Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for North Star Center Drinking Water System, Ester, Alaska PWSID # 310942

September 2002

DRINKING WATER PROTECTION PROGRAM REPORT Report 442

Alaska Department of Environmental Conservation

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The Drinking Water Protection Program 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. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for North Star Center is a Class A (community) water system consisting of one well along the Parks Highway west of Ester, Alaska. Identified potential and current sources of contaminants for North Star Center public drinking water source include: fuel storage tanks, septic systems, underground mines, a closed leaking underground storage tanks (LUST) site, roads, and residential area. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, the public water sources for North Star Center received a vulnerability rating of **High** for bacteria and viruses, nitrates and nitrites, volatile organic chemicals, and heavy metals, **Medium** for other organic chemicals, and **Low** for synthetic organic chemicals.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

DESCRIPTION OF THE FAIRBANKS AREA, ALASKA

Fairbanks Area

The Fairbanks area is located in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location information). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The Koyukon Athabascans are native to the Fairbanks area. Non-native population of the area began as a trading post on the Chena River. The discovery of gold in the early 1900s brought more than 6,000 prospectors during the Pedor Dome gold rush (ADCED, 2002). Construction of the Alcan Highway in the 1940s and the Trans-Alaska oil pipeline in the 1970s helped to continue the growth and development of the Fairbanks area.

Ester

Ester is located 8.5 miles west of Fairbanks along the George Parks Highway. Ester originally began as a mining camp established before 1905 and officially became a community in 1936 (ADCED, 2002).

The majority of Ester residents have individual wells and septic systems, and the remainder haul water from a central water point in Ester (ADCED, 2002). Heating oil (stored in both above and below ground 275 to 500-gallon tanks) is used for heating homes and buildings. Electricity is provided by Golden Valley Electric Association. Refuse is transported to the Fairbanks North Star Borough landfill.

Climate

The Fairbanks area experiences extreme weather variations according to season. Temperatures in January vary from –22 to –2 degrees Farenheight and from 50 to 72 degrees in July (ADCED, 2002). Average annual precipitation in the area is 11.3 inches (ADCED, 2002). Ice fog is common during the winter.

Topography and Drainage

The Fairbanks area includes two distinct topographic areas: the floodplain of the Tanana River and the Chena River, and the uplands north of this floodplain. Ester is located in the uplands. Elevation in the uplands varies from about 500 feet to 2500 feet.

The uplands are drained by many small creeks that flow into the Chena, Tanana, and Chatanika Rivers. The hydrology of these streams is greatly affected by the distribution of permafrost. Streams in the upper areas are dry most of the summer with runoff occurring during spring snowmelt and after heavy summer rains.

Geology and Soils

Bedrock under the Fairbanks area is predominantly a metamorphosed marine mud deposit, called a pelitic schist. Calc-mica schist, marble, and quartzite are also found in the area. The schist is locally intruded by granitic rocks – granite and quartz diorite.

Permafrost is common on the lower part of the north-facing slopes and valley bottoms (Nelson, 1978).

Groundwater

Groundwater is principally contained in fractured bedrock of the Yukon-Tanana complex (King, 1969). Groundwater flows through bedrock primarily within the fractures. The capacity of the rocks to yield water to wells depends in part on their ability to hold fractures open against the pressure of overlying rocks. The water wells in the Ester area with the greatest well recharge appear to be in quartz veins, quartzite, and siliceous schist (Nelson, 1978).

Groundwater in the uplands is recharged by local precipitation. Outflow of ground water in the uplands primarily occurs two ways. In areas under artesian pressure (pressure caused by overlying permafrost), water can flow to the surface through thawed conduits within the permafrost. Otherwise groundwater will flow under the permafrost (if present) and out to the groundwater beneath the adjacent flood plain or creek valley (Nelson, 1978).

NORTH STAR CENTER PUBLIC DRINKING WATER SYSTEM

North Star Center North Star Center is a Class A (community) water system. The system consists of one well along the Parks Highway west of Ester, Alaska (T1S, R2W, Section 10) (See Map 1 of Appendix A). This area is at an elevation of approximately 650 feet above sea level.

According to the Sanitary Survey (8/27/99), the depth of the well is 96 feet and has a 20-foot screen. Although a well log is not available for this well, other wells in the area are screened in bedrock and it is assumed that this well is also. The Sanitary Survey (8/27/99) also indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is also appropriately sloped away from the well providing adequate surface water drainage. The well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves 90 non-residents through one service connection.

NORTH STAR CENTER 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. Some areas are more likely to allow contamination to reach the well than others. 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 DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

An outline of the immediate watershed was used to determine the size and shape of the DWPA for North Star Center. Available geology was also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful

DWPA (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The DWPAs 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. An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources (*Jokela et. al., 1991*).

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 DWPA zones and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. TOT
B	Less than the 2 year TOT
C	Less Than the 5 year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

The DWPA for North Star Center is limited by its immediate watershed and includes only Zones A and B (See Map 1 of Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the North Star Center 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 Maps 2 through 5 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 sorted and ranked 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. Further, contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well.

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

VULNERABILITY OF NORTH STAR CENTER DRINKING WATER SOURCE

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

- Natural susceptibility; and
- Contaminant risks.

Each of the six categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the

Drinking Water Source to Contamination (0 – 100). A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

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

The well for North Star Center is completed in an unconfined aquifer setting. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for North Star Center.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	24	Very High
Natural Susceptibility	24	Medium

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data 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. 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	36	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	20	Medium

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

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	75	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	60	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	75	High
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	20	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is very high with large capacity and residential septic systems presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Large capacity septic systems, designated a type of Class V Injection well by the Environmental Protection Agency (EPA), differ from residential septic systems in that they serve multiple dwellings, businesses, or communities.

Monitoring samples analyzed in September 2001 were positive for bacteria and viruses. The positive samples indicating that the source is susceptable to bacteria and viruses contamination and therefore increase the

vulnerability score. The source of the bacteria and viruses is unknown. Subsequent samples taken in each of the following three months after the positive result in September all had negative results for bacteria and viruses. 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 with large capacity and residential septic systems, because of their effluent discharge, posing the most significant contaminant risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history for North Star Center well indicates that low concentrations of nitrate have been detected. Existing nitrate concentration is approximately 1.4 mg/L or 14% of the Maximum Contaminant Level (MCL) of 10mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Throughout the past 5 years nitrate and/or nitrite concentrations at this site have remained relatively constant with levels varying between 12-15% of the MCL.

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

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

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is high with the density of residential heating oil storage tanks in Zones A and B creating the most significant risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). Both underground and above ground heating oil storage tanks are the standard way of heating homes and businesses in the Ester area. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Regular system maintenance can help prevent many of these harmful fuel leaks.

Recent sampling history of North Star Center's well indicates that a low level of one of the contaminants within the Volatile Organic Chemicals category was detected in the water. Total Trihalomethanes (TTHM) were detected on 8/20/98 at a concentration of 0.0018 mg/L, or 2% of the MCL (0.08 mg/L). TTHM are usually found in drinking water as a byproduct of drinking water disinfection. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is very high with the underground mines in the DWPA creating the most significant risk (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). Water flowing over and through the metal-rich rock exposed by mining activities can react with the chemicals in the rock to contaminate the surface and ground waters. This occurrence is called acid mine drainage, and is often generated from waste rock piles or other mining wastes. Acid mine drainage can occur at an active or inactive mine and continue long after mining ends.

Monitoring samples analyzing chemicals within the Heavy Metals, Cyanide and Other Inorganic Chemicals category were collected in 1998 and 1995. Only barium and fluoride were detected in very low concentrations in both years, with the most recent concentrations of 0.0008 mg/L and 0.510 mg/L, respectively. Both of these levels were well below the chemicals' respective MCLs of 2 mg/L and 4 mg/L, and do not represent risk to North Star Center's drinking water source. 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.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is low with the large capacity and residential septic systems representing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals of the well is low.

Other Organic Chemicals

The contaminant risk for other organic chemicals is medium with the large capacity and residential septic systems and the roads within the DWPA representing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well is medium.

Review of the historical sampling data indicates that no synthetic organic chemicals or other organic chemicals have been sampled for in North Star Center's drinking water within the past 5 years (See Charts 11 and 13 – Contaminant Risks for Synthetic Organic Chemicals and Other Organic Chemicals in Appendix D, respectively).

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving North Star Center. The overall vulnerability of this source to contamination is **High** for bacteria and viruses, nitrates and nitrites, volatile organic chemicals, and heavy metals, and **Medium** for other organic chemicals, and **Low** for synthetic organic chemicals. 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 North Star Center 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 North Star Center public drinking water source.

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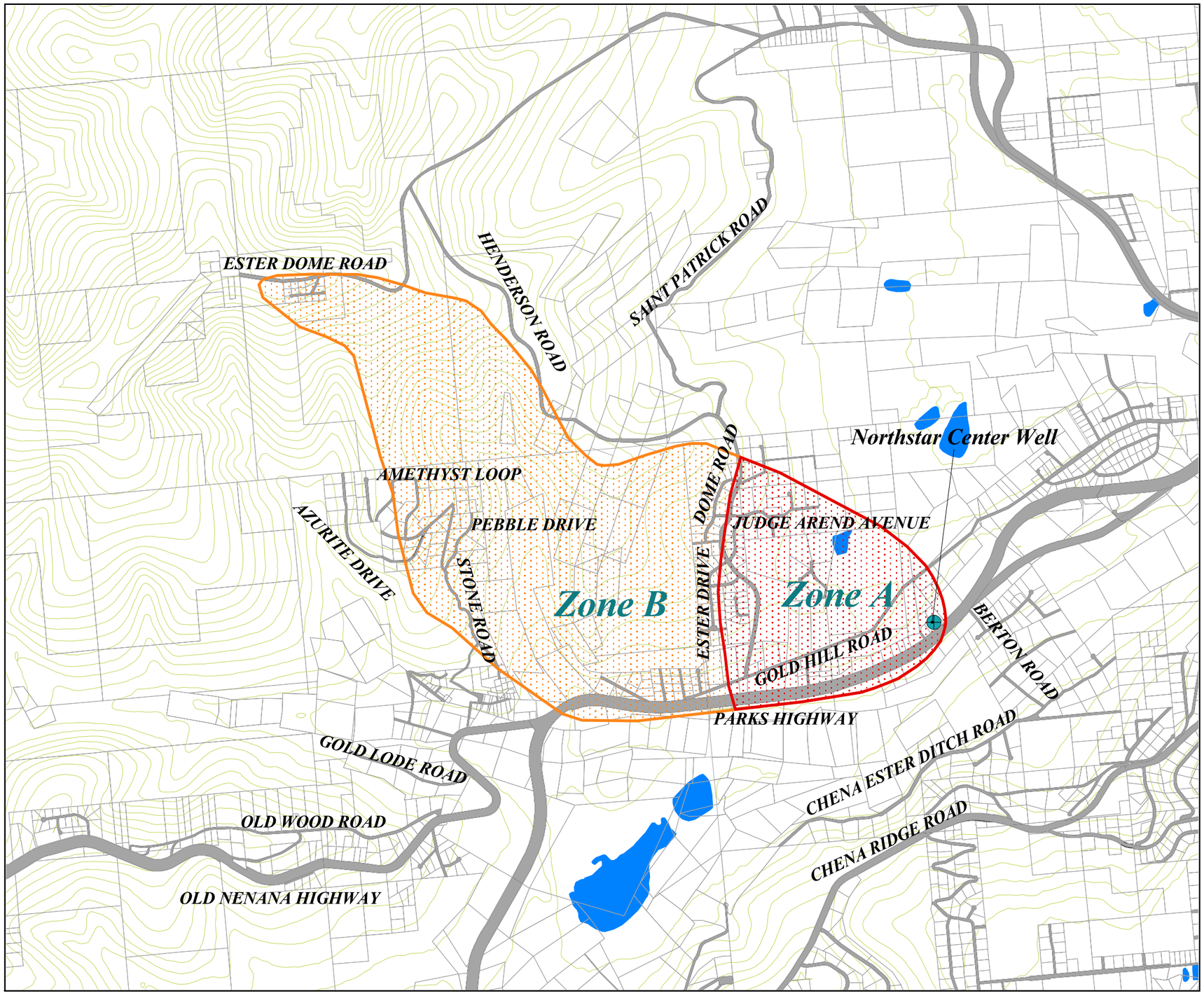
APPENDIX A

North Star Center
Drinking Water Protection Area Location Map
(Map 1)

Northstar Center Drinking Water Protection Area



2 0 2 Miles

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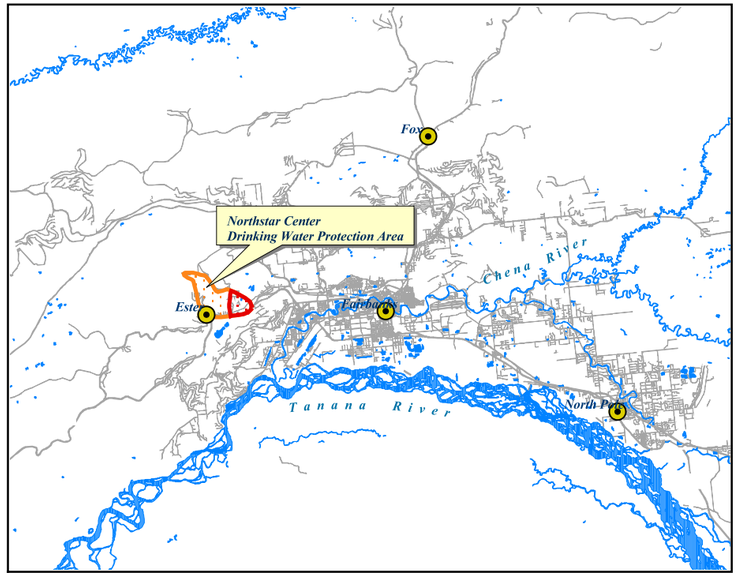
Legend

- Northstar Center Well
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less Than 2 Years Travel Time
- Parcels
- Lakes
- Roads
- Elevation Contours (20 meters)



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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for North Star Center (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Northstar Center***

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Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	
Metals mining, underground (active or inactive?)	E05	E05-1	A	2	Great Dharma Prospect
Residential Areas	R01	R01-1	A	4	Approximately 175 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	4	Approximately 65 residential septic systems located in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-1 - 65	A	4	Approximately 64 residential heating oil underground storage tanks located in Zone A
Tanks, diesel (above ground)	T06	T06-1	A	2	4' by 6' fuel oil tank next to the well house for Northstar Center
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	2	
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	2	1000-gallon fuel tank
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U08-1	A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	2	
Highways and roads, dirt/gravel	X24	X24-01	A	2	
Highways and roads, dirt/gravel	X24	X24-02	A	2	
Highways and roads, dirt/gravel	X24	X24-03	A	2	
Highways and roads, dirt/gravel	X24	X24-04	A	2	
Highways and roads, dirt/gravel	X24	X24-05	A	2	
Highways and roads, dirt/gravel	X24	X24-06	A	2	
Highways and roads, dirt/gravel	X24	X24-07	A	2	
Highways and roads, dirt/gravel	X24	X24-08	A	2	
Highways and roads, dirt/gravel	X24	X24-09	A	2	
Highways and roads, dirt/gravel	X24	X24-10	A	2	
Heavy equipment rental/storage	C18	C18-1	B	3	
Metals mining, underground (active or inactive?)	E05	E05-2	B	3	Crown Point Mine
Metals mining, underground (active or inactive?)	E05	E05-3	B	3	Little Eva Mines

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Metals mining, underground (active or inactive?)	E05	E05-4	B	3	Hess & Thomas Prospect
Metals mining, underground (active or inactive?)	E05	E05-5	B	3	Flower Mine
Metals mining, underground (active or inactive?)	E05	E05-6	B	3	Clipper Mine
Residential Areas	R01	R01-2	B	5	Approximately 200 acres of residential area within Zone B
Septic systems (serves one single-family home)	R02	R02-66-152	B	5	Approximately 87 residential septic systems located within Zone B
Tanks, heating oil, residential (above ground)	R08	R08-66-152	B	5	Approximately 87 residential heating oil underground fuel storage tanks located within Zone B
Highways and roads, dirt/gravel	X24	X24-11	B	2	
Highways and roads, dirt/gravel	X24	X24-12	B	2	
Highways and roads, dirt/gravel	X24	X24-13	B	2	
Highways and roads, dirt/gravel	X24	X24-14	B	2	
Highways and roads, dirt/gravel	X24	X24-15	B	2	
Highways and roads, dirt/gravel	X24	X24-17	B	3	
Highways and roads, dirt/gravel	X24	X24-18	B	3	
Highways and roads, dirt/gravel	X24	X24-19	B	3	
Highways and roads, dirt/gravel	X24	X24-20	B	3	
Highways and roads, dirt/gravel	X24	X24-21	B	3	
Highways and roads, dirt/gravel	X24	X24-22	B	3	
Highways and roads, dirt/gravel	X24	X24-23	B	3	
Highways and roads, dirt/gravel	X24	X24-24	B	3	
Highways and roads, dirt/gravel	X24	X24-25	B	3	

Table 2

Contaminant Source Inventory and Risk Ranking for Northstar Center
Sources of Bacteria and Viruses

PWSID 310942.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	Low	4	Approximately 65 residential septic systems located in Zone A
Residential Areas	R01	R01-1	A	Low	4	Approximately 175 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-02	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-04	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-05	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-06	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-07	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-08	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-09	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-10	A	Low	2	
Residential Areas	R01	R01-2	B	Low	5	Approximately 200 acres of residential area within Zone B
Septic systems (serves one single-family home)	R02	R02-66-152	B	Low	5	Approximately 87 residential septic systems located within Zone B
Highways and roads, dirt/gravel	X24	X24-11	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-12	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-13	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-14	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-15	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-17	B	Low	3	

Contaminant Source Inventory and Risk Ranking for Northstar Center

Sources of Bacteria and Viruses

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-18	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-19	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-20	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-21	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-22	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-23	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-24	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-25	B	Low	3	

Table 3

Contaminant Source Inventory and Risk Ranking for Northstar Center
Sources of Nitrates/Nitrites

PWSID 310942.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	Low	4	Approximately 65 residential septic systems located in Zone A
Residential Areas	R01	R01-1	A	Low	4	Approximately 175 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-02	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-04	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-05	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-06	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-07	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-08	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-09	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-10	A	Low	2	
Residential Areas	R01	R01-2	B	Low	5	Approximately 200 acres of residential area within Zone B
Septic systems (serves one single-family home)	R02	R02-66-152	B	Low	5	Approximately 87 residential septic systems located within Zone B
Highways and roads, dirt/gravel	X24	X24-11	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-12	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-13	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-14	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-15	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-17	B	Low	3	

Contaminant Source Inventory and Risk Ranking for Northstar Center

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-18	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-19	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-20	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-21	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-22	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-23	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-24	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-25	B	Low	3	

Table 4

Contaminant Source Inventory and Risk Ranking for Northstar Center
Sources of Volatile Organic Chemicals

PWSID 310942.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Tanks, heating oil, residential (above ground)	R08	R08-1 - 65	A	Medium	4	Approximately 64 residential heating oil underground storage tanks located in Zone A
Tanks, diesel (above ground)	T06	T06-1	A	Medium	2	4' by 6' fuel oil tank next to the well house for Northstar Center
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	Low	2	1000-gallon fuel tank
Metals mining, underground (active or inactive?)	E05	E05-1	A	Medium	2	Great Dharma Prospect
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U08-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	4	Approximately 175 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	Low	4	Approximately 65 residential septic systems located in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-02	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-04	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-05	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-06	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-07	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-08	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-09	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-10	A	Low	2	
Heavy equipment rental/storage	C18	C18-1	B	Medium	3	

Contaminant Source Inventory and Risk Ranking for Northstar Center

Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Metals mining, underground (active or inactive?)	E05	E05-2	B	Medium	3	Crown Point Mine
Metals mining, underground (active or inactive?)	E05	E05-3	B	Medium	3	Little Eva Mines
Metals mining, underground (active or inactive?)	E05	E05-4	B	Medium	3	Hess & Thomas Prospect
Metals mining, underground (active or inactive?)	E05	E05-5	B	Medium	3	Flower Mine
Metals mining, underground (active or inactive?)	E05	E05-6	B	Medium	3	Clipper Mine
Residential Areas	R01	R01-2	B	Low	5	Approximately 200 acres of residential area within Zone B
Septic systems (serves one single-family home)	R02	R02-66-152	B	Low	5	Approximately 87 residential septic systems located within Zone B
Tanks, heating oil, residential (above ground)	R08	R08-66-152	B	Medium	5	Approximately 87 residential heating oil underground fuel storage tanks located within Zone B
Highways and roads, dirt/gravel	X24	X24-11	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-12	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-13	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-14	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-15	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-17	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-18	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-19	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-20	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-21	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-22	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-23	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-24	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-25	B	Low	3	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Metals mining, underground (active or inactive?)	E05	E05-1	A	Very High	2	Great Dharma Prospect
Metals mining, underground (active or inactive?)	E05	E05-2	B	Very High	3	Crown Point Mine
Metals mining, underground (active or inactive?)	E05	E05-3	B	Very High	3	Little Eva Mines
Metals mining, underground (active or inactive?)	E05	E05-4	B	Very High	3	Hess & Thomas Prospect
Metals mining, underground (active or inactive?)	E05	E05-5	B	Very High	3	Flower Mine
Metals mining, underground (active or inactive?)	E05	E05-6	B	Very High	3	Clipper Mine
Tanks, heating oil, nonresidential (underground)	T16	T16-1	A	Low	2	1000-gallon fuel tank
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	Low	4	Approximately 65 residential septic systems located in Zone A
Residential Areas	R01	R01-1	A	Low	4	Approximately 175 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-02	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-04	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-05	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-06	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-07	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-08	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-09	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-10	A	Low	2	

Contaminant Source Inventory and Risk Ranking for Northstar Center

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Heavy equipment rental/storage	C18	C18-1	B	Low	3	
Residential Areas	R01	R01-2	B	Low	5	Approximately 200 acres of residential area within Zone B
Septic systems (serves one single-family home)	R02	R02-66-152	B	Low	5	Approximately 87 residential septic systems located within Zone B
Highways and roads, dirt/gravel	X24	X24-11	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-12	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-13	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-14	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-15	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-17	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-18	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-19	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-20	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-21	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-22	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-23	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-24	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-25	B	Low	3	

Table 6

Contaminant Source Inventory and Risk Ranking for Northstar Center
Sources of Synthetic Organic Chemicals

PWSID 310942.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	Low	4	Approximately 65 residential septic systems located in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	4	Approximately 175 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-66-152	B	Low	5	Approximately 87 residential septic systems located within Zone B
Residential Areas	R01	R01-2	B	Low	5	Approximately 200 acres of residential area within Zone B

Table 7

Contaminant Source Inventory and Risk Ranking for Northstar Center

Sources of Other Organic Chemicals

PWSID 310942.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-1 - 65	A	Low	4	Approximately 65 residential septic systems located in Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Residential Areas	R01	R01-1	A	Low	4	Approximately 175 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-02	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-04	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-05	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-06	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-03	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-07	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-08	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-09	A	Low	2	
Highways and roads, dirt/gravel	X24	X24-10	A	Low	2	
Heavy equipment rental/storage	C18	C18-1	B	Medium	3	
Residential Areas	R01	R01-2	B	Low	5	Approximately 200 acres of residential area within Zone B
Septic systems (serves one single-family home)	R02	R02-66-152	B	Low	5	Approximately 87 residential septic systems located within Zone B
Highways and roads, dirt/gravel	X24	X24-11	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-12	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-13	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-14	B	Low	2	
Highways and roads, dirt/gravel	X24	X24-15	B	Low	2	

Contaminant Source Inventory and Risk Ranking for Northstar Center

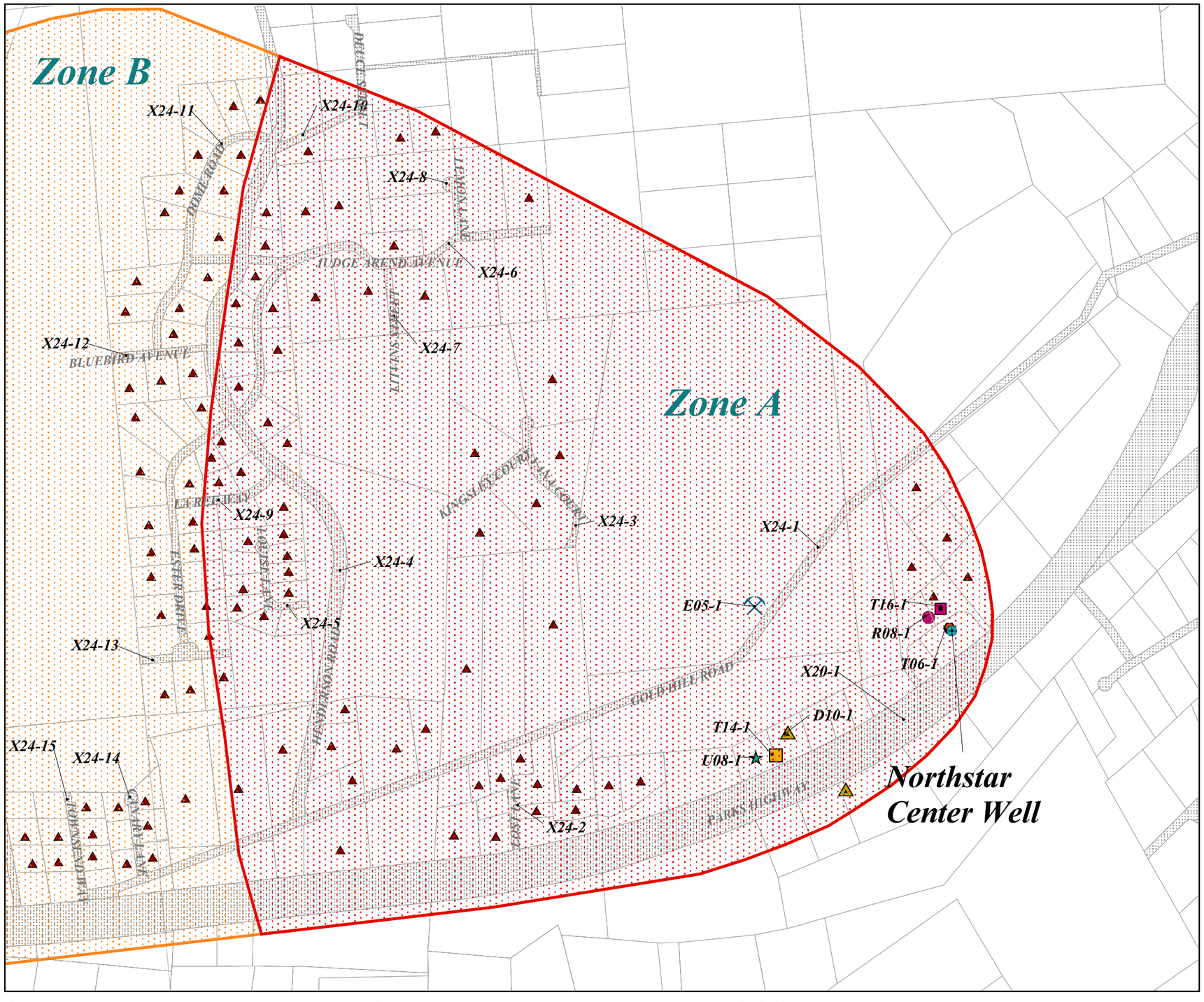
Sources of Other Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-17	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-18	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-19	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-20	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-21	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-22	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-23	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-24	B	Low	3	
Highways and roads, dirt/gravel	X24	X24-25	B	Low	3	

APPENDIX C

North Star Center
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-5)

Northstar Center Drinking Water Protection Area With Potential & Existing Contaminant Sources

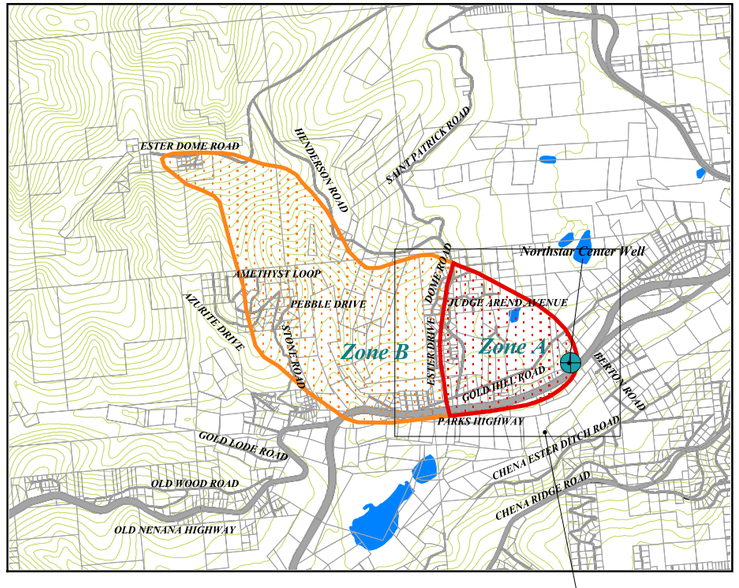


0.5 0 0.5 Miles

PWSID 310942.001

Legend

- Northstar Center Well
- Zone A Protection Area
- Several Months Travel Time
- Zone B Protection Area
- Less Than 2 Years Travel Time
- Parcels
- Potential Contaminant Sources
- Heavy Equipment Rental & Storage (C18)
- Large Capacity Septic Systems (D10)
- Residential Heating Oil Tank - Above Ground (R8)
- Residential Heating Oil Tank - Underground (R9)
- Non-Residential Heating Oil Tank - Underground (T16)
- Diesel Tank - Aboveground (T6)
- Closed Leaking Underground Fuel Storage Tank Site (U8)
- Non-Residential Heating Oil Tank - Above Ground (T14)
- Underground Metals Mines (E5)
- Residential Septic Systems (R2)
- Roads (X20 or X24)

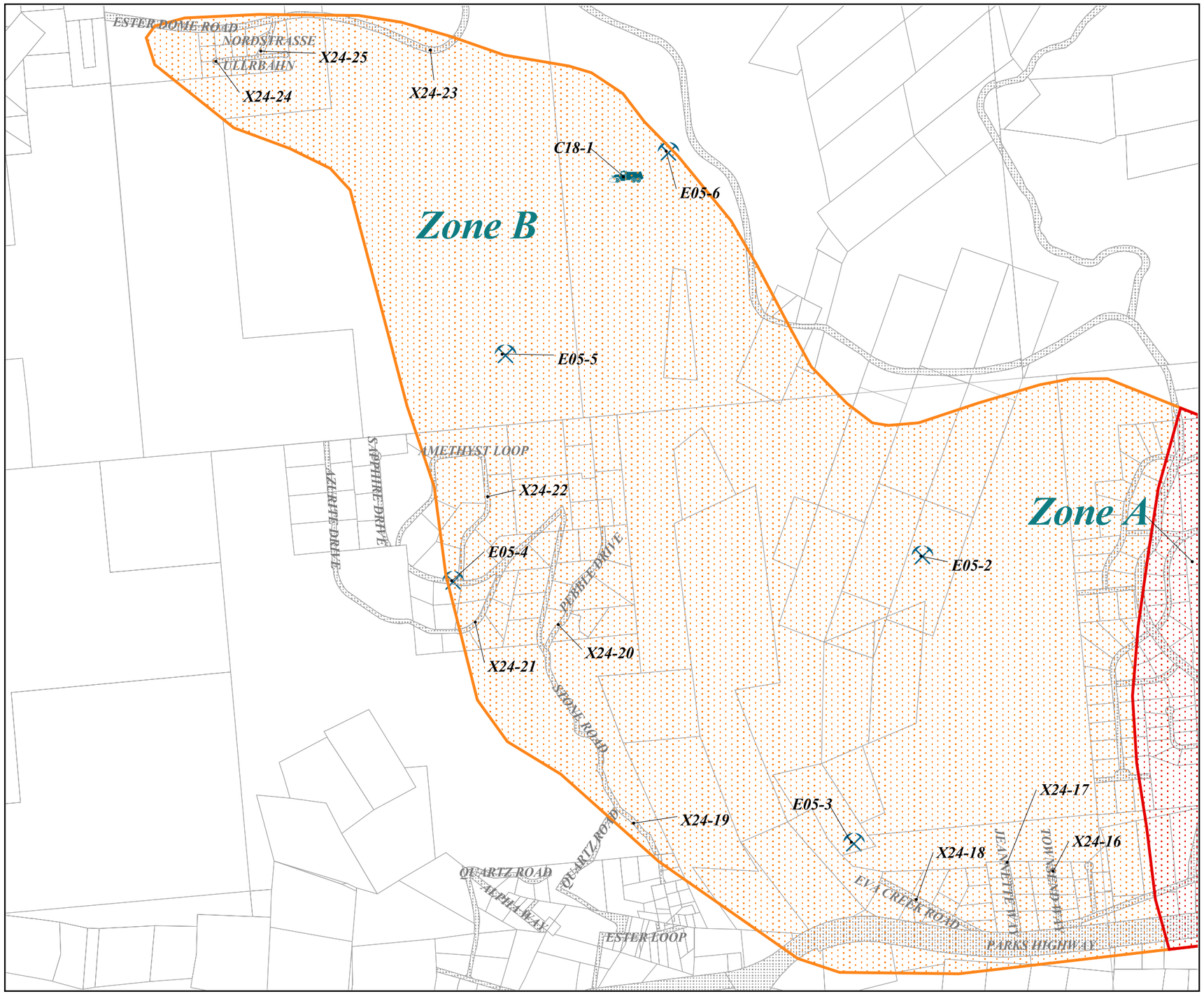


Area of Map

N W E S

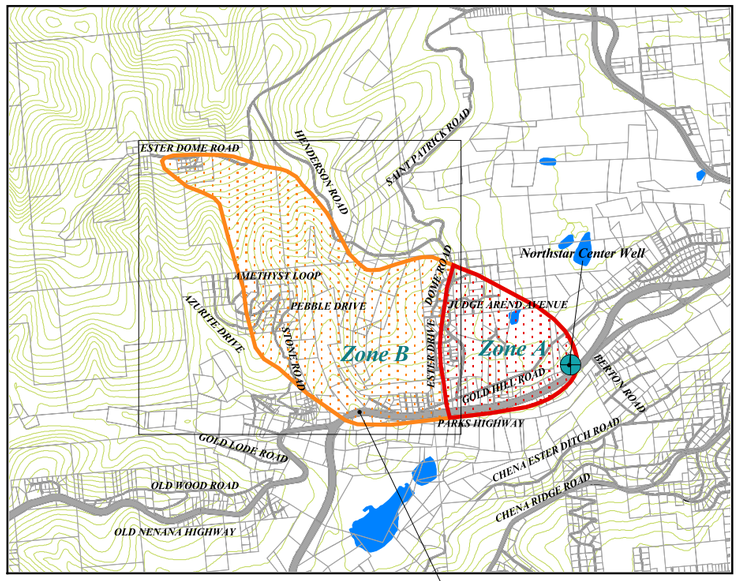
Map 2

Northstar Center Drinking Water Protection Area With Potential & Existing Contaminant Sources



Legend

- Northstar Center Well
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less Than 2 Years Travel Time
  - Parcels
- Potential Contaminant Sources
  - Heavy Equipment Rental & Storage (C18)
  - Large Capacity Septic Systems (D10)
  - Residential Septic Systems (R2)
  - Residential Heating Oil Tank - Above Ground (R8)
  - Non-Residential Heating Oil Tank - Underground (T16)
  - Diesel Tank - Aboveground (T6)
  - Closed Leaking Underground Fuel Storage Tank Site (U8)
  - Underground Metals Mines (E5)
  - Roads (X20 or X24)



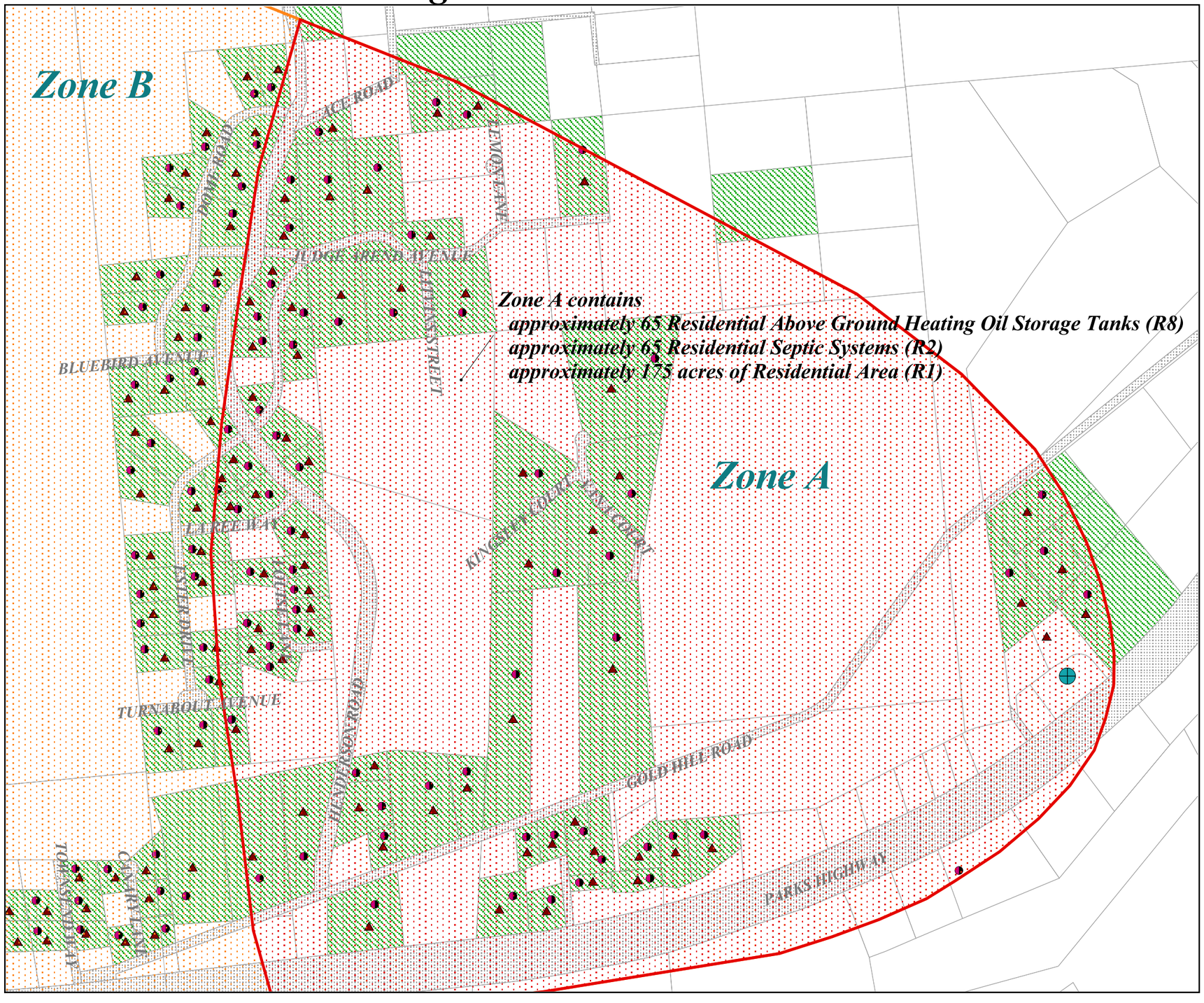
Area of Map

N
W
E
S

PWSID 310942.001

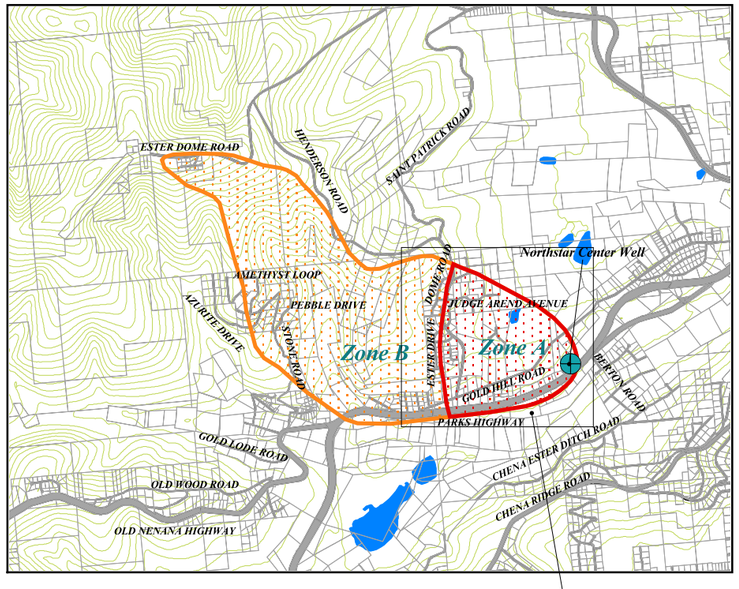
Map 3

Northstar Center Drinking Water Protection Area with Potential & Existing Contaminant Sources



Legend

- Northstar Center Well
- Zone A Protection Area
- Several Months Travel Time
- Zone B Protection Area
- Less Than 2 Years Travel Time
- Parcels
- Residential Septic Systems (R2)
- Residential Heating Oil Tank - Above Ground (R8)
- Roads (X20 or X24)
- Residential Area (R1)



Area of Map

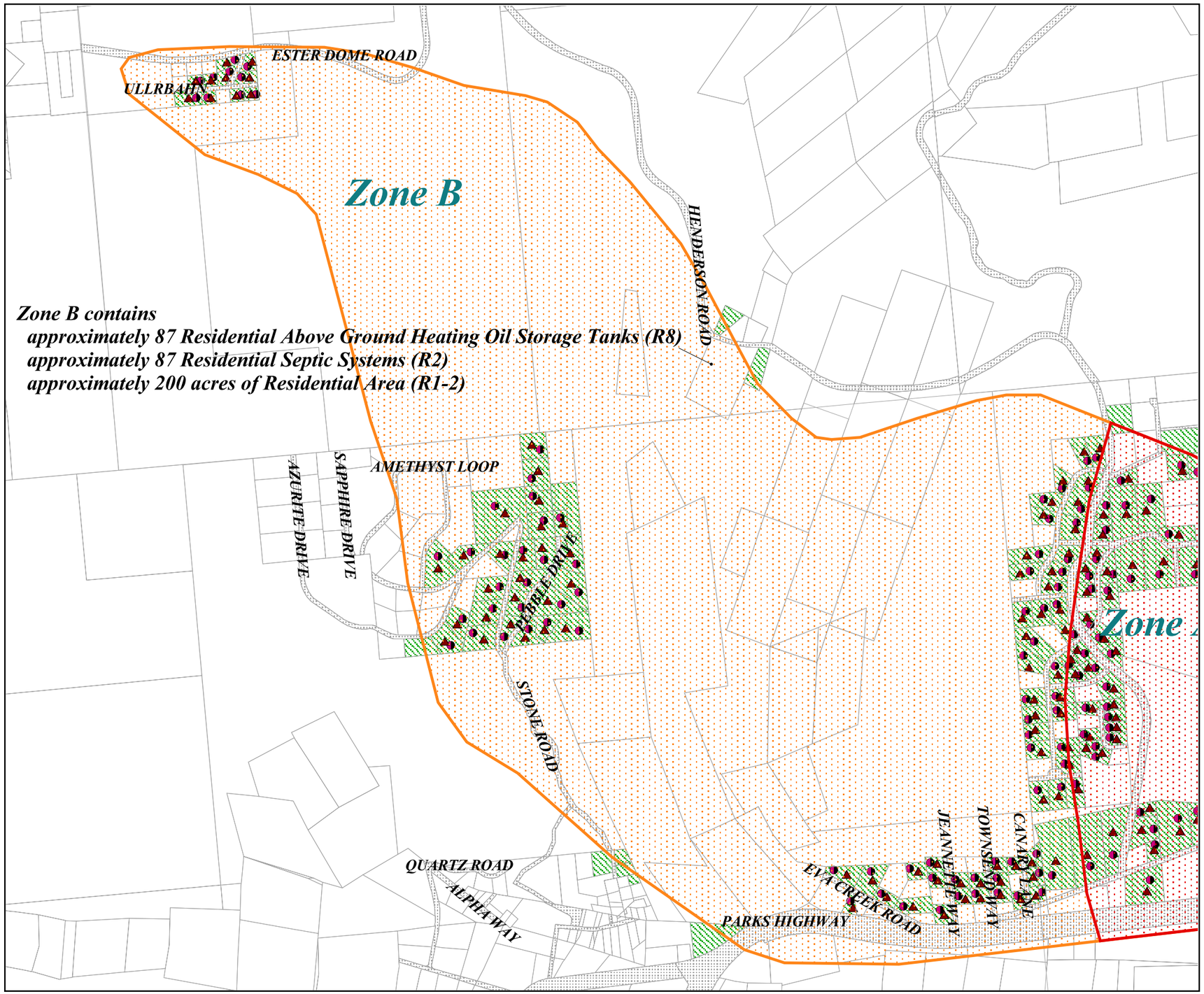
N W E S

0.5 0 0.5 Miles

PWSID 310942.001

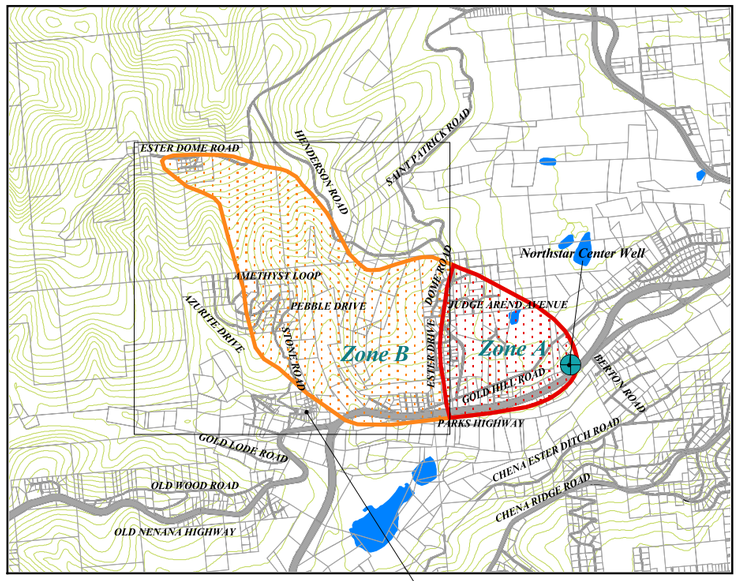
Map 4

Northstar Center Drinking Water Protection Area with Potential & Existing Contaminant Sources



Legend

- Northstar Center Well
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less Than 2 Years Travel Time
- Parcels
- Residential Septic Systems (R2)
- Residential Heating Oil Tank - Underground (R9)
- Roads (X20 or X24)
- Residential Area (R1)



Area of Map

N W E S

PWSID 310942.001

Map 5

APPENDIX D

Vulnerability Analysis for North Star Center Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Northstar Center

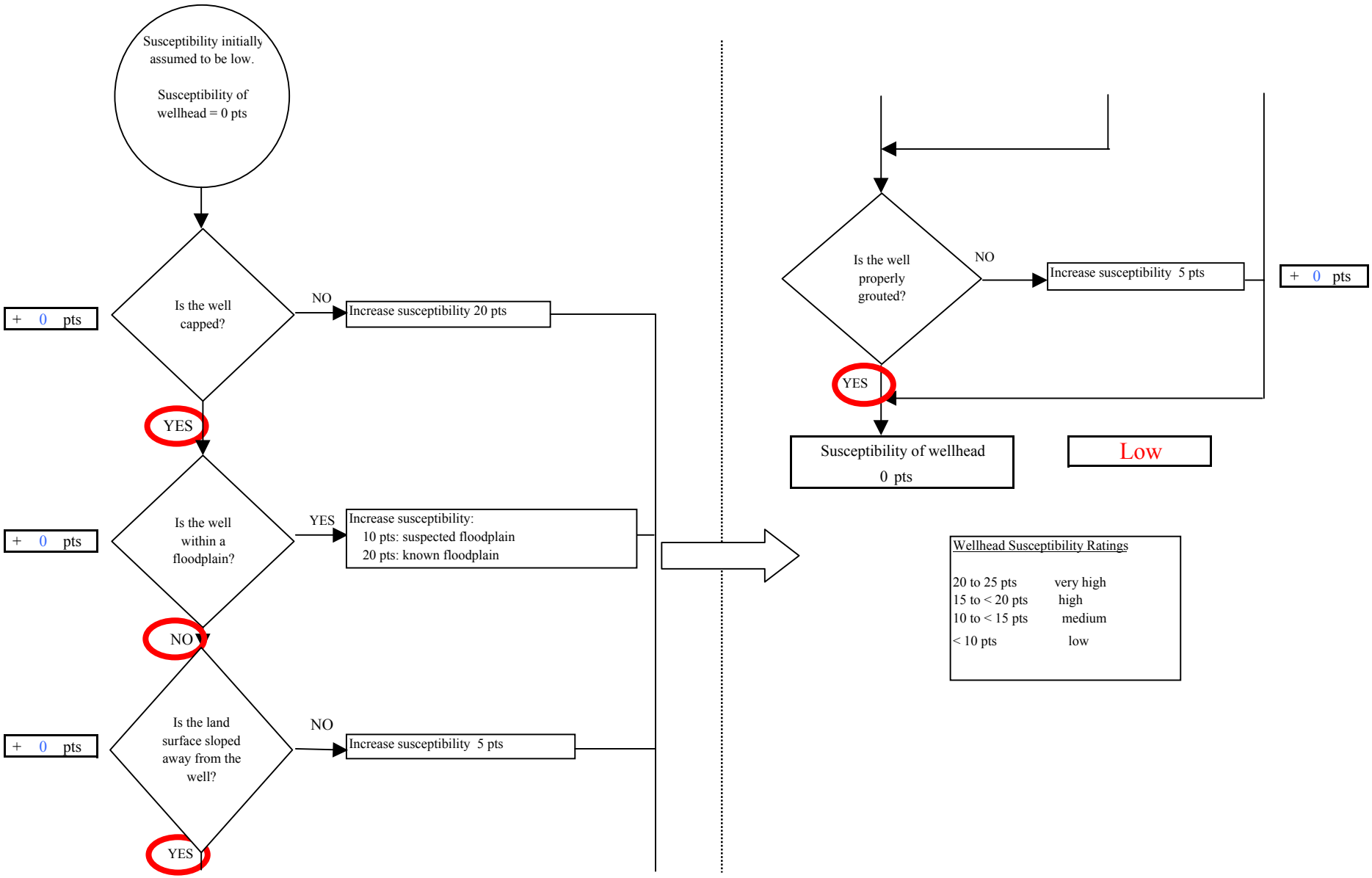


Chart 2. Susceptibility of the aquifer - Northstar Center

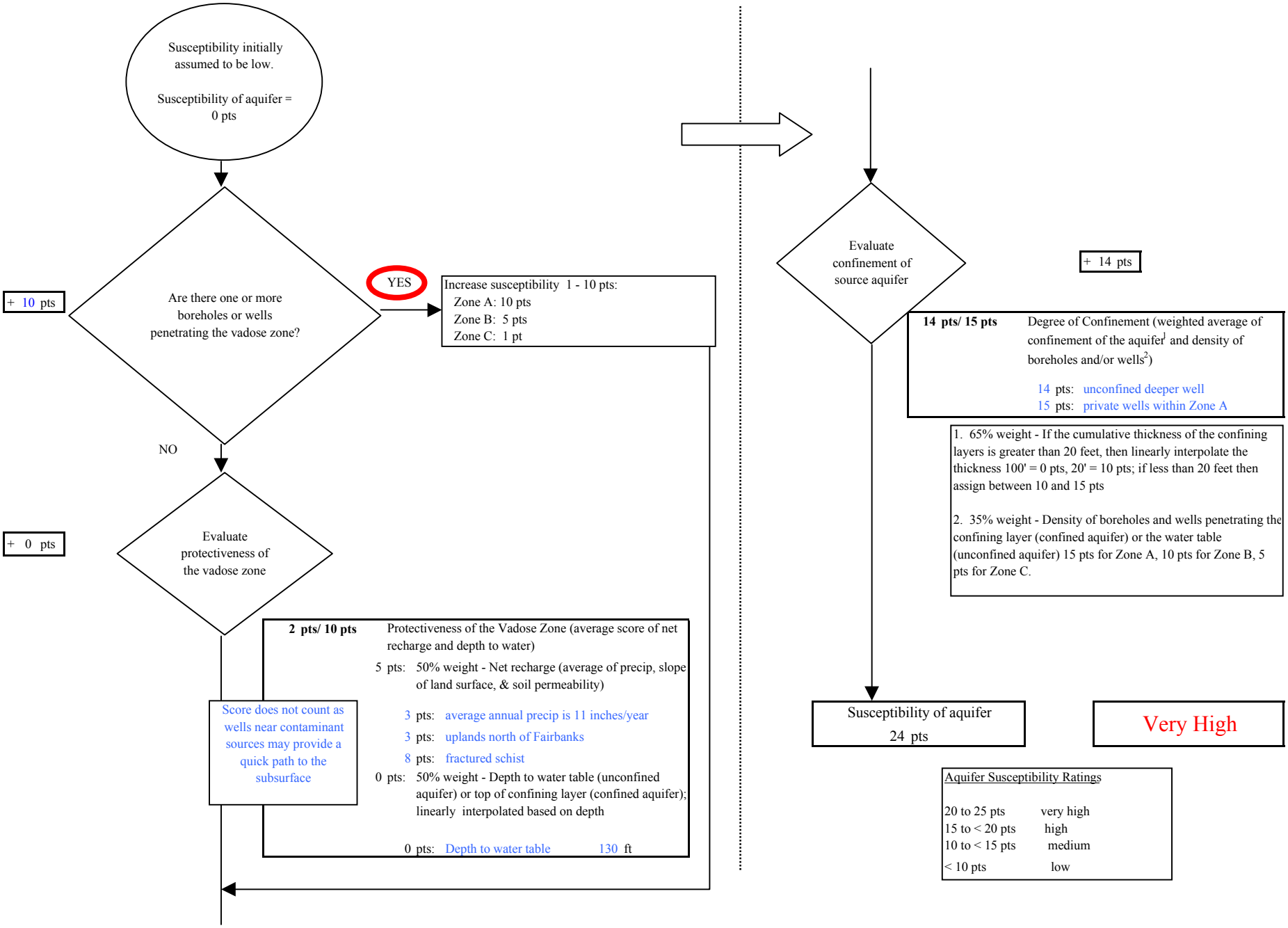
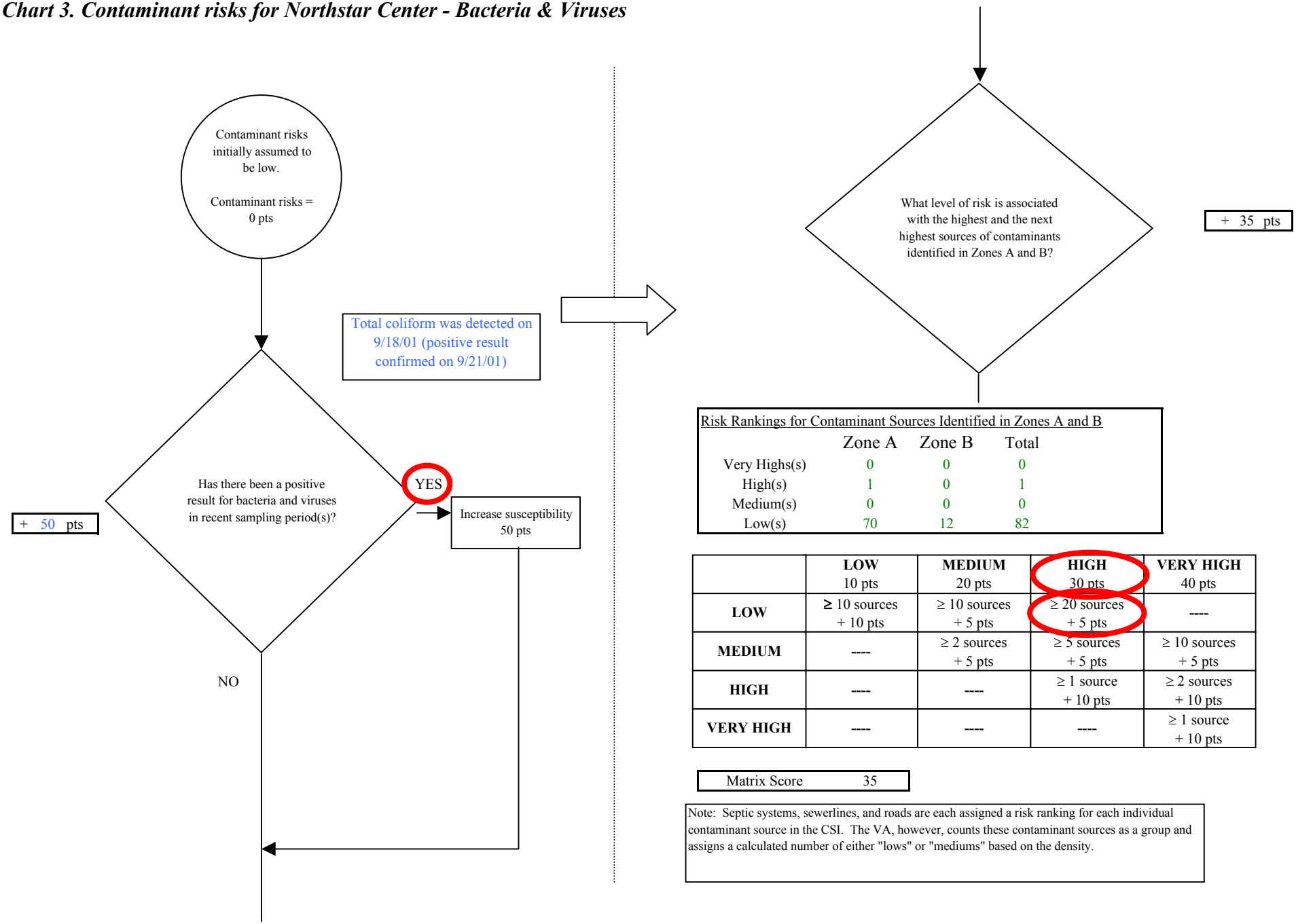


Chart 3. Contaminant risks for Northstar Center - Bacteria & Viruses



Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	70	12	82

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

Matrix Score 35

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

Chart 3. Contaminant risks for Northstar Center - Bacteria & Viruses

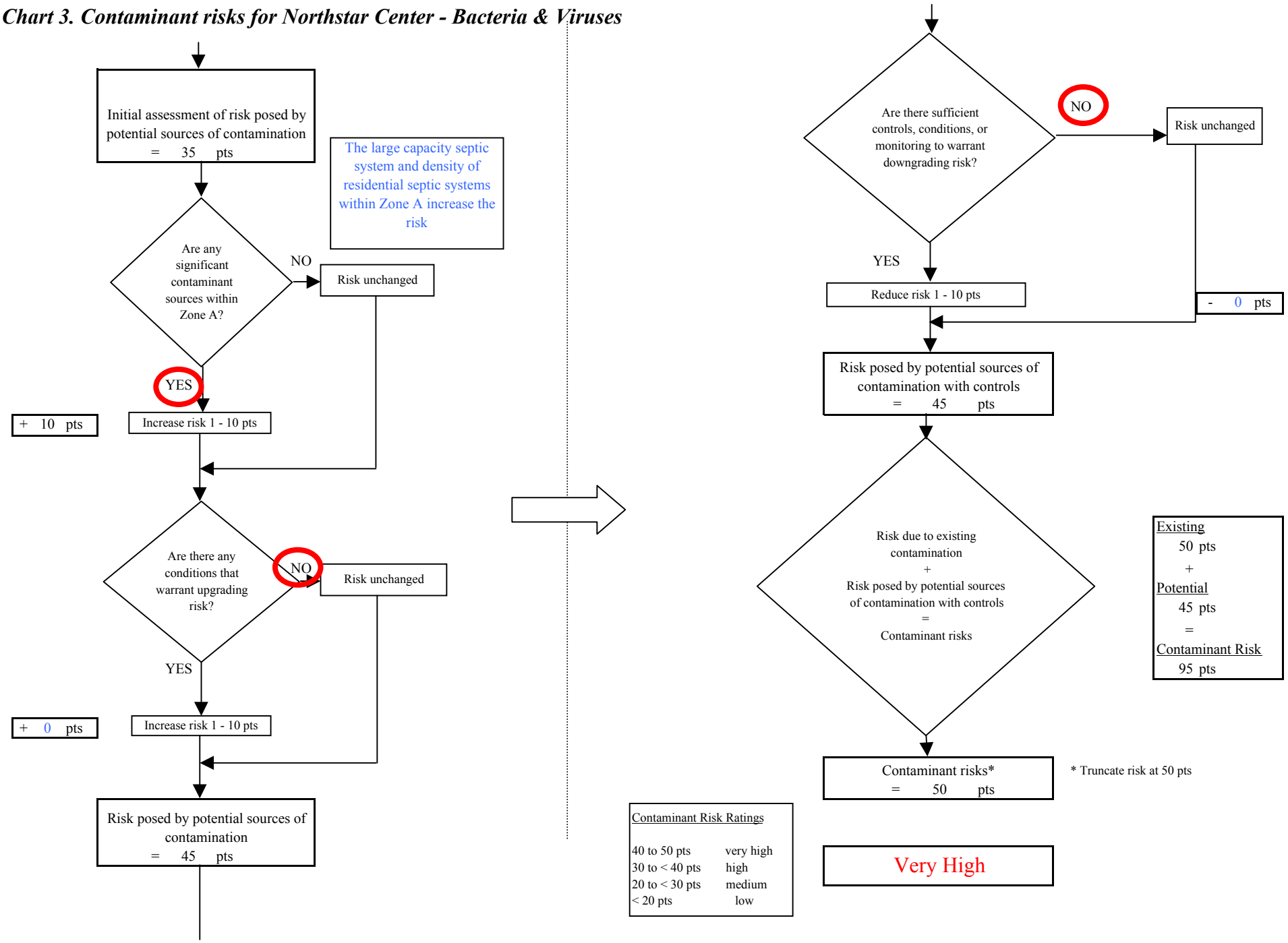


Chart 4. Vulnerability analysis for Northstar Center - Bacteria & Viruses

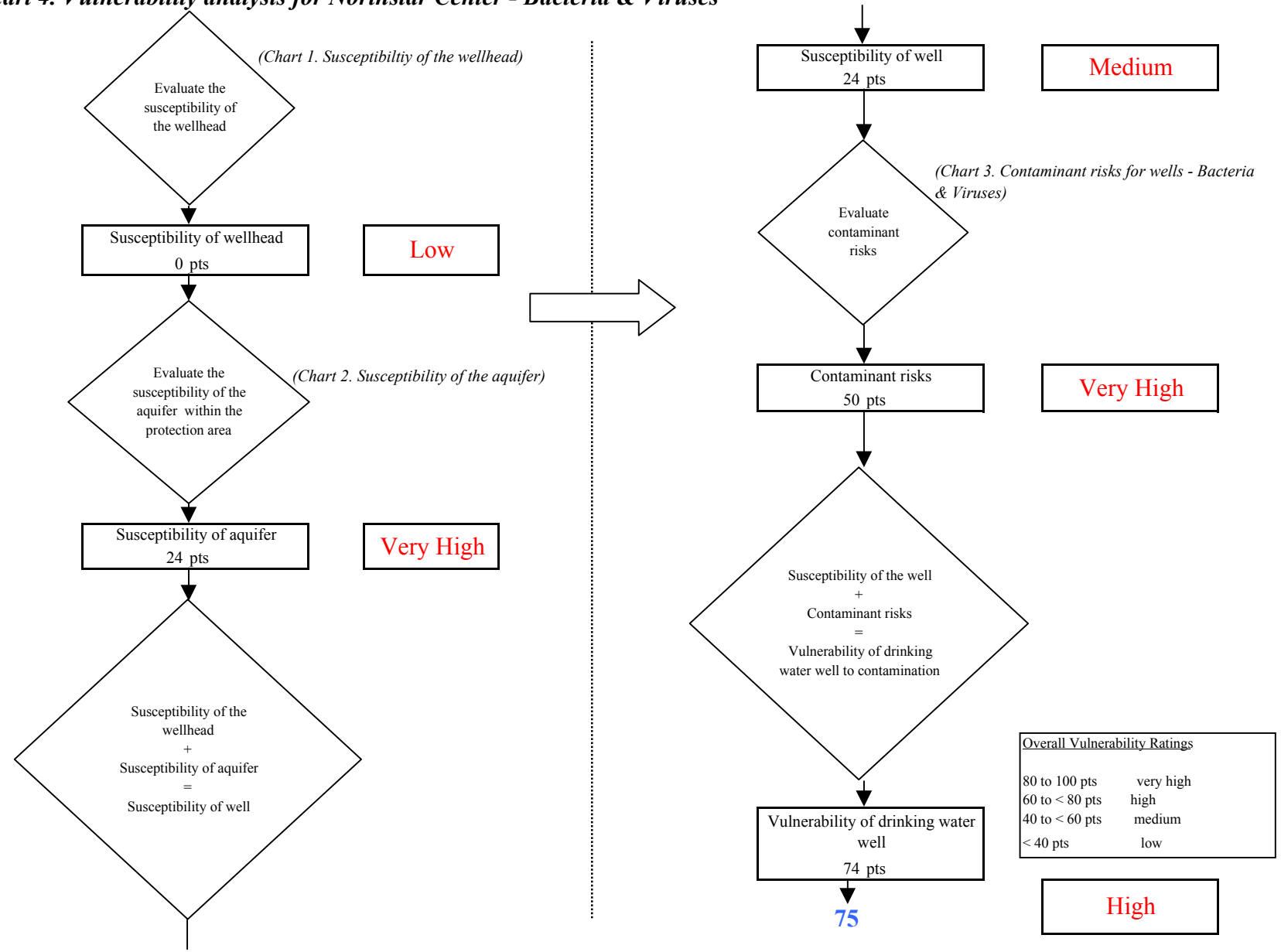


Chart 5. Contaminant risks for Northstar Center - Nitrates and Nitrites

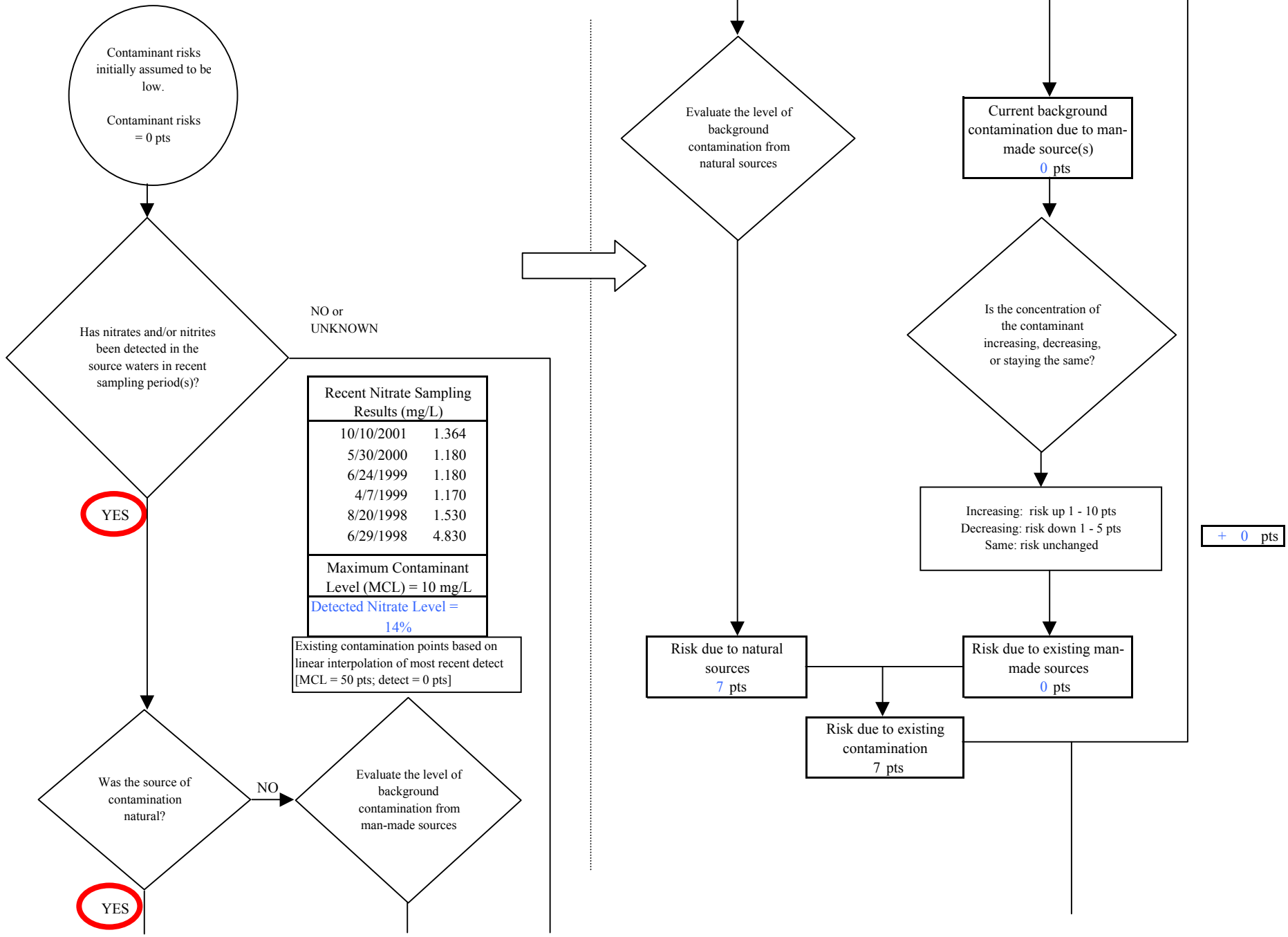
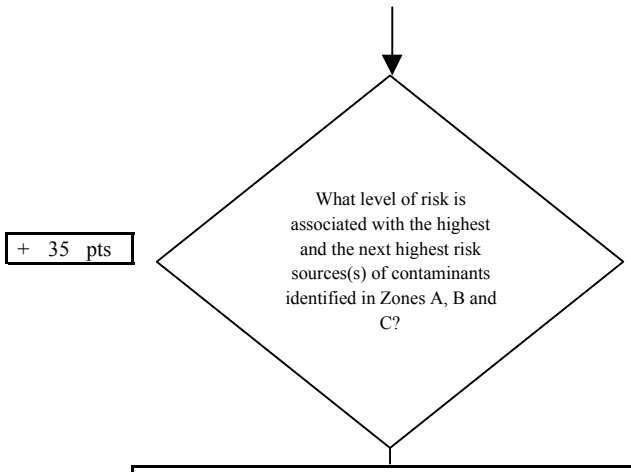


Chart 5. Contaminant risks for Northstar Center - Nitrates and Nitrites



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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	0	1
Medium(s)	0	0	0
Low(s)	70	21	91

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

Matrix Score 35

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

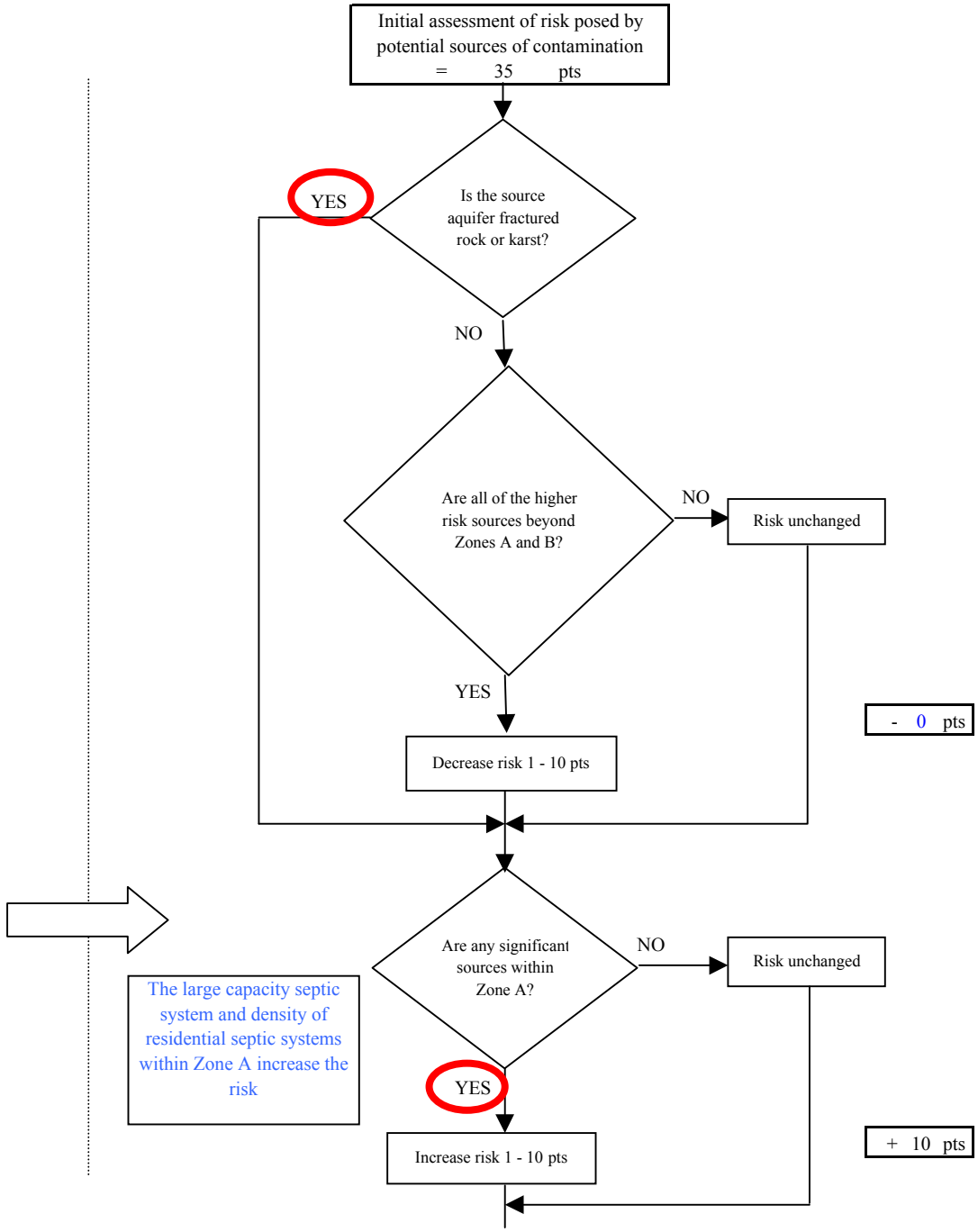


Chart 5. Contaminant risks for Northstar Center - Nitrates and Nitrites

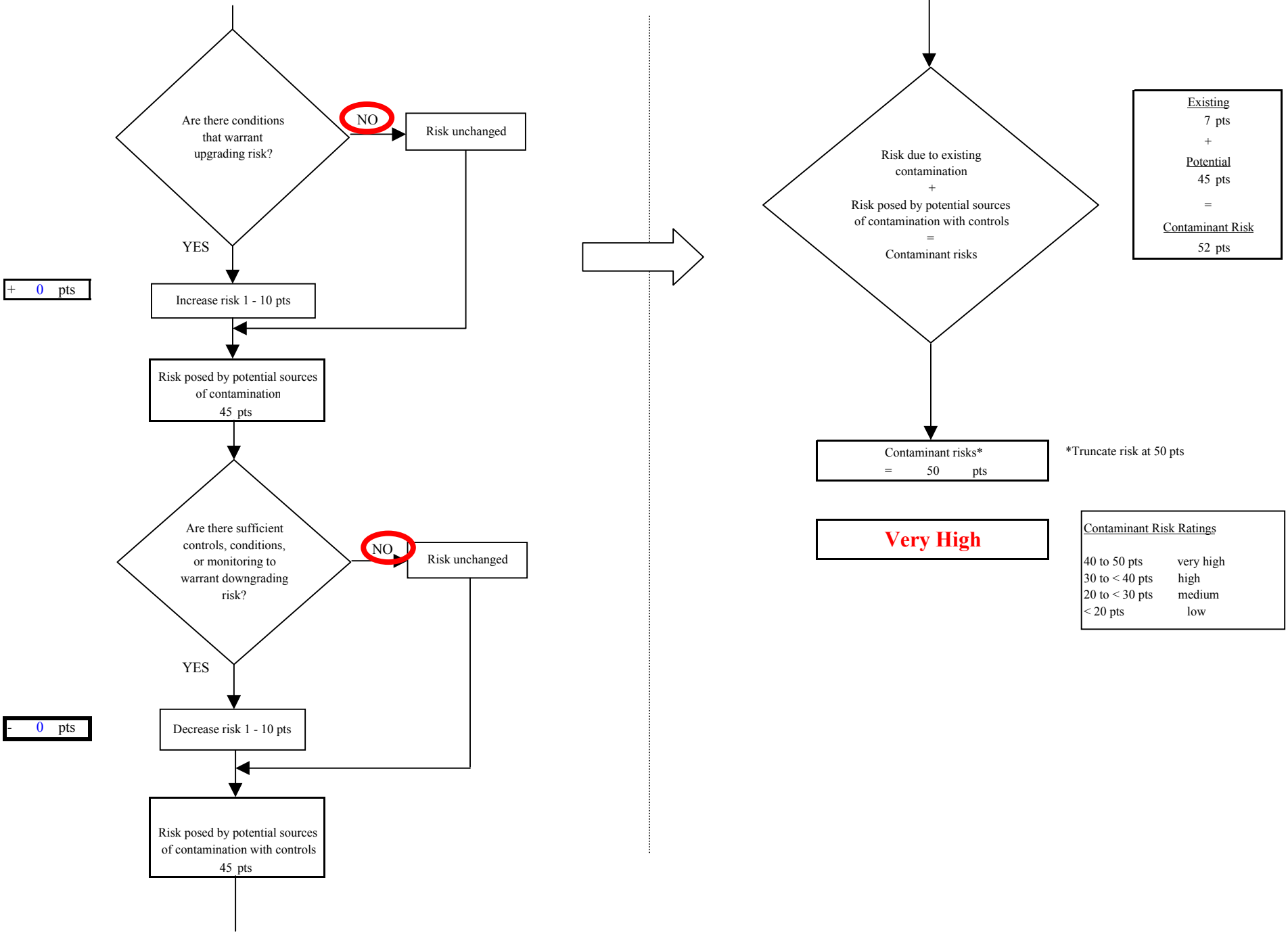


Chart 6. Vulnerability analysis for Northstar Center - Nitrates and Nitrites

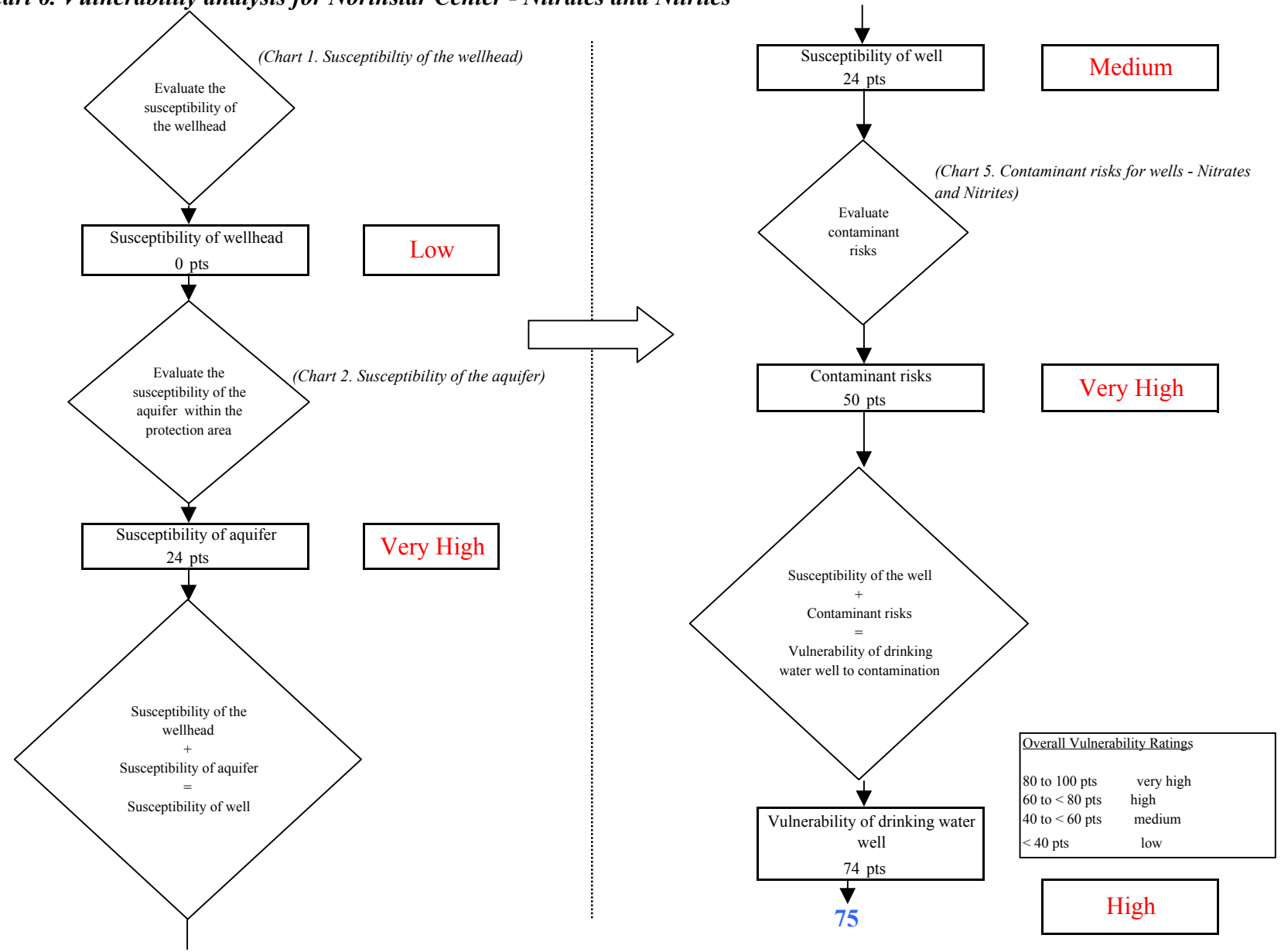


Chart 7. Contaminant risks for Northstar Center - Volatile Organic Chemicals

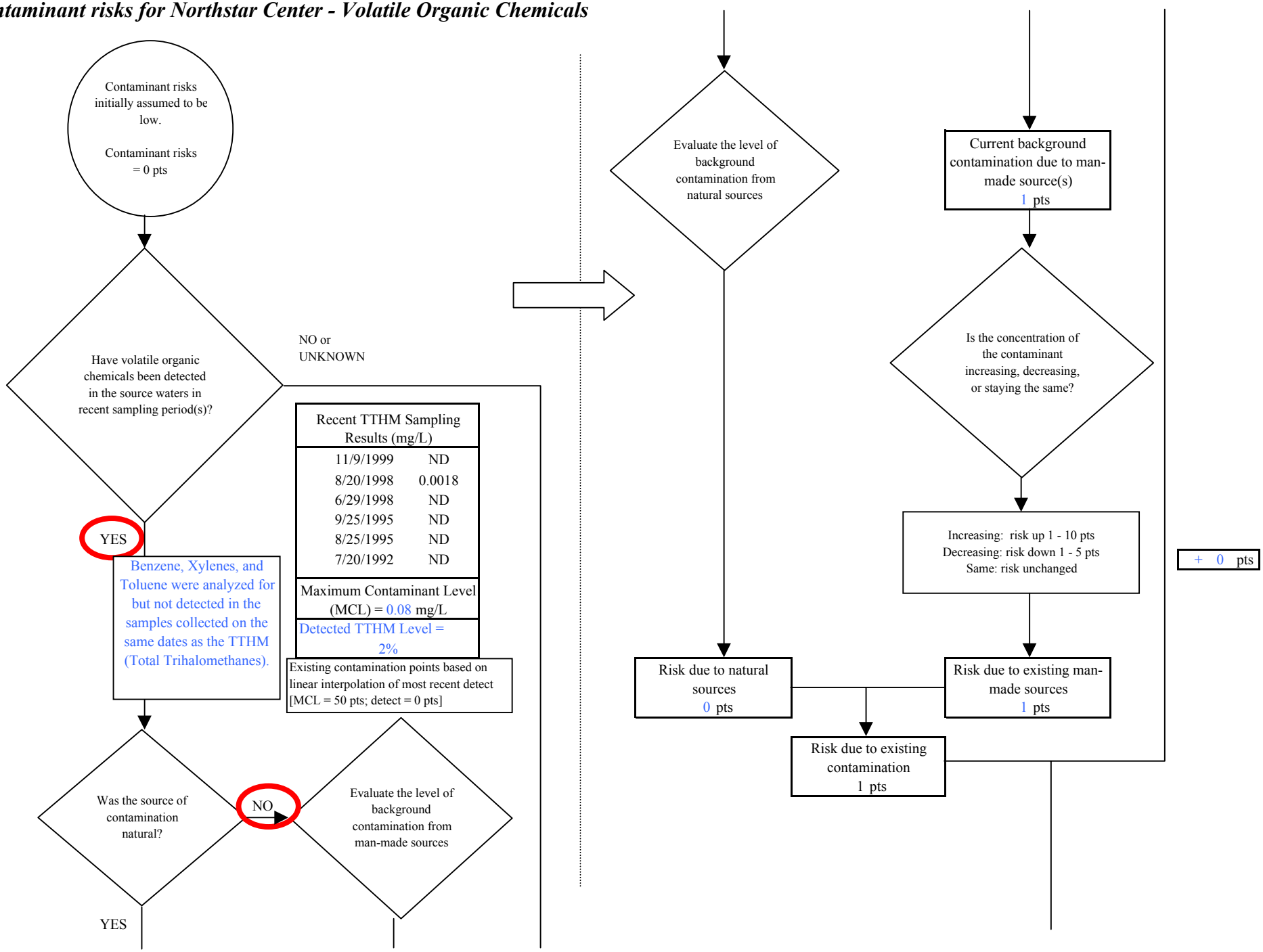
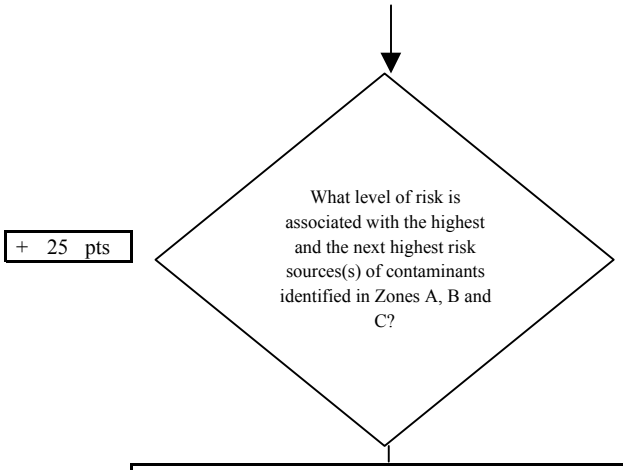


Chart 7. Contaminant risks for Northstar Center - Volatile Organic Chemicals



+ 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)	67	92	159
Low(s)	13	5	18

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

Matrix Score 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.

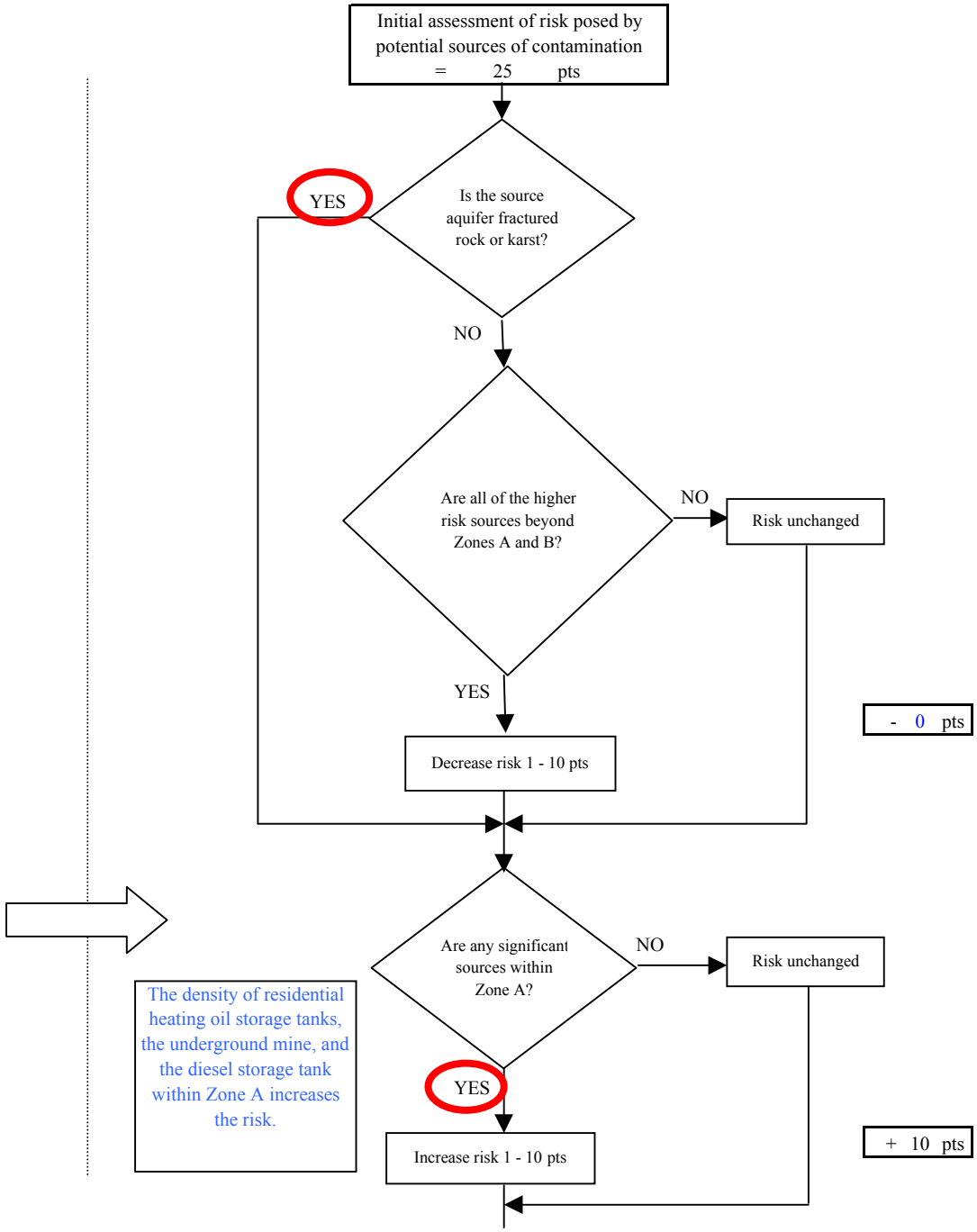
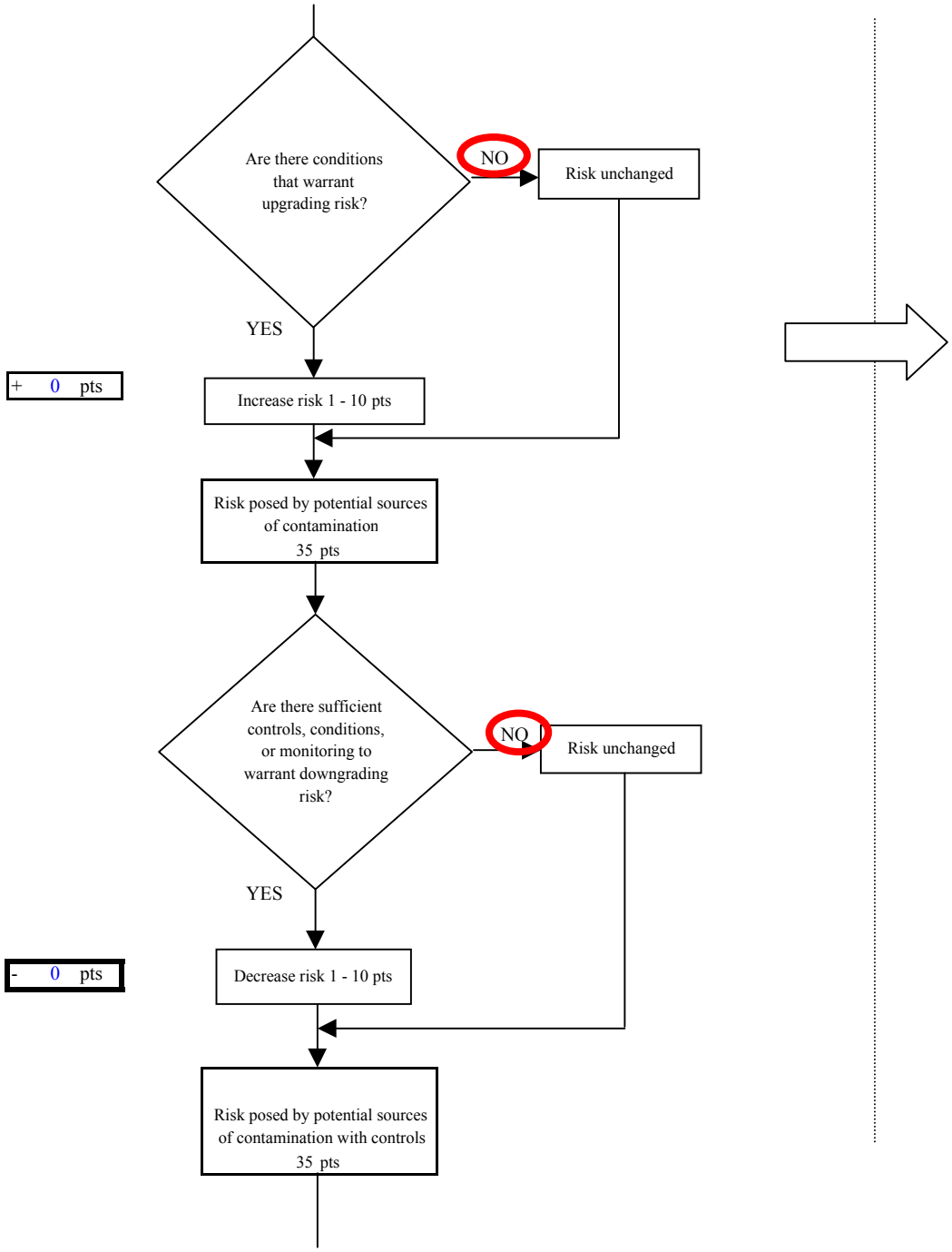
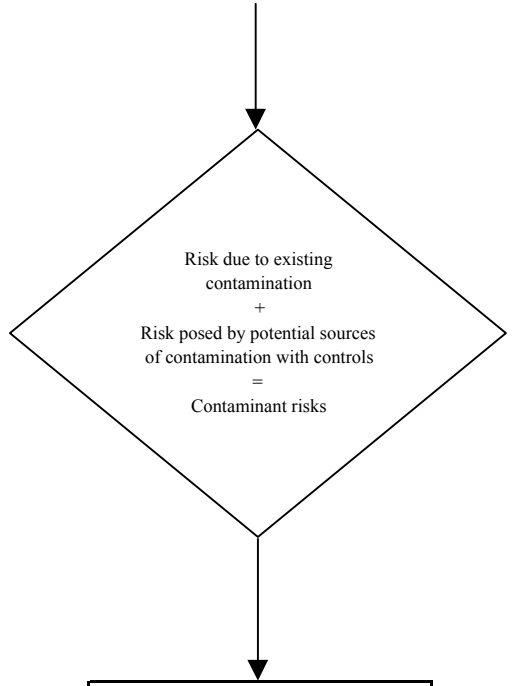


Chart 7. Contaminant risks for Northstar Center - Volatile Organic Chemicals





Existing
1 pts
+
Potential
35 pts
=
Contaminant Risk
36 pts

Contaminant risks*
= 36 pts

*Truncate risk at 50 pts

High

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

Chart 8. Vulnerability analysis for Northstar Center - Volatile Organic Chemicals

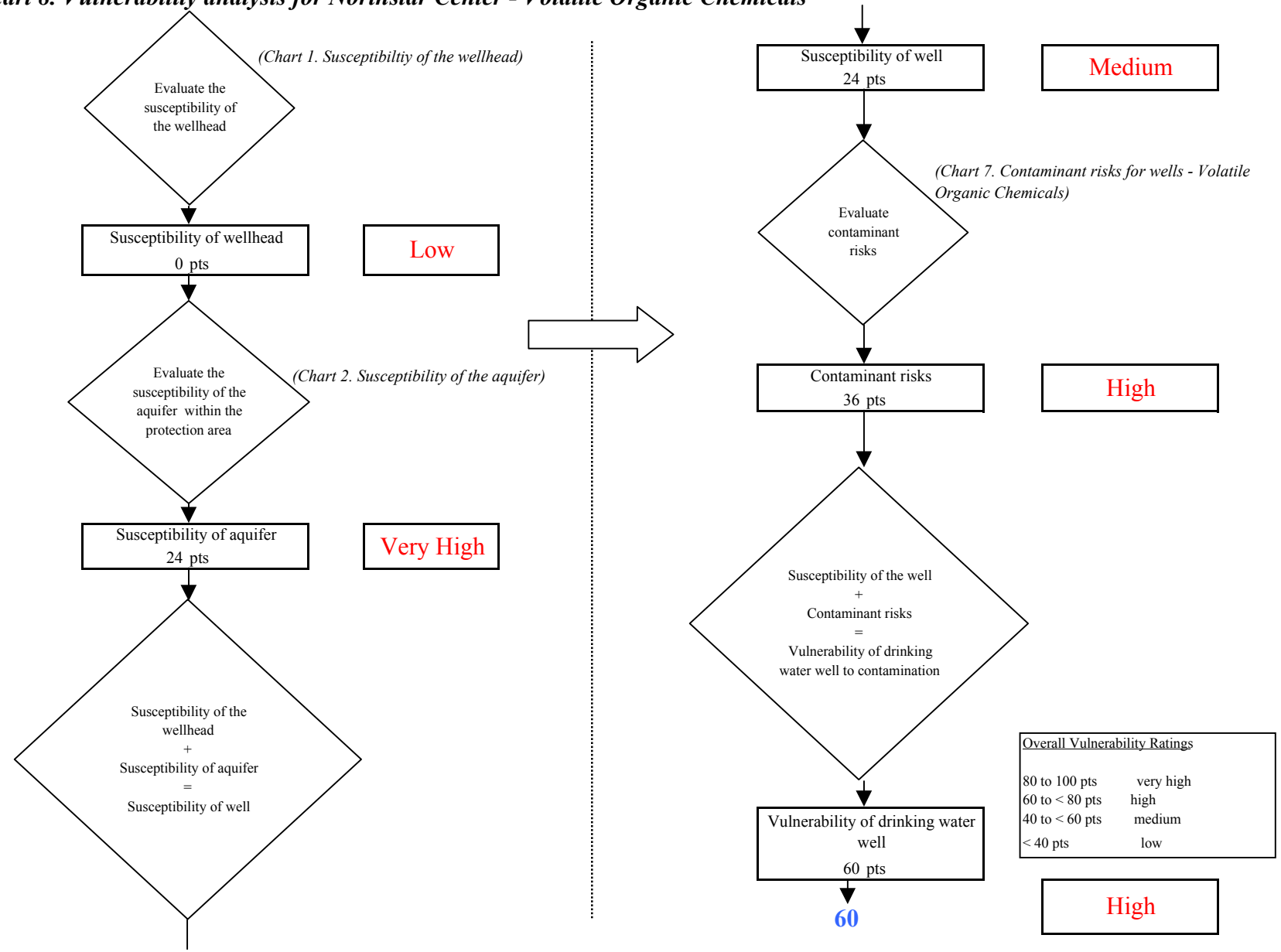


Chart 9. Contaminant risks for Northstar Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

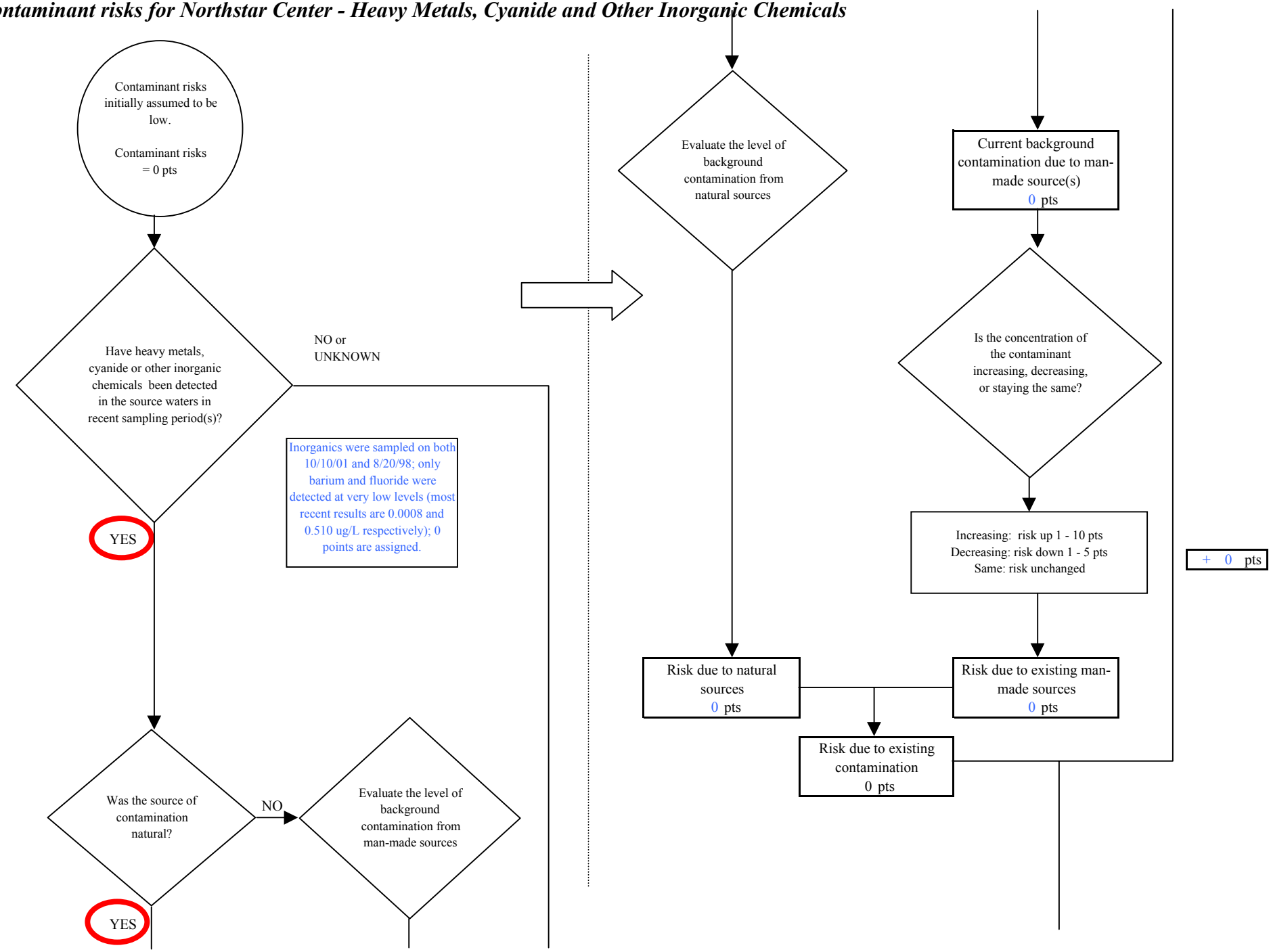


Chart 9. Contaminant risks for Northstar Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 50 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)	1	5	6
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	7	5	12

	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 50

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 = 50 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

The underground mine within Zone A increases the risk.

YES → Increase risk 1 - 10 pts

+ 10 pts

Chart 9. Contaminant risks for Northstar Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

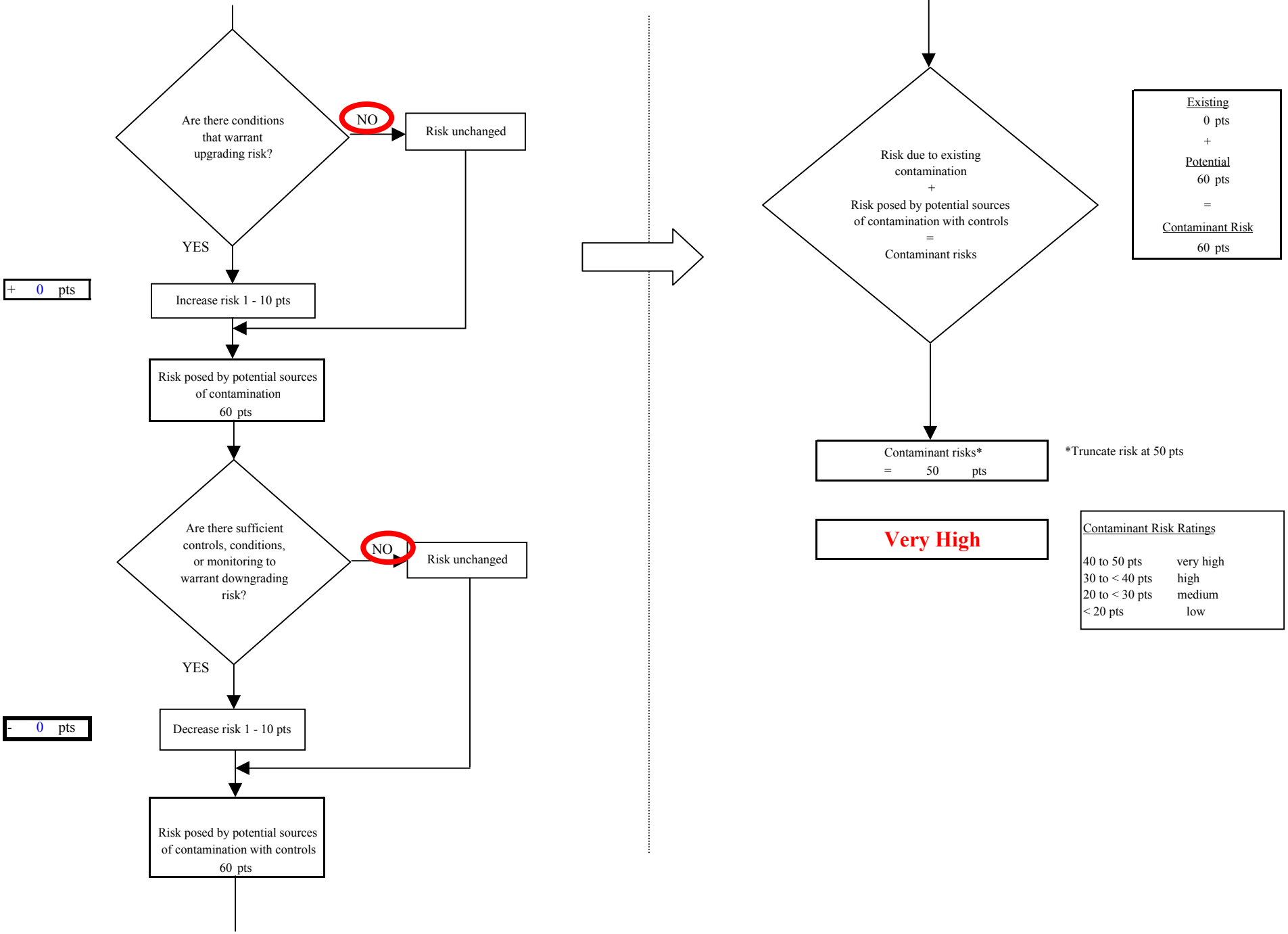


Chart 10. Vulnerability analysis for Northstar Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

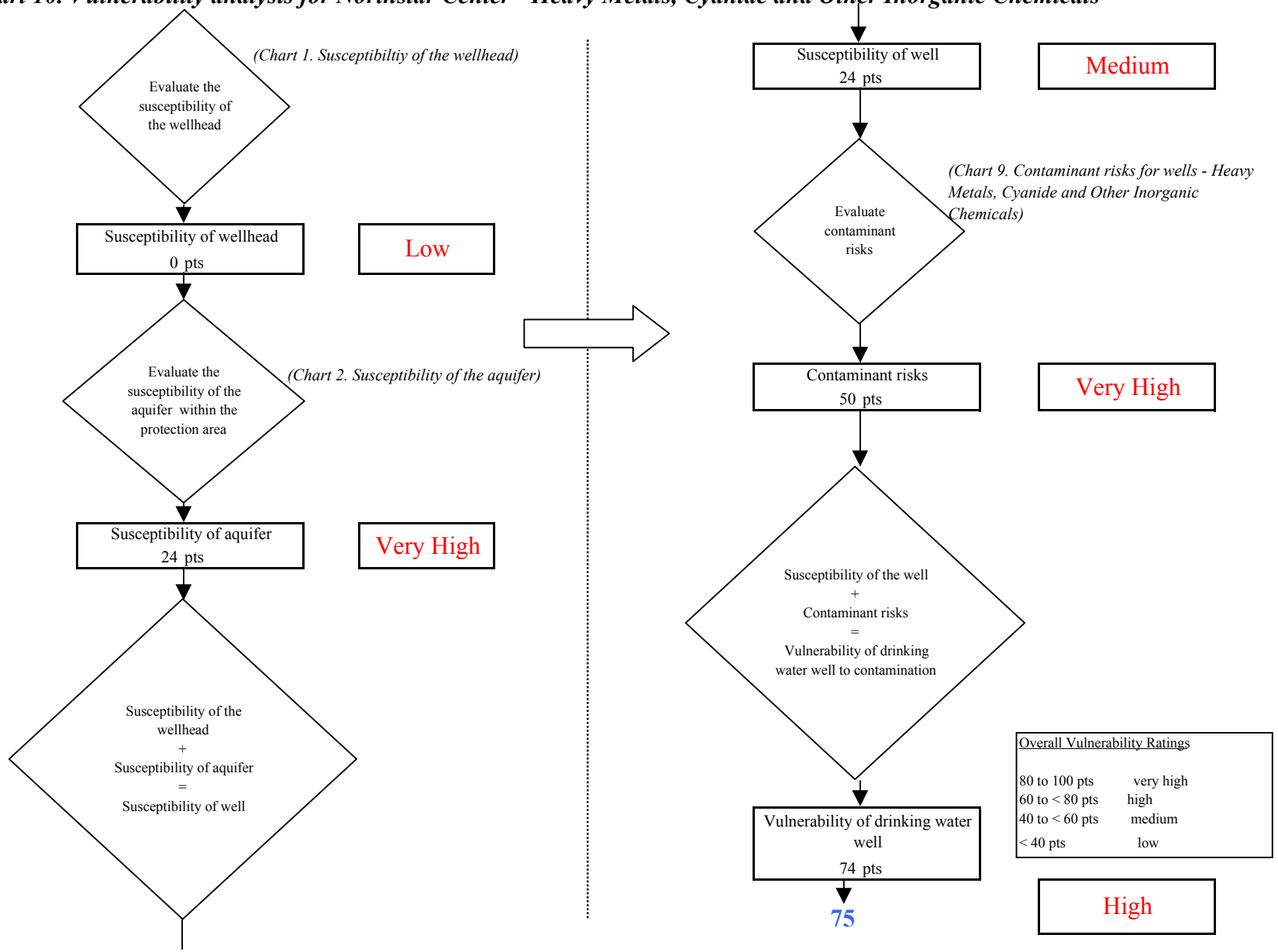


Chart 11. Contaminant risks for Northstar Center - Synthetic Organic Chemicals

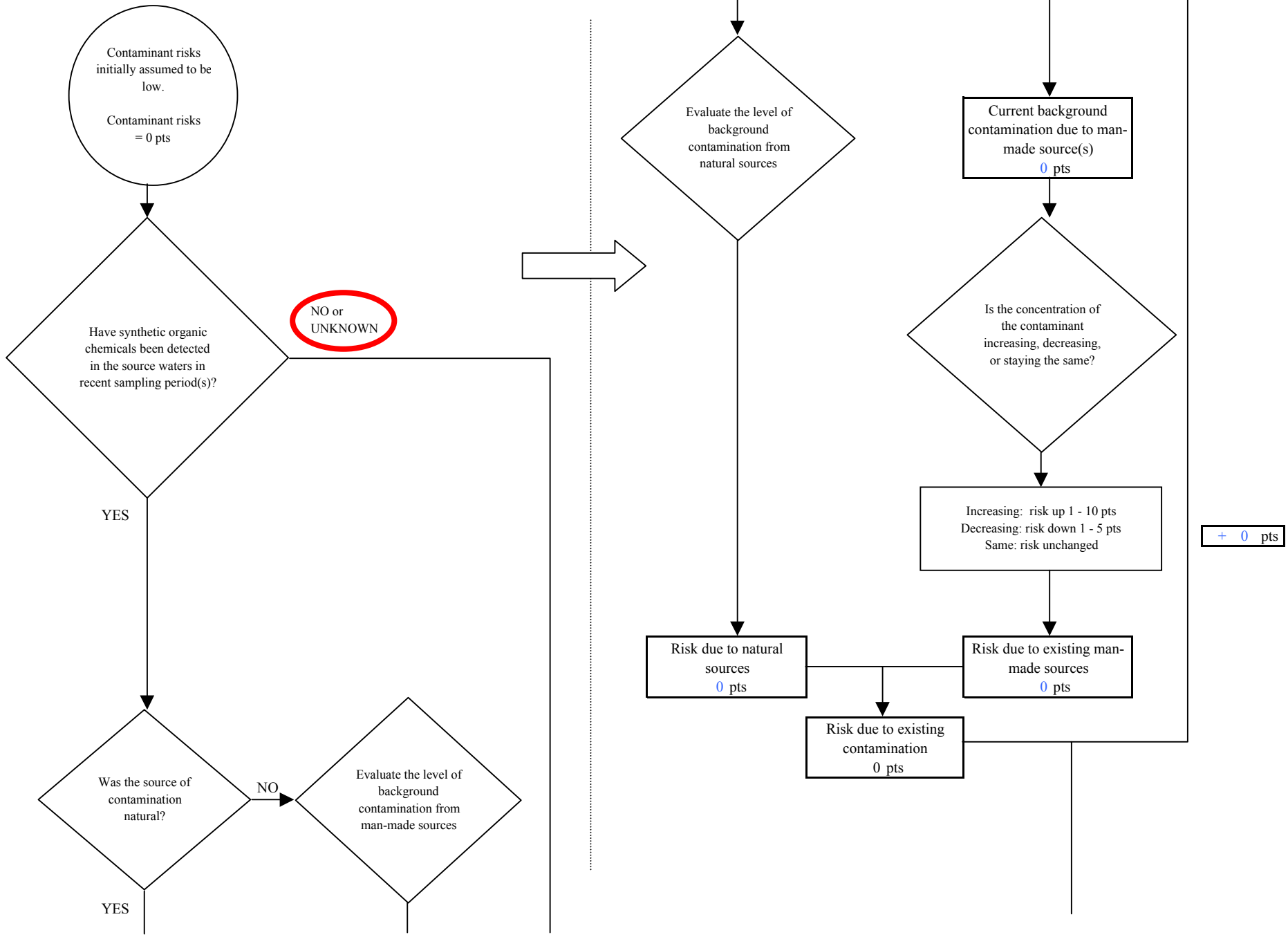
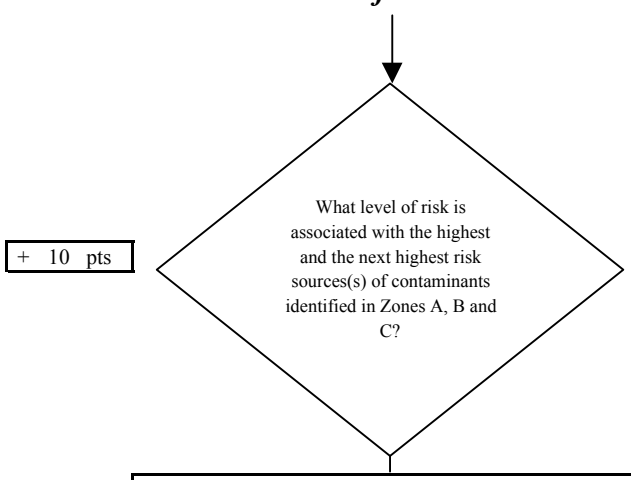


Chart 11. Contaminant risks for Northstar Center - Synthetic Organic Chemicals



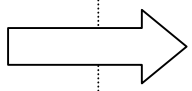
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	3	6

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

Matrix Score 10

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



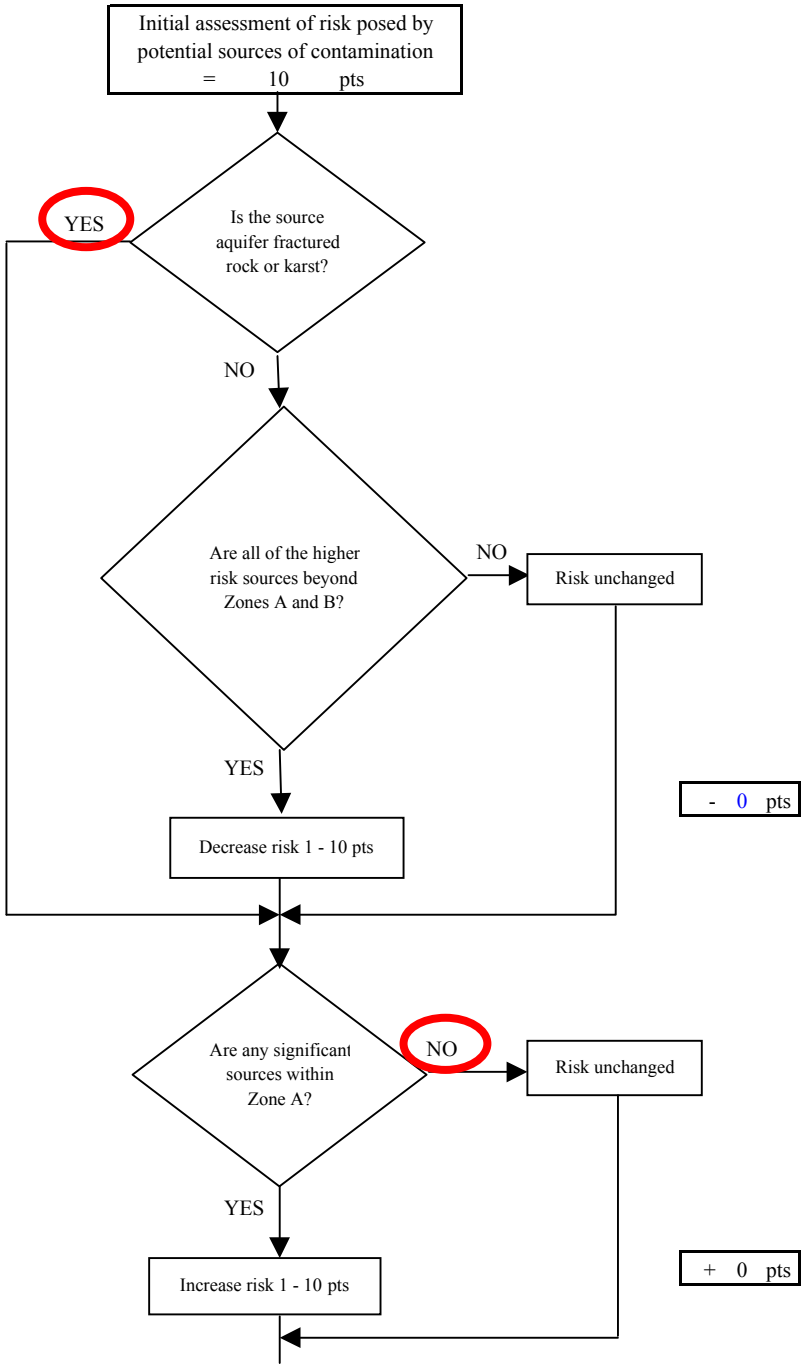
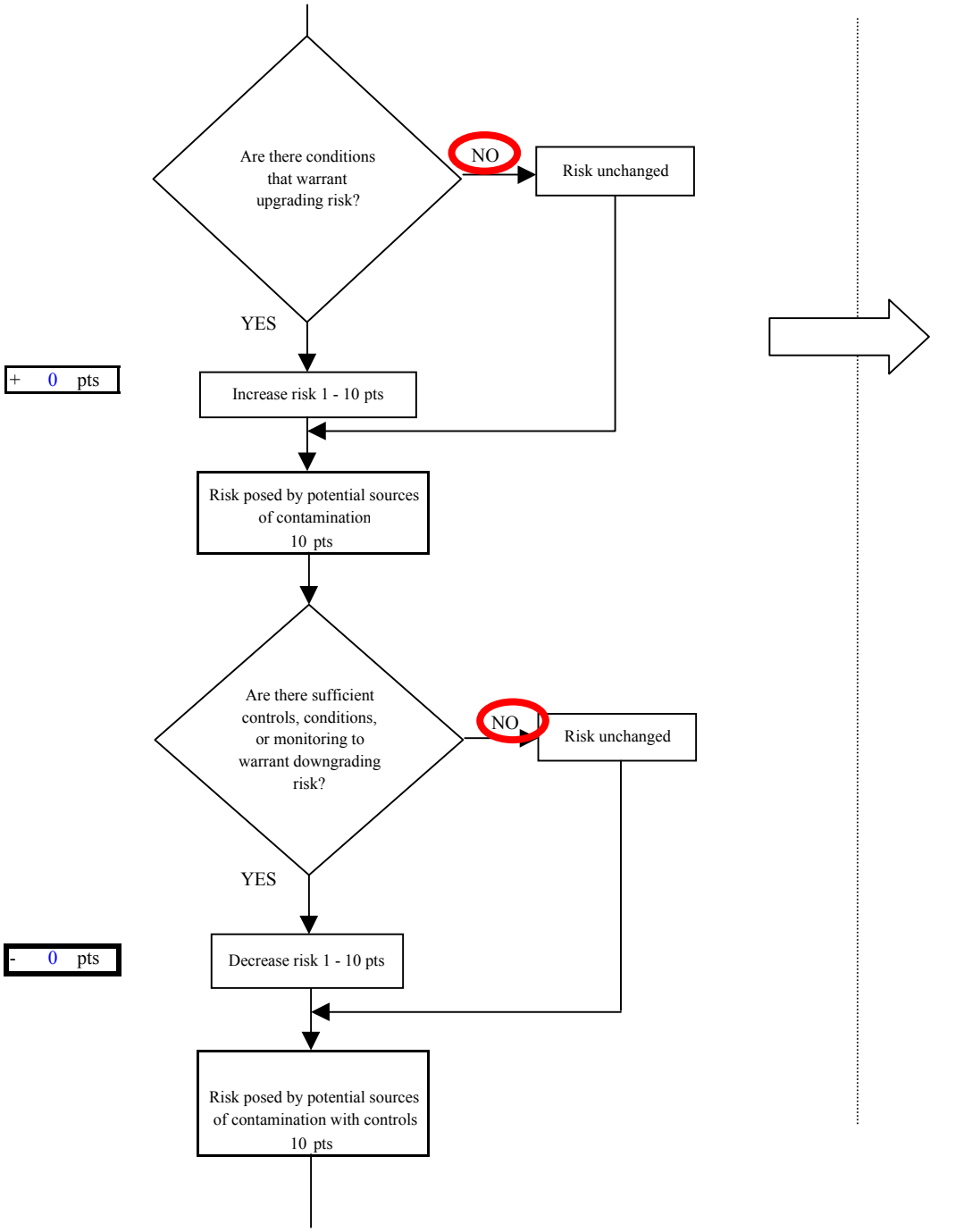


Chart 11. Contaminant risks for Northstar Center - Synthetic Organic Chemicals



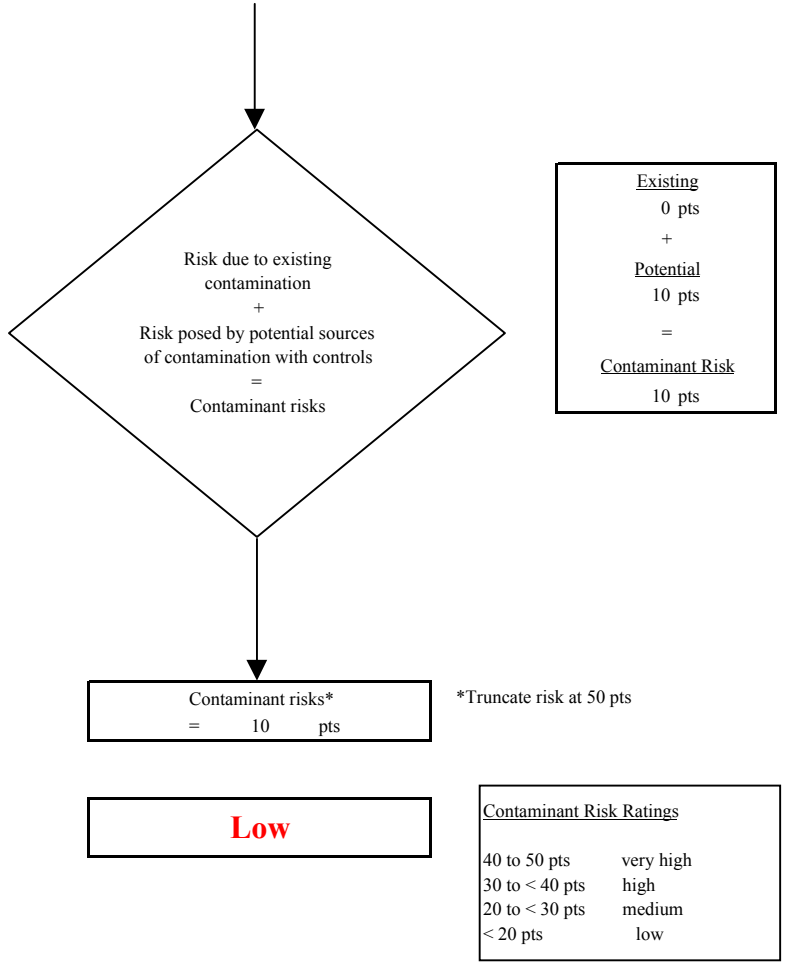


Chart 12. Vulnerability analysis for Northstar Center - Synthetic Organic Chemicals

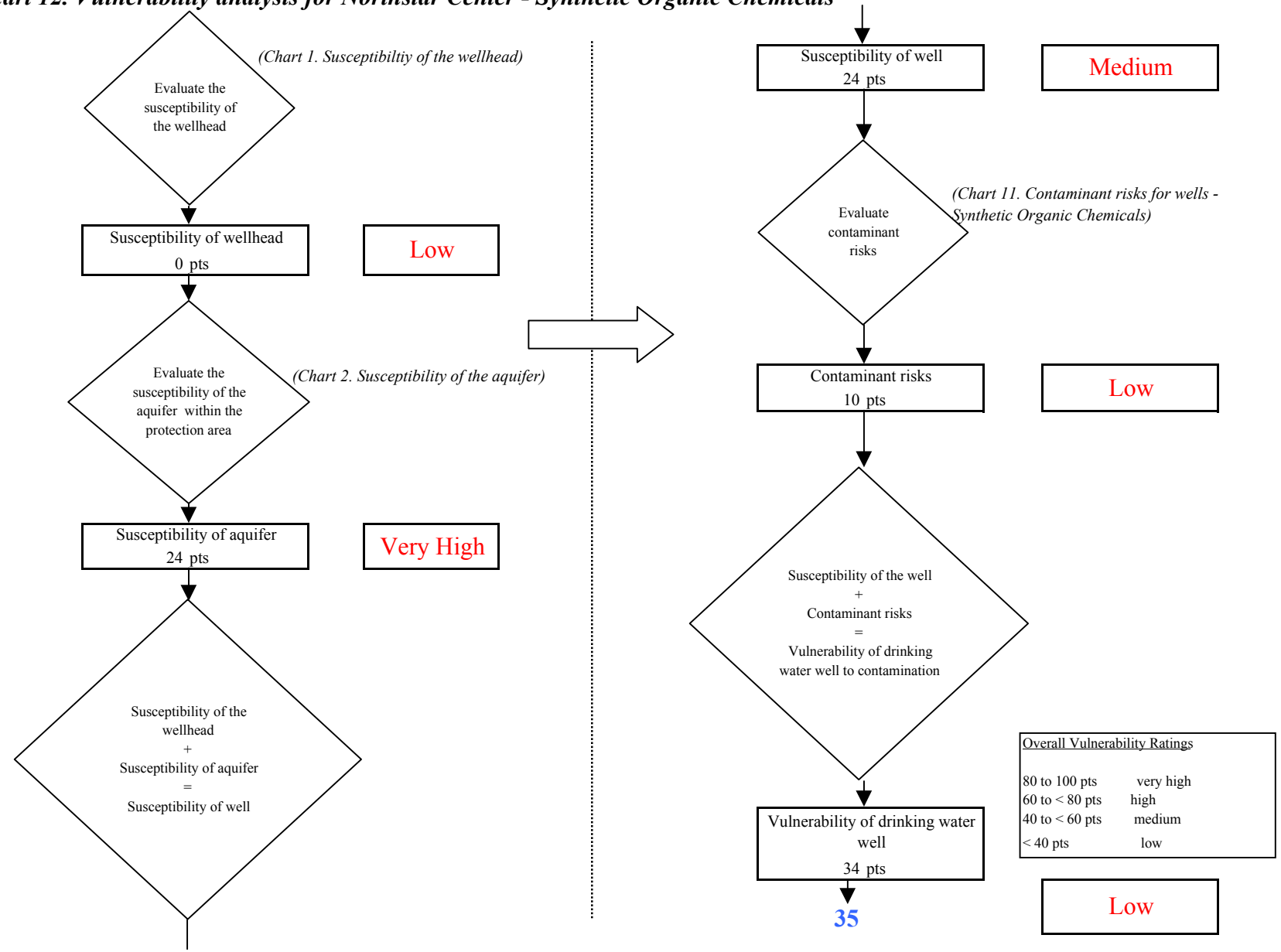


Chart 13. Contaminant risks for Northstar Center - Other Organic Chemicals

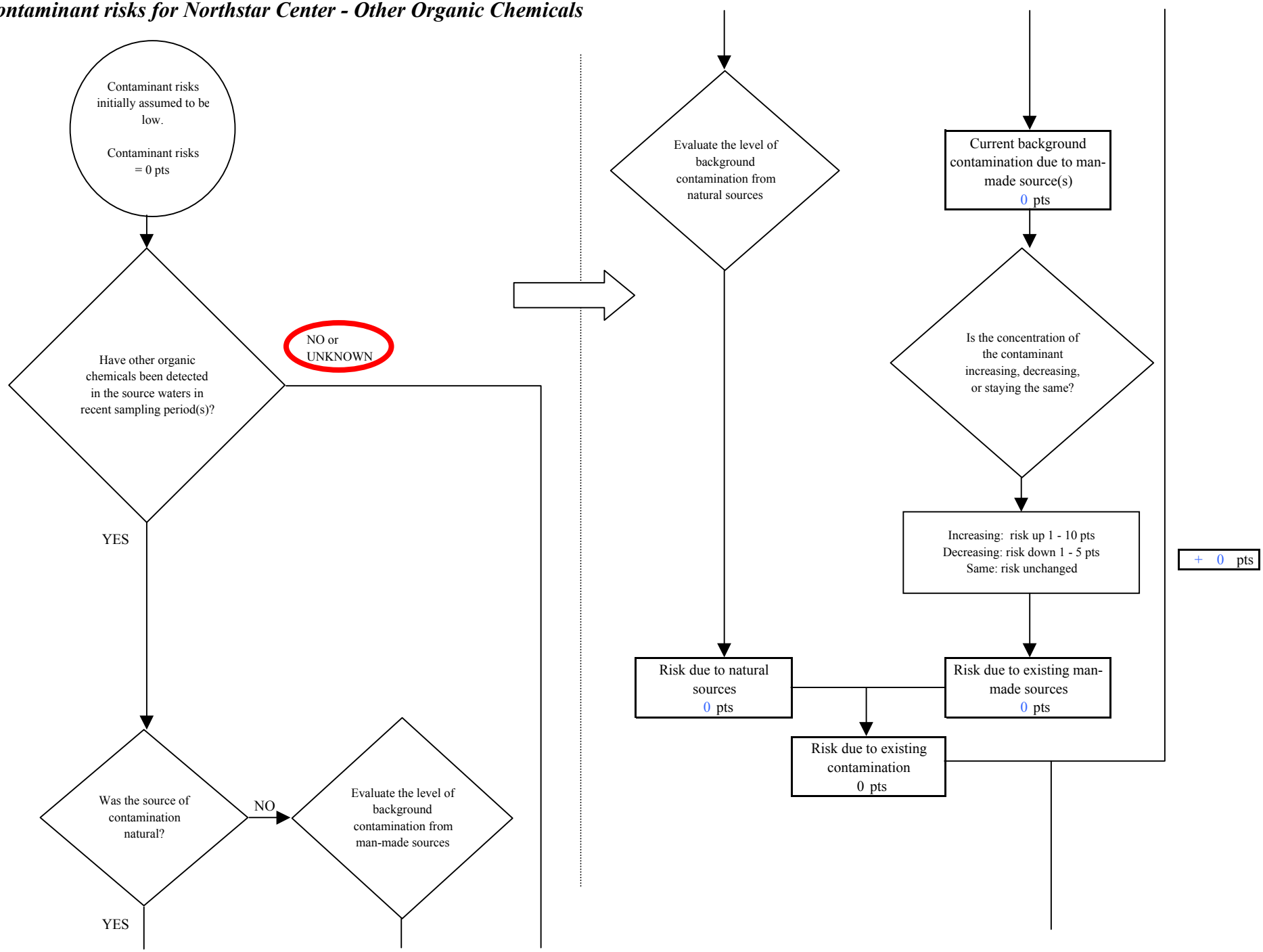


Chart 13. Contaminant risks for Northstar Center - Other Organic Chemicals

+ 20 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	1	1
Low(s)	4	4	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 20

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO → Risk unchanged

YES → Decrease risk 1 - 10 pts

- 0 pts

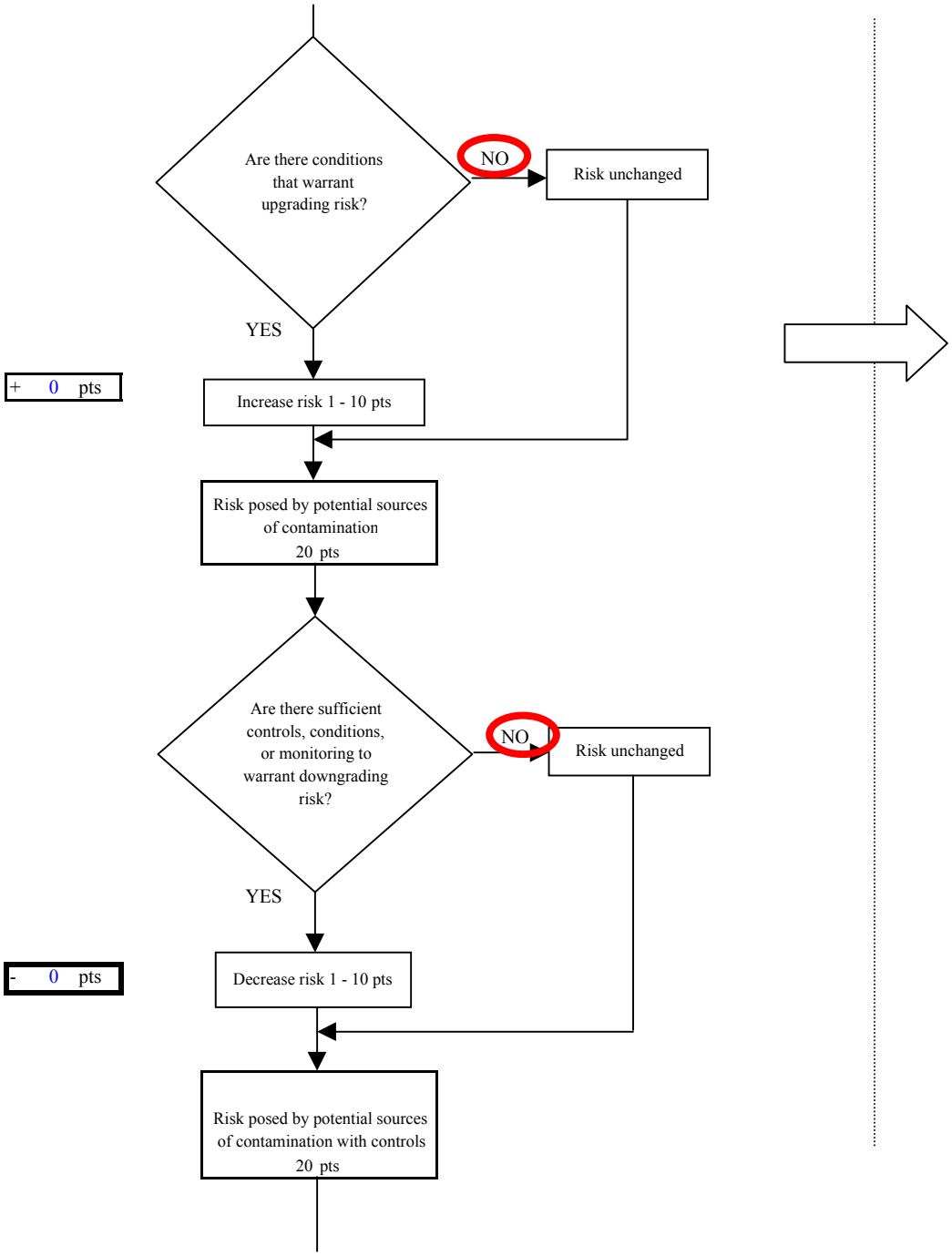
Are any significant sources within Zone A?

NO → Risk unchanged

YES → Increase risk 1 - 10 pts

+ 0 pts

Chart 13. Contaminant risks for Northstar Center - Other Organic Chemicals



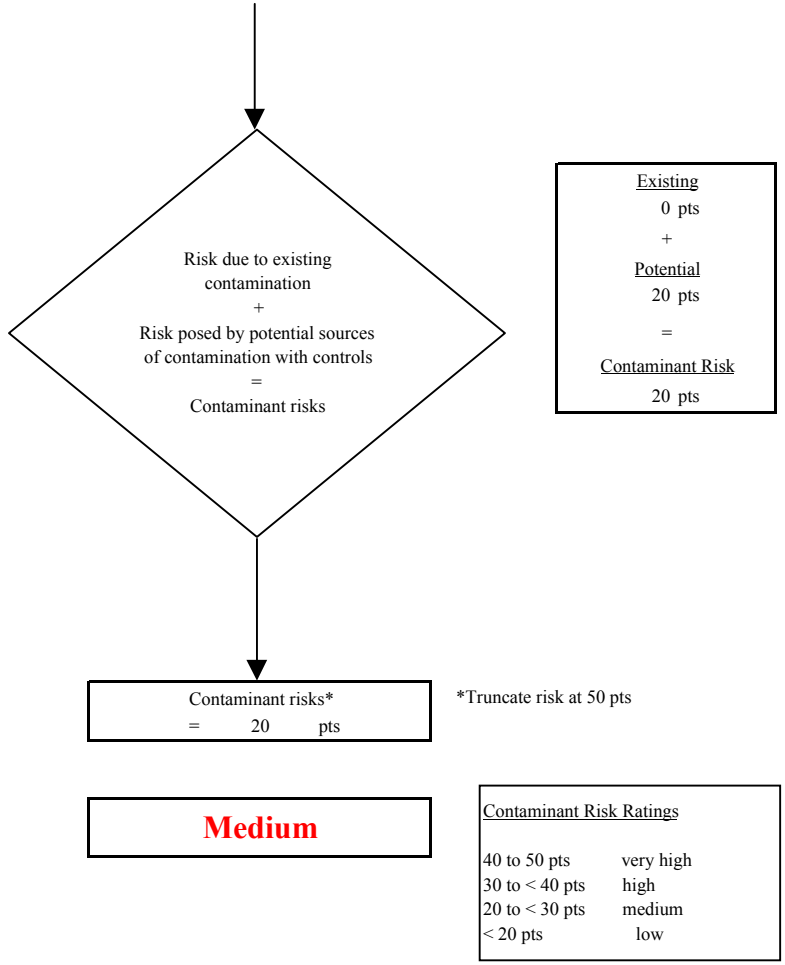


Chart 14. Vulnerability analysis for Northstar Center - Other Organic Chemicals