Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Agrium - Well No. 10 and No. 12 Drinking Water System, Nikiski area, Alaska PWSID 240919.002 and 240919.003

December 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1294
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.

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Agrium is a Class A (non-transient/non-community) water system consisting of six wells. This report reviews Agrium - Well No. 10 and No. 12. The wells are located off of the Kenai Spur Highway. The wellheads received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the Agrium-Well No. 10 and No. 12 include: residential septic systems, large capacity septic system, roads residential area, logging area and recognized contaminated sites. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, inorganic chemicals, synthetic organic chemicals and other organic chemicals. Overall, the public water source for the Agrium received a vulnerability rating of **Low** for volatile organic chemicals, synthetic organic chemicals and other organic chemicals, **Medium** for nitrate/nitrites, bacteria/ viruses and **High** and inorganic chemicals

AGRIUM PUBLIC DRINKING WATER SYSTEM

The Agrium public water system (PWS) is a Class A (non-transient/non-community) water system. The system consists of six wells. This report reviews Agrium-Well No. 10 and No. 12 which are completed in the unconfined aquifer.
For information on Well No. 7A, 14, 15 and 16 refer to Source Water Assessment-Report No. 1295

The Agrium wells are located in Nikiski off of the Kenai Spur Highway. (See Map 1 of Appendix A). Nikiski is part of the Kenai Peninsula Borough, which is located directly south of the city of Anchorage (Please see the inset of Map 1 in Appendix A for location). The borough encompasses 25,600 square miles, of which only 15,700 square miles is land.

The Kenai Peninsula is broken into two distinct geographic areas; the Kenai Mountains and the Kenai Lowlands. Nikiski and its surrounding communities are located in the Kenai Lowlands. Communities located within the Kenai Lowlands include Sterling, Soldotna, Kenai, Nikiski, Clam Gulch, Ninilchik, and Homer.

The Kenai Peninsula area topography varies from about 3,000 feet to 5,000 feet above sea level in the Kenai Mountains, the highest point being about 6,400 feet above sea level. The Kenai Peninsula is dotted with many lakes and small streams, including three large lakes (Kenai Lake, Skilak Lake, and Tustemena Lake) and two substantial rivers (Kenai River, and Kasilof River) (USGS 1915).

The Agrium water system is located within the Kenai Lowlands, which is a sub-province of the Cook Inlet-Susitna Lowland physiographic region. The Kenai Lowland is a glaciated coastal shelf situated west of the northeast-trending Kenai Mountains. Approximately 100 miles long, the coastal shelf is bordered on the west by Cook Inlet, on the east by Kenai Mountains, on the north by Turnagain Arm, and on the south by the Caribou Hills and Kachemak Bay. The following summary of regional geology and hydrogeology is based on studies by Bailey and Hogan (1995); Freethey and Scully (1980); Glass (1996); Hartman, et al. (1972); and Karlstrom (1964).

The Kenai Lowland is underlain by bedrock. Tertiary sedimentary bedrock is more than 500 feet below the city of Kenai airport, but is exposed along beach cliffs and road cuts near the southwest end of the lowland. Unconsolidated surficial deposits of Quaternary age include coastal deposits, glaciolacustrine deposits, glaciofluvial deposits, glacial moraine deposits, and periglacial wind deposits. Unconsolidated Quaternary cover on the lowlands generally thickens from south to North being thin or absent in the Homer area, and over 750 feet thick near Nikiski.

The most significant groundwater resources of the Kenai Lowlands are contained in Quarternary coarse-grained sands and gravels. Flood plain, river terrace and other alluvial deposits are common aquifer materials in the area, and are characterized by high rates of recharge, and large saturated thicknesses. Other favorable materials include proglacial lake and associated river deposits and glacial outwash deposits consisting of meltwater sorted sand and gravel material. Unsorted glacial moraine and drift deposits generally have poor groundwater yields, as do discontinuous

layers of confining clays and silt that are common throughout the unconsolidated materials. The relatively thicker sequence of unconsolidated sediments in the northern portions of the Kenai Lowlands locally hosts thicker, more extensive clay aquitards and multiple aquifers.
The Kenai Peninsula area has a central water system, however, many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are deep with depths between 50 and 200 feet. Static water levels in many of these wells are between 10 and 30 feet below the surface. Although groundwater quality can vary significantly in short distance, groundwater supplies are abundant in the area.

According to the latest Sanitary Survey (10/25/02) the depths of the well No. 10 and No. 12 are 78 feet and 74 feet below ground surface (bgs) respectively. The static water level at the time of drilling for Well No. 10 and No. 12 were 15 and 27 feet bgs respectively.

The Sanitary Survey indicates that the wells are properly sealed. A properly installed sanitary seal may provide protection against contaminant from entering the source waters at the casing. The wells are not located in a floodplain and the surface is sloped away from the wellheads. Since the wells were drilled in 1967, prior to grouting regulations it is assumed that the well is not grouted. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

Well No. 10 and No. 12 are secondary sources for the Agrium water system. They operate year round and serve up to 330 residents, 40 nonresidents through 18 service connections.
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AGRIUM DRINKING WATER PROTECTION AREA

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

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

An analytical calculation was used to determine the size and shape of the DWPA for Agrium. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (*Freeze and Cherry 1979*). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.
The protection areas established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. time-of-travel
B	Less than 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The DWPA for the Agrium was determined using an analytical calculation and includes Zone A, B, C, and D (See Map 1 of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Agrium DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

- Bacteria and viruses;
- Nitrates and/or nitrites;

- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

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

RANKING OF CONTAMINANT RISKS

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

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

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

Tables 2 through 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, heavy metals/ cyanide/other inorganic chemicals, synthetic organic chemicals and other organic chemicals.

VULNERABILITY OF AGRIUM DRINKING WATER SYSTEM

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

- Natural susceptibility; and
- Contaminant risks.

Appendix D contains eight 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. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses' Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals/ cyanide/other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the 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

Agrium-Well No. 10 and No. 12 are completed in the unconfined aquifer. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer.

Table 2. Susceptibility

	Score	**Rating**
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	18	High
Natural Susceptibility	23	Medium

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

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

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

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	24	Medium
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	45	Very High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

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	35	Low
Nitrates and Nitrites	45	Medium
Volatile Organic Chemicals	35	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	70	High
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	35	Low

Bacteria and Viruses

Residential septic systems, a large capacity septic system and residential area represent the greatest risk for bacteria and viruses to this drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coli forms and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Sampling has detected bacteria within source waters. The sampling results do not indicate which source the positive sample was obtained from.

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 low**.**

Nitrates and Nitrites

Residential septic systems, a large capacity septic system and residential area represent the greatest risk to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for Agrium Well No.10 and No. 12 indicates that low nitrate concentrations have been detected. The nitrate concentration from the most recent detect is 17% (1.71 mg/L) of the Maximum Contaminant Level (MCL) of 10 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. The reported nitrate concentrations suggest that the nitrate concentrations are attributed to natural sources. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L. therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources. Though existing nitrate contamination was detected at the site, recent data indicates that nitrate concentrations are safe with respect to human health.

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 medium.

Volatile Organic Chemicals

The roads, residential area and a large capacity septic system represent the greatest identified risk for volatile organic chemical contamination to the well.

Approximately 20% residents in the area typically heat their homes with various types of on-site fuel sources, including propane and heating oil stored in aboveground or underground storage tanks. Although this report does not address heating oil tanks (unless their location is known), they can pose a risk of volatile organic chemical contamination to drinking water sources. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Secondary containment around the tank and regular system maintenance can help prevent many of these harmful fuel leaks and help protect the drinking water supply.

Volatile Organic Chemicals have not been detected within source waters. 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 low.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

Roads, residential areas, residential septic systems and large capacity septic systems present the greatest risk for inorganic chemicals to the well.

Samplings of inorganic chemicals have detected barium, beryllium, fluoride, lead, nickel and thallium at levels below the maximum contaminant levels (MCLs).

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

Synthetic Organic Chemicals

Residential areas, residential septic systems and large capacity septic systems represent the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been detected in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Other Organic Chemicals

The roads, residential area and a large capacity septic system represent the greatest risk for other organic chemicals to the well.

Other organic chemicals have not been detected in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

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APPENDIX A

Agrium
Drinking Water Protection Area Location Map
(Map 1)

Map 1- Agrium Drinking Water Protection Area

PWSID: 240919.001 and 240919.006

PWSID: 240969.001, 004, 005 and 006

PWSID: 240969.002 and 003

Area of Map

Feet 1:21,860

0 1,300 2,600

Data Sources:
Kenai Borough: Roads and parcels
USGS-63,360 topo map and hillshade
Potential Sources of Contamination: ADEC

Legend

Public Water System		
240919.001	240919.004	Zone A Protection Area
240919.002	240919.005	Zone B Protection Area
240919.003	240919.006	Zone C Protection Area
		Zone D Protection Area

Roads

Rivers and Streams

Tyonek
Hope
Nikiski
Kenai
Ridgeway
Sterling
Cooper Landing
Cohoe
Ninilchik
Happy Valley
Nikolaevsk
Fox River
Anchor Point
Fritz Creek

APPENDIX B

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

Table 1

Contaminant Source Inventory for ***Agrium-Well No. 10***

PWSID 240919.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	2	1 residential septic in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	A	2	UNOCAL Chem/Cabin Lake Drum Site-49 drum containing solids and liquids were dumped at two locations. Closed
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	2	Zone A has 3 roads. Assumed to be paved.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	2	
Logging (active or inactive?)	E02	E02-01	B	2	
Residential Areas	R01	R01-2	B	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	2	40 residential septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-3-5	B	2	Zone B has 3 roads. Assumed to be paved.
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	B	2	Zone C has 3 roads. Assumed to be paved.
Logging (active or inactive?)	E02	E-2-02	C	2	
Residential Areas	R01	R01-3	C	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	2	17 residential septics in Zone C

Table 2

Contaminant Source Inventory and Risk Ranking for Agrium-Well No. 10 Sources of Bacteria and Viruses

PWSID 240919.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	1 residential septic in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	Zone A has 3 roads. Assumed to be paved.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	High	2	
Residential Areas	R01	R01-2	B	Low	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	Low	2	40 residential septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-3-5	B	Low	2	Zone B has 3 roads. Assumed to be paved.
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	B	Low	2	Zone C has 3 roads. Assumed to be paved.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	Low	2	17 residential septics in Zone C

Table 3

Contaminant Source Inventory and Risk Ranking for Agrium-Well No. 10 Sources of Nitrates/Nitrites

PWSID 240919.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	1 residential septic in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	Zone A has 3 roads. Assumed to be paved.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	High	2	
Logging (active or inactive?)	E02	E02-01	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	Low	2	40 residential septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-3-5	B	Low	2	Zone B has 3 roads. Assumed to be paved.
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	B	Low	2	Zone C has 3 roads. Assumed to be paved.
Logging (active or inactive?)	E02	E-2-02	C	Low	2	
Residential Areas	R01	R01-3	C	Low	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	Low	2	17 residential septics in Zone C

Table 4

Contaminant Source Inventory and Risk Ranking for Agrium-Well No. 10 Sources of Volatile Organic Chemicals

PWSID 240919.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	1 residential septic in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	A	Low	2	UNOCAL Chem/Cabin Lake Drum Site-49 drum containing solids and liquids were dumped at two locations. Closed
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	Zone A has 3 roads. Assumed to be paved.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low	2	
Logging (active or inactive?)	E02	E02-01	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	Low	2	40 residential septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-3-5	B	Low	2	Zone B has 3 roads. Assumed to be paved.
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	B	Low	2	Zone C has 3 roads. Assumed to be paved.
Logging (active or inactive?)	E02	E-2-02	C	Low	2	
Residential Areas	R01	R01-3	C	Low	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	Low	2	17 residential septics in Zone C

Table 5

Contaminant Source Inventory and Risk Ranking for Agrium-Well No. 10

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 240919.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	1 residential septic in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	Zone A has 3 roads. Assumed to be paved.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low	2	
Logging (active or inactive?)	E02	E02-01	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	Low	2	40 residential septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-3-5	B	Low	2	Zone B has 3 roads. Assumed to be paved.
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	B	Low	2	Zone C has 3 roads. Assumed to be paved.
Logging (active or inactive?)	E02	E-2-02	C	Low	2	
Residential Areas	R01	R01-3	C	Low	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	Low	2	17 residential septics in Zone C

Table 6

Contaminant Source Inventory and Risk Ranking for Agrium-Well No. 10
Sources of Synthetic Organic Chemicals

PWSID 240919.002

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Residential Areas	R01	R01-1	A	Low	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	1 residential septic in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	Low	2	40 residential septics in Zone B
Residential Areas	R01	R01-3	C	Low	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	Low	2	17 residential septics in Zone C

Table 7

Contaminant Source Inventory and Risk Ranking for Agrium-Well No. 10
Sources of Other Organic Chemicals

PWSID 240919.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low	2	Zone A has 19 residential acres
Septic systems (serves one single-family home)	R02	R02-1	A	Low	2	1 residential septic in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	Zone A has 3 roads. Assumed to be paved.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low	2	
Residential Areas	R01	R01-2	B	Low	2	Zone B has 42 residential acres
Septic systems (serves one single-family home)	R02	R02-2-41	B	Low	2	40 residential septics in Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-3-5	B	Low	2	Zone B has 3 roads. Assumed to be paved.
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	B	Low	2	Zone C has 3 roads. Assumed to be paved.
Residential Areas	R01	R01-3	C	Low	2	Zone C has 58 residential acres
Septic systems (serves one single-family home)	R02	R02-42-50	C	Low	2	17 residential septics in Zone C

APPENDIX C

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

U04-01

Well No. 12

Well No. 10

CABIN LAKE RD

BARANOFF DR

SHELIKOFF ST

INTERLAKE DR

BELMORAL CT

JOSEPHINE WAY

STEV

ALOMA ST

STRAWBERRY AV

BLUEBERRY LN

LOG DRIVE CT

JAN LN

DIRT RD

DP RD

E02-02

E02-01

Zone A has:
1 residential septic system (R02)
1large capacity septic system (D10)
3 roads (X20)
19 residential acres (R02)

Zone B hasA:
40 residential Septic Systems (R02)
3 road (X20)
42 residential acres (R01)

Zone C has:
17 residential septic systems (R02)
3 roads (X20)
58 residential acres (R01)

Area of Map

Map 2- Agrium (Well No. 10 and No. 12) Potential and Existing Source of Contamination

PWSID: 240919.002 and 240919.003

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 190 380 760 Feet

1:4,716

Data Sources:
Kenai Borough: Roads and parcels
Potential Sources of Contamination: ADEC

Public Water System	
240919.001	
240919.002	
240919.003	
240919.004	
240919.005	
240919.006	

- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area
- Injection wells (Class V) Septic System (D10)
- Septic systems (R02)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
- Roads
- Parcels
- Rivers and Streams
- Residential (R02)
- Water
- Logging (inactive/active) (E02)

APPENDIX D

Vulnerability Analysis for Agrium Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Agrium-Well 10 and 12 PWSID 240969.002 and 003

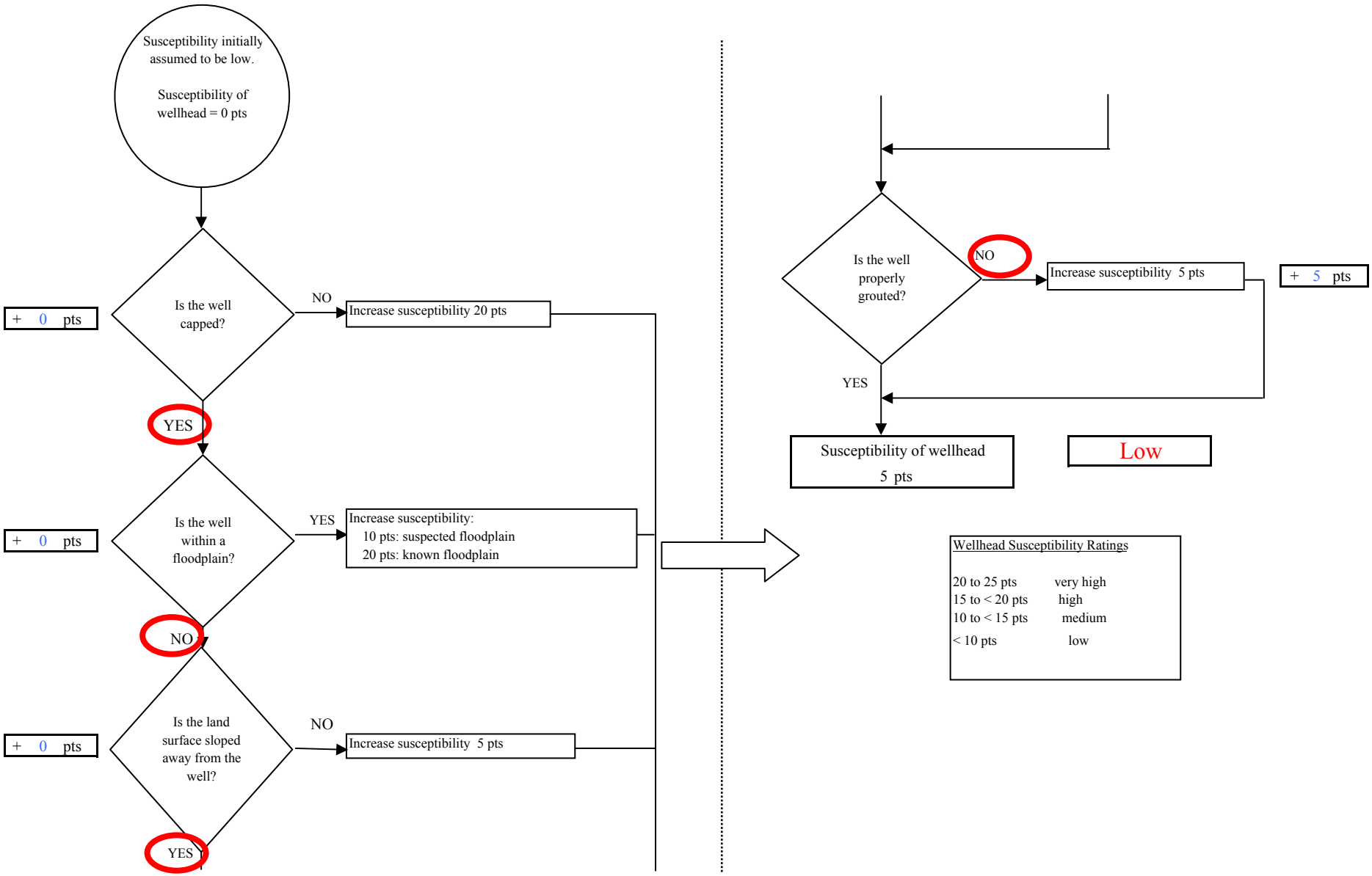


Chart 2. Susceptibility of the aquifer - Agrium-Well 10 and 12 PWSID 240969.002 and 003

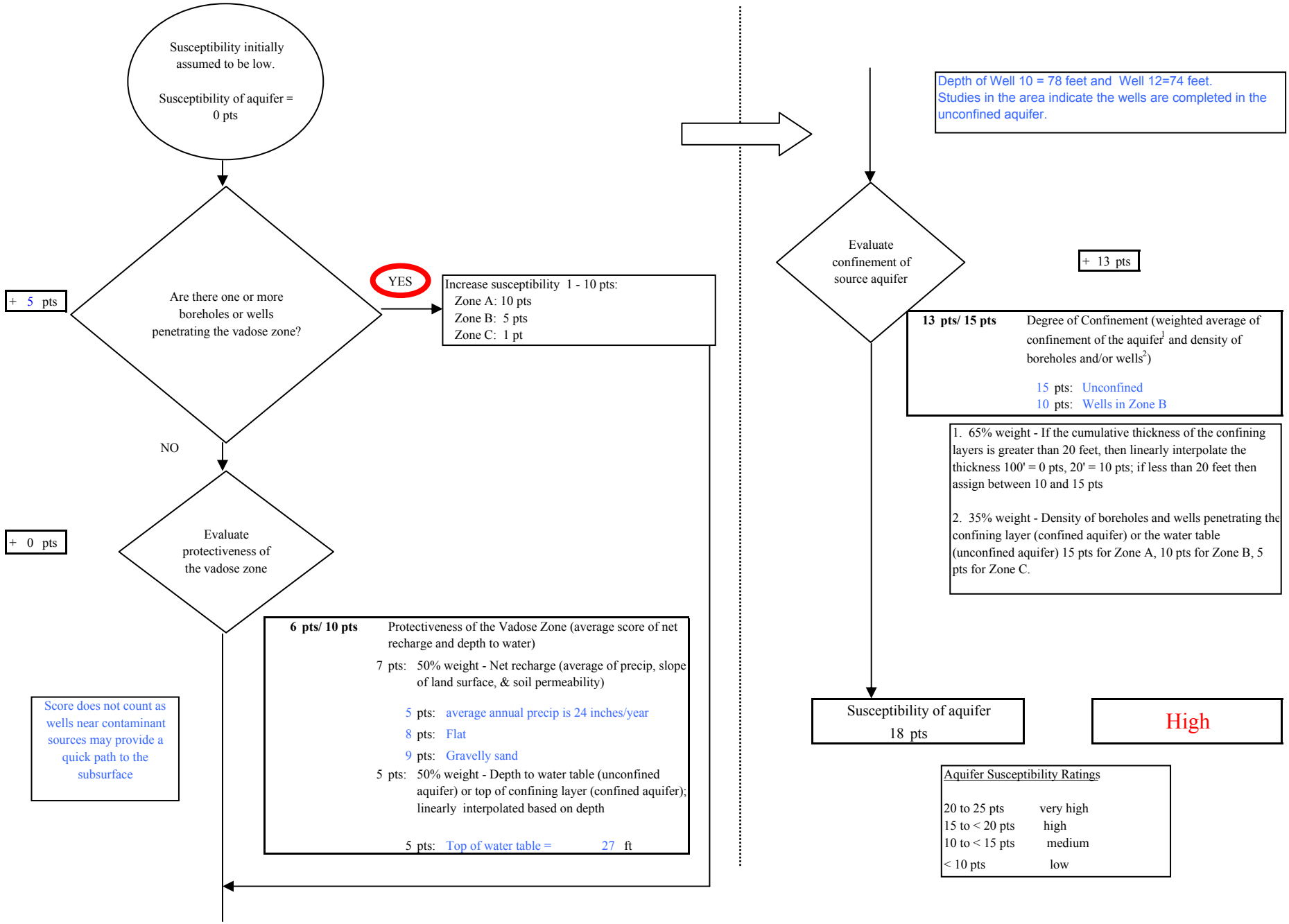
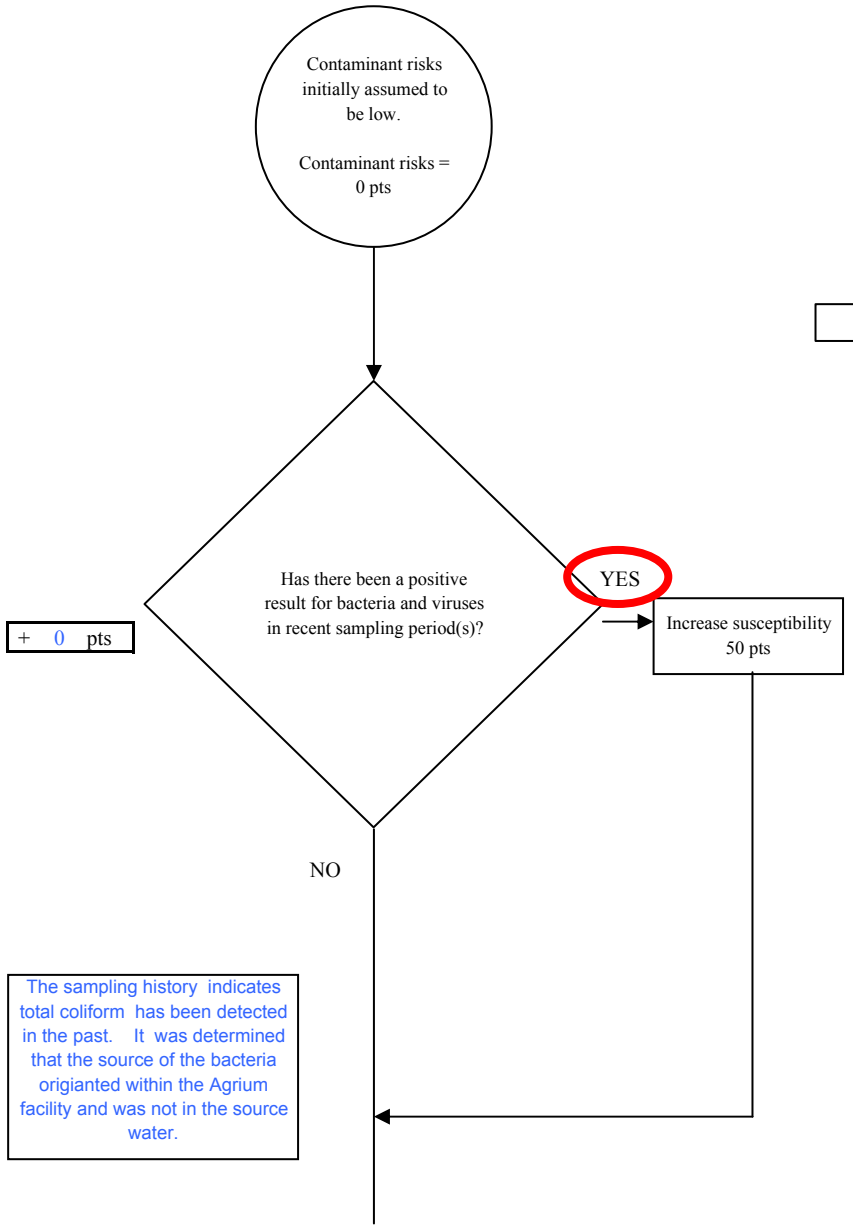
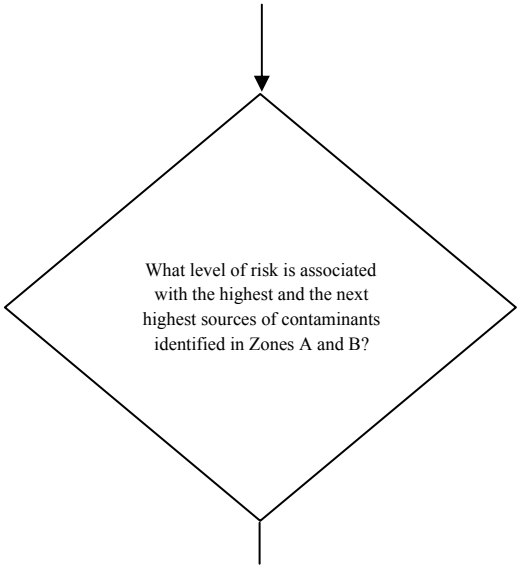


Chart 3. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	6	9

	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 3. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Bacteria & Viruses

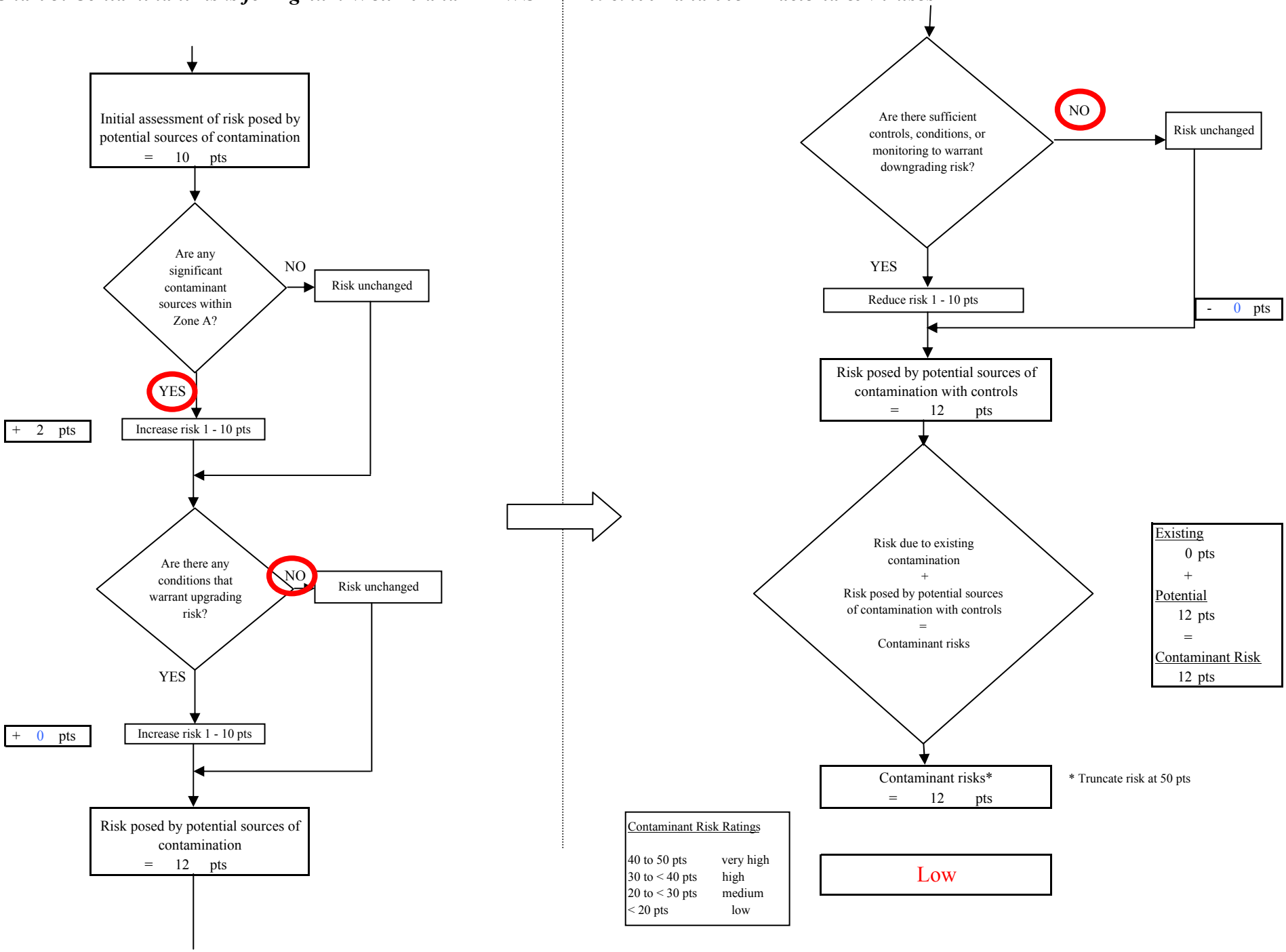


Chart 4. Vulnerability analysis for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Bacteria & Viruses

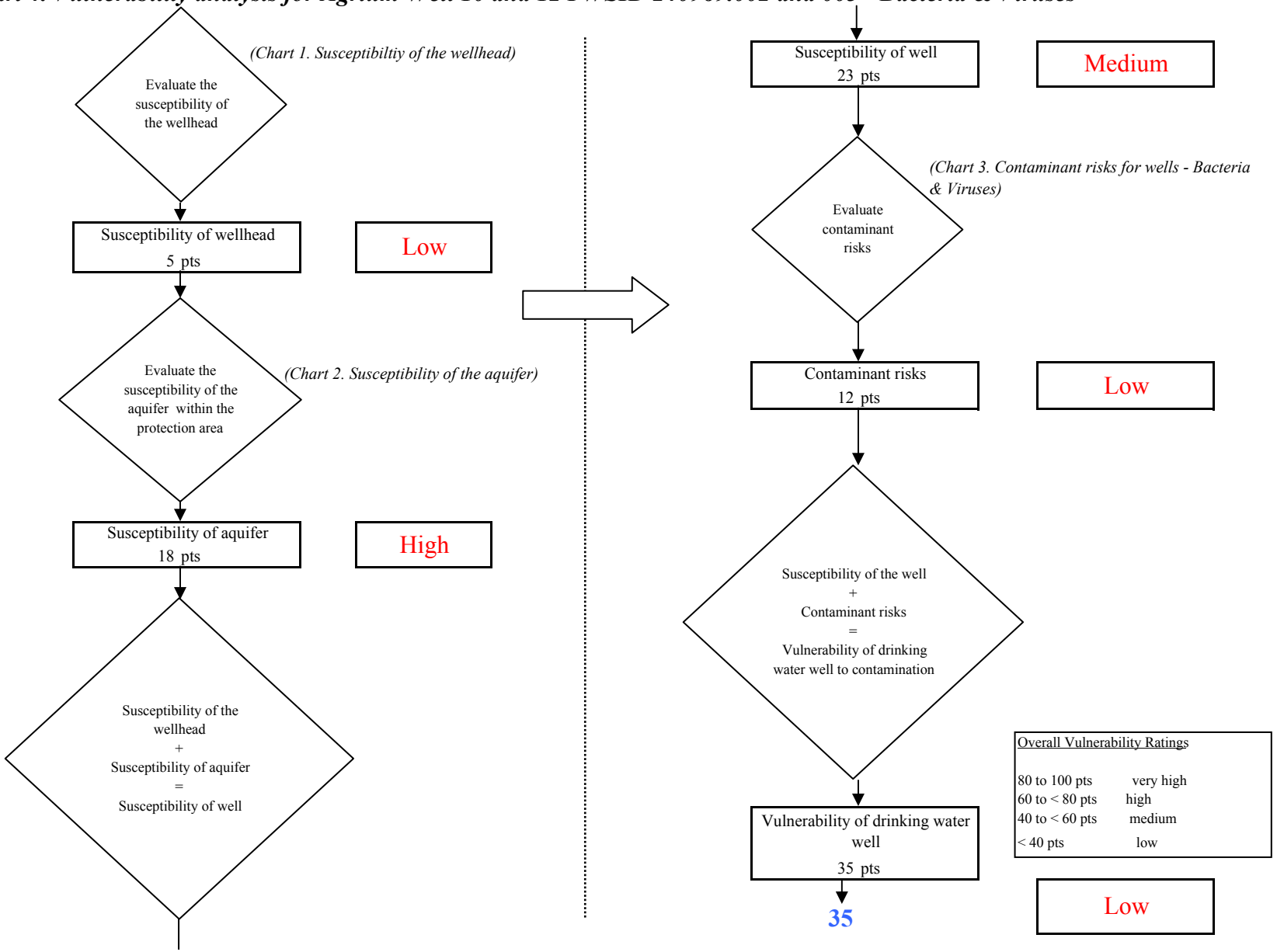


Chart 5. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Nitrates and Nitrites

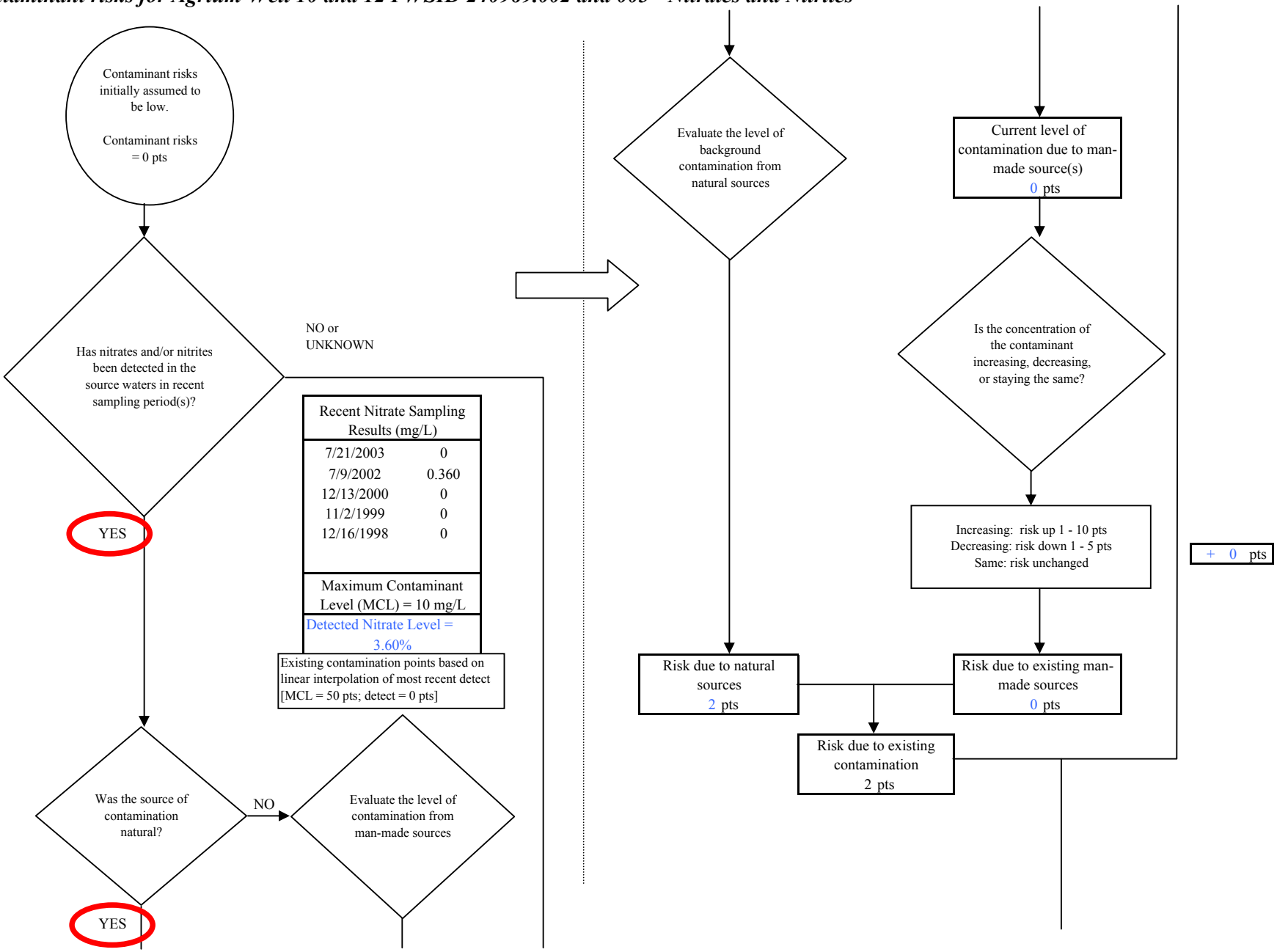


Chart 5. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Nitrates and Nitrites

+ 20 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)	0	0	0
Medium(s)	0	0	0
Low(s)	3	10	13

	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.

Initial assessment of risk posed by potential sources of contamination = 20 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

+ 2 pts

Chart 5. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Nitrates and Nitrites

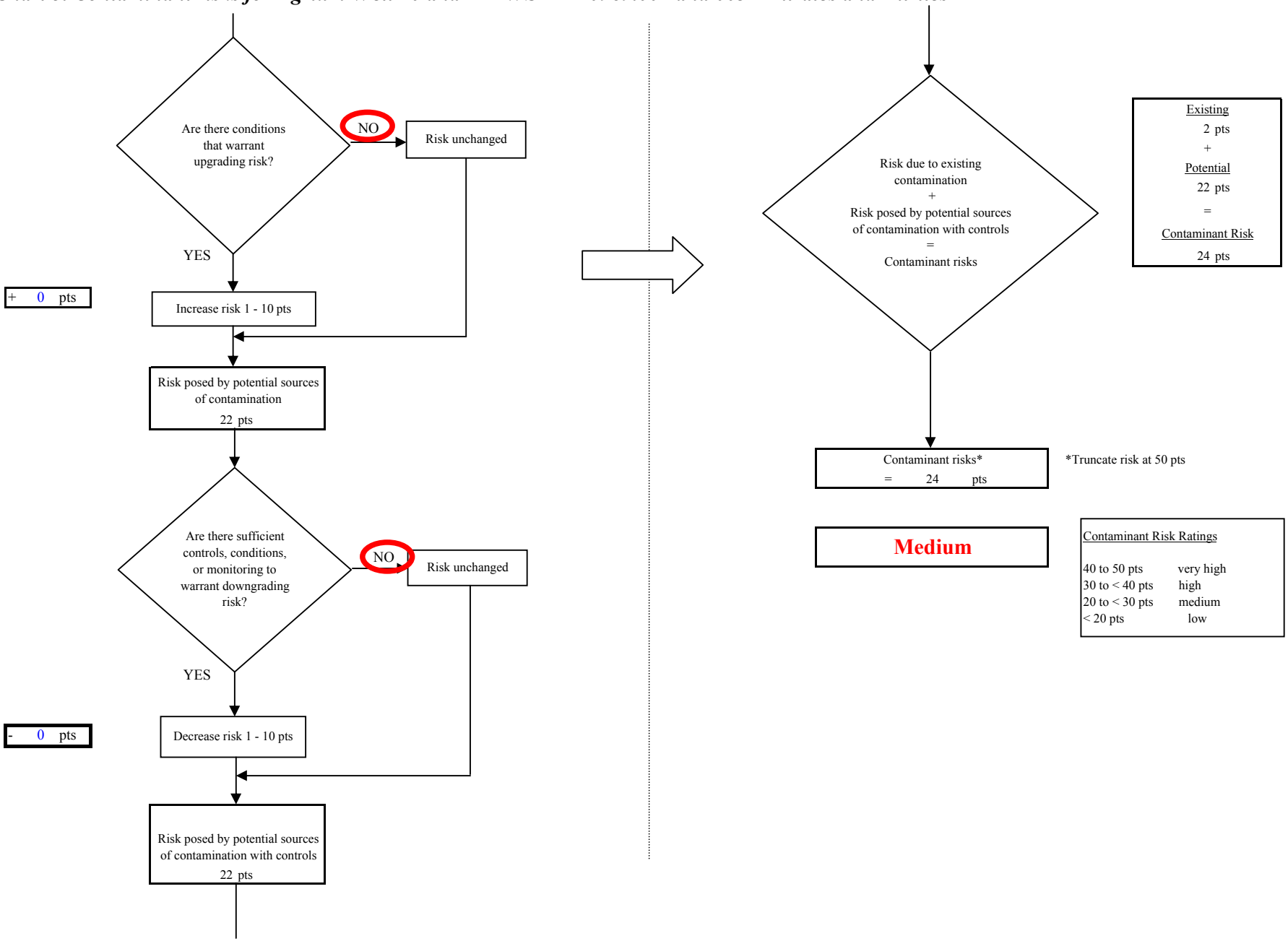


Chart 6. Vulnerability analysis for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Nitrates and Nitrites

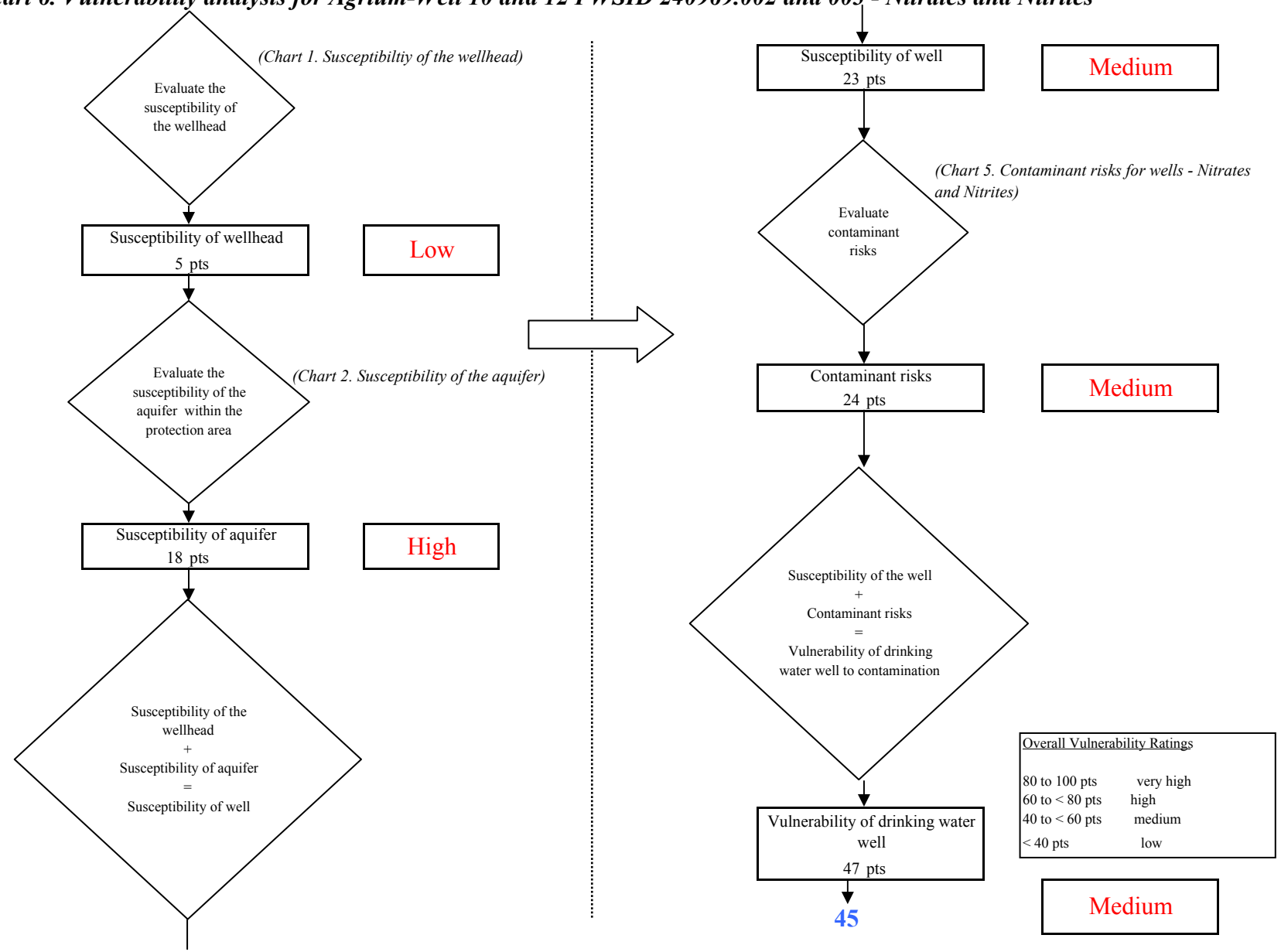


Chart 7. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Volatile Organic Chemicals

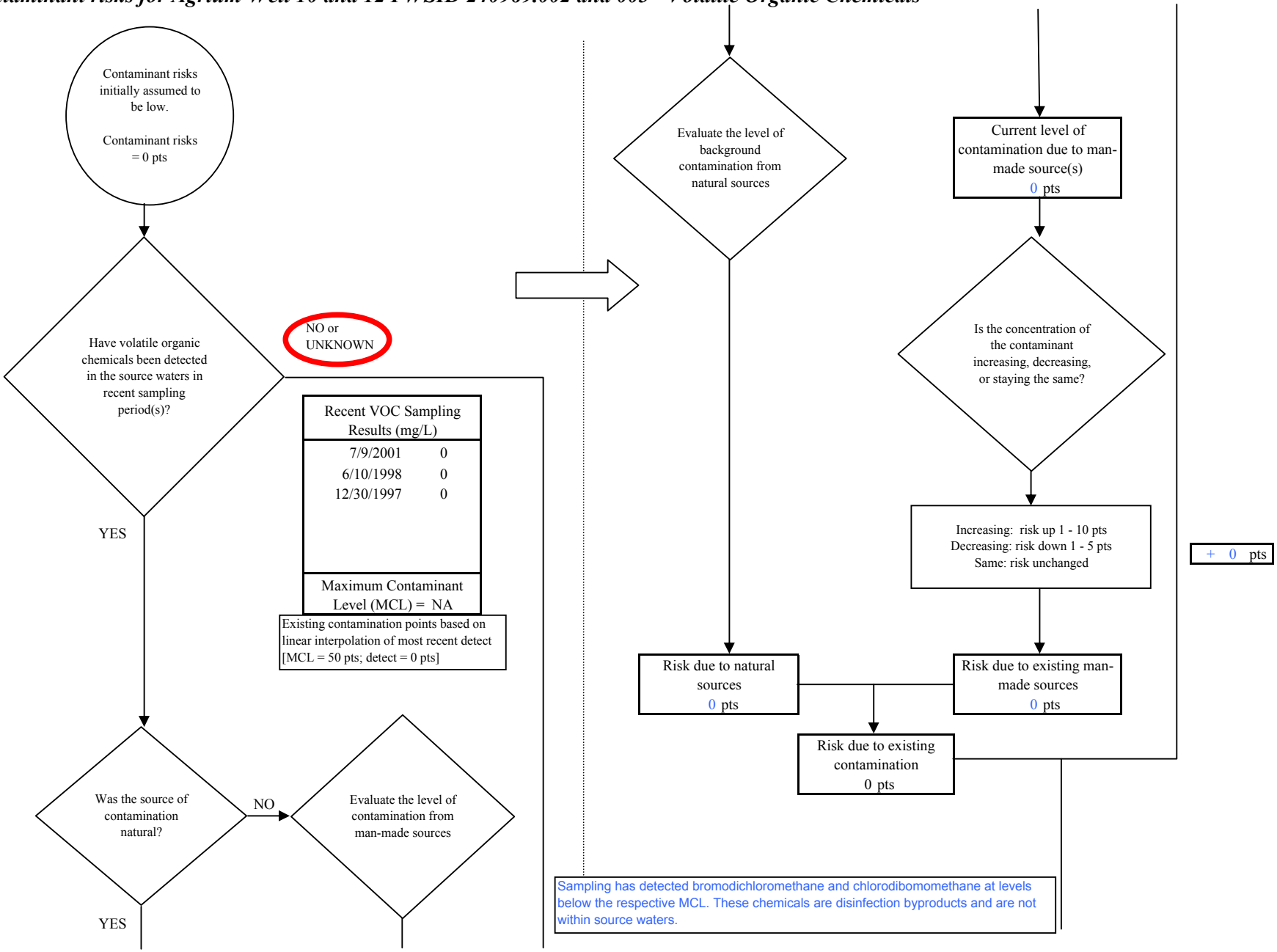


Chart 7. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Volatile Organic Chemicals

+ 10 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)	0	0	0
Medium(s)	0	0	0
Low(s)	4	5	9

	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.

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

+ 2 pts

Chart 7. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Volatile Organic Chemicals

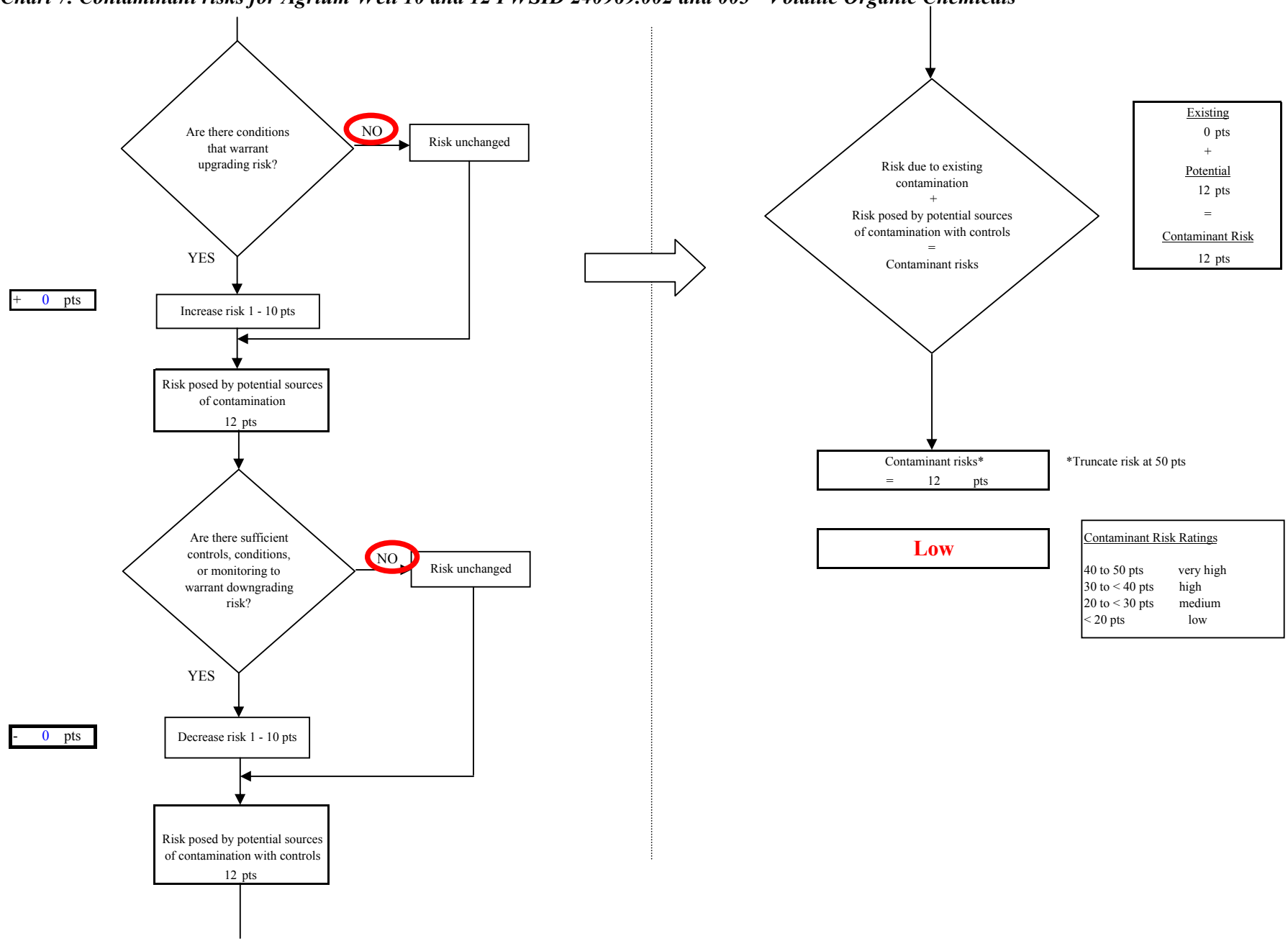


Chart 8. Vulnerability analysis for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Volatile Organic Chemicals

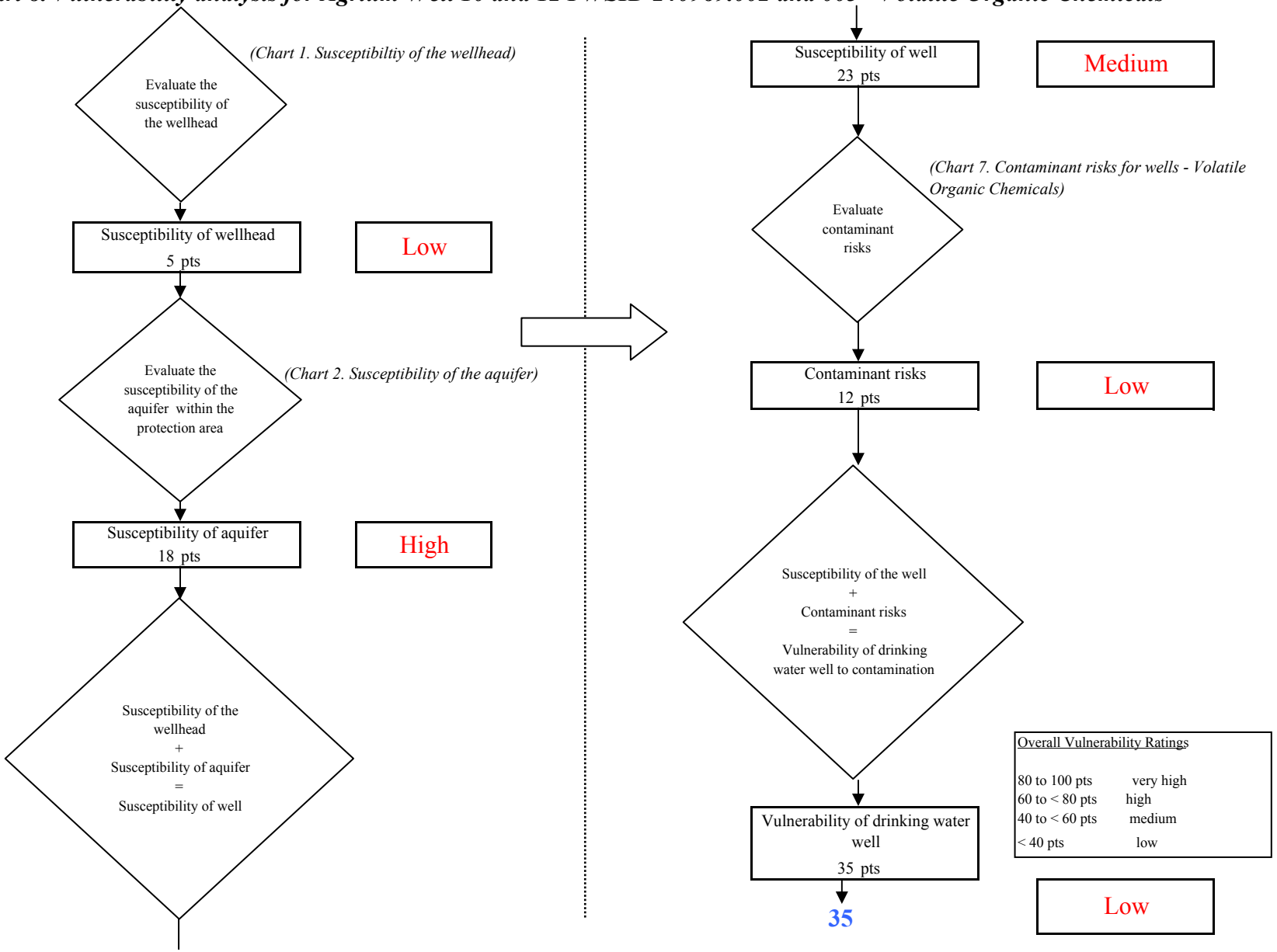


Chart 9. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Heavy Metals, Cyanide and Other Inorganic Chemicals

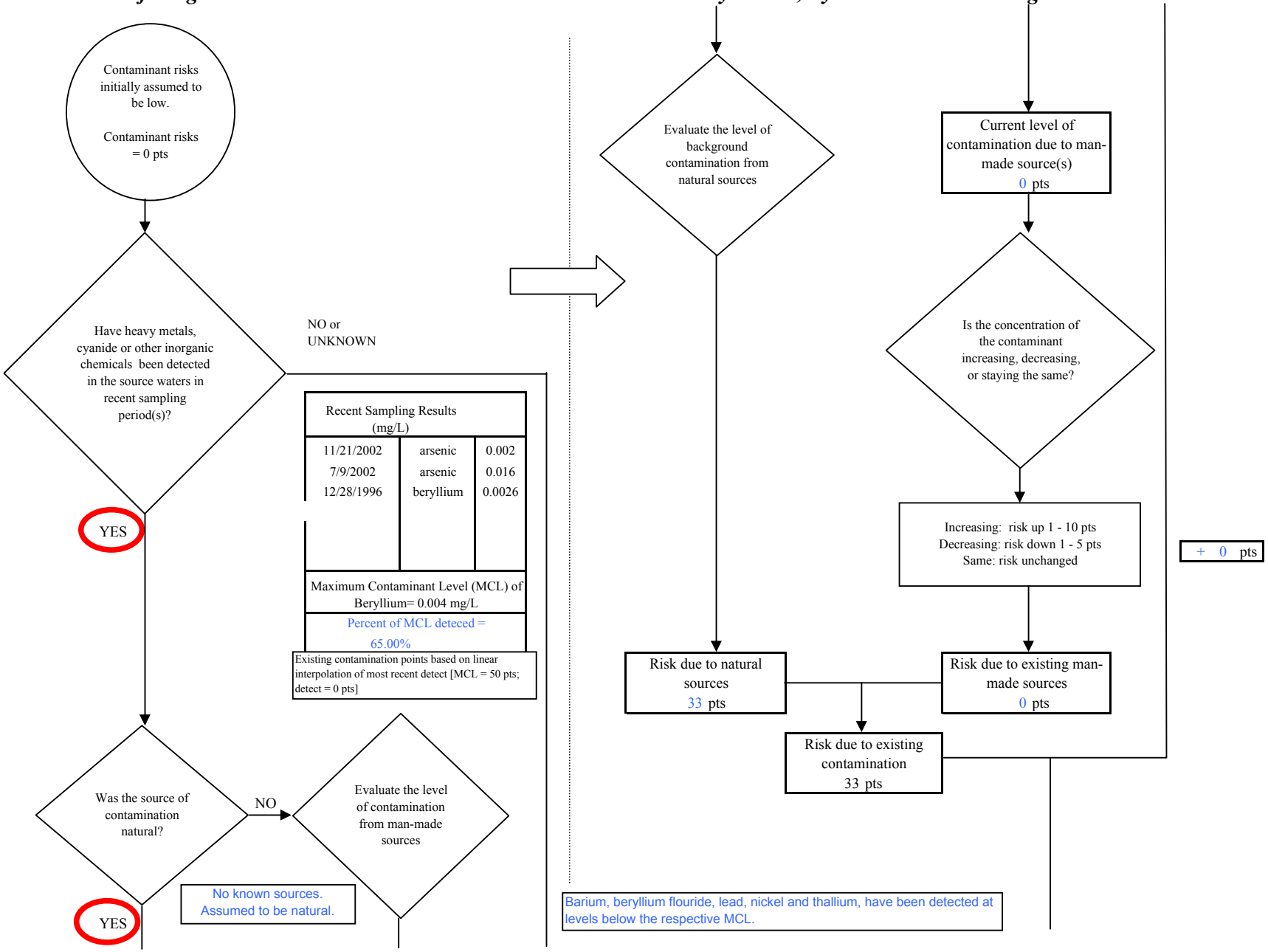
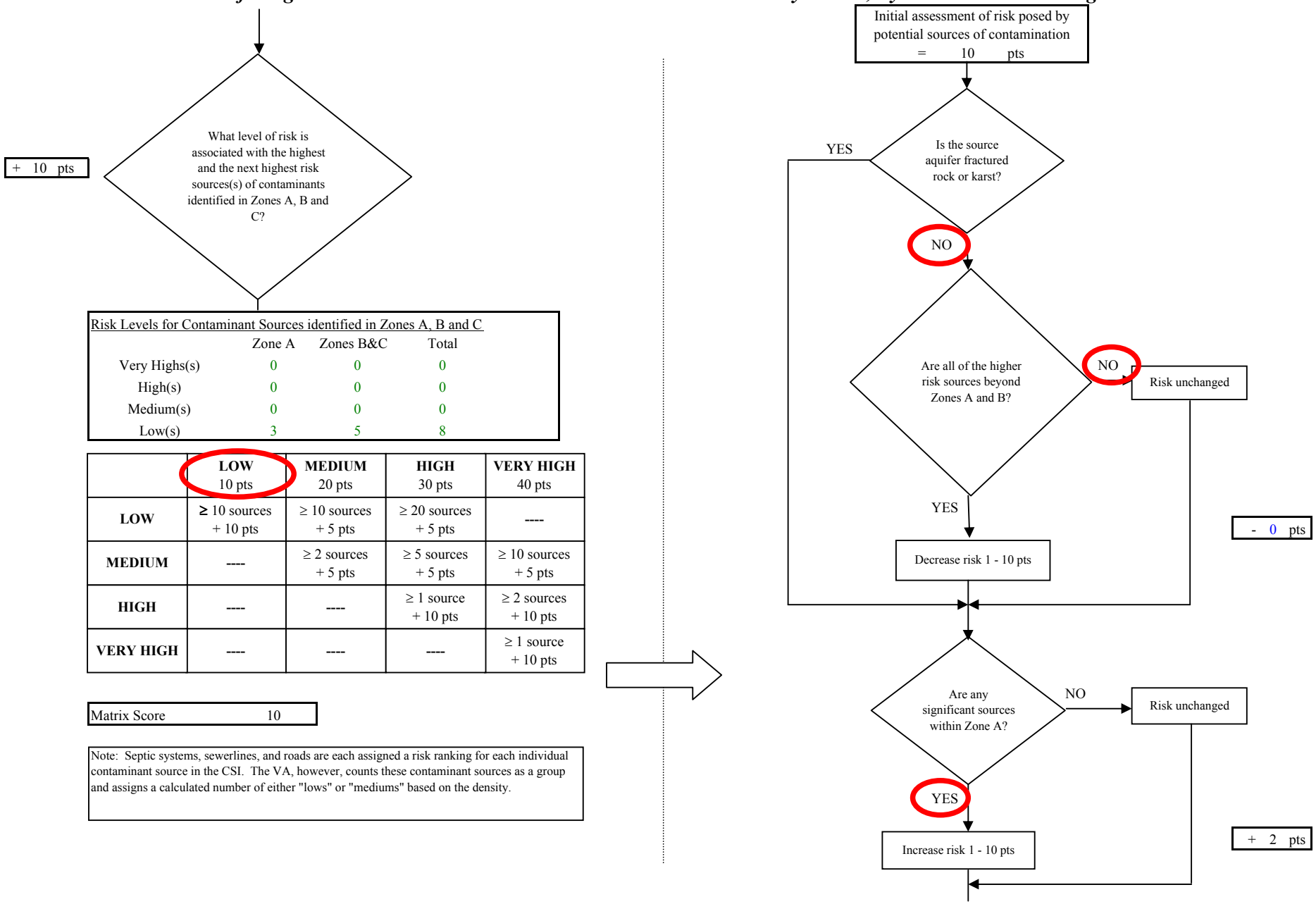


Chart 9. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Heavy Metals, Cyanide and Other Inorganic Chemicals



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)	3	5	8

	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 9. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Heavy Metals, Cyanide and Other Inorganic Chemicals

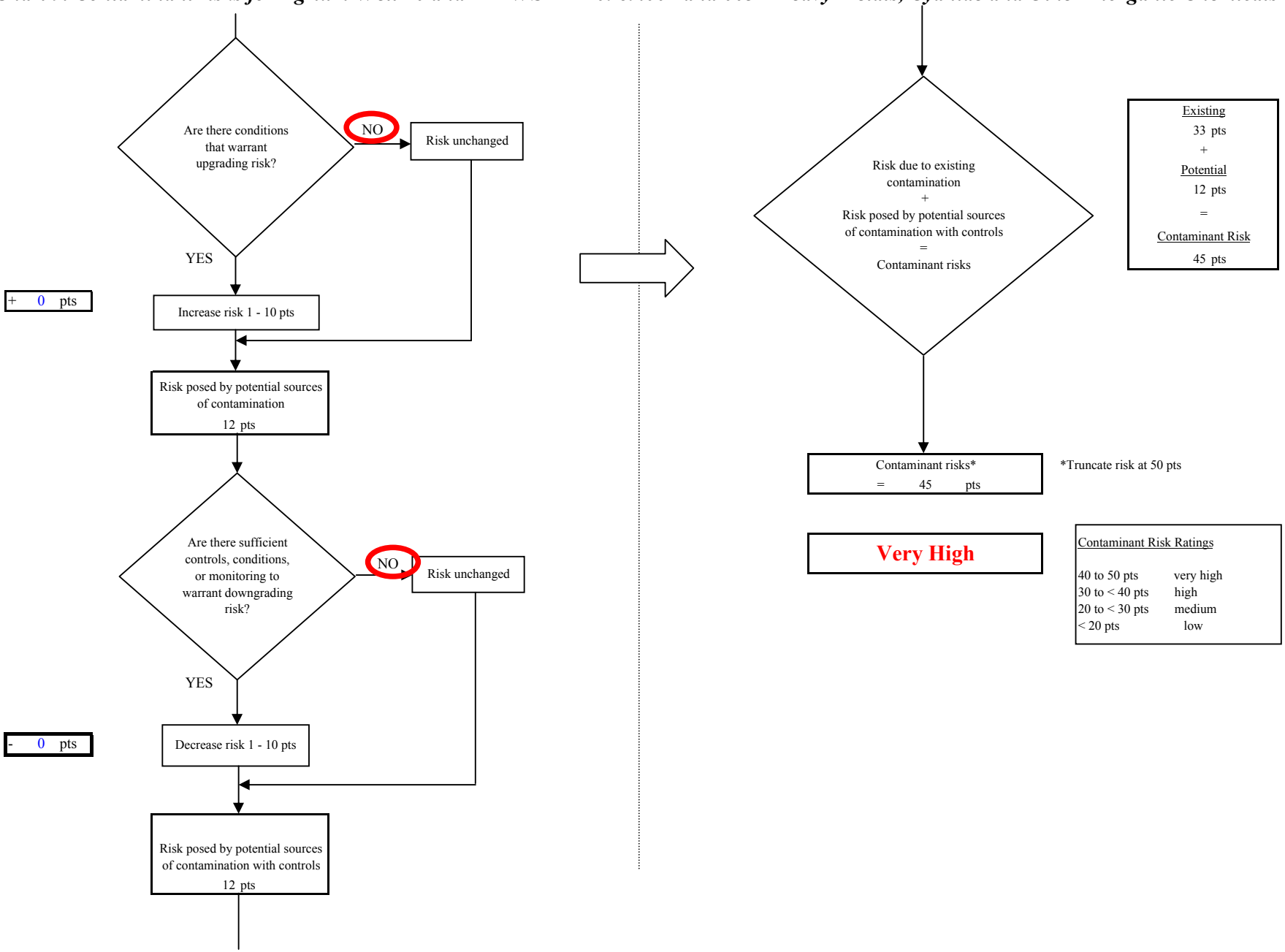


Chart 10. Vulnerability analysis for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Heavy Metals, Cyanide and Other Inorganic Chemicals

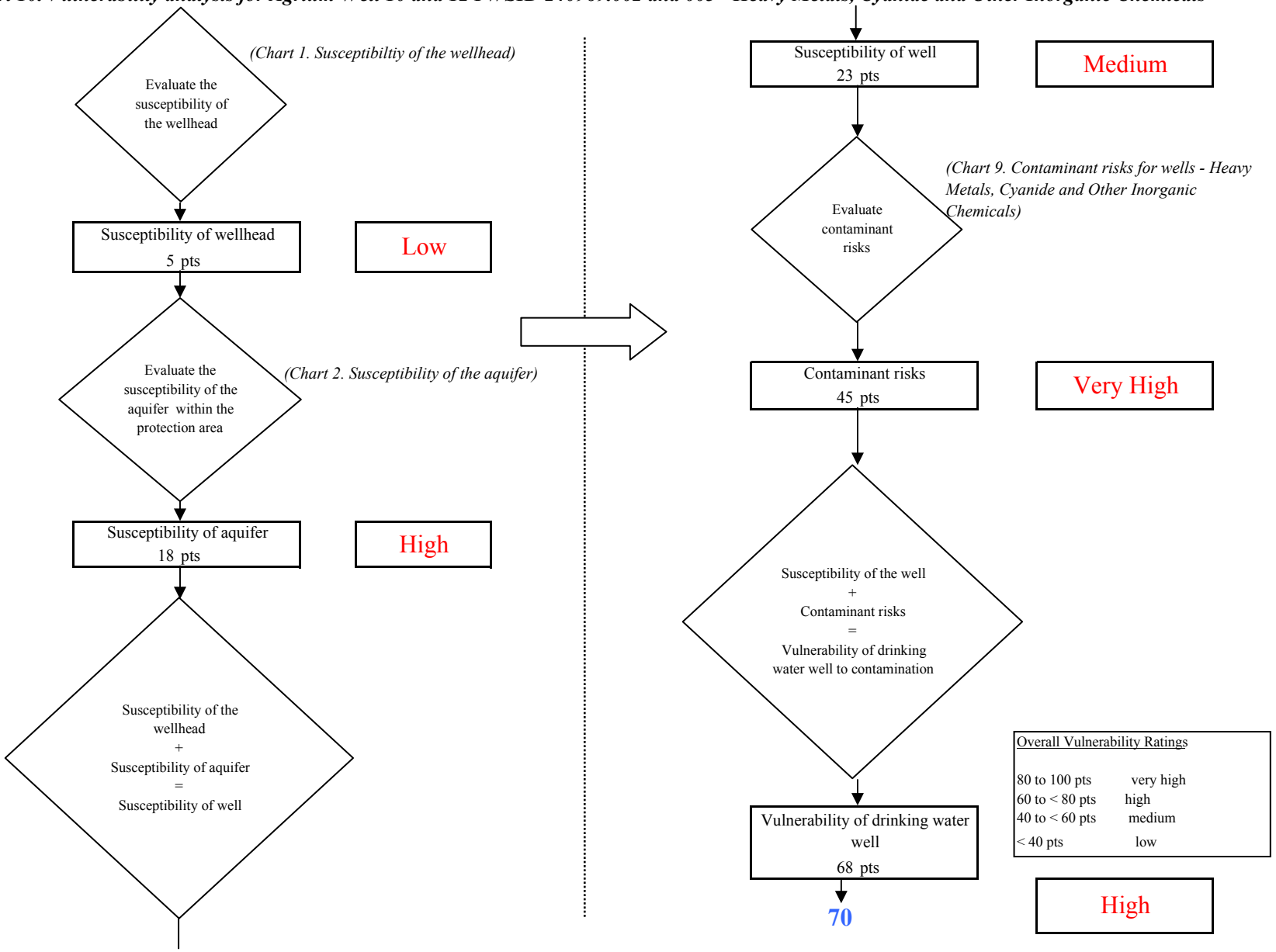


Chart 11. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Synthetic Organic Chemicals

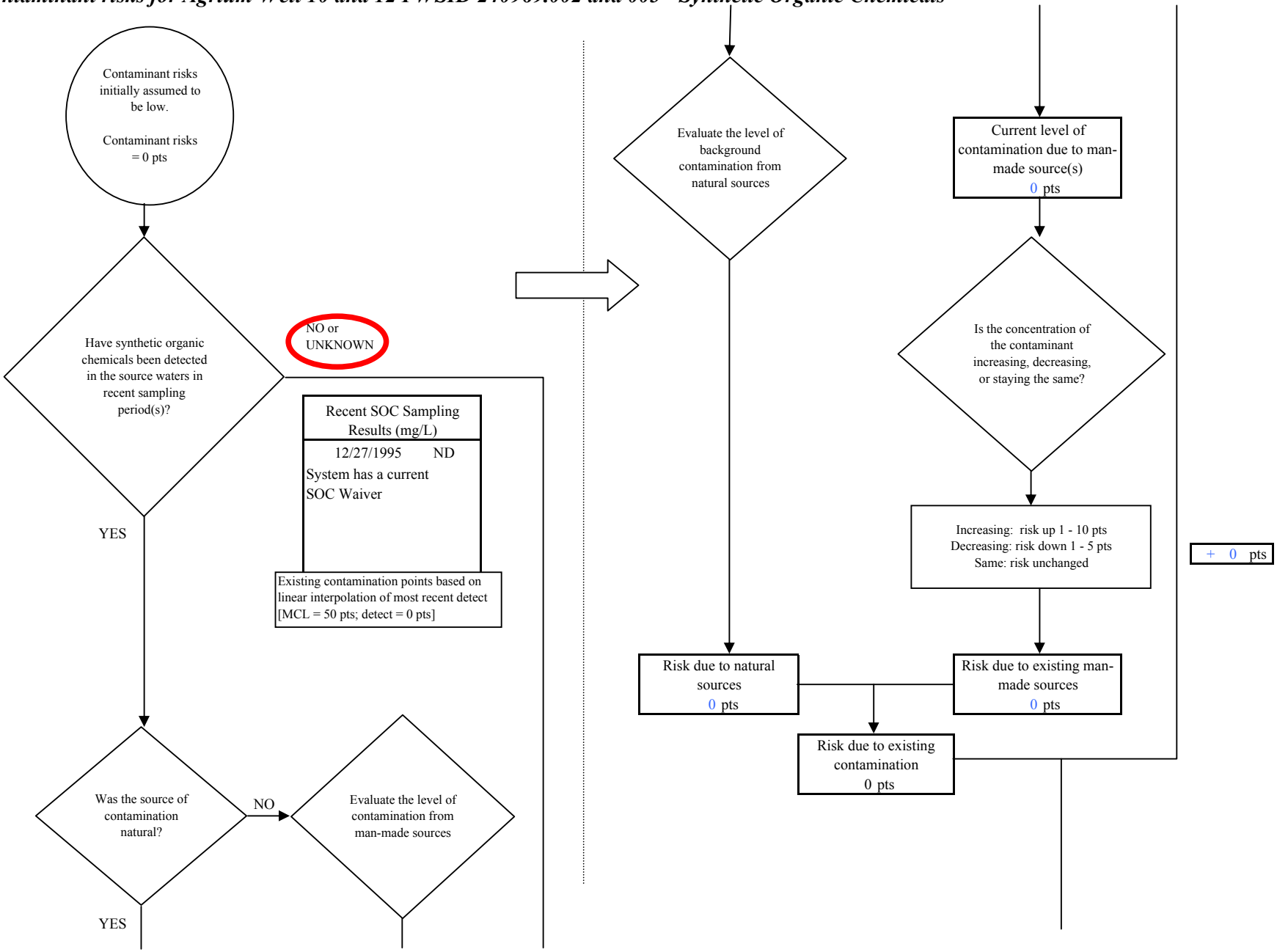


Chart 11. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Synthetic Organic Chemicals

+ 10 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)	0	0	0
Medium(s)	0	0	0
Low(s)	2	2	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.

Initial assessment of risk posed by potential sources of contamination = 10 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

+ 2 pts

Chart 11. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Synthetic Organic Chemicals

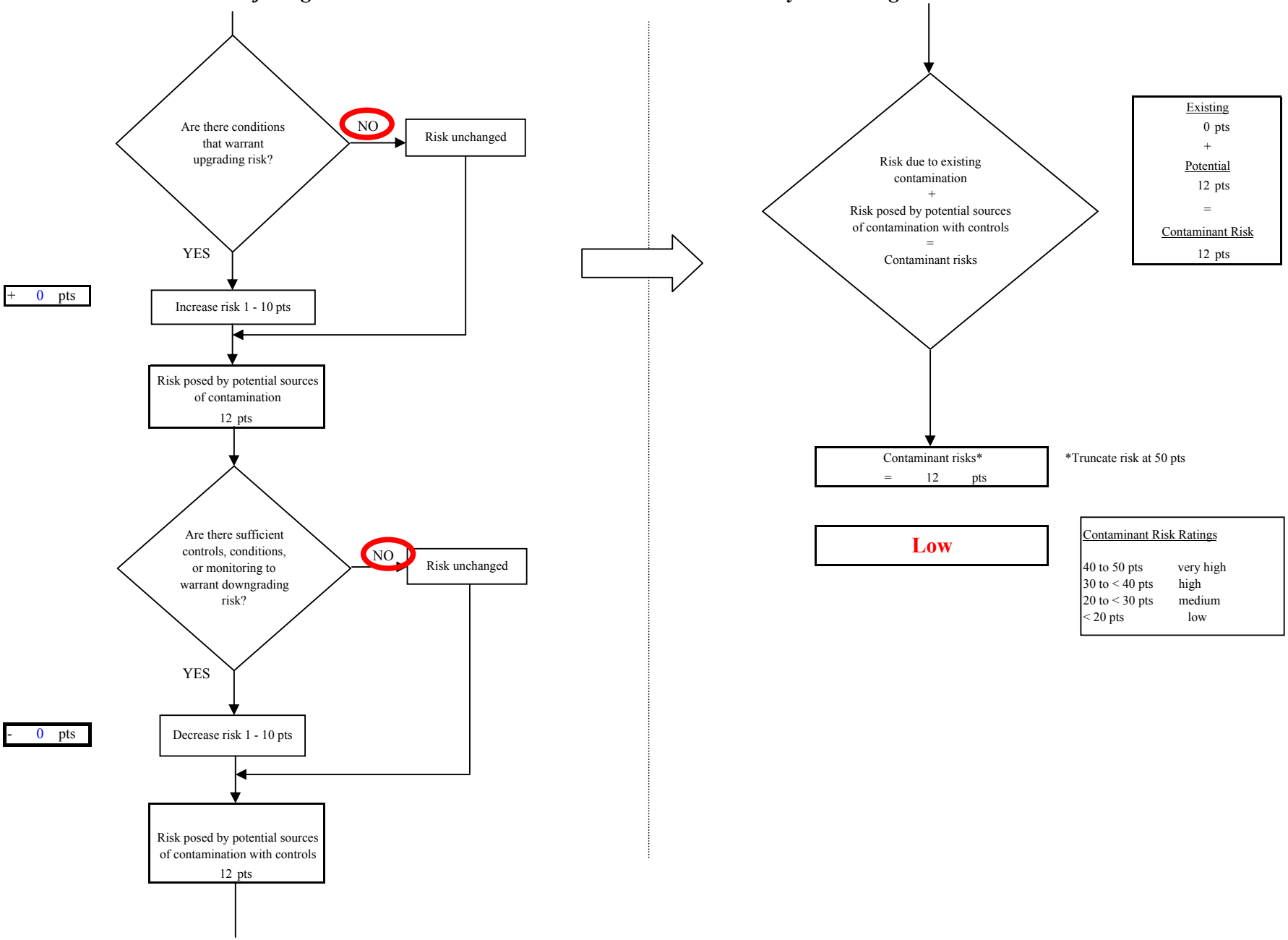


Chart 12. Vulnerability analysis for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Synthetic Organic Chemicals

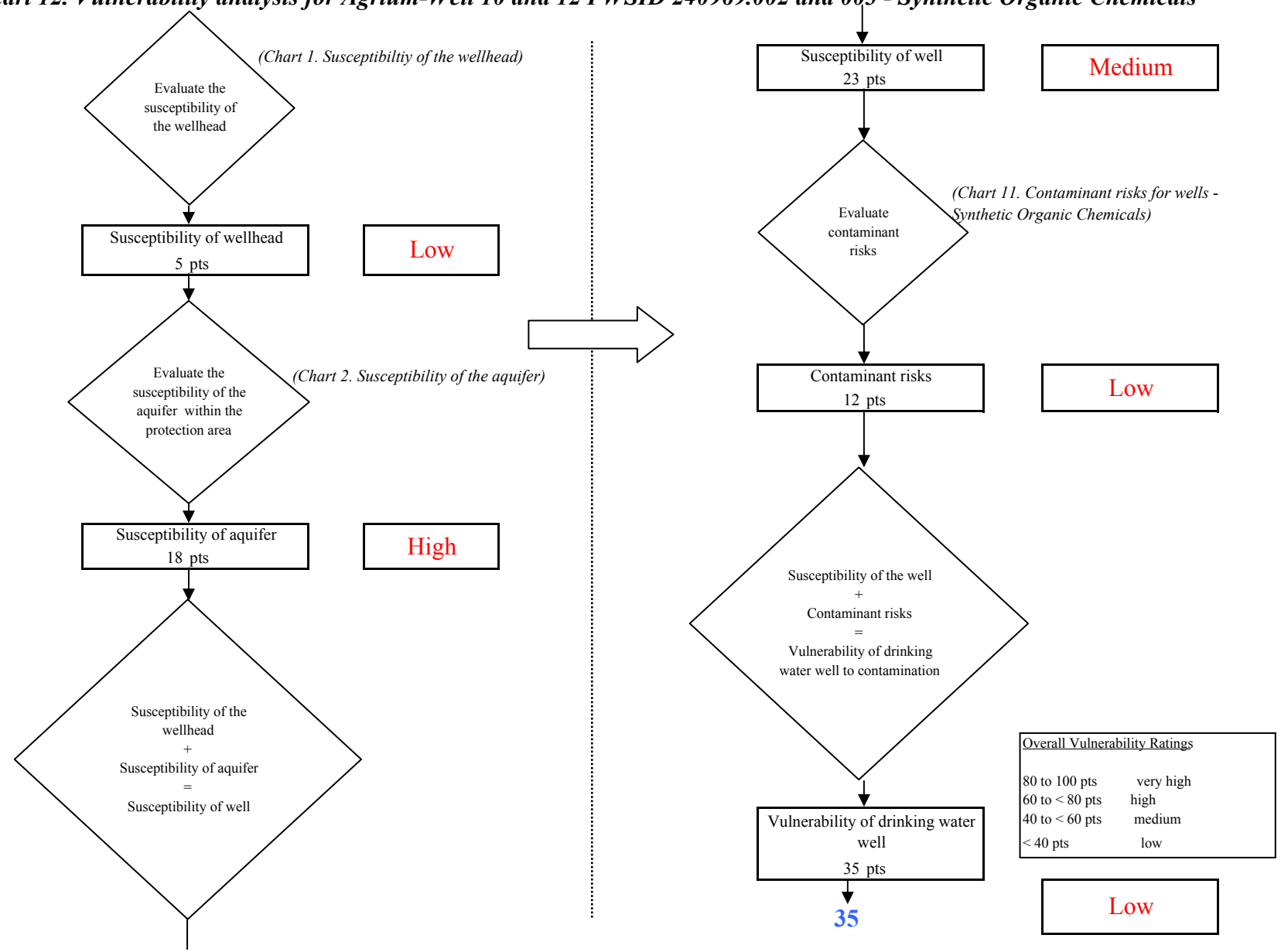


Chart 13. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Other Organic Chemicals

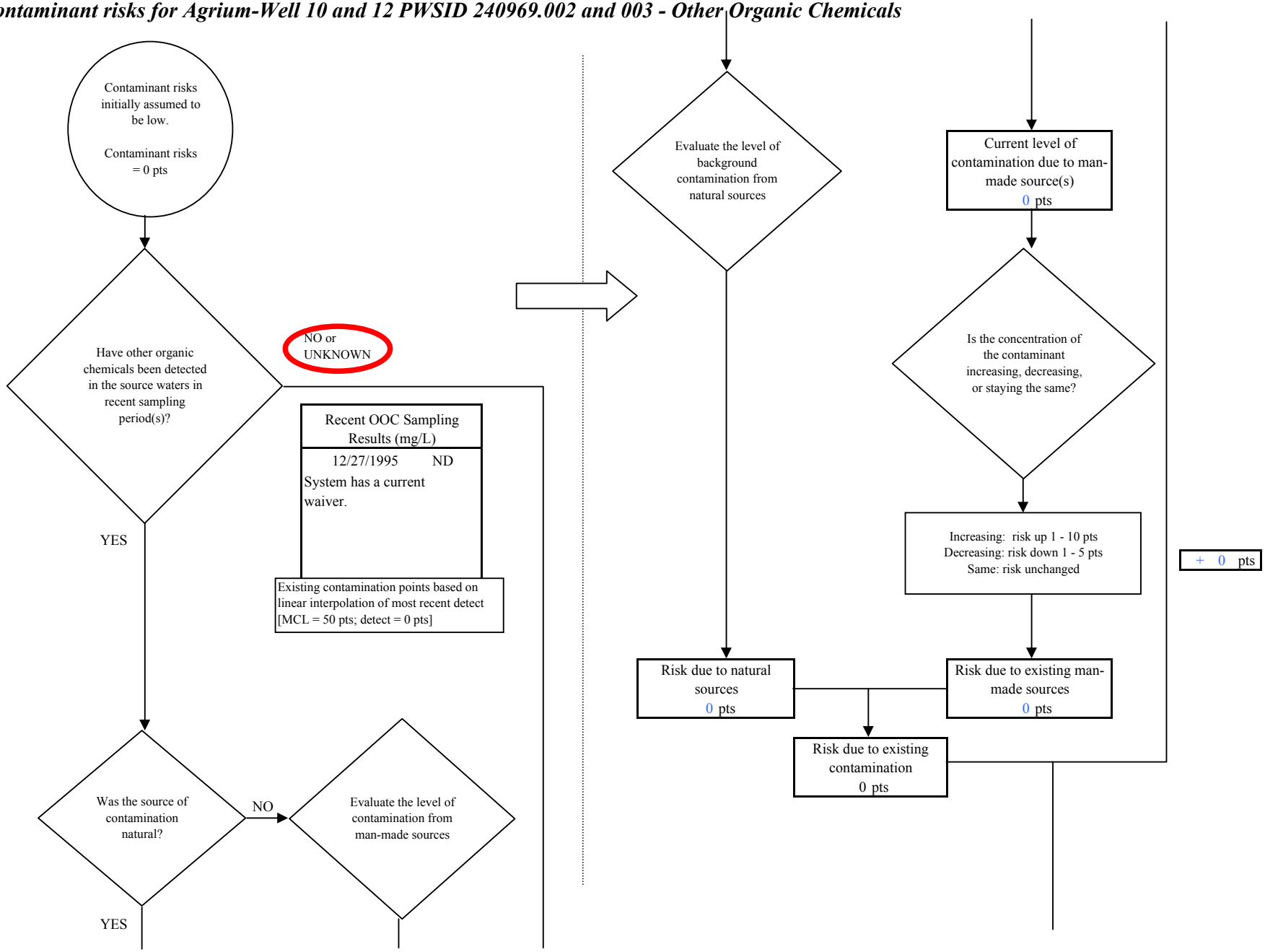
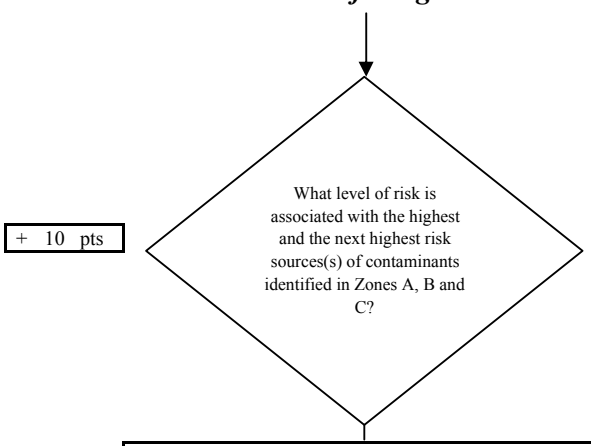


Chart 13. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Other Organic Chemicals



+ 10 pts

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)	3	3	6

	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.

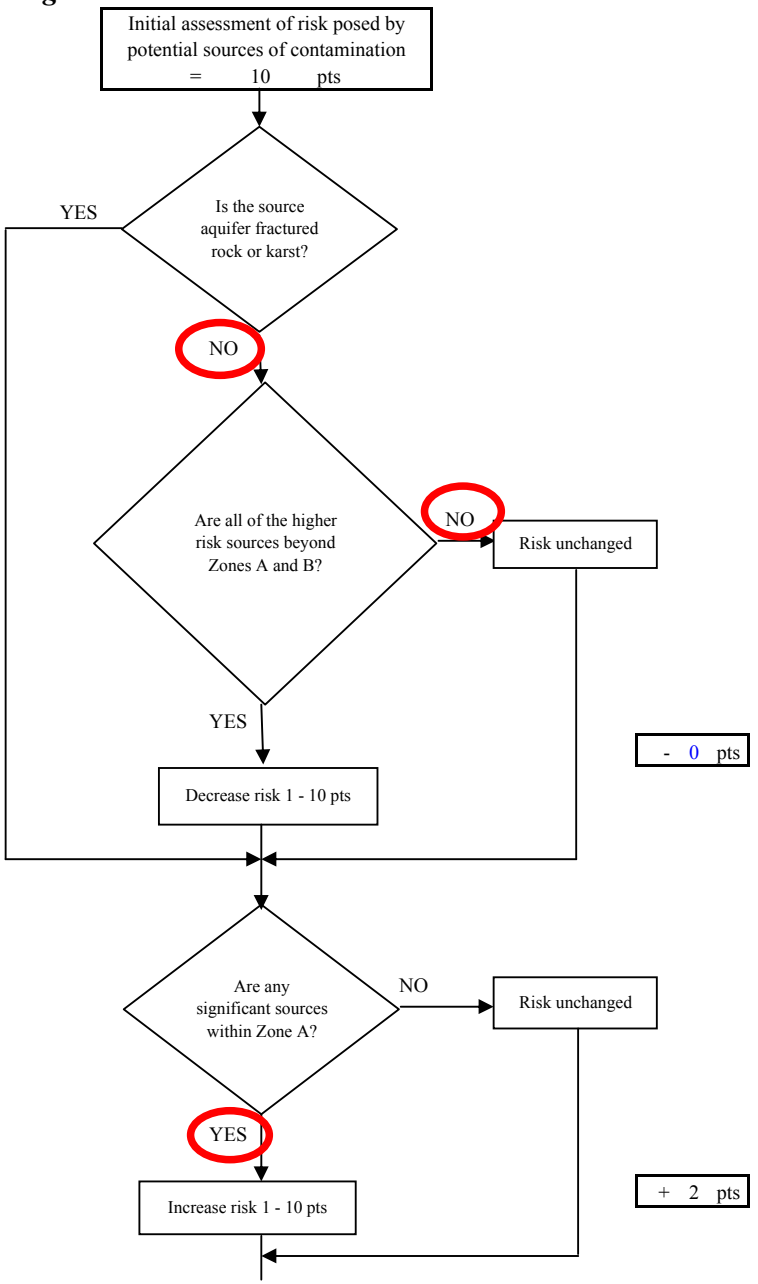


Chart 13. Contaminant risks for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Other Organic Chemicals

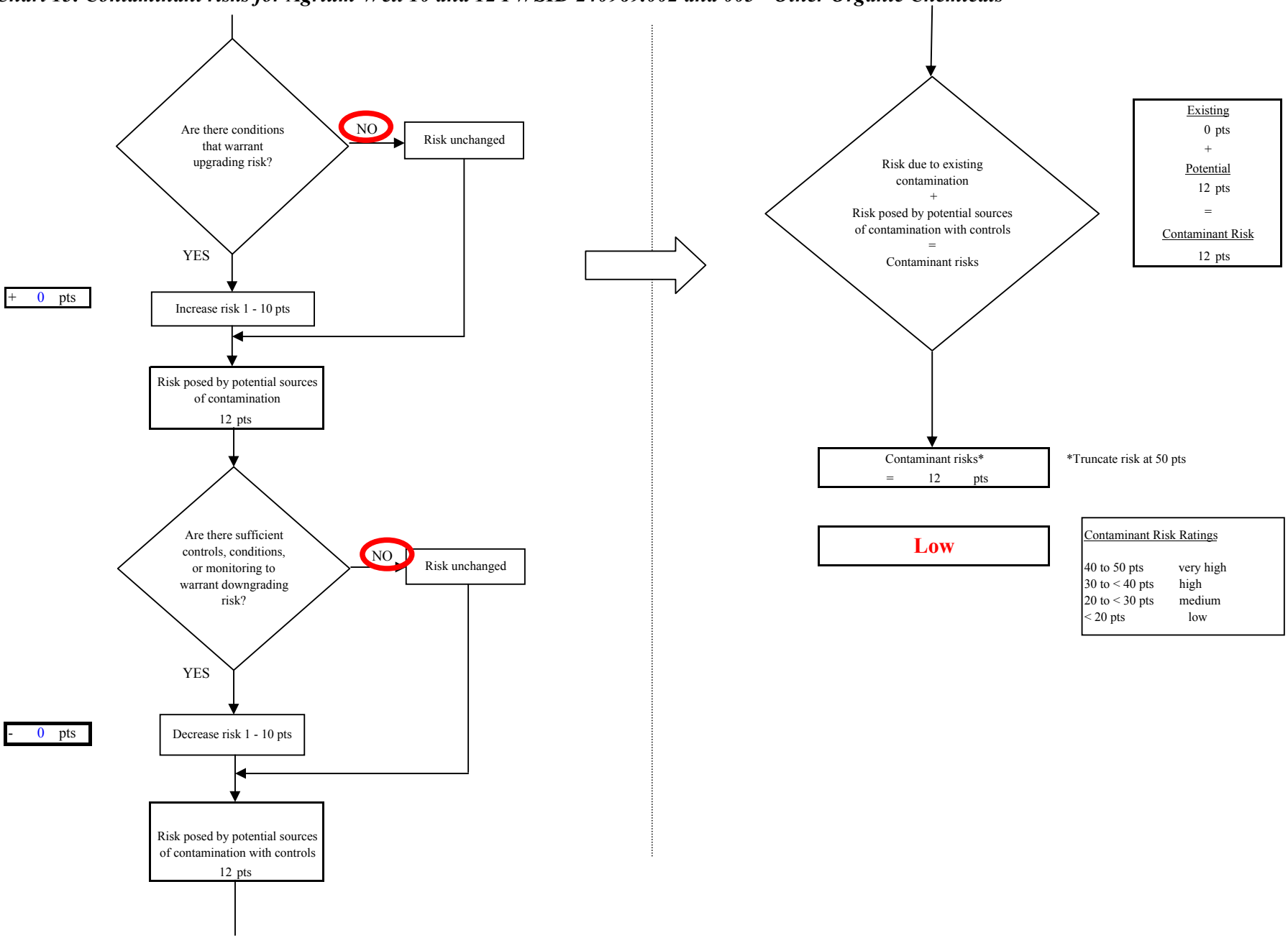


Chart 14. Vulnerability analysis for Agrium-Well 10 and 12 PWSID 240969.002 and 003 - Other Organic Chemicals