petroleum product bulk station/terminals | X11 | X11-02 | B | Very High | C | School Fuel Storage |

***Table 5***

# *Contaminant Source Inventory and Risk Ranking for Kokhanok Water & WW System*

## *Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

***PWSID 263006.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Landfills (municipal; Class III) | D51 | D51-01 | C | High | C | Kokhanok Class III Landfill |
| Landfills (municipal; Class III) | D51 | D51-02 | C | High | C | Old Kokhanok Landfill |

***Table 6***

# *Contaminant Source Inventory and Risk Ranking for Kokhanok Water & WW System Sources of Synthetic Organic Chemicals*

***PWSID 263006.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Landfills (municipal; Class III) | D51 | D51-01 | C | Very High | C | Kokhanok Class III Landfill |
| Landfills (municipal; Class III) | D51 | D51-02 | C | Very High | C | Old Kokhanok Landfill |

**Table 7**

# *Contaminant Source Inventory and Risk Ranking for Kokhanok Water & WW System*
## *Sources of Other Organic Chemicals*

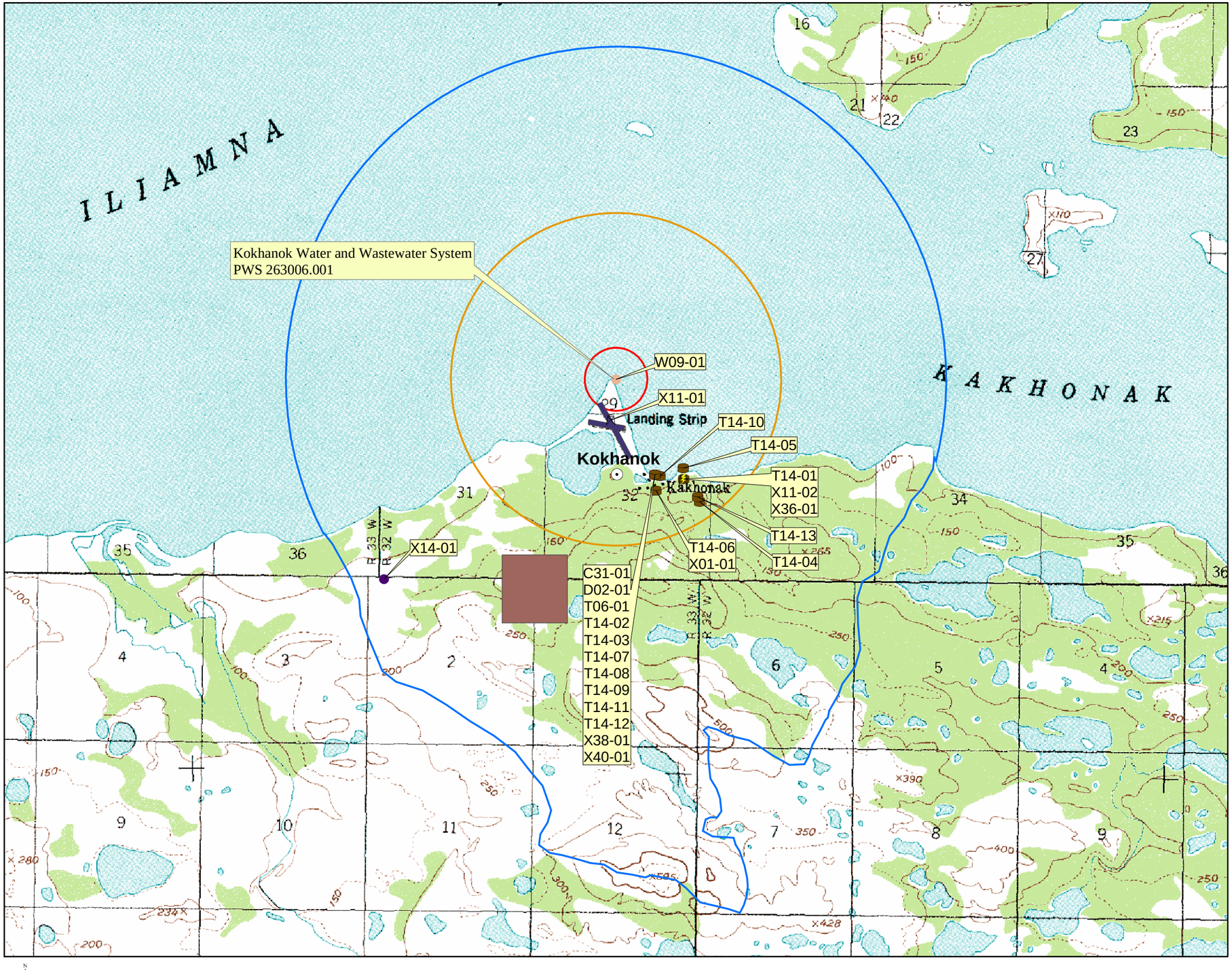
**PWSID 263006.001**

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Scrap, salvage, or junk yards | D59 | D59-01 | B | High | C | School dump |
| Petroleum product bulk station/terminals | X11 | X11-01 | B | High | C | Fuel Storage Site |
| Petroleum product bulk station/terminals | X11 | X11-02 | B | High | C | School Fuel Storage |
| Fuel barges (operating in area) | X18 | X18-01 | B | High | C | Barge, Boat & Floatplane Landing Site |
| Electric power generation (fossil fuels) | X36 | X36-01 | B | High | C | School Power House |
| Landfills (municipal; Class III) | D51 | D51-01 | C | Very High | C | Kokhanok Class III Landfill |
| Landfills (municipal; Class III) | D51 | D51-02 | C | Very High | C | Old Kokhanok Landfill |

# APPENDIX C

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

# Public Water System for PWS #263006.001 Kokhanok Water and Wastewater System
## Showing Potential and Existing Sources of Contamination




## LEGEND

- Public Water System

***Hydrography/Physical***

- Parcels
- Stream
- Aqueduct or Pipeline
- Lake or Pond
- Glacier
- Contours (approx. 70 ft.)

***Transportation***

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

***Surface Water Protection Zones***

- Zone A – 1000 Feet from Surface Water
- Zone B – 1 Mile from Surface Water
- Zone C – 10 Miles from Intake or Watershed Boundary

***Existing or Potential Contaminant Sources***

- Motor vehicle repair shop (C31)
- Sewage Lagoon (D02)
- Backup Generator (T06)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Reservoir/Water Supply (W09)
- Cemetery (X01)
- Fuel Storage >500 gallons (X11)
- Fire Station (X38)
- Hospital/Clinic/ER (X40)
- Landfills (Municipal, Class III) (D51)
- Airport or Landing Strip (X14)

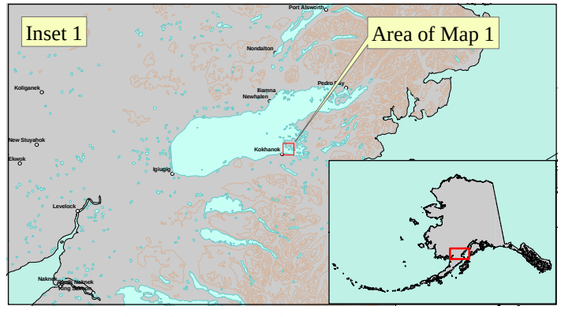
**Data Sources:**
**Contaminant Sources, Public Water System Wells, Contours**
**Alaska Department of Environmental Conservation (ADEC)**

**Critical Facilities**
**Federal Emergency Mangement Agency (FEMA)**

**All other data**
**United States Geological Survey (USGS)**

**Drinking Water Protection Areas based on ADEC published document:**
**"Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems"**

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



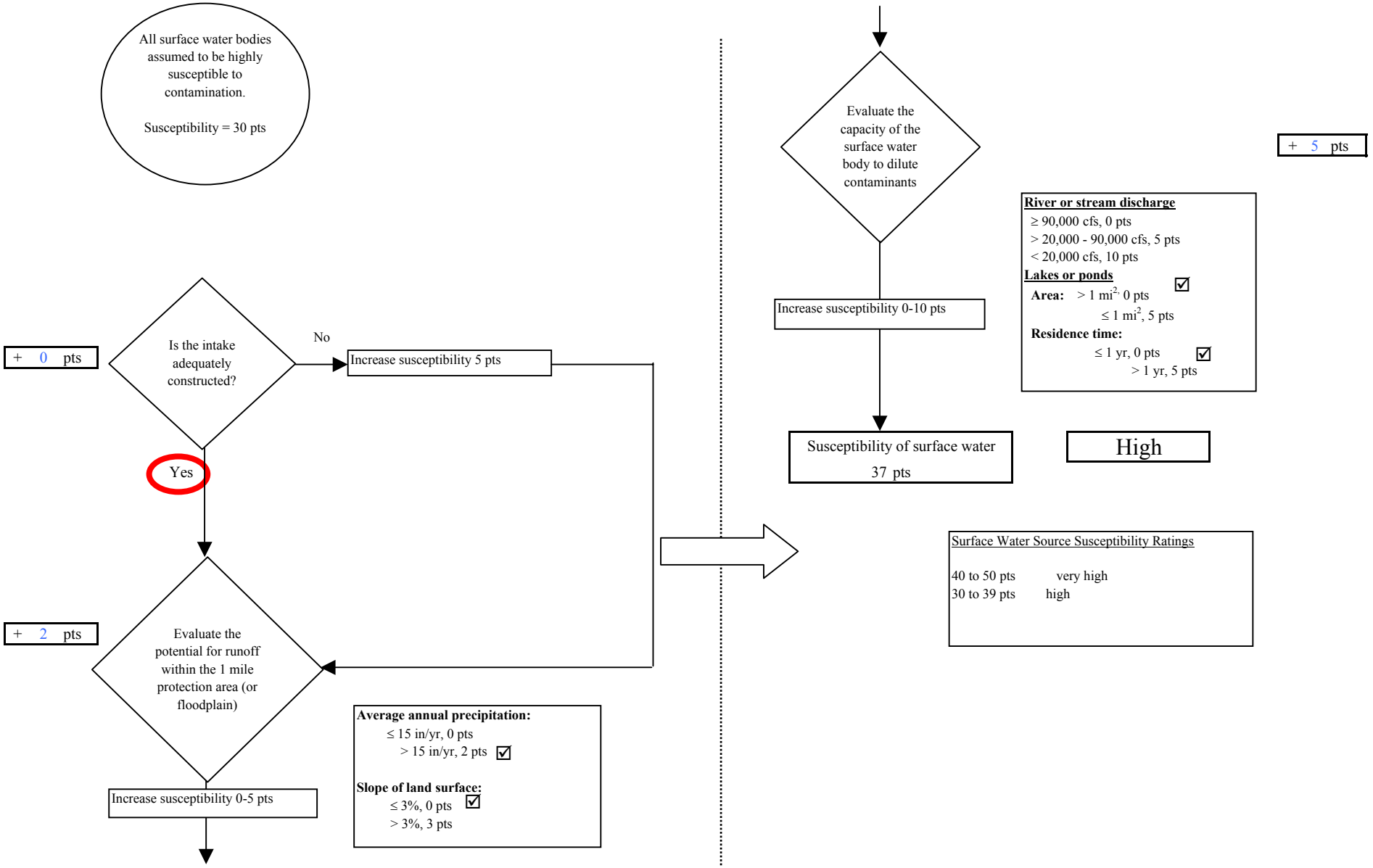

0 0.25 0.5 1 1.5 2 Miles

Kokhanok Water and Wastewater System
PWS 263006.001
Appendix C Map C

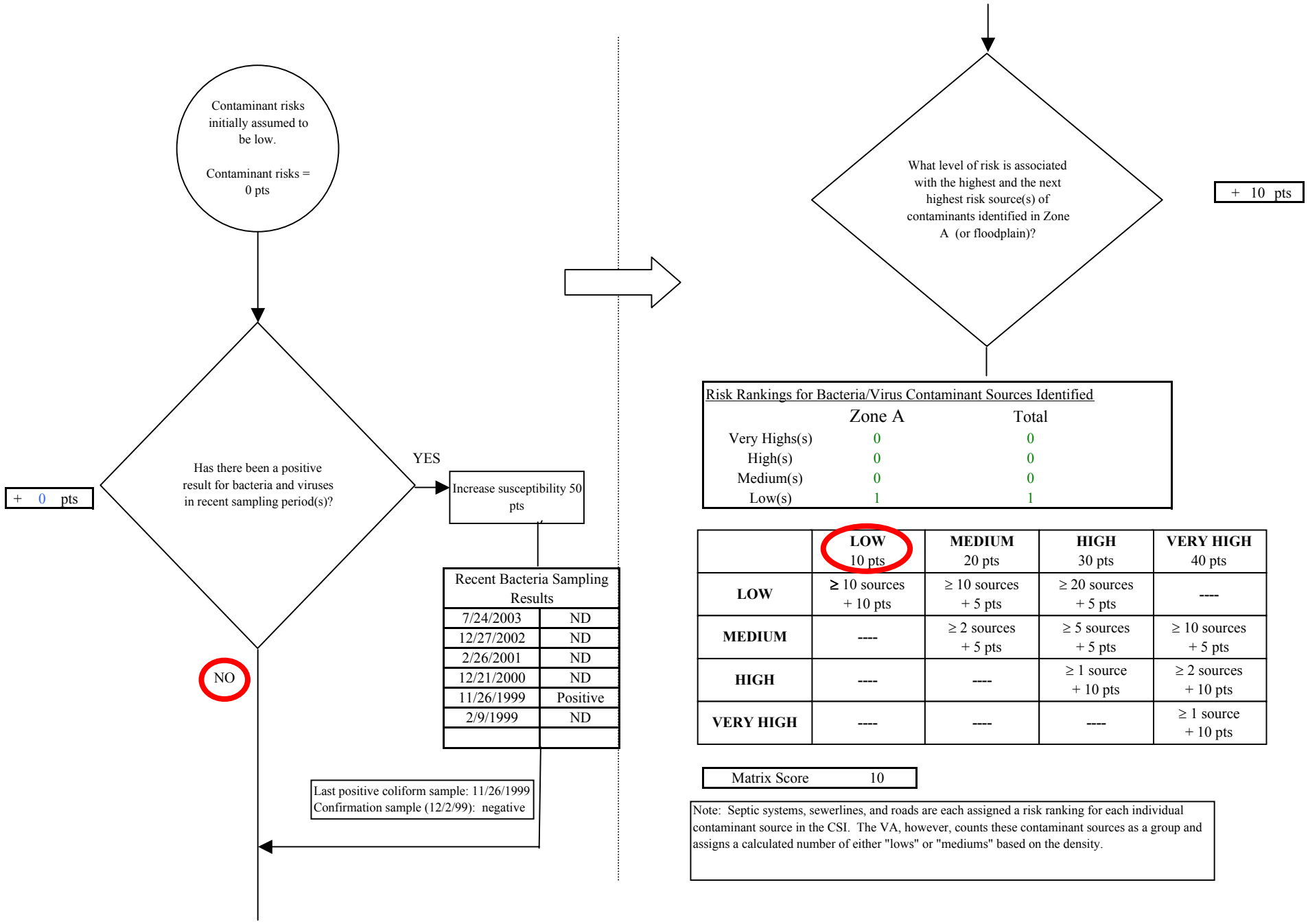
# APPENDIX D

## Vulnerability Analysis and Contaminant Risks
## (Charts 1-13)

## *Chart 1. Susceptibility of the Surface Water Source - Kokhanok Water and Wastewater System (PWS No. 263006.001)*



## *Chart 2. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Bacteria & Viruses*




Risk Rankings for Bacteria/Virus Contaminant Sources Identified

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

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

Matrix Score 10

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

## *Chart 2. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Bacteria & Viruses*

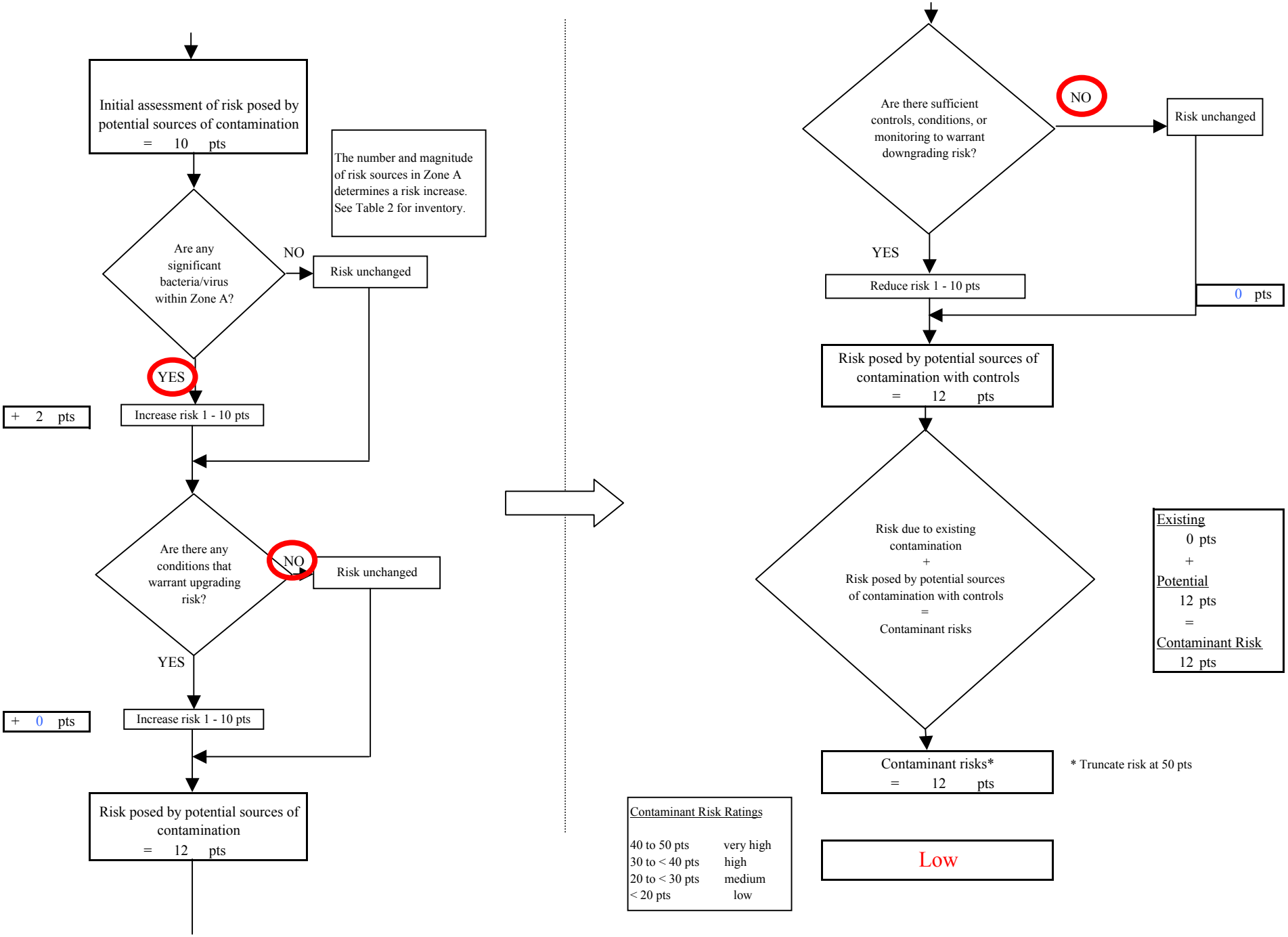
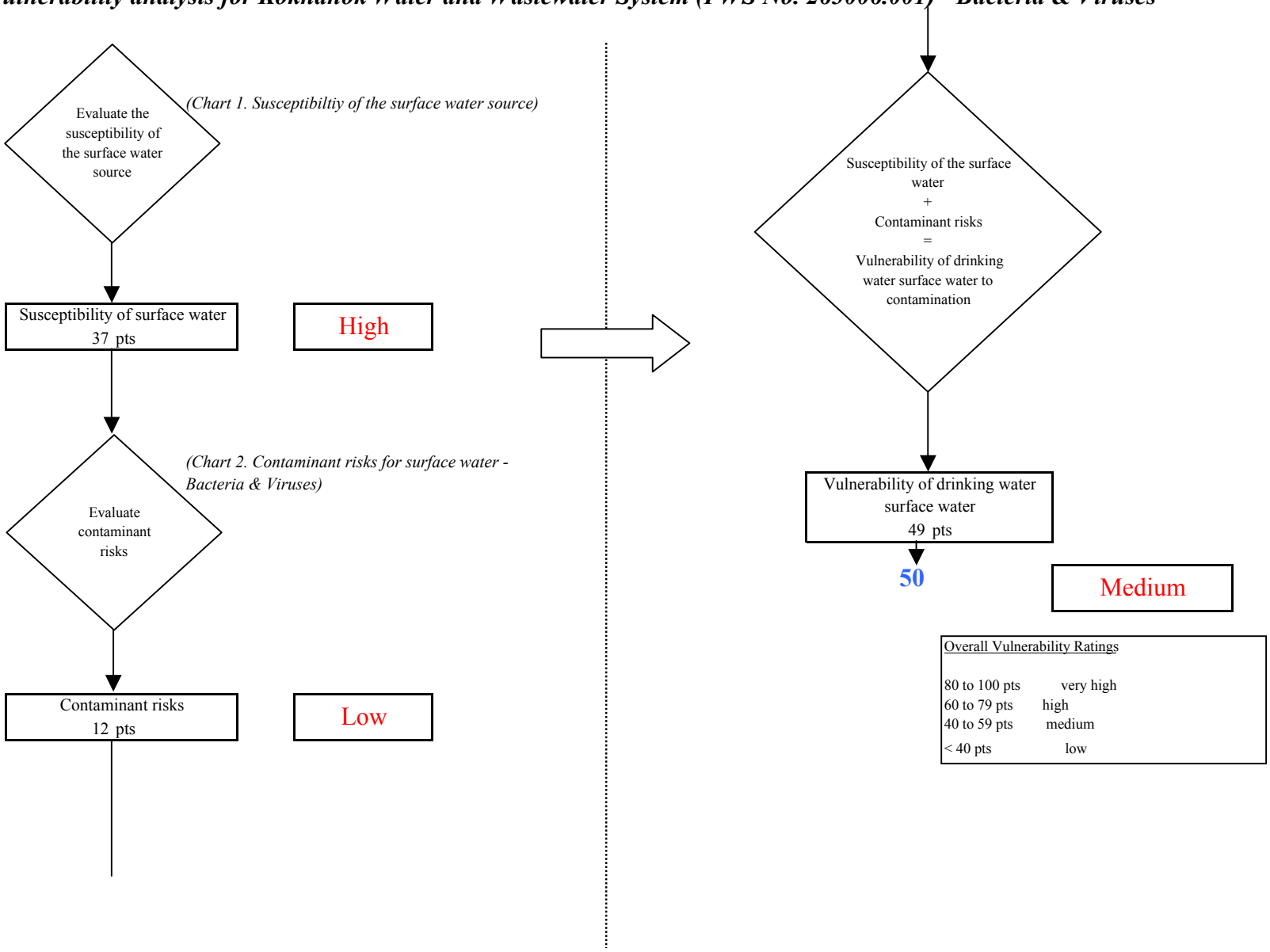
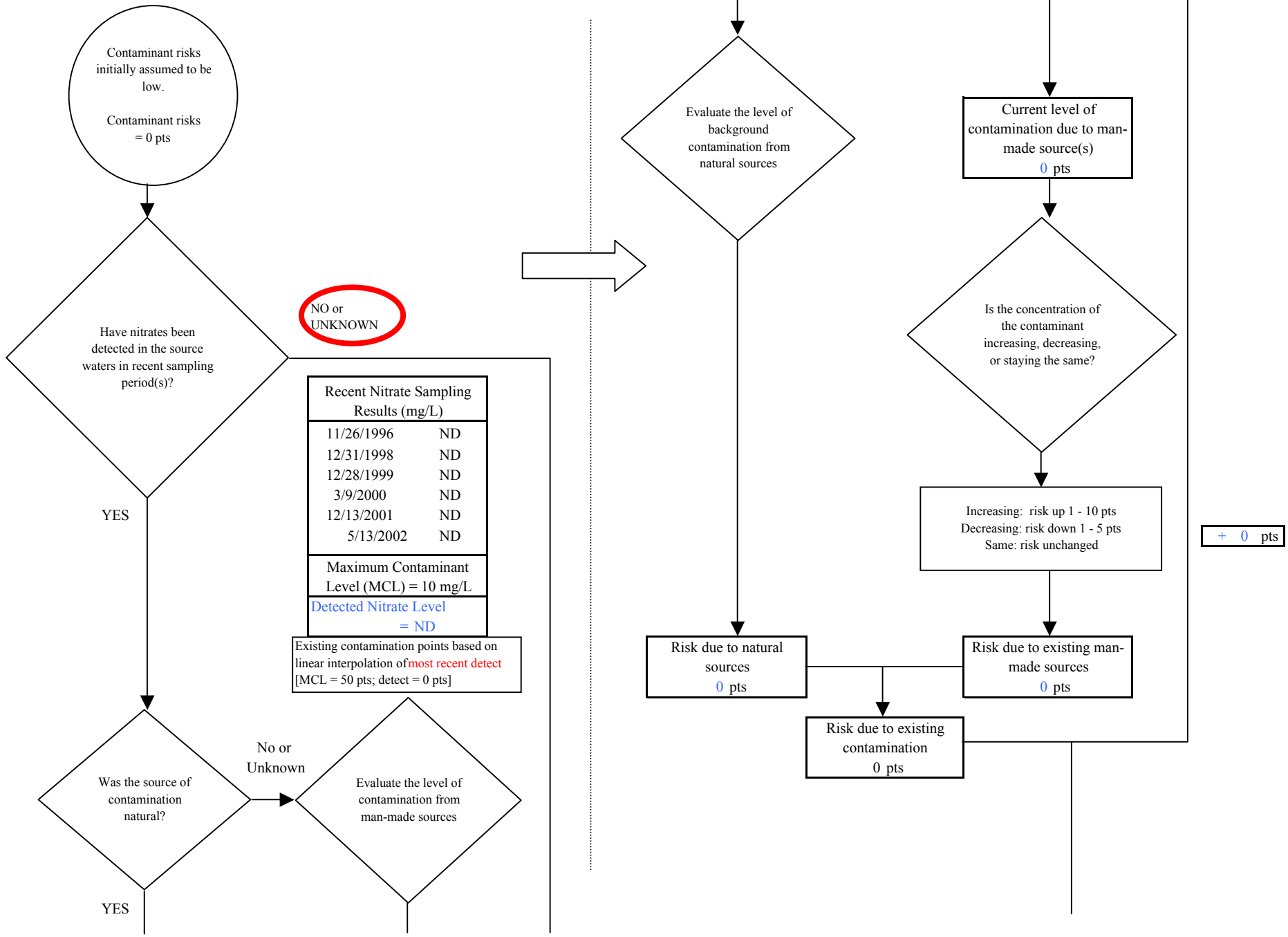


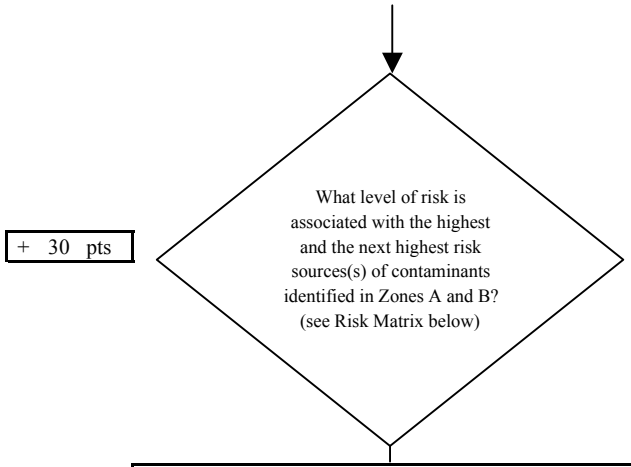
***Chart 3. Vulnerability analysis for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Bacteria & Viruses***



## *Chart 4. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Nitrates and Nitrites*



## *Chart 4. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Nitrates and Nitrites*




+ 30 pts

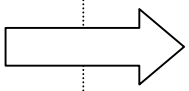
Risk Levels for Nitrate/Nitrite Sources identified in Zones A and B

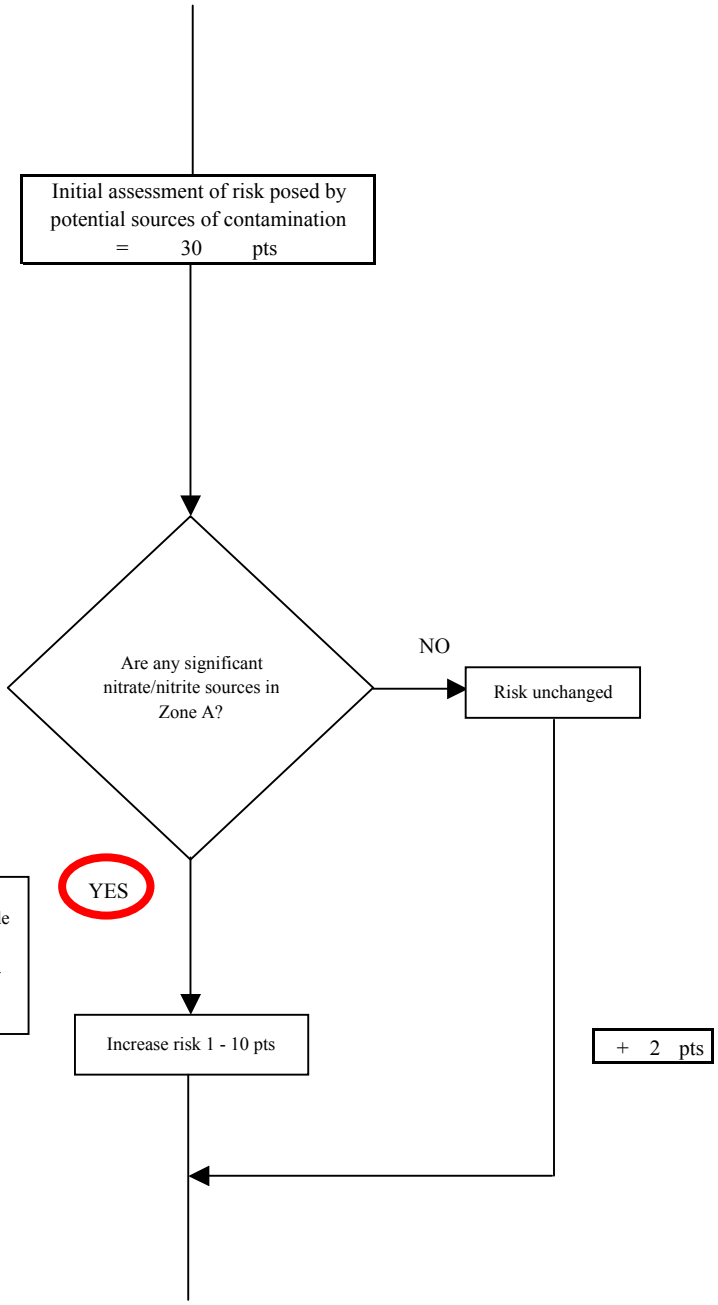
| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 1 | 1 |
| Medium(s) | 0 | | 0 |
| Low(s) | 1 | | 1 |

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

Matrix Score 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 4. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Nitrates and Nitrites*

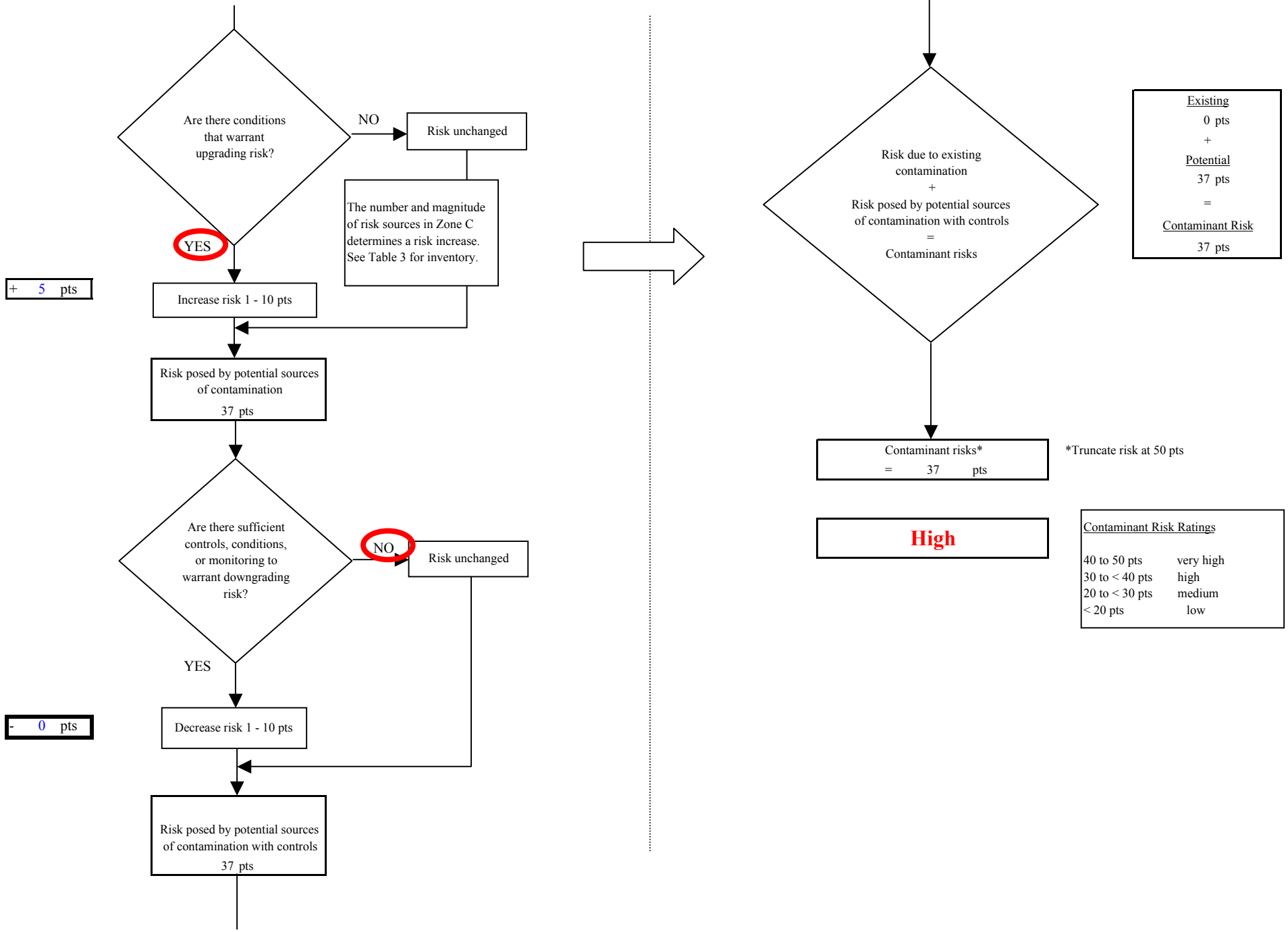
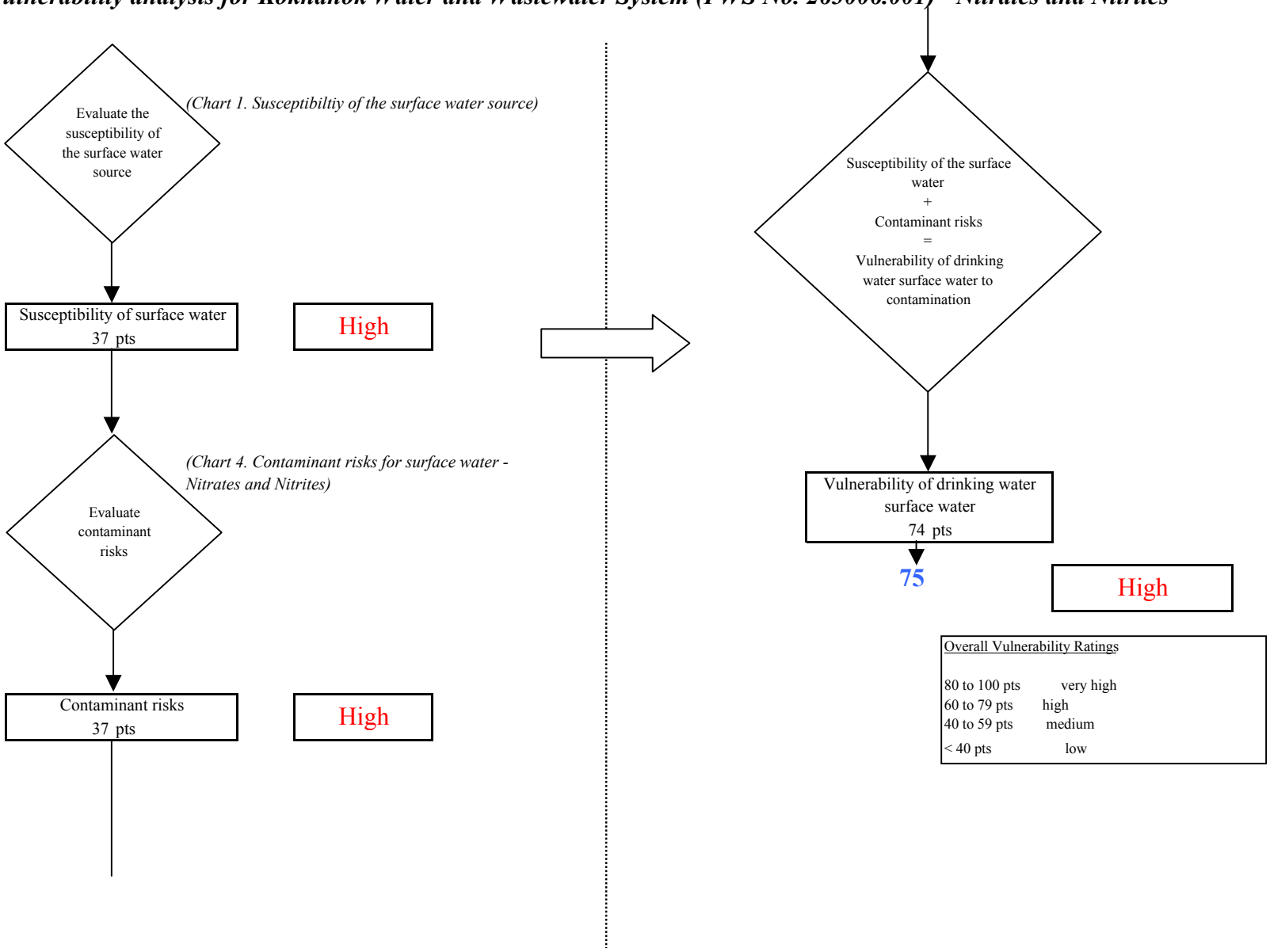
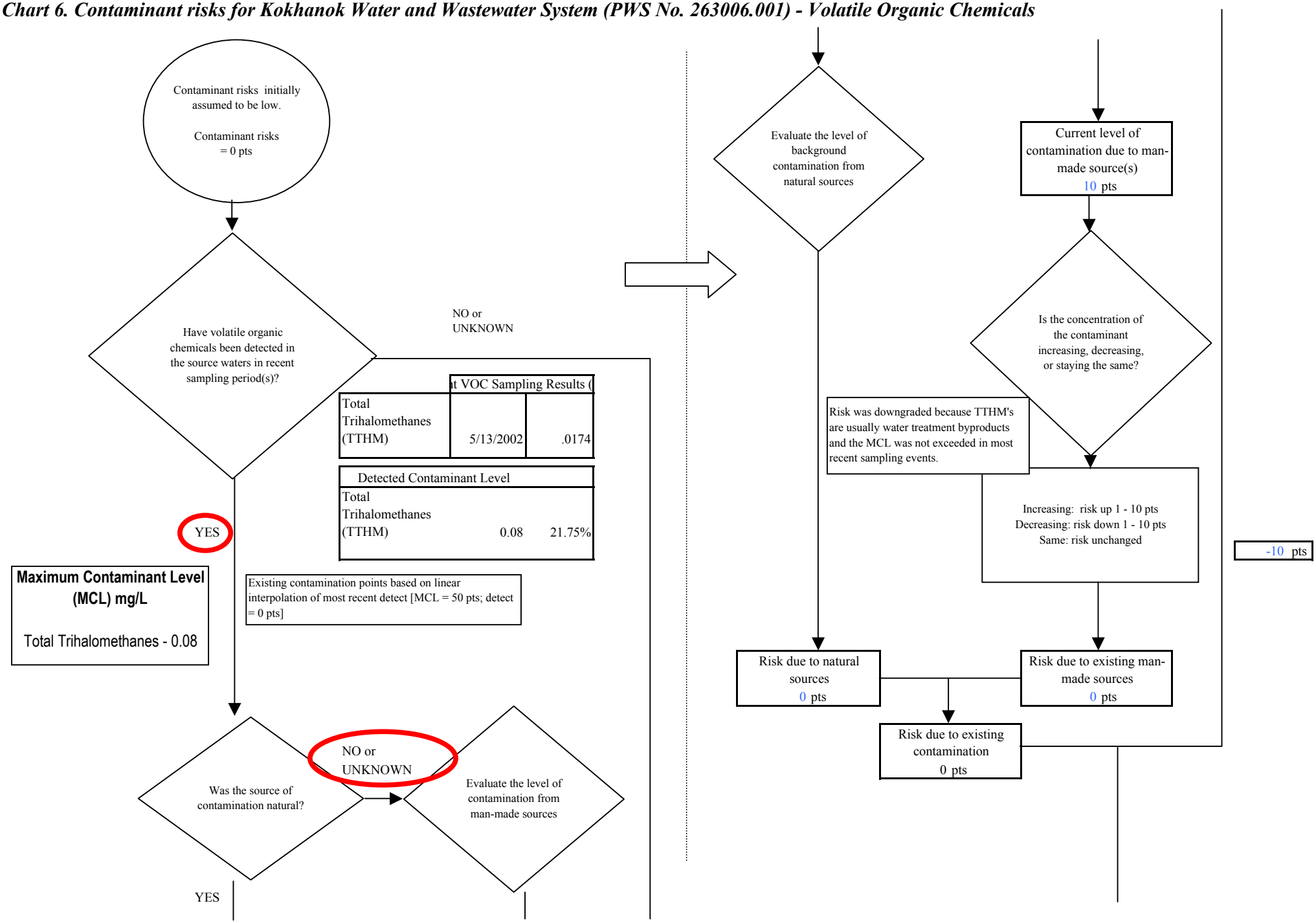


***Chart 5. Vulnerability analysis for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Nitrates and Nitrites***



## *Chart 6. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Volatile Organic Chemicals*



## *Chart 6. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Volatile Organic Chemicals*

+ 50 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 = 50 pts

Are any significant VOC sources in Zone A?

NO → Risk unchanged → + 0 pts

YES → Increase risk 1 - 10 pts

Risk Levels for VOC Sources identified in Zones A and B

| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 2 | 2 |
| High(s) | 0 | 0 | 0 |
| Medium(s) | 0 | | 0 |
| Low(s) | 0 | | 0 |

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

Matrix Score 50

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 6. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Volatile Organic Chemicals*

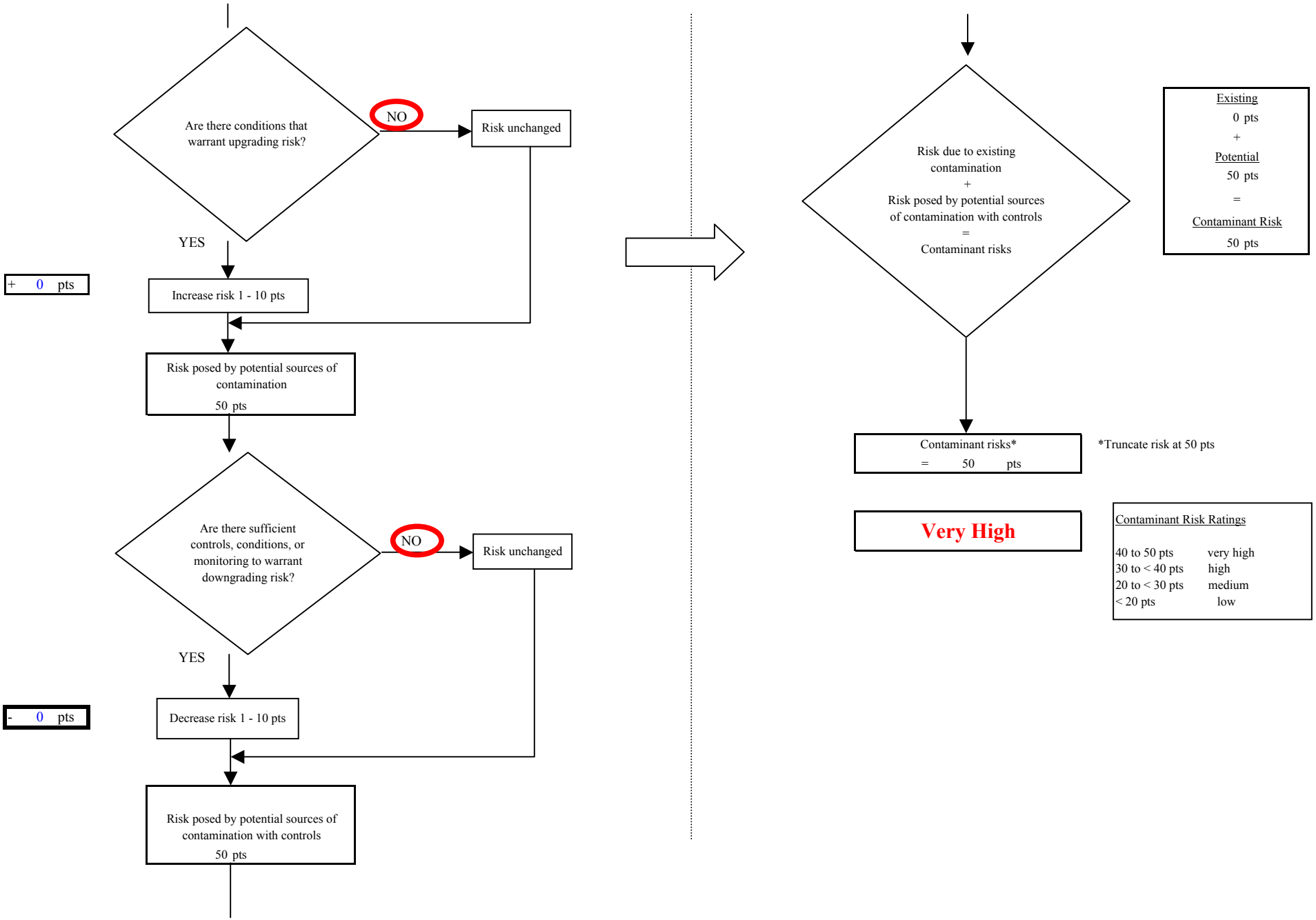
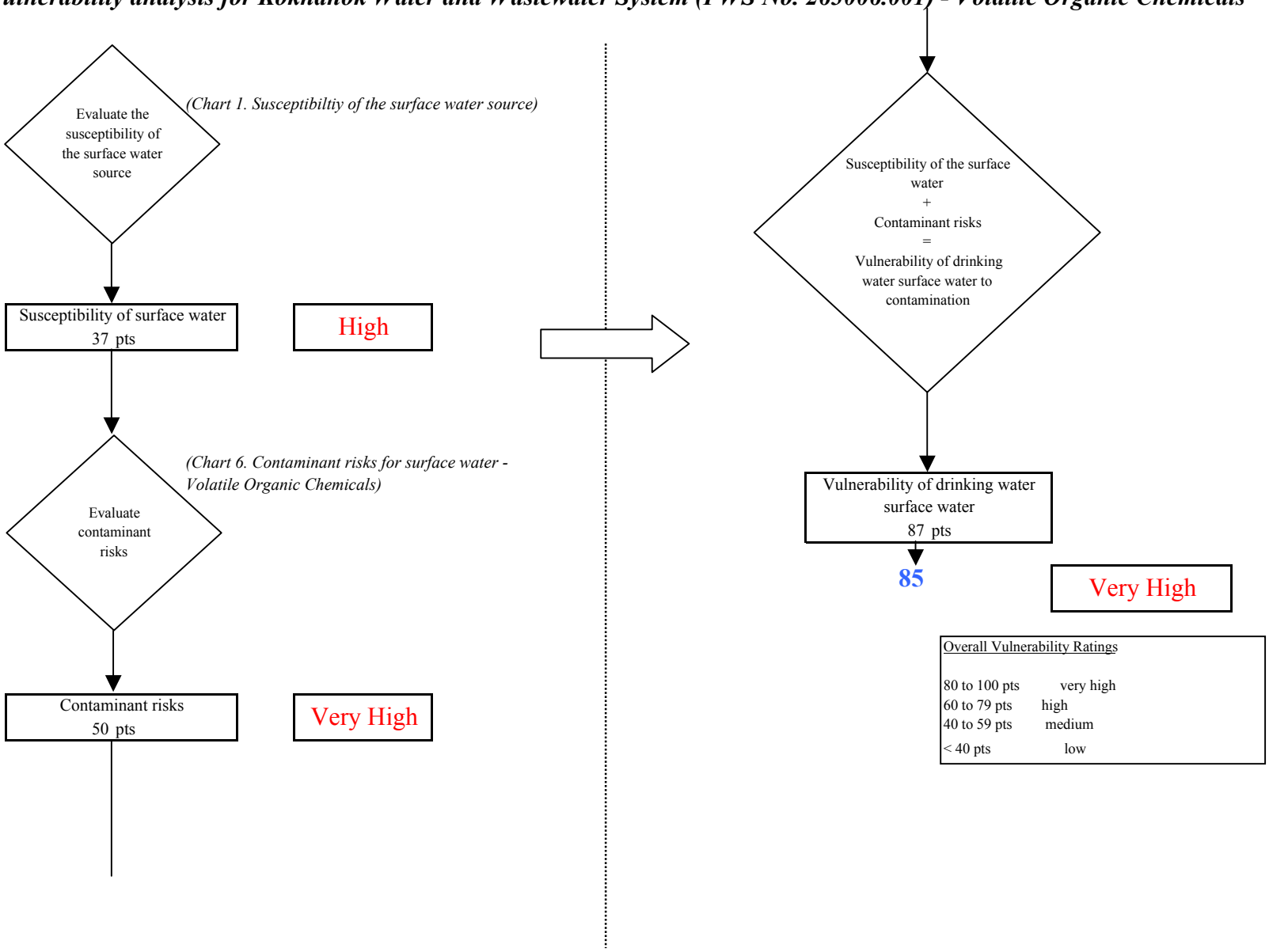
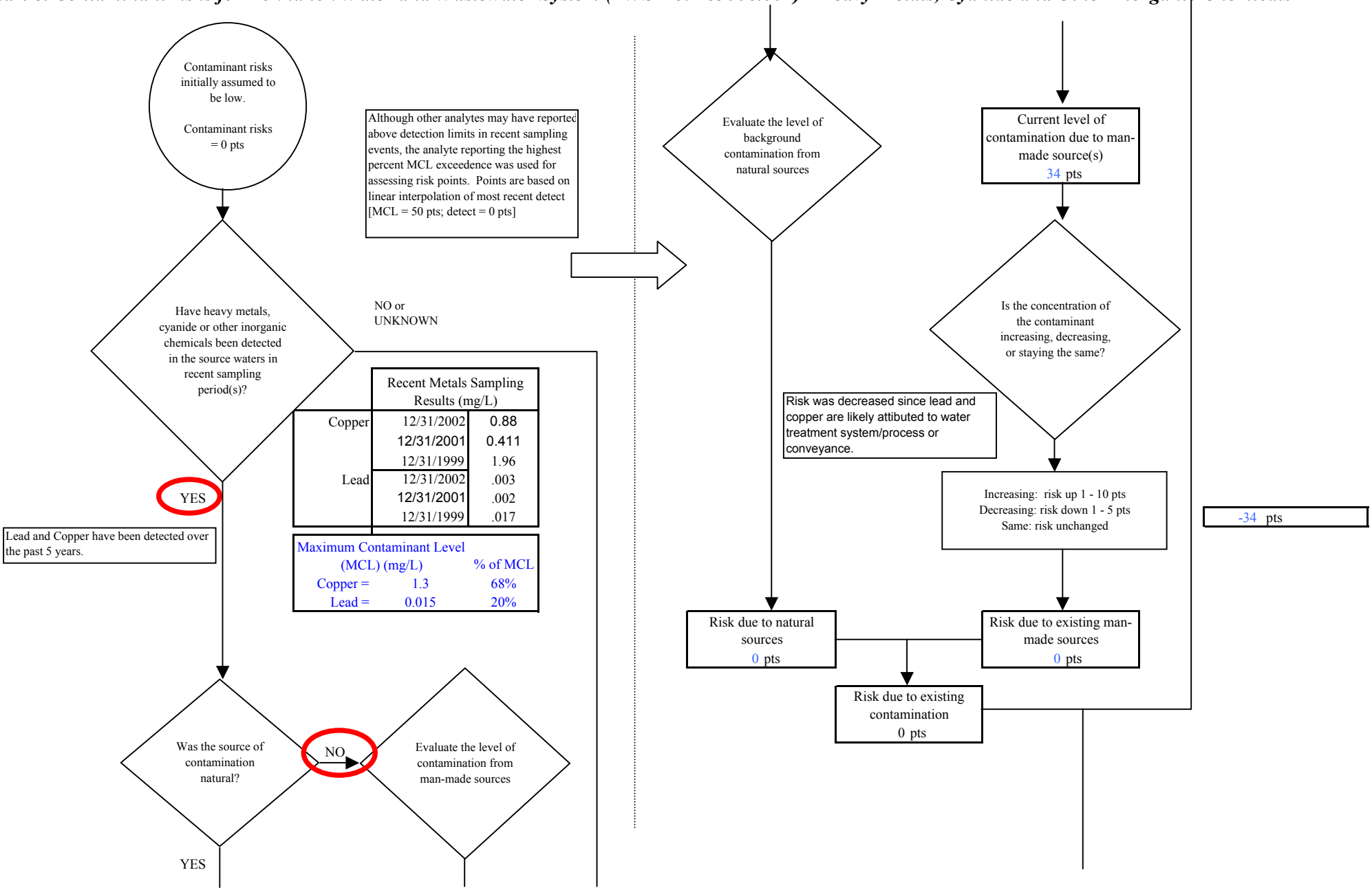


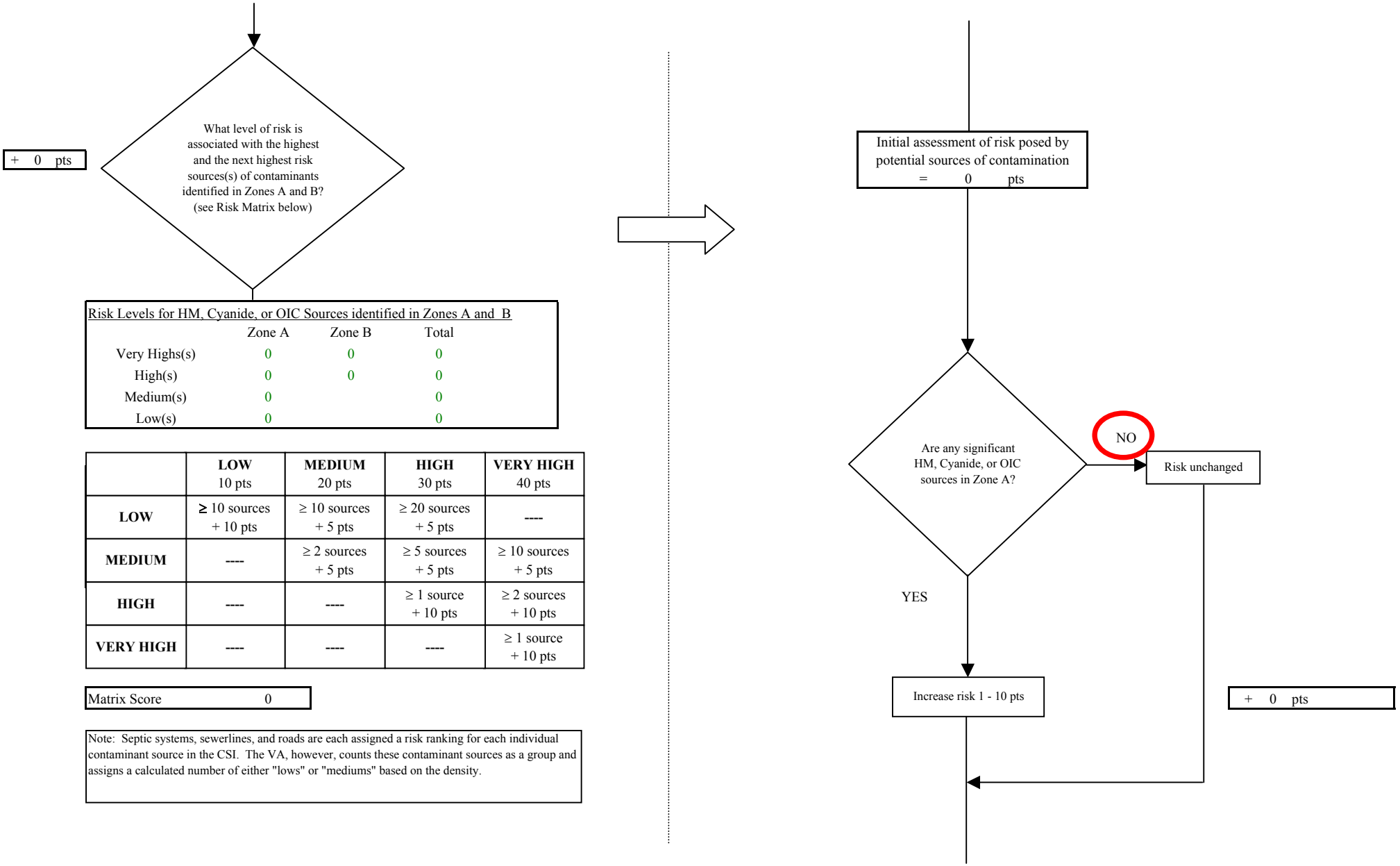
***Chart 7. Vulnerability analysis for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Volatile Organic Chemicals***



## *Chart 8. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals*



## *Chart 8. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals*




Risk Levels for HM, Cyanide, or OIC Sources identified in Zones A and B

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

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

Matrix Score 0

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 8. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals***

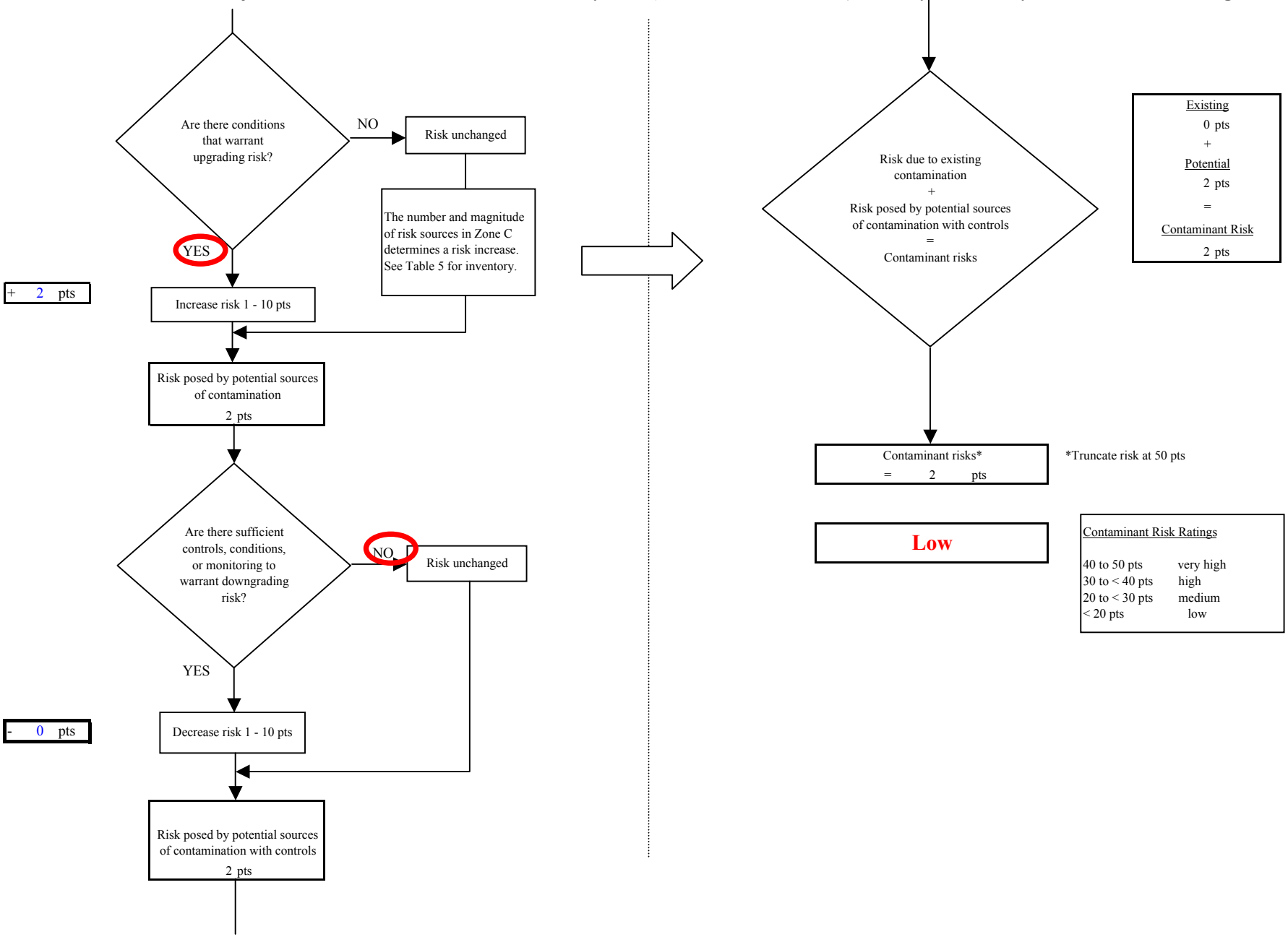


***Chart 9. Vulnerability analysis for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals***

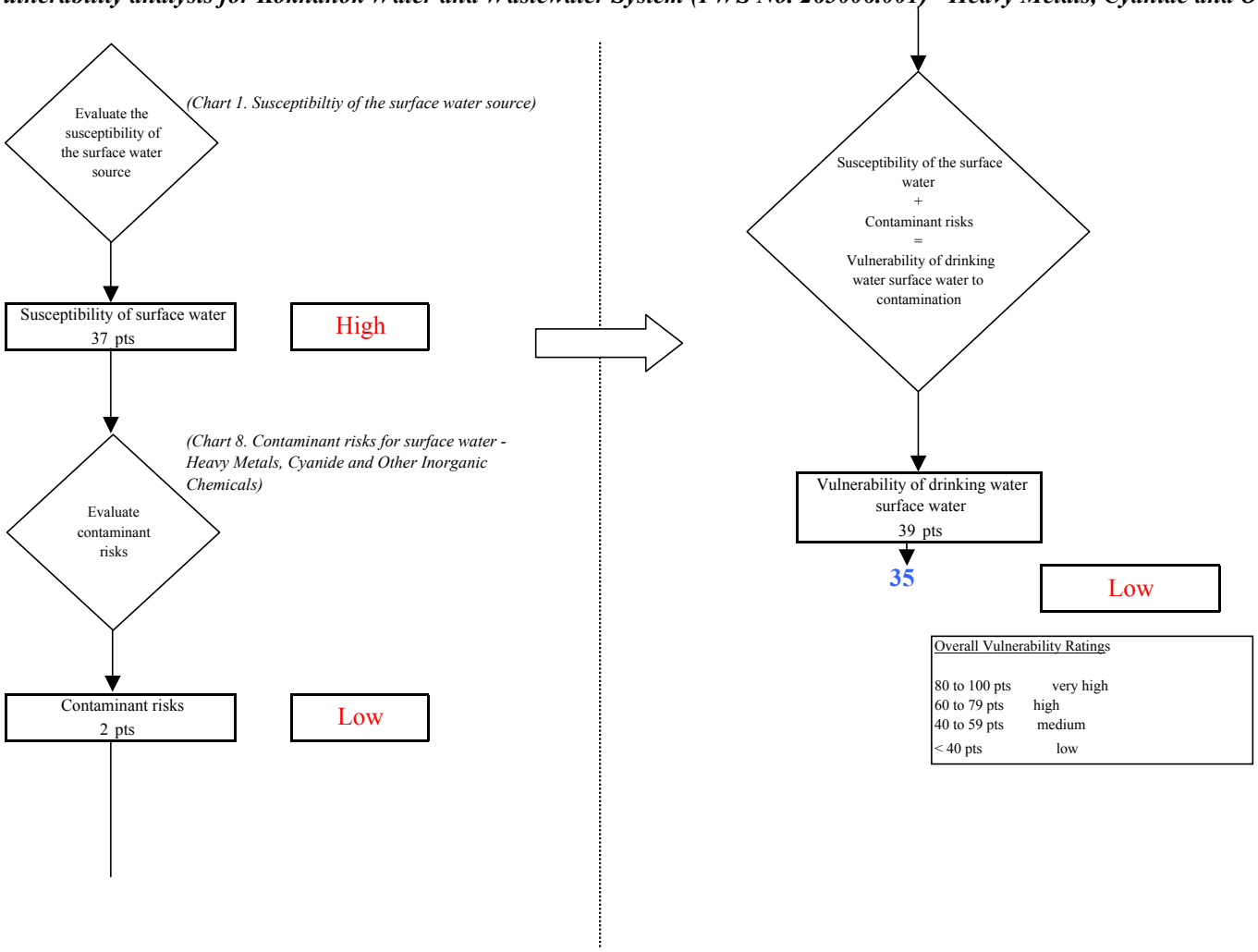
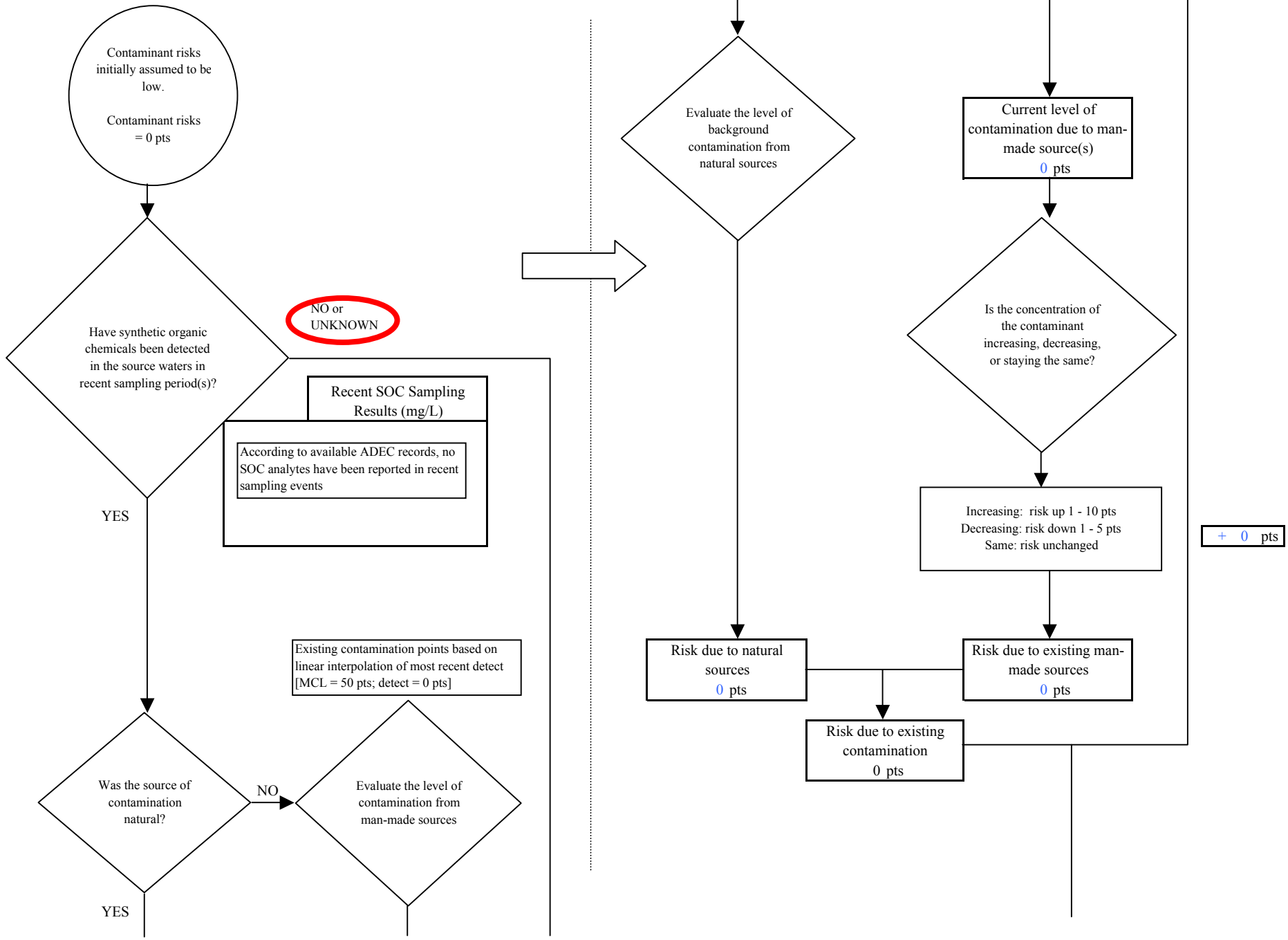


***Chart 10. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Synthetic Organic Chemicals***



## *Chart 10. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Synthetic Organic Chemicals*

+ 0 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)

Risk Levels for SOC Sources identified in Zones A and C

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

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

Matrix Score 0

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

Initial assessment of risk posed by potential sources of contamination = 0 pts

Are any significant SOC sources in Zone A?

NO

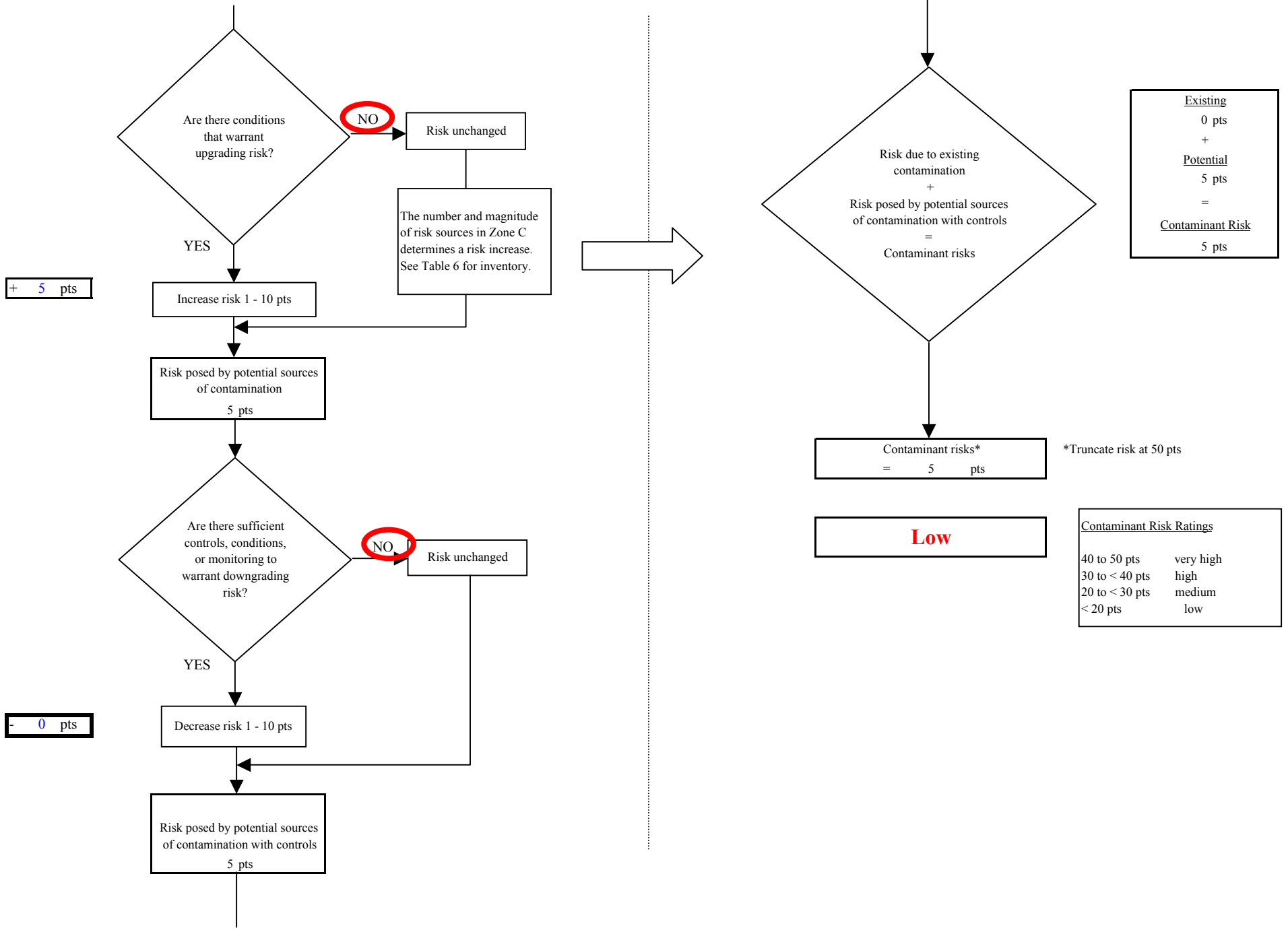
Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

## *Chart 10. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Synthetic Organic Chemicals*



## *Chart 11. Vulnerability analysis for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Synthetic Organic Chemicals*

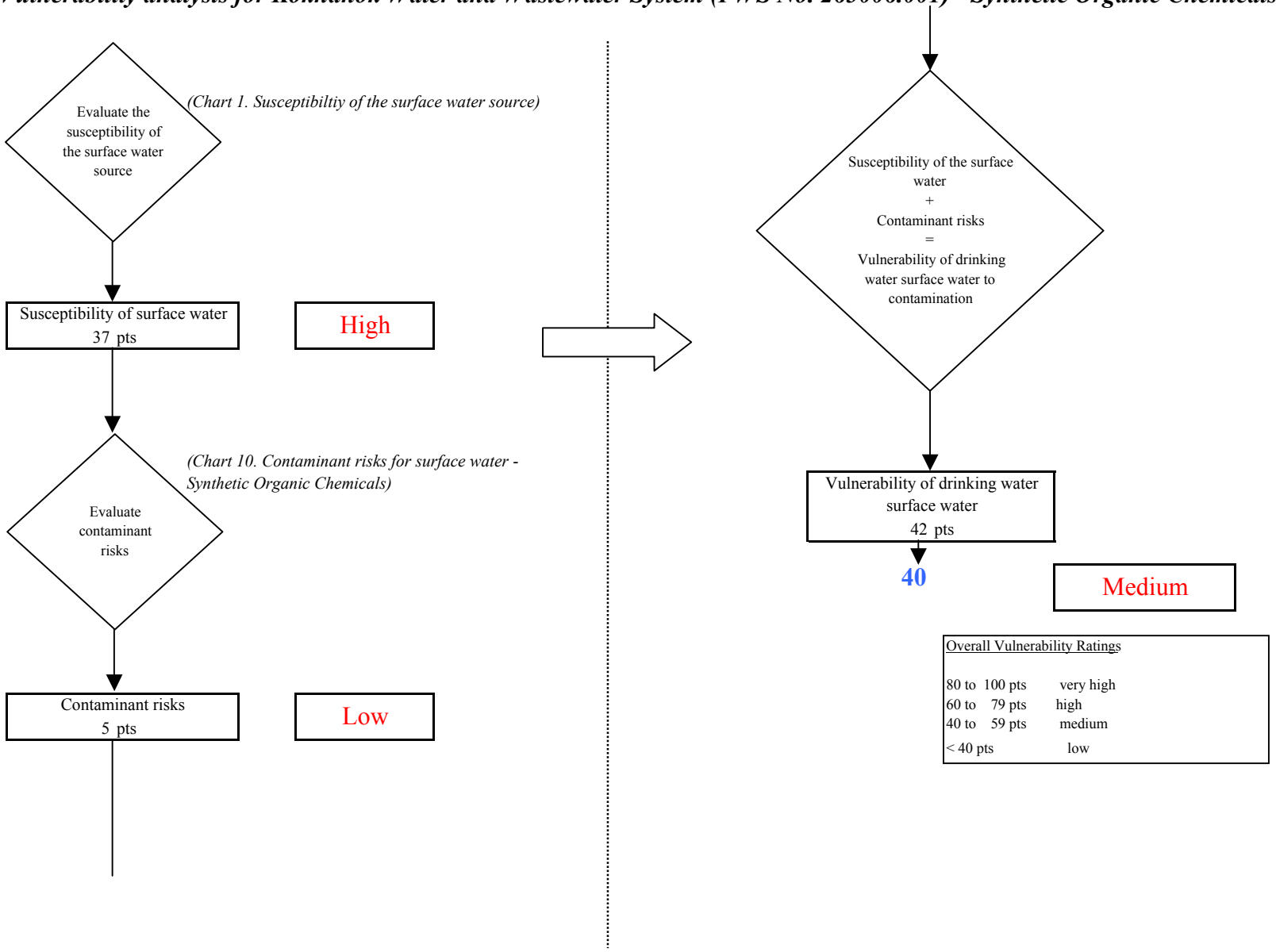
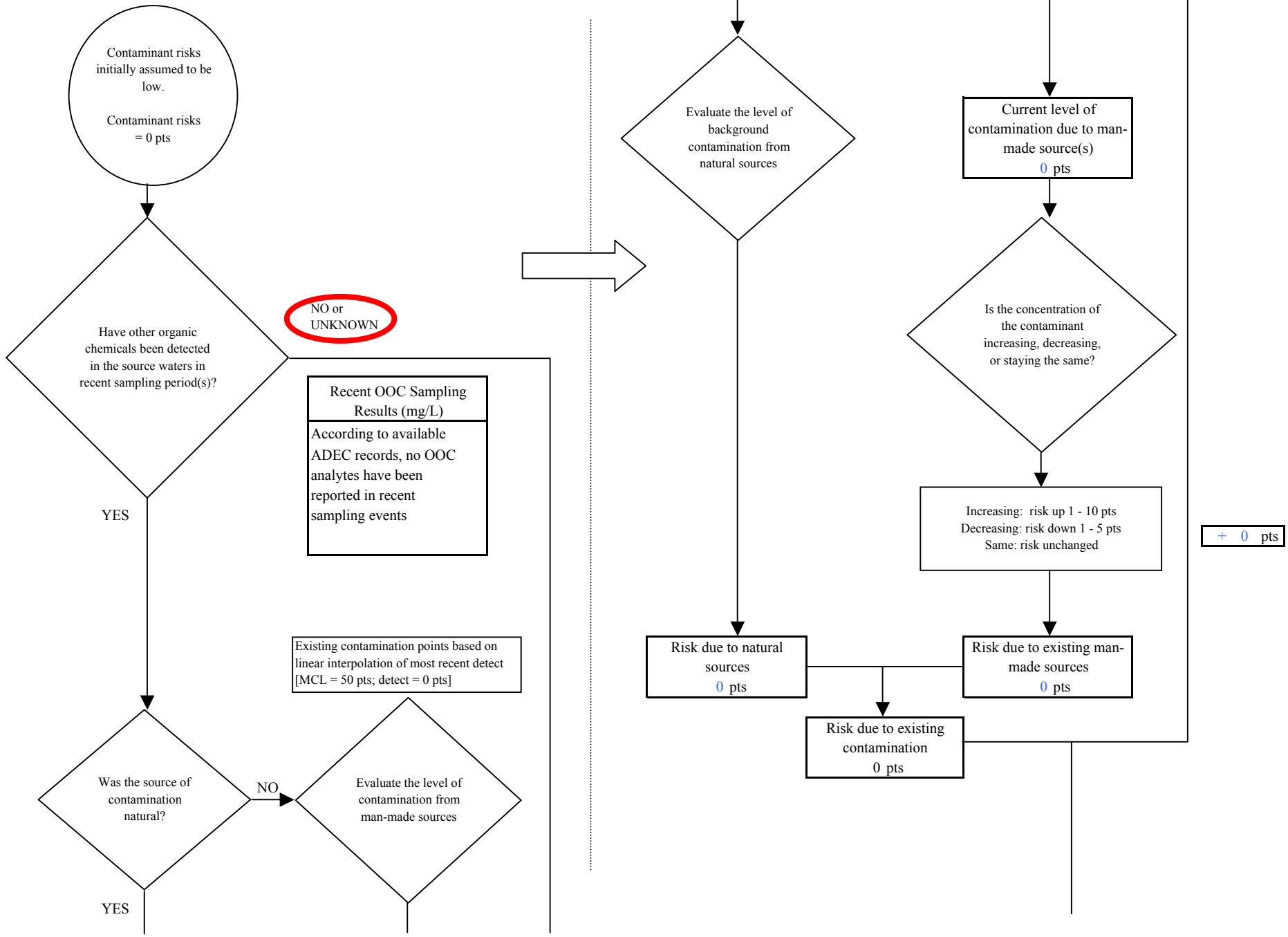


***Chart 12. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Other Organic Chemicals***



## *Chart 12. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Other Organic Chemicals*

+ 40 pts

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

Risk Levels for OOC Sources identified in Zones A and B

| | Zone A | Zone B | Total |
|---|---|---|---|
| Very Highs(s) | 0 | 0 | 0 |
| High(s) | 0 | 5 | 5 |
| Medium(s) | 0 | 0 | 0 |
| Low(s) | 0 | 0 | 0 |

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

Matrix Score 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.

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

Are any significant sources <1000 ft from the spring, lake, river, or stream, or within the floodplain?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

## *Chart 12. Contaminant risks for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Other Organic Chemicals*

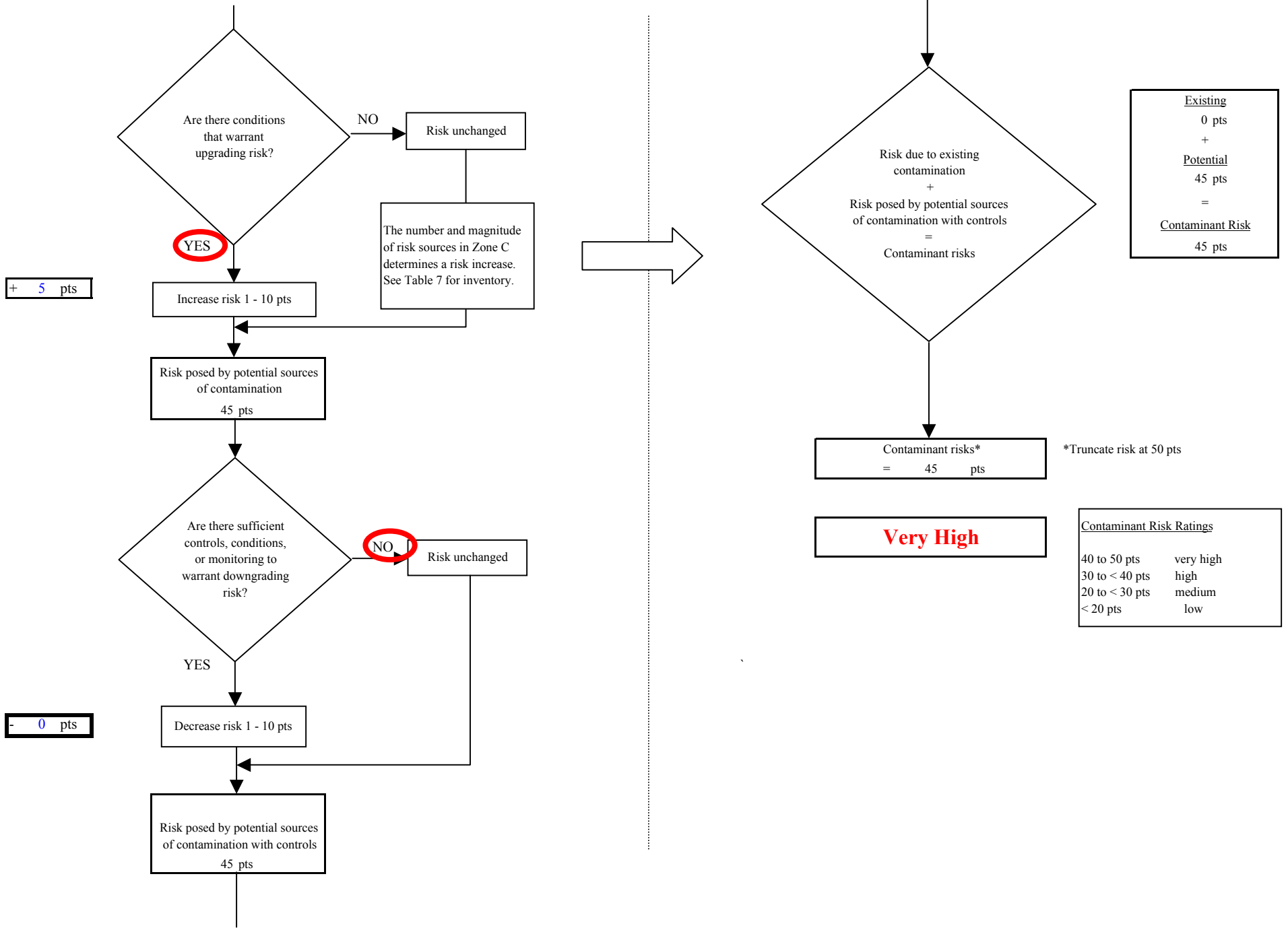


***Chart 13. Vulnerability analysis for Kokhanok Water and Wastewater System (PWS No. 263006.001) - Other Organic Chemicals***