Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for United States Air Force Chugach Support Services Drinking Water System, King Salmon, Alaska

PWSID # 260503.002

July 2004

DRINKING WATER PROTECTION PROGRAM REPORT 1054
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

The United States Air Force (USAF) Chugach Support Services have three Public Water System (PWS) wells. It is assumed from PWS No. 260503.005 that the well (PWS No. 260503.002) has been used as a drinking water source since it was drilled in 1952. This source water assessment report is exclusively limited to PWSID #260503.002.

The well is a Class A (community and non-transient non-community) water system located at Mile 0.5, along the east side of the Alaska Peninsula Highway, in King Salmon, Alaska. Available records indicate that there is secondary storage of drinking water, with a combined capacity of 50,000-gallons, and that the drinking water source is treated with calcium hypochlorite. This system operates year round and serves approximately 55 residents and 75 non-residents through 26 service connections. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produce a **Low** rating for the natural susceptibility of the well.

Identified potential and current sources of contaminants for the public drinking water source include: motor/motor vehicle repair shops, domestic wastewater collection systems, a landfill, nonresidential heating oil tanks, DEC recognized contaminated sites, abandoned wells, monitoring wells, a petroleum product bulk station/terminal, government vehicle maintenance facilities, roads, a pipeline, and electric power generation. 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 **Medium** for bacteria and viruses, and a vulnerability rating of **High** for the nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

PUBLIC DRINKING WATER SYSTEM

The USAF Chugach Support Services well is a Class A (community/non-transient/non-community) public water system. The system is located at Mile 0.5, along the east side of the Alaska Peninsula Highway, in King Salmon, Alaska (Sec. 23, T17S, R45W, Seward Meridian; see Map A of Appendix A). King Salmon is located on the north bank of the Naknek River near Bristol Bay. The community is located approximately 15 miles upriver from Naknek and 280 miles southwest of Anchorage. The community has a population of 392 (ADCED, 2003). Average annual precipitation in King Salmon is 20 inches, including approximately 45 inches of snowfall. Temperatures range from 42 to 63°F in the summer and 29 to 44°F in the winter. Temperatures can be as extreme as -46 to 88°F.

The community of King Salmon obtains most of their water supply from individual wells. Most households are served by the piped sewage collection system and the remaining households have individual septic tanks (ADCED, 2003). King Salmon receives electrical power from the Naknek Electric Association operated by the REA Cooperative. Power generating facilities are fueled by diesel. Refuse is collected by the Peterson Sanitation Company and trucked to the landfill located at mile five of King Salmon-Naknek Road (ADCED, 2003).

Well construction details are unknown, however it is assumed from PWS No. 260503.005 that the depth of the primary water well is 237 feet below the ground surface. It is also assumed that the well is screened in a confined aquifer based on available construction details for surrounding wells. The well is not located within a floodplain.

Information acquired from a July 2003 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.

Three aquifer units are known to exist in the King Salmon area; these aquifers consist of unconsolidated, well sorted to poorly sorted silty and gravely sands separated by aquitard units consisting of silty sands, silts, and clays (Pikul, 2004).

The A-Aquifer, which has been eroded through by Eskimo Creek, King Salmon Creek, and the Naknek River, is unconfined and is exposed in many areas within the King Salmon area. It's depth ranges from the surface at the Naknek River to 45 feet bgs along the northern margin of King Salmon Air Station, and the saturated thickness ranges from zero to 15 feet. This aquifer is likely recharged by precipitation and influent stream flow. Underlying the A-Aquifer is the A-Aquitard ranging from 7 to 22 feet thick (Pikul, 2004).

Under the A-Aquitard lies the B-Aquifer ranging from 50 to 80 feet bgs beneath the surface, with a thickness ranging from 15 to 40 feet. Many of the residential drinking water supply wells are screened in this aquifer. Beneath the aquifer lies the B-Aquitard with a thickness ranging from 10 to 120 feet (Pikul, 2004).

The entire Bristol Bay area was formerly covered by glaciers and the topography is representative of a postglacial area. Soils in the Naknek River area is an organic surface mat underlain by three to four feet of volcanic ash and silty sands and gravels. These deposits are generally well drained, although lower parts of the landscape have poorly drained soils with shallow permafrost (DOWL, 1982).

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 USAF Chugach Support Services 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 and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	Several months travel time
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 USAF Chugach Support Services 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 USAF Chugach Support Services 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 USAF Chugach Support Services' water well is assumed to be 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	0	Low
Susceptibility of the Aquifer	19	High
Natural Susceptibility	19	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This score has been derived from an examination of existing and historical contamination that has been detected at the drinking water source through routine sampling. It also evaluates potential sources of contamination. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

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	35	High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide and Other Inorganic Chemicals	50	Very High
Synthetic Organic Chemicals	50	Very High
Other Organic Chemicals	50	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	55	Medium
Nitrates and Nitrites	70	High
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide and Other Inorganic Chemicals	70	High
Synthetic Organic Chemicals	70	High
Other Organic Chemicals	70	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **High**. The risk is primarily attributed to the presence of domestic wastewater collection systems, and abandoned wells in Zone A (see Table 2 – Appendix B).

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 **Medium**.

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 abandoned wells Zone A (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, the reported concentrations of nitrates do not exceed the maximum contaminant level (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 petroleum product bulk station/terminal in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 4 – Appendix B).

A detectable concentration of dichloromethane was reported in a sampling event for this public water system. However, the detectible concentration of dichloromethane reported in 2000 was well below the MCL of 0.005 mg/L. Dichloromethane is considered a possible laboratory contaminant and is assume to not be from the source waters. Since the reported concentration of dichloromethane in recent sampling events did not exceed the applicable MCL, risk points were not retained.

Aside from possible laboratory contaminants, other possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports. See Table 4 in Appendix B for a complete listing.

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 abandoned wells in Zone A. Numerous other potential contaminant sources are also found within the protection area (see Table 5 – Appendix B).

Based on a review of recent sampling records for this public water system, high levels of lead have been detected. This analyte exceeded the MCL of 0.015 mg/L (see Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

While the source of lead is unknown, it could be indicative of recent maintenance to the water treatment/conveyance system.

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 abandoned wells in Zone A. 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 USAF Chugach Support Services. Historically, the system has held an SOC/OOC sampling waiver. It is unknown whether the waiver is in place at this time. (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 A. 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 USAF Chugach Support Services. Historically, the system has held an SOC/OOC sampling waiver. It is unknown whether the waiver is in place at this time. (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 USAF Chugach Support Services and the community of King Salmon 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

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APPENDIX A

Drinking Water Protection Area Location Map
(Map A)

APPENDIX B

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

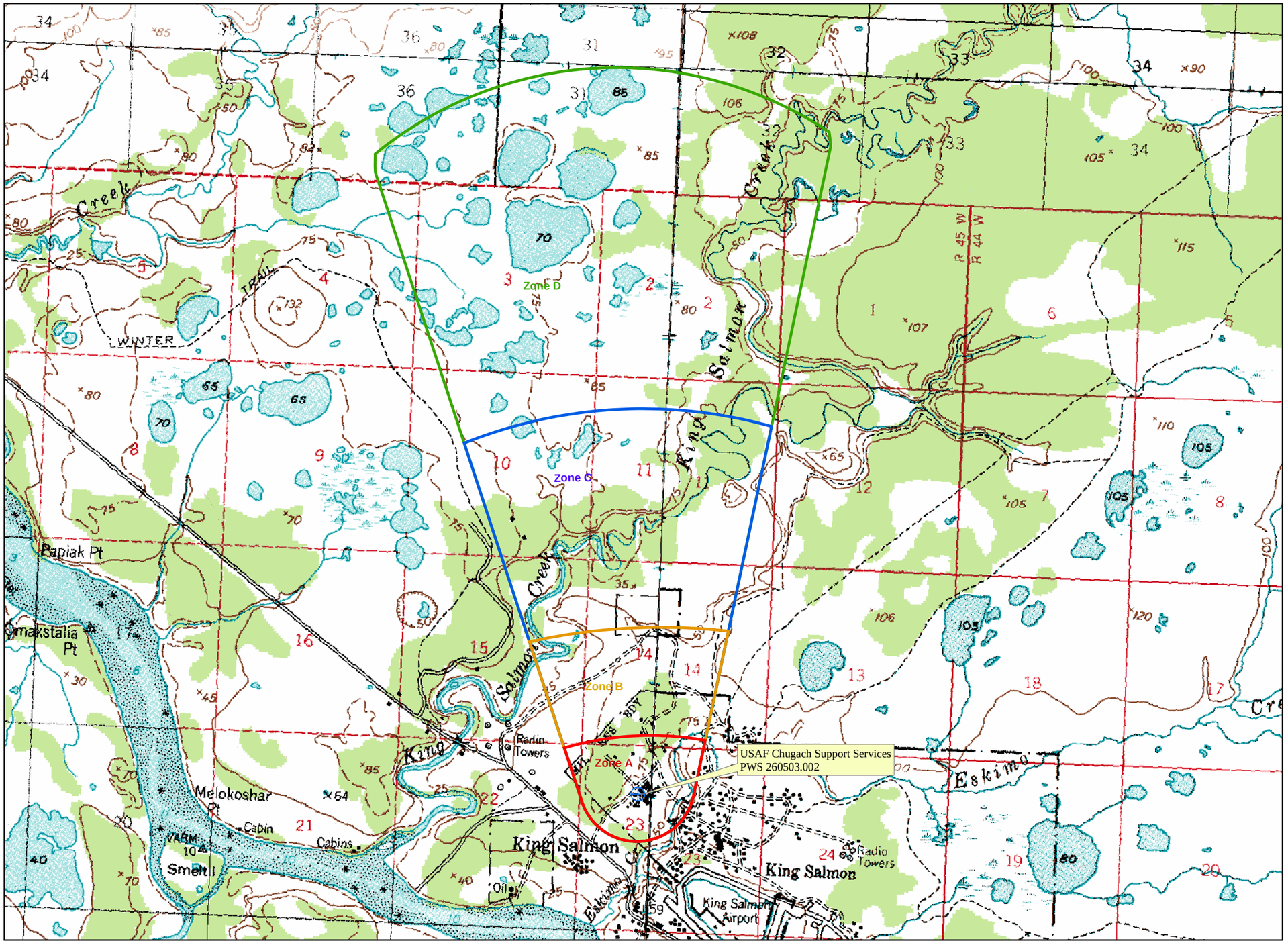
APPENDIX C

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 #260503.002 USAF Chugach Support Services



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)

Groundwater 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

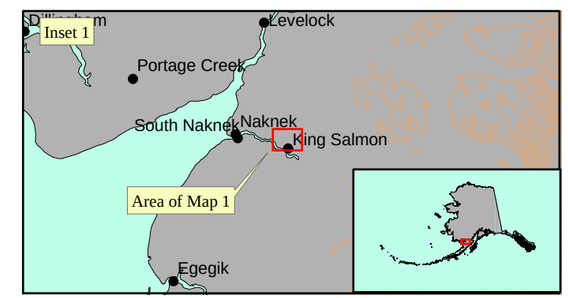
Data Sources:
Contaminant Sources, Public Water System Wells, Contours
Alaska Department of Environmental Conservation (ADEC)

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 0.375 0.75 1.5 2.25 3 Miles

USAF Chugach Support Services
PWS 260503.002

Appendix A Map A

Table 1

Contaminant Source Inventory for
USAF Chugach Support Services

PWSID 260503.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-01	A	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	C	
Landfills (industrial; type of industrial waste?)	D52	D52-01	A	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	C	Boiler Plant
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	C	King Salmon Air Station SS11; Reckey: 198825X920204; Status: Active; Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO and TCE. Placed in Zone A to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Abandoned wells	W01	W01-01	A	C	CSS, 10 water wells abandoned
Monitoring wells	W06	W06-01	A	C	1-12 Monitoring Wells in Zone A/Zone 1
Petroleum product bulk station/terminals	X11	X11-01	A	C	
Government vehicle maintenance facilities	X19	X19-01	A	C	
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	C	
Electric power generation (fossil fuels)	X36	X36-01	A	C	Building 638
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	B	C	King Salmon Air Station LF05; Reckey: 199025X904004; Status: Active; Estimated 500,000 barrels and other solid waste disposal site from the 1950's to 1970's.
Monitoring wells	W06	W06-02	A	C	1-12 Monitoring Wells in Zone B/Zone 1
Monitoring wells	W06	W06-03	B	C	1-25 Monitoring Wells in Zone B/Zone 3
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assume 1-20 roads in Zone B
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	C	C	King Salmon Air Station LF14; Reckey: 199025X904003; Status: Active; Estimated 500,000 barrels and miscellaneous solid waste disposal area from the early 1940's to the mid-1960's.
Monitoring wells	W06	W06-04	C	C	1-25 Monitoring Wells in Zone C/Zone 3

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-03	C	C	Assume 1-20 roads in Zone C

Table 2

Contaminant Source Inventory and Risk Ranking for USAF Chugach Support Services Sources of Bacteria and Viruses

PWSID 260503.002

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	
Abandoned wells	W01	W01-01	A	Medium	C	CSS, 10 water wells abandoned
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 3

Contaminant Source Inventory and Risk Ranking for USAF Chugach Support Services Sources of Nitrates/Nitrites

PWSID 260503.002

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	
Abandoned wells	W01	W01-01	A	High	C	CSS, 10 water wells abandoned
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 4

Contaminant Source Inventory and Risk Ranking for USAF Chugach Support Services Sources of Volatile Organic Chemicals

PWSID 260503.002

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Boiler Plant
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	High	C	King Salmon Air Station SS11; Reckey: 198825X920204; Status: Active; Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO and TCE. Placed in Zone A to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Abandoned wells	W01	W01-01	A	High	C	CSS, 10 water wells abandoned
Petroleum product bulk station/terminals	X11	X11-01	A	Very High	C	
Government vehicle maintenance facilities	X19	X19-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Medium	C	
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	Building 638
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	B	High	C	King Salmon Air Station LF05; Reckey: 199025X904004; Status: Active; Estimated 500,000 barrels and other solid waste disposal site from the 1950's to 1970's.
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	C	High	C	King Salmon Air Station LF14; Reckey: 199025X904003; Status: Active; Estimated 500,000 barrels and miscellaneous solid waste disposal area from the early 1940's to the mid-1960's.

Table 5

Contaminant Source Inventory and Risk Ranking for USAF Chugach Support Services Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 260503.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	Medium	C	
Tanks, heating oil, nonresidential (aboveground)	T14	T14-01	A	Low	C	Boiler Plant
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	King Salmon Air Station SS11; Reckey: 198825X920204; Status: Active; Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO and TCE. Placed in Zone A to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Abandoned wells	W01	W01-01	A	Very High	C	CSS, 10 water wells abandoned
Monitoring wells	W06	W06-01	A	Medium	C	1-12 Monitoring Wells in Zone A/Zone 1
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	
Government vehicle maintenance facilities	X19	X19-01	A	Low	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	Low	C	
Electric power generation (fossil fuels)	X36	X36-01	A	Medium	C	Building 638
Monitoring wells	W06	W06-03	B	Medium	C	1-25 Monitoring Wells in Zone B/Zone 3
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Table 6

Contaminant Source Inventory and Risk Ranking for USAF Chugach Support Services Sources of Synthetic Organic Chemicals

PWSID 260503.002

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	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	King Salmon Air Station SS11; Reckey: 198825X920204; Status: Active; Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO and TCE. Placed in Zone A to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Abandoned wells	W01	W01-01	A	High	C	CSS, 10 water wells abandoned
Petroleum product bulk station/terminals	X11	X11-01	A	Low	C	

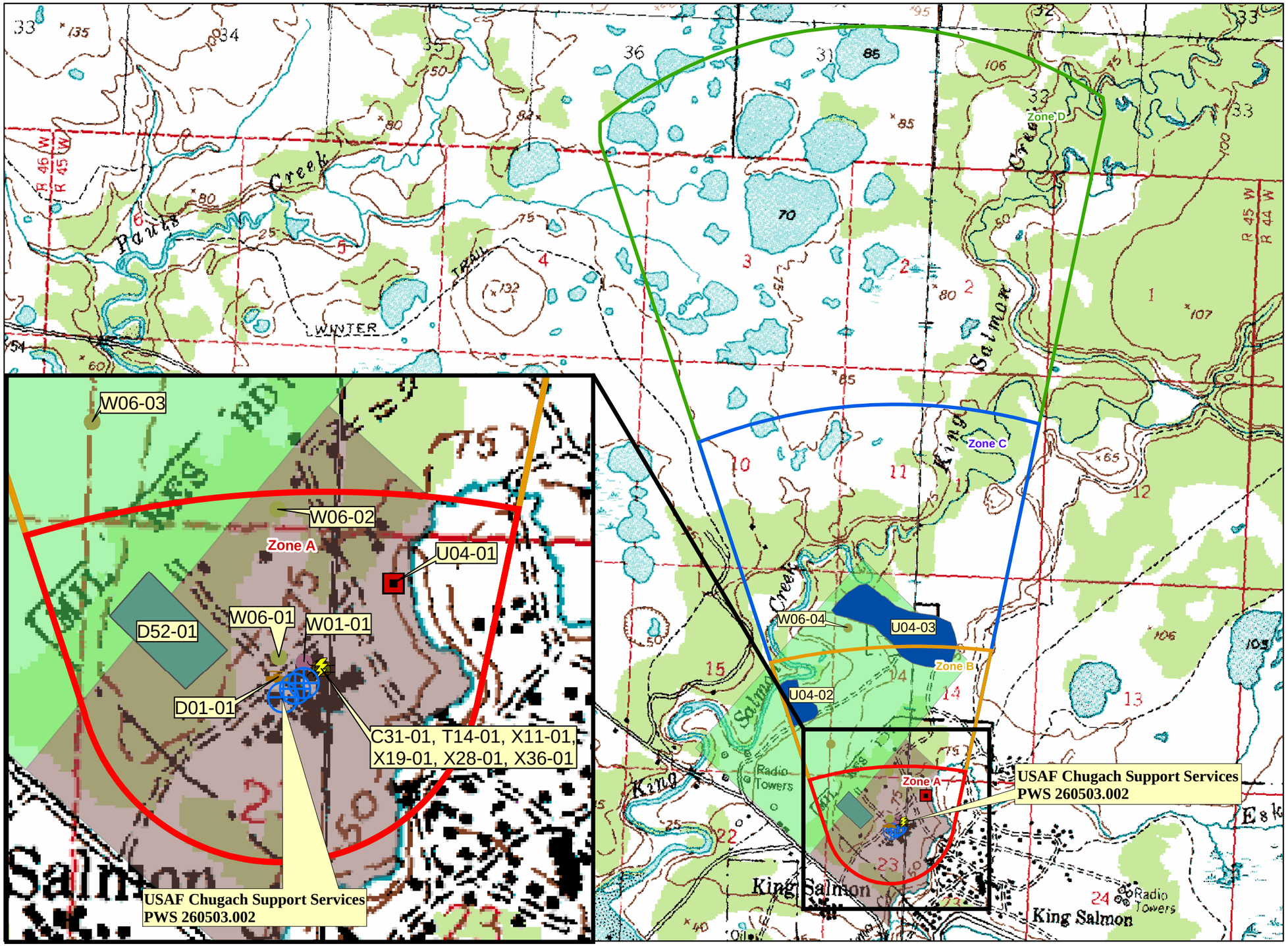
Table 7

Contaminant Source Inventory and Risk Ranking for USAF Chugach Support Services Sources of Other Organic Chemicals

PWSID 260503.002

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Risk Ranking for Analysis	Map Number	Comments
Motor /motor vehicle repair shops	C31	C31-01	A	Medium	C	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-01	A	High	C	
Landfills (industrial; type of industrial waste?)	D52	D52-01	A	Very High	C	
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	Low	C	King Salmon Air Station SS11; Reckey: 198825X920204; Status: Active; Eskimo Creek Seeps 1 and 2: Contaminants of concern include DRO and TCE. Placed in Zone A to be conservative as "source of seep is unidentified" (ADEC Contaminated Sites Database)
Abandoned wells	W01	W01-01	A	High	C	CSS, 10 water wells abandoned
Petroleum product bulk station/terminals	X11	X11-01	A	High	C	
Government vehicle maintenance facilities	X19	X19-01	A	Medium	C	
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assume 1-20 roads in Zone A
Pipelines (oil and gas)	X28	X28-01	A	High	C	
Electric power generation (fossil fuels)	X36	X36-01	A	High	C	Building 638
Highways and roads, dirt/gravel	X24	X24-02	B	Low	C	Assume 1-20 roads in Zone B

Public Water Well System for PWS #260503.002 USAF Chugach Support Services
Showing Potential and Existng Sources of Contamination



LEGEND

- Public Water System Well

Transportation

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

Hydrography/Physical

- Parcels
- Stream
- Lake or Pond
- Contours

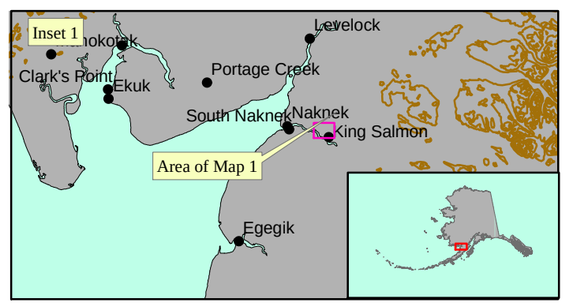
Groundwater Protection Zones

- 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
- Groundwater Zone 1
- Groundwater Zone 3

Existing or Potential Contaminant Sources

- Motor vehicle repair shop (C31)
- Domestic wastewater collection system (sewer lines) (D01)
- Nonresidential aboveground heating oil tanks (T14)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04-01)
- Abandoned wells (W01)
- Monitoring wells (W06)
- Petroleum product bulk station/terminal (X11)
- Government vehicle maintenance facilities (X19)
- Oil and gas pipelines (X28)
- Electric power generation (fossil fuels) (X36)
- Landfills (industrial) (D52)
- Contaminated sites, DEC recognized, non-Superfund, non-RCRA (U04-02 and U04-03)

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 0.4 0.8 1.6 2.4 3.2 Miles

USAF Chugach Support Services
PWS 260503.002

Appendix C Map C

Chart 1. Susceptibility of the wellhead - USAF Chugach Support Services (PWS No. 260503.002)

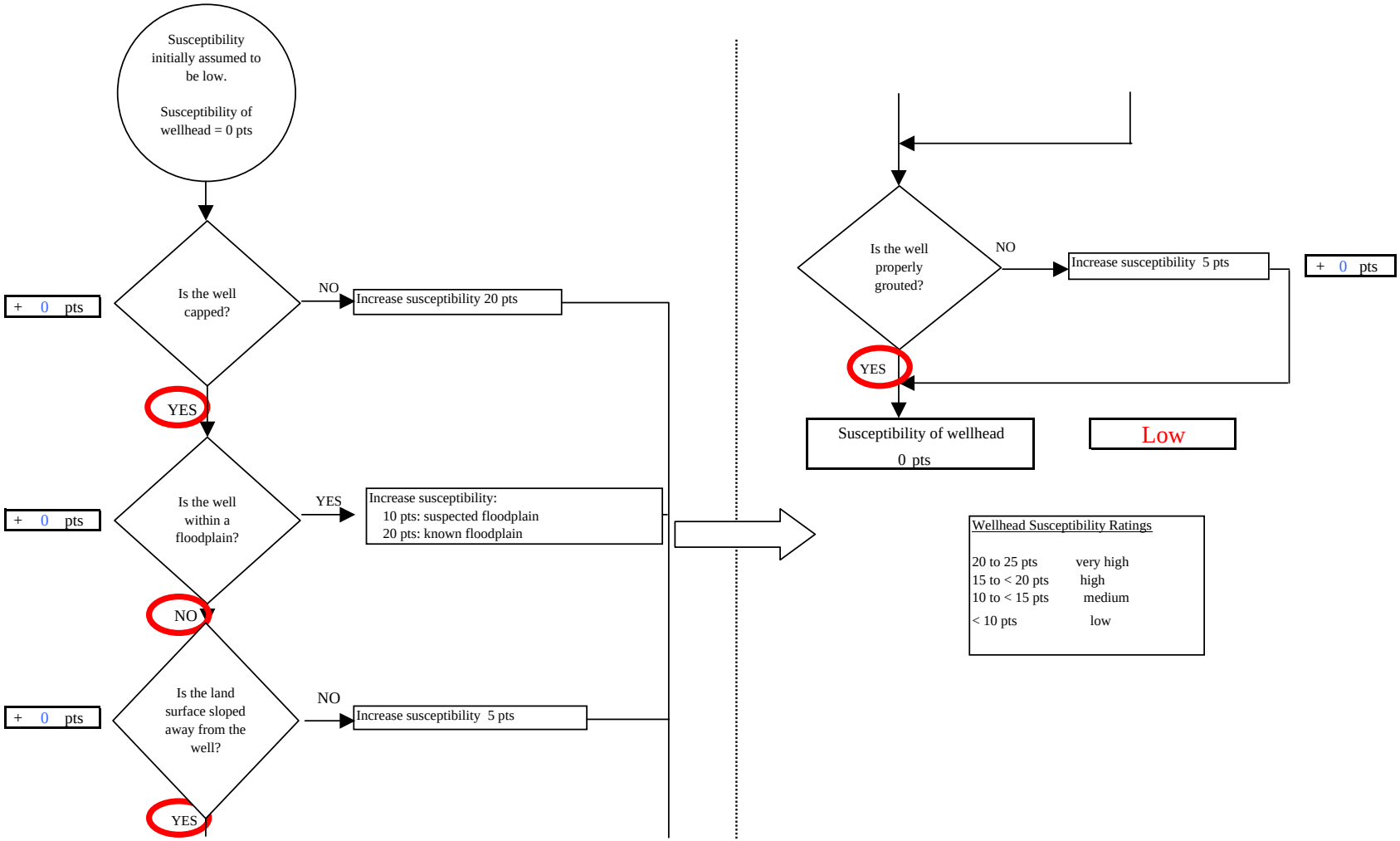


Chart 2. Susceptibility of the aquifer USAF Chugach Support Services (PWS No. 260503.002)

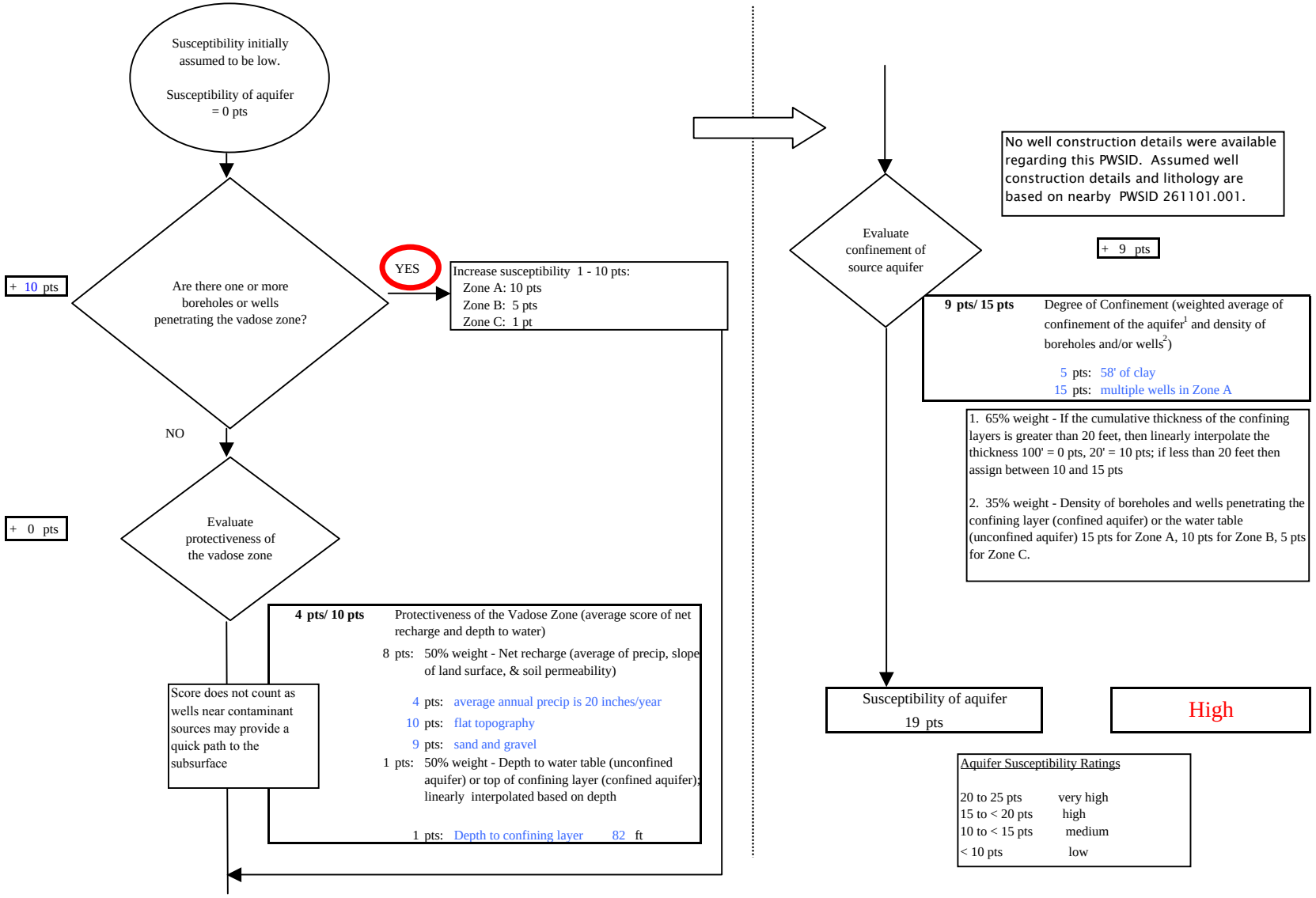
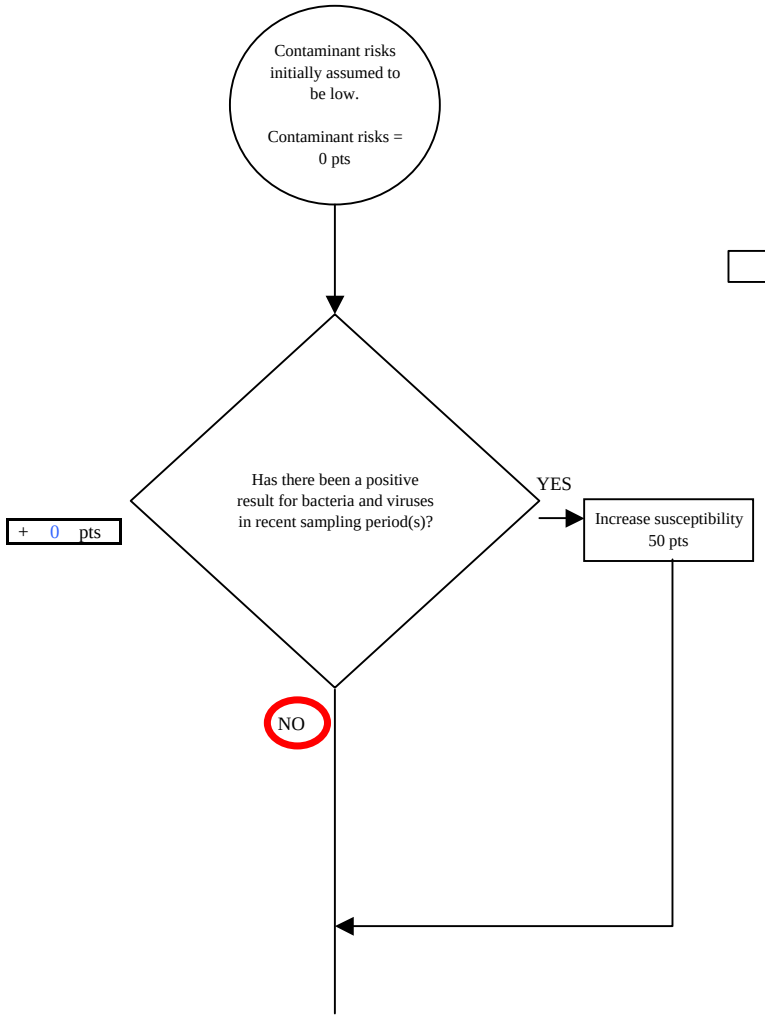
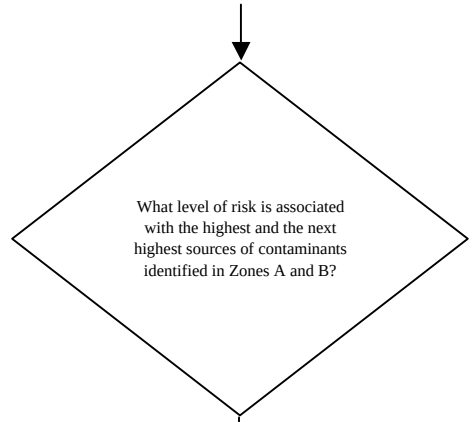


Chart 3. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Bacteria & Viruses





+ 25 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	11	0	11
Low(s)	1	1	2

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

Matrix Score 25

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 USAF Chugach Support Services (PWS No. 260503.002) - Bacteria & Viruses

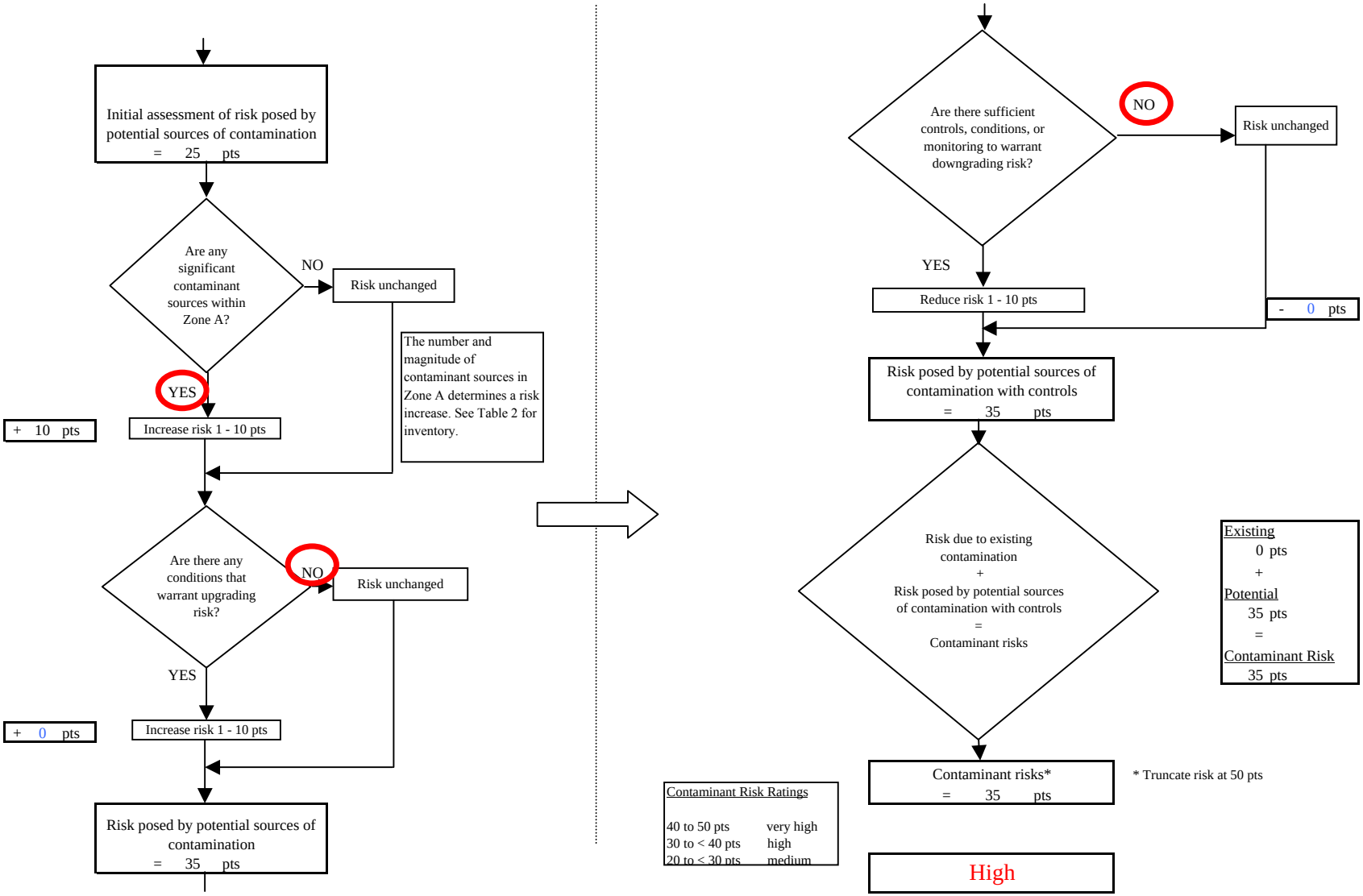


Chart 4. Vulnerability analysis for USAF Chugach Support Services (PWS No. 260503.002) - Bacteria & Viruses

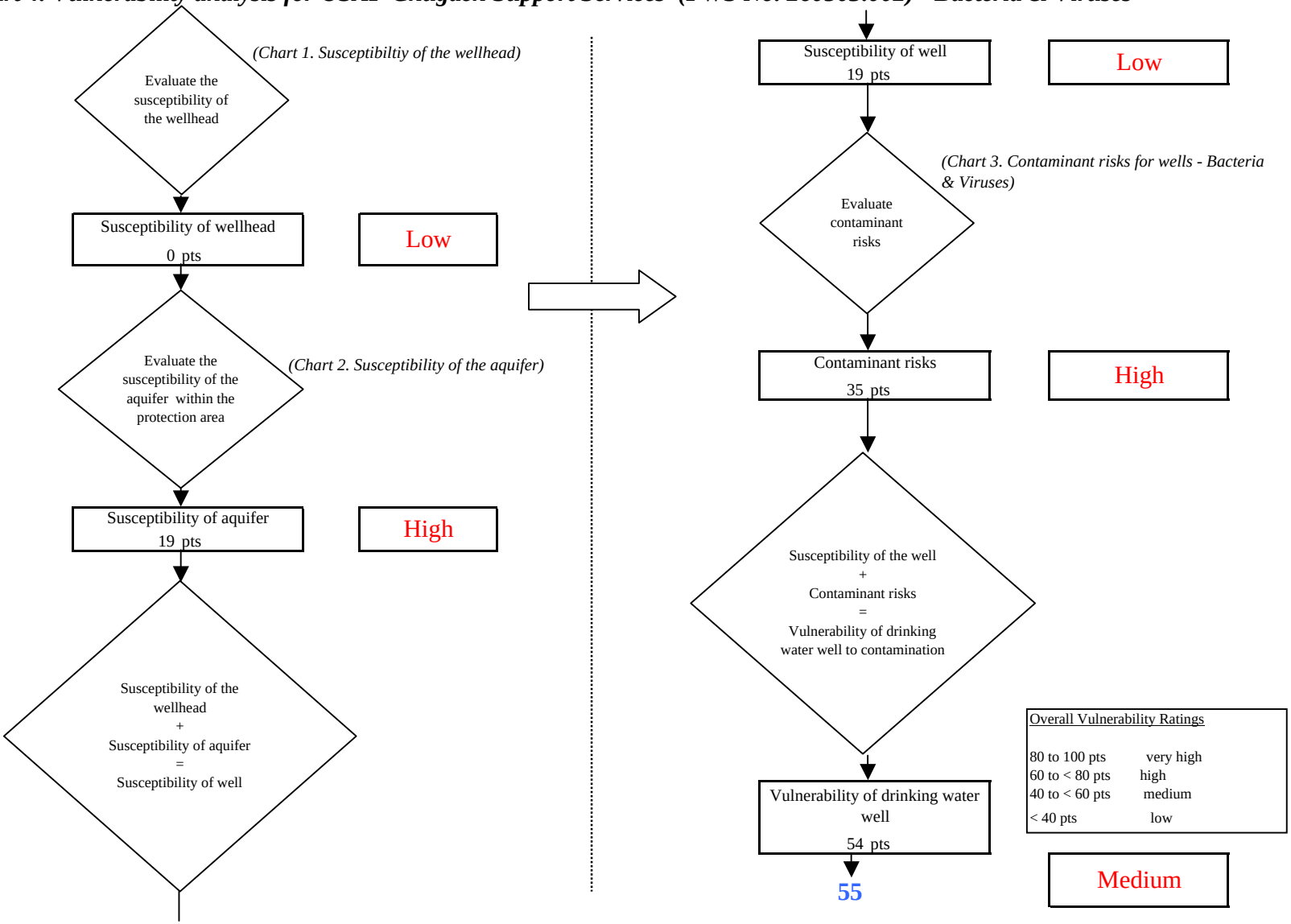


Chart 5. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Nitrates and Nitrites

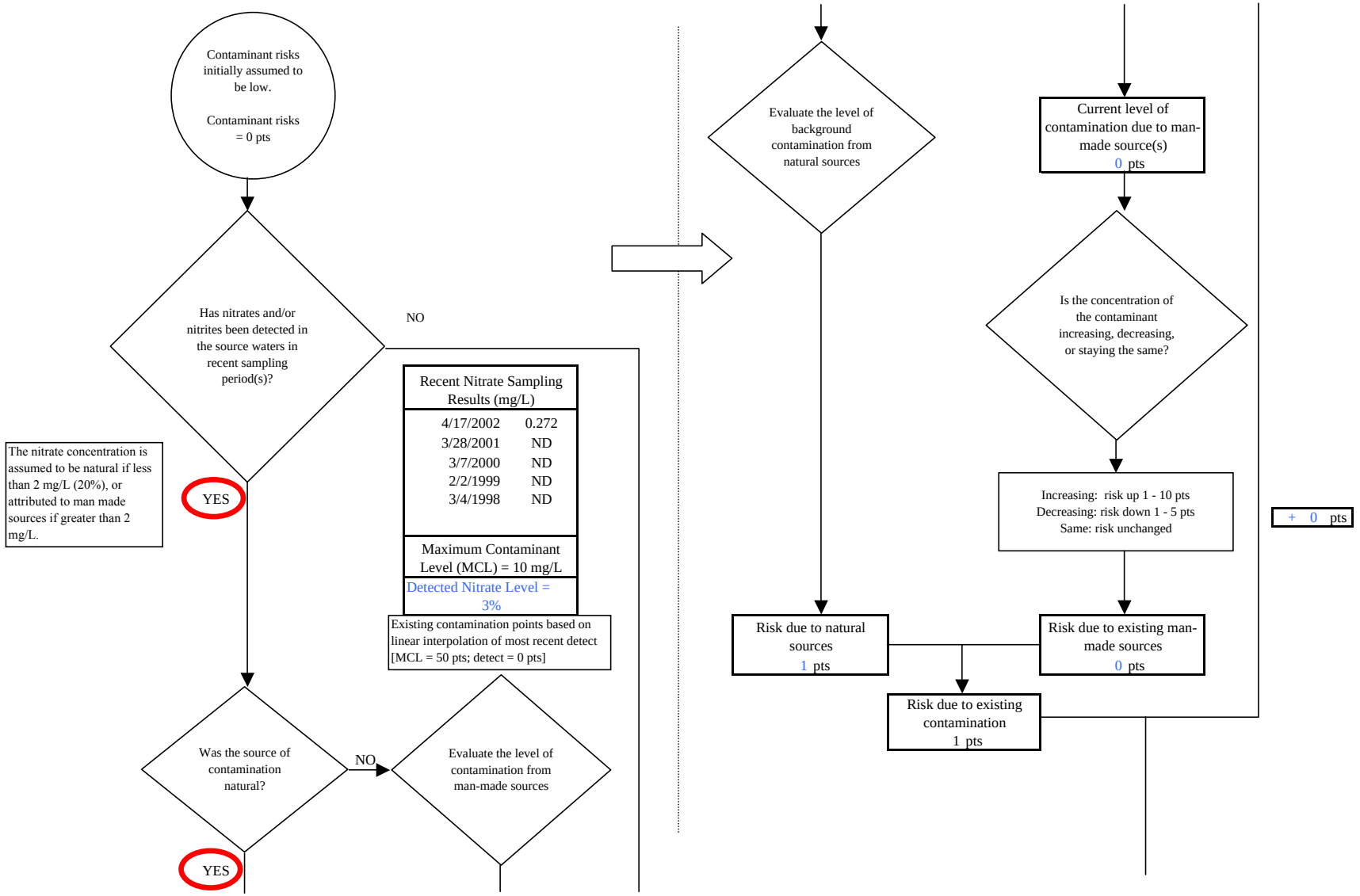


Chart 5. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Nitrates and Nitrites

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	10	0	10
Medium(s)	1	0	1
Low(s)	1	1	2

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

Matrix Score 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.

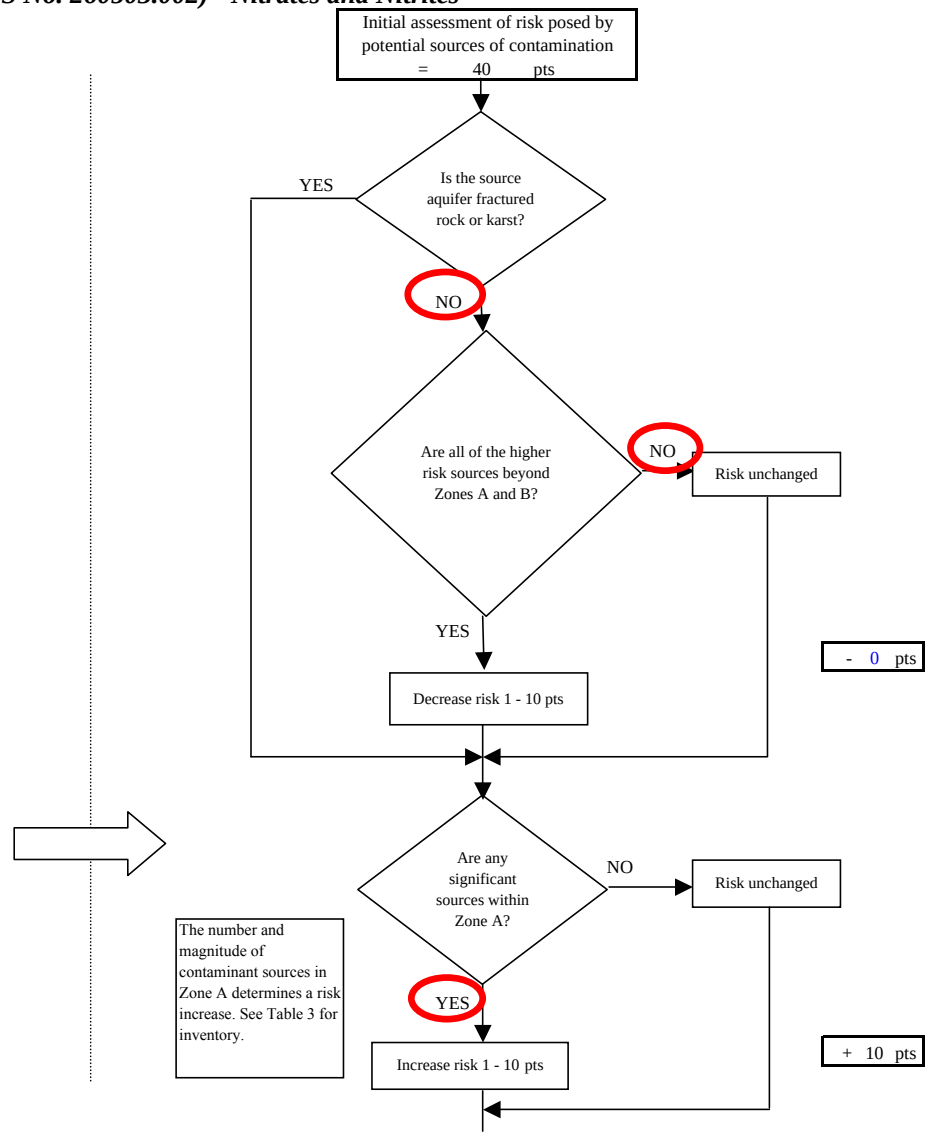


Chart 5. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Nitrates and Nitrites

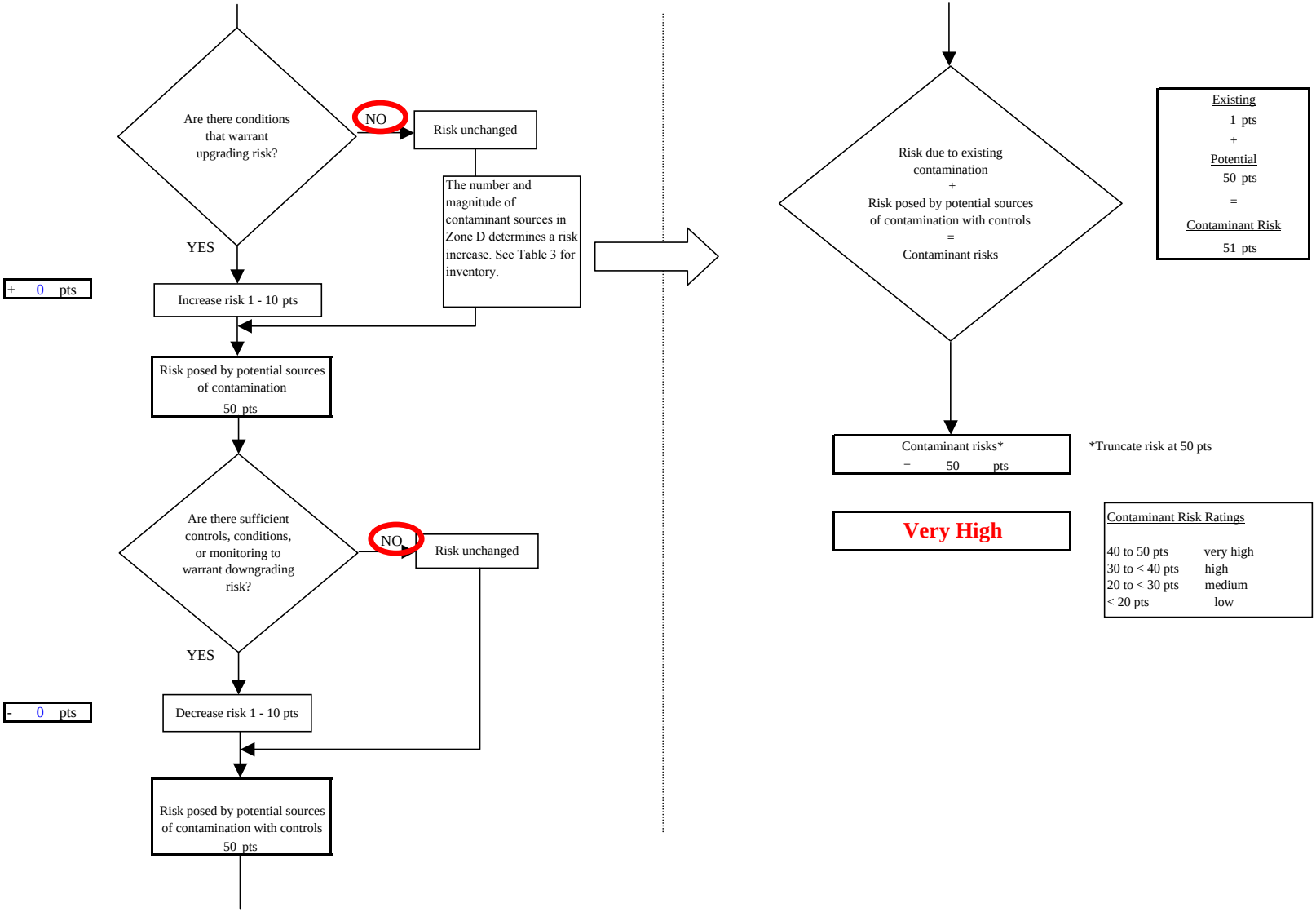


Chart 6. Vulnerability analysis for USAF Chugach Support Services (PWS No. 260503.002) - Nitrates and Nitrites

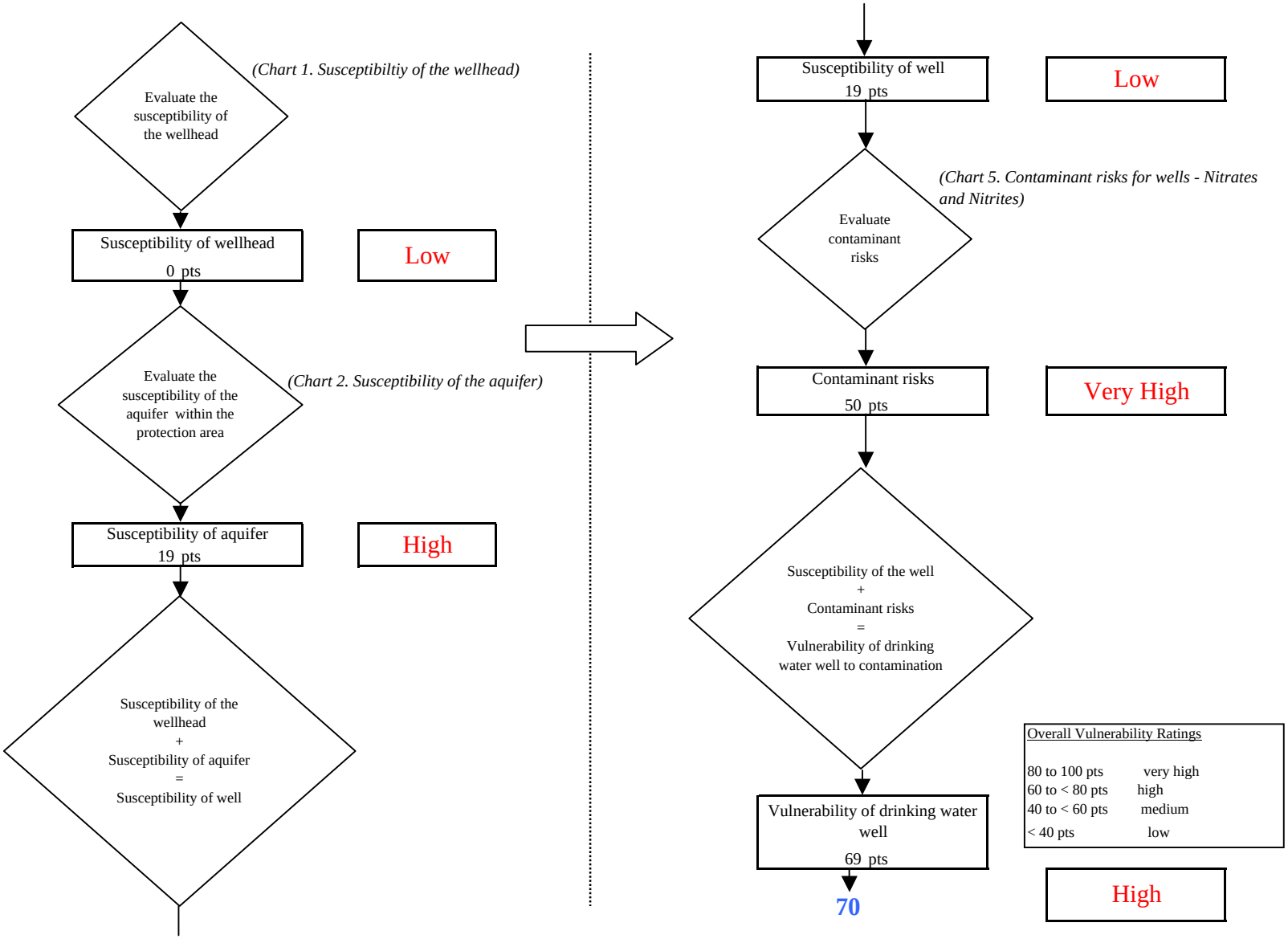


Chart 7. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Volatile Organic Chemicals

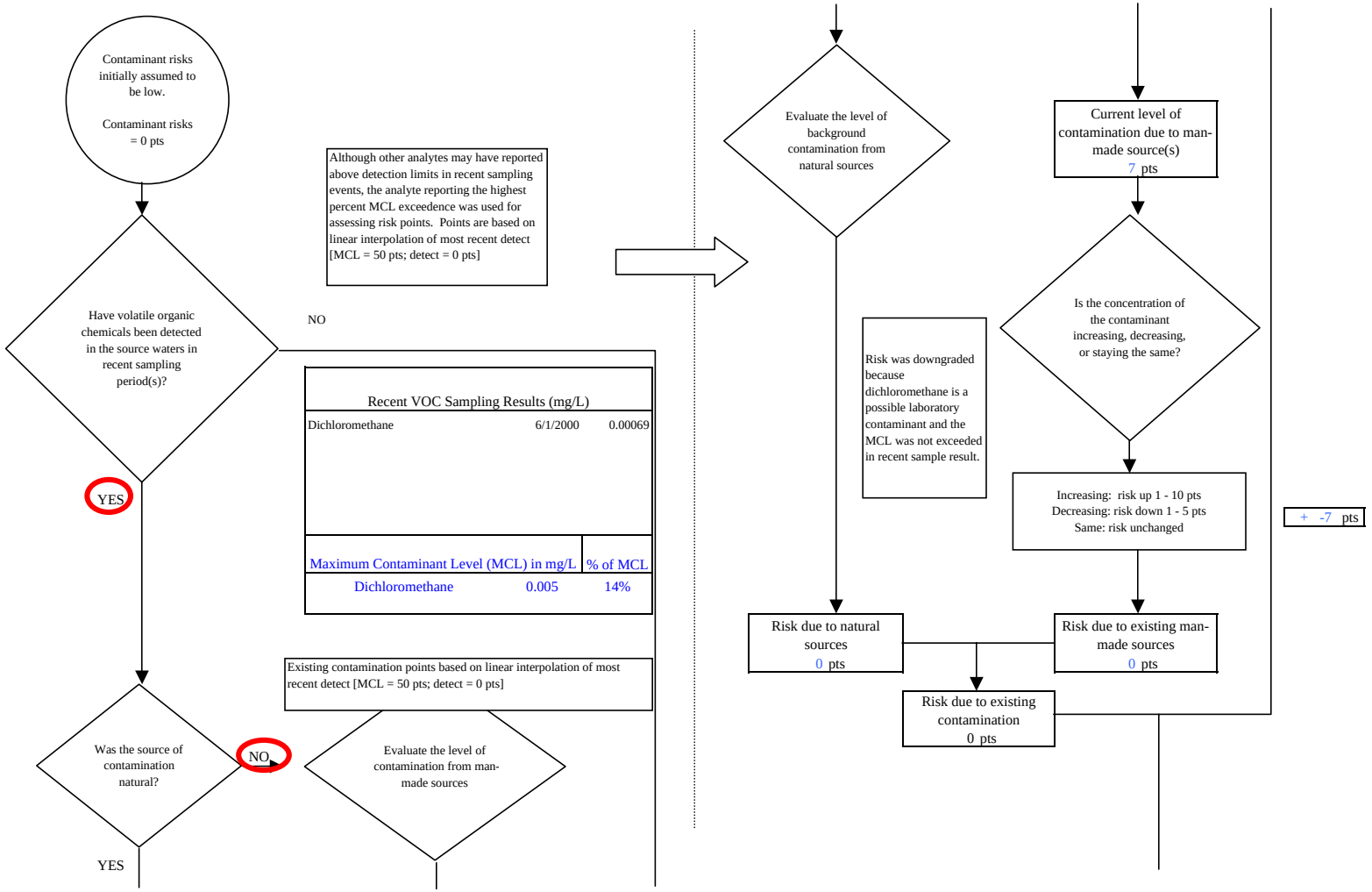
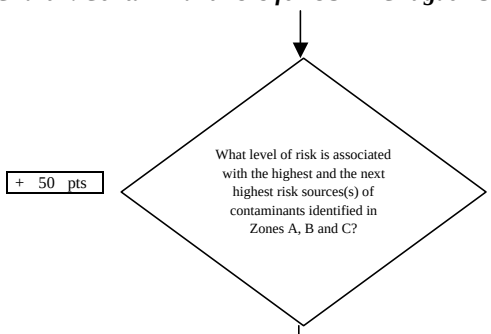


Chart 7. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Volatile Organic Chemicals



+ 50 pts

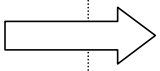
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	1	0	1
High(s)	11	2	13
Medium(s)	5	0	5
Low(s)	2	1	3

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

Matrix Score 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.



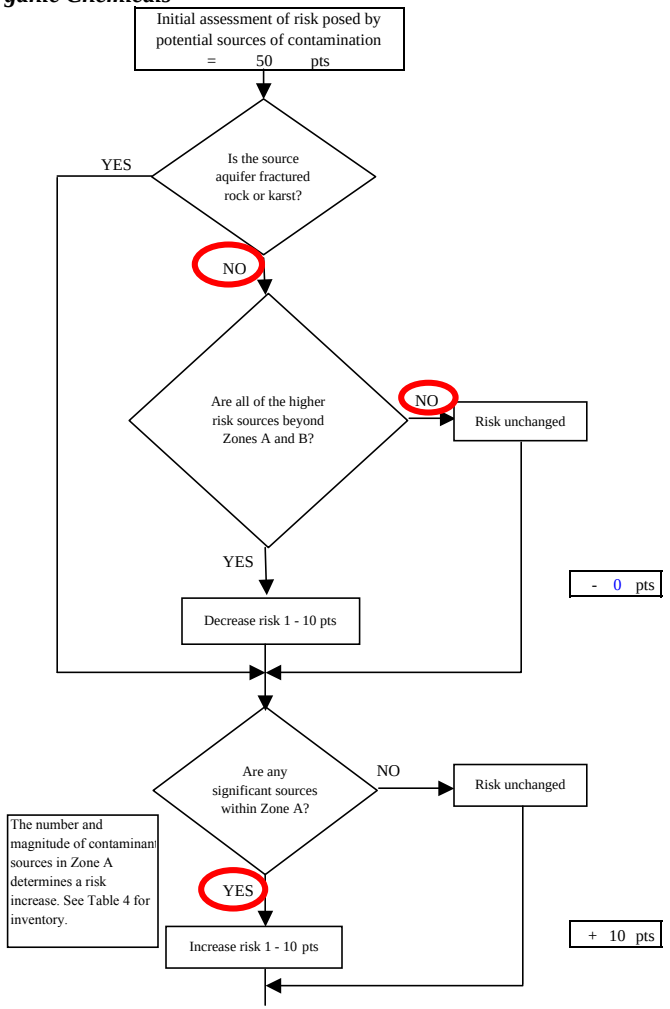


Chart 7. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Volatile Organic Chemicals

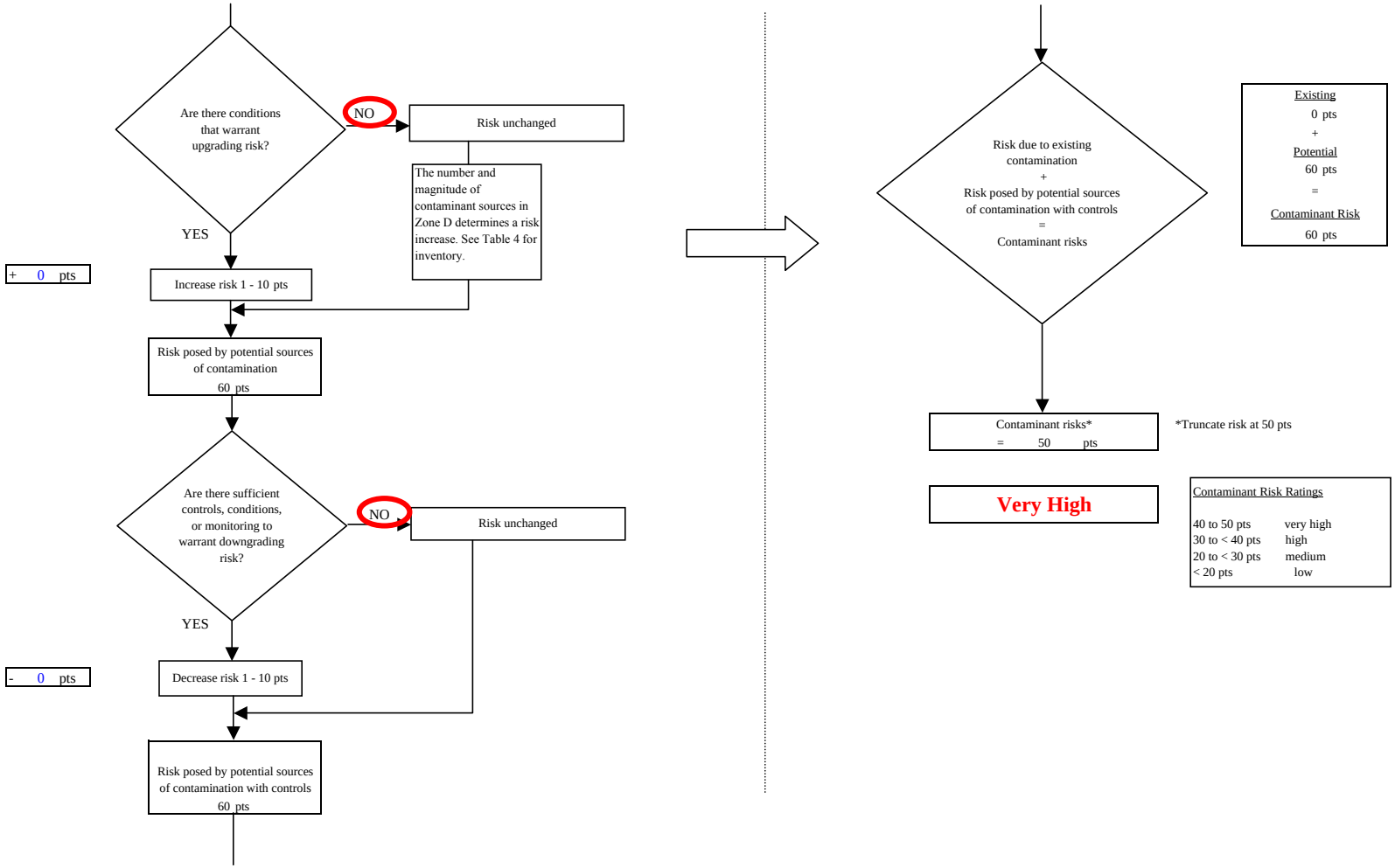


Chart 8. Vulnerability analysis for USAF Chugach Support Services (PWS No. 260503.002) - Volatile Organic Chemicals

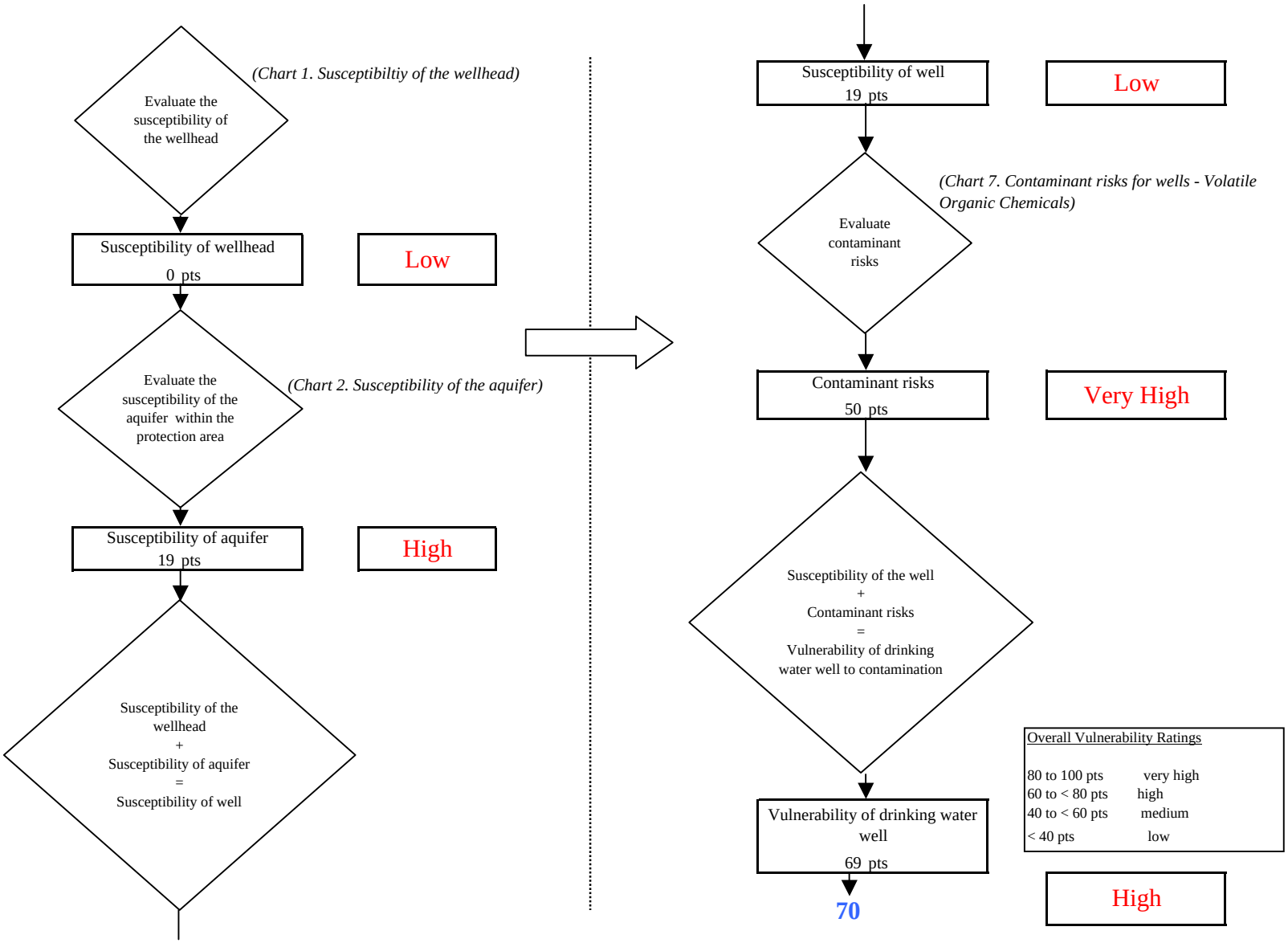


Chart 9. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Heavy Metals, Cyanide and Other Inorganic Chemicals

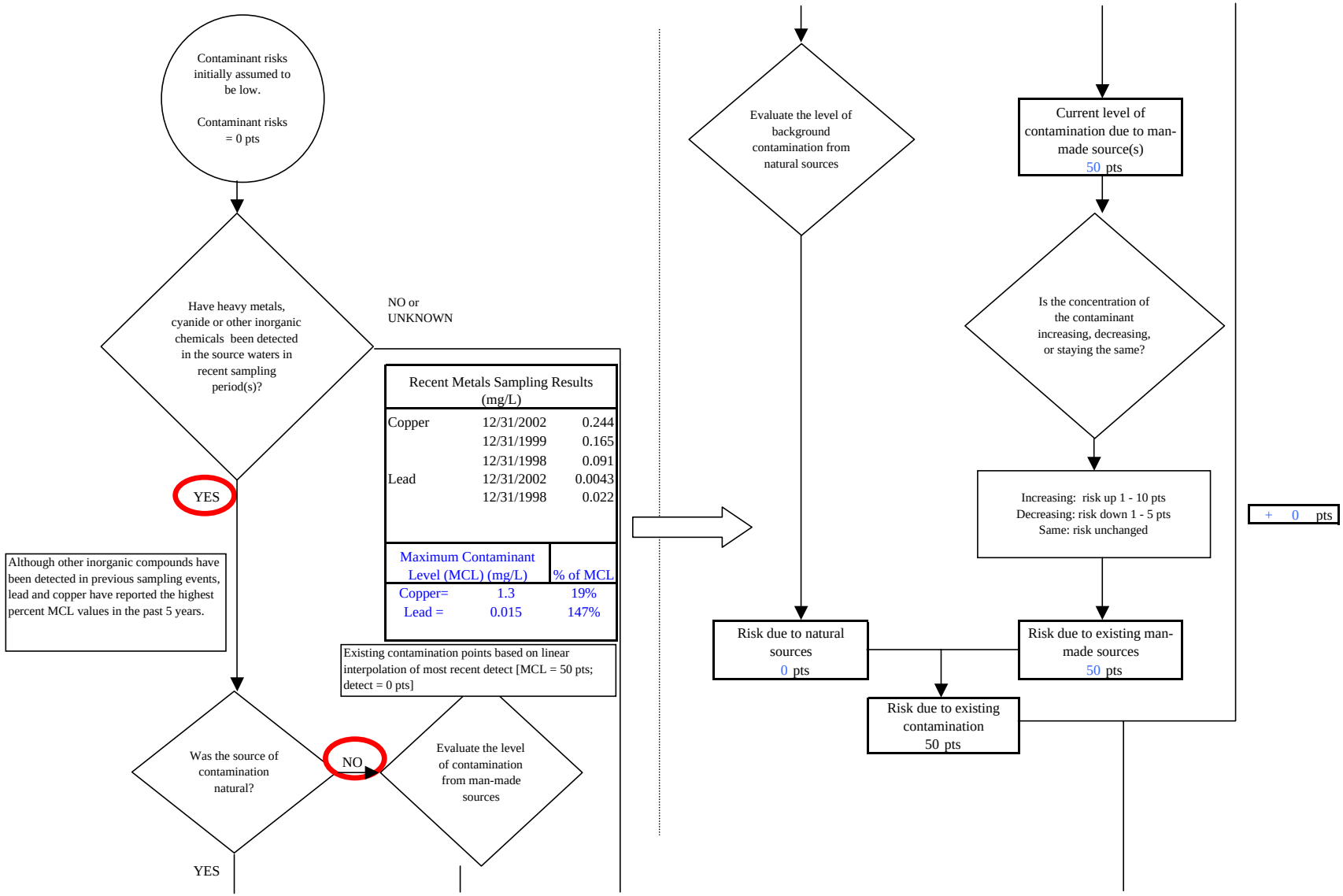


Chart 9. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 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)	10	0	10
High(s)	0	0	0
Medium(s)	39	50	89
Low(s)	6	1	7

	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

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO → Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

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

Chart 9. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Heavy Metals, Cyanide and Other Inorganic Chemicals

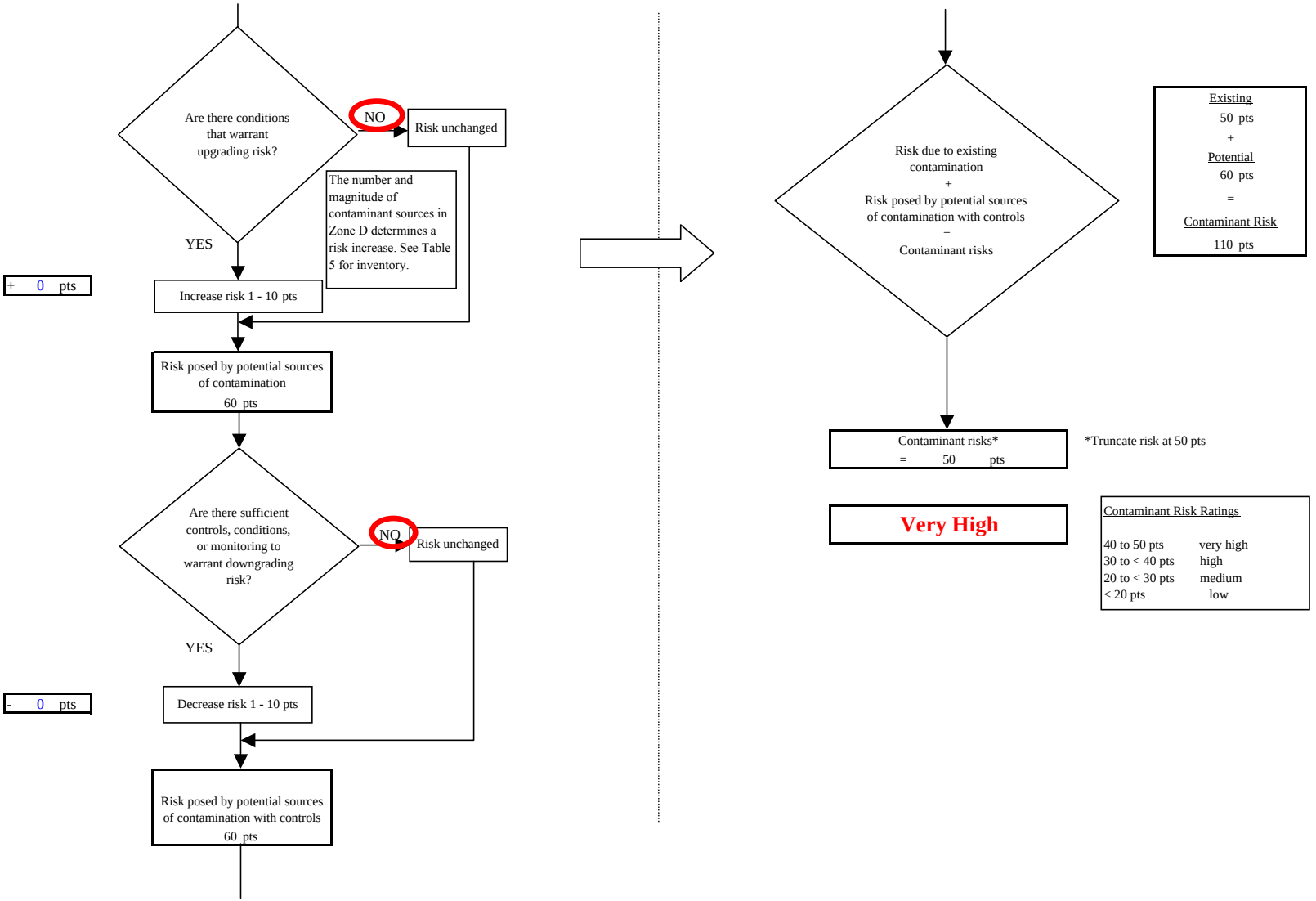


Chart 10. Vulnerability analysis for USAF Chugach Support Services (PWS No. 260503.002) - Heavy Metals, Cyanide and Other Inorganic Chemicals

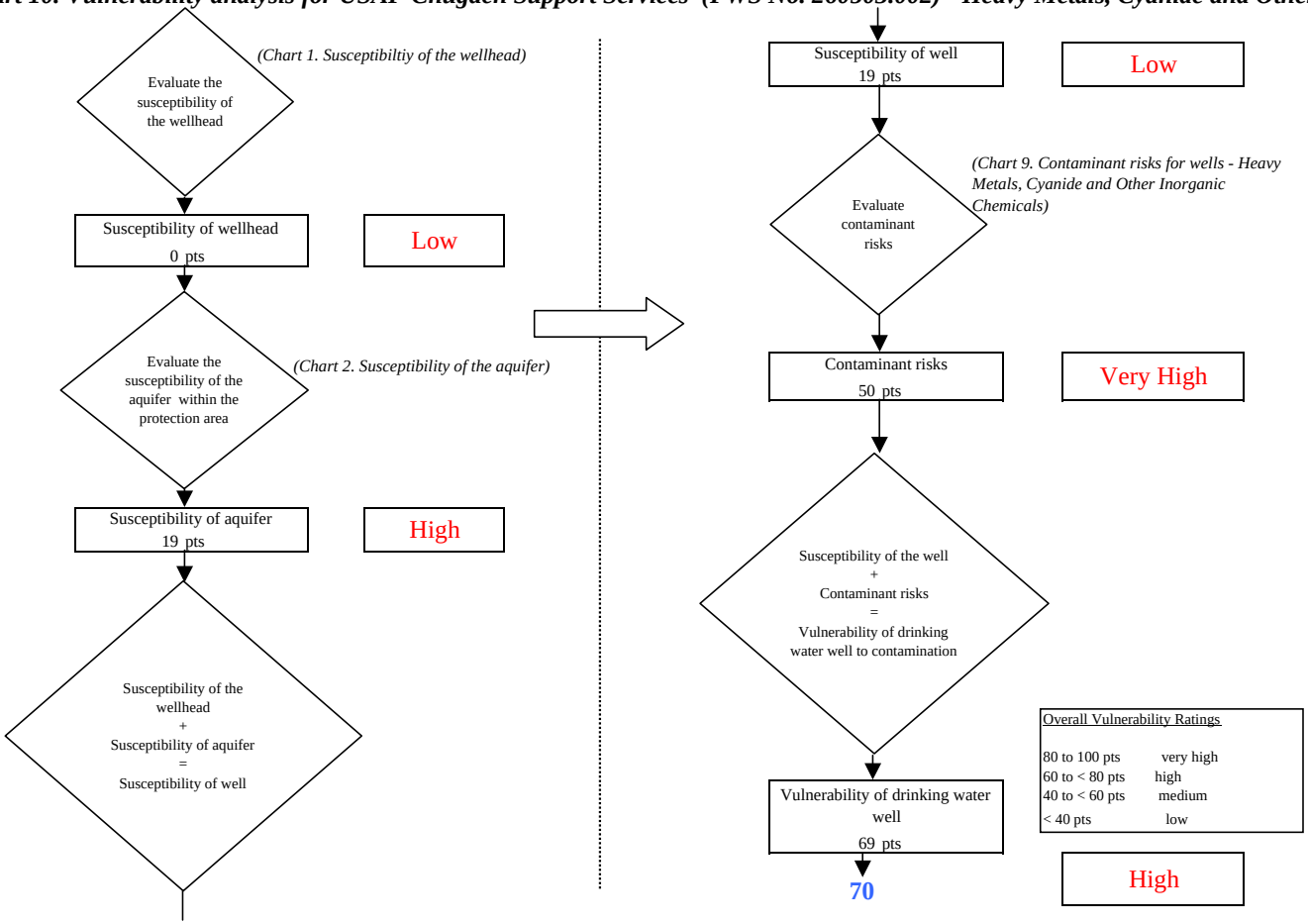


Chart 11. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Synthetic Organic Chemicals

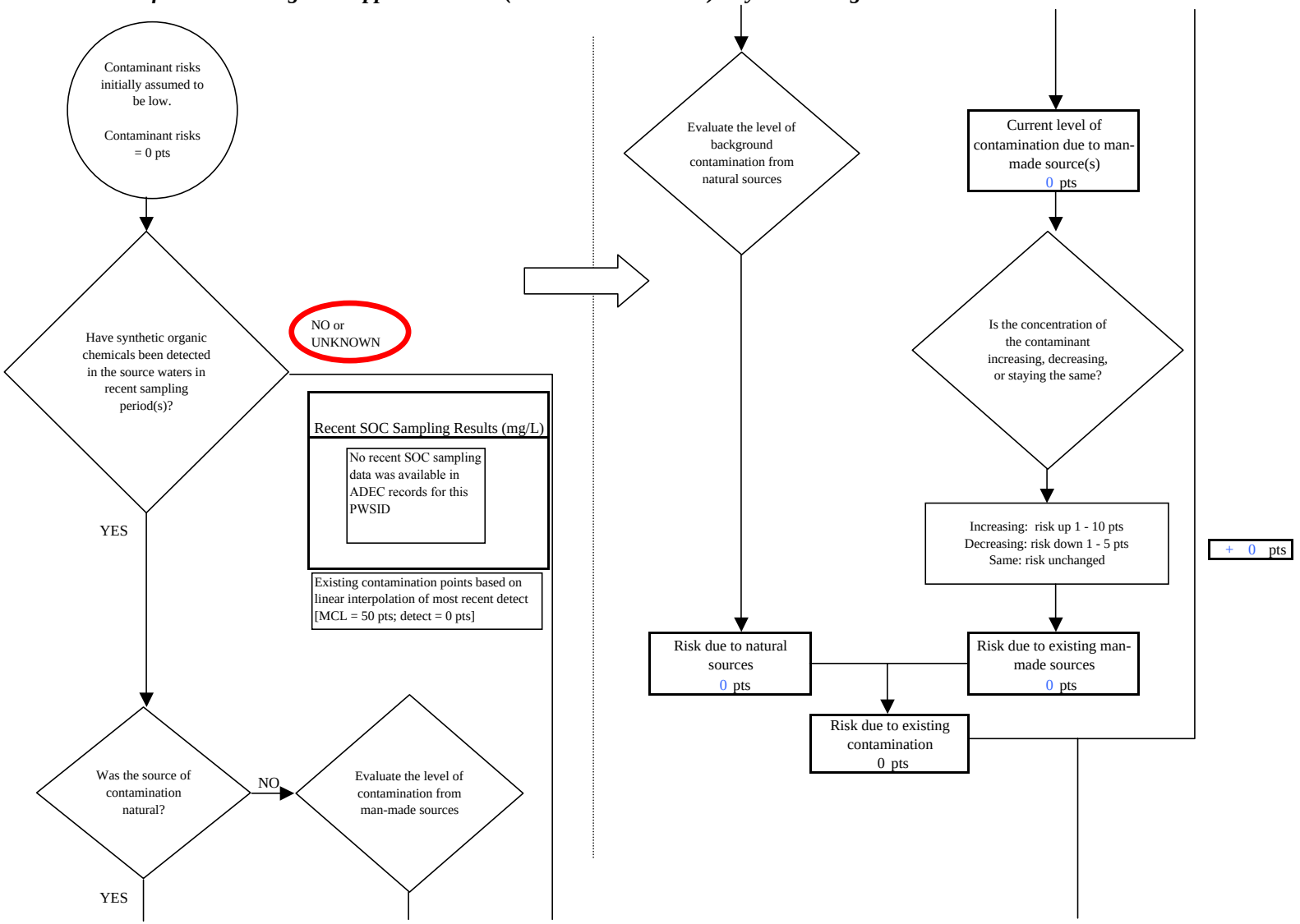
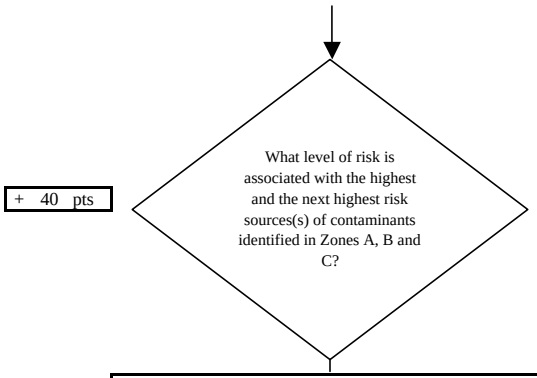


Chart 11. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Synthetic Organic Chemicals



+ 40 pts

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	10	0	10
Medium(s)	0	0	0
Low(s)	3	0	3

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

Matrix Score 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.

The number and magnitude of contaminant sources in Zone A determines a risk increase. See Table 6 for inventory.

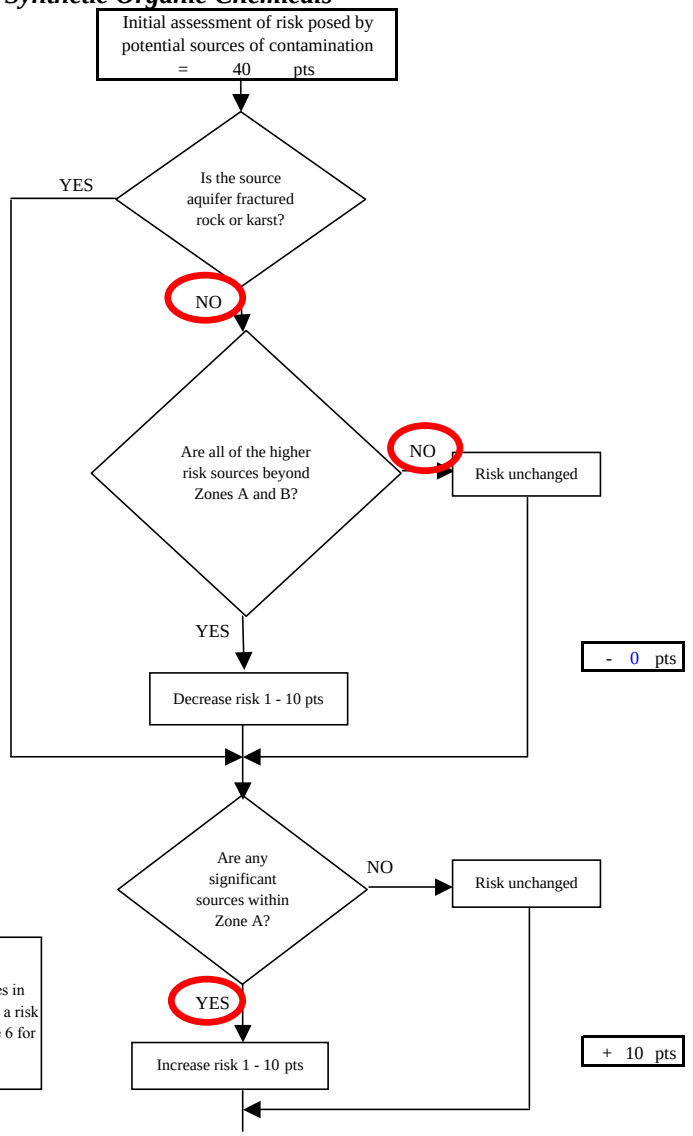


Chart 11. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Synthetic Organic Chemicals

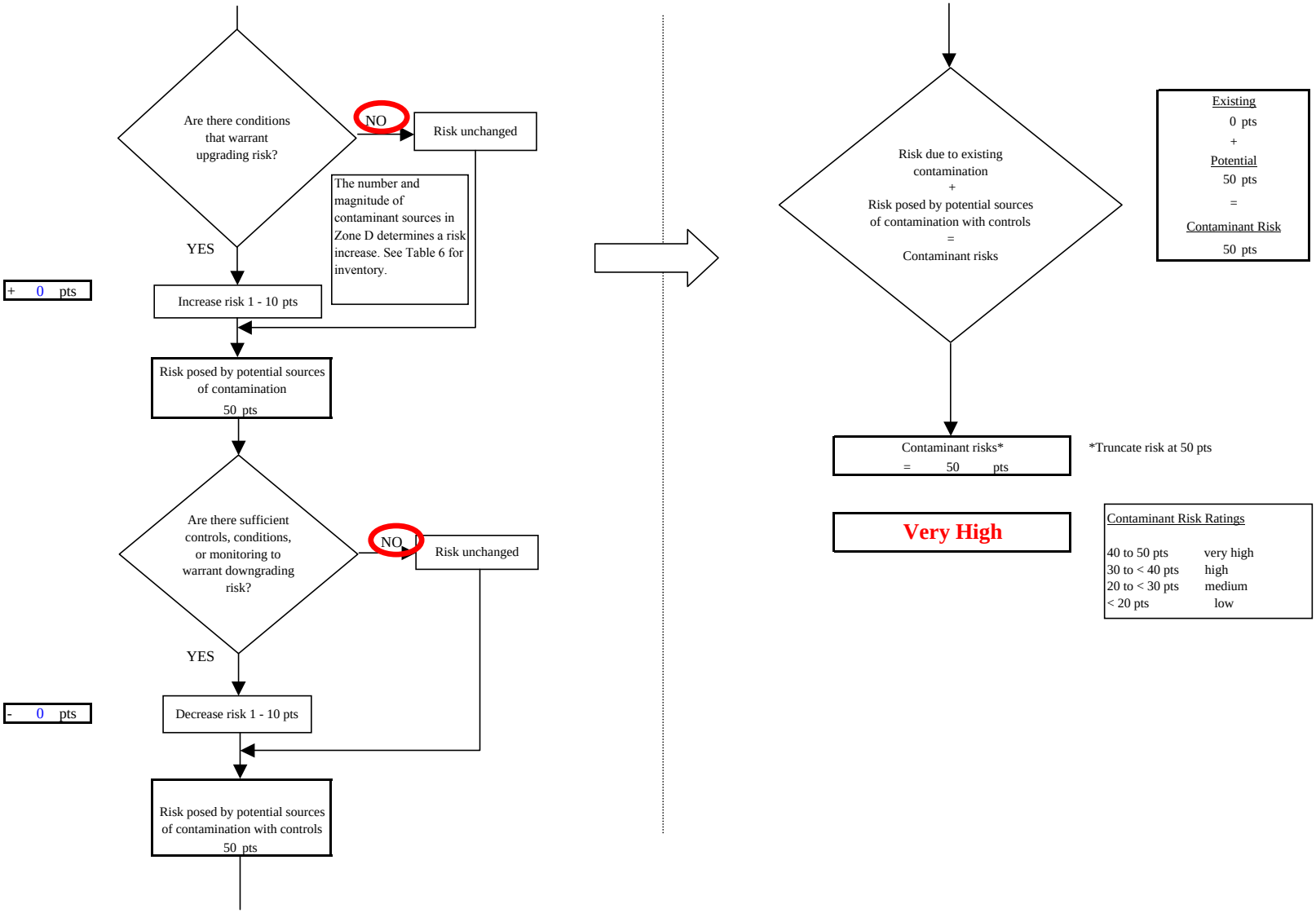


Chart 12. Vulnerability analysis for USAF Chugach Support Services (PWS No. 260503.002) - Synthetic Organic Chemicals

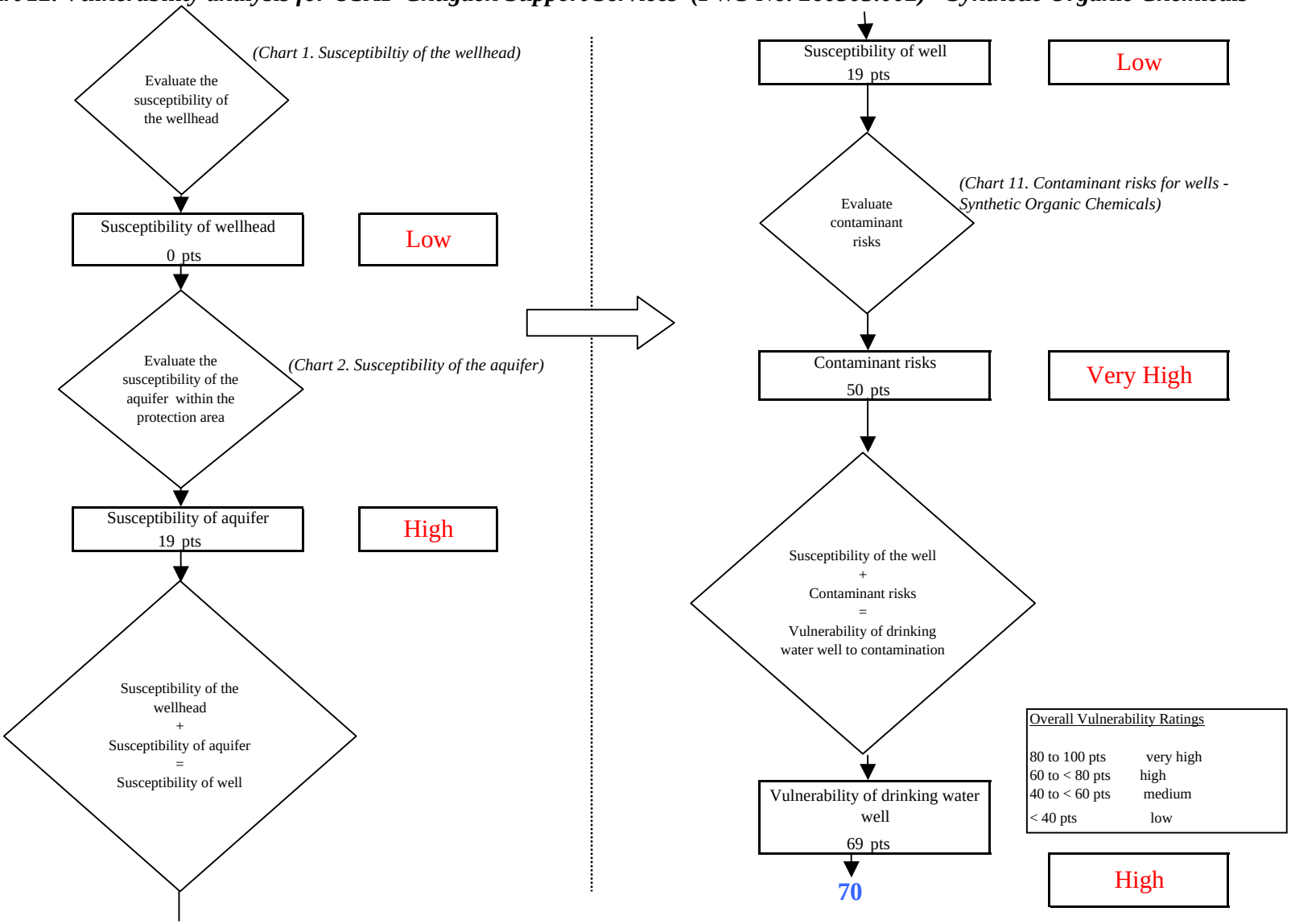


Chart 13. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Other Organic Chemicals

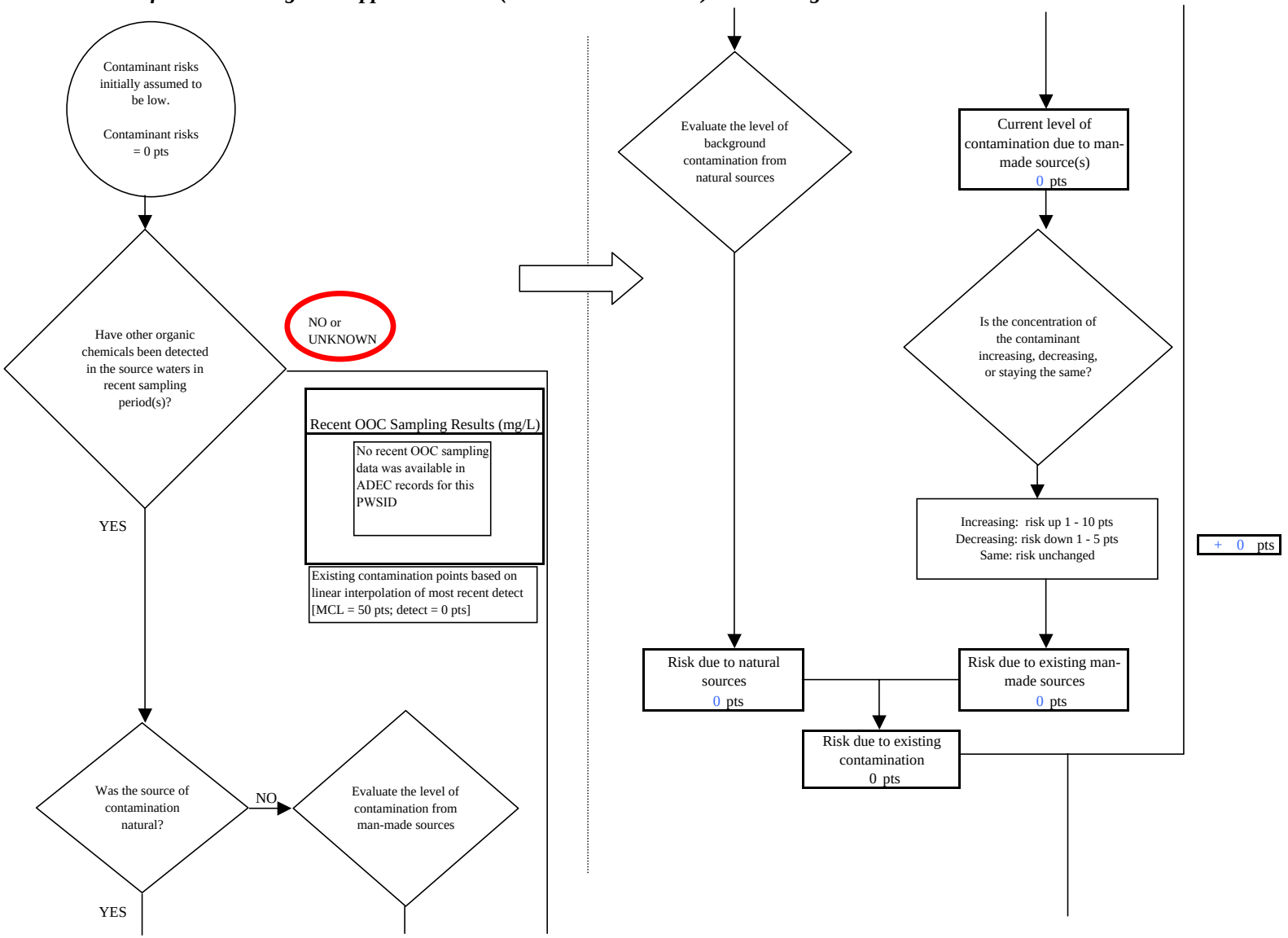
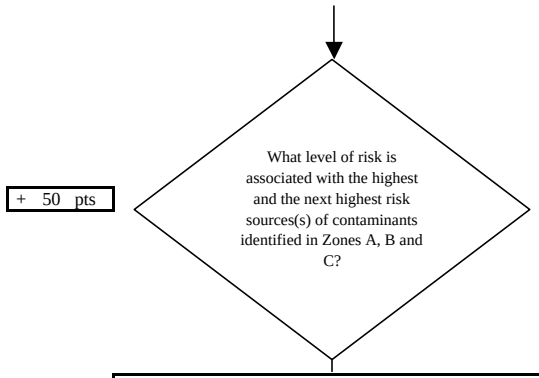


Chart 13. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Other Organic Chemicals



+ 50 pts

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)	14	0	14
Medium(s)	2	0	2
Low(s)	2	1	3

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

Matrix Score 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.

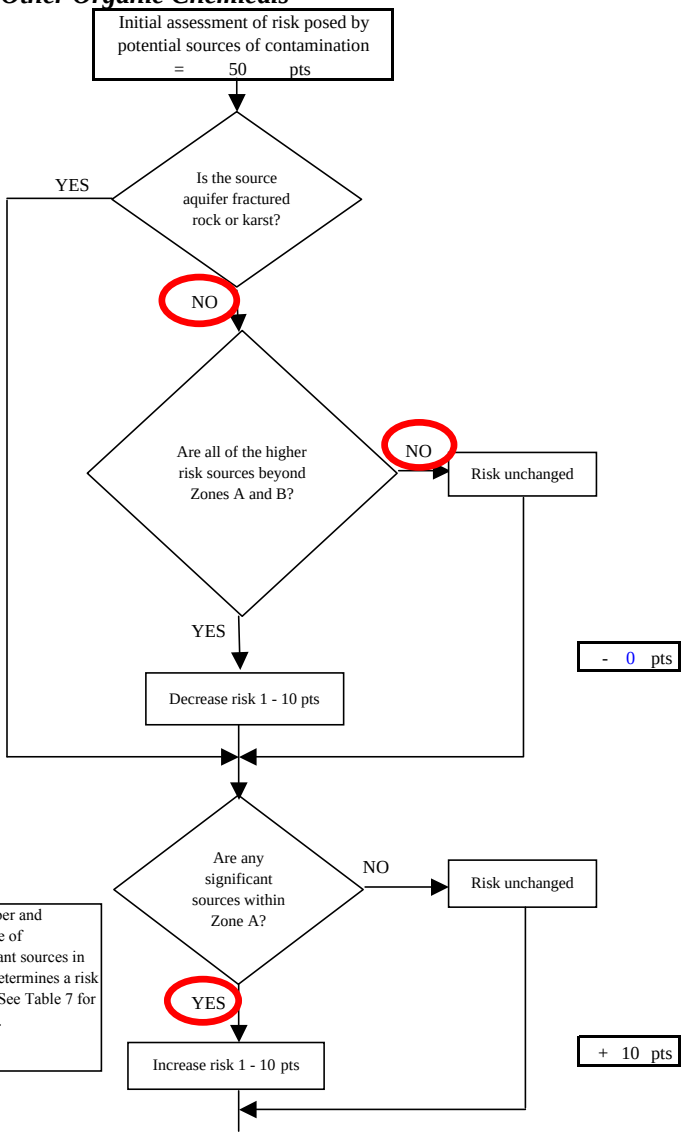


Chart 13. Contaminant risks for USAF Chugach Support Services (PWS No. 260503.002) - Other Organic Chemicals

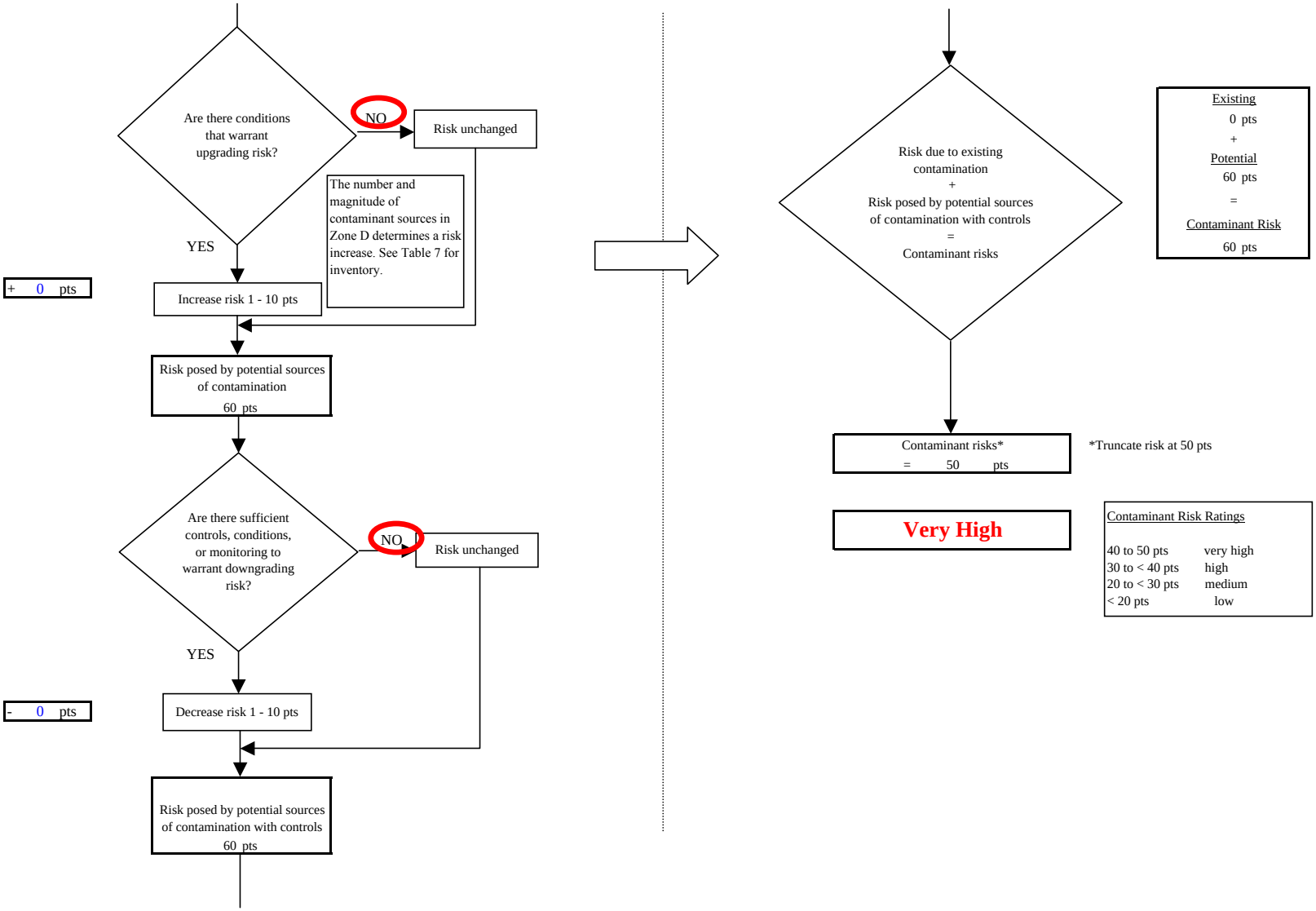


Chart 14. Vulnerability analysis for USAF Chugach Support Services (PWS No. 260503.002) - Other Organic Chemicals