Source Water Assessment -
BLM Anchorage District Office
Anchorage, Alaska

Hydrogeologic Susceptibility and Vulnerability Analysis

DRINKING WATER PROTECTION PROGRAM REPORT 20

August 2001

Source Water Assessment - BLM Anchorage District Office Anchorage, Alaska

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2001

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Source Water Assessment for BLM Anchorage District Office's Source of Public Drinking Water, Anchorage, Alaska

Hydrogeologic Susceptibility and Vulnerability Analysis

By Heather A. Hammond

Drinking Water Protection Program
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EXECUTIVE SUMMARY

BLM Anchorage District Office's Public Water System is a Class A (non-transient/non-community) water system consisting of two wells in the Anchorage area. Identified potential and current sources of contaminants for BLM Anchorage District Office include: activities along dirt and/or gravel roads, activities along recreation trails, and an active landing strip. 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 synthetic organic chemicals. Overall, BLM Anchorage District Office's public water sources received a vulnerability rating of **Low** for bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, and other synthetic organic chemicals.

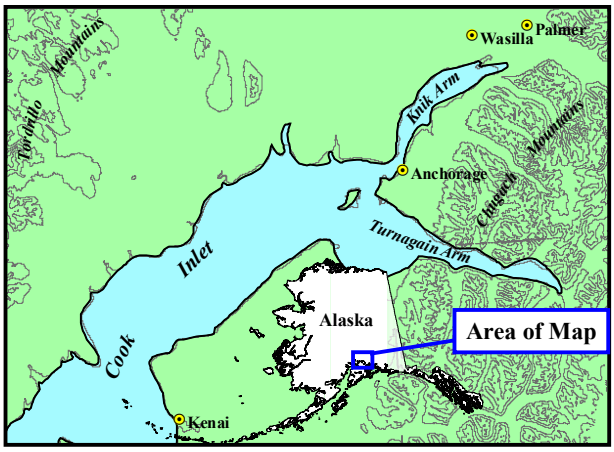

Figure 1. Index map showing the location of Anchorage, Alaska

INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners and/or 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 BLM Anchorage District Office's sources of public drinking water. This water system consists of two wells in the Anchorage area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic 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 local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

DESCRIPTION OF THE ANCHORAGE AREA, ALASKA

Location

Anchorage, located in southcentral Alaska, encompasses 1,698 square miles of land and 264 square miles of water. The area containing a majority of the urban development, commonly referred to as the Anchorage Bowl, encompasses approximately 180 square miles (*Partick, Brabets, and Glass, 1989*) and envelopes the low lands of the area. This area is bounded on the east by the Chugach Mountains and the north, west, and south by the Knik and Turnagain Arms of Cook Inlet (Figure 1). In recent times, urban development has extended eastward along the flanks of the Chugach Mountains. This area, known locally as the Anchorage Hillside, contains development at elevations exceeding 3,700 feet in elevation above sea level.

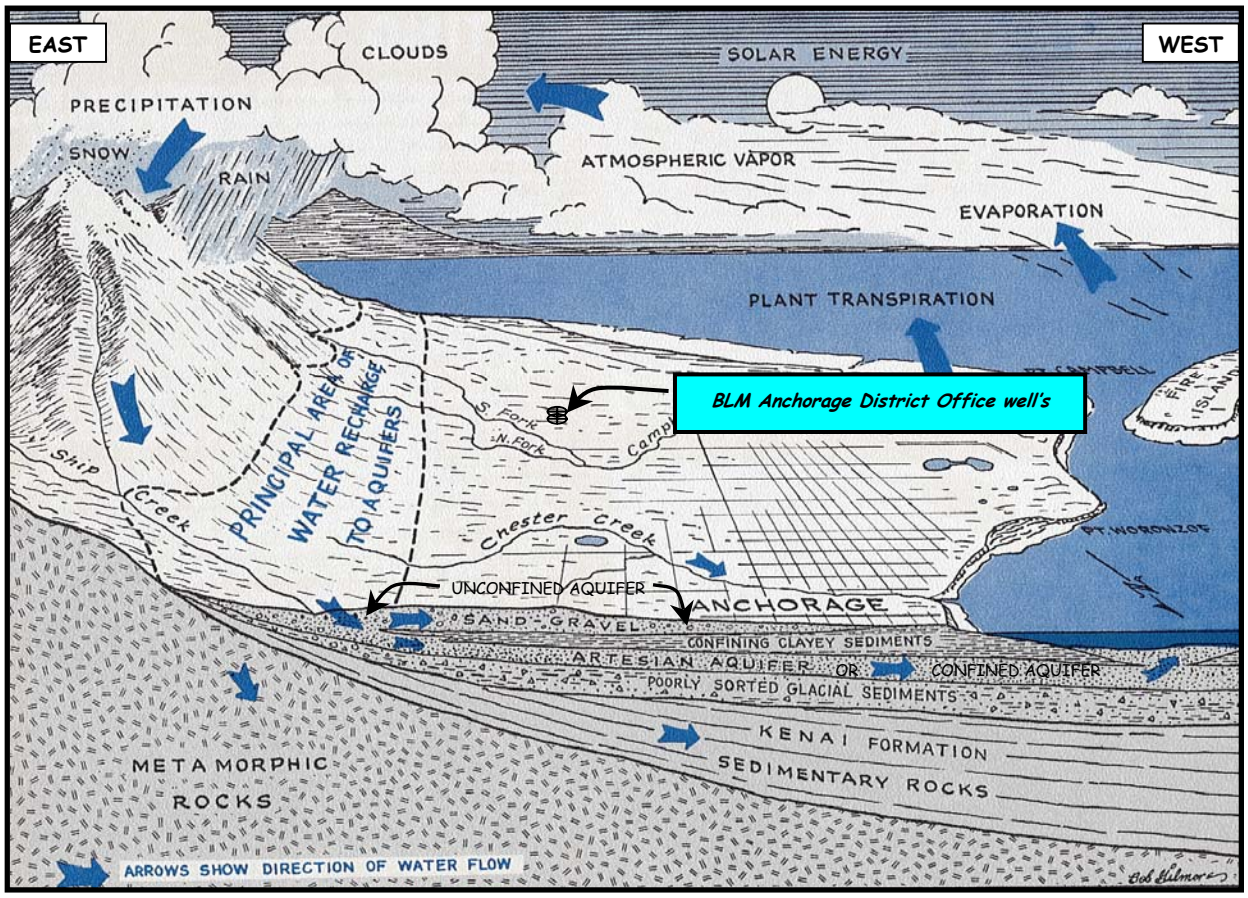

Figure 2. Generalized hydrologic cycle in the Anchorage area [*Barnwell, George, Dearborn,Weeks, and Zenone*, 1972].

Climate

The Anchorage area climate is somewhat transitional in that it does not experience large daily and annual temperature fluctuations like those experienced in the interior of Alaska nor does it experience high amounts of precipitation typified by gulf coast regions. Mean annual precipitation at the Anchorage International Airport is approximately 16 inches per year. On the average, Anchorage receives a total snow accumulation of 69 inches per year. Precipitation generally increases inland toward the Chugach Mountains where annual precipitation may exceed 160 inches per year [*Barnwell, George, Dearborn, Weeks, and Zenone*, 1972]. Mean daily temperature ranges from 65^{o} F during July to 8^{o} F in January [*Western Regional Climate Center*, 2000].

Physiography and Groundwater Conditions

Surface elevations in the Anchorage area range from sea level at the Knik and Turnagain Arms to well over 5,000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Anchorage Bowl.

The backbone of the Chugach Mountains is composed primarily of metamorphic marine and volcanic rocks (bedrock). These high peaks that bound Anchorage's east-side are flanked with colluvium or slope deposits. These slope deposits eventually grade into the glacial and stream deposits at lower elevations in the Anchorage Bowl.

In the Anchorage area, two principal groundwater flow systems or aquifers exist (see Figure 2). The upper unconfined aquifer or water-table aquifer is separated from a lower confined aquifer system by layers of silty, clayey glacially derived sediments (confining layer) [*Ulery and Updike*, 1983]. The lower confined aquifer system consists of a series of hydrologically interconnected layers and lenses of gravel, sand and silt that, collectively, form the confined aquifer. The confining layer ranges from 0 to 270 feet thick throughout the Anchorage area and generally thins with increasing distance from Cook Inlet, thus pinching out at

the mountain front [*Patrick, Brabets, and Glass*, 1989]. Water enters or recharges these two aquifer systems in several different ways. Along the front of the Chugach Mountains, groundwater seeps from fractures in bedrock into the sediments. At these higher elevations, rain and snowmelt also enters the sediments. This area along the mountain front is considered the principal recharge area for wells in the Anchorage area. Precipitation in the low lands may also percolate directly into the ground. Lastly, aquifers may also be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). Groundwater flow in the confined aquifer is generally east to west from the mountain front toward Cook Inlet, except in areas where the direction of flow is influenced by large municipal or industrial production wells. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surfacial topography as well as its close connection with surface water bodies.

BLM ANCHORAGE DISTRICT OFFICE'S PUBLIC DRINKING WATER SYSTEM

BLM Anchorage District Office's public water system is a Class A (transient/non-community) water system, which is owned by and operated by the U.S. Bureau of Land Management. The system consists of two wells, which are located northwest of the Campbell Airstrip adjacent to the BLM building (see Figure 3). According to the well logs, BLM Anchorage District Office's wells are not properly grouted. Well #1 penetrates discontinuous confining layers of blue clay with sand and gravel for a cumulative total of 87 feet. The completed well has a total depth of 349 feet below land surface. The well has a six-inch casing and is screened in clay and gravel from 335 to 346 feet below land surface. Static water level was recorded at 56 feet below land surface at the time of drilling (June 1966). Well #2 situated approximately 261 feet southeast of Well #1, penetrates blue clay and till from 40 feet to a depth of 79 feet below land surface. The completed well has a total depth of 169 feet below land surface and has a six-inch casing. Static water level was recorded at 45 feet below land surface. It was not indicated in the well log whether the well was screened at the time of drilling (July, 1966)

BLM Anchorage District Office's water system operates year round and serves approximately 100 non-residents through two service connections.

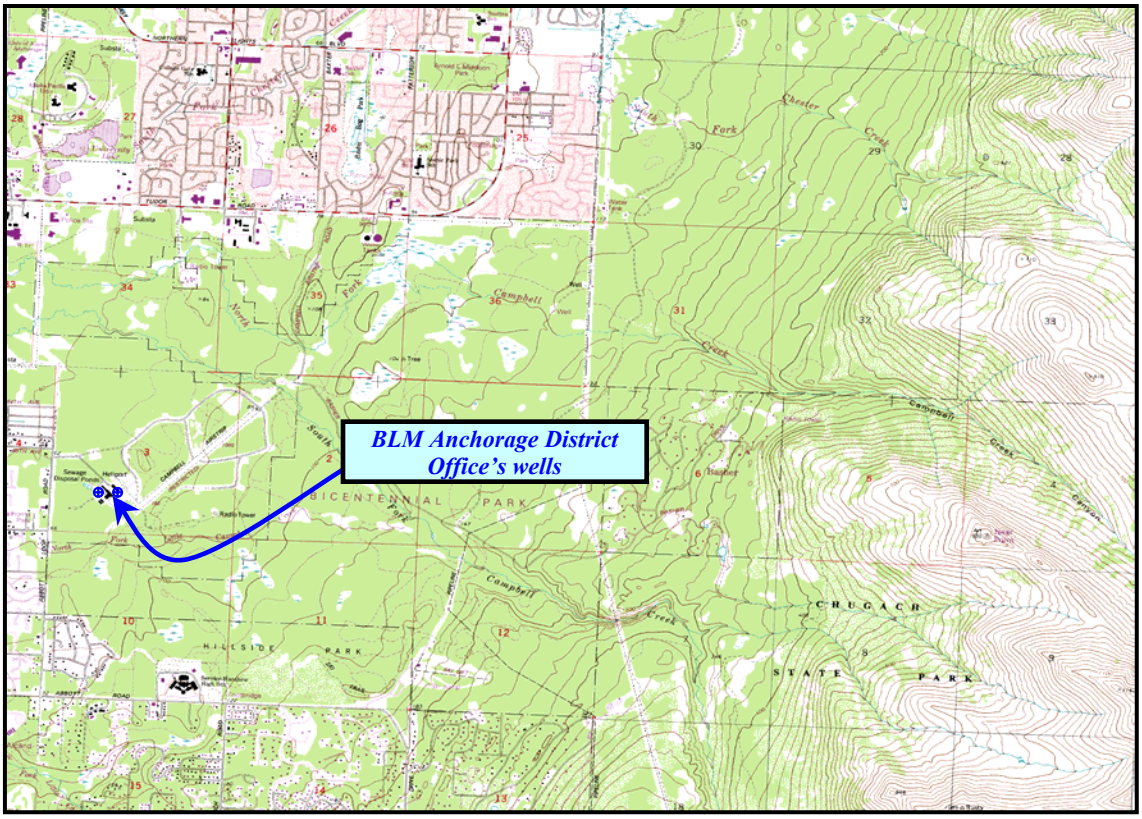

Figure 3. Map showing the location of the drinking water source for BLM Anchorage District Office [Base: USGS Anchorage A8 NE].

ASSESSMENT AND PROTECTION AREAS FOR BLM ANCHORAGE DISTRICT OFFICE'S DRINKING WATER SOURCES

The Drinking Water Protection and Assessment Areas that have been established for BLM Anchorage District Office's sources of drinking water are the areas that are most sensitive to contamination. These areas have served as a basis for assessing the risk of the drinking water sources to contamination. The zones around the drinking water sources are the most critical areas for the preservation of the quality of the drinking water for these sources. For simplicity, these areas will be known as your Drinking Water Protection Areas and will serve as the areas of focus for voluntary protection efforts.

Conceptually, groundwater enters the aquifer systems along the front range of the Chugach Mountains (Figure 2) and flows toward Cook Inlet. An analytical calculation was used to calculate the size and shape of the area that contributes water to the well. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*). This analytical calculation was used as a guide as the first step in establishing the protection areas for BLM Anchorage District Office's drinking water sources. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at meaningful and conservative protection areas with respect to public health (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation are separated into zones. These zones correspond to a time-of-travel. Time-of-travel is the time required for water to move in the saturated zone of the ground from a specific point to the well. The Drinking Water Protection Area for BLM Anchorage District Office contains four zones, Zone A through Zone D (See Map 1 in Appendix A). Zone A corresponds to the area between the well and the distance equal to ¼ of the distance of the 2-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to the well may be on the order of several days to several hours. Zone A also extends downgradient from the well to take into account the area of the aquifer that is influenced by pumping of the well.

Zone B corresponds to a time-of-travel of less than two years. Zones C through D correspond to those areas between 5 years and 10 years time-of-travel, respectively.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within BLM Anchorage District Office's Drinking Water Protection Areas. This survey was completed through a search of agency records and other publicly available information. 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 public water system assessments, six categories of drinking water contaminants were inventoried. They include:

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

Map 2 and Map 3 in Appendix C depict the Contaminant Source Inventory for BLM Anchorage District Office. Inventoried potential sources of contamination within Zones A through D were activities associated with gravel roads, recreational type activities and an active landing strip (see Table 1 in Appendix B). Below is a summary of the contaminant sources inventoried within BLM Anchorage District Office's protection areas:

- gravel roads;
- recreation trails and
- an active landing strip.

These potential contaminant sources present risk for all six categories of drinking water contaminants for BLM Anchorage District Office's drinking water sources.

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 well.

VULNERABILITY OF BLM ANCHORAGE DISTRICT OFFICE'S DRINKING WATER SOURCES

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 have been analyzed and an overall vulnerability score of 0 to 100 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 Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
+
Susceptibility of the Aquifer (0 – 25 Points)

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

BLM Anchorage District Office's wells penetrates discontinuous confining layers of blue clay and till with sand and gravel which may provide a protective barrier against the movement of contaminants in the subsurface. The water table appears to be deep near the wells ranging from 45 to 56 feet below ground surface. According to a Sanitary Survey dated 09/12/96 the ground surface is not properly drained or sloped away from the well sites. Therefore the wells have slight potential flood hazards and do not appear to be properly grouted which can facilitate movement of contaminants along the well casing and into source waters.

Combining the susceptibility of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility of the well to contamination (See Appendix D). Table 1 and Table 2 show the overall Susceptibility score and rating for the BLM Anchorage District Office wells.

Table 1. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination – Well #1

	Score	Rating
Susceptibility of the Wellhead	10	Low
Susceptibility of the Aquifer	5	Medium
Natural Susceptibility	15	Low

Table 2. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination – Well #2

	Score	Rating
Susceptibility of the Wellhead	10	Low
Susceptibility of the Aquifer	6	Medium
Natural Susceptibility	16	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. Recreation trails and Campbell Airstrip contribute the highest risk for potential contamination to BLM Anchorage District Office's 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 7). This portion of the analysis examines any existing or historical contamination that has been detected at the drinking water source through routine sampling. It also reviews contamination that has or may have occurred but has not arrived or been detected at the well. Table 3 and Table 4 summarize the Contaminant Risks for each category of drinking water contaminants for well #1 and #2.

Table 3. Contaminant Risks – Well #1

Contaminant Risks	Score	Rating
Bacteria and Viruses	11	Low
Nitrates and/or Nitrites	12	Low
Volatile Organic Chemicals	11	Low
Heavy Metals, Cyanide, And Other Inorganic Chemicals	11	Low

Synthetic Organic Chemicals	0	Low
Other Synthetic Organic Chemicals	11	Low

Table 4. Contaminant Risks – Well #2

Contaminant Risks	Score	Rating
Bacteria and Viruses	11	Low
Nitrates and/or Nitrites	12	Low
Volatile Organic Chemicals	11	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	11	Low
Synthetic Organic Chemicals	0	Low
Other Synthetic Organic Chemicals	11	Low

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a Class A public drinking water system. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analysis for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals, respectively.

Vulnerability of the drinking water source to contamination is the combination of susceptibility of the aquifer and the well with contaminant risks. Table 5 and Table 6 contain 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.

Table 5. Overall Vulnerability of BLM Anchorage District Office's Public Drinking Water Source to Contamination by Category – Well #1

Category	Score	Rating
Bacteria and Viruses	25	Low
Nitrates and Nitrites	25	Low
Volatile Organic Chemicals	25	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	25	Low
Synthetic Organic Chemicals	15	Low
Other Synthetic Organic Chemicals	25	Low

Table 6. Overall Vulnerability of BLM Anchorage District Office's Public Drinking Water Source to Contamination by Category – Well #2

Category	Score	Rating
Bacteria and Viruses	25	Low
Nitrates and Nitrites	30	Low
Volatile Organic Chemicals	25	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	25	Low
Synthetic Organic Chemicals	15	Low
Other Synthetic Organic Chemicals	25	Low

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, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals, respectively.

Nitrates and/or nitrites are found in natural background concentration at the site, as elsewhere in the Alaska. Sampling history of BLM Anchorage District Office's source waters indicate low concentrations of nitrate (See Chart 5 – Contaminant Risks for Nitrates and/or Nitrites in Appendix D and Appendix E). Existing nitrate contamination is approximately 4% of the allowable limit (MCL) for this contaminant. The Maximum Contaminant Level or MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects. Due to the high solubility and weak retention by soil, nitrates are very mobile in soil, moving at approximately the same rate as water. Though existing contamination

was detected at the site in natural background concentrations for nitrates, the amount detected remains at very safe levels with respect to human health.

The overall score for bacteria and viruses and nitrates and/or nitrites for BLM Anchorage District Office's source water is low. Activities associated with recreation trails intersecting the protection areas drive the scores for these contaminant categories.

Other low potential and existing sources of bacteria and viruses and nitrates and/or nitrites for BLM Anchorage District Office's source waters include activities associated with Far North Bicentennial Park and Hillside Park, Campbell Airstrip Road and the Unnamed Access Road leading to the Campbell Airstrip.

The overall score for volatile organic chemicals for BLM Anchorage District Office's drinking water source is low. Activities associated with Campbell Airstrip drive the score for volatile organic chemicals.

Campbell Airstrip intersects the Zone B protection areas. An accidental release of fuel could enter the aquifer through the land surface and flow toward the well. Due to the potential of an accidental release occurring the airstrip was initially ranked as posing medium potential contaminant risk for volatile organic chemicals. However, this airstrip is only actively used during the summer months (June through September) for emergency purposes only. Therefore, this potential source of contamination has been reduced and ranks as a low for volatile organic chemicals.

Other potential and existing contaminant sources for BLM Anchorage District Office's source waters include activities associated with highways and roads (dirt and/or gravel) within the protection area. Because roads do pose potential threat for fuel spills to occur, dirt and/or gravel roads are ranked as a very low potential sources of volatile organic chemicals along with bacteria and viruses and nitrates and/or nitrites.

SUMMARY

A *Source Water Assessment* has been completed for BLM Anchorage District Office's sources of public drinking water. The overall vulnerability of this source to contamination is **Low** for bacteria and viruses, nitrates and/or nitrites and volatile organic chemicals, heavy metals, synthetic organic chemicals, and other synthetic organic chemicals. 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 BLM Anchorage District Office 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.

REFERENCES CITED

Barnwell, W.W., George, R.S., Dearborn, L.L., Weeks, J.B., and Zenone, C., 1972, Water for Anchorage: an atlas of the water resources of the Anchorage area, Alaska: U.S. Geological Survey Open-File Report, 76 p.

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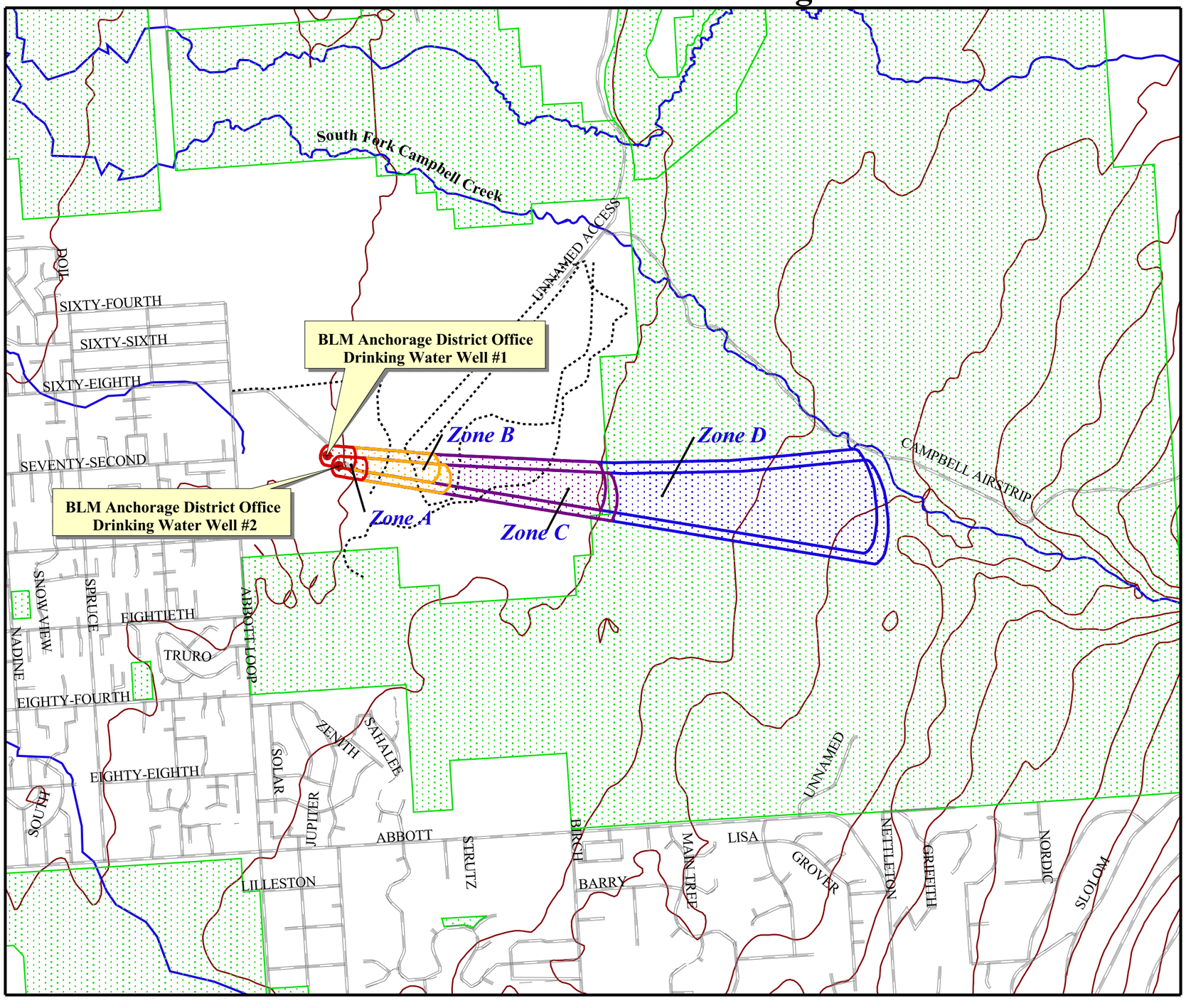
APPENDIX A

BLM Anchorage District Office's Drinking Water Protection Area

Drinking Water Protection Area for BLM Anchorage District Office



- BLM Anchorage District Office Wells 1&2

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Anchorage Roads (X20)
- Trails (X46)
- Chugach State Park
- Anchorage Streams
- Elevation Contours

N
W E
S

4000 0 4000 Feet

PWSID 212178

Map 1

APPENDIX B

Contaminant Source Inventory and Risk Ranking for BLM Anchorage District Office

Table 1

Contaminant Source Inventory for
BLM Anchorage District Office - Wells 1 and 2

PWSID 212178

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Location	Map Number	Notes/Comments
Highways and roads, dirt/gravel	X24	X24-1	A	Unnamed Road	2	
Airports	X14	X14-1	B	Campbell Airstrip intersecting Zone B	2	
Dog walking areas/foot trails	X46	X46-1	B	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-2	B	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-3	B	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-4	C	Trail intersecting Zone C	3	
Dog walking areas/foot trails	X46	X46-5	C	Trail intersecting Zone D	3	

Table 2

Contaminant Source Inventory and Risk Ranking for BLM Anchorage District Office Wells 1 and 2 Sources of Bacteria and Viruses

PWSID 212178

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	A	Very Low	1	Unnamed Road	2	
Dog walking areas/foot trails	X46	X46-1	B	Low	2	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-2	B	Low	3	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-3	B	Low	4	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-4	C	Low	5	Trail intersecting Zone C	3	
Dog walking areas/foot trails	X46	X46-5	C	Low	6	Trail intersecting Zone D	3	

Table 3

Contaminant Source Inventory and Risk Ranking for BLM Anchorage District Office Wells 1 and 2 Sources of Nitrates/Nitrites

PWSID 212178

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	A	Very Low	1	Unnamed Road	2	
Dog walking areas/foot trails	X46	X46-1	B	Low	2	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-2	B	Low	3	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-3	B	Low	4	Trail within Zone B	2	
Dog walking areas/foot trails	X46	X46-4	C	Low	5	Trail intersecting Zone C	3	
Dog walking areas/foot trails	X46	X46-5	C	Low	6	Trail intersecting Zone D	3	

Table 4

Contaminant Source Inventory and Risk Ranking for
BLM Anchorage District Office Wells 1 and 2
Sources of Volatile Organic Chemicals

PWSID 212178

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Airports	X14	X14-1	B	Low	1	Campbell Airstrip intersecting Zone B	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	Unnamed Road	2	

Table 5

Contaminant Source Inventory and Risk Ranking for
BLM Anchorage District Office Wells 1 and 2
Sources of Heavy Metals, Cyanide, Inorganic Chemicals

PWSID 212178

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Airports	X14	X14-1	B	Low	1	Campbell Airstrip intersecting Zone B	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	Unnamed Road	2	

Table 6

Contaminant Source Inventory and Risk Ranking for
BLM Anchorage District Office Wells 1 and 2
Sources of Synthetic Organic Chemicals

PWSID 212178

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments

No known potential or existing sources of contaminant for Synthetic Organic Chemicals.

Table 7

Contaminant Source Inventory and Risk Ranking for
BLM Anchorage District Office Wells 1 and 2
Sources of Other Inorganic Chemicals

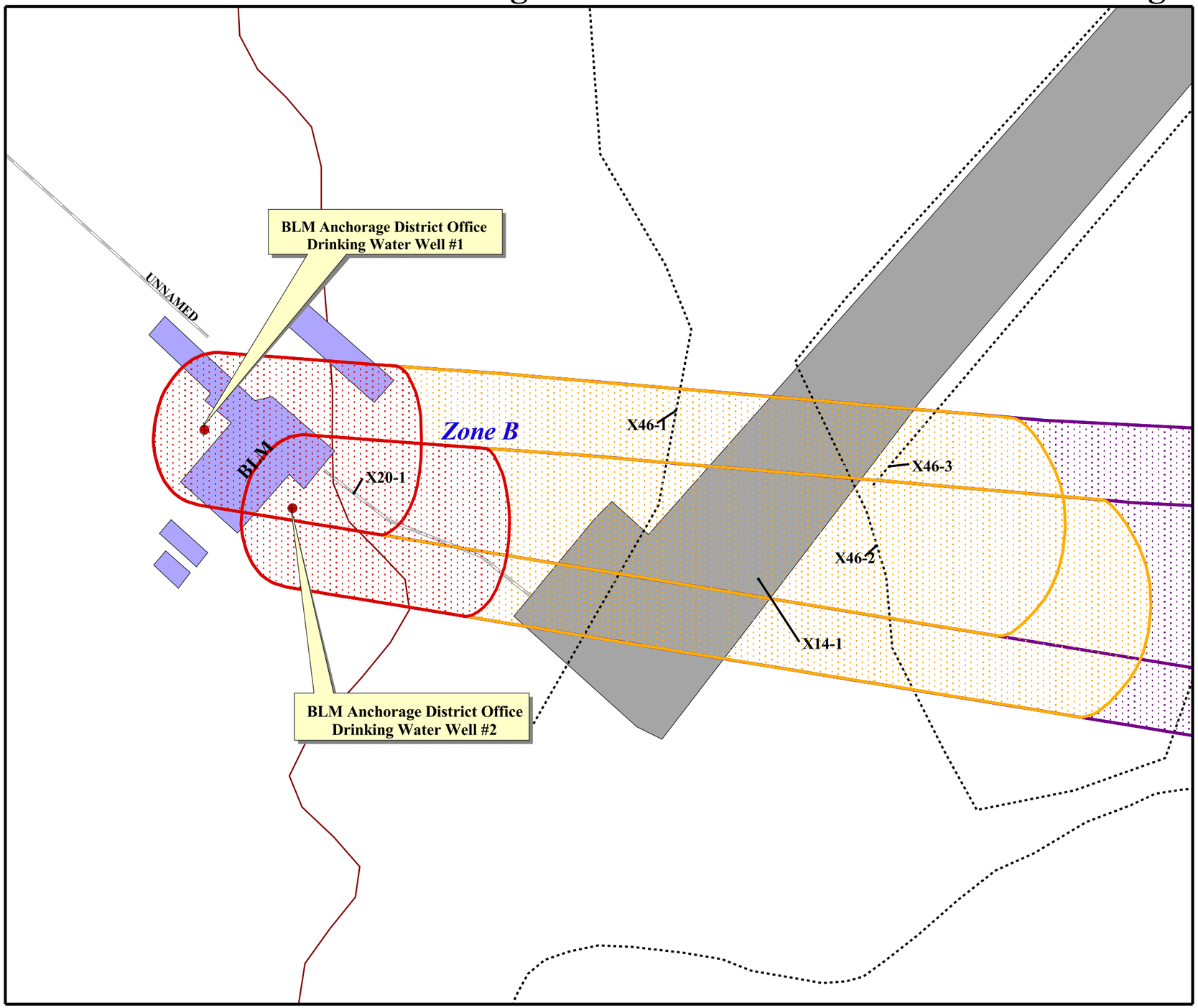
PWSID 212178

Contaminant Source Type	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank After Analysis	Location	Map Number	Comments
Airports	X14	X14-1	B	Low	1	Campbell Airstrip intersecting Zone B	2	
Highways and roads, dirt/gravel	X24	X24-1	A	Low	2	Unnamed Road	2	

APPENDIX C

BLM Anchorage District Office's Drinking Water Protection Area and Potential & Existing Contaminant Sources

Drinking Water Protection Area for
BLM Anchorage District Office and Potential & Existing Contaminant Sources



- BLM Anchorage District Office Wells 1&2

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Anchorage Roads (X20)
- Trails (X46)
- MOA Buildings
- Campbell Landing Strip (X14)
- Elevation Contours

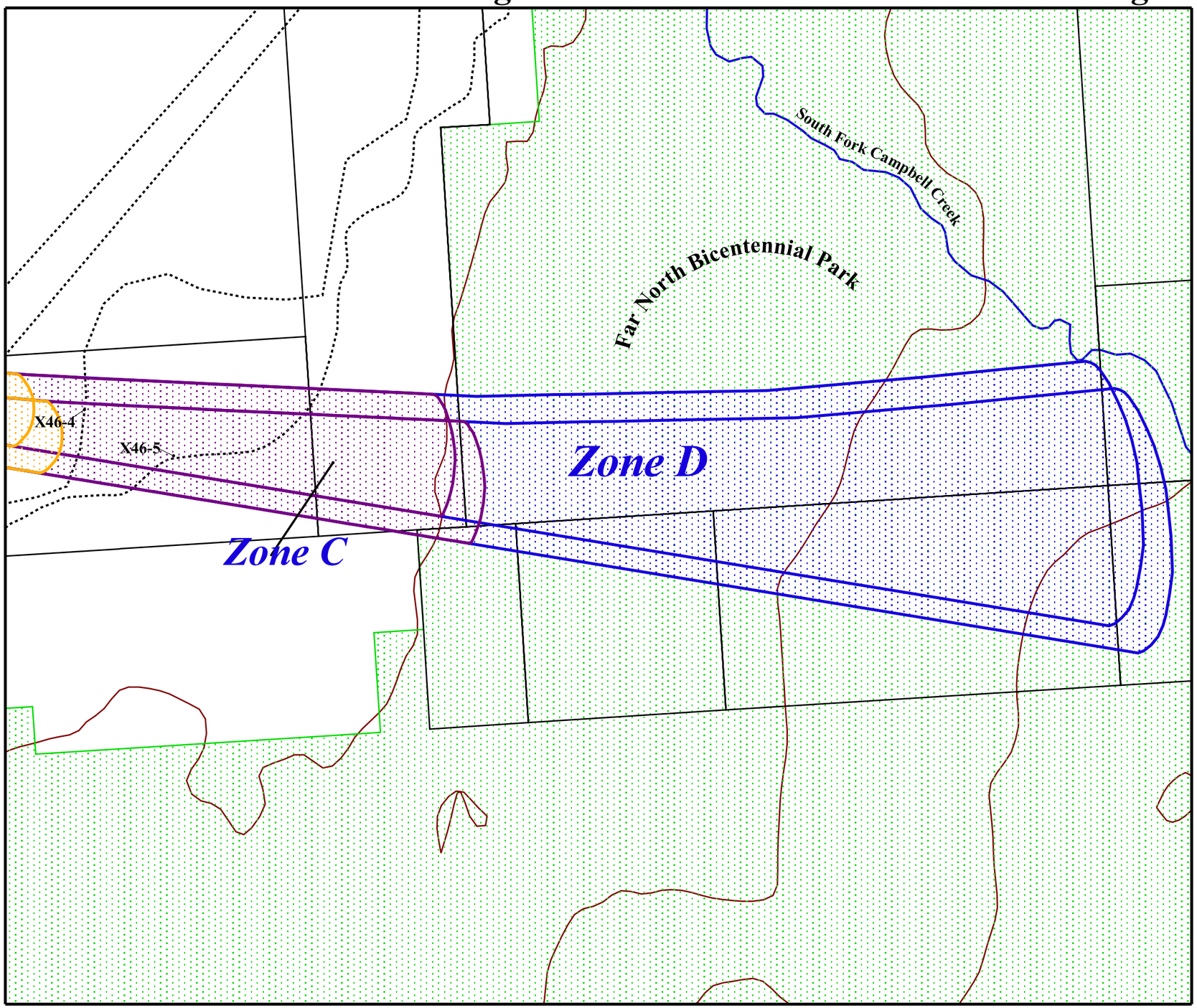
N
W E
S

500 0 500 Feet

PWSID 212178

Map 2

Drinking Water Protection Area for
BLM Anchorage District Office and Potential & Existing Contaminant Sources



- BLM Anchorage District Office Well #1

Zone A Protection Area
- Several Months Travel Time

Zone B Protection Area
- Less Than 2 Years Travel Time

Zone C Protection Area
- Less Than 5 Years Travel Time

Zone D Protection Area
- Less Than 10 Years Travel Time
- Trails (X46)
- Anchorage Land Parcles
- Chugach State Park
- Anchorage Streams
- Elevation Contours

N
W E
S

2000 0 2000 Feet

PWSID 212178

Map 3

APPENDIX D

Vulnerability Analysis for BLM Anchorage District Office's Public Drinking Water Source Well #1

Chart 1. Susceptibility of the wellhead – BLM Anchorage District Office Well #1

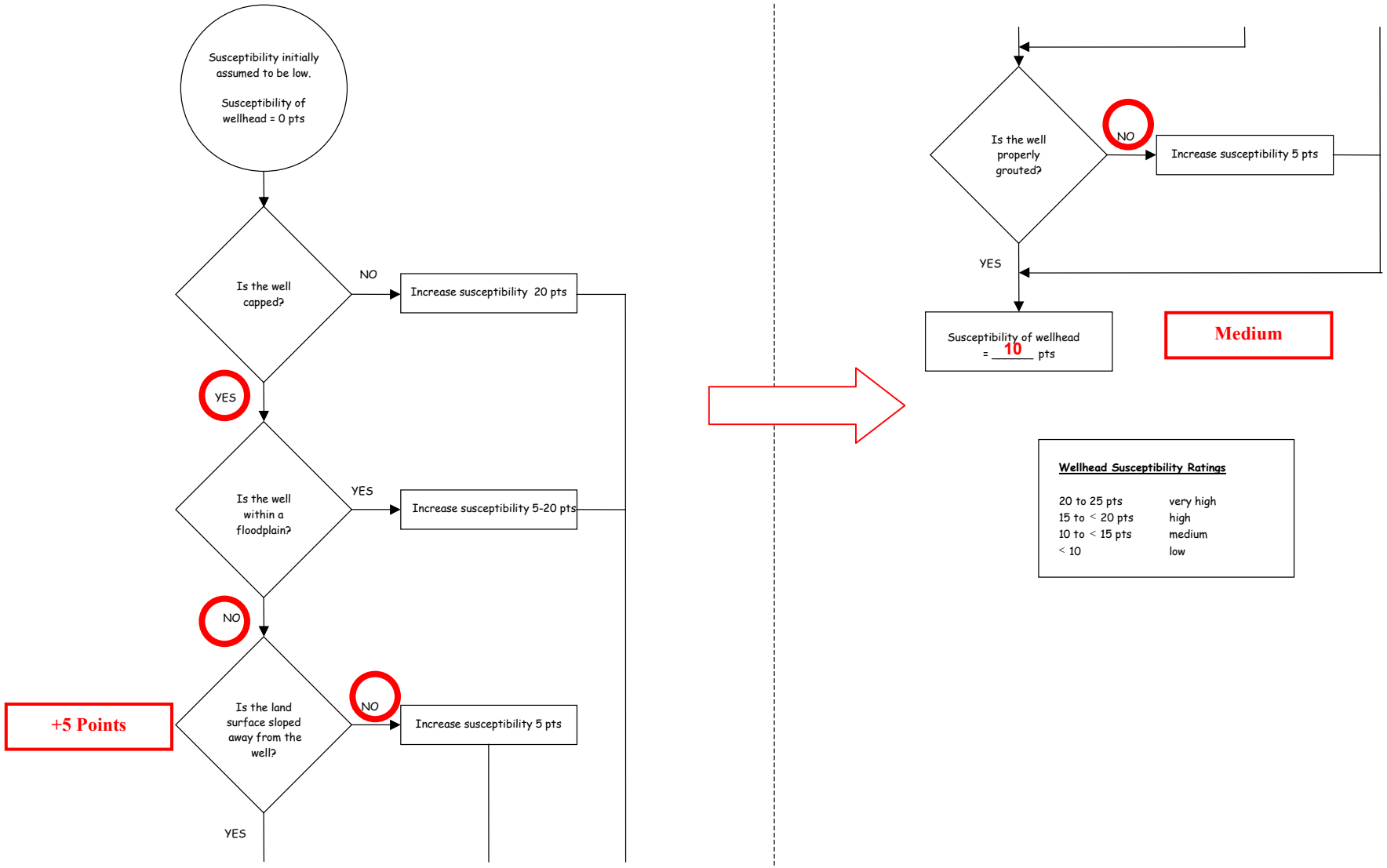
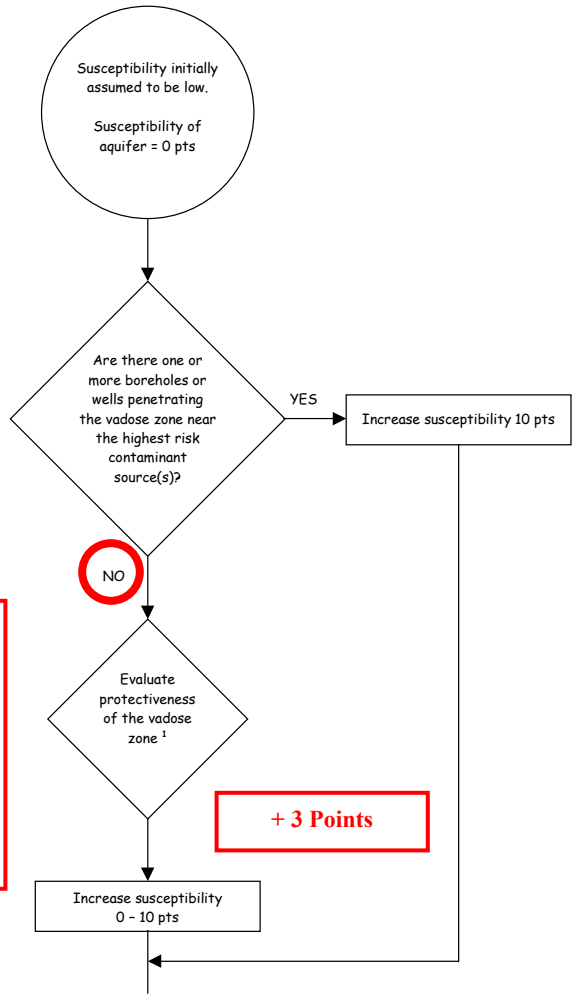


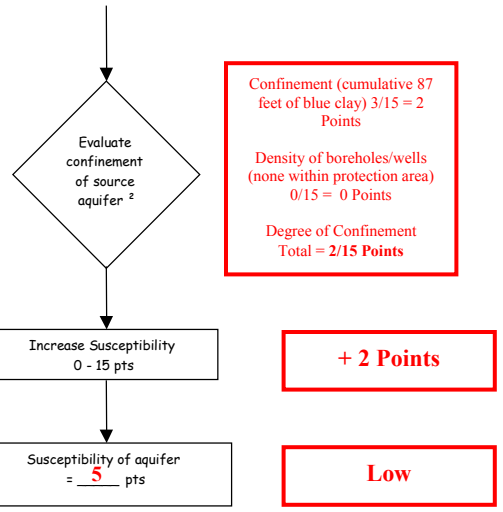
Chart 2. Susceptibility of the aquifer – BLM Anchorage District Office Well #1



Recharge (20-30 inches per year, base of Chugach Mountains, and blue clay with sand and gravel – 87 feet)
2/10 = 1 Point

Depth to top of confining unit (55 feet) 3/10 = 2 Points

Protectiveness of the Vadose Zone Total = **3/10 Points**



Confinement (cumulative 87 feet of blue clay) 3/15 = 2 Points

Density of boreholes/wells (none within protection area) 0/15 = 0 Points

Degree of Confinement Total = **2/15 Points**

+ 2 Points

Low

1. **Protectiveness of the Vadose Zone**
   - net recharge (function of precipitation, slope of land surface, & permeability of soils)
     [0 – 10 pts; 50% weight]
   - depth to water table (unconfined aquifer) or top of confining layer (confined aquifer)
     [interpolate linearly: 100' – 20', 0 – 5 pts; 20' – 0', 5 – 10 pts; 50% weight]

2. **Degree of Confinement**
   - confined verses unconfined aquifer
     [confined: K ≤ 10^{-6} cm/s, minimum thickness of at least one layer = 20 ft, interpolate linearly 100' – 20', 0 – 10 pts; unconfined = 15 pts; 65% weight]
   - density of boreholes and wells penetrating the confining layer (confined aquifer) or the water table (unconfined aquifer)
     [confined: 0 – 15 pts; unconfined = 15 pts; 35% weight]

Aquifer Susceptibility Ratings

20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

Low

Chart 3. Contaminant risks for BLM Anchorage District Office Well #1 – Bacteria & Viruses

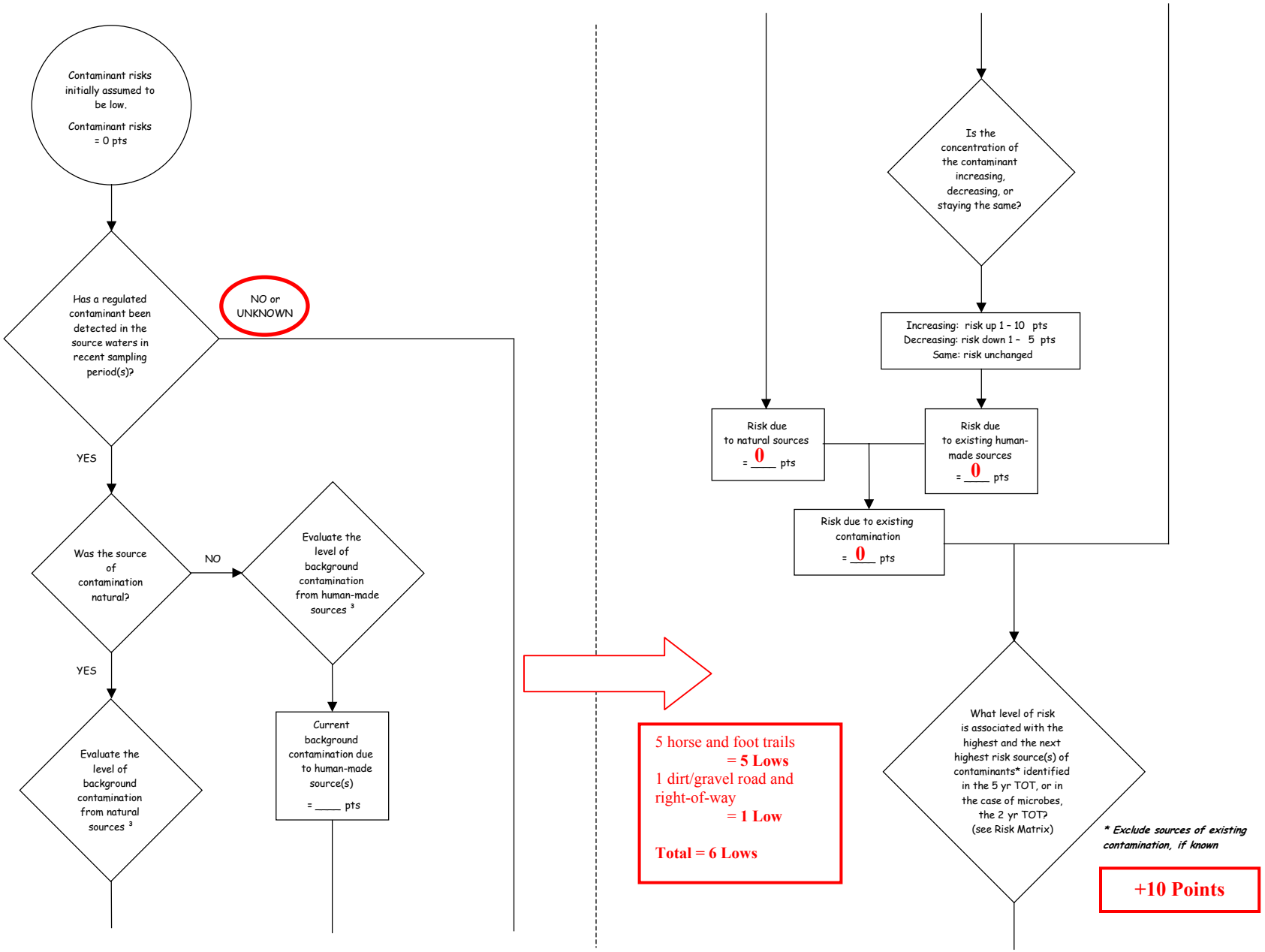


Chart 3. Contaminant risks for BLM Anchorage District Office Well #1 – Bacteria & Viruses (Continued)

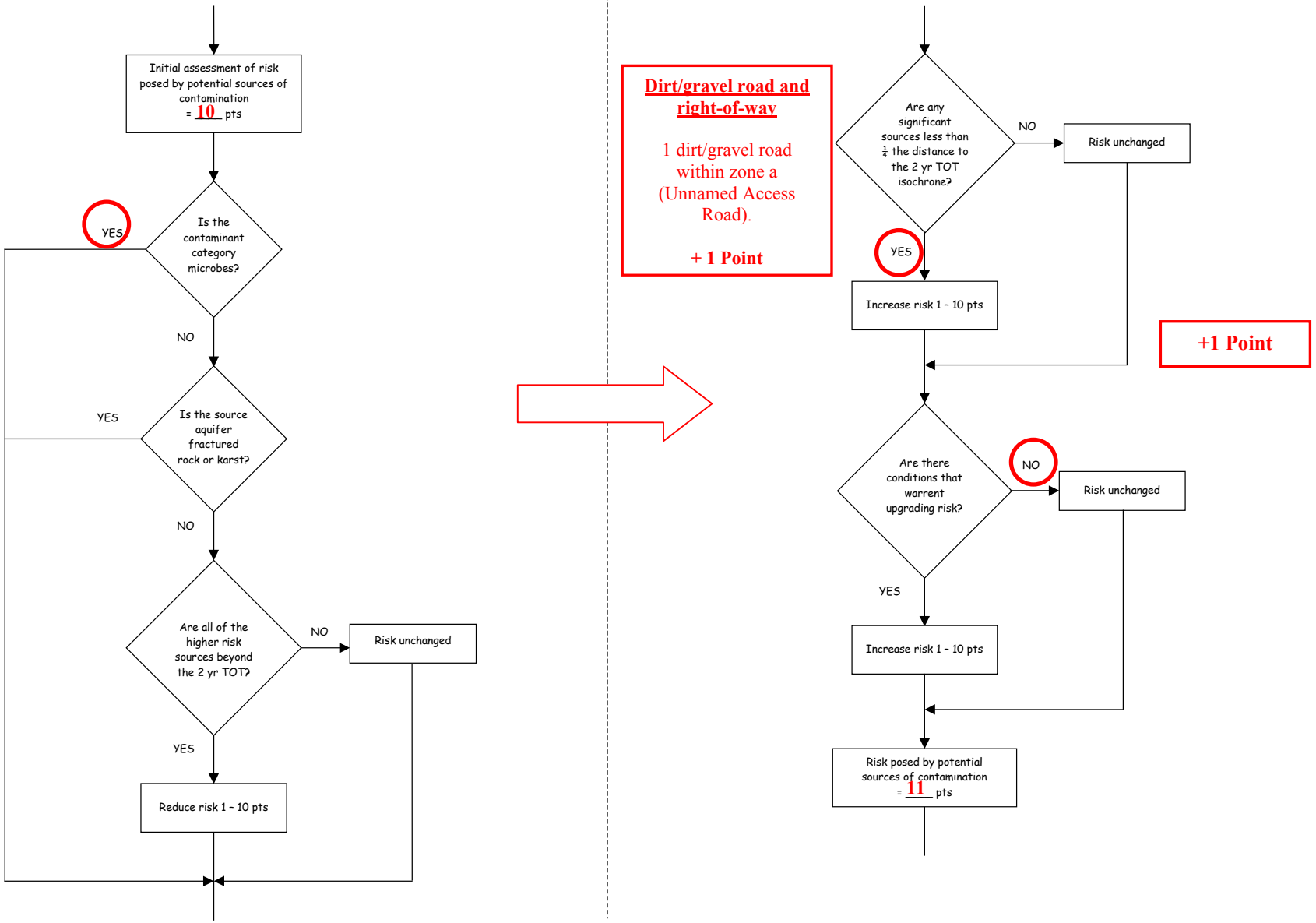
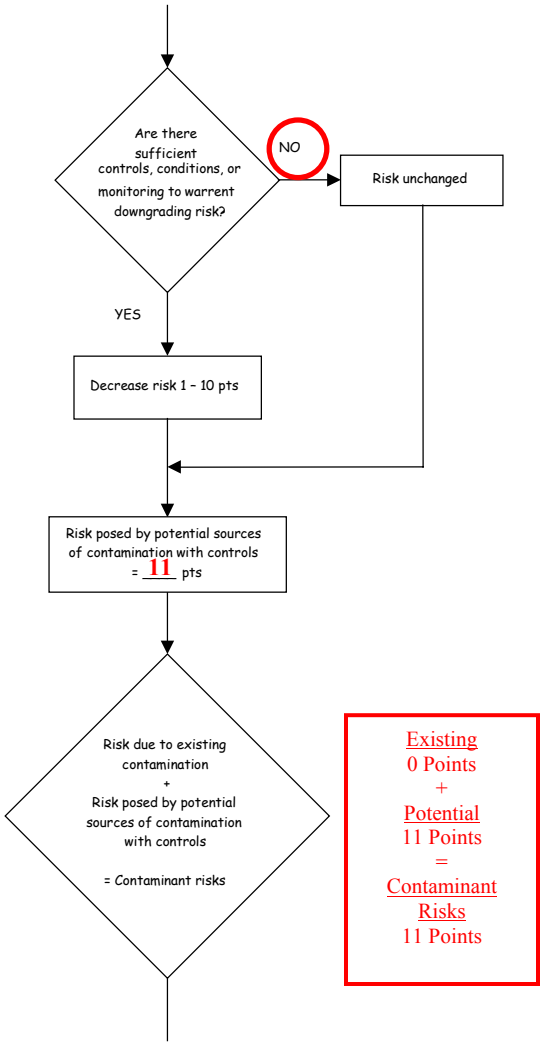
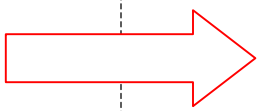


Chart 3. Contaminant risks for BLM Anchorage District Office Well #1 – Bacteria & Viruses (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points



** Truncate risk at 50 pts*

Contaminant risks* = 11 pts

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 1. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #1 – Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

5 Horse and foot trails, 1 dirt/gravel road and right-of-way	**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

Chart 4. Vulnerability analysis for BLM Anchorage District Office Well #1 – Bacteria & Viruses

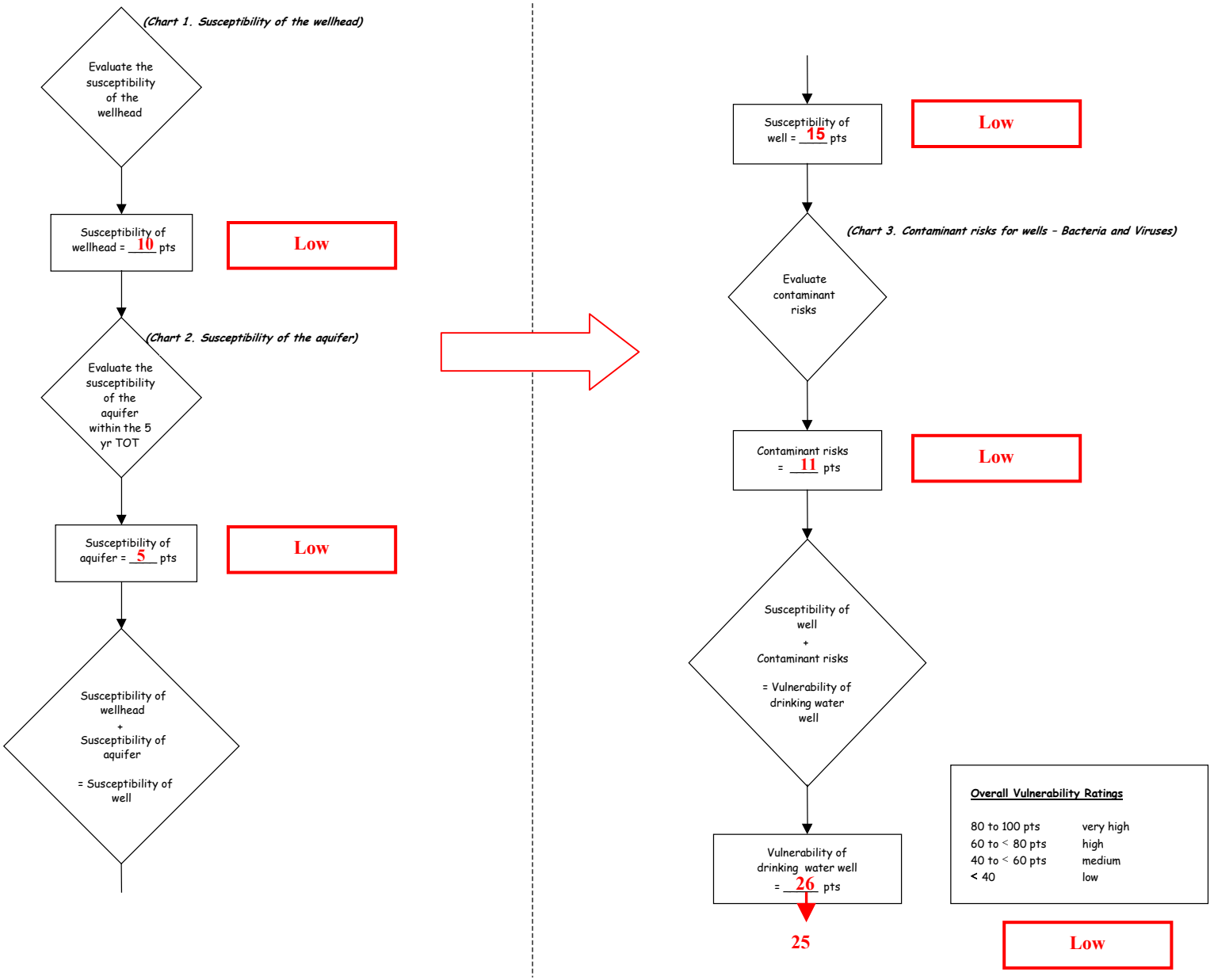


Chart 5. Contaminant risks for BLM Anchorage District Office Well #1 – Nitrates and Nitrites

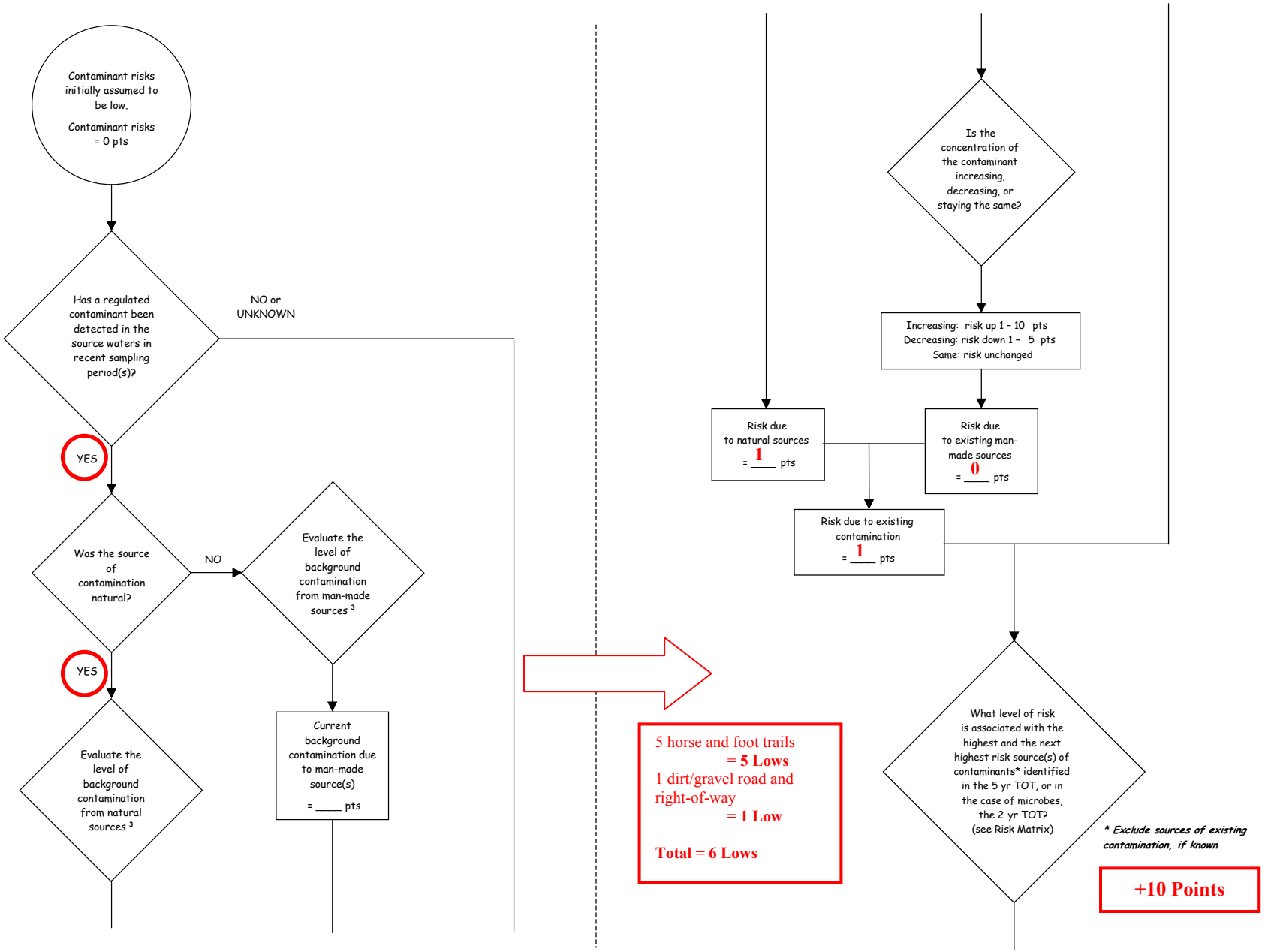


Chart 5. Contaminant risks for BLM Anchorage District Office Well #1 – Nitrates and Nitrites (Continued)

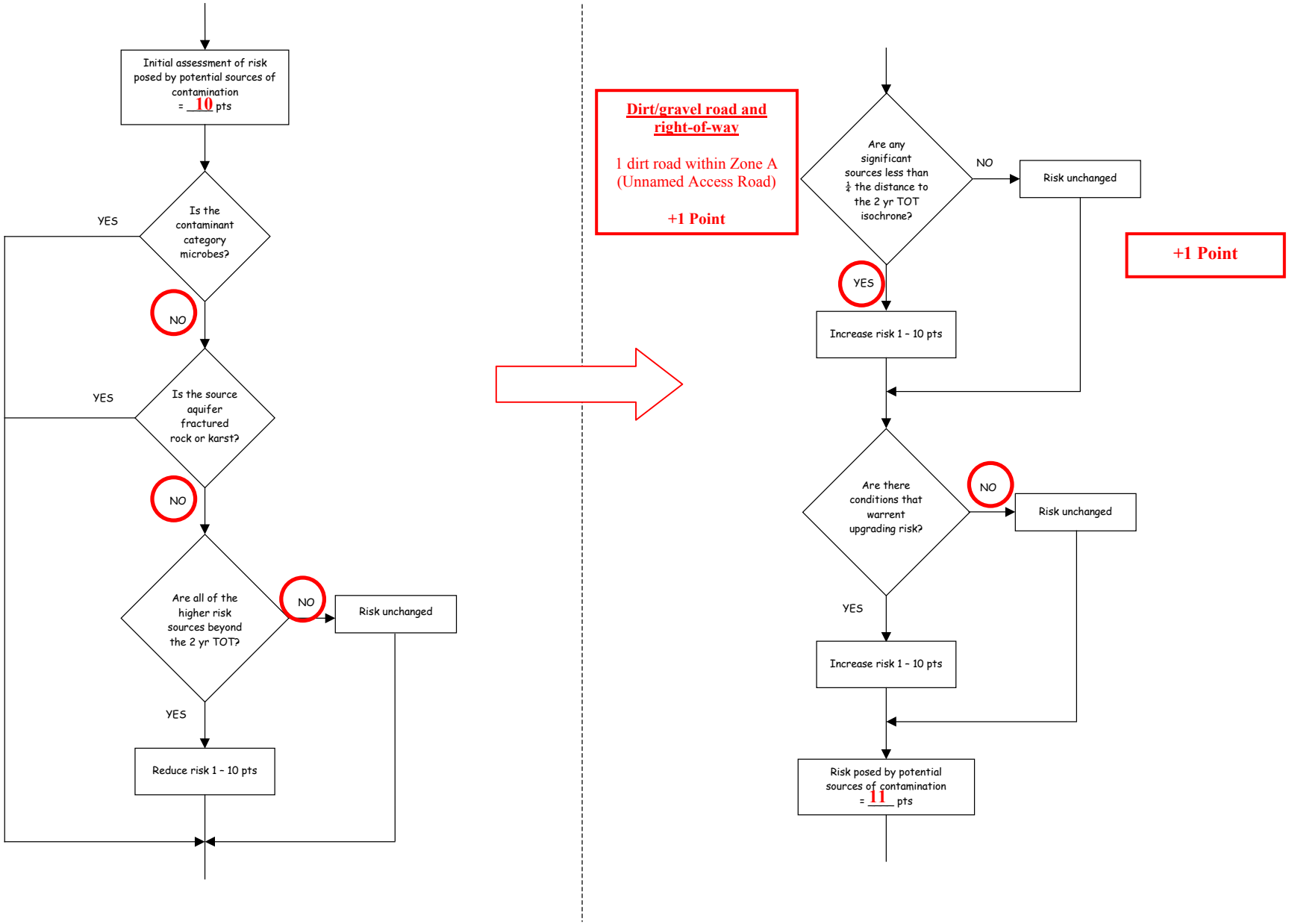
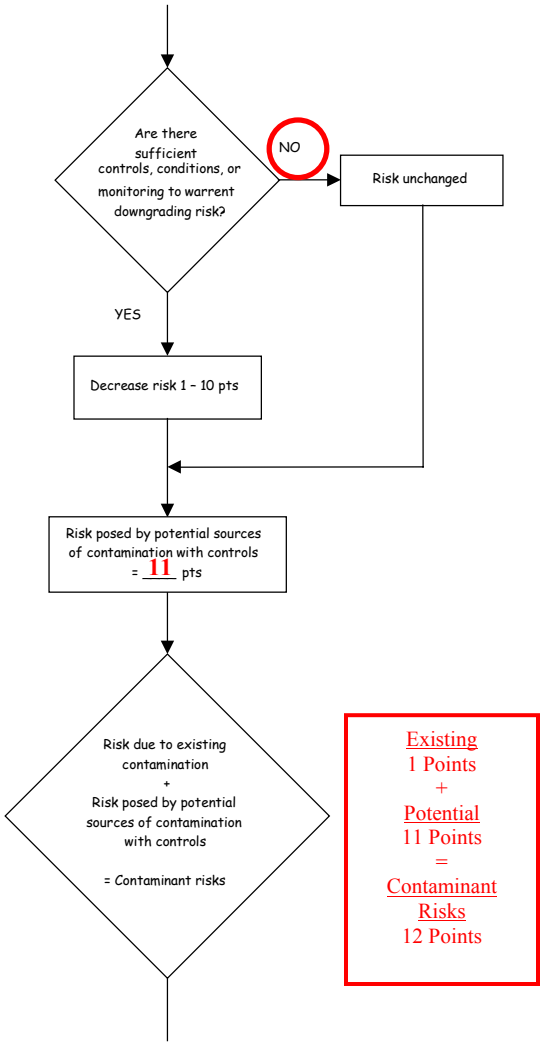
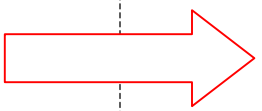
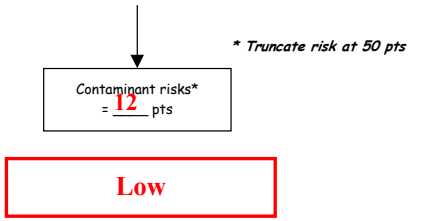


Chart 5. Contaminant risks for BLM Anchorage District Office Well #1 – Nitrates and Nitrites (Continued)



Existing
1 Points
+
Potential
11 Points
=
Contaminant
Risks
12 Points





3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

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

Nitrate
0.440 mg/L on 11/30/98
0.240 mg/L on 02/06/96
0.200 mg/L on 03/21/95
0.190 mg/L on 10/29/93
0.300 mg/L on 04/01/92
ND mg/L on 11/18/96

Maximum Contaminant Level (MCL) = 10mg/L

0.440/10 or 4.4% of MCL

+1 Point

Table 2. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #1 – Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

5 horse and foot trails, 1 dirt/gravel road and right-of-way	**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

Chart 6. Vulnerability analysis for BLM Anchorage District Office Well #1 – Nitrates and Nitrites

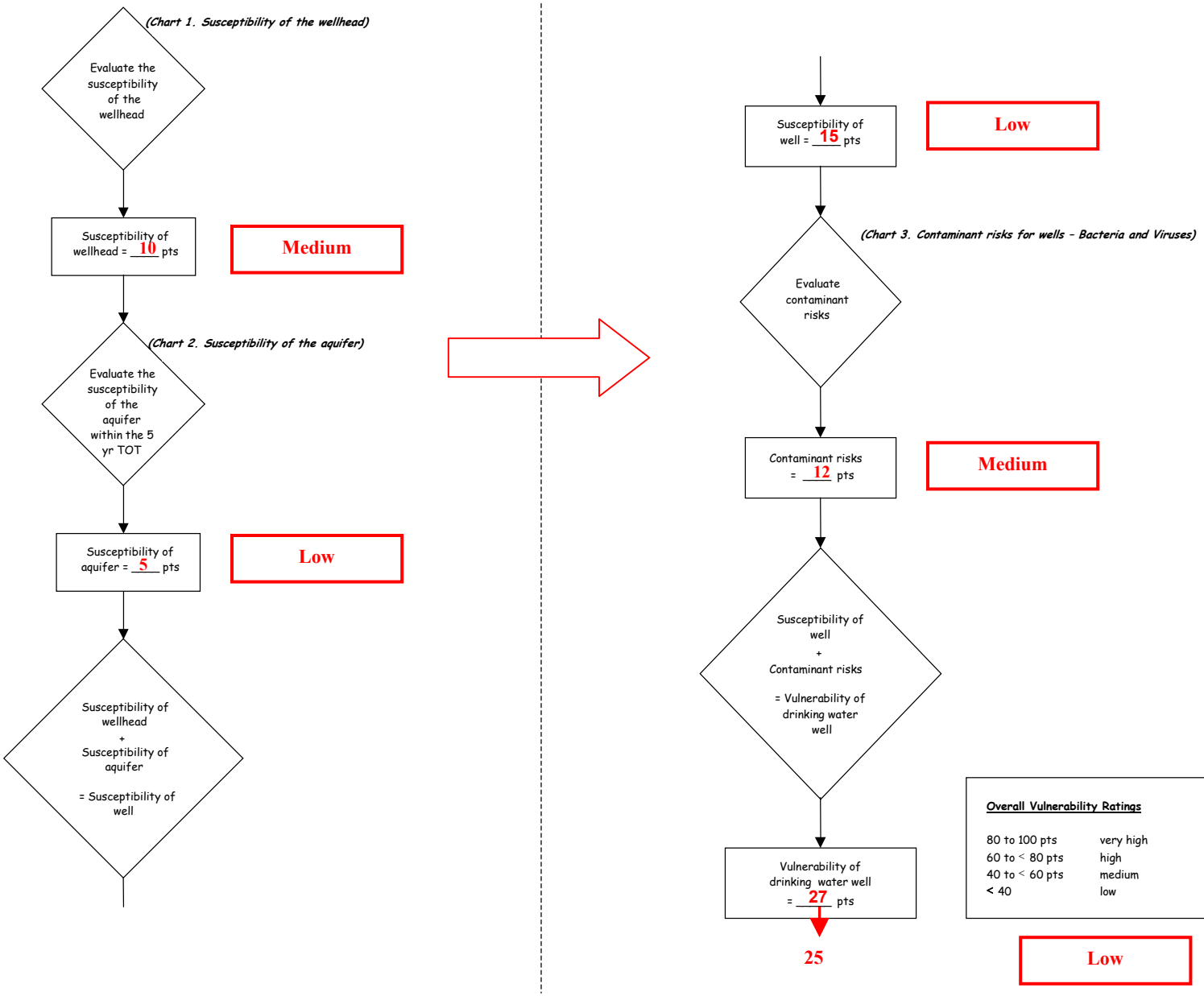


Chart 7. Contaminant risks for BLM Anchorage District Office Well #1 – Volatile Organic Chemicals

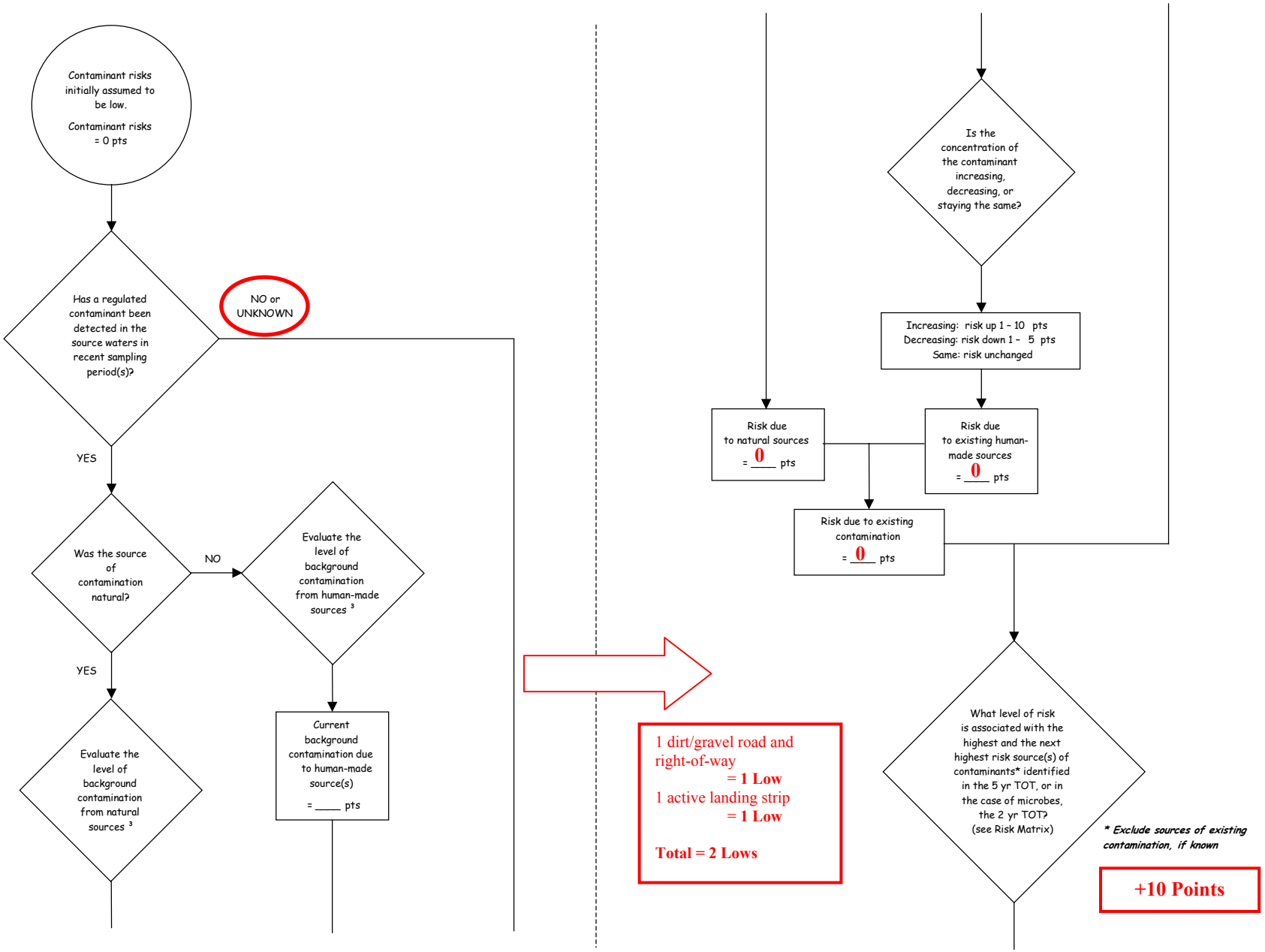


Chart 7. Contaminant risks for BLM Anchorage District Office Well #1 – Volatile Organic Chemicals (Continued)

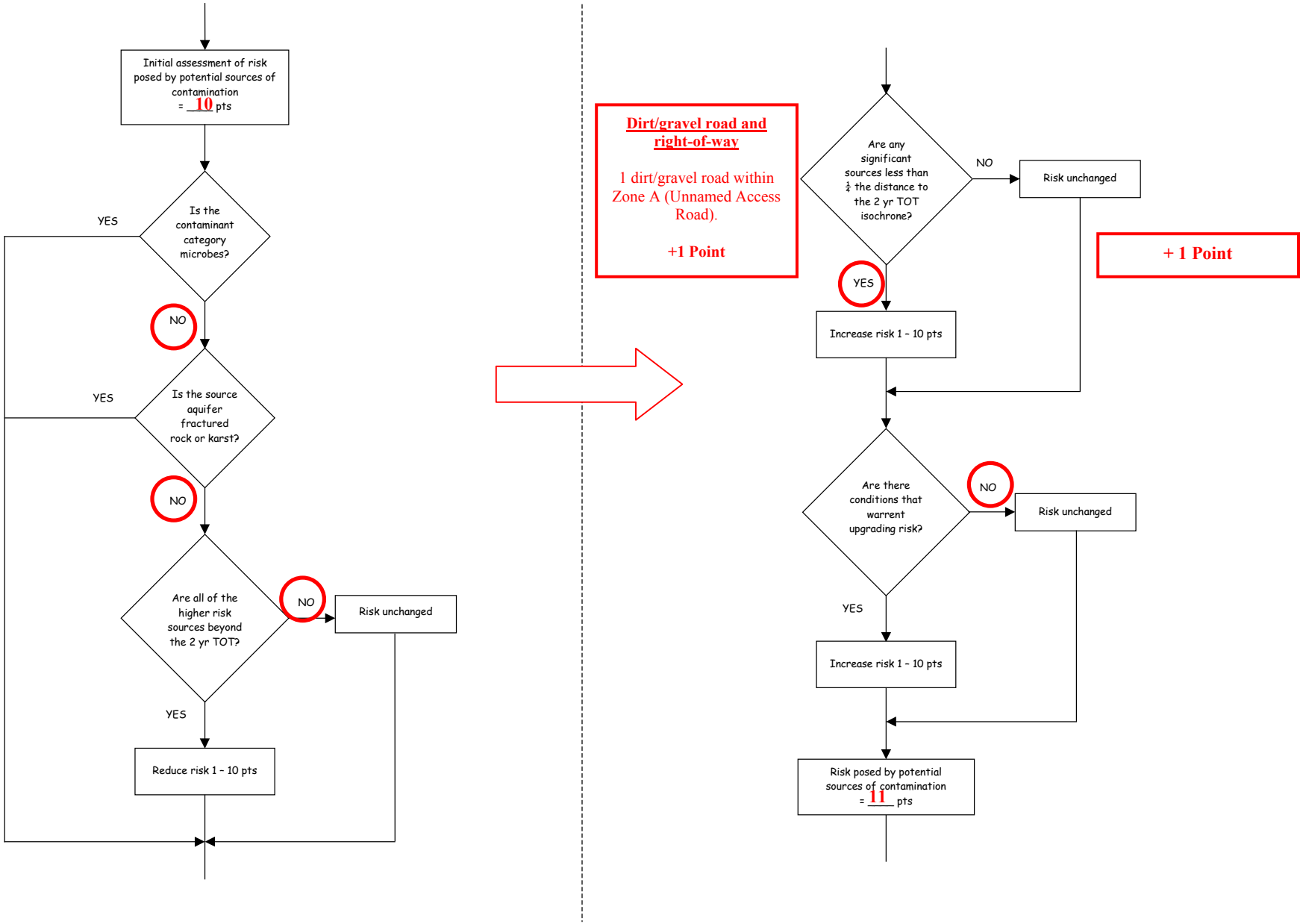
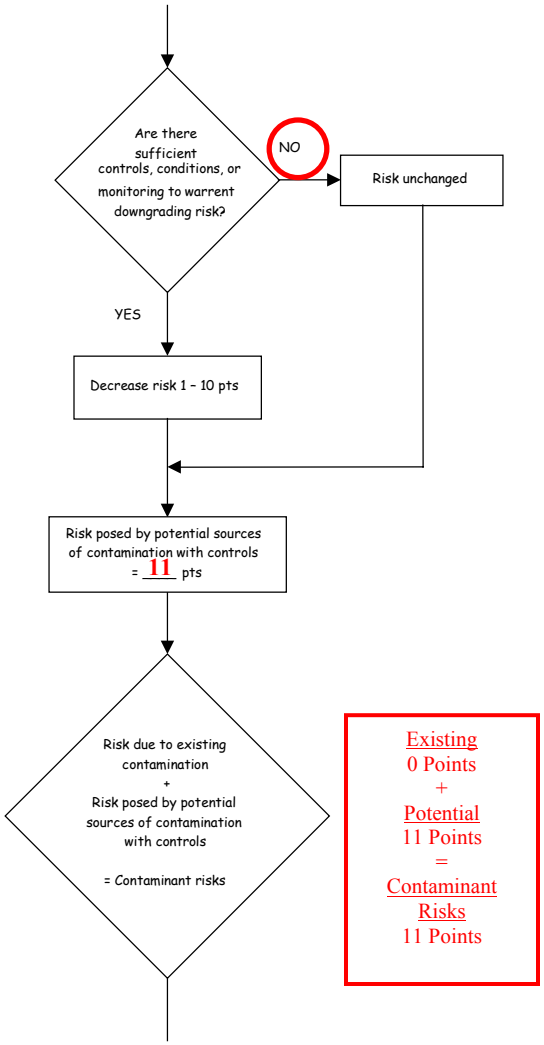
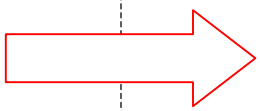
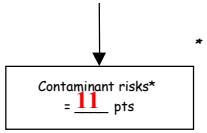


Chart 7. Contaminant risks for BLM Anchorage District Office Well #1 – Volatile Organic Chemicals (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points





** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 3. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #1 – Volatile Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	1 dirt/gravel road and right-of-way, 1 active landing strip	**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

Chart 8. Vulnerability analysis for BLM Anchorage District Office Well #1 – Volatile Organic Chemicals

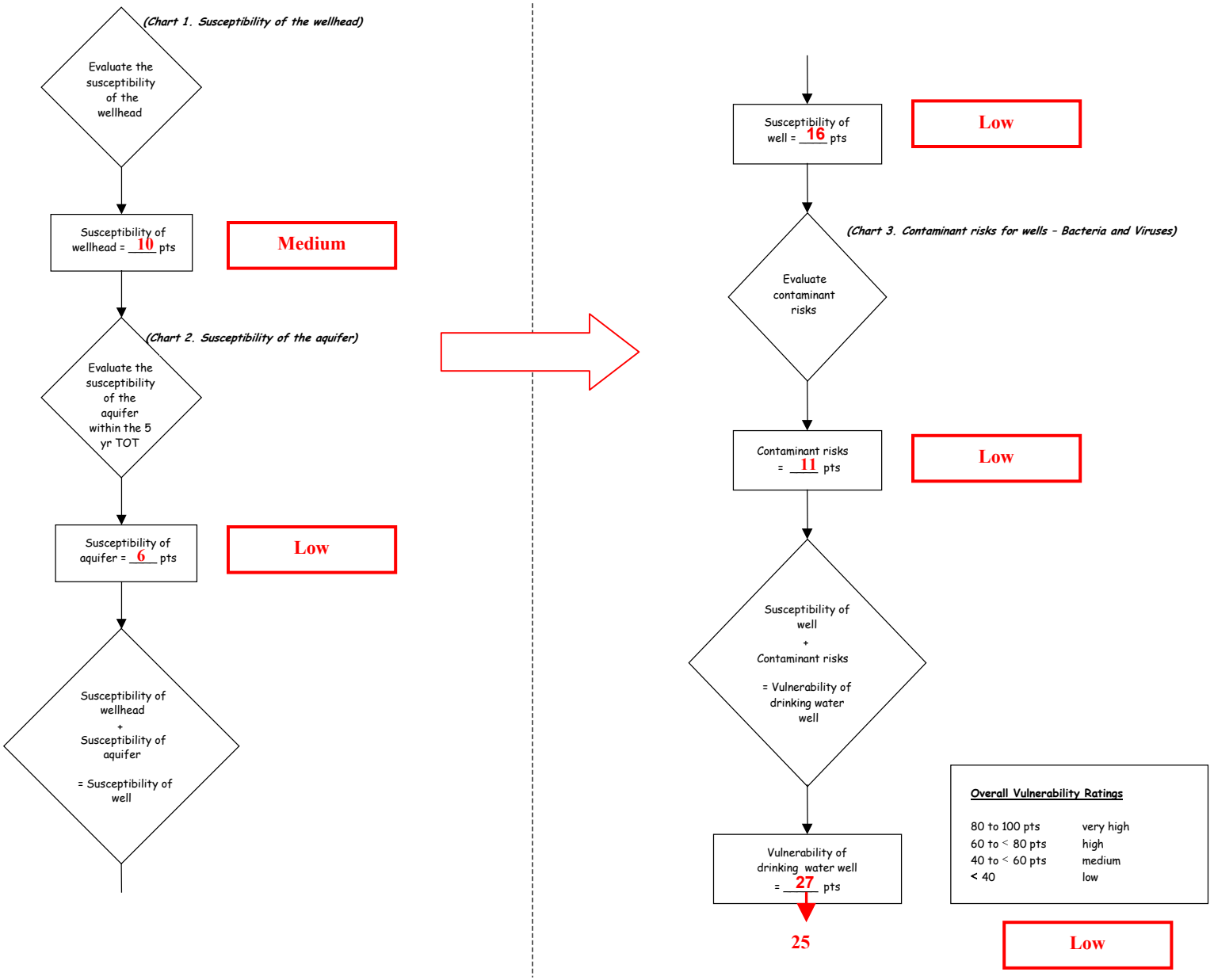


Chart 9. Contaminant risks for BLM Anchorage District Office Well #1 – Heavy Metals, Cyanide and Other Inorganic Chemicals

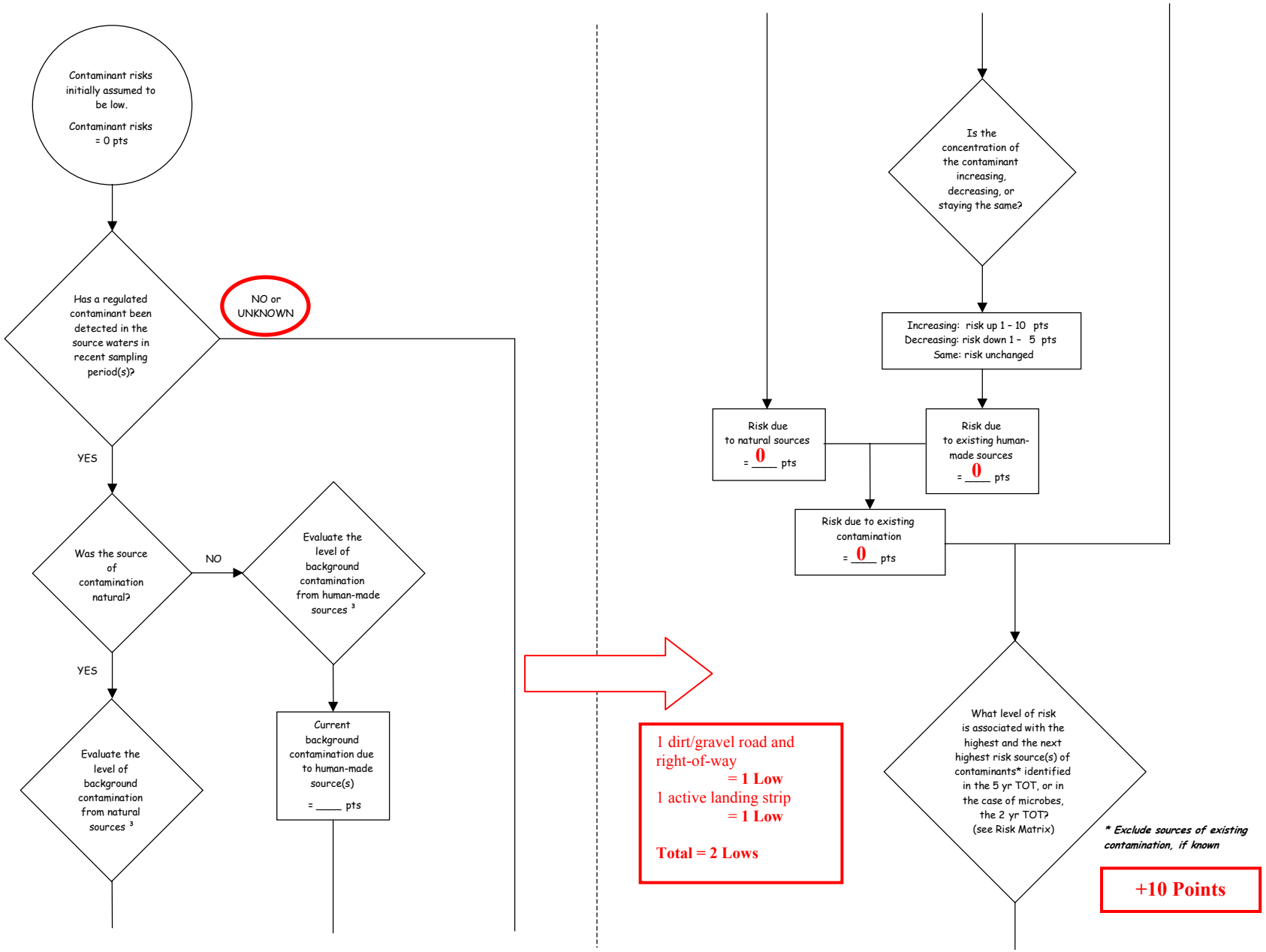


Chart 9. Contaminant risks for BLM Anchorage District Office Well #1 – Heavy Metals, Cyanide and Other Inorganic Chemicals (Continued)

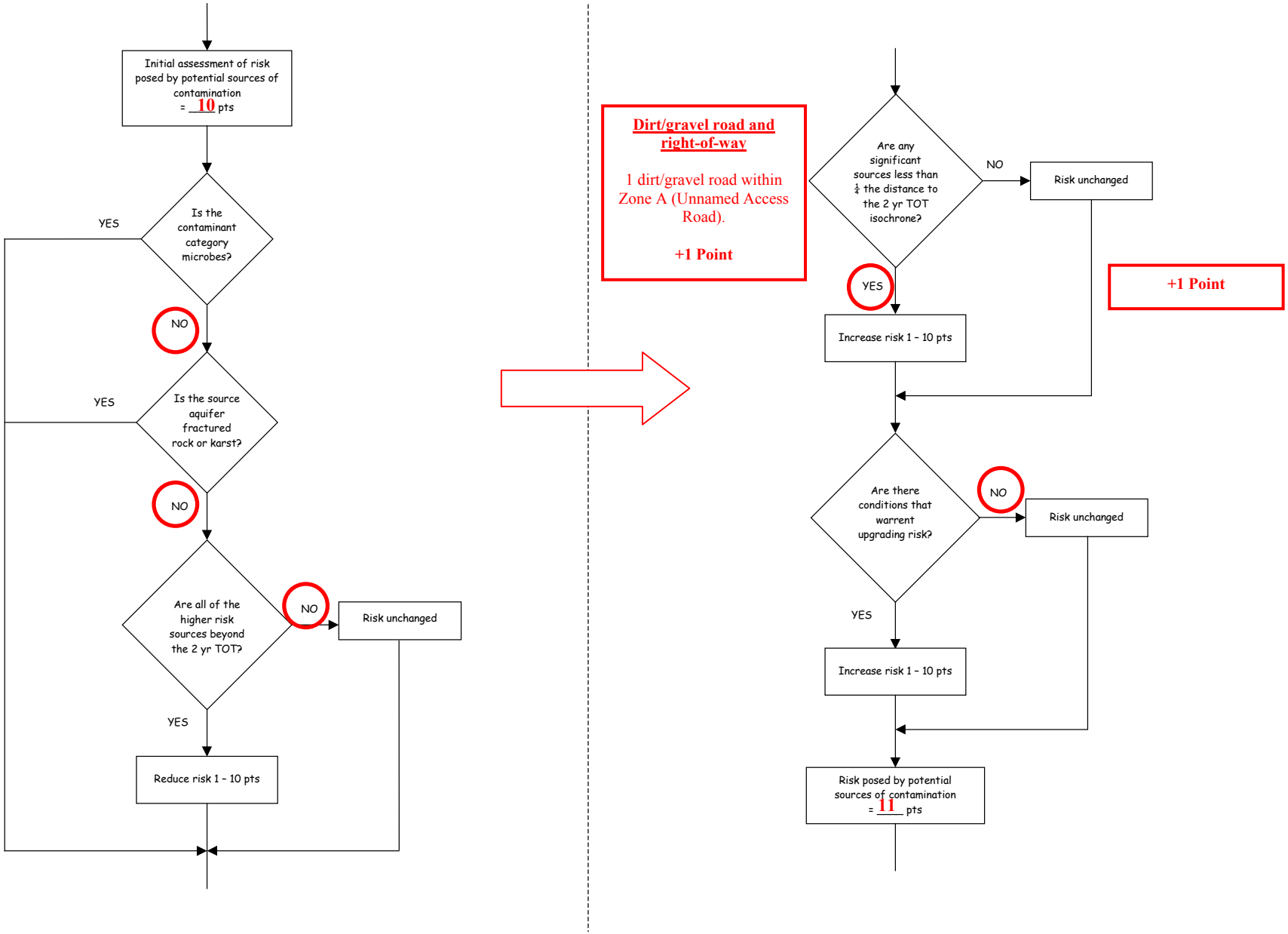
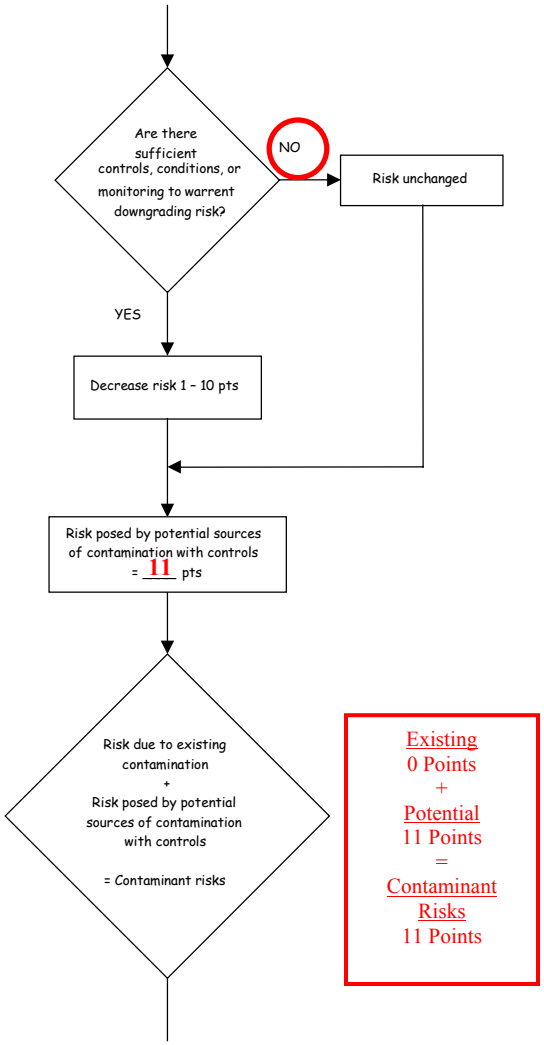
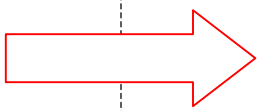
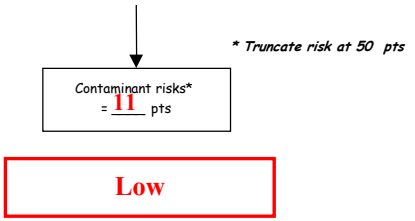


Chart 9. Contaminant risks for BLM Anchorage District Office Well #1 – Heavy Metals, Cyanide and Other Inorganic Chemicals (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points





3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 4. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #1 – Heavy Metals, Cyanide and Other Inorganic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

1 dirt/gravel road and right-of-way, 1 active landing strip	**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

Chart 10. Vulnerability analysis for BLM Anchorage District Office Well #1 – Heavy Metals, Cyanide and Other Inorganic Chemicals

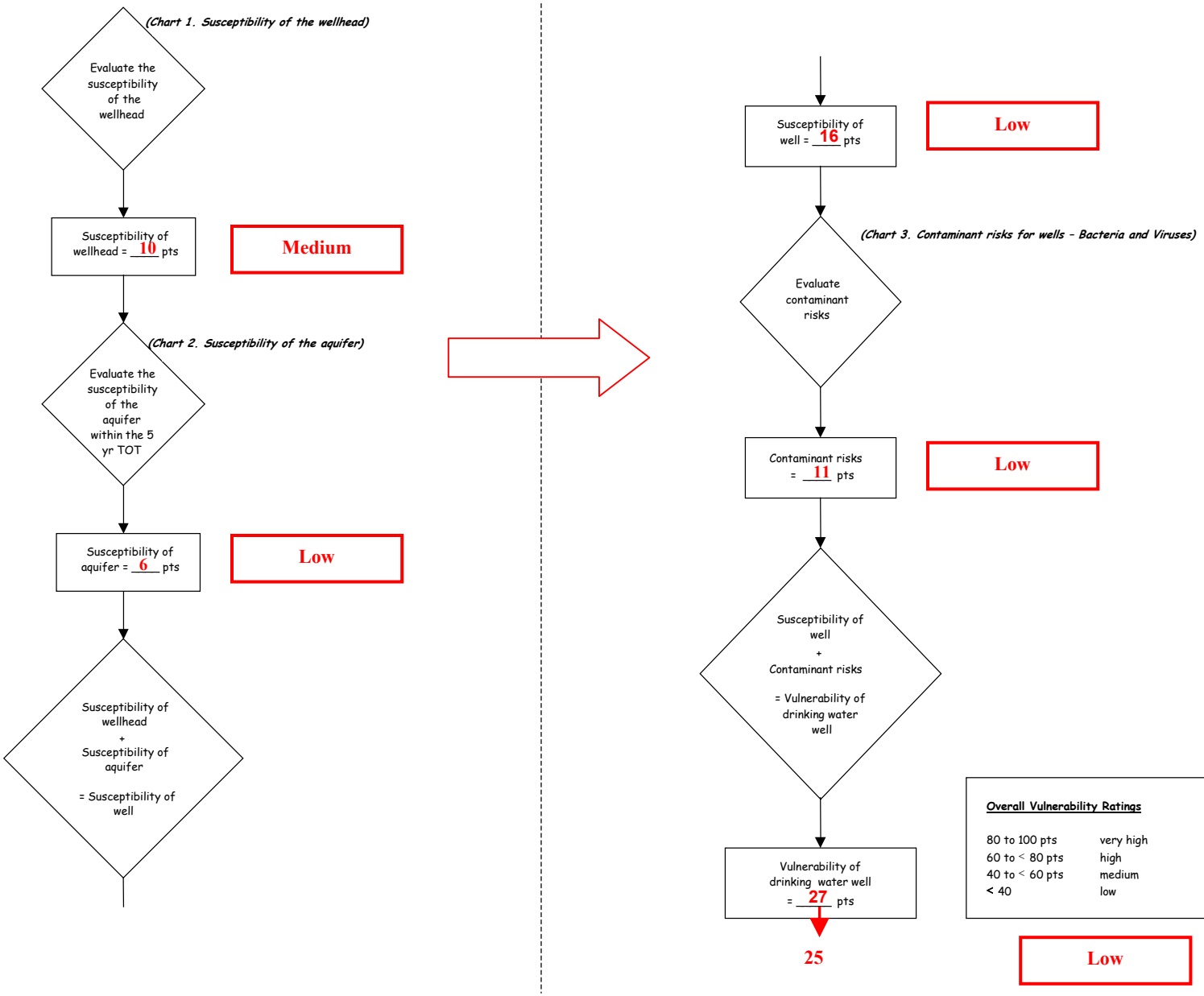


Chart 11. Contaminant risks for BLM Anchorage District Office Well #1 – Synthetic Organic Chemicals

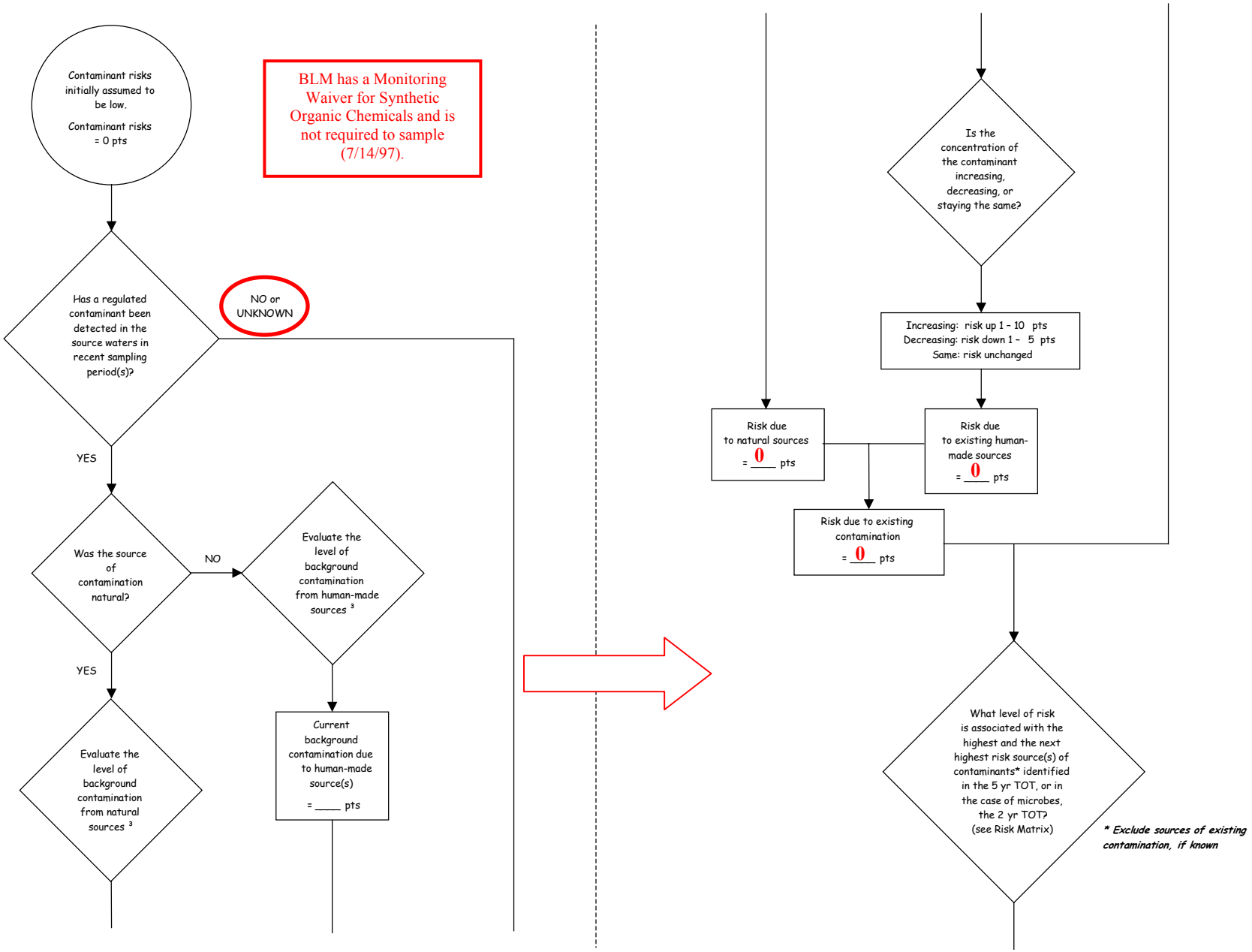


Chart 11. Contaminant risks for BLM Anchorage District Office Well #1 – Synthetic Organic Chemicals (Continued)

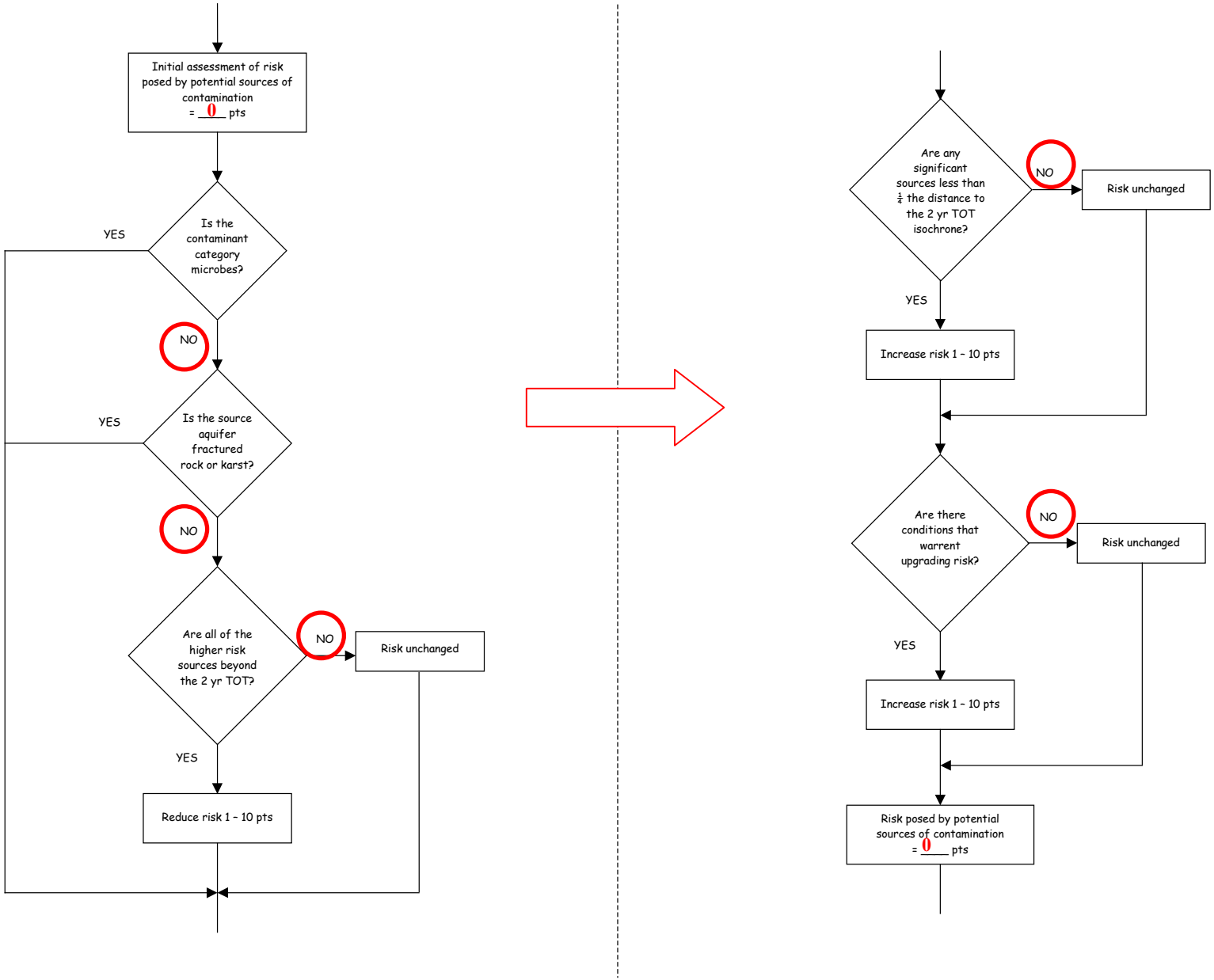
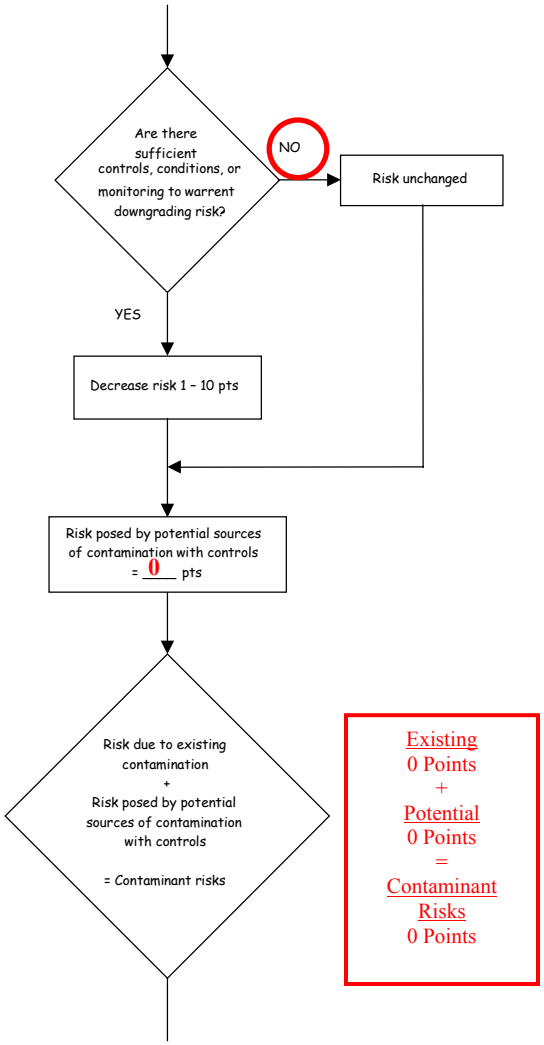


Chart 11. Contaminant risks for BLM Anchorage District Office Well #1 – Synthetic Organic Chemicals (Continued)



Existing
0 Points
+
Potential
0 Points
=
Contaminant
Risks
0 Points

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

** Truncate risk at 50 pts*

Contaminant risks*
= 0 pts

Low

Table 5. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #1 – Synthetic Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

No known potential or existing sources of synthetic organic chemicals.	**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

Chart 12. Vulnerability analysis for BLM Anchorage District Office Well #1 – Synthetic Organic Chemicals

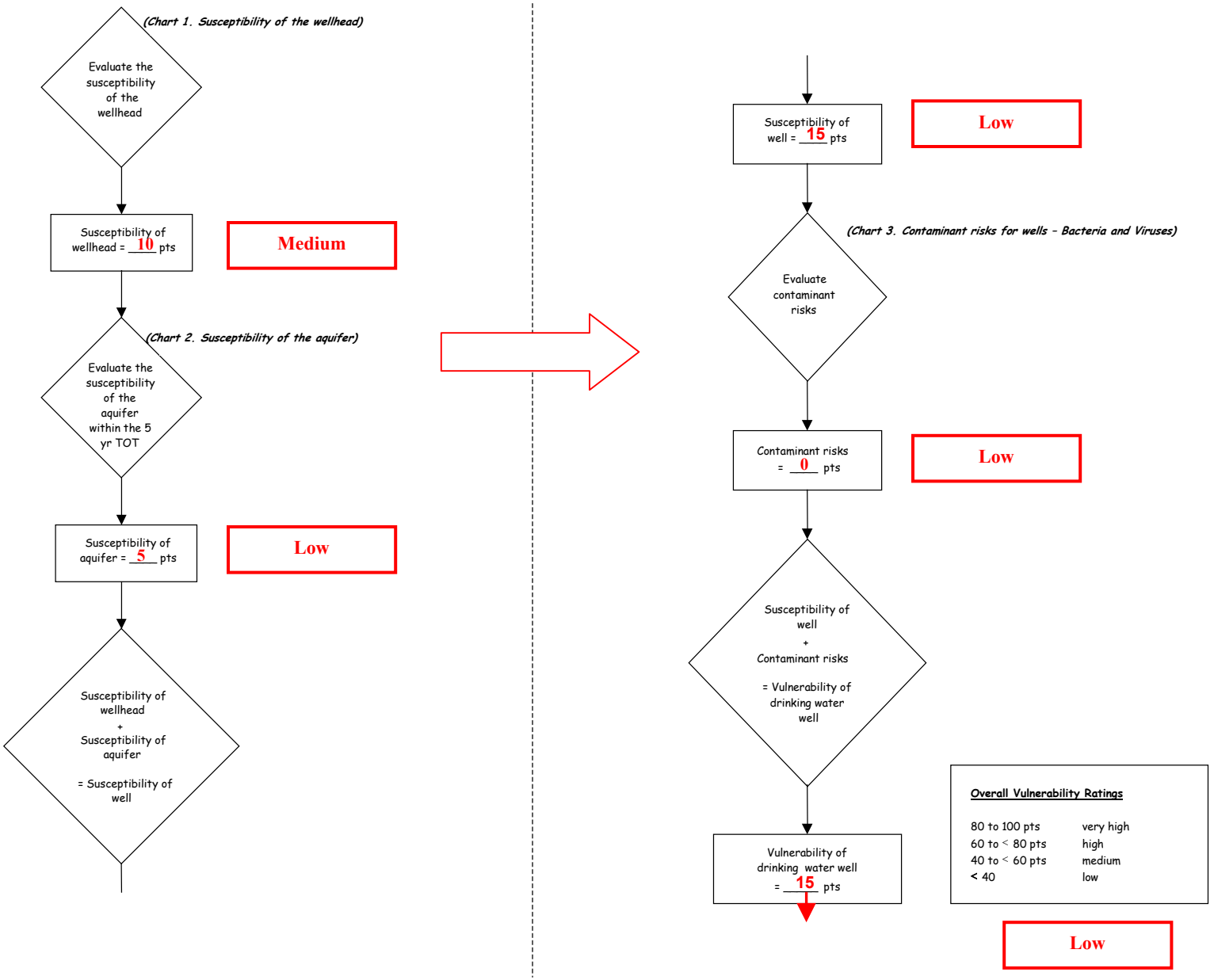


Chart 13. Contaminant risks for BLM Anchorage District Office Well #1 – Other Organic Chemicals

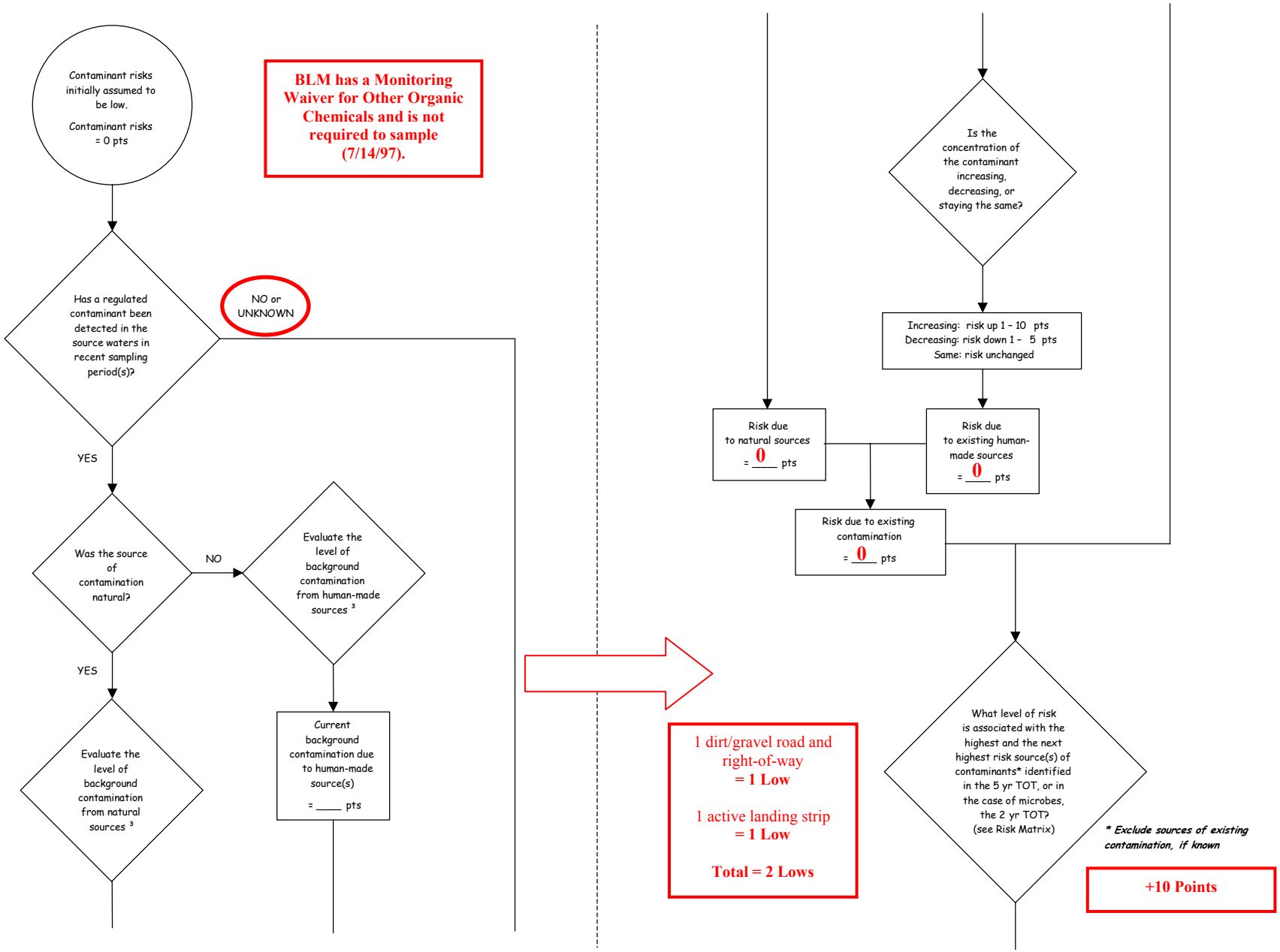
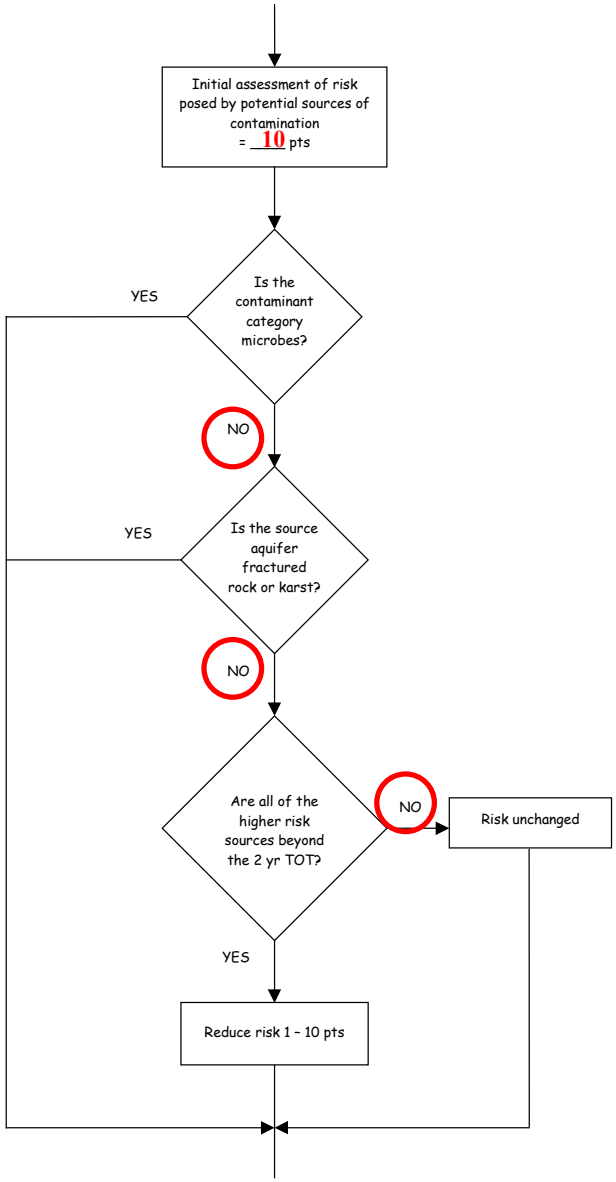


Chart 13. Contaminant risks for BLM Anchorage District Office Well #1 – Other Organic Chemicals (Continued)



Dirt/gravel road and right-of-way

1 dirt/gravel road (unnamed access road) and right-of-way
= 1 Low

Total = 1 Low

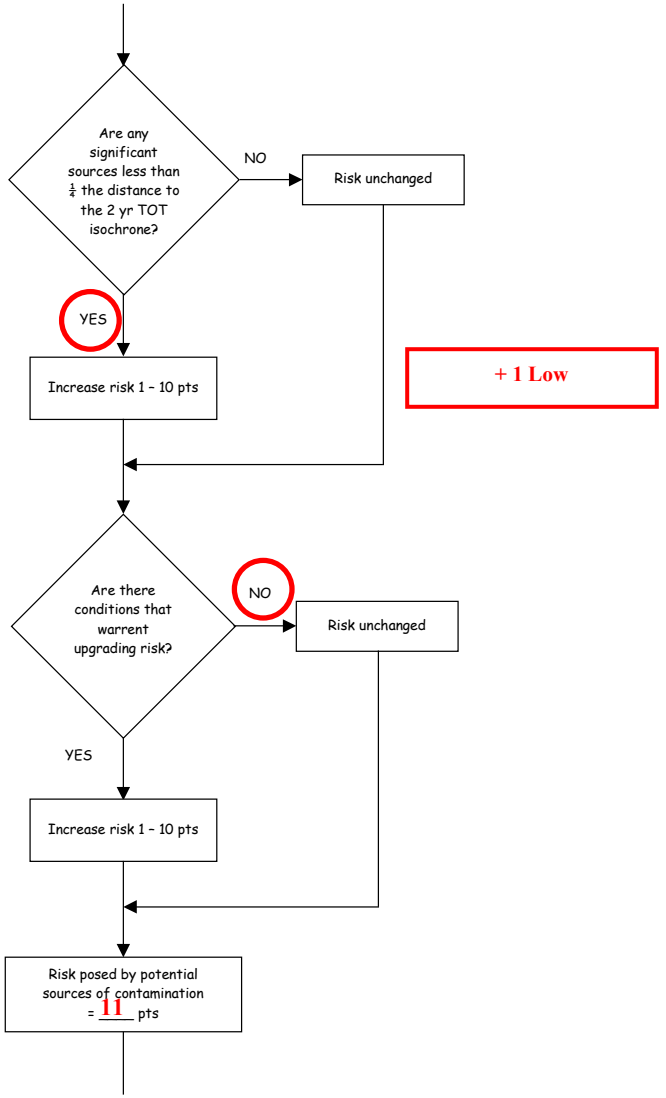
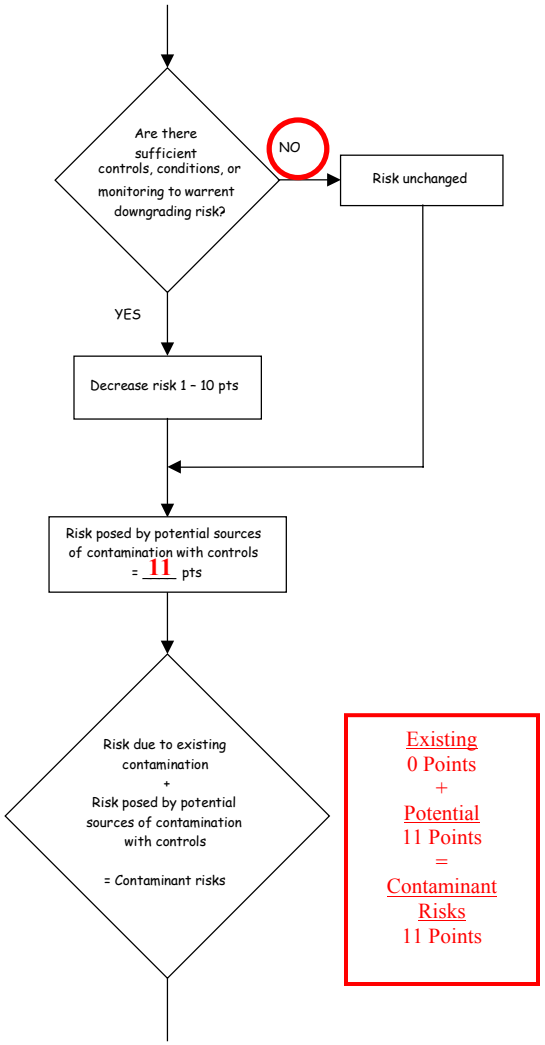
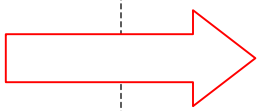
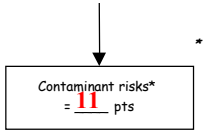


Chart 13. Contaminant risks for BLM Anchorage District Office Well #1 – Other Organic Chemicals (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points





** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

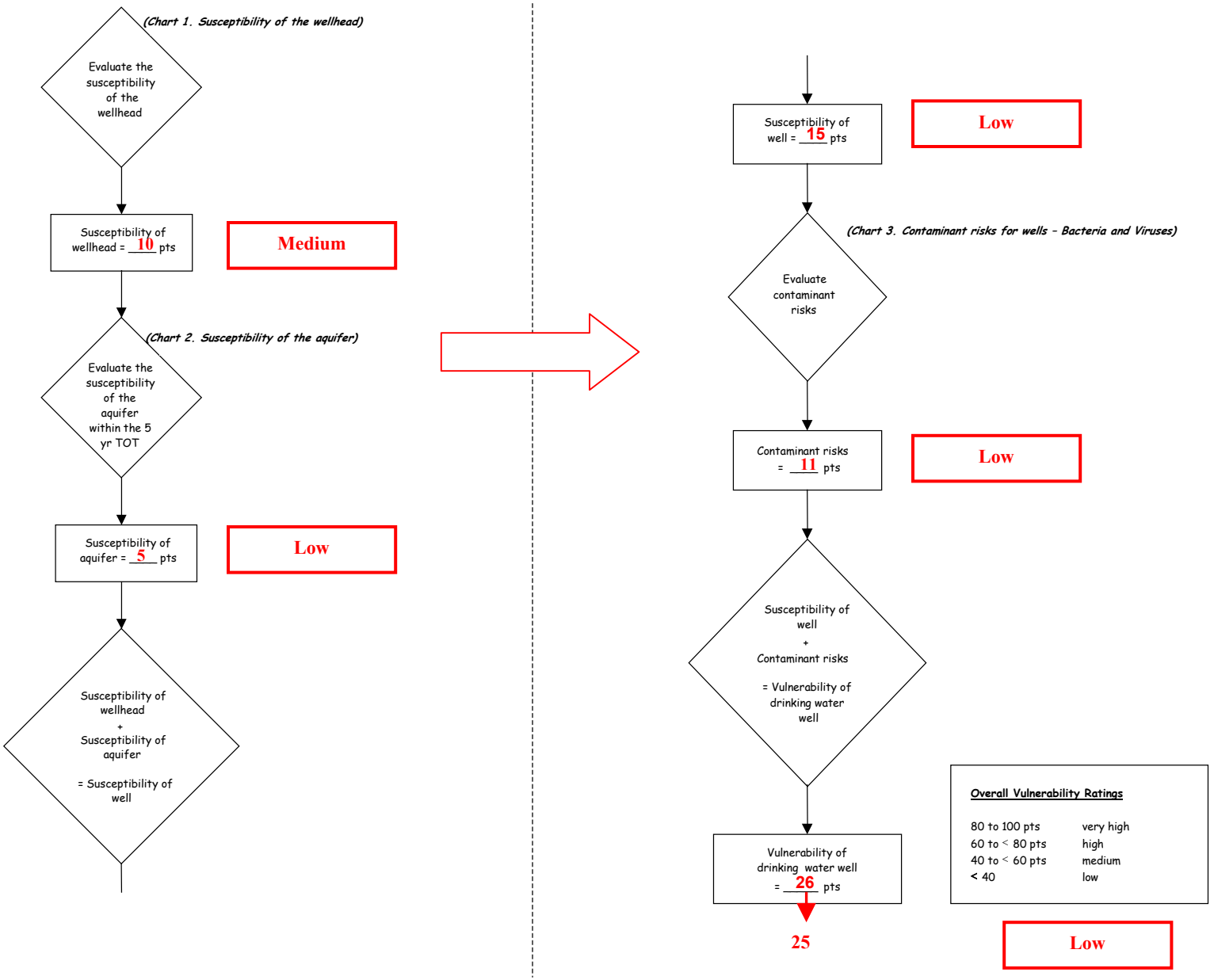
Table 6. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #1 – Other Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

1 dirt/gravel road and right-of-way, 1 active landing strip	**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

Chart 14. Vulnerability analysis for BLM Anchorage District Office Well #1 – Other Organic Chemicals



APPENDIX E

Vulnerability Analysis for BLM Anchorage District Office's Public Drinking Water Source Well #2

Chart 1. Susceptibility of the wellhead – BLM Anchorage District Office Well #2

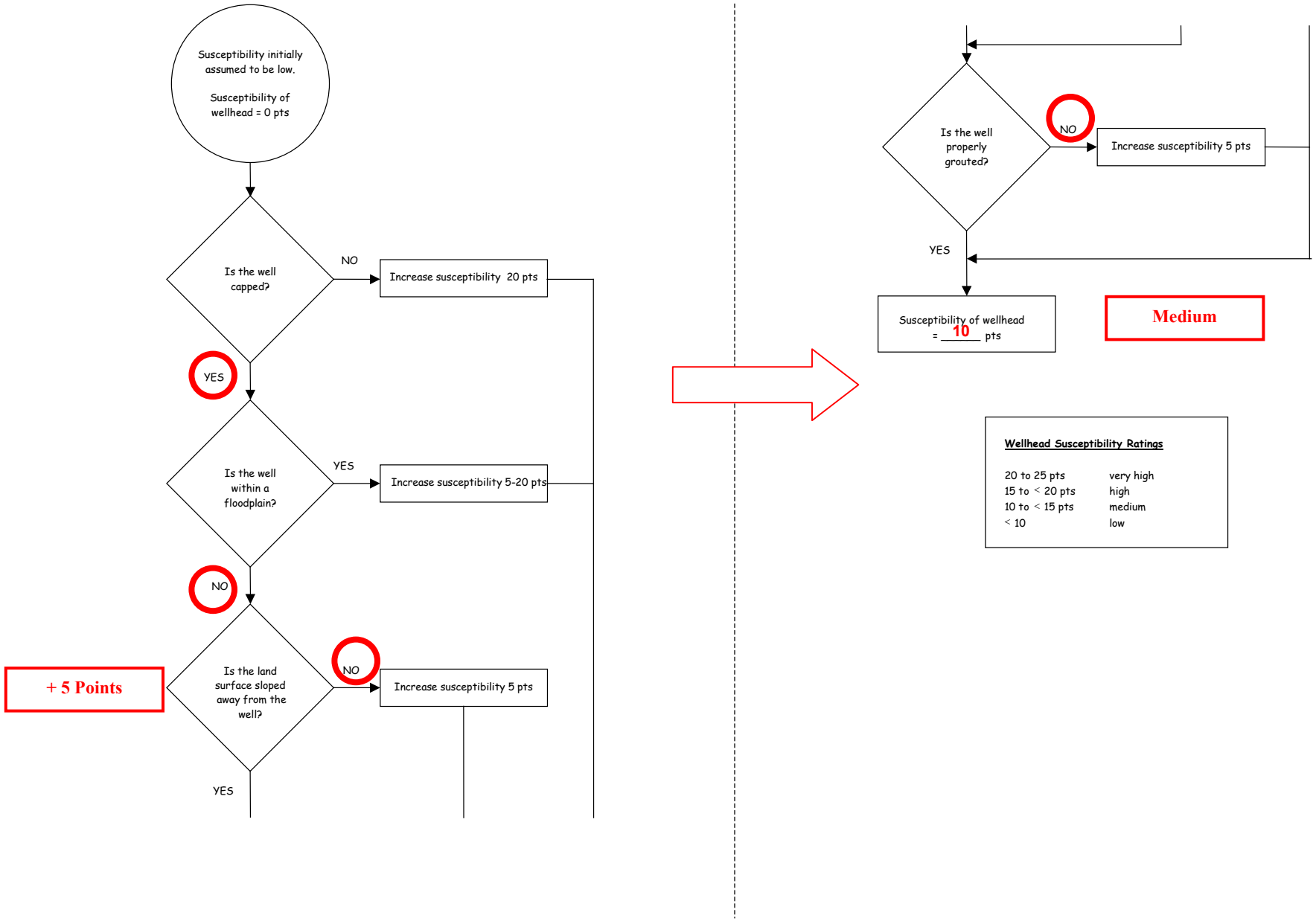
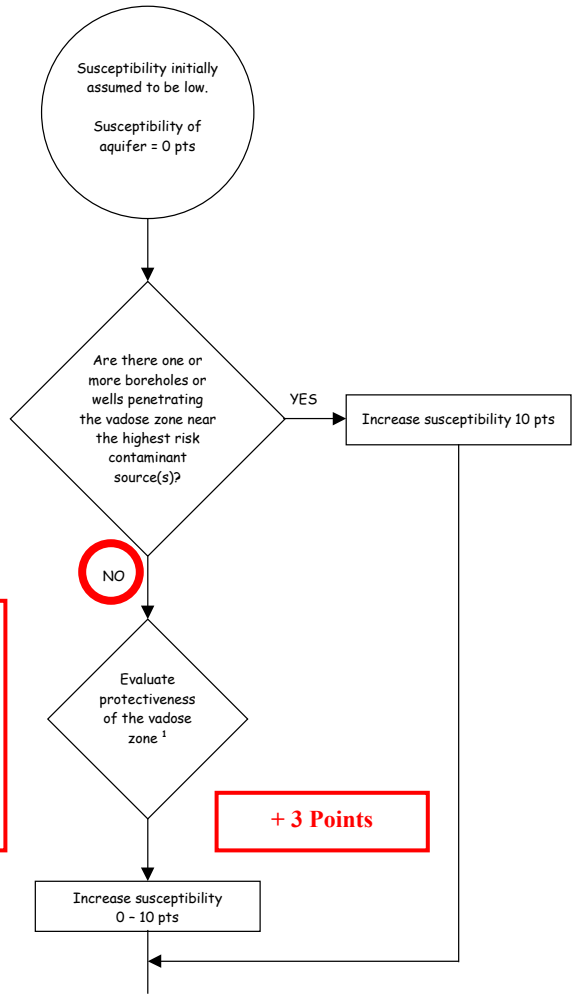


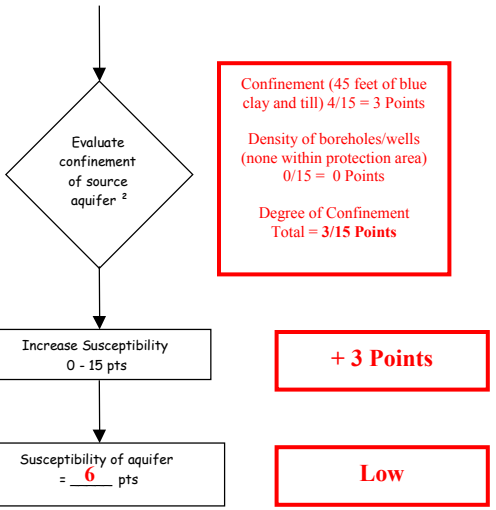
Chart 2. Susceptibility of the aquifer – BLM Anchorage District Office Well #2



Recharge (20-30 inches per year, base of Chugach Mountains, blue clay with till – 45 feet) 2/10 = 1 Point

Depth to bottom of confining unit (40 feet) 4/10 = 2 Points

Protectiveness of the Vadose Zone Total = 3/**10 Points**



Confinement (45 feet of blue clay and till) 4/15 = 3 Points

Density of boreholes/wells (none within protection area) 0/15 = 0 Points

Degree of Confinement Total = **3/15 Points**

+ 3 Points

Low

1. **Protectiveness of the Vadose Zone**
   - net recharge (function of precipitation, slope of land surface, & permeability of soils) [0 – 10 pts; 50% weight]
   - depth to water table (unconfined aquifer) or top of confining layer (confined aquifer) [interpolate linearly: 100' – 20', 0 – 5 pts; 20' – 0', 5 – 10 pts; 50% weight]

2. **Degree of Confinement**
   - confined verses unconfined aquifer [confined: K ≤ 10^{-6} cm/s, minimum thickness of at least one layer = 20 ft, interpolate linearly 100' – 20', 0 – 10 pts; unconfined = 15 pts; 65% weight]
   - density of boreholes and wells penetrating the confining layer (confined aquifer) or the water table (unconfined aquifer) [confined: 0 – 15 pts; unconfined = 15 pts; 35% weight]

Aquifer Susceptibility Ratings

20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

Low

Chart 3. Contaminant risks for BLM Anchorage District Office Well #2 – Bacteria & Viruses

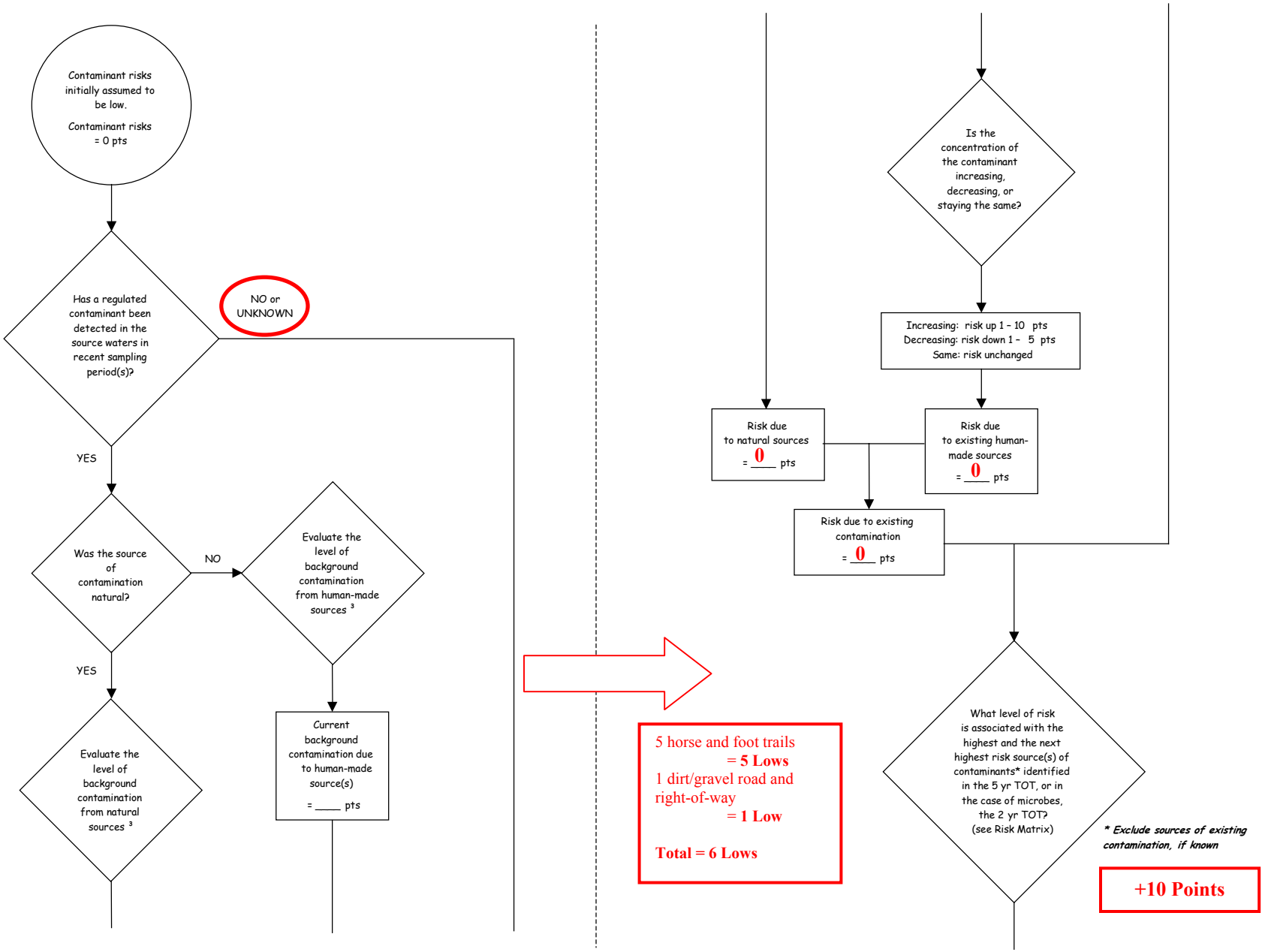


Chart 3. Contaminant risks for BLM Anchorage District Office Well #2 – Bacteria & Viruses (Continued)

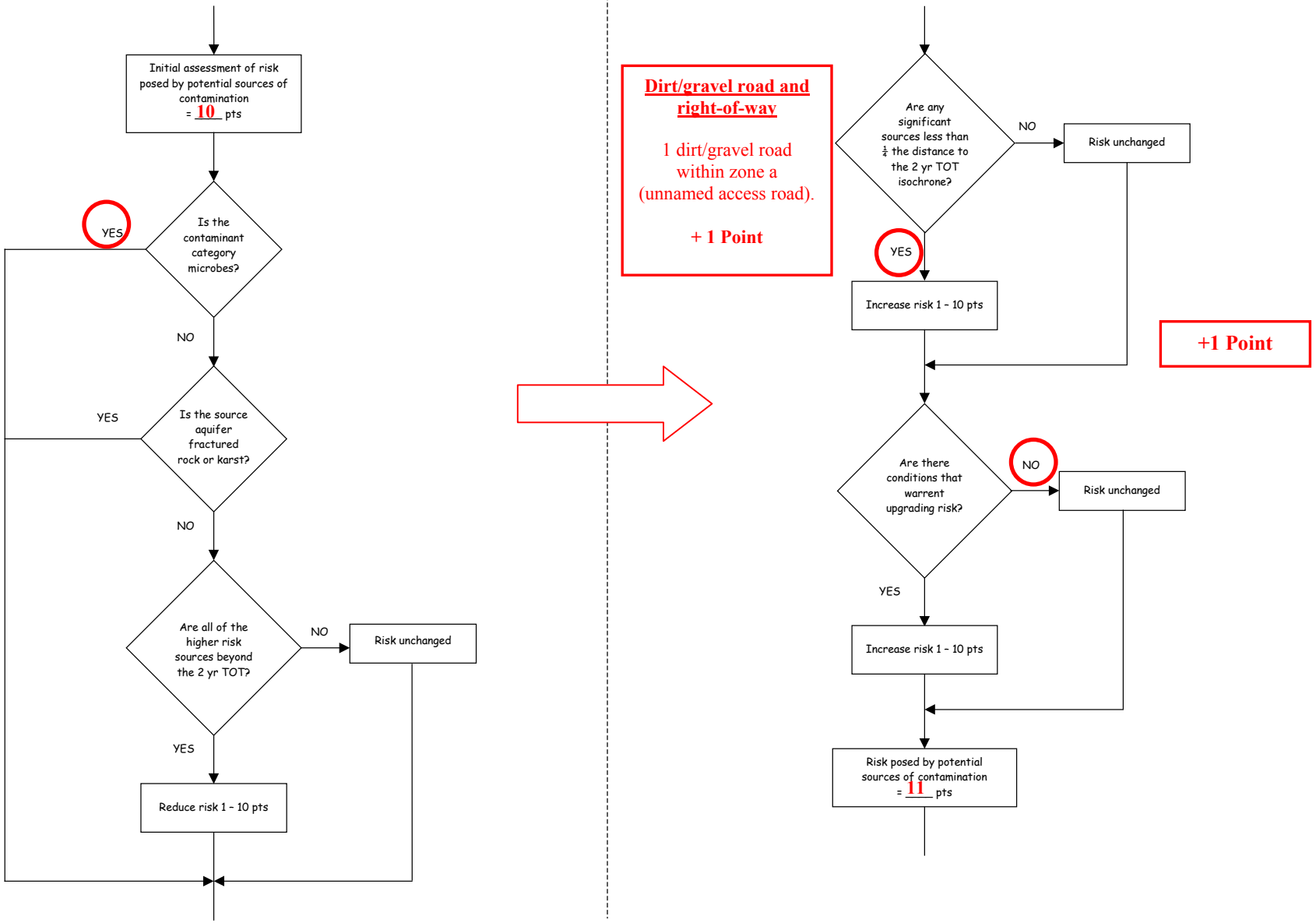
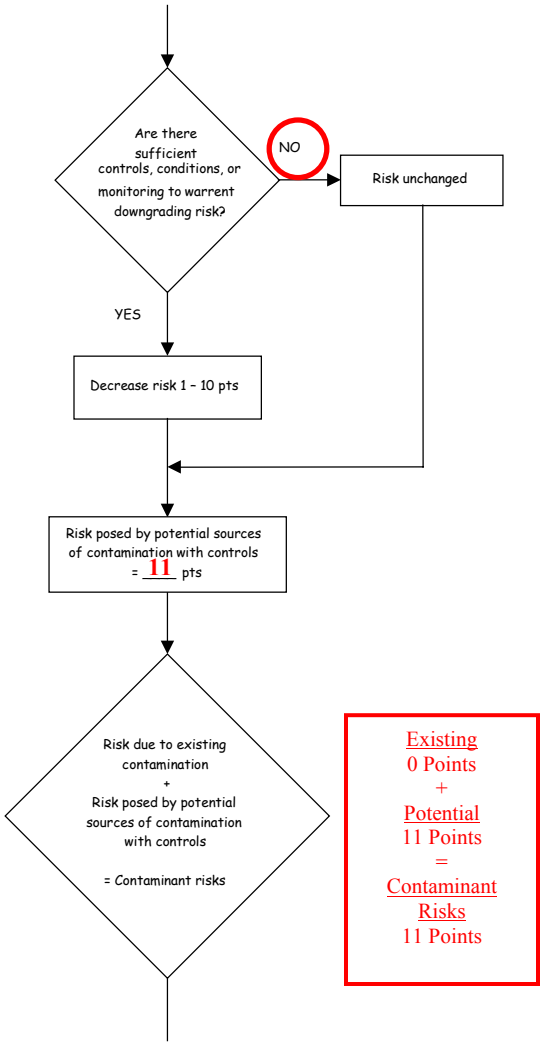
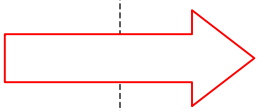
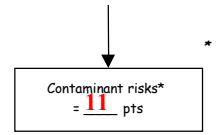


Chart 3. Contaminant risks for BLM Anchorage District Office Well #2 – Bacteria & Viruses (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points





** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 1. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #2 – Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

5 Horse and foot trails, 1 dirt/gravel road and right-of-way	**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

Chart 4. Vulnerability analysis for BLM Anchorage District Office Well #2 – Bacteria & Viruses

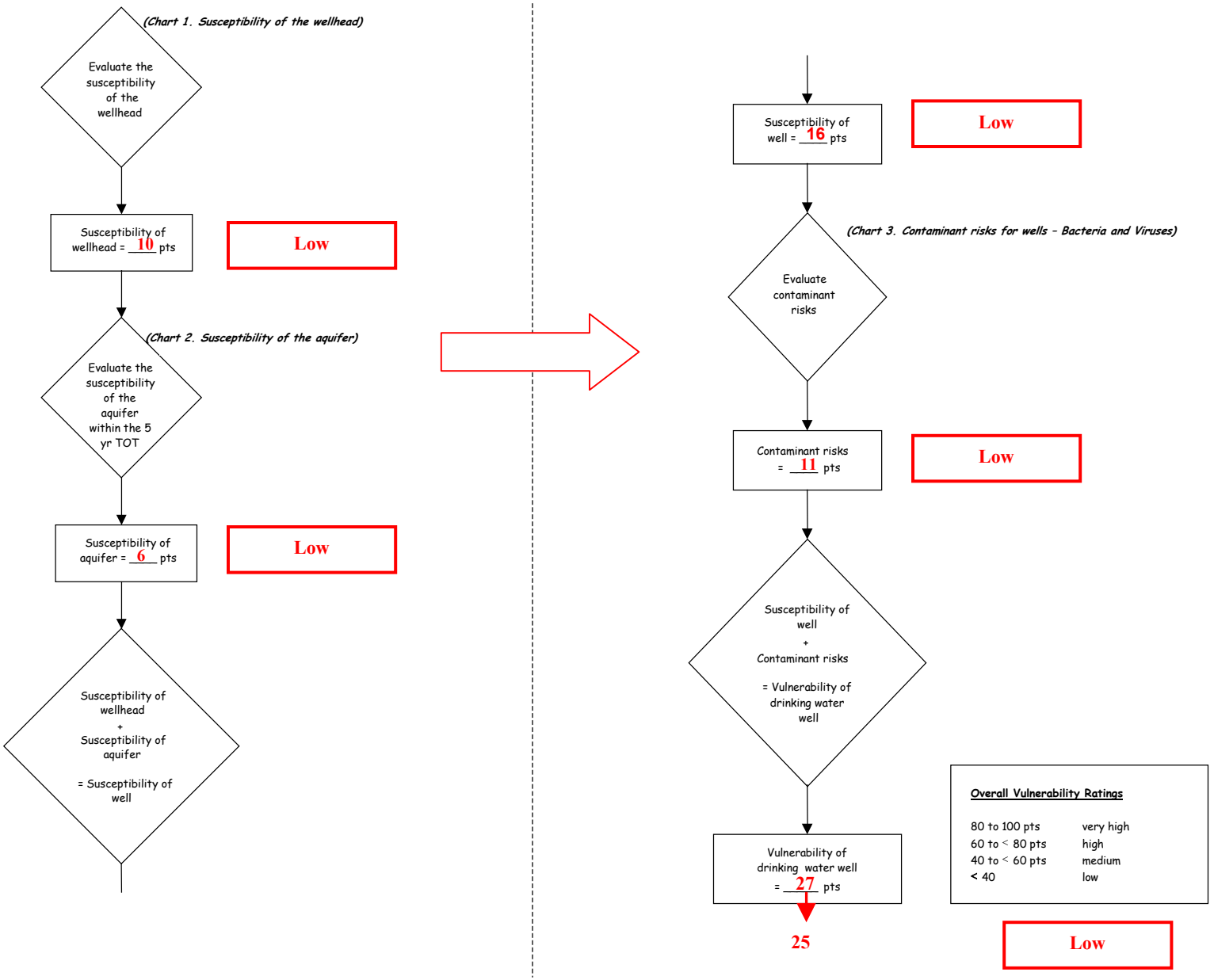


Chart 5. Contaminant risks for BLM Anchorage District Office Well #2 – Nitrates and Nitrites

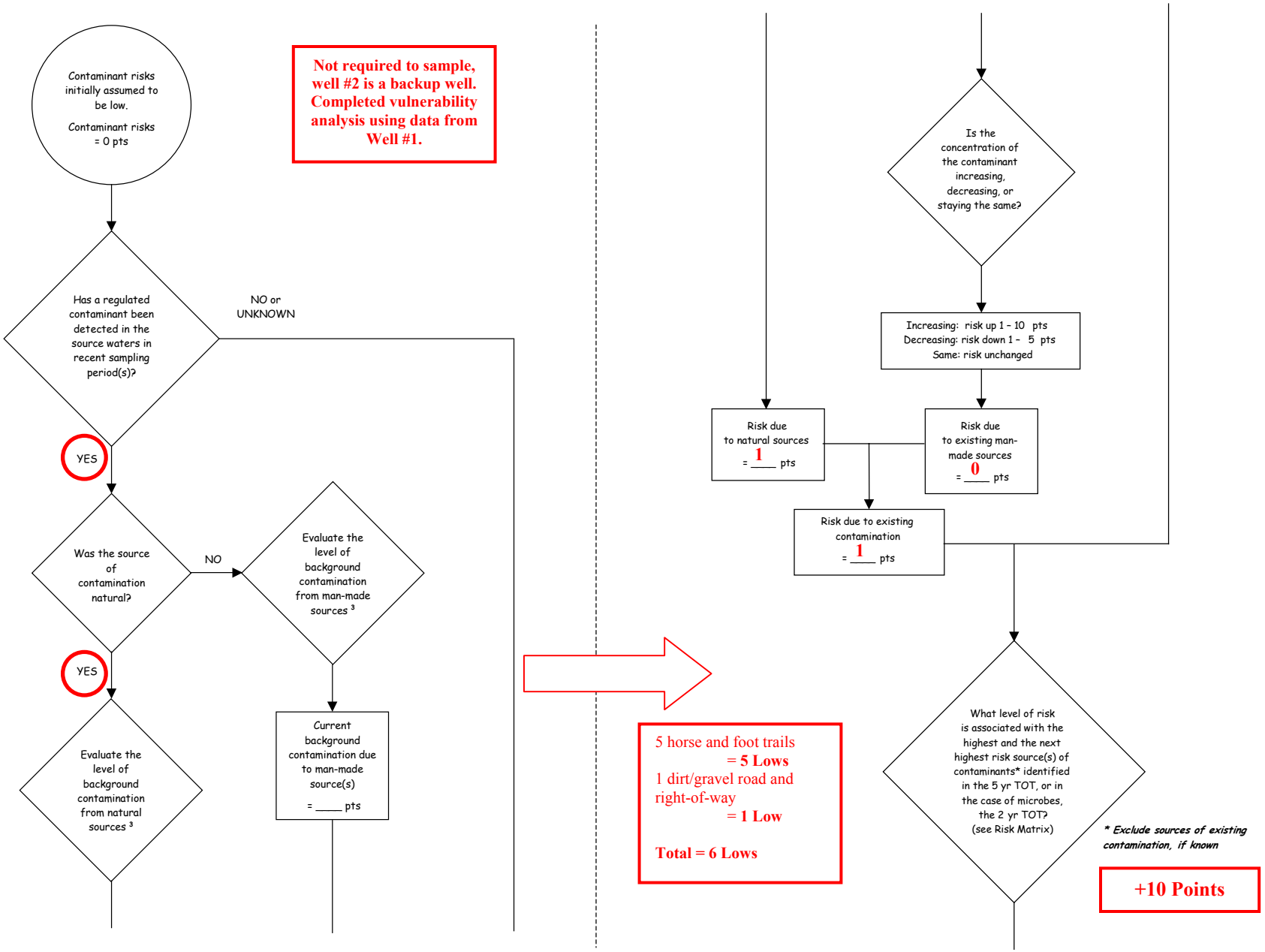


Chart 5. Contaminant risks for BLM Anchorage District Office Well #2 – Nitrates and Nitrites (Continued)

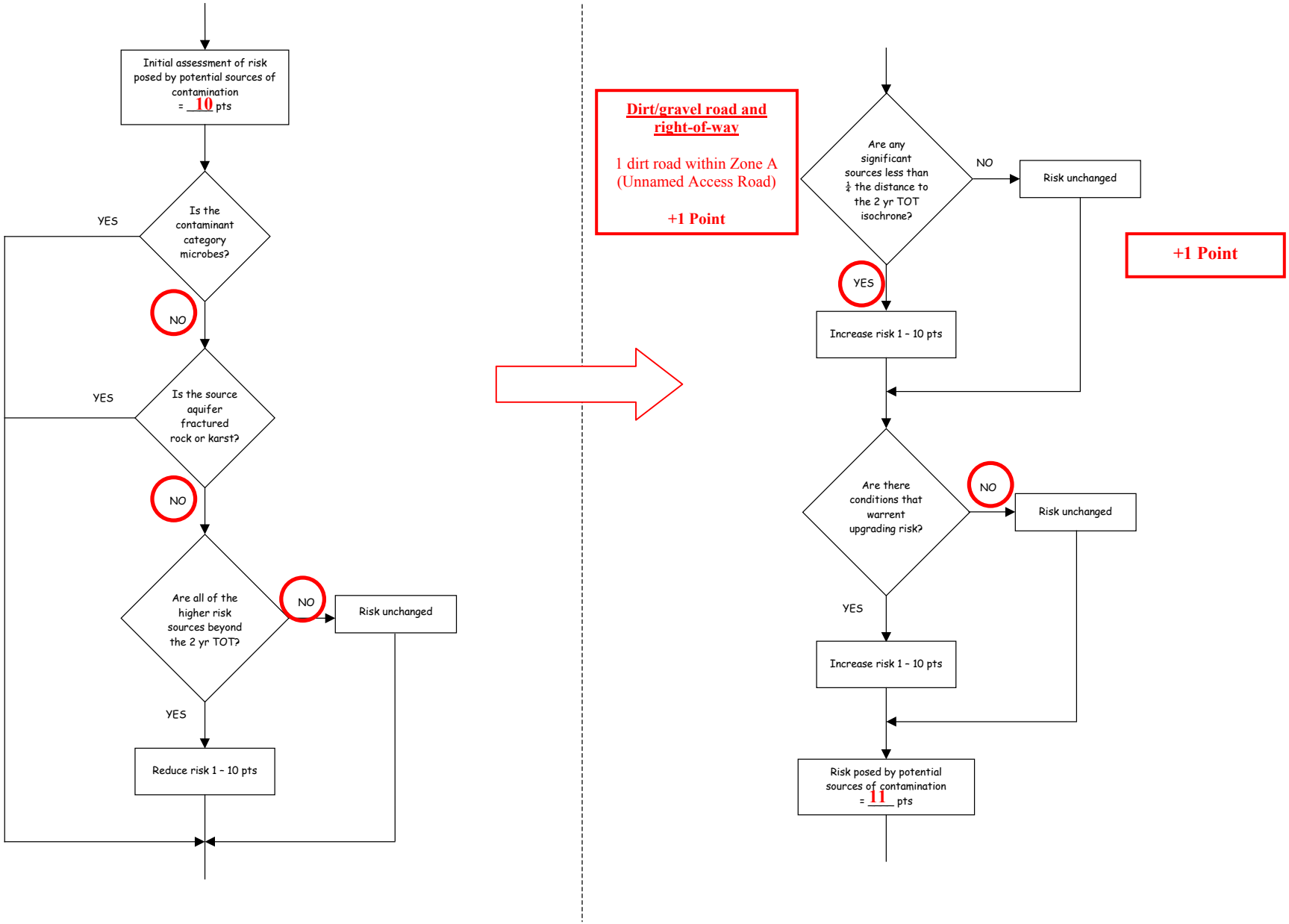
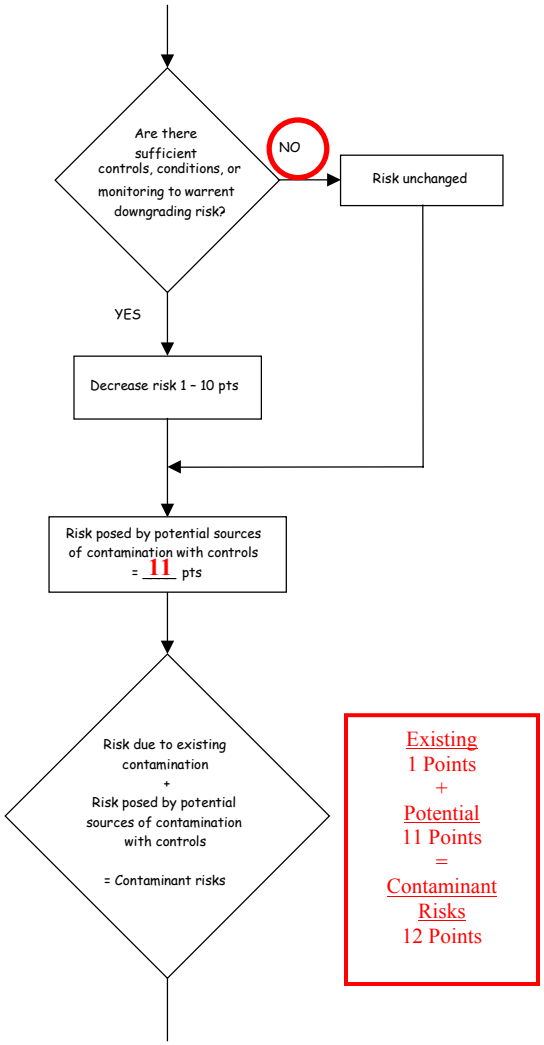


Chart 5. Contaminant risks for BLM Anchorage District Office Well #2 – Nitrates and Nitrites (Continued)



Existing
1 Points
+
Potential
11 Points
=
Contaminant
Risks
12 Points

* *Truncate risk at 50 pts*

Contaminant risks*
= 12 pts

Low

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

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

Nitrate
(sample data from well #1)
0.440 mg/L on 11/30/98
0.240 mg/L on 02/06/96
0.200 mg/L on 03/21/95
0.190 mg/L on 10/29/93
0.300 mg/L on 04/01/92
ND mg/L on 11/18/96

Maximum Contaminant Level (MCL) = 10mg/L

0.440/10 or 4.4% of MCL

+1 Point

Table 2. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #2 – Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

5 horse and foot trails, 1 dirt/gravel road and right-of-way	**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

Chart 6. Vulnerability analysis for BLM Anchorage District Office Well #2 – Nitrates and Nitrites

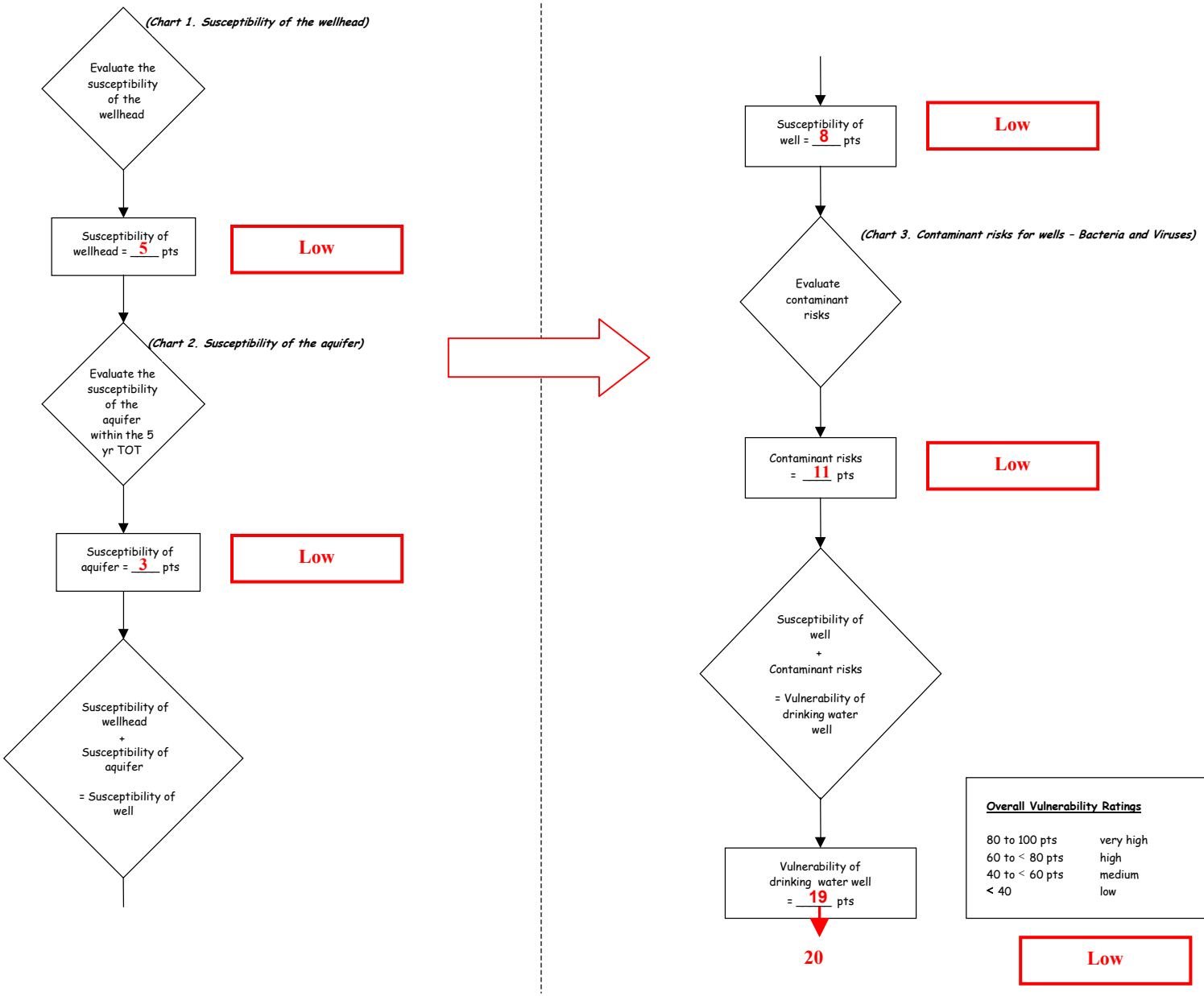


Chart 7. Contaminant risks for BLM Anchorage District Office Well #2 – Volatile Organic Chemicals

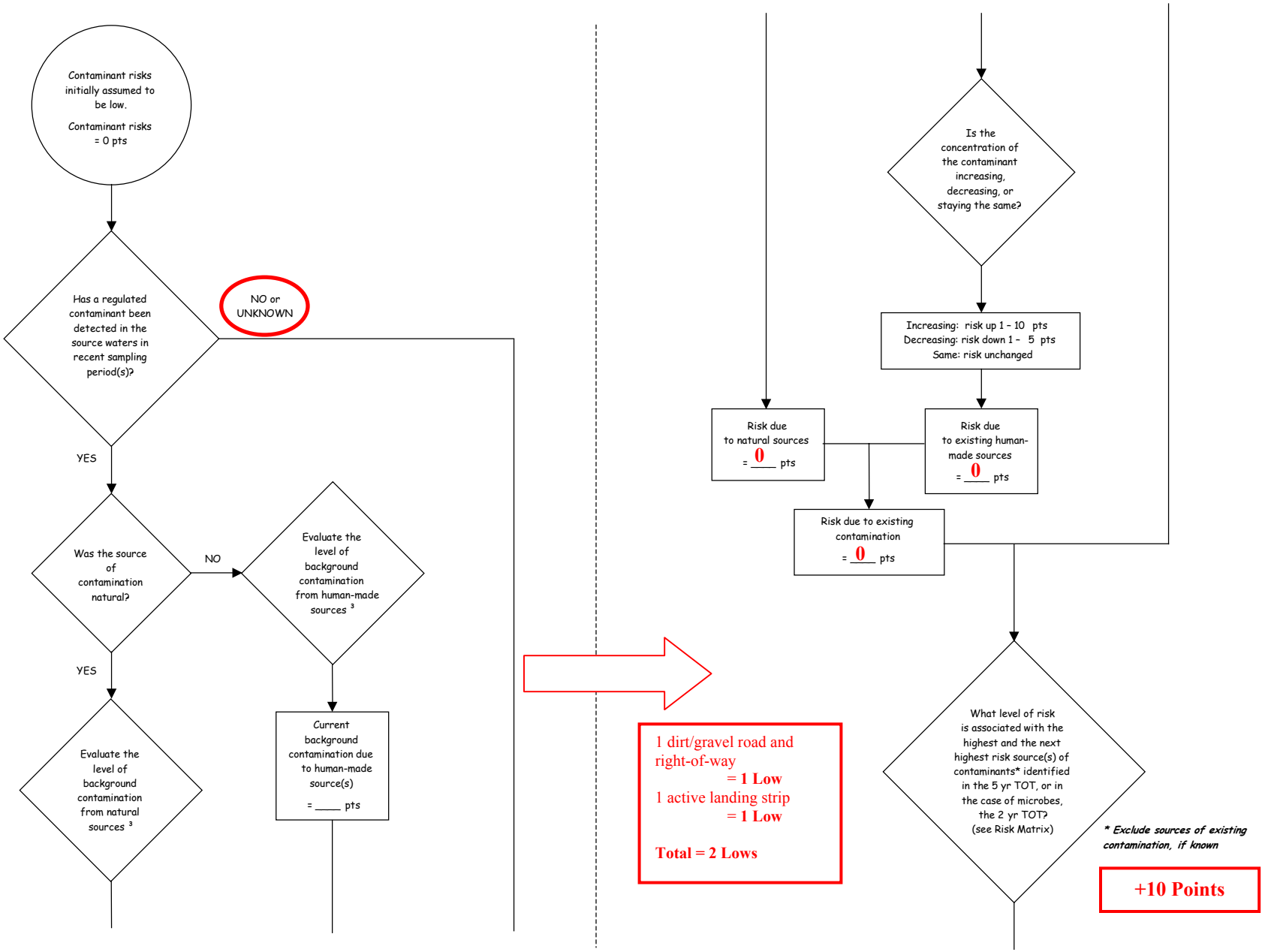


Chart 7. Contaminant risks for BLM Anchorage District Office Well #2 – Volatile Organic Chemicals (Continued)

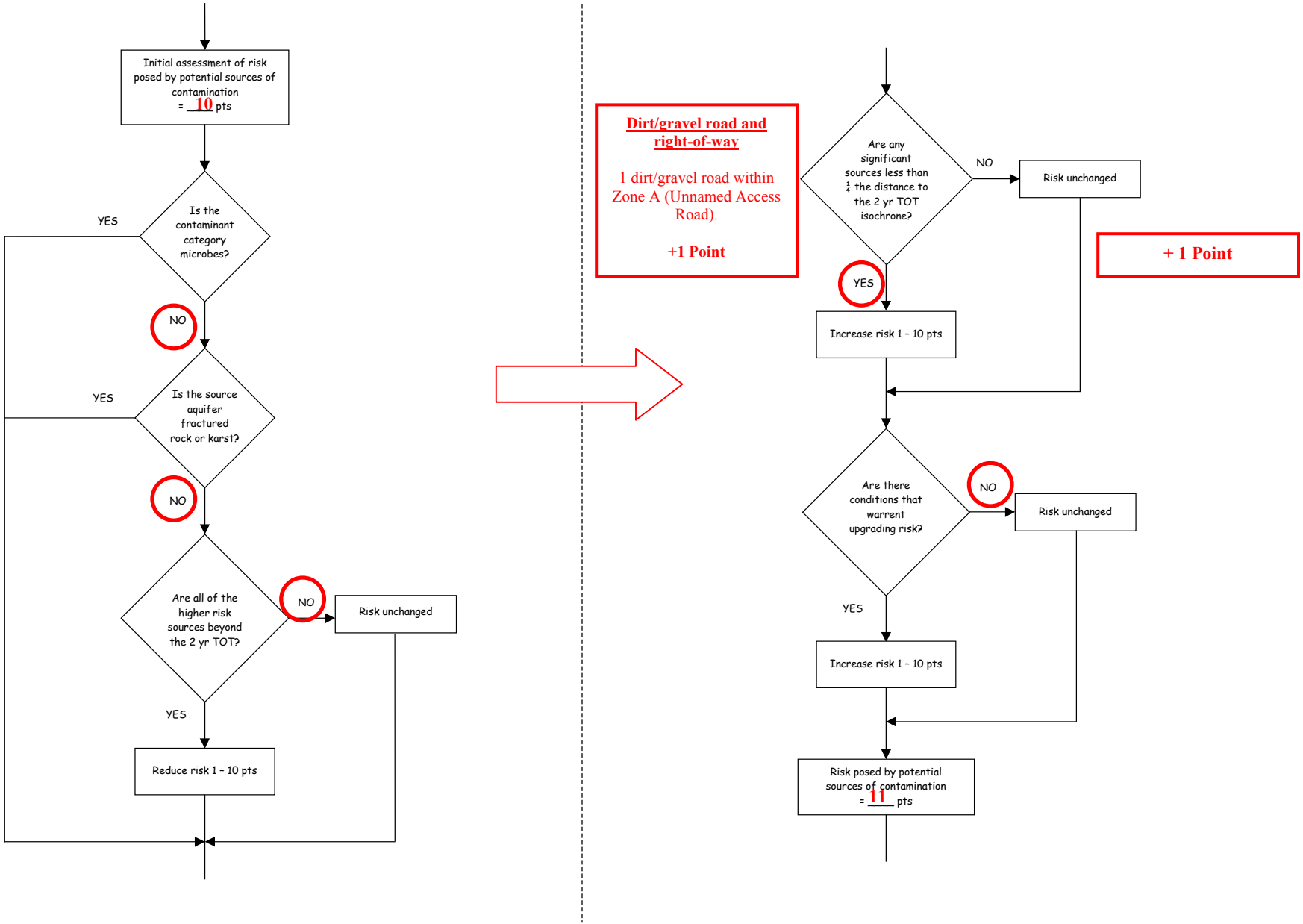
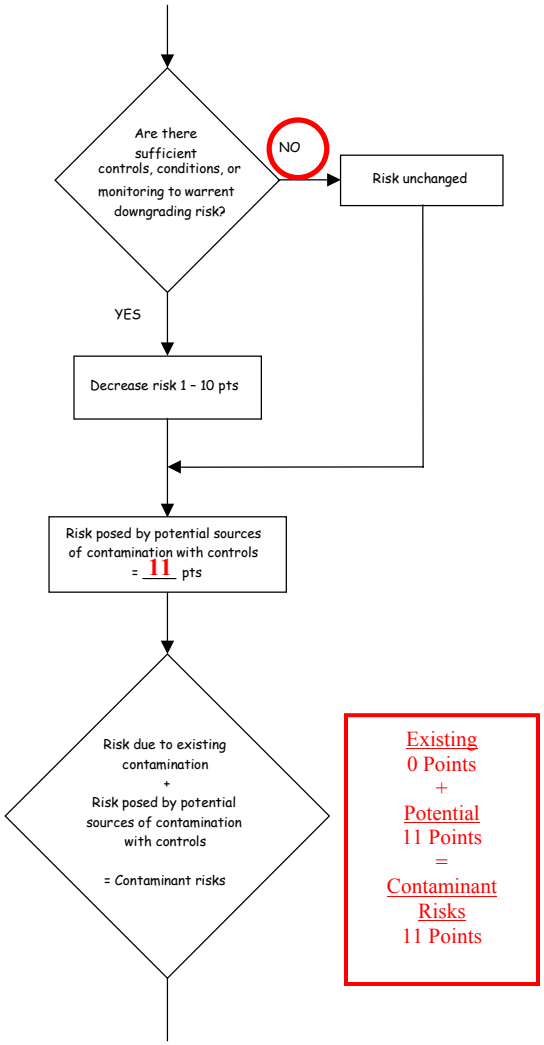
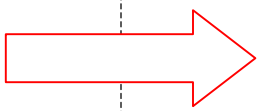
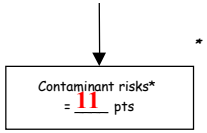


Chart 7. Contaminant risks for BLM Anchorage District Office Well #2 – Volatile Organic Chemicals (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points





** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 3. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #2 – Volatile Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	1 dirt/gravel road and right-of-way, 1 active landing strip	**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

Chart 8. Vulnerability analysis for BLM Anchorage District Office Well #2 – Volatile Organic Chemicals

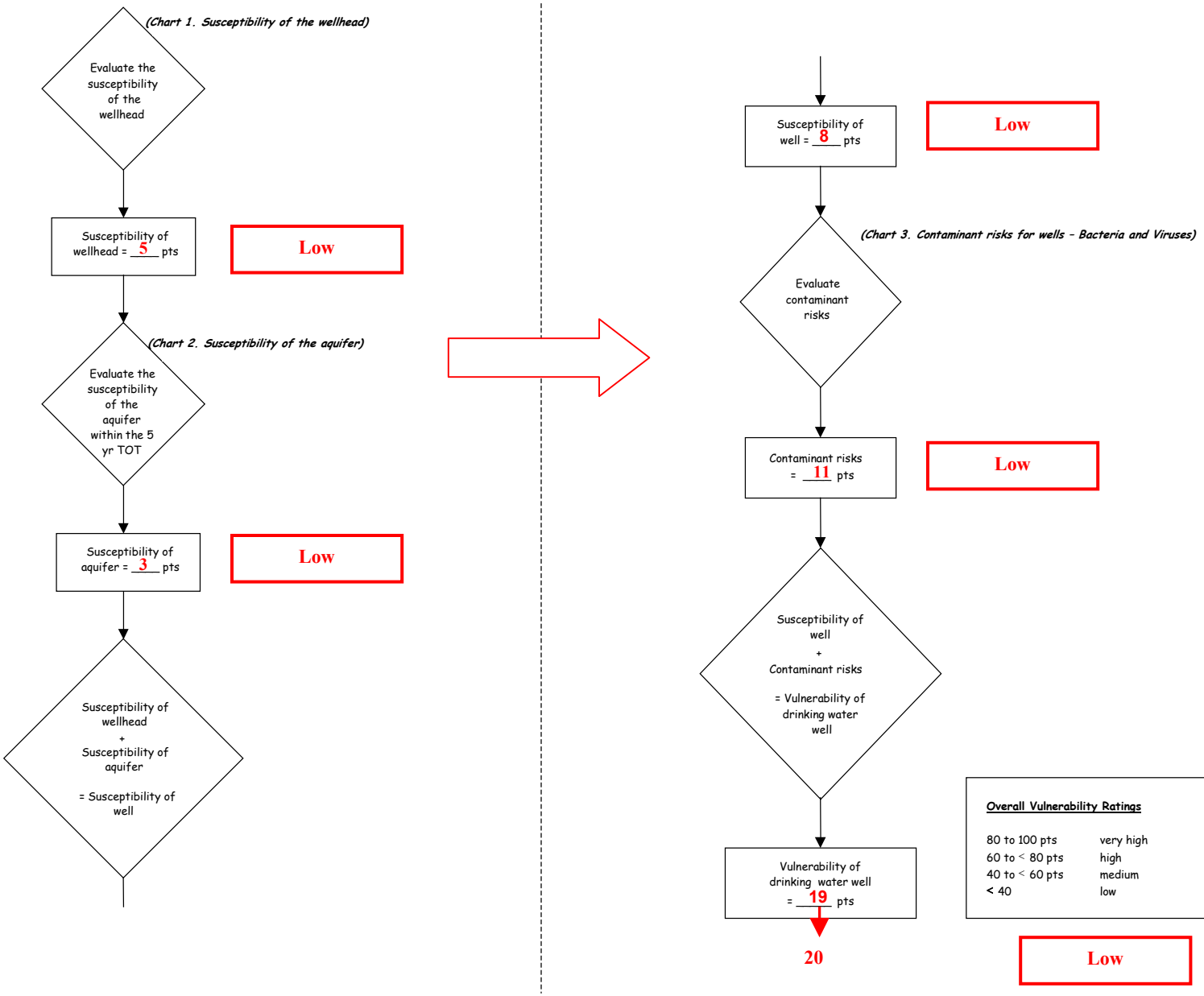


Chart 9. Contaminant risks for BLM Anchorage District Office Well #2 – Heavy Metals, Cyanide and Other Inorganic Chemicals

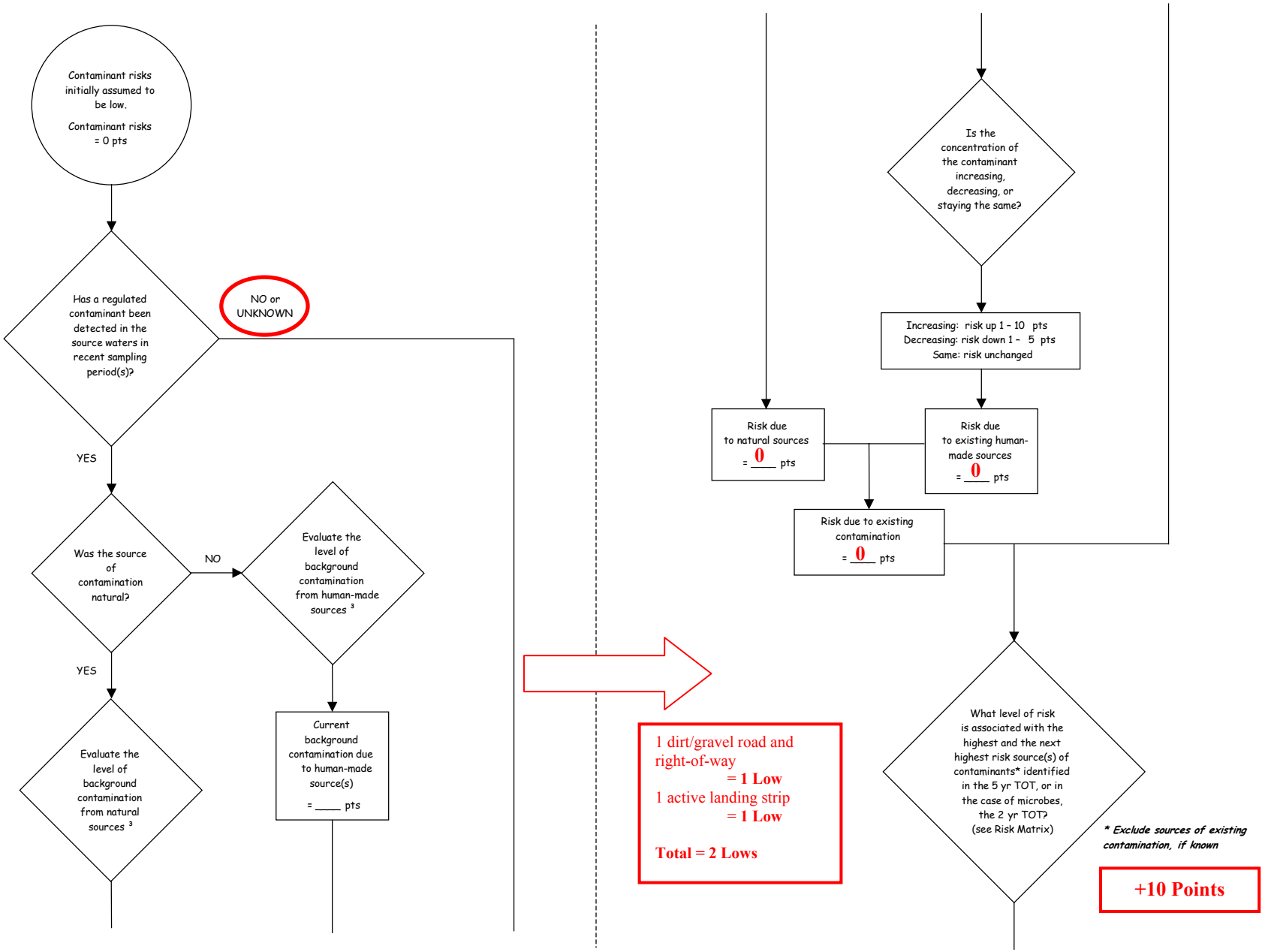


Chart 9. Contaminant risks for BLM Anchorage District Office Well #2 – Heavy Metals, Cyanide and Other Inorganic Chemicals (Continued)

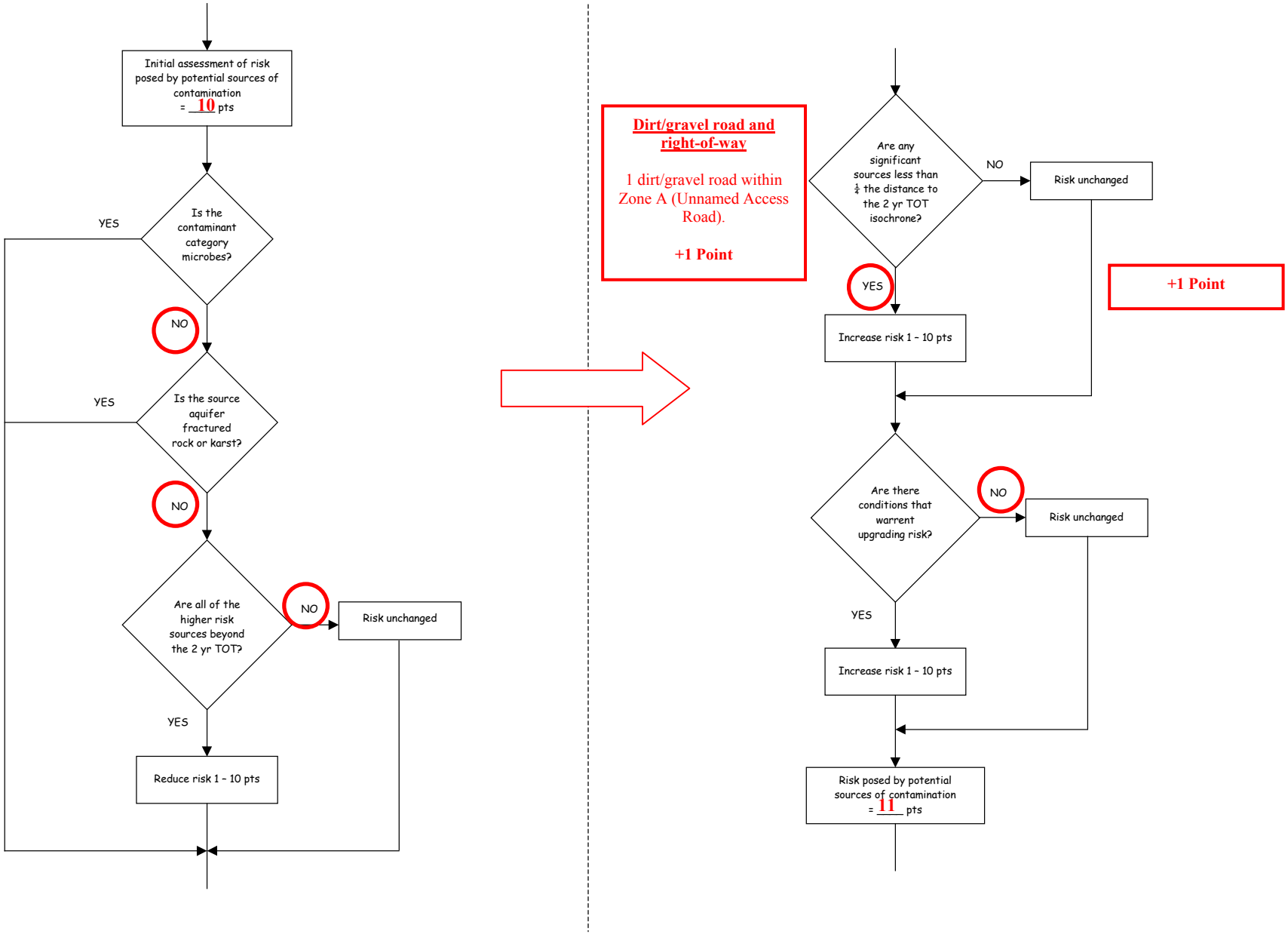
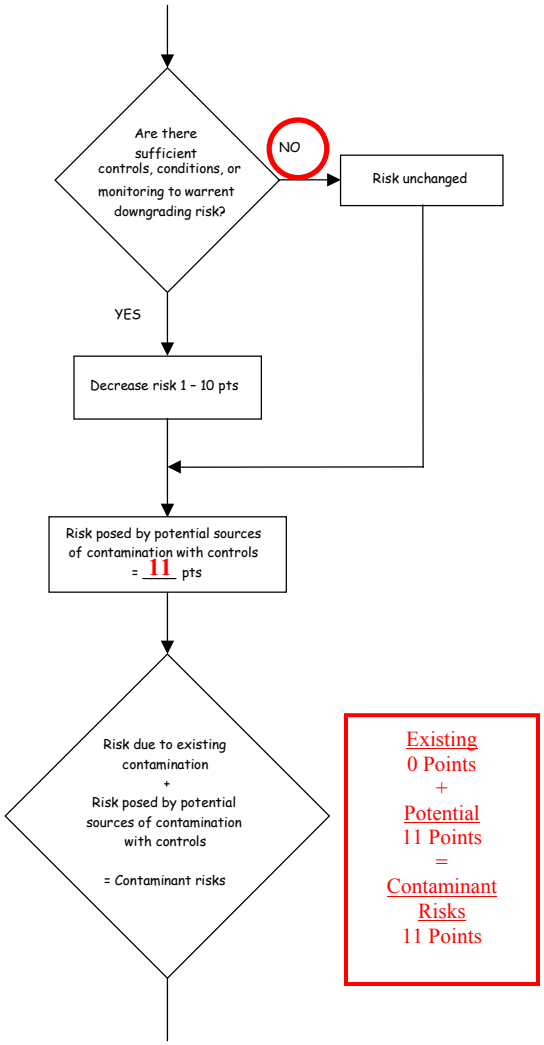
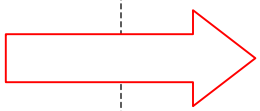
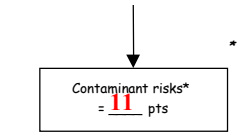


Chart 9. Contaminant risks for BLM Anchorage District Office Well #2 – Heavy Metals, Cyanide and Other Inorganic Chemicals (Continued)



Existing
0 Points
+
Potential
11 Points
=
Contaminant Risks
11 Points





** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 4. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #2 – Heavy Metals, Cyanide and Other Inorganic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

1 dirt/gravel road and right-of-way, 1 active landing strip	**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

Chart 10. Vulnerability analysis for BLM Anchorage District Office Well #2 – Heavy Metals, Cyanide and Other Inorganic Chemicals

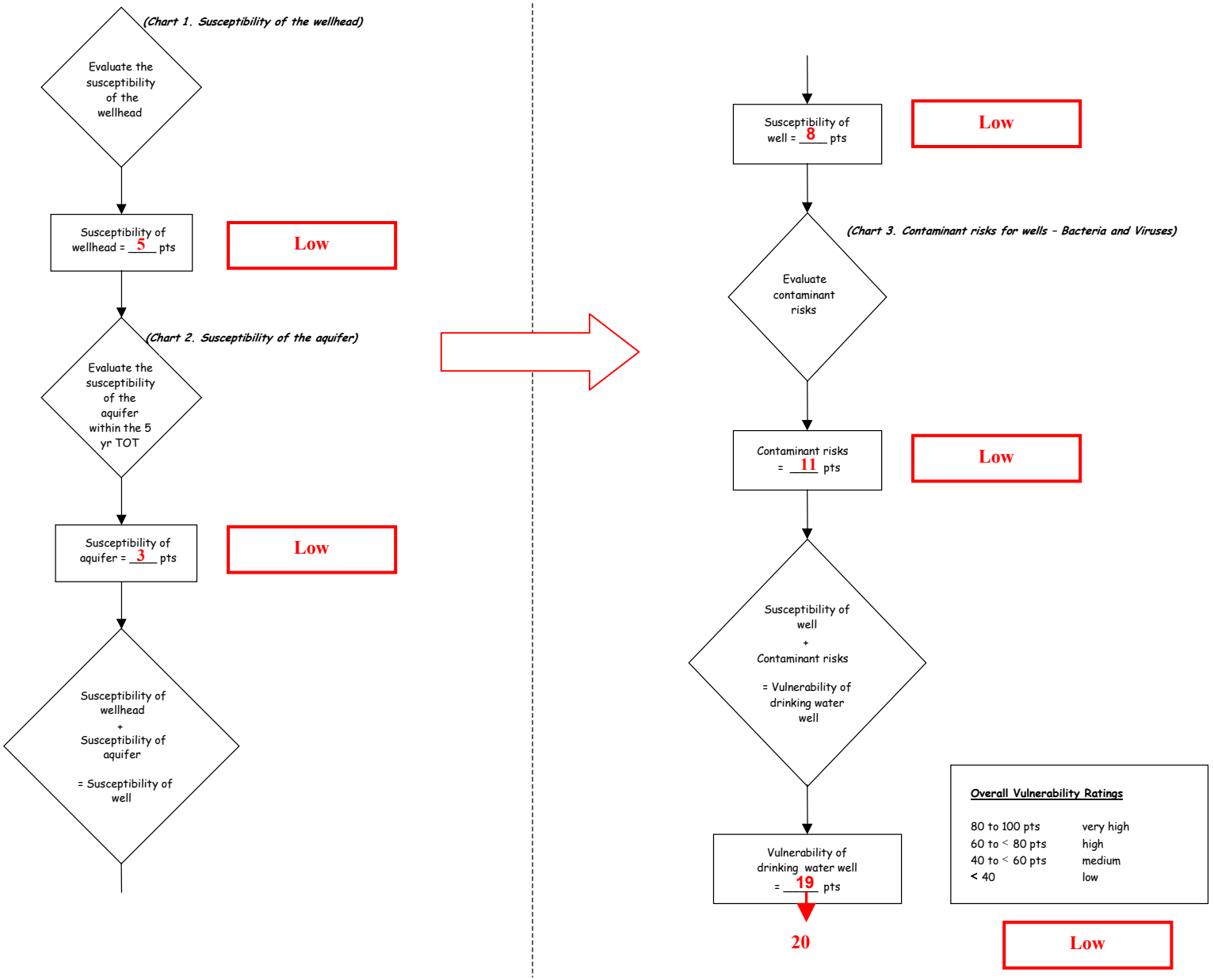


Chart 11. Contaminant risks for BLM Anchorage District Office Well #2 – Synthetic Organic Chemicals

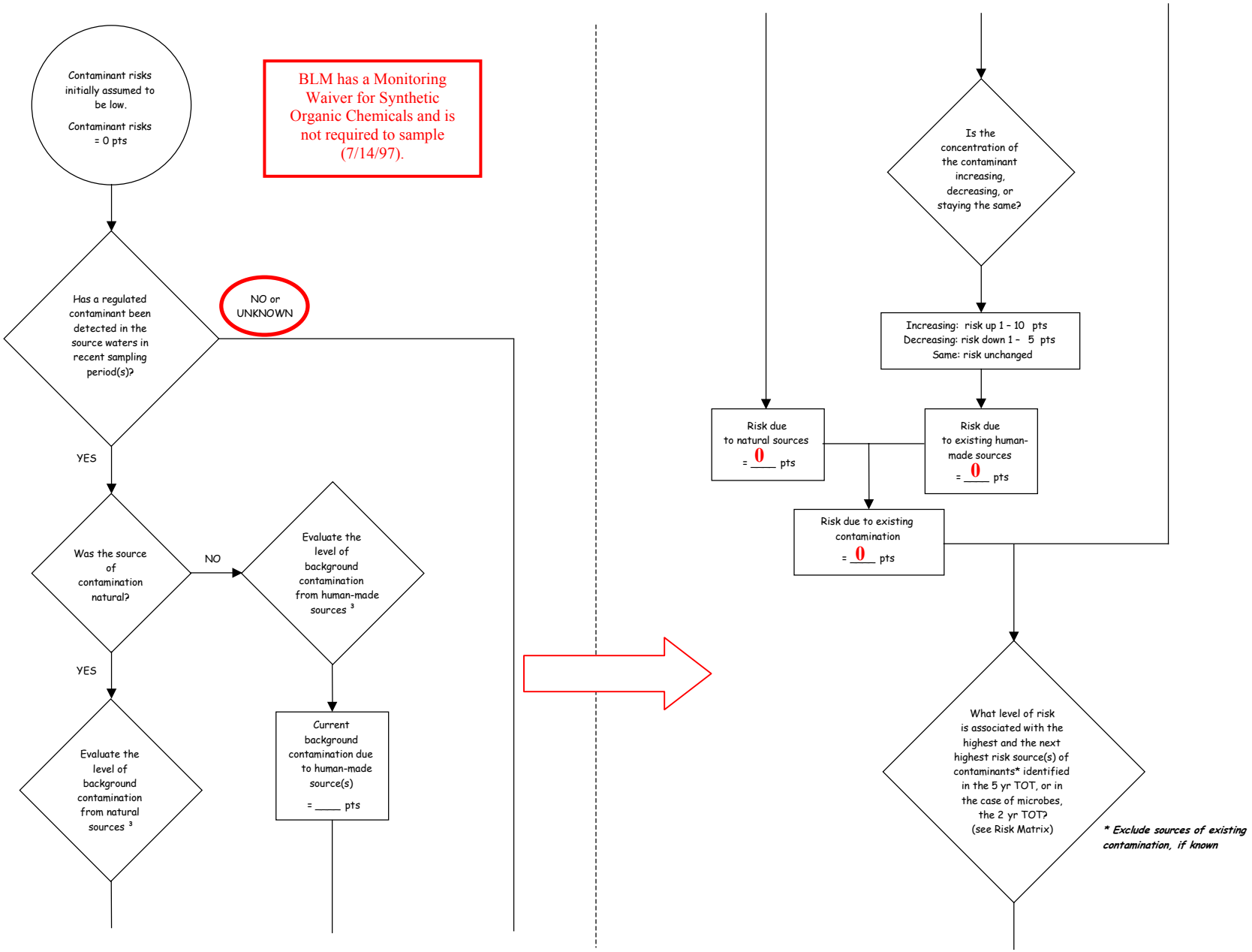


Chart 11. Contaminant risks for BLM Anchorage District Office Well #2 – Synthetic Organic Chemicals (Continued)

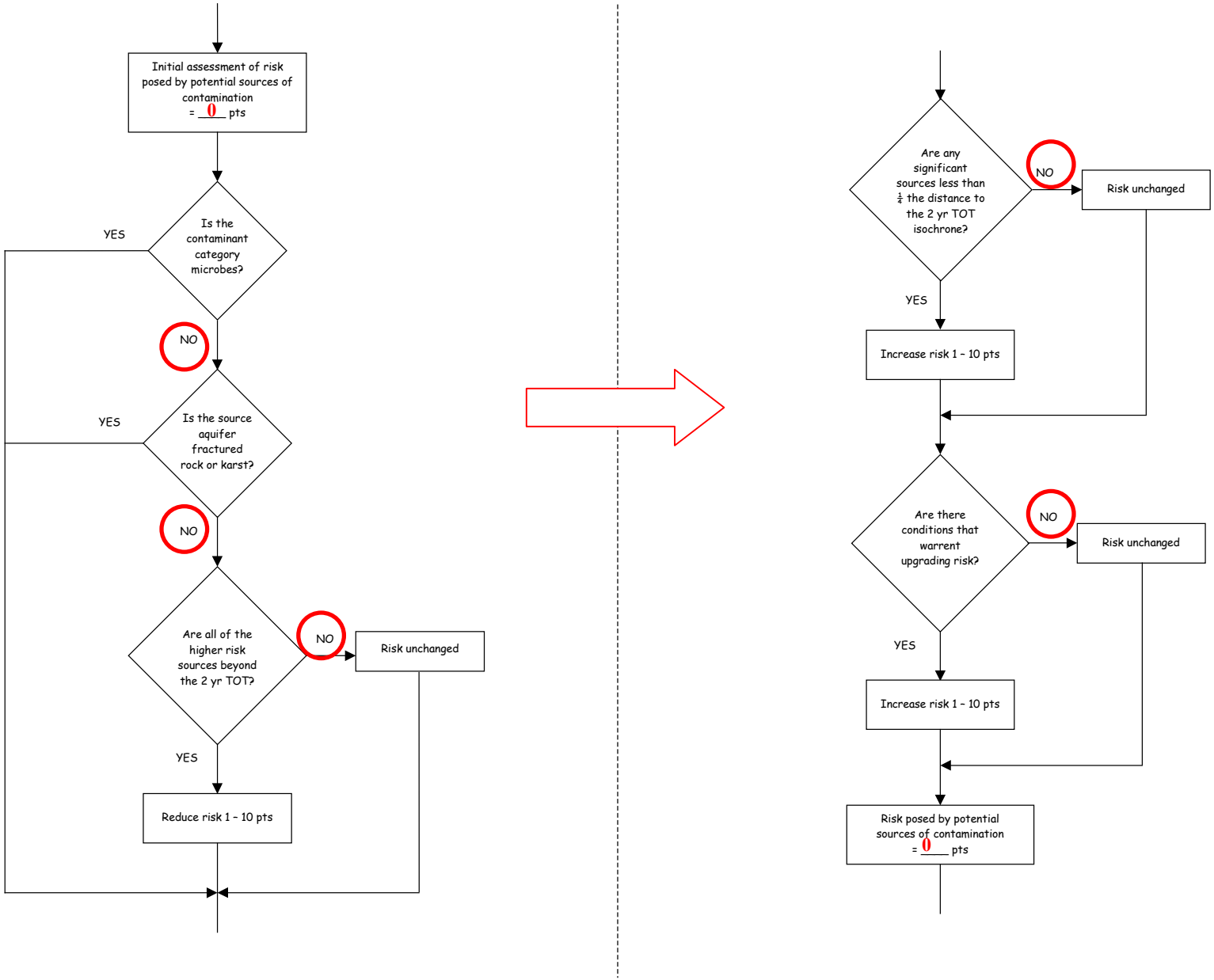
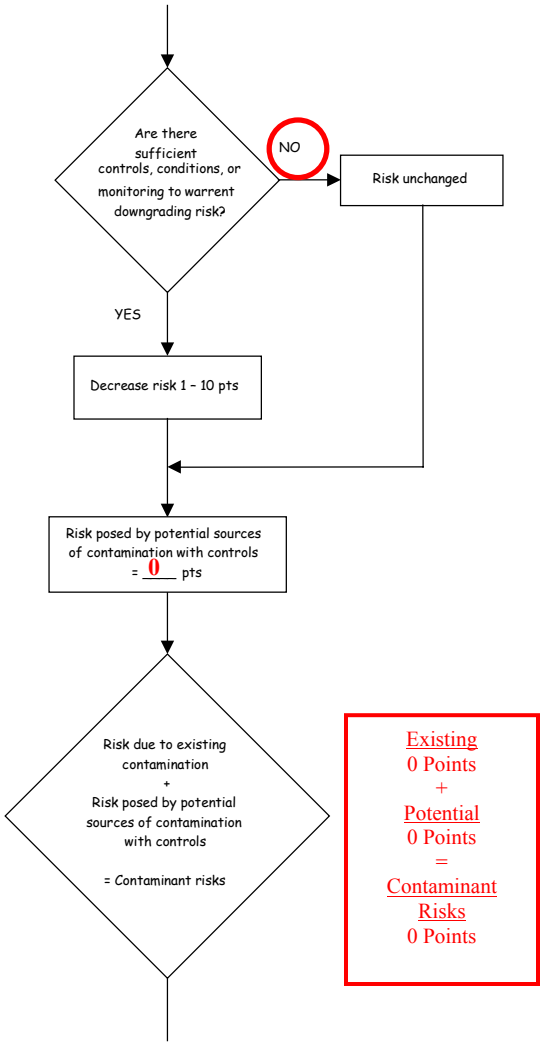


Chart 11. Contaminant risks for BLM Anchorage District Office Well #2 – Synthetic Organic Chemicals (Continued)



Existing
0 Points
+
Potential
0 Points
=
Contaminant
Risks
0 Points

Contaminant risks*
= 0 pts

** Truncate risk at 50 pts*

Low

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 5. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #2 – Synthetic Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

No known potential or existing sources of synthetic organic chemicals.	**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

Chart 12. Vulnerability analysis for BLM Anchorage District Office Well #2 – Synthetic Organic Chemicals

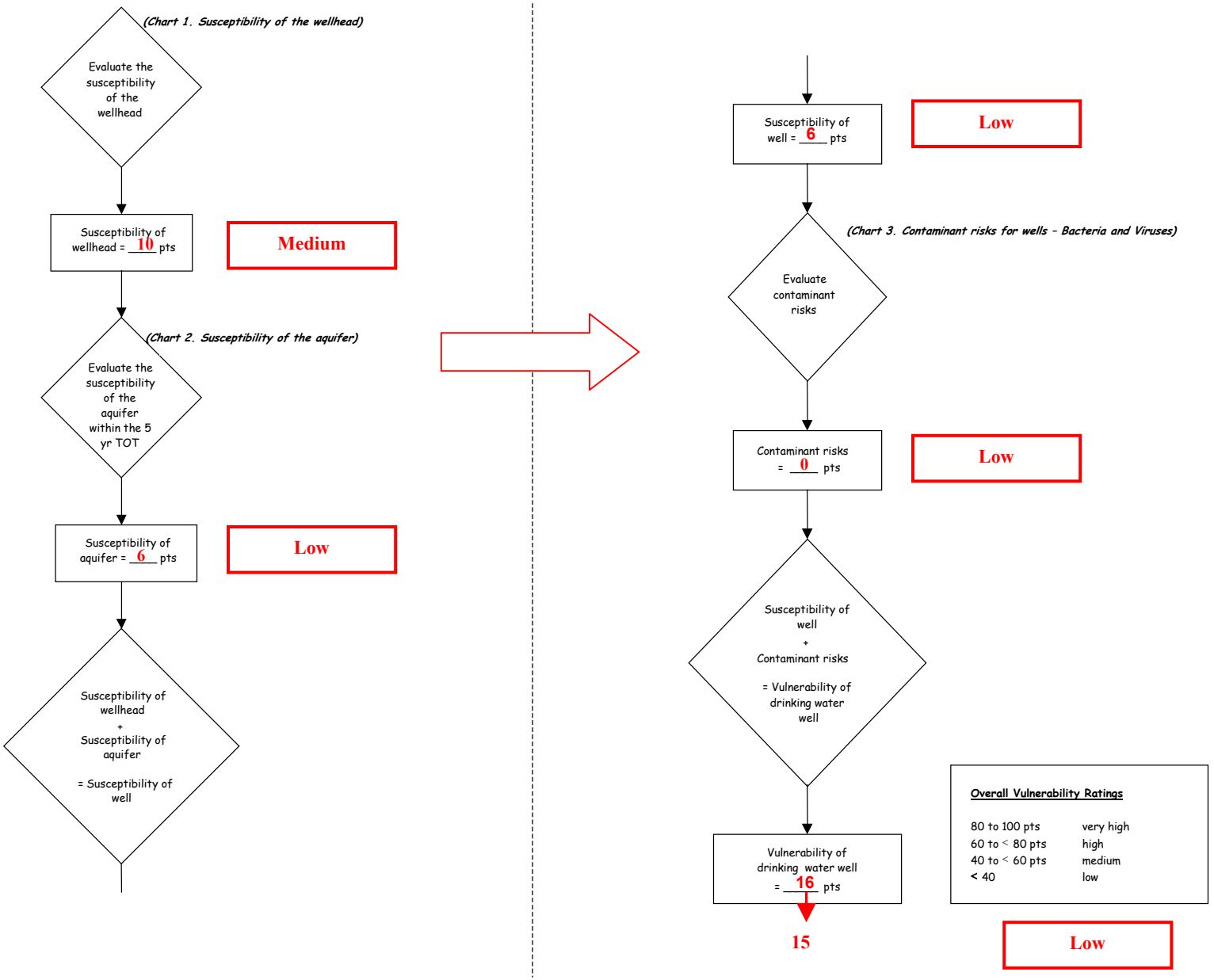


Chart 13. Contaminant risks for BLM Anchorage District Office Well #2 – Other Synthetic Organic Chemicals

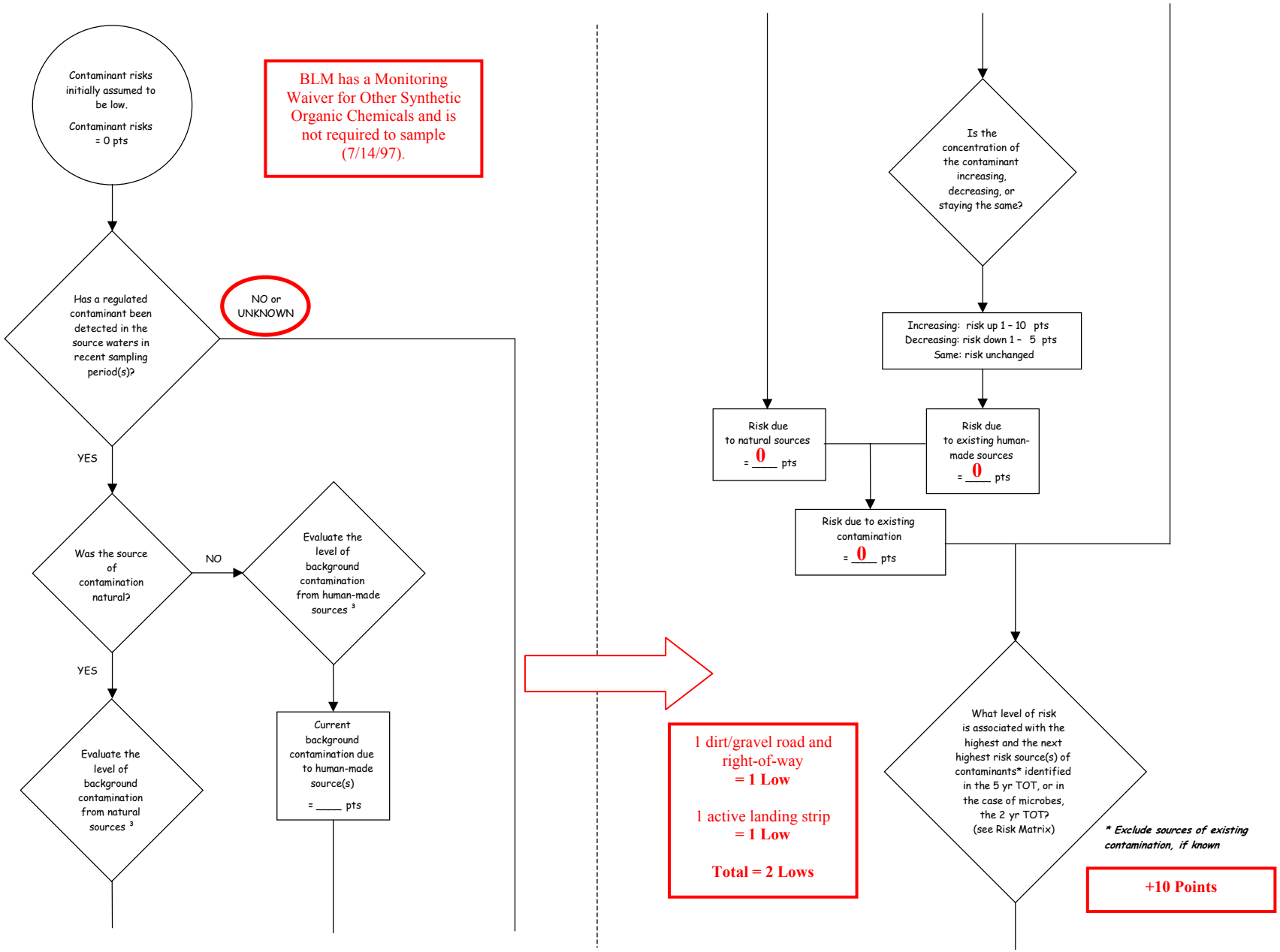
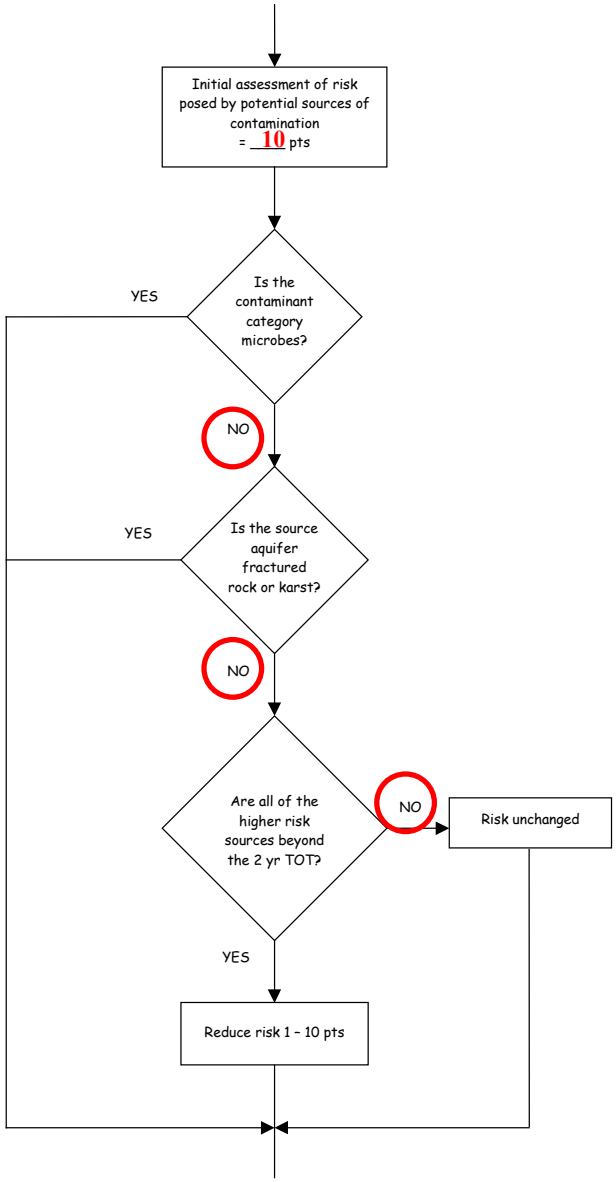


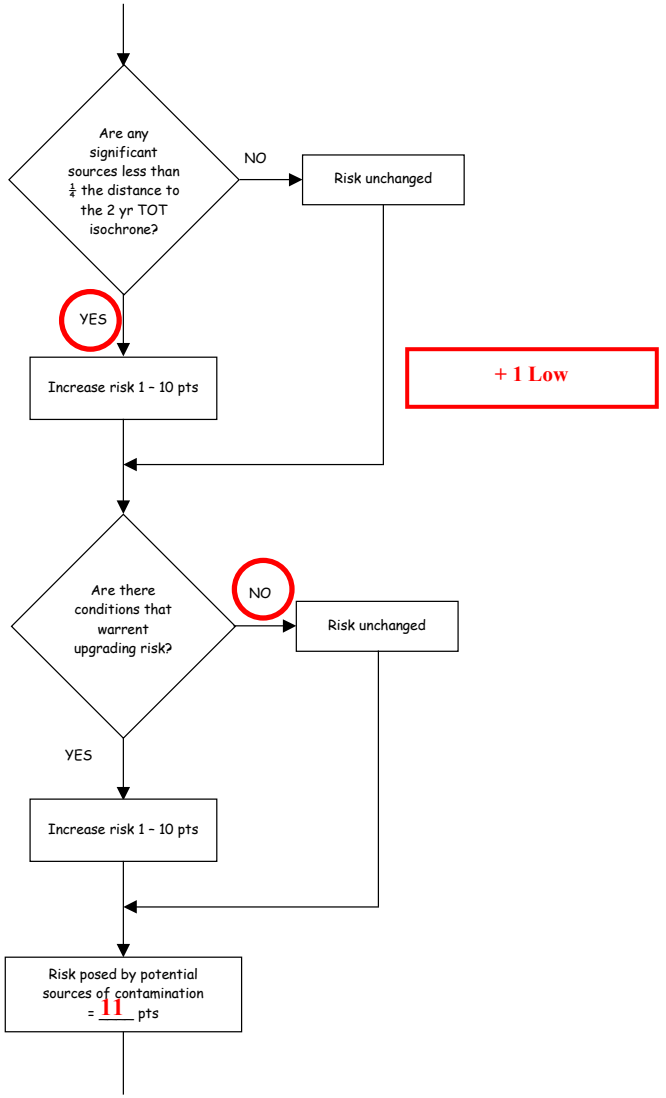
Chart 13. Contaminant risks for BLM Anchorage District Office Well #2 – Other Synthetic Organic Chemicals (Continued)



Dirt/gravel road and right-of-way

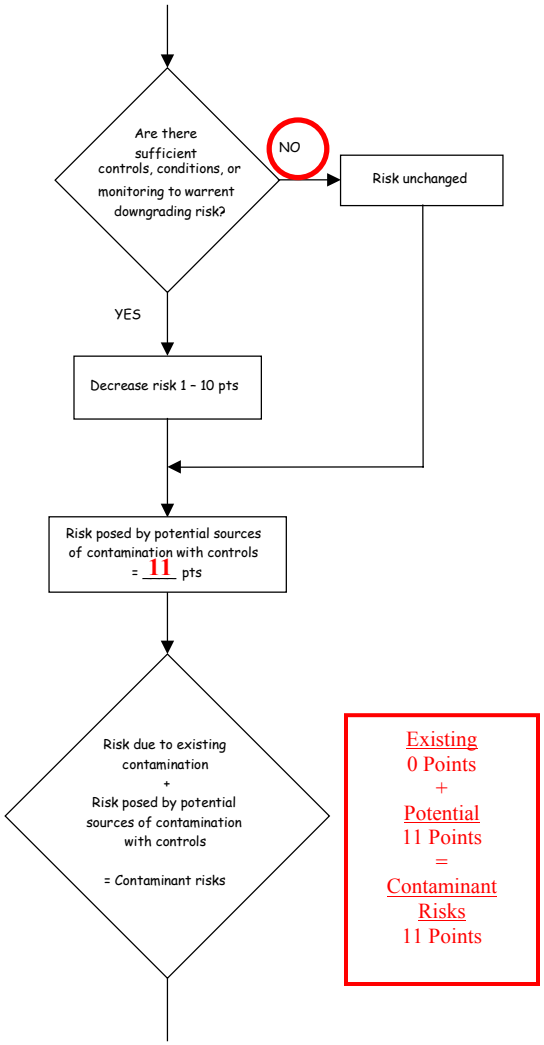
1 dirt/gravel road (unnamed access road) and right-of-way
= 1 Low

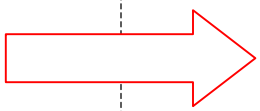
Total = 1 Low

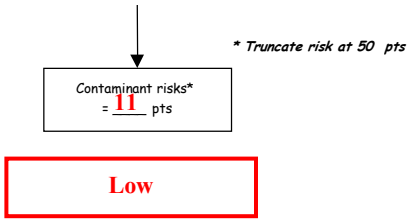


+ 1 Low

Chart 13. Contaminant risks for BLM Anchorage District Office Well #2 – Other Synthetic Organic Chemicals (Continued)







3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 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

Table 6. Risk Matrix for Contaminant Sources for BLM Anchorage District Office Well #2 – Other Synthetic Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)

1 dirt/gravel road and right-of-way, 1 active landing strip	**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

Chart 14. Vulnerability analysis for BLM Anchorage District Office Well #2 – Other Synthetic Organic Chemicals