Hydrologic Susceptibility and Vulnerability Assessment for US Army Ft. Richardson - Ship Creek Public Drinking Water Source, Anchorage, Alaska

DRINKING WATER PROTECTION PROGRAM REPORT 14

January 2001

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By TRENA K. HALLBACK

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2001

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By TRENA K. HALLBACK

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The US Army Ft. Richardson Ship Creek Public Water System is a Class A (community) water system consisting of one surface water source. Identified potential and current sources of contaminants for the Ft. Richardson Ship Creek source are activities associated with recreational trails, gravel roads, wastewater holding tanks, and a contaminated site due to leaking underground fuel storage tanks. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, and other organic chemicals. Overall, Ft. Richardson's Ship Creek public water system received a vulnerability rating of **Medium** for bacteria and viruses, nitrates and/or nitrites, heavy metals, volatile organic chemicals, other organic chemicals, and synthetic organic chemicals.

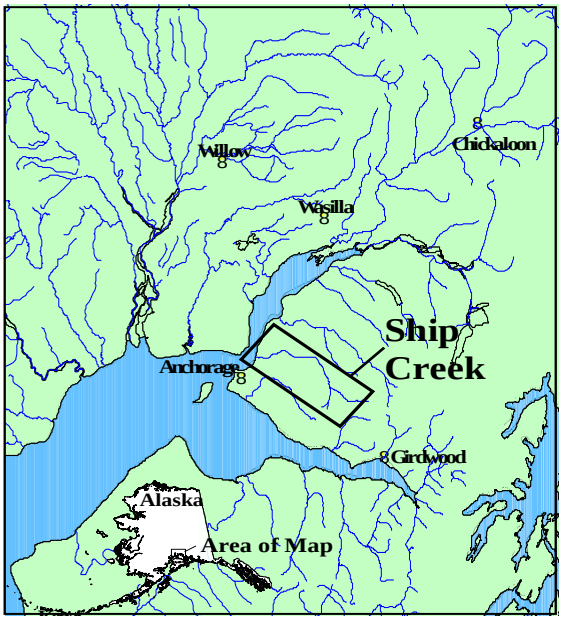

Figure 1. Index map showing the location of Ship Creek.

INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners/operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for the Ft. Richardson's Ship Creek source of public drinking water. This source consists of one surface water body in the Anchorage area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, combines a review of the natural hydrologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for voluntary local protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

PHYSIOGRAPHY OF THE SHIP CREEK WATERSHED, ALASKA

The Ship Creek watershed is located in southcentral Alaska within the states largest city, Anchorage. This area is bounded on the north, west, and south by two estuaries, Knik and Turnagain Arms of Cook Inlet, and on the east by the Chugach Mountains. Ship Creek lies within the Chugach State Park and begins at an elevation of 5,100 feet, within a glacially carved valley of the Chugach Mountains. The area is structurally complex and composed of variably metamorphosed sedimentary and igneous rocks (Clark, 1972). The upper areas of this valley contain mountainous terrain with bedrock exposures. The lower region contains terrain comprised of glacial outwash and stream deposits.

The vegetation surrounding Ship Creek varies with the elevation. The upper portion of the basin is sparsely forested consisting of sub alpine and alpine vegetation.

The middle portion of the basin is partly forested. The lower portion of the basin is industrialized and commercialized with intermittent green belts. Approximately 29 miles long, Ship Creek occupies an area of 90 square miles and has an average total annual discharge of 58,514 cubic feet per second (Bertrand, 1999). Mean annual precipitation is approximately 35 inches per year. Mean daily temperature ranges from 65° F in the summer months to 8° F during winter months, with total snowfall of 71 inches (Western Regional Climate Center, 2000).

FT. RICHARDSON - SHIP CREEK PUBLIC WATER SYSTEM

The Ft. Richardson - Ship Creek Public Water System is a Class A (community) water system, which is owned and operated by the US Army. The system receives its water directly from an intake in Ship Creek, located approximately 500 feet above sea level. This water system operates year round and serves approximately 11,500 residents through multiple service connections.

ASSESSMENT AND PROTECTION AREA FOR FT. RICHARDSON - SHIP CREEK

The Drinking Water Protection and Assessment Areas that has been established for Ft. Richardson's Ship Creek public drinking water source are the areas that are most sensitive to contamination. These areas have served as a basis for assessing the risk of the drinking water source to contamination. The zones around the drinking water source are the most critical areas for the preservation of the quality of the water system's drinking water. For simplicity, these areas will be known as the Drinking Water Protection Areas and will serve as the focus for voluntary protection efforts.

Conceptually, surface water flow is downgradient over steep bedrock slopes toward the unconsolidated stream and glacial deposits in the valley. Water enters the stream either through overland flow or through baseflow into the stream. Baseflow is the portion of a stream's discharge or flow from groundwater seeping into the stream.

The Drinking Water Protection Areas established for surface water bodies by the Alaska Department of Environmental Conservation (ADEC) are separated into zones. The Drinking Water Protection Areas for the Ft. Richardson's Ship Creek source contains three zones,

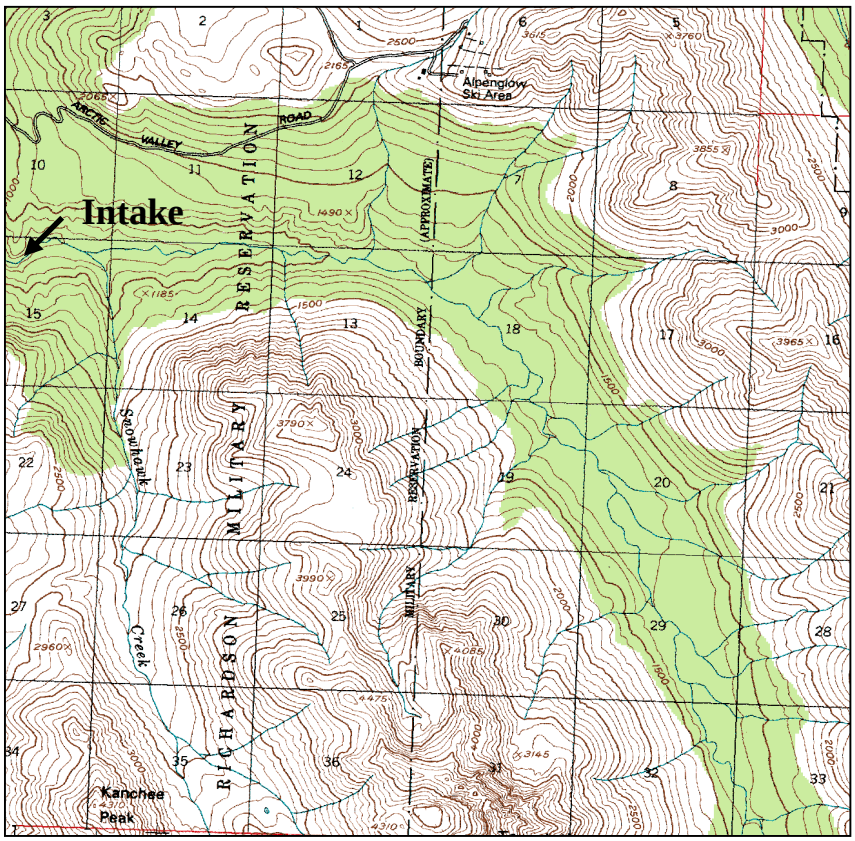

Figure 2. Map showing the location of the drinking water source intake at Ship Creek.

Zone A through Zone C (See Map 1 and Map 2 in Appendix A). These zones identify areas along Ship Creek and its main feeder tributaries. Contaminants released within these areas can potentially pollute the drinking water source. Zone A corresponds to an area within 1000 feet of Ship Creek and its main tributaries. Zone B identifies the area within one mile, and Zone C identifies the entire watershed.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within Ft. Richardson's Ship Creek Drinking Water Protection Areas. This survey was completed through a search of agency records, other publicly available information, and verified by the operator of the public water system. Potential sources of contamination to drinking water supplies cover 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 this assessment and all Class A assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

Map 3 in Appendix B depicts the Contaminant Source Inventory for Ft. Richardson's Ship Creek. Inventoried potential sources of contamination within Zones A through Zone C are listed in Table 1 of Appendix A. Below is a summary of the contaminant sources inventoried within Ft. Richardson's Ship Creek protection area:

- Recreation areas;
- Gravel roads;
- Wastewater holding tank; and
- Contaminated site due to leaking underground fuel storage tanks.

These potential contaminant sources present risk for five of the six categories of drinking water contaminants.

RANKING OF CONTAMINANT RISKS

Potential and existing sources of contamination have been identified, sorted, and ranked 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. Contaminant risks are further a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the surface water body.

VULNERABILITY OF FT. RICHARDSON - SHIP CREEK SOURCE WATER

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

- Natural susceptibility; and
- Contaminant risks.

Each of the six categories of drinking water contaminants are analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

A score for the susceptibility of the surface water body to contamination is achieved by examining the construction of the intake, potential for runoff, and the capacity of the water body to dilute contaminants. Ship Creek water source has an inheritant risk simply because it is a surface water body. Surface water generally has more debris and dirt particles (higher turbidity) and biological contamination. Contaminants are able to flow directly into the water source. Table 1 shows the overall susceptibility score and rating for Ft. Richardson's Ship Creek drinking water source. Due to the high potential for runoff and the low discharge rate of Ship Creek, it receives a susceptibility rating of High.

Table 1. Susceptibility of the Surface Water Source to Contamination

	Score	Rating
Susceptibility	40	High

Contaminant risks to a drinking water source depend on the type, number and/or density, and distribution of contaminant sources. Recreation trails, gravel roads, a wastewater holding tank, and a contaminated site due to leaking underground fuel storage tanks contribute the highest risk for potential contamination to the Ft. Richardson's Ship Creek source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks (See Appendix D) is assigned based on the findings of the Contaminant Source Inventory (Appendix B - Table 1 – Table 6). This portion of the analysis examines any existing or historical contamination that has been detected in the drinking water source through routine sampling. It also reviews contamination that has or may occur within 1000 feet of the surface water body. Table 2 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	15	Low
Nitrates and/or Nitrites	13	Low
Volatile Organic Chemicals	10	Low
Heavy Metals, Cyanide, and other Inorganic Chemicals	10	Low
Synthetic Organic Chemicals	0	Low
Other Organic Chemicals	10	Low

Vulnerability of the drinking water source to contamination is the combination of susceptibility of the surface water source and the contaminant risks. Table 3 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants (See Appendix D). Note: scores are rounded off to the nearest five.

The ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals are listed in Tables 2 through 6 in Appendix B.

The Ship Creek Trail extends approximately six miles along the northeast shore of Ship Creek. This trail poses the highest risk for potential contamination to the creek. The trail is limited to hiking, and has additional routes that extend up into the watershed. The use of this trail is considered low. Other potential sources of contamination include a ski resort, gravel roads, a wastewater holding tank, and a contaminated site due to leaking underground fuel storage tanks.

Table 3. Overall Vulnerability of Ft. Richardson - Ship Creek Public Drinking Water System to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	55	Medium
Nitrates and Nitrites	55	Medium
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide, and other Inorganic Chemicals	50	Medium
Synthetic Organic Chemicals	40	Medium
Other Organic Chemicals	50	Medium

The recreation trail and ski area rank as the highest potential sources of contamination by bacteria and viruses and nitrates and/or nitrites. Bacteria, viruses, nitrates and/or nitrites are detectable in natural background levels for many water systems throughout the area. The sampling history of Ft. Richardson's Ship Creek water source identifies low concentrations of nitrates. According to ADEC records, existing nitrate concentrations are 10 percent of the maximum contaminant level (MCL) for this contaminant. Activities along the recreation trail have the potential to increase the amount of nitrates moving directly into the water source. The close proximity of the hiking trail to the shores of Ship Creek increases the risk of contamination to the water source. However, due to the low use of the hiking trail the risk to the water source is downgraded.

Further up the watershed lies a 6600-gallon wastewater holding tank. Once every ten days the wastewater holding tank is emptied into a sewage transfer truck and sewage is transported off site. The holding tank is located in Zone C, and because of its distance from Ship Creek it poses a low potential risk.
The existing low-level concentrations combined with

the low use of the trail have resulted in an overall risk ranking of Medium for nitrates and/or nitrites.

The same wastewater holding tank and recreation areas pose a potential source of contamination by bacteria and viruses as well. The greatest risks to health are microbiological contamination such as bacteria, viruses, and protozoa. Only a small amount of bacteria and viruses are required to endanger public health. The overall risk ranking for bacteria and viruses is Medium due to the activities related to, and the location of the recreation areas and wastewater holding tank.

In 1990, a 2000-gallon diesel fuel tank was excavated and removed from a building located at the ski resort. During the tank removal, surrounding soil was found to be contaminated with petroleum. ADEC records (File # L76-1.12) indicate 570 cubic yards of soil were excavated to a depth of 20 feet below ground surface, at which point bedrock was encountered. Contamination was evident on the bedrock. The tank was replaced with a 3000-gallon diesel fuel tank and covered with a concrete pad. In 1996, another 4000 cubic yards of soil was excavated to remove residual contamination at this site. In 1999, the tank was removed, and another 250 cubic yards of soil was excavated.

In 1993, the ski resort experienced a surface spill of heating oil when the integrity of a fuel oil pipeline was breached. The contaminated soil was removed to a depth of five feet and transported off site.

These events contribute the highest potential risk of contamination by volatile organic chemicals. The site has been remediated to ADEC standards and is considered closed. This combined with the location and distance away from the creek's shore result in an overall risk ranking of Medium for this category of contaminants.

Natural background levels of heavy metals exist throughout the Chugach Mountains (Clark and Bartsch, 1971). The areas gravel roads rank as the highest potential source of contamination by heavy metals, cyanide, other inorganic chemicals, and other organic chemicals. The overall risk ranking for heavy metals is Medium.

There are no known potential or existing sources of synthetic organic chemicals within this watershed.

SUMMARY

A *Source Water Assessment* has been completed for the Ft. Richardson's Ship Creek public drinking water source. The overall vulnerability for this source to contamination is **Medium** for bacteria and viruses, nitrates and/or nitrites, heavy metals, volatile organic chemicals, synthetic organic chemicals, and other organic chemicals. This assessment of contaminant risks can be used as a foundation for local voluntary efforts as well as a basis for the continuous efforts on the part of the Municipality of Anchorage 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 public drinking water source.

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Bertrand, C.M., et. al, 1999, Water Resources Data Alaska Water Year 1998: USGS Water-Data Report AK-98-1.

Clark, Sandra H.B., 1972, Reconnaissance Bedrock Geologic Map of the Chugach Mountains Near Anchorage, Alaska.

Clark, Sandra B. and Bartsch, Susan R., 1971, Reconnaissance Geologic Map and Geochemical Analyses of Stream Sediment and Rock Samples of the Anchorage B-7 Quadrangle, Alaska: USGS Open File Report 71-0071.

Western Regional Climate Center, 2000, December 18, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wrcc.dri.edu/index.html

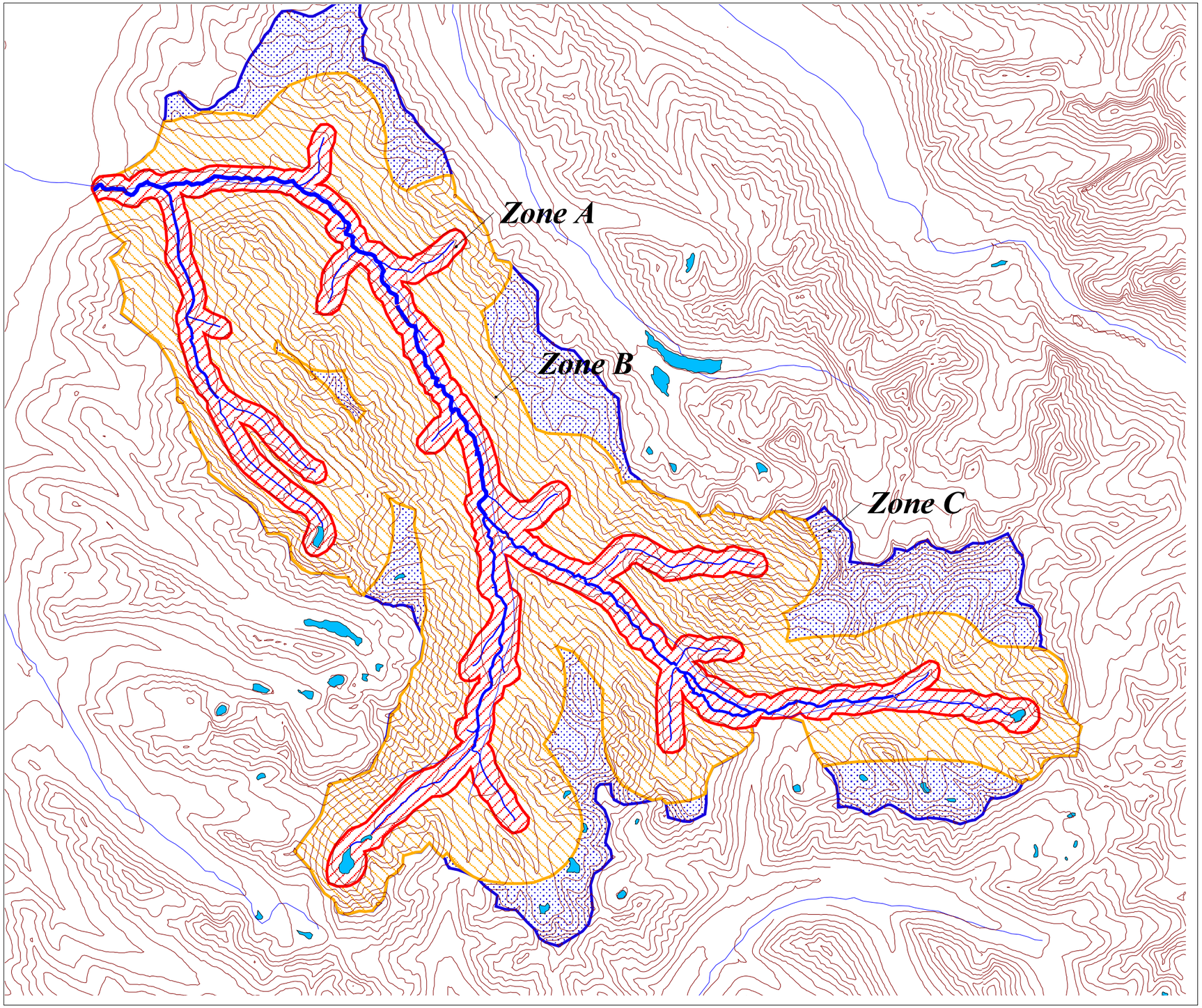
APPENDIX A

MOA - Ship Creek
Drinking Water Protection Areas

US Army
Ft. Richardson
Ship Creek
PWSID 212039.001
Drinking Water Protection Areas

Elevation Contours
Lakes
Streams
2nd order streams
3rd order streams
4th order streams
Zone A
1000 feet from surface water body
Zone B
1 mile from surface water body
Zone C
Enitre watershed

N
W
E
S



5 0 5 10 Miles

Map 1

US Army
Ft. Richardson
Ship Creek
PWSID 212039.001
Drinking Water Protection Areas

- Roads
- Ship creek gravel roads.shp
- Elevation Contours
- Lakes
- 2nd order streams
- 3rd order streams
- 4th order streams

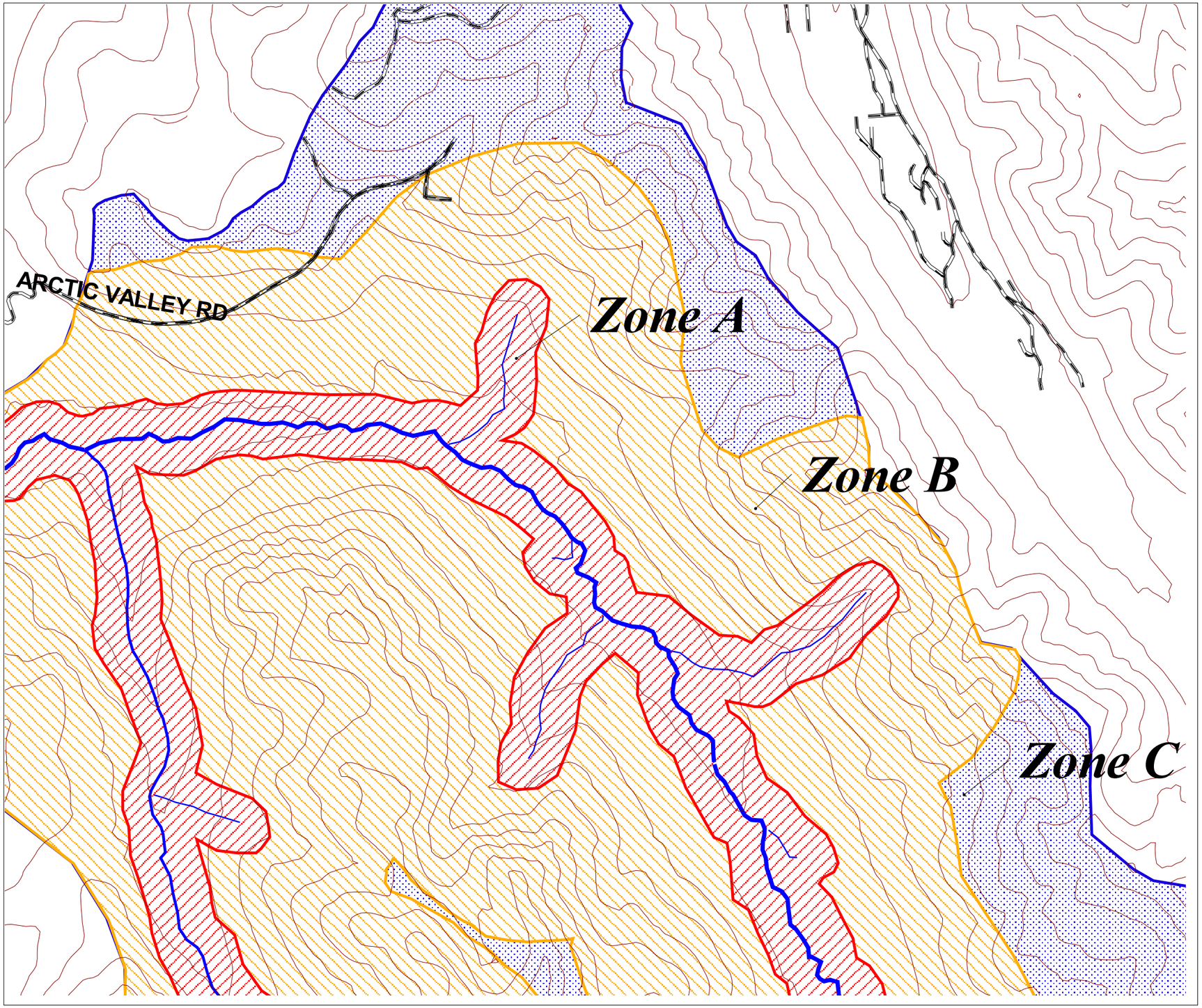
Zone A
- 1000 feet from surface water body

Zone B
- 1 mile from surface water body

Zone C
- Enitre watershed

N
W E
S

Map 2



2 0 2 Miles

APPENDIX B

Contaminant Source Inventory and Risk Ranking for MOA - Ship Creek

Table 1 Contaminant Source Inventory for ***PWSID 212039.001***

US Army Fort Richardson

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Location*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	C	Ft. Richardson, Bldg. 8102	2	ADEC File # L76-1.12
Highways and roads, dirt/gravel	X24	X24-1	B, C	Arctic Valley Road	2	
Recreational trails/areas	X46	X46-1	B, C	Alpenglow Ski Area	2	
Recreational trails/areas	X46	X46-2	A, B	Ship Creek Trail	2	
Highways and roads, dirt/gravel	X24	X24-1	C	Restricted access road	2	
Wastewater Holding Tank	T22	T22-1	C	Alpenglow Ski Area	2	

Contaminant Source Inventory and Risk Ranking for

Table 2 ***PWSID 212039.001***

US Army Fort Richardson

Sources of Bacteria and Viruses

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Recreational trails/areas	X46	X46-1	B, C	Low	1	Alpenglow Ski Area	2	
Recreational trails/areas	X46	X46-2	A, B	Low	2	Ship Creek Trail	2	
Wastewater Holding Tank	T22	T22-1	C	Low	3	Alpenglow Ski Area	2	

Contaminant Source Inventory and Risk Ranking for

Table 3 ***PWSID 212039.001***

US Army Fort Richardson

Sources of Heavy Metals, Cyanide and Other Inorganic Chemical

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	B, C	Low	1	Arctic Valley Road	2	
Highways and roads, dirt/gravel	X24	X24-1	C	Low	2	Restricted access road	2	

Contaminant Source Inventory and Risk Ranking for

Table 4 ***PWSID 212039.001***

US Army Fort Richardson

Sources of Nitrates/Nitrites

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Recreational trails/areas	X46	X46-1	B, C	Low	1	Alpenglow Ski Area	2	
Recreational trails/areas	X46	X46-2	A, B	Low	2	Ship Creek Trail	2	
Wastewater Holding Tank	T22	T22-1	C	Low	3	Alpenglow Ski Area	2	

Contaminant Source Inventory and Risk Ranking for

Table 5 ***PWSID 212039.001***

US Army Fort Richardson

Sources of Other Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Highways and roads, dirt/gravel	X24	X24-1	B, C	Low	1	Arctic Valley Road	2	
Highways and roads, dirt/gravel	X24	X24-1	C	Low	2	Restricted access road	2	

Contaminant Source Inventory and Risk Ranking for

Table 6 ***PWSID 212039.001***

US Army Fort Richardson

Sources of Volatile Organic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Overall Rank after Analysis*	*Location*	*Map Number*	*Comments*
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U4	U4-1	C	Low	1	Ft. Richardson, Bldg. 8102	2	ADEC File # L76-1.12
Highways and roads, dirt/gravel	X24	X24-1	B, C	Very Low	2	Arctic Valley Road	2	
Highways and roads, dirt/gravel	X24	X24-1	C	Very Low	3	Restricted access road	2	

APPENDIX C

Ft. Richardson - Ship Creek
Drinking Water Protection Areas
and Potential & Existing Contaminant Sources

US Army
Ft. Richardson
Ship Creek
PWSID 212039.001
Drinking Water Protection Areas and Potential and Existing Contaminant Sources

- Intake
- Wastewater Holding Tank
- Radio towers
- Streams
- Restricted access roads
- Roads
- Contaminated sites, DEC recognized
- Railroads
- Trails
- Elevation Contours
- Lakes
- Recreational trails/area
- 2nd order streams
- 3rd order streams
- 4th order streams

Zone A
- 1000 feet from surface water body

Zone B
- 1 mile from surface water body

Zone C
- Enitre watershed

N
W E
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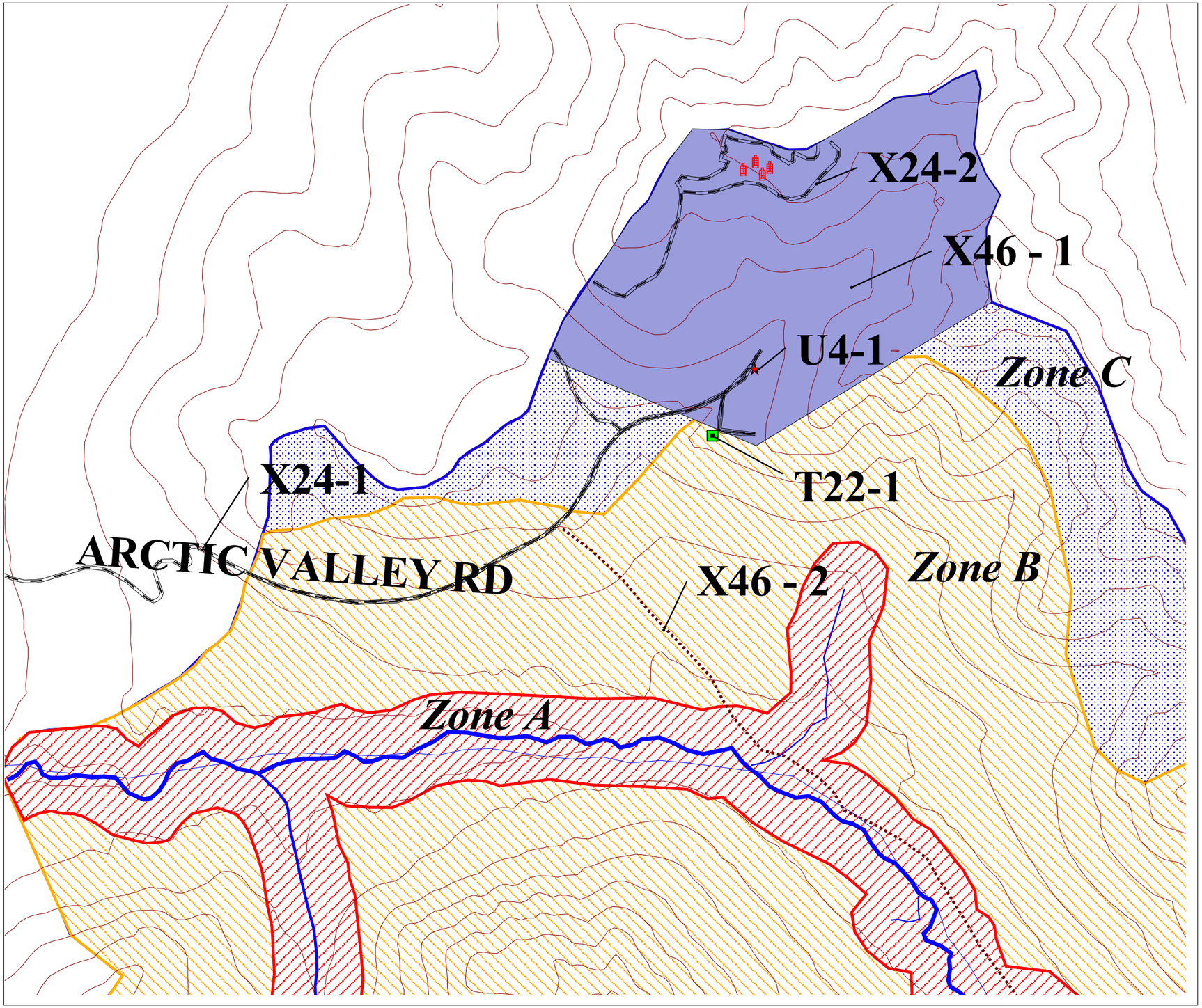
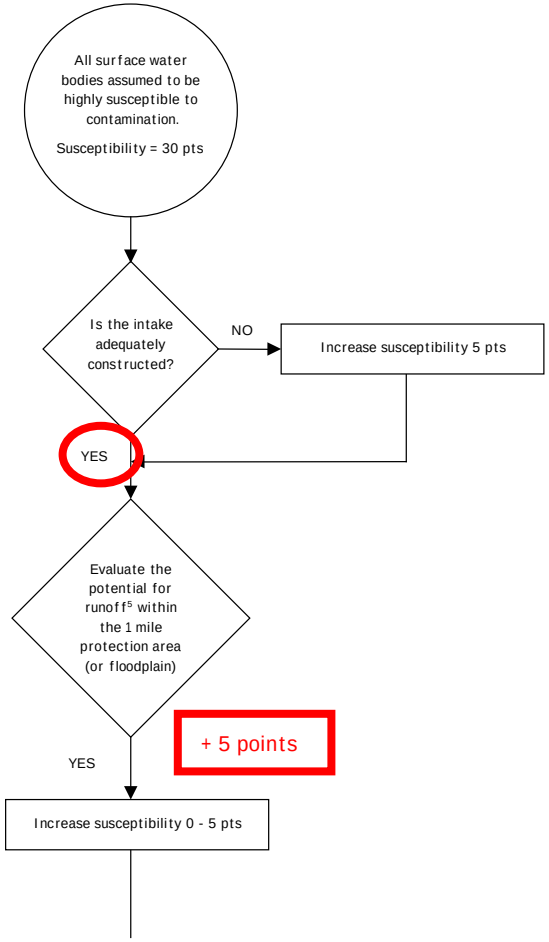


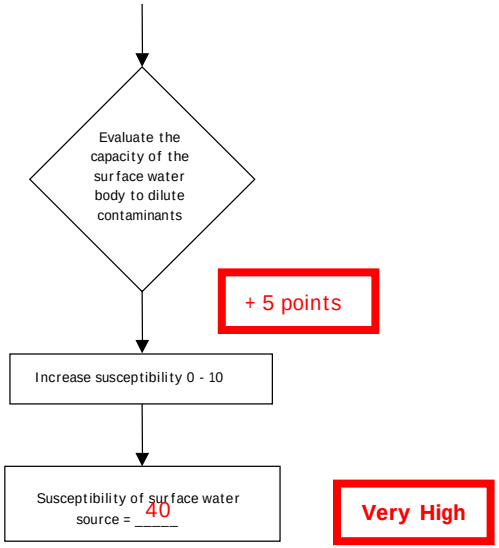
Map 3

APPENDIX D

Vulnerability Analysis for MOA - Ship Creek Public Drinking Water System

Chart 1. Susceptibility of the Surface Water Source





5. Potential for Runoff

Average annual precipitation:
≤ 15 in/ yr, 0 pts
> 15 in/ yr, 2 pts

Slope of land surface:
≤ 3%, 0 pts
> 3%, 3 pts

6. Capacity to Dilute Contaminants

Average total annual stream or river discharge
> 90,000 cfs, 0 pts.
20,000 – 89,999 cfs, 5 pts.
< 20,000 cfs, 10 pts .

Lakes or ponds
Area:
> 1 mi ^{2}, 0 pts
≤ 1 mi ^{2}, 5 pts

Residence time:
≤ 1 yr, 0 pts
> 1 yr, 5 pts

Runoff:
Annual precipitation
35 in. = 2 pts.
Slope >3% = 3 pts.

Surface Water Source Susceptibility Ratings

40 to 50 pts	very high
30 to < 40 pts	high

Capacity to Dilute:
Stream discharge 58,514 cfs
= 5 pts.

Chart 2. Contaminant Risks for Ft. Richardson Ship Creek - Bacteria and Viruses

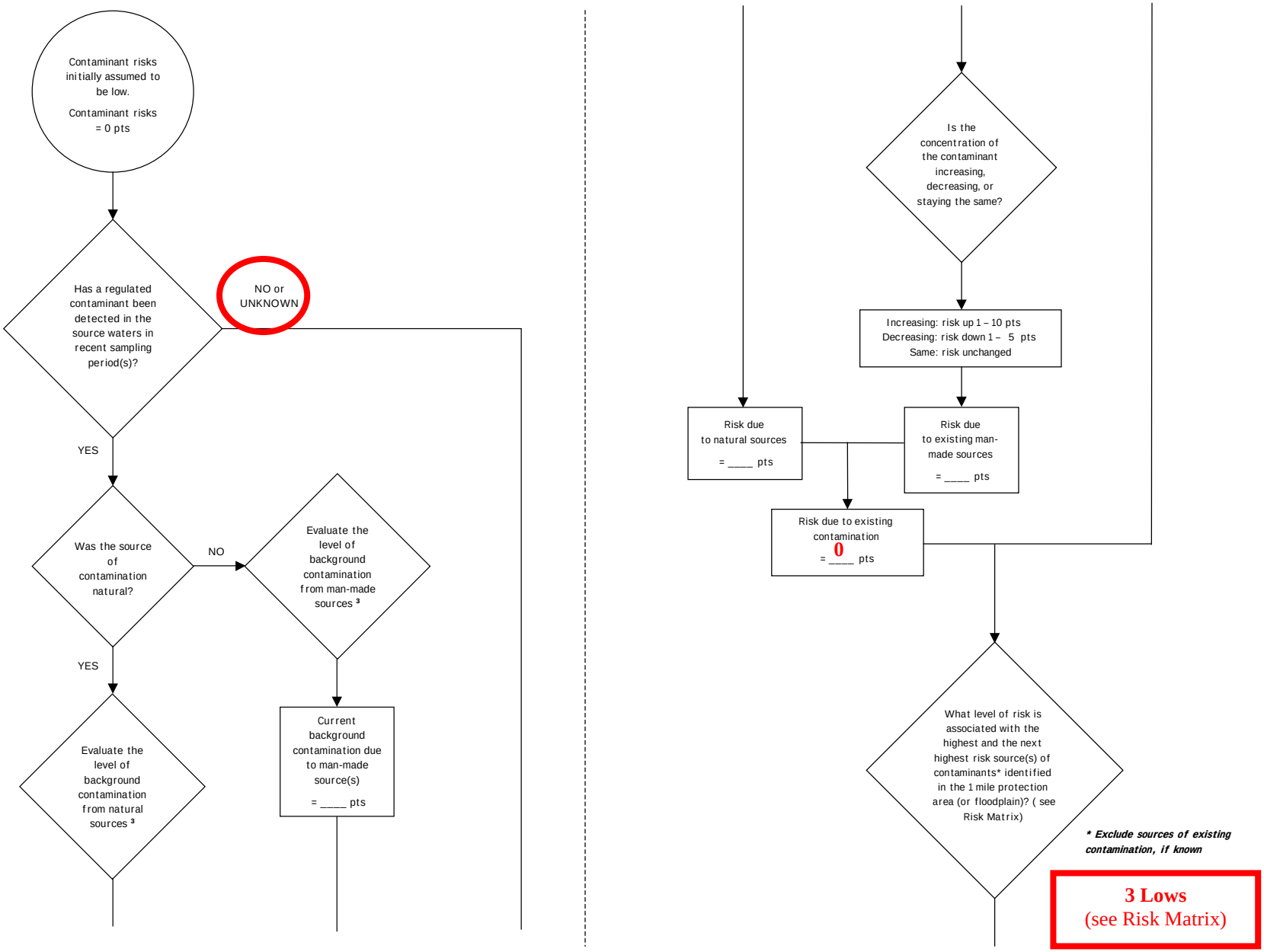
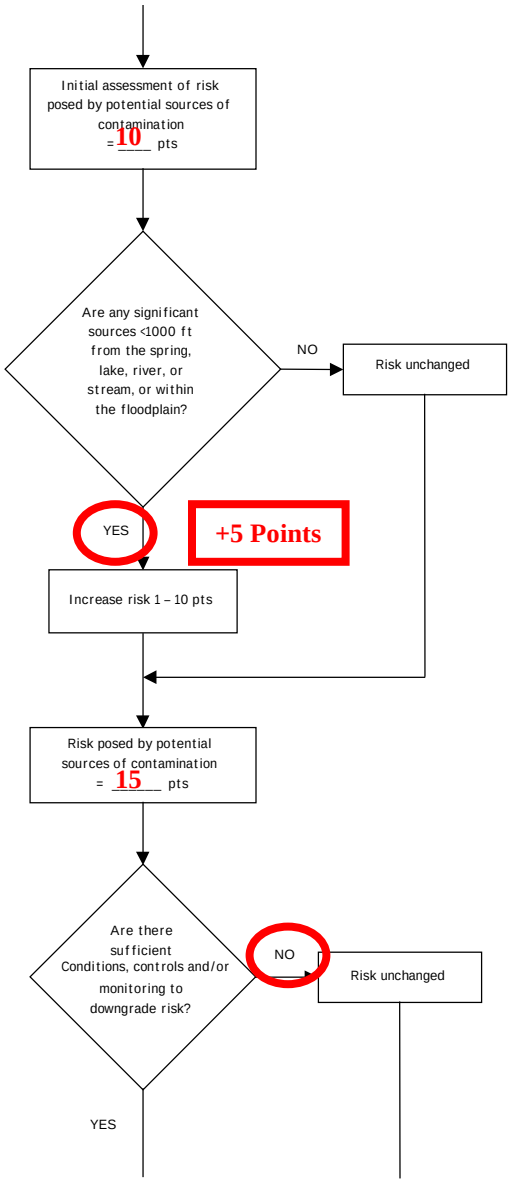
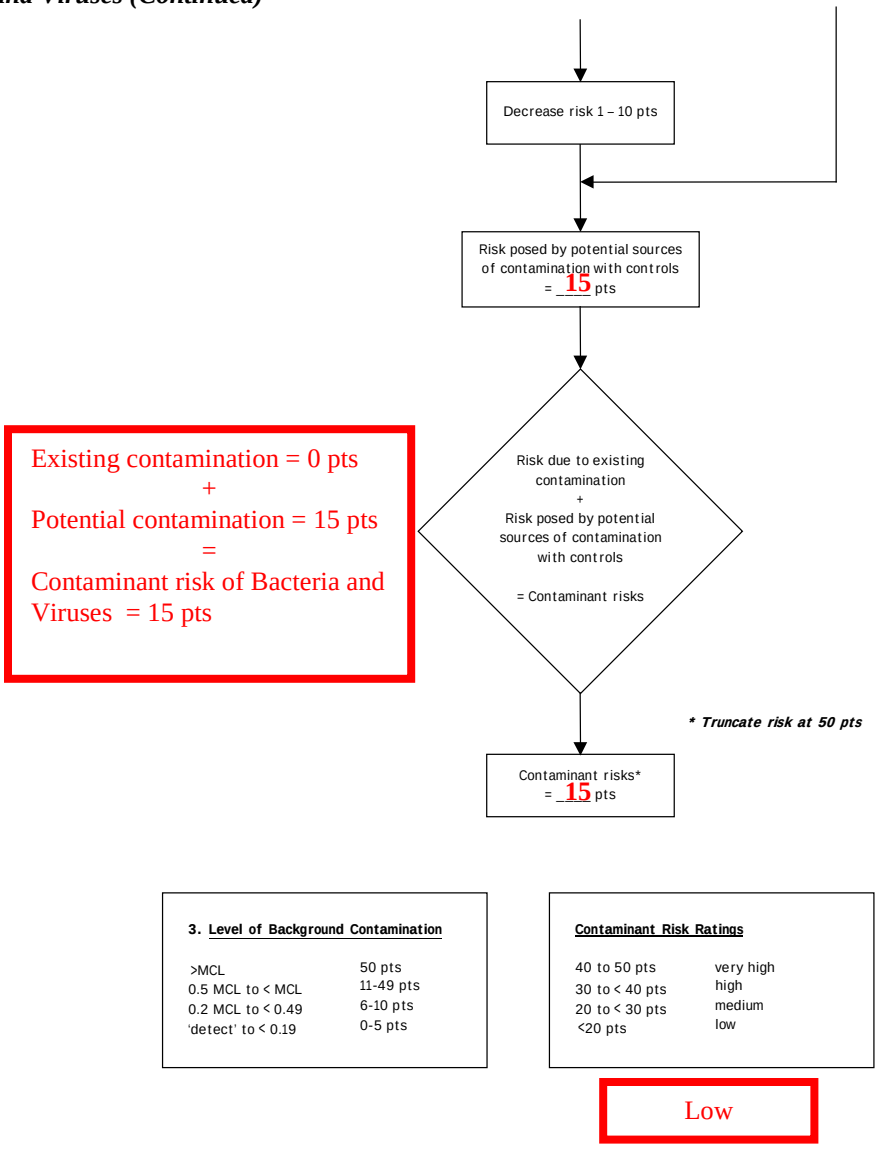


Chart 2. Contaminant Risks for Ft. Richardson Ship Creek - Bacteria and Viruses (Continued)





3. Level of Background Contamination

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

Contaminant Risk Ratings

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

Low

Table 1. Risk Matrix for Contaminant Sources for Bacteria and Viruses - Ft. Richardson Ship Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Ship Creek Trail	VERY LOW 5 PTS	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
Very Low	≥ 10 sources + 5 pts	≥ 10 sources + 2 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

Chart 3. Vulnerability Analysis for Bacteria and Viruses - Ft. Richardson Ship Creek

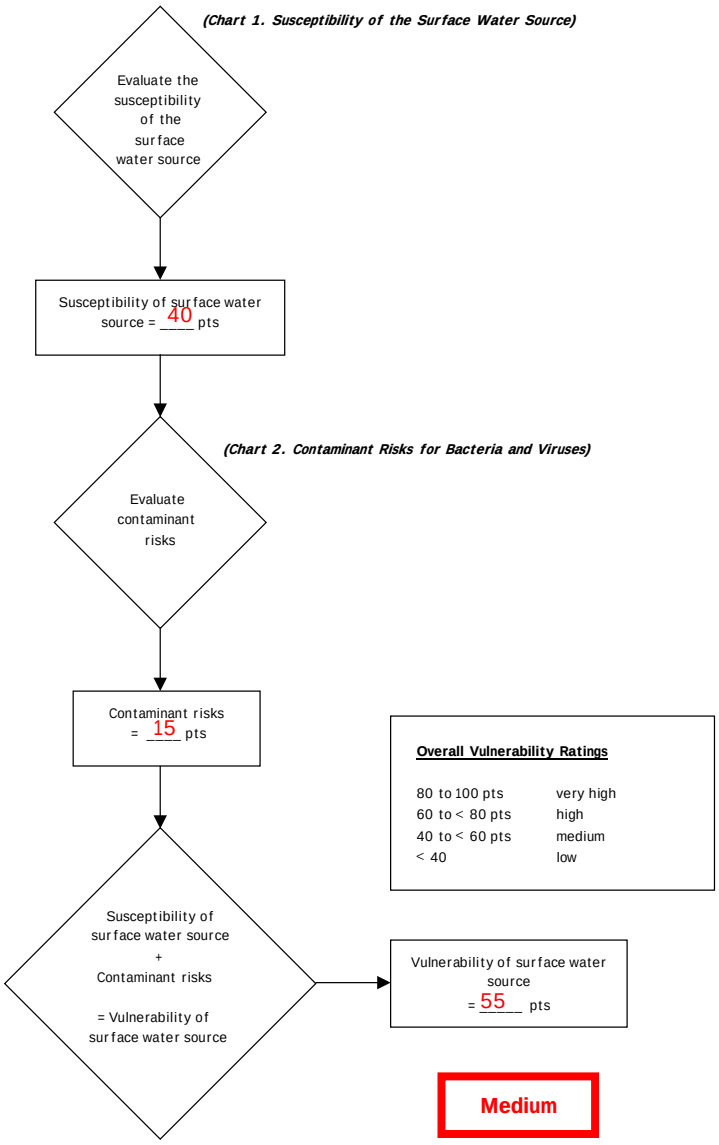


Chart 4. Contaminant Risks for Ft. Richardson Ship Creek - Nitrates/nitrites

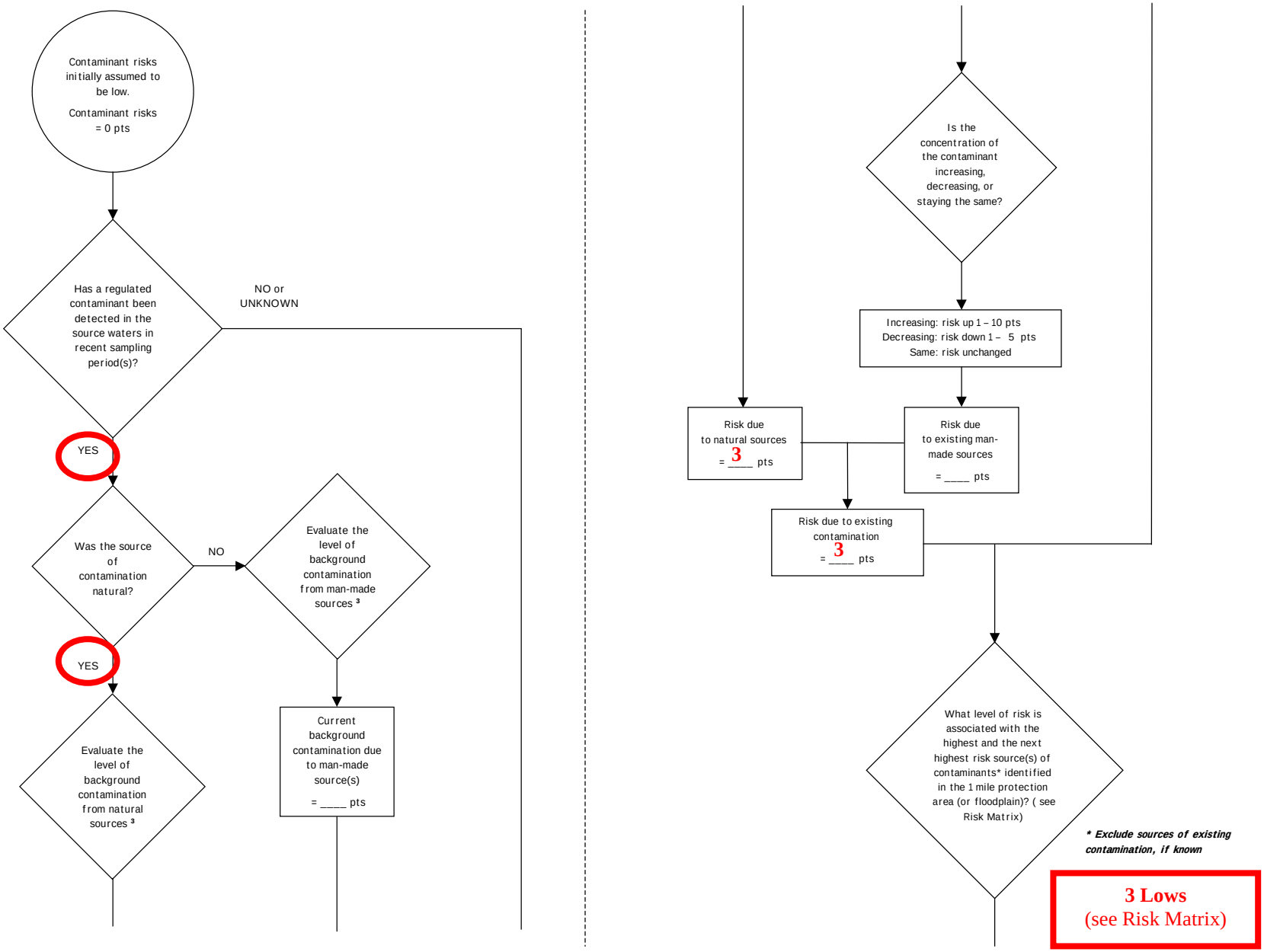
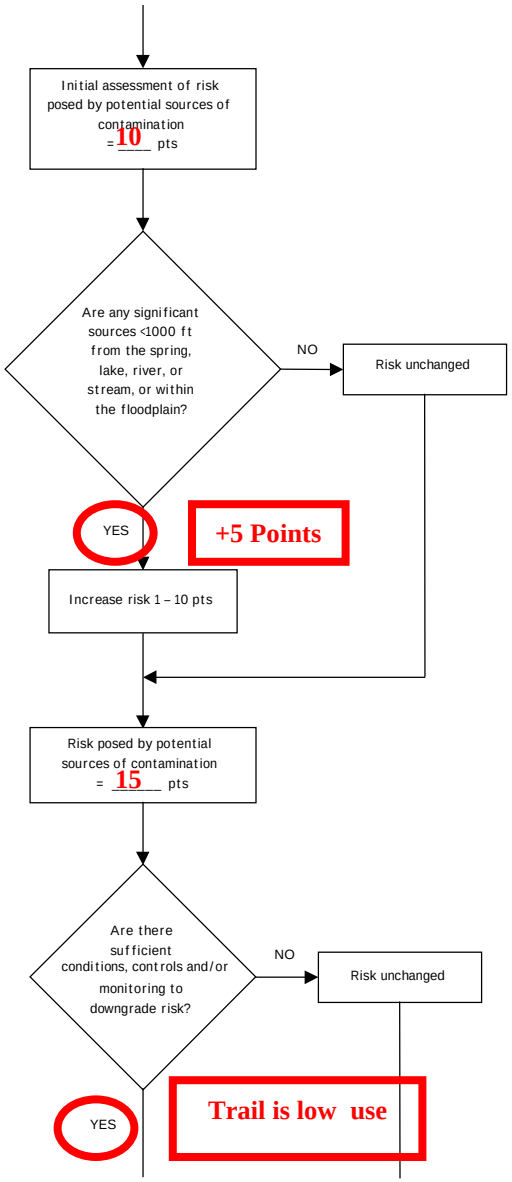
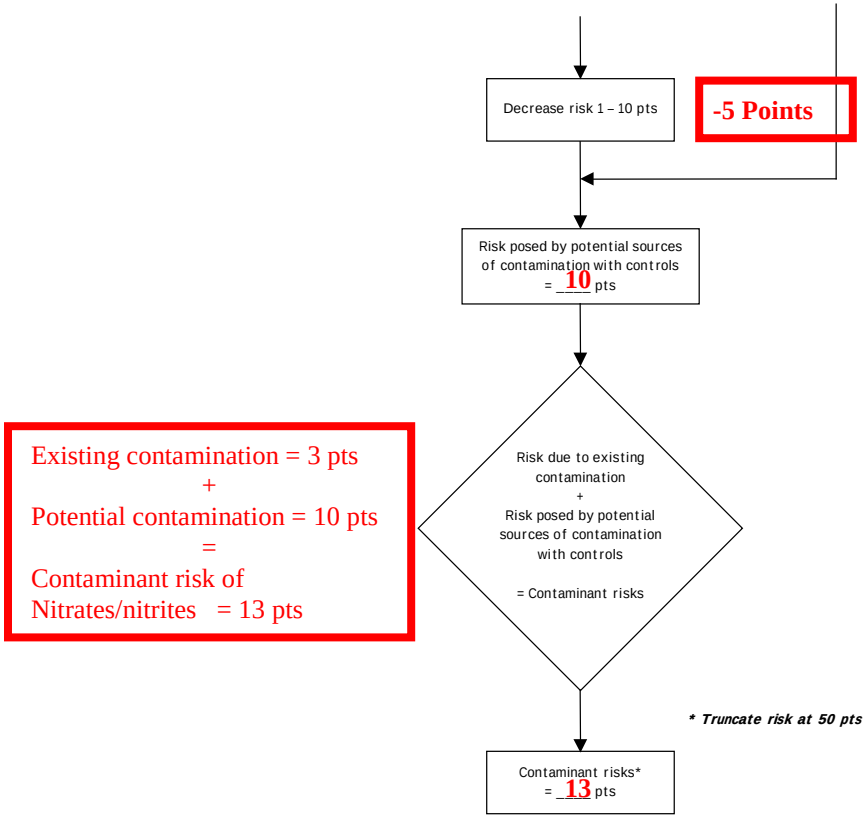


Chart 4. Contaminant Risks for Ft. Richardson Ship Creek - Nitrates/nitrites (Continued)





Existing contamination = 3 pts
+
Potential contamination = 10 pts
=
Contaminant risk of Nitrates/nitrites = 13 pts

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19 MCL	0-5 pts

Contaminant Risk Ratings

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

Nitrate = 1.01 m/L

Maximum Contaminant Level (MCL) = 10

1.01/10 = 0.101 of MCL

+3 points

Low

Table 2. Risk Matrix for Contaminant Sources for Nitrates/nitrites - Ft. Richardson Ship Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Ship Creek Trail	VERY LOW 5 PTS	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
Very Low	≥ 10 sources + 5 pts	≥ 10 sources + 2 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

Chart 5. Vulnerability Analysis for Nitrates/nitrites- Ft. Richardson Ship Creek

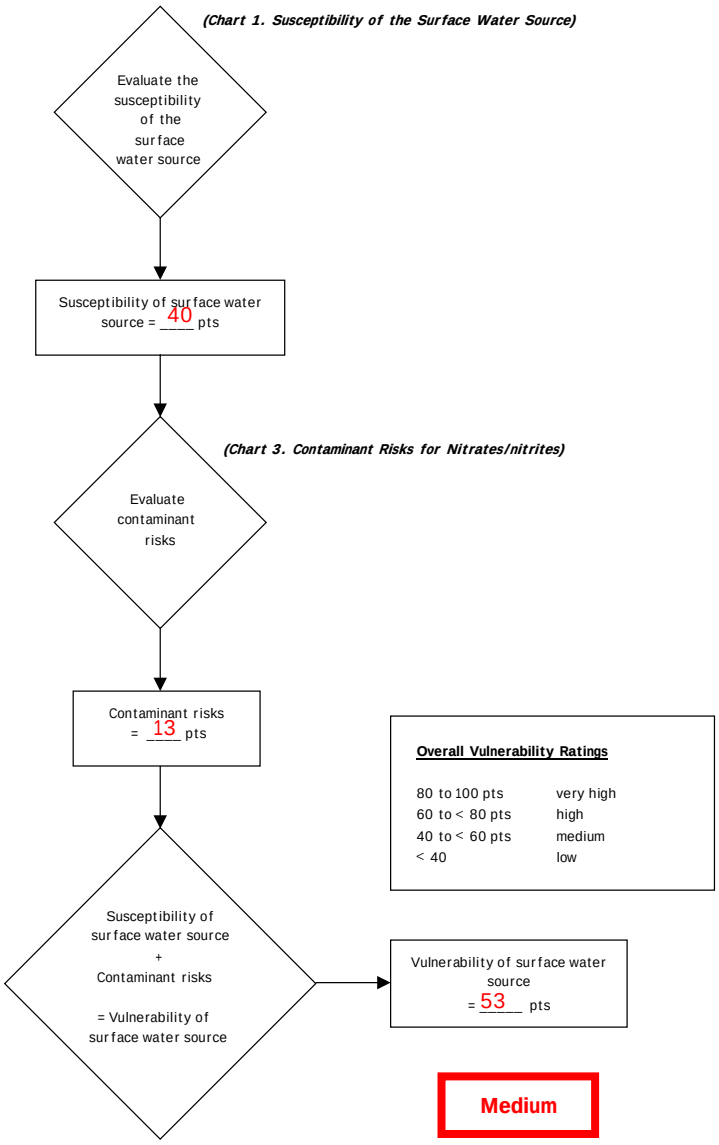


Chart 6. Contaminant Risks for Ft. Richardson Ship Creek - Volatile Organic Chemicals

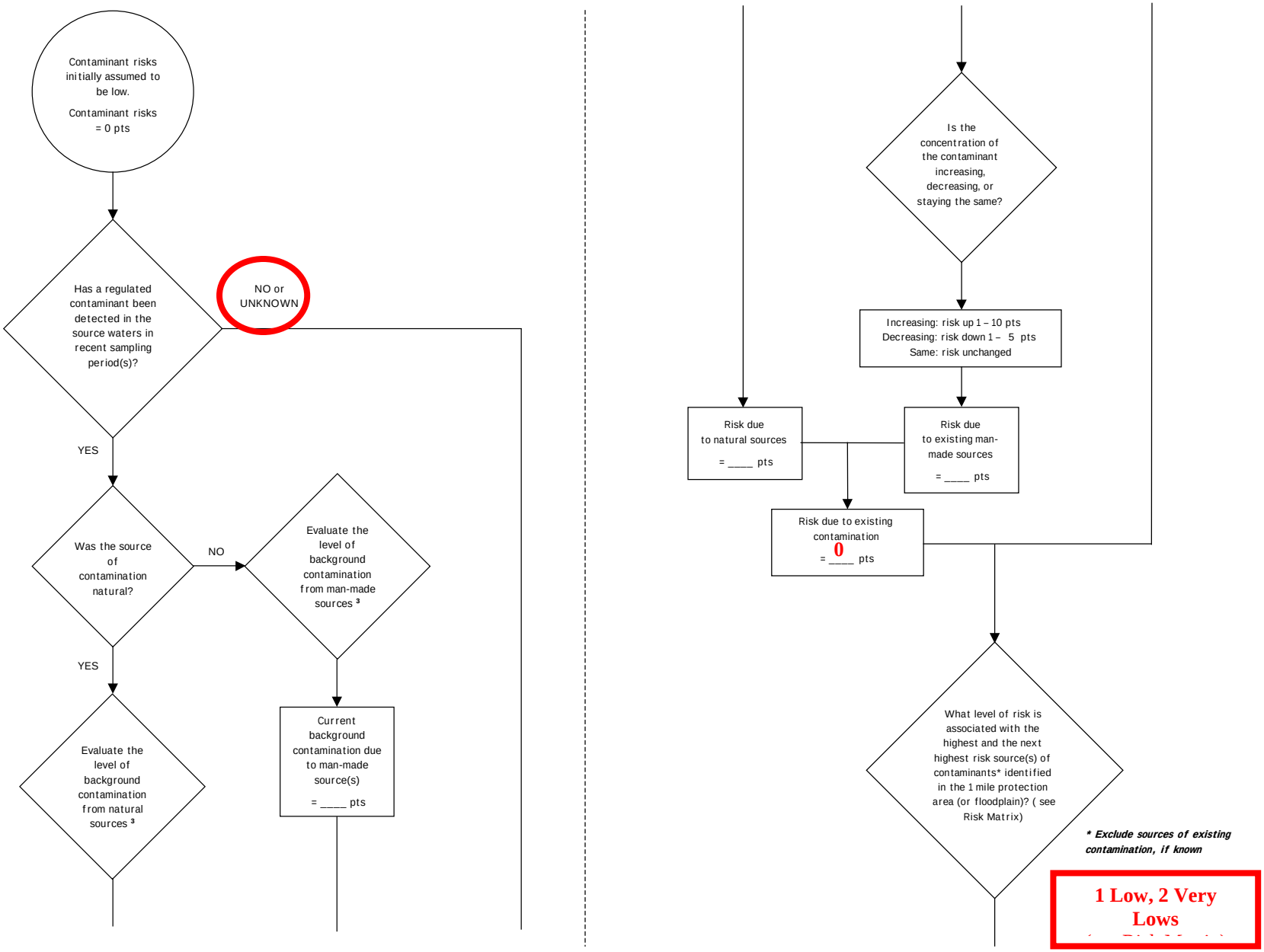
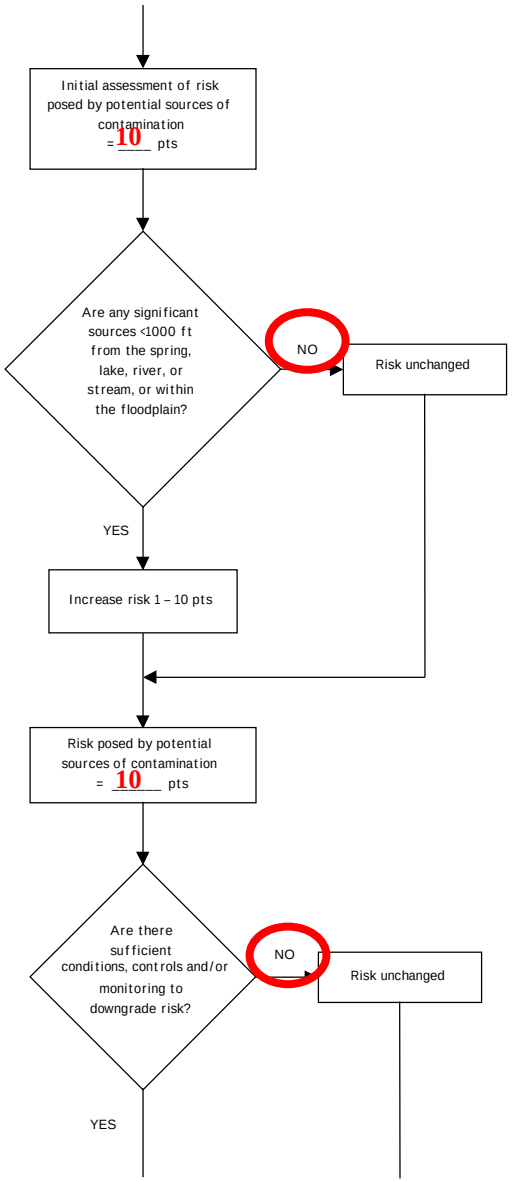


Chart 6. Contaminant Risks for Ft. Richardson Ship Creek - Volatile Organic Chemicals (Continued)



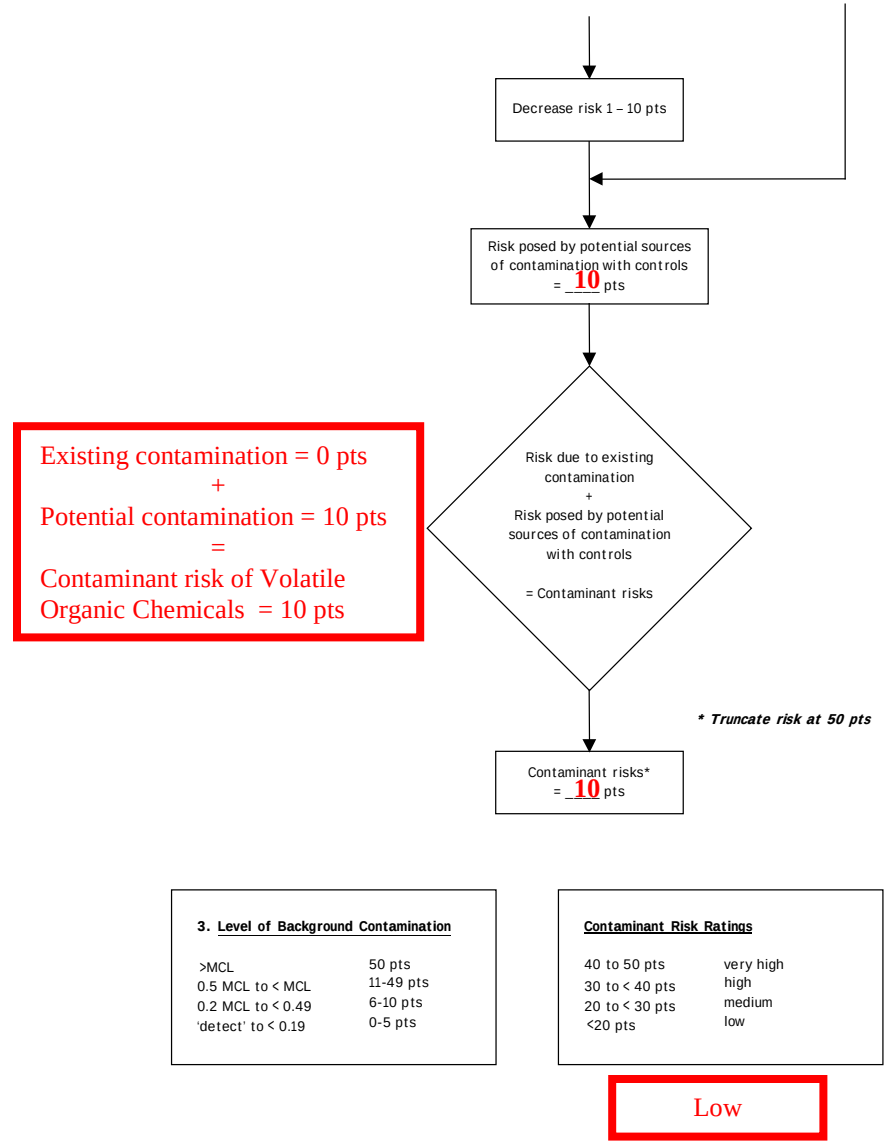


Table 3. Risk Matrix for Contaminant Sources for Volatile Organic Chemicals - Ft. Richardson Ship Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Contaminated Site U4-1	VERY LOW 5 PTS	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
Very Low	≥ 10 sources + 5 pts	≥ 10 sources + 2 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

Chart 7. Vulnerability Analysis for Volatile Organic Chemicals - Ft. Richardson Ship Creek

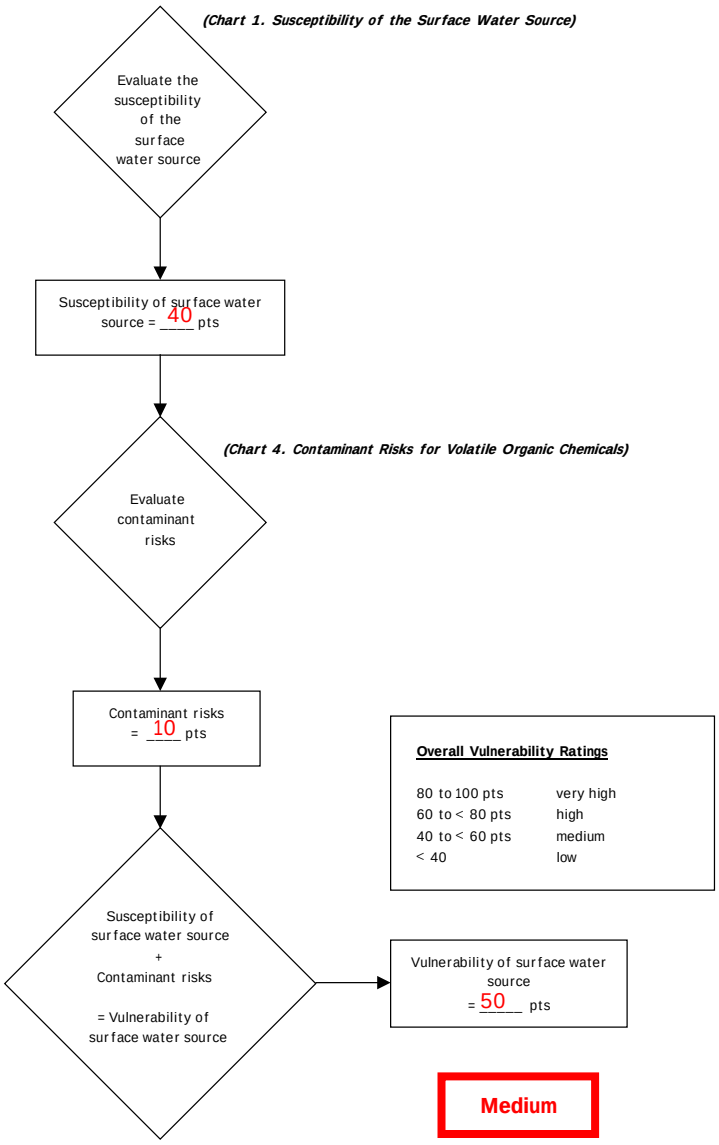


Chart 8. Contaminant Risks for Ft. Richardson Ship Creek - Other Organic Chemicals

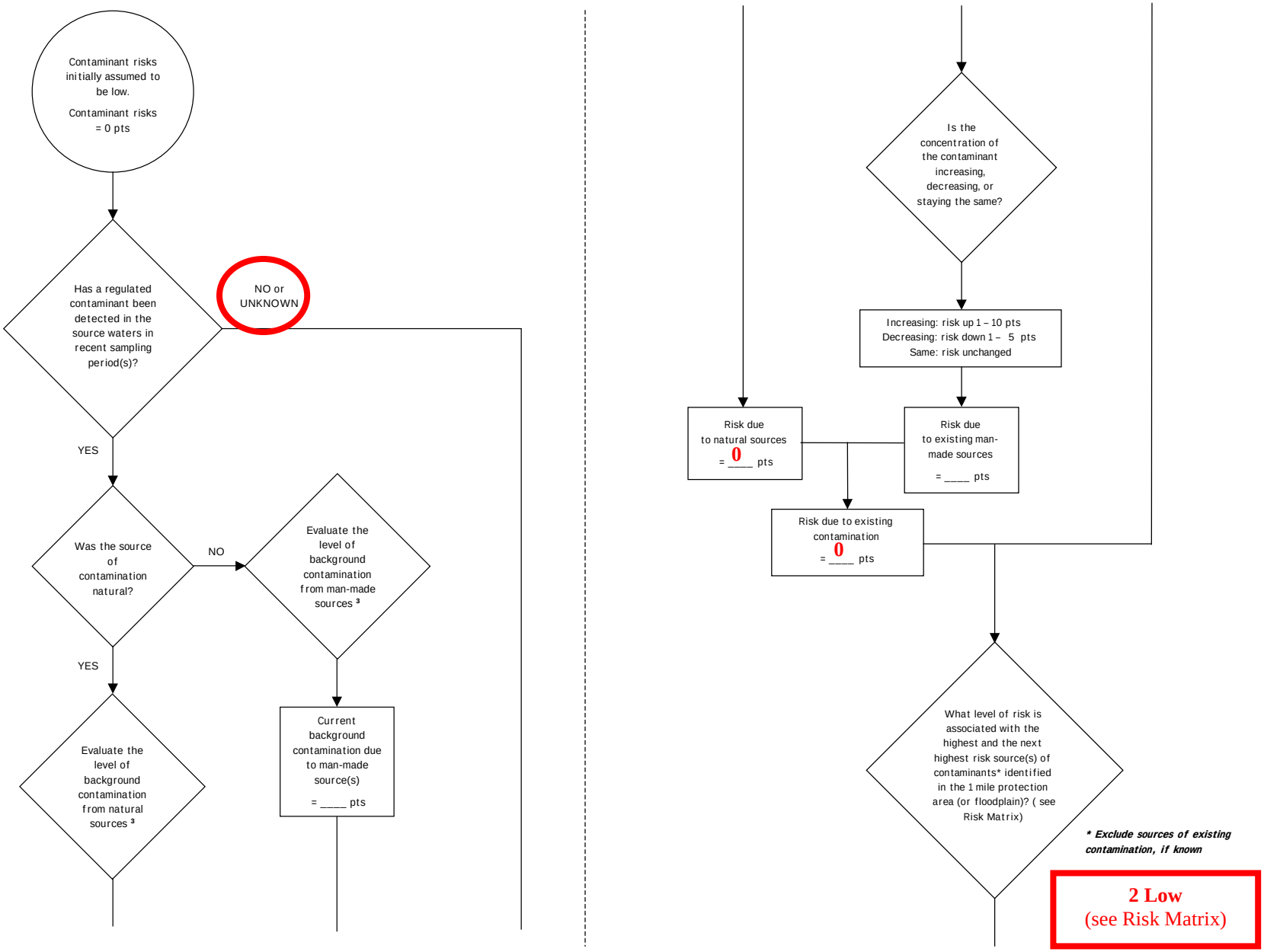
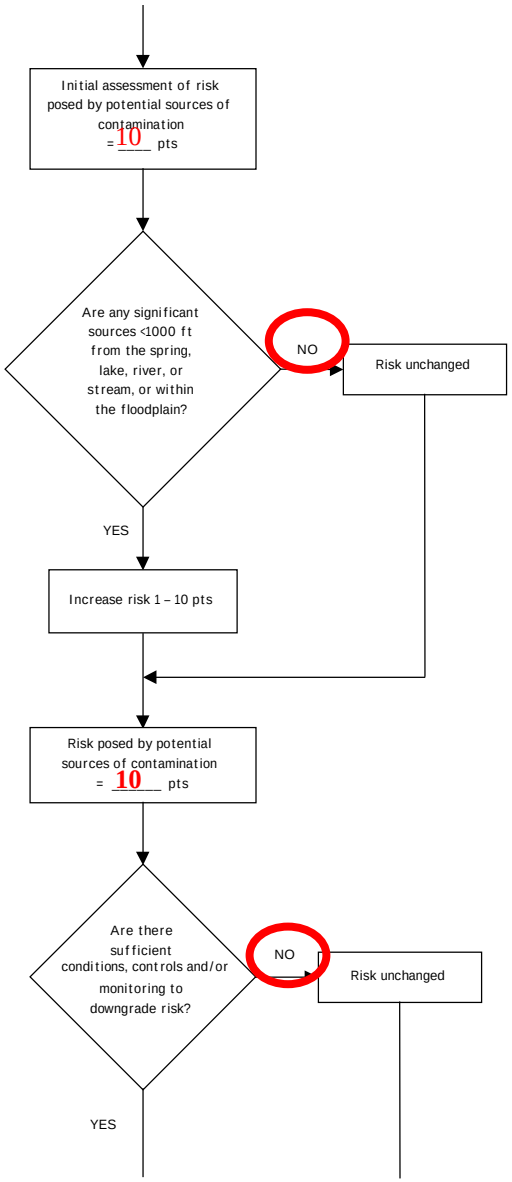
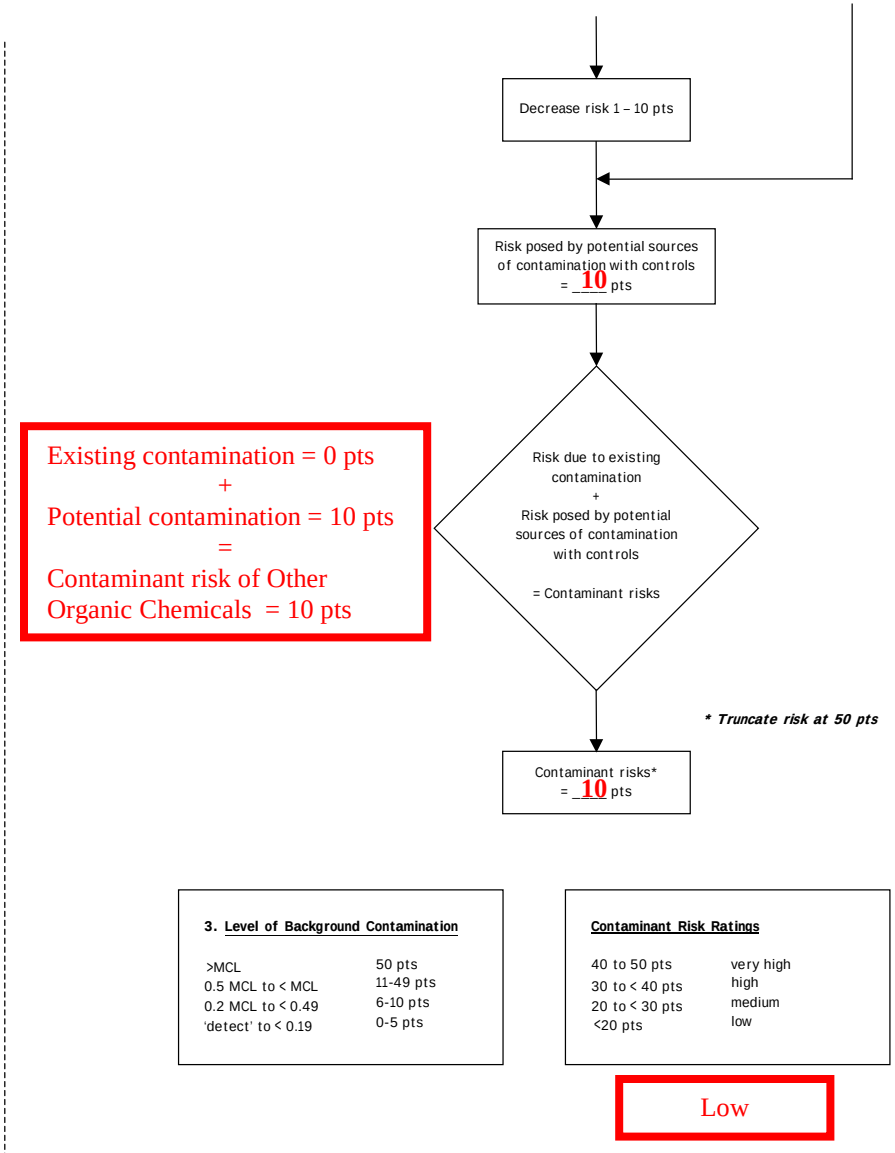


Chart 8. Contaminant Risks for Ft. Richardson Ship Creek - Other Organic Chemicals (Continued)





Existing contamination = 0 pts
+
Potential contamination = 10 pts
=
Contaminant risk of Other Organic Chemicals = 10 pts

3. Level of Background Contamination

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

Contaminant Risk Ratings

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

Low

Table 4. Risk Matrix for Contaminant Sources for Other Organic Chemicals - Ft. Richardson Ship Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

Arctic Valley Road	VERY LOW 5 PTS	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
Very Low	≥ 10 sources + 5 pts	≥ 10 sources + 2 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

Chart 9. Vulnerability Analysis for Other Organic Chemicals- Ft. Richardson Ship Creek

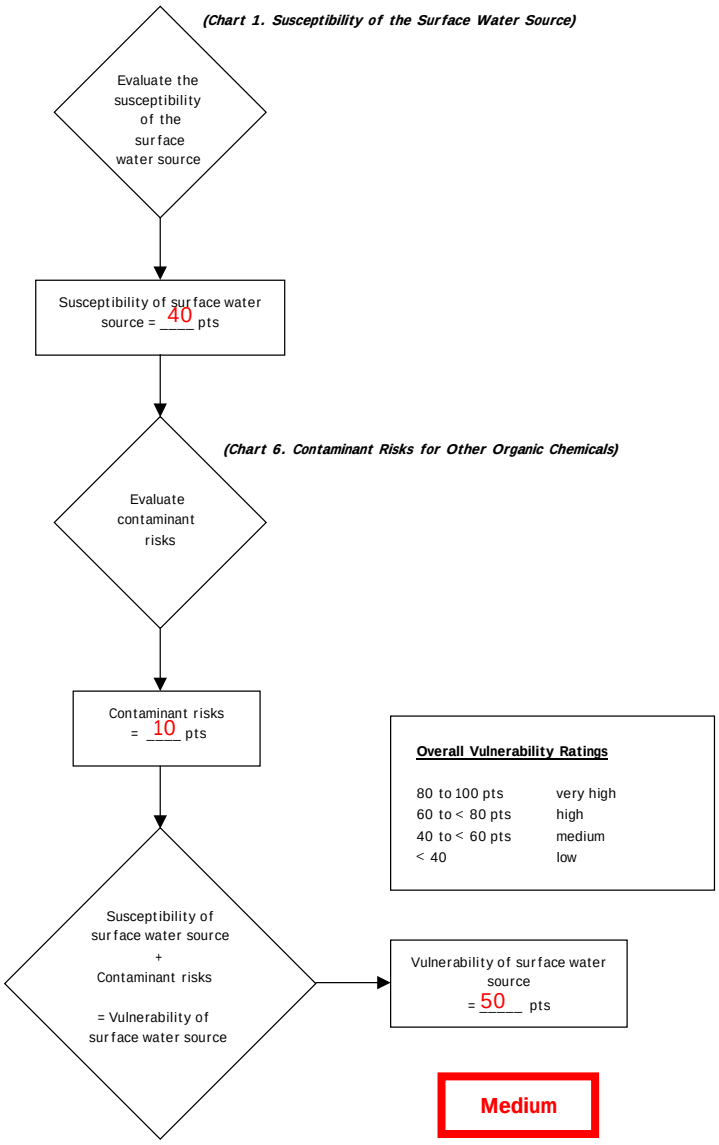


Chart 10. Contaminant Risks for Ft. Richardson Ship Creek - Heavy Metals

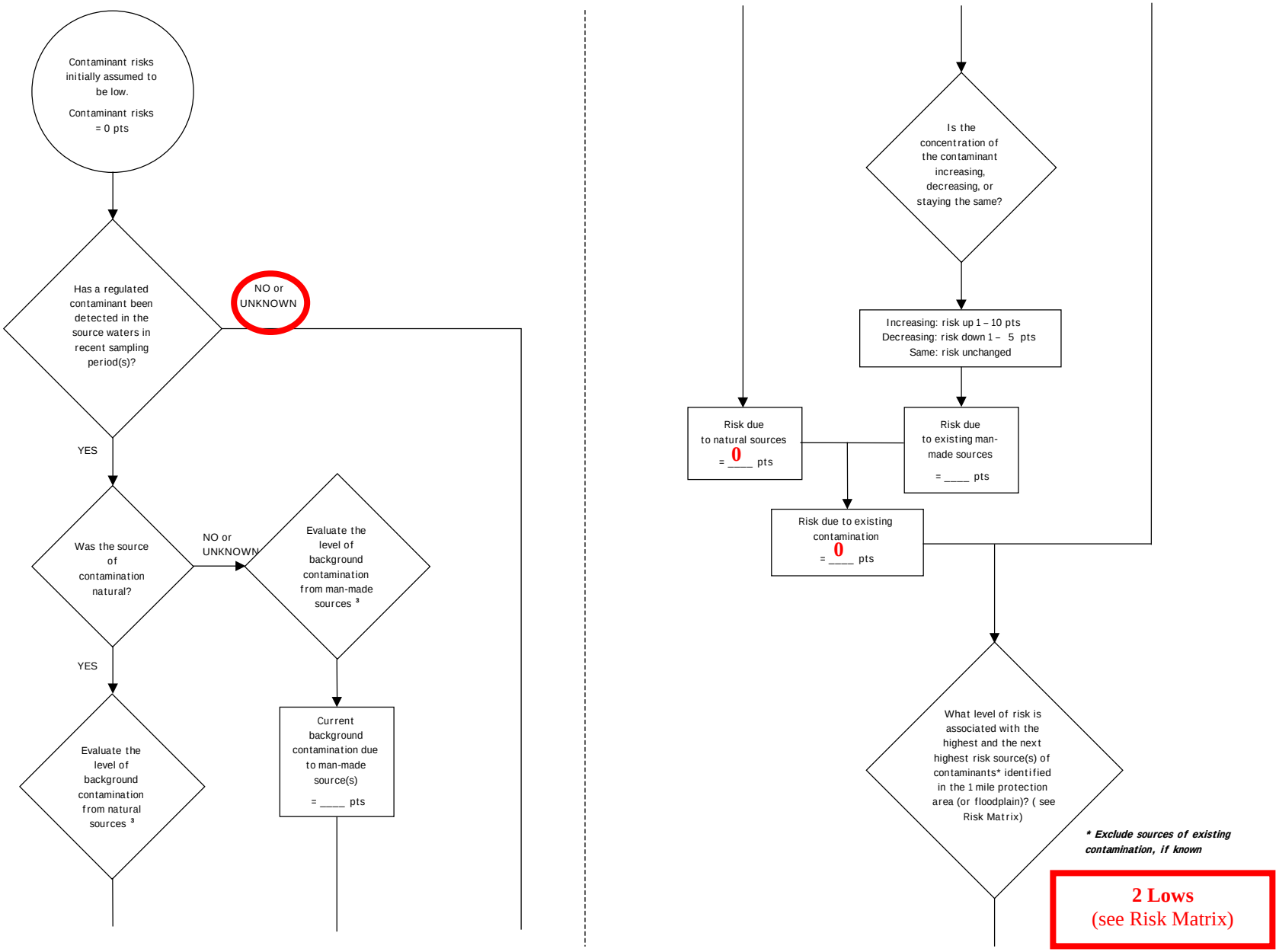
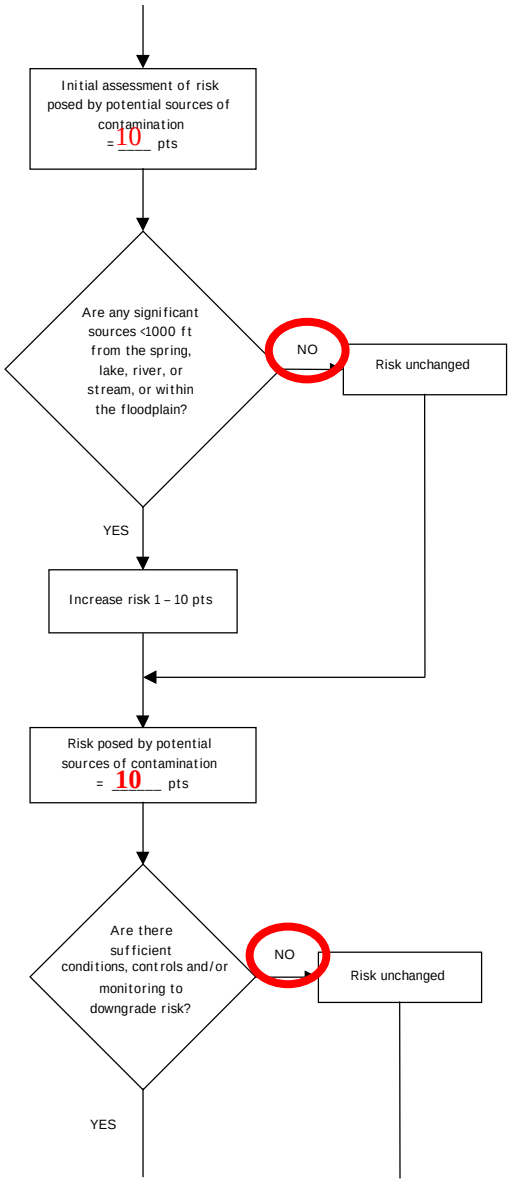
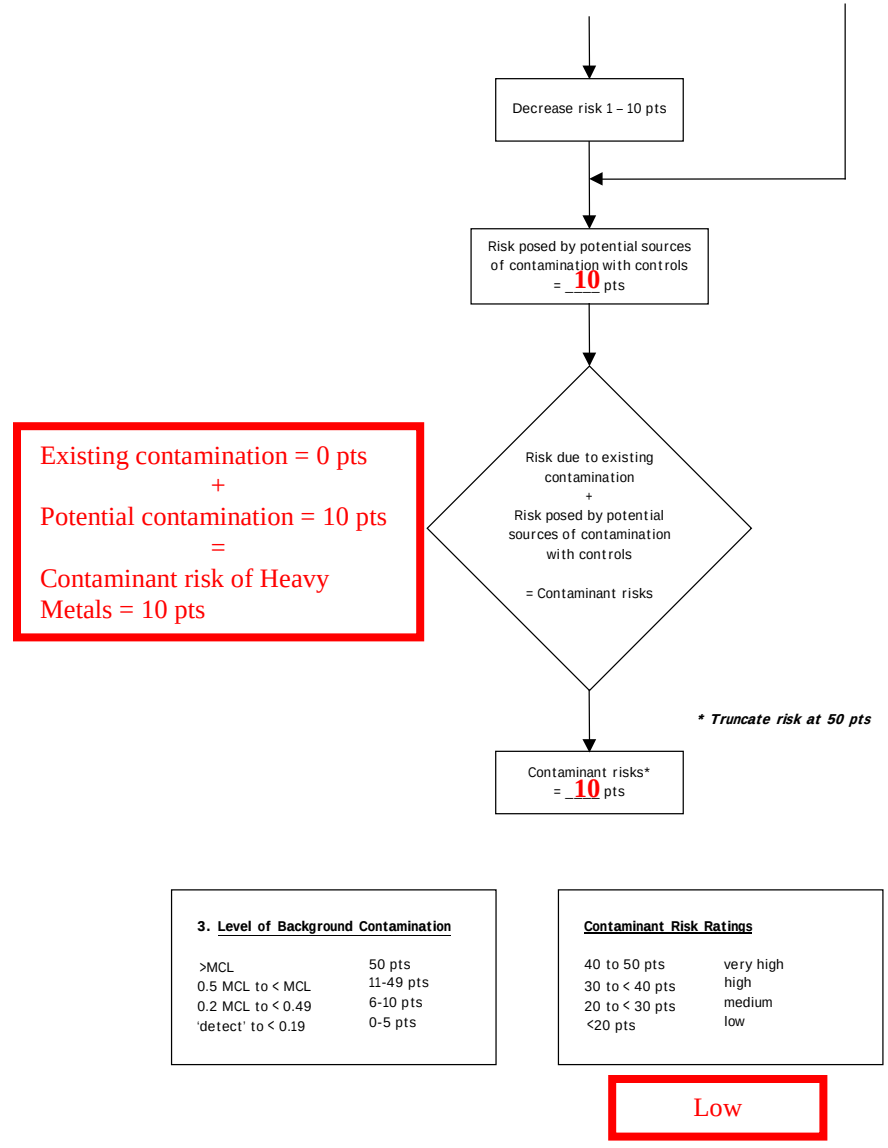


Chart 10. Contaminant Risks for Ft. Richardson Ship Creek - Heavy Metals (Continued)





3. Level of Background Contamination

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

Contaminant Risk Ratings

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

Low

Table 5. Risk Matrix for Contaminant Sources for Heavy Metals - Ft. Richardson Ship Creek

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Arctic Valley Road	VERY LOW 5 PTS	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
Very Low		≥ 10 sources + 5 pts	≥ 10 sources + 2 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

Chart 11. Vulnerability Analysis for Heavy Metals- Ft. Richardson Ship Creek

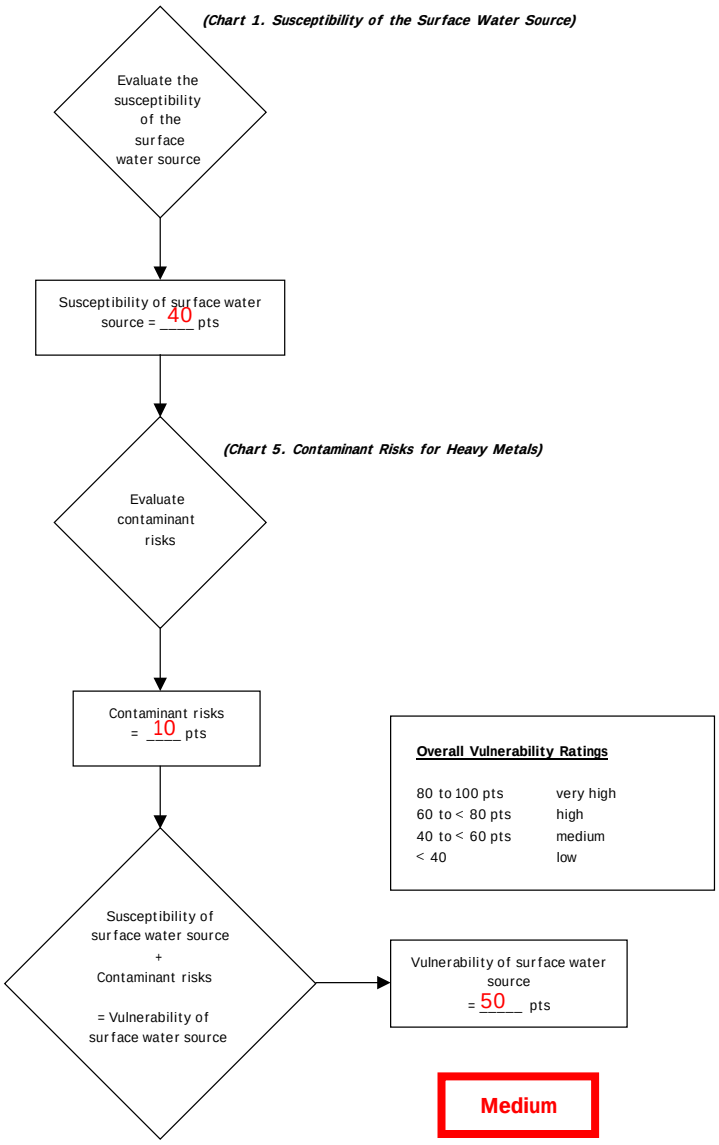


Chart 12. Contaminant Risks for Ft. Richardson Ship Creek - Synthetic Organic Chemicals

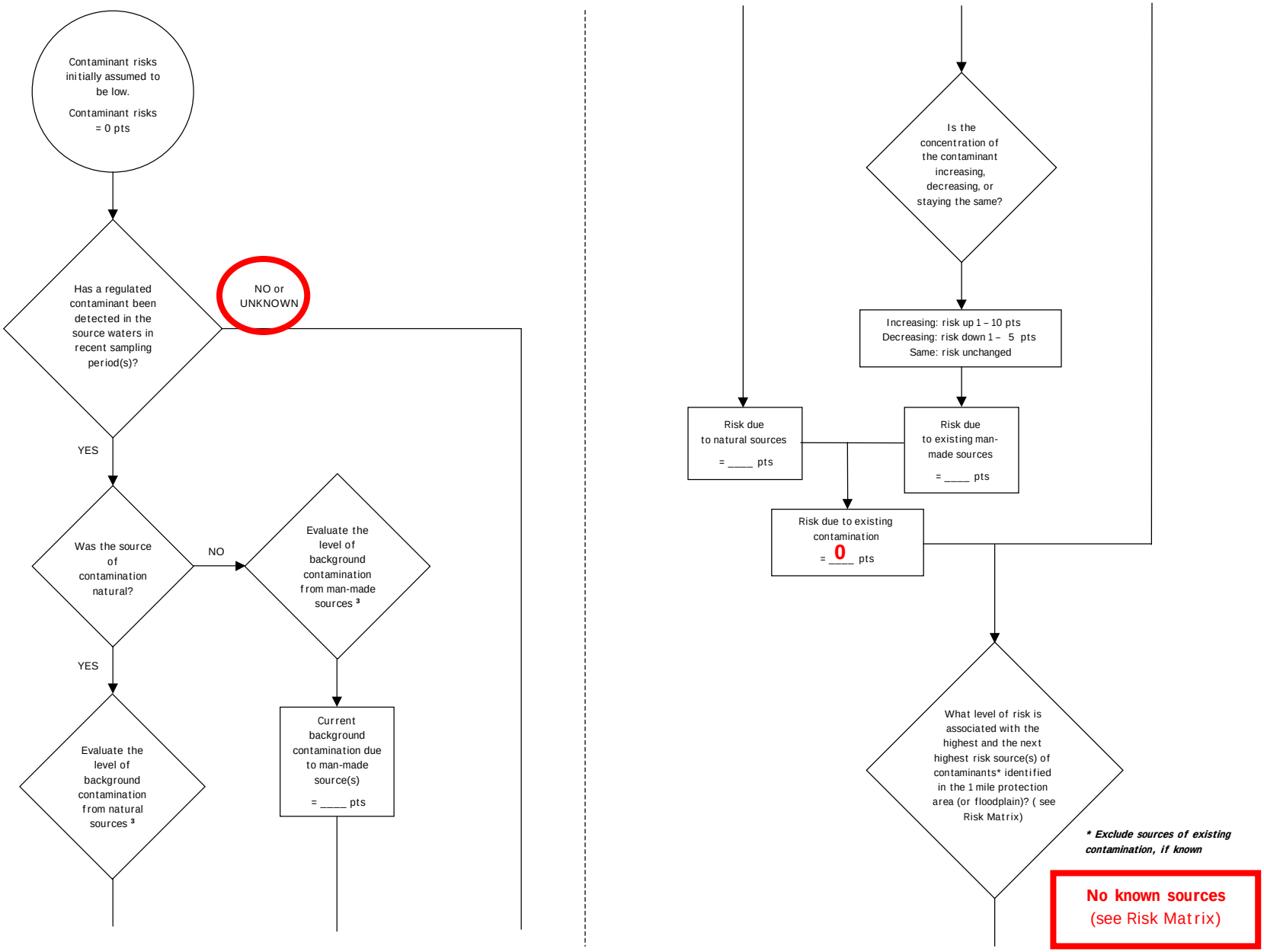
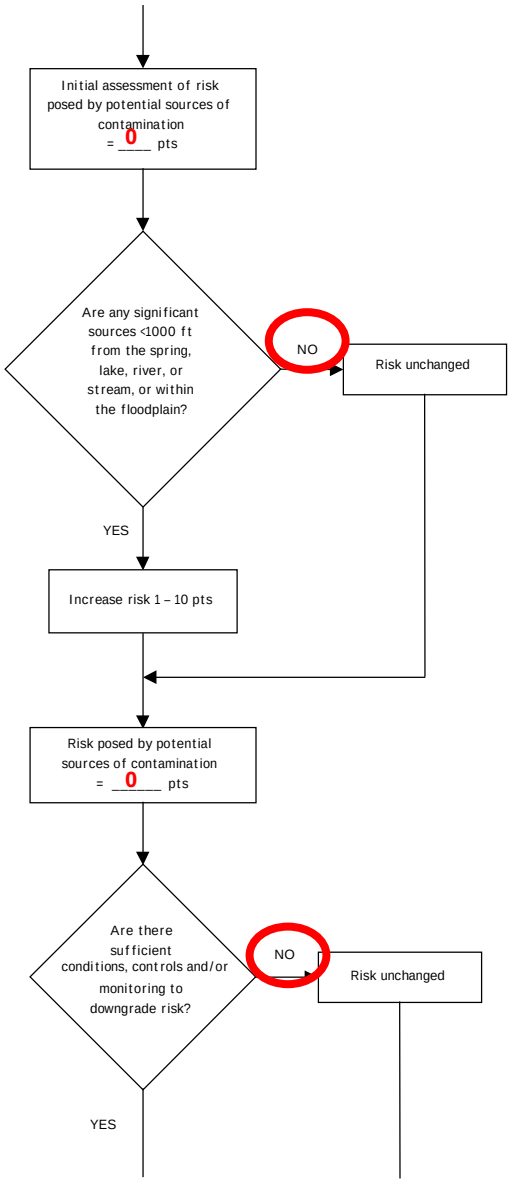
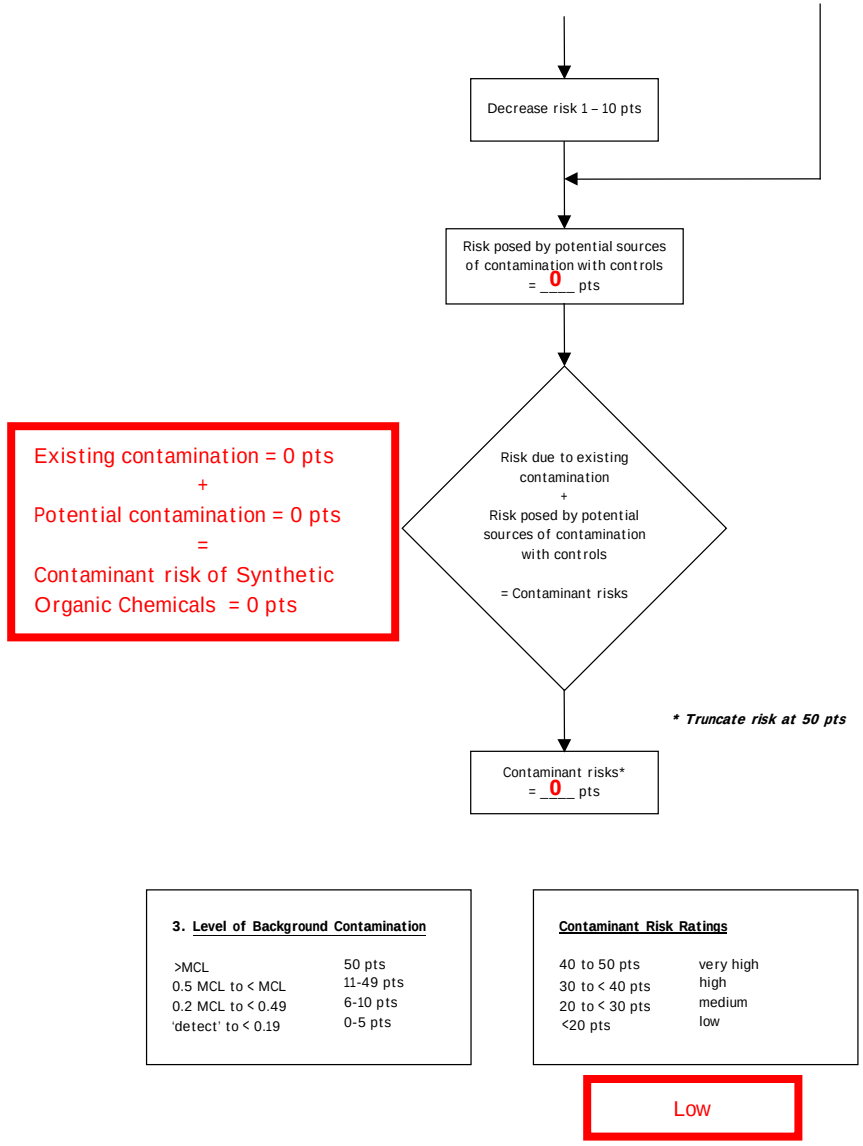


Chart 12. Contaminant Risks for Ft. Richardson Ship Creek - Synthetic Organic Chemicals (Continued)





3. Level of Background Contamination

>MCL	50 pts
0.5 MCL to < MCL	11-49 pts
0.2 MCL to < 0.49	6-10 pts
'detect' to < 0.19	0-5 pts

Contaminant Risk Ratings

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

Low

Chart 13. Vulnerability Analysis for Synthetic Organic Chemicals- Ft. Richardson Ship Creek