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# Best practices for cycle path winter maintenance processes

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## Winter maintenance in Finland

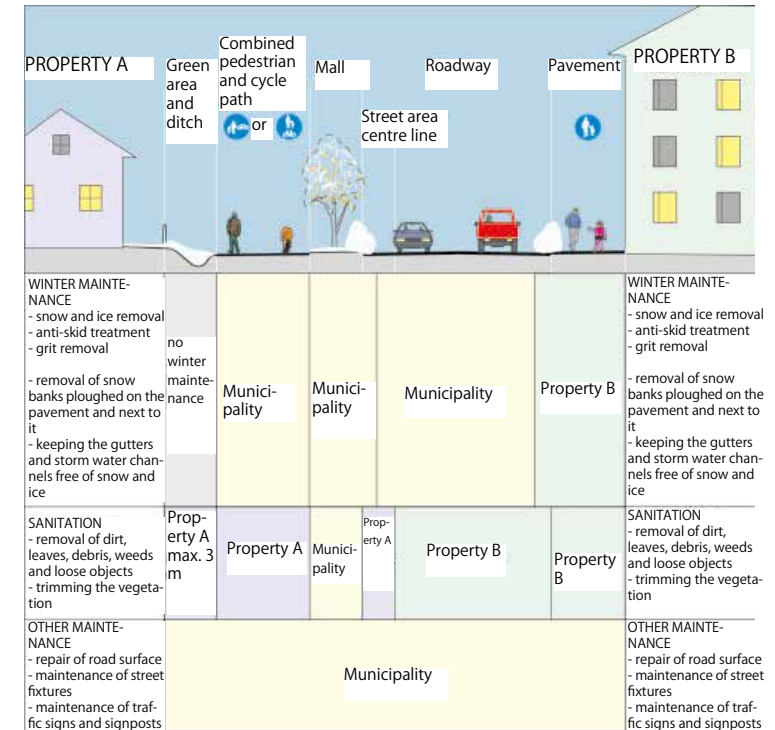
### Street maintenance is the responsibility of the municipality

In Finland, the law states that maintenance and public sanitation of streets and certain public areas are the responsibility of the municipality. The owner of a plot has a duty to take care of the maintenance of the pavement next to plot by keeping it clear of snow and taking care of gritting and salting, for example. Figure 1 presents the responsibilities related to street maintenance. It is also possible for the municipality to take over the maintenance of the pavements belonging to the plot owner. [1]

According to the law, the municipality has the right to prioritise the streets to be maintained. This makes it possible to give priority to the maintenance of more significant transport routes. The maintenance classification should be performed separately for vehicle traffic, and footways and cycle paths. According to the Maintenance and Public Sanitation Act, the roads must be kept in a satisfactory condition for traffic. However, the Act does not define a specific level for the quality of the maintenance, leaving this the responsibility of each respective municipality. [2]

Therefore, it is the task of a municipality to organise the maintenance as well as to define the level of quality and the actions and measures to meet this level. Hence the criteria of time limits, snow thickness or the methods to be used, for example, can vary significantly between cities. The importance of winter maintenance of cycle paths and footways also varies between cities.

### Street maintenance and sanitation responsibilities



*Fig. 1. Street maintenance responsibilities. In principle, pavement maintenance is the responsibility of the property owner, and the municipality takes care of the other traffic routes. [3]*

According to the Maintenance and Public Sanitation Act, the roads must be kept in a satisfactory condition for traffic. However, the definition of the level of quality is the responsibility of the municipality.

## Challenges in cycle path winter maintenance

Winter maintenance is one of the most important means available for controlling cyclist and pedestrian volumes during the winter months. The number of cyclists can be increased by keeping the routes free from snow and ice. Cycling usually declines during the snowy winter period: in the summer time, there can be up to 10 times more cyclists on the roads. Although the snow conditions in many Finnish cities are challenging, the number of cyclists can be significantly increased by improving winter maintenance. Cycling is also possible in winter as long as winter maintenance is used to create sufficient conditions for it. [4] [5]



**Fig. 2.** Snow ploughed on cycle path makes safe movement difficult and encourages cyclists to use the road instead.

**Fig. 3.** The excess snow ploughed from the road often piles up on cycle paths and footways located next to the road.



**Fig. 4.** In winter maintenance, intersections are often problematic. The snow tends to pile up at the ends of the pedestrian crossings, making them more difficult to use for pedestrians and cyclists.





## Implementation of the study

### Example cities

In order to find the best cycle path winter maintenance practices, four Nordic example cities were selected: Copenhagen, Denmark; Linköping and Umeå, Sweden and Oulu, Finland. The material was collected by separately interviewing the employees responsible for maintenance in each respective city. In all cities, the winter maintenance of cycle paths and footways has been prioritised, and various practices are used to maintain a high-quality network of cycling and pedestrian routes throughout the year.

Copenhagen's winter maintenance processes are among the most effective. The city lives up to its cycling city reputation in summer and winter, as the efficient and proactive use of salt prevents the cycle paths from icing over, keeping the cycling conditions safe throughout the year. Linköping has set stringent quality requirements for the city's 90-km long main cycle path network. Snow coverage of 1 cm is enough to send the combined snow sweeping/salting vehicles into action to clear the cycle paths of snow and to prevent the road surface from freezing over. In Umeå, the snow conditions are challenging. To ensure a good level of quality, the City has subsequently decided to maintain the streets in the city centre area itself. Oulu is probably the best-known cycling city in Finland. Thanks to good winter maintenance, cycling is a quick and efficient alternative to motoring, even in the winter time.

The methods used to achieve a high winter maintenance quality in the example cities differ. The winter maintenance process and methods used are adapted to the city-specific characteristics and weather conditions. A common feature for all of the cities is that they appreciate the cyclists' needs and prioritise these in their winter maintenance processes.



*Fig. 5. Example cities in Finland, Sweden and Denmark.*



## Winter conditions in the example cities

Winter maintenance is mainly organised based on the weather conditions, which vary from city to city. In Copenhagen, there is not a lot of snow in the winter, but slipperiness often causes problems. In Oulu and Umeå, the ground may be covered with snow for more than 150 days of the year. This means that ploughing and snow storage become critical factors. In Linköping, the winter conditions are somewhere in between those of the other cities. See Table 1 for winter conditions in the cities studied.

|                  | Linköping  | Umeå   | Copenhagen   | Oulu  |
|------------------|--|--|--|---|
| Inhabitants      | 147,334 (2011)   | 117,294 (2012)   | 549,050 (2012)   | 190,847 (2013)  |
| Length of winter | 75 days of snow coverage (on average, 1961–1990)             | 150 days of snow coverage (on average, 1961–1990)            | Cold season<br>21 Nov –22 Mar  | 160–175 days of snow coverage (on average, 1981–2010) |
| Mean temperature | Approximately 6 degrees (yearly mean temperature, 1961–2011) | Approximately 3 degrees (yearly mean temperature, 1965–2011) | The highest daytime temperature: below 6 degrees (on average, 21 Nov–22 Mar) | 2–3 degrees (annual mean temperature)                 |
| Snow depth       | 20 cm (on average, 15 Feb 1981–1990)                         | 50–60 cm (on average, 15 Feb 1981–1990)                      | 6.8 cm (greatest depth on average, 8 Jan)                                    | 40–60 cm (on average, 15 Mar 1981–2010)               |

*Table 1. Winter conditions in the example cities.*

[6] [7] [8] [9] [10] [11] [12]

*Linköping*



*Umeå*



*Copenhagen*



*Oulu*



## Winter maintenance processes in example cities

### One step at a time toward objectives

Efficient and effective winter maintenance requires a well-planned maintenance process. Each part of the process must function seamlessly together to ensure a route that is safe and easy to navigate. Each study city has worked out their winter maintenance differently, but the level of cycle path and footway maintenance quality has been raised to a high level in all of them. It is even higher than that applied to road maintenance. See Table 2 for some key figures related to winter maintenance in the example cities.

With regard to winter maintenance, it is particularly important that the City upholds the set quality requirements and that the high winter maintenance levels are adhered to. Because it is seldom possible to achieve the high-quality standards with respect to the whole route network, Linköping and Umeå, for example, have prioritised a network of routes to be maintained at a particularly high maintenance quality level. The network is used to inform the citizens of the routes that are suitable for pedestrians and cyclists throughout the year, regardless of the weather. Cyclists and pedestrians must be assured that the route is always going to be safe to use.

It is wise to start improving the quality of winter maintenance through small actions rather than trying to raise the quality level of the entire network immediately. For example, by selecting one of the most heavily-used cycle paths and then promising to keep it in good condition, it is possible to show the inhabitants what a high level route at its best can be like. This way, you can attract more people to engage in winter cycling.

In Umeå, for example, the maximum snow coverage on the prioritised cycle path network was previously 2 cm. However, the City soon realised that keeping up that quality level was too challenging, and the snow limit was raised to 4 cm. The citizens have been happy with this change, because they now know what kind of winter maintenance quality level to expect. Even with the raised snow limit, the high-quality winter maintenance in Umeå makes cycling easy.

**Quality criteria must be set so that the stated quality level can be maintained throughout the entire winter.**



|                                   | Linköping   | Umeå   | Copenhagen   | Oulu*   |
|-----------------------------------|---|--|--|---|
| Snow ploughing times per winter   | 100, class I cycle paths<br>25, class II cycle paths<br>(on average)          | 30, class I cycle paths<br>15, class II cycle paths<br>(on average)  | 29, cycle paths<br>9, footways<br>(2011/12)  | 36, in total class I and II routes (2012)   |
| Anti-skid treatments per winter   | 100, class I cycle paths<br>25, class II cycle paths<br>(on average)          | 19, class I and II cycle paths<br>(on average)   | 29, class A cycle paths<br>9, footways<br>(2011/12)  | 16, in total class I and II routes (2012)   |
| Amount of snow removed per winter | 200,000–300,000 m <sup>3</sup><br>(on average)                                | 162,520 m <sup>3</sup> (2011/12)   | In an average winter, snow removal is not required   | approximately 300,000 m <sup>3</sup><br>(including footways in the city centre)   |
| Budget per year                   | Footways and cycle paths approximately 2.4 million in EUR (20 million in SEK) | Total budget approximately 4.1 million in EUR (about 35 million in SEK)<br>Cycle paths approximately 0.8 million in EUR (about 7 million in SEK) | Total budget 4.7 million in EUR (35 million in DKK),<br>Cycle paths and footways not separated | EUR 720,000 per year, class I pedestrian and cycle routes<br>EUR 550,000 per year, class II pedestrian and cycle routes |
| Cycle paths, km                   | Ca. 560 km (including the prioritised 90 km long network) (2012)              | 67 km, prioritised routes<br>171, other cycle paths and footways (2012)  | 358 km (2012)  | 600 km (2012)   |

**Table 2.** Key figures related to the winter maintenance of the study cities.

\* The number of times City of Oulu snow ploughs and anti-skid treatments are employed and the amount of snow removed only include maintenance actions carried out by Oulu technical public utility (TEKLI), not outside contractors.

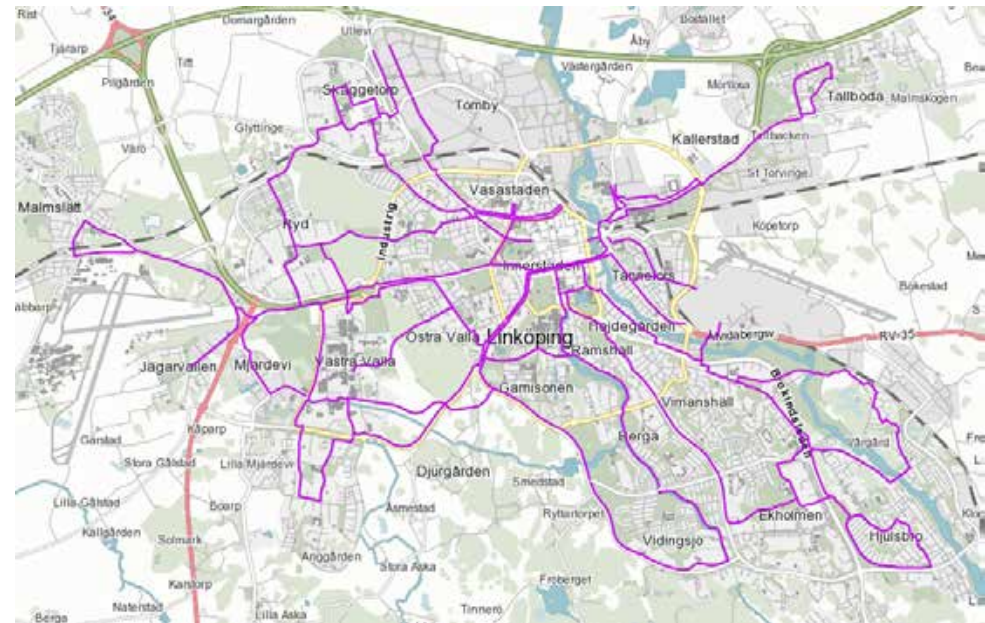


## Linköping

### Prioritised 90-km cycle path network

In total, there are approximately 560 km of cycle paths and footways in the Linköping city area. Out of that, approximately 90 km belong to the prioritised cycle path network. The network is designed to connect the most important business areas, the university, schools and the city centre to the residential areas. The winter maintenance requirements are higher for the prioritised network than on other cycle paths. The snow limit is 1 cm, and maintenance is carried out using a combination of sweeping and salting. Thanks to the prioritised network, the residents can rest assured that certain routes will be easily accessible for cyclists and pedestrians throughout the winter.

The general snow limit on Linköping's street plan is 3 cm (except for the local streets belonging to the 'lokalvägnät' where it is 5 cm) for cycle paths and roads alike. Time limits have been placed to prioritise the winter maintenance criteria of the city centre and travel centre areas. The city centre must be clear of snow within 6 hours and the public transportation centre within 3 hours after the snowfall has stopped.



*Fig. 6. The snow limit for Linköping's prioritised 90-km cycle path network is 1 cm. [13]*

### Maintenance requirements

#### Prioritised 90-km cycle path and footway network

- Snow limit 1 cm
- Work must be completed within 4 hours from when the snow limit is reached
- Work methods used are sweeping and salting. If the temperature falls below -10 degrees, salt cannot be used. When the snowfall is heavy, plough is used instead of sweeping.

#### Other cycle path and footway network

- Snow limit 3 cm
- Work must be completed within 8 hours from when the snow limit is reached
- Methods used are ploughing and sanding

## Works contracts

There are seven contract areas in Linköping, and six contractors. The works contracts are awarded for five years at a time. The contract period is designed to be long enough to make it worthwhile for the contractors to invest in new equipment, for example. The contracts are mainly based on geographical areas, with the exception of the prioritised 90-km cycle path and footway network, the maintenance of which has been given to a single contractor, even though the network passes through several separate contract areas. This way, only one contractor has had to acquire the special sweeping and salting equipment required. A continuous contract area also ensures that the quality remains uniform throughout the route.

The contractors decide themselves when they start the maintenance, but they are required to send an e-mail notification before starting each action. This is to make sure that the city personnel in charge of the maintenance are aware of the status of the street network. An e-mail will also be sent to the City's customer service centre so that they are able to answer any questions regarding the winter maintenance.



*Figures 7 and 8. The prioritised cycle path network is maintained using a method that combines sweeping and salting. During heavy snowfall, ploughing is used instead of sweeping.*

## Working dialogue with the contractors

When necessary, the City is in contact with the contractors on a daily basis. In their monthly meetings, the City and the contractors discuss the work carried out and any problems that may have arisen. Sometimes the City personnel in charge of the maintenance take part in these contractor meetings and meet the drivers themselves. This way, they have the opportunity to discuss important matters at the grassroots level and, on the other hand, to hear the views and comments of the drivers regarding winter maintenance.

Some contractor equipment has GPS locators, enabling the City to monitor the maintenance actions. The GPS locators make it easier to track where the driver has been at any given time and to verify that all routes are cleared as agreed. The locator also provides detailed location information on possible road surface failures or other problems reported by the driver. The City's goal is to have GPS locators available on all contractor equipment.

## WINTER MAINTENANCE PROCESS

### Before taking any action

- The contractors decide when and what actions they start, and notify the City via e-mail.
- The e-mail is sent to the City personnel in charge of maintenance and those working in customer service.

### During maintenance actions

- Drivers keep driver's logs.
- Some vehicles have GPS locators that allow the monitoring of their movements.
- If necessary, the City and the contractors contact each other by telephone on a daily basis.

### Follow-up

- City representatives and contractors have monthly meetings to discuss problems regarding winter maintenance, for example.
- City representatives can also visit the contractor's own meetings.





## Pavement maintenance

In Linköping, pavement maintenance is the responsibility of the property owner. However, not all property owners carry out their duties in accordance with the required level, which can cause problems – especially in the city centre. Therefore, the City initiated a project which aimed to get the property owners to purchase winter maintenance services for their respective pavements from the contractor managing the area. This way, the pavements could be maintained at the same time as the other parts of the routes, thus improving quality levels. The method was tested during winter 2012–2013 on one street section, and the results were promising.



*Fig. 9. In Linköping, the heating system keeps the pedestrian areas clear of ice.*



*Fig. 10. In Linköping, as is the case with Finnish cities, pavement maintenance is the responsibility of the property owner.*

## Umeå

### Prioritised cycle path and footway network

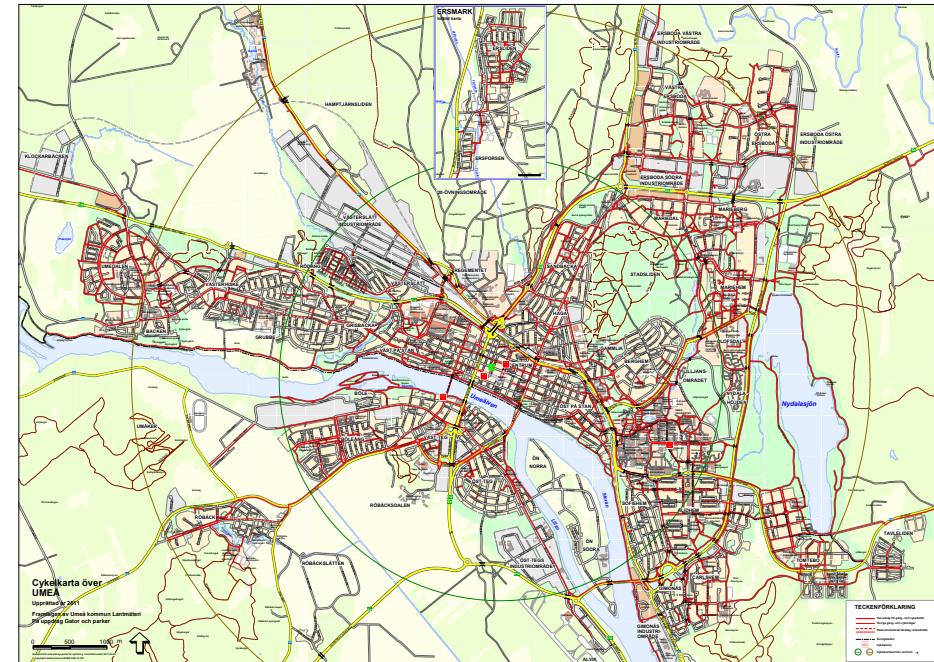
There is a total of approximately 240 km of cycle paths and footways in Umeå. Of these, 67 km belong to the prioritised cycle path and footway network, which has more stringent winter maintenance quality requirements. The prioritised network connects all residential areas to the university, hospital and the city centre. Most of the residents work or go to school within these areas, so good connections are important.

The City has drafted a winter maintenance quality declaration, which guarantees that the main streets will be ploughed after a 4–6 cm snowfall, and the prioritised cycle paths after a 4 cm snowfall. On the other cycle paths and footways, the snow limit is 6–8 cm. On the prioritised network, the goal is to carry out proactive anti-skid treatment.

### Warm wetted sand

In the warm wetted sand method, sand is mixed with hot water before applying it to the road surface. This makes the sand stick more effectively to the surface, providing higher traction than in normal sanding. In particular, this method is suitable for conditions where the temperature is below  $-1\text{ }^{\circ}\text{C}$ . [14]

The method was introduced in Umeå in 2006 and during the winter of 2011–2012 the properties of the method were studied by VTI (Statens väg- och transportforskningsinstitut) [15]. The warm wetted sand was found to be more effective than normal sand but slightly more expensive. The efficiency of the method, however, cuts the number of sanding times required. Therefore, there was no significant increase in total costs after introducing the method in Umeå.



*Fig. 11. In Umeå, the prioritised cycle path and footway network extends to different parts of the city. Other cycle paths complement the network. [16]*

### Maintenance requirements

#### Prioritised cycle path and footway network

- Snow limit 4 cm
- Anti-skid treatment should be carried out proactively
- Methods in use are ploughing and warm wetted sanding

#### Other cycle path and footway network

- Snow limit 6–8 cm
- Anti-skid treatment is applied when ice is detected
- Methods used are ploughing and sanding

## Works contracts

In Umeå, the City itself is responsible for winter maintenance in the city centre. The maintenance of the other city areas have been awarded to an outside contractor with a 3-year works contract. The contract can, however, be extended by a further 2 years. Although it is more expensive for the City to maintain the city centre itself than using an outside contractor, the City wants to invest in the quality of the maintenance. It is possible to guarantee high quality and invest in small details by using your own personnel than by using an outside contractor.

External contractor decides on the actions they take independently, but they must contact the City before starting any actions. Subsequently, the City always has two employees on standby to receive the notifications from the contractors and to control the maintenance work. In order to manage the maintenance more efficiently, the City aims to take more responsibility for decision-making regarding, for example, when the actions should commence.



**Figures 12 and 13.** In Umeå, the prioritised network is used to separate the cycle path network from other traffic in most locations, including the city centre.



## GPS locators make monitoring easier

The street and park department at the City of Umeå uses the ISO 9001 certification, with which the quality of the winter maintenance is monitored and evaluated. A GPS tracking system helps with quality control and devices have been installed in the equipment of both the City of Umeå and the contractor. The system makes it possible to track the movements of the maintenance equipment along the road network, and to identify the driver and the time of day. In particular, this makes it easier to monitor the actions carried out by the contractor and, on the other hand, to locate problematic areas on the map.

Furthermore, the City and the contractor also meet twice a month in the winter time. In order to bring up any problems and to be able to address them as soon as possible, there are weekly meetings with those responsible for the maintenance performed by the City.



*Fig. 14. The City of Umeå has opted to build green areas between the cycle paths and footways and the road, and use them for snow storage.*

## WINTER MAINTENANCE PROCESS

### Before taking any action

- The contractors decide when and what actions to start, and notify the City of them.
- There are two City employees continuously on standby to control winter maintenance.

### During maintenance actions

- GPS locators are used to monitor the movement of the equipment. The information reveals the identity of the driver, the time of driving and the route taken.
- The City has its own checklist for maintenance quality monitoring. Quality inspections are made when necessary.

### Follow-up

- City representatives and the contractor meet twice a month.
- There are weekly meetings with those responsible for the maintenance performed by the City.
- ISO 9001 certification system is utilised in quality control.

## De-icing system

In Umeå, the most important cyclist and pedestrian underpasses and bridges are heated. Heating is used to ensure that these locations are safe to move in. In some locations, the motive has been to minimise the risk of winter maintenance damage to a particularly expensive surface material.

The heating system utilises district heating circulating water. De-icing systems cost 2.5–3 times more compared to the traditional maintenance methods, but the benefits they offer are deemed to outweigh the higher costs.



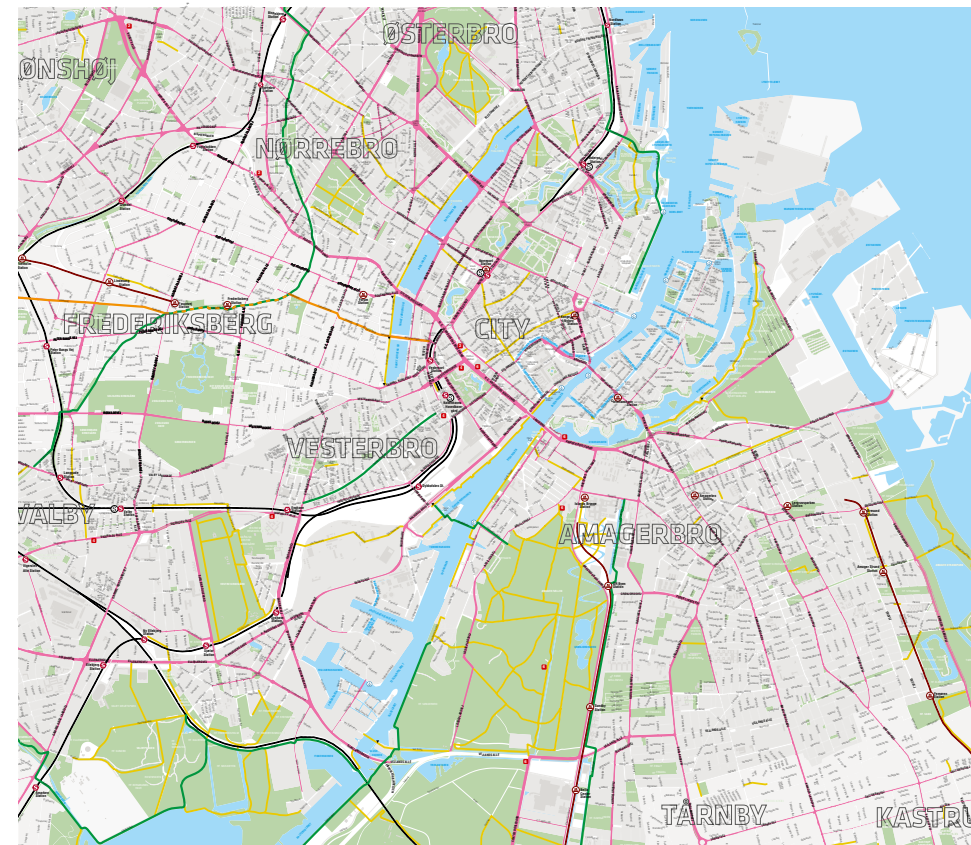
## Copenhagen

### Continuous cycle path network

In Copenhagen city centre, the street space is usually divided into three parts: road, one-way cycle path edged with kerb stones, and pavement. There is a total of 358 km of cycle paths, and they are kept free from snow by sweeping or, in case of heavy snowfall, ploughing. The main method of anti-skid treatment is salting, and the aim is to use it proactively on the cycle paths. Like Linköping, Copenhagen also uses combined sweeping and salting equipment.

The three different maintenance classes in use in the city are A, B and C, of which class A is of the highest quality. All cycle paths belong to class A, and all pavements to class B. The snow limit for classes A and B is 2–3 cm. The roads may belong to class A, B or C. Class C routes are cleared of snow only after the higher class routes have been cleared.

The quality of Copenhagen's winter maintenance is based on proactive salting. The aim is to apply salt to the cycle paths before they freeze, which ensures safe cycling, regardless of the weather.



### Maintenance requirements

#### Class A (cycle paths)

- Snow limit 2–3 cm
- The aim is to keep the routes clear of ice at all times
- Methods used are sweeping/ploughing and salting

#### Class B (pavements)

- Snow limit 2–3 cm
- The aim is to clear any ice from the routes by applying anti-skid treatment with a few hours delay
- Methods used are sweeping/ploughing and salting

*Fig. 15. Copenhagen has a comprehensive cycle path network that is separated from both motor and pedestrian traffic. [17]*

## Works contracts

There are 40 different contractors operating citywide in Copenhagen. The contracts have been determined route-specifically, and the number of routes per contractor can vary. The duration of the contracts is four years. The route-specific contracts help to minimise quality issues when moving from one contract area to another, and the quality is even across the whole street network.

The contractors have agreed that the last contractor to arrive at a road junction clears the junction area of snow. This way, everybody knows whose responsibility it is. The City has also taken over some junction areas belonging to private roads that otherwise would not be under the City's maintenance responsibility. This is to ensure a high maintenance quality level throughout the city and on the main cycling routes.

The decisions regarding the winter maintenance actions in Copenhagen are made by the City. Winter maintenance is managed from a control room, from where things like weather conditions and sending orders to contractors to undertake actions are monitored. Thanks to the control room, dozens of contractors can be managed easily and in a systematic manner.

**In Copenhagen, the last contractor to arrive at a junction is required to clear the junction area of snow.**

## Control room

The entire maintenance responsibility of the City of Copenhagen is controlled around the clock from the control room. There are always two duty officers monitoring the weather and making decisions on winter maintenance actions. The control room receives information from ten measurement locations around the city. Among other things, the points provide information about the amount of salt and traction on the routes' surfaces. Around-the-clock monitoring allows for high-quality winter maintenance, thanks to proactive salting.

The duty officers can contact the contractors directly and instruct them on what actions should be taken. On the class A routes, the contractors have 45 minutes to start work after acknowledging the notification. On class B routes, the deadline is 1 h 15 min and on the class C routes it is 1 h 30 min. The movement of the contractors can be monitored via GPS locators.





## Continuous monitoring

The City of Copenhagen has three employees who are responsible for monitoring the quality of the winter maintenance. Quality control takes place every time the equipment is on the move.

At the beginning of the winter the City has a meeting with all the contractors to explain the maintenance procedures. However, the City and the contractors exchange information continuously throughout the winter. The City aims to provide the contractors with both positive and negative feedback when necessary. The idea of the feedback is to let the contractors know that they are subject to constant supervision.



*Fig. 16. A salted and swept route offers good traction, making cycling safe and easy.*

## WINTER MAINTENANCE PROCESS

### Before taking any action

- The control room monitors the weather conditions and decides on the actions to be taken.
- The control room sends a message to the contractors who acknowledge it and start the work within a certain time limit.

### During maintenance actions

- The movement of the equipment can be monitored from the control room using GPS positioning.
- Quality is always assured after maintenance actions.

### Follow-up

- The City keeps in regular contact with the contractors throughout the winter, giving both positive and negative feedback.
- The City makes the decisions, the contractors merely carry out the tasks.

## Oulu

### A separate and straightforward cycle path network

There are approximately 600 km of cycle paths in Oulu, the winter maintenance of which has been divided into two quality classes. On the class I cycle paths, the snow limit is 2 cm, and the routes are to be ploughed by the end of the following workday. In case of continuous snowfall, the snow limit is 3 cm. The snow should be ploughed before the following morning and afternoon rush hours at 7 am and 4 pm, respectively. If there is snowfall after 6 pm, it does not need to be ploughed before 7 am the following morning, unless the snowfall is in excess of 8 cm. On the class II cycle paths, the snow limits are 3 cm and 5 cm in case of a continuous snowfall. Slush should be removed from the cycle paths and footways when it reaches 3 cm on the class I routes and 5 cm on the class II routes. [18]

In general, the anti-skid treatment used on the cycle paths is ploughing and sanding. At certain locations, separate permission can be granted for the use of salt in spring and autumn. The ploughs use perforated blades so as not to create a slippery surface.

At the beginning of 2013, Oulunsalo, Haukipudas and Kiiminki merged with the City of Oulu, which is now also responsible for their winter maintenance. In this study, however, we only concentrate on the winter maintenance of Oulu proper.

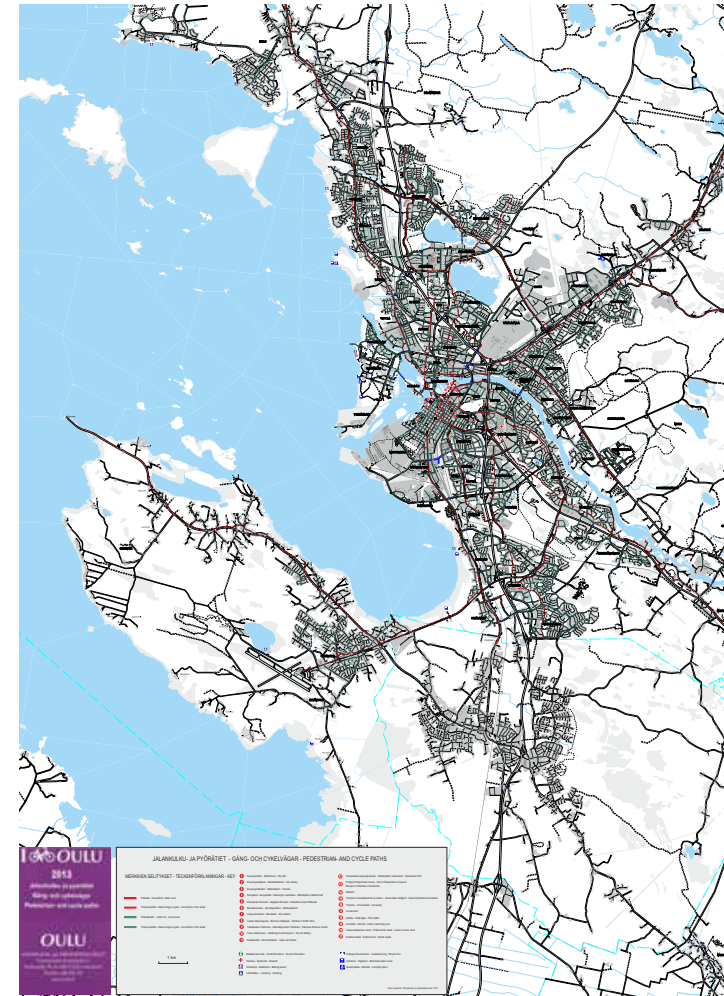
#### Maintenance requirements

##### Class I

- Snow limit 2 cm, 3 cm during snowfall
- The aim is to keep the routes clear of ice at all times
- Ploughing and anti-skid treatment is carried out before 7 am and 4 pm. After 6 pm, the snow does not need to be ploughed unless the accumulated snow coverage thickness is over 8 cm.
- Methods used are ploughing and sanding

##### Class II

- Snow limit 3 cm, 5 cm during snowfall
- The aim is to clear any ice from the routes by applying anti-skid treatment with a few hours delay
- Ploughing and anti-skid treatment is carried out after the maintenance of the class I routes
- Methods used are ploughing and sanding



*Fig. 17. In Oulu, the cycle path network runs separate from the vehicle traffic, making winter maintenance easier and more efficient. [19]*

## Works contracts

There are eight regional maintenance areas in Oulu proper, four of which are managed by the Oulu technical public utility (TEKLI). The other areas have been given to outside contractors. There are four outside contractors with four-year works contracts. The contract periods overlap so that all contracts do not expire at the same time. Therefore, one contract is tendered each year. As a result, contractors who lose the contract this year can bid for a maintenance contract in another area the following year.

The contractors decide themselves when to start the maintenance actions. However, the City contacts the contractors via telephone or e-mail to discuss actions when necessary. The monthly meetings between the City and the contractors cover issues such as what actions have been carried out, and feedback regarding maintenance.

### TEKLI

The Oulu technical public utility, or TEKLI, began its operations in early 2008. As a public utility, it offers maintenance and building services, machine and transport services, and real estate and logistics services. A management board subordinate to Oulu City Council is responsible for the operations and viability of the department. At the moment, TEKLI is responsible for the maintenance of four contract areas. [20]



*Fig. 18. De-iced footways facilitate the use of bicycle racks in the winter, and covering the racks facilitates winter maintenance.*

*Fig. 19. In Oulu, the ploughed surface must not be left slippery, so the ploughs must use a perforated blade.*



## Follow-up

The contractors are not obliged to notify the City of the actions they carry out in real time, but the quality of the maintenance is monitored via inspections and field reviews. Inspections apply to TEKLI, too. The contractors must follow the winter maintenance criteria stated in the quality cards. Among other things, the cards specify the snow and time limits, the grade of sand to be used and the properties of the ploughing equipment.

The City also has a browser-based information website for saving contract-related documents such as works contracts, ploughing logbooks and quality cards. This facilitates communication between the City and the contractors and ensures that all parties have the same information at their disposal.

During 2013, Oulu implemented a GPS tracking system for ploughing and sanding equipment for a new area contract. The goal is to extend the use of the GPS system whenever new work contracts are concluded.



*Fig. 20. Junctions are often left unattended, especially where contract areas meet at a junction. With proper maintenance, however, it is possible to ensure safe crossing for cyclists and pedestrians alike.*

## WINTER MAINTENANCE PROCESS

### Before taking any action

- The contractors decide themselves when to start the maintenance actions. The City monitors the quality of the work.

### During maintenance actions

- Field reviews are used to monitor the level of maintenance whenever possible. Customer feedback, in particular, is one criteria used to review possible quality issues.

### Follow-up

- There is a monthly site meeting held between the City and contractors
- Contractors are required to follow the requirements stated in the quality cards when carrying out their duties.

## Works contracts in brief

|                          | Linköping  | Umeå   | Copenhagen  | Oulu  |
|--------------------------|--|--|---|---|
| Number of contractors    | 6  | 1 + the City takes care of the maintenance of the centre itself  | 40  | 4 + Oulu technical public utility (TEKLI)   |
| Number of contract areas | 7  | 2  | –   | 8   |
| Type of contract         | Regional, 90-km route, route-specific  | Regional   | Route-specific  | Regional  |
| Equipment                | 3 salting and sweeping machines<br>55 tractors for the whole route (cycle paths and roads) | 19 tractors, 2 of which are for sanding only and the rest for ploughing and sanding.<br>In total with the contractor: 45 tractors. | 28 tractors for cycle path maintenance (salting and sweeping)<br>36 tractors for footway maintenance (salting and sweeping) | TEKLI:<br>20 ploughing tractors + 4 sub-contractor tractors<br>19 tractors for sanding<br>(In addition, the propriety equipment of the other contractors) |

## Communication with stakeholders

### Linköping – dialogue is the key to success

In Linköping, the City and the contractors are engaged in an open dialogue. Both parties give feedback and contact each other by e-mail or phone on a daily basis during the winter when necessary. Although there are occasional winter maintenance quality problems in Linköping at junctions and contract area borders, for example, these issues are easily addressed through dialogue. An open, working dialogue ensures that issues can be solved quickly and easily by a single call, if necessary.

Besides the contractors, the City is in contact with various stakeholders during the winter. The public transport operator, for example, is informed in good time of any winter maintenance problems. This way, the operator can take the conditions into account and inform customers of any possible changes due to winter maintenance.

### Umeå also informs its citizens

In Umeå, contractors are obliged to notify the City before starting any maintenance actions. The City utilises the information provided by the contractor efficiently to inform citizens. The web pages of the City contain continuously updated information about winter maintenance, including locations and what is happening next. This way, the citizens can check for themselves exactly when the streets nearby will be ploughed. This reduces the amount of calls to the city customer service centre and maintenance team. If the City's customer services centre receives calls related to maintenance, the callers can be referred to the web pages, which often provide an answer to the problem.

The screenshot shows the Umeå kommun website with a green header and navigation menu. The main content area is titled "Snöröjning och sandning" (Snow clearing and sanding). It features a large image of a snowplow clearing a road. Below the image, there is a "Snödagbok" (Snow diary) section with a yellow background, indicating sanding of prioritized GC-roads and streets. A "Chatta Öppet" (Chat Open) button is visible in the bottom left corner. The right sidebar contains sections for "Kontakt och felanmälan" (Contact and reporting), "Mer information" (More information), and "Ordlista" (Glossary).

*Fig. 21. The City of Umeå website provides an easy way to check what is going on with regard to maintenance. The electronic form makes it possible to give feedback regarding any winter maintenance problems and to indicate the problem areas on the map. [21]*



## Winter maintenance into consideration in road network planning

### The basis for winter maintenance is created during the planning stage

To facilitate efficient and easy-to-operate winter maintenance, the routes must support winter maintenance. Maintenance is easier when the routes are separate from other traffic, as in Oulu and Umeå. When the snow is ploughed from the road, it doesn't accumulate on the cycle paths and footways. A separate, uniform route is easy to plough and sand without the need to worry about other traffic.

### Observing the requirements of snow logistics

The space requirements for snow logistics are often ignored when planning areas and streets. If there is no storage space for snow next to or near the streets, the ploughed snow must be transported elsewhere. This can increase winter maintenance costs significantly. In Umeå, the aim is to leave a 3-metre wide safety strip between the cycle paths and footways and the road for easy storage of the ploughed snow. In Copenhagen, there is always a half a metre of space left between the road and the cycle path for snow storage. This way, there is no need to transport snow during an average winter. Besides space for snow storage, the planning must take into account the melt water flows in the spring.



*Figures 22 and 23. When the route is separated from the other traffic, maintenance is easier. That is one of the reasons for the high-quality winter maintenance found in Oulu and Umeå.*

### Aiming for minimum snow removal

In Umeå, snowfall during the winter is heavy, and removal of snow increases costs. Hence the desire to minimise the need for snow logistics. In residential areas where there are two pavements, one is used to store snow. This means that pedestrians may have to use the road or the pavement on the other side for some distance. This is not considered a problem, since the traffic is light and slow-moving.



**Fig. 24.** In Copenhagen, planners have added a half-metre wide space for snow between the cycle path and road, eliminating the need to transport snow during a normal winter.



**Fig. 25.** Using appropriate machines for the routes guarantees consistent quality. (Copenhagen and Linköping)

## Principles of winter maintenance

**Keep your promises.**

**Do not try to do everything at once. Select a prioritised route of a suitable length for high-quality maintenance throughout the year.**

**Monitor the level of maintenance throughout the winter and maintain ongoing dialogue with the contractors.**

**It is easier to develop maintenance when you know the situation on the streets.**

**Take maintenance requirements into account when planning the routes. Significant savings can be achieved by planning the places for snow storage, for example.**

**Select the most appropriate maintenance methods for the weather conditions in the city.**





## Sources

- [1] Maintenance and Public Sanitation Act, 1978: *Laki kadun ja eräiden yleisten alueiden kunnossa- ja puhtaanapidosta*. 31 August 1978/669.
- [2] Association of Finnish Local and Regional Authorities, 2007. *Katujen kunnossa- ja puhtaanapidon laatutaso ja väylien luokittelu*. Association of Finnish Local and Regional Authorities. Kuntatalon paino. Helsinki, 2007.
- [3] Ministry of the Environment, 2005: *Kadut kuntoon: Vastuut kadun kunnossa- ja puhtaanapidosta muuttuivat 1.11.2005*. Ministry of the Environment brochure, November 2005. Soprano Oyj. Ministry of the Environment and Association of Finnish Local and Regional Authorities.
- [4] Ministry of Transport and Communications, 2003: *Talvipyöräily: The extent, motives and barriers to health*. Ministry of Transport and Communications' JALOIN programme City of Helsinki, City of Oulu, City of Rovaniemi and the Finnish Road Administration, Oulu 2003.
- [5] Bergström, Anna, 2002: *Winter maintenance and cycle paths*. A PhD thesis in English. Royal Institute of Technology, Stockholm. Stockholm 2002.
- [6] Finnish Meteorological Institute, 2013: [WWW] The official website of the Finnish Meteorological Institute. [www.ilmatieteenlaitos.fi](http://www.ilmatieteenlaitos.fi) (25 May 2013)
- [7] City of Copenhagen, 2013: [WWW] Statistikbanken. <http://www.kk.dk/da/om-kommunen/fakta-og-statistik/statistik-og-historie/statistikbanken> (29 May 2013)
- [8] Linköping Municipality, 2013: [WWW] "Statistik Årsbok för Linköping". <http://app.linkoping.se/statdok/sabok/innehall.htm> (29 May 2013)
- [9] City of Oulu, 2013: [WWW] Official website of the City of Oulu at [www.ouka.fi](http://www.ouka.fi) (29 May 2013)
- [10] SMHI, 2013: [WWW] Swedish Meteorological and Hydrological Institute's website at [www.smhi.se](http://www.smhi.se) (25 May 2013)
- [11] Umeå Municipality, 2013: [WWW] Umeå Municipality statistics, population. <http://www.umea.se/umeakommun/kommunochpolitik/faktaomkommunen/statistikochanalyser/befolkning.4.3c34d75c1292984ed9680001542.html> (29 May 2013)
- [12] Weatherspark, 2013: [WWW] Average weather for Kastrup near Copenhagen, Denmark. <https://weatherspark.com/averages/28823/Kastrup-near-Copenhagen-Capital-Region-of-Denmark> (25 May 2013)
- [13] Linköping Municipality, 2012: [WWW] "Linköpings karta, Sopade och saltade cykelbanor". Available at <http://kartan.linkoping.se> (7 October 2013)
- [14] Norem, Harald, 2009: *A winter maintenance strategy for roads based on climatic factors*. VTI report 630A, published in 2009.
- [15] Niska, Anna. 2013. *Varmsandning på gång- och cykelvägar, Utvärdering i Umeå av för- och nackdelar med metoden*. VTI rapport 796. VTI 2013.
- [16] Umeå Municipality, 2013: [WWW] Cycling map on Umeå Municipality's website. Available at [www.umea.se](http://www.umea.se) (7 October 2013)
- [17] Københavns kommune. 2013. *Cykelkort København, Cycling map Copenhagen*. Københavns kommune, Teknik- og Miljøforvaltningen. 4. udgave. 2013
- [18] City of Oulu, 2013: Indicative maintenance quality cards.
- [19] City of Oulu, 2013: "Pedestrian- and cycle paths 2013" map. City of Oulu, Urban and Environmental Services.
- [20] Oulu technical public utility, 2008: Annual report 2008. Oulu technical public utility. Available at [http://oulu.ouka.fi/tekli/tiedostot/Tekli\\_Toimintakertomus\\_08.pdf](http://oulu.ouka.fi/tekli/tiedostot/Tekli_Toimintakertomus_08.pdf) (11 October 2013)
- [21] Umeå Municipality, 2013: [WWW] Snöröjning och sandning. <http://www.umea.se/umeakommun/trafikochinfrastruktur/renhallningochsnorojning/snorojningochsandning.4.bbd1b101a585d7048000173733.html> (16 October 2013)

**Interviews:**

City of Copenhagen, Kim Sørensen – person in charge of maintenance, 14 December 2012

City of Linköping, Lise-Lotte Johansson – person in charge of maintenance, 5 December 2012

City of Oulu, Kai Mäenpää – head of maintenance, 20 February 2013

City of Oulu, Minna Komulainen – maintenance supervisor, 20 February 2013

Oulu technical public utility, Ilmari Kyllönen – works manager, 29 April 2013

City of Umeå, Marie Frostvinge – traffic planning manager, 12 December 2012

City of Umeå, Torbjörn Sandberg – street operations manager, 12 December 2012