Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Spenard Heights, Anchorage, Alaska PWSID # 211821

DRINKING WATER PROTECTION PROGRAM REPORT Report 475

Alaska Department of Environmental Conservation

Source Water Assessment for Spenard Heights Anchorage, Alaska PWSID# 211821

DRINKING WATER PROTECTION PROGRAM REPORT 465

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.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for Spenard Heights Source of Public Drinking Water, Anchorage, Alaska

---

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Spenard Heights is a Class A (community) water system consisting of one well in the Anchorage area. Identified potential and current sources of contaminants for Spenard Heights public drinking water source include: approximately 60 acres of residential area, sewer lines, roads, a construction trade area, a scrap/salvage yard, and parks and recreation trails. 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 drinking water source for Spenard Heights received a vulnerability rating of **High** for heavy metals, cyanide and other inorganic chemicals, **Medium** for bacteria and viruses, and nitrates and/or nitrites, and **Low** for volatile organic chemicals, synthetic organic chemicals, and other organic chemicals.

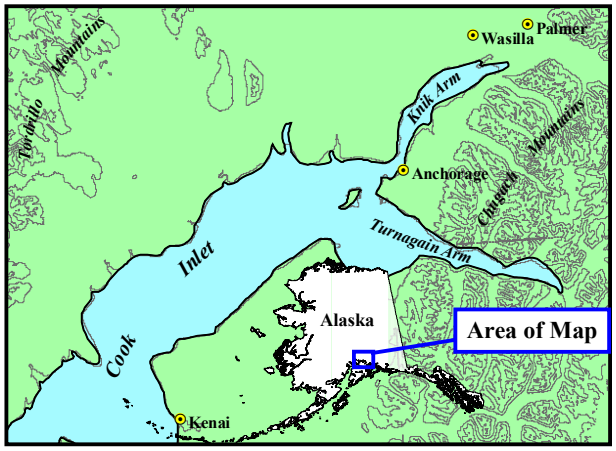


Figure 1. Index map showing the location of Anchorage, Alaska

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 ANCHORAGE AREA, ALASKA

Location

Anchorage, located in south-central Alaska, encompasses 1,698 square miles of land and 264 square miles of water. The area containing a majority of the urban development, commonly referred to as the Anchorage Bowl, encompasses approximately 180 square miles [*Partick, Brabets, and Glass, 1989*] and envelopes the low lands of the area. This area is bounded on the east by the Chugach Mountains and the north, west, and south by the Knik and Turnagain Arm of Cook Inlet (Figure 1). In recent times, urban development has extended eastward along the flanks of the Chugach Mountains. This area, known locally as the Anchorage Hillside, contains development at elevations exceeding 3,700 feet in elevation above sea level.

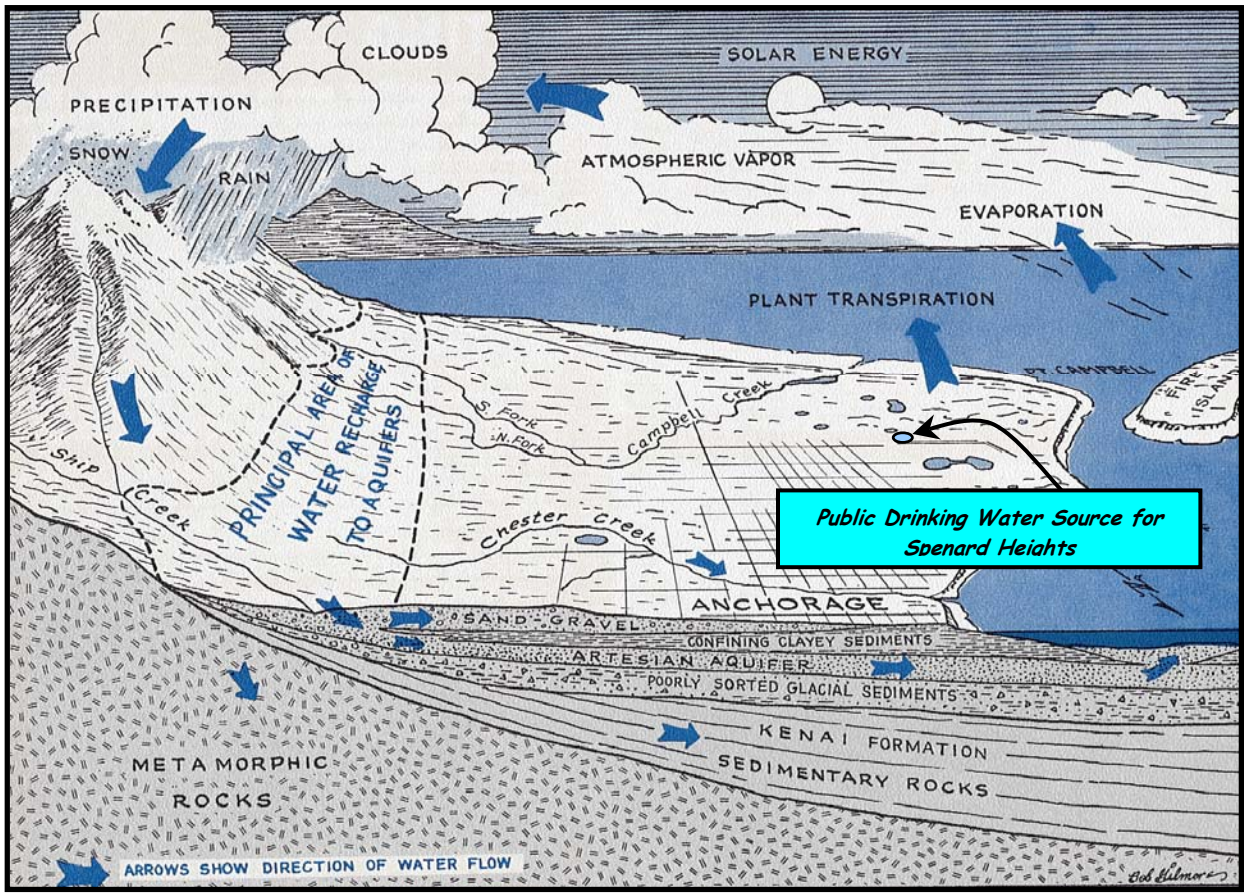


Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

The Anchorage area climate is somewhat transitional in that it does not experience large daily and annual temperature fluctuations like those experienced in the interior of Alaska nor does it experience high amounts of precipitation typified by gulf coast regions. Mean annual precipitation at the Anchorage International Airport is approximately 16 inches per year. On average, Anchorage receives a total snow accumulation of 69 inches per year. Precipitation generally increases inland toward the Chugach Mountains where annual precipitation may exceed 160 inches per year [*Barnwell, George, Dearborn, Weeks, and Zenone*, 1972]. Mean daily temperature ranges from 65^{o} F during July to 8^{o} F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at Knik and Turnagain Arms to well over 5,000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Anchorage Bowl.

The backbone of the Chugach Mountains is composed primarily of metamorphic marine and volcanic rocks (bedrock). These high peaks that bound Anchorage's east side are flanked with colluvium or slope deposits. These slope deposits eventually grade into the glacial and stream deposits at lower elevations in the Anchorage Bowl.

In the Anchorage area, two principal groundwater flow systems or aquifers exist (see Figure 2). The upper unconfined aquifer or water-table aquifer is separated from a lower confined aquifer system by layers of silty, clayey glacially derived sediments (confining layer) [*Ulery and Updike*, 1983]. The lower confined aquifer system consists of a series of hydrologically interconnected layers and lenses of gravel, sand and silt that, collectively, form the confined aquifer. The confining layer ranges from 0 to 270 feet thick throughout the Anchorage area and generally thins with increasing distance from Cook Inlet, thus pinching out at the mountain front [*Patrick, Brabets, and Glass*, 1989].

Water enters or recharges these two aquifer systems in several different ways. Along the front of the Chugach Mountains, groundwater seeps from fractures in

bedrock into the sediments. At these higher elevations, rain and snowmelt also enters the sediments. This area along the mountain front is considered the principal recharge area for wells in the Anchorage area. Precipitation in the low lands may also percolate directly into the ground. Lastly, aquifers may also be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). Groundwater flow in the confined aquifer is generally east to west from the mountain front toward Cook Inlet and Turnagain Arm, except in areas where the direction of flow is influenced by large municipal or industrial production wells. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surfacial topography as well as its close connection with surface water bodies.

SPENARD HEIGHTS PUBLIC DRINKING WATER SYSTEM

Spenard Heights is a Class A (community) water system. The system consists of one well located between 61st and 62nd Avenue off of Jewel Lake Road (See Map 1 of Appendix A). This area is at an elevation of approximately 100 feet above sea level.

According to the well log, installation of the well occurred on October 31, 1973, and was drilled to a depth of the well was drilled to 130 feet and was completed in a 6-inch casing. The well penetrates layers of sand, clay and gravel. There is a confining layer, consisting of gravel and hardpan from 50 to 100 feet below the land surface. However, near the base of the Chugach Mountains, these clay layers tend to thin out toward the mountains. Therefore, contaminants that enter the subsurface near the base of the mountains may enter the confined aquifer uninhibited by the absence of any protective layer.

The most recent Sanitary Survey (09/25/96) indicates that 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 Sanitary Survey also indicates that the land surface is appropriately sloped away from the well providing adequate surface water drainage. Both wells are grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates year-round and serves 100 residents through 25 service connections.

SPENARD HEIGHTS 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 Spenard Heights. 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 (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 Spenard Heights 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 4 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.

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 SPENARD HEIGHTS'S 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)

Table 2 shows the Susceptibility scores and ratings for the wells serving Spenard Heights.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	8	Low
Natural Susceptibility	13	Low

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	25	Medium
Nitrates and/or Nitrites	30	High
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

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	40	Medium
Nitrates and Nitrites	45	Medium
Volatile Organic Chemicals	25	Low
Heavy Metals, Cyanide and Other Inorganic Chemicals	65	High
Synthetic Organic Chemicals	25	Low
Other Organic Chemicals	25	Low

Bacteria and Viruses
The contaminant risk for bacteria and viruses is medium with residential areas and sewer lines presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability is medium.

Nitrates and Nitrites
The contaminant risk for nitrates and nitrites is high with residential areas, sewer lines and parks and recreation trails presenting the most significant risk to the drinking water well.

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]. Sampling history for Spenard Heights indicates no nitrates and/or nitrites have been detected in the source waters (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

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

Volatile Organic Chemicals
The contaminant risk for volatile organic chemicals is low with roads, residential area, a construction trade area, and sewer lines presenting the most significant risk for volatile organic chemicals (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Recent sampling history of Spenard Heights well indicates that no volatile organic chemicals have been detected in the source waters.

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

Heavy Metals, Cyanide, and Other Inorganic Chemicals
The contaminant risk for heavy metals, cyanide and other inorganic chemicals is high with residential areas, roads, and the construction trade area presenting the most significant risk to the drinking water well (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D.

Review of recent sampling history revealed that low concentrations of inorganic chemicals have been detected in Spenard Heights sources waters. Sampling done on December 5, 2002 showed arsenic at 0.018mg/L or 180% of the MCL for arsenic. The most recent water sample was taken on November 16, 2001 and lab analysis revealed that arsenic was not detected. Barium was also detected at very low levels in a sample taken November 19, 1998 and has not been detected at the well since (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appeidix D).

According to a study conducted by the United States Geological Survey (USGS), arsenic in ground water is largely the result of minerals dissolving from weathered rocks and soils. Several types of cancer have been linked to arsenic in water. In 2001 the US Environmental Protection Agency (EPA) lowered the maximum level of arsenic permitted in drinking water from 50 micrograms per liter (ug/L) to 10 ug/L. The health effects of Arsenic depend on the concentration of arsenic in drinking water and the amount of water consumed.

Barium can come from the discharge of drilling wastes; discharge from metal refineries; or the erosion of natural deposits. There are no mining activities occurring near the protection area for Spenard Heights. It is suspected that the detected levels of barium are a result of the erosion of natural deposits. The (EPA) has found barium to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: gastrointestinal disturbances and muscular weakness. Long-term health effects include high blood pressure.

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

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is low with sewer lines representing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals is low.

Other Organic Chemicals

The contaminant risk for other organic chemicals is low with the sewer lines, roads, and a construction trade area representing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals is low (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D, respectively).

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Spenard Heights. The overall vulnerability of well to contamination is **High** for heavy metals, cyanide and other inorganic chemicals, **Medium** for bacteria and viruses, nitrates and/or nitrites, and **Low** for volatile organic chemicals, synthetic organic chemicals, and other 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 Spenard Heights 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 Spenard Heights' public drinking water source.

REFERENCES

Barnwell, W.W., George, R.S., Dearborn, L.L., Weeks, J.B., and Zenone, C., 1972, Water for Anchorage: an atlas of the water resources of the Anchorage area, Alaska: U.S. Geological Survey Open-File Report, 76 p.

Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: U.S. Geological Survey Water-Resources Investigations Report 88-4139, 41p.

Ulery, C.A. and Updike, R.G, 1983, Subsurface structure of the cohesive facies of the Bootlegger Cove Formation, Southwest Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 84, 5 p.

United States Geological Survey., 2002, Arsenic in Groundwater of the United States. Retrieved July 5, 2002. [www.document]. URL http://co.water.usgs.gov/trace/arsenic/

United States Environmental Protection Agency, 2001, Office of Water, National Primary Drinking Water Regulations, Consumer Factsheet on Arsenic. Retrieved February 2002. [WWW document]. URL http://www.epa.gov/safewater/dwh/c-ioc/arsenic.html

United States Environmental Protection Agency (EPA, Office of Water). 2001, July 23.Retrieved February 2002 [WWW document]. URL http://www.epa.gov/safewater/ars/ars_rule_factsheet.html

United States Environmental Protection Agency (EPA, Office of Water). 2002, May 22. Retrieved July 12, 2002 [WWW document]. URL http://www.epa.gov/safewater/dwh/c-ioc/barium.html

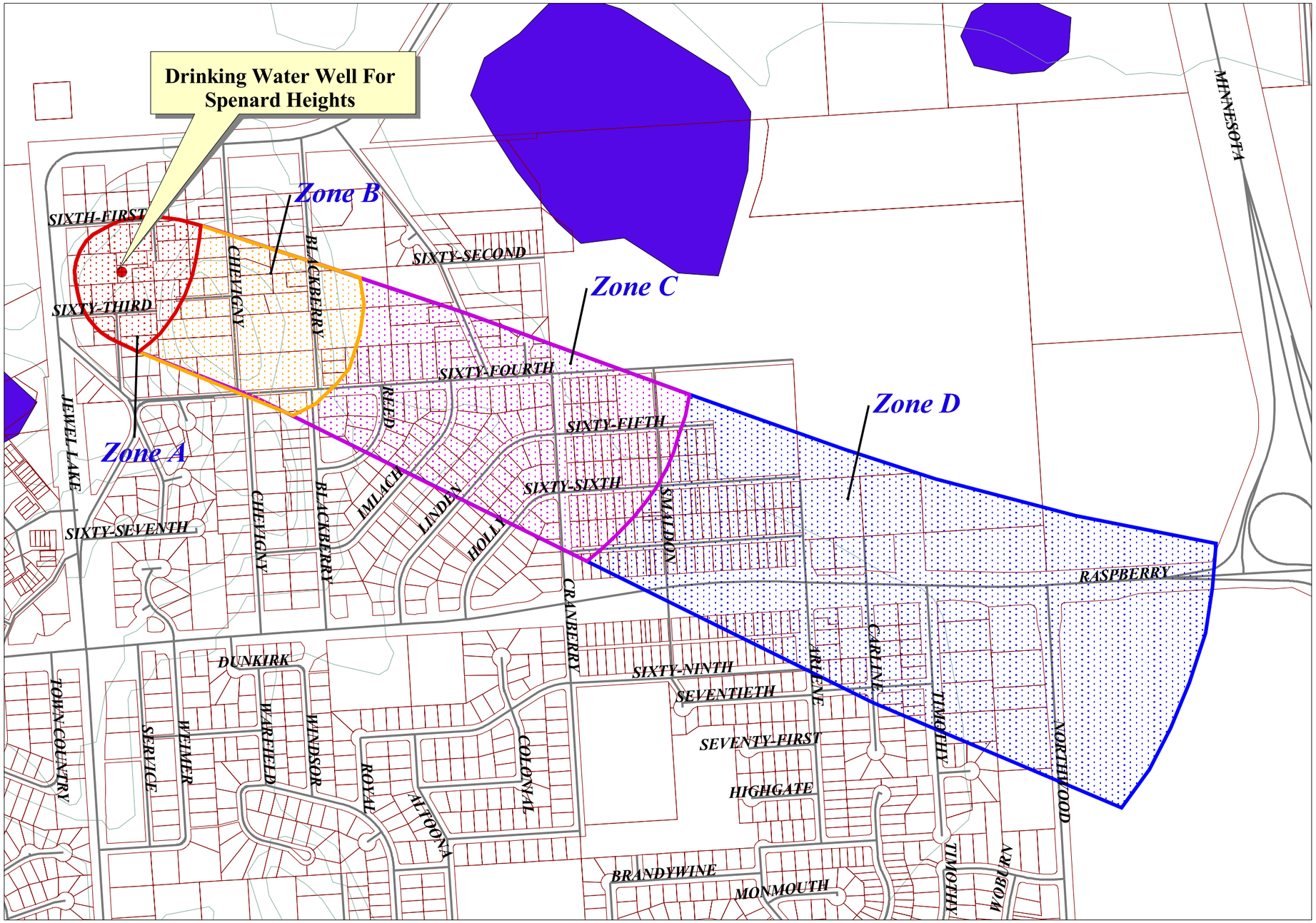
Wang, B., Strelakos, P.M., and Jokela, B., 2000, Nitrate Source Indicators In Groundwater of the Scimitar Subdivision, Peters Creek Area, Anchorage Alaska: U.S. Geological Survey Water-Resources Investigations Report 00-4137, 25p.

Western Regional Climate Center, 2000, August 24, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wrcc.dri.edu/index.html

APPENDIX A

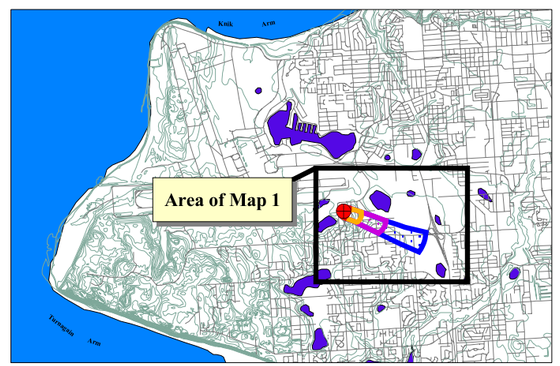
Spenard Heights
Drinking Water Protection Area Location Map
(Map 1)

Drinking Water Protection Area and
Potential & Existing Contaminant Sources for Spenard Heights



- Spenard Heights Drinking Water Well
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less Than 2 Years Travel Time
- Zone C Protection Area
  - Less Than 5 Years Travel Time
- Zone D Protection Area
  - Less Than 10 Years Travel Time
- Roads (X20)
- Land Parcels
- Elevation Contours
- Lakes

N
W E
S



900 0 900 1800 2700 3600 Feet

PWSID 211821.001

Map 1

APPENDIX B

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

Table 1 *Contaminant Source Inventory for* ***PWSID 211821.001***

Spenard Heights SD

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Along High Place	2	
Residential Areas	R01	R1-1	A	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	High Place	2	
Highways and roads, paved (cement or asphalt)	X20	X24-1	A	61st	2	
Highways and roads, paved (cement or asphalt)	X20	X24-2	A	63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B		2	
Residential Areas	R01	R1-2	B	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	64th	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X24-3	B	Mary Anne	2	
Highways and roads, paved (cement or asphalt)	X20	X24-4	B	Chevigny	2	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	12 sewer lines in Zone C	2	
Highways and roads, paved (cement or asphalt)	X20		C	7 roads in Zone C	2	
Construction trade areas and materials	C09	C9-1	C	Cranberry and 66th	3	
Residential Areas	R01	R1-3	C	Entire Subdivision	3	
Municipal or city parks (with green areas)	X04	X4-1	C	Conners Lake Park	3	
Municipal or city parks (with green areas)	X04	X4-2	C	Southwood Park	3	
Scrap, salvage, or junk yards	D59	D59-1	D	67th and Arlene	4	

Table 2

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD Sources of Bacteria and Viruses

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Medium	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Medium	Along High Place	2	
Residential Areas	R01	R1-1	A	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	High Place	2	
Highways and roads, paved (cement or asphalt)	X20	X24-1	A	Low	61st	2	
Highways and roads, paved (cement or asphalt)	X20	X24-2	A	Low	63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Medium	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Medium	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Medium	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Medium		2	
Residential Areas	R01	R1-2	B	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	64th	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X24-3	B	Low	Mary Anne	2	
Highways and roads, paved (cement or asphalt)	X20	X24-4	B	Low	Chevigny	2	

Table 2 (continued)

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD
Sources of Bacteria and Viruses

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	Medium	12 sewer lines in Zone C	2	
Highways and roads, paved (cement or asphalt)	X20		C	Low	7 roads in Zone C	2	
Residential Areas	R01	R1-3	C	Low	Entire Subdivision	3	
Municipal or city parks (with green areas)	X04	X4-1	C	Medium	Conners Lake Park	3	
Municipal or city parks (with green areas)	X04	X4-2	C	Medium	Southwood Park	3	

Table 3

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD Sources of Nitrates/Nitrites

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Medium	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Medium	Along High Place	2	
Residential Areas	R01	R1-1	A	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	High Place	2	
Highways and roads, paved (cement or asphalt)	X20	X24-1	A	Low	61st	2	
Highways and roads, paved (cement or asphalt)	X20	X24-2	A	Low	63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Medium	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Medium	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Medium	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Medium		2	
Residential Areas	R01	R1-2	B	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	64th	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X24-3	B	Low	Mary Anne	2	
Highways and roads, paved (cement or asphalt)	X20	X24-4	B	Low	Chevigny	2	

Table 3 (continued)

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD Sources of Nitrates/Nitrites

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	Medium	12 sewer lines in Zone C	2	
Highways and roads, paved (cement or asphalt)	X20		C	Low	7 roads in Zone C	2	
Residential Areas	R01	R1-3	C	Low	Entire Subdivision	3	
Municipal or city parks (with green areas)	X04	X4-1	C	Medium	Conners Lake Park	3	
Municipal or city parks (with green areas)	X04	X4-2	C	Medium	Southwood Park	3	

Table 4

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD Sources of Volatile Organic Chemicals

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Low	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Low	Along High Place	2	
Residential Areas	R01	R1-1	A	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	High Place	2	
Highways and roads, paved (cement or asphalt)	X20	X24-1	A	Low	61st	2	
Highways and roads, paved (cement or asphalt)	X20	X24-2	A	Low	63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Low	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Low	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Low	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Low		2	
Residential Areas	R01	R1-2	B	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	64th	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X24-3	B	Low	Mary Anne	2	
Highways and roads, paved (cement or asphalt)	X20	X24-4	B	Low	Chevigny	2	

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD
Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		C	Low	7 roads in Zone C	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	Low	12 sewer lines in Zone C	2	
Construction trade areas and materials	C09	C9-1	C	Low	Cranberry and 66th	3	
Residential Areas	R01	R1-3	C	Low	Entire Subdivision	3	

Table 5

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Low	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Low	Along High Place	2	
Residential Areas	R01	R1-1	A	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	High Place	2	
Highways and roads, paved (cement or asphalt)	X20	X24-1	A	Low	61st	2	
Highways and roads, paved (cement or asphalt)	X20	X24-2	A	Low	63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Low	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Low	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Low	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Low		2	
Residential Areas	R01	R1-2	B	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	64th	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X24-3	B	Low	Mary Anne	2	
Highways and roads, paved (cement or asphalt)	X20	X24-4	B	Low	Chevigny	2	

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Location***	***Map Number***	***Comments***
Highways and roads, paved (cement or asphalt)	X20		C	Low	7 roads in Zone C	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	Low	12 sewer lines in Zone C	2	
Construction trade areas and materials	C09	C9-1	C	Low	Cranberry and 66th	3	
Residential Areas	R01	R1-3	C	Low	Entire Subdivision	3	
Municipal or city parks (with green areas)	X04	X4-1	C	Low	Conners Lake Park	3	
Municipal or city parks (with green areas)	X04	X4-2	C	Low	Southwood Park	3	
Scrap, salvage, or junk yards	D59	D59-1	D	High	67th and Arlene	4	

Table 6

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD
Sources of Synthetic Organic Chemicals

PWSID 211821.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Low	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Low	Along High Place	2	
Residential Areas	R01	R1-1	A	Low	Entire Subdivision	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Low	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Low	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Low	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Low		2	
Residential Areas	R01	R1-2	B	Low	Entire Subdivision	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	Low	12 sewer lines in Zone C	2	
Residential Areas	R01	R1-3	C	Low	Entire Subdivision	3	
Municipal or city parks (with green areas)	X04	X4-1	C	Low	Conners Lake Park	3	
Municipal or city parks (with green areas)	X04	X4-2	C	Low	Southwood Park	3	

Table 7

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD
Sources of Other Organic Chemicals

PWSID 211821.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Location	Map Number	Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	Off of 61st	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	Off of Loganberry Street	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Low	Along 63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Low	Along High Place	2	
Residential Areas	R01	R1-1	A	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	High Place	2	
Highways and roads, paved (cement or asphalt)	X20	X24-1	A	Low	61st	2	
Highways and roads, paved (cement or asphalt)	X20	X24-2	A	Low	63rd	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Low	Along Mary Anne	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Low	Along 64th	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Low	Along Blackberry	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Low		2	
Residential Areas	R01	R1-2	B	Low	Entire Subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	64th	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	Blackberry	2	
Highways and roads, paved (cement or asphalt)	X20	X24-3	B	Low	Mary Anne	2	
Highways and roads, paved (cement or asphalt)	X20	X24-4	B	Low	Chevigny	2	

Contaminant Source Inventory and Risk Ranking for Spenard Heights SD

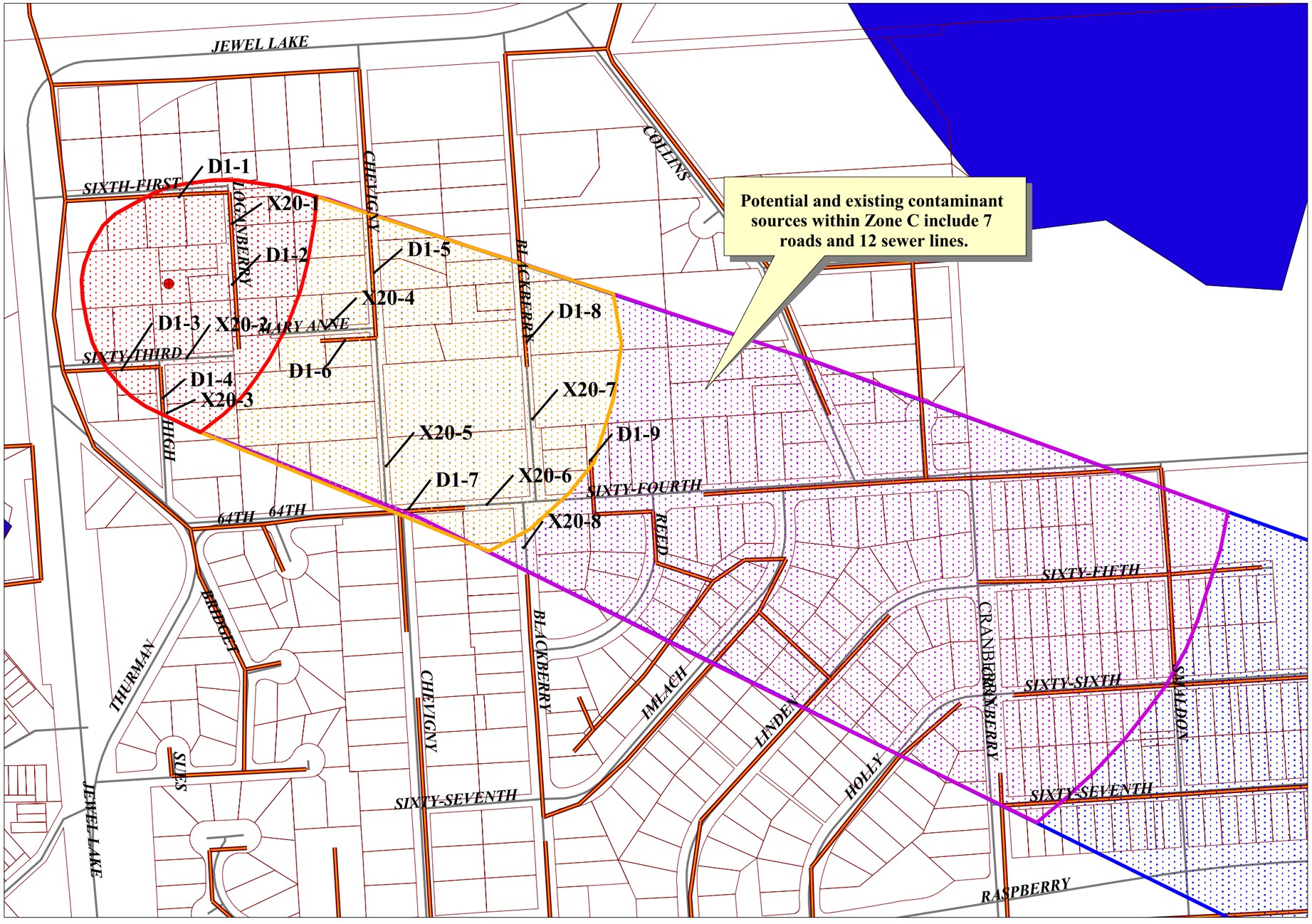
Sources of Other Organic Chemicals

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Location***	***Map Number***	***Comments***
Highways and roads, paved (cement or asphalt)	X20		C	Low	7 roads in Zone C	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01		C	Low	12 sewer lines in Zone C	2	
Construction trade areas and materials	C09	C9-1	C	Low	Cranberry and 66th	3	
Residential Areas	R01	R1-3	C	Low	Entire Subdivision	3	
Scrap, salvage, or junk yards	D59	D59-1	D	High	67th and Arlene	4	

APPENDIX C

Spenard Heights
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-4)

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Spenard Heights



- Spenard Heights Drinking Water Well

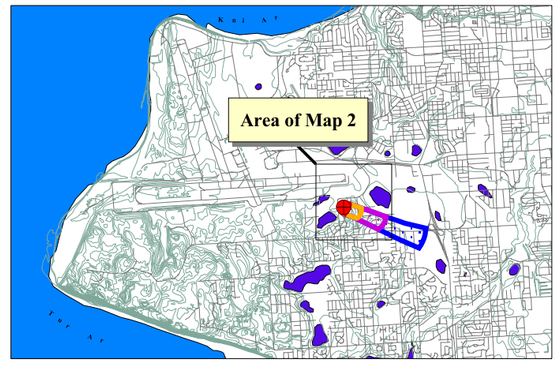
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Sewers (D1)
- Roads
- Land Parcels
- Lakes

N
W E
S

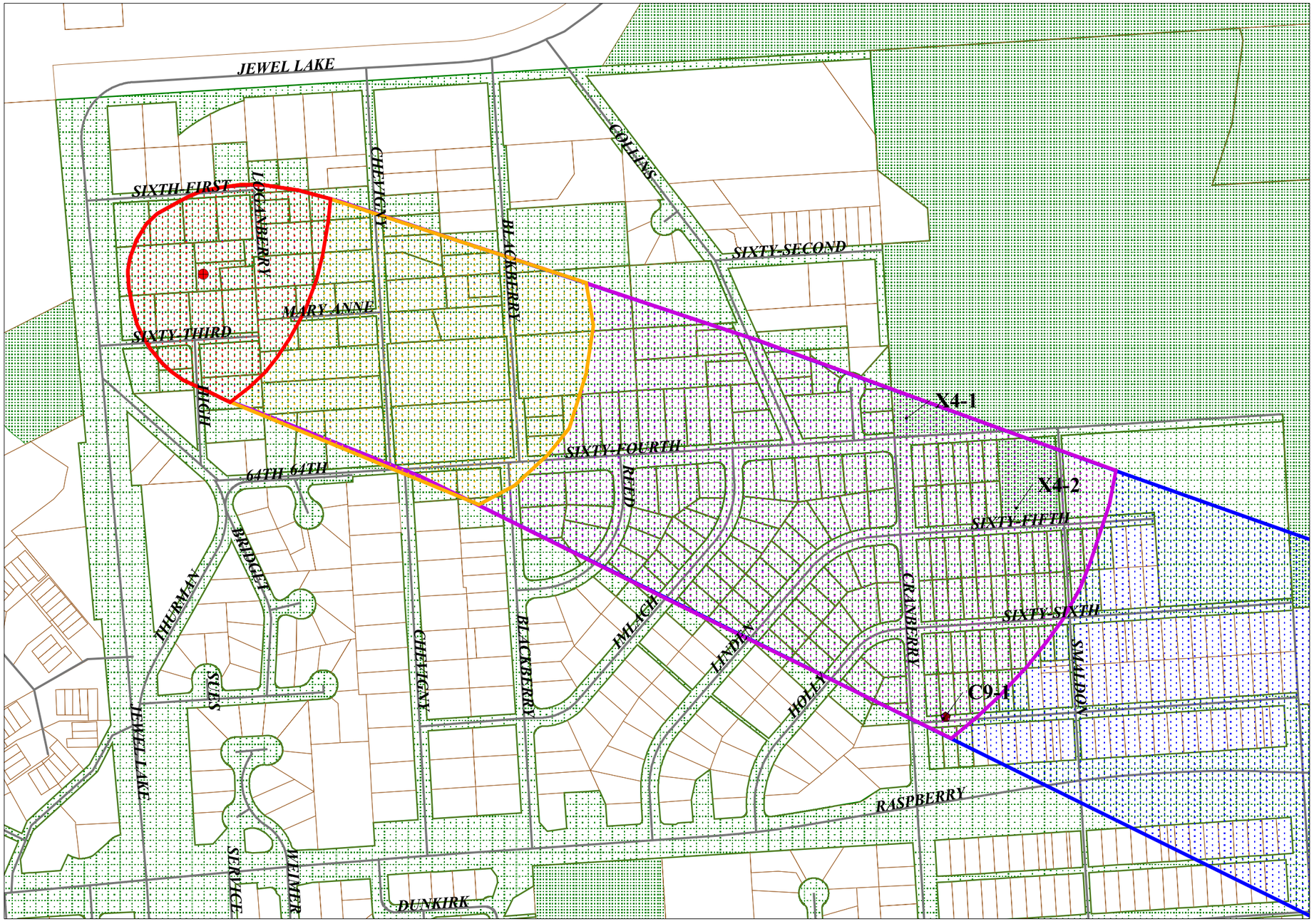


400 0 400 800 1200 1600 Feet

PWSID 211821.001

Map 2

Drinking Water Protection Area and
Potential & Existing Contaminant Sources for Spenard Heights



- Spenard Heights Drinking Water Well

Zone A Protection Area
- Several Months Travel Time

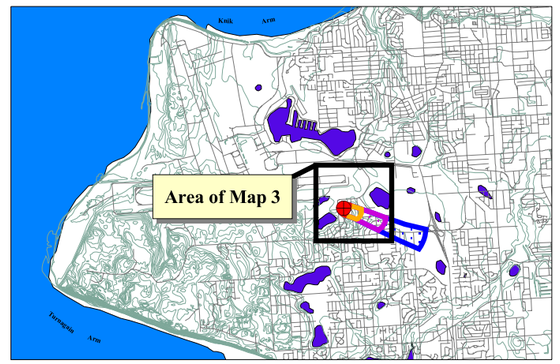
Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time

Contaminant Sources
- Construction trade areas (C9)
- Roads
- Land Parcels
- Parks (X4)
- Residential Area (R1)

N
W E
S

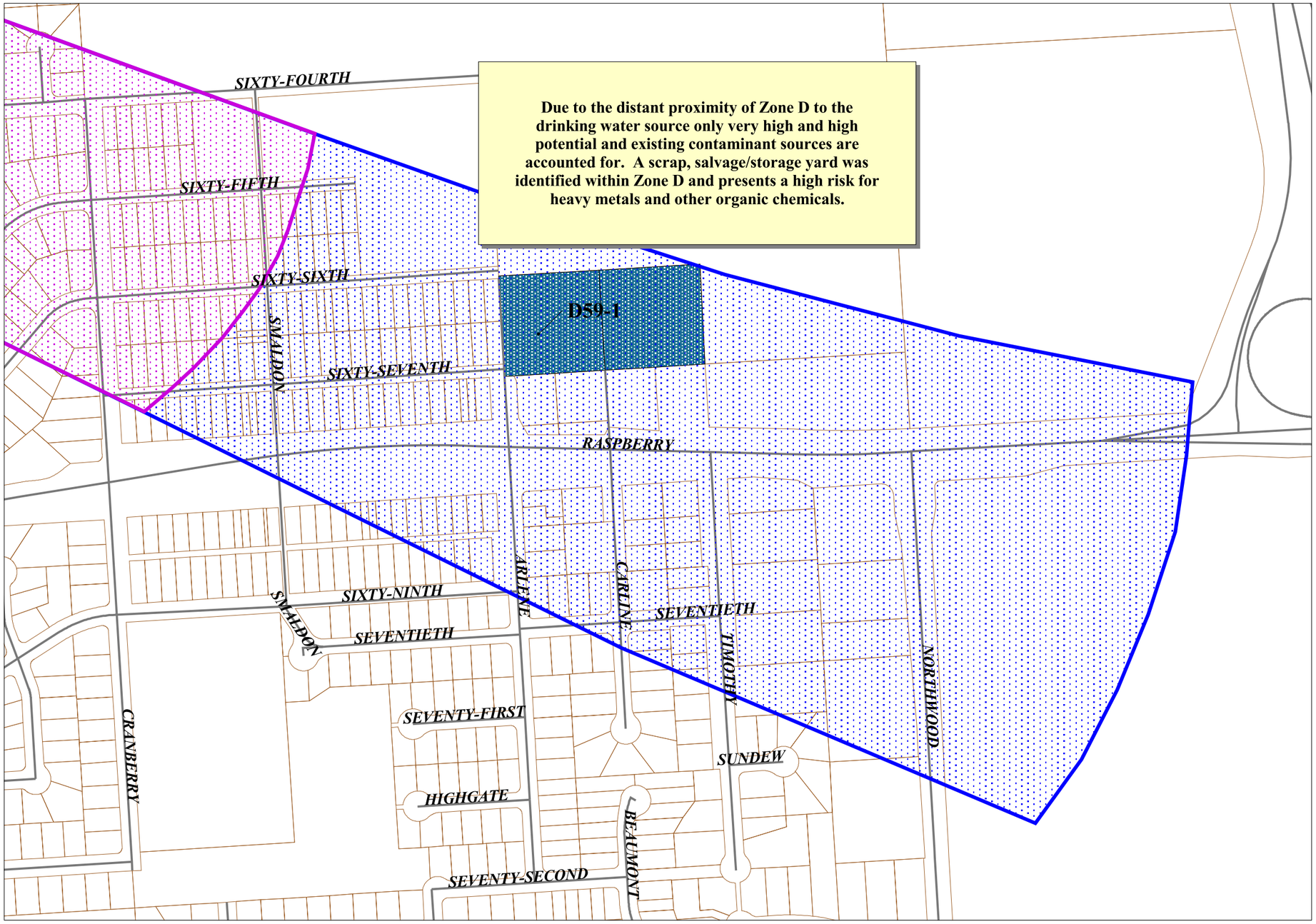


500 0 500 1000 1500 2000 Feet

PWSID 211821.001

Map 3

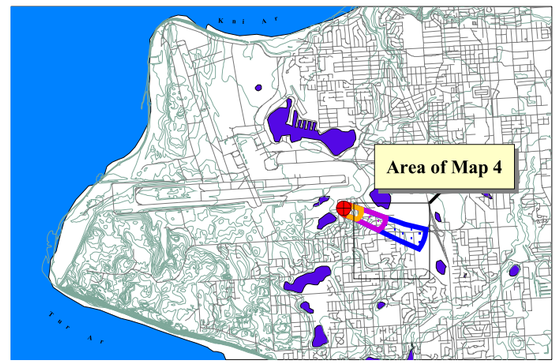
Drinking Water Protection Area and Potential & Existing Contaminant Sources for Spenard Heights



Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Roads
- Scrap, salvage, and junk yards (D59)
- Land Parcels

N
W E
S



400 0 400 800 1200 1600 Feet

PWSID 211821.001

Map 4

APPENDIX D

Vulnerability Analysis for Spenard Heights

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Spenard Heights

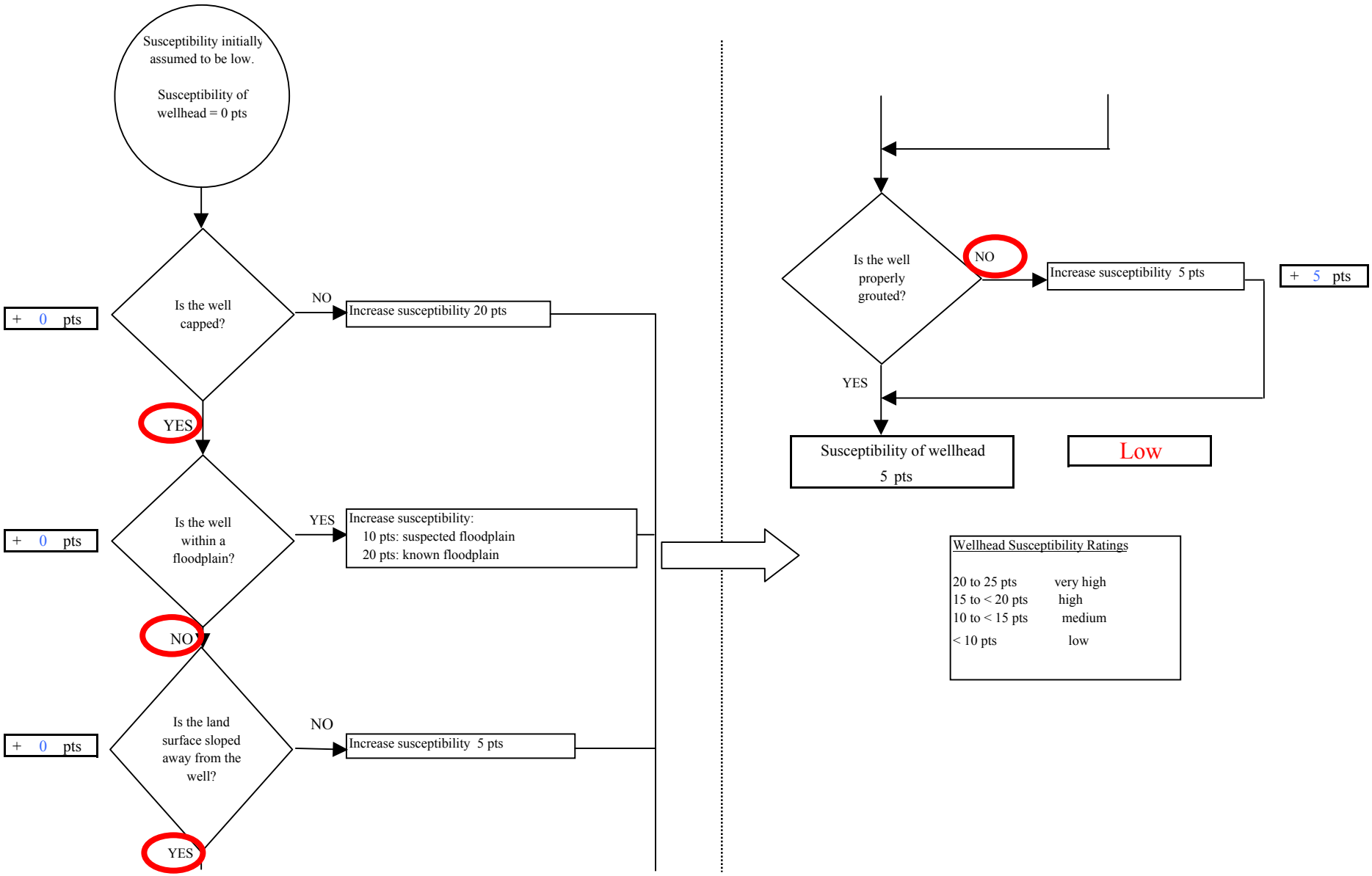


Chart 2. Susceptibility of the aquifer - Spenard Heights

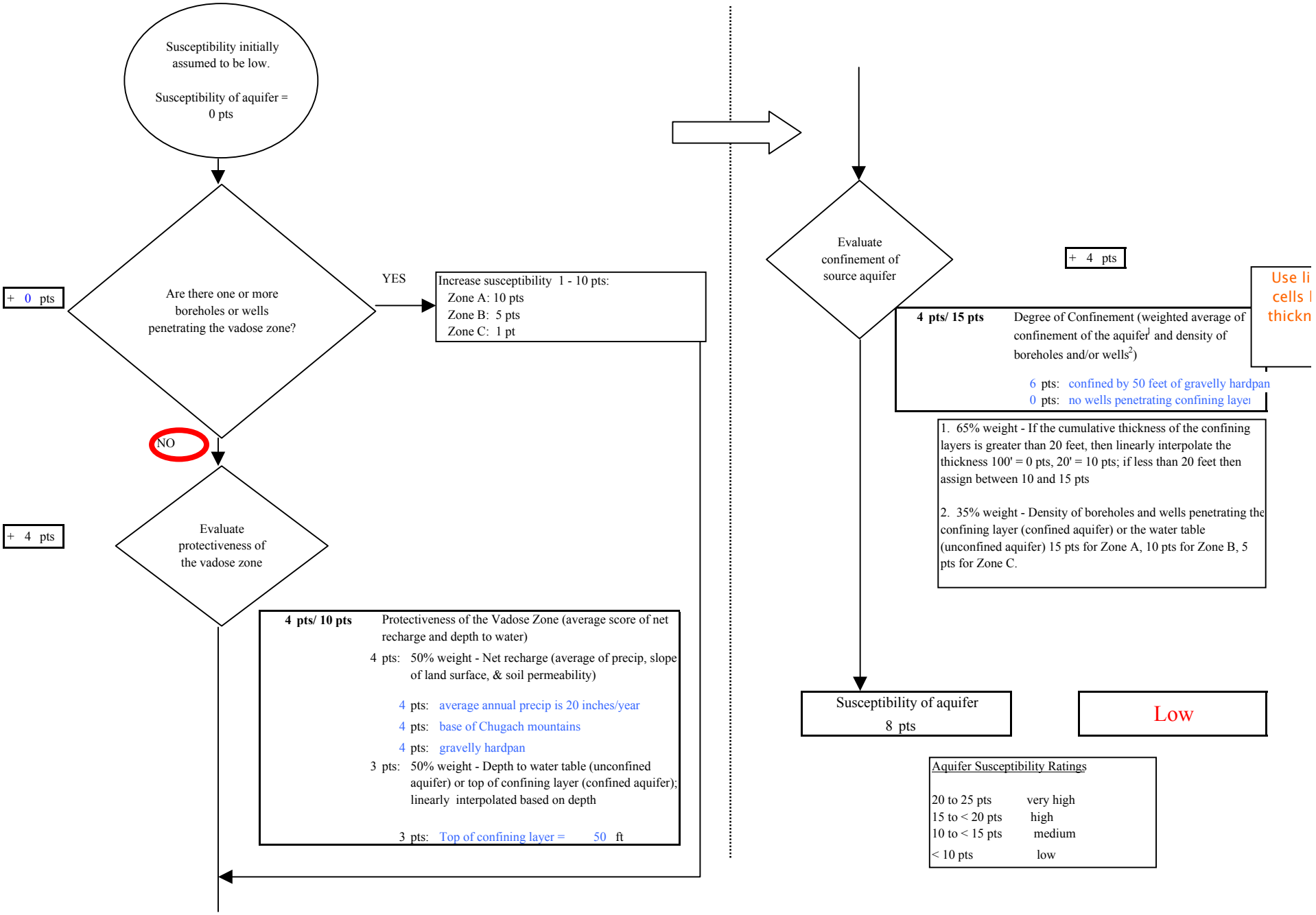
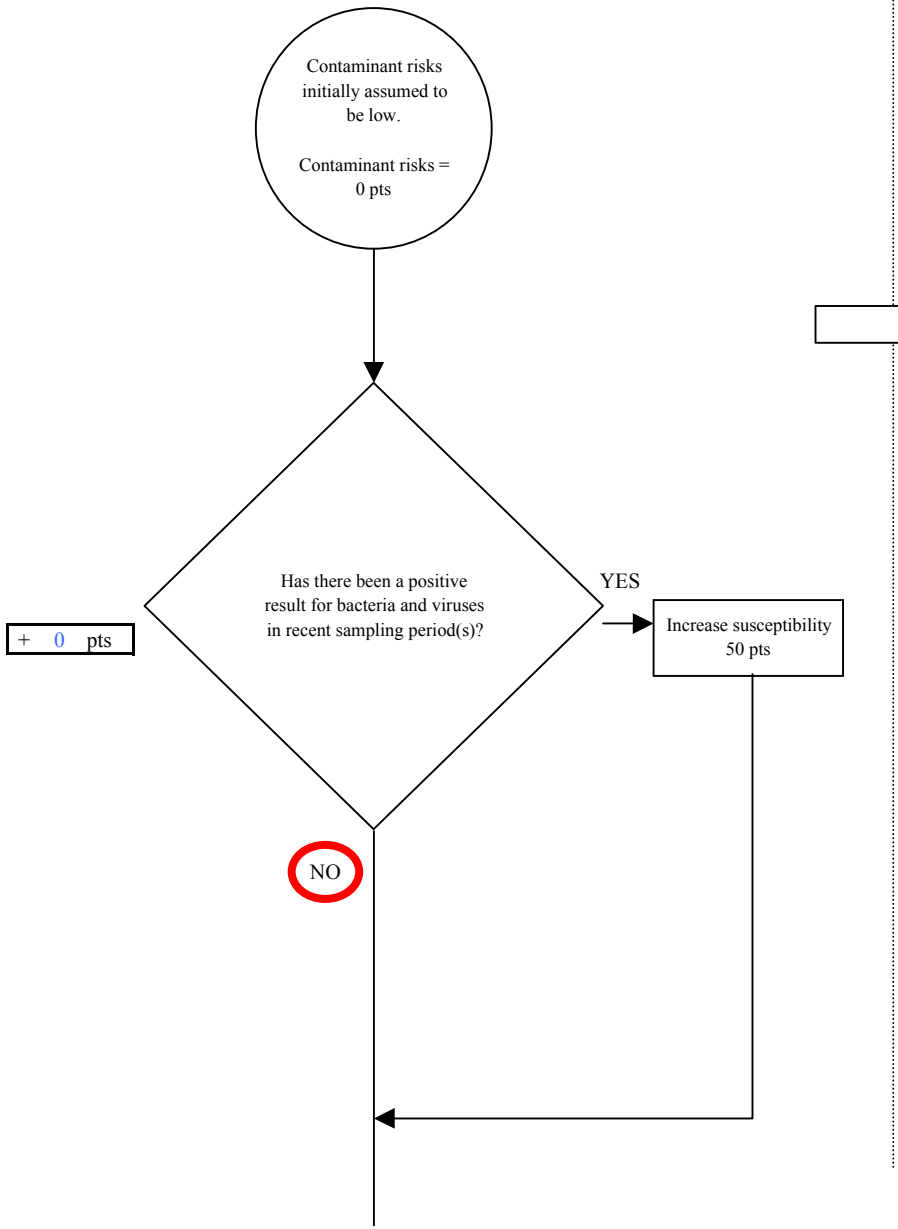
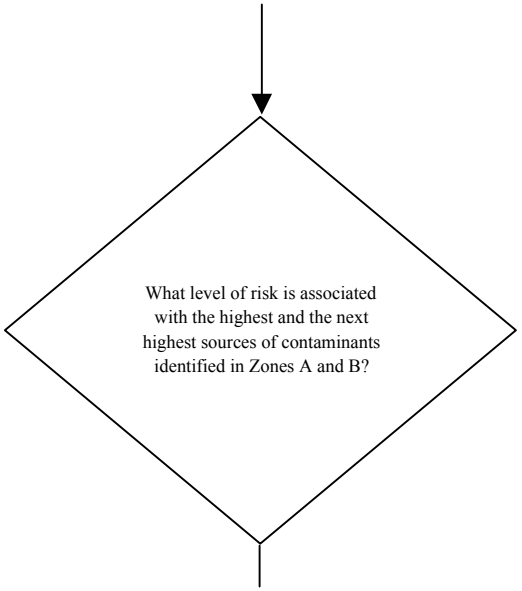


Chart 3. Contaminant risks for Spenard Heights - Bacteria & Viruses





+ 20 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	2	3	5

	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.

Chart 3. Contaminant risks for Spenard Heights - Bacteria & Viruses

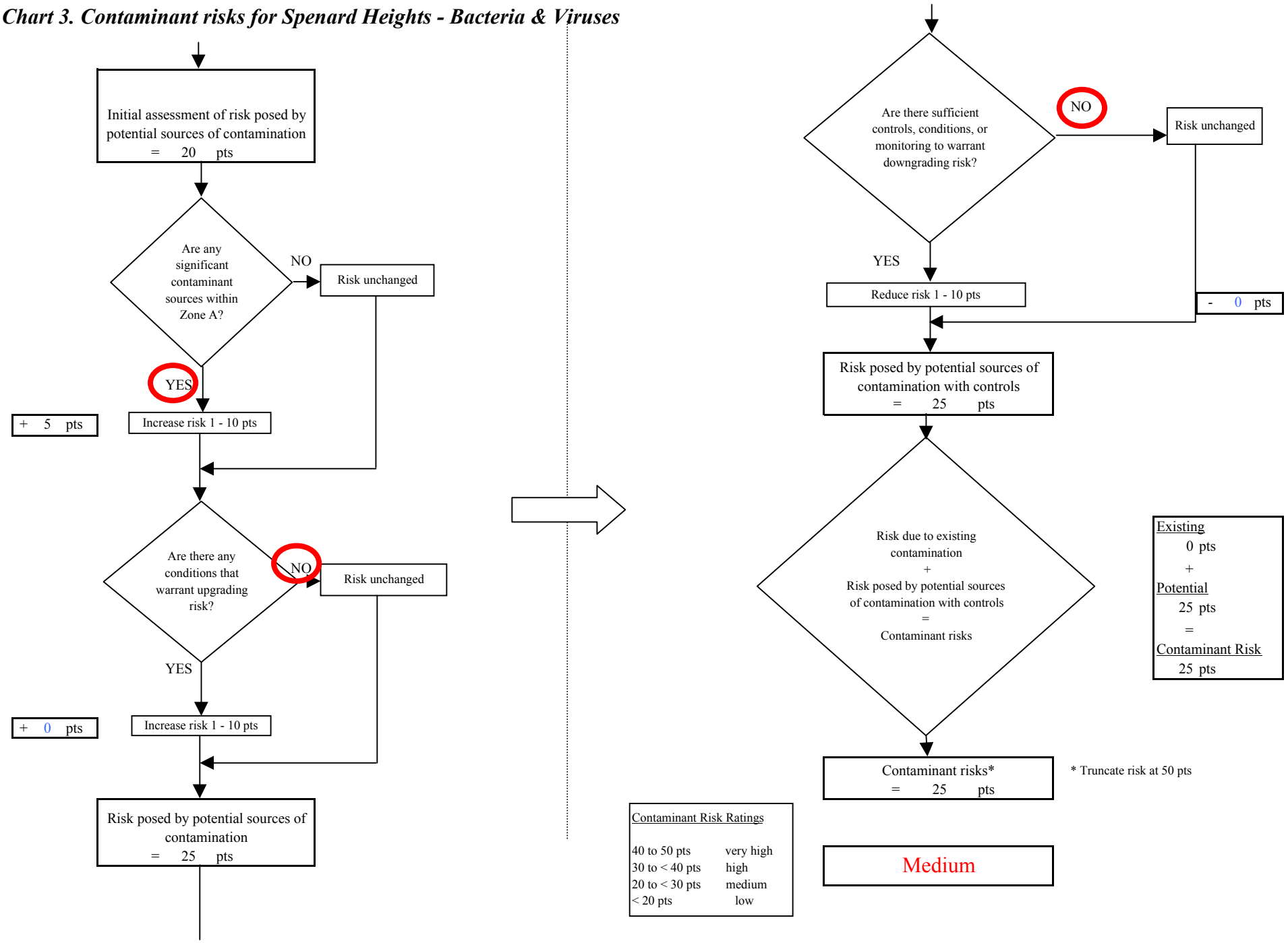


Chart 4. Vulnerability analysis for Spenard Heights - Bacteria & Viruses

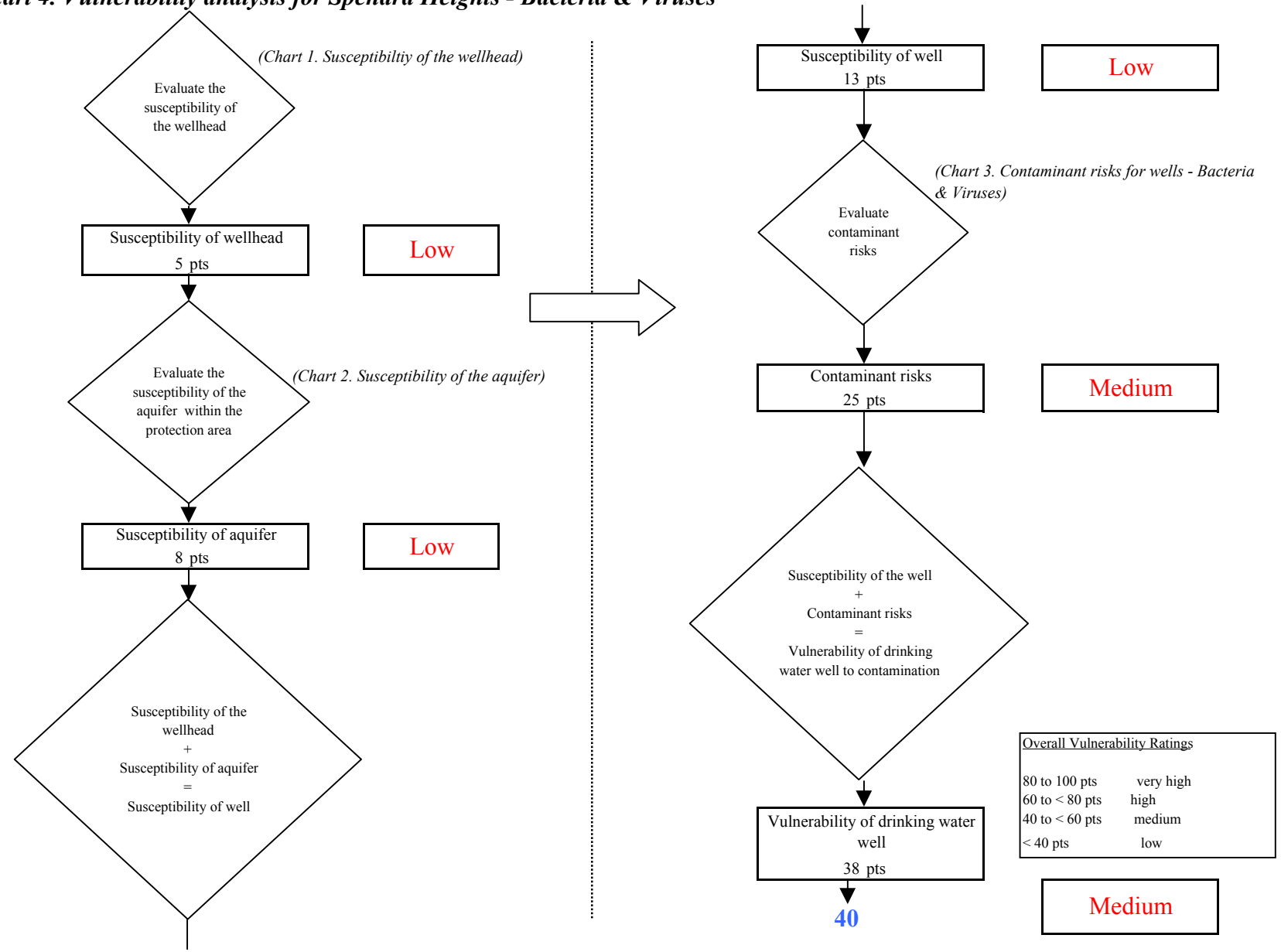


Chart 5. Contaminant risks for Spenard Heights - Nitrates and Nitrites

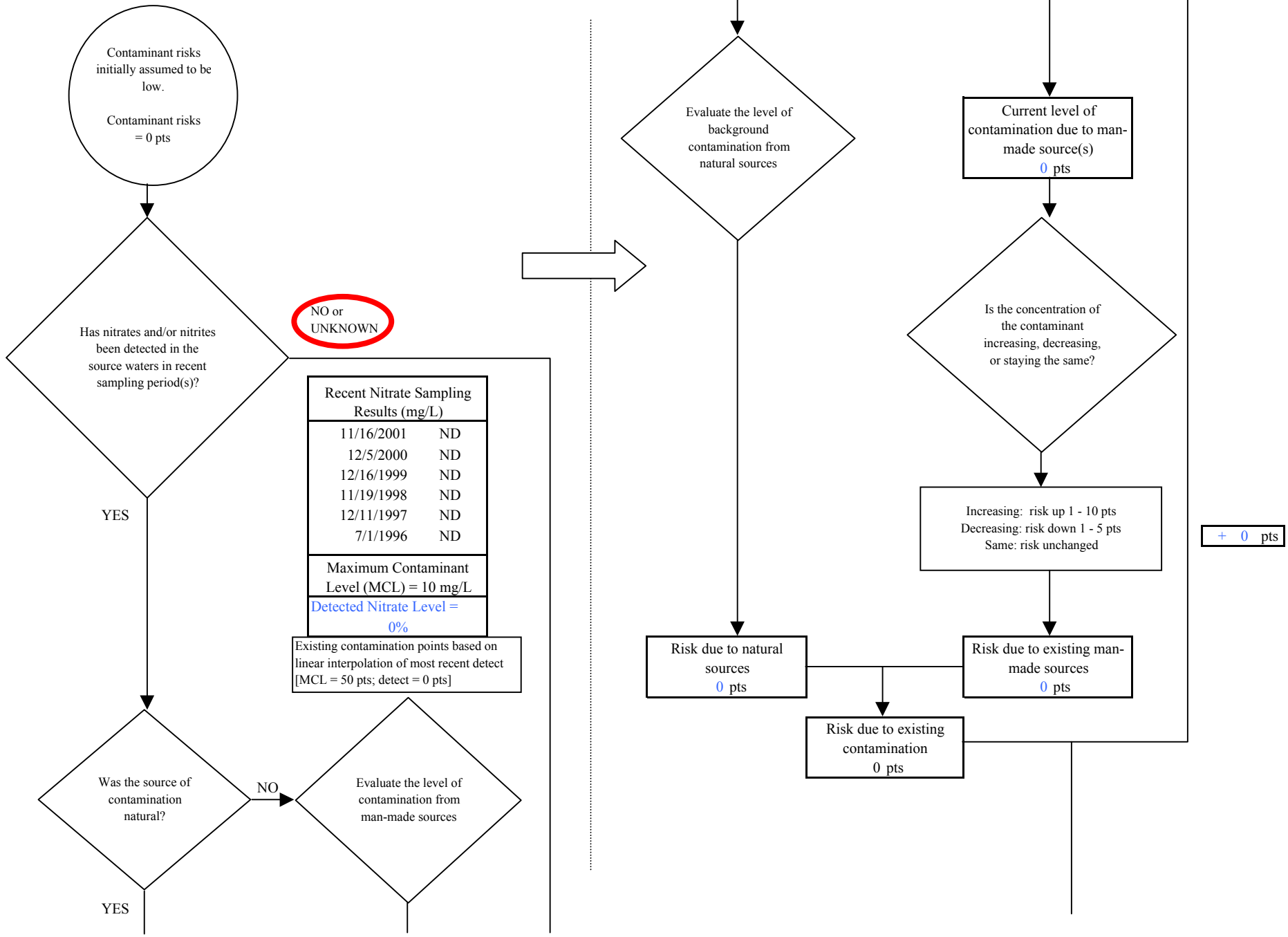


Chart 5. Contaminant risks for Spenard Heights - Nitrates and Nitrites

+ 25 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)	1	2	3
Low(s)	2	5	7

	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.

Initial assessment of risk posed by potential sources of contamination = 25 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

+ 5 pts

Chart 5. Contaminant risks for Spenard Heights - Nitrates and Nitrites

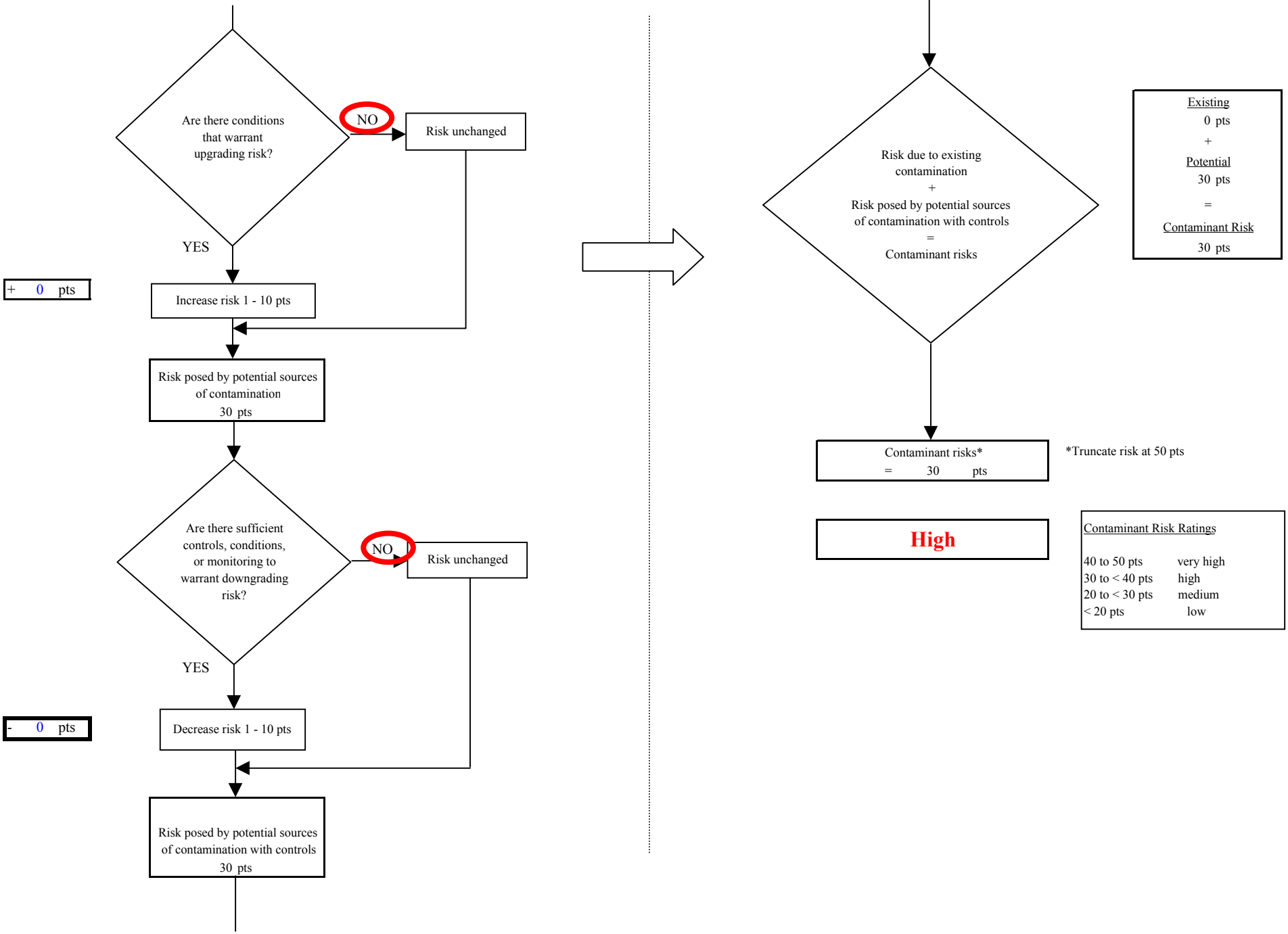


Chart 6. Vulnerability analysis for Spenard Heights - Nitrates and Nitrites

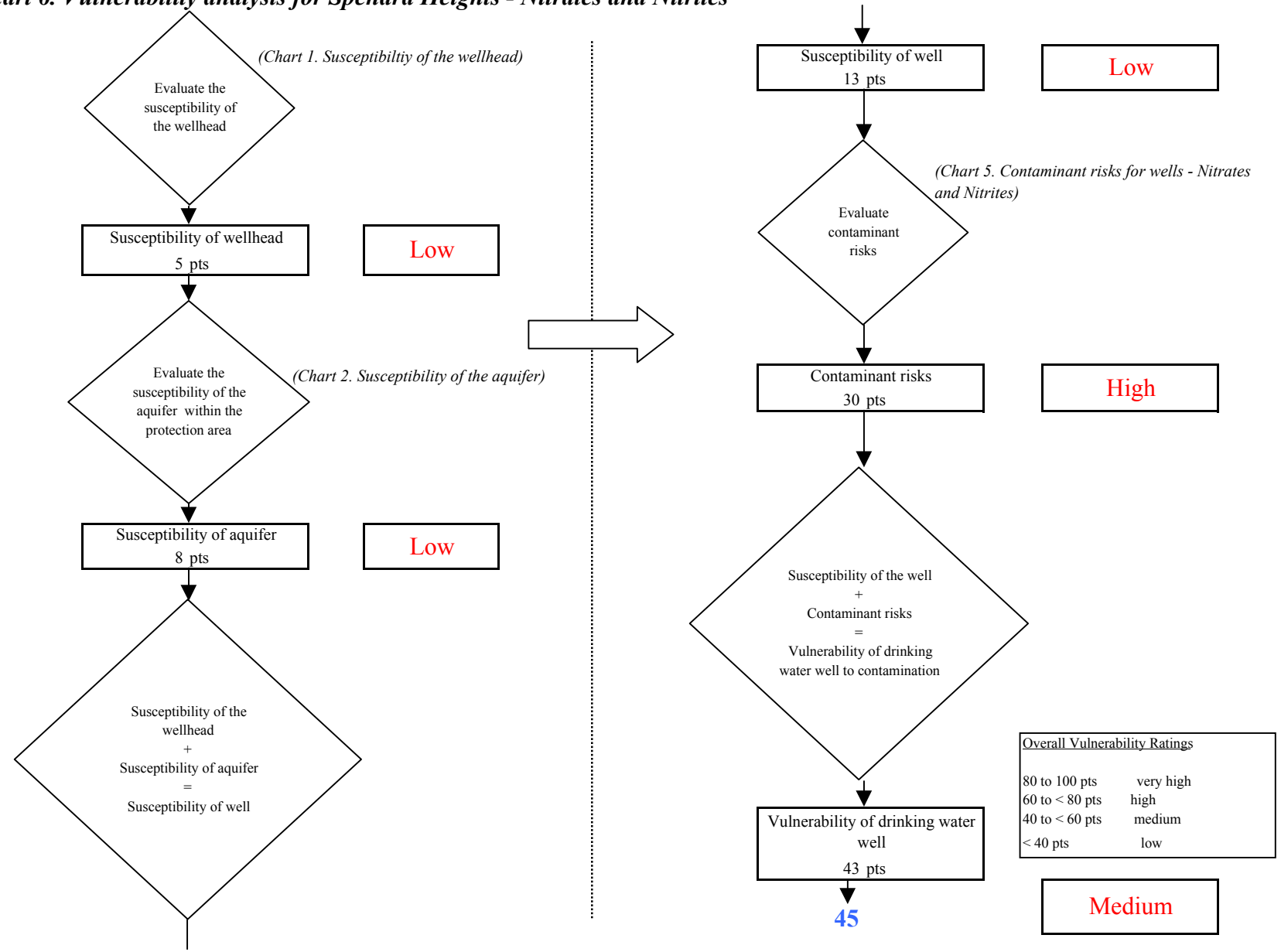


Chart 7. Contaminant risks for Spenard Heights - Volatile Organic Chemicals

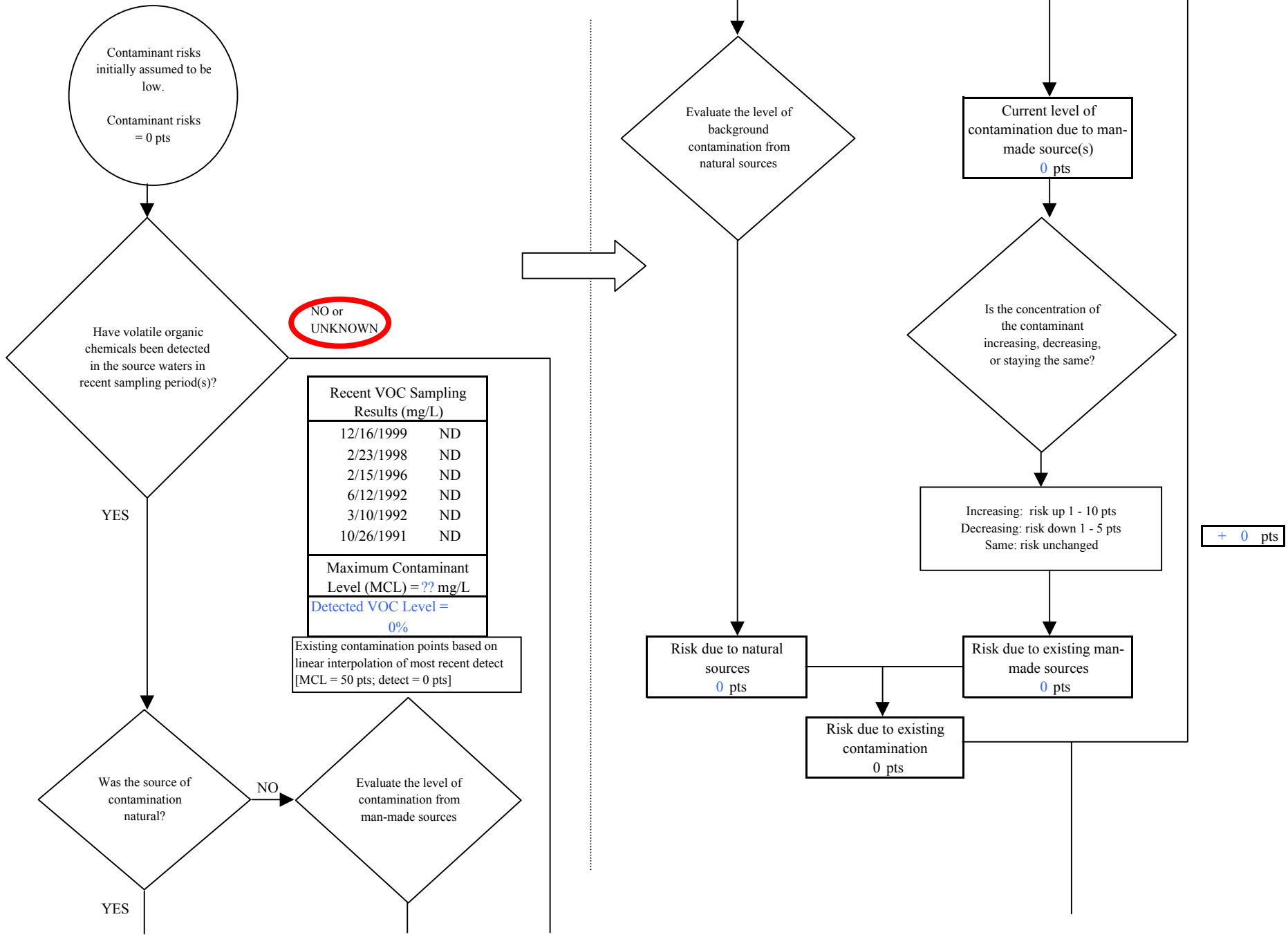


Chart 7. Contaminant risks for Spenard Heights - Volatile Organic Chemicals

+ 10 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	5	8

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

Matrix Score 10

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

- 0 pts

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

+ 2 pts

Increase risk 1 - 10 pts

Chart 7. Contaminant risks for Spenard Heights - Volatile Organic Chemicals

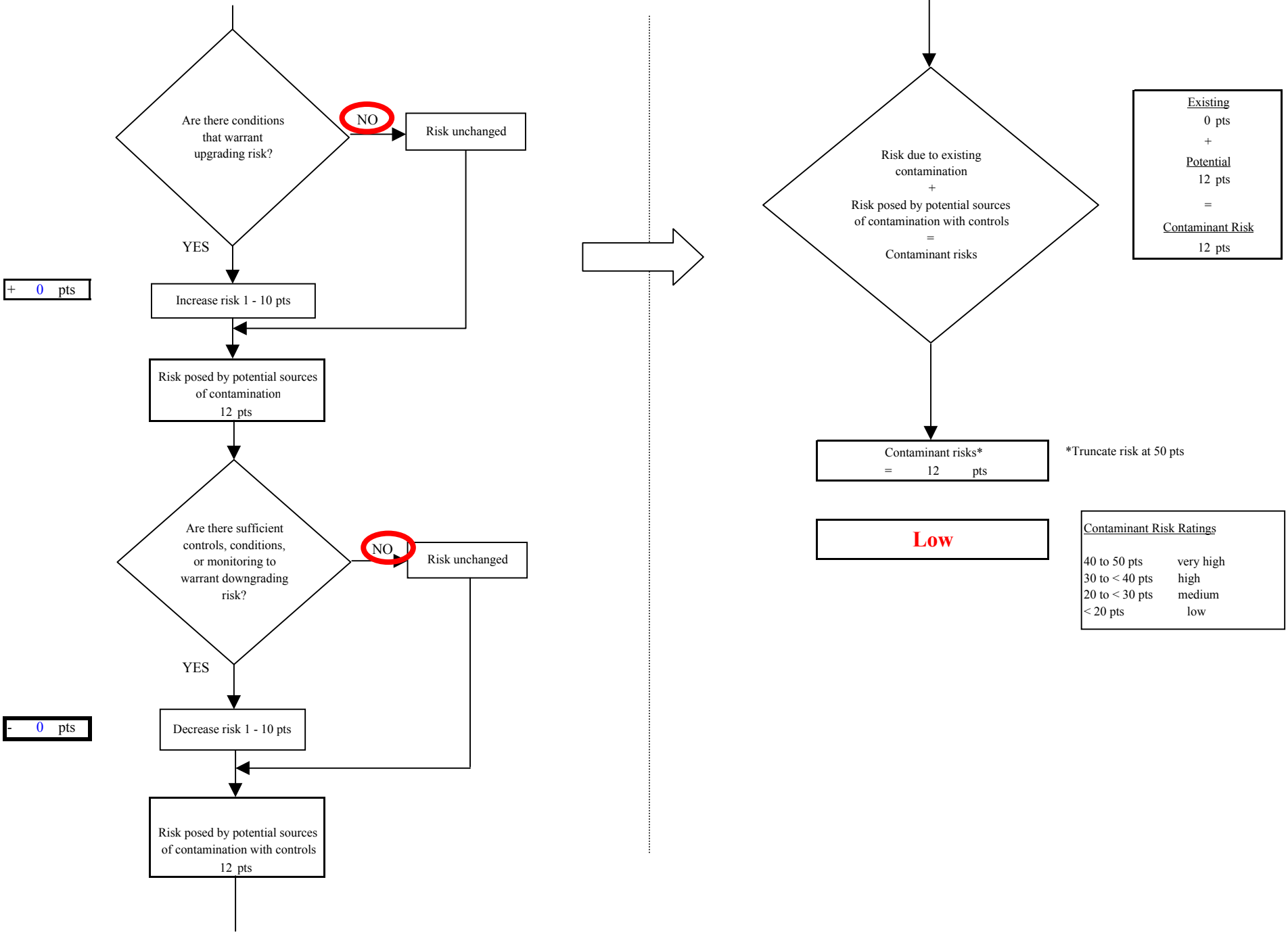


Chart 8. Vulnerability analysis for Spenard Heights - Volatile Organic Chemicals

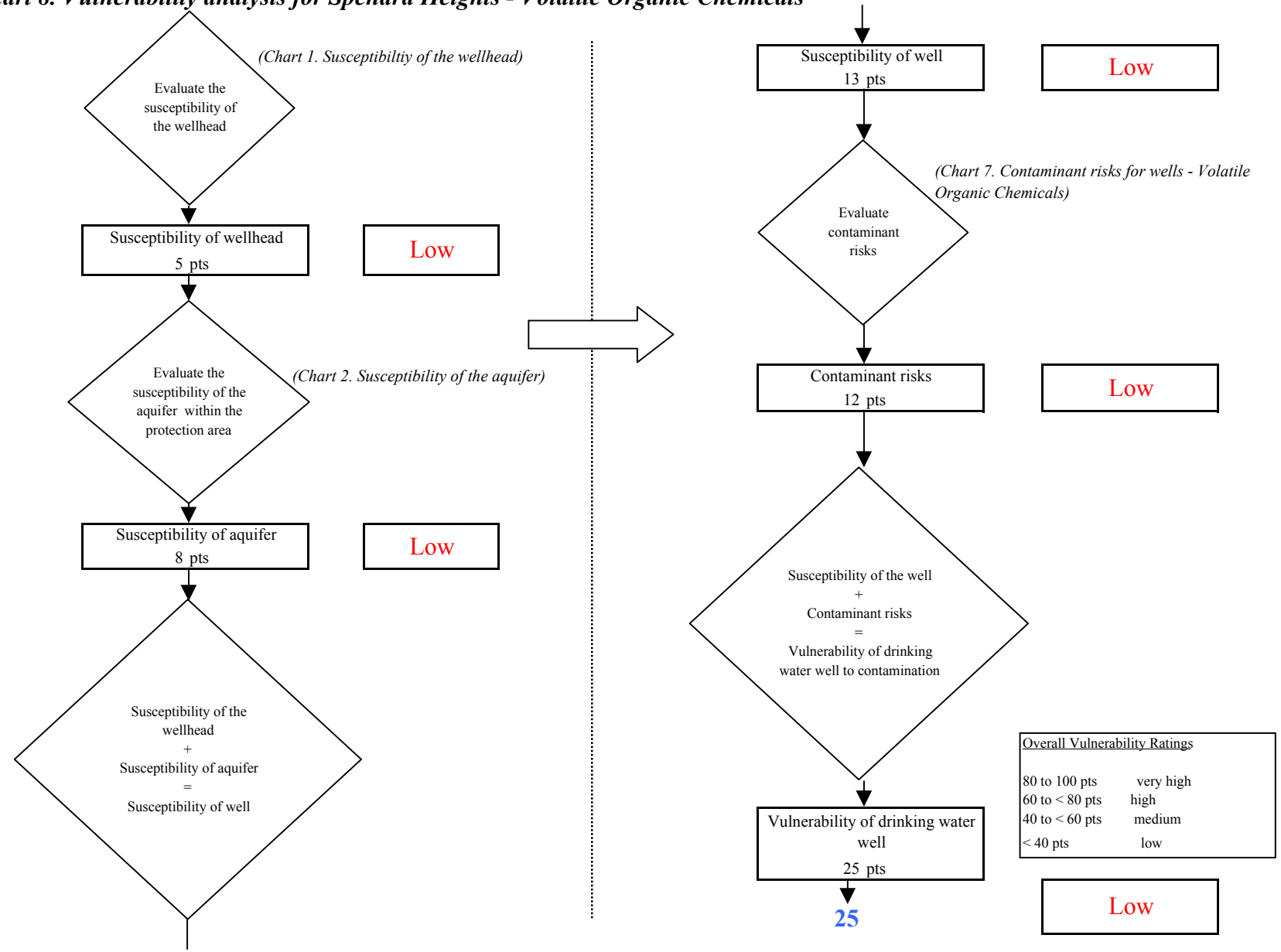


Chart 9. Contaminant risks for Spenard Heights - Heavy Metals, Cyanide and Other Inorganic Chemicals

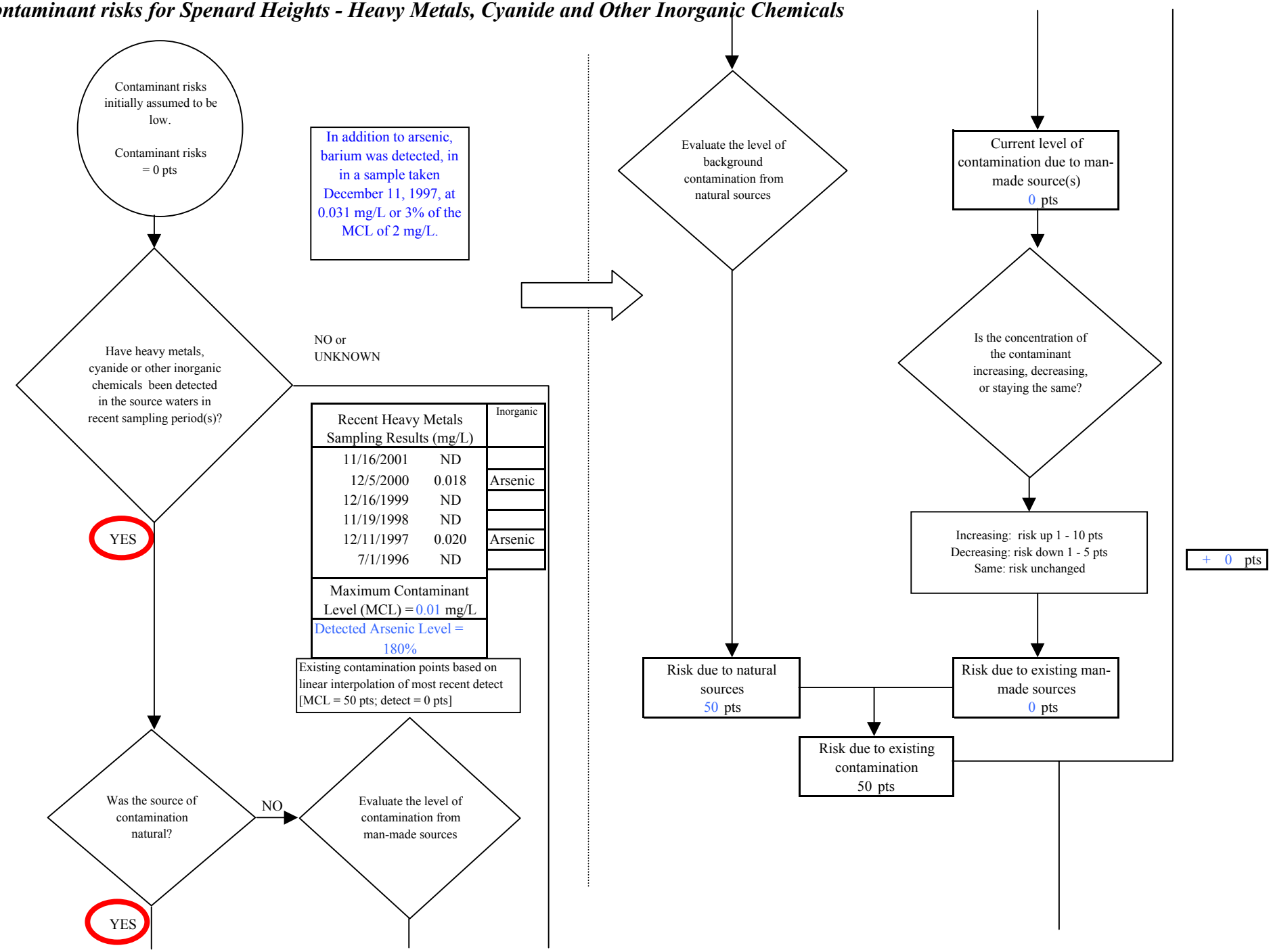


Chart 9. Contaminant risks for Spenard Heights - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 10 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	7	10

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

Matrix Score 10

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 9. Contaminant risks for Spenard Heights - Heavy Metals, Cyanide and Other Inorganic Chemicals

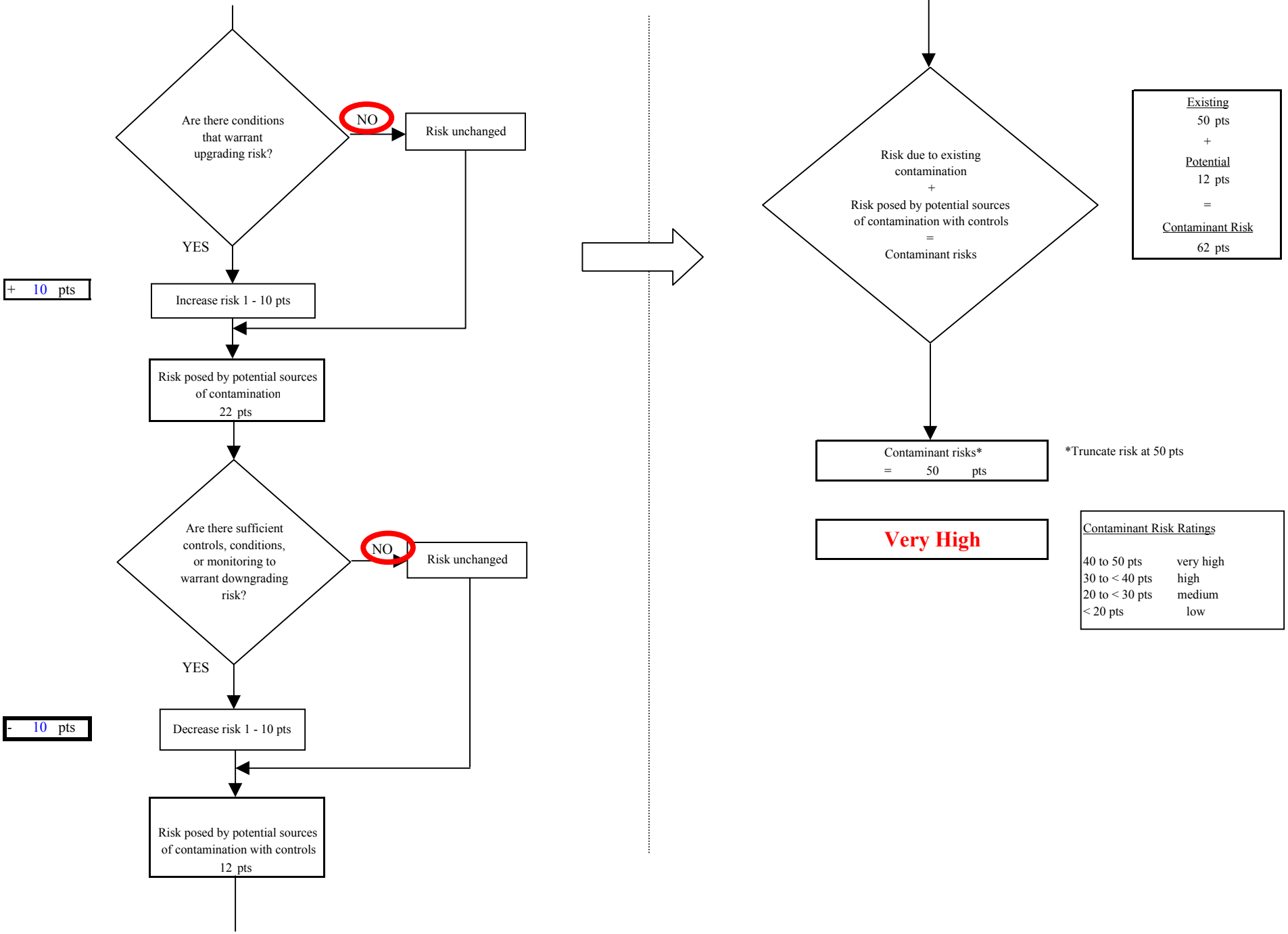


Chart 10. Vulnerability analysis for Spenard Heights - Heavy Metals, Cyanide and Other Inorganic Chemicals

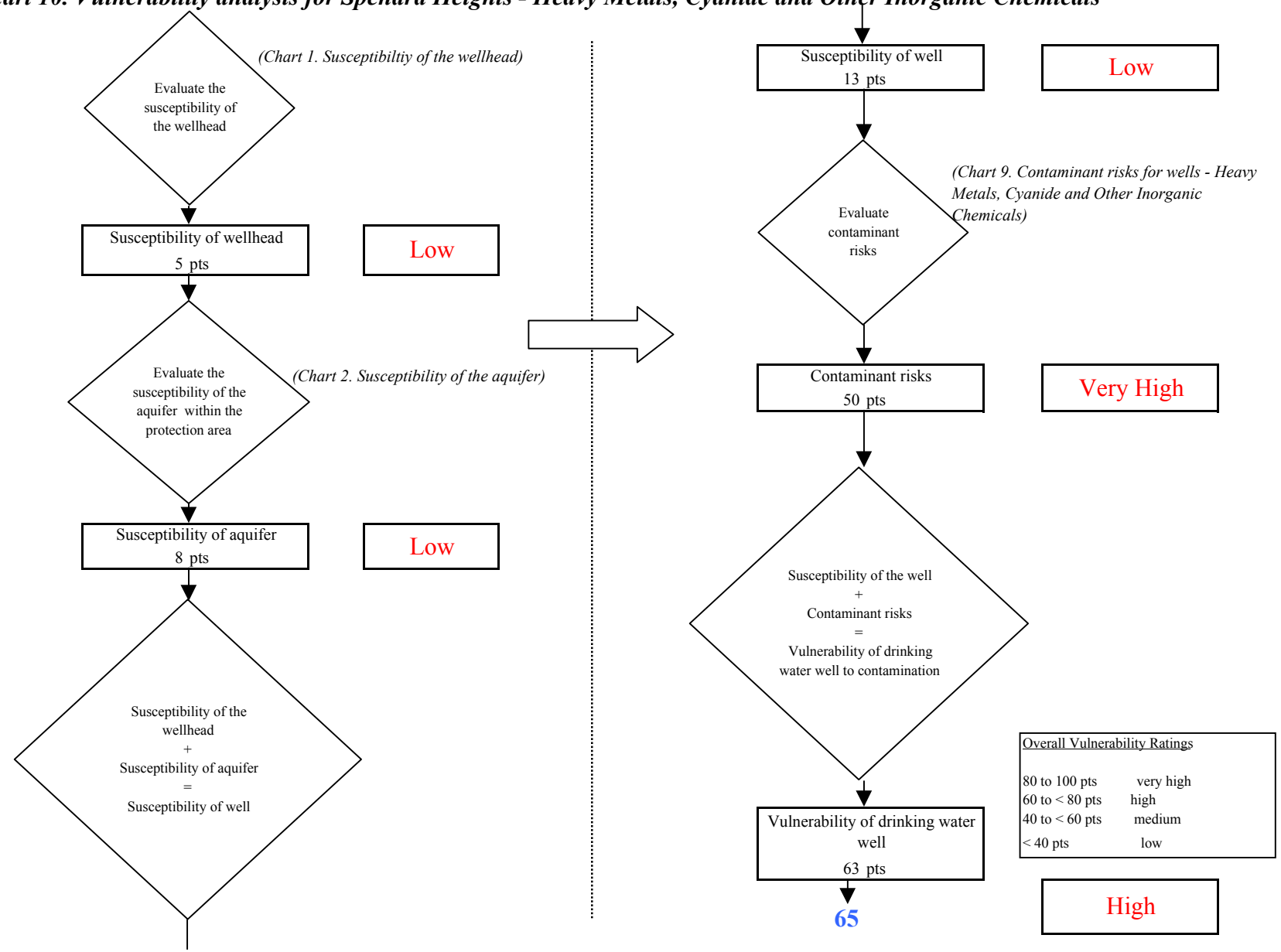


Chart 11. Contaminant risks for Spenard Heights - Synthetic Organic Chemicals

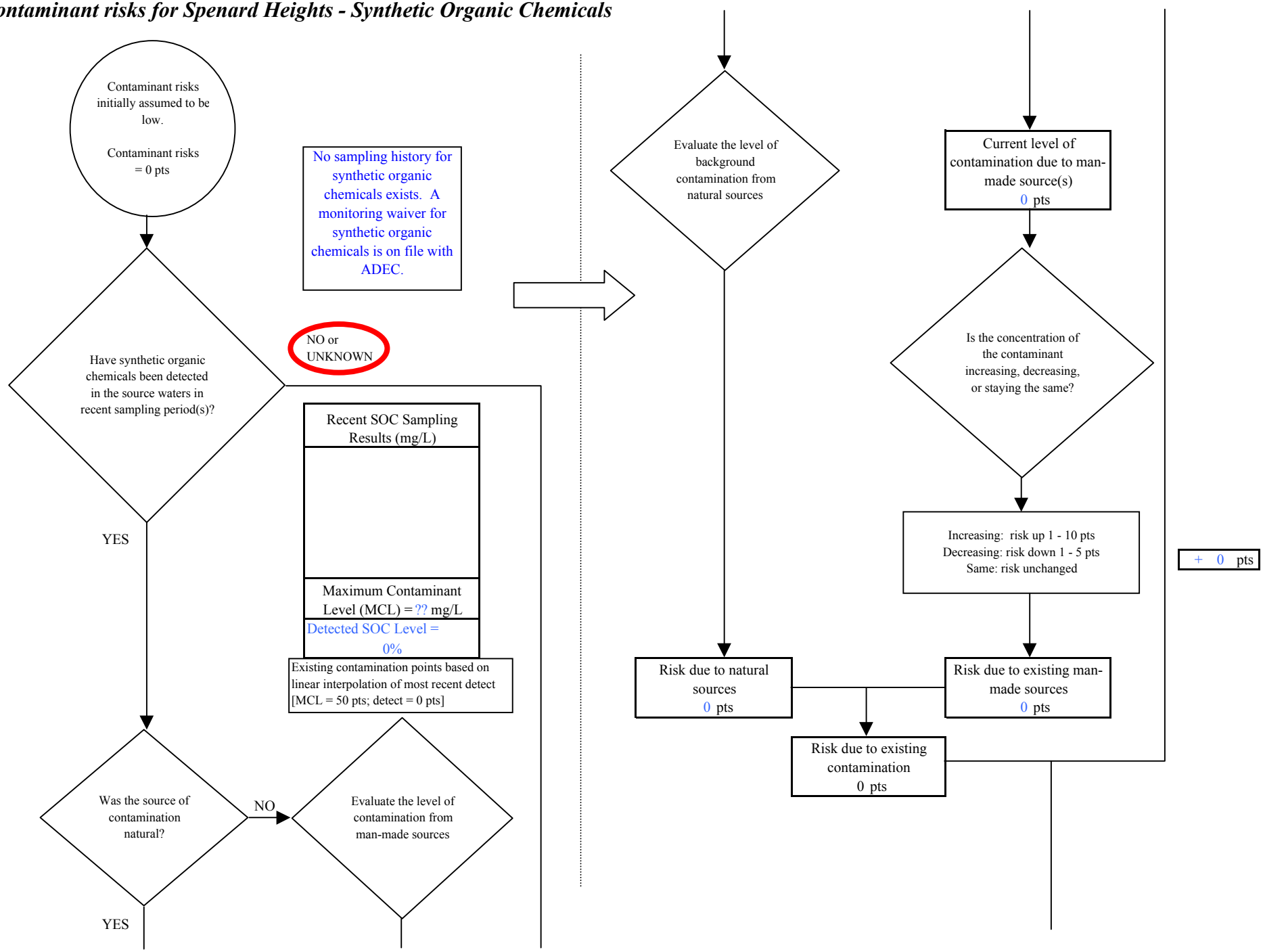
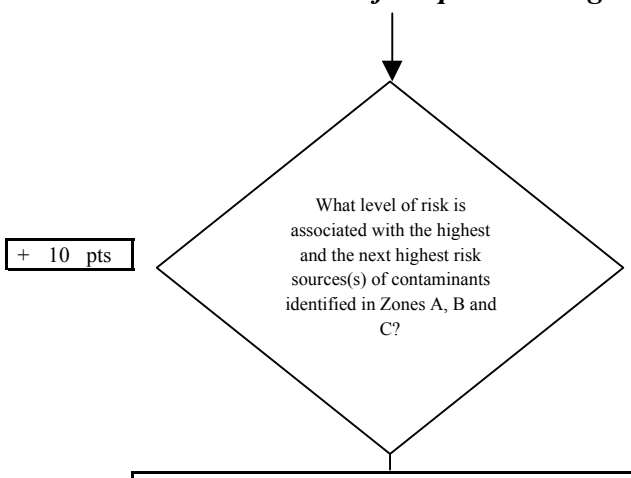


Chart 11. Contaminant risks for Spenard Heights - Synthetic Organic Chemicals



+ 10 pts

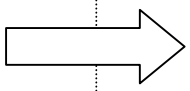
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	5	7

	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.



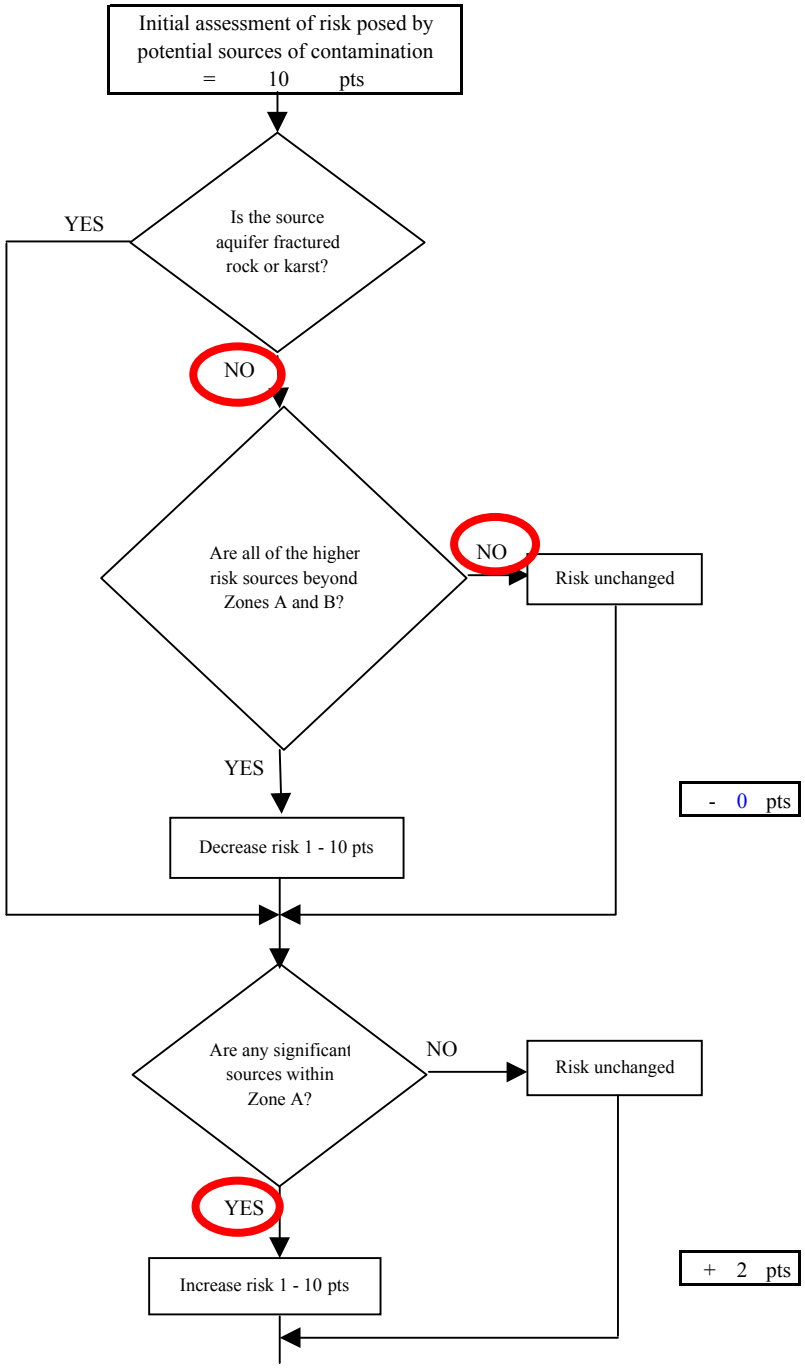
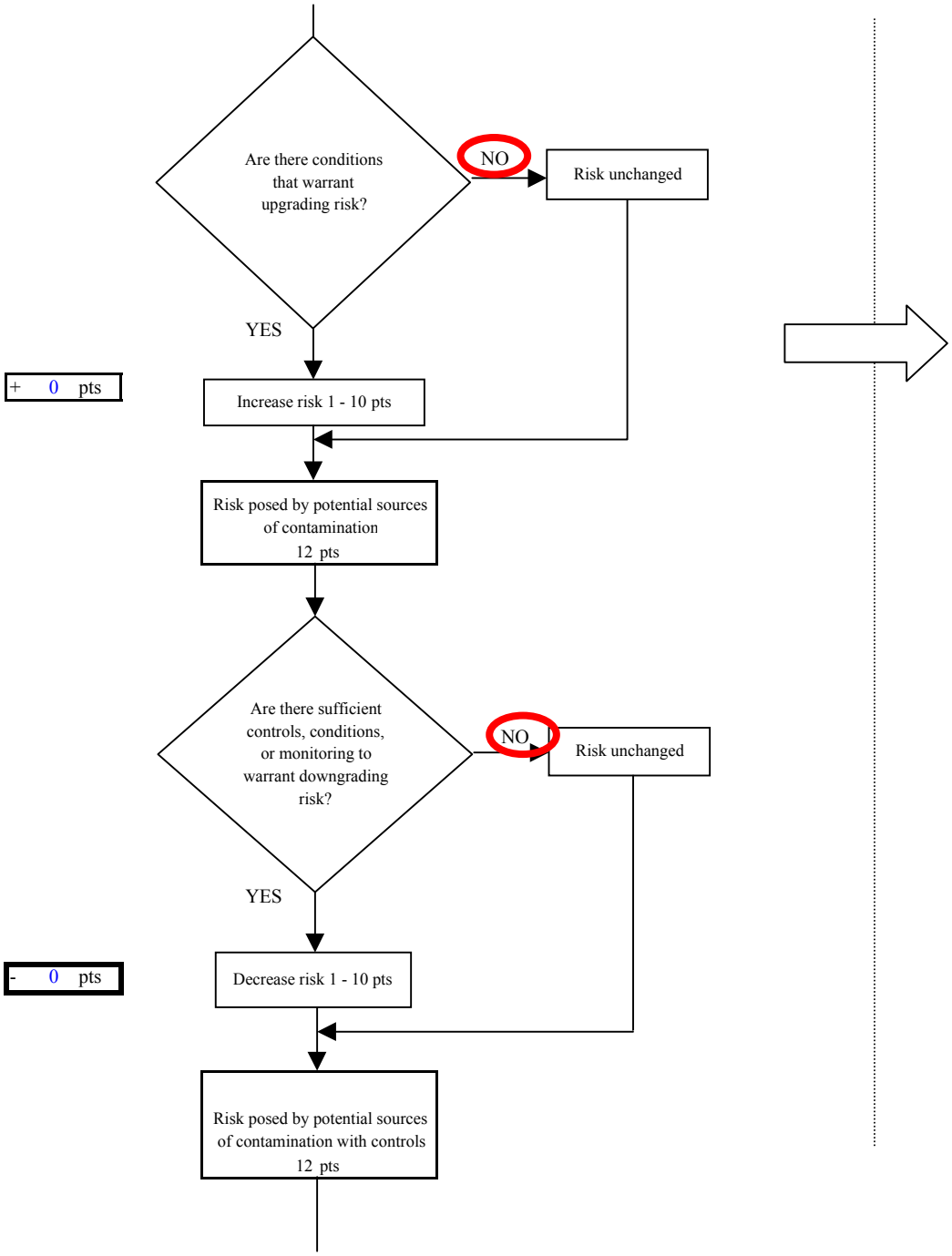


Chart 11. Contaminant risks for Spenard Heights - Synthetic Organic Chemicals



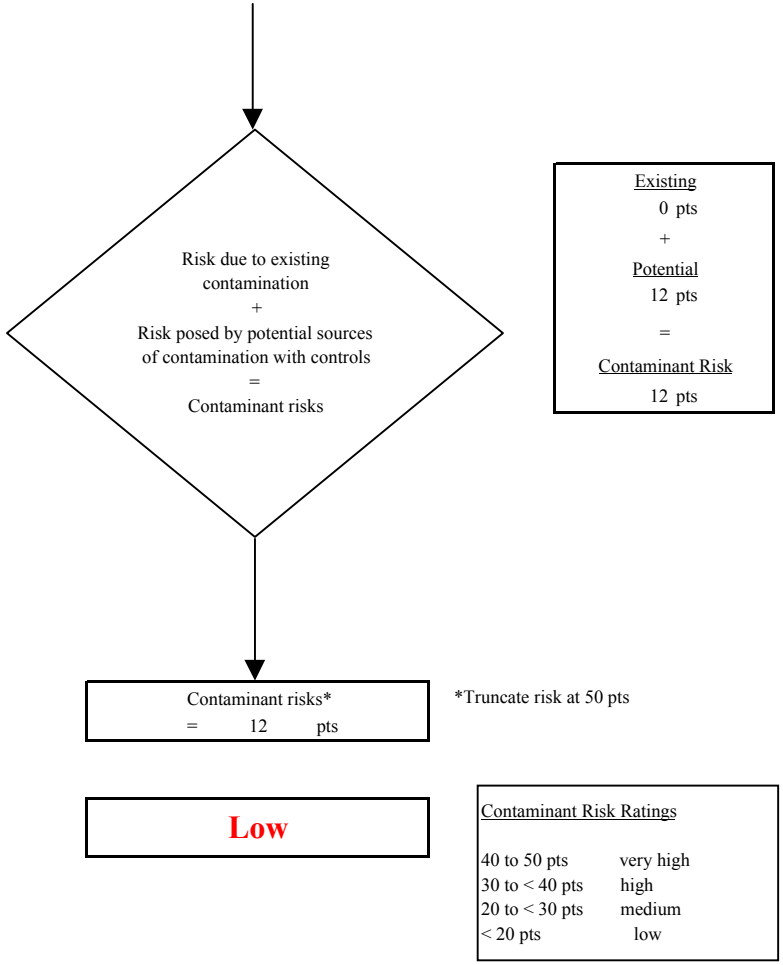


Chart 12. Vulnerability analysis for Spenard Heights - Synthetic Organic Chemicals

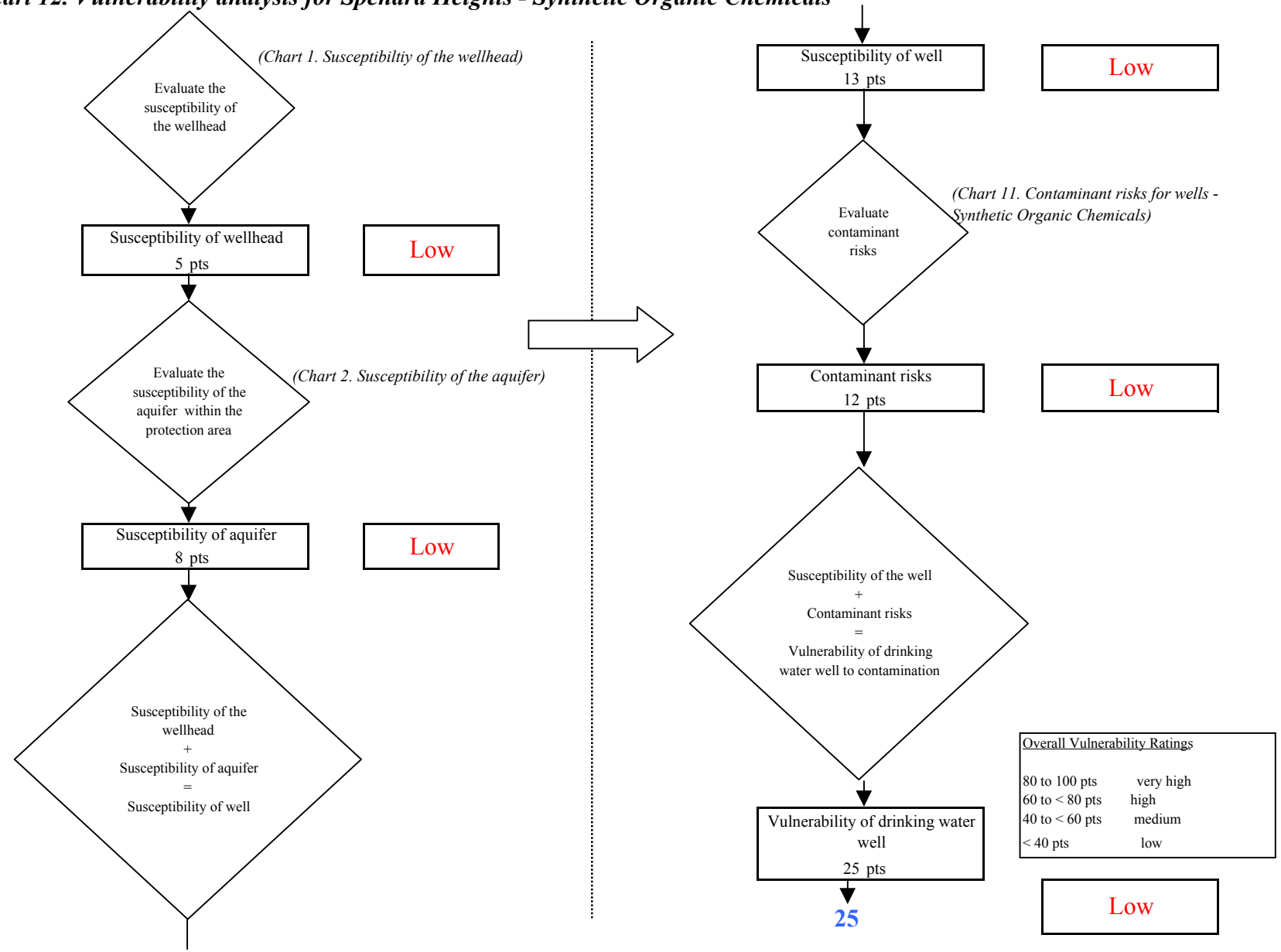


Chart 13. Contaminant risks for Spenard Heights - Other Organic Chemicals

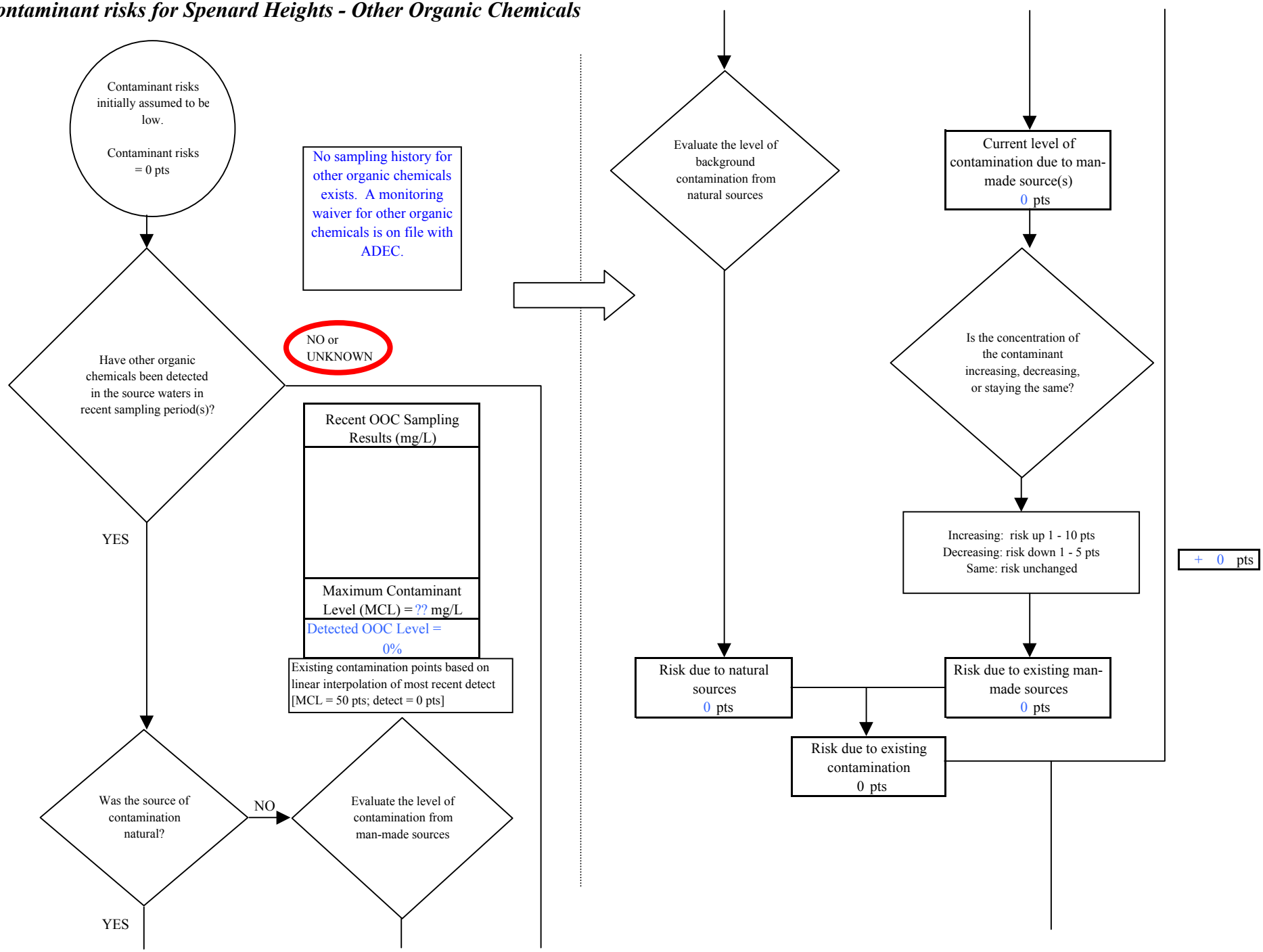


Chart 13. Contaminant risks for Spenard Heights - Other Organic Chemicals

+ 10 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	4	7

	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.

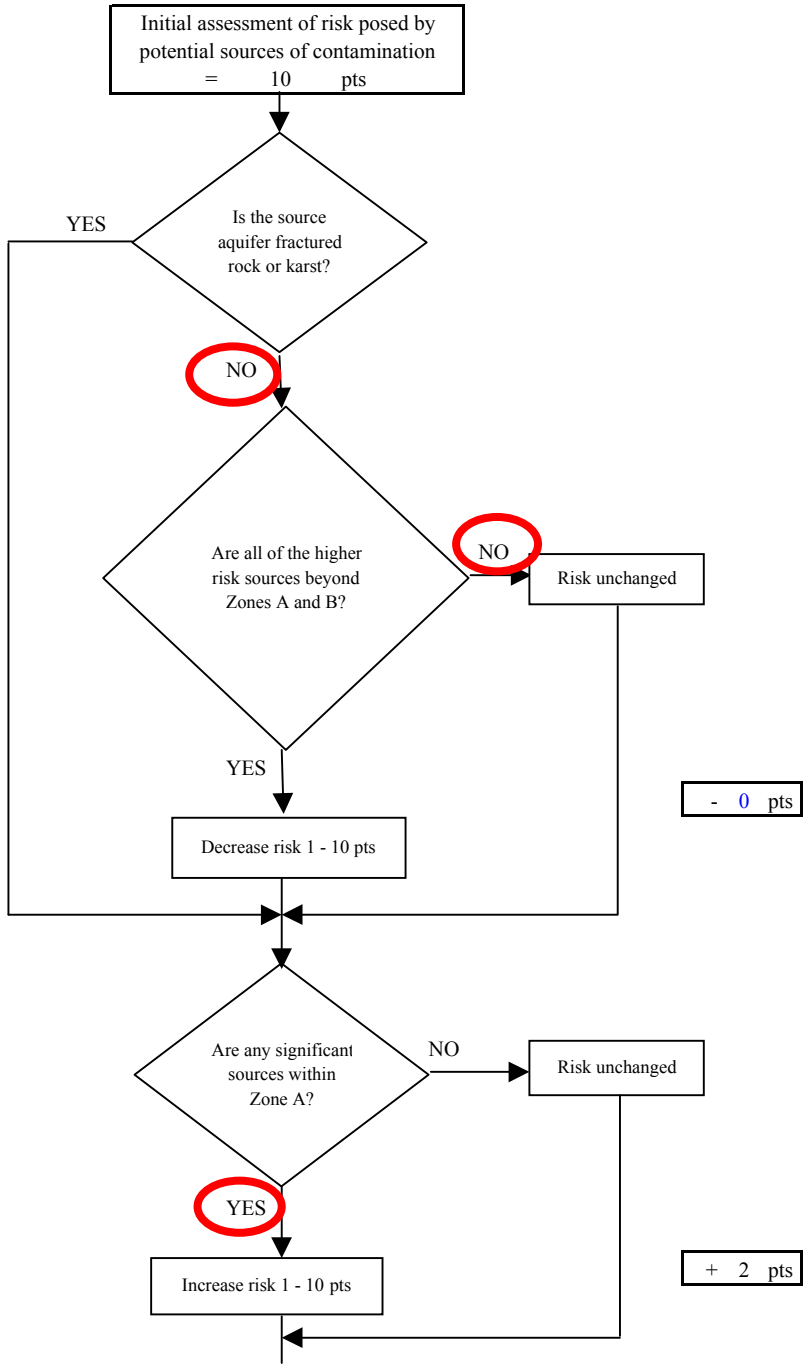


Chart 13. Contaminant risks for Spenard Heights - Other Organic Chemicals

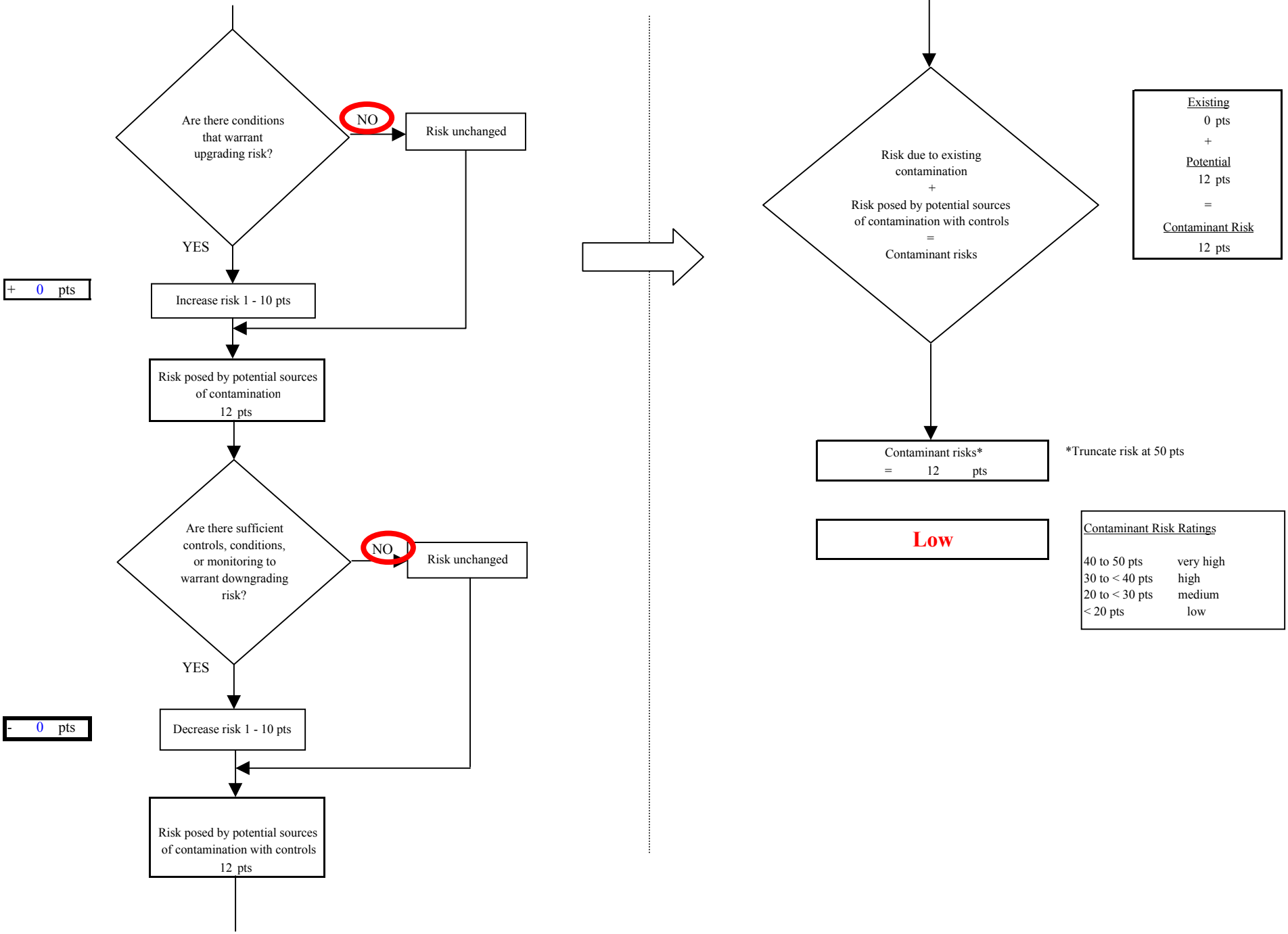


Chart 14. Vulnerability analysis for Spenard Heights - Other Organic Chemicals