Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Highland Correctional Center Drinking Water System, Eagle River, Alaska PWSID # 211083.001 and .002

DRINKING WATER PROTECTION PROGRAM REPORT #992

Alaska Department of Environmental Conservation

June, 2003

Source Water Assessment for Highland Correctional Center Drinking Water System
Eagle River, Alaska
PWSID# 211083.001 and .002

By Suzan J. Hill

DRINKING WATER PROTECTION PROGRAM REPORT 992

The Drinking Water Protection Program 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. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for Highland Correctional Center Source of Public Drinking Water,
Eagle River, Alaska

By Suzan J. Hill

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Highland Correctional Center is a Class A (community) water system consisting of two wells in the Eagle River, Alaska area. Identified potential and current sources of contaminants for Highland Correctional Center public drinking water source include an above ground diesel tank, large capacity and residential septic systems, municipal sewer lines, roads, and approximately 306 acres of residential area. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals and other organic chemicals. Overall, the public water source for Highland Correctional Center received a vulnerability rating of **High** for bacteria and viruses; and nitrates and nitrites, **Medium** for volatile organic chemicals and heavy metals, and **Low** for synthetic organic chemicals and other organic chemicals.

INTRODUCTION

The Alaska Department of Environmental Conservation (ADEC) is completing source water assessments for all public drinking water sources in the State of Alaska. The purpose of this 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. The results of this source water assessment can be used to decide where voluntary protection efforts are needed and feasible, and also what efforts will be most effective in reducing contaminant risks to your water system.

This source water assessment combines a review of the natural conditions at the site and the potential and existing contaminant risks. These are combined to determine the overall vulnerability of the drinking water source to contamination.

DESCRIPTION OF THE CHUGACH MOUNTAIN FRONT EAST OF ANCHORAGE

Location

Between the Chugach Mountain Front east of Anchorage and Knik Arm lie the communities of Eagle River, Chugiak, Peters Creek, and Eklutna. The Eagle River Valley is one of the largest valleys in the western Chugach Mountains. Eagle River and the neighboring communities are located in the Municipality of Anchorage Borough.

Glacial and alluvial forces have shaped the Eagle River Valley and Chugach Mountain front in this area. These forces have resulted in the U-shaped river valleys and moraine-mantled mountain flanks of the mountain front and lakes, streams and undulating ridges and hills of the glaciated lowlands extending to Knik Arm.

Precipitation

Eagle River averages between 20 and 25 inches of precipitation per year, including about 68 inches of snowfall.

Topography and Drainage

The area topography varies from sea level to about 400 feet in the area surrounding Knik Arm to several thousand feet on the surrounding ridges and mountain flanks.

Groundwater

Although the quality can vary significantly in a short distance, groundwater supplies are generally abundant in the area, except for some reported well failures that have occurred within the city limits of Eagle River. Groundwater occurs within both confined and unconfined aquifers and from both unconsolidated and bedrock aquifers. Many homes and businesses in the

area rely on individual wells for their water supply. Most of these wells are shallow with depths of less than 100 feet to 200 feet. Static water levels in many of these wells are less than 15 feet below the surface.

Geology and Soils

Most of the soils in the area provide good sources of sand, gravel and topsoil. The deposition of silt, clay and organic muck in old lakes, oxbows and depressions means that some areas have soil conditions that vary over relatively short distances.

HIGHLAND CORRECTIONAL CENTER PUBLIC DRINKING WATER SYSTEM

Highland Correctional Center is a Class A (community) water system. The system consists of two wells and is located at Mile 9.5 New Glenn Highway. (See Map 1 of Appendix A). This area is at an elevation of approximately 425 feet above sea level.

The primary well is Well #2. According to the Well Log for Well #2, there is sandy gravel from 0 to 5 feet; boulders from 5 to 7 feet; silty gravel from 7 to 14 feet; sandy gravel from 14 to 22 feet; medium gravel and water from 22 to 28 feet; silty cobble gravel from 28 to 29 feet; small gravel from 29 to 34 feet; and brown clay from 34 feet to a total well depth of 75 feet. The well was drilled on 10/14/72 and had a static water level of 6 feet.

The secondary well is Well #1A. According to the Well Log for Well #1A, there is rocks and gravel from 0 to 10 feet; large rocks from 10 to 20 feet; rock mixed with clay from 20 to 25 feet; water bearing and gravel from 25 to 32 feet; dark gray clay from 32 to 40 feet; dark sand from 40 to 41 feet; and bedrock from 41 feet to a total depth of 45 feet. The date of drilling is unknown. The static water level was 18 feet.

Well #1 was abandoned as a dry hole and the 8" casing was capped on 10/11/72.

The last Sanitary Survey conducted was 12/22/98, however a copy could not be found in ADEC records. Earlier Sanitary Surveys indicated that the wells were installed with a cap providing a sanitary seal. A properly installed sanitary seal may provide protection against contaminants from entering the source waters at the well casing. The land surface is also appropriately sloped away from the wells providing adequate surface water drainage. The wells are not grouted according to ADEC regulations. Proper grouting provides added protection against contaminants travelling along the well casing and into source waters.

This system operates year-round and serves 285 residents and 100 non-residents through 5 service connections.

HIGHLAND CORRECTIONAL CENTER WELL DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. Some areas are more likely to allow contamination to reach the well than others. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater recharge area. This area is designated as the Drinking Water Protection Area (DWPA). Because releases of contaminants within the DWPA are most likely to impact the drinking water well, this area will serve as the focus for voluntary protection efforts. (Please refer to the Guidance Manual for Class A Public Water Systems for additional information).

The DWPA's established for wells by the ADEC are separated into four zones. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the DWPA. 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), and State of Alaska Department of Water Resources (Jokela et. al., 1991).

The time of travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the four DWPA zones and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	¼ the distance for the 2-yr. TOT
B	Less than the 2 year TOT
C	Less Than the 5 year TOT
D	Less than the 10 year TOT

As an example, water moving through the aquifer in Zone B will reach the well in less than 2 years from the time it crosses the outer limit of Zone B.

Zone A also incorporates the area down-gradient from the well to take into account the area of the aquifer that is influenced by pumping of the well. Water within the aquifer in Zone A will reach the well in several hours to several months.

The DWPA for the Highland Correctional Center contain three zones: Zone A, Zone B, Zone C, and Zone D (see Map 1 in Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Highland Correctional Center DWPA. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

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

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

The sources are displayed on Maps 2 and 3 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source.

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

VULNERABILITY OF HIGHLAND CORRECTIONAL CENTER DRINKING WATER SOURCE

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 has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

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

A score for the 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)

The well for Highland Correctional Center is completed in a confined aquifer setting. The aquifer that is utilized by the well is protected from surface contamination by approximately 41 feet of relatively impermeable clay. Table 2 shows the Susceptibility scores and ratings for Highland Correctional Center.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	18	High
Natural Susceptibility	23	Medium

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. This data has been derived from an examination of existing and historical contamination that has been detected at the drinking water source

through routine sampling. It also evaluates potential sources of contamination. Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	30	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	22	Medium
Synthetic Organic Chemicals	12	Low
Other Organic Chemicals	12	Low

Appendix D contains fourteen charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 14 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, synthetic organic chemicals, and other organic chemicals, respectively.

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	75	High
Nitrates and Nitrites	75	High
Volatile Organic Chemicals	55	Medium
Heavy Metals, Cyanide and Other Inorganic Chemicals	45	Medium
Synthetic Organic Chemicals	35	Low
Other Organic Chemicals	35	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is very high with large capacity and residential septic systems in Zones A and B presenting the most significant risk to the drinking water well (See Chart 3 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Recent sampling of Highland Correctional Center shows no detection of Bacteria and Viruses. After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is High.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is very high with large capacity and residential septic systems in Zones A and B posing the most significant contaminant risk to this source of public drinking water (See Chart 5 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Nitrates are very mobile, moving at approximately the same rate as water.

Sampling history for Highland Correctional Center well indicates that low concentrations of nitrate have been detected. At the latest sampling period, a low concentration of nitrate and/or nitrite was detected at 0.621 mg/L or 6% of the Maximum Contaminant Level (MCL) of 10mg/L. The 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.

It is unknown how much of the existing nitrate concentration can be attributed to natural or human-made sources. Nitrate concentrations in uncontaminated groundwater are typically less than 2 milligrams per liter (mg/L) and are derived primarily from the decomposition of organic matter in soils [Wang, Strelakos, Jokela, 2000].

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 High.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is high with an above ground diesel fuel tank presenting the most significant risk to the drinking water well (See Chart 7 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). Recent sampling history of Highland Correctional Center did not detect any chemicals in the Volatile Organic Chemicals category. 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 Medium.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The contaminant risk for heavy metals is medium with no contaminant sources posing significant risk to the drinking water well (See Chart 9 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D). Monitoring samples analyzing chemicals within the Heavy Metals, Cyanide and Other Inorganic Chemicals collected on 6/28/02 showed very small amounts of Barium, well below the MCL.

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 contaminant risk for synthetic organic chemicals is low with no contaminant sources posing significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to synthetic organic chemicals of the well is Low.

Other Organic Chemicals

The contaminant risk for other organic chemicals is low with no contaminant sources posing a significant risk. After combining the contaminant risk with the natural susceptibility of the well, the overall vulnerability to other organic chemicals of the well is Low.

There is no recent sampling history for contaminants within the synthetic organic chemicals or other organic chemicals categories for Highland Correctional Center' drinking water (See Charts 11 and 13 – Contaminant Risks for Synthetic Organic Chemicals and Other Organic Chemicals in Appendix D, respectively).

SUMMARY

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 Highland Correctional Center 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 Highland Correctional Center public drinking water source.

REFERENCES CITED

Munter, J.A., and Allely, R. D., 1992, Water-Supply Aquifers at Eagle River, Alaska: State of Alaska Division of Geological & Geophysical Surveys Professional Report 108.

Patrick, L.D., Brabets, T.P., and Glass, R.L., 1989, Simulation of ground-water flow at Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 88-4139, 41p.

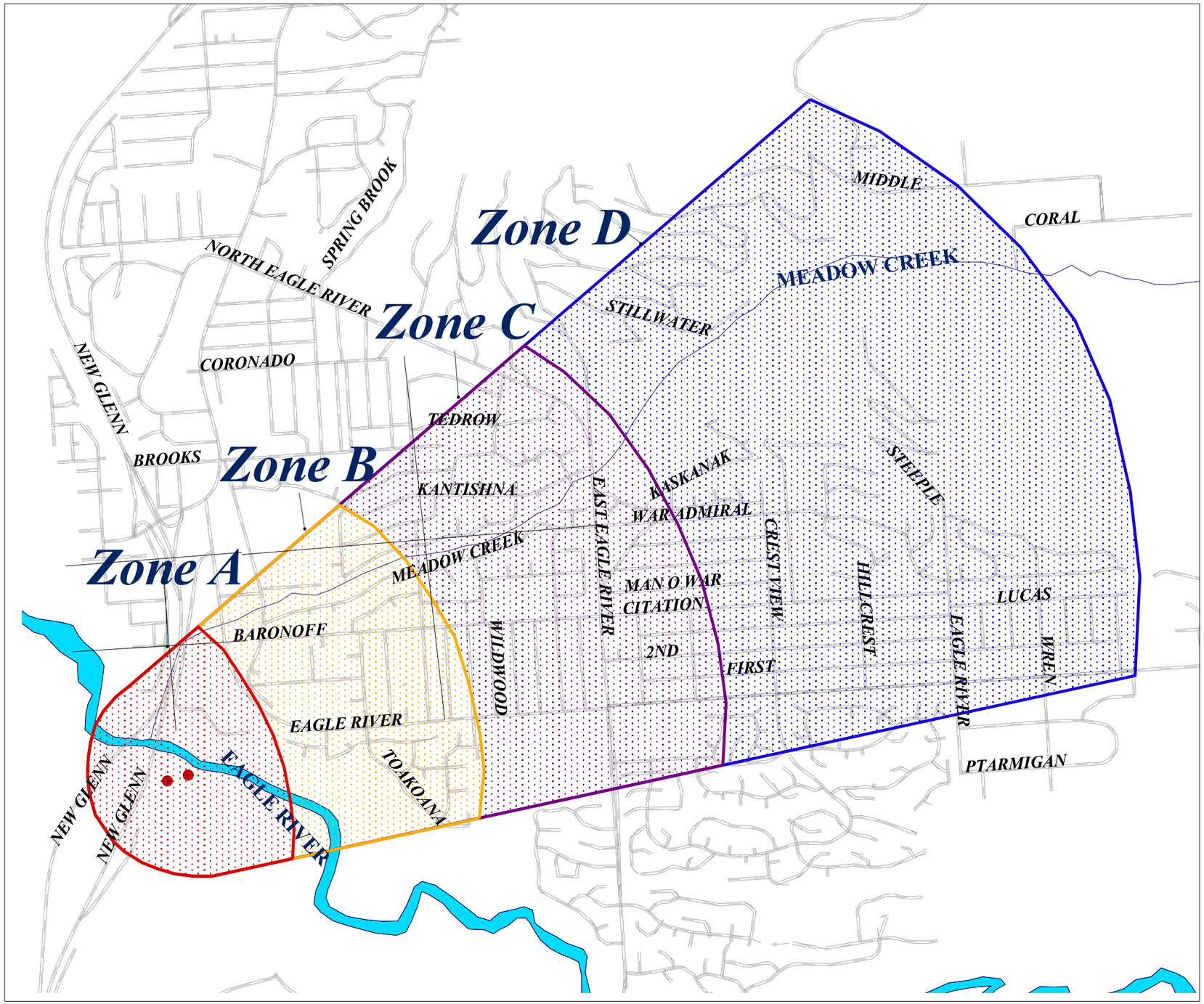
Wang, B., Strelakos, P.M., and Jokela, J.B., 2000, Nitrate source indicators in ground water of the scimitar subdivision, Peters Creek Area, Anchorage, Alaska: US Geological Survey Water-Resources Investigations Report 00-4137.

Weather Underground, June 18, 2002, Web extension to the *Western Regional Climate Center* [WWW document]. URL http://www.wunderground.com

APPENDIX A

Highland Correctional Center
Drinking Water Protection Area Location Map
(Map 1)

Hiland Correctional Center Protection Area Wells 1 and 2- #211083



800 0 800 1600 2400 3200 Yards

Legend

- Hiland Correctional Center Well Locations

Zone A
- Several Months Travel Time

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel

Zone D
- Less Than Ten Year Time of Travel
- Roads
- Rivers or Streams
- Lakes

N
W E
S

Map One

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Highland Correctional Center (Tables 1-7)

Table 1

Contaminant Source Inventory for
SOA Hiland Mountain Correctional

PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	2	
Tanks, diesel (above ground)	T06	T06-1	A	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	2	
Residential Areas	R01	R01-1	B	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4-19	B	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	3	
Residential Areas	R01	R01-2	C	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	3	
Highways and roads, paved (cement or asphalt)	X20	X20-20-38	C	3	

Table 2

Contaminant Source Inventory and Risk Ranking for SOA Hiland Mountain Correctional Sources of Bacteria and Viruses

PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Medium	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	Medium	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	High	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	High	2	
Residential Areas	R01	R01-1	B	Low	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4-19	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	Medium	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	High	3	
Residential Areas	R01	R01-2	C	Low	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-20-38	C	Low	3	

Table 3

Contaminant Source Inventory and Risk Ranking for SOA Hiland Mountain Correctional Sources of Nitrates/Nitrites

PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Medium	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	High	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	Medium	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	High	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	High	2	
Residential Areas	R01	R01-1	B	Low	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4-19	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	Medium	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	High	3	
Residential Areas	R01	R01-2	C	Low	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-20-38	C	Low	3	

Table 4

Contaminant Source Inventory and Risk Ranking for SOA Hiland Mountain Correctional Sources of Volatile Organic Chemicals

PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	Low	2	
Tanks, diesel (above ground)	T06	T06-1	A	Medium	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low	2	
Residential Areas	R01	R01-1	B	Low	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4-19	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	Low	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	Low	3	
Residential Areas	R01	R01-2	C	Low	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-20-38	C	Low	3	

Table 5

Contaminant Source Inventory and Risk Ranking for SOA Hiland Mountain Correctional Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low	2	
Residential Areas	R01	R01-1	B	Low	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4-19	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	Low	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	Low	3	
Residential Areas	R01	R01-2	C	Low	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-20-38	C	Low	3	

Table 6

Contaminant Source Inventory and Risk Ranking for SOA Hiland Mountain Correctional Sources of Synthetic Organic Chemicals

PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low	2	
Residential Areas	R01	R01-1	B	Low	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	Low	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	Low	3	
Residential Areas	R01	R01-2	C	Low	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	Low	3	

Table 7

Contaminant Source Inventory and Risk Ranking for SOA Hiland Mountain Correctional Sources of Other Organic Chemicals

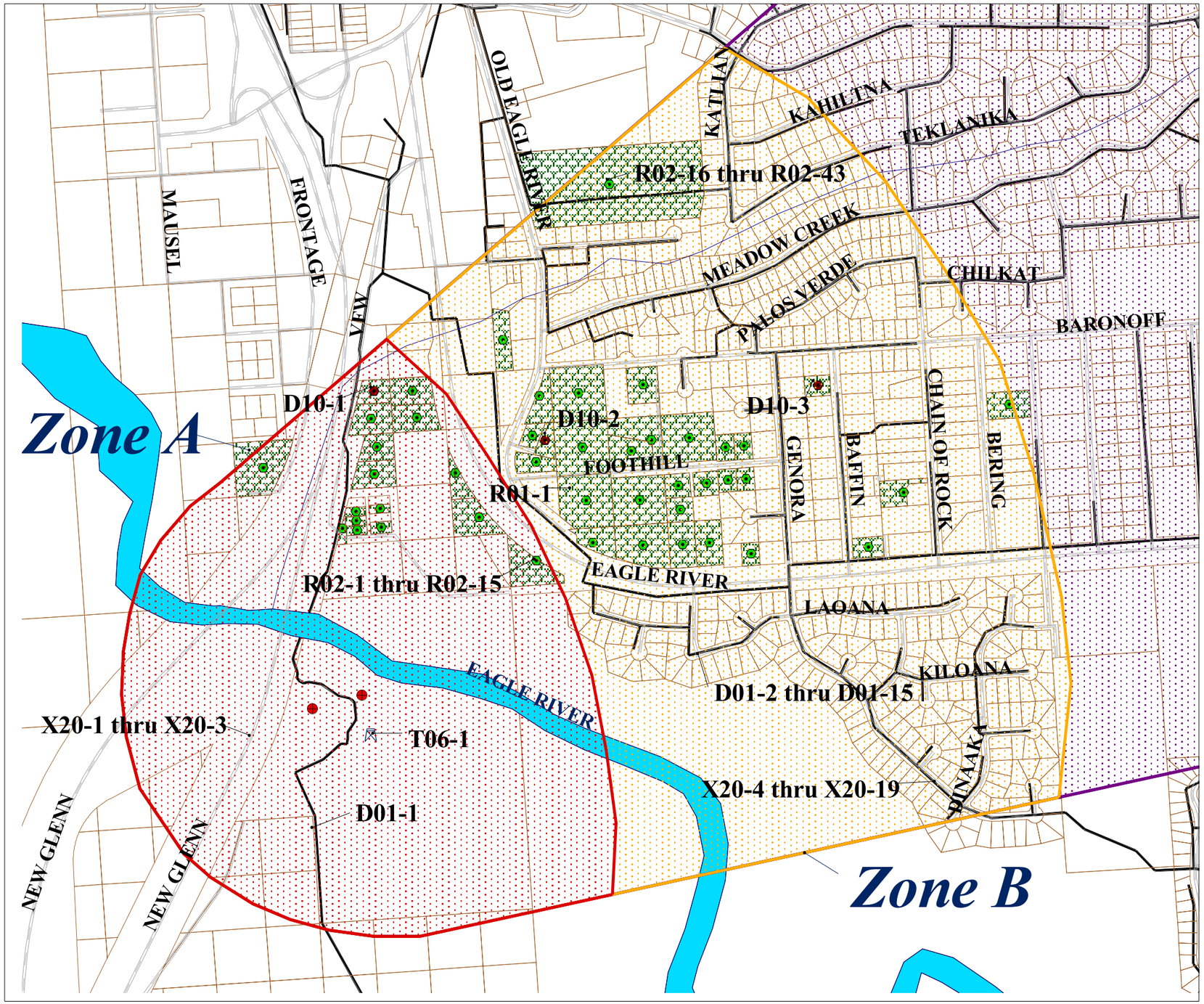
PWSID 211083.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-1	A	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	A	Low	2	
Septic systems (serves one single-family home)	R02	R02-1-15	A	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-2-15	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-2	B	Low	2	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low	2	
Residential Areas	R01	R01-1	B	Low	2	102 Acres
Septic systems (serves one single-family home)	R02	R02-16-43	B	Low	2	
Highways and roads, paved (cement or asphalt)	X20	X20-4-19	B	Low	2	
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-16-25	C	Low	3	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-4	C	Low	3	
Residential Areas	R01	R01-2	C	Low	3	204 Acres
Septic systems (serves one single-family home)	R02	R02-44-138	C	Low	3	
Highways and roads, paved (cement or asphalt)	X20	X20-20-38	C	Low	3	

APPENDIX C

Highland Correctional Center
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Maps 2-3)

Hiland Correctional Center Existing and Potential Contaminant Sources



Legend

- Hiland Correctional Center Well Locations

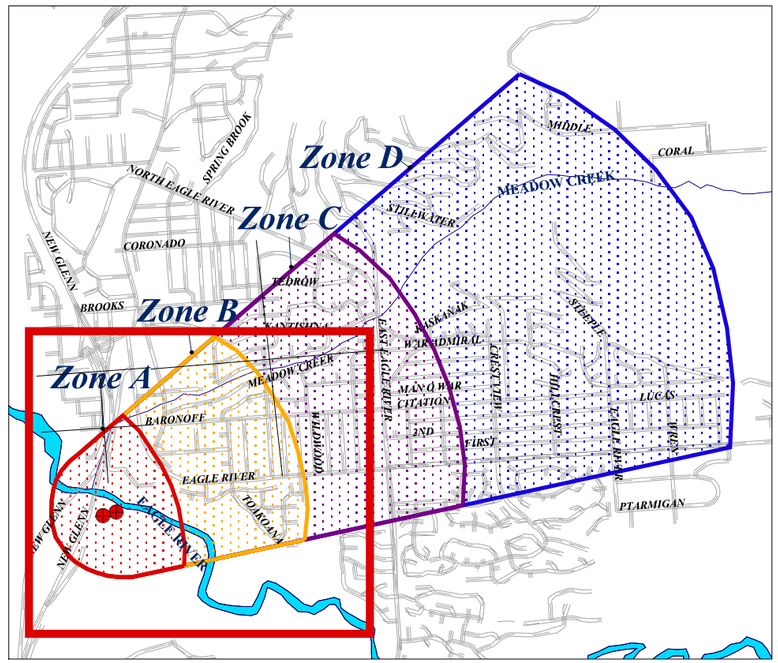
Zone A
- Several Months Travel Time

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel

Zone D
- Less Than Ten Year Time of Travel
- Roads (X20)
- Rivers or Streams
- Lakes
- Land Parcels
- Sewer Lines (D01)
- Diesel Fuel Tank (T06)

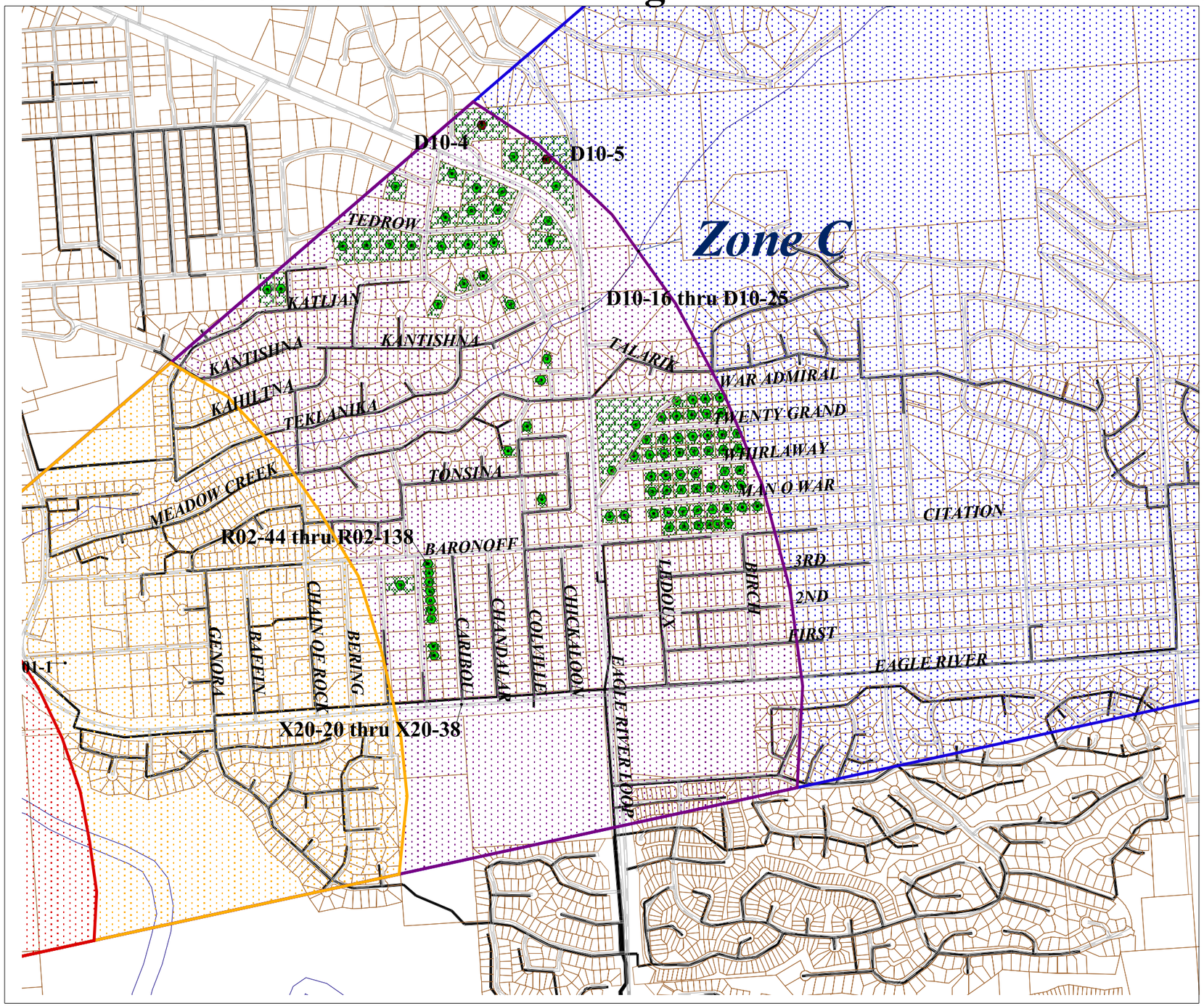
Septic Systems
- Large Capacity Septic Systems (D10)
- Residential Septic Systems (R02)
- Residential Areas (R01)



N W E S

Map Two

Hiland Correction Center Existing and Potential Contaminant Sources



Legend

- Hiland Correctional Center Well Locations

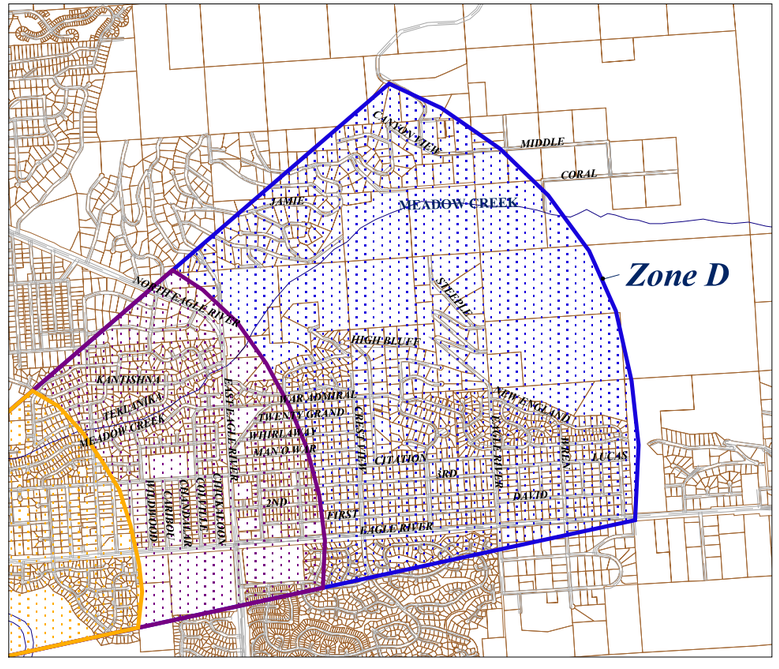
Zone A
- Several Months Travel Time

Zone B
- Less Than Two Years Time of Travel

Zone C
- Less Than Five Years Time of Travel

Zone D
- Less Than Ten Year Time of Travel
- Rivers or Streams
- Land Parcels
- Roads (X20)
- Sewer Lines (D01)
- Residential Areas (R01)

Septic Systems
- Large Capacity Septic Systems (D10)
- Residential Septic Systems (R02)



N
W E
S

Map Three

APPENDIX D

Vulnerability Analysis for Highland Correctional Center Public Drinking Water Source

(Charts 1-14)

Chart 1. Susceptibility of the wellhead - Hiland Correctional Center

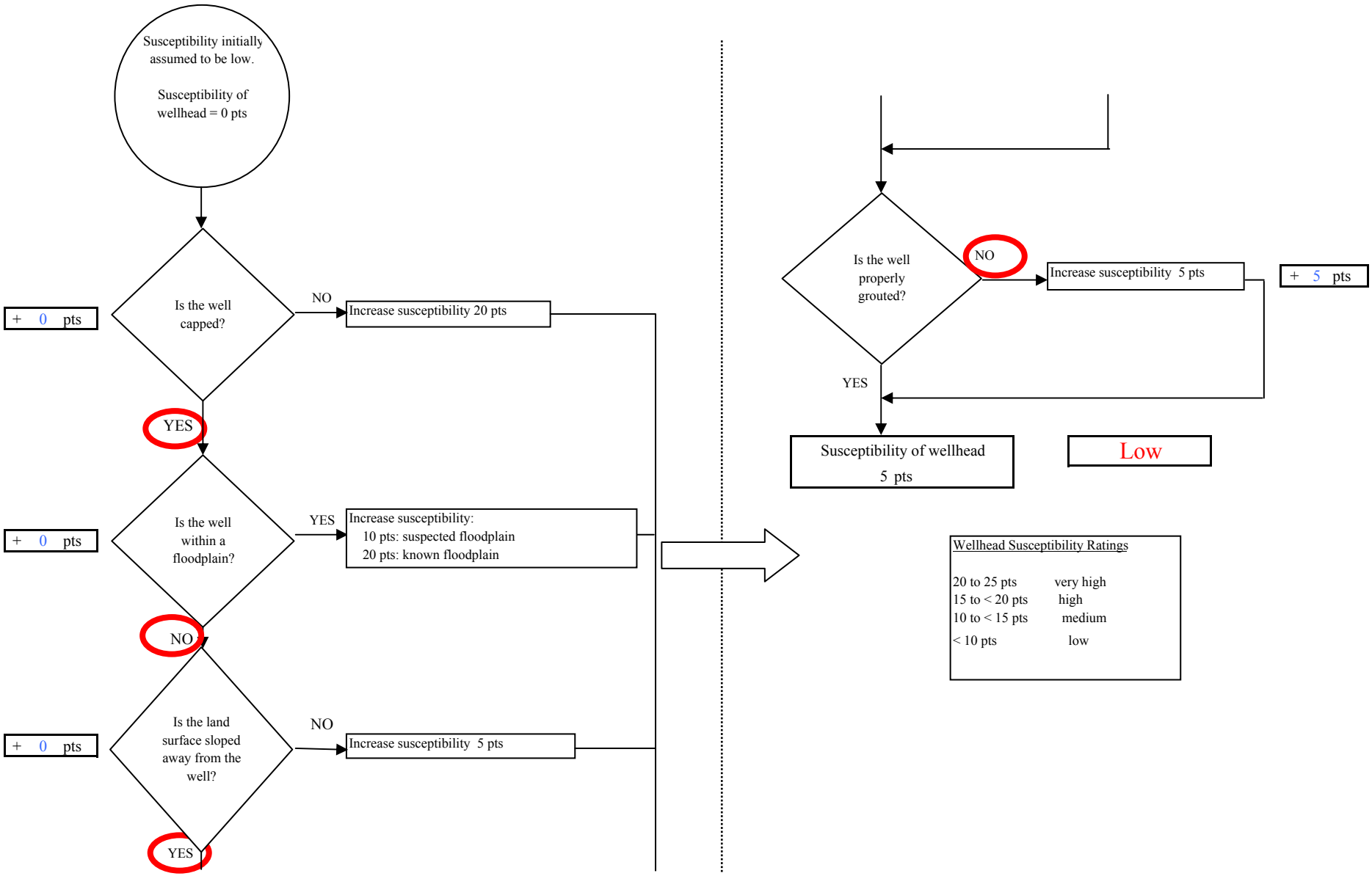


Chart 2. Susceptibility of the aquifer - Hiland Correctional Center

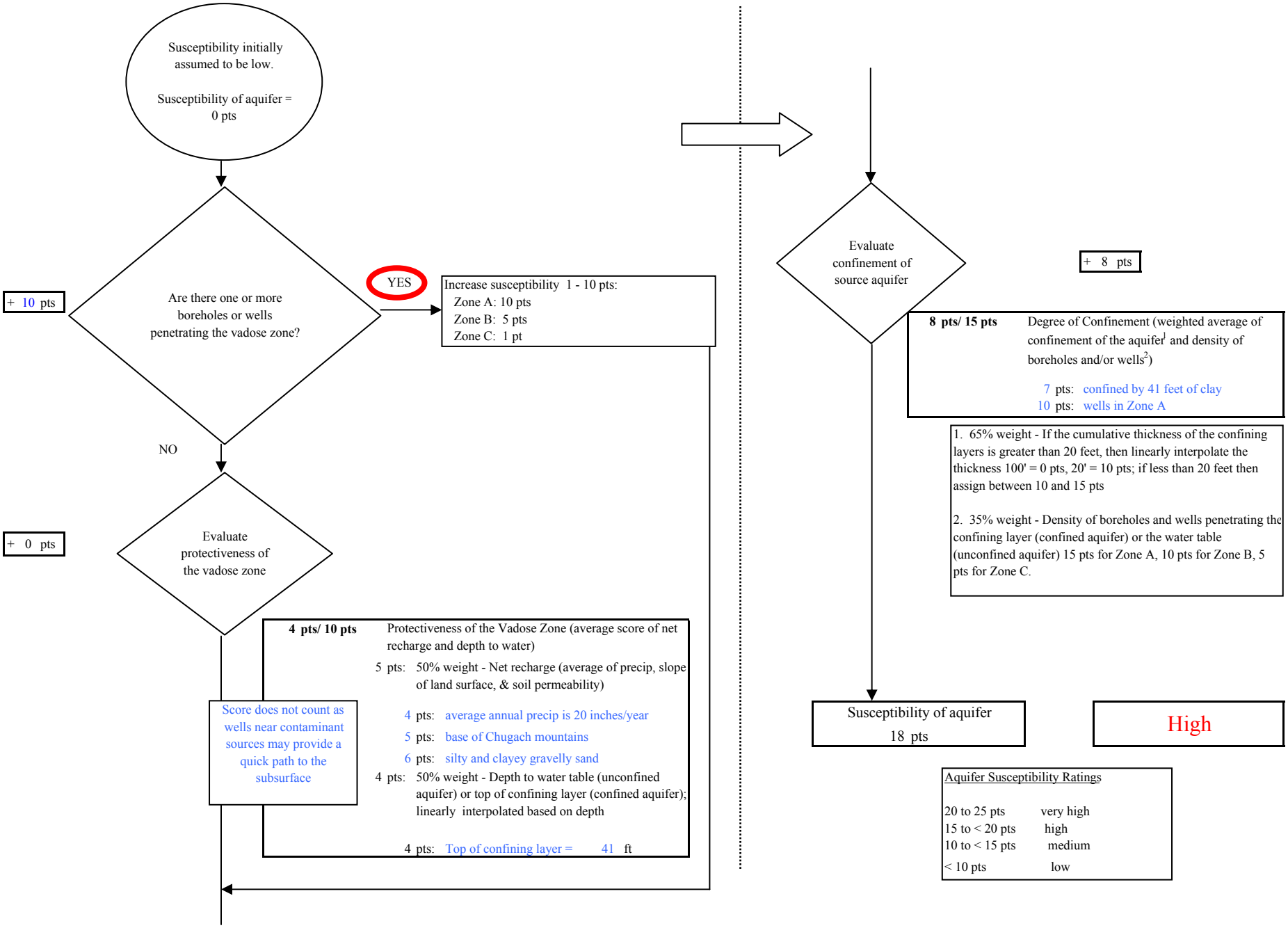
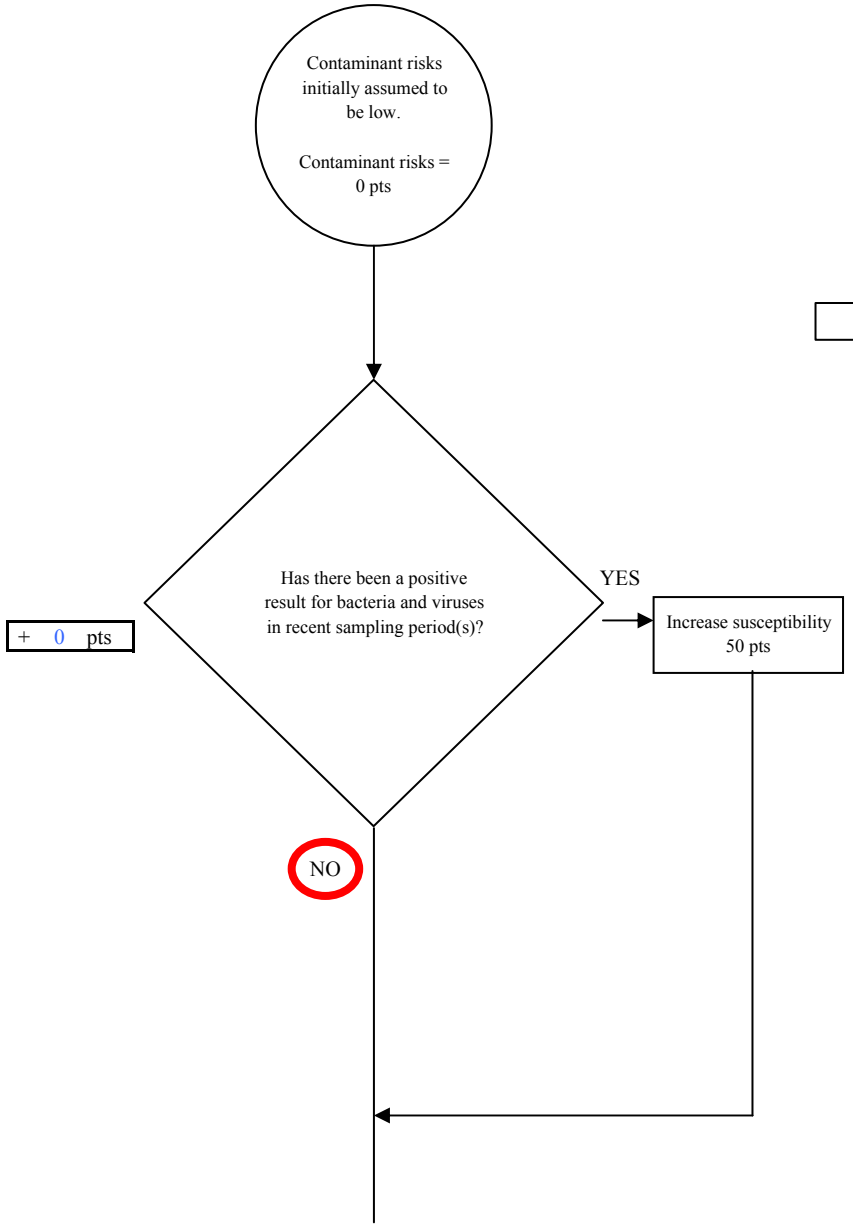
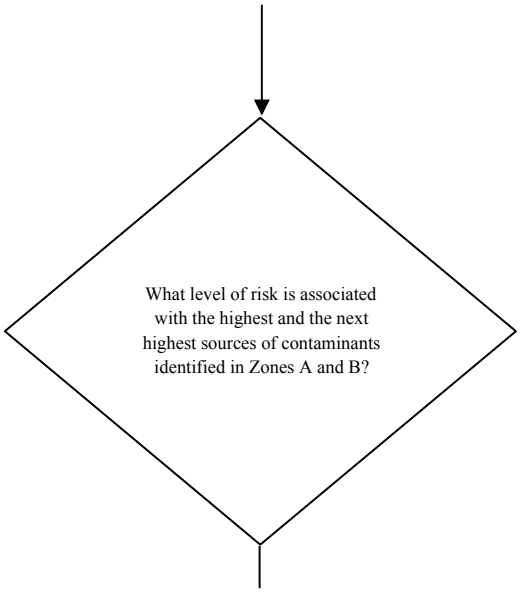


Chart 3. Contaminant risks for Hiland Correctional Center - Bacteria & Viruses





+ 40 pts

Risk Rankings for Contaminant Sources Identified in Zones A and B

	Zone A	Zone B	Total
Very Highs(s)	0	0	0
High(s)	1	2	3
Medium(s)	1	0	1
Low(s)	16	8	24

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

Matrix Score 40

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

Chart 3. Contaminant risks for Hiland Correctional Center - Bacteria & Viruses

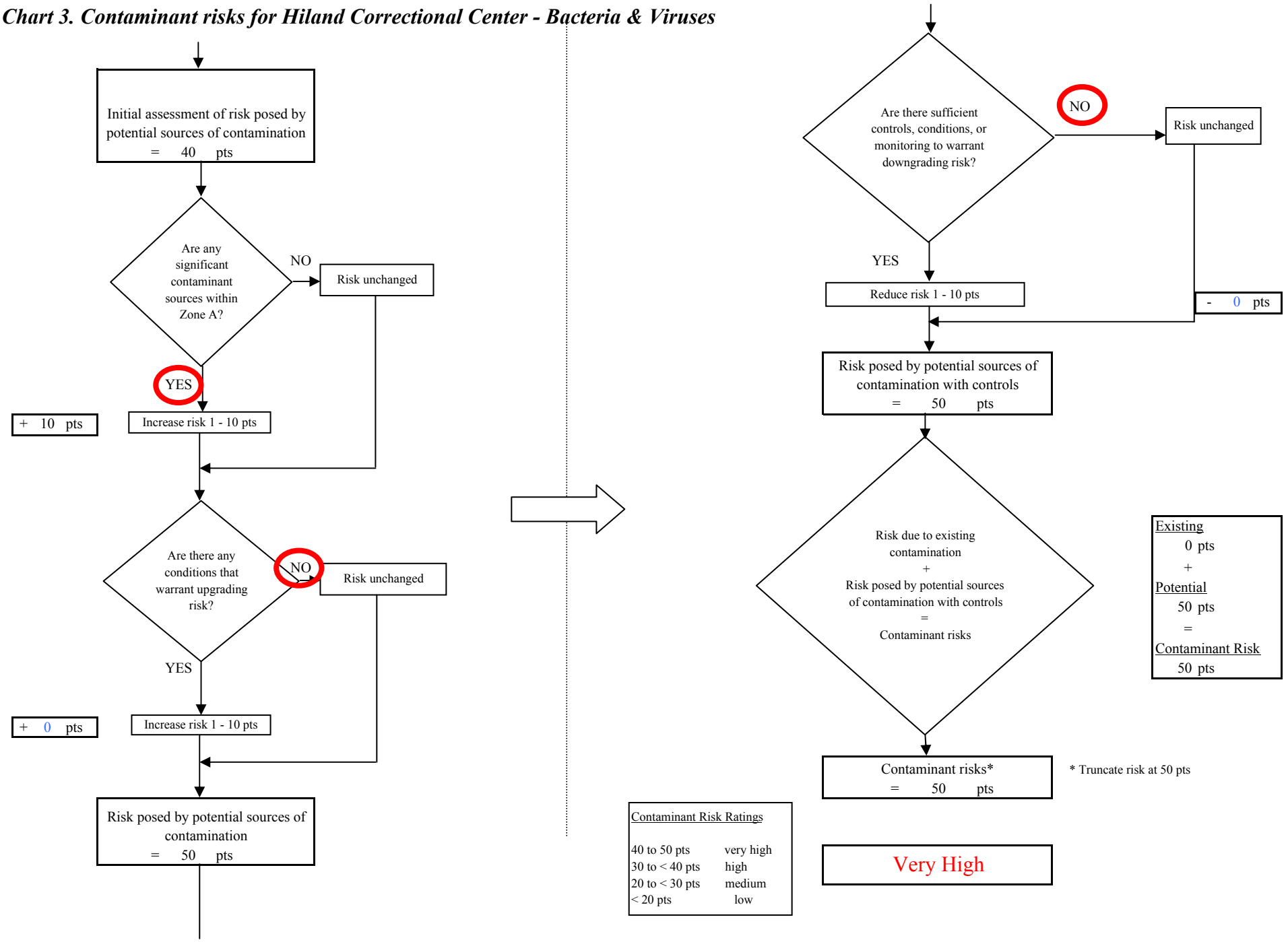


Chart 4. Vulnerability analysis for Hiland Correctional Center - Bacteria & Viruses

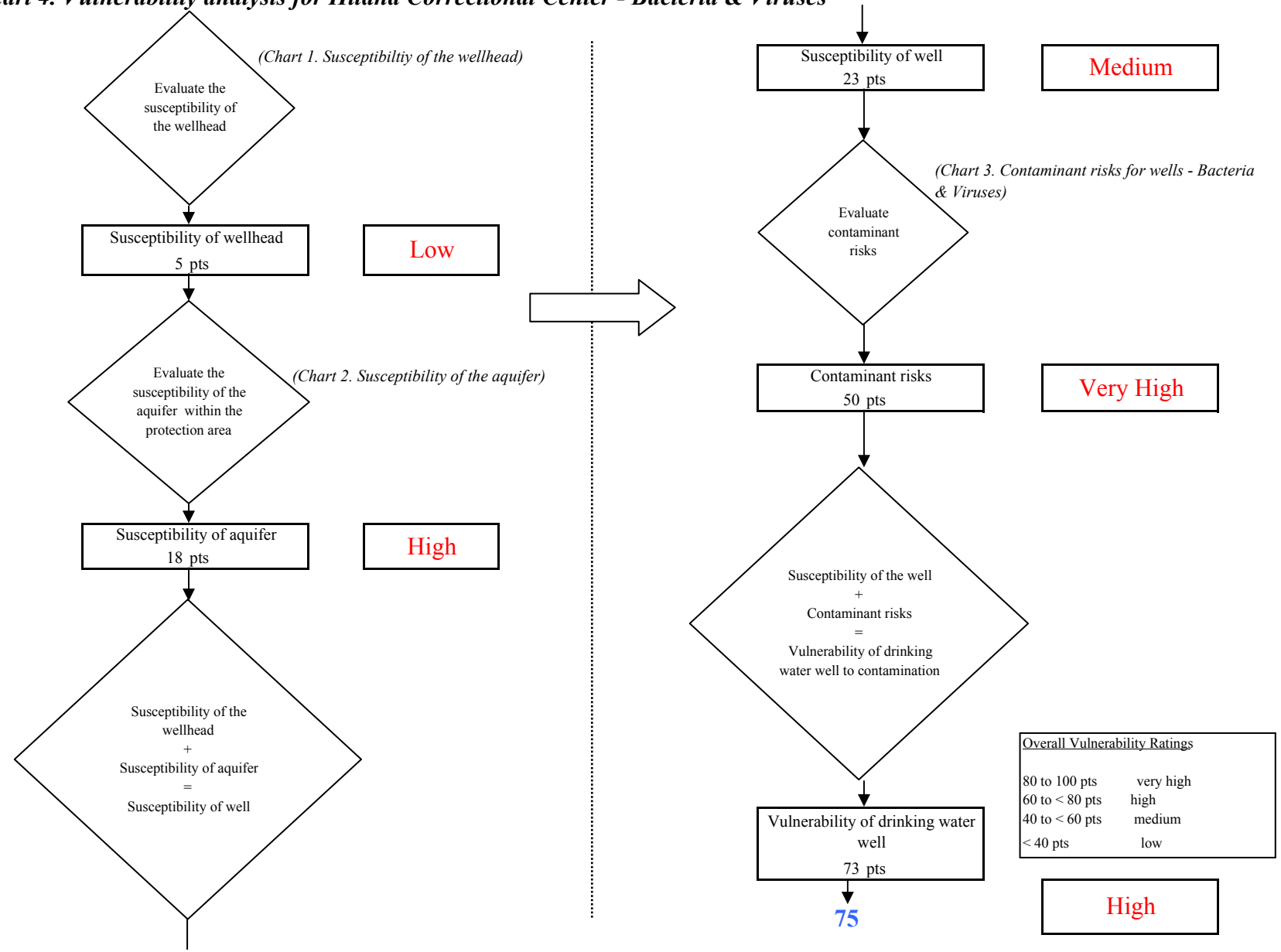


Chart 5. Contaminant risks for Hiland Correctional Center - Nitrates and Nitrites

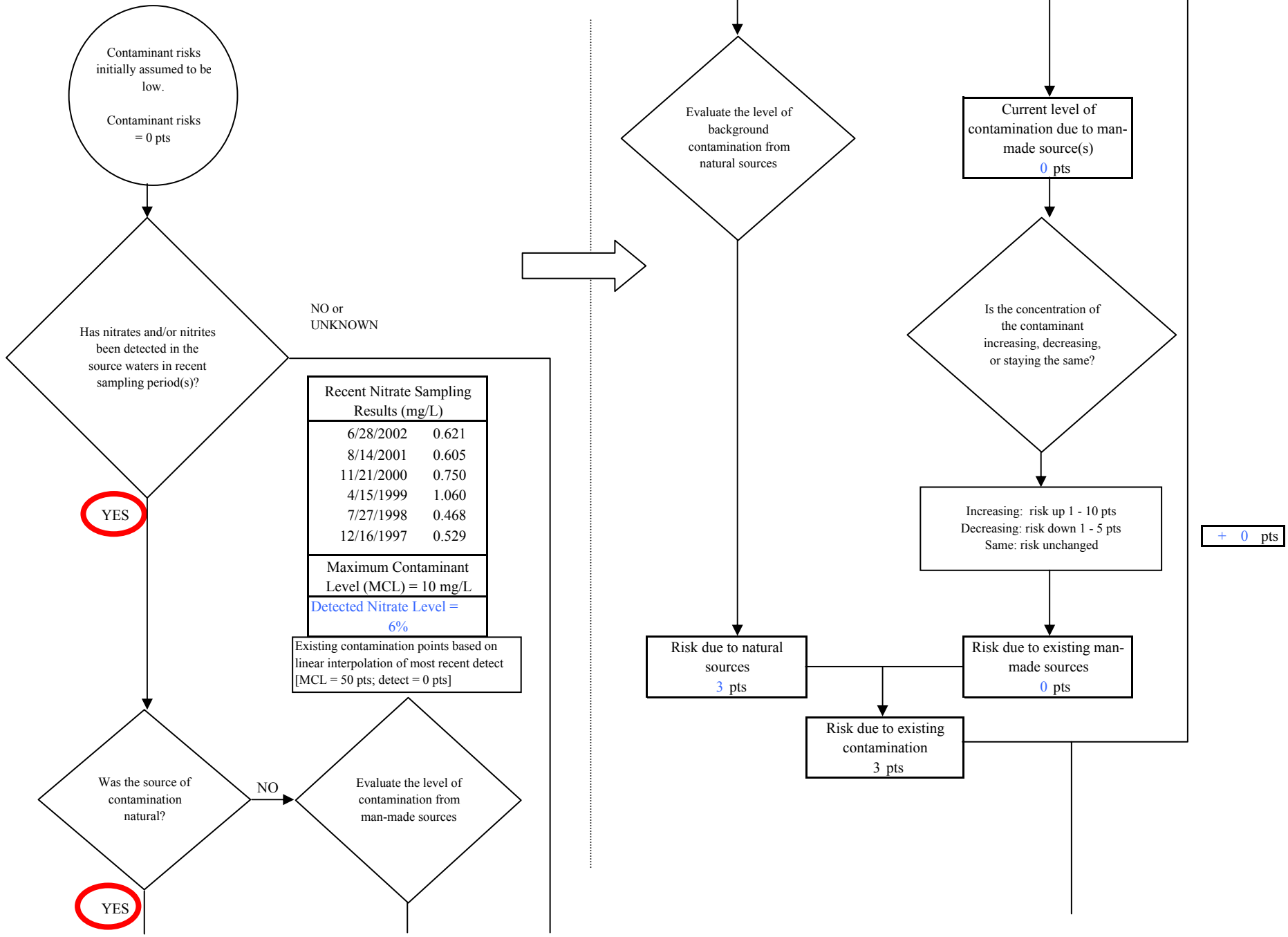


Chart 5. Contaminant risks for Hiland Correctional Center - Nitrates and Nitrites

+ 40 pts

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

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

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	1	3	4
Medium(s)	1	0	1
Low(s)	16	21	37

	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

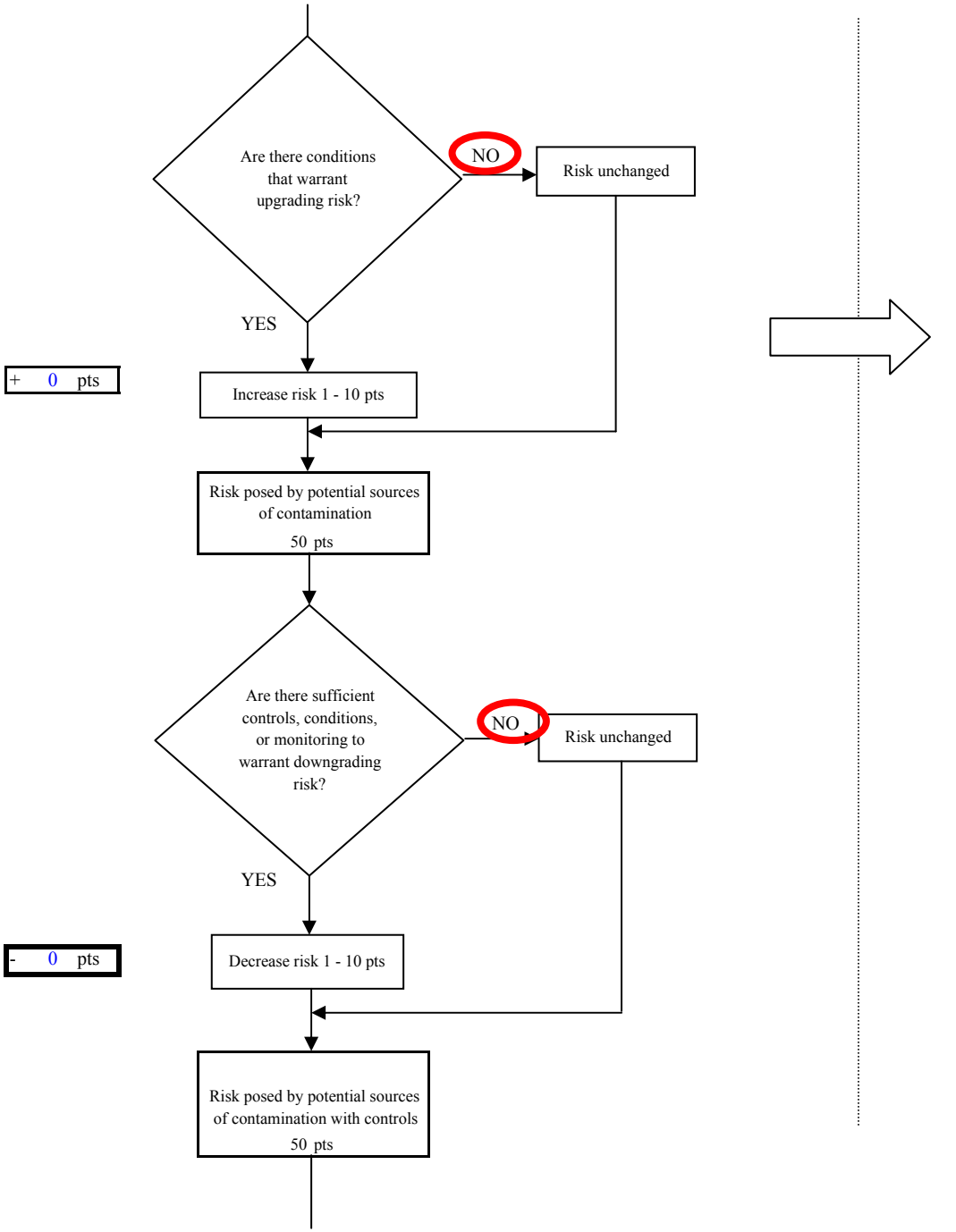
Risk unchanged

YES

Increase risk 1 - 10 pts

+ 10 pts

Chart 5. Contaminant risks for Hiland Correctional Center - Nitrates and Nitrites



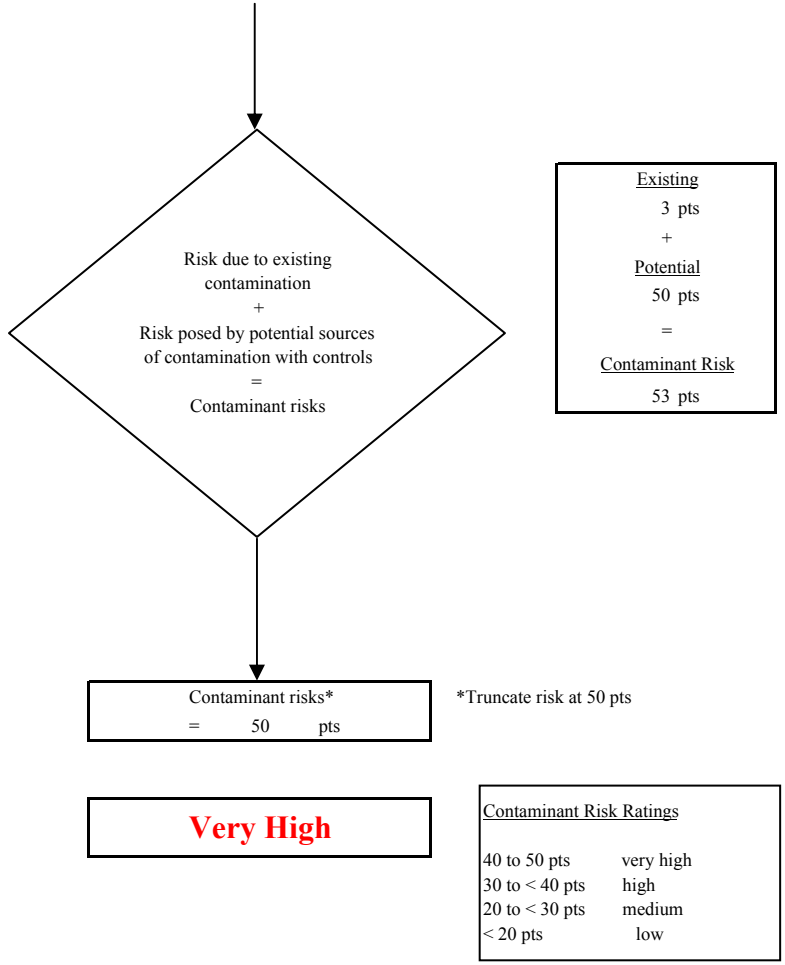


Chart 6. Vulnerability analysis for Hiland Correctional Center - Nitrates and Nitrites

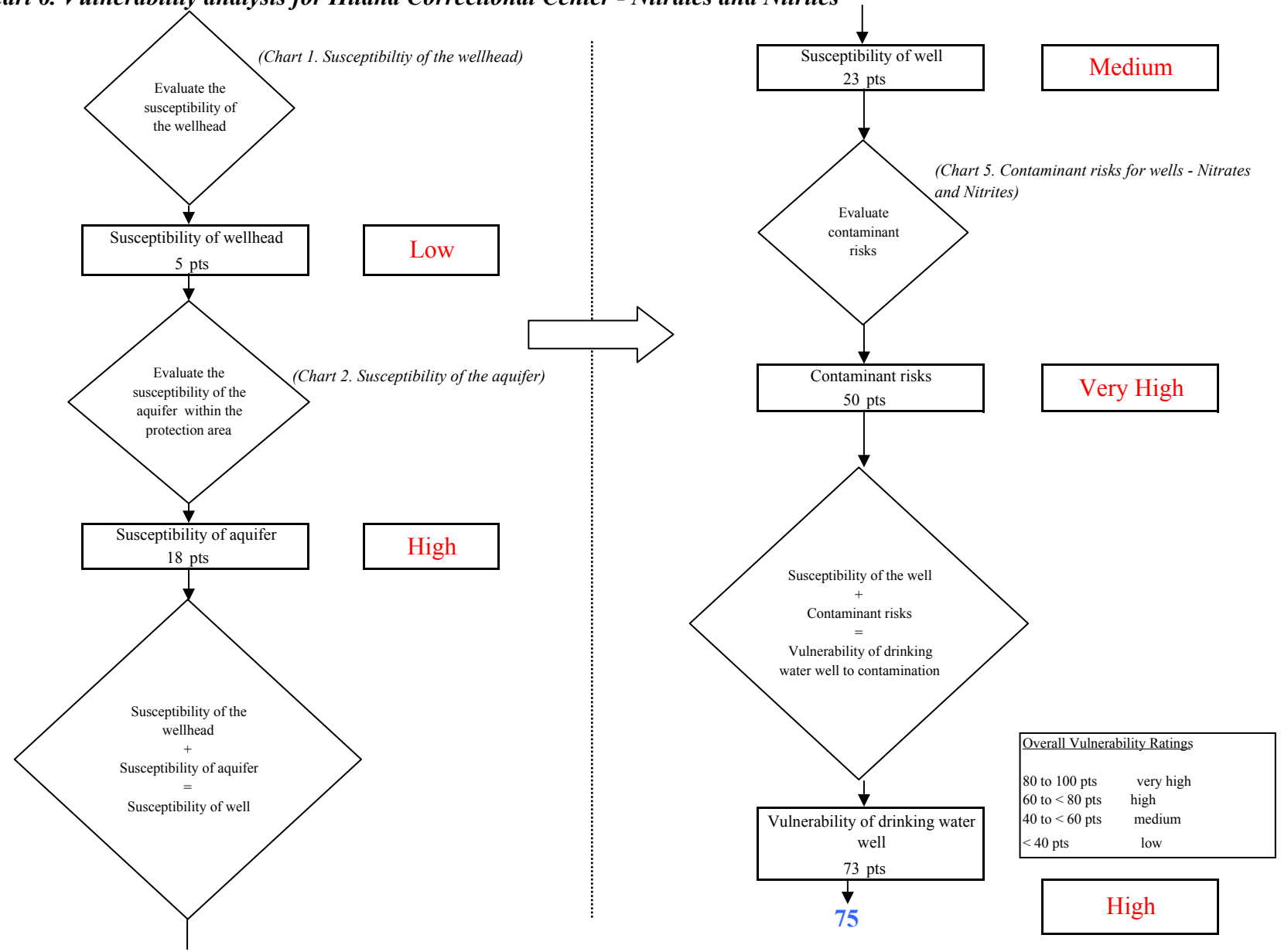


Chart 7. Contaminant risks for Hiland Correctional Center - Volatile Organic Chemicals

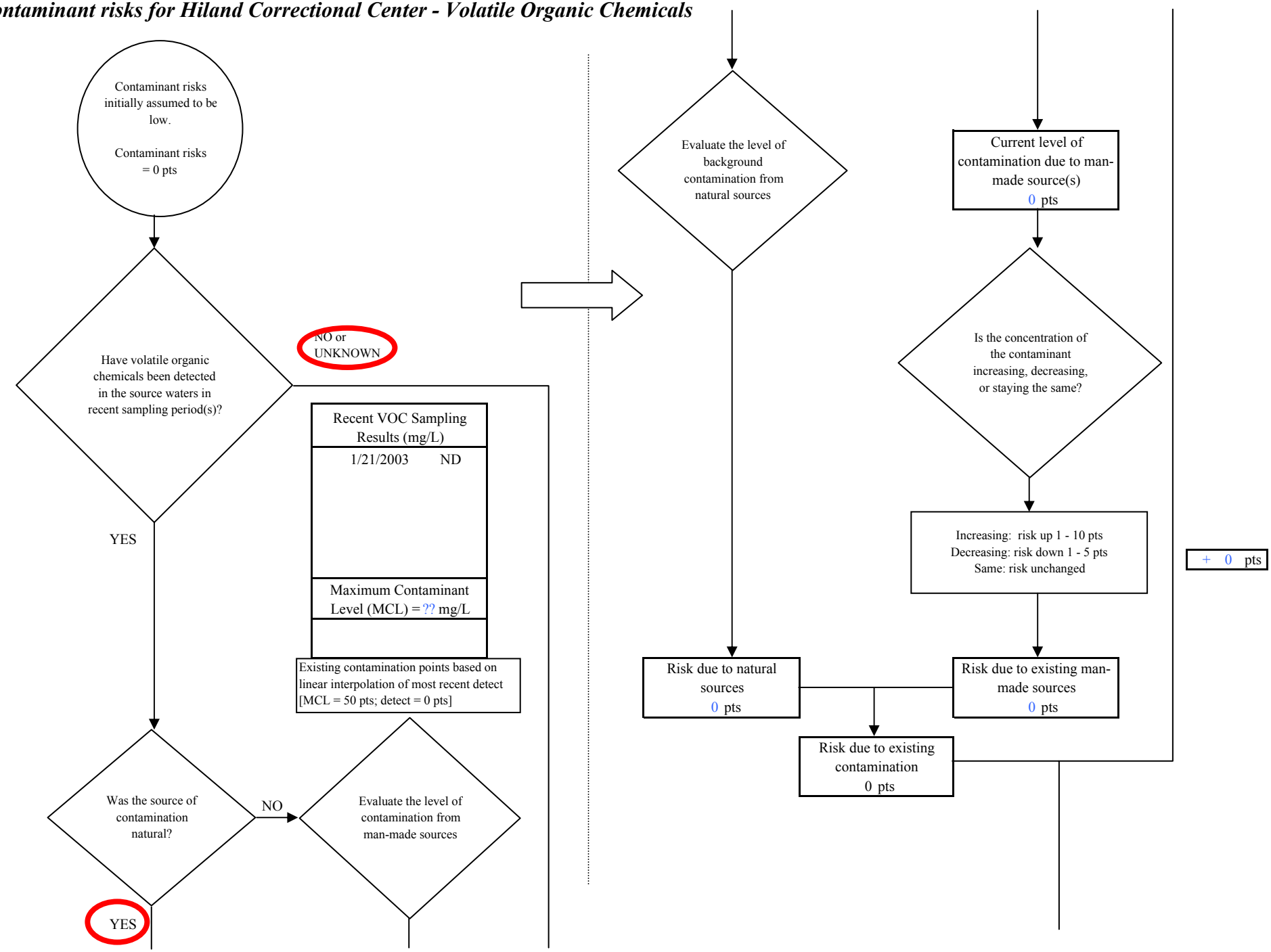


Chart 7. Contaminant risks for Hiland Correctional Center - Volatile Organic Chemicals

+ 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)	1	0	1
Low(s)	4	10	14

	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

+ 5 pts

Chart 7. Contaminant risks for Hiland Correctional Center - Volatile Organic Chemicals

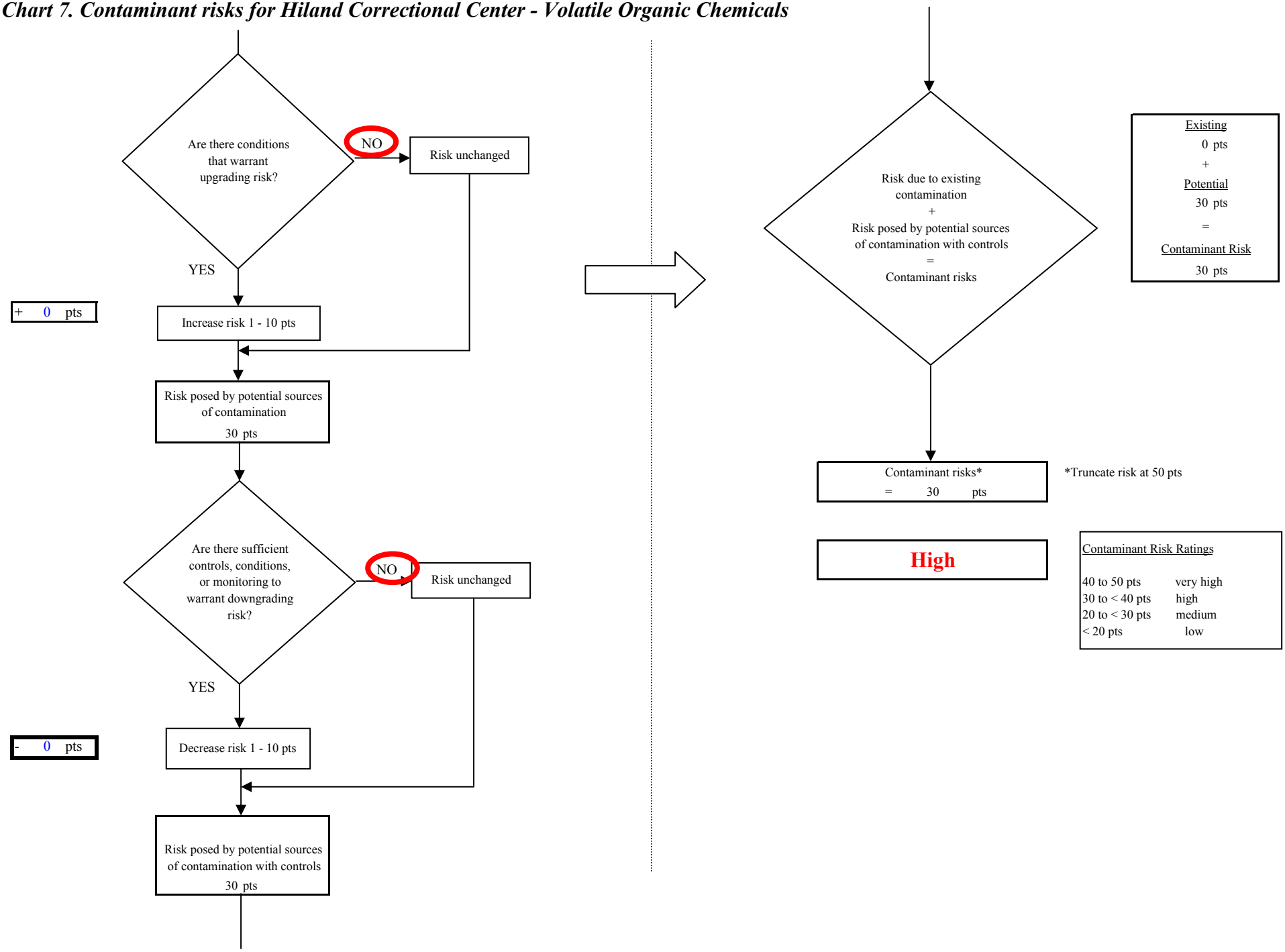


Chart 8. Vulnerability analysis for Hiland Correctional Center - Volatile Organic Chemicals

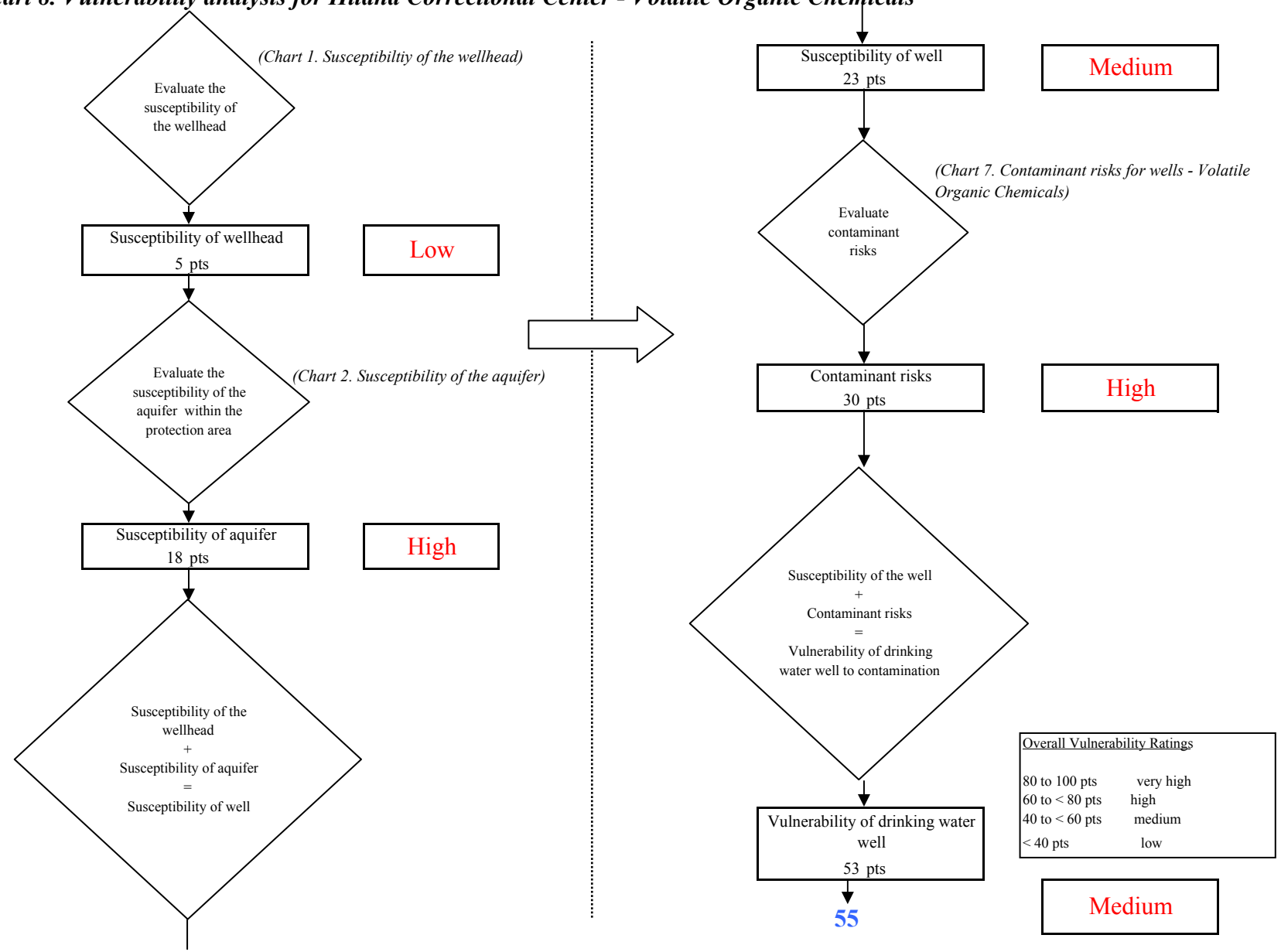


Chart 9. Contaminant risks for Hiland Correctional Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

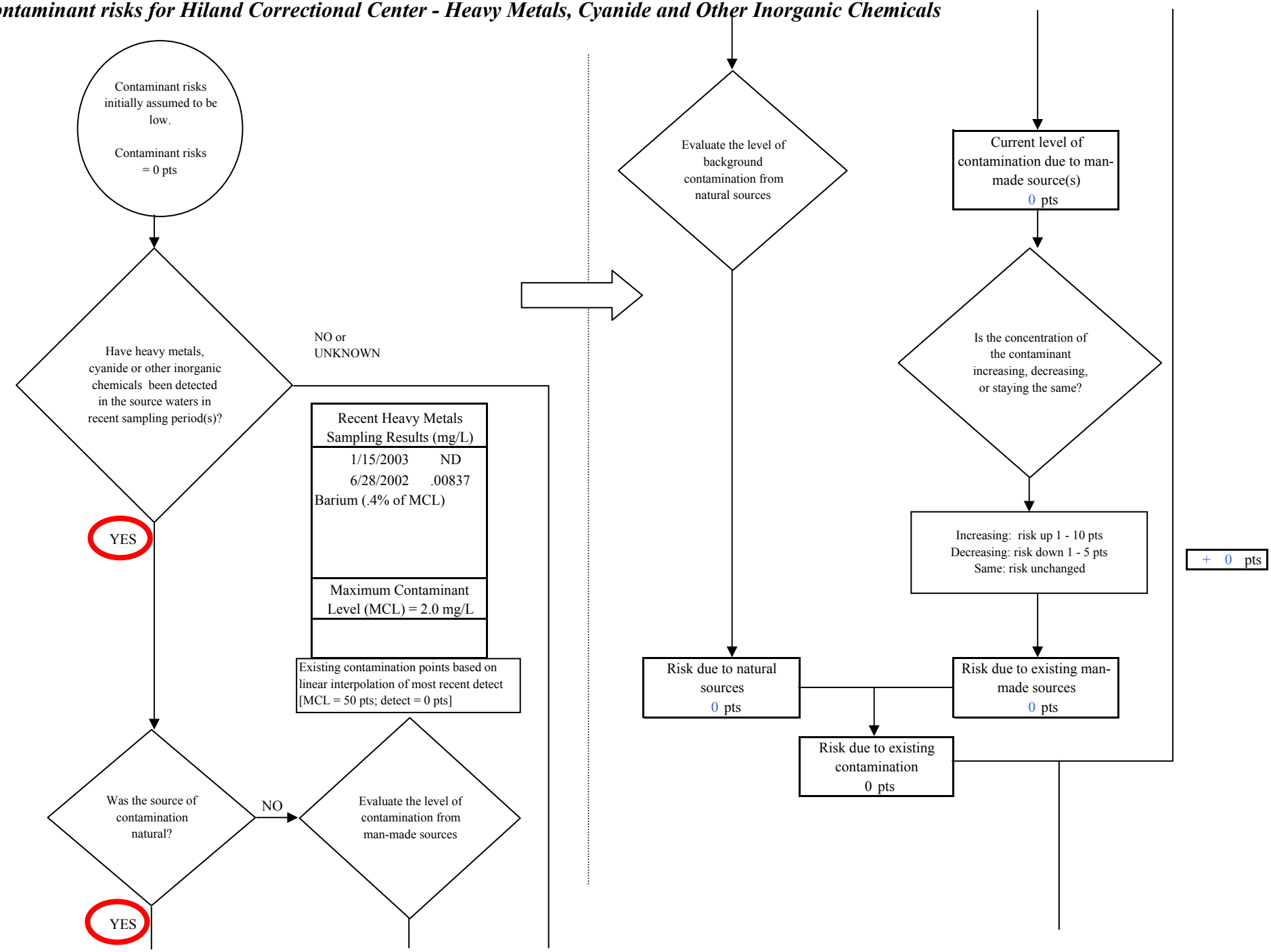


Chart 9. Contaminant risks for Hiland Correctional Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

+ 20 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	0	0
Low(s)	4	7	11

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

Matrix Score 20

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 = 20 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

+ 2 pts

Chart 9. Contaminant risks for Hiland Correctional Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

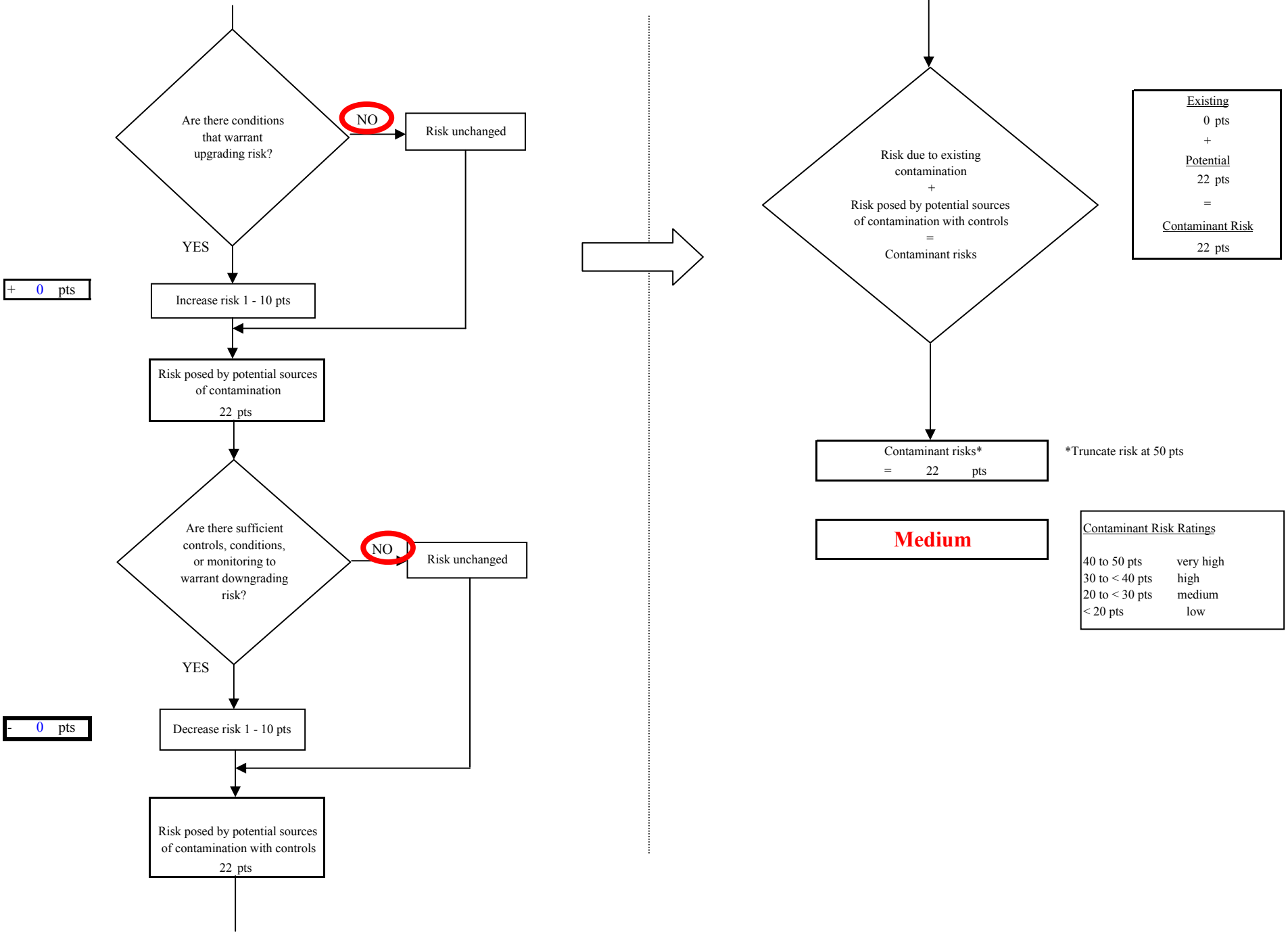


Chart 10. Vulnerability analysis for Hiland Correctional Center - Heavy Metals, Cyanide and Other Inorganic Chemicals

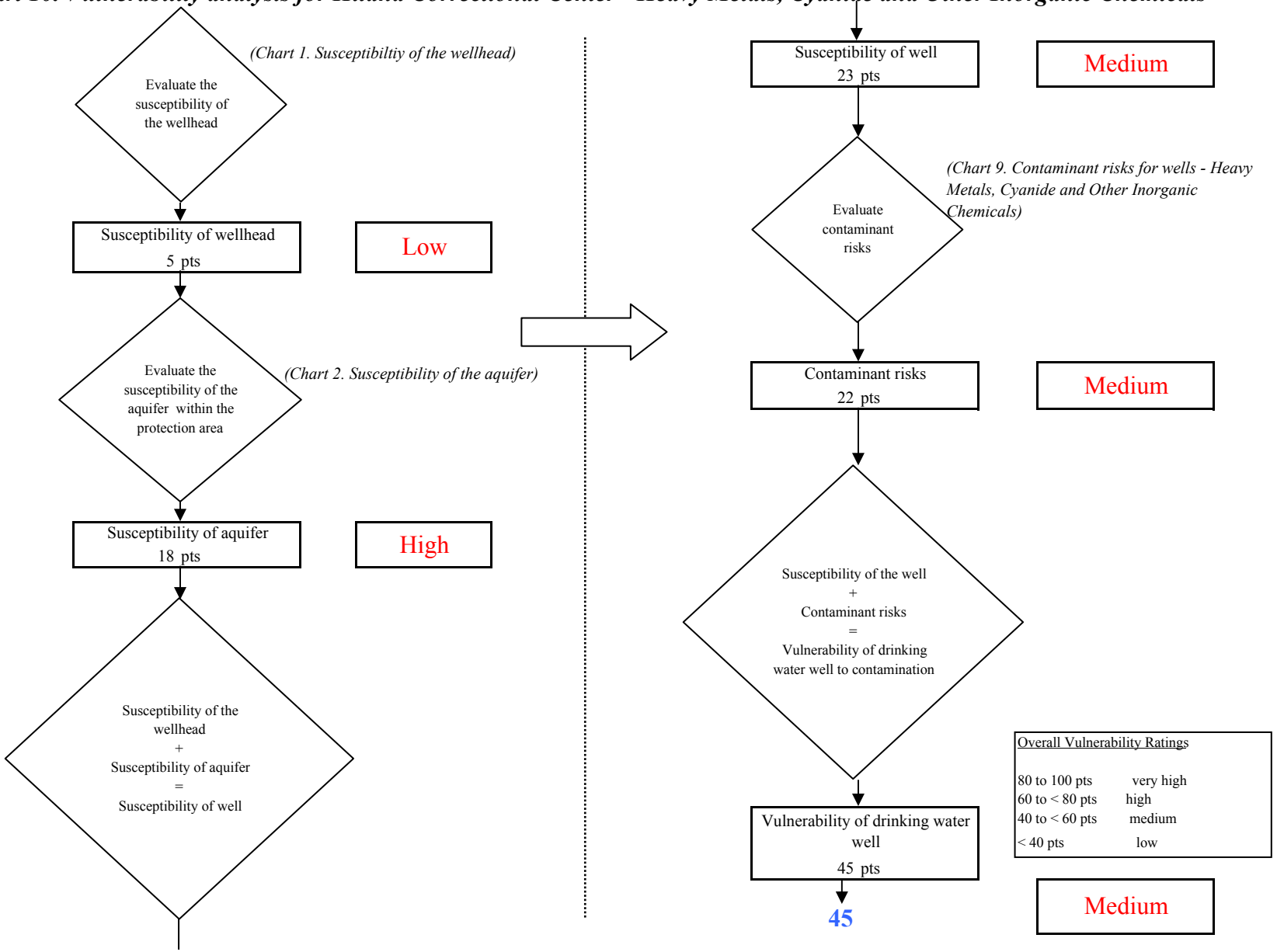


Chart 11. Contaminant risks for Hiland Correctional Center - Synthetic Organic Chemicals

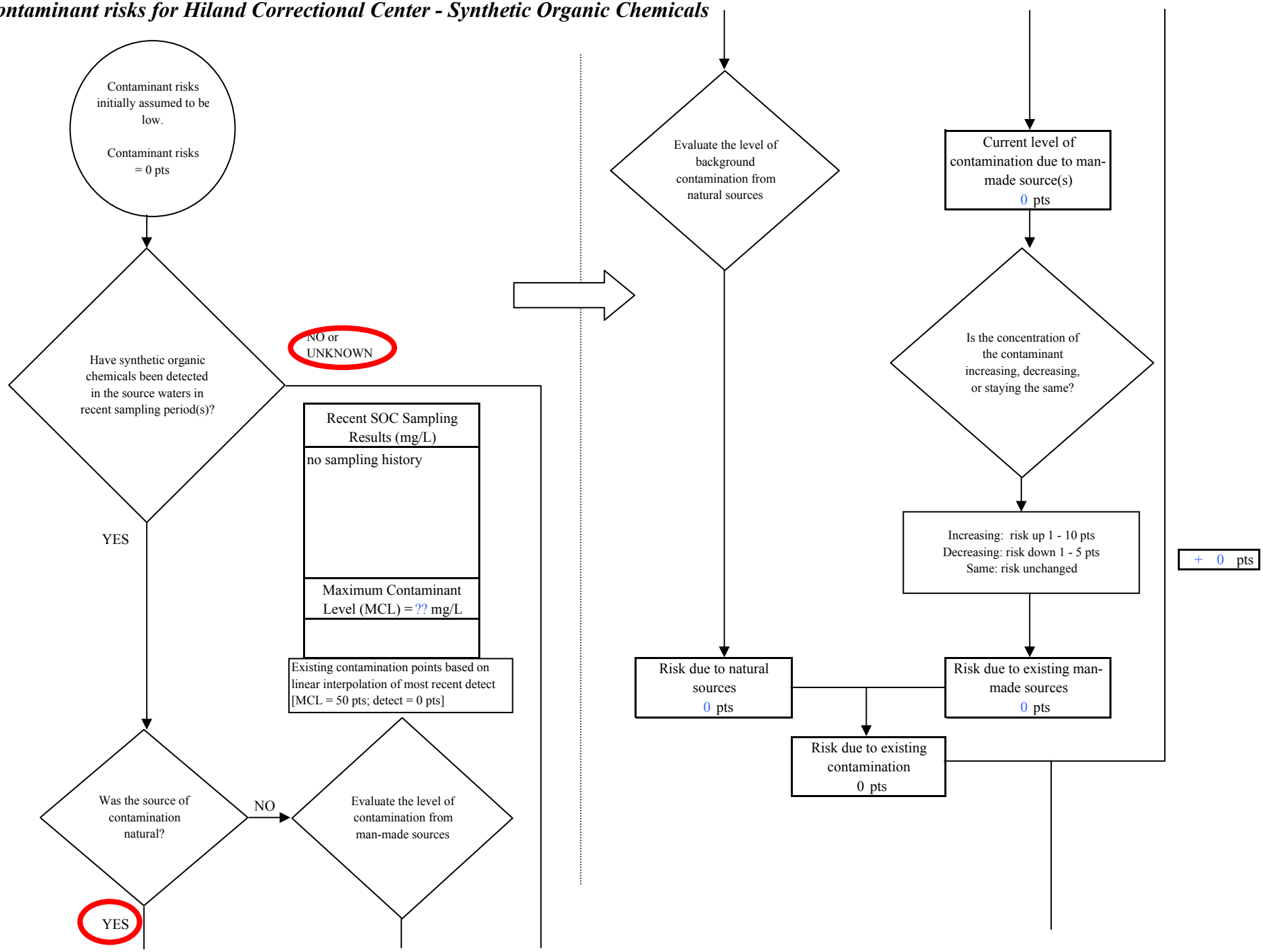
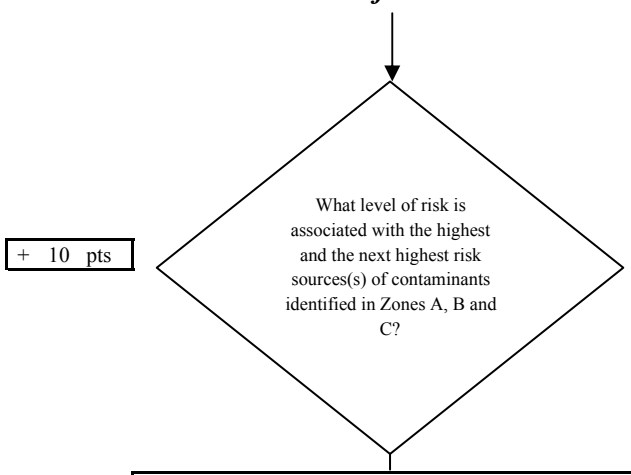


Chart 11. Contaminant risks for Hiland Correctional Center - Synthetic Organic Chemicals



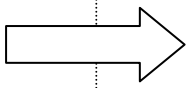
+ 10 pts

Risk Levels for Contaminant Sources identified in Zones A, B and C			
	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	3	6	9

	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.



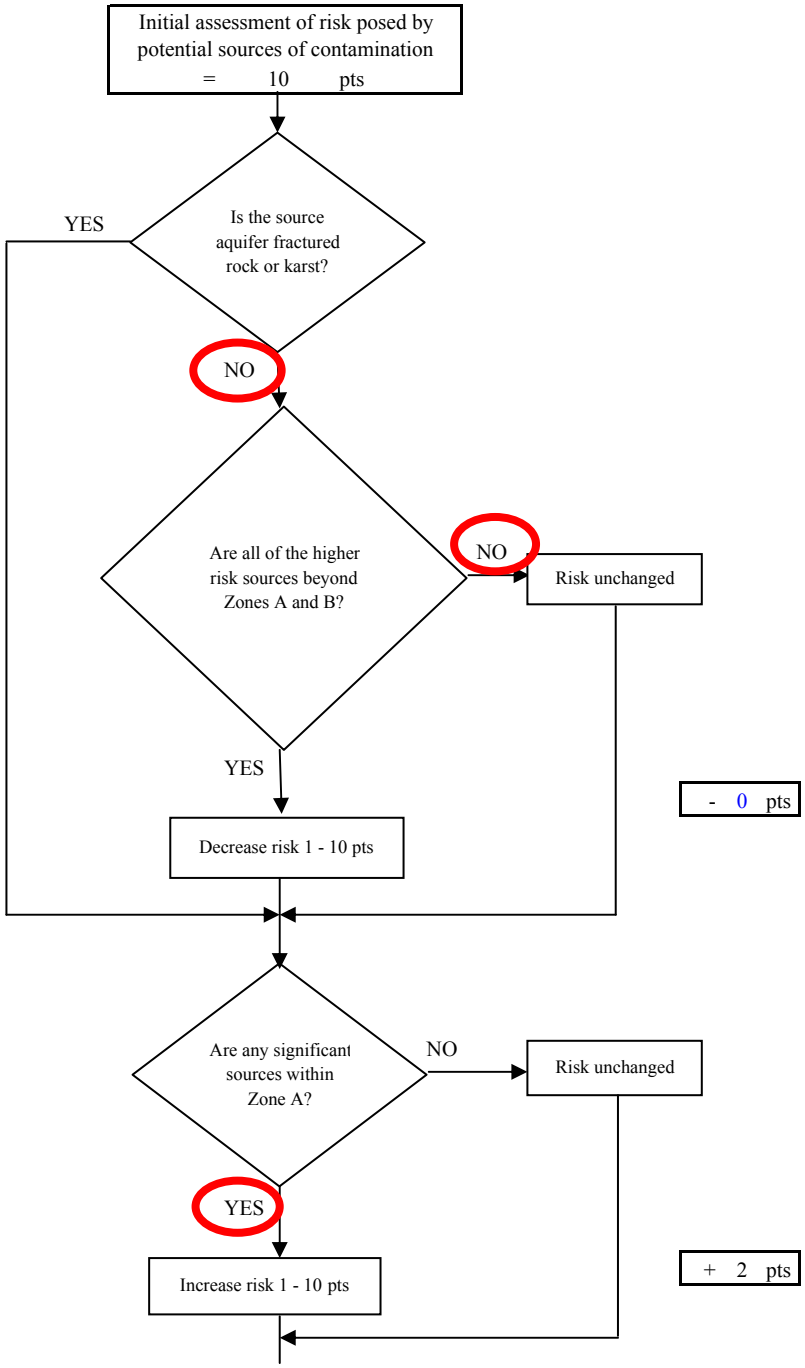


Chart 11. Contaminant risks for Hiland Correctional Center - Synthetic Organic Chemicals

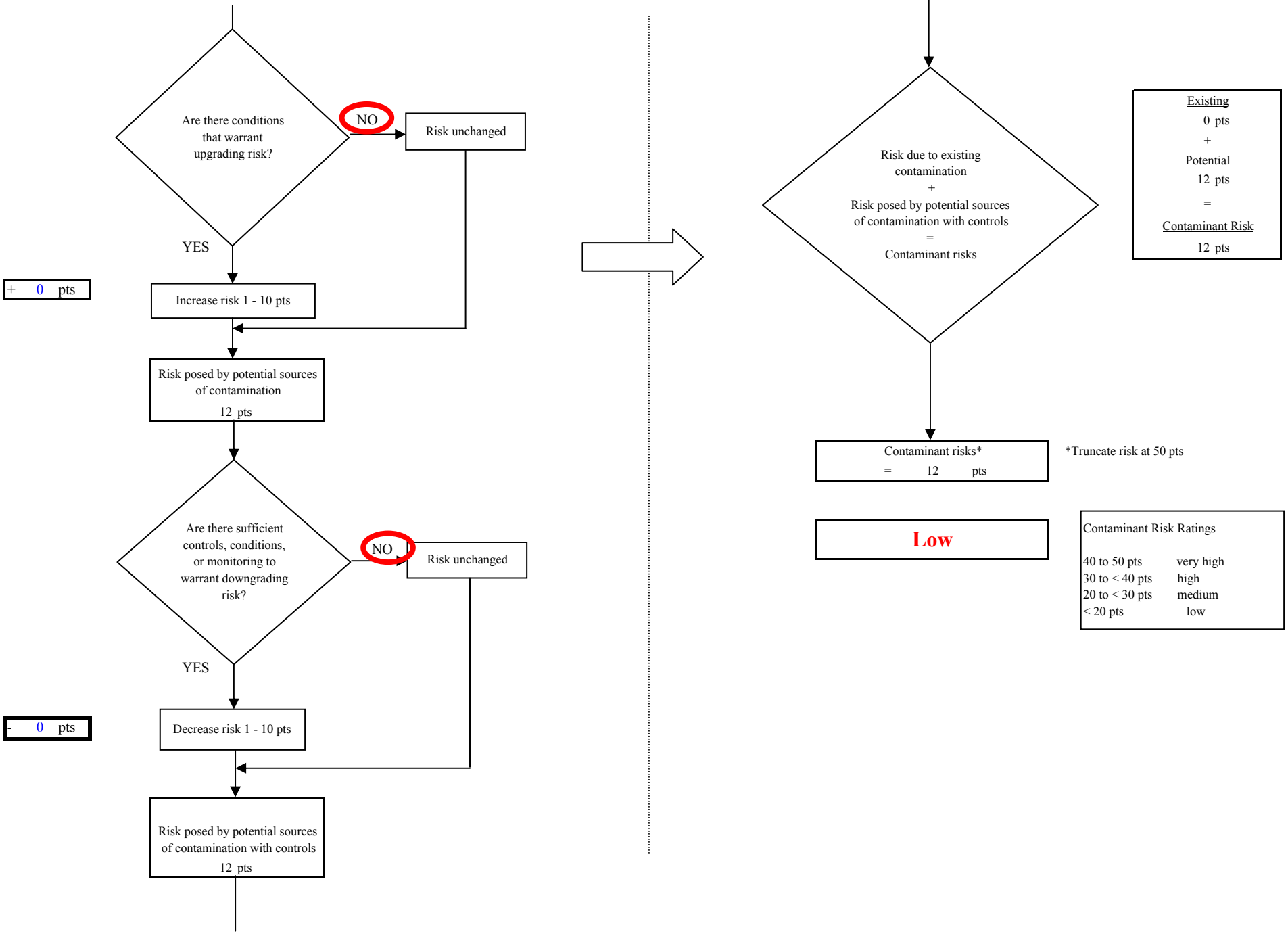


Chart 12. Vulnerability analysis for Hiland Correctional Center - Synthetic Organic Chemicals

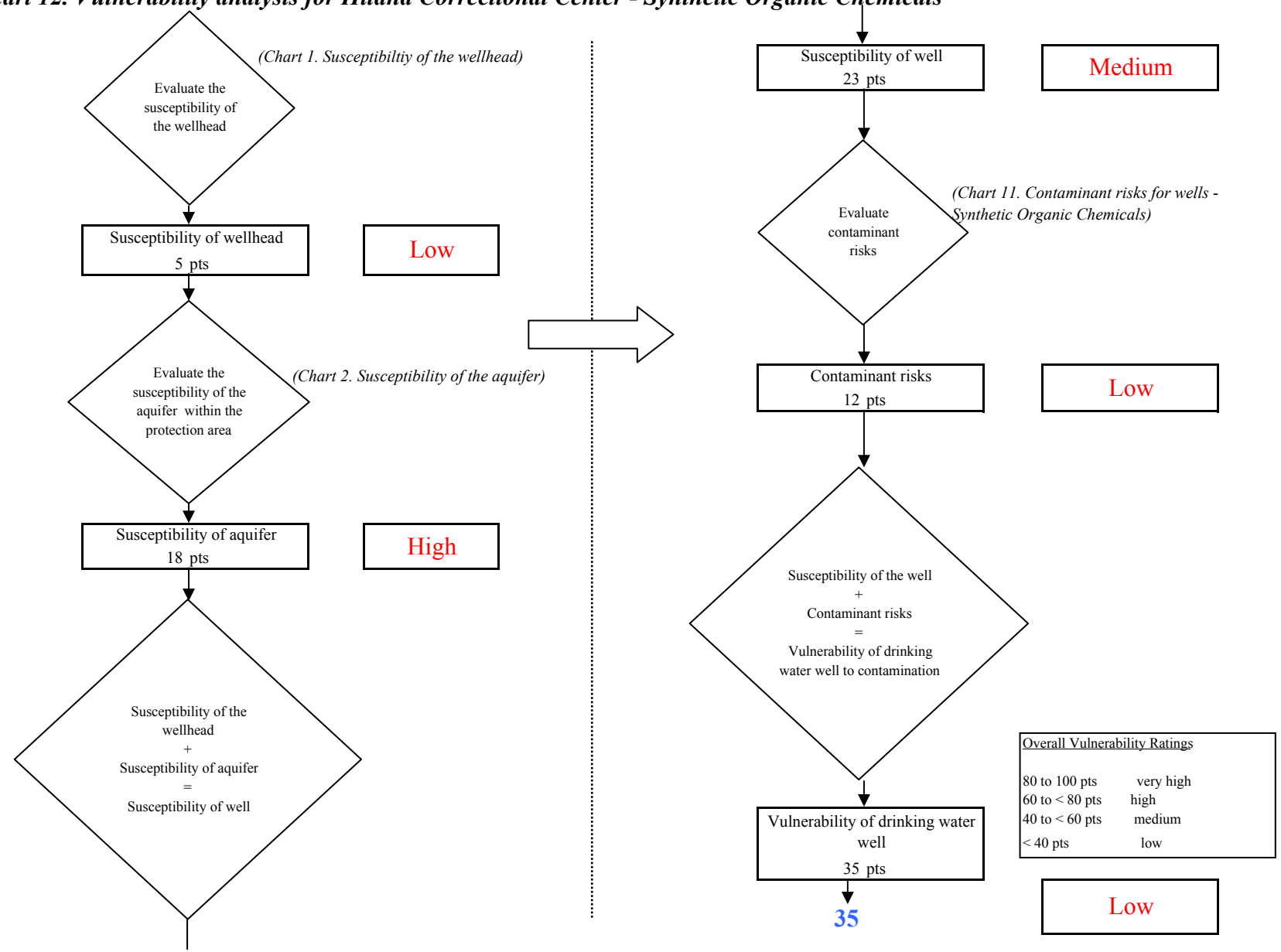


Chart 13. Contaminant risks for Hiland Correctional Center - Other Organic Chemicals

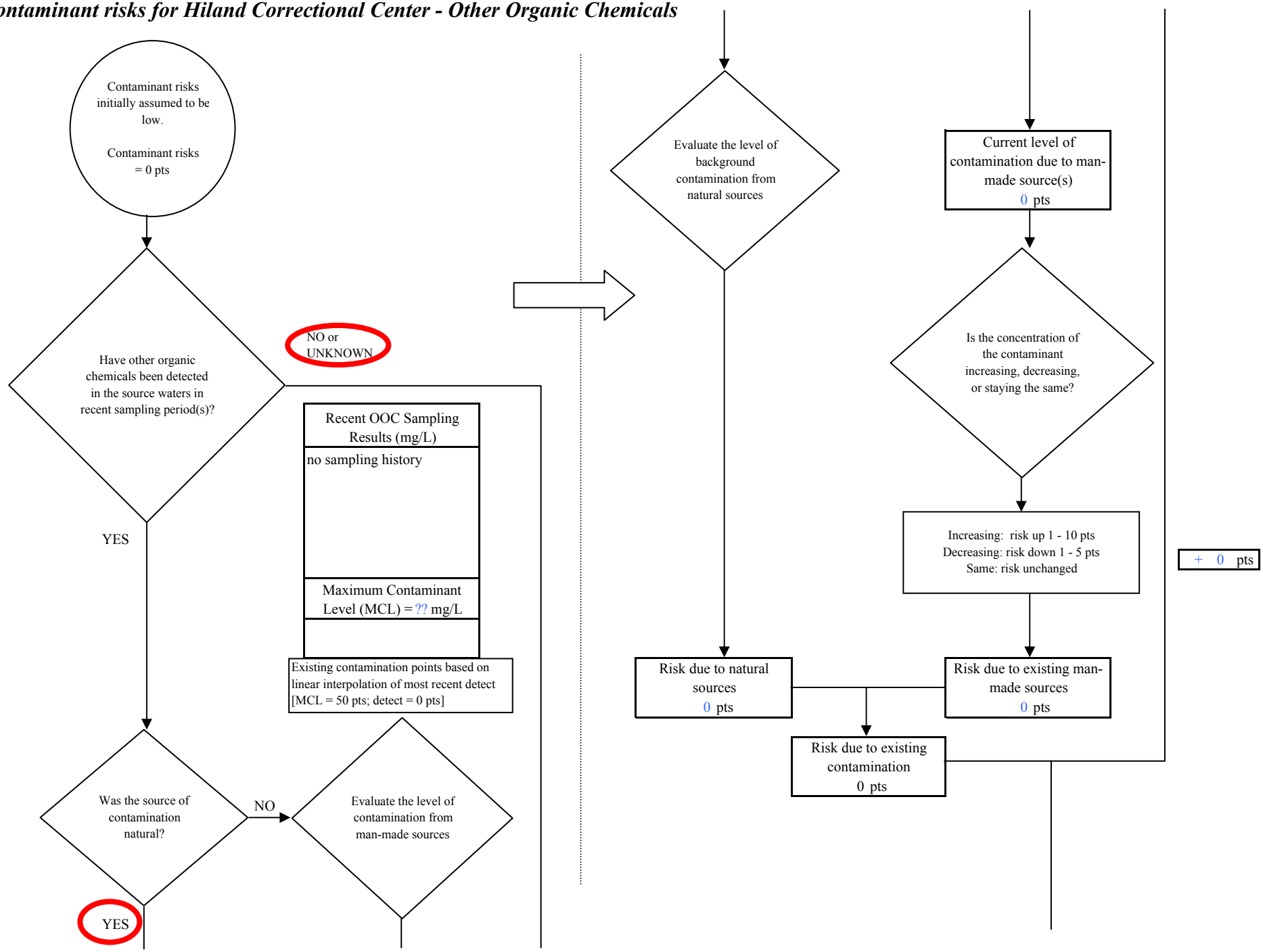
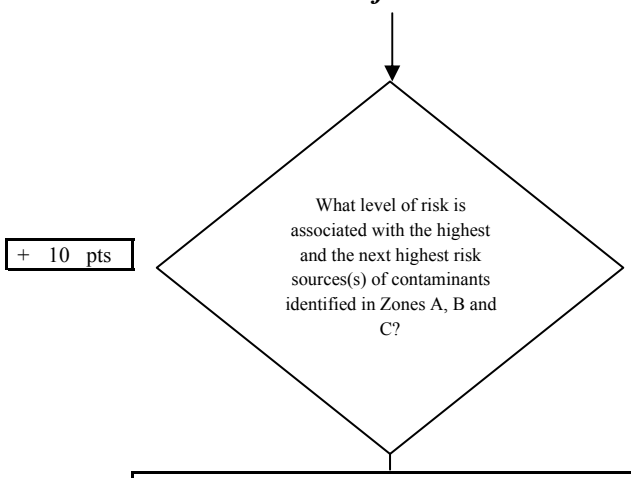


Chart 13. Contaminant risks for Hiland Correctional Center - Other Organic Chemicals



+ 10 pts

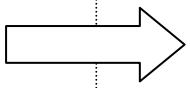
Risk Levels for Contaminant Sources identified in Zones A, B and C

	Zone A	Zones B&C	Total
Very Highs(s)	0	0	0
High(s)	0	0	0
Medium(s)	0	0	0
Low(s)	4	6	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 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.



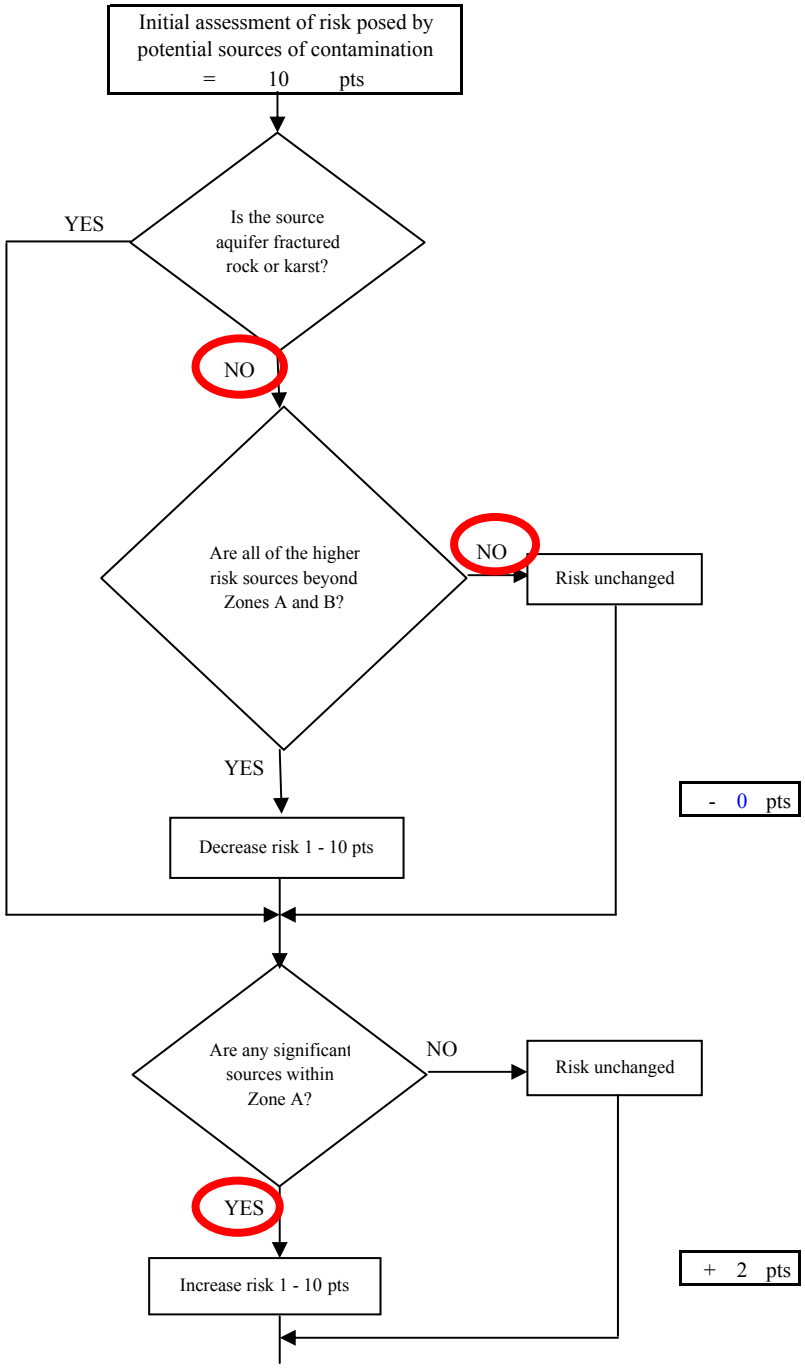


Chart 13. Contaminant risks for Hiland Correctional Center - Other Organic Chemicals

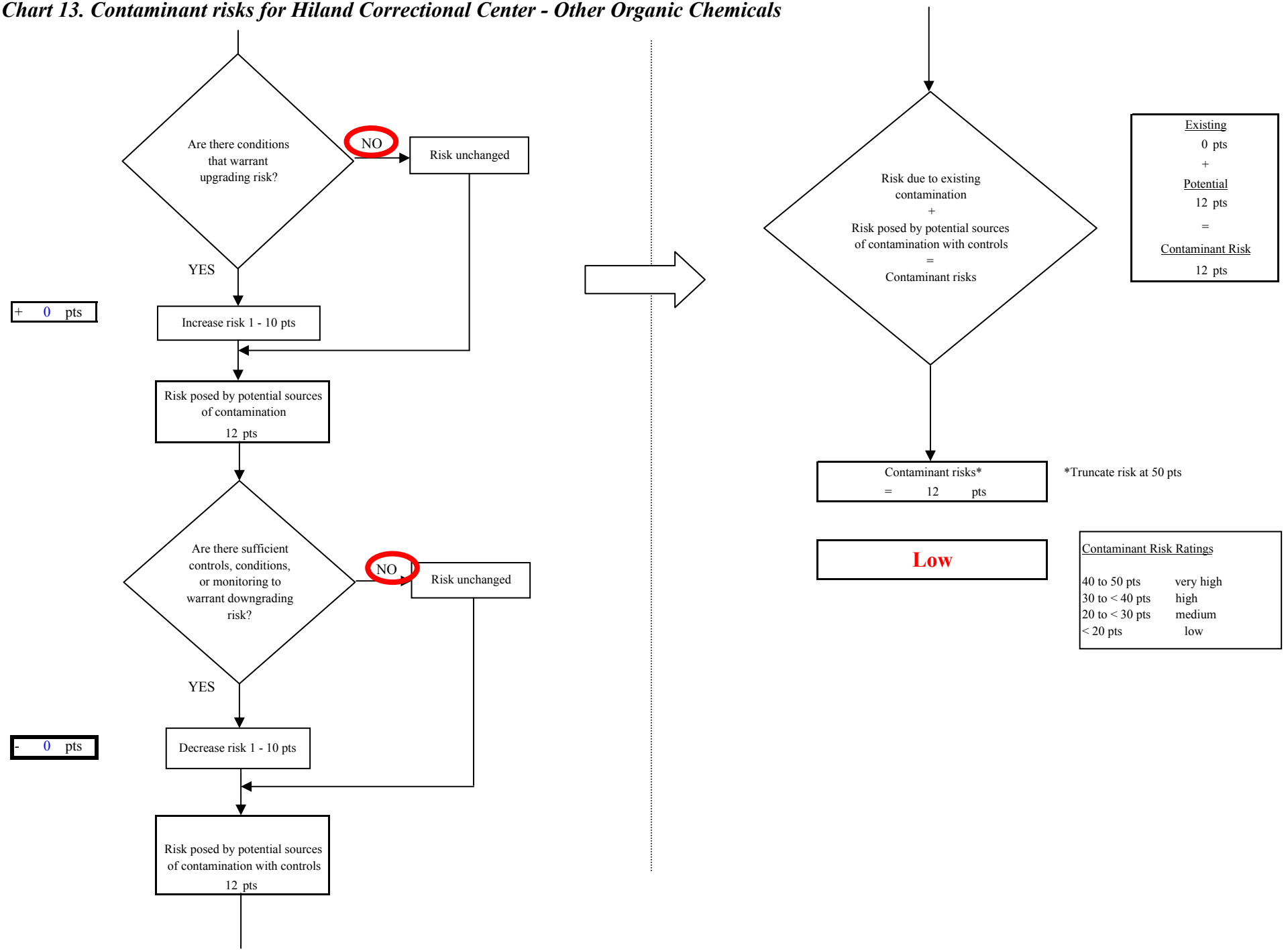


Chart 14. Vulnerability analysis for Hiland Correctional Center - Other Organic Chemicals