Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for the CRBHA Chitina HUD Housing Drinking Water System, Chitina, Alaska

PWSID # 299001.001

June 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1376
Alaska Department of Environmental Conservation

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

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

CONTENTS

TABLES

APPENDICES

Source Water Assessment for CRBHA Chitina HUD Housing Source of Public Drinking Water, Chitina, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The CRBHA Chitina HUD Housing has one Public Water System (PWS) wells. The well (PWS No. 299001.001) has been used as a drinking water source since it was drilled in 1997.

The well is a Class A (community and non-transient non-community) water system located in Chitina, Alaska. Available records indicate that there is secondary storage of drinking water, however the capacity is unknown. Records also indicate that the drinking water source is not treated. This system operates year round and serves approximately 25 residents. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Medium**. 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: a gas station (without repair shop), domestic wastewater collection systems, a honey bucket disposal area, a large-capacity septic system, pit toilets, individual septic systems, residential heating oil tanks, underground diesel and gasoline tanks, closed underground gasoline tanks, a DEC recognized contaminated site, open leaking underground fuel storage tanks (LUST) sites, and roads. A detailed inventory can be found in Table 1 of Appendix B. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

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

PUBLIC DRINKING WATER SYSTEM

The CRBHA Chitina HUD Housing PWS well is a Class A (community/non-transient/non-community) public water system. The system is located Chitina, Alaska (Sec. 14, T004S, R005E, Copper River Meridian, see Map A of Appendix A). The community of Chitina is located on the west bank of the Copper River at its confluence with the Chitina River, at mile 34 of the Edgerton Highway, 53 miles southeast of Copper Center. The community has a population of 132 (ADCED, 2003). Average annual precipitation in Chitina is 12 inches, including approximately 52 inches of snowfall. Temperatures can be as extreme as -58 to 91°F.

The residents of Chitina haul water from a well at the Fire Hall or have individual wells. Outhouses and individual septic systems provide sewage disposal. Less than 20% of homes are completely plumbed (ADCED, 2003). Chitina receives electrical power from Chitina Electric Inc; power-generating facilities are diesel powered. Refuse collection services are available from Copper Basin Sanitation (ADCED, 2003).

According to information supplied by ADEC for the CRBHA Chitina HUD Housing PWS, the depth of the well is 260 feet below the ground surface. Based on available well construction details, the well is screened in an unconfined aquifer. The well is not located within a floodplain.

Information acquired from an August 2000 community water system survey for the PWS 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 survey also 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 Glennallen area is in the southeastern portion of the Copper River basin, in southeastern Interior

Alaska. The Copper River basin, ranging from 500 to over 4,000 feet above sea level, is an intermontane basin rimmed by peaks of the Chugach, Alaska, Talkeetna, and Wrangell mountains. The terrain of the basin can be divided into two physiographic sub-units: the rolling, hummocky Copper River basin piedmont surface, and the Copper River basin trough. The Copper River basin trough is generally flat and lacks the hummocky, rolling character of the piedmont surface.

The terrain, geology of the unconsolidated deposits, and foundation materials of the Copper River basin are related to Pliestocene and recent events. Glaciers from the Chugach, Wrangell, Talkeetna, and Alaska Ranges repeatedly invaded the basin, perhaps at times filling it and flowing across the divides to the north, west, east, and south. Such extensive glaciation has resulted in the deposition o large thicknesses of coarse glacial boulder clays (till) and coarse outwash gravel and sand on the piedmont surface, with finer till and outwash interbedded with lake deposits in the basin trough.

The Glennallen area is within the discontinuous permafrost zone. Surface soils in the area generally consist of silt and clay with pebbles underlain by boulder clay with till, underlain by glacial outwash sand and gravel, underlain by boulder clay or till (Nichols, 1956).

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 CRBHA Chitina HUD Housing Public Water System. 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 CRBHA Chitina HUD Housing PWS was determined using an analytical calculation and includes Zone A to the limits of the watershed (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 CRBHA Chitina HUD Housing School Public Water System 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 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 CRBHA Chitina HUD Housing PWS water well was completed in an unconfined aquifer. Unconfined aquifers are more 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	14	Medium

Natural Susceptibility	14	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	50	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	65	High
Nitrates and Nitrites	65	High
Volatile Organic Chemicals	65	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	65	High
Synthetic Organic Chemicals	25	Low
Other Organic Chemicals	24	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of a honey bucket disposal area and a large-capacity septic system in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 2 – Appendix B).

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2003).

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 **High**.

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 a honey bucket disposal area and a large-capacity septic system in Zone A. Numerous other potential contaminant sources are also found within the protection area (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 nitrates have been detected in recent sampling events, however they did not exceed the MCL of 10mg/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 **High.**

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of a gasoline station (without repair shop), underground gasoline and diesel fuel tanks, DEC recognized contaminated sites, and open leaking underground fuel storage tank (LUST) sites in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

All recent VOC sampling data was below detection limits for CRBHA Chitina HUD Housing (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, and roads. 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 **High**.

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very High**. The risk is primarily attributed to the presence of an underground gasoline fuel tank in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, moderate levels of lead and high levels of copper have been detected. Copper exceeded its MCL of 0.015 mg/L in 2002 (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). The reported concentrations of lead and copper are likely attributed to the water treatment/conveyance system, however risk points were assigned for copper since it exceeded 100% of the MCL in 2002.

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

The contaminant risk for synthetic organic chemicals is **Low**. The risk is primarily attributed to the lack of significant SOC contaminant sources in Zone A (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the CRBHA Chitina HUD Housing Public Water System (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 **Low**. The risk is primarily attributed to the lack of significant OOC contaminant sources in Zone A (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the CRBHA Chitina HUD Housing Public Water System (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 CRBHA Chitina HUD Housing and the community of Chitina 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

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

Nichols, D. R., 1956, Information from Permafrost and Groundwater Conditions in the Glennallen area, Alaska, Open File Report 56-91, U.S. Geological Survey, dated January 1956.

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 #299001.001 CRBHA Chitina HUD Housing

CRBHA Chitina HUD Housing
PWS 299001.001

Zone A

0 0.2 0.4 0.8 1.2 1.6 Miles

LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

Transportation

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

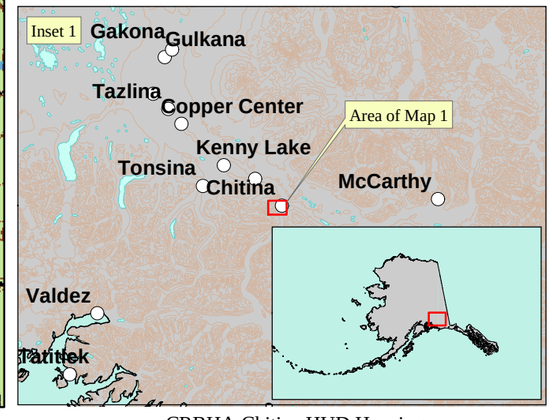
Groundwater Protection Zones

- Zone A Protection Area– Several Months Travel Time or watershed boundary

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.



CRBHA Chitina HUD Housing
PWS 299001.001
Appendix A Map A

APPENDIX B

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

Table 1

Contaminant Source Inventory for ***CRBHA Chitina HUD Housing***

PWSID 299001.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	C	CHITINA FUEL AND GROCERY
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	HUD Housing
Honey bucket disposal areas (community)	D07	D07-01	A	C	Assume one honeybucket disposal area in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	C	CHITNA FIELD STREET
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	C	Assume 15 or less individual septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 10 or less residential heating oil tanks in Zone A
Tanks, diesel (underground)	T08	T08-01	A	C	CHITINA FUEL AND GROCERY
Tanks, gasoline (underground)	T12	T12-01	A	C	CHITINA FUEL AND GROCERY
Closed tanks, gasoline (underground)	T13	T13-01	A	C	CHITINA FUEL AND GROCERY
Closed tanks, gasoline (underground)	T13	T13-02	A	C	CHITINA FUEL AND GROCERY
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	Trading Post Café/Chitina Saloon, Reckey #1985240128301, Status: Diesel contamination 1984; Class B well contaminated; quantity and extent unknown; possible source is fuel spills associated with old power plant close to site or on-site tanks.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	C	ADOTPF-Chitina Maintenance Station, Reckey #1997240033803, Facility ID 411, Event ID 1351, Status: Contaminated soils used as backfill. Soils at gasoline and diesel dispenser islands exceed ADEC cleanup levels.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	A	C	Strelna Roadhouse, Reckey #1990240033201, Facility ID 3142, Event ID 557, Status: Contaminated soil next to gasoline storage tanks caused by overflow at the nozzle as autos were filled with fuel.
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A

Table 2

Contaminant Source Inventory and Risk Ranking for CRBHA Chitina HUD Housing Sources of Bacteria and Viruses

PWSID 299001.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	HUD Housing
Honey bucket disposal areas (community)	D07	D07-01	A	High	C	Assume one honeybucket disposal area in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	CHITNA FIELD STREET
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 3

Contaminant Source Inventory and Risk Ranking for CRBHA Chitina HUD Housing Sources of Nitrates/Nitrites

PWSID 299001.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	HUD Housing
Honey bucket disposal areas (community)	D07	D07-01	A	High	C	Assume one honeybucket disposal area in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	CHITNA FIELD STREET
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Medium	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 4

Contaminant Source Inventory and Risk Ranking for CRBHA Chitina HUD Housing Sources of Volatile Organic Chemicals

PWSID 299001.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	High	C	CHITINA FUEL AND GROCERY
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	HUD Housing
Honey bucket disposal areas (community)	D07	D07-01	A	Low	C	Assume one honeybucket disposal area in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CHITNA FIELD STREET
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 10 or less residential heating oil tanks in Zone A
Tanks, diesel (underground)	T08	T08-01	A	High	C	CHITINA FUEL AND GROCERY
Tanks, gasoline (underground)	T12	T12-01	A	High	C	CHITINA FUEL AND GROCERY
Closed tanks, gasoline (underground)	T13	T13-01	A	Medium	C	CHITINA FUEL AND GROCERY
Closed tanks, gasoline (underground)	T13	T13-02	A	Medium	C	CHITINA FUEL AND GROCERY
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	High	C	Trading Post Café/Chitina Saloon, Reckey #1985240128301, Status: Diesel contamination 1984; Class B well contaminated; quantity and extent unknown; possible source is fuel spills associated with old power plant close to site or on-site tanks.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	High	C	ADOTPF-Chitina Maintenance Station, Reckey #1997240033803, Facility ID 411, Event ID 1351, Status: Contaminated soils used as backfill. Soils at gasoline and diesel dispenser islands exceed ADEC cleanup levels.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	A	High	C	Strelna Roadhouse, Reckey #1990240033201, Facility ID 3142, Event ID 557, Status: Contaminated soil next to gasoline storage tanks caused by overflow at the nozzle as autos were filled with fuel.
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 5

Contaminant Source Inventory and Risk Ranking for CRBHA Chitina HUD Housing

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 299001.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	Low	C	CHITINA FUEL AND GROCERY
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	HUD Housing
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CHITNA FIELD STREET
Pit toilets (open hole), nonresidential (one or more)	D16	D16-01	A	Low	C	Assume 35 or less pit toilets/outhouses in Zone A
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Tanks, gasoline (underground)	T12	T12-01	A	Medium	C	CHITINA FUEL AND GROCERY
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Trading Post Café/Chitina Saloon, Reckey #1985240128301, Status: Diesel contamination 1984; Class B well contaminated; quantity and extent unknown; possible source is fuel spills associated with old power plant close to site or on-site tanks.
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

Table 6

Contaminant Source Inventory and Risk Ranking for CRBHA Chitina HUD Housing Sources of Synthetic Organic Chemicals

PWSID 299001.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	HUD Housing
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CHITNA FIELD STREET
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Trading Post Café/Chitina Saloon, Reckey #1985240128301, Status: Diesel contamination 1984; Class B well contaminated; quantity and extent unknown; possible source is fuel spills associated with old power plant close to site or on-site tanks.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	Low	C	ADOTPF-Chitina Maintenance Station, Reckey #1997240033803, Facility ID 411, Event ID 1351, Status: Contaminated soils used as backfill. Soils at gasoline and diesel dispenser islands exceed ADEC cleanup levels.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	A	Low	C	Strelna Roadhouse, Reckey #1990240033201, Facility ID 3142, Event ID 557, Status: Contaminated soil next to gasoline storage tanks caused by overflow at the nozzle as autos were filled with fuel.

Table 7

Contaminant Source Inventory and Risk Ranking for CRBHA Chitina HUD Housing Sources of Other Organic Chemicals

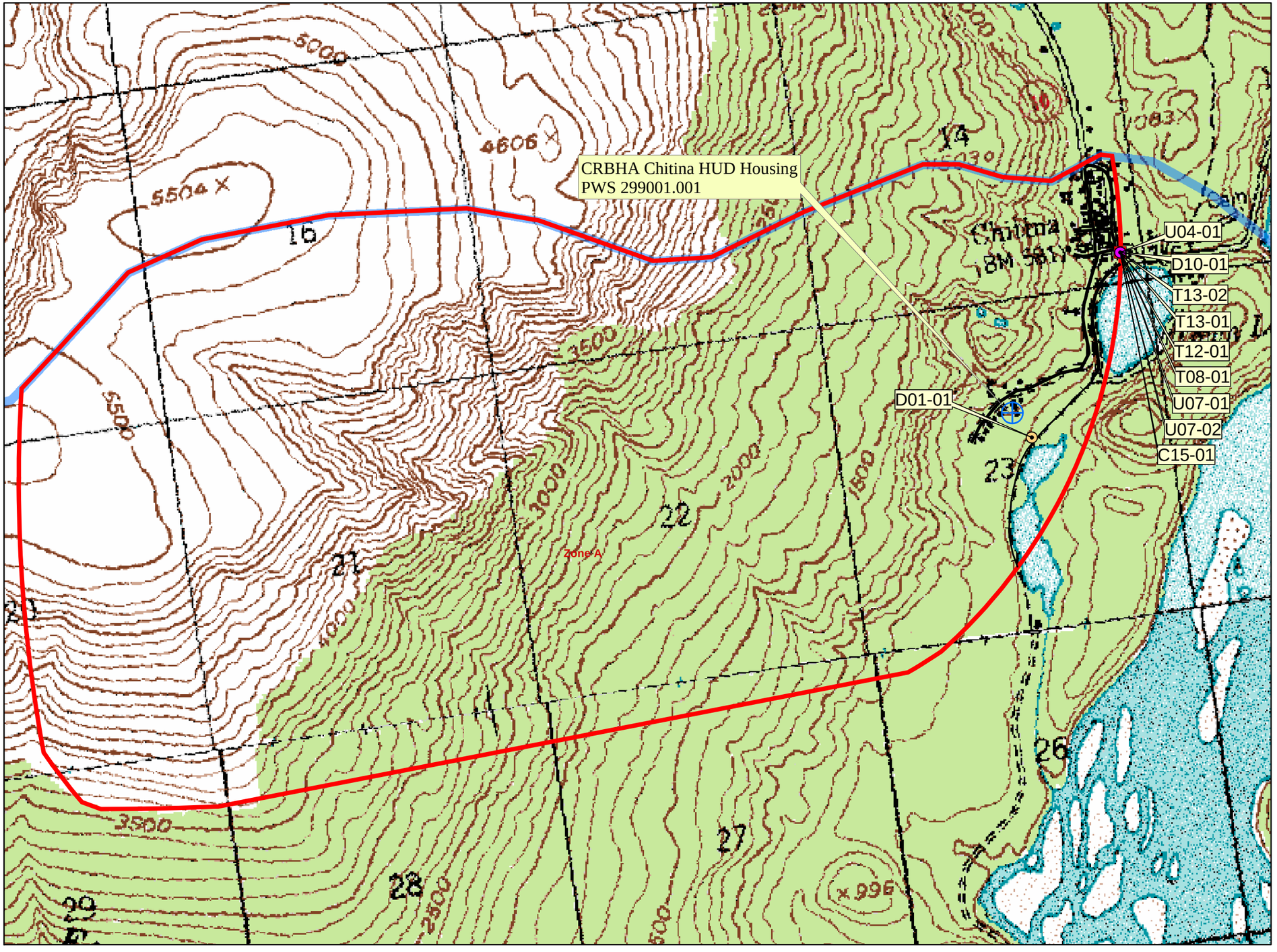
PWSID 299001.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	Low	C	CHITINA FUEL AND GROCERY
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	HUD Housing
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CHITNA FIELD STREET
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 15 or less individual septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Trading Post Café/Chitina Saloon, Reckey #1985240128301, Status: Diesel contamination 1984; Class B well contaminated; quantity and extent unknown; possible source is fuel spills associated with old power plant close to site or on-site tanks.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	Low	C	ADOTPF-Chitina Maintenance Station, Reckey #1997240033803, Facility ID 411, Event ID 1351, Status: Contaminated soils used as backfill. Soils at gasoline and diesel dispenser islands exceed ADEC cleanup levels.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-02	A	Low	C	Strelna Roadhouse, Reckey #1990240033201, Facility ID 3142, Event ID 557, Status: Contaminated soil next to gasoline storage tanks caused by overflow at the nozzle as autos were filled with fuel.
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A

APPENDIX C

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

Public Water Well System for PWS #299001.001 CRBHA Chitina HUD Housing
Potential and Existing Sources of Contamination



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours
- Watershed Boundary

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 or watershed boundary

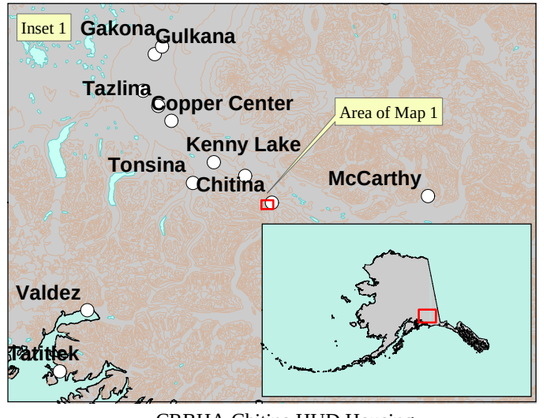
Existing or Potential Contaminant Sources

- Gasoline stations without repair shop (C15)
- Domestic wastewater collection systems (sewer lines or lift stations) (D01)
- Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)
- Tanks, diesel (underground) (T08)
- Tanks, gasoline (underground) (T12)
- Closed tanks, gasoline (underground) (T13)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
- Open Leaking Underground Storage Tank (LUST) (lubricants or other petroleum products) (U07)

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.



0 0.125 0.25 0.5 0.75 1 Miles

CRBHA Chitina HUD Housing
PWS 299001.001
Appendix C Map C

APPENDIX D

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

Chart 1. Susceptibility of the wellhead - CRBHA Chitina HUD Housing (PWS No. 299001.001)

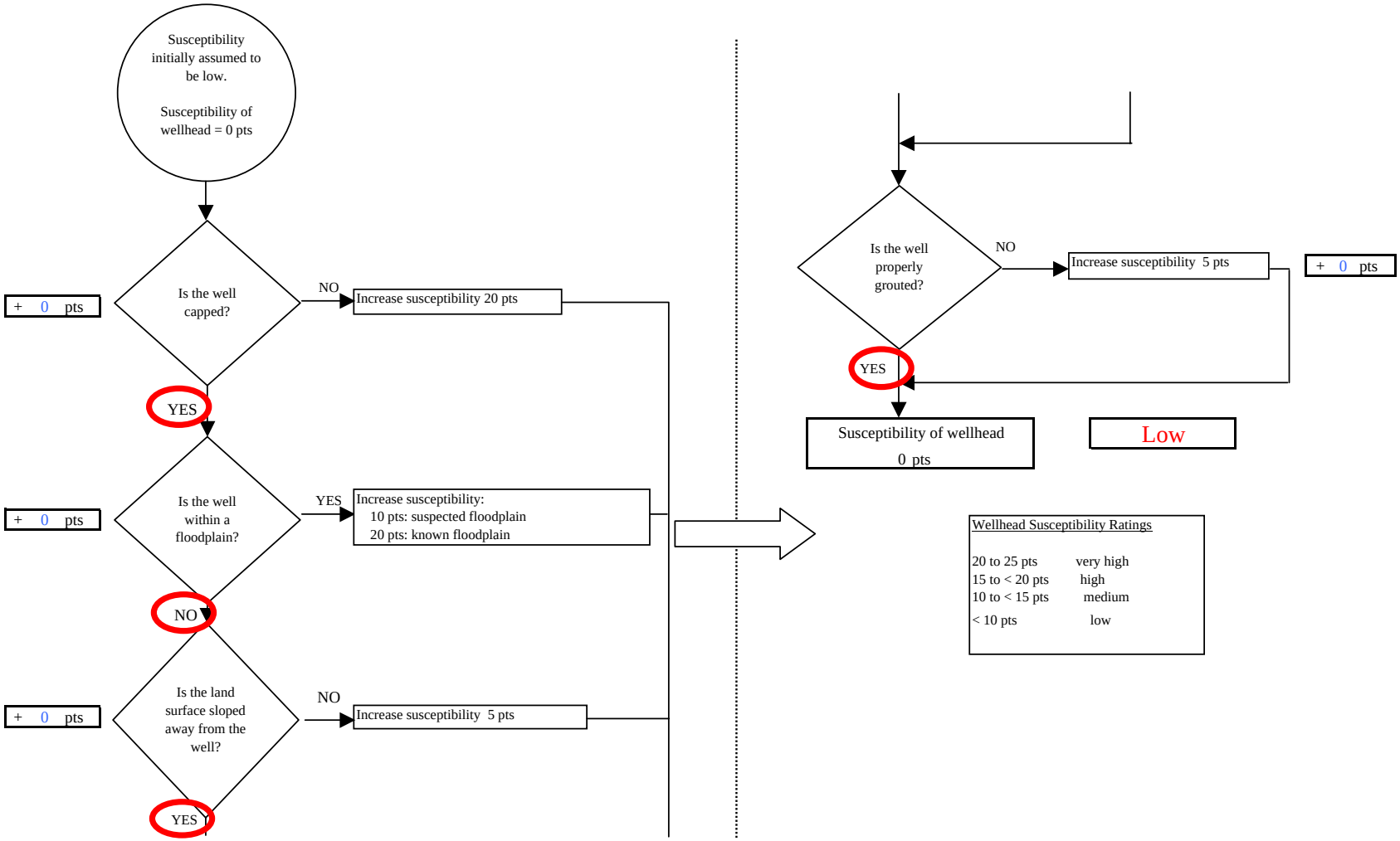


Chart 2. Susceptibility of the aquifer CRBHA Chitina HUD Housing (PWS No. 299001.001)

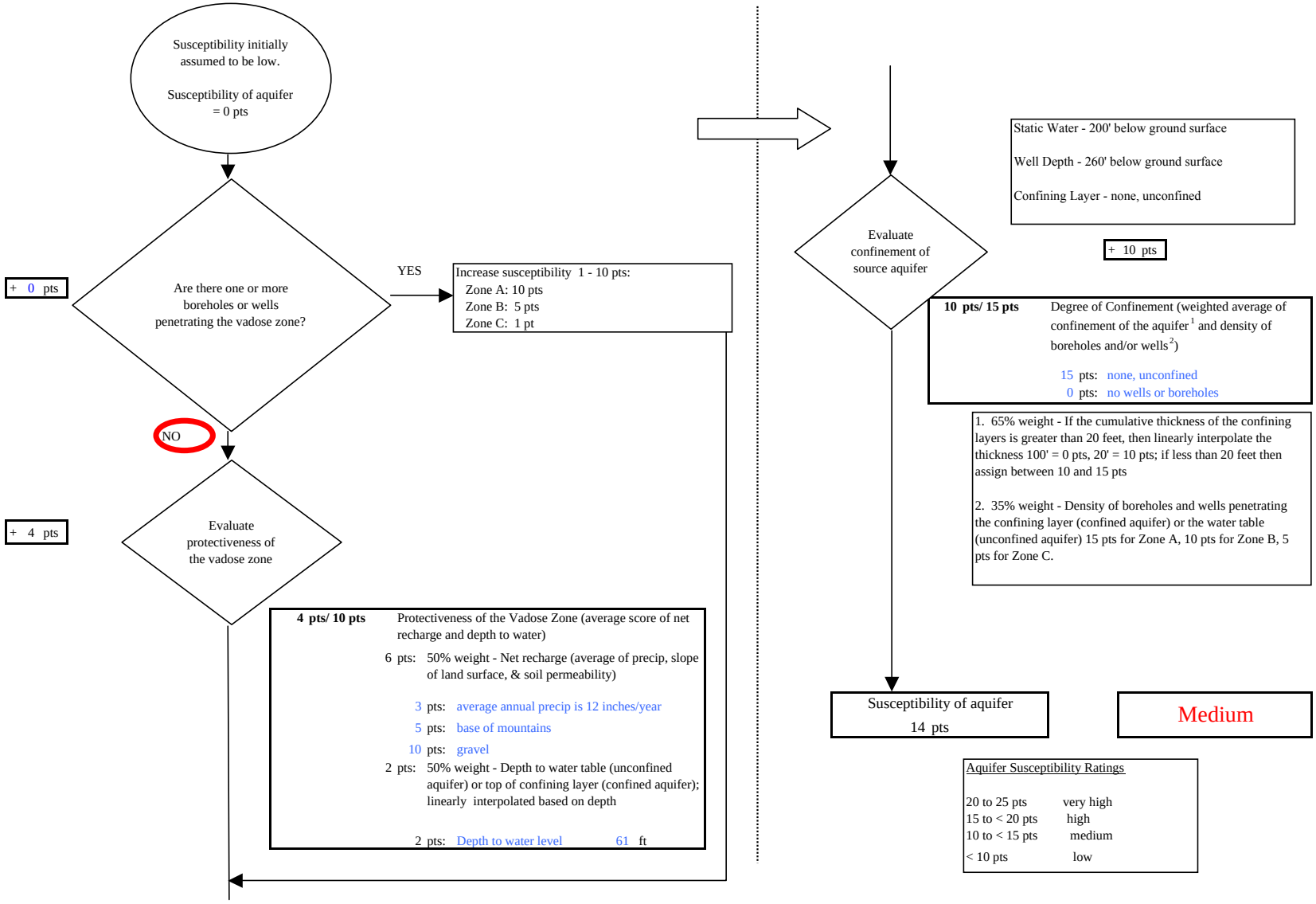
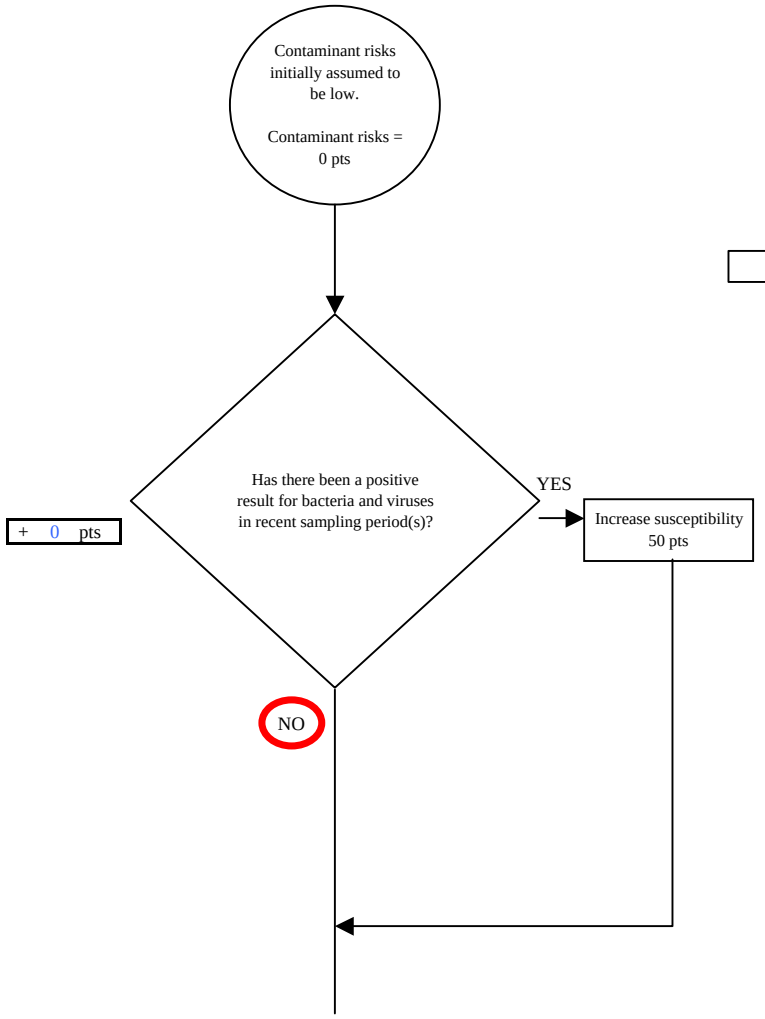
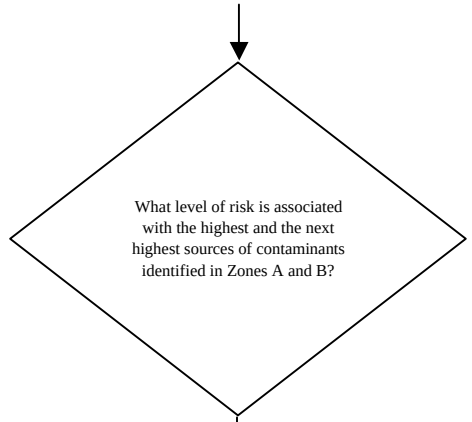


Chart 3. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Bacteria & Viruses





+ 40 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)	2	0	2
Medium(s)	36	0	36
Low(s)	15	0	15

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

Matrix Score 40

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

Chart 3. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Bacteria & Viruses

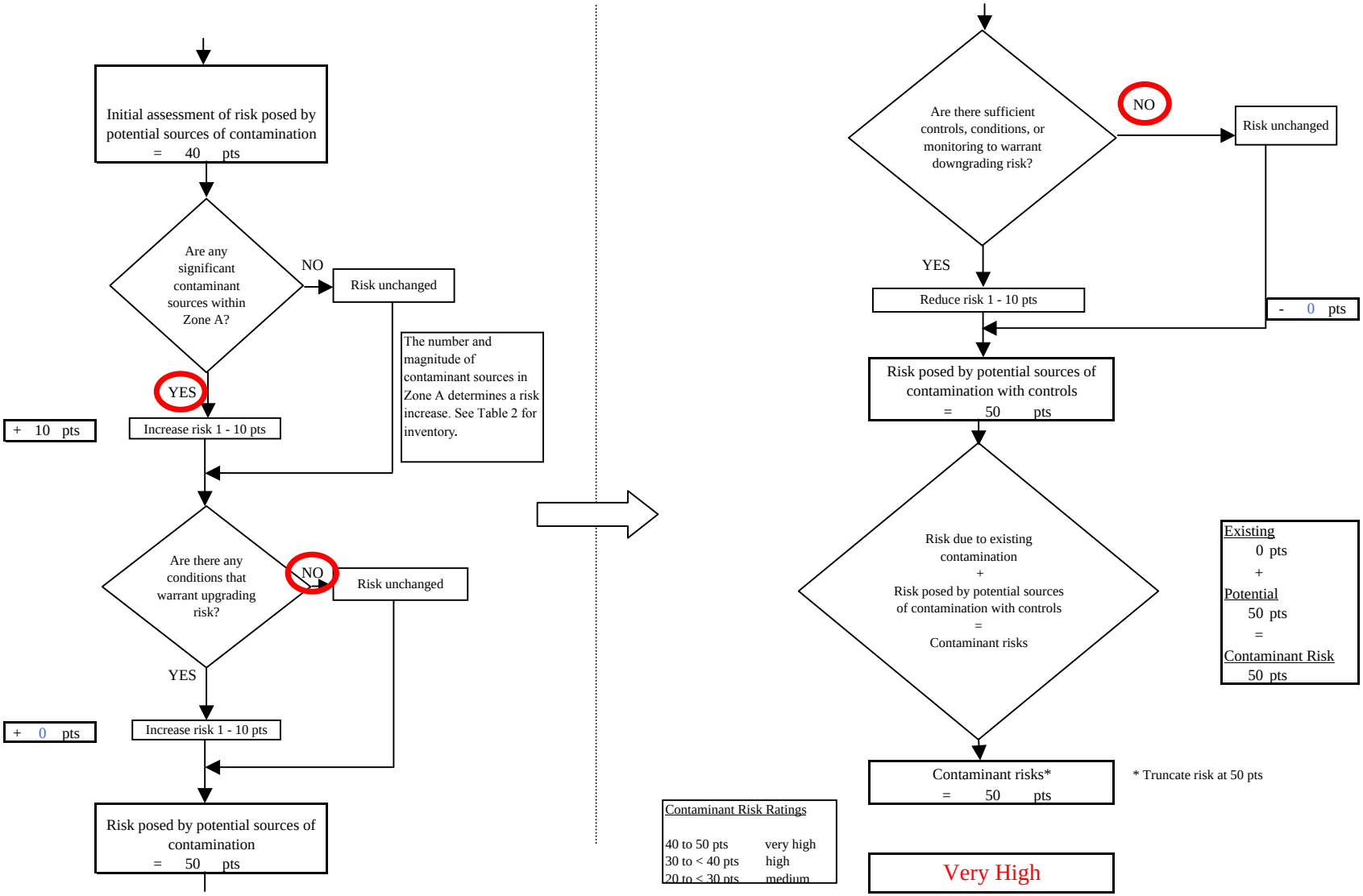


Chart 4. Vulnerability analysis for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Bacteria & Viruses

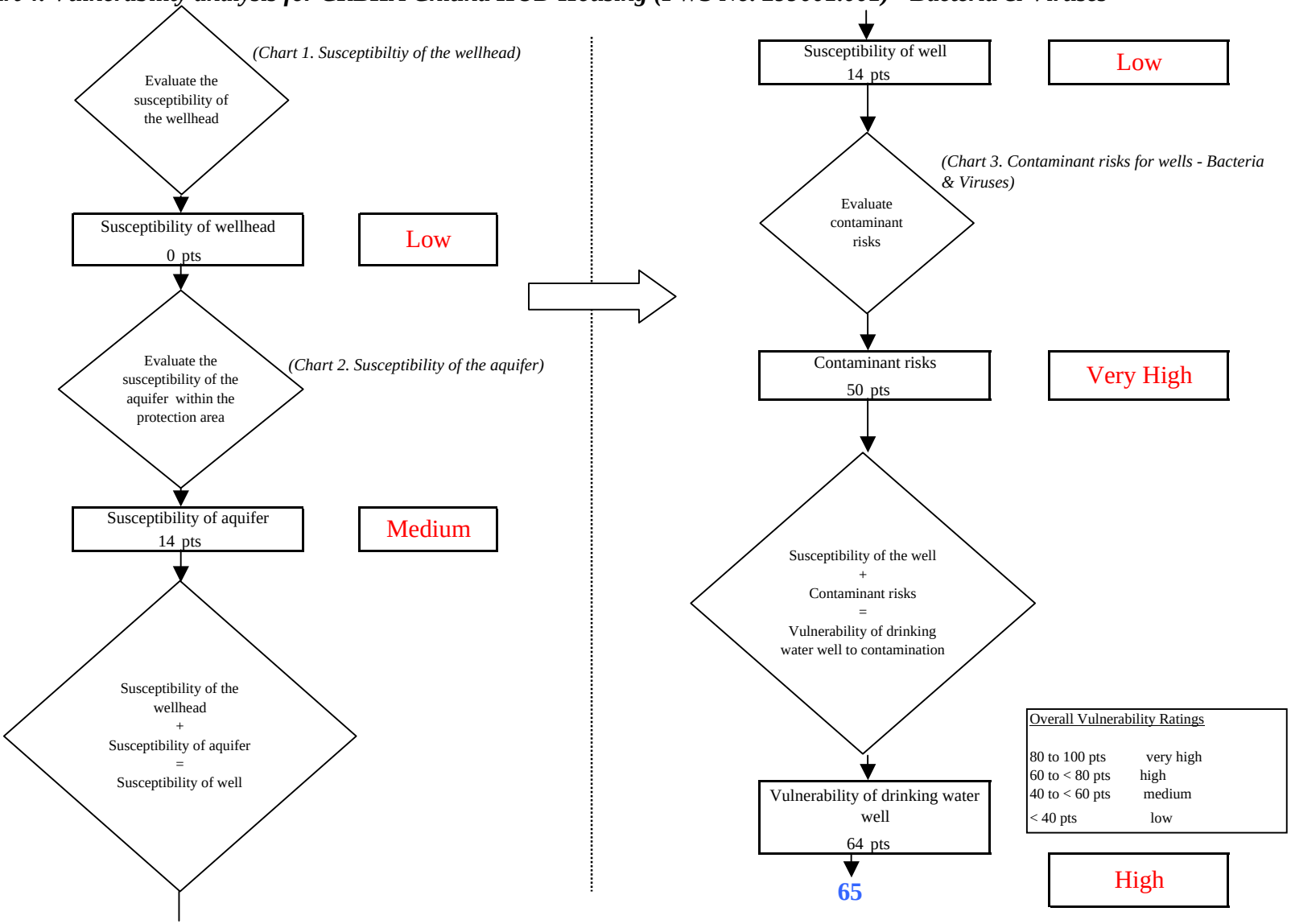


Chart 5. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Nitrates and Nitrites

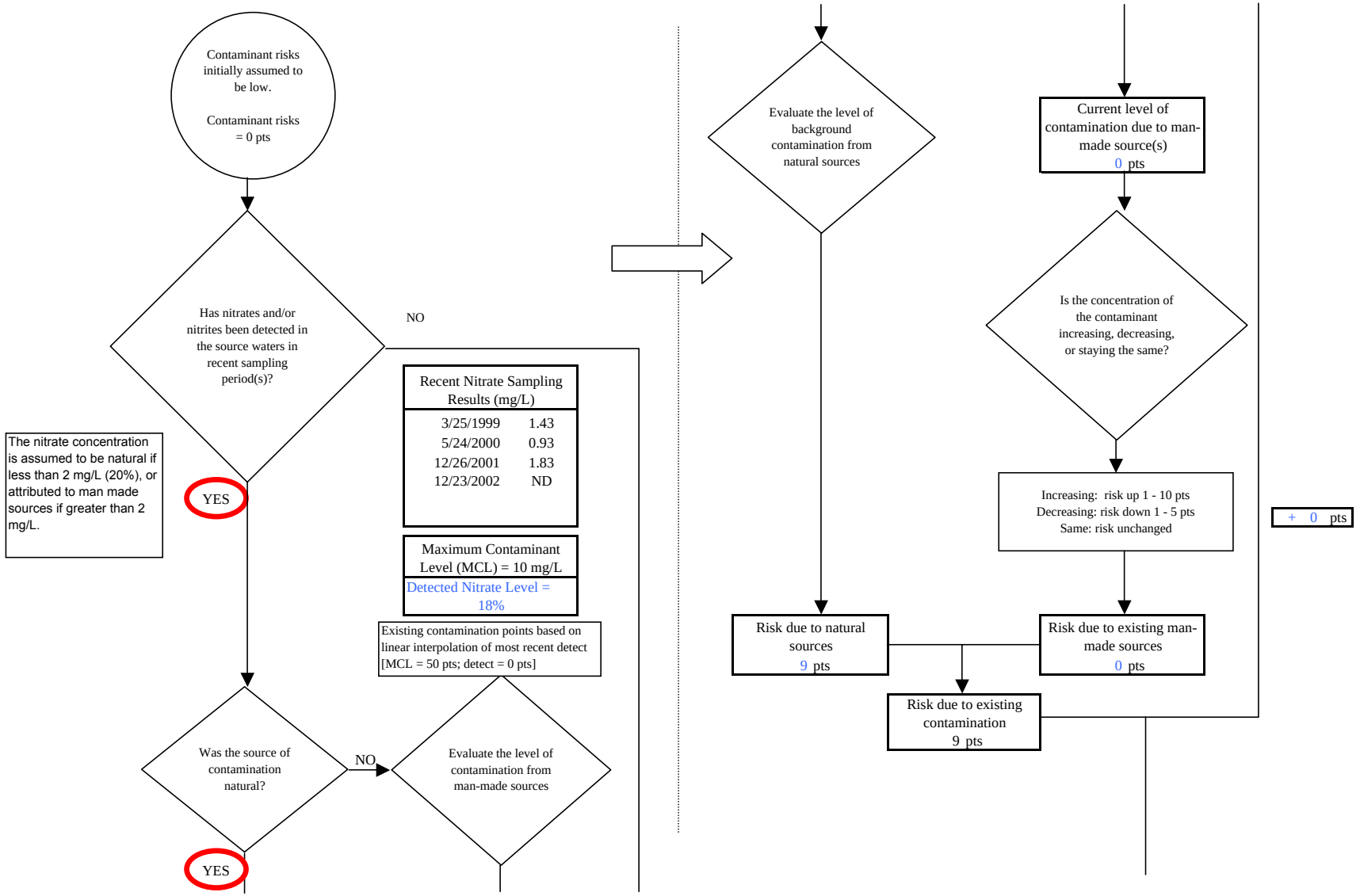


Chart 5. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Nitrates and Nitrites

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	2	0	2
Medium(s)	36	0	36
Low(s)	15	0	15

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

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES

- 0 pts

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

+ 10 pts

Increase risk 1 - 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 3 for inventory.

Chart 5. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Nitrates and Nitrites

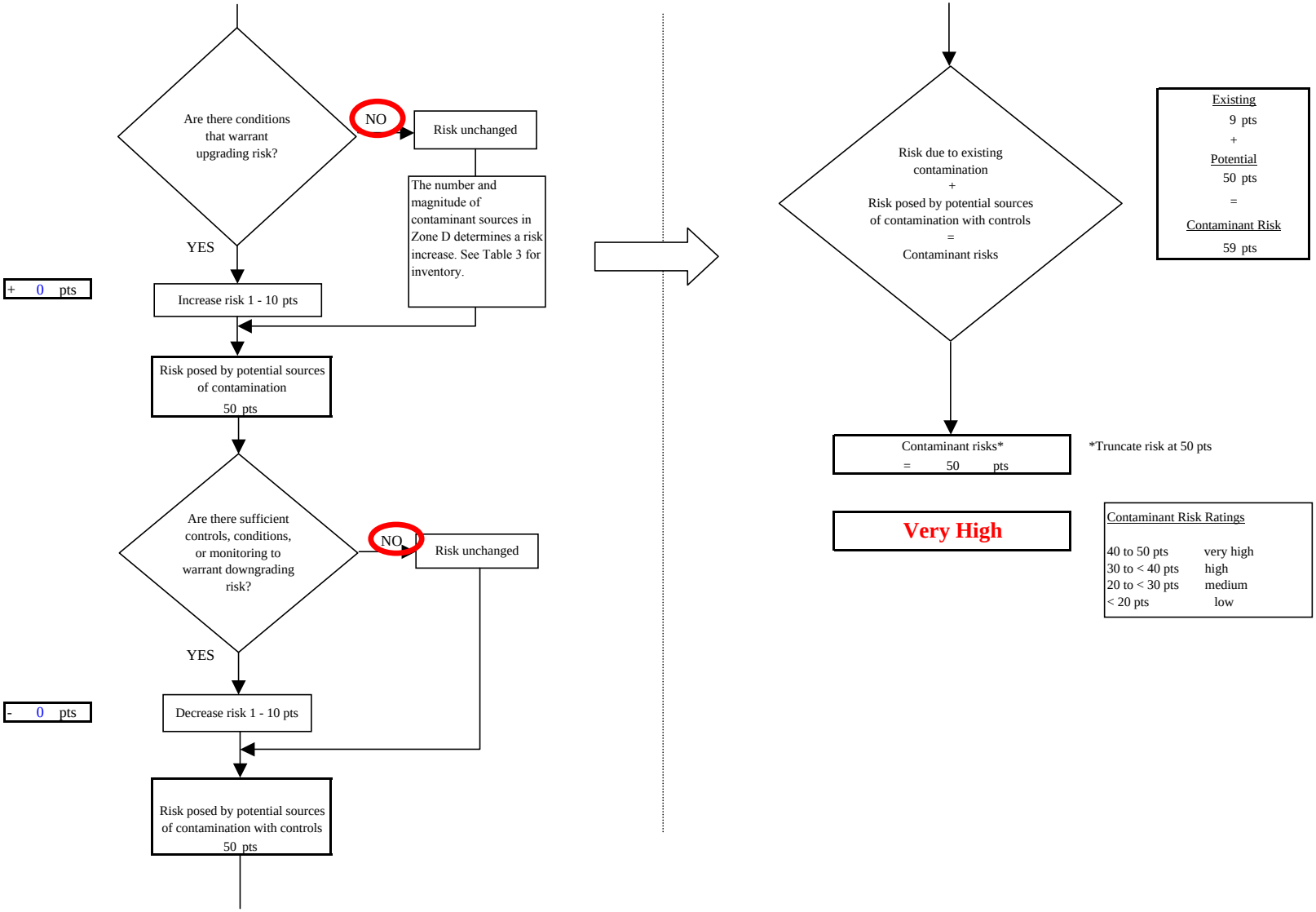


Chart 6. Vulnerability analysis for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Nitrates and Nitrites

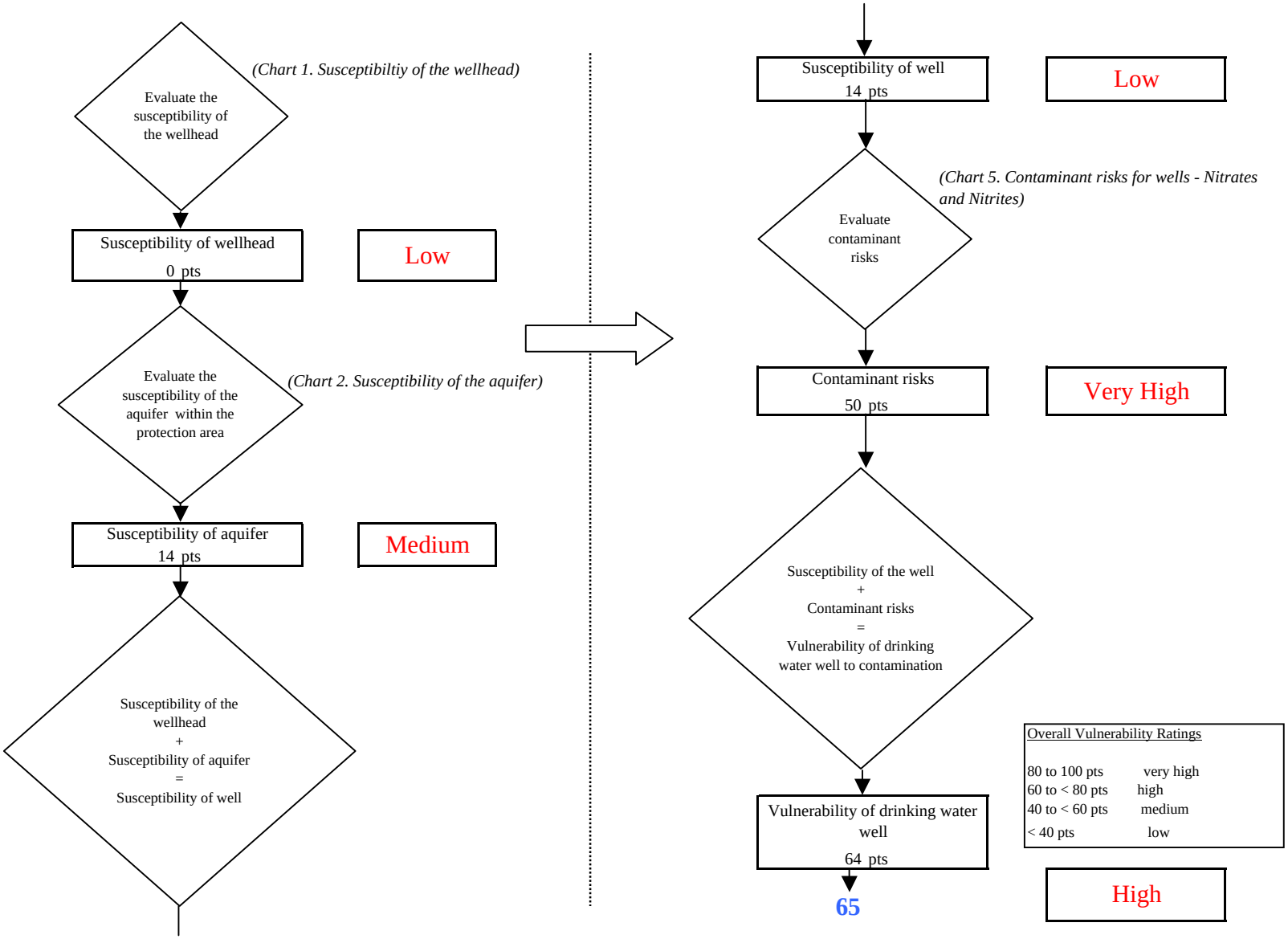


Chart 7. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Volatile Organic Chemicals

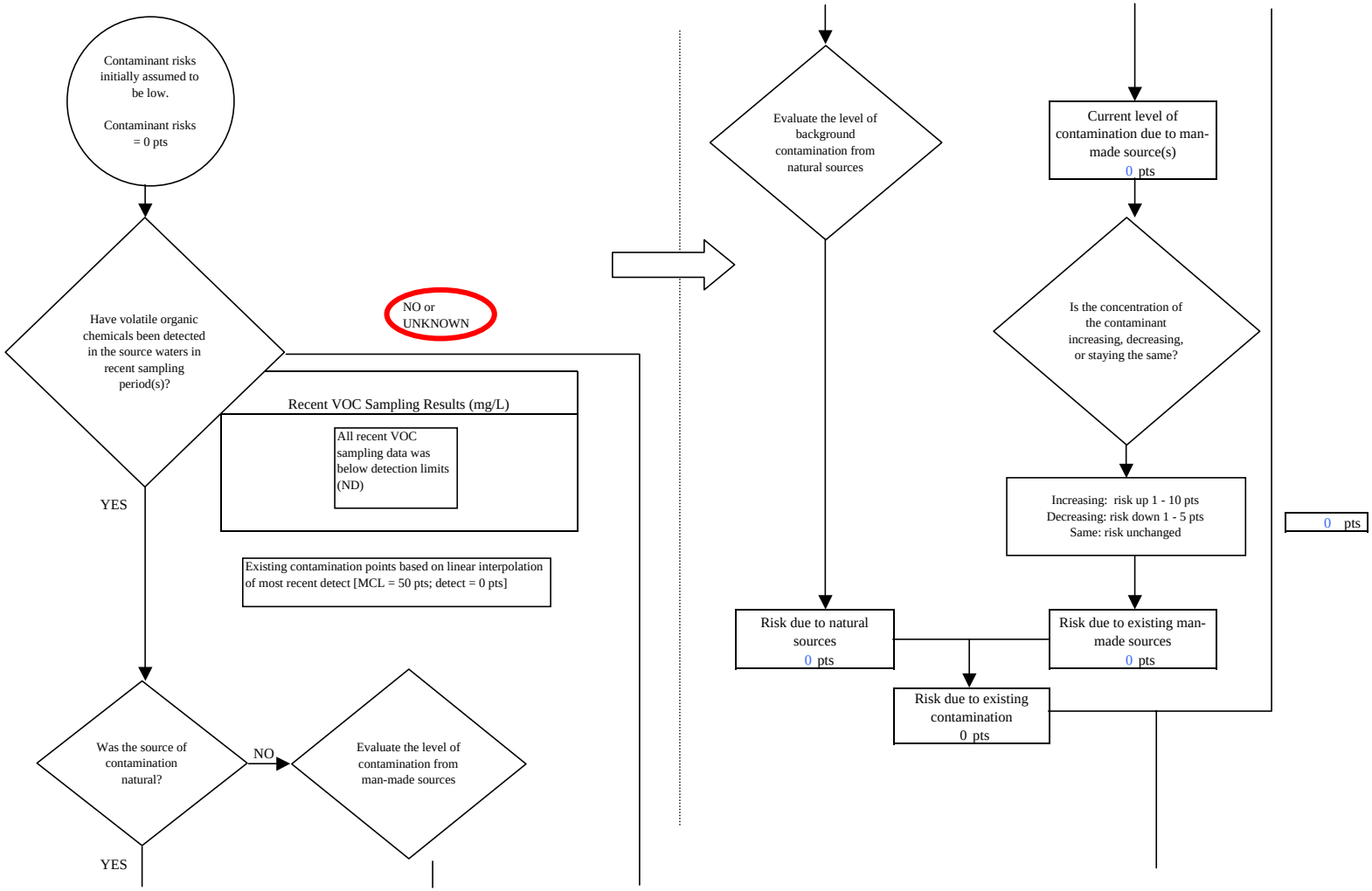


Chart 7. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Volatile Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	6	0	6
Medium(s)	11	0	11
Low(s)	40	0	40

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

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 4 for inventory.

Chart 7. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Volatile Organic Chemicals

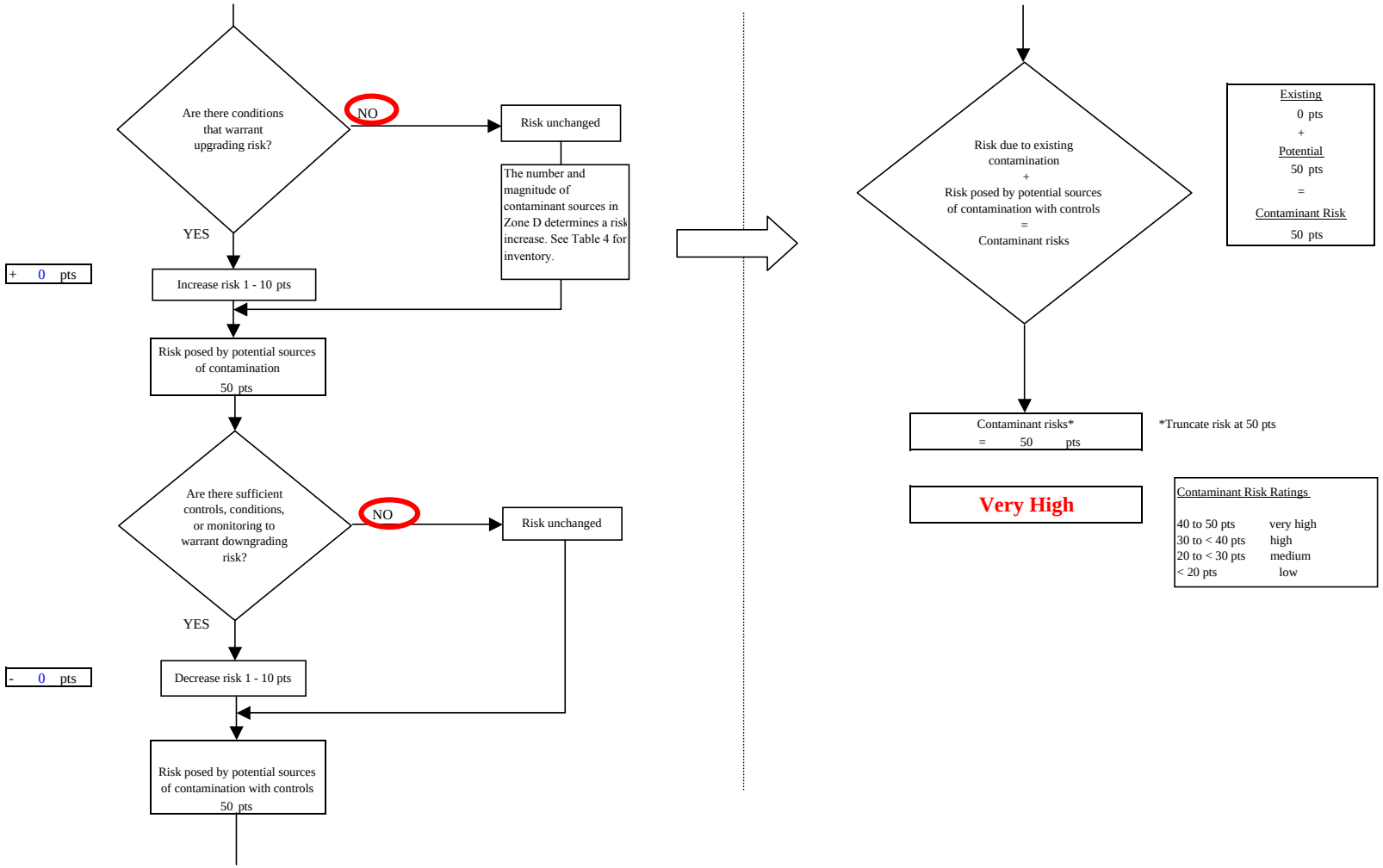


Chart 8. Vulnerability analysis for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Volatile Organic Chemicals

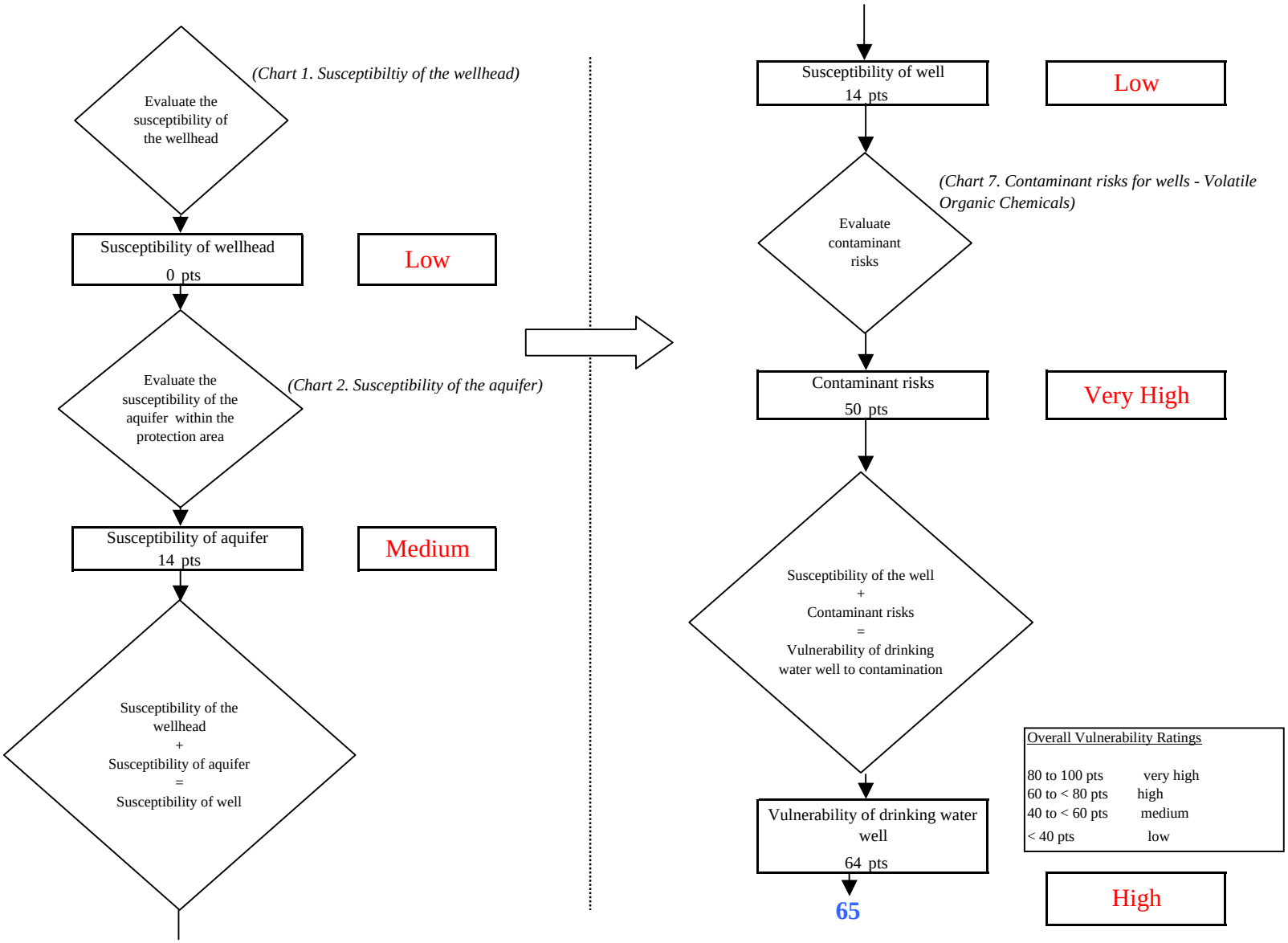


Chart 9. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

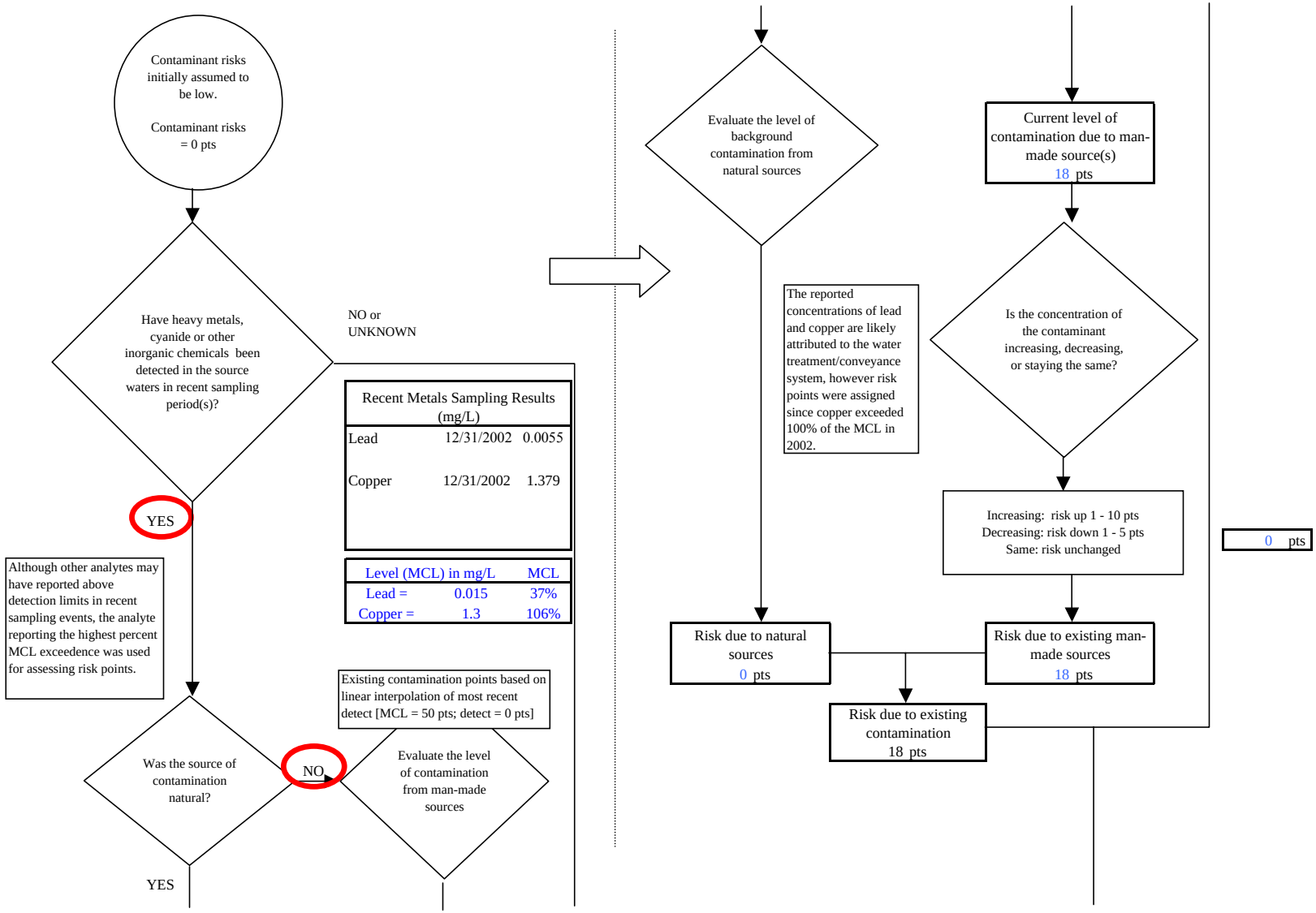
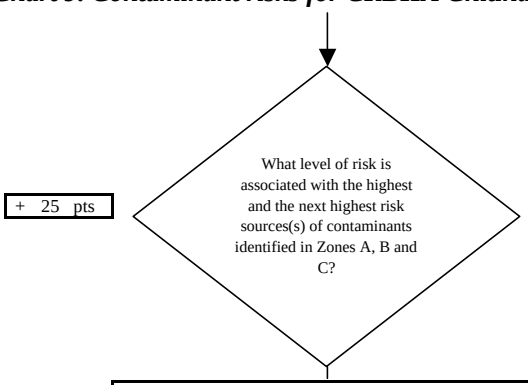


Chart 9. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 25 pts

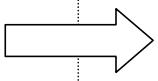
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	41	0	41

	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 25

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.



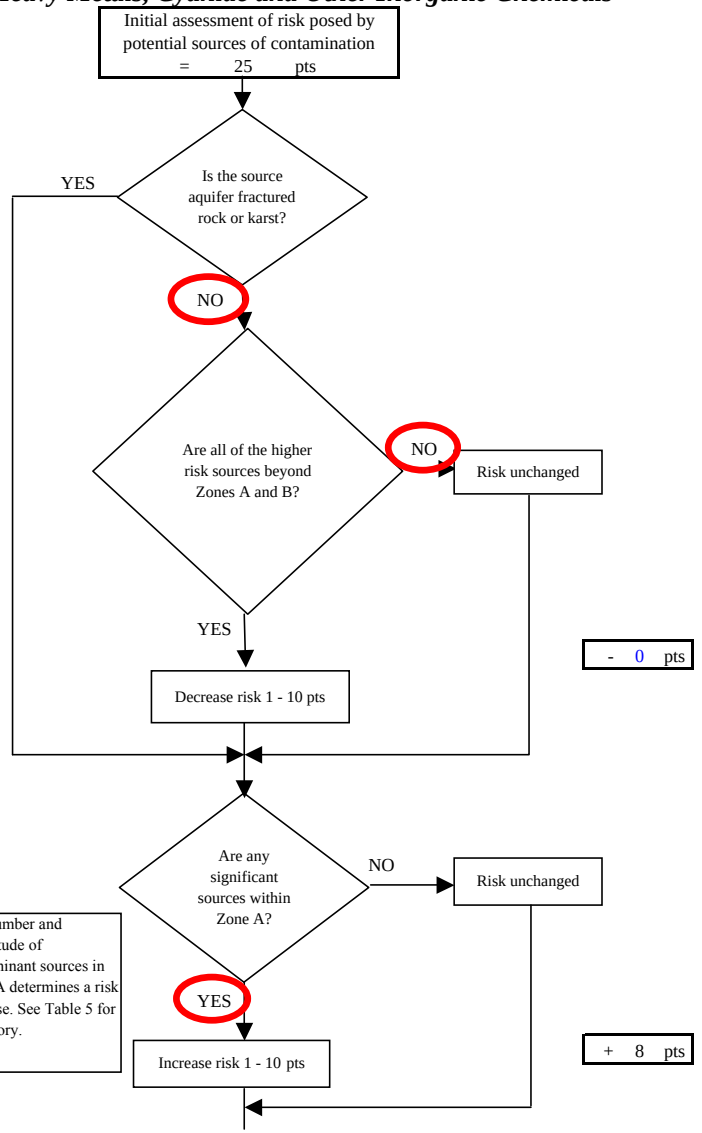


Chart 9. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

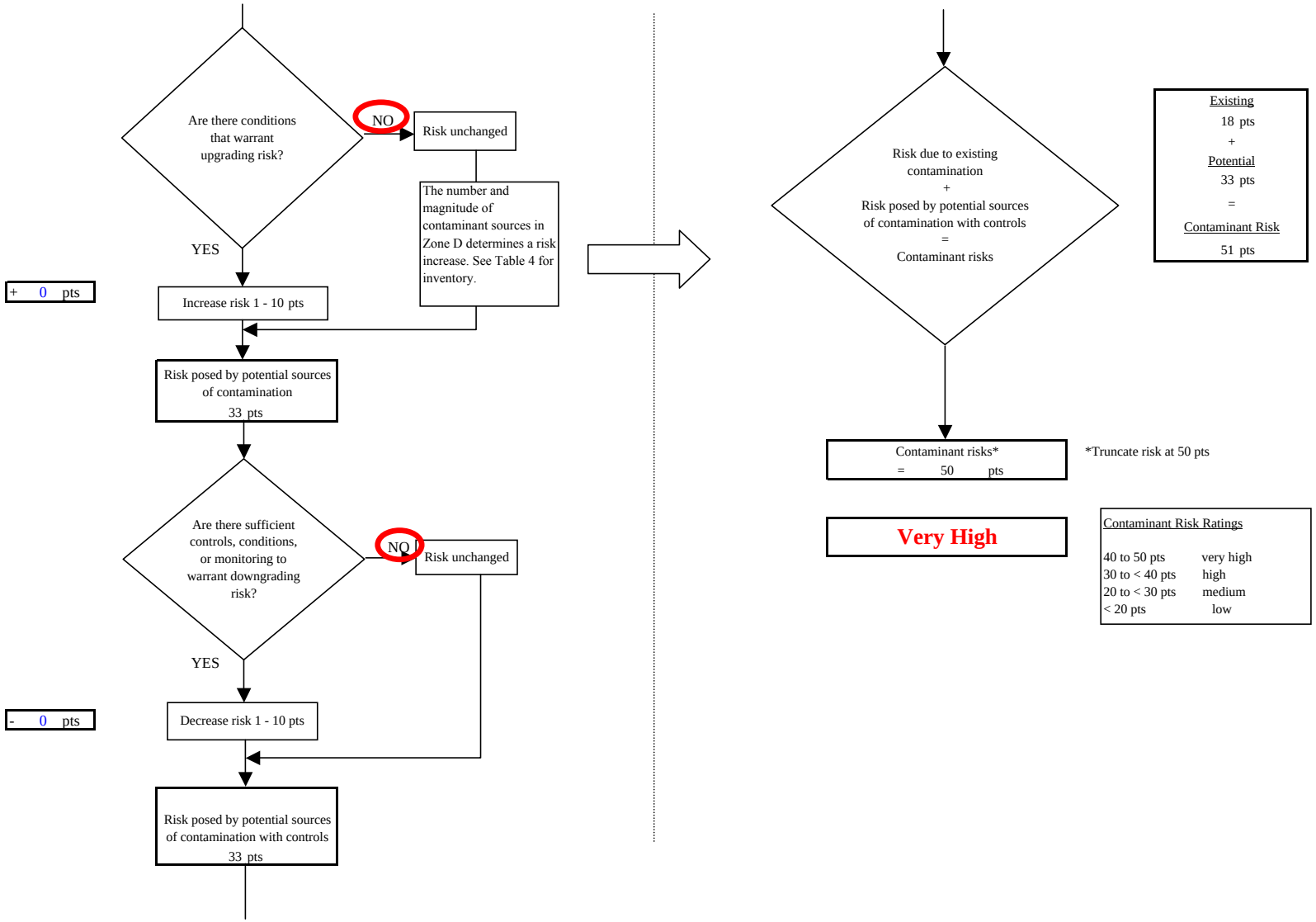


Chart 10. Vulnerability analysis for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

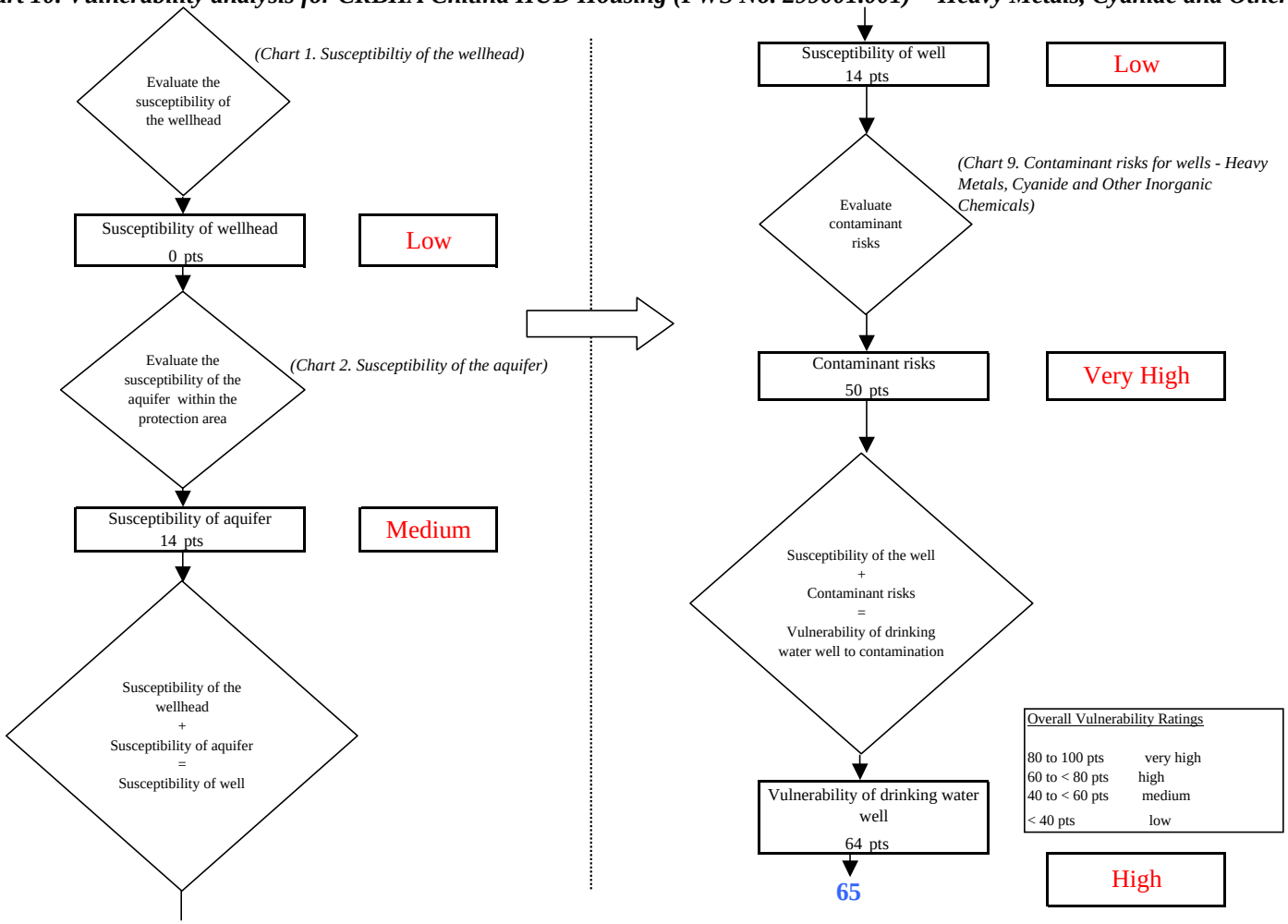


Chart 11. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Synthetic Organic Chemicals

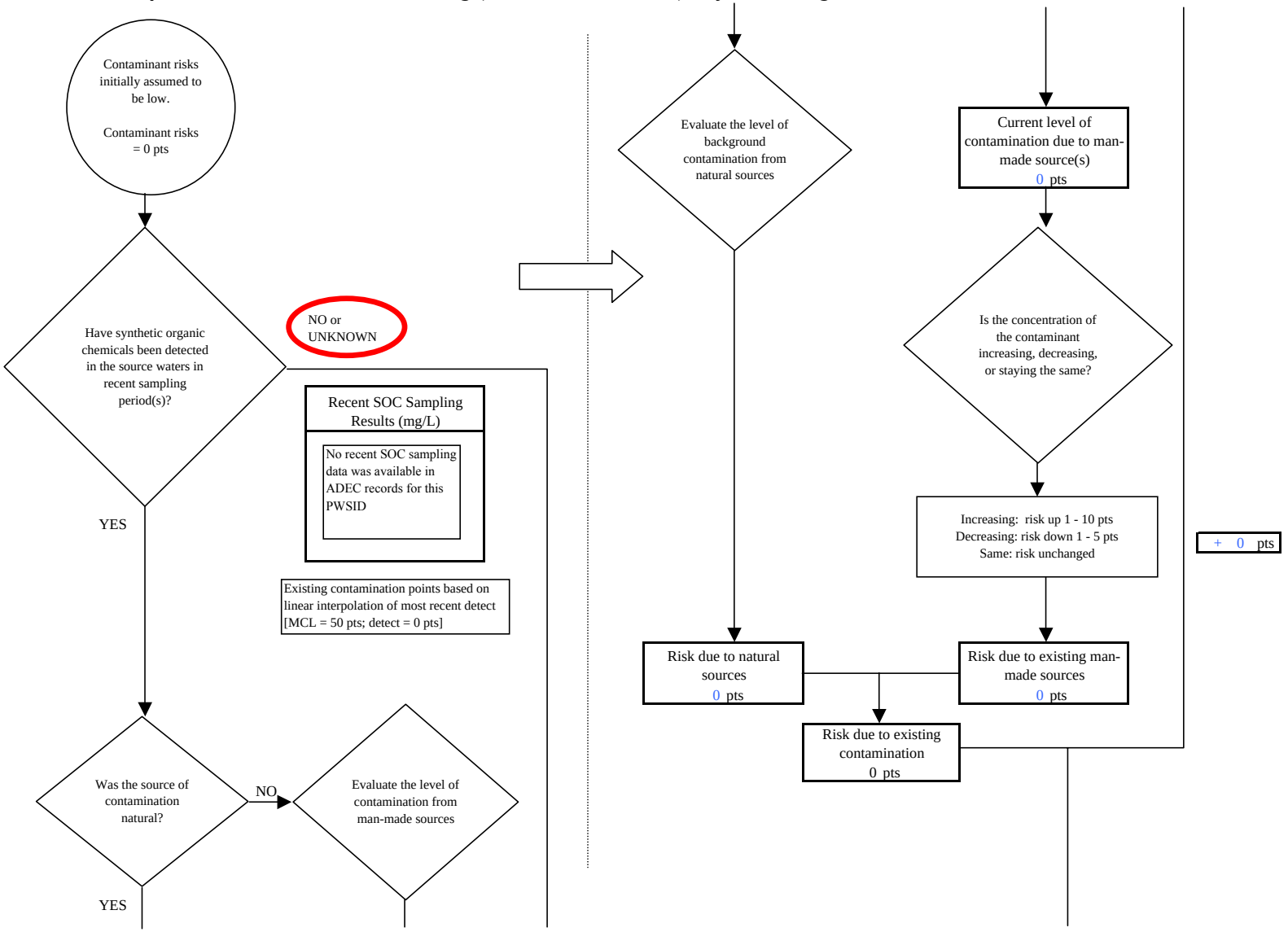
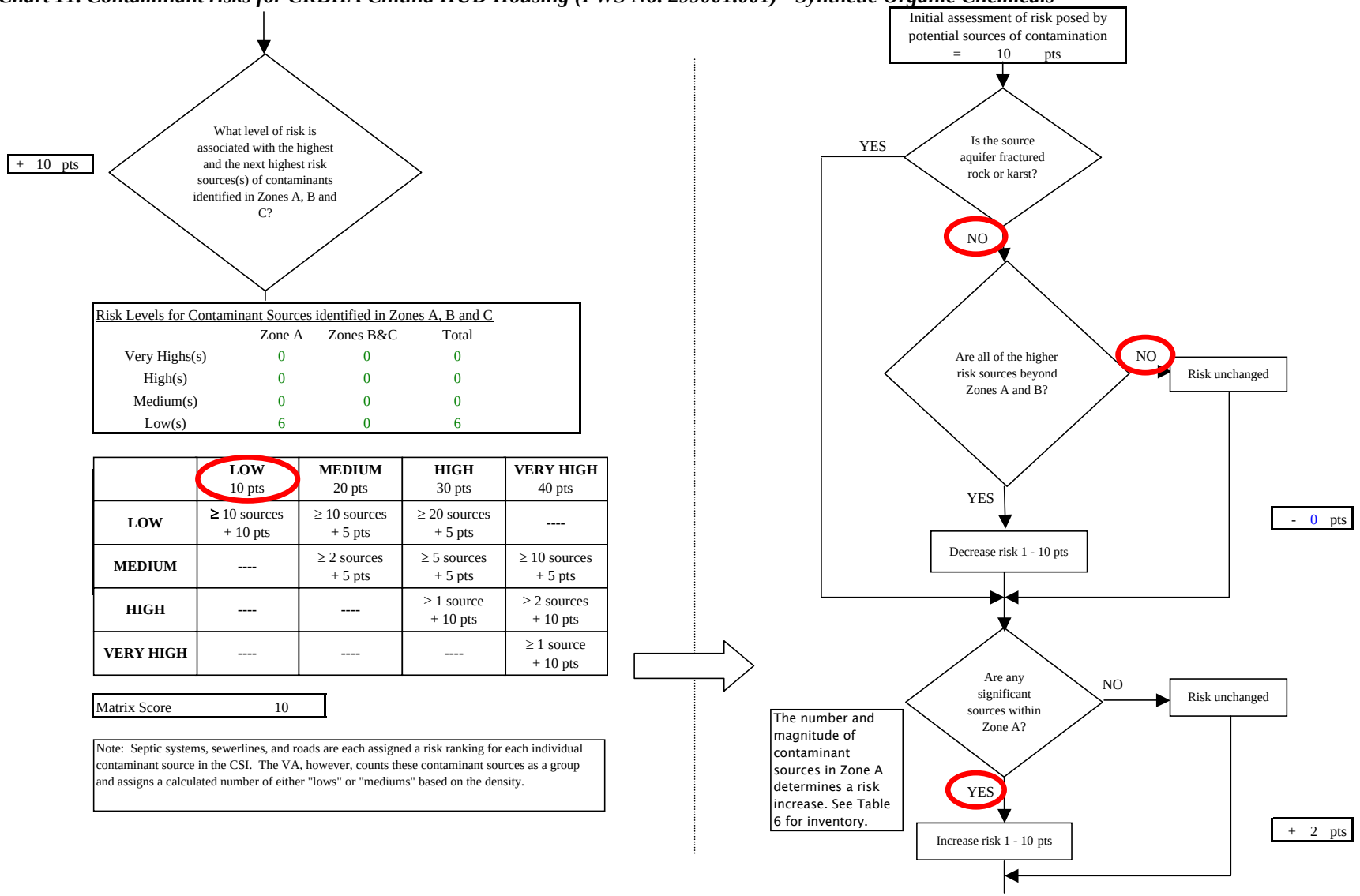


Chart 11. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Synthetic Organic Chemicals



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	6	0	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 11. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Synthetic Organic Chemicals

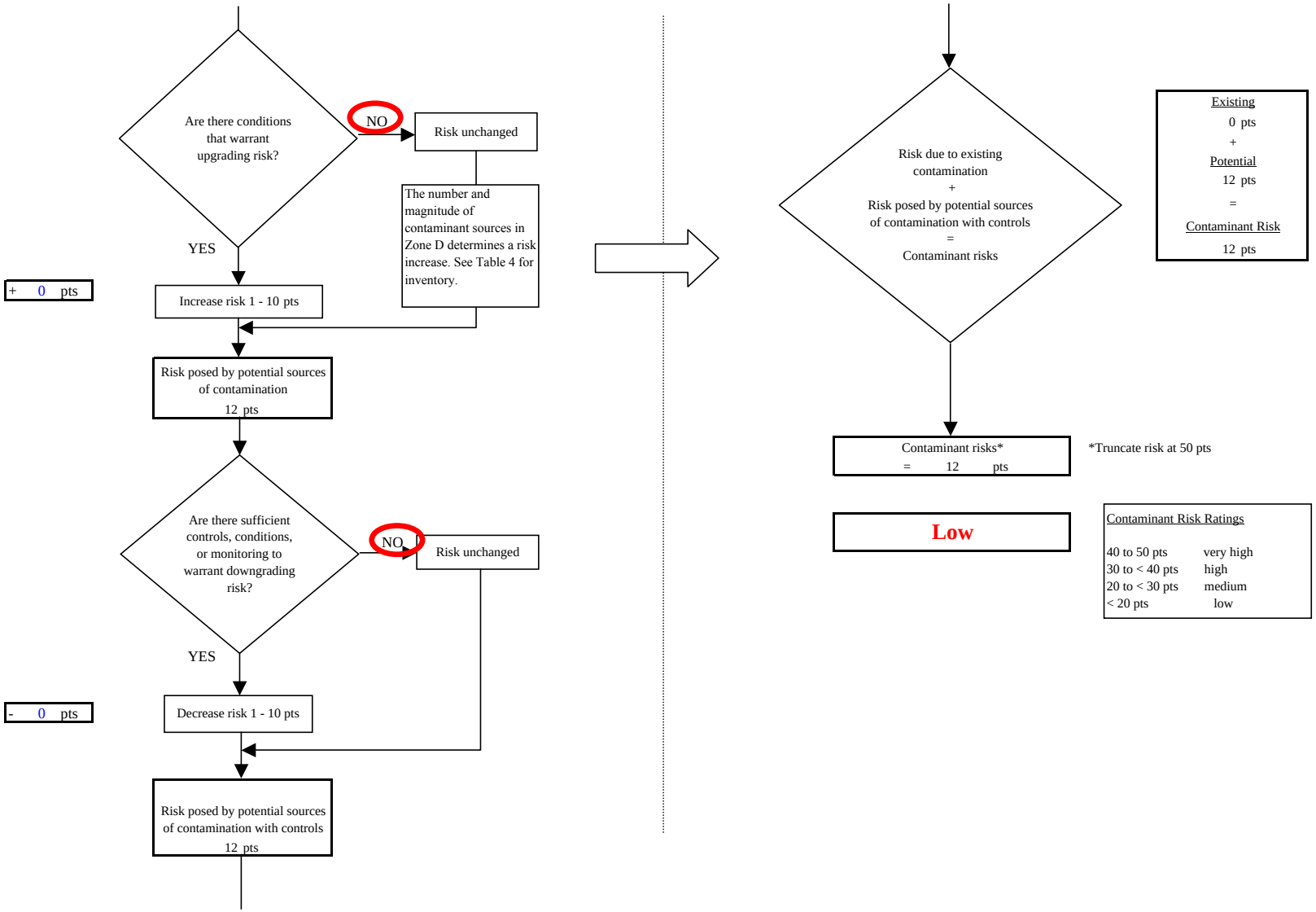


Chart 12. Vulnerability analysis for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Synthetic Organic Chemicals

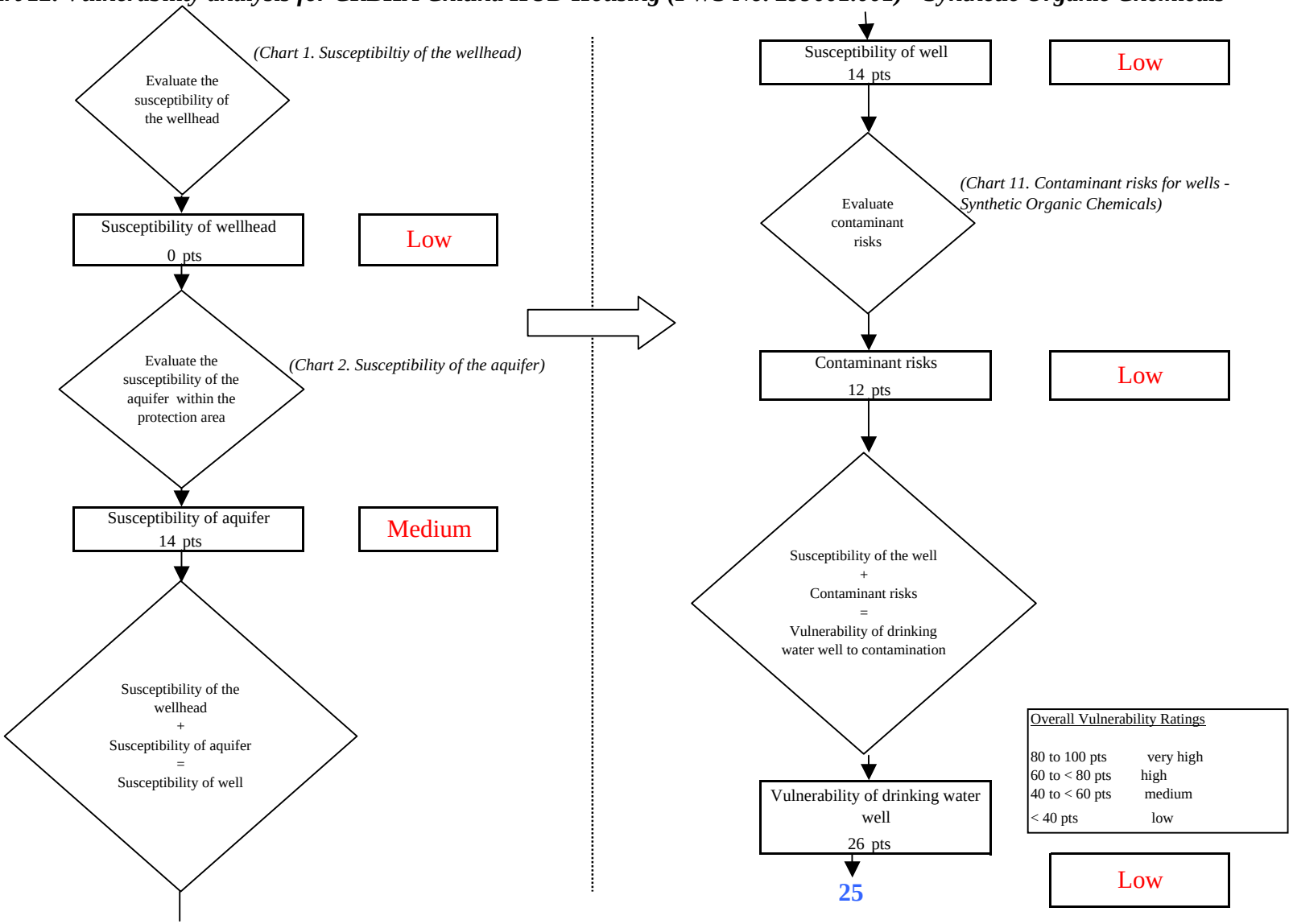


Chart 13. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Other Organic Chemicals

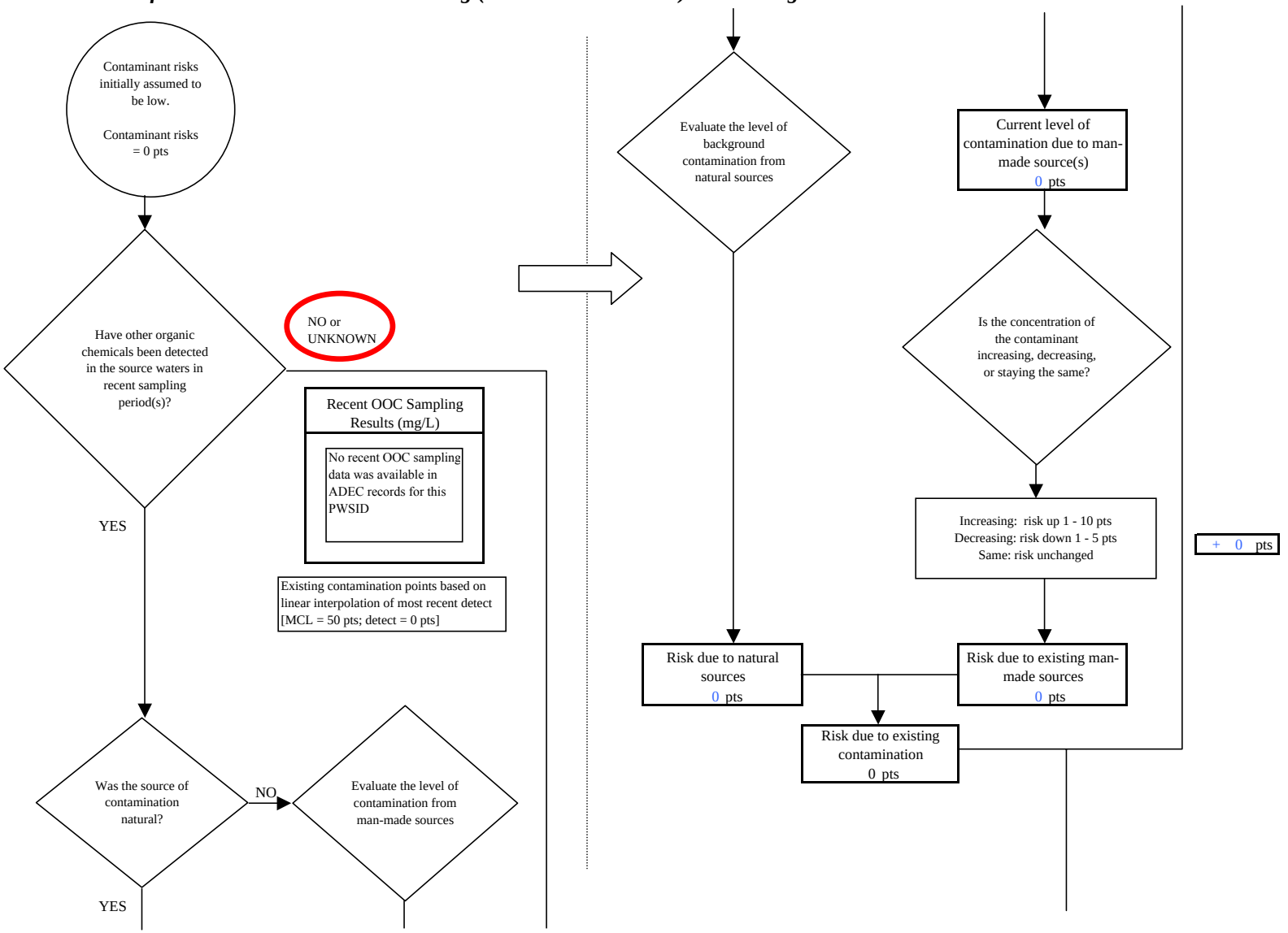
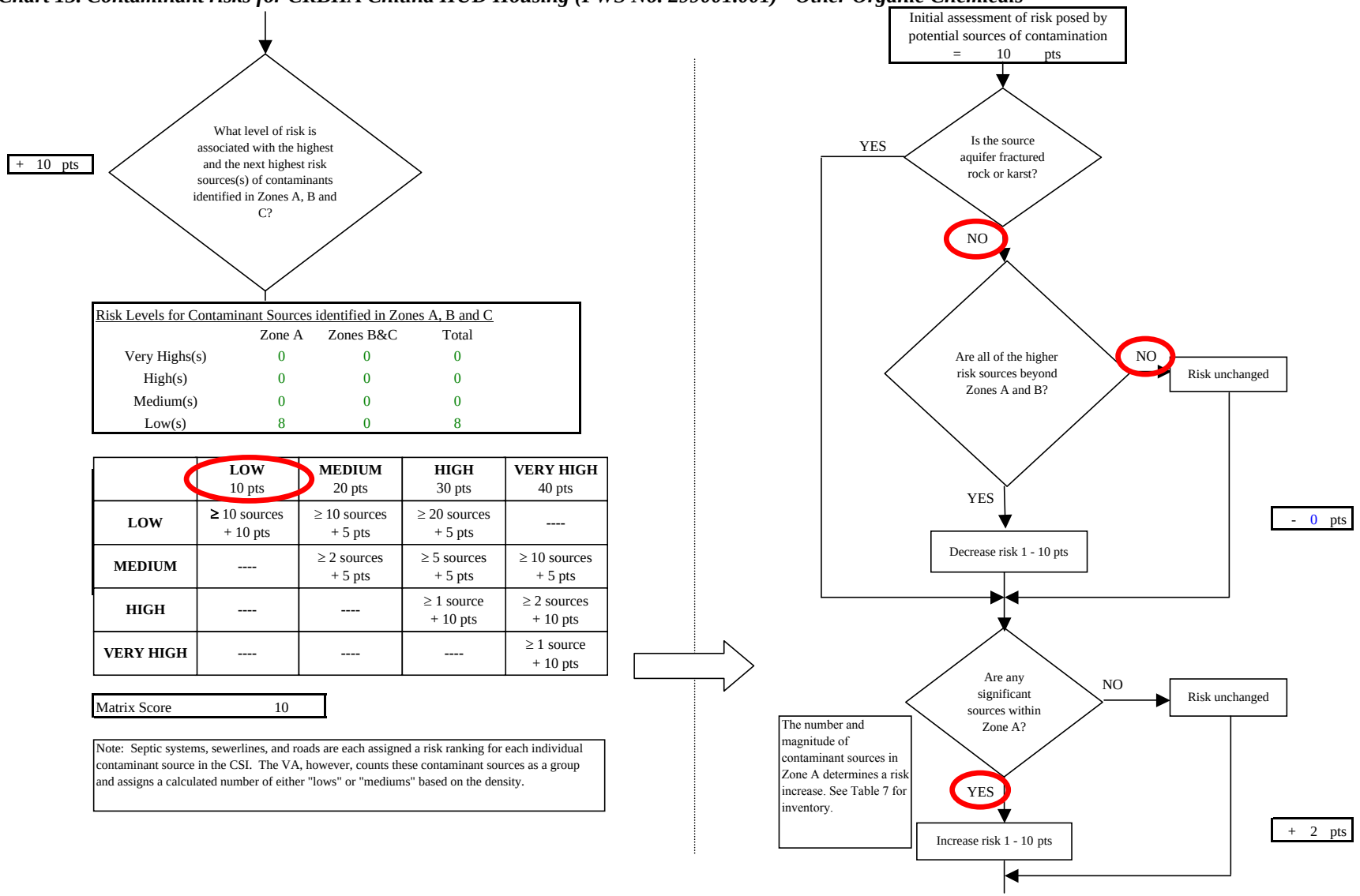


Chart 13. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Other Organic Chemicals



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	8	0	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 13. Contaminant risks for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Other Organic Chemicals

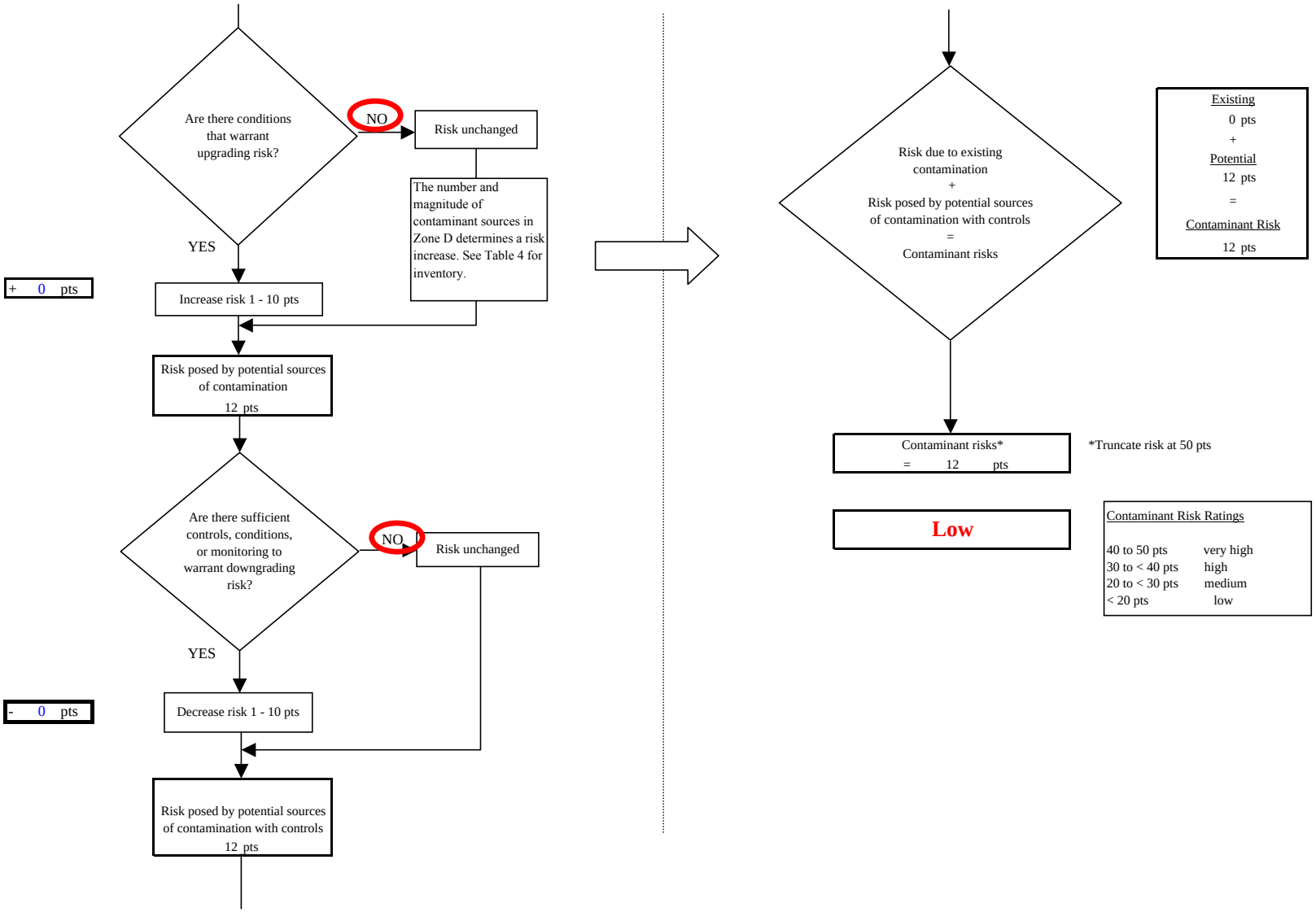


Chart 14. Vulnerability analysis for CRBHA Chitina HUD Housing (PWS No. 299001.001) - Other Organic Chemicals