Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Royal Roller Rink's
Drinking Water System,
Anchorage, Alaska
PWSID # 215613

DRINKING WATER PROTECTION PROGRAM REPORT # 587
Alaska Department of Environmental Conservation

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

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

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Royal Roller Rink is a Class B (transient/non-community) water system consisting of one well in the Anchorage Area. Identified potential and current sources of contaminants for Royal Roller Rink's public drinking water source includes gasoline stations, sewer lines, underground fuel storage tanks, leaking underground fuel storage tank sites, ADEC recognized contaminated sites, a construction trade area, medical facilities, a firehouse, roads, residential areas, and recreation trails. 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 source for Royal Roller Rink received a vulnerability rating of **High** for bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

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 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. 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.

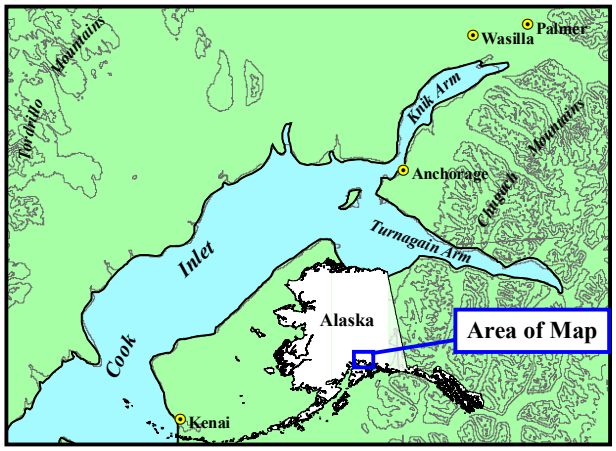

Figure 1. Index map showing the location of Anchorage, Alaska

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

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

Anchorage, located in south-central 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 Arm 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 in elevation above sea level.

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 average, Anchorage receives a total snow accumulation of 69 inches per year. Precipitation generally increases inland toward the Chugach Mountains where annual

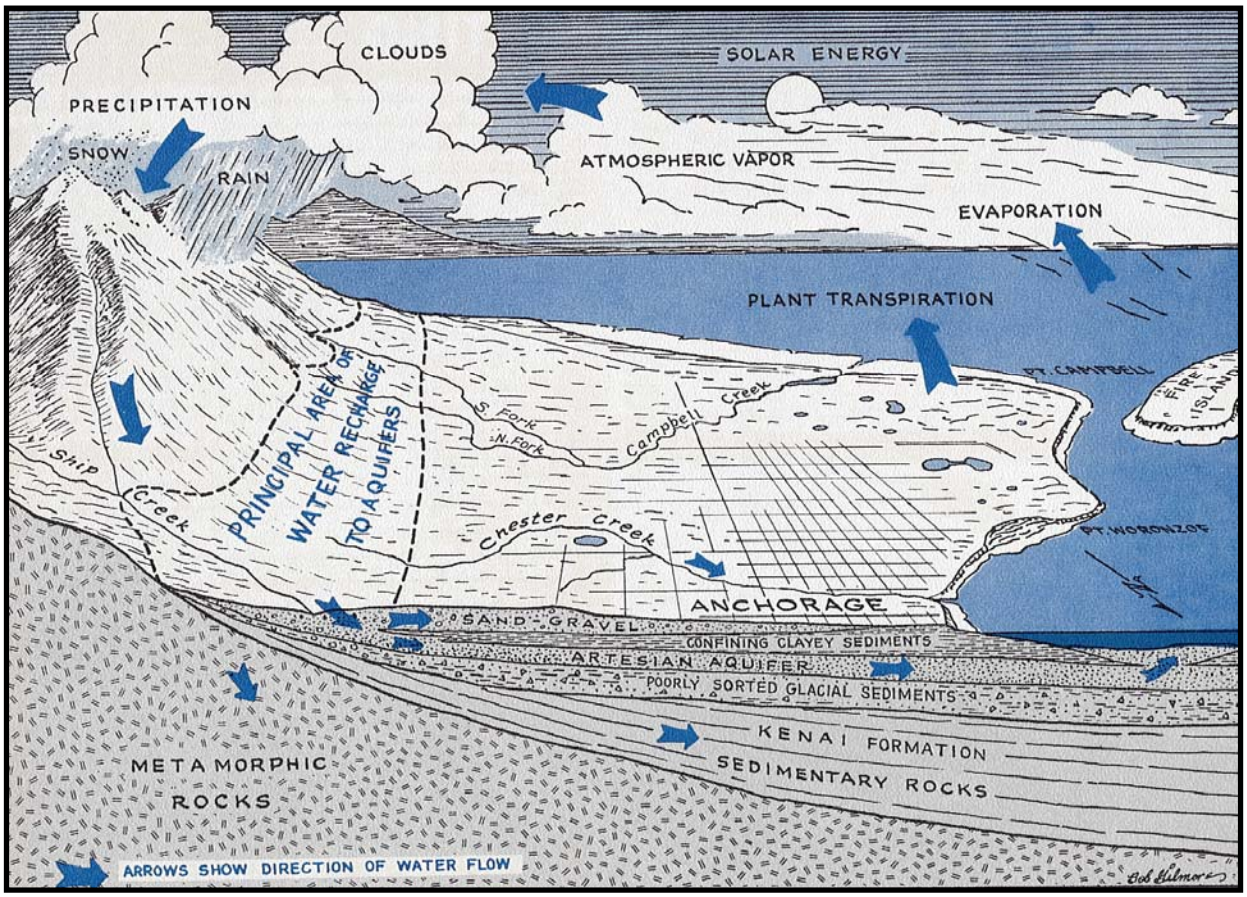

Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

precipitation may exceed 160 inches per year [*Barnwell, George, Dearborn, Weeks, and Zenone*, 1972]. Mean daily temperature ranges from 65° F during July to 8° F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at 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 and Turnagain Arm, 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.

ROYAL ROLLER RINK'S PUBLIC DRINKING WATER SYSTEM

Royal Roller Rink is a Class B (transient/non-community) water system. The system consists of one well off of Debarr Road. This area is at an elevation of approximately 200 feet above sea level.

There is no well log available for the well serving Royal Roller Rink. The most recent Sanitary Survey (05/05/99) indicates the sanitary seal was not properly installed at the time the Survey was conducted. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. According to the Sanitary Survey, the land surface is appropriately sloped to provide adequate surface water drainage. It is suspected that the well was not grouted according to ADEC regulations during installation. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

ROYAL ROLLER RINK'S DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate 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 releases 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 aquifer characteristics to arrive at a meaningful DWPA (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The DWPAs established for wells by the ADEC are separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. The 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 Royal Roller Rink's 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 source water assessments, three categories of drinking water contaminants were inventoried:

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

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

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking 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.

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.

VULNERABILITY OF THE ROYAL ROLLER RINK 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)

Because no well log was available, geologic information was gathered from wells within a ¼ mile radius of Royal Roller Rink's source of public drinking water. Based on the information gathered, it is suspected that the well for Royal Roller Rink is completed in a confined aquifer setting. The depth to the top of the confining layer is approximately 55 feet below land surface and consists of a layer of silt and hardpan with a thickness of approximately 48 feet. This confining layer may provide a protective barrier against the movement of contaminants in the subsurface. However, near the base of the Chugach Mountains, these clay layers tend to be discontinuous and thin toward the mountains. Therefore, contaminants that enter the subsurface near the base of the mountains may enter the confined aquifer uninhibited by the absence of any protective layer. Table 2 shows the Overall Susceptibility score and rating for Royal Roller Rink.

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	9	Low
Natural Susceptibility	34	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	30	High
Nitrates and/or Nitrites	30	High
Volatile Organic Chemicals	50	Very High

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

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

Table 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 Royal Roller Rink to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	65	High
Nitrates and Nitrites	65	High
Volatile Organic Chemicals	85	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.

Bacteria and Viruses
The residential sewer lines, residential area, and medical facilities present the greatest risk for bacteria and viruses. Other potential contaminant sources for bacteria and viruses include roads, and recreation trails. The risk to Royal Roller Rink's source of public drinking water with regard to bacteria and viruses is high after combining the scores for contaminant risk and vulnerability.

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 (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Nitrates and/or Nitrites
The residential sewer lines within the protection area present the greatest risk for nitrates and/or nitrites. Other potential contaminant sources of nitrates and/or nitrites that exist within the protection area include residential area, recreation trails, roads, and medical facilities. The risk to Royal Roller Rink's source of public drinking water with regard to nitrates and/or nitrites is high after combining the scores for contaminant risk and vulnerability.

Nitrates and/or nitrites are found in natural background concentration 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 Royal Roller Rink indicates that no nitrates and/or nitrites have been detected (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Volatile Organic Chemicals
The gasoline stations, underground fuel storage tanks, and the ADEC recognized contaminated site pose the greatest risk for volatile organic chemical contamination. Other potential sources of volatile organic chemicals within the protection area include construction trade areas, residential sewer lines, residential area, roads, medical facilities and a firehouse. The risk to Royal Roller Rink's source of public drinking water with regard to volatile organic chemicals is high after combining the scores for contaminant risk and vulnerability.

The contaminated site located within Zone C (U4-1) is associated with a mobile home park. According to ADEC's Contaminated Sites division numerous heating oil tanks were removed during the early 1990's. Contamination from the heating oil tanks was widespread. Groundwater contamination was noted at the time of excavation but the extent and flow direction is unknown. Remediation of this site remains active and has a high priority.

Review of historical sampling data indicates that no volatile organic chemicals have been detected that the well (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals).

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Royal Roller Rink. The overall vulnerability of this source to contamination is **High** for bacteria and viruses, nitrates and/or nitrites, and 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 Royal Roller Rink 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 Royal Roller Rink's public drinking water source.

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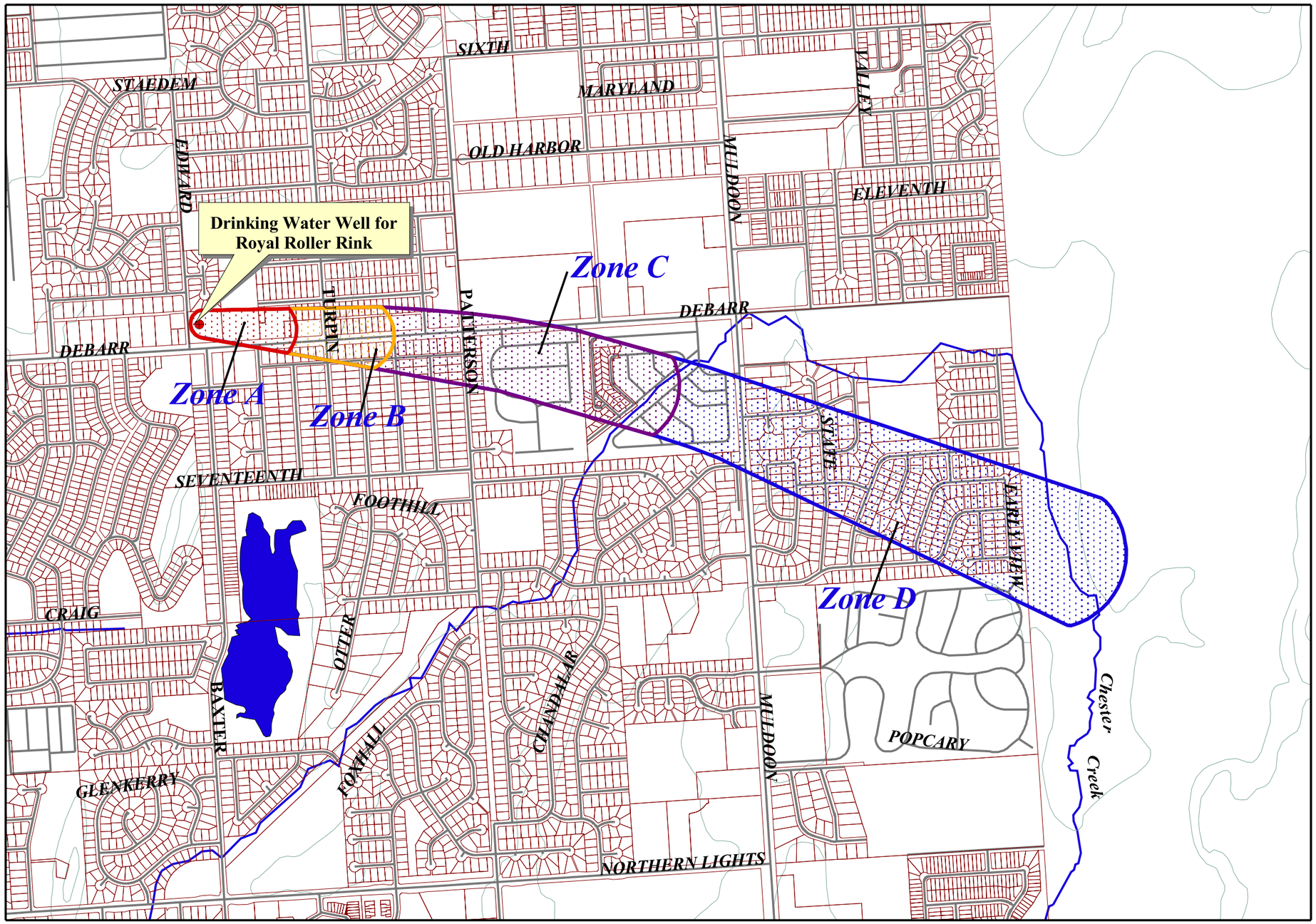
APPENDIX A

Royal Roller Rink's
Drinking Water Protection Area
(Map 1)

Drinking Water Protection Area and Potential & Existing Contaminant Sources for Royal Roller Rink



Drinking Water Well
- Royal Roller Rink

Zone A
- Several Months Travel Time

Zone B
- Less Than 2 Years Travel Time

Zone C
- Less Than 5 Years Travel Time

Zone D
- Less Than 10 Years Travel Time

Land Parcels

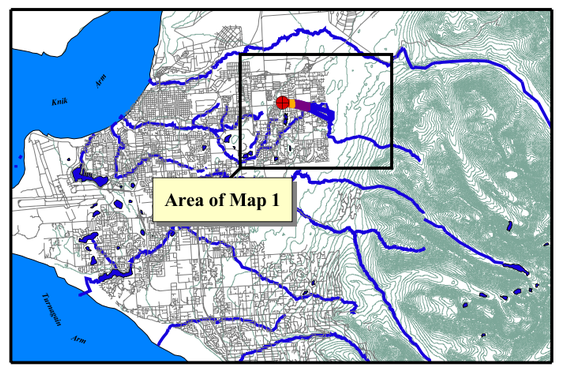
Roads (X20)

Elevation Contours

Streams

Lakes

N
W E
S



2000 0 2000 4000 6000 Feet

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Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink (Tables 1-4)

Table 1

Contaminant Source Inventory for ***Royal Roller Rink***

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Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Gasoline stations (with repair shop)	C16	C16-1	A		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A		2	
Tanks, gasoline (underground)	T12	T12-1	A		2	
Tanks, gasoline (underground)	T12	T12-1	A		2	
Tanks, gasoline (underground)	T12	T12-2	A		2	
Tanks, gasoline (underground)	T12	T12-3	A		2	
Closed tanks, gasoline (underground)	T13	T13-1	A	Debarr and Patterson	3	
Closed tanks, gasoline (underground)	T13	T13-2	A		3	
Closed tanks, gasoline (underground)	T13	T13-3	A		3	
Closed tanks, heating oil, nonresidential (underground)	T17	T17-1	A		2	
Tanks, diesel (underground)	T08	T8-1	A		2	
Tanks, diesel (underground)	T08	T8-1	A		2	
Closed tanks, diesel (underground)	T09	T9-1	A		2	
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	A		2	Borings found soil and ground water contamination (Diesel Range Organics)
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U8-1	A		2	
Dog walking areas/foot trails	X46	X46-1	A		3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A, B, C	Debarr	2	
Dog walking areas/foot trails	X46	X46-2	A, B, C	along Debarr	3	

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Construction trade areas and materials	C09	C9-1	B	6831 Debarr	3	
Residential Areas	R01	R1-1	B	entire subdivision	3	
Residential Areas	R01	R1-2	B	entire subdivision	2	Approximately 10 acres of residential area.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Turpin	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B		2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-2	B	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-3	B	Turpin and Debarr	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B, C	Mink	2	
Dog walking areas/foot trails	X46	X46-3	B, C	off Turpin	3	
Dog walking areas/foot trails	X46	X46-4	B, C	off Turpin	3	
Construction trade areas and materials	C09	C9-2	C	7101 Debarr	4	
Construction trade areas and materials	C09	C9-3	C		3	
Residential Areas	R01	R1-3	C		2	Approximately 45 acres of residential area
Closed tanks, gasoline (underground)	T13	T13-4	C		3	
Closed tanks, lubricants or other petroleum products (underground)	T21	T21-1	C	Debarr and Patterson	4	
Closed tanks, diesel (underground)	T09	T9-2	C	Debarr and Patterson	4	
Closed tanks, diesel (underground)	T09	T9-2	C		3	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-1	C	Debarr and Patterson	4	Numerous heating oil tanks were removed during the early 90's. Groundwater cont. noted - extent and flow direction is unknown.
Firehouses	X38	X38-1	C	Patterson and Debarr	4	
Dog walking areas/foot trails	X46	X46-5	C	off Patterson	4	
Dog walking areas/foot trails	X46	X46-6	C	along Chester Creek	4	

Table 2

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink
Sources of Bacteria and Viruses

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Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Location	Map Number	Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Medium		2	
Dog walking areas/foot trails	X46	X46-1	A	Low		3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A, B, C	Low	Debarr	2	
Dog walking areas/foot trails	X46	X46-2	A, B, C	Low	along Debarr	3	
Residential Areas	R01	R1-1	B	Low	entire subdivision	3	
Residential Areas	R01	R1-2	B	Low	entire subdivision	2	Approximately 10 acres of residential area.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	Turpin	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Medium	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-2	B	Medium	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-3	B	Medium	Turpin and Debarr	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B, C	Low	Mink	2	
Dog walking areas/foot trails	X46	X46-3	B, C	Low	off Turpin	3	
Dog walking areas/foot trails	X46	X46-4	B, C	Low	off Turpin	3	
Residential Areas	R01	R1-3	C	Low		2	Approximately 45 acres of residential area
Dog walking areas/foot trails	X46	X46-5	C	Low	off Patterson	4	

Table 2 (continued)

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink Sources of Bacteria and Viruses

PWSID 215613.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Dog walking areas/foot trails	X46	X46-6	C	Low	along Chester Creek	4	

Table 3

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink
Sources of Nitrates/Nitrites

PWSID 215613.001

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Location	Map Number	Comments
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Medium		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Medium		2	
Dog walking areas/foot trails	X46	X46-1	A	Low		3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A, B, C	Low	Debarr	2	
Dog walking areas/foot trails	X46	X46-2	A, B, C	Low	along Debarr	3	
Residential Areas	R01	R1-1	B	Low	entire subdivision	3	
Residential Areas	R01	R1-2	B	Low	entire subdivision	2	Approximately 10 acres of residential area.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	Turpin	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Low	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-2	B	Low	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-3	B	Low	Turpin and Debarr	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B, C	Low	Mink	2	
Dog walking areas/foot trails	X46	X46-3	B, C	Low	off Turpin	3	
Dog walking areas/foot trails	X46	X46-4	B, C	Low	off Turpin	3	
Residential Areas	R01	R1-3	C	Low		2	Approximately 45 acres of residential area
Dog walking areas/foot trails	X46	X46-5	C	Low	off Patterson	4	

Table 3 (continued)

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink
Sources of Nitrates/Nitrites

PWSID 215613.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Dog walking areas/foot trails	X46	X46-6	C	Low	along Chester Creek	4	

Table 4

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink
Sources of Volatile Organic Chemicals

PWSID 215613.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Gasoline stations (with repair shop)	C16	C16-1	A	High		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-1	A	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-2	A	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-3	A	Low		2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D1-4	A	Low		2	
Tanks, gasoline (underground)	T12	T12-1	A	High		2	
Tanks, gasoline (underground)	T12	T12-1	A	High		2	
Tanks, gasoline (underground)	T12	T12-2	A	High		2	
Tanks, gasoline (underground)	T12	T12-3	A	High		2	
Closed tanks, gasoline (underground)	T13	T13-1	A	Medium	Debarr and Patterson	3	
Closed tanks, gasoline (underground)	T13	T13-2	A	Medium		3	
Closed tanks, gasoline (underground)	T13	T13-3	A	Medium		3	
Closed tanks, heating oil, nonresidential (underground)	T17	T17-1	A	Low		2	
Tanks, diesel (underground)	T08	T8-1	A	High		2	
Tanks, diesel (underground)	T08	T8-1	A	High		2	
Closed tanks, diesel (underground)	T09	T9-1	A	Medium		2	
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	A	High		2	Borings found soil and ground water contamination (Diesel Range Organics)
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U8-1	A	Low		2	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A, B, C	Low	Debarr	2	
Construction trade areas and materials	C09	C9-1	B	Low	6831 Debarr	3	

Table 4 (continued)

Contaminant Source Inventory and Risk Ranking for Royal Roller Rink
Sources of Volatile Organic Chemicals

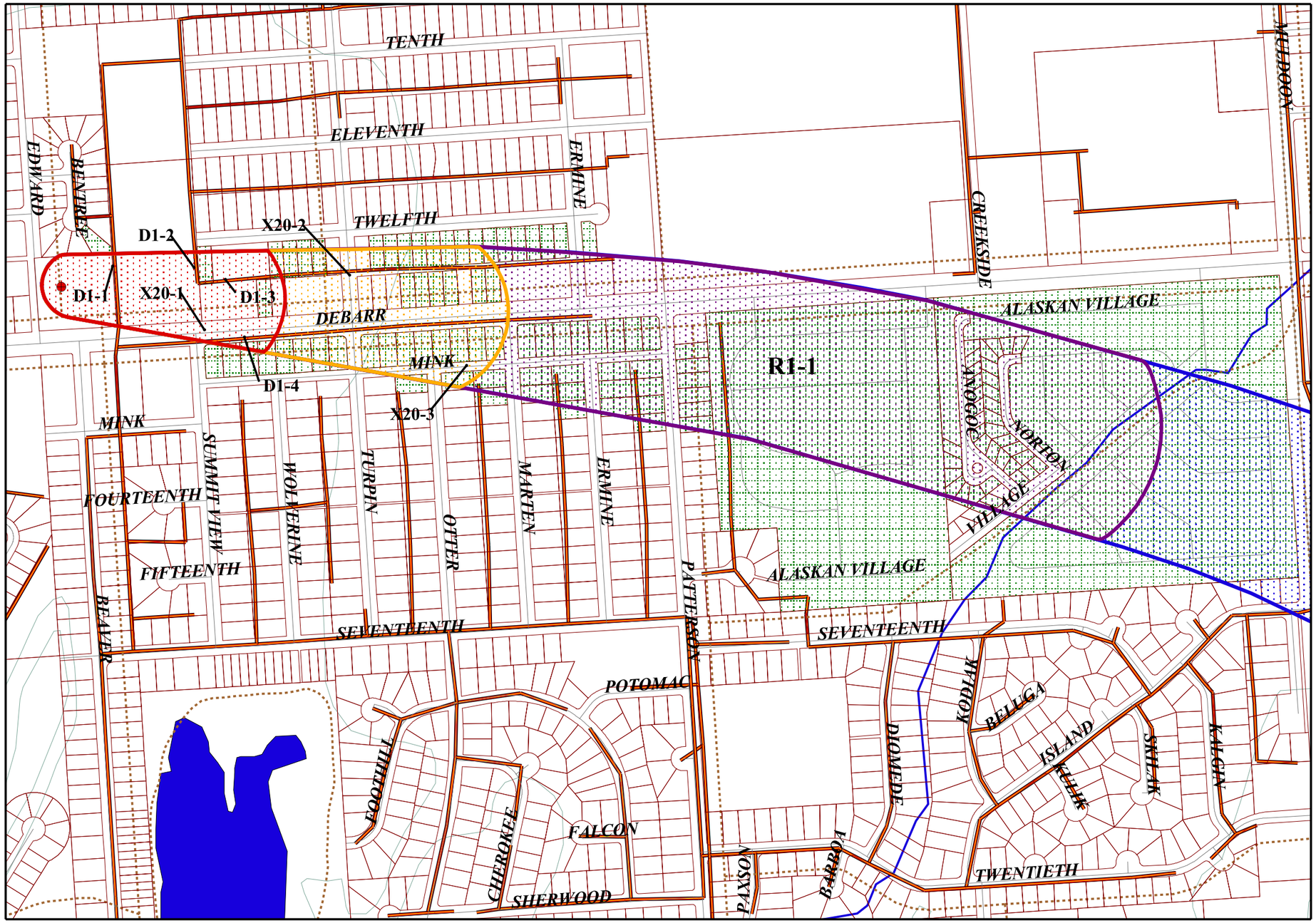
PWSID 215613.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R1-1	B	Low	entire subdivision	3	
Residential Areas	R01	R1-2	B	Low	entire subdivision	2	Approximately 10 acres of residential area.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low	Turpin	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4	B	Low		2	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-1	B	Low	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-2	B	Low	Turpin and Debarr	3	
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40	X40-3	B	Low	Turpin and Debarr	3	
Highways and roads, paved (cement or asphalt)	X20	X20-3	B, C	Low	Mink	2	
Construction trade areas and materials	C09	C9-2	C	Low	7101 Debarr	4	
Construction trade areas and materials	C09	C9-3	C	Low		3	
Residential Areas	R01	R1-3	C	Low		2	Approximately 45 acres of residential area
Closed tanks, gasoline (underground)	T13	T13-4	C	Medium		3	
Closed tanks, lubricants or other petroleum products (underground)	T21	T21-1	C	Low	Debarr and Patterson	4	
Closed tanks, diesel (underground)	T09	T9-2	C	Medium		3	
Closed tanks, diesel (underground)	T09	T9-2	C	Medium	Debarr and Patterson	4	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U4-1	C	High	Debarr and Patterson	4	Numerous heating oil tanks were removed during the early 90's. Groundwater cont. noted - extent and flow direction is unknown.
Firehouses	X38	X38-1	C	Low	Patterson and Debarr	4	

APPENDIX C

Royal Roller Rink's
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-4)

Drinking Water Protection Area and
Potential & Existing Contaminant Sources for Royal Roller Rink



Drinking Water Well
- Royal Roller Rink

Zone A
- Several Months Travel Time

Zone B
- Less Than 2 Years Travel Time

Zone C
- Less Than 5 Years Travel Time

Zone D
- Less Than 10 Years Travel Time

Land Parcels

Residential Area (R1)

Roads (X20)

Trails (X46)

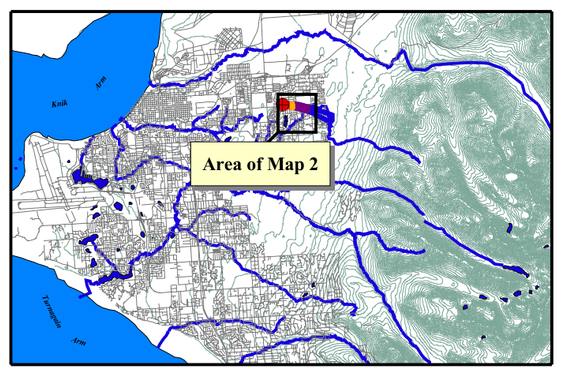
Sewer Lines (D1)

Elevation Contours

Streams

Lakes

N
W E
S

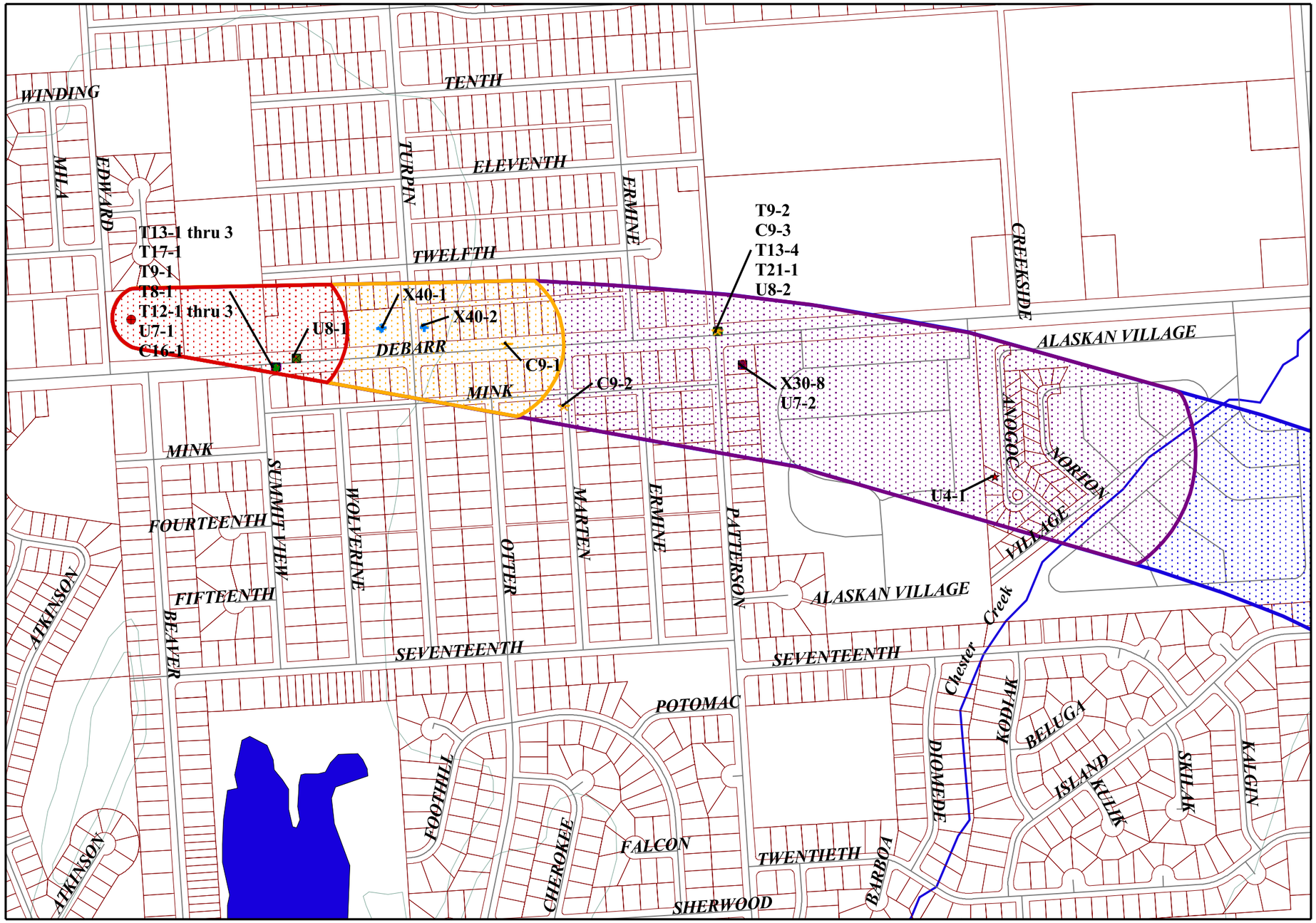


900 0 900 1800 2700 Feet

PWSID 215613.001

Map 2

Drinking Water Protection Area and Potential & Existing Contaminants for Royal Roller Rink



Drinking Water Well
- Royal Roller Rink

Zone A
- Several Months Travel Time

Zone B
- Less Than 2 Years Travel Time

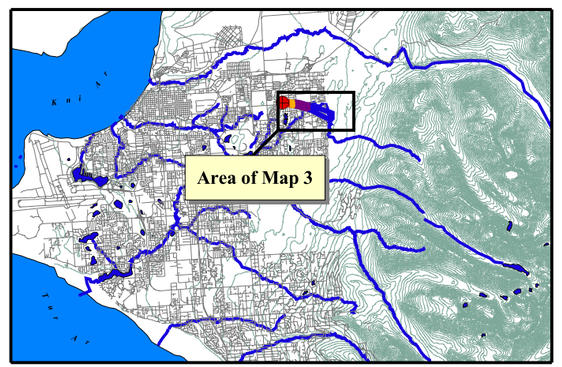
Zone C
- Less Than 5 Years Travel Time

Zone D
- Less Than 10 Years Travel Time

Potential & Existing Contaminant Sources
- Gasoline station (C16)
- Motor vehicle supply stores (C28)
- Construction trade area (C9)
- Underground gasoline tank (T12)
- Closed underground gasoline tank (T13)
- Closed underground heating oil tank (T17)
- Closed undergroun petroleum tank (T21)
- Underground diesel tank (T8)
- Closed underground diesel tank (T9)
- ADEC recognized contaminanted site (U4)
- Open leaking underground storage tank (U7)
- Closed leaking underground fuel storage tank (U8)
- Firehouses (X38)
- Medical faicility (X40)

Land Parcels
Roads (X20)
Elevation Contours
Streams
Lakes

N
W E
S

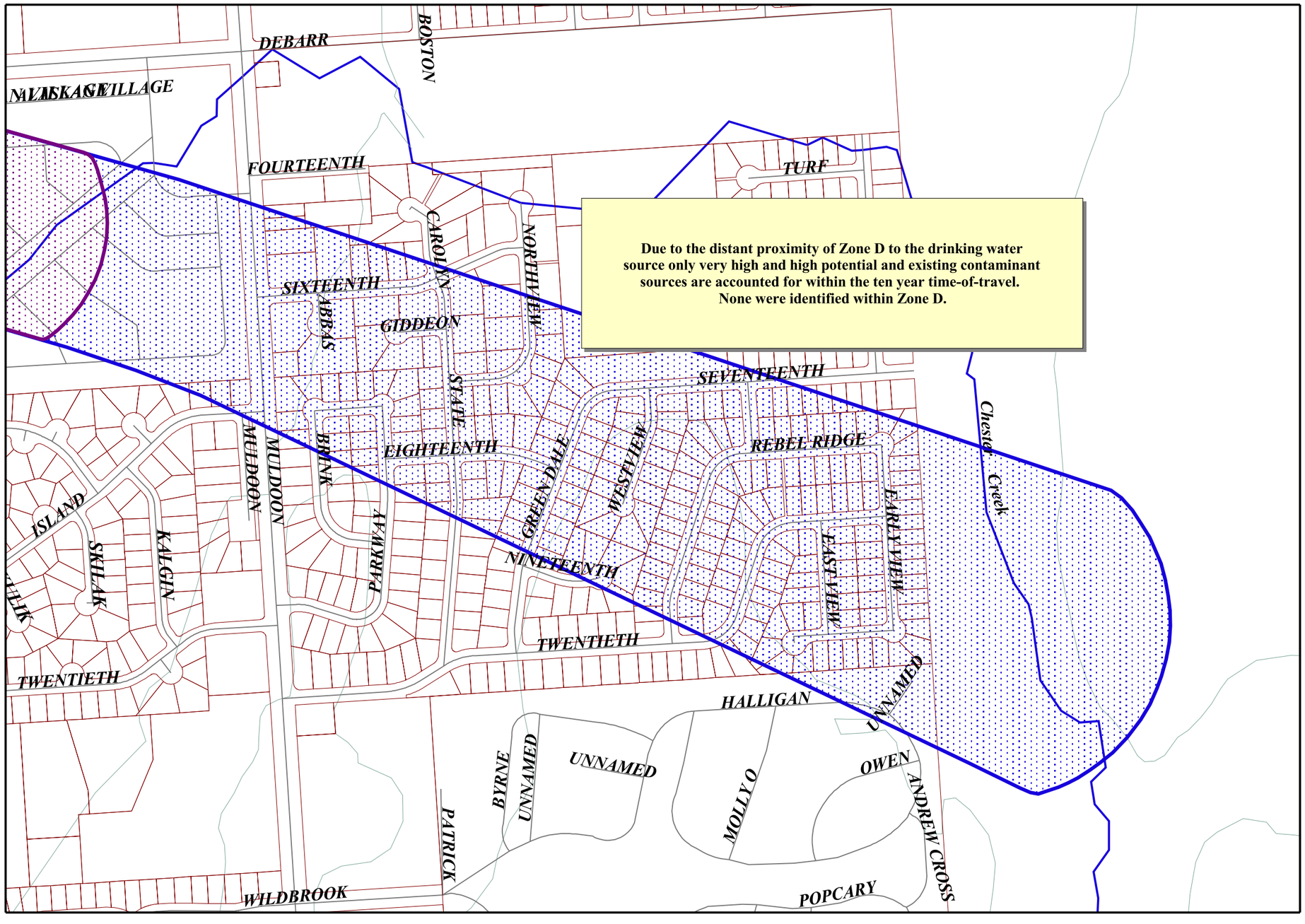


900 0 900 1800 2700 Feet

PWSID 215613.001

Map 3

Drinking Water Protection Area and
Potential & Existing Contaminant Sources for Royal Roller Rink



Drinking Water Well
- Royal Roller Rink

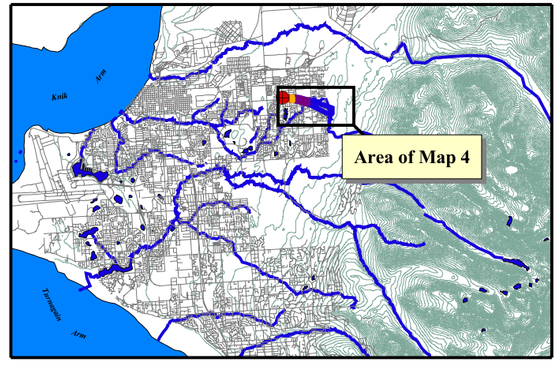
Zone A
- Several Months Travel Time

Zone B
- Less Than 2 Years Travel Time

Zone C
- Less Than 5 Years Travel Time

Zone D
- Less Than 10 Years Travel Time
- Land Parcels
- Roads (X20)
- Elevation Contours
- Streams
- Lakes

N
W E
S



800 0 800 1600 2400 Feet

PWSID 215613.001

Map 4

APPENDIX D

Vulnerability Analysis for Royal Roller Rink's Public Drinking Water Source

(Charts 1-8)

Chart 1. Susceptibility of the wellhead - Royal Roller Rink

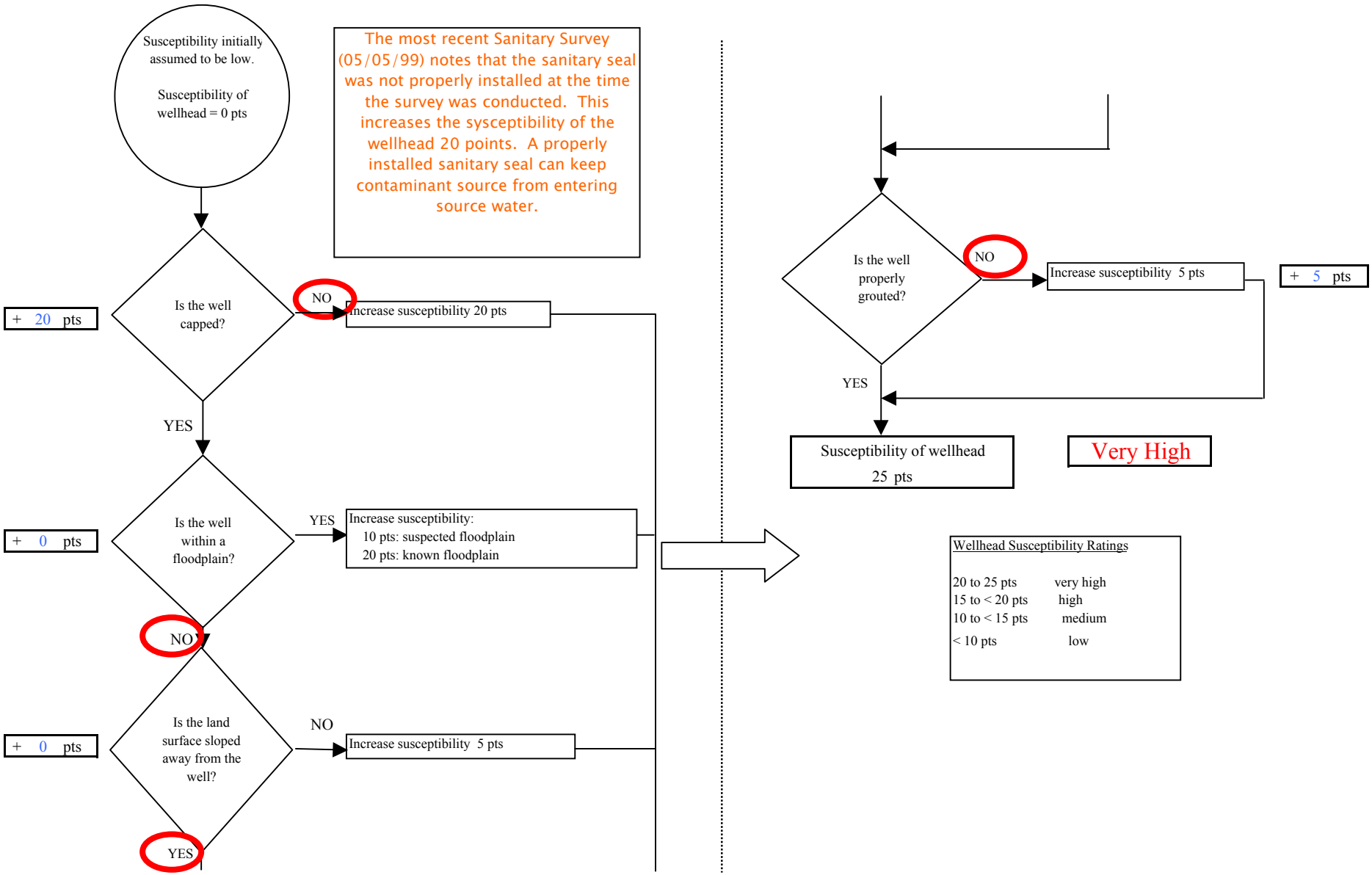


Chart 2. Susceptibility of the aquifer - Royal Roller Rink

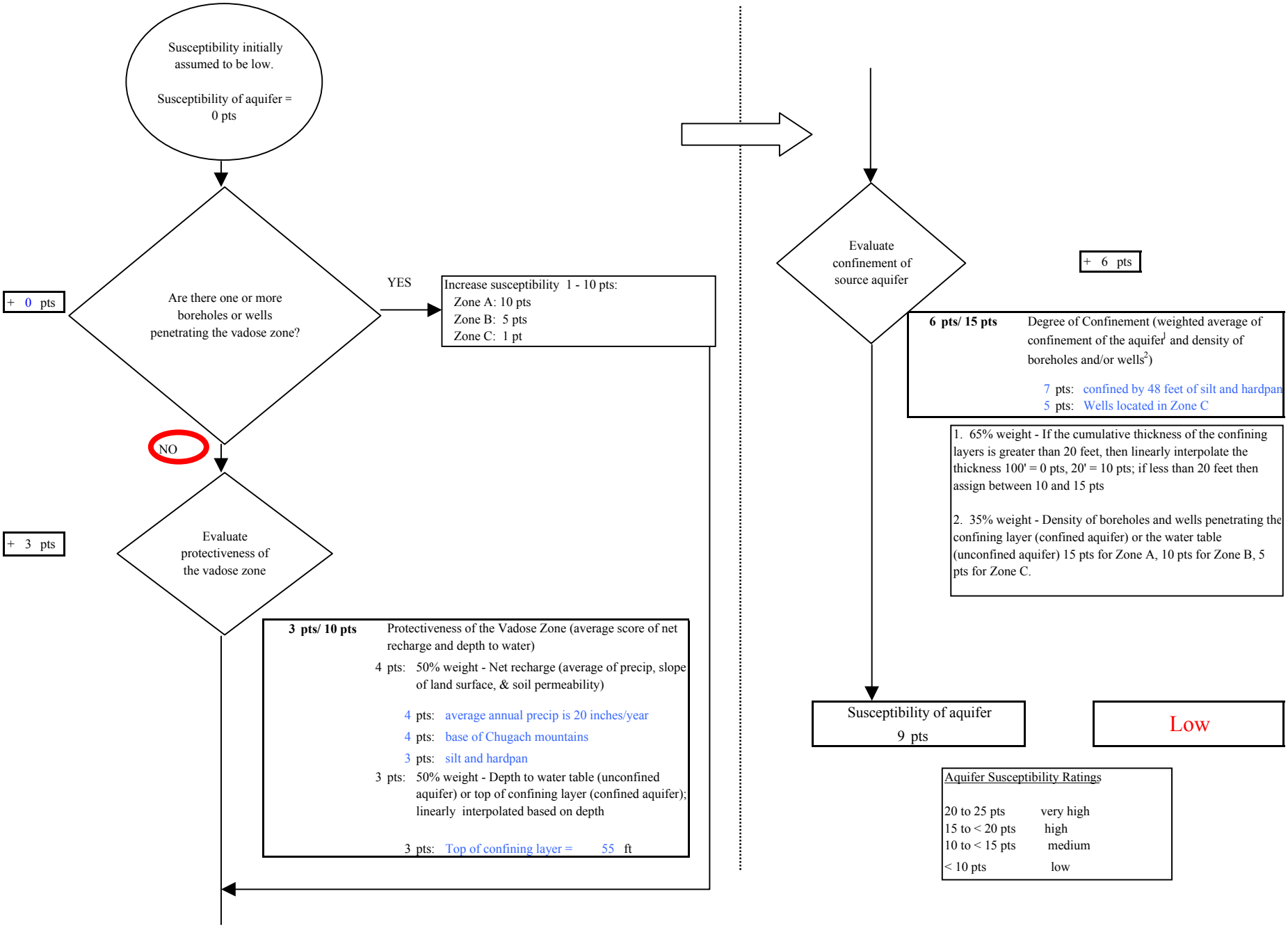
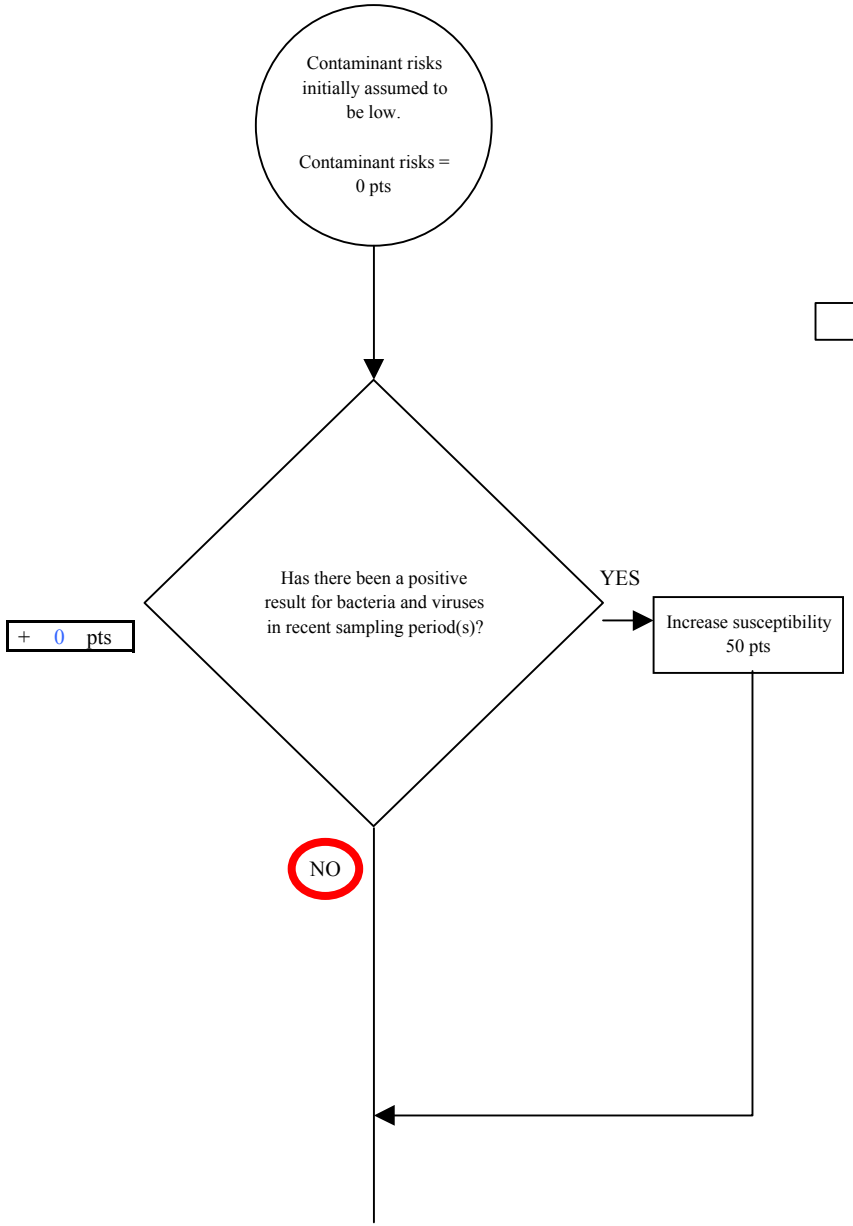
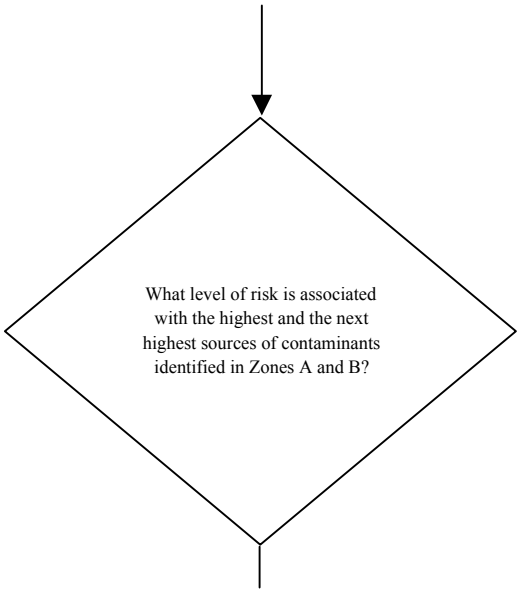


Chart 3. Contaminant risks for Royal Roller Rink - Bacteria & Viruses





+ 25 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	3	4
Low(s)	3	5	8

	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

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 3. Contaminant risks for Royal Roller Rink - Bacteria & Viruses

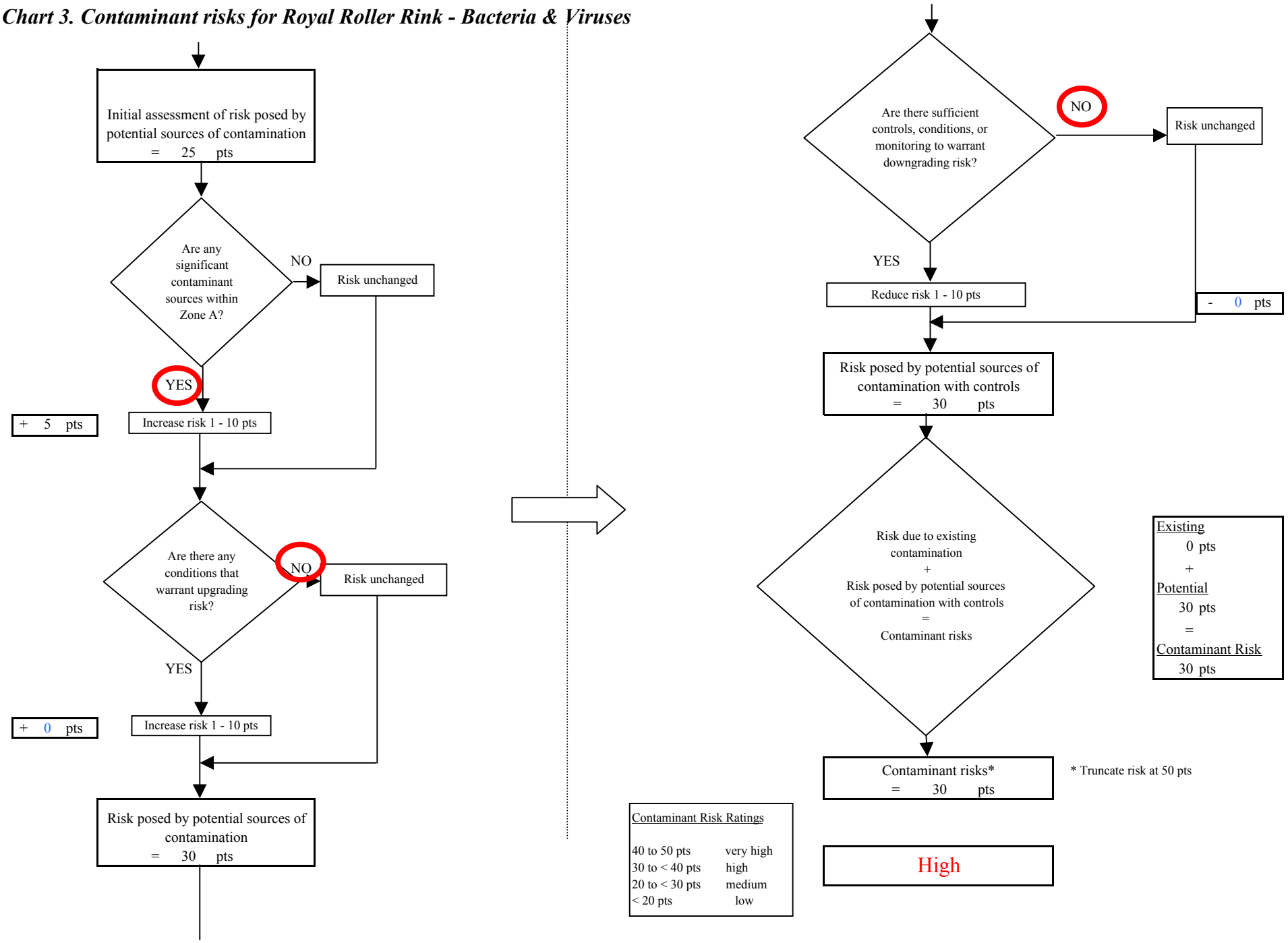


Chart 4. Vulnerability analysis for Royal Roller Rink - Bacteria & Viruses

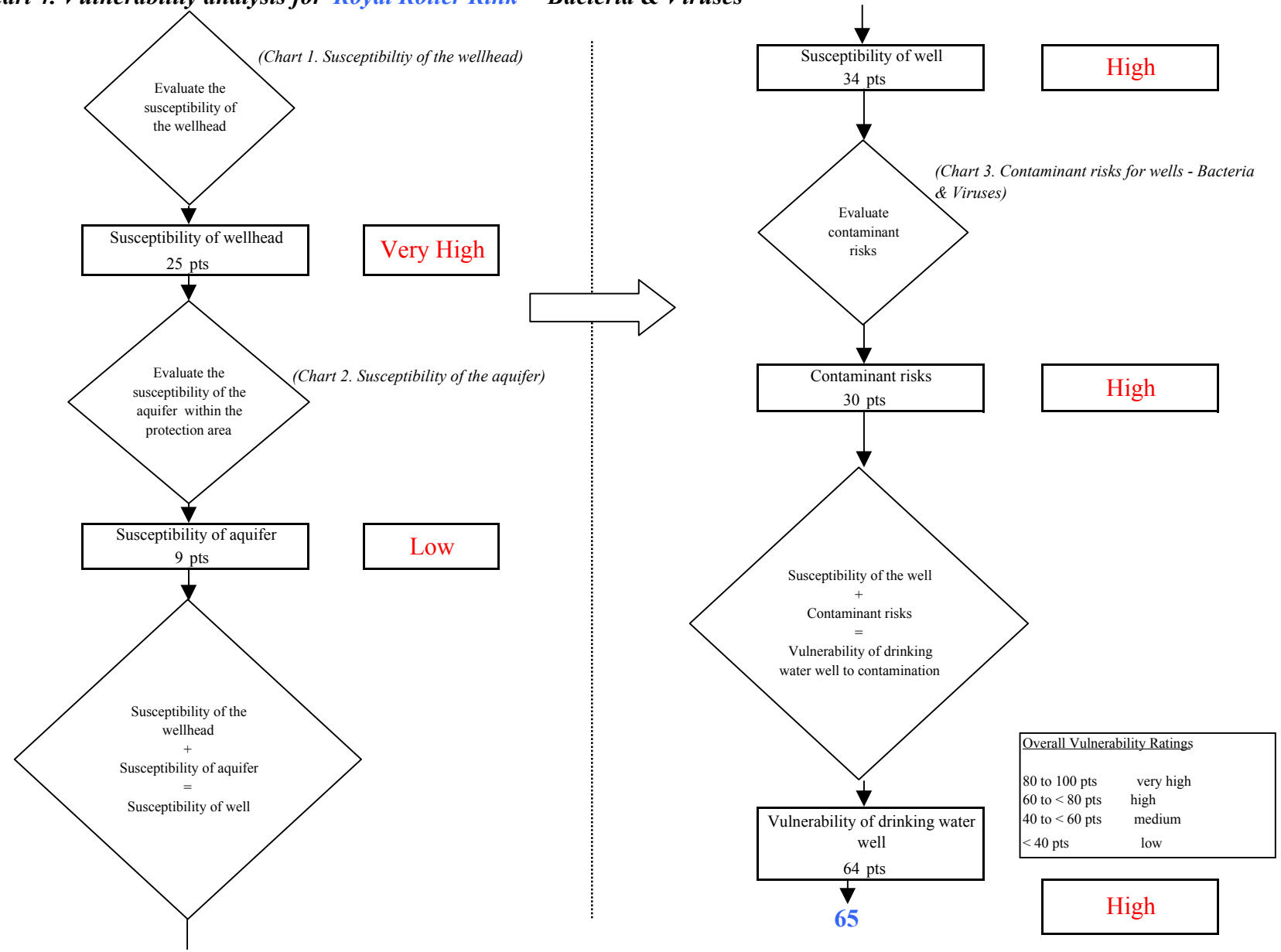


Chart 5. Contaminant risks for Royal Roller Rink - Nitrates and Nitrites

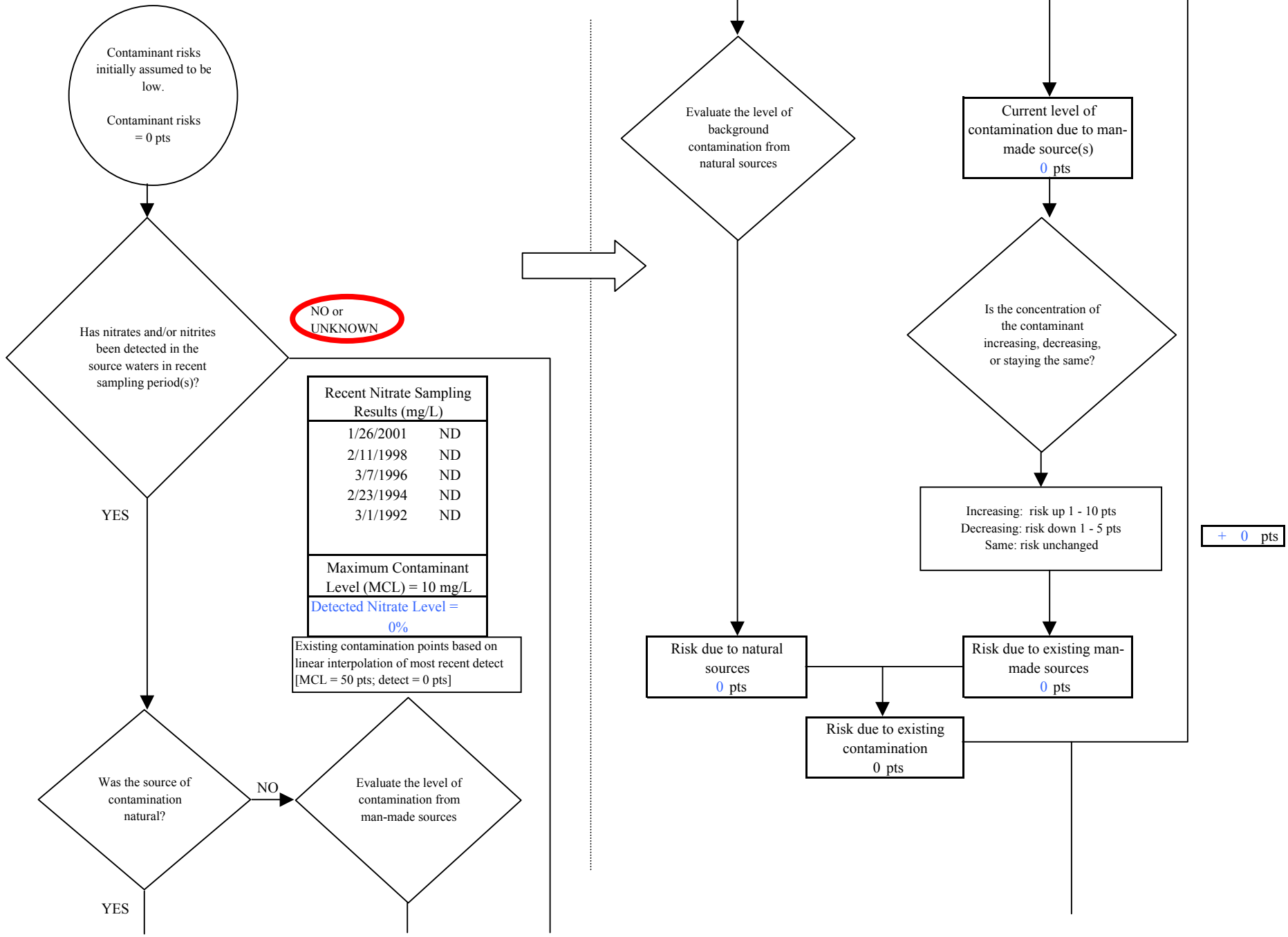
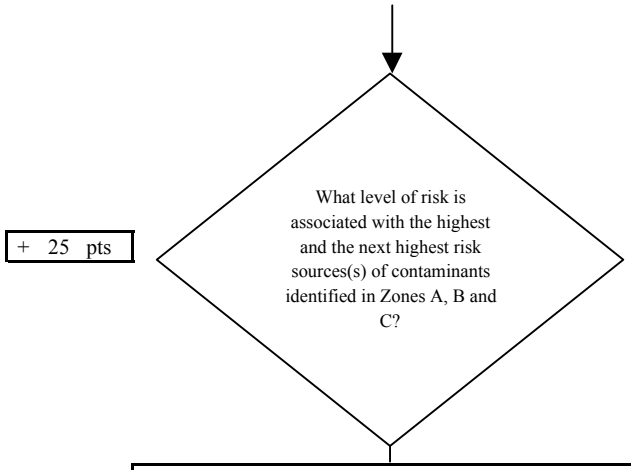


Chart 5. Contaminant risks for Royal Roller Rink - Nitrates and Nitrites



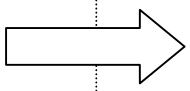
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	3	11	14

	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

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.



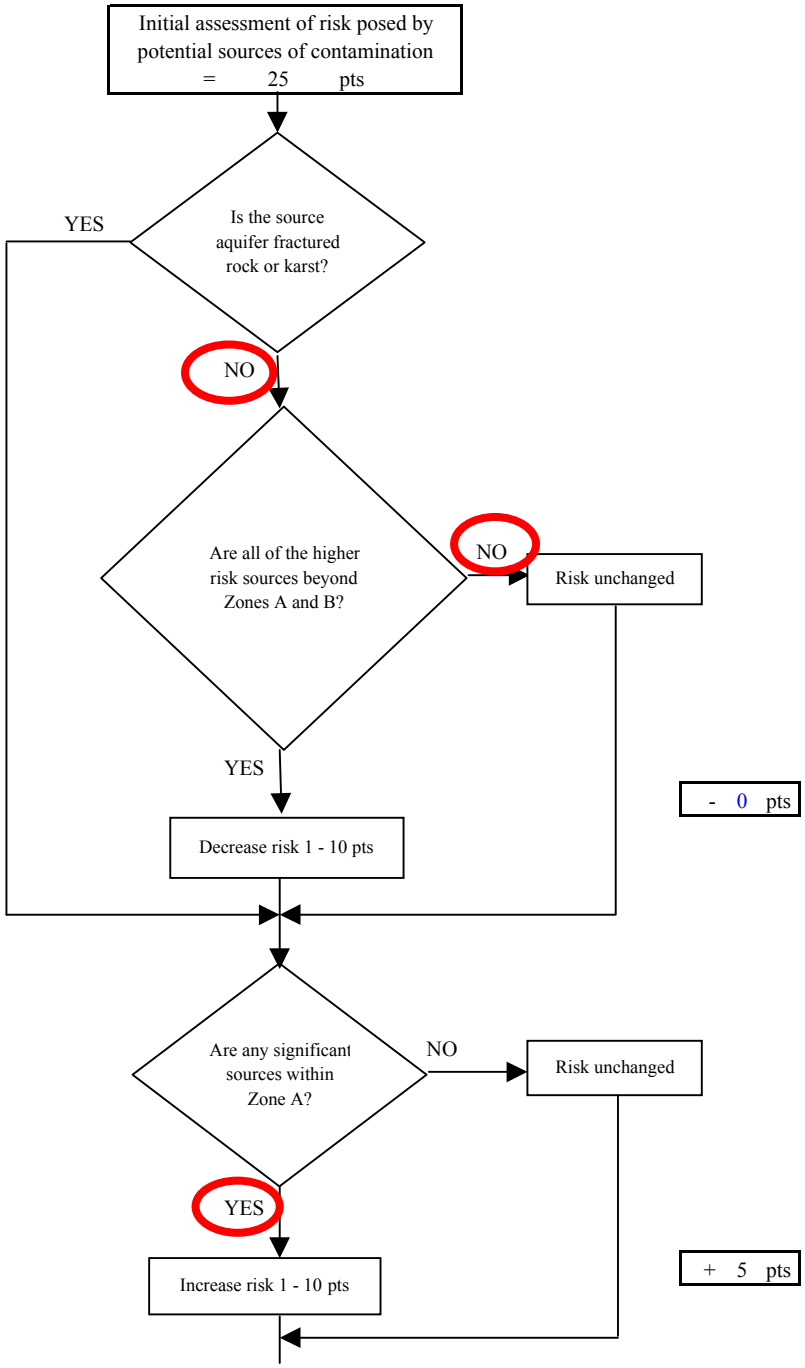


Chart 5. Contaminant risks for Royal Roller Rink - Nitrates and Nitrites

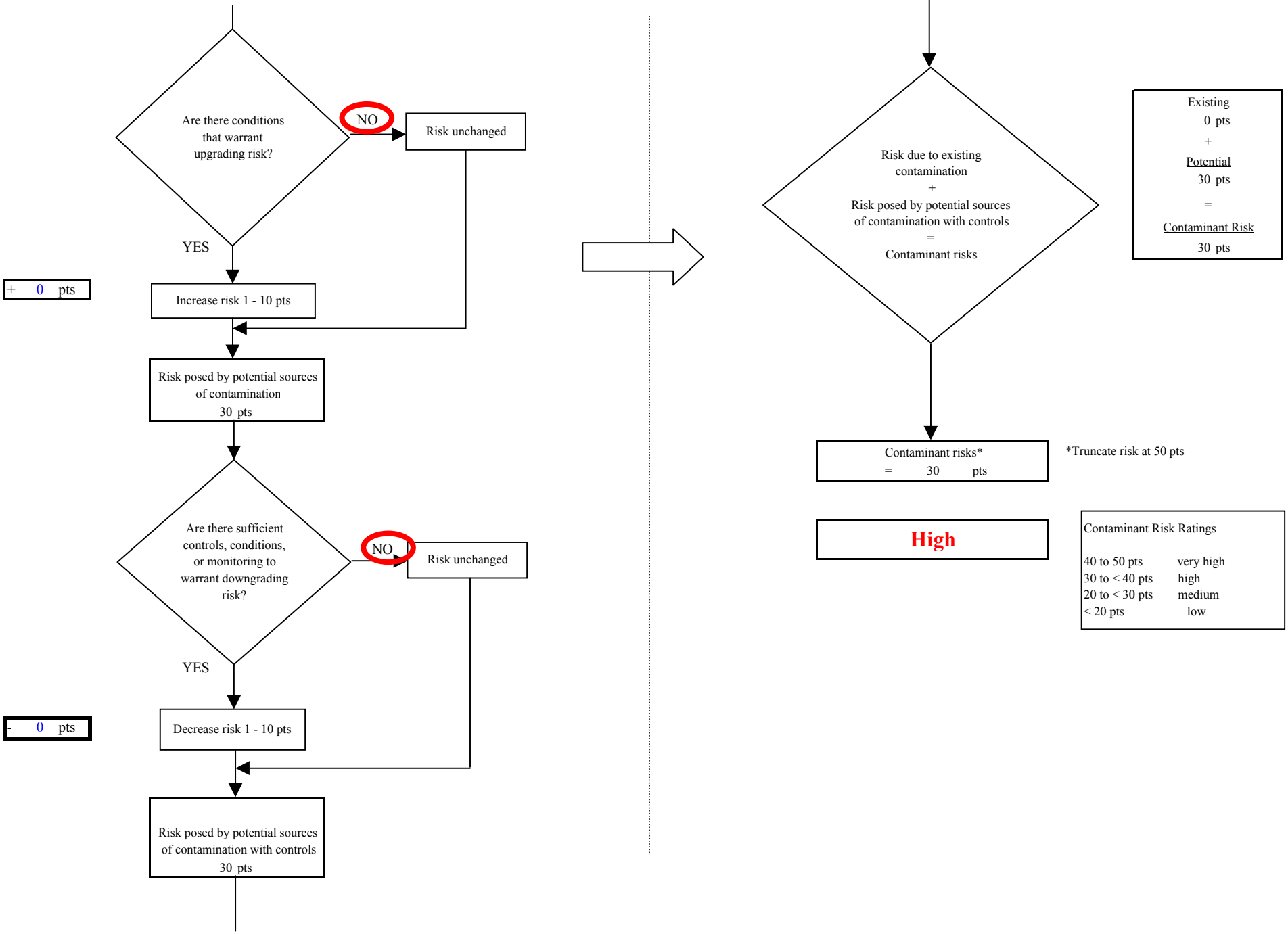


Chart 6. Vulnerability analysis for Royal Roller Rink - Nitrates and Nitrites

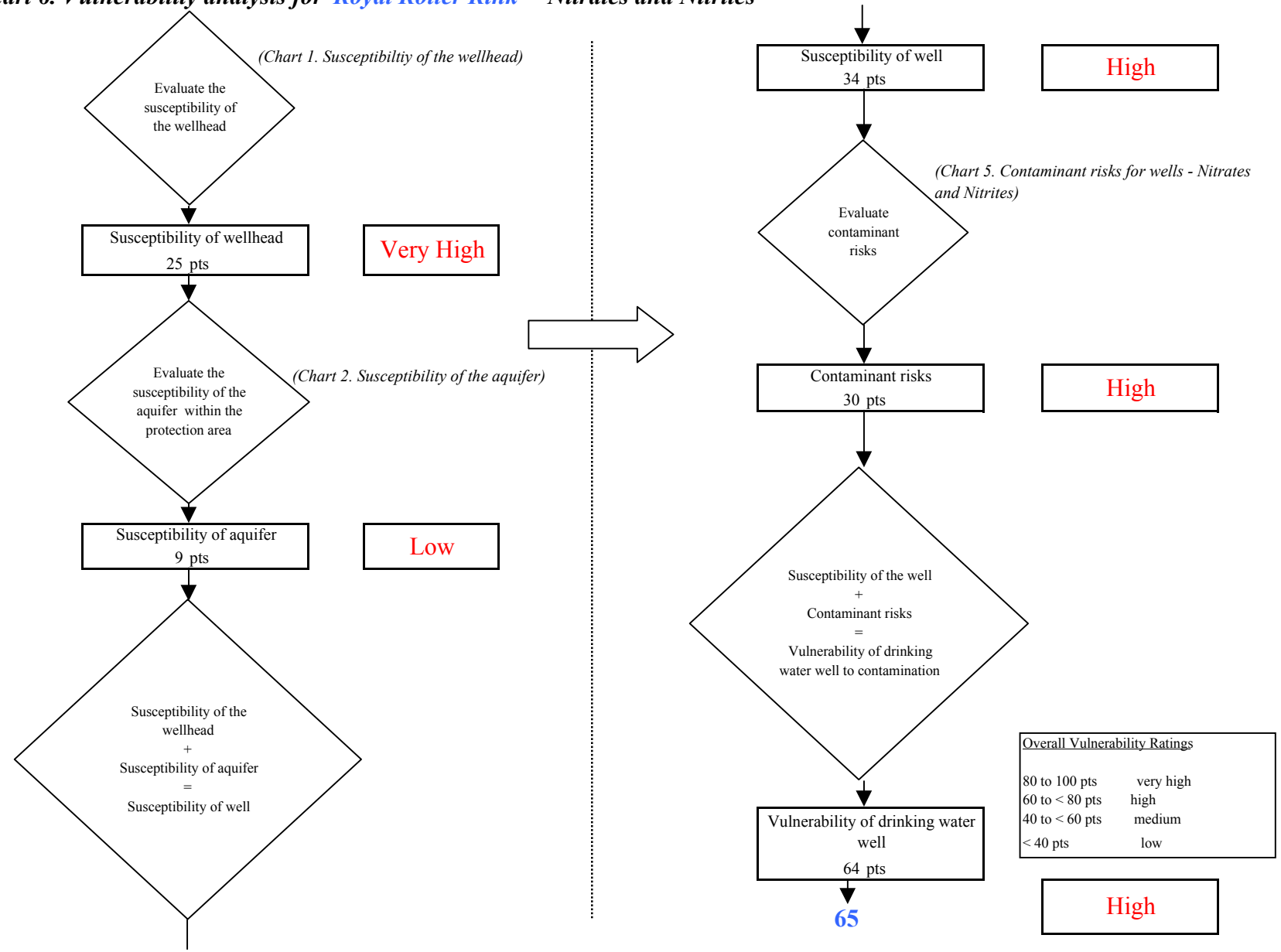


Chart 7. Contaminant risks for Royal Roller Rink - Volatile Organic Chemicals

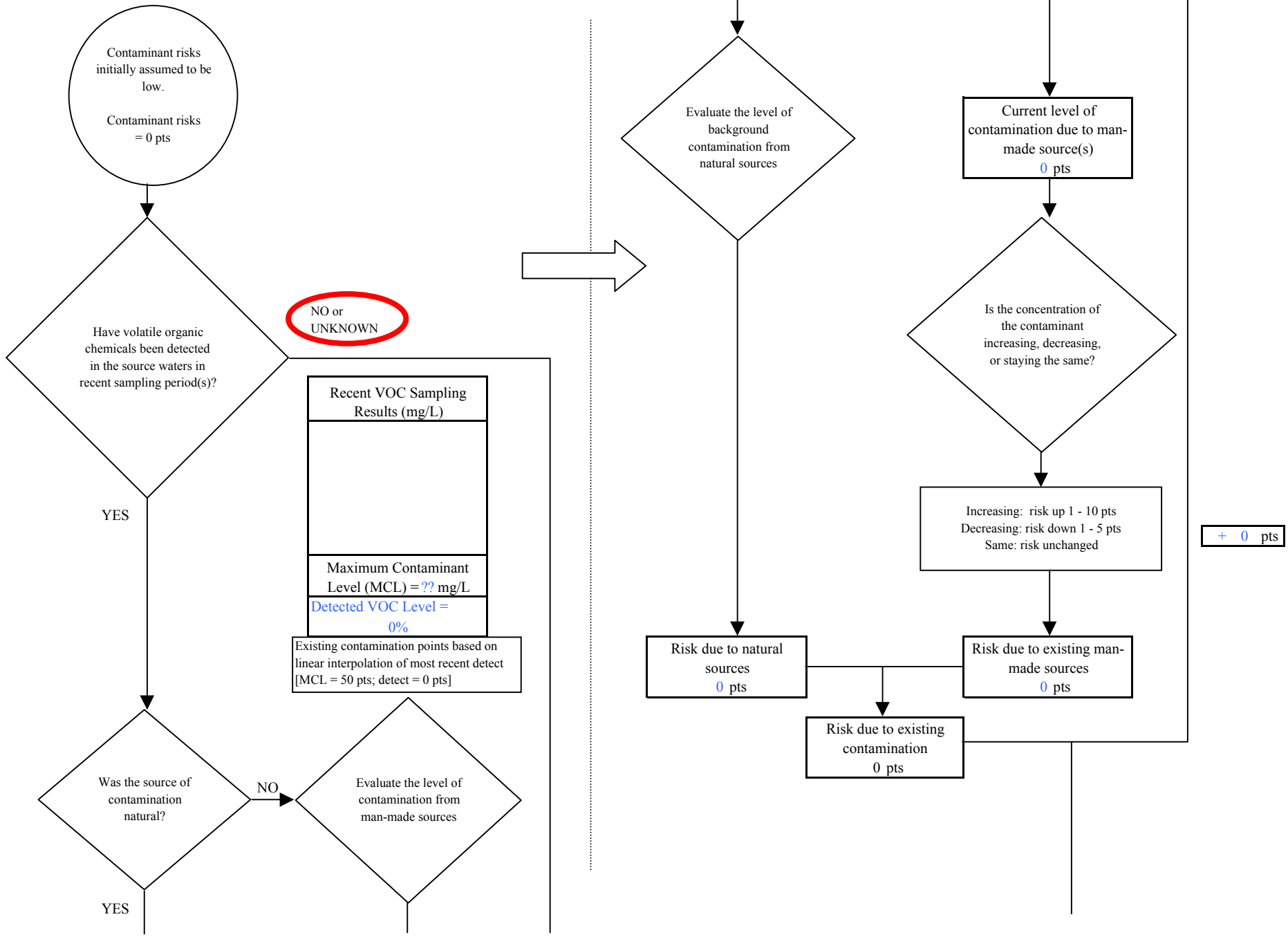


Chart 7. Contaminant risks for Royal Roller Rink - Volatile Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	8	1	9
Medium(s)	4	3	7
Low(s)	4	12	16

	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

Matrix Score 40

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

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

Is the source aquifer fractured rock or karst?

YES

NO

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

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

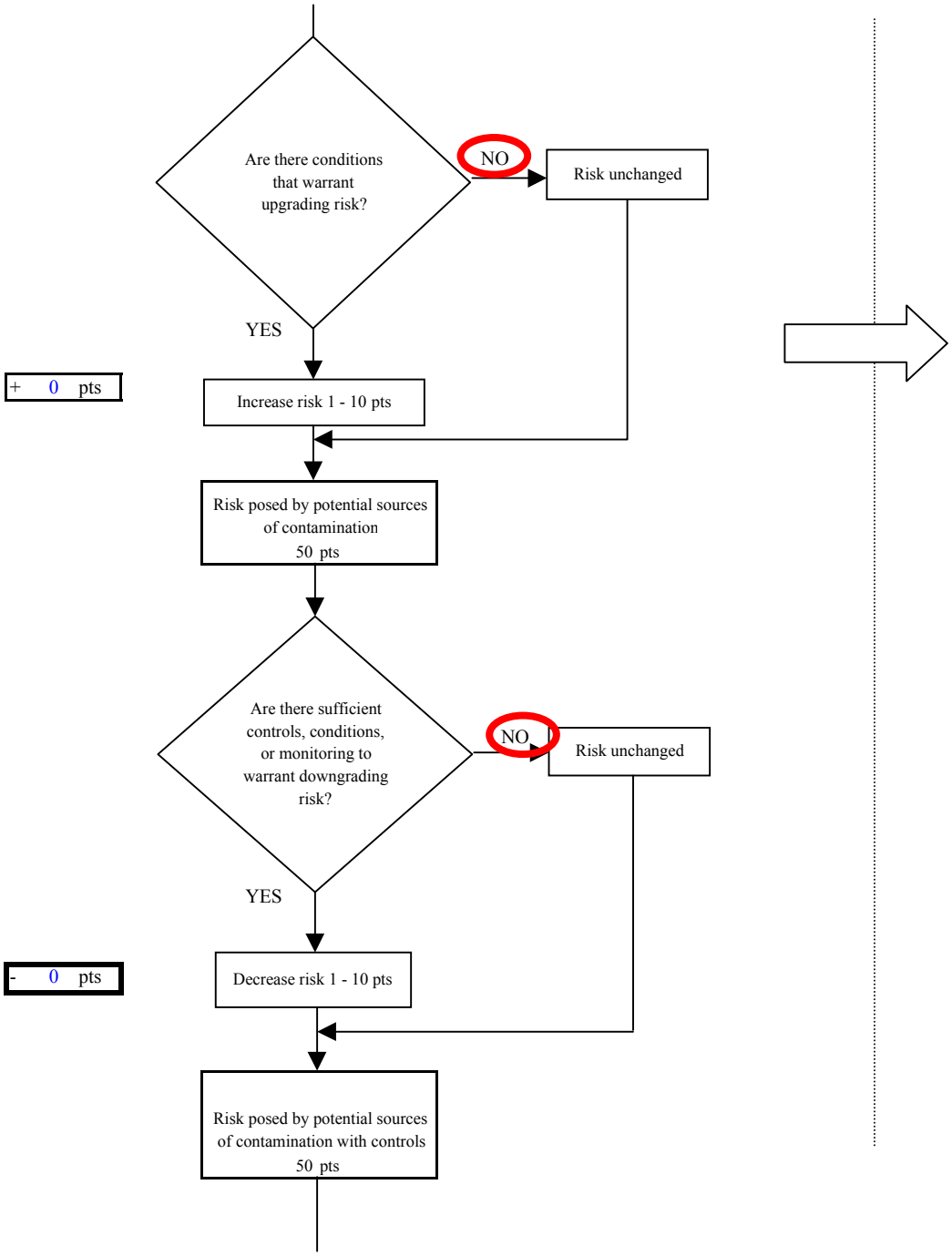
Risk unchanged

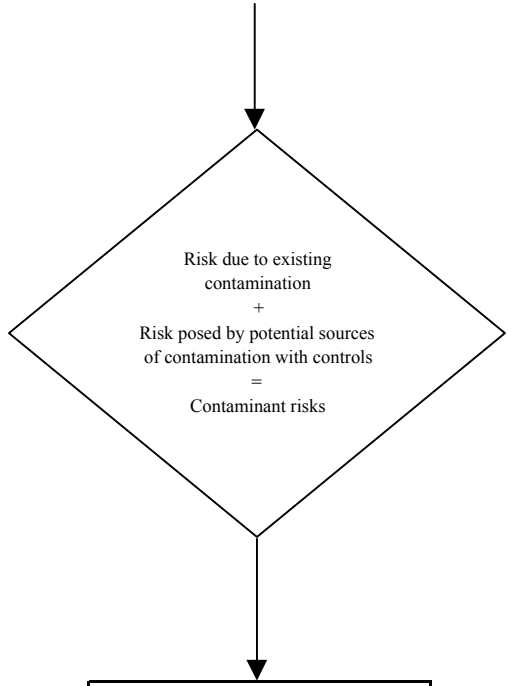
YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 7. Contaminant risks for Royal Roller Rink - Volatile Organic Chemicals





Existing
0 pts
+
Potential
50 pts
=
Contaminant Risk
50 pts

Contaminant risks*
= 50 pts

*Truncate risk at 50 pts

Very High

Contaminant Risk Ratings

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

Chart 8. Vulnerability analysis for Royal Roller Rink - Volatile Organic Chemicals