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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
Shopper's Cache and Laundry Well  
Drinking Water System,  
Birchwood, Alaska

Shopper's Cache and Laundry Well #214861

DRINKING WATER PROTECTION PROGRAM REPORT # 211  
Alaska Department of Environmental Conservation

AUGUST 2002

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# Source Water Assessment for Shopper's Cache and Laundry Well Drinking Water System, Birchwood, Alaska Shopper's Cache and Laundry Well #214861

By Shannon & Wilson, Inc.

DRINKING WATER PROTECTION PROGRAM REPORT # 211

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

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

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# Source Water Assessment for Shopper's Cache and Laundry Well Source of Public Drinking Water, Birchwood, Alaska

By Shannon & Wilson, Inc.

## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The Shopper's Cache and Laundry Well is a Class B (transient/non-community) water system consisting of one well near the intersection of the Old Glenn Highway and Skyview Avenue. Identified potential and current sources of contaminants for Shopper's Cache and Laundry Well public drinking water source include: gasoline stations; laundromats; motor vehicle repair shops; single family septic systems; gasoline and diesel underground storage tanks; and paved roads. 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 sources for Shopper's Cache and Laundry Well received a vulnerability rating of **Very High** for volatile organic chemicals, **Medium** for bacteria and viruses, and **Medium** for nitrates and nitrites.

### 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 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. Shannon & Wilson has been contracted to perform these assessments under the supervision of ADEC.

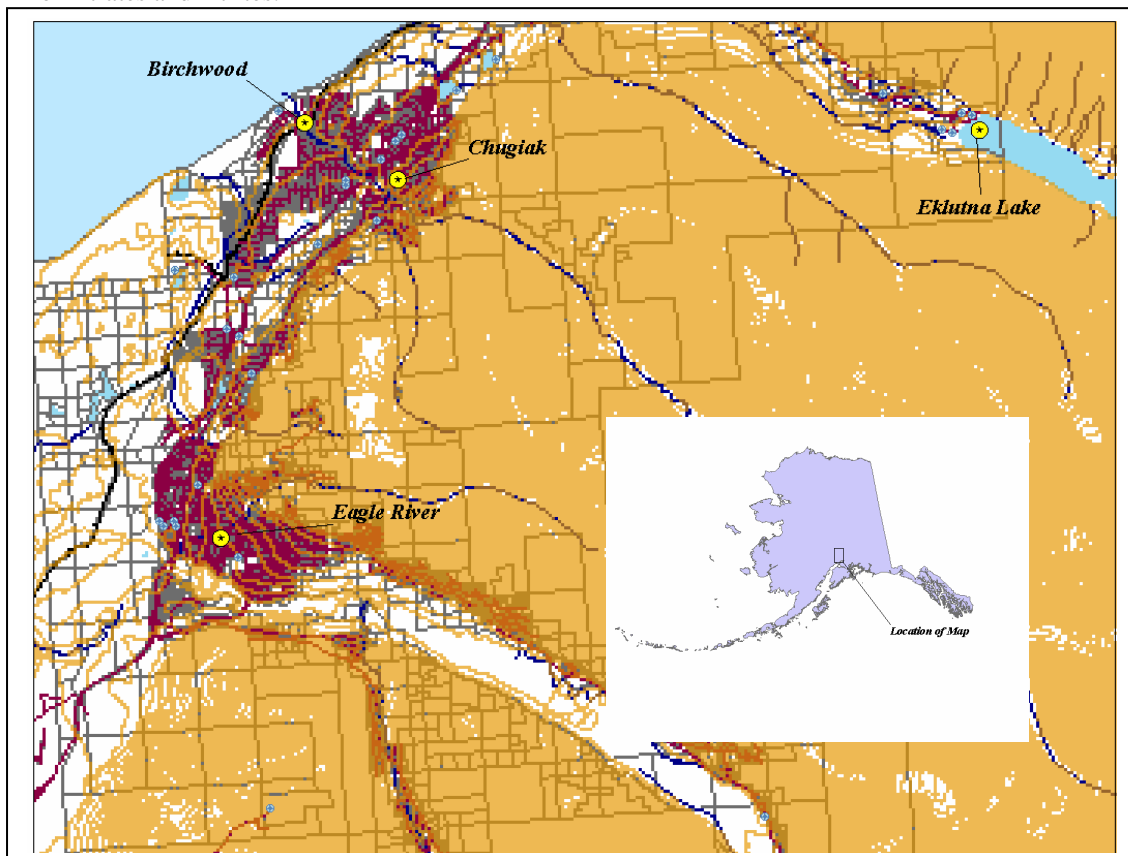


Figure 1. Index map showing the location of the Eagle River Valley and Surrounding Areas.

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 CHUGACH MOUNTAIN FRONT EAST OF ANCHORAGE**

### **Location**

Between the Chugach Mountain Front east of Anchorage and Knik Arm lie the communities of Eagle River, Chugiak, Peters Creek, and Eklutna. The Eagle River Valley is one of the largest valleys in the western Chugach Mountains. The area surrounding Eagle River is shown in Figure 1. Eagle River and the neighboring communities are located in the Municipality of Anchorage.

Glacial and alluvial forces have shaped the Eagle River Valley and Chugach Mountain front in this area. These forces have resulted in the U-shaped river valleys and moraine-mantled mountain flanks of the mountain front and lakes, streams and undulating ridges and hills of the glaciated lowlands extending to Knik Arm.

### **Precipitation**

Eagle River averages between 20 and 25 inches of precipitation per year, including about 68 inches of snowfall.

### **Topography and Drainage**

The area topography varies from sea level to about 400 feet in the area surrounding Knik Arm to several thousand feet on the surrounding ridges and mountain flanks.

### **Groundwater**

Although the quality can vary significantly in a short distance, groundwater supplies are generally abundant in the area, except for some reported well failures that have occurred within the city limits of Eagle River. Groundwater occurs within both confined and unconfined aquifers and from both unconsolidated and bedrock aquifers. Many homes and businesses in the area rely on individual wells for their water supply. Most of these wells are shallow with depths of less than 100 feet to 200 feet. Static water levels in many of these wells are less than 15 feet below the surface.

## **Geology and Soils**

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic muck in old lakes, oxbows and depressions means that some areas have soil conditions that vary over relatively short distances.

## **SHOPPER'S CACHE AND LAUNDRY WELL PUBLIC DRINKING WATER SYSTEM**

Shopper's Cache and Laundry Well is a Class B (transient/non-community) water system. The system consists of one well on the Old Glenn Highway in Birchwood, Alaska.

Based on a nearby well log completed for the water system, the total depth of the Shoppers Cache and Laundry Well is approximately 269 feet below ground surface and was completed with 6-inch well casing. The most recent Sanitary Survey (1/14/91) indicates the well has a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is sloped away from the well, and apparently provides adequate surface water drainage. It is unknown if the well was grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves 0 residents and more than 30 non-residents through one service connection.

## **SHOPPER'S CACHE AND LAUNDRY WELL 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 a release 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 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. Additional methods were also used 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 B Public Water Systems for additional information).

The DWPAs established for wells by the ADEC are separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. The TOT 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 TOT for each:

**Table 1. Definition of Zones**

Zone	Definition
A	¼ the distance for the 2 year 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.

## 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 Shopper's Cache and Laundry Well 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 B public water system assessments, three categories of drinking water contaminants were inventoried, they include:

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

Inventoried potential sources of contamination within Zones A through Zone D were associated with residential and light industrial type activities. The sources are summarized in the tables in Appendix B.

## RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are sorted and ranked according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Further, contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well.

## VULNERABILITY OF SHOPPER'S CACHE AND LAUNDRY WELL 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 three categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the  
Drinking Water Source to Contamination (0 – 100).

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

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

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

The well for Shopper's Cache and Laundry Well is completed in an unconfined aquifer setting. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Overall Susceptibility score and rating for Shopper's Cache and Laundry Well.

**Table 2. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination**

	<b>Score</b>	<b>Rating</b>
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	High

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 or 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**

<b>Category</b>	<b>Score</b>	<b>Rating</b>
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	28	Medium
Volatile Organic Chemicals	50	Very High

Appendix D contains eight 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 8 contain the Contaminant

Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

Table 4 contains the overall vulnerability scores (0 - 100) and ratings for each of the three categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability of Shopper's Cache and Laundry Well to Contamination by Category**

<b>Category</b>	<b>Score</b>	<b>Rating</b>
Bacteria and Viruses	40	Medium
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	80	Very High

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 gasoline stations, laundromats; motor vehicle repair shops; single family septic systems; gasoline and diesel underground storage tanks; and paved roads create a risk increase for bacteria and viruses, nitrates and nitrites, and volatile organic compounds.

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Shopper's Cache and Laundry Well.

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, adopted from the U.S. Geological Survey (Wang, et al., 2000).

Sampling history for Shopper's Cache and Laundry Well indicates that low concentrations of nitrates have been detected (see Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). The maximum reported existing nitrate concentration is approximately 3.100 mg/L or 31% of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. 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 safe levels with respect to human health.

## SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Shopper's Cache and Laundry Well. The overall vulnerability of this source to contamination is **Very High** for volatile organic chemicals, **Medium** for bacteria and viruses, and **Medium** for nitrates and nitrites. 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 Shopper's Cache and Laundry Well 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 Shopper's Cache and Laundry Well public drinking water source.



## REFERENCES CITED

Munter, J.A., and Allely, R. D., 1992, Water-Supply Aquifers at Eagle River, Alaska: State of Alaska Division of Geological & Geophysical Surveys Professional Report 108.

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

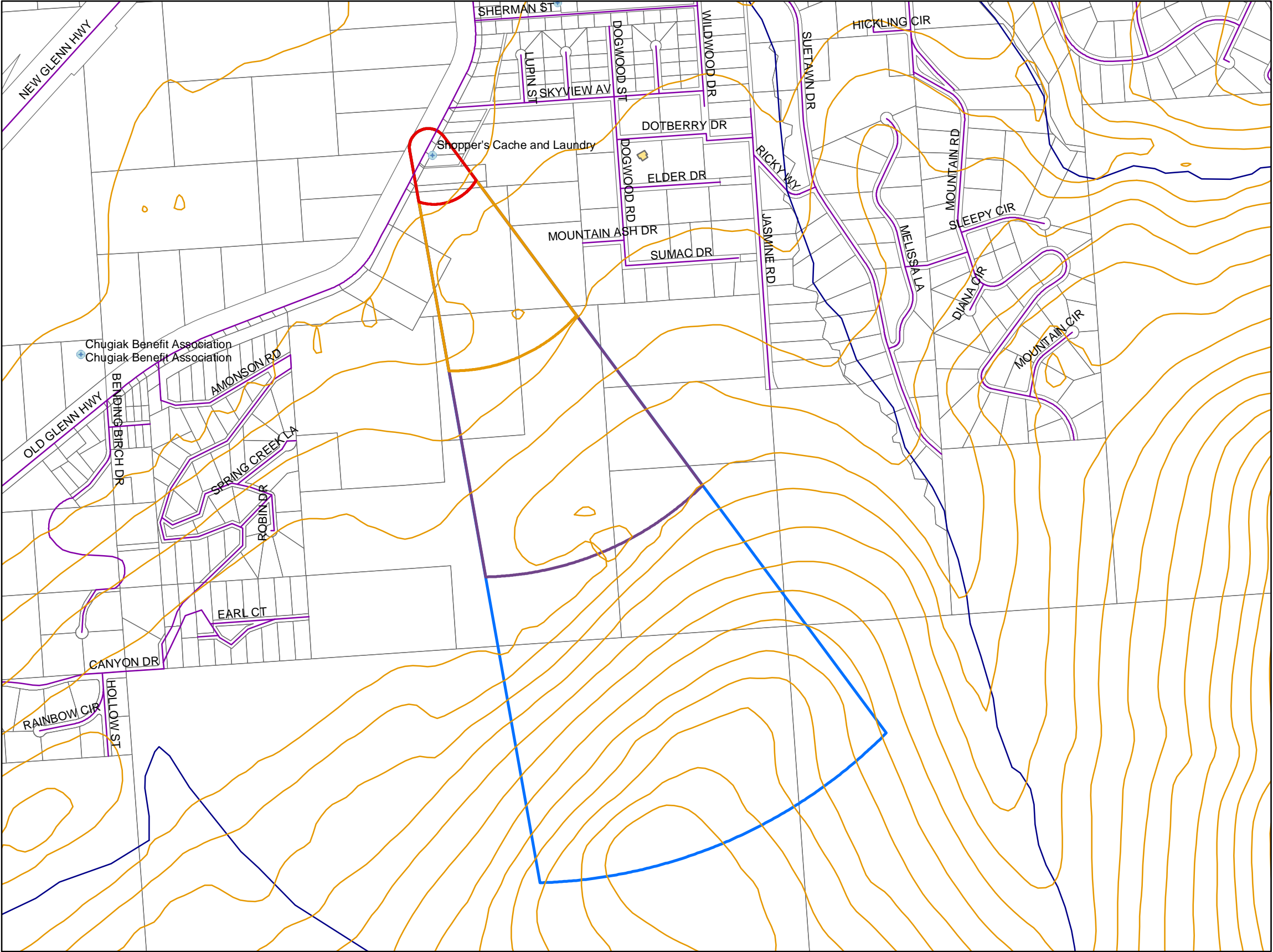
Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

Weather Underground, June 18, 2002, Web extension to the *Western Regional Climate Center* [WWW document].  
URL <http://www.wunderground.com>

## **APPENDIX A**

### **Shopper's Cache and Laundry Well Drinking Water Protection Area (Map 1)**

Drinking Water Protection Areas for Shopper's Cache and Laundry



● Shopper's Cache and Laundry Well

25m Contours

Railroads

Streams

Roads

Site Buildings

MOA Buildings

MOA land parcels

**Zone A Protection Area**

Several Months Travel Time

**Zone B Protection Area**

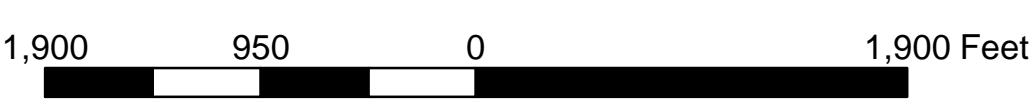
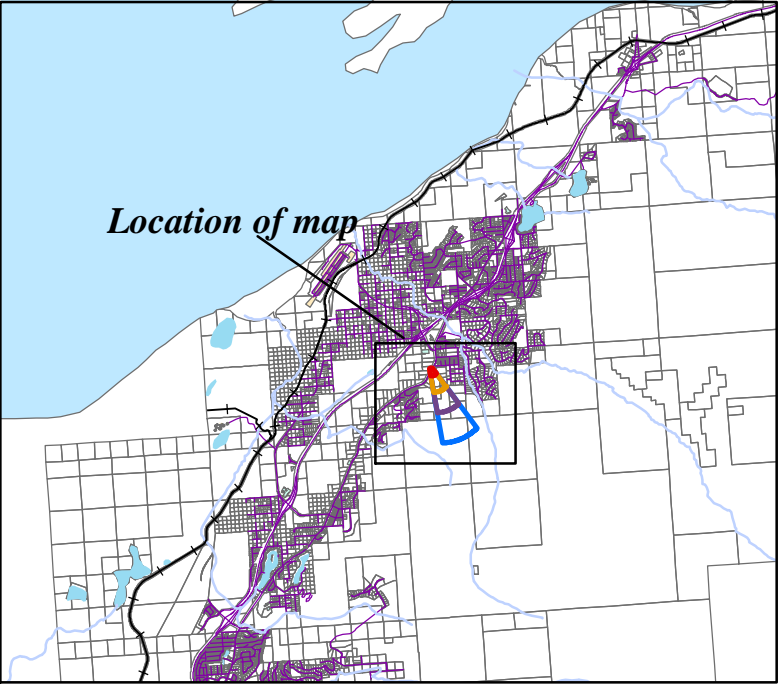
Less than 2-Years Travel Time

**Zone C Protection Area**

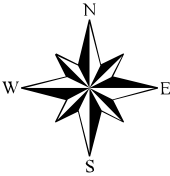
Less than 5-Years Travel Time

**Zone D Protection Area**

Less than 10-Years Travel Time



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## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking for Shopper's Cache and Laundry Well (Tables 1-4)**

**Table 1**

**Contaminant Source Inventory for  
Shopper's Cache and Laundry**

**PWSID 214861.001**

<b>Contaminant Source Type</b>	<b>Contaminant Source ID</b>	<b>CS ID tag</b>	<b>Zone</b>	<b>Location</b>	<b>Map Number</b>	<b>Comments</b>
Residential Areas	R01	R1-1	A	Residences between Elder Drive and Sumac Drive	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-1	A	south of Elder Drive	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Dogwood Road	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Elder Drive	2	
Residential Areas	R01	R1-2	B	Residences south of Sumac Drive	2	10 Acres
Septic systems (serves one single-family home)	R02	R2-2	B	south of Elder Drive	3	
Septic systems (serves one single-family home)	R02	R2-3	B	south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-4	B	south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-5	B	south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-6	B	south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-7	B	south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-8	B	south of Sumac Drive	3	
Highways and roads, dirt/gravel	X24	X24-3	B	Sumac Drive	2	
Highways and roads, dirt/gravel	X24	X24-4	B	Jasmine Road	2	
Residential Areas	R01	R1-3	C	Residences east of Jasmine Road	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-10	C	east off Jasmine Road	3	
Septic systems (serves one single-family home)	R02	R2-11	C	east off Jasmine Road	3	
Septic systems (serves one single-family home)	R02	R2-12	C	south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-9	C	south of Sumac Drive	3	

*Contaminant Source Inventory and Risk Ranking for  
Shopper's Cache and Laundry*

*PWSID 214861.001*

**Table 2**

*Sources of Bacteria and Viruses*

<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>
Residential Areas	R01	R1-1	A	Low		Residences between Elder Drive and Sumac Drive	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-1	A	Low		south of Elder Drive	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Low		Dogwood Road	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Low		Elder Drive	2	
Residential Areas	R01	R1-2	B	Low		Residences south of Sumac Drive	2	10 Acres
Septic systems (serves one single-family home)	R02	R2-2	B	Low		south of Elder Drive	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-4	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-5	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-6	B	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-7	B	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-8	B	Low		south of Sumac Drive	3	
Highways and roads, dirt/gravel	X24	X24-3	B	Low		Sumac Drive	2	
Highways and roads, dirt/gravel	X24	X24-4	B	Low		Jasmine Road	2	

*Contaminant Source Inventory and Risk Ranking for  
Shopper's Cache and Laundry*

*PWSID 214861.001*

**Table 3**

*Sources of Nitrates/Nitrites*

<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>
Residential Areas	R01	R1-1	A	Low		Residences between Elder Drive and Sumac Drive	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-1	A	Low		south of Elder Drive	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Low		Dogwood Road	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Low		Elder Drive	2	
Residential Areas	R01	R1-2	B	Low		Residences south of Sumac Drive	2	10 Acres
Septic systems (serves one single-family home)	R02	R2-2	B	Low		south of Elder Drive	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-4	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-5	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-6	B	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-7	B	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-8	B	Low		south of Sumac Drive	3	
Highways and roads, dirt/gravel	X24	X24-3	B	Low		Sumac Drive	2	
Highways and roads, dirt/gravel	X24	X24-4	B	Low		Jasmine Road	2	
Residential Areas	R01	R1-3	C	Low		Residences east of Jasmine Road	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-10	C	Low		east off Jasmine Road	3	
Septic systems (serves one single-family home)	R02	R2-11	C	Low		east off Jasmine Road	3	
Septic systems (serves one single-family home)	R02	R2-12	C	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-9	C	Low		south of Sumac Drive	3	

# Contaminant Source Inventory and Risk Ranking for Shopper's Cache and Laundry

PWSID 214861.001

Table 4

## Sources of Volatile Organic Chemicals

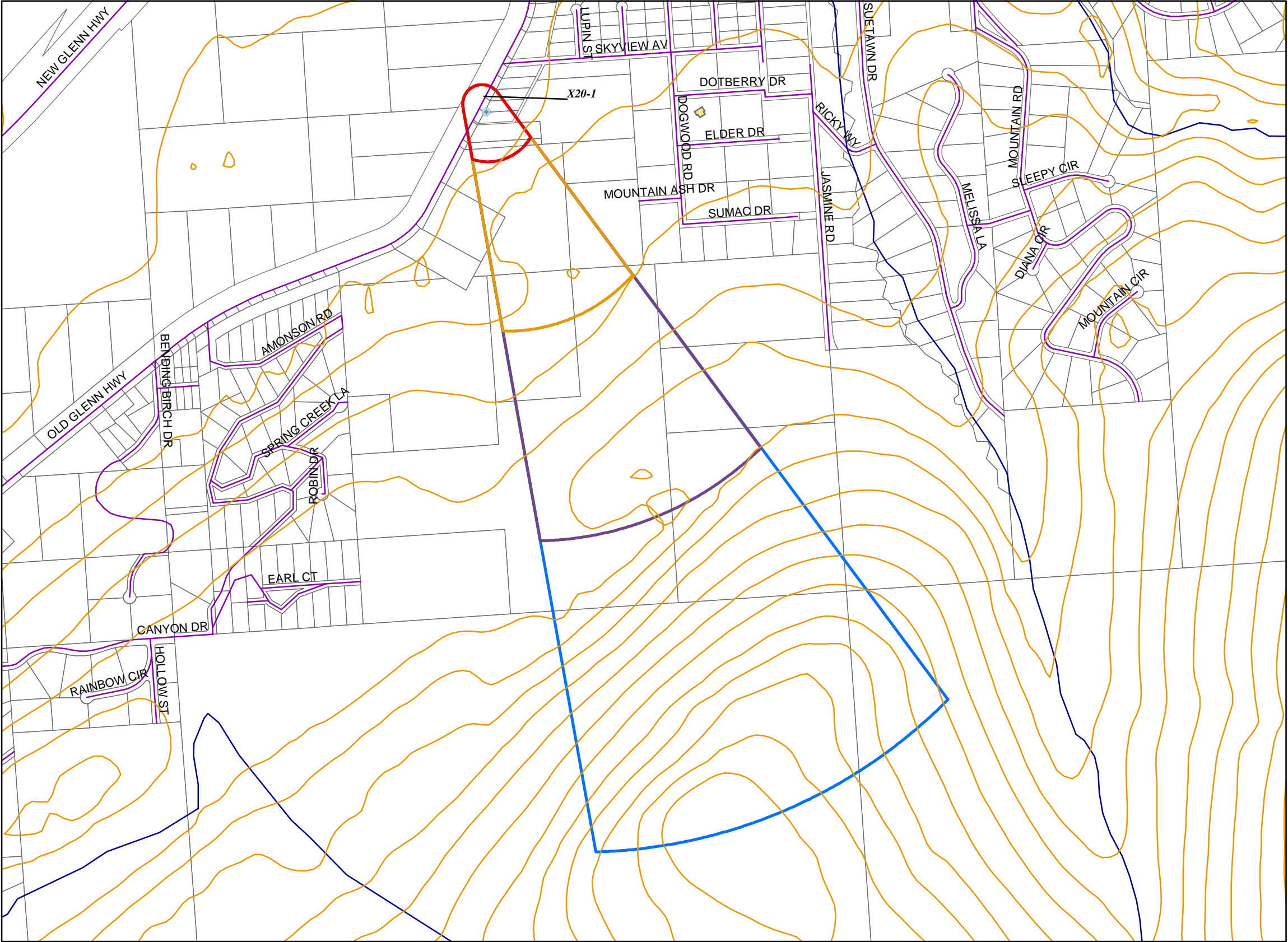
<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Overall Rank after Analysis</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Residential Areas	R01	R1-1	A	Low		Residences between Elder Drive and Sumac Drive	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-1	A	Low		south of Elder Drive	3	
Highways and roads, dirt/gravel	X24	X24-1	A	Low		Dogwood Road	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Low		Elder Drive	2	
Residential Areas	R01	R1-2	B	Low		Residences south of Sumac Drive	2	10 Acres
Septic systems (serves one single-family home)	R02	R2-2	B	Low		south of Elder Drive	3	
Septic systems (serves one single-family home)	R02	R2-3	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-4	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-5	B	Low		south of Elder Drive, north of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-6	B	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-7	B	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-8	B	Low		south of Sumac Drive	3	
Highways and roads, dirt/gravel	X24	X24-3	B	Low		Sumac Drive	2	
Highways and roads, dirt/gravel	X24	X24-4	B	Low		Jasmine Road	2	
Residential Areas	R01	R1-3	C	Low		Residences east of Jasmine Road	2	2 Acres
Septic systems (serves one single-family home)	R02	R2-10	C	Low		east off Jasmine Road	3	
Septic systems (serves one single-family home)	R02	R2-11	C	Low		east off Jasmine Road	3	
Septic systems (serves one single-family home)	R02	R2-12	C	Low		south of Sumac Drive	3	
Septic systems (serves one single-family home)	R02	R2-9	C	Low		south of Sumac Drive	3	



## **APPENDIX C**

### **Shopper's Cache and Laundry Well Drinking Water Protection Area and Potential and Existing Contaminant Sources (Maps 2-3)**

# Drinking Water Protection Areas for Shopper's Cache and Laundry and Potential and Existing Sources of Contamination



Shopper's Cache and Laundry Well

25m Contours

Railroads

Streams

Roads

MOA land parcels

**Zone A Protection Area**

Several Months Travel Time

**Zone B Protection Area**

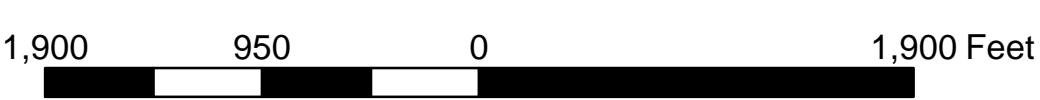
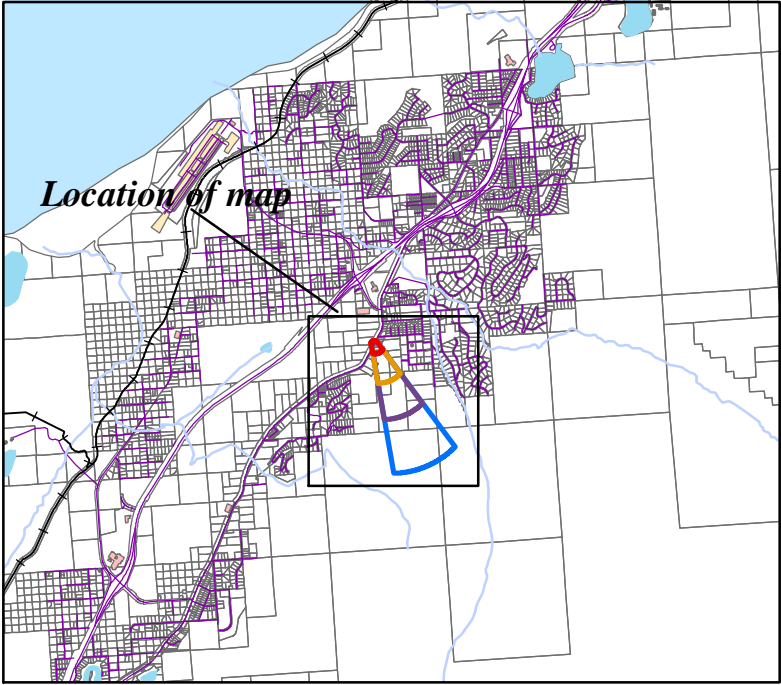
Less than 2-Years Travel Time

**Zone C Protection Area**

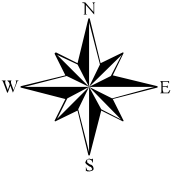
Less than 5-Years Travel Time

**Zone D Protection Area**

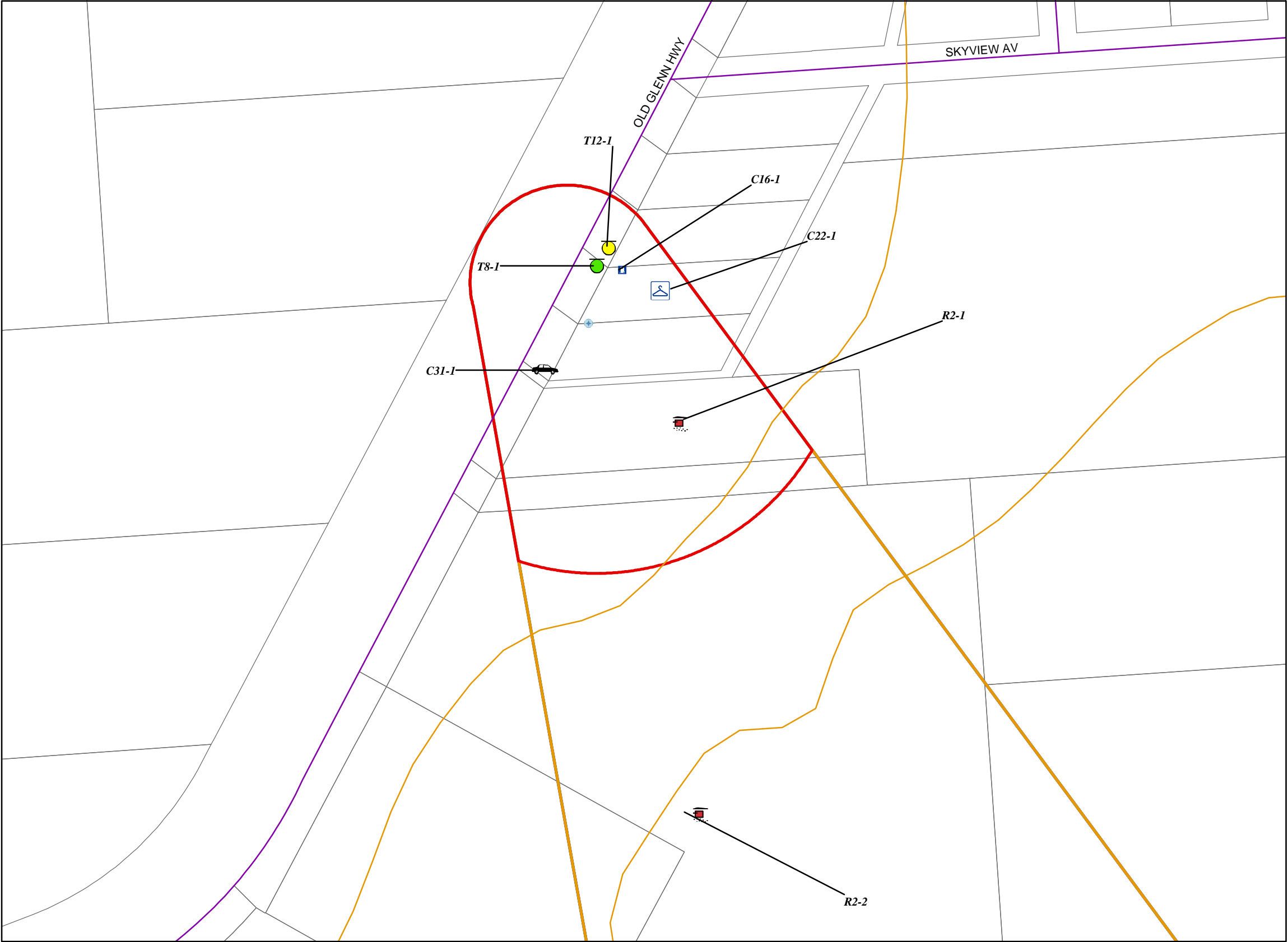
Less than 10-Years Travel Time



PWSID 214861.001



# Drinking Water Protection Areas for Shopper's Cache and Laundry and Potential and Existing Sources of Contamination



Shopper's Cache and Laundry Well

Single Family Septic Systems (R2)

Laundromat, C22

Gasoline stations (with repair shop), C16

Motor Vehicle Rapair Shop, C31

Tanks, diesel (underground), T8

Tanks, gasoline (underground), T12

25m Contours

Railroads

Streams

Roads

MOA land parcels

Zone A Protection Area

Several Months Travel Time

Zone B Protection Area

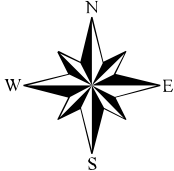
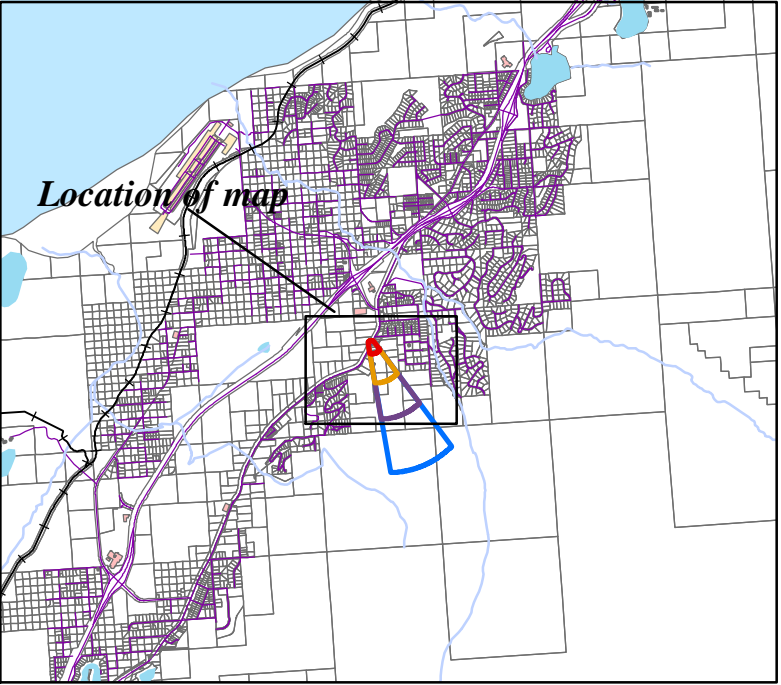
Less than 2-Years Travel Time

Zone C Protection Area

Less than 5-Years Travel Time

Zone D Protection Area

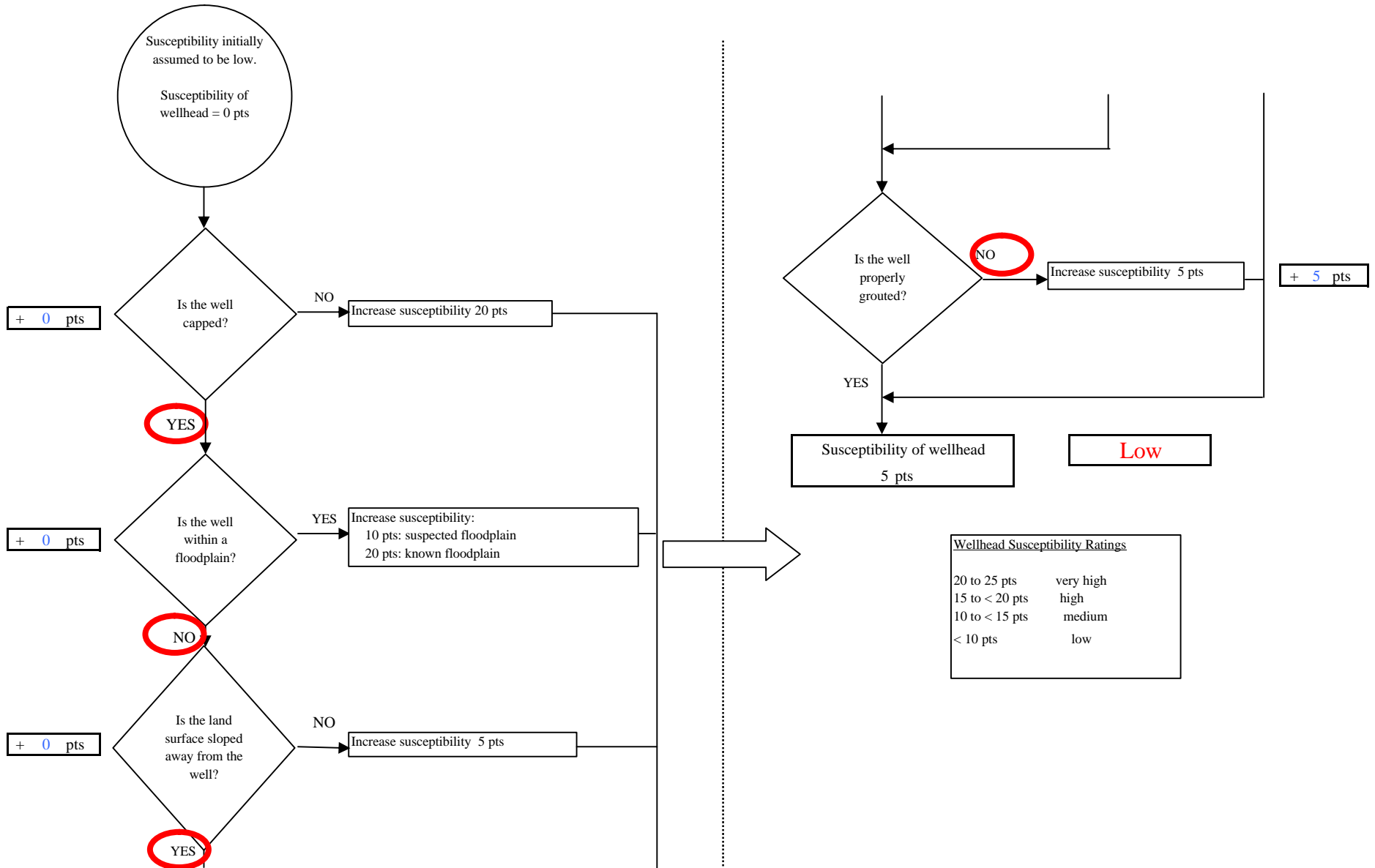
Less than 10-Years Travel Time



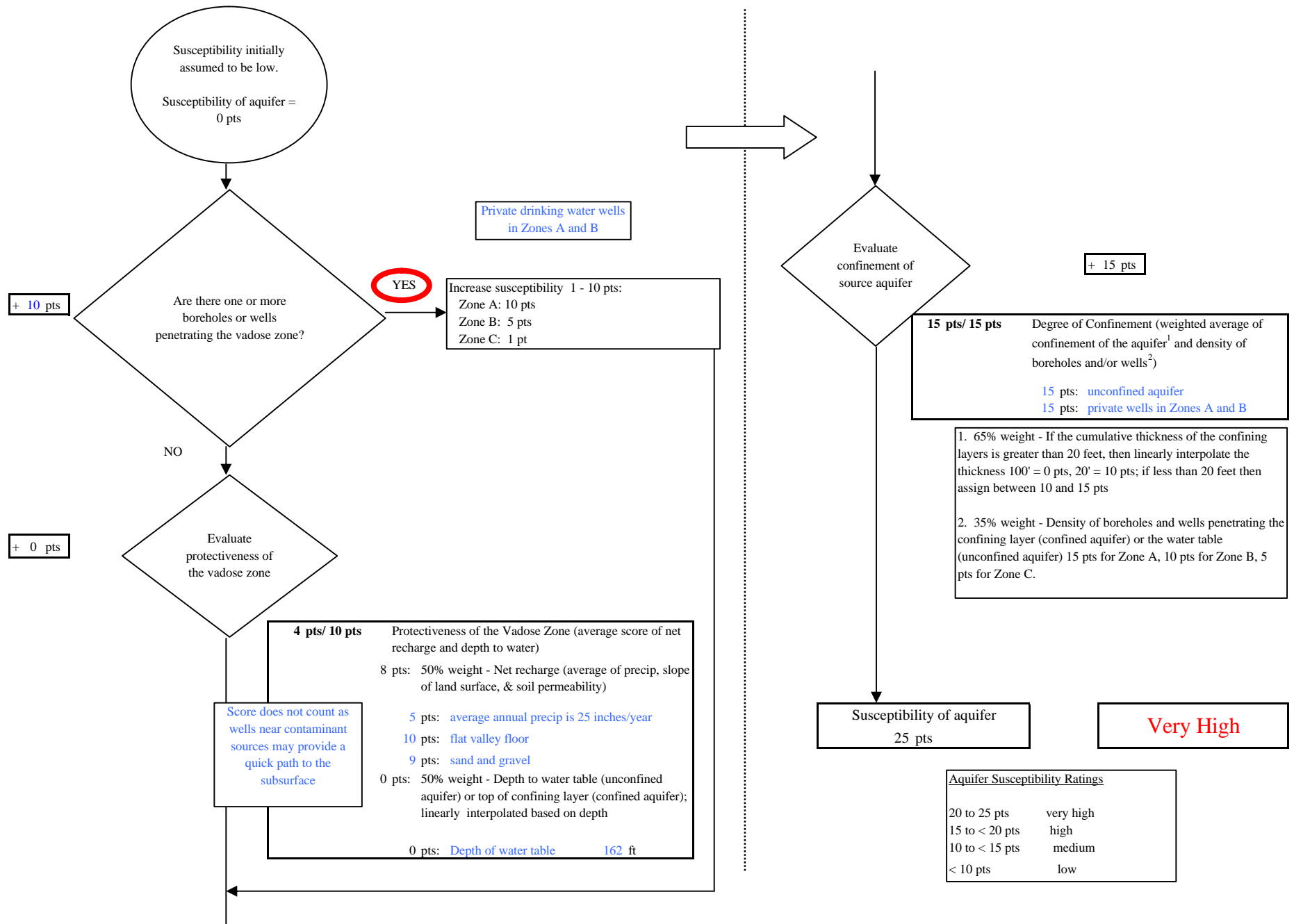
## **APPENDIX D**

### **Vulnerability Analysis for Shopper's Cache and Laundry Well Public Drinking Water Source (Charts 1-8)**

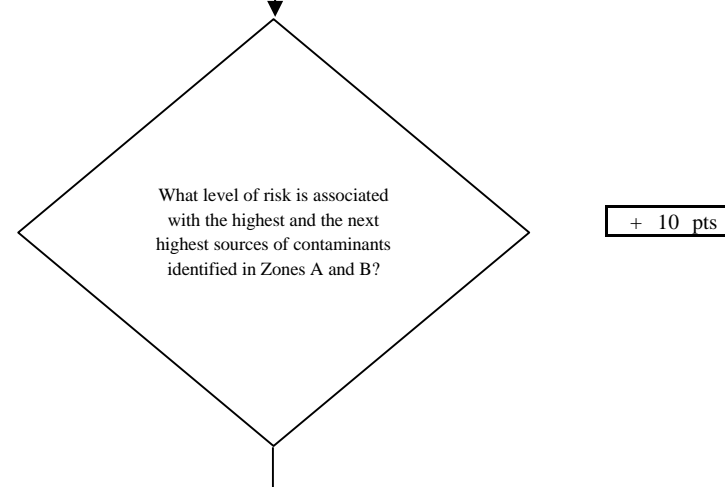
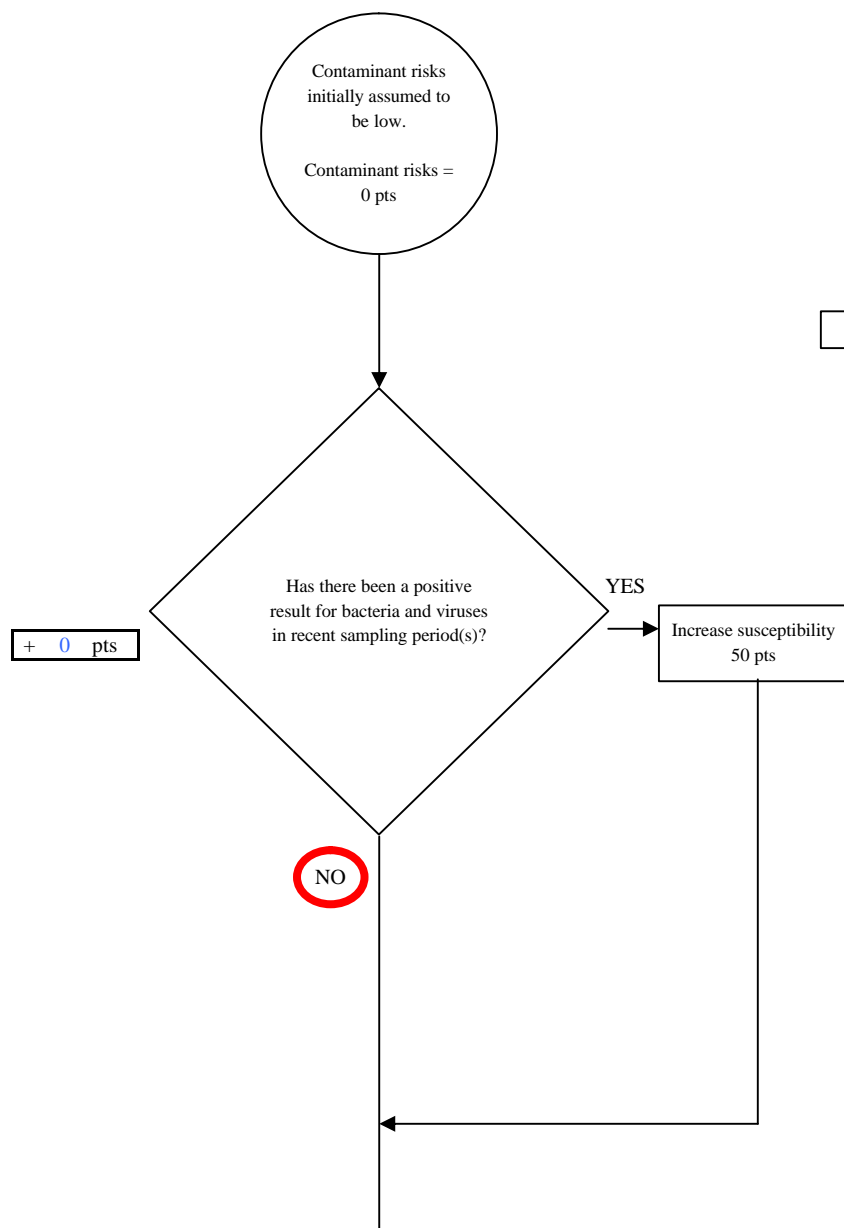
**Chart 1. Susceptibility of the Wellhead - Shopper's Cache and Laundry**



**Chart 2. Susceptibility of the Aquifer - Shopper's Cache and Laundry**



**Chart 3. Contaminant Risks for Shopper's Cache and Laundry - Bacteria & Viruses**



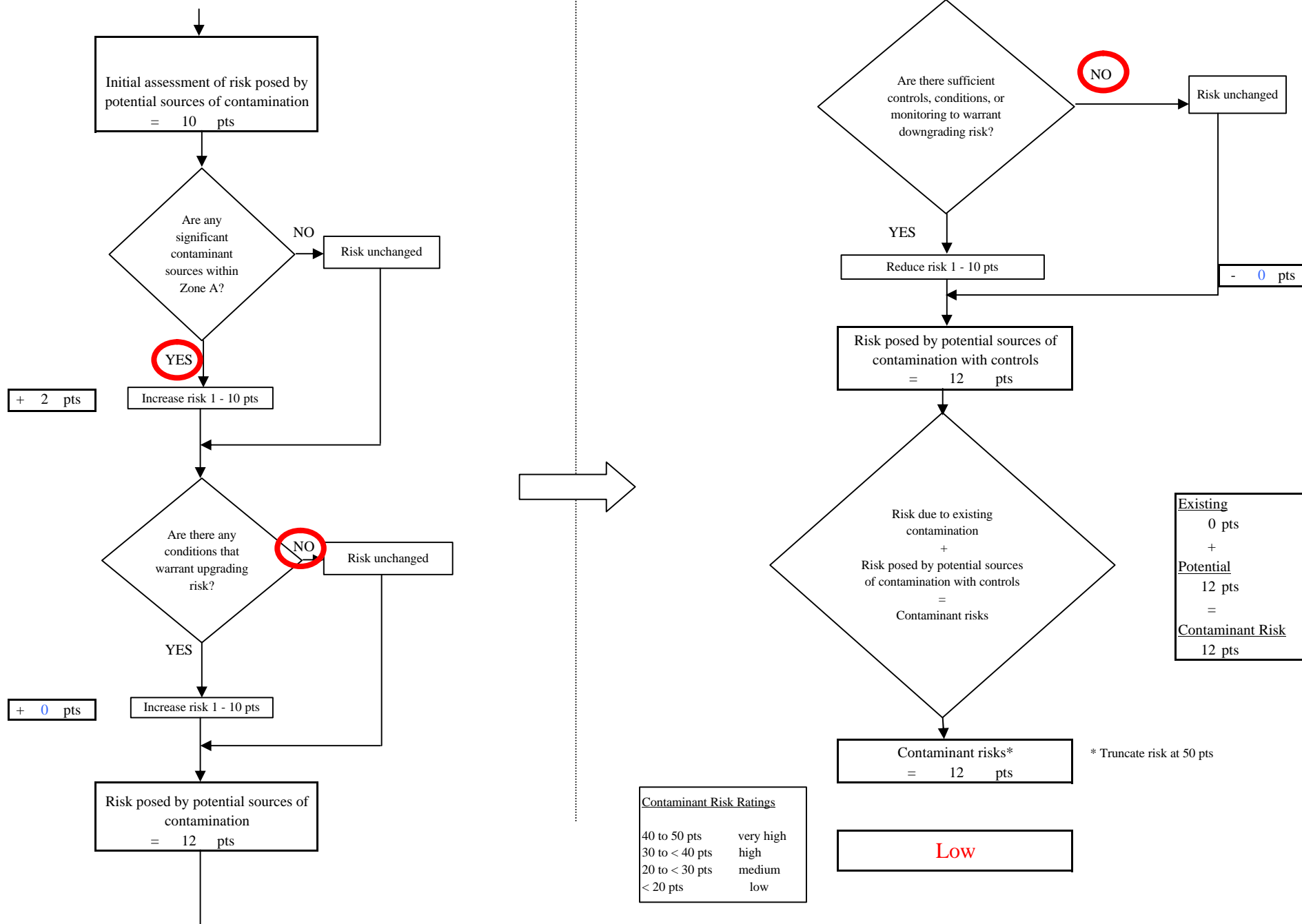
Risk Rankings for Contaminant Sources Identified in Zones A and B			
	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	1	4

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

Matrix Score 10

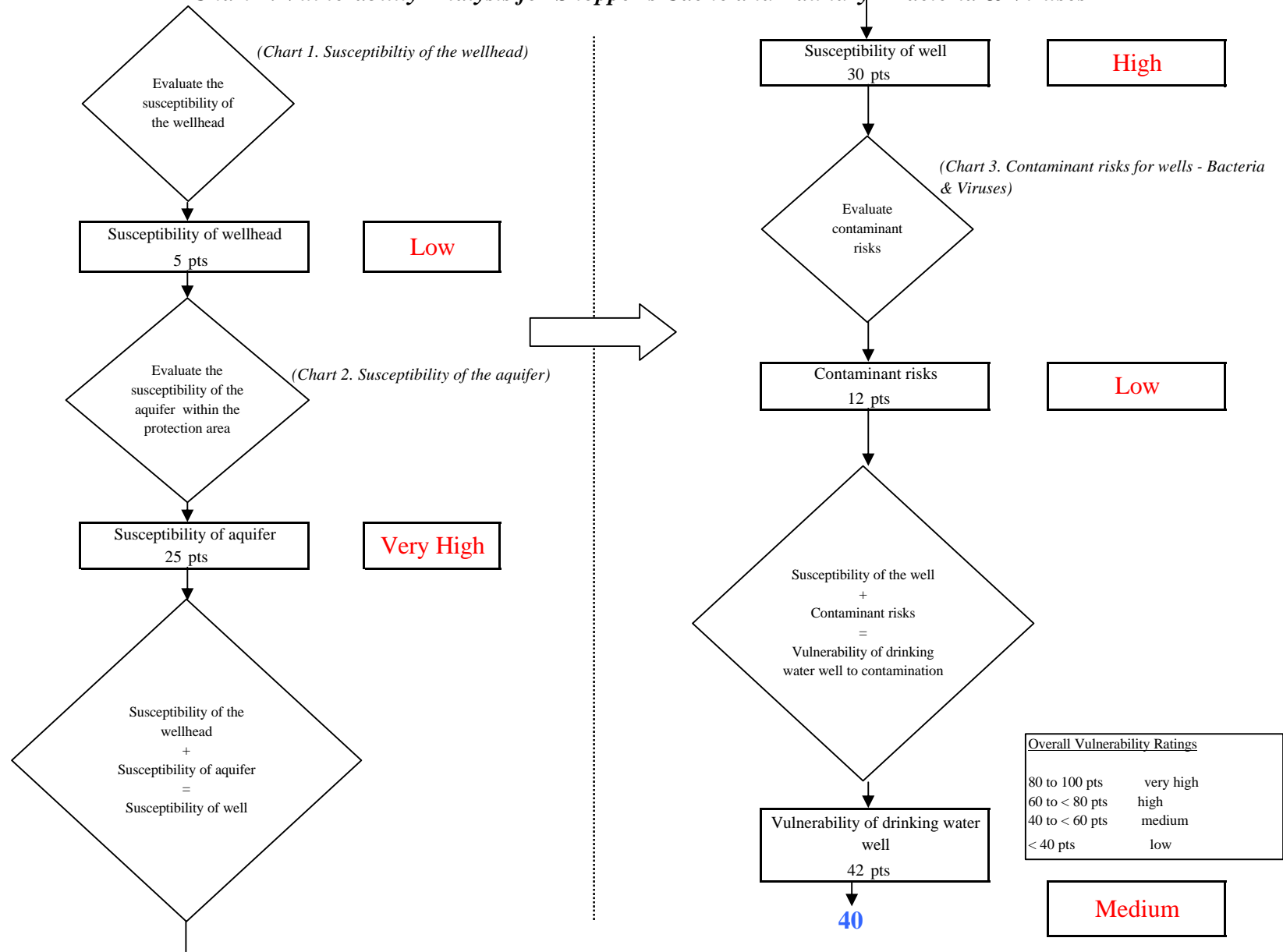
Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.

**Chart 3. Contaminant Risks for Shopper's Cache and Laundry - Bacteria & Viruses**

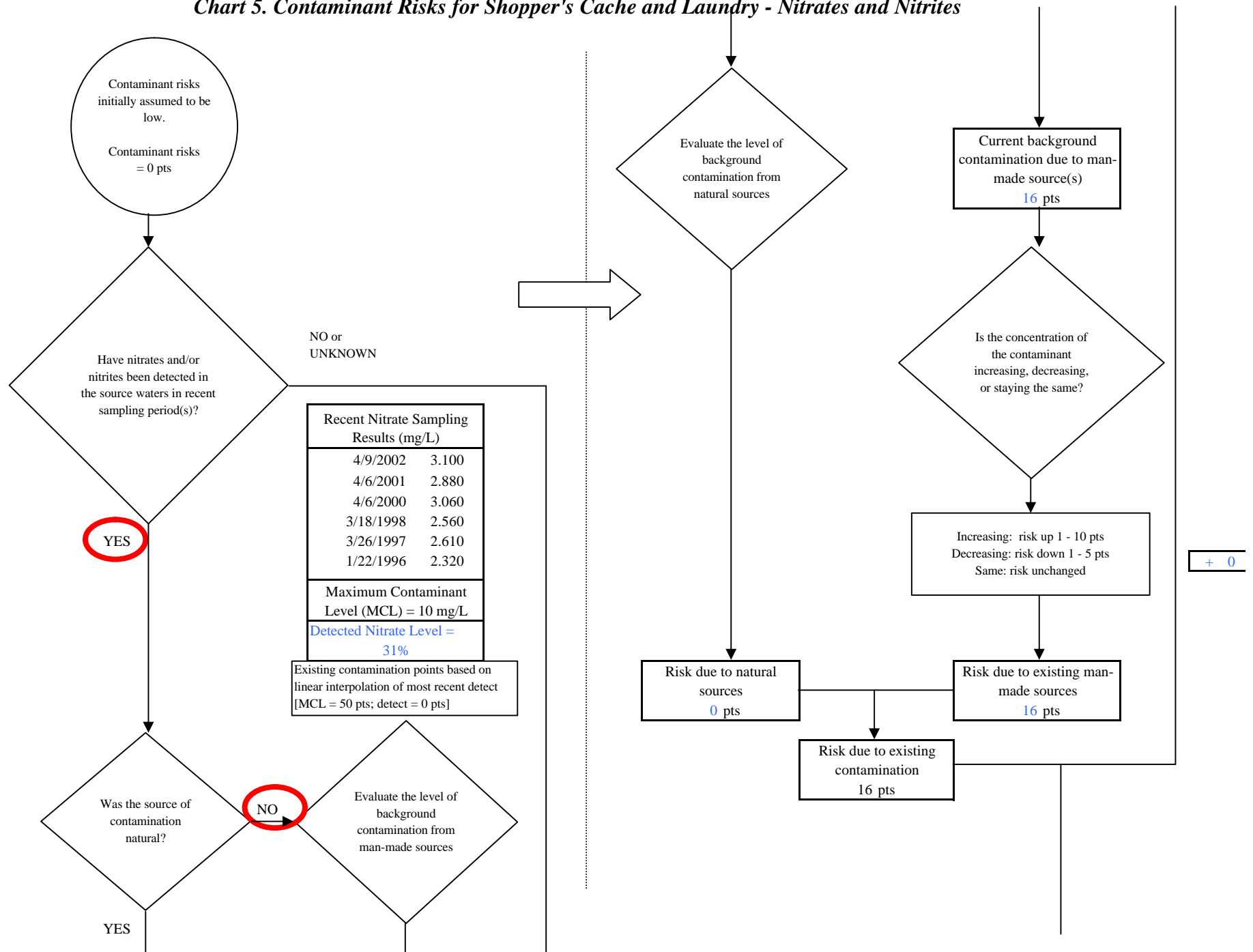




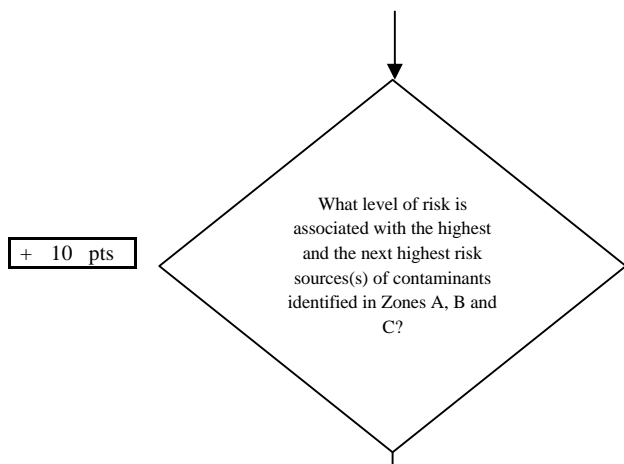
**Chart 4. Vulnerability Analysis for Shopper's Cache and Laundry - Bacteria & Viruses**



**Chart 5. Contaminant Risks for Shopper's Cache and Laundry - Nitrates and Nitrites**



**Chart 5. Contaminant Risks for Shopper's Cache and Laundry - Nitrates and Nitrites**



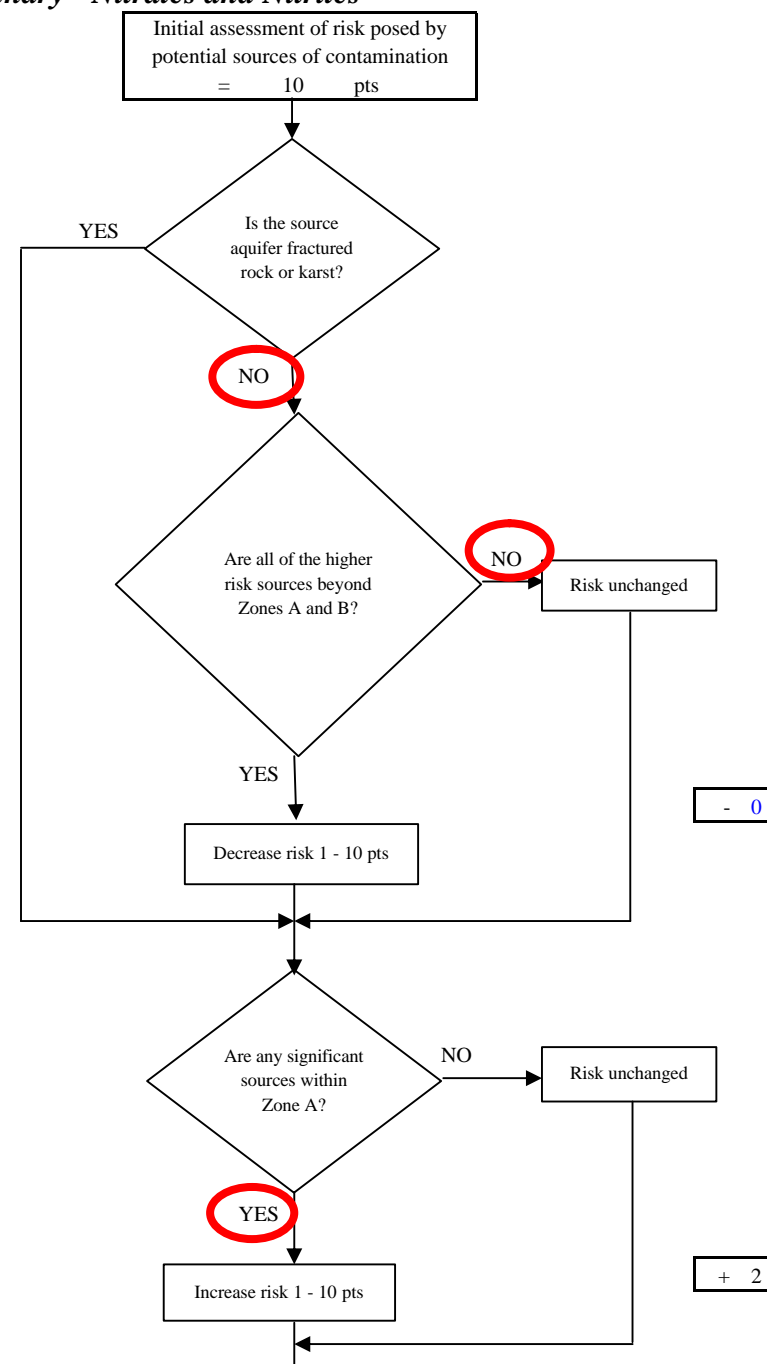
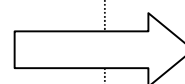
+ 10 pts

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	0	2

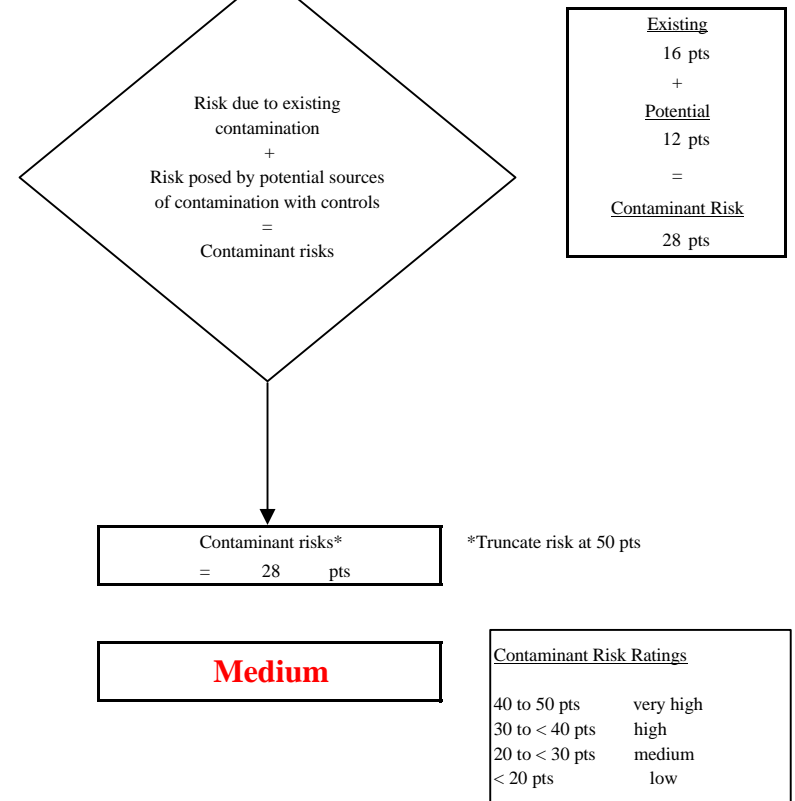
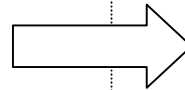
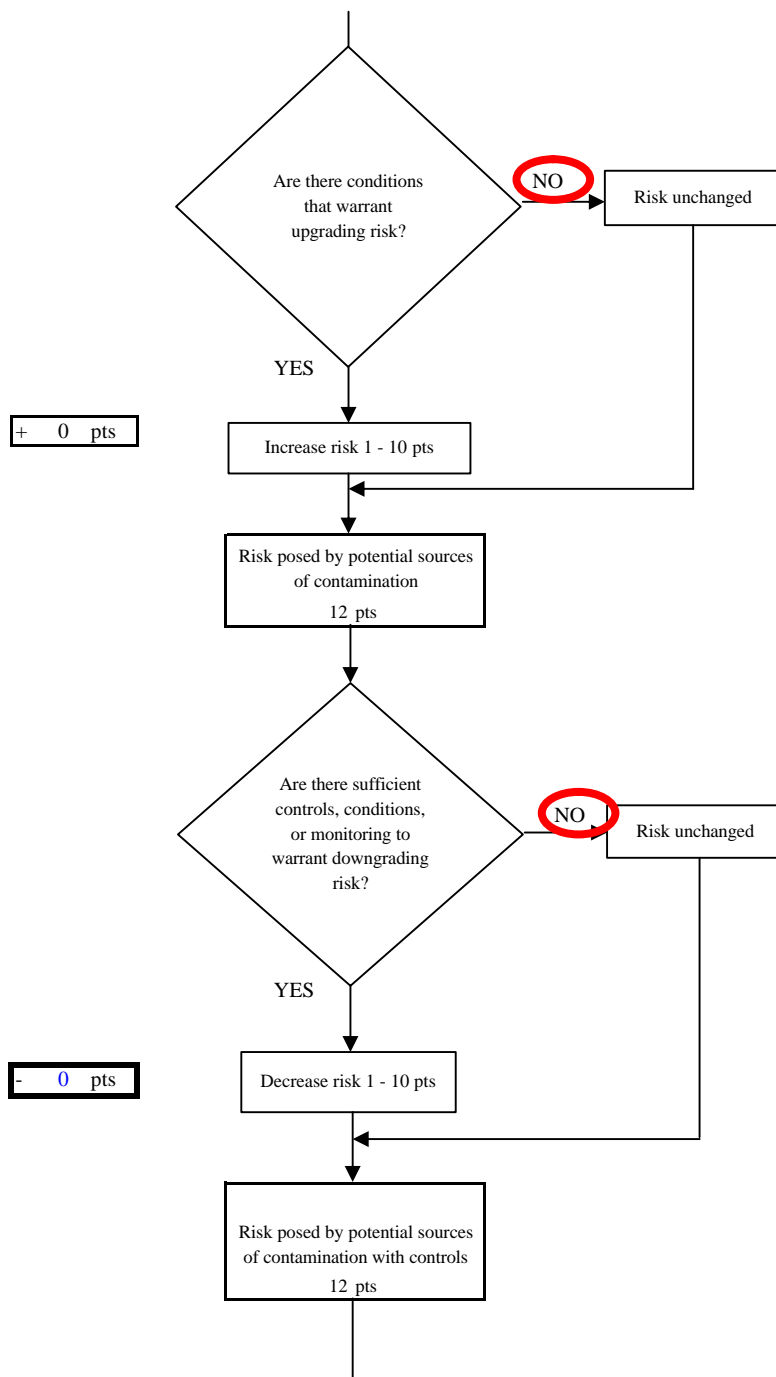
	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 10

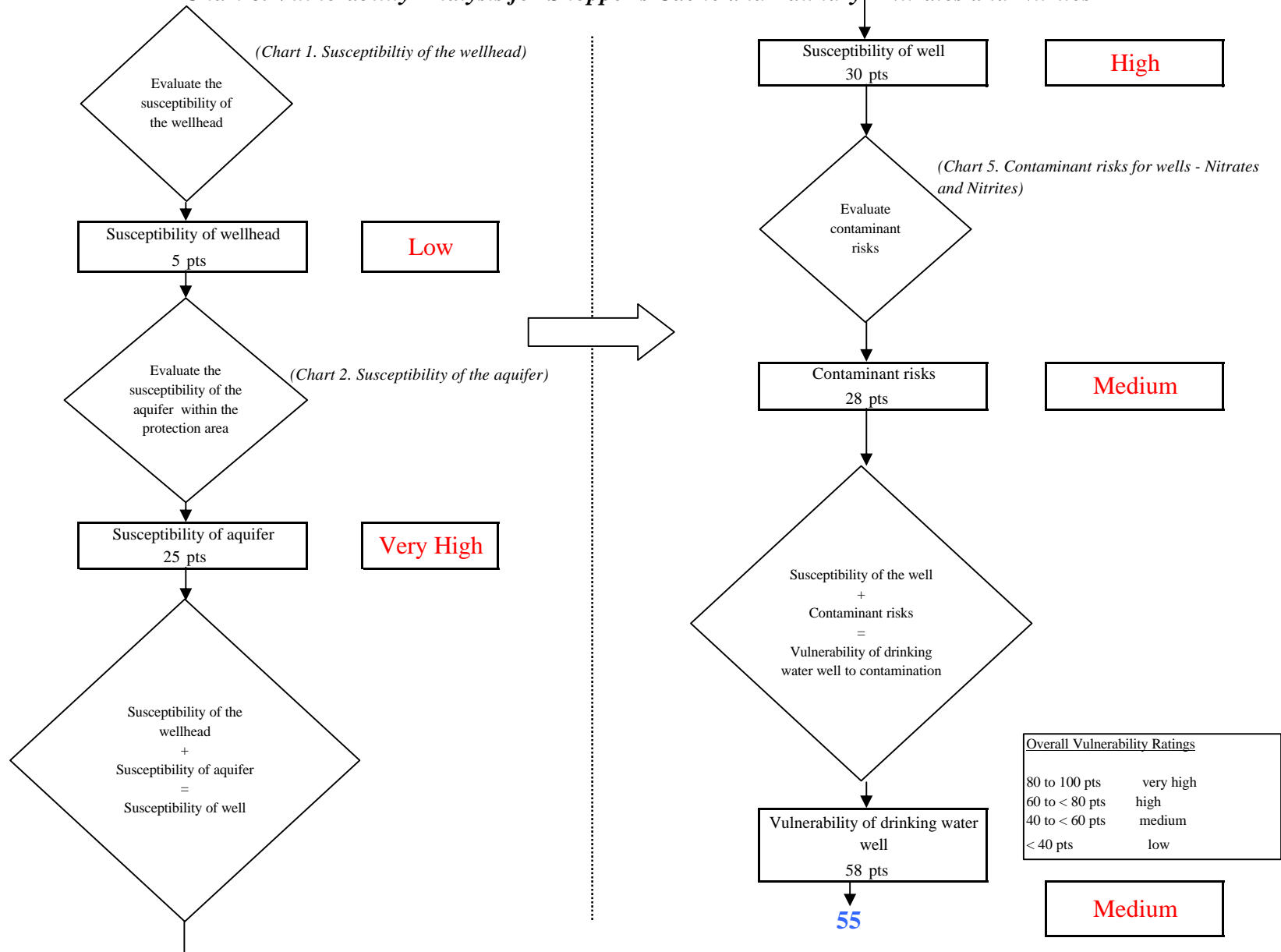
Note: Septic systems, sewerlines, and roads are each assigned a risk ranking for each individual contaminant source in the CSI. The VA, however, counts these contaminant sources as a group and assigns a calculated number of either "lows" or "mediums" based on the density.



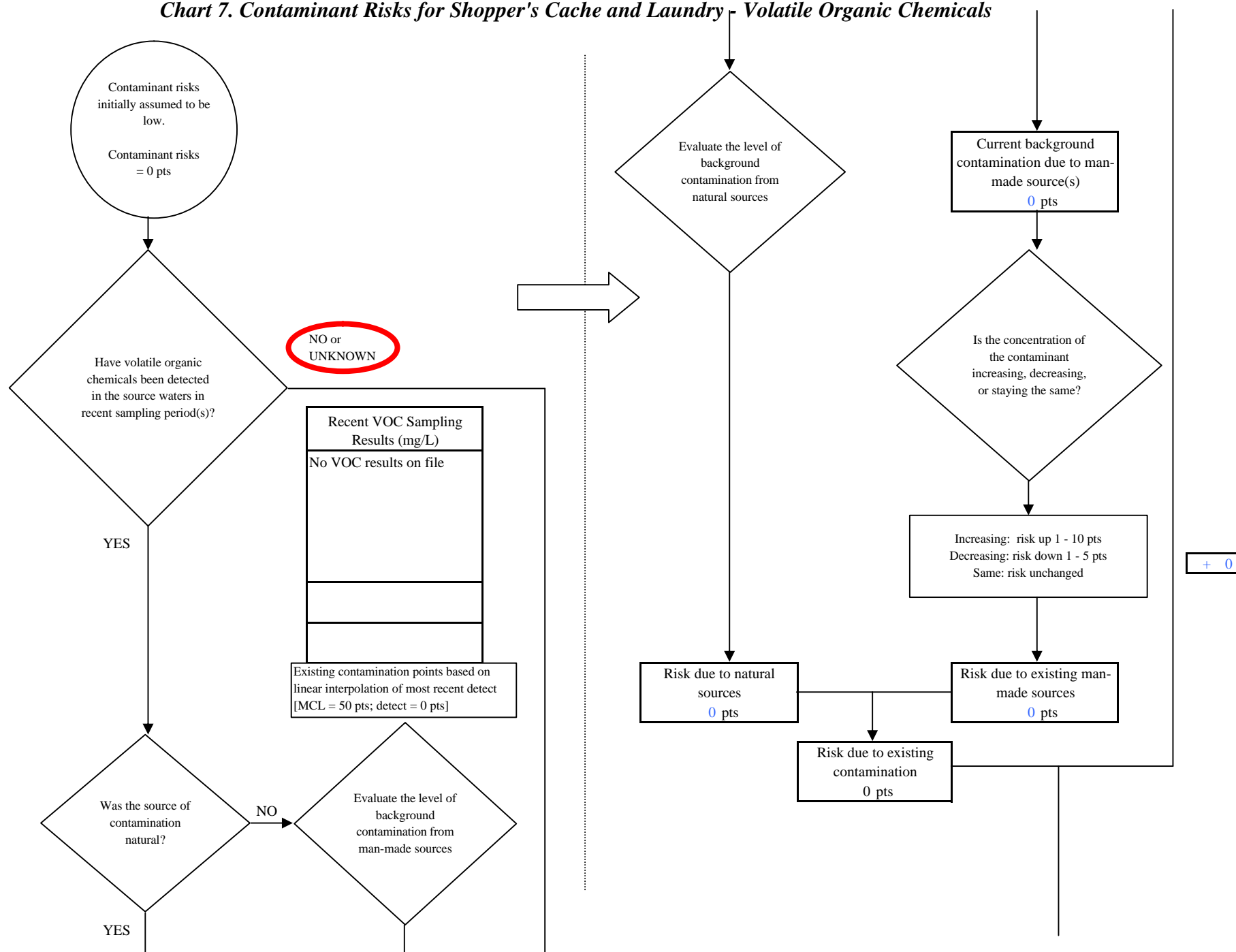
**Chart 5. Contaminant Risks for Shopper's Cache and Laundry - Nitrates and Nitrites**



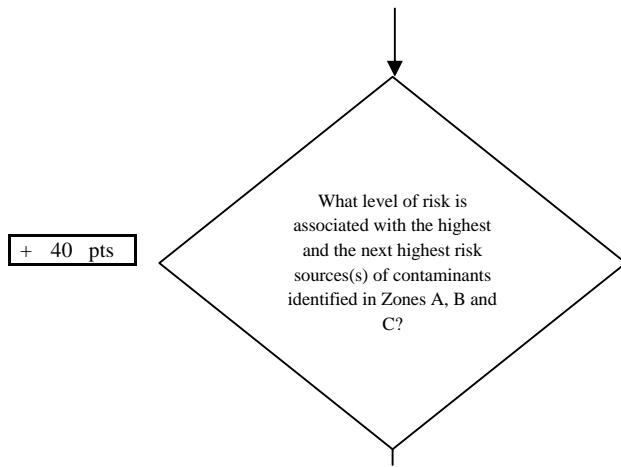
**Chart 6. Vulnerability Analysis for Shopper's Cache and Laundry - Nitrates and Nitrites**



**Chart 7. Contaminant Risks for Shopper's Cache and Laundry - Volatile Organic Chemicals**



**Chart 7. Contaminant Risks for Shopper's Cache and Laundry - Volatile Organic Chemicals**

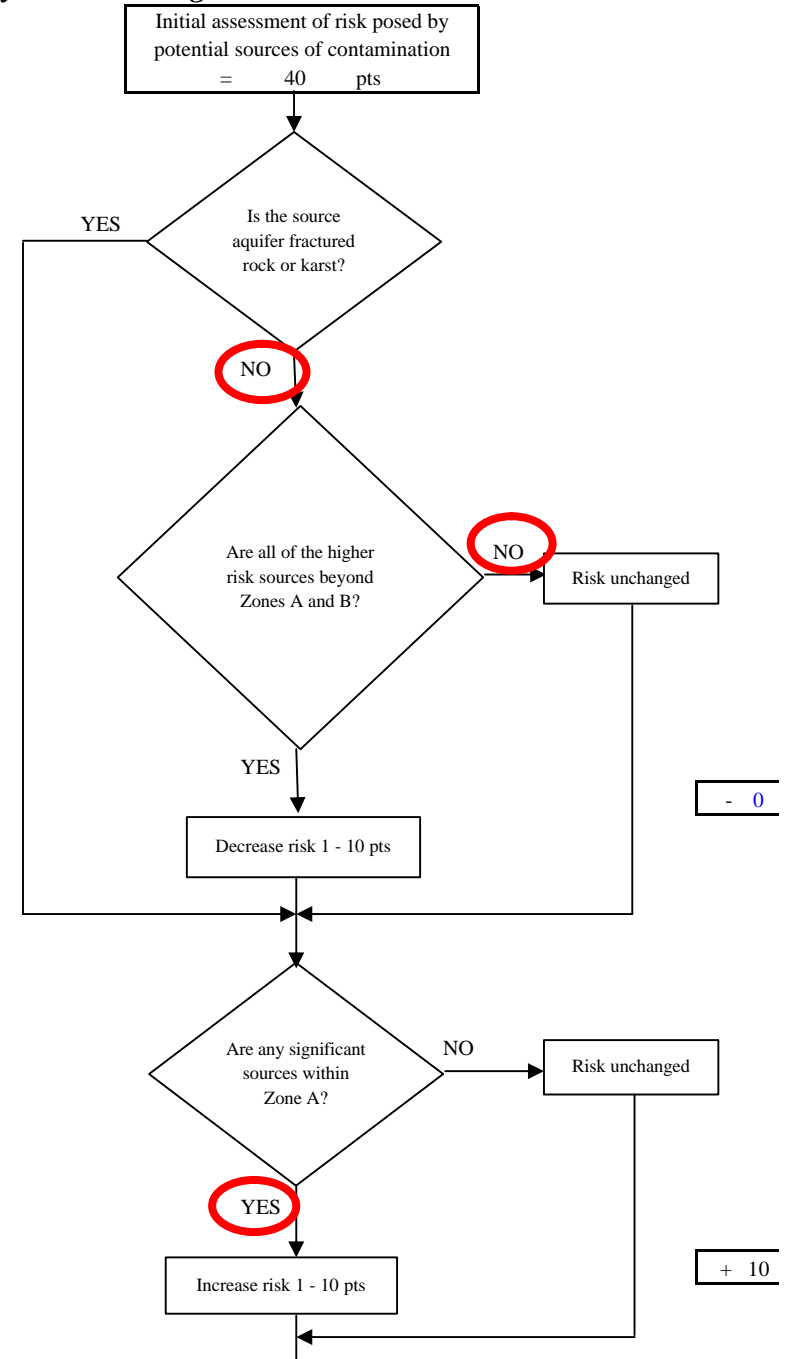


Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	3	0	3
Medium(s)	1	0	1
Low(s)	3	0	3

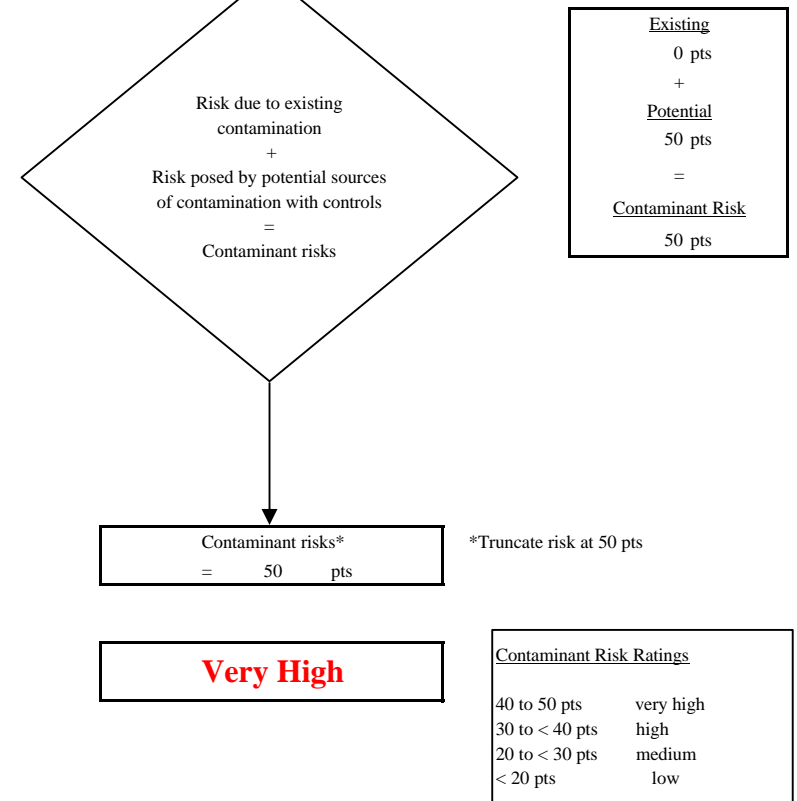
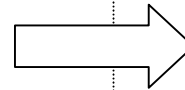
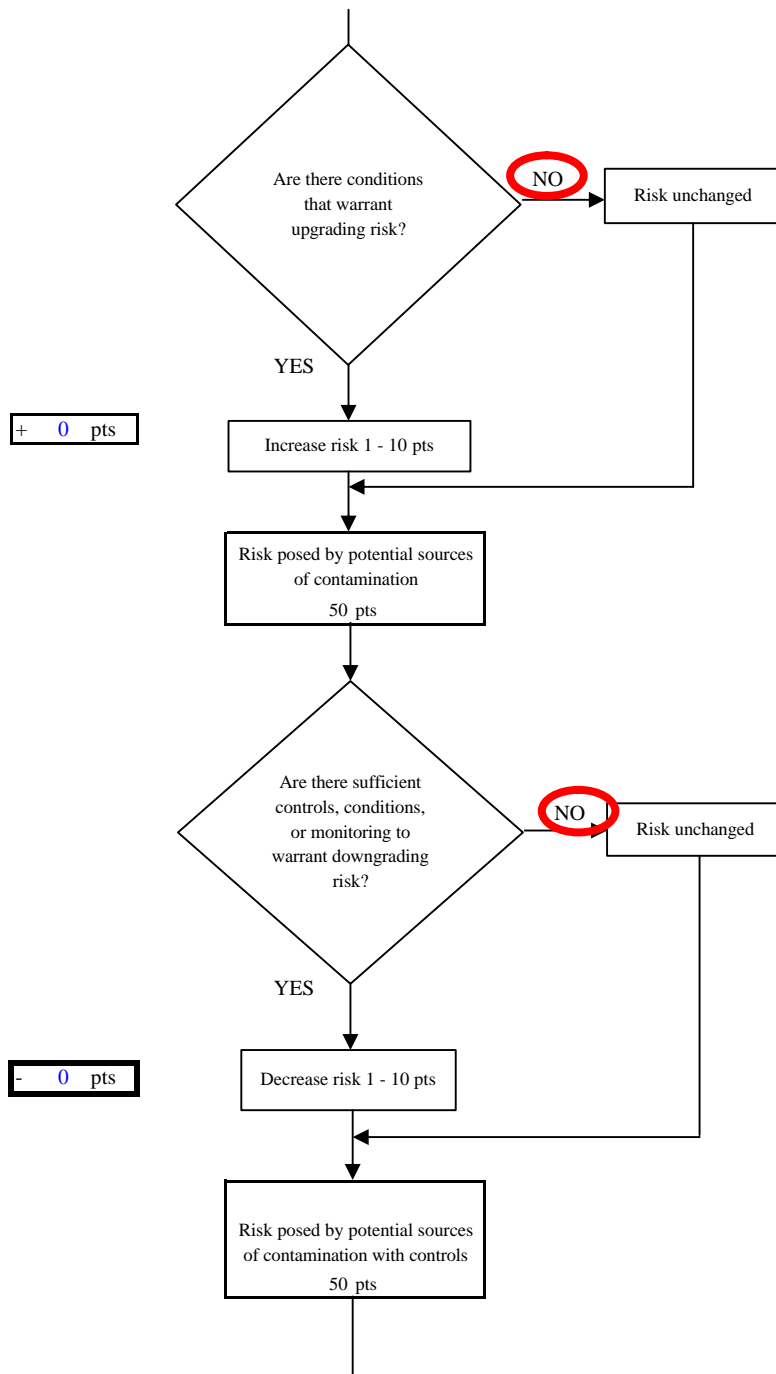
	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 40

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



**Chart 7. Contaminant Risks for Shopper's Cache and Laundry - Volatile Organic Chemicals**





**Chart 8. Vulnerability Analysis for Shopper's Cache and Laundry - Volatile Organic Chemicals**

