Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for KPBSD Hope Elementary School Drinking Water System, Hope area, Alaska PWSID 240595.001

May 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1510
Alaska Department of Environmental Conservation

Source Water Assessment for KPBSD Hope Elementary School Drinking Water System Hope area, Alaska

KPBSD Hope Elementary School

May 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1510

The Drinking Water Protection Program (DWPP) 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. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for KPBSD Hope Elementary School Source of Public Drinking Water, Hope area, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for KPBSD Hope Elementary School is a Class A (Non-Transient/Non-Community) water system consisting one well. The well is located near the intersection of Hope Road and Palmer Creek Road. The well received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for the KPBSD Hope Elementary School include: residential areas, residential septic systems, roads and mines. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals, inorganic chemicals, synthetic organic chemicals and other organic chemicals. Overall, the KPBSD Hope Elementary School received a vulnerability rating of **Medium** for volatile organic chemicals and **Low** for bacteria/ viruses, nitrates/nitrites, inorganic chemicals, synthetic organic chemicals and other organic chemicals

KPBSD HOPE ELEMENTARY SCHOOL-PUBLIC DRINKING WATER SYSTEM

The KPBSD Hope Elementary School public water system (PWS) is a Class A (Non-Transient/Non-Community) water system. The system consists of one well. The well is located near the intersection of Hope Road and Palmer Creek Road. (See Map 1 of Appendix A).

The KPBSD Hope Elementary School is located in the Kenai Peninsula Borough, which is located directly south of the city of Anchorage (See inset of Map 1 in Appendix A for location). The borough encompasses 25,600 square miles, of which only 15,700 square miles is land.

The Hope area is located on the northern end of the Kenai Peninsula at approximately mile 16 of the Hope Highway, which leads northwest along the south side of the Turnagain Arm of Cook Inlet. The Hope intersection is at mile 56.7 of the Seward Highway. The community of Hope is located near the mouth of Resurrection Creek.

The Hope area averages about 22.5 inches of precipitation per year, with approximately 89.5 inches of snowfall (ACRC 2002).

Hope lies in the Resurrection Creek valley, which cuts through the steeply rising peaks of the Kenai Mountains. Most of the homes and businesses are located at the mouth of Resurrection Creek or on the gentler slopes at the base of the mountains. Numerous small creeks provide drainage off the hills into Resurrection Creek, which flows into Turnagain Arm.

There is no municipal water supply. Approximately one-fourth of homes uses individual water wells and septic tank systems, and is fully plumbed. The school operates its own well water system. Many homes in this area are used only seasonally (ADCED 2002).

Bedrock in the Kenai Mountains comprises slates and greywackes of the Cretaceous-age Valdez Group. Surface sediments in the glaciated valleys are predominantly poorly-sorted sand and gravel of glacial origin, which may have been reworked by post-glacial stream action.

The Sanitary Survey (2001) indicates that the wellhead is protected with a sanitary seal. A properly installed sanitary seal may provide protection against contaminant from entering the source waters at the casing. The well is not located in a floodplain. The land surface is sloped away from the casing. Since the wells were drilled in 1986, prior to grouting regulations, it is assumed that they are not grouted. Proper grouting provides added protection against contaminants traveling along the well casing and into source waters.

This system operates year round and serves up to 19 residents through 1 service connection.

KPBSD HOPE ELEMENTARY SCHOOL WATER 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. 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 protection area are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts.
An analytical calculation was used to determine the size and shape of the DWPA for KPBSD Hope Elementary School. The input parameters describing the attributes of the aquifer in this calculation were adopted from Groundwater (*Freeze and Cherry 1979*). Available geology and groundwater contours were also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

The protection areas established for wells by the ADEC are usually separated into four zones, limited by the watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

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 protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. time-of-travel
B	Less than 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The DWPA for the KPBSD Hope Elementary School was determined using an analytical calculation and includes Zone A, B, C, and D (See Map 1 of 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 KPBSD Hope Elementary School 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 Map 1 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. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, inorganic chemicals, synthetic organic chemicals and other organic chemicals.

VULNERABILITY OF KPBSD HOPE ELEMENTARY SCHOOL DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and

- Contaminant risks.

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively..

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

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

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The well log indicates that the well is 160 feet deep and is screened from 116.5 feet to 141 feet below ground surface (bgs). The well penetrates a small silt confining layer from 100 to 103 feet bgs and is completed in a semi-confined aquifer. The confining layer may provide protection from the movement of contaminants in the subsurface. However, wells penetrating the confining layers upgradient from the well may provide a path for contaminants to enter the confined aquifer.

Table 2 shows the Susceptibility scores and ratings for the KPBSD Hope Elementary School.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	18	High
Natural Susceptibility	23	Medium

Contaminant Risk Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score 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. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants..

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	2	Low
Nitrates and/or Nitrites	14	Low
Volatile Organic Chemicals	25	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	13	Very High
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

Again, rankings are assigned according to a point score:

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

Overall Vulnerability Ratings	
80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	25	Low
Nitrates and Nitrites	25	Low
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	35	Low
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	35	Low

Bacteria and Viruses

Roads, residential area and residential septic systems represent the greatest risk for bacteria and viruses to this drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). Sampling has not detected bacteria or viruses within source waters.

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 low**.**

Nitrates and Nitrites

Roads, residential area and residential septic systems represent the greatest risk to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. The sampling history for the KPBSD Hope Elementary School well indicates that nitrate concentrations have ranged from 0.0 mg/l to 1.02 mg/l. The reported nitrate concentrations suggest that the nitrate concentrations are attributed to natural sources. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/l therefore, nitrate concentrations above 2 mg/L may be indicative of man-made sources. The most recent nitrate level detected was 4% (0.39 mg/L) of the Maximum Contaminant Level (MCL) of 10 mg/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. Though existing nitrate contamination was detected at the site, recent data indicates that nitrate concentrations are safe with respect to human health.

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

Volatile Organic Chemicals

Road, residential areas, residential septic systems, roads and existing contamination represent the greatest identified risk for volatile organic chemical contamination to the well.

Approximately 20% residents in the area typically heat their homes with various types of on-site fuel sources, including propane and heating oil stored in aboveground or underground storage tanks. Although this report does not address heating oil tanks (unless their location is known), they can pose a risk of volatile organic chemical contamination to drinking water sources. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Secondary containment around the tank and regular system maintenance can help prevent many of these harmful fuel leaks and help protect the drinking water supply.

Recent sampling detected dichloromethane at 26% (0.0013 mg/l) of the MCL of 0.005 mg/l. According to

the USEPA, “the greatest use of dichloromethane is as a paint remover. Other uses include: solvent and cleaning agent in a variety of industries, a fumigant for strawberries and grains; and to extract substances from foodstuffs.” The source if dichloromethane is not known. However it is a common laboratory contaminant and may be attributed to contamination occurring within the laboratory. This report assumes that the dichloromethane detected is in the source water. The volatile organic chemical concentrations detected in source waters are safe with respect to human health

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

Residential areas, residential septic systems, roads and metals mining represent the greatest risk for inorganic chemicals to the well.

Samplings of inorganic chemicals have detected barium at levels below the current maximum contaminant levels (MCLs). The most recent detection of barium was <1% (0.004 mg/l) of the 2.0 mg/l MCL.

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 low.

Synthetic Organic Chemicals

Residential area and residential septic systems represent the greatest risk for inorganic chemicals to the well.

Sampling for synthetic organic chemicals has not occurred. The system currently has an SOC waiver and is not required to sample.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Other Organic Chemicals

Roads, residential areas and residential septic systems represent the greatest risk for other organic chemicals to the well.

Sampling for other organic chemicals has not occurred. The system currently has an OOC waiver and is not required to sample.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2002 [WWW document]. URL http://www.dced.state.ak.us/mra/CF_BLOCK.cfm.

Alaska Department of Environmental Conservation, Contaminated Sites Database, 2003 [WWW database], URL http://www.state.ak.us/dec/dspar/csites/cs_search.htm

Alaska Department of Environmental Conservation, Leaking Underground Storage Tank Database, 2003 [WWW database], URL http://www.dec.state.ak.us/spar/stp/ust/search/fac_search.asp

Freethey, G.W., and Scully, D.R. 1980 Water Resources of the Cook Inlet Basin, Alaska. U.S. Geological Survey Hydrologic Investigation Atlas HA-620, prepared in cooperation with Alaska Water Study Committee, State of Alaska Department of Natural Resources, and Division of Geological and Geophysical Surveys.

Freeze, R. A., and Cherry, J.A. 1979, Groundwater, Prentice-Hall, Englewood Cliffs, New Jersey

Hartman, D.C., Pessel, G.H., and McGee, D.I., 1972 Kenai Group of Cook Inlet Basin, Alaska: State of Alaska. Open File Report #49, Department of Natural Resources Division of Geological and Geophysical Surveys, 5p.

Martin, G.C., Johnson, B.L., and Grant, 1915, Geology and mineral resources of Kenai Peninsula, Alaska: US Geological Survey Bulletin 587, 243 p., maps.

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

ACKNOWLEDGMENT

Source Water Assessments in the Hope area were jointly prepared by ADEC-Drinking Water Protection Program and Ecology and Environment Inc. The Drinking Water Protection Program would like to thank Ecology and Environment for their efforts in researching the area.

APPENDIX A

KPBSD Hope Elementary School
Drinking Water Protection Area Location Map
(Map 1)

Map 1- Hope Elementary School-Drinking Water Protection Area

PWSID: 240595.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

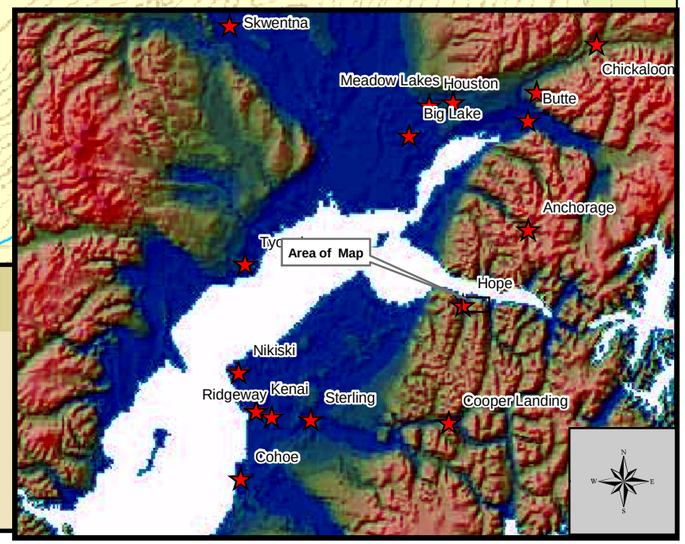
Feet
0 2,440 4,880 9,760

1:26,691

Data Sources:
Kenai Borough: Roads and parcels
Topographic Map- USGS 63k
Potential Sources of Contamination: ADEC

Legend

- Class A Public Water System
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area
- Roads
- Rivers and Streams



APPENDIX B

Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary School (Tables 1-7)

Table 1

Contaminant Source Inventory for ***KPBSD Hope Elementary***

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	2	
Septic systems (serves one single-family home)	R02	R02-2	A	2	Zone B has 3 residential acres
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	2	
Metals mining, placer	E04	E04-1	B	2	Bear 3 Mine Claim
Septic systems (serves one single-family home)	R02	R02-3	B	2	Zone B has 1 residential septics
Metals mining, placer	E04	E04-2	C	2	London Mining Company
Metals mining, placer	E04	E04-3	D	2	Bear 4 Mine Claim

Table 2

Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary Sources of Bacteria and Viruses

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Zone B has 3 residential acres
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	

Table 3

Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary Sources of Nitrates/Nitrites

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Zone B has 3 residential acres
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	

Table 4

Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary Sources of Volatile Organic Chemicals

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Zone B has 3 residential acres
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	

Table 5

Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Zone B has 3 residential acres
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	
Metals mining, placer	E04	E04-1	B	Low	2	Bear 3 Mine Claim
Metals mining, placer	E04	E04-2	C	Low	2	London Mining Company
Metals mining, placer	E04	E04-3	D	Low	2	Bear 4 Mine Claim

Table 6

Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary Sources of Synthetic Organic Chemicals

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Zone B has 3 residential acres

Table 7

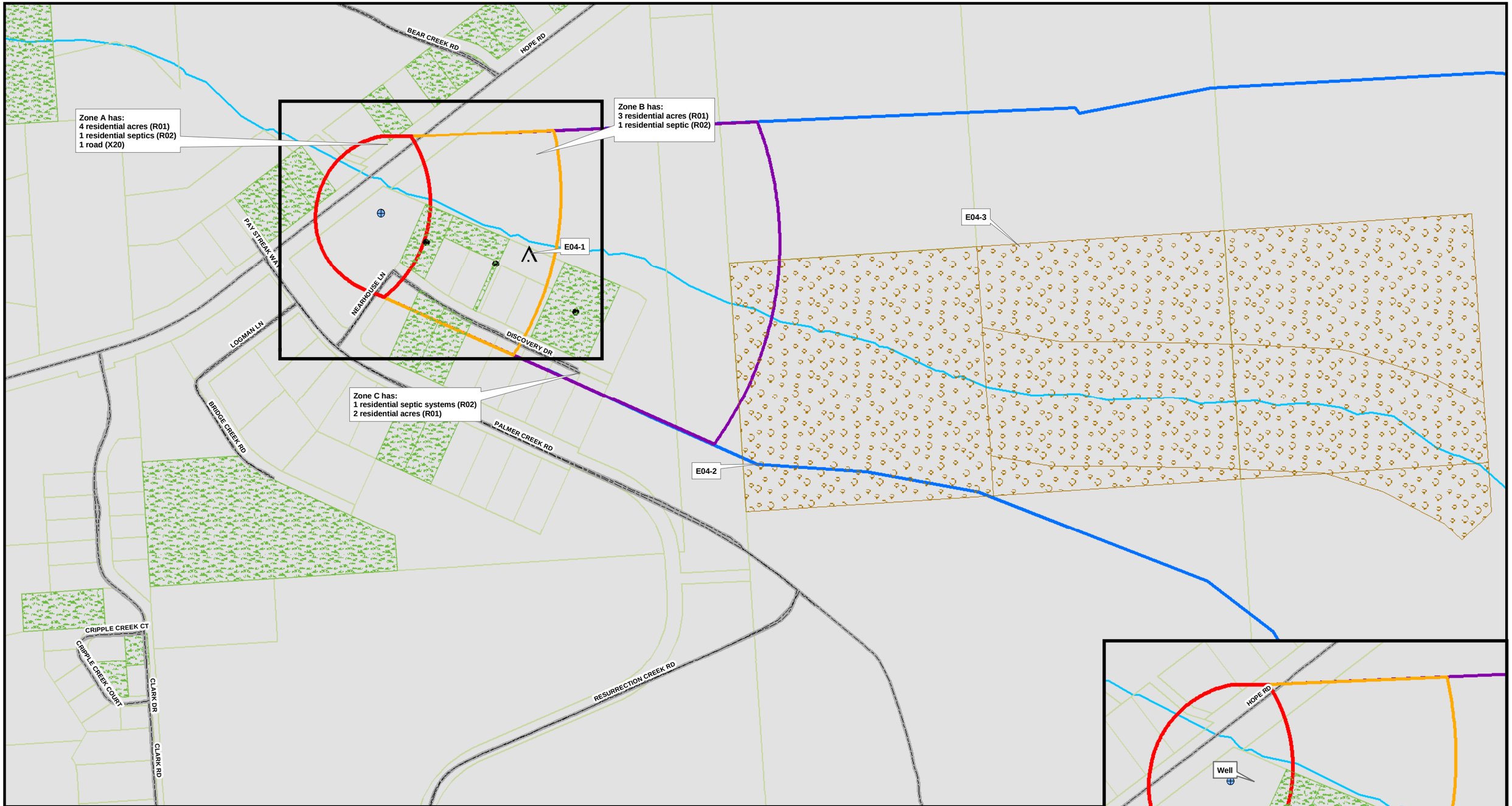
Contaminant Source Inventory and Risk Ranking for KPBSD Hope Elementary Sources of Other Organic Chemicals

PWSID 240595.001

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	
Residential Areas	R01	R01-1	A	Low	2	Zone A has 4 residential acres
Septic systems (serves one single-family home)	R02	R02-1-2	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-2	A	Low	2	Zone B has 3 residential acres
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low	2	

APPENDIX C

KPBSD Hope Elementary School
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)



Map 2- KPBSD Hope Elementary School: Potential and Existing Sources of Contamination

PWSID: 240595.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

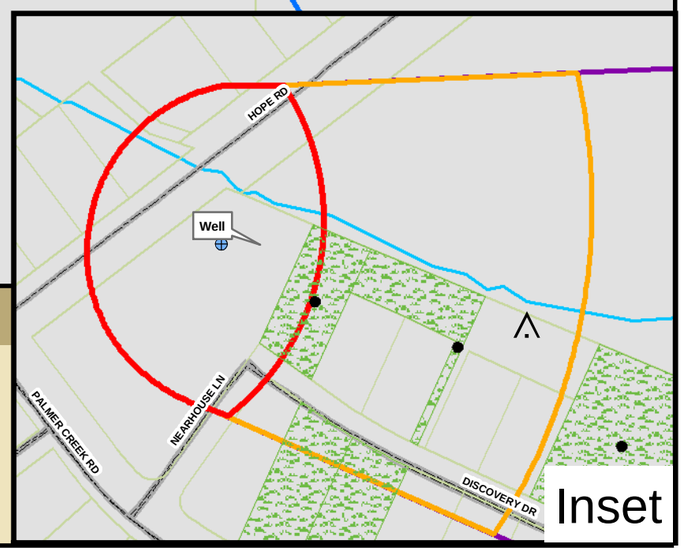
0 500 1,000 Feet

1:5,868

Data Sources:
Roads and parcels: Kenai Borough
Potential Sources of Contamination: ADEC

Legend

- Class A Public Water System
- Zone A Protection Area
- Zone B Protection Area
- Zone C Protection Area
- Zone D Protection Area
- Parcels
- Roads
- Water
- Rivers and Streams
- Residential Area (R01)
- Septic systems (serves one single-family home and/or less than 20 people)(R02)
- Metals mining, placer-(E04)
- Metals mining, placer (Past Producer)-(E04)



APPENDIX D

Vulnerability Analysis for KPBSD Hope Elementary School Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - KPBSD Hope Elementary

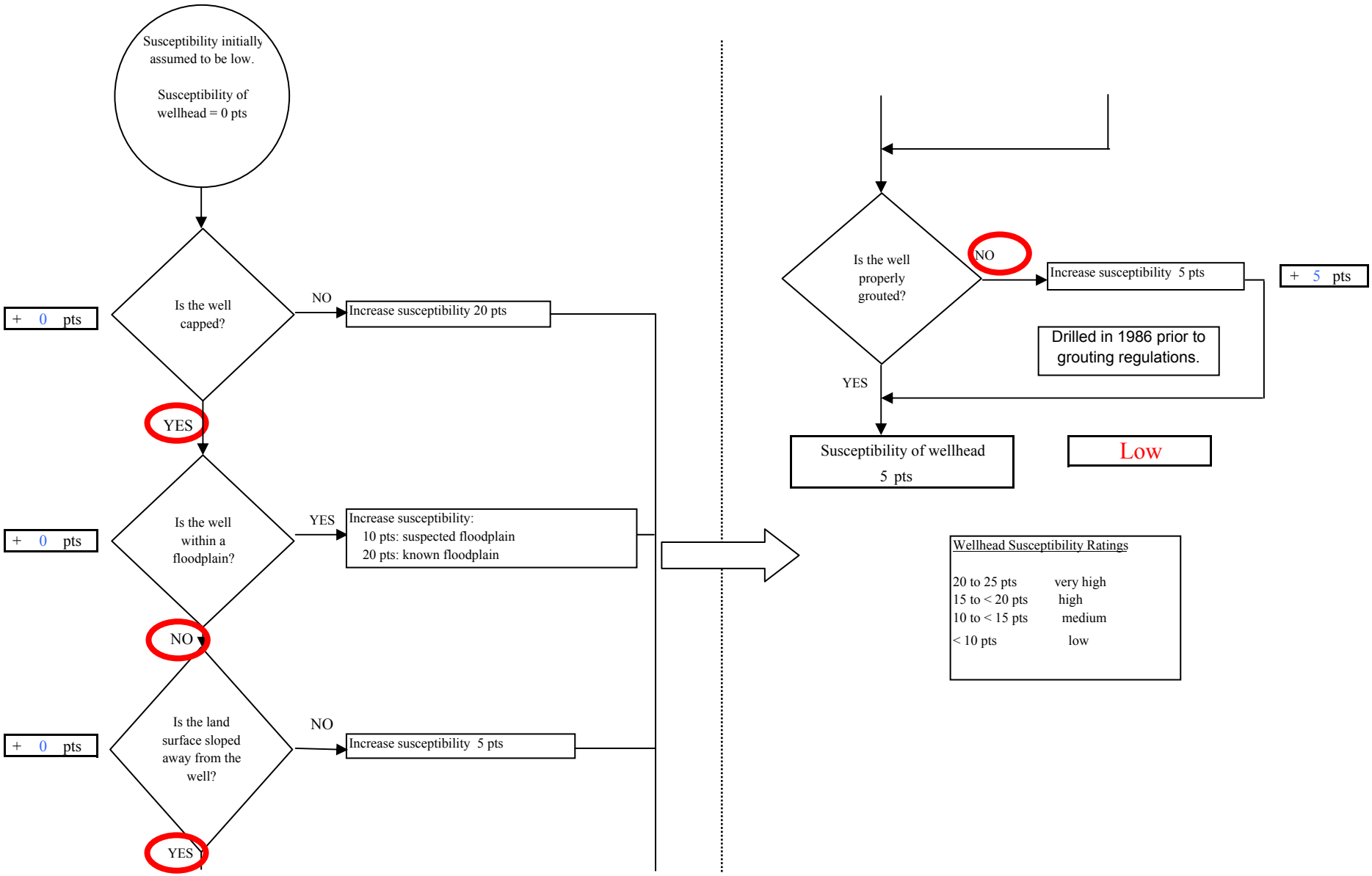


Chart 2. Susceptibility of the aquifer - KPBSD Hope Elementary

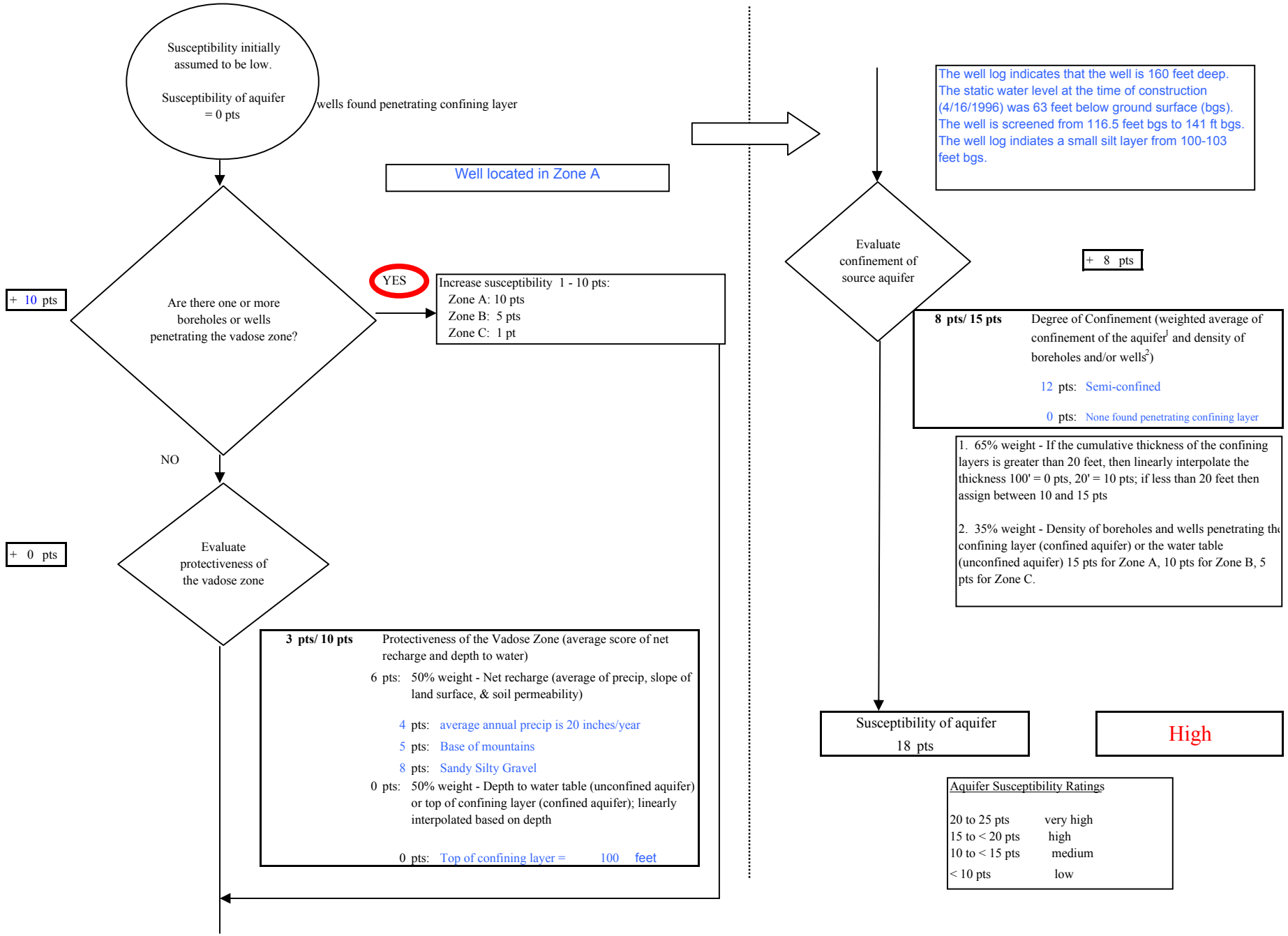
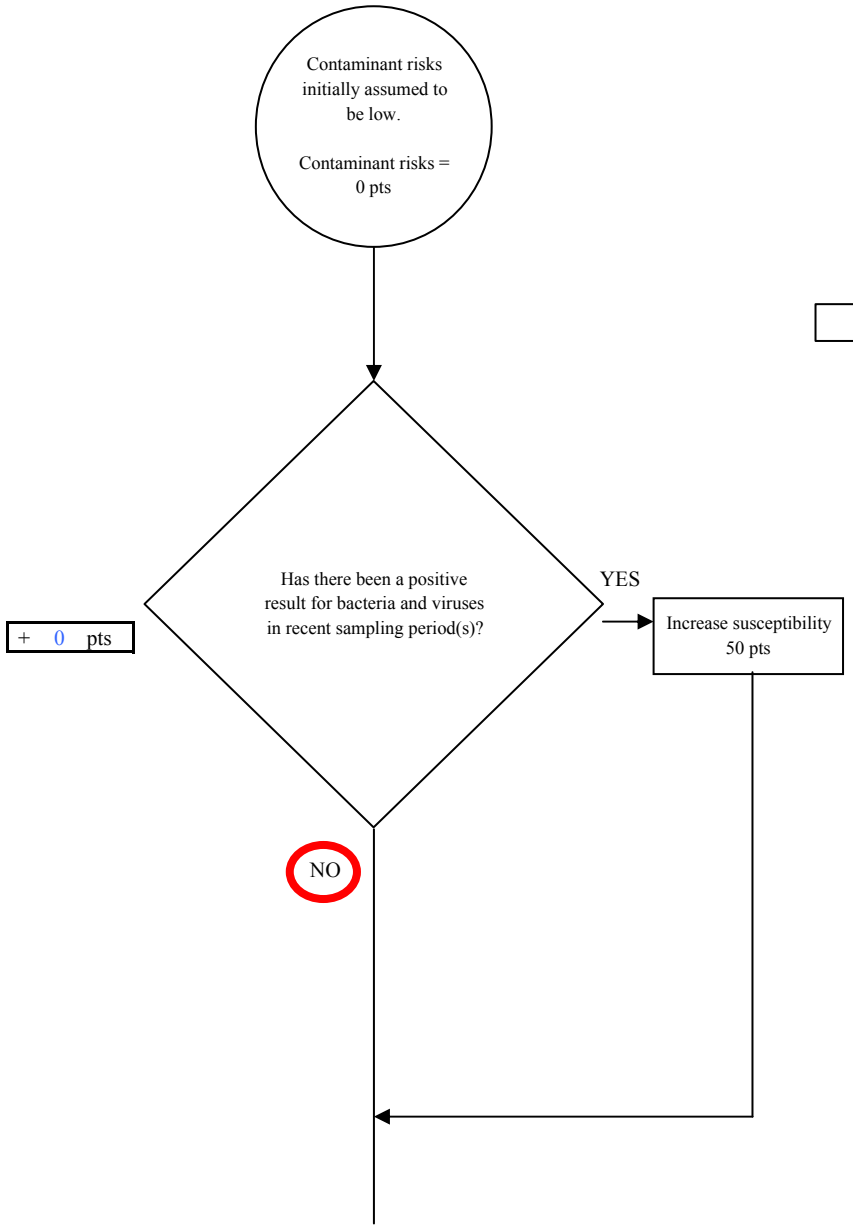
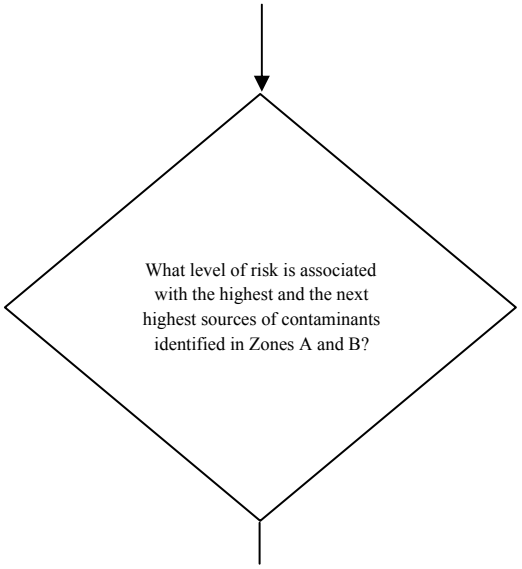


Chart 3. Contaminant risks for KPBSD Hope Elementary - Bacteria & Viruses





+ 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)	5	0	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 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 KPBSD Hope Elementary - Bacteria & Viruses

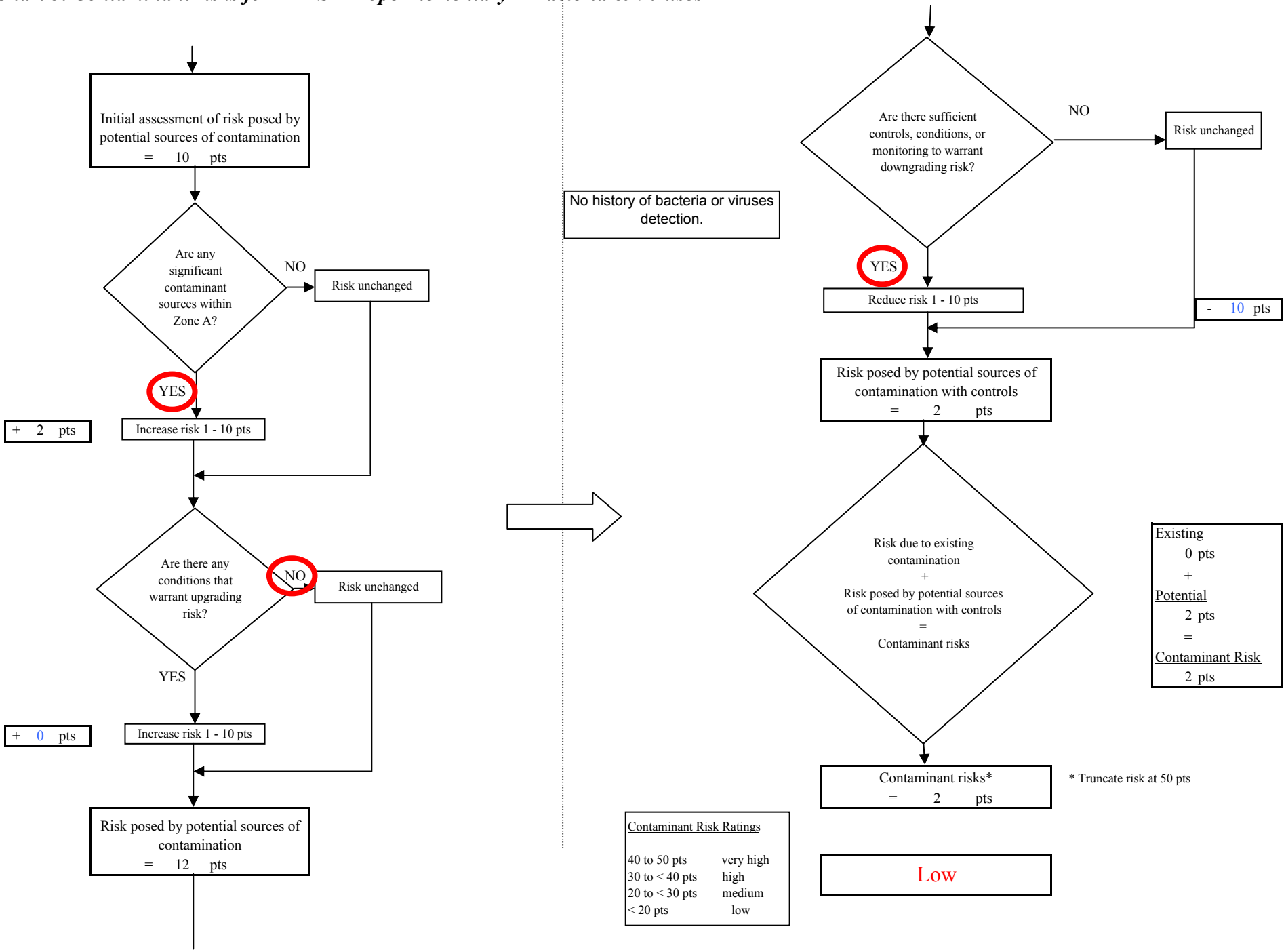


Chart 4. Vulnerability analysis for KPBSD Hope Elementary - Bacteria & Viruses

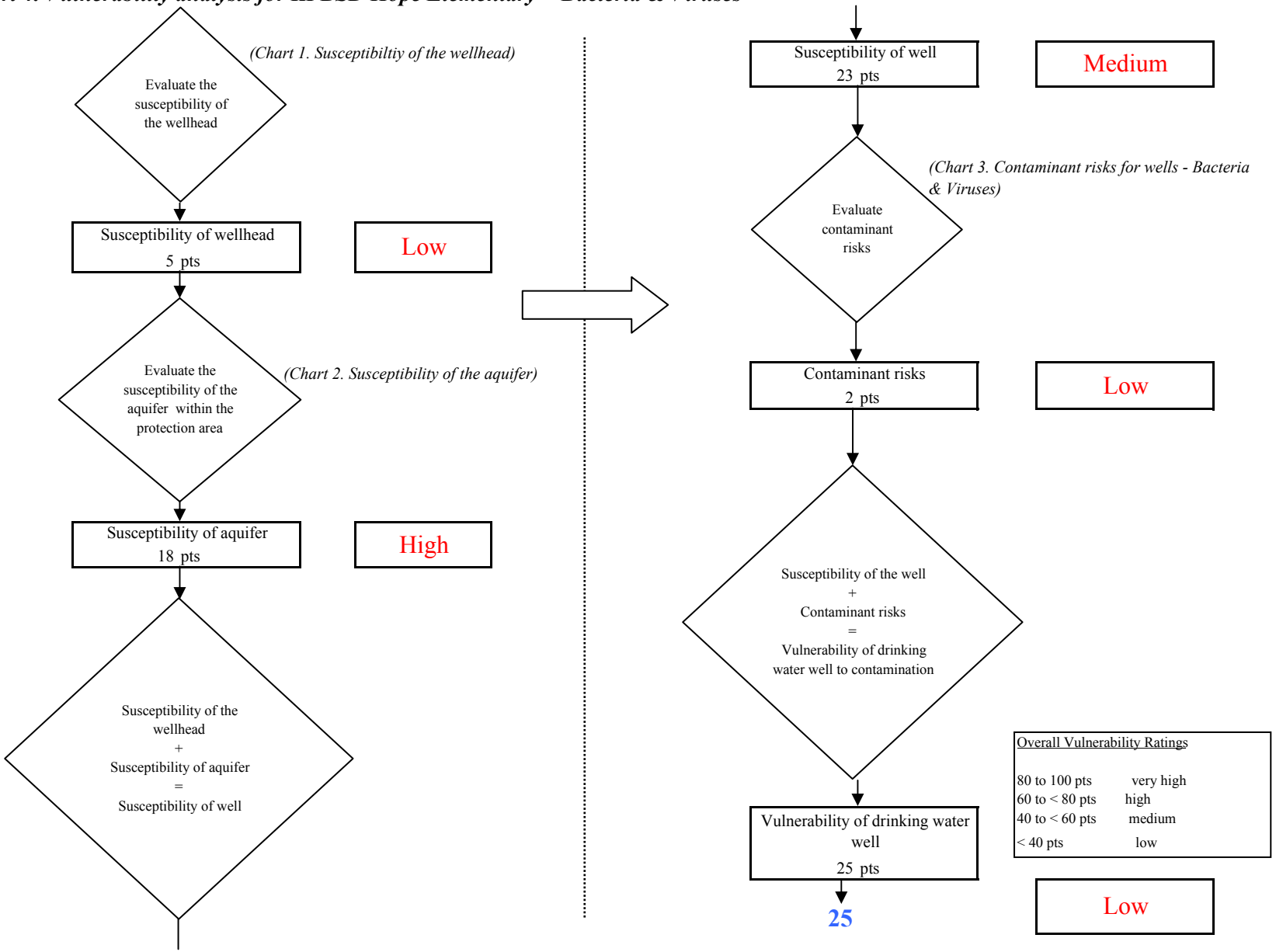


Chart 5. Contaminant risks for KPBSD Hope Elementary - Nitrates and Nitrites

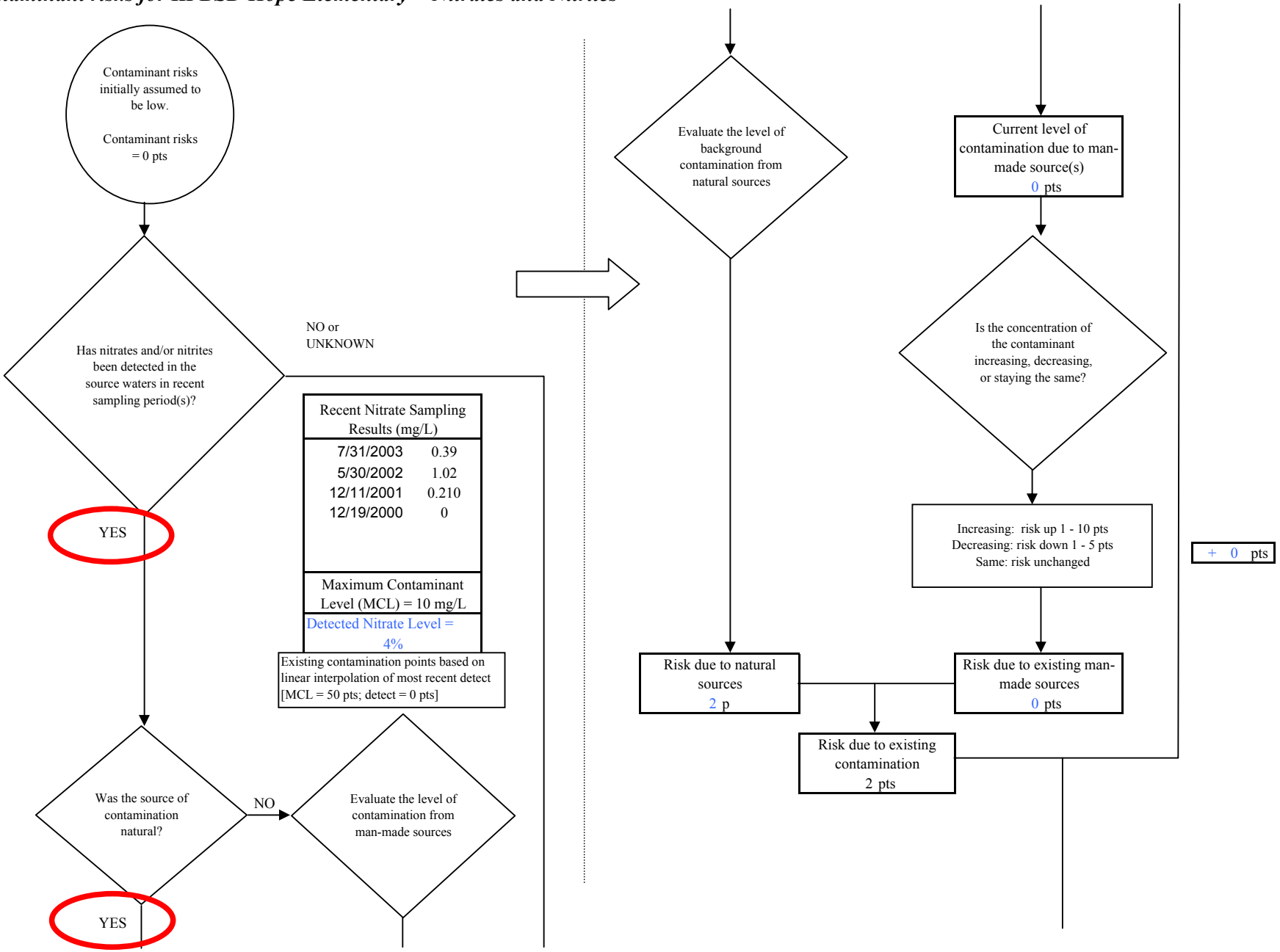


Chart 5. Contaminant risks for KPBSD Hope Elementary - Nitrates and Nitrites

+ 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)	5	0	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 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?

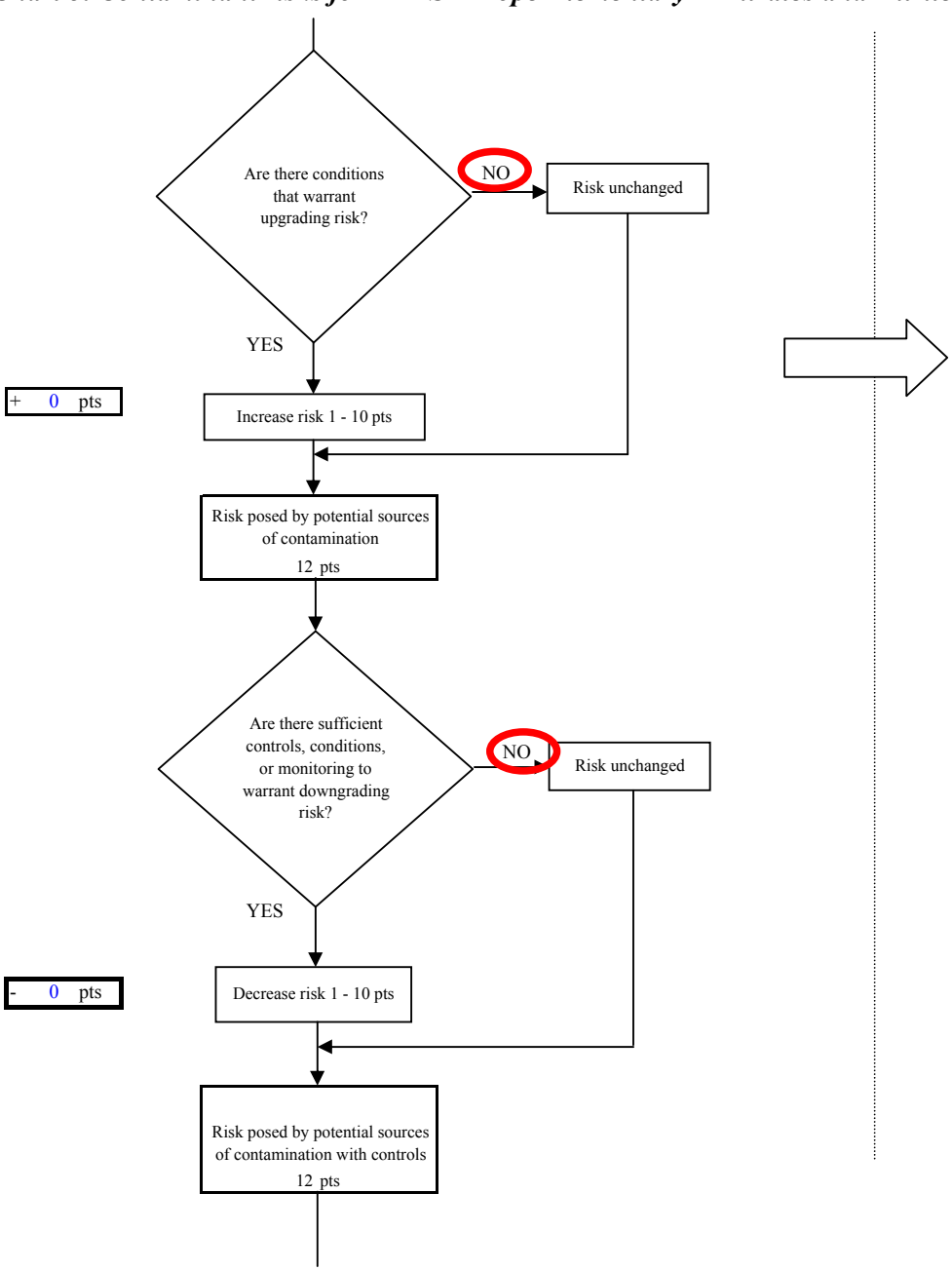
NO → Risk unchanged

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 5. Contaminant risks for KPBSD Hope Elementary - Nitrates and Nitrites



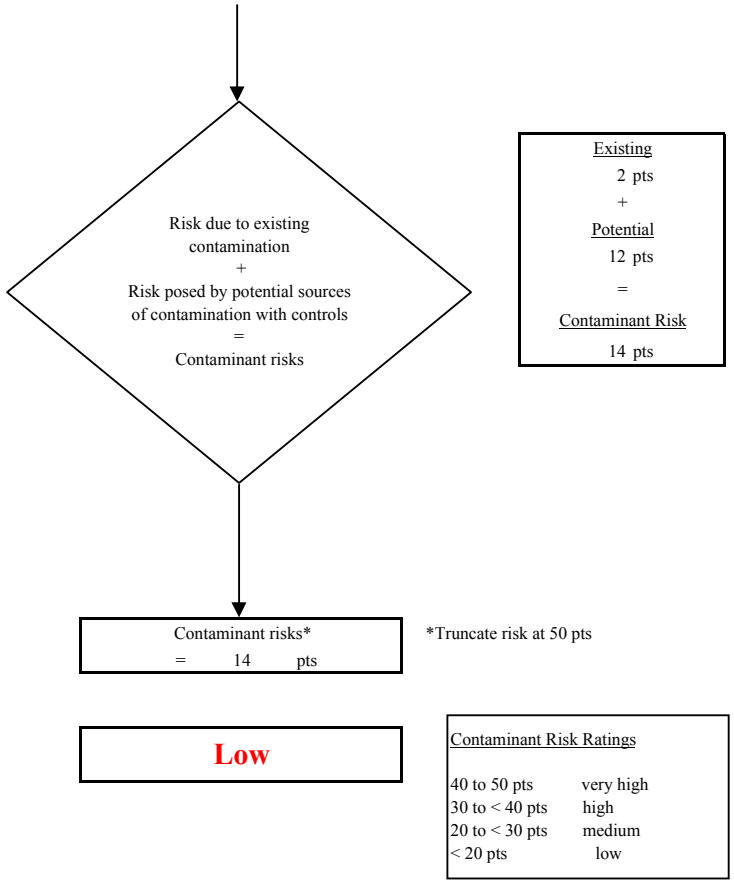


Chart 6. Vulnerability analysis for KPBSD Hope Elementary - Nitrates and Nitrites

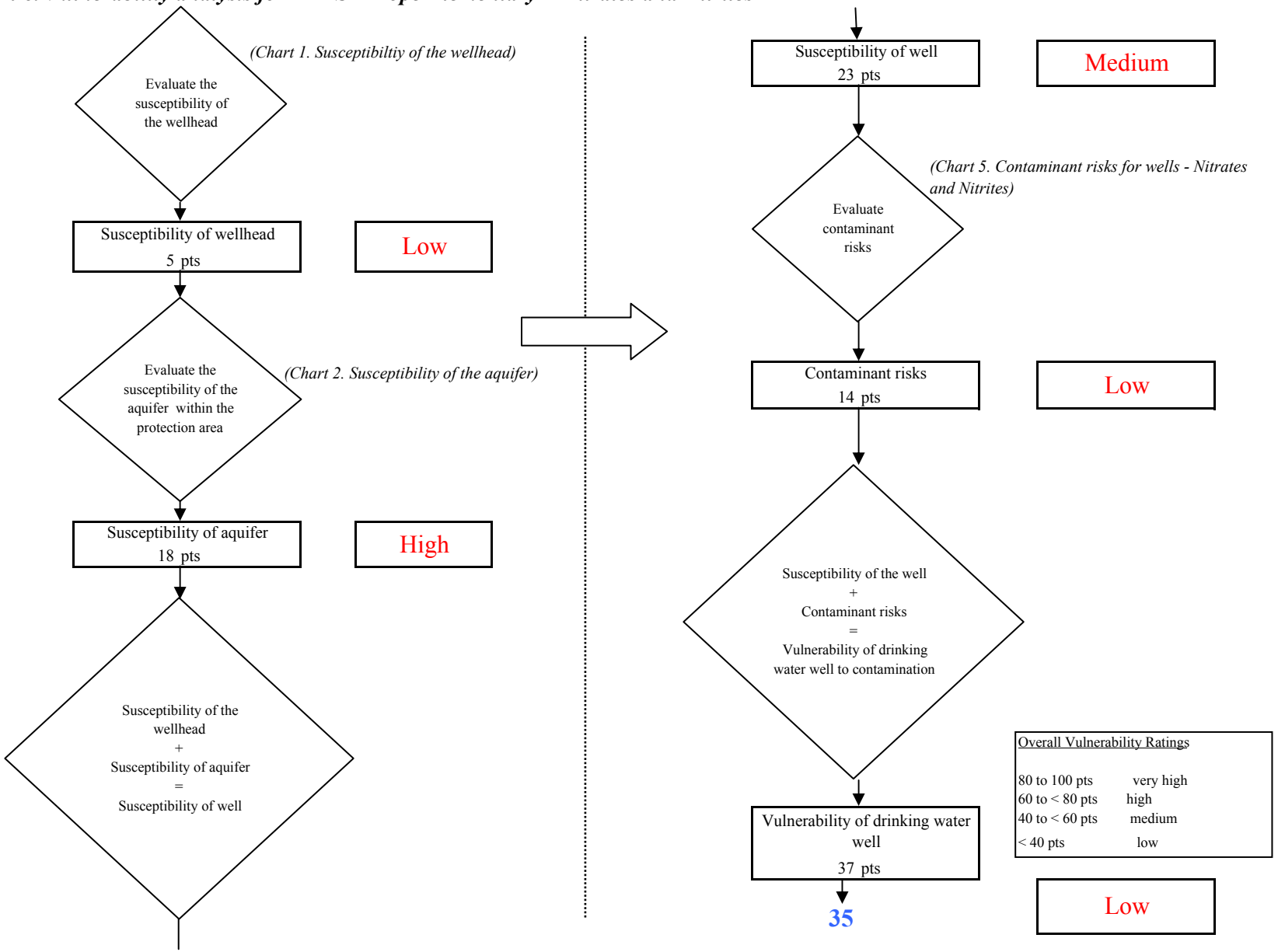


Chart 7. Contaminant risks for KPBSD Hope Elementary - Volatile Organic Chemicals

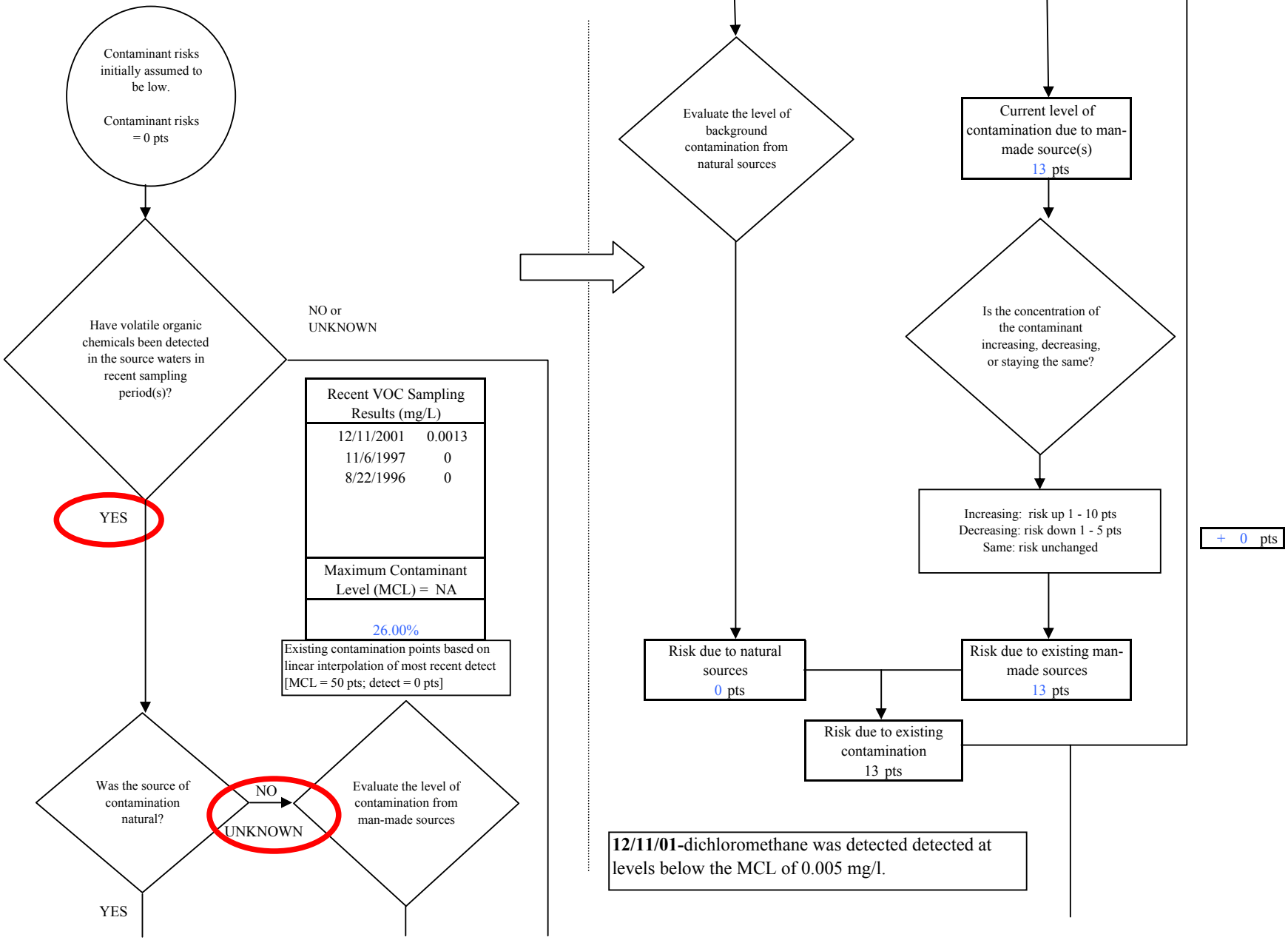
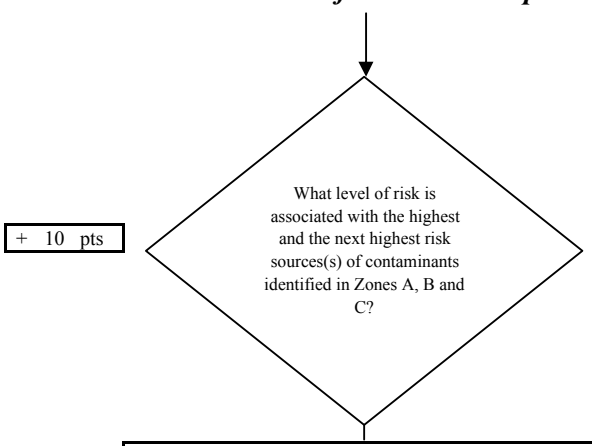


Chart 7. Contaminant risks for KPBSD Hope Elementary - Volatile Organic Chemicals



+ 10 pts

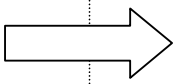
Risk Levels for Contaminant Sources identified in Zones A, B and C

	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	0	3

	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.



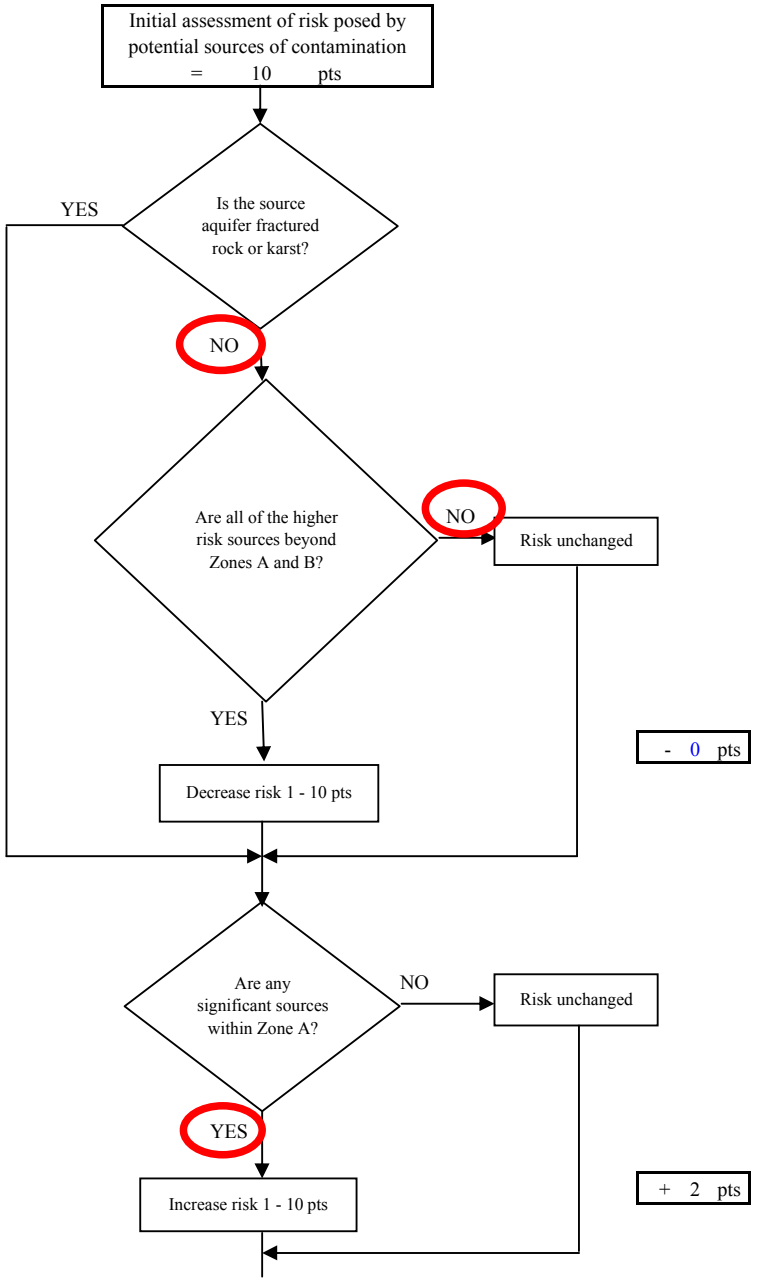


Chart 7. Contaminant risks for KPBSD Hope Elementary - Volatile Organic Chemicals

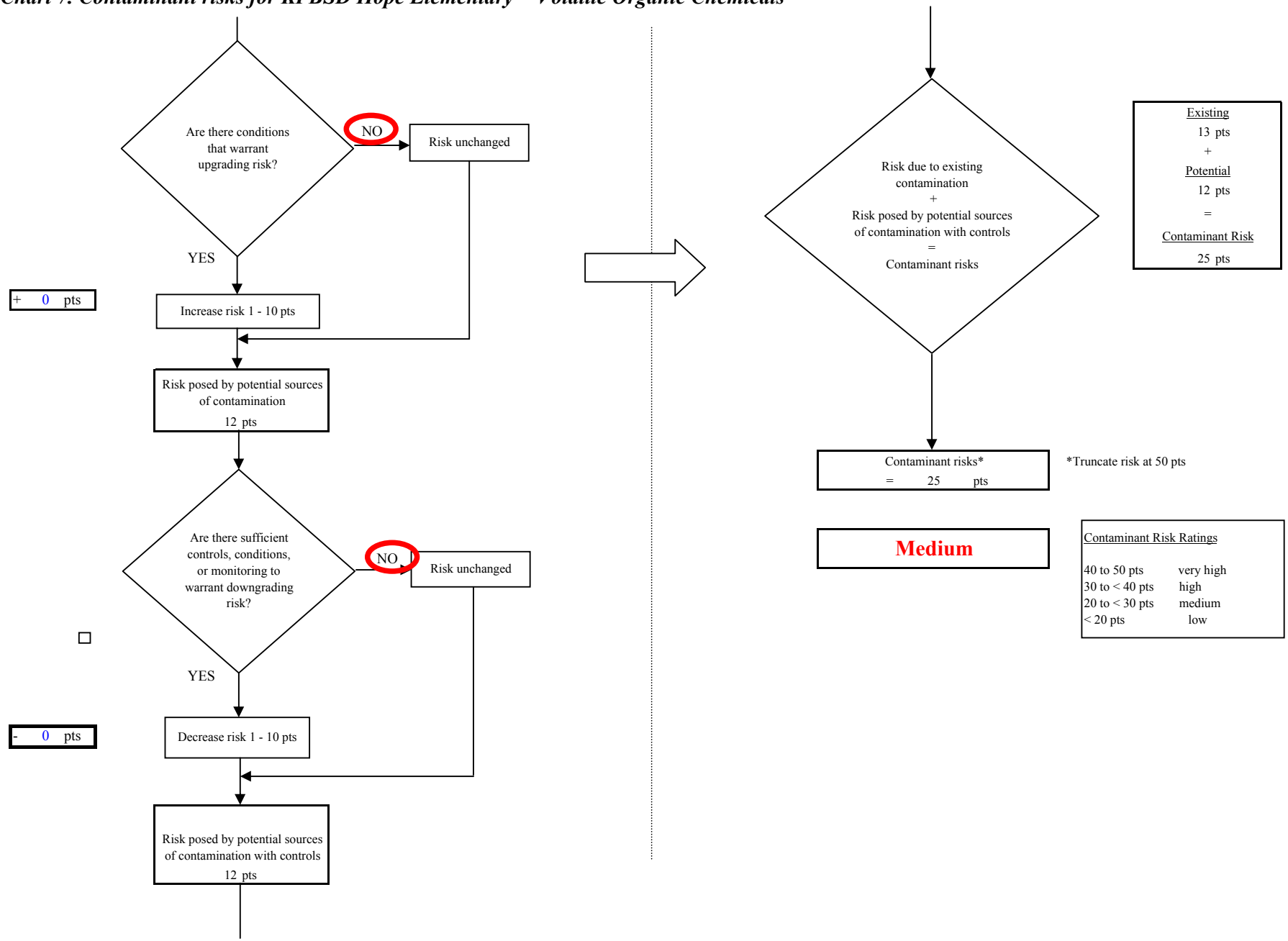


Chart 8. Vulnerability analysis for KPBSD Hope Elementary - Volatile Organic Chemicals

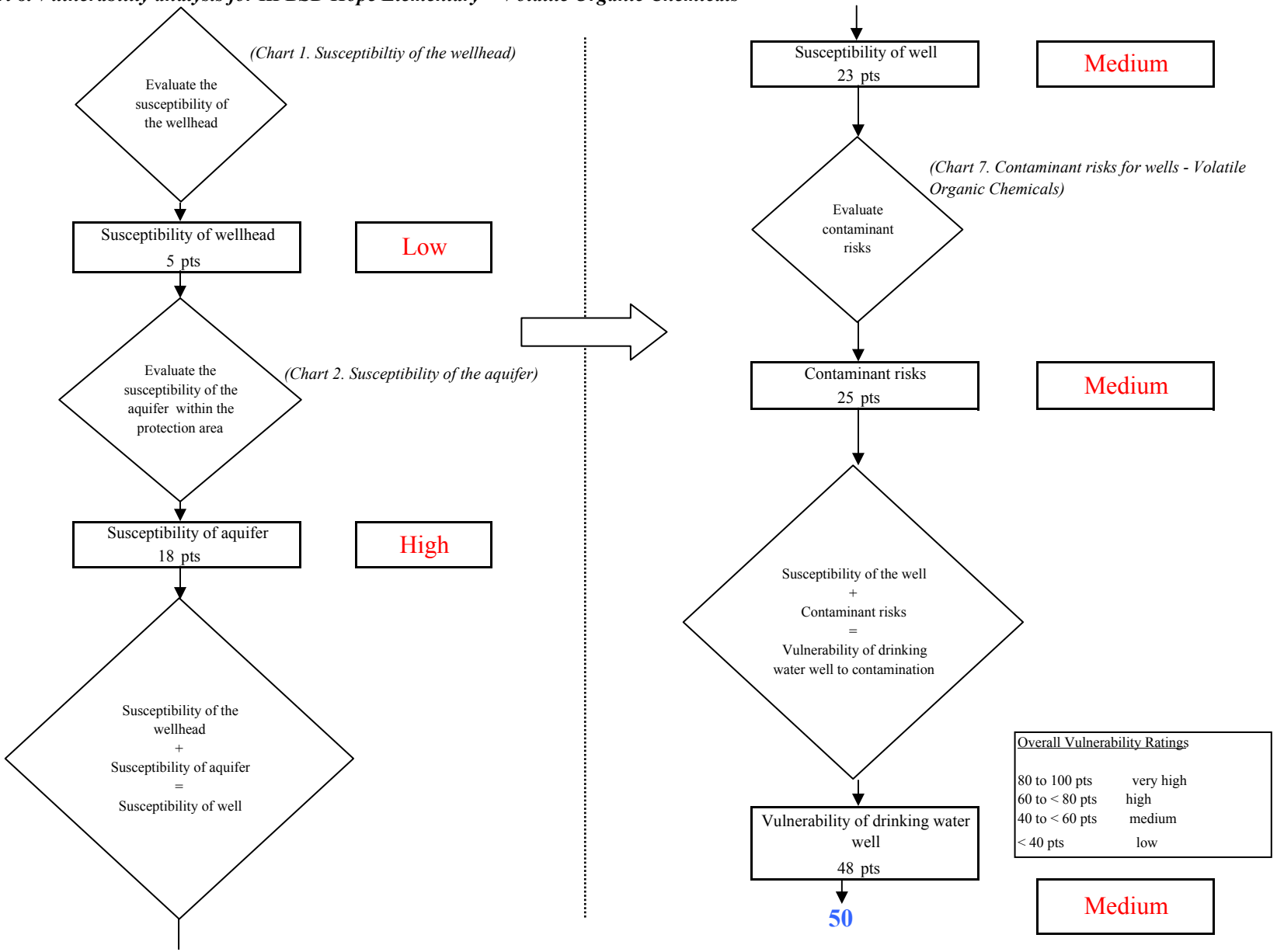


Chart 9. Contaminant risks for KPBSD Hope Elementary - Heavy Metals, Cyanide and Other Inorganic Chemicals

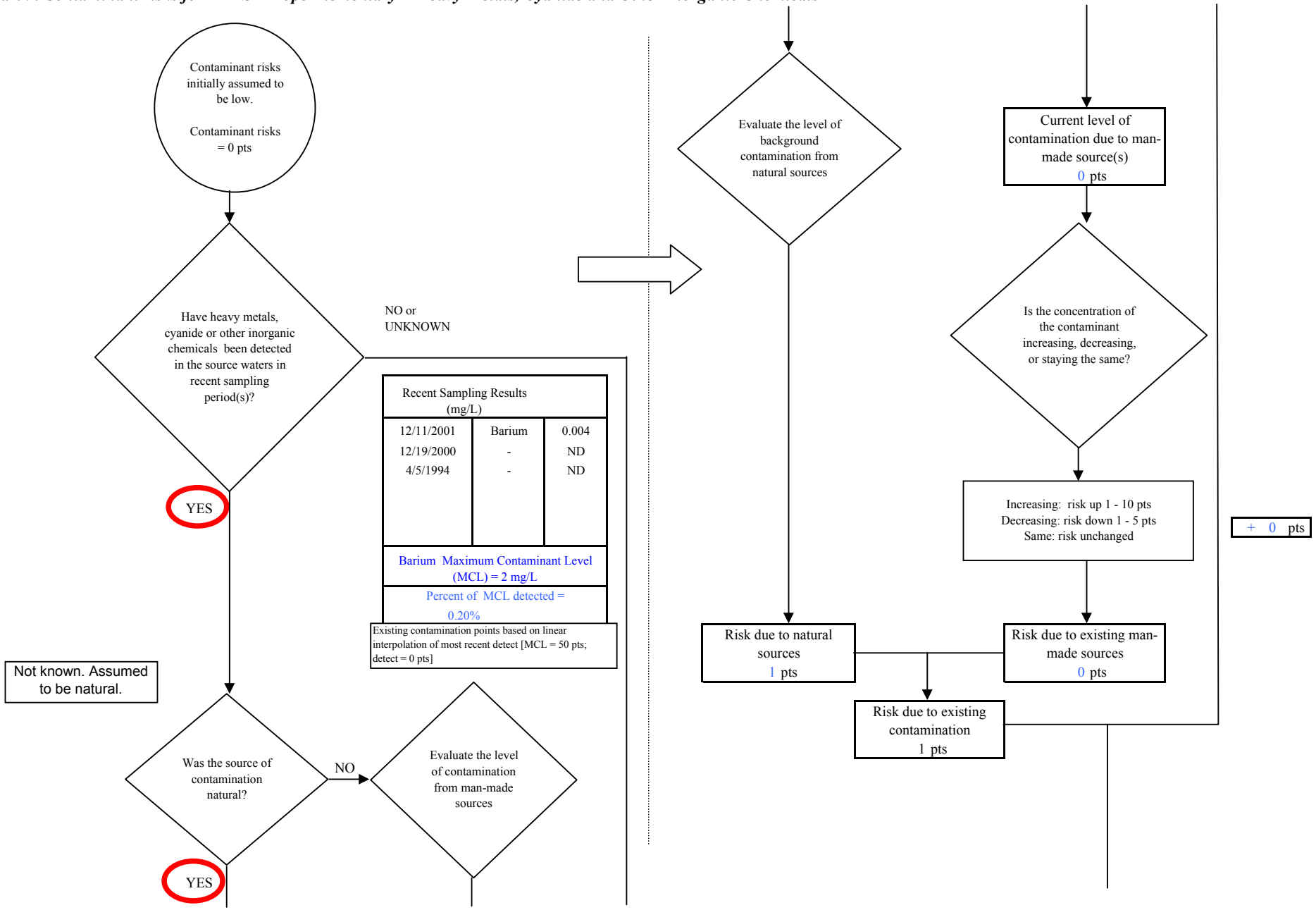
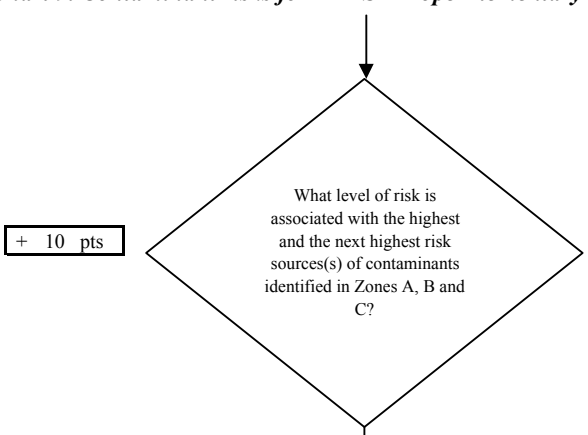


Chart 9. Contaminant risks for KPBSD Hope Elementary - Heavy Metals, Cyanide and Other Inorganic Chemicals



+ 10 pts

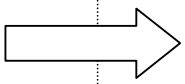
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	2	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 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.



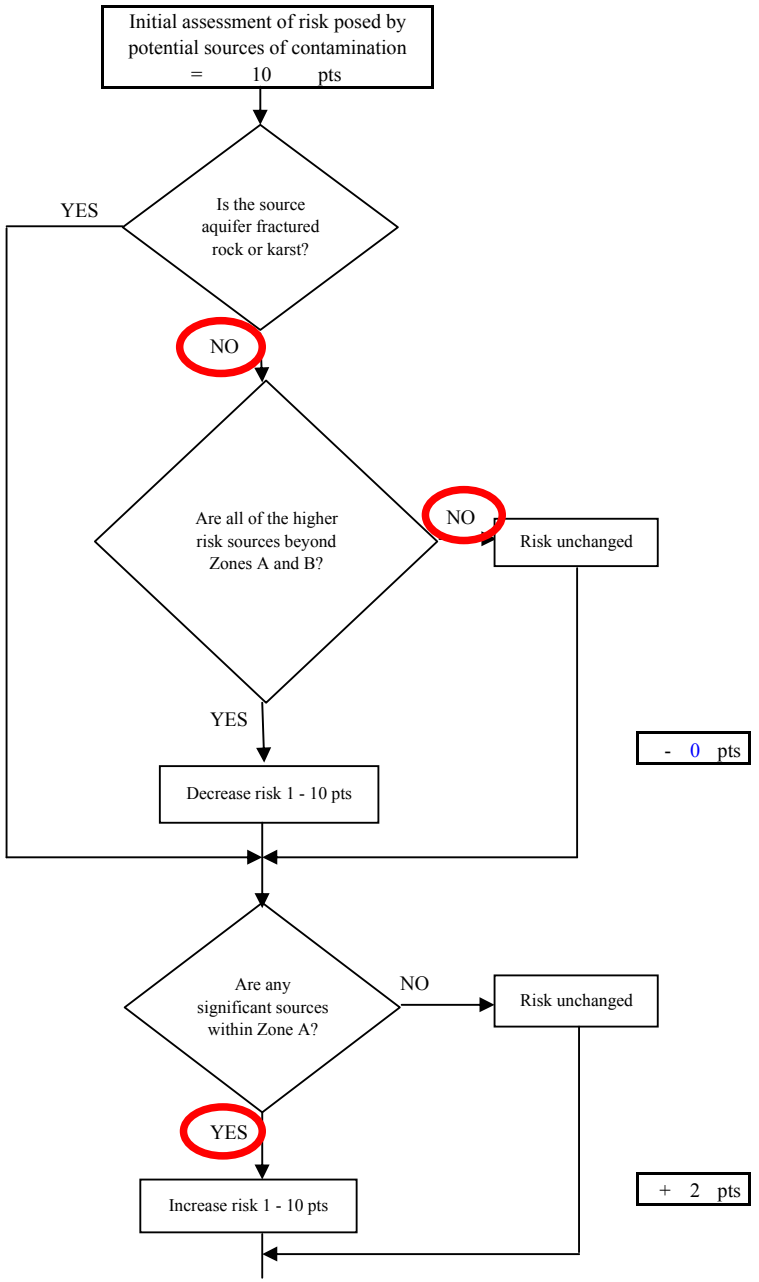


Chart 9. Contaminant risks for KPBSD Hope Elementary - Heavy Metals, Cyanide and Other Inorganic Chemicals

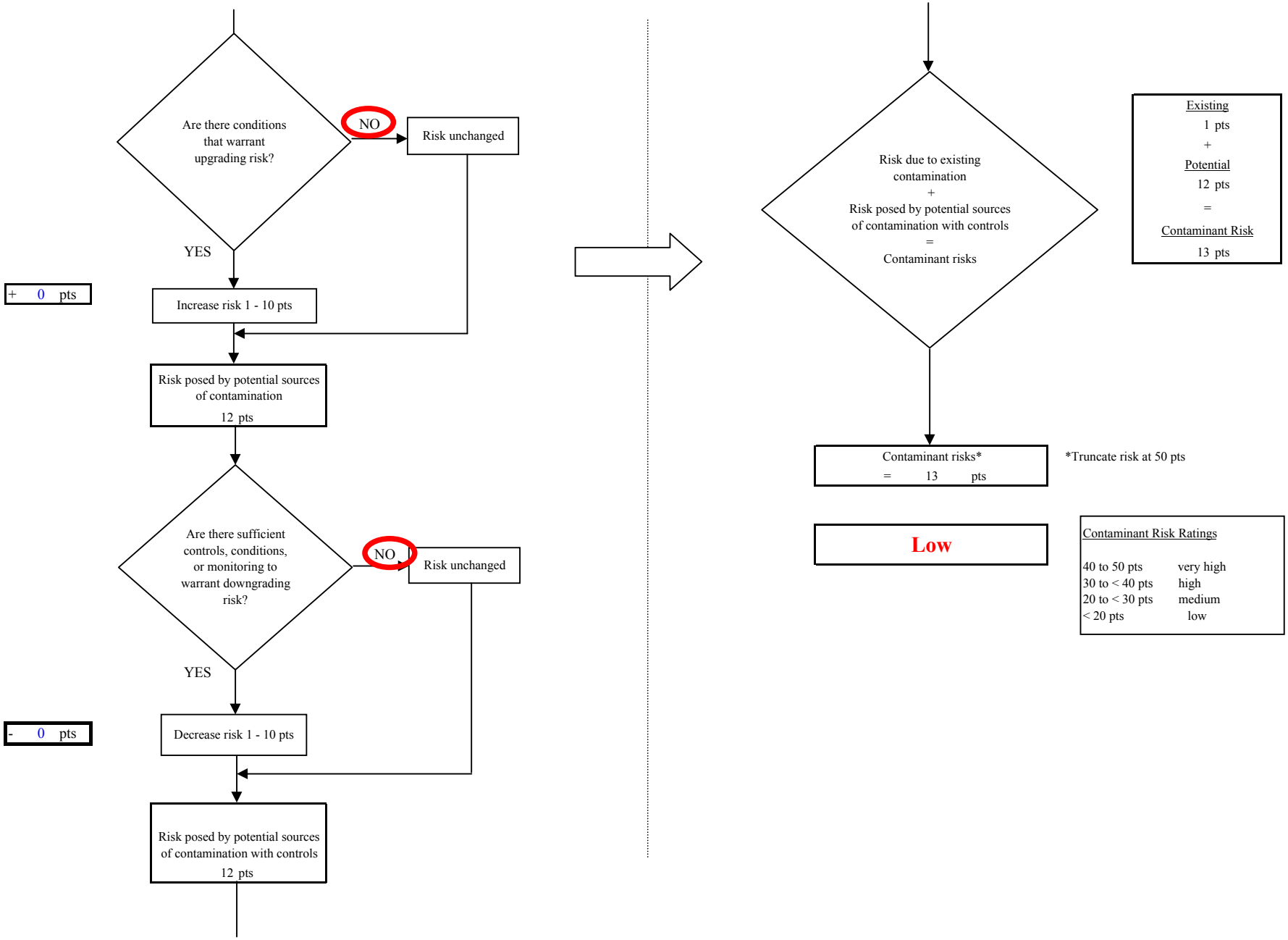


Chart 10. Vulnerability analysis for KPBSD Hope Elementary - Heavy Metals, Cyanide and Other Inorganic Chemicals

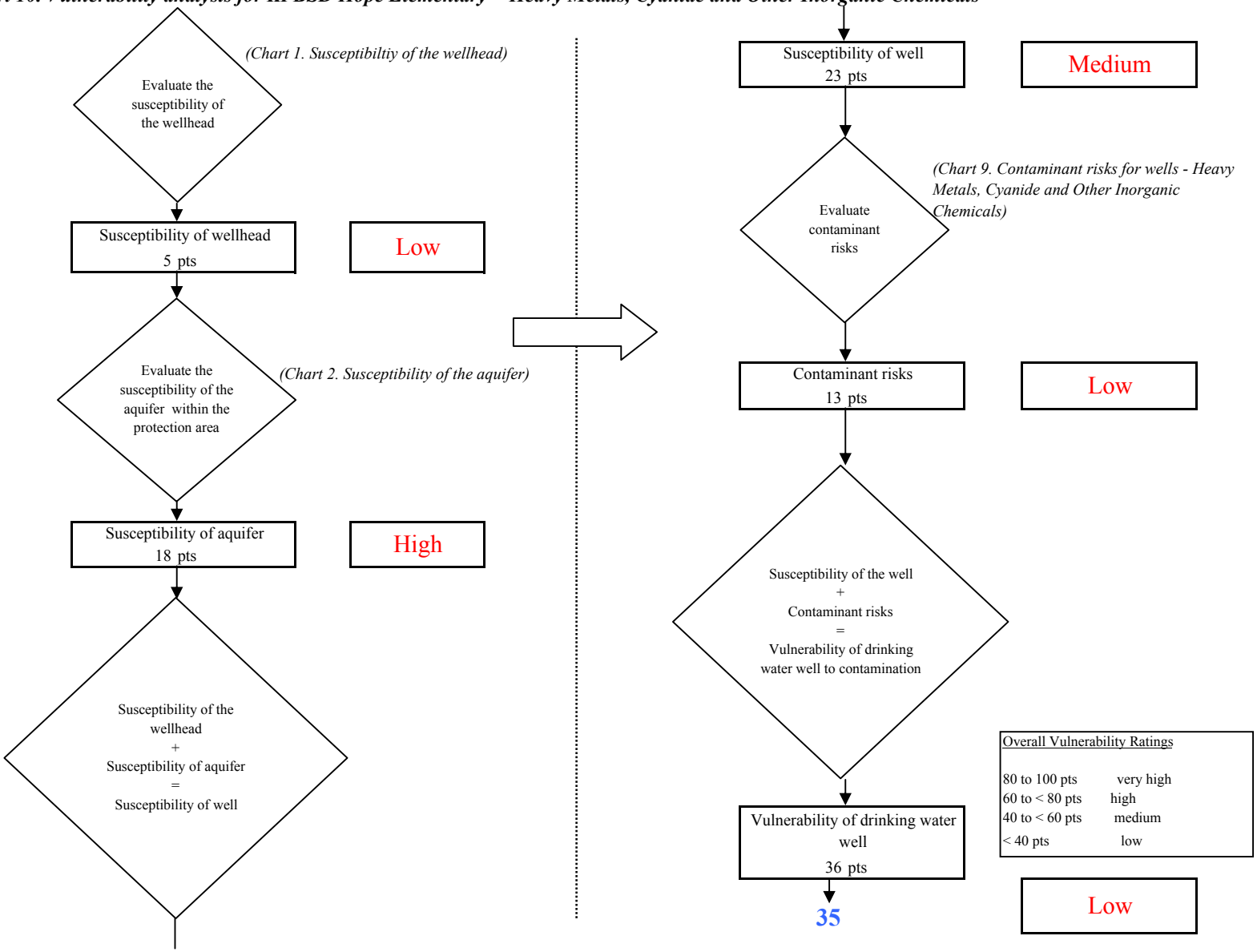


Chart 11. Contaminant risks for KPBSD Hope Elementary - Synthetic Organic Chemicals

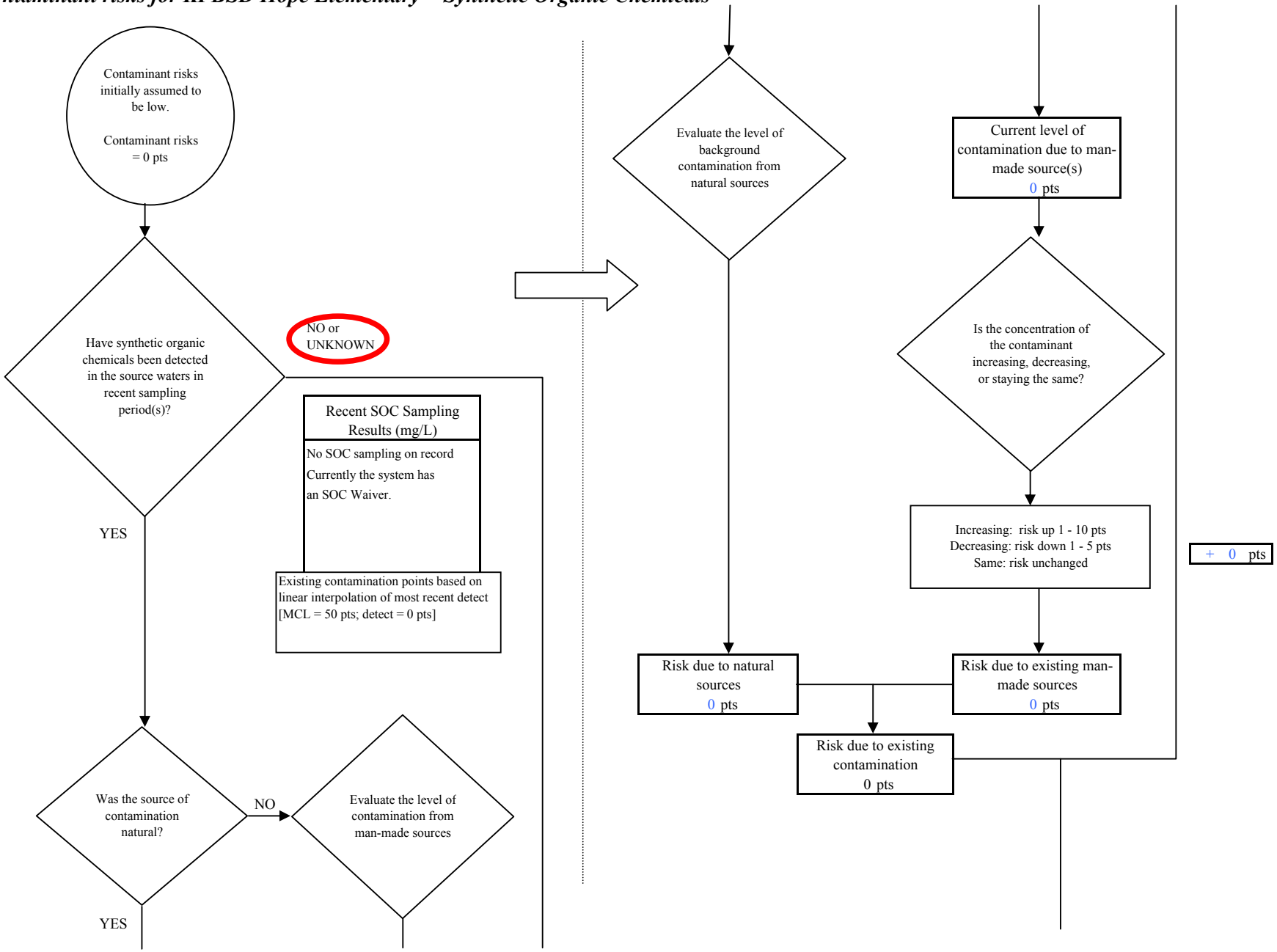


Chart 11. Contaminant risks for KPBSD Hope Elementary - Synthetic Organic Chemicals

+ 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)	2	0	2

	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

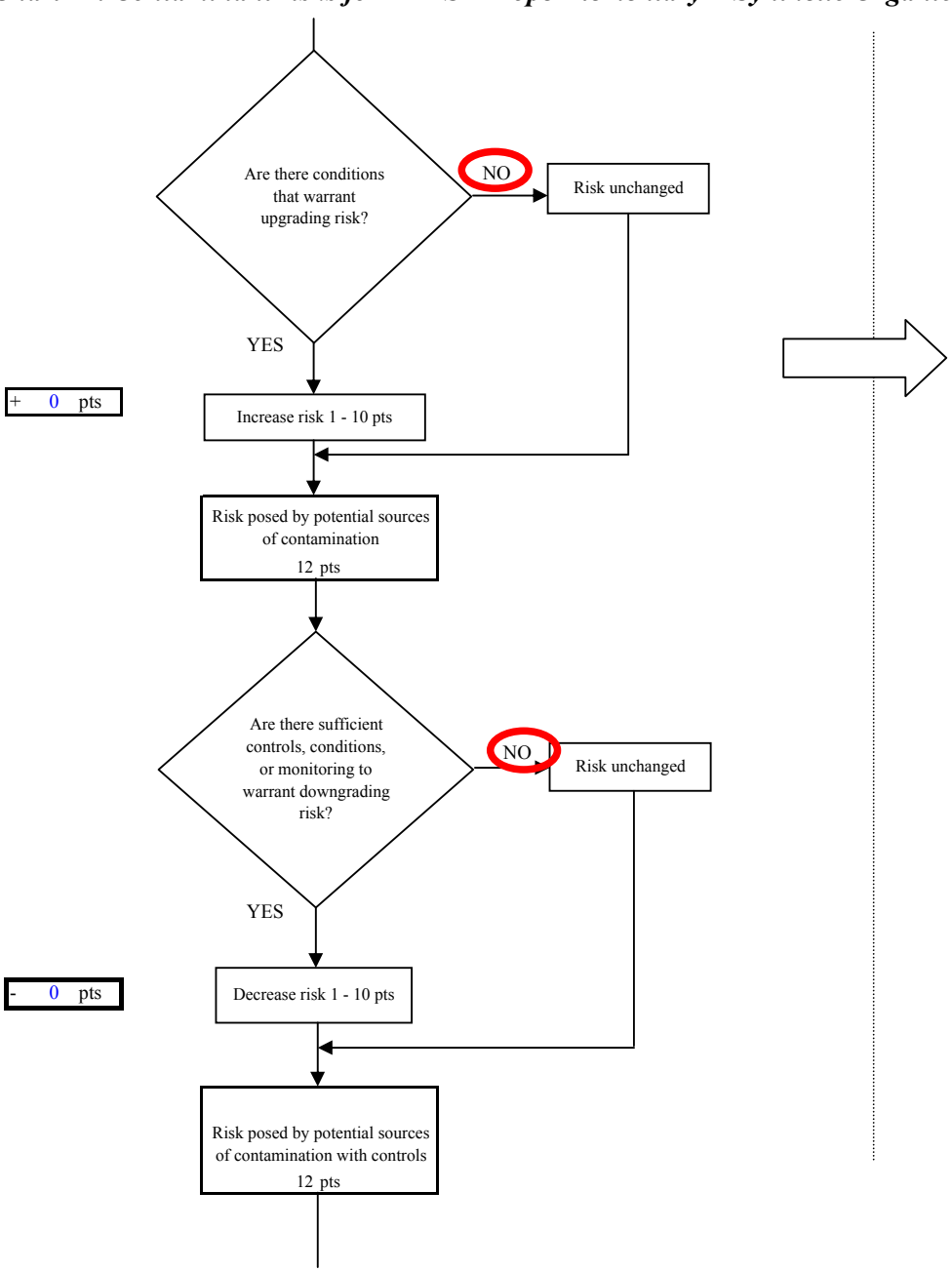
Risk unchanged

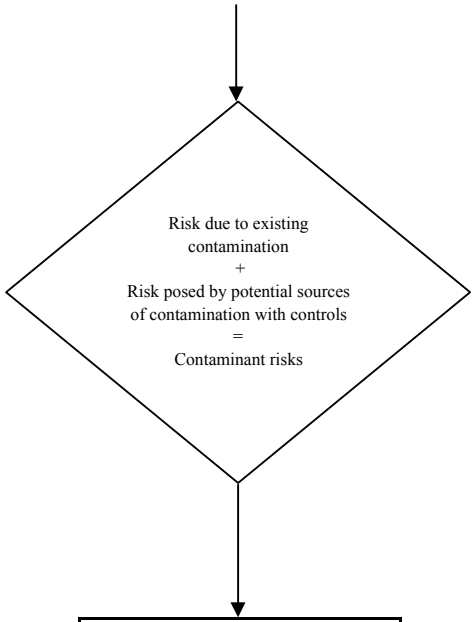
YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 11. Contaminant risks for KPBSD Hope Elementary - Synthetic Organic Chemicals





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

Contaminant risks*
= 12 pts

*Truncate risk at 50 pts

Low

Contaminant Risk Ratings

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

Chart 12. Vulnerability analysis for KPBSD Hope Elementary - Synthetic Organic Chemicals

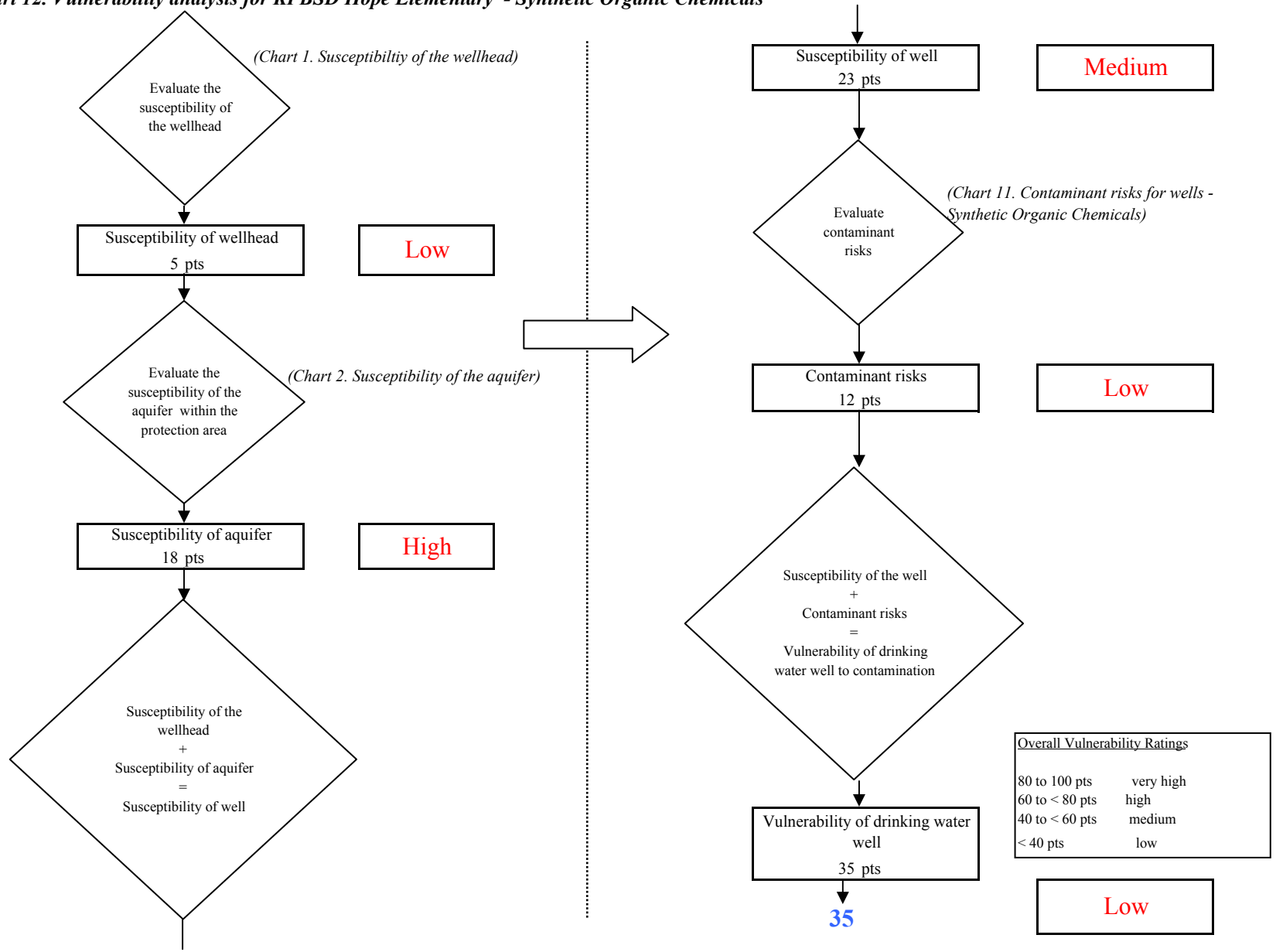


Chart 13. Contaminant risks for KPBSD Hope Elementary - Other Organic Chemicals

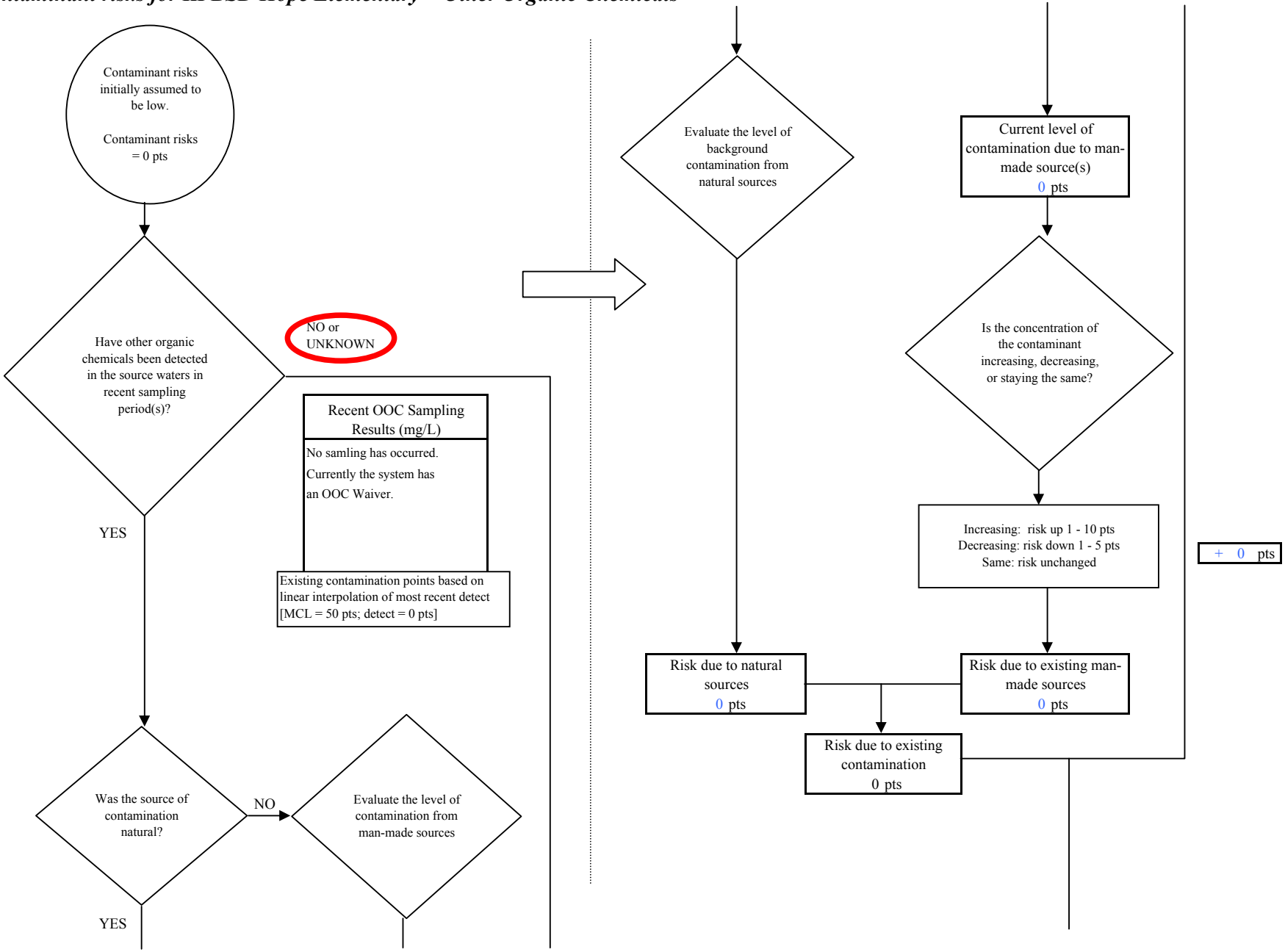


Chart 13. Contaminant risks for KPBSD Hope Elementary - Other Organic Chemicals

+ 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)	3	0	3

	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

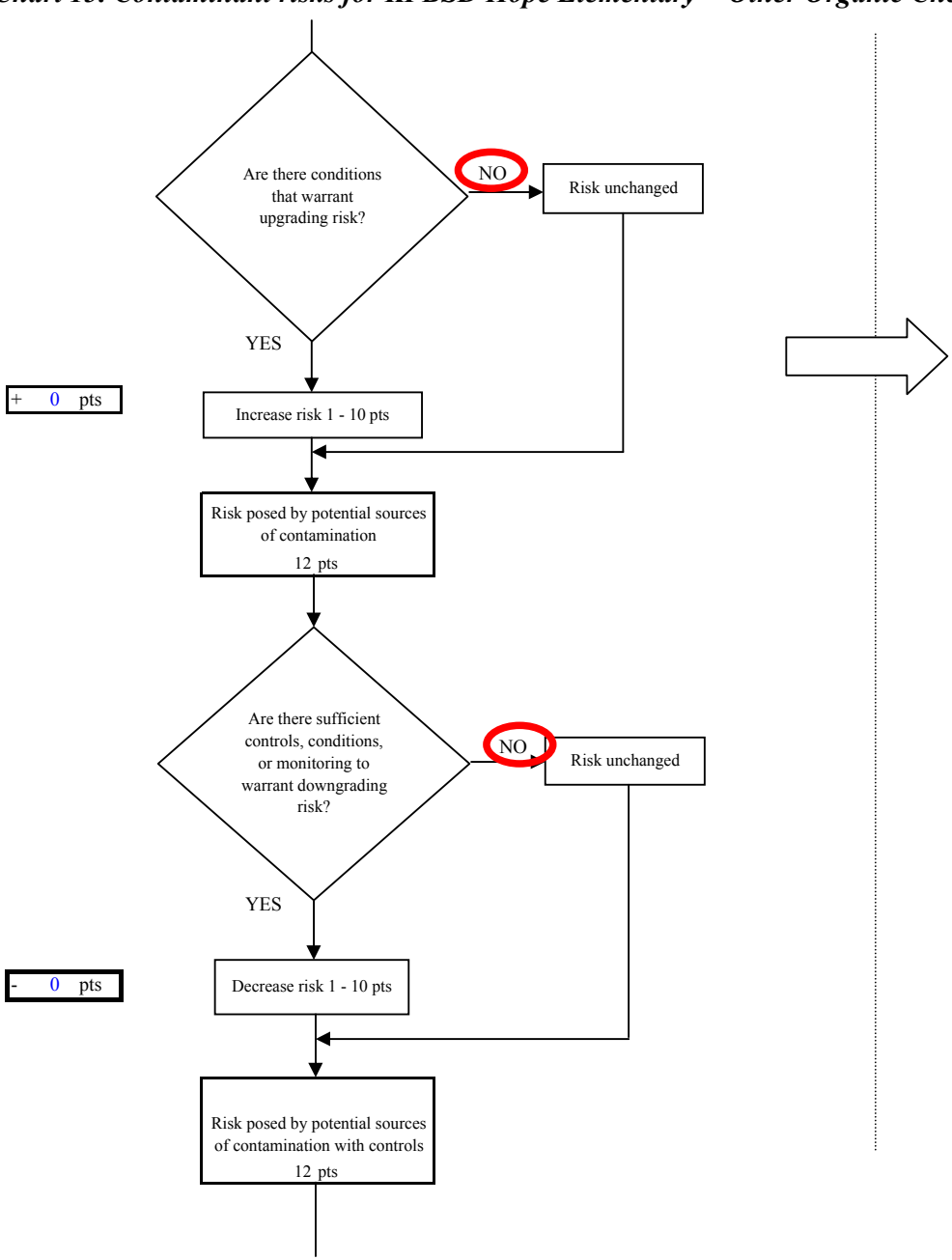
Risk unchanged

YES

Increase risk 1 - 10 pts

+ 2 pts

Chart 13. Contaminant risks for KPBSD Hope Elementary - Other Organic Chemicals



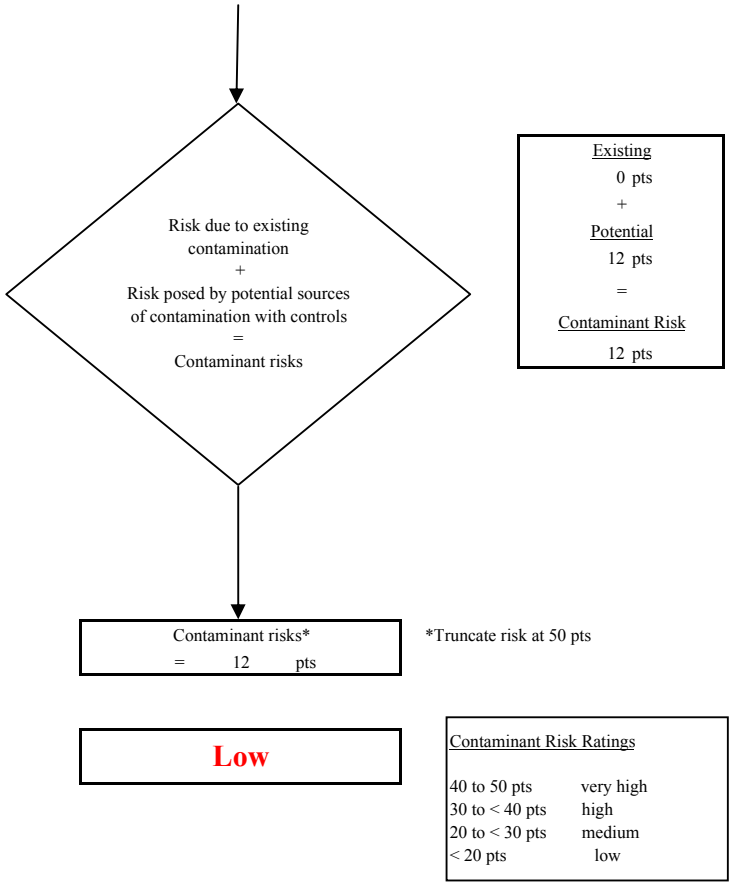


Chart 14. Vulnerability analysis for KPBSD Hope Elementary - Other Organic Chemicals