



Snow removal and ice control on highways

Snow fighting is a complex project, requiring the coordination of many groups and individuals. For this reason, every effort must be made to plan all actions well in advance. Even though the operations are conducted under the most adverse weather conditions, effective planning can reduce hazards for the operating personnel and for the general public as well as use equipment as efficiently as possible.

1. Compounding the problems of snow removal and ice control are limited visibility, accentuated by glare and reduced light; amount of snow; variable temperatures; wind velocities; traffic maintenance and control during operations; and reduced traction experienced by all vehicles. Effective planning recognizes these problems.
2. This data sheet describes how to prepare for the various hazards surrounding snow removal and ice control on highways. It also discusses the need for planning, present techniques and the use of personnel, equipment and materials.

Planning

3. The purpose of planning is not only to work out a method of assigning workers and equipment on hand, but to develop the most economical and safest method for ensuring that prevailing snow removal and ice control standards are met. Planning should assure adequate coverage on all high-priority roads, frequently enough to stay ahead of most storms. At the same time, it should provide guidelines to take care of emergencies on other roads. Consequently, in making the plan, the first problem is to determine the minimum equipment and personnel that will be needed for snow removal and ice control operations. Unlike most other operations, snow removal is not limited by areas or predictable time schedules.
4. Good plans are based on this thought: The only way to handle variations in conditions or to meet emergencies is to be ahead of a storm whenever feasible. This concept narrows down to four basic points:

- a. Traffic patterns during snowstorms or ice conditions. Only take all equipment off one road to use on another road when action cannot be avoided. Crews should never be directed to take on more than they can handle.
- b. Availability of personnel and equipment to meet emergencies. Have enough available heavy equipment (four-wheeldrive loaders, snow-blowers, dump trucks, motor- graders, end loaders, etc.) if the snowfall is heavy enough to require this type of equipment or the snow begins to drift. Use only qualified operators for all equipment.
- c. Proper personnel schedules to effectively complete a snow removal operation on a shift basis. Without proper planning, an entire crew may become exhausted, especially if a storm continues over a 24-hour period. As a result, the efficiency and the safety of an operation may be greatly jeopardized. Sleep deficit is a significant hazard for crew members who are working extended shifts. One effect of sleep deficit can be “microsleep” or falling asleep driving vehicles. Another effect of sleep deficit is impaired judgment. Many factors contribute to sleep deficit problems.

The following precautions can reduce the likelihood of sleep deficit problems:

- Maintain substations where snow crews can come off the road for 5-10 minutes to move around.
- Provide high-protein snacks at these locations free or at a low cost. Candy should never be substituted for these snacks. High-protein snacks also are preferable to coffee.
- Teach crews a series of isometric exercises they can perform in the cab of their vehicles. Employees should be encouraged to do a series of light calisthenic exercises when they

are in the substations. This is particularly critical around 3:00-4:00 a.m.

- d. Proper assignments and priorities. Plans should designate priorities for plowing and removing snow as well as for applying chemicals and abrasives. (In general, priority-one highways will require more attention at the initial phase of a storm, such as the early application of chemicals or abrasives to prevent snow from caking on the surface and to allow the complete removal of surplus snow.)

Personnel training

5. Training should include lectures and practice sessions (operations) to familiarize all personnel with planned operations: the geographical areas to be covered, the problems to be expected, the desired results from each worker and crew. (Question-and-answer sessions may prove beneficial.) Instructions concerning the proper maintenance of the equipment should draw on the experience of veterans in previous snow removal operations. All personnel should be made aware of their particular role in planning and training programs during the pre-snow months of August, September and October.
6. After necessary practice runs have been made, the division superintendent should prepare maps to show priority routes for snow plowing and sanding in multi-lane sections. Copies of the maps should be available in each maintenance section shed before winter begins. Operators should study them and become thoroughly familiar with the priority routes.
7. Basic criteria for personnel planning should include the following:
 - Training programs capable of turning out competent operators and supervisors
 - Routes that personnel can reasonably cover

- Channeling of all information into a central operational headquarters that can convey information effectively and efficiently

Equipment selection

8. Equipment should be selected to meet road designs and to minimize hazards and hardships for the motoring public. The following aspects should be considered:

- Accessibility of crossovers
- Width and composition of shoulders
- Adjacent roadside conditions such as bridge abutments, hedges, directional signs, gullies and overhead wires that may be hanging too low due to accumulation of snow, ice or both
- Snow fences
- Adequate dump trucks
- Type of plow (V types with one-way, reversible, wings and left-hand graders)
- Whether equipment is provided with two-way radios. (This should be mandatory.)

Inspection and maintenance

9. Because vehicle cabs are usually closed during snow removal operations, exhaust systems should be checked frequently and maintained in first-class condition on all equipment. A good exhaust system is perhaps one of the most important features of this equipment. A faulty exhaust on a closed-cab vehicle can cause the operator to lose consciousness, potentially resulting in the death of the operator, serious consequences to other personnel and the public, as well as to equipment.
10. Preventive maintenance should be constantly performed on all spreaders and salt trucks because of the corrosive action of salt. On trucks it is desirable to have fixed ladders (with metal or

perforated steps) on the passenger side to provide safer footing than a wheel or tire. Windshield wipers should be kept in firstclass condition, because accumulation of snow and ice on the windshield can be a problem. Heaters and defrosters also should be maintained in good working order. Heated rear lights have proven useful for melting snow from the rear warning lights on plow-trucks. These lights must be kept clean and functional. Hydraulic systems should be kept in good working condition, and no one should go beneath a raised truck body without first blocking the body with a safety bar to prevent it from falling in the event of a malfunction. All slow-moving vehicles such as front loaders and graders used for snow removal should be equipped with "Slow-moving vehicle" identification emblems front and rear.

11. Inspection of snow plows should include keeping the blades in good condition and assuring that attaching assemblies are in good working order. (A tungsten carbide blade is helpful because it reduces the number of blade changes required.) Overexertion due to lifting a plow into position and attaching it to the equipment can be prevented by blocking the plow off the ground at the exact height of the attaching assembly of the equipment. This blocking will eliminate the need for manual lifting, either for attaching the plow to, or detaching it from, the equipment. This method also provides for ease in servicing and prevents the plow from freezing to the ground. Materials used for blocking plows should be substantial and solid, not haphazard.
12. Maintain an inspection report on each vehicle. This should include a checklist of deficiencies, the date and corrective actions taken to eliminate the deficiencies found. Thoroughly inspect blowers and start the engine periodically throughout the snow season to assure availability when needed. Immediately before the snow season, inspect and conduct a test run of all mounted snow equipment. Each vehicle's crew should consist of the same

personnel whenever possible.

13. Familiarize workers with the rules that make work safer:

- Before each use, check all equipment— lights, brakes, windshield wipers, exhaust systems, tires, chains and steering. Warning lights must be visible from all sides, even when blades are raised or lowered.
- Respect the rights of others. Be considerate of motorists who have trouble driving in snow. When possible, help stranded motorists.
- Keep first-aid kits completely stocked.
- Check fire extinguishers and flares often.
- Observe all traffic laws.
- Remember: Driving above speed limits or too fast for conditions can cause incidents or deaths, especially in a snowstorm or at night. Resist the urge to accomplish a job in a hurry.
- Follow a regular maintenance routine all winter.
- Equipment operators should inspect vehicles after each storm and report needed repairs to the garage or the staff mechanic.
- Inspect the condition of the mold-board and cutting edges of all snowplows. Also, order adequate stocks of parts for all types of plows.
- Inspect snowplow hoists and underbody blades.
- Check air and hydraulic hoses and other critical parts for power units. Obtain adequate replacement stocks.
- Mount, load, and test mechanical and motorized distributors. Make all necessary repairs and order critical parts.

- Keep on hand sufficient stocks of tire chains, tires, spreader repair parts, and other miscellaneous supplies and tools.
- Look for signs of operator fatigue. A limit of 12 continuous hours on duty seems fairly common in public works agencies in the snowbelt, although some organizations permit longer work periods. Usually, the routine is 12 hours on and 12 hours off.

Assignment of personnel and equipment

- 14.** To the extent possible, personnel, especially equipment operators, should be regularly assigned to the same area and perform a dry run on the assigned area(s) to assure familiarity. By following this policy, operators become familiar with the obstacles and potential hazards they will encounter, so they can devise their own methods to avoid delays and expedite safe and efficient operations.
- 15.** Consideration should be given to the number of lane miles included in each route to be handled by each team using equipment.
- 16.** Reversible plows lend themselves to a flexible operation. High-speed plows can be used in open areas with little fractional congestion (parked cars, close buildings, etc.).
- 17.** In snow removal operations, the number of workers needed depends on the number of trucks and other equipment necessary to maintain continuous plowing operations with frequency of coverage and effectiveness of assignment. In assigning personnel, the design should be based on an eight-hour shift, five-day week; however, the maximum resource is provided by a 12-hour shift, seven-day week.
- 18.** After determining the equipment needed by laying out a plowing plan, decide on the number of workers required.
- 19.** Power controls and radio-equipped plow-trucks

have created one operator per truck operations.

20. In addition to the timekeeper and superintendent, the number of workers needed in an area for snow removal depends on the following guidelines:

- There should be one qualified operator for each truck or motor grader needed for snow removal for each shift. For example, if five trucks and one motor grader are needed, there would be six operators on each of two shifts, or a total of 12 operators. One foreman should take the supervisory shift.
- Allow for up to two additional temporary maintenance employees as a reserve to replace those who may be ill when an emergency occurs or unable to report for other reasons.
- To summarize, these are the suggested total operators for an area determined to need five trucks and one motor grader to maintain adequate continuous plowing:

5 trucks by 2 shifts = *10 operators*

*1 motor-grader
by 2 shifts* = *2 operators*

*additional temporary
employees* = *2 operators*

*employees subject
to assignment change* = *14 operators*

In this example, assume that one truck is assigned to work alone, and two others are designated as subject to change of assignment.

- Motor graders given such assignments still need only one operator per shift. This does not mean that if a greater number of operators are needed for other major activities throughout the rest of the year, there should not be more than 14. This is simply the number that can accomplish the work

safely and consistently under all but the most unusual conditions.

Adjustments

21. How might these values and patterns be adjusted?

For example, to take care of an urban or mountainous segment of high-priority highways, there are several things to consider. Steeper grades mean slower plowing speeds, the rate of snowfall may be higher, and drifting snowbanks present a particular problem. In addition, the danger of traffic getting stuck and blocking the road is far higher than in normal situations. In short, capacity should be increased in some way by shortening the length of assignments, by using heavier equipment, by using more pieces of equipment, or by some combination of these. The problem is to make this adjustment without neglecting other roads, if possible.

22. By the same token, if a road does not normally require immediate attention, it may call for a somewhat lesser capacity to move snow. For example, round-trip times and, therefore, mileages may be longer, and fewer pieces of equipment may be required.

23. The idea is to meet the following objectives:

- Coverage of roads on a planned basis
- The most practical number of workers and amount of equipment, considering local conditions and changing road assignments
- Provisions for handling typical emergencies, so they can be taken care of without losing control of an overall situation.

24. It should be evident that planning is possible and necessary to prevent trouble in most situations. Planning for standby auxiliary operators, rental equipment, etc., may provide for solutions to unforeseen problems. However, no two storms are alike, and once in a while even well-laid plans

may not completely work out. In such situations, avoid panic. As long as possible, use the plans and maintain some level of service on all roads. Make changes only under drastic conditions to maximize workers, equipment and service.

Salt spreading operations and snow plowing

25. Snow plowing and salt spreading operations are among the toughest operations that maintenance equipment and personnel must perform.

Therefore, if equipment maintenance, personnel training and operational planning are neglected during the pre-season months, needs are not likely to be met during the winter months.

26. Automatic spreaders are recommended because they provide a uniform application of salt, cinders and sand and eliminate the hazard of manual operation.

Planning snow and ice control

27. A planner should accumulate a good set of storm records before setting standards on permissible snow buildup and length of time to remove snow.

28. Snow fences are a definite advantage along roads and where drifting is a problem. Where possible, ask the permission of property owners along the routes to install the fences. If installed properly, they will decrease the need to converge on trouble spots and free crews to concentrate on complete coverage elsewhere. In addition, routes over bridges constructed with expansion joints at an angle should be plowed with these obstructions known in advance, so operators can adjust and steer the plows to avoid these areas.

29. No two snow storms are exactly alike, but several things are common to most of them:

- Chemicals are usually applied at certain speeds, depending on the nature of the road and amount of traffic.

- In each locality, there are places where icing is more likely to occur (notably, on bridges, where drifts tend to be a problem) and where trucks or other vehicles are likely to get stalled on the road, impeding snow removal equipment as well as traffic.

30. After reviewing the type of equipment available, the chemical storage facilities used, and the personnel available, a plan should be developed to take care of most storms.

Remember: When handling snow and ice, it is the equipment and operator(s) that do the work. The fewer person-hours needed to keep the equipment going, the more efficient the operation.

Planning chemical and plowing routes

31. When planning an operation it is necessary to establish certain standards. Make a sketch of the overall layout of each area of responsibility and area boundaries (Figure 1).

32. Review the various parts of the operation, such as abrasive, sodium chloride, and calcium chloride requirements. After reviewing the requirements, as set forth in snow and ice control standards, outline a few conclusions:

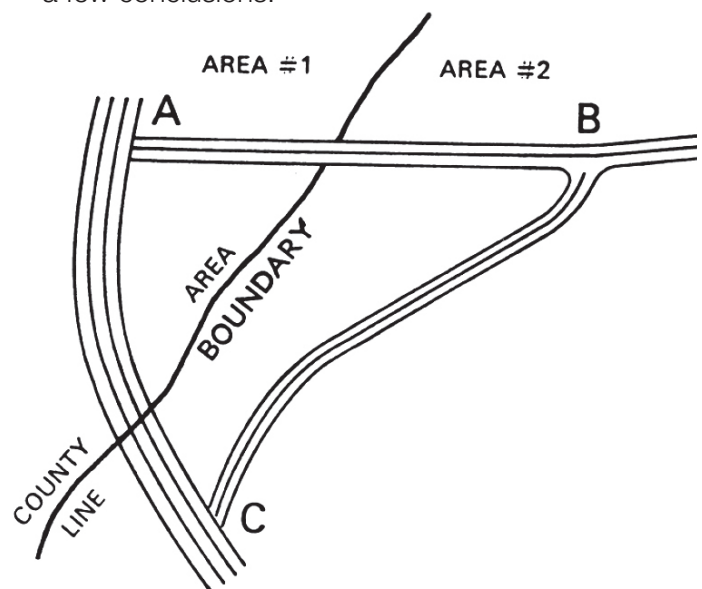


Figure 1. This overall layout sketch shows an area of responsibility and the area boundaries.

- With the exception of three-lane roads, two trucks should normally be used to apply chemicals or abrasives on two lanes at one time. On three-lane roads, they should apply chemicals or abrasives on one and one-half lanes at one time.
- Route assignments should be varied for level of service desired. Plans should be developed permitting a continuous spread of chemicals without changing the spreader settings. Exceptions should be permitted to vary the rate in trouble spots.
- The plans should be designed to keep deadheading (not plowing on a return trip) to a minimum.
- Provide for sections of road that may be traded with the adjoining area, if it is obviously feasible to do so. (If such a trade is made, it should include total responsibility for snow and ice removal abrasive, chemical and plowing— not just a part of the operation.)
- The plans should give the maximum amount of coverage with the minimum amount of personnel, equipment and materials.

33. Everyone concerned must completely understand how a plan should be developed and how it will work. The following questions provide some examples.

a. Why should there be 25 lane-miles for chemicals and plowing routes?

- No truck should have to reload to be able to apply eight tons of salt within the first hour of snowfall on all roads. Twenty-five lane-miles present no problems with straight salt and use the maximum rate of spreading mixture. Straight salt weighs more than calcium chloride, and the rate at which it is applied depends on such variables as ice, traffic, temperatures and result desired. Therefore, a five-ton load should be more than enough to

handle an assignment of 25 lane-miles.

Note: The use of straight salt is currently being questioned because of road damage and pollution problems.

- Straight calcium chloride, however, cannot be used at maximum recommended rates on an assignment of 25 lane-miles. The truck will hold only about 3 1/2 tons; at 900 pounds per two lane-miles, this will go only about 7.7 miles. The use of straight calcium chloride is rarely necessary. Some states use a mixture of sodium and calcium chloride at a rate of five to one. However, straight calcium chloride may be required often enough to justify planning for it in some areas (when temperatures are so low a mix is not effective). In sum, 25 lane-miles for planning purposes should ensure all roads are salted quickly when straight salt or a mixture is used, and it will not seriously affect the ability to complete the job even under unusually cold icing conditions, where straight calcium chloride may be indicated.

b. Why should there be 25 trip-miles for plowing routes?

- Continuous coverage during storms should be provided for all priority-one and priority-two roads. On priority-one roads, normal plans should provide for consistent snow removal or plowing over virtually all of the traveled way. Normal trip mileage for priority-one roads should not be less than 20 miles or more than 30 miles. Priority-two roads should be provided for in the same manner but with the objective of 25-30 miles for a trip. This will provide coverage roughly every hour on priority-one roads and every hour-and-a-half on priority-two roads, when required. (Standards for the State of Minnesota list its priorities as follows: priority one – 2 hours; priority two – 3 hours, priority three – 4 hours; priority 4 – 8 hours.)

c. What are the characteristics of assignments for salt and calcium routes?

- Trucks should be designated so they do not change the types of assignments, except for curves, hills and intersections. For example, a truck assigned to salt 1 1/2 lanes of a 3-lane road should be kept on that kind of assignment if practical, even if a small amount of deadheading is required. This will permit setting the spreader once at the beginning of a storm and not having to change it except to stop and start. Ideally there will be no deadheading and no need to stop to change settings. Judgment must be used when coming up with the best plan.

d. What are the characteristics of assignments for plowing routes?

- Recommended length, time and plow speed are shown in Table 1. These values are basic guidelines for use when planning for plowing. They will work out in most situations, but adjustments will be necessary in a number of cases.
- Conditions requiring different assignment lengths include urban areas and mountainous segments of roads, where plowing speeds would usually be slower than normal. The primary consideration is to adjust plans to provide regular coverage within a reasonable time.
- The one-hour frequency established for priority-one roads is near the maximum

anticipated need, and something a little less than this will be adequate for most storms. The planning process should provide for a higher level of service when indicated by weather or traffic conditions. This can be accomplished by careful planning for the priority-two roads. Plans for priority-two roads should provide a measure of regular coverage while snow is falling in most storms. This equipment, however, can quickly be brought back on the priority-one roads when storm conditions are worse than normal and the one-hour frequency is required.

Priority one (two lanes)

- Two trucks in echelon, 800-1,000 feet apart, or one truck with plow and wing (Figure 2).

Priority one (three lanes)

- Two trucks in echelon. If additional trucks or plowing units are available, they should be used on the three-lane route but also should be designated as available for assignments elsewhere if needed. This type of assignment should be handled by versatile operators. Two trucks should be 800-1,000 feet apart (Figure 3).

Priority one (four lanes, not divided)

- Three trucks in echelon with truck number three designated as available for assignment elsewhere, if needed. Trucks one and two should be 800-1,000 feet apart. The rear truck may be permitted to lag behind (Figure 4).

Table 1. Characteristics of assignments for plowing routes

Road priority	Length	Time*	Plow speed
One	20-25 mi (32-40 km) round trip	60-80 min round trip	20-25 mph (8.9-11.7 m/sec)
Two	25-30 mi (40-48 km) round trip	90-120 min round trip	—
Three	50-75 mi (80-120 km) per truck	—	—

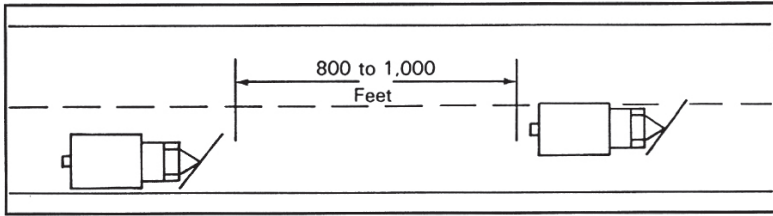


Figure 2. Two trucks in echelon operate 800-1,000 feet apart.

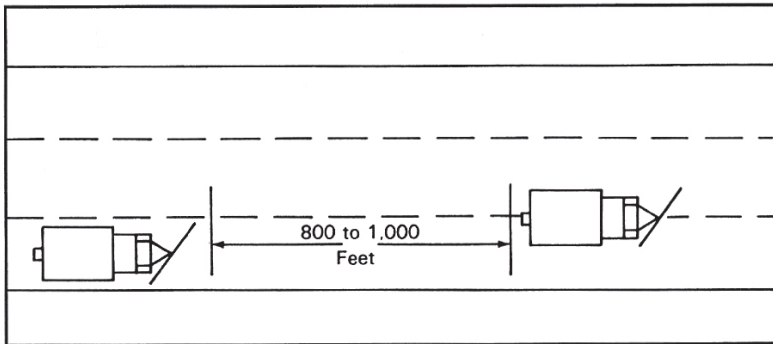


Figure 3. Two trucks in echelon operate on a three-lane route.

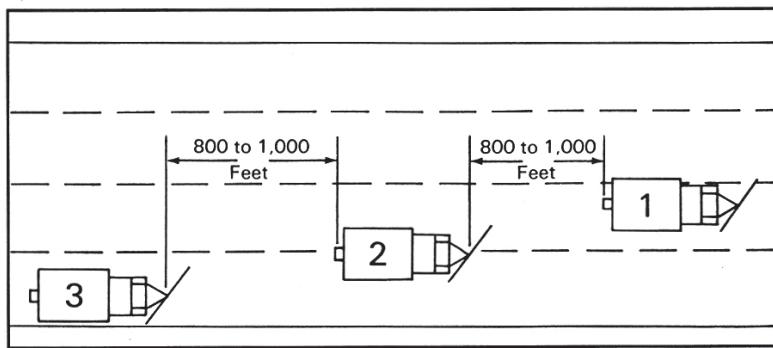


Figure 4. Three trucks in echelon operate on a four-lane route.

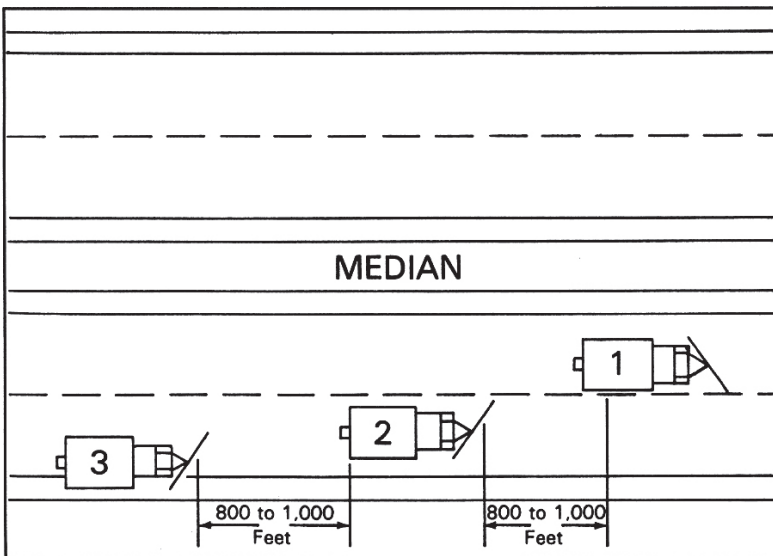


Figure 5. Three trucks in echelon—one pushing left and two pushing right—operate on a four-lane, divided interstate highway.

Priority one (four lanes divided; interstate)

- Three trucks, with truck number one pushing left (where there is a depressed median), Front truck should be independent, and all trucks should be 800-1,000 feet apart (Figure 5).

Priority one (more than four lanes)

- For six lanes, four trucks should be used with one or two pushing left (only when there is a depressed median) and the remainder to the right. All trucks should be 800-1,000 feet apart, depending on the location of the crown of the road. Trucks may be supplemented with a motor grader, if needed.

Interchanges

- Early and complete plowing at heavily traveled interchanges is essential. It must be given high priority and be coordinated with plowing on the main line. (Extra equipment should be assigned where necessary to assure free flow of interchange traffic.)
- Windrows of snow must not be left at either end of ramps. Care must be exercised when plowing overpass structures and elevated roadways to prevent snow from being thrown on the road below or on private property.
- Interchanges may not need extra trucks if they

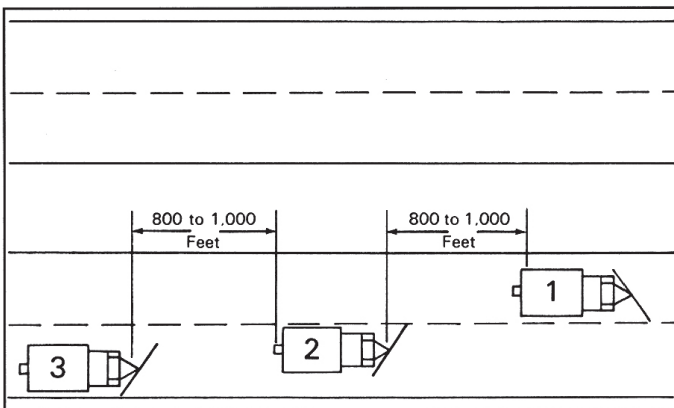


Figure 6. Three trucks in echelon operate with one pushing left (only when there is a depressed median) into the median to avoid a windrow in the traveled way. Trucks two and three are pushing to the right.

represent the end of two separate plowing assignments. The mileage and time involved in plowing such interchanges (and while turning around at the end of the route) should be included in the planning of routes.

Priority one (four lanes divided)

- Three trucks, with truck No. 1 pushing left (only when there is a depressed median) into the median, preferably positioned to avoid leaving windrows in traveled way. Trucks one, two and three should operate independently. Truck No. 3 is designated as available to be moved and all trucks should be 800-1,000 feet apart (Figure 6).

Priority two (two lanes)

- One truck on the road, supplemented by a motor grader where possible (Figure 7).
- e. When is trading a section of road advisable?
- The trading of roads for snow removal between areas, residences and even districts, should be done where it is obviously to the organization's advantage to do so. Generally, pieces of road traded should be traded for the entire snow removal responsibility.

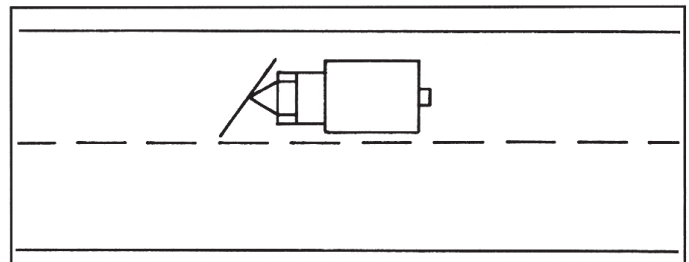


Figure 7. This truck operates alone on a two-lane highway. The truck plow is pushing to the right.

Preparing chemical and plans

34. Plowing plans should be prepared in the following manner:

- Mark off area boundaries on a regional map.
- Indicate snow removal or plowing priorities for each road in a different color:
 - For priority one, use red
 - For priority two, use blue
 - For priority three, use green
 A felt-tipped marker works well for this purpose.

- c. Make a rough sketch of the important roads, showing them as they would look from above, as in Figure 8. This will permit salting and plowing routes to be drawn in some detail. Indicate on each sketch the priorities and mileages of major segments of roads, the locations and important items such as area headquarters, storage facilities and particularly steep grades.
- d. Prepare the salting plan and plowing plan as described in the following paragraphs.

35. Salting routes should be laid out and sketched. They should meet the following objectives:

- Assignments are for 25-lane mile.
- Deadheading is avoided.

- No adjustment of road speed or spreader setting will be required during the course of application. (Exceptions may be made when warranted.)
- Obtain coverage as quickly as possible on all roads requiring an initial application.
- Achieve all these conditions with the fewest possible trucks.

36. Results should be entered on the salting plan forms (Figures 9 and 10). The exact lane-miles assigned to each spreader should be determined, and a written set of instructions for each spreader should be provided, indicating its destination, unless otherwise instructed.

37. Any wide variations from 25 lane-miles should be noted and, if necessary, the plan reworked to bring them more closely in line. If assignments can be adjusted to use one less spreader without requiring any one spreader to handle more than 30 lanemiles, this plan may prove worthwhile. However, even at 30 lane-miles, a truck should bring back straight salt, if spread at 400-500 pounds per 2 lane-miles.

Note: In some types of storms, salt should not be used at all because the surface can become even more slippery.

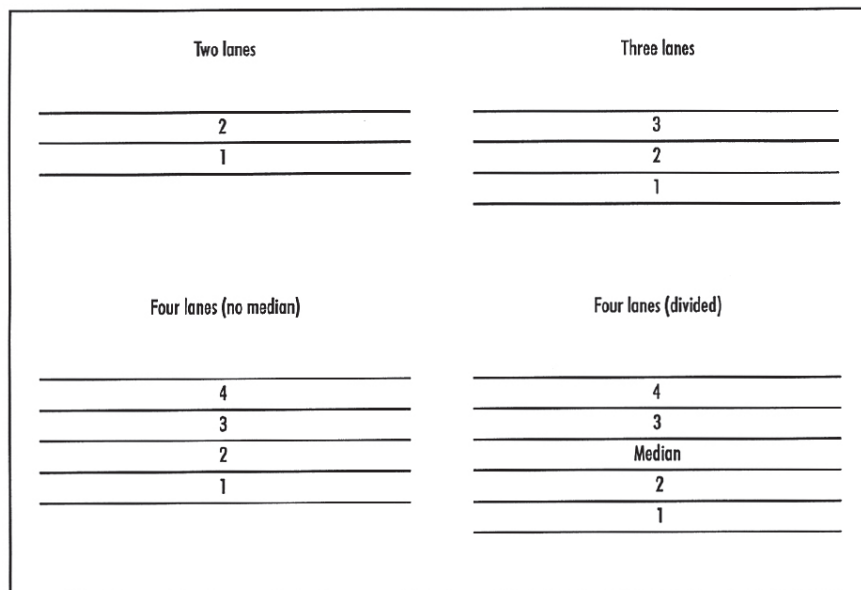


Figure 8. These sketches show how roads would look from above.

Salting Plan
Winter of 1966 - 1967

District POKEY
Residency SUNSHINE
Area Slushy Mountain

Route	Application To Be Made		Miles	Road Type	Lanes Serviced	Total Lane Miles	Equipment Used	
	From	To					Day Operator	Night Operator
50 1	JANESVILLE	TOP Slushy MT.	10.3	3	1 1/2	15.45	ED# 1752	
	TOP Slushy MT.	JANESVILLE	10.3	3	1 1/2	15.45	S.J. SNEED	A. Palmer
						(30.9)		
50 1	Start 4 Lane	County Line	7.1	4D	2	14.2	ED# 2143	
	County Line	Start 4 Lane	7.1	4D	2	14.2	B. Caspar	J. Nicklaus
						(28.4)		
22 1	Area Shop	Janesville	1.5	2	2	3.0	ED# 2142	
50 1	Janesville	Start 4 Lane	1.4	3	1 1/2	2.1	G. Payer	J. Barros
50 1	Start 4 Lane	Janesville	1.4	3	1 1/2	2.1		
22 1	Janesville	County Line	5.4	2	2	10.8		
22 1	Area Shop	RAW RIVER BR.	5.7	2	2	11.4		
						(29.4)		

Road Type Code:
 2 - 2 Lane D - Divided
 3 - 3 Lane I - Interstate
 4 - 4 Lane A - Non-Interstate
 Etc. Access Controlled

Remarks
 ED# 3014 Assigned to Sand Bow River Bridge at beginning of Storm. Then go to Route 50 Slushy Mt. and Sand trouble spots as needed

Figure 9. This salting plan shows the number of priorities (three in this case) and routes.

Salting Plan
Winter of 1966 - 1967

District POKEY
Residency Sunshine
Area Slushy Mountain

Route	Application To Be Made		Miles	Road Type	Lanes Serviced	Total Lane Miles	Equipment Used	
	From	To					Day Operator	Night Operator
50 1	JANESVILLE	TOP Slushy MT.	10.3	3	1 1/2	15.45	ED# 1752	
	TOP Slushy MT.	JANESVILLE	10.3	3	1 1/2	15.45	S.J. SNEED	A. Palmer
						(30.9)		
50 1	Janesville	Start 4 Lane	1.4	3	1 1/2	2.1	ED# 2143	
	Start 4 Lane	County Line	7.1	4D	2	14.2	B. Caspar	J. Nicklaus
	County Line	Start 4 Lane	7.1	4D	2	14.2		
	Start 4 Lane	Janesville	1.4	3	1 1/2	2.1		
						(32.6)		
22 1	RAW RIVER BR.	JANESVILLE	7.2	2	2	14.4	ED# 2142	
	JANESVILLE	COUNTY LINE	5.4	2	2	10.8	G. PAYER	J. BARROS
						(25.2)		

Road Type Code:
 2 - 2 Lane D - Divided
 3 - 3 Lane I - Interstate
 4 - 4 Lane A - Non-Interstate
 Etc. Access Controlled

Remarks
 ED# 3014 Assigned to Sand Bow River Bridge at beginning of Storm. Then go to Route 50 Slushy Mt. and Sand Trouble spots as needed

Figure 10. This salting plan shows the number of priorities (seven) and routes.

- 38. A primary and an alternate operator should be assigned to each salting route on each shift. (Only one worker per salting truck is absolutely needed to perform the initial salting run.) If additional personnel are available, two workers can be sent with a truck (though a truck should never be delayed while waiting for a second worker). Getting this job done quickly is important enough that alternate operators should be assigned and trained to take over without special instructions if a primary operator cannot report for work.
- 39. The regular operator is responsible for maintaining the truck and spreader. As some spreaders operate hydraulically, only highly qualified mechanics should perform maintenance. It is the operator's responsibility to check the oil and gas in the spreader engine, run it daily, and so on. The alternate operator should be responsible for the equipment only when called upon to operate it. (This includes, however, checking it over before operating it.)
- 40. When a good plan has been set, final sketch maps should be made and each truck's assignment marked in a different color and labeled as to the salting plan. The plan then should be discussed with all supervisors.

Note: If there is a truck normally assigned to spread abrasives at trouble spots either at the beginning, throughout, or at planned intervals during a storm, this should be noted on the remarks section of the salting plan.

- 41. Plowing routes should be laid out on a copy of the sketch map. (Generally, units will be placed together to work as a team in providing regular service to a road segment or group of segments.) When possible, follow the guidelines discussed earlier for assigning equipment to different road types.

Remember: The objective is to be able to obtain service on an hourly basis on priority-one roads and every 1/2 hour on prioritytwo roads. This means round-trip mileage should be 20-25 miles on priority-one roads and 25-30 miles on priority-two roads.

- 42. The actual round-trip mileage for each truck, and the estimated time in minutes it should take to travel, should be worked out. Consider known factors affecting how fast the plow can be driven (slower on steep, curvy roads and urban streets, faster on straight, level rural highways).
- 43. Adjust assignments, if necessary, to bring each truck to within 10-15 minutes of the desired round-trip time estimated on the basis of average storm conditions. (A form should be designed to accomplish this.) If these requirements cannot be met with equipment on hand, decide what is the best achievable time with what is available, what is needed to meet the standard and what plans can be made to use it. These problems then should be discussed with all supervisors.

Table 2. Application rates of chemicals (number per lane-mile)

	Temperature		
	Below 10° F	10-15° F	15-32° F
Calcium pellets	200-375	250-300	175-250
Calcium flakes	350-450	275-350	200-275
Salt	400-550	250-400	200-250
¼ calcium pellets, ¾ salt	350-475	250-300	200-250
¼ calcium flakes, ¾ salt	250-500	250-350	200-250

Treated abrasives (ice) ½ cu yd per lane-mile
 Treated abrasives (packed snow) ½ cu yd per lane-mile

Note: The recommended materials and rates are in bold. Quantities should be doubled for two-lane roadways.

Storage

44. Set up salting routes so they bring spreaders back toward storage sites as they empty. It may be possible to stockpile salt at several locations so spreaders won't waste time deadheading.
45. Table 2 lists the application rates of chemicals per lane-mile. Chemicals and abrasives should be spread full width on highly congested or urban areas and in danger spots where fast melting of the entire surface is essential for full skid control.
46. In rural areas, chemicals and abrasives may be spread by confining the width of the spread to the middle third or less of a two-lane roadway. On roadways where the crown goes only one way, the chemical should be applied to the high side of the roadway.
47. On low-volume roads, skid control may be provided at a minimum cost by spreading abrasives full width at intervals close enough to provide safe movement.

Planning chemical and plowing routes for interchanges

48. By using a chemical and plowing sketch, work out

an actual round-trip distance for each truck and the estimated time in minutes it would take to travel it. Consider known factors affecting how fast the plow can drive—faster on straight, level, rural highways. Adjust assignments, if necessary, to bring each truck to within 10-15 minutes of the desired round-trip time, estimated on the basis of average storm conditions. Using salting or plowing plan forms can be helpful. When the plan is approved by an engineer, written instructions can be posted.

49. Interchanges must be kept clear of snow and ice. If an off ramp is blocked and backs traffic out into the through lanes, it will eventually block everything.
50. Figure 11 depicts the type of interchange most commonly used with intersecting secondary routes and, in some instances, that carries a below-average daily traffic count. It is an example of a simple diamond type interchange in the middle of an assignment being handled by a team of trucks. (An extra truck may be required to handle it.)
51. When simple diamond interchanges are involved, one truck may be assigned to handle two interchanges. Such interchange trucks should

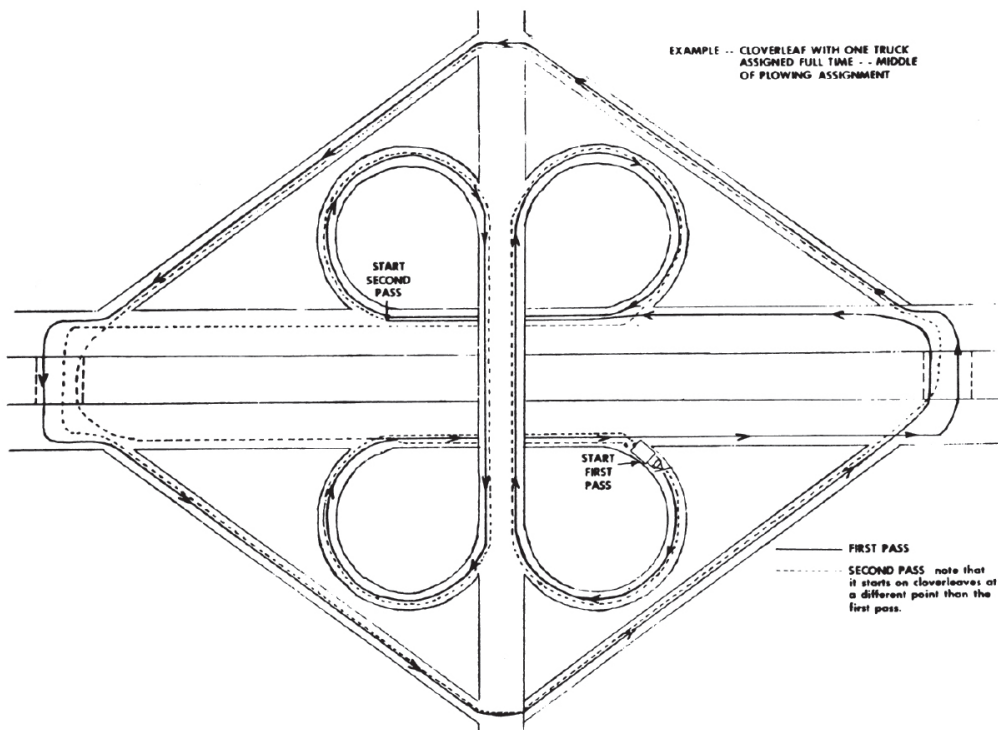


Figure 11. This typical interchange is most commonly used with intersecting secondary routes and a possible below-average traffic count.

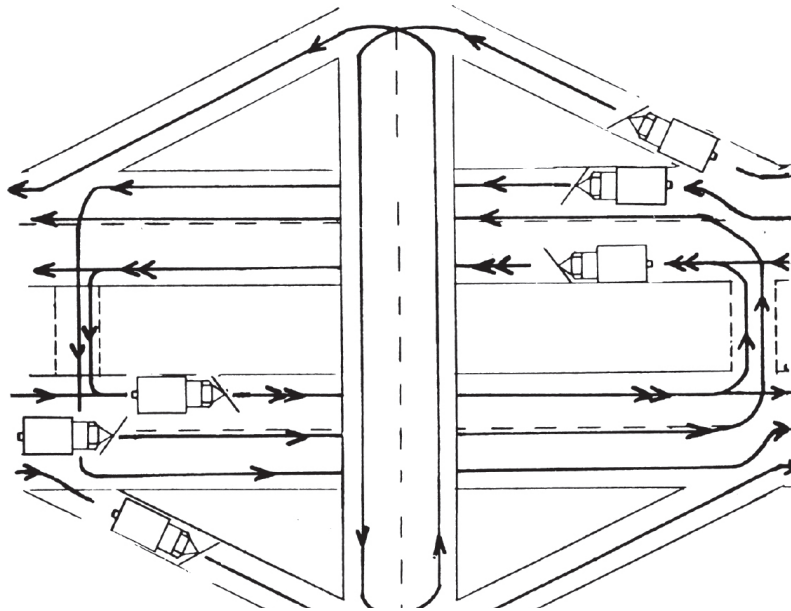


Figure 12. A diamond interchange such as this may be located at the end of two salting or plowing routes.

travel on the main line with plows down to supplement pushing back. In some cases, these trucks can regularly relieve one of the main-line trucks.

- 52. Road distances should be assigned to this type of interchange, and maintenance superintendents should be encouraged to determine how many trucks will be needed to properly maintain the interchange.
- 53. Work out each situation, and give some idea how to approach the problem of planning for snow and ice control at interchanges.
- 54. In any explanation of the interchange to maintenance personnel, point out that the same basic values should be used for planning situations that are like those involved at other types of interchanges (Figure 12).
- 55. When a truck with a snowplow is making sharp left turns, very little snow is being moved; the plow blade merely slices through the snow. In view of this, intersecting roads with an off ramp may require special attention.

Sources of information

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