Source Water Assessment -
Rabbit Creek Community Church
Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

DRINKING WATER PROTECTION PROGRAM REPORT 148

October 2001

Source Water Assessment -
Rabbit Creek Community Church
Anchorage, Alaska

By HEATHER A. HAMMOND

DRINKING WATER PROTECTION PROGRAM REPORT 148

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2001

CONTENTS

	Page
Executive Summary	1
Introduction	1
Description of the Anchorage area, Alaska	1
Rabbit Creek Community Church's Public Water Source	3
Assessment/Protection Area for Rabbit Creek Community Church's Public Drinking Water Source	3
Inventory of Potential and Existing Contaminant Sources	4
Ranking of Contaminant Risks	4
Vulnerability of Rabbit Creek Community Church's Public Drinking Water Source	5
Summary	6
References Cited	7

TABLES

TABLE	1. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination	5
	2. Contaminant Risks	5
	3. Overall Vulnerability of Rabbit Creek Community Church's Public Drinking Water Source to Contamination	6

ILLUSTRATIONS

		Page
FIGURE	1. Index map showing the location of Anchorage, Alaska	1
	2. Generalized hydrologic cycle in the Anchorage area	2
	3. Map showing the location of drinking water source for Rabbit Creek Community Church	3

APPENDICES

APPENDIX

A. Rabbit Creek Community Church's Drinking Water Protection Area (Map 1)

B. Contaminant Source Inventory for Rabbit Creek Community Church (Table 1)
Contaminant Source Inventory and Risk Ranking for Rabbit Creek Community Church – Bacteria and Viruses (Table 2)
Contaminant Source Inventory and Risk Ranking for Rabbit Creek Community Church – Nitrates and/or Nitrites (Table 3)
Contaminant Source Inventory and Risk Ranking for Rabbit Creek Community Church – Volatile organic chemicals (Table 4)

C. Rabbit Creek Community Church's Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2 – Map 4)

D. Vulnerability Analysis for Contaminant Source Inventory and Risk Ranking for Rabbit Creek Community Church's Public Drinking Water Source (Chart 1 – Chart 8 and Table 1 – Table 3)

Source Water Assessment - Rabbit Creek Community Church, Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

By Heather A. Hammond

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Rabbit Creek Community Church's Public Water System is a Class B (transient/non-community) drinking water source consisting of one well. Identified potential and current sources of contaminants for Rabbit Creek Community Church include: activities associated with highways and roads, activities along recreation trails, septic systems, residential areas, activities associated with orchards and nurseries and a public utility corridor. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, Rabbit Creek Community Church's public water source received a vulnerability rating of **Low** for bacteria and viruses, nitrates and/or nitrites and volatile organic chemicals.

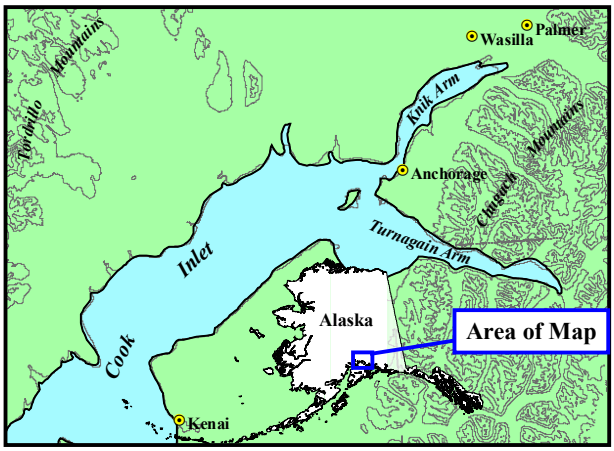


Figure 1. Index map showing the location of Anchorage, Alaska

INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for Rabbit Creek Community Church's source of public drinking water. This source consists of one well in the Anchorage area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

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

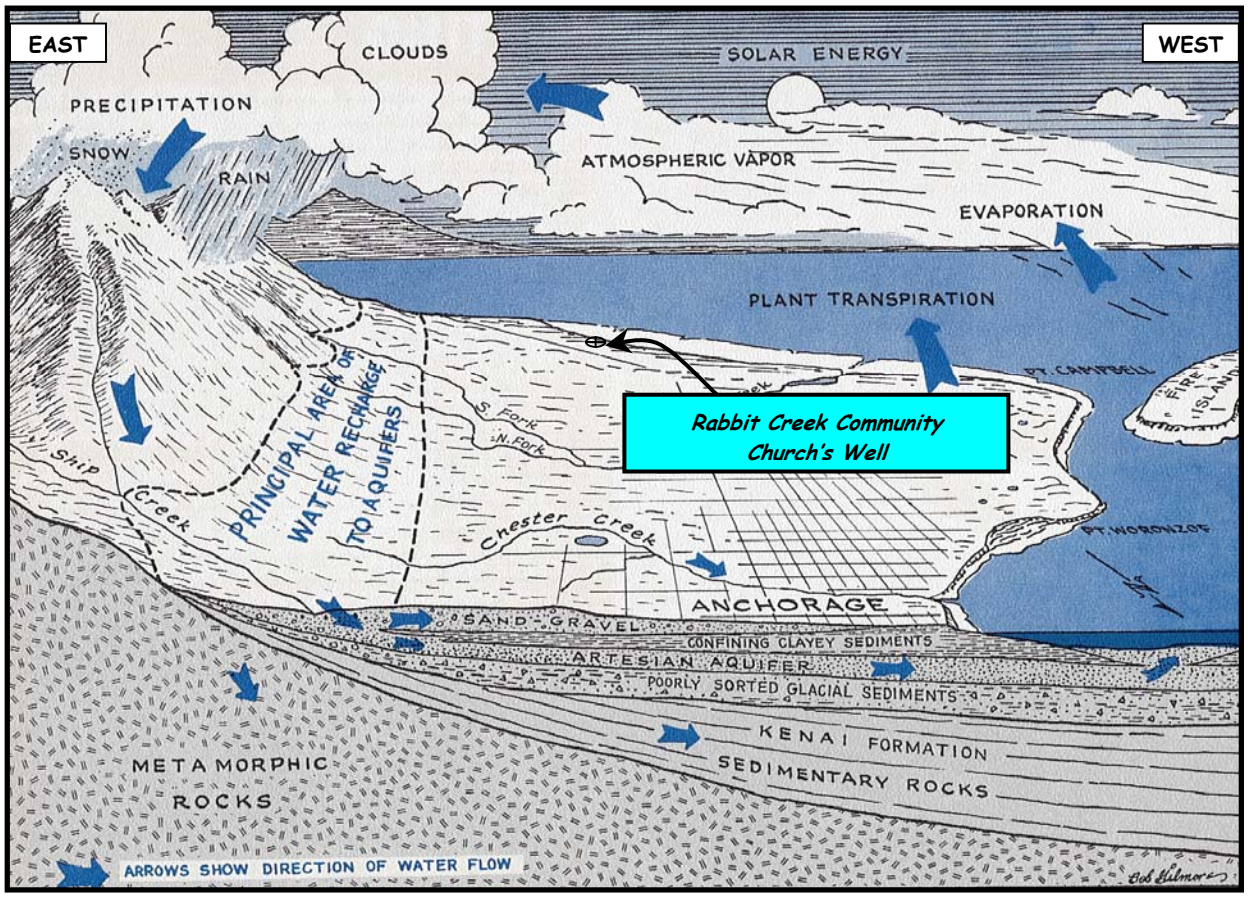


Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

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

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at the 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, except in areas where the direction of flow is influenced by large municipal or industrial production wells. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surfacial topography as well as its close connection with surface water bodies.

RABBIT CREEK COMMUNITY CHURCH'S PUBLIC DRINKING WATER SOURCE

Rabbit Creek Community Church's public water source is a Class B (transient/non-community) water system, which is owned and operated by the Rabbit Creek Community Church, Inc. The source consists of one well near the base of the Chugach Mountains and is at an elevation of approximately 500 feet above sea level. The well is located approximately 65 feet north of Rabbit Creek Road (see Figure 3). According to the well log, Rabbit Creek Community Church's well penetrates layers of gravelly silt and clay to a total depth of 251 feet below land surface. The well log does not indicate that grouting took place during installation. The well intake was finished with perforated pipe from 197 to 225 feet and had a static water level of 65 feet below land surface at the time of drilling (12/11/82).

Rabbit Creek Community Church's water system operates year round and serves approximately 5 residents and 200 non-residents through one service connection.

ASSESSMENT AND PROTECTION AREA FOR RABBIT CREEK COMMUNITY CHURCH'S DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Rabbit Creek Community Church is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of

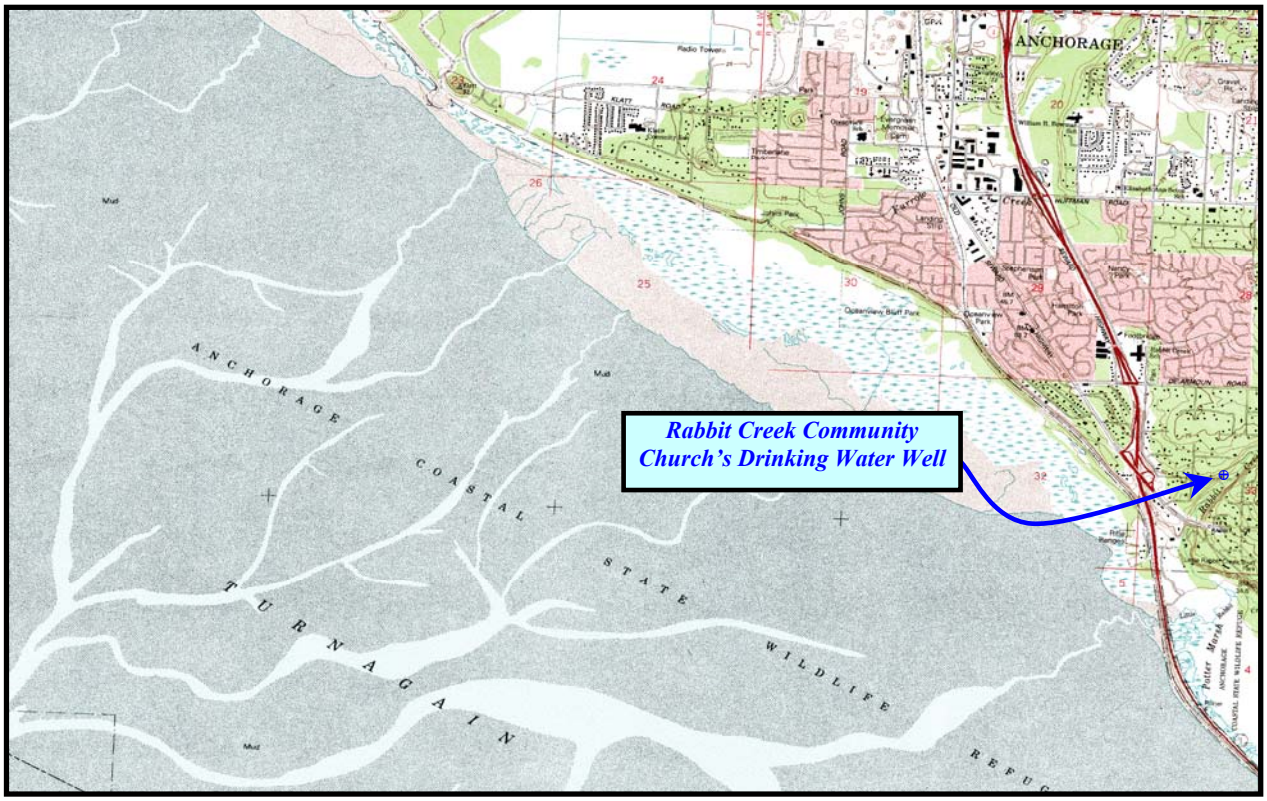


Figure 3. Map showing the location of the drinking water source for Rabbit Creek Community Church [Base: USGS Anchorage A8 SW].

the drinking water source to contamination. The zone around the drinking water source is the most critical area for the preservation of the quality of the drinking water for this source. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the area of focus for voluntary protection efforts.

Conceptually, groundwater enters the aquifer systems along the front range of the Chugach Mountains (Figure 2) and flows toward Cook Inlet and Turnagain Arm. An analytical calculation was used to calculate the size and shape of the area that contributes water to the well. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey [*Patrick, Brabets, and Glass, 1989*]. This analytical calculation was used as a guide as the first step in establishing the protection area for Rabbit Creek Community Church's drinking water source. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful and conservative protection area with respect to public health (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation are separated into zones. These zones correspond to a time-of-travel. Time-of-travel is the time required for water to move in the saturated zone of the ground from a specific point to the well. The Drinking Water Protection Area for Rabbit Creek Community Church contains four zones, Zone A through Zone D (See Map 1 in Appendix A). Zone A corresponds to the area between the well and the distance equal to ¼ of the distance of the 2-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to the well may be on the order of several days to several hours. Zone A also extends downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well.

Zone B corresponds to a time-of-travel of less than two years. Zones C through D correspond to those areas between 5 years and 10 years time-of-travel, respectively.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within Rabbit Creek Community Church's Drinking Water Protection Area. This survey was completed through a search of agency records and other publicly available information.

Potential sources of contamination to drinking water supplies cover a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of this assessment and all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

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

Maps 2 through 4 in Appendix C depict the Contaminant Source Inventory for Rabbit Creek Community Church. Inventoried potential sources of contamination within Zones A through D were activities associated with highways and roads, activities associated with recreation trails, septic systems, residential areas and activities associated with orchards and nurseries (see Table 1 in Appendix B). Below is a summary of the contaminant sources inventoried within Rabbit Creek Community Church's protection area:

- Highways and roads;
- Recreation trails;
- Septic systems;
- Residential areas;
- Orchards and nurseries; and
- A public utility corridor.

These potential contaminant sources present risk for all three categories of drinking water contaminants for Rabbit Creek Community Church's drinking water source.

RANKING OF CONTAMINANT RISKS

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

those types of contaminant sources as well as the proximity of those sources to the well.

VULNERABILITY OF RABBIT CREEK COMMUNITY CHURCH'S DRINKING WATER SOURCE

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

- natural susceptibility; and
- contaminant risks.

Each of the three categories of drinking water contaminants have been analyzed and an overall vulnerability score of 0 to 100 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 Rabbit Creek Community Church is completed in a transition zone between unconfined and confined aquifer conditions. This semi-confined aquifer condition results from the discontinuous and thinning nature of silt and clay layers near the base of the Chugach Mountains that form confining layers lower in the Anchorage Bowl. Therefore, contaminants that enter the subsurface near the base of the mountains may enter the semi-confined aquifer uninhibited by the absence of any protective layer. Private drinking water wells occur within the protection area for Rabbit Creek Community Church. If not properly constructed, the private wells can provide a quick path for contaminants to the subsurface. Therefore, the presence of the private wells increase the likelihood of contaminants reaching the source aquifer.

Rabbit Creek Community Church's well penetrates layers of gravelly silt and clay, as well as 125 feet of hard silt and clay (confining unit), which may provide a protective barrier against the movement of contaminants in the subsurface. According to the well log the well was drilled to a depth of 251 feet below land surface and was finished in a 6 inch casing with perforations from 197 to 225 feet below land surface. The well was not grouted at the time of drilling (12/11/82).

Combining the susceptibility of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility of the well to contamination (See Appendix D). Table 1 shows the overall Susceptibility score and rating for Rabbit Creek Community Church.

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

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	6	Low
Natural Susceptibility	20	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. Septic systems, residential areas and orchards and nurseries contribute the highest risk for potential contamination to Rabbit Creek Community Church's source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (Appendix B - Table 1 – Table 4). This portion of the analysis examines any existing or historical contamination that has been detected at the drinking water source through routine sampling. It also reviews contamination that has or may have occurred but has not arrived or been detected at the well. Table 2 through Table 4 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	28	Medium
Volatile Organic Chemicals	12	Low

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a Class B 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 Analysis for nitrates and nitrites, and volatile organic chemicals, respectively.

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

Table 3. Overall Vulnerability of Rabbit Creek Community Church's Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	20	Low
Nitrates and Nitrites	35	Low
Volatile Organic Chemicals	25	Low

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, respectively.

Overall, contaminant risk for bacteria and viruses and volatile organic chemicals is low with the density of septic systems driving the score for contaminant risk. The contaminant risk for nitrates and/or nitrites is medium with orchards and nurseries driving the score for contaminant risk.

Combining the potential bacteria and viruses, volatile organic chemicals and nitrates and/or nitrites contaminant risk with the susceptibility of the well yields an overall vulnerability to contamination of low for Rabbit Creek Community Church's source of public drinking water with respect to each contaminant category.

Other low potential contaminant sources for bacteria and viruses and volatile organic chemicals include activities associated with residential areas, activities associated with recreation trails, highways and roads, and a public utility corridor.

Because roads do pose potential for fuel spills to occur, highways and roads are ranked as very low potential sources of volatile organic chemicals along with bacteria and viruses and nitrates and/or nitrites. The utility corridor, though not heavily used, represents a very low contamination risk from volatile organic chemicals due to activities along the corridor. Overall, this corridor ranks as a very low potential source of contamination due to its proximity to Rabbit Creek Community Church's source of public drinking water.

Other low potential sources of nitrates and/or nitrites include activities associated with residential areas, activities associated with recreation trails, septic systems, and highways and roads.

SUMMARY

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

REFERENCES CITED

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

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

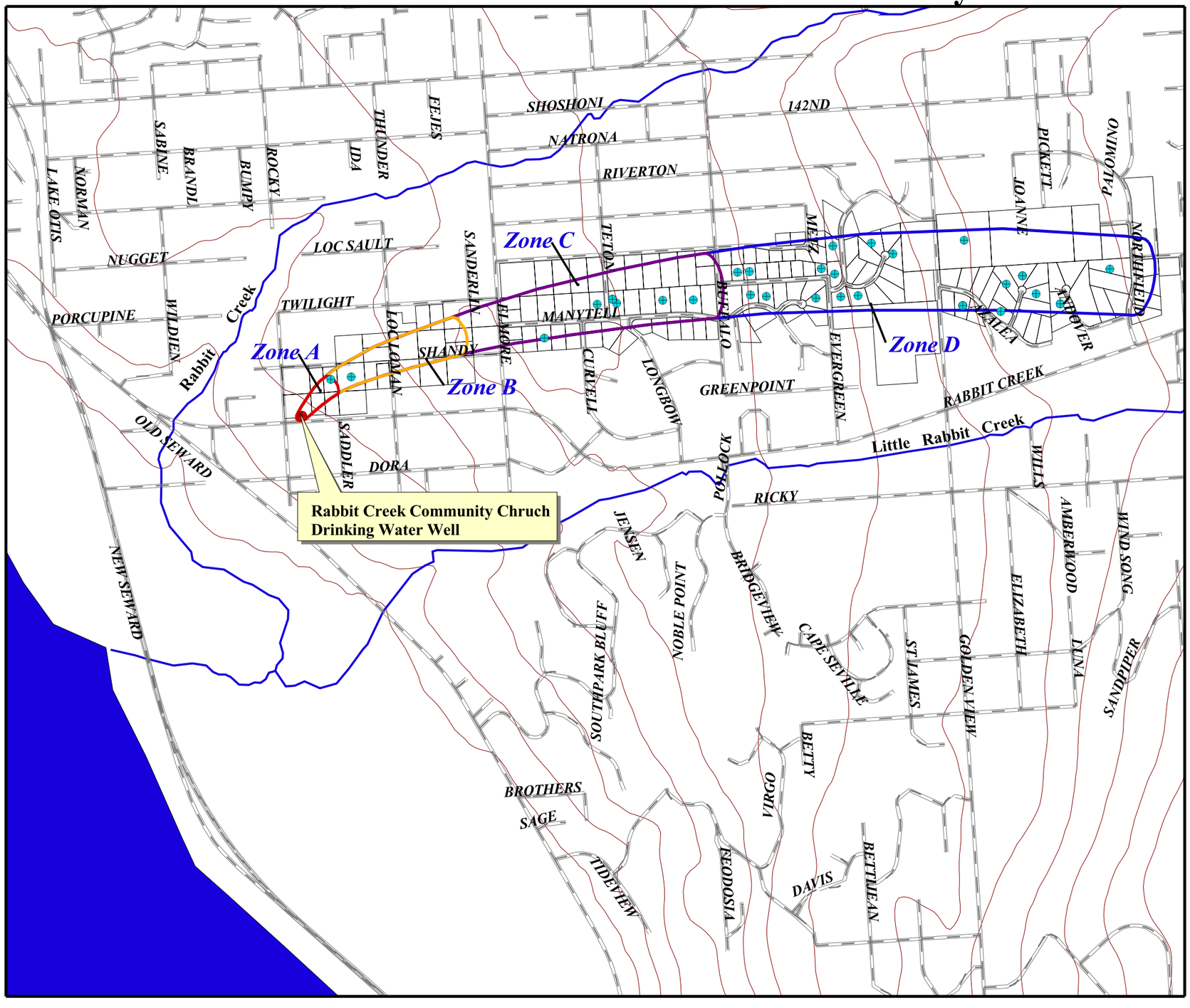
Ulery, C.A. and Updike, R.G, 1983, Subsurface structure of the cohesive facies of the Bootlegger Cove Formation, Southwest Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 84, 5 p.

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

APPENDIX A

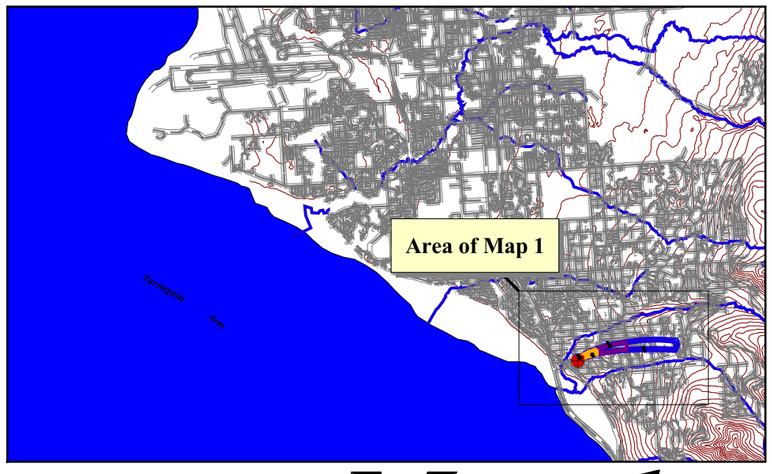
Rabbit Creek Community Church's
Drinking Water Protection Area

Drinking Water Protection Area for Rabbit Creek Community Church



Drinking Water Well Location
Private and Public Wells
Zone A Protection Area
Several Months Travel Time
Zone B Protection Area
Less Than 2 Years Travel Time
Zone C Protection Area
Less Than 5 Years Travel Time
Zone D Protection Area
Less Than 10 Years Travel Time
Anchorage Land Parcels
Anchorage Roads
Anchorage Streams
Elevation Contours
Cook Inlet

N W E S



PWSID 218108.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Rabbit Creek Community Church

Table 1

Contamiant Source Inventory for
Rabbit Creek Community Church

PWSID 218108.001

Contaminant Source Category	Contaminant Source ID	CD ID Tag	Zone	Location	Map	Comments
Residential Areas	R1	R1-1	A	Residential areas located within Zone A	2	
Septic systems (serves one single-family home)	R2	R2-1	A	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-2	A	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-3	A	Within Zone A near Rabbit Creek Road	2	
Dog walking areas/foot trails	X46	X46-1	A	Near the stagnation point of Zone A	2	
Orchards or nurseries	A10	A10-1	B	Off of Rabbit Creek Road	2	
Residential Areas	R1	R1-2	B	Residential areas located within Zone B	2	
Septic systems (serves one single-family home)	R2	R2-10	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-11	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-12	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-13	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-14	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-4	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-5	B	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-6	B	Off of Locloman Lane	2	
Septic systems (serves one single-family home)	R2	R2-7	B	Off of Locloman Lane	2	
Septic systems (serves one single-family home)	R2	R2-8	B	Off of Locloman Lane	2	
Septic systems (serves one single-family home)	R2	R2-9	B	Off of Locloman Lane	2	
Residential Areas	R1	R1-3	C	Residential areas located within Zone C	3	
Septic systems (serves one single-family home)	R2	R2-15-39	C	Septics located within Zone C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4-9	C	All roads located within Zone C	3	

Public utility easements/corridors	X42	X42-1	C	Public utility easement/corridor along dual purpose pipeline	3	Pipeline is currently transporting natural gas but has transported oil in the past.
Dog walking areas/foot trails	X46	X46-2	C	Trail along west side of Elmore Road	3	
Dog walking areas/foot trails	X46	X46-3	C	Trail along east side of Elmore Road	3	

Table 2

Contaminant Source Inventory and Risk Ranking for
Rabbit Creek Community Church
Sources of Bacteria and Viruses

PWSID 218108.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Dog walking areas/foot trails	X46	X46-1	A	Low	1	Near the stagnation point of Zone A	2	
Residential Areas	R1	R1-1	A	Low	2	Residential areas located within Zone A	2	
Septic systems (serves one single-family home)	R2	R2-1	A	Low	3	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-2	A	Low	4	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-3	A	Low	5	Within Zone A near Rabbit Creek Road	2	
Residential Areas	R1	R1-2	B	Low	6	Residential areas located within Zone B	2	
Septic systems (serves one single-family home)	R2	R2-4	B	Very Low	7	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-5	B	Very Low	8	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-6	B	Very Low	9	Off of Locloman Lane	2	
Septic systems (serves one single-family home)	R2	R2-7	B	Very Low	10	Off of Locloman Lane	2	
Septic systems (serves one single-family home)	R2	R2-10	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-11	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-12	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-13	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-14	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-8	B	Very Low		Off of Locloman Lane	2	
Septic systems (serves one single-family home)	R2	R2-9	B	Very Low		Off of Locloman Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	B	Very Low		Shandy Court	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Very Low		Locloman Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Very Low		Shandy Court	2	
Residential Areas	R1	R1-3	C	Low		Residential areas located within Zone C	3	
Septic systems (serves one single-family home)	R2	R2-15-39	C	Medium		Septics located within Zone C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-4-9	C	Very Low		All roads located within Zone C	3	
Dog walking areas/foot trails	X46	X46-2	C	Low		Trail along west side of Elmore Road	3	

Dog walking areas/foot trails	X46	X46-3	C	Low		Trail along east side of Elmore Road	3	

Table 3

Contaminant Source Inventory and Risk Ranking for
Rabbit Creek Community Church
Sources of Nitrates/Nitrites

PWSID 218108.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Orchards or nurseries	A10	A10-1	B	Medium	1	Off of Rabbit Creek Road	2	
Dog walking areas/foot trails	X46	X46-1	A	Low	2	Near the stagnation point of Zone A	2	
Septic systems (serves one single-family home)	R2	R2-1	A	Low	3	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-2	A	Low	4	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-3	A	Low	5	Within Zone A near Rabbit Creek Road	2	
Residential Areas	R1	R1-1	A	Low	6	Residential areas located within Zone A	2	
Septic systems (serves one single-family home)	R2	R2-4	B	Very Low	7	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-5	B	Very Low	8	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-6	B	Very Low	9	Off of Locloman Lane	2	
Residential Areas	R1	R1-2	B	Low	10	Residential areas located within Zone B	2	
Septic systems (serves one single-family home)	R2	R2-13	B	Very Low		Off of Shandy Court	2	
Residential Areas	R1	R1-3	C	Low		Residential areas located within Zone C	3	
Septic systems (serves one single-family home)	R2	R2-15-39	C	Medium		Septics located within Zone C	3	

Table 4

Contaminant Source Inventory and Risk Ranking for
Rabbit Creek Community Church
Sources of Volatile Organic Chemicals

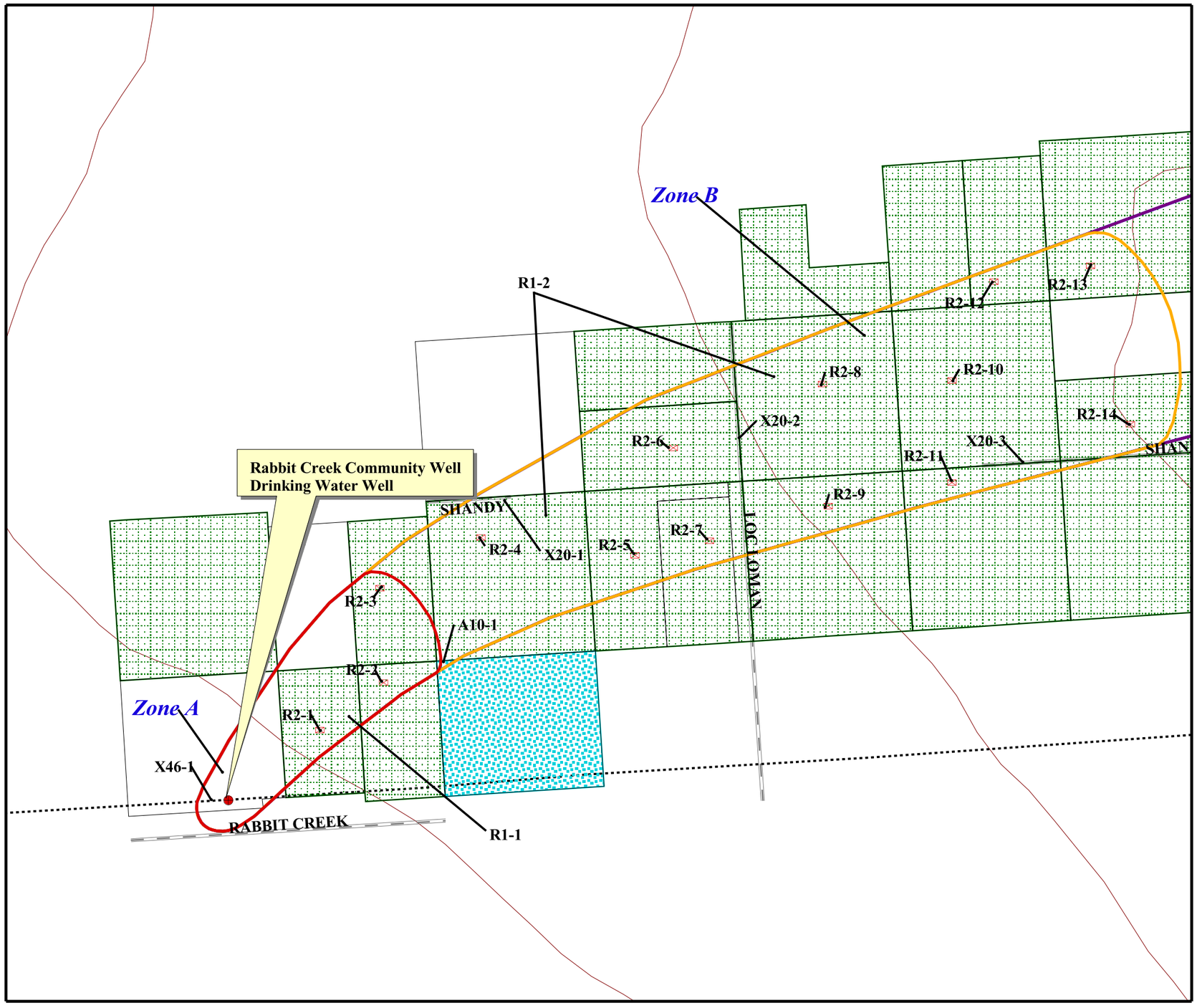
PWSID 218108.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Highways and roads, paved (cement or asphalt)	X20	X20-1	B	Very Low	1	Shandy Court	2	
Residential Areas	R1	R1-1	A	Low	2	Residential areas located within Zone A	2	
Septic systems (serves one single-family home)	R2	R2-1	A	Low	3	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-2	A	Low	4	Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-3	A	Low	5	Within Zone A near Rabbit Creek Road	2	
Residential Areas	R1	R1-2	B	Low	6	Residential areas located within Zone B	2	
Septic systems (serves one single-family home)	R2	R2-4	B	Very Low	7	Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-5	B	Very Low	8	Off of Shandy Court	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Very Low	9	Locloman Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B	Very Low	10	Shandy Court	2	
Orchards or nurseries	A10	A10-1	B	Low		Off of Rabbit Creek Road	2	
Septic systems (serves one single-family home)	R2	R2-10	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-11	B	Very Low		Off of Shandy Court	2	
Septic systems (serves one single-family home)	R2	R2-6	B	Very Low		Off of Locloman Lane	2	

APPENDIX C

Rabbit Creek Community Church's Drinking Water Protection Area and Potential & Existing Contaminant Sources

Drinking Water Protection Area for
Rabbit Creek Community Church and Potential & Existing Contaminant Sources



- Drinking Water Well Location

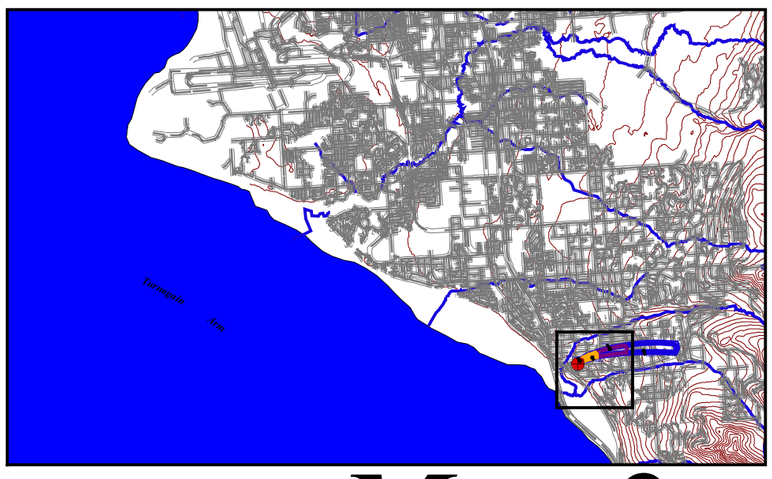
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Anchorage Land Parcels
- Orchards or nurseries (A10)
- Lawns and Gardens (R1)
- Septic Systems (R2)
- Trails (X46)
- Anchorage Roads (X20)
- Elevation Contours

N
W E
S

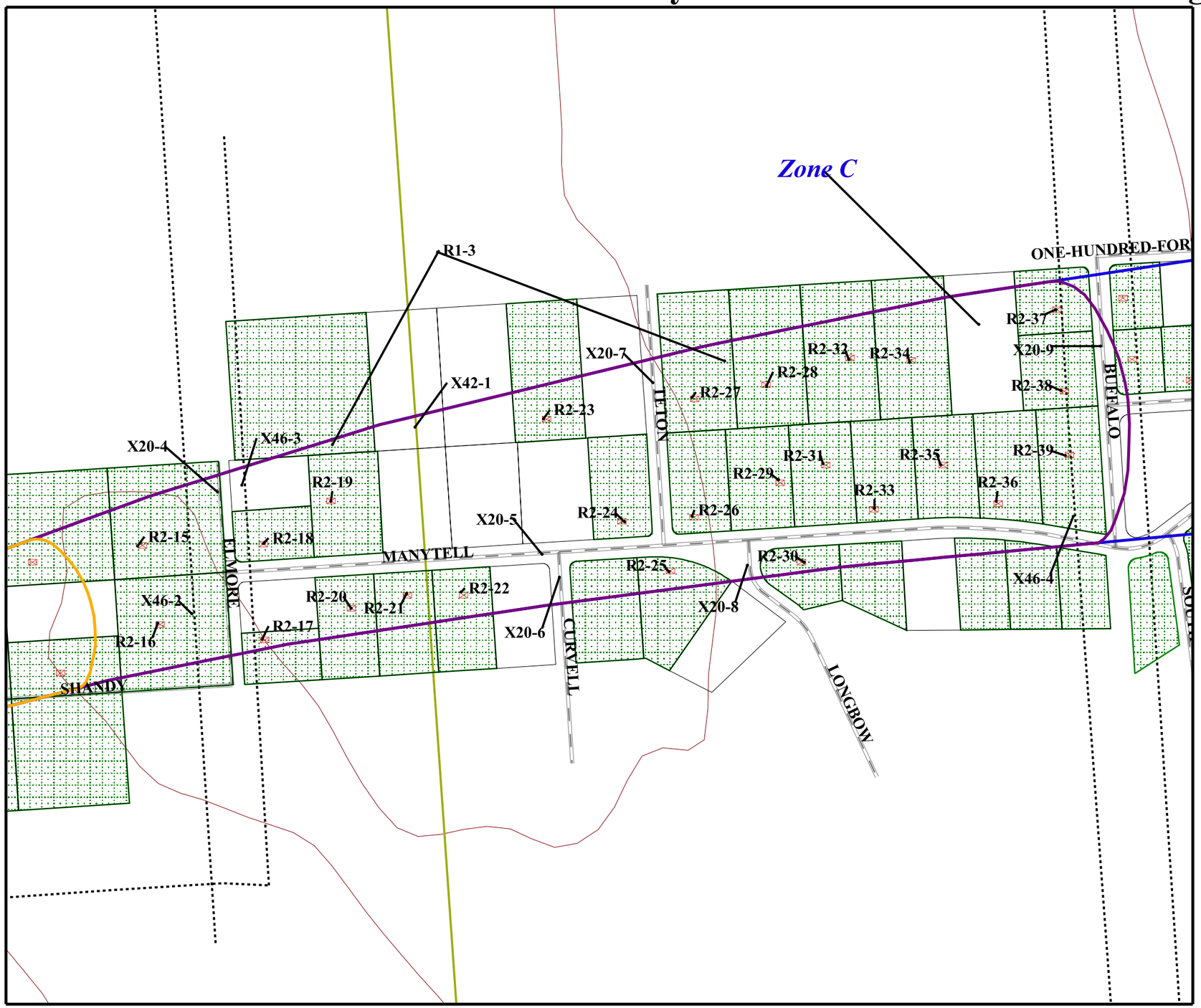


400 0 400 800 Feet

PWSID 218108.001

Map 2

Drinking Water Protection Area for
Rabbit Creek Community Church and Potential & Existing Contaminant Sources



- Drinking Water Well Location

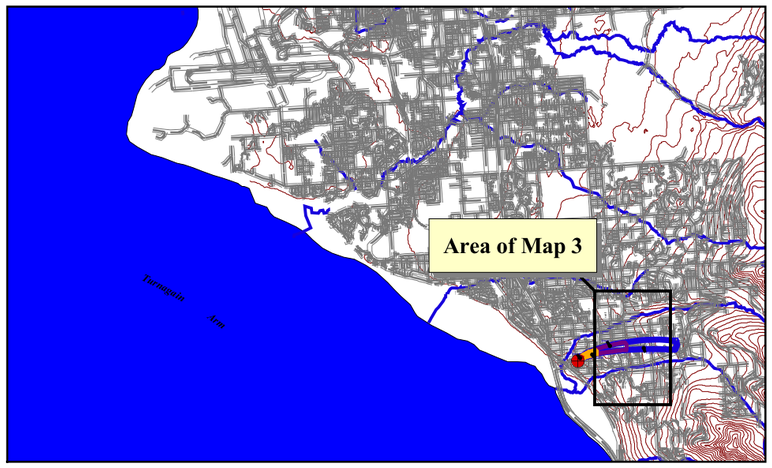
Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Anchorage Land Parcels
- Lawns and Gardens (R1)
- Septic Systems (R2)
- Public Utility Easement/Corridor (X42)
- Trails (X46)
- Anchorage Roads (X20)
- Elevation Contours

N W E S

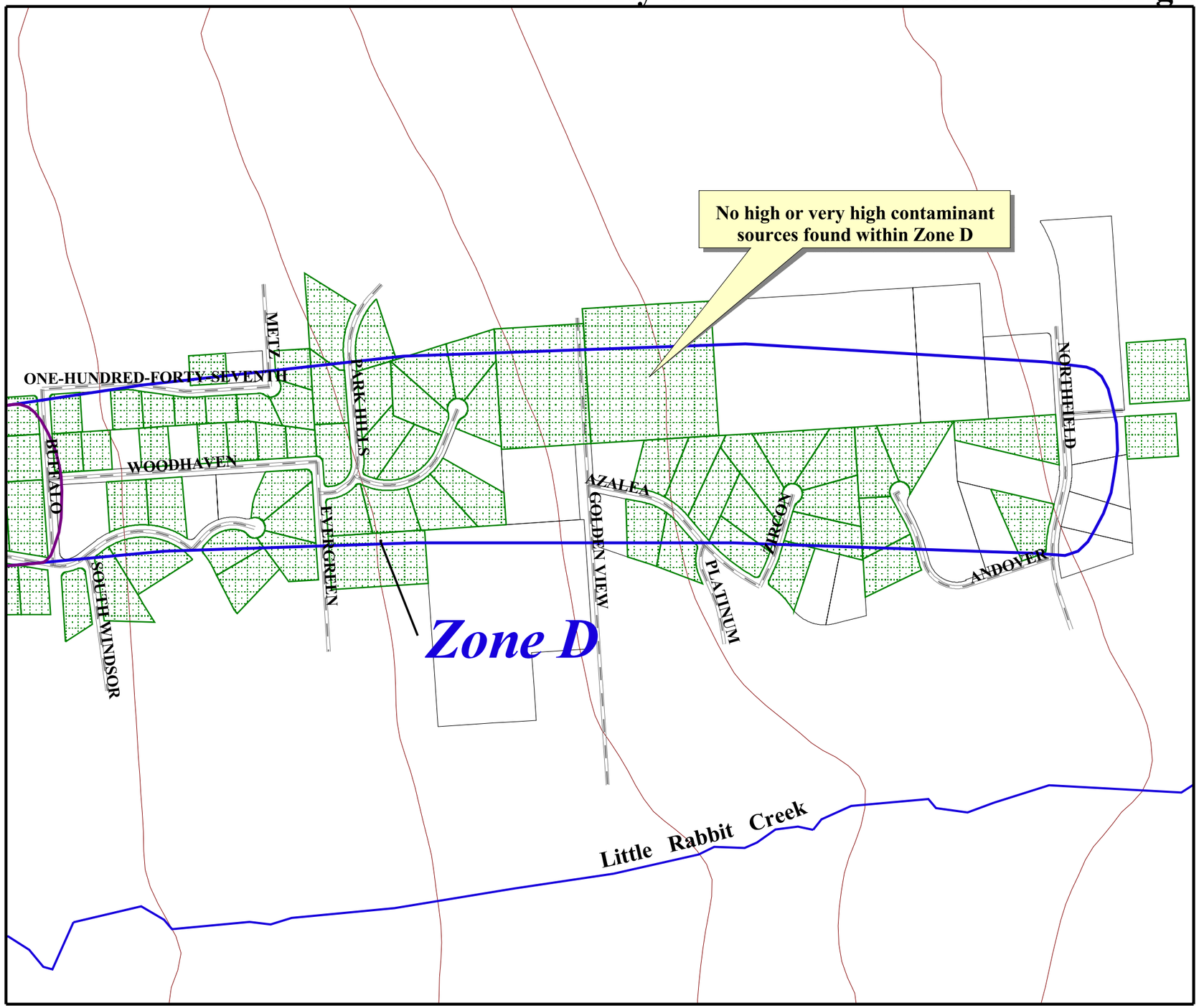


500 0 500 1000 Feet

PWSID 218108.001

Map 3

Drinking Water Protection Area for
Rabbit Creek Community Church and Potential & Existing Contaminant Sources



- Drinking Water Well Location

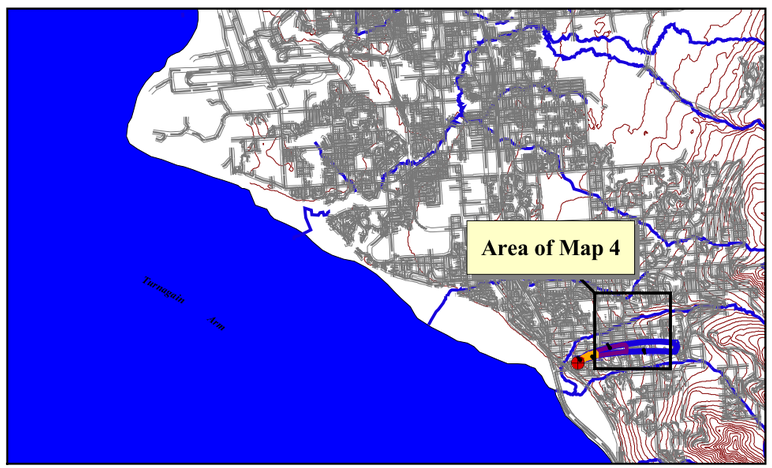
Zone A Protection Area
- Several Months Travel Time

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)
- Anchorage Land Parcels
- Anchorage Roads (X20)
- Anchorage Streams
- Elevation Contours

N
W E
S



1000 0 1000 2000 Feet

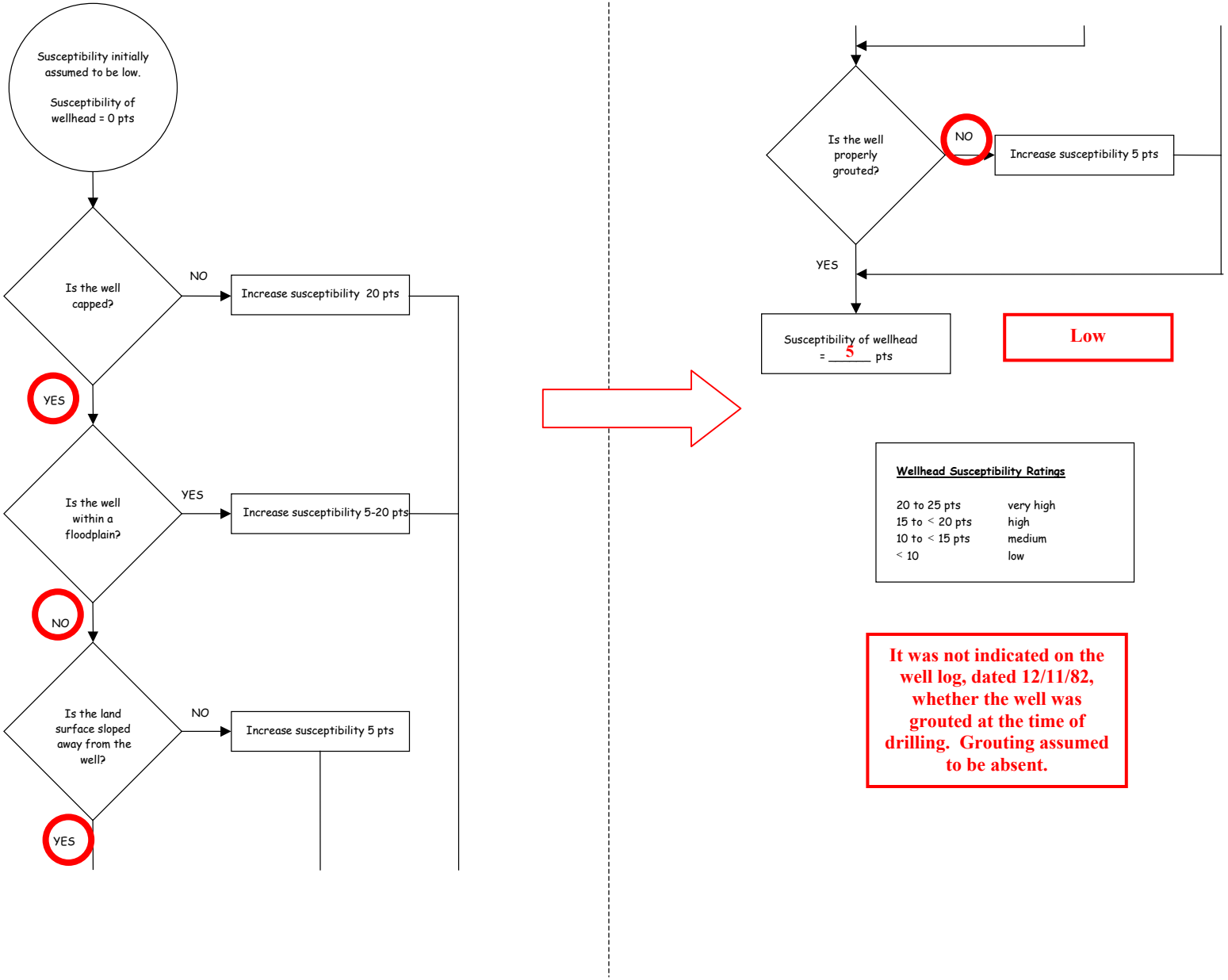
PWSID 218108.001

Map 4

APPENDIX D

Vulnerability Analysis for Rabbit Creek Community Church's Public Drinking Water Source

Chart 1. Susceptibility of the wellhead – Rabbit Creek Community Church

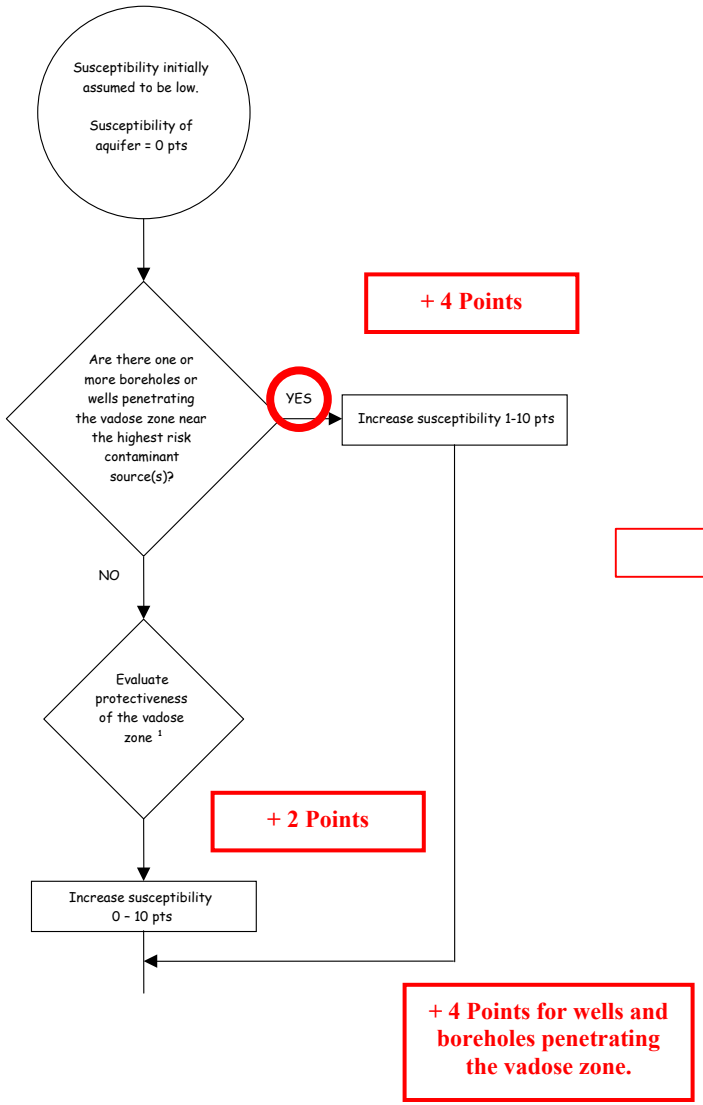


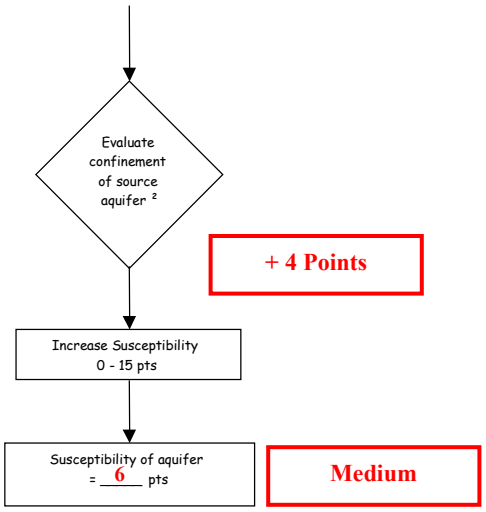
Wellhead Susceptibility Ratings

20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

It was not indicated on the well log, dated 12/11/82, whether the well was grouted at the time of drilling. Grouting assumed to be absent.

Chart 2. Susceptibility of the aquifer – Rabbit Creek Community Church





1. **Protectiveness of the Vadose Zone**
   - net recharge (function of precipitation, slope of land surface, & permeability of soils) [0 – 10 pts; 50% weight]
   - depth to water table (unconfined aquifer) or top of confining layer (confined aquifer) [interpolate linearly: 100' – 20', 0 – 5 pts; 20' – 0', 5 – 10 pts; 50% weight]

Recharge (20-30 inches per year, base of Chugach Mountains) 4/10 = 2 Points

Depth to top of confining unit (235 feet) 0/10 = 0 Points

Protectiveness of the Vadose Zone Total = **2/10 Points**

2. **Degree of Confinement**
   - confined verses unconfined aquifer [confined: K ≤ 10^{-6} cm/s, minimum thickness of at least one layer = 20 ft, interpolate linearly 100' – 20', 0 – 10 pts; unconfined = 15 pts; 65% weight]
   - density of boreholes and wells penetrating the confining layer (confined aquifer) or the water table (unconfined aquifer) [confined: 0 – 15 pts; unconfined = 15 pts; 35% weight]

Confinement (125 feet of hard silty clay and hardpan) 0/15 = 0 Points

Density of boreholes/wells 10/15 = 4 Points

Degree of Confinement Total = **4/15 Points**

Aquifer Susceptibility Ratings

20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

Low

Chart 3. Contaminant risks for Rabbit Creek Community Church – Bacteria and Viruses

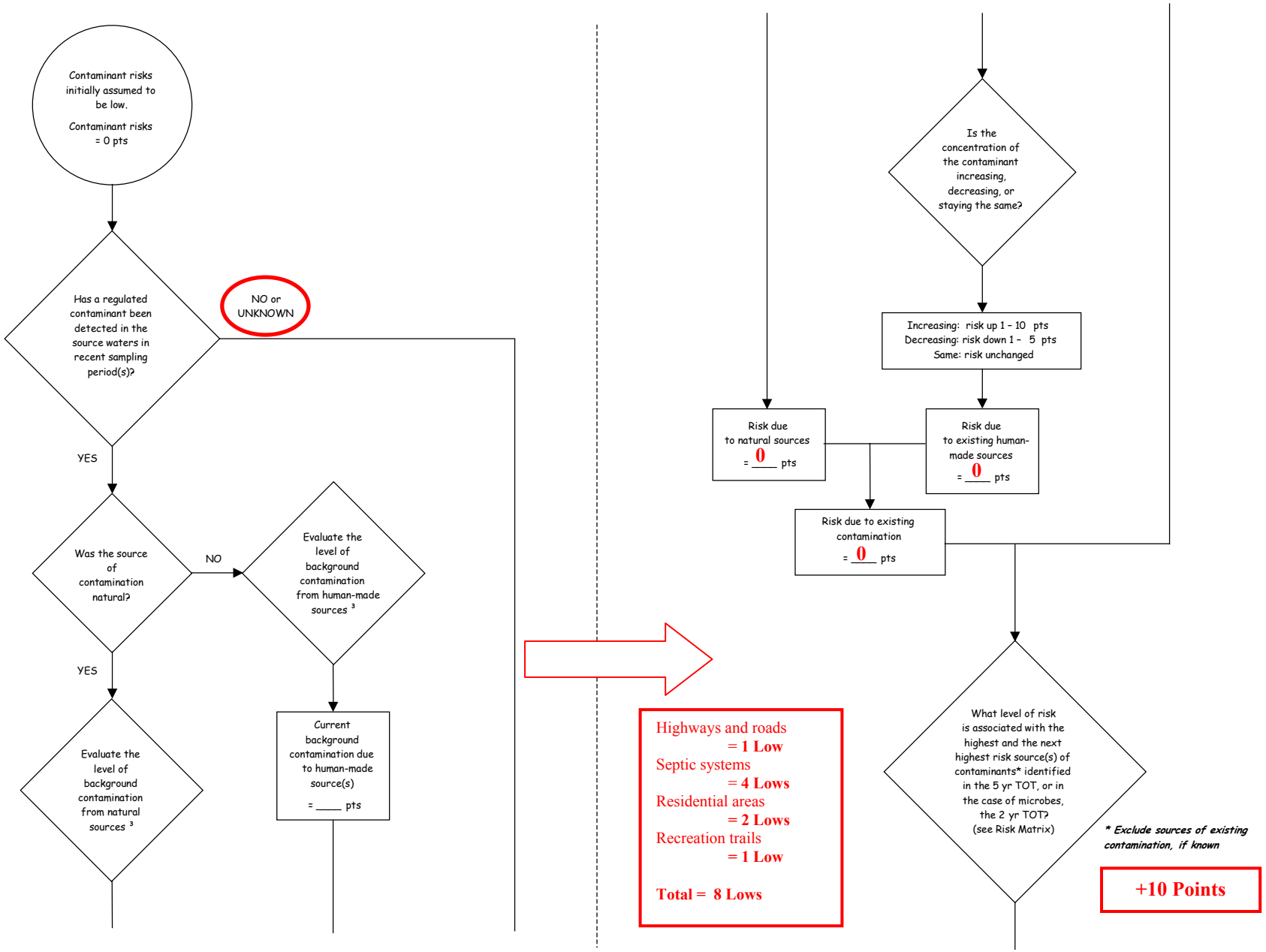


Chart 3. Contaminant risks for Rabbit Creek Community Church – Bacteria and Viruses (Continued)

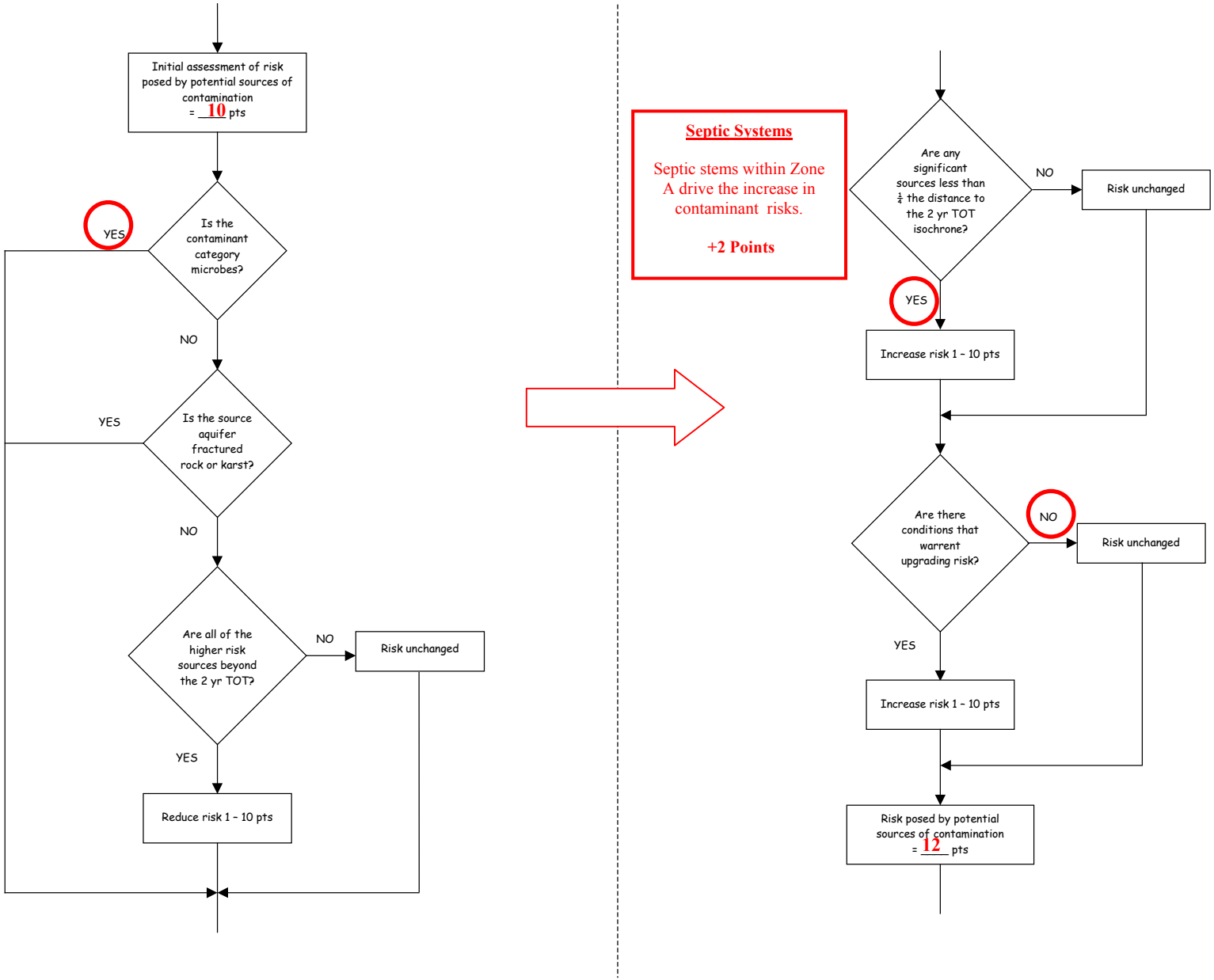
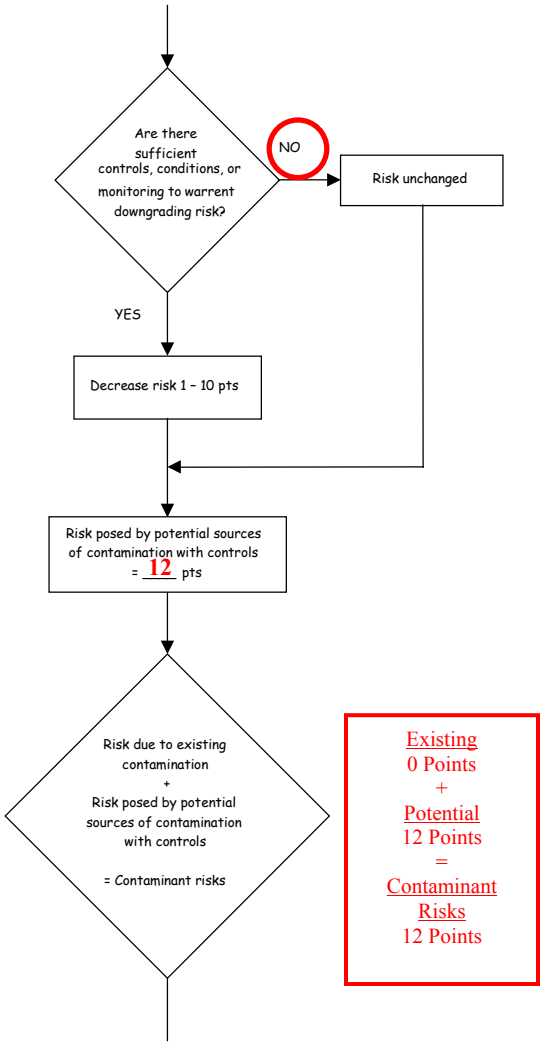
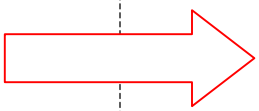


Chart 3. Contaminant risks for Rabbit Creek Community Church – Bacteria and Viruses (Continued)



Existing
0 Points
+
Potential
12 Points
=
Contaminant Risks
12 Points



** Truncate risk at 50 pts*

Contaminant risks*
= 12 pts

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Table 1. Risk Matrix for Contaminant Sources for Rabbit Creek Community Church – Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Highways and roads, septic systems, residential areas, recreation trails	**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

Chart 4. Vulnerability analysis for Rabbit Creek Community Church – Bacteria & Viruses

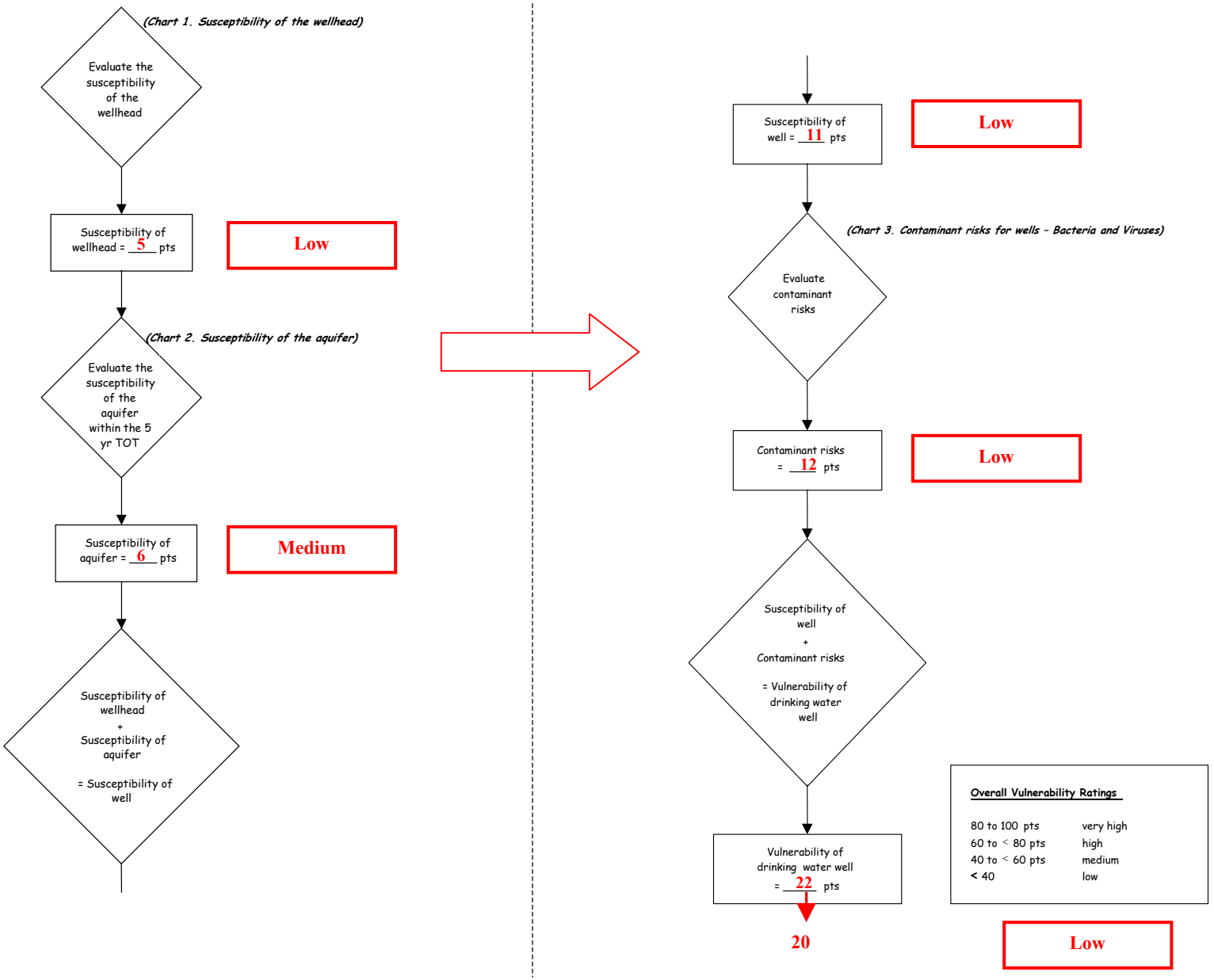


Chart 5. Contaminant risks for Rabbit Creek Community Church – Nitrates and Nitrites

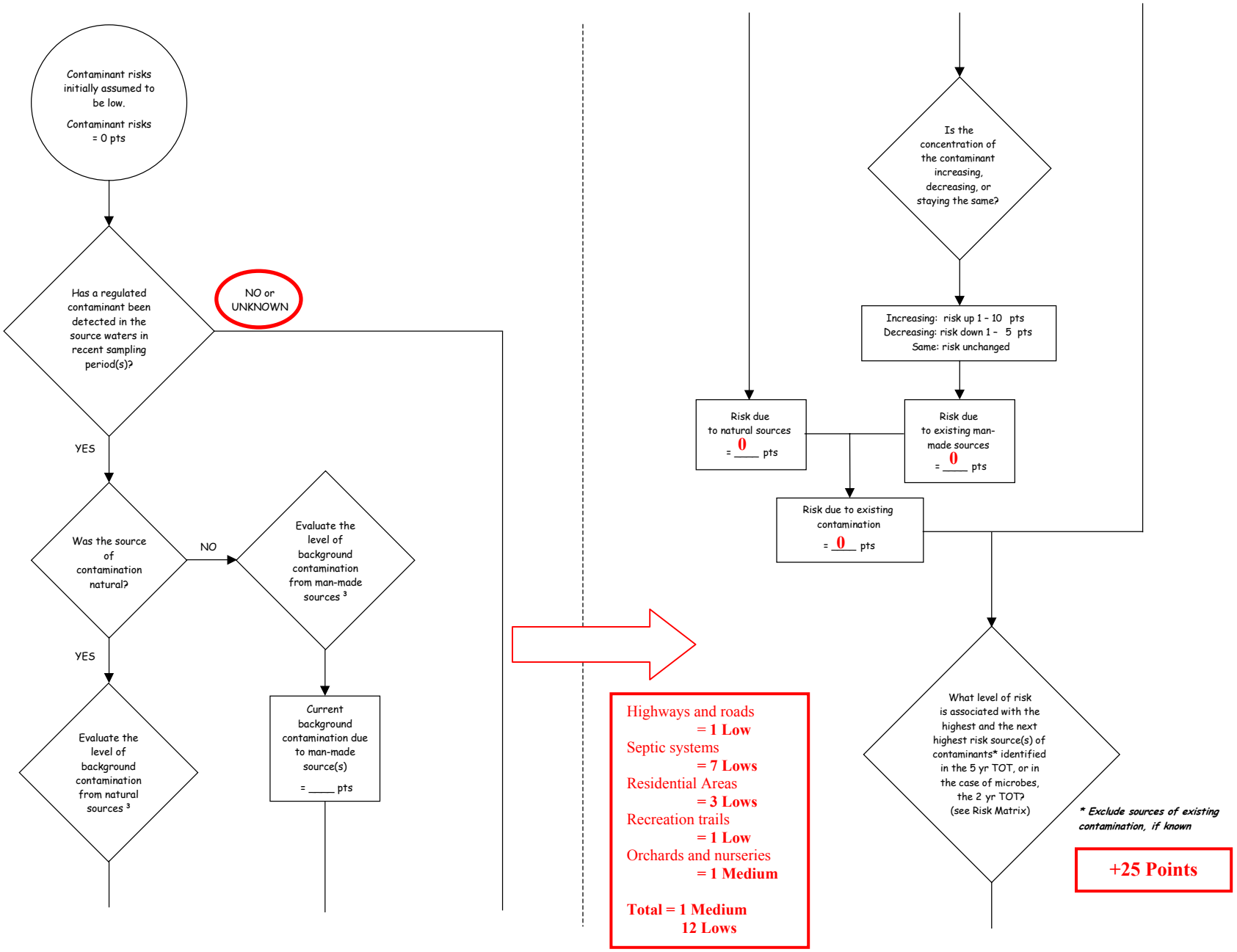


Chart 5. Contaminant risks for Rabbit Creek Community Church – Nitrates and Nitrites (Continued)

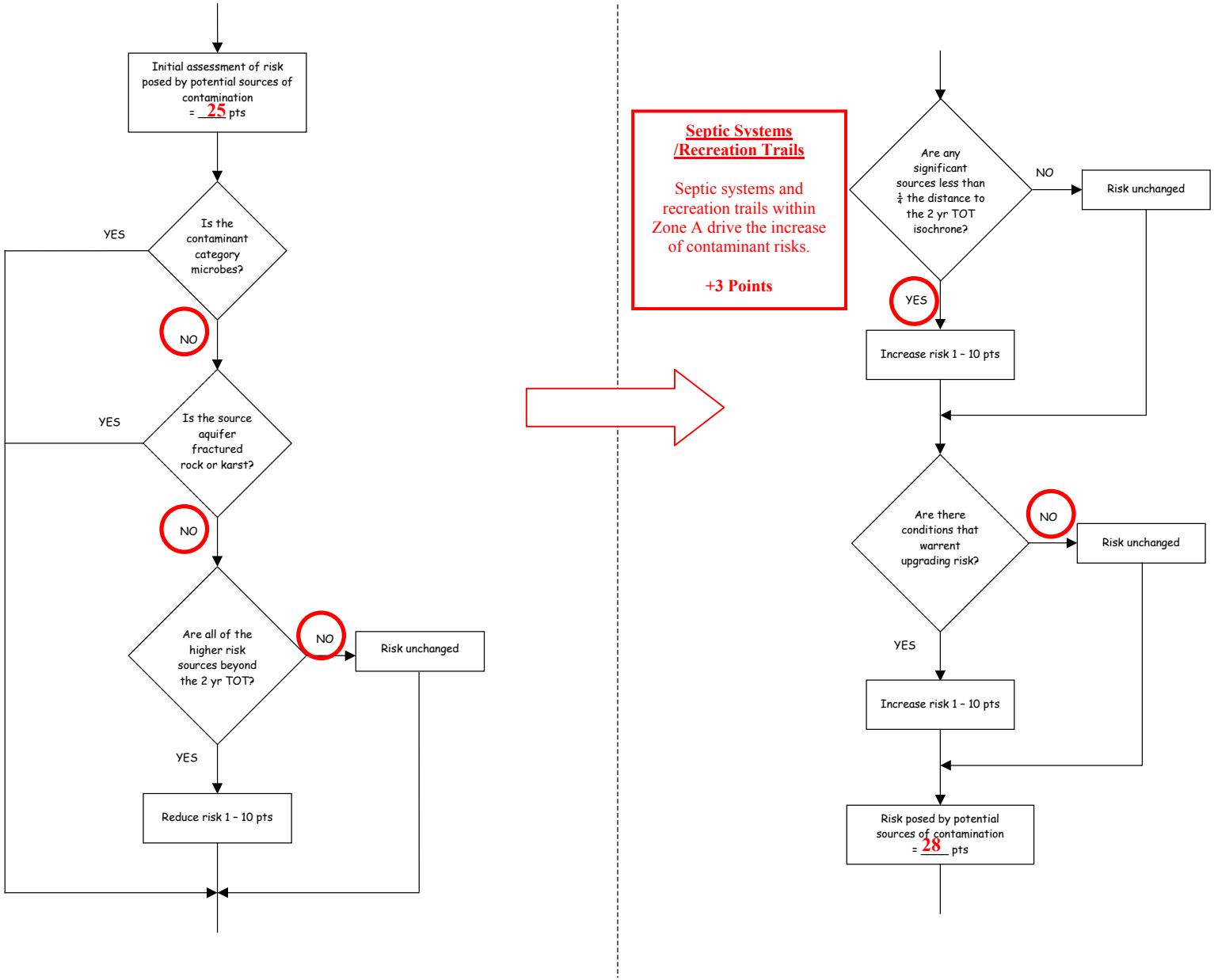
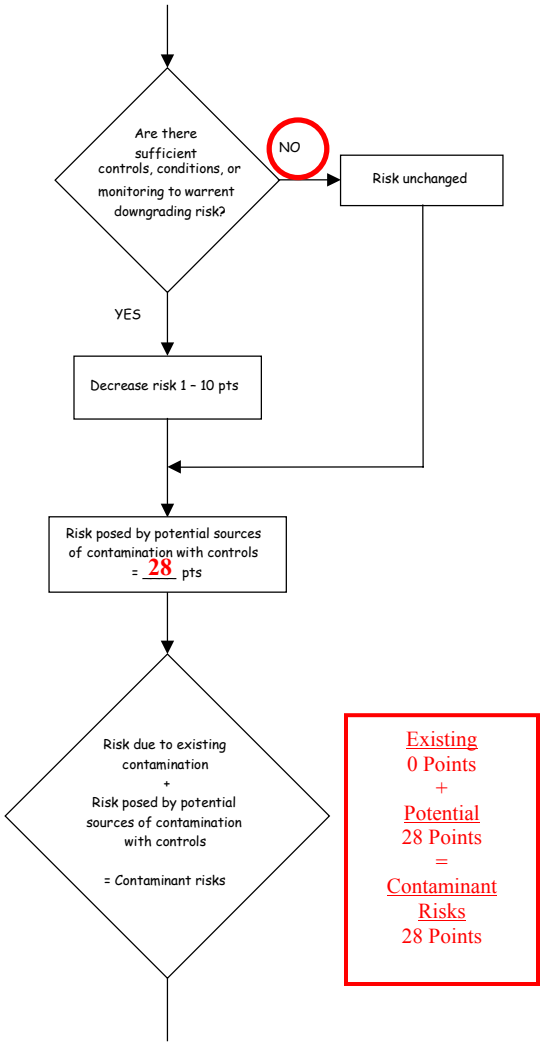
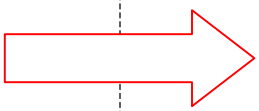
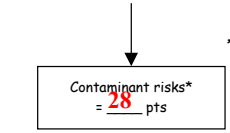


Chart 5. Contaminant risks for Rabbit Creek Community Church – Nitrates and Nitrites (Continued)



Existing
0 Points
+
Potential
28 Points
=
Contaminant Risks
28 Points





Medium

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Nitrates and/or Nitrites

Historical sampling data indicates that no nitrates and/or nitrites have been detected.

Table 2. Risk Matrix for Contaminant Sources for Rabbit Creek Community Church – Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Highways and roads, septic systems, residentail areas, recreation trails	**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

Chart 6. Vulnerability analysis for Rabbit Creek Community Church – Nitrates and Nitrites

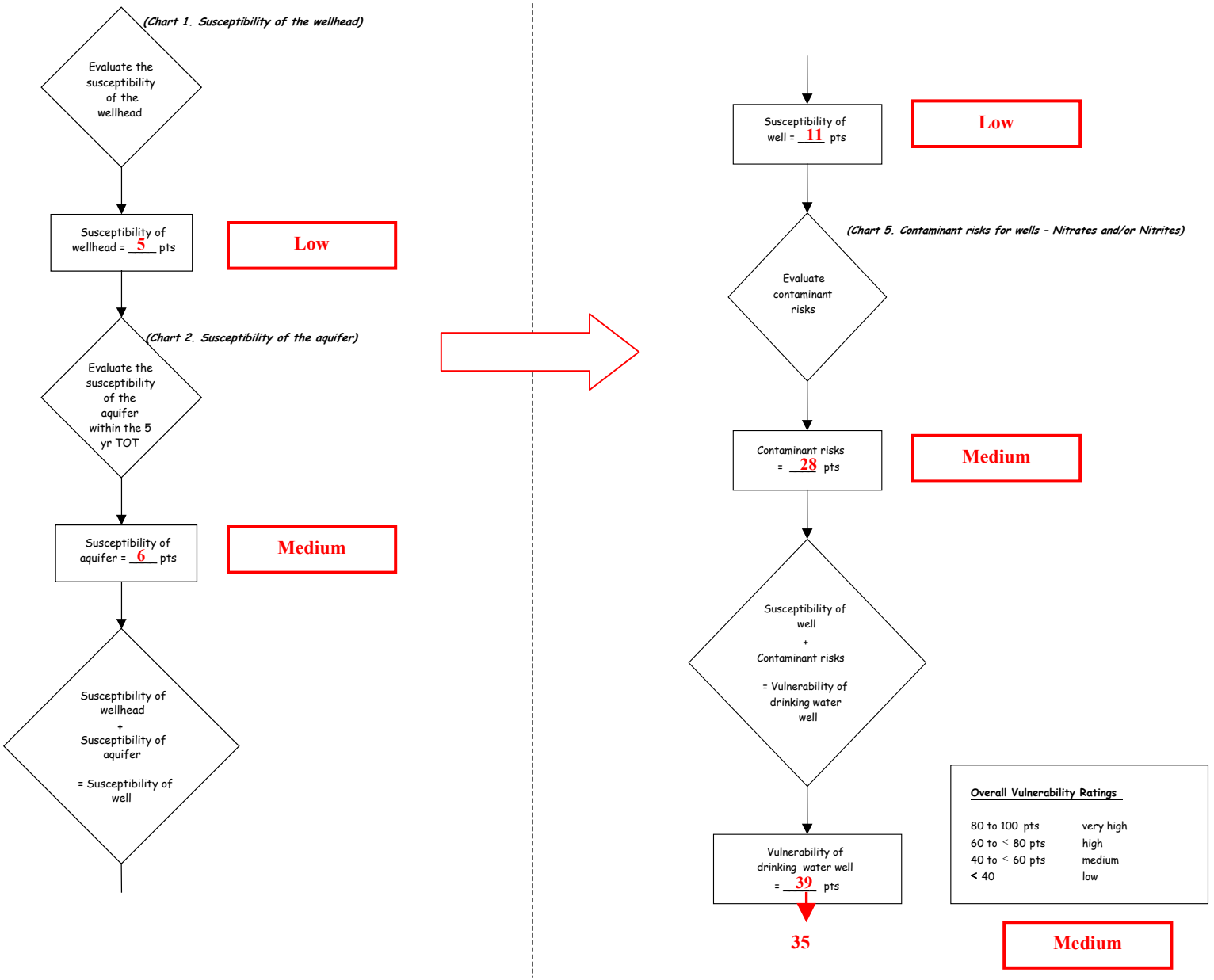


Chart 7. Contaminant risks for Rabbit Creek Community Church – Volatile Organic Chemicals

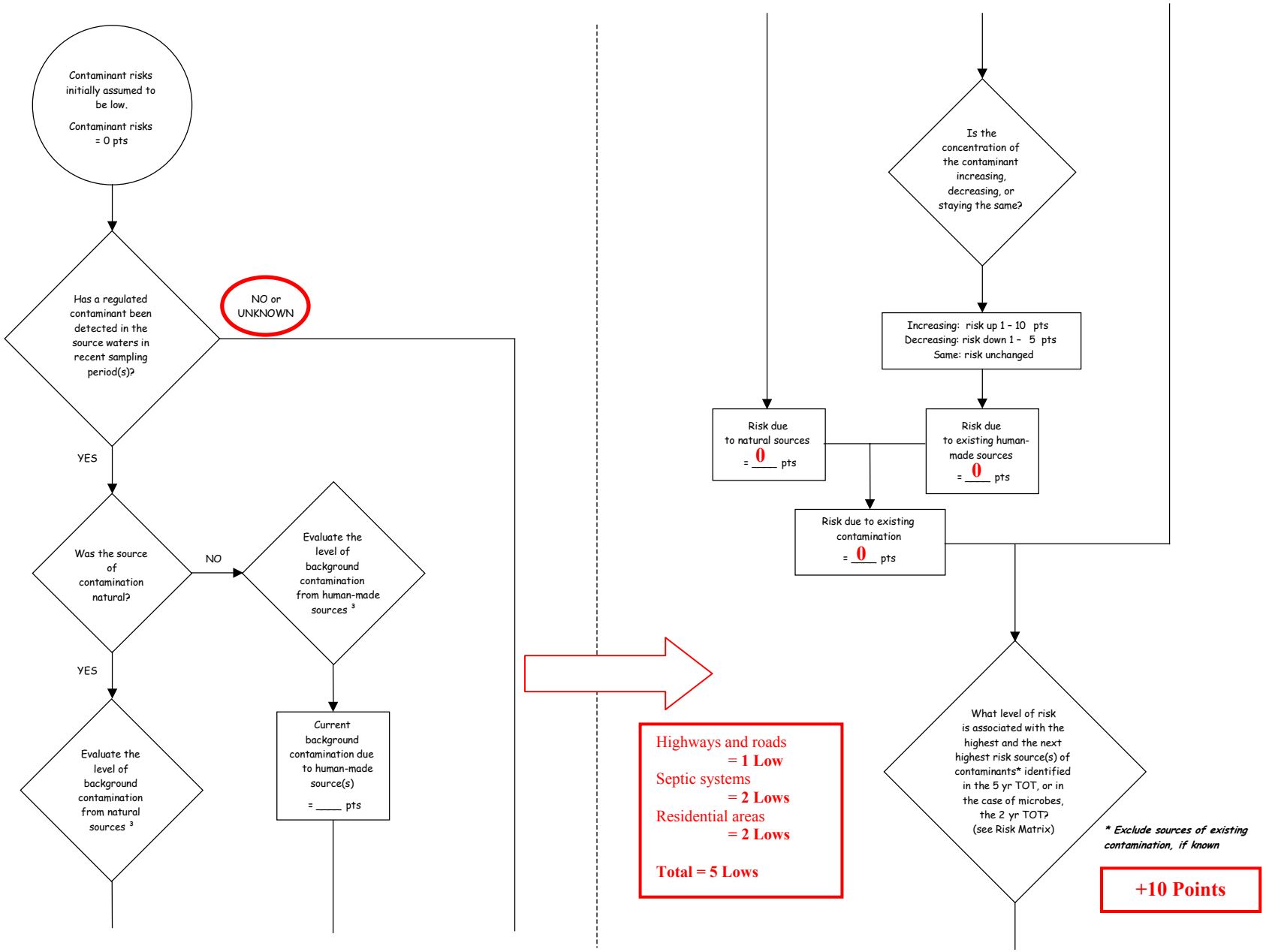


Chart 7. Contaminant risks for Rabbit Creek Community Church – Volatile Organic Chemicals (Continued)

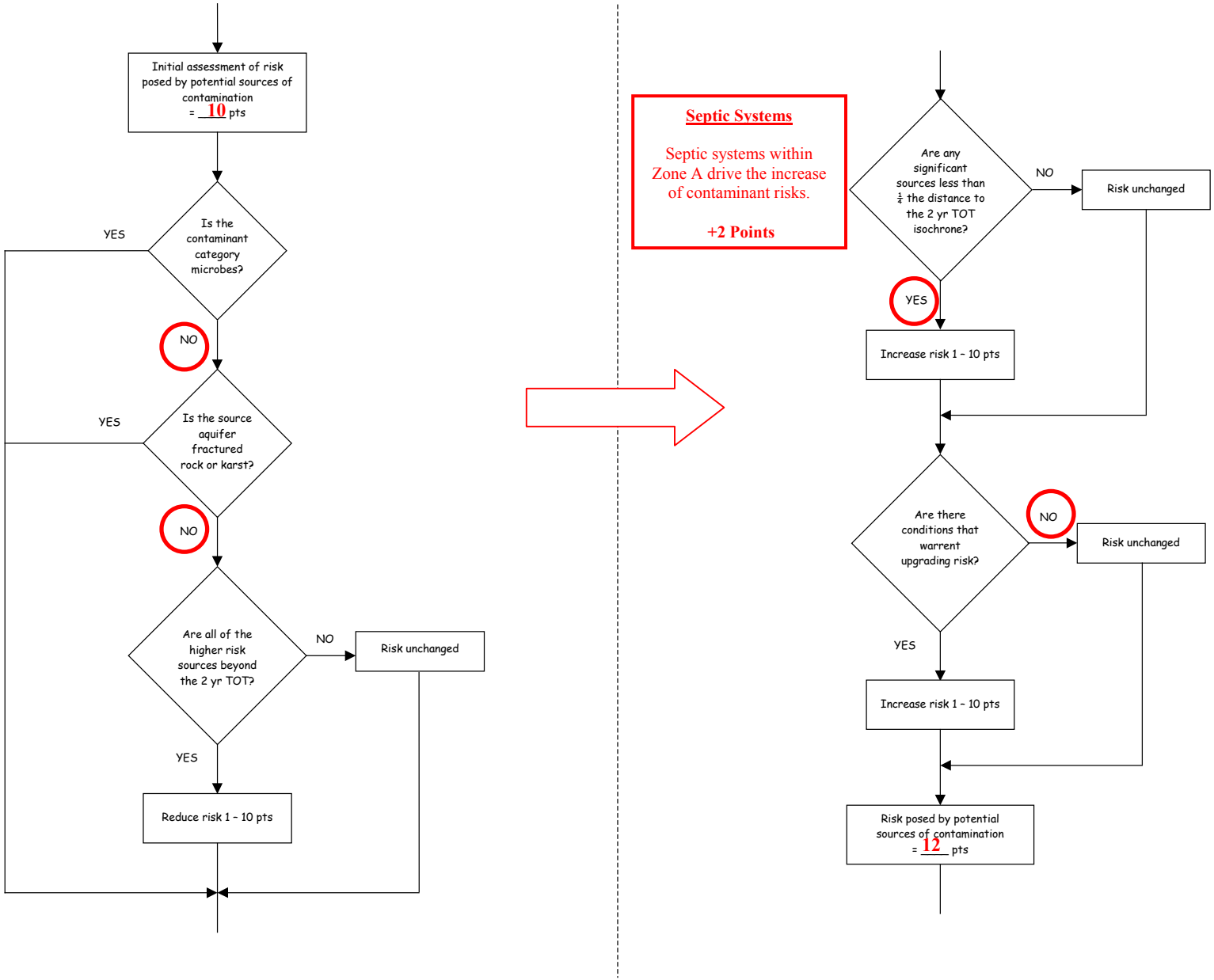
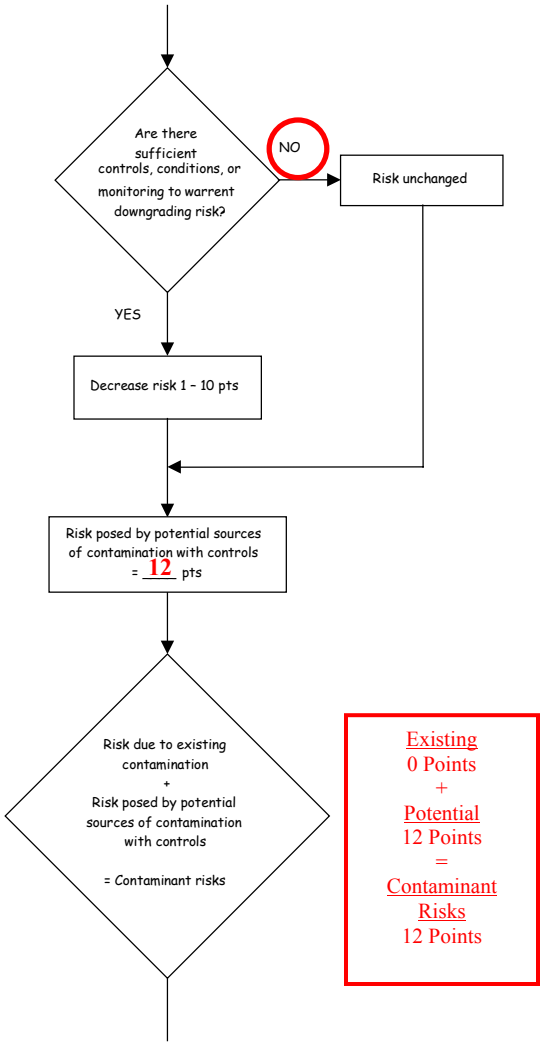
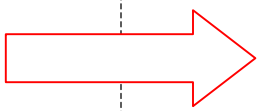


Chart 7. Contaminant risks for Rabbit Creek Community Church – Volatile Organic Chemicals (Continued)



Existing
0 Points
+
Potential
12 Points
=
Contaminant Risks
12 Points



** Truncate risk at 50 pts*

Contaminant risks* = 12 pts

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Table 3. Risk Matrix for Contaminant Sources for Rabbit Creek Community Church – Volatile Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Highways and roads, septic systems, residential areas	**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

Chart 8. Vulnerability analysis for Rabbit Creek Community Church – Volatile Organic Chemicals