Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for the TeckCominco Pogo Creek Camp

Big Delta, Alaska

PWSID # 372384.001

October 2004

DRINKING WATER PROTECTION PROGRAM REPORT #1247

Alaska Department of Environmental Conservation

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

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

CONTENTS

TABLES

APPENDICES

Source Water Assessment for the TeckCominco Pogo Creek Camp Drinking Water System

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The water system for the Teck-Pogo, Inc. Pogo Creek Camp is a Class A water system (community) consisting of a single water intake. The intake well is a 24-ft deep infiltration gallery located along the Goodpaster River. The wellhead and the aquifer both received a susceptibility rating of **High**. Combining these two produces a rating of **High** for the overall natural susceptibility of the well. Identified potential and current sources of contaminants for the Pogo Creek Camp intake area include: mining areas, above ground fuel tanks, a gravel quarry, a large-capacity septic system, and an industrial waste disposal well. These identified potential and existing sources of contamination may be sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals. Combining the natural susceptibility of the well with the contaminant risks, the Pogo Creek Camp received a vulnerability rating of **Medium** for synthetic organic chemicals; **High** for volatile organic chemicals; and **Very High** for bacteria and viruses, nitrates and/or nitrites, heavy metals, and other organic chemicals. 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 Tech-Pogo, Inc. to protect public health.

DRINKING WATER SYSTEM AND AREA OVERVIEW

The Pogo Creek Camp water system is a Class A (community) water system consisting of a single water intake. The intake well is a 24-ft deep infiltration gallery located along the Goodpaster River. It has been classified by ADEC as a groundwater source under the direct influence of surface water. This well typically supplies a total demand of about 2,400 gallons per day and was installed in 1998. Because of the surface water influence, the water is chlorinated and filtered prior to distribution.

The Tech-Pogo, Inc. - Pogo Creek Camp is located along the Goodpaster River, approximately 35-miles northeast of Big Delta, 37-miles northeast of Delta Junction, and 90-miles southeast of Fairbanks. (Sec. 27, T05S, R014E, Fairbanks Meridian) (See Map 1 of Appendix A). The Pogo gold project lies within the Tintina gold belt of eastern Alaska. The Pogo deposit was discovered in 1994 and was surface drilled from 1995-1997 by Sumitomo, and has been surface and underground mined from 1998-2000 by Teck Cominco. The current gold resource is estimated to be 5.5 million ounces (TeckCominco, 2003).

The Pogo claims are underlain by high-grade gneisses of the Yukon-Tanana terrane which have been locally intruded by granitic rocks. Common rock types include biotite gneiss, augen gneiss, mafic schist and gneiss, pelitic schist, quartzite and quartzo-feldspathic schist. The gold deposit occurs as two "stacked" shallow-dipping quartz vein systems, generally 4 to 12 meters in thickness, named the "L1" and "L2" lenses. A third vein system has been encountered at depth, but requires additional drilling to determine its significance. The "L1" and "L2" veins are dominantly quartz with approximately 3% sulfide minerals. Approximately 96% of the gold occurs as free gold (TeckCominco, 2003).

This area of Interior Alaska experiences seasonal extremes. The average low temperature in January is -11; the average high during July is 69. Temperature extremes have been recorded from -63 to 92. The annual precipitation is 11 inches, including 37 inches of snow (ADCED, 2003).

The latest Sanitary Survey (1999) indicates that the system intake is screened and that the infiltration gallery is capped and housed within a wooden structure. System operators report that a new water intake should be in place within the next 6-months.

POGO CREEK CAMP DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the intake area. These areas are determined by looking at the characteristics of the surface, soil, groundwater, aquifer, and intake.

The most probable means for contamination to reach the water intake is via area that contributes water to the intake, the groundwater and surface water recharge area. This area is designated as the drinking water protection area. Because releases of contaminants within the protection area are most likely to impact the water intake, this area will serve as the focus for voluntary protection efforts.

An outline of the immediate and adjacent watershed was used to determine the size and shape of the protection area for the Pogo Creek Camp water system. Available geology was also considered in accounting for uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The protection areas established for wells under the direct influence of surface water by the ADEC are usually separated into four zones, limited by the watershed boundary. These zones correspond to the size of the contributing watershed and to differences in the time-of-travel (TOT) of the water moving through the aquifer to the intake location. An analytical calculation was used to determine the size and shape of the protection area. The input parameters describing the attributes of the aquifer in this calculation were adopted from a 1979 groundwater publication by Allan Freeze and John A. Cherry.

The time of travel for contaminants (TOT) within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the protection zones for wells under the direct influence of surface water:

Table 1. Definition of Zones

Zone	Definition
A	Groundwater – several months TOT
E	Within 1000-feet of the hydrology network
F	Within 1-mile of the hydrology network
G	Entire watershed boundary

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 Pogo Creek Camp protection area. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

- Bacteria and Viruses;
- Nitrates and/or Nitrites;
- Volatile Organic Chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic Organic Chemicals; and
- Other Organic Chemicals.

The sources are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

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

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

The TOT for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. For example. Bacteria and Viruses are only inventoried in Zone A because of their short life span.

Tables 2 through 7 (if necessary) in Appendix B contain the ranking of potential and existing sources of contamination with respect each contaminant source.

VULNERABILITY OF THE DRINKING WATER SYSTEM

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water

source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Chart 4 contains the 'Vulnerability Analysis for Bacteria & Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

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

- Natural susceptibility; and
- Contaminant risks.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

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

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The infiltration gallery in the Pogo Creek Camp is located in an unconfined aquifer, which increases the possibility of surface contaminants reaching the water source. Table 2 shows the Susceptibility scores and ratings for the basin.

Table 2. Susceptibility of the Wellfield

	Score	Rating
Susceptibility of the Wellhead	15	High
Susceptibility of the Aquifer	18	High
Natural Susceptibility	33	High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	45	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	40	Very High

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

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings	
80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	80	Very High
Nitrates and Nitrites	80	Very High
Volatile Organic Chemicals	75	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	80	Very High
Synthetic Organic Chemicals	45	Medium
Other Organic Chemicals	70	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is very high with industrial process water disposal wells and a large-capacity septic system presenting the most significant risks to the water intake area (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the Pogo Creek Camp water system. After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is very high.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is very high with a gravel quarry, industrial process water disposal wells, and a large-capacity septic system posing the most significant risks to the water intake (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water. Sampling history indicates that low concentrations (below the MCL) of nitrates have been detected in samples collected from 2001 - 2003. The Maximum Contaminant Level (MCL) for nitrate 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.

It is unknown how much of the existing nitrate concentration can be attributed to natural or human-made sources. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L, or 20% of the MCL, and are derived primarily from the decomposition of organic matter in soils [Wang, Strelakos, Jokela, 2000].

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is very high.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is very high with industrial process water waste disposal wells, aviation fuel tanks, and diesel fuel tanks creating the most significant risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). The most common causes of fuel leaks of these tanks are overfilling with fuel, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Regular system maintenance can help prevent many of these harmful fuel leaks.

Volatile organic chemicals have not been detected in significant levels during recent sampling. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is very high with mining activity and industrial process water disposal wells posing the greatest risk of contamination (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Heavy metals, cyanide and other inorganic chemicals have not been detected in significant concentrations during recent sampling. After combining the contaminant risk for heavy metals with the natural

susceptibility of the well, 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 well, the overall vulnerability to synthetic organic chemicals of the well is medium (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

Review of the historical sampling data indicates that no synthetic organic chemicals have been detected in amounts exceeding the MCL within the past 5 years.

Other Organic Chemicals

The contaminant risk for other organic chemicals is very high with industrial process water disposal wells posing the greatest risk to the water intake. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well 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 detected in amounts exceeding the MCL within the past 5 years.

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 TeckCominco 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 Pogo Creek Camp drinking water source.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2002 [WWW document]. URL: http://www.dced.state.ak.us/mra/CF_BLOCK.cfm

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

Jokela, J.B., Munter, J.A., and Evans, J.G., 1991, Ground-water resources of the Palmer-Big Lake area, Alaska: a conceptual model. Division of Geological &Geophysical Surveys Reports of Investigations 90-4, State of Alaska Department of Natural Resources, Fairbanks, AK.

TeckCominco, 2003. Pogo Project. http://www.teckcominco.com/operations/pogo/index.htm . Date accessed, November 7, 2003.

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

APPENDIX A

Pogo Creek Camp
Drinking Water Protection Area
(Map 1)

Pogo Creek Camp
Drinking Water Protection Area
(Total area of Zone C = 676.45 sq. miles)

Map 1: Pogo Creek Camp Drinking Water Protection Area

PWSID: 372384.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 2.5 5 10 15 20 Miles

1:350,253

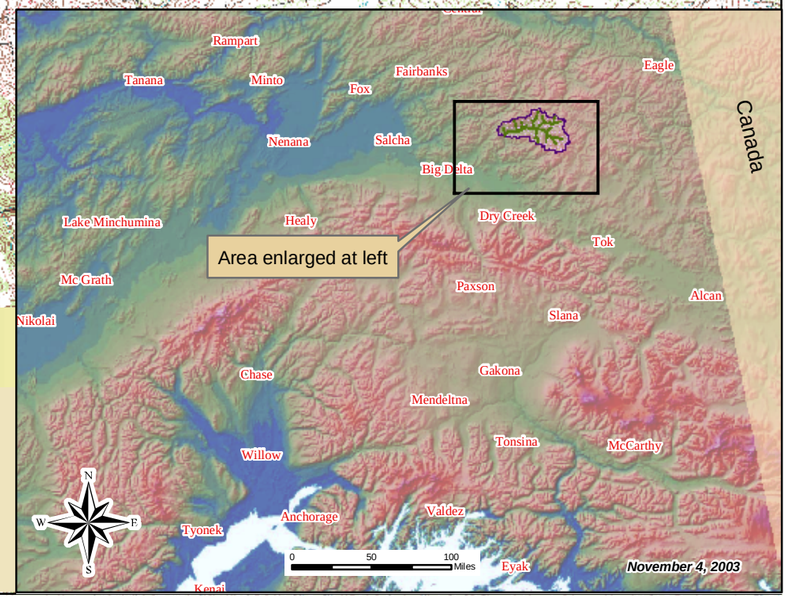
Data Sources:

Background image
- USGS 1:250,000 mapping

Protection zones E, F, & G were delineated based upon streams noted on USGS 1:63,000 mapping. Zone A was created using intake infiltration gallery design information.

Legend

- Pogo Creek Camp PWS
- Stream
- Zone A Protection Area
- Zone E Protection Area
- Zone F Protection Area
- Zone G Protection Area



APPENDIX B

Contaminant Source Inventory and Risk Ranking

(Tables 1-7)

Table 1

Contaminant Source Inventory for ***Pogo Creek Camp***

PWSID 372384.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Domestic water treatment - filter backwash water lagoons/ponds	D06	D06 -1	A	2	From operator info.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	2	From operator info.
Injection wells (Class V) Industrial Process Water & Water Disposal Wells	D40	D40 -1	A	2	From operator info.
Metals mining, underground (active)	E05	E05 - 1	A	2	From operator info.
Quarries (gravel)	E10	E10 -1	A	2	From operator info.
Fuel drums (above ground)	T01	T01 1-15	A	2	From operator info. 5-15 total @ 55-gallons each
Tanks, aviation fuel (above ground)	T02	T02 1-2	A	2	From operator info. 2 total @ 15,000 gallons each
Tanks, diesel (above ground)	T06	T06 1-8	A	2	From operator info. 8 total @ 15,000 gallons each
Monitoring wells	W06	W06 1-6	A	2	From operator info.
Metals mining, placer (active or inactive?)	E04	E04 1-5	E	2	From DWPP Contaminant Sources Database
Metals mining, placer (active or inactive?)	E04	E04 6-7	F	2	From DWPP Contaminant Sources Database
Metals mining, placer (active or inactive?)	E04	E04 8-9	G	2	From DWPP Contaminant Sources Database

Table 2

Contaminant Source Inventory and Risk Ranking for Pogo Creek Camp Sources of Bacteria and Viruses

PWSID 372384.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Domestic water treatment - filter backwash water lagoons/ponds	D06	D06 -1	A	High	2	From operator info.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	High	2	From operator info.
Injection wells (Class V) Industrial Process Water & Water Disposal Wells	D40	D40 -1	A	High	2	From operator info.

Table 3

Contaminant Source Inventory and Risk Ranking for Pogo Creek Camp Sources of Nitrates/Nitrites

PWSID 372384.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	High	2	From operator info.
Injection wells (Class V) Industrial Process Water & Water Disposal Wells	D40	D40 -1	A	High	2	From operator info.
Quarries (gravel)	E10	E10 -1	A	Low	2	From operator info.

Table 4

Contaminant Source Inventory and Risk Ranking for Pogo Creek Camp

Sources of Volatile Organic Chemicals

PWSID 372384.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	Low	2	From operator info.
Injection wells (Class V) Industrial Process Water & Water Disposal Wells	D40	D40 -1	A	High	2	From operator info.
Metals mining, underground (active)	E05	E05 - 1	A	Low	2	From operator info.
Quarries (gravel)	E10	E10 -1	A	Low	2	From operator info.
Fuel drums (above ground)	T01	T01 1-15	A	Low	2	From operator info. 5-15 total @ 55-gallons each
Tanks, aviation fuel (above ground)	T02	T02 1-2	A	Medium	2	From operator info. 2 total @ 15,000 gallons each
Tanks, diesel (above ground)	T06	T06 1-8	A	Medium	2	From operator info. 8 total @ 15,000 gallons each

Table 5

Contaminant Source Inventory and Risk Ranking for Pogo Creek Camp

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 372384.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	Low	2	From operator info.
Injection wells (Class V) Industrial Process Water & Water Disposal Wells	D40	D40 -1	A	High	2	From operator info.
Metals mining, underground (active)	E05	E05 - 1	A	High	2	From operator info.
Metals mining, placer (active or inactive?)	E04	E04 1-5	E	Medium	2	From DWPP Contaminant Sources Database
Metals mining, placer (active or inactive?)	E04	E04 6-7	F	Medium	2	From DWPP Contaminant Sources Database
Metals mining, placer (active or inactive?)	E04	E04 8-9	G	Medium	2	From DWPP Contaminant Sources Database

Table 6

Contaminant Source Inventory and Risk Ranking for Pogo Creek Camp Sources of Synthetic Organic Chemicals

PWSID 372384.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	Low	2	From operator info.

Table 7

Contaminant Source Inventory and Risk Ranking for Pogo Creek Camp Sources of Other Organic Chemicals

PWSID 372384.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10 -1	A	Low	2	From operator info.
Injection wells (Class V) Industrial Process Water & Water Disposal Wells	D40	D40 -1	A	High	2	From operator info.
Quarries (gravel)	E10	E10 -1	A	Low	2	From operator info.

APPENDIX C

Pogo Creek Camp
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Water System Intake

E04-1-5 Metals Mining
Placer Mines (located in Zone E)

E04 - 6 & 7 Metals Mining
Placer Mines (located in Zone F)

E04 - 8 & 9 Metals Mining
Placer Mines (located in Zone G)

T06 - 1 through 8
(Diesel fuel tanks, above ground)

D06 - 1
(Dom. water treatment, filter backwash and water lagoon)

T02 - 1 & 2
(Aviation fuel tanks, above ground)

E10 - 1
(Gravel quarry)

D10 - 1
(Large capacity septic system)

W06 - 1 through 6
(Monitoring wells)

D40 - 1
(Class V injection well - Industrial process water disposal)

Water Intake

T01- 1 through 15
(Above ground fuel drums)

E05 - 1
(Underground metals mining)

0 375 750 1,500 2,250 Feet

Area enlarged at left

0 5 10 20 Miles

November 3, 2003

Map 2: Potential and Existing Contaminant Sources

PWSID: 372384.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1 2 Miles

1:133,194

Data Sources:

Background image
- USGS 1:250,000 mapping

Protection zones E, F, and G were delineated based upon streams noted on USGS 1:63,000 mapping. Zone A was creating using intake infiltration gallery design information.

Legend

- Pogo Creek Camp PWS
- Zone A Protection Area
- Zone E Protection Area
- Zone F Protection Area
- Zone G Protection Area

APPENDIX D

Vulnerability Analysis for the Pogo Creek Camp

(Charts 1-14)

Chart 1. Susceptibility of the Wellhead - Teck Cominco - Pogo Creek Camp

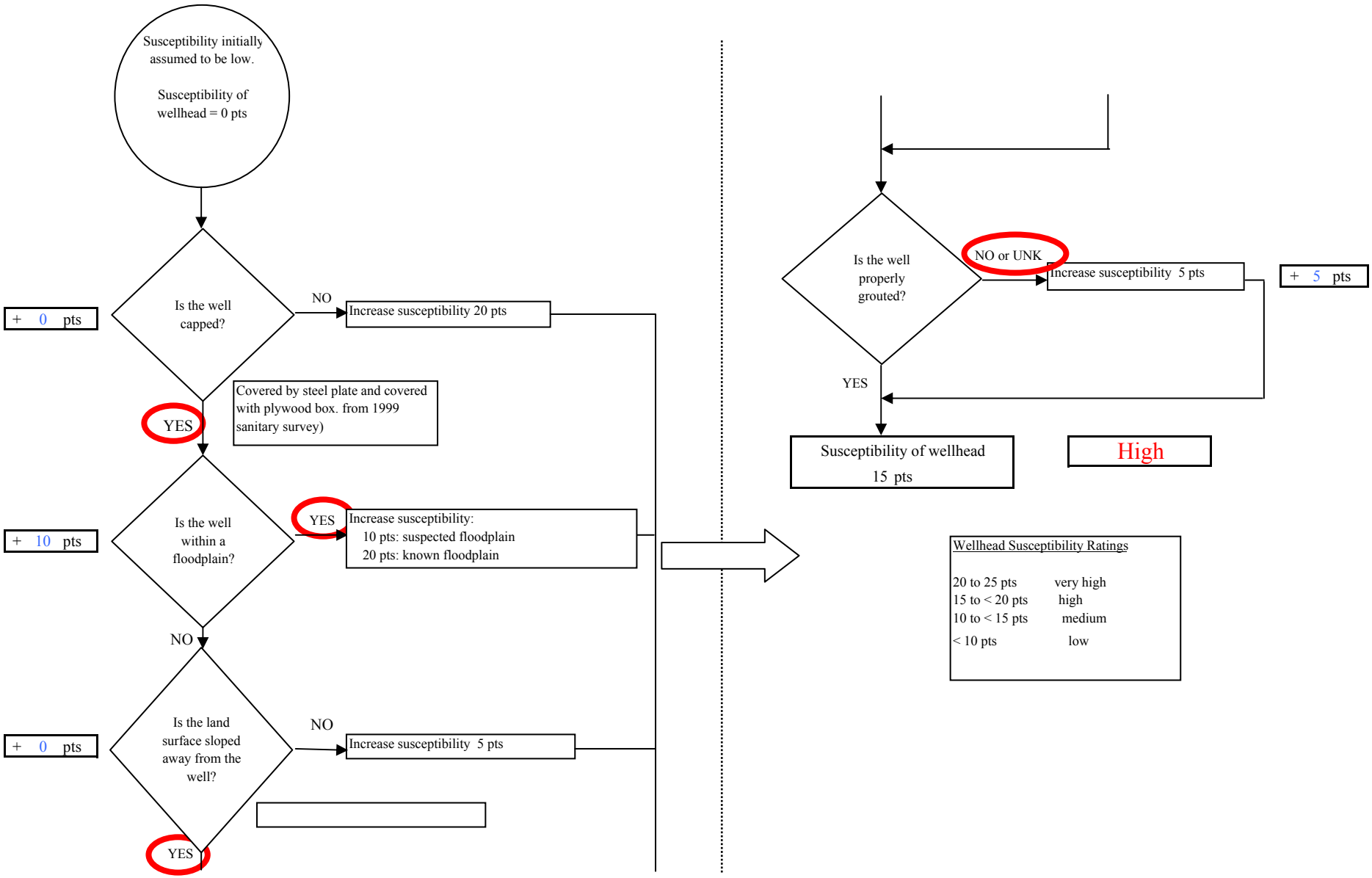


Chart 2. Susceptibility of the Aquifer - Teck Cominco - Pogo Creek Camp

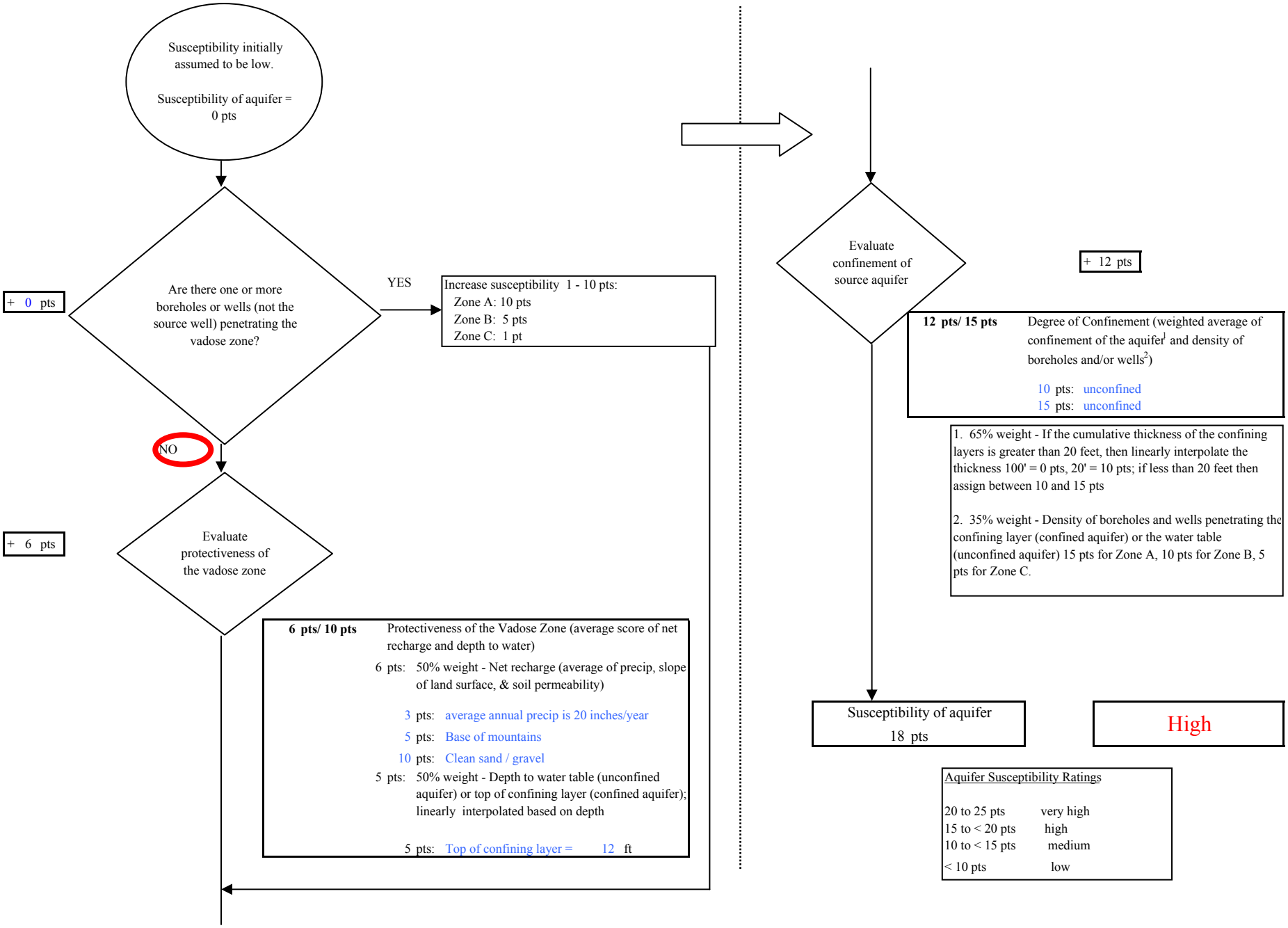
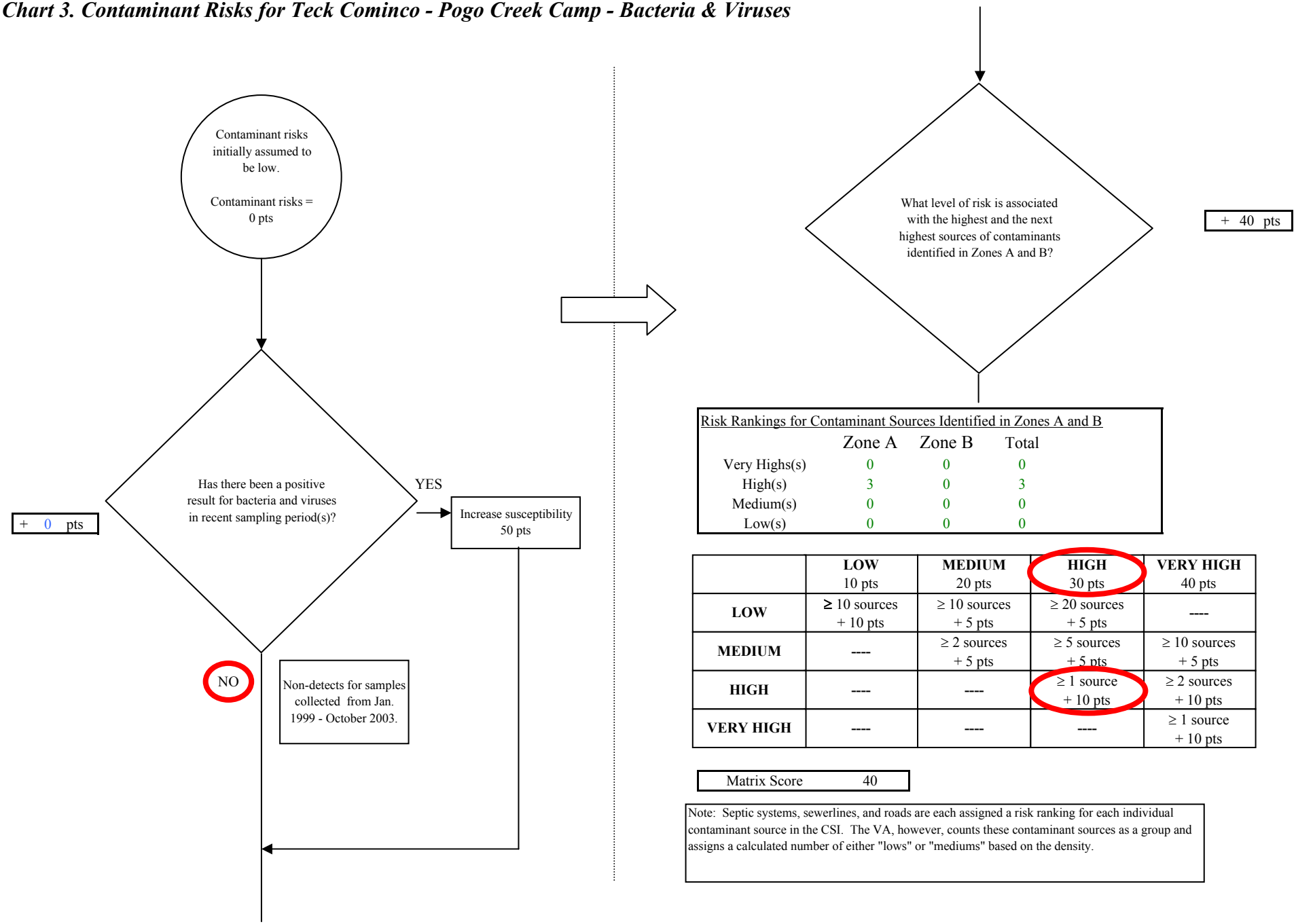


Chart 3. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Bacteria & Viruses



Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	3	0	3
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.

Chart 3. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Bacteria & Viruses

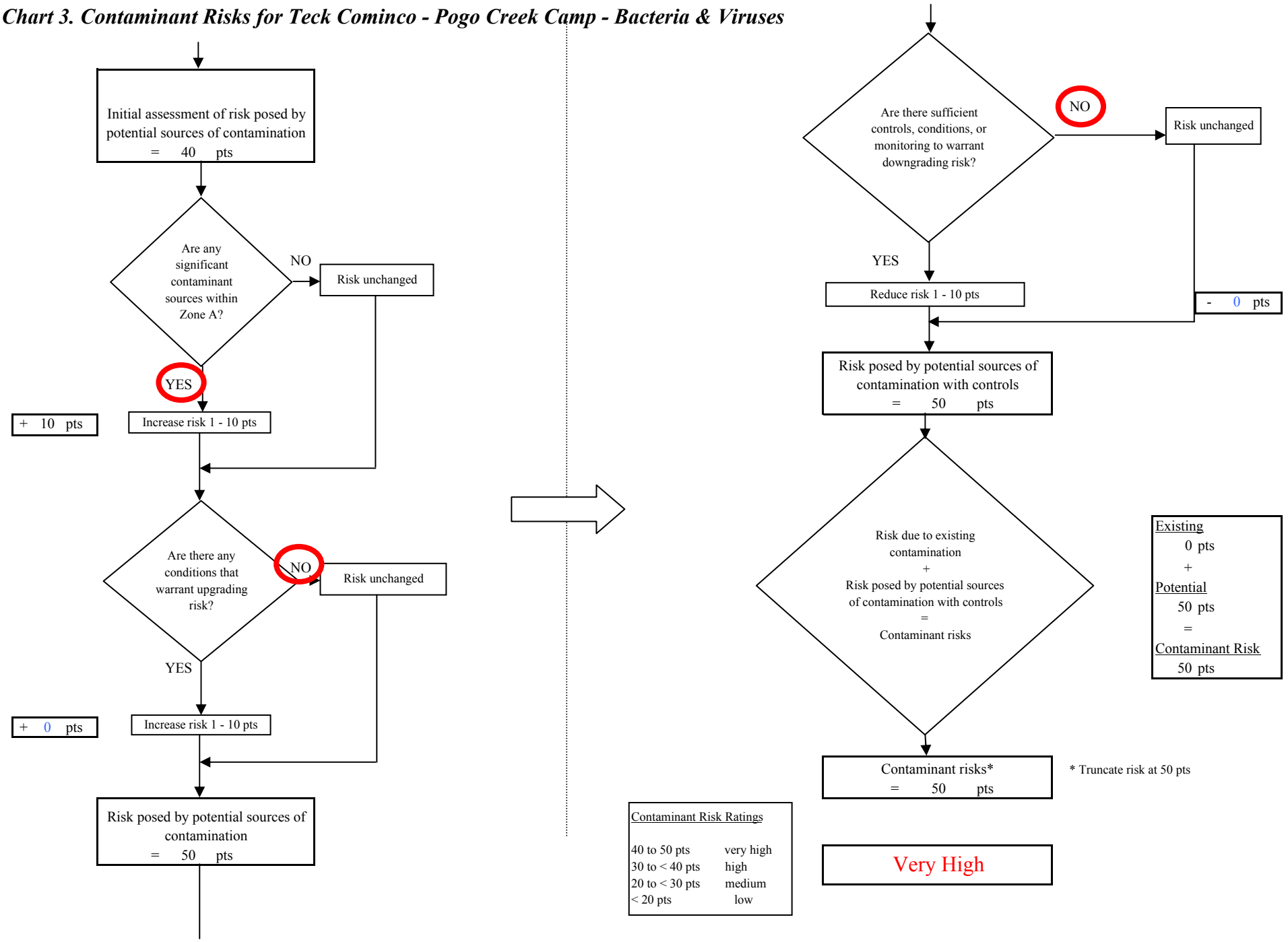


Chart 4. Vulnerability Analysis for Teck Cominco - Pogo Creek Camp - Bacteria & Viruses

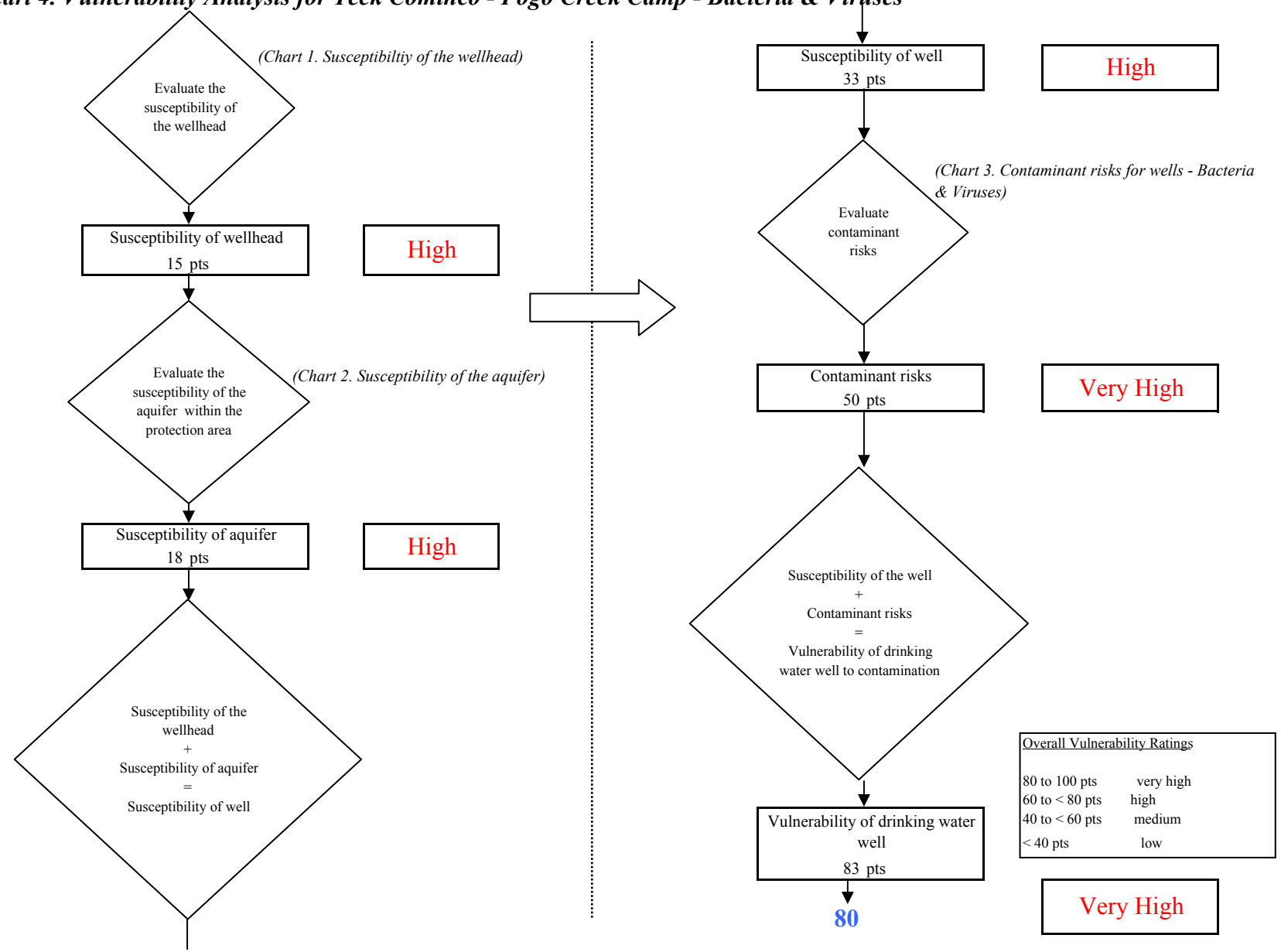


Chart 5. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Nitrates and Nitrites

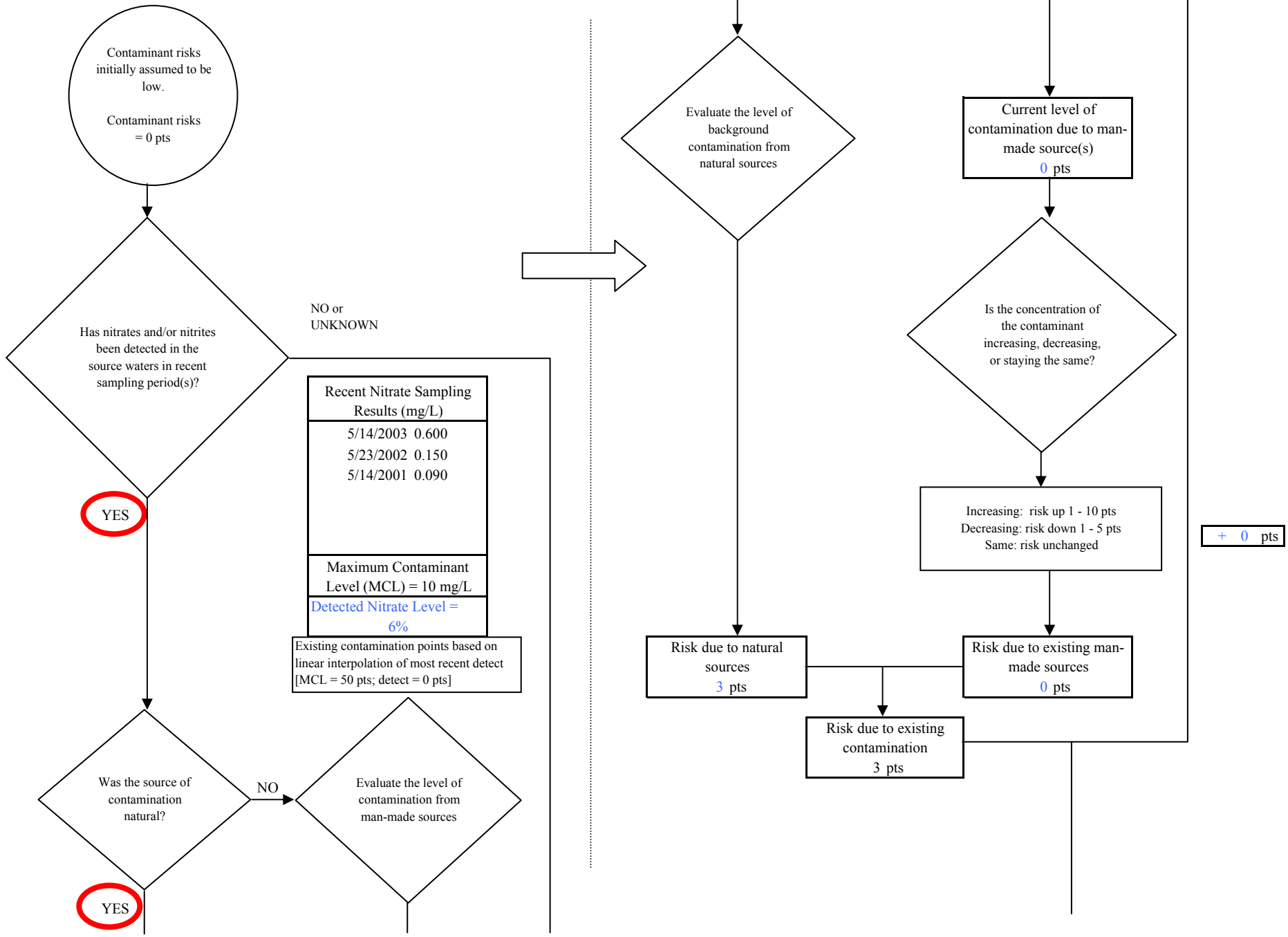


Chart 5. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Nitrates and Nitrites

+ 40 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

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

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

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

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO or UNK

Are all of the higher risk sources beyond Zones A and B?

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

Chart 5. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Nitrates and Nitrites

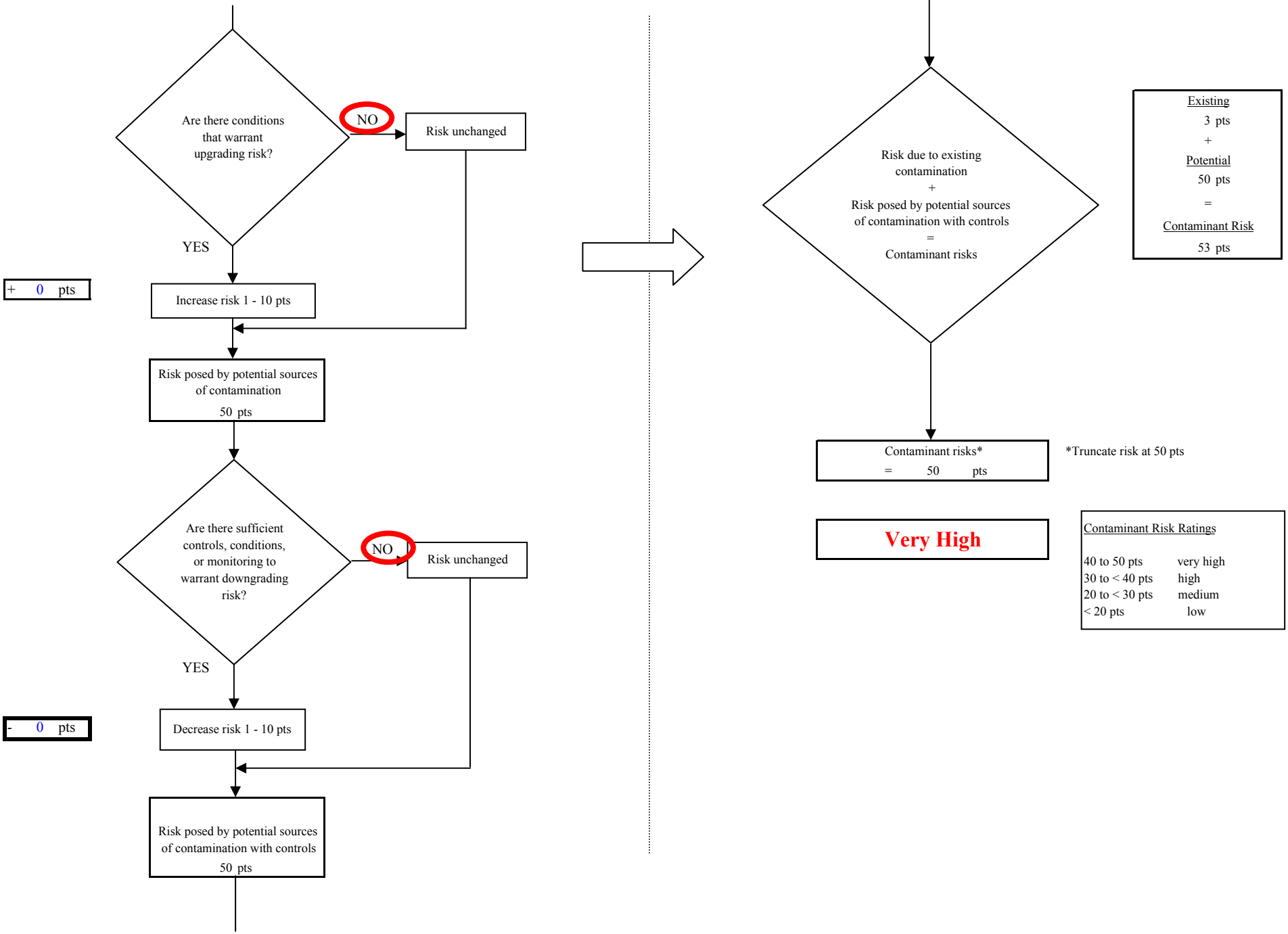


Chart 6. Vulnerability Analysis for Teck Cominco - Pogo Creek Camp - Nitrates and Nitrites

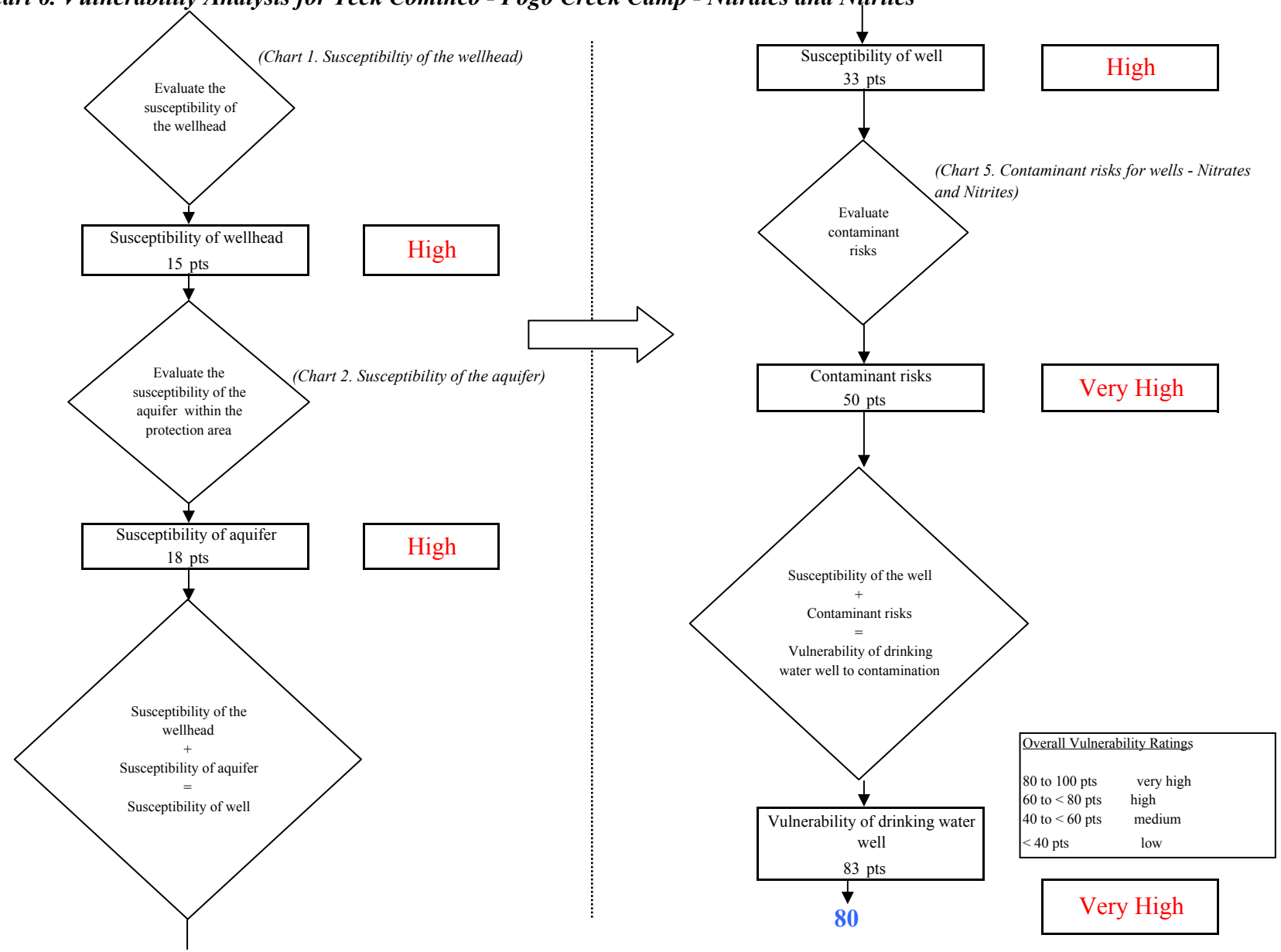


Chart 7. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Volatile Organic Chemicals

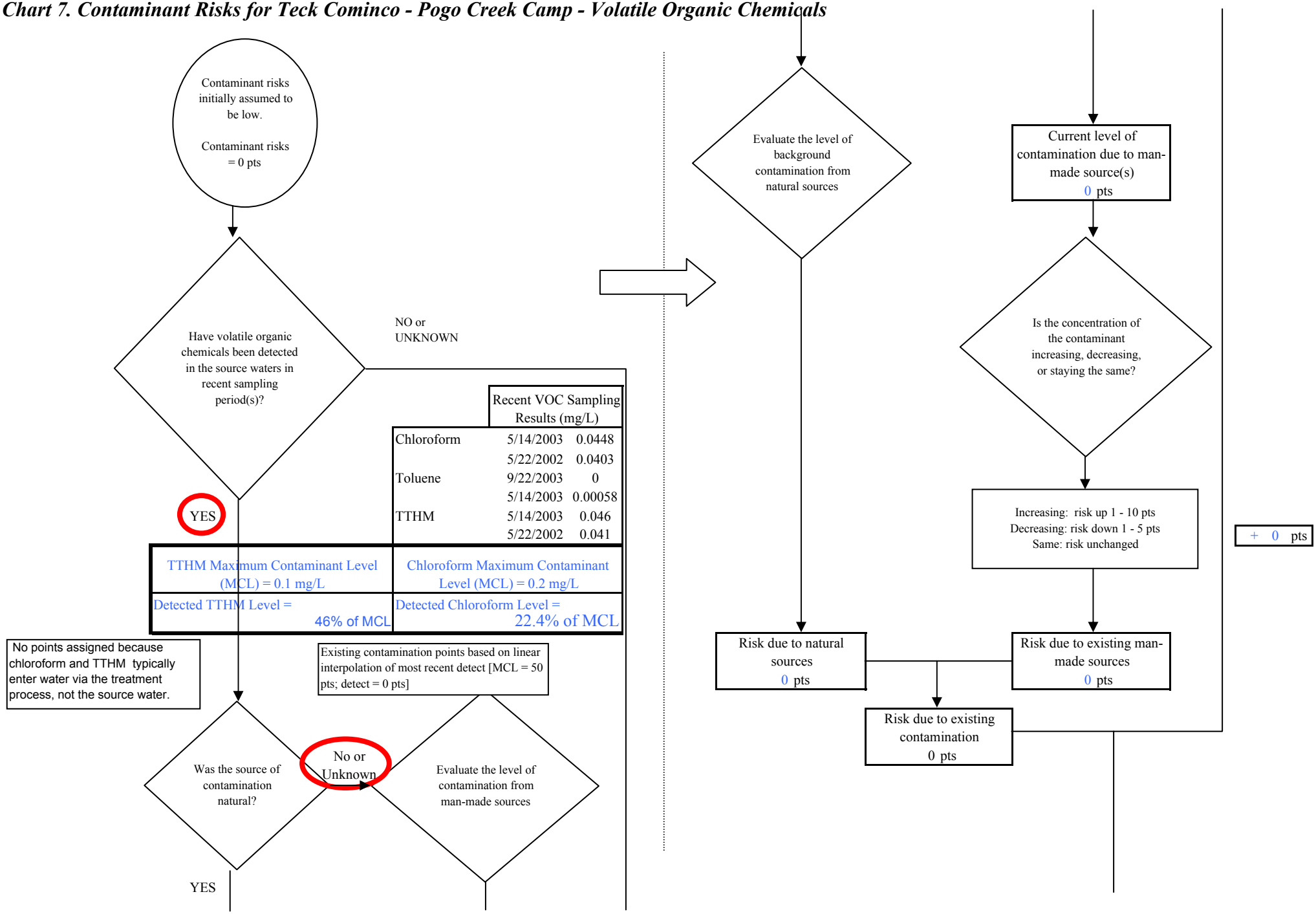


Chart 7. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Volatile Organic Chemicals

+ 35 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	10	0	10
Low(s)	18	0	18

	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 35

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 = 35 pts

Is the source aquifer fractured rock or karst?

YES

NO or UNK

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 7. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Volatile Organic Chemicals

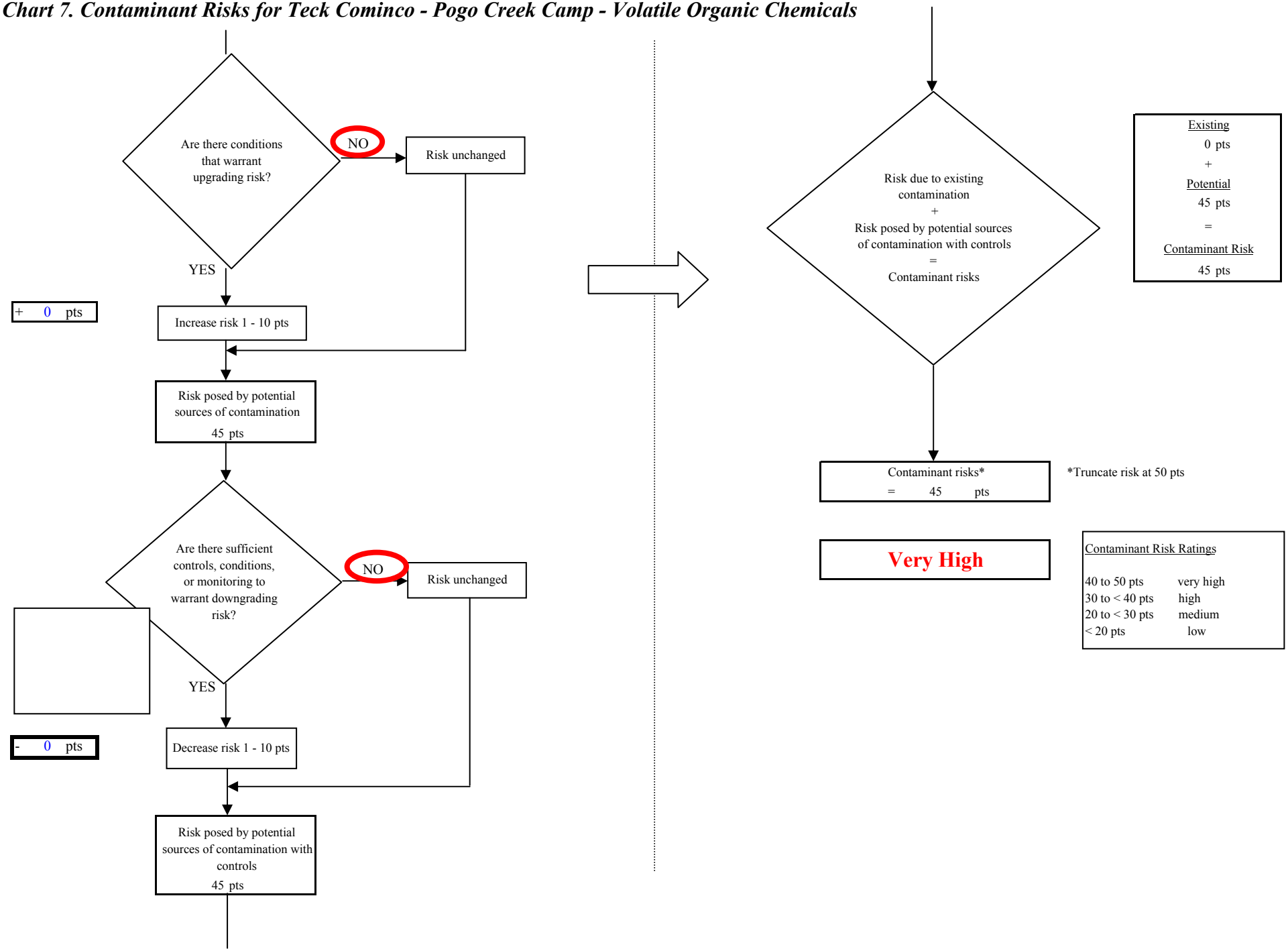


Chart 8. Vulnerability Analysis for Teck Cominco - Pogo Creek Camp - Volatile Organic Chemicals

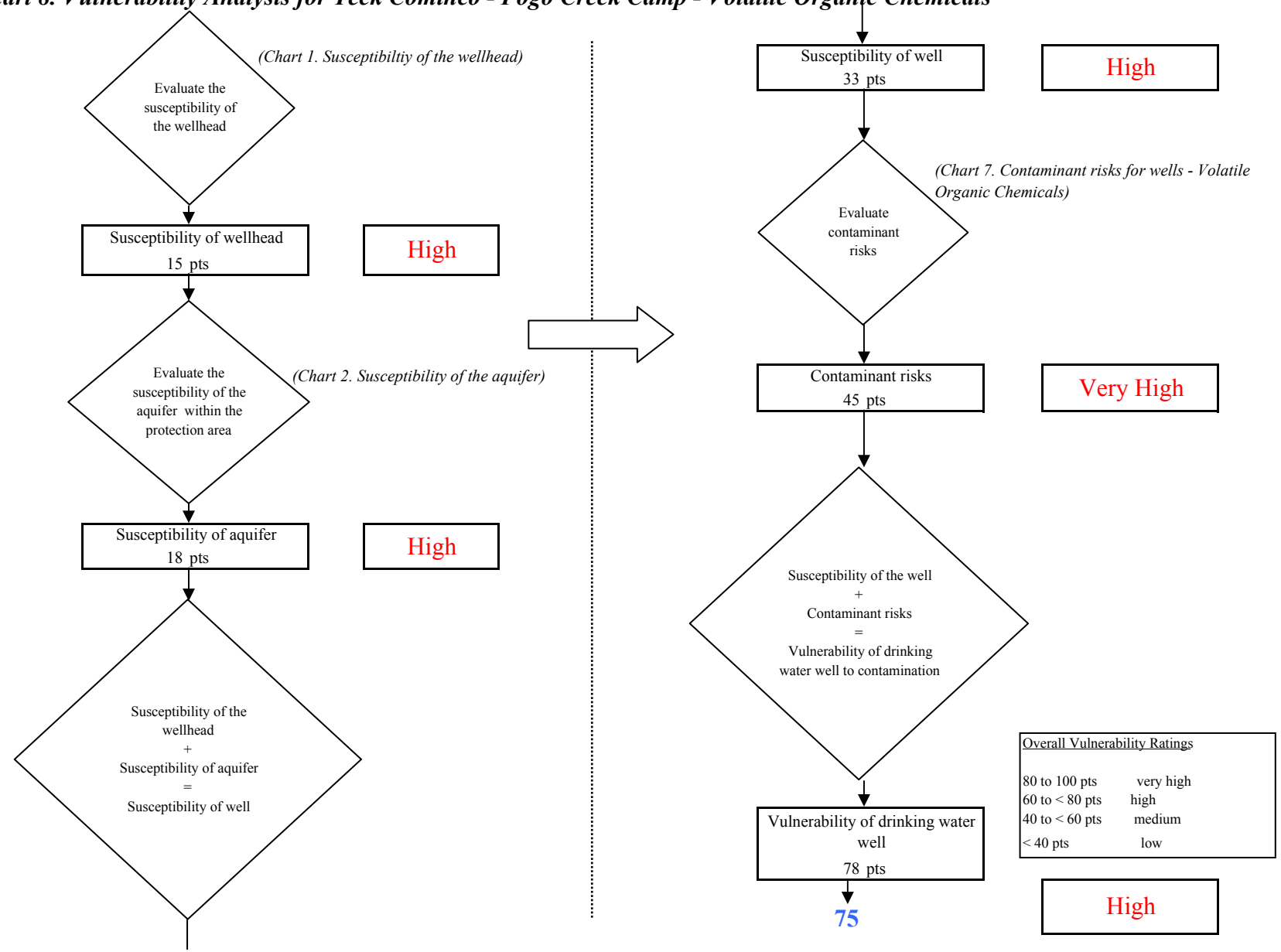


Chart 9. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Heavy Metals, Cyanide and Other Inorganic Chemicals

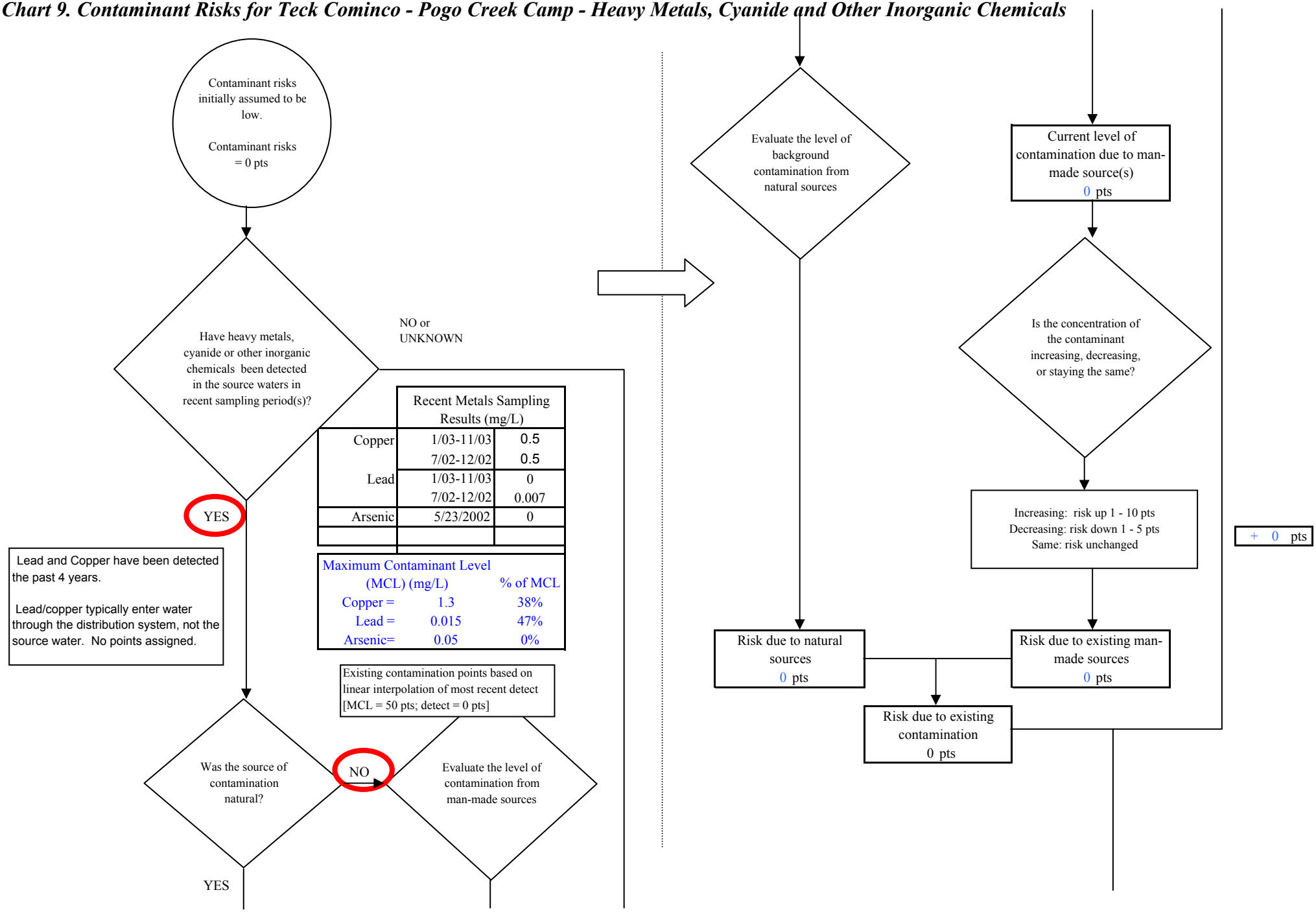


Chart 9. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 40 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

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

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

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

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO or UNK

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 9. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Heavy Metals, Cyanide and Other Inorganic Chemicals

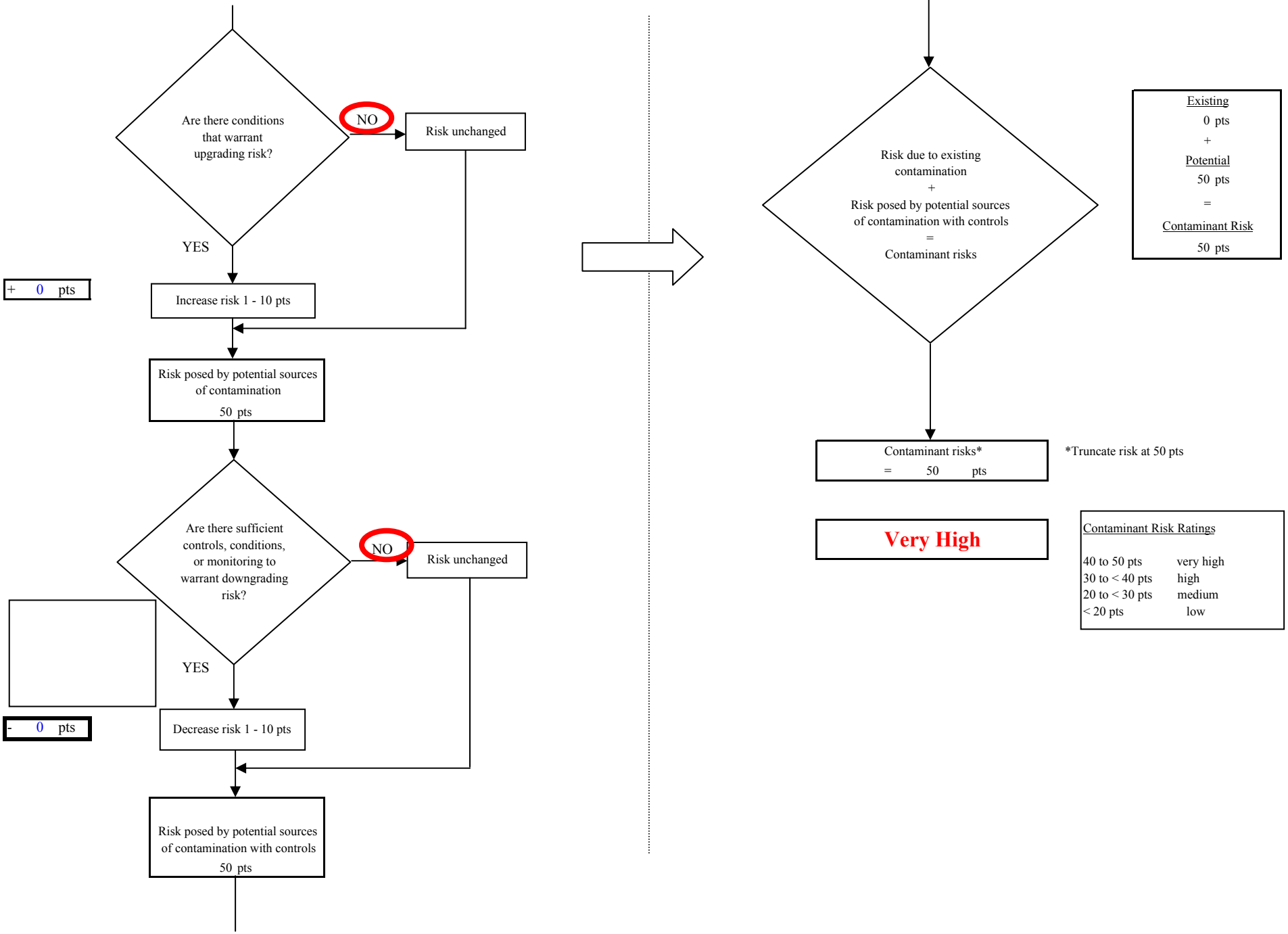


Chart 10. Vulnerability Analysis for Teck Cominco - Pogo Creek Camp - Heavy Metals, Cyanide and Other Inorganic Chemicals

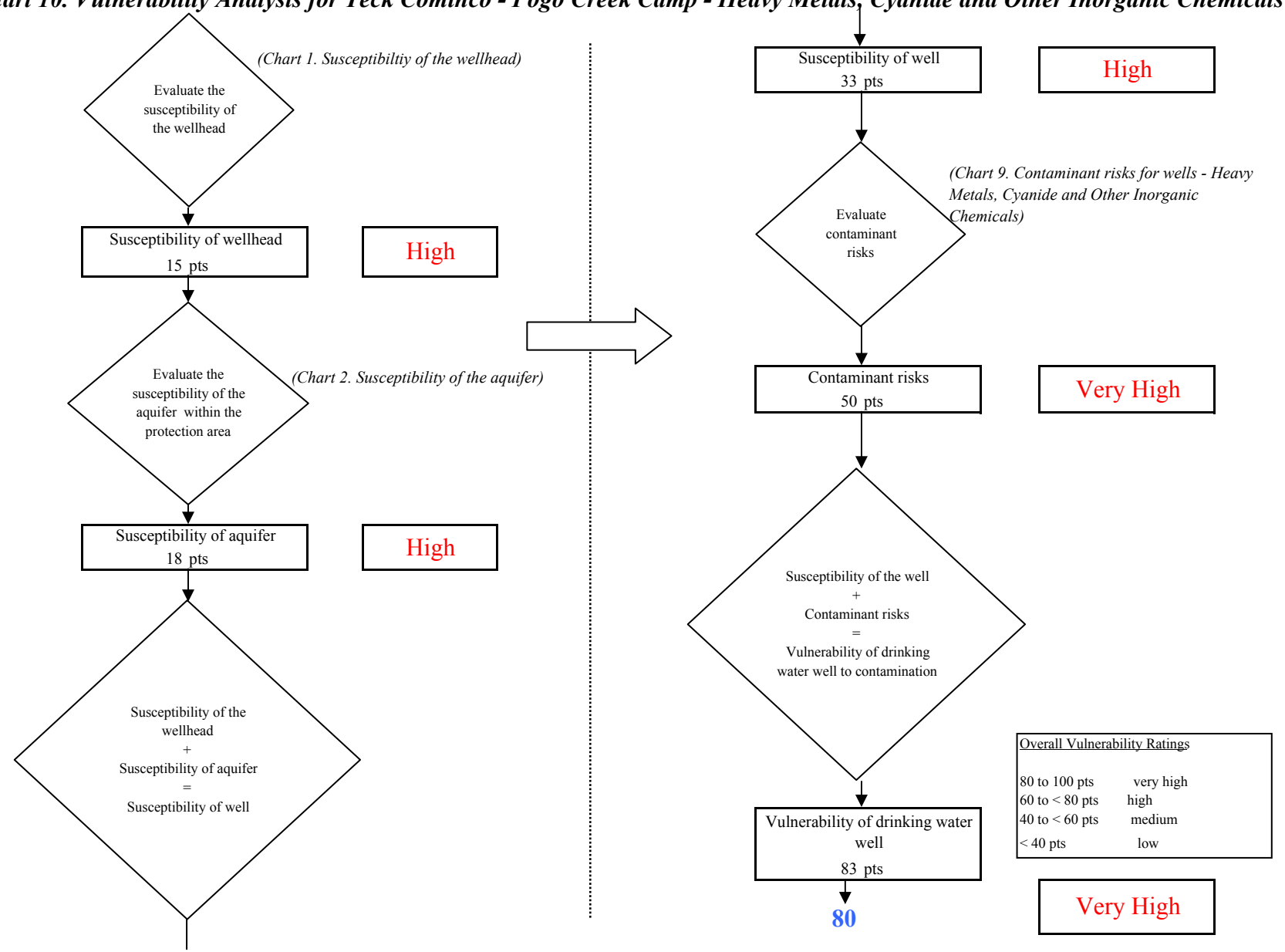


Chart 11. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Synthetic Organic Chemicals

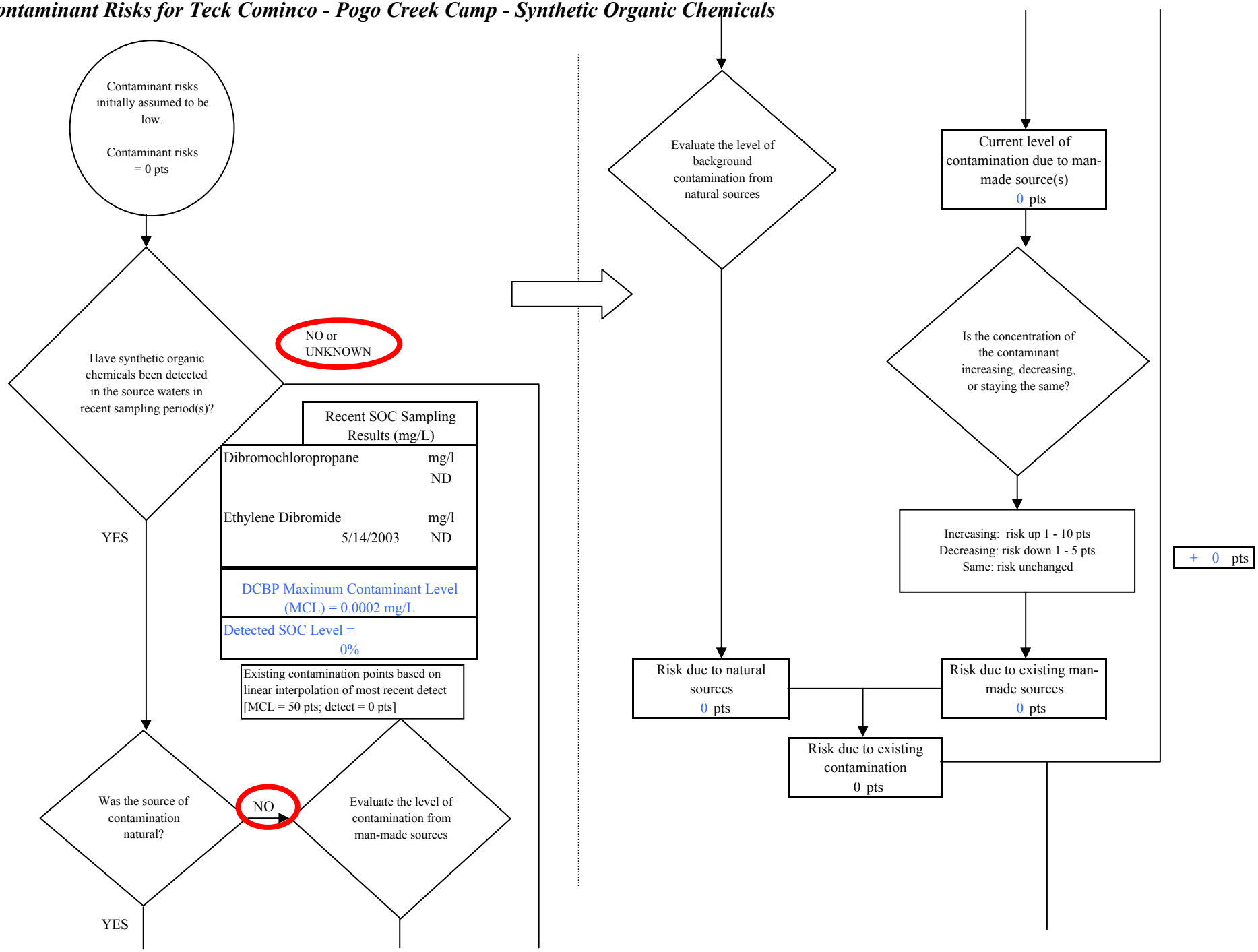
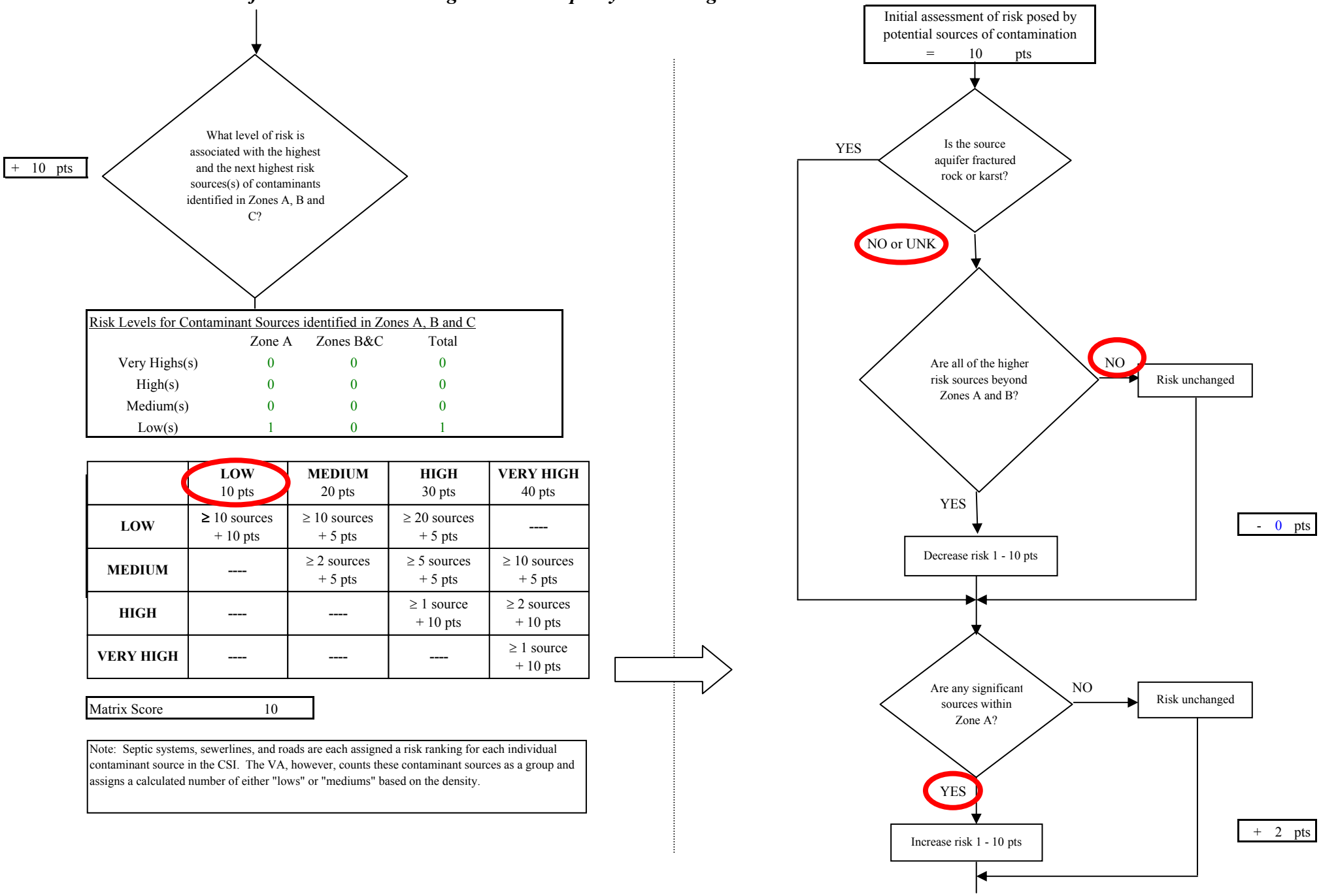


Chart 11. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Synthetic Organic Chemicals



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

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

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

Matrix Score 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 11. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Synthetic Organic Chemicals

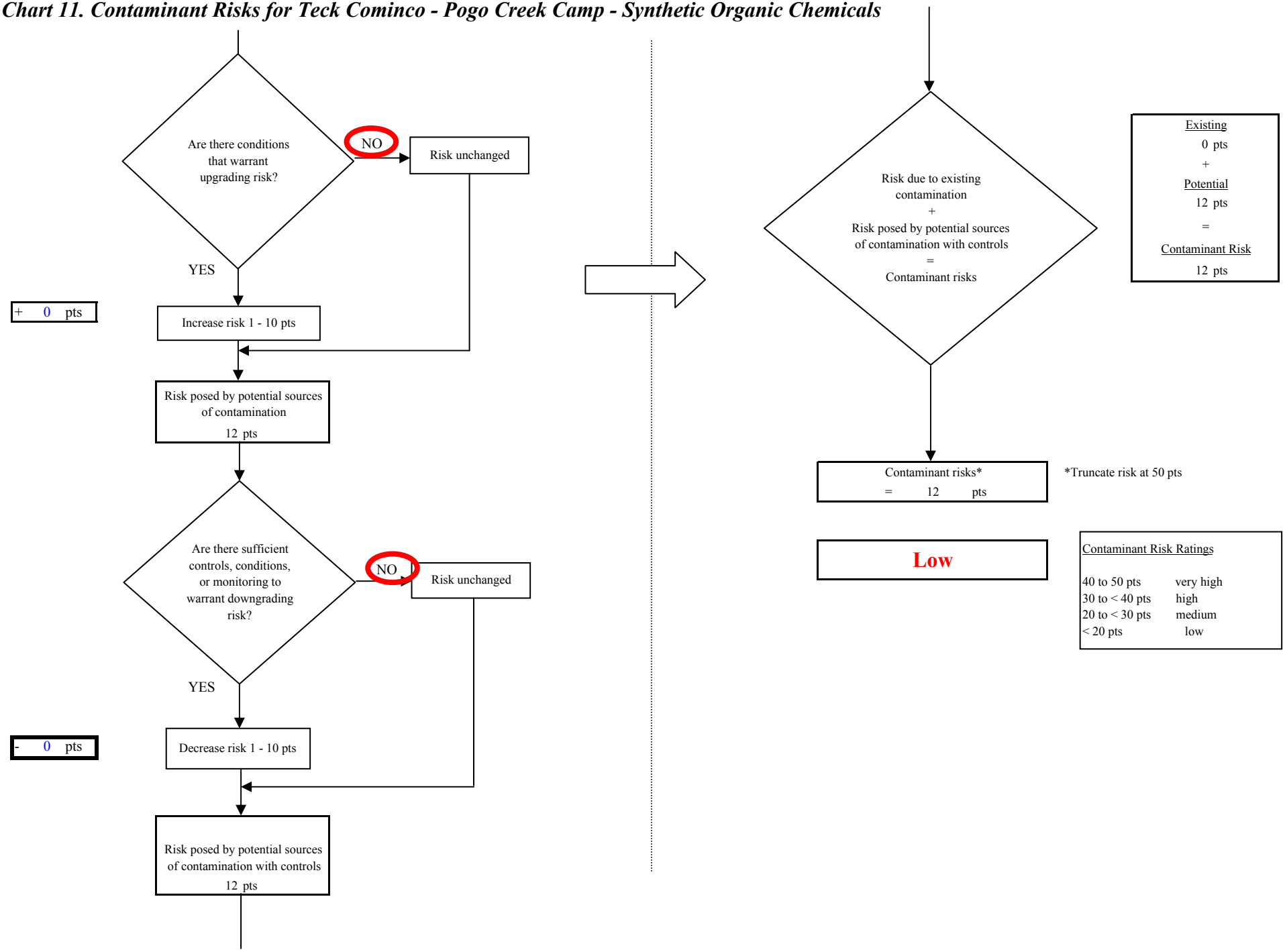


Chart 12. Vulnerability Analysis for Teck Cominco - Pogo Creek Camp - Synthetic Organic Chemicals

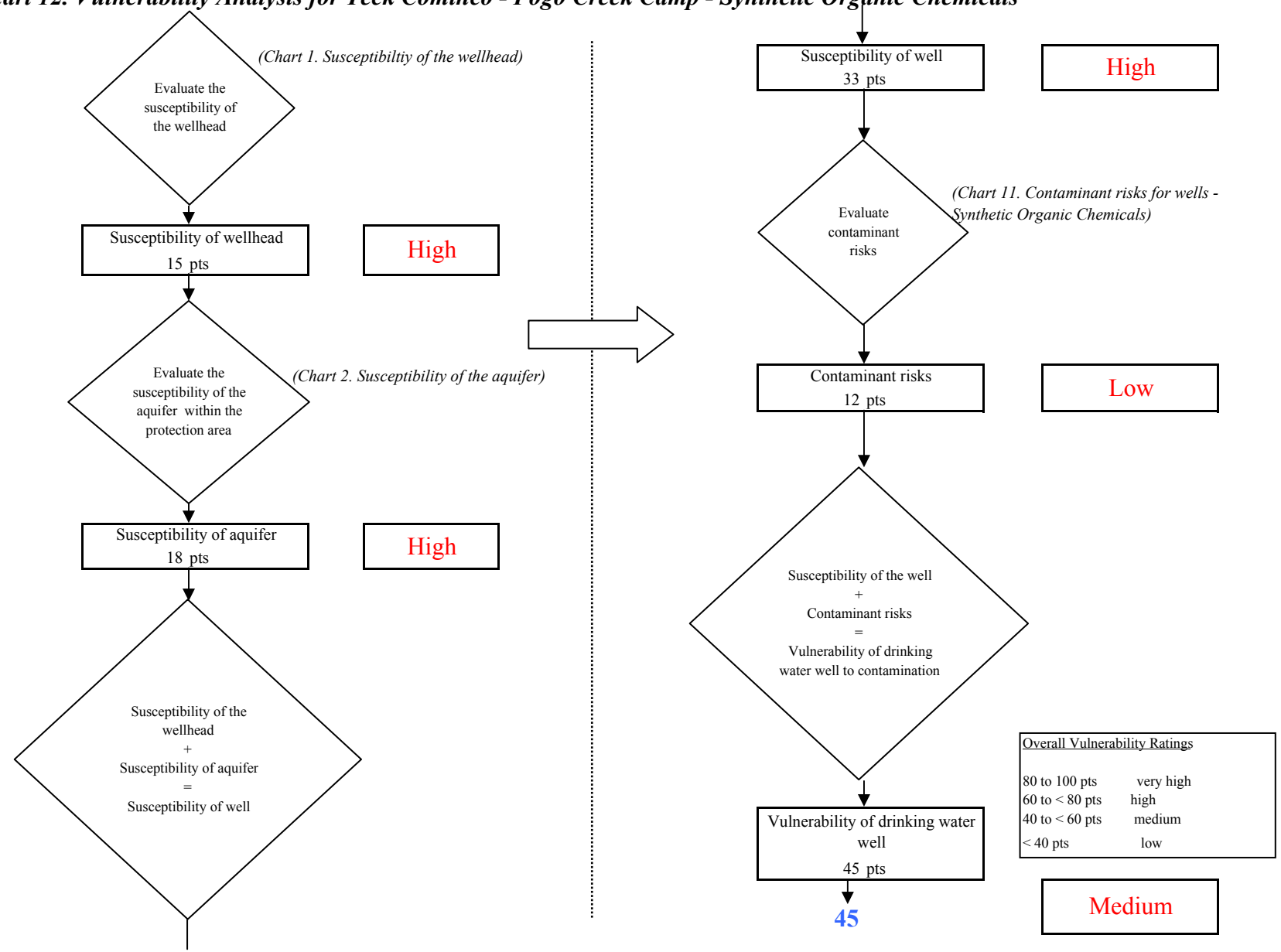


Chart 13. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Other Organic Chemicals

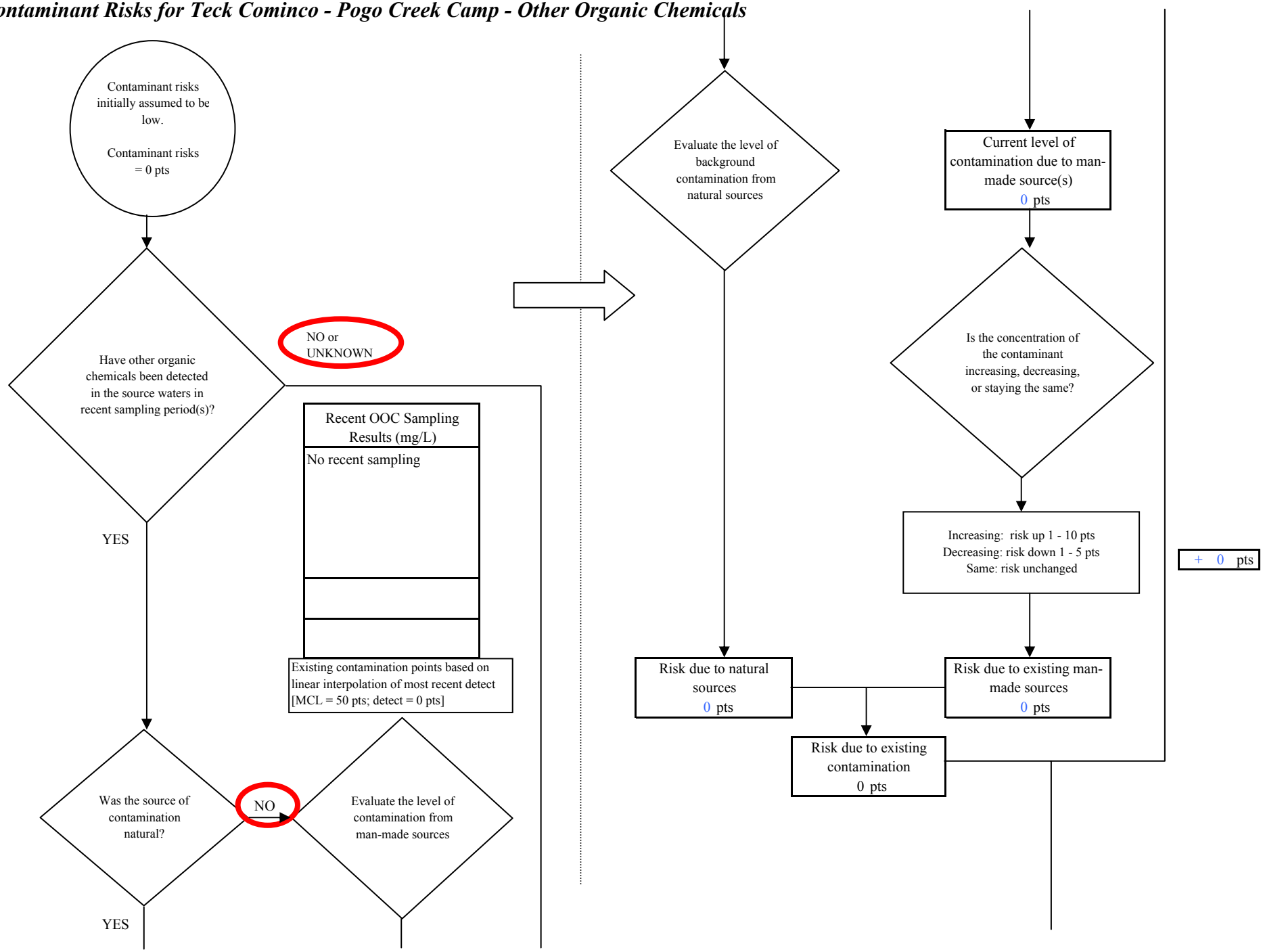


Chart 13. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Other Organic Chemicals

+ 30 pts

What level of risk is associated with the highest and the next highest risk sources(s) of contaminants identified in Zones A, B and C?

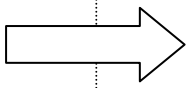
Risk Levels for Contaminant Sources identified in Zones A, B and C

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

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

Matrix Score 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.



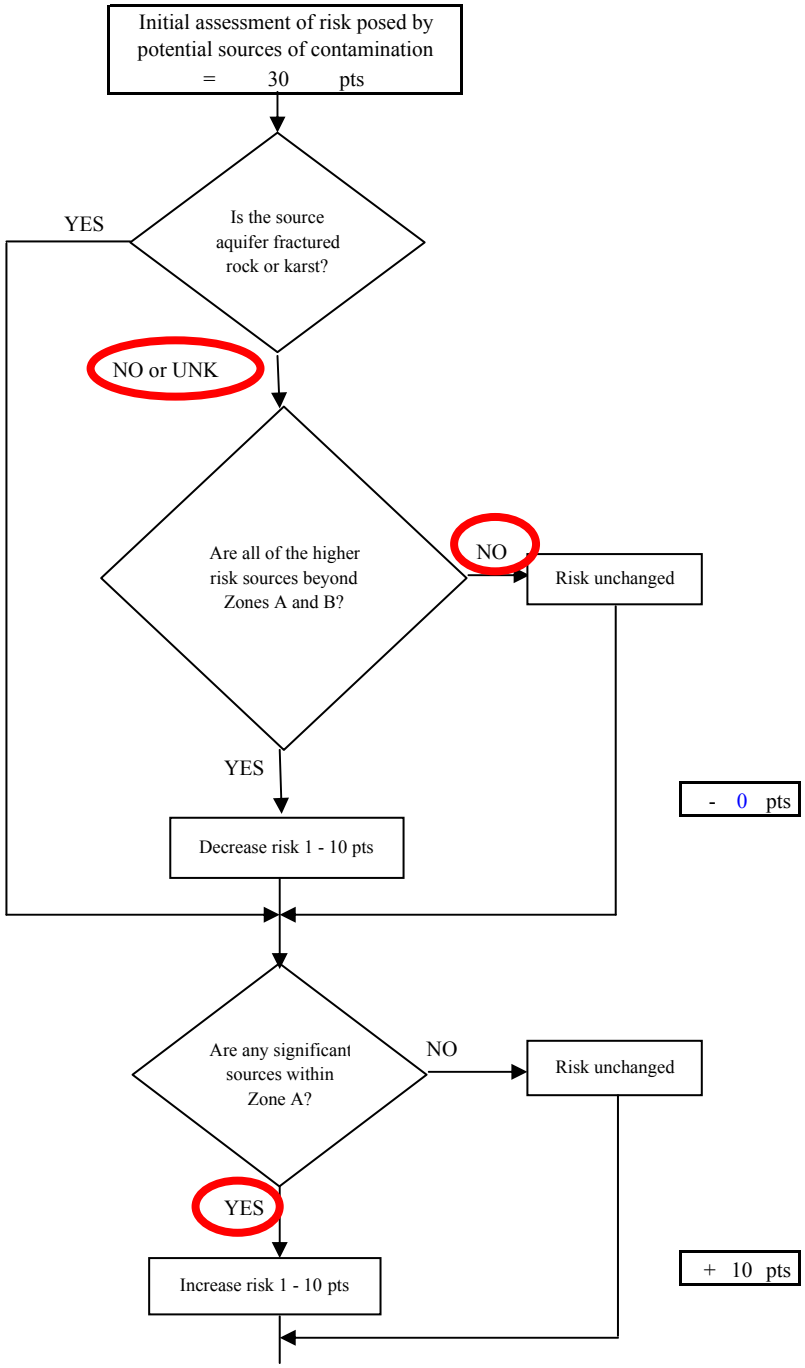


Chart 13. Contaminant Risks for Teck Cominco - Pogo Creek Camp - Other Organic Chemicals

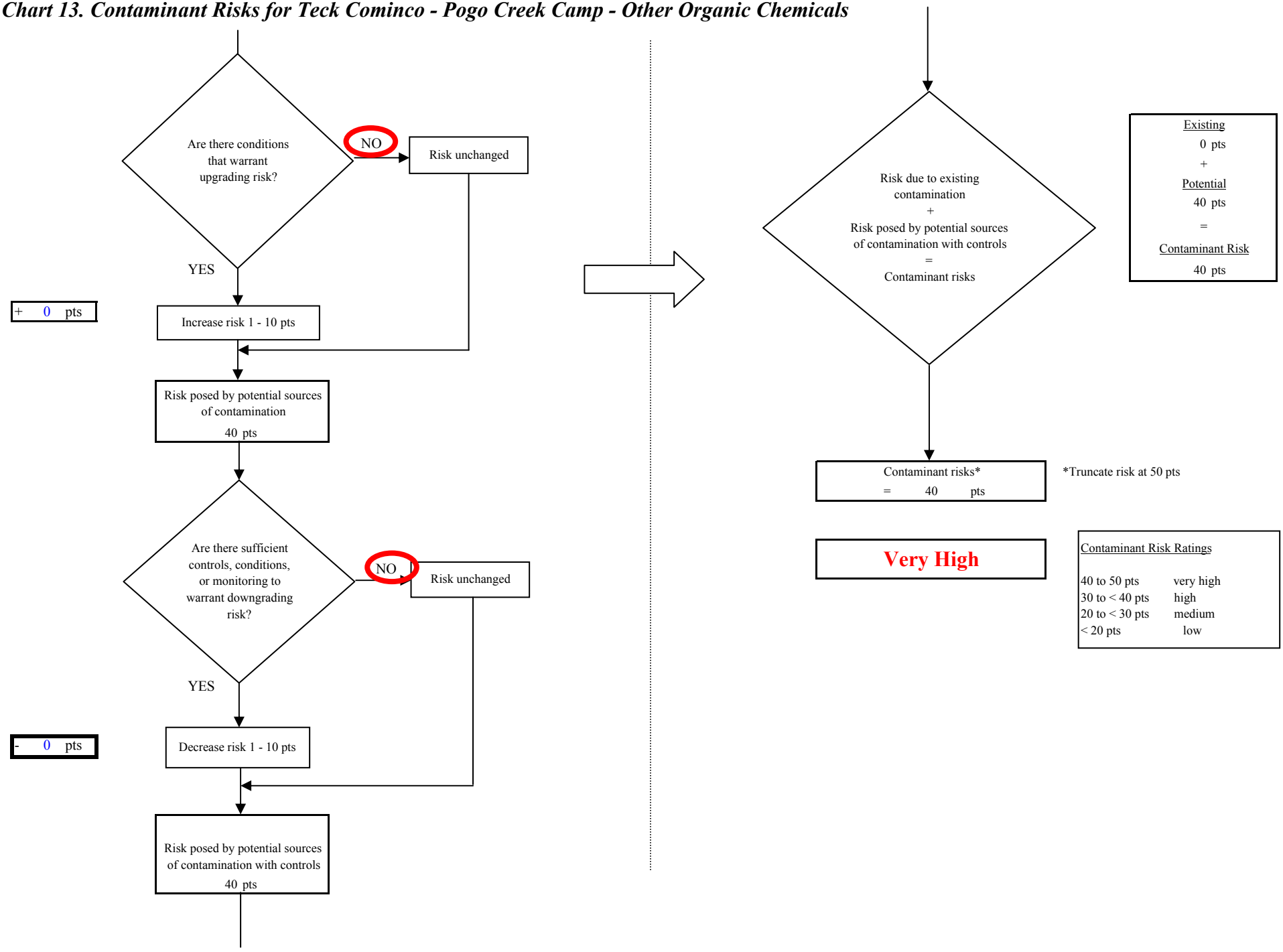


Chart 14. Vulnerability Analysis for Teck Cominco - Pogo Creek Camp - Other Organic Chemicals