

Source Water Assessment for Judy's Cafe Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

DRINKING WATER PROTECTION PROGRAM REPORT 419
PWSID 212958.001

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Source Water Assessment for the Source of Public Drinking Water Serving Judy's Cafe, Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

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Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Public Water System for Judy's Café is a Class B (transient/non-community) water system consisting of one well in the Anchorage area. Identified potential and current sources of contaminants for the Judy's Cafe includes approximately 13 acres of residential area, sewer lines, roads, medical veterinary facilities, motor vehicle repair shops, a Class V motor vehicle waste disposal well, and recreation trails. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water source for Judy's Cafe received a vulnerability rating of **medium** for bacteria and viruses, nitrates and/or nitrates, and volatile organic chemicals.



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

INTRODUCTION

The purpose of this environmental 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. This assessment was completed for the source of public drinking water serving Judy's Cafe. This water system consists of one well in the Anchorage area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

Anchorage, located in southcentral 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 Arms 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.

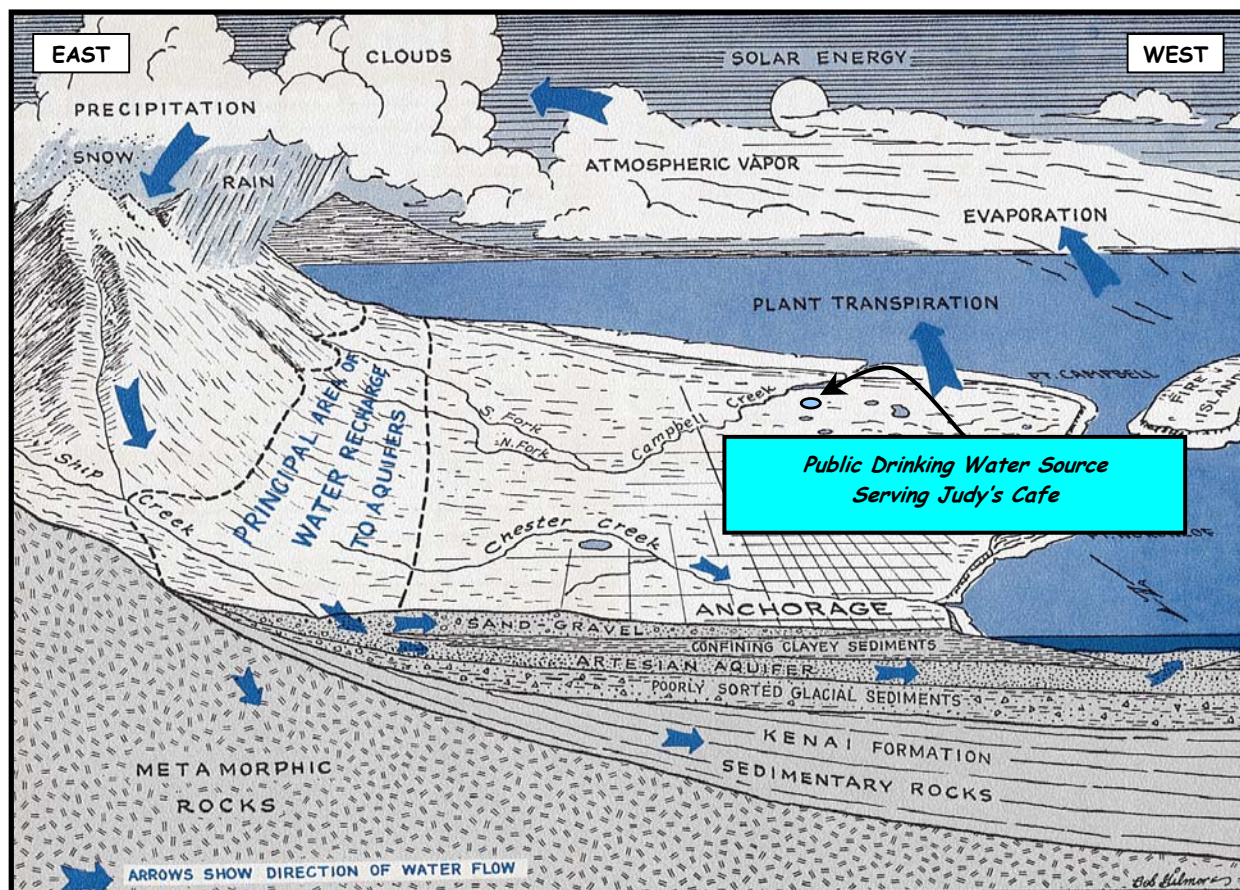


Figure 2. Generalized hydrologic cycle in the Anchorage area [Barnwell, George, Dearborn, Weeks, and Zenone, 1972].

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° F during July to 8° 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 enter 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.

PUBLIC DRINKING WATER SYSTEM SERVING JUDY'S CAFE

The public water system serving Judy's Cafe is a Class B (transient/non-community) water system. The systems

consists of one well, and is located off of the Old Seward Highway near the foothills of the Chugach Mountains at an elevation of approximately 200 feet above sea level (see Figure 3).

According to the most recent Sanitary Survey the system was built in 1970 with a production rate of 7,200 gallons per day. The well site is properly drained and protected so that foreign matter and surface water do not enter the well along the casing. It is unknown whether the well was grouted at the time of drilling. Proper grouting provides added protection against contaminants traveling from the ground surface and along the well casing into source waters.

This system operates year round serving 2 residents and 30 non-residents through 1 service connection.

ASSESSMENT AND PROTECTION AREA FOR THE DRINKING WATER SOURCE SERVING JUDY'S CAFE

The Drinking Water Protection and Assessment Area that

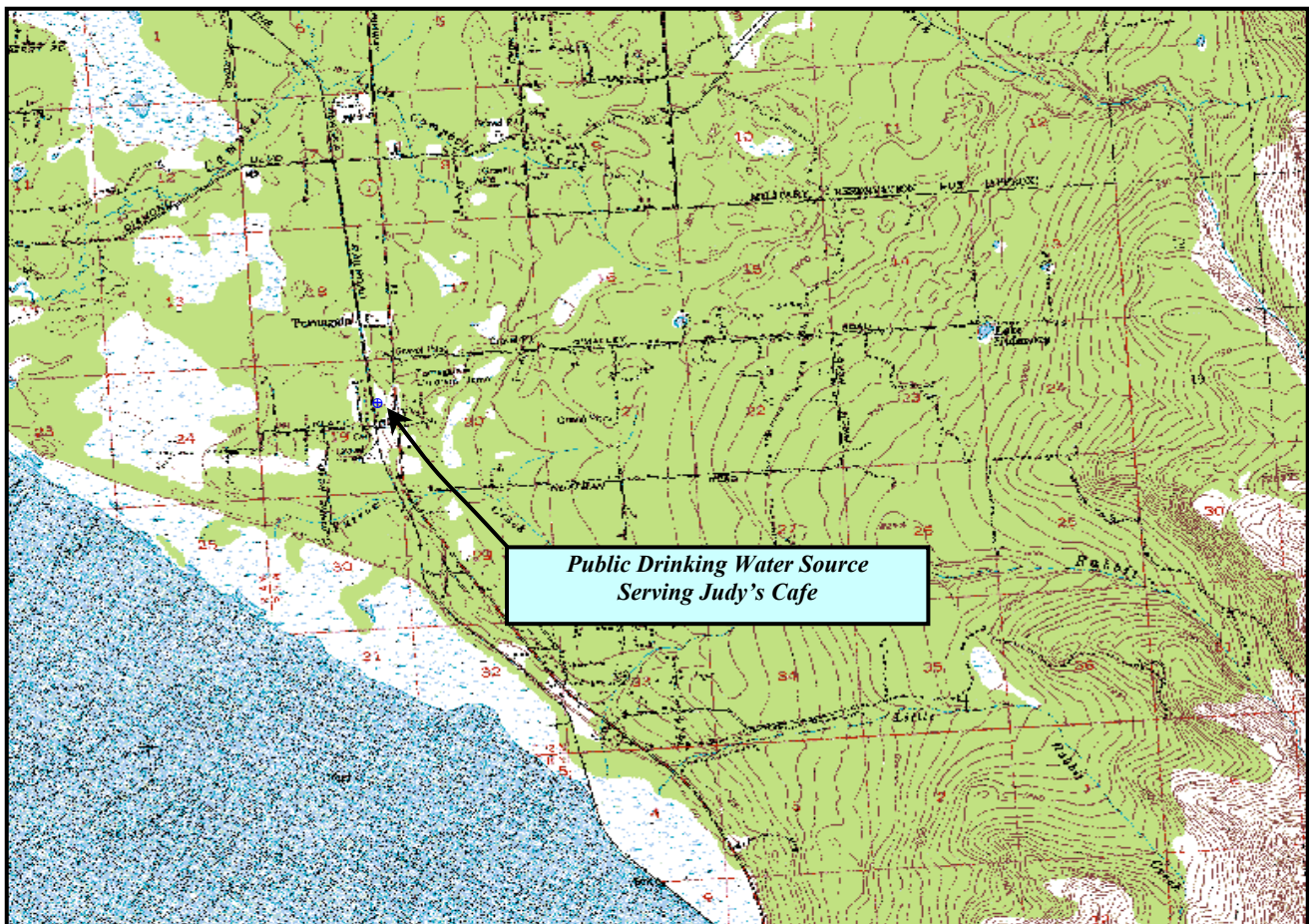


Figure 3. Map showing the location of the drinking water source for Judy's Cafe [Base: USGS Anchorage A8].

has been established for the source of drinking water serving Judy's Cafe is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of the drinking water source to contamination. The zones around the drinking water source outline the most critical area for the preservation of the quality of the drinking water for this system. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the focus for voluntary protection efforts.

Conceptually, groundwater enters the aquifer systems along the front range of the Chugach Mountains (Figure 2) and flows toward Cook Inlet. An analytical calculation was used to determine the size and shape of the area that contributes water to the well. 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*]. This analytical calculation was used as a guide as the first step in establishing the protection area for each public drinking water source in Anchorage. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at meaningful and conservative protection areas with respect to public health (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation are separated into zones. These zones correspond to a time-of-travel. Time-of-travel is the time required for water to move in the saturated zone of the ground from a specific point to the well. The Drinking Water Protection Area for Judy's Cafe contains four zones, Zone A through Zone D (See Map 1 in Appendix A). Zone A corresponds to the area between the well and the distance equal to $\frac{1}{4}$ of the distance of the 2-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to the well may be on the order of several days to several hours. Zone A also extends downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Zone B corresponds to a time-of-travel of less than two years. Zones C and D correspond to those areas between 5 years and 10 years time-of-travel, respectively.

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 Drinking Water Protection Area for Judy's Cafe. This survey was completed through a search of agency records and other publicly available

information. Potential sources of contamination to drinking water supplies cover 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 this assessment and all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses
- Nitrates and/or nitrites
- Volatile organic chemicals

Maps 2 and 3 in Appendix C depict the Contaminant Source Inventory for Judy's Cafe. Table 1 in Appendix B lists the inventoried potential sources of contamination within Zones A through D. Below is a summary of the contaminant sources inventoried within the Drinking Water Protection Area for Judy's Cafe:

- Approximately 13 acres of residential area;
- Sewer lines;
- roads;
- medical/veterinary facilities;
- a Class V motor vehicle waste disposal well;
- recreation trails.

These potential and existing contaminant sources present risk for all three categories of drinking water contaminants.

RANKING OF CONTAMINANT RISKS

Potential and existing sources of contamination have been 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. Contaminant risks are further a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the public drinking water well.

VULNERABILITY OF THE DRINKING WATER SOURCE SERVING JUDY'S CAFE

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

natural susceptibility; and

- contaminant risks.

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

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

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

$$\begin{aligned} &\text{Susceptibility of the Wellhead (0 – 25 Points)} \\ &+ \\ &\text{Susceptibility of the Aquifer (0 – 25 Points)} \\ &= \text{Natural Susceptibility (Susceptibility of the Well)} \\ &\quad \text{(0 – 50 Points)} \end{aligned}$$

The well log was not available for the drinking water well serving Judy's Cafe. Therefore, the geological information presented was gathered from well logs within ¼ mile of the well serving Judy's Cafe. The well was drilled to a total depth of 125 feet below ground surface and was completed in a 6 inch well casing. According to surrounding well logs the well penetrates a confined aquifer. The depth to the top of the confining layer is approximately 40 feet below ground surface and consists of a layer of sandy clay and has a thickness of approximately 7 feet. This confining layer may provide a protective barrier against the movement of contaminants in the subsurface. However, near the base of the Chugach Mountains, these clay layers tend to be discontinuous and thin 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.

Combining the susceptibility of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility of the well to contamination (See Appendix D). Table 1 depicts the overall Susceptibility score and rating for the source of public drinking water serving Judy's Cafe.

Table 1. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	17	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (See Appendix B - Table 1 – Table 7). This portion of the analysis examines any existing or historical contamination that has been detected at the drinking water source through routine sampling. It also reviews contamination that has or may have occurred but has not arrived or been detected at the well. Table 2 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	25	Medium
Nitrates and/or Nitrites	33	High
Volatile Organic Chemicals	32	High

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a Class B public drinking water system. 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 8 contain the Contaminant Risks and Vulnerability Analysis for nitrates and nitrites, volatile organic chemicals, respectively. Vulnerability of the drinking water source to contamination is the combination of susceptibility of the aquifer and the well

with contaminant risks. Table 3 contains the overall vulnerability scores (0 – 100) and ratings for each of the three categories of drinking water contaminants (See Appendix D). Note: scores are rounded off to the nearest five.

Table 3. Overall Vulnerability of the Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	40	Medium
Nitrates and Nitrites	50	Medium
Volatile Organic Chemicals	50	Medium

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

The contaminant risk is medium for bacteria and viruses and high for nitrates and/or nitrites with residential areas, sewer lines, roads, medical/veterinary facilities, and a Class V motor vehicle waste disposal well presenting the most significant risk to the drinking water well. After combining the contaminant risk with the susceptibility of the well the overall vulnerability to contamination is medium from bacteria and viruses and nitrates and/or nitrites.

Review of historical sampling data indicates that bacteria and viruses have not been detected in the source of public drinking water serving Judy's Cafe.

Nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere throughout Alaska. 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 the well indicates that low concentrations of nitrates have been detected (See Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Existing nitrate concentration is approximately 6% of the Maximum Contaminant Level or MCL. 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. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water. Though existing nitrate contamination was detected at the site, concentrations remain at very safe levels with respect to human health.

The contaminant risk for volatile organic chemicals is high with a Class V motor vehicle waste disposal well, a motor vehicle repair shop, roads, and sewer lines presenting the most significant risk to the drinking water well. Combining the contaminant risk for volatile organic chemicals with the susceptibility of the well reduces the overall vulnerability of the well to contamination to medium.

There is Class V motor vehicle waste disposal well located within the Zone B protection area. According to the United States Environmental Protection Agency's (USEPA) Office on Water, a motor vehicle waste disposal well is a type of Class V injection well which is typically a shallow disposal system that receives or has received fluids from vehicular repair or maintenance activities, such as an auto body repair shop, automotive repair shops, new and used car dealerships, specialty repair shop (e.g., transmission and muffler repair shop), or any area where vehicular repair work is performed.

The USEPA's Office on Water describes motor vehicle waste disposal wells as floor drains or sinks in service bays that are tied into a shallow disposal system (see Figure 4). Most commonly, these shallow systems are septic systems or drywells, but any underground system that receives motor vehicle waste would be considered a motor vehicle waste disposal well. A variety of names are used to describe shallow disposal systems including: cesspools, catchbasins, and sinkholes, underground vaults, or drain tanks.

Roads within the protection area are a significant source of potential contamination from bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Because roads do pose a potential for fuel spills to occur,

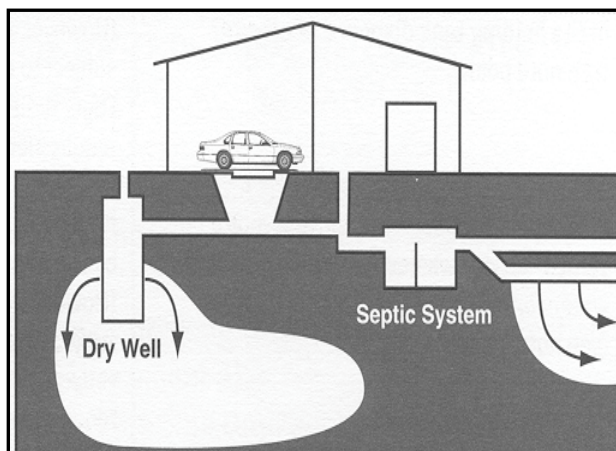


Figure 4. Motor vehicle waste disposal system

major routes were ranked as a low potential source of contamination to the drinking water source.

Review of the historical sampling data indicates that no volatile organic chemical contamination has been detected in the source of public drinking water serving Judy's Cafe.

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Judy's Cafe. The overall vulnerability of this source to contamination is **medium** for bacteria and viruses, nitrates and/or nitrites, and volatile 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 Judy's Cafe to protect public health. It is anticipated that *Source Water Assessments* will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the public drinking water source serving Judy's Cafe.

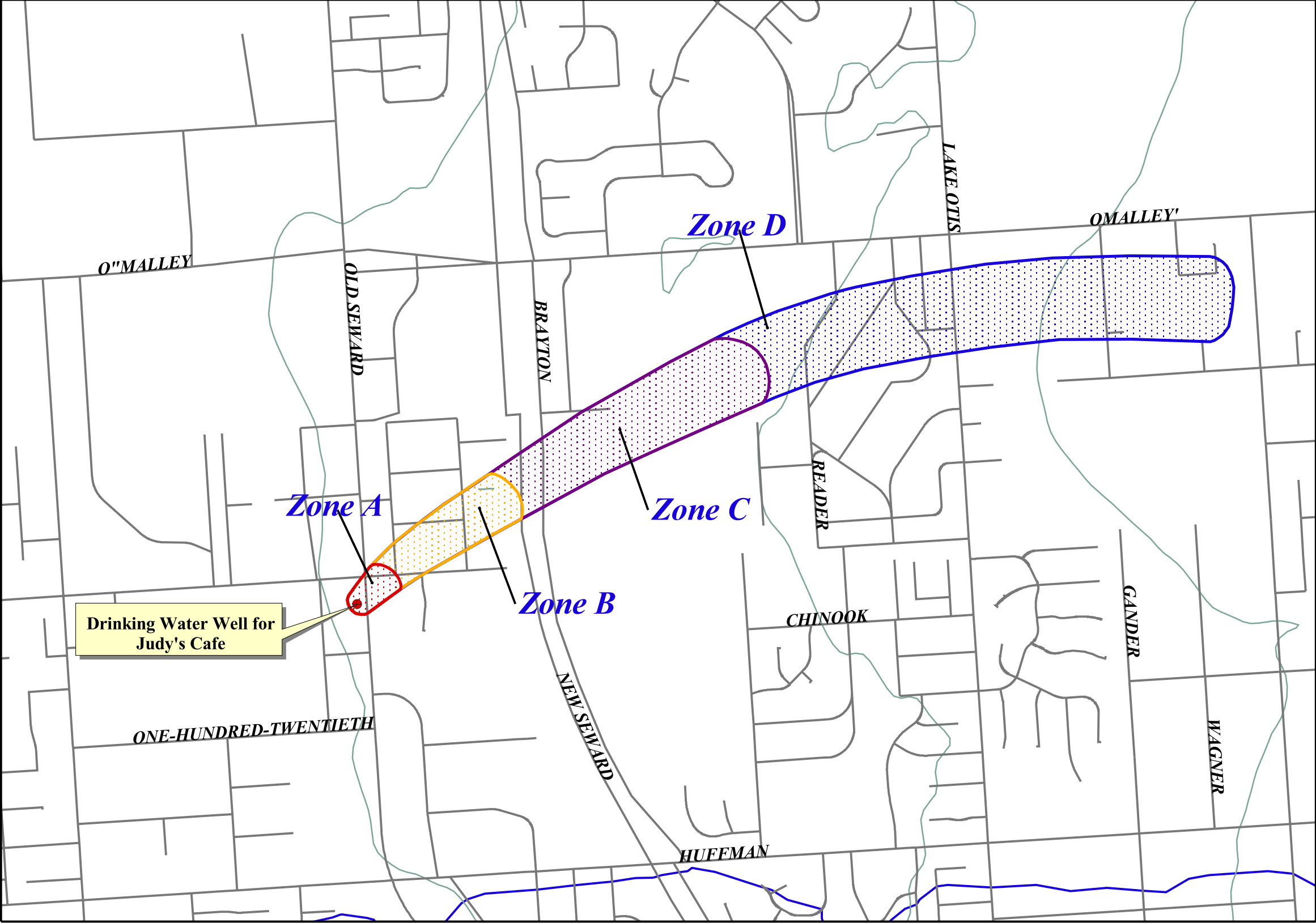
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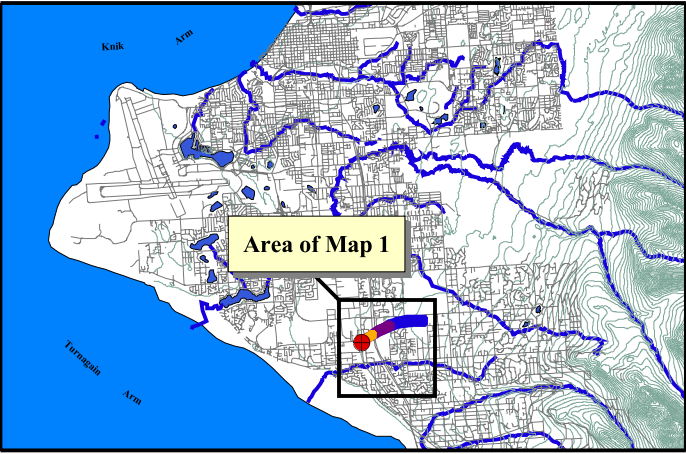
APPENDIX A

Drinking Water Protection Area for Judy's Cafe

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Judy's Cafe



- Drinking Water Well for Judy's Cafe
- 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
- Anchorage Roads (X20)
- Elevation Contours
- Streams



500 0 500 1000 Feet

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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Judy's Cafe

Table 1

**Contaminant Source Inventory for
Judy's Café**

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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	along Klatt	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	along Daryl	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Old Seward	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Klatt	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Daryl	2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	A	11650 Old Seward	3	
Dog walking areas/foot trails	X46	X46-1	A	along Old Seward	3	
Dog walking areas/foot trails	X46	X46-2	A		3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A, B	off Daryl	2	
Motor /motor vehicle repair shops	C31	C31-1	B	Off of Daryl	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D10-4	B	along Broaddus	2	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	1105 Klatt	3	
Residential Areas	R01	R1-1	B	entire subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Broaddus	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Cornelia	2	
Dog walking areas/foot trails	X46	X46-3	B		4	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5-7	C	2 sewer lines in Zone C	2	
Residential Areas	R01	R1-2	C	entire subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	C	3 roads in Zone C	2	
Dog walking areas/foot trails	X46	X46-4	C		4	
Dog walking areas/foot trails	X46	X46-5	C		4	

Table 2

*Contaminant Source Inventory and Risk Ranking for
Judy's Café
Sources of Bacteria and Viruses*

PWSID 212958.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	1	along Klatt	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	2	along Daryl	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A, B	Medium	3	off Daryl	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D10-4	B	Medium	4	along Broaddus	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5-7	C	Medium	5	2 sewer lines in Zone C	2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	A	Medium	6	11650 Old Seward	3	
Residential Areas	R01	R1-1	B	Low	7	entire subdivision	3	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	Low	8	1105 Klatt	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	9	along Old Seward	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	10		3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		Old Seward	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low		Klatt	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low		Daryl	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		Broaddus	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low		Cornelia	2	
Dog walking areas/foot trails	X46	X46-3	B	Low			4	
Residential Areas	R01	R1-2	C	Low		entire subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	C	Low		3 roads in Zone C	2	
Dog walking areas/foot trails	X46	X46-4	C	Low			4	
Dog walking areas/foot trails	X46	X46-5	C	Low			4	

Table 2 (continued)

Contaminant Source Inventory and Risk Ranking for
Judy's Café
Sources of Bacteria and Viruses

PWSID 212958.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Overall Rank after Analysis	Location	Map Number	Comments
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Table 3

*Contaminant Source Inventory and Risk Ranking for
Judy's Café
Sources of Nitrates/Nitrites*

PWSID 212958.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	1	along Klatt	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	2	along Daryl	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A, B	Medium	3	off Daryl	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D10-4	B	Medium	4	along Broaddus	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5-7	C	Medium	5	2 sewer lines in Zone C	2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	A	Low	6	11650 Old Seward	3	
Residential Areas	R01	R1-1	B	Low	7	entire subdivision	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	8	along Old Seward	3	
Dog walking areas/foot trails	X46	X46-2	A	Low	9		3	
Dog walking areas/foot trails	X46	X46-3	B	Low	10		4	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		Old Seward	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low		Klatt	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low		Daryl	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		Broaddus	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low		Cornelia	2	
Residential Areas	R01	R1-2	C	Low		entire subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	C	Low		3 roads in Zone C	2	
Dog walking areas/foot trails	X46	X46-4	C	Low			4	
Dog walking areas/foot trails	X46	X46-5	C	Low			4	

Table 4

*Contaminant Source Inventory and Risk Ranking for
Judy's Café
Sources of Volatile Organic Chemicals*

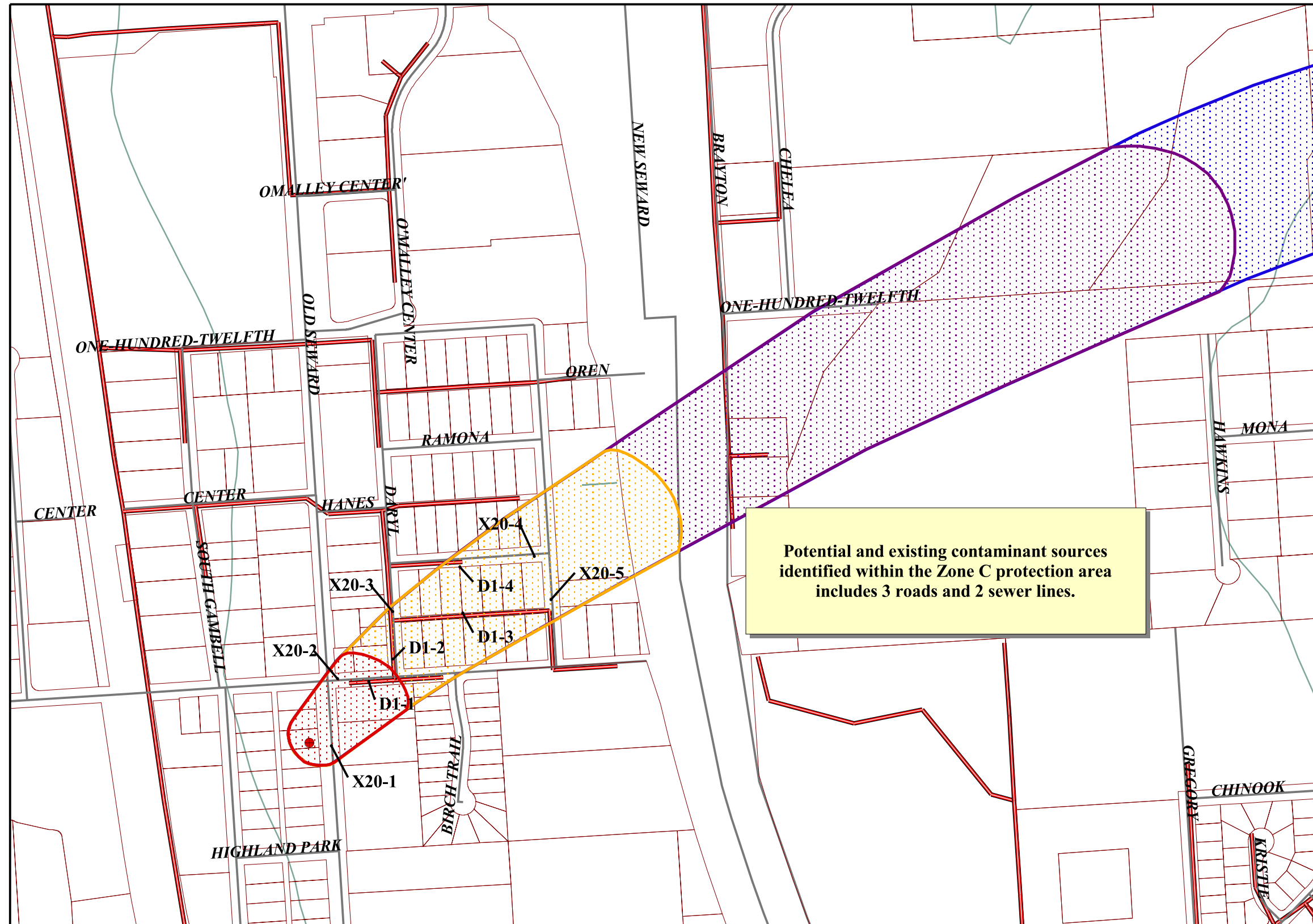
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<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-1	B	High	1	1105 Klatt	3	
Motor /motor vehicle repair shops	C31	C31-1	B	Medium	2	Off of Daryl	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	3	Old Seward	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	4	Klatt	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	5	Daryl	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	6	Broaddus	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	7	Cornelia	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	8	along Klatt	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	9	along Daryl	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A, B	Low	10	off Daryl	2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	A	Low		11650 Old Seward	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D10-4	B	Low		along Broaddus	2	
Residential Areas	R01	R1-1	B	Low		entire subdivision	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5-7	C	Low		2 sewer lines in Zone C	2	
Residential Areas	R01	R1-2	C	Low		entire subdivision	3	
Highways and roads, paved (cement or asphalt)	X20	X20-6-8	C	Low		3 roads in Zone C	2	

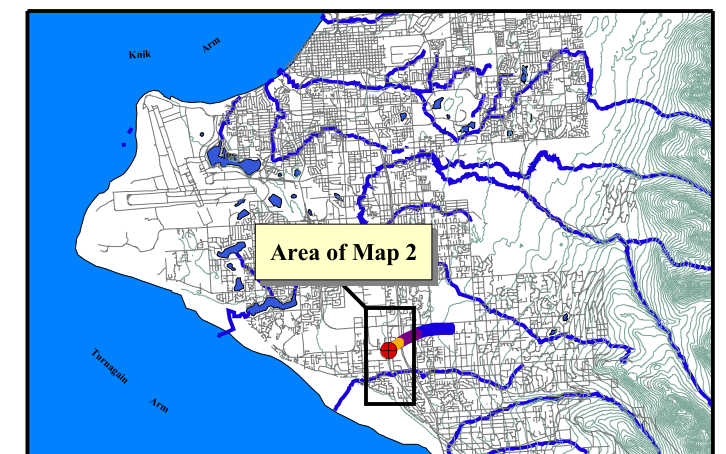
APPENDIX C

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Judy's Cafe

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Judy's Cafe



- Drinking Water Well for Judy's Cafe
- 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
- Anchorage Land Parcels
- Anchorage Roads (X20)
- Sewer Lines (D1)
- Elevation Contours

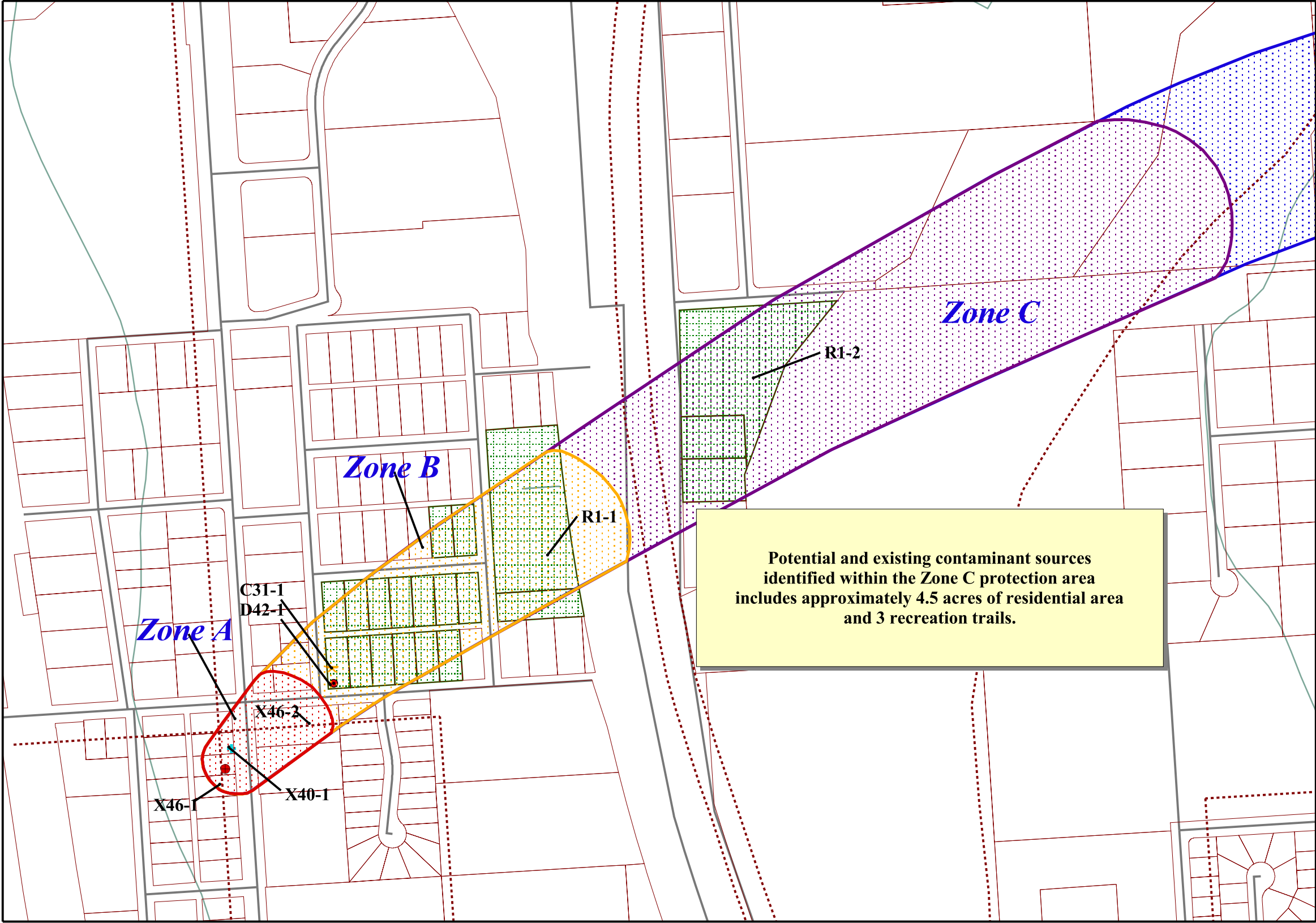


500 0 500 1000 Feet

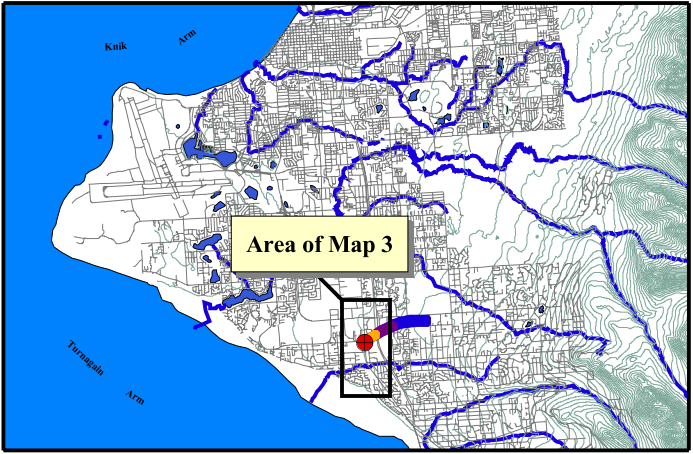
PWSID 212958.001

Map 2

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Judy's Cafe



- Drinking Water Well for Judy's Cafe
- 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
- Anchorage Land Parcels
- Potential and Existing Contaminant Sources**
- ✂ Motor Vehicle Repair (C31)
 - Class V Motor Vehicle Waste Disposal Well (D42)
 - + Medical Veterinary Facility (X40)
 - ▨ Residential Area (R1)
 - ⋯ Recreation Trails (X46)
 - Anchorage Roads (X20)
 - Elevation Contours



500 0 500 1000 Feet

PWSID 212958.001

Map 3

APPENDIX D

Vulnerability Analysis

Chart 1. Susceptibility of the wellhead - *Judy's Café*

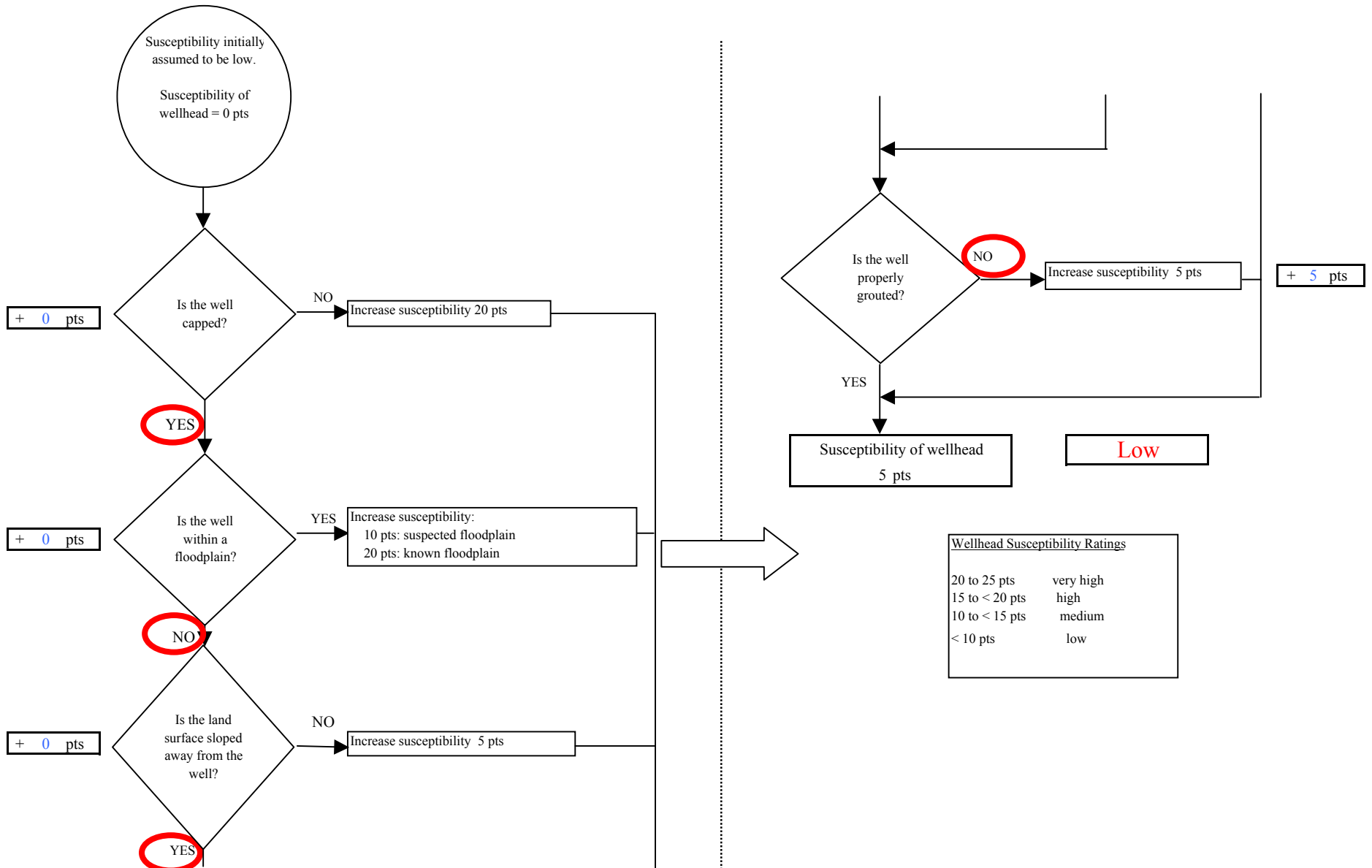


Chart 2. Susceptibility of the aquifer - Judy's Café

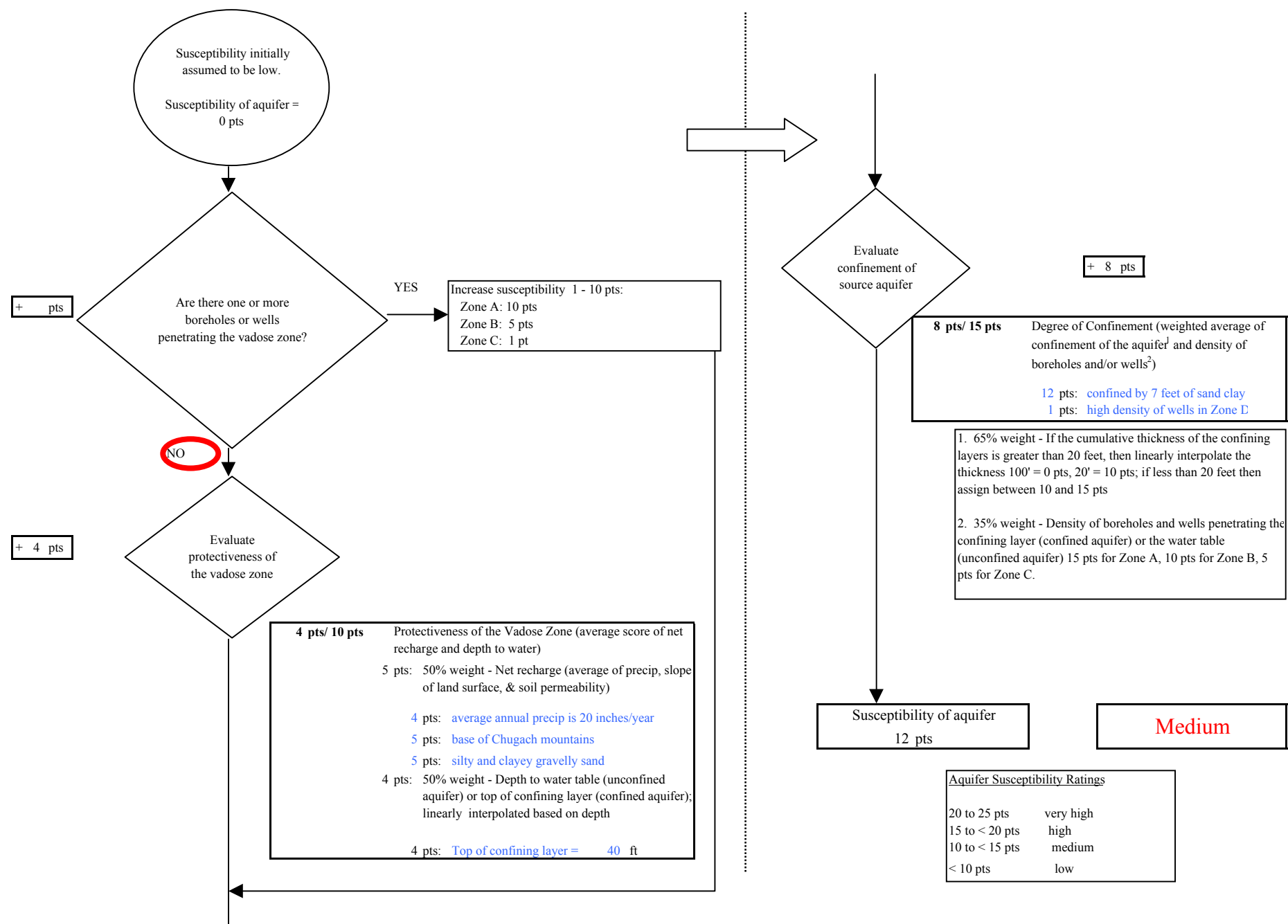


Chart 3. Contaminant risks for *Judy's Cafe - Bacteria & Viruses*

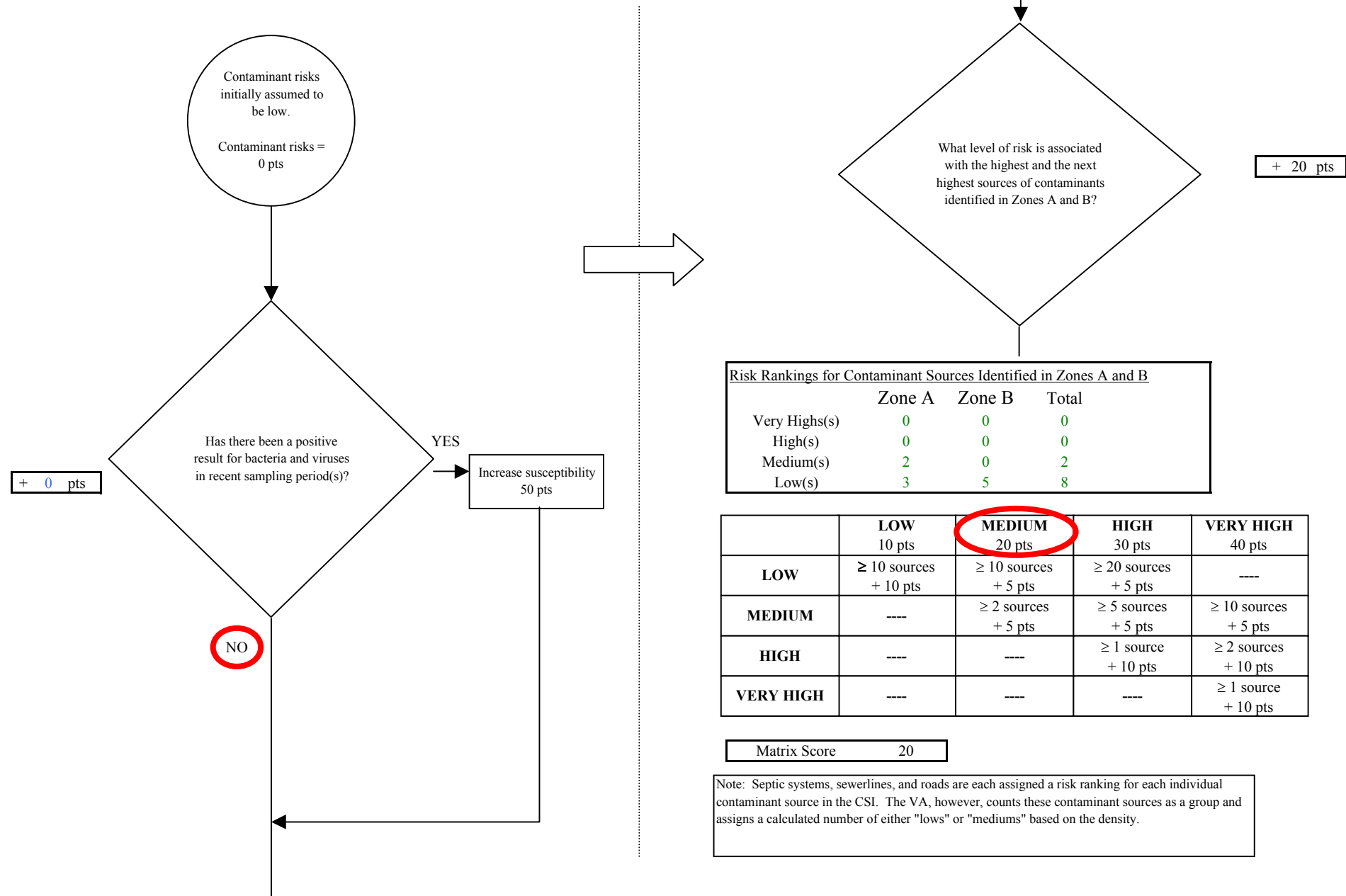


Chart 3. Contaminant risks for Judy's Cafe - Bacteria & Viruses

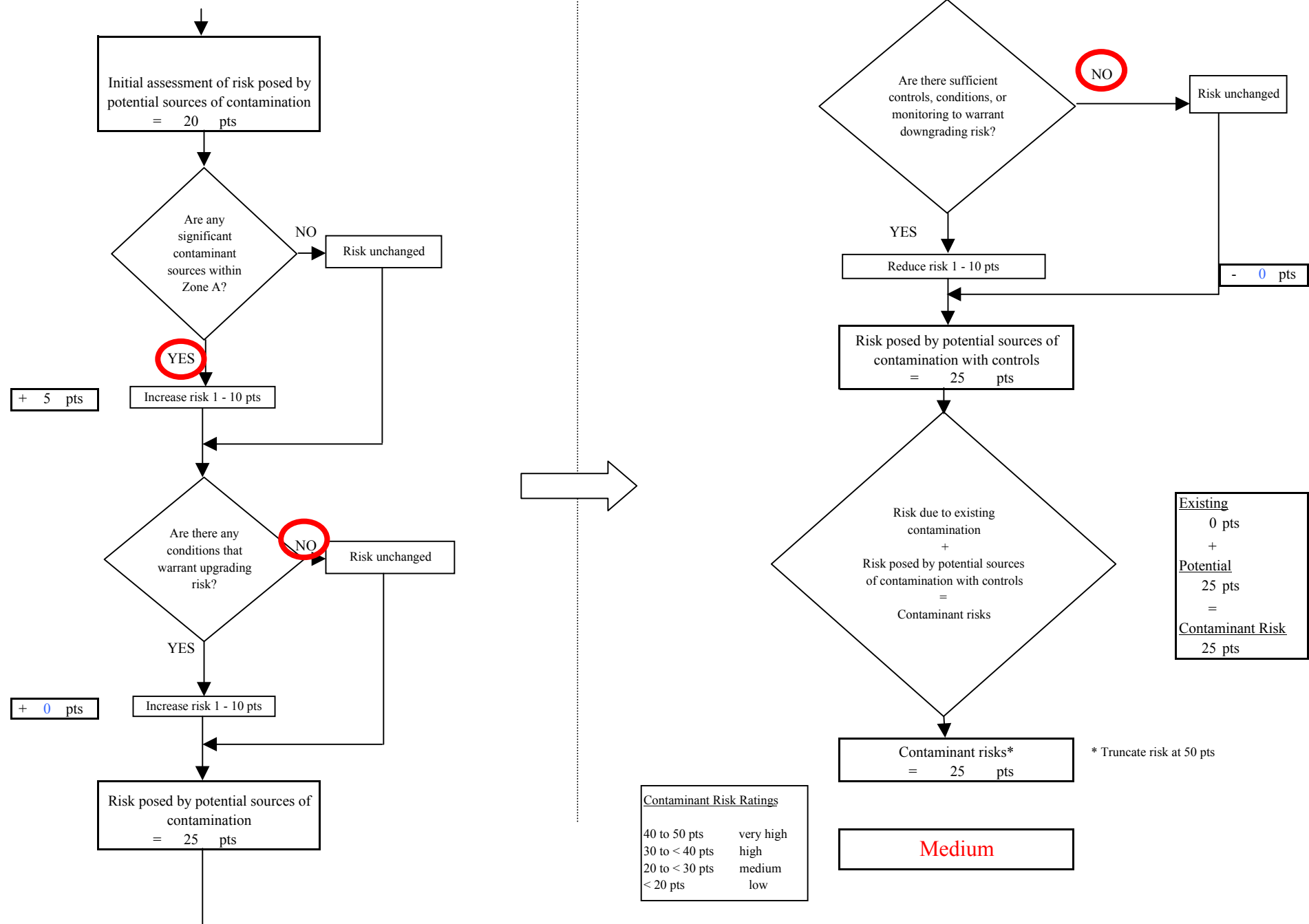


Chart 4. Vulnerability analysis for *Judy's Cafe* - Bacteria & Viruses

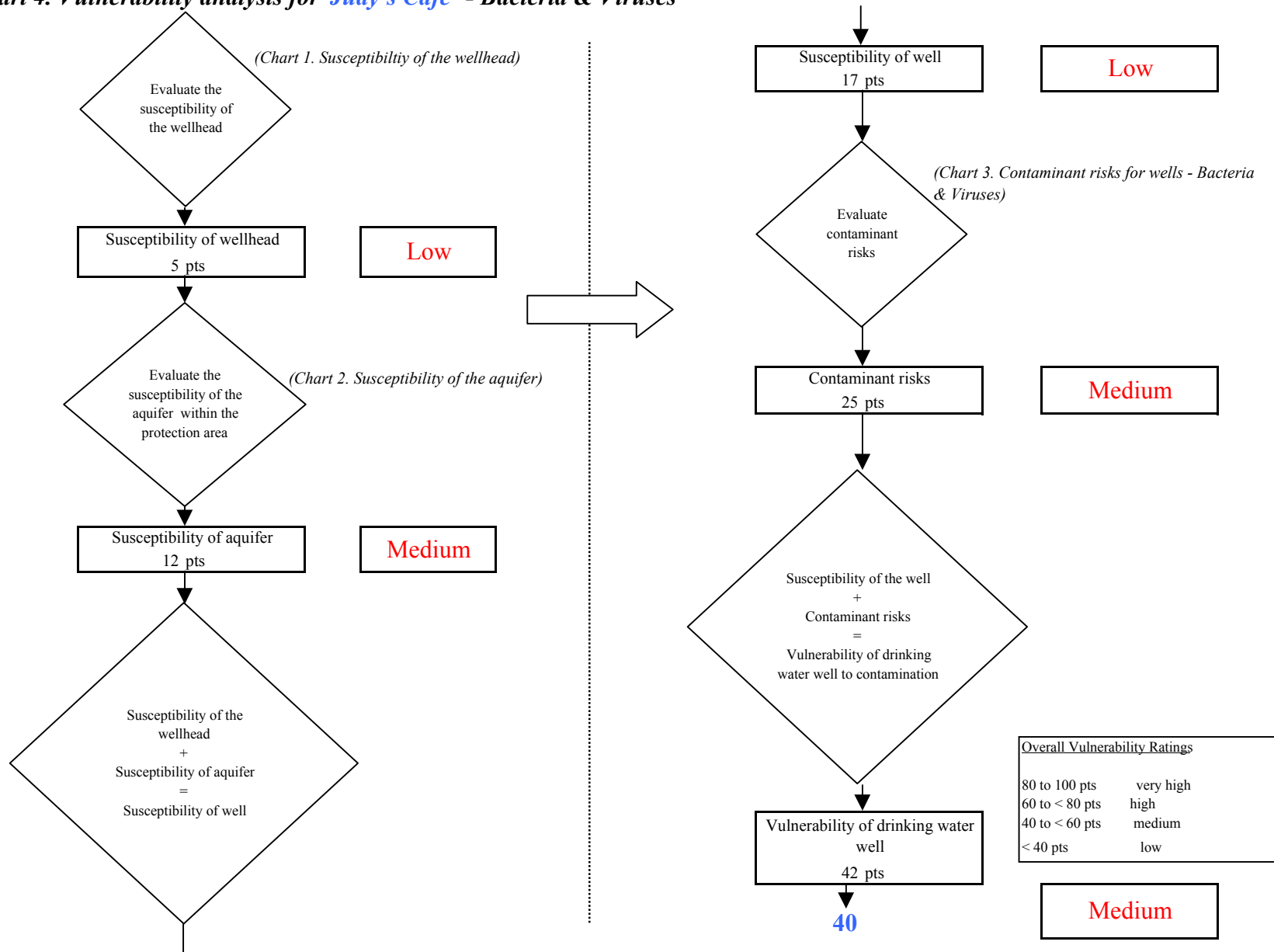


Chart 5. Contaminant risks for *Judy's Cafe* - Nitrates and Nitrites

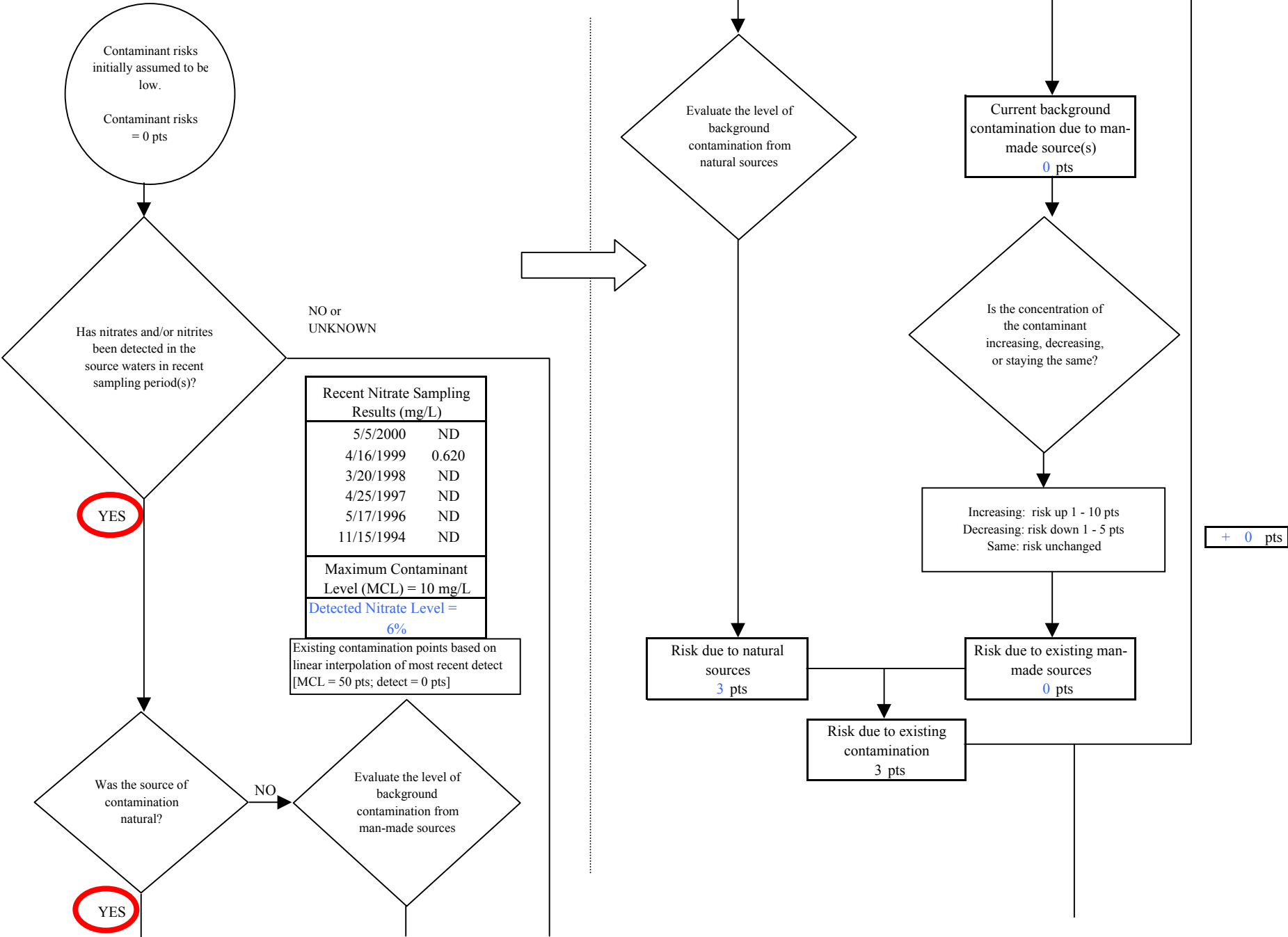


Chart 5. Contaminant risks for Judy's Cafe - Nitrates and Nitrites

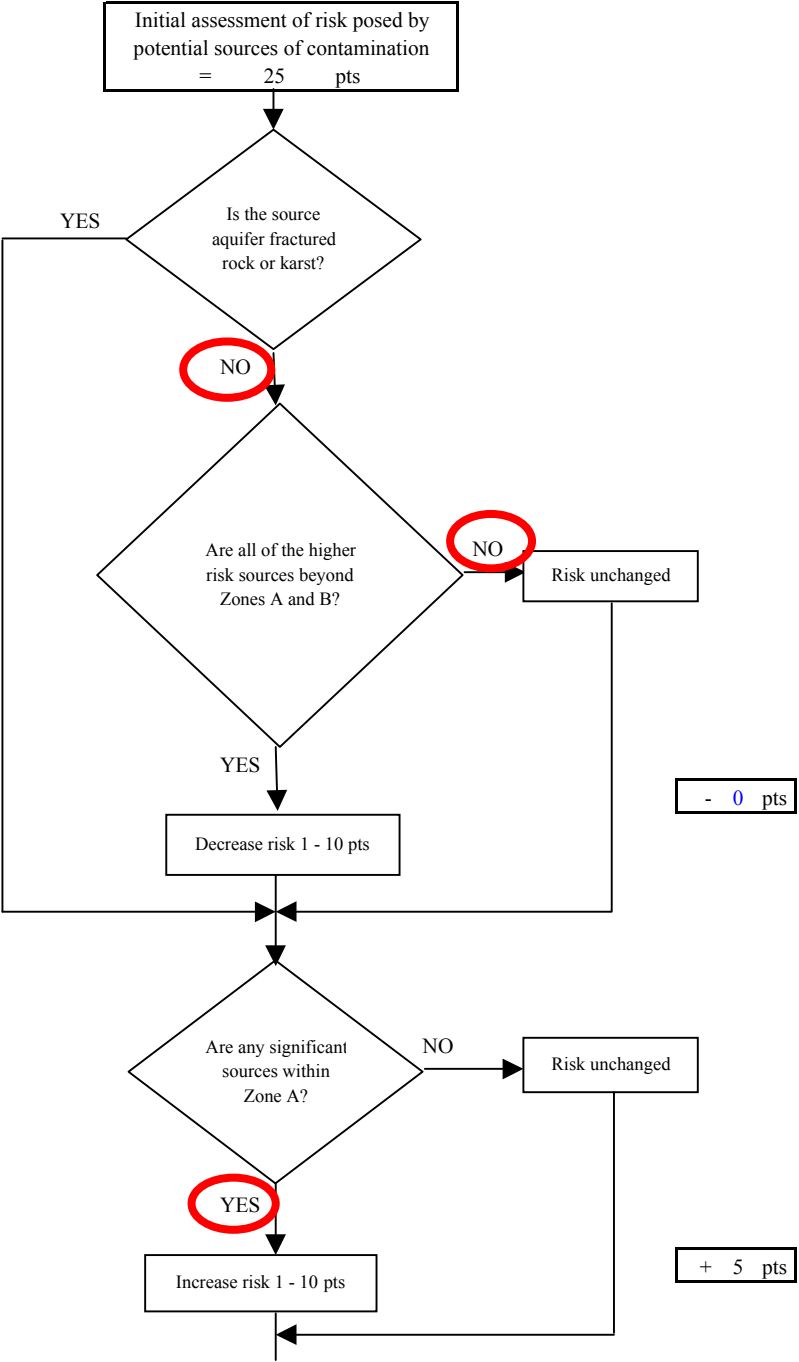
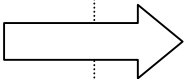
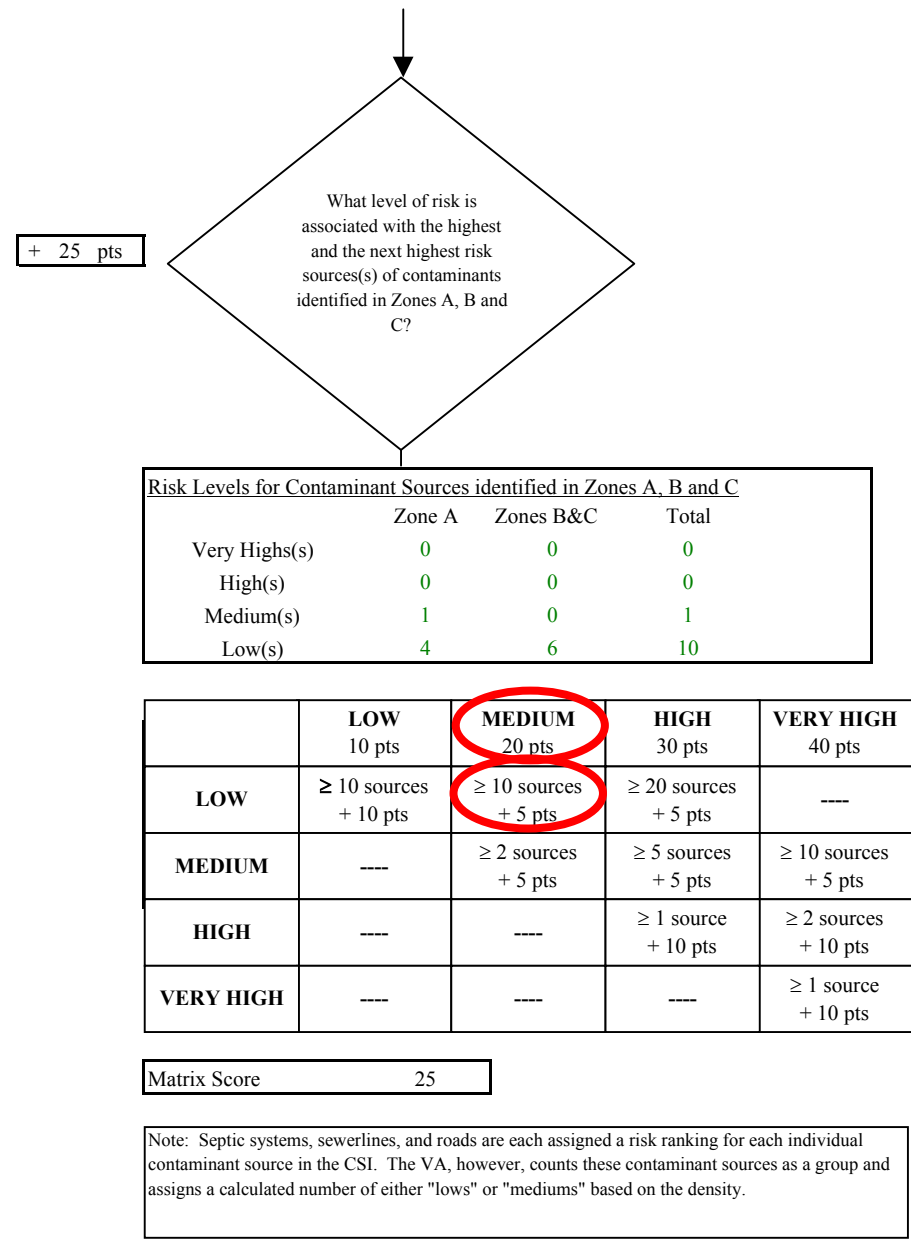


Chart 5. Contaminant risks for Judy's Cafe - Nitrates and Nitrites

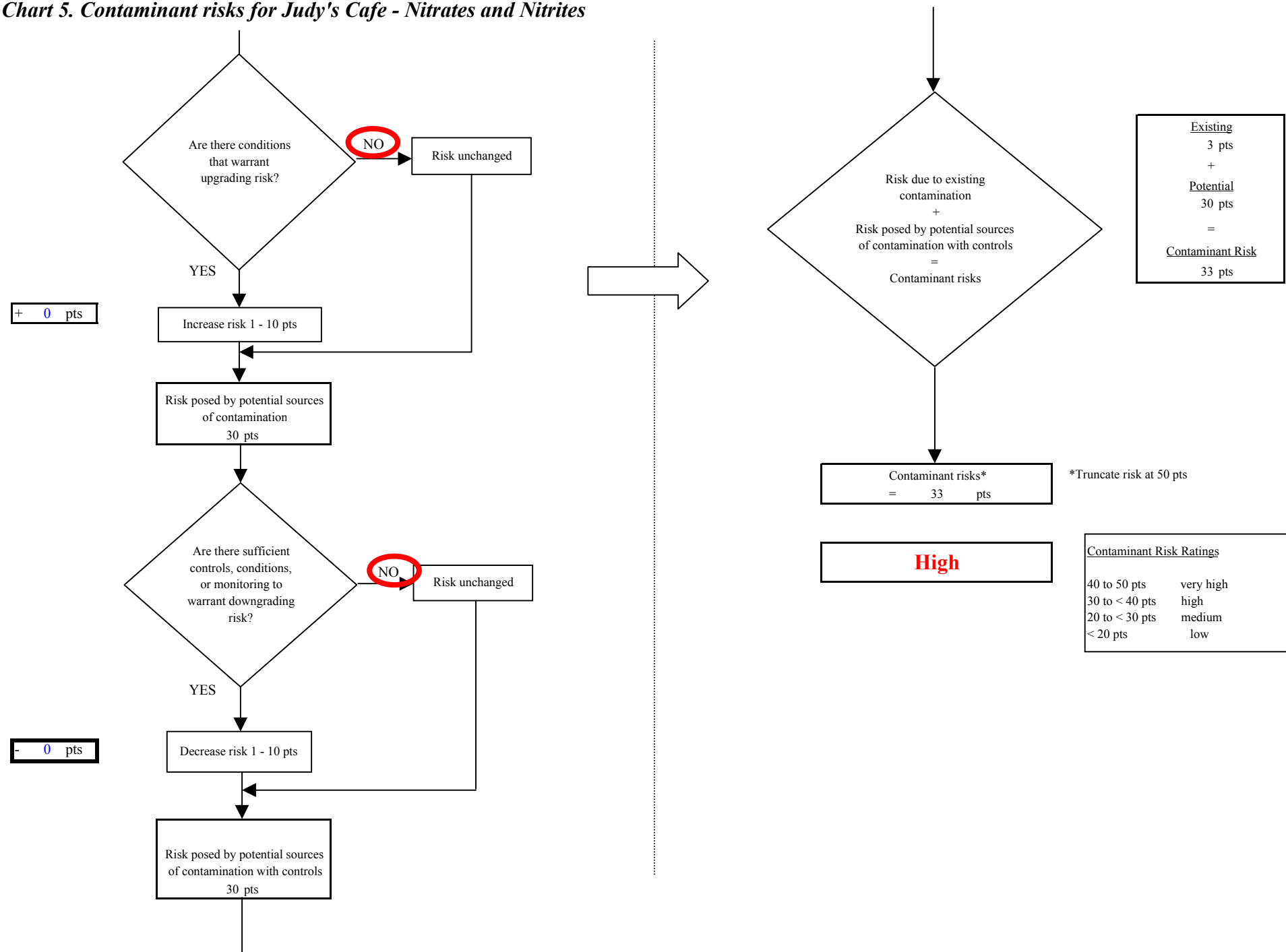


Chart 6. Vulnerability analysis for *Judy's Cafe* - Nitrates and Nitrites

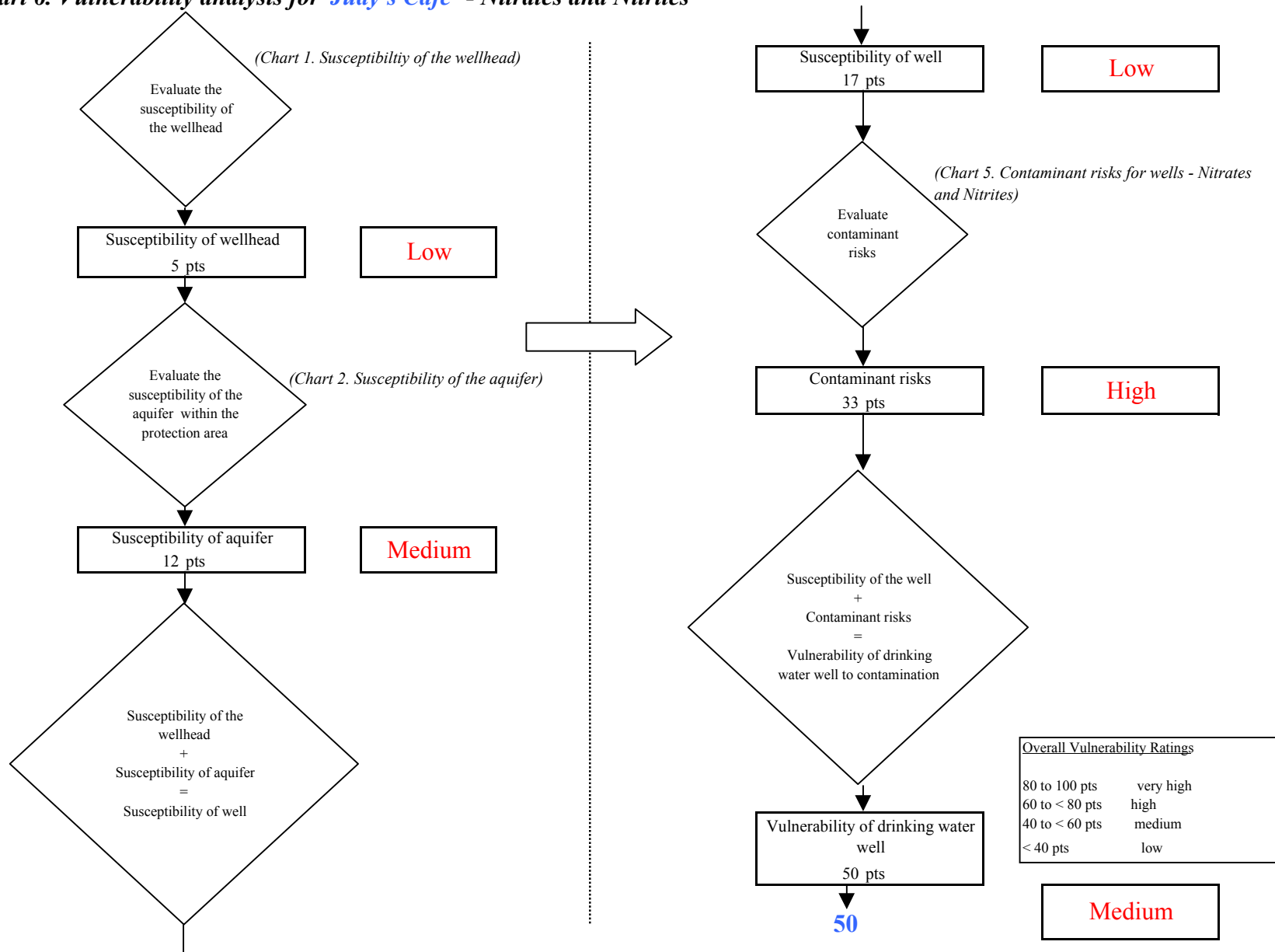


Chart 7. Contaminant risks for *Judy's Cafe* - Volatile Organic Chemicals

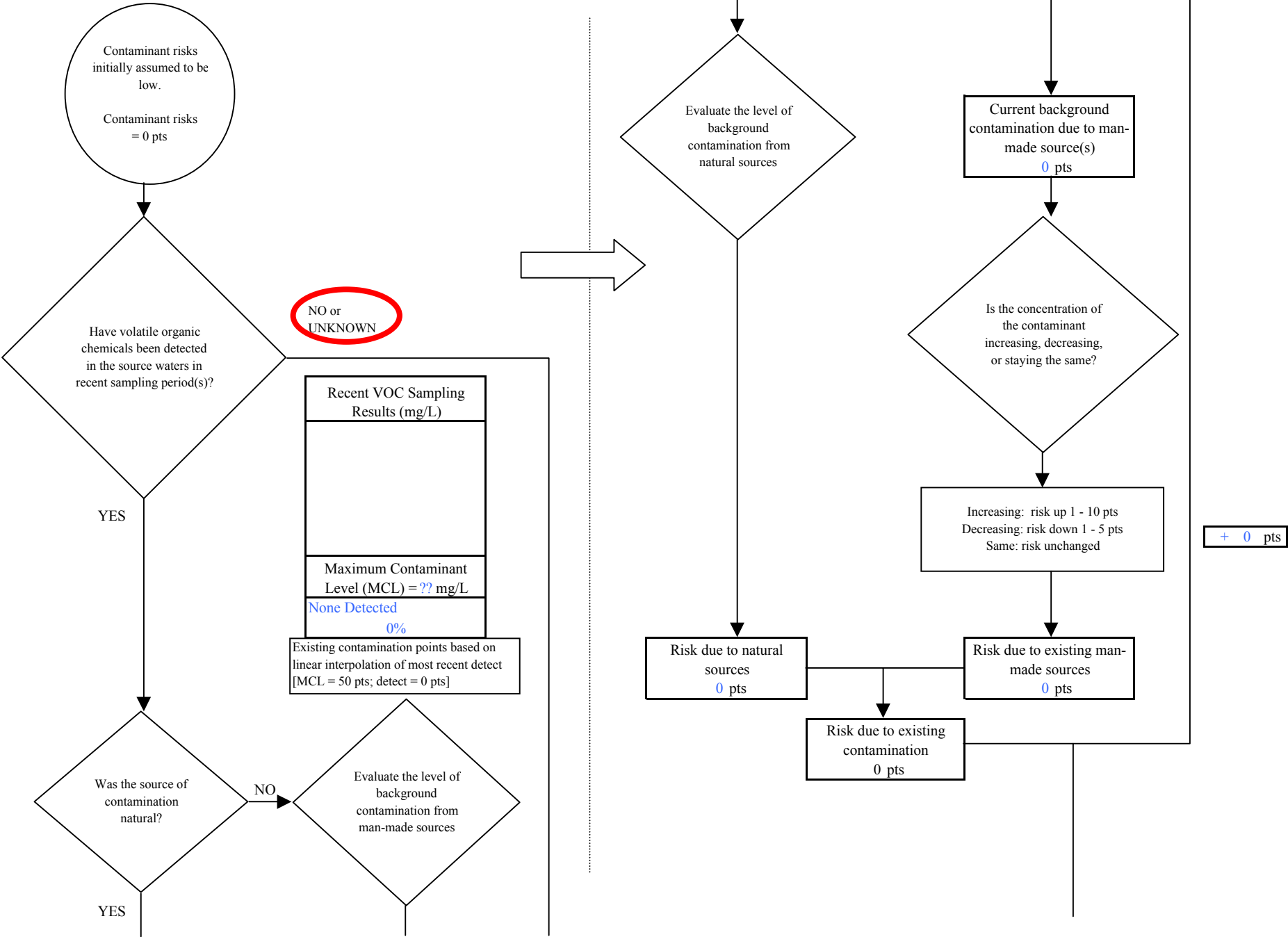


Chart 7. Contaminant risks for Judy's Cafe - Volatile Organic Chemicals

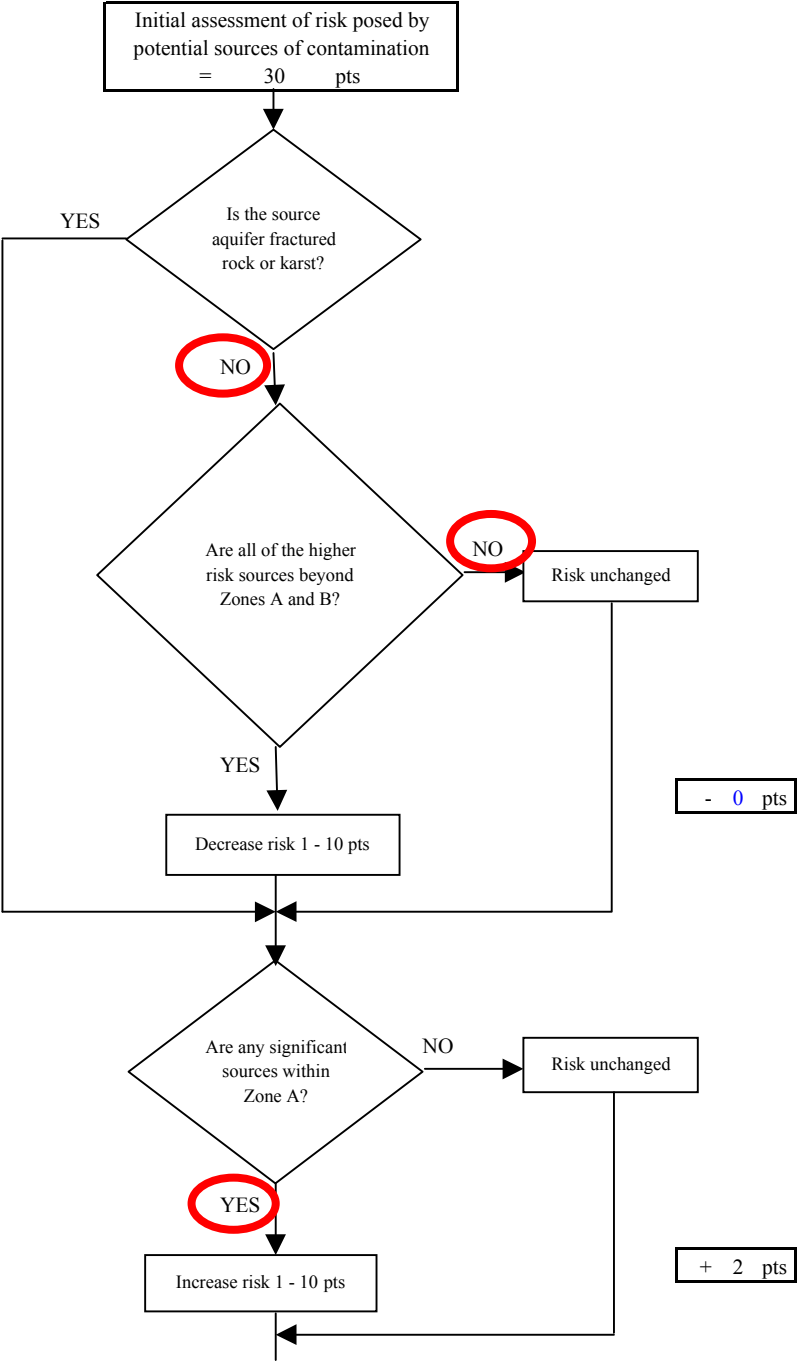
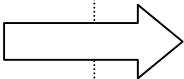
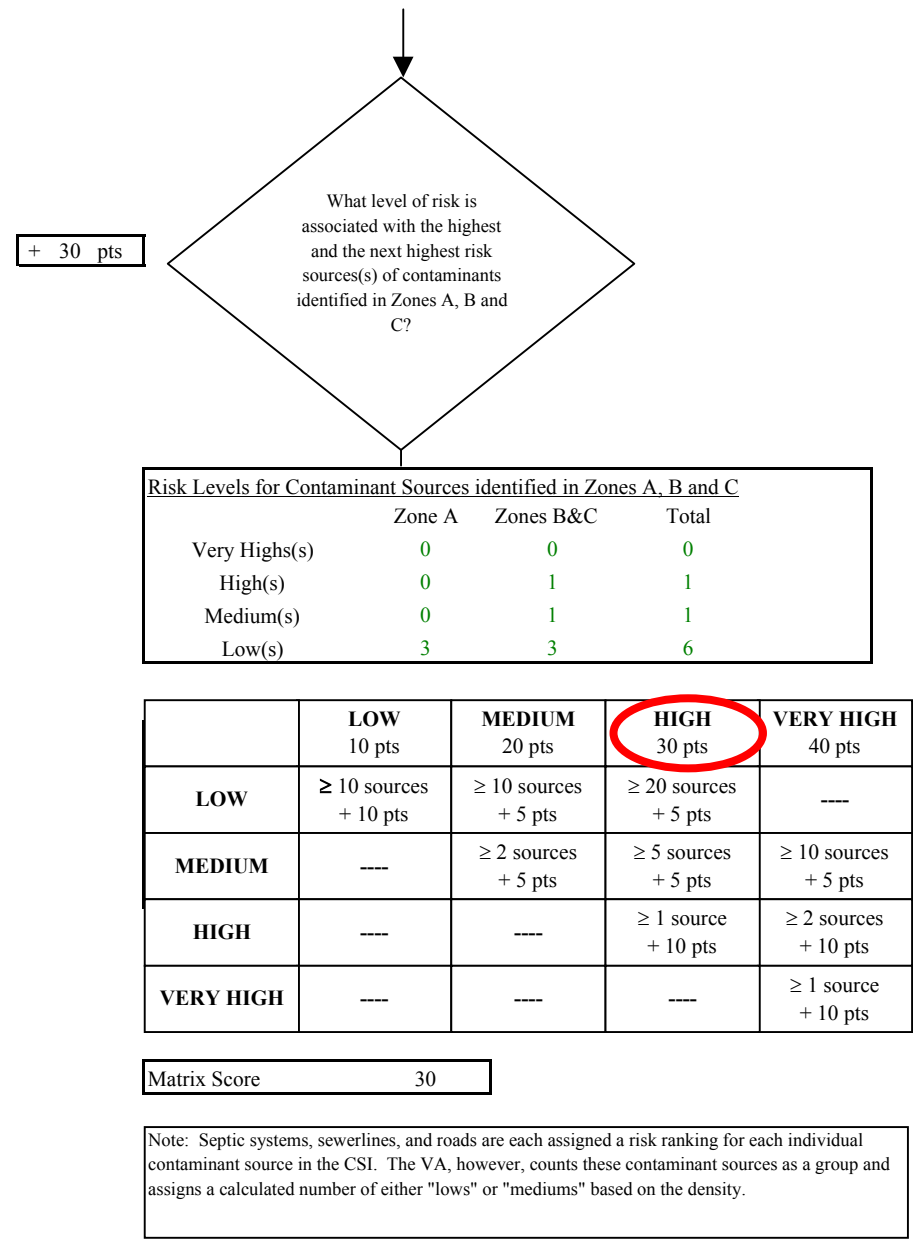


Chart 7. Contaminant risks for Judy's Cafe - Volatile Organic Chemicals

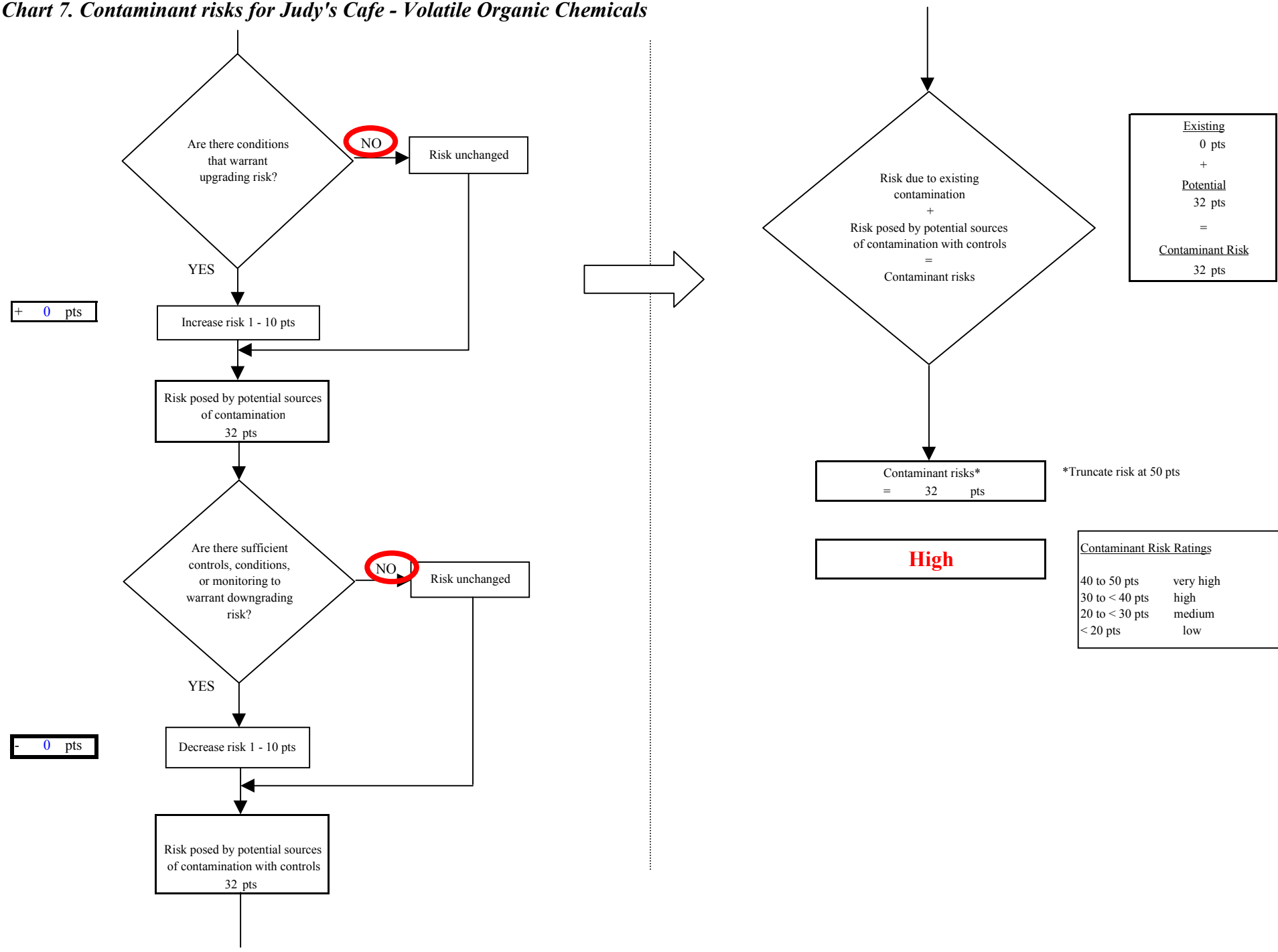


Chart 8. Vulnerability analysis for *Judy's Cafe* - Volatile Organic Chemicals

