Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Naukati Bay Prince of Wales Island, Alaska

PWSID # 121188

September 2003

Drinking Water Protection Program Report #832

Alaska Department of Environmental Conservation

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Naukati Bay
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The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Source Water Assessment for the Naukati Bay – Prince of Wales Island, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Naukati Bay water system is a Class A (community) water system that obtains water from a small pond in-line with an unnamed stream. The system's intake is located approximately 1200-feet upstream from the shoreline and is accessible via gravel road. The overall protection area received a susceptibility rating of "**very high**". *A rating of high to very high is typical for all systems with surface water catchment areas*. Identified potential and current sources of contaminants for the drinking water source include gravel roads, potential logging areas, residences, and septic systems. Potential and existing sources of the following contaminants were evaluated for this 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. Combining the susceptibility of the surface water source with the contaminant risk, this water system has received a vulnerability rating of **"high"** for nitrates and/or nitrites, synthetic organic chemicals, and other organic chemicals; and "**very high**" for bacteria and viruses, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals.

DRINKING WATER SYSTEM AND AREA OVERVIEW

The Naukati Bay water system is a Class A (community) water system that operates year round and serves approximately 32 users. The water system has two connections, one to the school and another to a U.S. Forest Service building. The system's intake is located approximately 1200-feet upstream of the shoreline of Tuxekan Narrows (T69S, R80E, Section 19) (See Map 1 of Appendix A). Access to the intake is available via a gravel road. Naukati Bay is located in the Ketchikan Recording District on Prince of Wales Island in the Southeast Panhandle of Alaska (Please see the inset of Map 1 in Appendix A for location). The current population is approximately 110 (ADCED, 2003).

In addition to the water system, nine logging camp homes in Naukati Bay are connected to another piped water and sewer system with full plumbing. Approximately 27 homesteaders collect rainwater or haul water and use outhouses. Funds have been requested to study alternatives for a treated community water source and sewage disposal system. The community burns its refuse and ships the ash to Thorne Bay's landfill (ADCED, 2003).

Rounded mountains composed primarily of carbonate rocks (limestone and marble) geologically characterize the Naukati Bay area. Wetlands tend to be uncommon in these areas except on non-carbonate intrusions or on glacial hardpans overlying carbonate rocks. Areas often show bare rock interspersed with sparsely vegetated thin soils. At lower elevations the vegetation is robust and consists of highly productive Western Hemlock and Sitka Spruce forests. Surface and subsurface waters often have high pH levels, alkalinity, and dissolved solute concentrations (USDA, 2001).

The area is dominated by a cool, maritime climate. Average temperatures in the summer range from 46 to 70; winter temperatures range from 32 to 42. (ADCED, 2003).

The most recent Sanitary Survey (2002) indicates that the intake is screened, although the intake frequently freezes during the winter. Treatment consists of filtration and chlorination. Water system operators did not provide information regarding streamflow, but it is estimated to be less than 10 cubic feet per second (cfs). The average daily production is approximately 500 gallons.

NAUKATI BAY 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 10-11of 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 Naukati Bay 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 Naukati Bay 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 Naukati Bay 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 Zones 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.

Tables 2 through 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, and other organic chemicals.

VULNERABILITY OF THE NAUKATI BAY 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 Naukati Bay 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. Naukati Bay Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	17	Low
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	37	High
Synthetic Organic Chemicals	12	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. Naukati Bay Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	100	Very High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	100	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	90	Very High
Synthetic Organic Chemicals	60	High
Other Organic Chemicals	60	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is "very high". Typically, there is positive coliform detection in water samples, which is normal in samples of raw water collected from surface water sources. (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.

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 remains "very high".

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is "low" with the proximity of the source water to residences, septic systems, gravel roads, and possible logging areas posing the most significant contaminant risks to this source of public drinking water (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 Naukati Bay water source indicates that nitrates have not been detected since 1998. 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).

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the source, the overall vulnerability of the well 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).

Chloroform, tolulene, and dichloromethane have been detected during recent sampling, although below MCL levels. The MCL for chloroform is 0.2 milligrams per liter (mg/L) and the MCL for dichloromethane is 0.1 mg/L. Both of these chemicals originate from human-made sources. Chloroform and tolulene are often present in trace amounts following the water treatment process. Other possible sources of volatile organic chemicals in the protection area are residential areas, septic systems, potential logging areas, and gravel roads. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the source, the overall vulnerability of the well to contamination is "very high".

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is "high". This is primarily due to the detection of lead and copper during 1997-1998 (See Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Possible sources of these chemicals in the protection area are residential areas, septic systems, potential logging areas, and gravel 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 "very 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 well is "high" (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

Possible sources of these chemicals in the protection area are residential areas and septic systems.

Review of the historical sampling data indicates that sampling for dibromochloropropane occurred in 2002, but was not detected.

Other Organic Chemicals

The contaminant risk for other organic chemicals is "low". Three sources of potential contaminants of this type are the residential area, septic systems, and gravel roads. 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).

Review of the historical sampling data indicates that no other organic chemicals have been sampled since 1993.

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

Naukati Bay
Drinking Water Protection Area Location Map
(Map 1)

Naukati Bay Camp -
Drinking Water Protection Area

Map 1: Naukati Bay Camp Drinking Water Protection Area

PWSID: 121188.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 2,000 4,000 8,000 12,000 16,000 Feet

1:48,000

Data Sources:

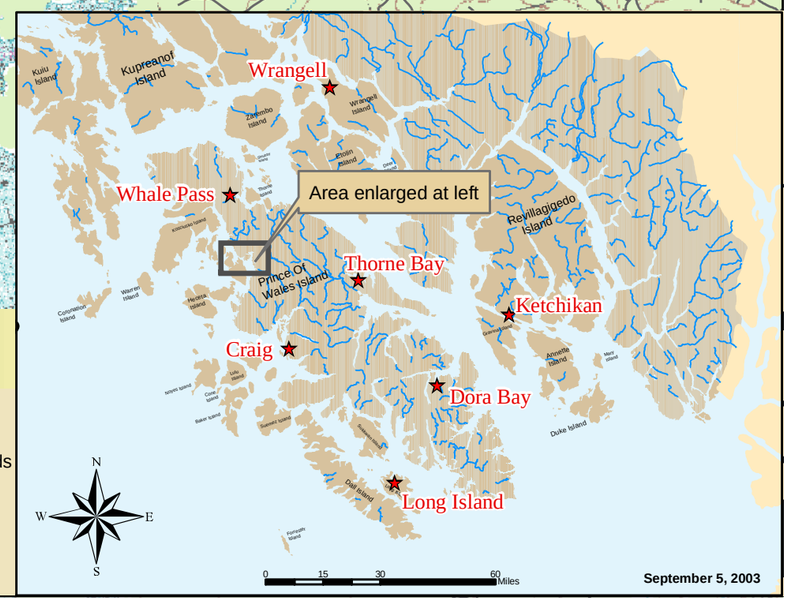
Background image - USGS 1:63,000 mapping
Lakes & streams - U.S. Forest Service, Tongass
Roads - Ketchikan Gateway Borough

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

- Naukati Bay Camp PWS Intake
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Roads
- Lake



September 5, 2003

APPENDIX B

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

Table 1

Contaminant Source Inventory for ***Naukati Bay Camp***

PWSID 121188.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Logging (potential)	E02	E02 1-6	A	2	From Tongass GIS data
Residential Areas	R01	R01 1-2	A	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	2	From PWS contact communication
Highways and roads, dirt/gravel	X24	X24 1-4	A	2	From Tongass GIS data

Table 2

Contaminant Source Inventory and Risk Ranking for Naukati Bay Camp Sources of Bacteria and Viruses

PWSID 121188.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01 1-2	A	Low	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	Low	2	From PWS contact communication
Highways and roads, dirt/gravel	X24	X24 1-4	A	Low	2	From Tongass GIS data

Table 3

Contaminant Source Inventory and Risk Ranking for Naukati Bay Camp Sources of Nitrates/Nitrites

PWSID 121188.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Logging (potential)	E02	E02 1-6	A	Low	2	From Tongass GIS data
Residential Areas	R01	R01 1-2	A	Low	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	Low	2	From PWS contact communication
Highways and roads, dirt/gravel	X24	X24 1-4	A	Low	2	From Tongass GIS data

Table 4

Contaminant Source Inventory and Risk Ranking for Naukati Bay Camp
Sources of Volatile Organic Chemicals

PWSID 121188.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Logging (potential)	E02	E02 1-6	A	Medium	2	From Tongass GIS data
Residential Areas	R01	R01 1-2	A	Low	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	Low	2	From PWS contact communication
Highways and roads, dirt/gravel	X24	X24 1-4	A	Low	2	From Tongass GIS data

Table 5

Contaminant Source Inventory and Risk Ranking for Naukati Bay Camp

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 121188.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Logging (potential)	E02	E02 1-6	A	Low	2	From Tongass GIS data
Residential Areas	R01	R01 1-2	A	Low	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	Low	2	From PWS contact communication
Highways and roads, dirt/gravel	X24	X24 1-4	A	Low	2	From Tongass GIS data

Table 6

Contaminant Source Inventory and Risk Ranking for Naukati Bay Camp
Sources of Synthetic Organic Chemicals

PWSID 121188.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01 1-2	A	Low	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	Low	2	From PWS contact communication

Table 7

Contaminant Source Inventory and Risk Ranking for Naukati Bay Camp
Sources of Other Organic Chemicals

PWSID 121188.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Residential Areas	R01	R01 1-2	A	Low	2	From PWS contact communication
Septic systems (serves one single-family home)	R02	R02 1-2	A	Low	2	From PWS contact communication
Highways and roads, dirt/gravel	X24	X24 1-4	A	Low	2	From Tongass GIS data

APPENDIX C

Naukati Bay
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

X24 - 1 through 4
(Gravel/dirt roads)

E02 - 1 through 6
(Potential logging area)

R01 - 1 through 2
(Residential areas)

R02 - 1 through 2
(Residential septic systems)

Water Treatment Facility

Area enlarged at left

Map 2: Potential and Existing Contaminant Sources

PWSID: 121188.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 250 500 1,000 1,500 Feet

1:6,000

Data Sources:

Background image - USGS 1:24,000 mapping
Lakes & streams - U.S. Forest Service, Tongass
Roads, property lines - Ketchikan Gateway Borough

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

- Naukati Bay Camp Water Intake
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Residential Areas
- Septics
- Lake
- Stream
- Roads

N W E S

0 0.75 1.5 3 Miles

September 5, 2003

APPENDIX D

Vulnerability Analysis and Contaminant Risks
(Charts 1-13)

Chart 1. Susceptibility of the Surface Water Source - Naukati Bay

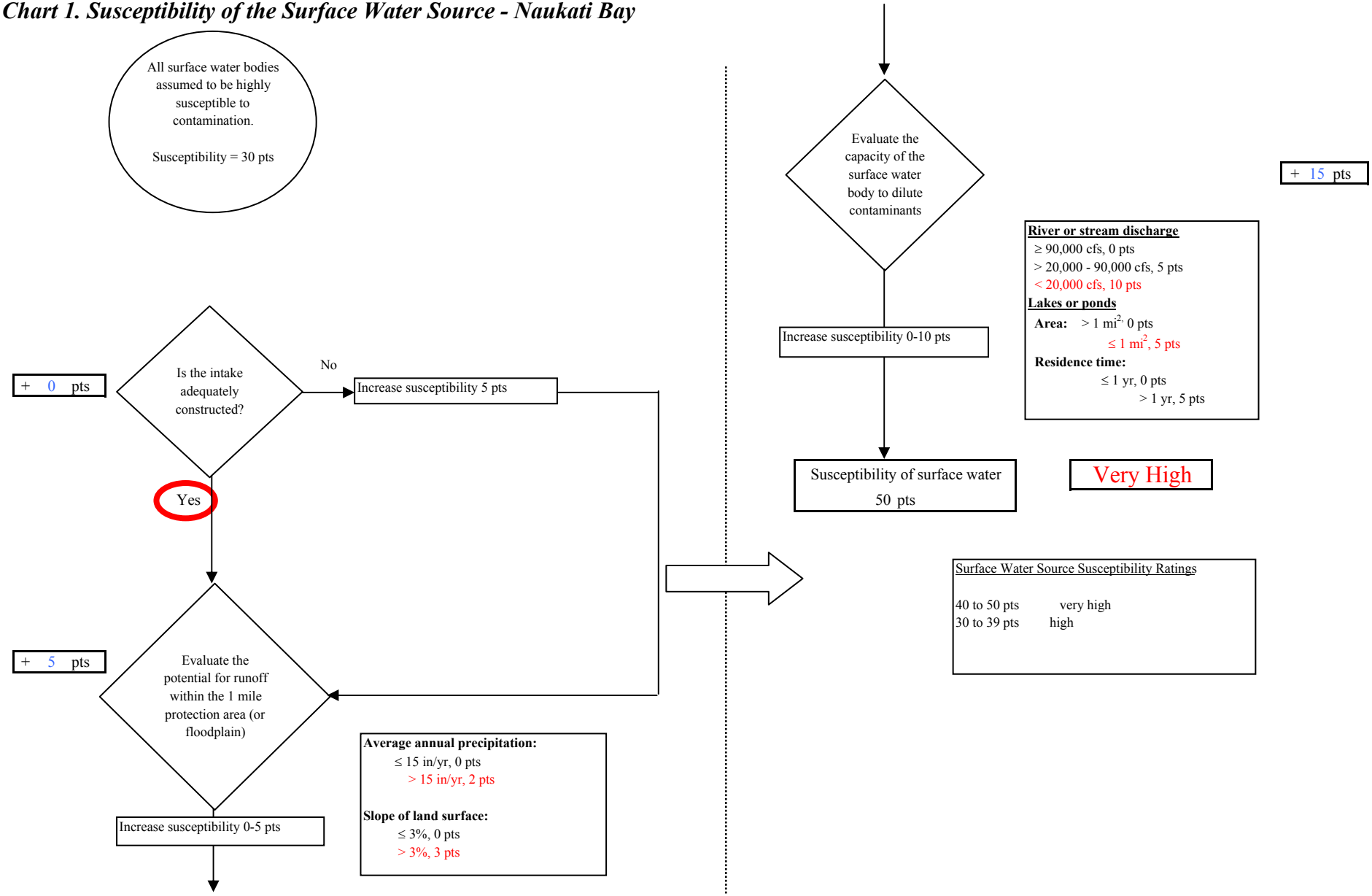
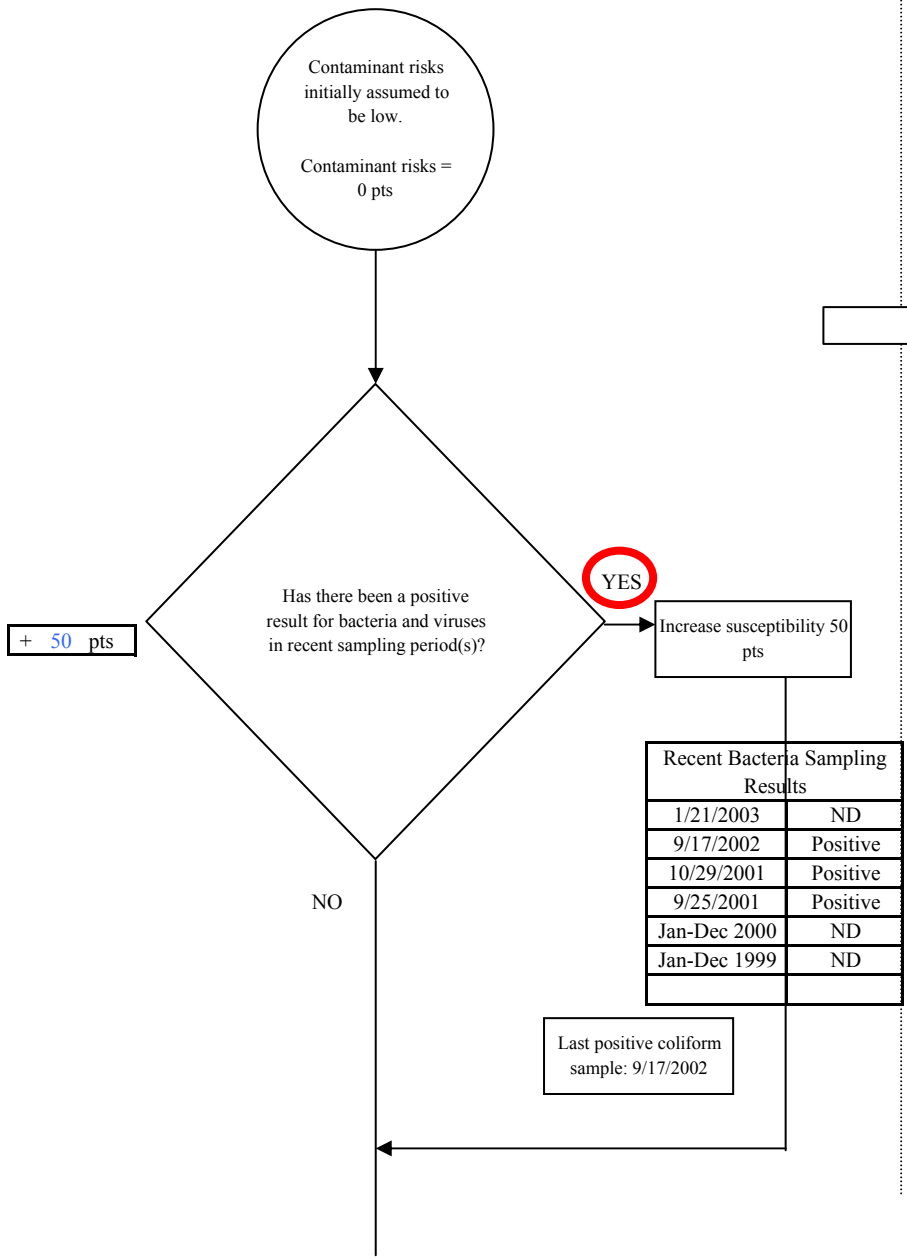
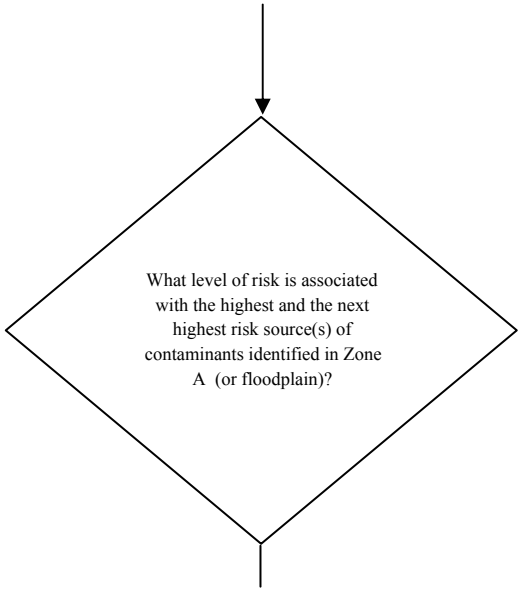


Chart 2. Contaminant risks for Naukati Bay - Bacteria & Viruses





+ 10 pts

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)	4	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 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 Naukati Bay - Bacteria & Viruses

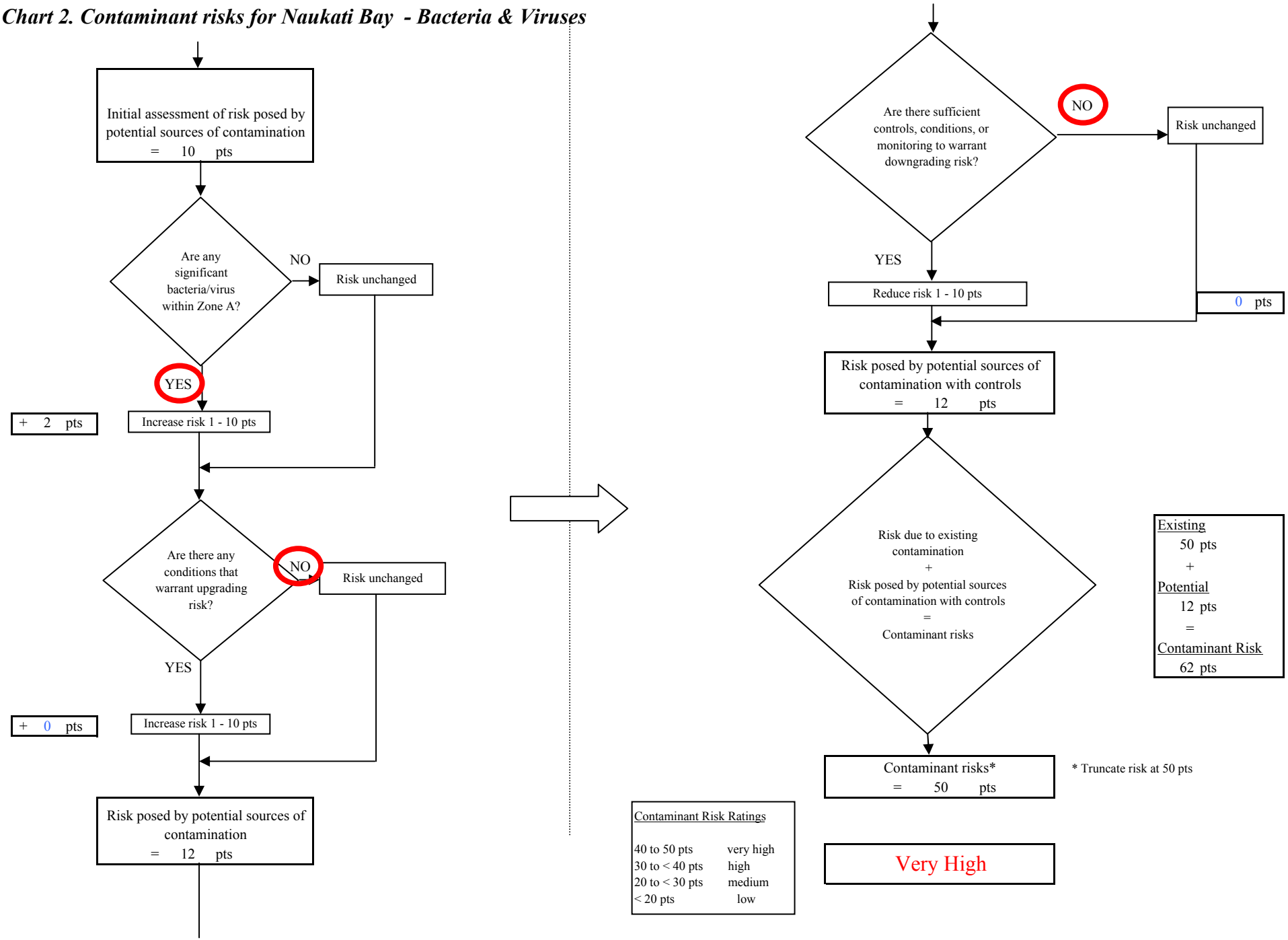


Chart 3. Vulnerability analysis for Naukati Bay - Bacteria & Viruses

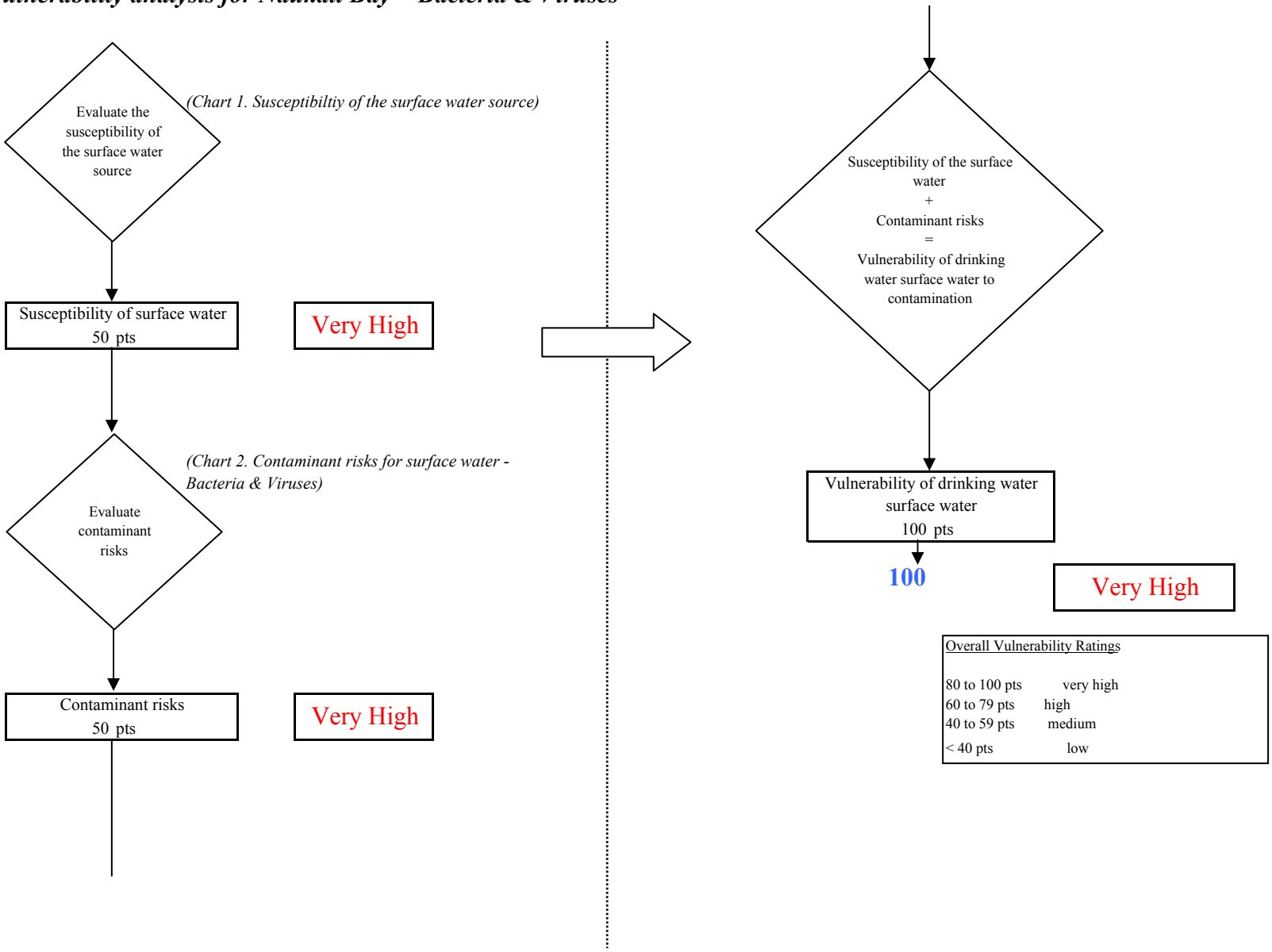


Chart 4. Contaminant risks for Naukati Bay - Nitrates and Nitrites

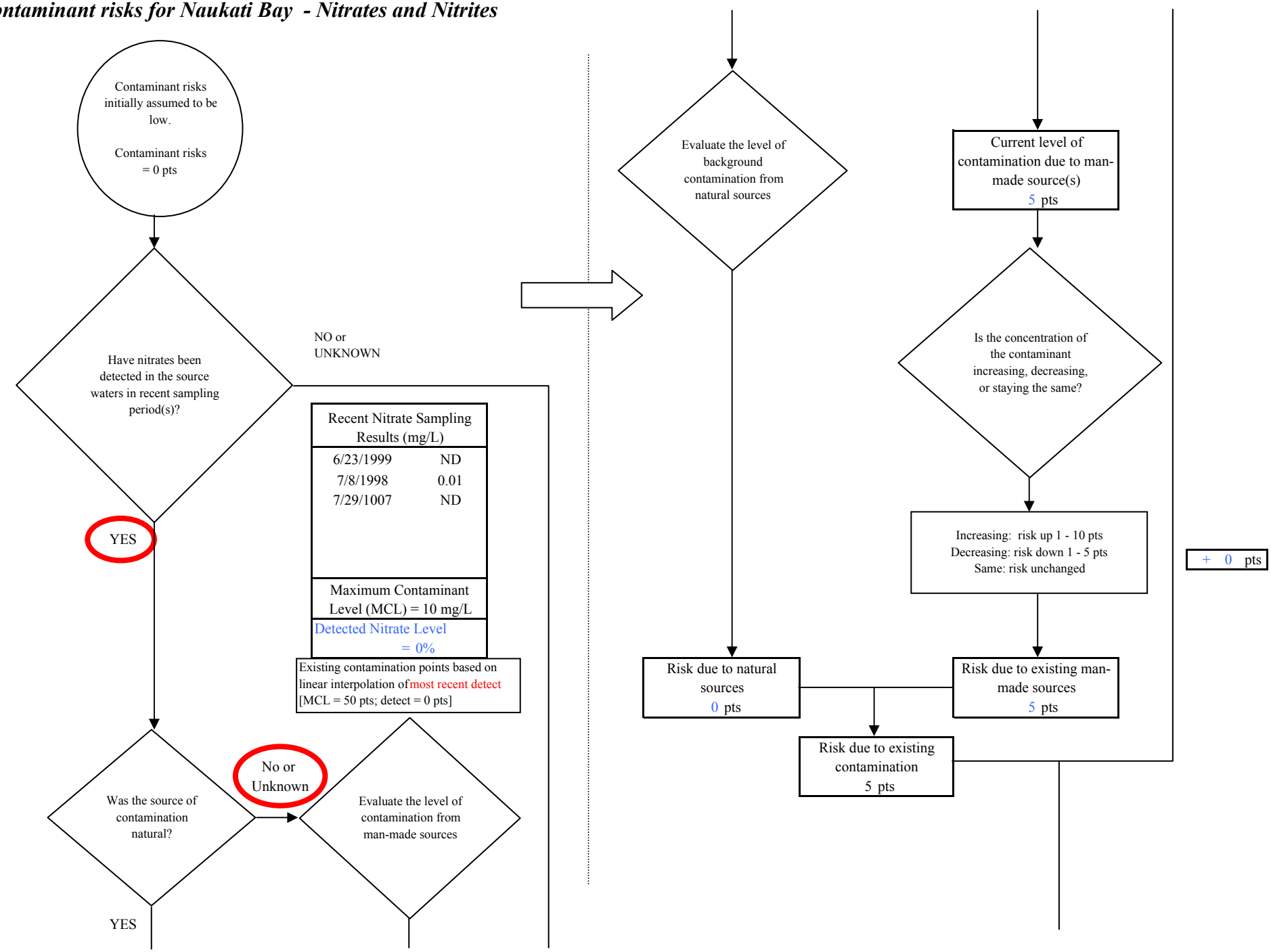
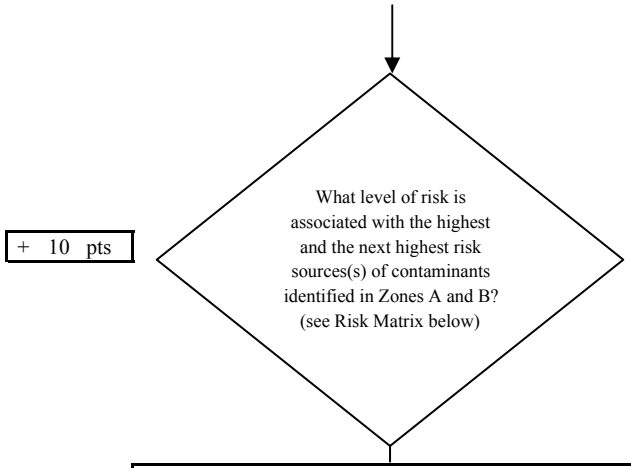


Chart 4. Contaminant risks for Naukati Bay - Nitrates and Nitrites



+ 10 pts

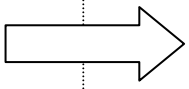
Risk Levels for Nitrate/Nitrite Sources identified in Zones A and B

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

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

Matrix Score 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.



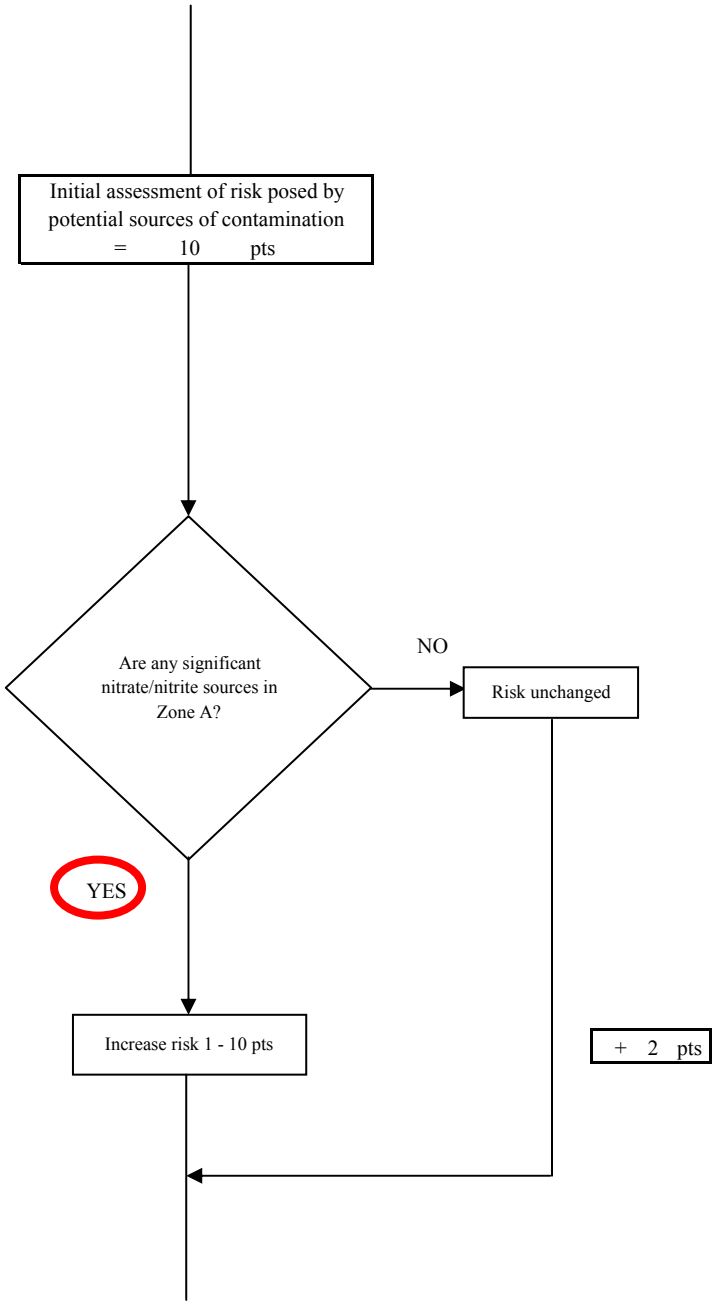


Chart 4. Contaminant risks for Naukati Bay - Nitrates and Nitrites

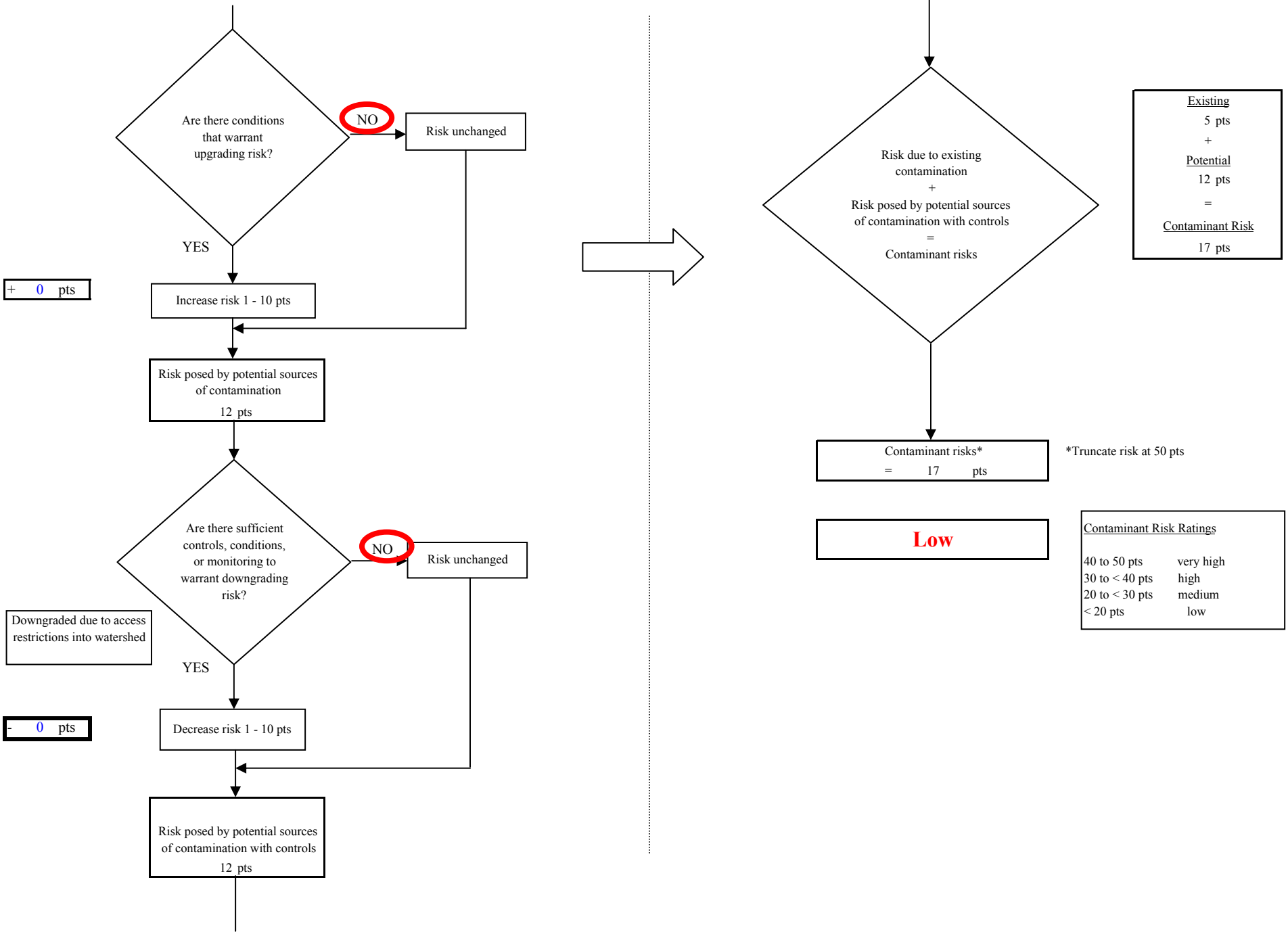


Chart 5. Vulnerability analysis for Naukati Bay - Nitrates and Nitrites

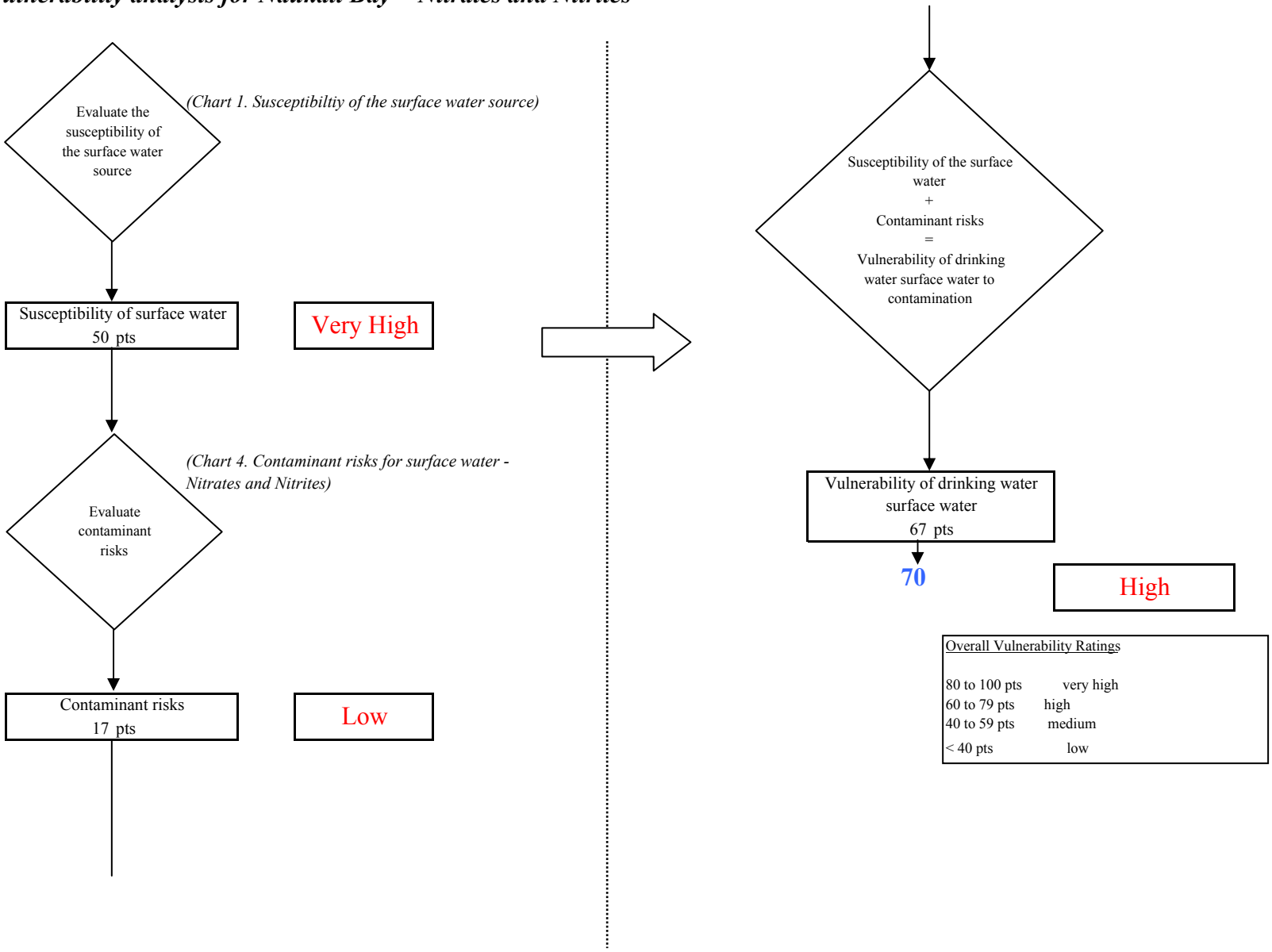


Chart 6. Contaminant risks for Naukati Bay - Volatile Organic Chemicals

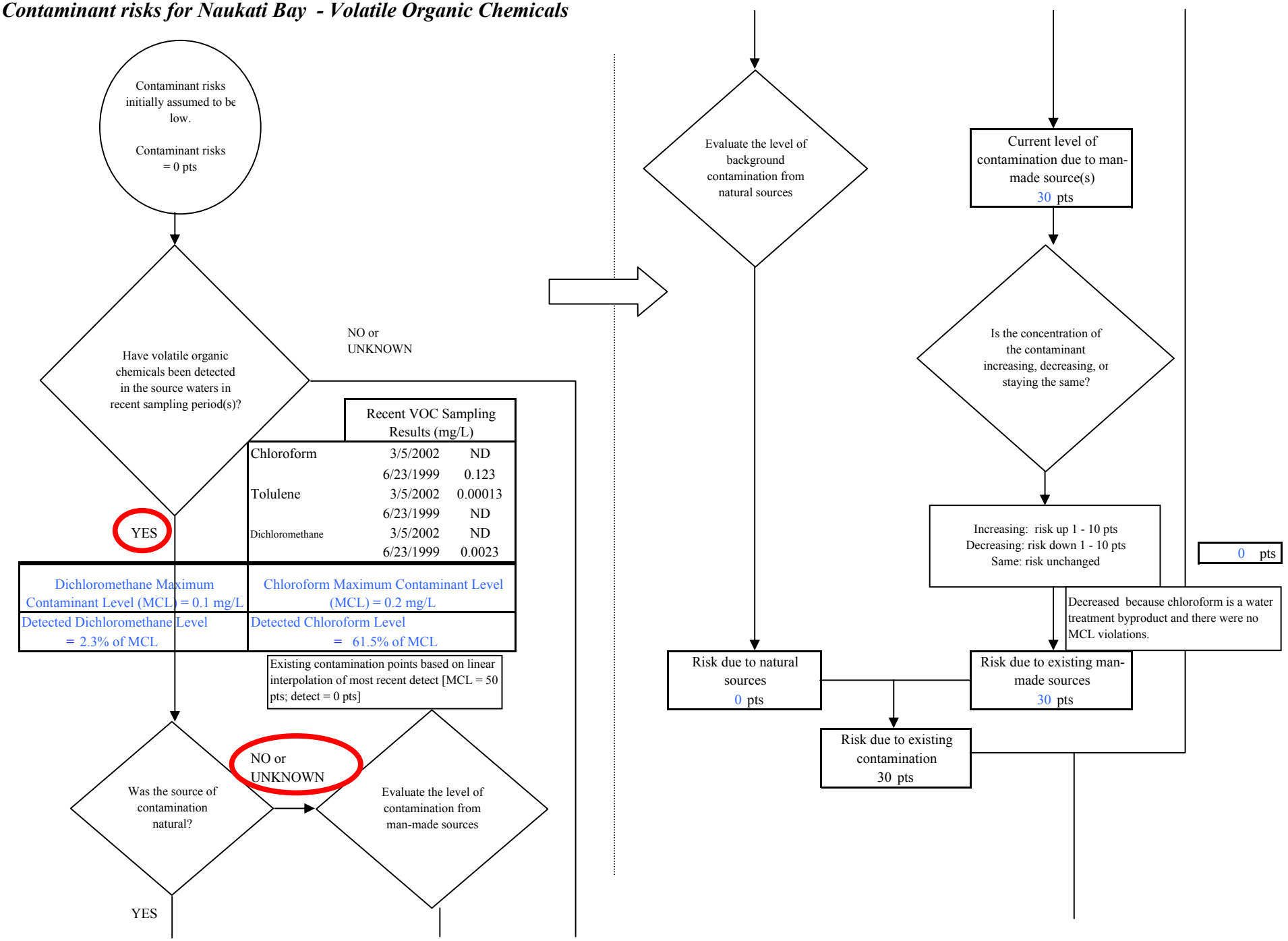
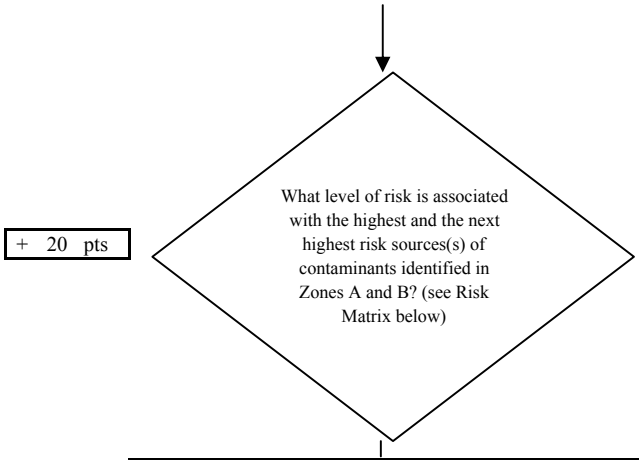


Chart 6. Contaminant risks for Naukati Bay - Volatile Organic Chemicals



+ 20 pts

Risk Levels for VOC Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1		1
Low(s)	3		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 20

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

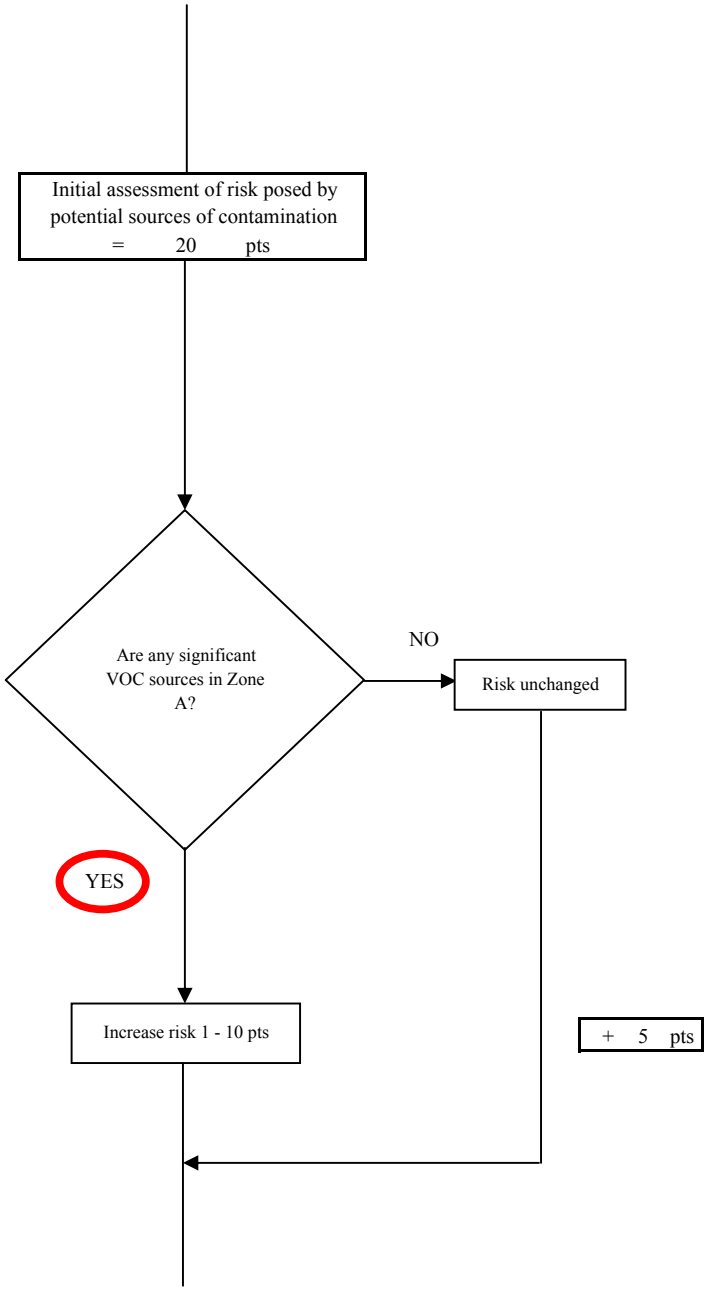


Chart 6. Contaminant risks for Naukati Bay - Volatile Organic Chemicals

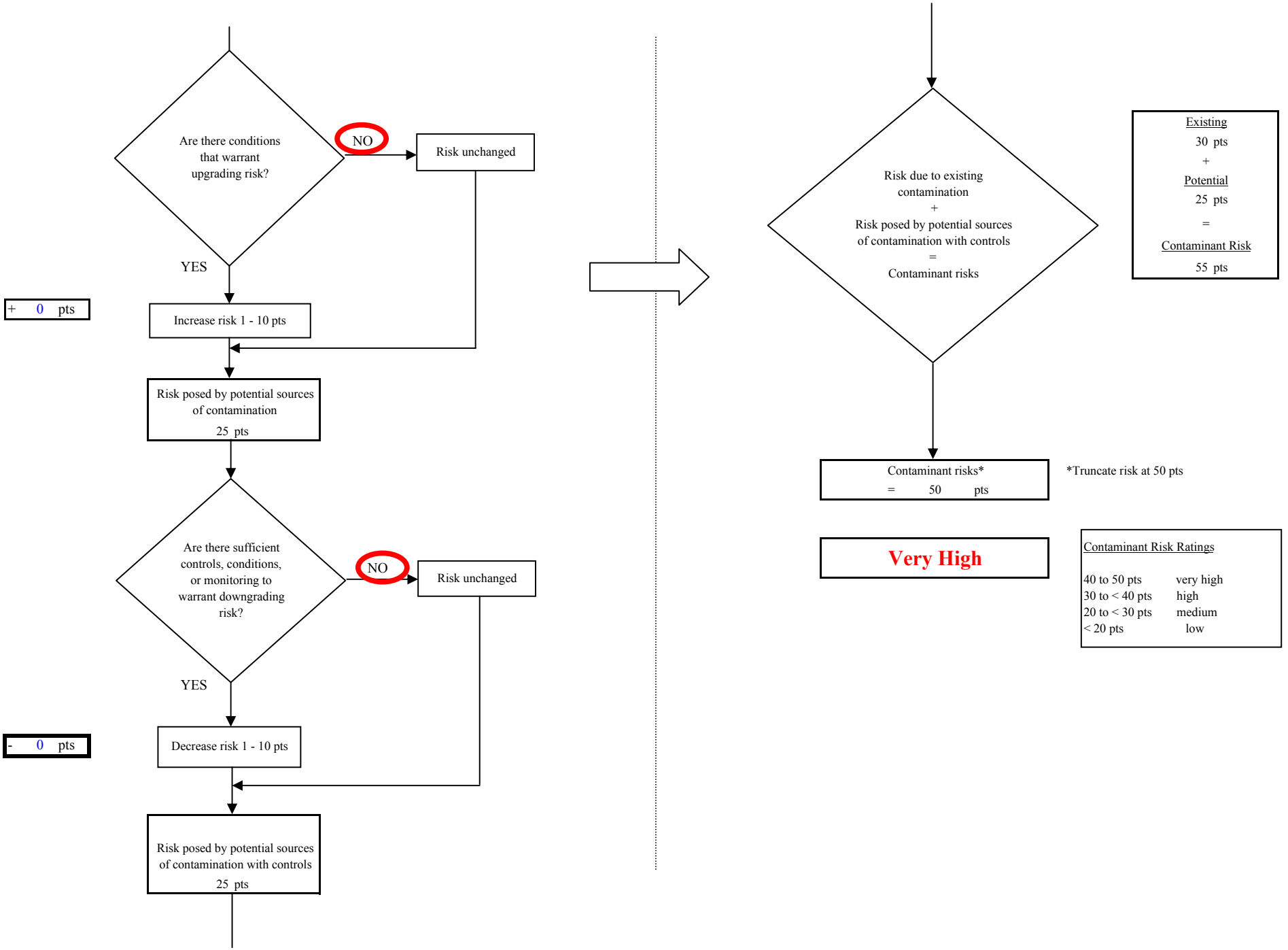

Are there conditions that warrant upgrading risk?
NO
Risk unchanged
YES
+ 0 pts
Increase risk 1 - 10 pts
Risk posed by potential sources of contamination
25 pts
Are there sufficient controls, conditions, or monitoring to warrant downgrading risk?
NO
Risk unchanged
YES
- 0 pts
Decrease risk 1 - 10 pts
Risk posed by potential sources of contamination with controls
25 pts
Risk due to existing contamination
+
Risk posed by potential sources of contamination with controls
=
Contaminant risks
Existing
30 pts
+
Potential
25 pts
=
Contaminant Risk
55 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 7. Vulnerability analysis for Naukati Bay - Volatile Organic Chemicals

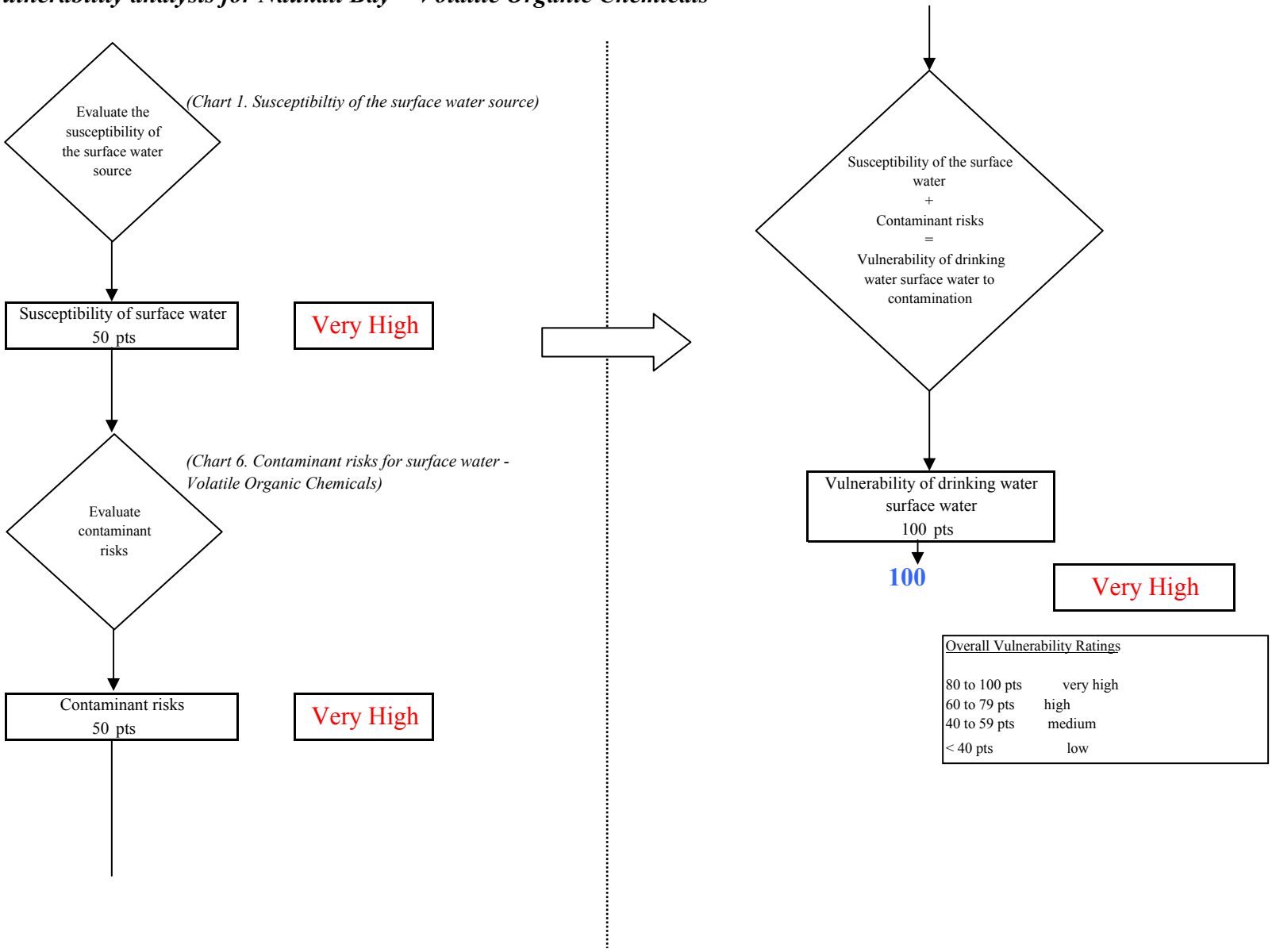


Chart 8. Contaminant risks for Naukati Bay - Heavy Metals, Cyanide and Other Inorganic Chemicals

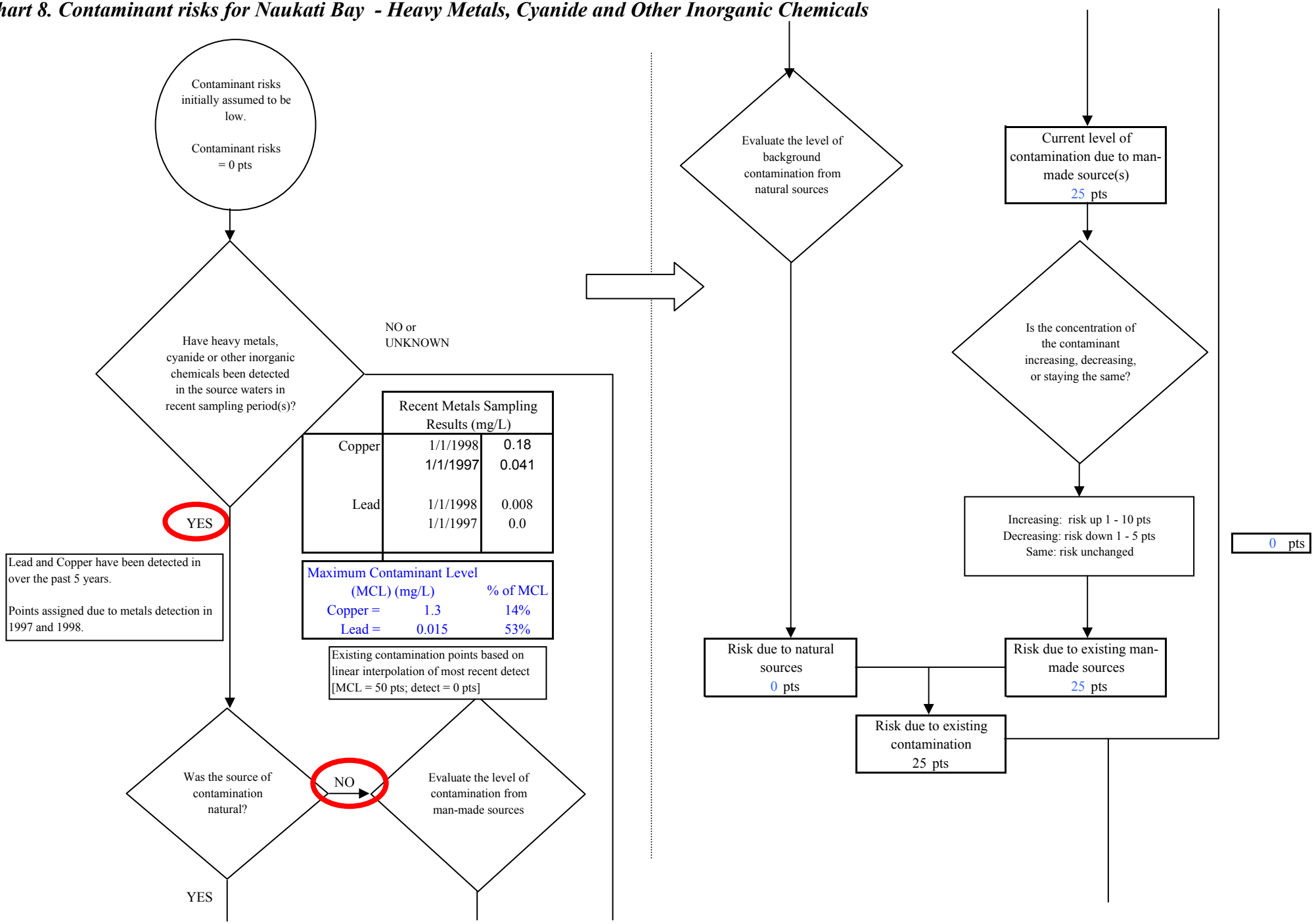
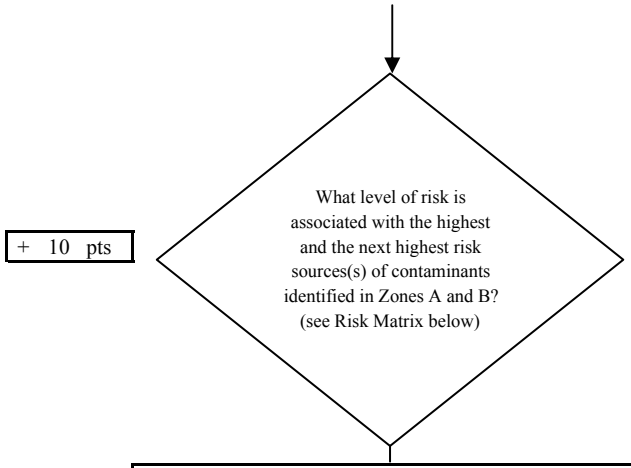


Chart 8. Contaminant risks for Naukati Bay - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 10 pts

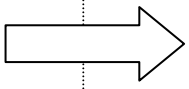
Risk Levels for HM, Cyanide, or OIC Sources identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0		0
Low(s)	4		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 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.



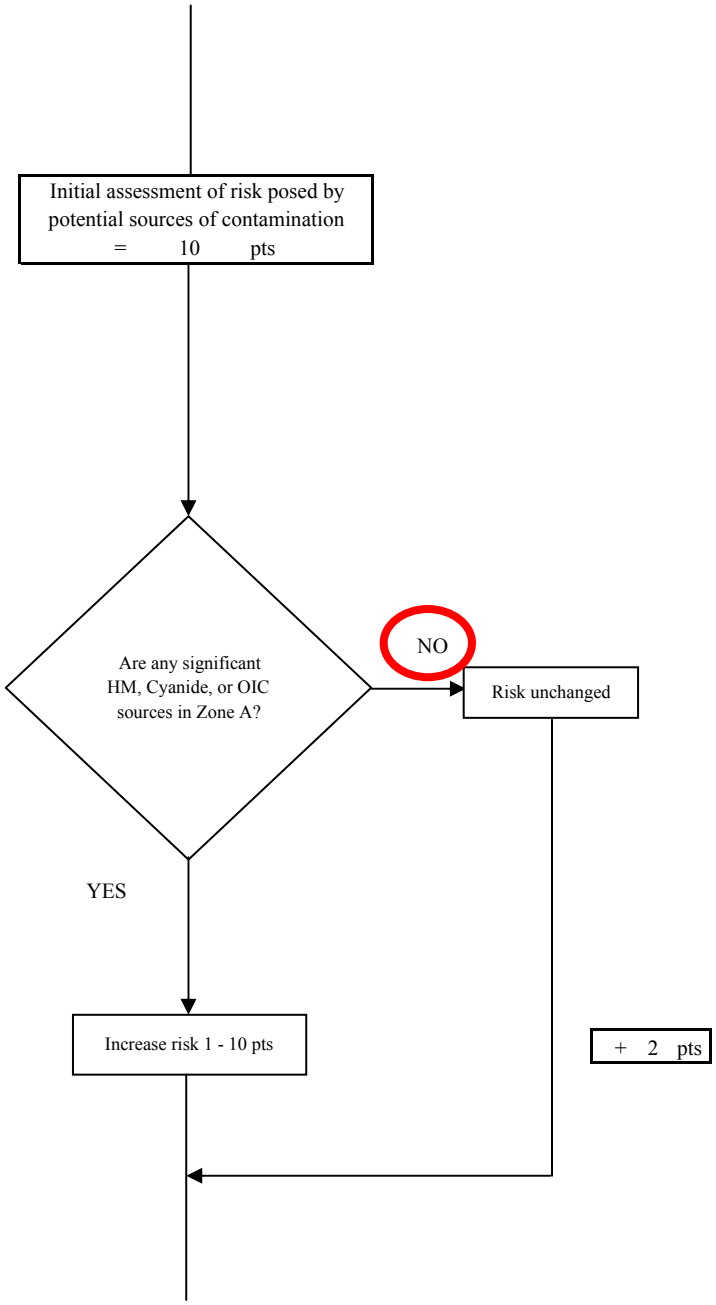


Chart 8. Contaminant risks for Naukati Bay - Heavy Metals, Cyanide and Other Inorganic Chemicals

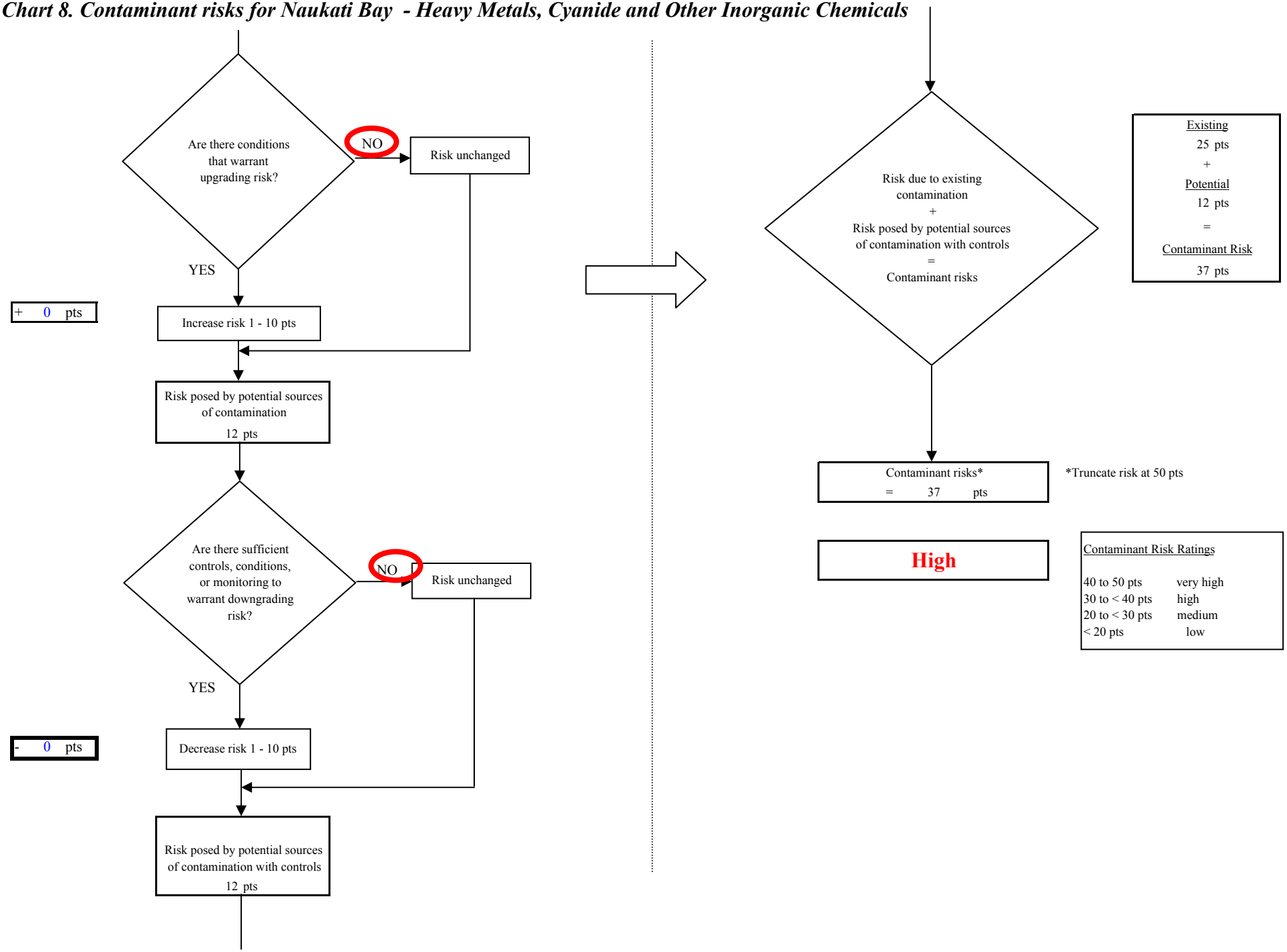


Chart 9. Vulnerability analysis for Naukati Bay - Heavy Metals, Cyanide and Other Inorganic Chemicals

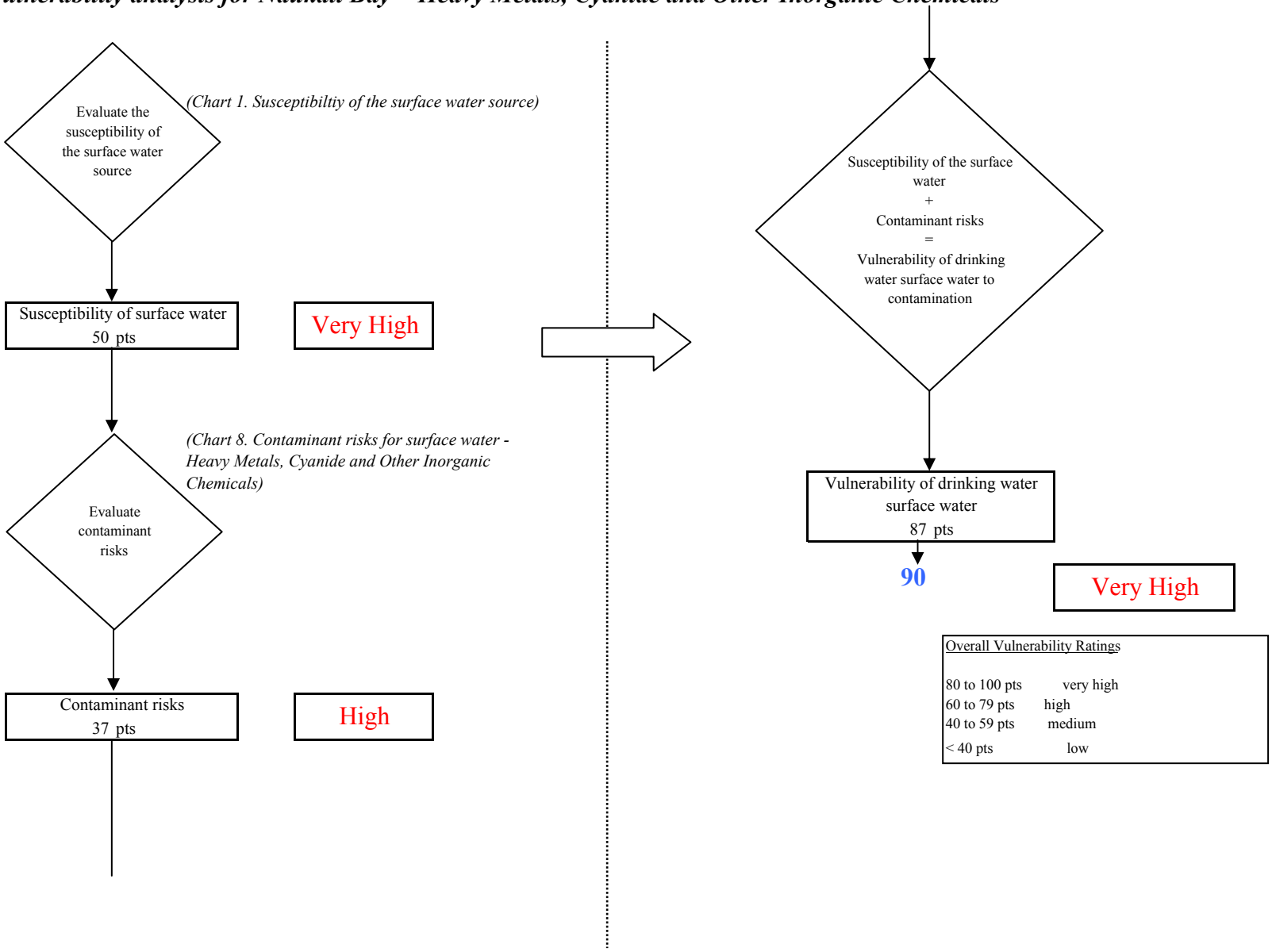


Chart 10. Contaminant risks for Naukati Bay - Synthetic Organic Chemicals

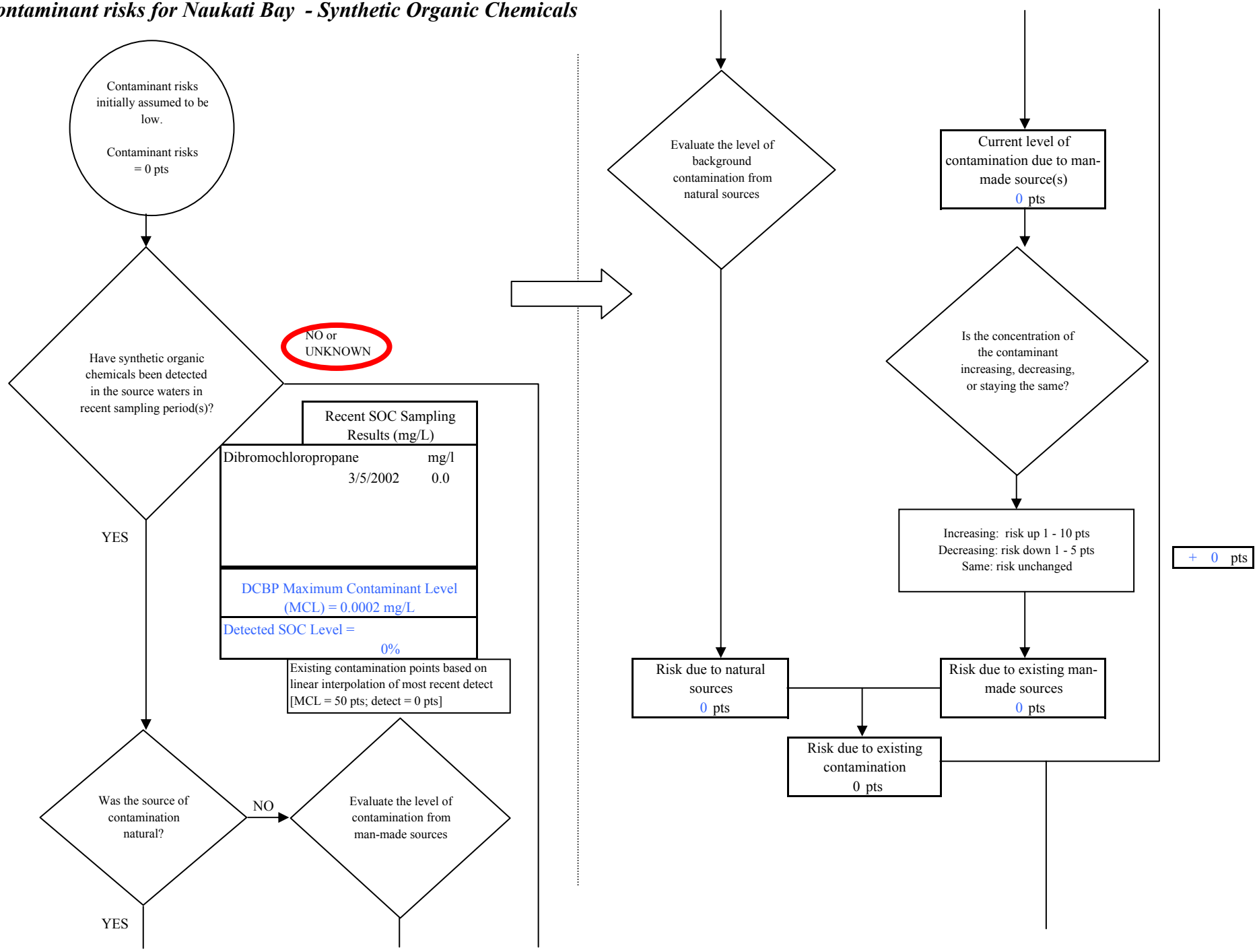
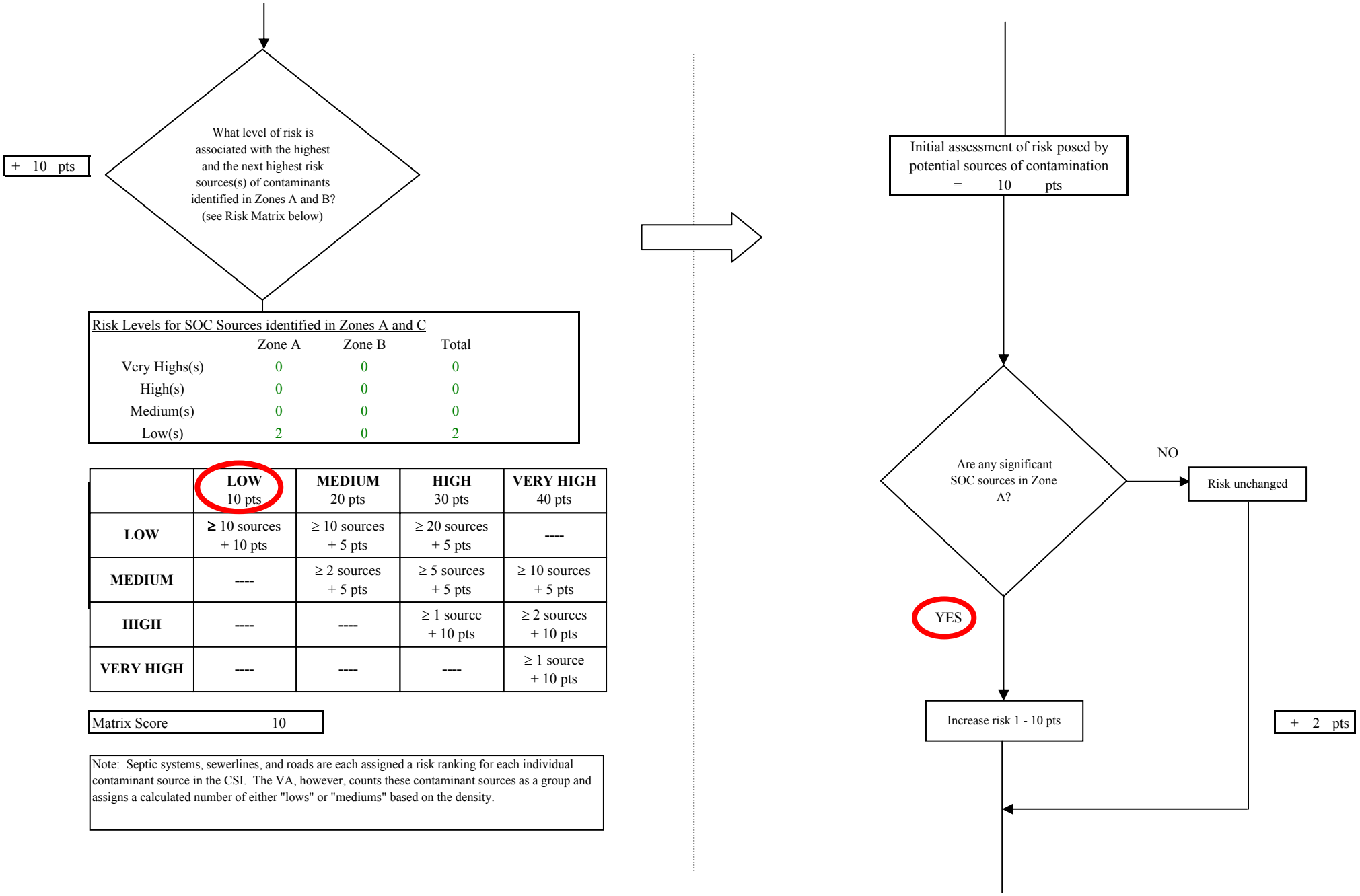


Chart 10. Contaminant risks for Naukati Bay - Synthetic Organic Chemicals



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)	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 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 10. Contaminant risks for Naukati Bay - Synthetic Organic Chemicals

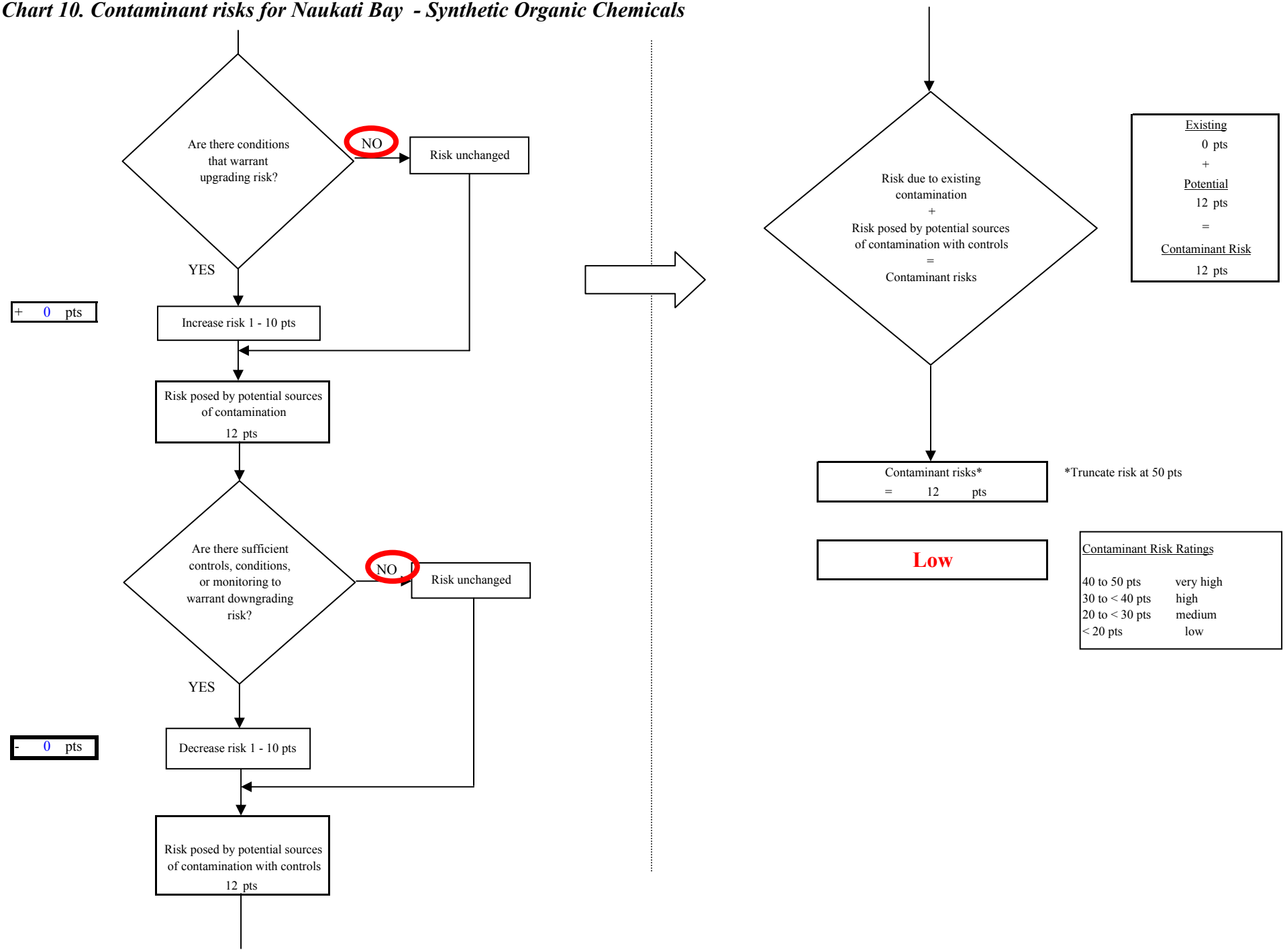


Chart 11. Vulnerability analysis for Naukati Bay - Synthetic Organic Chemicals

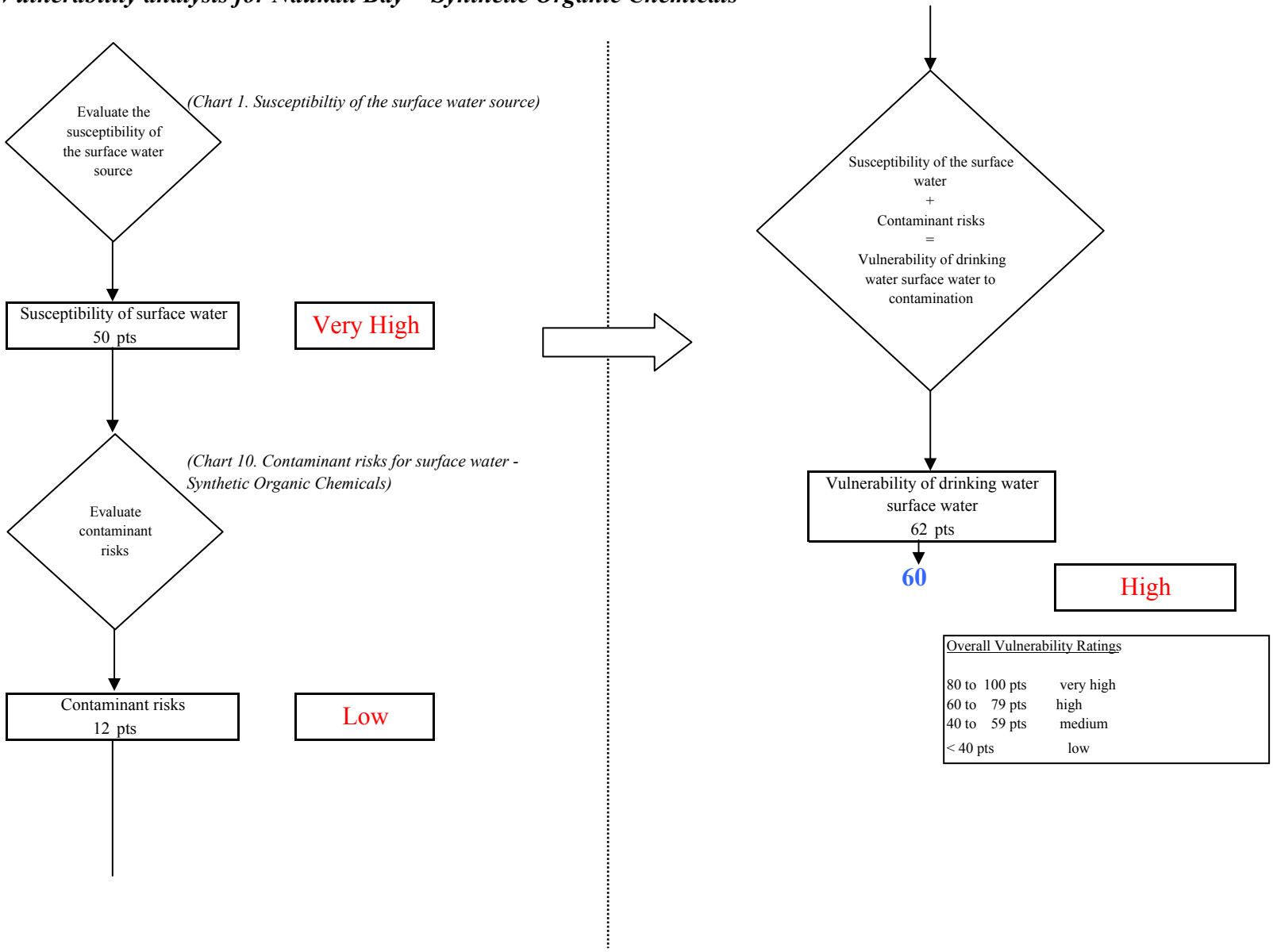


Chart 12. Contaminant risks for Naukati Bay - Other Organic Chemicals

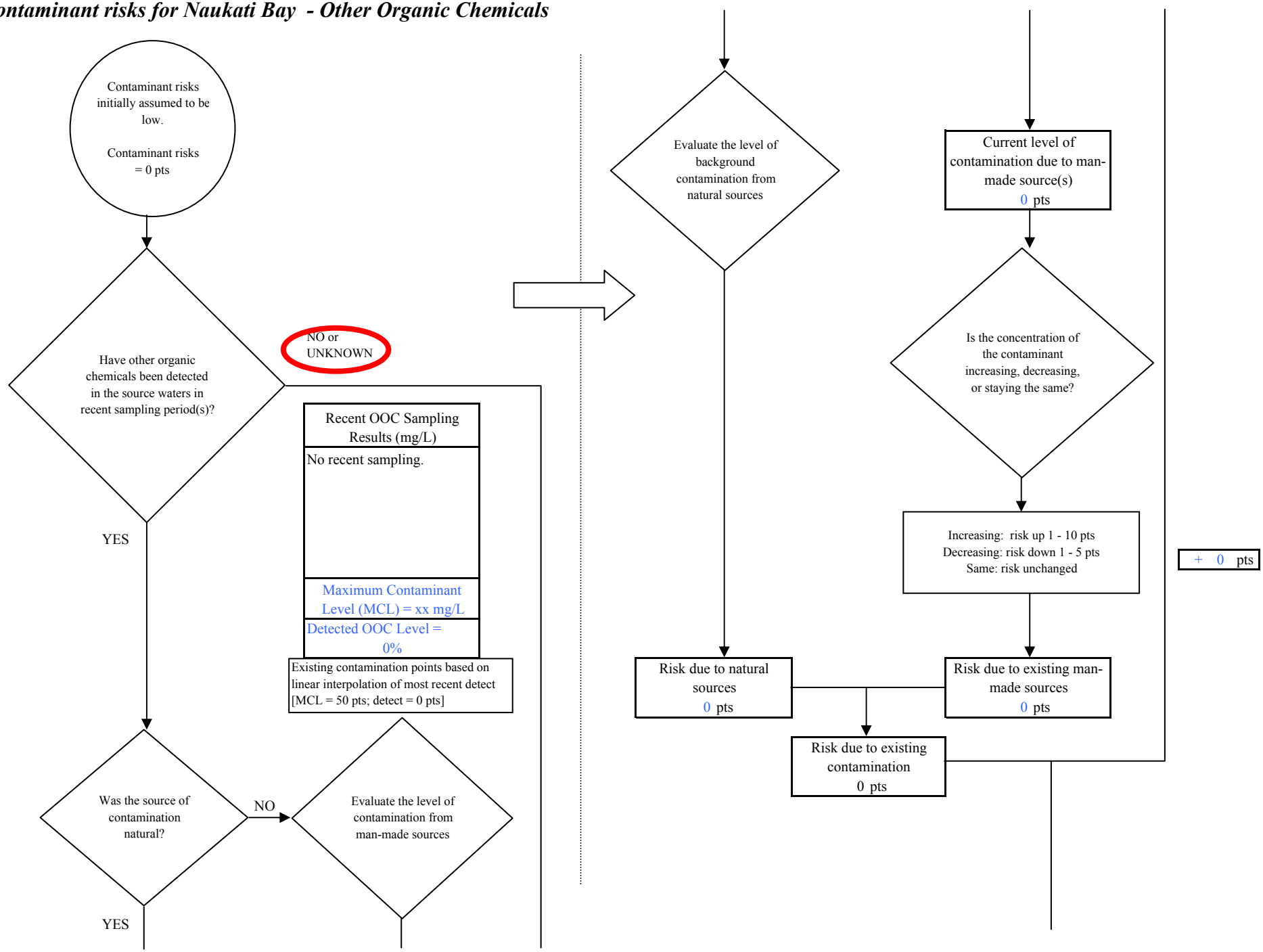
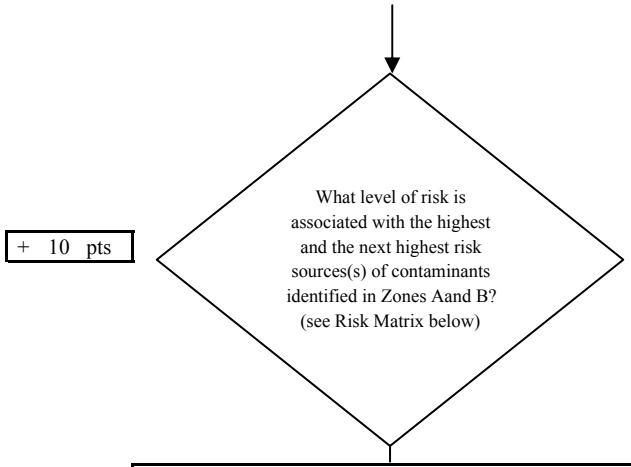


Chart 12. Contaminant risks for Naukati Bay - Other Organic Chemicals



+ 10 pts

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	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 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.

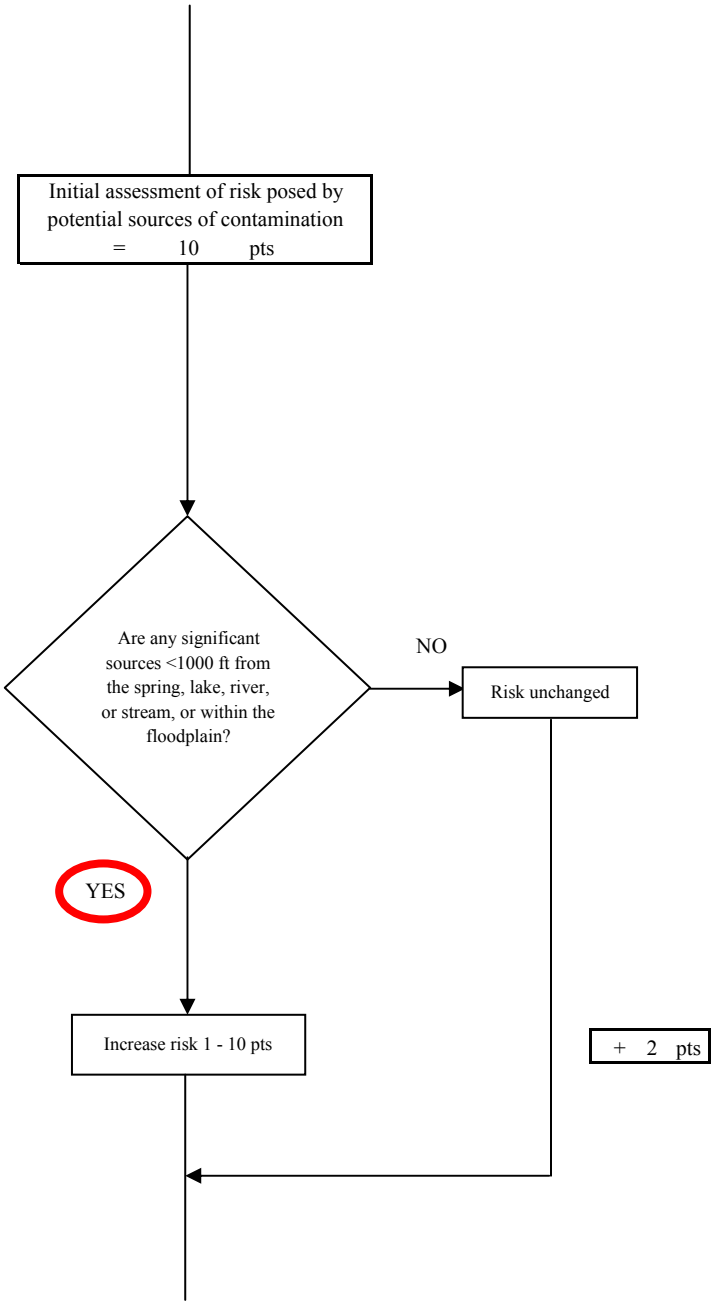


Chart 12. Contaminant risks for Naukati Bay - Other Organic Chemicals

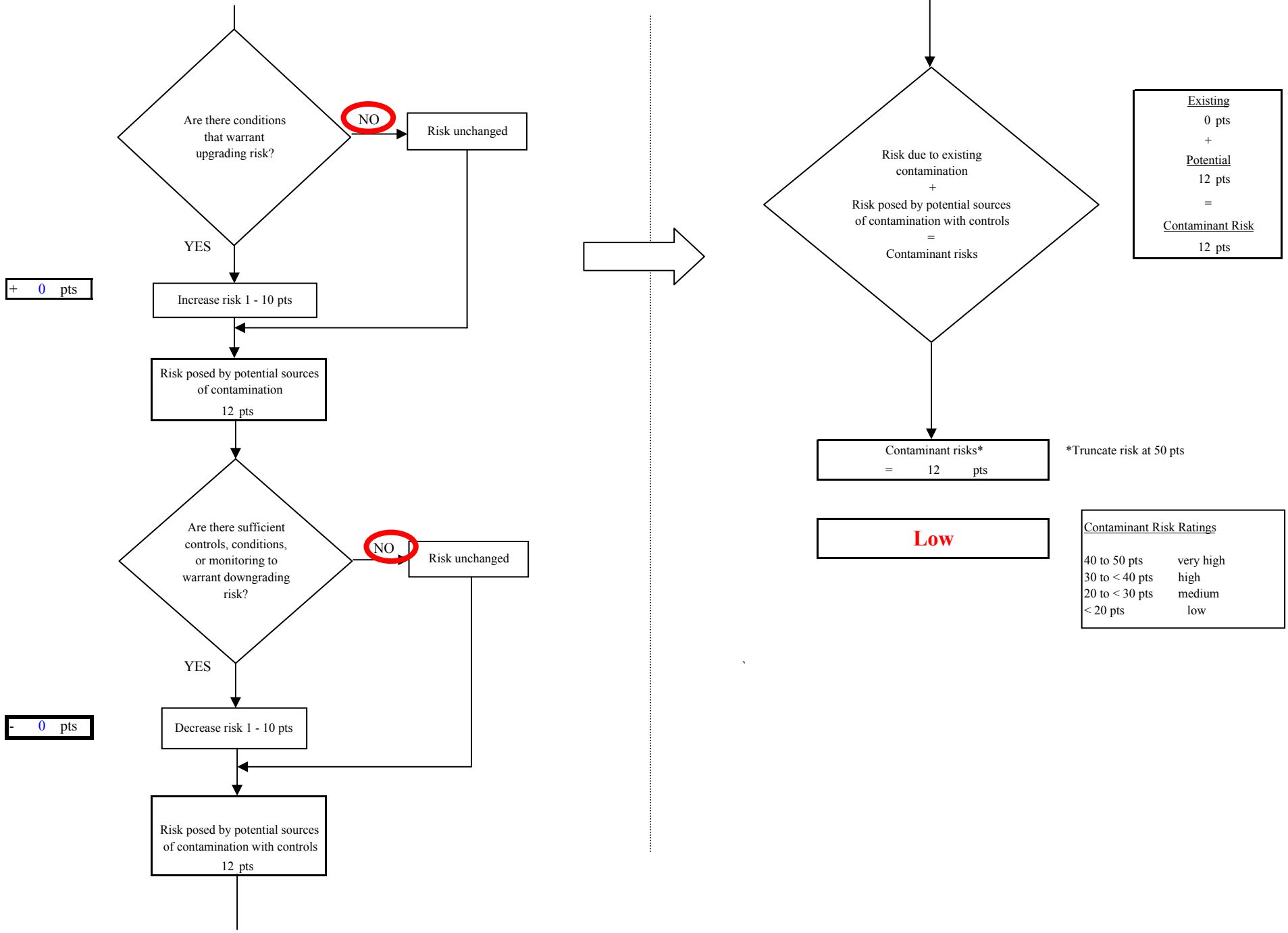


Chart 13. Vulnerability analysis for Naukati Bay - Other Organic Chemicals