

## Wastewater Facility Operation Challenges in Cold Weather

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## The Challenges

- For 5 to 6 months of the year Maine operators face an environment of cold, snow and ice in their operations at wastewater facilities.
- These conditions present enormous challenges that are rarely encountered elsewhere
- Very little specific help has been published for wastewater operations in coldweather climates

## Solutions

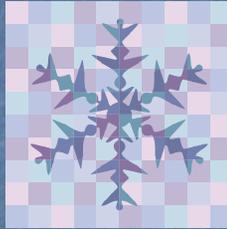
- Maine operators have faced and overcome a wide variety of problems over the years
- Innovation and creativity: Operators know lots of "tricks of the trade" gained through experience
- Try to bring these together in this session
- Successful operators plan ahead!

## Cold Weather Challenges

- Conditions faced by operators
- Planning for cold weather
- Designing for cold weather
- Safety

## Winter conditions

- Low Temperatures
- Snow
- Ice
- Wind
- Melt water
- Short day length



## Low Temperature

- Freezes water!
- Effects efficiency of wastewater treatment process
- Effects mechanical systems
- Presents hazards to the worker

## Planning for low temperatures

- Insulate and protect critical water lines (chem feed, samplers, etc)
- Assure heating systems are in place and operational.
- Winterize exposed mechanical systems
- Conduct as much exterior maintenance as possible prior to onset of winter

## Insulation and Heat



## Planning for low temperatures

- Make sure stored equipment (valves, pumps, pipes) are completely drained or winterized with antifreeze to assure functional when needed.



## Planning for low temperature

- Condensation can be a big problem in winter.
- Causes ice up on doors and windows which leads to many sprung hinges when these are forced open or closed
- Insulate and or ventilate areas with problems

## Snow

- Expect 100+ inches each winter in N. Maine
- Covers manholes, hatches, curbs, tools
- Restricts access
- Adds weight loads to structures
- Expensive to move

## Snow

- Northern and western Maine average around 100 inches each season.
- At Caribou WS average period with snow cover is Nov 11 through April 17... (over 5 months)



## Snow removal

- Need to maintain access to facility treatment structures, pump stations, storage buildings, hatches, sampling locations.
- May need to relieve snow loads from building roofs and tank covers.
- May want to maintain snow cover in places to provide insulation for underground water lines

## Planning ahead

- Late fall walk around and clean up
- Pick up hoses, extension cords, trash, tools and store materials undercover.
- Mark low structures like culverts, curbs, driveway edges, lagoon liner edges, hatches and manholes that could be damaged by plows and loaders. Grade stakes work well
- Pre-locate critical access points

## Planning ahead

- Know where snow is going to be put during removal.
- Establish plow lanes and snow dumps
- Avoid piling against walls and fences
- Consider where melt water will go to avoid icing problems and flooding during thaws
- Plow trucks, snowblowers, shovels, roof rakes ready to go and ACCESSIBLE?

## Snow removal protection

- Concrete pylons can be installed to protect low structures from damage by loaders and plows
- Space them closer than the narrowest plow!



## Clearing off roofs

- Weight depends on density of snow and can be deceptive.
- Aging structures can fail under snowload that they previously withstood.
- Maintaining even distribution of weight is critical in removal process. (Domes and arches)
- Hazardous for workers: Work from ground with roof rakes when possible

## Snow removal from roofs



## Ice

- Can be significant weight load on structures
- Expansion during ice formation can damage concrete and masonry, burst pipes.
- Falling ice can cause injury and significant damage.
- Presents slip hazards for workers.
- Ice cover can damage lagoons

## Ice



## Ice

- Will form on walkways, railings, aerators and anyplace splashing or drips occur in exposed locations.
- Ice dams can form on poorly insulated roofs and cause considerable damage from leaks or by falling on other structures, vehicles, etc
- Refreeze of meltwater from snow in exposed locations
- Serious slip hazard.

## Ice and lagoons

- Ice cover on wastewater lagoons can cause serious damage to liner, aerators, baffles and other structures.
- Especially important to monitor storage lagoons that have fluctuating levels during period when ice cover exists.

## Ice and lagoons

- Ice blocks and shelves can hang on sides during drawdown.
- Slip off during melt and will tear and puncture liner and shear off lines, baffles and aeration headers.
- Seasonal discharge and snowfluent storage lagoons most susceptible.

## Ice and lagoons



## Ice and lagoons

- Rocks and gravel from roadways can become sandwiched between liner and ice layer and slice through liner as ice moves vertically.
- Lateral movement of ice sheets can tear out baffle anchors and impact concrete structures.

## Ice and lagoons



- Liner and structure repairs are costly and time consuming.

## Planning ahead

- Clear gravel and rocks off lagoon liner edges.
- Remove and store unneeded surface aerators prior to freeze up
- Remove lines and floats prior to freeze up
- Monitor curtain baffles
- Plan for gradual drawdown

## Ice and concrete

- On freezing, water expands about 10%
- Pores, holes and cracks allow water to soak into concrete and masonry
- Freezing and thawing cycles put tremendous stress on concrete structures
- Spalling occurs when ice forms beneath surface causing large pieces of concrete to flake off.

## Ice and concrete

- Air-entrained concrete provides spaces within the concrete to relieve stresses.
- Properly sealed concrete prevents water absorption and freeze/thaw damage.
- De-icing agents increase the number of freeze/thaw events and increases damage to concrete.

## Preventing damage to concrete

- Avoid use of de-icing agents on concrete (use gravel and sand)
- Repair chips and cracks and seal with commercial grade sealer
- Seal exposed anchor holes
- Shovel stairs and walkways ASAP
- Address drainage and drip problems to prevent buildup and need for de-icing agents.

## Wind

- Moves snow causing drifting and unevenly distributed snow-loads on buildings
- Increases cooling effect through wind chill
- Can tear off unsecured doors and hatches

## Planning for high winds

- Secure tarps, bulk bags, empty barrels etc that could be blown into treatment units
- May want to provide windbreaks for exposed work areas such as tank walkways and sampling points
- Consider establishing snow fencing or planting windbreaks in areas where drifting snows create problems

## Melt Water

- Large amounts of precipitation water are stored in the snowpack.
- Most thaw events are high runoff events resulting in high flows to treatment facilities
- Ice jams on receiving waters can flood facilities and damage outfall structures.
- Small amounts can cause nuisances and slip hazards when they refreeze

## Planning for the thaw

- Develop a wet weather operations plan and stick to it.
- Maintain collection system and work to reduce inflow and infiltration
- Make sure CSO points, pump stations, headworks, extra tankage, and treatment units are ready to go.
- Monitor weather and keep staff apprised

## Planning for the thaw

- Consider meltwater flows in snow removal activities.
- Check and maintain stormwater control structures to divert runoff away from facility.
- Make sure culverts and stormdrains are in good condition and free of blockages prior to winter
- Mark and protect culverts.

## Planning for the thaw

- Marking culverts and stormdrains in the fall will help to locate them if freeze up should occur.



## Flooding and Ice Jams



Aroostook River, Fort Fairfield ME

Photo: George Watson, Director, Fort Fairfield Public Works

## Flooding and Ice Jams

- Many Maine rivers are prone to ice jams and flooding.
- Aroostook, Sandy and St. John rivers are shallow and wide with low banks.
- Other rivers have low areas that are flood prone.

## Flooding and Ice jams

- Can cause significant and costly damage to wastewater treatment facilities.
- Develop an flood emergency action plan and take part in local emergency management planning
- Protect critical equipment from damage

## Ice Damage



## Limited Day Length

- Only 9 hours of daylight in early winter
- Sunlight intensity is much less in winter due to low angle of sun in winter sky.
- Short day length limits outdoor work day
- Need increased work lighting indoors
- Can effect workers (Seasonal Affective Disorder)

## Lighting

- Check lighting in all work areas
- Clean fixtures and replace bulbs regularly.
- Add fixtures in inadequately lit areas
- Have portable work lighting available for emergency work
- Headlamps for task lighting a good idea

## Designing for Cold Weather

- Make sure design process has role for operator.
- Consider cold weather operations when reviewing project plans
- Make sure the design works FOR the operator
- Communicate concerns

## Common Design Problems

- No thought about snow removal (dead ends, fencing at driveway edges, no protection for low structures)
- Exposed mechanical systems and work areas
- Sampling points and lines susceptible to freeze up
- Condensation not considered
- Inadequate concrete for steps, pump stations

