Source Water Assessment -
Chapel By The Sea
Anchorage, Alaska

A Hydrogeologic Susceptibility and Vulnerability Analysis

DRINKING WATER PROTECTION PROGRAM REPORT 61

September 2001

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Anchorage, Alaska

By HEATHER A. HAMMOND

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2001

CONTENTS

TABLES

ILLUSTRATIONS

APPENDICES

Source Water Assessment - Chapel By The Sea, Anchorage, Alaska

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Chapel By The Sea'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 Chapel By The Sea include: activities associated with highways and roads, activities along recreation trails, septic systems, sewer lines, residential areas and construction trade areas. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, Chapel By The Sea's public water source received a vulnerability rating of **Medium** for bacteria and viruses and volatile organic chemicals, and **High** for nitrates and/or nitrites.

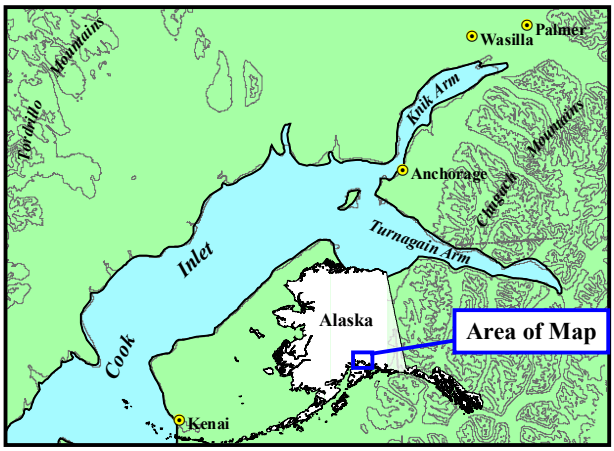

Figure 1. Index map showing the location of Anchorage, Alaska

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 Chapel By The Sea'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.

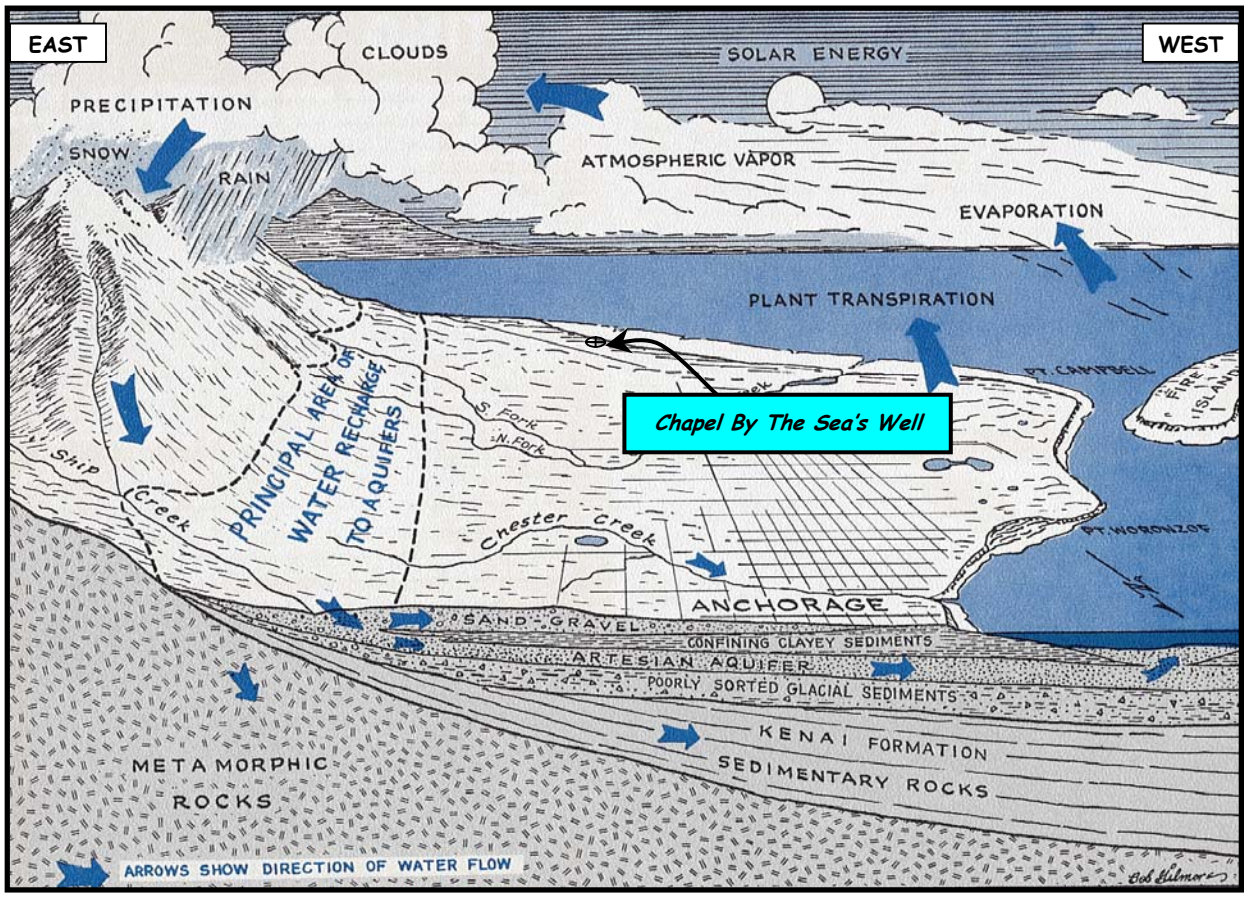

Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

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.

CHAPEL BY THE SEA'S PUBLIC DRINKING WATER SOURCE

Chapel By The Sea's public water source is a Class B (transient/non-community) water system, which is owned and operated by the Chapel By The Sea, Inc. The source consists of one well near the base of the Chugach Mountains and is at an elevation of approximately 250 feet above sea level. The well is located approximately 330 feet southwest of the New Seward Highway (see Figure 3). According to the well log, Chapel By The Sea's well penetrates layers of sandy gravel and gravely silt to a total depth of 120 feet below land surface. The well appears to be grouted. However, the vertical extent of grouting is unknown. The well intake was finished with perforated pipe and had a static water level of 85 feet below land surface at the time of drilling (3/4/00).

Chapel By The Sea's water system operates year round and serves approximately 10 residents and 220 non-residents through one service connection.

ASSESSMENT AND PROTECTION AREA FOR CHAPEL BY THE SEA'S DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Chapel By The Sea is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of the drinking water source to contamination. The 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

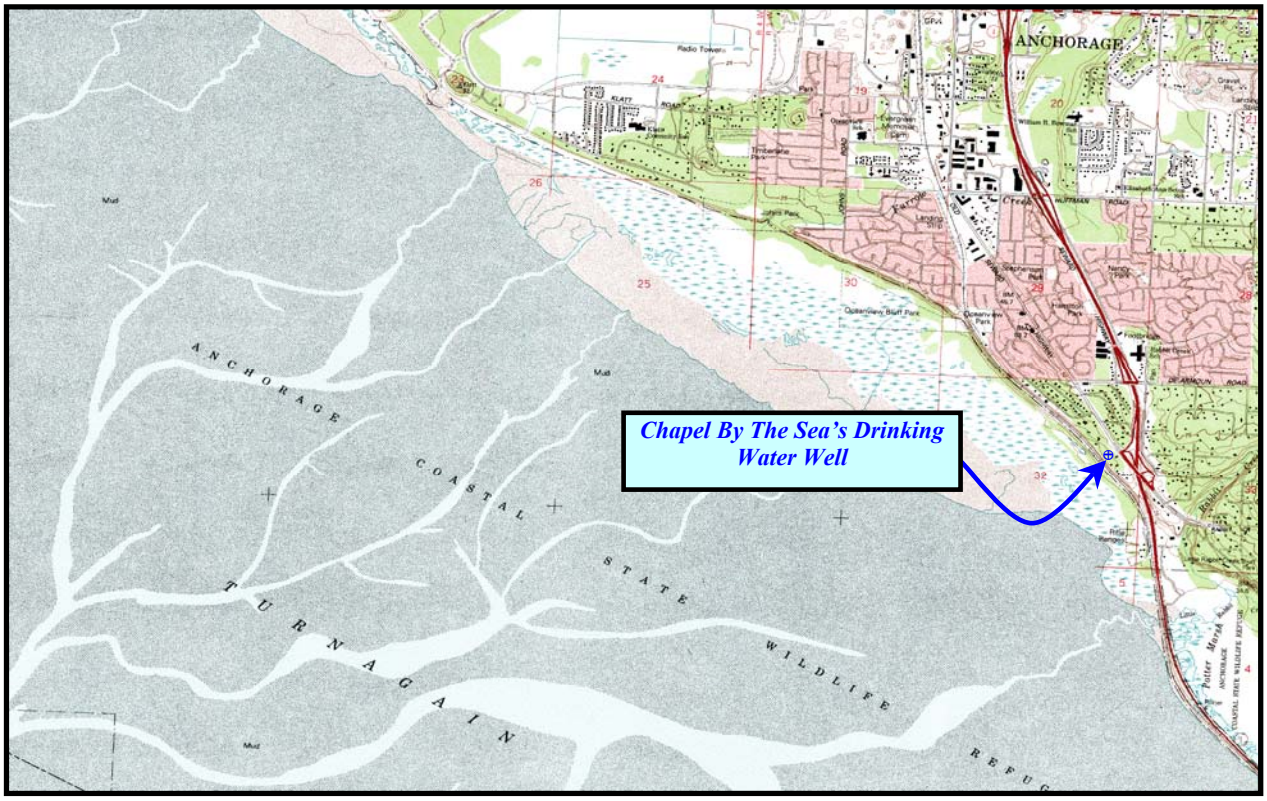

Figure 3. Map showing the location of the drinking water source for Chapel By The Sea [Base: USGS Anchorage A8 SW].

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. 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 Chapel By The Sea'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 Chapel By The Sea 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 Chapel By The Sea'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 Chapel By The Sea. Inventoried potential sources of contamination within Zones A through D were activities associated with highways and roads, activities associated with recreation trails, septic systems, sewer lines, residential areas and construction trade areas (see Table 1 in Appendix B). Below is a summary of the contaminant sources inventoried within Chapel By The Sea's protection area:

- Highways and roads;
- Recreation trails;
- Septic systems;
- Sewer lines;
- Residential areas; and
- Construction trade areas.

These potential contaminant sources present risk for all three categories of drinking water contaminants for Chapel By The Sea'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 CHAPEL BY THE SEA'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 Chapel By The Sea 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 Chapel By The Sea. 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.

Chapel By The Sea's well penetrates layers of sandy gravel, gravely silt, as well as 28 feet of silt (semi-confining unit), which may provide a protective barrier against the movement of contaminants in the subsurface. Static water level is 85 feet below land surface. The well log indicates that the well was grouted from the land surface at the time of drilling. However, the vertical extent of the grout is unknown. Proper grouting can provide a protective barrier against the movement of contaminants along well casing.

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 Chapel By The Sea.

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

	Score	Rating
Susceptibility of the Wellhead	20	High
Susceptibility of the Aquifer	13	Medium
Natural Susceptibility	33	High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. Highways and roads and septic systems contribute the highest risk for potential contamination to Chapel By The Sea'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	22	Medium
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 Chapel By The Sea's Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	55	Medium
Nitrates and Nitrites	60	High
Volatile Organic Chemicals	45	Medium

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

Nitrates and/or nitrites are found in natural background concentration at the site, as elsewhere in Alaska. Nitrate concentrations in uncontaminated groundwater are typically less than 2 milligrams per liter (MG/L) and are derived primarily from the decomposition of soil organic matter [Wang, Strelakos, Jokela, 2000].

Sampling history of Chapel By The Sea's source waters indicate low concentrations of nitrates (See Chart 5 – Contaminant Risks for nitrates and/or nitrites in Appendix D). Existing nitrate contamination is approximately 2.3 mg/L or 23% of the allowable limit (MCL) for this contaminant. The Maximum Contaminant Level or 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 in soil, moving at approximately the same rate as water.

Though existing contamination was detected at the site in natural background concentrations for nitrates, the amount detected remains at very safe levels with respect to human health.

Other low potential and existing sources of nitrates and/or nitrites for Chapel By The Sea's source waters include activities associated recreation trails, and highways and roads.

The overall vulnerability score for bacteria and viruses and volatile organic chemicals for Chapel By The Sea's source of drinking water is medium. The sewer line along Lake Otis Parkway and the density of septic systems in Zone A through Zone C along with highways and roads drive the overall vulnerability score for bacteria and viruses and volatile organic chemicals. 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.

Other low potential and existing sources of bacteria and viruses and volatile organic chemicals for Chapel By The Sea's source of drinking water include activities associated with residential areas and recreation trails, and construction trade areas located within the protection area.

The overall vulnerability score for nitrates and/or nitrites for Chapel By The Sea's drinking water source is high. The sewer line along Lake Otis Parkway and the density of septic systems in Zone A through Zone C along with residential areas drive the overall vulnerability score for nitrates and/or nitrites.

SUMMARY

A *Source Water Assessment* has been completed for Chapel By The Sea's source of public drinking water. The overall vulnerability of this source to contamination is **Medium** for bacteria and viruses and volatile organic chemicals and **High** for 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 Chapel By The Sea 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.

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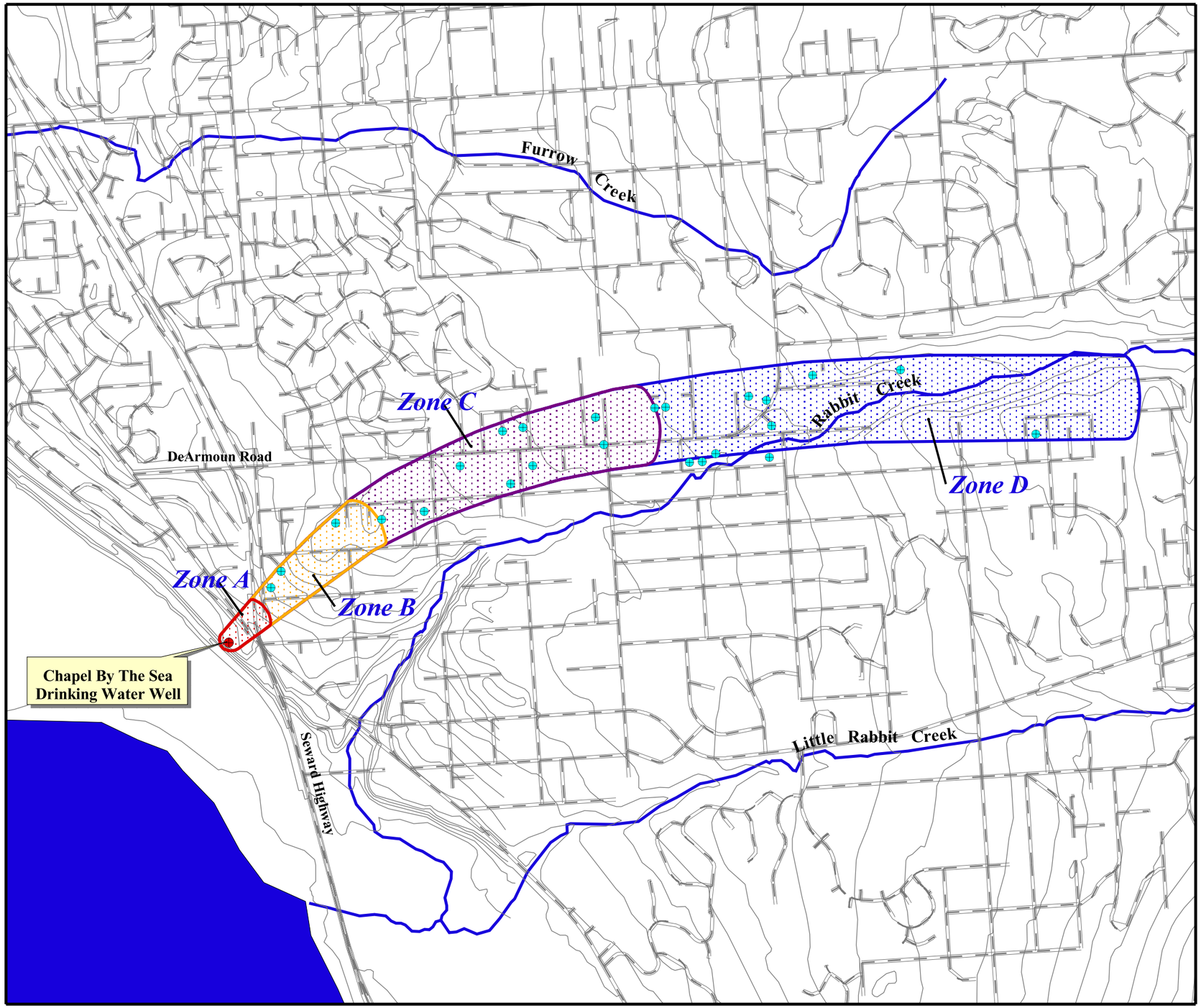
APPENDIX A

Chapel By The Sea's
Drinking Water Protection Area

Drinking Water Protection Area for Chapel By The Sea



- Drinking Water Well
- Public & Private Drinking Water Wells

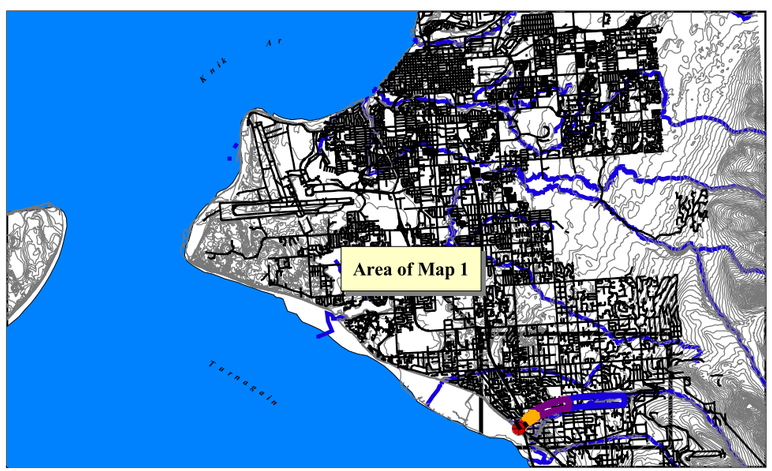
Zone A Protection Area
- Several Months Travel Time

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 Roads
- Elevation Contours
- Anchorage Streams
- Turnagain Arm of Cook Inlet

N W E S



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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Chapel By The Sea

Table 1

Contaminant Source Inventory for Chapel By The Sea

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Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Location	Map	Comments
Lawns and gardens	R1	R1-1	A	Residential areas located within Zone A	3	
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Along Old Seward Highway	2	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Along Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	New Seward Highway	2	
Dog walking areas/foot trails	X46	X46-1	A	Trail along the Old Seward Highway	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	B	Sewar line running along Lake Otis	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	B	Sewar line running along Lake Otis	2	
Lawns and gardens	R1	R1-2	B	Residential areas located within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Along One-hundred-forty-fourth Ave.	2	

Septic systems (serves one or more single-family homes)	R2	R2-20	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-23	B	Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-24	B	Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-25	B	Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-26	B	Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-27	B	Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-28	B	Along Brandl Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-3	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-4	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Along Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	One-Hundred-Fourty-Second Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Lake Otis	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Ivory Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Wildien Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	One-Hundred-Fortyfourth Ave.	2	

Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Saine Street	2	
Dog walking areas/foot trails	X46	X46-2	B	Trail along the west side of Lake Otis	3	
Dog walking areas/foot trails	X46	X46-3	B	Trail along the east side of Lake Otis	3	
Construction trade areas and materials	C9	C9-1	C	Located off of Rocky Road in Zone C	2	
Construction trade areas and materials	C9	C9-2	C	Located off of Rocky Road in Zone C	2	
Lawns and gardens	R1	R1-3	C	Residential areas located within Zone C	3	
Septic systems (serves one or more single-family homes)	R2	R2-29-98	C	Septic systems located within Zone C	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11-20	C	Roads located within Zone C	2	
Dog walking areas/foot trails	X46	X46-4-7	C	Trails located within Zone C	3	

Table 2

Contaminant Source Inventory and Risk Ranking for
Chapel By The Sea
Sources of Bacteria and Viruses

PWSID 215663.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	1	Along Old Seward Highway	2	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	2	Along Old Seward Highway	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	B	Low	3	Sewar line running along Lake Otis	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	B	Low	4	Sewar line running along Lake Otis	2	
Septic systems (serves one or more single-family homes)	R2	R2-3	B	Very Low	7	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-4	B	Very Low	8	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Very Low	9	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Very Low	10	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Very Low		Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Very Low		Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-23	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-24	B	Very Low		Along Sabrine Street	2	

Septic systems (serves one or more single-family homes)	R2	R2-25	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-26	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-27	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-28	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-29-98	C	Very Low		Septic systems located within Zone C	2	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Very Low		Along Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Very Low		Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Very Low		One-Hundred-Fourty-Second Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11-20	C	Very Low		Roads located within Zone C	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Very Low		Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Very Low		New Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Very Low		Lake Otis	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Very Low		Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Very Low		Ivory Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Very Low		Wildien Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Very Low		One-Hundred-Fortyfourth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Very Low		Saine Street	2	
Dog walking areas/foot trails	X46	X46-1	A	Low		Trail along the Old Seward Highway	3	
Dog walking areas/foot trails	X46	X46-2	B	Low		Trail along the west side of Lake Otis	3	
Dog walking areas/foot trails	X46	X46-3	B	Low		Trail along the east side of Lake Otis	3	
Dog walking areas/foot trails	X46	X46-4-7	C	Low		Trails located within Zone C	3	

Table 3

Contaminant Source Inventory and Risk Ranking for
Chapel By The Sea
Sources of Nitrates/Nitrites

PWSID 215663.001

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Low	1	Along Old Seward Highway	2	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Low	2	Along Old Seward Highway	2	
Residential Areas	R1	R1-1	A	Low	3	Residential areas located within Zone A	3	
Dog walking areas/foot trails	X46	X46-1	A	Low	4	Trail along the Old Seward Highway	3	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	B	Very Low	5	Sewar line running along Lake Otis	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	B	Very Low	6	Sewar line running along Lake Otis	2	
Residential Areas	R1	R1-2	B	Low	7	Residential areas located within Zone B	3	
Septic systems (serves one or more single-family homes)	R2	R2-3	B	Very Low	8	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-4	B	Very Low	9	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Very Low	10	Along Nugget Lane	2	
Residential Areas	R1	R1-3	C	Low		Residential areas located within Zone C	3	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Very Low		Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Very Low		Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-21	B	Very Low		Along One-hundred-forty-fourth Ave.	2	

Septic systems (serves one or more single-family homes)	R2	R2-22	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-23	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-24	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-25	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-26	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-27	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-28	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-29-98	C	Very Low		Septic systems located within Zone C	2	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Very Low		Along Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Very Low		Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Very Low		One-Hundred-Fourty-Second Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11-20	C	Very Low		Roads located within Zone C	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Very Low		Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Very Low		New Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Very Low		Lake Otis	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Very Low		Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Very Low		Ivory Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Very Low		Wildien Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Very Low		One-Hundred-Fortyfourth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Very Low		Saine Street	2	
Dog walking areas/foot trails	X46	X46-2	B	Low		Trail along the west side of Lake Otis	3	

Dog walking areas/foot trails	X46	X46-3	B	Low		Trail along the east side of Lake Otis	3	
Dog walking areas/foot trails	X46	X46-4-7	C	Low		Trails located within Zone C	3	

Table 4

Contaminant Source Inventory and Risk Ranking for
Chapel By The Sea
Sources of Volatile Organic Chemicals

PWSID 215663.001

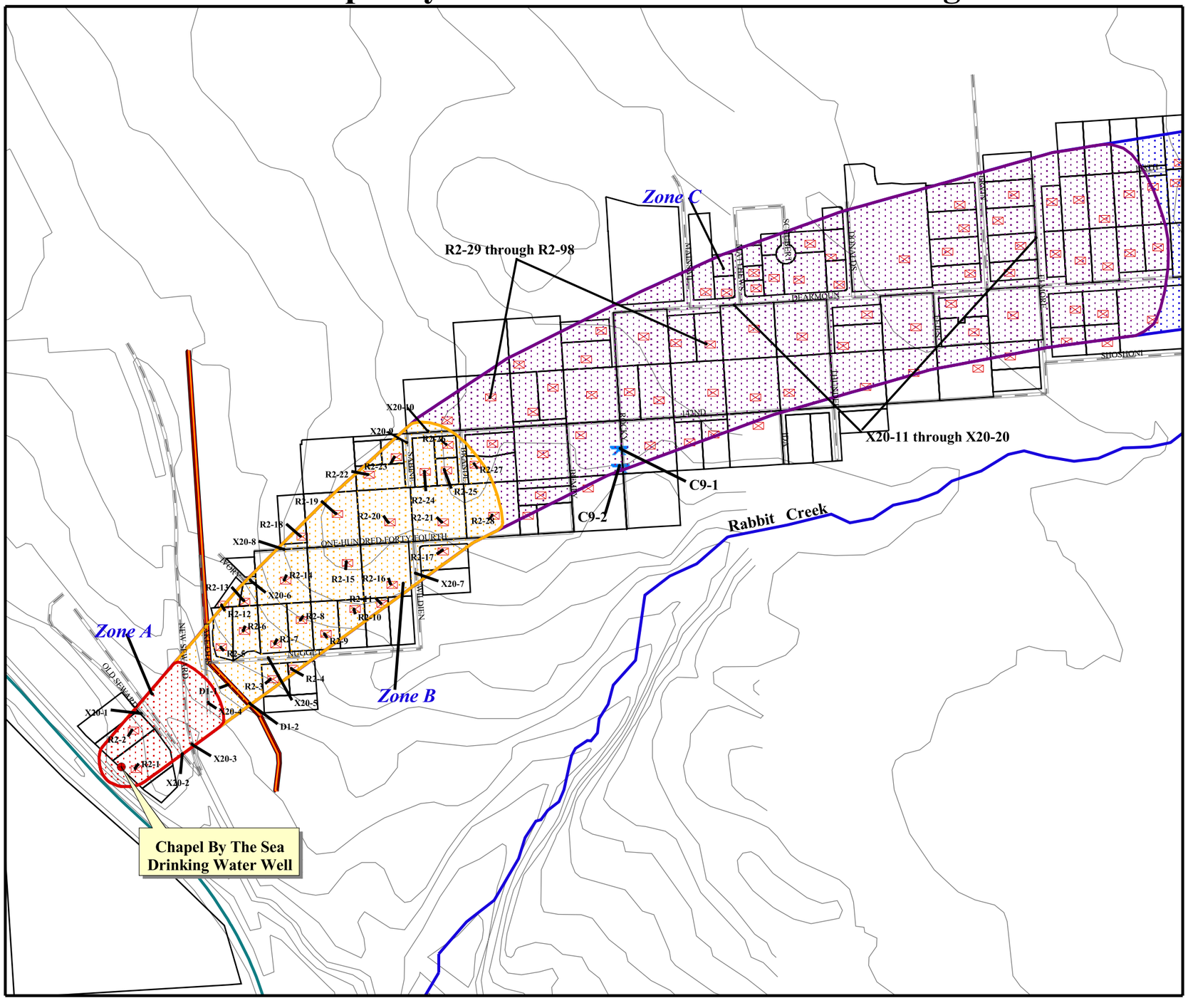
Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	1	Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Low	2	New Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low	3	Lake Otis	2	
Septic systems (serves one or more single-family homes)	R2	R2-1	A	Very Low	4	Along Old Seward Highway	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-1	B	Low	6	Sewar line running along Lake Otis	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D1	D1-2	B	Low	7	Sewar line running along Lake Otis	2	
Septic systems (serves one or more single-family homes)	R2	R2-3	B	Very Low	8	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-4	B	Very Low	9	Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-5	B	Very Low	10	Along Nugget Lane	2	
Construction trade areas and materials	C9	C9-1	C	Low		Located off of Rocky Road in Zone C	2	
Construction trade areas and materials	C9	C9-2	C	Low		Located off of Rocky Road in Zone C	2	
Septic systems (serves one or more single-family homes)	R2	R2-10	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-11	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-12	B	Very Low		Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-13	B	Very Low		Along Ivory Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-14	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-15	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-16	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-17	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-18	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-19	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-2	A	Very Low		Along Old Seward Highway	2	
Septic systems (serves one or more single-family homes)	R2	R2-20	B	Very Low		Along One-hundred-forty-fourth Ave.	2	

Septic systems (serves one or more single-family homes)	R2	R2-21	B	Very Low		Along One-hundred-forty-fourth Ave.	2	
Septic systems (serves one or more single-family homes)	R2	R2-22	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-23	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-24	B	Very Low		Along Sabrine Street	2	
Septic systems (serves one or more single-family homes)	R2	R2-25	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-26	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-27	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one single-family home)	R2	R2-28	B	Very Low		Along Brandl Drive	2	
Septic systems (serves one or more single-family homes)	R2	R2-29-98	C	Very Low		Septic systems located within Zone C	2	
Septic systems (serves one or more single-family homes)	R2	R2-6	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-7	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-8	B	Very Low		Along Nugget Lane	2	
Septic systems (serves one or more single-family homes)	R2	R2-9	B	Very Low		Along Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-10	B	Very Low		One-Hundred-Fourty-Second Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-11-20	C	Low		Roads located within Zone C	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Low		Old Seward Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-5	B	Low		Nugget Lane	2	
Highways and roads, paved (cement or asphalt)	X20	X20-6	B	Low		Ivory Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-7	B	Low		Wildien Drive	2	
Highways and roads, paved (cement or asphalt)	X20	X20-8	B	Low		One-Hundred-Fortyfourth Ave.	2	
Highways and roads, paved (cement or asphalt)	X20	X20-9	B	Very Low		Saine Street	2	
Rail corridors	X30	X30-1	A	Low		Corridor located west of well	2	

APPENDIX C

Chapel By The Sea's
Drinking Water Protection Area
and Potential & Existing Contaminant Sources

Drinking Water Protection Area for
Chapel By The Sea and Potential & Existing Contaminant Sources



- Drinking Water Well

Zone A Protection Area
- Several Months Travel Time

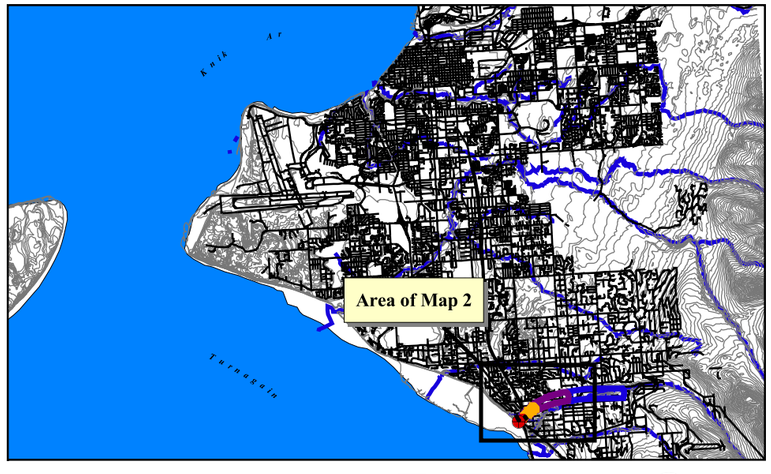
Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- MOA Land Parcels
- Septic Systems (R2)
- MOA Roads (X20)

Potential Contaminant Sources
- Constructiion trade areas and materials (C9)
- Sewer Lines (D1)
- MOA Railroads (X30)
- Anchorage Streams
- Elevation Contours

N
W E
S



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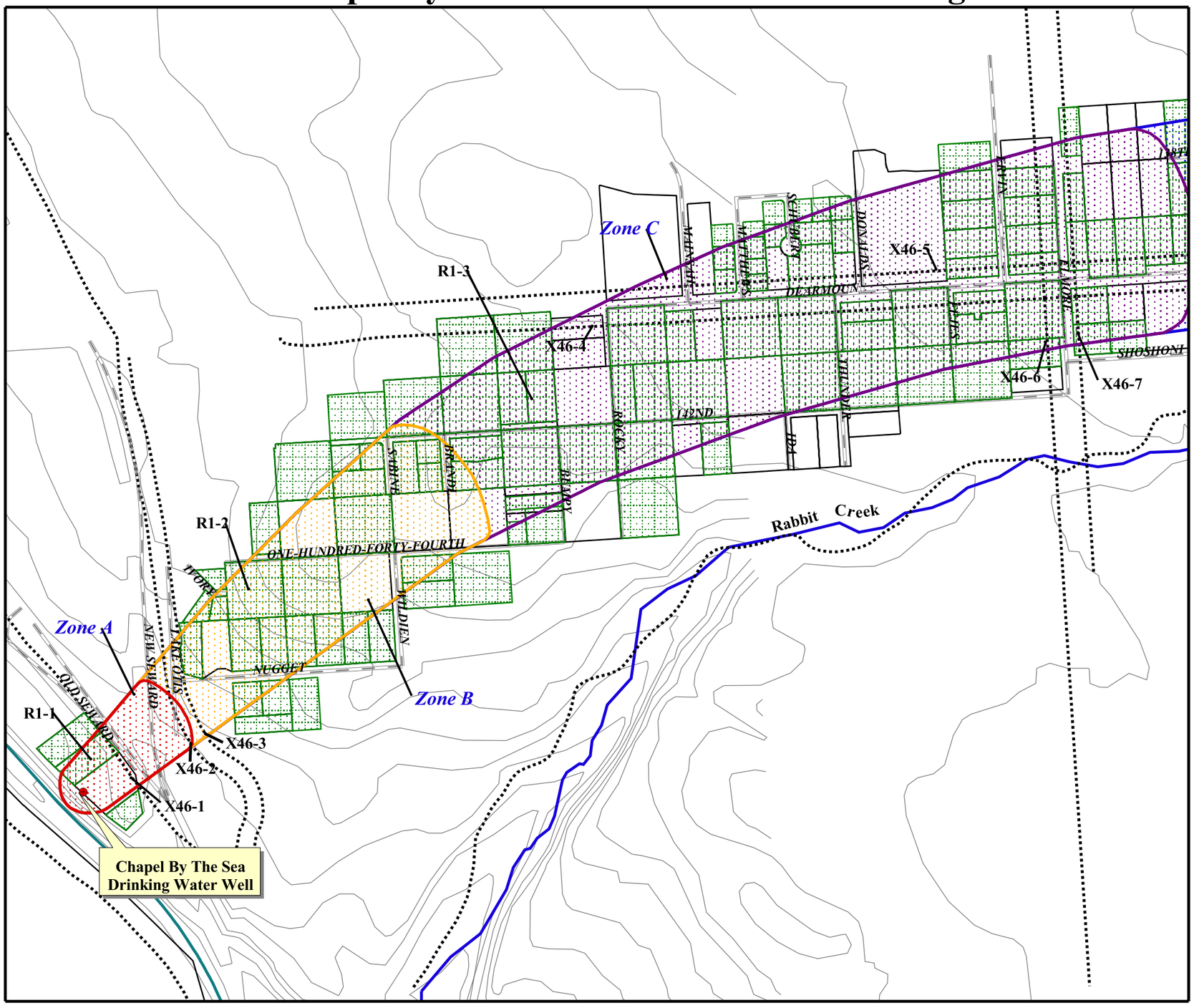
Map 2

Drinking Water Protection Area for
Chapel By The Sea and Potential & Existing Contaminant Sources



- Drinking Water Well

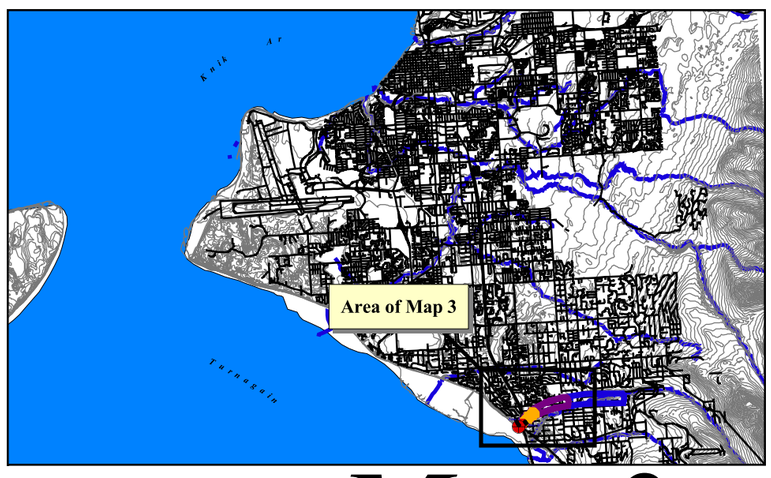
Zone A Protection Area
- Several Months Travel Time

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)
- MOA Land Parcels
- MOA Roads (X20)
- Trails (X46)
- MOA Railroads (X30)
- Turnagain Arm of Cook Inlet
- Anchorage Streams
- Elevation Contours

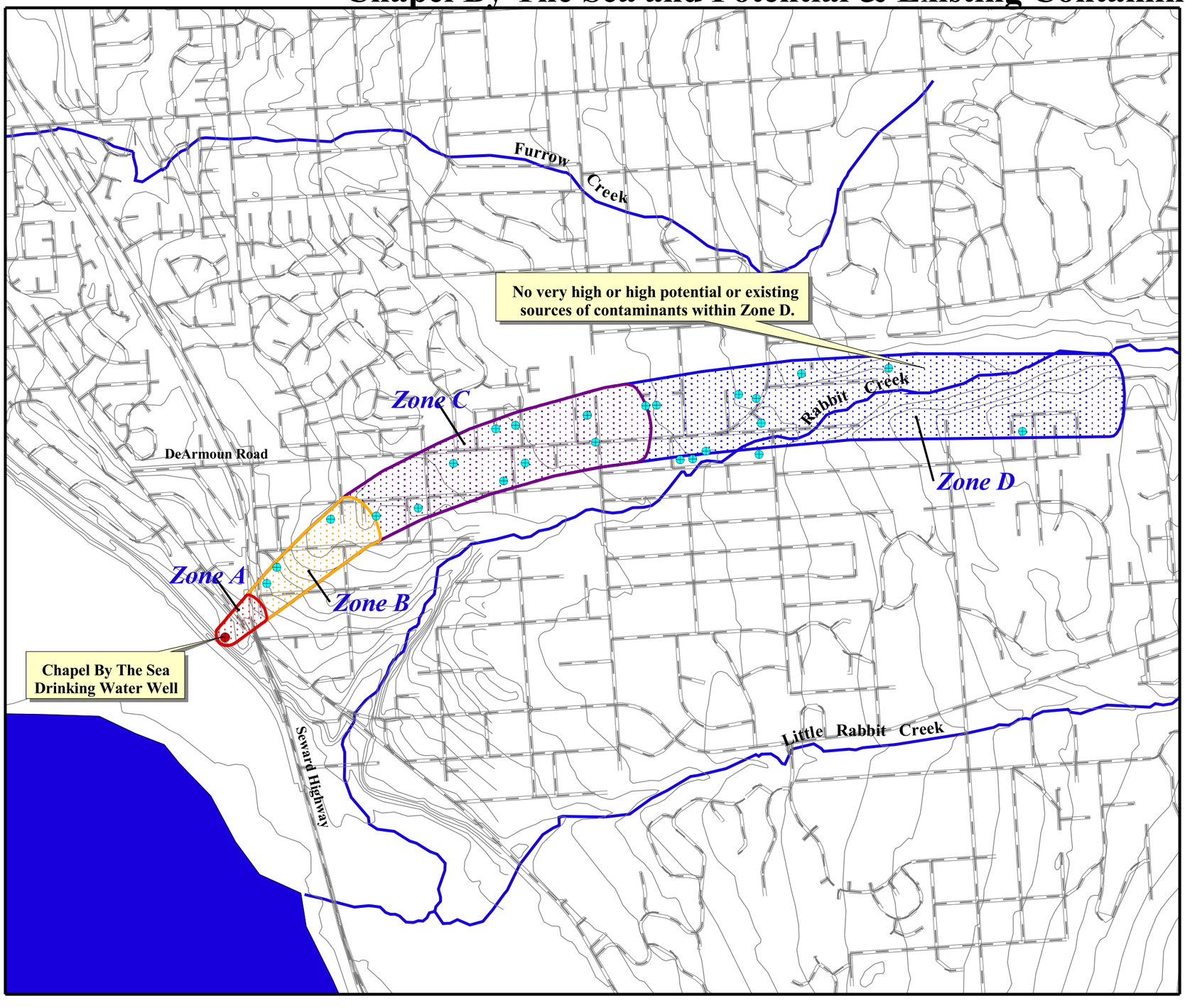
N W E S



PWSID 215663.001

Map 3

Drinking Water Protection Area for
Chapel By The Sea and Potential & Existing Contaminant Sources



- Drinking Water Well
- Public & Private Drinking Water Wells

Zone A Protection Area
- Several Months Travel Time

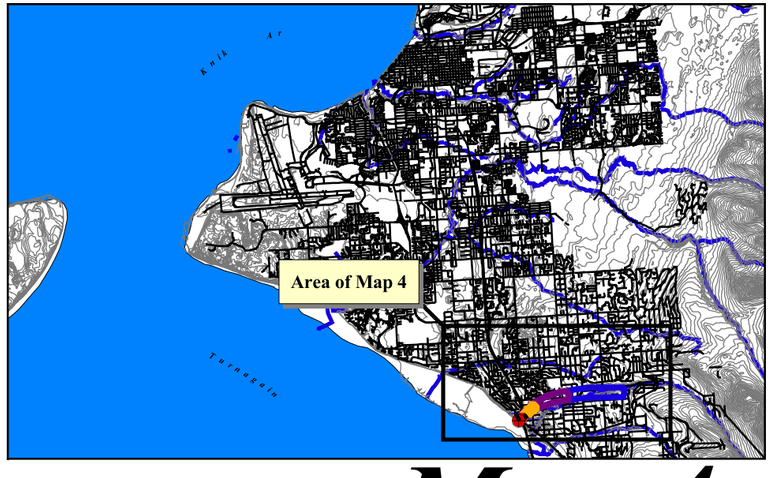
Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time

- Anchorage Roads
- Elevation Contours
- Anchorage Streams
- Turnagain Arm of Cook Inlet

N
W E
S



3000 0 3000 Feet

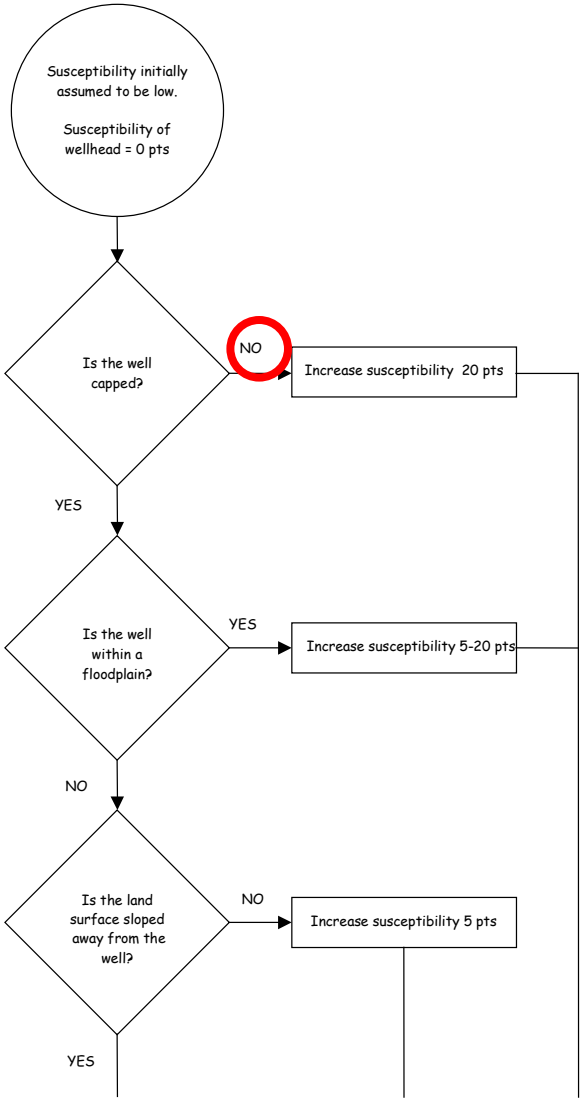
PWSID 215663.001

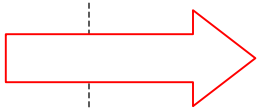
Map 4

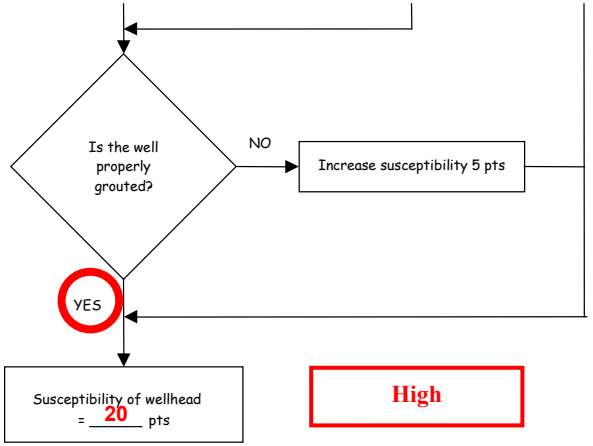
APPENDIX D

Vulnerability Analysis for Chapel By The Sea's Public Drinking Water Source

Chart 1. Susceptibility of the wellhead – Chapel By The Sea





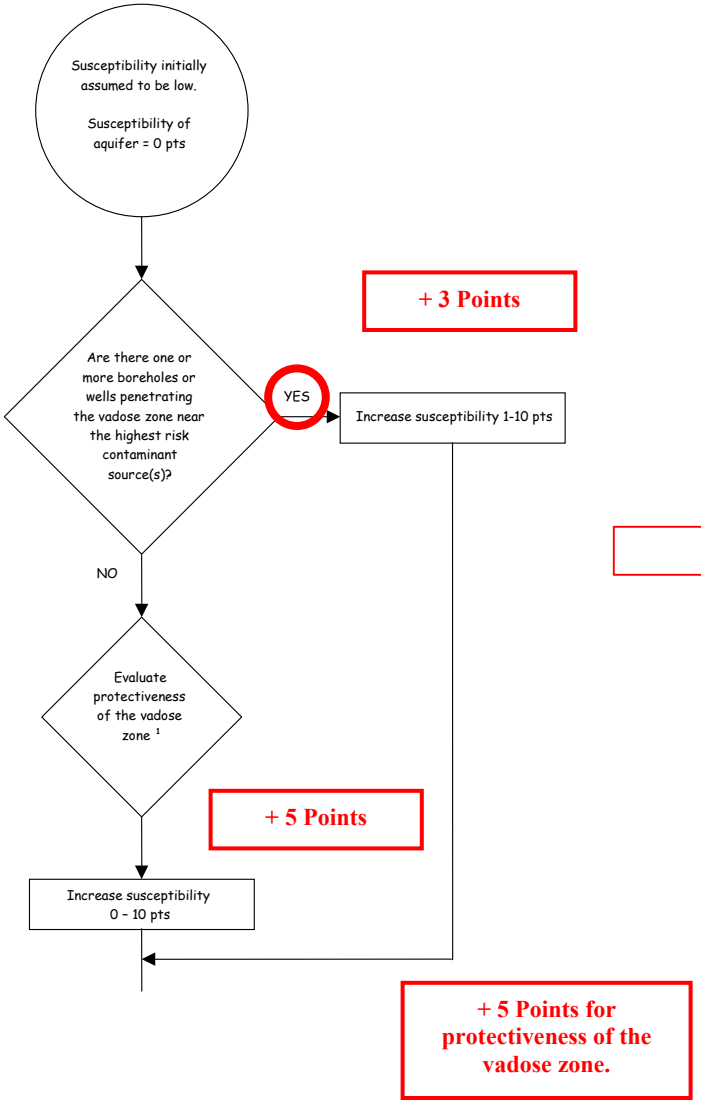


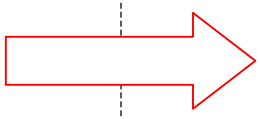
Wellhead Susceptibility Ratings

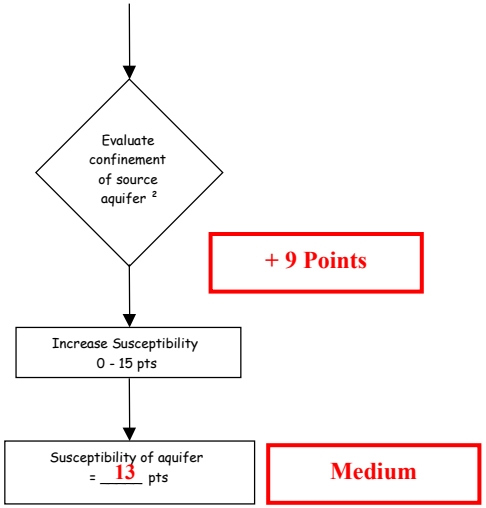
20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

The most recent sanitary survey (08/17/99) indicates that the well is below ground surface and enclosed in concrete. At the time the sanitary survey was completed there was no lid/cover on the concrete enclosure. Instead a wooden flower pot was used to cover the well. It was also noted that the sanitary seal on the well was cracked and monitoring holes were not properly plugged.

Chart 2. Susceptibility of the aquifer – Chapel By The Sea







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) 9/10 = 4 Points

Depth to top of confining unit (61 feet) 2/10 = 1 Point

Protectiveness of the Vadose Zone Total = **5/10 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 (28 feet of silt) 9/15 = 6 Points

Density of boreholes/wells 10/15 = 3 Points

Degree of Confinement Total = **9/15 Points**

Aquifer Susceptibility Ratings

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

Medium

Chart 3. Contaminant risks for Chapel By The Sea – Bacteria and Viruses

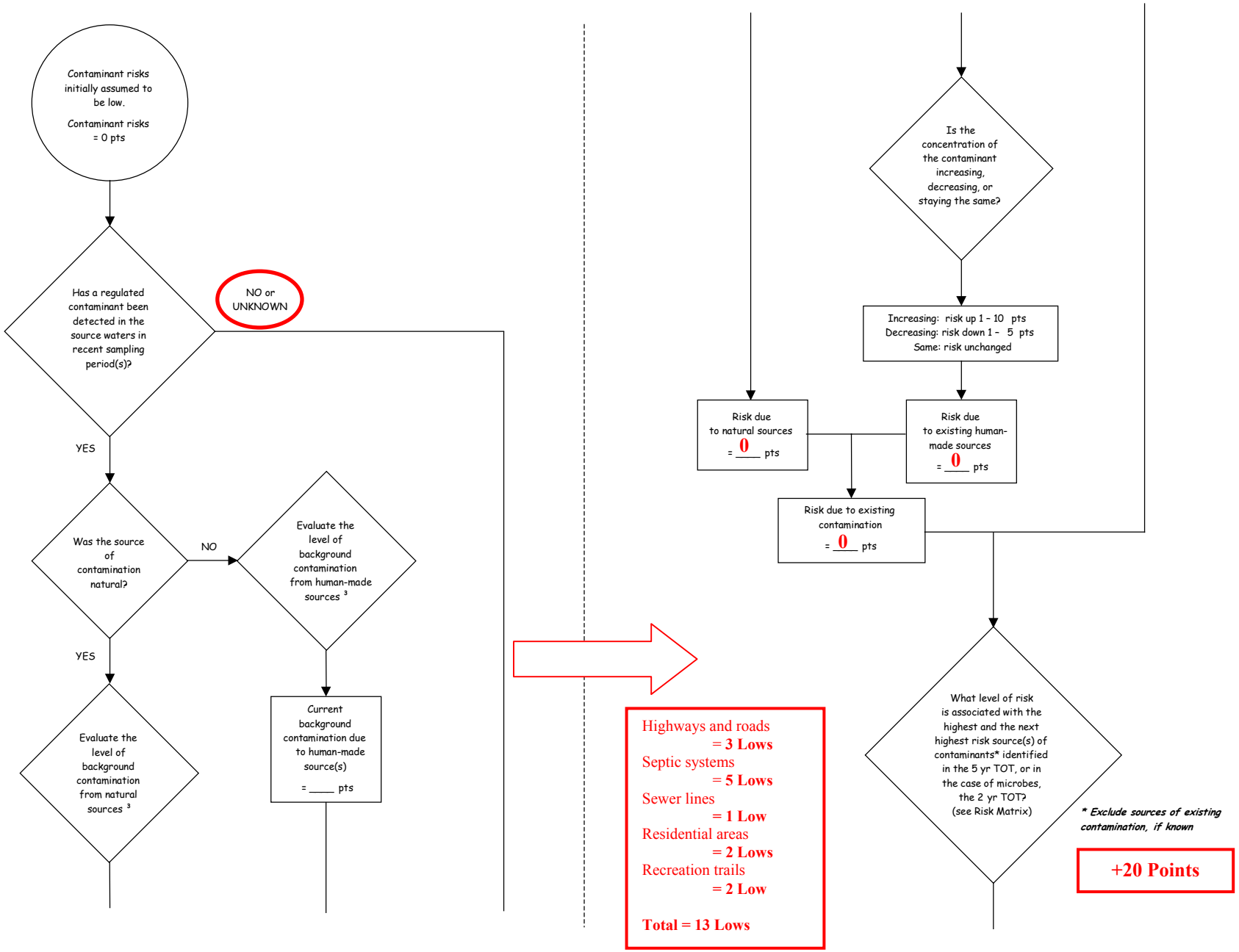


Chart 3. Contaminant risks for Chapel By The Sea – Bacteria and Viruses (Continued)

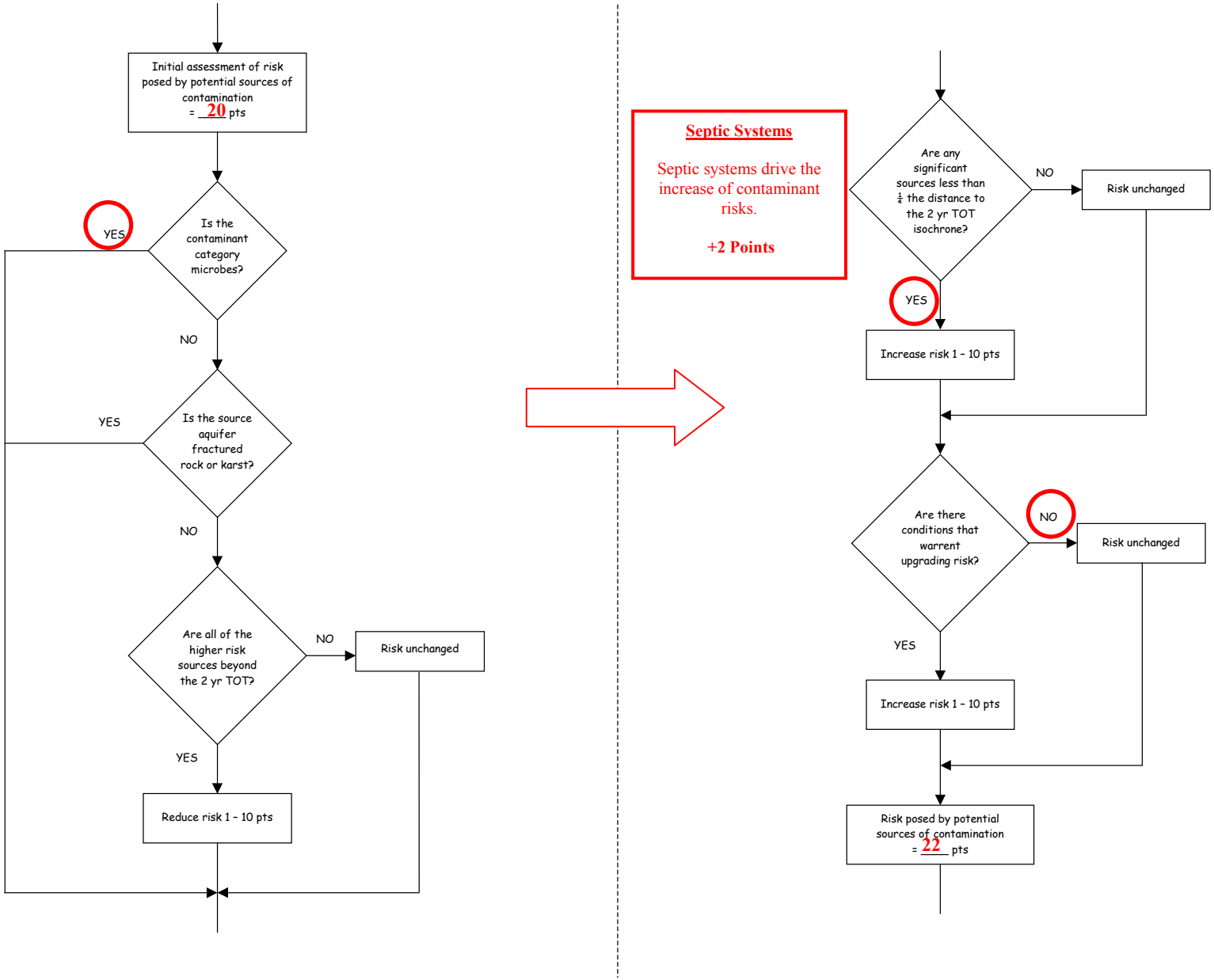
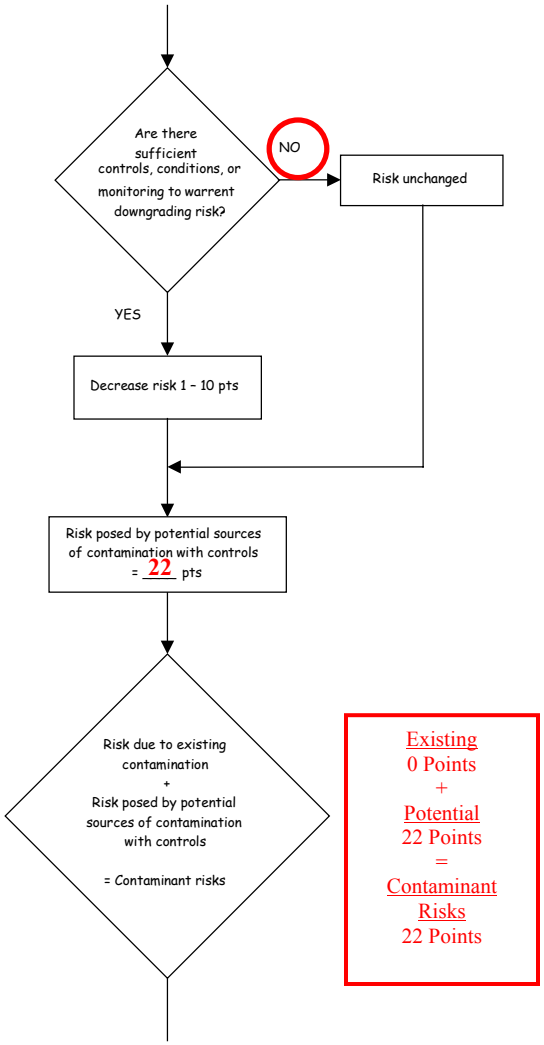
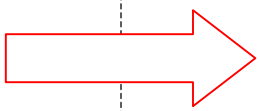
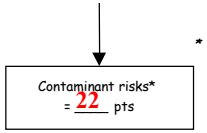


Chart 3. Contaminant risks for Chapel By The Sea – Bacteria and Viruses (Continued)



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





** Truncate risk at 50 pts*

Medium

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 Chapel By The Sea – Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Highways and roads, septic systems, sewer lines, 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 Chapel By The Sea – Bacteria & Viruses

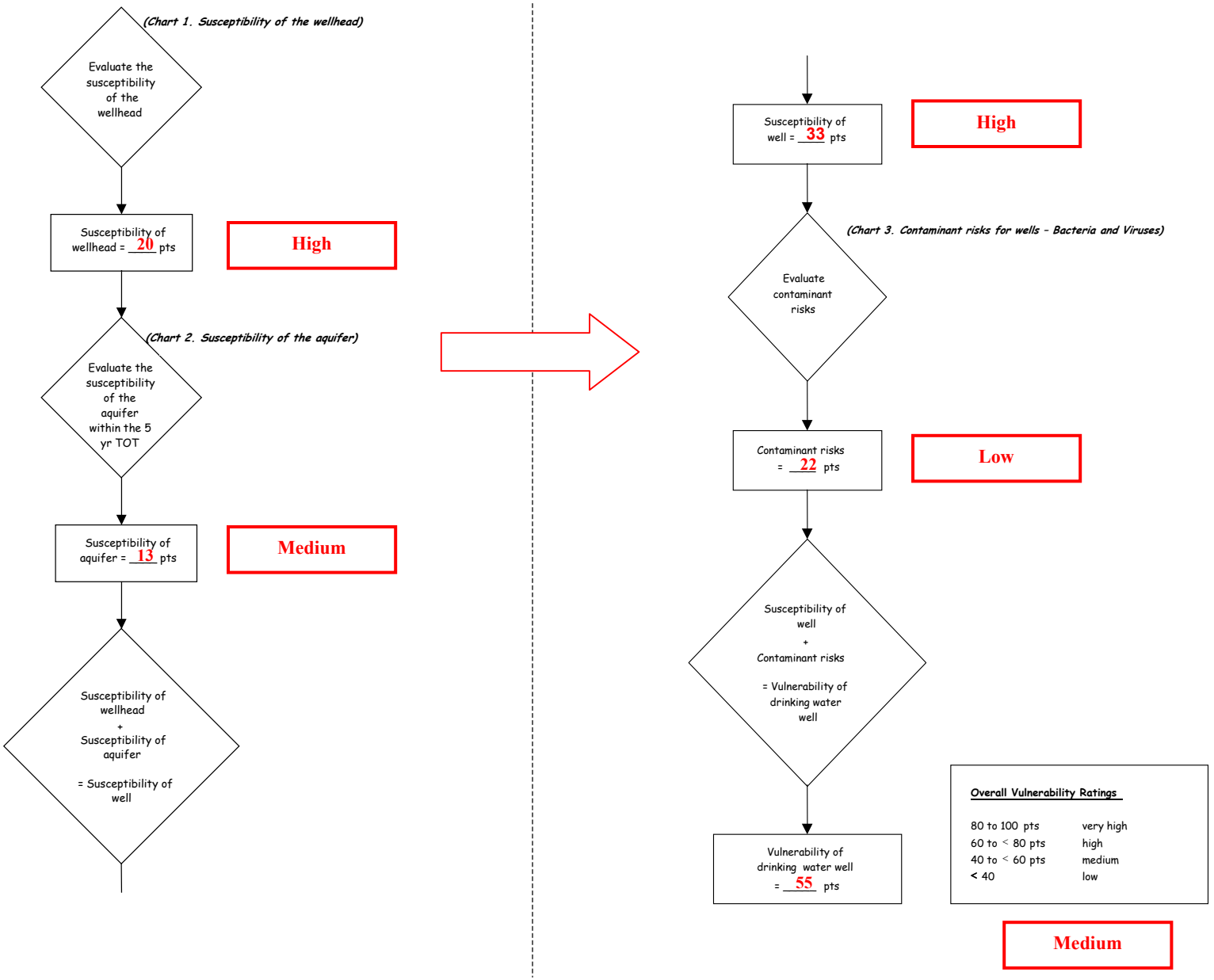


Chart 5. Contaminant risks for Chapel By The Sea – Nitrates and Nitrites

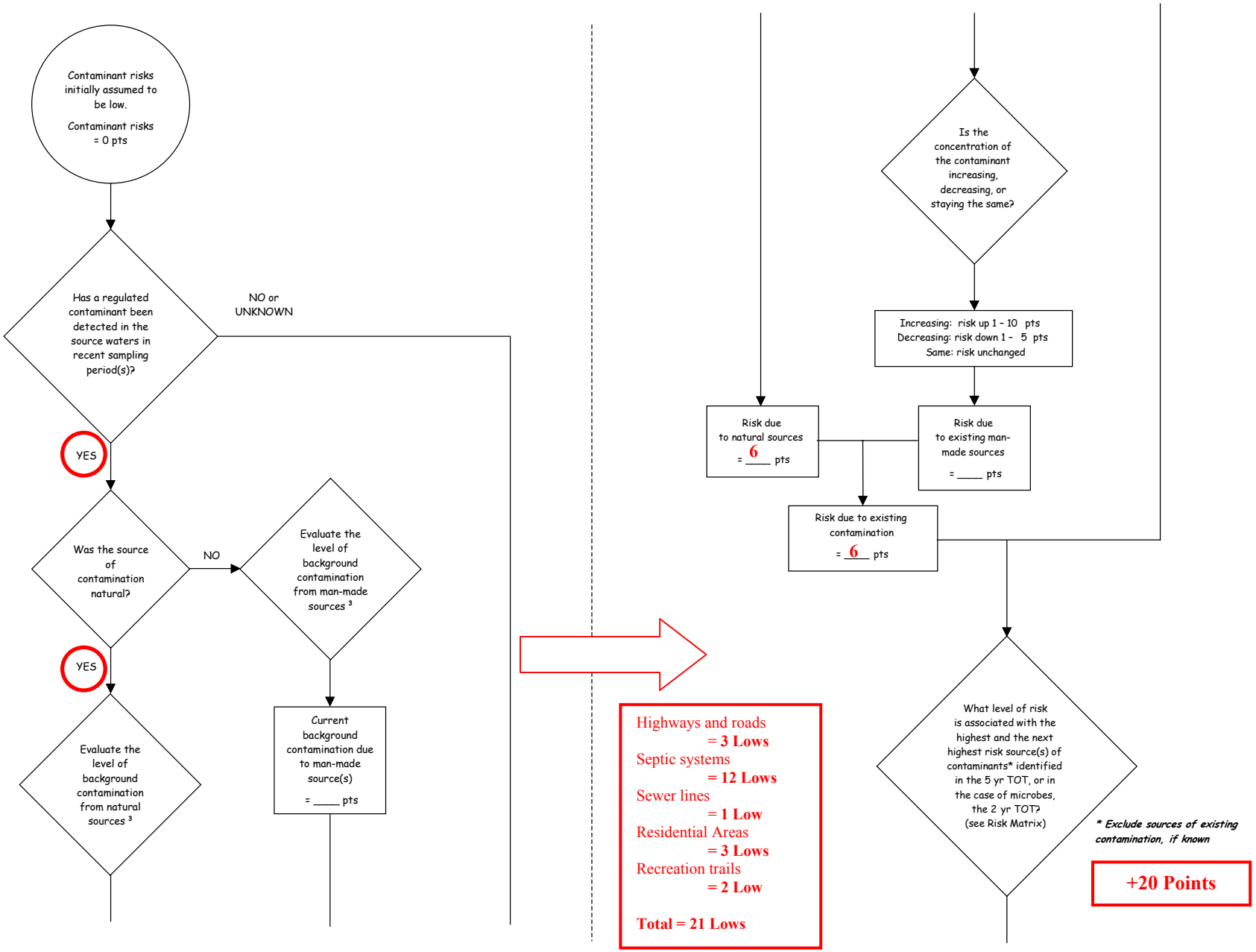


Chart 5. Contaminant risks for Chapel By The Sea – Nitrates and Nitrites (Continued)

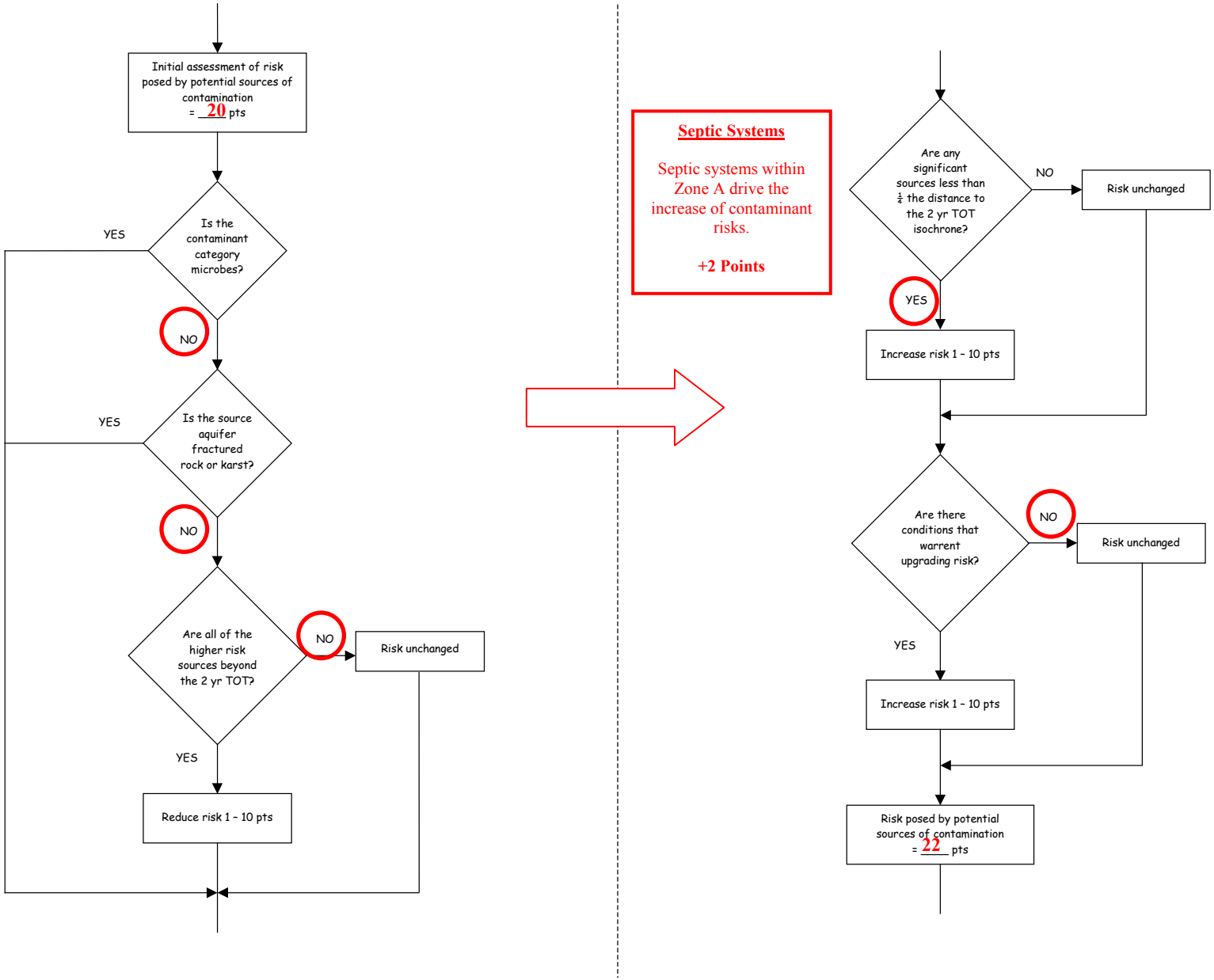
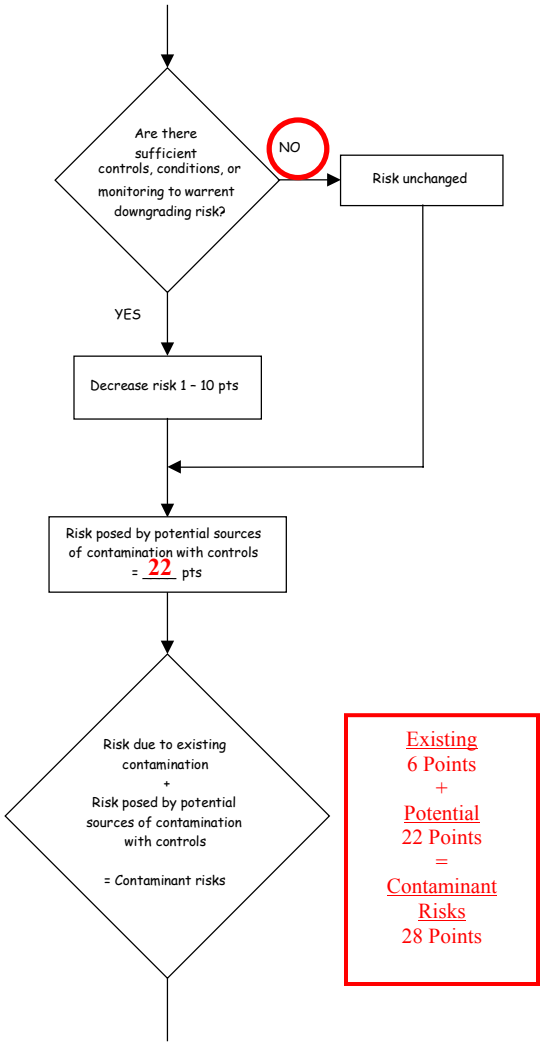


Chart 5. Contaminant risks for Chapel By The Sea – Nitrates and Nitrites (Continued)



Existing
6 Points
+
Potential
22 Points
=
Contaminant Risks
28 Points

* *Truncate risk at 50 pts*

Contaminant risks*
= 28 pts

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

Nitrate

2.3 mg/L (08/10/00)
0.9 mg/L (11/18/99)
1.7 mg/L (10/15/98)
1.1 mg/L (05/14/98)
1.4 mg/L (12/11/97)
1.5 mg/L (10/10/96)
2.3 mg/L (11/16/95)
2.5 mg/L (12/08/94)
2.5 mg/L (12/17/93)
1.7 mg/L (06/17/92)

Maximum Contaminant Level (MCL) = 10mg/L

2.3/10
= 0.23 or 23% of MCL

+6 Points

Table 2. Risk Matrix for Contaminant Sources for Chapel By The Sea – Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Highways and roads, septic systems, sewer lines, 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 Chapel By The Sea – Nitrates and Nitrites

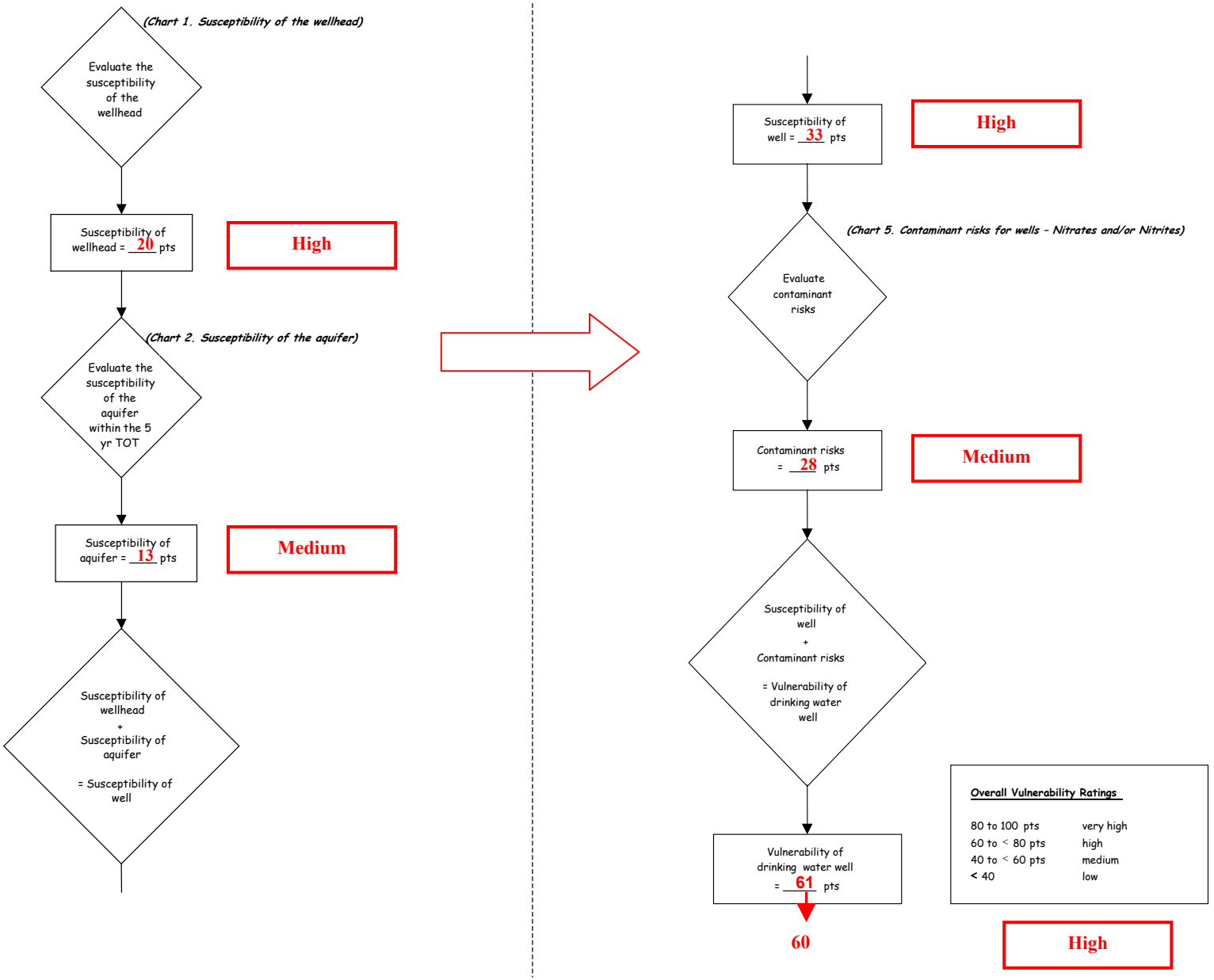


Chart 7. Contaminant risks for Chapel By The Sea – Volatile Organic Chemicals

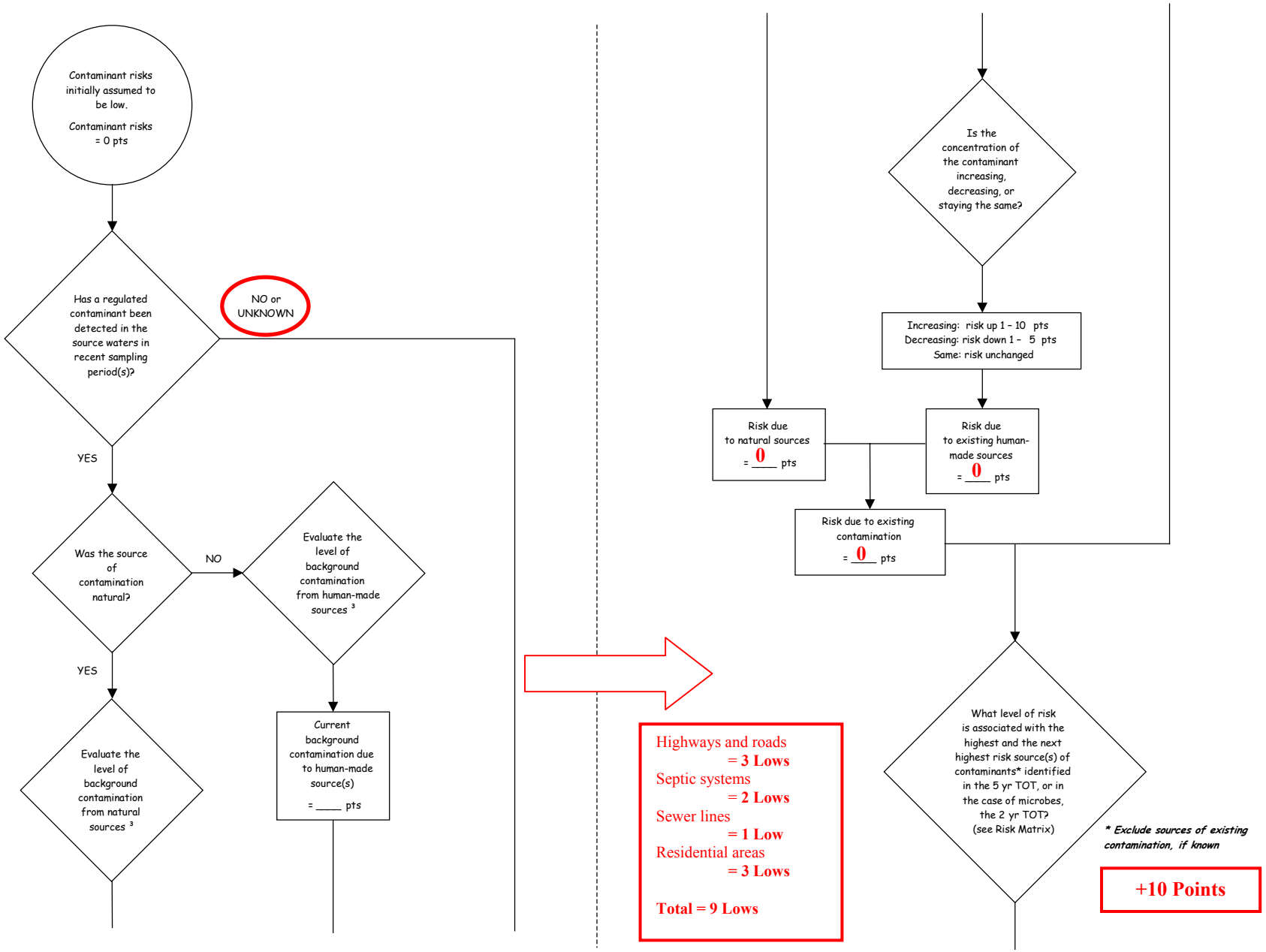


Chart 7. Contaminant risks for Chapel By The Sea – Volatile Organic Chemicals (Continued)

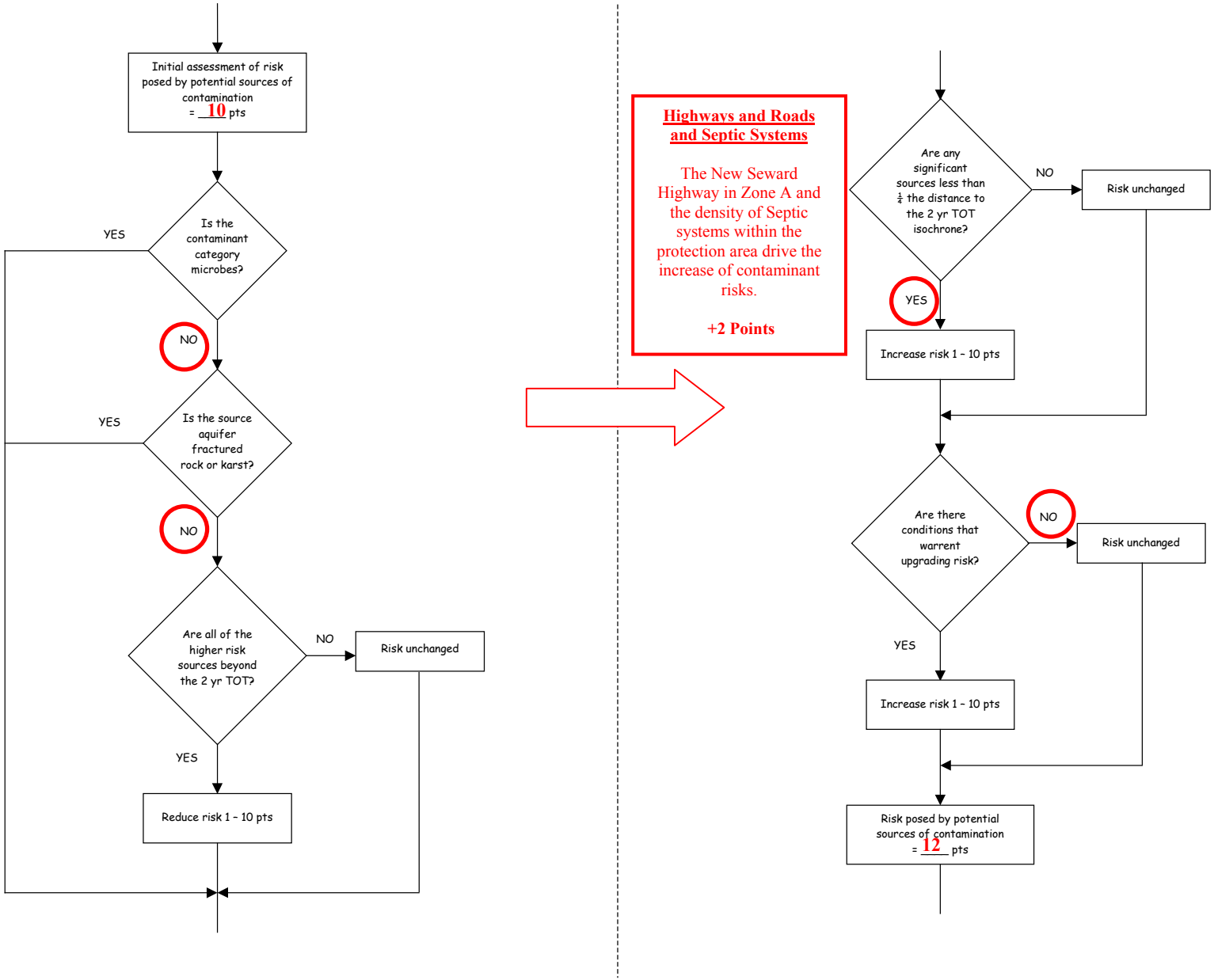
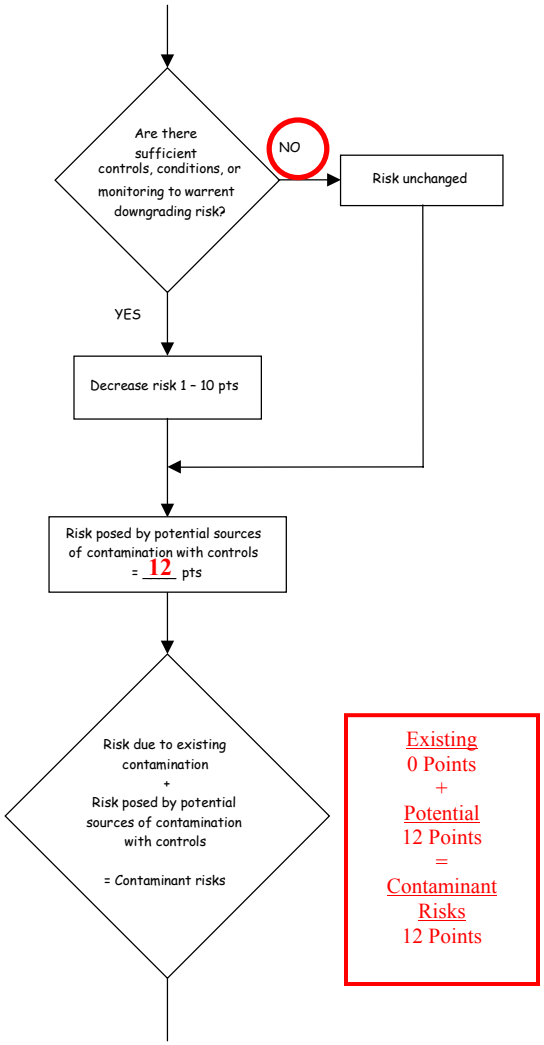
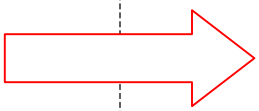
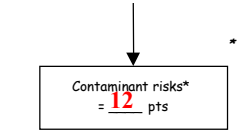


Chart 7. Contaminant risks for Chapel By The Sea – Volatile Organic Chemicals (Continued)



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





** Truncate risk at 50 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 Chapel By The Sea – Volatile Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Highways and roads, septic systems, sewer lines, 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 8. Vulnerability analysis for Chapel By The Sea – Volatile Organic Chemicals