**4-5: Ice Storm**

Ice storms are characterized by ice accretion from freezing rain, which can weigh down trees and power lines, causing outages and potentially occurring in conjunction with flooding (see: Inundation Flooding & Fluvial Erosion). Ice storms can occur alone or in conjunction with snow storms (see Snow Storms), blizzards (see Snow Storms, for wind impacts, see: Wind), and extreme cold (see Extreme Cold).

Significant accumulations of ice can cause hazardous conditions for travel, weigh down trees and power lines, and cause power outages. Freezing rain can also be combined with mixed precipitation and snowfall, hiding ice accumulation and further hindering travel. Ice accumulation on waterways is associated with the potential for ice jams and flooding (see: Inundation Flooding & Fluvial Erosion).

NOAA’s WPC WSSI (see Snow Storms), includes ice accumulation as a weighted factor to depict severity of transportation and downed trees/powerlines due to the accumulated ice in combination with wind. Flash freeze is also a weighted factor used to depict severity primarily to transportation of situations where temperatures rapidly fall below freezing during precipitation with the presence of liquid water.

**Location**

There is no specific region of Vermont that is more vulnerable to ice storms. Ice tends to accumulate earlier and remain longer during the winter season in mountainous regions of the state.

Ice Storm History

* **Ice Storm, January 6, 1998 (DR-1201):** Known as *The Great Ice Storm*, an unusual combination of precipitation and temperature led to the accumulation of more than 3” of ice in many locations, causing closed roads, downed power lines, and damage to thousands of trees. This storm was estimated as a 200-500 year event. Power was out up to 10 days in some areas and 700,000 acres of forest were damaged in Vermont. Vermont suffered no fatalities, unlike Quebec where 3 million people lost power and 28 were killed. Temperatures rose after the storm, causing the ice to melt and permitting crews to reopen roads, which kept many residents from freezing in their unheated homes. Over $6 million worth of estimated property damage.
* **Ice Storm, December 11, 2008 (DR-1816):** Winter storms and high winds resulted in extensive power outages, primarily in southern Vermont counties. Upward of 40,000 homes were without power for several days during this period.
* **Snow Storm, December 28, 2011:** A strong cold front moved across Vermont during the late morning and afternoon hours accounting for a rapid cool down and localized snow squalls with heavy snow. The western slopes of the Green Mountains saw 5-12” of snow along foothill communities. Near white-out conditions in snow squalls and rapidly freezing road ways accounted for numerous vehicle accidents as well as a closure of I-89 between Richmond and Waterbury.
* **Ice Storm, December 20-21, 2013 (DR-4163):** Approximately 1/4-1/3” of ice accumulation from freezing rain on December 20 with an additional 1/2-3/4” of ice accumulation as well as 1- 2” of sleet December 21 in portions of northern Vermont. Very cold temperatures (-10°F to teens) followed the event with no melting, thus ice stayed on trees and utility lines through December, prolonging recovering. The greatest impact was in northwest Vermont, with widespread tree and utility line damage as well as numerous vehicle accidents. More than 75,000 customers were without power from hours to days. Over $4 million in property damage estimated.
* **Winter Storm, December 29, 2015:** Snow overspread Vermont around midnight on December 29th and ended by mid to late afternoon, changing to sleet and freezing rain before ending. Snowfall amounts across the area was 3 to 7 inches with limited icing. Motor accidents occurred across the region, including a Semi, SUV crash along Route 4 near Killington, VT during the afternoon that resulted in 3 indirect fatalities.
* **Winter Storm, January 12, 2018:** A warm moist flow followed by an artic front caused an inch or more of precipitation across Vermont in the form of rain, freezing rain, sleet, and snow. Temperatures 25-20 degrees above normal caused significant snowmelt followed by an inch of rain which caused rivers to approach bankfull with several reports of rivers flooding due to ice jams. Some of these rivers included the Winooski near Montpelier Jct, Lamoille at Johnson, Passumpsic near Lyndonville, Missisquoi near Swanton and the Connecticut river near Windsor. Sharply falling temperatures in the overnight allowed for a flash freezing of roads making for extremely hazardous travel.
* **Ice Storm, January 12, 2020:** A moisture laden storm tracking along an old cold front positioned itself on the international border near western Vermont on the 11th of January with temperatures across Vermont ranging in the 50s to 60s. As the front progressed south into Vermont, moderate to heavy rain fell across the region. During the early morning of the 12th the cold front slipped south and ¼ to ½ inches of ice accretion was widespread, resulting in hazardous travel and scattered power outages.

Ice Storm Trends

The Steering Committee considered the probability of a plausibly significant extreme ice event to be Likely, with minor impacts on built environment and natural environment, and moderate impacts on people and economy.

According to the 2018 National Climate Assessment, there is an observable increase in the frequency of the most severe winter storms in the Northeast since observations began in 1950[[1]](#footnote-2).

Vulnerability

People

Ice storms can cause extensive disruptions to transportation and connection between people and services, including disruptions in communication infrastructure. People in rural areas are temporarily cut off from emergency services. Transportation becomes extremely difficult. Bridges and overpasses become particularly dangerous as they tend to freeze before other surfaces. Ice accumulation can immobilize a region, stranding commuters, closing airports, halting the flow of critical supplies, and disrupting emergency and medical services. The weight of ice can bring down trees and power lines, cutting off power to homes and businesses needed for electric heating system, lights, communications and life support equipment. Homes with generators or propane-based heating systems can lead to carbon monoxide poisoning if not properly ventilated[[2]](#footnote-3). Homes may be isolated for days, sometimes requiring emergency personnel to navigate hazardous conditions for wellness checks.

Built Environment

The greatest impact on infrastructure from ice storms is typically the downing of powerlines, causing widespread blackouts. Industries that rely on power to function can be severely impacted by loss of power, such as dairy farmers who rely on electric milking machines to milk the cows. Dangerous conditions due to ice on roadways and other transportation infrastructure can disrupt key supply chains.

Natural Environment

The impacts of ice storms on the natural environment can be extensive for both flora and fauna. Accumulated ice can weigh down trees, causing limbs to break off and fall. Our natural environment is more adapted to these changes, whereas urban landscaping often faces unique challenges of soil compaction, shallow root systems, and impervious surfaces that interact with winter weather differently than less disturbed environments. Soil compaction and underlying infrastructure can prevent urban tree roots from moving lower towards sources of groundwater and places that don’t freeze during the winter. As a result, prolonged exposure to frost can impact the hydraulic conductivity for street trees by breaking these columns resulting in air filled conduits. Expanding air bubbles during temperature fluctuations can further impact tree health[[3]](#footnote-4). Native species that are well suited to local climate conditions are ideally selected for planting along town and city streets[[4]](#footnote-5). The use of salt on roads during the winter can increase water stress, affect soil quality, mineral nutrition, and accumulation to toxic levels within salt sensitive plants. Exposure to high levels of salt in salt sensitive plants can result in poor growth, stunted leaves, heavy seed loads, twig and branch die-back, leaf scorch, and premature leaf drop. Plants stressed by excessive salt are also more susceptible to biotic diseases and insect pests[[5]](#footnote-6). A reduction in the use of chloride-based de-icers is encouraged for the general health of soils and plants. Street trees can often be seen with a coat of white paint on the lower 2-3 ft of the trunk. This maintenance is done to prevent sunscald, a condition where the bark will crack due to large temperature fluctuations during the winter. Since white paint has a higher albedo than the bark, it is used to reflect solar energy that would typically warm up the trunk only to freeze and crack when the sun disappears behind a cloud/sets[[6]](#footnote-7).

Economy

The costs of ice prevention, repairing damage from ice storms and loss of business during ice events can have severe economic impacts on cities and towns. For Class I highways in Vermont, winter maintenance (which includes salt application rates, cost per centerline mile of plowing, and hourly cost of plowing) was totaled to around $6,400 per mile[[7]](#footnote-8). This study accounted for only the Class I highways, leaving significant costs for local roadways for towns to pay for. In 2010, the town of Jericho spent $14,969 on winter maintenance and grading for 7/10ths of a mile for a gravel road[[8]](#footnote-9). With roughly 55% of Vermont roads being dirt or gravel, this can become a significant expenditure for the state and towns[[9]](#footnote-10). With automotive transit being a major aspect of society, icy road conditions hindering travel can limit commuting and travel, forcing businesses to temporarily close. Vermont has prominent agricultural and forestry industries that focus mainly on dairy products/other livestock products[[10]](#footnote-11) and maple sugaring respectively[[11]](#footnote-12). Winter storms and cold snaps can increase stress on livestock, potentially leading to a loss of livestock if extreme. Freezing rain on the limbs of trees, both sugaring and orchard, can damage stock and hurt associated businesses.

Ice Storm Current Capabilities and Mitigation

State facilities and individual towns are generally well prepared to deal with ice storms. VTrans winter maintenance road crews are experienced and well-equipped to keep highways open and municipal road crews are also generally well-prepared. Most critical State facilities have emergency backup generators in case of loss of power due to icing.

This Plan has identified a priority mitigation strategy (see: Mitigation Strategy) to increase Public Service Department capacity to maximize utilization of available federal dollars (including IIJA, IRA, ARPA, and EDA) towards utility resilience implementation work. A mitigation strategy to identify and evaluate microgrid feasibility for rural energy systems/hubs - including assessing locations for resilience hubs in coordination with utilities and RPC work under Act 174 will also address ice storm vulnerability. The next step action will be to identify scales of resilience and opportunities across distribution utilities and appropriate opportunities to support equitable access to resilience - assessing disparity between utility providers.

Though several towns in the State are considering burying power lines for long-term mitigation against both wind and ice events, a statewide approach to power line burying is not being considered at this time due to being cost prohibitive.

1. https://nca2018.globalchange.gov/chapter/2#key-message-8 [↑](#footnote-ref-2)
2. https://www.healthvermont.gov/sites/default/files/documents/pdf/English\_CO\_Safety\_Tips.pdf [↑](#footnote-ref-3)
3. https://www.frontiersin.org/articles/10.3389/fpls.2016.00867/full [↑](#footnote-ref-4)
4. https://vtrans.vermont.gov/sites/aot/files/highway/documents/environmental/VTrans%20Landscape%20Guide.pdf [↑](#footnote-ref-5)
5. https://plant-pest-advisory.rutgers.edu/impact-of-road-salt-on-adjacent-vegetation/ [↑](#footnote-ref-6)
6. http://pubs.cahnrs.wsu.edu/publications/wp-content/uploads/sites/2/publications/fs197e.pdf [↑](#footnote-ref-7)
7. https://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/Class%20I%20Town%20Highways%20White%20Paper.pdf [↑](#footnote-ref-8)
8. https://www.ccrpcvt.org/wp-content/uploads/2016/02/SkunkHollowRoad\_RevisedReport\_20110602.pdf [↑](#footnote-ref-9)
9. https://www.burlingtonfreepress.com/story/news/local/2015/03/15/march-vermont-mud-eye/24783751/ [↑](#footnote-ref-10)
10. <https://ustr.gov/map/state-benefits/vt> [↑](#footnote-ref-11)
11. <https://extension.psu.edu/maple-syrup-production> [↑](#footnote-ref-12)