Source Water Assessment:

Hydrogeologic Susceptibility and Vulnerability Assessment for Tesoro-Parks Drinking Water Well, Wasilla, Alaska

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DRINKING WATER PROTECTION PROGRAM REPORT *86*

October 2001

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By Shannon & Wilson, Inc.

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: OCTOBER 2001

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By Shannon & Wilson, Inc.

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Tesoro-Parks 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 of the Parks Highway in Wasilla, Alaska. Identified potential and current sources of contaminants for Tesoro-Parks include: 2 "contaminated sites," a gasoline station, residential roads, 5 underground gasoline tanks, nonresidential aboveground heating oil tanks, a railroad corridor, a motor/ motor vehicle repair shop, a residential septic system, and approximately 1 acre 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, Tesoro-Parks public water source received vulnerability ratings of **Low** for bacteria and viruses, nitrates and/or nitrites, and **High** for volatile organic chemicals.

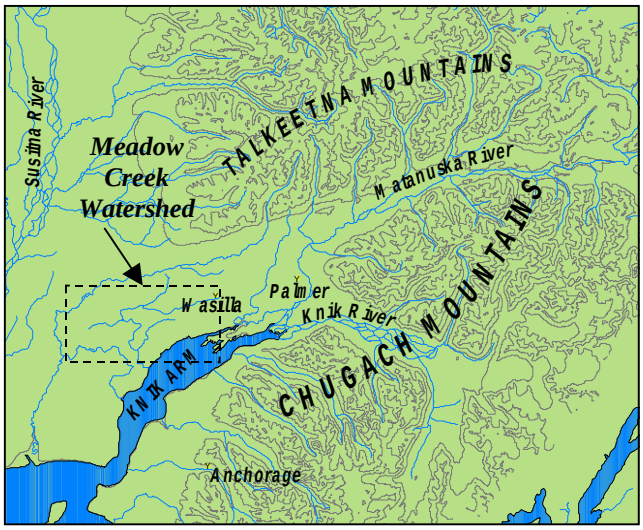

Figure 1. Index Map showing the location of the Matanuska-Susitna Valley and the Meadow Creek Watershed.

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 Tesoro-Parks 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 state's 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 6,000 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.

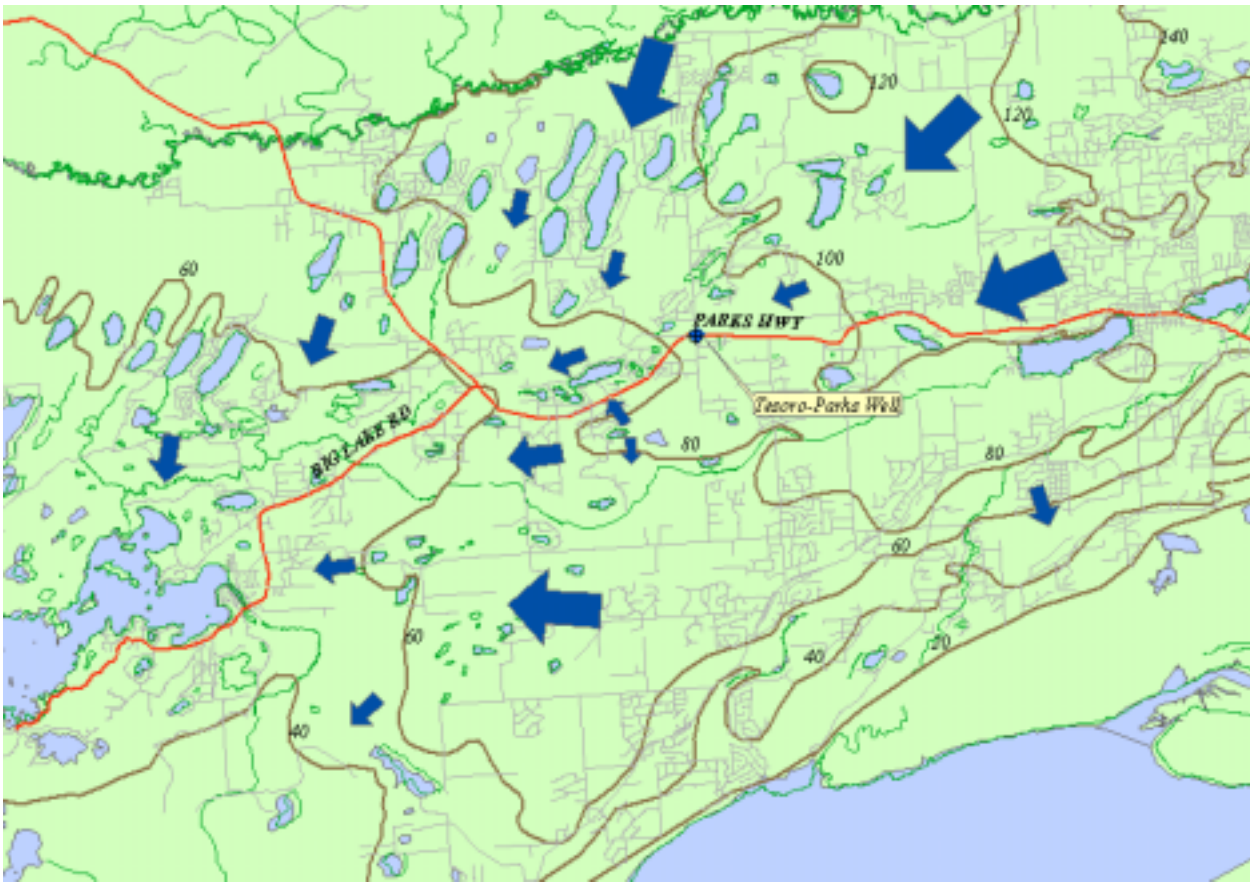

Figure 2. Map showing regional ground-water flow in Matanuska-Susitna Valley. *(Jokela, Munter and Evans, 1991)*

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).

TESORO-PARKS PUBLIC WATER SOURCE

Tesoro-Parks public water source is located in the Meadow Creek watershed at the corner of Sylvan Road and Parks Highway (Mile 49 Parks Highway). The system is a Class B public drinking water source and is owned and operated by the Tesoro Northstore. The source consists of one well at the northwestern corner of Lot 1 Runion Subdivision. The well is located at an elevation of approximately 270 feet above sea level. The well is inferred to tap the underlying, unconfined aquifer. In a July 22, 1996, letter to the ADEC, prepared by Gilfilian Engineering & Environmental Testing, Inc., the new well was to be constructed in accordance with applicable regulations. This would include a grout seal. According to the well log, the well penetrates sandy gravel, gravel, hard clay, and sand and gravel with clay to a total depth of 80 feet below land surface. The well is cased to a depth of 72 feet with well screen from 72 feet to 80 feet below land surface in gravel. Based on engineer's flow test report, the static water level is about 15 feet below land surface. Although hard clay was encountered during drilling from 29 to 34 feet below land surface, the extent and nature of this potential confining layer is unknown and the well is assumed to tap the unconfined aquifer.

This water source operates year round. The Tesoro-Parks drinking water source is assumed to serve no residents and approximately 40 non-residents through one service connection.

ASSESSMENT AND PROTECTION AREA FOR TESORO-PARKS DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Tesoro-Parks 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 Tesoro-Parks 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 Tesoro-Parks. 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 Tesoro-Parks 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 Tesoro-Parks corresponds to a time-of-travel of less than two years and extends eastward. 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 1.1 miles from the Tesoro-Parks 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 Tesoro-Parks' 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 Tesoro-Parks. Inventoried potential sources of contamination within Zones A through Zone B were associated with on-site and nearby commercial type activities including the railroad corridor (see Table 1 in Appendix B). Zones C and D contain only undeveloped land. Below is a summary of the contaminant sources inventoried within the Tesoro-Parks protection area:

- Large Capacity Septic Systems;
- Approximately 23 acres of residential area;
- Activities associated with roads;
- Nonresidential aboveground heating oil tanks
- Residential aboveground heating oil tanks
- Water Supply Wells
- Fire Burn Pits
- Single family septic systems
- Laundromats

These potential contaminant sources present risk for all three categories of drinking water contaminants for Tesoro-Parks 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 TESORO-PARKS 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)

Tesoro-Parks' 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. Based on the well information the well is grouted. The presence of grouting can prevent 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 Tesoro-Parks.

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

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	22	Very High
Natural Susceptibility	22	Medium

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. Fuel distribution activities, underground storage tanks, aboveground storage tanks, engine repair shops, activities associated with the highway and roads, railroad corridor, the abandoned well, and residential septic systems contribute the highest risk for potential contamination to the Tesoro-Parks 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	12	Low
Nitrates and/or Nitrites	13	Low
Volatile Organic Chemicals	50	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.

Table 3. Overall Vulnerability of Tesoro-Parks Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	35	Low
Nitrates and Nitrites	35	Low
Volatile Organic Chemicals	70	High

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 very high 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 Tesoro-Parks source water indicates low concentrations of nitrate were reported in August 1999 and March 2001 (See Chart 6-Contaminant Risks for Nitrates/Nitrites in Appendix D). The reported nitrate contamination was less than 10% of the Maximum Contaminant Level (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 Tesoro-Parks water source remains at safe levels, with respect to human health.

There are five underground storage tanks at the site and fuel distribution appurtenances. These tanks and activities associated with fuel distribution are contaminant risks for volatile organic chemicals (VOCs). 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. Toluene was reported in the well's source at a concentration of 0.30 ug/l in September 1996 (only test data available). This concentration is well below the State and Federal MCL for drinking water. The public water system is not required to sample for VOCs, thus it is unknown if any VOCs are reaching the well's source.

SUMMARY

A *Source Water Assessment* has been completed for the Tesoro-Parks source of public drinking water. The overall vulnerability of this source to contamination is **Low** for bacteria and viruses, nitrates and/or nitrites, and **High** for 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

Tesoro-Parks
Drinking Water Protection Area

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Tesoro-Parks

APPENDIX C

Tesoro-Parks
Drinking Water Protection Area
and Potential & Existing Contaminant Sources

APPENDIX D

Vulnerability Analysis for Tesoro-Parks Public Drinking Water Source

Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Location	Map	Comments
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1		B&J Rainbow Center	3	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-2	A	Tesoro-Parks	3	Two Leaking Underground Storage Tank Cases (one open
Gasoline stations (without repair shop)	C15	C15-1	A	Southeast of Well	3	
Residential Areas	R1	R1-1	A	East of Tesoro-Parks	2	<1 Acre
Septic systems (serves one single-family home)	R2	R2-1	A	North of Parks Hwy	3	
Tanks, gasoline (underground)	T12	T12-1	A	Tesoro-Parks	3	
Tanks, gasoline (underground)	T12	T12-2	A	Tesoro-Parks	3	
Tanks, gasoline (underground)	T12	T12-3	A	Tesoro-Parks	3	
Tanks, gasoline (underground)	T12	T12-4	A	Tesoro-Parks	3	
Tanks, gasoline (underground)	T12	T12-5	A	Tesoro-Parks	3	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-1	A	North of Parks Hwy	3	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-2	A	North of Parks Hwy	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Parks Highway	2	
Highways and roads, paved (cement or asphalt)	X20	X20-2	A	Sylvan Road	2	
Highways and roads, paved (cement or asphalt)	X20	X20-3	A	Pittman Rd.	2	
Motor /motor vehicle repair shops	C31	C31-1	B	North of Parks Hwy	3	
Rail Corridor	X30	X30-1	A	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*	*2*	*East of Tesoro-Parks*	*2*	*<1 Acre*
Septic systems (serves one single-family home)	*R2*	*R2-1*	*A*	*Very Low*	*3*	*North of Parks Hwy*	*3*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-1*	*A*	*Very Low*	*4*	*Parks Highway*	*2*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-2*	*A*	*Very Low*	*5*	*Sylvan Road*	*2*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-3*	*A*	*Very Low*		*Pittman Rd.*	*2*	

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*	*1*	*East of Tesoro-Parks*	*2*	*<1 Acre*
Septic systems (serves one single-family home)	*R2*	*R2-1*	*A*	*Very Low*	*2*	*North of Parks Hwy*	*3*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-1*	*A*	*Very Low*	*3*	*Parks Highway*	*2*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-2*	*A*	*Very Low*	*4*	*Sylvan Road*	*2*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-3*	*A*	*Very Low*	*5*	*Pittman Rd.*	*2*	

Contaminant Source Category	*Contaminant Source ID*	*CS ID Tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank After Analysis*	*Location*	*Map*	*Comments*
Gasoline stations (without repair shop)	*C15*	*C15-1*	*A*	*High*	*1*	*Southeast of Well*	*3*	
Tanks, gasoline (underground)	*T12*	*T12-1*	*A*	*High*	*2*	*Tesoro-Parks*	*3*	
Tanks, gasoline (underground)	*T12*	*T12-2*	*A*	*High*	*3*	*Tesoro-Parks*	*3*	
Tanks, gasoline (underground)	*T12*	*T12-3*	*A*	*High*	*4*	*Tesoro-Parks*	*3*	
Tanks, gasoline (underground)	*T12*	*T12-4*	*A*	*High*	*5*	*Tesoro-Parks*	*3*	
Tanks, gasoline (underground)	*T12*	*T12-5*	*A*	*High*		*Tesoro-Parks*	*3*	
Residential Areas	*R1*	*R1-1*	*A*	*Low*		*East of Tesoro-Parks*	*2*	*<1 Acre*
Tanks, heating oil, nonresidential (aboveground)	*T14*	*T14-1*	*A*	*Low*		*North of Parks Hwy*	*3*	
Tanks, heating oil, nonresidential (aboveground)	*T14*	*T14-2*	*A*	*Low*		*North of Parks Hwy*	*3*	
Septic systems (serves one single-family home)	*R2*	*R2-1*	*A*	*Very Low*		*North of Parks Hwy*	*3*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-1*	*A*	*Very Low*		*Parks Highway*	*2*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-2*	*A*	*Very Low*		*Sylvan Road*	*2*	
Highways and roads, paved (cement or asphalt)	*X20*	*X20-3*	*A*	*Very Low*		*Pittman Rd.*	*2*	
Rail Corridor	*X30*	*X30-1*	*A*	*Low*		*North of Parks Hwy*	*3*	
Motor /motor vehicle repair shops	*C31*	*C31-1*	*B*	*Medium*		*North of Parks Hwy*	*3*	

Chart 1. Susceptibility of the Wellhead – Tesoro - Parks

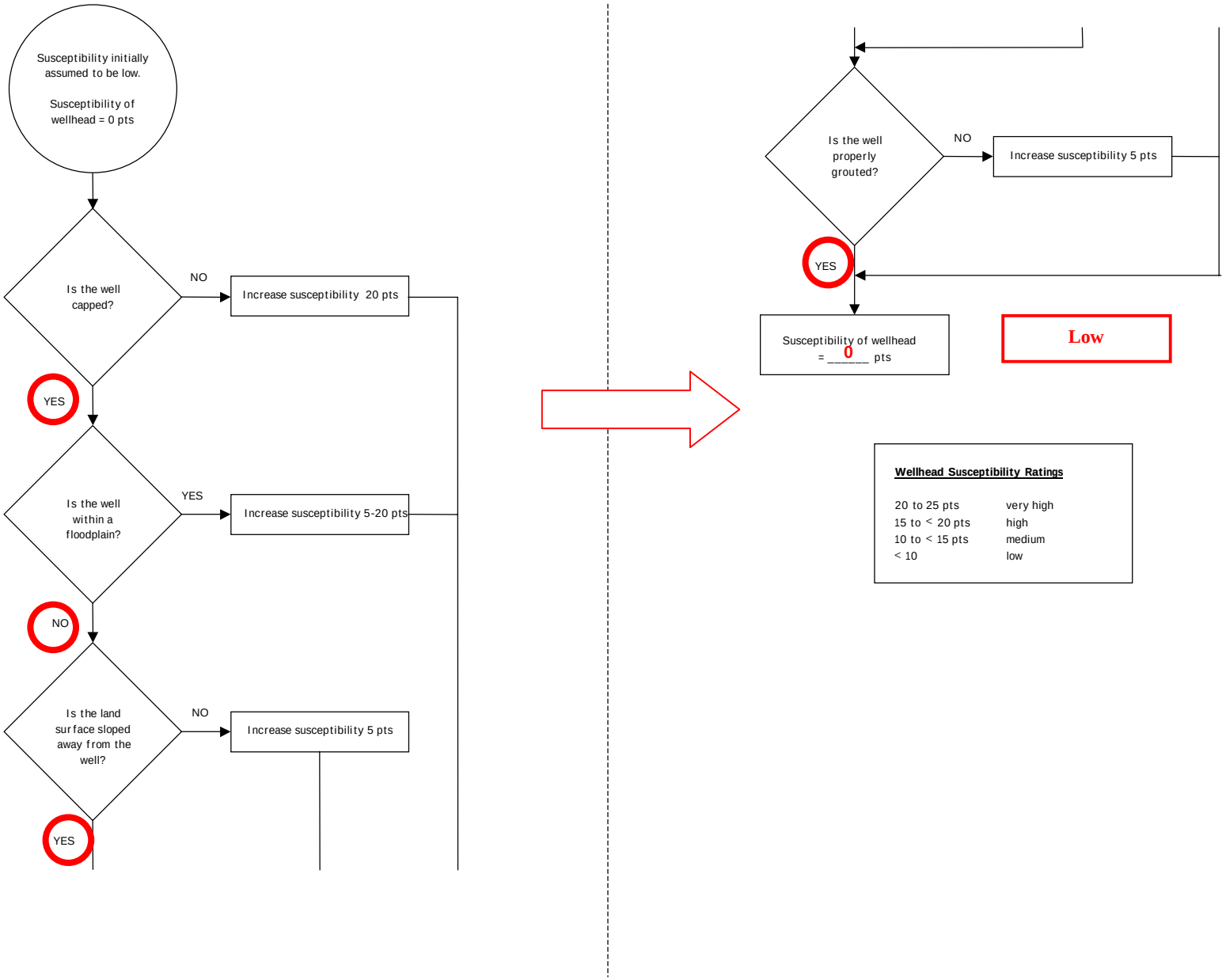
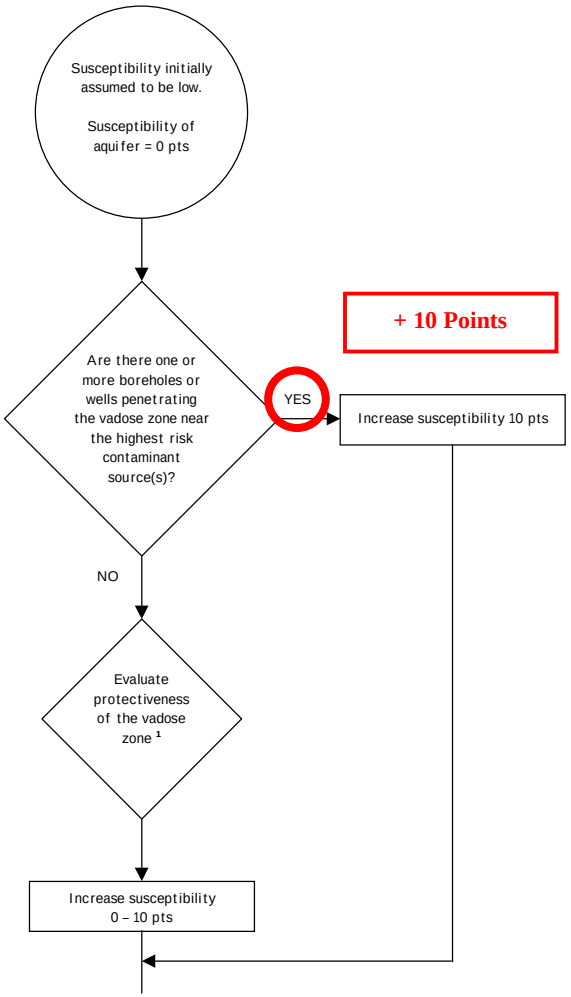
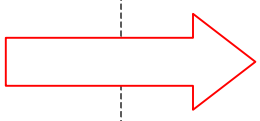
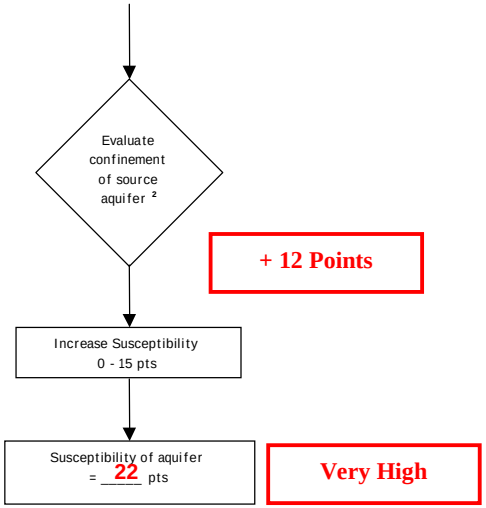


Chart 2. Susceptibility of the Aquifer – Tesoro - Parks







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 = 15 feet
Interpolate linearly = 6 pts.
6 pts. X 50% = **3 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 80 feet=10 pts.
Several wells/boreholes in proximity = 15 pts.

10(65%) + 15(35%) =**12 pts.**

Total = 12 of 15 Points

Aquifer Susceptibility Ratings

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

Very High

Chart 3. Contaminant risks for Tesoro-Parks – Bacteria & Viruses

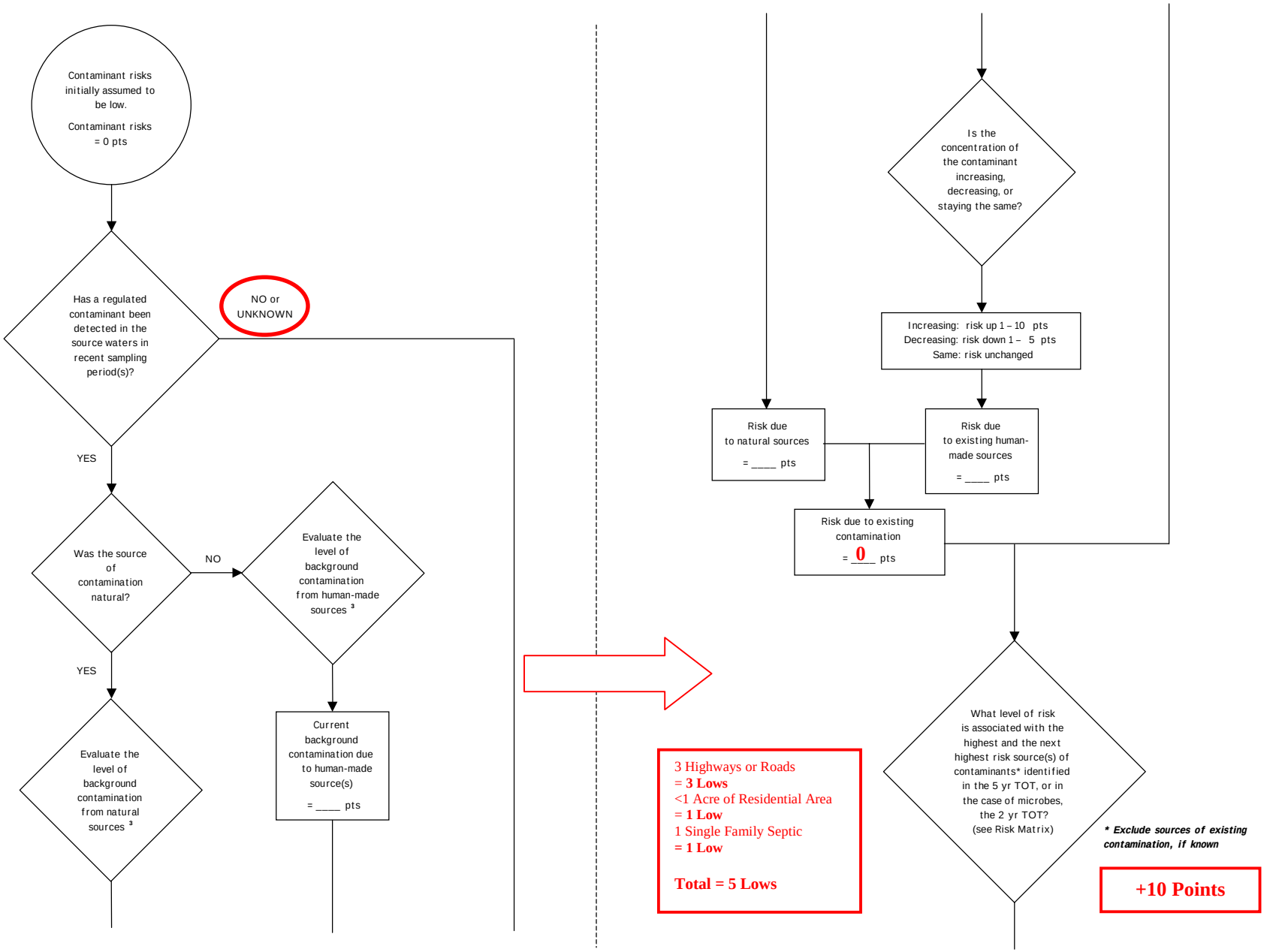


Chart 3. Contaminant risks for Tesoro-Parks– Bacteria & Viruses (Continued)

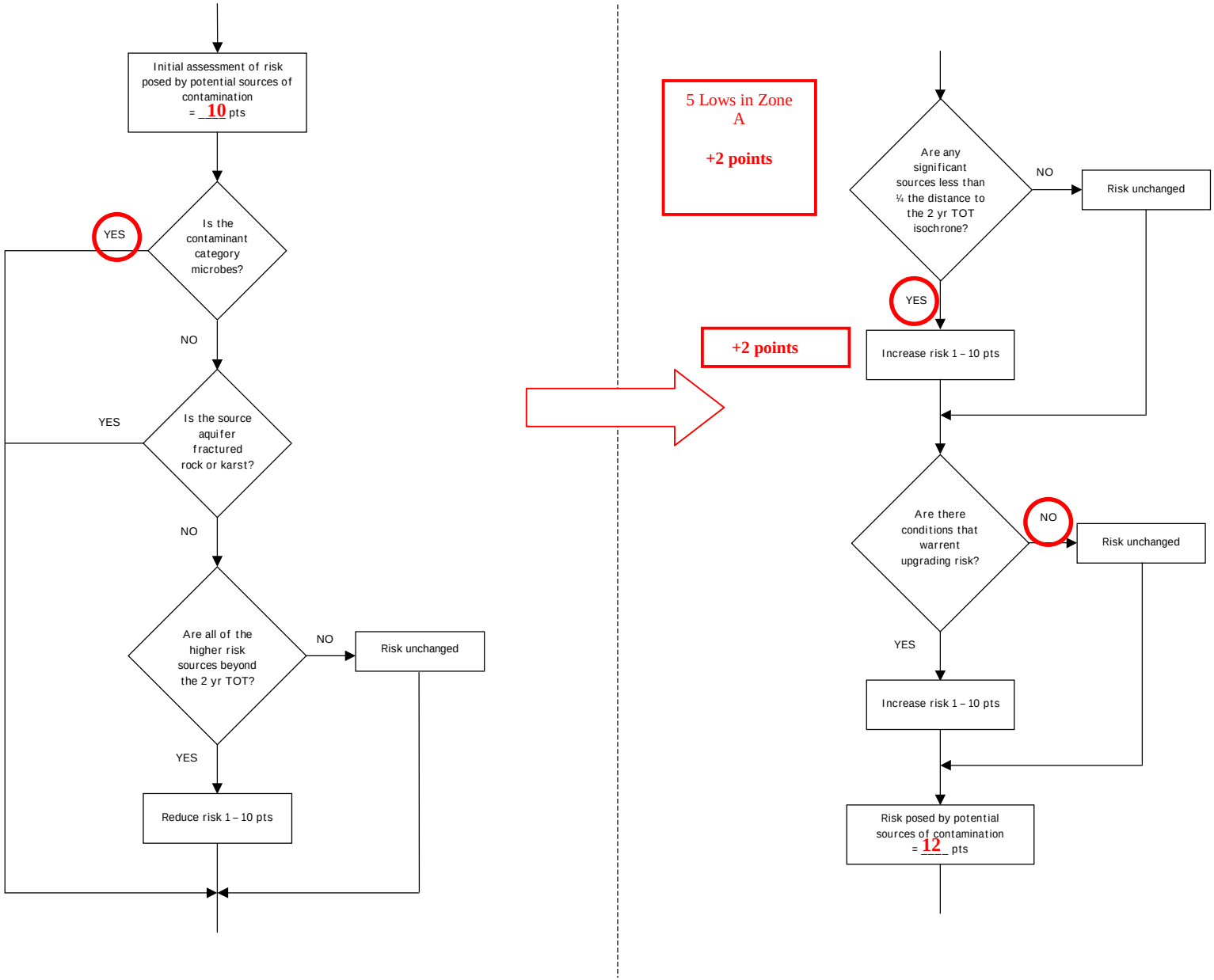
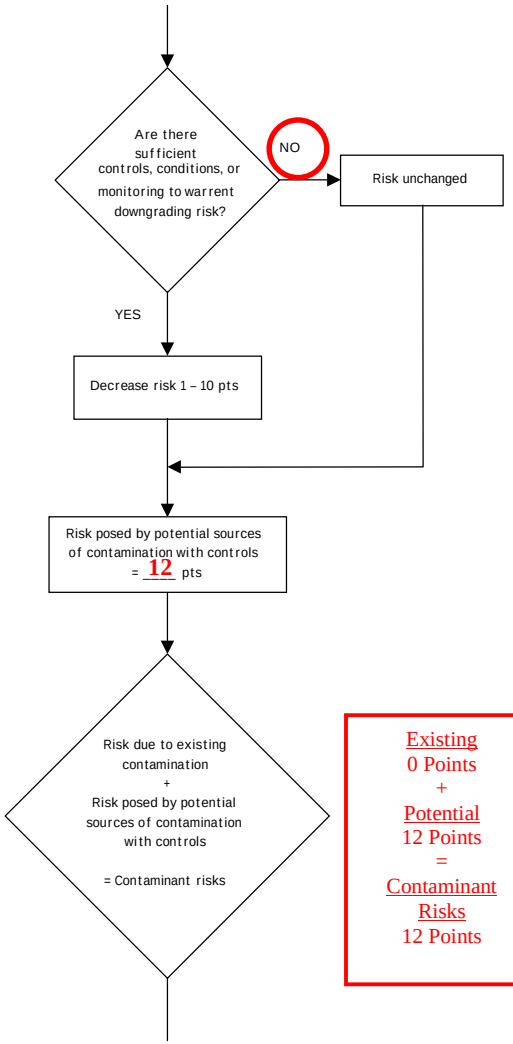


Chart 3. Contaminant risks for Tesoro-Parks – Bacteria & Viruses (Continued)



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

* *Truncate risk at 50 pts*

Contaminant risks*
= 12 pts

Low

3. Level of Background Contamination

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

Contaminant Risk Ratings

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

Sample Date	Result
6/27/01	Non Detect (ND)
3/21/01	ND
12/19/00	ND
9/27/00	ND
6/12/00	ND

Table 1. Risk Matrix for Contaminant Sources for Tesoro-Parks– Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Total = 5 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 4. Vulnerability Analysis for Tesoro-Parks – Bacteria & Viruses

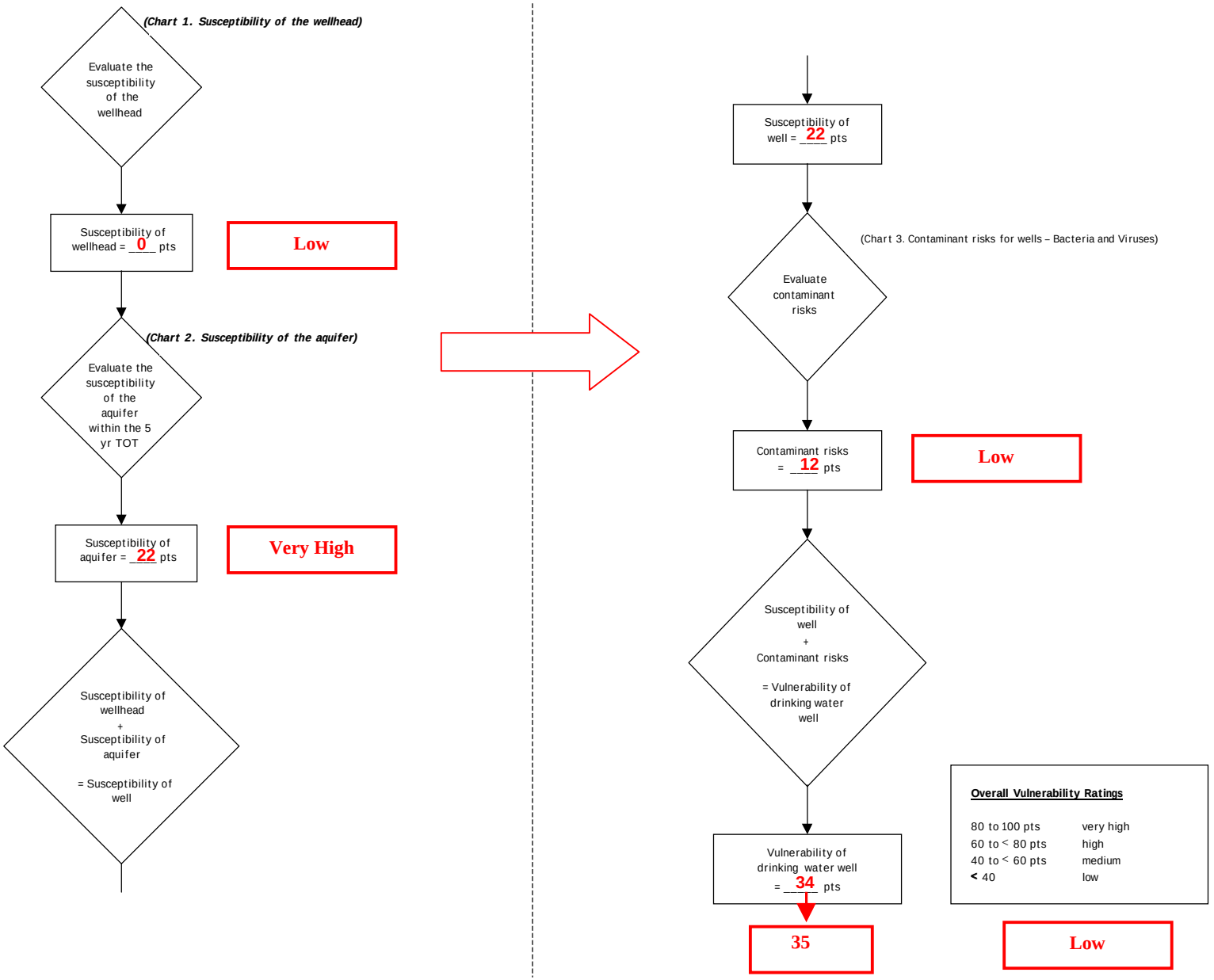


Chart 5. Contaminant Risks for Tesoro-Parks – Nitrates and Nitrites

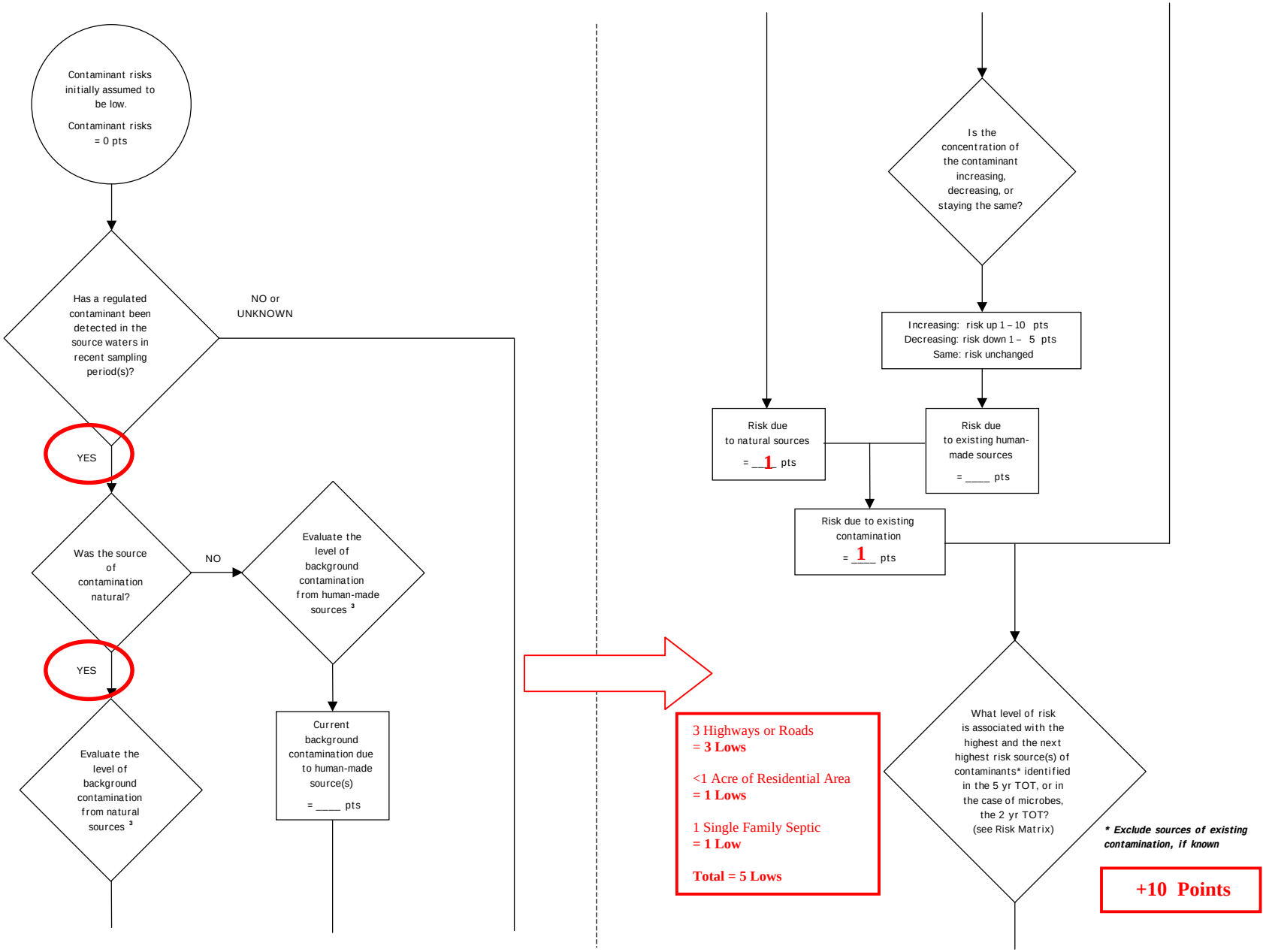


Chart 5. Contaminant risks for Tesoro-Parks– Nitrates and Nitrites (Continued)

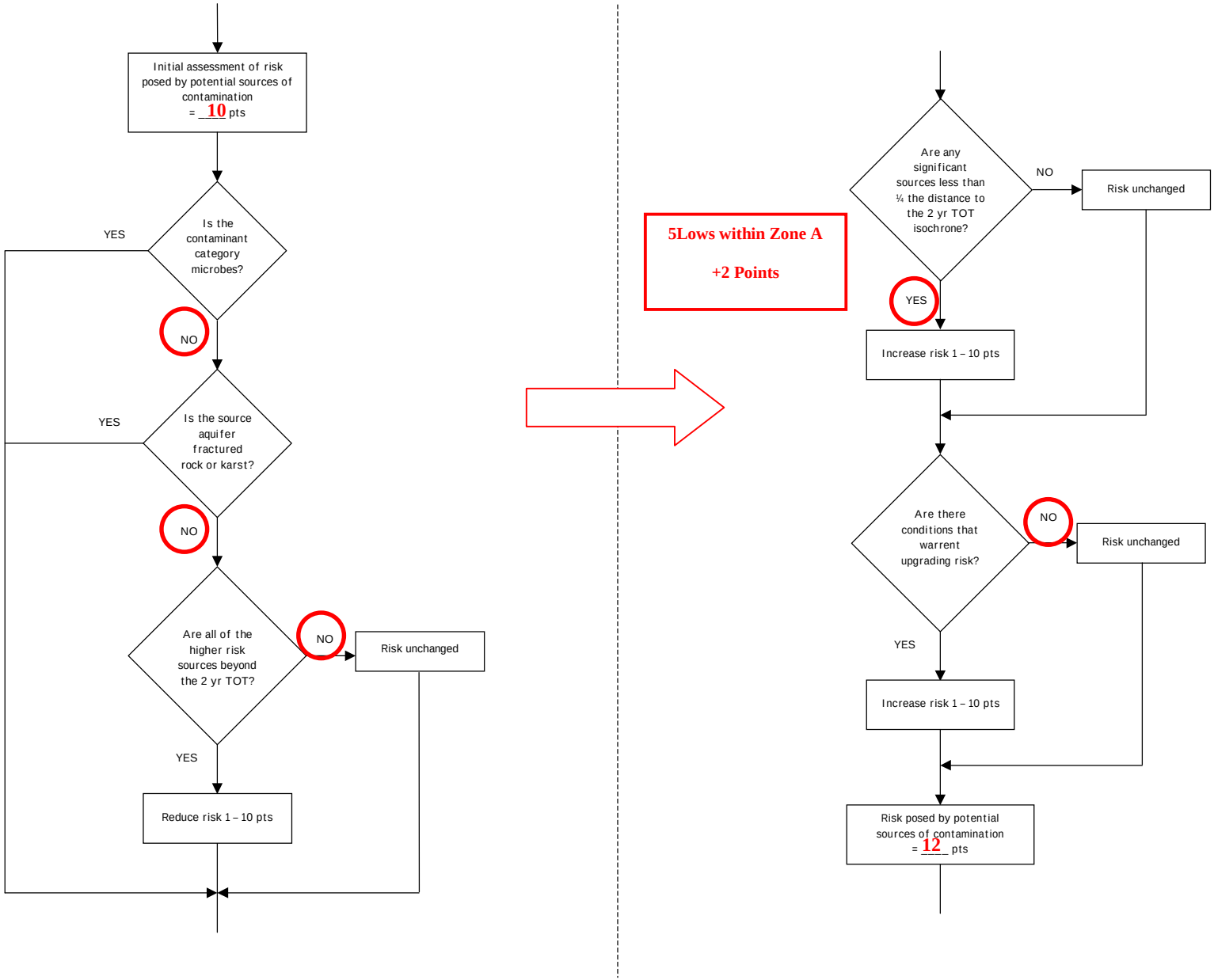
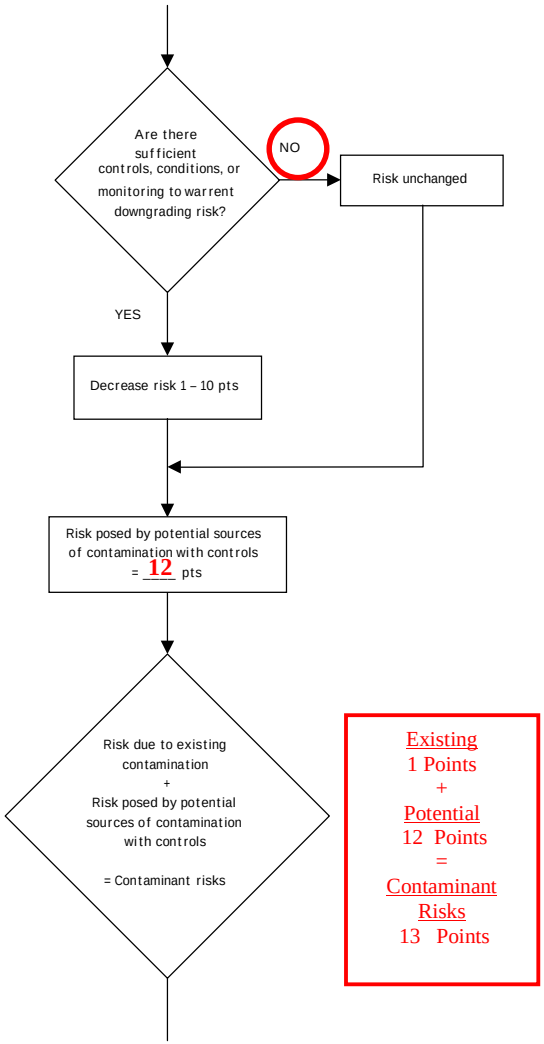


Chart 5. Contaminant risks for Tesoro-Parks – Nitrates and Nitrites (Continued)



Existing
1 Points
+
Potential
12 Points
=
Contaminant Risks
13 Points

* *Truncate risk at 50 pts*

Contaminant risks*
= 13 pts

Low

3. Level of Background Contamination

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

Contaminant Risk Ratings

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

Sample Date	Concentration
3/21/01	0.417 mg/L
12/19/00	Not Detected (ND)
12/12/00	ND
08/11/99	0.380 mg/L
11/12/98	ND

Maximum Contaminant Level (MCL)= 10mg/L
(0.417 mg/L)/(10 mg/L) = 0.0417 of MCL

Interpolated Linearly = **1 Points**

Table 2. Risk Matrix for Contaminant Sources for Tesoro-Parks– Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Total = 5 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 Tesoro-Parks – Nitrates and Nitrites

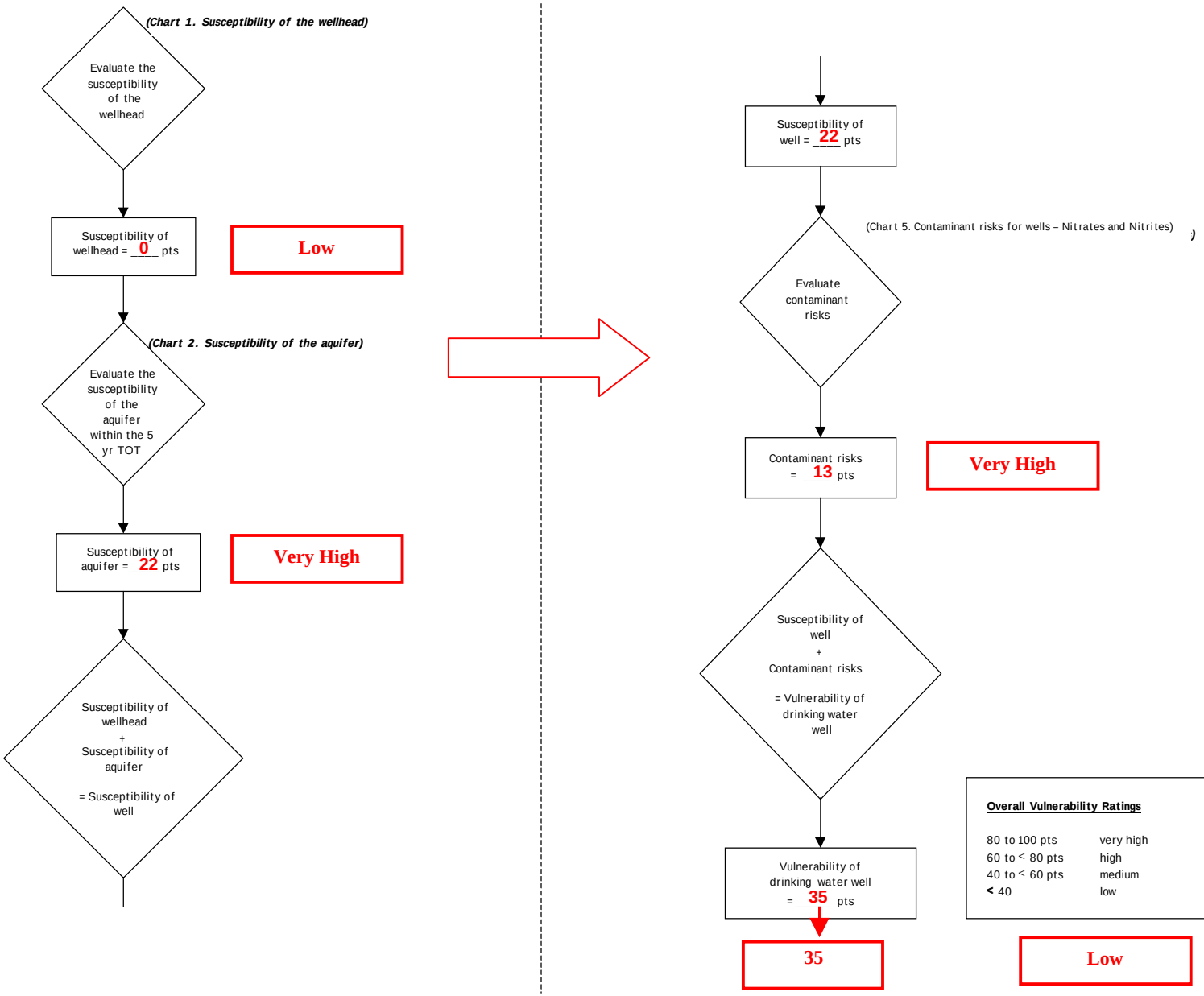
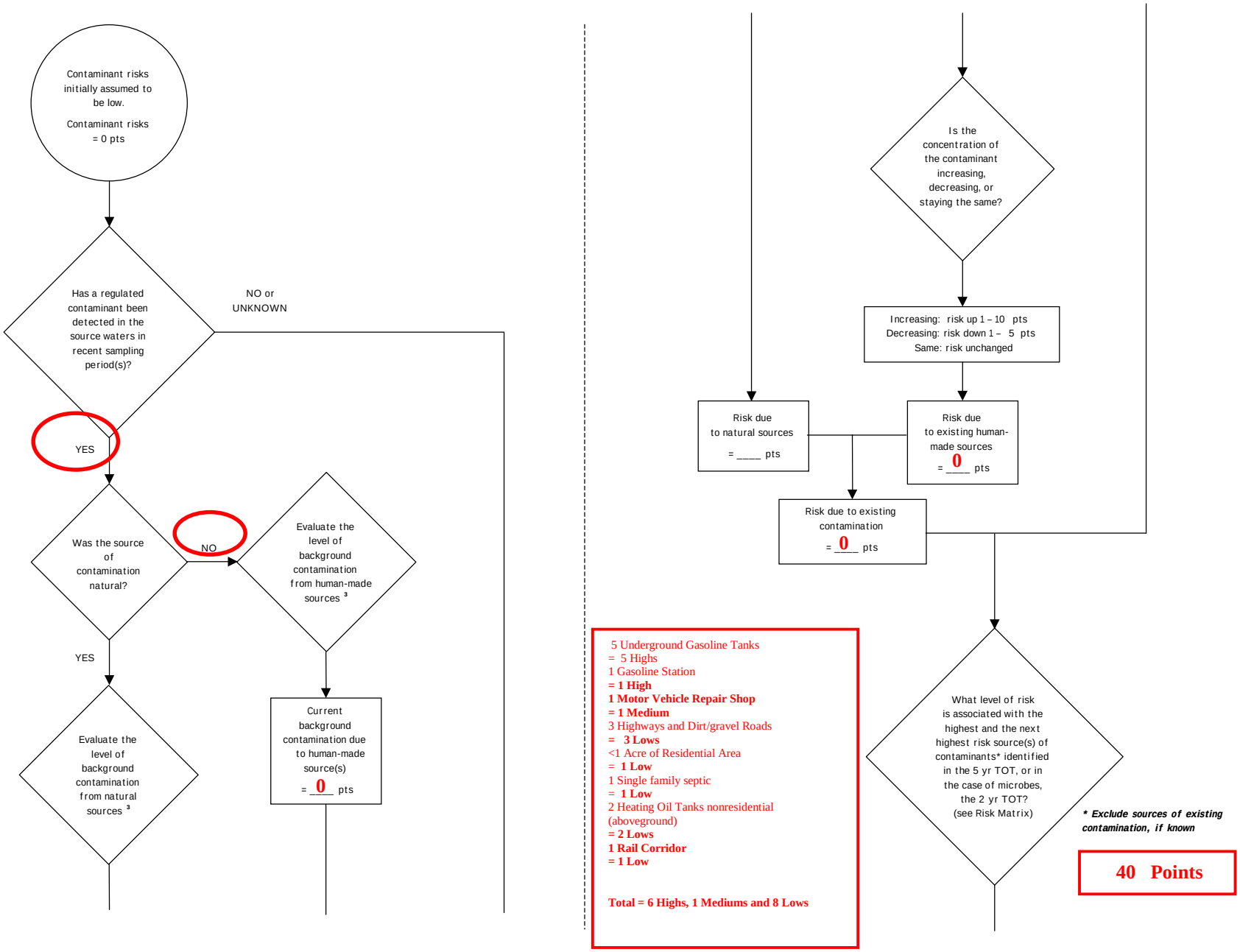


Chart 7. Contaminant Risks for Tesoro-Parks – Volatile Organic Chemicals



5 Underground Gasoline Tanks
= 5 Highs
1 Gasoline Station
= 1 High
1 Motor Vehicle Repair Shop
= 1 Medium
3 Highways and Dirt/gravel Roads
= 3 Lows
<1 Acre of Residential Area
= 1 Low
1 Single family septic
= 1 Low
2 Heating Oil Tanks nonresidential (aboveground)
= 2 Lows
1 Rail Corridor
= 1 Low

Total = 6 Highs, 1 Mediums and 8 Lows

Chart 7. Contaminant Risks for Tesoro-Parks – Volatile Organic Chemicals (Continued)

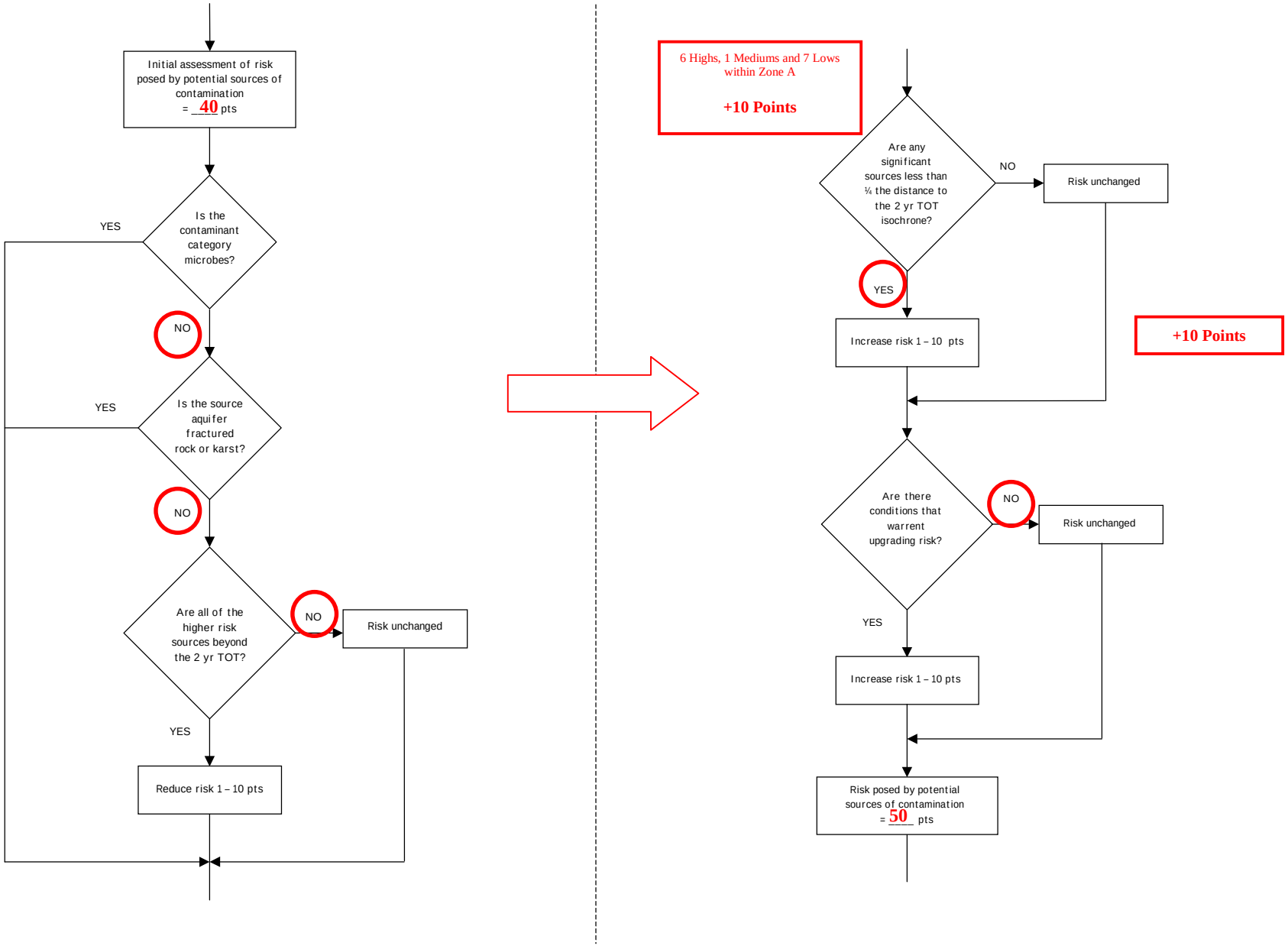
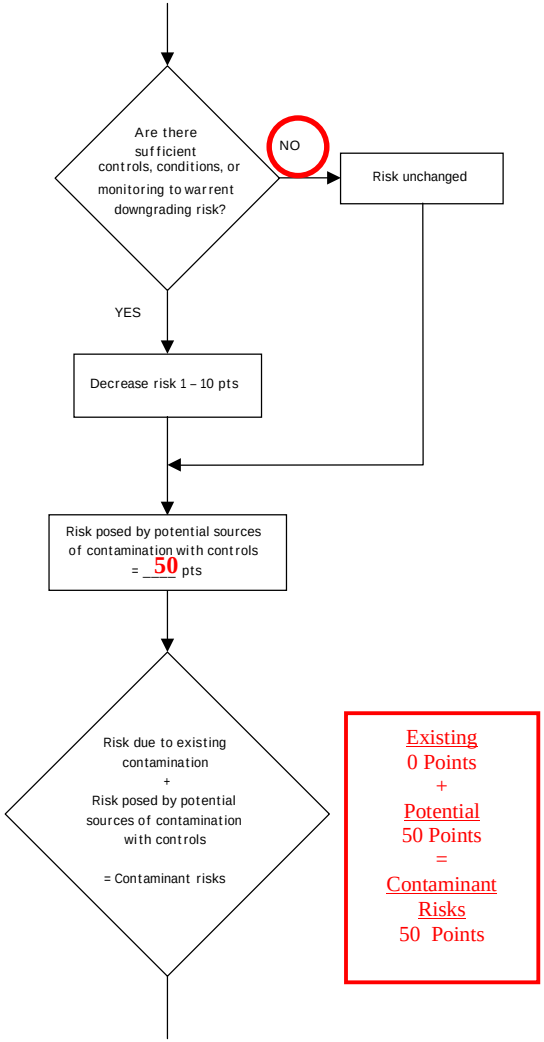


Chart 7. Contaminant Risks for Tesoro-Parks– Volatile Organic Chemicals (Continued)



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

* Truncate risk at 50 pts

Contaminant risks*
= 50 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

On 9/27/96 the well was sampled for numerous Volatile Organic Chemicals, all were not detectable except toluene at 0.0003 mg/L.

Maximum Contaminant Level (MCL) for toluene = 1 mg/L
(0.0003 mg/L)/(1 mg/L) = 0.0003 of MCL

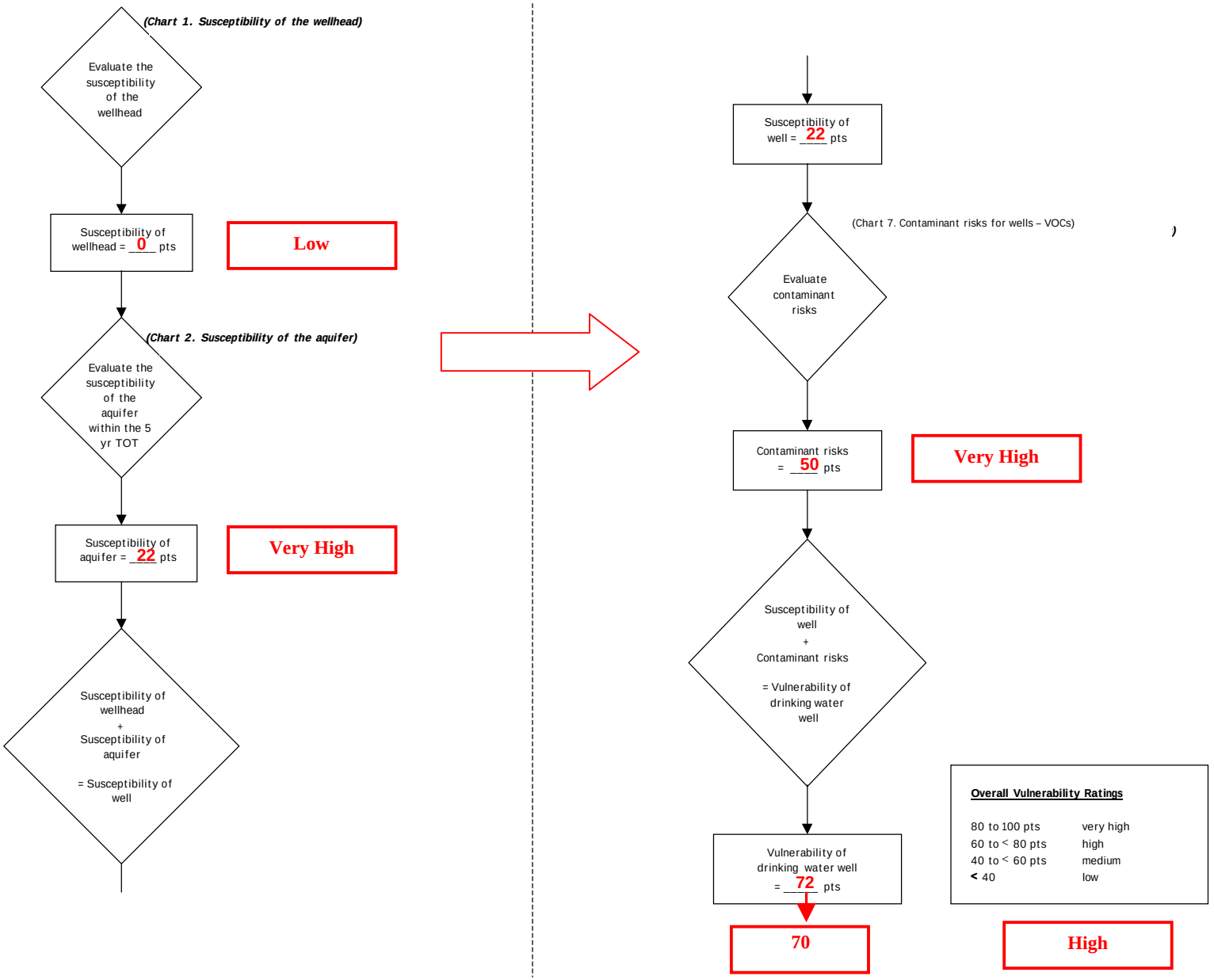
Interpolated Linearly = **0 Points**

Table 3. Risk Matrix for Contaminant Sources for Tesoro-Parks – Volatile Organic Chemicals

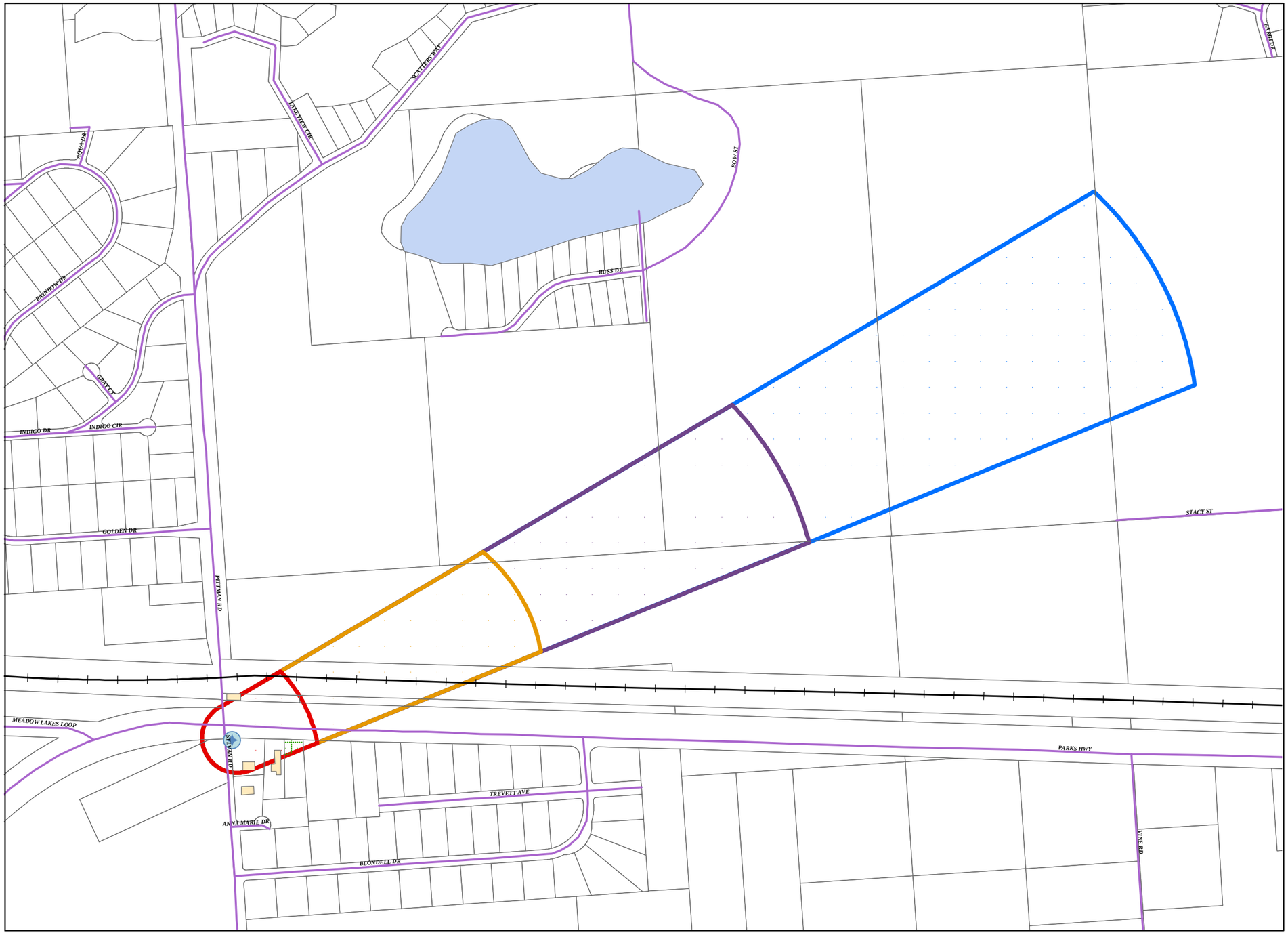
Level of Risk Associated with the Highest Risk Sources

Total = 6 Highs, 1 Mediums and 8 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 Tesoro-Parks – *Volatile Organic Chemicals*



Drinking Water Protection Areas for Tesoro-Parks

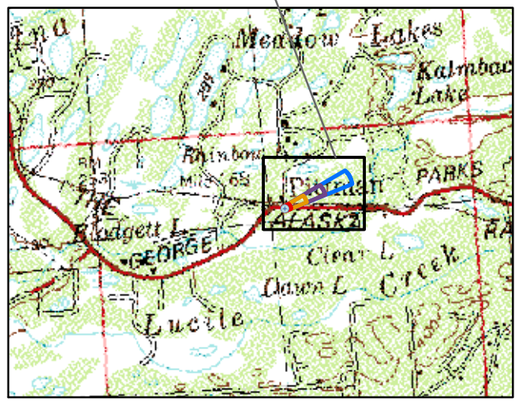


690 0 690 Feet

PWSID 225502.001

- **Tesoro - Parks Well**
- **MSB roads**
- **Railroad**
- **MSB parcel core**
- **Buildings**
- **Lakes**
- **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

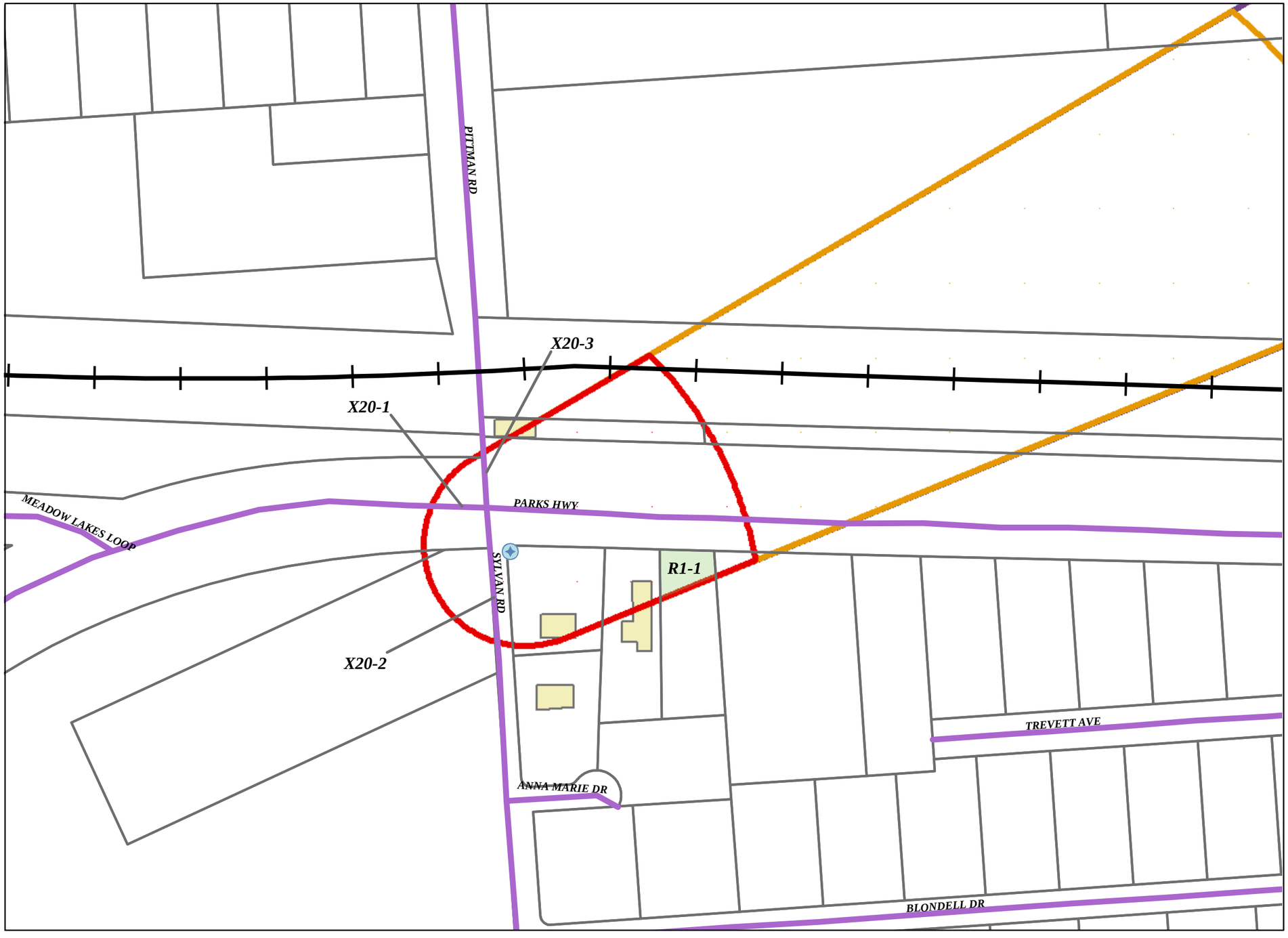
Location of Map



N
W E
S

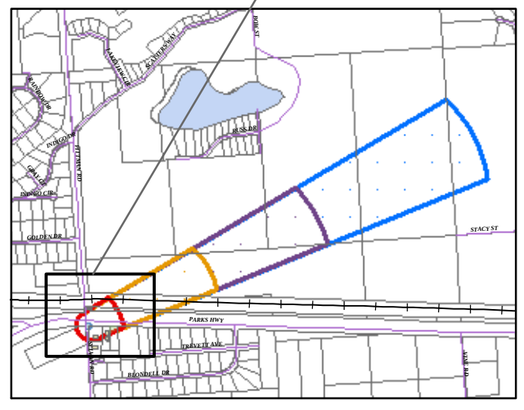
Map 1

Drinking Water Protection Areas for Tesoro-Parks and Potential and Existing Sources of Contamination



Tesoro - Parks Well
MSB roads
MSB parcel core
Residential Area
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
Railroad

Location of Map



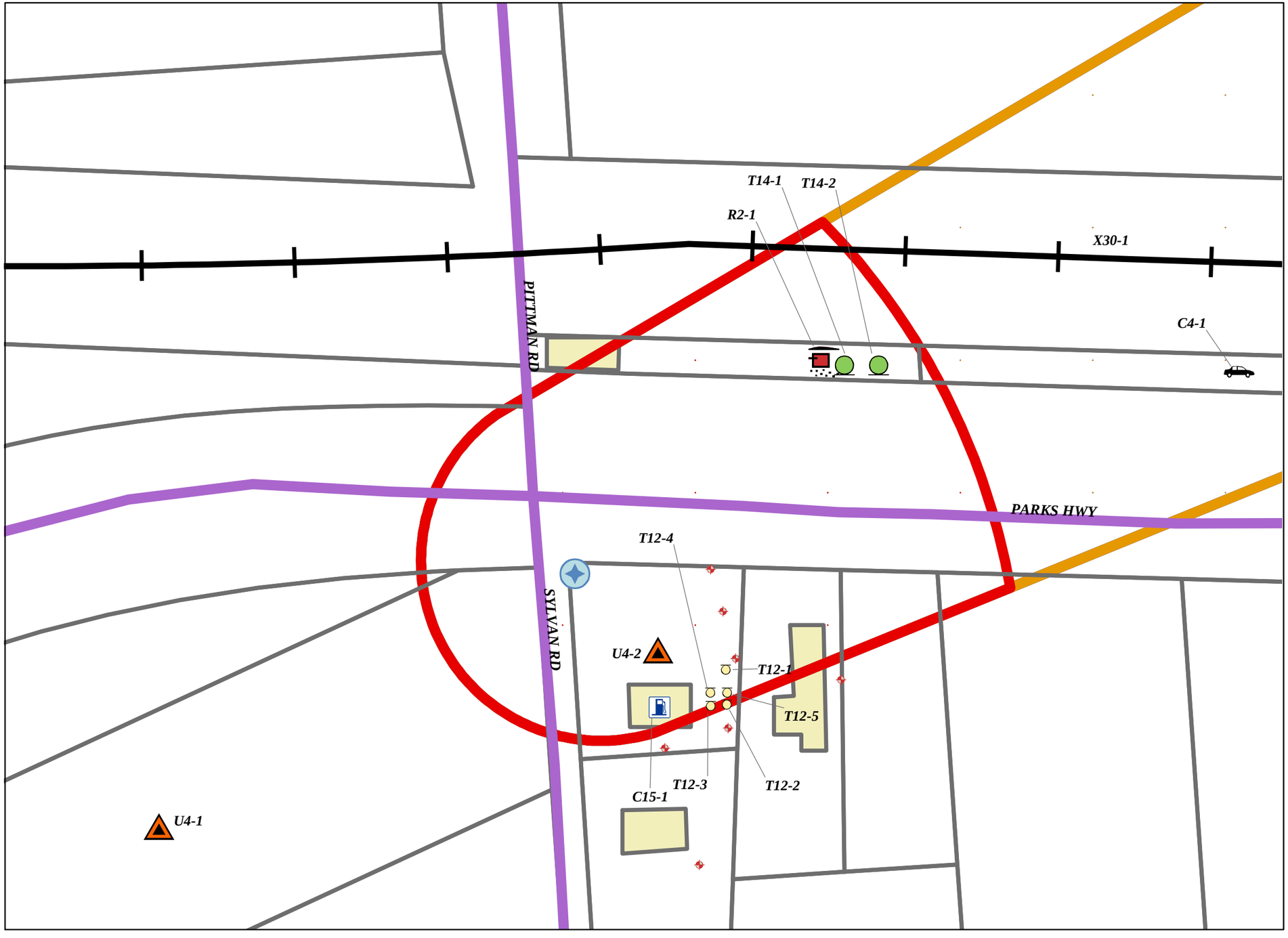
240 0 240 Feet

PWSID 225502.001

N
W E
S

Map 2

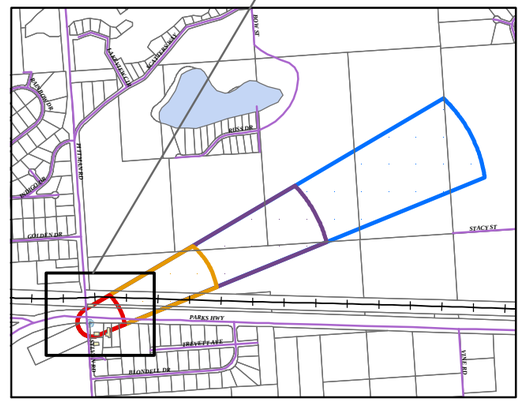
Drinking Water Protection Areas for Tesoro-Parks and Potential and Existing Sources of Contamination



130 0 130 Feet

Tesoro - Parks Well
Gasoline Station (C15)
Motor/ Motor Vehicle Repair Shop (C31)
Underground Gasoline Storage Tank (T12)
Nonresidential Heating Oil AST (T14)
ADEC Recognized "Contaminated Site" (U4)
Monitoring Wells (W6)
Single Family Septic System (R2)
MSB roads
MSB parcel core
Lakes
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

Location of Map



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Map 3