



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
The Foothills Congregation
Drinking Water System,
Anchorage, Alaska
PWSID # 216449.001

DRINKING WATER PROTECTION PROGRAM REPORT # 467
Alaska Department of Environmental Conservation

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By Heather A. Hammond

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

These assessments are intended to provide public water systems owners and/or 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 Foothills Congregation’s Source of Public Drinking Water, Anchorage, Alaska

By Heather A. Hammond

Drinking Water Protection Program Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Foothills Congregation 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 Foothills Congregation’s public drinking water source include: approximately 21 acres of residential area, roads, sewer lines, residential septic systems, an asphalt and tar processing/storage site, and parks 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 sources for Foothills Congregation received a vulnerability rating of **Medium** for bacteria and viruses, nitrates and/or nitrites, and **Low** for volatile organic chemicals.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide public

water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska’s public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system.

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

DESCRIPTION OF THE 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.

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

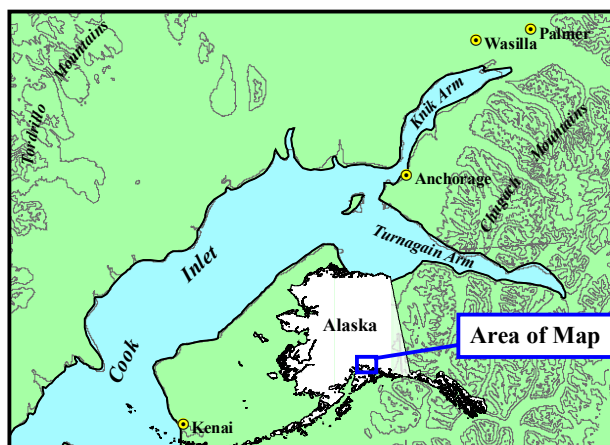


Figure 1. Index map showing the location of Anchorage, Alaska

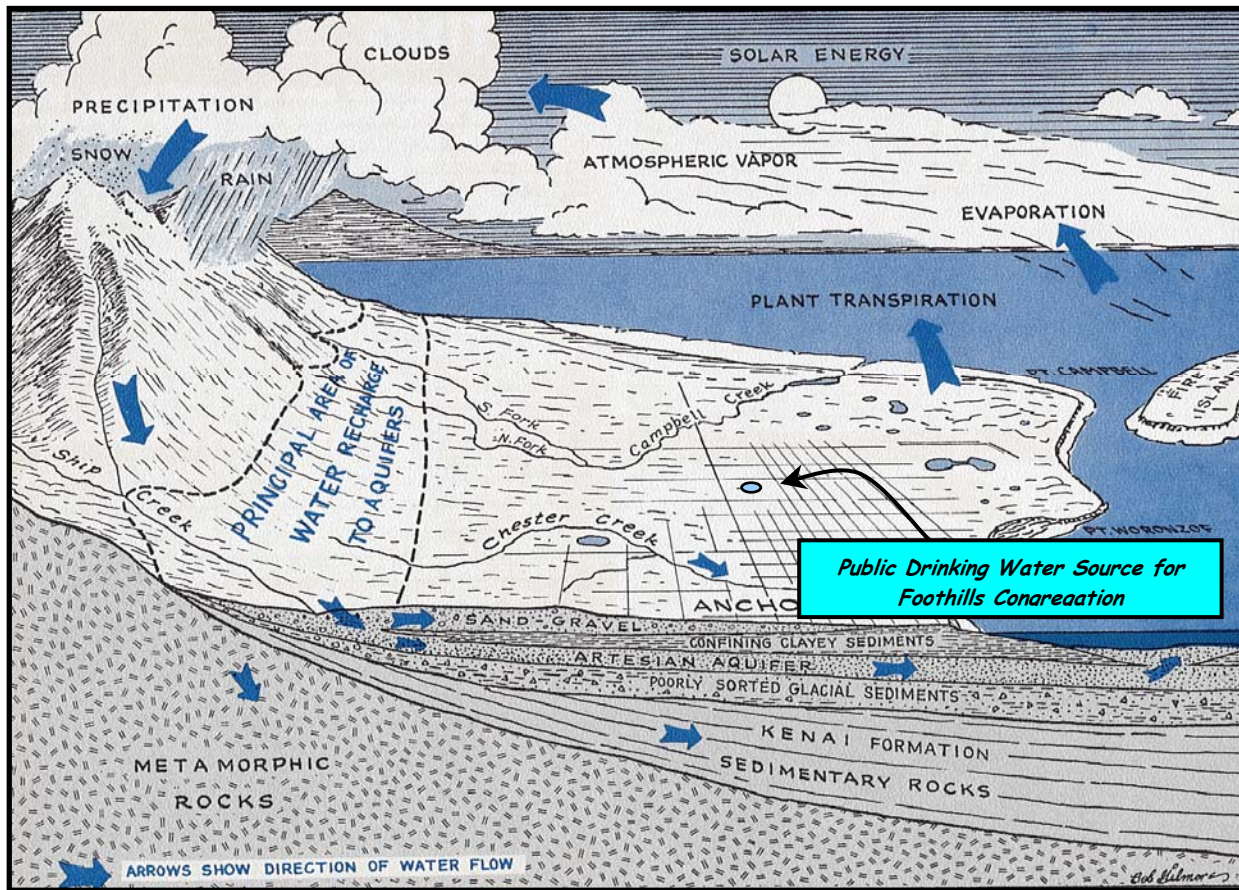


Figure 2. Generalized hydrologic cycle in the Anchorage area [Barnwell, George, Dearborn, Weeks, and Zenone, 1972].

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 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 surficial topography as well as its close connection with surface water bodies.

FOOTHILLS CONGREGATION'S PUBLIC DRINKING WATER SYSTEM

Foothills Congregation is a Class B (transient/non-community) water system. The system consists of one well off of East 48th Avenue. This area is at an elevation of approximately 150 feet above sea level.

There is no well log available for the well serving Foothills Congregation. According to the most recent Sanitary Survey (09/08/99) installation of the well occurred during the early 1970's. It is suspected that the well was drilled to a total depth of approximately 137 feet below ground surface and was completed in 6-inch well casing. The Sanitary Survey indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at

the well casing. The Sanitary Survey also notes that the land surface is appropriately sloped to provide adequate surface water drainage. Due to the date that the well was installed it is suspected that the well was not 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 2 residents, and 244 non-residents through one service connection.

FOOTHILLS CONGREGATION'S DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate 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.

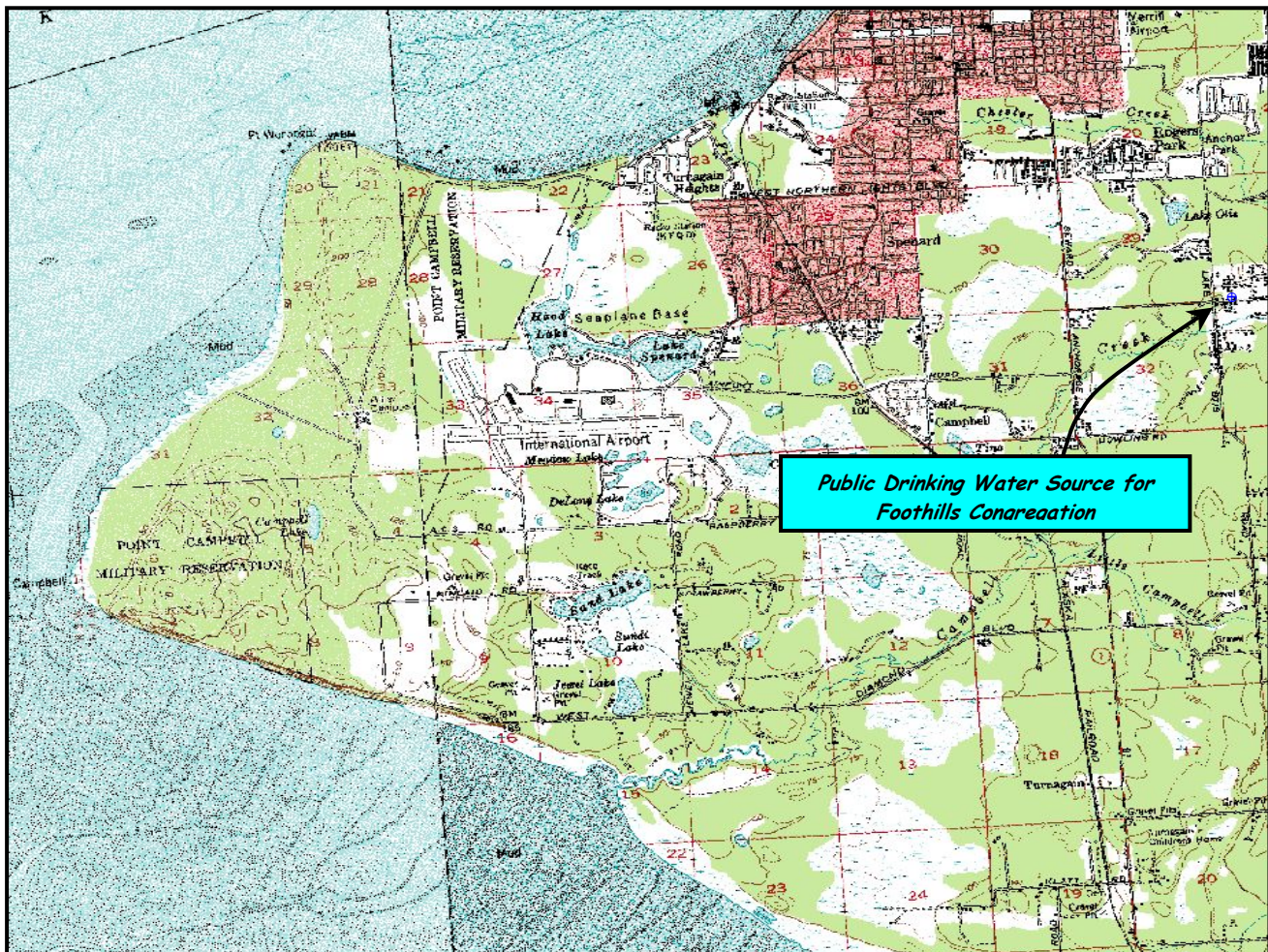


Figure 3. Map showing the location of the drinking water sources for Foothills Congregation [Base: USGS Tyonek A1].

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 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*). 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 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 five 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 Foothills Congregation’s 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 source water assessments, three categories of drinking water contaminants were inventoried:

- 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 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 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.

VULNERABILITY OF THE FOOTHILLS CONGREGATION 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:

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

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

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

Because no well log was available, geologic information was gathered from wells within a ¼ mile radius of Foothills Congregation’s source of public drinking water. Based on the information gathered, it is suspected that the well for Foothills Congregation is completed in a confined aquifer setting. The depth to the top of the confining layer is approximately 100 feet below land surface and consists of a layer of clay and gravel with a thickness of approximately 9 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. Table 2 shows the Overall Susceptibility score and rating for Foothills Congregation.

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

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	9	Low
Natural Susceptibility	14	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 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

Category	Score	Rating
Bacteria and Viruses	30	High

Nitrates and/or Nitrites	30	High
Volatile Organic Chemicals	22	Medium

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 3 contains the overall vulnerability scores (0 – 10) 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 Foothills Congregation to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	45	Medium
Nitrates and Nitrites	45	Medium
Volatile Organic Chemicals	35	Low

Tables 2 through 5 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 residential areas, septic systems, and sewer lines present the greatest risk for bacteria and viruses, and nitrates and/or nitrites contaminant categories. The risk to Foothills Congregation’s source of public drinking water with regard to bacteria and viruses and nitrates and/or nitrites is medium after combining the scores for contaminant risk and vulnerability.

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 Foothills Congregation (See Chart 3 – Contaminant Risks for Bacteria and Viruses

in Appendix D).

Nitrates and/or nitrites are found in natural background concentration 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 Foothills Congregation indicates that no nitrates and/or nitrites have been detected (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

The asphalt and tar processing/storage area, as well as roads and sewer lines pose the greatest risk for volatile organic chemical contamination. The risk to Foothills Congregation's source of public drinking water with regard to volatile organic chemicals is low after combining the scores for contaminant risk and vulnerability.

Review of historical sampling data indicates that no volatile organic chemicals have been detected that the well.

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Foothills Congregation. The overall vulnerability of this source to contamination is **Medium** for bacteria and viruses, nitrates and/or nitrites, and **Low** 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 Foothills Congregation 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 Foothills Congregation's public drinking water source.

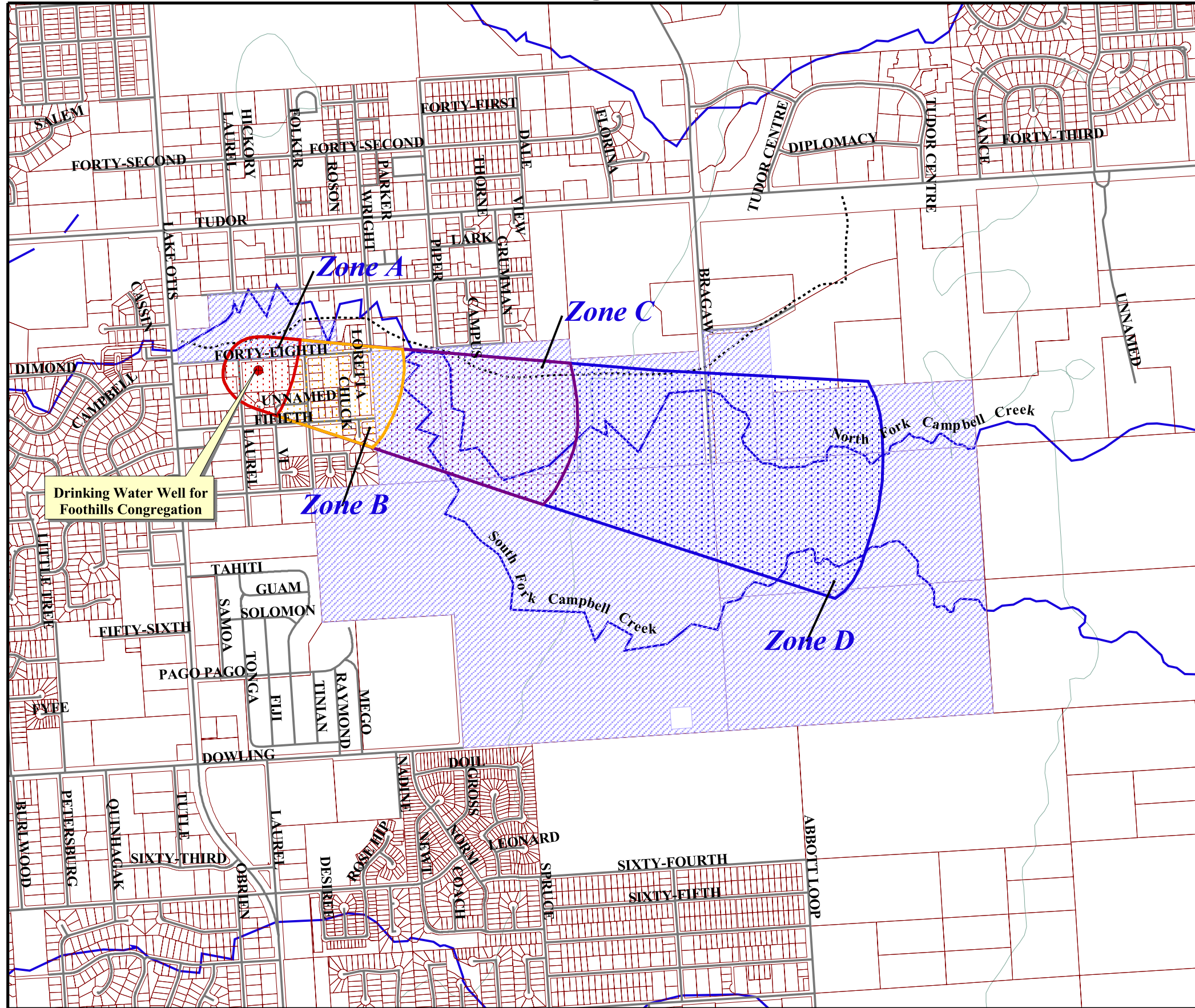
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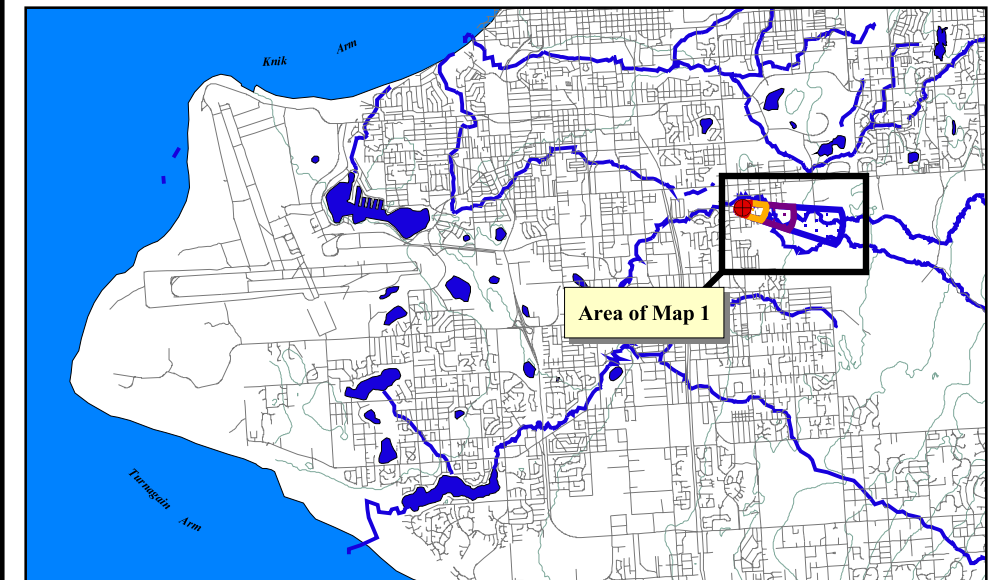
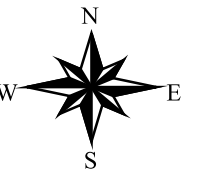
APPENDIX A

Foothills Congregation's Drinking Water Protection Area (Map 1)

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Foothills Congregation



- Foothills Congregation
- 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 Parks (X4)
- Trails (X46)
- Anchorage Roads
- Land Parcels
- Anchorage Streams
- Elevation Contours



2000 0 2000 4000 Feet

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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Foothills Congregation (Tables 1-4)

Table 1

**Contaminant Source Inventory for
Foothills Congregation**

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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 Forthy-eighth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Along Hartman Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Along Forthy-eighth Ave.	3	
Residential Areas	R01	R1-1	A	Residential areas located within Zone A	3	6 acres of residential area in Zone A.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Laurel Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Forty-eighth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Hartman Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	A	Unnamed Road	2	
Municipal or city parks (with green areas)	X04	X4-1	A	Anchorage parks within Zone A	2	
Dog walking areas/foot trails	X46	X46-1	A	Trail intersecting Zone A	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-10	B	Along Wright Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Along Loretta Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Along Sundance Circle	3	
Asphalt and tar processing/storage	I03	I3-1	B	Off of Forty-eighth Ave.	2	
Lawns and gardens	R01	R1-2	B	Residential areas located within Zone B	3	15 acres of residential area in Zone B.

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Location</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one or more single-family homes)	R02	R2-1	B	Septic system off of Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11	B	Sundance Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Folker Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Unnamed Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Fiftieth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Loretta Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Wright Street	2	
Municipal or city parks (with green areas)	X04	X4-2	B	Anchorage parks intersecting Zone B	2	
Municipal or city parks (with green areas)	X04	X4-3	B	Anchorage parks intersecting Zone B	2	
Dog walking areas/foot trails	X46	X46-2	C	Trail intersecting Zone C along North Fork Campbell Creek	4	

Table 2

*Contaminant Source Inventory and Risk Ranking for
Foothills Congregation
Sources of Bacteria and Viruses*

PWSID 216449.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	Along Forthy-eighth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	Along Hartman Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Medium	Along Forthy-eighth Ave.	3	
Residential Areas	R01	R1-1	A	Low	Residential areas located within Zone A	3	6 acres of residential area in Zone A.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	Laurel Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	Forty-eighth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	Hartman Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	A	Low	Unnamed Road	2	
Municipal or city parks (with green areas)	X04	X4-1	A	Medium	Anchorage parks within Zone A	2	
Dog walking areas/foot trails	X46	X46-1	A	Low	Trail intersecting Zone A	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-10	B	Medium	Along Wright Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Medium	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Medium	Along Loretta Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Medium	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Medium	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Medium	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Medium	Along Sundance Circle	3	
Lawns and gardens	R01	R1-2	B	Low	Residential areas located within Zone B	3	15 acres of residential area in Zone B.

Table 2 (continued)

*Contaminant Source Inventory and Risk Ranking for
Foothills Congregation
Sources of Bacteria and Viruses*

PWSID 216449.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one or more single-family homes)	R02	R2-1	B	Low	Septic system off of Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Low	Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11	B	Low	Sundance Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	Folker Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low	Unnamed Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low	Fiftieth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low	Loretta Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	Wright Street	2	
Municipal or city parks (with green areas)	X04	X4-2	B	Medium	Anchorage parks intersecting Zone B	2	
Municipal or city parks (with green areas)	X04	X4-3	B	Medium	Anchorage parks intersecting Zone B	2	
Dog walking areas/foot trails	X46	X46-2	C	Low	Trail intersecting Zone C along North Fork Campbell Creek	4	

Table 3

*Contaminant Source Inventory and Risk Ranking for
Foothills Congregation
Sources of Nitrates/Nitrites*

PWSID 216449.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium	Along Forthy-eighth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium	Along Hartman Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Medium	Along Forthy-eighth Ave.	3	
Residential Areas	R01	R1-1	A	Low	Residential areas located within Zone A	3	6 acres of residential area in Zone A.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	Laurel Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	Forty-eighth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	Hartman Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	A	Low	Unnamed Road	2	
Municipal or city parks (with green areas)	X04	X4-1	A	Medium	Anchorage parks within Zone A	2	
Dog walking areas/foot trails	X46	X46-1	A	Low	Trail intersecting Zone A	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-10	B	Medium	Along Wright Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Medium	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Medium	Along Loretta Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Medium	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Medium	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Medium	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Medium	Along Sundance Circle	3	
Lawns and gardens	R01	R1-2	B	Low	Residential areas located within Zone B	3	15 acres of residential area in Zone B.

Table 3 (continued)

*Contaminant Source Inventory and Risk Ranking for
Foothills Congregation
Sources of Nitrates/Nitrites*

PWSID 216449.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one or more single-family homes)	R02	R2-1	B	Low	Septic system off of Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Low	Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11	B	Low	Sundance Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	Folker Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low	Unnamed Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low	Fiftieth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low	Loretta Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	Wright Street	2	
Municipal or city parks (with green areas)	X04	X4-2	B	Medium	Anchorage parks intersecting Zone B	2	
Municipal or city parks (with green areas)	X04	X4-3	B	Medium	Anchorage parks intersecting Zone B	2	
Dog walking areas/foot trails	X46	X46-2	C	Low	Trail intersecting Zone C along North Fork Campbell Creek	4	

Table 4

*Contaminant Source Inventory and Risk Ranking for
Foothills Congregation
Sources of Volatile Organic Chemicals*

PWSID 216449.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low	Along Forty-eighth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low	Along Hartman Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Low	Along Forty-eighth Ave.	3	
Residential Areas	R01	R1-1	A	Low	Residential areas located within Zone A	3	6 acres of residential area in Zone A.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	Laurel Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low	Forty-eighth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	Hartman Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	A	Low	Unnamed Road	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-10	B	Low	Along Wright Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	B	Low	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-5	B	Low	Along Loretta Circle	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-6	B	Low	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-7	B	Low	Along Folker Street	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-8	B	Low	Along Fiftieth Ave.	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-9	B	Low	Along Sundance Circle	3	
Asphalt and tar processing/storage	I03	I3-1	B	Medium	Off of Forty-eighth Ave.	2	
Lawns and gardens	R01	R1-2	B	Low	Residential areas located within Zone B	3	15 acres of residential area in Zone B.

Table 4 (continued)

Contaminant Source Inventory and Risk Ranking for
Foothills Congregation
Sources of Volatile Organic Chemicals

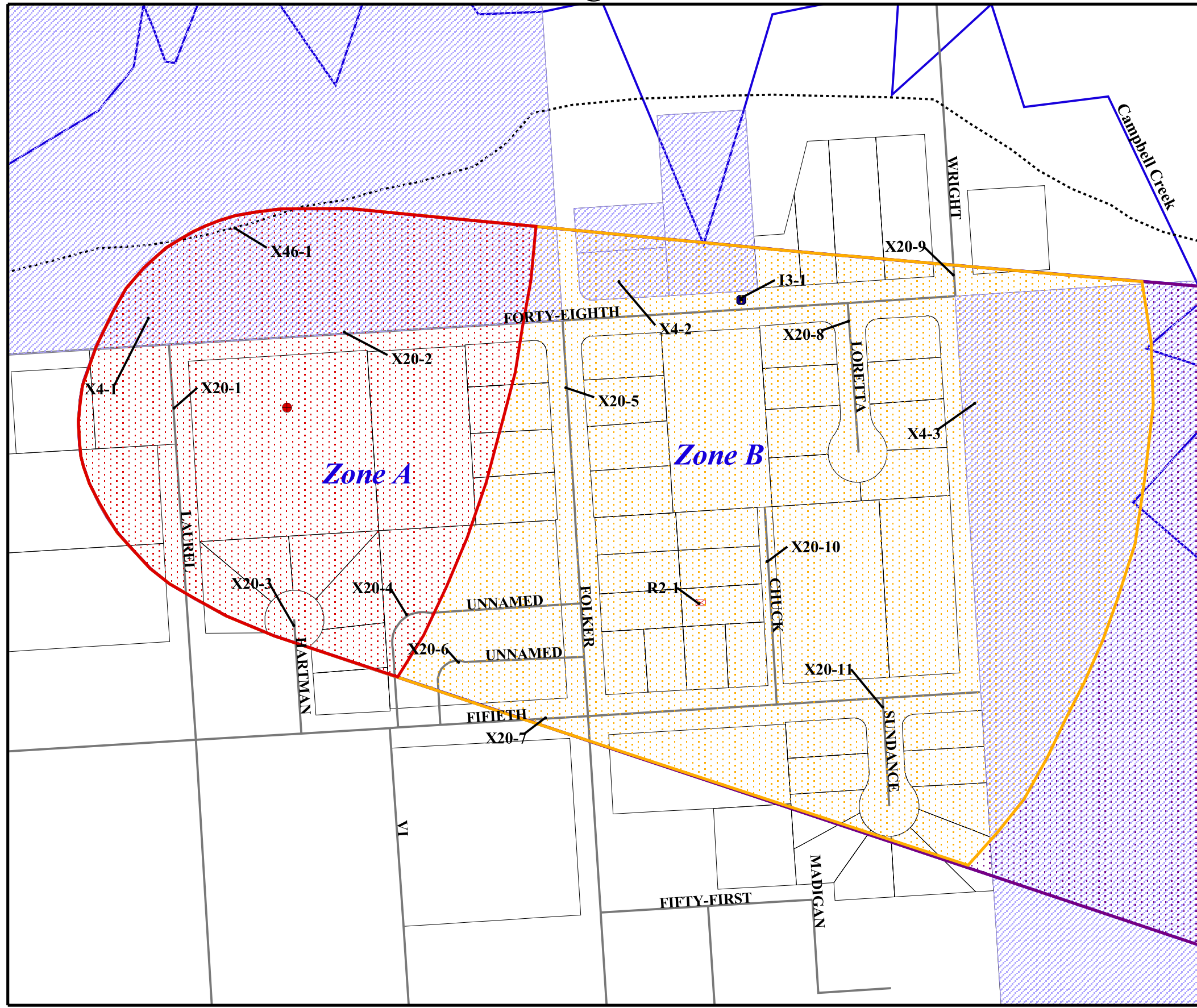
PWSID 216449.001

<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>Location</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one or more single-family homes)	R02	R2-1	B	Low	Septic system off of Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Low	Chuck Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11	B	Low	Sundance Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low	Folker Street	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low	Unnamed Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low	Fiftieth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low	Loretta Circle	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Low	Wright Street	2	

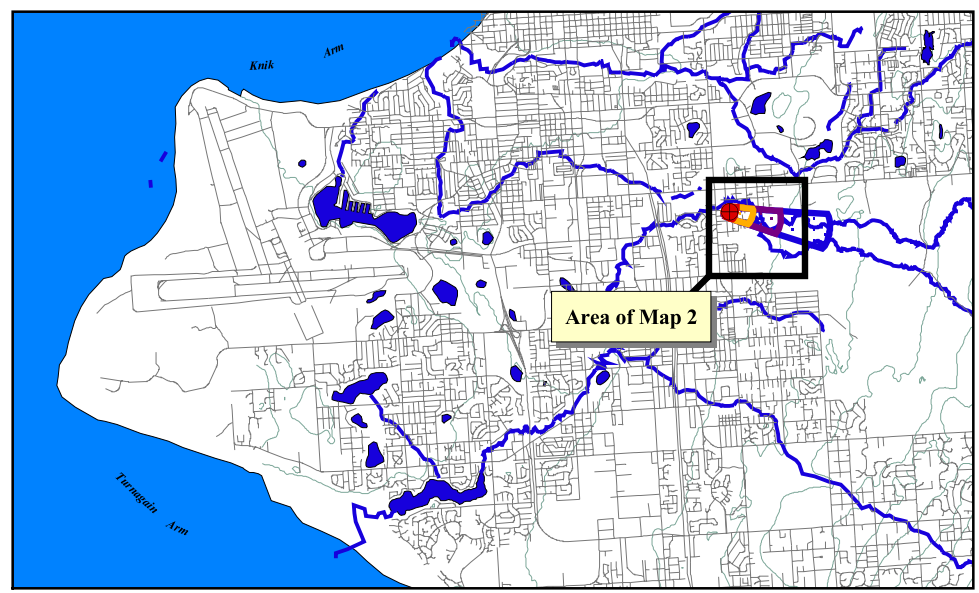
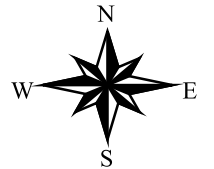
APPENDIX C

Foothills Congregation's Drinking Water Protection Area and Potential and Existing Contaminant Sources (Maps 2-4)

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Foothills Congregation



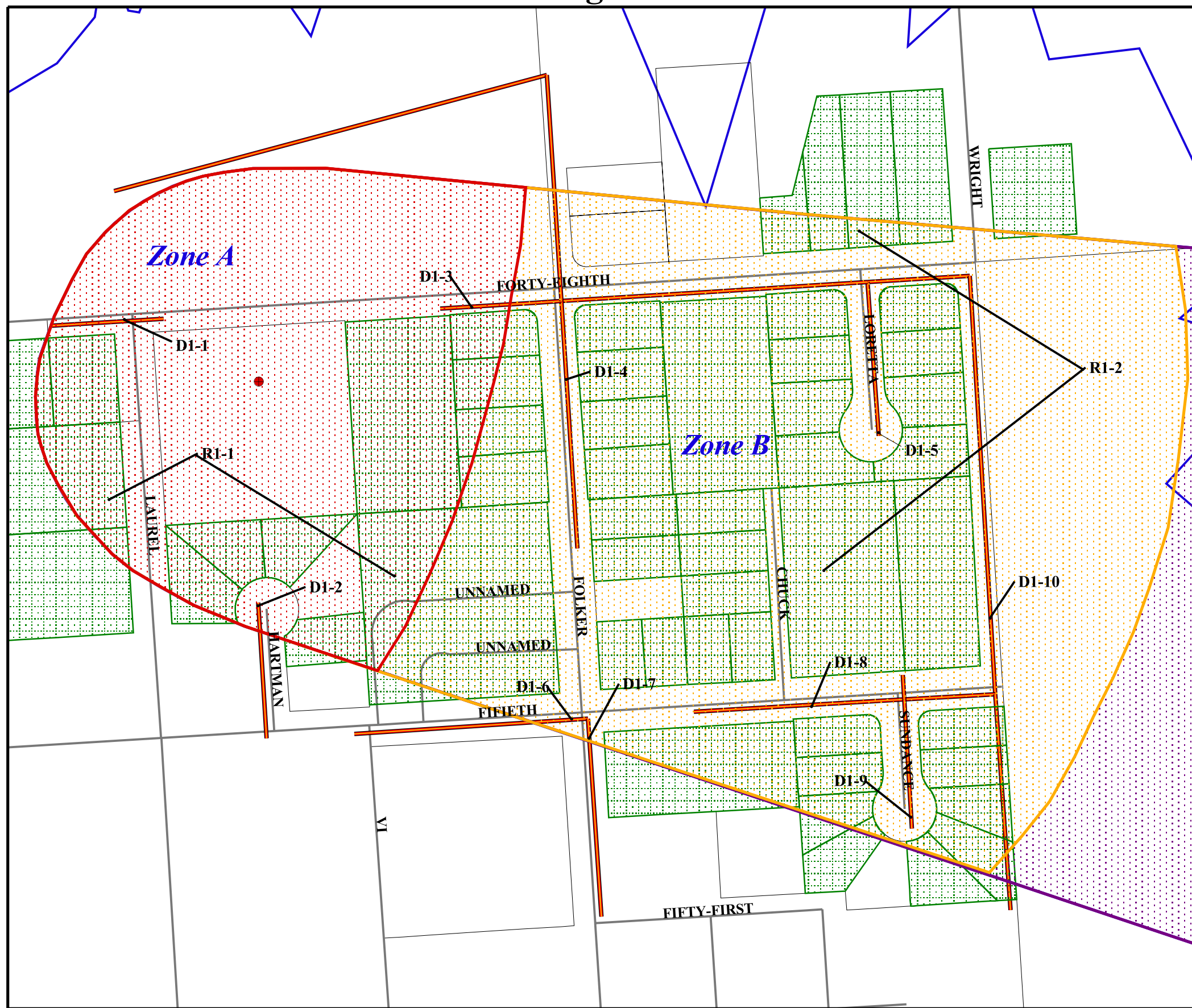
- Foothills Congregation
- Zone A Protection Area**
- ▨ Several Months Travel Time
- Zone B Protection Area**
- ▨ Less Than 2 Years Travel Time
- Zone C Protection Area**
- ▨ Less Than 5 Years Travel Time
- Zone D Protection Area**
- ▨ Less Than 10 Years Travel Time
- Potential Contaminant Sources**
- Asphalt and Tar Processing/Storage (I3)
- ▨ Septic Systems (R2)
- ▨ Anchorage Parks (X4)
- ▨ Trails (X46)
- ▨ Anchorage Roads (X20)
- ▨ Anchorage Land Parcels
- ▨ Anchorage Streams
- ▨ Elevation Contours



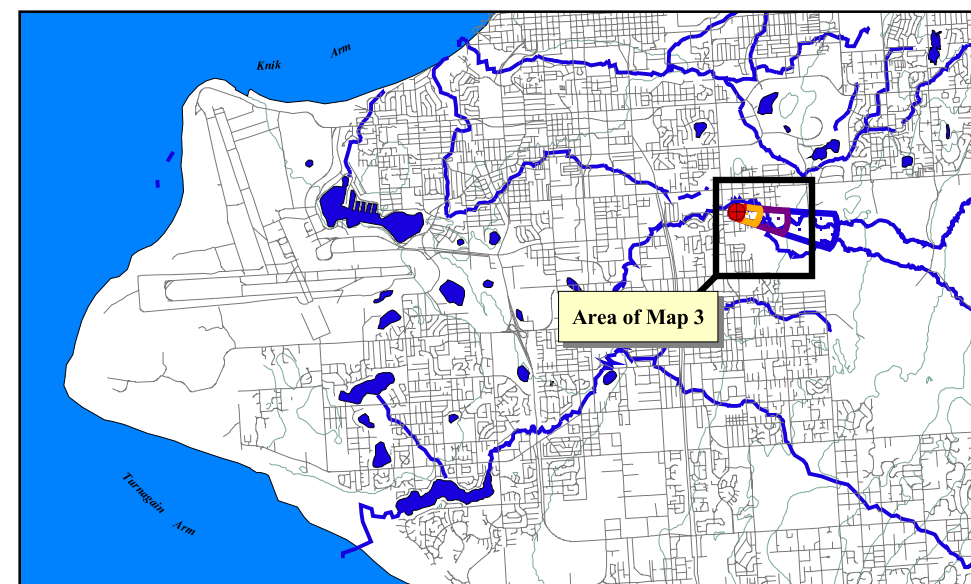
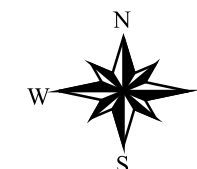
PWSID 216449.001

Map 2

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Foothills Congregation



- Foothills Congregation
- 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
- ▨ Lawns and Gardens (R1).shp
- ▨ Sewer Lines (D1)
- ▨ Anchorage Roads (X20)
- ▨ Anchorage Land Parcels
- ▨ Anchorage Streams
- ▨ Elevation Contours

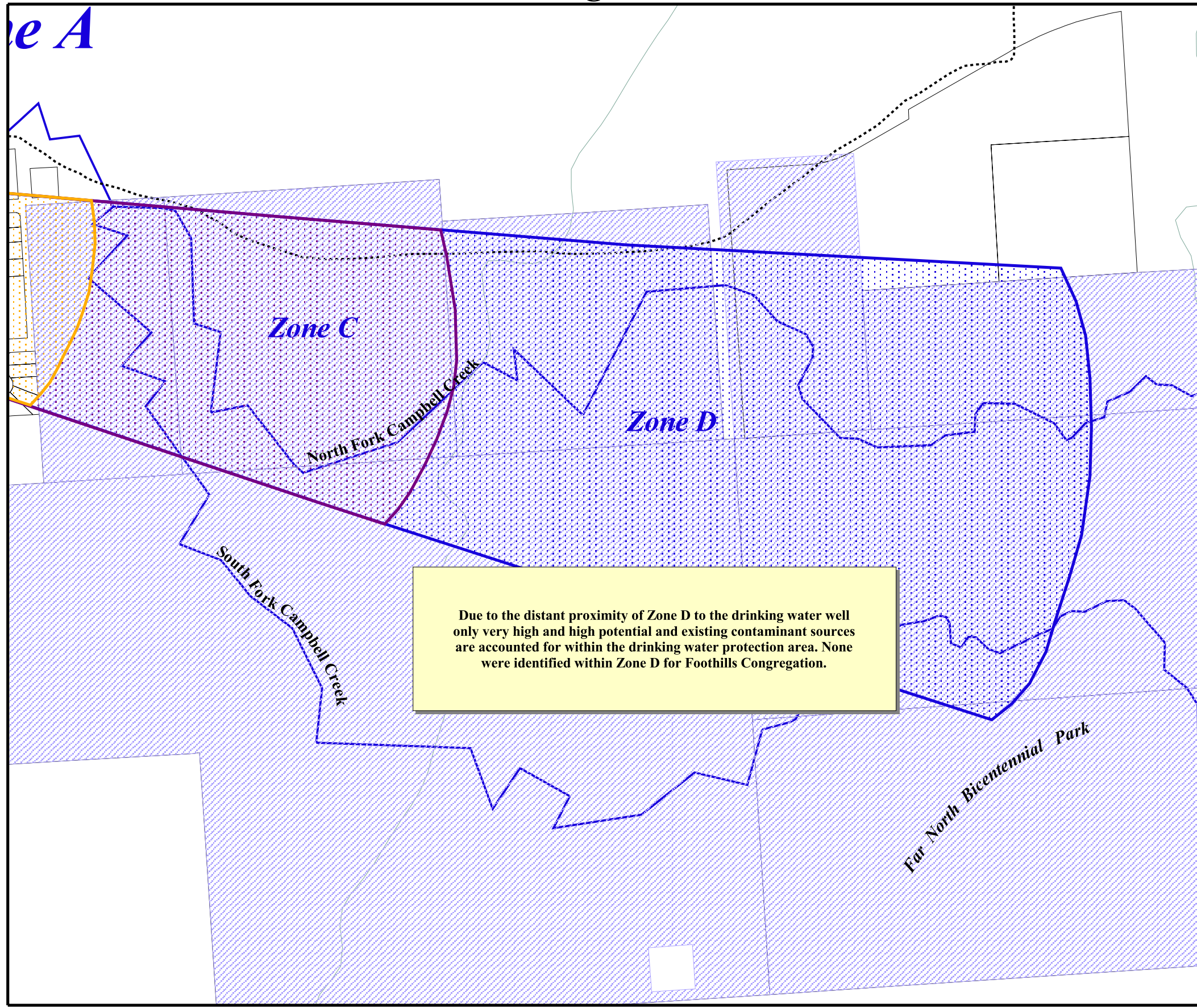


300 0 300 600 Feet

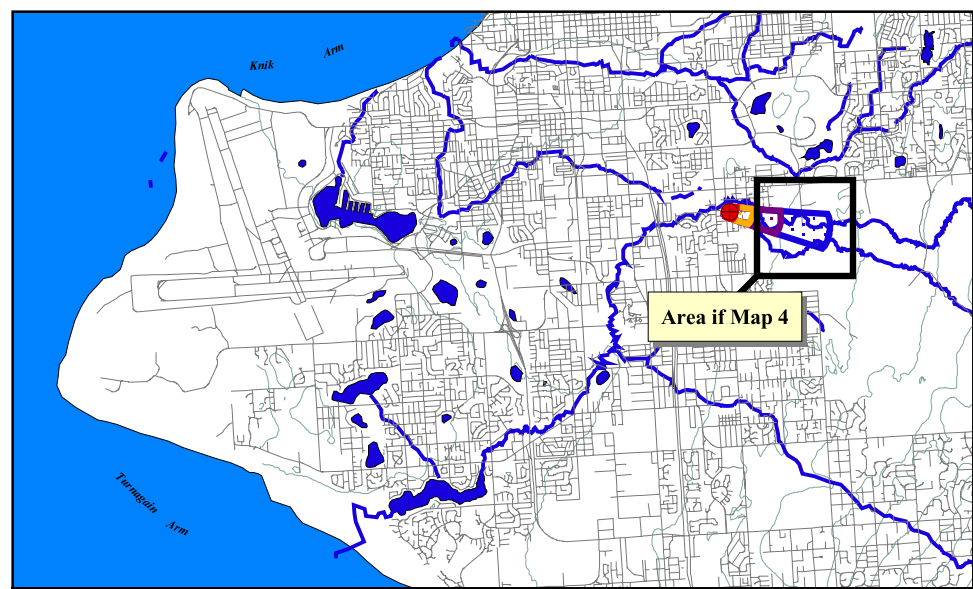
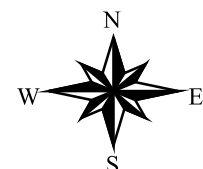
PWSID 216449.001

Map 3

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Foothills Congregation



- Foothills Congregation
- 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 Parks (X4)
- Trails (X46)
- Anchorage Land Parcels
- Elevation Contours
- Anchorage Streams



900 0 900 1800 Feet

PWSID 216449.001

Map 4

APPENDIX D

Vulnerability Analysis for Foothills Congregation's Public Drinking Water Source (Charts 1-8)

Chart 1. Susceptibility of the wellhead - Foothills Congregation

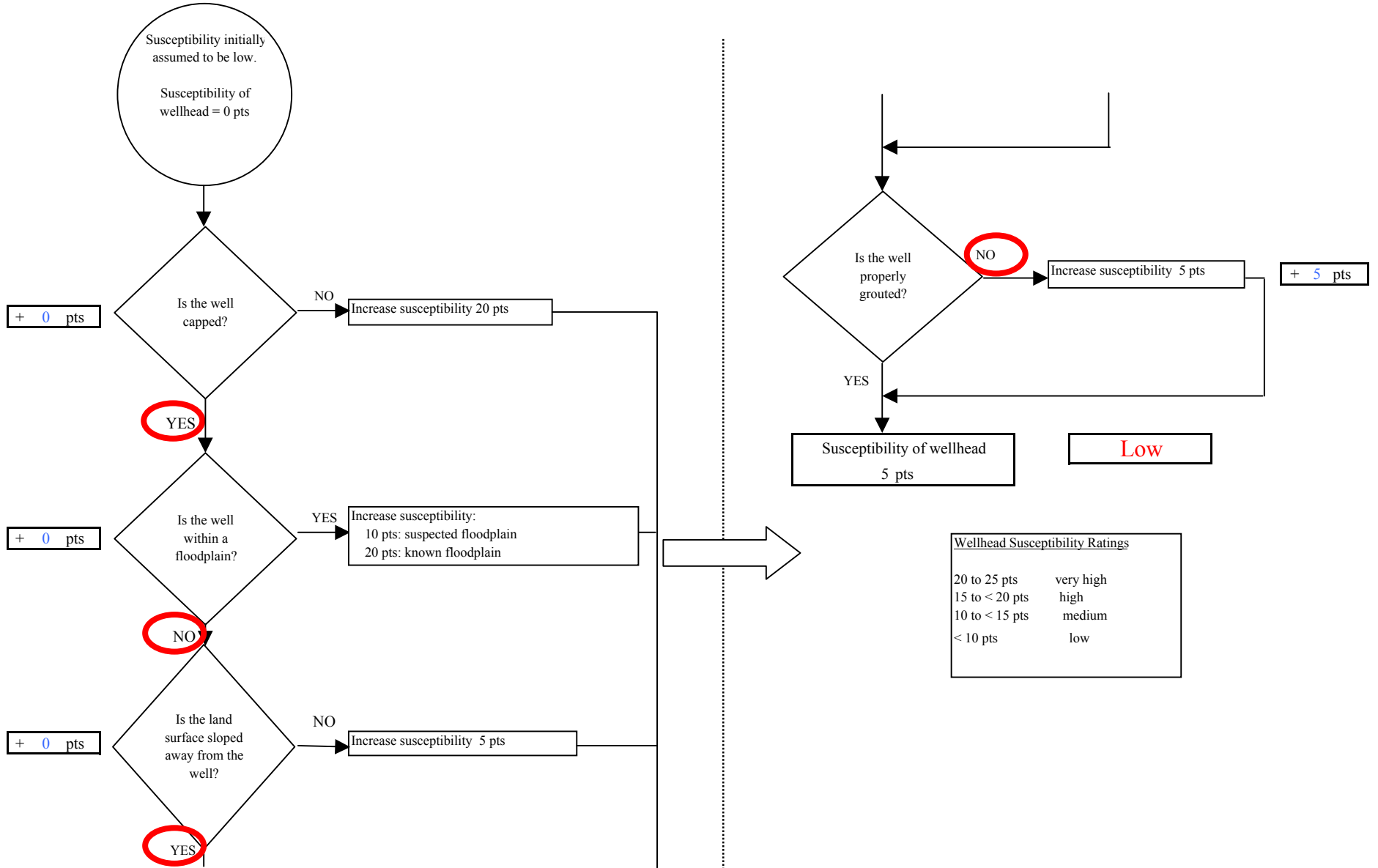


Chart 2. Susceptibility of the aquifer - Foothills Congregation

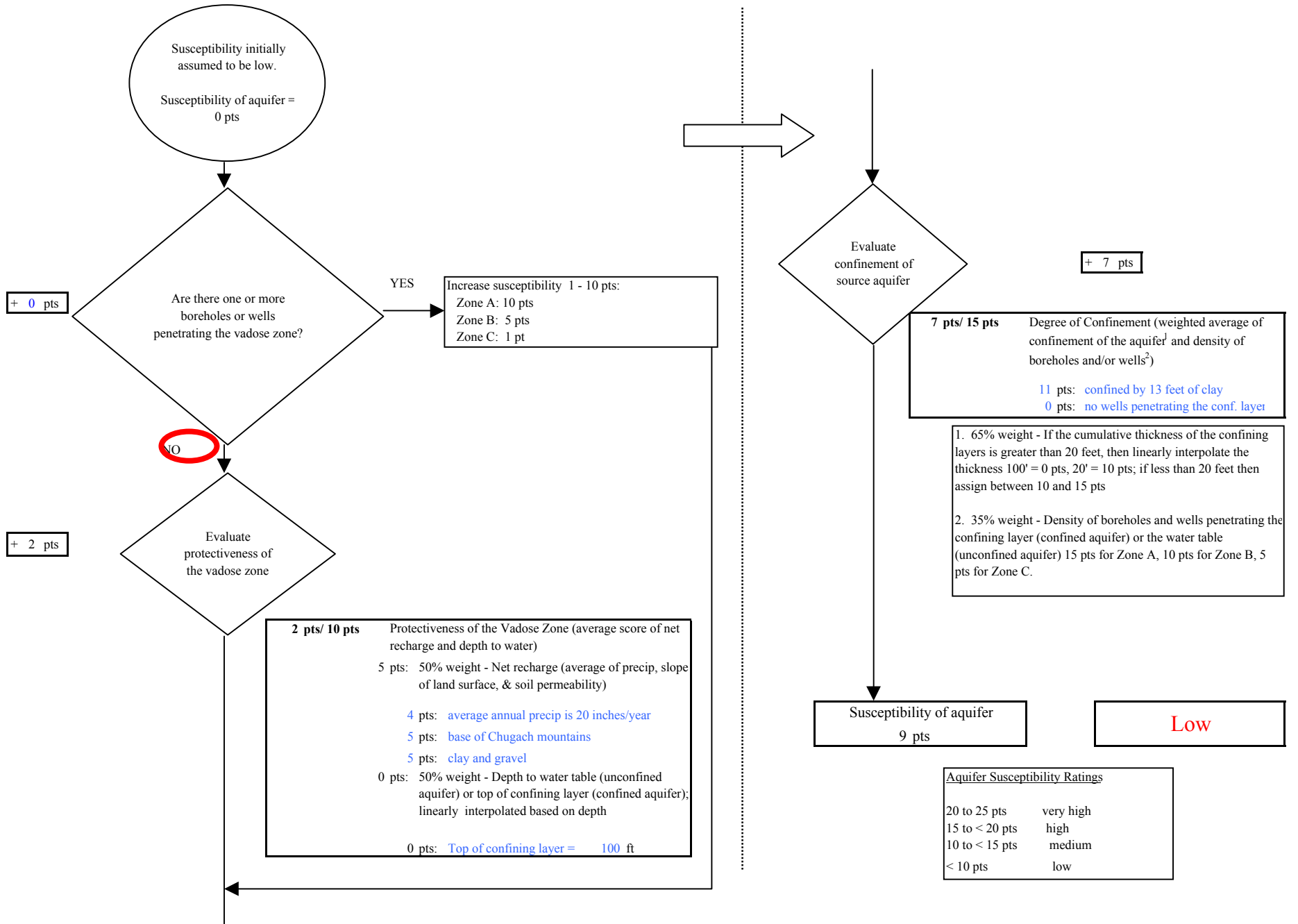
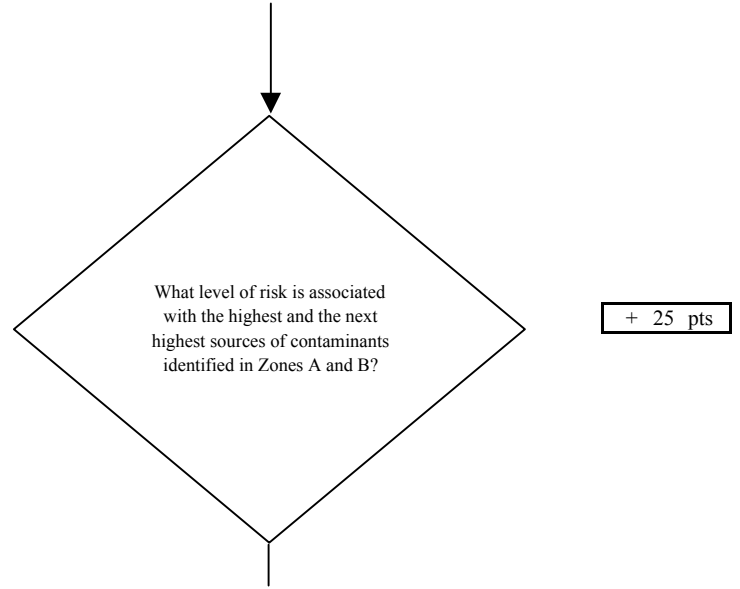
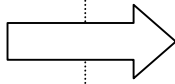
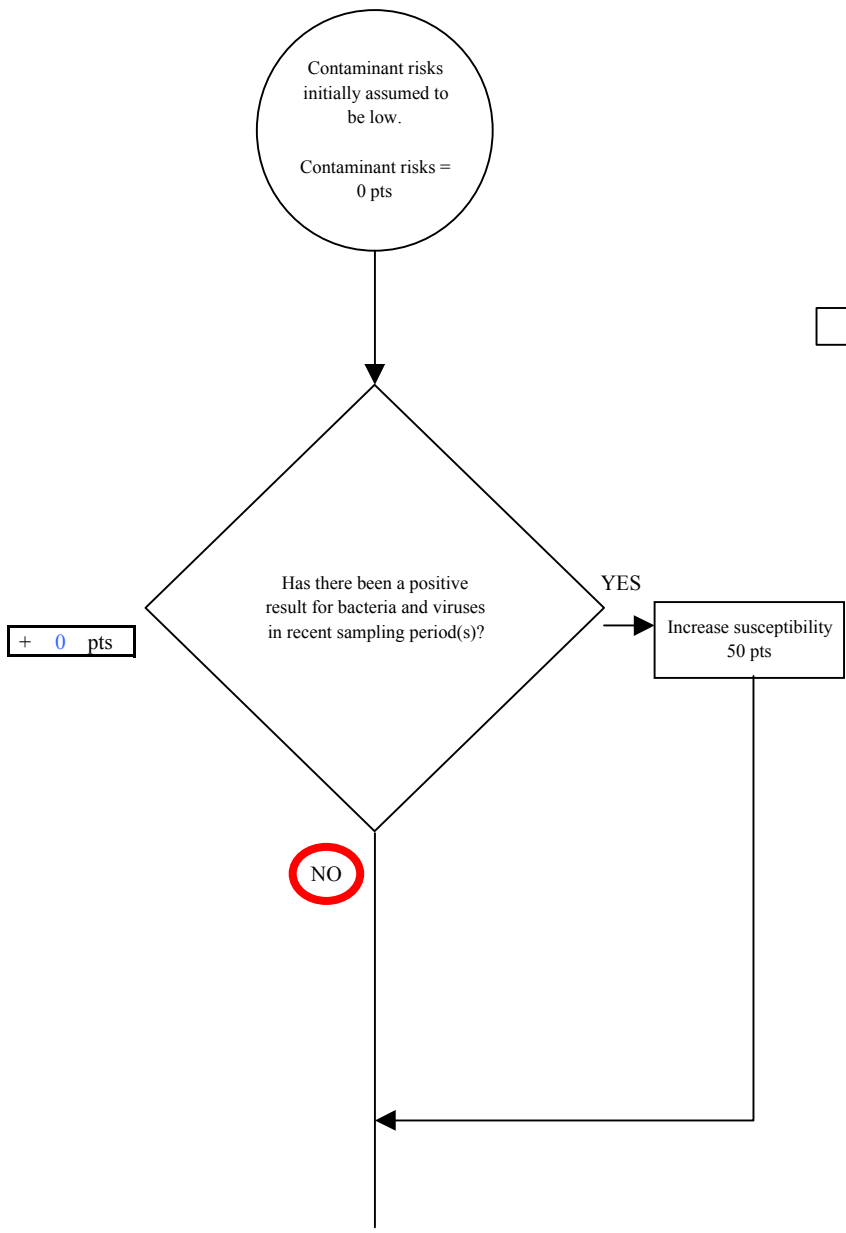


Chart 3. Contaminant risks for *Foothills Congregation - Bacteria & Viruses*



Risk Rankings for Contaminant Sources Identified in Zones A and B

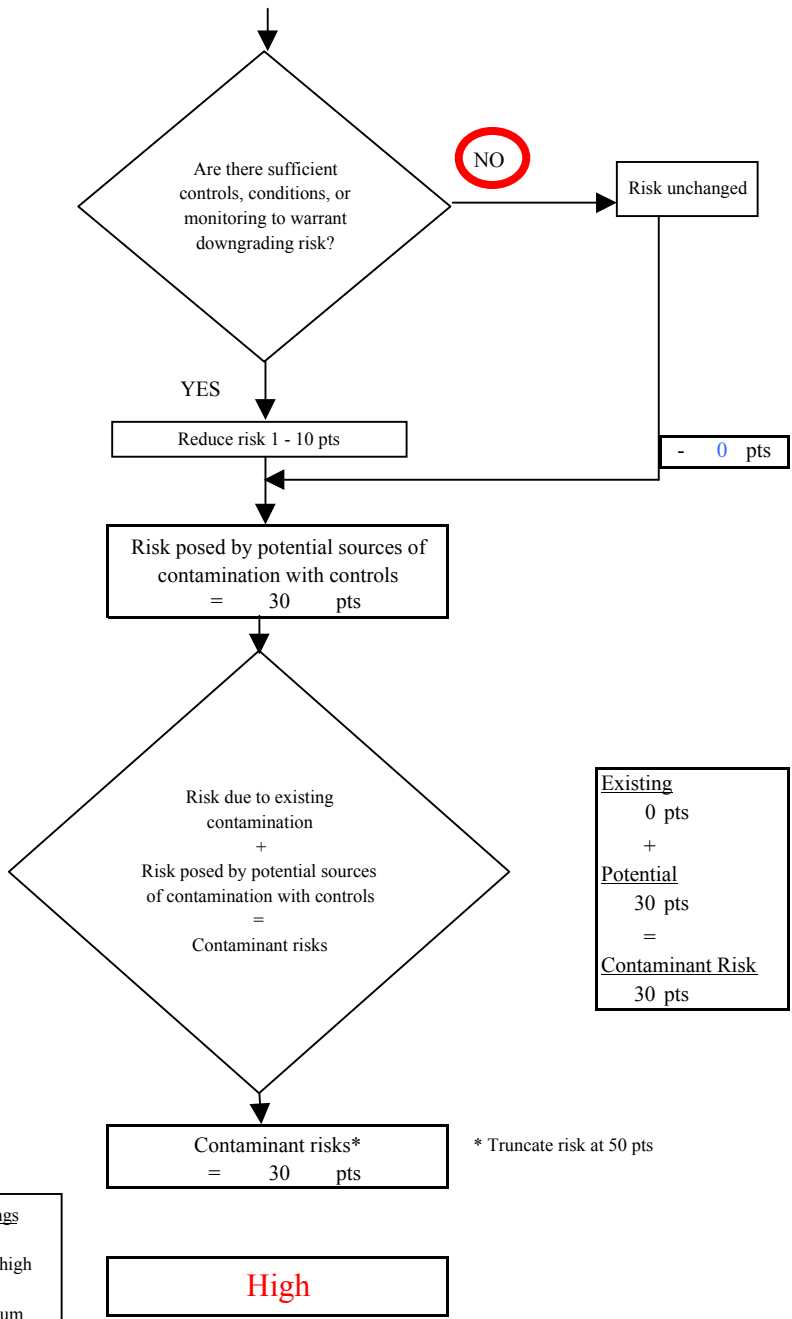
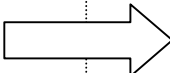
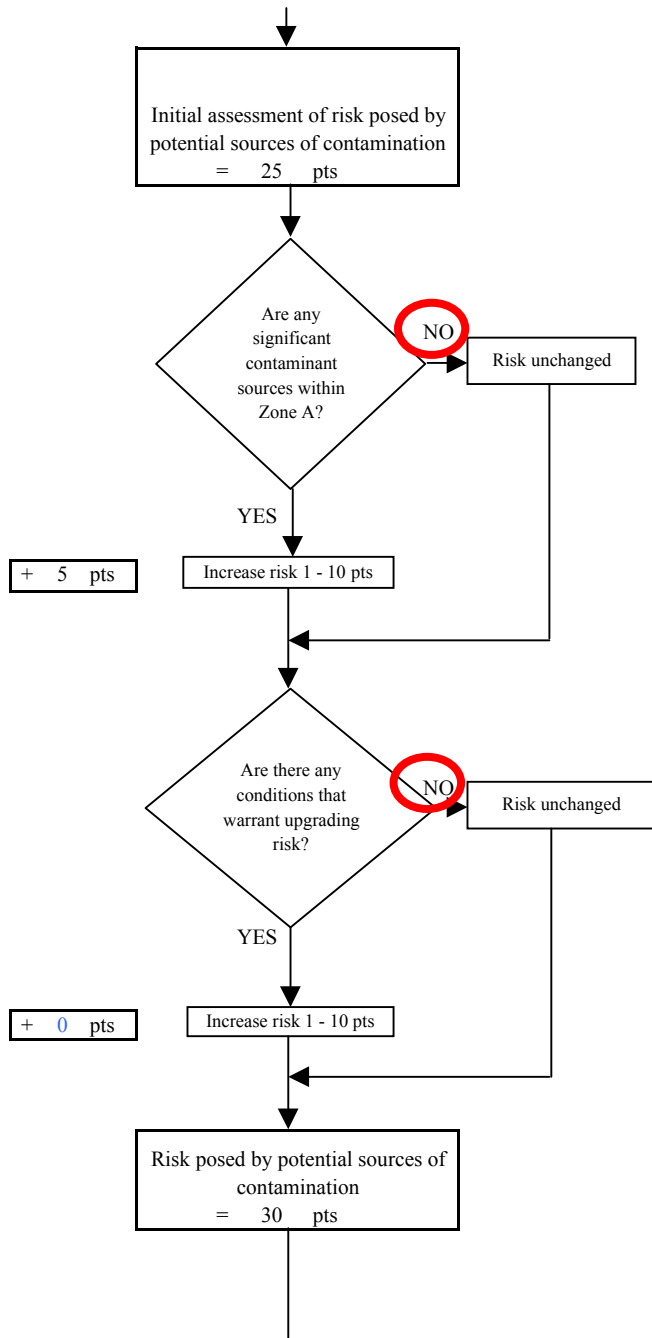
	Zone A	Zone B	Total
Very High(s)	0	0	0
High(s)	0	0	0
Medium(s)	2	2	4
Low(s)	3	4	7

	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 25

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

Chart 3. Contaminant risks for Foothills Congregation - Bacteria & Viruses



Existing	0 pts
+	
Potential	30 pts
=	
Contaminant Risk	30 pts

Contaminant Risk Ratings	
40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20 pts	low

* Truncate risk at 50 pts

Chart 4. Vulnerability analysis for Foothills Congregation - Bacteria & Viruses

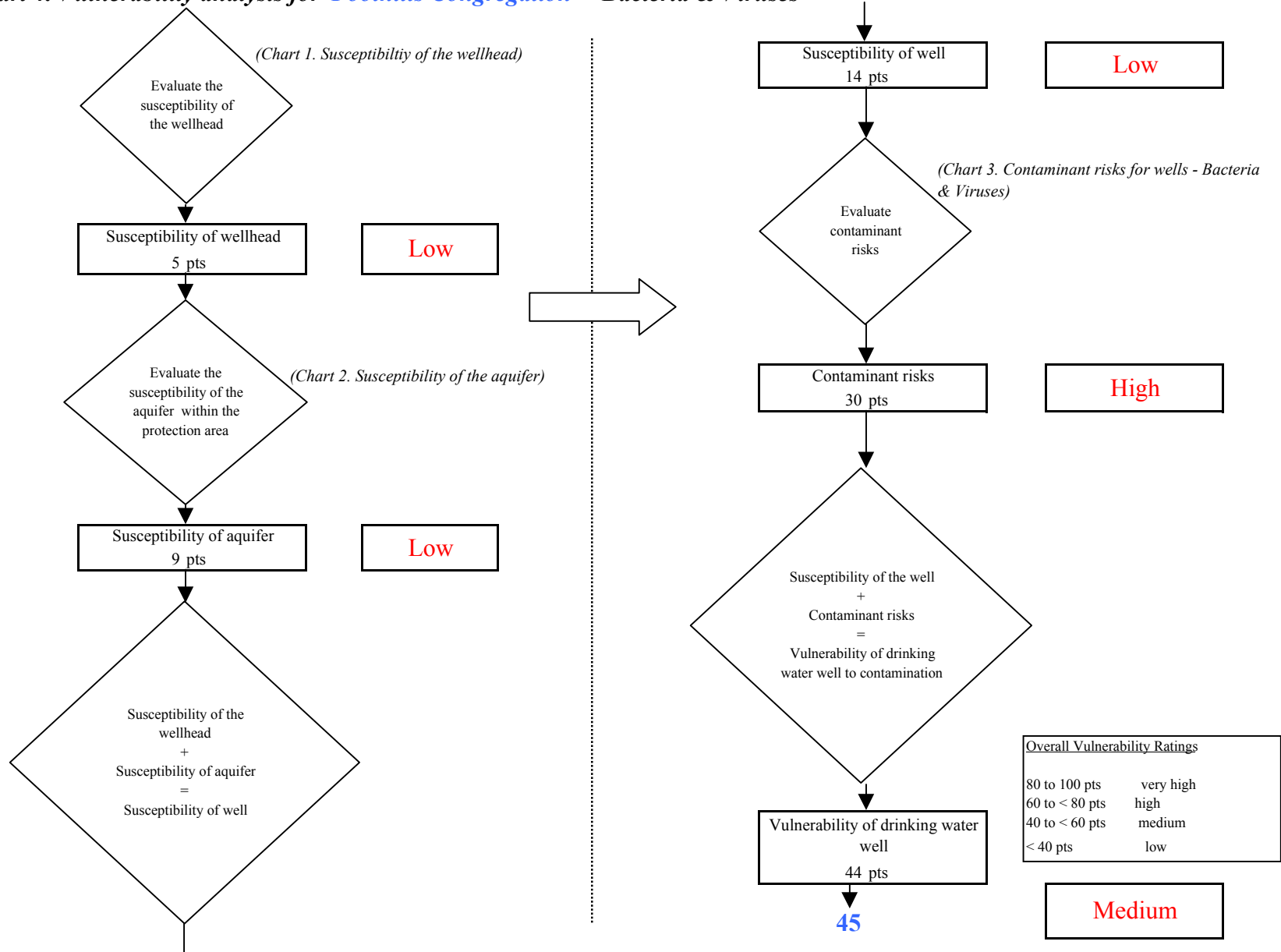


Chart 5. Contaminant risks for *Foothills Congregation* - Nitrates and Nitrites

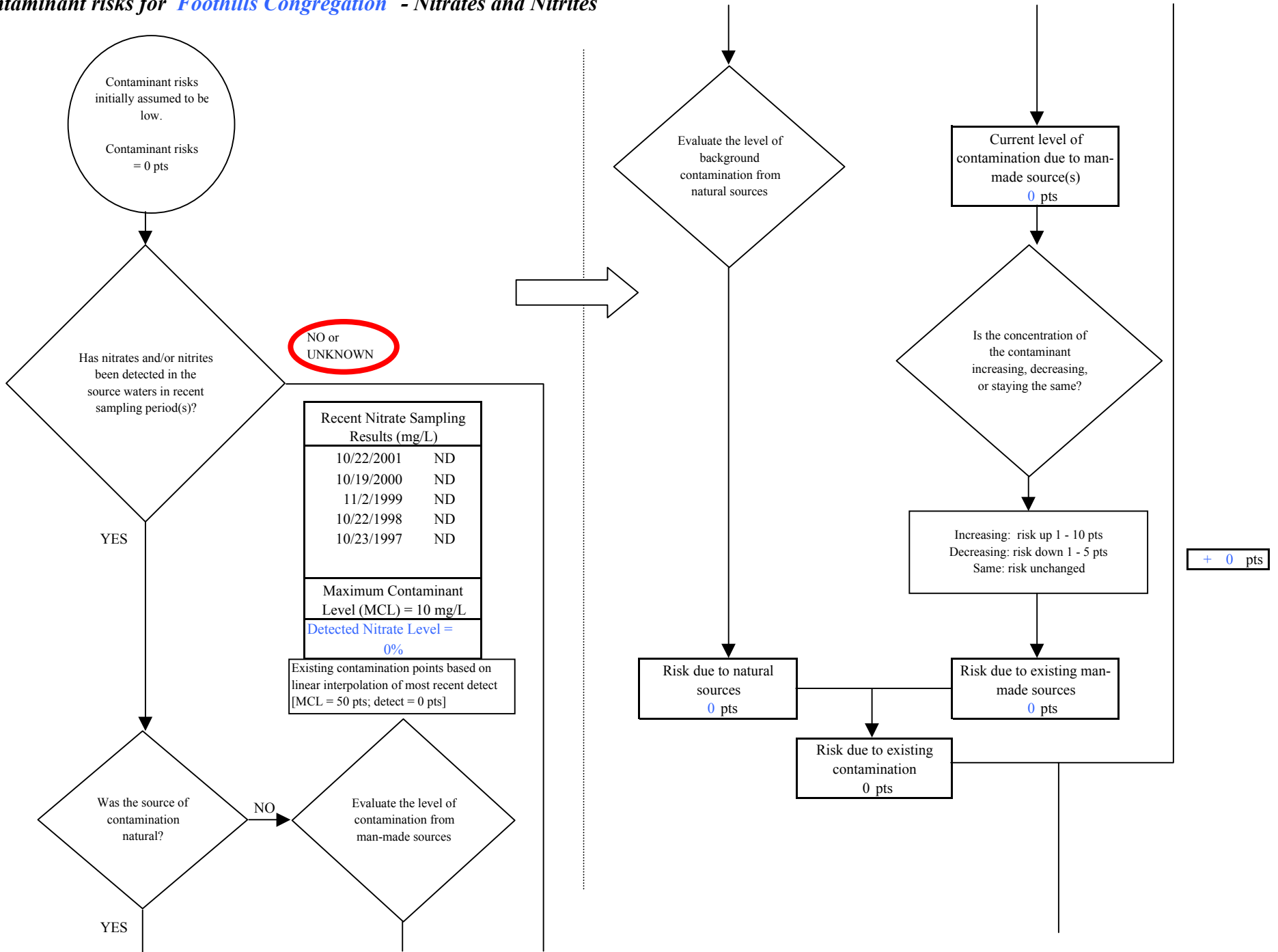
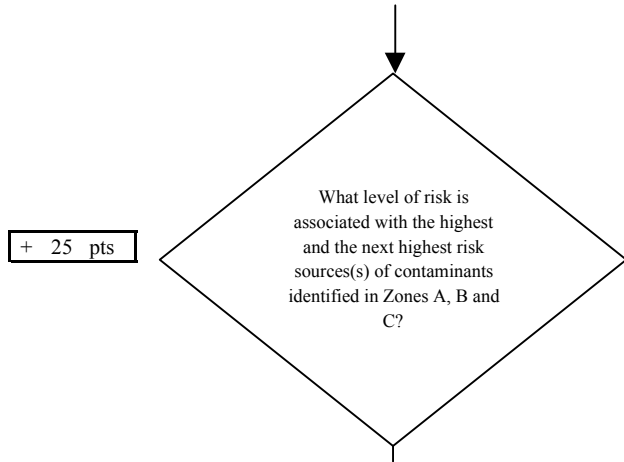


Chart 5. Contaminant risks for Foothills Congregation - Nitrates and Nitrites



Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	2	2	4
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 25

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

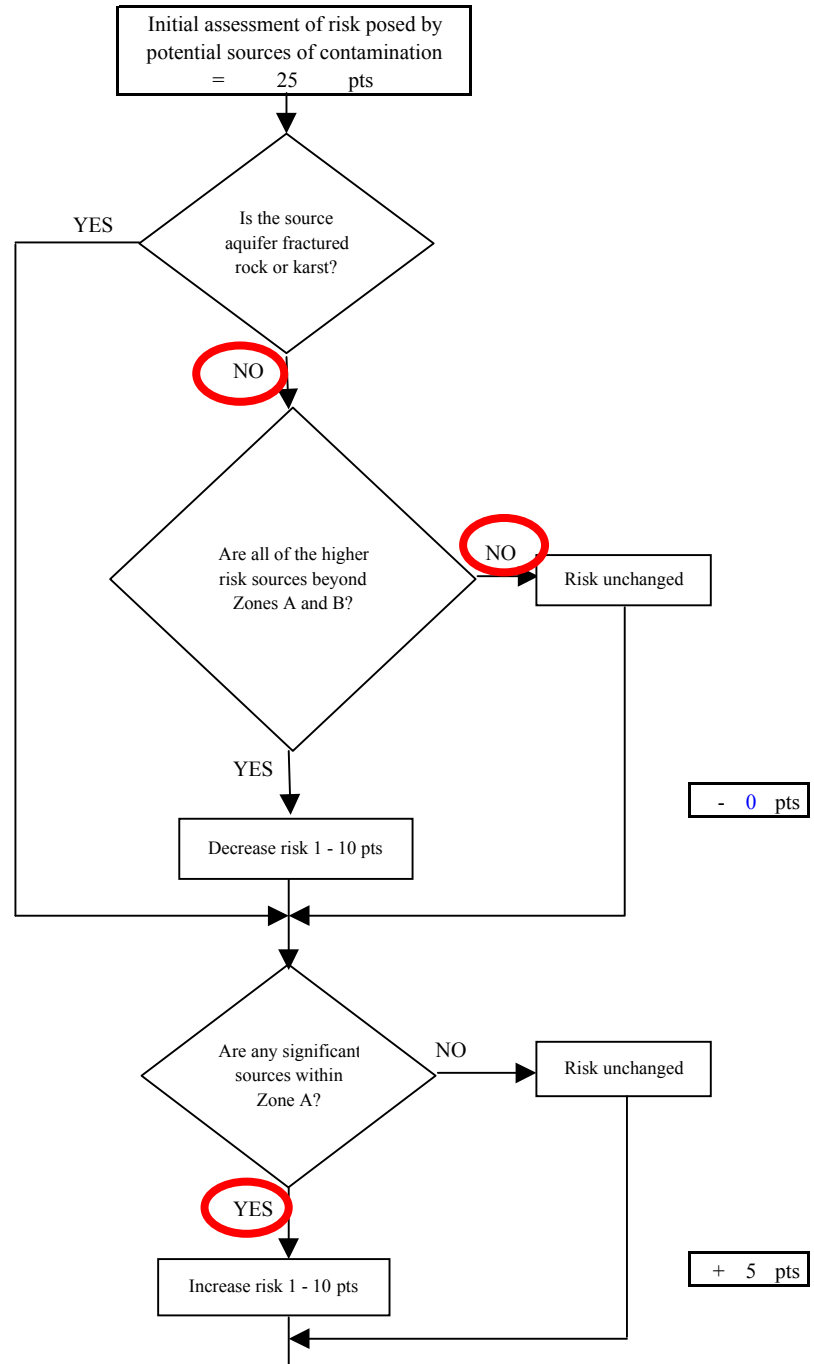
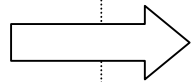


Chart 5. Contaminant risks for Foothills Congregation - Nitrates and Nitrites

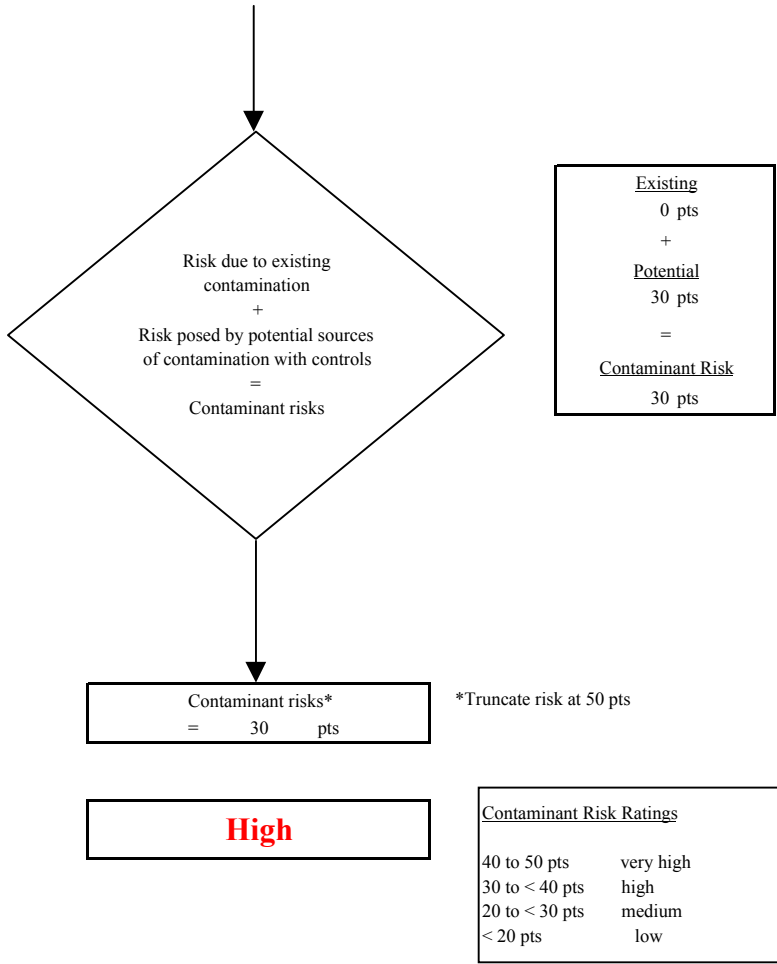
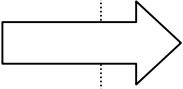
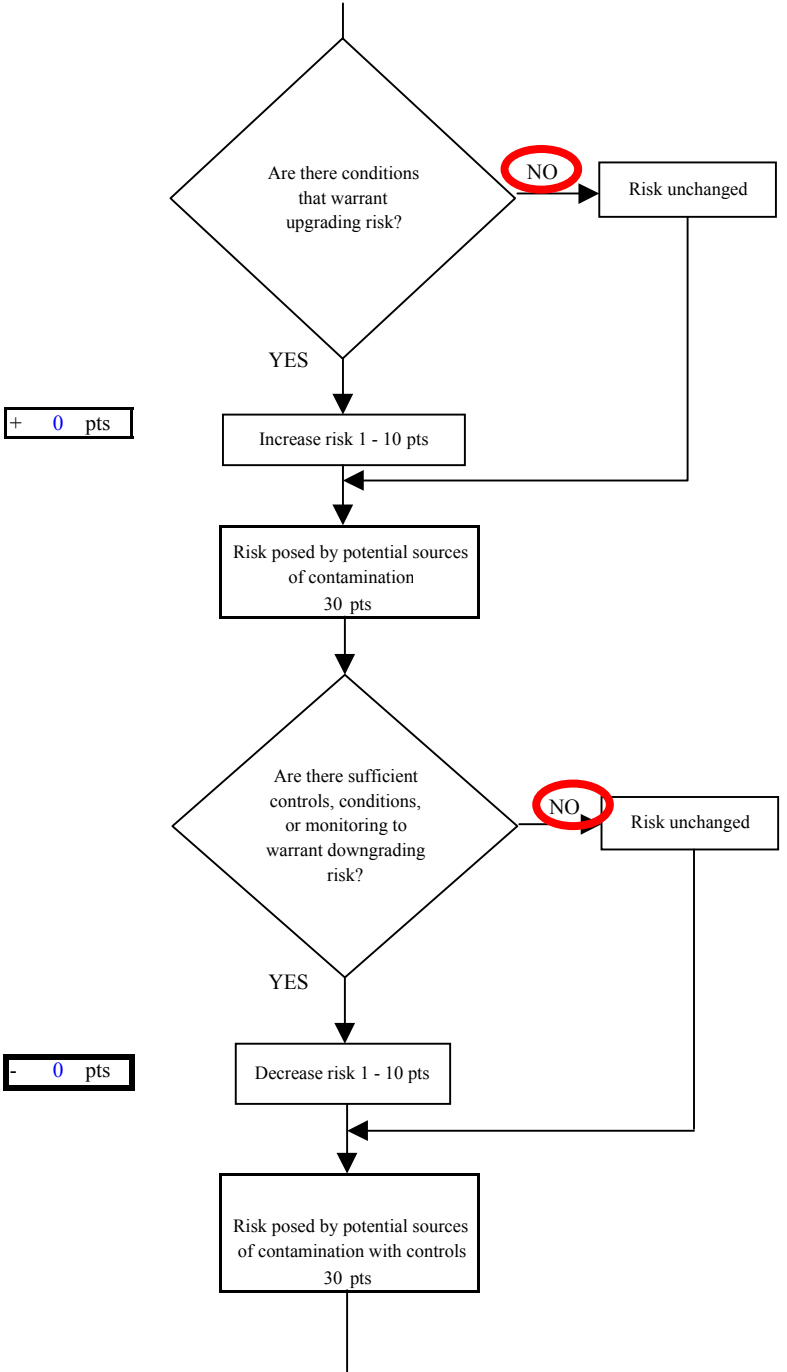


Chart 6. Vulnerability analysis for Foothills Congregation - Nitrates and Nitrites

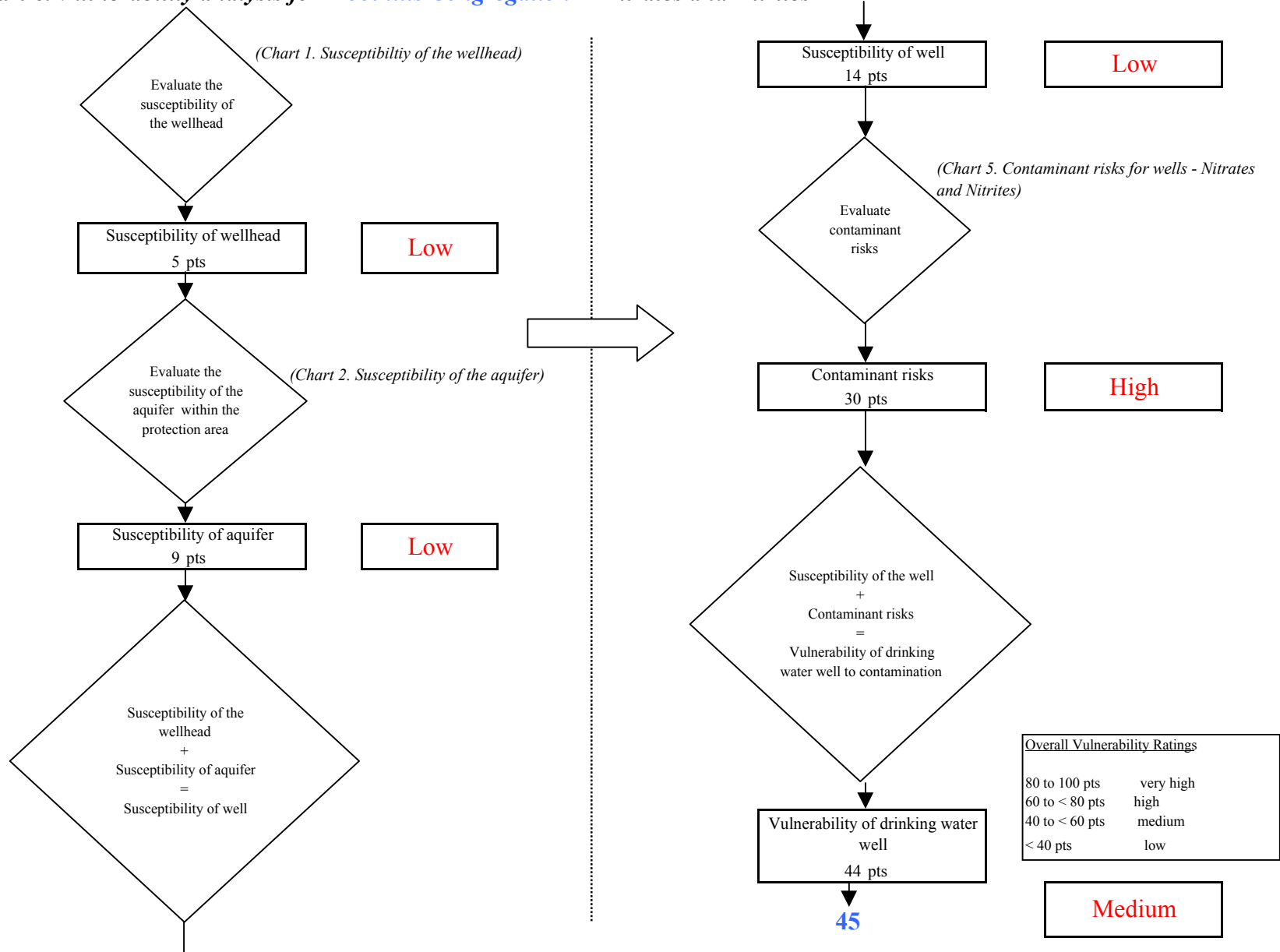


Chart 7. Contaminant risks for *Foothills Congregation* - Volatile Organic Chemicals

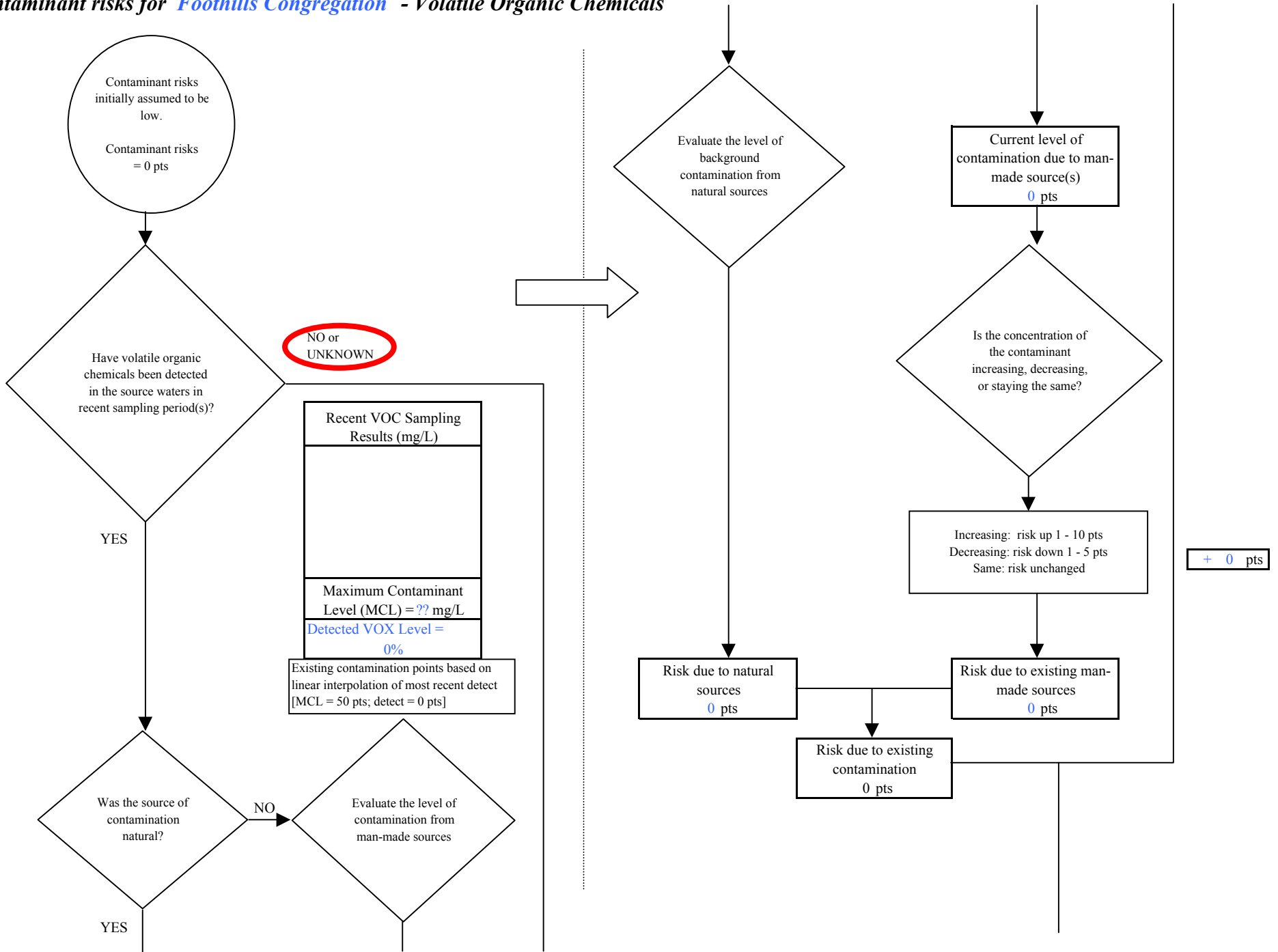
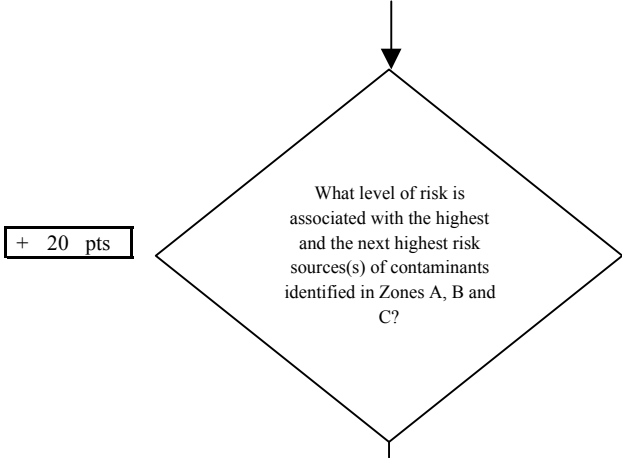


Chart 7. Contaminant risks for Foothills Congregation - Volatile Organic Chemicals



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)	0	0	0
Medium(s)	0	1	1
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 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.

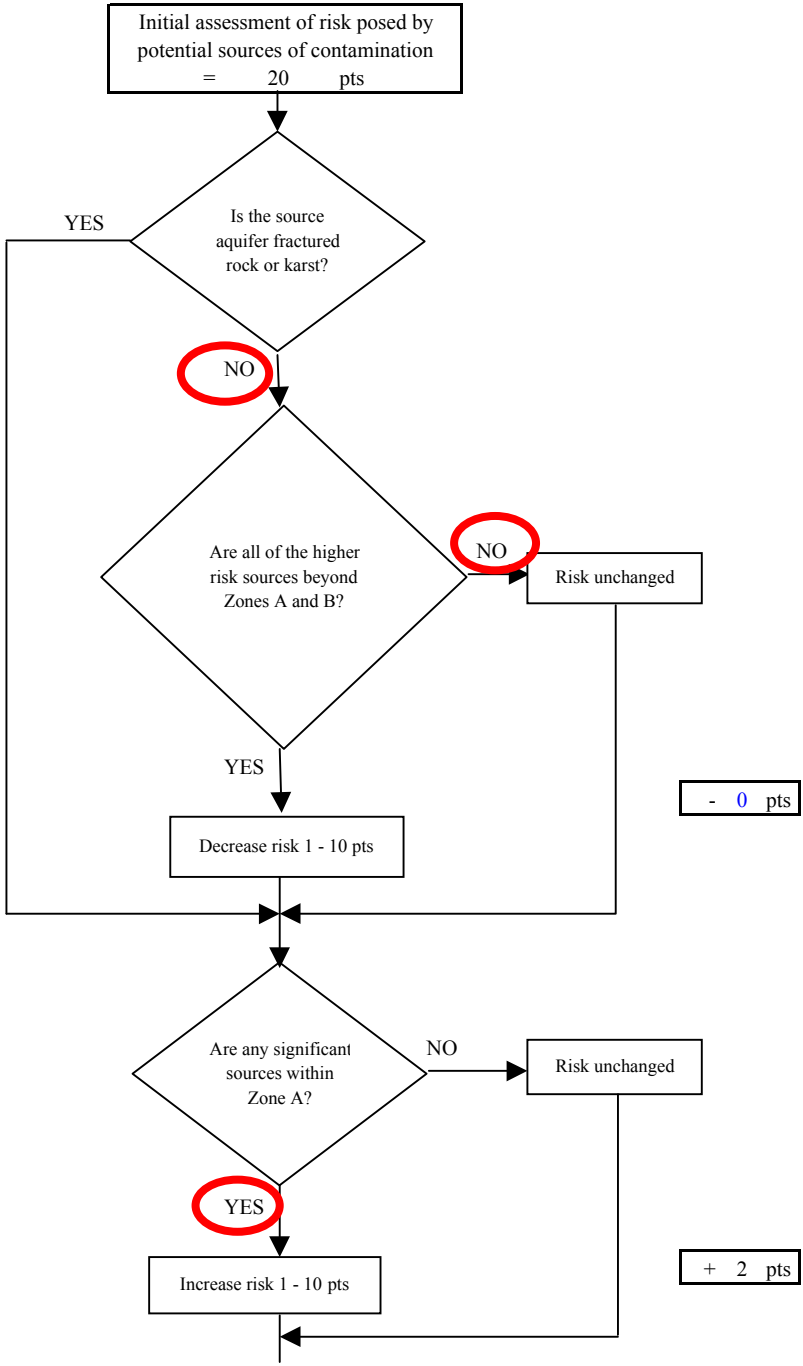
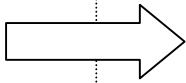


Chart 7. Contaminant risks for Foothills Congregation - Volatile Organic Chemicals

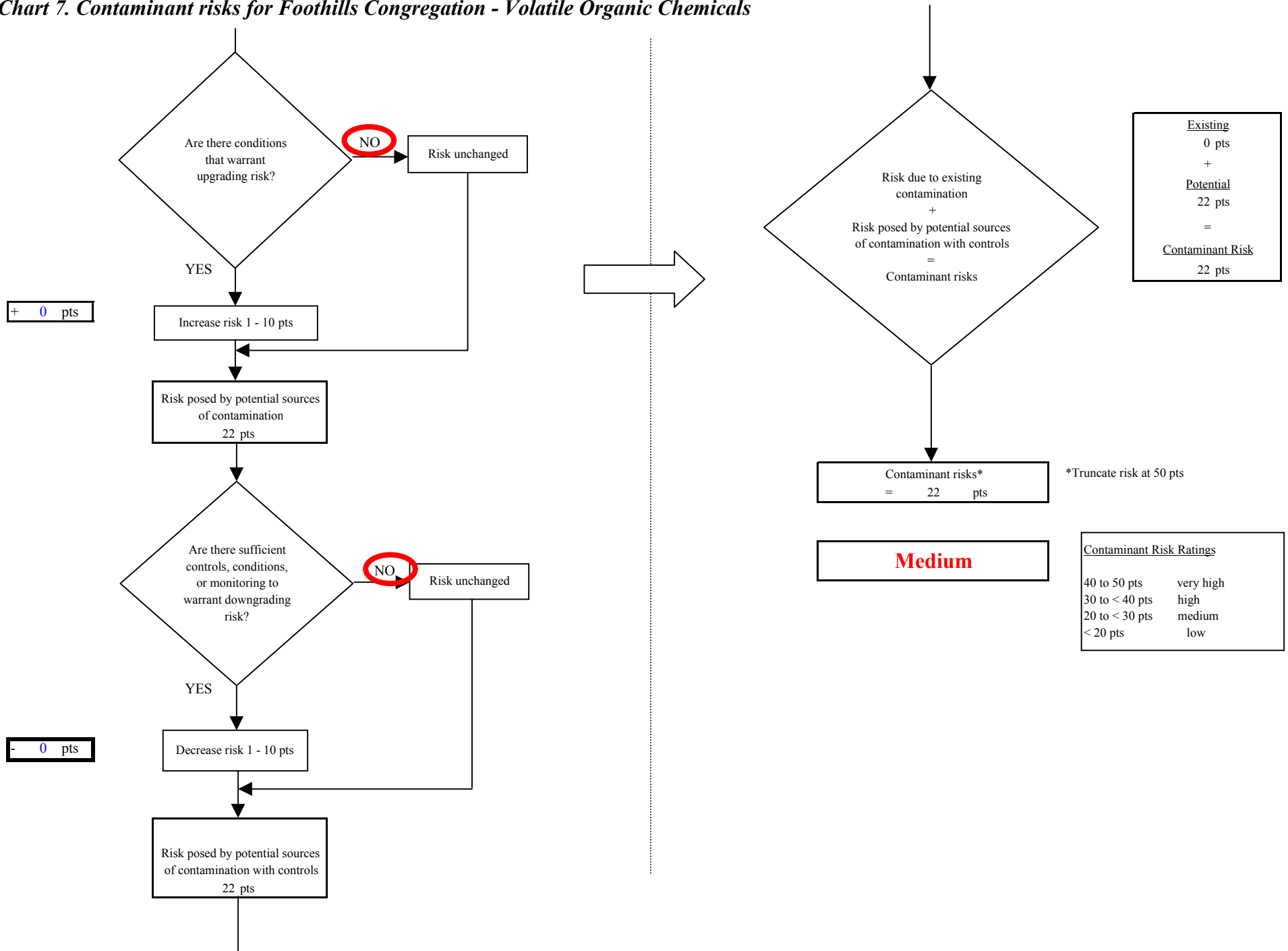


Chart 8. Vulnerability analysis for Foothills Congregation - Volatile Organic Chemicals

