Source Water Assessment for Violet Circle

A Hydrogeologic Susceptibility and Vulnerability Assessment

DRINKING WATER PROTECTION PROGRAM REPORT 398
PWSID 226428.001

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Source Water Assessment for Violet Circle

By 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/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.

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2002

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By Alaska Department of Environmental Conservation

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Violet Circle is a Class A (community) drinking water source consisting of one well. Identified potential and current sources of contaminants for Violet Circle includes: one paved road three gravel roads, residential septic systems, one landfill and lawns and gardens. These existing and potential sources of contamination are considered a source of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, Violet Circle public water source received vulnerability rating of **Low** for bacteria and viruses, volatile organic chemicals, heavy metals, synthetics organic chemicals, other organic chemicals and **High** for nitrates and/or nitrites.

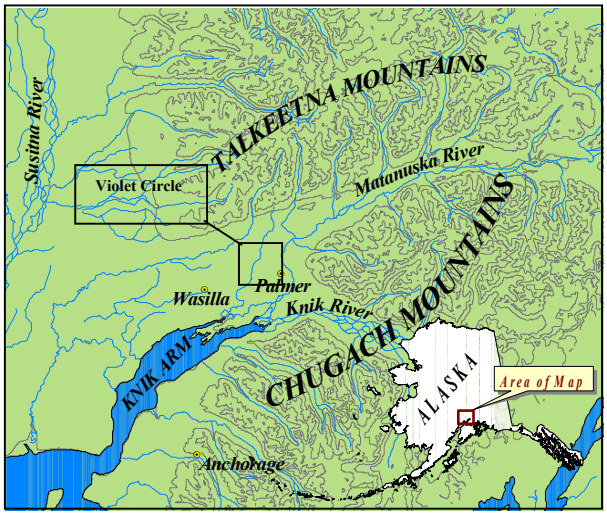

Figure 1. Index Map showing the location of the Matanuska-Susitna Valley and Violet Circle

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 Violet Circle source of public drinking water. This source consists of one well in the Sutton area (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 MATANUSKA-SUSITNA VALLEY-AREA, ALASKA

Location

The Matanuska-Susitna Valley is part of the lowland lying about 50 miles north of Anchorage in south-central Alaska. The well described in this report is part of the Matanuska River Watershed. This study area is roughly bounded on the north by the Talkeetna Mountains; on the west by Wasilla Creek; on the south by the Knik River; and on the east by the Chugach Mountains. The area covers approximately 150 square miles.

Climate

The climate of the Matanuska-Susitna Valley is the result of a combination of marine and continental influences. The 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 is approximately 15 inches per year. On the average, the Valley receives a total snow accumulation of 58 inches per year. Precipitation generally increased inland toward the Talkeetna Mountains where annual precipitation may exceed 60 inches. Mean daily temperature ranges from 67° F during July to 5° F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

The Matanuska-Susitna Valley is surrounded by rugged mountains that rise abruptly above the valley floor. The Chugach Mountains at the southern edge of the valley reach altitudes greater than 6300 feet. These mountains are composed primarily of metamorphosed sedimentary marine and volcanic rocks. Along the northern edge of the valley, peaks in the Talkeetna Mountains reach altitudes of 3000 to 5000 feet. The Talkeetna Mountains are composed mainly of igneous rocks, chiefly granite intrusives and subordinate lavas and tuffs; Cretaceous and Tertiary sedimentary rocks form the south flank of the mountains. Although the altitude of the valley floor ranges from sea level at Knik Arm to 1000 feet at the base of Wishbone Hill, the local relief is commonly not more than 100 to 200 feet.

The Matanuska and Knik River's drain the area. These rivers are braided glacial outwash streams having wide floodplains. Drainage is poor in many interstream tracts resulting in large areas of swampy ground with shallow lakes occupying depressions.

The Matanuska-Susitna Valley is floored with unconsolidated deposits, chiefly glacial drift that represents several episodes of glacial advances and retreats. The drift includes till, outwash stream deposits, and estuarine and lake deposits. Physiographic features formed by these deposits in or adjacent to the study area include end moraine, lateral moraines, eskers, crevasse fillings, and other pitted

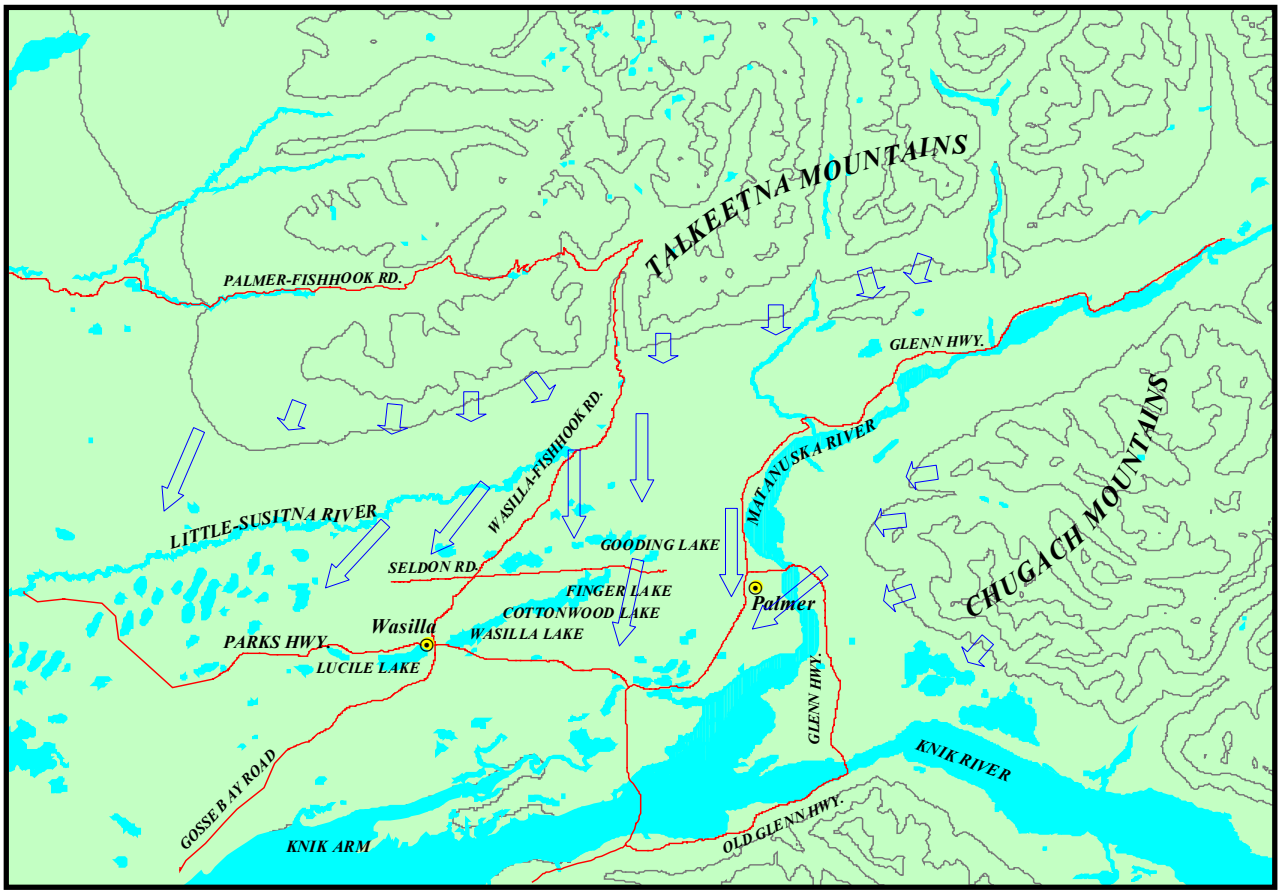

Figure 2. Map showing groundwater flow in the Matanuska-Susitna Valley (Jokela, Munter and Evans, 1991).

features, river terraces, outwash floodplains and an extensive estuarine flat (Trainer, 1960).

The glacial till and bedrock form aquifers of minor importance. The chief hydrologic significance of the till is in confining the artesian aquifer. Generally, the till is poorly permeable, although locally thin layers of sand may yield small quantities of water. Till that is present at or near the land surface in much of the area makes the acquisition of shallow groundwater difficult. The bedrock is poorly permeable. It yields water only from fractures, whose location and frequency cannot be easily predicted.

The chief aquifers are composed of outwash sand and gravel laid down by melt-water streams or in lakes. The outwash deposits are of two chief forms. The first consists of sheet-like deposits that lie just beneath the ground surface. These deposits range in thickness from a few feet to more than 100 feet. They typically rest on till or bedrock. The water in these deposits is unconfined. The other outwash deposits are buried beneath till. They are known to be as much as 50 to 60 feet thick, and probably are considerably thicker in some places. They commonly contain confined, or artesian, groundwater. Well logs and data from pumping tests suggest that outwash sand and gravel form a continuous or nearly continuous sheet in an area of more than 10 square miles north and west of Palmer (Jakola et al, 1991).

In the Mat-Su Valley, groundwater is primarily recharged by snowmelt and precipitation infiltrating both directly and also from the infiltration into the foothill slopes of the Talkeetna and Chugach Mountains. In addition,, aquifers may be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). This is the case for the water-table aquifers in the terrace south of Palmer and in the Bodenburg Butte area, which receive underground flow from the Matanuska River. Groundwater flow in the confined aquifers is generally from the north and north-northwest. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surficial topography as well as its close connection with surface water bodies (Trainer,1960).

VIOLET CIRCLE PUBLIC WATER SOURCE

Violet Circle public water source is a Class A (community) water source, which is privately owned and operated. The source consists of one well located approximately 1600 ft of the Glenn Highway, approximately 200 feet off of Stapleton Avenue. The well is at an approximate elevation of 175 feet above sea level. It is unknown whether the well is grouted. Records show the well penetrates silty sand and gravel from the surface to 52 feet below the surface, brown clay from 52-82', gravely hardpan from 82-89'sand and gravel from 89-145 and gravely hard pan from 145-148'. The depth of the well is 147.4' and it is screened from 127.4 to 147.4 feet. The well had a static water level of 65 feet below the surface at the time of drilling (2/16/82).

The water system at Violet Circle consists of a single 315-gallon hydropneumatic tank and collectively serves approximately 40 residents through 13 service connections and operates 365 days per year.

ASSESSMENT AND PROTECTION AREA FOR VIOLET CIRCLE DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Violet Circle 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.

Conceptually, groundwater enters the aquifer systems along the front range of the Talkeetna Mountains and flows toward Cook Inlet. An analytical calculation was used to calculate the size and shape of the area that contributes water to the well. The input parameters describing the attributes of the aquifer in this calculation were adopted from the well log and the recent Sanitary Survey. This analytical calculation was used as a guide in establishing the protection area for Violet Circle. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful and conservative protection area with respect to public health (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation (ADEC) 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 Violet Circle contains four zones, Zone A, Zone B, Zone C and Zone D (Map 1, 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 down gradient 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 Violet Circle corresponds to a time-of-travel of less than two years and extends toward base of the Talkeetna Mountains. Zone C protection area corresponds to a time-of-travel of greater than 2 years and less than 5 years. Zone D corresponds to a time-of-travel of greater than 5 years and less than 10 years.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within Violet Circle Drinking Water Protection Area. This survey was completed through a search of agency records and other publicly available information.

Potential sources of contamination to drinking water supplies cover a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of this assessment and all Class A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses
- Nitrates and/or nitrites
- Volatile organic chemicals
- Heavy metals, cyanide, and other inorganic chemicals
- Synthetic organic chemicals
- Other organic chemicals

Table 1 in Appendix C lists the Contaminant Source Inventory for Violet Circle. Below is a summary of the categories of the contaminant sources inventoried within the Equestrian Acres protection area:

- Paved and gravel Roads
- Residential Septic Systems
- Residential Areas

These potential contaminant sources present risks for all six categories of drinking water contaminants for Violet Circle 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 (Appendices B & C).

VULNERABILITY OF VIOLET CIRCLE 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)

The Violet Circle well is completed in a confined aquifer setting. The well penetrates a clay layer from 52-82'below the surface. This clay layer may provide a protective barrier from the movement of contaminants in the subsurface. However, records indicate that protective barriers throughout the Matanuska-Susitna basin are discontinuous and thin. This may be attributed to the layers pinching out near the base of the Talkeetna Mountains and the repeated glaciation that occurred in the area. The discontinuous, thin layers reduce the

protectiveness and increase the range of contaminant movement in the subsurface.

Combining the susceptibilities of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility (Appendix D). Table 1 shows the overall Susceptibility score and rating for Violet Circle.

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

	Score	Rating
Susceptibility of the Wellheads	5	Low
Susceptibility of the Aquifer	14	Medium
Natural Susceptibility	19	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (See Appendix B - Table 1 – Table 7). This portion of the analysis examines recent existing or historical contamination that has been detected at the drinking water sources through routine sampling. It also reviews contamination that has or may have occurred but has not arrived or been detected at the either 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	50	Very High
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, And Other Inorganic Chemicals	15	Low
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a Class A public drinking water system. 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 14 contain the Contaminant Risks and Vulnerability Analysis for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

Vulnerability of drinking water sources 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 six categories of drinking water contaminants (See Appendix D). Note: scores are rounded off to the nearest five.

Table 3. Overall Vulnerability of Violet Circle Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	31	Low
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	31	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	35	Low
Synthetic Organic Chemicals	31	Low
Other Organic Chemicals	30	Low

Tables 2 through 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

The contaminant risk for the Bacteria/Viruses is driven by the potential risk associated with roads and residential septic systems. No detection of Bacteria and Viruses has occurred in recent sampling history. Combining the contamination risk with the natural susceptibility of the well leads to an overall vulnerability to bacteria and virus contamination of low.

The contaminant risk for Nitrate/Nitrites are driven by the potential risk associated with roads and residential septic systems and the risk associated with exisiting

contamination. Recent historical sampling data indicates that Nitrates were detected at 58% the maximum contaminant level (MCL) of 10 mg/l during the most recent sampling event (7/12/01). (See Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D.) Combining the contamination risk with the natural susceptibility of the well leads to an overall vulnerability to nitrate/nitrite contamination of high. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful effects.

Nitrates and/or nitrites are found in natural background concentration at this site, as elsewhere in Alaska. Other sources of nitrate and/or nitrites are human sewage, livestock manure, especially from feedlots and fertilizers. Due to high solubility and weak retention by soil, nitrates are very mobile often moving at approximately the same rate as water. It is unknown whether the existing contamination is naturally occurring or human influenced. According to the EPA, short-term exposure to levels excessively above the MCL has caused serious illness and sometimes death. Serious illness in infants can occur due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of the childs blood. This can be an acute condition in which health deteriorates rapidly over a period of days. Symptoms include shortness of breath and blueness of the skin. Long term exposure to nitrates and nitrites at levels above the MCL can lead to diuresis, increased starchy deposits and hemorrhaging of the spleen. (EPA, 2001)

The contaminant risk for volatile organic chemicals are driven by the potential risk associated with roads, residential areas and septic systems.

Recent historical sampling indicate no detection of volatile organic chemicals. Combining the contaminant risk with the natural susceptibility of the well leads to an overall vulnerability to volatile organic chemical contamination of low.

The contaminant risk for heavy metals and inorganic are driven by roads, residential areas and septic systems and existing contamination.

Recent historical sampling indicates that nickel was detected at very low levels. Sampling done on 7/12/01 detected nickel at 0.00686 mg/l or 7% the MCL of 0.1mg/l. Combining the contaminant risk with the natural susceptibility of the well leads to an overall vulnerability to heavy metals and inorganic chemical contamination of low

According to the United States Environmental Protection Agency (USEPA), nickel is a metal found in natural deposits as ores containing other elements. The greatest use of nickel is in making stainless steel and other alloys.

Nickel is not known to cause any health problems when people are exposed to it at levels above the MCL for relatively short periods of time. Nickel has the potential to cause the following effects from long term exposure at levels above the MCL: decreased body weight; heart and liver damage; skin irritation. (EPA, 2001). The levels detected at Violet Circle are very low and remain safe for human consumption. It is unknown whether the existing contamination is naturally occurring or human influenced.

The contaminant risk for synthetic organic chemicals is driven by the potential risk associated with residential septic systems and residential areas.

Recent sampling history indicates that no synthetic organic contamination has been detected. Contamination risks for other organic chemicals is driven by the potential risks associated with roads, septic systems and residential areas.

Recent sampling history indicates that no contamination from other organic chemicals have bee detected.

SUMMARY

A *Source Water Assessment* has been completed for the source of public drinking water serving Violet Circle. The overall vulnerability of this source to contamination is **Low** for bacteria and viruses, volatile organic chemicals, heavy metals and inorganic chemicals, synthetic organic chemicals, other organic chemicals. The overall vulnerability of this source to nitrate/nitrite contamination is **High**. 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 Violet Circle 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 Violet Circle's public drinking water source.

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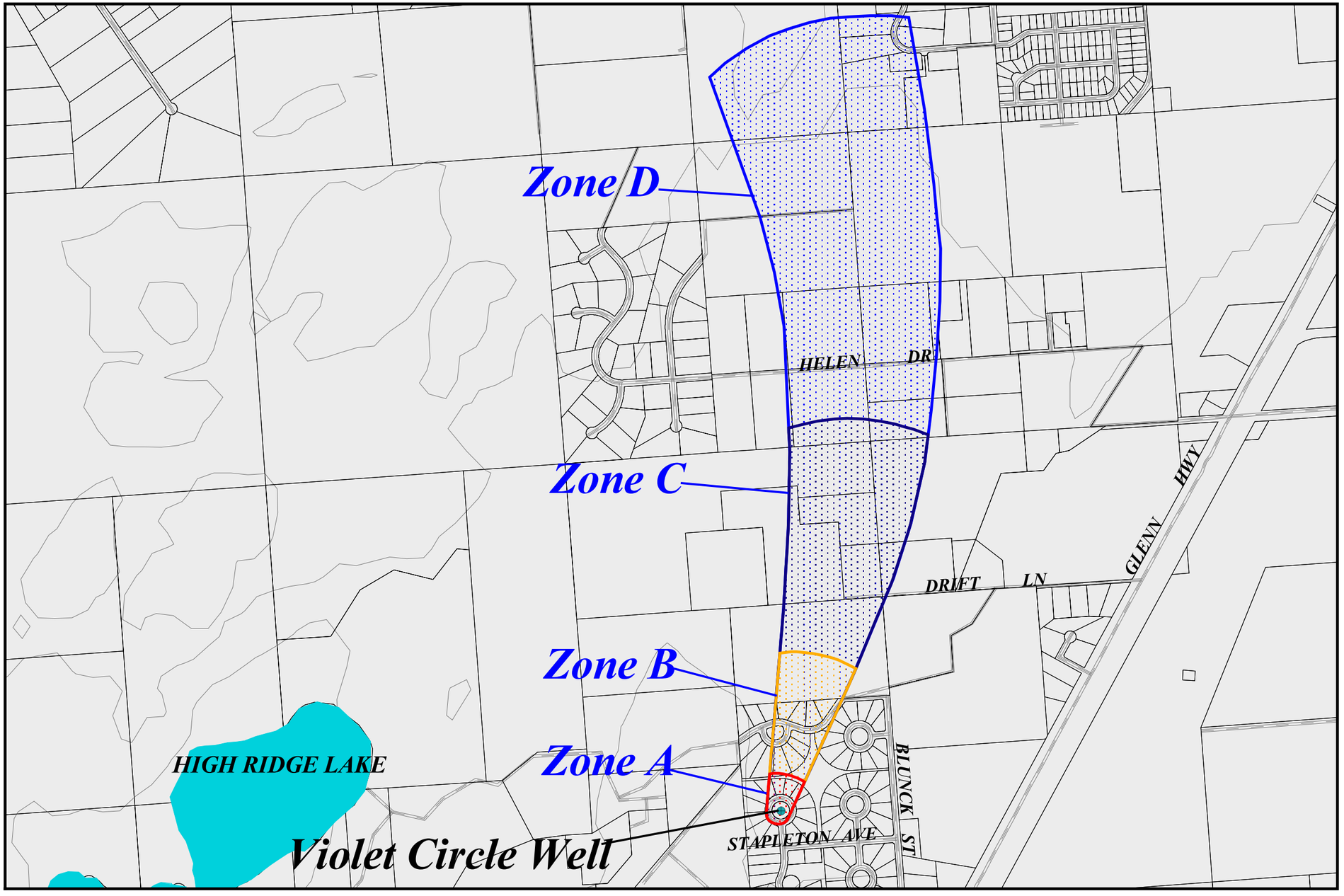
APPENDIX A

Violet Circle
Drinking Water Protection Area

Drinking Water Protection Area for Violet Circle



700 0 700 1400 Feet

Legend

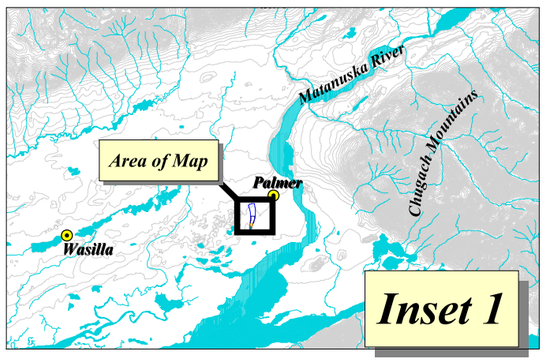
- Violet Circle Public Water System

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less than 5 Years Travel Time

Zone C Protection Area
- Less than 2 Years Travel Time

Zone D Protecition Area
- Less than 10 Years Travel Time
- Lakes
- Rivers and Streams
- Matanuska Susitna Borough Parcels
- Roads
- Elevation Contours



N W E S

PWSID 226428.001

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Violet Circle

Table 1 *Contaminant Source Inventory for* ***PWSID 226428.001***

Violet Circle

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Residential Area in Zone A	2	
Septic systems (serves one single-family home)	R02	R02-01	A	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Near Violet Circle	3	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Violet Circle	2	
Residential Areas	R01	R01-02	B	Residential Area in Zone B	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Near Valley Crest Drive	3	
Highways and roads, dirt/gravel	X24	X24-01	B	Cullison Circle	2	
Highways and roads, dirt/gravel	X24	X24-02	B	Valley Crest Drive	2	
Residential Areas	R01	R01-03	C	Residential Area in Zone C	2	
Septic systems (serves one single-family home)	R02	R02-06	C	Near Valley Crest Drive	3	
Highways and roads, dirt/gravel	X24	X24-03	C	Drift Lane	2	

Table 2

Contaminant Source Inventory and Risk Ranking for Violet Circle

Sources of Bacteria and Viruses

PWSID 226428.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Low	Near Violet Circle	3	
Residential Areas	R01	R01-01	A	Low	Residential Area in Zone A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	Violet Circle	2	
Highways and roads, dirt/gravel	X24	X24-01	B	Low	Cullison Circle	2	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	Valley Crest Drive	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Valley Crest Drive	3	
Residential Areas	R01	R01-02	B	Low	Residential Area in Zone B	2	
Residential Areas	R01	R01-03	C	Low	Residential Area in Zone C	2	
Septic systems (serves one single-family home)	R02	R02-06	C	Low	Near Valley Crest Drive	3	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	Drift Lane	2	

Table 3

Contaminant Source Inventory and Risk Ranking for Violet Circle

Sources of Nitrates/Nitrites

PWSID 226428.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-01	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Low	Near Violet Circle	3	
Residential Areas	R01	R01-01	A	Low	Residential Area in Zone A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	Violet Circle	2	
Highways and roads, dirt/gravel	X24	X24-01	B	Low	Cullison Circle	2	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	Valley Crest Drive	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Valley Crest Drive	3	
Residential Areas	R01	R01-02	B	Low	Residential Area in Zone B	2	
Residential Areas	R01	R01-03	C	Low	Residential Area in Zone C	2	
Septic systems (serves one single-family home)	R02	R02-06	C	Low	Near Valley Crest Drive	3	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	Drift Lane	2	

Table 4

Contaminant Source Inventory and Risk Ranking for Violet Circle

Sources of Volatile Organic Chemicals

PWSID 226428.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	Violet Circle	2	
Highways and roads, dirt/gravel	X24	X24-01	B	Low	Cullison Circle	2	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	Valley Crest Drive	2	
Residential Areas	R01	R01-01	A	Low	Residential Area in Zone A	2	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Low	Near Violet Circle	3	
Residential Areas	R01	R01-02	B	Low	Residential Area in Zone B	2	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	Drift Lane	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Valley Crest Drive	3	
Residential Areas	R01	R01-03	C	Low	Residential Area in Zone C	2	
Septic systems (serves one single-family home)	R02	R02-06	C	Low	Near Valley Crest Drive	3	

Table 5

Contaminant Source Inventory and Risk Ranking for Violet Circle

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 226428.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	Violet Circle	2	
Highways and roads, dirt/gravel	X24	X24-01	B	Low	Cullison Circle	2	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	Valley Crest Drive	2	
Residential Areas	R01	R01-01	A	Low	Residential Area in Zone A	2	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Low	Near Violet Circle	3	
Residential Areas	R01	R01-02	B	Low	Residential Area in Zone B	2	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	Drift Lane	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Valley Crest Drive	3	
Residential Areas	R01	R01-03	C	Low	Residential Area in Zone C	2	
Septic systems (serves one single-family home)	R02	R02-06	C	Low	Near Valley Crest Drive	3	

Table 6

Contaminant Source Inventory and Risk Ranking for Violet Circle

Sources of Synthetic Organic Chemicals

PWSID 226428.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Residential Areas	R01	R01-01	A	Low	Residential Area in Zone A	2	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Low	Near Violet Circle	3	
Residential Areas	R01	R01-02	B	Low	Residential Area in Zone B	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Valley Crest Drive	3	
Septic systems (serves one single-family home)	R02	R02-06	C	Low	Near Valley Crest Drive	3	
Residential Areas	R01	R01-03	C	Low	Residential Area in Zone C	2	

Table 7

Contaminant Source Inventory and Risk Ranking for Violet Circle

Sources of Other Organic Chemicals

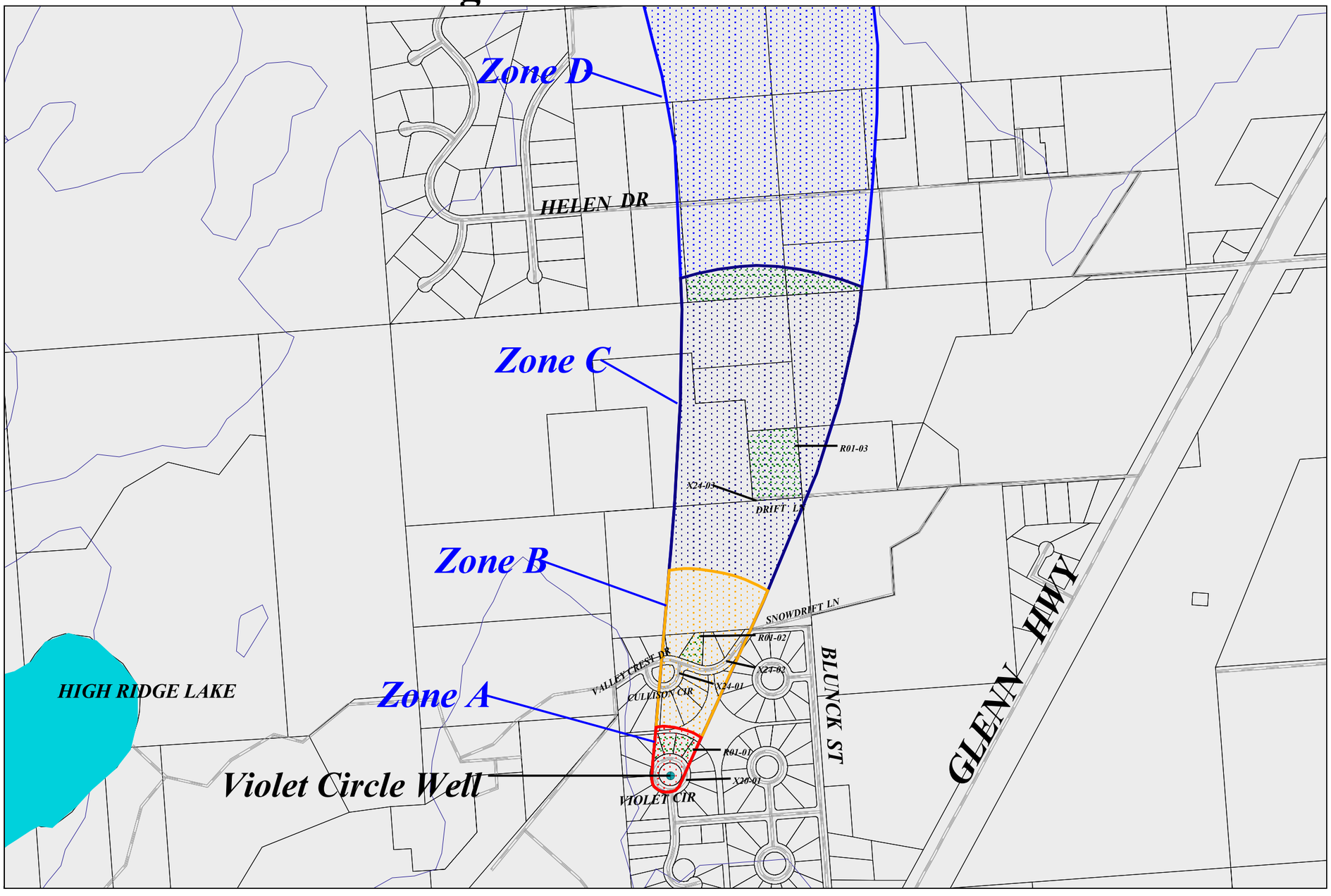
PWSID 226428.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	Violet Circle	2	
Highways and roads, dirt/gravel	X24	X24-01	B	Low	Cullison Circle	2	
Highways and roads, dirt/gravel	X24	X24-02	B	Low	Valley Crest Drive	2	
Residential Areas	R01	R01-01	A	Low	Residential Area in Zone A	2	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-02	A	Low	Near Vilolet Circle	3	
Septic systems (serves one single-family home)	R02	R02-03	A	Low	Near Violet Circle	3	
Septic systems (serves one single-family home)	R02	R02-04	A	Low	Near Violet Circle	3	
Residential Areas	R01	R01-02	B	Low	Residential Area in Zone B	2	
Highways and roads, dirt/gravel	X24	X24-03	C	Low	Drift Lane	2	
Septic systems (serves one single-family home)	R02	R02-05	B	Low	Near Valley Crest Drive	3	
Residential Areas	R01	R01-03	C	Low	Residential Area in Zone C	2	
Septic systems (serves one single-family home)	R02	R02-06	C	Low	Near Valley Crest Drive	3	

APPENDIX C

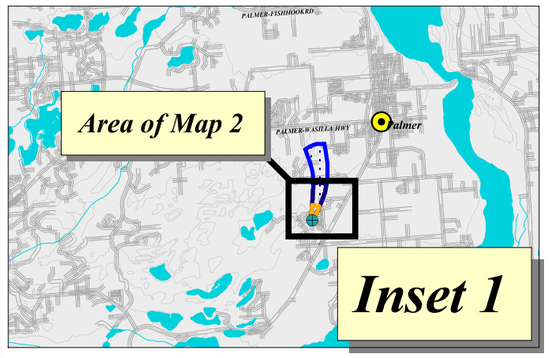
Violet Circle
Drinking Water Protection Area
And Potential & Existing Contaminant Sources

Drinking Water Protection Area for Violet Circle and Potential and Exisitng Sources of Contamination



Legend

- Violet Circle Public Water System
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less than 5 Years Travel Time
- Zone C Protection Area
  - Less than 2 Years Travel Time
- Zone D Protecition Area
  - Less than 10 Years Travel Time
  - Residential (R02)
  - Roads
  - Cities



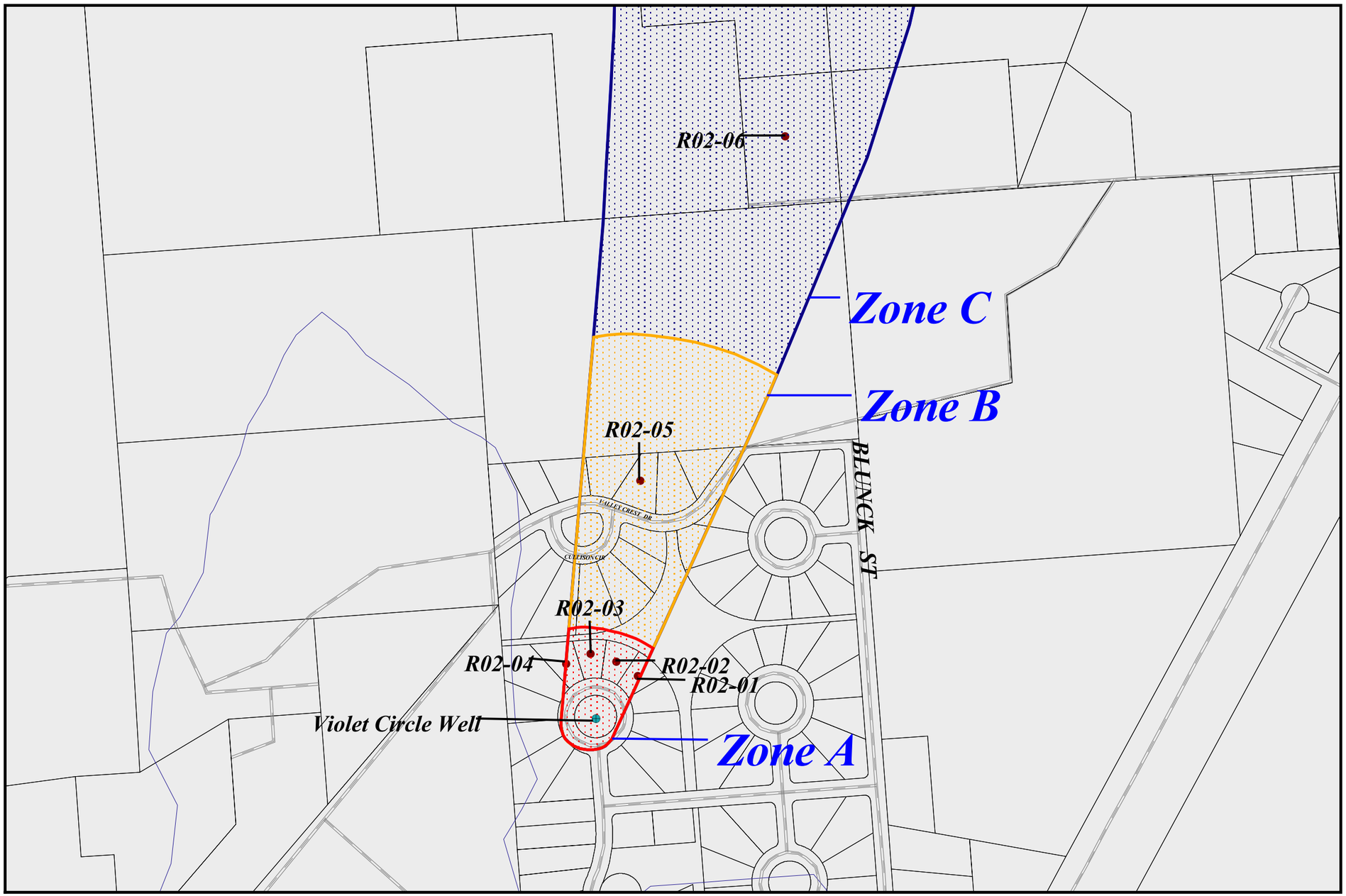
N
W E
S

1000 0 1000 Feet

PWSID 226428.001

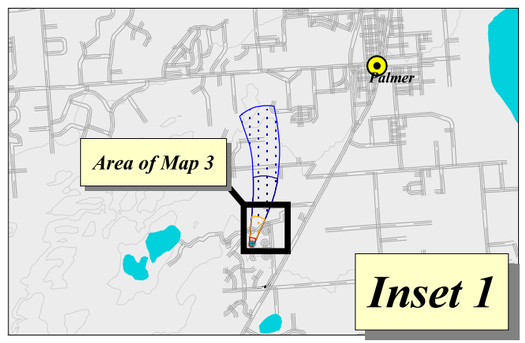
Map 2

Drinkingwater Protection Area for Violet Circle and Potential and Existing Sources of Contamination



Legend

- Violet Circle Public Water System
- Zone A Protection Area
  - Several Months Travel Time
- Zone B Protection Area
  - Less than 5 Years Travel Time
- Zone C Protection Area
  - Less than 2 Years Travel Time
- Zone D Protecition Area
  - Less than 10 Years Travel Time
- Septics (R02)
- Lakes
- Rivers and Streams
- Roads
- Elevation Contours
- Matanuska Susitna Borough Parcels
- Cities



N
W E
S

300 0 300 Feet

PWSID 226428.001

Map 3

APPENDIX D

Vulnerability Analysis for Violet Circle Public Drinking Water Source

Chart 1. Susceptibility of the wellhead - Violet Circle

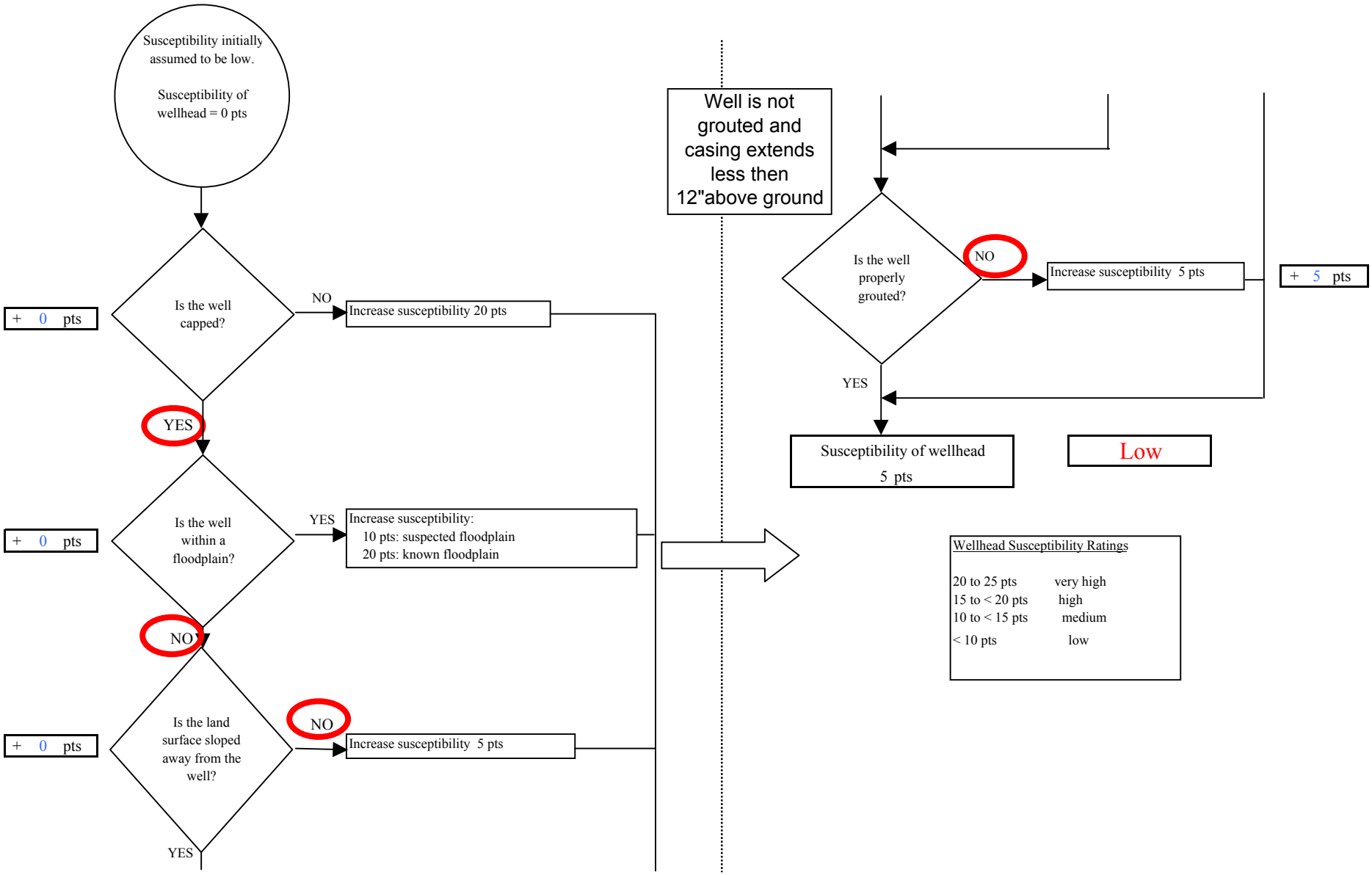


Chart 2. Susceptibility of the aquifer - Violet Circle

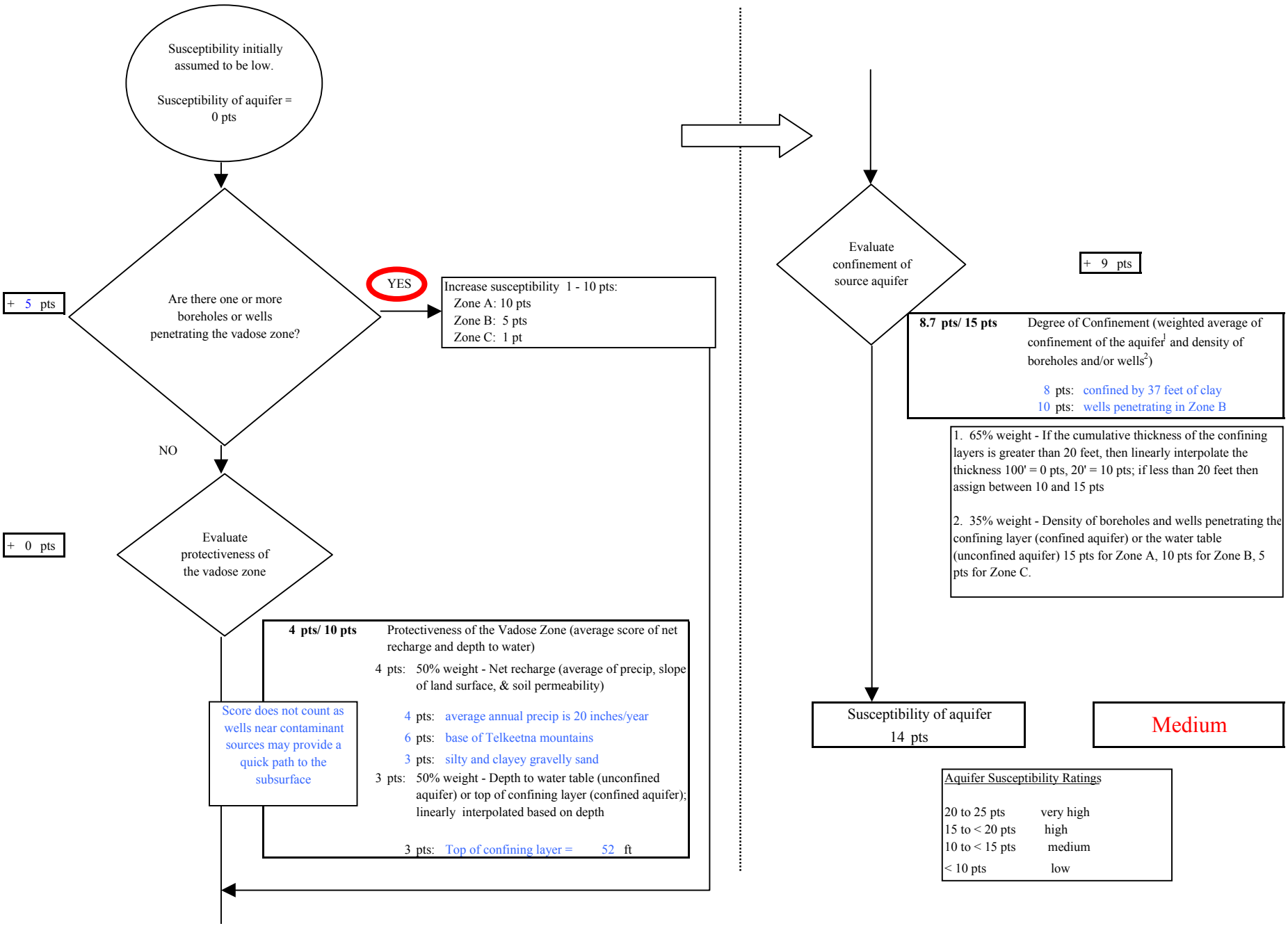
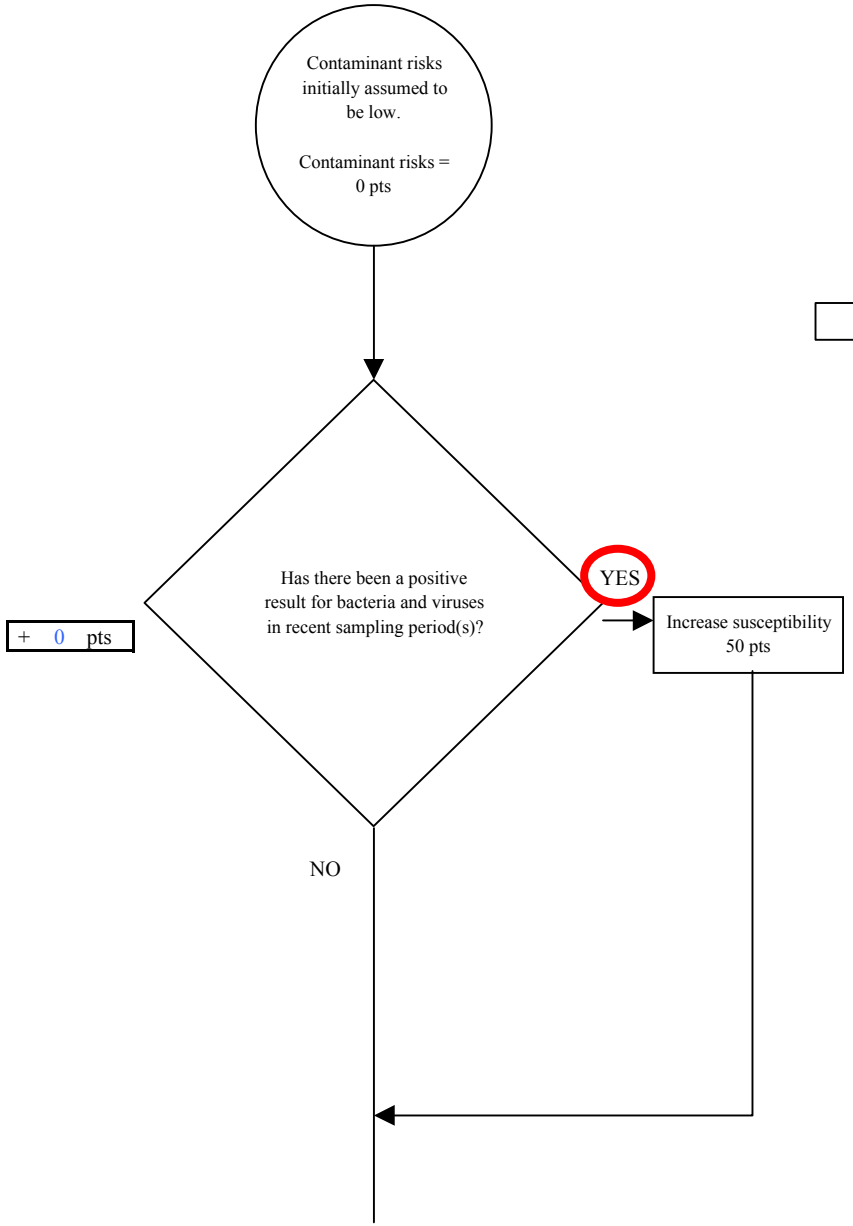
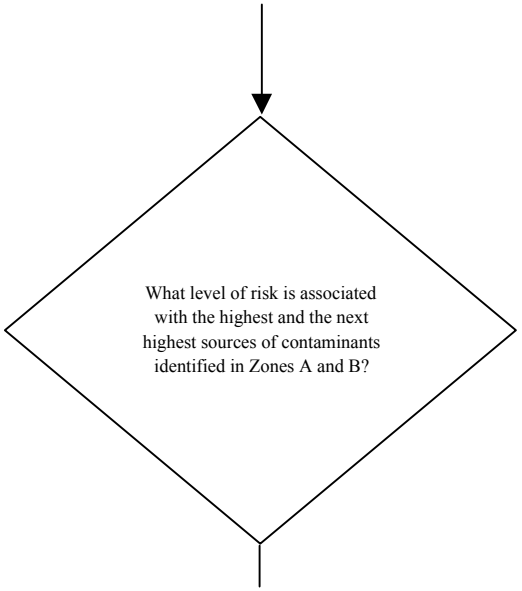


Chart 3. Contaminant risks for Violet Circle - Bacteria & Viruses





+ 10 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)	0	0	0
Low(s)	7	3	10

	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 10

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 Violet Circle - Bacteria & Viruses

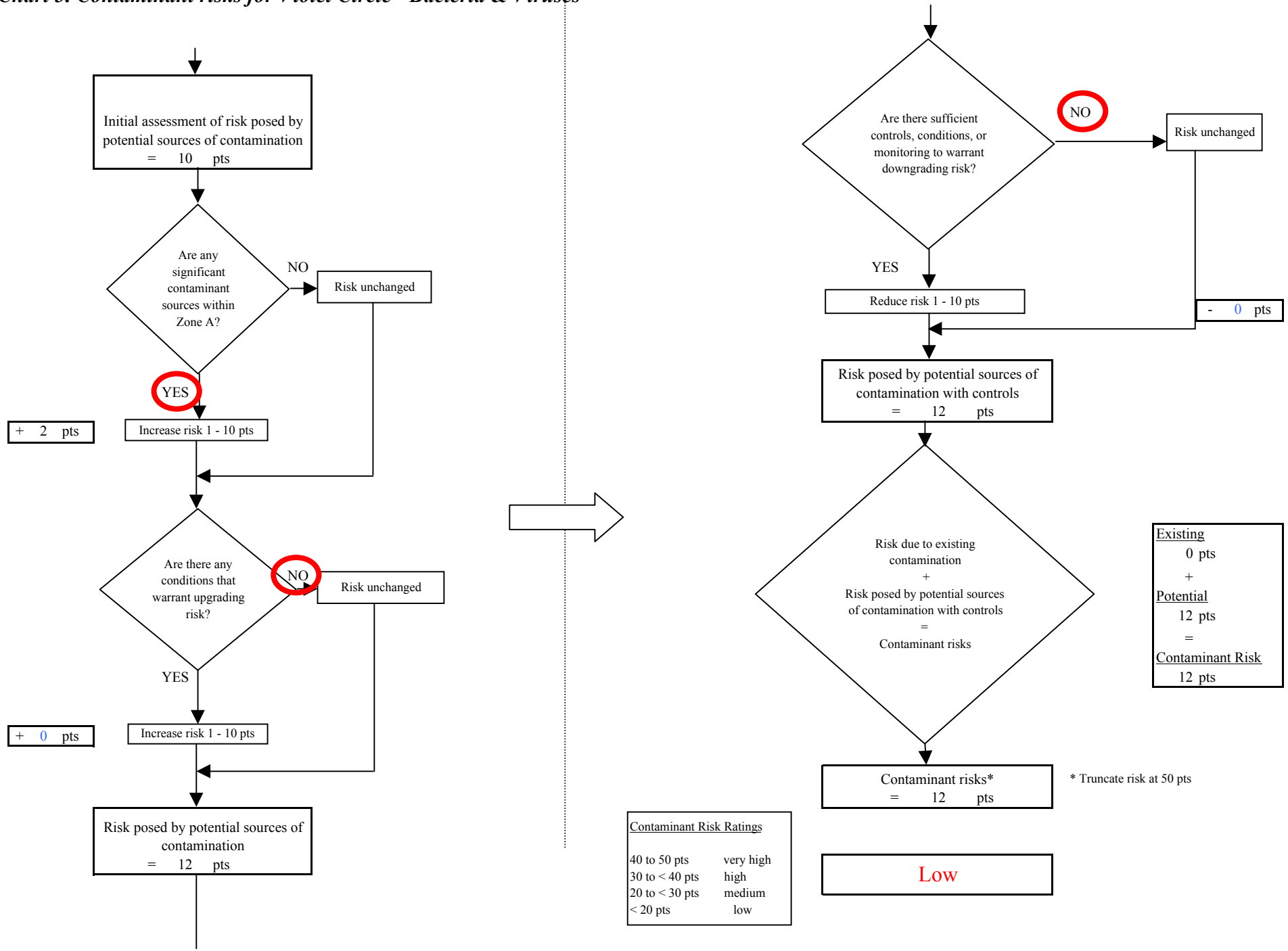


Chart 4. Vulnerability analysis for Violet Circle - Bacteria & Viruses

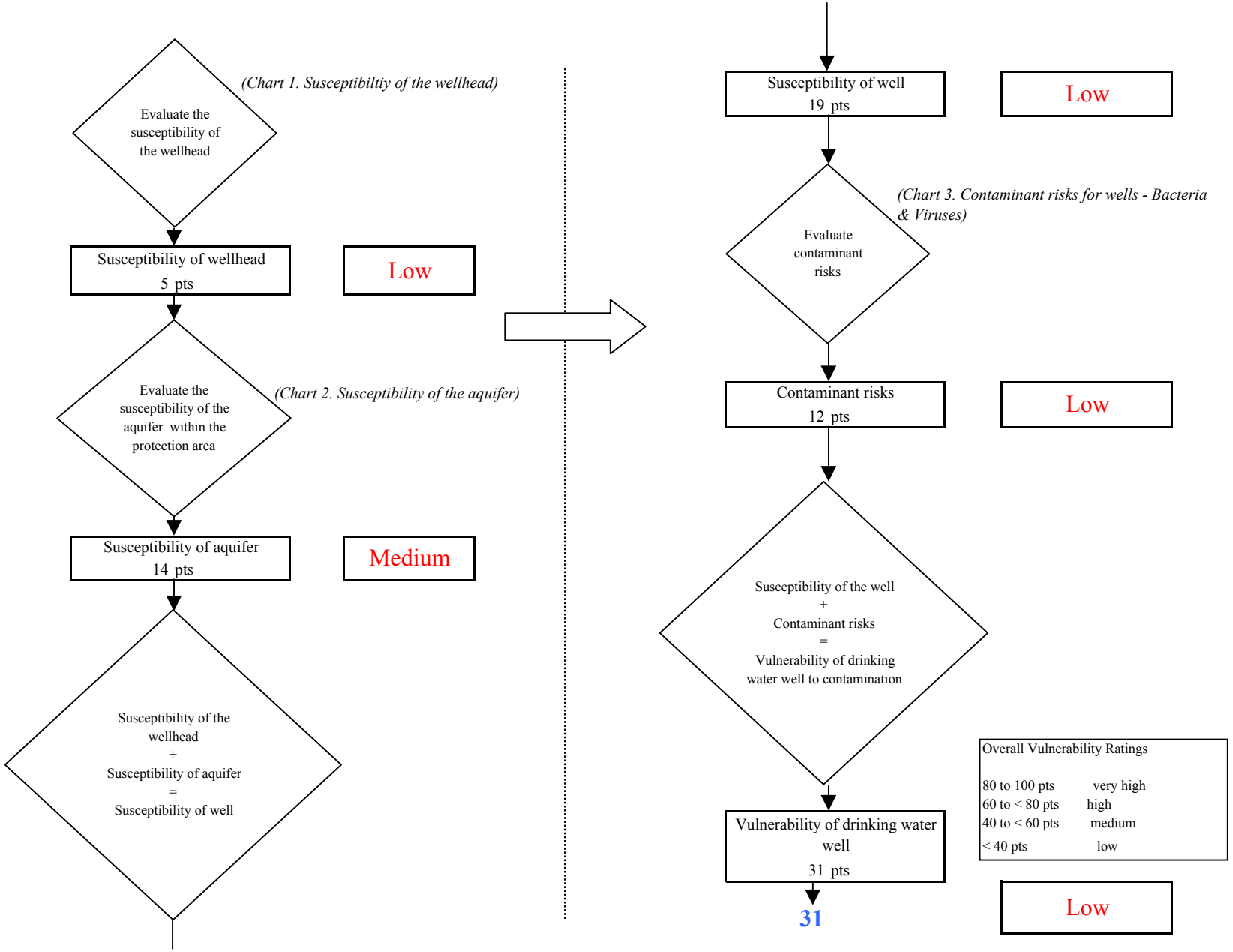


Chart 5. Contaminant risks for Violet Circle - Nitrates and Nitrites

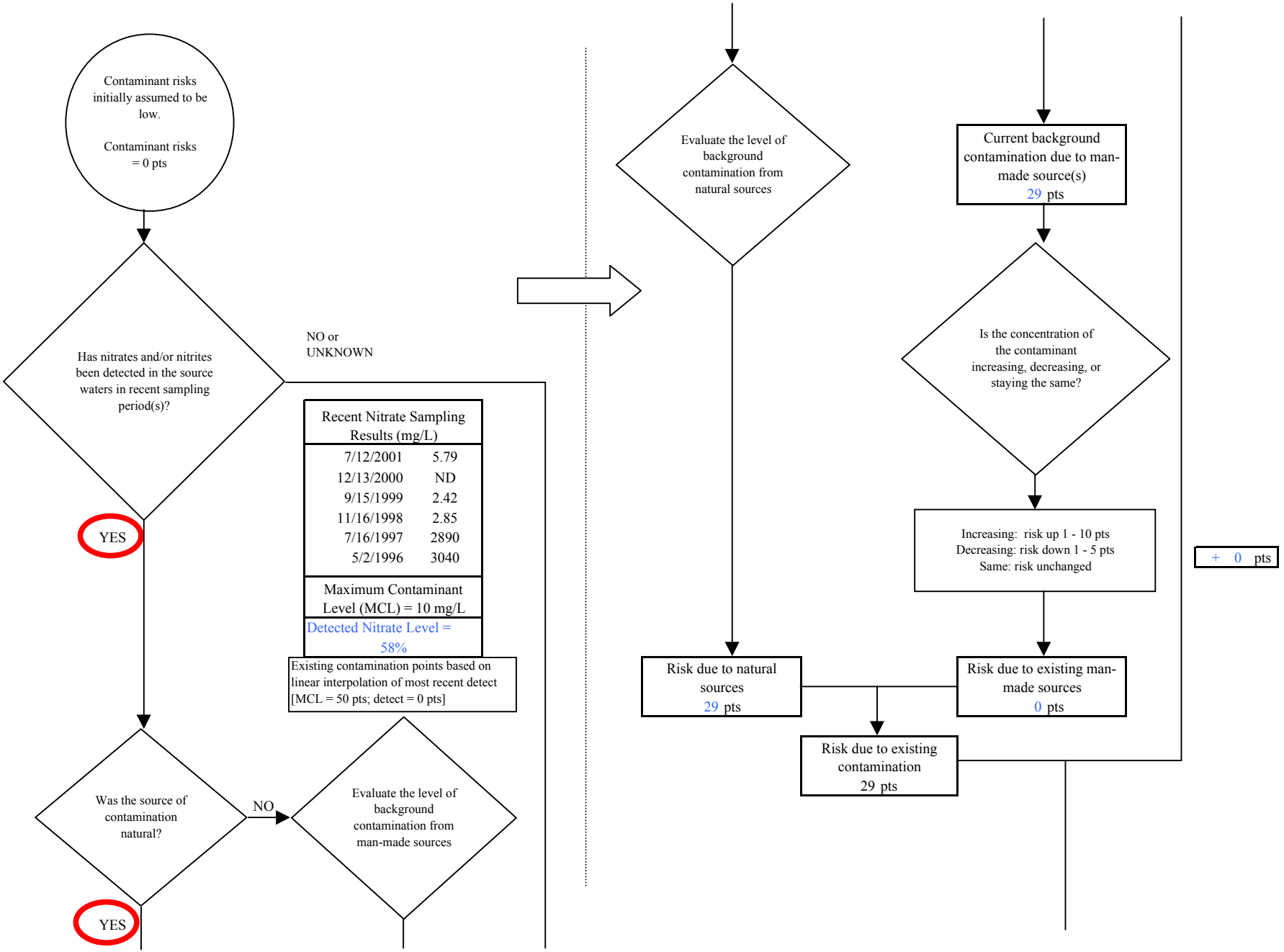


Chart 5. Contaminant risks for Violet Circle - Nitrates and Nitrites

+ 20 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	7	4	11

	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 20

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.

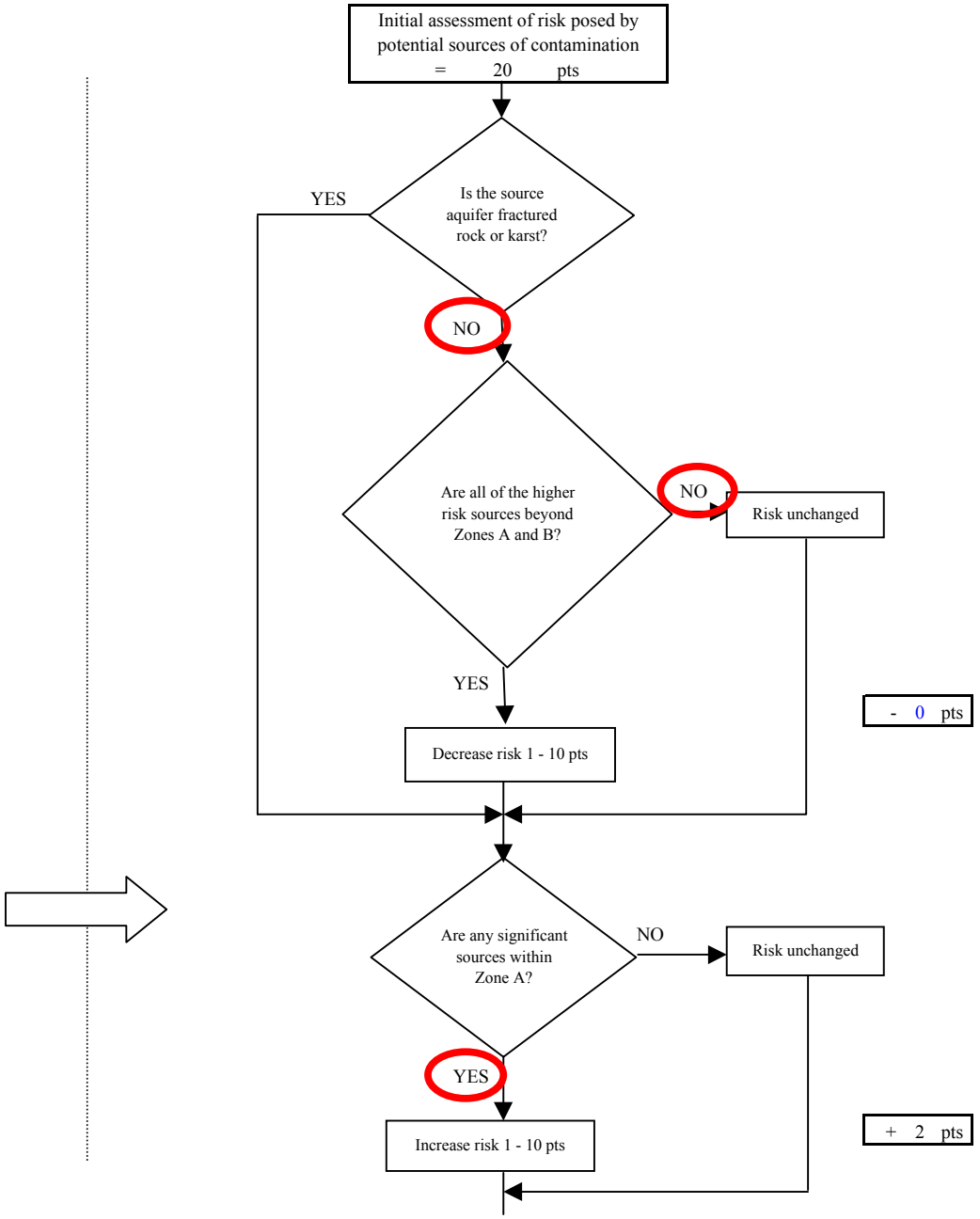


Chart 5. Contaminant risks for Violet Circle - Nitrates and Nitrites

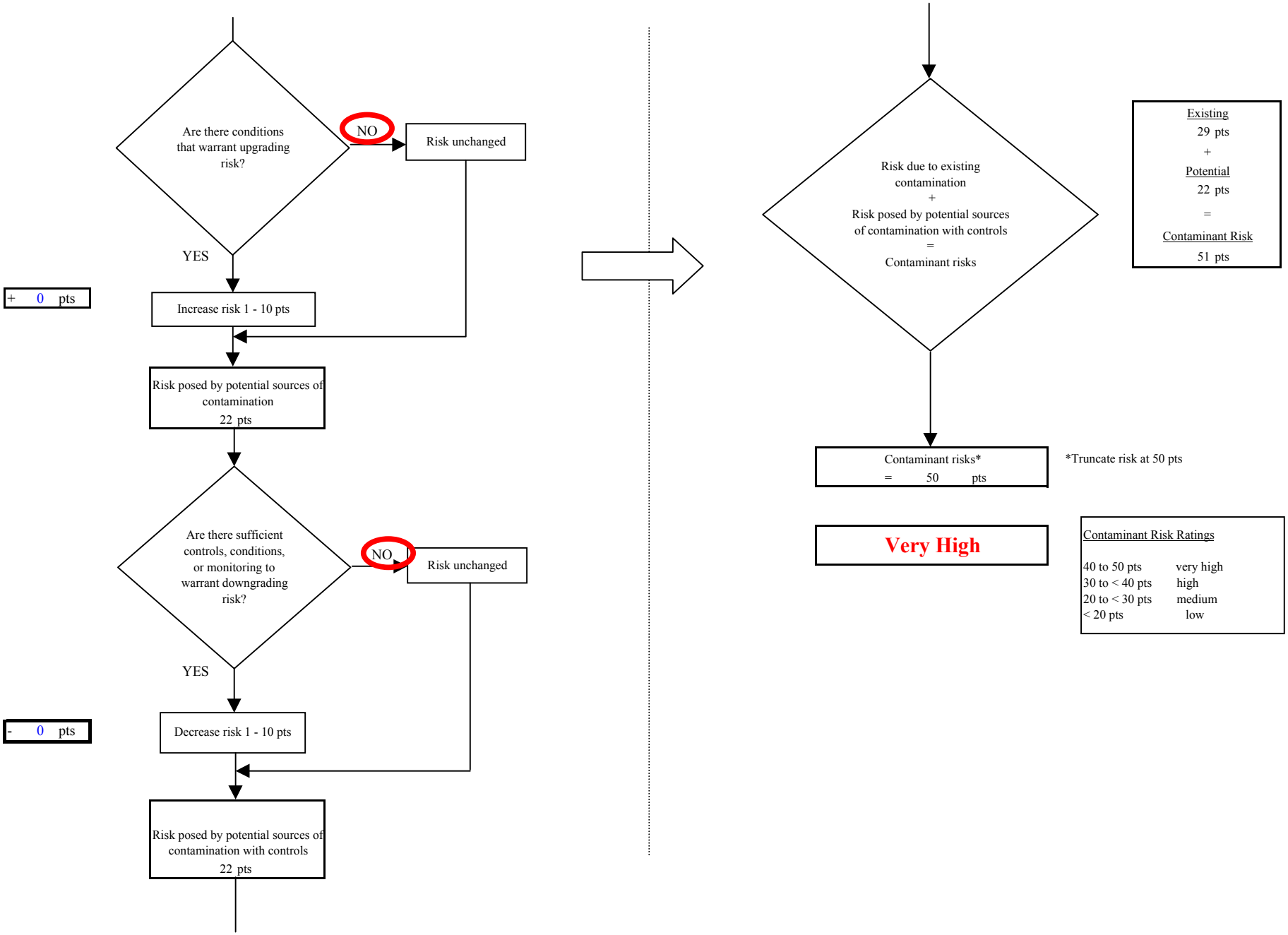


Chart 6. Vulnerability analysis for Violet Circle - Nitrates and Nitrites

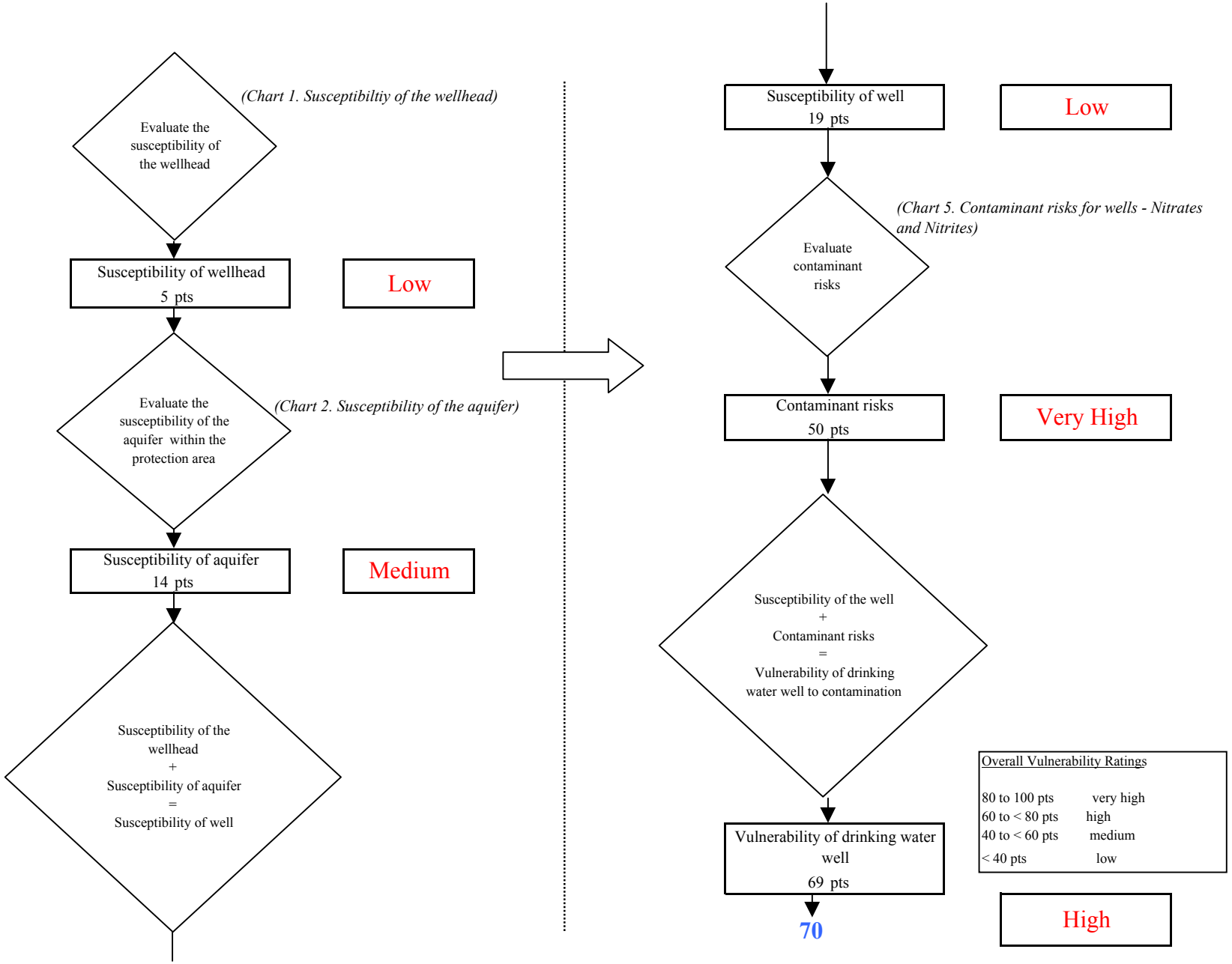


Chart 7. Contaminant risks for Violet Circle - Volatile Organic Chemicals

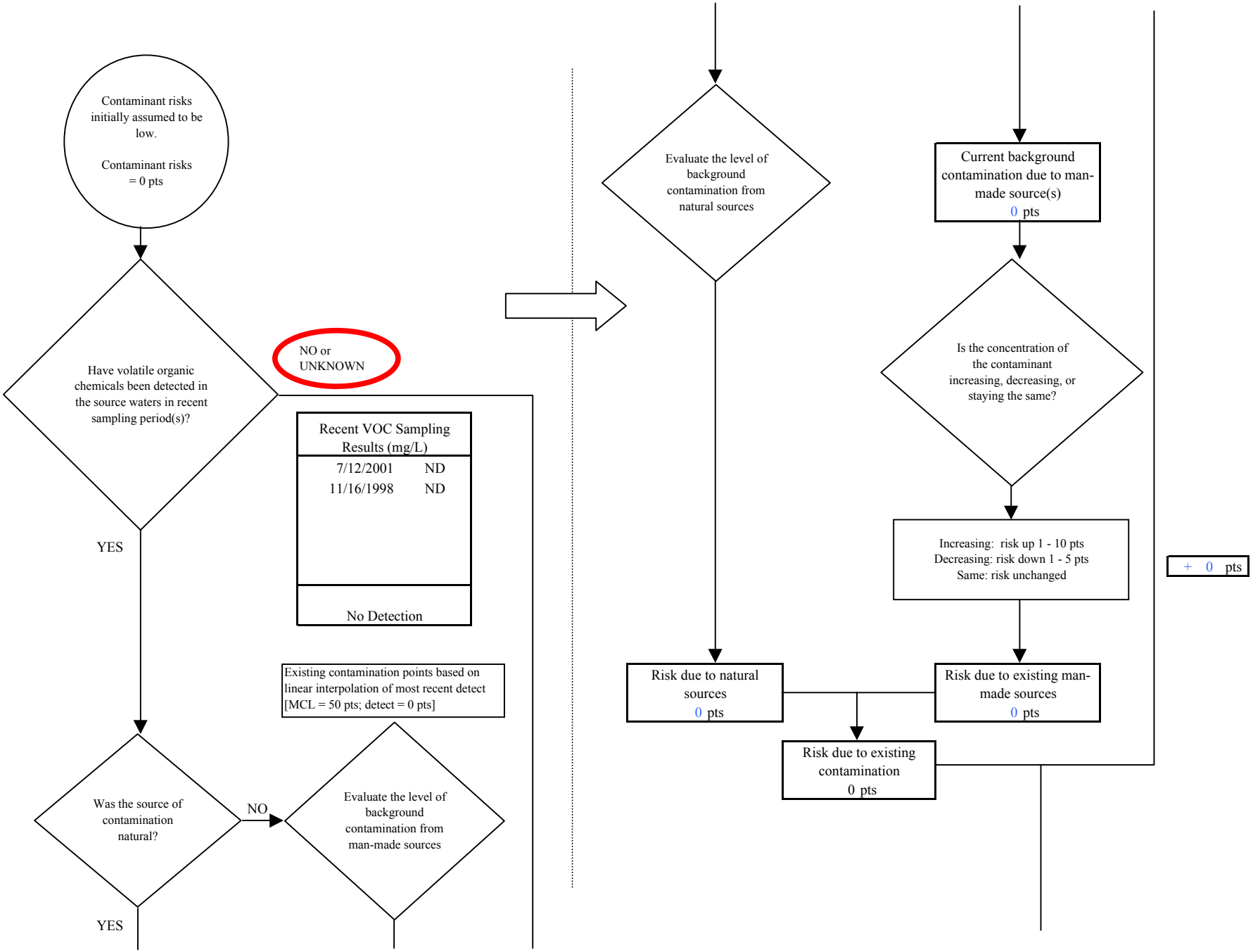


Chart 7. Contaminant risks for Violet Circle - Volatile Organic Chemicals

+ 10 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	4	4	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	10

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 = 10 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

+ 2 pts

Chart 7. Contaminant risks for Violet Circle - Volatile Organic Chemicals

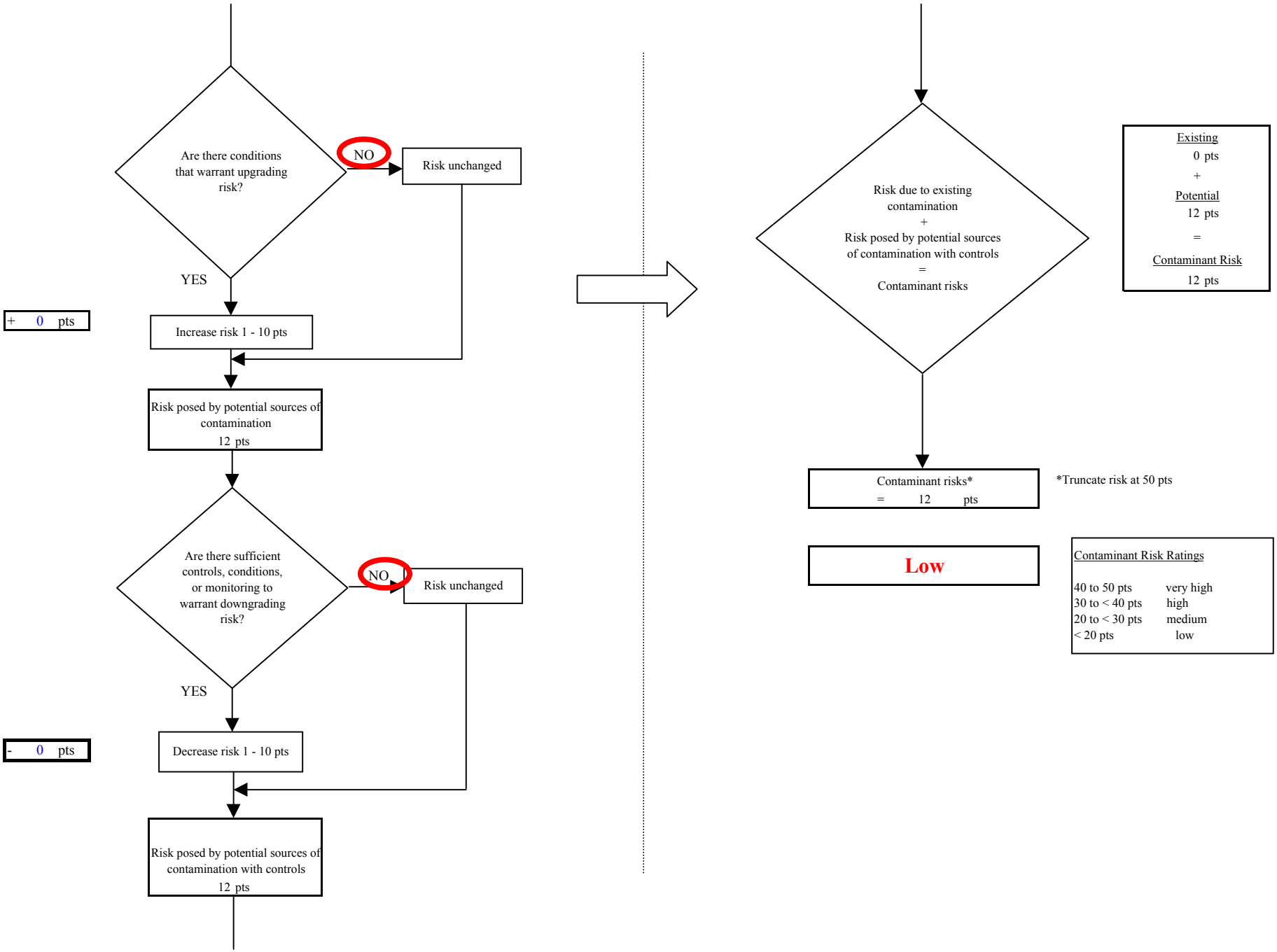


Chart 8. Vulnerability analysis for Violet Circle - Volatile Organic Chemicals

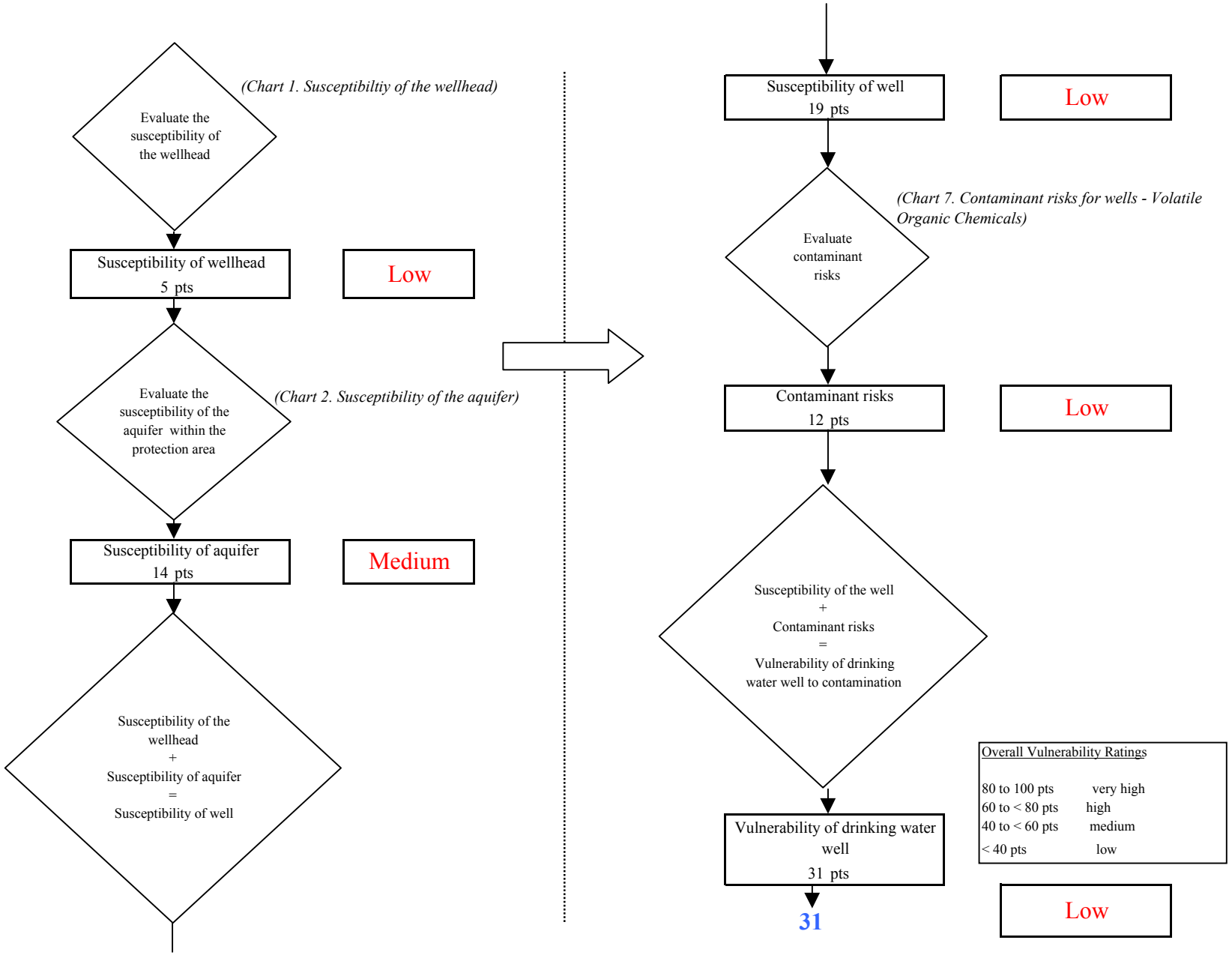


Chart 9. Contaminant risks for Violet Circle - Heavy Metals, Cyanide and Other Inorganic Chemicals

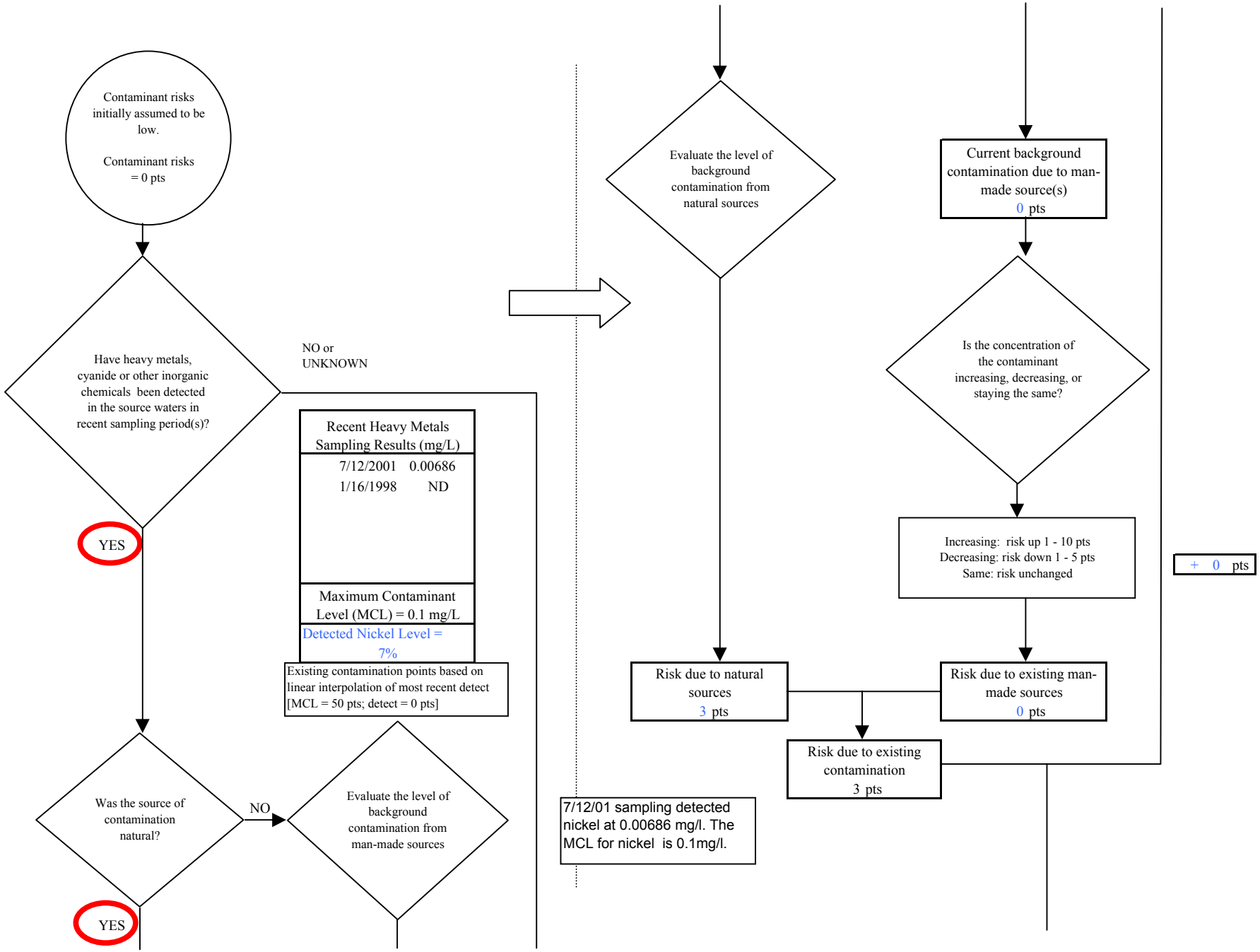
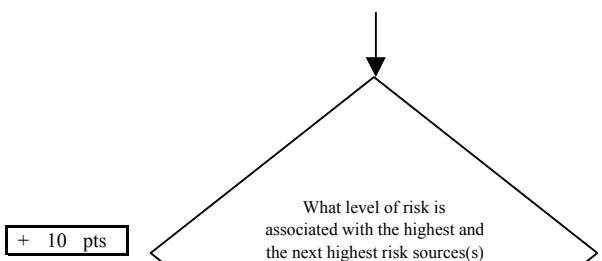


Chart 9. Contaminant risks for Violet Circle - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 10 pts

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)	0	0	0
Low(s)	4	4	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 10

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.

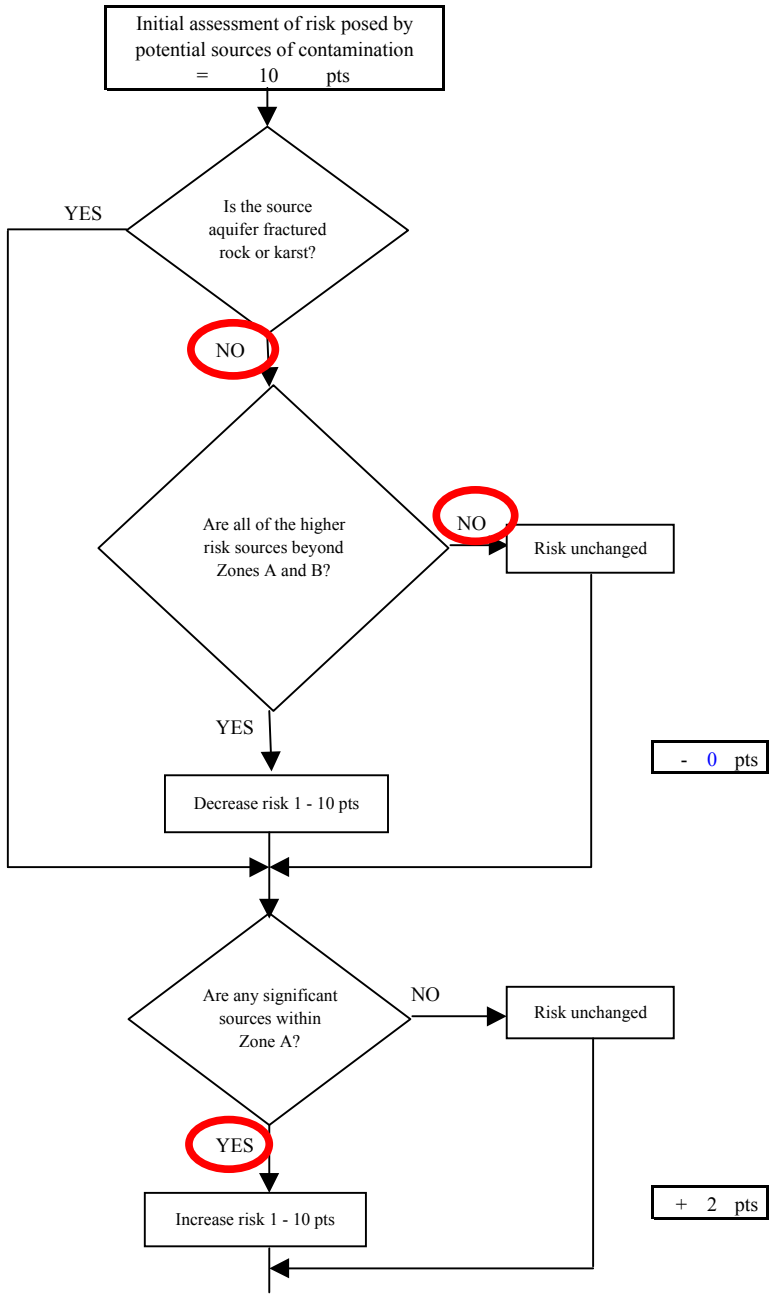


Chart 9. Contaminant risks for Violet Circle - Heavy Metals, Cyanide and Other Inorganic Chemicals

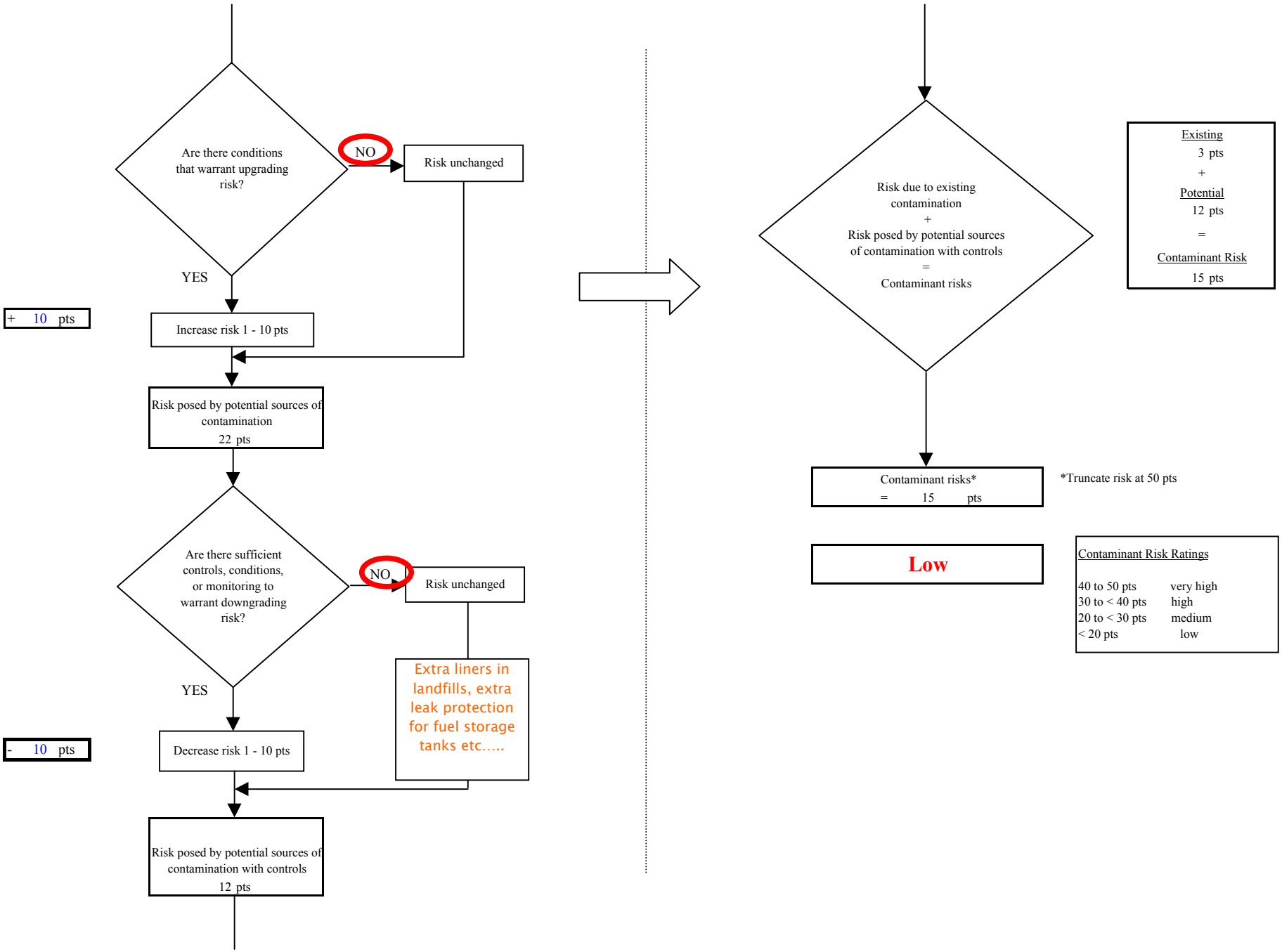


Chart 10. Vulnerability analysis for Violet Circle - Heavy Metals, Cyanide and Other Inorganic Chemicals

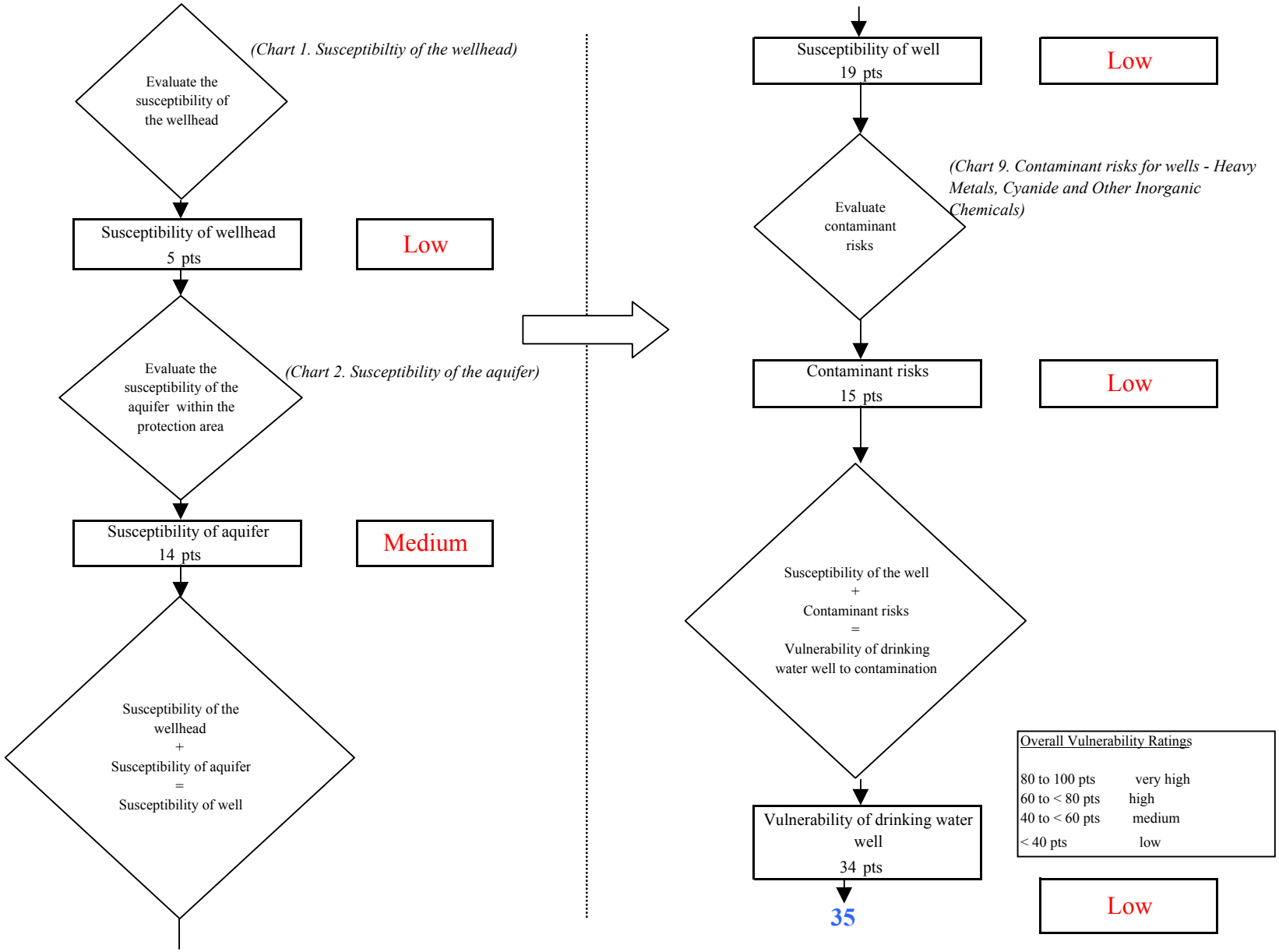


Chart 11. Contaminant risks for Violet Circle - Synthetic Organic Chemicals

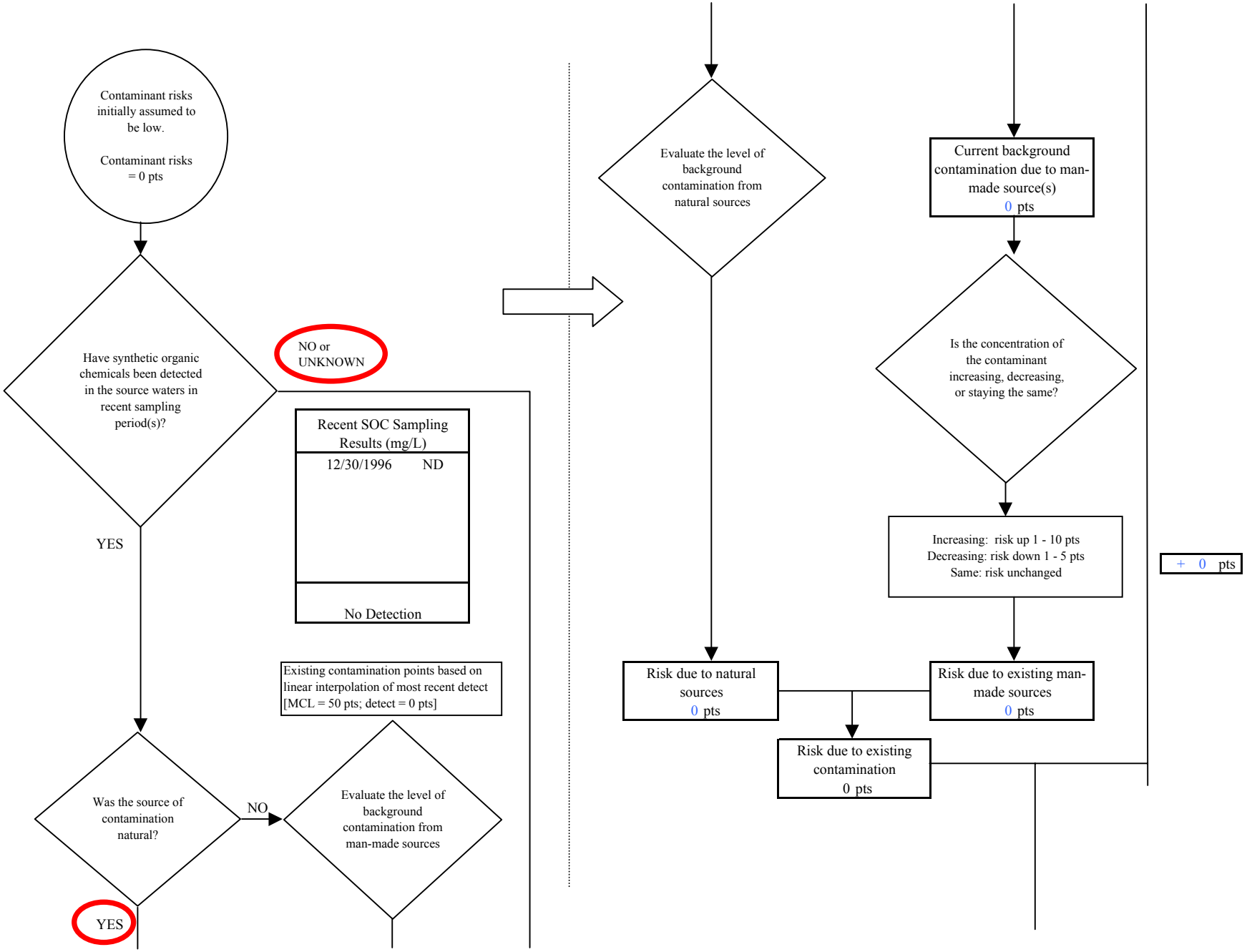
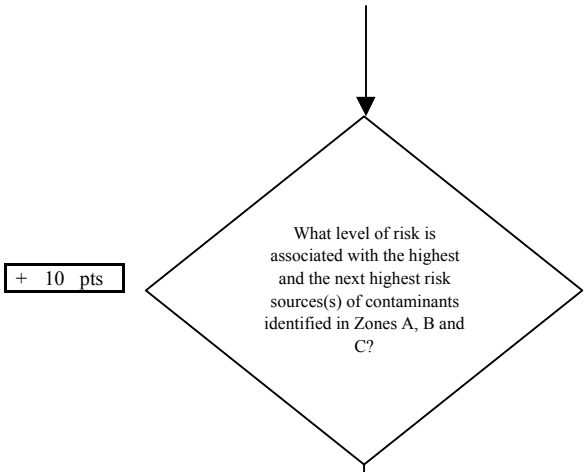


Chart 11. Contaminant risks for Violet Circle - Synthetic Organic Chemicals



+ 10 pts

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)	0	0	0
Low(s)	3	3	6

	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 10

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.

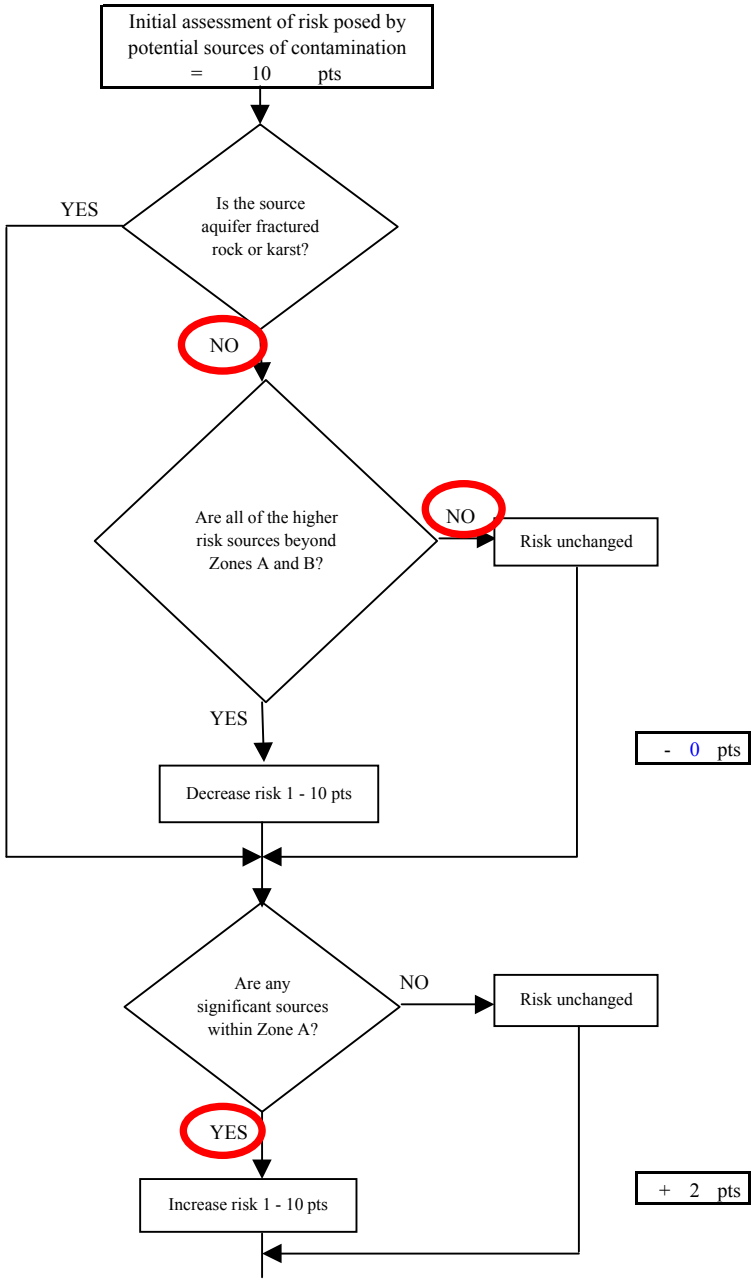
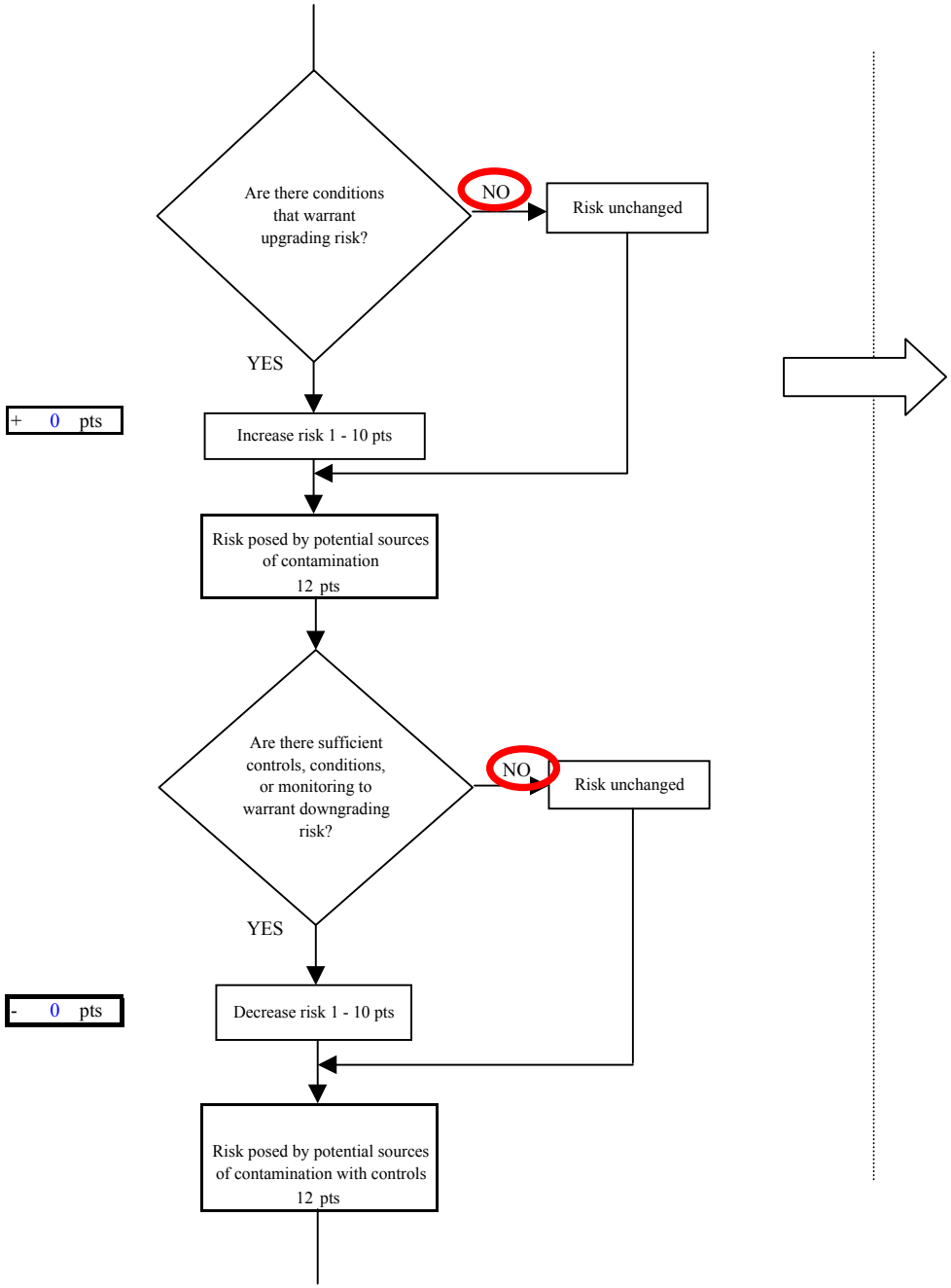


Chart 11. Contaminant risks for Violet Circle - Synthetic Organic Chemicals



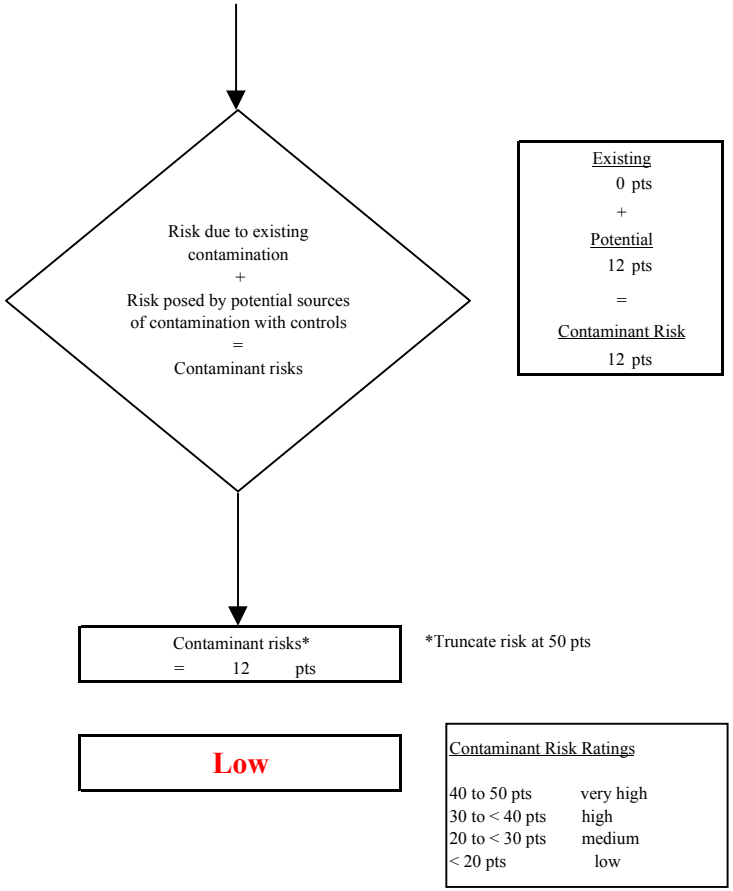


Chart 12. Vulnerability analysis for Violet Circle - Synthetic Organic Chemicals

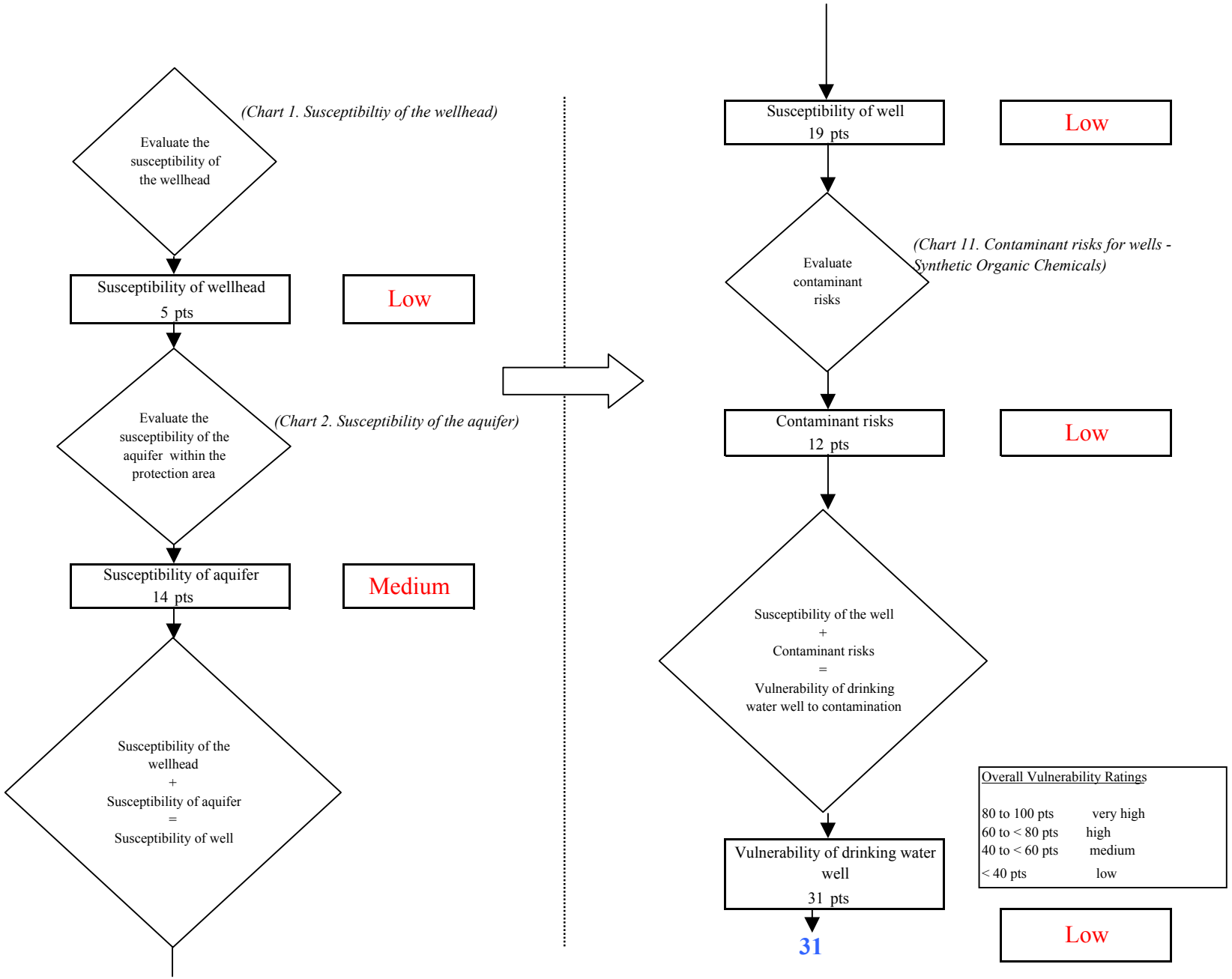


Chart 13. Contaminant risks for Violet Circle - Other Organic Chemicals

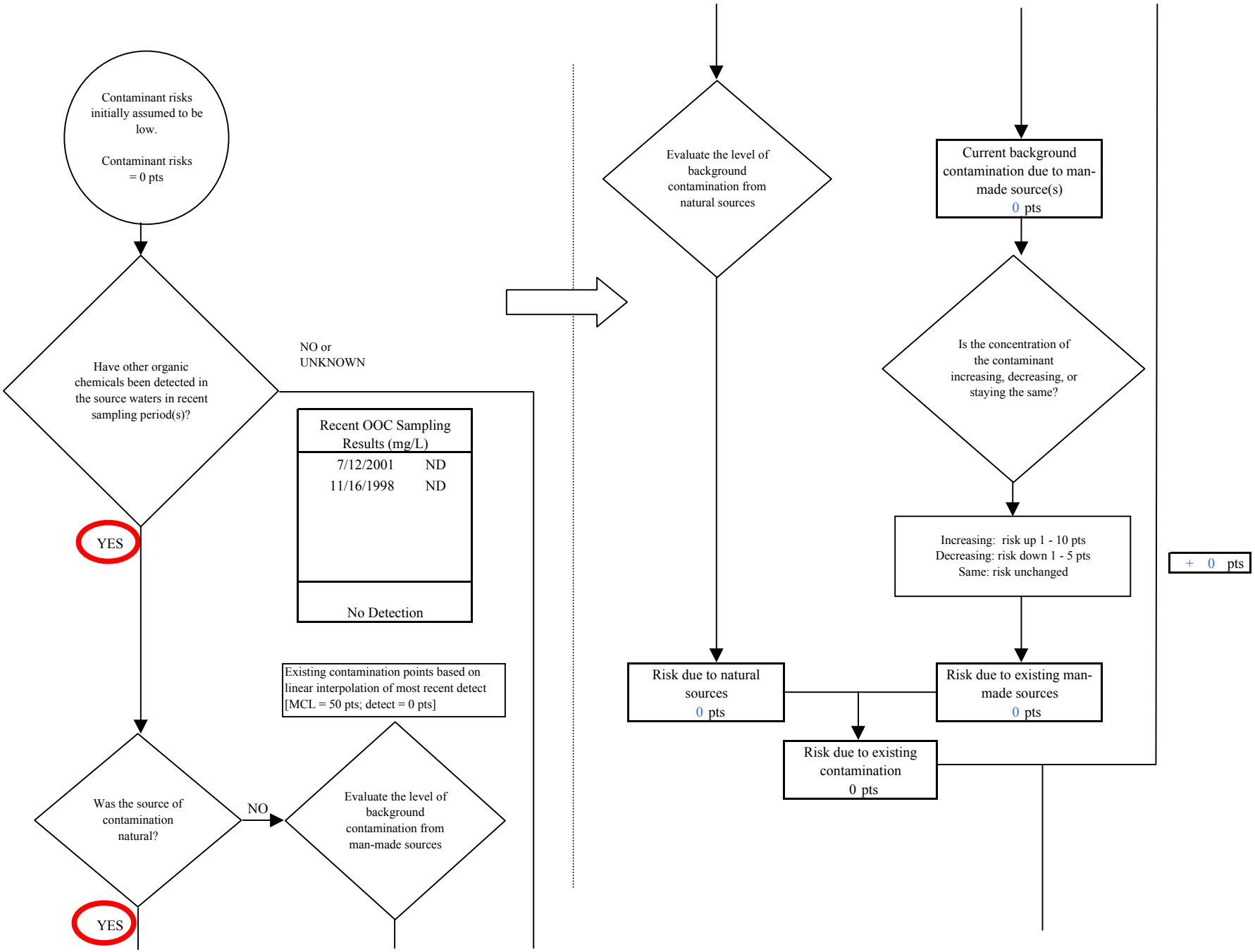


Chart 13. Contaminant risks for Violet Circle - Other Organic Chemicals

+ 10 pts

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

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	4	4	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 10

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 = 10 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

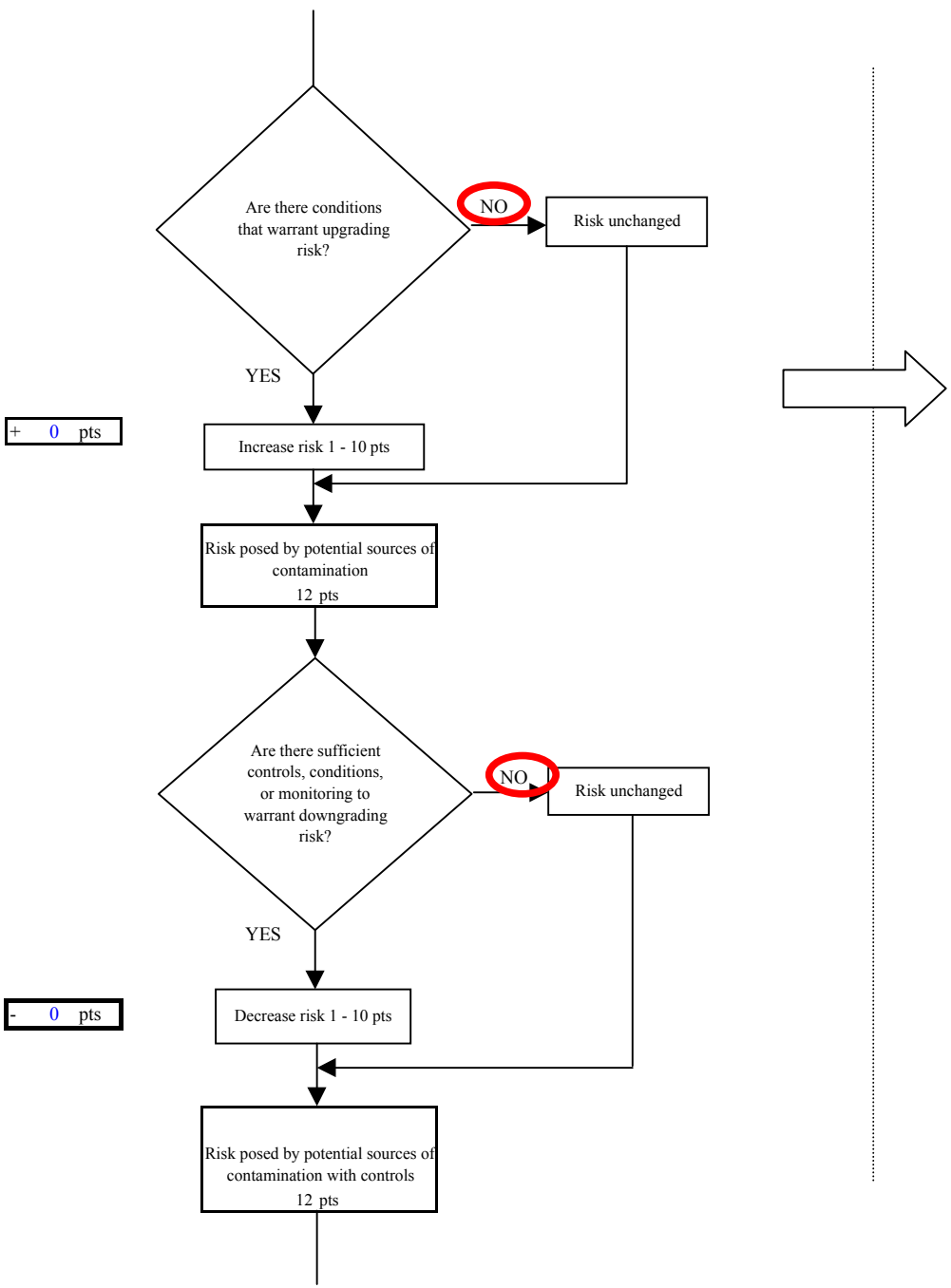
Risk unchanged

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 13. Contaminant risks for Violet Circle - Other Organic Chemicals



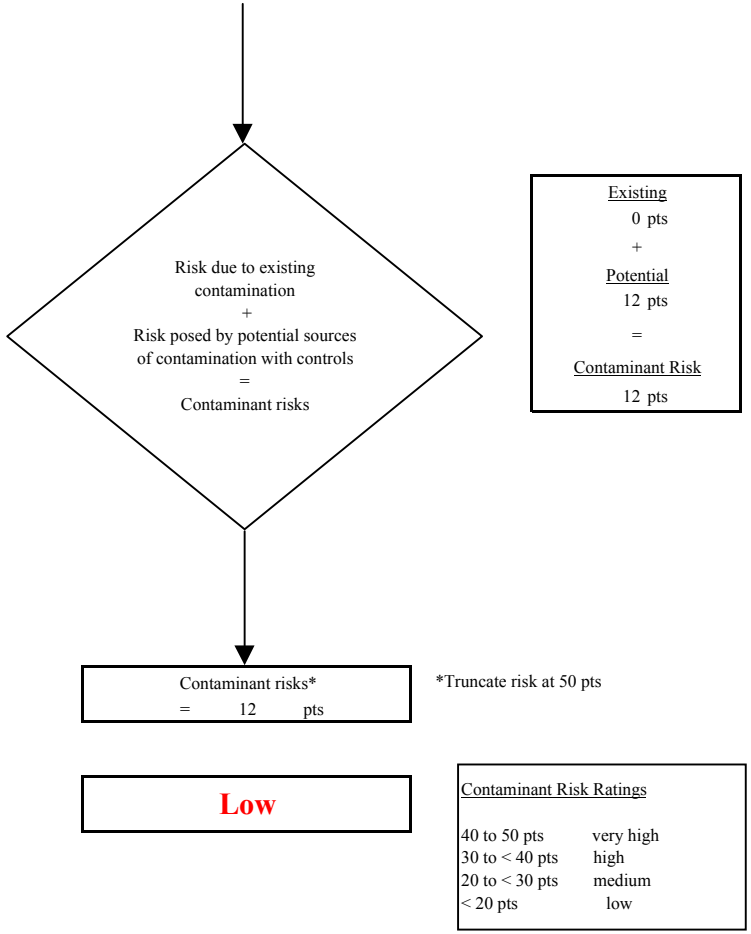


Chart 14. Vulnerability analysis for Violet Circle - Other Organic Chemicals