Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Eagle River Church of Nazarene Drinking Water System, Eagle River, Alaska

Eagle River Church of Nazarene # 216994

DRINKING WATER PROTECTION PROGRAM REPORT # 216
Alaska Department of Environmental Conservation

AUGUST 2002

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By Shannon & Wilson, Inc.

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

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

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Source Water Assessment for Eagle River Church of Nazarene Source of Public Drinking Water, Eagle River, Alaska

By Shannon & Wilson, Inc.

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Eagle River Church of Nazarene is a Class B (transient/non-community) water system consisting of one well, south, Alaska. Identified potential and current sources of contaminants for Eagle River Church of Nazarene public drinking water source include: recycling facilities, pet groomers, residential areas, large capacity and single family septic systems, dirt/gravel and paved roads, forested lands, gasoline stations, motor vehicle repair shops, car washes, gasoline and diesel underground storage tanks, heavy equipment storage, welding shops, and explosives manufacturing. 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 Eagle River Church of Nazarene received a vulnerability rating of **High** for volatile organic chemicals, **Medium** for bacteria and viruses, and **High** 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.

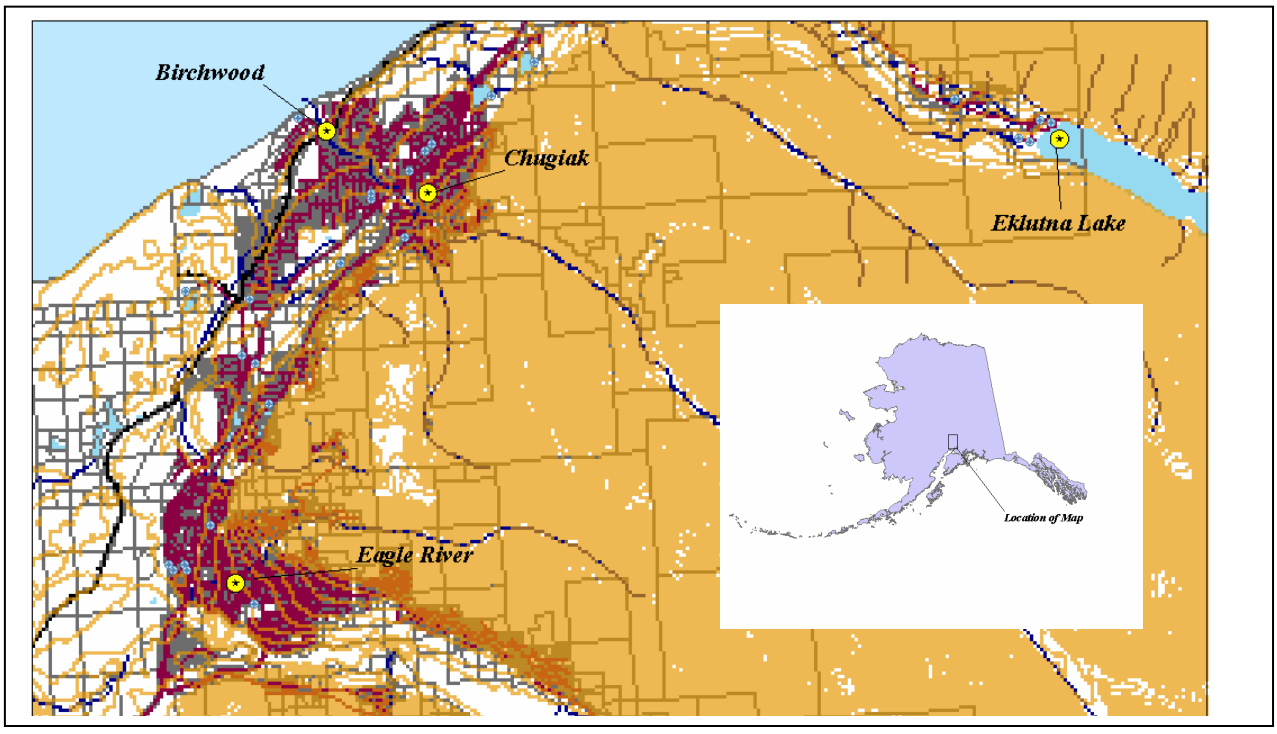


Figure 1. Index map showing the location of the Eagle River Valley and Surrounding Areas.

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 Borough.

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.

EAGLE RIVER CHURCH OF NAZARENE PUBLIC DRINKING WATER SYSTEM

Eagle River Church of Nazarene is a Class B (transient/non-community) water system. The system consists of one well near the Artillery Road exit of the Glenn Highway.

Based on well construction details of surrounding wells, it is assumed that the total depth of the Eagle River Church of the Nazarene well is approximately 124 feet below ground surface and was completed with 6-inch well casing. The most recent Sanitary Survey (10/16/98) indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is appropriately sloped away from the well, and provides adequate surface water drainage. The well was not 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 120 non-residents through one service connection.

EAGLE RIVER CHURCH OF NAZARENE 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 Eagle River Church of Nazarene 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 EAGLE RIVER CHURCH OF NAZARENE 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 Eagle River Church of Nazarene 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 Eagle River Church of Nazarene.

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

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	30	Medium

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing 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	12	Low
Nitrates and/or Nitrites	43	Very High
Volatile Organic Chemicals	42	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 Eagle River Church of Nazarene to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	40	Medium
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	70	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 recycling facilities, residential areas, large capacity and single family septic systems, dirt/gravel and paved roads, pet groomers, forested lands, gasoline stations, motor vehicle repair shops, car washes, gasoline and diesel underground storage tanks, heavy equipment storage, welding shops, and explosives manufacturing 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 Eagle River Church of Nazarene.

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 Eagle River Church of Nazarene 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 0.150 mg/L or 2% 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 Eagle River Church of Nazarene. The overall vulnerability of this source to contamination is **High** for volatile organic chemicals, **Medium** for bacteria and viruses, and **High** 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 Eagle River Church of Nazarene 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 Eagle River Church of Nazarene 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.

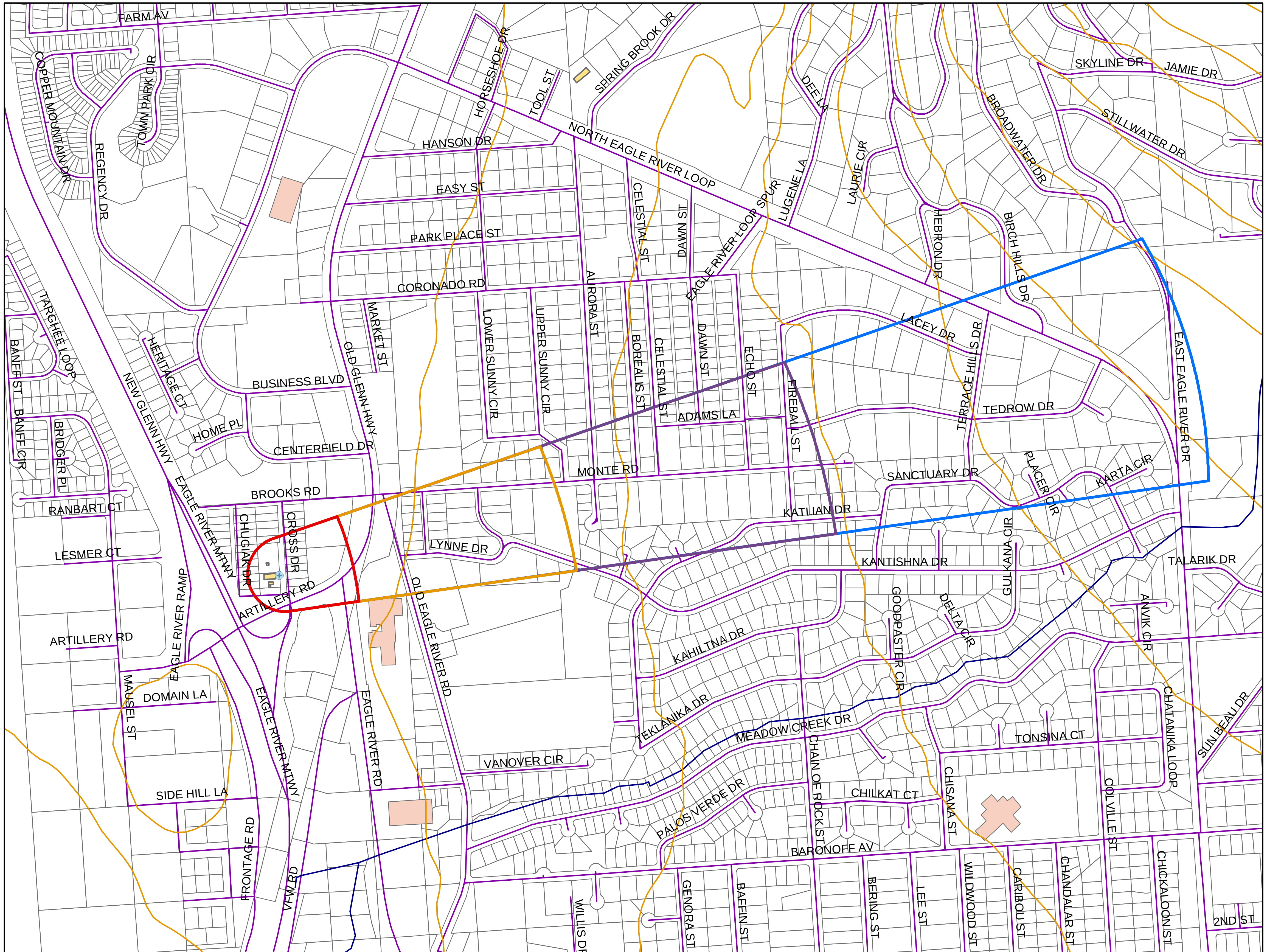
Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

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

APPENDIX A

Eagle River Church of Nazarene
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Areas for Eagle River Church of Nazarene



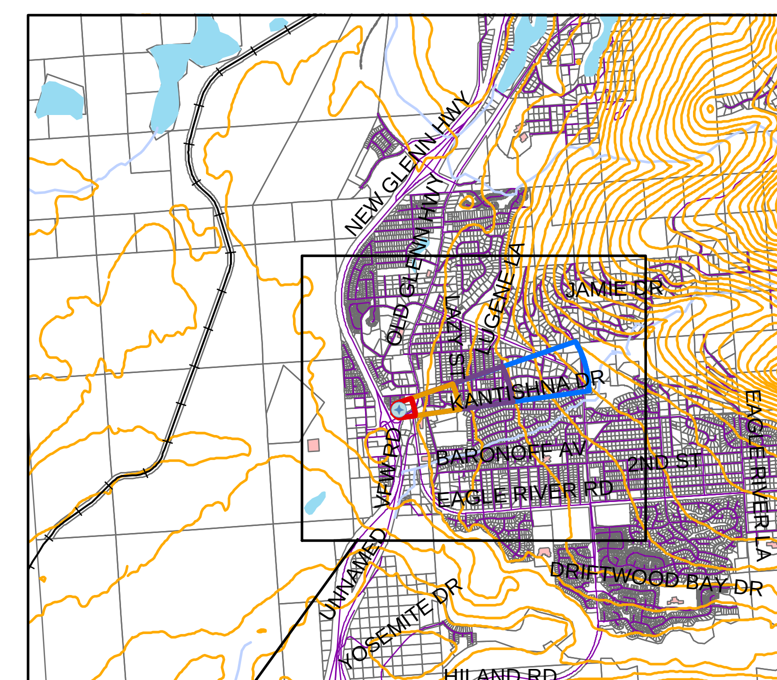
- Eagle River Church of Nazarene Well
- 25m Contours
- Streams
- Roads
- MOA land parcels
- Lakes

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



Location of map

1,500 750 0 1,500 Feet

PWSID 216994.001

N W E S

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Eagle River Church of Nazarene (Tables 1-4)

Table 1 *Contaminant Source Inventory for* ***PWSID 216994.001***

Eagle River Church of Nazarene

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-1	A	Southwest of well	3	
Pet groomers	C34	C34-1	A	Southwest of well	3	
Recycling and waste reduction facilities	D57	D57-1	A	Corner of Cross Road and Artillery Road	3	
Residential Areas	R01	R1-1	A	Residences along Cross Drive	2	3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R2-1	A	Off Artillery Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Old Glenn Highway	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Cross Drive	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Eagle River Mtwy	2	
Highways and roads, dirt/gravel	X24	X24-3	A	Eagle River Road	2	
Forested land (pesticide application)	X48	X48-1	A	Off Artillery Road	3	
Gasoline stations (without repair shop)	C15	C15-1	B	Off Artillery Road	3	
Motor /motor vehicle repair shops	C31	C31-2	B	Old Eagle River Road	3	
Motor /motor vehicle repair shops	C31	C31-3	B	Rroad east of Old Eagle River Road, off Lynne Drive	3	
Car washes with engine or undercarriage cleaning	C08	C8-1	B	Off Eagle River Road	3	
Recycling and waste reduction facilities	D57	D57-2	B	Off Lynne Drive	3	
Residential Areas	R01	R1-2	B	Residences off Monte Road	2	14 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R2-2-13	B	Off Monte Road, Zone B	3	11 septic systems in Zone B
Tanks, gasoline (underground)	T12	T12-1	B	Off Artillery Road	3	
Tanks, diesel (underground)	T08	T8-1	B	Off Artillery Road	3	
Highways and roads, dirt/gravel	X24	X24-4-7	B	Roads in Zone B	2	4 roads in Zone B
Heavy equipment rental/storage	C18	C18-1	C	Celestial Street	3	
Welding shops	C43	C43-1	C	Echo Street	3	
Construction trade areas and materials	C09	C9-1	C	Aurora Street	3	

Contaminant Source Type	*Contaminant*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	C	Between Monte Road and Katlian Drive, west of Fireball Street	3	
Explosives and ammunitions manufacturing	I15	I15-1	C	Katlian Drive, east of Fireball Street	3	
Residential Areas	R01	R1-3	C	Residences off Monte Road	2	40 acres of residential area in Zone C
Septic systems (serves one single-family home)	R02	R2-14-35	C	Off Monte Road, Zone C	3	21 septic systems in Zone C
Highways and roads, paved with Arctic asphalt (Herbicide application)	X23	X23-1	C	Fireball Street	3	
Highways and roads, dirt/gravel	X24	X24-8-27	C	Roads in Zone C	2	20 roads in Zone C

Contaminant Source Inventory and Risk Ranking for

Table 2 ***PWSID 216994.001***

Eagle River Church of Nazarene

Sources of Bacteria and Viruses

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R1-1	A	Low	1	Residences along Cross Drive	2	3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R2-1	A	Low	2	Off Artillery Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	3	Old Glenn Highway	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	4	Cross Drive	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Low	5	Eagle River Mtwy	2	
Highways and roads, dirt/gravel	X24	X24-3	A	Low	6	Eagle River Road	2	
Residential Areas	R01	R1-2	B	Low	7	Residences off Monte Road	2	14 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R2-2-13	B	Low	8	Off Monte Road, Zone	3	11 septic systems in Zone B
Highways and roads, dirt/gravel	X24	X24-4-7	B	Low	9	Roads in Zone B	2	4 roads in Zone B

Contaminant Source Inventory and Risk Ranking for

Table 3 ***PWSID 216994.001***

Eagle River Church of Nazarene

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Explosives and ammunitions manufacturing	I15	I15-1	C	Very High	1	Katlian Drive, east of Fireball Street	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	C	High	2	Between Monte Road and Katlian Drive, west of Fireball Street	3	
Residential Areas	R01	R1-1	A	Low	3	Residences along Cross Drive	2	3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R2-1	A	Low	4	Off Artillery Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	5	Old Glenn Highway	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	6	Cross Drive	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Low	7	Eagle River Mtwy	2	
Highways and roads, dirt/gravel	X24	X24-3	A	Low	8	Eagle River Road	2	
Residential Areas	R01	R1-2	B	Low	9	Residences off Monte Road	2	14 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R2-2-13	B	Low	10	Off Monte Road, Zone	3	11 septic systems in Zone B
Highways and roads, dirt/gravel	X24	X24-4-7	B	Low		Roads in Zone B	2	4 roads in Zone B
Residential Areas	R01	R1-3	C	Low		Residences off Monte Road	2	40 acres of residential area in Zone C
Septic systems (serves one single-family home)	R02	R2-14-35	C	Low		Off Monte Road, Zone	3	21 septic systems in Zone C
Highways and roads, paved with Arctic asphalt (Herbicide application)	X23	X23-1	C	Low		Fireball Street	3	
Highways and roads, dirt/gravel	X24	X24-8-27	C	Low		Roads in Zone C	2	20 roads in Zone C

Contaminant Source Inventory and Risk Ranking for

Table 4 ***PWSID 216994.001***

Eagle River Church of Nazarene

Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-1	B	High	1	Off Artillery Road	3	
Car washes with engine or undercarriage cleaning	C08	C8-1	B	High	2	Off Eagle River Road	3	
Tanks, gasoline (underground)	T12	T12-1	B	High	3	Off Artillery Road	3	
Tanks, diesel (underground)	T08	T8-1	B	High	4	Off Artillery Road	3	
Motor /motor vehicle repair shops	C31	C31-1	A	Medium	5	Southwest of well	3	
Motor /motor vehicle repair shops	C31	C31-2	B	Medium	6	Old Eagle River Road	3	
Motor /motor vehicle repair shops	C31	C31-3	B	Medium	7	Rroad east of Old Eagle River Road, off Lynne Drive	3	
Heavy equipment rental/storage	C18	C18-1	C	Medium	8	Celestial Street	3	
Welding shops	C43	C43-1	C	Medium	9	Echo Street	3	
Explosives and ammunitions manufacturing	I15	I15-1	C	Medium	10	Katlian Drive, east of Fireball Street	3	
Pet groomers	C34	C34-1	A	Low		Southwest of well	3	
Residential Areas	R01	R1-1	A	Low		Residences along Cross Drive	2	3 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R2-1	A	Low		Off Artillery Road	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		Old Glenn Highway	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low		Cross Drive	2	
Highways and roads, dirt/gravel	X24	X24-2	A	Low		Eagle River Mtwy	2	
Highways and roads, dirt/gravel	X24	X24-3	A	Low		Eagle River Road	2	
Residential Areas	R01	R1-2	B	Low		Residences off Monte Road	2	14 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R2-2-13	B	Low		Off Monte Road, Zone	3	11 septic systems in Zone B
Highways and roads, dirt/gravel	X24	X24-4-7	B	Low		Roads in Zone B	2	4 roads in Zone B
Construction trade areas and materials	C09	C9-1	C	Low		Aurora Street	3	

Contaminant Source Inventory and Risk Ranking for

Table 4 (continued) ***PWSID 216994.001***

Eagle River Church of Nazarene

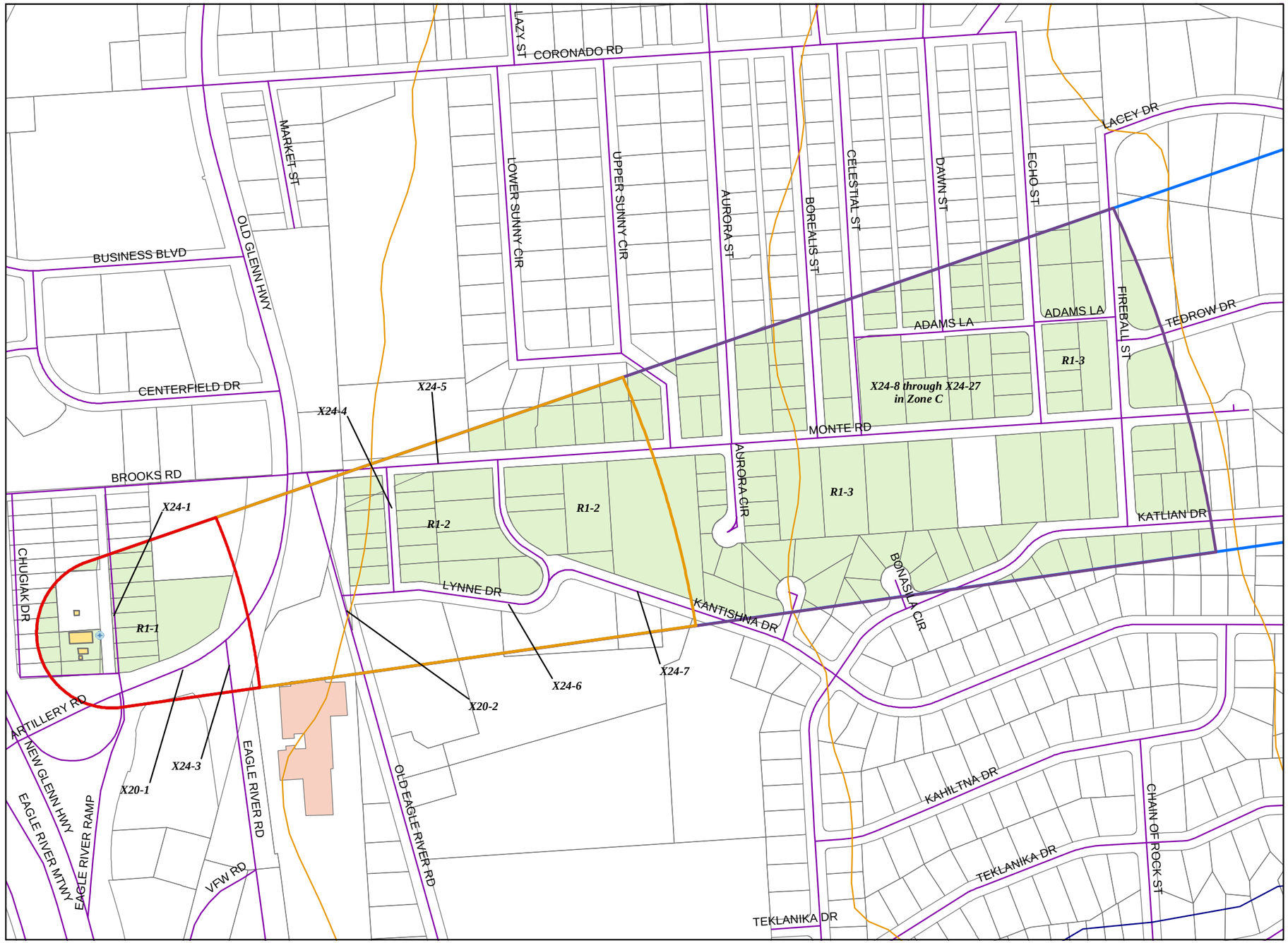
Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	C	Low		Between Monte Road and Katlian Drive, west of Fireball Street	3	
Residential Areas	R01	R1-3	C	Low		Residences off Monte Road	2	40 acres of residential area in Zone C
Septic systems (serves one single-family home)	R02	R2-14-35	C	Low		Off Monte Road, Zone	3	21 septic systems in Zone C
Highways and roads, paved with Arctic asphalt (Herbicide application)	X23	X23-1	C	Low		Fireball Street	3	
Highways and roads, dirt/gravel	X24	X24-8-27	C	Low		Roads in Zone C	2	20 roads in Zone C

APPENDIX C

Eagle River Church of Nazarene
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-3)

Drinking Water Protection Areas for Eagle River Church of Nazarene and Potential and Existing Sources of Contamination



760 380 0 760 Feet

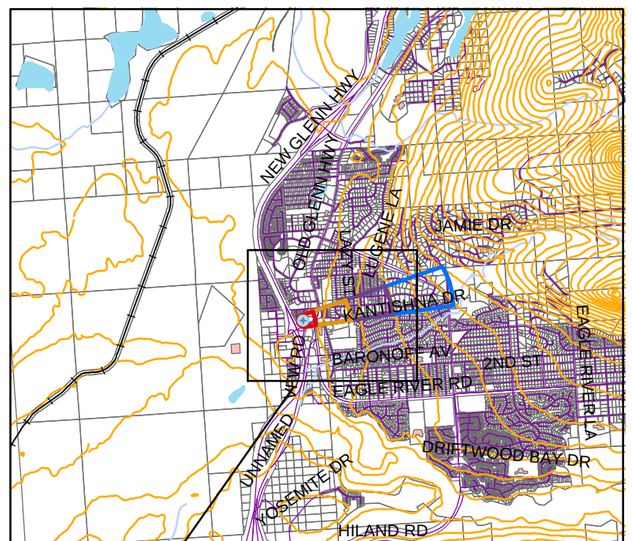
Eagle River Church of Nazarene Well
25m Contours
Streams
Roads
Residential Areas (R1)
MOA land parcels
Lakes

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



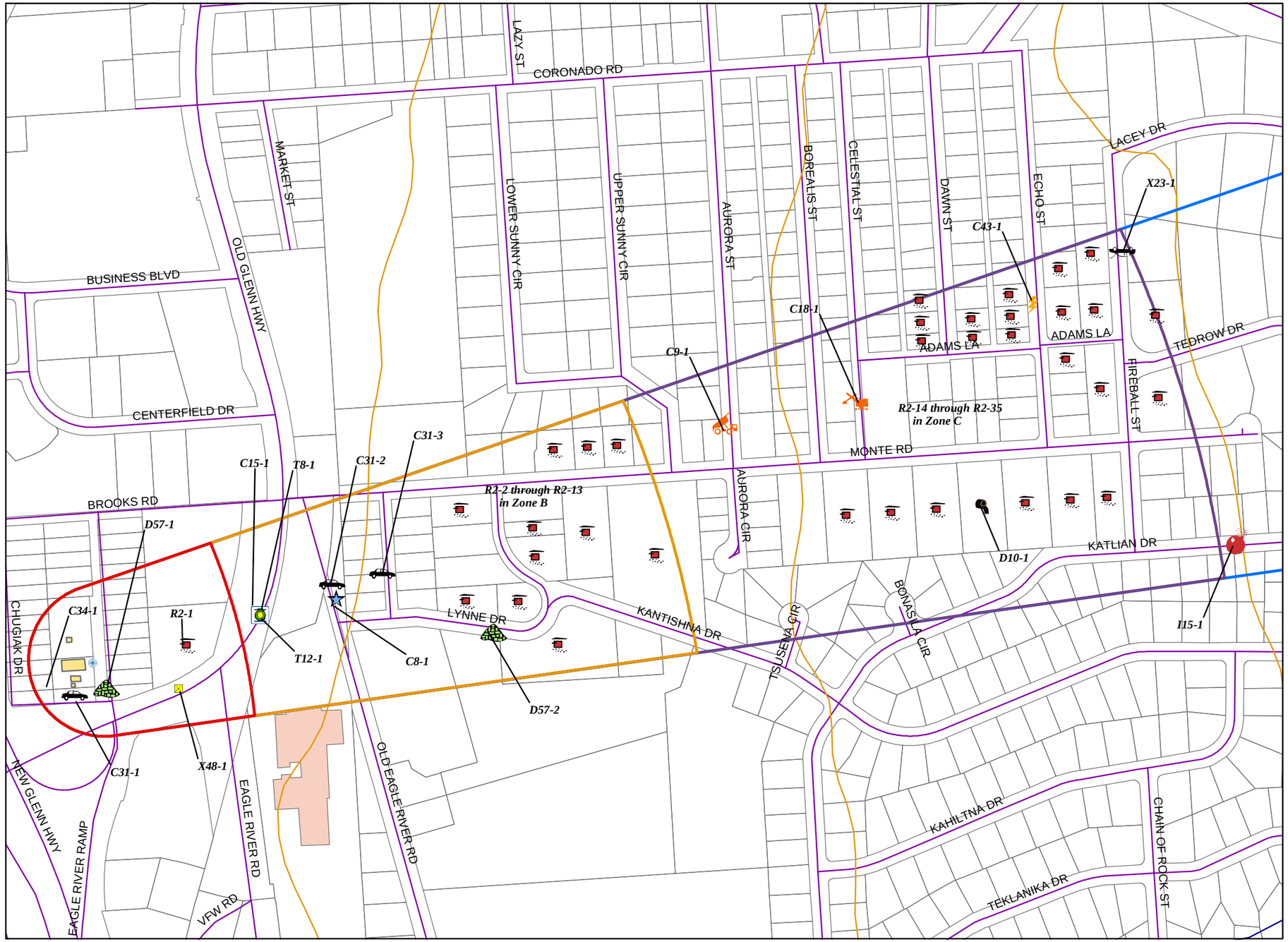
Location of map

PWSID 216994.001

N W E S

Map 2

Drinking Water Protection Areas for Eagle River Church of Nazarene and Potential and Existing Sources of Contamination



750 375 0 750 Feet

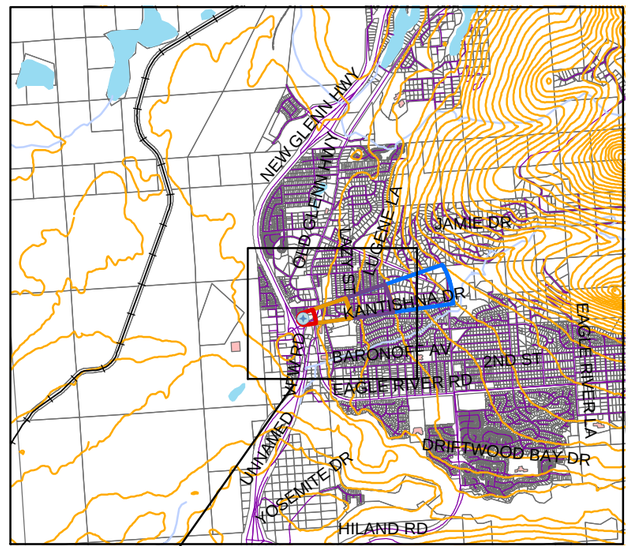
- Eagle River Church of Nazarene Well
- Car washes with engine or undercarriage cleaning, C8
- Construction trade areas and materials, C9
- Explosives and ammunitions manufacturing, I15
- Gasoline stations (without repair shop), C15
- Heavy equiptment rental/storage, C18
- Kennels, X48
- Motor / motor vehicle repair shops, C31
- Motor vehicle/general storage yards/facilities, X27
- Scrap, salvage, or junk yards, D57
- Tanks, diesel (underground), T8
- Tanks, gasoline (underground), T12
- Welding shops, C43
- Motor Vehicle Rapair Shop, C31
- Pet Groomer, C34
- Large Capacity Septic System (D10)
- Single Family Septic System (R2)
- 25m Contours
- Streams
- Roads
- MOA land parcels
- Lakes

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



Location of map

PWSID 216994.001

N W E S

Map 3

APPENDIX D

Vulnerability Analysis for Eagle River Church of Nazarene Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the Wellhead - Eagle River Church of the Nazarene

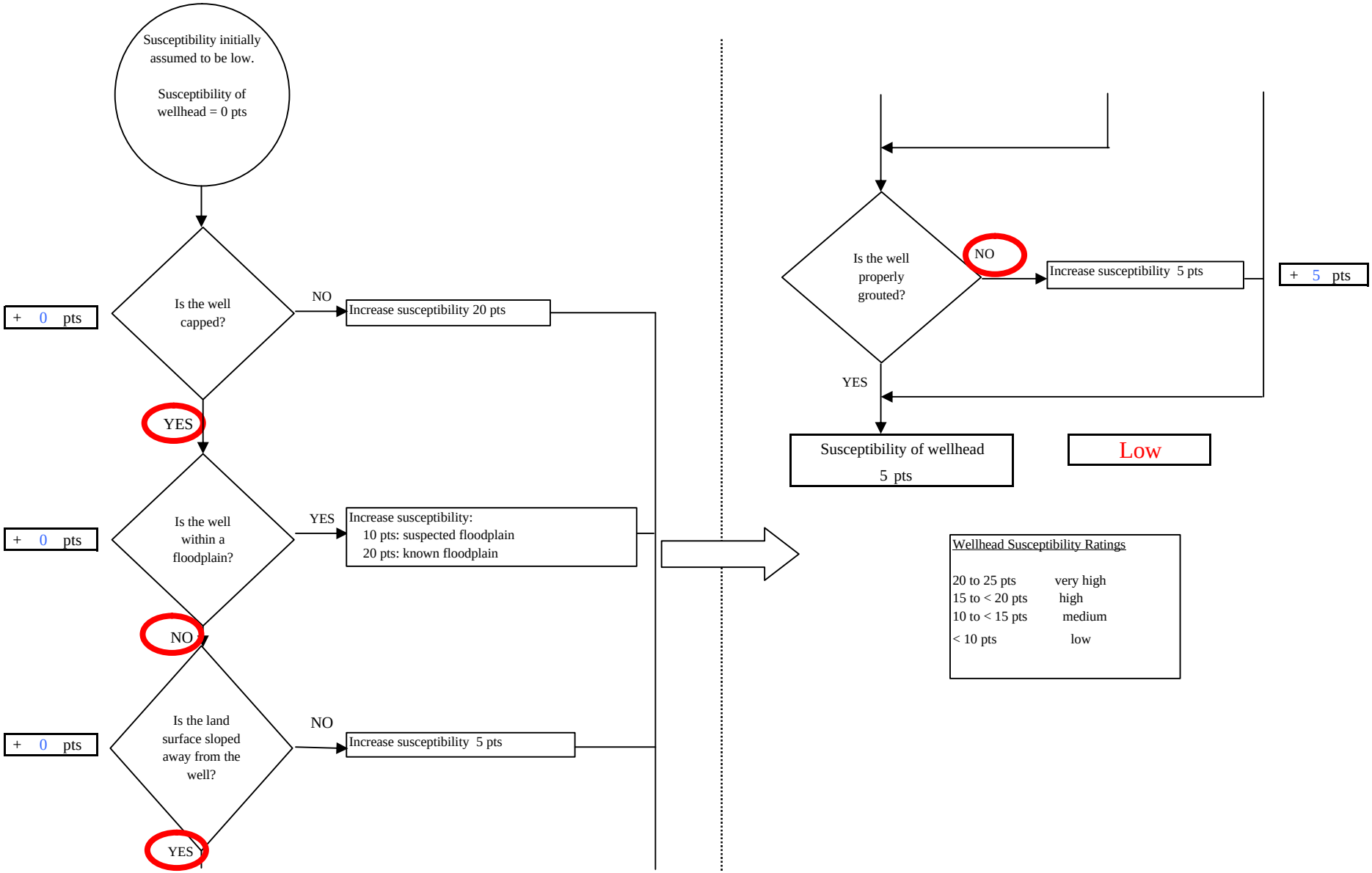


Chart 2. Susceptibility of the Aquifer - Eagle River Church of the Nazarene

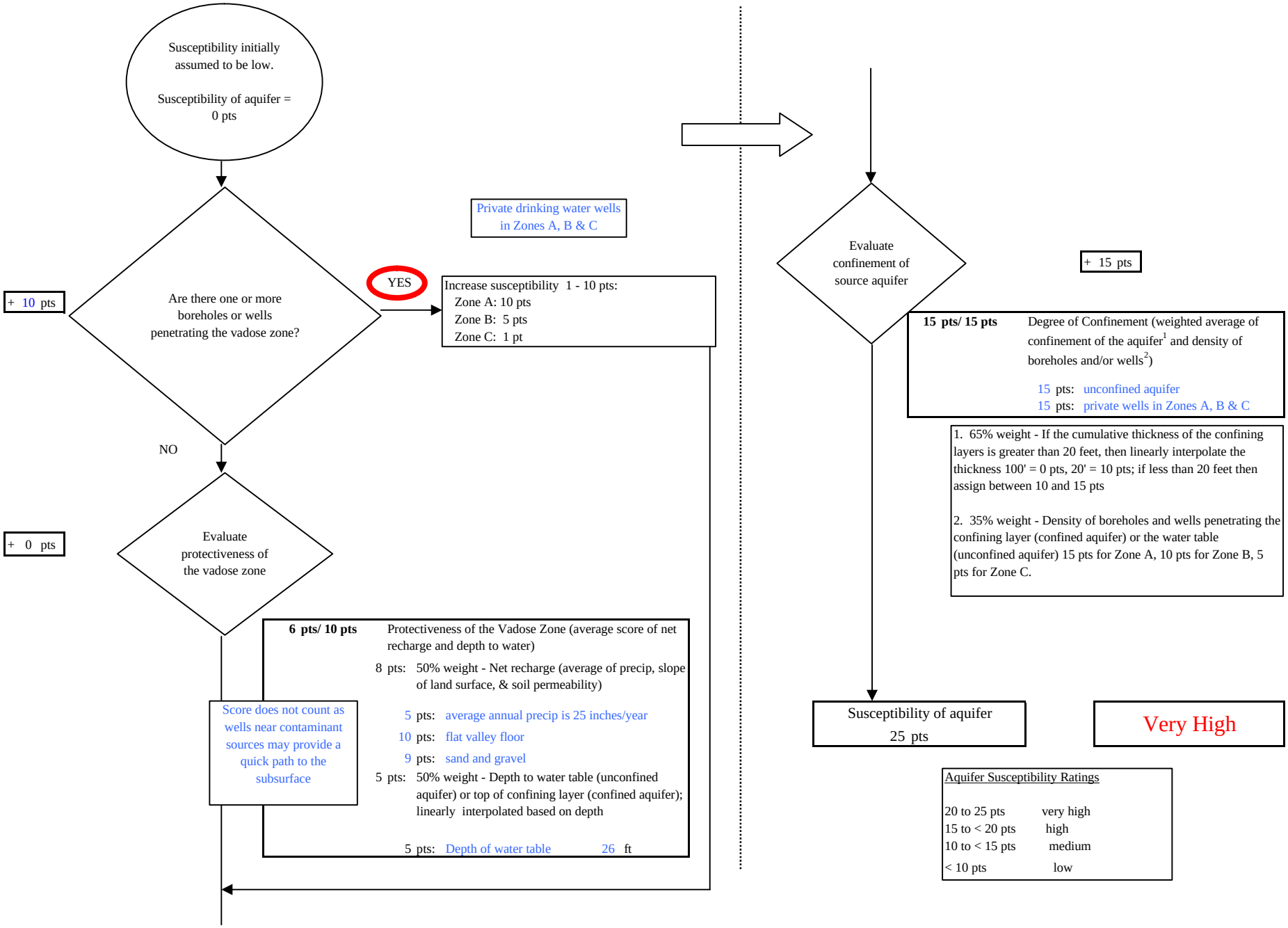
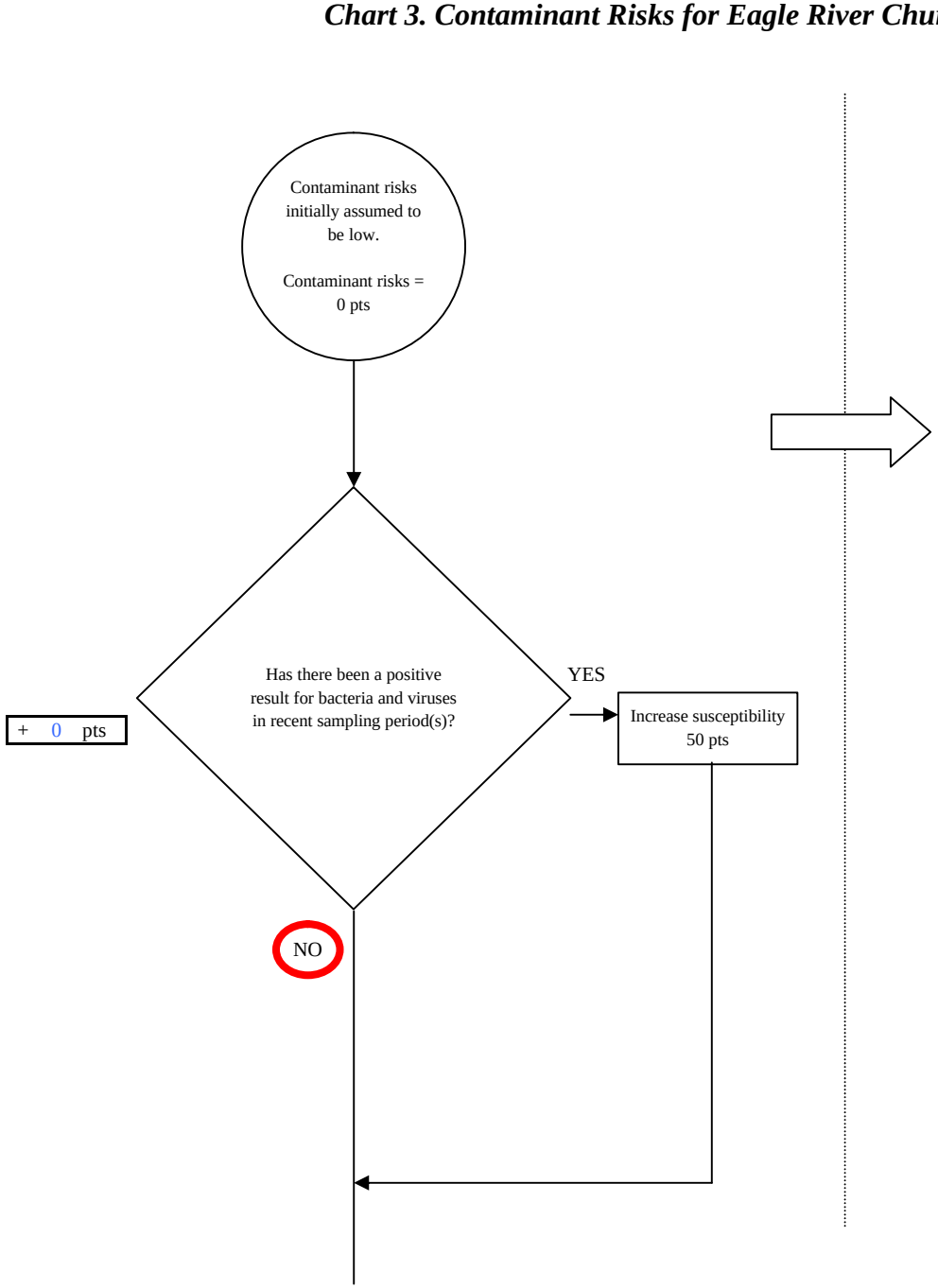
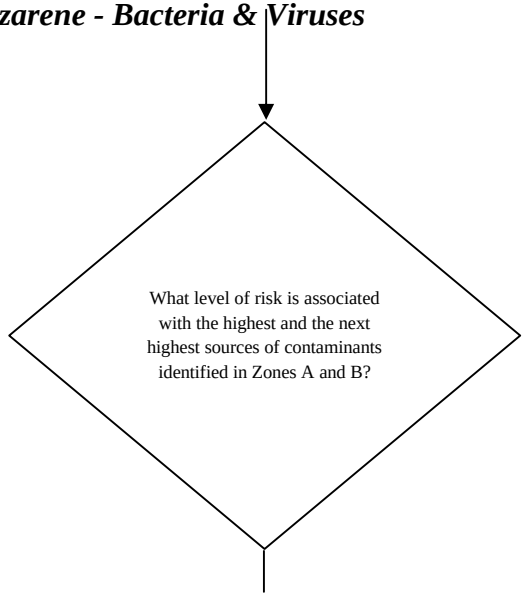


Chart 3. Contaminant Risks for Eagle River Church of the Nazarene - Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

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

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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 3. Contaminant Risks for Eagle River Church of the Nazarene - Bacteria & Viruses

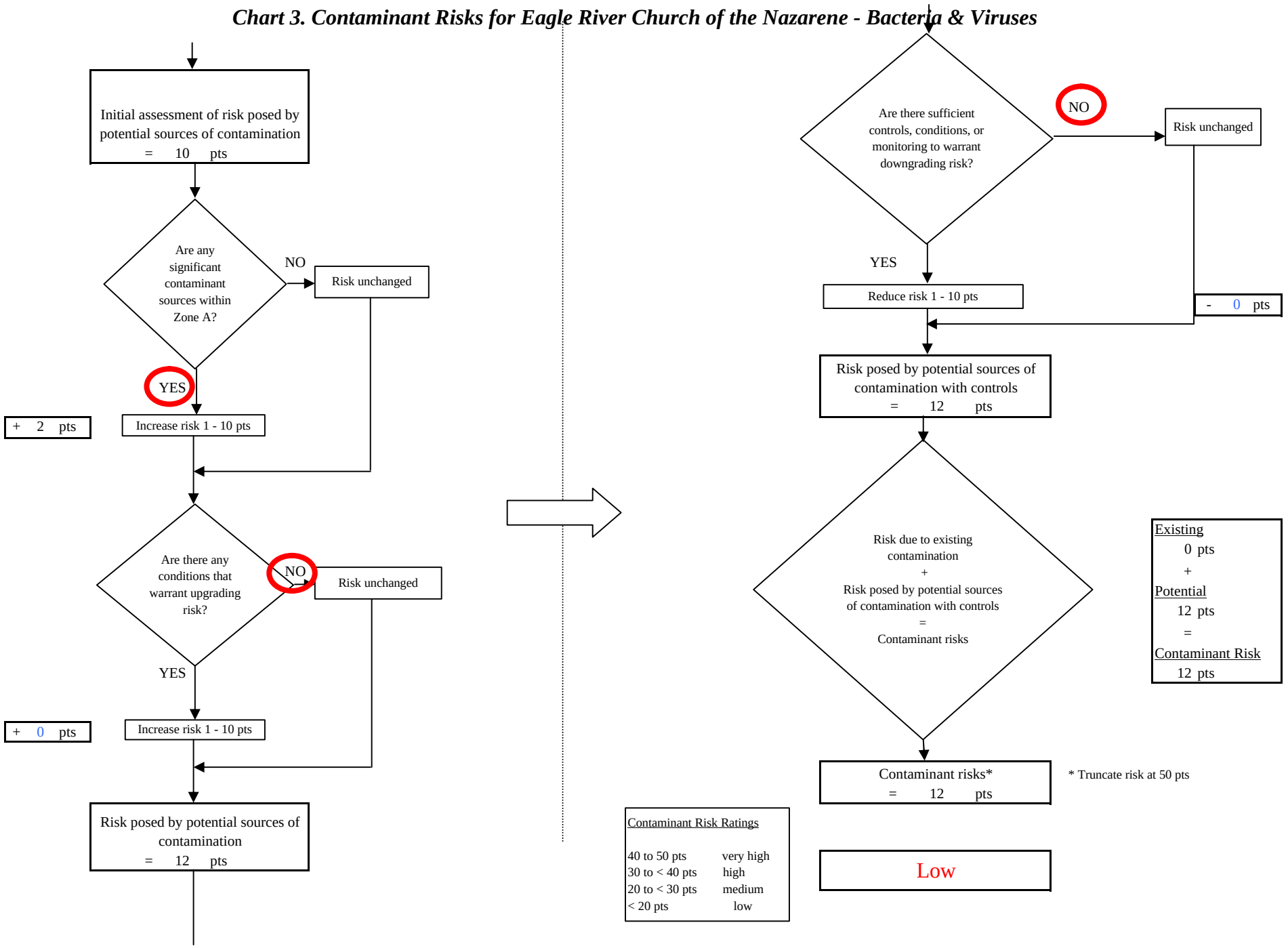


Chart 4. Vulnerability Analysis for Eagle River Church of the Nazarene - Bacteria & Viruses

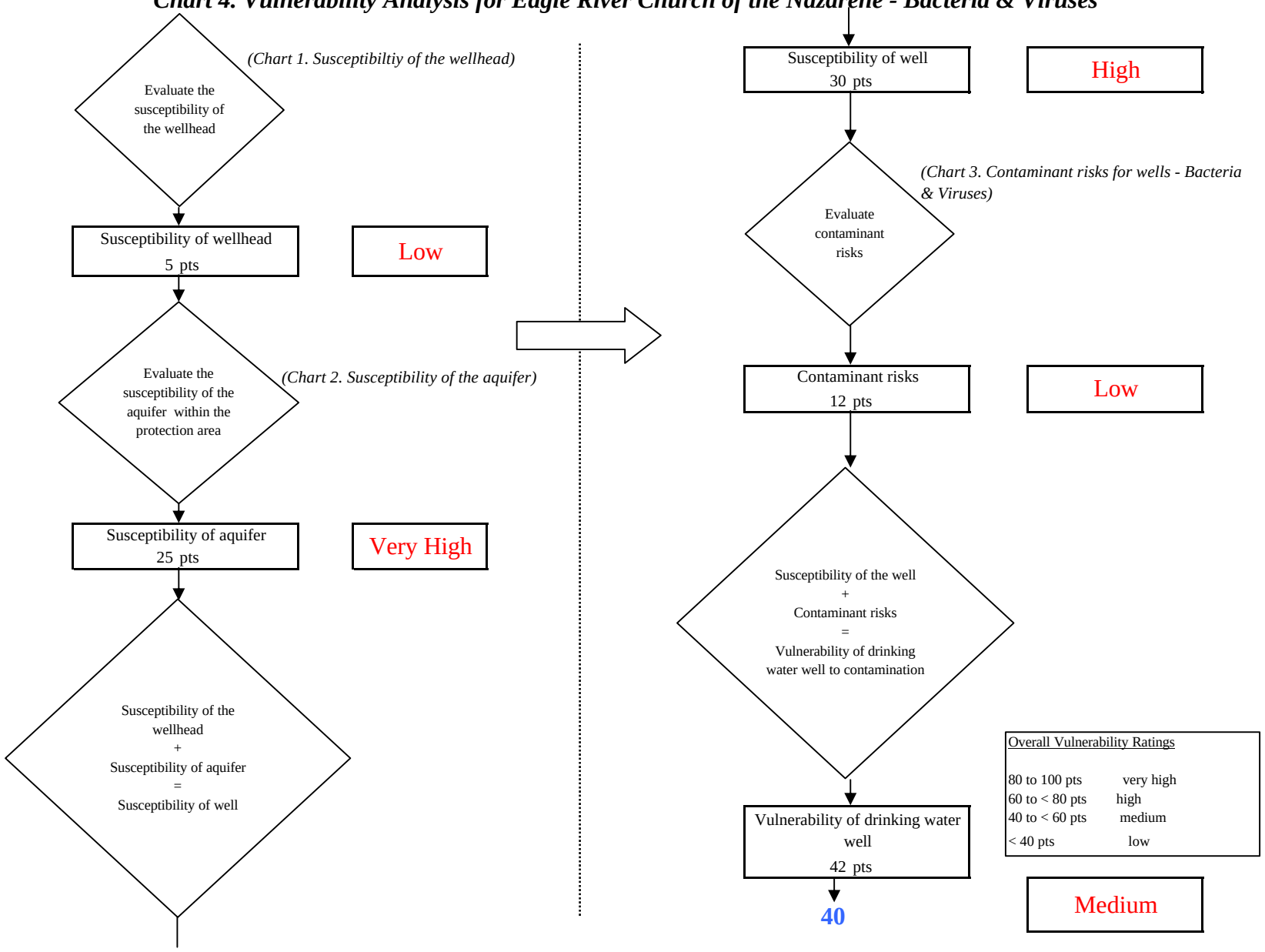


Chart 5. Contaminant Risks for Eagle River Church of the Nazarene - Nitrates and Nitrites

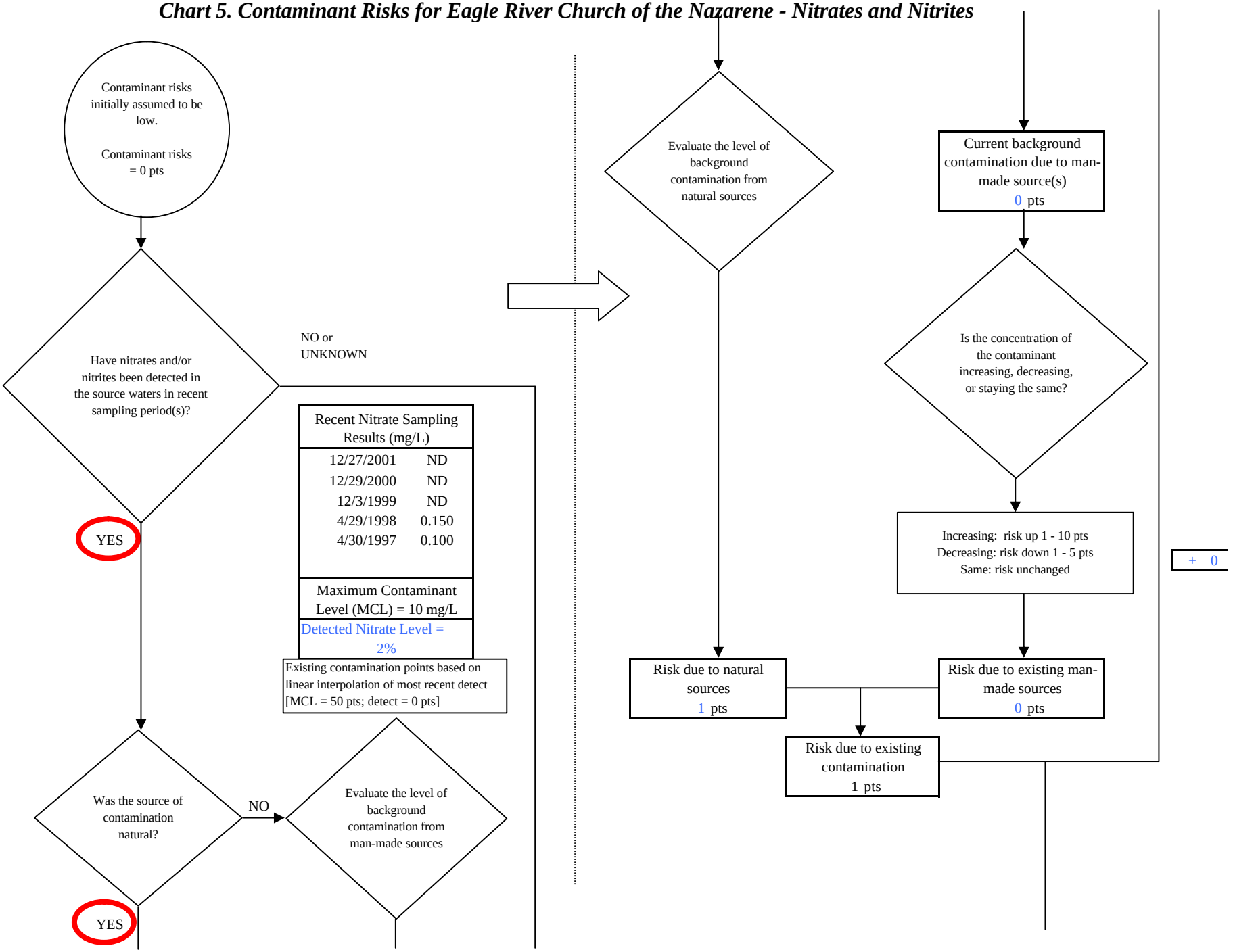


Chart 5. Contaminant Risks for Eagle River Church of the Nazarene - Nitrates and Nitrates

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	1	1
High(s)	0	1	1
Medium(s)	0	0	0
Low(s)	2	6	8

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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.

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

- 0

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

+ 2

Increase risk 1 - 10 pts

Chart 5. Contaminant Risks for Eagle River Church of the Nazarene - Nitrates and Nitrites

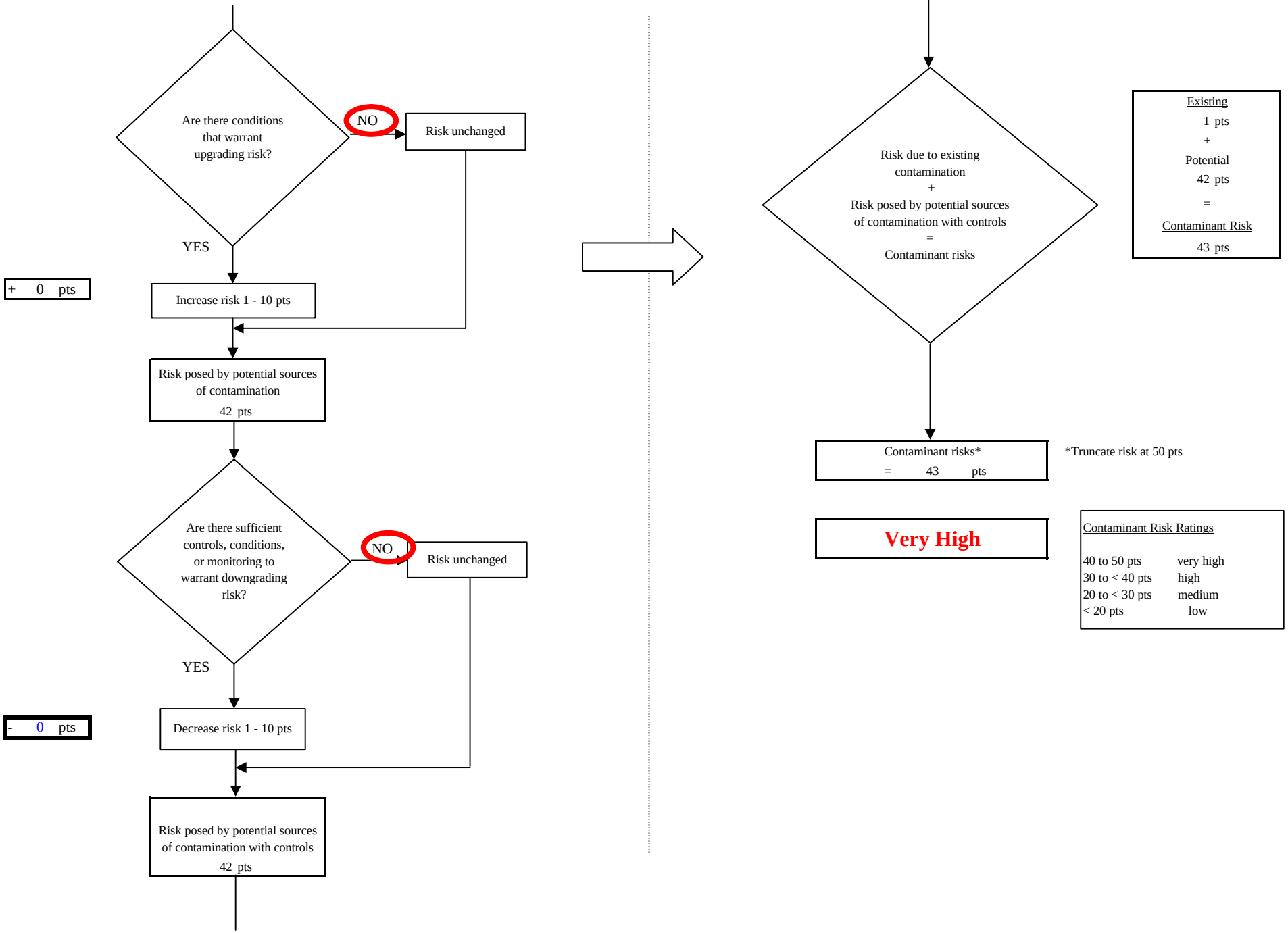


Chart 6. Vulnerability Analysis for Eagle River Church of the Nazarene - Nitrates and Nitrites

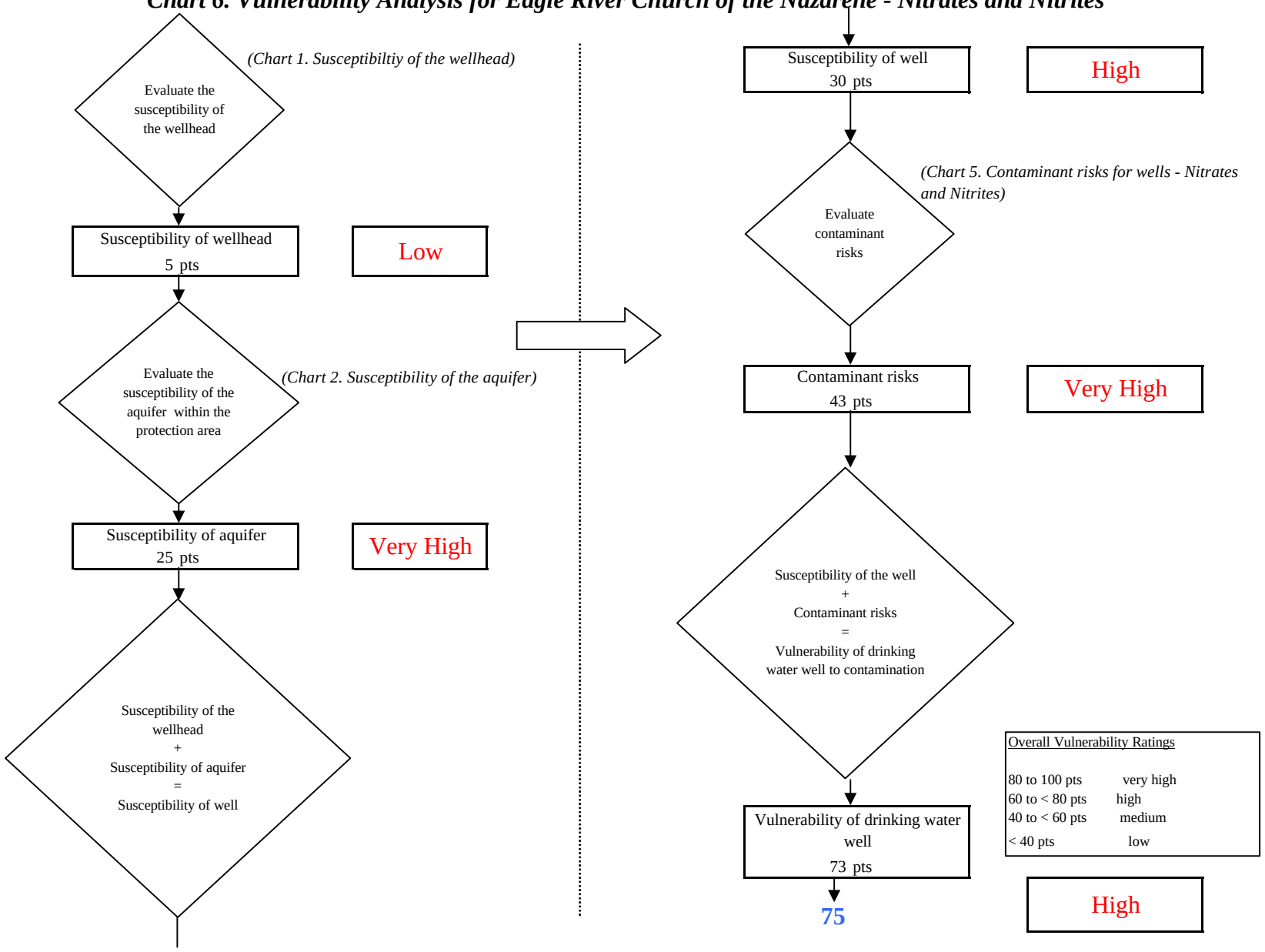


Chart 7. Contaminant Risks for Eagle River Church of the Nazarene - Volatile Organic Chemicals

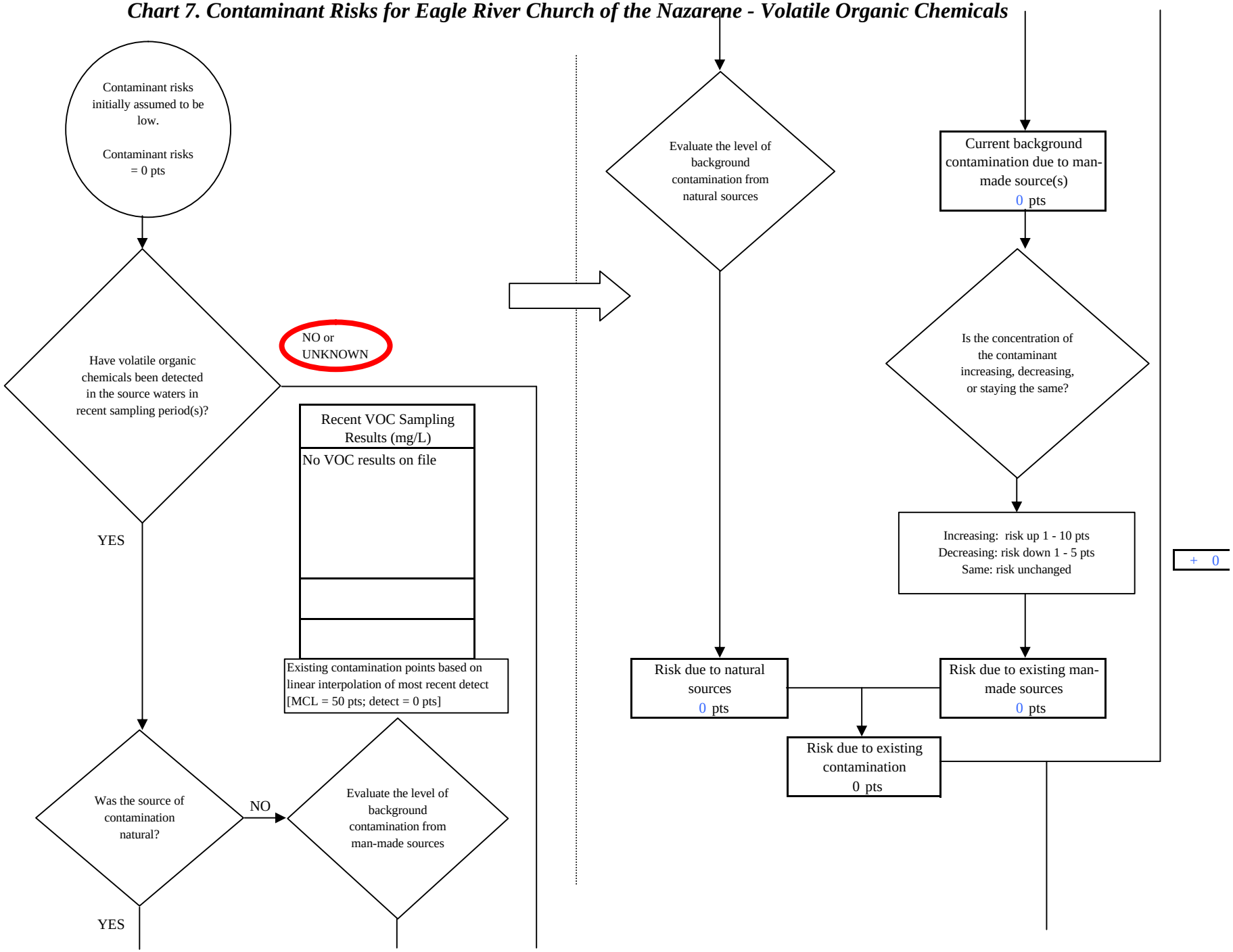


Chart 7. Contaminant Risks for Eagle River Church of the Nazarene - Volatile Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	4	4
Medium(s)	1	5	6
Low(s)	4	5	9

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 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.

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 5

Chart 7. Contaminant Risks for Eagle River Church of the Nazarene - Volatile Organic Chemicals

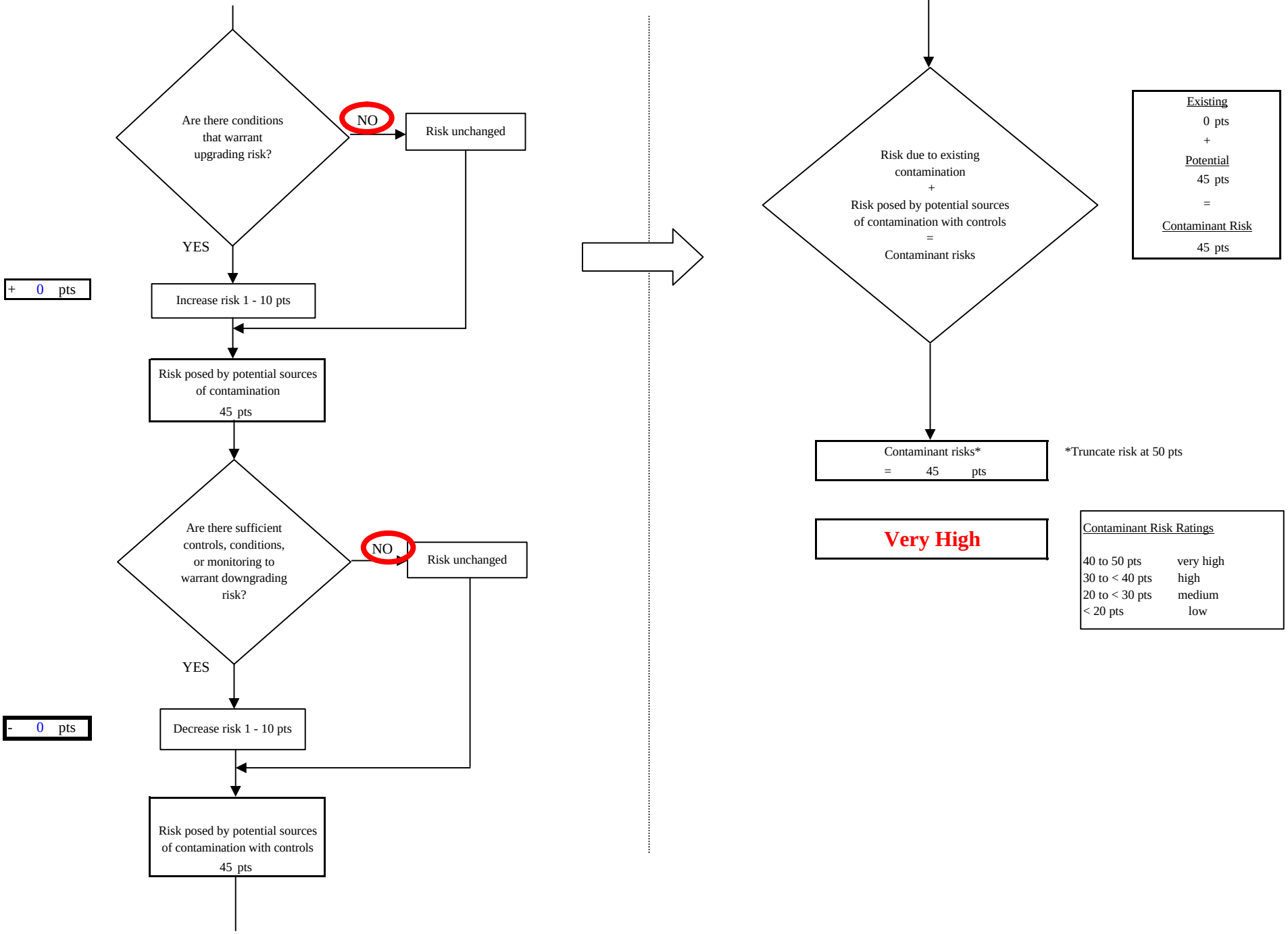


Chart 8. Vulnerability Analysis for Eagle River Church of the Nazarene - Volatile Organic Chemicals