# Source Water Assessment:

## Hydrogeologic Susceptibility and Vulnerability Assessment for Roadside Inn Drinking Water Well, Wasilla, Alaska

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DRINKING WATER PROTECTION PROGRAM REPORT *74*

October 2001

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By Shannon & Wilson, Inc.

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: OCTOBER 2001

**CONTENTS**



# TABLES



# ILLUSTRATIONS



# APPENDICES

# Hydrogeologic Susceptibility and Vulnerability Assessment for Roadside Inn Public Drinking Water Source, Wasilla, Alaska

By Shannon & Wilson, Inc.

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**Drinking Water Protection Program**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The Roadside Inn well is a Class B drinking water source consisting of one well. The well is located in the Meadow Creek watershed at approximately Mile 49.5 Parks Highway, Wasilla, Alaska. Identified potential and current sources of contaminants for Roadside Inn include: high-capacity septic systems, residential roads, residential aboveground heating oil tank, residential septic systems, highways and roads, a gasoline station, log milling activities, gasoline tanks, Alaska Department of Environmental Conservation (ADEC) recognized contaminated sites, a motor vehicle storage yard, a motor vehicle disposal well, a rail corridor, a motor/vehicle repair shop, and approximately 21 acres of residential area. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, Roadside Inn public water source received vulnerability ratings of **High** for bacteria and viruses and nitrates and/or nitrites and **Medium** volatile organic chemicals.

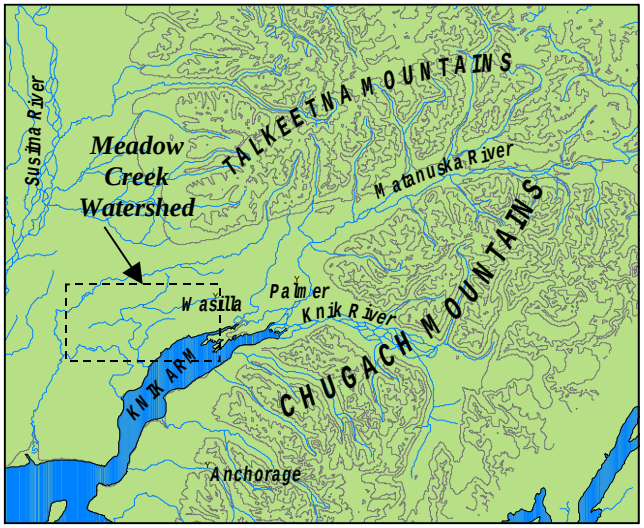


Figure 1. Index Map showing the location of the Matanuska-Susitna Valley and the Meadow Creek Watershed.

## INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners/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 the Roadside Inn source of public drinking water. This source consists of one well in the Meadow Creek Watershed (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 MEADOW CREEK - AREA, ALASKA

### Location

The Meadow Creek watershed, located in southcentral Alaska, lies within the Matanuska-Susitna Borough. The Borough encompasses 24,694 square miles and supports a population in 2000 of 59,322. The Borough is contained within the watersheds of the Matanuska and Susitna Rivers which flow from the glacier melt waters in the Alaska Range, Talkeetna Mountains, and the Chugach Mountains to tidewater in the Knik Arm of Upper Cook Inlet *(Jokela, Munter and Evans, 1991)* (Figure 1). The area between the Matanuska and Susitna Valley is commonly referred to as the Mat-Su Valley. The Meadow Creek watershed contains 115 lakes, including Big Lake, and extends from an area northwest of Wasilla to the west end of Big *Lake (Jokela, Munter and Evans, 1991*), as shown in Figure 1.

The Borough's close proximity to Anchorage and its abundance of surface-water resources has helped contribute to rapid growth over the last two decades. The population has tripled since 1980. As of 1998, approximately 9% of the state's population resided in the Matanuska-Susitna Borough. The projected growth rate is expected to be 3.3% per year, three times higher then the state rate. At this rate, the Borough will have approximately 13% of the states population by 2018 *(ADOL, 1999).*

**Climate**

The Meadow Creek-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.

The mean daily temperature ranges from 69.4 degrees Fahrenheit during the summer months to 13.8 degrees Fahrenheit during the winter months. The annual precipitation in the Meadow Creek-area is approximately 20 inches per year and total snow is around 59 inches per year. The average snow depth during snowy months is 6.4 inches *(Western Regional Climate Center, 2000).* Precipitation generally increases inland toward the Talkeetna Mountains where annual precipitation may exceed 60 inches per year *(Brabets, 1997).*

**Physiography and Groundwater Conditions**

Surface elevations in the Matanuska-Susitna Borough range from sea level where the Knik River and Matanuska River enter the Cook Inlet to well over 6000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Mat-Su Valley.

The regional geology and ground water conditions of the Mat-Su Valley vary greatly depending on location. The terrain is dominated by distinctive landforms created by repeated glacial advances and retreats during the Pleistocene epoch (2 million to 10,000 years before present). The unconsolidated layers, layers of sediment that are not cemented together, are comprised of various mixtures of fine- to coarse-grained particles (clay to boulders). The majority of wells in the Mat-Su Valley are located in unconsolidated layers consisting of relatively well sorted sands and gravels. These unconsolidated layers vary substantially in size and distribution throughout the Valley. In general, the unconsolidated layers increase in thickness as you move towards Cook Inlet. *(Jokela, Munter, Evans, 1991).* Throughout the area, numerous confining layers ranging from less than 1- to 60-feet thick, separate the unconsolidated layers.

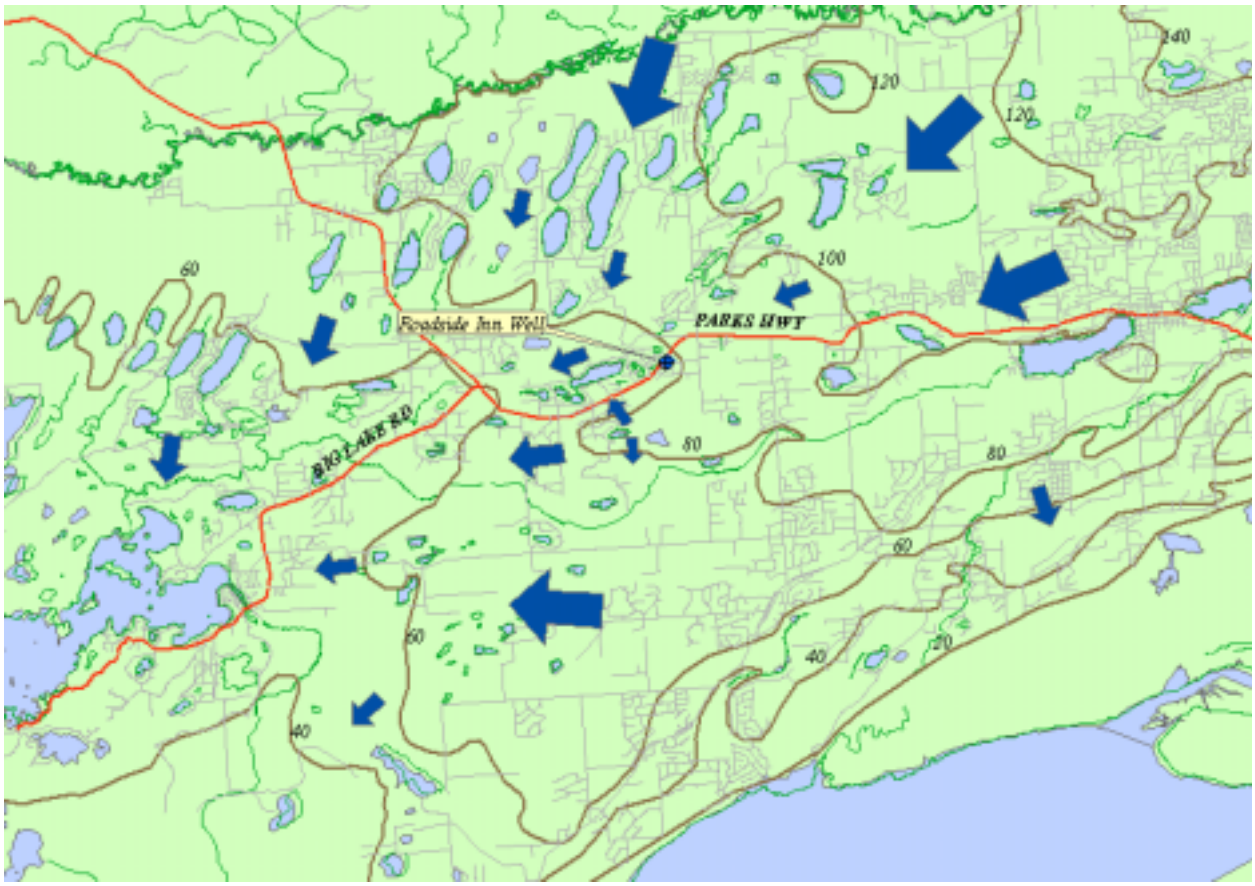


**Figure 2. Map showing regional ground-water flow in Matanuska-Susitna Valley. *(Jokela, Munter and Evans, 1991)***

In the Mat-Su Valley, the groundwater is primarily recharged by snowmelt and precipitation infiltrating into the foothill slopes of the Talkeetna or Chugach Mountains and by direct precipitation and snowmelt throughout the study area.

Groundwater flow in the confined aquifer is generally, north to south in the central region of the valley, toward the Matanuska River in the eastern region and the slope is predominantly northeast to northwest in the western region. The direction of groundwater flow in the upper unconfined aquifer's are more variable due to the influence from surficial topography as well as its close connection with surface water bodies. *(Jokela, Munter and Evans, 1991)* (Figure 2).

## ROADSIDE INN PUBLIC WATER SOURCE

Roadside Inn public water source is located in the Meadow Creek watershed. The system is a Class B public drinking water source and is owned and operated by Robert Fisher. The Roadside Inn is located on Lot 1 Block 1 of Savannah Subdivision, Wasilla, Alaska, approximately Mile 49.5 Parks Highway. The source consists of one well near the northern edge of the property. It is located at an elevation of approximately 170 feet above sea level. The well is located near the corner of Marigold Drive and the Parks Highway, and it is inferred to tap the underlying, unconfined aquifer. According to the well log, the Roadside Inn well does not appear to be grouted and penetrates silty clay, silty gravel, and coarse gravel to a total depth of 46 feet below land surface. The well is cased to a depth of 46 feet below land surface in sand and gravel. Based on Drillers Log the static water level is about 26 feet below land surface.

This water source operates year round. The Roadside Inn drinking water source is assumed to serve no residents and approximately 50 non-residents through one service connection.

## ASSESSMENT AND PROTECTION AREA FOR ROADSIDE INN DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Roadside Inn 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. This zone around the drinking water source is the most critical area for the preservation of the quality of the drinking water for this source. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the area of focus for voluntary protection efforts.

Groundwater recharge for the Roadside Inn water system enters the aquifer system through infiltration of direct precipitation within the area. 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 well logs from the surrounding area and from past studies *(Jokela, Munter and Evans, 1991).* This analytical calculation was used as a guide as the first step in establishing the protection area for Roadside Inn. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics in an attempt 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 Areas for Roadside Inn contain four zones, Zone A, Zone B, Zone C and 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.

The Zone B protection area for Roadside Inn corresponds to a time-of-travel of less than two years and extends northeastward. The Zone C protection area extends from the 2-year time of travel to the 5-year time of travel. Lastly, Zone D extends from Zone C to the end of the protection area, roughly 1.2 miles from the Roadside Inn well.

## 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 Roadside Inn's Drinking Water Protection Area. This survey was completed through a search of agency records and other publicly available information, as well as a reconnaissance of the area surrounding the well.

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;
- Volatile organic chemicals;

Map 2 and Map 3 in Appendix C depict the Contaminant Source Inventory for Roadside Inn. Inventoried potential sources of contamination within Zones A through Zone D are associated with residential and commercial type activities (See Table 1 in Appendix B). Only high and very high potential and existing sources of contamination were inventoried within Zone D. Two large capacity septic systems, a boat/auto motor repair shop, and a motor vehicle repair shop were identified in Zone D. Below is a summary of the contaminant sources inventoried within the Roadside Inn protection area:

- High-capacity septic systems;
- Highway and residential roads;
- A residential aboveground heating oil tank;
- Residential septic systems;
- ADEC Contaminated Sites;
- A gasoline station;
- Log Milling activities;
- A motor vehicle disposal
- Gasoline tanks;
- A motor vehicle storage yard;
- A rail corridor;
- A boat/auto motor repair shop;
- 21 acres of residential area.

These potential contaminant sources present risk for all three categories of drinking water contaminants for Roadside Inn 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 ROADSIDE INN DRINKING WATER SOURCES**

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)

Roadside Inn's well is completed in an unconfined aquifer setting. Therefore, contaminants that enter the subsurface within the vicinity of the well and Drinking Water Protection Area may enter the aquifer uninhibited by the absence of any protective layer. It is unclear whether the well is grouted. For purposes of this study, it is assumed that the well is not grouted. The absence of grouting can allow the transport of contaminants from the surface along the 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 (See Appendix D). Table 1 shows the overall Susceptibility score and rating for Roadside Inn.

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

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 5 | Low |
| Susceptibility of the Aquifer | 16 | High |
| Natural Susceptibility | 21 | Medium |

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. Large-capacity septic systems, approximately 21 acres of residential area, residential septic systems, residential aboveground tank, paved and unpaved roads, gasoline station, underground storage

tanks, ADEC Contaminated Sites, motor repair shops, log milling activities, vehicle waste disposal system, vehicle storage area, rail corridor, and a highway and residential roads contribute the highest risk for potential contamination to the Roadside Inn 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 summarizes the Contaminant Risks for each category of drinking water contaminants.

**Table 2. Contaminant Risks**

| Contaminant Risks | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 39 | High |
| Nitrates and/or Nitrites | 40 | Very High |
| Volatile Organic Chemicals | 38 | 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 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 unless the resulting score would denote a higher risk.

**Table 3. Overall Vulnerability of Roadside Inn Public Drinking Water Source to Contamination by Category**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 60 | High |
| Nitrates and Nitrites | 60 | High |
| Volatile Organic Chemicals | 59 | 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.

Overall, the contaminant risks for bacteria and viruses and nitrate/nitrites category are high and very high, respectively, with large capacity septic systems driving the scores. Combining the potential contamination risk for each category with the susceptibility of the well, yields an overall vulnerability to these contaminants as high for this source of public drinking water.

Nitrates and/or nitrites are found in natural background concentrations at the site, as elsewhere in Alaska. The sampling history of the Roadside Inn source water indicates low concentrations of nitrate reported in September 1997 November 1999. (See Chart 6-Contaminant Risks for Nitrates/Nitrites in Appendix D). The reported nitrate contamination was less than 10% of the allowable limit (MCL) for this contaminant. Due to high solubility and weak retention by soil, nitrates are very mobile in soil, moving approximately the same rate as water. Nevertheless, the current nitrate concentration in the Roadside Inn water source remains at safe levels, with respect to human health. A "Positive" result for coliform bacteria was reported in July 2000. Subsequent samples from several fixtures connected to the water system on July 17, 2000 did not indicate the presence of coliform bacteria.

There is a gasoline station (Tesoro) within 3,000 feet of the well. The site has two ADEC leaking underground storage tank (LUST) case numbers assigned to it, Recky numbers 96220026801 and 96220009201. These cases have been assigned to the site due to contamination resulting from former underground storage tanks that were located at the site. The site is currently being remediated by an active, in situ remediation system and a groundwater monitoring program has been implemented. The gasoline station currently utilizes underground storage tanks for the storage of fuel. These tanks remain a potential source for VOC contamination. In addition, the B&J Center

contaminated site has an ADEC file #1993220110601 associated with it. This is apparently due to a release of used oil at the site. The site status is unknown but it is noted in ADEC's Contaminated Sites Database as a low priority site, suggesting that the impact to groundwater and the potential for migration of contaminants are low. The public water system is not required to sample for volatile organic chemicals (VOCs), thus it is unknown if any VOCs from these or other sources are reaching the source.

**SUMMARY**

A *Source Water Assessment* has been completed for the Roadside Inn source of public drinking water. The overall vulnerability of this source to contamination is **High** for bacteria and viruses and nitrates and/or nitrites and **Medium** volatile organic chemicals. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the Alaska Department of Environmental Conservation 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

# Roadside Inn
# Drinking Water Protection Area

# APPENDIX B

# Contaminant Source Inventory and Risk Ranking for Roadside Inn

# APPENDIX C

# Roadside Inn
# Drinking Water Protection Area
# and Potential & Existing Contaminant Sources

# APPENDIX D

# Vulnerability Analysis for Roadside Inn Public Drinking Water Source

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Residential Areas | R1 | R1-1 | A | East of Roadside Inn | 2 | 2 Acres |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Pittman Road | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | A | Marigold Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | A | 001 Alley | 2 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-1 | B | North of Marigold Lane | 3 | |
| Residential Areas | R1 | R1-2 | B | South of Marigold Dr | 2 | <1 Acre |
| Gasoline stations (without repair shop) | C15 | C15 | C | Tesoro-Parks | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-2 | C | South of B&J Rainbow Center | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-3 | C | Southeast of Tesoro-Parks | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-4 | C | South of Parks Hwy | 3 | |
| Logging (active or inactive?) | E2 | E2 | C | South of Parks Hwy | 3 | |
| Residential Areas | R1 | R1-3 | C | East of Pittman Road | 2 | 18 Acres |
| Septic systems (serves one single-family home) | R2 | R2-1 | C | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-2 | C | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-3 | C | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-4 | C | North of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-5 | C | South of Parks Hwy | 3 | |

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R2 | R2-6 | C | South of parks Hwy | 3 | |
| Tanks, heating oil, residential (above ground) | R8 | R8-1 | C | South of Tesoro-Parks | 3 | |
| Tanks, gasoline (underground) | T12 | T12-1 | C | Tesoro-Parks | 3 | 26,000 gallon poly. (double walled) |
| Tanks, gasoline (underground) | T12 | T12-2 | C | Tesoro-Parks | 3 | 10,000 gallon (installed 9/1/01) |
| Tanks, gasoline (underground) | T12 | T12-3 | C | Tesoro-Parks | 3 | 10,000 gallon (installed 9/1/01) |
| Tanks, gasoline (underground) | T12 | T12-4 | C | Tesoro-Parks | 3 | 15,000 gallon (installed 9/1/01) |
| Tanks, gasoline (underground) | T12 | T12-5 | C | Tesoro-Parks | 3 | 20,000 gallon (installed 9/1/01) |
| Contaminated sites, DEC recognized, non-Superfund, non-RCRA | U4 | U4-1 | C | In B&J Rainbow Center | 3 | |
| Contaminated sites, DEC recognized, non-Superfund, non-RCRA | U4 | U4-2 | C | Tesoro-Parks | 3 | Two Leaking Underground Storage Tank (diesel) cases, |
| Abandoned wells | W1 | W1-1 | C | West of Tesoro-Parks Bldg. | 3 | |
| Highways and roads, paved (cement or asphalt) | X20 | X20-2 | C | Parks Highway | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-3 | C | Blondell Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-4 | C | Anna Marie Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-5 | C | Trevett Ave. | 2 | |
| Motor vehicle/general storage yards/facilities | X27 | X27-1 | C | Behind B&J Rainbow Center | 3 | |
| Rail corridors | X30 | X30-1 | C | Southeast of Parks Hwy | 3 | |
| Motor /motor vehicle repair shops | C31 | C31-1 | D | North of Parks Hwy | 3 | |

| *Contaminant Source Category* | *Contaminant Source ID* | *CS ID Tag* | *Zone* | *Location* | *Map* | *Comments* |
|---|---|---|---|---|---|---|
| *Motor /motor vehicle repair shops* | *C31* | *C31-2* | *D* | *North of Parks Hwy* | *3* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-5* | *D* | *North of Parks Hwy* | *3* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-6* | *D* | *North of RR Tracks* | *3* | |

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank After Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Residential Areas | R1 | R1-1 | A | Low | | East of Roadside Inn | 2 | 2 Acres |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Very Low | | Pittman Road | 2 | |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Very Low | | Pittman Road | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | A | Very Low | | Marigold Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | A | Very Low | | 001 Alley | 2 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-1 | B | High | 1 | North of Marigold Lane | 3 | |
| Residential Areas | R1 | R1-2 | B | Low | | South of Marigold Dr | 2 | <1 Acre |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-2 | C | High | 2 | South of B&J Rainbow Center | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-3 | C | High | 3 | Southeast of Tesoro-Parks | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-4 | C | High | 4 | South of Parks Hwy | 3 | |
| Residential Areas | R1 | R1-3 | C | Low | | East of Pittman Road | 2 | 18 Acres |
| Abandoned wells | W1 | W1-1 | C | Medium | | West of Tesoro-Parks Bldg. | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-1 | C | Very Low | | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-2 | C | Very Low | | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-3 | C | Very Low | | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-4 | C | Very Low | | North of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-5 | C | Very Low | | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-6 | C | Very Low | | South of parks Hwy | 3 | |

| *Contaminant Source Category* | *Contaminant Source ID* | *CS ID Tag* | *Zone* | *Risk Ranking for Analysis* | *Overall Rank After Analysis* | *Location* | *Map* | *Comments* |
|---|---|---|---|---|---|---|---|---|
| *Tanks, heating oil, residential (above ground)* | *R8* | *R8-1* | *C* | *Very Low* | | *South of Tesoro-Parks* | *3* | |
| *Highways and roads, paved (cement or asphalt)* | *X20* | *X20-2* | *C* | *Very Low* | | *Parks Highway* | *2* | |
| *Highways and roads, dirt/gravel* | *X24* | *X24-3* | *C* | *Very Low* | | *Blondell Drive* | *2* | |
| *Highways and roads, dirt/gravel* | *X24* | *X24-4* | *C* | *Very Low* | | *Anna Marie Drive* | *2* | |
| *Highways and roads, dirt/gravel* | *X24* | *X24-5* | *C* | *Very Low* | | *Trevett Ave.* | *2* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-5* | *D* | *High* | *5* | *North of Parks Hwy* | *3* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-6* | *D* | *High* | | *North of RR Tracks* | *3* | |
| *Motor /motor vehicle repair shops* | *C31* | *C31-2* | *D* | *Medium* | | *North of Parks Hwy* | *3* | |

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank After Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Residential Areas | R1 | R1-1 | A | Low | | East of Roadside Inn | 2 | 2 Acres |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Very Low | | Pittman Road | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | A | Very Low | | Marigold Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | A | Very Low | | 001 Alley | 2 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-1 | B | High | 1 | North of Marigold Lane | 3 | |
| Residential Areas | R1 | R1-2 | B | Low | | South of Marigold Dr | 2 | <1 Acre |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-2 | C | High | 2 | South of B&J Rainbow Center | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-3 | C | High | 3 | Southeast of Tesoro-Parks | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-4 | C | High | 4 | South of Parks Hwy | 3 | |
| Abandoned wells | W1 | W1-1 | C | High | 5 | West of Tesoro-Parks Bldg. | 3 | |
| Logging (active or inactive?) | E2 | E2 | C | Low | | South of Parks Hwy | 3 | |
| Residential Areas | R1 | R1-3 | C | Low | | East of Pittman Road | 2 | 18 Acres |
| Septic systems (serves one single-family home) | R2 | R2-1 | C | Very Low | | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-2 | C | Very Low | | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-3 | C | Very Low | | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-4 | C | Very Low | | North of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-5 | C | Very Low | | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-6 | C | Very Low | | South of parks Hwy | 3 | |

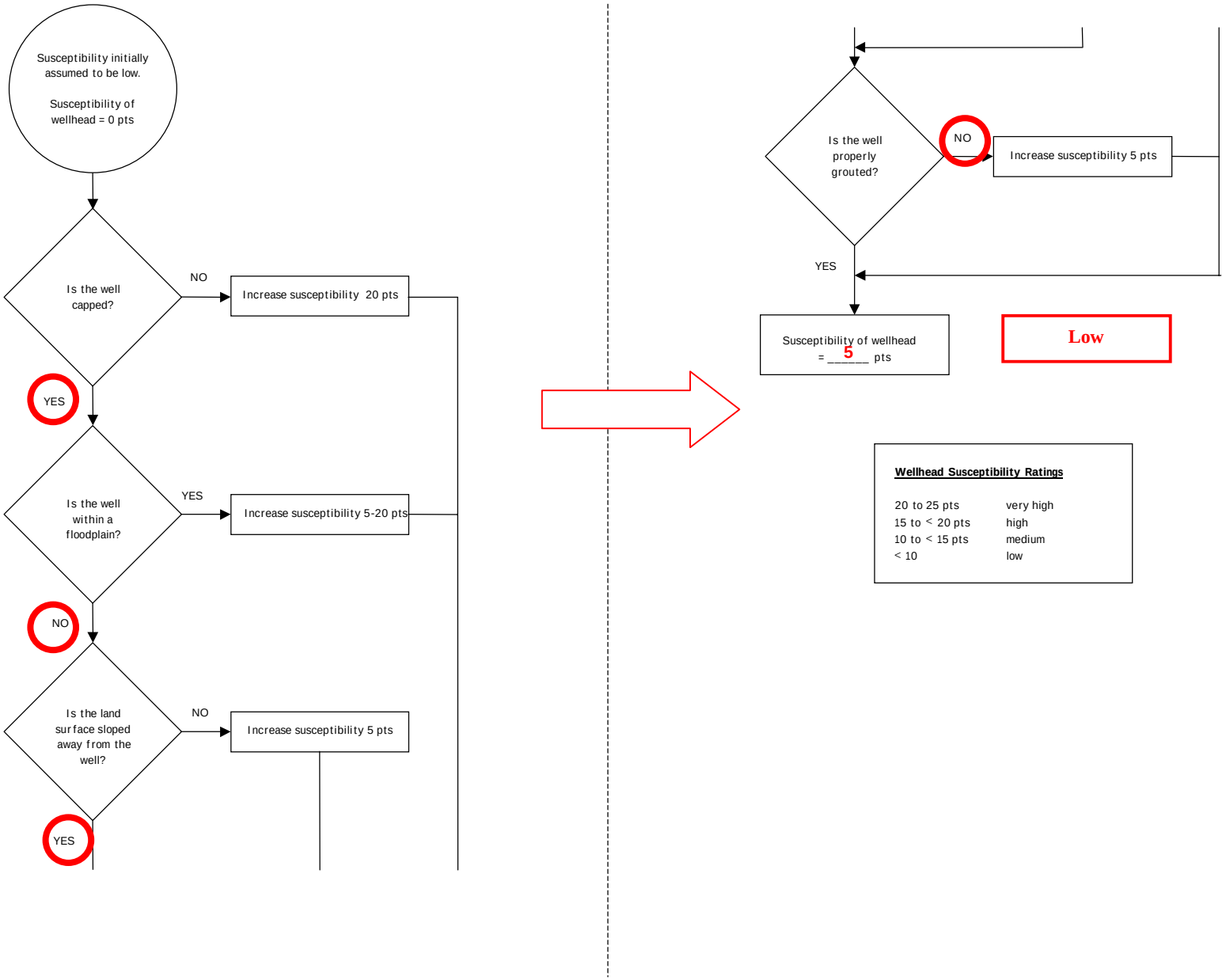
| *Contaminant Source Category* | *Contaminant Source ID* | *CS ID Tag* | *Zone* | *Risk Ranking for Analysis* | *Overall Rank After Analysis* | *Location* | *Map* | *Comments* |
|---|---|---|---|---|---|---|---|---|
| *Tanks, heating oil, residential (above ground)* | *R8* | *R8-1* | *C* | *Very Low* | | *South of Tesoro-Parks* | *3* | |
| *Highways and roads, paved (cement or asphalt)* | *X20* | *X20-2* | *C* | *Very Low* | | *Parks Highway* | *2* | |
| *Highways and roads, dirt/gravel* | *X24* | *X24-3* | *C* | *Very Low* | | *Blondell Drive* | *2* | |
| *Highways and roads, dirt/gravel* | *X24* | *X24-4* | *C* | *Very Low* | | *Anna Marie Drive* | *2* | |
| *Highways and roads, dirt/gravel* | *X24* | *X24-5* | *C* | *Very Low* | | *Trevett Ave.* | *2* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-5* | *D* | *High* | | *North of Parks Hwy* | *3* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-6* | *D* | *High* | | *North of RR Tracks* | *3* | |

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank After Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Residential Areas | R1 | R1-1 | A | Low | | East of Roadside Inn | 2 | 2 Acres |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Very Low | | Pittman Road | 2 | |
| Highways and roads, paved (cement or asphalt) | X20 | X20-1 | A | Very Low | | Pittman Road | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | A | Very Low | | Marigold Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | A | Very Low | | 001 Alley | 2 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-1 | B | Low | | North of Marigold Lane | 3 | |
| Residential Areas | R1 | R1-2 | B | Low | | South of Marigold Dr | 2 | <1 Acre |
| Gasoline stations (without repair shop) | C15 | C15 | C | High | 1 | Tesoro-Parks | 3 | |
| Logging (active or inactive?) | E2 | E2 | C | High | | South of Parks Hwy | 3 | |
| Tanks, gasoline (underground) | T12 | T12-1 | C | High | 2 | Tesoro-Parks | 3 | 26,000 gallon poly. (double walled) |
| Tanks, gasoline (underground) | T12 | T12-2 | C | High | 3 | Tesoro-Parks | 3 | 10,000 gallon (installed 9/1/01) |
| Tanks, gasoline (underground) | T12 | T12-3 | C | High | 4 | Tesoro-Parks | 3 | 10,000 gallon (installed 9/1/01) |
| Tanks, gasoline (underground) | T12 | T12-4 | C | High | 5 | Tesoro-Parks | 3 | 15,000 gallon (installed 9/1/01) |
| Tanks, gasoline (underground) | T12 | T12-5 | C | High | | Tesoro-Parks | 3 | 20,000 gallon (installed 9/1/01) |
| Abandoned wells | W1 | W1-1 | C | High | | West of Tesoro-Parks Bldg. | 3 | |
| Motor vehicle/general storage yards/facilities | X27 | X27-1 | C | High | | Behind B&J Rainbow Center | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-2 | C | Low | | South of B&J Rainbow Center | 3 | |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-3 | C | Low | | Southeast of Tesoro-Parks | 3 | |

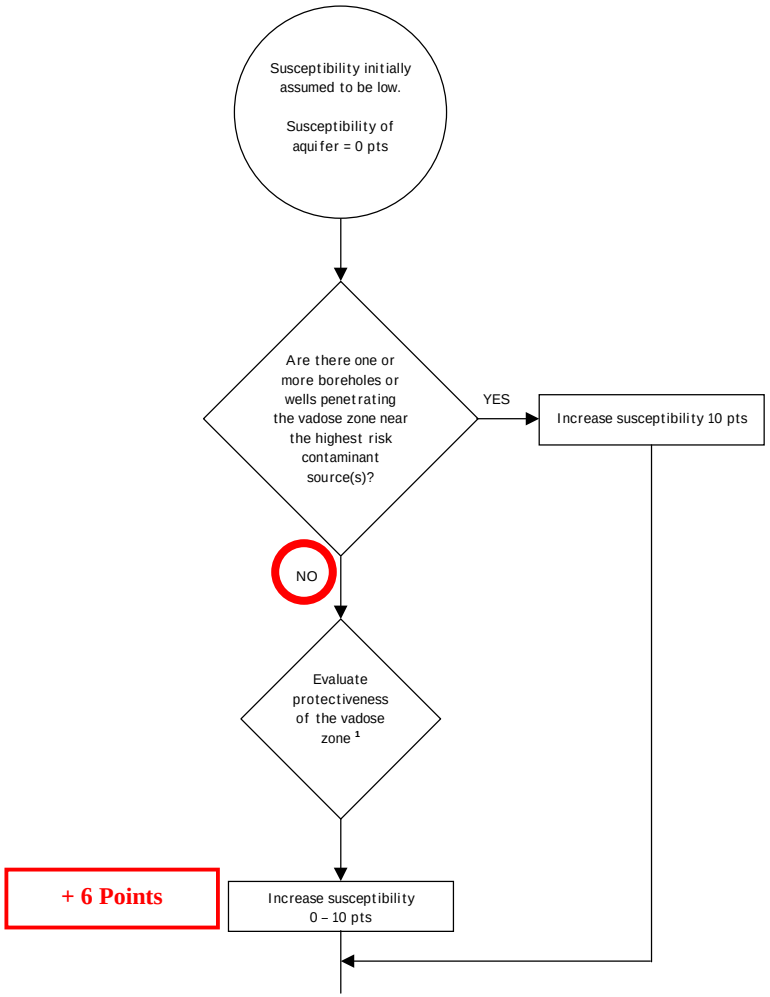
| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank After Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield | D10 | D10-4 | C | Low | | South of Parks Hwy | 3 | |
| Logging (active or inactive?) | E2 | E2 | C | Low | | South of Parks Hwy | 3 | |
| Residential Areas | R1 | R1-3 | C | Low | | East of Pittman Road | 2 | 18 Acres |
| Motor vehicle/general storage yards/facilities | X27 | X27-1 | C | Low | | Southwest of B+J Rainbow Center | 3 | |
| Motor vehicle/general storage yards/facilities | X27 | X27-1 | C | Low | | Behind B&J Rainbow Center | 3 | |
| Rail corridors | X30 | X30-1 | C | Low | | Southeast of Parks Hwy | 3 | |
| Tanks, heating oil, residential (above ground) | R8 | R8-1 | C | Medium | | South of Tesoro-Parks | 3 | |
| Abandoned wells | W1 | W1-1 | C | Medium | | West of Tesoro-Parks Bldg. | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-1 | C | Very Low | | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-2 | C | Very Low | | South of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-3 | C | Very Low | | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-4 | C | Very Low | | North of Blondell Rd | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-5 | C | Very Low | | South of Parks Hwy | 3 | |
| Septic systems (serves one single-family home) | R2 | R2-6 | C | Very Low | | South of parks Hwy | 3 | |
| Tanks, heating oil, residential (above ground) | R8 | R8-1 | C | Very Low | | South of Tesoro-Parks | 3 | |
| Highways and roads, paved (cement or asphalt) | X20 | X20-2 | C | Very Low | | Parks Highway | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-3 | C | Very Low | | Blondell Drive | 2 | |
| Highways and roads, dirt/gravel | X24 | X24-4 | C | Very Low | | Anna Marie Drive | 2 | |

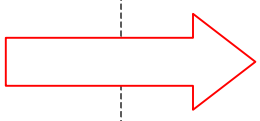
| *Contaminant Source Category* | *Contaminant Source ID* | *CS ID Tag* | *Zone* | *Risk Ranking for Analysis* | *Overall Rank After Analysis* | *Location* | *Map* | *Comments* |
|---|---|---|---|---|---|---|---|---|
| *Highways and roads, dirt/gravel* | *X24* | *X24-5* | *C* | *Very Low* | | *Trevett Ave.* | *2* | |
| *Motor /motor vehicle repair shops* | *C31* | *C31-2* | *D* | *High* | | *North of Parks Hwy* | *3* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-5* | *D* | *Low* | | *North of Parks Hwy* | *3* | |
| *Injection wells (Class V) Large-Capacity Septic System (Drainfield* | *D10* | *D10-6* | *D* | *Low* | | *North of RR Tracks* | *3* | |
| *Motor /motor vehicle repair shops* | *C31* | *C31-1* | *D* | *Medium* | | *North of Parks Hwy* | *3* | |
| *Motor /motor vehicle repair shops* | *C31* | *C31-2* | *D* | *Medium* | | *North of Parks Hwy* | *3* | |
| *Motor /motor vehicle repair shops* | *C31* | *C31-2* | *D* | *Medium* | | *North of Parks Hwy* | *3* | |

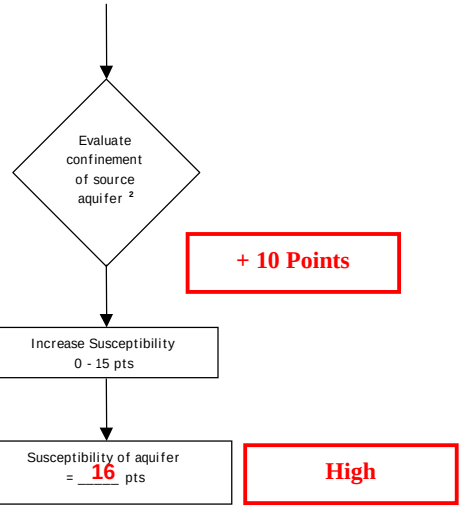
***Chart 1. Susceptibility of the Wellhead – Roadside Inn***



## *Chart 2. Susceptibility of the Aquifer – Roadside Inn*






**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]

Precipitation=20"/Yr.= 4 pts.
Soil = Silt/Loam = 4 pts.
Slope = 0-5% = 10 pts.
18 pts./3 = 6 pts.
6 pts. X 50% = **3 pts.**

Depth to water table = 26 feet
Interpolate linearly = 5 pts.
5 pts. X 50% = **2.5 pts.**

**Total = 6 of 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 = 10 - 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 = 10-15 pts; 35% weight]

Unconfined Aquifer

Well depth 140 feet = 10 pts.
Few wells/boreholes in proximity = 10 pts.

10(65%) + 10(35%) =**10 pts.**

**Total = 10 of 15 Points**

**Aquifer Susceptibility Ratings**

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

**High**

***Chart 3. Contaminant risks for Roadside Inn – Bacteria & Viruses***

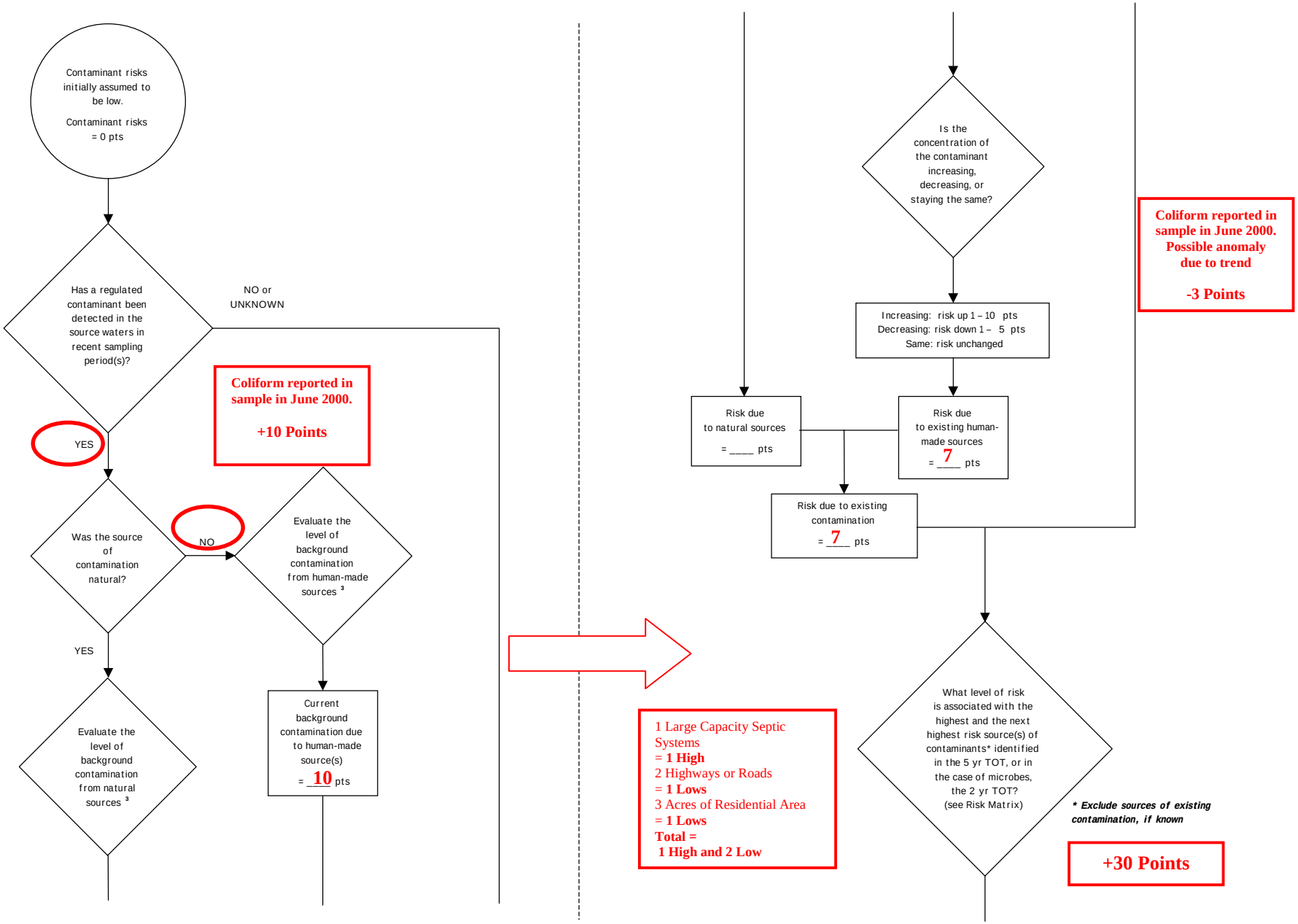


*Chart 3. Contaminant risks for Roadside Inn– Bacteria & Viruses (Continued)*

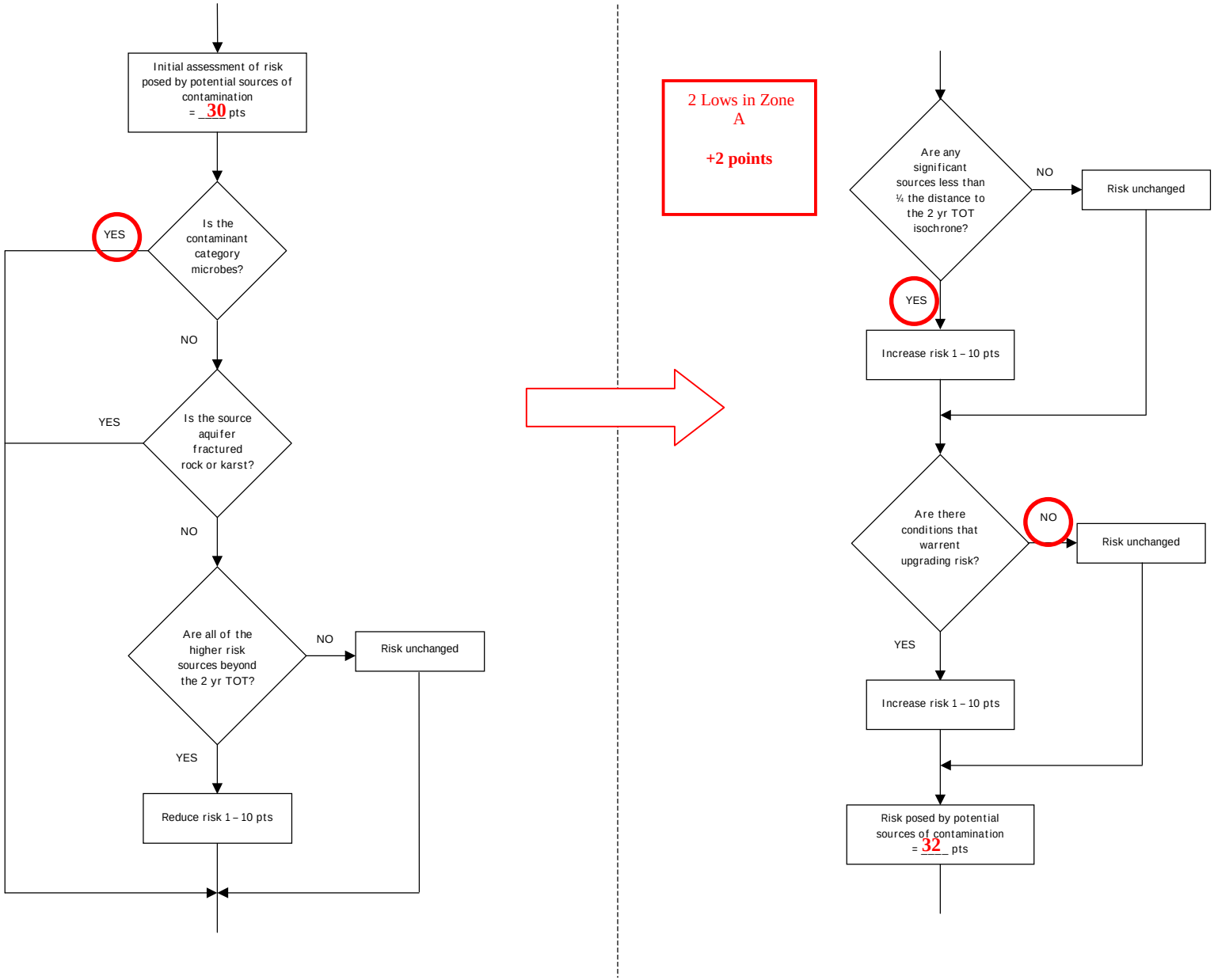
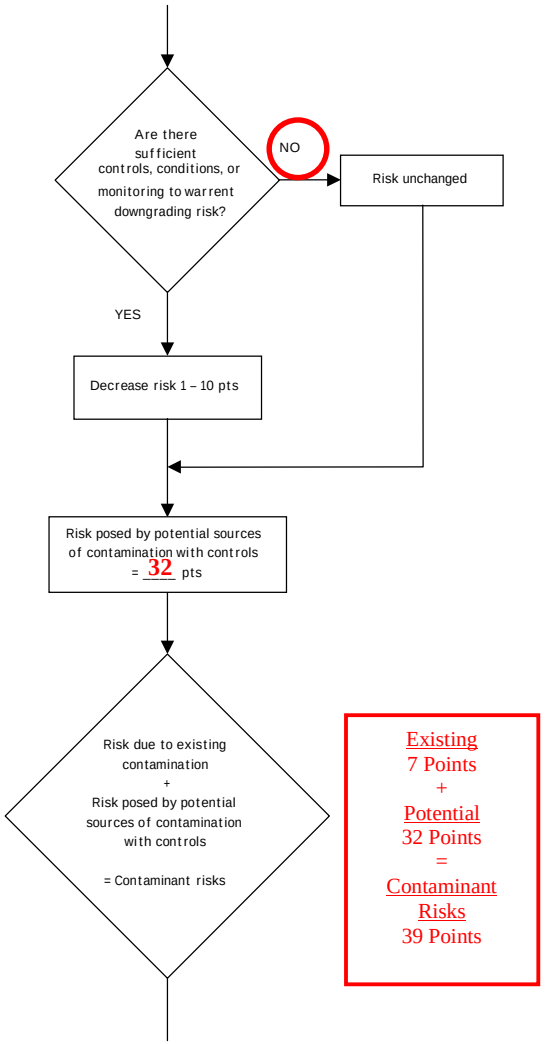


***Chart 3. Contaminant risks for Roadside Inn– Bacteria & Viruses (Continued)***




Existing
7 Points
+
Potential
32 Points
=
Contaminant Risks
39 Points

* Truncate risk at 50 pts

Contaminant risks*
= 39 pts

**High**

**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 |

| Sample Date | Result |
|---|---|
| 6/21/01 | Non Detect (ND) |
| 2/21/01 | ND |
| 10/24/00 | ND |
| 7/17/00 | ND |
| 7/13/00 | Positive |

**Table 1. Risk Matrix for Contaminant Sources for Roadside Inn– Bacteria & Viruses**

**Level of Risk Associated with the Highest Risk Sources**

| **Total = 1 High and 2 Low** | **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 Roadside Inn – Bacteria & Viruses*

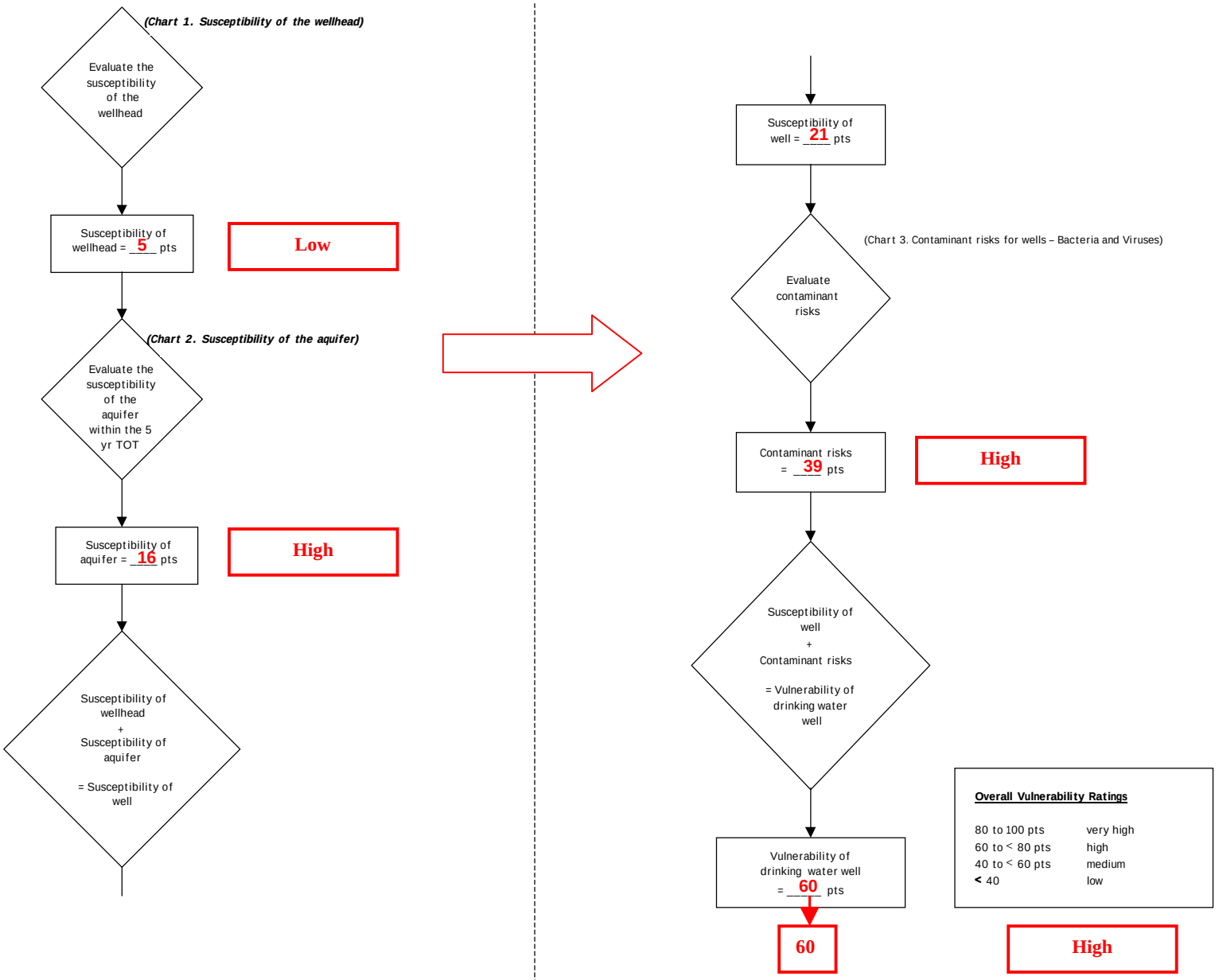


***Chart 5. Contaminant Risks for Roadside Inn – Nitrates and Nitrites***

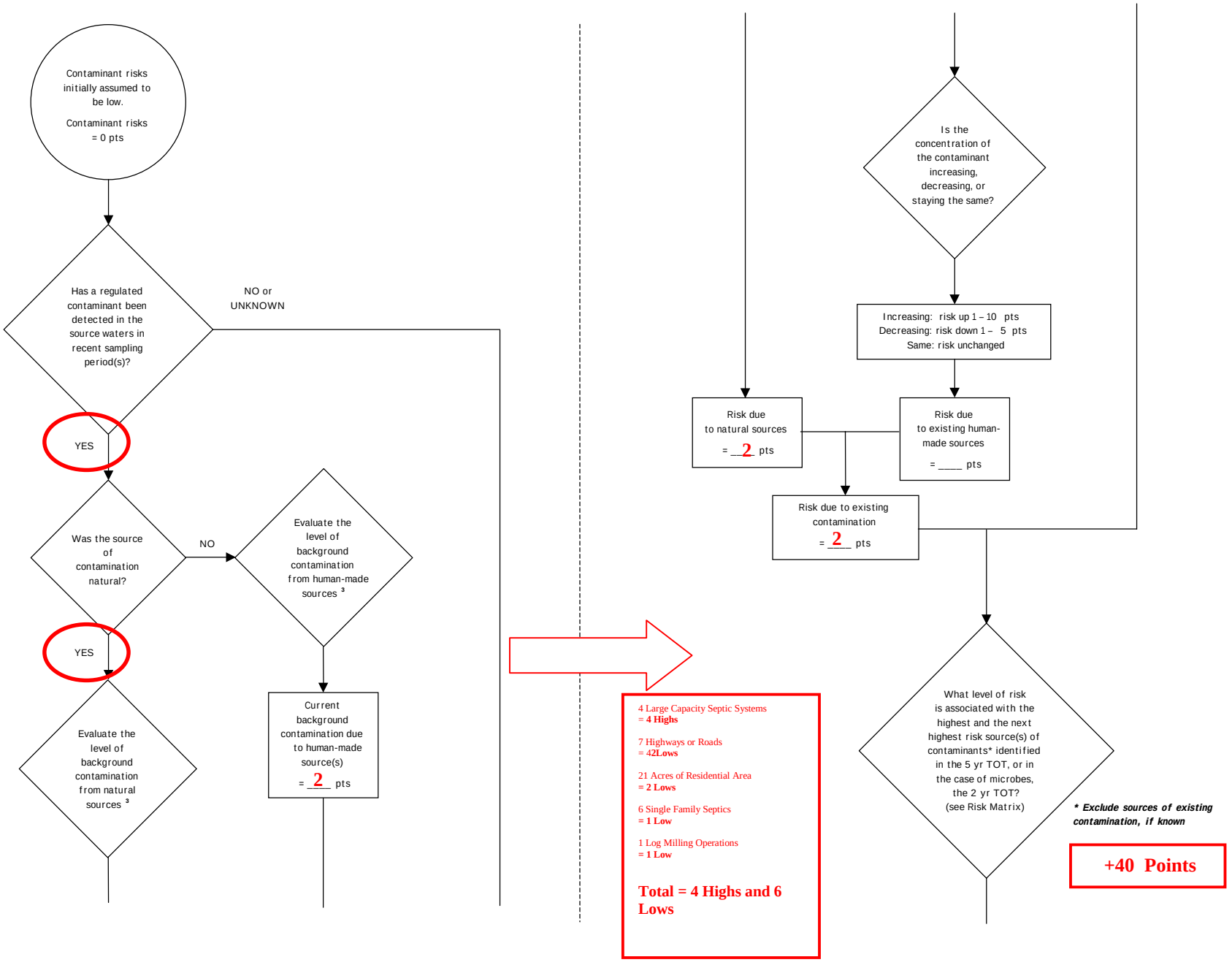


*Chart 5. Contaminant risks for Roadside Inn– Nitrates and Nitrites (Continued)*

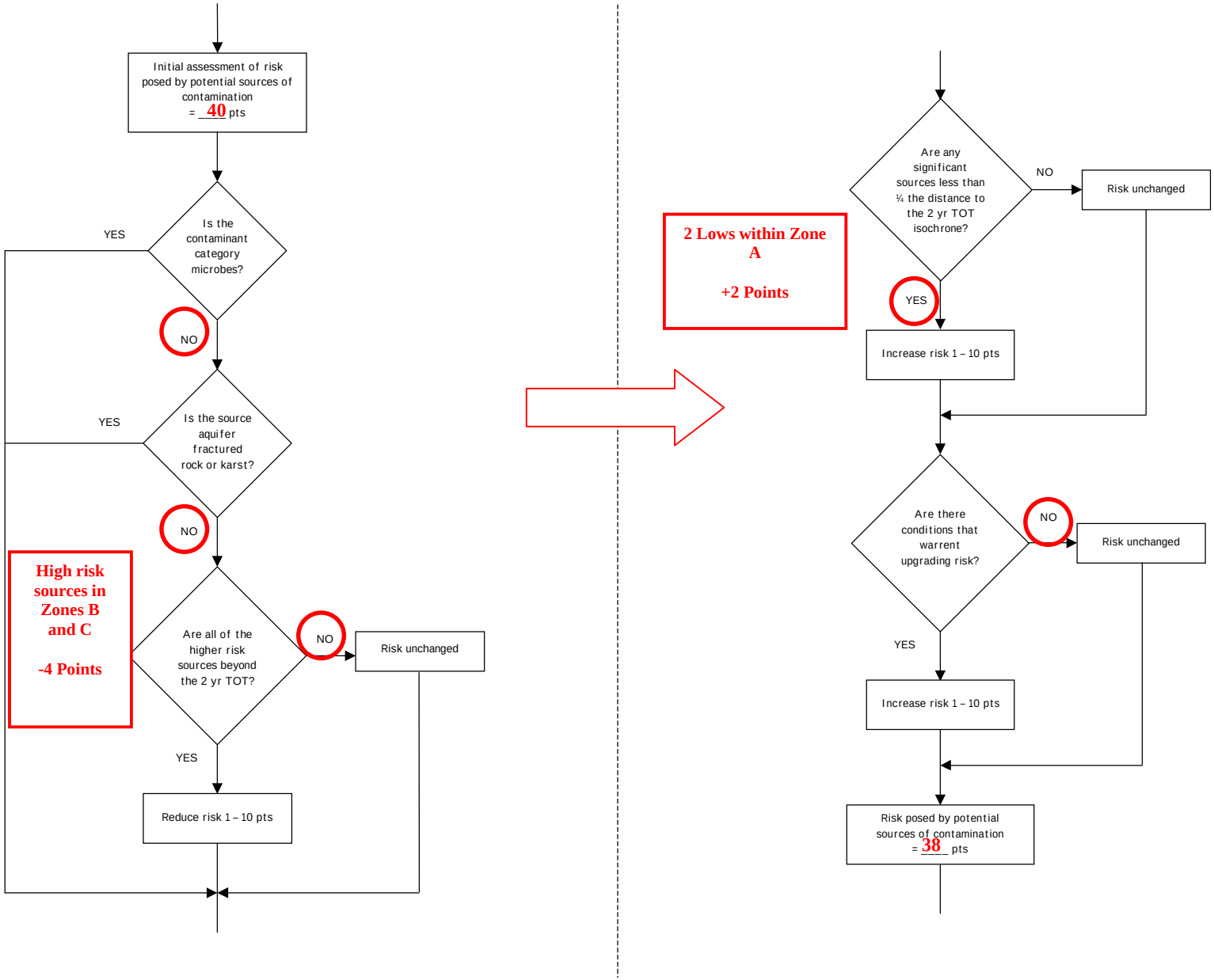
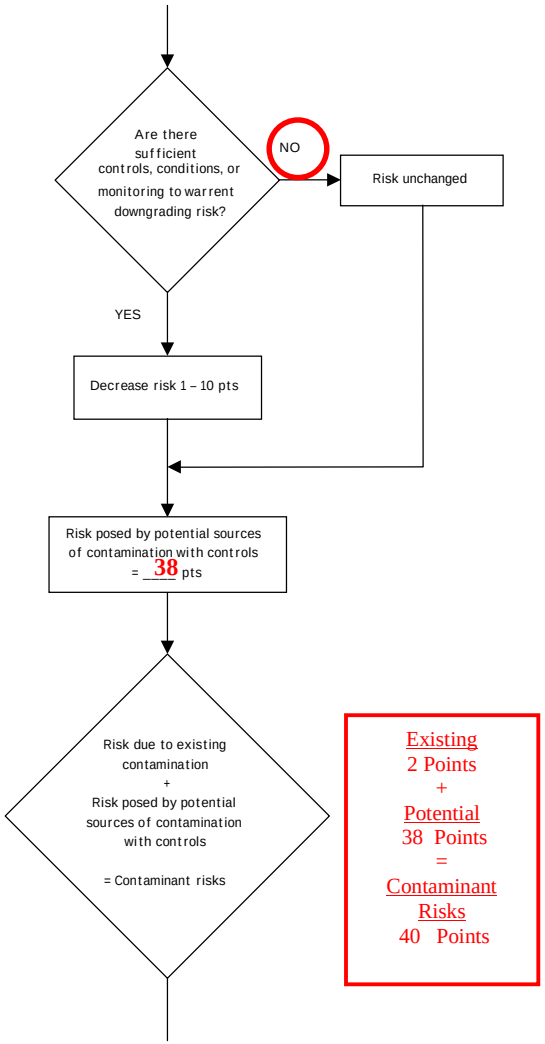


***Chart 5. Contaminant risks for Roadside Inn– Nitrates and Nitrites (Continued)***




Existing
2 Points
+
Potential
38 Points
=
Contaminant Risks
40 Points

* Truncate risk at 50 pts

Contaminant risks*
= 40 pts

**Very High**

**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 |

| Sample Date | Concentration |
|---|---|
| 6/7/00 | 0.648 mg/L |
| 11/2/99 | 0.663 mg/L |
| 3/3/99 | ND |
| 9/8/97 | 0.12 mg/L |
| 7/10/96 | ND |

Maximum Contaminant Level (MCL)= 10mg/L
(0.663 mg/L)/(10 mg/L) = 0.0663 of MCL

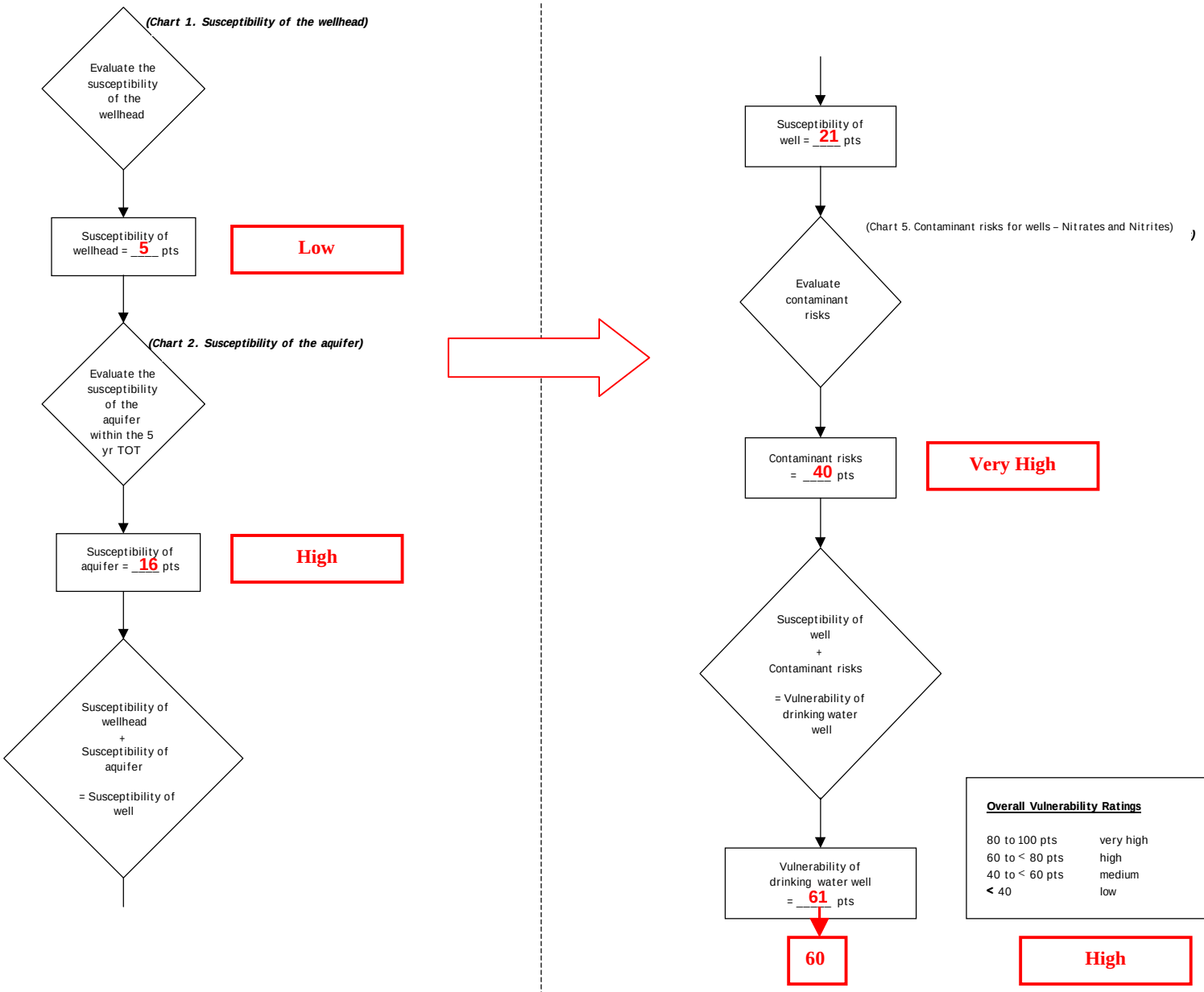
Interpolated Linearly = **2 Points**

*Table 2. Risk Matrix for Contaminant Sources for Roadside Inn– Nitrates and Nitrites*

**Level of Risk Associated with the Highest Risk Sources**

| **Total = 4 Highs and 6 Lows** | **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 Roadside Inn – Nitrates and Nitrites*



## *Chart 7. Contaminant Risks for Roadside Inn – Volatile Organic Chemicals*

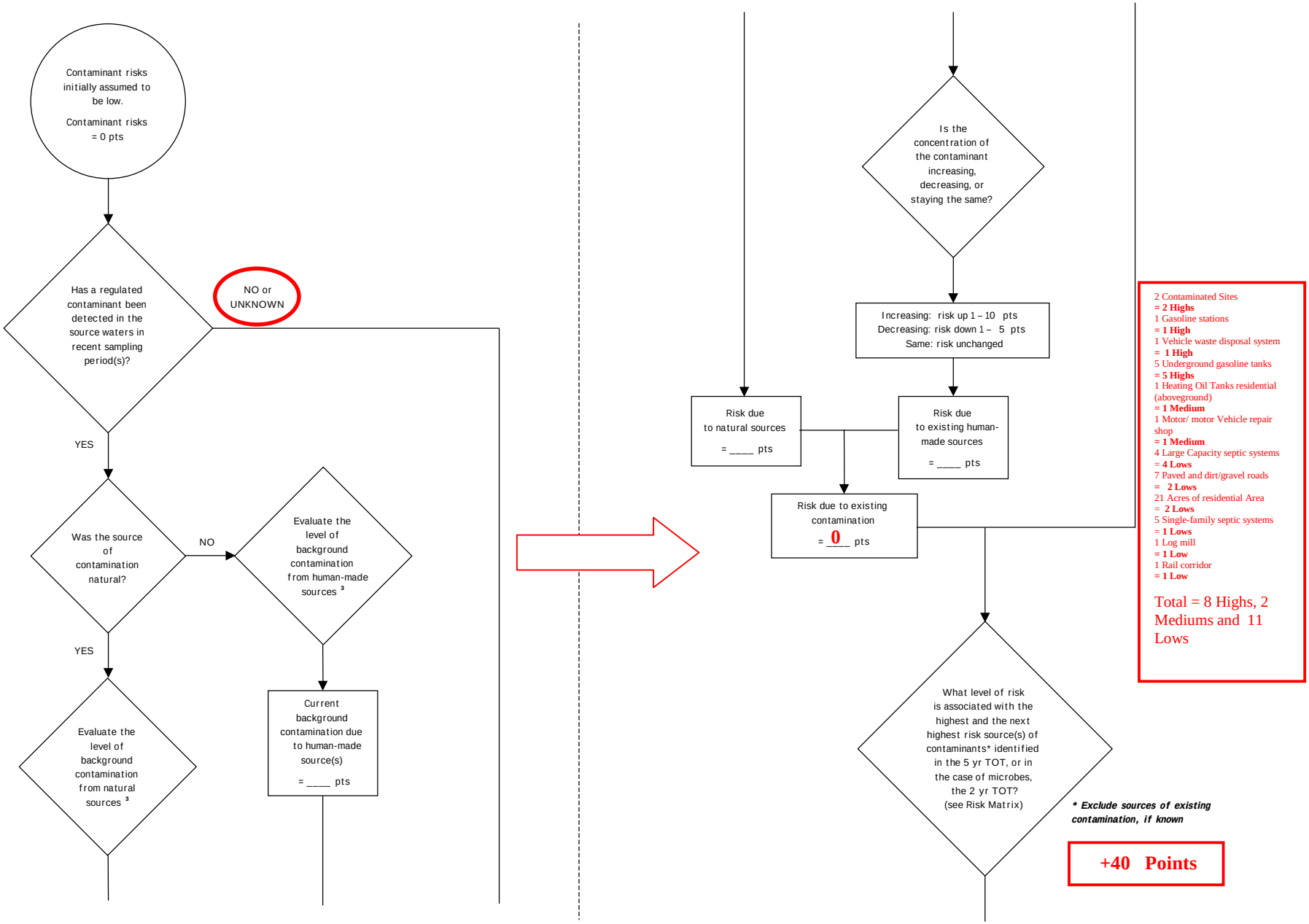


*Chart 7. Contaminant Risks for Roadside Inn – Volatile Organic Chemicals (Continued)*

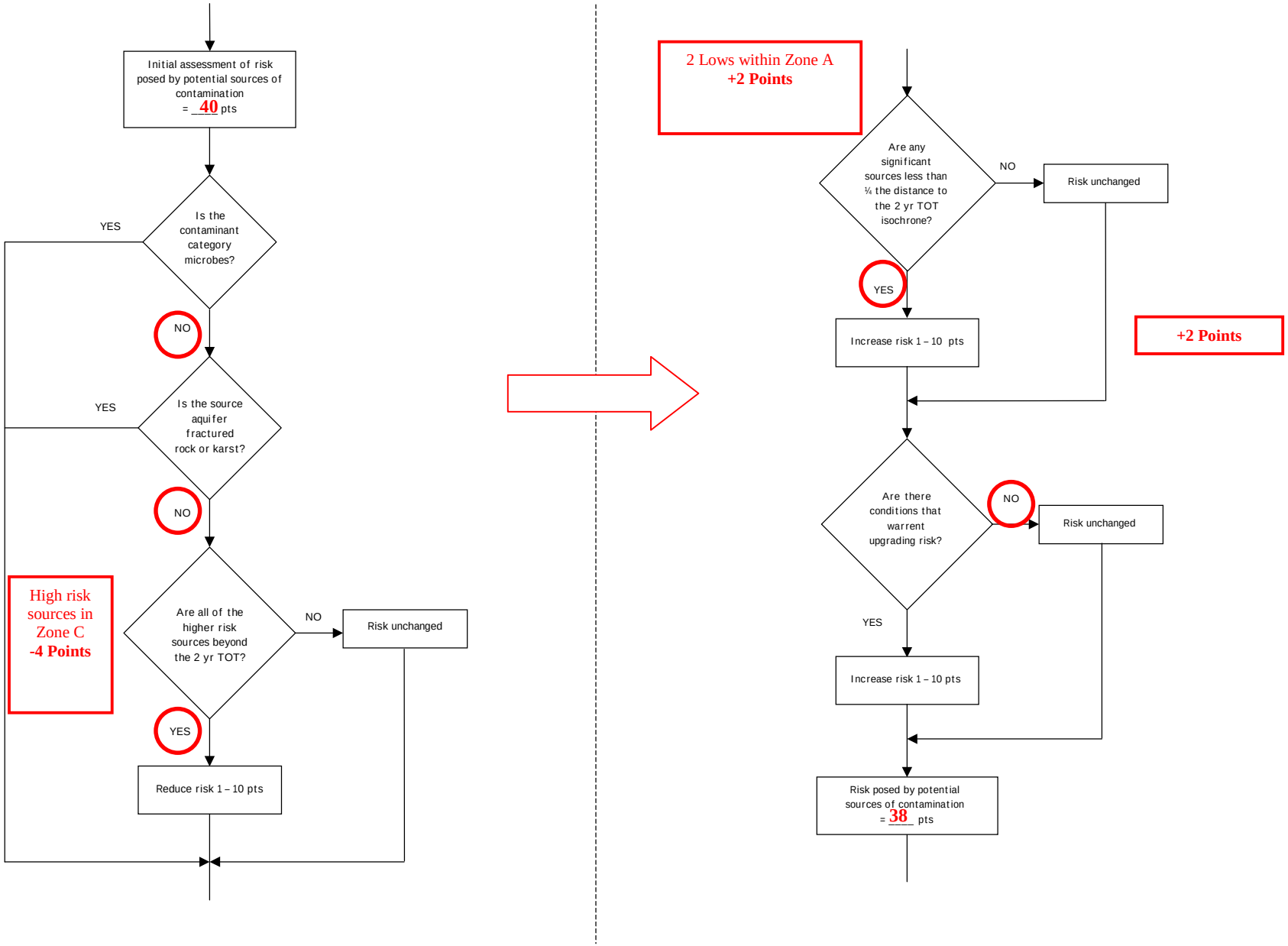
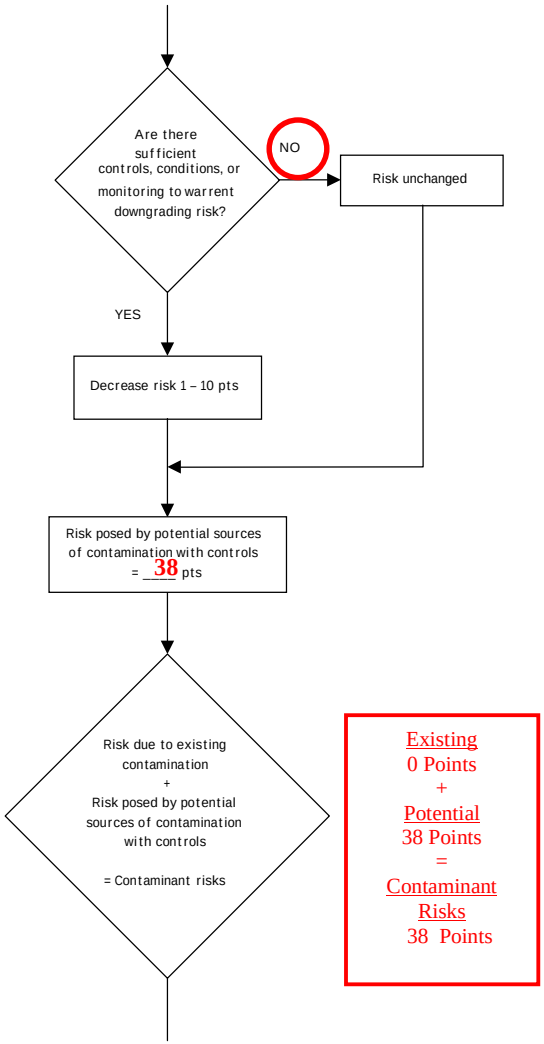


*Chart 7. Contaminant Risks for Roadside Inn – Volatile Organic Chemicals (Continued)*




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

* Truncate risk at 50 pts

Contaminant risks*
= 38 pts

**High**

**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**

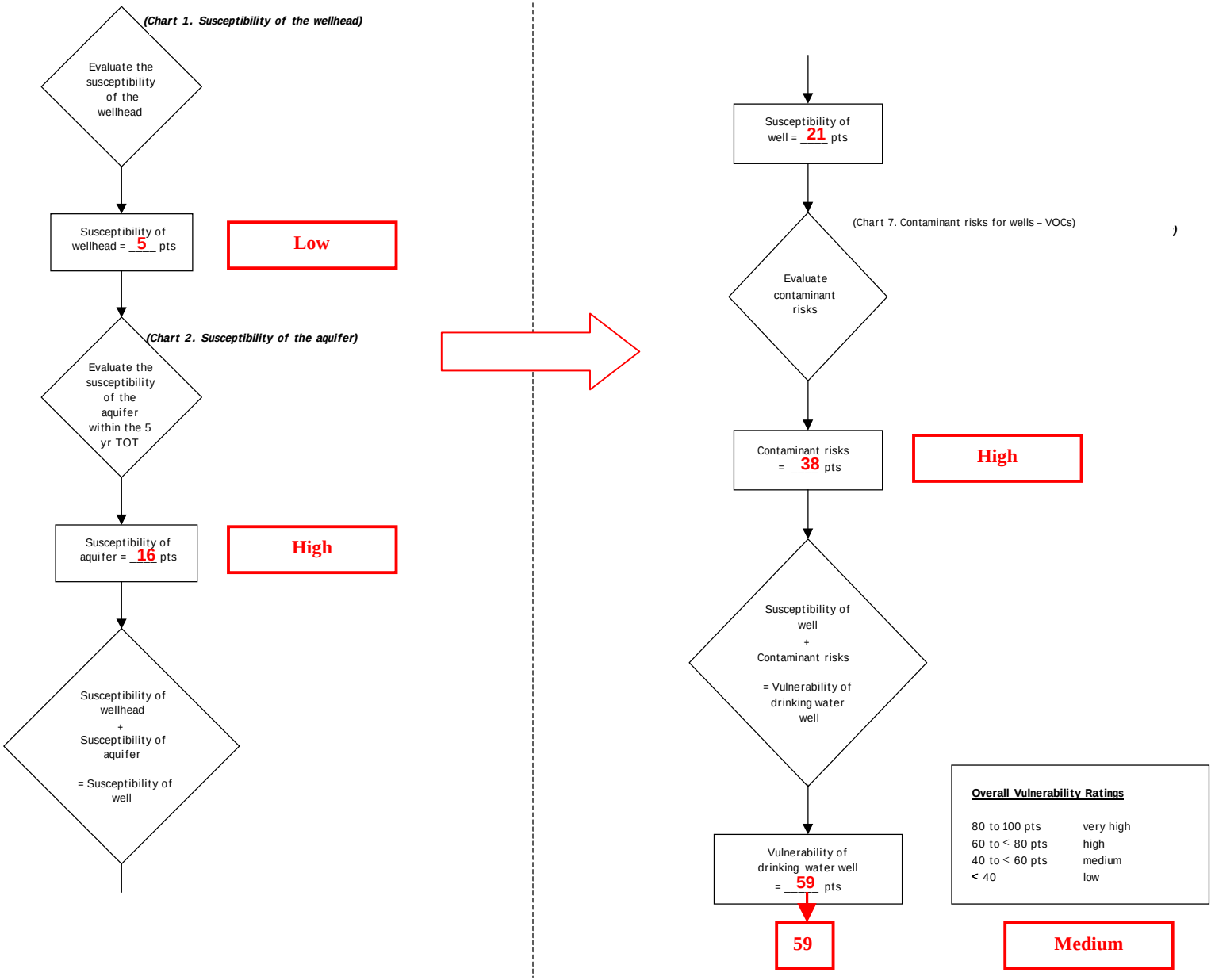
| | |
|---|---|
| 40 to 50 pts | very high |
| 30 to < 40 pts | high |
| 20 to < 30 pts | medium |
| < 20 | low |

*Table 3. Risk Matrix for Contaminant Sources for Roadside Inn – Volatile Organic Chemicals*

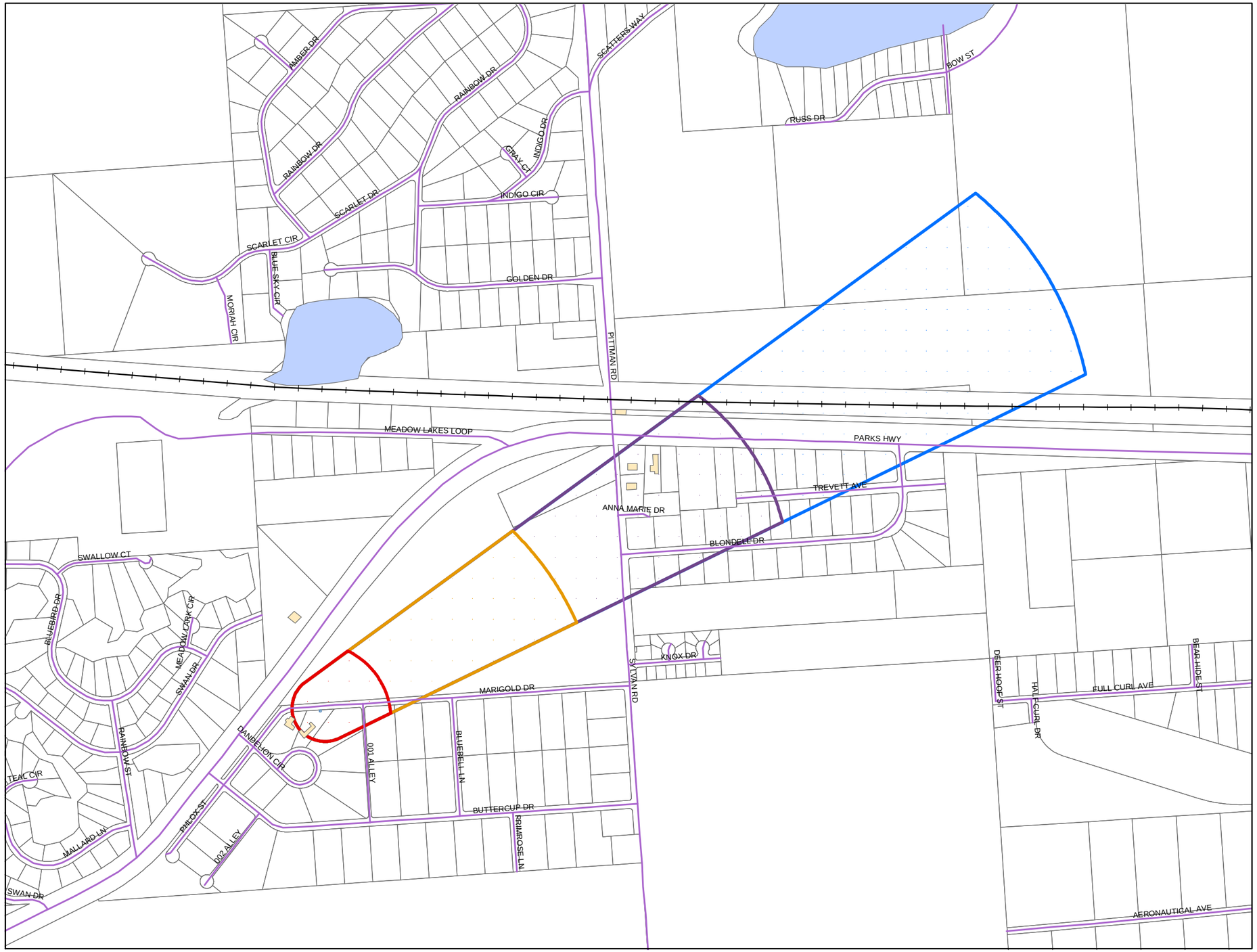
**Level of Risk Associated with the Highest Risk Sources**

| **Total = 8 Highs, 2 Mediums and 11 Lows** | **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 Roadside Inn – Volatile Organic Chemicals*



# *Drinking Water Protection Areas for Roadside Inn*




**Roadside Inn Well**
**MSB roads**
**Railroad**
**Buildings**
**Lakes**
**MSB parcel core**

**Zone A Protection Area**
Several Months Travel Time

**Zone B Protection Area**
Less Than 2-Years Travel Time

**Zone C Protection Area**
Less Than 5-Years Travel Time

**Zone D Protection Area**
Less Than 10-Years Travel Time

***Location of Map***

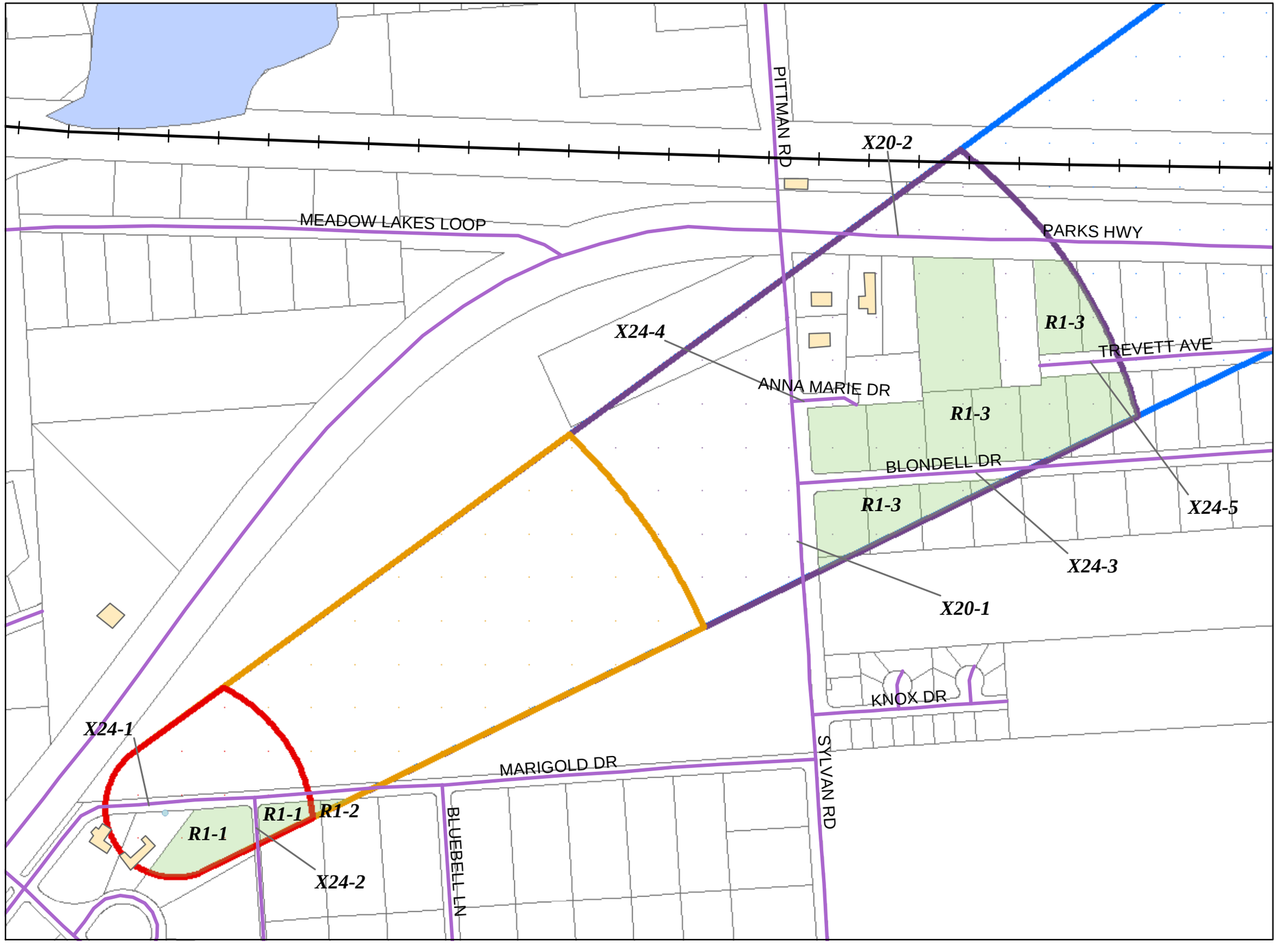

840 0 840 Feet

***PWSID 223080.001***

N
W E
S

# ***Map 1***

# *Drinking Water Protection Areas for Roadside Inn and Potential and Existing Sources of Contamination*




- Roadside Inn Well
- MSB roads
- Railroad
- Residential Area
- Buildings
- Lakes
- MSB parcel core

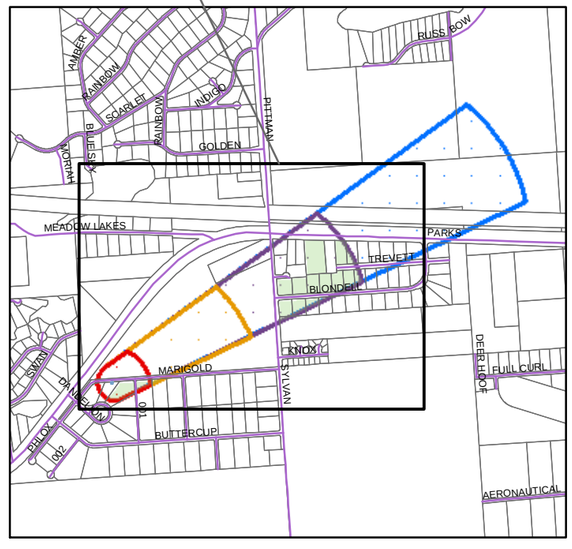
**Zone A Protection Area**
Several Months Travel Time

**Zone B Protection Area**
Less Than 2-Years Travel Time

**Zone C Protection Area**
Less Than 5-Years Travel Time

**Zone D Protection Area**
Less Than 10-Years Travel Time

***Location of Map***



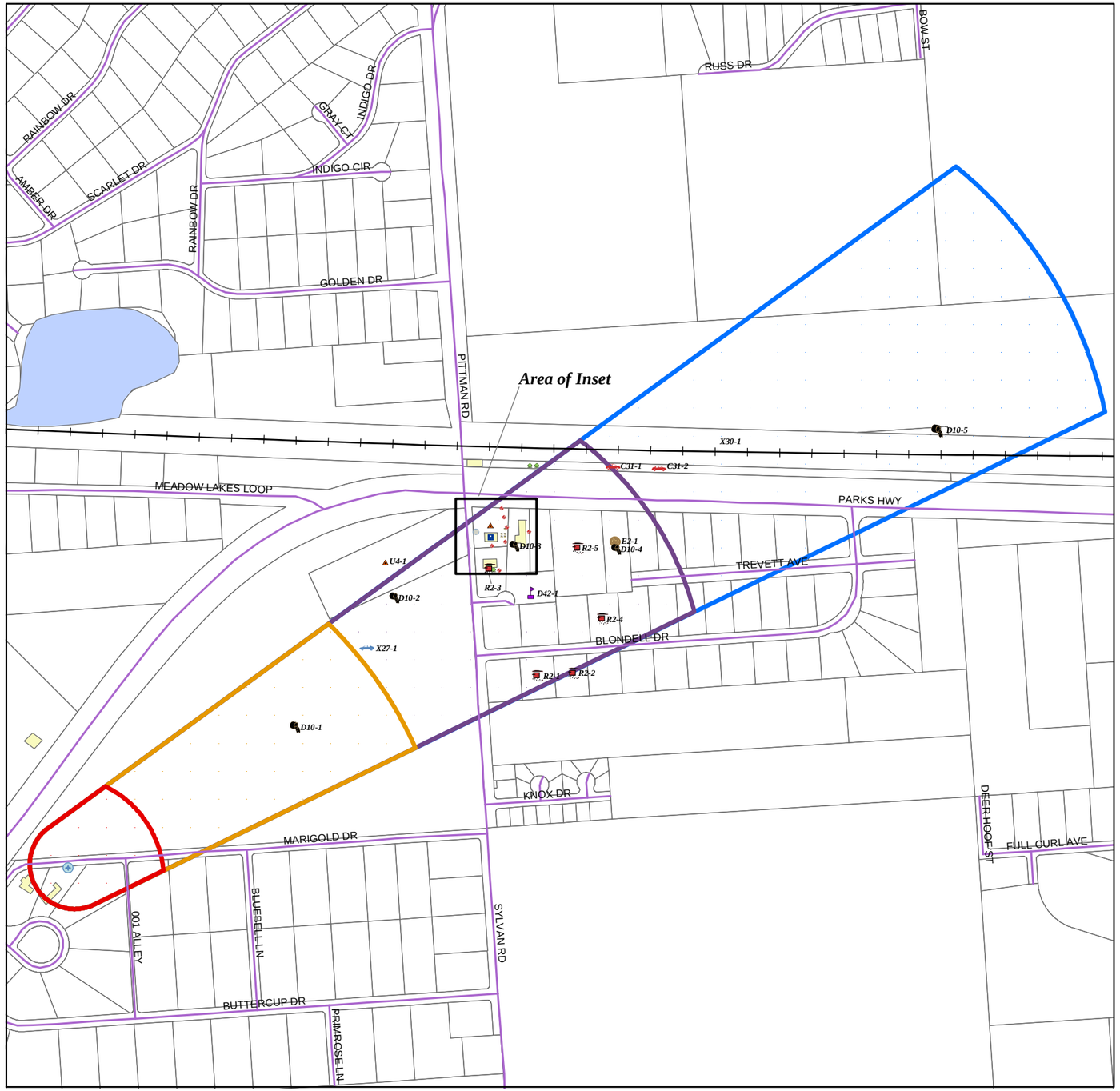

400 0 400 Feet

***PWSID 223080.001***

N
W E
S

# ***Map 2***

# *Drinking Water Protection Areas for Roadside Inn and Potential and Existing Sources of Contamination*




775 0 775 Feet

**Roadside Inn Well**
**Large Capacity Septic System (D10)**
**Motor Vehicle Waste Disposal System (D42)**
**Single Family Septic System (R2)**
**MSB roads**
**Railroad**
**Lakes**
**MSB parcel core**
**Buildings**

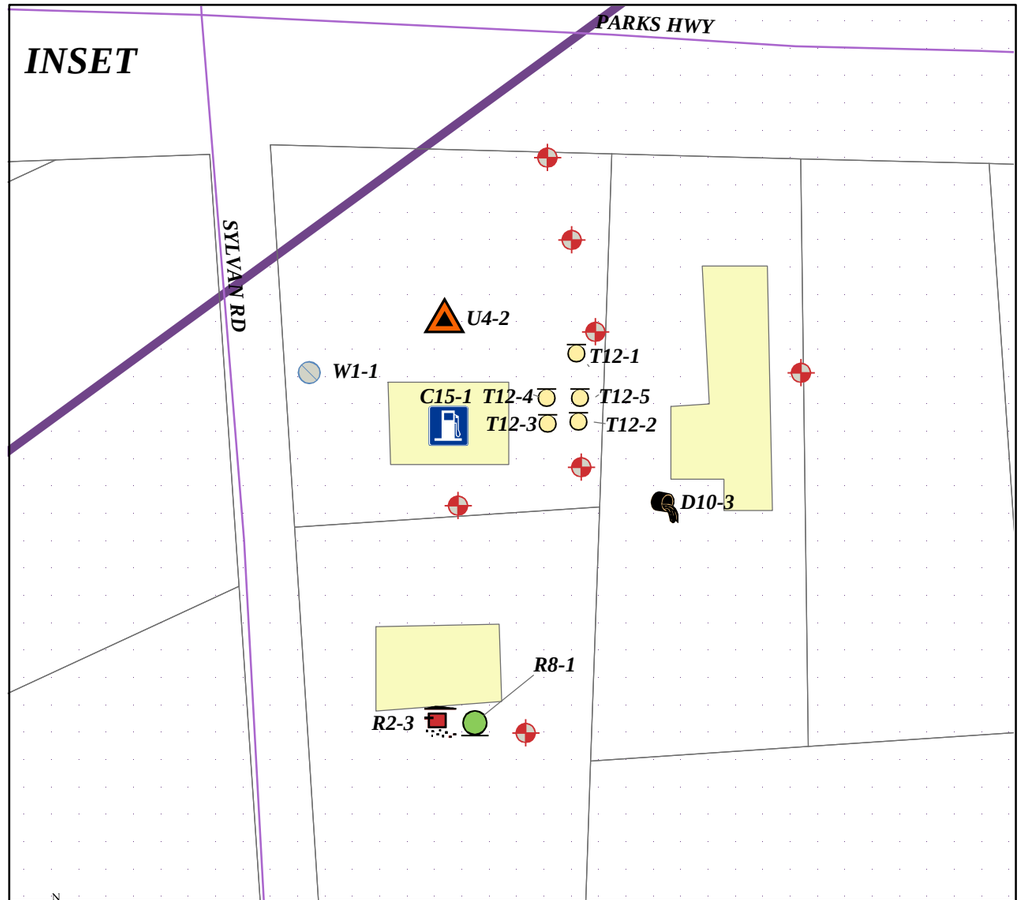
**Zone A Protection Area**
Several Months Travel Time

**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

**Gasoline Station (C15)**
**Motor/ Motor Vehicle Repair Shops (C31)**
**Logging Activites (E2)**
**Residential Heating Oil AST (R8)**
**Underground Gasoline Storage Tank (T12)**
**Nonresidential Heating Oil AST (T14)**
**ADEC Recognized "Contaminated Site" (U4)**
**Abandoned Well (W1)**
**Monitoring Wells**
**Motor Vehicle Storage Yard (X27)**

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N
W E
S

# *Map 3*