University Health and Safety

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# Rosemount Research Center / Gopher Ordnance Works

# Physical Hazards Assessment

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## Summary

During the months of June and July 2015, a physical hazards assessment was conducted at the former site of the 6000-acre Gopher Ordnance Works located at the Rosemount Research Center which is owned by the University of Minnesota. A team of University of Minnesota health and safety professionals physically walked the site to visually inspect the site to identify, catalog and analyze physical hazards. Each hazard was given a risk rating based on the inherent level of hazardousness as well as the likelihood of public access to the location of the hazard.

The assessment identified a number of high-risk hazards that should be addressed as soon as reasonably possible, along with numerous lower risk hazards which should become part of a long-range plan as funds become available or as site redevelopment proceeds.

Due to vegetation overgrowth and the vastness of the property, it is acknowledged that not every potential physical hazard was identified. However, this work provides an accurate assessment of the types and severity of existing physical hazards, along with a means of prioritizing remediation efforts.

## Background

Prior to University ownership of the property, the land was used by the United States Department of Defense to accommodate the Gopher Ordnance Works, which manufactured smokeless gun powder (Figure 1). When the plant was abandoned in 1945 and 1946, several hundred buildings were removed, excluding the foundations and much of the infrastructure, leaving large areas with ruins of irregular concrete blocks and exposed rebar. In 1945, the property had an estimated 250 manholes accessing the sewer systems. Most of the manholes still exist, a number of which are currently uncovered or have decaying covers (Figure 2). There are also signs of unauthorized public access to the property, evidenced by graffiti and litter from trespassers.

The objective of this physical hazards assessment is to identify and analyze existing physical hazards to inform mitigation efforts and ultimately reduce the risk of harm to site visitors and trespassers. For the purpose of this report, a “physical hazard” is defined as an environmental condition that can cause or lead to immediate physical harm to people (this does not include constituents of concern such as mercury, lead, asbestos and other hazardous substances, which are being investigated and addressed with oversight from the Minnesota Pollution Control Agency as part of a separate environmental response action project for the site).

This report provides information to assist in planning for mitigation actions or control of physical hazards on site.

# Process

## *Field Work*

A field inspection team consisting of nine University Health and Safety (UHS) staff members from the University of Minnesota surveyed the site for physical hazards.

The general approach used to identify physical hazards was to walk the entire property, section by section (Figure 3). Field inspectors spent 9 days on site for a total of approximately 650 labor-hours. The field investigators would line up across one end of a section and traverse it to the opposite end. Each inspector used a Global Positioning System (GPS)-enabled digital camera to photograph and record the location of each hazard. Logging GPS coordinates of each hazard is intended to facilitate remediation efforts.

The team also identified areas containing attractions (i.e., areas with abandoned structures visible from roadways that could invite urban explorers), and areas with visible signs of trespassing (e.g., graffiti, party debris, etc.). Many of the areas required a significant effort to traverse due to prohibitive vegetation overgrowth.

## *Hazard Location Data*

Photos with GPS coordinates were downloaded into ArcMap and integrated into the University GIS database for inventory and tracking, and to assist with mitigation planning.

Hazards were identified and broken into 10 general categories and plotted in our GIS system (Figure 4). These categories include:

- Deep holes/pits > 12 inch diameter, and > 4 feet deep (covered or uncovered)
- Access to fall hazards > 8 feet
- Access to fall hazards < 8 feet but > 4 feet
- Crumbling, toppling structures/columns
- Structure at risk of collapse
- Impalement hazards (walking level, horizontal, or vertical)
- Access to abandoned buildings
- Culverts (accessible, > 12 inch diameter)
- Tripping hazards with sharp edges
- Debris piles (wood, metal, concrete)
- Shallow holes/pits > 12 inch diameter, and < 4 feet deep
- Ground protrusions (vertical pipes, posts, hydrants)

## *Attraction and Trespass Area Data*

Areas containing attractions with visible signs of trespassing and areas where University employees and lessees work were designated high access areas and marked as such in the ArcMap system (see Images 1 - 4 for examples of attractions and trespass indicators). Areas with secure fencing and monitoring were designated as low access and the remainder was designated as medium access (Figure 5). High access areas present a higher level of risk because of a higher probability of the public or University employees coming into contact with the hazards. Field note: The survey team noted that many areas of the site are posted with "No Trespassing" signs.

**Image 1: Attractions – Ammonia Storage Tank (8-Ball)**

**Image 2: Attractions – Power Plant Exhaust Stacks (5-Stack)**


**Image 3: Evidence of Trespass - Graffiti**

**Image 4: Evidence of Trespass - Graffiti**

### *Analysis*

Each of the data points was assigned to one of twelve hazard type classifications. Each of those hazard classifications was given a severity designation of high, medium, or low, along with a corresponding numerical designation of 10, 5, or 3. The hazards given a rating of 10 have the potential for severe injury or death. Hazard severity designations were based on the cumulative professional judgment of the safety experts involved in the data analysis.

Additionally, each identified hazard was given an accessibility rating of high, medium, or low, along with a corresponding numerical designation of 3, 2, or 1 based on proximity to an attraction, evidence of trespassing, and accessibility. Areas with a higher likelihood of trespassing present a higher potential public risk than other areas at the site. The two ratings were multiplied to give an overall risk ranking of each hazard (Table 1).

| Hazard Level | Hazard x Accessibility | | |
|---|---|---|---|
| | High (3) | Medium (2) | Low (1) |
| (10) | 30 | 20 | 10 |
| (5) | 15 | 10 | 5 |
| (3) | 9 | 6 | 3 |

**Table 1: Overall risk ranking for hazard types found on site**

## Results

2049 data points representing potential physical hazards were gathered, analyzed, and ranked according to overall risk. Counts for each of the risk rankings are included in Table 2.
Rankings of 30 are considered high-risk hazards; rankings of 20 are considered medium hazards; and rankings less than 20 are considered low risk.

| Total number of hazards identified = 2049 | Hazard Level | Hazard x Accessibility | | |
|---|---|---|---|---|
| | | High (3) | Medium (2) | Low (1) |
| Deep holes/pits > 12 inch diameter; > 4 feet deep * | -10 | 35 | 47 | 5 |
| Access to fall hazards > 8 ft | -10 | 7 | 2 | 0 |
| Structure at risk of collapse | -10 | 1 | 0 | 0 |
| Access to fall hazards < 8 ft but > 4 ft | -5 | 32 | 133 | 4 |
| Crumbling, toppling structures/columns | -5 | 4 | 2 | 0 |
| Impalement hazards (walking level, horizontal or vertical) | -5 | 19 | 123 | 5 |
| Access to abandon buildings | -5 | 11 | 8 | 0 |
| Culverts (accessible, > 12 inch diameter) | -5 | 18 | 31 | 1 |
| Sharp trip hazards | -5 | 9 | 60 | 1 |
| Debris piles (wood, metal, concrete) | -3 | 53 | 145 | 21 |
| Shallow holes/pits > 12 inch diameter, and < 4 feet deep | -3 | 28 | 58 | 3 |
| Ground protrusions (vertical pipes, posts, hydrants) | -3 | 334 | 810 | 39 |

**Table 2: Hazard counts in each risk category**

*Note: A total of 87 manholes or pits were recorded during the assessment. Based on historical records, it is believed there could be 100 or more such features on the property that were not identified and mapped during this survey because of ground cover, debris obscuring the holes, or simply because the spacing of the survey team members.

*High Risk Hazards*

The hazards receiving the highest overall risk ratings, that is, the top hazards located in high access/trespass areas are considered high-risk hazards. High-risk hazards included: covered and uncovered manholes and pits greater than 4 feet deep (identified 35 times), fall hazards of greater than 8 feet in elevation (identified7 times), and one instance of a structure in danger of collapse (Attachments 1, 2 and Figure 6, 6A, 6B). Although there were 35 instances of manholes and pits identified in the high access areas, historical records suggest there may be a total of 80 or more in these areas.

*Medium and Low Risk Hazards*

The medium and low risk physical hazards consist of a range of risk ratings and should be prioritized as such (Attachment 3). Manholes and pits (identified 47 times) and fall hazards (identified 2 times) located in the medium access areas received the highest risk ratings in this group (Figure 7). The rest of the hazards (e.g., exposed rebar constituting impalement hazards, general trip hazards, debris piles, access to abandon buildings, shallow holes, etc.) dropped off in relative risk. A large portion of the accessible areas are difficult to reach due to high levels of overgrowth. These areas would likely require clear-cutting in order to access the hazards and as such could be given lower priority in long term remediation efforts. Hazards in the inaccessible fenced and monitored area are the lowest priority.

## Recommendations

1) Initiate immediate action to mitigate the high-risk hazards (hazards with risk ratings of 30) as these present the most significant risk of harm to the public because they are located in areas likely to be visited by trespassers. The high-risk hazards primarily consist of access to fall hazards, access to unprotected manholes and pits, and one instance of a structure at risk of collapse. In order to provide thorough mitigation, additional inspection should be conducted to confirm the locations of all sewer access points (manholes/pits) in the accessible and trespass areas. Each of the high-risk hazards should either be eliminated or access to those locations should be controlled and monitored.
2) Initiate immediate action to appropriately post and maintain additional “No Trespassing” signage around the property. This would prompt law abiding community members to keep off the property.
3) Consider demolition of the remaining exhaust stacks from the two power plants (4-stack and 5-stack), and demolition and removal of the spherical ammonia storage container (8-ball). This would remove the most visible structures which have been historic attractions to trespassers.
4) Establish a long-range plan to mitigate the other hazards on the site, prioritizing them based on risk ratings. Consider addressing these as part of long term site redevelopment or as funding becomes available.
5) Assess the means, methods and costs for mitigating the hazards, particularly the high-risk items.

**Attachment 1: Examples of High-Risk hazards**


**Fall Hazard: Deteriorated steps and supporting structures**


**Fall Hazard: Stacks have vertical cables that could invite climbers**

**Fall Hazard: Steps leading to an unprotected second level**

**Attachment 1 (continued): Examples of High-Risk Hazards**



**Uncovered holes/manholes**



**Covered holes and pits**


**Holes and pits obscured by growth**

**Depth of some holes**

**Structure at risk of collapse**

**Table 3 – List of all High-Risk Hazards**

| Hazard ID | Primary Hazard | Hazard Ranking | Access Rating | Overall Ranking | UTM_N | UTM_E |
|---|---|---|---|---|---|---|
| 0-P1000001 | Structure at risk of collapse | 10 | 3 | 30 | 4952504.752 | 495781.9709 |
| 1-P1000059 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4952758.911 | 495930.6129 |
| 1-P1000066 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4951801.095 | 494008.5566 |
| 2-P1000024 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4952672.517 | 495926.3789 |
| 3-P1000104 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4951855.316 | 494101.0049 |
| 7-P1000010 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4952306.072 | 495732.7854 |
| 7-P1000016 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4952330.747 | 495746.4405 |
| 7-P1000046 | Access to Fall Hazards > 8 ft. | 10 | 3 | 30 | 4952780.924 | 495767.1941 |
| 1-P1000060 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952733.582 | 495974.1499 |
| 1-P1000072 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4951899.259 | 493963.3291 |
| 1-P1000094 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952036.74 | 493783.727 |
| 2-P1000008 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952340.906 | 495782.5236 |
| 2-P1000012 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952390.59 | 495774.197 |
| 2-P1000023 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952729.465 | 495662.017 |
| 2-P1000066 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952336.127 | 495121.4852 |
| 2-P1000070 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952510.544 | 495017.3502 |
| 2-P1000088 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952622.152 | 495136.2195 |
| 3-P1000012 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952307.299 | 495742.9053 |
| 3-P1000027 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952786.683 | 495928.4307 |
| 3-P1000080 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952268.48 | 495218.0055 |
| 3-P1000098 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952255.906 | 495541.1486 |
| 3-P1000100 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952253.429 | 495552.8059 |
| 3-P1000107 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4951959.525 | 494103.3687 |
| 4-P1000090 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952297.993 | 495367.1738 |
| 4-P1000093 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952301.666 | 495408.7525 |
| 4-P1000107 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952297.541 | 495571.5346 |
| 5-P1000005 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952331.43 | 495648.1105 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5-P1000155 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4951863.721 | 494020.7145 |
| 5-P1000157 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4951889.987 | 493980.0401 |
| 5-P1000158 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4951904.441 | 494032.1919 |
| 5-P1000162 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952265.164 | 494015.5873 |
| 5-P1000165 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952286.46 | 494009.4476 |
| 6-P1000018 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952526.55 | 495488.7625 |
| 6-P1000019 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952615.767 | 495428.1135 |
| 6-P1000021 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952666.69 | 495414.0718 |
| 6-P1000035 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952464.304 | 494959.6812 |
| 7-P1000035 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952803.824 | 495668.006 |
| 7-P1000098 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952790.746 | 495393.0435 |
| 7-P1000304 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952498.254 | 495360.4985 |
| 8-P1000048 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952857.189 | 495691.1378 |
| 8-P1000200 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952230.988 | 495433.5602 |
| 8-P1000208 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952353.665 | 495621.0682 |
| 8-P1000248 | Deep Holes/Pits > 12 in. diameter, > 4 ft. deep | 10 | 3 | 30 | 4952504.329 | 495074.0984 |

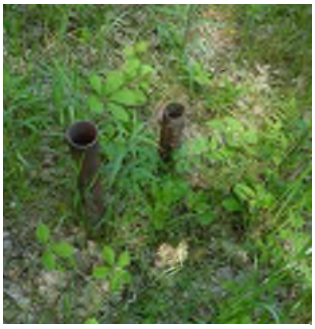
**Attachment 3: Examples of lower risk hazards**



**Shallow holes**



**Impalement hazards**


**Ground protrusions**



**Debris piles**