# DETERIORATED UNTREATED WOOD PILES

## CAUSE, DETECTION AND CORRECTION

## BACKGROUND – CAUSE

Woodpiles support many buildings in the NWT. Some buildings have woodpiles that have been treated with preservative before installation. For example, the Ft. Simpson Health Centre has pressure-creosoted piles. Other piles have been installed with no wood preservative treatment, often in permafrost soils. Preservative treatment can slow the rate of wood rot, but not eliminate it. Many buildings in the Mackenzie River Valley and Delta regions are supported on untreated woodpiles, installed typically in the 1970's and earlier. Many of the piles supporting these buildings have been in service for 40 years and are reaching the end of their natural service life.

### Natural Decay

Pile rotting is a natural decay process caused by microbes (fungi and bacteria) found naturally in wood and in the environment. Under certain conditions, the microbes grow by consuming the strong fibres of the wood, causing rot, and destroying the strength of the pile. These conditions usually include sufficient water, temperatures above freezing, and oxygen. Not all decay-causing microbes need oxygen.

### Older Piles

Untreated woodpiles are at greater risk of losing structural support capacity as they age, compared to preservative treated piles. They eventually become too weak to safely support the building and contents, even if they were installed in permafrost ground. The reason for this is the top of the pile is exposed for part of the year to wet and warm conditions near the surface of the ground. Those conditions activate the decay-causing microbes near the ground surface, causing the wood to rot and lose strength. Eventually the pile can be weak enough to collapse from the vertical structural load.

### Safety Factors

New piles are typically chosen to be larger than needed for the structural loads. The size is determined by engineering codes and standards. Part of a pile may be able to rot away before it becomes too weak to support the actual building weight. However, sometimes there can be strong horizontal forces acting on the pile system of a building. These forces may be caused by extreme wind conditions or earthquakes. The structural capacity of weakened piles that would otherwise safely support the weight of the building and contents may, under these conditions, be exceeded.

### Monitoring

Untreated wood piles installed in cold regions with moderate summer temperatures and lots of rain, a characteristic of the Mackenzie Valley basin, have been found to be at risk of accelerated decay, compared to cold regions where the summer warming period is drier and shorter. As a result, the GNWT since the mid-1990's has investigated, monitored and remedied deteriorating untreated woodpiles supporting the buildings it operates.

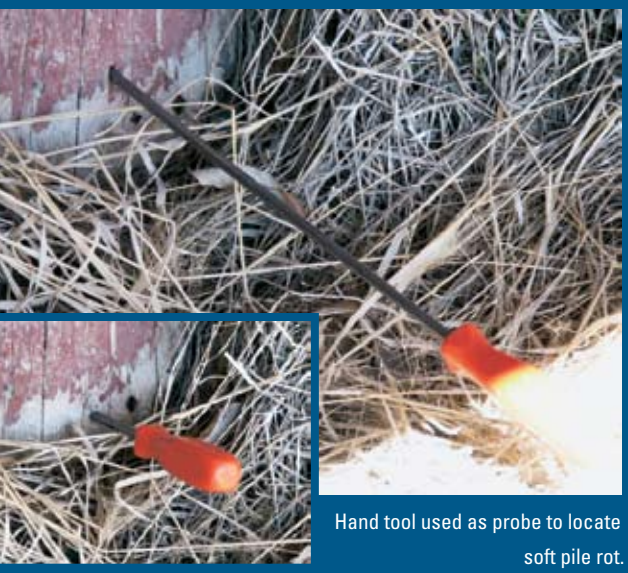
Total pile collapse and shift at ground level.

Total Pile collapse at Ground level.

Depression holds water around pile, speeding up rot.

TECHNICAL EXPERTISE NORTH OF 60°

**Technical Support Services**



Hand tool used as probe to locate soft pile rot.

Rotted wood is easily penetrated by hand driven tools.

Sampling of pile interior allows detailed diagnosis of wood rot progress in a lab.

# FINDING ROTTED PILES

## Initial Examination

Visual examination and penetration testing is the first line of detecting untreated woodpile rot. If woodpile rot is found early, there are chemical treatments available to stop or slow the rate of decay. Diagnosing and treating rot is a technical challenge. The advice of specialized wood protection consultants should be obtained. Sophisticated investigation techniques are available to examine deteriorated woodpiles, including ultrasound and x-ray imaging.

## Risk Analysis

Which buildings are at greater risk? Untreated woodpiles that support buildings in low-lying areas with poor drainage, or with water retained on or beneath the ground surface, are more likely to rot than buildings on dry, well-drained sites. Also at increased risk are buildings with un-ventilated enclosed crawl spaces that keep the ground warm and the moisture content high under the building, compared to buildings with cold ventilated crawl spaces.

## Regular Examination

In cold regions woodpile foundations on all buildings more than ten years old need to be periodically checked for deterioration. Make sure drainage is adequate to remove surface water away from the pile foundation to slow the rate of woodpile rot. Annual inspections when the ground and the pile temperature are at or above 5 degrees Celsius are required to effectively investigate pile status.

## Simple Detection

All building maintainers can become familiar with visual inspection techniques and simple penetration testing. Expose the pile by digging down 300 to 400 millimetres beneath the surface of the ground, until solid un-deteriorated wood is found. Use flat head screwdriver and hand pressure to probe the pile all around the outside surface in order to locate and measure the depth of rotted wood. Scrape beneath and above the rotted zone of the pile with a strong knife blade to find the un-deteriorated parts of the pile. Coat disturbed pile surfaces and holes with penetrating wood preservative.

## Specialized Testing

Specialized investigation methods available today to examine deteriorated woodpiles include core sampling, ultrasound and x-ray imaging. Specialized diagnosis and treatment of woodpile rot is technically challenging, and relies on the expertise of specialized wood protection consultants. Bore holes created during testing or treatment must be plugged or filled to prevent water filling the void.

# CORRECTION PROCEDURES

## DETERMINING THE PROBLEM

### Professional Inspection and Safety Review

If you find woodpile rot and determine its location and extent, it is essential to have the piles and the building substructure inspected by professional structural engineering consultants and specialists in woodpile deterioration and remediation. Consult with the local regulatory agencies responsible for building safety, such as the local building inspection department or the Office of the Fire Marshal. That authority will need to assess the life safety risk issues caused by the weakened building foundations and rotted piles.

### Safety Review Outcome

The outcome of a safety review by the building safety authority may vary from a recommendation for re-testing the building at a future time, to stopping the active use of the building until remedial measures can be taken. Temporary fixes, such as blocking to support vertical loads at deteriorated piles, will not necessarily provide the required strength for wind and earthquake loads.

### Short and Long Term Repairs

All untreated woodpiles subject to rot will eventually deteriorate and become too weak to safely support the building above. Before that time, they can be strengthened by putting on splints or sleeves to connect the solid portions of the pile. Another approach is that alternative short-term foundation units, such as blocking to support the building on the ground, can be introduced. Eventually, the foundation system at the end of its technical service life must be replaced or the building demolished or moved to a new foundation system.

Temporary support allows new pile sections to be installed.

New steel posts connect solid piles below the earth to the building.

The rotted portion of this pile has been replaced with new material.

Steel sleeves connect new piles to solid portions of original piles.

Wood crib blocking provides interim support for failed pile. Water must be drained to eliminate frost heaving.

# PWS ACTION PLAN

As many of the wooden piles supporting GNWT infrastructure are reaching the end of their service life, PWS has established a formal Risk Management and Safety Program to ensure the safe operation of GNWT infrastructure. To address these concerns, PWS has implemented three new initiatives to address the problem:

1. Staffing of a Risk Management and Safety Officer/Specialist
2. Implementing a GNWT Building Condition Assessment reporting system
3. Accelerating the Wood Pile Inspection and Repair Program

### For further information, please contact:


Risk Management and Safety Officer/Specialist
Facility Management
Asset Management Division
Public Works and Services
Government of the Northwest Territories
Box 1320, Yellowknife, NT, X1A 2L9

**Tel:** (867) 873-7028
**Fax:** (867) 873-0226


# SAFETY IS EVERYONE'S RESPONSIBILITY

## MONITORING AND OVERSIGHT

### Building operators or owners can monitor woodpiles:

- **KEEP DRY.**
  Make sure there is good drainage of water away from the piles. Divert surface water. Maintain air-drying of the piles.
- **REGULARLY MONITOR AND MEASURE.**
  Make a visual and probe inspection and write down the condition, pile moisture measurement and pile softness, as part of routine building maintenance.
- **TRACK THE TREND.**
  Review the change in condition to determine if pile deterioration is increasing.

### Specialists are needed to do more detailed evaluation and testing:

- **PILE CONDITION ANALYSIS**
  Detailed probing and measurement of the different types of rot that may affect a pile foundation by woodpile specialists.
- **FOUNDATION AND SUBSTRUCTURE ANALYSIS**
  Determining the operating structural capacity of the pile foundations and assessing the foundation capacity to support the building through structural engineering.
- **ENGINEERING SURVEY AND ASSESSMENT OF THE SUPERSTRUCTURE**
  To determine if the building has changed as a result of movement or settlement in the foundation system.
- **BUILDING FAILURE RISK AND STRUCTURAL SAFETY**
  Determined through reverse-engineering the existing structure, in accordance with engineering design rules and standards.
- **COST-BENEFIT REINVESTMENT ANALYSIS**
  To determine the economic cost to conserve or extend building service life.


**Prepared By:**
Technical Support Services
Asset Management Division
Public Works and Services
Government of the NWT



**For more information, contact:**
Manager
Technical Support Services
Tel: (867) 920-8088
Fax: (867) 873-0226
http://www.pws.gov.nt.ca/


Northwest Territories Public Works and Services