Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
University of Alaska (Emergency well)
Drinking Water System,
Fairbanks, Alaska
PWSID 310683.3

December 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1261
Alaska Department of Environmental Conservation

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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.

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Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability to potential contamination of the emergency well serving the University of Alaska public water system. This Class A (community) water system consists of four active wells, three at the corner of Geist Road and Fairbanks Street and one further north along the Alaska Railroad in Fairbanks, Alaska. This report is an assessment of the well further north along the Alaska Railroad. This well received a natural susceptibility rating of **Medium**. This rating is a combination of a **Medium** rating for the actual wellhead and a **High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the emergency well of the University of Alaska public water system include: an electric power generation plant, a Leaking Underground Fuel Storage Tank site, and an ADEC-recognized contaminated site. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals. Combining the natural susceptibility of the well with the contaminant risk, the public water system for emergency well of the University of Alaska public water system received an overall vulnerability rating of **High** for bacteria and viruses, volatile organic chemicals, and heavy metals and other inorganic chemicals, and other organic chemicals, and a **Low** for nitrates and/or nitrites, and synthetic organic chemicals,.

UNIVERSITY OF ALASKA (EMERGENCY WELL) PUBLIC DRINKING WATER SYSTEM

University of Alaska public water system is a Class A (community) water system. The system consists of four active wells, three at the corner of Geist Road and Fairbanks Street and one further north along the Alaska Railroad in Fairbanks, Alaska (T1S, R1W, Section 6) (See Map 1 of Appendix A). This report is an assessment of the well further north along the Alaska Railroad. Fairbanks is located in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

Golden Heart Utilities provides water and sewer for the city of Fairbanks. Electricity is provided by Golden Valley Electric Association. The majority of residents (approximately 70%) use heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) to heat homes and buildings (ADCED, 2002). Garbage collection services are proved by the city, and refuse is transported to the Fairbanks North Star Borough Class I Landfill on South Cushman Street.

The Fairbanks area includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The emergency well for the University of Alaska water system is located in the alluvial plain at an elevation of approximately 435 feet above sea level.

According to the well log for emergency well, the depth of the well is 44 feet below the ground surface and is screened in gravels and sand. The alluvial plain consists of alternating layers of sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, T.L. 1958). Areas with discontinuous permafrost may locally affect the ground water flow directions.

Primarily the Tanana River, but also the Chena River contributes water to this alluvial aquifer. The Chena River typically only contributes water when its stage is high and the Tanana is low (Nelson, 1978). The Tanana River gets approximately 85% of its water from snowmelt of the Alaska Range and 15% from the Yukon-Tanana uplands (Anderson, 1970).

The University of Alaska public drinking water system serves approximately 5,000 people.

UNIVERSITY OF ALASKA (EMERGENCY WELL) DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. 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 capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape. The emergency well of the University of Alaska water system is probably getting its water from both the alluvial aquifer and the bedrock upgradient from it.

There are many different methods for calculating the size of capture zones. This assessment uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated in this assessment is an estimate using the available information and resources, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture zone are general for the whole alluvial plain and were obtained from various United States Geological Survey (USGS) reports, area well logs, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

An outline of the immediate watershed was used to delineate the protection area for the emergency well of the University of Alaska water system because its source waters are in fractured bedrock. Available geology was also considered to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful protection area.

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into four zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety). Because the rate at which water travels through fractured bedrock is unknown but usually relatively fast, the protection area for the emergency well of the University of Alaska water system consists only of Zone A.

The following is a summary of the four 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 time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the University of Alaska (Emergency well) on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program (DWPP) has completed an inventory of potential and existing sources of contamination within the University of Alaska (Emergency well) protection area. This inventory was completed through a search of agency records and other publicly available information. 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 2 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 each 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 combination of toxicity and volume associated with that source. Rankings include:

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

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 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect the six contaminant categories.

VULNERABILITY OF UNIVERSITY OF ALASKA (EMERGENCY WELL) 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 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 properties of the aquifer and the presence of other wells or boreholes in the area. 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 the water system’s contaminant sample results. Lastly, Chart 4 combines the results of the first three charts to produce 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 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 wellhead for the emergency well of the University of Alaska water system received a Medium Susceptibility rating. The SOC/OOC Monitoring Waiver Application (7/14/97) indicates there is a seal on the well. The land surface is sloped away from the wells, however the well is located in a vault negating the effectiveness of the sloped surface. The well is not grouted. A sanitary seal prevents potential contaminant from entering the well, while a sloped land surface and grouting help to prevent contaminants from traveling down the outside of the well casing.

The aquifer the emergency well of the University of Alaska water system is completed in received a High Susceptibility rating. The highly transmissive aquifer material (sand and gravel) in the area allows contaminants to travel downward from the surface with the precipitation and surface water runoff. The shallow water table allows potential contaminants to come into contact with the water table with little natural filtering where they can disperse quickly. Wells in the area can also provide a quick pathway for contaminants to travel down into the aquifer if the wells are not grouted correctly. Table 2 summarizes the Susceptibility scores and ratings for the emergency well of the University of Alaska water system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	10	Medium
Susceptibility of the Aquifer	17	High
Natural Susceptibility	27	Medium

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

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

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

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	9	Low
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	0	Low
Other Organic Chemicals	40	Very High

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:

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

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	75	High
Nitrates and Nitrites	35	Low
Volatile Organic Chemicals	75	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	75	High
Synthetic Organic Chemicals	25	Low
Other Organic Chemicals	65	High

Bacteria and Viruses

Although there are no identified sources of Bacteria and Viruses located in the protection area, coliforms (bacteria) have been detected in the water.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms 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). Coliforms were detected most recently in this water system on 7/17/03 and 7/15/03. Fecal coliforms and E.Coli have not been detected recently (within the past 5 years).

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

There are also no identified sources of nitrates and nitrites in the protection area.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates were most recently detected at a concentration of 1.80 mg/L or 18% of its Maximum Contaminant Level (MCL) in the water system. An MCL is the highest concentration of a contaminant allowed in drinking water by the Environmental Protection Agency (EPA).

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 low.

Volatile Organic Chemicals

The DEC-recognized contaminated site and the electric power station represent the greatest risk of volatile organic chemical contamination to the emergency well of the University of Alaska water system.

The DEC-recognized contaminated site is located at University of Alaska's physical plant (RecKey 1988310929112). Fuel contamination was found in the soil and ground water during the removal of old fuel storage tanks in 1986. Saturated soils were removed and ground water was monitored. No further remedial action is planned.

Volatile Organic Chemicals including 1,1 Dichloroethane, Benzene, Bromodichloromethane, Chlorodibromomethane, Chloroform, and Trichloroacetic acid have all been detected within the past 5 years in this water system. 1,1-Dichloroethane was only detected once in a very low concentration. Benzene has been consistently detected during routine sampling, most recently at concentrations ranging from 0.0091 mg/L on 7/23/03 to 0.00391 mg/L on 12/16/02. The MCL for Benzene is 0.005 mg/L. Benzene in groundwater is commonly associated with fuel contamination. Short-term exposure to Benzene in concentrations above the MCL has been found to potentially cause temporary nervous system disorders, immune system depression and anemia (EPA, 2002). Benzene has been found to potentially cause cancer after long-term exposures greater than the MCL (EPA, 2002). Bromodichloromethane, Chlorodibromomethane, Chloroform, and Trichloroacetic acid are common disinfection byproducts and are not usually found in the source water.

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 very high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The electric power generation plant represents the risk to Heavy Metals, Cyanide, and Other Inorganic Chemicals for this source of public drinking water.

Arsenic, Barium, Chromium, and Fluoride have all been detected during recent sampling. Arsenic has been consistently detected during recent routine sampling. It was most recently detected on 9/17/03 at a concentration of 0.0056 mg/L, or 56% of its MCL. Arsenic occurs naturally in the environment as well as from outside sources such mining and smelting (EPA, 2002). Studies have linked long-term exposure to arsenic above its MCL in drinking water to cancer as well as cardiovascular, pulmonary, immunological, neurological, and endocrine (e.g., diabetes) effects (EPA, 2002).

Barium, Chromium, and Fluoride were detected only once in extremely small concentrations with respect to their MCLs.

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.

Synthetic Organic Chemicals

There are no identified sources of synthetic organic chemicals in the protection area.

Synthetic Organic Chemicals were sampled most recently on 6/11/96; none were detected.

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

Other Organic Chemicals

The electric power generation plant represents the greatest risk to Other Organic Chemicals for the emergency well of the University of Alaska public drinking water system.

Other Organic Chemicals were sampled most recently on 6/11/96; none were detected.

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

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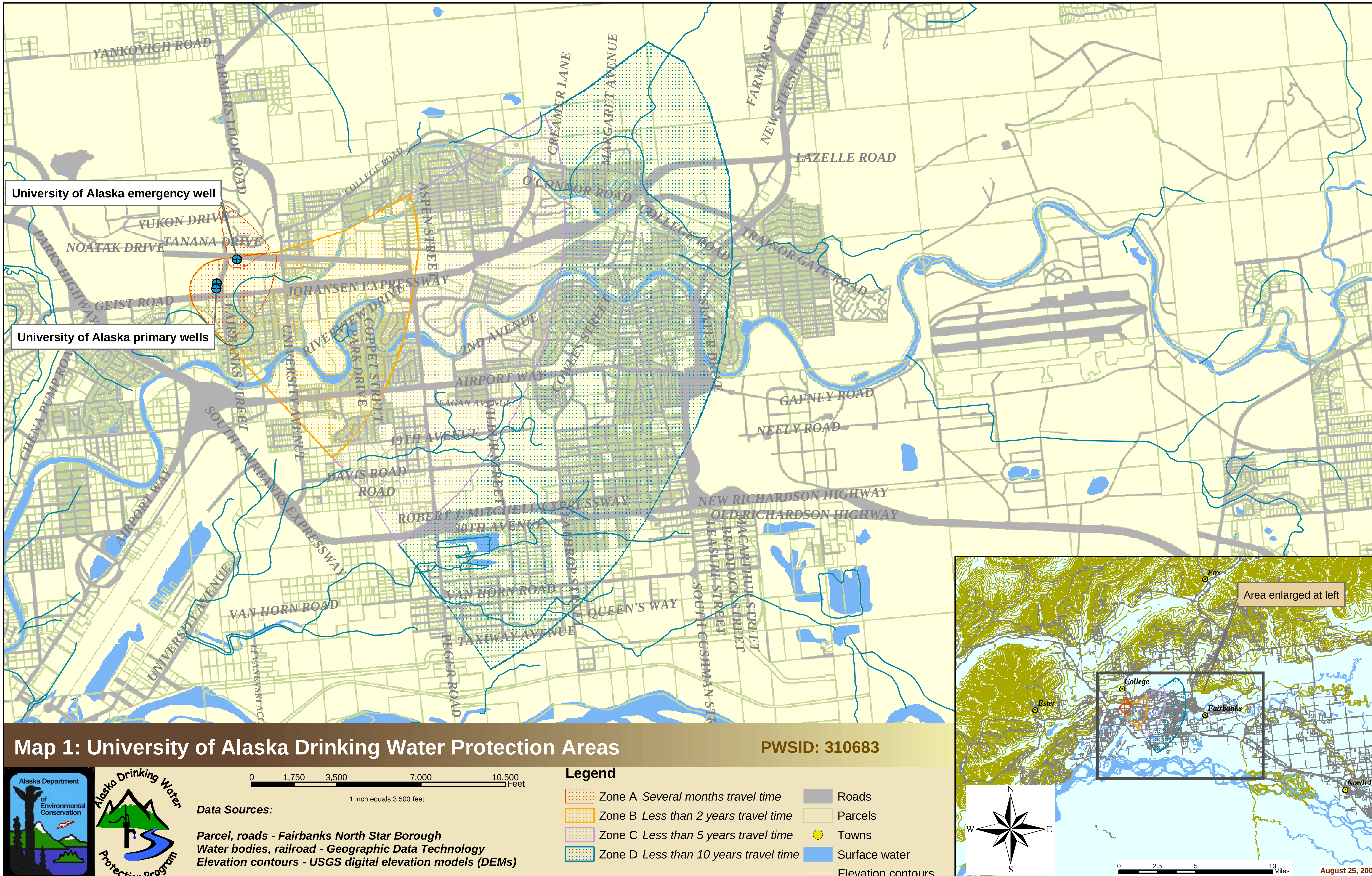
APPENDIX A

University of Alaska (Emergency well)
Drinking Water Protection Area Location Map
(Map 1)



Map 1: University of Alaska Drinking Water Protection Areas

APPENDIX B

Contaminant Source Inventory and Risk Ranking for University of Alaska (Emergency well) (Tables 1-7)

Table 1

Contaminant Source Inventory for
University of Alaska

PWSID 310683.003

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	A	2	UAF Physical Plant; RecKey 1988310929112
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	A	2	803 Alumni Drive; File Number 105.26.030
Electric power generation (fossil fuels)	X36	X36-1	A	2	Tanana Drive

Table 2

Contaminant Source Inventory and Risk Ranking for University of Alaska Sources of Volatile Organic Chemicals

PWSID 310683.003

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	A	Very High	2	UAF Physical Plant; RecKey 1988310929112
Electric power generation (fossil fuels)	X36	X36-1	A	Medium	2	Tanana Drive

Table 3

Contaminant Source Inventory and Risk Ranking for University of Alaska
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 310683.003

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Electric power generation (fossil fuels)	X36	X36-1	A	Medium	2	Tanana Drive

Table 4

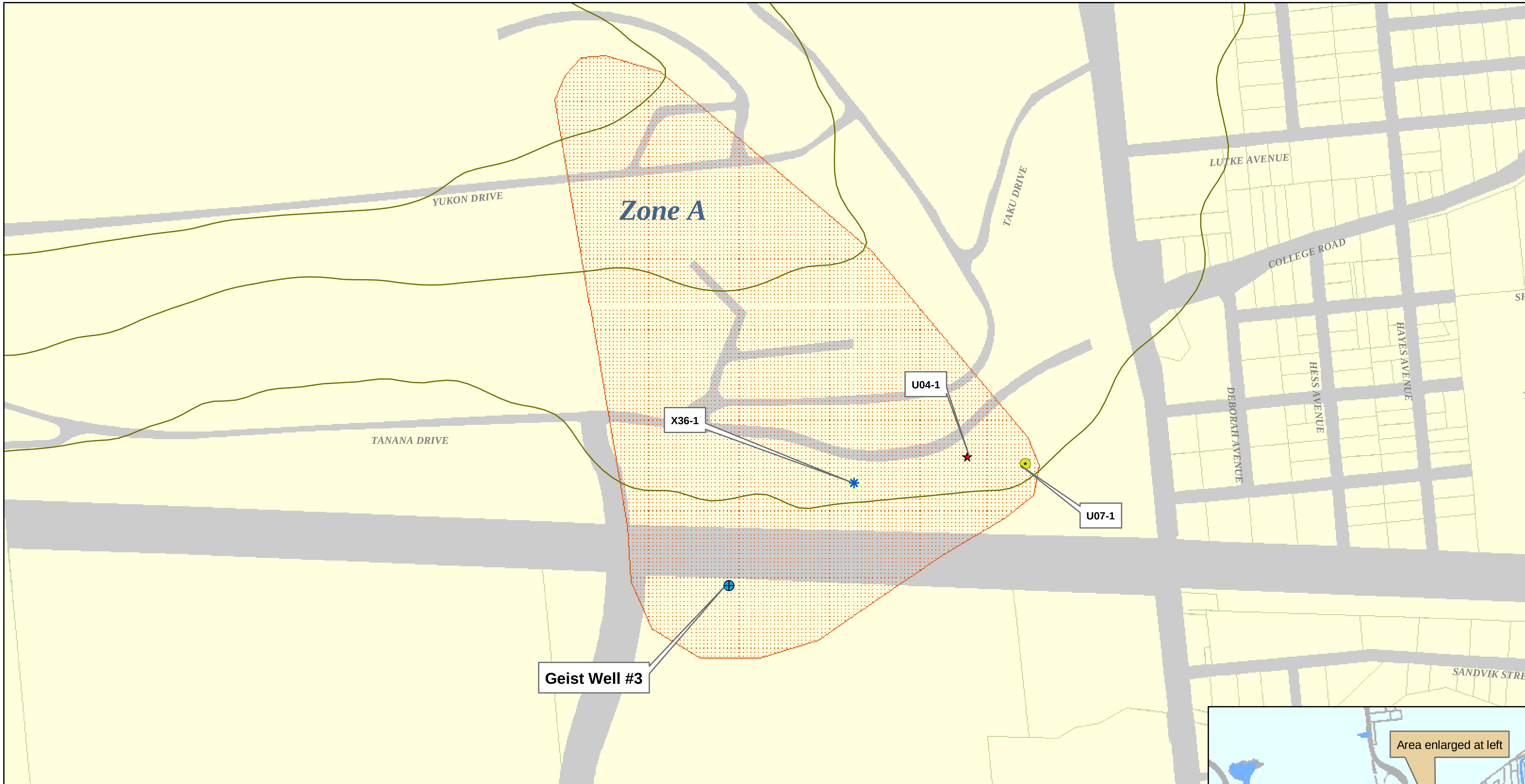
Contaminant Source Inventory and Risk Ranking for University of Alaska
Sources of Other Organic Chemicals

PWSID 310683.003

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Electric power generation (fossil fuels)	X36	X36-1	A	High	2	Tanana Drive

APPENDIX C

University of Alaska (Emergency well)
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)



Map 2: Potential Contaminant Sources

PWSID: 310683

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 200 400 800 Feet

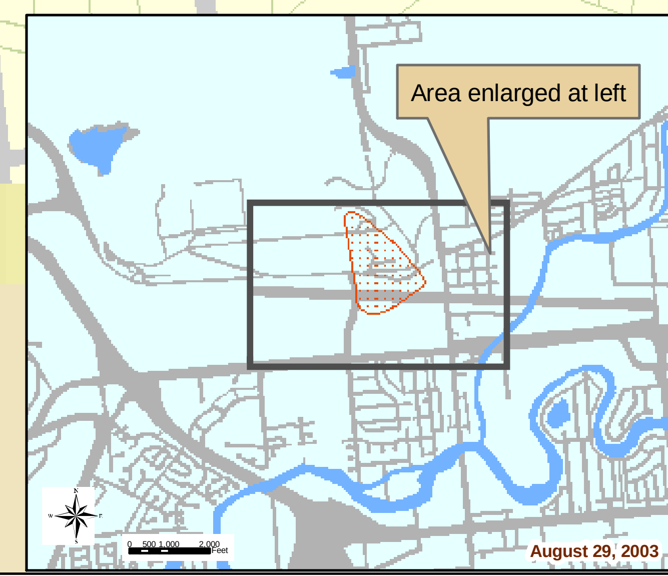
1 inch equals 400 feet

Data Sources:

Parcel, roads - Fairbanks North Star Borough
Water bodies, railroad - Geographic Data Technology
Elevation contours - USGS digital elevation models (DEMs)

Legend

- U04, Contaminated sites, DEC recognized
- U07, Open LUST Sites
- X36, Electric power generation (fossil fuels)
- Parcels
- Roads
- Elevation contour (20 m)



APPENDIX D

Vulnerability Analysis for University of Alaska (Emergency well) Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - University of Alaska (Emergency well)

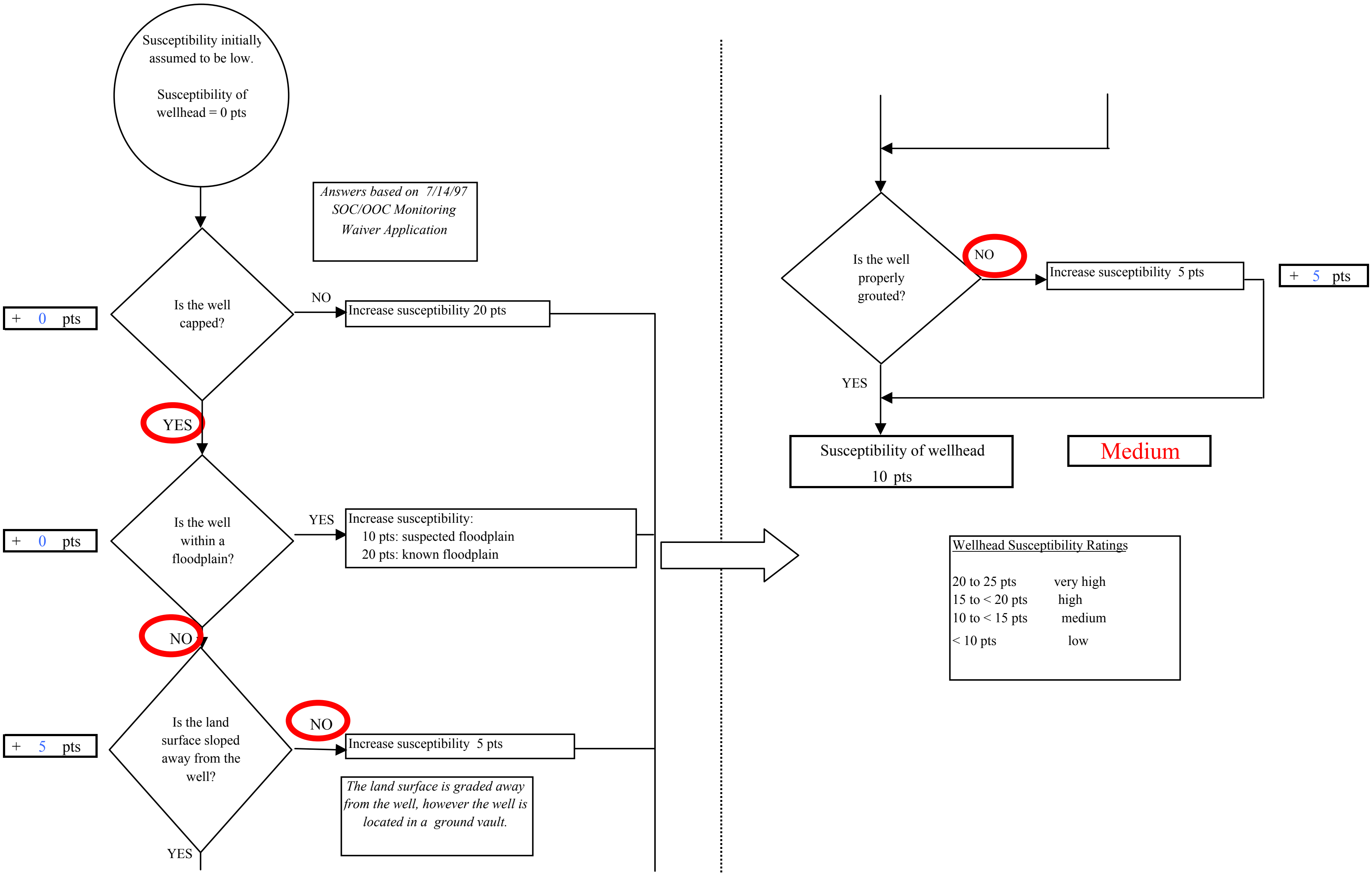


Chart 2. Susceptibility of the aquifer - University of Alaska (Emergency well)

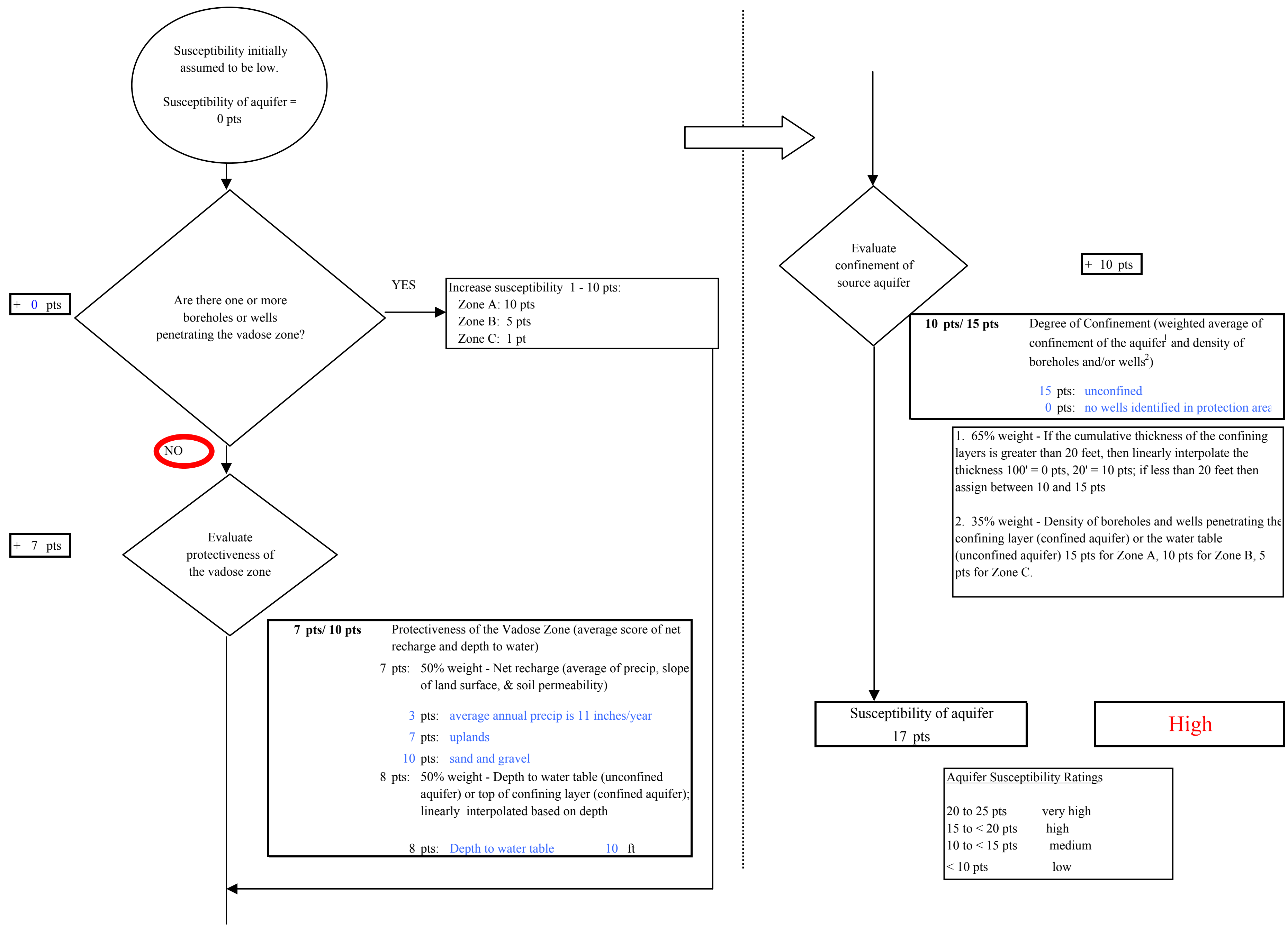
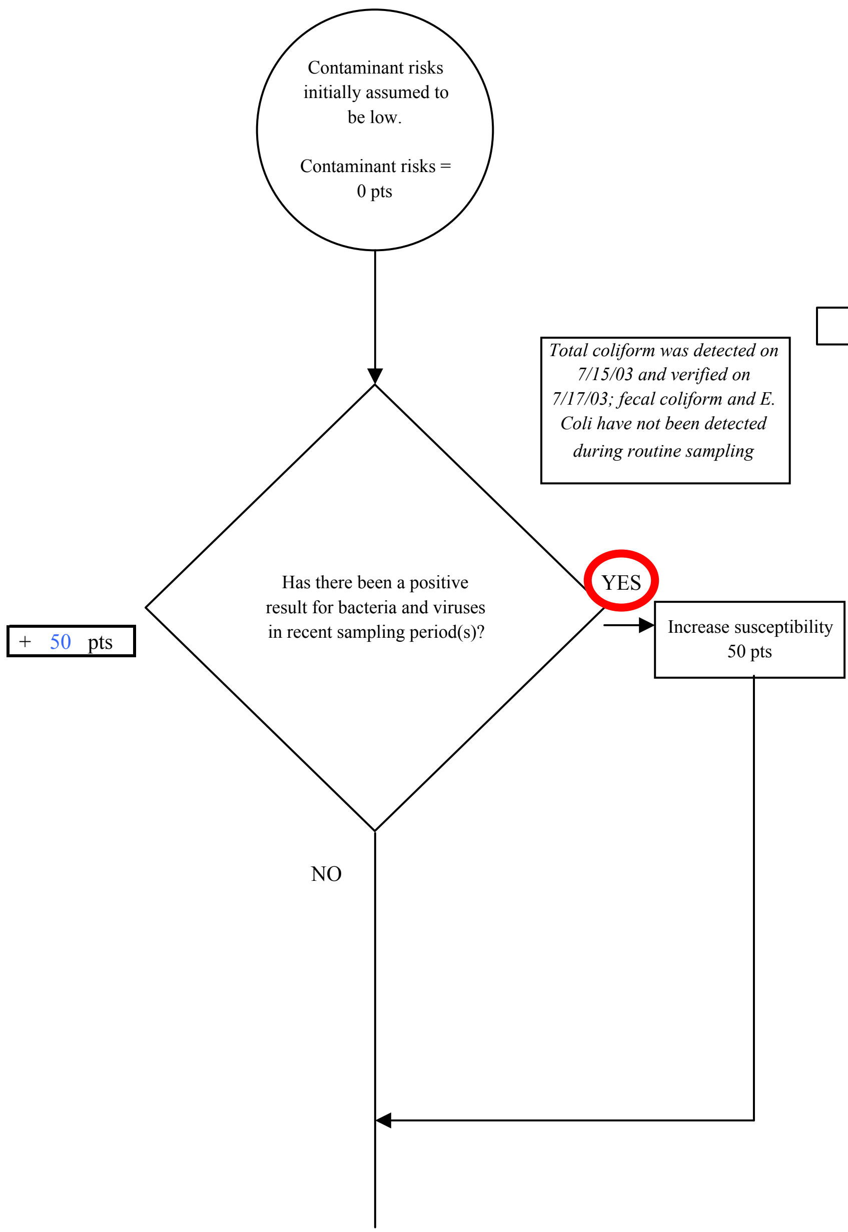
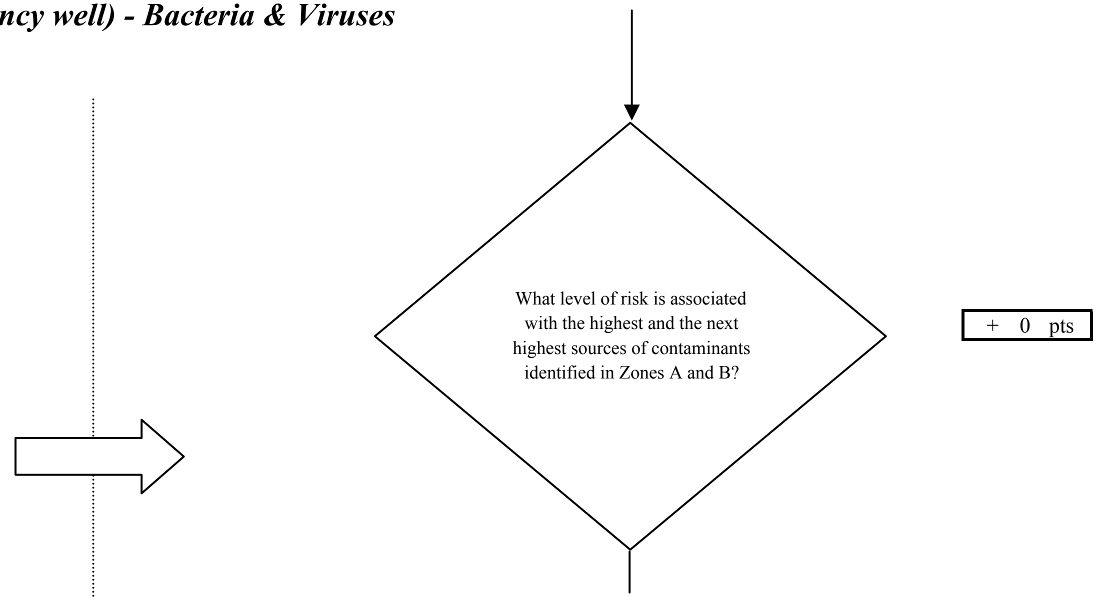


Chart 3. Contaminant risks for University of Alaska (Emergency well) - Bacteria & Viruses





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)	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 0

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 University of Alaska (Emergency well) - Bacteria & Viruses

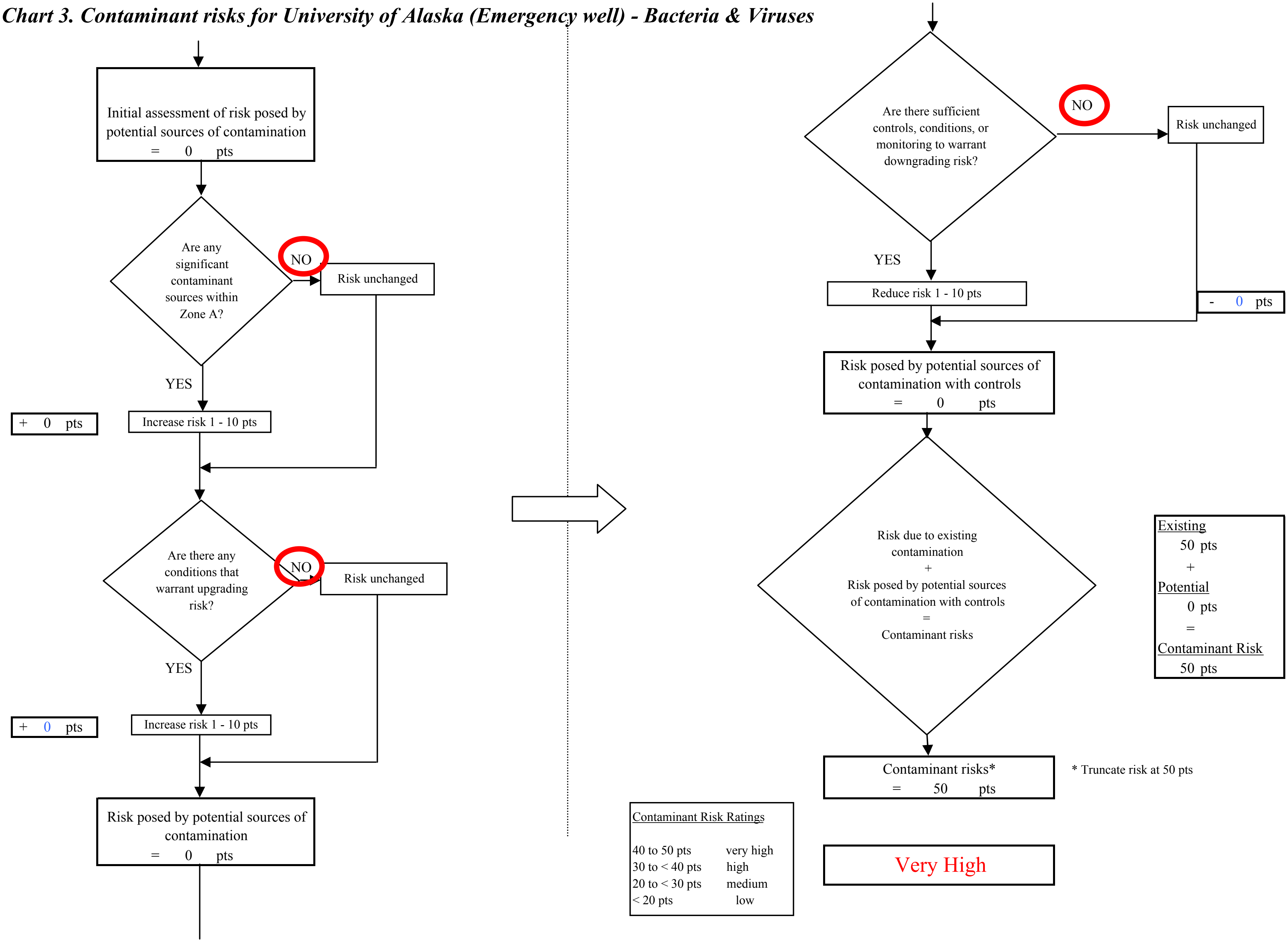


Chart 4. Vulnerability analysis for University of Alaska (Emergency well) - Bacteria & Viruses

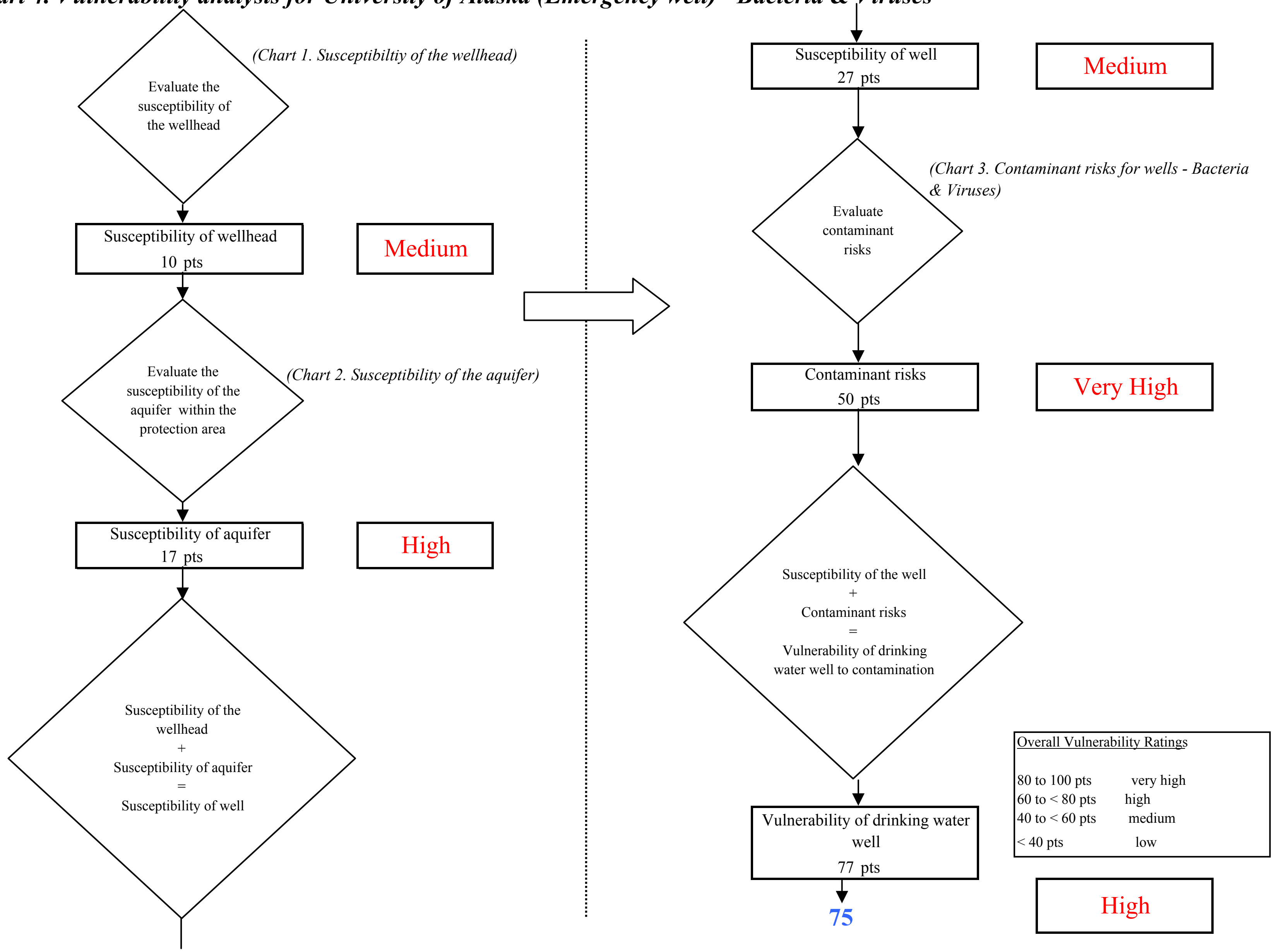
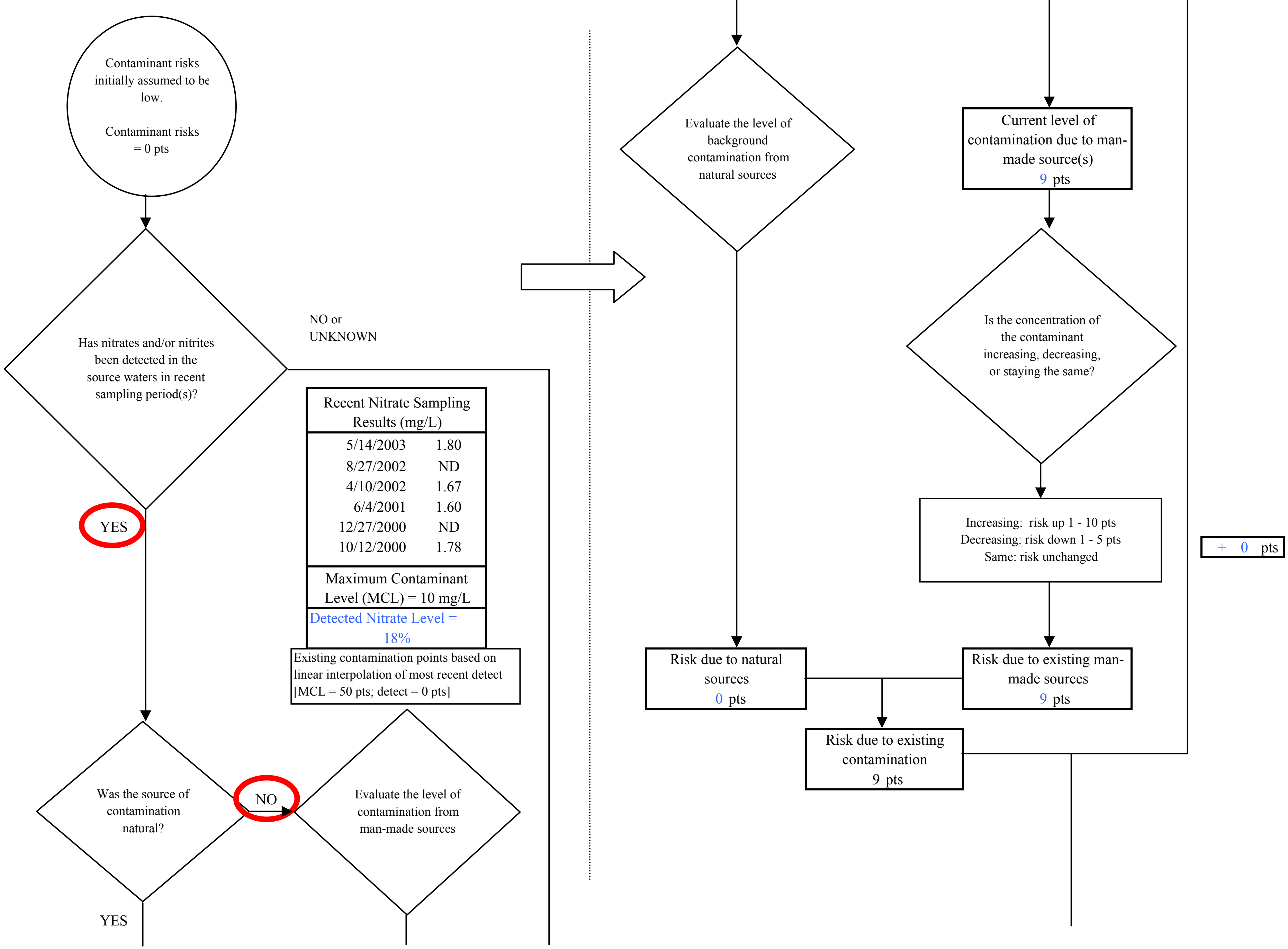


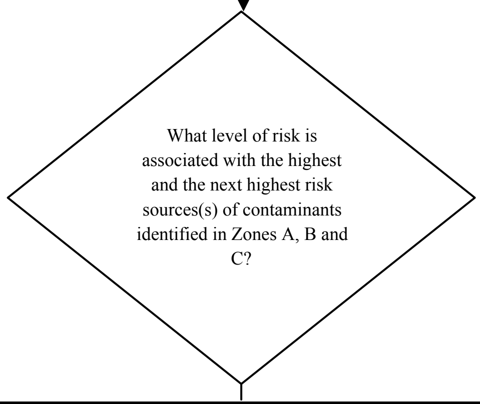
Chart 5. Contaminant risks for University of Alaska (Emergency well) - Nitrates and Nitrites



Recent Nitrate Sampling Results (mg/L)	
5/14/2003	1.80
8/27/2002	ND
4/10/2002	1.67
6/4/2001	1.60
12/27/2000	ND
10/12/2000	1.78
Maximum Contaminant Level (MCL) = 10 mg/L	
Detected Nitrate Level = 18%	

Chart 5. Contaminant risks for University of Alaska (Emergency well) - Nitrates and Nitrites

+ 0 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)	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 0

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

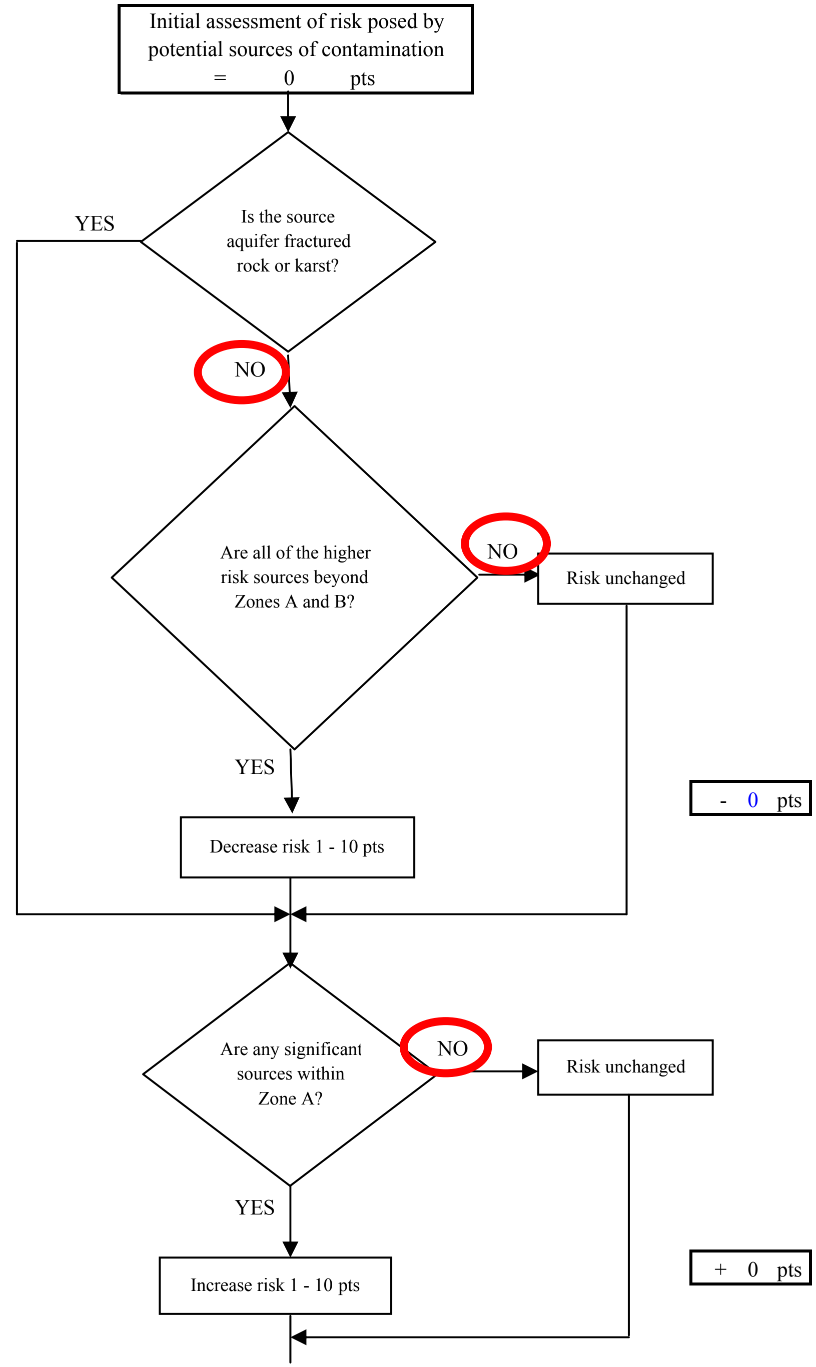


Chart 5. Contaminant risks for University of Alaska (Emergency well) - Nitrates and Nitrites

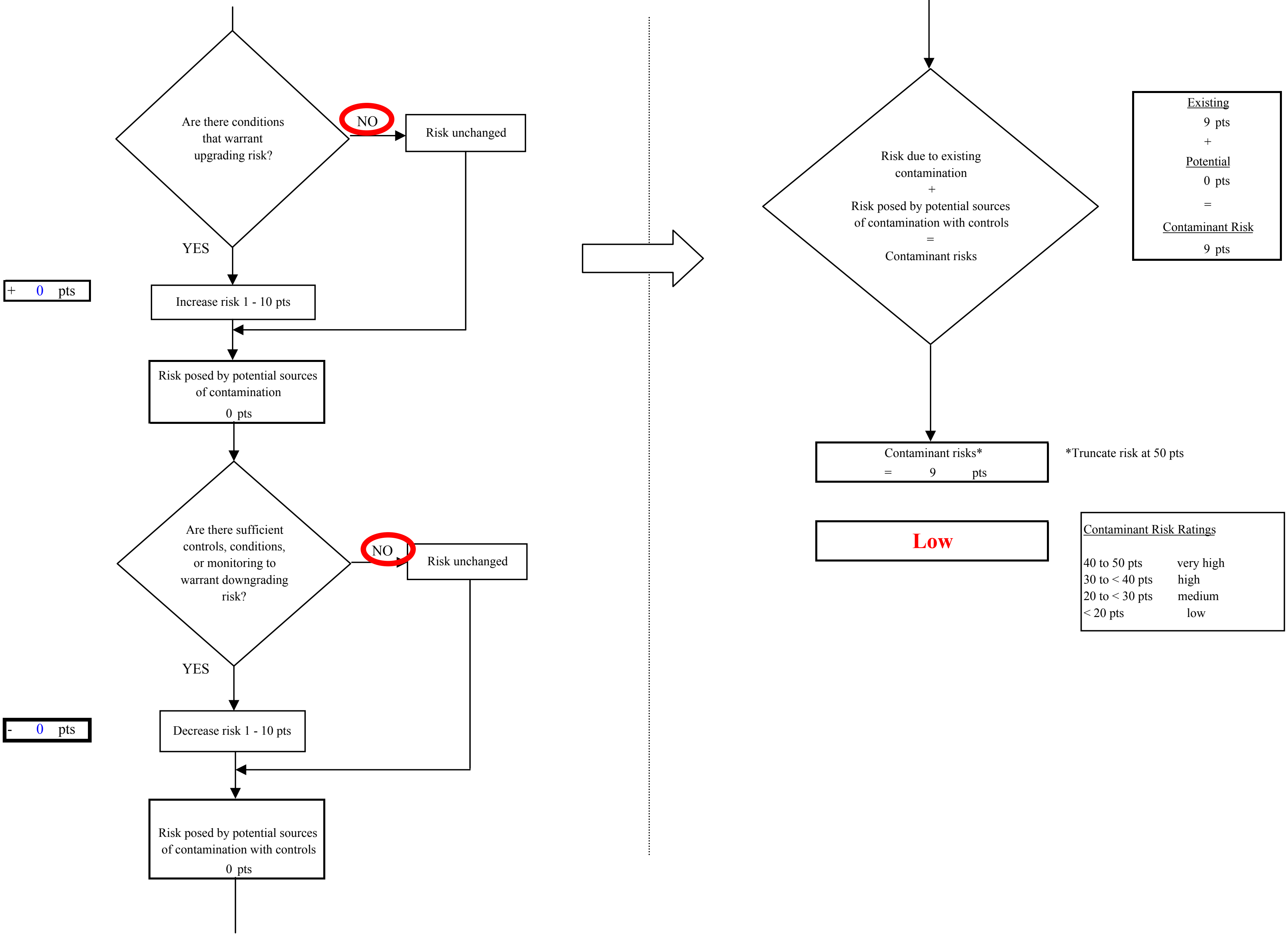


Chart 6. Vulnerability analysis for University of Alaska (Emergency well) - Nitrates and Nitrites

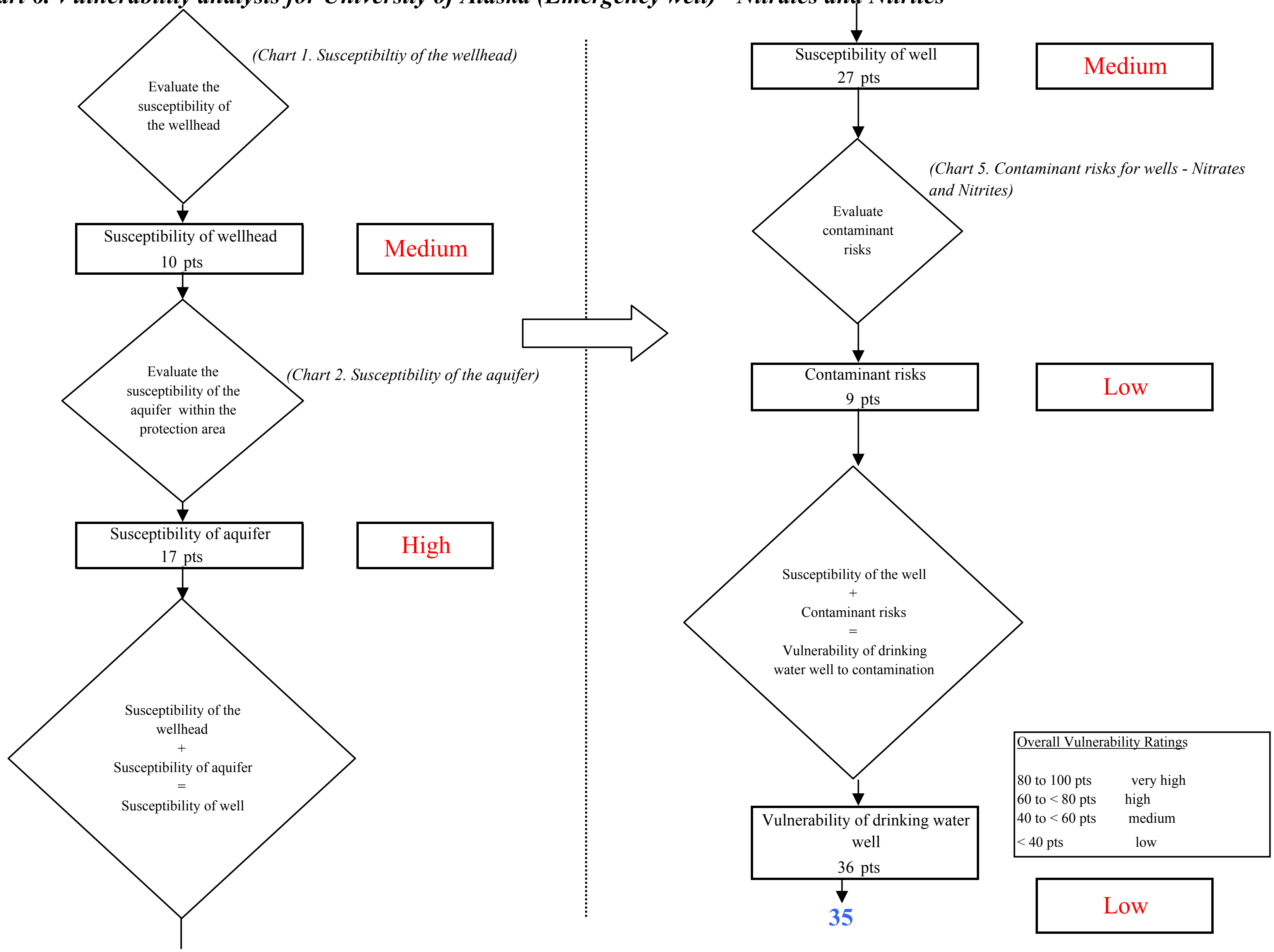


Chart 7. Contaminant risks for University of Alaska (Emergency well) - Volatile Organic Chemicals

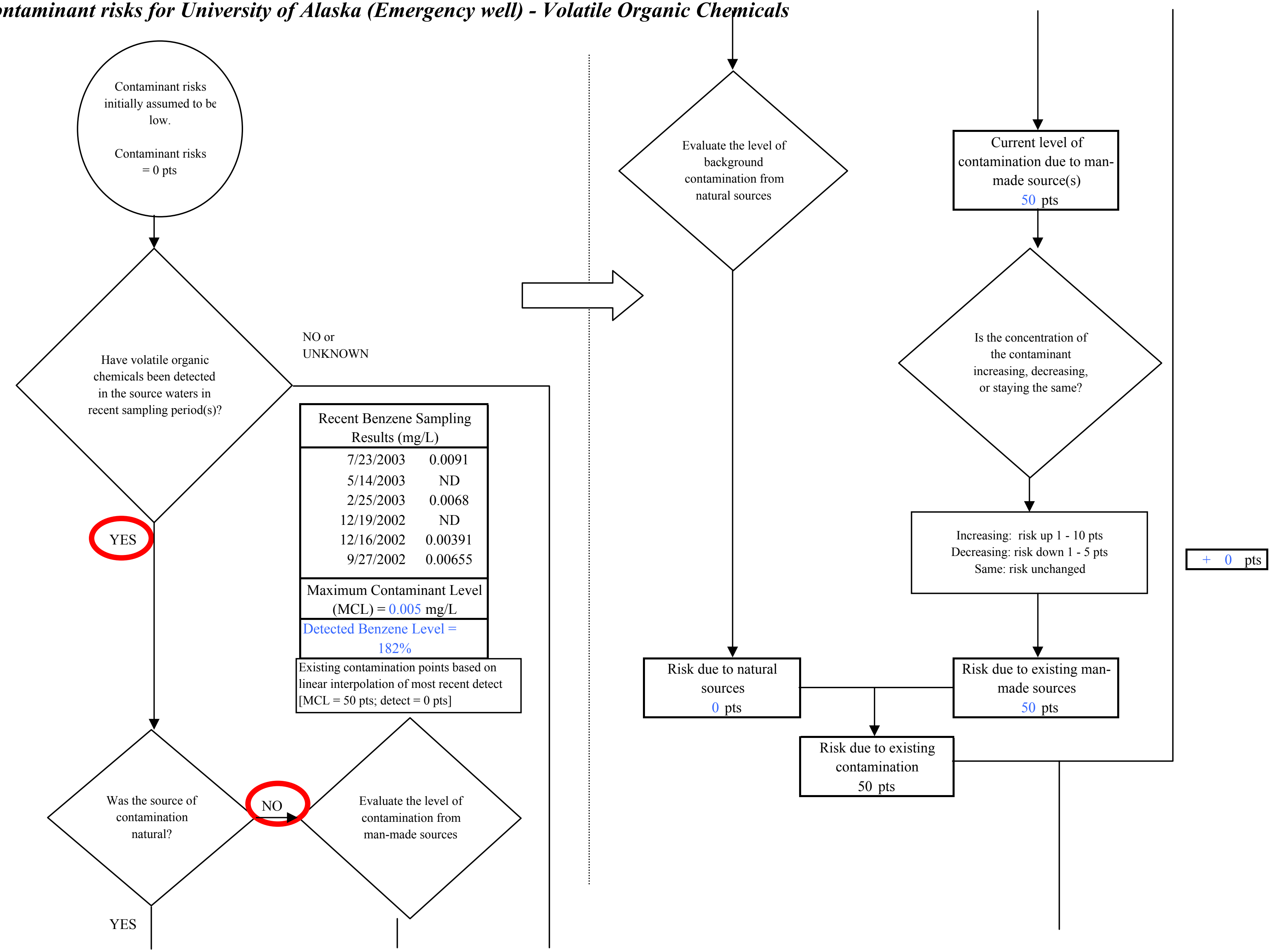
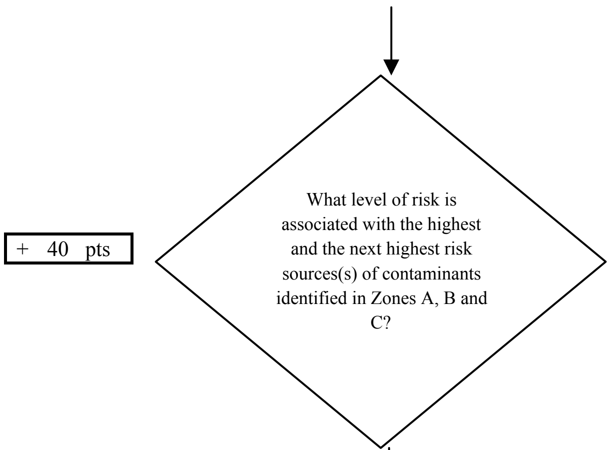


Chart 7. Contaminant risks for University of Alaska (Emergency well) - Volatile Organic Chemicals



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

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

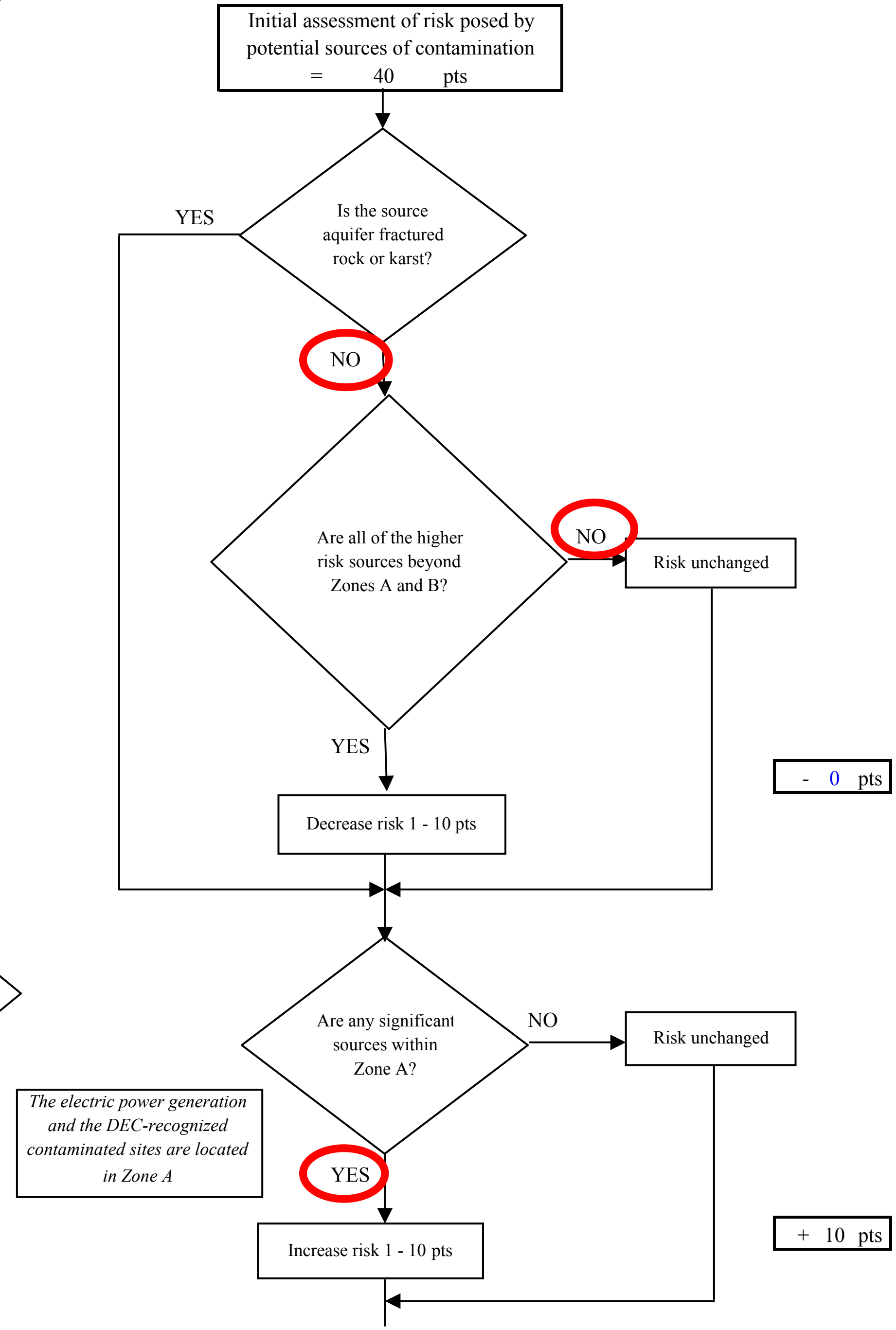


Chart 7. Contaminant risks for University of Alaska (Emergency well) - Volatile Organic Chemicals

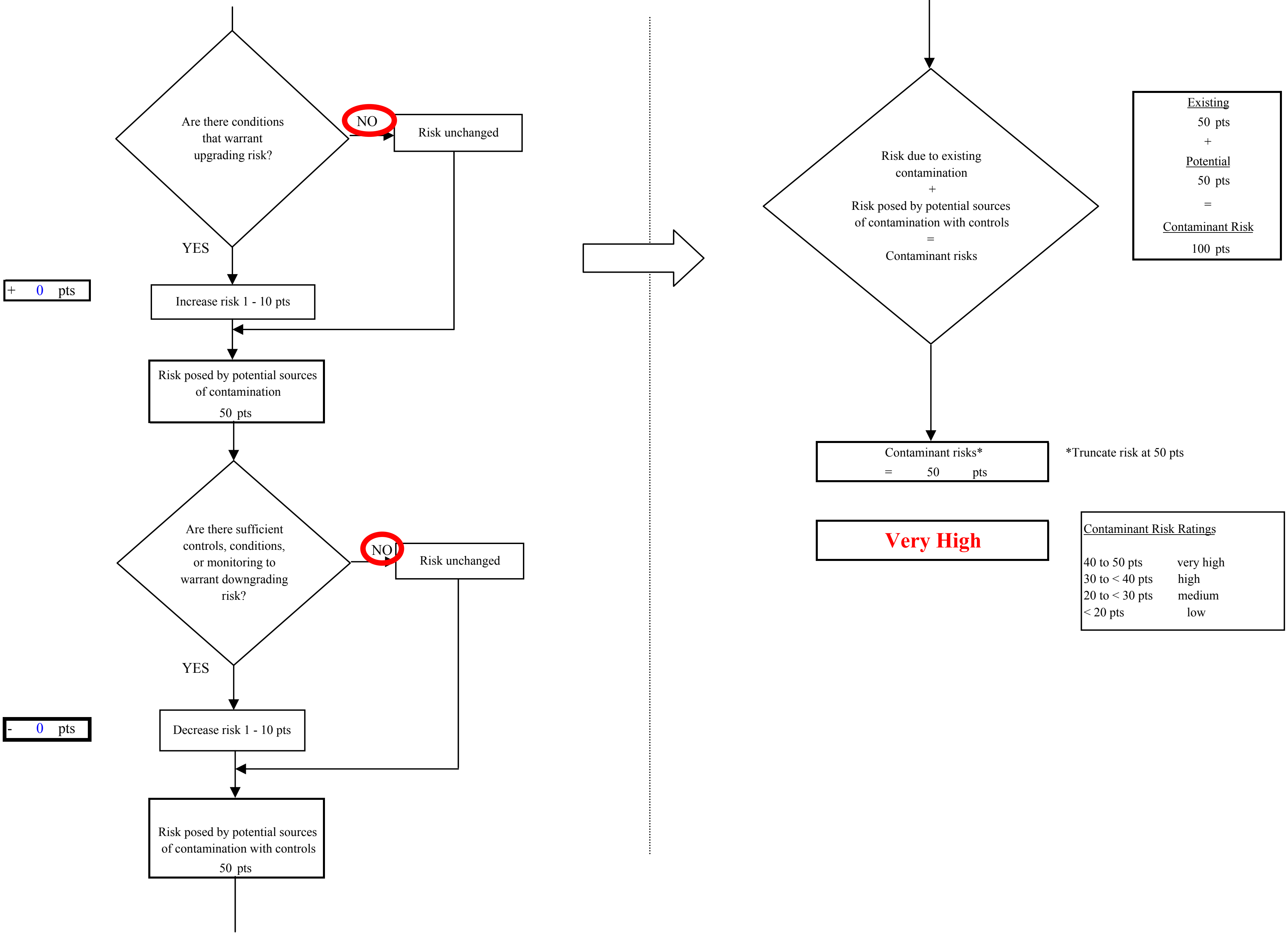


Chart 8. Vulnerability analysis for University of Alaska (Emergency well) - Volatile Organic Chemicals

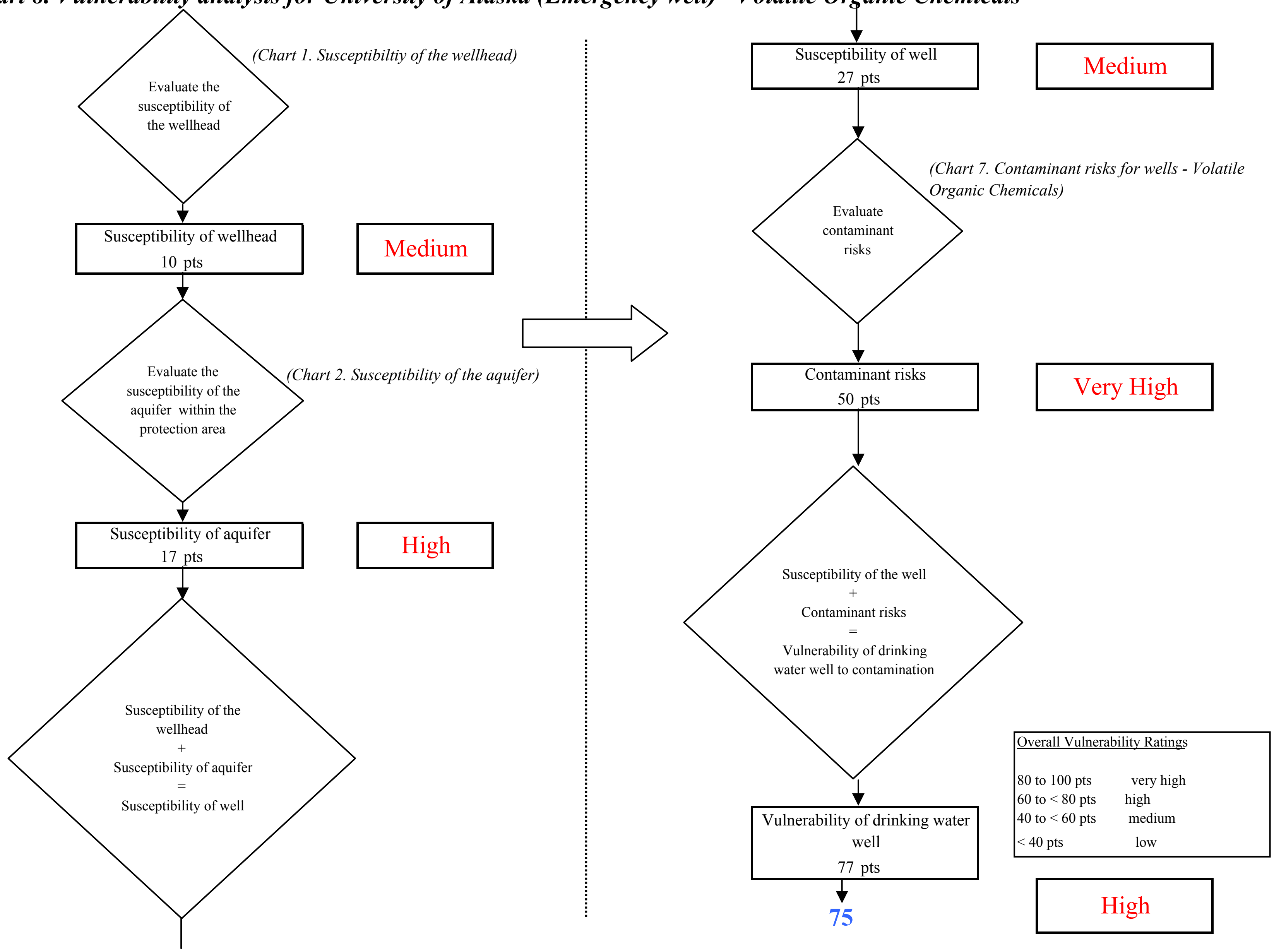
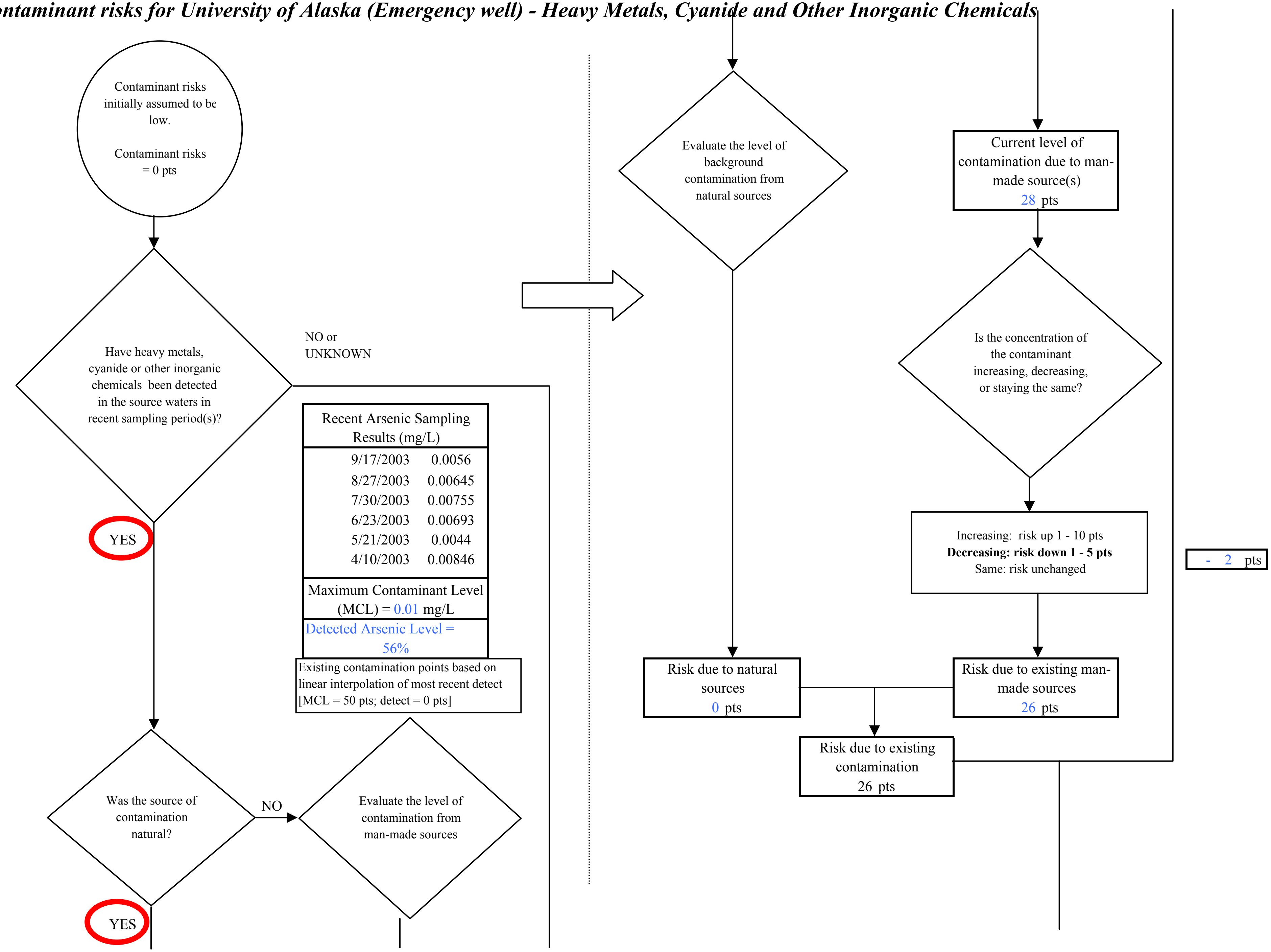
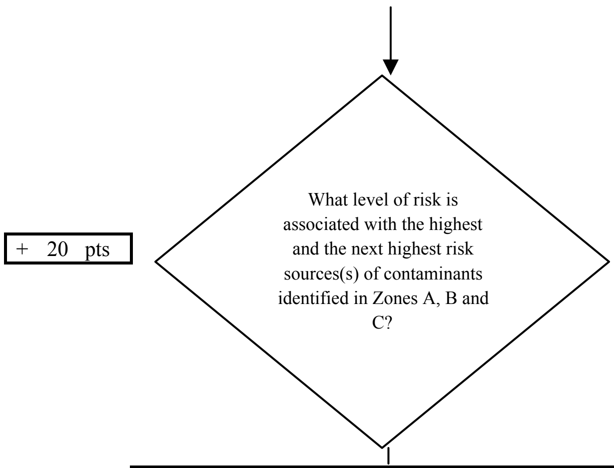


Chart 9. Contaminant risks for University of Alaska (Emergency well) - Heavy Metals, Cyanide and Other Inorganic Chemicals



Recent Arsenic Sampling Results (mg/L)	
9/17/2003	0.0056
8/27/2003	0.00645
7/30/2003	0.00755
6/23/2003	0.00693
5/21/2003	0.0044
4/10/2003	0.00846
Maximum Contaminant Level (MCL) = 0.01 mg/L	
Detected Arsenic Level = 56%	

Chart 9. Contaminant risks for University of Alaska (Emergency well) - Heavy Metals, Cyanide and Other Inorganic Chemicals



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)	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 20

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

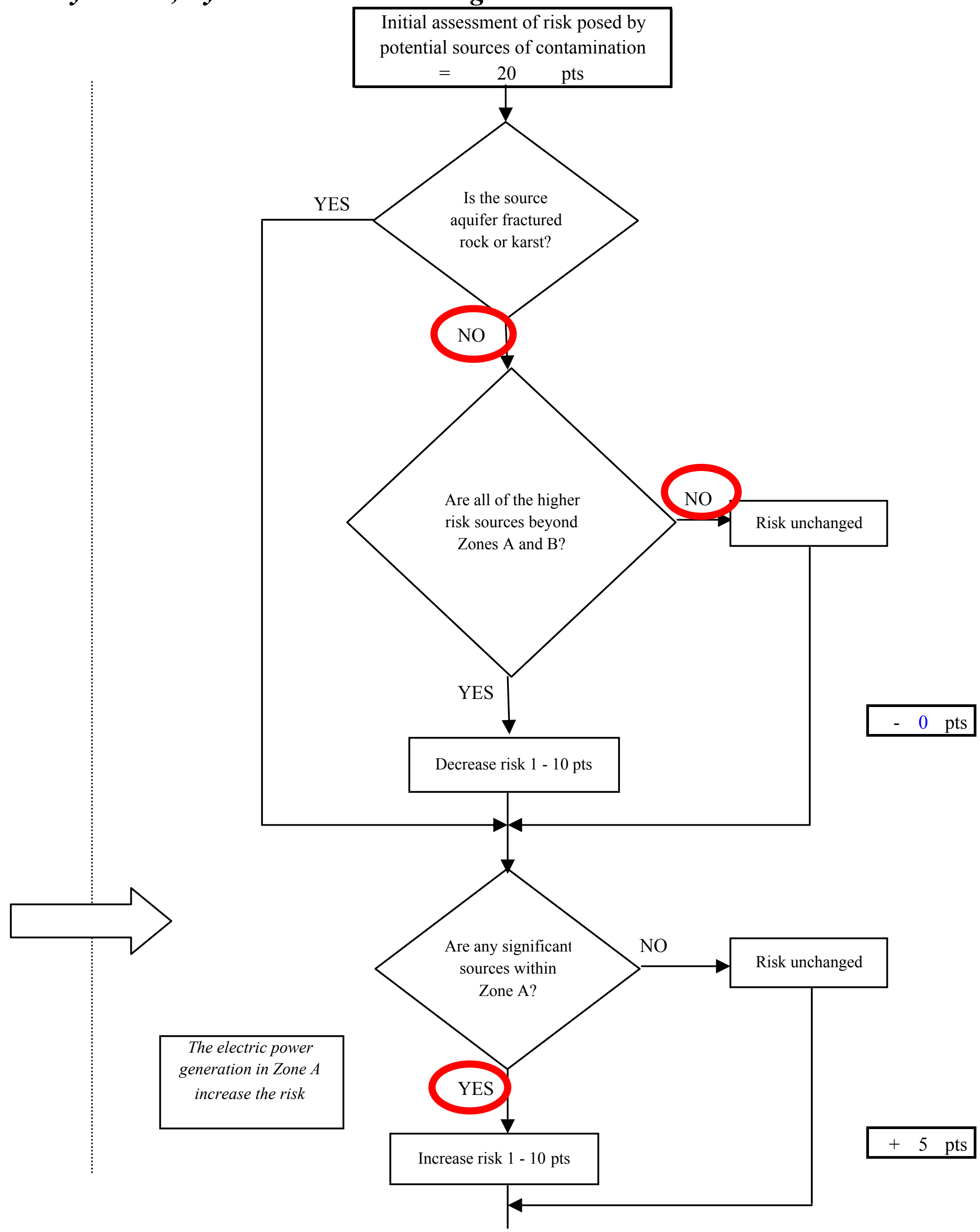


Chart 9. Contaminant risks for University of Alaska (Emergency well) - Heavy Metals, Cyanide and Other Inorganic Chemicals

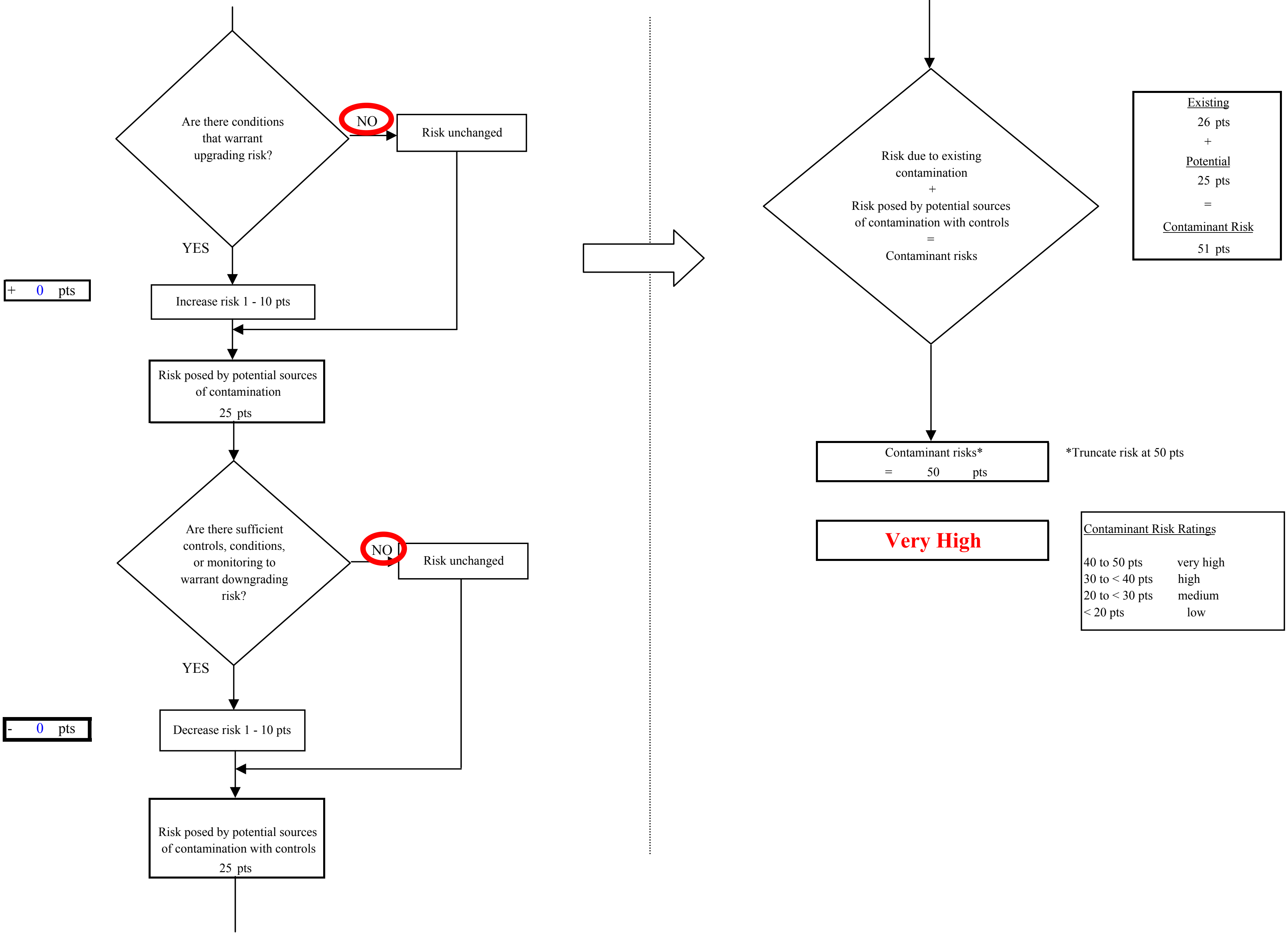


Chart 10. Vulnerability analysis for University of Alaska (Emergency well) - Heavy Metals, Cyanide and Other Inorganic Chemical

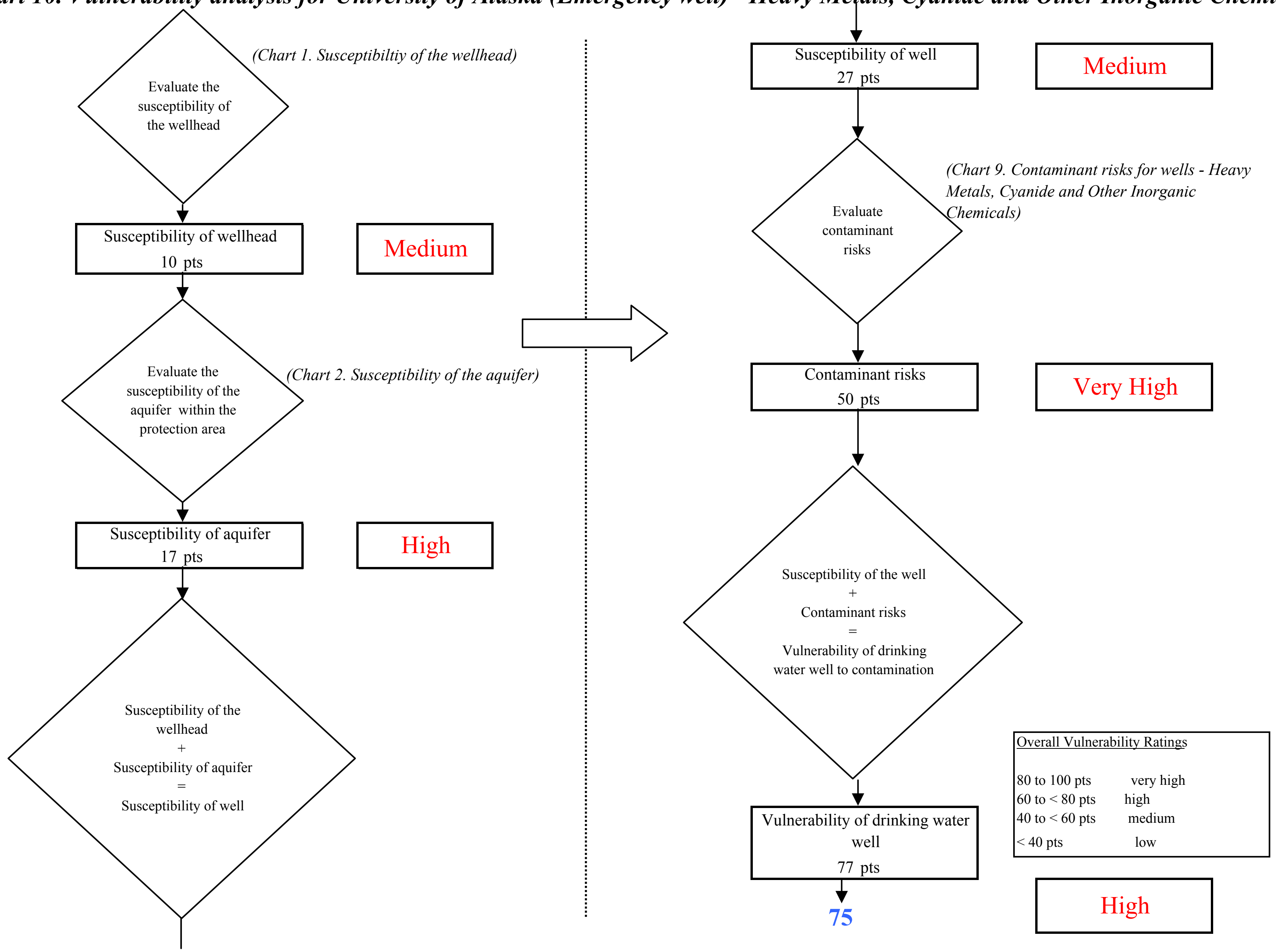


Chart 11. Contaminant risks for University of Alaska (Emergency well) - Synthetic Organic Chemicals

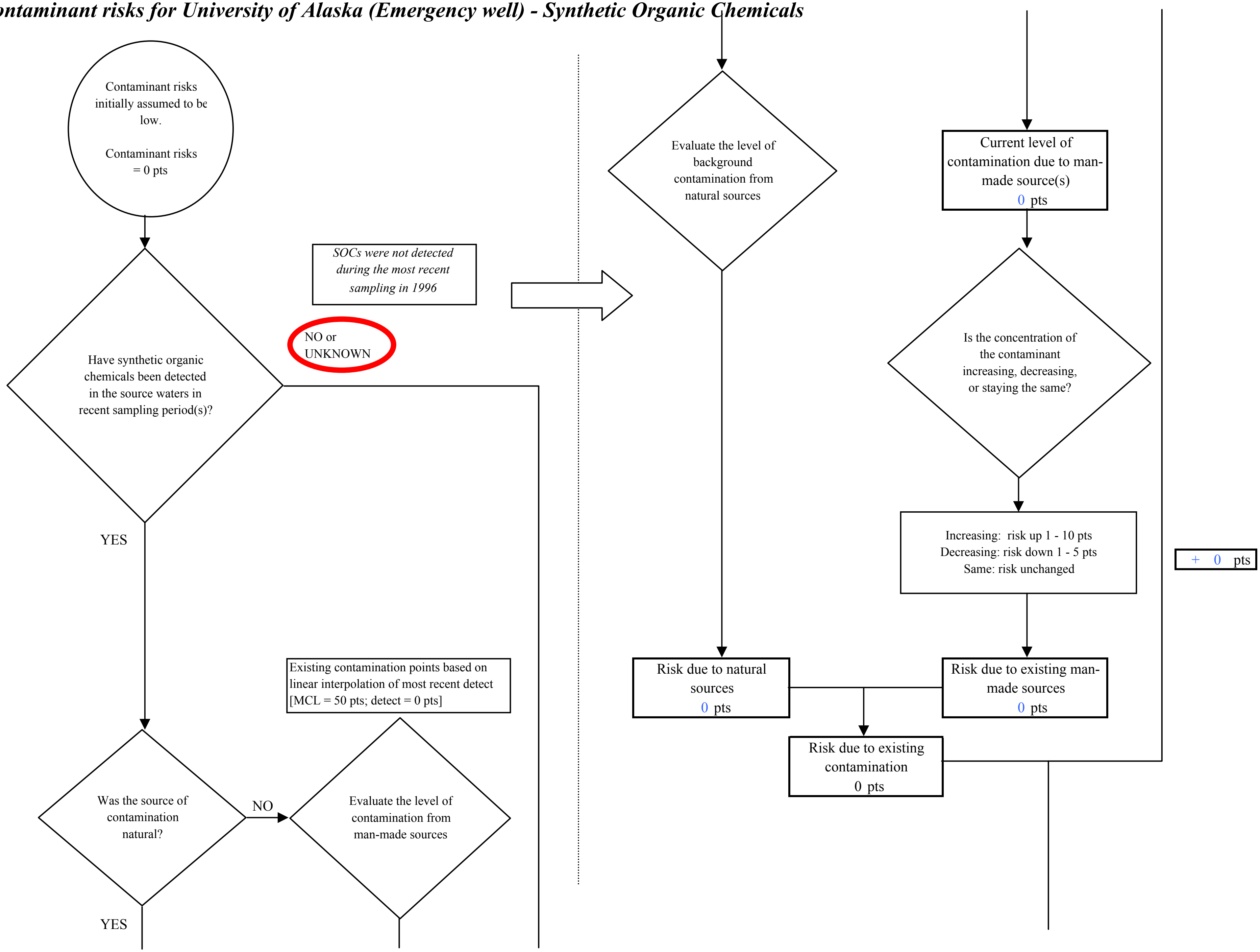
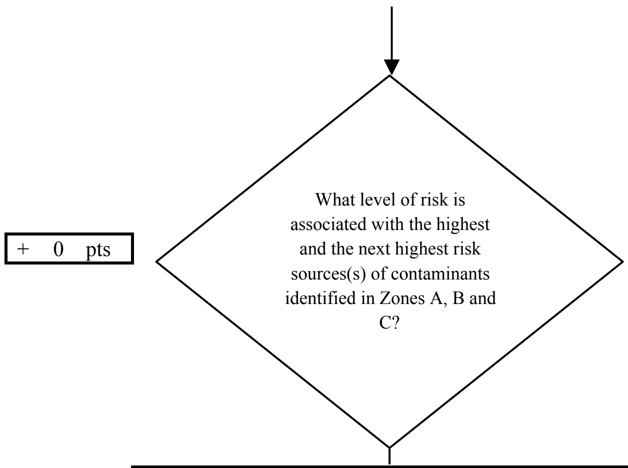


Chart 11. Contaminant risks for University of Alaska (Emergency well) - Synthetic Organic Chemicals



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)	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 0

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.

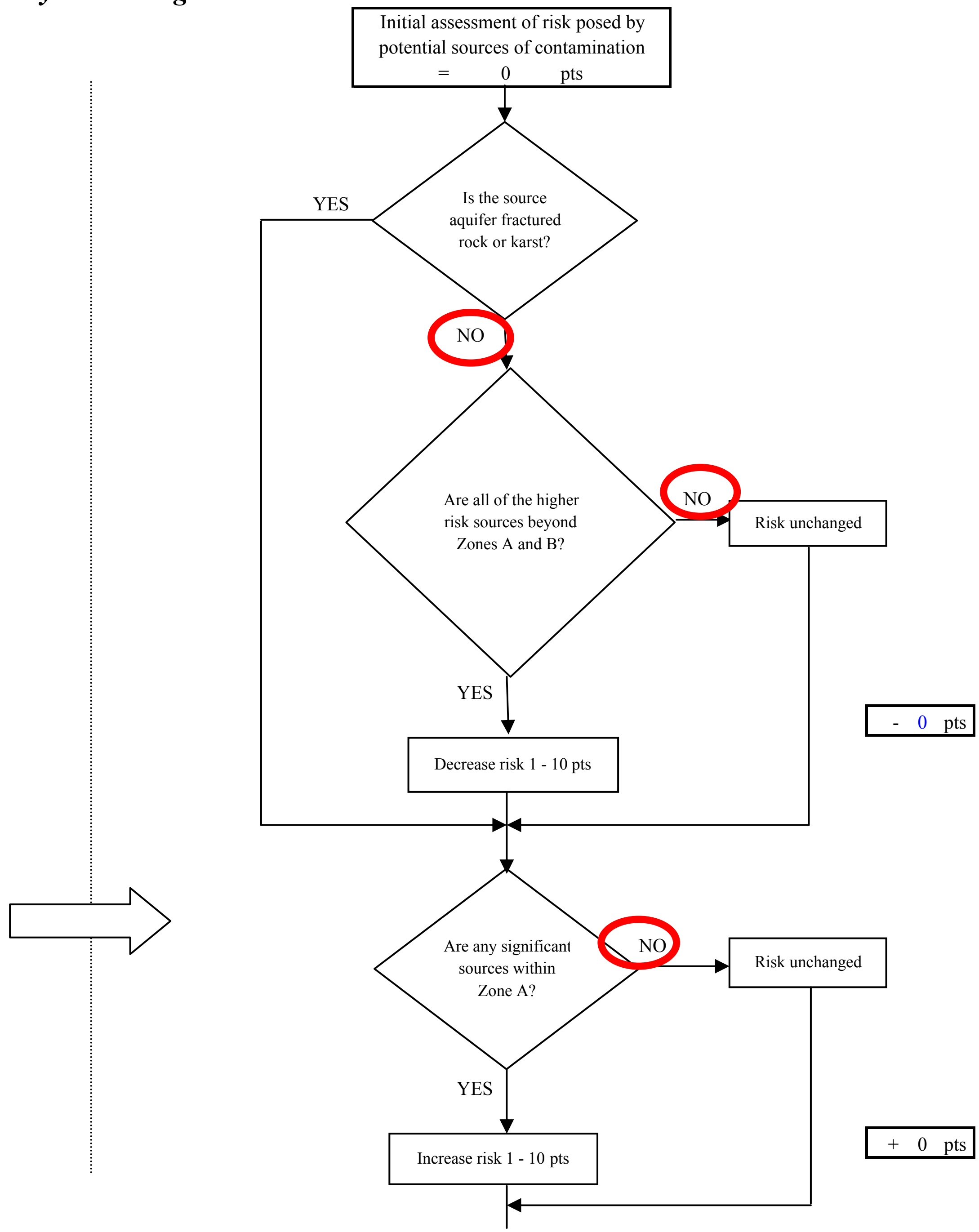


Chart 11. Contaminant risks for University of Alaska (Emergency well) - Synthetic Organic Chemicals

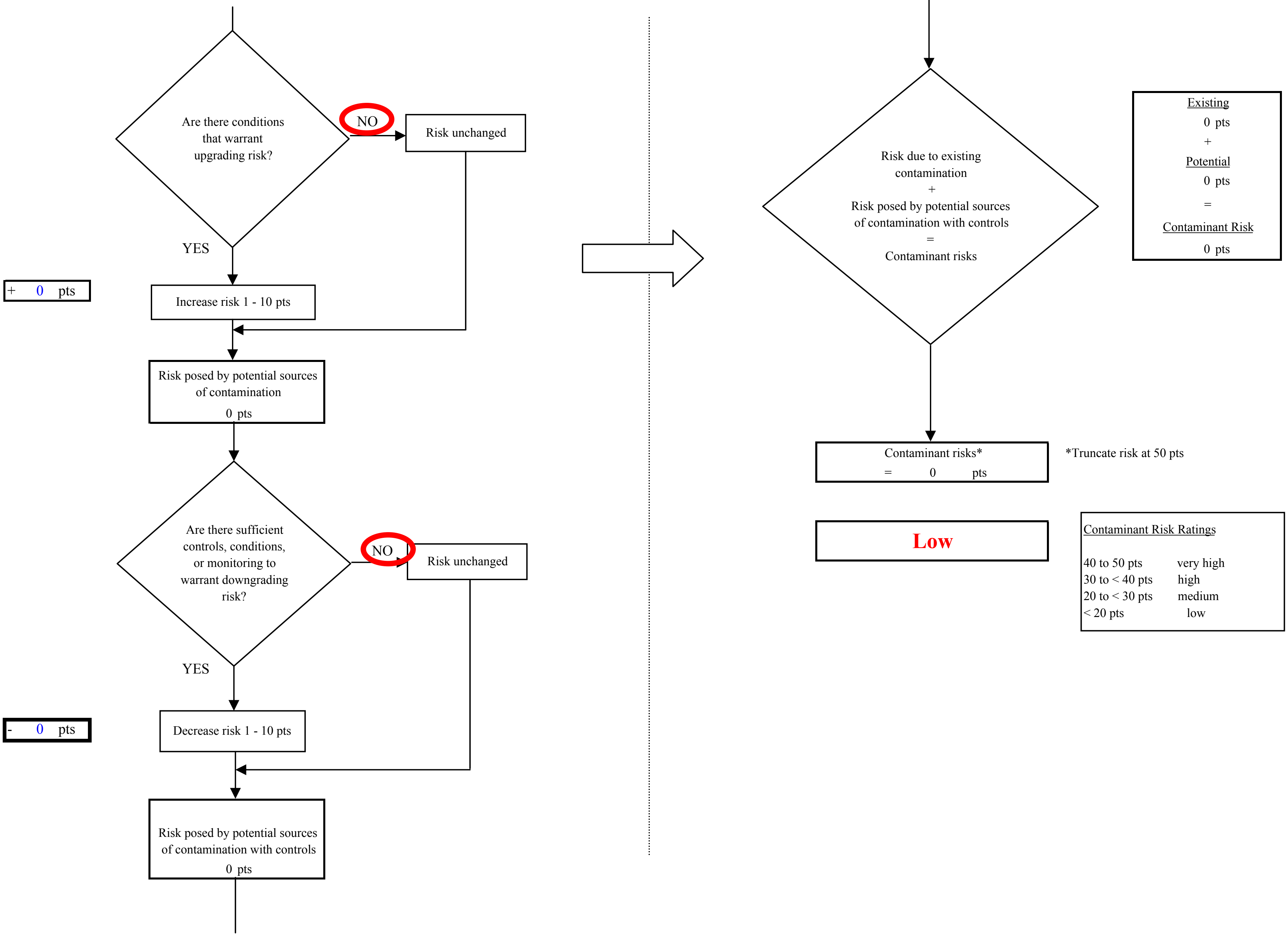


Chart 12. Vulnerability analysis for University of Alaska (Emergency well) - Synthetic Organic Chemicals

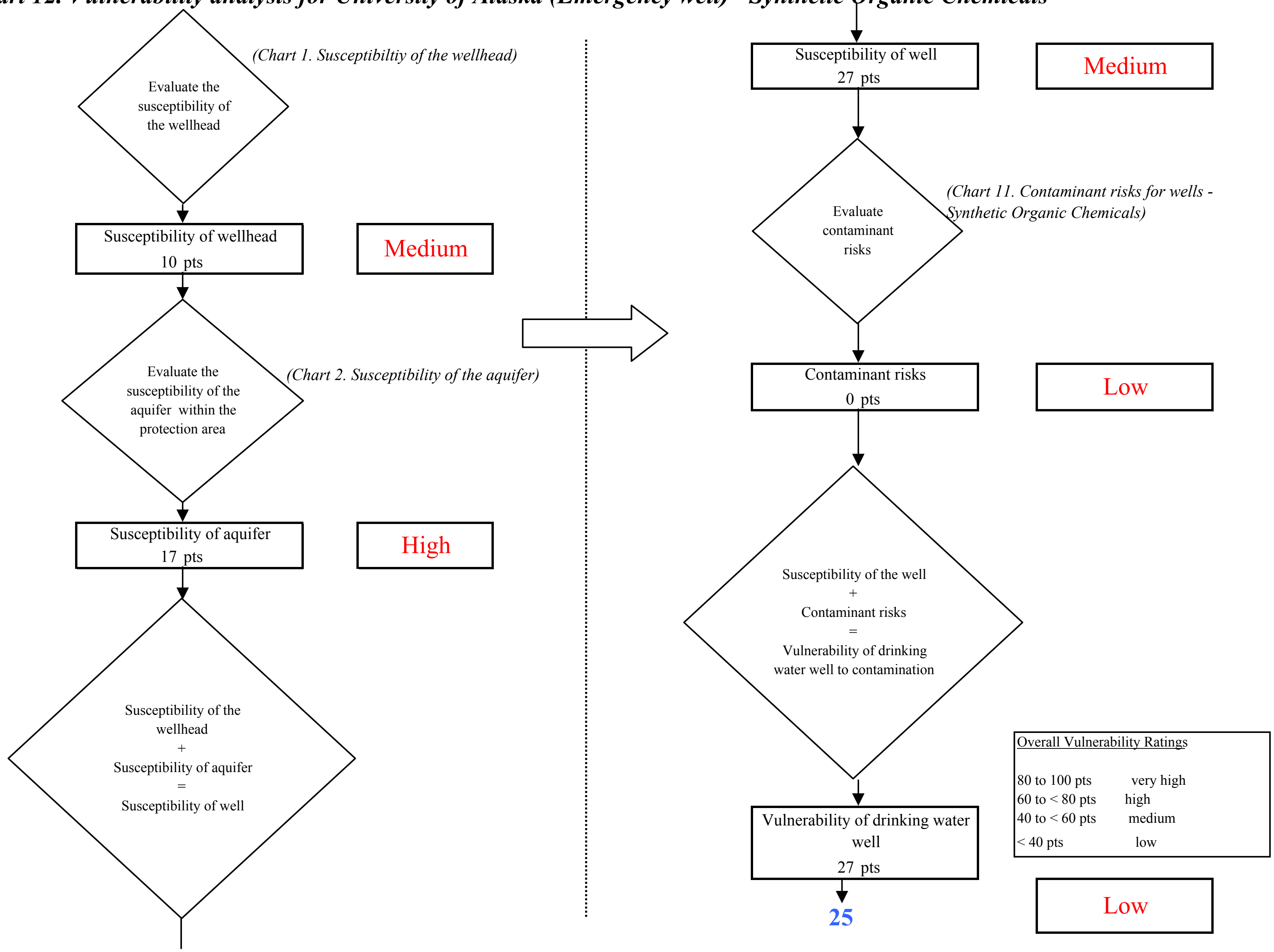


Chart 13. Contaminant risks for University of Alaska (Emergency well) - Other Organic Chemicals

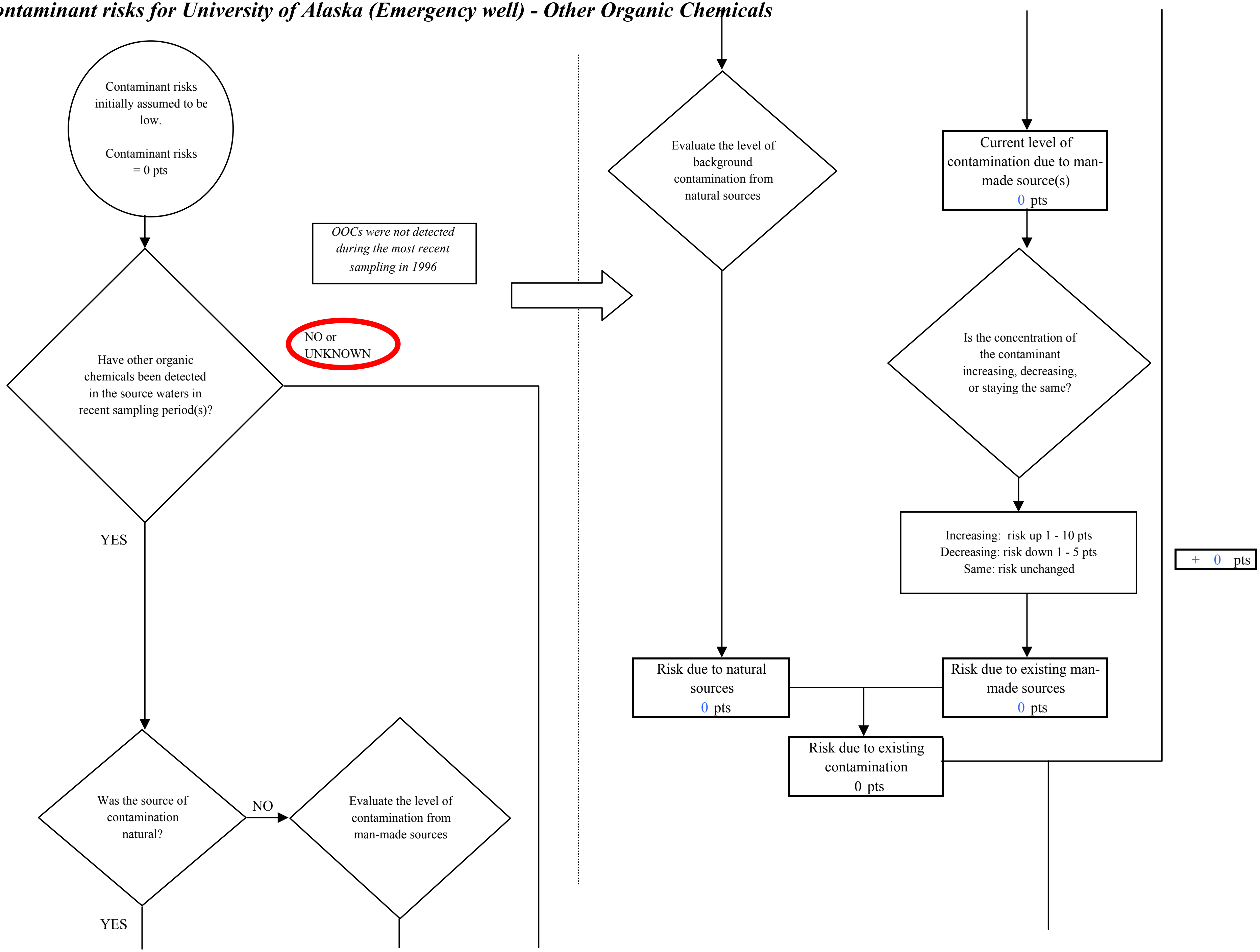
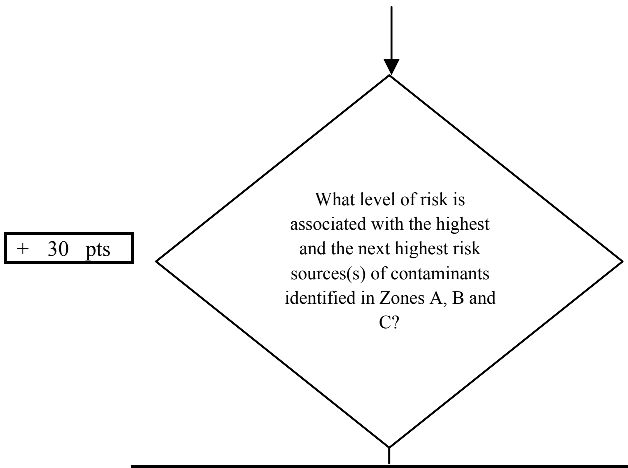


Chart 13. Contaminant risks for University of Alaska (Emergency well) - Other Organic Chemicals



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	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.

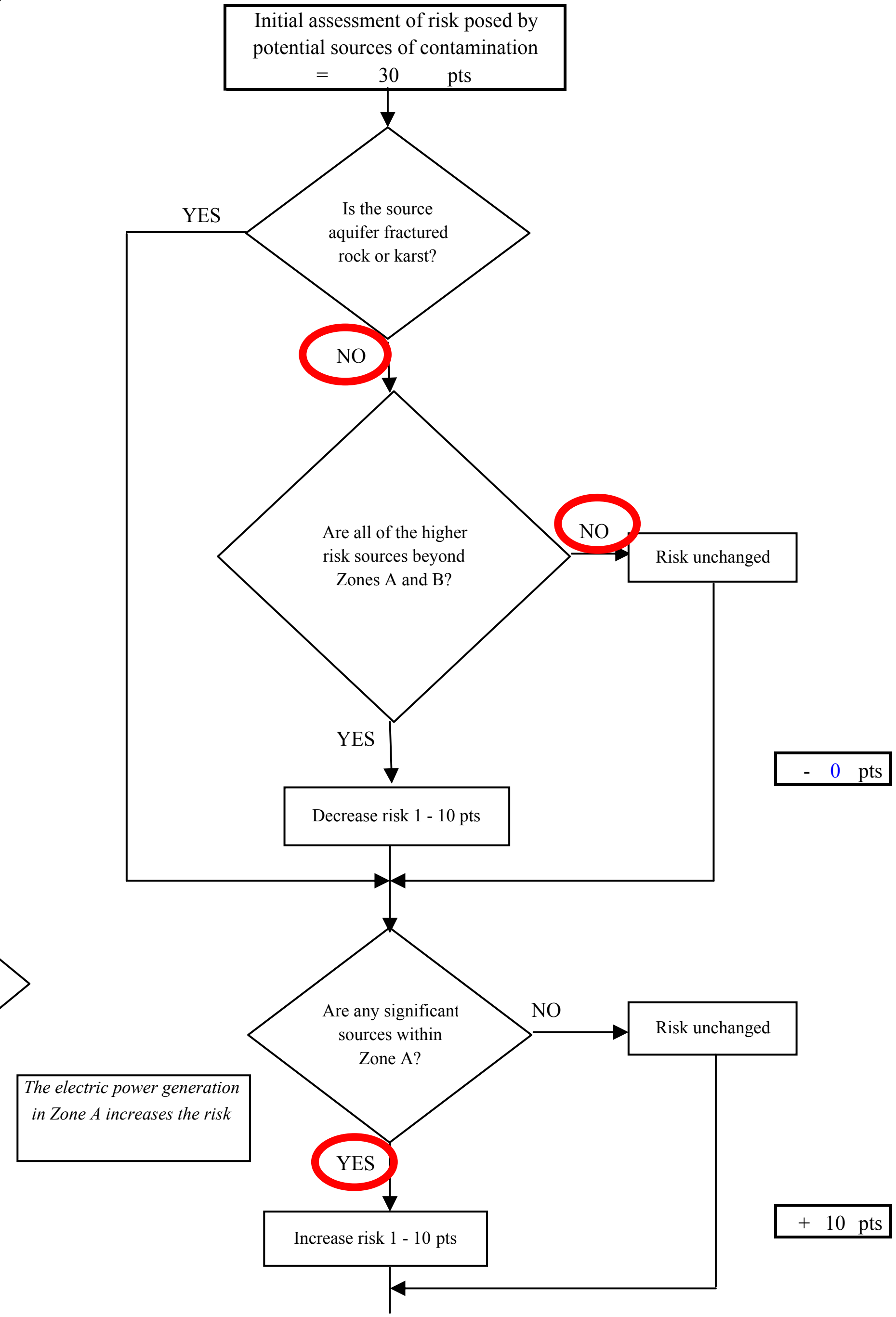


Chart 13. Contaminant risks for University of Alaska (Emergency well) - Other Organic Chemicals

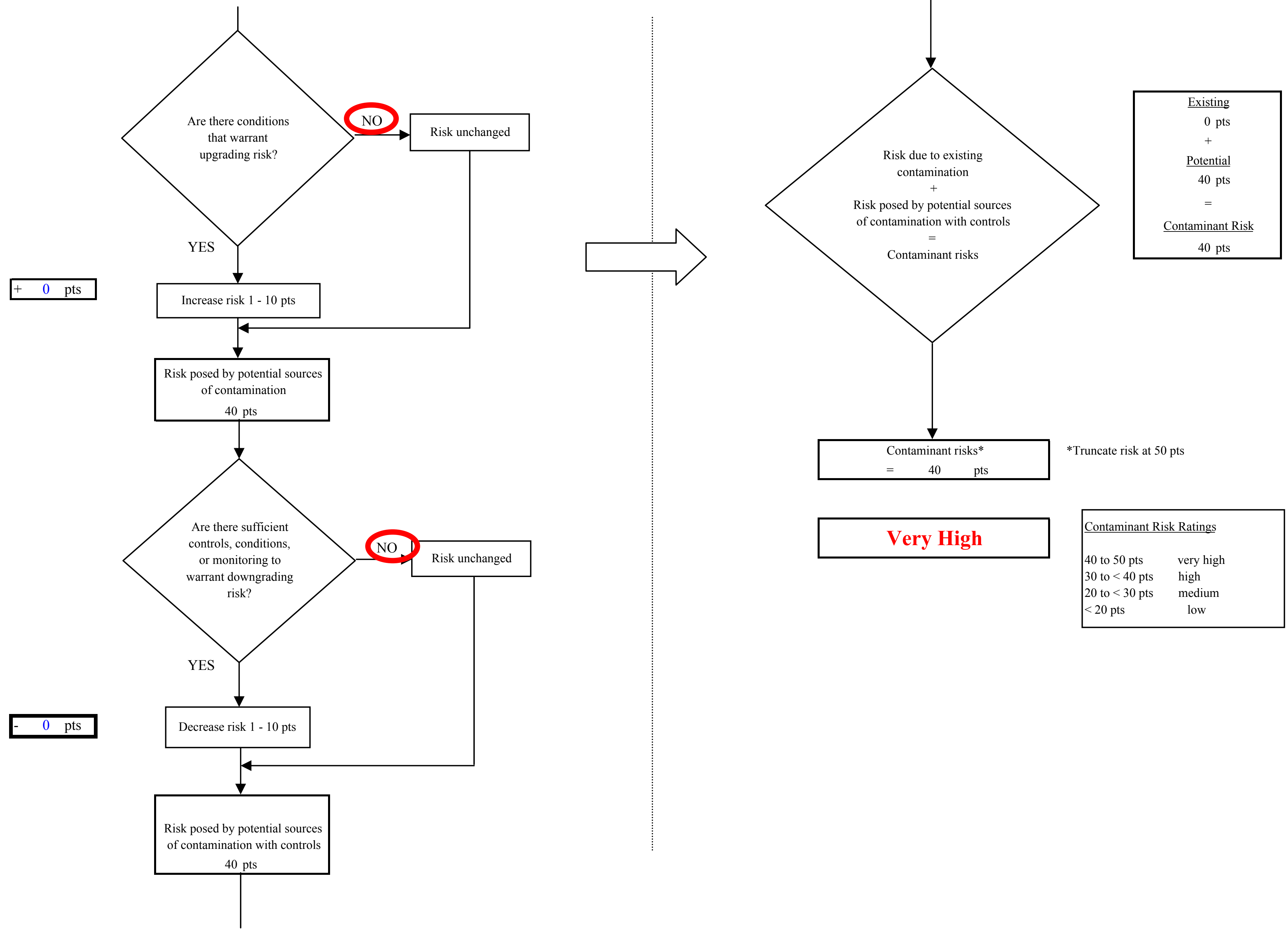


Chart 14. Vulnerability analysis for University of Alaska (Emergency well) - Other Organic Chemicals