Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Cottonwood Creek Elementary Drinking Water System, Wasilla, Alaska PWSID # 223658.001

DRINKING WATER PROTECTION PROGRAM REPORT #764

Alaska Department of Environmental Conservation

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By Suzan J. Hill

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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.

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Wasilla, Alaska

By Suzan J. Hill

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Cottonwood Creek Elementary is a Class A (non-transient, non-community) water system consisting of one well in the Wasilla, Alaska area. Identified potential and current sources of contaminants for Cottonwood Creek Elementary public drinking water source include large capacity septic systems, a vehicle maintenance facility, an above ground diesel storage tank, a closed contaminant site, residential septic systems, roads, and approximately 14 acres of residential area. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, the public water source for Cottonwood Creek Elementary received a vulnerability rating of **High** for bacteria and viruses, and nitrates and nitrites; **Medium** for volatile organic chemicals, heavy metals, and other organic chemicals; and **Low** for synthetic 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.

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 WASILLA AREA, ALASKA

Location

Wasilla is located near the center of the Matanuska-Susitna (Mat-Su) Borough in south central Alaska. The Mat-Su Borough encompasses approximately 23,000 square miles, including the majority of the drainage of the Susitna and Matanuska Rivers. Wasilla is located south of the Talkeetna Mountains, about 12 miles north of Knik Arm on Cook Inlet (Wickersham Alaska Corporation, 1986), (Matanuska-Susitna Borough/Fran Seager, 1991). Wasilla is 30 air miles north/northeast of Anchorage, adjacent to the Alaska Railroad main line and the George Parks Highway (ADNR, 1981).

Climate

The climate in Wasilla is transitional between the extremes of Interior Alaska and the wet conditions found along the coastal areas.

Wasilla is less than 15 miles from Knik Arm and about 75 miles from Prince William Sound. Summer temperatures are more moderate than those in the Interior due to the proximity to the coast. The Chugach and Talkeetna Mountains and the Alaska Range also protect Wasilla from the frigid cold of the Interior Alaska winter and act to break up strong storm fronts (Brabets, 1997), (Western Regional Climate Center, 2000).

Wasilla averages about 18 inches of precipitation per year, including about 59 inches of snowfall. Winter thaws can decrease snow cover to a few inches. Mean monthly high temperatures in Wasilla range from about 22 degrees in December and January to 69 degrees in July. The frost-free period in spring and summer averages 115 days, with the first frost usually arriving by September 1.

The record low for Wasilla was -50 degrees in January 1947. The highest recorded temperature was 90 degrees in 1969 (*Wickersham Alaska Corporation, 1986*).

Topography and Drainage

The Wasilla area topography varies from about 300 feet to 500 feet above sea level. The surrounding terrain gradually rises from south to north. The Wasilla area has hundreds of small lakes, several large lakes, and two substantial streams. At 387 acres, ***Wasilla Lake*** is one of the largest lakes in Southcentral Alaska (*Renshaw Consulting Engineers, 1983*).

The Cottonwood Creek drainage system, of which Wasilla Lake is part, begins northeast of Wasilla and discharges into Knik Arm about 15 miles to the south.

Cottonwood Creek is a popular salmon fishing stream (outside city limits), and has an average rate of flow of about 16 cubic feet per second near the outfall from Wasilla Lake.

At 362 acres, ***Lake Lucille*** is slightly smaller than Wasilla Lake. However, although within close proximity, they are part of two separate drainages and have significantly different characteristics. Lake Lucille is shallow with an average depth of five and a half feet. Its primary water source is springs in the lake bed. No significant creek leads into it and Lucille Creek is a low flow stream that drains it into Big Lake. Water circulation and flushing action through the lake is slow.

Although the quality can vary significantly in a short distance, groundwater supplies are abundant in the area. The Wasilla area has a central water system, and several subdivisions have private water systems. Many homes and businesses in the area, however, rely on individual wells for their water supply. Most of these wells are shallow with depths of less than 100 feet. Static water levels in many of these wells is around 30 feet below the surface. The coarse gravel underlying the Wasilla area provides a large aquifer even in the winter when infiltration is low (*Trainer, 1953*).

Geology and Soils

A lake covered the Susitna River valley lowland during glacial times. The deposition of glacial silts and clays played an important part in the make up of the soils of the area.

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic muck in old lakes and depressions means that some areas have soil conditions that vary over relatively short distances. The U.S. Soil Conservation Service has mapped seven soil associations in and around Wasilla.

The Homestead and Knik soil types predominate the Wasilla area, with smaller areas of Coal Creek, Jacobsen, Salamatof, and Slikok soil types.

The ***Homestead*** series is common in the Wasilla area especially north of the Parks Highway from the west end of Lake Lucille. Homestead soils are shallow, well-drained silty soils over loose sand and gravel. They have formed on broad out wash plains and gravel moraines and run from nearly flat terrain to steep areas.

Homestead series is prevalent along Church Road north of the Parks Highway and throughout the Mission Hills subdivision.

The ***Knik*** series is the other major soil type in the area. It includes most of the downtown area, north and south of Lake Lucille and Wasilla Lake.

Knik soils are shallow, well-drained and silty, overlaying coarse, gravelly material, although scattered areas of poorly drained soils are also included. The soils are extensive over a broad range of slopes from flat to steep escarpments.

The ***Coal Creek*** series consists of dark-colored, poorly drained soils that formed in moderately deep silty material over compacted, fine-textured sediments. These soils occur in nearly level to gently sloping stream valleys, on the border of muskegs, and in small depressions. They are sometimes characterized by hillside seeps. This soil unit is found in small areas north and west of the downtown area.

The ***Jacobsen*** series is a very poorly drained, very stony silt loam found in broad depressions. The type is found west of Lake Lucille, south of the railroad, about even with Church Road.

The ***Salamatof*** and ***Slikok*** series are found within low areas and consist of poorly drained, peat, muck, and silty sediments in shallow depressions throughout the eastern side of the city. High water tables, often at or just below the surface, are characteristics of these soils. The banks of Cottonwood Creek south of Wasilla Lake have the greatest concentrations of these soils.

Finally, the ***Wasilla*** series consists of somewhat poorly drained soils with layers of sand and compacted finer material. They do not have the high organic content of the Slikok series. These soils are not extensive in the local area and are most commonly found southeast of Lake Lucille along the Knik-Goose Bay Road (*Wickersham Alaska Corporation, 1986*).

COTTONWOOD CREEK ELEMENTARY PUBLIC DRINKING WATER SYSTEM

Cottonwood Creek Elementary is a Class A (non-transient, non-community) water system. The system consists of one well and is located at 800 N. Seward Meridian Road (See Map 1 of Appendix A). This area is at an elevation of approximately 100 feet above sea level.

According to the Well Log, there is top soil from 0 to 5 feet, silty gravel from 5 to 134 feet; sandy gravel from 134 to 153 feet; silty sand from 153 to 157 feet; and gravel and sand from 157 feet to a total well depth of 161 feet . The well was drilled on 6/7/82 and had a static water level of 101 feet. The Sanitary Survey (10/26/01) indicates the well was installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is also appropriately sloped away from the well providing adequate surface water drainage. The well is not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves 500 non-residents through 1 service connection.

COTTONWOOD CREEK ELEMENTARY WELL DRINKING WATER PROTECTION AREA

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

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the Drinking Water Protection Area (DWPA). Because 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. (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The DWPA's 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. 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).

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 5 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 down-gradient 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.

The DWPA for the Cottonwood Creek Elementary contain four zones: Zone A, Zone B, Zone C, and Zone D (see Map 1 in Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Cottonwood Creek Elementary'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 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, and
- Other organic chemicals.

The sources are displayed on Maps 2 and 3 of Appendix C and summarized in Table 1 of 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 7 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF COTTONWOOD CREEK ELEMENTARY 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 six categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

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

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

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

The well for Cottonwood Creek Elementary is completed in an unconfined aquifer setting. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, contaminants at the surface have the potential to adversely impact this aquifer. Table 2 shows the Susceptibility scores and ratings for Cottonwood Creek Elementary.

Table 2. Susceptibility

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

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing and 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	40	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	25	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	20	Medium
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	25	Medium

Appendix D contains fourteen 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 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	60	High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	45	Medium
Heavy Metals, Cyanide and Other Inorganic Chemicals	40	Medium
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	45	Medium

Bacteria and Viruses
The contaminant risk for bacteria and viruses is very high with a large capacity septic system in Zone A presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Recent sampling of Cottonwood Creek Elementary shows no detection of Bacteria and Viruses. After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Nitrates and Nitrites
The contaminant risk for nitrates and nitrites is very high with large capacity and residential septic systems posing the most significant contaminant risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history for Cottonwood Creek Elementary well indicates that low concentrations of nitrate have been detected. At the latest sampling period, a low concentration of nitrate and/or nitrite was detected at 0.302 mg/L or 3% of the Maximum Contaminant Level (MCL) of 10mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects.

It is unknown how much of the existing nitrate concentration can be attributed to natural or human-made sources. 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].

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Volatile Organic Chemicals
The contaminant risk for volatile organic chemicals is medium with an above ground diesel storage tank and a vehicle maintenance facility presenting the most significant risk to the drinking water well (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). Recent sampling history of Cottonwood Creek Elementary did not detect any chemicals in the Volatile Organic Chemicals category. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

Heavy Metals, Cyanide, and Other Inorganic Chemicals
The contaminant risk for heavy metals is medium with large capacity and residential septic systems presenting the most significant risk to the drinking water well (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). Monitoring samples analyzing chemicals within the Heavy Metals, Cyanide and Other Inorganic Chemicals collected on 3/13/02 showed a concentration of arsenic - 8.0 mg/L or 16% of the MCL. Arsenic can be the result of natural deposit erosion, runoff from orchards or runoff from glass and electronics production wastes. The potential health effects from concentrations of arsenic include skin damage, problems with the circulatory system and possible increased risk of cancer. Small amounts of barium were also detected.

After combining the contaminant risk for heavy metals, cyanide, and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

Synthetic Organic Chemicals
The contaminant risk for synthetic organic chemicals is low with residential areas representing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals of the well is low.

Other Organic Chemicals
The contaminant risk for other organic chemicals is medium with a vehicle maintenance facility within the DWPA representing the most significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well is medium.

Review of the historical sampling data indicates that no synthetic organic chemicals or other organic chemicals were detected in Cottonwood Creek Elementary's drinking water the last time it was sampled (See Charts 11 and 13 – Contaminant Risks for Synthetic Organic Chemicals and Other Organic Chemicals in Appendix D, respectively).

SUMMARY

A *Source Water Assessment* has been completed for the sources of public drinking water serving Cottonwood Creek Elementary. Overall, the public water source for Cottonwood Creek Elementary received a vulnerability rating of **High** for bacteria and viruses, and nitrates and nitrites; **Medium** for volatile organic chemicals, heavy metals, and other organic chemicals; and **Low** for synthetic 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 Cottonwood Creek Elementary 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 Cottonwood Creek Elementary public drinking water source.

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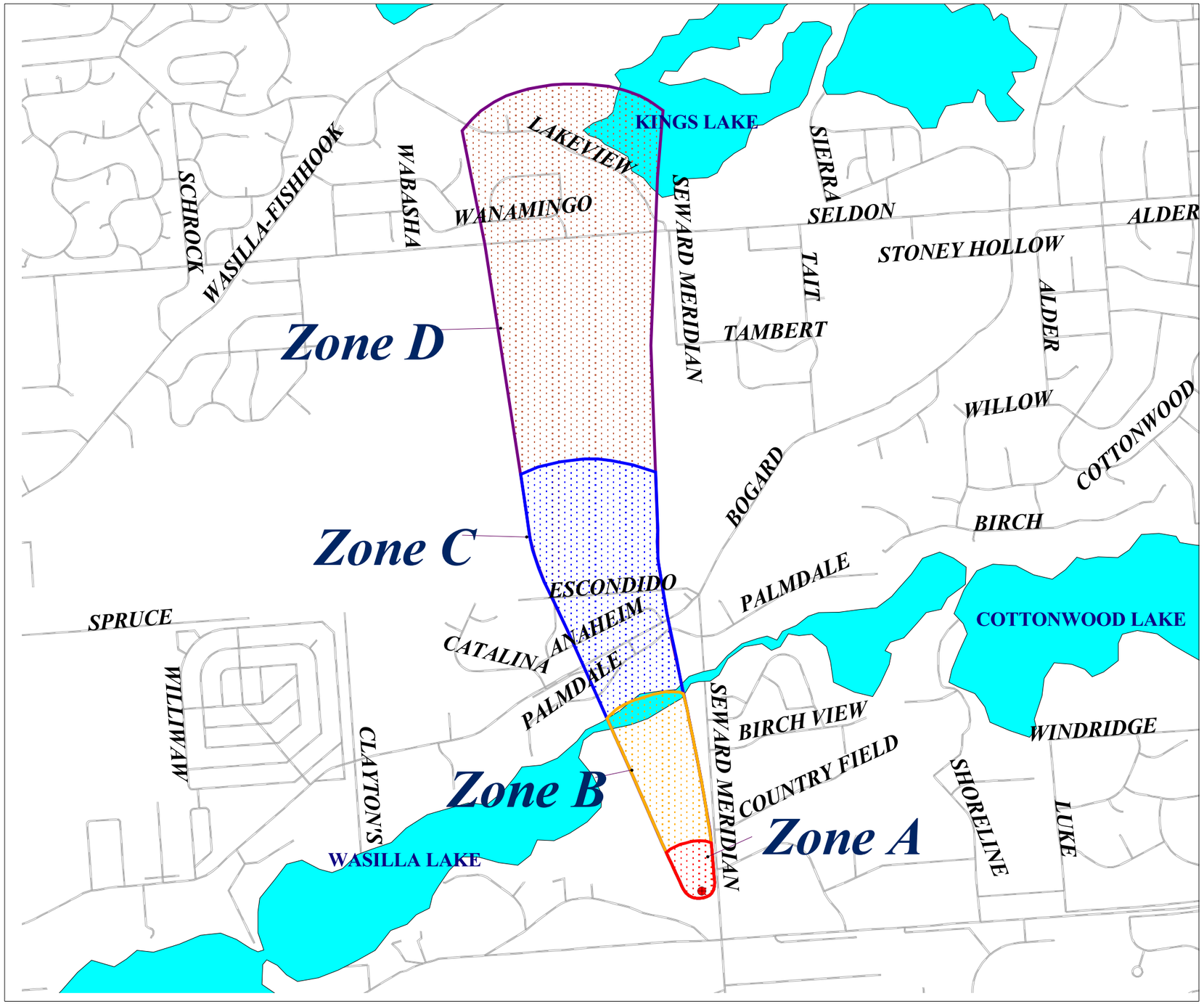
APPENDIX A

Cottonwood Creek Elementary Well #1
Drinking Water Protection Area Location Map
(Map 1)

Cottonwood Creek Elem. Protection Area - PWS #223658.001



Legend

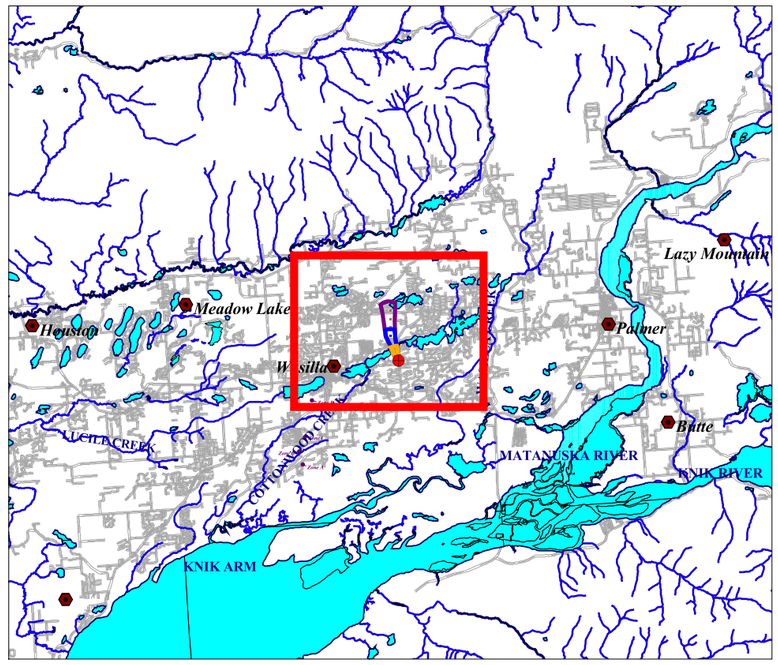
- Cottonwood Creek Elem. Well Location

Zone A
- Several Months Travel Time

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel

Zone D
- Less Than Ten Years Time of Travel
- Lakes
- Roads



3000 0 3000 6000 9000 12000 Feet

N W E S

MAP ONE

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Cottonwood Creek Elementary Well #1 (Tables 1-7)

Table 1

Contaminant Source Inventory for
MSBSD Cottonwood Creek Elementary

PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	
Tanks, diesel (above ground)	T06	T06-1	A	2	
Government vehicle maintenance facilities	X19	X19-1	A	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	C	3	
Residential Areas	R01	R01-1	C	3	14 Acres
Septic systems (serves one single-family home)	R02	R02-1-30	C	3	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	C	3	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-2	C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	C	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	D	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	D	3	

Table 2

Contaminant Source Inventory and Risk Ranking for MSBSD Cottonwood Creek Elementary Sources of Bacteria and Viruses

PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	

Table 3

Contaminant Source Inventory and Risk Ranking for MSBSD Cottonwood Creek Elementary Sources of Nitrates/Nitrites

PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	C	High	3	
Residential Areas	R01	R01-1	C	Low	3	14 Acres
Septic systems (serves one single-family home)	R02	R02-1-30	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	C	Low	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	D	High	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	D	High	3	

Table 4

Contaminant Source Inventory and Risk Ranking for MSBSD Cottonwood Creek Elementary Sources of Volatile Organic Chemicals

PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Tanks, diesel (above ground)	T06	T06-1	A	Medium	2	
Government vehicle maintenance facilities	X19	X19-1	A	Medium	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	C	Low	3	
Residential Areas	R01	R01-1	C	Low	3	14 Acres
Septic systems (serves one single-family home)	R02	R02-1-30	C	Low	3	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-2	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	C	Low	3	

Table 5

Contaminant Source Inventory and Risk Ranking for MSBSD Cottonwood Creek Elementary Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Government vehicle maintenance facilities	X19	X19-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	C	Low	3	
Residential Areas	R01	R01-1	C	Low	3	14 Acres
Septic systems (serves one single-family home)	R02	R02-1-30	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	C	Low	3	

Table 6

Contaminant Source Inventory and Risk Ranking for MSBSD Cottonwood Creek Elementary Sources of Synthetic Organic Chemicals

PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	C	Low	3	
Residential Areas	R01	R01-1	C	Low	3	14 Acres
Septic systems (serves one single-family home)	R02	R02-1-30	C	Low	3	

Table 7

Contaminant Source Inventory and Risk Ranking for MSBSD Cottonwood Creek Elementary Sources of Other Organic Chemicals

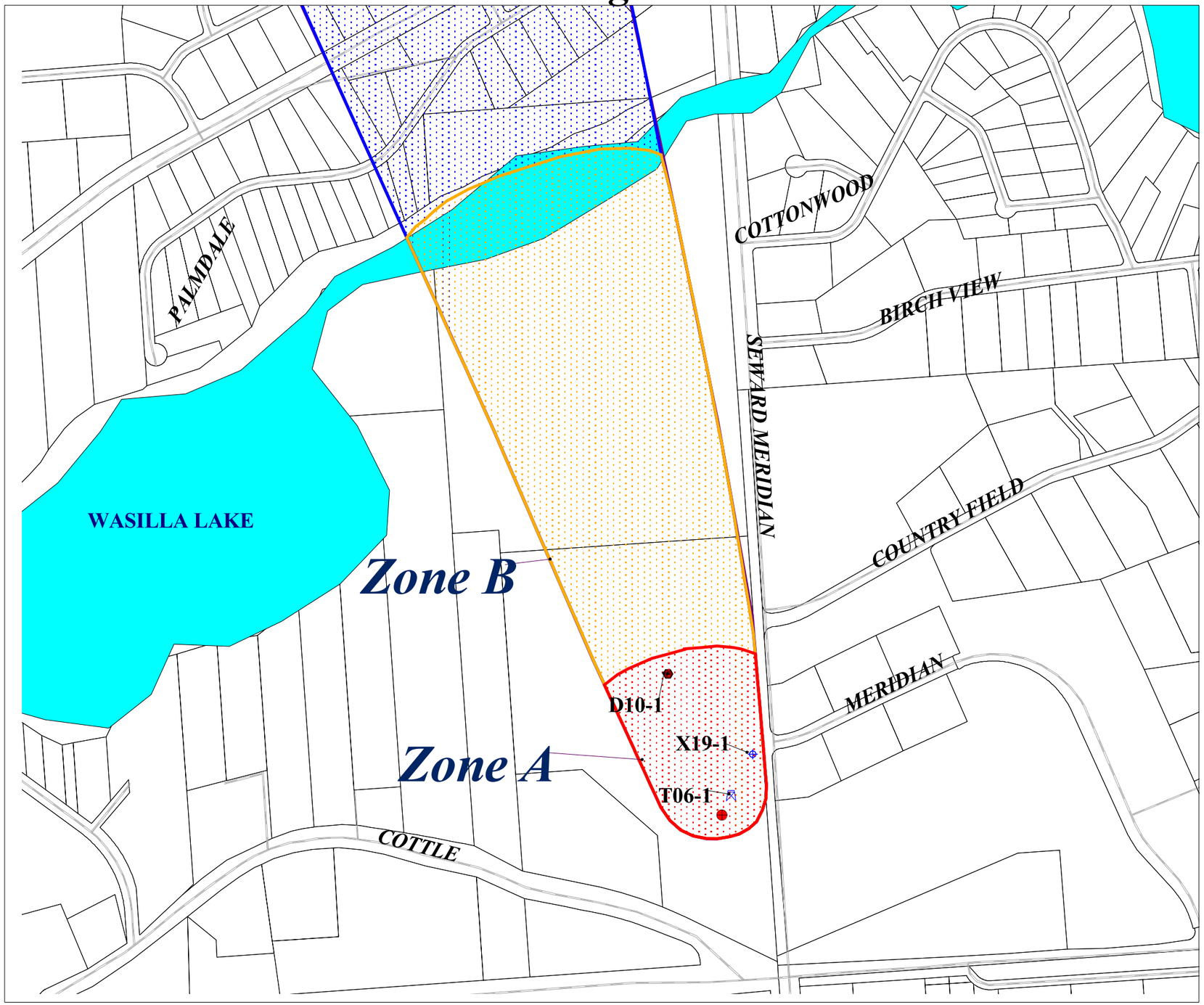
PWSID 223658.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Government vehicle maintenance facilities	X19	X19-1	A	Medium	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	C	Low	3	
Residential Areas	R01	R01-1	C	Low	3	14 Acres
Septic systems (serves one single-family home)	R02	R02-1-30	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-1-5	C	Low	3	

APPENDIX C

Cottonwood Creek Elementary Well #1
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-3)

Cottonwood Creek Elem. Existing and Potential Contaminant Sources - PWS #223658



800 0 800 1600 2400 3200 Feet

Legend

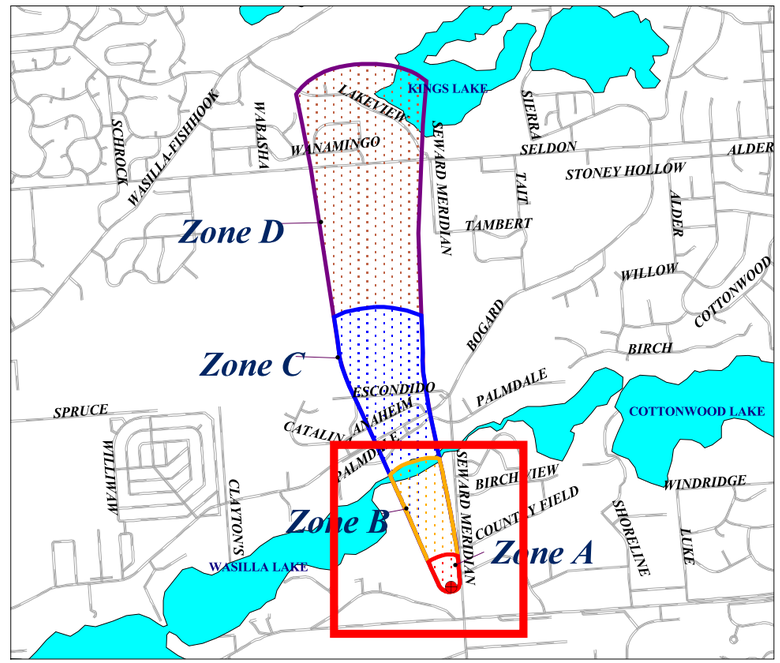
- Cottonwood Creek Elem. Well Location

Zone A
- Several Months Travel Time

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel

Zone D
- Less Than Ten Years Time of Travel
- Lakes
- Roads
- Land Parcels
- Large Capacity Septic Systems (D10)
- Government Vehicle Maintenance Facility (X19)
- Above Ground Diesel Tank (T06)



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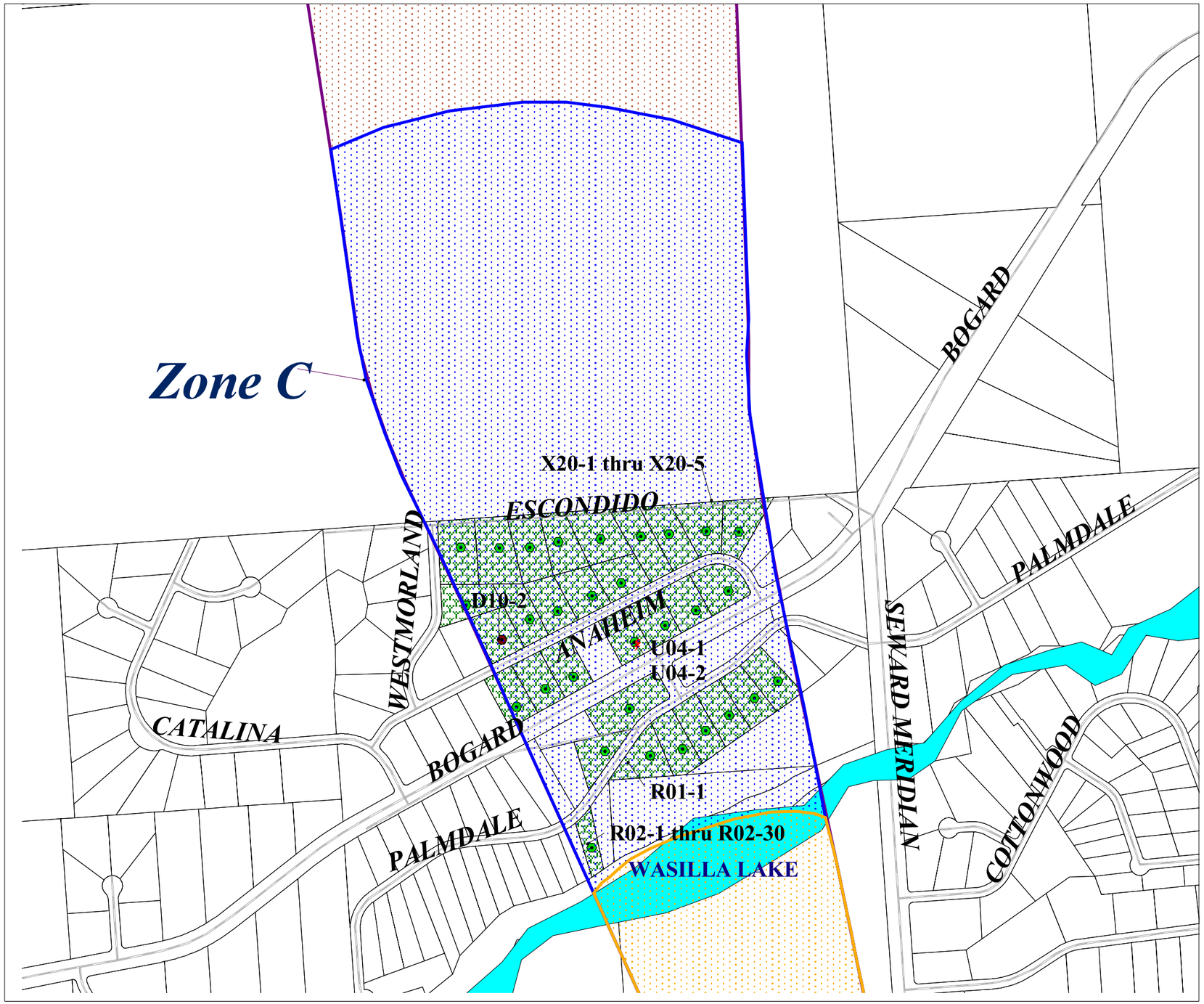
MAP TWO

Cottonwood Creek Elem. Existing and Potential Contaminant Sources - PWS #223658



800 0 800 1600 2400 3200 Feet

Legend

- Cottonwood Creek Elem. Well Location

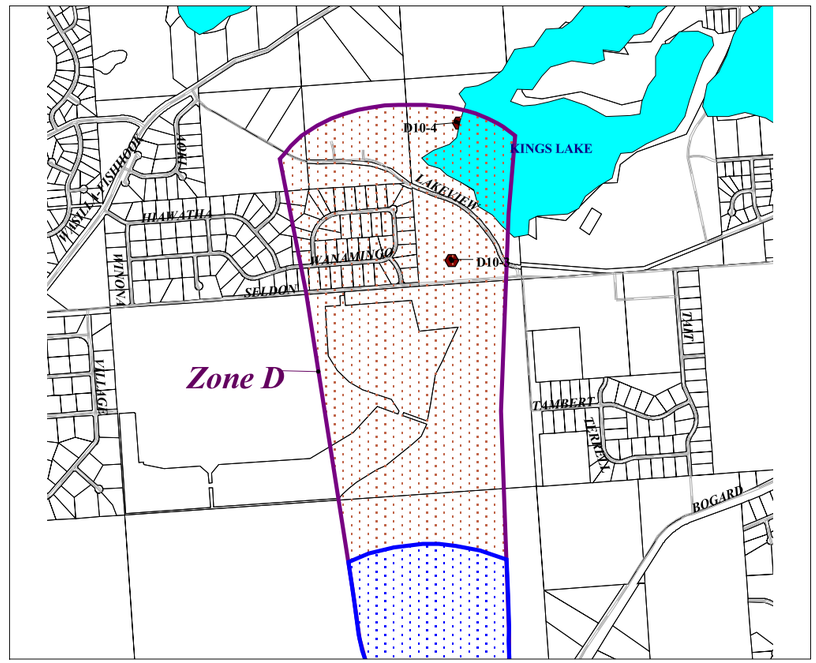
Zone A
- Several Months Travel Time

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel

Zone D
- Less Than Ten Years Time of Travel
- Lakes
- Roads (X20)
- Land Parcels
- Contaminated Sites (U04)

Septic Systems
- Large Capacity Septic Systems (D10)
- Residential Septics (R02)
- Residential Areas (R01)



N W E S

MAP THREE

APPENDIX D

Vulnerability Analysis for Cottonwood Creek Elementary Well #1 Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Cottonwood Creek Elem.

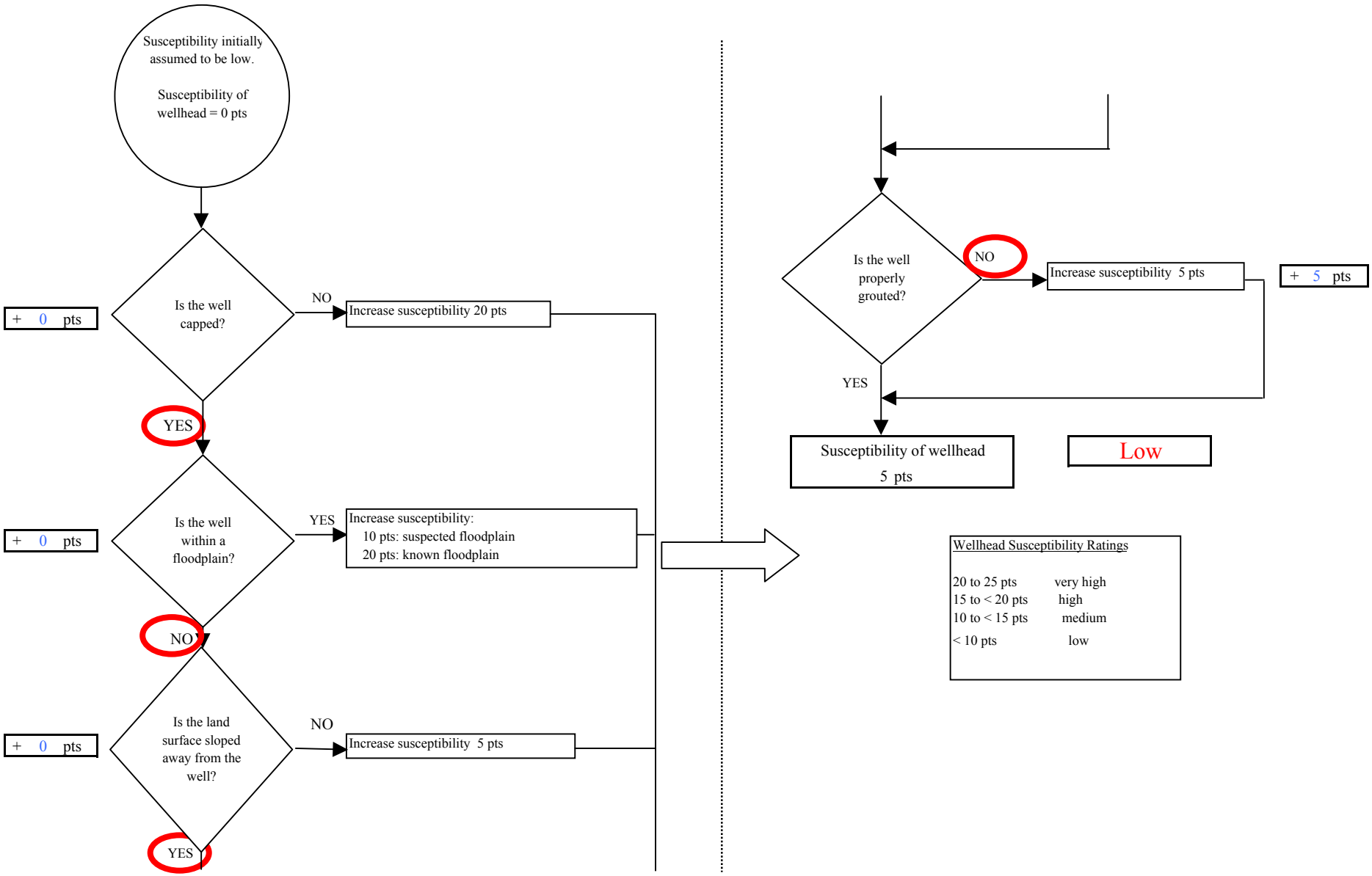


Chart 2. Susceptibility of the aquifer - Cottonwood Creek Elem.

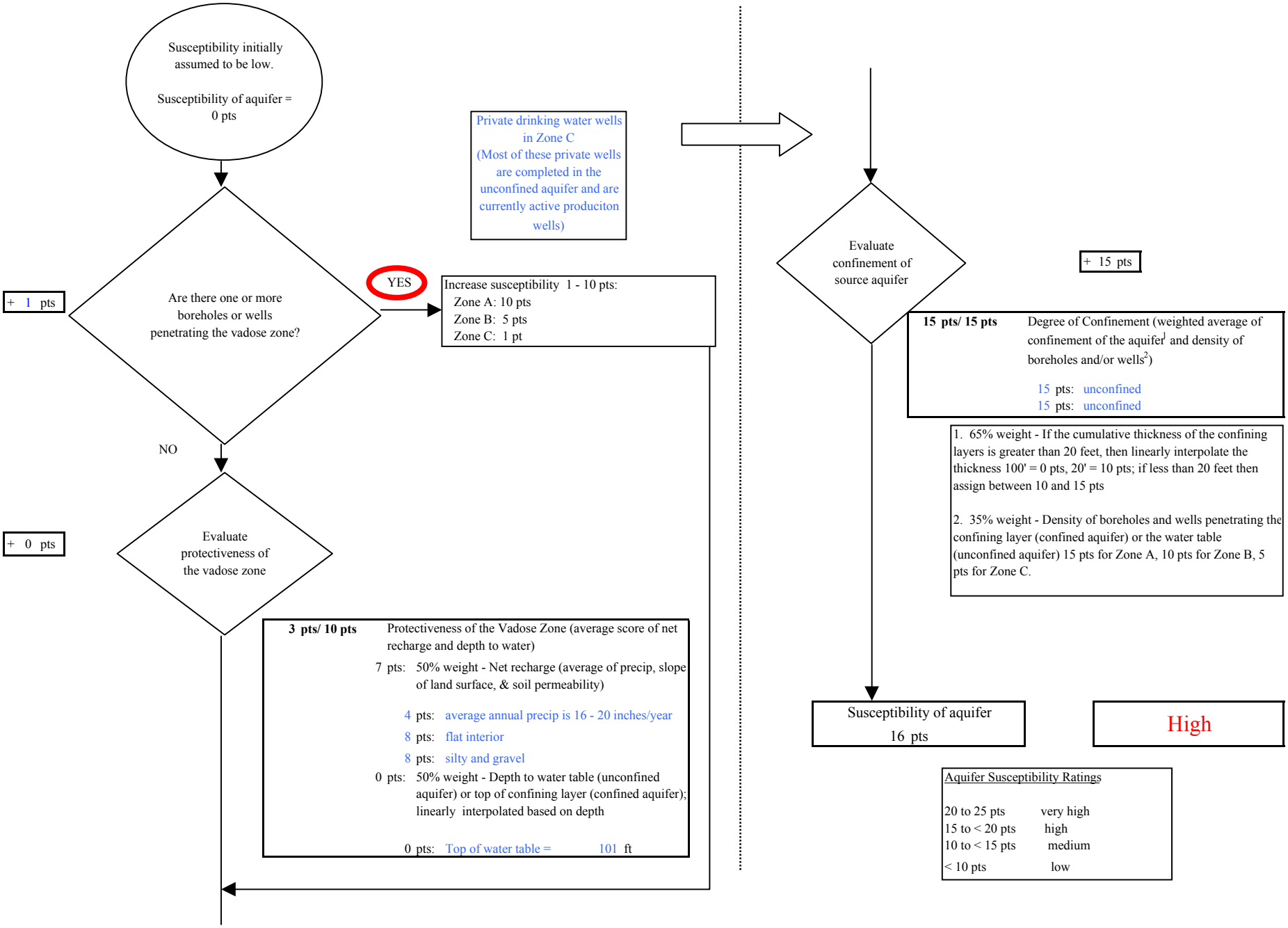
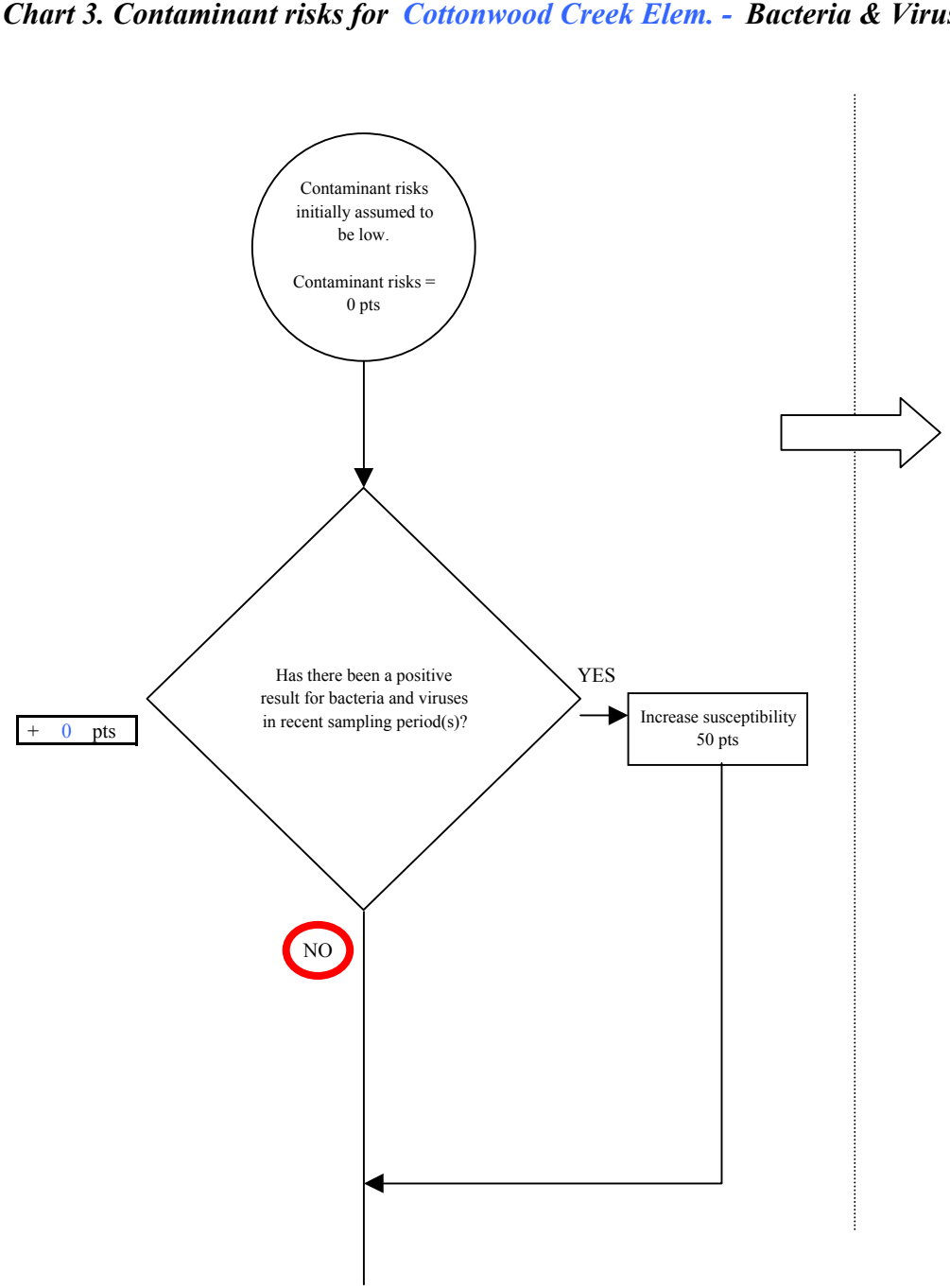
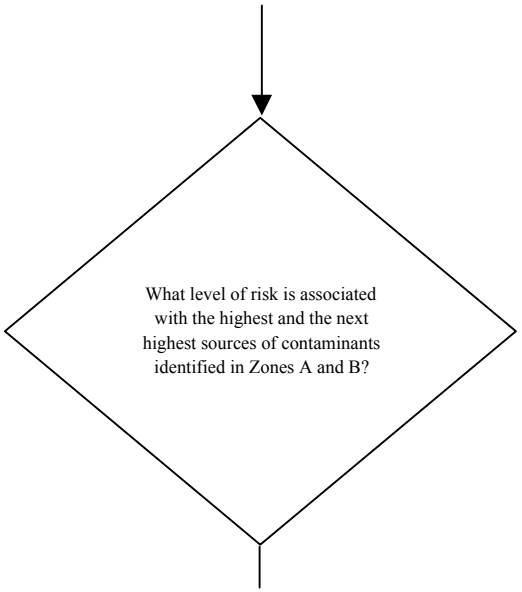


Chart 3. Contaminant risks for Cottonwood Creek Elem. - Bacteria & Viruses





+ 30 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)	1	0	1
Medium(s)	0	0	0
Low(s)	0	0	0

	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 30

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 Cottonwood Creek Elem. - Bacteria & Viruses

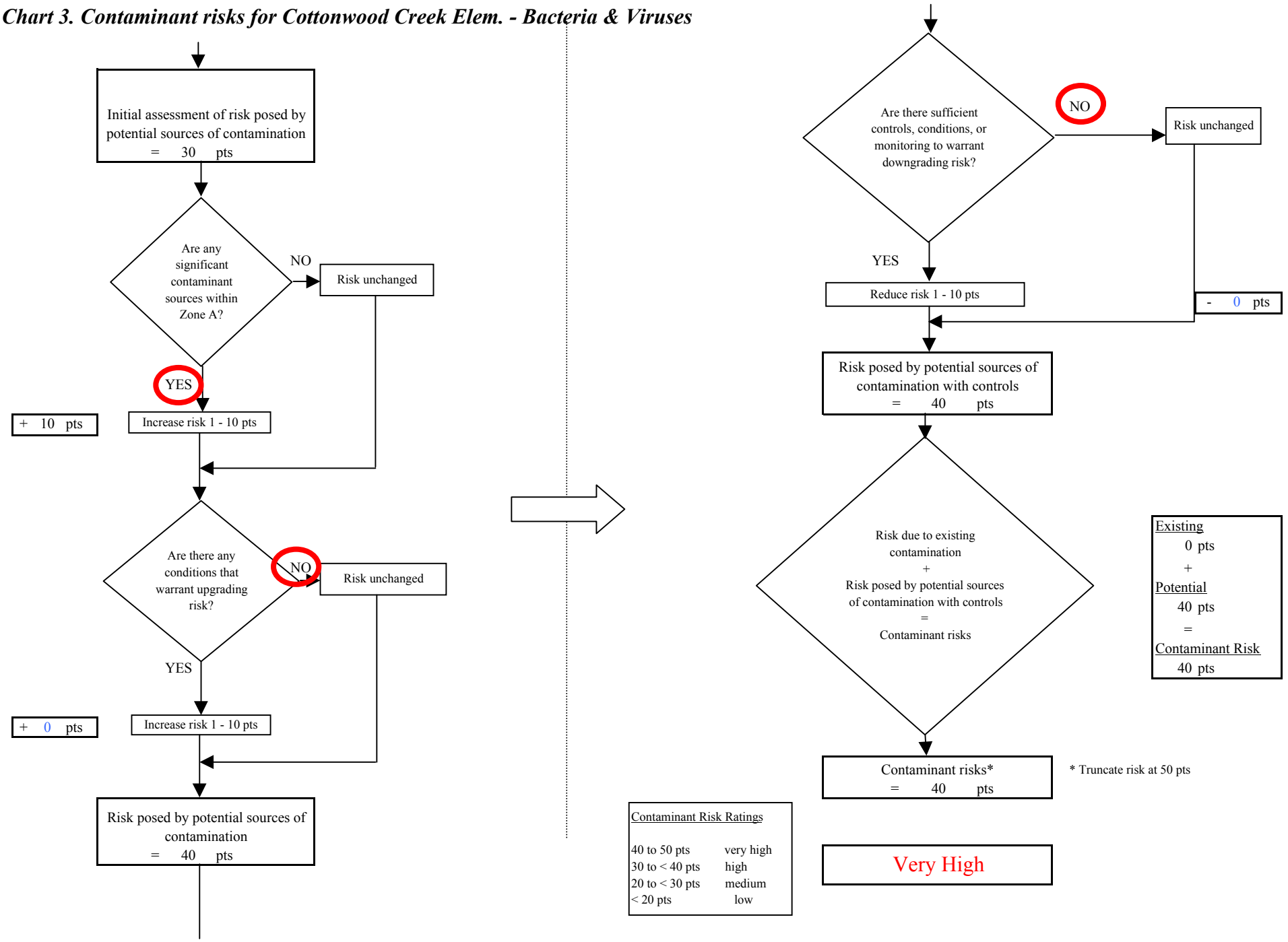


Chart 4. Vulnerability analysis for Cottonwood Creek Elem. - Bacteria & Viruses

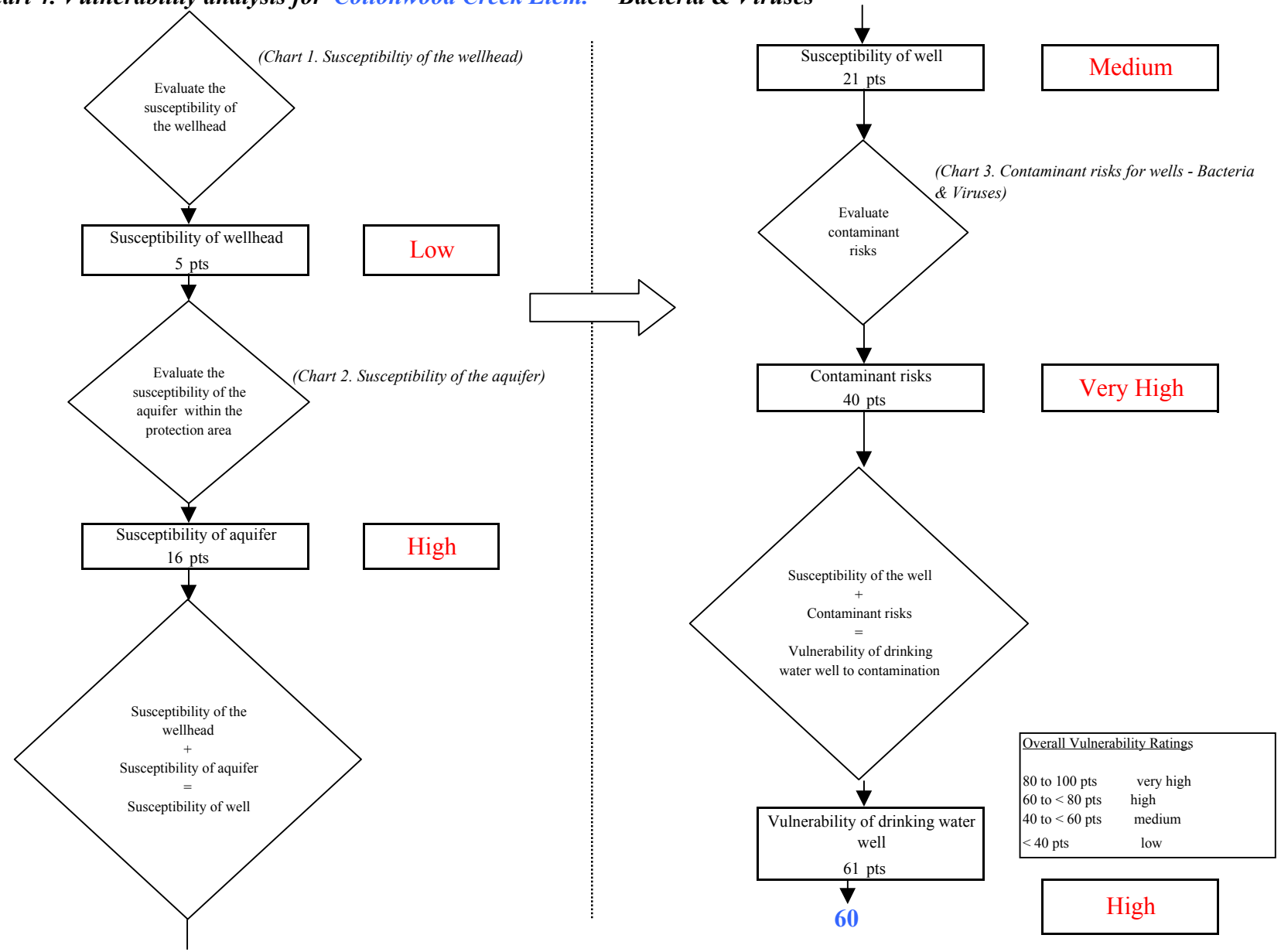


Chart 5. Contaminant risks for Cottonwood Creek Elem. - Nitrates and Nitrites

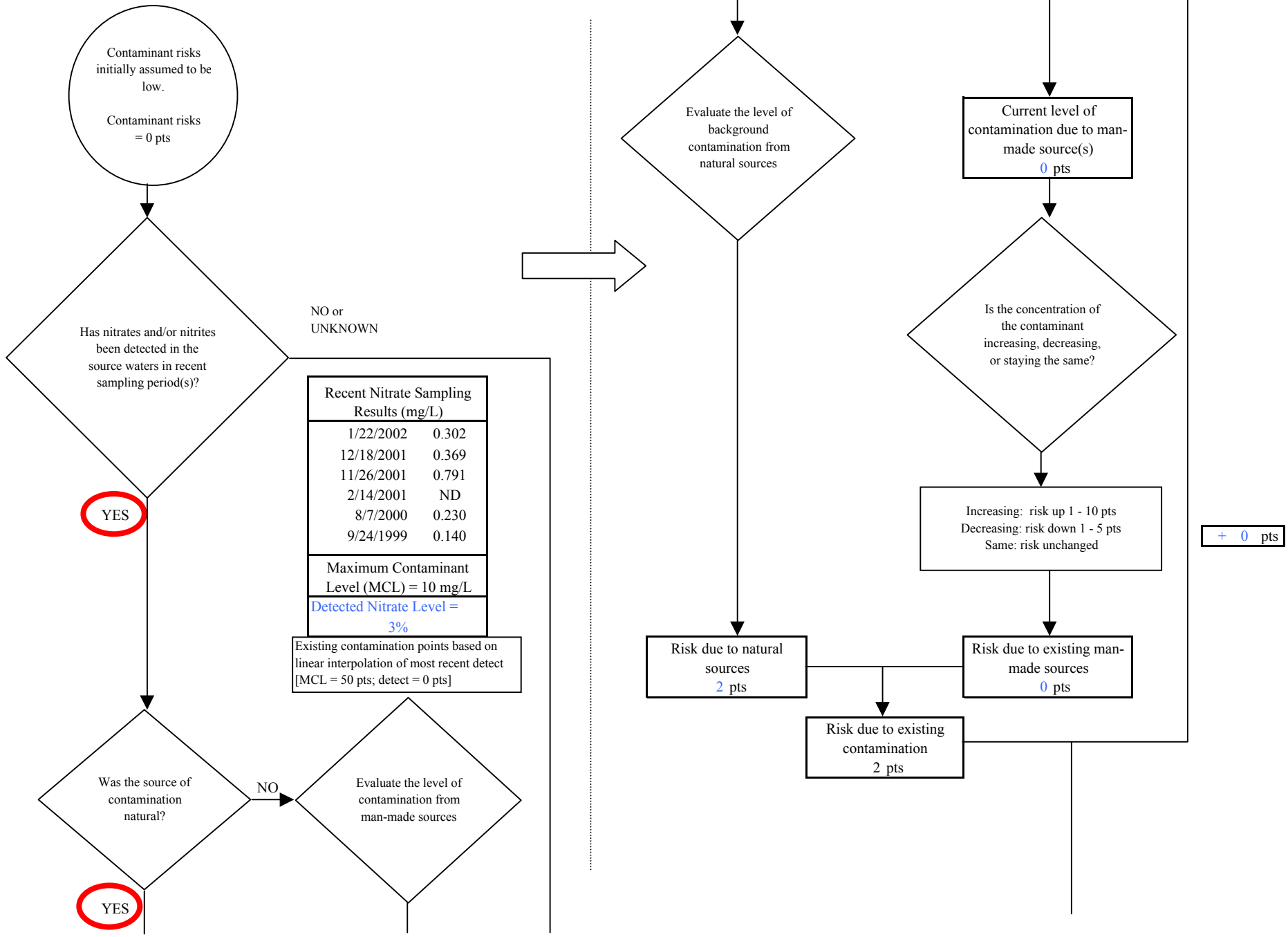


Chart 5. Contaminant risks for Cottonwood Creek Elem. - Nitrates and Nitrites

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	1	2
Medium(s)	0	0	0
Low(s)	0	5	5

	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

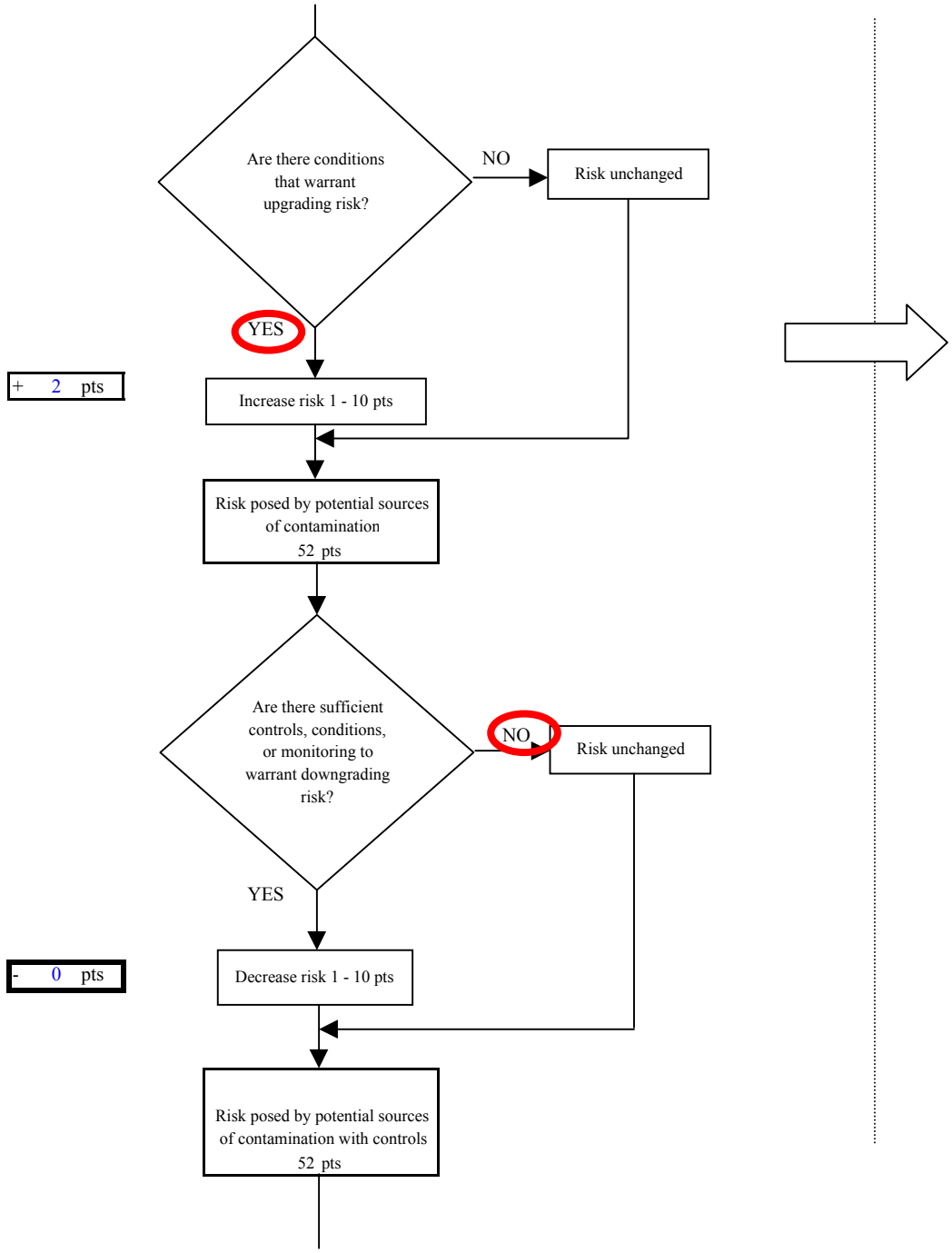
Risk unchanged

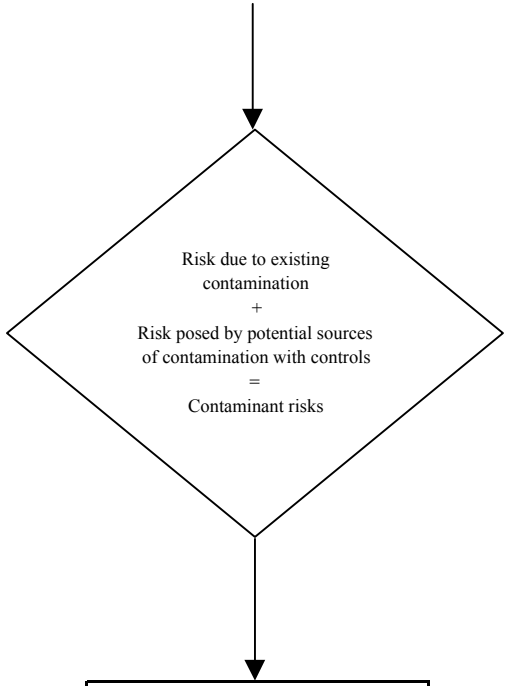
YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 5. Contaminant risks for Cottonwood Creek Elem. - Nitrates and Nitrites





Existing
2 pts
+
Potential
52 pts
=
Contaminant Risk
54 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 6. Vulnerability analysis for Cottonwood Creek Elem. - Nitrates and Nitrites

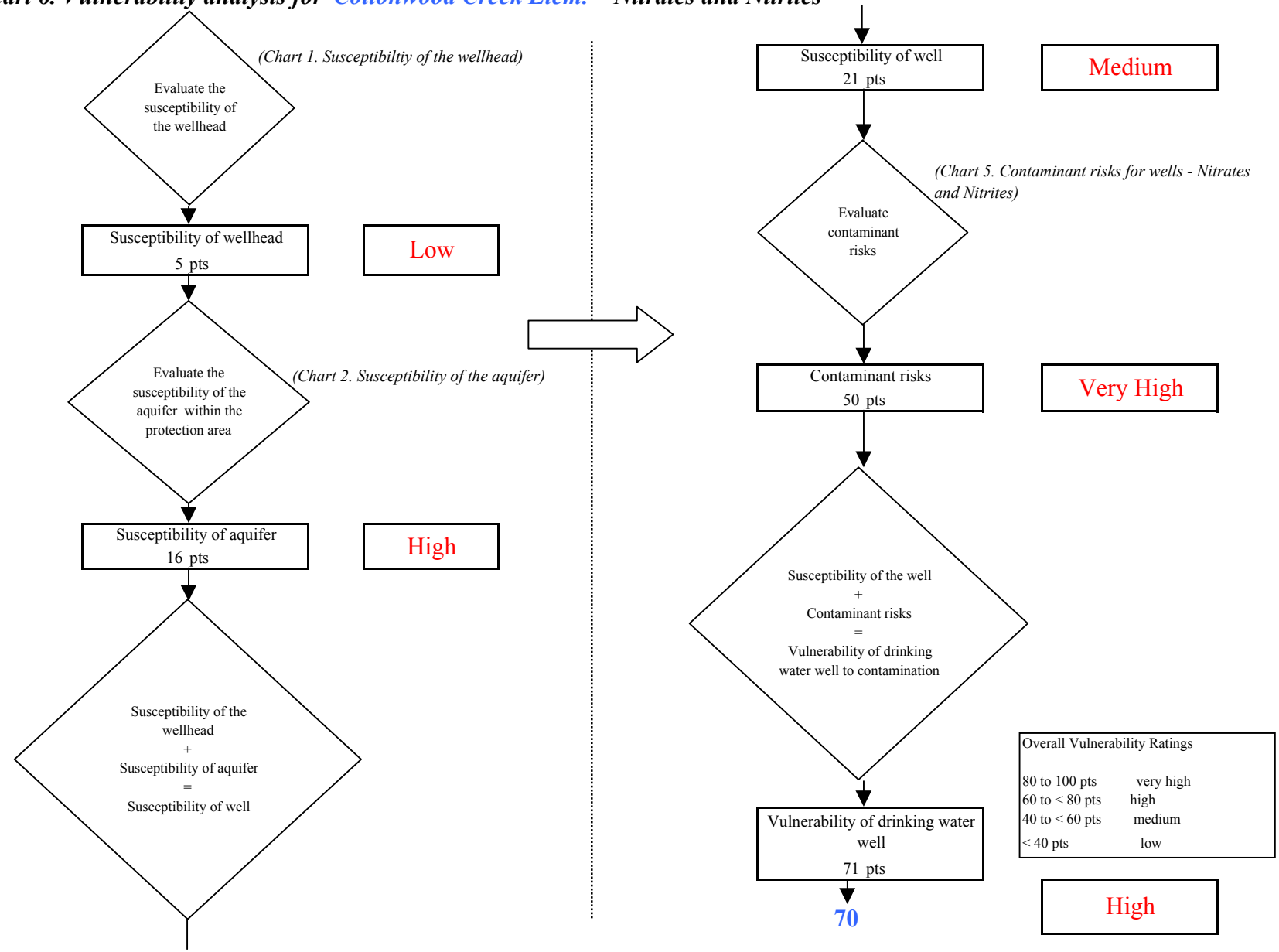


Chart 7. Contaminant risks for Cottonwood Creek Elem. - Volatile Organic Chemicals

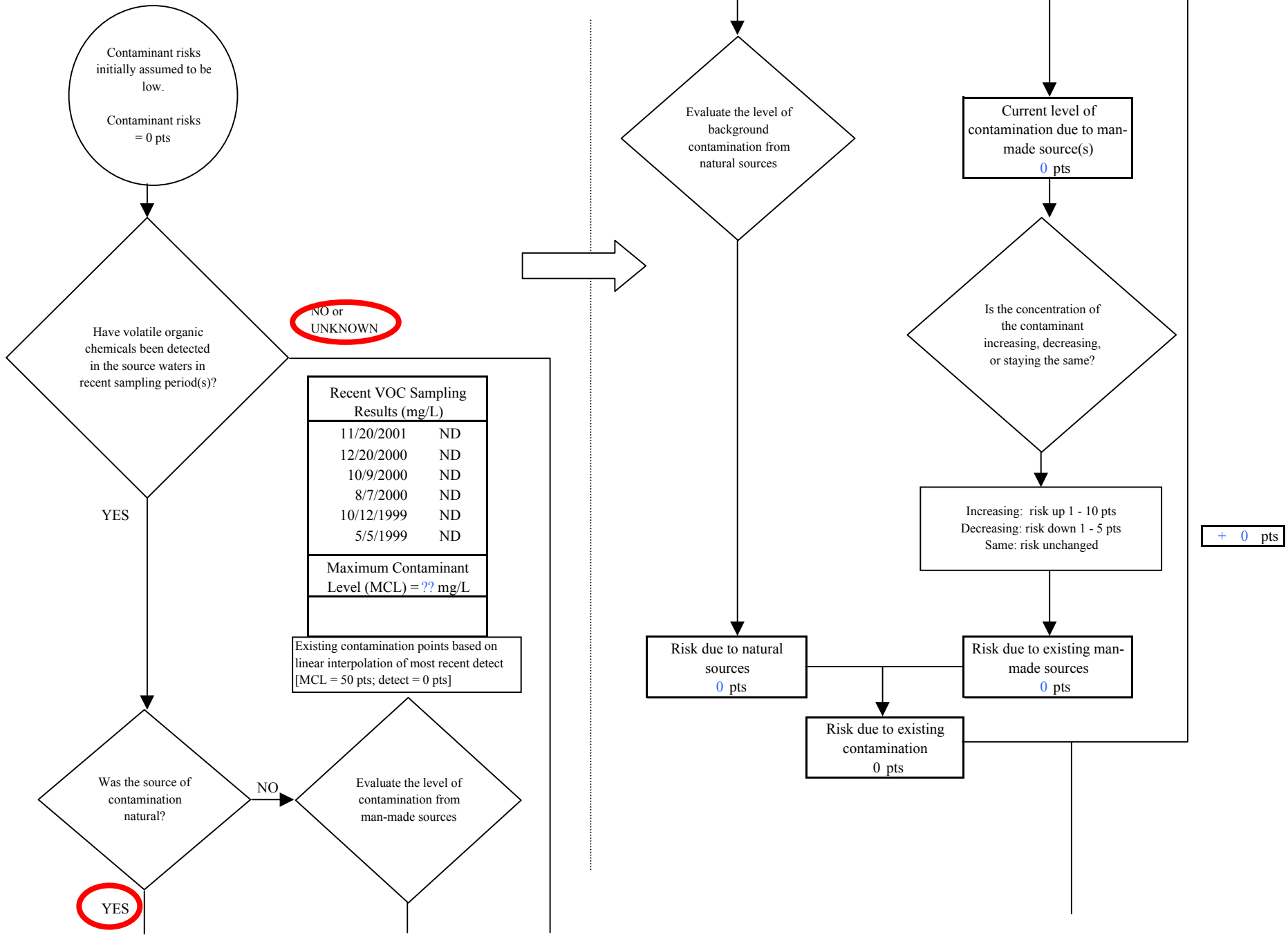


Chart 7. Contaminant risks for Cottonwood Creek Elem. - Volatile Organic Chemicals

+ 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)	2	0	2
Low(s)	1	5	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 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.

Initial assessment of risk posed by potential sources of contamination = 20 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

+ 5 pts

Chart 7. Contaminant risks for Cottonwood Creek Elem. - Volatile Organic Chemicals

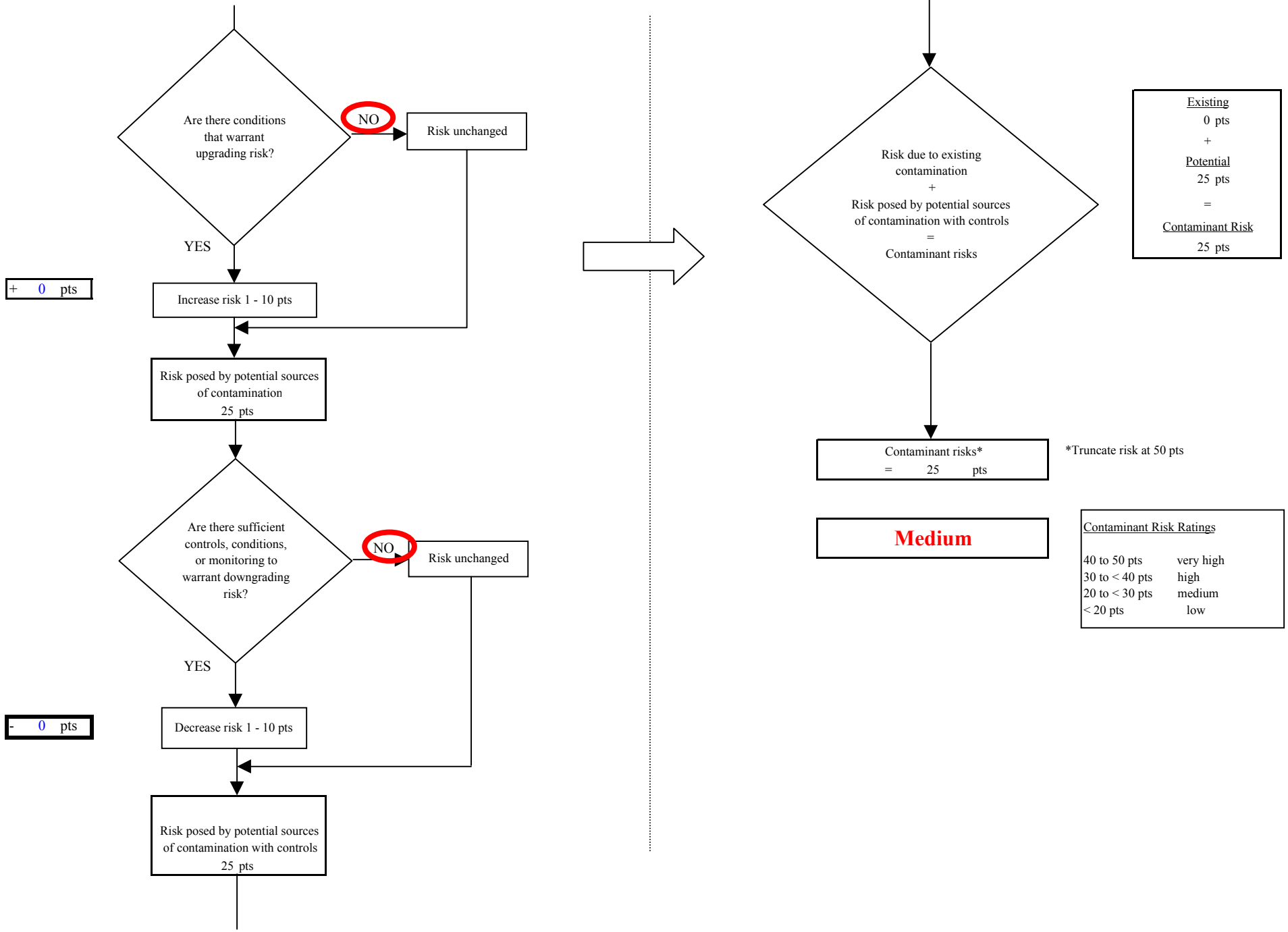


Chart 8. Vulnerability analysis for Cottonwood Creek Elem. - Volatile Organic Chemicals

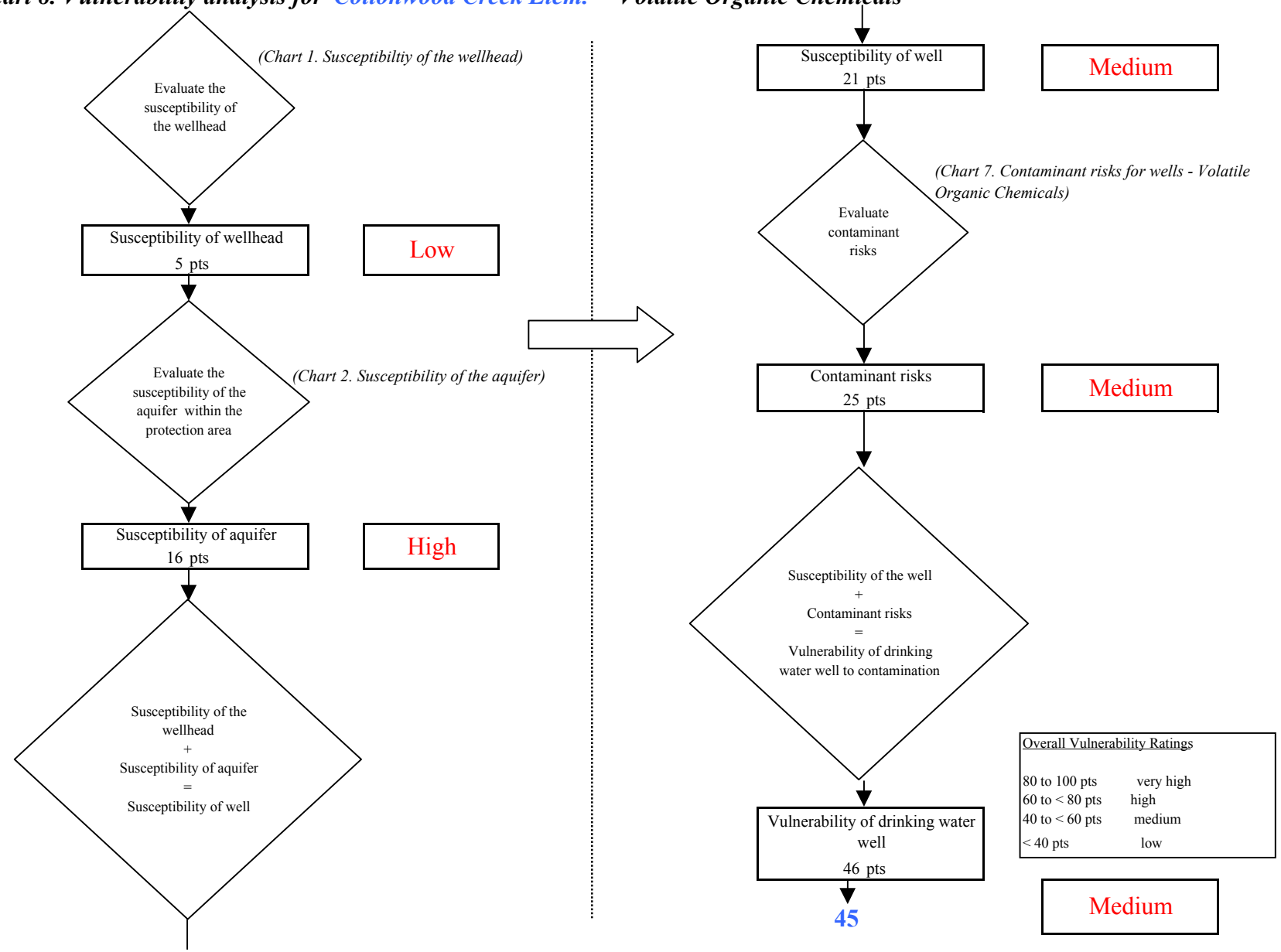


Chart 9. Contaminant risks for Cottonwood Creek Elem. - Heavy Metals, Cyanide and Other Inorganic Chemicals

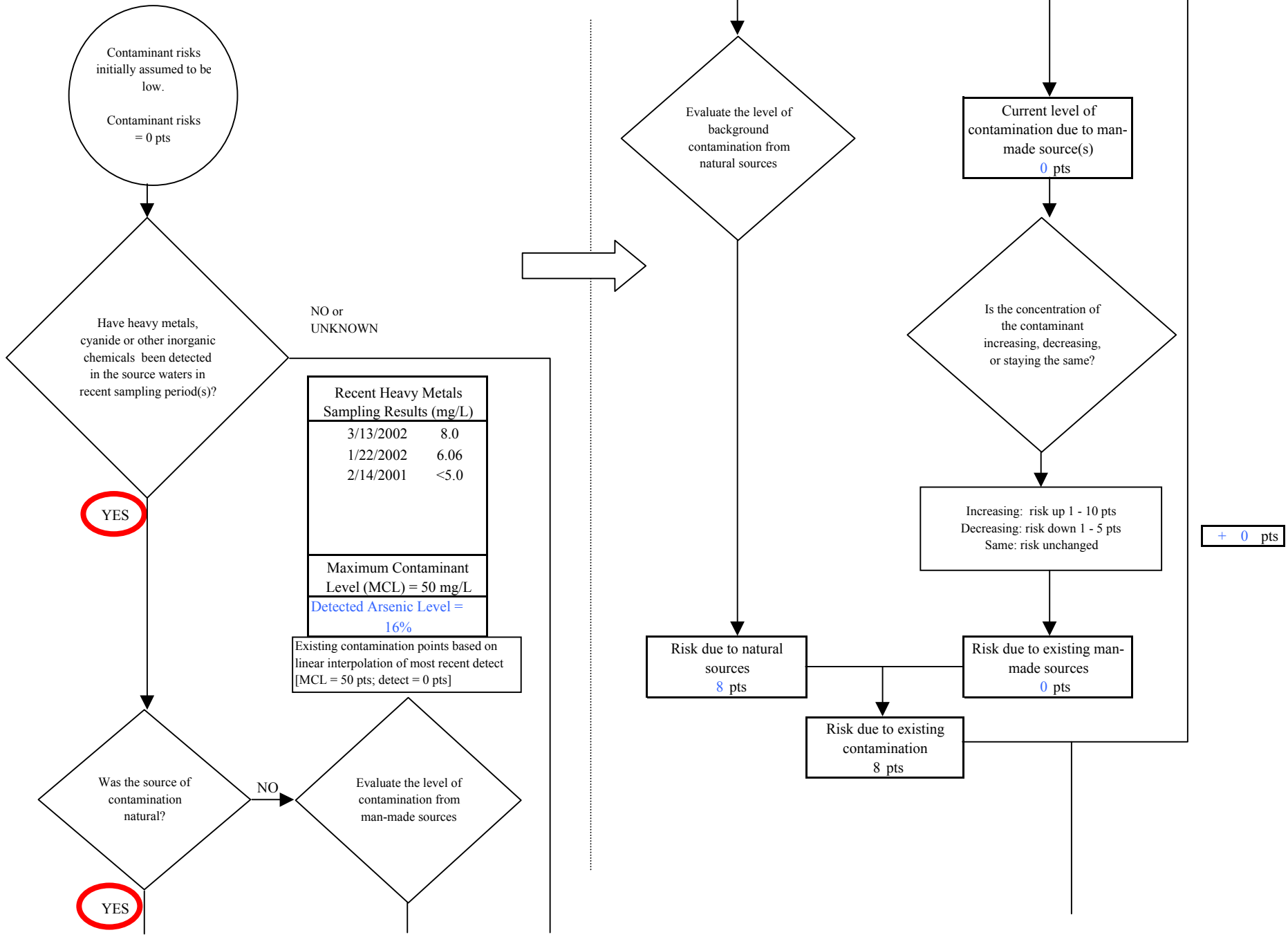


Chart 9. Contaminant risks for Cottonwood Creek Elem. - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 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)	2	4	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.

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 9. Contaminant risks for Cottonwood Creek Elem. - Heavy Metals, Cyanide and Other Inorganic Chemicals

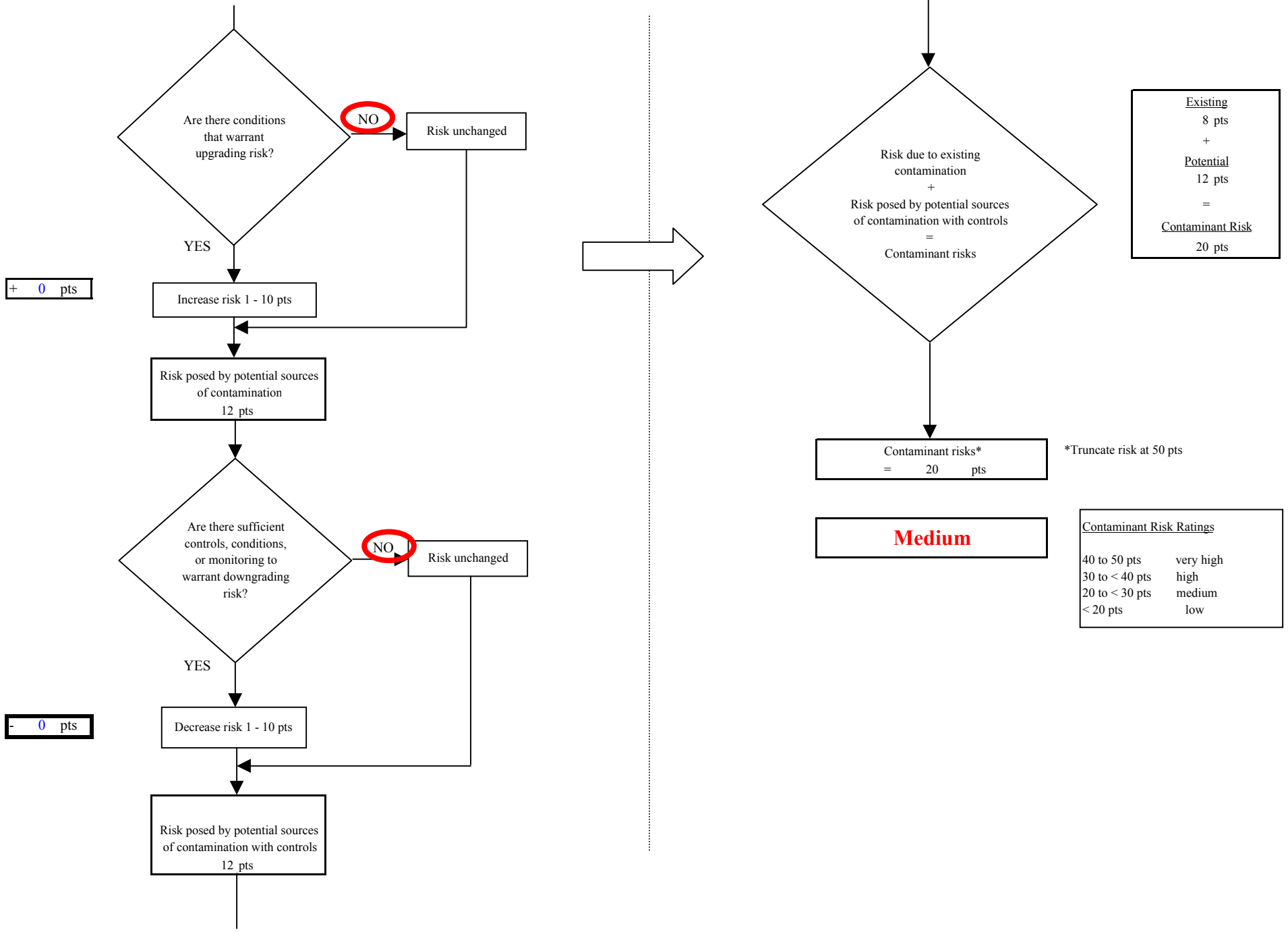


Chart 10. Vulnerability analysis for Cottonwood Creek Elem. - Heavy Metals, Cyanide and Other Inorganic Chemicals

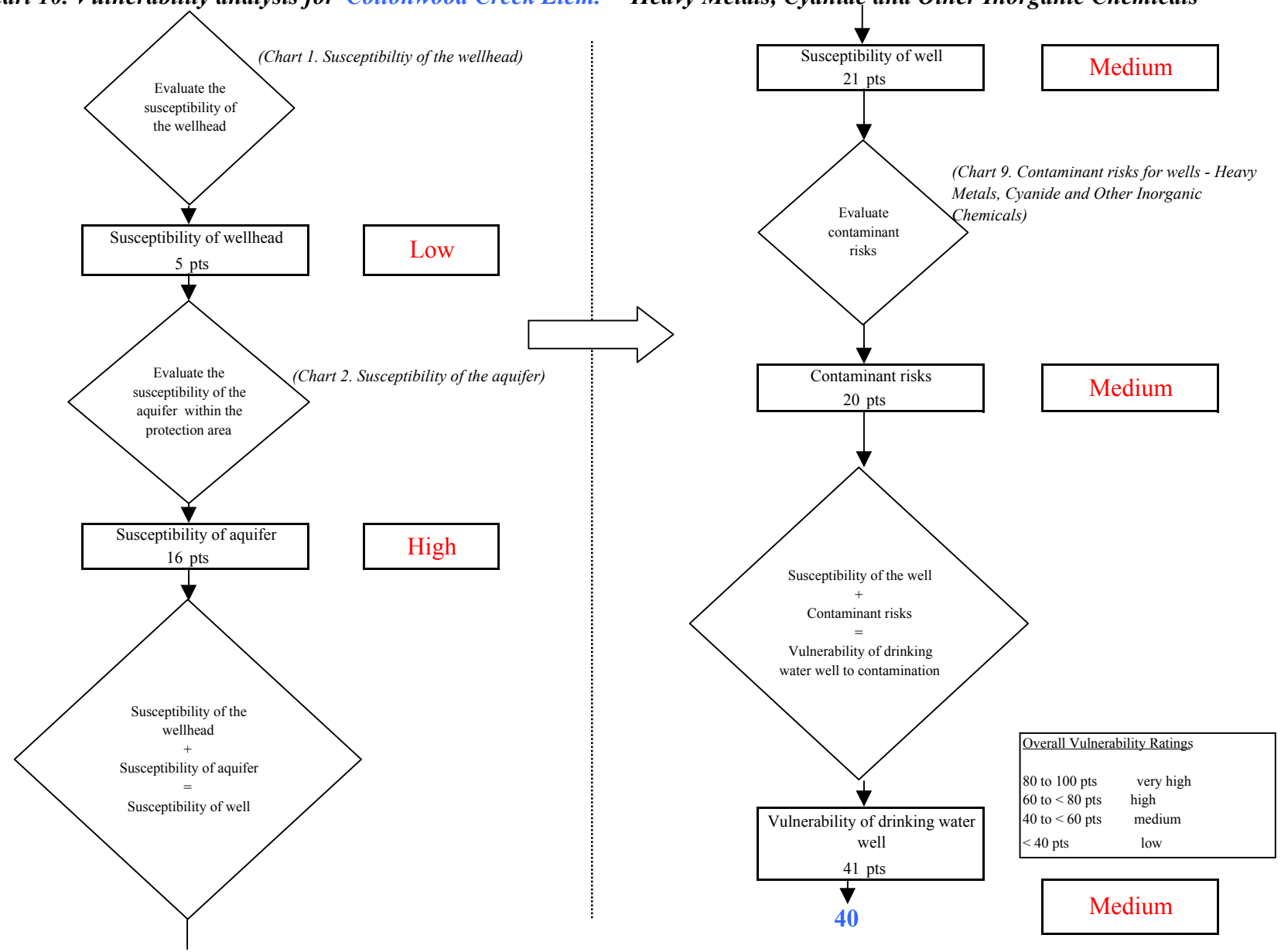


Chart 11. Contaminant risks for Cottonwood Creek Elem. - Synthetic Organic Chemicals

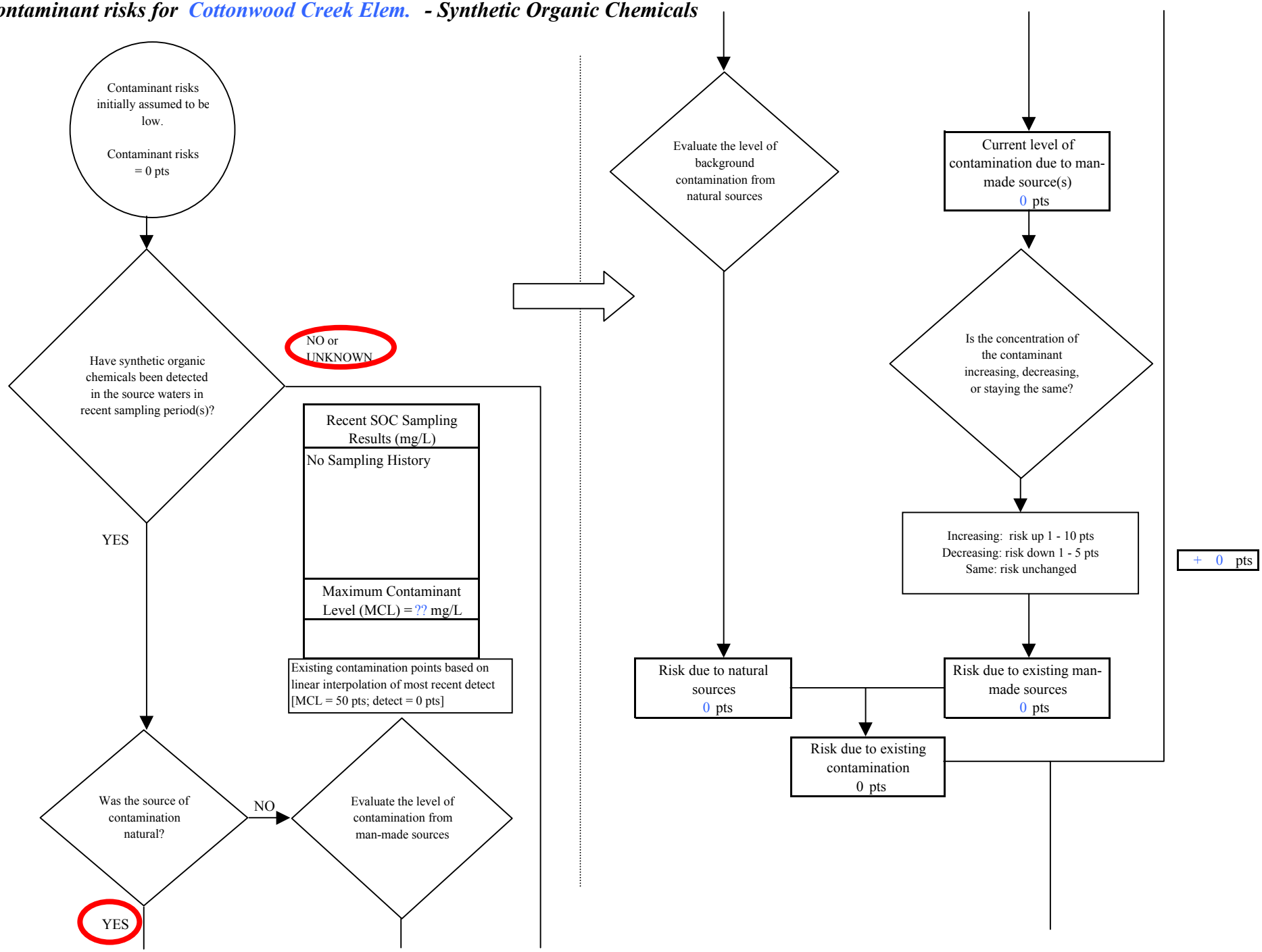
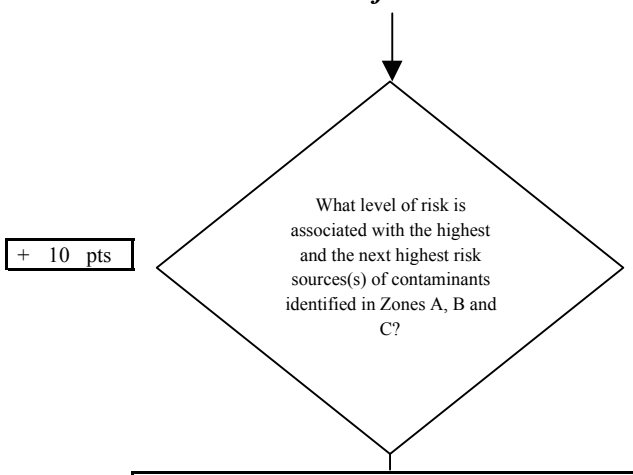


Chart 11. Contaminant risks for Cottonwood Creek Elem. - Synthetic Organic Chemicals



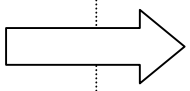
+ 10 pts

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)	1	3	4

	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.



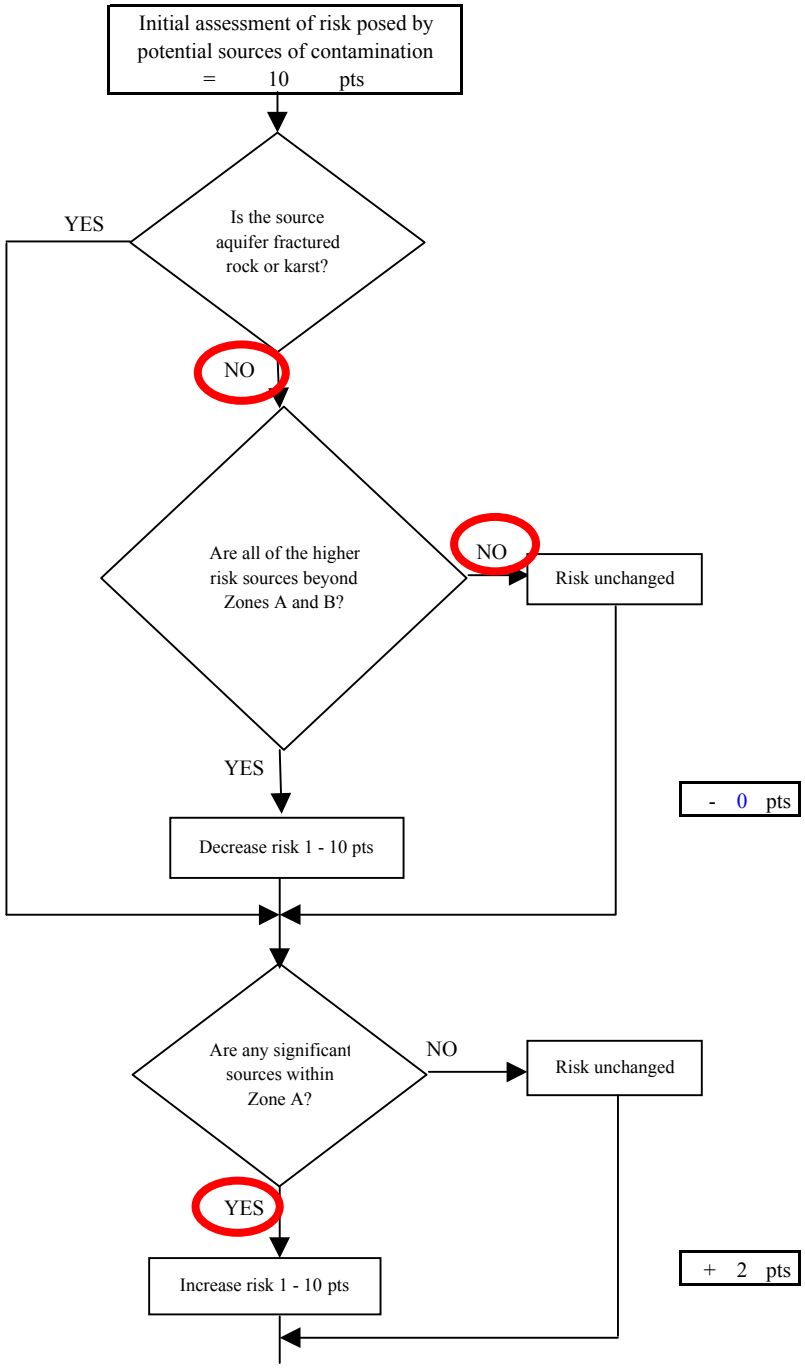
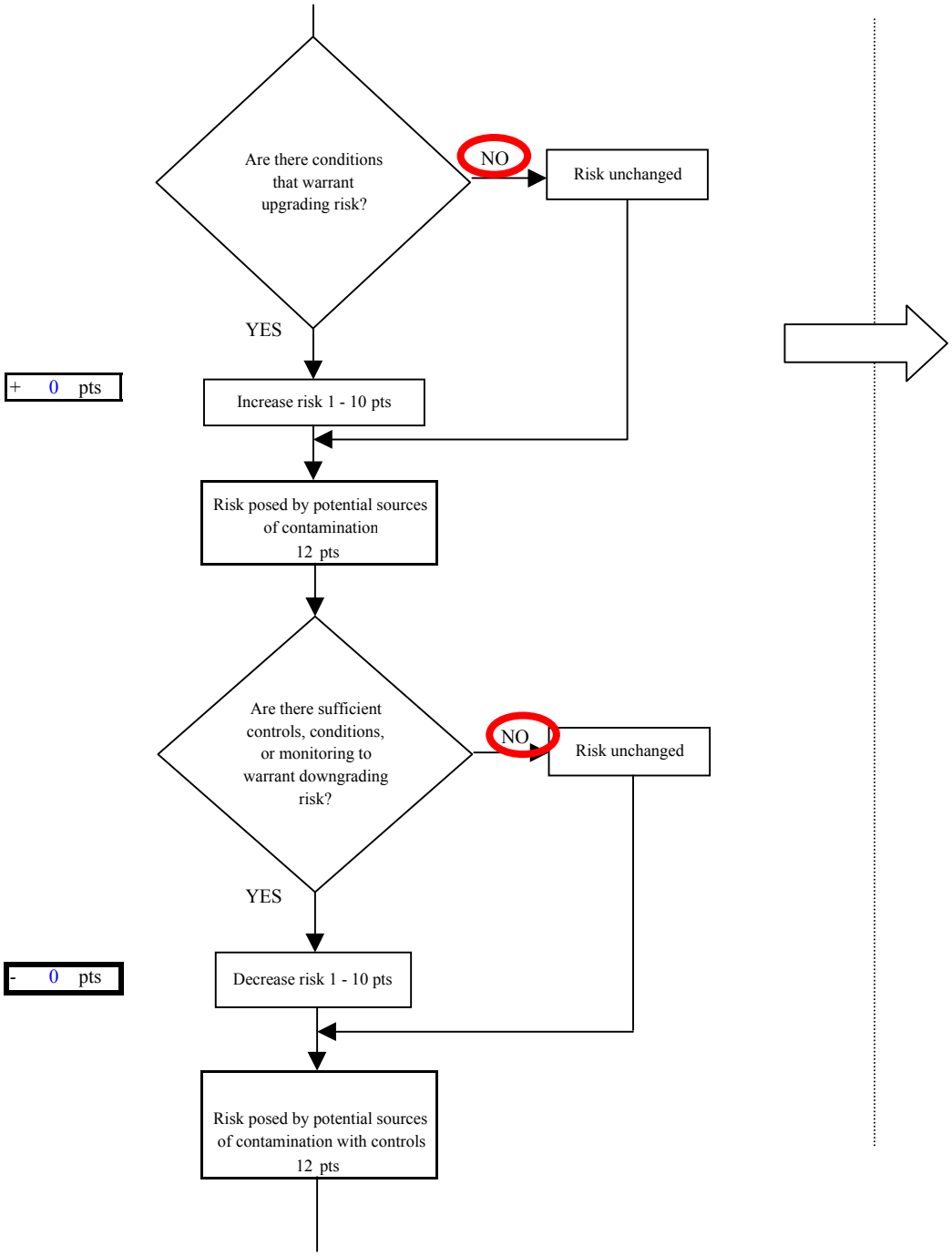


Chart 11. Contaminant risks for Cottonwood Creek Elem. - Synthetic Organic Chemicals



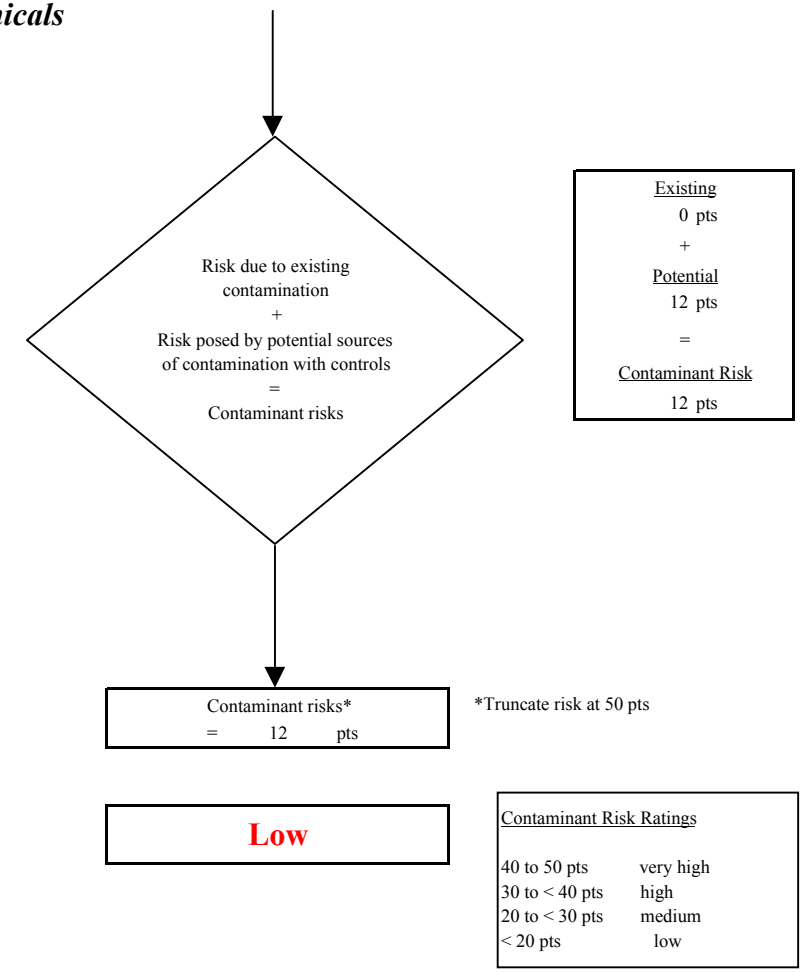


Chart 12. Vulnerability analysis for Cottonwood Creek Elem. - Synthetic Organic Chemicals

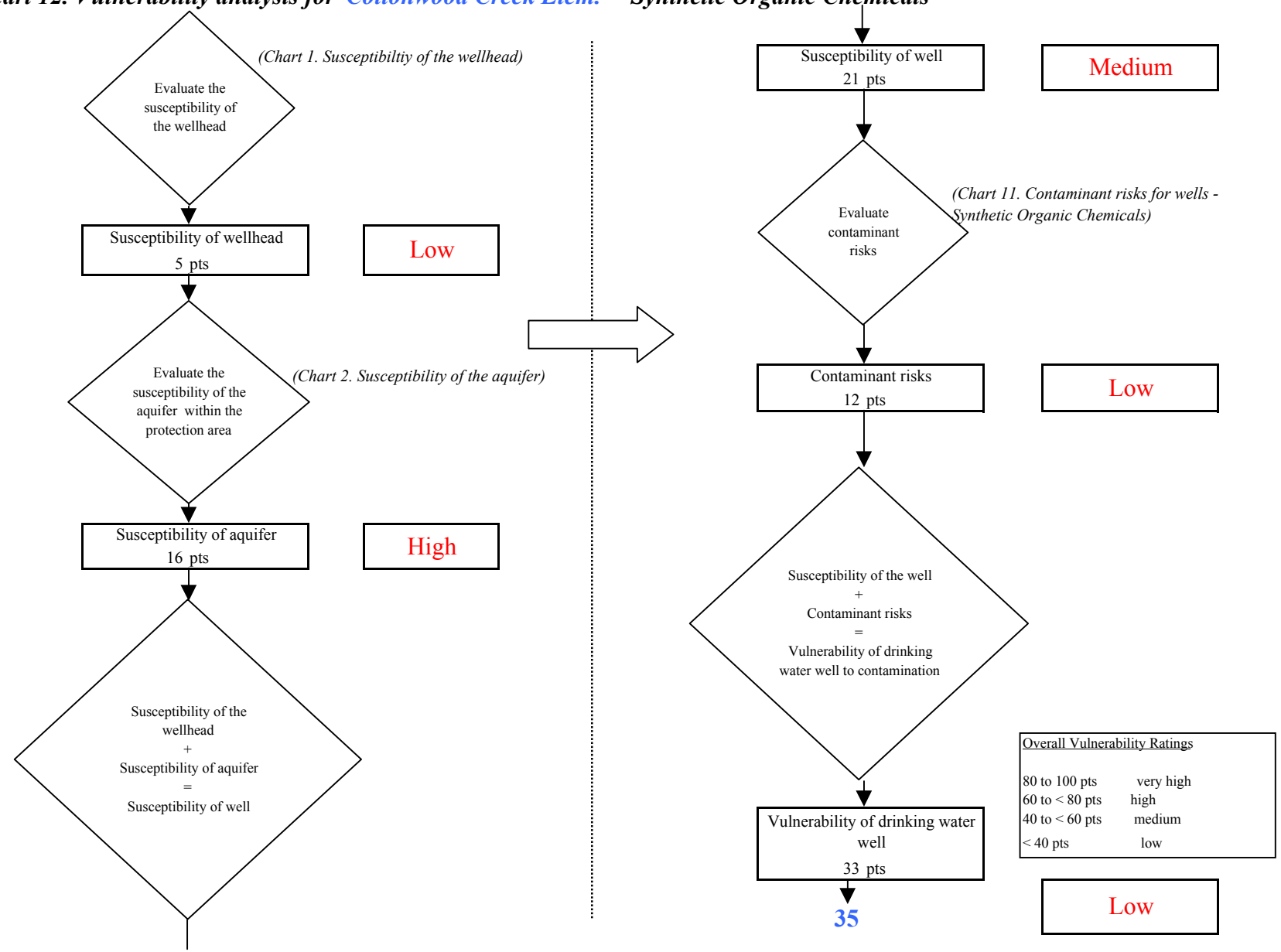


Chart 13. Contaminant risks for Cottonwood Creek Elem. - Other Organic Chemicals

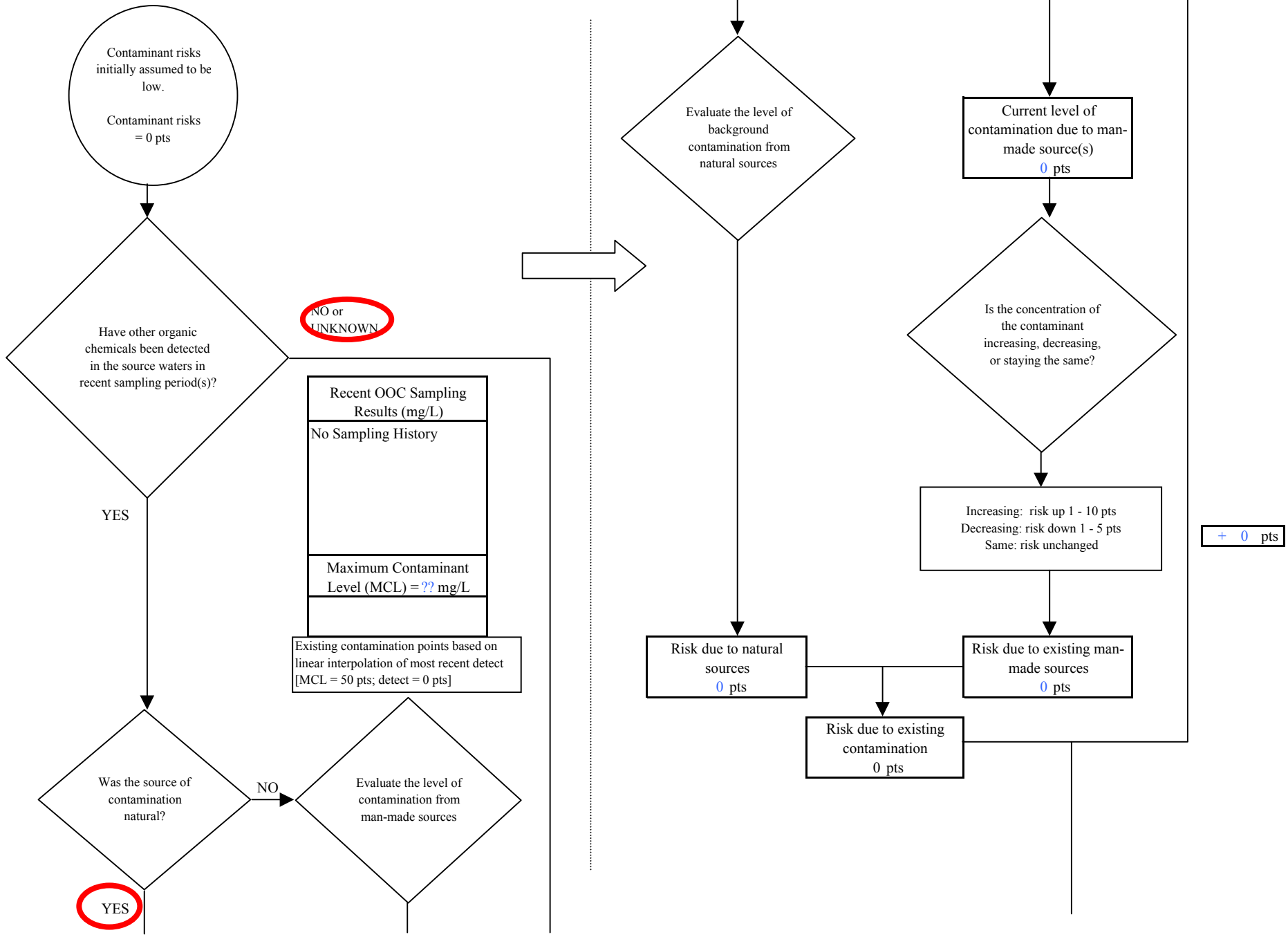


Chart 13. Contaminant risks for Cottonwood Creek Elem. - Other Organic Chemicals

+ 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)	1	0	1
Low(s)	1	4	5

	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.

Initial assessment of risk posed by potential sources of contamination = 20 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

+ 5 pts

Chart 13. Contaminant risks for Cottonwood Creek Elem. - Other Organic Chemicals

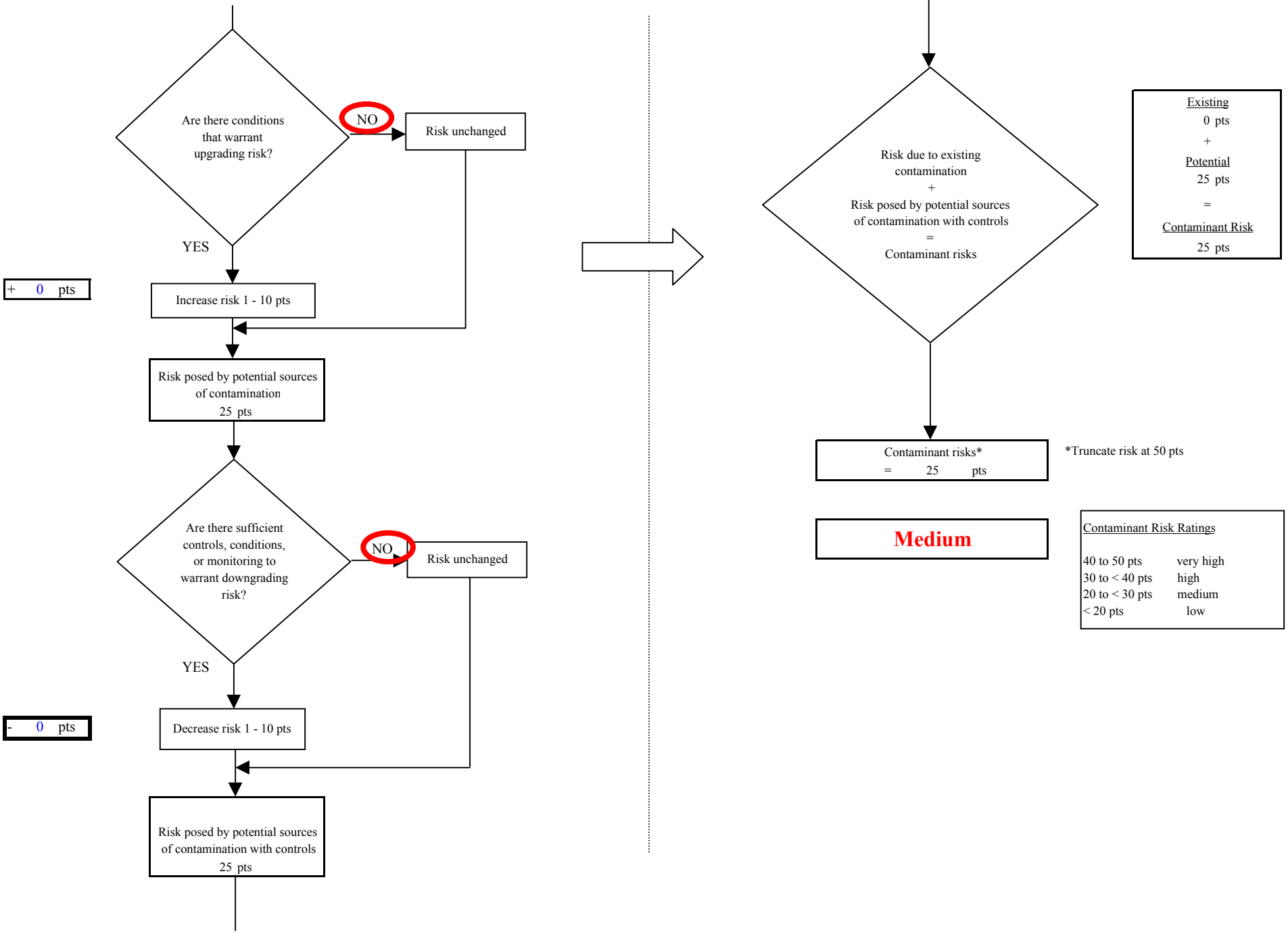


Chart 14. Vulnerability analysis for Cottonwood Creek Elem. - Other Organic Chemicals