Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Alpine Inn No.1 Drinking Water System, Cooper Landing, Alaska PWSID # 244808.001

DRINKING WATER PROTECTION PROGRAM REPORT # 375
Alaska Department of Environmental Conservation

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By URS Corporation

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By URS Corporation

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Alpine Inn No.1 is a Class B (transient/non-community) water system consisting of one well located in Cooper Landing, Alaska. Identified potential and current sources of contaminants for Alpine Inn No.1 public drinking water source include: large capity septic systems, residential septic systems, highways and roads, logging activities, 7.56 acres of residential areas, and residential heating oil tanks. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Alpine Inn No.1 received a vulnerability rating of **Very High** for volatile organic chemicals, bacteria and viruses, and nitrates and nitrites.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this assessment is to provide owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system. URS Corporation has been contracted to perform these assessments under the supervision of ADEC.

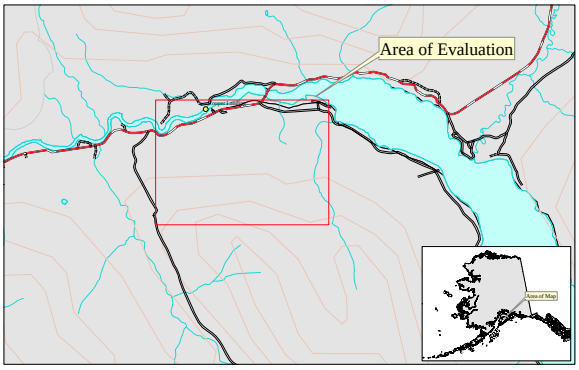
This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

DESCRIPTION OF COOPER LANDING, ALASKA

Location

Cooper Landing is part of the Kenai Peninsula Borough, which is located directly south of the city of Anchorage. The borough encompasses 25,600 square miles, only 15,700 square miles, which is land. (Kenai Peninsula Borough, 2002) The Kenai Peninsula is broken into two distinct geographic areas; the Kenai Mountains and the Kenai Lowland. Towns located within the Kenai Mountains include Moose Pass, Cooper Landing, Crown Point, and Seward. The Kenai Lowlands are located in the west and comprise about 2,900 square miles and include the towns of Sterling, Soldotna, Kenai, Clam Gulch, Ninilchik and Homer. Two main highways divide the peninsula; the Seward Highway begins in Anchorage and ends in Seward, connecting the Turnagain Arm to the peninsula. The Sterling Highway splits off from Seward Highway at Tern Lake Junction and runs east and west to Kenai, where it then turns south and ends in Homer. The peninsula is bordered by the Prince William Sound in the east, Gulf of Alaska in the south and the Cook Inlet in the west. The Kenai River, located in the Kenai Mountains, is the largest stream within the peninsula, beginning at Kenai Lake and draining into the Cook Inlet through the Kenai Lowlands (*USGS, 1915*).

Figure 1



Glaciers occupied the Kenai Peninsula during the early Quaternary time, however the exact date is unknown. During that time, the entire Kenai Mountains area was covered by a system of glaciers (*USDA, 1962*).

Precipitation

The community of Cooper Landing averages about 21.4 inches of precipitation every year, with the most precipitation occurring in the fall.

Topography and Drainage

The Kenai Peninsula area topography varies from about 3000 feet to 5000 feet above sea level in the Kenai Mountains, the highest point being about 6,400 feet above sea level. The Kenai Peninsula is dotted with many lakes and small streams, including three large lakes (Kenai Lake, Skilak Lake and Tustumena Lake) and three substantial rivers (Kenai River and Kasilof River) (*USGS, 1915*).

Kenai Lake is a one of the best-known fishing areas in the Kenai Peninsula. It is a popular trout and Dolly Varden fishing area. It is also known for its unusual color, which is caused by glacial silt (*Milepost, 2000*). This lake is located on the Sterling Highway, just after the Tern Lake Junction and before Cooper Landing, approximately 43 miles northeast of Seward. It is the source of the Kenai River at about 470 feet above sea level.

Skilak Lake is larger than Kenai Lake and about 300 feet lower in altitude. The Kenai River connects Kenai Lake to Skilak Lake before continuing onto the Cook Inlet. Skilak Lake is known for good salmon, rainbow trout and Dolly Varden fishing. This lake is located off of the Sterling Highway on Skilak Loop Road, about 15 miles west of the Kenai Lake (*Milepost, 2000*).

The ***Kenai River*** watershed covers over 2,200 square miles and runs over 80 miles in length. This watershed includes the towns of Cooper Landing, Sterling, Soldotna and Kenai. Several tributaries flow into the river, including the Snow River, Trail Creek, Killey River and Funny River. Glaciers along the path of the river continually supply the waters with sediment, keeping the waters turbid (*http://www.kenai-watershed.org/ - Kenai River Watershed and USGS, 1915*).

Groundwater

Although the quality can vary significantly in a short distance, groundwater supplies are abundant in the area. The Kenai River Center, GW Scientific, and Restoration Science and Engineering are currently investigating the interactions that occur between the Kenai River Watershed and groundwater in the Lower Kenai area (Soldotna)(*http://www.kenai-watershed.org/spawning /kenai_river/kenai_river.html, 2002*).

The Kenai Peninsula area has a central water system, and several subdivisions have private water systems. Many homes and businesses in the area, however, rely on individual wells for their water supply. Most of these wells are deep with depths between 50 and 200 feet. Static water levels in many of these wells are between 10 and 30 feet below the surface.

Geology and Soils

The Kenai Mountains in this area are composed of the Valdez Group, a widely distributed flysch in southcentral Alaska. The group is predominantly dark gray mudstone, siltstone, argillite, and slate, with sandstone (mostly greywacke) interbeds. The rocks are locally calcareous and highly deformed, showing cleavage development, disrupted beds, and folding. Where sedimentary features are preserved, the sandstones are typically turbidites. The age of the Valdez Group is considered late Cretaceous. The formation consists of clastic debris that is likely shed from an uplifted arc and deposited by turbidity flows in an elongate trench (Crossen, 1992).

The Valdez Group is one of the two rock units making up the Chugach terrane, which is one of the four tectonostratigraphic terranes found in southcentral Alaska. The Kenai Mountains and Kenai Peninsula lie in the present arc-trench gap, between the volcanoes of the Aleutian Range arc and the Aleutian trench. The Kenai-Chugach Range is underlain by an oceanic flysch and mélange accretion complex that records convergent margin history extending back to Triassic time. The Kenai-Chugach Range is largely underlain by subduction rocks and is one of the main topographic features that flank the seaward edge of the forearc basin in southcentral Alaska (Crossen, 1992).

Various Quaternary-age surficial deposits are found in the general area. The origin of these deposits is predominantly glacial, with components of alluvial, colluvial, and lacustrine deposition (Winkler, 1992). The glacier ice mass deposited silt, sand, gravel, cobbles and boulders during multiple glacial advancements and recessions. The soils deposited during the glacial advancements were consolidated by the weight of the ice. During the recessional phase of glaciation, soils consolidated by the ice mass were probably eroded to some degree by melt water, and unconsolidated alluvial materials were deposited.

ALPINE INN NO. 1 PUBLIC DRINKING WATER SYSTEM

Alpine Inn No.1 is a Class B (transient/non-community) water system. The system consists of one well near the intersection of Edwards Street and the Sterling Highway (T5N, R3W, Section 28). This area is at an elevation of approximately 500 feet above sea level.

A well log was not available for with site, however, according to the sanitary survey completed for the water system, installation of the well occurred in August 1978, to a total depth of approximately 122 feet below ground surface and was completed in 6-inch well casing. The most recent Sanitary Survey (8/15/90) indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is also appropriately sloped away from the well providing adequate surface water drainage. It is not known if the well has been grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

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

ALPINE INN NO. 1 DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. Some areas are more likely to allow contamination to reach the well than others. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the Drinking Water Protection Area (DWPA). Because a release of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.

An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources (*Jokela et. al., 1991*). Additional methods were also used to take into account any uncertainties in groundwater flow and

The DWPAs established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the DWPA. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (Patrick, Brabets, and Glass, 1989), and State of Alaska Department of Water Resources (Jokela et. al., 1991). Additional methods were also used to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful DWPA (Please refer to the Guidance Manual for Class Bs for additional information).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four DWPA zones and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. TOT
B	Less than the 2 year TOT
C	Less Than the five year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Alpine Inn No.1 DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

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

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

RANKING OF CONTAMINANT RISKS

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

VULNERABILITY OF ALPINE INN NO. 1 DRINKING WATER SOURCE

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

- Natural susceptibility; and
- Contaminant risks.

Each of the three categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

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

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

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

The well for Alpine Inn No.1 is completed in an unconfined aquifer setting. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Overall Susceptibility score and rating for Alpine Inn No.1.

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

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	50	Very High

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing or historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	35	High

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and

Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

Table 3 contains the overall vulnerability scores (0 – 10) and ratings for each of the three categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability of Alpine Inn No. 1 to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	100	Very High
Nitrates and Nitrites	100	Very High
Volatile Organic Chemicals	85	Very High

Tables 2 through 5 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

The large capacity septic systems, and residential septic systems, create a risk increase for the bacteria and viruses, and nitrates and nitrites contaminant categories.

Only a small amount of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Alpine Inn No.1.

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

Sampling history for Alpine Inn No.1 well indicates that low concentrations of nitrate have been detected (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Existing nitrate concentration is approximately 1.1 mg/L or 11% of the Maximum Contaminant Level (MCL) of 10mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Due to the high solubility and weak retention by soil, nitrates are very mobile, moving at approximately the same rate as water. Though existing nitrate contamination was detected at the site, concentrations remain at very safe levels with respect to human health.

The seven residential and non-residential heating oil aboveground storage tanks located in Zone A form the greatest risk for volatile organic chemicals.

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Alpine Inn No. 1. The overall vulnerability of this source to contamination is **Very High** for volatile organic chemicals, bacteria and viruses, and nitrates and nitrites. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Alpine Inn No.1 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 Alpine Inn No.1 public drinking water source.

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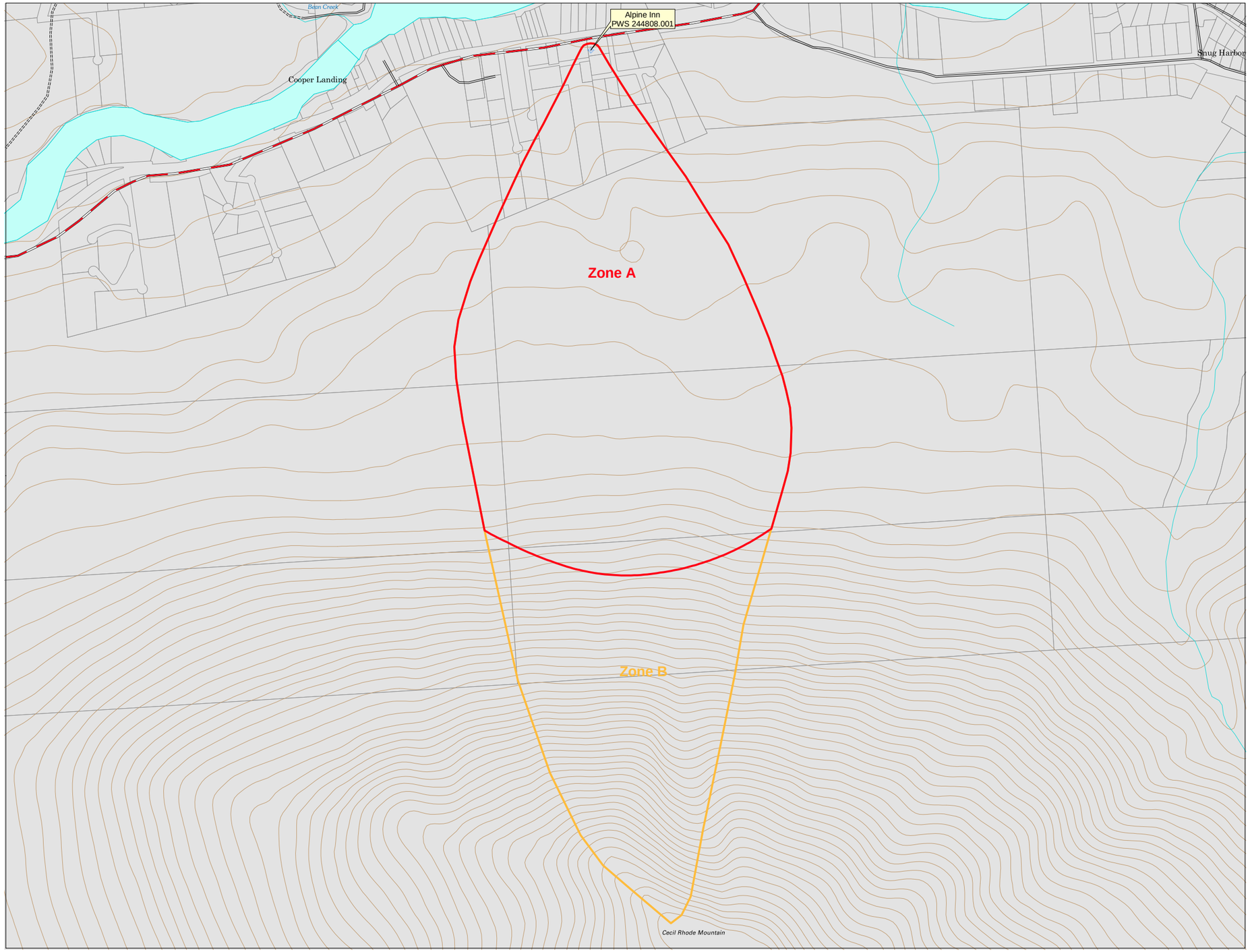
APPENDIX A

Alpine Inn No.1
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Areas for the Public Water Well System for PWS # 244808.001 Alpine Inn



LEGEND

- Public Water System Well

Groundwater Protection Zones

- Zone A – Several Months Travel Time
- Zone B – Less Than 2 Years Travel Time

Hydrography/Physical

- Parcels
- Stream
- Aqueduct or Pipeline
- Lake or Pond
- Glacier
- Contours (approx. 70 ft.)

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)
- Road Ferry Crossing

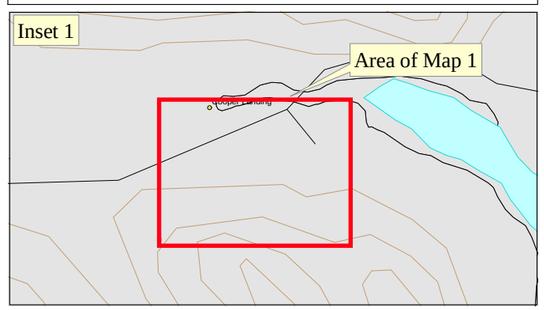
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Parcels
Kenai Peninsula Borough

All other data
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC
Calculation Spreadsheet.

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 750 1,500 3,000 4,500 6,000 Feet

Alpine Inn PWS 244808.001

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Alpine Inn No.1 (Tables 1-4)

Table 1 *Contaminant Source Inventory for* **PWSID 244808.001**

Alpine Inn

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A		1	
Logging (active)	E02	E02-01	A		1	
Logging (active)	E02	E02-02	A		1	
Logging (active)	E02	E02-03	A		1	
Logging (active)	E02	E02-04	A		1	
Logging (active)	E02	E02-05	A		1	
Residential Areas	R01	R01-01	A		1	7.56 Acres
Septic systems (serves one single-family home)	R02	R02-01	A		1	
Septic systems (serves one single-family home)	R02	R02-02	A		1	
Septic systems (serves one single-family home)	R02	R02-03	A		1	
Tanks, heating oil, residential (above ground)	R08	R08-01	A		1	
Tanks, heating oil, residential (above ground)	R08	R08-02	A		1	
Tanks, heating oil, residential (above ground)	R08	R08-03	A		1	
Tanks, heating oil, residential (above ground)	R08	R08-04	A		1	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A		1	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A		1	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A		1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	LISA AVE.	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	PATRICIA LANE	1	
Logging (active)	E02	E02-06	B		1	

Table 2

Contaminant Source Inventory and Risk Ranking for Alpine Inn

Sources of Bacteria and Viruses

PWSID 244808.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	1		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	2		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	3		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	High	4		1	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	5		1	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	6		1	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	7		1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	8	LISA AVE.	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	9	PATRICIA LANE	1	
Residential Areas	R01	R01-01	A	Low	10		1	7.56 Acres

Table 3

Contaminant Source Inventory and Risk Ranking for Alpine Inn
Sources of Nitrates/Nitrites

PWSID 244808.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	1		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	2		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	3		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	High	4		1	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	5		1	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	6		1	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	7		1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	8	LISA AVE.	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	9	PATRICIA LANE	1	
Logging (active)	E02	E02-01	A	Low	10		1	
Logging (active)	E02	E02-02	A	Low			1	
Logging (active)	E02	E02-03	A	Low			1	
Logging (active)	E02	E02-04	A	Low			1	
Logging (active)	E02	E02-05	A	Low			1	
Residential Areas	R01	R01-01	A	Low			1	7.56 Acres
Logging (active)	E02	E02-06	B	Low			1	

Table 4

Contaminant Source Inventory and Risk Ranking for Alpine Inn
Sources of Volatile Organic Chemicals

PWSID 244808.001

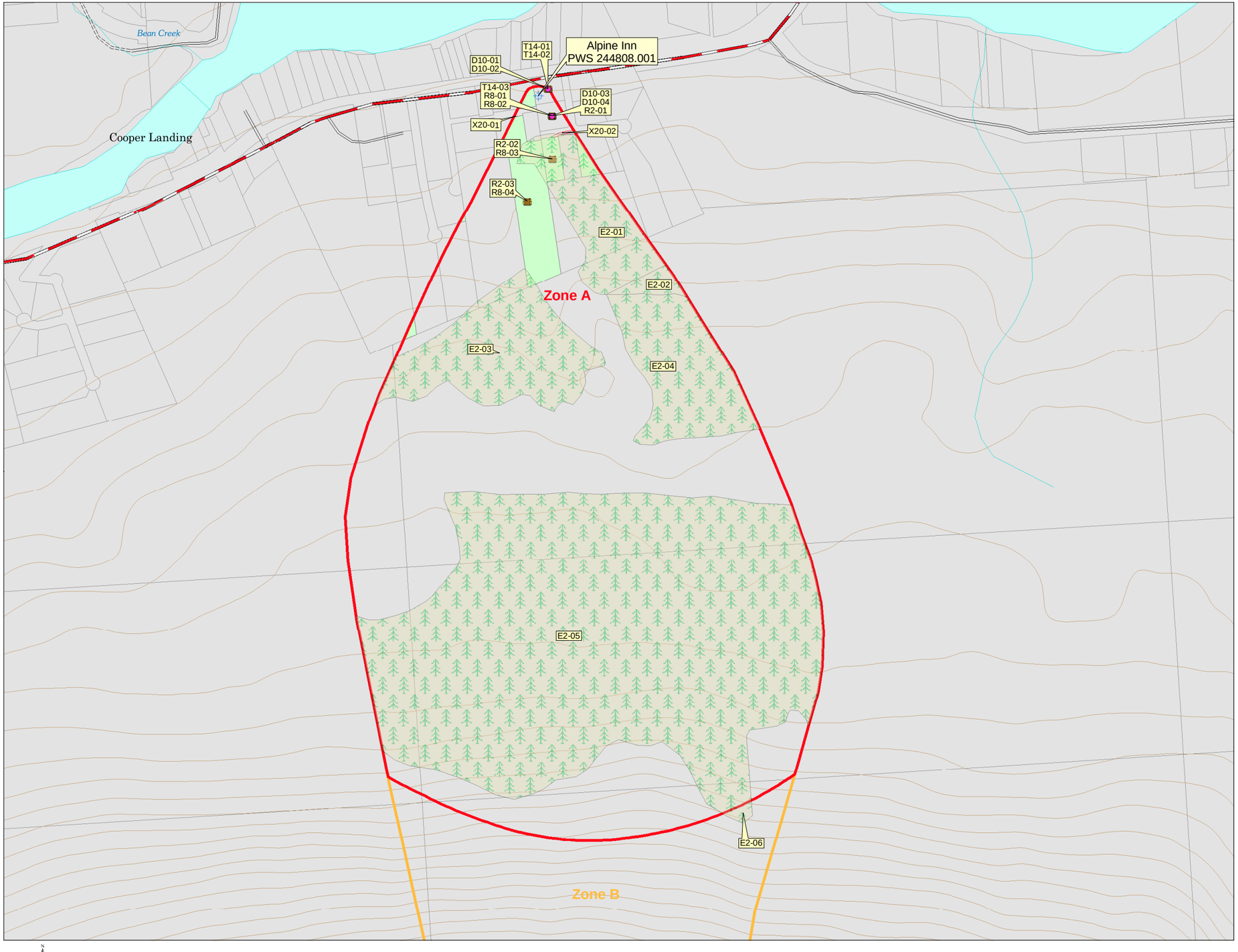
Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Medium	1		1	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-02	A	Medium	2		1	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-03	A	Medium	3		1	
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	4		1	
Tanks, heating oil, residential (above ground)	R08	R08-02	A	Medium	5		1	
Tanks, heating oil, residential (above ground)	R08	R08-03	A	Medium	6		1	
Tanks, heating oil, residential (above ground)	R08	R08-04	A	Medium	7		1	
Logging (active)	E02	E02-01	A	Low	8		1	
Logging (active)	E02	E02-02	A	Low	9		1	
Logging (active)	E02	E02-03	A	Low	10		1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low			1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low			1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low			1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	Low			1	
Logging (active)	E02	E02-04	A	Low			1	
Logging (active)	E02	E02-05	A	Low			1	
Residential Areas	R01	R01-01	A	Low			1	7.56 Acres
Septic systems (serves one single-family home)	R02	R02-01	A	Low			1	
Septic systems (serves one single-family home)	R02	R02-02	A	Low			1	
Septic systems (serves one single-family home)	R02	R02-03	A	Low			1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low		LISA AVE.	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low		PATRICIA LANE	1	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Logging (active)	E02	E02-06	B	Low			1	

APPENDIX C

Alpine Inn No.1
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Drinking Water Protection Areas for the Public Water Well System for PWS # 244808.001 Alpine Inn
Showing Potential and Existing Sources of Contamination



LEGEND

- Public Water System Well

Groundwater Protection Zones

- Zone A – Several Months Travel Time
- Zone B – Less Than 2 Years Travel Time

Contaminant Sources

- Septic systems (serves one single-family home and/or less than 20 people) (R2)
- Injection wells (Class V) Septic System (Drainfield Disposal Method) (D10)
- Tanks, heating oil, non residential (aboveground) (T14)
- Tanks, heating oil, residential (aboveground) (R8)
- Highways and roads, paved (cement or asphalt) (X20)
- Logging (E2)
- Residential Areas (R1)

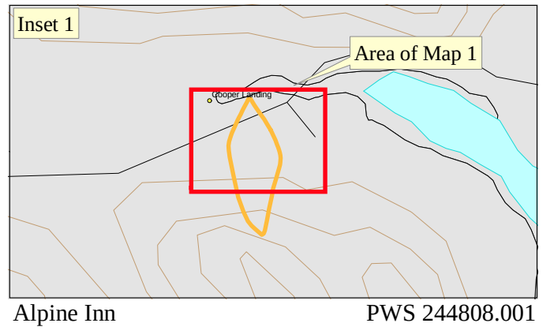
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

Parcels
Kenai Peninsula Borough

All other data
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC
Calculation Spreadsheet.

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 500 1,000 2,000 3,000 4,000 Feet

Alpine Inn PWS 244808.001

APPENDIX D

Vulnerability Analysis for Alpine Inn No.1 Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Alpine Inn (244808.001)

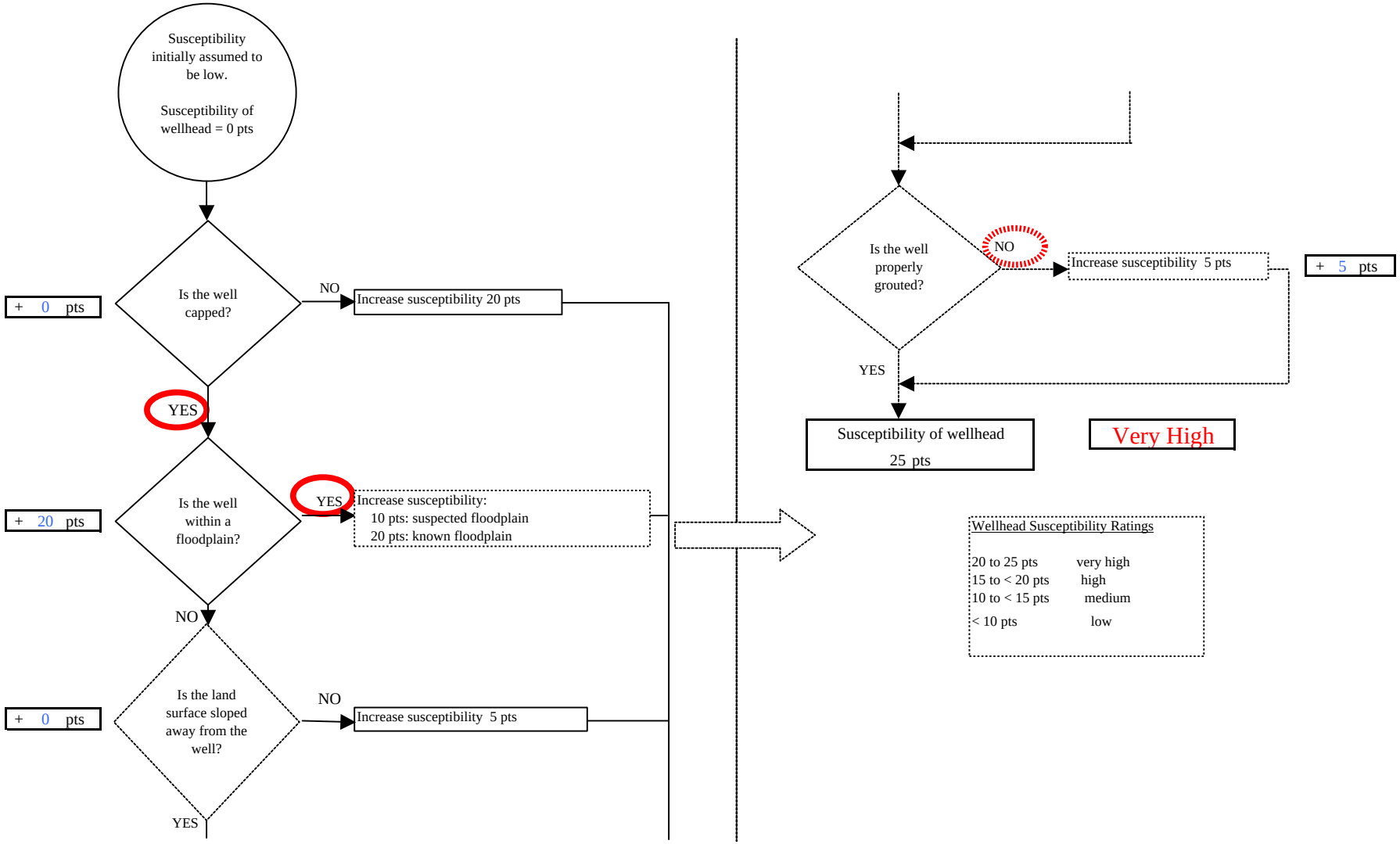


Chart 2. Susceptibility of the aquifer - Alpine Inn (244808.001)

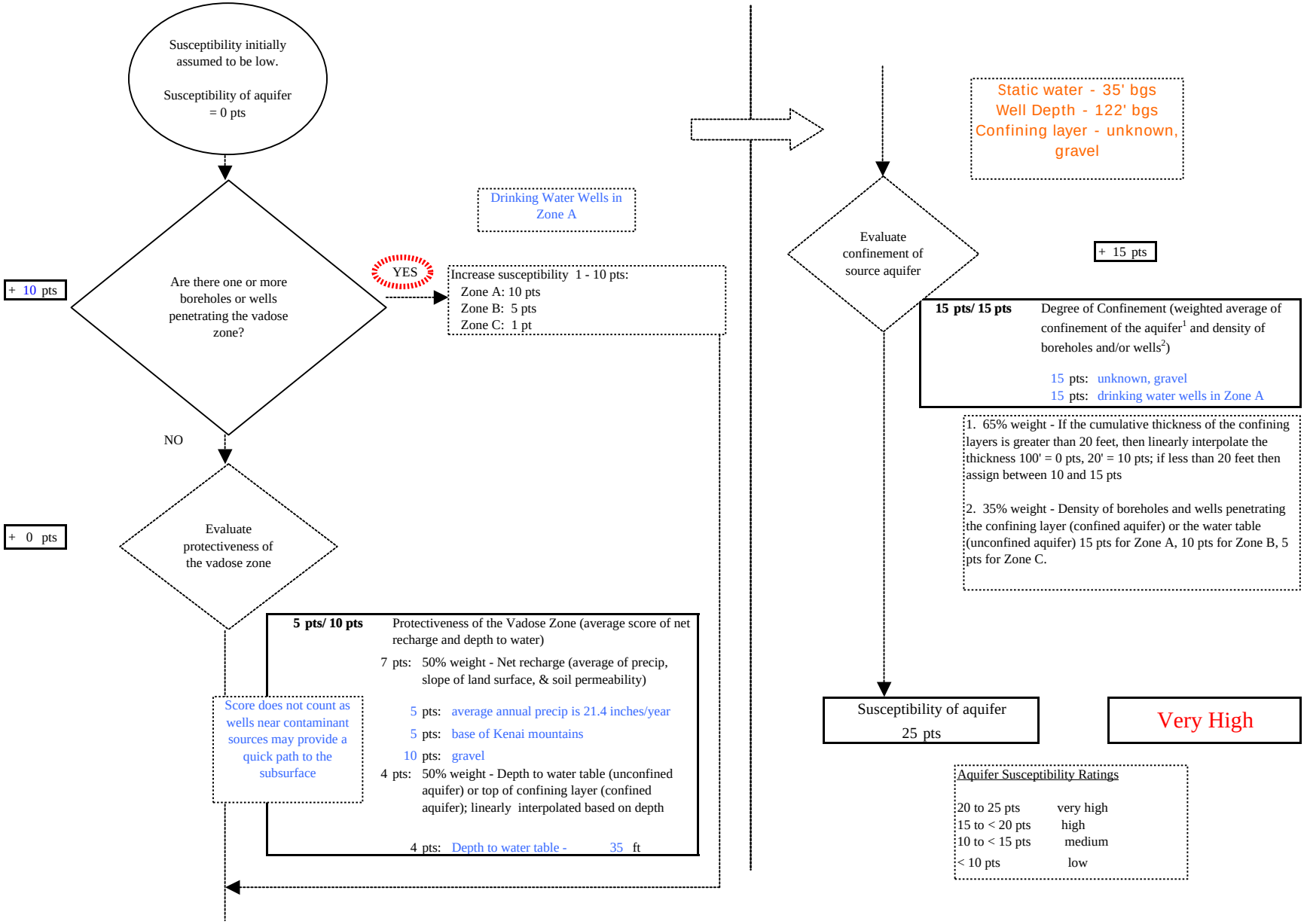
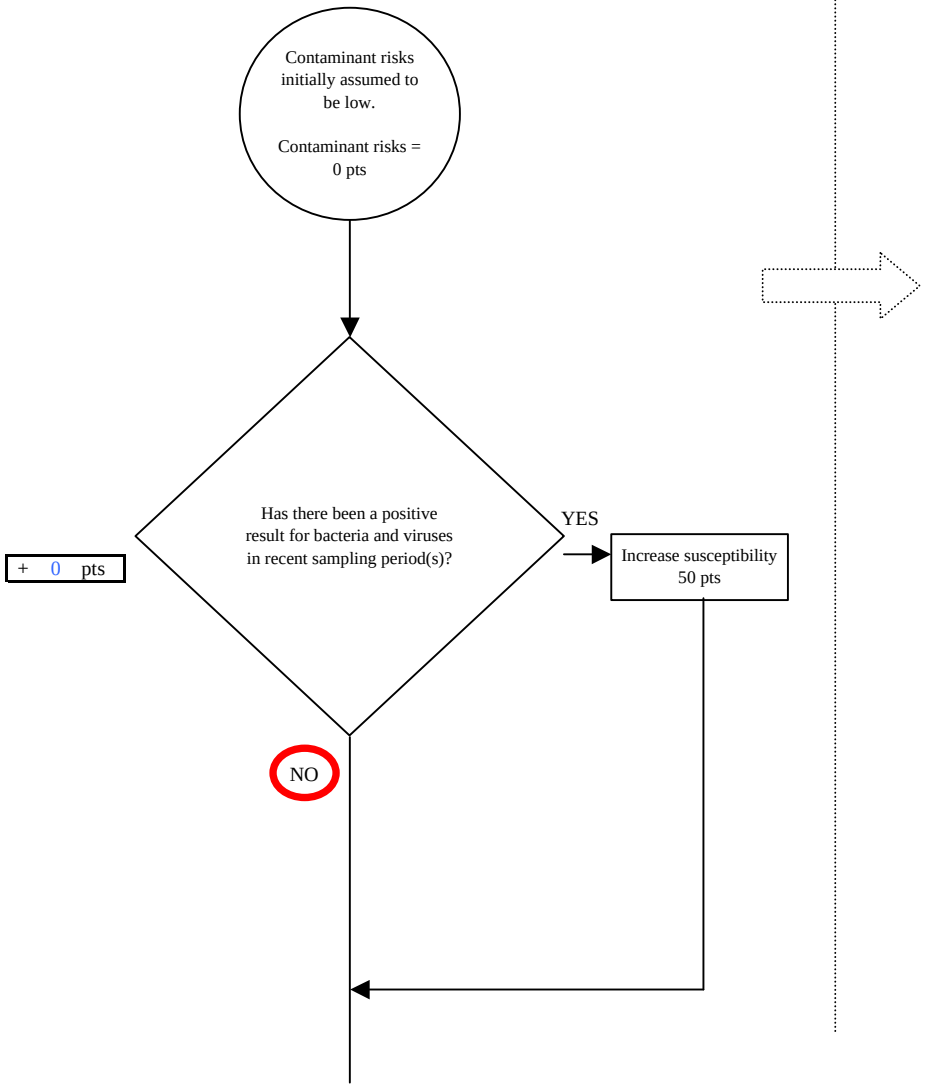
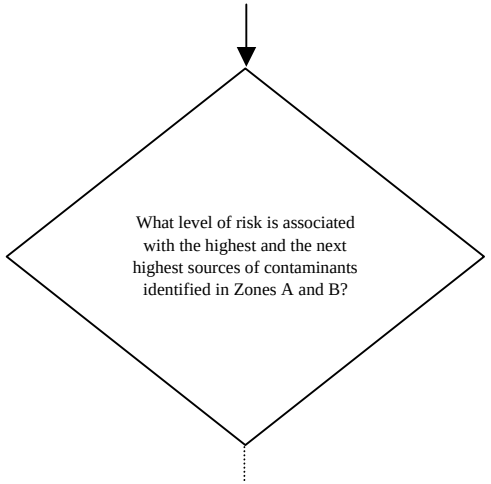


Chart 3. Contaminant risks for Alpine Inn (244808.001) - Bacteria & Viruses





+ 40 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	4	0	4
Medium(s)	0	0	0
Low(s)	5	0	5

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 40

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

Chart 3. Contaminant risks for Alpine Inn (244808.001) - Bacteria & Viruses

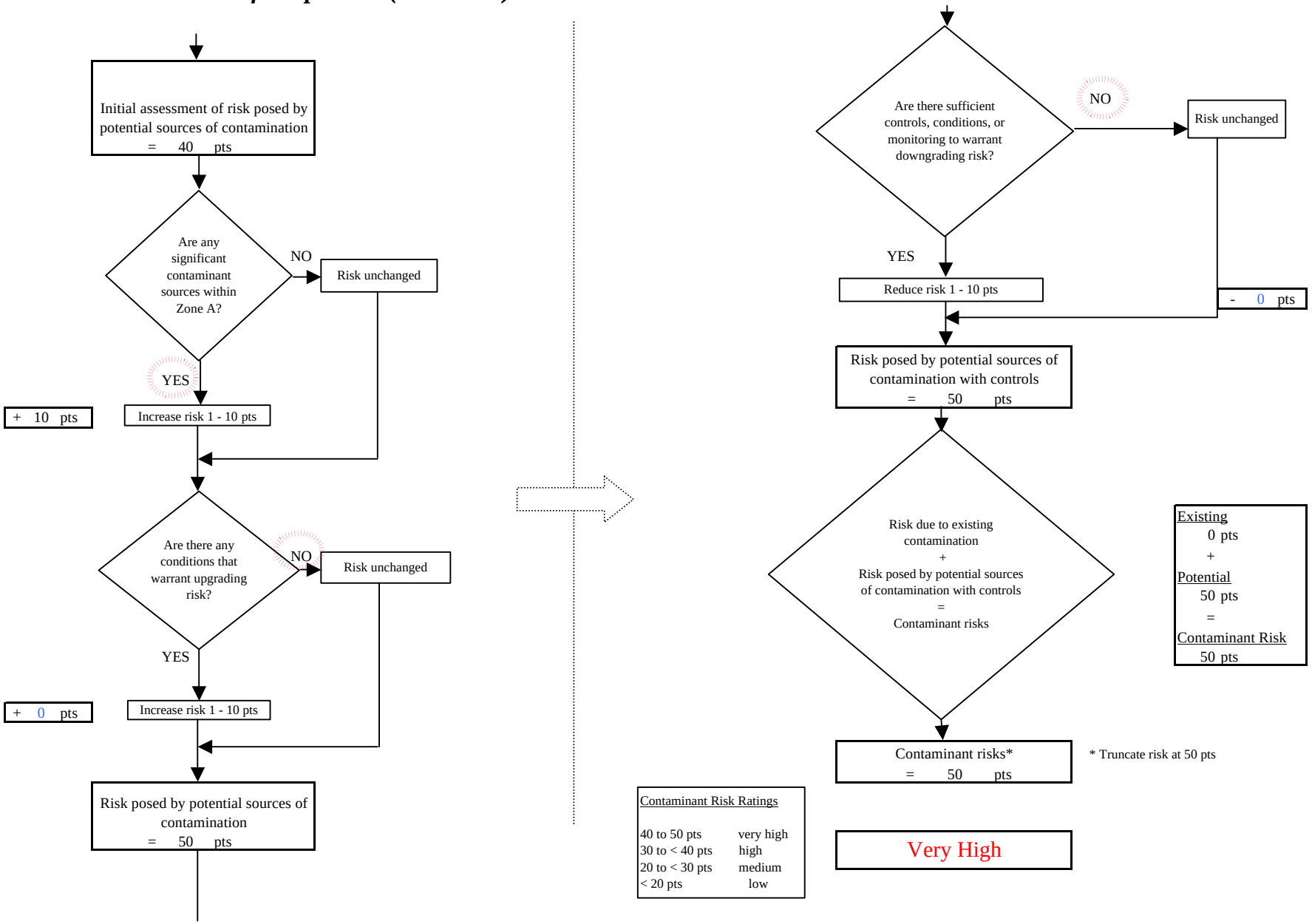


Chart 4. Vulnerability analysis for Alpine Inn (244808.001) - Bacteria & Viruses

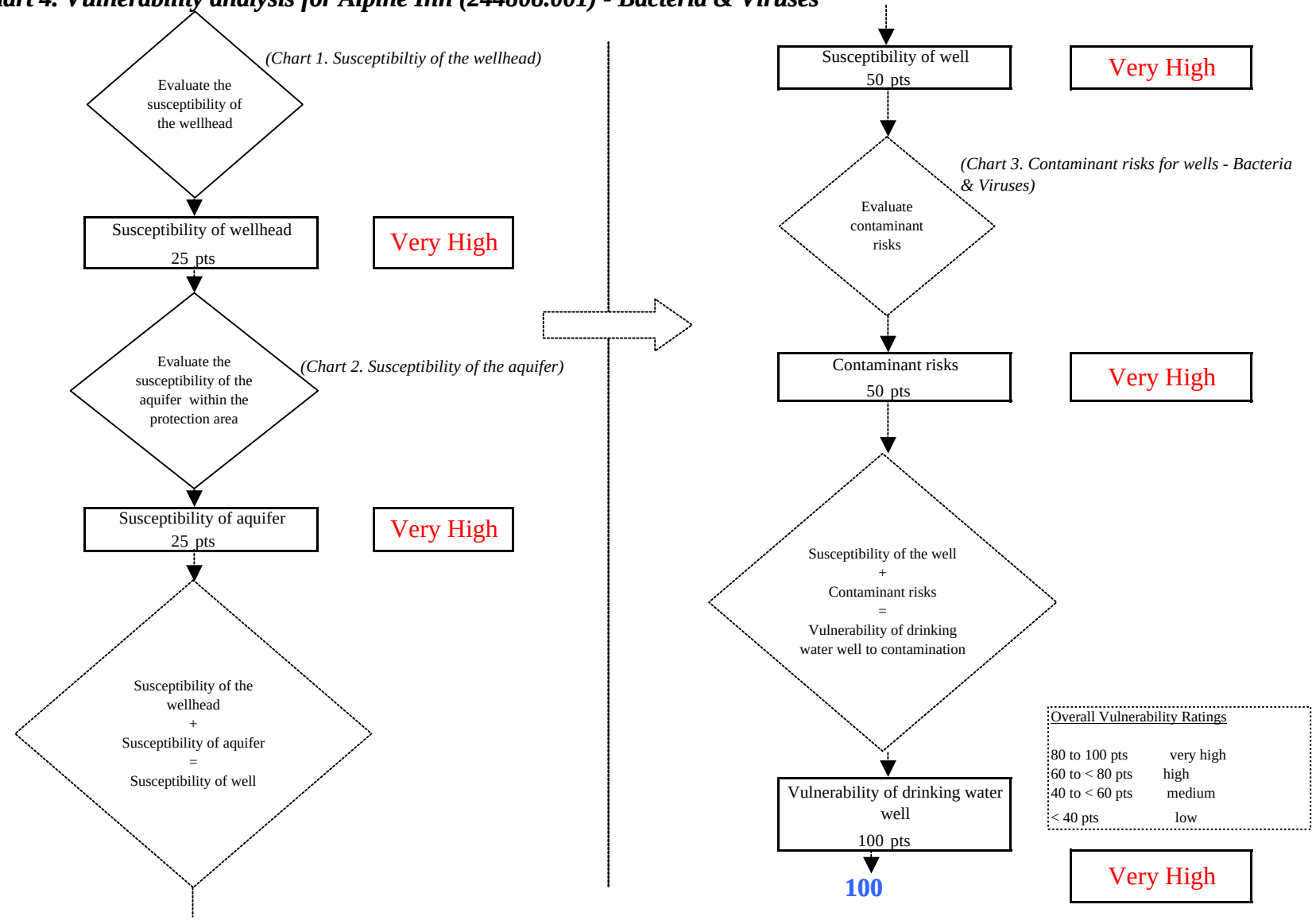


Chart 5. Contaminant risks for Alpine Inn (244808.001) - Nitrates and Nitrites

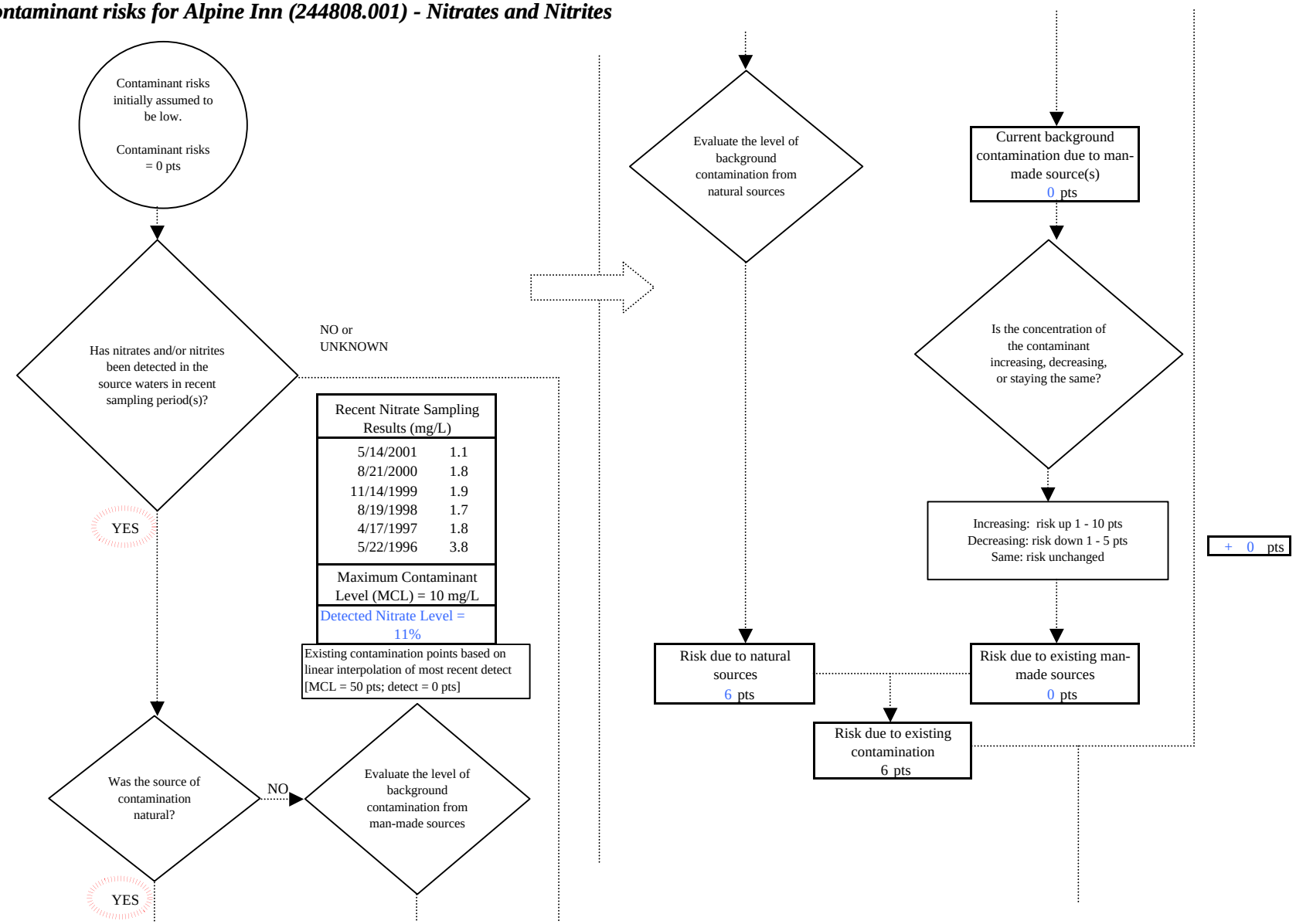


Chart 5. Contaminant risks for Alpine Inn (244808.001) - Nitrates and Nitrites

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	4	0	4
Medium(s)	0	0	0
Low(s)	7	1	8

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 40

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

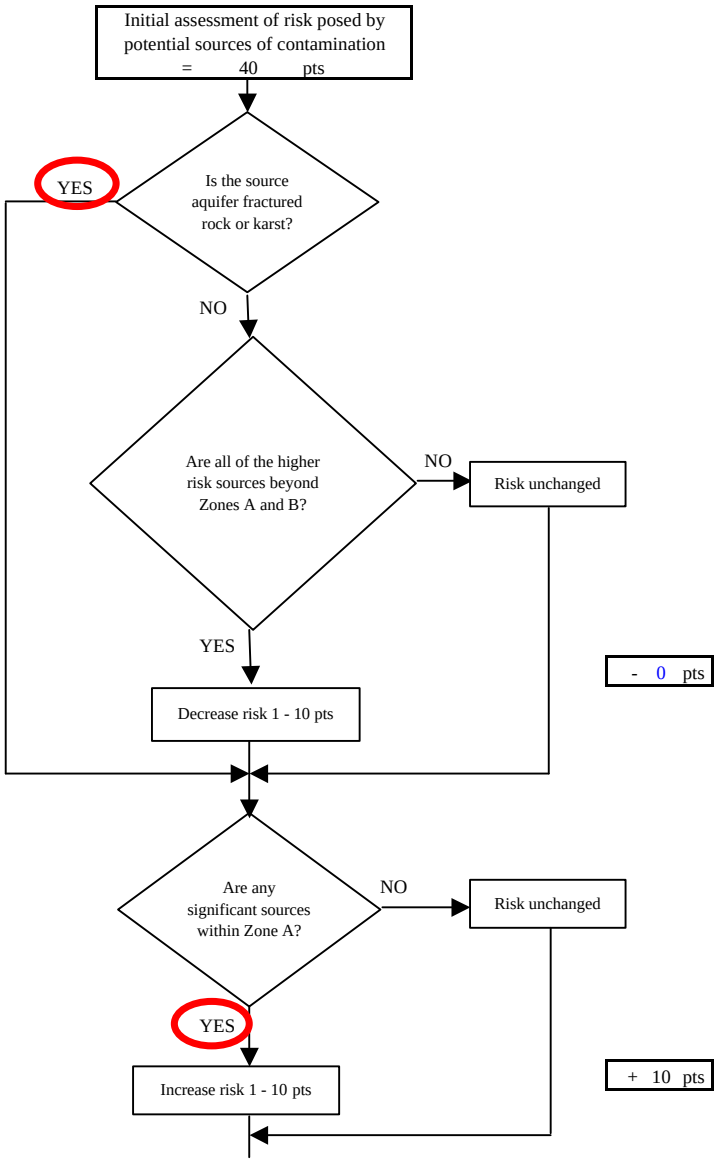
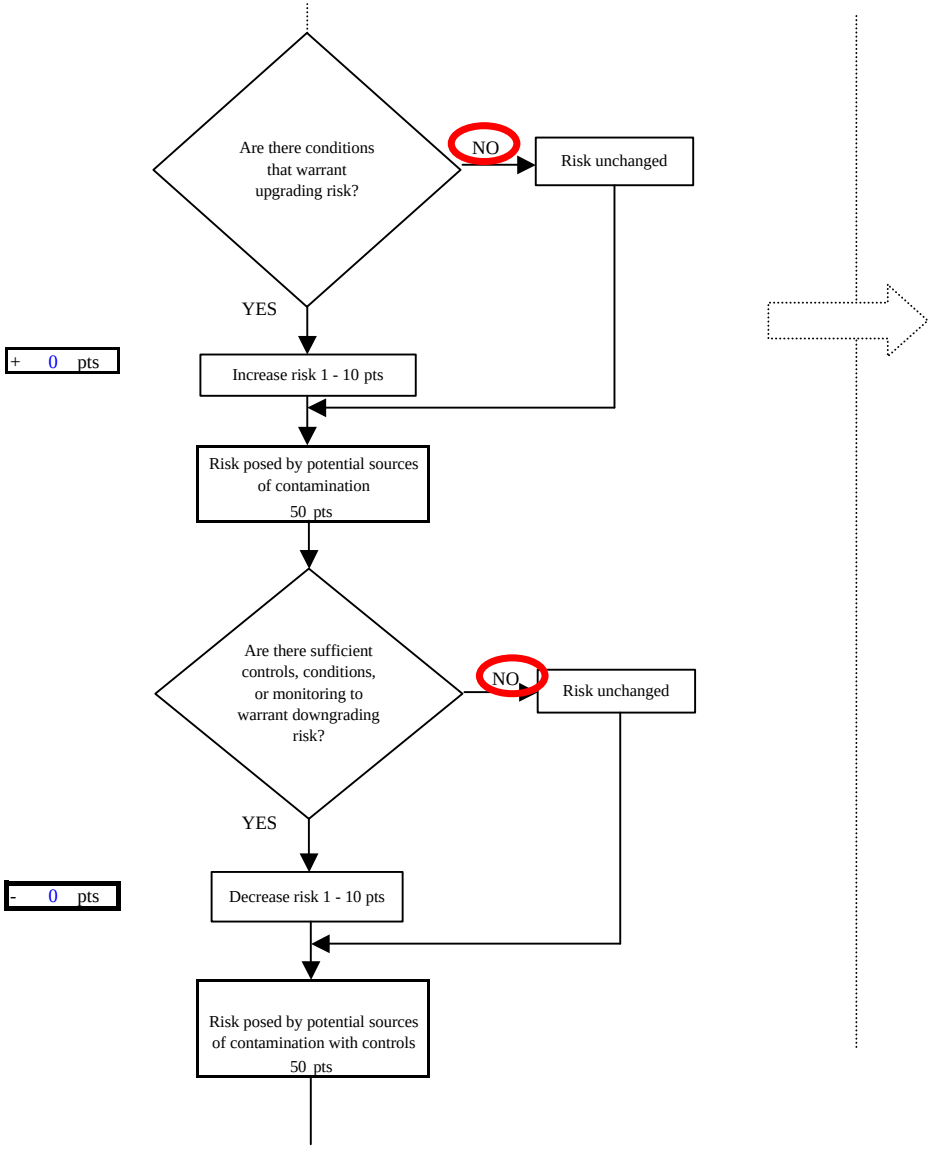


Chart 5. Contaminant risks for Alpine Inn (244808.001) - Nitrates and Nitrites



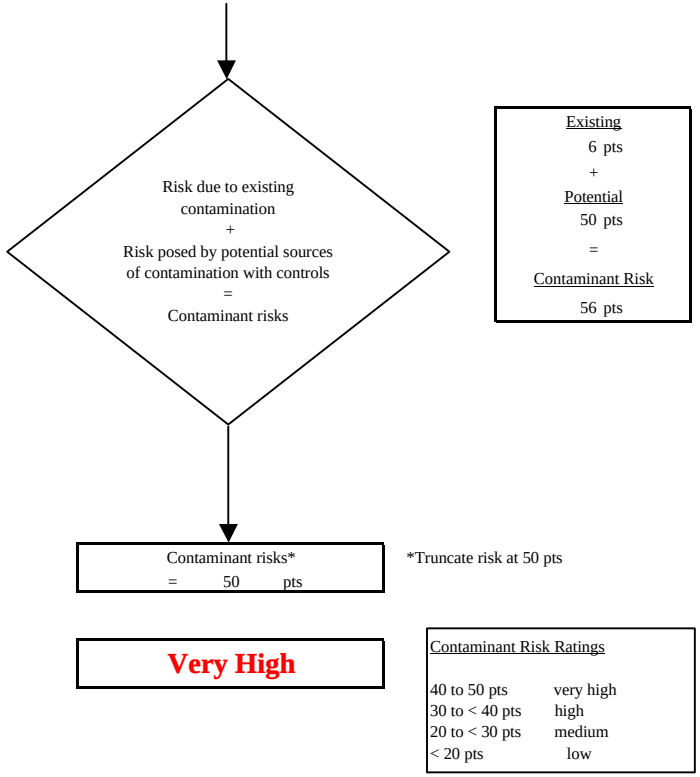


Chart 6. Vulnerability analysis for Alpine Inn (244808.001) - Nitrates and Nitrites

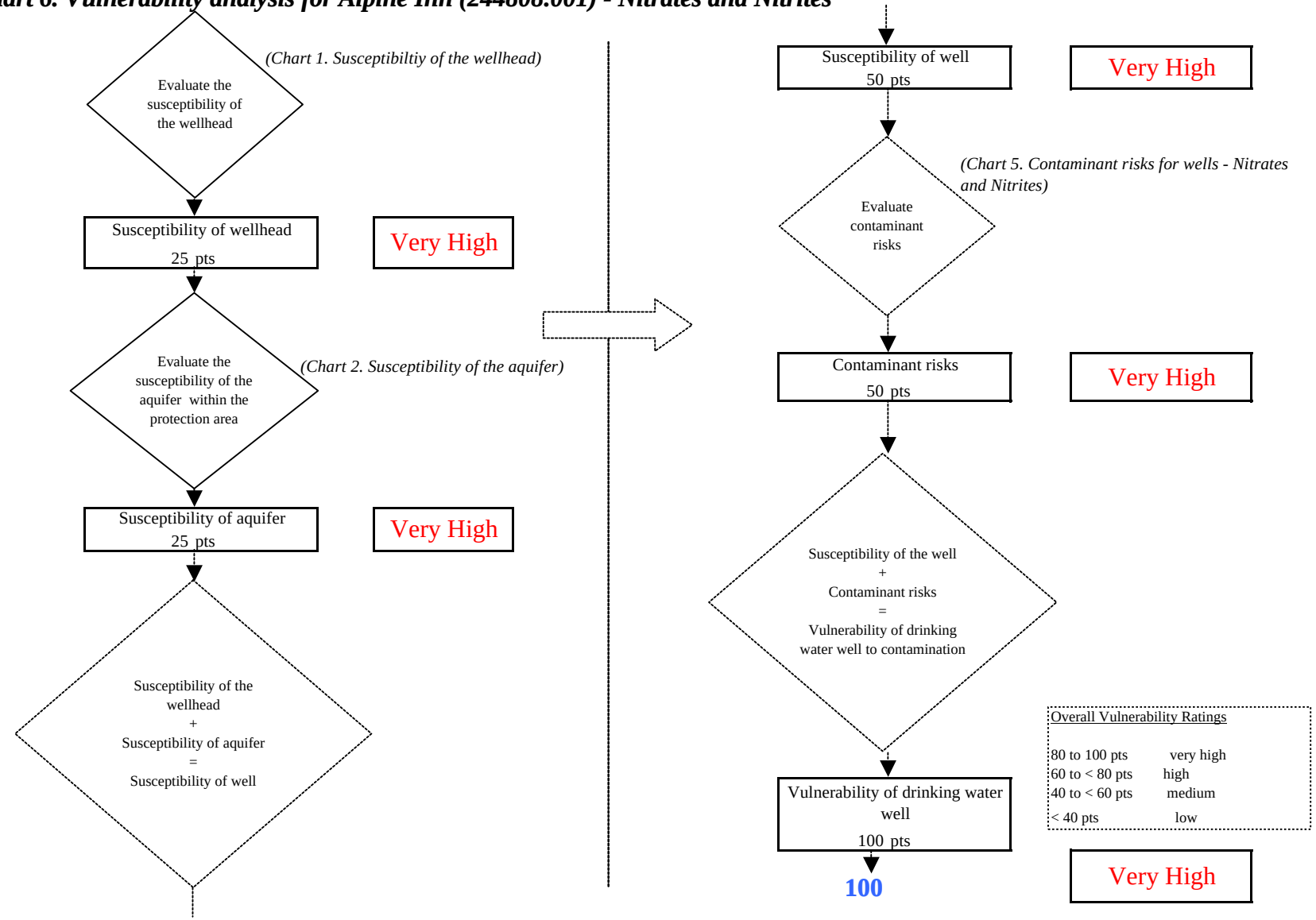


Chart 7. Contaminant risks for Alpine Inn (244808.001) - Volatile Organic Chemicals

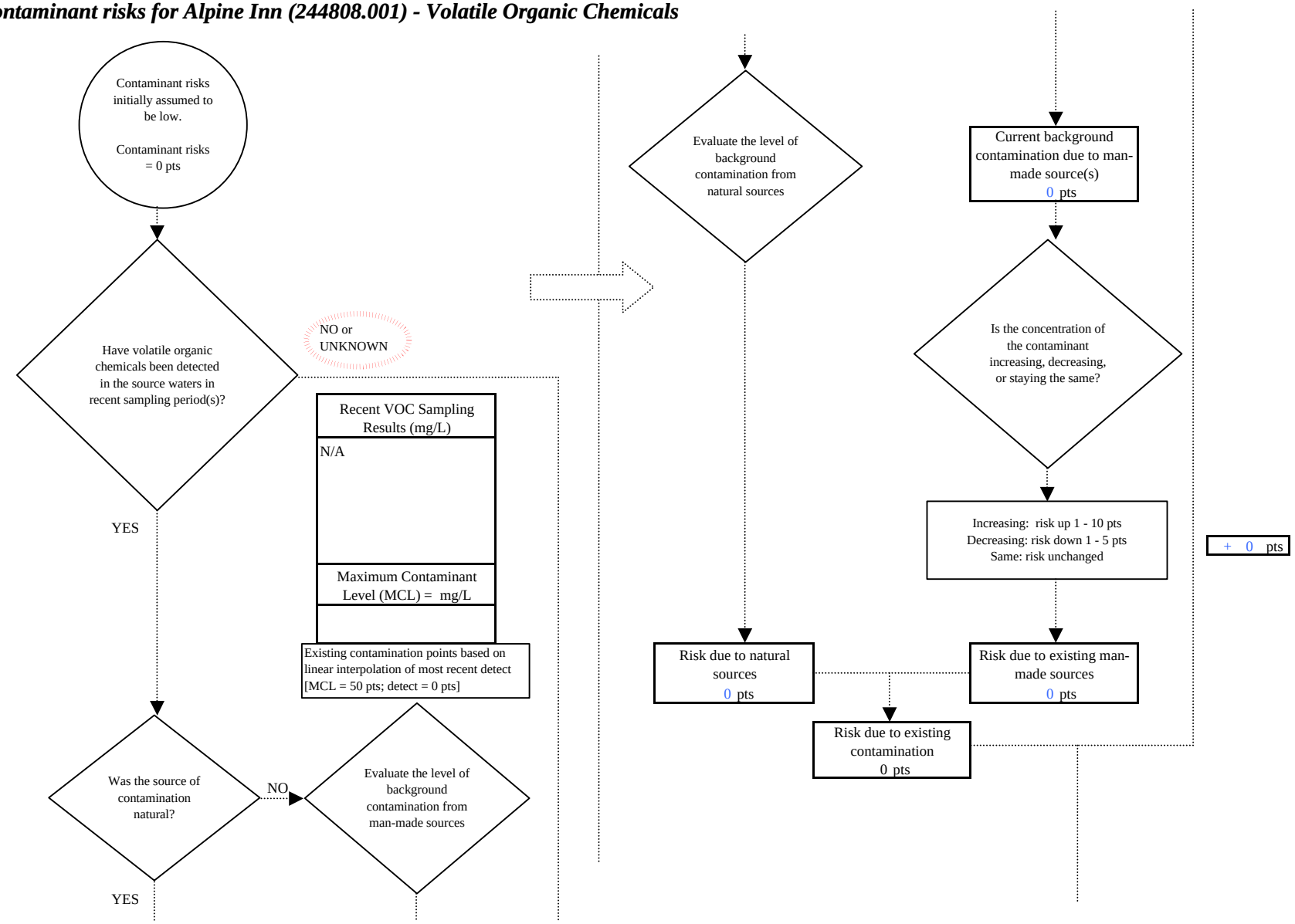


Chart 7. Contaminant risks for Alpine Inn (244808.001) - Volatile Organic Chemicals

+ 25 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	7	0	7
Low(s)	12	1	13

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	[3] 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 25

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

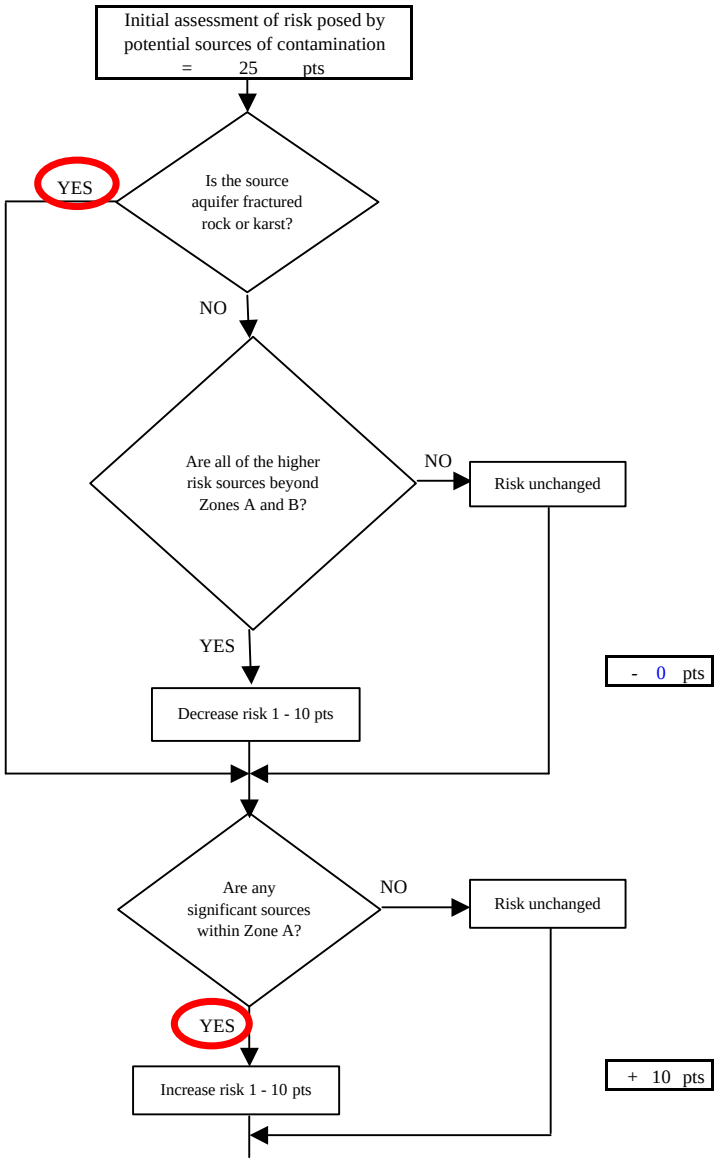
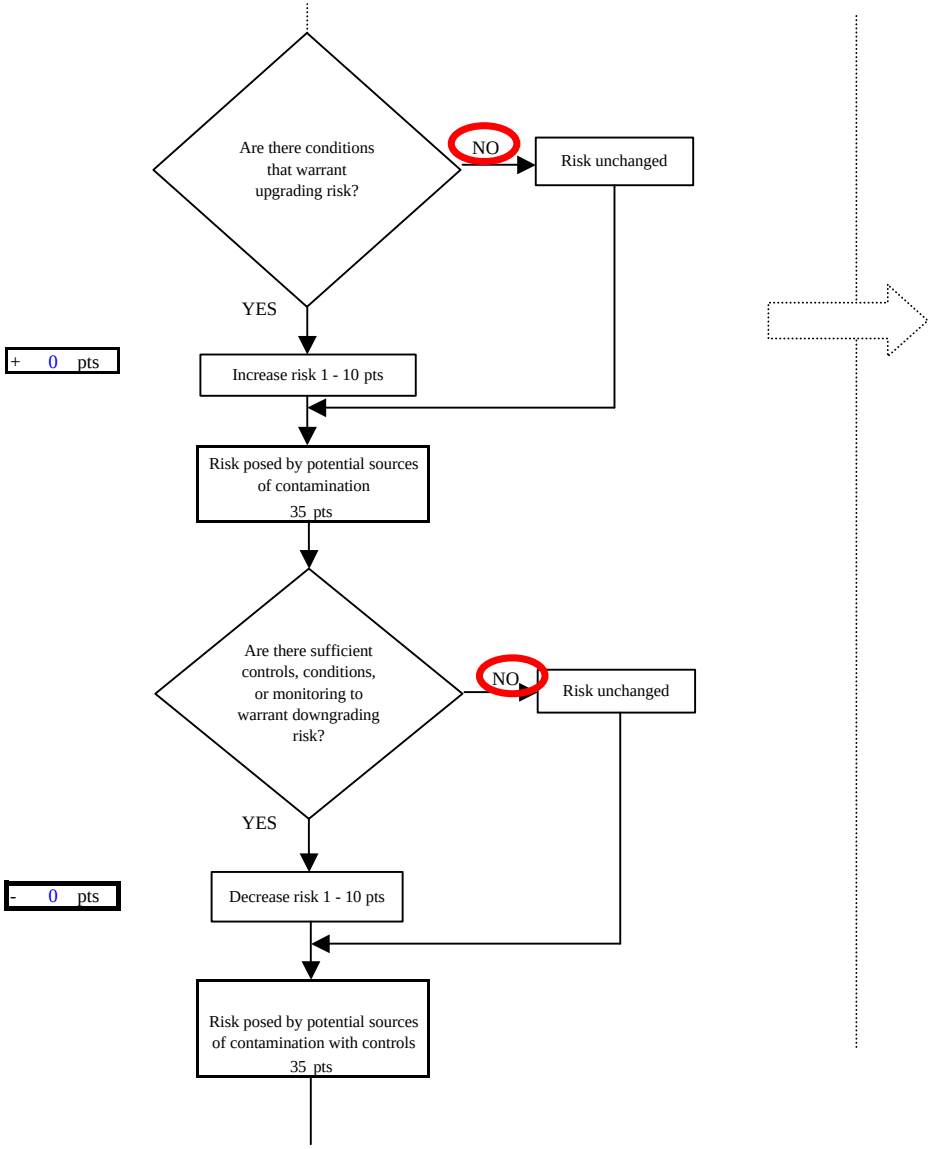


Chart 7. Contaminant risks for Alpine Inn (244808.001) - Volatile Organic Chemicals



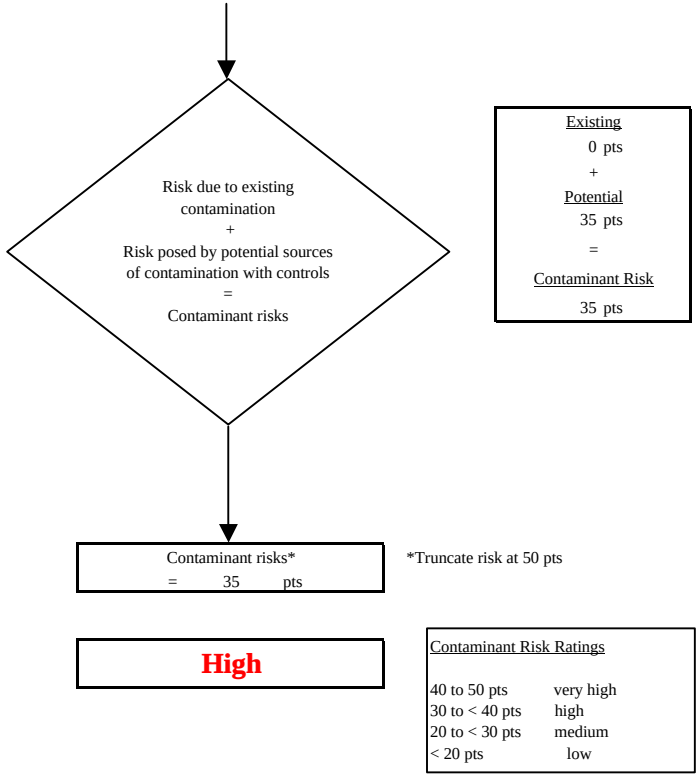


Chart 8. Vulnerability analysis for Alpine Inn (244808.001) - Volatile Organic Chemicals