



Mark Begich, Mayor

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# **Anchorage Street Deicer and Sand Inventory: 2003 Data Report**

Document No. WMP APr03006

**MUNICIPALITY OF ANCHORAGE  
WATERSHED MANAGEMENT SERVICES**

OCTOBER 2003







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## Acronyms and Abbreviations

ADOT	Alaska Department of Transportation
CBD	Central Business District
cy	cubic yards
DPW	Department of Public Works
gal	gallons
kg	kilogram
M&O	Maintenance and Operations
M&OY	Maintenance and Operating Yard
MOA	Municipality of Anchorage
SMD	Street Maintenance Division
WMP	Watershed Management Program
WMS	Watershed Management Section

## Executive Summary

This inventory documents quantity and area distribution of winter street traction enhancement materials. The annual inventory process is to determine how much sand, salt, and deicer are applied in the Municipality of Anchorage (MOA), and when and where these materials are used, for both the Alaska Department of Transportation (ADOT) and MOA.

This report uses the following inventory data to calculate the MOA Street and Maintenance Division (SMD) and ADOT Maintenance and Operations (M&O) application totals for sand, salt, and deicer brine for the 2002/2003-winter season (October through April):

- Estimates of leftover materials from the previous season (sand, salt, and deicer brine).
- Purchase records of materials from the current season (sand, salt, and deicer brine).
- Recorded amounts of brine used for pre-wetting, applying directly, and street sweeping (brine only).
- Estimates of materials surplus from the current season (sand, salt, and deicer brine).

Table A presents estimates of total application quantities of sand, salt, and deicer for SMD and M&O in 2002/2003.

**Table A 2002/2003 Total Application of Street Traction Enhancement Materials**

Facility	(tons)			(gallons)				(kilograms)
	Applied Sand	Applied Salt in Sand	Applied Raw Salt	at 25% Mg/Cl <sub>2</sub>		Potassium Acetate		Total Chloride
				Brine Applied Prewet	Brine Applied Direct	Deicer Applied Prewet	Deicer Applied Direct	
SMD	7,160	560	0	47,980	120,820 <sup>1</sup>	0	56,430 <sup>1</sup>	461,420
M&O	29,910	3,550	0	26,990	56,670	0	0	2,029,890
<b>TOTAL</b>	<b>37,070</b>	<b>4,110</b>	<b>0</b>	<b>74,970</b>	<b>177,490</b>	<b>0</b>	<b>56,430</b>	<b>2,491,310</b>

Key:

1 – Includes material applied during sweeping activities.

% - percent

Mg/Cl<sub>2</sub> – magnesium chloride

In addition to calculating application totals for sand, salt, and deicer brine, swept quantities of sand were estimated by surveying individual sweeping piles. Approximately 20 percent (%) of all sand applied to streets was picked up by sweepers in the spring and summer of 2003.

Calculated application totals were then compared to actual quantities applied in each area of Anchorage, which were derived from application logs kept by operators during the winter. A comparison of SMD results suggests inventory logs overestimated sand by 29% of the total application and M&O underestimated total sand application by 50%. Salt application by weight of sand was derived from actual application quantities, and then distributed over each service

area as a percentage of the sand applied in that area. SMD results show a mixture of 8% by weight of salt to sand, and M&O results show a higher ratio at 12% by weight salt to sand. SMD application totals reported on Inventory Log Forms for brine salt (magnesium chloride deicer) were underestimated by 51% of the calculated total application, while M&O brine salt application was underestimated by 30%. SMD liquid deicer (potassium acetate deicer) inventory logs underestimated total application by 49%.

Table B presents the historical application totals over the 5-year history of the inventory program. Sand application decreased by 20% in 2002/2003, compared to the 2001/2002 winter. Total chloride increased by 7%. This is a result of the decreased use of brine salt (magnesium chloride) but an increased use in salt.

**Table B    Historical Application Totals**

<b>Year</b>	<b>Sand (tons)</b>	<b>Salt (tons)</b>	<b>Brine Salt (gallons)</b>	<b>Chloride (kilograms)</b>
98/99	30,330	1,850	309,500	1,299,990
99/00	34,530	2,000	212,730	1,293,760
00/01	39,480	3,380	434,810	2,254,820
01/02	48,820	3,670	324,000	2,313,800
02/03	37,070	4,110	252,460	2,491,310



## Introduction

Data were collected for the Municipality of Anchorage (MOA), Watershed Management Section (WMS) by MWH, with cooperation from the MOA Street Maintenance Department (SMD) and the State of Alaska Department of Transportation (ADOT), Maintenance and Operations (M&O). The objective of the annual inventory process is to determine how much sand, salt, and deicer are applied in the MOA, and when and where these materials are used. Data from this season and previous years can be compared to note relative changes in quantities applied. In addition, application data by area may provide information about chloride loading in MOA watersheds. Results of the 2002/2003 inventory are presented in this document.

This report uses the following inventory data to calculate SMD and M&O application totals for sand, salt, and deicer brine for the 2002/2003-winter season (October through April):

- Estimates of leftover materials from the previous season (sand, salt, and deicer brine).
- Purchase records of materials from the current season (sand, salt, and deicer brine).
- Recorded amounts of brine used for prewetting , applying directly, and street sweeping (brine only).
- Estimates of surplus materials from the current season (sand, salt, and deicer brine).

Calculated application totals were then compared to actual quantities applied in each area of the Anchorage Bowl and MOA. Totals were derived from application logs kept by operators during the winter; any differences were noted and adjustments were made.

In addition to calculating application totals for sand, salt, and deicer brine, swept quantities of sand were estimated. Historical application of sand, salt, and deicer inventory and snow haul sites are also discussed. Finally, recommendations are given for possible future operations and inventory procedures.

Inventory of these traction enhancement materials is mandated by a 5-year U.S. Environmental Protection Agency National Pollutant Discharge Elimination System Permit, numbered AKS05255-8, which was assigned to both SMD and M&O in 1998 and expires in 2003. To provide the required inventory data of street sand, salt, and deicer use, the MOA Department of Public Works (DPW) WMS designed and implemented a sand, salt, and deicer inventory program in fall of 1998.

Data in this report were inventoried under DPW Watershed Management Program (WMP) Project No. 95004. The inventory data report builds on the following documents:

- Municipal Assessment Document No. WMP Apd99002, 1998-1999 Street Sand and Deicer Inventory Design.
- Municipal Assessment Document, WMP Apr99002, Anchorage Street Deicer and Sand Inventory: 1999 Data Report (Reese, 1999).

- WMP Apr00001, Anchorage Street Deicer and Sand Inventory: 2000 Data Report (Reese, 2000).
- WMP Apr01003, Anchorage Street Deicer and Sand Inventory: 2001 Data Report (Reese and Cohn, 2001).
- WMP Apr02001, Anchorage Street Deicer and Sand Inventory: 2002 Data Report.

Additional references can be found in the bibliography at the end of this document.

## Background

SMD and M&O share road maintenance within the MOA. SMD generally services streets with lower traffic volumes, including the Central Business District (CBD), while M&O services larger volume streets (arterial) in Anchorage, Eagle River, Birchwood, and Girdwood. Both SMD and M&O use sand, salt, and brine salt (deicer) on streets throughout the city of Anchorage and the greater MOA area to enhance vehicle traction in winter.

In addition to using magnesium chloride as a deicer, SMD purchased potassium acetate, which was applied primarily in the CBD and used to a limited degree in sweeping. Potassium acetate is more expensive, but is being evaluated for better performance than magnesium chloride. Sand and salt quantities are given in tons; deicer quantities are given in gallons.

Sand is applied for road conditions of “fresh snow” (during plowing), “mostly glazed or black ice,” “mostly bare and dry tracks,” and “mostly packed snow and ice.” Sand is applied in all SMD and M&O application areas, with the exception of the CBD. Both SMD and M&O mix salt into sand upon delivery, to keep the sand friable and prevent it from freezing. M&O applies extra salt primarily when snow is wet and heavy to prevent snow from going to “pack.” SMD does not apply extra salt. Deicer is applied to streets directly to enhance traction, and is used as a pre-wet spray for sand application to secure the sand in place on icy roads. SMD also uses deicer when sweeping streets in the spring. For spring street sweeping, a diluted solution of approximately 50 percent (%) water and 50% deicer is used.

## Report Organization

This document has been organized in the following manner:

**Introduction.** Discusses the purpose of the report, and gives primary information sources, and report organization.

**Inventory.** Estimates quantities of sand, salt, and deicer applied by SMD and M&O during the 2002/2003 winter season.

**Application Areas.** Describes application areas, and gives quantities of sand, salt, and deicer applied in each area by SMD and M&O, as taken from application logs kept by operators.

**Historical Application.** Describes historical application of sand, salt, and deicer inventories.

**Recommendations.** Provides recommendations for future operations and inventory procedures.

**Conclusions.** Summarizes the 2002/2003 inventory street sand and deicer.

**References.** Includes the references cited in this report.

**List of Preparers.** Lists names and contact phone numbers of people involved in writing this report.

**Appendix A.** Presents conversion factors for representing salt and deicer in kilograms (kg) of chloride.

**Appendix B.** Contains project correspondence, including notes and information from meetings, phone logs, and pertinent project email.

**Appendix C.** Contains SMD and M&O liquid magnesium chloride specifications.

**Appendix D.** Presents typical Inventory Log Forms that were used by operators for 2001/2002, and updated forms for 2002/2003.

**Appendix E.** Contains calculations and quantities of pile volumes for sand and street-sweeping waste.

**Appendix F.** Contains a compilation of inventory log raw data.

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## Inventory

This section summarizes sand, salt, and deicer inventory quantities from the 2002/2003-winter season and spring sweeping/cleanup in the MOA. Tables 1a through 1e present surplus, purchase, sweeping, leftover, and calculated total application quantities of sand, salt, and deicer for SMD and M&O. MOA SMD includes Eagle River and the Anchorage Bowl. ADOT M&O includes Eagle River, the Anchorage Bowl, and Girdwood. Quantities are reported by both volume and mass in kg of chloride, where applicable.

**Table 1a 2002/2003 Mineral Sand**

Area	Mineral Sand (tons)						
	Fall 2002			Winter 2002/2003	Summer 2003		
	Leftover Sand	Purchased Sand	Total Available Sand	Total Applied Sand	Sand Swept from Streets	Fugitive Applied Sand	Surplus Sand
SMD	12,800	6,000	18,800	7,160	Unk	Unk	11,640
M&O	13,760	37,540	51,300	29,910	Unk	Unk	21,390
<b>TOTAL</b>	<b>26,560</b>	<b>43,540</b>	<b>70,100</b>	<b>37,070</b>	<b>7,000</b>	<b>30,070</b>	<b>33,030</b>

**Table 1b 2002/2003 Granular Salt**

Area	Granular Salt (tons)							
	Fall 2002			Winter 2002/2003		Summer 2003		
	Leftover Salt	Purchased Salt	Total Available Salt	Applied Salt in Sand	Applied Raw Salt	Applied in Sweeping	Total Applied	Surplus Salt
SMD	110	500	610	560	0	0	560	50
M&O	50	3,615	3,615	3,550	0	0	3,550	65
<b>TOTAL</b>	<b>160</b>	<b>4,065</b>	<b>4,225</b>	<b>4,110</b>	<b>0</b>	<b>0</b>	<b>4,110</b>	<b>115</b>

**Table 1c 2002/2003 Brine Salt**

Area	Brine Salt (gallons at 25% Mg/Cl <sub>2</sub> )							
	Fall 2002			Winter 2002/2003		Summer 2003		
	Leftover Brine	Brine Purchased	Total Available Brine	Brine Applied as Prewet	Brine Applied as Direct	Brine Applied in Sweeping/ Dust Control	Total Applied	Surplus Brine
SMD	5,000	163,800	168,800	47,980	77,080	43,740	168,800	0
M&O	23,820	60,177	84,000	26,990	26,990	29,680	83,660	340
<b>TOTAL</b>	<b>29,820</b>	<b>223,977</b>	<b>252,797</b>	<b>74,970</b>	<b>104,070</b>	<b>73,420</b>	<b>252,460</b>	<b>340</b>

**Table 1d 2002/2003 Liquid Deicer**

Area	Liquid Deicer (gallons at 50% Potassium Acetate)							
	Fall 2002			Winter 2002/2003		Summer 2003		
	Leftover Deicer	Deicer Purchased	Total Available Deicer	Deicer Applied as Prewet	Deicer Applied as Direct	Deicer Applied in Sweeping	Total Deicer Applied	Surplus Deicer
SMD	200	61,230	61,430	0	47,655	8,775	56,430	5,00
M&O	0	0	0	0	0	0	0	0
<b>TOTAL</b>	<b>200</b>	<b>61,230</b>	<b>61,430</b>	<b>0</b>	<b>47,655</b>	<b>8,775</b>	<b>56,430</b>	<b>5,000</b>

**Table 1e 2002/2003 Total Applied Chloride and Deicer Chemical (kilograms)**

Area	Chloride			Potassium Acetate
	Chloride as Granular Salt	Chloride as Brine	Total	Total
SMD	308,178	153,242	461,420	18,271
M&O	1,953,632	76,258	2,029,890	0
<b>TOTAL</b>	<b>2,261,810</b>	<b>229,500</b>	<b>2,491,310</b>	<b>18,271</b>

Key:

M&O – Alaska Department of Transportation Maintenance and Operations

MgCl<sub>2</sub> – magnesium chloride

Unk - Unknown

SMD – Municipality of Anchorage Street Maintenance Division

Chloride calculations shown in Appendix A.

Values rounded to the nearest ten units.

Sand density = 1.25 tons/cubic yard

## Leftover Quantities

Inventory Data Reports are re-titled “leftover” for the 2002/2003 inventory. This quantity refers to the amount not used in 1 year (Surplus 2001/2002), and stored temporarily for use next year (Leftover 2002). The leftover quantity plus the purchase quantity is equal to the total available for a given material at the start of the 2002/2003 season. Leftover quantities for 2001/2002 were estimated in most cases through communications with Devin Branham at SMD or Jerry Reed at M&O. In some cases, MWH surveyed available piles for sand and salt. (All granular street salt that SMD purchases is mixed into its sand pile upon delivery; no “extra salt” is directly applied or inventoried by SMD).

SMD sand was stored in Anchorage at the Kloop, South Anchorage, and Commercial Maintenance Facilities, and in Eagle River at the Hiland Storage Facility. M&O sand was stored and Tudor surplus/quantities of sand, salt, and deicer reported in the 2001/2002 Street Deicing and Sand Maintenance and Operations Yard (M&OY), and O’Malley Snow Disposal Site. Additionally, M&O stored sand at Girdwood M&OY, Mile 0.5 on Hiland Road, the Birchwood Airport M&OY, and Turnagain Pass.

SMD deicer is stored in Anchorage at the Kloop Maintenance Facility and in Eagle River at the Hiland Storage Facility. M&O deicer is stored in Anchorage at the Tudor M&OY, Birchwood Airport M&OY, and Girdwood M&OY. SMD and M&O personnel measured the quantity of deicer leftover in each storage tank and provided an estimate to MWH for this report.

## **Purchase Quantities**

SMD and M&O purchased sand, salt, and deicer for use within the Anchorage Bowl. In addition to magnesium chloride deicer, SMD uses potassium acetate, which is applied primarily in the Anchorage CBD. However, reported surplus quantities include both SMD-Anchorage Bowl and SMD-Eagle River totals.

M&O purchased magnesium chloride for deicer use within a large area that includes the Anchorage Bowl, Girdwood, Birchwood, and Eagle River. SMD purchased magnesium chloride for use on SMD-maintained roads in Anchorage proper; SMD also maintains roads from Eagle River to Eklutna.

Purchase information for sand, salt, and deicer was obtained through communications with both SMD and M&O personnel (Appendix B). Specifications for both potassium acetate and magnesium chloride are provided in Appendix C.

## **Total Application Quantities**

SMD-Anchorage, SMD-Eagle River, M&O-Anchorage, and M&O-Girdwood are the four main facilities for street deicing and sand application operations. Each station has a fleet of trucks that are used to carry out day-to-day material application. Generally, total application quantities were calculated by adding surplus quantities from the previous season and amounts of street sand, salt, and deicer purchased for the current season, and then subtracting quantities left over at the end of the current season. In other words, leftover materials added to purchased materials, minus surplus materials at the end of the current season should approximately equal total materials applied during the winter.

### **MINERAL SAND**

Inventory of sand application is more straightforward than other traction enhancement material inventories. Purchased quantities are assumed to be highly accurate. Volumes of leftover and surplus sand piles were estimated with relative accuracy by using a survey level and stadia rod.

### **GRANULAR SALT**

Inventory of salt application is not straightforward because a portion of salt is mixed into sand. Each facility estimates the percentage of sand mixed with salt, which generally ranges between 4% to 9% salt in sand. Salt application quantities for 2002/2003 were calculated using the method described for mineral sand. M&O-Anchorage also applies raw salt directly to streets.

This quantity was extracted directly from inventory logs for calculating total applied salt, although this year there was no extra salt applied directly.

### **PREWET AND DIRECT APPLICATION OF BRINE**

Inventory of deicer brine application is more difficult, because the application is separated into two distinct types: prewet and direct. Deicer is applied to streets directly to enhance traction, and is used as a prewet spray for sand application to secure sand in place on icy roads. Deicer is also applied directly during spring sweeping and for dust control.

Prewet brine sprayers on sand trucks are inconsistent; prewet sprayers on one truck operate differently from a prewet sprayer on another truck. Prewet sprayers are designed to spray brine on falling sand at a specified rate, but often the spray nozzle becomes clogged. Although prewet application rates are set, actual rates tend to be slightly to significantly different from set rates.

Each facility has its own methodology for determining application quantity. For this inventory, the actual application total for prewet brine is back-calculated using a combination of known quantities (i.e., leftover, purchased, and surplus), along with information provided by SMD and M&O personnel.

Additionally, SMD contracts out a small amount of the city's sweeping and operates its own sweeping program for the rest of the city streets. This year, SMD also contracted out all of M&O sweeping, so that M&O was not involved with any sweeping activities.

Variables used to determine brine application include the following:

- A – Total Available Brine
- B – Brine Applied as Direct (quantity obtained from Inventory Log Forms)
- C – Brine Applied as Prewet
- D – Brine Applied in Sweeping/Dust Control (quantity obtained from Inventory Log Forms)
- E – Surplus Brine
- F – Total Brine Applied

Below are the methods employed to determine the 2002/2003 application quantities for deicer brine application by facility.

**SMD-Anchorage** – Operators inventory the amount of prewet brine used in a shift and record this amount on Inventory Log Forms. Prewet brine was separated from direct brine application by determining which truck was being operated at the time of application. Tanker trucks are capable of using direct magnesium chloride or potassium acetate (Branham, 2002). Specific truck numbers can be found in correspondence provided in Appendix B.



Application of brine applied as prewet and total applied brine for SMD-Anchorage were determined by using the following equations:

- Calculation for Brine Applied as Prewet (C) :  $(A - B - D - E) = C$
- Calculation for Total Applied (F):  $(B+C+D) = F$

SMD-Anchorage is the only facility that currently stores and uses liquid deicer in the form of potassium acetate. Potassium acetate is only applied as a direct application and is never used as prewet. Adding leftover quantities from the previous season and amounts of deicer purchased for the current season, and then subtracting surplus quantities from the current season, gives calculated total application quantities for Anchorage.

**SMD-Eagle River** – Operators inventory the amount of prewet brine used in a shift and record this amount on Inventory Log Forms. All brine applied by SMD-Eagle River is assumed to be applied as prewet and was added to the calculated value for SMD in Table 1c. SMD-Eagle River quantities are combined with SMD-Anchorage quantities for reporting purposes.

**M&O-Anchorage** – Operators inventory the amount of direct brine applied in a shift and records the amount on Inventory Log Forms. All brine recorded by M&O Anchorage is directly applied.

Application of brine applied as prewet and total applied brine for M&O Anchorage were determined by using the following equations:

- Calculation for Brine Applied as Prewet (C):  $(A - B - D - E) = C$
- Calculation for Total Applied (F):  $(B+C+D) = F$

**M&O-Girdwood** – Operators inventory the amount of prewet brine used in a shift and record this amount on Inventory Log Forms. All brine applied by M&O-Girdwood is assumed to be applied as prewet and was added to the calculated value for M&O in Table 1c. M&O-Girdwood quantities are combined with M&O-Anchorage quantities for reporting purposes.

Application quantities were also calculated for each area in the MOA from logs filled out by SMD and M&O application workers throughout the 2002/2003-winter season.

## Sweeping Quantities

Sweeping quantities for SMD were calculated by surveying four piles using a standard survey level and stadia rod, and using one estimate provided by SMD contractors. SMD piles were located at the Kloep Snow Disposal Site (Anchorage), and Hiland Road Storage Facility (Eagle River). Calculations from the sweeping pile survey are provided in Appendix E.

Since SMD performed and contracted all sweeping activities in Anchorage this year, it was relatively easy to determine quantities. All contractor quantities are estimated by recording the

number of truckloads dumped in each area, with one load equaling 8 cubic yards, unless otherwise noted by the contractor.

### **Surplus Quantities**

Surplus quantities of sand, salt, and deicer consist of materials purchased for application in 2002/2003 that were not used. The quantity of surplus materials is dependent on climate and is expected to change from one year to the next. Surplus quantities of sand, salt, and deicer from the 2002/2003 will be considered leftover quantities when evaluating the 2003/2004-winter season. Surplus quantities of salt and deicer from the 2002/2003 were estimated in most cases through communications with SMD and M&O. Surplus quantities of sand were surveyed by MWH for SMD and M&O facilities. Larry Bushnell, M&O General Foreman in Girdwood, conducted one estimate for leftover sand at Girdwood. For sand, which is stored in piles, dimensions of the piles were measured using a standard survey level and stadia rod. Calculations from the sand pile survey are provided in Appendix E.

SMD sand was stored at the same places as leftover sand, which were the Kloop Maintenance Facilities (Anchorage), and Hiland Road Storage Facility (Eagle River). M&O sand was stored at Tudor M&OY, and O'Malley Snow Disposal Site. Additionally, M&O stored sand at Girdwood M&OY, Mile 0.5 on Hiland Road, the Birchwood Airport M&OY, and Turnagain Pass.

## Application by Area

ADOT and the MOA are each responsible for maintaining certain street types. Local/collector streets have less traffic, while arterial streets have a higher volume of traffic. Figure 1 shows that the MOA services primarily local/collector streets, with the exception of the CBD, while ADOT services arterial streets. SMD and M&O operators maintain application log sheets throughout the winter season. Operators record sand, salt, and deicer amounts, area(s) of application, date, and other identifying information (see copies of SMD and M&O Inventory Log Forms in Appendix D). Data from application areas can be used to provide more resolution in distributing applied materials. Also, calculated application totals and application totals by area can be compared.

SMD application Areas 1, 2, and 3 are shown on Figure 2. The CBD is considered to be downtown Anchorage between 3rd and 9th Avenues and L and Karluk Streets. SMD-Eagle River also contains SMD application Areas 1, 2, and 3. M&O application Areas 1, 2, 3, and 4 are shown on Figure 3. M&O Area 5 includes Eagle River and Birchwood, north of Anchorage proper. M&O in Girdwood also applies sand, salt, and deicer in the following six areas: Area 1 is the Whittier Access Road, Area 2 is the Seward Highway, Area 3 is the Alyeska Highway, Area 4 is Crow Creek Road, Area 5 is the Portage Highway, and Area 6 is Airport Road (Girdwood).

Sand, salt, and deicer application totals for each area were determined from operators' logs. By knowing the sand truck volume and the level of sand at the beginning and end of a shift, sand application volumes can be measured with relative accuracy. Operators estimate the total amount of sand applied over the course of a shift, and the distribution percentage for each application area. Granular salt is applied to streets by M&O in Anchorage only. Generally, this quantity of salt is relatively small and can be tracked. All other salt applied to streets is mixed into the sand. Deicer has multiple uses for both SMD and M&O. During the winter, deicer is applied directly as traction enhancement and as a prewet spray to help with sand application. SMD also uses deicer for street sweeping and dust control in the spring.

Application data by area for sand, salt, and deicer are discussed in this section; any differences are noted between the calculated application totals from Tables 1a through 1e.

### Calculating Sand, Salt, and Deicer Application by Area

**Sand** – Application totals by area were taken directly from Inventory Log Forms for all SMD and M&O facilities. Adjusted values were calculated by using total application quantities for sand presented in Table 1a and determining the percent increase or decrease. This is accomplished by dividing the inventory value for a “Material Quantity Area” by the “Total” for all areas and multiplying the result (a percent of the “Total” for all areas) by the “Total Applied Sand” value. The result is the adjusted value.

**Example:** from Table 2b

Material Quantity Area 1 = 1, 840 tons

Total for all areas = 5,150 tons

Total applied Sand (extracted from Table 1a calculations) = 6,030 tons

Equation (1):  $1,840\text{tons}/5,150\text{ tons} \approx 0.357$

Equation (2):  $0.357 \times 6,030 = 2,155\text{ tons} = (\text{adjusted value})$

**Salt** – Application totals by area for salt are based on the percent salt in sand determined for each facility. These values are calculated by dividing “Total Applied Salt” for each facility by “Total Applied Sand” for each facility, then multiplying this percent by the total sand for each service area.

Total values for SMD in Tables 1a through 1d are the combined totals of SMD-Anchorage and SMD-Eagle River. Total values for M&O in Tables 1a through 1d are combined totals for M&O-Anchorage and M&O-Girdwood. Therefore, the value presented in these tables for “Salt in Sand” do not reflect the percent of salt in sand for an individual facility.

Applied granular salt values are taken directly from inventory logs and assumed to be the most accurate estimate of this application type.

**Deicer** – Prewet sprayers are designed to spray brine on falling sand at a specified rate. Although prewet application rates are set, actual rates will tend to be slightly to significantly different from set rates. Each facility has its own methodology for determining the application quantity. For this inventory, the actual application total for prewet brine is back-calculated using a combination of known quantities (i.e., “Leftover,” “Purchased,” and “Surplus”), along with information provided by SMD and M&O personnel for sanders that use prewet deicer.

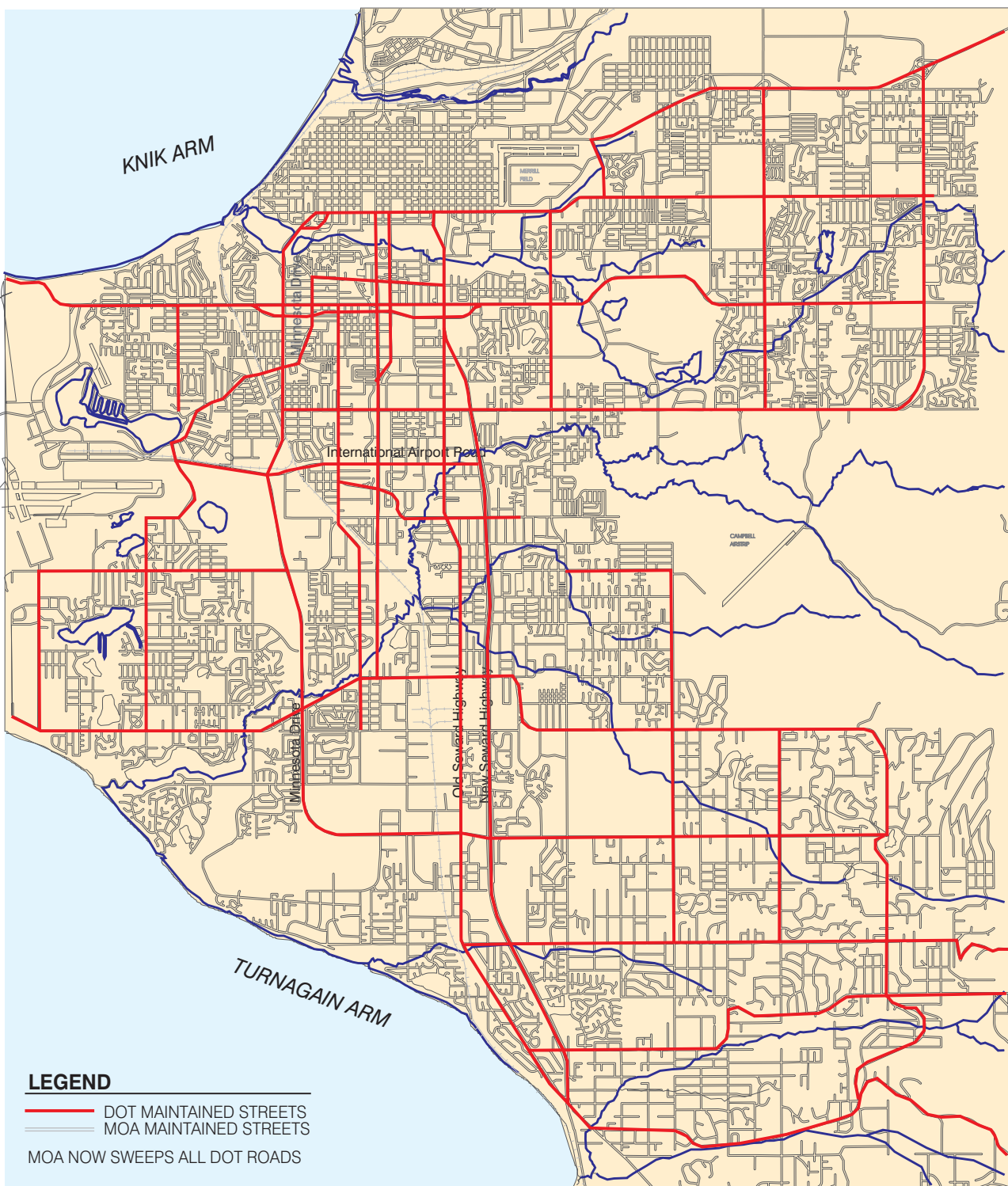
It is estimated that the prewet sprayers work 40% of the time at a rate of 9 gallons (gal)/cubic yard (cy) in Anchorage and Eagle River/Birchwood (Reed, 2001). Girdwood sanders appear to work better. Girdwood uses prewet 75% of the time at a rate of 6 gal/cy (Bushnell, 2002).

Direct application of deicer was recorded on M&O-Anchorage Inventory Log Forms for 2002/2003. M&O-Girdwood applied deicer only as prewet, and did not record deicer on Inventory Log Forms.

#### **M&O Anchorage Deicer Calculation:**

Equation 3:  $((\text{Sand Quantity (cy)} \times 9 \text{ (gal/cy)} \times 0.40 \text{ (\% of time deicer working)}) + \text{Direct (gal)})$

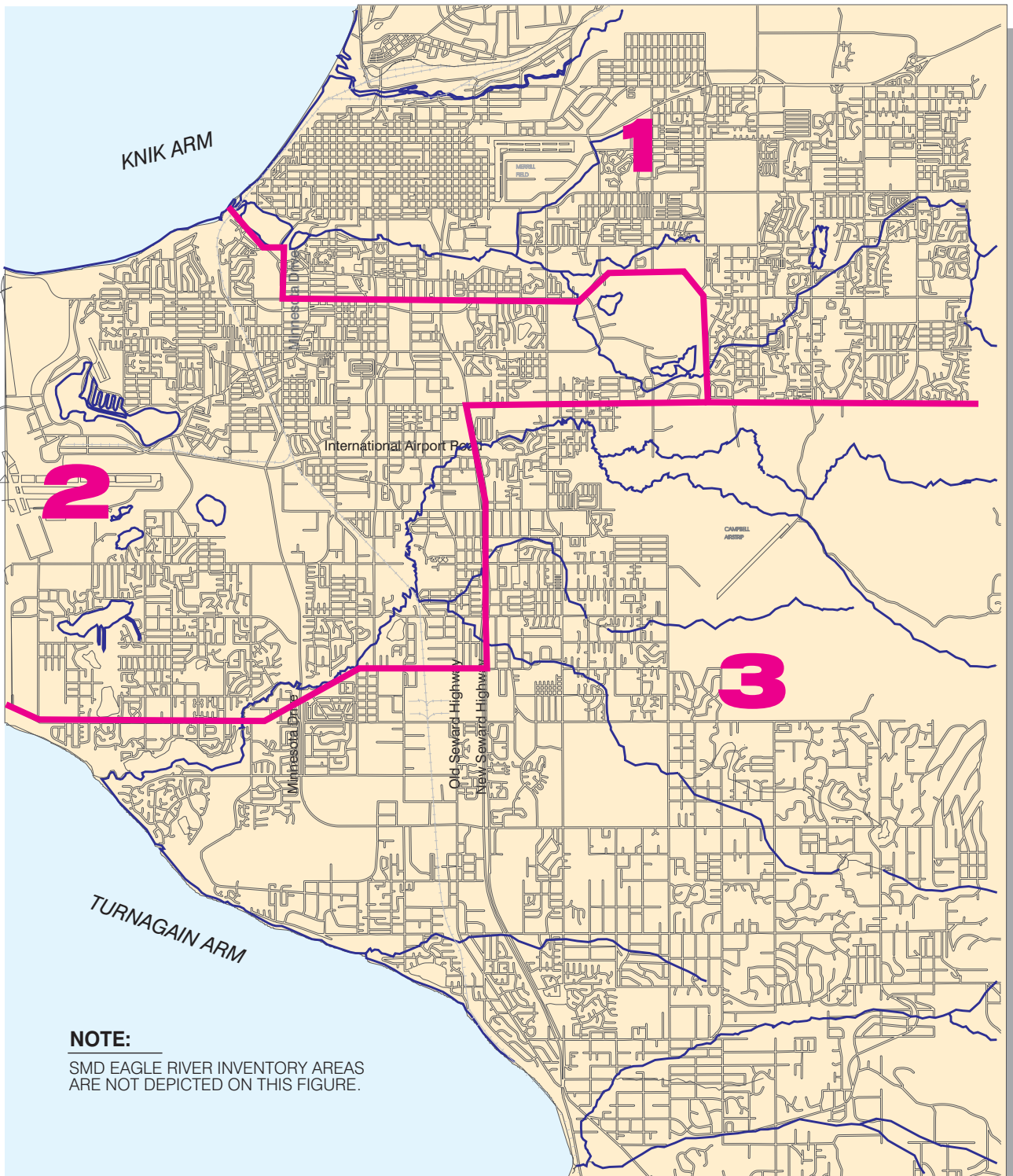
Inventory log data were then adjusted using the same methodology presented for sand (Equations 1 and 2).



**FIGURE 1**  
MUNICIPALITY OF ANCHORAGE  
ANCHORAGE STREET DEICER & SAND INVENTORY: 2003 DATA REPORT

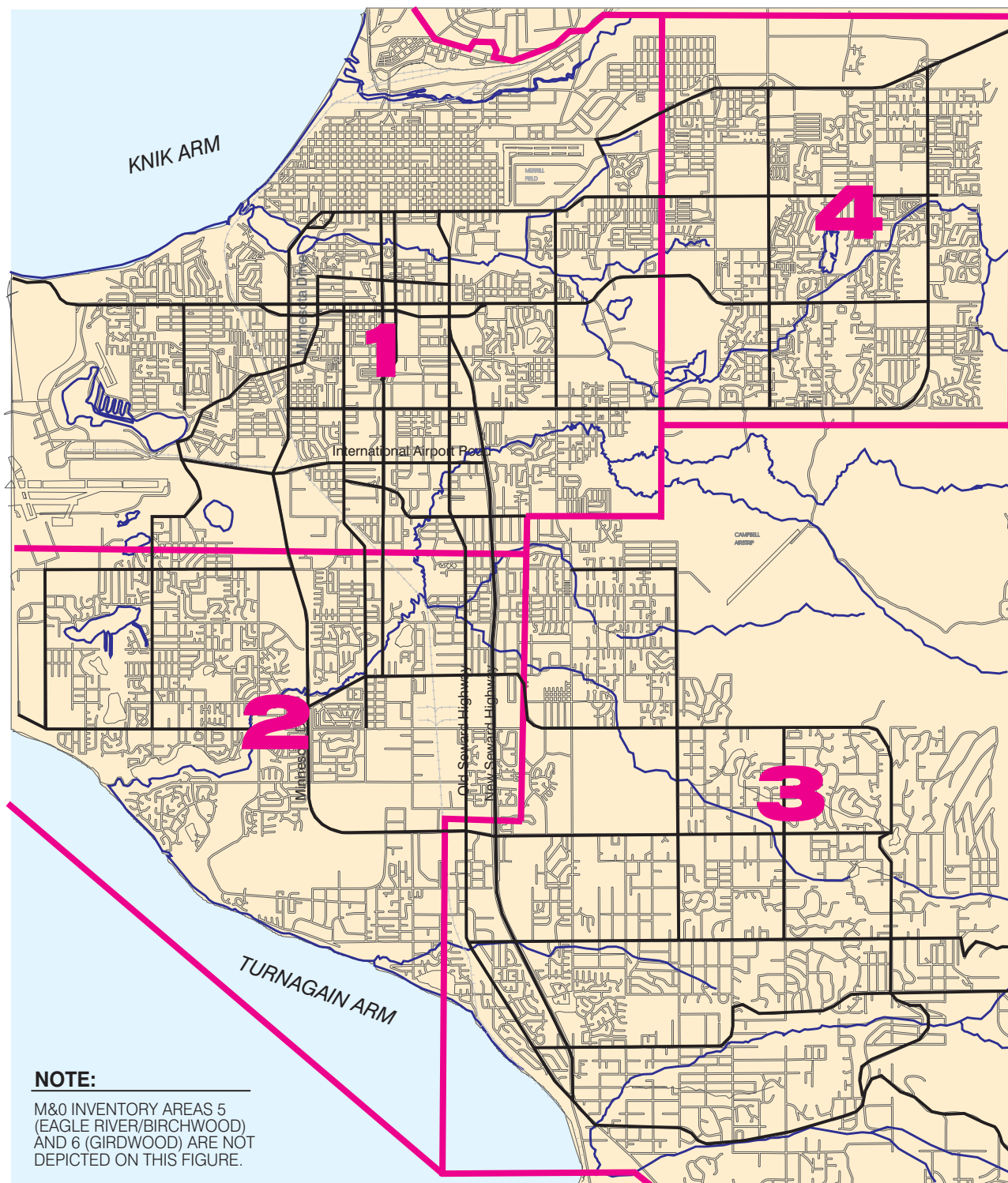
**DOT & MOA MAINTAINED STREETS**











**FIGURE 3**  
MUNICIPALITY OF ANCHORAGE  
ANCHORAGE STREET DEICER & SAND INVENTORY: 2003 DATA REPORT  
**M&O STREET DEICER AND SAND INVENTORY AREAS**



## M&O Girdwood Deicer Calculation

Equation (4): ((Sand Quantity (cy) x 6 (gal<sup>cy-1</sup>) x 0.75 (% of time deicer working))

For SMD sanders and tankers, deicer usage is recorded on Inventory Log Forms. Application totals by area were taken directly from Inventory Log data for both SMD Anchorage and SMD-Eagle River. SMD Eagle River Inventory data was assumed to be accurate because gross estimates would be necessary when attempting to calculate surplus leftover quantities for 2001/2002.

More information will be obtained from SMD-Eagle River in following years, as SMD personnel gain familiarity with the reporting process and inventory information need.

Tables 2a through 2d present street traction enhancement quantities by service area. Only application quantities from inventory logs are listed.

**Table 2a Inventory Log Application by Service Area: SMD Anchorage**

Material	Material Quantity				Total All Areas
	CBD	Area 1	Area 2	Area 3	
Sand (tons)	0	2,903	4,871	4,226	12,000
Applied Salt in Sand (tons at 3% of sand)	0	87	3.5	3	9
Brine Salt (gallons at 25% Mg/Cl <sub>2</sub> )	0	26,118	34,558	21,461	82,137
Liquid Deicer (gallons at 50% potassium acetate)	28,282	364	84	0	28,730

Key:

% – percent

CBD – Central Business District

MgCl<sub>2</sub> – magnesium chloride

**Table 2b Inventory Log Application by Service Area: SMD Eagle River**

Material	Material Quantity			Total All Areas
	Area 1	Area 2	Area 3	
Sand (tons)	73	85	75	232
Applied Salt in Sand (tons at 5% of sand)	4	4.3	4	12
Brine Salt (gallons at 25% Mg/Cl <sub>2</sub> )	125	172	120	417

Key:

% – percent

MgCl<sub>2</sub> – magnesium chloride

**Table 2c Inventory Log Application by Service Area: M&O Anchorage**

Material	Material Quantity						Total All Areas
	Area 1	Area 2	Area 3	Area 4	Area 5	Other	
Sand (tons)	904	2,345	1,525	1,569	1,993	6,645	14,981
Applied Salt in Sand (tons at 8% of sand)	72	188	122	126	159	332	1,198
Brine Salt <sup>1</sup> (gallons at 25% MgCl <sub>2</sub> )	8,815	17,240	1,000	11,385	9,569	29,681	48,010
Applied Granular Salt (tons)	0	0	0	0	0	33	33

Key:

1 – Brine salt – prewet rate of [(sand quantity x 9 gallons per cubic yard x 0.4) + direct application totals from inventory logs]

% – percent

MgCl<sub>2</sub> – magnesium chloride**Table 2d Inventory Log Application by Service Area: M&O Girdwood**

Material	Material Quantity						Total All Areas
	Area 1	Area 2	Area 3	Area 4	Area 5	Other	
Sand (tons)	115	3,165	615	115	655	35	4,700
Applied Salt in Sand (tons at 9% of sand)	10	300	50	10	50	10	430
Brine Salt <sup>1</sup> (gallons at 25% MgCl <sub>2</sub> )	270	7,370	1,430	260	1,520	90	10,930 <sup>2</sup>
Applied Granular Salt	NA	NA	NA	NA	NA	NA	NA

Key:

1 – Brine salt – prewet rate (sand quantity x 6 gallons per cubic yard x 0.75)

2 – Brine salt total – total calculated, using brine salt equation above

% – percent

NA – not applicable

MgCl<sub>2</sub> – magnesium chloride

## Calculated and Inventoried Application Total Comparisons

Significant differences might exist between calculated application totals and inventoried application totals. Calculating application totals is an approximate process dependent on the accuracy of estimating leftover, purchased, and surplus quantities of street traction enhancement materials. Estimating quantities for both the 2001/2002 and 2002/2003 seasons were approximate, and estimation error is a practical reality. However, results from this process are considered to be the best estimate available in relation to the actual quantities. Therefore, it is assumed that differences observed between calculated and inventoried application totals might be due to reporting error, missing data, or other errors in the data from operators' logs.

In most cases, understanding application methods and where on-hand estimation involves a high level of guesswork might explain differences in results. In other cases, a basic assumption,

such as the percentage of salt in sand or the rate of prewet deicer application, might have a range that allows for a certain amount of variance.

Differences are calculated to help managers adjust inventory practices. Differences between calculated application totals and application totals for sand applied during the 2002/2003 winter season are provided below.

#### **SMD Sand Application 2002/2003**

• SMD Actual Sand Application Total =	7,160 tons
• SMD Inventoried Application Total =	12,232 tons
• SMD Anchorage =	12,000
• SMD Eagle River =	232
• SMD Total =	overestimated by 5,072 (29%)

#### **M&O Sand Application 2002/2003**

• M&O Actual Sand Application Total =	29,910 tons
• M&O Inventoried Application Total =	14,981 tons
• M&O Anchorage =	Unknown
• M&O Girdwood =	Unknown
• M&O Total =	underestimated by 14,929 tons (50%)

Calculated application totals for salt and the percent by weight of salt to sand applied during the 2002/2003 winter season are provided below.

#### **SMD Salt Application 2002/2003**

SMD applied 100% of the total amount of salt available for the 2002/2003-winter season. No salt was applied directly to streets by SMD.

• SMD Total =	560 tons (8% by weight of salt to sand)
---------------	---

#### **M&O Salt Application 2002/2003**

M&O applied approximately 98% of the total amount of salt available for the 2002/2003-winter season, approximately 0% was applied directly to streets.

• M&O Total Salt in Sand =	3,550 tons (12% by weight salt to sand )
----------------------------	--

Differences between calculated application totals and application totals for brine salt applied during the 2002/2003 winter season are provided below

### **SMD Brine Salt Application 2002/2003**

- SMD Actual Brine Salt Application Total = 168,800 gal
  - SMD Inventoried Brine Salt Application Total = 82,554 gal
  - **SMD Anchorage** = 158,800 gal, underestimated by 82,137 gal
  - **SMD Eagle River** = 10,000 gal, underestimated by 417 gal
- 
- **SMD Total** = 168,800 gal, underestimated by 86,246 gal (51%)

### **M&O Brine Salt Application 2002/2003**

- M&O Actual Brine Salt Application Total = 84,000 gal
  - M&O Inventoried Brine Salt Application Total = 58,940 gal
- 
- **M&O Total** = underestimated by 25,060 gal (30%)

### **SMD Liquid Deicer Application 2002/2003**

Differences between calculated application totals and application totals by area for potassium acetate applied for the 2002/2003 winter season include:

- SMD Actual Brine Salt Application Total = 56,430 tons
- SMD Inventoried Brine Salt Application Total = 28,730 tons
- SMD Anchorage = 56,430 gal, underestimated by 27,700 gal (49%)

## Historical Application

This section presents historic data from 1998 to 2003 for application of sand, salt, and deicer for the MOA, and notes possible correlations between historic application totals.

Figure 4 depicts historical application data. Inventory data have been collected for five winter seasons, from 1998/1999 to the present. SMD-Eagle River data for all years was appended to the existing data set to present a more accurate application history; therefore, values might be different than in previous inventory reports.

As shown, application amounts for the 2002/2003 season decreased in comparison to the 2001/2002 application amounts for sand and total chloride. Only granular salt applications increased in 2002/2003 compared to the previous season. Significant decreases are observed for sand application, which decreased by 11,700 tons (24%). Salt application increased by 440 tons (11%). Total chloride applications decreased by 52,000 kilograms (2%). Deicer application decreased by 145,000 gallons (45%), perhaps due to relatively milder seasonal conditions. Use of liquid deicer (potassium acetate) decreased 21%.

**Figure 4 Historical Application of Sand, Salt, and Deicer****SAND (ton)**

YEAR	TOTAL
98/99	30,330
99/00	34,530
00/01	39,480
01/02	48,820
02/03	37,070

\* Mineral sand - no salt

**SALT (ton)**

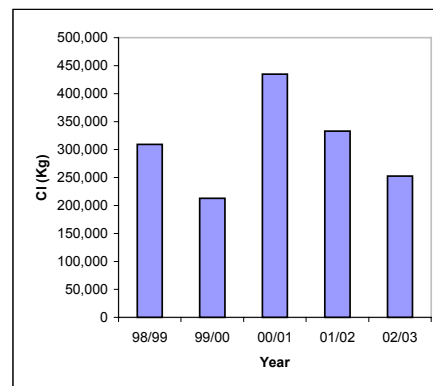
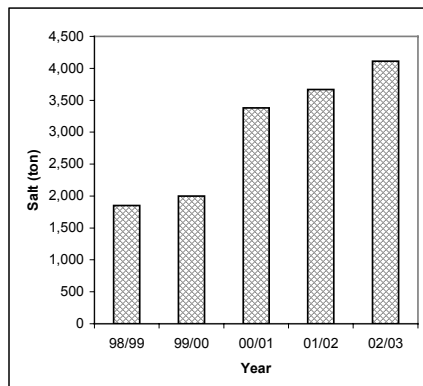
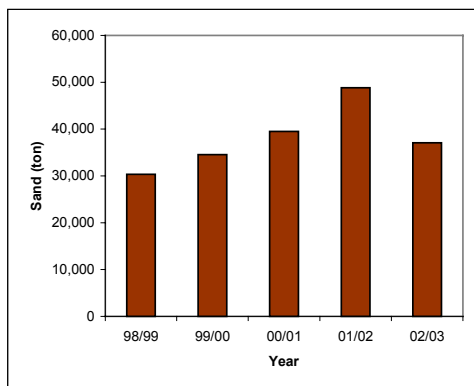
YEAR	TOTAL
98/99	1,850
99/00	2,000
00/01	3,380
01/02	3,670
02/03	4,110

\* Granular salt - raw salt and sand salt

**Brine (gal)**

00/01	TOTAL
98/99	309,500
99/00	212,730
00/01	434,810
01/02	332,920
02/03	252,460

\* 25% Magnesium chloride and water

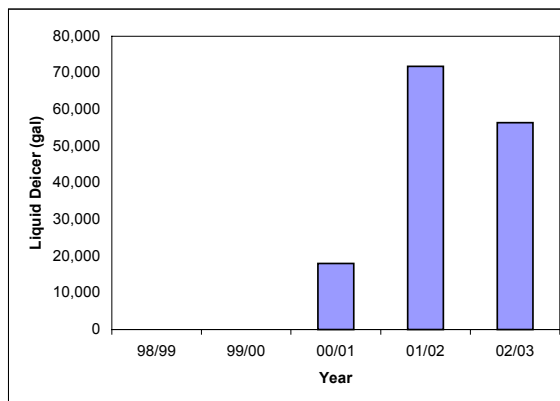
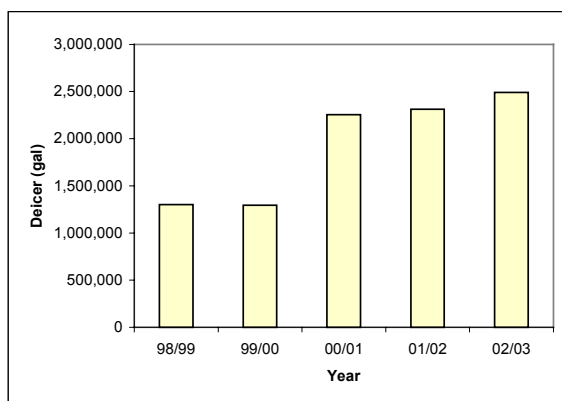
**Total Chloride (Kg)**

YEAR	TOTAL
98/99	1,299,990
99/00	1,293,760
00/01	2,254,820
01/02	2,313,800
02/03	2,491,310

\* Raw salt, sand salt, brine

**Total Liquid Deicer (gal)**

YEAR	TOTAL
98/99	0
99/00	0
00/01	18,000
01/02	71,800
02/03	56,430

**Note:**

SMD-Eagle River historical data is included for all years and applications  
 Y-axis scale changes based on application  
 98/99 and 99/00 Data taken from WMS, 2000c. WMS Project No: 95004  
 00/01 Data taken from WMS, 2001 WMS Project No: 95004  
 \* SMD = MOA Street Maintenance and M&O = DOT Street Maintenance  
 PA = Potassium Acetate



## Snow Haul Areas

Snow is plowed and removed from streets and hauled to snow disposal sites throughout Anchorage. Both SMD and M&O remove snow from streets and maintain their own snow disposal sites. Each snow disposal site stores snow from certain areas of Anchorage. This section describes current SMD and M&O snow removal areas and snow disposal facilities.

### SMD Snow Haul Areas

Snow disposal operations have not altered significantly since their description in the 1998 WMS report, “Magnesium Chloride Deicer in Snow Disposal Sites at Anchorage, Alaska: Data Report” (Document No. WMP APr98001). An updated version of a map of snow removal areas and corresponding snow disposal sites is shown on Figure 5.

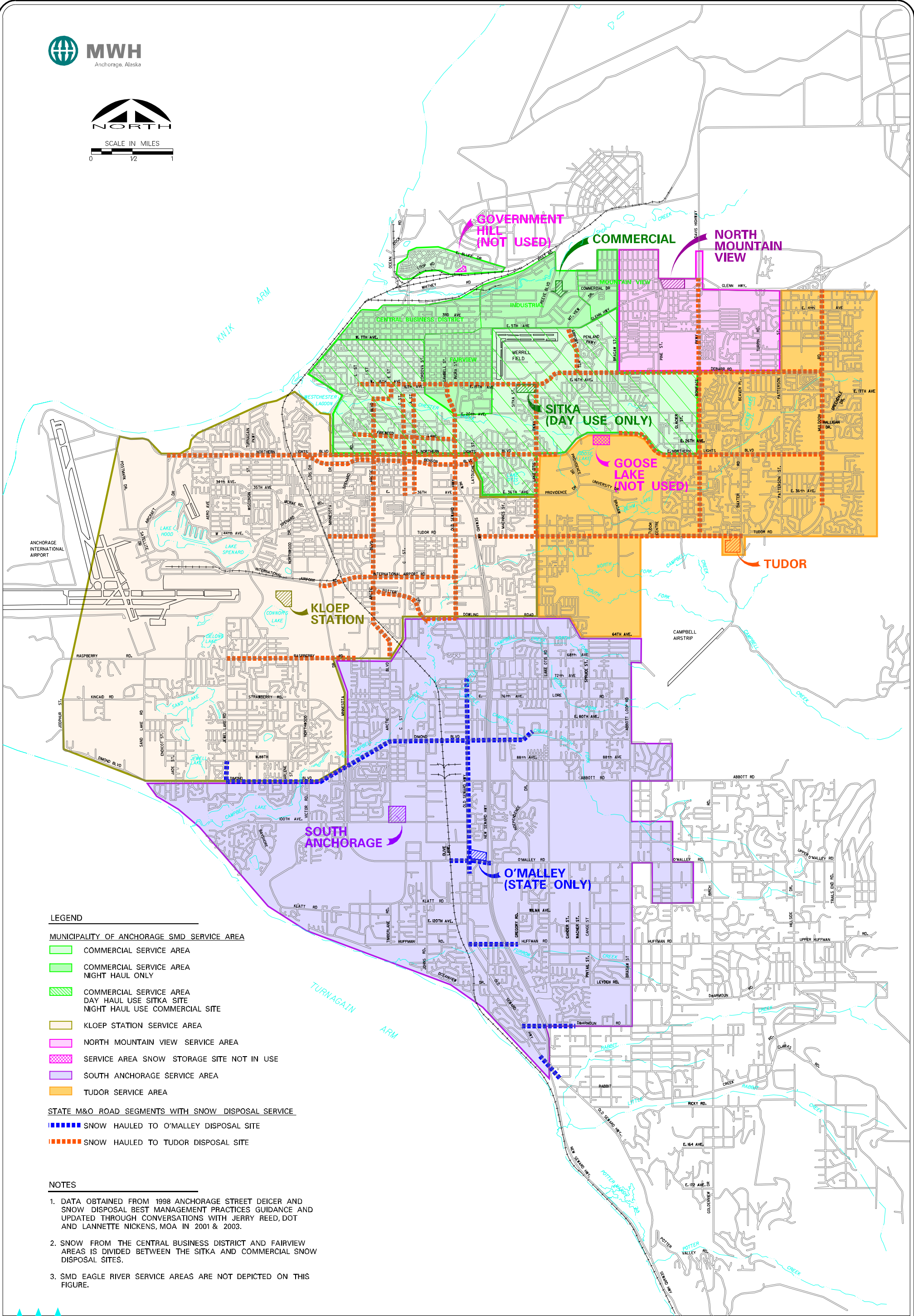
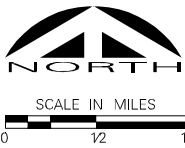
Since the 1998 snow disposal site data report, the Government Hill and Goose Lake snow disposal sites are no longer used, and the Sitka snow disposal site is not used at night due to its close proximity to homes. A site called Halligan in previous inventory reports no longer exists. The Commercial snow disposal site generally takes snow that would have otherwise gone to Government Hill. Commercial also takes snow at night that would have been disposed of at the Sitka snow disposal site. Snow that would have gone to the Goose Lake or Halligan snow disposal sites now goes to either the Commercial or the Tudor snow disposal sites.

### M&O Snow Haul Areas

M&O maintains three snow disposal sites within Anchorage: Highland Road, Tudor, and O’Malley. Snow removed from roads in Eagle River is generally taken to the Highland Road snow disposal site. Snow removed from the Muldoon, Lake Otis, and Midtown (Gambell/Ingra, Northern Lights/Benson, Fireweed) areas is generally taken to the Tudor snow disposal site. Snow removed from International Airport Road, Dimond, Old Seward, South Anchorage, and sometimes Minnesota Drive, is generally taken to O’Malley snow disposal site.

Generally, snow from M&O application Areas 1 and 4 goes to the Tudor snow disposal site and snow hauled from Area 2 goes to the O’Malley snow disposal site (Figures 3 and 5). Very little snow is removed by the M&O from Area 3, except snow from some overpass areas. Snow hauled from Minnesota Drive is sometimes taken to the O’Malley snow disposal site because it is often easier to continue south toward O’Malley than to turn east toward Tudor. Haul areas are general and not firmly established. When an operator is driving east or west, it might be easier to continue toward Tudor than go south to O’Malley. If traveling north or south, it might be easier to drive down to O’Malley (Figure 5).

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LEGEND

MUNICIPALITY OF ANCHORAGE SMD SERVICE AREA

- COMMERCIAL SERVICE AREA
- COMMERCIAL SERVICE AREA NIGHT HAUL ONLY
- COMMERCIAL SERVICE AREA DAY HAUL USE SITKA SITE NIGHT HAUL USE COMMERCIAL SITE
- KLOOP STATION SERVICE AREA
- NORTH MOUNTAIN VIEW SERVICE AREA
- SERVICE AREA SNOW STORAGE SITE NOT IN USE
- SOUTH ANCHORAGE SERVICE AREA
- TUDOR SERVICE AREA

STATE M&O ROAD SEGMENTS WITH SNOW DISPOSAL SERVICE

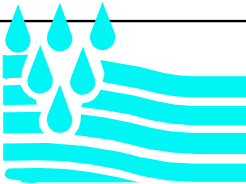
- SNOW HAULED TO O'MALLEY DISPOSAL SITE
- SNOW HAULED TO TUDOR DISPOSAL SITE

NOTES

- DATA OBTAINED FROM 1998 ANCHORAGE STREET DEICER AND SNOW DISPOSAL BEST MANAGEMENT PRACTICES GUIDANCE AND UPDATED THROUGH CONVERSATIONS WITH JERRY REED, DOT AND LANNETTE NICKENS, MOA IN 2001 & 2003.
- SNOW FROM THE CENTRAL BUSINESS DISTRICT AND FAIRVIEW AREAS IS DIVIDED BETWEEN THE SITKA AND COMMERCIAL SNOW DISPOSAL SITES.
- SMD EAGLE RIVER SERVICE AREAS ARE NOT DEPICTED ON THIS FIGURE.

FIGURE 5

MUNICIPALITY OF ANCHORAGE  
ANCHORAGE STREET DEICER & SAND INVENTORY: 2003 DATA REPORT  
**SNOW DISPOSAL SITES  
AND SERVICE AREAS**



ANCHORAGE  
WATERSHED  
MANAGEMENT



## Recommendations

During the course of the sand, salt, and deicer inventory, observations were made that might help to improve inventory accuracy in the future.

### Inventory

Surveying sand and salt volumes, in combination with tracking purchase quantities, has resulted in more accurate estimates of total application amounts. The same techniques have been employed for deicer usage, but more emphasis needs to be placed on the importance of obtaining accurate deicer estimates for surplus and leftover quantities. Material inventory does not stop at the end of the snow season. Surplus and leftover amounts will continue to be measured through formal surveys each year, and material purchase records will be made readily available to those preparing the inventory. Both agencies have continued to improve inventory through increased quality control.

### Prewet Deicer Inventory

Accurate inventory of prewet deicer is the most problematic and requires an increased level of detail and attention. SMD-Eagle River and M&O-Girdwood personnel assume that nearly all deicer is applied as prewet. Therefore, the amount of deicer reported on Inventory Log Forms is considered prewet and direct deicer application is assumed to be negligible.

SMD-Anchorage records all deicer application on the Inventory Log Forms. Prewet deicer application can be distinguished from direct deicer application by truck numbers, which correlate to a specific truck type. For example, if the truck is a tanker, then it applies deicer directly to streets, but if the truck is a sander – it applies deicer as prewet. However, the 2002/2003 Inventory Log Forms underestimated the total application of deicer by 51%. Operators have continued to improve methods to measure amounts of direct and prewet deicer used during a shift. The Inventory Log Form for 2003/2004 will clearly record the amount used and the type of application as “prewet” or “direct.”

M&O-Anchorage only records the direct application of deicer, making it necessary to use the calculated application totals and derived empirical equations to determine the prewet application totals. The empirical equations are formulated by observations made by M&O personnel, who then make recommendations for application rates and prewet device usage. Although this has proven to be effective, the utility of providing documentation of prewet deicer data would support and verify the assumptions made. The Inventory Log Form for 2003/2004 will clearly record the amount used and the type of application “prewet” or “direct.”

Increased accuracy of prewet deicer inventory will be helpful to identify application distribution. To more accurately inventory prewet deicer, the amount of prewet deicer used during a shift will be inventoried instead of the rate. Differentiating between deicer applied as

direct and deicer applied as prewet on inventory forms will save time and provide a better understanding of the deicer application process.

### **SMD Eagle River**

To complete the incorporation of the SMD-Eagle River into the street deicer and sand inventory, maps of Eagle River service areas and snow haul sites will be provided in the 2003/2004 data report.

## Conclusions

With more emphasis placed on leftover, purchased, and surplus quantities, the level of accuracy for estimating application totals has increased. Combining the surveyed data with purchase quantities has become a key tool for increasing the accuracy of inventory results. This is most apparent when comparing these measured values to Inventory Log data. This data report shows how this information can be incorporated with the Inventory Log data by using the relative percent distribution obtained from the inventory forms to estimate a more realistic application by service area.

It is anticipated that future inventory estimates will be increasingly accurate, due to the implementation of more efficient and precise accounting methods used to inventory street traction enhancement materials.

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