



# **RISK RANKING AND RISK REDUCTION PROCESS MOONLIGHT WELLS PROTECTION AREA**

**BEESC Project No. 26094**

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**Prepared for:**

**City of Nome, Alaska**



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## **INTRODUCTION**

The purpose of the risk ranking exercise was to estimate the level of potential risk of adverse effects various activities could have on the usability of the City of Nome's water supply, commonly known as Moonlight Springs (MLS) and Moonlight Wells aquifer. Adverse effects typically relate to aquifer contamination or available quantity of water.

The results of the risk ranking process provide guidance for analyzing Moonlight Wells Permit applications and the stipulation of best management practices (BMPs) in permits. BMPs are temporary or permanent construction, operating and maintenance policies, and protective measures intended to reduce the risk of polluting or diminishing the Moonlight Springs and Moonlight Wells water supply to a level acceptable to the City of Nome. Typically, higher risk activities will have more stringent BMP requirements. Some low risk activities may have no special requirements.

The risk ranking process was subjective. Knowledgeable individuals assigned severity and likelihood values to activities based upon their professional judgment and predetermined criteria. The severity and likelihood values assigned by the group were based upon a worst-case perspective for the activity. The group acknowledged that risks generally can be reduced to acceptable levels through the implementation of engineering and administrative controls. These controls (BMPs) would be imposed upon activities in the Moonlight Wells Protection Area through State of Alaska and federal permits and authorizations, and through the City of Nome's Potable Water Supply Ordinance of the Nome Municipal Code and Moonlight Wells Permit.

## **RISK RANKING METHODOLOGY**

Twenty-two activities that may occur within the MLS protection area were identified and ranked with potential risk they presented to the City of Nome's water supply. The activities investigated are described in the section of this report titled *Results of the Risk Ranking Process*.

Risk ranking was based upon the likelihood and severity of adverse effects arising from an activity occurring within the protection area. The risk ranking methodology and results of the risk ranking process are described in more detail in the following sections.

**EVENT LIKELIHOOD**

Several factors were considered when determining the likelihood of detrimental incidents that could affect the MLS public water source. The factors included, but were not limited to, the following items:

- Whether location, climate, economics, or other factors affect the likelihood of an event;
- Whether the activity is likely to occur within the MLS protection area boundary;
- Whether the activity already occurs in the area;
- Whether the activity is commonly associated with a commercial or residential activity;
- Whether there have traditionally been problems and concerns related to the activity; and
- Whether the activity is regulated.

Each activity was assigned a likelihood rating between 1 and 5. The events having the lowest likelihood were rated as 1. Events having the highest likelihood were rated as 5. Table 1 Likelihood Criteria gives more detail on the criteria used to estimate the likelihood rating.

**EVENT SEVERITY**

Event severity was assigned using a method similar to assignment of likelihood values. The criteria for estimating the severity level is found in Table 2 Severity Level.

The criteria used to determine severity level were:

- Protection area or aquifer remediation costs;
- The cost of new public water system facilities or additional treatment to handle contaminants; and
- The length of time the water system might be out of service.

Severity values ranged from 1 through 5, with 1 being the lowest (least severe), and 5 being the highest (most severe).

**EVENT RISK RANKING**

To determine an activity's risk ranking, severity and likelihood values were entered on the matrix shown below. The value found at the intersection of likelihood and severity ratings gives the ranking of potential risk. For example, where Severity is 2 (Medium-Low) and Likelihood is 3 (Medium), the Risk Ranking is Low.

	<b>Likelihood – Increasing</b>					
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Severity – Increasing</b>	<b>5</b>	3	2	2	1	1
	<b>4</b>	4	3	2	2	1
	<b>3</b>	4	4	3	2	2
	<b>2</b>	4	4	4	3	2
	<b>1</b>	4	4	4	4	3

<b>Ranking of Potential Risk</b>	
<b>1 - Severe</b>	
<b>2 - High</b>	
<b>3 - Medium</b>	
<b>4 - Low</b>	

The following tables give the criteria used to rate the likelihood and severity of activity related incidents.

**Table 1 Likelihood Criteria**

<b>Likelihood</b>	<b>Description</b>
High	<b>A commonly occurring activity</b>
Med-High	<b>An activity that is not unusual, yet not common</b>
Med	<b>May occur several times during the lifetime of the system</b>
Med-Low	<b>Rarely occurs</b>
Low	<b>Not likely to occur</b>

**Table 2 Severity Level**

<b>Severity Level</b>	<b>Remediation Cost</b>	<b>Cost New Facilities or Additional Treatment</b>	<b>Loss of Use</b>
High	> \$10 million remediation cost	> \$10 million initial cost or > \$1 million annual costs	Complete loss of resource (> 1 year)
Med-High	\$5 - \$10 million remediation cost	\$4 million initial cost or \$0.5 million annual costs	Temporary loss of resource (< 1 year)
Med	\$0.5 - \$5 million remediation cost	\$2 million initial costs or \$250,000 annual costs	Temporary loss of resource (< 1 month)
Med-Low	< \$0.5 million remediation cost	\$1 million initial costs or \$1,000 annual costs	Temporary loss of 2 million gallons storage (inability to use resource for 1 week)
Low	Minimal remediation costs	No additional treatment required	No loss of resource

## RESULTS OF THE RISK RANKING PROCESS

Each activity was assessed for potential risk, using the methodology described in the previous section. The ranking of potential risk for each of the activities is shown below.

### **Activity: Aboveground Oil/Fuel Storage Tanks < 1000 Gallons**

<b>Likelihood</b>	<b>Severity</b>	<b>Ranking of Potential Risk</b>
<b>High</b>	<b>Medium-Low</b>	<b>High</b>
<b>Comments:</b> <ul style="list-style-type: none"> <li>Leaking piping most likely</li> <li>Leaking tanks – unlikely</li> <li>Overfills, spills, and fuel handling likely sources</li> <li>Water contaminated by released hydrocarbons could be treated</li> </ul>		

**Activity: Aboveground Oil/Fuel Storage Tanks > 10,000 Gallons**

Likelihood	Severity	Ranking of Potential Risk
Medium-Low	High	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Leaking piping a likely source</li> <li>Leaking tanks</li> <li>Overfills, spills, and fuel handling are likely sources</li> <li>Large tanks would probably be related to industrial or mining activities</li> <li>Water contaminated by released hydrocarbons could be treated</li> </ul>		

**Activity: Aboveground Oil/Fuel Storage Tanks > 1000 Gallons < 10,000 Gallons**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-High	Severe
<b>Comments:</b> <ul style="list-style-type: none"> <li>Leaking piping is a likely source</li> <li>Leaking tanks</li> <li>Overfills, spills, and fuel handling are likely sources</li> <li>This size range of tanks is the most likely to cause problems</li> </ul>		

**Activity: Agriculture and Vegetation Control**

Likelihood	Severity	Ranking of Potential Risk
Low	Low	Low
<b>Comments:</b> There is little opportunity for agriculture within the Moonlight Springs area. <ul style="list-style-type: none"> <li>Herbicides could be a concern if improperly used or stored</li> </ul>		

**Activity: Animal Lots**

Likelihood	Severity	Ranking of Potential Risk
Medium	Low	Low
<b>Comments:</b> <ul style="list-style-type: none"> <li>Dog lots – it would take a large operation to impact the aquifer</li> </ul>		

**Activity: Chemical/Fertilizer Application**

Likelihood	Severity	Ranking of Potential Risk
Low	Low	Low
<b>Comments:</b> <ul style="list-style-type: none"> <li>Same concerns as with use of pesticides, however, proper use of fertilizers would not pose much risk.</li> </ul>		

**Activity: Discharge of More than 10,000 Gallons of Contained Water**

Likelihood	Severity	Ranking of Potential Risk
Medium-High	Medium	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>From tanks, hydrostatic testing of pipes and tanks, and swimming pools, etc.</li> <li>These waters may contain metals or hydrocarbons</li> <li>Discharge of these waters is subject to permits</li> </ul>		

**Activity: Discharge of Less than 10,000 Gallons of Contained Water**

Likelihood	Severity	Ranking of Potential Risk
Medium-High	Medium-Low	Medium
<b>Comments:</b> <ul style="list-style-type: none"> <li>From tanks, hydrostatic testing of pipes and tanks, and swimming pools, etc.</li> <li>These waters may contain metals or hydrocarbons</li> <li>Discharge of these waters is subject to permits</li> </ul>		

**Activity: Excavation Dewatering of More than 250,000 Gallons**

Likelihood	Severity	Ranking of Potential Risk
High	Low	Medium
<b>Comments:</b> <ul style="list-style-type: none"> <li>Associated with mining or gravel pit</li> <li>May introduce sediments into the aquifer</li> <li>If long-term dewatering is required, could have an impact on available water quantity</li> </ul>		

**Activity: Excavation Dewatering of Less than 250,000 Gallons**

Likelihood	Severity	Ranking of Potential Risk
High	Low	Medium
<b>Comments:</b>		
<ul style="list-style-type: none"> <li>A relatively benign activity; high likelihood drives rating</li> </ul>		

**Activity: Exploration Boreholes**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b>		
<ul style="list-style-type: none"> <li>Activities that create a conduit from the ground surface into the aquifer could cause problems, unless properly sealed.</li> </ul>		

**Activity: Hard Rock Mining**

Likelihood	Severity	Ranking of Potential Risk
High	High	Severe
<b>Comments:</b>		
<ul style="list-style-type: none"> <li>Hard rock mining that either provides a direct contaminant conduit to the aquifer, or interrupts the recharge of the aquifer, or removes the aquifer is a concern.</li> </ul>		

**Activity: Hazardous Material Storage**

Likelihood	Severity	Ranking of Potential Risk
Medium-High	High	Severe
<b>Comments:</b>		
<ul style="list-style-type: none"> <li>The storage and possible release of solvents, acids, glycols, etc., could contaminate the aquifer for a very long time; household use of these materials is of less consequence than commercial and industrial use.</li> </ul>		

**Activity: Hazardous Waste Storage, Transportation, and Disposal**

Likelihood	Severity	Ranking of Potential Risk
Medium-High	High	Severe
<b>Comments:</b>		
<ul style="list-style-type: none"> <li>Improper storage, transportation and disposal of Resource Conservation and Recovery Act (RCRA)-regulated wastes could cause problems if released into environment. Practices such as storing these wastes in appropriate containers and relying upon permitted transporters and disposal facilities will reduce risks.</li> </ul>		

**Activity: Industrial Activities**

Likelihood	Severity	Ranking of Potential Risk
Medium	Medium	Medium
<b>Comments:</b> <ul style="list-style-type: none"> <li>Small industrial shops (welding, auto shops) may be established within the protection boundary. Some of the consequences of these shops have been discussed in other categories, and may include concerns with solvents, fuels, waste oil, etc.</li> </ul>		

**Activity: Land Application of Biosolids**

Likelihood	Severity	Ranking of Potential Risk
Low	Medium-High	Low
<b>Comments:</b> <ul style="list-style-type: none"> <li>Typically, biosolids are a byproduct of wastewater treatment plants and can contain bacteria, viruses, and metals. Direct application of biosolids to land is regulated by permit. Permits are not issued unless it can be demonstrated that pathogens and metals are not an issue.</li> </ul>		

**Activity: Landfarming Contaminated Soils**

Likelihood	Severity	Ranking of Potential Risk
Low	Medium-High	Low
<b>Comments:</b> <ul style="list-style-type: none"> <li>A relatively low-cost method of cleaning up contaminated soils; may be ineffective in relatively cold climates.</li> </ul>		

**Activity: Landfill Establishment and Operation**

Likelihood	Severity	Ranking of Potential Risk
Medium-Low	Medium-High	Medium
<b>Comments:</b> <ul style="list-style-type: none"> <li>Other than small, private dumps, this activity would be done by the City, military or commercial venture, and would be regulated.</li> </ul>		

**Activity: Mobile Fuel Tanks, Tank Trucks**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-High	Severe
<b>Comments:</b> <ul style="list-style-type: none"> <li>This is an unregulated activity that could cause major problems in the event of an accident where a significant quantity of fuel is spilled.</li> <li>Other concerns relate to poor fuel transfer practices that results in spills.</li> </ul>		

**Activity: Placer Mining, Tailings Placement**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Placer mining tailings and overburden placement is not considered a problem, however, there could be problems with turbidity and increases in naturally occurring metals.</li> <li>Materials that have been subjected to amalgamation pose a greater risk.</li> </ul>		

**Activity: Polluted Soil Disposal**

Likelihood	Severity	Ranking of Potential Risk
Low	High	Medium
<b>Comments:</b> <ul style="list-style-type: none"> <li>This activity includes landfilling of contaminated soils; contaminant concentrations must be within regulatory limits.</li> </ul>		

**Activity: Quarries or Excavations**

Likelihood	Severity	Ranking of Potential Risk
High	Medium	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Could increase turbidity</li> <li>Dewatering could reduce water availability within the aquifer</li> <li>If a lake formed that fed into the aquifer, Moonlight Springs could be considered as "groundwater under the direct influence of surface water".</li> </ul>		

**Activity: Residential Development**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Has least amount of state and federal regulatory oversight</li> <li>Impacts could occur from wells, fuel tanks, uncontrolled dumping, and excavation</li> </ul>		

**Activity: Roads**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Application of dust control palliatives is one concern.</li> <li>Secondary impacts from spills from accidents, runoff.</li> </ul>		

**Activity: Solid Waste Disposal**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Uncontrolled dumping could cause problems, i.e., waste oil, glycols, solvents, and metals</li> <li>Small mining operations</li> </ul>		

**Activity: Stockpiling Contaminated Soil**

Likelihood	Severity	Ranking of Potential Risk
Medium-High	Medium-High	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Particularly concerned with potential of contaminants to leach into ground beneath the stockpile</li> </ul>		

**Activity: Underground Oil/Fuel Storage Tanks**

Likelihood	Severity	Ranking of Potential Risk
Low	High	Medium
<b>Comments:</b> <ul style="list-style-type: none"> <li>Not encouraged; most tanks are above ground</li> </ul>		

**Activity: Underground Injection Wells**

Likelihood	Severity	Ranking of Potential Risk
Medium	Medium-High	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>May be associated with mining</li> <li>Controlled by existing permit program and strict effluent quality criteria; injection into drinking water sources not allowed if it would cause the violation of a drinking water standard/requirement.</li> </ul>		

**Activity: Wastewater Disposal Systems**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Holding tanks</li> <li>Pit privies</li> <li>Conventional systems</li> <li>If properly constructed, should not pose a problem</li> </ul>		

**Activity: Water Wells**

Likelihood	Severity	Ranking of Potential Risk
High	Medium-Low	High
<b>Comments:</b> <ul style="list-style-type: none"> <li>Primary concern is that wells provide a direct conduit to the aquifer whereby contaminants could be introduced.</li> <li>If properly constructed and abandoned, should not pose a problem</li> </ul>		

**Activity: Wetlands Fill**

Likelihood	Severity	Ranking of Potential Risk
Medium-High	Low	Low
<b>Comments:</b> <ul style="list-style-type: none"> <li>Structural fill – there may be risks associated with using fills consisting of arsenic-bearing soils</li> </ul>		

**ACTIVITIES SORTED BY POTENTIAL RISK**

The following four tables list the various activities sorted by the potential risk ranking value assigned to them during the ranking process.

**Table 3 Activities Having a Potential Risk Ranking of Severe**

Aboveground oil/fuel storage tanks, > 1000 gallons - < 10,000 gallons
Hard rock mining, chemically treated mining solid waste tailings placement
Hazardous material storage
Hazardous waste storage, transportation and disposal
Mobile fuel tanks, tank trucks

**Table 4 Activities Having a Potential Risk Ranking of High**

Aboveground oil/fuel storage tanks, < 1000 gallons
Aboveground oil/fuel storage tanks, > 10,000 gallons
Discharge of > 10,000 gallons of contained water from tanks, hydrostatic testing, swimming pools, etc.
Exploration boreholes
Placer mining activity, and placement of tailings
Quarries or excavation
Residential development
Roads
Solid waste disposal
Stockpiling contaminated soil
Underground injection wells
Wastewater disposal systems
Water wells

**Table 5 Activities Having a Potential Risk Ranking of Medium**

Discharge of < 10,000 gallons of contained water from tanks, hydrostatic testing, swimming pools, etc.
Excavation dewatering, < 250,000 gallons
Excavation dewatering, > 250,000 gallons
Industrial activity
Land application of biosolids
Landfill establishment and operation
Polluted soil disposal
Underground oil/fuel storage tanks

**Table 6    Activities Having a Potential Risk Ranking of Low**

Agriculture, vegetation control
Animal lots
Chemical/fertilizer application
Landfarming of contaminated soils
Wetlands fill – structural fills free of arsenic or other harmful components that could leach into groundwater

**ANALYZING AND REDUCING RISKS ASSOCIATED WITH A PROPOSED ACTIVITY**

The potential risk of activities must be considered when issuing Moonlight Wells Permits for activities within the Moonlight Wells Protection Area. Risk must be reduced to an acceptable level through the use of technical/engineering and administrative controls. Many appropriate controls have been adopted in State of Alaska and federal regulatory and permitting programs. These State and federal controls, as well as those developed by the City of Nome, have been adopted as BMPs in the City's Moonlight Wells Permit program.

The following steps provide guidance for analyzing the risks associated with an activity in the Moonlight Wells Protection Area.

**REVIEW PERMIT APPLICATION INFORMATION**

When a permit is requested for an activity within the protection area boundary, it should contain a good description of the proposed action. The permit application form will guide the applicant in describing the aspects of the project that have the potential for impacting the City of Nome's municipal water supply. The applicant should have also described what BMPs have been adopted to reduce the risk of groundwater contamination. Incomplete permit applications will not allow the reviewer to adequately make decisions. Additional information should be requested of the applicant until a thorough understanding of the activity is achieved.

**IDENTIFY POTENTIAL HAZARDS**

From the information contained in the permit application, and through discussions with the applicant, the permit reviewer will need to identify undesirable consequences that may arise from the proposed activity. The permit reviewer should ask the questions, "What can go wrong?" and "What are the causes of what can go wrong?" with the overall activity or its component parts. Case histories or case studies of similar activities can provide insight into the possible undesirable consequences of the proposed project.

**ANALYZE HAZARDS AND RISKS**

After identifying what may go wrong and the possible causes, the permitter should seek to determine the probability or likelihood that the detrimental event will occur, and then the severity of the consequences if the event occurs. The combination of likelihood and severity defines the level of risk. An appropriate method to define levels of potential risk is described earlier in this

document. The levels of potential risk associated with particular activities may be appropriate in analyzing the proposed permit action, or additional analysis may be required for specific project activities, or different activities that have not yet been analyzed.

## **REDUCING RISK**

If an activity is determined to have an unacceptable level of risk, the risk will need to be reduced or mitigated by reducing either the likelihood or severity of an event, or both.

Likelihood of an event could be reduced, for example, by one of the following approaches:

- Removing or eliminating the hazard entirely;
- Employing designs that reduce the likelihood of leaks and spills;
- Substituting a different, less hazardous process or activity; or
- Relocating the hazard to an area outside the protection area.

For example, eliminating significant gasoline storage, and utilizing diesel-fueled equipment will reduce the likelihood of spills contaminating groundwater with a highly mobile product and also the possible creation of RCRA hazardous wastes.

Another scenario might be storage of hazardous chemicals at a location outside of the MLS Protection Area and bring only the quantity needed for the short-term use to the site where they are used.

Severity of events can be reduced by:

- Providing barriers or isolating contaminant sources so escape to the environment is reduced; and
- Providing administrative controls, such as procedures, signage, training, and inspection.

Some examples of steps to reduce severity of events are leak testing of fuel tanks and lines, having emergency response plans, and training employees to report all spills.

## **APPLYING BMPs**

Several hundred BMPs were identified for activities that may occur within the Moonlight Wells Protection Area. Most of the BMPs are regulatory requirements. In assessing a project and identifying opportunities to reduce risk, the permitter should identify BMPs that may apply to the activity, and whether the applicant has included them in the activity/project plan.

If the applicant has not included adequate BMPs in the project description, it is the responsibility of the permitter to:

- Discuss with the applicant the utilization of the BMPs identified as part of the Moonlight Wells Permit process, or adoption of alternative BMPs to reduce risk to appropriate levels and maintain regulatory compliance; and
- Ensure that the agreed upon BMPs are included in the project description and the final development permit.