Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for The Copper River School District – Gakona School Drinking Water System, Gakona, Alaska

PWSID # 380361.001

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DRINKING WATER PROTECTION PROGRAM REPORT 1392
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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Source Water Assessment for Copper River School District - Gakona School Source of Public Drinking Water, Gakona, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The Copper River School District (CRSD) Gakona School has one Public Water System (PWS) well. The well (PWS No. 380361.001) has been used as a drinking water source since it was drilled in 1974.

The well is a Class A (community and non-transient non-community) water system located northeast of the confluence of the Gakona and Copper Rivers in Gakona, Alaska. Available records indicate that there is secondary storage of drinking water, with a capacity of 700-gallons, and that the drinking water is not treated. This system operates year round and serves approximately 30 non-residents. The wellhead received a susceptibility rating of **Medium** and the aquifer received a susceptibility rating of **Medium**. Combining these two ratings produce a **Medium** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: gasoline stations, large capacity septic systems, fuel tanks, landfills, and ADEC recognized contaminated sites. A detailed inventory can be found in Table 1 of Appendix B. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

Overall, the water well received a vulnerability rating of **High** for bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals contaminant categories.

PUBLIC DRINKING WATER SYSTEM

The CRSD Gakona School well is a Class A (community/non-transient/non-community) public water system. The system is located directly outside the mechanical room at the Gakona School, northeast of the confluence of the Gakona and Copper Rivers in Gakona, Alaska (Sec. 18, T006N, R001E, Copper River Meridian; see Map A of Appendix A). The community is located just east of the Richardson Highway at mile 2 of the Tok Cutoff to the Glenn Highway. Gakona has a population of 214 (ADCED, 2003). Average annual precipitation in Gakona is 13 inches, with 61 inches of snowfall. Temperature extremes range from -62 to 91°F.

Residents use individual wells and septic systems with complete plumbing (ADCED, 2003). Gakona receives electrical power from Copper Valley Electric Association, a REA cooperative. Power generating facilities are hydroelectric with diesel backup. Refuse is collected by individuals and transported to the landfill in Glennallen (ADCED, 2003).

According to information supplied by ADEC for the CRSD Gakona School PWS, the depth of the well is 60 feet below the ground surface, and the well is screened from 55-60’ in a confined aquifer. The well is located within a suspected floodplain.

Information acquired from a June 2002 sanitary survey for the public water system indicated that the land surface was sloped away from the well. Generally, land surfaces that slope away from the wellhead promote surface water drainage, which reduces the potential of contaminant migration down the well casing annulus. The sanitary survey indicates that the well is grouted according to ADEC regulations. Proper grouting provides added protection against contaminants traveling along the well casing annulus and into source waters.

The Glennallen area is in the southeastern portion of the Copper River basin, in southeastern Interior Alaska. The Copper River basin, ranging from 500 to over 4,000 feet above sea level, is an intermontane basin rimmed by peaks of the Chugach, Alaska, Talkeetna, and Wrangell mountains. The terrain of the basin can be divided into two physiographic sub-units: the rolling, hummocky Copper River basin piedmont surface, and the Copper River basin trough. The Copper River basin trough is generally flat and

lacks the hummocky, rolling character of the piedmont surface.

The terrain, geology of the unconsolidated deposits, and foundation materials of the Copper River basin are related to Pleistocene and recent events. Glaciers from the Chugach, Wrangell, Talkeetna, and Alaska Ranges repeatedly invaded the basin, perhaps at times filling it and flowing across the divides to the north, west, east, and south. Such extensive glaciation has resulted in the deposition of large thicknesses of coarse glacial boulder clays (till) and coarse outwash gravel and sand on the piedmont surface, with finer till and outwash interbedded with lake deposits in the basin trough.

The Glennallen area is within the discontinuous permafrost zone.

Surface soils in the area generally consist of silt and clay with pebbles underlain by boulder clay with till, underlain by glacial outwash sand and gravel, underlain by boulder clay or till (Nichols, 1956).

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 the CRSD Gakona School PWS. 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, as well as the three protection area zones for wells under the influence of surface water, 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 the 2 year time-of-travel
C	Less Than the 5 year time-of-travel
D	Less than the 10 year time-of-travel

The DWPA for the CRSD Gakona School's PWS was determined using an analytical calculation and includes Zones A, B, C, and D (See Map A 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 CRSD Gakona 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,
- Other organic chemicals.

The sources are displayed on Map C 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 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, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

VULNERABILITY OF THE 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 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. 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 CRSD Gakona School's water well is completed in a confined aquifer. Confined aquifers are less susceptible to potential groundwater quality impacts posed by the migration of surface water contaminants downward from the surface. Table 2 shows the susceptibility scores and ratings for this PWS.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	10	Medium
Susceptibility of the Aquifer	12	Medium
Natural Susceptibility	22	Medium

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:

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	50	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	44	Very High
Synthetic Organic Chemicals	41	Very high
Other Organic Chemicals	47	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	70	High
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	65	High
Synthetic Organic Chemicals	65	High
Other Organic Chemicals	70	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High**. The risk is primarily attributed to the presence of large capacity septic systems and a landfill located in Zones A and C. Numerous other potential contaminant sources are also located in the protection area (see Table 2 – Appendix B).

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are 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. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2003). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination.

No positive bacteria counts have been reported in recent (within five years) sampling events (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D). Only a small amount of bacteria and viruses are required to endanger public health.

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**. The risk to this source of public drinking water is primarily attributed to the presence of large capacity septic systems and a landfill located in Zones A and C. Numerous other potential contaminant sources are also located in the protection area (see Table 3 – Appendix B).

Nitrates are very mobile, moving at approximately

the same rate as water. The sampling history for this well indicates that low levels of nitrates have been detected in recent sampling events, however have not exceeded the MCL of 10 mg/L. 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 (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D).

Nitrate levels are often derived from the decomposition of organic matter in soils. Although the nitrate source is unknown, such occurrences may be attributed to septic systems or other sources.

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 **High**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Very High**. The risk is primarily attributed to the presence of a gasoline station, fuel tanks, ADEC recognized contaminated sites, and a landfill located in Zones A and C. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

All recent VOC sampling reported concentrations below detection limits (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D).

Possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports.

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 **High**.

Heavy Metals, Cyanide and Other Inorganic Chemicals

The contaminant risk for heavy metals, cyanide and other inorganic chemicals is **Very High**. The risk is primarily attributed to the presence of arsenic in recent sampling events and a landfill located in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 5 – Appendix B).

Based on review of recent sampling records for this public water system, levels of arsenic have been detected but have not exceeded the MCL of 0.05 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

Arsenic occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks, and forest fires, or through human actions. Short-term exposure to high doses of arsenic can cause adverse health effects, but such effects are unlikely to occur from U.S. public water supplies that are in compliance with the previous arsenic standard of 50 ppb (EPA 2001).

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 **High**.

Synthetic Organic Chemicals

The contaminant risk for synthetic organic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfill in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 6 – Appendix B).

No recent sampling data was available in ADEC records for the CRSD Gakona School (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

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 **High**.

Other Organic Chemicals

The contaminant risk for other organic chemicals is **Very High**. The risk is primarily attributed to the presence of a landfill in Zone C. Numerous other potential contaminant sources are also found within the protection area (see Table 7 – Appendix B).

No recent sampling data was available in ADEC records for the CRSD Gakona School (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

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**.

Using the Source Water Assessment

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the community of Gakona to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

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

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

APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

APPENDIX B

Contaminant Source Inventory and Risk Ranking (Tables 1-7)

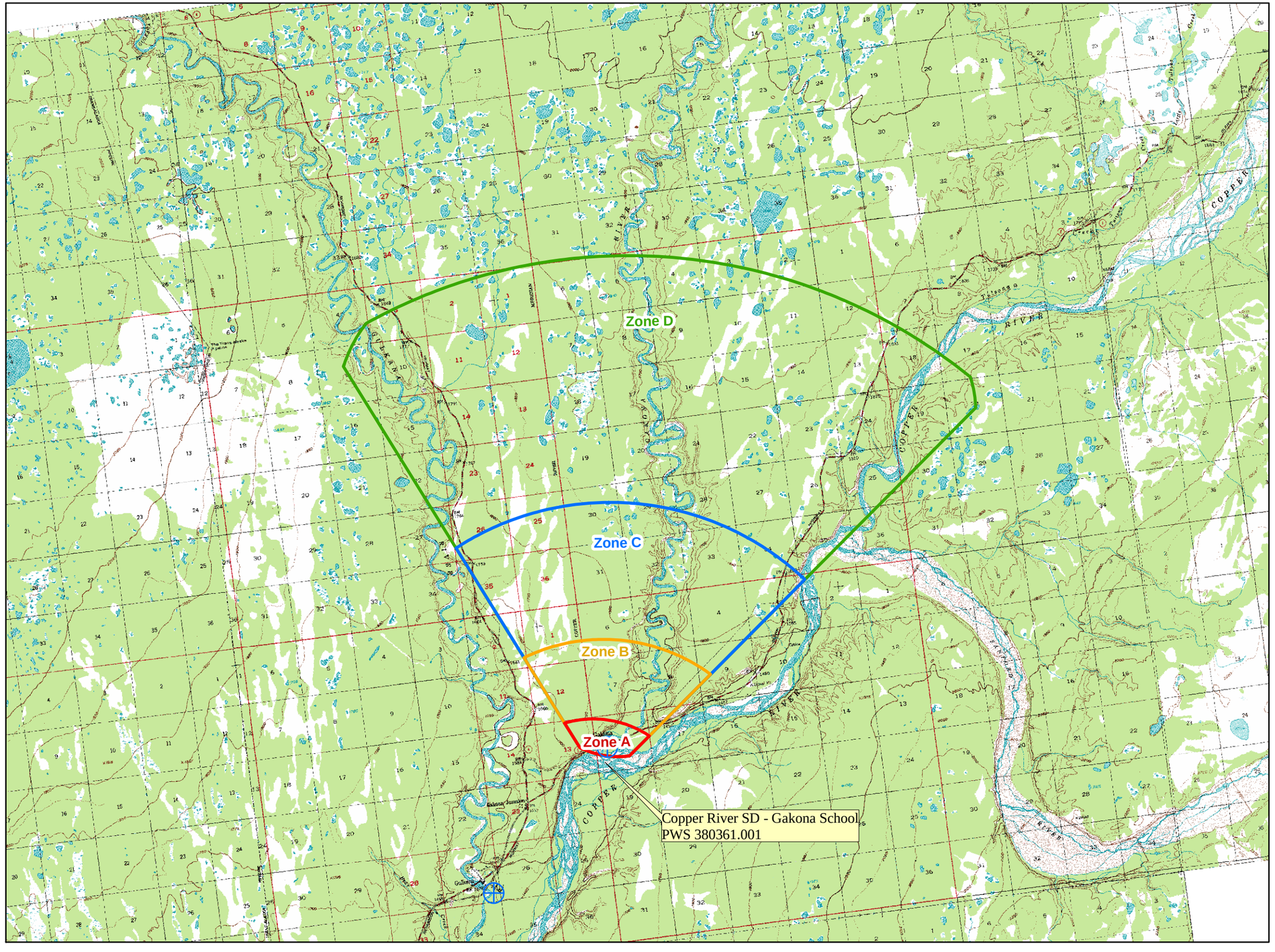
APPENDIX C

Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

APPENDIX D

Vulnerability Analysis for Public Drinking Water Source (Charts 1-14)

Public Water Well System for PWS #380361.001 Copper River SD - Gakona School



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

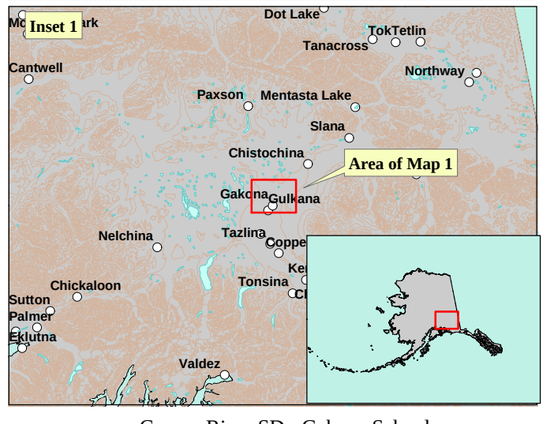
Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time

Data Sources:
- Contaminant Sources, Public Water System Wells, Contours Alaska Department of Environmental Conservation (ADEC)
- Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
- United States Geological Survey (USGS)
- Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 1.25 2.5 5 7.5 10 Miles

Copper River SD - Gakona School
PWS 380361.001
Appendix A Map A

Table 1

Contaminant Source Inventory for

Copper R SD-Gakona School

PWSID 380361.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	C	Gakona Lodge & Trading Post
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	C	
Septic systems (serves one single-family home)	R02	R02-01	A	C	Assume 80 or less individual septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	C	Assume 80 or less residential heating oil tanks in Zone A
Tanks, diesel (underground)	T08	T08-01	A	C	Gakona Lodge & Trading Post
Tanks, gasoline (underground)	T12	T12-01	A	C	Gakona Lodge & Trading Post
Tanks, heating oil, nonresidential (underground)	T16	T16-01	A	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	Sourdough Roadhouse. Reckey: 1988330129107. Status: Inactive. Well water samples in 1983-84 found benzene contamination above MCL.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	C	SLANA MAINTENANCE STATION
Government vehicle maintenance facilities	X19	X19-01	A	C	SLANA MAINTENANCE STATION
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	C	C	Gakona & Gulkana
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	D	C	High Freq Active Auroral Research. Reckey: 1994330134102. Status: Inactive. A spill was discovered after two diesel generators were removed from the HAARP site. 3 cubic yards of soil has been contaminated by the presumed release of diesel fuel.
Municipal or city parks (with green areas)	X04	X04-01	D	C	WRANGELL-SAINT ELIAS NP&P

Table 2

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School Sources of Bacteria and Viruses

PWSID 380361.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	High	C	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 80 or less individual septic systems in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	C	High	C	Gakona & Gulkana

Table 3

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School Sources of Nitrates/Nitrites

PWSID 380361.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	High	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	High	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	High	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	High	C	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 80 or less individual septic systems in Zone A
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	C	Very High	C	Gakona & Gulkana

Table 4

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School Sources of Volatile Organic Chemicals

PWSID 380361.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	High	C	Gakona Lodge & Trading Post
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	Low	C	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 80 or less individual septic systems in Zone A
Tanks, heating oil, residential (above ground)	R08	R08-01	A	Medium	C	Assume 80 or less residential heating oil tanks in Zone A
Tanks, diesel (underground)	T08	T08-01	A	High	C	Gakona Lodge & Trading Post
Tanks, gasoline (underground)	T12	T12-01	A	High	C	Gakona Lodge & Trading Post
Tanks, heating oil, nonresidential (underground)	T16	T16-01	A	Low	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	High	C	Sourdough Roadhouse. Reckey: 1988330129107. Status: Inactive. Well water samples in 1983-84 found benzene contamination above MCL.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	High	C	SLANA MAINTENANCE STATION
Government vehicle maintenance facilities	X19	X19-01	A	Medium	C	SLANA MAINTENANCE STATION
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	C	High	C	Gakona & Gulkana

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School

Sources of Volatile Organic Chemicals

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	U04-02	D	High	C	High Freq Active Auroral Research. Reckey: 1994330134102. Status: Inactive. A spill was discovered after two diesel generators were removed from the HAARP site. 3 cubic yards of soil has been contaminated by the presumed release of diesel fuel.

Table 5

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 380361.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	Low	C	Gakona Lodge & Trading Post
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	Low	C	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 80 or less individual septic systems in Zone A
Tanks, gasoline (underground)	T12	T12-01	A	Medium	C	Gakona Lodge & Trading Post
Tanks, heating oil, nonresidential (underground)	T16	T16-01	A	Low	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Sourdough Roadhouse. Reckey: 1988330129107. Status: Inactive. Well water samples in 1983-84 found benzene contamination above MCL.
Government vehicle maintenance facilities	X19	X19-01	A	Low	C	SLANA MAINTENANCE STATION
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	C	High	C	Gakona & Gulkana

Table 6

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School Sources of Synthetic Organic Chemicals

PWSID 380361.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	Low	C	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 80 or less individual septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Sourdough Roadhouse. Reckey: 1988330129107. Status: Inactive. Well water samples in 1983-84 found benzene contamination above MCL.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	Low	C	SLANA MAINTENANCE STATION
Landfills (municipal; Class III)	D51	D51-01	C	Very High	C	Gakona & Gulkana

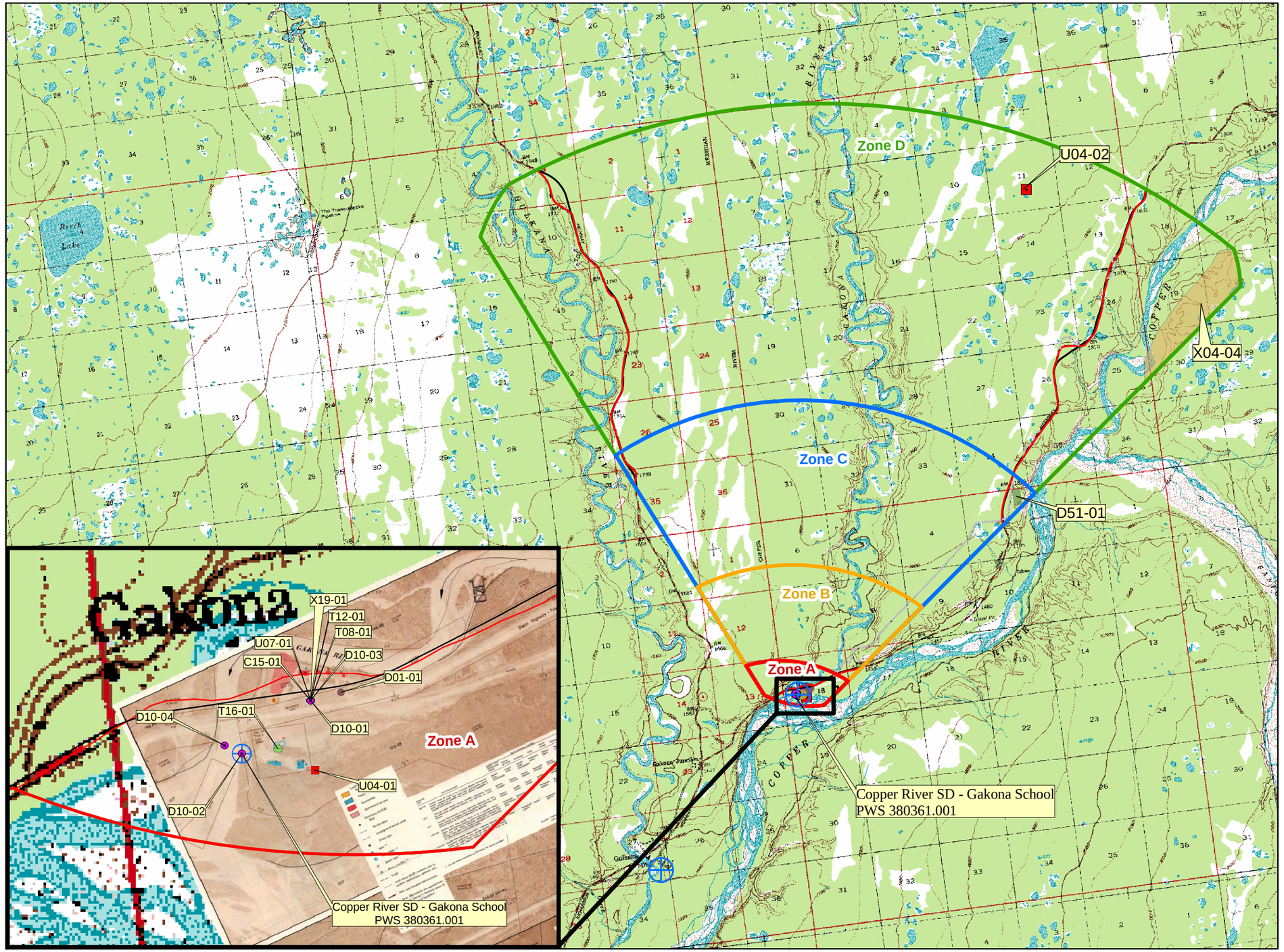
Table 7

Contaminant Source Inventory and Risk Ranking for Copper R SD-Gakona School Sources of Other Organic Chemicals

PWSID 380361.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Gasoline stations (without repair shop)	C15	C15-01	A	Low	C	Gakona Lodge & Trading Post
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Low	C	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	A	Low	C	CARRIAGE HOUSE/GAKONA LANDING
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-02	A	Low	C	COPPER R SD-GAKONA SCHOOL
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-03	A	Low	C	GAKONA JUNCTION VILLAGE
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04	A	Low	C	
Septic systems (serves one single-family home)	R02	R02-01	A	Low	C	Assume 80 or less individual septic systems in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	Sourdough Roadhouse. Reckey: 1988330129107. Status: Inactive. Well water samples in 1983-84 found benzene contamination above MCL.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	A	Low	C	SLANA MAINTENANCE STATION
Government vehicle maintenance facilities	X19	X19-01	A	Medium	C	SLANA MAINTENANCE STATION
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Landfills (municipal; Class III)	D51	D51-01	C	Very High	C	Gakona & Gulkana

Public Water Well System for PWS #380361.001 Copper River SD - Gakona School
Showing Potential and Existing Sources of Contamination



LEGEND

Public Water System Well

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

Transportation

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)

Protection Zones

- Zone A Protection Area– Several Months Travel Time
- Zone B Protection Area– 2 Years Travel Time
- Zone C Protection Area– 5 Years Travel Time
- Zone D Protection Area– 10 Years Travel Time

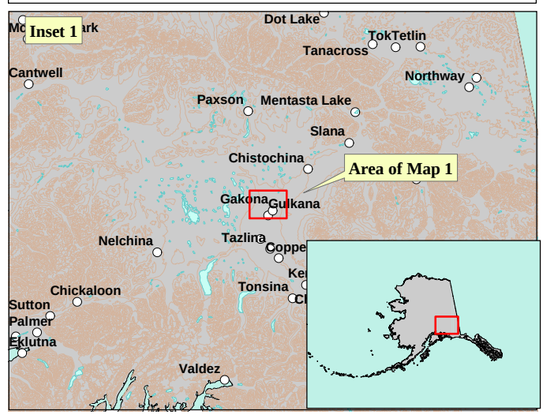
Existing or Potential Contaminant Sources

- Gasoline stations without repair shops (C15)
- Domestic wastewater collection systems (D01)
- Injection wells (Class V) Large-Capacity Septic System (D10)
- Tanks, diesel (underground) (T08)
- Tanks, gasoline (underground) (T12)
- Tanks, heating oil, nonresidential (underground) (T16)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04)
- Open Leaking Underground Fuel Storage Tank (LUST) (U07)
- Government vehicle maintnance facilities (X19)
- Landfills (municipal; Class III) (D51)
- Municipal or city parks (X04)

Data Sources:
- Contaminant Sources, Public Water System Wells, Contours Alaska Department of Environmental Conservation (ADEC)
- Critical Facilities, Federal Emergency Management Agency (FEMA)

All other data:
- United States Geological Survey (USGS)
- Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems" published by ADEC

URS Corporation does not guarantee the accuracy or validity of the data provided.



0 1.25 2.5 5 7.5 10 Miles

Copper River SD - Gakona School
PWS 380361.001
Appendix C Map C

Chart 1. Susceptibility of the wellhead - Copper River SD - Gakona School (PWS No. 380361.001)

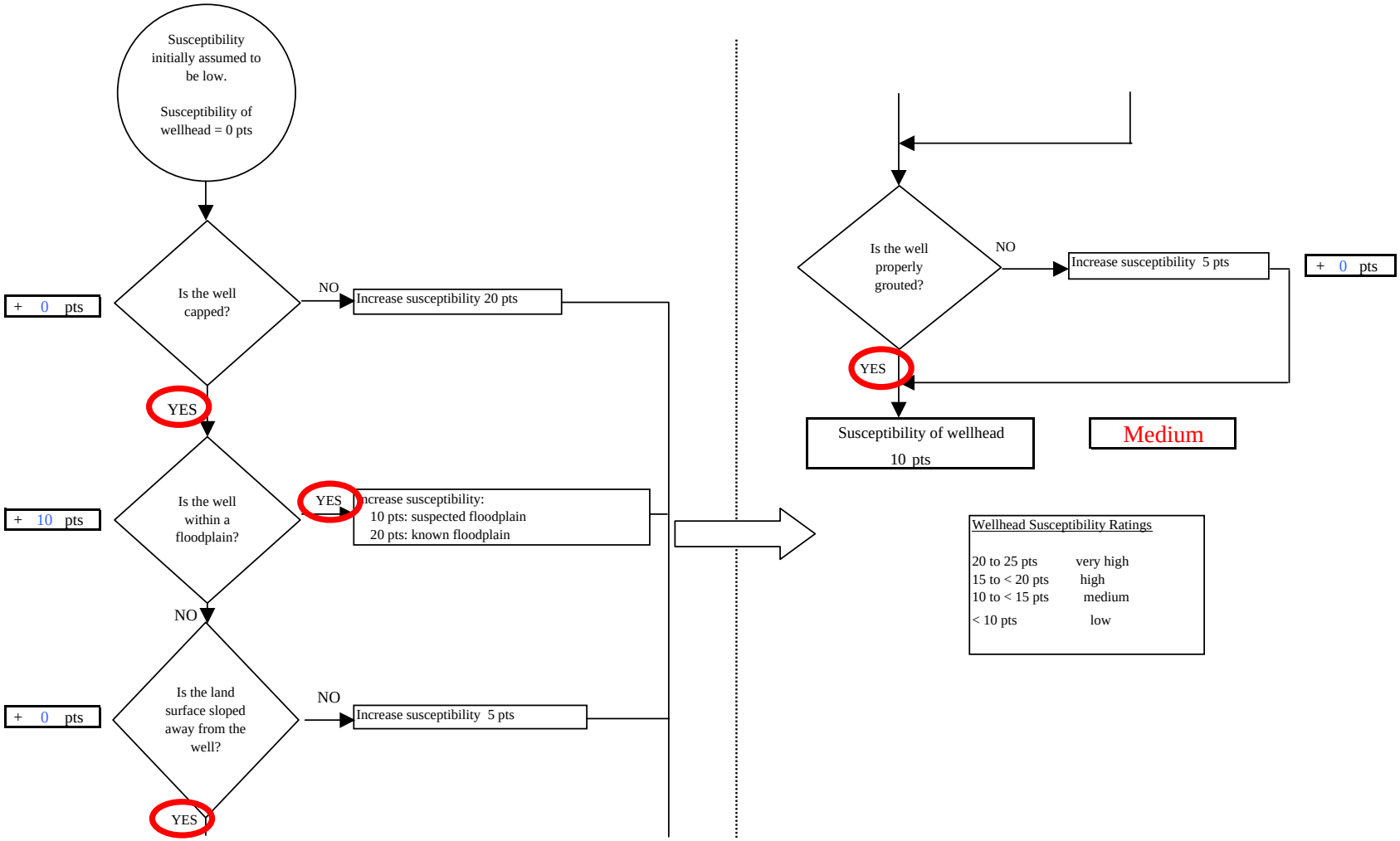


Chart 2. Susceptibility of the aquifer Copper River SD - Gakona School (PWS No. 380361.001)

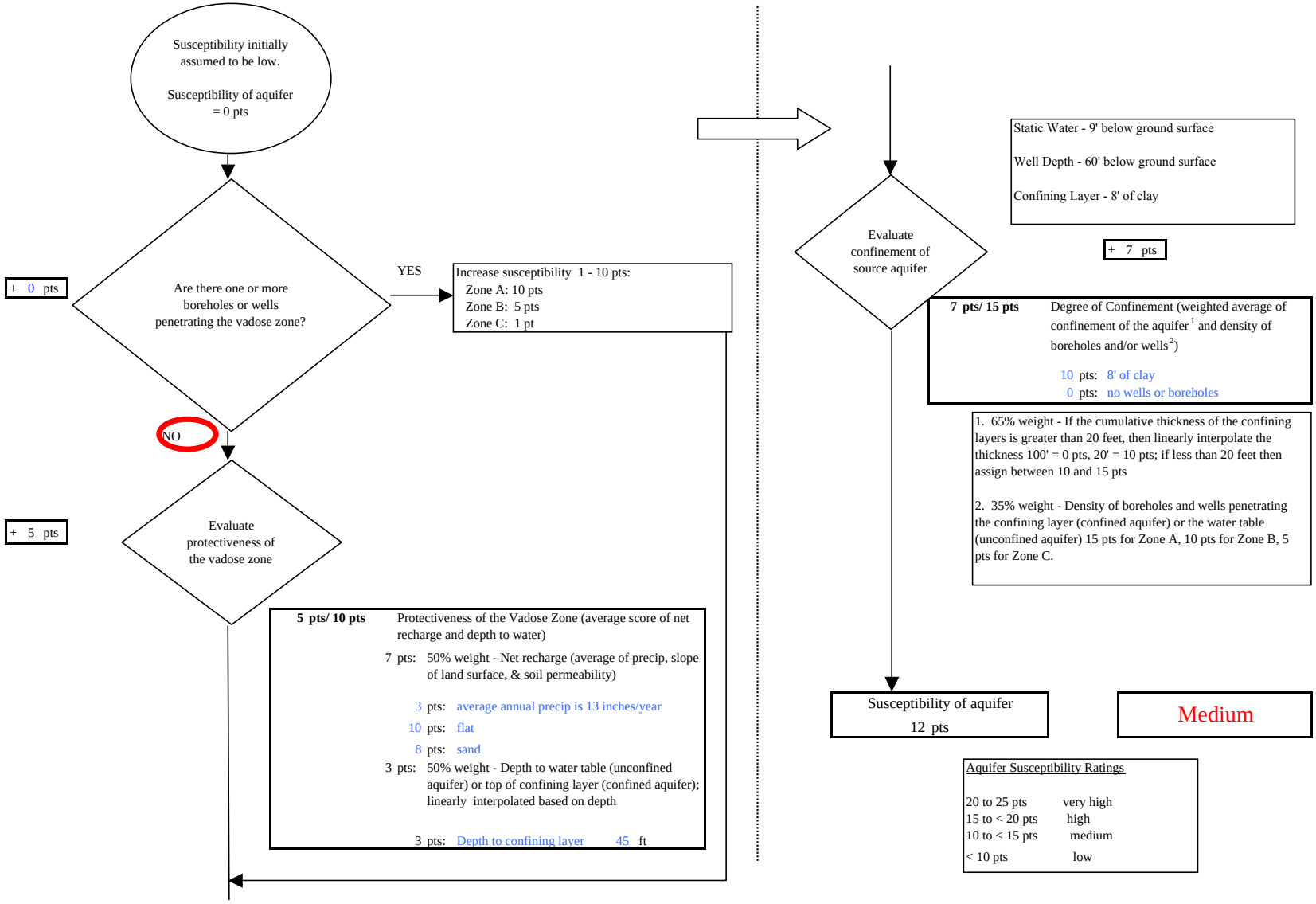
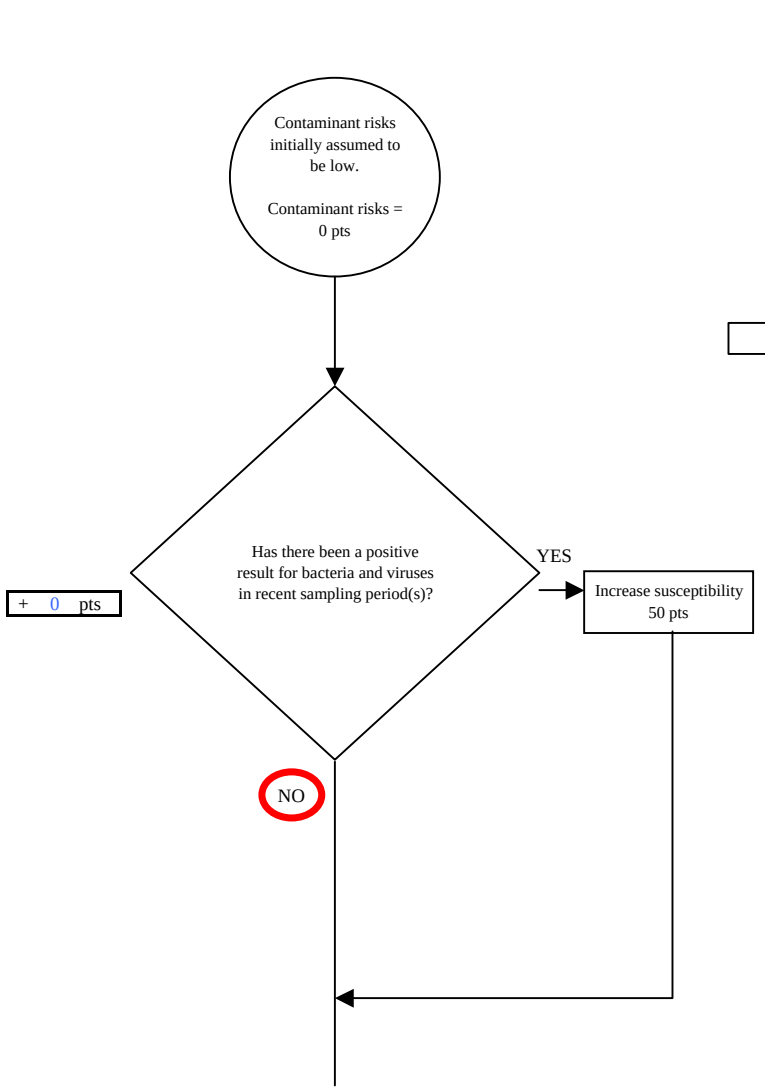
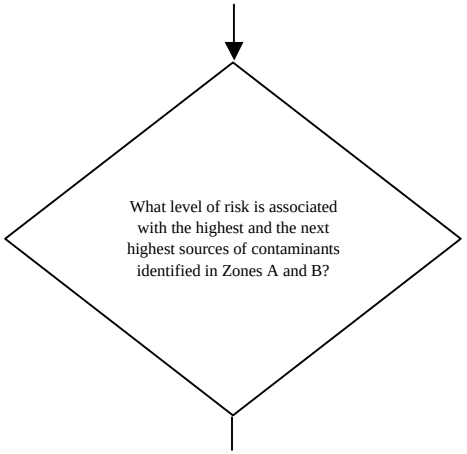


Chart 3. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Bacteria & Viruses





+ 40 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)	4	0	4
Medium(s)	1	0	1
Low(s)	80	0	80

	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 3. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Bacteria & Viruses

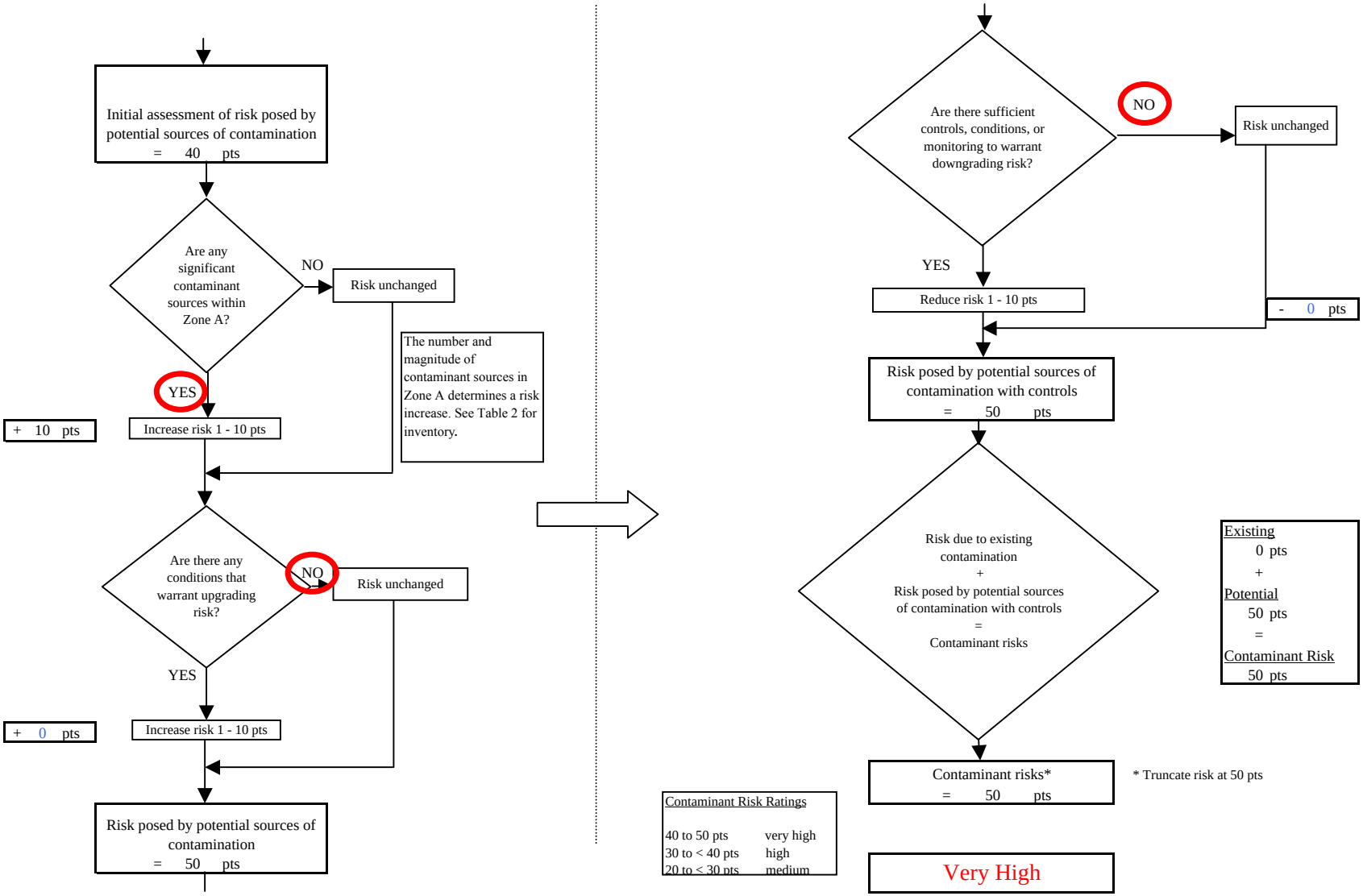


Chart 4. Vulnerability analysis for Copper River SD - Gakona School (PWS No. 380361.001) - Bacteria & Viruses

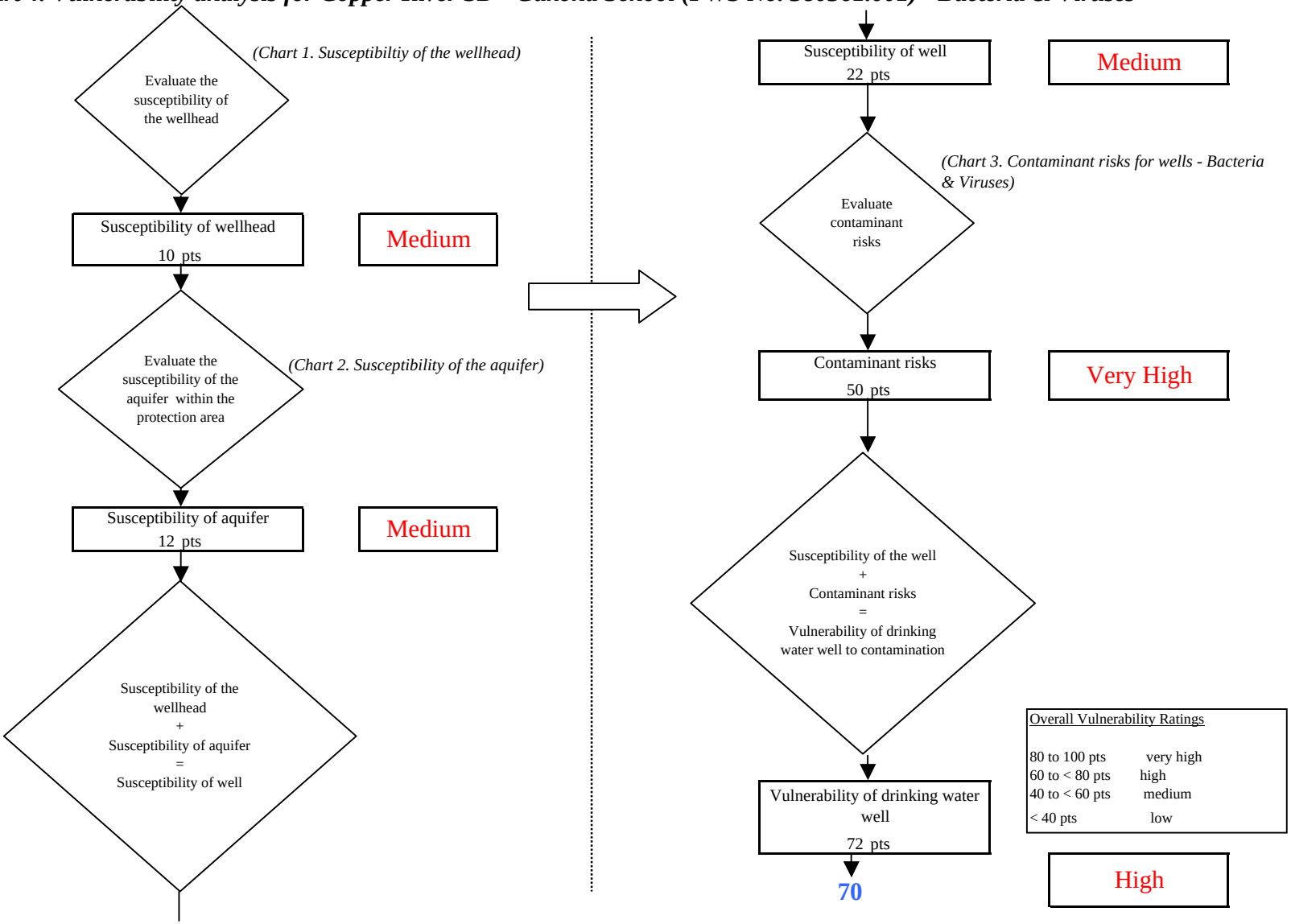


Chart 5. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Nitrates and Nitrites

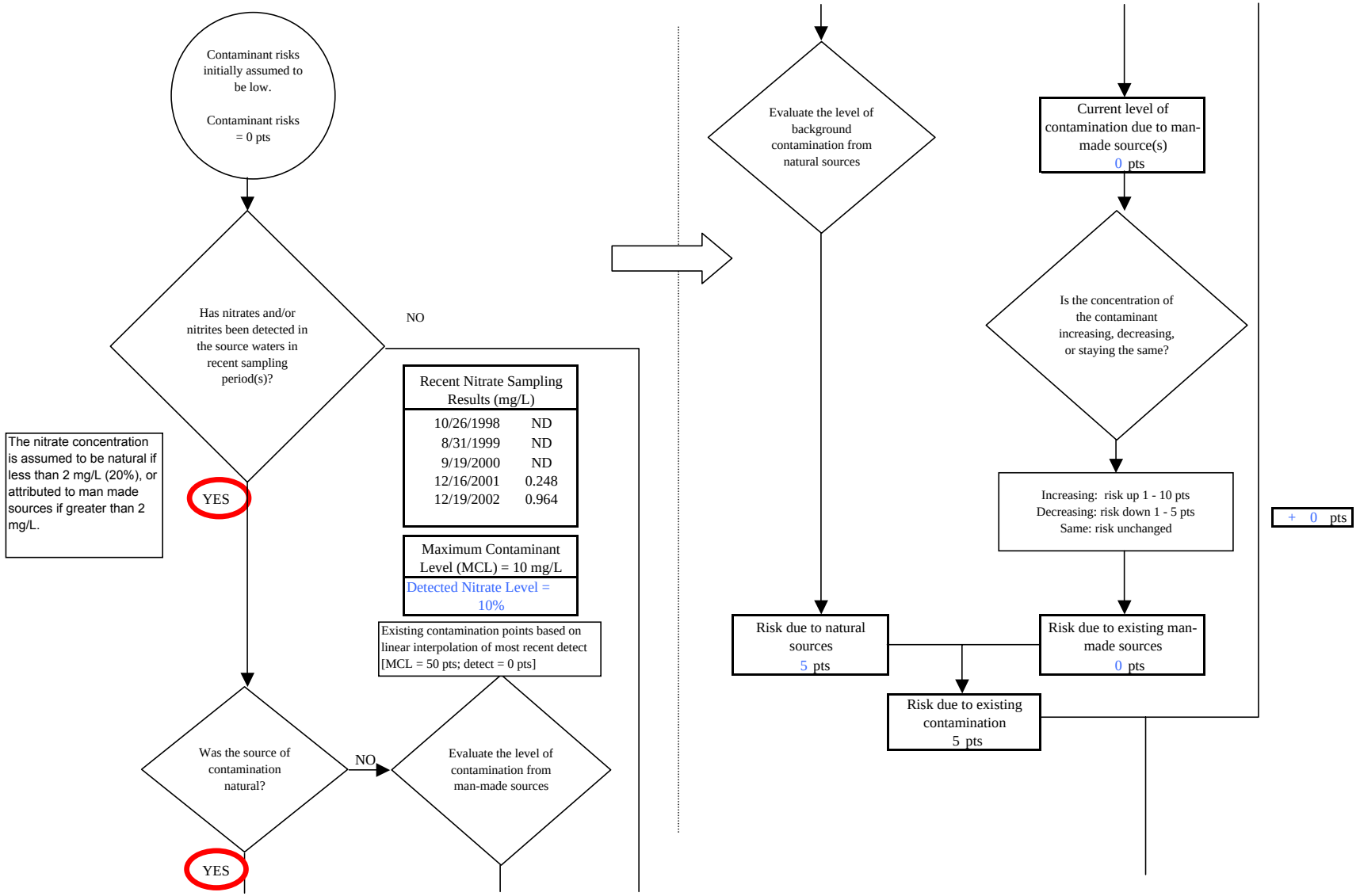


Chart 5. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Nitrates and Nitrites

+ 50 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	1	1
High(s)	4	0	4
Medium(s)	1	0	1
Low(s)	80	0	80

	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 50

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 = 50 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

- 1 pts

Decrease risk 1 - 10 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

+ 10 pts

Increase risk 1 - 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 3 for inventory.

Chart 5. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Nitrates and Nitrites

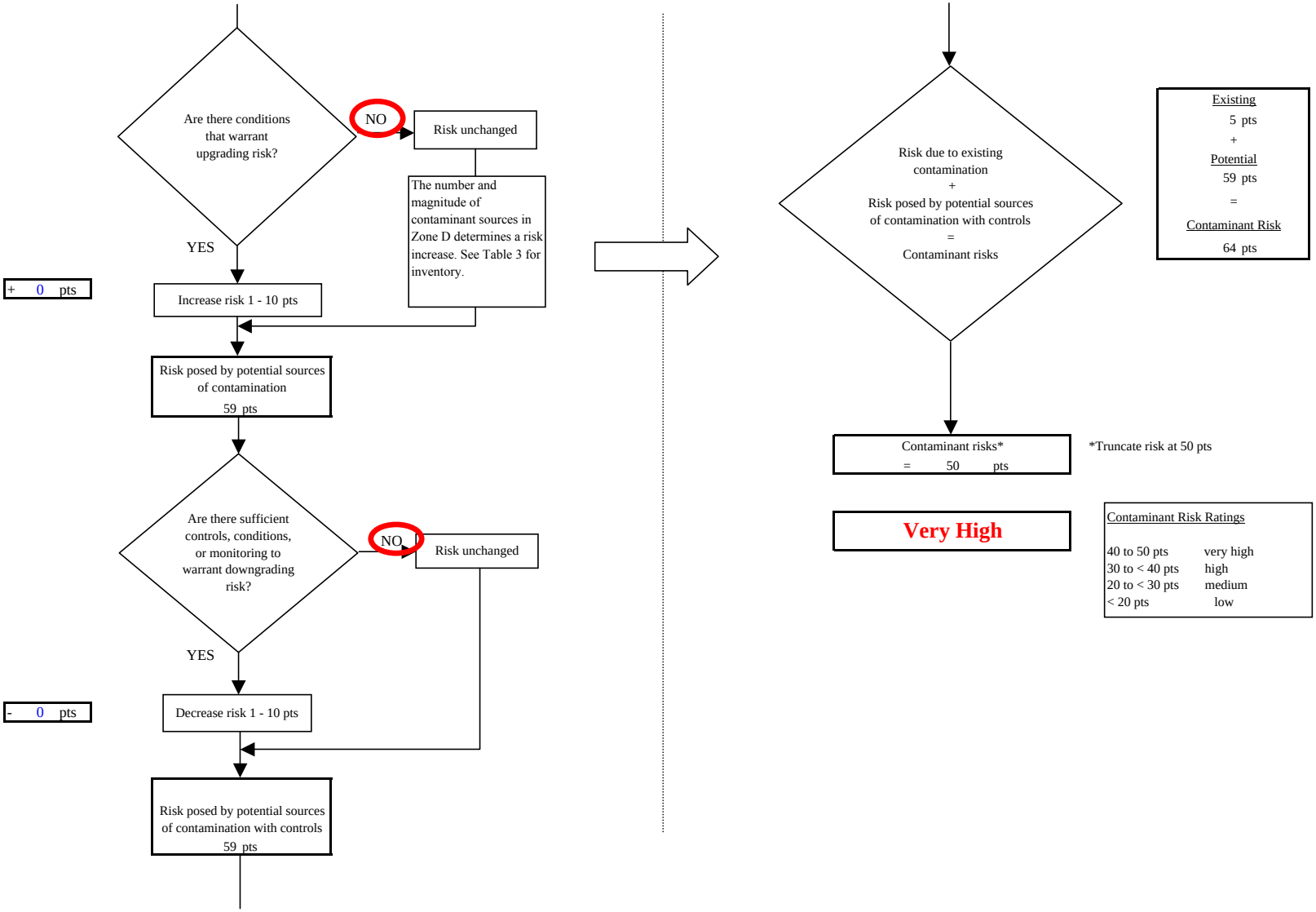


Chart 6. Vulnerability analysis for Copper River SD - Gakona School (PWS No. 380361.001) - Nitrates and Nitrites

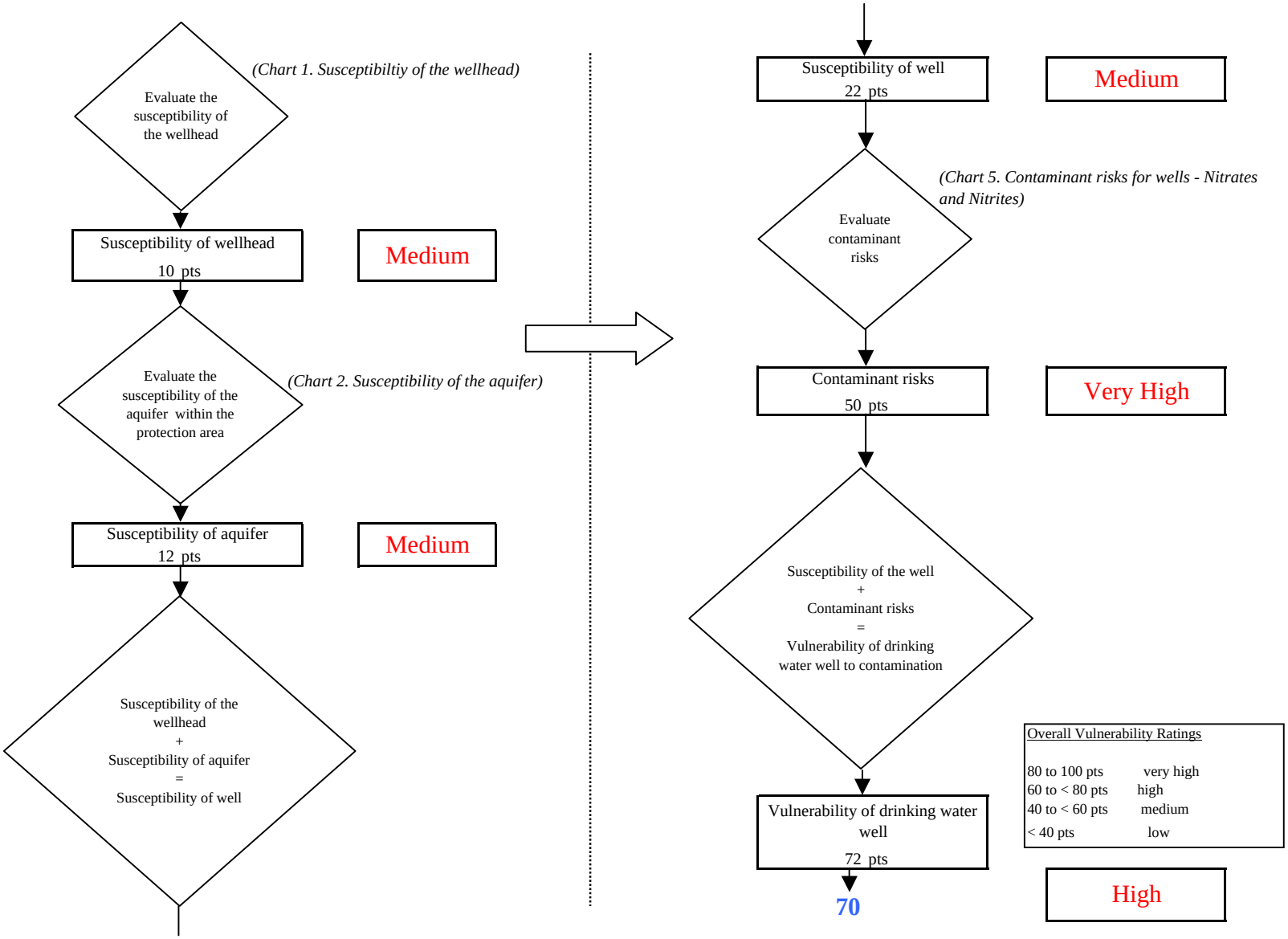


Chart 7. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Volatile Organic Chemicals

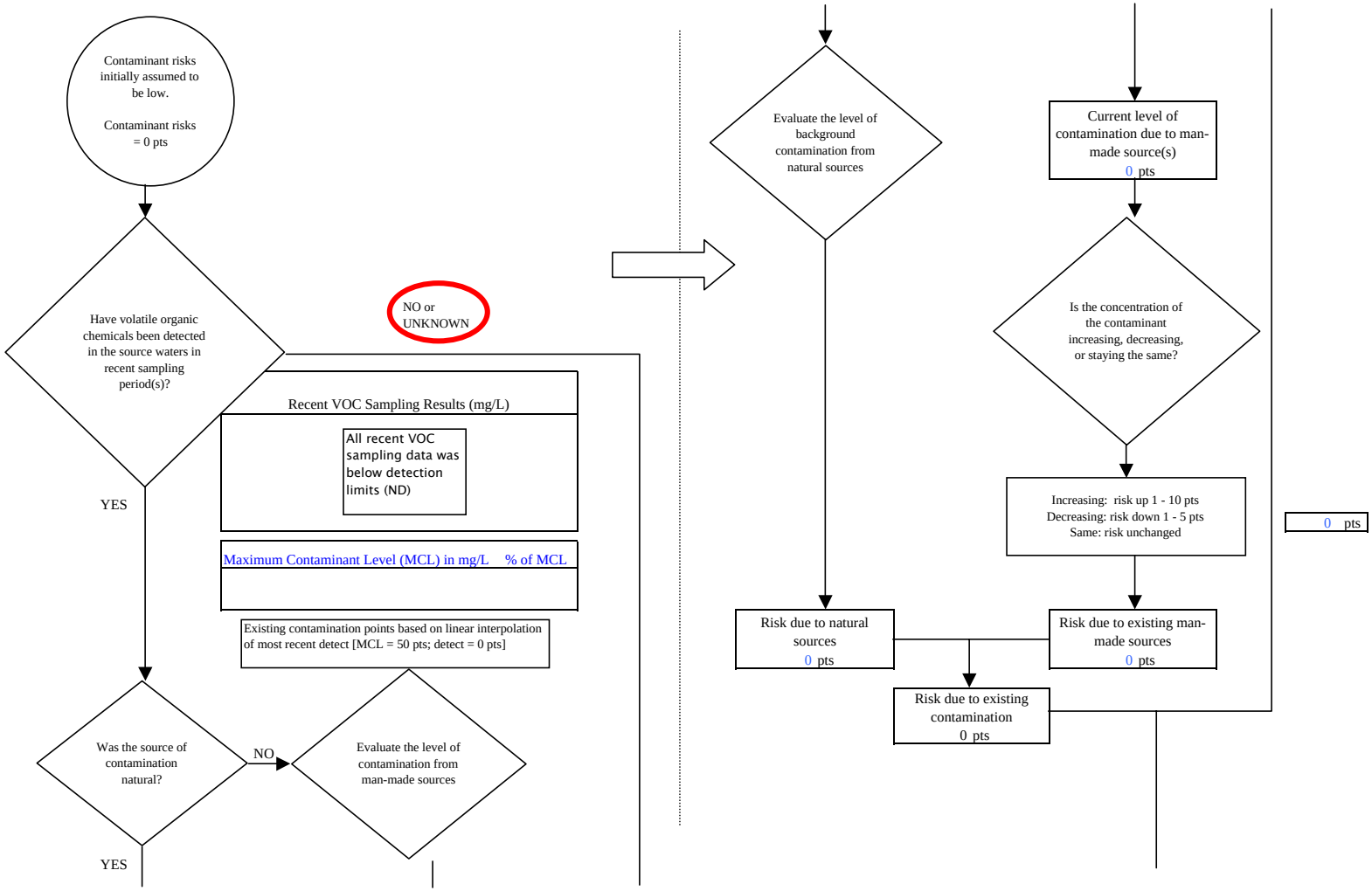


Chart 7. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Volatile Organic Chemicals

+ 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)	5	1	6
Medium(s)	81	0	81
Low(s)	11	0	11

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 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

- 1 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 4 for inventory.

Chart 7. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Volatile Organic Chemicals

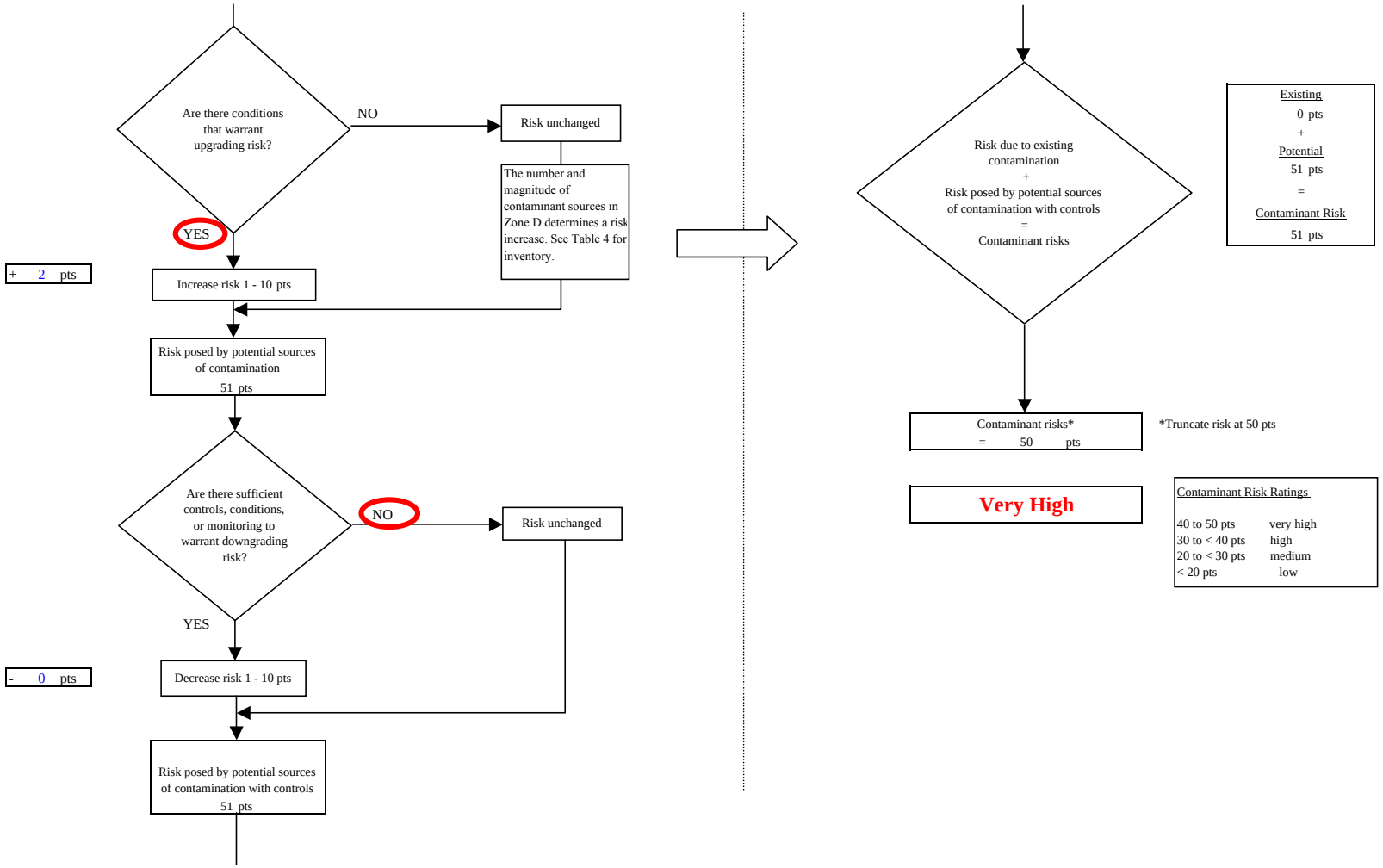


Chart 8. Vulnerability analysis for Copper River SD - Gakona School (PWS No. 380361.001) - Volatile Organic Chemicals

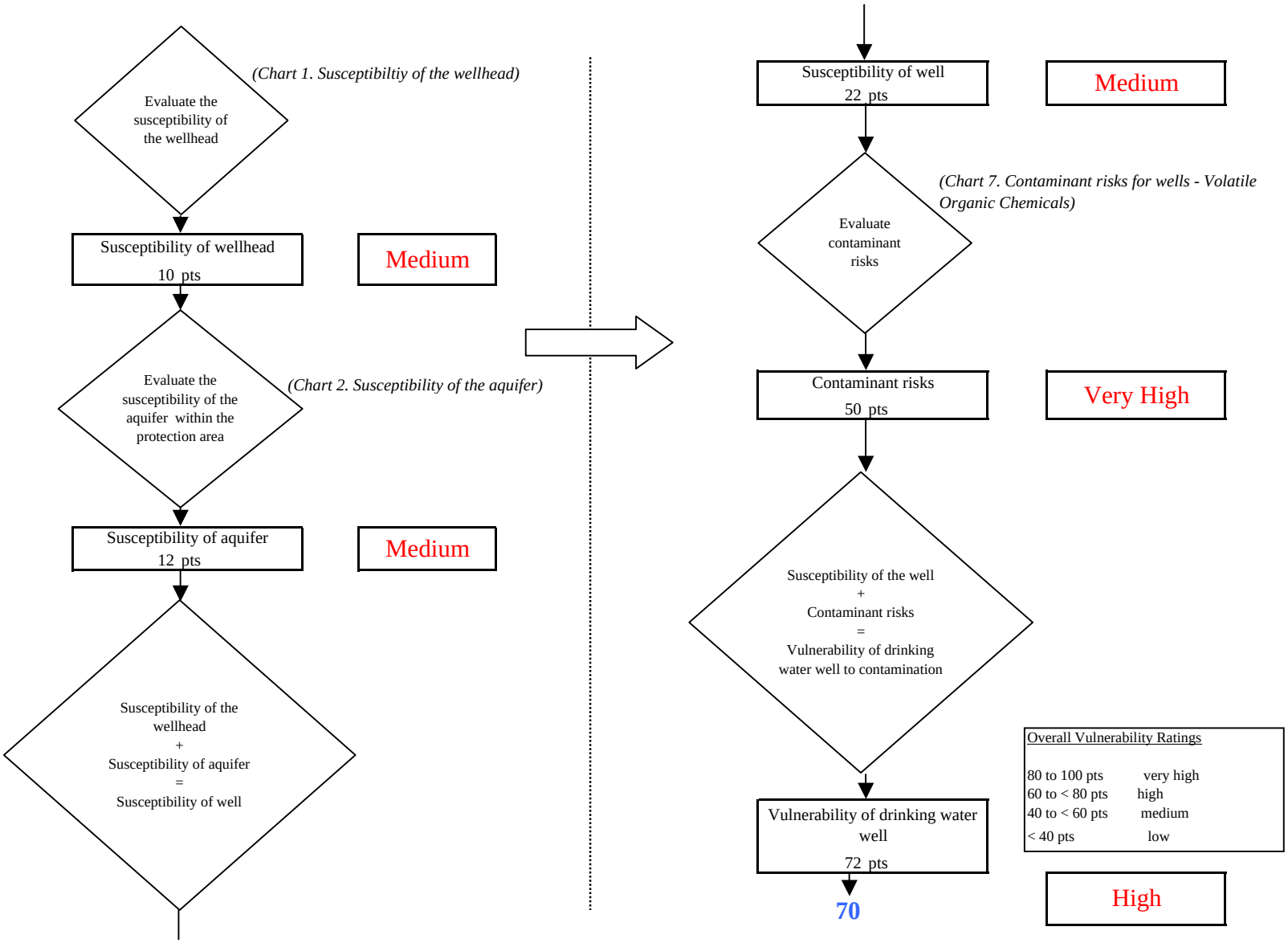


Chart 9. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

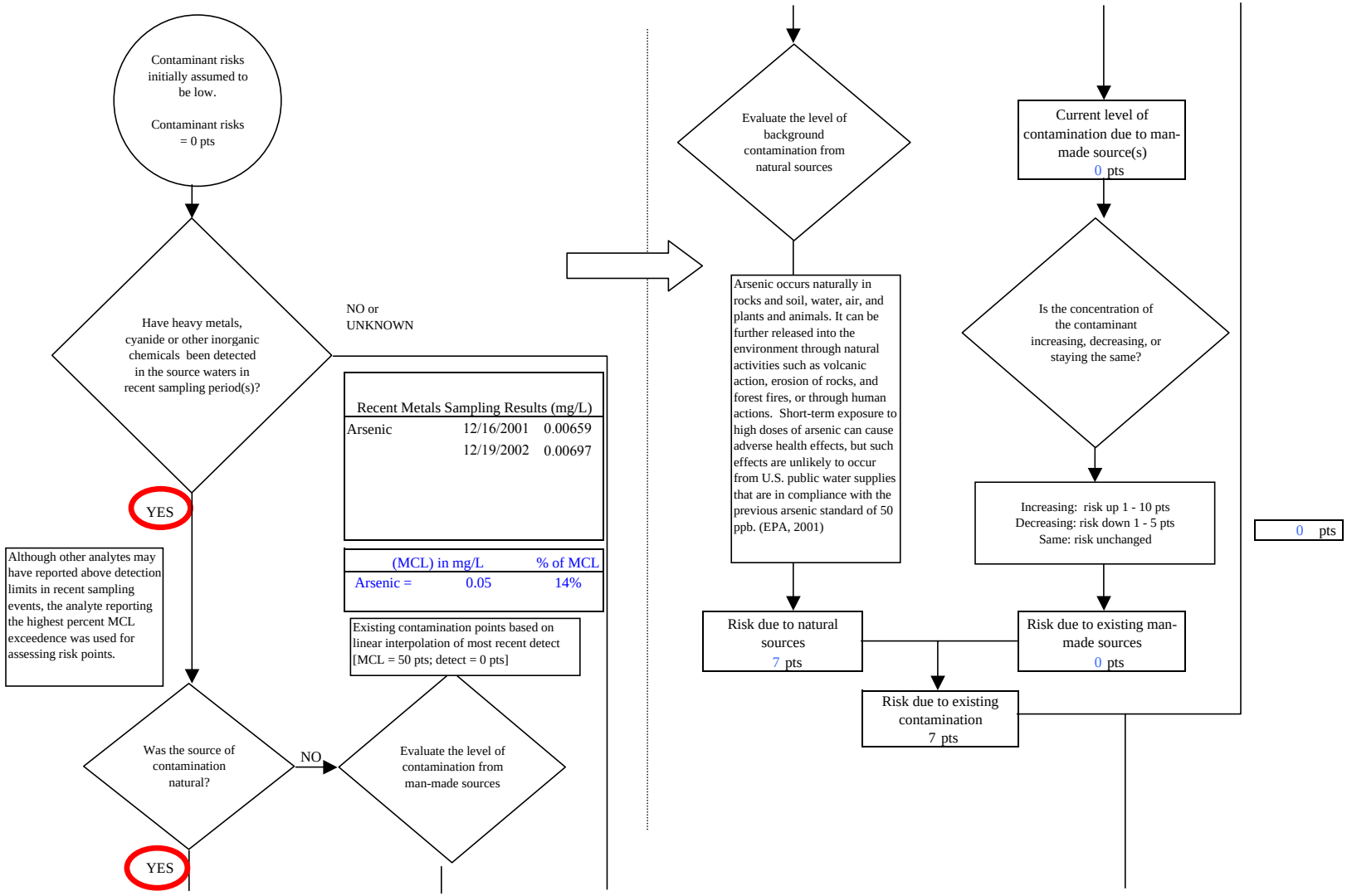


Chart 9. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 30 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	1	1
Medium(s)	1	0	1
Low(s)	12	0	12

	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.

Initial assessment of risk posed by potential sources of contamination = 30 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

- 1 pts

Are any significant sources within Zone A?

NO → Risk unchanged

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 5 for inventory.

YES

Increase risk 1 - 10 pts

+ 8 pts

Chart 9. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals

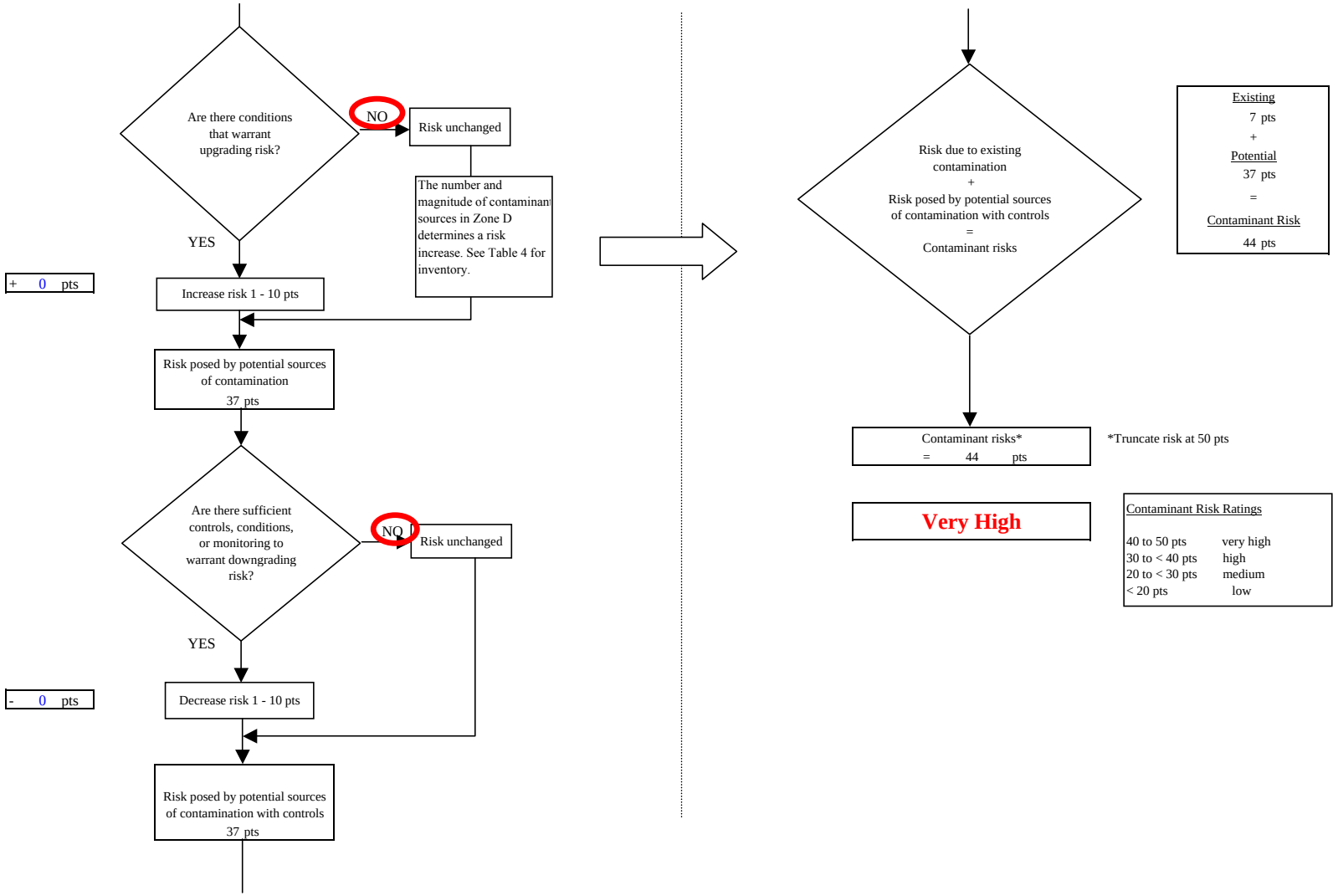


Chart 10. Vulnerability analysis for Copper River SD - Gakona School (PWS No. 380361.001) - Heavy Metals, Cyanide and Other Inorganic C

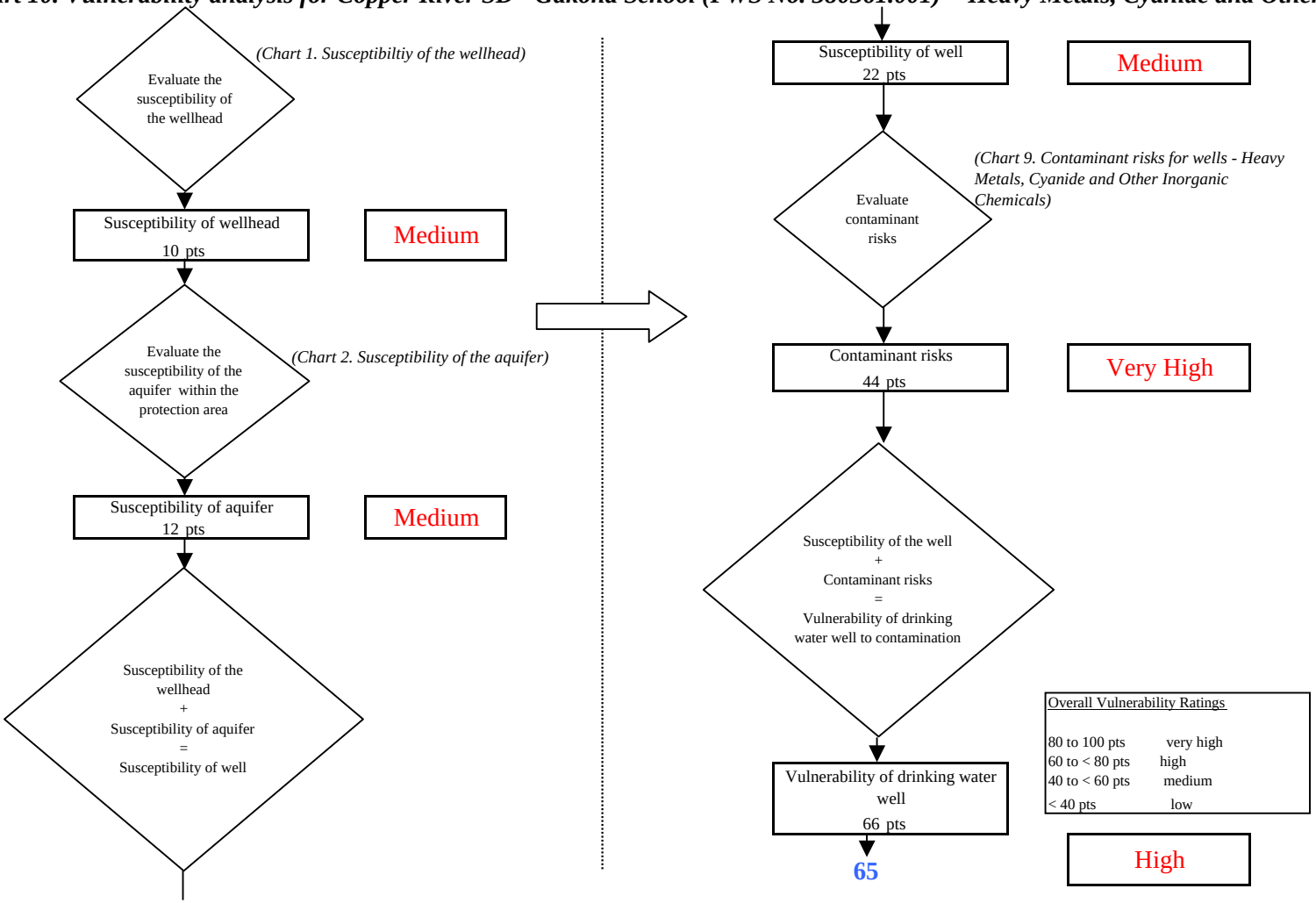


Chart 11. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Synthetic Organic Chemicals

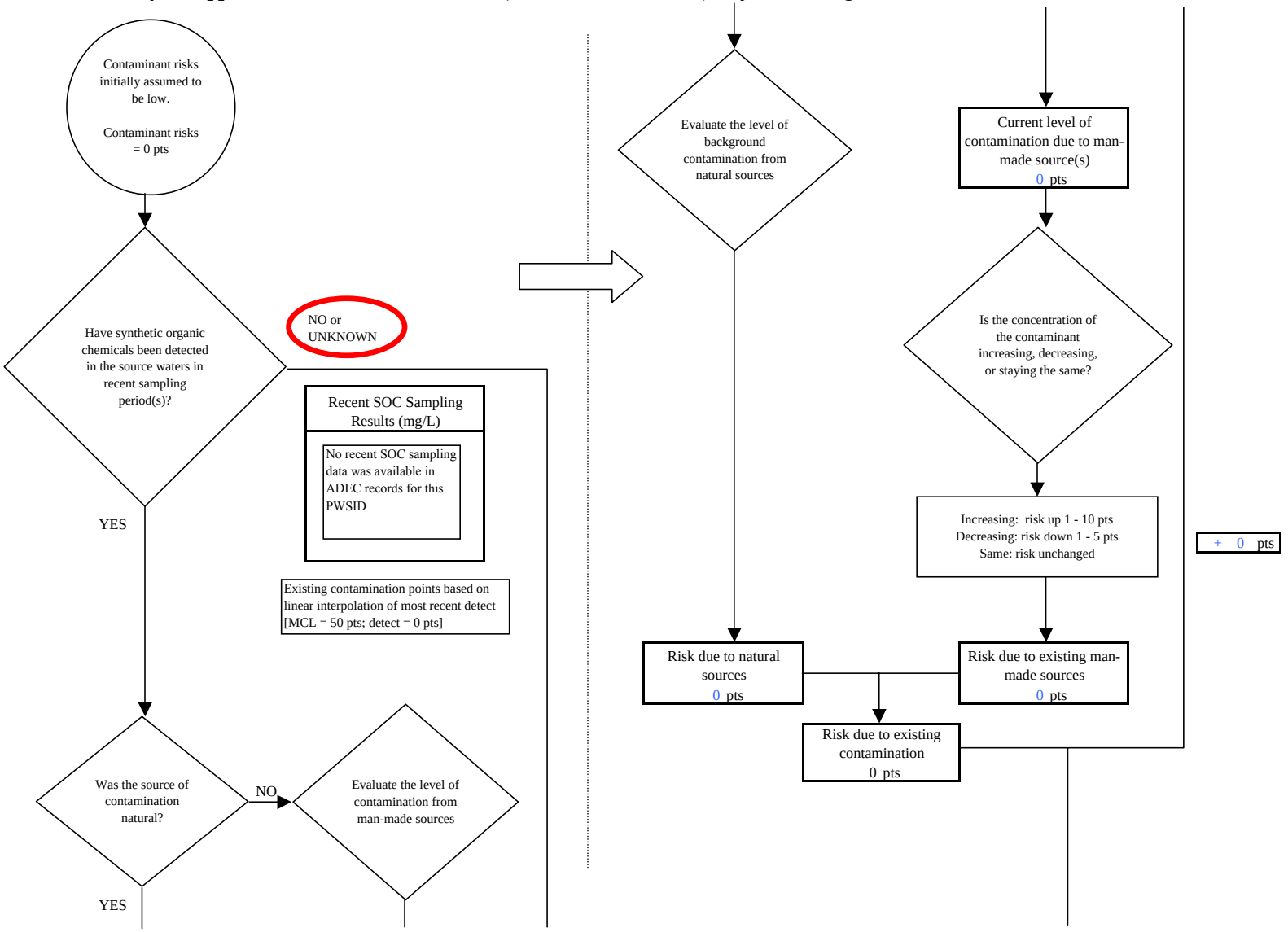
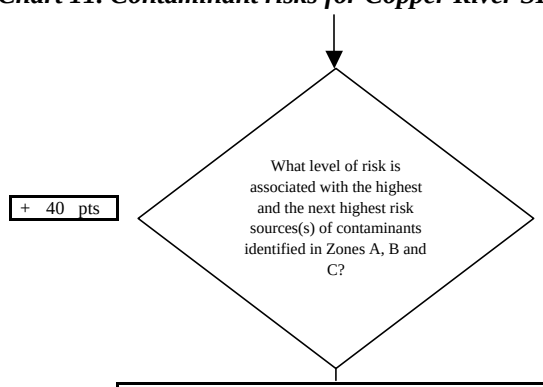


Chart 11. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Synthetic Organic Chemicals



+ 40 pts

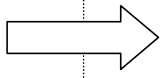
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	1	1
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	8	0	8

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 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.



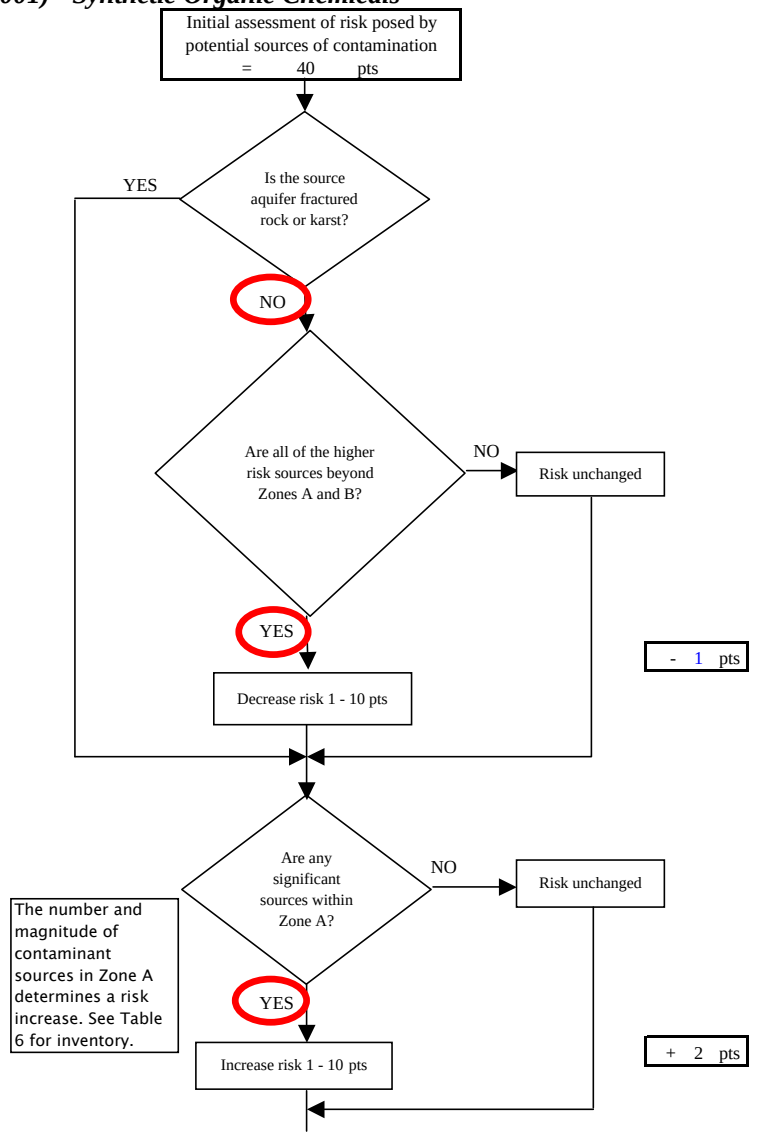


Chart 11. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Synthetic Organic Chemicals

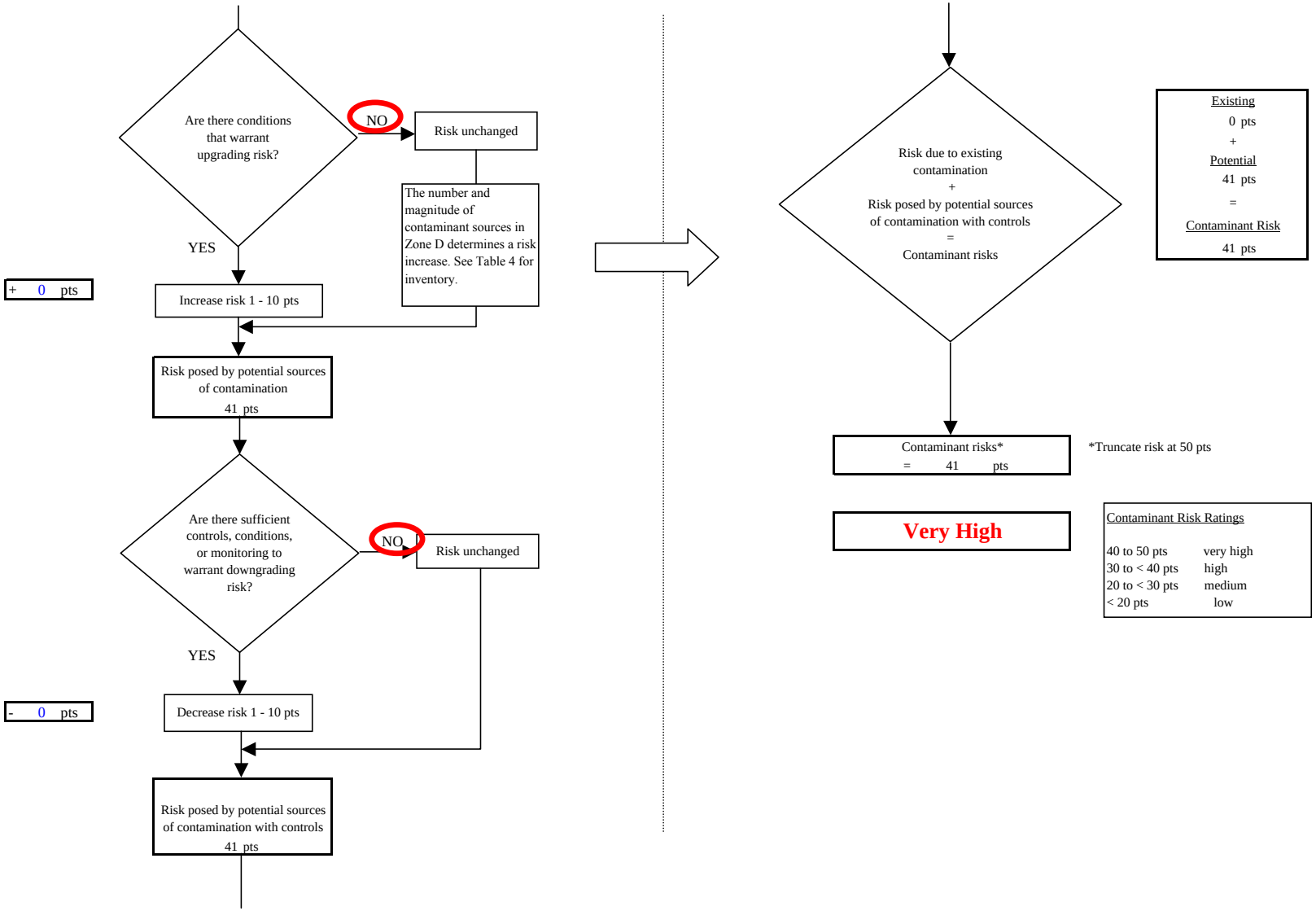


Chart 12. Vulnerability analysis for Copper River SD - Gakona School (PWS No. 380361.001) - Synthetic Organic Chemicals

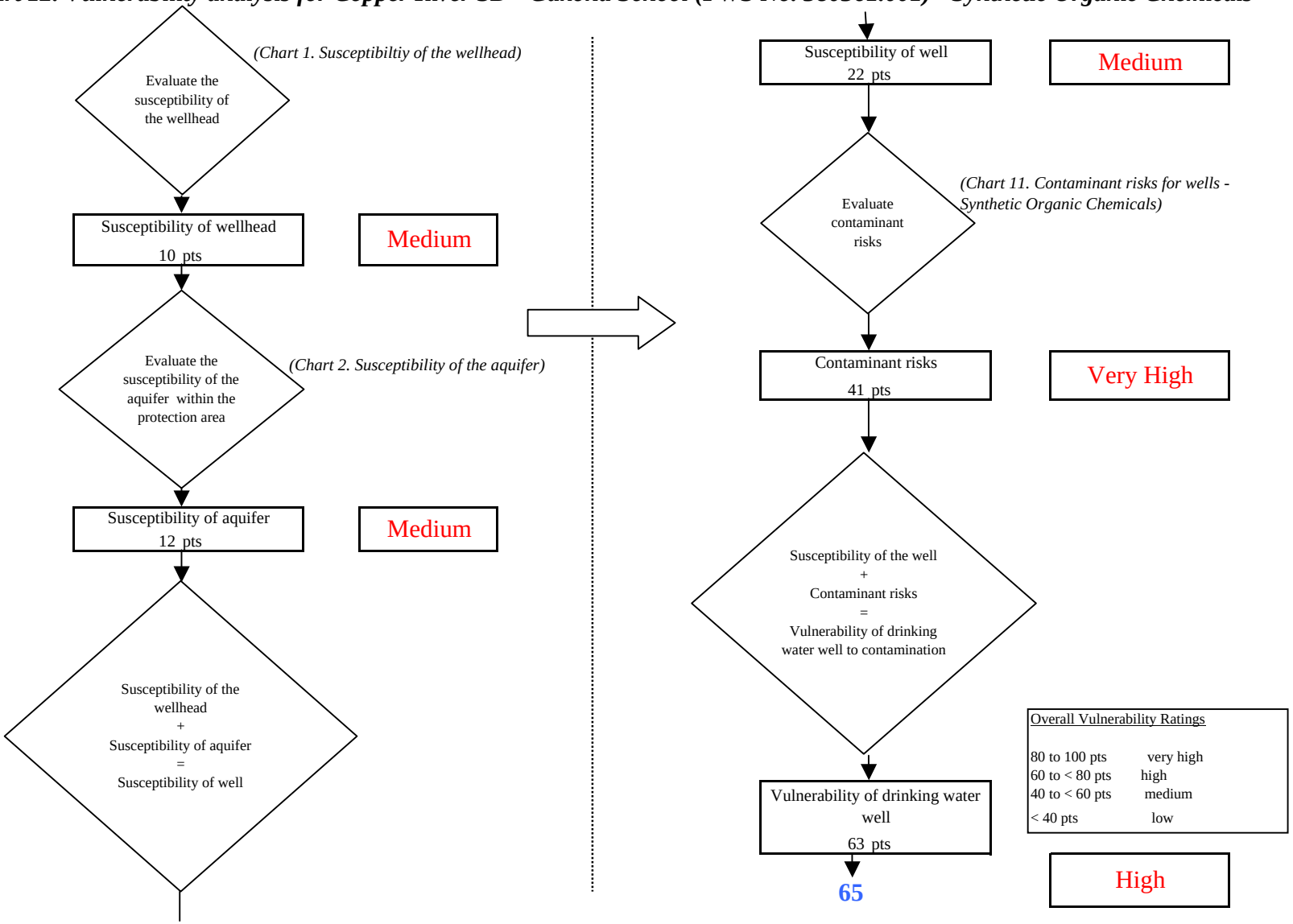


Chart 13. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Other Organic Chemicals

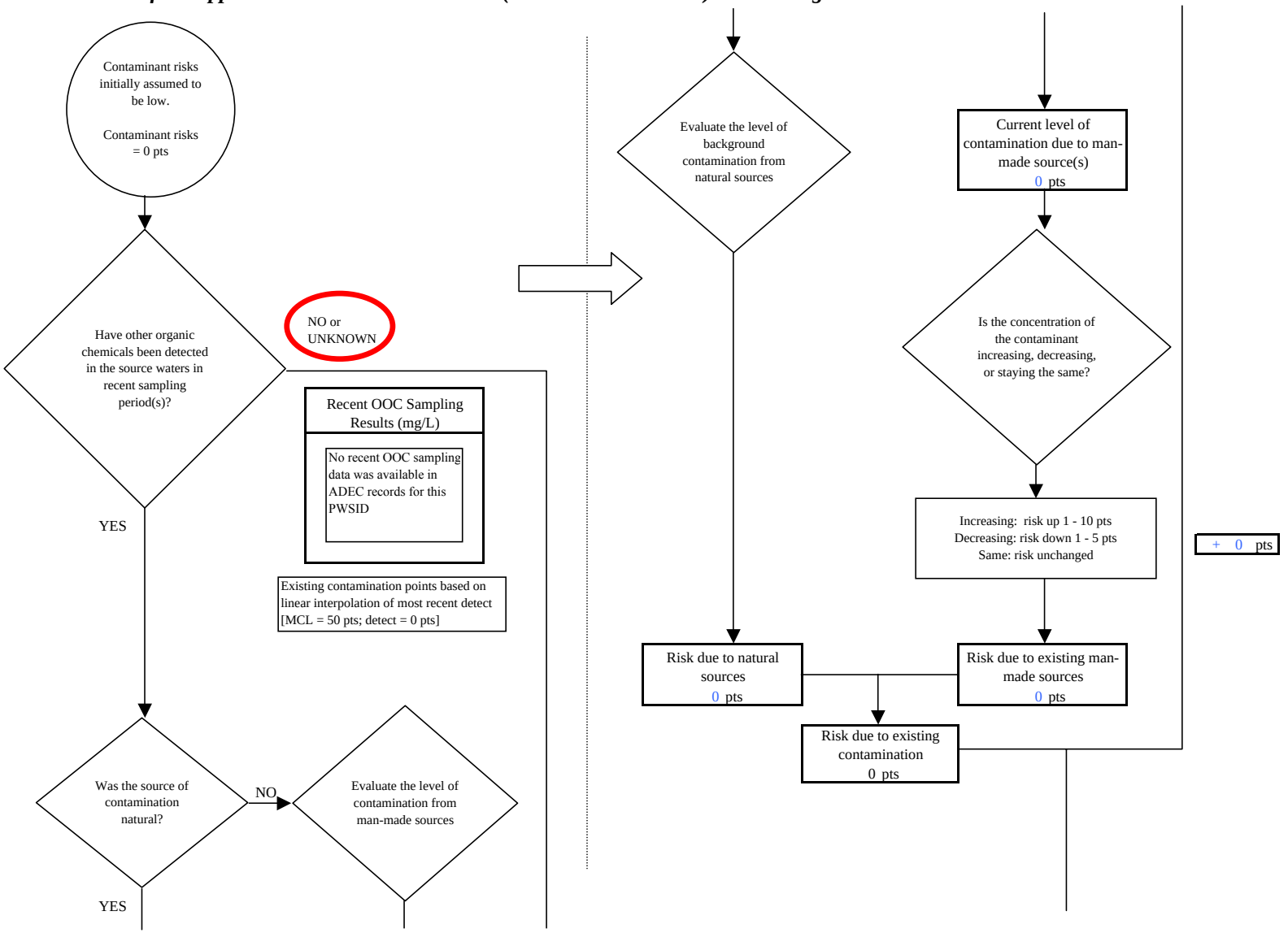
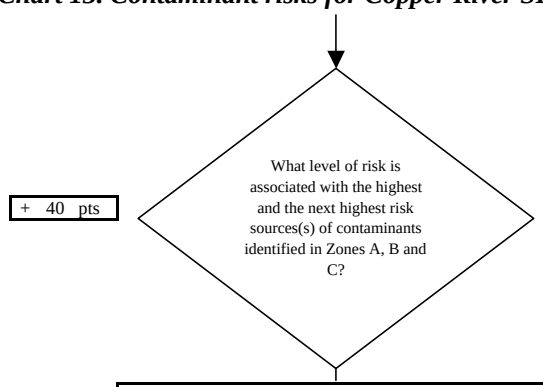


Chart 13. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Other Organic Chemicals



+ 40 pts

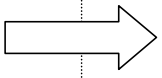
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	1	1
High(s)	0	0	0
Medium(s)	1	0	1
Low(s)	10	0	10

	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source + 10 pts

Matrix Score 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.



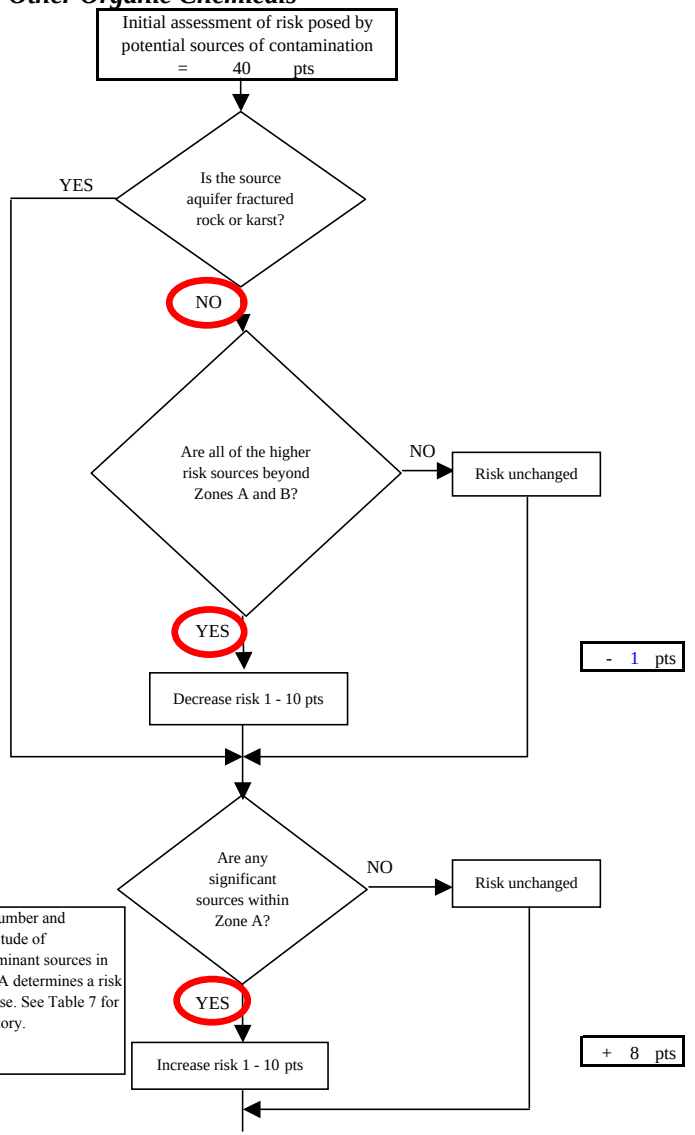


Chart 13. Contaminant risks for Copper River SD - Gakona School (PWS No. 380361.001) - Other Organic Chemicals

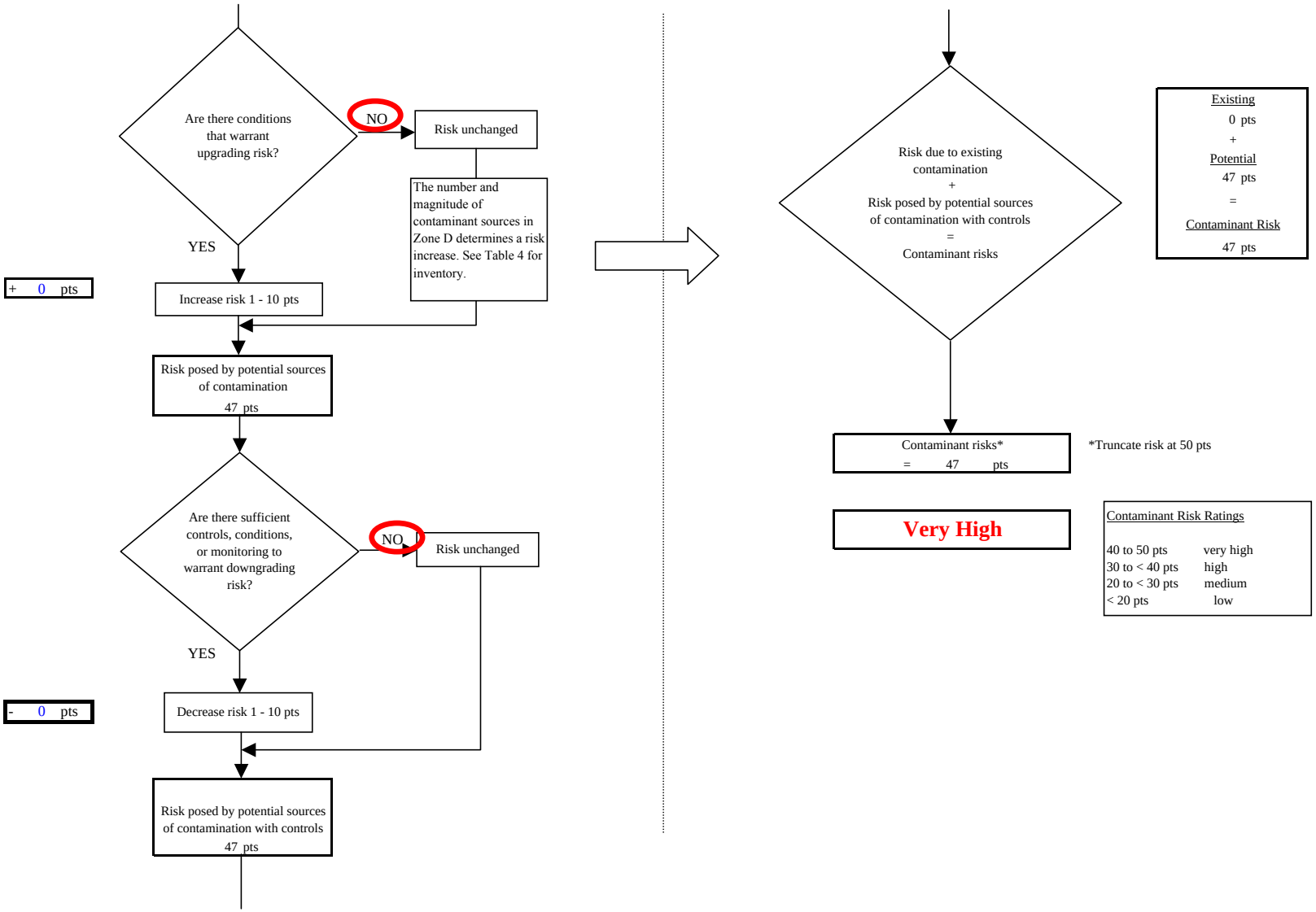


Chart 14. Vulnerability analysis for Copper River SD - Gakona School (PWS No. 380361.001) - Other Organic Chemicals