Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Badger Mobile Home Park Drinking Water System,
Fairbanks area, Alaska
PWSID 310641

July 2003

DRINKING WATER PROTECTION PROGRAM REPORT Report 1022
Alaska Department of Environmental Conservation

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The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Source Water Assessment for Badger Mobile Home Park Source of Public Drinking Water, Fairbanks Area, Alaska

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Badger Mobile Home Park to potential contamination. This Class A (non-community) water system consists of one well on Badger Road just east of Arctic Fox Drive approximately 5 miles northwest of North Pole, Alaska. The well received a natural susceptibility rating of **Medium**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Very High** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Badger Mobile Home Park public water system include: residential heating oil storage tanks, residential septic systems, roads, residential area, a kennel, an electronics manufacturing plant, a Leaking Underground Storage Tank site, and an ADEC-recognized contaminated site. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals (VOCs), heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals (SOCs), and other organic chemicals (OOCs). Combining the natural susceptibility of the well with the contaminant risk, the public water system for Badger Mobile Home Park received an overall vulnerability rating of **High** for VOCs and OOCs; a **Medium** for nitrates and/or nitrites, and heavy metals, cyanide, and other inorganic chemicals, and a **Low** for bacteria and viruses, and SOCs.

BADGER MOBILE HOME PARK PUBLIC DRINKING WATER SYSTEM

Badger Mobile Home Park public water system is a Class A (community) water system. The system consists of one well Badger Road just east of Arctic Fox Drive approximately 5 miles northwest of North Pole, Alaska (T1S, R2E, Section 19) (See Map 1 of Appendix A). North Pole is located southeast of Fairbanks in the Fairbanks North Star Borough which is near the center of Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include : College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The majority of residents located in the area surrounding the city of Fairbanks use individual water wells or hauled water, and septic systems (ADCED, 2002). Heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) is used for heating homes and buildings. Refuse is transported to the Fairbanks North Star Borough landfill.

The Fairbanks area includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The Badger Mobile Home Park water system is located in the alluvial plain at an elevation of approximately 425 feet above sea level.

According to the most recent sanitary survey (9/28/00) for this water system, the depth of the well is estimated at 40 feet below the ground surface. Other wells in this area are screened in a combination of sand and gravel and it is assumed that this one is also. The alluvial plain consists of alternating layers of sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, T.L. 1958). Areas with discontinuous permafrost may locally affect the ground water flow directions.

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

The Badger Mobile Home Park public water system serves 60 residents through 31 service connections.

BADGER MOBILE HOME PARK DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. These

areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

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

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

The water table in the area of the Badger Mobile Home Park, the area between the Tanana and the Chena Rivers, is primarily influenced by the level of water flow in each river. The capture zones were drawn based on three separate configurations of the water table during various stages of the rivers: a period of high stage in the Chena River (October 14-17, 1986), high stage in the Tanana River (July 16-17, 1987), and low stages in both rivers (March 30-April 3, 1988) (Glass and others, 1996). High water levels in the Chena usually occur in the spring due to runoff from the uplands and in late summer due to rainstorms (Nelson, 1978). The Tanana usually experiences high flow during the hot, dry periods of mid-summer when maximum snowmelt from the Alaska Range occurs (Nelson, 1978). Groundwater in this area generally flows toward the northwest, from the Tanana River to the Chena River, however flow is reversed very near the Chena River during its high stage periods (Glass and others, 1996). These flow reversals are of short duration (i.e. days versus months) and of limited extent, generally within 1000 feet of the river (Nakanishi, et all, 1998).

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

The protection areas established for wells are usually separated into four zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the four zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. time-of-travel
B	Less than 2 years time-of-travel
C	Less than 5 years time-of-travel
D	Less than 10 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Badger Mobile Home Park on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program (DWPP) has completed an inventory of potential and existing sources of contamination within the Badger Mobile Home Park protection area. This inventory was completed through a search of agency records and other publicly available information. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

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

The sources are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are each assigned a ranking according to what type and level of

risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a combination of toxicity and volume associated with that source. Rankings include:

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

Bacteria and Viruses are only inventoried in Zones A and B because of their short life span. Only "Very High" and "High" rankings are inventoried within the outer Zone D due to the probability of contaminant dilution by the time the contaminants get to the well.

Tables 2 through 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals.

VULNERABILITY OF BADGER MOBILE HOME PARK DRINKING WATER SYSTEM

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

- Natural susceptibility; and
- Contaminant risks.

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the properties of the aquifer and the presence of other wells or boreholes in the area. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to Bacteria and Viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of the water system's contaminant sample results. Lastly, Chart 4 combines the results of the first three charts to produce the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Natural Susceptibility is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
(Chart 1 of Appendix D)

+

Susceptibility of the Aquifer (0 – 25 Points)
(Chart 2 of Appendix D)

=

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

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

The wellhead for the Badger Mobile Home Park received a Low Susceptibility rating. The most recent sanitary survey (9/28/00) indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted. A sanitary seal prevents potential contaminant from entering the well while sloping of the land surface and grouting help to prevent potential contaminants from traveling down the outside of the well casing.

The aquifer the Badger Mobile Home Park well is completed in received a Very High Susceptibility rating. The highly transmissive aquifer material and the high water table in the area allow contaminants to travel downward from the surface with the precipitation and surface water runoff. Table 2 summarizes the Susceptibility scores and ratings for Badger Mobile Home Park.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	20	Very High
Natural Susceptibility	20	Medium

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of

contaminant sources. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

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

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

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	25	Medium
Volatile Organic Chemicals	50	Very High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	35	High
Synthetic Organic Chemicals	10	Low
Other Organic Chemicals	40	Very High

Finally, an overall vulnerability score is assigned for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility (0 – 50 points)
+
Contaminant Risks (0 – 50 points)
=
Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

Again, rankings are assigned according to a point score:

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

Table 4 contains the overall vulnerability scores (0 – 100) and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	70	High
Nitrates and Nitrites	45	Medium
Volatile Organic Chemicals	70	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	55	Medium
Synthetic Organic Chemicals	30	Low
Other Organic Chemicals	60	High

Bacteria and Viruses

The residential septic systems in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coli forms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coli forms and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). A sample collected on 10/26/01tested positive for total coli form and fecal coli form. All other samples did not detect coli forms in the water.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Nitrates and Nitrites

The residential septic systems in the protection area also represent the greatest risk to to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have not been detected in in recent sampling history for the Badger Mobile Home Park well.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

Volatile Organic Chemicals

The residential heating oil tanks and the electrical equipment manufacturing plant represent the greatest risk for volatile organic chemical contamination to the well.

Both underground and above ground heating oil storage tanks are the standard way of heating homes and businesses in the area surrounding Fairbanks. The most common causes of fuel leaks of these heating oil systems are overfilling the tank, ruptured fuel lines, leaking storage tanks, damaged or faulty valves and vandalism. Regular system maintenance can help prevent many of these harmful fuel leaks.

Volatile Organic Chemicals were sampled on 3/17/99 and 2/27/99 in the Badger Mobile Home Park public water system. None were detected on either sampling event. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is high.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The electrical equipment manufacturing plant represents the greatest risk for inorganic chemicals to the well.

Inorganic chemicals were sampled on 2/20/95. Arsenic, barium, fluoride, and selenium were all detected well below their respective maximum contaminant levels (MCLs). Arsenic was detected at the greatest concentration with respect to its MCL (0.005 mg/L or 10%). In greater quantities, arsenic is known to cause skin damage, problems with circulatory systems, and may create an increased risk of developing cancer (EPA, 2002).

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

Synthetic Organic Chemicals

The residential septic systems represent the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been sampled for in this water system.

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

Other Organic Chemicals

The electronic equipment manufacturing plant represents the greatest risk for other organic chemicals to the well.

Other organic chemicals have not been sampled for in this water system.

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

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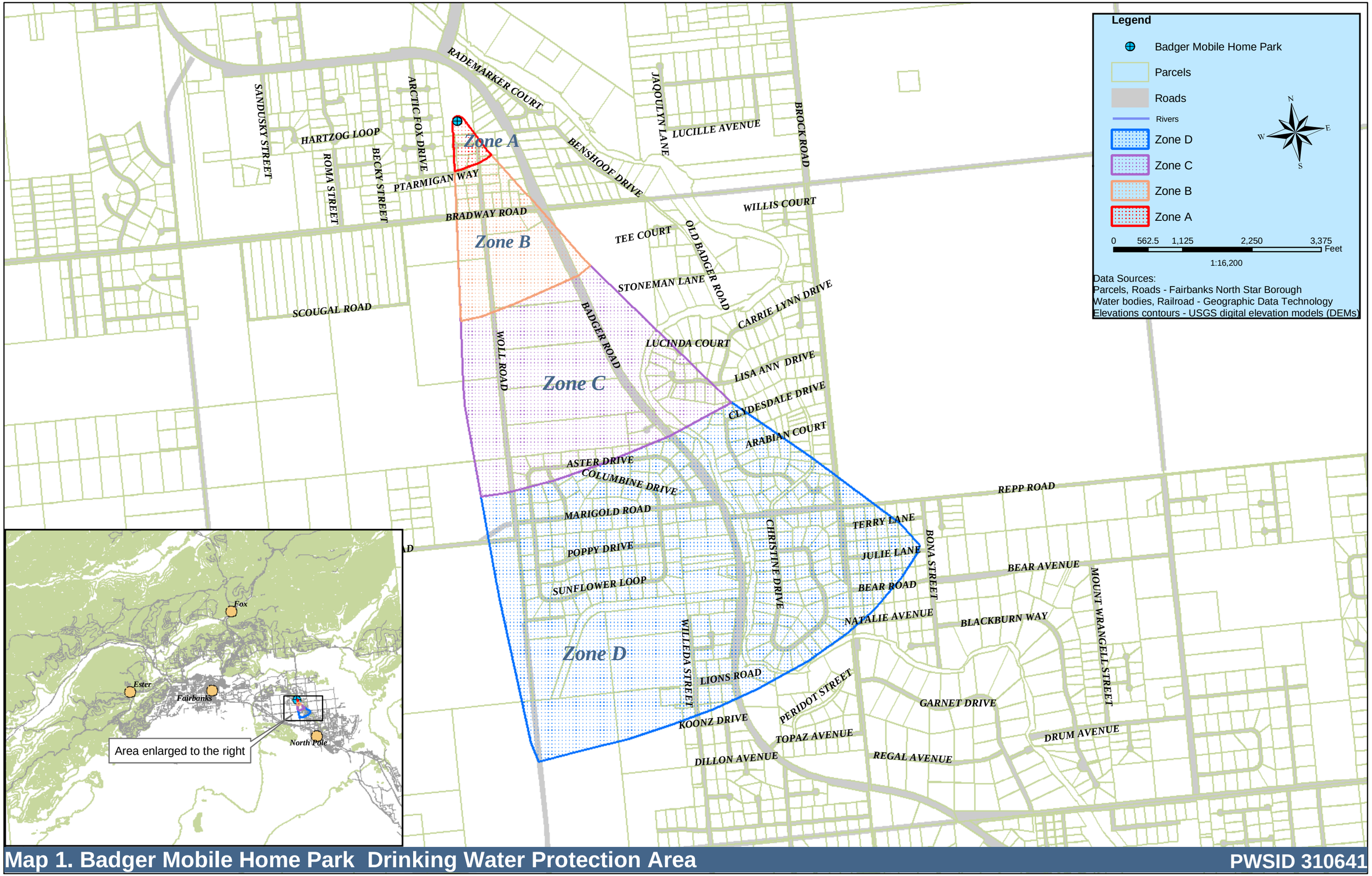
APPENDIX A

Badger Mobile Home Park
Drinking Water Protection Area Location Map
(Map 1)



Map 1. Badger Mobile Home Park Drinking Water Protection Area **PWSID 310641**

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Badger Mobile Home Park***

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	2	Approximately 5 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		A	2	Number based on tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		A	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		A	2	Dassel Court; Woll Road
Electrical, electronic, computer, and communications equipment/component manufacturing	I13	I13-1	B	2	2395 Badger Road
Residential Areas	R01	R01-2	B	2	Approximately 15 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		B	2	Number based on tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		B	2	Number based on tax parcels designated as residential
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-1	B	2	Arctic Acres Store; 2387 Badger Road; site investigation on-going
Closed Leaking Underground Fuel Storage Tank (LUST) Sites	U08	U08-1	B	2	FNSB - North Star Volunteer Fire Dept. Station #1; 2358 Bradway Road; site cleanup complete on 9/7/00
Highways and roads, paved (cement or asphalt)	X20		B	2	Bradway Road; Badger Road
Residential Areas	R01	R01-3	C	2	Approximately 40 acres in Zone C
Septic systems (serves one single-family home)	R02		C	2	Number based on tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		C	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	2	Aster Drive; Lisa Ann Drive
Kennels	X49	X49-1	C	2	2502 Badger Road
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-1	D	2 inset	1751 Christine Drive Fuel Spill; residential heating oil spill; site closed in 1998.

Table 2

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park Sources of Bacteria and Viruses

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Dassel Court; Woll Road
Septic systems (serves one single-family home)	R02		A	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-1	A	Low	2	Approximately 5 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Bradway Road; Badger Road
Septic systems (serves one single-family home)	R02		B	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-2	B	Low	2	Approximately 15 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	Aster Drive; Lisa Ann Drive
Septic systems (serves one single-family home)	R02		C	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-3	C	Low	2	Approximately 40 acres in Zone C
Kennels	X49	X49-1	C	Medium	2	2502 Badger Road

Table 3

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park Sources of Nitrates/Nitrites

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Dassel Court; Woll Road
Septic systems (serves one single-family home)	R02		A	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-1	A	Low	2	Approximately 5 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		B	Low	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Bradway Road; Badger Road
Residential Areas	R01	R01-2	B	Low	2	Approximately 15 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		C	Low	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	Aster Drive; Lisa Ann Drive
Residential Areas	R01	R01-3	C	Low	2	Approximately 40 acres in Zone C
Kennels	X49	X49-1	C	Medium	2	2502 Badger Road

Table 4

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park Sources of Volatile Organic Chemicals

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Tanks, heating oil, residential (above ground)	R08		A	Medium	2	Number based on tax parcels designated as residential
Septic systems (serves one single-family home)	R02		A	Low	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Dassel Court; Woll Road
Residential Areas	R01	R01-1	A	Low	2	Approximately 5 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		B	Low	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Bradway Road; Badger Road
Tanks, heating oil, residential (above ground)	R08		B	Medium	2	Number based on tax parcels designated as residential
Electrical, electronic, computer, and communications equipment/component manufacturing	I13	I13-1	B	Very High	2	2395 Badger Road
Residential Areas	R01	R01-2	B	Low	2	Approximately 15 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	Aster Drive; Lisa Ann Drive
Septic systems (serves one single-family home)	R02		C	Low	2	Number based on tax parcels designated as residential
Tanks, heating oil, residential (above ground)	R08		C	Medium	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-3	C	Low	2	Approximately 40 acres in Zone C

Table 5

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Dassel Court; Woll Road
Septic systems (serves one single-family home)	R02		A	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-1	A	Low	2	Approximately 5 acres of residential area in Zone A
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Bradway Road; Badger Road
Septic systems (serves one single-family home)	R02		B	Low	2	Number based on tax parcels designated as residential
Electrical, electronic, computer, and communications equipment/component manufacturing	I13	I13-1	B	High	2	2395 Badger Road
Residential Areas	R01	R01-2	B	Low	2	Approximately 15 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		C	Low	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	Aster Drive; Lisa Ann Drive
Residential Areas	R01	R01-3	C	Low	2	Approximately 40 acres in Zone C

Table 6

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park Sources of Synthetic Organic Chemicals

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02		A	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-1	A	Low	2	Approximately 5 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		B	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-2	B	Low	2	Approximately 15 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02		C	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-3	C	Low	2	Approximately 40 acres in Zone C

Table 7

Contaminant Source Inventory and Risk Ranking for Badger Mobile Home Park Sources of Other Organic Chemicals

PWSID 310641.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20		A	Low	2	Dassel Court; Woll Road
Septic systems (serves one single-family home)	R02		A	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-1	A	Low	2	Approximately 5 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02		B	Low	2	Number based on tax parcels designated as residential
Highways and roads, paved (cement or asphalt)	X20		B	Low	2	Bradway Road; Badger Road
Electrical, electronic, computer, and communications equipment/component manufacturing	I13	I13-1	B	Very High	2	2395 Badger Road
Residential Areas	R01	R01-2	B	Low	2	Approximately 15 acres of residential area in Zone B
Highways and roads, paved (cement or asphalt)	X20		C	Low	2	Aster Drive; Lisa Ann Drive
Septic systems (serves one single-family home)	R02		C	Low	2	Number based on tax parcels designated as residential
Residential Areas	R01	R01-3	C	Low	2	Approximately 40 acres in Zone C

APPENDIX C

Badger Mobile Home Park
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

POLAR BEAR COURT
CANDLE LITE LOOP
LUCILLE AVENUE
HARTZOG LOOP
ARCTIC FOX DRIVE
DASSEL COURT
BENSHOOF DRIVE
BECKY STREET
BADGER ROAD
GOLF COURT
PTARMIGAN WAY
BRADWAY ROAD
TEE COURT
OLD BADGER ROAD
STONEMAN LANE
SCOUGAL ROAD
CARRIE LYNN DRIVE
KATY JILL COURT
LUCINDA COURT
LISA ANN DRIVE
WOLL ROAD
ARABIAN COURT
ASTER DRIVE
FOXGLOVE STREET
COLUMBINE DRIVE
CLYDESDALE DRIVE

Zone A
Zone B
Zone C

R01-1
8 R08s in Zone B
8 R02s in Zone B
R01-2
U07-1
U07-2
I13-1
X30-1
R01-3
X49-1
22 R02s in Zone C
22 R08s in Zone C
Area enlarged at the left
U04-1

Legend

- Badger Mobile Home Park well
- ADEC contaminated site (U04)
- Leaking Underground Storage Site (U07)
- Electronic equipment manufacturing (I13)
- Kennel (X49)
- Residential heating oil tanks (R08)
- Residential septic systems (R02)
- Residential area (R01)
- Parcels
- Roads (X20 or X24)
- Rivers

N
W
E
S

Data Sources:
Parcels, Roads - Fairbanks North Star Borough
Water bodies, Railroad - Geographic Data Technology

0 362.5 725 1,450 2,175 Feet

1:8,700

Map 2. Badger Mobile Home Park Potential Contaminant Sources

PWSID 310641

APPENDIX D

Vulnerability Analysis for Badger Mobile Home Park Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Badger Mobile Home Park

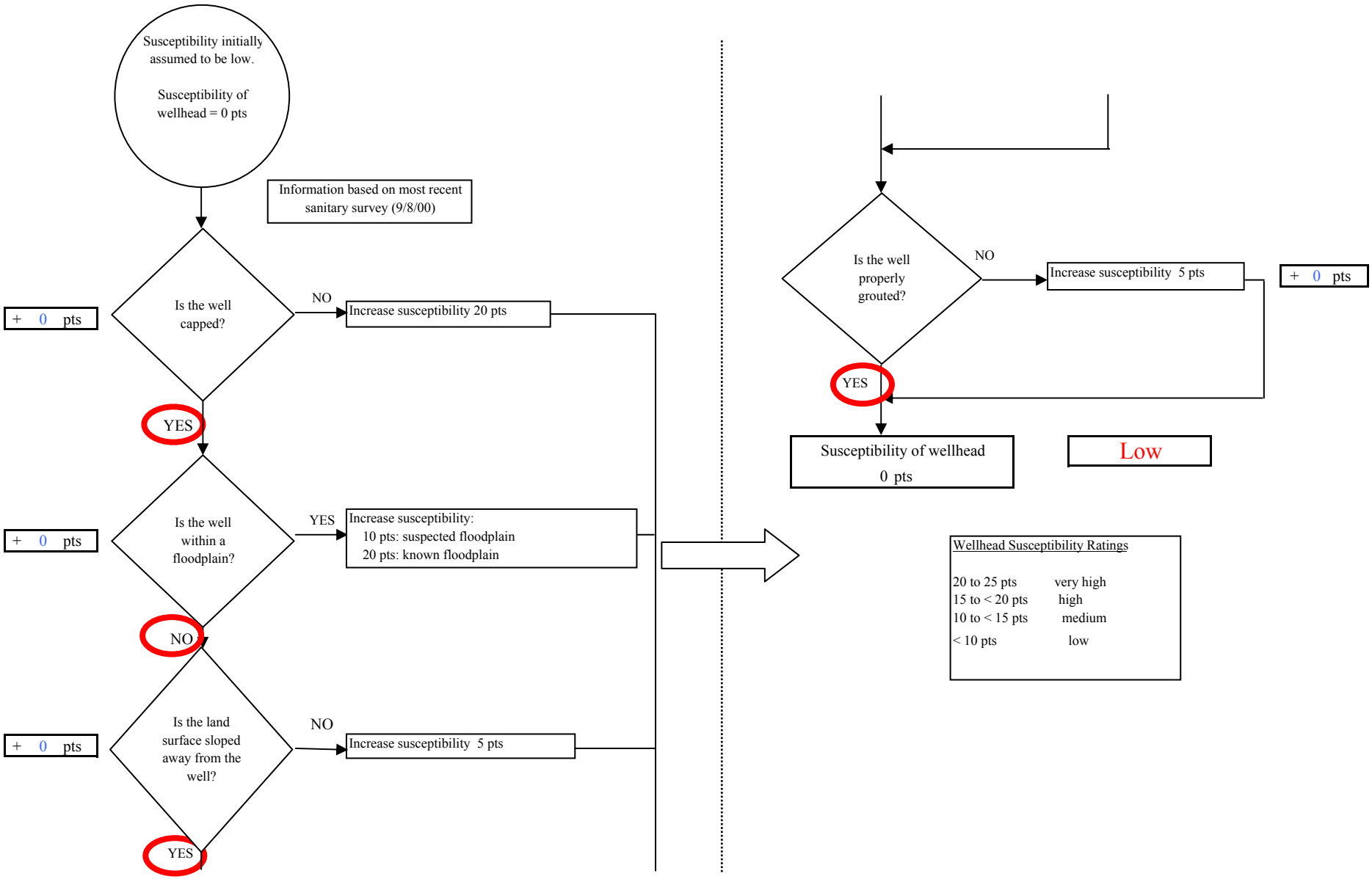


Chart 2. Susceptibility of the aquifer - Badger Mobile Home Park

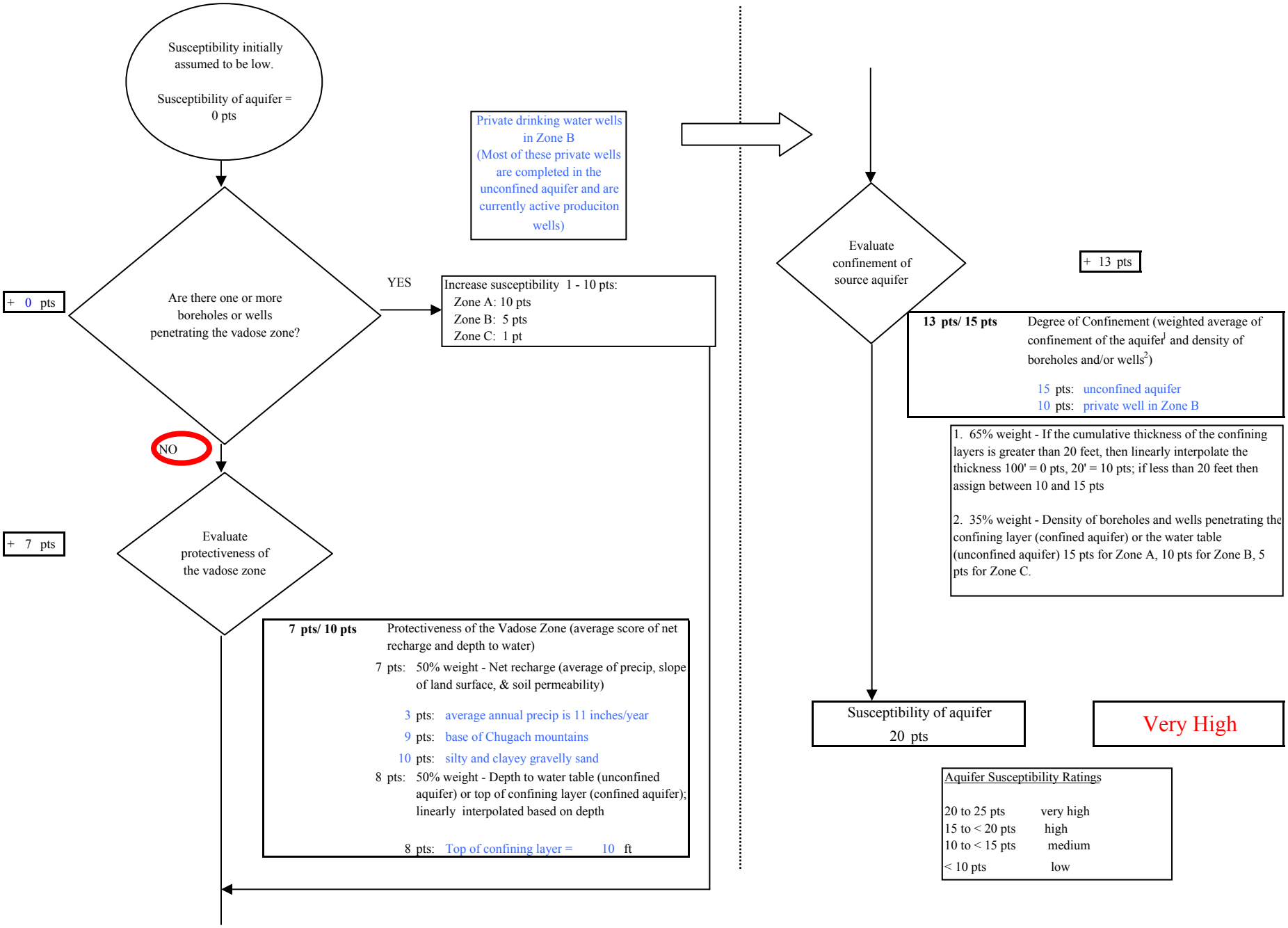
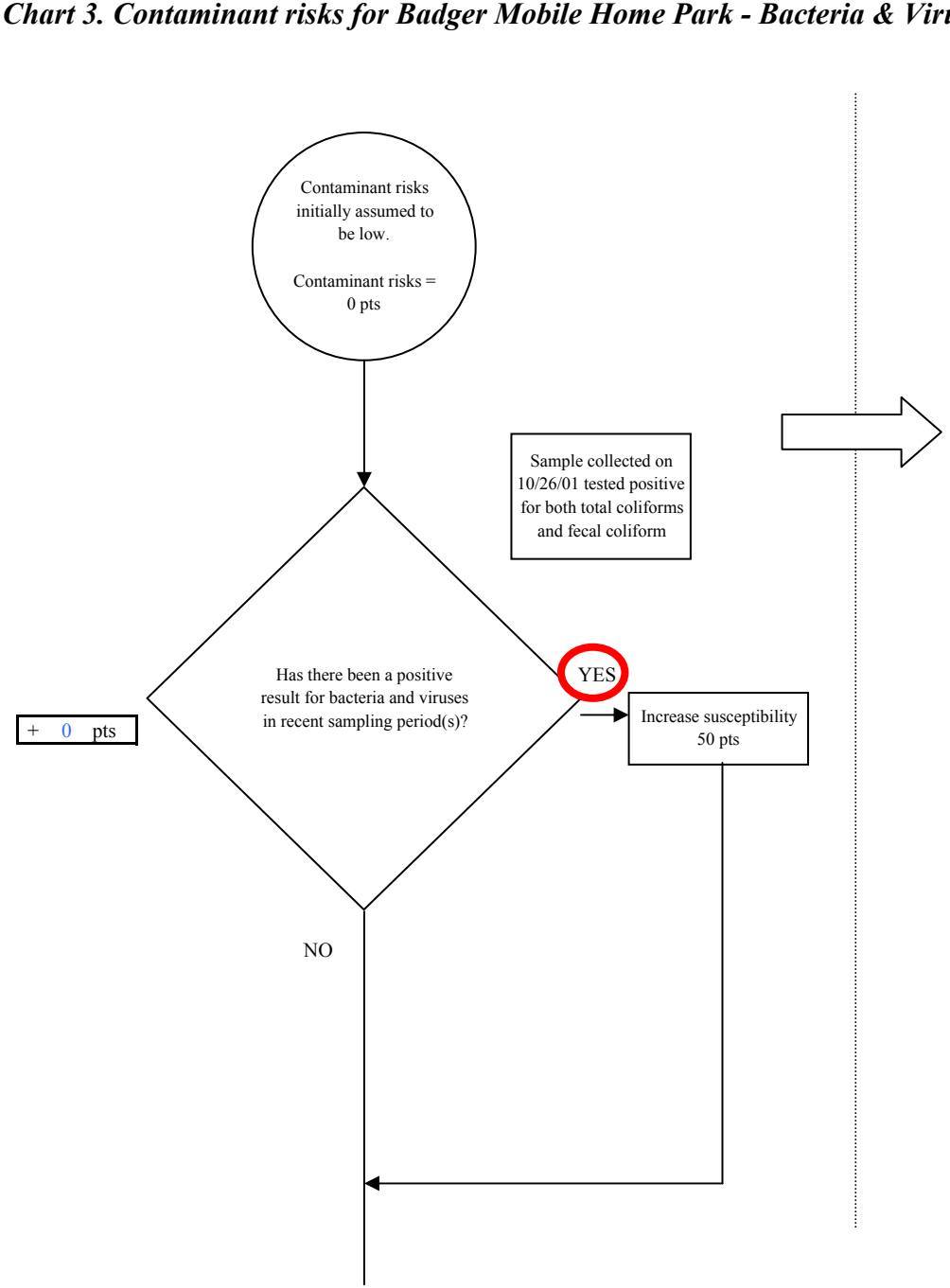
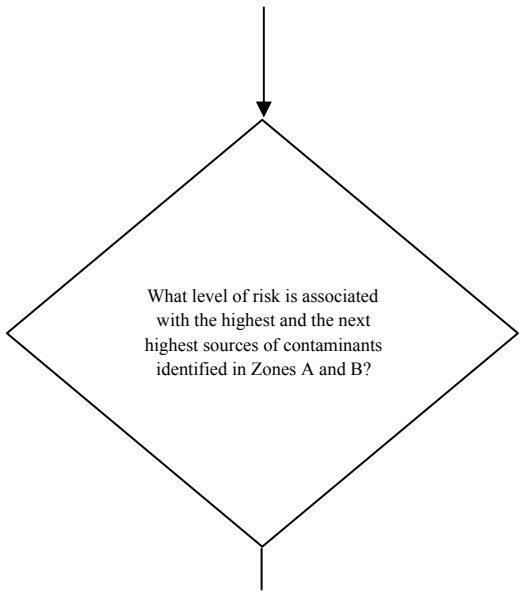


Chart 3. Contaminant risks for Badger Mobile Home Park - Bacteria & Viruses





+ 10 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	5	3	8

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

Matrix Score 10

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

Chart 3. Contaminant risks for Badger Mobile Home Park - Bacteria & Viruses

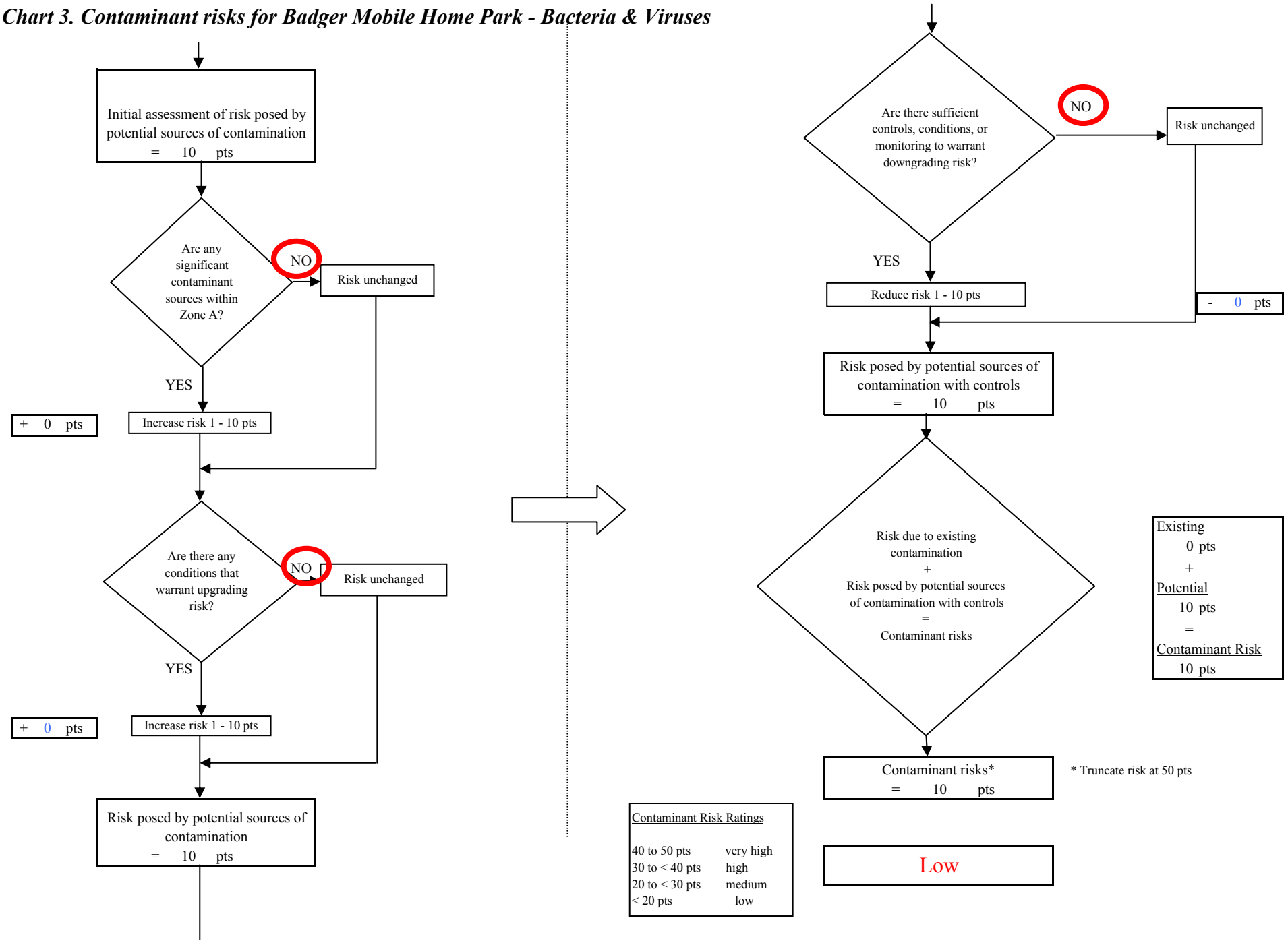


Chart 4. Vulnerability analysis for Badger Mobile Home Park - Bacteria & Viruses

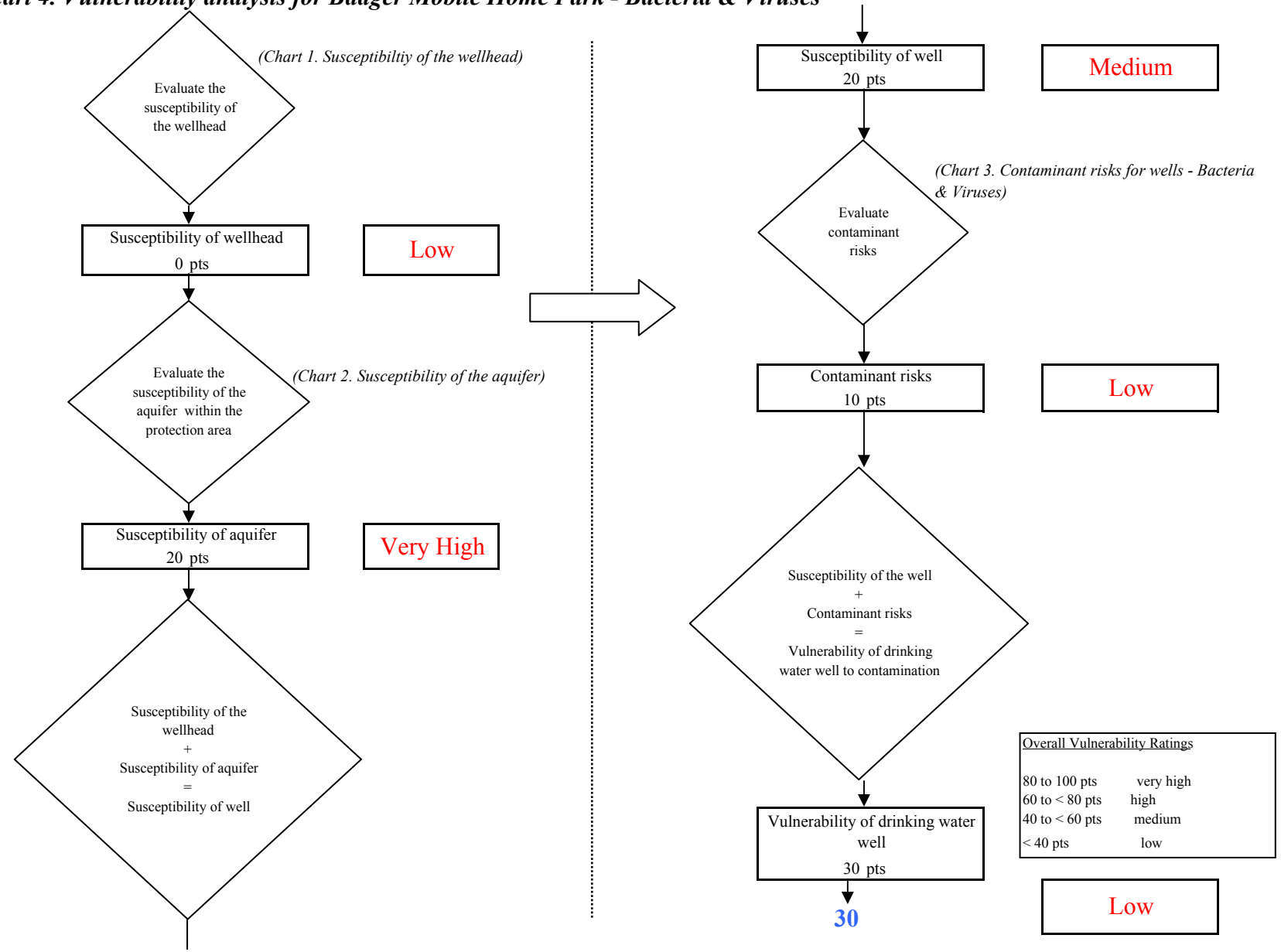


Chart 5. Contaminant risks for Badger Mobile Home Park - Nitrates and Nitrites

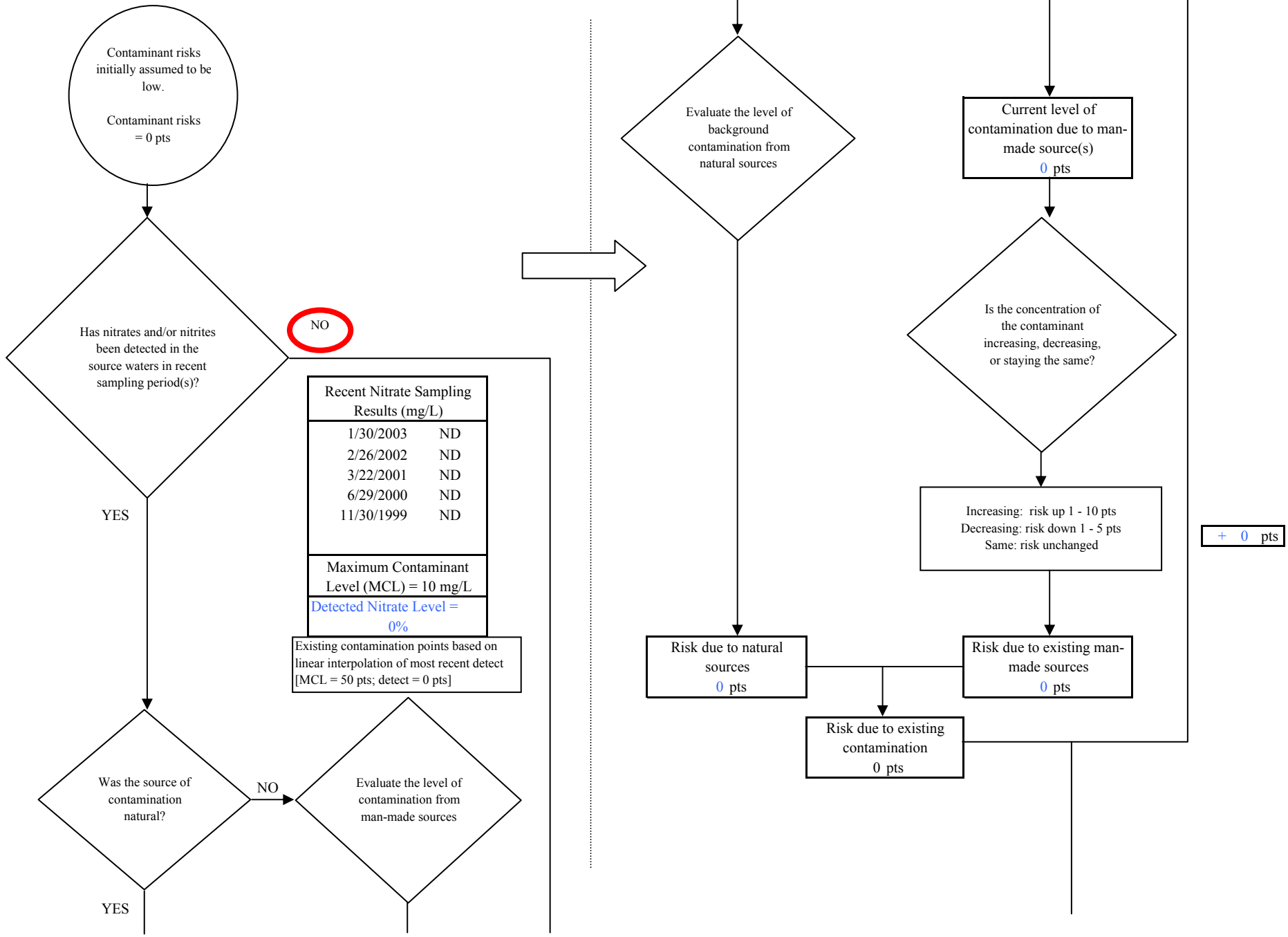


Chart 5. Contaminant risks for Badger Mobile Home Park - Nitrates and Nitrites

+ 25 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	1	1
Low(s)	5	5	10

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

Matrix Score 25

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

Initial assessment of risk posed by potential sources of contamination = 25 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

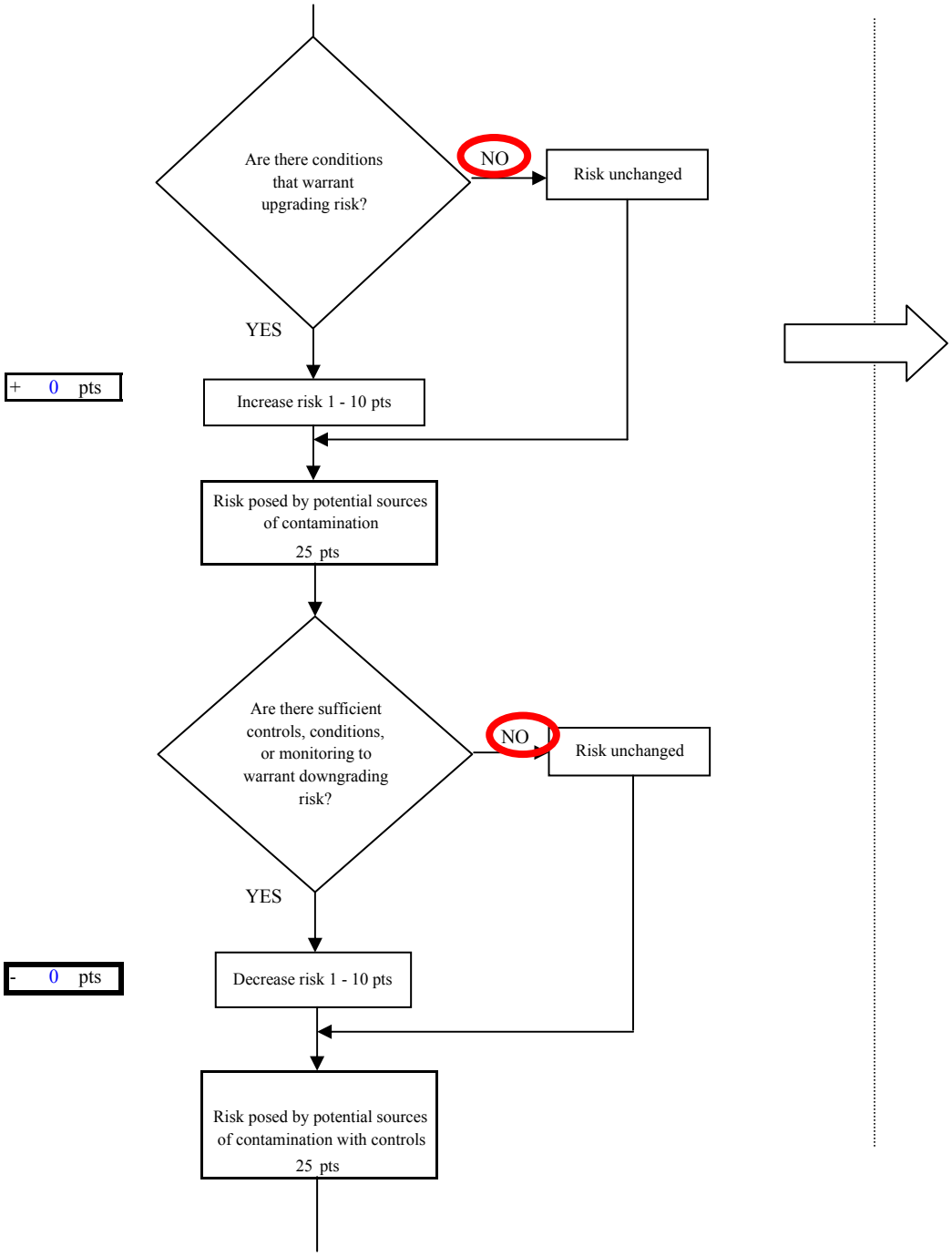
Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 5. Contaminant risks for Badger Mobile Home Park - Nitrates and Nitrites



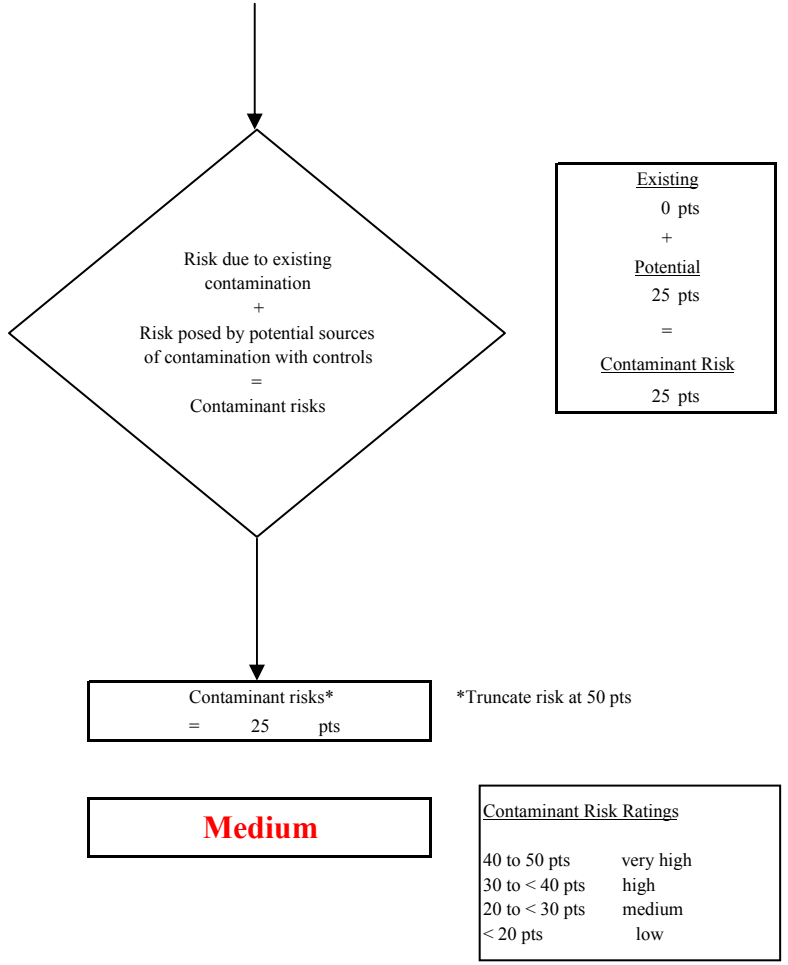


Chart 6. Vulnerability analysis for Badger Mobile Home Park - Nitrates and Nitrites

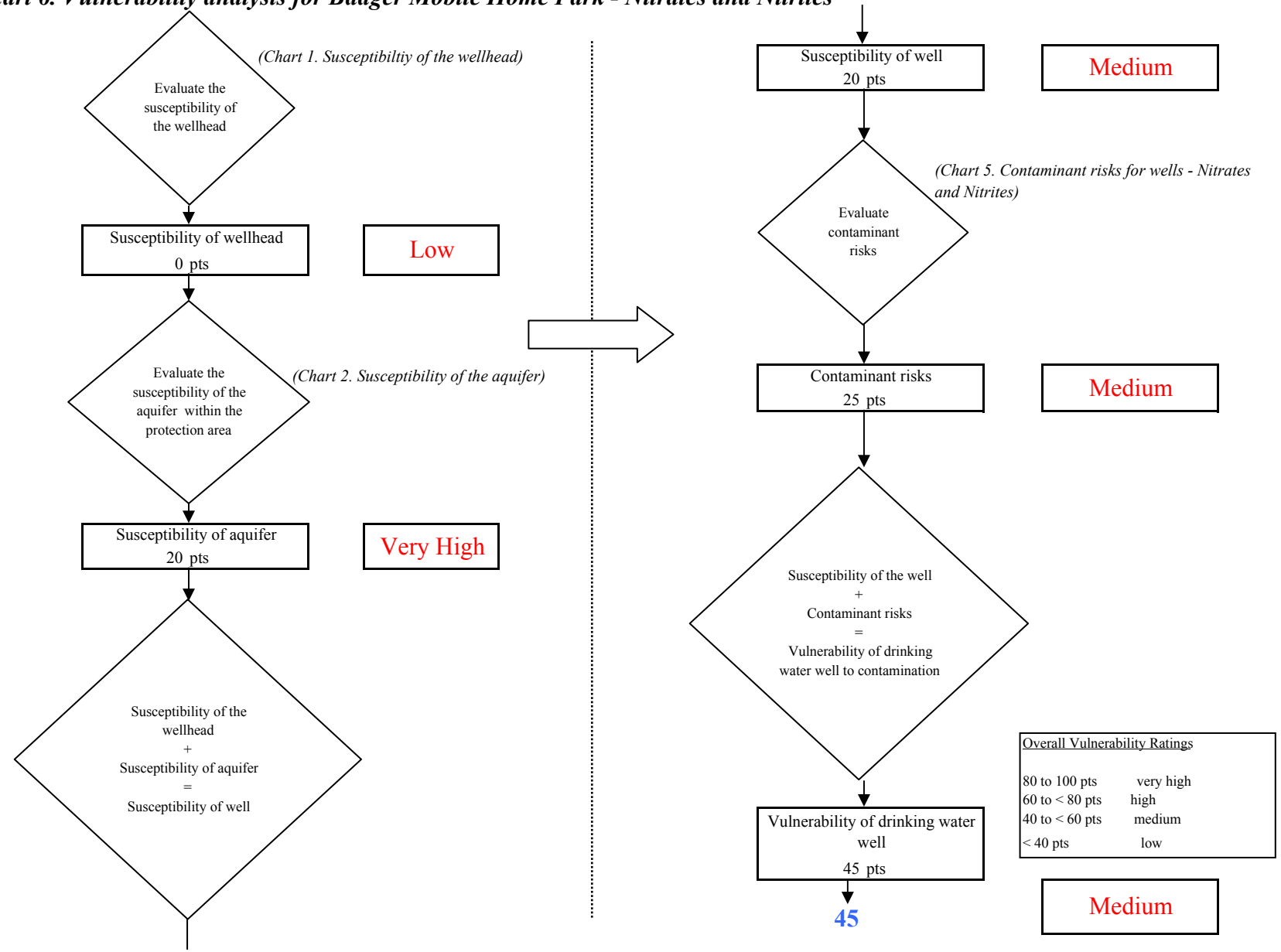


Chart 7. Contaminant risks for Badger Mobile Home Park - Volatile Organic Chemicals

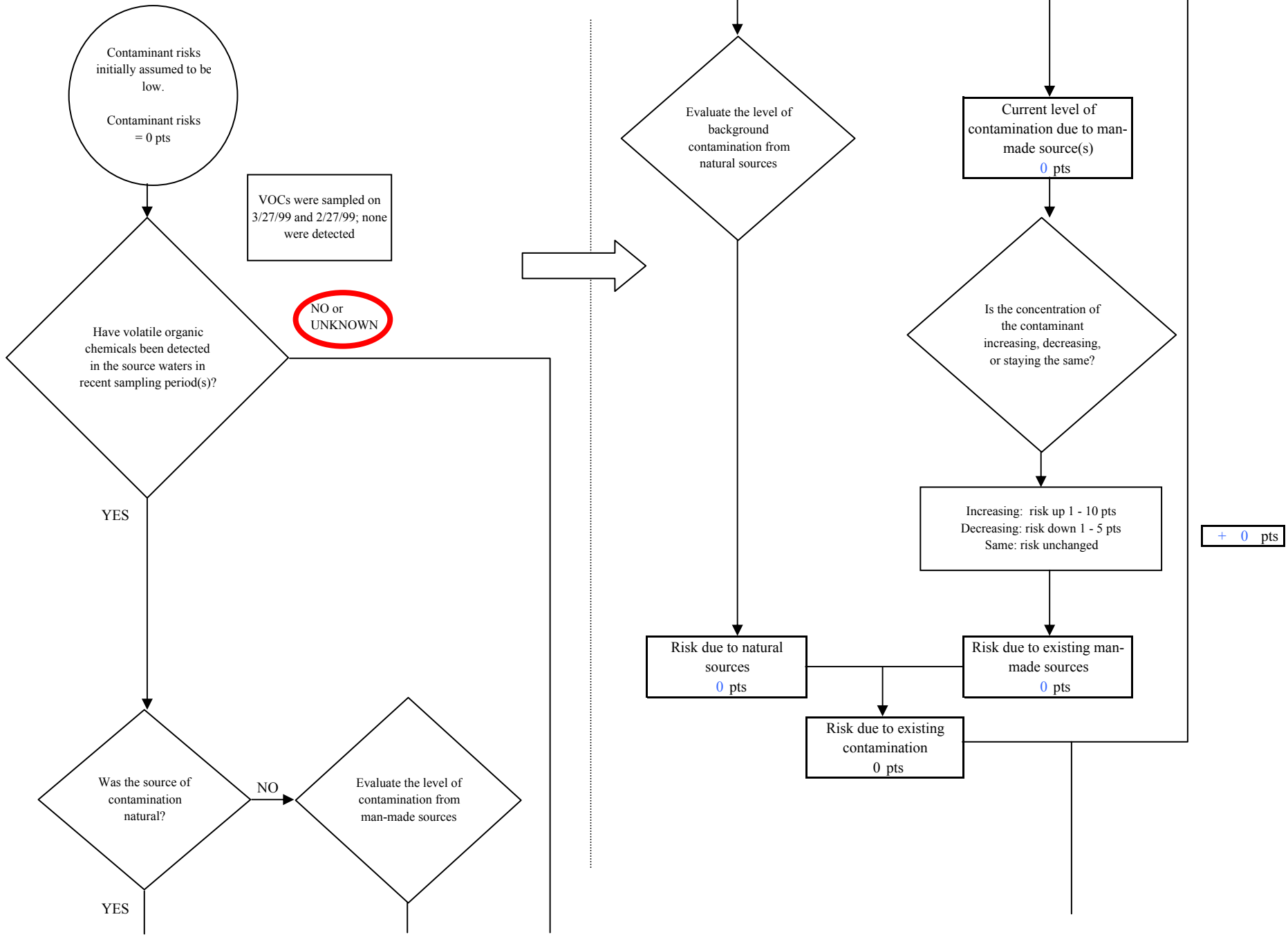
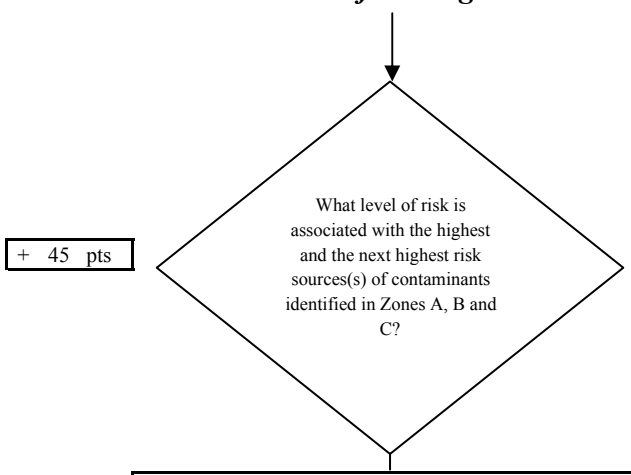


Chart 7. Contaminant risks for Badger Mobile Home Park - Volatile Organic Chemicals



+ 45 pts

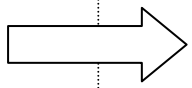
Risk Levels for Contaminant Sources identified in Zones A, B and C

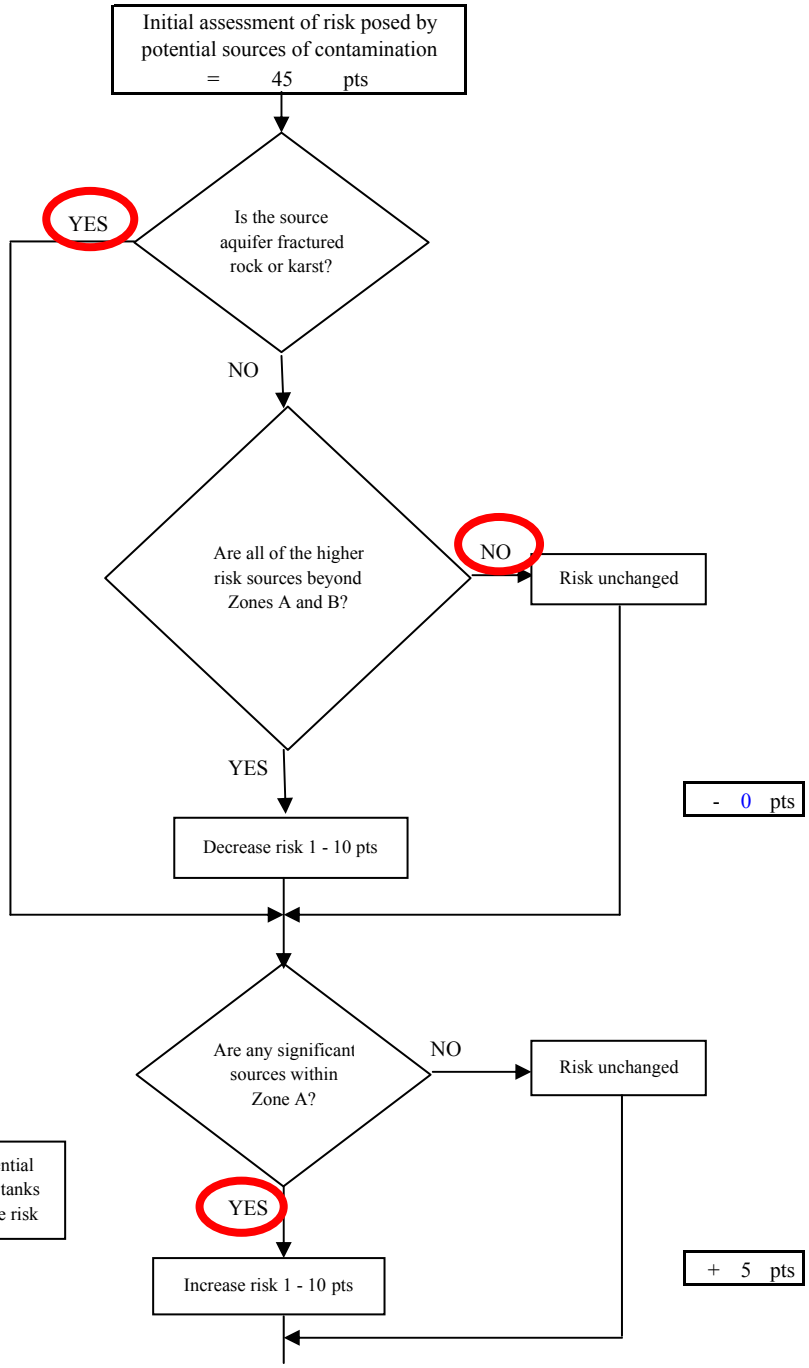
	Zone A	Zones B&C	Total
Very Highs(s)	0	1	1
High(s)	0	0	0
Medium(s)	4	32	36
Low(s)	3	3	6

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

Matrix Score 45

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





The residential heating oil tanks increase the risk

Chart 7. Contaminant risks for Badger Mobile Home Park - Volatile Organic Chemicals

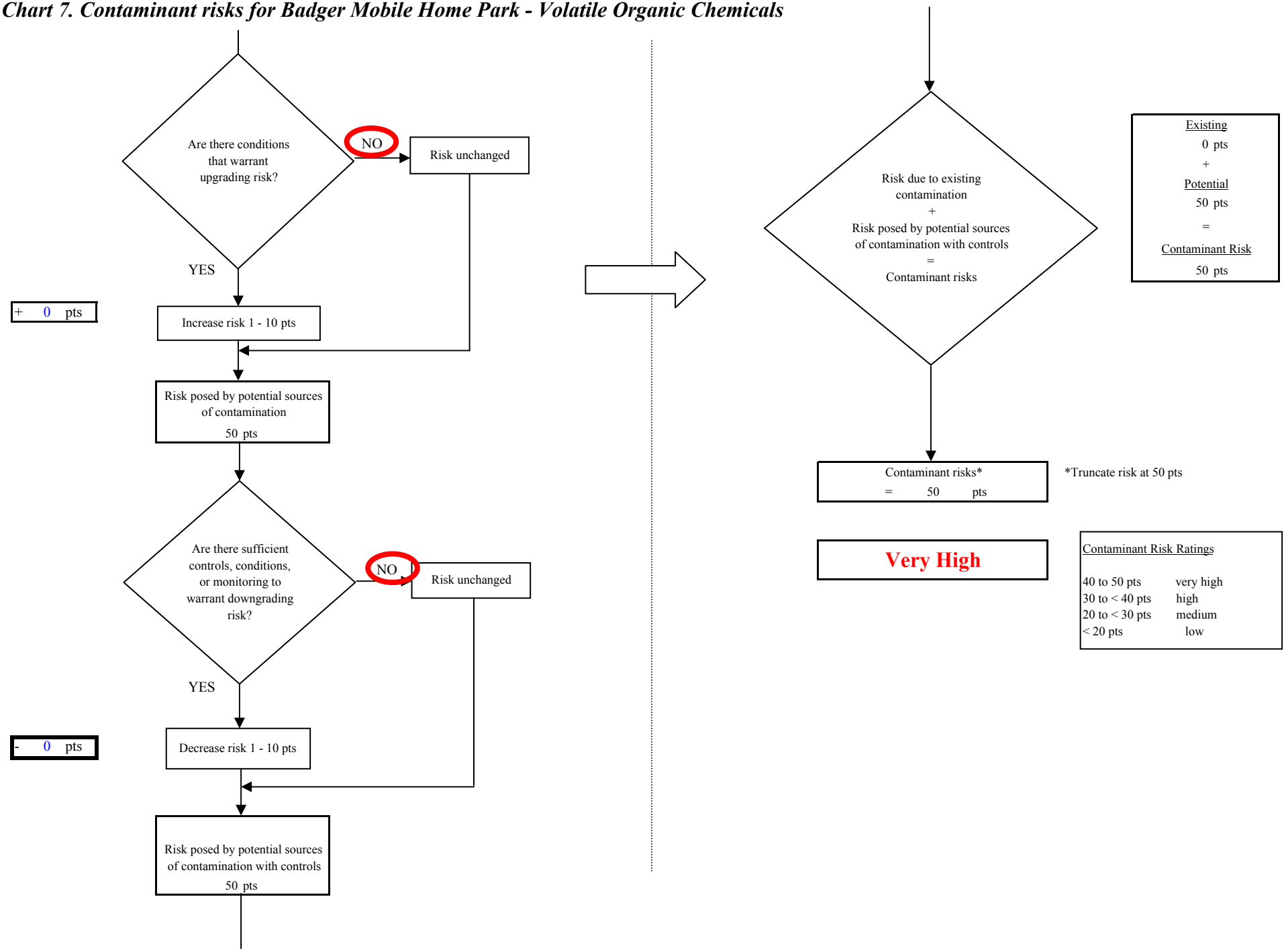


Chart 8. Vulnerability analysis for Badger Mobile Home Park - Volatile Organic Chemicals

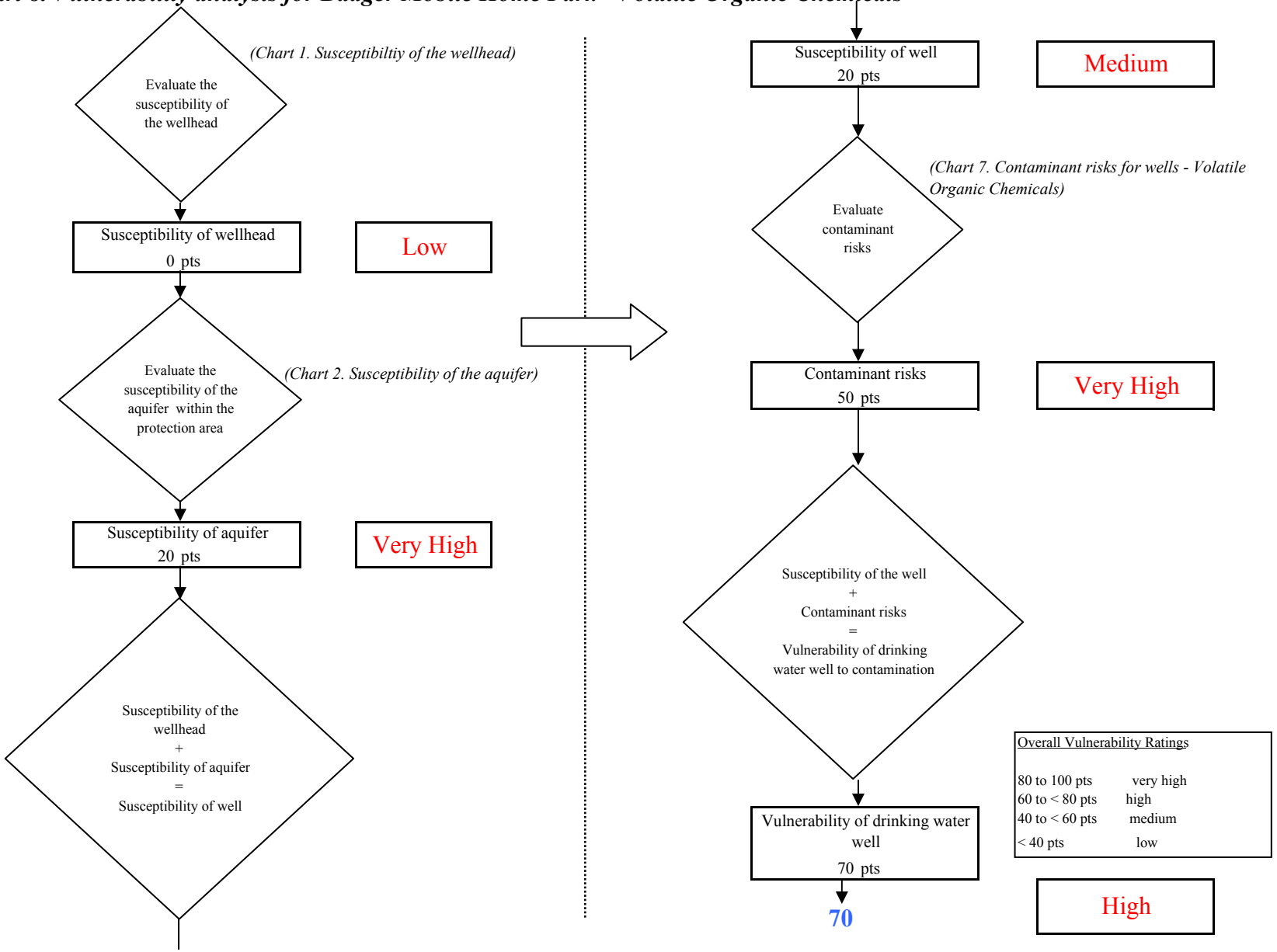


Chart 9. Contaminant risks for Badger Mobile Home Park - Heavy Metals, Cyanide and Other Inorganic Chemicals

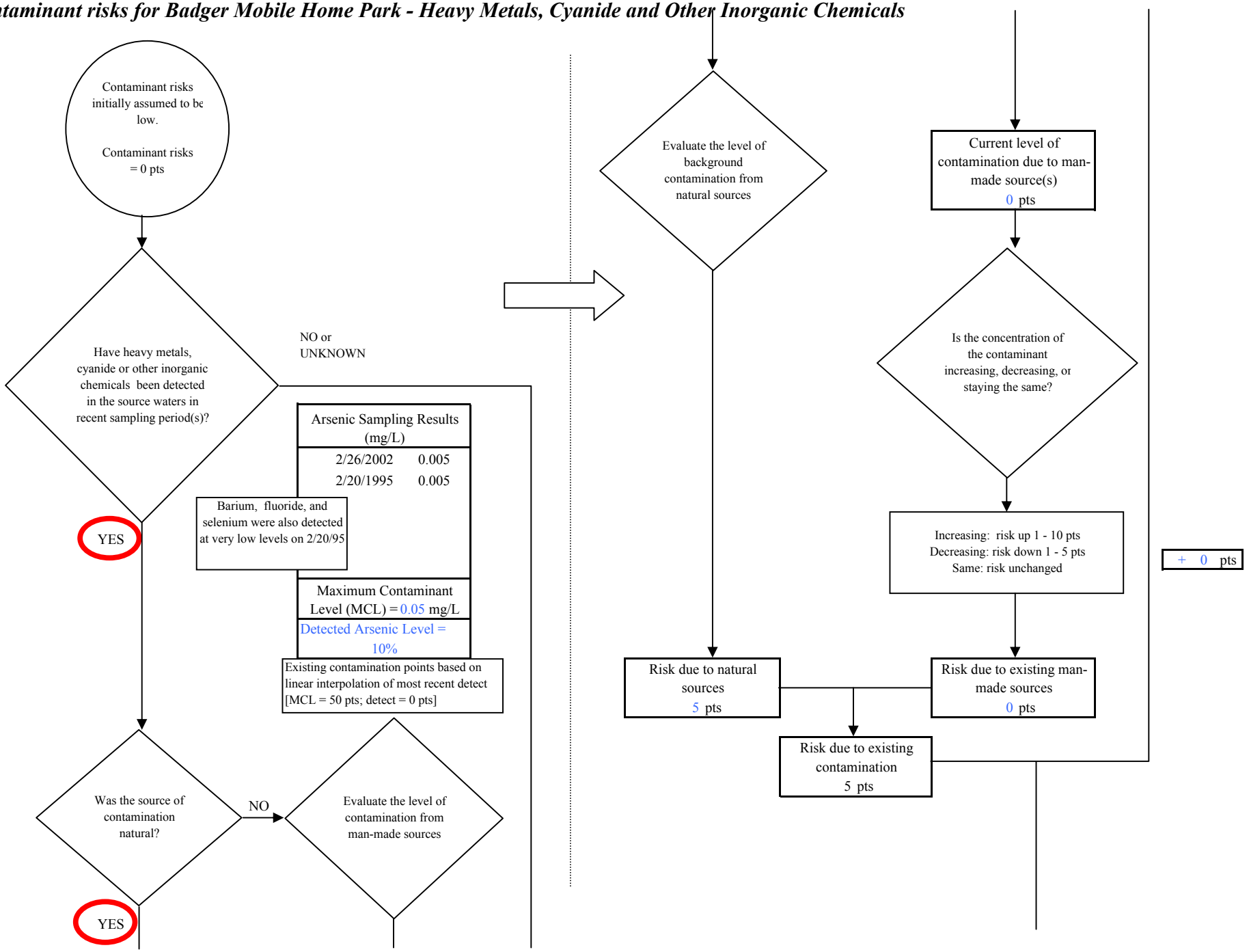


Chart 9. Contaminant risks for Badger Mobile Home Park - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 30 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	1	1
Medium(s)	0	0	0
Low(s)	3	3	6

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

Matrix Score 30

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

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

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

Risk unchanged

YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 9. Contaminant risks for Badger Mobile Home Park - Heavy Metals, Cyanide and Other Inorganic Chemicals

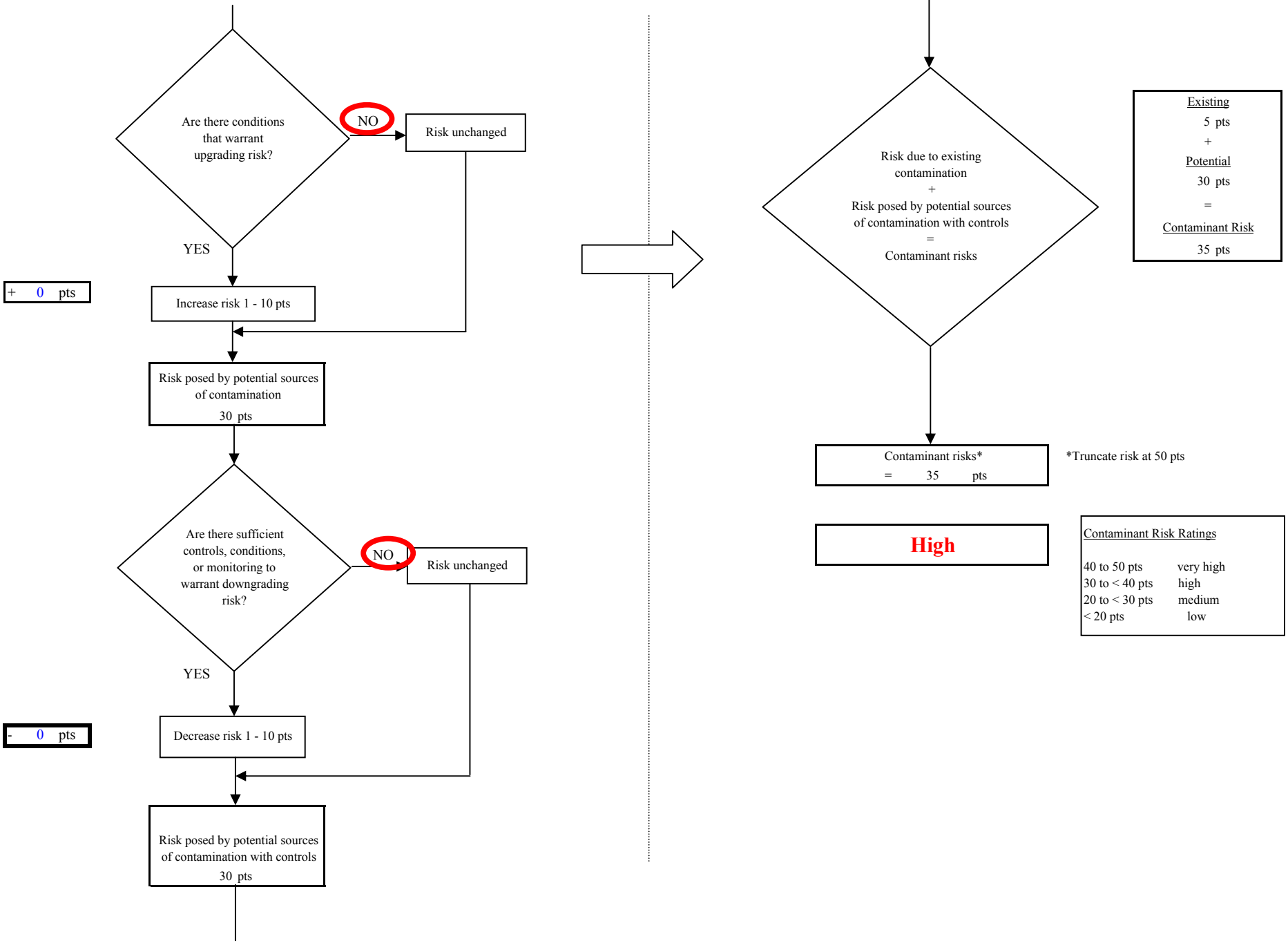


Chart 10. Vulnerability analysis for Badger Mobile Home Park - Heavy Metals, Cyanide and Other Inorganic Chemicals

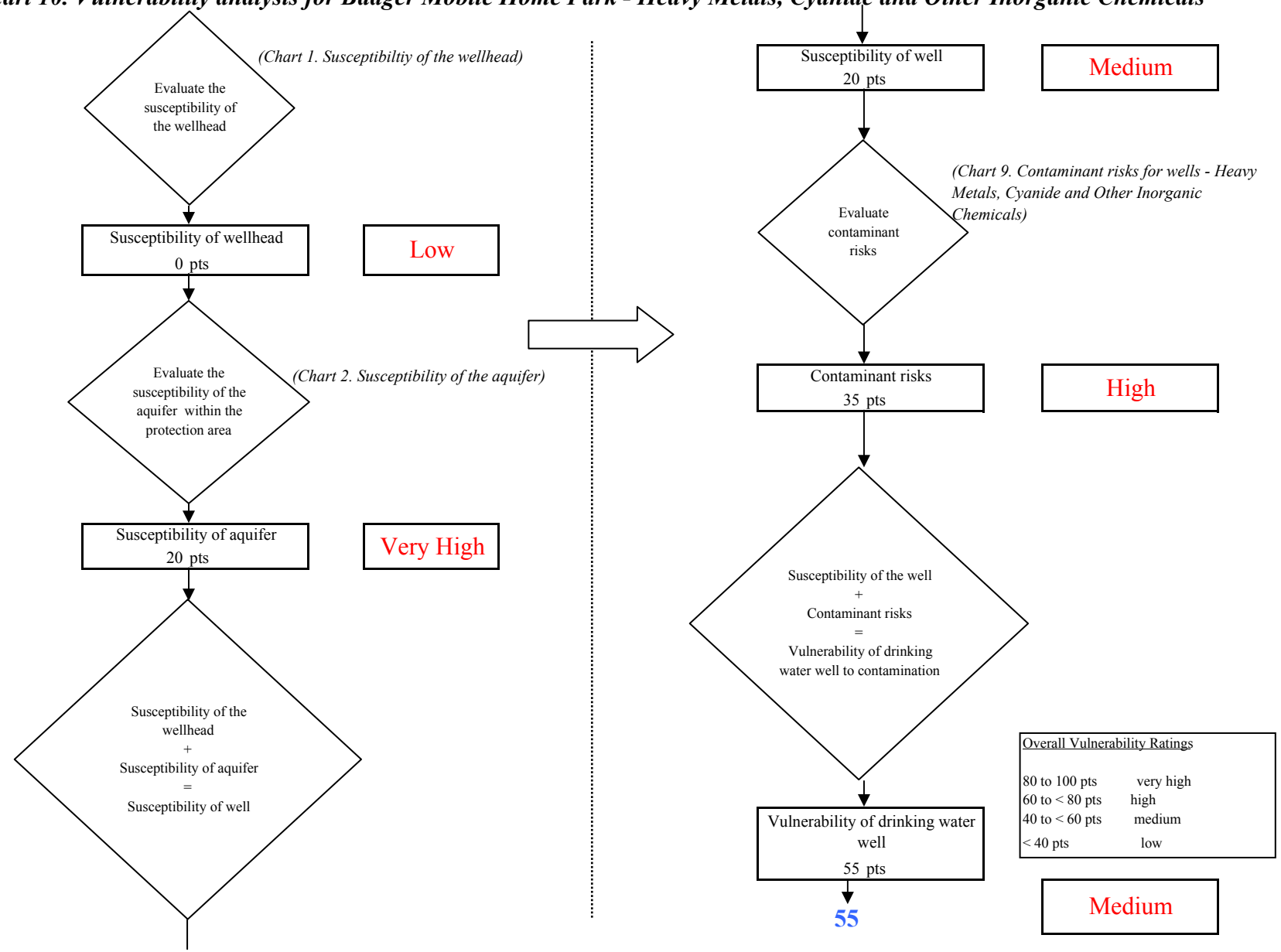


Chart 11. Contaminant risks for Badger Mobile Home Park - Synthetic Organic Chemicals

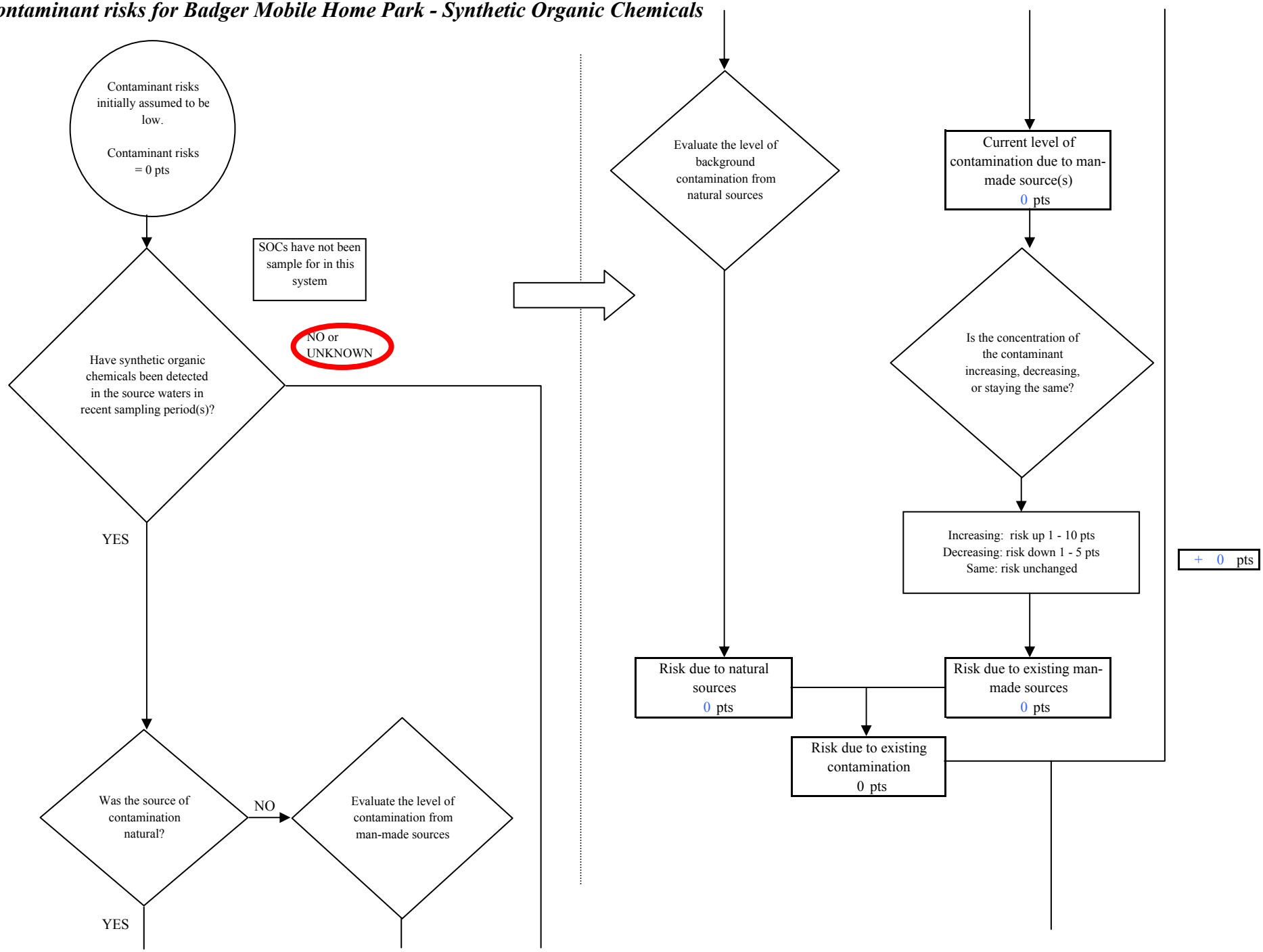
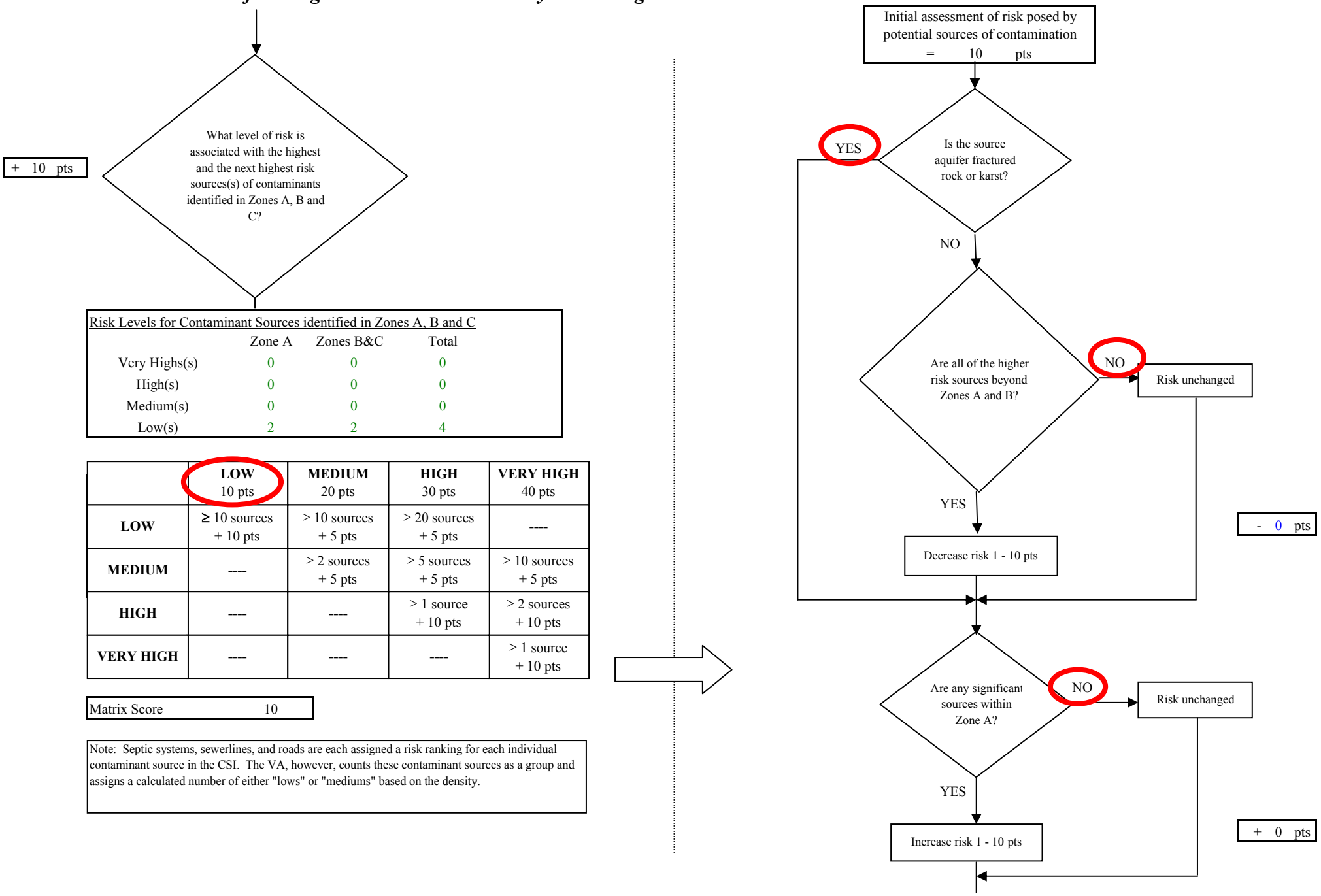


Chart 11. Contaminant risks for Badger Mobile Home Park - Synthetic Organic Chemicals



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

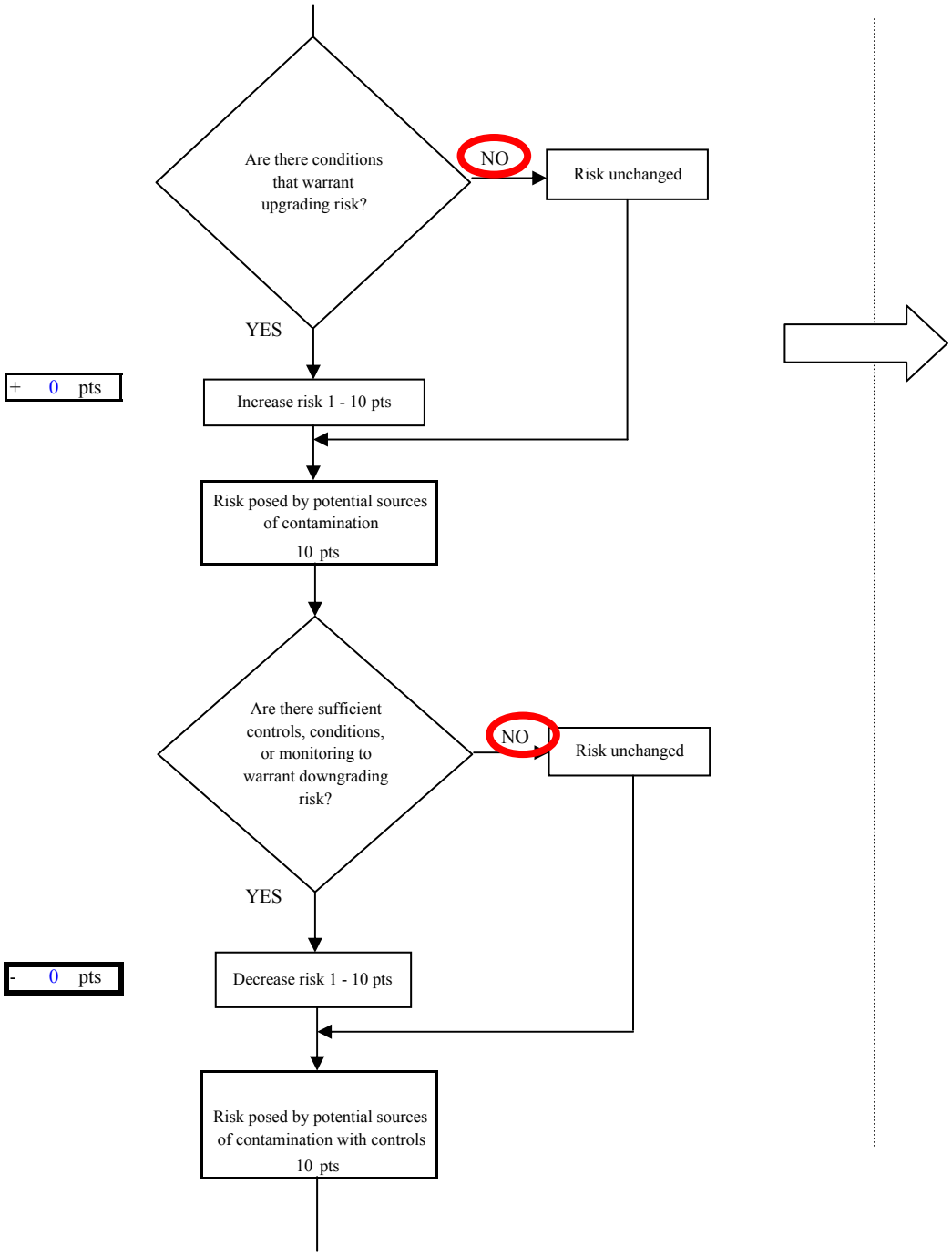
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	2	2	4

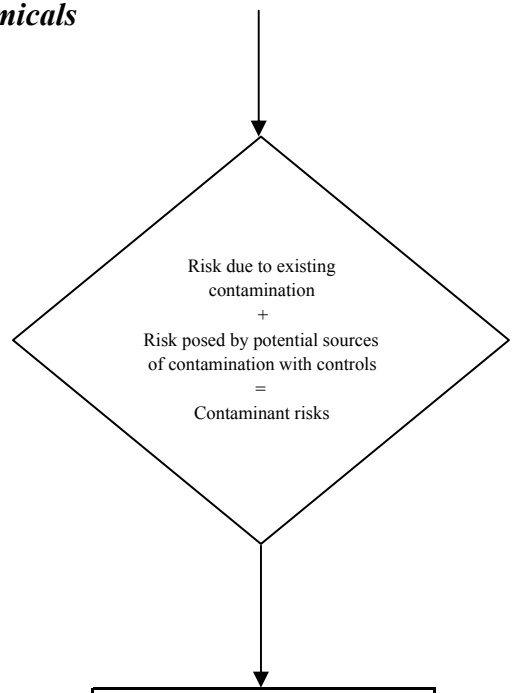
	LOW 10 pts	**MEDIUM** 20 pts	**HIGH** 30 pts	**VERY HIGH** 40 pts
LOW	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	----
MEDIUM	----	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
HIGH	----	----	≥ 1 source + 10 pts	≥ 2 sources + 10 pts
VERY HIGH	----	----	----	≥ 1 source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

Matrix Score 10

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

Chart 11. Contaminant risks for Badger Mobile Home Park - Synthetic Organic Chemicals





Existing
0 pts
+
Potential
10 pts
=
Contaminant Risk
10 pts

Contaminant risks*
= 10 pts

*Truncate risk at 50 pts

Low

Contaminant Risk Ratings

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

Chart 12. Vulnerability analysis for Badger Mobile Home Park - Synthetic Organic Chemicals

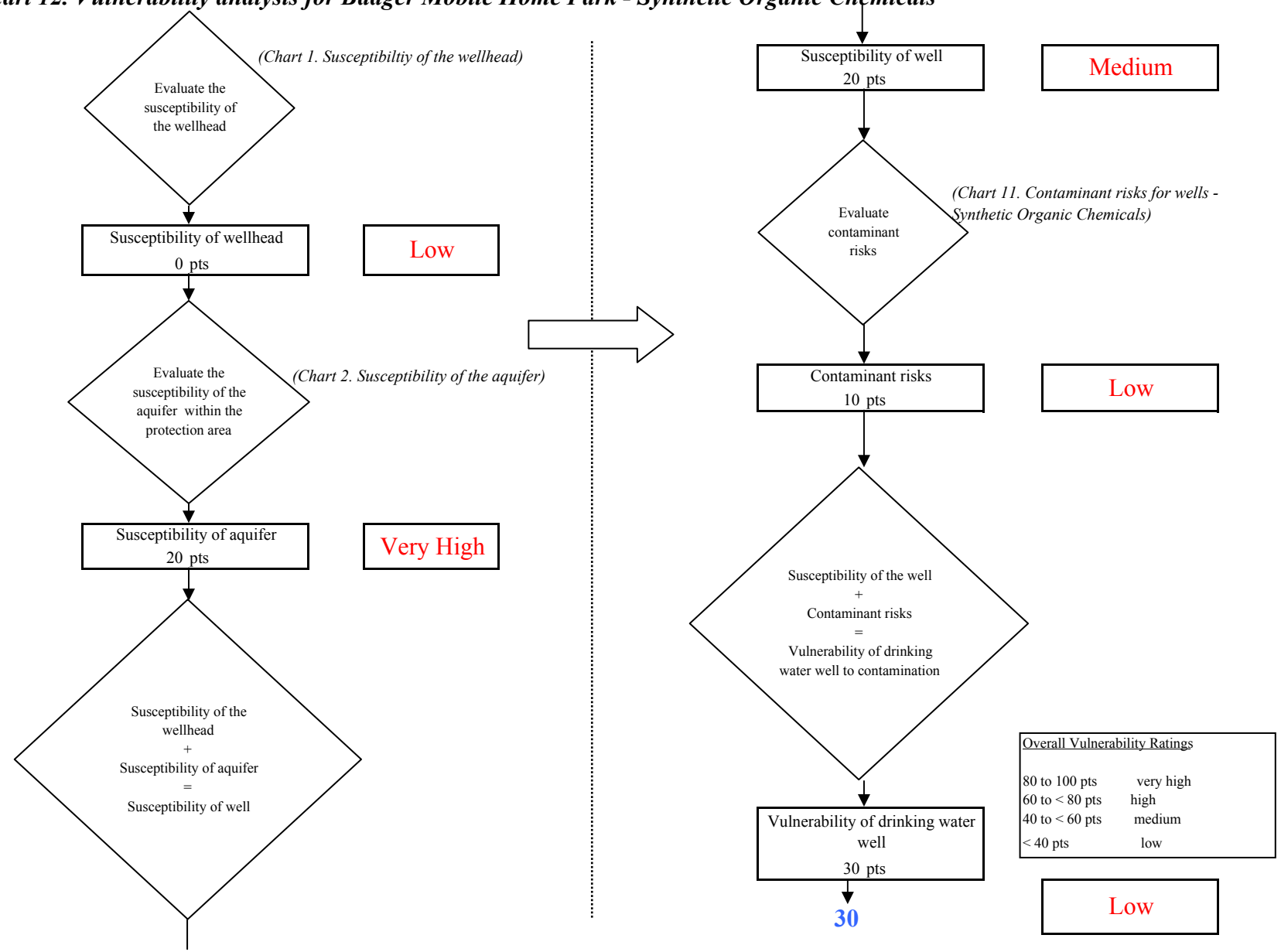


Chart 13. Contaminant risks for Badger Mobile Home Park - Other Organic Chemicals

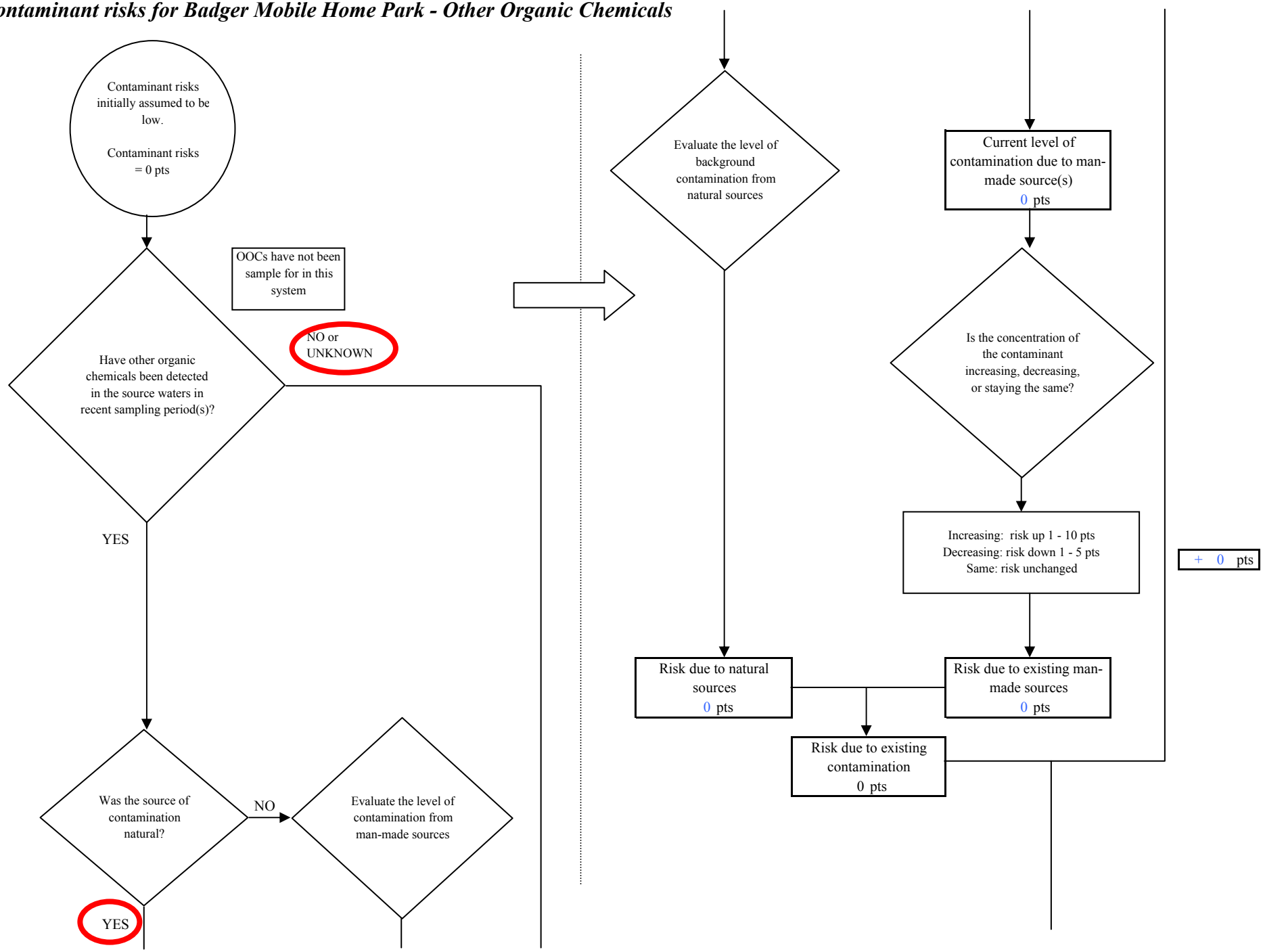


Chart 13. Contaminant risks for Badger Mobile Home Park - Other Organic Chemicals

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	1	1
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	3	6

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

Matrix Score 40

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

Initial assessment of risk posed by potential sources of contamination = 40 pts

Is the source aquifer fractured rock or karst?

YES

NO

Are all of the higher risk sources beyond Zones A and B?

NO

Risk unchanged

YES

Decrease risk 1 - 10 pts

- 0 pts

Are any significant sources within Zone A?

NO

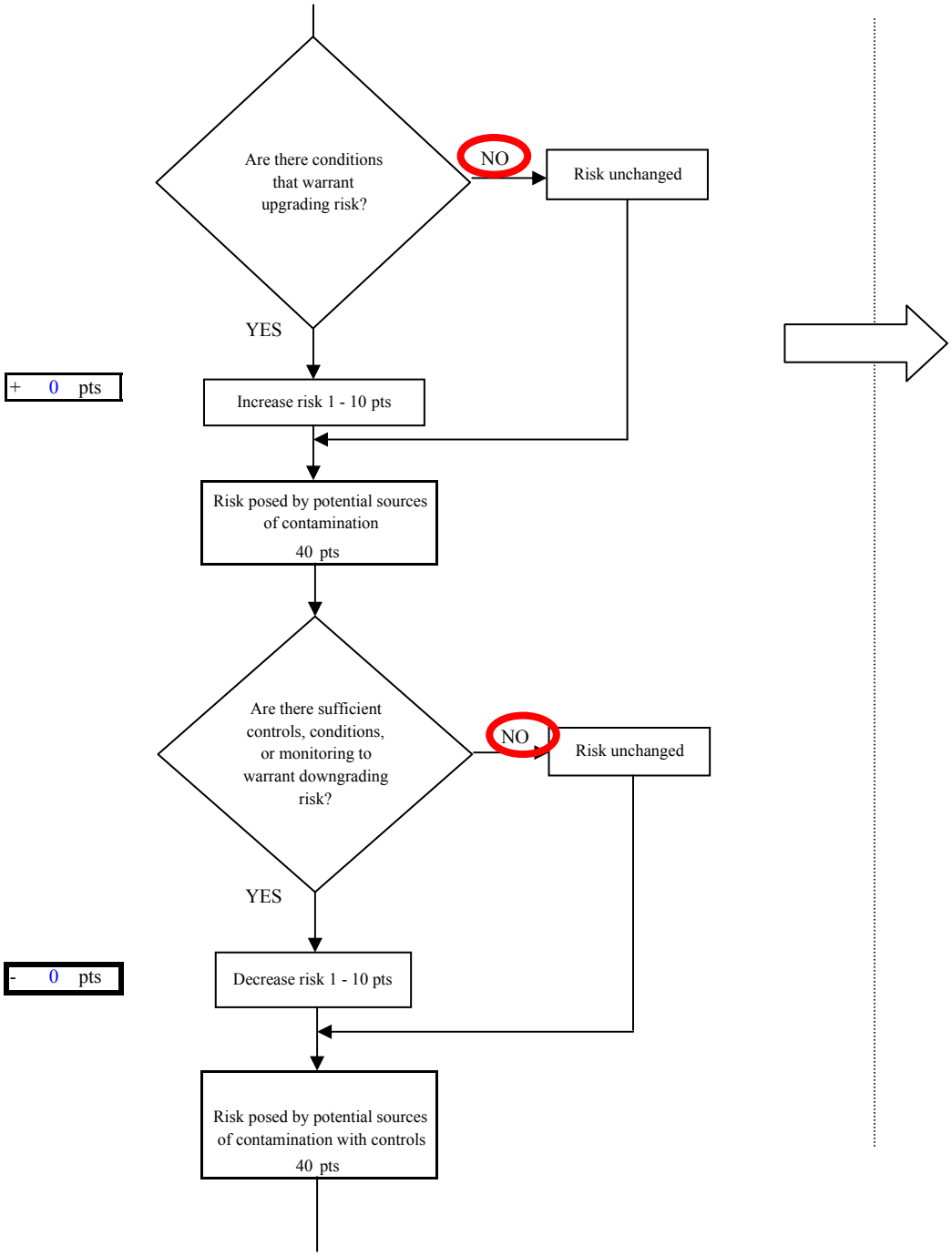
Risk unchanged

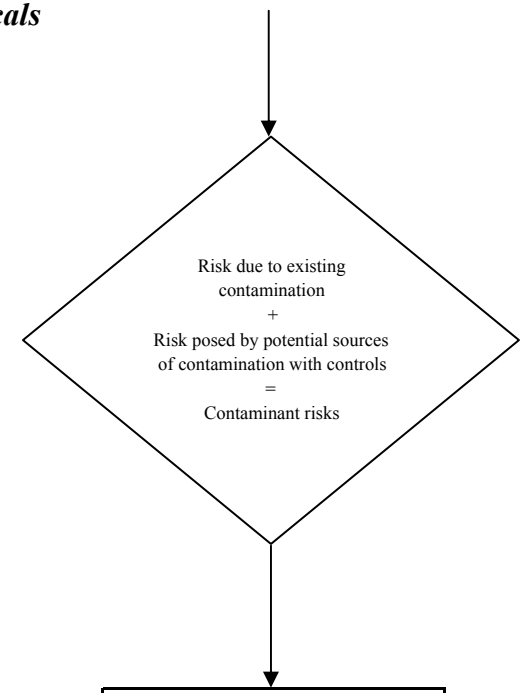
YES

Increase risk 1 - 10 pts

+ 0 pts

Chart 13. Contaminant risks for Badger Mobile Home Park - Other Organic Chemicals





Existing
0 pts
+
Potential
40 pts
=
Contaminant Risk
40 pts

Contaminant risks*
= 40 pts

*Truncate risk at 50 pts

Very High

Contaminant Risk Ratings

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

Chart 14. Vulnerability analysis for Badger Mobile Home Park - Other Organic Chemicals