

DIFFERENTIATED WINTER MAINTENANCE IN VIENNA

Peter NUTZ, Ph.D.

Vienna City Administration, Municipal Department 48
Waste Management, Street Cleaning and Vehicle Fleet
peter.nutz@wien.gv.at

ABSTRACT

Compared to rural roads or highways winter maintenance in cities is different in many ways. The different modes of transportation, the lack of space for snow, narrow roads and one-way streets make planning winter maintenance very complex.

The road network in Vienna has been divided into 4 categories with different treatment intervals and periods. Different categories of roads require different vehicles and working hours models in order to provide a good quality winter maintenance.

In Vienna bikeways and bicycle lanes are treated to raise the share of bicyclists in the mode of transportation. On a prioritized bikeway network special small tractors with brine-spreader on a trailer take care of a consistent quality on the prioritized lanes.

In pedestrian areas with a huge amount of walking and shopping people winter maintenance is a challenge during times of high pedestrian volume. Thus it is necessary to finish the winter maintenance during the night to have clean and ice-free pedestrian areas until morning.

The lack of space for snow to be stored temporarily is one of the challenges in urban areas. To get the snow out of public traffic areas it has to be dispatched.

1. WINTER MAINTENANCE IN VIENNA: RESOPONSIBILITIES AND FACTS

1.1. General facts about Vienna:

Vienna is the capitol of Austria with an area of 414.65 km² and a population of 1.87 Million people in the city (1. January 2017). The Elevation reaches from 151m above seas level to 542m. Winters are relatively dry and cold with average temperatures at about freezing point, the temperature record low is -17.6°C. The mean annual snowfall is 68cm with a minimum of 2 cm (2013/2014) and a maximum of 229 cm (1877/1878).

1.2. Responsibilities

Within the Vienna City Administration the Municipal Department 48 - Waste Management, Street Cleaning and Vehicle Fleet – (MA 48) is responsible for winter maintenance on public roads (except highways) and pavements with no adjoining owner or the City of Vienna as adjoining owners. The division Street Cleaning and Winter Maintenance is the leading operational division in the Municipal Department 48 (MA 48) supported by other divisions.



On highways all over Austria the Highway company *ASFINAG* is responsible for winter maintenance. Highways within the area of Vienna are maintained from 2 *ASFINAG* depots. Due to the sharp responsibility boundaries a good cooperation between MA 48 and

ASFINAG has been established. Since it is not possible to turn around at the highway access, the routes are coordinated to minimize route lengths for both partners.

Wiener Linien is the biggest operator of public transport systems (bus, tram, metro) in Vienna and responsible for winter maintenance on separated tram tracks and most tram stops.

The pavement in front of a property line is in responsibility of the adjoining owner according to federal law. The owners have to clean the pavement and keep it free of ice and snow from 6 am to 10 pm Monday to Sunday. This leads to a situation where responsibility and often quality of winter maintenance changes every 15 meters.

1.3. Organisation of Municipal Department 48 (MA 48)

Vienna is organised in 13 cleaning districts of the MA 48 division Street Cleaning and Winter Maintenance with 12 day cleaning districts and one additional cleaning district for night hours, based in the inner city of Vienna. Each cleaning district is lead by one cleaning district manager and has at least one maintenance depot. This division operates the fleet of small vehicles (up to 9.5t) and provides the manual workers.

The trucks used in winter maintenance are provided by the MA 48 division Vehicle Fleet. During winter, work in two shifts is common to ensure a continuous service interval in winter maintenance. These two divisions work close together under supervision of a winter maintenance manager.

Under regular conditions, all roads, bikeways and bicycle lanes in responsibility of MA 48 are serviced using own vehicles. The number of vehicles is adjusted to the current weather situation and can reach up to 250 vehicles. In case of heavy snowfall, freezing rain or similar weather conditions, around 100 contractors can be used to help out. The contractors have their own personal, vehicles, ploughs and spreaders and only conduct winter maintenance if they have been requested by MA 48.

Pavements in responsibility of MA 48 and mixed bicycle/pedestrian areas are serviced by contractors. Different to the contractors for roads, these companies are fully responsible for the winter maintenance without direct instructions from MA 48.

1.4. Storage capacity for salt

The main salt storage hall at the Danube harbour of Vienna has a capacity of around 45,000 tons of salt. The salt delivery from the vendor to the hall is usually done using ships or trains. 13 winter maintenance depots with 43 salt silos and 17 brine mixing plants are distributed in the city area. To get the salt from the harbour to the silos at the depots trucks are used. Silo capacity is between 75t and 600t with the new silos on the top end of capacity. Table 1 gives an overview of some facts about winter maintenance in Vienna.

The brine mixing plants are fully automatic and draw the necessary salt from the silos. Due to the extensive use of brine storage capacity and efficiency of mixing plants has been raised with a goal of 1.7 Million litres storage capacity.

Table 1: Facts about winter maintenance in Vienna

| | |
|---|--|
| Staff in winter maintenance | Up to 1,400 people |
| Vehicles (own and contractors) | 352 Trucks or multi-equipment carrier |
| Serviced traffic area | 24 Mio. m ² |
| Serviced road network | 2,800 km |
| Pedestrian crossings | around 24,000 |
| Parking places for handicapped (voluntarily) | around 2,600 |
| Pavement serviced by MA 48, combined pedestrian/cycling areas and markets | Around 610 km |
| Winter maintenance service depots | 15 |
| Salt silos | 37 |
| Salt storage capacity | 55,000 tons of salt 960,000 litres of brine |

2. PRIORISATION OF ROADS AND ROUTE PLANING

The planning of winter maintenance routes and related topics are done within the division Street Cleaning and Winter Maintenance. The winter maintenance interval and service time depends on the priority of the particular road, topographic conditions and requirements of public transport. Winter maintenance routes for ploughing and salting are planned concerning the mentioned parameters as well as traffic organisation and are adapted continuously.

The planning of winter maintenance routes for a road network of around 6,000 lane kilometres is a complex task as the following items have to be considered:

- one-ways
- Dead end roads
- Turning relations
- Very narrow roads
- Parked cars blocking roads
- Compliance with given service intervals
- Preferably few overlapping routes

As a result, the routes are planned using a GIS application for better presentation and usability. Even with the GIS application, the first sketches are done by hand due to limitations with the application. However, if the routes are in the system it is possible to have an excellent overview of all winter maintenance routes displayed on an Intranet-page. Also the plans are printed out and distributed to the winter maintenance vehicle drivers so they know exactly where to drive.

Winter maintenance routes in Vienna are divided into 3 different priorities for roads and 1 for bikeways. The differentiation is based on a guideline for winter maintenance in urban areas in Austria.

2.1. A-Routes

In Vienna the highest priority in the guidelines, P1, is serviced by A-Routes and contains inner-city main roads, access roads, roads with bus lines / trams, roads to access public hospitals and fire stations. The routes have a service interval of maximum 5 hours and are serviced 24h if necessary. A two-shift system is used with every shift regularly 8 hours long. The winter maintenance supervisor can extend the shift to 12 hours to ensure continuous winter maintenance if needed.

In the season 2017/2018 a total of 70 A-Routes exist, with one vehicle assigned to one route. These routes are always serviced by MA 48 trucks.

Figure 1 shows a sample of an A-Route printed on an A4 size paper for the driver. The route with starting and ending point as well as details of complicated intersections can be seen. Also additional information about important phone numbers, plough width, assigned B-Routes and winter maintenance depots are part of the route.

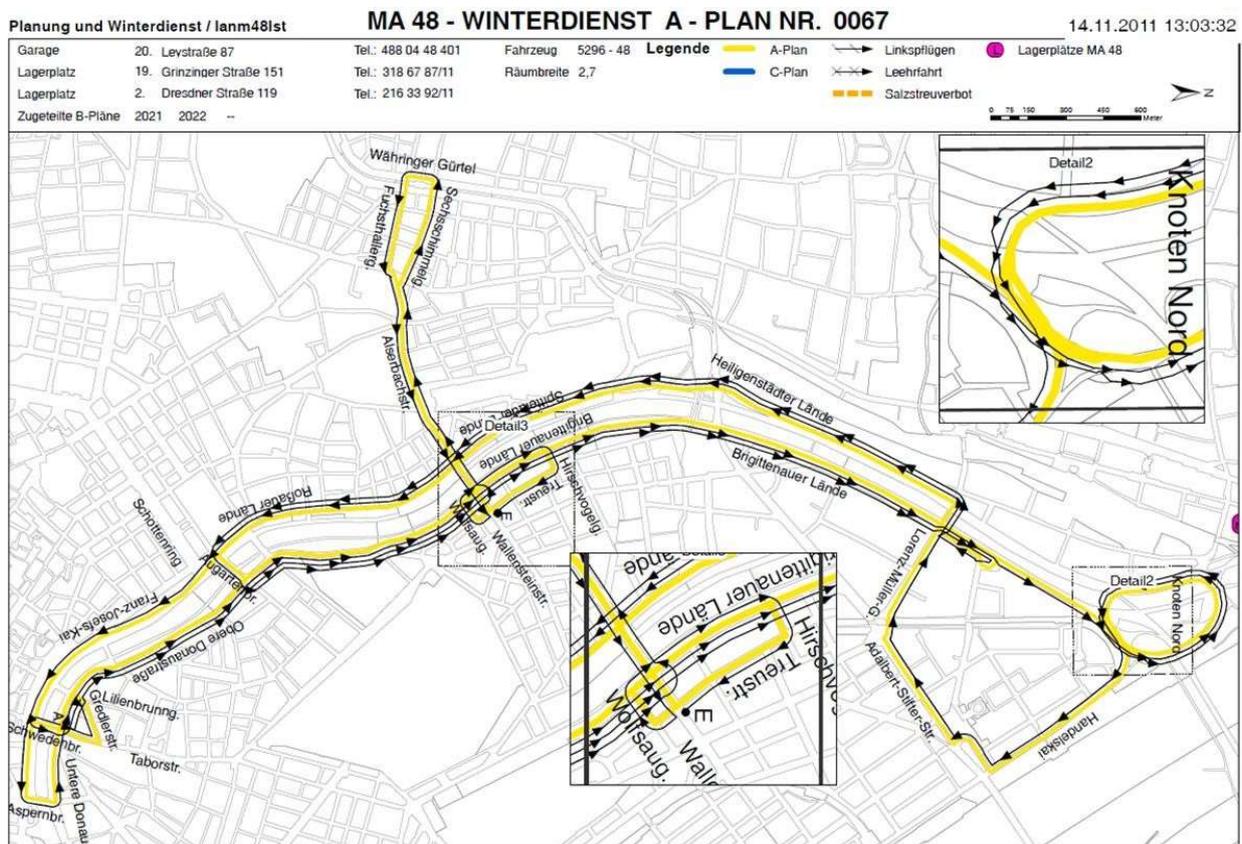


Figure 1: Sample of an A-route for the highest priority winter maintenance in Vienna

2.2. B-Routes

B-Routes cover category P2 of the guideline and are also serviced 24 hours every day if necessary. However the maximum service interval is 12 hours. B-Routes contain roads with minor traffic importance, feeder roads in residential and commercial areas, mountain roads.

B-routes are serviced by own trucks or contractor trucks. Regularly, one MA 48 truck services one A-Route and one or two B-Routes. In heavy winter weather, contractor trucks

service B-Routes and MA48 trucks only service A-Routes. In other words, at heavy winter weather one truck only services one route, if the weather is moderate one truck has two or three routes to service.

The layout of B-Routes is very similar to A-Routes, the biggest difference are red lines instead of yellow for the route. Additional to A-Routes also the information of the contractor and a partner-route is shown on B-routes. Partner-routes are a system to minimize the effect of outage or failure of contractors. Each B-Route has a partner-plan and had to service it in case of non-availability of the vehicle servicing the partner-plan.

2.3. K-Routes

K-Routes cover category P3 of the guideline and represent the subordinate road network. Even though the priority is low, there are 180 K-Routes to service roads with minor traffic importance or rural character. The maximum service interval is 12 hours. If there is no winter maintenance to be done drivers clean streets or empty trash bins like they do out of winter season.

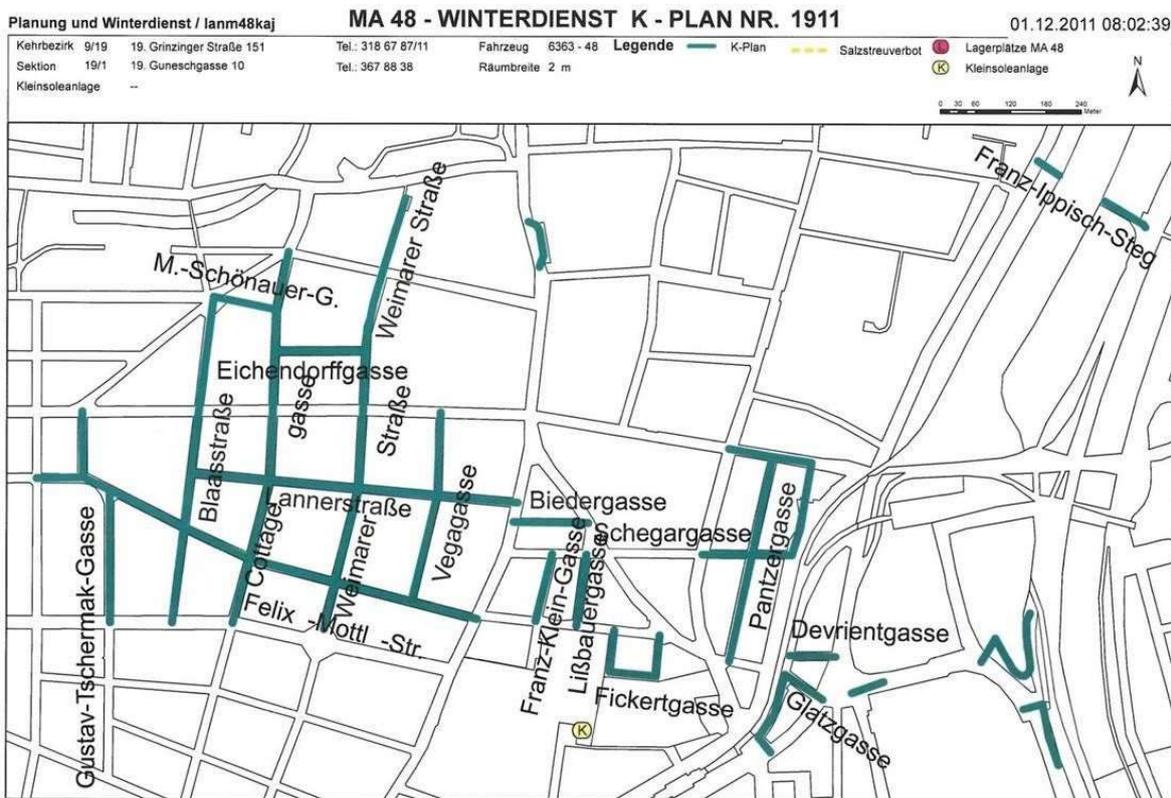


Figure 2: Sample of a K-Route for the lowest priority winter maintenance in Vienna

The routes are less complex than A or B-Routes, as they have no guidance where to start and end, only the roads that have to be serviced are marked. Otherwise, the system is the same.

2.4. R-Routes

For the winter maintenance on a defined bicycle lane network of around 280 km 37 R-routes are used. As bikeways are narrow sometimes, small tractors with small brine containers (300l) or brine trailers (1,200l) are used. R-Routes represent the guideline category P4, separated cycling lanes connecting neighbourhoods or with significance for commuter traffic.

Six small tractors have been equipped with 1,200l capacity brine trailers for better range. Also 13 semi-mobile brine mixing plants have been distributed around the city to shorten the distance between serviced area and brine refilling possibility. See also [1] for more information about the use of brine in Vienna.



Figure 3: Small vehicles for winter maintenance on small roads and bikeways

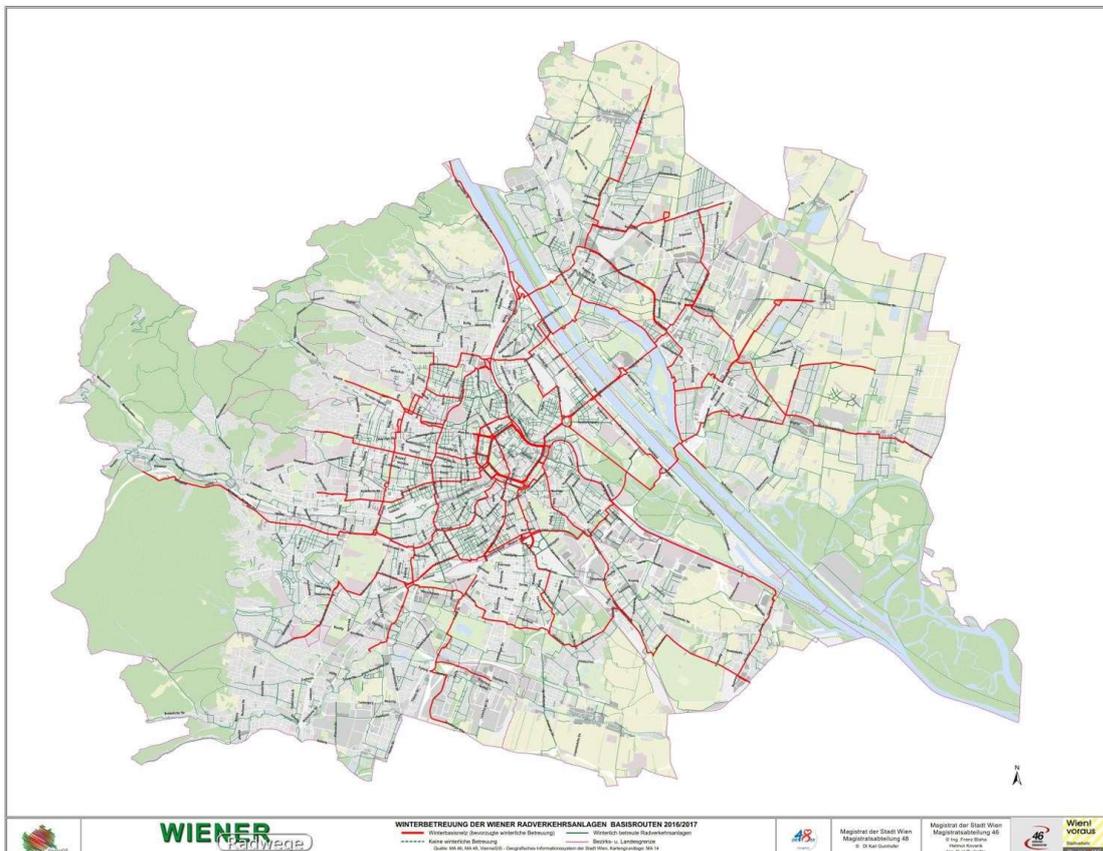


Figure 4: Winter service on the bikeway network in Vienna

3. OPERATIONAL

From November 1st to March 31st a group of winter maintenance supervisors is in charge of all winter maintenance operations. Each supervisor has a 24h duty from 6am to 6am of the following day. Main task of the supervisors are the coordination of all winter maintenance operations and decisions about number of employees and vehicles needed to perform cost efficient, high quality winter service.

Two meteorological services with different models provide the necessary information about weather situations. Different weather models and forms of transmission are used to enable comparison and improve resilience. The weather information includes:

- Short-term forecast 6 times a day written by meteorologists for operational decisions
- Mid-term forecast (5-days) once a day for staff allocation
- Nowcast portal that combines data from radar, weather stations and satellite image (see Figure 5) for the next 5 hours with 1km in space and 5min in time resolution
- Weather radar
- Weather warning if snowfall is predicted (by email and phone)

Based on the mid-term forecast the number of drivers - 0 to 70 - for A- and B-routes is planned on a weekly basis. These drivers are specialised in winter maintenance but can also be used for other work, like driving garbage trucks, if weather allows it.

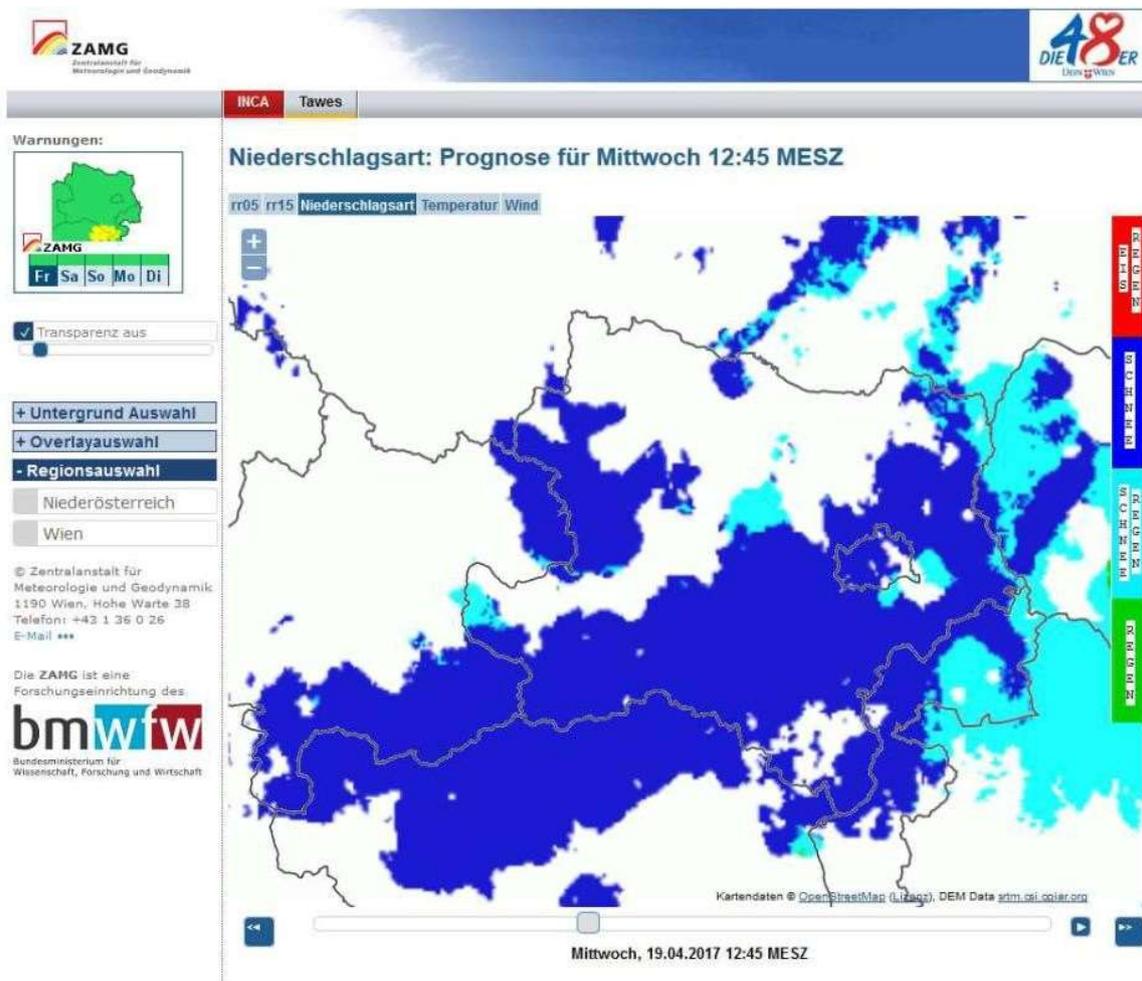


Figure 5: Snowfall predicted in the Nowcast-Portal INCA

4. SNOW REMOVAL

In urban areas place for snow storage is very limited since pavements, bikeways, bicycle lanes, parking lanes and road surface have to be kept clean of snow and ice. It is a logistic challenge to pile up the snow on defined places and dispatch it out of tight urban streets. Top priority tasks for snow removal are operations to ensure traffic safety, like keeping line of sights at crossings free of snow piles. Keeping parking lanes free of snow is not goal of snow removal.

Snow removal is only performed on demand typically during night hours. Some areas, like pedestrian zone in the inner district of Vienna and on several shopping streets have a bigger demand due to the high pedestrian density. During the day and in the evening snow is stored in small piles. Starting around midnight these piles are pulled together to bigger ones and trucks with cranes load up the snow. Figure 6 shows a bigger snow pile made during night ready for a truck to load it up. Snowfall has occurred in the afternoon and overnight, in the morning (7 am) the pedestrian areas have been cleared of snow already.

Up to 1,400 employees of MA 48 create stock up the snow to piles and private contractors dispatch it with trucks. Thus the snow removal operation has to be organised well to achieve efficient work. To coordinate all participants decisions have to be made around 48h in advance.



Figure 6: Snow pile ready to dispatch in the morning

Even though, the past few winters the annual snow depth was small, the summary of the last 13 years in table 2 shows the need of a well organised snow removal in Vienna. In the winters 2009/2010 and 2010/2011 around 20,000m³ of snow have been dispatched. In the winter 2004/2005 over 94,000m³ snow needed removal.

Table 2: Annual snowfall days, snow depths and removed snow in Vienna

| | 2016/17 | 2015/16 | 2014/15 | 2013/14 | 2012/13 | 2011/12 | 2010/11 | 2009/10 | 2008/09 | 2007/08 | 2006/07 | 2005/06 | 2004/05 |
|--------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Days with Snowfall [days] | 18 | 17 | 27 | 20 | 58 | 15 | 43 | 38 | 28 | 13 | 9 | 44 | 42 |
| Snow depth [cm] | 27 | 14 | 34 | 2 | 121 | 21 | 84 | 60 | 45 | 19 | 13 | 86 | 108 |
| Removed Snow [m ³] | 1,120 | 66 | 1,510 | 0 | 16,120 | 990 | 18,220 | 19,261 | 599 | 123 | 0 | 33,948 | 94,510 |

The snow is transported to one of five snow dispatch locations at the Danube or Danube channel where it is pulled into the flowing water (see Figure 6). Also two snow storage areas are available where snow melts naturally. These two are located in western and southern parts of Vienna where the distance to the Danube is too big for efficient snow removal. Each snow dispatch location has a daily limit and dispatched snow has to be measured for defined substances (e.g. heavy metals, COD).



Figure 6: Snow dispatched into Danube at one of five snow dispatch locations in Vienna

REFERENCES

1. Nutz, P. (2018) Experience with brine application in cities. XVth International Winter Road Congress.