



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for the
City of Angoon , Alaska

PWSID # 130017.001

September 2003

Drinking Water Protection Program Report #853

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

	Page
SECTION	
Executive Summary	1
Drinking Water System And Area Overview	1
City of Angoon Drinking Water Protection Area	1
Inventory of Potential and Existing Contaminant Sources	2
Ranking of Contaminant Risks	2
Vulnerability of the Drinking Water System	2
References	7

TABLES

TABLE		
1.	Definition of Zones	2
2.	Susceptibility of the Water Source	3
3.	City of Angoon Contaminant Risks	3
4.	City of Angoon Overall Vulnerability	3

APPENDICES

APPENDIX	
A.	City of Angoon Drinking Water Protection Area (Map 1)
B.	Contaminant Source Inventory and Risk Rankings (Tables 1 - 6)
C.	City of Angoon Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)
D.	Vulnerability Analysis and Contaminant Risks (Charts 1 – 13)

Source Water Assessment for the City of Angoon Public Water System

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The City of Angoon water system is a Class A (community) water system that obtains water from Tillinghast Lake. The intake is located approximately 3.5-miles southeast of Angoon and is accessible available via a restricted access gravel road. The overall protection area is approximately 0.7 square miles in size and received a susceptibility rating of **“very 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. A gravel road and beaver presence were identified as potential sources of contaminants for the drinking water source. This evaluation included all available water sampling data submitted to ADEC by the system operator. The samples may have been collected from either raw water or post-treated water. Combining the susceptibility of the surface water source with the contaminant risks, this water system has received a vulnerability rating of **“medium”** for synthetic organic chemicals, heavy metals, cyanide and other inorganic chemicals, and other organic chemicals; **“high”** for volatile organic chemicals; and **“very high”** for bacteria and viruses, and nitrates and/or nitrites.

DRINKING WATER SYSTEM AND AREA OVERVIEW

The City of Angoon (Sec. 25, T050S, R067E, Copper River Meridian) is a Tlingit community that is the only permanent settlement on Admiralty Island, located on the southwest coast at Kootznahoo Inlet. Angoon is 55 miles southwest of Juneau and 41 miles northeast of Sitka (Please see the inset of Map 1 in Appendix A for location). The current population is approximately 540 (ADCED, 2003). The City of Angoon water system is a Class A (community) water system that operates year round. The system’s intake is located approximately 3.5-miles southeast of Angoon on Tillinghast Lake (See Map 1 of Appendix A). The intake is accessible available via a restricted access gravel road.

95% of homes have complete plumbing. Piped sewage is processed at a secondary treatment plant which flows

to an ocean outfall. A new 500,000-gallon water tank has been constructed at the plant. The City collects refuse and hauls it to a landfill, located approximately two miles from Angoon. (ADCED, 2003).

The geology of the watershed area is heavily composed of carbonate rocks. The majority of them being limestone and marble. Most areas are well drained because the water percolates through the underlying carbonate bedrock. Because of this, wetlands are not typically present, except on areas of glacial hardpans or non-carbonate intrusion. Alpine areas here have significant bare areas, where soils are too thin to support vegetation. Lower elevations support forests of western hemlock and Sitka spruce. Both surface and subsurface waters often have high pH levels (USDA, 2001).

Angoon’s summer temperatures range from 45 to 61; winter temperatures range from 25 to 39. Extremes in temperature have been recorded from -6 to 77. Angoon receives much less precipitation than is typical of Southeast Alaska; averaging 43 inches annually, including 63 inches of snowfall. (ADCED, 2003).

The most recent Sanitary Survey (2000) indicates that the intake screens are protected from ice buildup and siltation. The survey also indicates that the system has an average production rate of 126 gallons per minute. The system operator indicated that the maximum depth of Tillinghast Lake is approximately 30, although depth around the lake is variable.

CITY OF ANGOON 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 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, limited by the watershed boundary. 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 City of Angoon includes each of these Zones (See Map 1 of Appendix A). It should be noted here that, because of the small watershed size, Zones C and B are identical.

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 City of Angoon 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.

Sources identified in the City of Angoon protection area are displayed on Map 2 of Appendix C and summarized 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 (if necessary) 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	5	
Dilution Capacity	15	
Overall Susceptibility	50	Very 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. City of Angoon Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	40	Very High
Nitrates and/or Nitrites	40	Very High
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	12	Low
Synthetic Organic Chemicals	0	Low
Other Organic Chemicals	12	Low

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. City of Angoon Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	80	Very High
Nitrates and Nitrites	90	Very High
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide, and		

Other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	50	Medium
Other Organic Chemicals	50	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is “very high”. 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).

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.

No positive bacteria counts have been detected in sampling collected since 1999. A possible source of bacteria is via paved or unpaved roads as well as the presence of beaver.

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 becomes “very high”.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is “very high” (See Chart 4 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history for the water source indicates that nitrates have not been detected in the sampling period 1997 - 2001. 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).

A possible source of nitrate/nitrites are paved/unpaved roads and the presence of beaver.

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 “very high”.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is “low” (See Chart 6 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Chloroform and trihalomethanes were detected during sampling in 2001-2002. The MCL for chloroform is 0.2 milligrams per liter (mg/L) and the MCL for total trihalomethanes is 0.1 mg/L. Both of these chemicals typically originate during the process of water treatment. Other volatile organic chemicals may also originate from paved or unpaved roads.

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the source, the overall vulnerability of the source to contamination is “high”.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is “low”. Copper and lead were detected in samples collected during 1999-2000, although in levels below the MCL (See Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). The MCL for copper is 1.3 mg/l. and the MCL for lead is 0.015 mg/l.

A typical source of these chemicals is the infrastructure of the distribution system following the treatment process. They may also originate from paved or unpaved roads.

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

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is “low”. 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).

Review of the historical sampling data indicates that test results for dibromochloropropane and ethylene dibromide in 2002 were negative.

Other Organic Chemicals

The contaminant risk for other organic chemicals is “low”. After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to other organic chemicals of the source is “high” (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

A possible source of these chemicals are
paved/unpaved roads

Review of the historical sampling data indicates that no
other organic chemicals have been sampled recently.

REFERENCES

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

United States Forest Service – Alaska Region (USDA), 2001. Technical Publication No. R10-TP-75. Ecological Subsections of Southeast Alaska and Neighboring Areas of Canada.

United States Environmental Protection Agency (EPA), 2003 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.

APPENDIX A

City of Angoon Drinking Water Protection Area Location Map (Map 1)

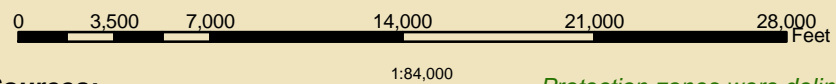


Map 1: City of Angoon - Drinking Water Protection Area

PWSID: 130017.001



Data Sources:
Background image
- USGS 1:63,000 mapping
Lakes, streams, & roads
- U.S. Forest Service, Tongass

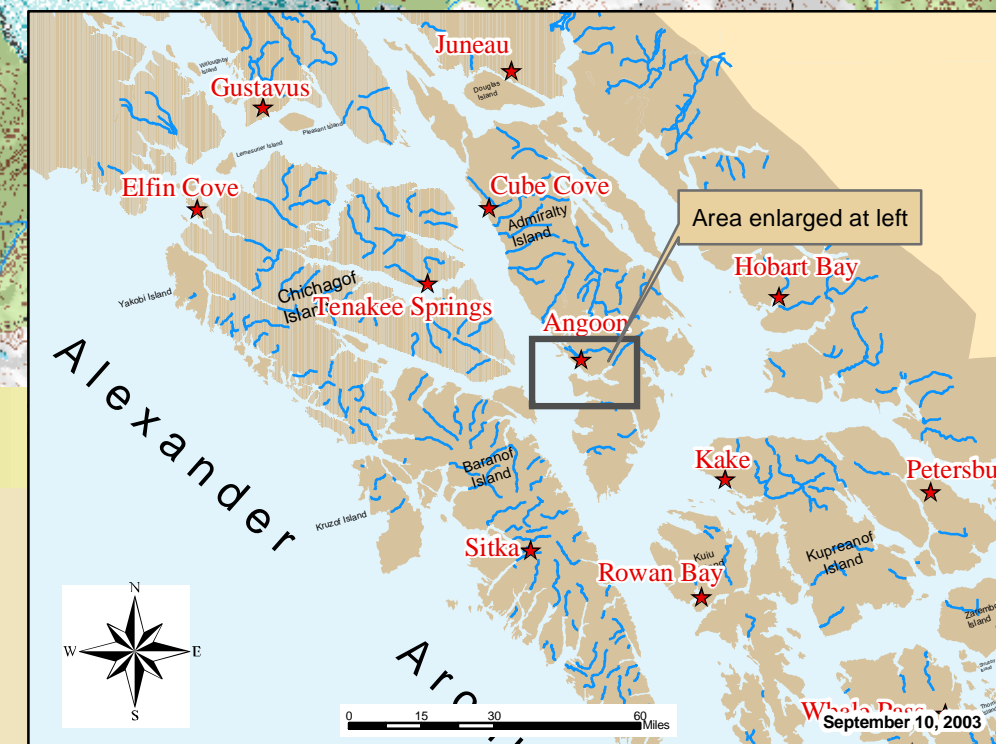


Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.

For this PWS, Zone C (the entire watershed) covers the same area as Zone B (areas within 1-mile of the stream).

Legend

- | | | | |
|--|------------------------|--|--------|
| | Angoon PWS Intake | | Stream |
| | Zone A Protection Area | | Roads |
| | Zone B Protection Area | | Lake |
| | Zone C Protection Area | | |



APPENDIX B

Contaminant Source Inventory and Risk Rankings (Tables 1 - 6)

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Beaver/muskrat/otter habitat	B01	B01 - 1	A	2	From City of Angoon information.
Highways and roads, dirt/gravel	X24	X24 - 1	A	2	From U.S. Forst Service, Tongass GIS data.

Table 2

*Contaminant Source Inventory and Risk Ranking for
Angoon PWS
Sources of Bacteria and Viruses*

PWSID 130017.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Beaver/muskrat/otter habitat	B01	B01 - 1	A	High	2	From City of Angoon information.
Highways and roads, dirt/gravel	X24	X24 - 1	A	Low	2	From U.S. Forst Service, Tongass GIS data.

Table 3

*Contaminant Source Inventory and Risk Ranking for
Angoon PWS
Sources of Nitrates/Nitrites*

PWSID 130017.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Beaver/muskrat/otter habitat	B01	B01 - 1	A	High	2	From City of Angoon information.
Highways and roads, dirt/gravel	X24	X24 - 1	A	Low	2	From U.S. Forst Service, Tongass GIS data.

Table 4

*Contaminant Source Inventory and Risk Ranking for
Angoon PWS
Sources of Volatile Organic Chemicals*

PWSID 130017.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24 - 1	A	Low	2	From U.S. Forst Service, Tongass GIS data.

Table 5

*Contaminant Source Inventory and Risk Ranking for
Angoon PWS
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

PWSID 130017.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24 - 1	A	Low	2	From U.S. Forst Service, Tongass GIS data.

Table 6

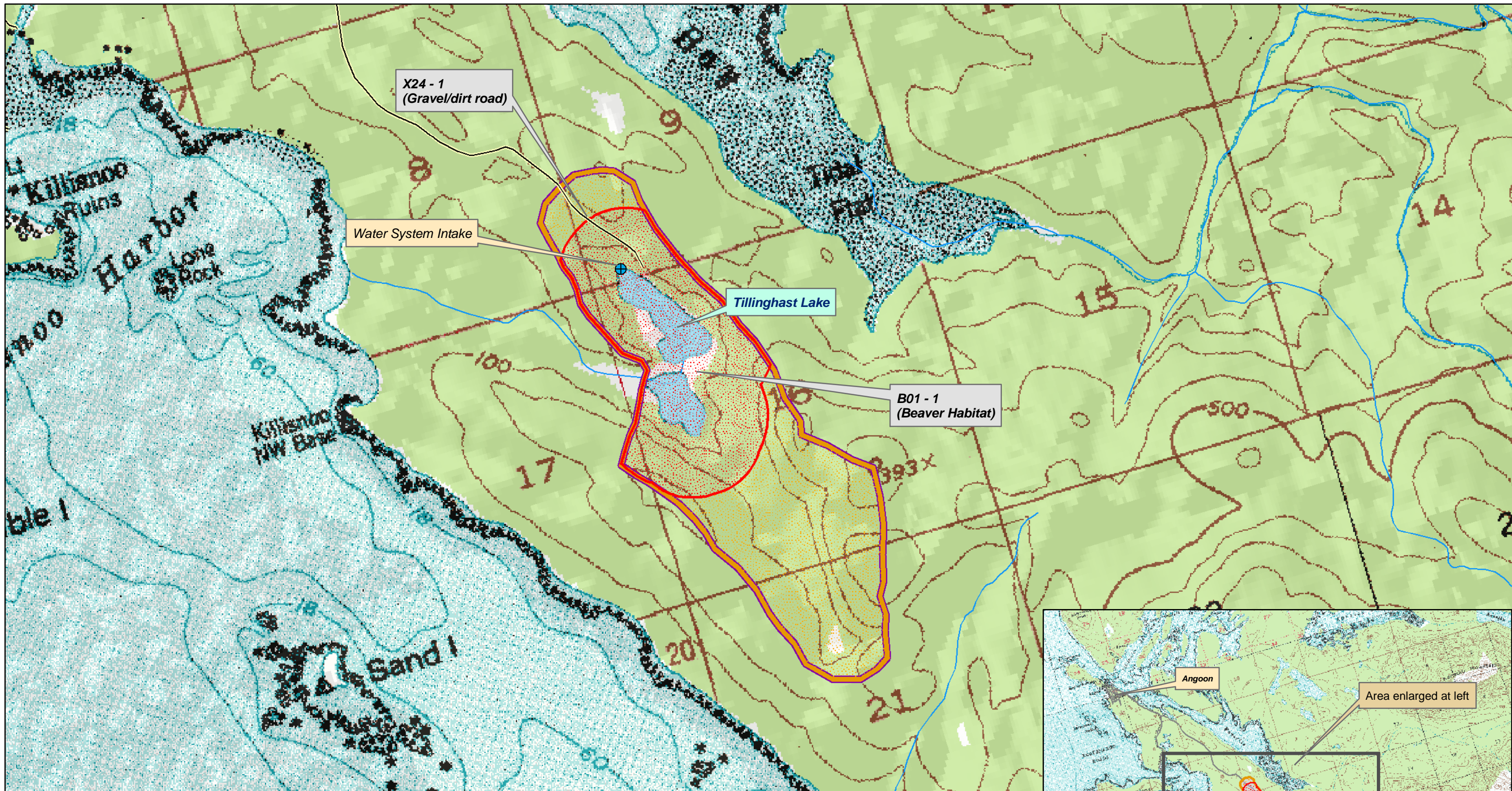
*Contaminant Source Inventory and Risk Ranking for
Angoon PWS
Sources of Other Organic Chemicals*

PWSID 130017.001

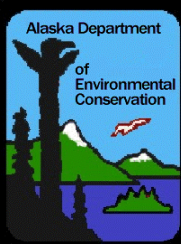

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24 - 1	A	Low	2	From U.S. Forst Service, Tongass GIS data.

APPENDIX C

City of Angoon Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)



Map 2: Potential and Existing Contaminant Sources PWSID: 130017.001

Data Sources:

Background image - USGS 1:63,000 mapping
Lakes, streams, & roads - U.S. Forest Service

Legend

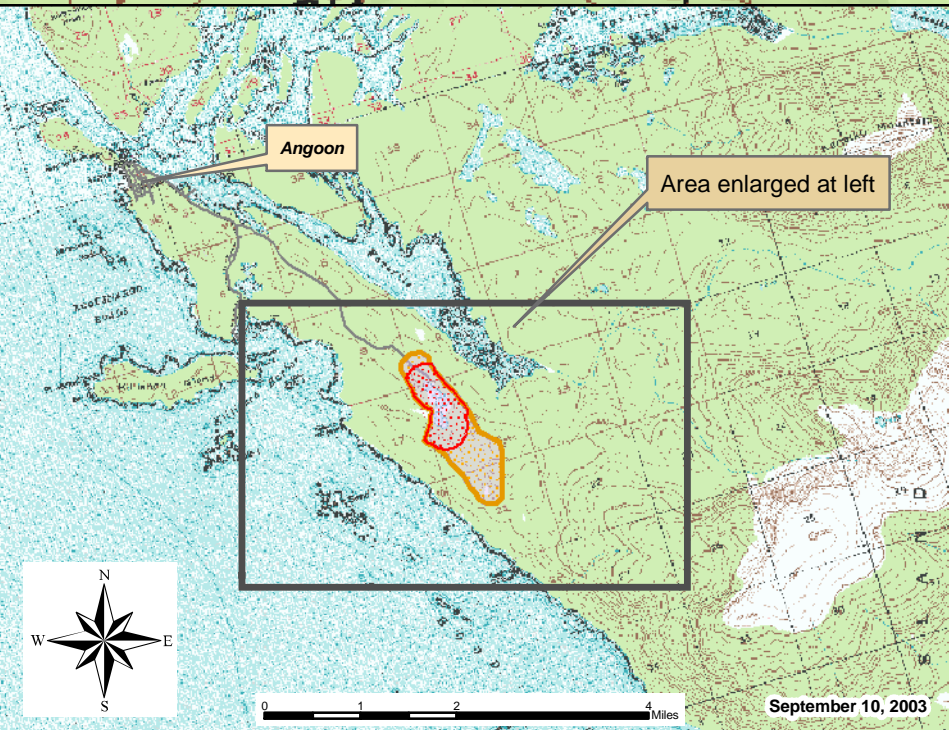
City of Angoon PWS	Potential Logging Area
Zone A Protection Area	Roads
Zone B Protection Area	Streams
Zone C Protection Area	Stream
Lake	

0 750 1,500 3,000 4,500 Feet

1:18,000

Protection zones were delineated based upon streams noted on USGS 1:63,000 mapping.

For this PWS, Zone C (the entire watershed) covers the same area as Zone B (areas within 1-mile of the stream).



Angoon

Area enlarged at left

0 1 2 4 Miles

September 10, 2003

APPENDIX D

Vulnerability Analysis and Contaminant Risks (Charts 1-13)

Chart 1. Susceptibility of the Surface Water Source - City of Angoon

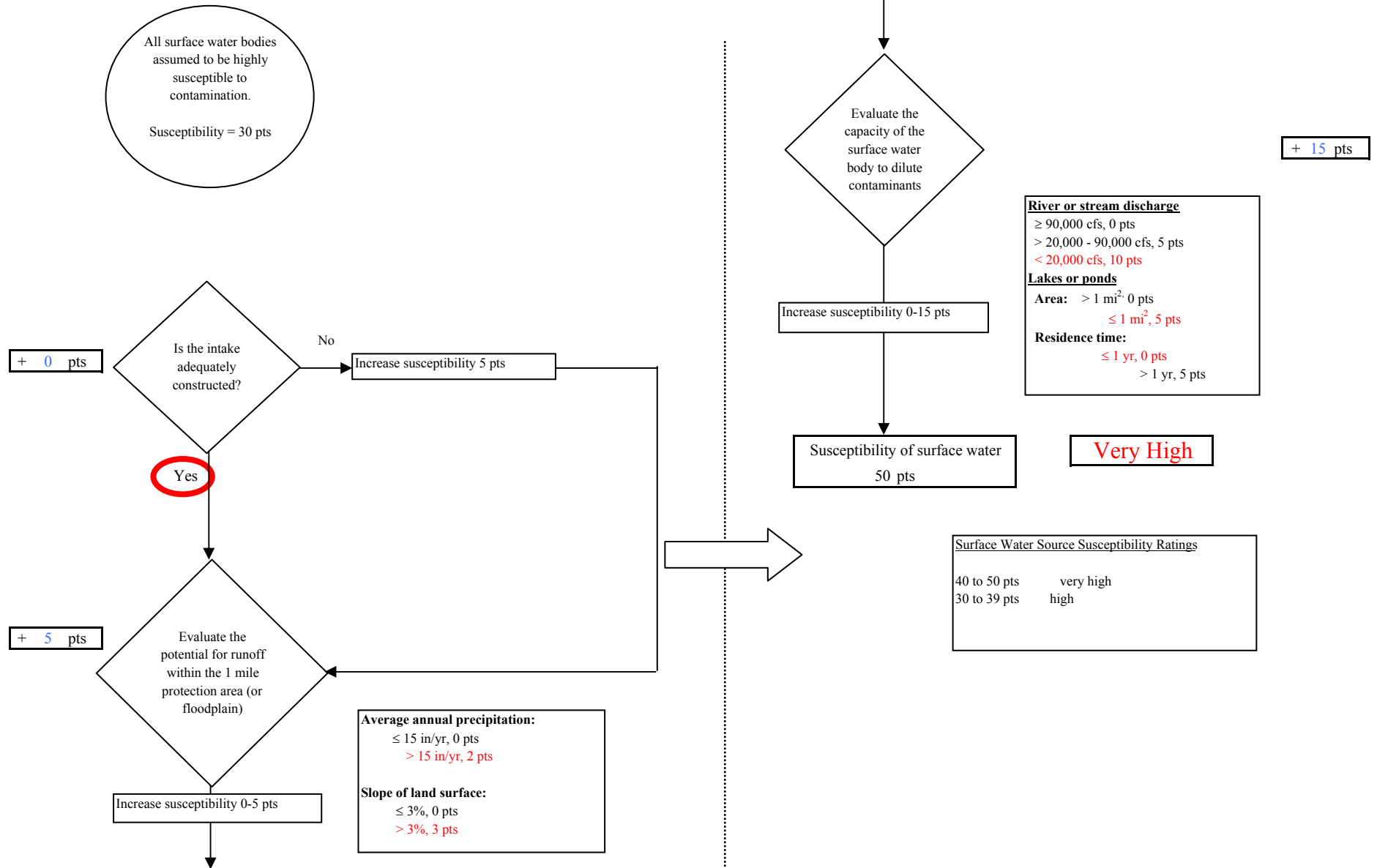


Chart 2. Contaminant risks for City of Angoon - Bacteria & Viruses

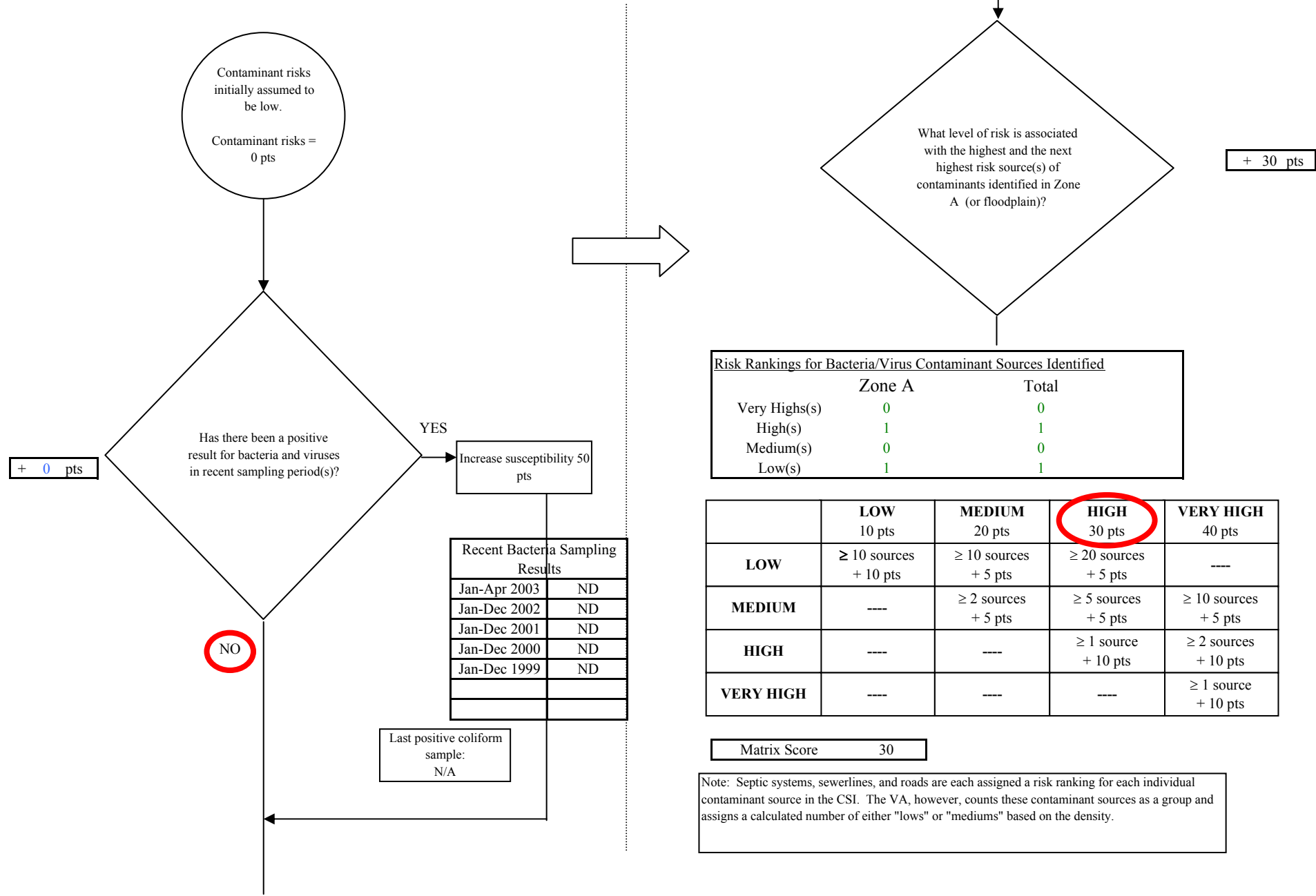


Chart 2. Contaminant risks for City of Angoon - Bacteria & Viruses

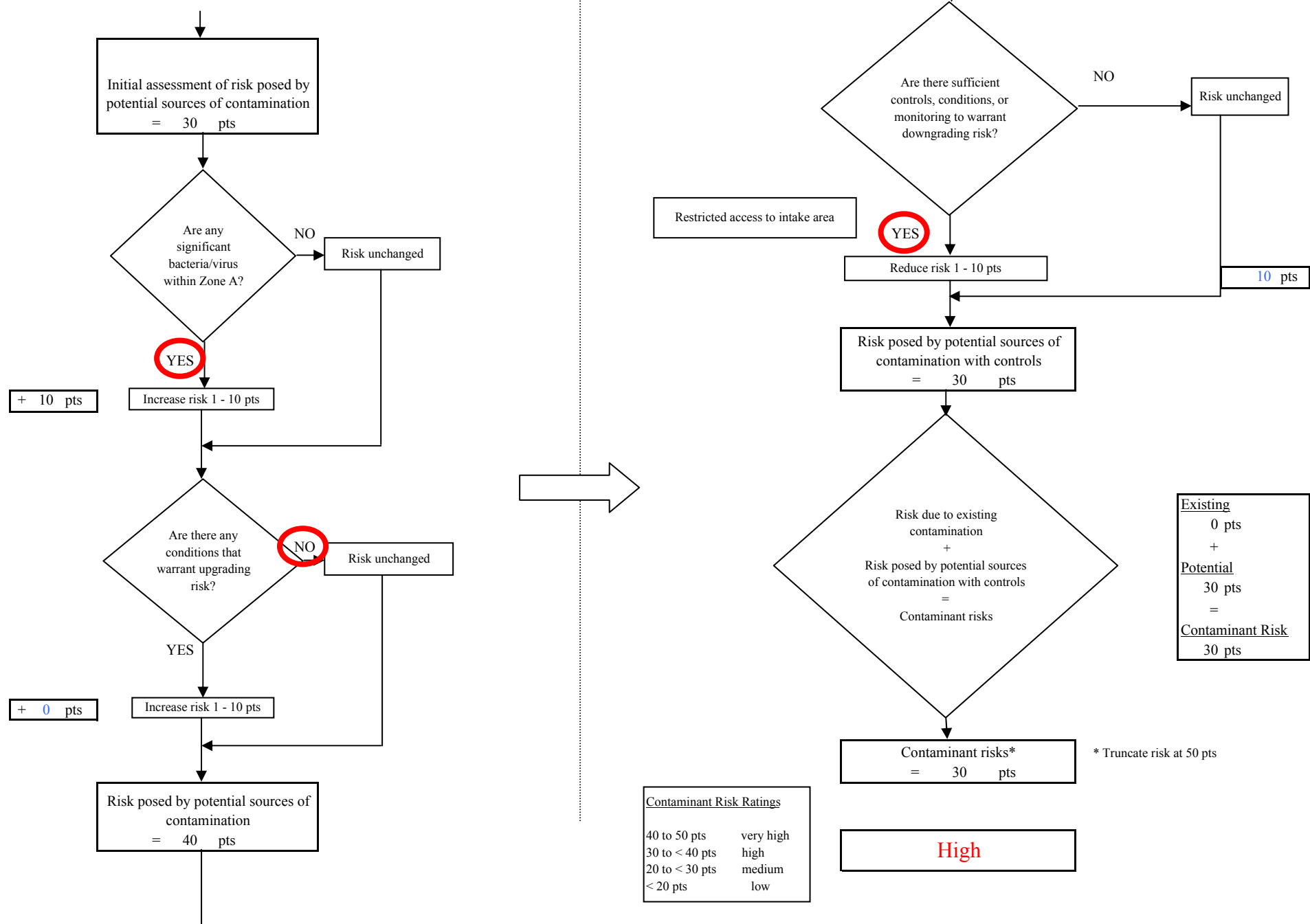


Chart 3. Vulnerability analysis for City of Angoon - Bacteria & Viruses

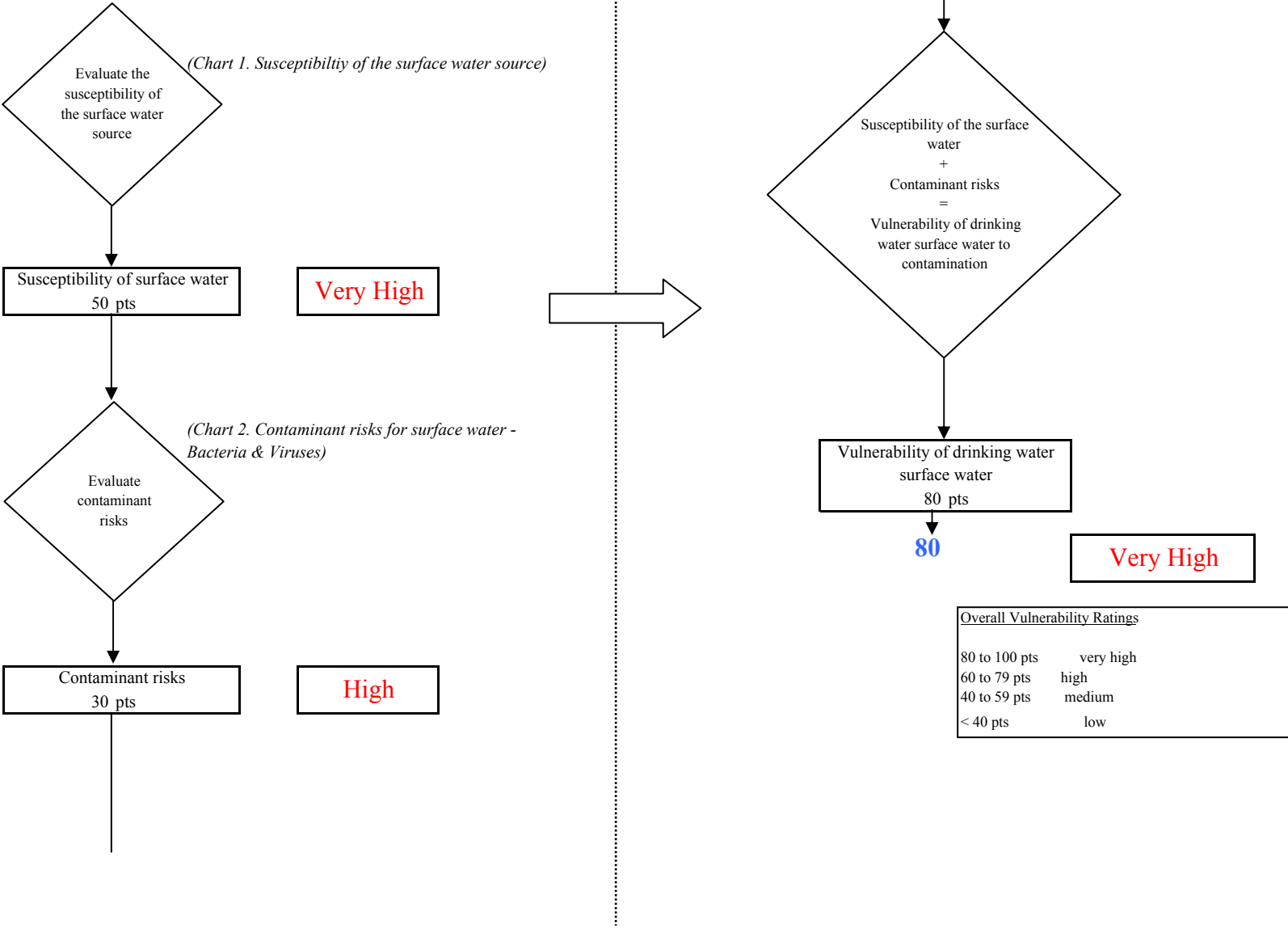


Chart 4. Contaminant risks for City of Angoon - Nitrates and Nitrites

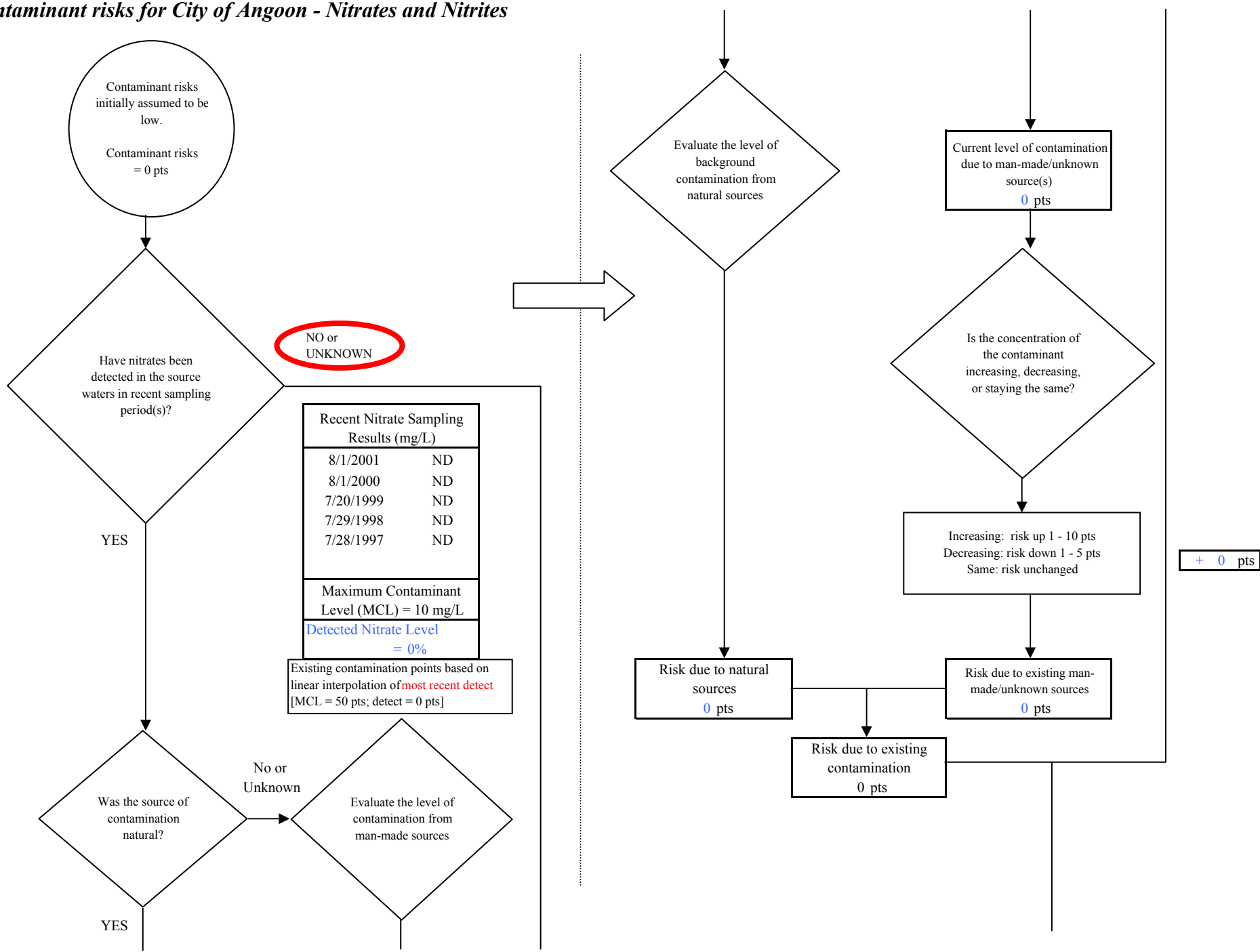


Chart 4. Contaminant risks for City of Angoon - Nitrates and Nitrites

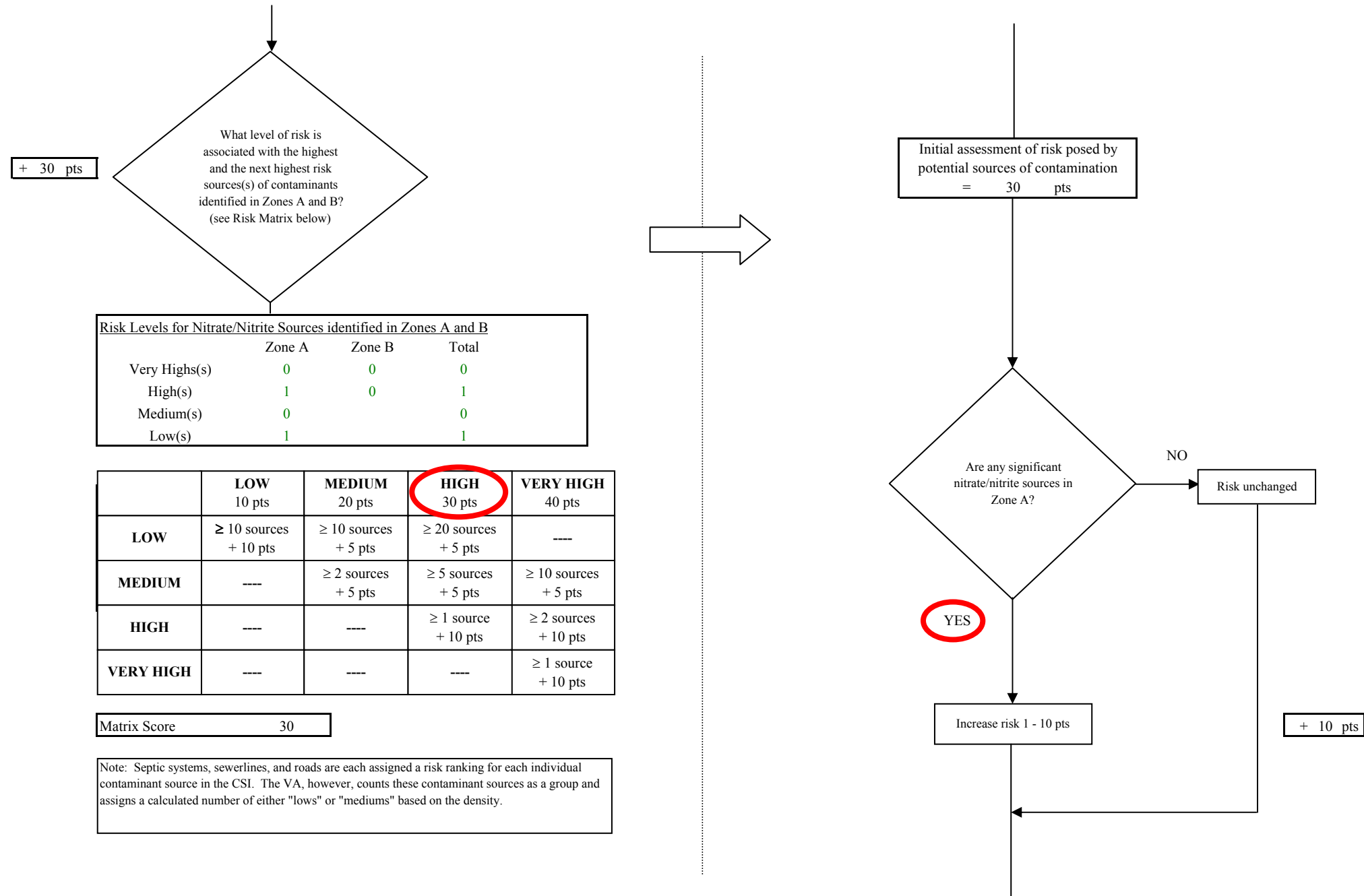


Chart 4. Contaminant risks for City of Angoon - Nitrates and Nitrites

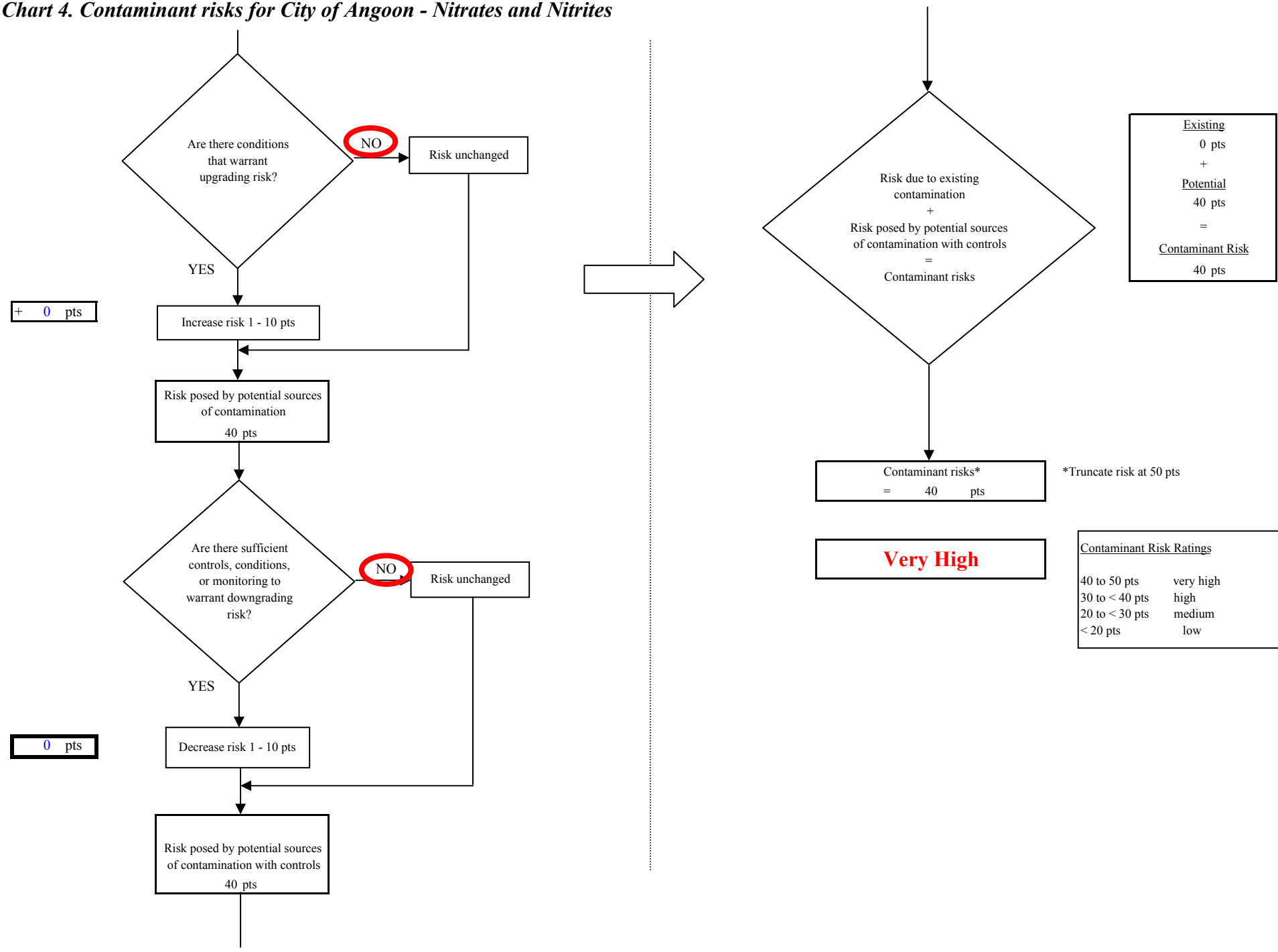


Chart 5. Vulnerability analysis for City of Angoon - Nitrates and Nitrites

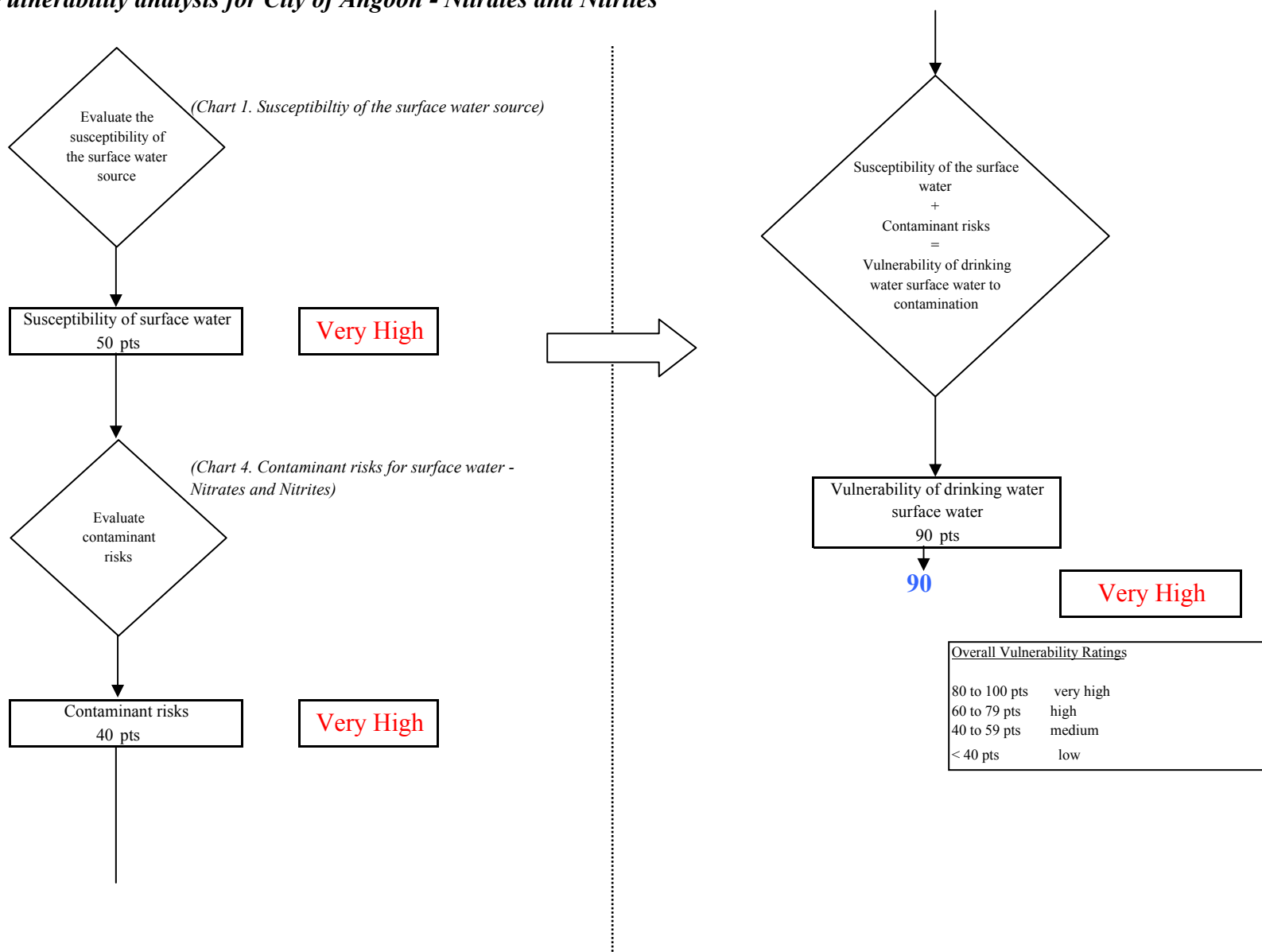


Chart 6. Contaminant risks for City of Angoon - Volatile Organic Chemicals

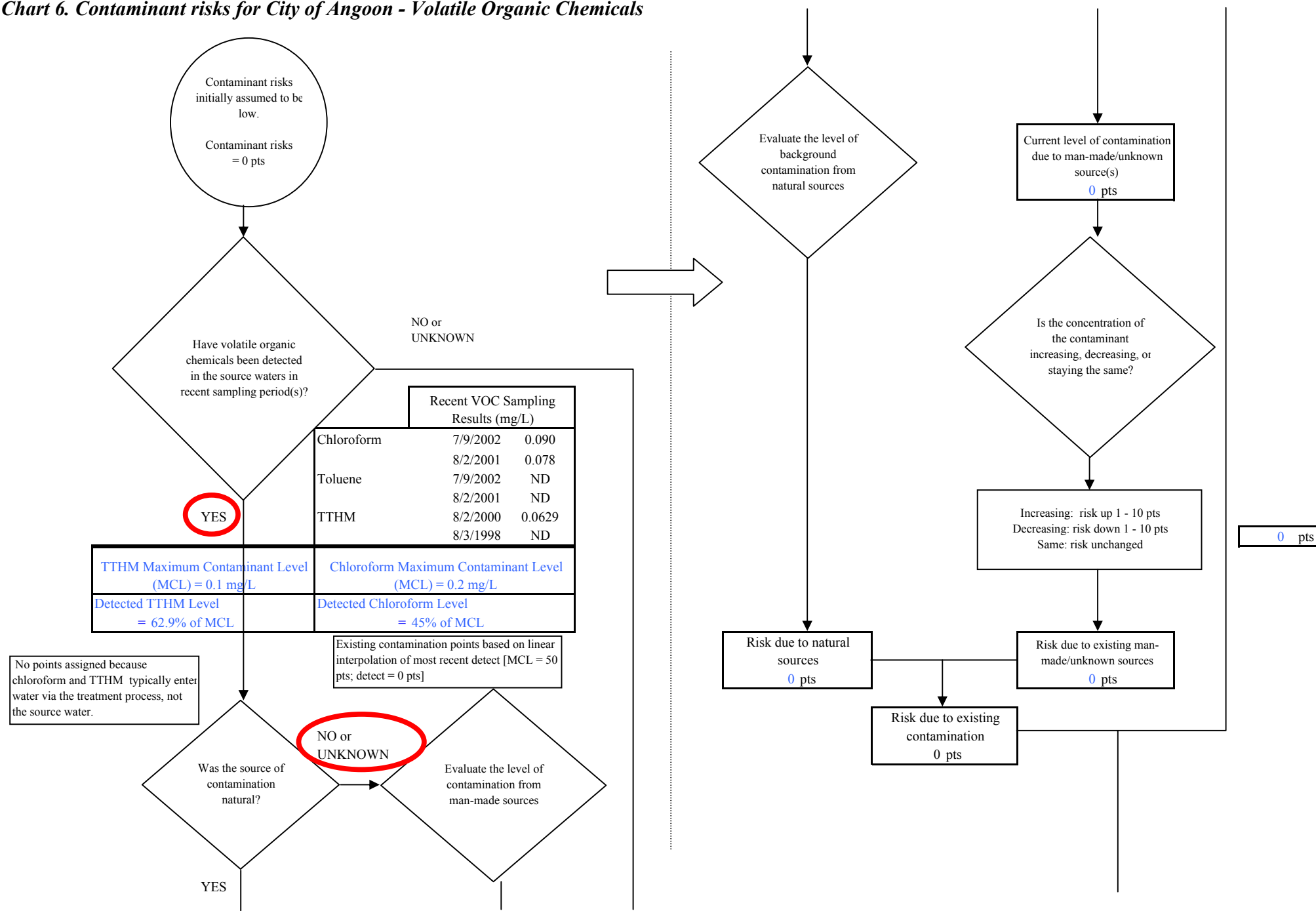


Chart 6. Contaminant risks for City of Angoon - Volatile Organic Chemicals

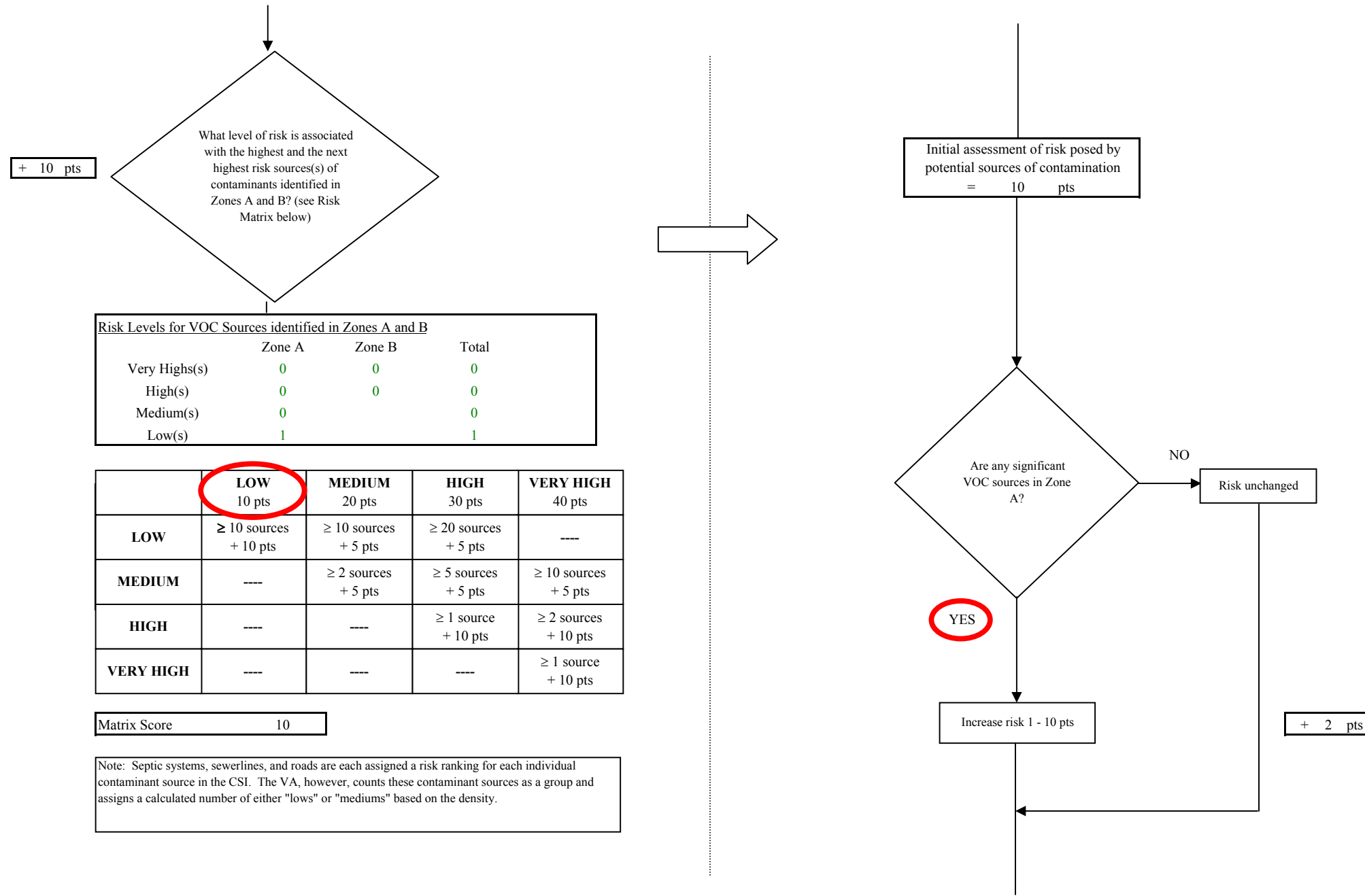


Chart 6. Contaminant risks for City of Angoon - Volatile Organic Chemicals

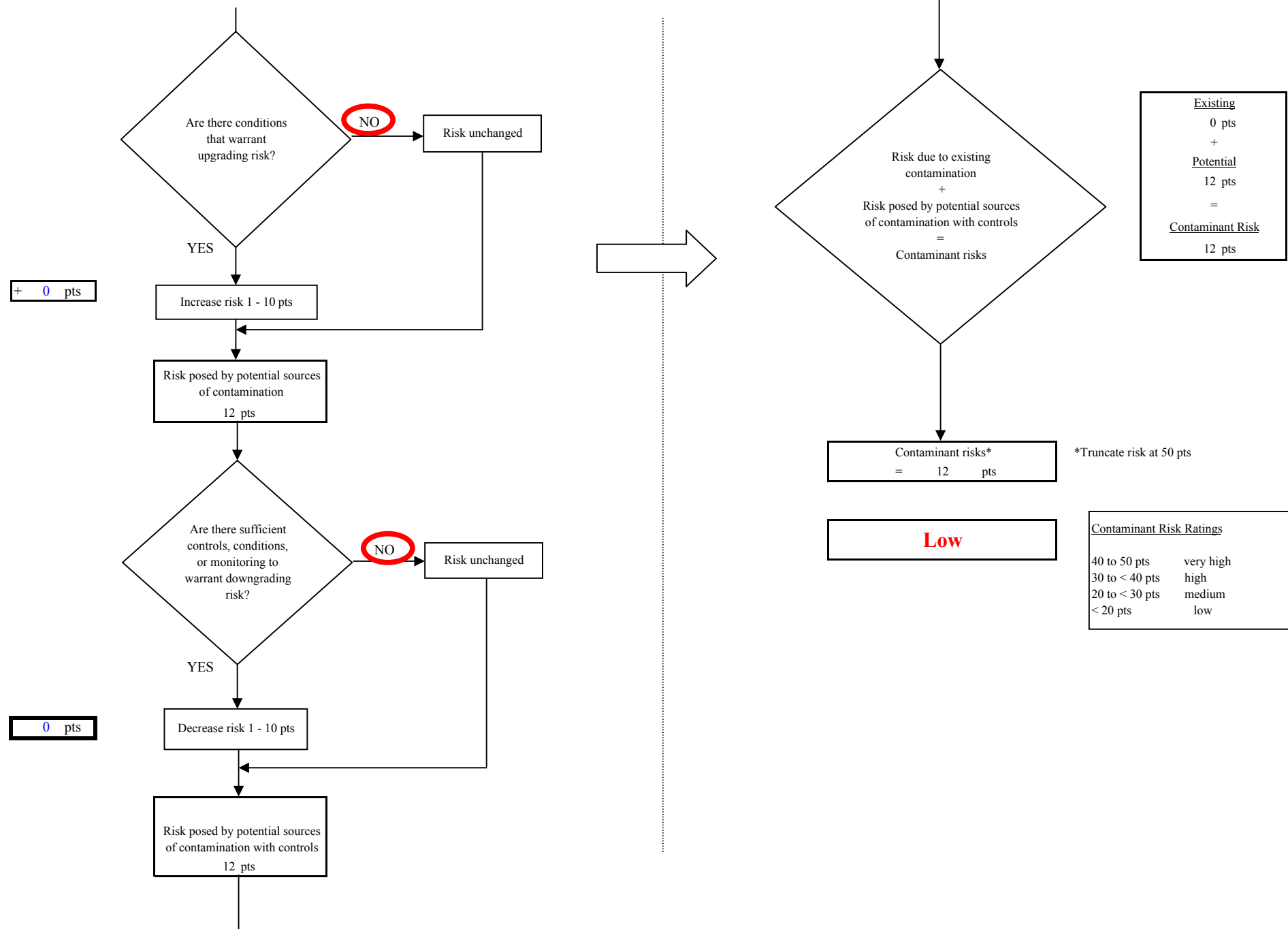


Chart 7. Vulnerability analysis for City of Angoon - Volatile Organic Chemicals

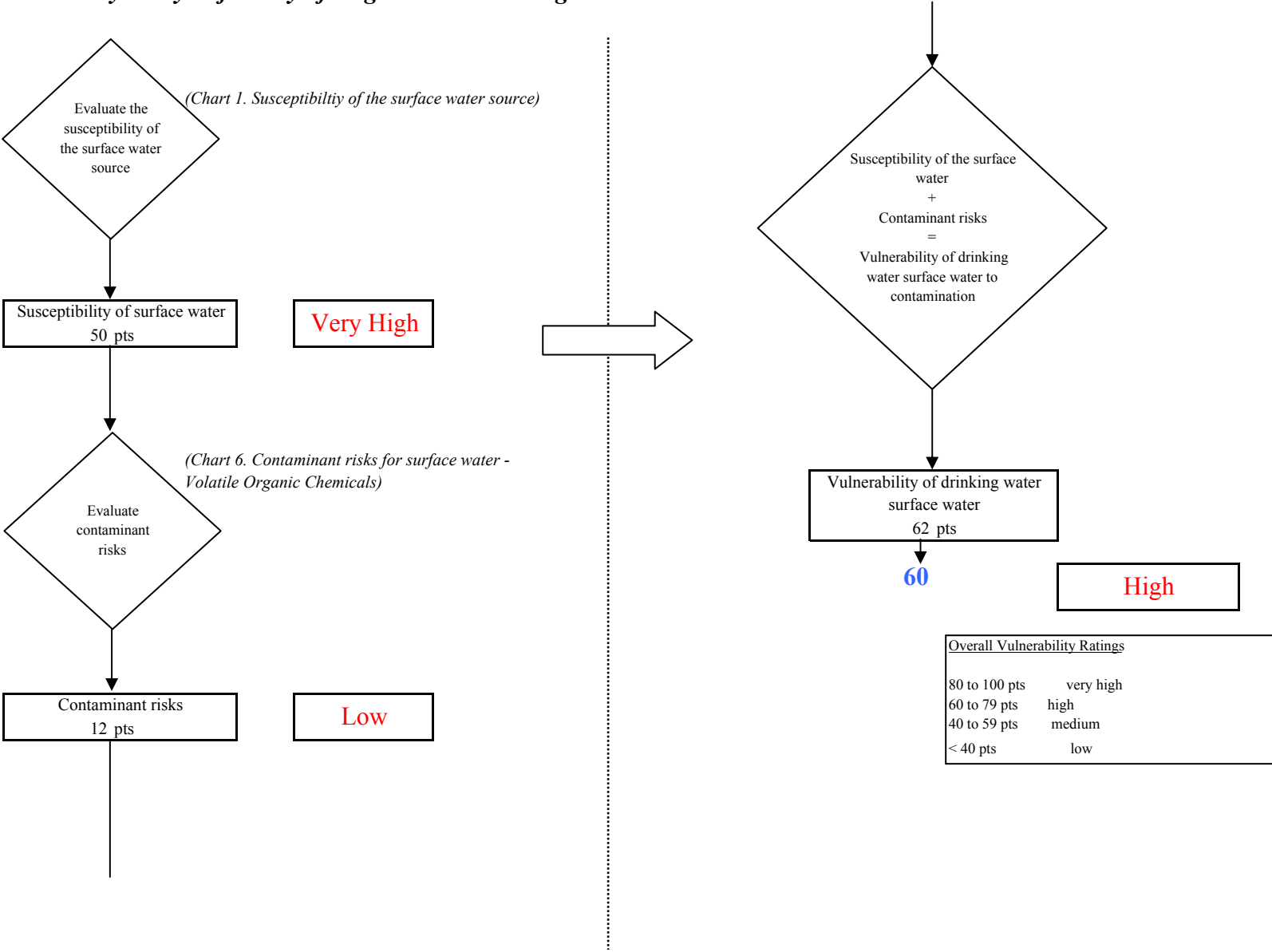


Chart 8. Contaminant risks for City of Angoon - Heavy Metals, Cyanide and Other Inorganic Chemicals

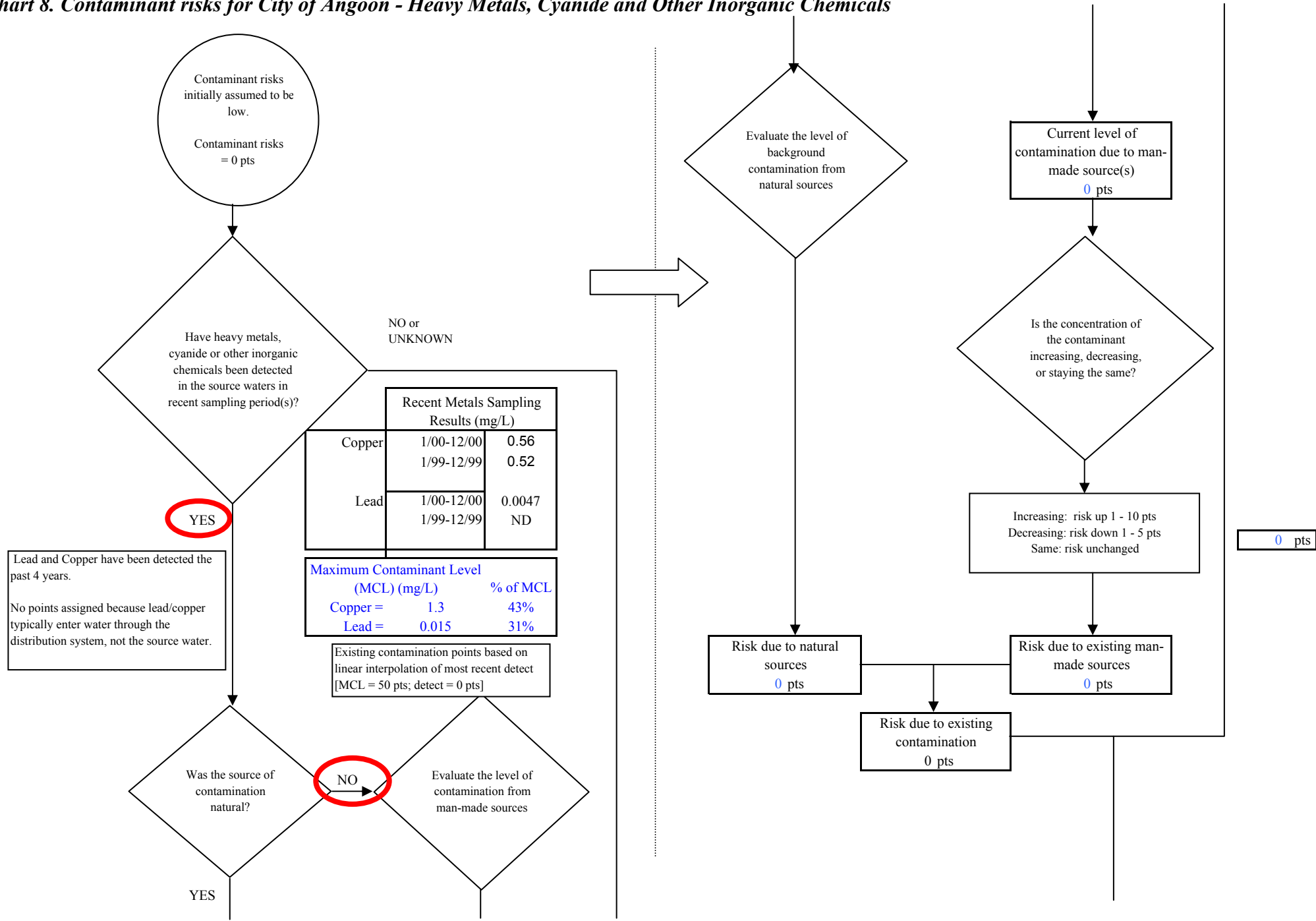


Chart 8. Contaminant risks for City of Angoon - Heavy Metals, Cyanide and Other Inorganic Chemicals

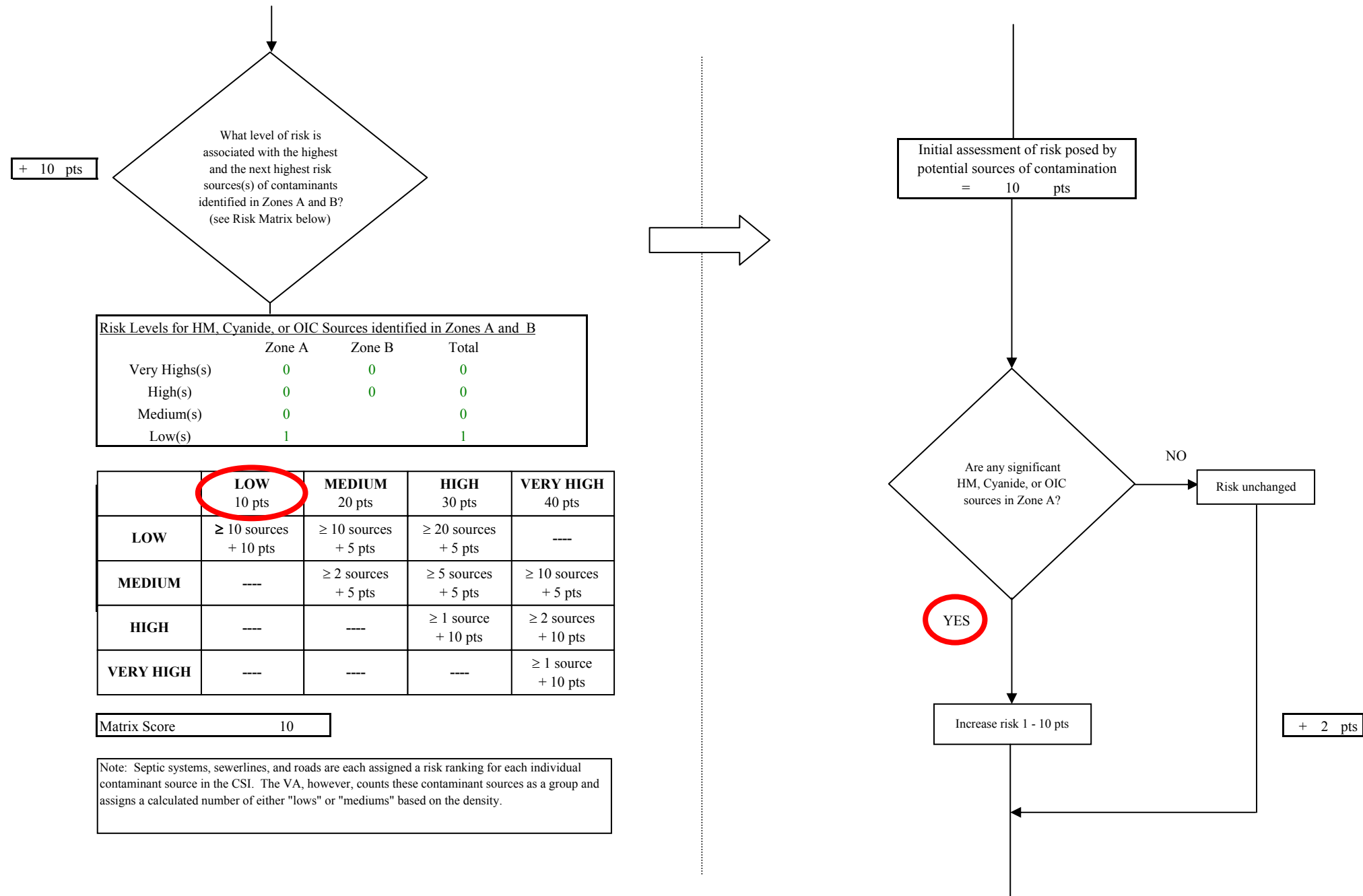


Chart 8. Contaminant risks for City of Angoon - Heavy Metals, Cyanide and Other Inorganic Chemicals

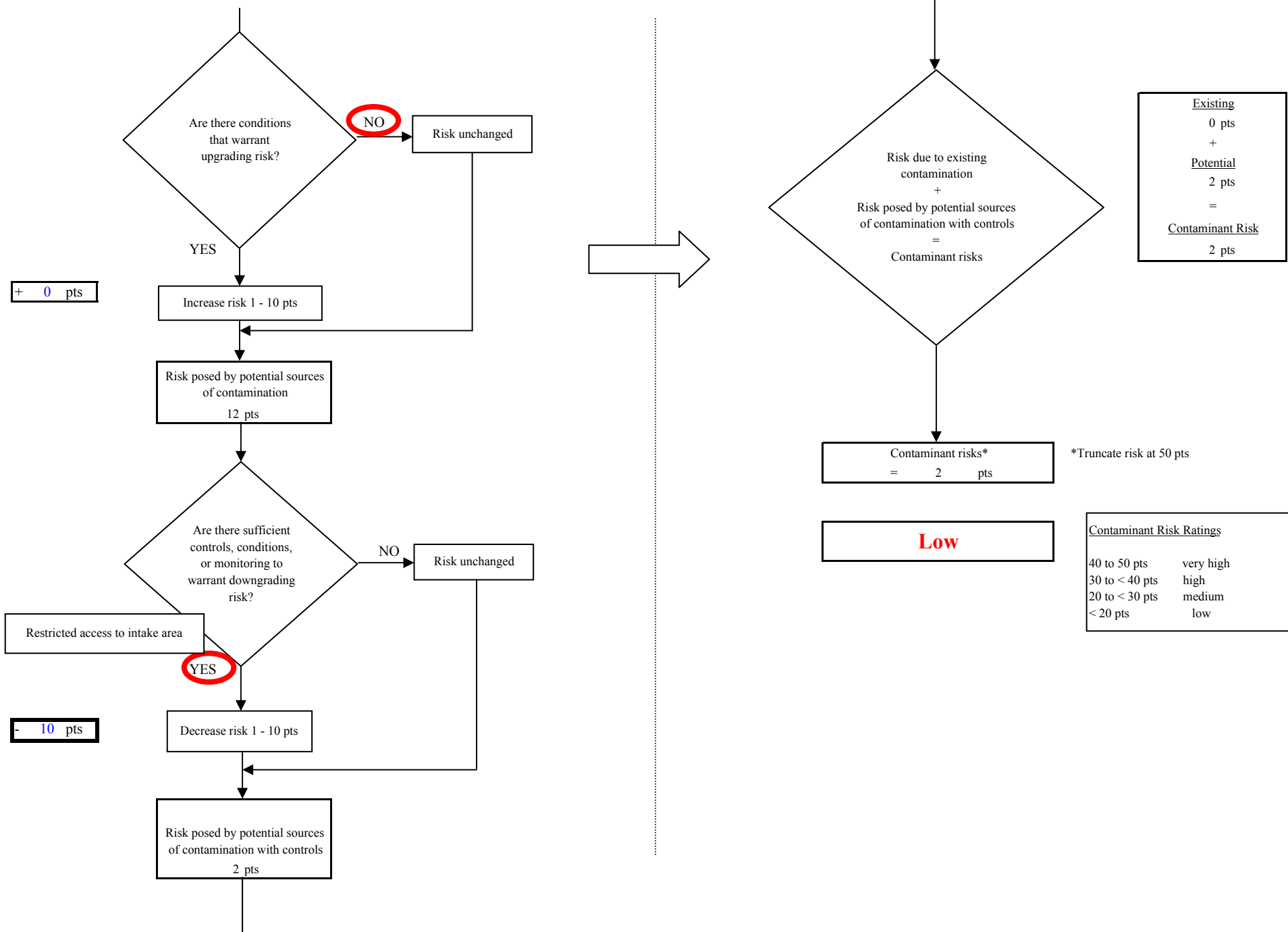


Chart 9. Vulnerability analysis for City of Angoon - Heavy Metals, Cyanide and Other Inorganic Chemicals

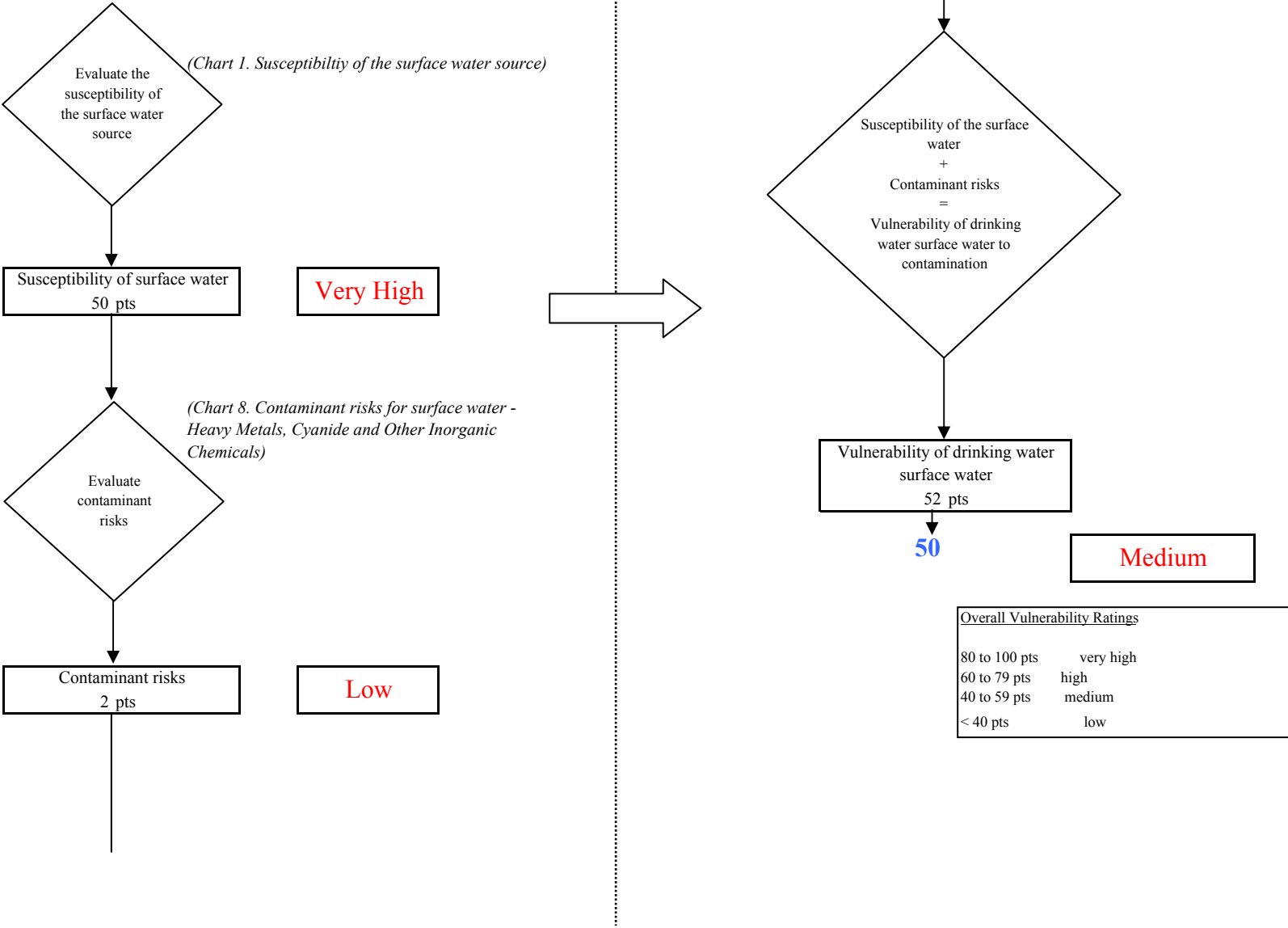


Chart 10. Contaminant risks for City of Angoon - Synthetic Organic Chemicals

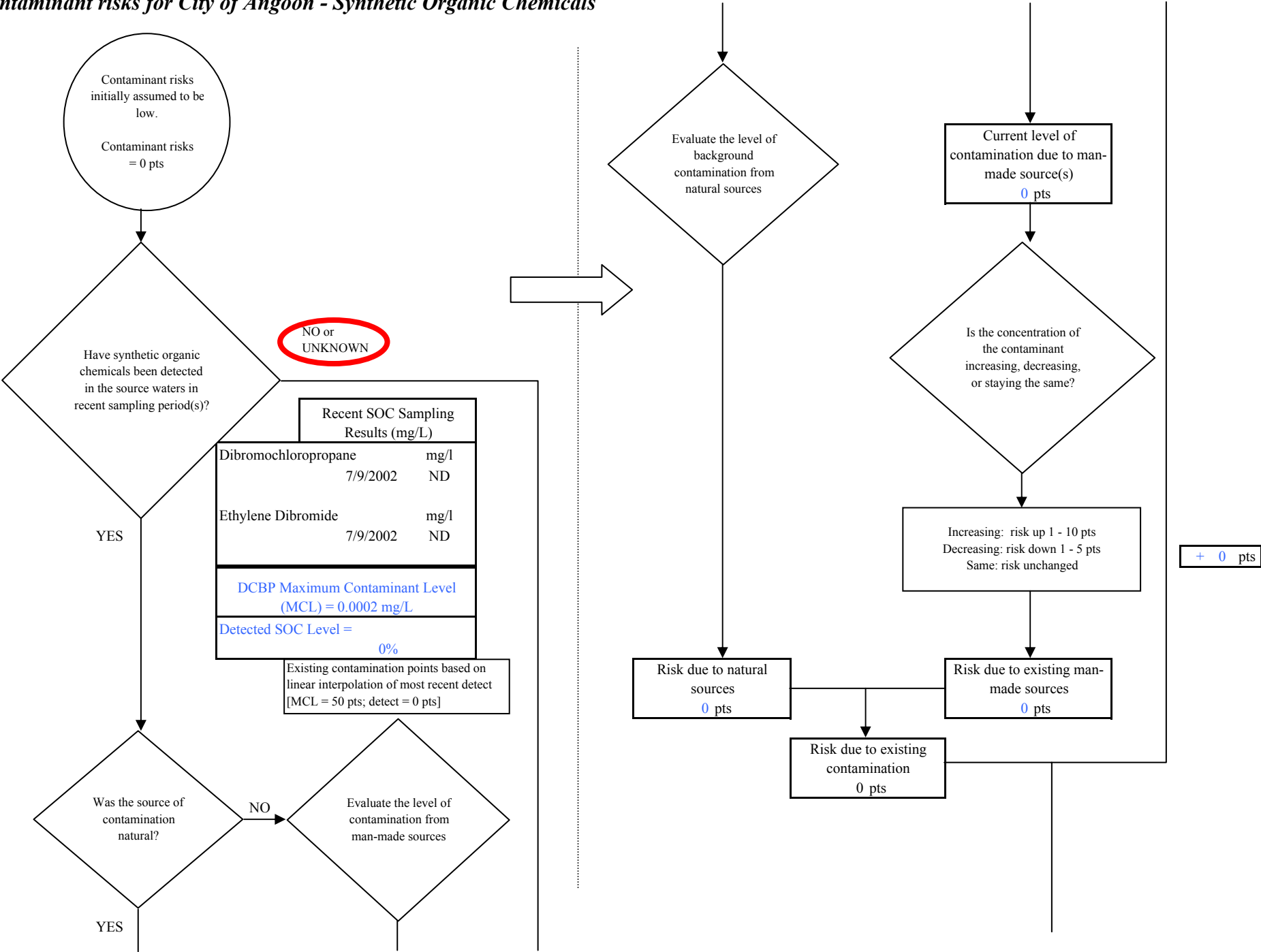


Chart 10. Contaminant risks for City of Angoon - Synthetic Organic Chemicals

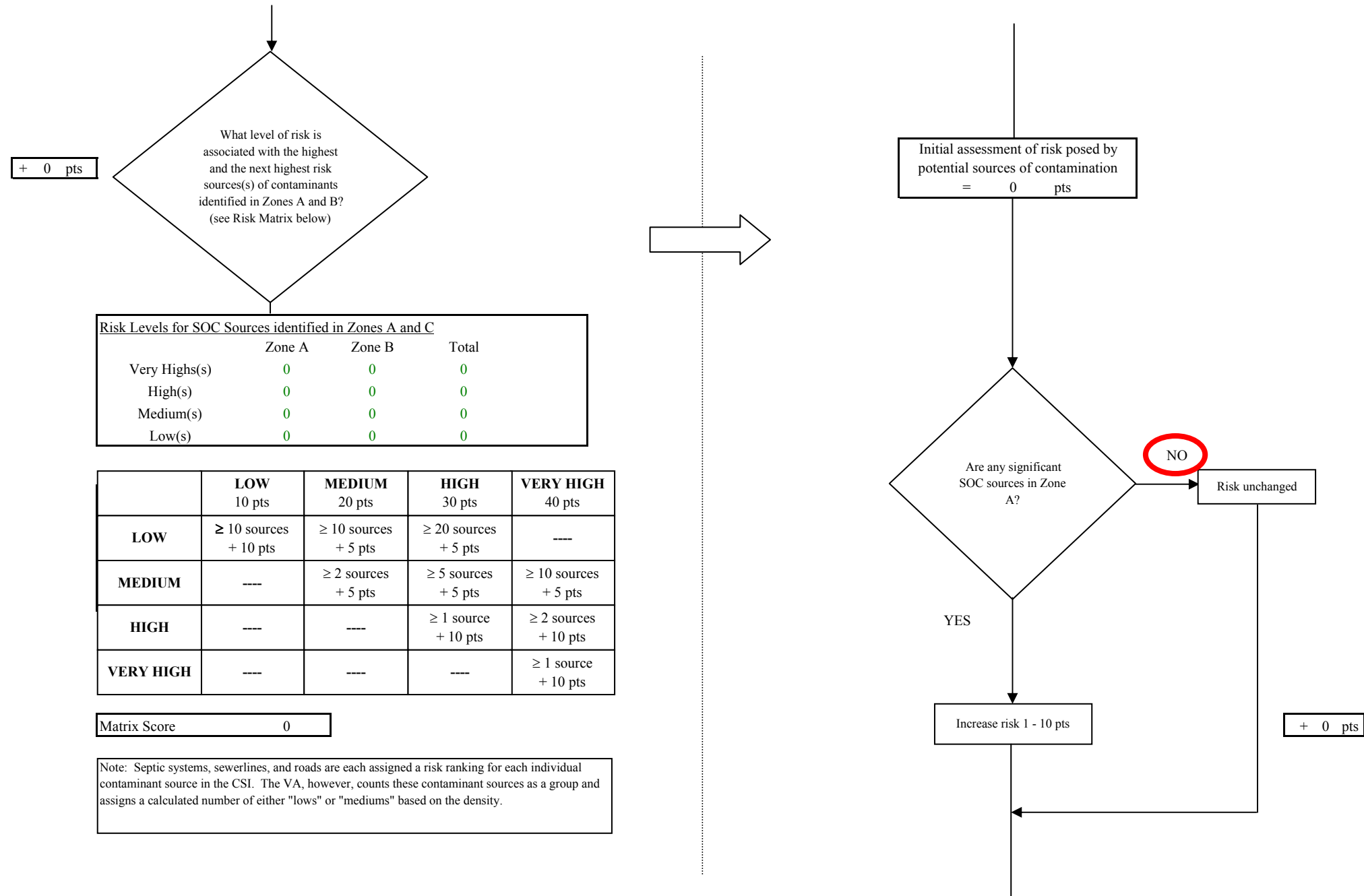


Chart 10. Contaminant risks for City of Angoon - Synthetic Organic Chemicals

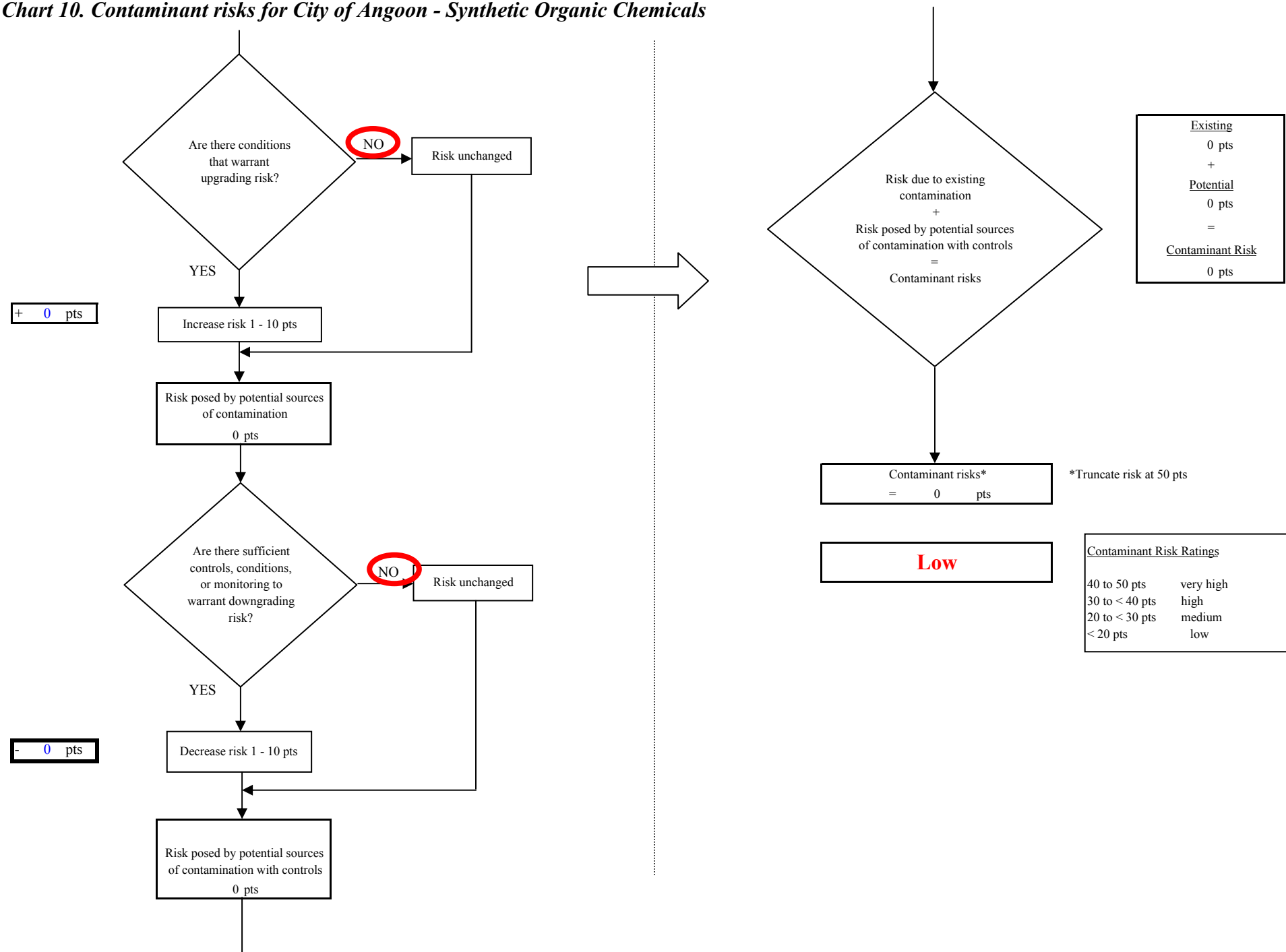


Chart 11. Vulnerability analysis for City of Angoon - Synthetic Organic Chemicals

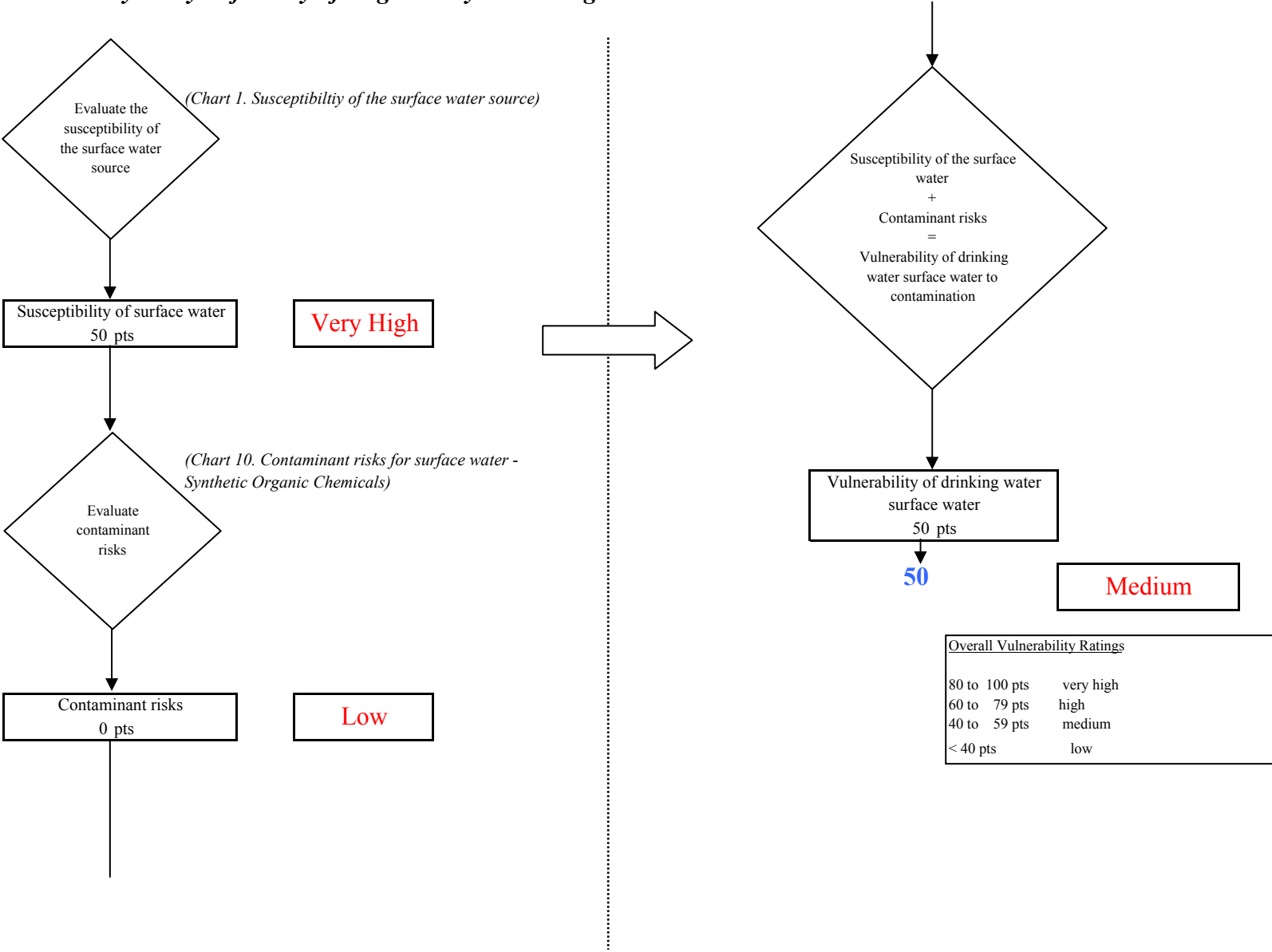


Chart 12. Contaminant risks for City of Angoon - Other Organic Chemicals

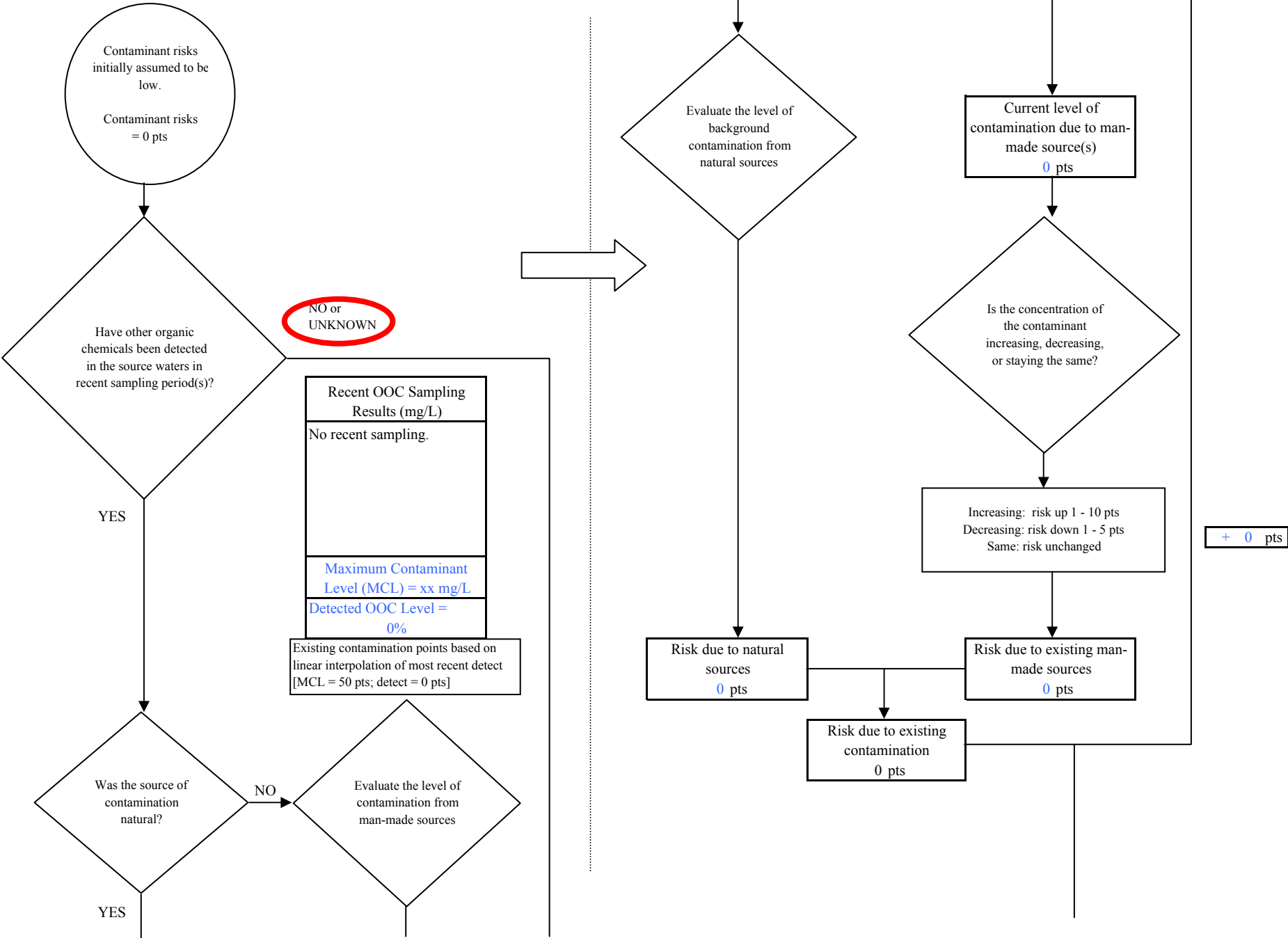


Chart 12. Contaminant risks for City of Angoon - Other Organic Chemicals

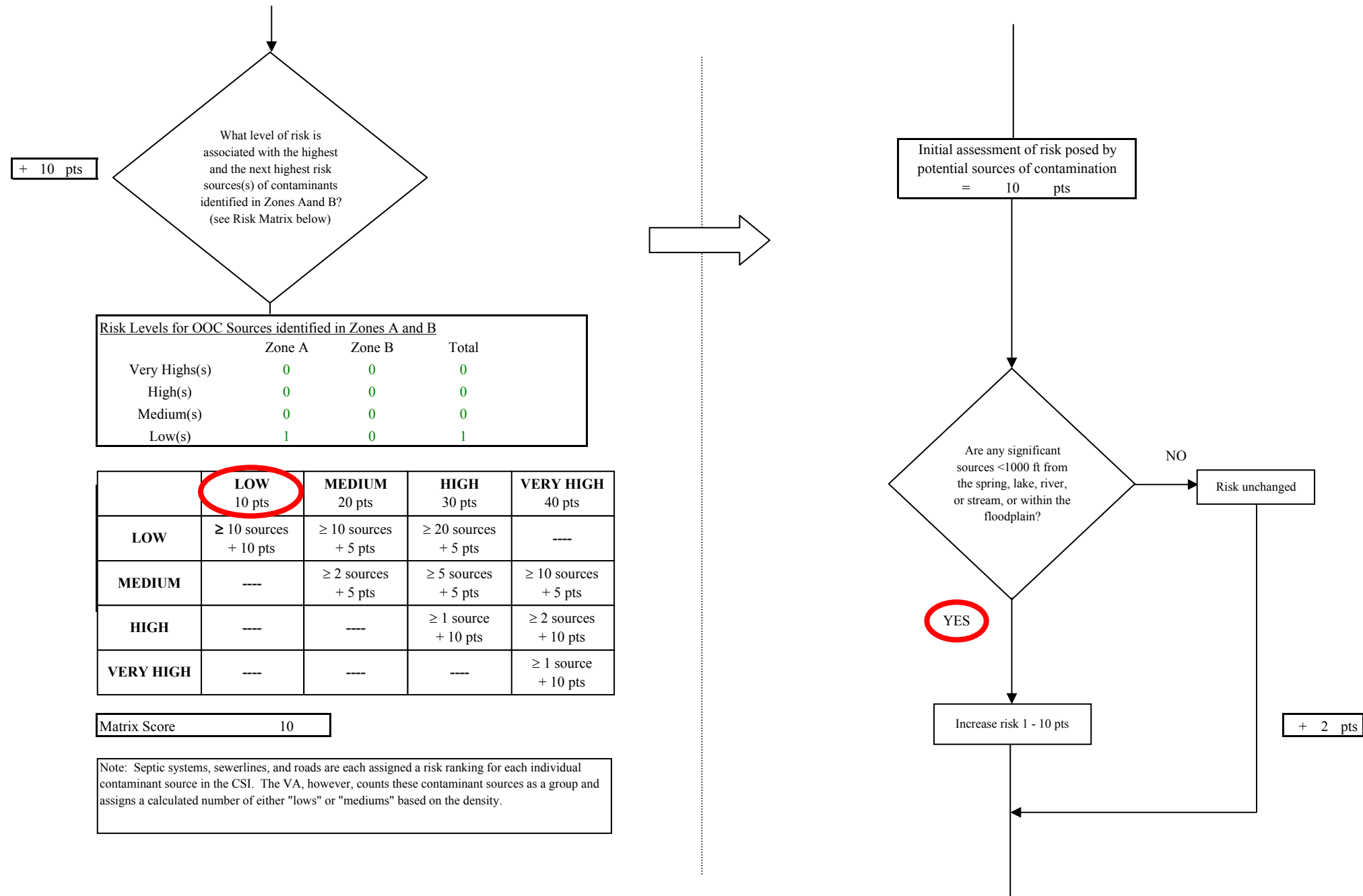


Chart 12. Contaminant risks for City of Angoon - Other Organic Chemicals

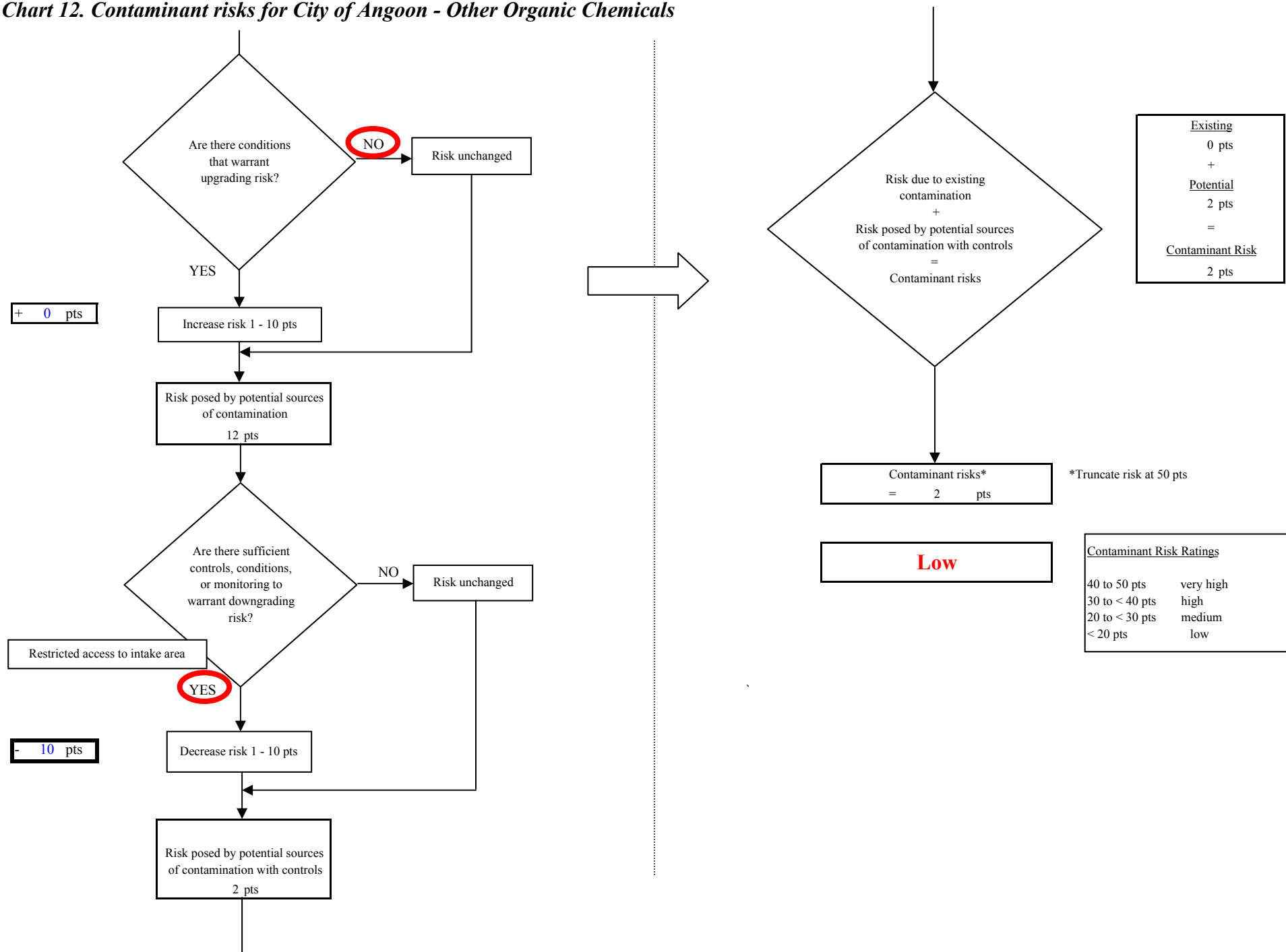


Chart 13. Vulnerability analysis for City of Angoon - Other Organic Chemicals

