

Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Fox Creek Townhouses
Drinking Water System,
King Salmon, Alaska

PWSID # 261101.001

April 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1058
Alaska Department of Environmental Conservation

Source Water Assessment for Fox Creek Townhouses Drinking Water System King Salmon, Alaska

PWSID # 261101.001

DRINKING WATER PROTECTION PROGRAM REPORT 1058

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

EXECUTIVE SUMMARY	1	INVENTORY OF POTENTIAL AND EXISTING	
PUBLIC DRINKING WATER SYSTEM	1	CONTAMINANT SOURCES	2
DRINKING WATER PROTECTION AREA	2	RANKING OF CONTAMINANT RISKS	2
		VULNERABILITY OF DRINKING WATER	
		SYSTEM	3

TABLES

Table 1. Definition of Zones	2
Table 2. Susceptibility	3
Table 3. Contaminant Risks	3
Table 4. Overall Vulnerability	4

APPENDICES

APPENDIX	A. Fox Creek Townhouses Drinking Water Protection Area (Map A)
	B. Contaminant Source Inventory for Fox Creek Townhouses (Table 1)
	Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses – Bacteria and Viruses (Table 2)
	Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses – Nitrates/Nitrites (Table 3)
	Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses – Volatile Organic Chemicals (Table 4)
	Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses – Heavy Metals, Cyanide and Other Inorganic Chemicals (Table 5)
	Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses – Synthetic Organic Chemicals (Table 6)
	Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses – Other Organic Chemicals (Table 7)
	C. Fox Creek Townhouses Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)
	D. Vulnerability Analysis for Contaminant Source Inventory and Risk Ranking for Fox Creek Townhouses Public Drinking Water Source (Charts 1 – 14)

Source Water Assessment for Fox Creek Townhouses Source of Public Drinking Water, King Salmon, Alaska

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Fox Creek Townhouses have one Public Water System (PWS) well. The well (PWS No. 261101.001) has been used as a drinking water source since it was drilled in 1995.

The well is a Class A (community and non-transient non-community) water system located at Mile 13 of the Naknek-King Salmon Highway in King Salmon, Alaska. Available records indicate that there is no secondary storage of drinking water, other than two pressure tanks, and that the drinking water source is treated with ozone. This system operates year round and serves approximately 30 residents through twelve service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Low**. Combining these two ratings produce a **Low** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: domestic wastewater collection systems, large capacity septic systems, aboveground fuel tanks, an airport, roads, underground fuel tanks, and ADEC recognized contaminated sites and leaking underground storage tank (LUST) sites. These identified potential and existing sources of contamination are considered as 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 chemical contaminant categories.

Overall, the water well received a vulnerability rating of **Medium** for bacteria and viruses, nitrates and nitrites, and volatile organic chemicals, and a vulnerability rating of **Low** for heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The Fox Creek Townhouses well is a Class A (community/non-transient/non-community) public

water system. The system is located at Mile 13 of the Naknek-King Salmon Highway in King Salmon, Alaska (Sec. 23, T17S, R45W, Seward Meridian; see Map A of Appendix A). King Salmon is located on the north bank of the Naknek River near Bristol Bay. The community is located about 15 miles upriver from Naknek and 280 miles southwest of Anchorage. The community has a population of 392 (ADCED, 2003). Average annual precipitation in King Salmon is 20 inches, including approximately 45 inches of snowfall. Temperatures range from 42 to 63°F in summer and 29 to 44°F in winter. Temperatures can be as extreme as -46 to 88°F.

The community of King Salmon obtains most of their water supply from individual wells. Most households are served by the piped sewage collection system and the remaining households have individual septic tanks (ADCED, 2003). King Salmon receives electrical power from the Naknek Electric Association operated by the REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by the Peterson Sanitation Company and trucked to the landfill located at mile five of King Salmon-Naknek Road (ADCED, 2003).

According to information supplied by ADEC for the Fox Creek Townhouses PWS, the depth of the primary water well is 200 feet below the ground surface and is screened in a confined aquifer based on available construction details. The well is not located within a floodplain.

Information acquired from a March 2003 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

The entire Bristol Bay area was formerly covered by glaciers and the topography is representative of a

postglacial area. Soils information is limited. Generally, the soils consist of silty sand overlying relatively clean sand. The silty soils are slightly frost-susceptible. Isolated pockets of permafrost are scattered throughout the area (DOWL, 1982).

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 the Fox Creek Townhouses PWS. 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 the 2 year time-of-travel
C	Less Than the 5 year time -of-travel
D	Less than the 10 year time -of-travel

The DWPA for the Fox Creek Townhouses PWS was determined using an analytical calculation and includes Zones A, B, C, and D (See Map A of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Fox Creek Townhouses 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,
- Other organic chemicals.

The sources are displayed on Map C 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 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE DRINKING WATER SYSTEM

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

- Natural susceptibility, and
- Contaminant risks.

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 and 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.

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 Fox Creek Townhouses’ water well is in a confined aquifer. Confined aquifers are less susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the susceptibility scores and ratings for this PWS.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	7	Low
Natural Susceptibility	7	Low

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	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	22	Medium
Synthetic Organic Chemicals	30	High
Other Organic Chemicals	30	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:

$$\begin{array}{r}
 \text{Natural Susceptibility (0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100).}
 \end{array}$$

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	55	Medium
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	55	Medium
Heavy Metals, Cyanide and Other Inorganic Chemicals	30	Low
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	35	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of large capacity septic systems in Zone A (see Table 2 – Appendix B).

No positive bacteria counts have been reported in recent (within five years) sampling events (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.

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 **Medium**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High**. The risk to this source of public drinking water is primarily attributed to the presence of large capacity septic systems in Zone A (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for this well indicates that low levels of nitrates have been detected in recent sampling events. However, the reported concentrations of nitrates do not exceed the maximum contaminant level (MCL) of 10 mg/L. 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 (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources. After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to nitrate and nitrite contamination is **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of an airport, and ADEC contaminated sites and LUST sites in Zones A, B, C, and D. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

A detectable concentration of dichloromethane was reported in a sampling event for this public water system. However, the detectable concentration of dichloromethane reported in 2000 was well below the MCL of 0.08 mg/L. Dichloromethane is considered a possible laboratory contaminant and is not from the source waters. Since the reported concentration of dichloromethane in recent sampling events did not exceed the applicable MCL, risk points were not retained.

Aside from being possible laboratory contaminants, possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports. See Table 4 in Appendix B for a complete listing.

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 **Medium**.

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Medium**. The risk is primarily attributed to the lack of contaminant sources present in Zone (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of copper and lead have been detected, but have not exceeded their respective MCLs of 1.3 mg/L and 0.015 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper and lead in recent sampling events are not likely to be representative of source water conditions. These two analytes are likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on the presence of these analytes.

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

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **High**. The risk is primarily attributed to the presence of an airport in Zones A, B, C, and D. Numerous other potential contaminant sources are

also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the Fox Creek Townhouses (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

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

Other Organic Chemicals

The contaminant risk for other organic chemicals is **High**. The risk is primarily attributed to the presence of an airport in Zones A, B, C, and D. Numerous other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the Fox Creek Townhouses (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

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

Using the Source Water Assessment

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the Fox Creek Townhouses and the community of King Salmon to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

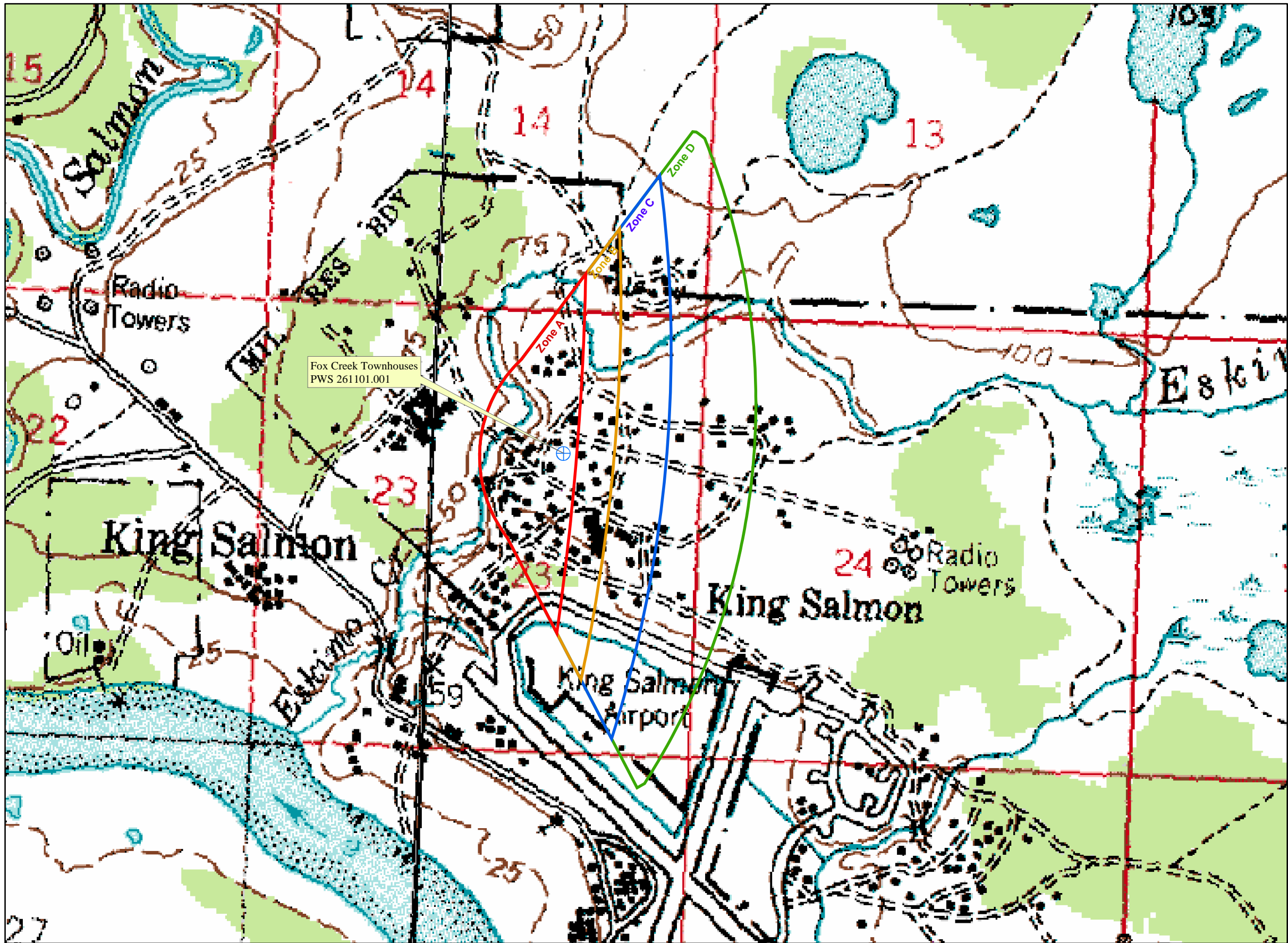
REFERENCES

- Alaska Department of Community and Economic Development (ADCED), 2003 [WWW document]. URL: http://www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm
- Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL http://www.state.ak.us/dec/dspar/csites/cs_search.htm
- Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp
- DOWL Engineers (DOWL), 1982, Upper Bristol Bay Region Community Planning Profiles.
- Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey
- United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL <http://www.epa.gov/safewater/mcl.html>.

APPENDIX A

Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWS #261101.001 Fox Creek Townhouses



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

Groundwater Protection Zones

- Zone A Protection Area- Several Months Travel Time
- Zone B Protection Area- 2 Years Travel Time
- Zone C Protection Area- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

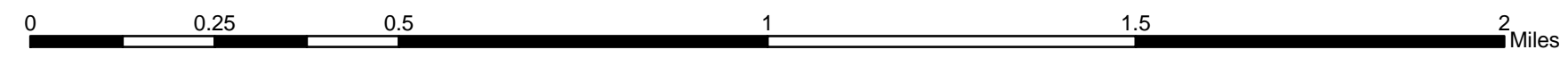
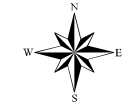
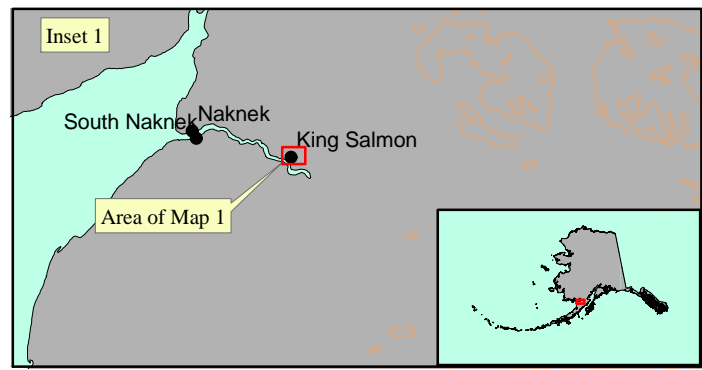
Data Sources:
 Contaminant Sources, Public Water System Wells, Contours
 Alaska Department of Environmental Conservation (ADEC)

Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
 United States Geological Survey (USGS)

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

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



APPENDIX B

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

Table 1

**Contaminant Source Inventory for
Fox Creek Townhouses**

PWSID 261101.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	C	4-Plex
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 20 or less heating oil tanks in Zone A
Airports	X14	X14-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-02	B	C	Assume municipal sewage available in Zone B
Tanks, heating oil, residential (above ground)	R08	R08-02	B	C	Assume 20 or less heating oil tanks in Zone B
Closed tanks, heating oil, nonresidential (underground)	T17	T17-01	B	C	Katmai National Park & Preserve
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	B	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Status: Inactive, diesel UST system removed and in the process broke the supply line to boiler room at the alert cell. UST replaced with no soil remediation, amount of GW contamination is unknown.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	C	Trident Seafoods/Farwest Fisheries, RecKey #1994250015751, Event ID 796, Facility ID 2653, petroleum contaminated soils occurred as a result of releases from an Avgas UST.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	B	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Event ID 652, Facility ID 540, during removal of diesel UST, supply line to boiler room broke. UST replaced with no soil remediation, amount of GW contamination unknown.
Airports	X14	X14-02	B	C	
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-03	C	C	Assume municipal sewage available in Zone C
Tanks, heating oil, residential (above ground)	R08	R08-03	C	C	Assume 20 or less heating oil tanks in Zone C

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Bacteria and Viruses*

PWSID 261101.001

Table 2

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	C	4-Plex
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-02	B	Medium	C	Assume municipal sewage available in Zone B
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-03	C	Medium	C	Assume municipal sewage available in Zone C
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Highways and roads, dirt/gravel	X24	X24-04	D	Low	C	Assume 1-20 roads in Zone D

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Nitrates/Nitrites*

PWSID 261101.001

Table 3

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Medium	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	C	4-Plex
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-02	B	Medium	C	Assume municipal sewage available in Zone B
Airports	X14	X14-02	B	Low	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-03	C	Medium	C	Assume municipal sewage available in Zone C
Airports	X14	X14-03	C	Low	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Airports	X14	X14-04	D	Low	C	
Highways and roads, dirt/gravel	X24	X24-04	D	Low	C	Assume 1-20 roads in Zone D

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Volatile Organic Chemicals*

PWSID 261101.001

Table 4

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	4-Plex
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 20 or less heating oil tanks in Zone A
Airports	X14	X14-01	A	High	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-02	B	Low	C	Assume municipal sewage available in Zone B
Tanks, heating oil, residential (above ground)	R08	R08-02	B	Medium	C	Assume 20 or less heating oil tanks in Zone B
Closed tanks, heating oil, nonresidential (underground)	T17	T17-01	B	Medium	C	Katmai National Park & Preserve
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	B	High	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Status: Inactive diesel UST system removed and in the process broke the supply line to boiler room at the alert cell. UST replaced with no soil remediation, amount of C contamination is unknown.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	High	C	Trident Seafoods/Farwest Fisheries, RecKey #1994250015751, Event ID 7 Facility ID 2653, petroleum contaminated soils occurred as a result of release from an Avgas UST.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	B	High	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Event ID 652 Facility ID 540, during removal of diesel UST, supply line to boiler room broke. UST replaced with no soil remediation, amount of GW contamination unknown.
Airports	X14	X14-02	B	High	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-03	C	Low	C	Assume municipal sewage available in Zone C
Tanks, heating oil, residential (above ground)	R08	R08-03	C	Medium	C	Assume 20 or less heating oil tanks in Zone C

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Volatile Organic Chemicals*

PWSID 261101.001

Table 4 (continued)

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Airports	X14	X14-03	C	High	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Tanks, heating oil, residential (above ground)	R08	R08-04	D	Medium	C	Assume 20 or less heating oil tanks in Zone D
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-02	D	High	C	King Salmon AS OT028 GW Zone 2, RecKey #199625X928902, Status: Active, DRO, GRO, BTEX, and TCE groundwater contamination.
Airports	X14	X14-04	D	High	C	
Highways and roads, dirt/gravel	X24	X24-04	D	Low	C	Assume 1-20 roads in Zone D

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses*

PWSID 261101.001

Table 5

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	4-Plex
Airports	X14	X14-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-02	B	Low	C	Assume municipal sewage available in Zone B
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	B	Low	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Status: Inactive diesel UST system removed and in the process broke the supply line to boiler room at the alert cell. UST replaced with no soil remediation, amount of contamination is unknown.
Airports	X14	X14-02	B	Low	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-03	C	Low	C	Assume municipal sewage available in Zone C
Airports	X14	X14-03	C	Low	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-02	D	Low	C	King Salmon AS OT028 GW Zone 2, RecKey #199625X928902, Status: Active, DRO, GRO, BTEX, and TCE groundwater contamination.
Airports	X14	X14-04	D	Low	C	
Highways and roads, dirt/gravel	X24	X24-04	D	Low	C	Assume 1-20 roads in Zone D

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Synthetic Organic Chemicals*

PWSID 261101.001

Table 6

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	4-Plex
Airports	X14	X14-01	A	Medium	C	
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-02	B	Low	C	Assume municipal sewage available in Zone B
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	B	Low	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Status: Inactive, diesel UST system removed and in the process broke the supply line to boiler room at the alert cell. UST replaced with no soil remediation, amount of contamination is unknown.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	Low	C	Trident Seafoods/Farwest Fisheries, RecKey #1994250015751, Event ID 7 Facility ID 2653, petroleum contaminated soils occurred as a result of release from an Avgas UST.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	B	Low	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Event ID 652 Facility ID 540, during removal of diesel UST, supply line to boiler room broke. UST replaced with no soil remediation, amount of GW contamination unknown.
Airports	X14	X14-02	B	Medium	C	
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-03	C	Low	C	Assume municipal sewage available in Zone C
Airports	X14	X14-03	C	Medium	C	
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-02	D	Low	C	King Salmon AS OT028 GW Zone 2, RecKey #199625X928902, Status: Active, DRO, GRO, BTEX, and TCE groundwater contamination.
Airports	X14	X14-04	D	Medium	C	

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Other Organic Chemicals*

PWSID 261101.001

Table 7

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-01	A	Low	C	Assume municipal sewage available in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	Triplex
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	4-Plex
Airports	X14	X14-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-02	B	Low	C	Assume municipal sewage available in Zone B
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-01	B	Low	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Status: Inactive diesel UST system removed and in the process broke the supply line to boiler room at the alert cell. UST replaced with no soil remediation, amount of C contamination is unknown.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	Low	C	Trident Seafoods/Farwest Fisheries, RecKey #1994250015751, Event ID 7 Facility ID 2653, petroleum contaminated soils occurred as a result of release from an Avgas UST.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	B	Low	C	King Salmon Combat Alert Cell, RecKey #199225X014202, Event ID 652 Facility ID 540, during removal of diesel UST, supply line to boiler room broke. UST replaced with no soil remediation, amount of GW contamination unknown.
Airports	X14	X14-02	B	Medium	C	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Domestic wastewater collection systems (sewer line or lift stations)	D01	D01-03	C	Low	C	Assume municipal sewage available in Zone C
Airports	X14	X14-03	C	Medium	C	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	C	Assume 1-20 roads in Zone C
Contaminated sites, DEC recognized, non-Superfund non-RCRA	U04	U04-02	D	Low	C	King Salmon AS OT028 GW Zone 2, RecKey #199625X928902, Status: Active, DRO, GRO, BTEX, and TCE groundwater contamination.
Airports	X14	X14-04	D	Medium	C	

Table 7 (continued)

*Contaminant Source Inventory and Risk Ranking for
Fox Creek Townhouses
Sources of Other Organic Chemicals*

PWSID 261101.001

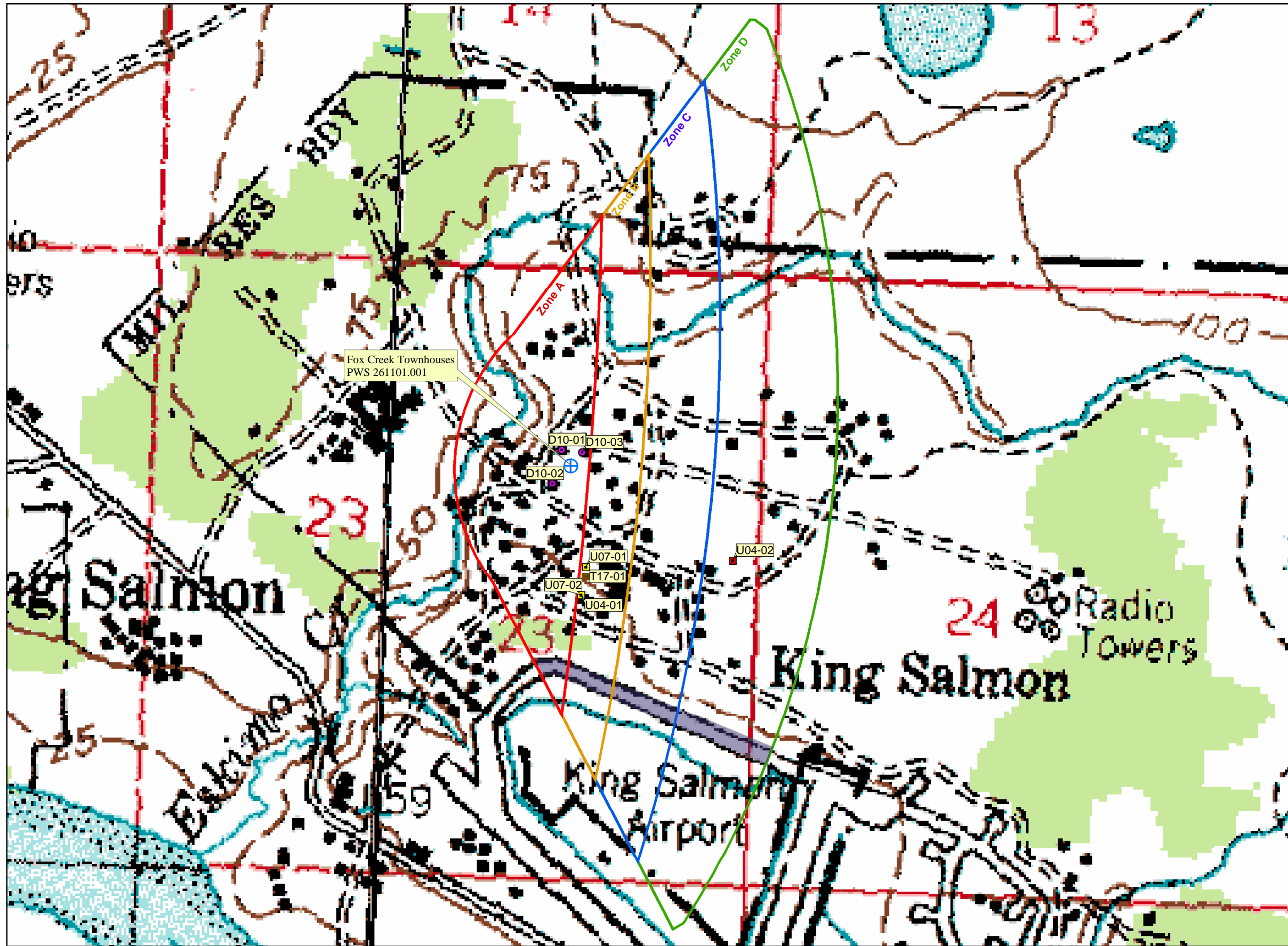
<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-04	D	Low	C	Assume 1-20 roads in Zone D

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Airports	X14	X14-03	C	C	
Highways and roads, dirt/gravel	X24	X24-03	C	C	Assume 1-20 roads in Zone C
Tanks, heating oil, residential (above ground)	R08	R08-04	D	C	Assume 20 or less heating oil tanks in Zone D
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	D	C	King Salmon AS OT028 GW Zone 2, RecKey #199625X928902, Status: Active, DRO, GRO, BTEX, and TCE groundwater contamination.
Airports	X14	X14-04	D	C	
Highways and roads, dirt/gravel	X24	X24-04	D	C	Assume 1-20 roads in Zone D

APPENDIX C

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

**Public Water Well System for PWS #261101.001 Fox Creek Townhouses
Showing Potential and Existing Sources of Contamination**



LEGEND

- Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

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

Groundwater Protection Zones

- Zone A Protection Area- Several Months Travel Time
- Zone B Protection Area- 2 Years Travel Time
- Zone C Protection Area- 5 Years Travel Time
- Zone D Protection Area- 10 Years Travel Time

Existing or Potential Contaminant Sources

- Injection wells (Class V) Large-capacity septic system (Drainfield disposal method) (D10)
- Closed tanks, heating oil, nonresidential (underground) (T17)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
- Open leaking underground fuel storage tank (LUST) (lubricants or other petroleum products) (U07)
- Airports/landing strips (X14)

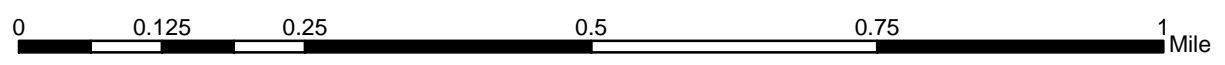
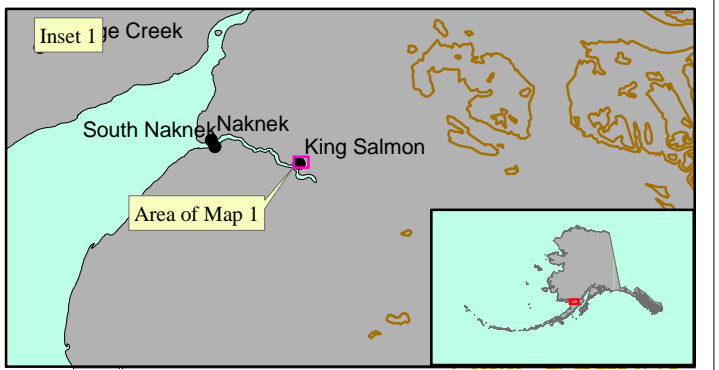
Data Sources:

Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)
Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:

United States Geological Survey (USGS)
Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

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



APPENDIX D

Vulnerability Analysis for Public Drinking Water Source (Charts 1-14)

Chart 1. Susceptibility of the wellhead - Fox Creek Townhouses (PWS No. 261101.001)

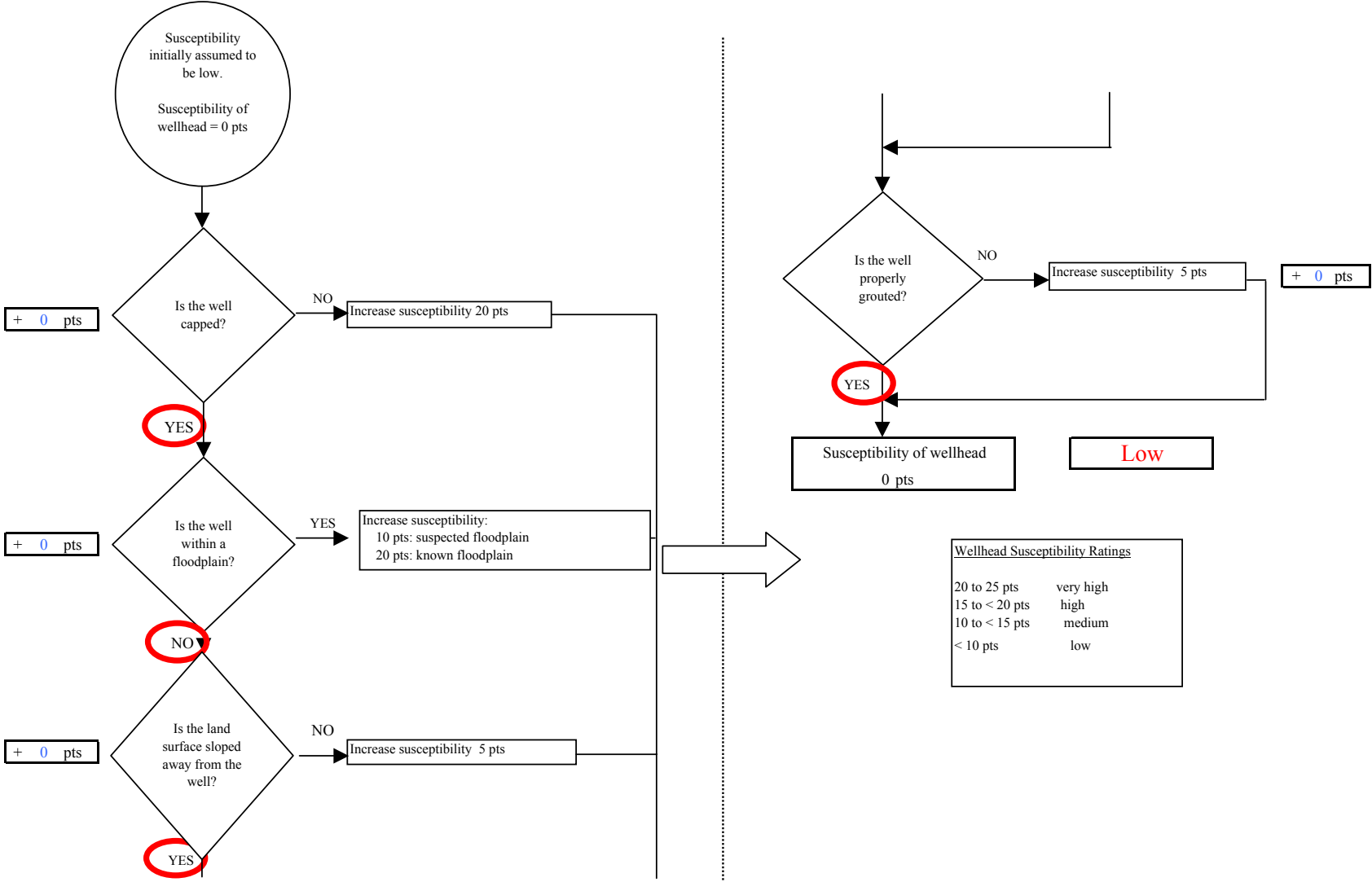


Chart 2. Susceptibility of the aquifer Fox Creek Townhouses (PWS No. 261101.001)

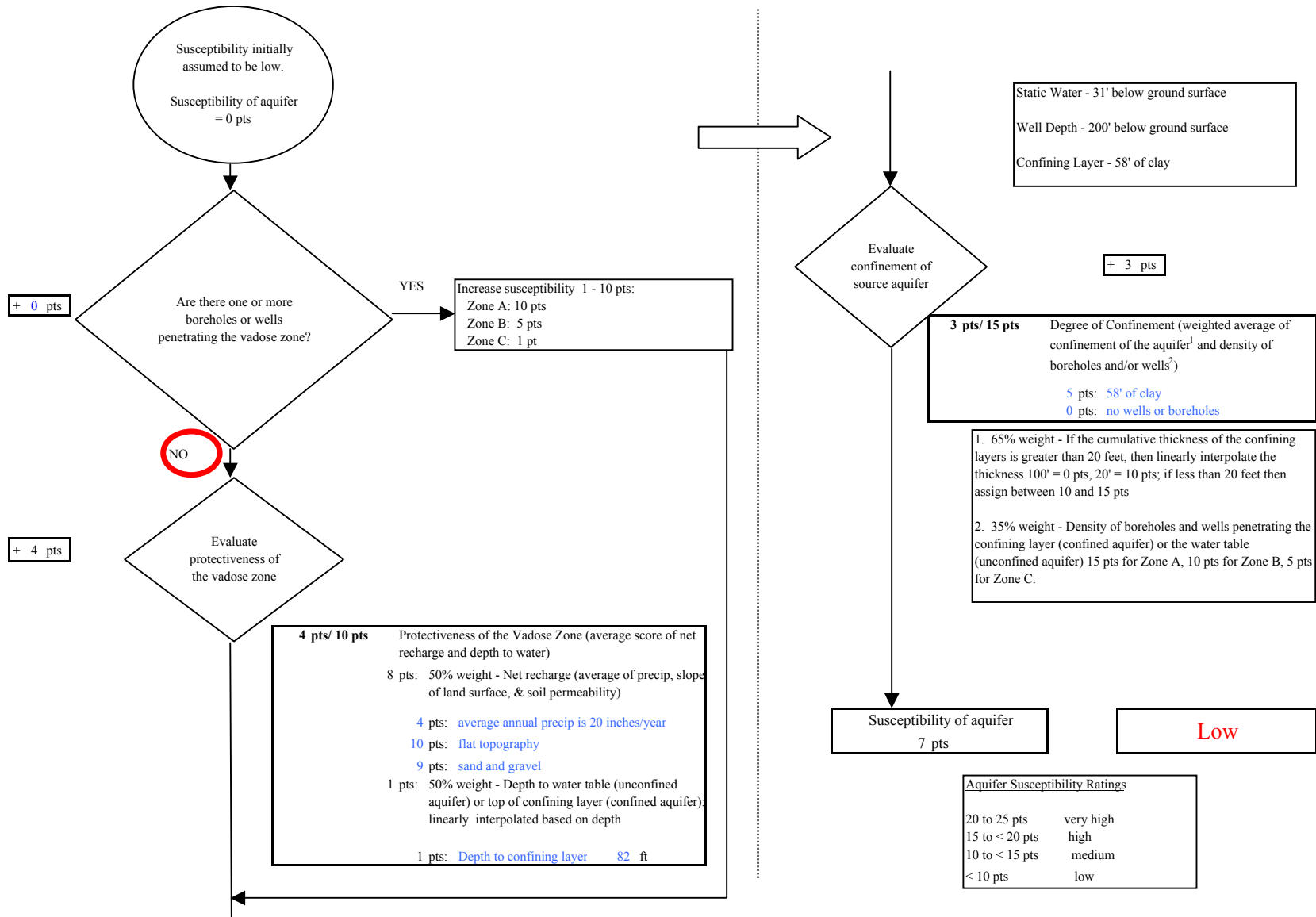


Chart 3. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Bacteria & Viruses

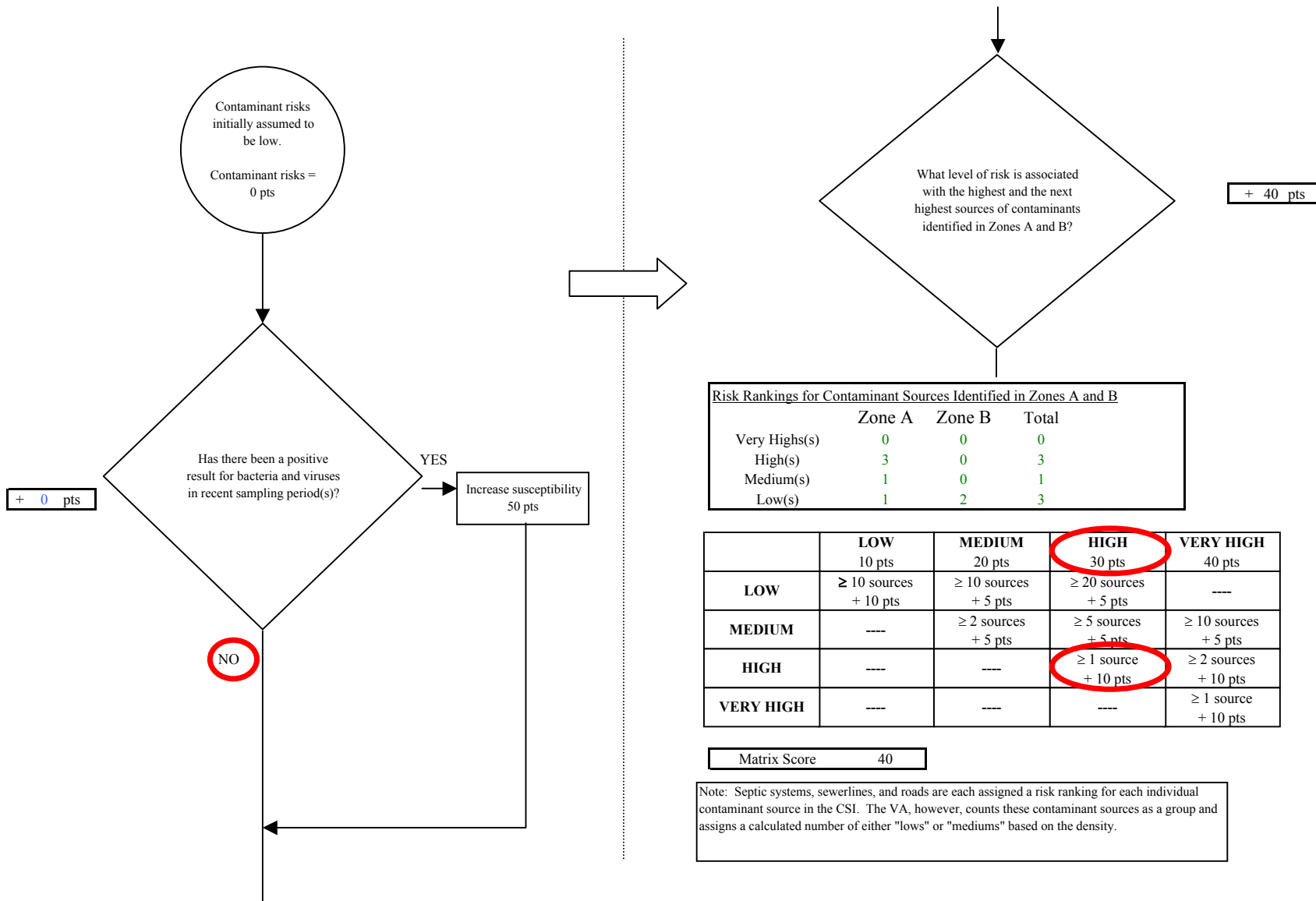


Chart 3. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Bacteria & Viruses

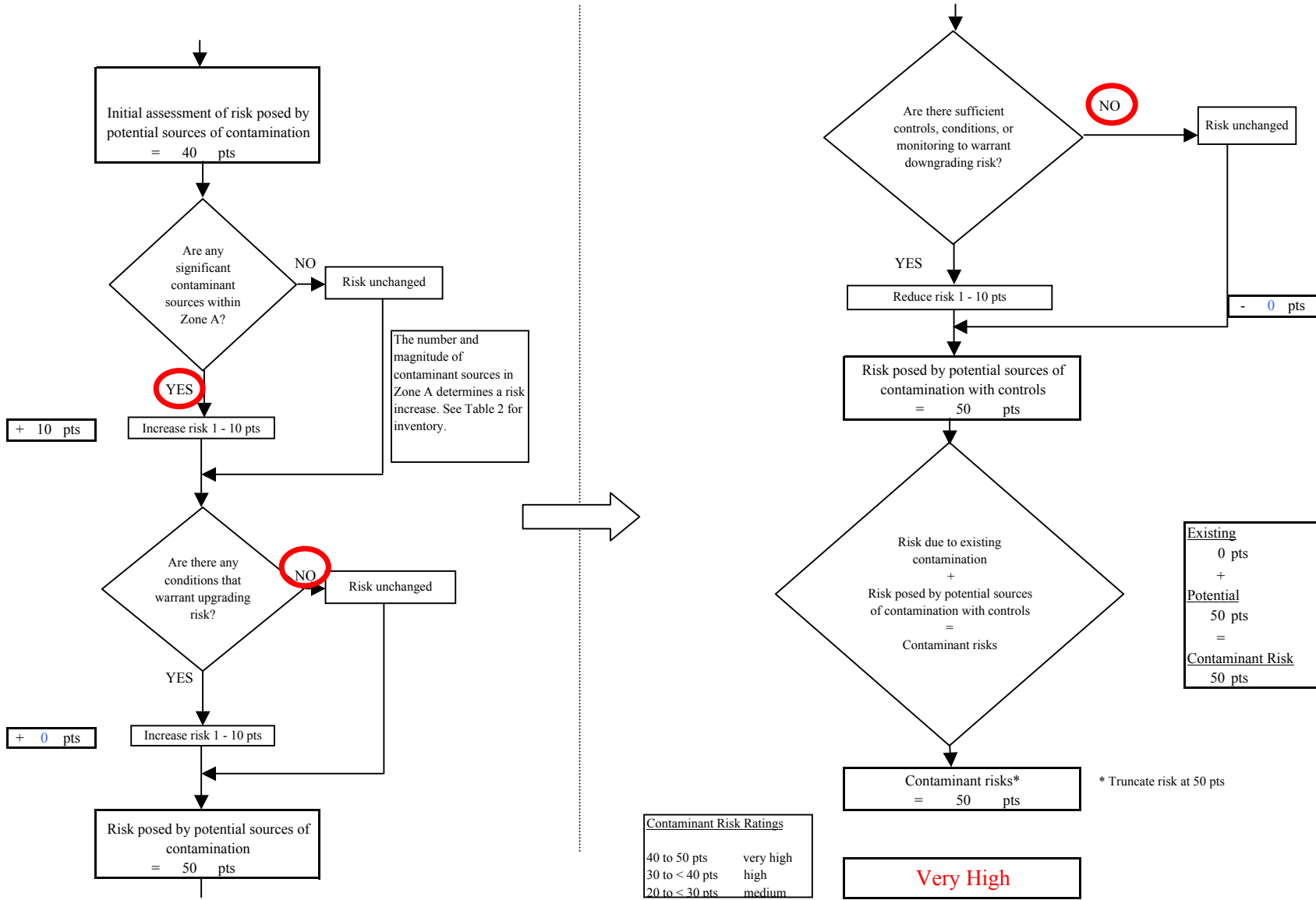


Chart 4. Vulnerability analysis for Fox Creek Townhouses (PWS No. 261101.001) - Bacteria & Viruses

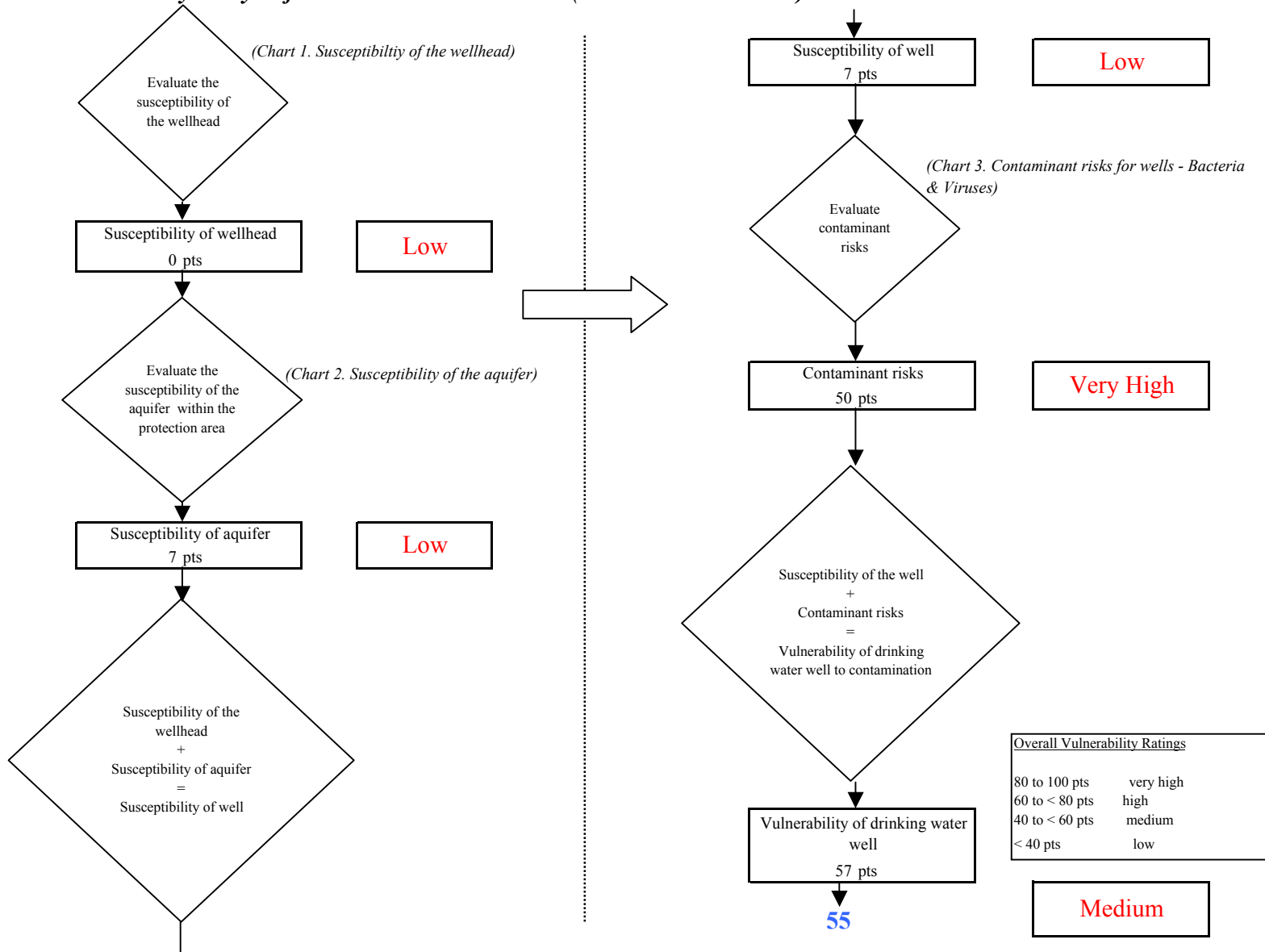


Chart 5. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Nitrates and Nitrites

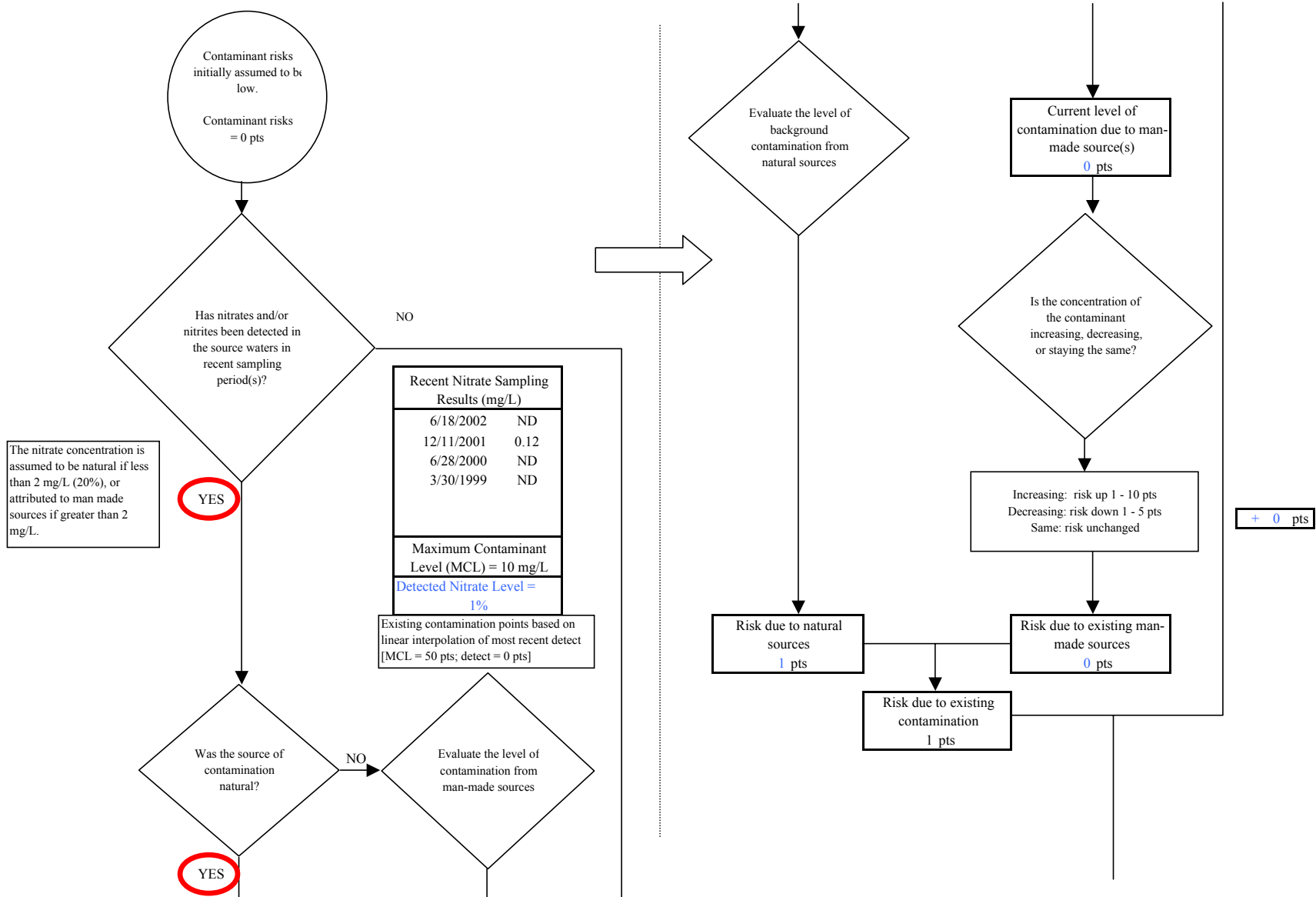


Chart 5. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Nitrates and Nitrites

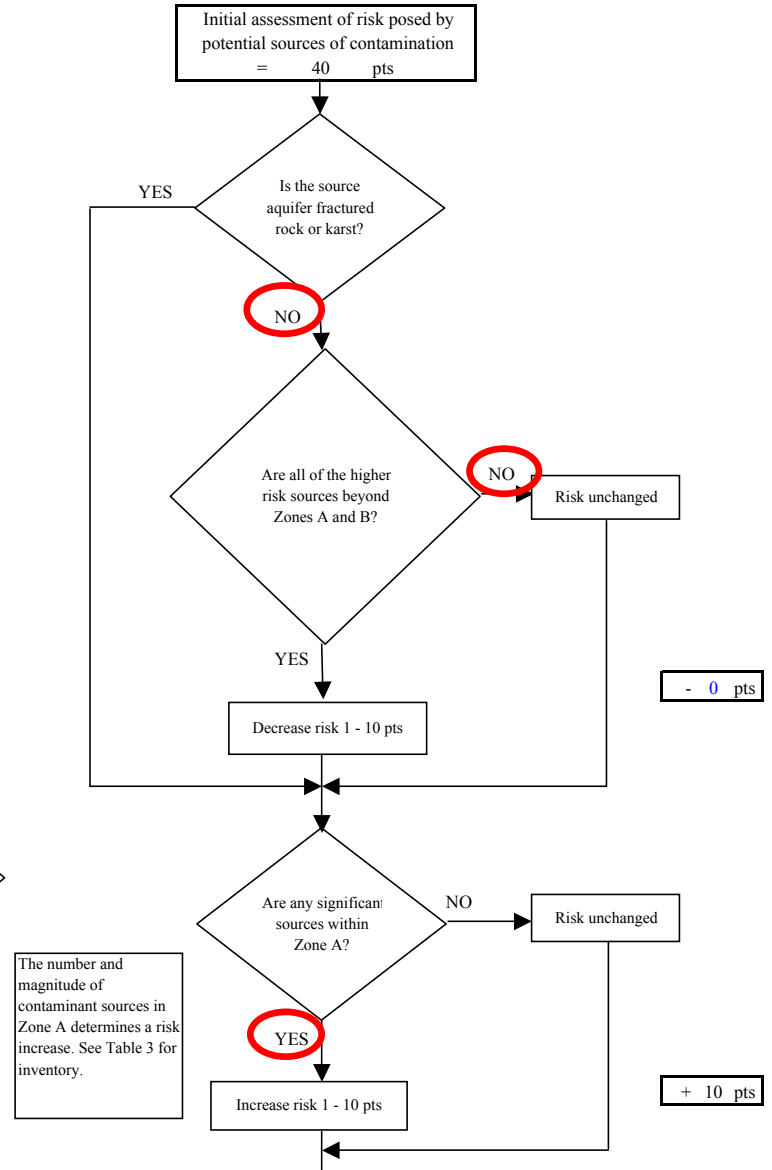
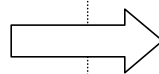
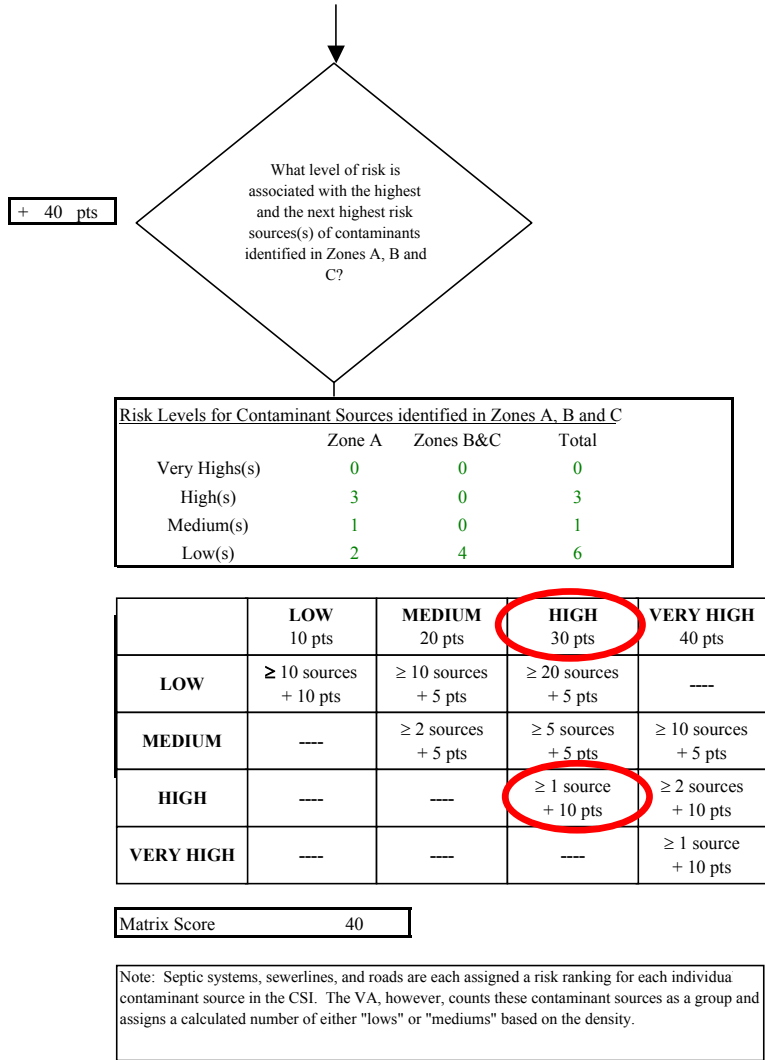


Chart 5. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Nitrates and Nitrites

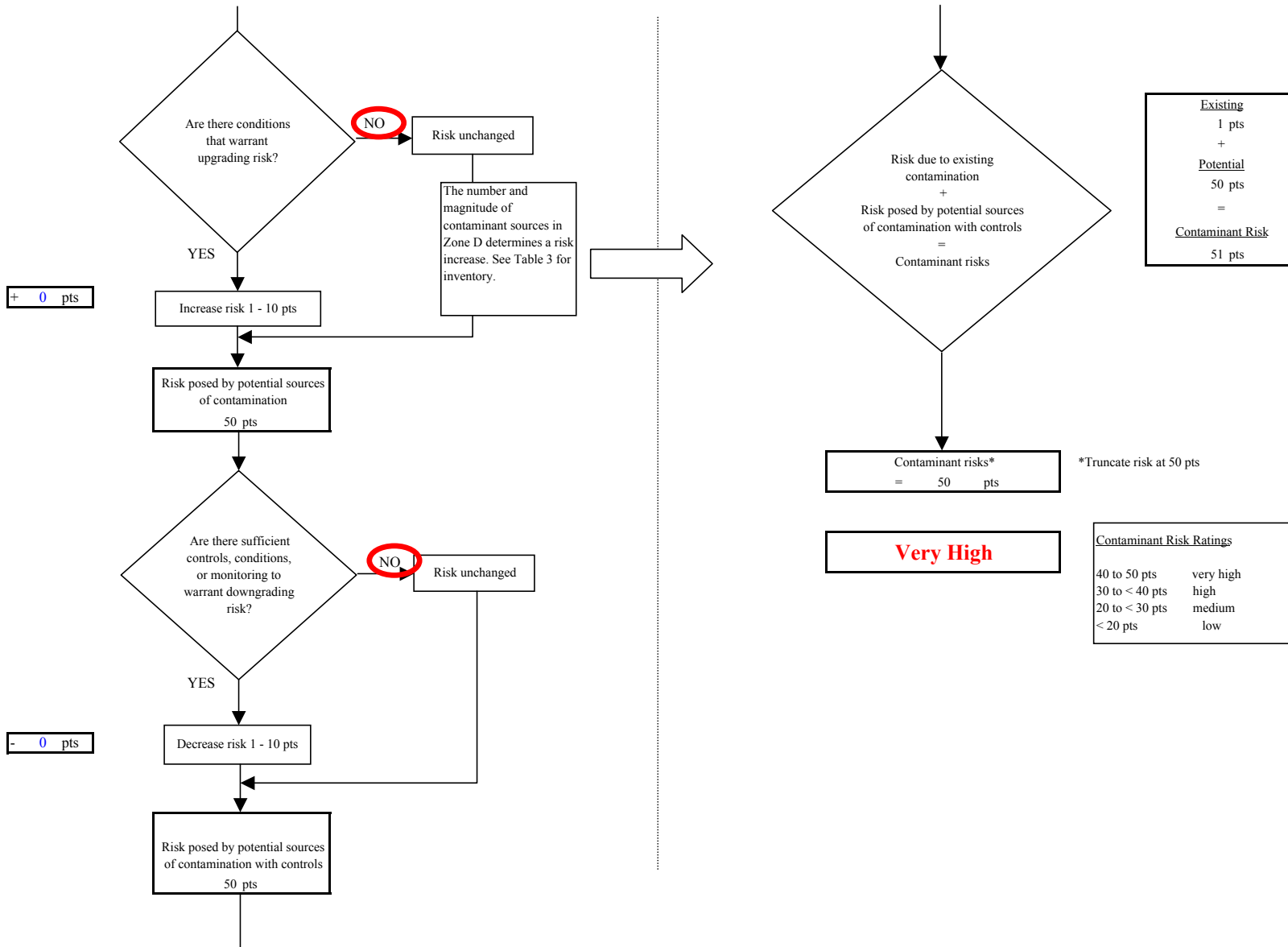


Chart 6. Vulnerability analysis for Fox Creek Townhouses (PWS No. 261101.001) - Nitrates and Nitrites

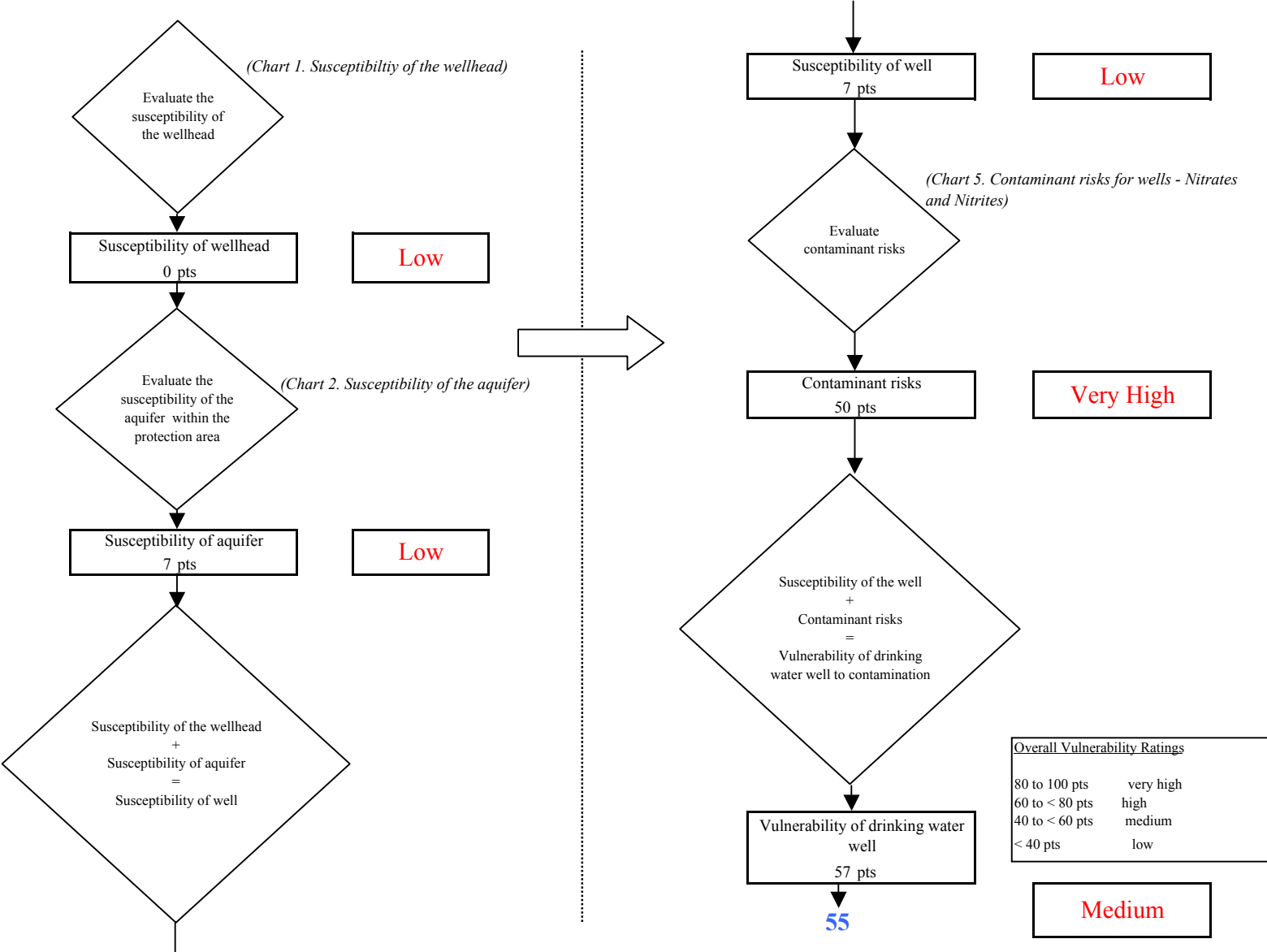


Chart 7. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Volatile Organic Chemicals

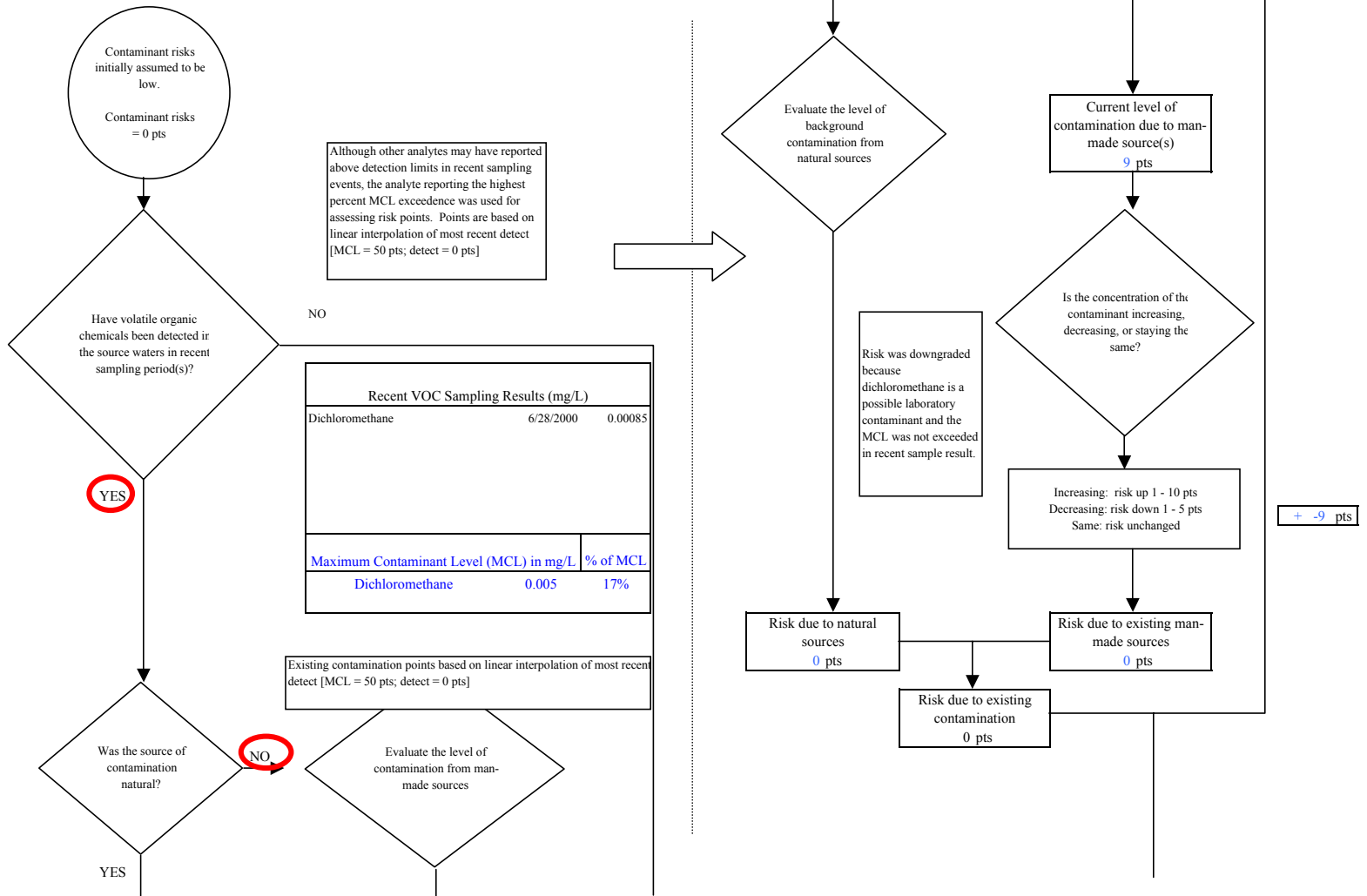


Chart 7. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Volatile Organic Chemicals

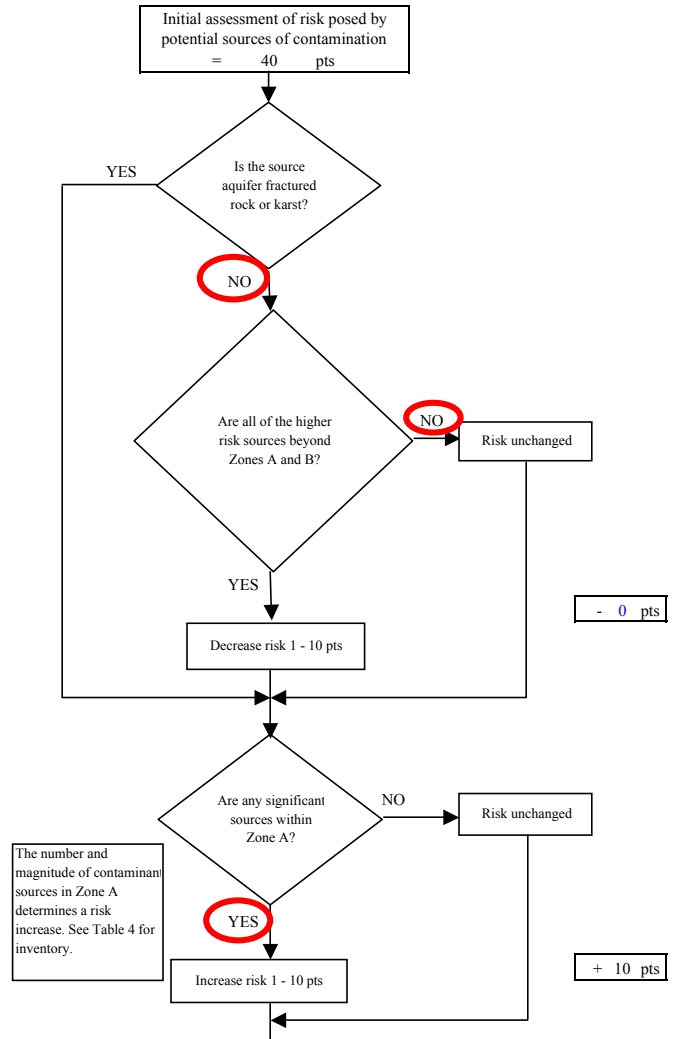
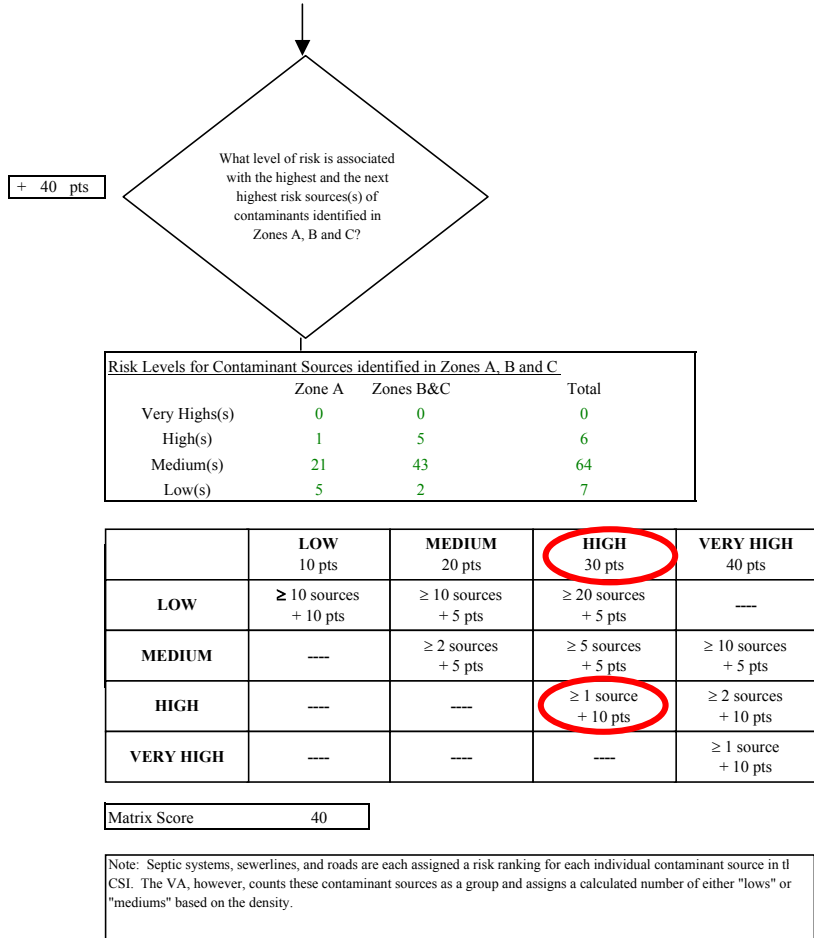


Chart 7. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Volatile Organic Chemicals

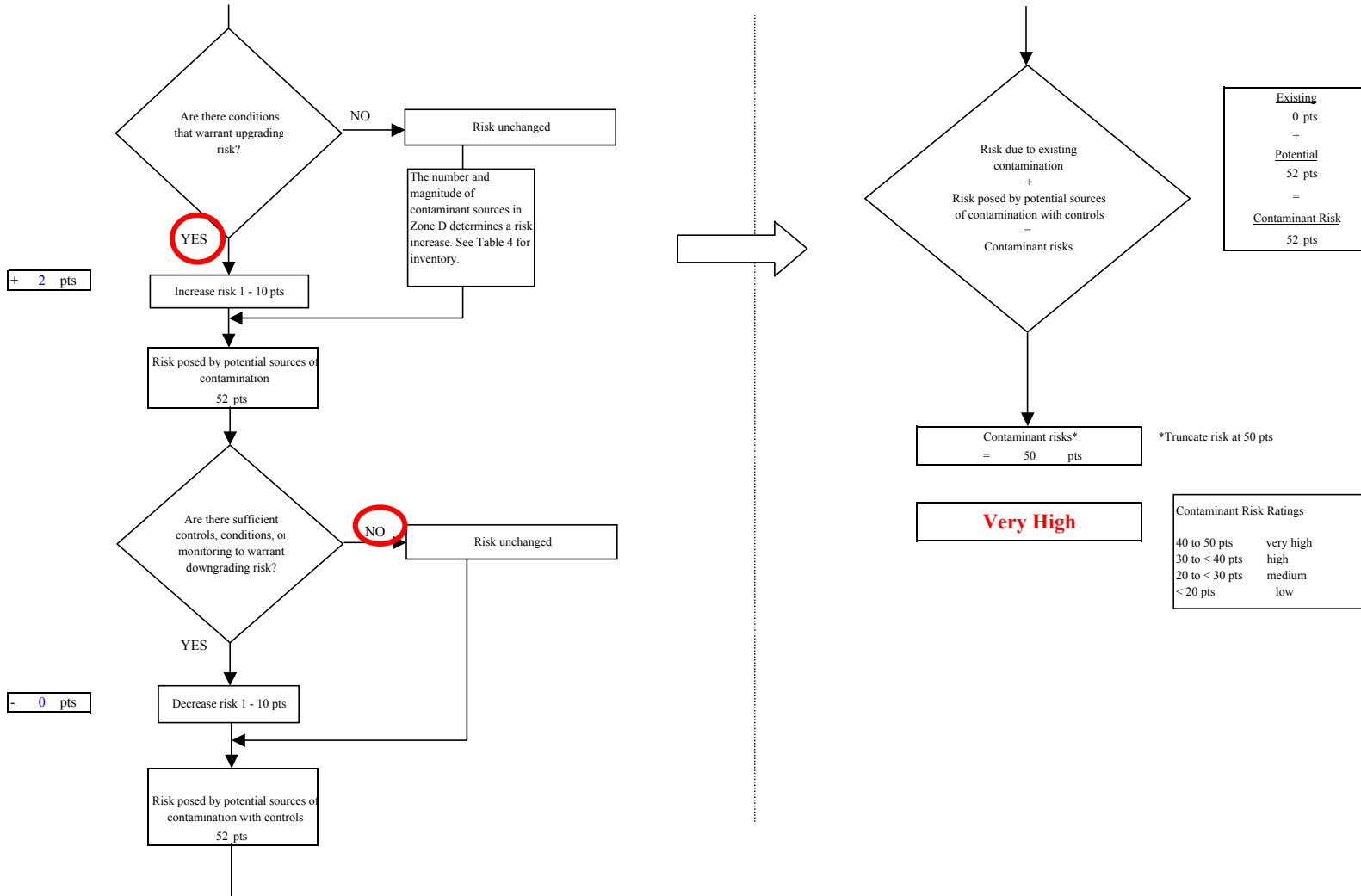


Chart 8. Vulnerability analysis for Fox Creek Townhouses (PWS No. 261101.001) - Volatile Organic Chemicals

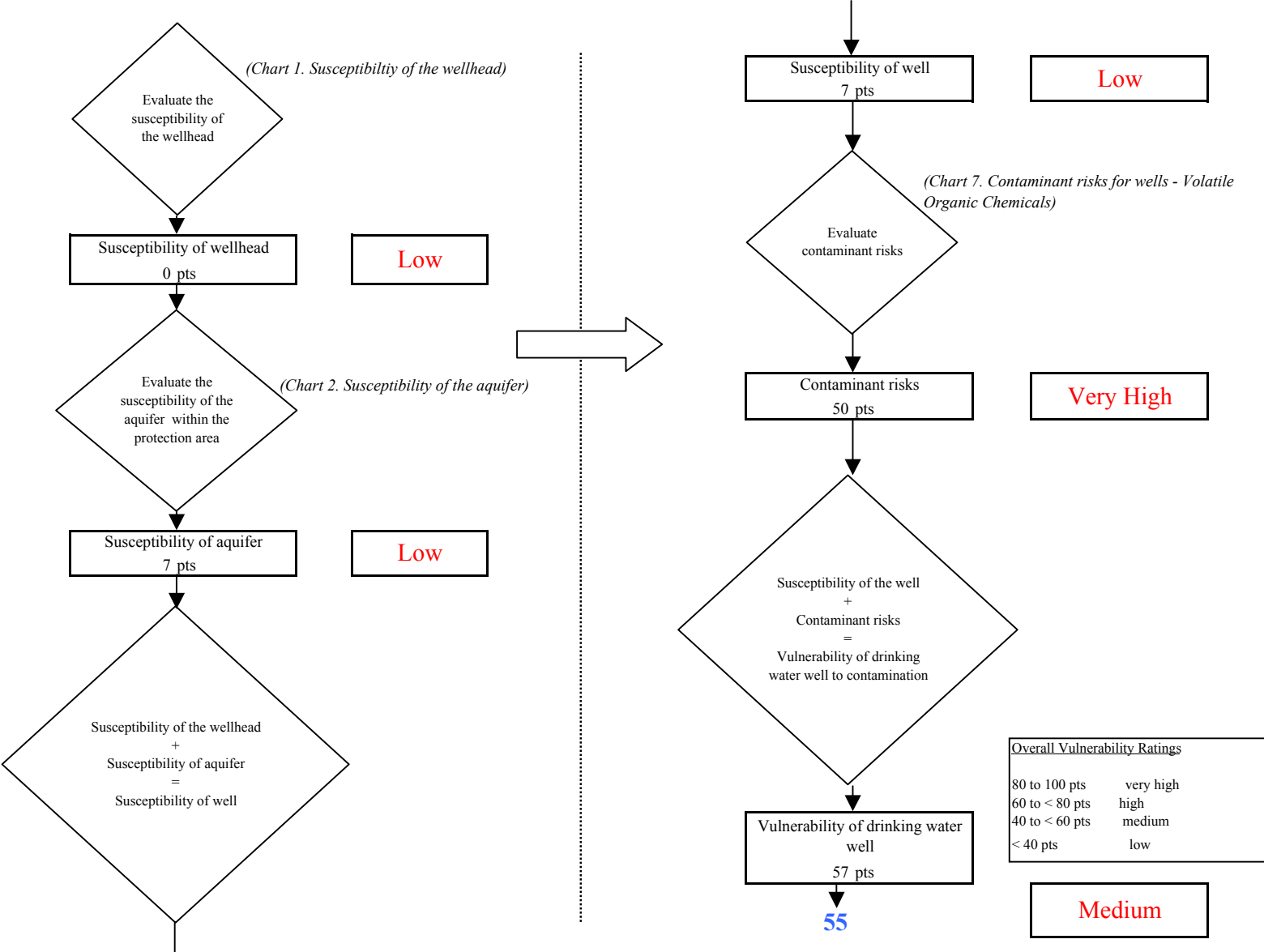


Chart 9. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

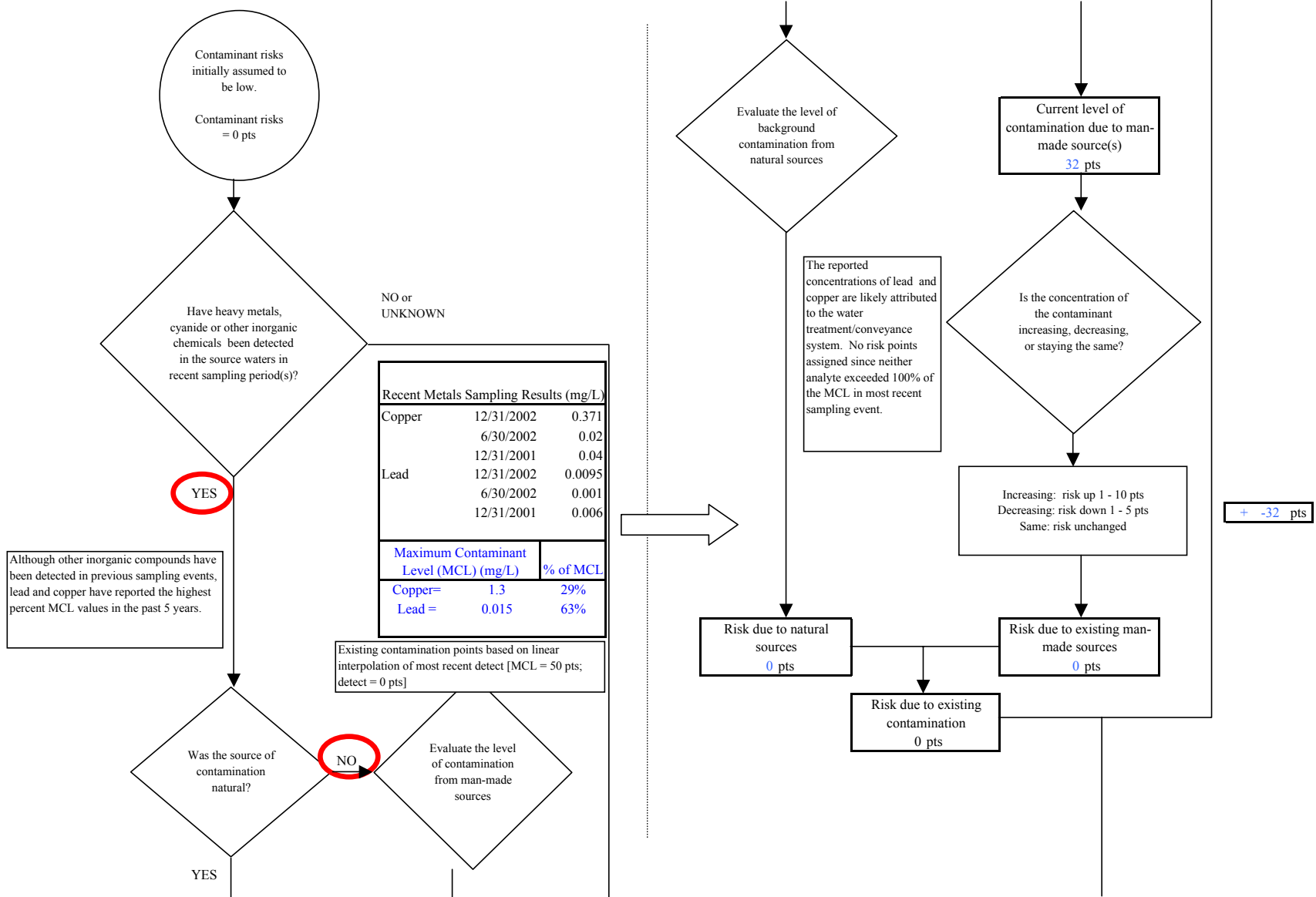
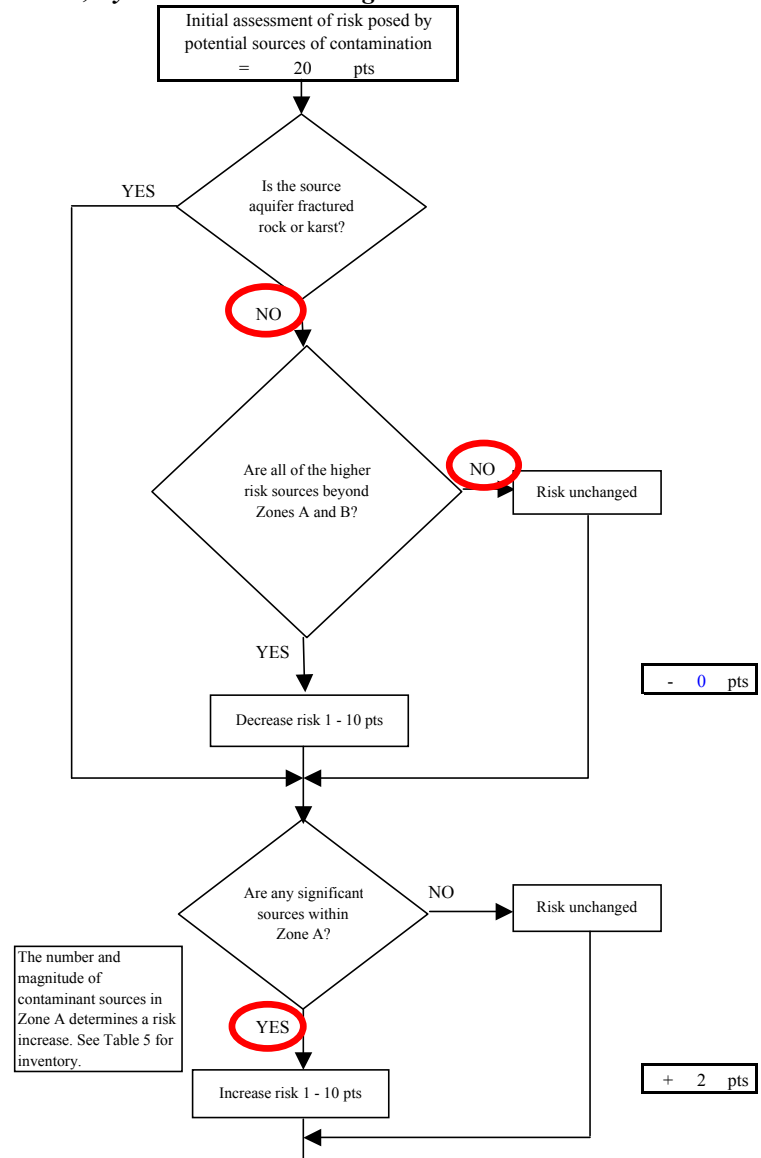
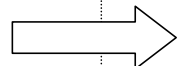
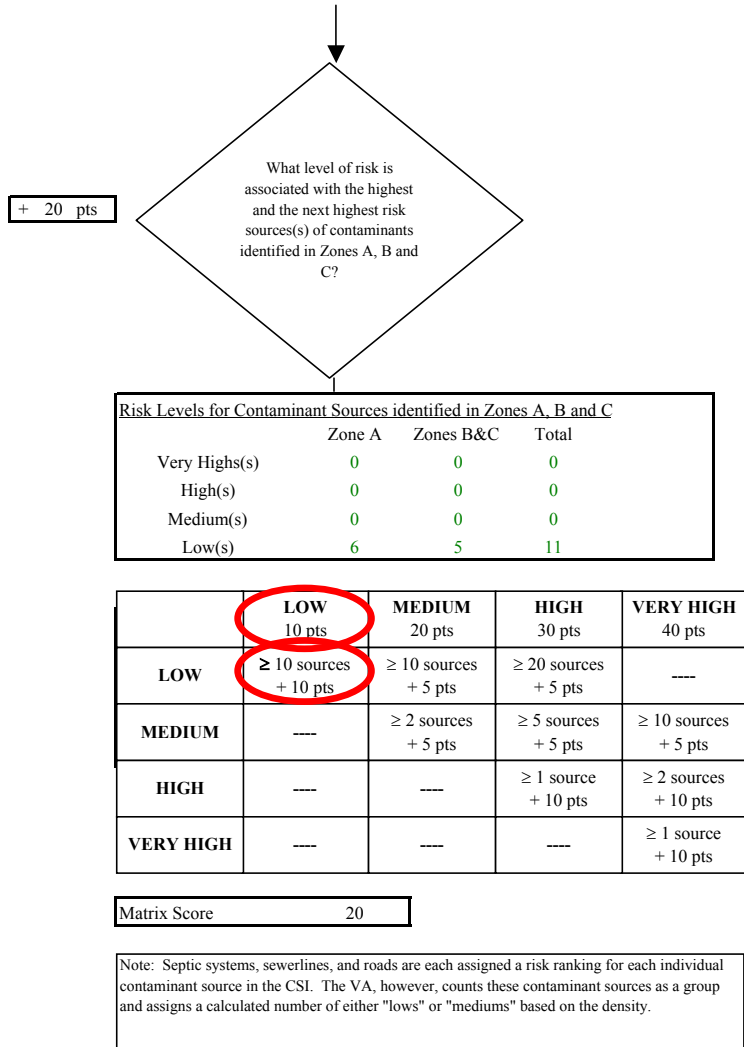


Chart 9. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



↓

Decrease risk 1 - 10 pts

- 0 pts

↓

Risk unchanged

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 5 for inventory.

Chart 9. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

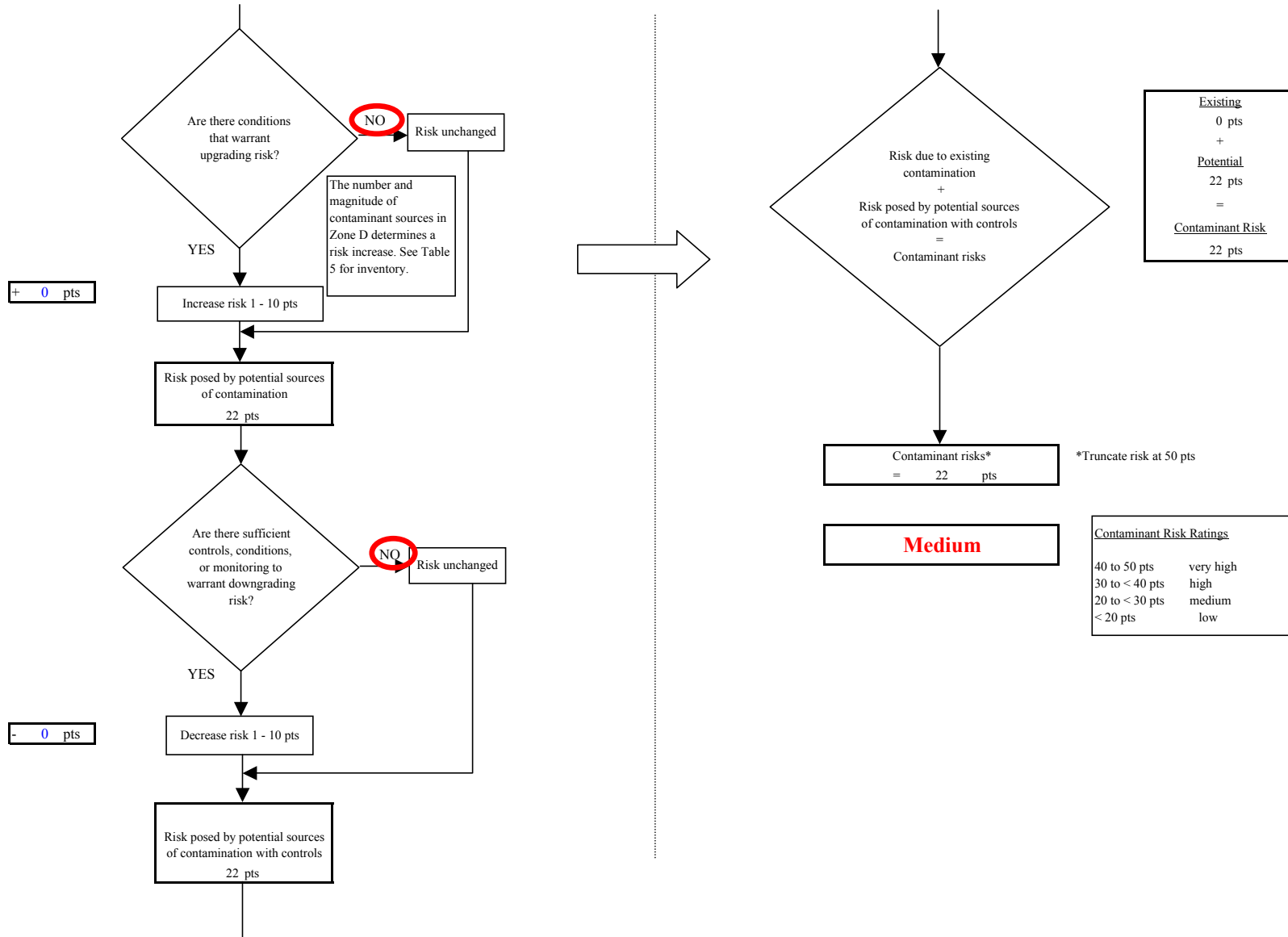


Chart 10. Vulnerability analysis for Fox Creek Townhouses (PWS No. 261101.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

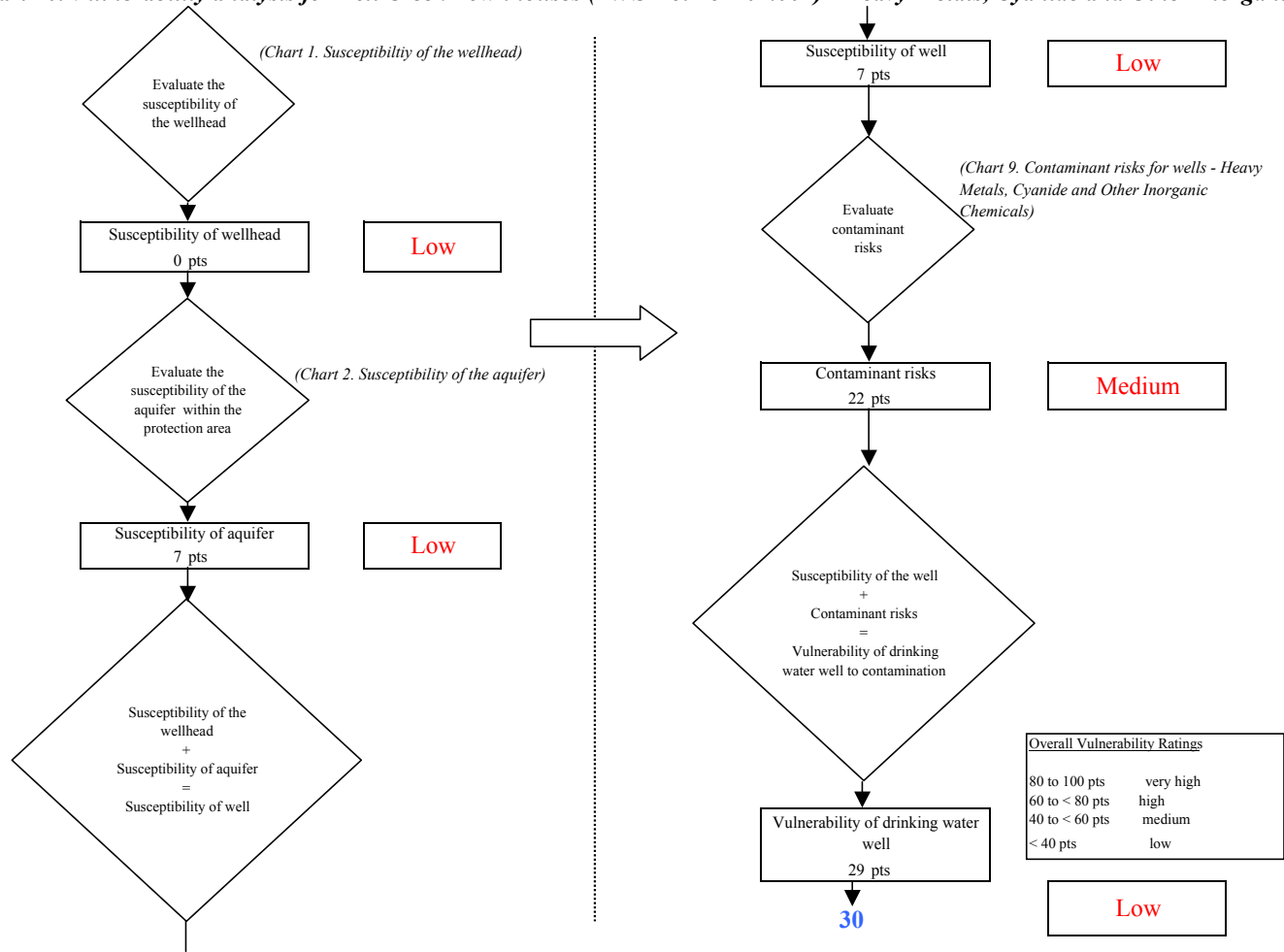


Chart 11. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Synthetic Organic Chemicals

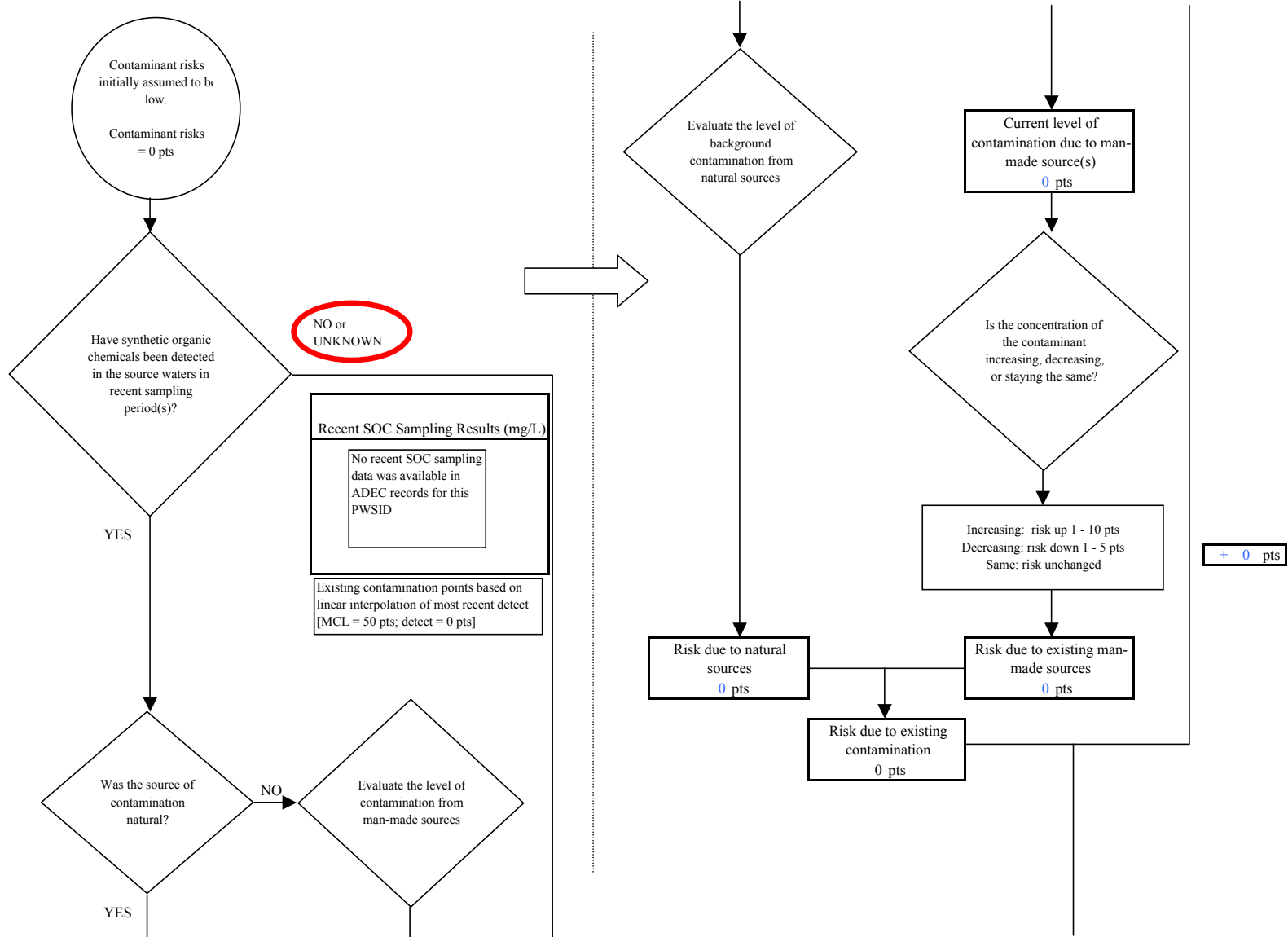
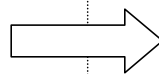
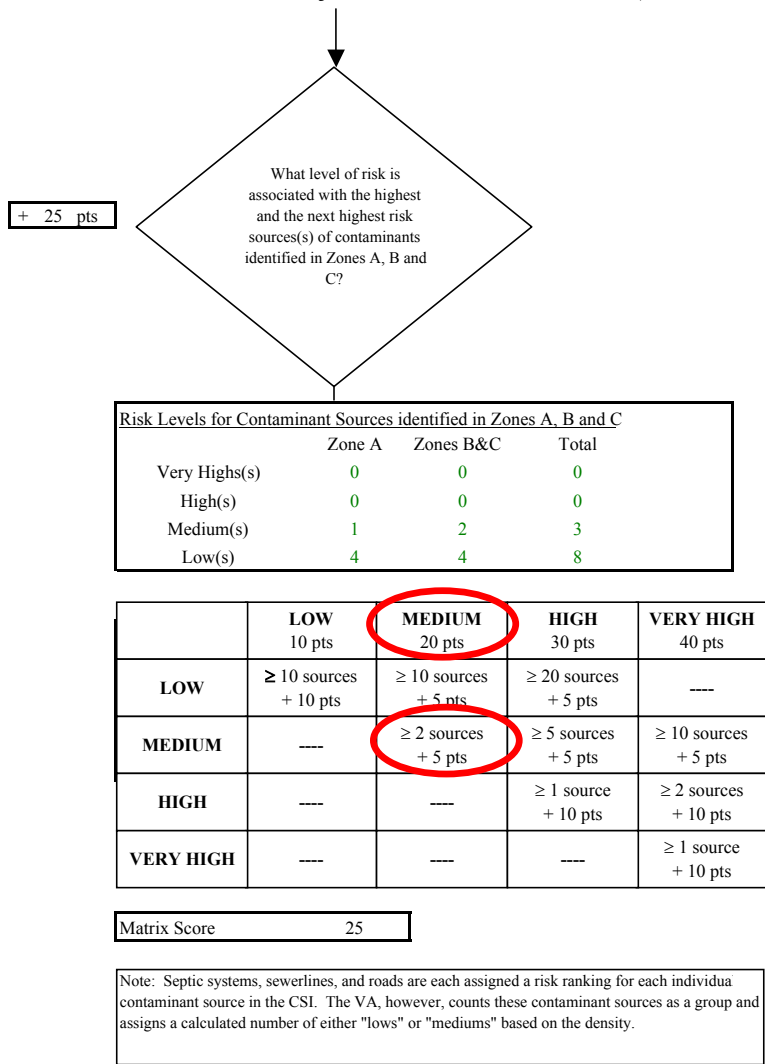


Chart 11. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Synthetic Organic Chemicals



The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.

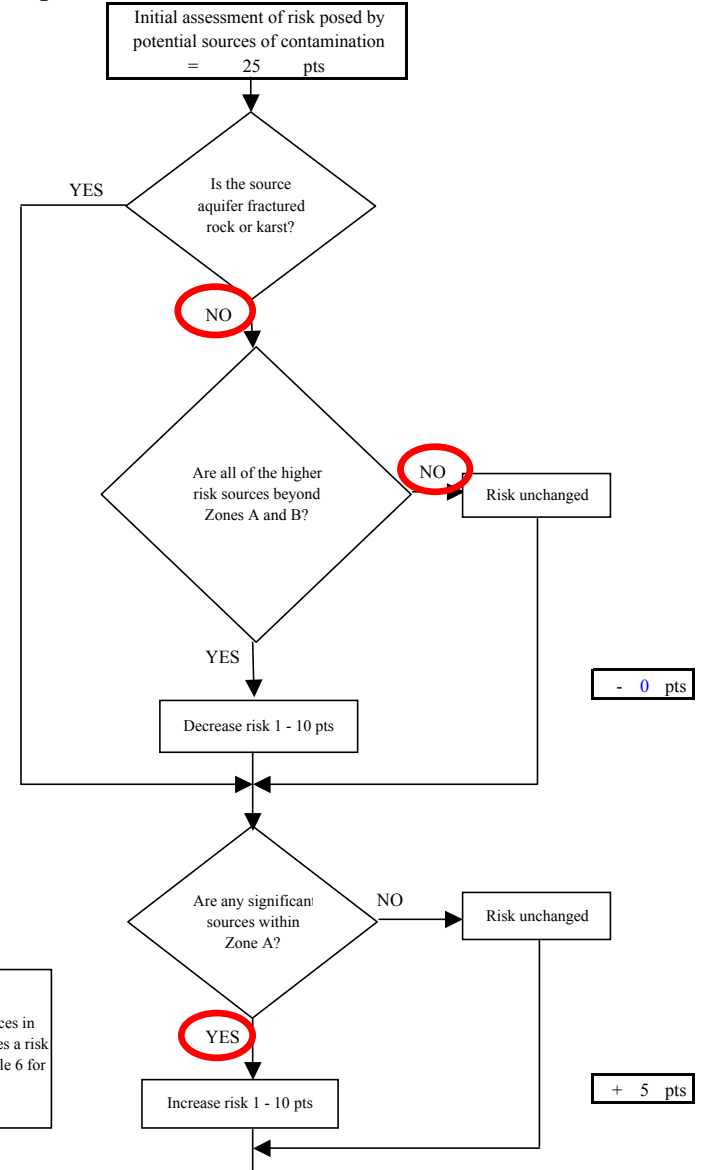


Chart 11. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Synthetic Organic Chemicals

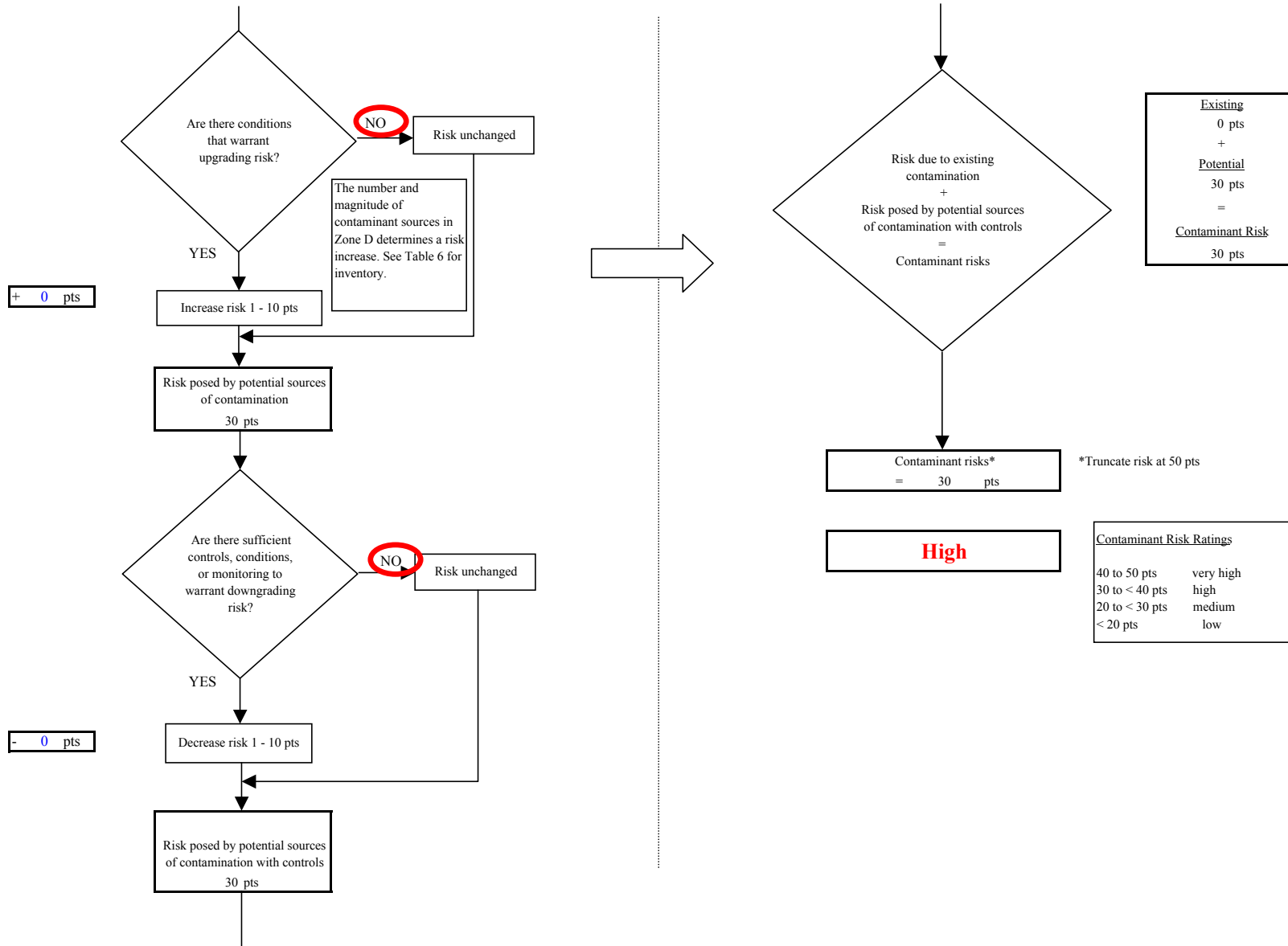


Chart 12. Vulnerability analysis for Fox Creek Townhouses (PWS No. 261101.001) - Synthetic Organic Chemicals

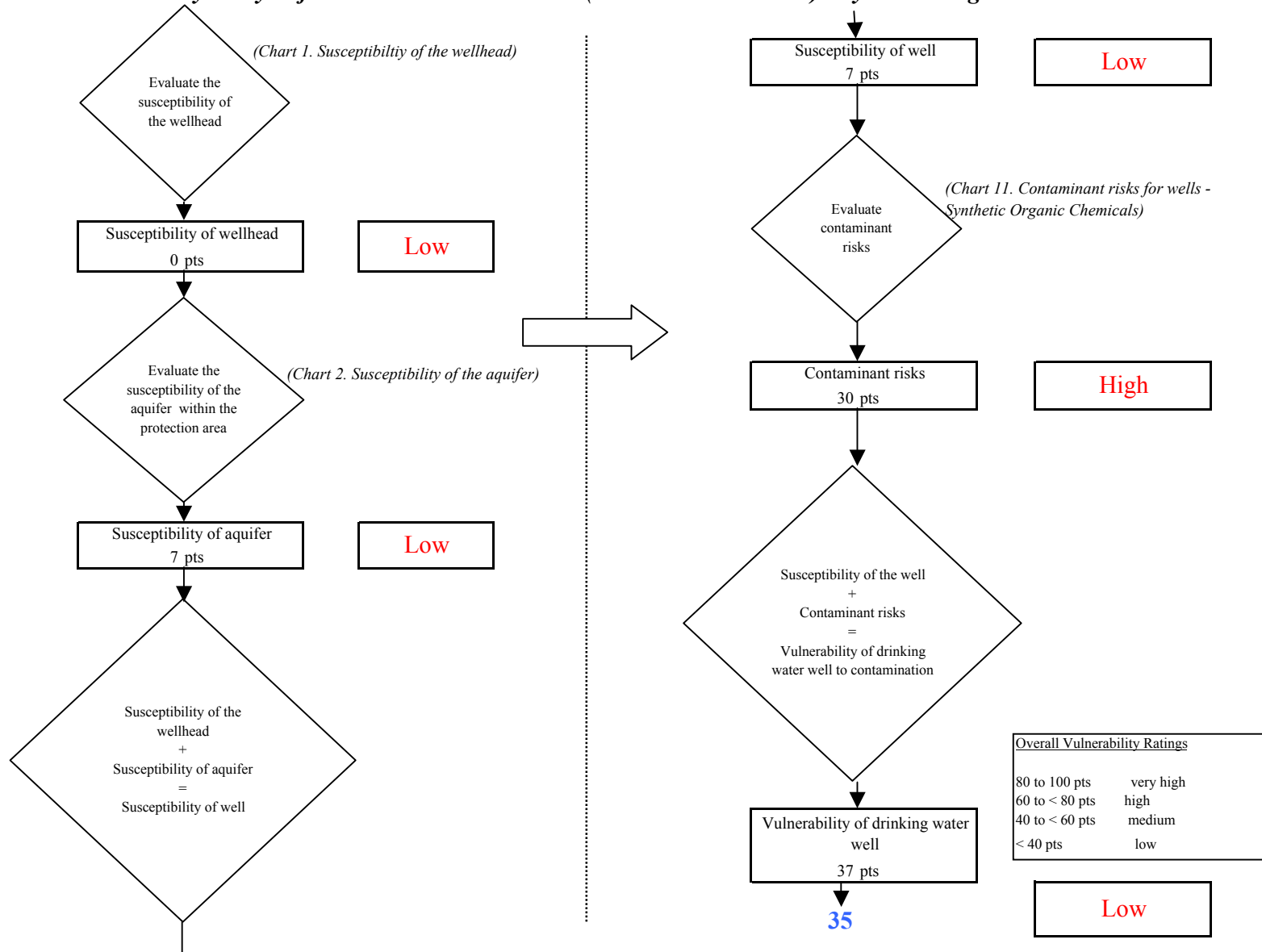


Chart 13. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Other Organic Chemicals

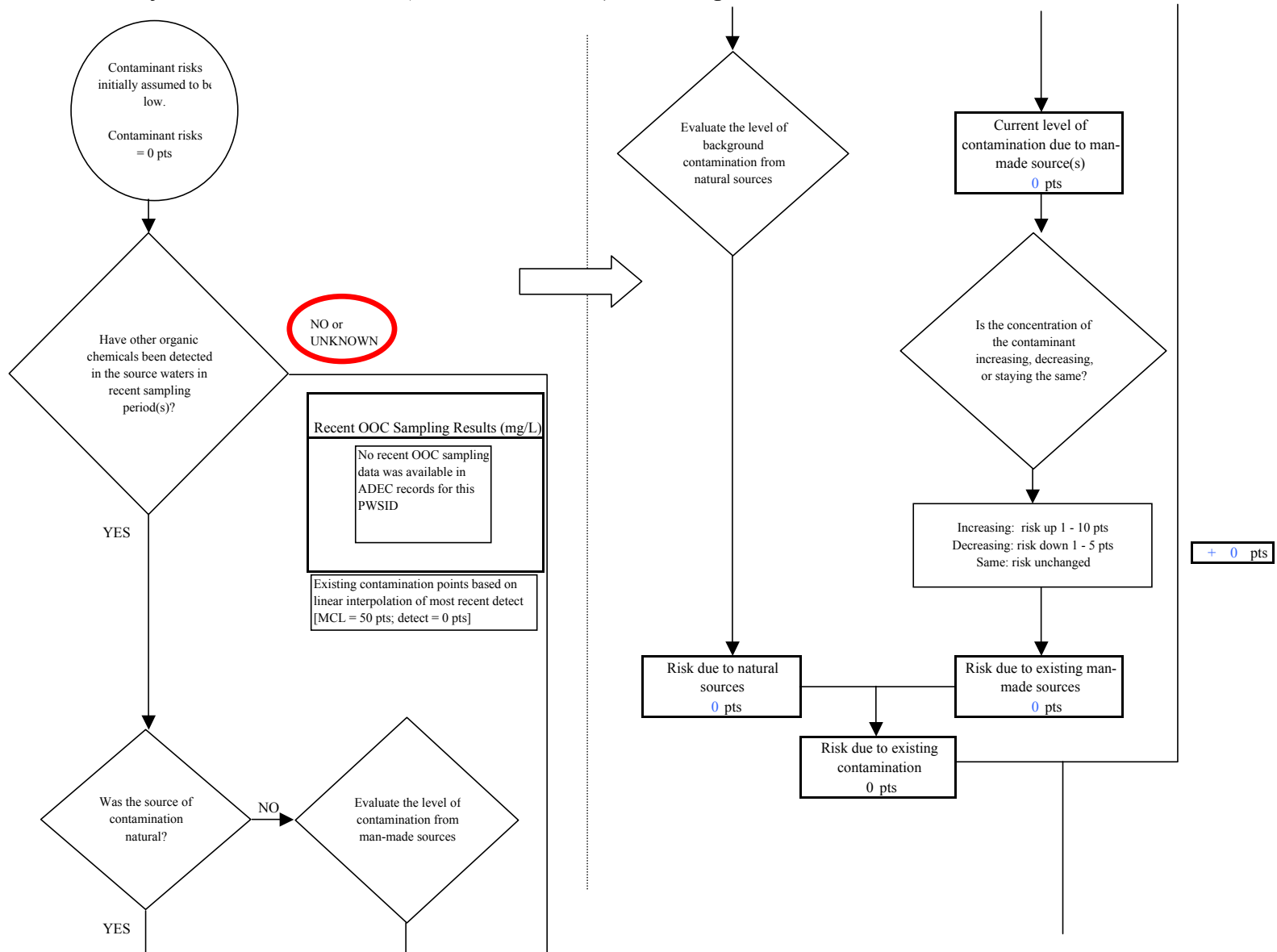


Chart 13. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Other Organic Chemicals

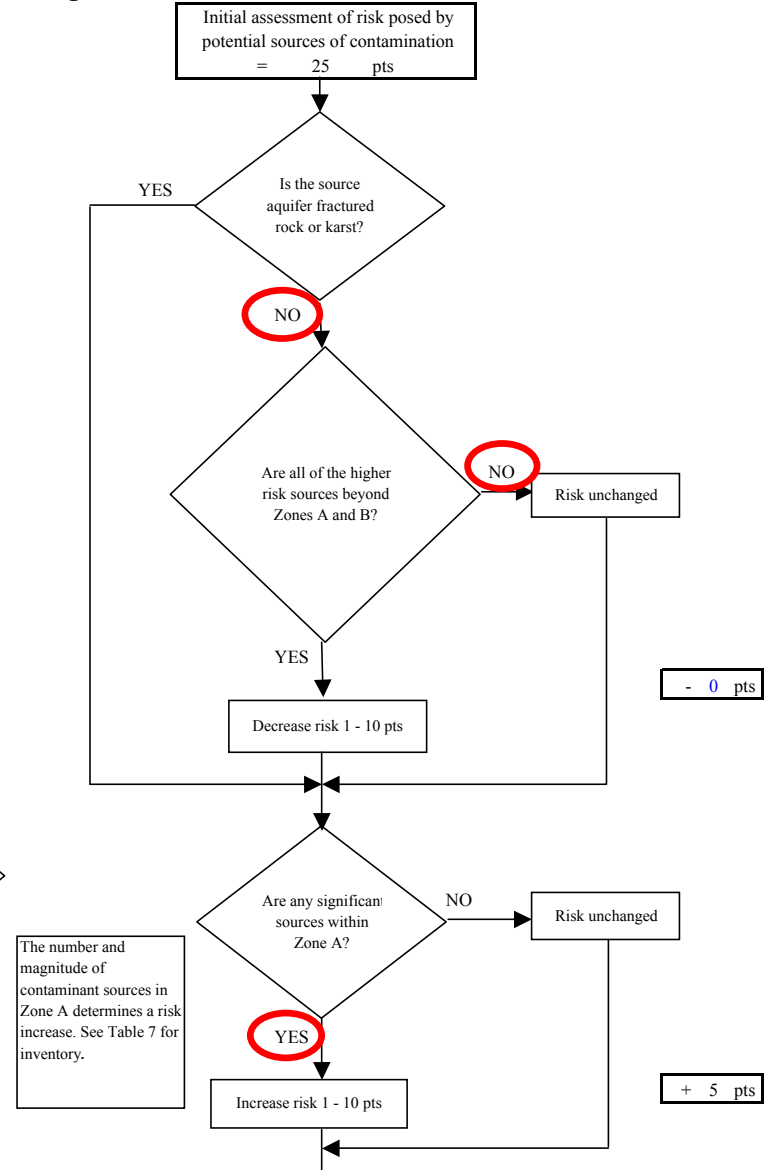
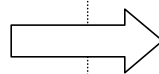
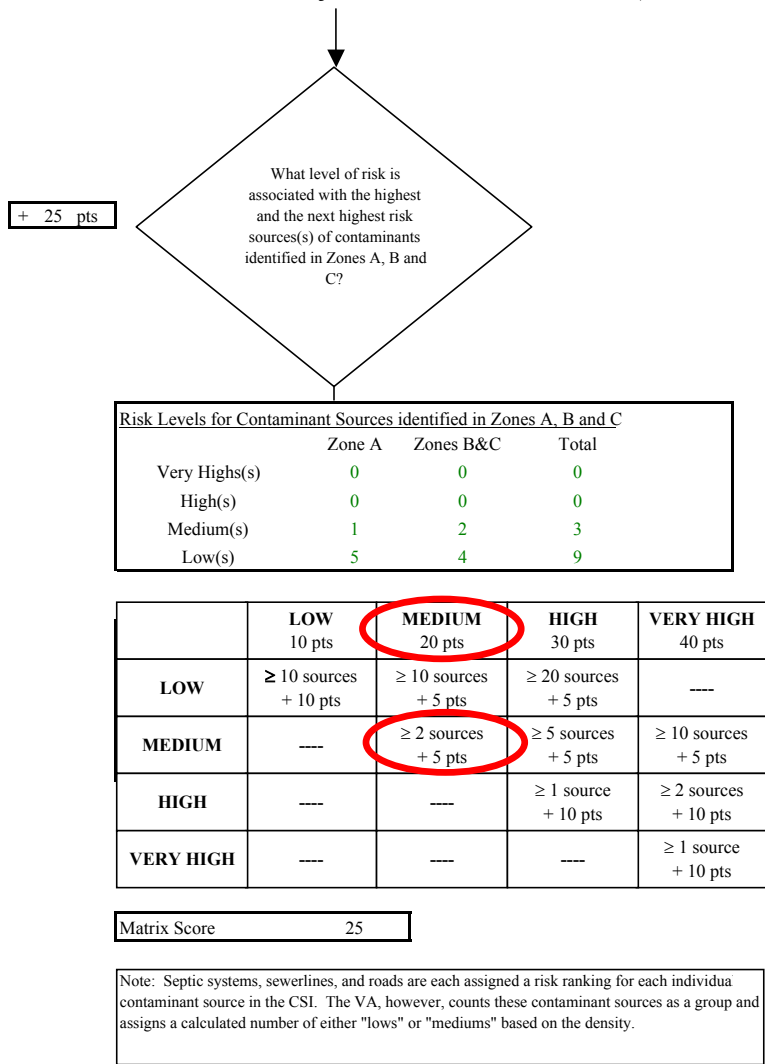


Chart 13. Contaminant risks for Fox Creek Townhouses (PWS No. 261101.001) - Other Organic Chemicals

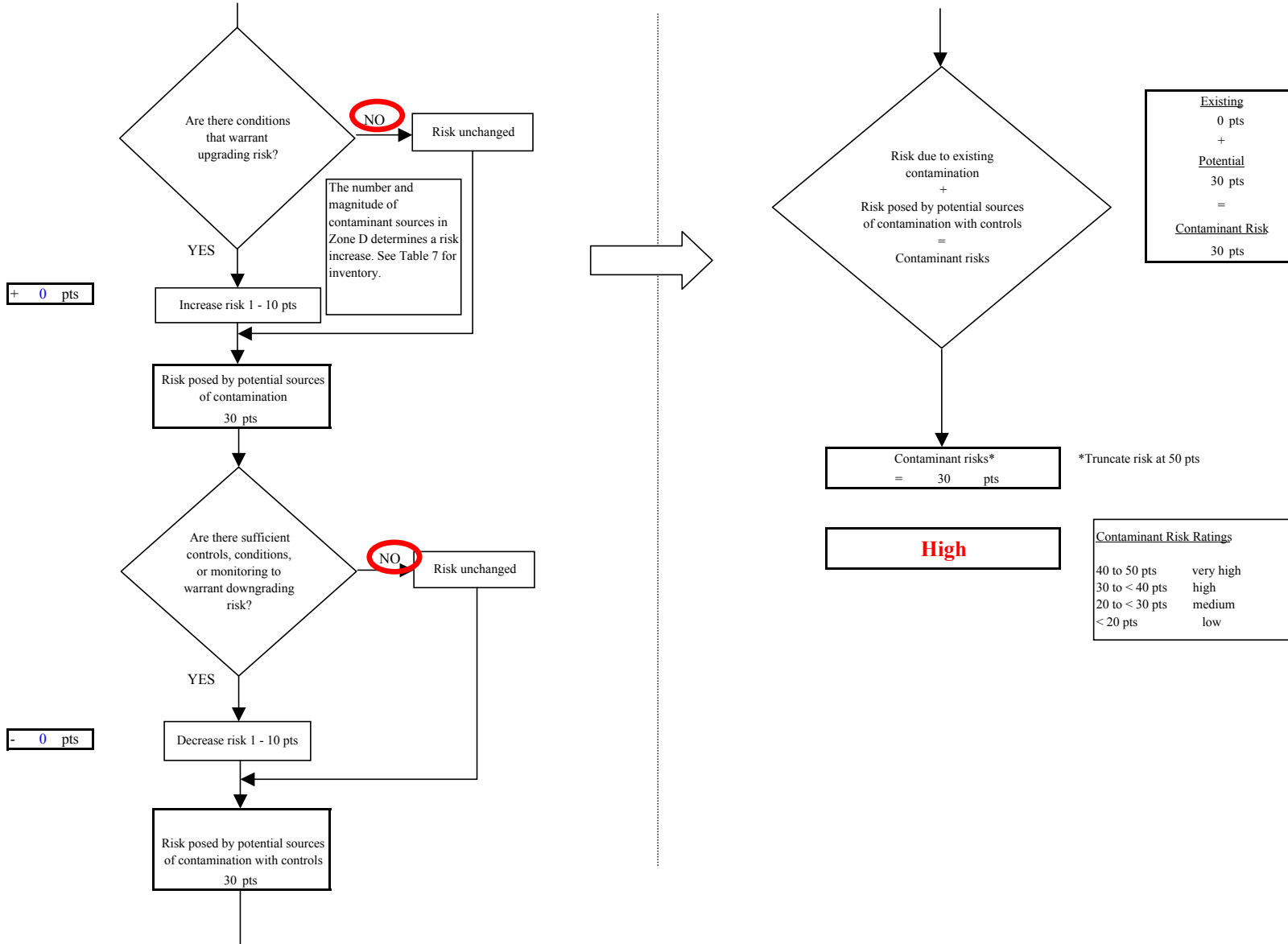


Chart 14. Vulnerability analysis for Fox Creek Townhouses (PWS No. 261101.001) - Other Organic Chemicals

