



KITSAP COUNTY PUBLIC WORKS

Road Maintenance Manual

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Foreword

Reliable, well-maintained roadway transportation facilities are essential to the well being of the county, its citizens, and its commerce. Our road maintenance and operations personnel are essential to the Kitsap County's transportation backbone—the Kitsap County road system. Public safety and safety for our employees is a high priority and must be considered in every decision and activity that affects roadway facilities. The goal of the Kitsap County Department of Public Works is to maintain the roadway system in a condition as near as possible to the condition of its initial construction or subsequent improvement. We take pride in, and strive for, excellence in the maintenance and operations of our roadway system. This manual provides our staff a comprehensive field reference for the maintenance practices and procedures that will ensure that excellence.

Don Schultz
Road Superintendent

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Emergency Procedures

This chapter provides guidance to reduce vulnerability of the county transportation system from any emergency or disaster by:

- Establishing capabilities for protecting the transportation system and employees from the effects of emergencies or disasters.
- Responding efficiently to emergencies and disasters.
- Assisting in recovery from the aftermath of any emergency or disaster.

This chapter describes emergency response procedures. This type of response may be required for small spills, snow and ice removal, traffic accidents, earthquakes, declared disasters, and disaster recovery. An emergency is defined as a situation involving natural phenomena, disasters, casualties, national defense or security measures, or other catastrophic events. Emergency procedures include the response activities that must be taken to prevent the imminent loss of human life or property. In the event of a non-weather related emergency the Director, Assistant Director or their designee notifies the Road Superintendent that an emergency response is needed. The Road Superintendent mobilizes in the same manner as described for weather related responses below.

Most emergency responses are caused by inclement weather. Kitsap County Public Works (KCPW) subscribes to WeatherNet to monitor daily weather forecasts. WeatherNet is a certified meteorologist weather forecasting service. WeatherNet provides advance notification for impending inclement weather that may require an emergency response. The Road Superintendent is notified by phone or e-mail when inclement weather is imminent. Based on these forecasts the Road Superintendent issues a mobilization order to area Road Supervisors. Road Supervisors mobilize appropriate road crews to respond to the forecast. During major storms crews work alternate 12-hour shifts until the emergency is over.

Area Road Supervisors mobilize road crew personnel. The Road Supervisors outline equipment utilization and develop a schedule for the response operation. They also assign specific areas of response. KCPW is responsible for these functions during an emergency response:

- Determine the functional parts of the county road network.
- Coordinate and control emergency traffic regulations with the County Sheriff's Department.
- Notify the local Washington Department of Fish and Wildlife (WDFW) local habitat biologist when an emergency response would normally require a Hydraulic Project Approval (HPA). KCPW obtains the HPA as soon as practical before taking the emergency action. KCPW will meet all conditions of the WDFW HPA permit when applicable and possible during emergency responses.
- Notify the National Marine Fisheries Service and U.S. Fish and Wildlife Service of emergency responses resulting in an "after the fact" consultation under the endangered species act when the response involved threatened or endangered species' water bodies.
- Reconstruct, repair and maintains roads, bridges, and alternate routes. Coordinate mobilization of staff and equipment required for an emergency response
- Participate on Damage Survey/Inspection Report Teams,.
- Provide support to the local Emergency Operations Center as requested.

Regional Emergency Response Plans

Each Kitsap County agency is required to develop and maintain an Emergency Response Plan. The plan establishes day-to-day operational procedures for emergency responses. Emergency response procedures clearly define employee roles and responsibilities.

Kitsap County Disaster Plan—Concept of Operations

Governments are responsible to make every effort to protect life and property during emergencies. When response efforts exceed local capability assistance is requested from the next

higher level of government. Local government may request assistance from state agencies and state agencies may request assistance from federal resources.

Organization and Assignment of Responsibilities

Kitsap 1 supports Road Department operations during inclement weather and emergency responses. Kitsap 1 provides emergency response assistance as requested. This includes administrative support of operations and communication support during emergency responses.

Administration and Logistics

Documentation is critical for successful reimbursement of funds and to support liability issues. Road Supervisors, their assistants, and the Road Superintendent are responsible for documenting all actions taken during emergency responses, including changes to established procedures and policies. Maintenance office staff is provided with the documentation and is responsible for completing proper records and forms, then forwarding the reports to the Road Superintendent. During emergency responses some administrative procedures are suspended, relaxed or optional.

Plan Development and Maintenance

The Kitsap County Disaster Plan provides guidelines for documenting emergency management activities. Local Agencies coordinate with state and federal agencies to develop and accomplish the tasks outlined in this plan.

Training and Exercises

Department of Emergency Management periodically provides training and exercises that test the Kitsap County Emergency Response Plan and Procedures.

Emergency Operating Procedures

Many situations require transportation crews for emergency responses. Vehicle accidents and hazardous material spills are the most common.

Hazardous materials spills may make driving unsafe, endanger lives, or contaminate the environment. Hazardous materials can make roadway surfaces slippery, impair visibility, and may require lane restrictions or road closures. Many materials may pose danger including explosives, flammables, corrosives, poisons, and radioactive materials. Other materials may not be hazardous, but can cause hazardous conditions on road surfaces. Bulky materials can block lanes causing restrictions and lane closures.

Employees at the scene of an accident or spill take emergency actions as required to protect human life and property until law enforcement or fire agency staff assume command and control of the incident. Law enforcement is responsible for safety measures at an accident site, and coordinates with the Department of Ecology for spill response and cleanup. The Incident Commander may request assistance from KCPW for traffic control and assistance cleaning up non-hazardous spills. KCPW employees are permitted to clean up hazardous material spills as outlined in the Comprehensive Emergency Management Plan, Emergency Support Function #10 Hazardous Materials, Attachment 3 Hazardous Materials Incident Response Levels and Action Classification. Road Department vehicles are equipped with Emergency Spill Kits. Cleaning spilled hazards is the responsibility of the owner or shipper of the cargo. When the responsible party can not be identified, the Department of Ecology assumes responsibility for the cleaning the spill area.

Maintenance Field Personnel

Maintenance employees take the actions listed below when responding to a hazardous materials condition.)

- Advise the Area Road Supervisor or Superintendent of the incident.
- Request aid from law enforcement and fire response agencies.

- Take precautionary action to protect employees, motorists and residents from exposure to the hazardous material.
- Provide traffic control. This may include closing the road or restricting lanes to ensure that no one comes in contact with the hazardous material.
- Report the exact location, cause of the temporary closure, and extent of the closure to the Area Road Supervisor or Superintendent. During regular working hours the Area Road Supervisor or Superintendent notifies Kitsap One. CENCOM and Kitsap County's Department of Emergency Management are advised of the incident by Kitsap One during regular working hours, or by the Area Road Supervisor or Superintendent outside or normal working hours.
- Avoid contact with human tissue and blood.
- Stay on site until required traffic control is established and until relieved by a Road Supervisor, Assistant Supervisor, or local law enforcement or fire response agency personnel.

Road Superintendent or Road Supervisor

The Road Superintendent and Road Supervisors take the following action when responding to a hazardous materials condition:

- Coordinate personnel and equipment and establish traffic controls to keep traffic from entering a hazardous area.
- Provide a complete report of the incident to the County Engineer and the Director of Public Works Department
- Monitor the response and ensure established procedures are followed. Patrol the area and assist stranded motorists.
- Establish safe detours. Detours should be established using state roads and highways when possible. Local roads can be used after surfaces, bridges, and overhead clearance restrictions have been reviewed. Use signs and other traffic control devices (e.g., barricades and flashing lights) to identify detours. Station flagging staff at traffic control devices as needed.
- Provide detour and restriction information to Kitsap One. Kitsap One will notify residents and motorists of detours and closures.
- Reopen roads when the response is completed.
- Advise the Road Superintendent, County Engineer, Director of Public Works, and CENCOM and Kitsap One when roads are reopened.

Abandoned Cargo

All cargo abandoned on Kitsap County property is removed at the owner's expense. Removing abandoned hazardous materials follows the procedures outlined above. Revised Code of Washington (RCW) 4.24.512 assigns responsibility for removing abandoned hazardous materials to the owner of the material.

If the abandoned material is hazardous establish traffic control, and call the Kitsap County Risk Manager. The Risk Manager notifies the Department of Ecology Spill Response Team. Ecology is responsible for coordinating clean up of abandoned hazardous materials. Abandoned material identified as hazardous but the container is not leaking or severely damaged can be moved to the edge of the shoulder to allow traffic flow prior to Ecology's arrival at the scene. Do not take abandoned materials to the maintenance facility.

If abandoned material is identified as non-hazardous and is reusable take it to the nearest maintenance facility. If the commodity is not claimed within thirty (30) days it becomes the property of KCPW and may be used for its intended purpose by KCPW.

Clearing the Roadway

KCPW does whatever is reasonable to reduce delays associated with accidents and emergency responses. Our "Open Roads" philosophy is to open roads for travel as soon as practical after an accident or emergency response. It is our obligation and responsibility to ensure safety first. This

includes a safe environment for our employees, emergency responders, and the public. Minimizing traffic delays is given priority over salvaging spilled or abandoned cargo. Bridges and transportation structures closed due to structural damage require approval from the Washington State Department of Transportation before traffic is allowed to use them.

Non-Hazardous Spills

Non-emergency field spills & small spills that you are comfortable cleaning up and have been trained, go ahead and do it. If this spill gets into the storm drainage system or surface waters – SSWM must be contacted. Call KCSSWM to report the spill. You may also get advice on proper disposal if needed. Berm divert or dike the material, try to prevent spills entering catch basins, streams, creeks or other water bodies.

Employees have been and are continually trained in spill response procedures. Spill cleanup equipment and resources are provided. Spill kits and emergency response handbooks are located in vehicles, at fuel pumps and near pieces of operational equipment. These spill kits are clearly marked.

Training Frequency

Road department employees are trained every June on spill response procedures and notification requirements. By performing training during this time frame new summer help employees will have the knowledge on how to respond to spills properly and the training will serve as a refresher for returning summer help and regular employees.

Field Spill Prevention

Check vehicles, equipment and complete a pre-trip inspection. Document your observations on the pre-trip inspection report. Check hoses and fittings for leaks. Look for any leaks when you arrive at the job site. Be aware of gauges. Hot temperatures indicate leaks. Inspect after operation, when you walk away look back at the equipment and check for leaks. Fuel auxiliary equipment before you leave the shop.

Facility Spill Prevention

Observe good housekeeping practices, inspect the facility regularly and document inspections. Inspect fuel islands daily – make sure spills are cleaned up properly. Do not store empty oil drums outside. Ensure that waste oils are being stored properly. Do not store batteries outside. Place gas and oil cans in the flammable storage locker – do not leave them in a pickup overnight. If you have a spill clean it up and report it to the Surface and Stormwater Division.

Work Zone Safety

Work zone traffic control and safety practices are important to ensure safety for employees and motorists. Traffic control guidelines in this manual provide the driving public positive and consistent guidance through work zones. Effective guidelines also reduce the risk to employees working in work zones.

The Secretary of Transportation adopted the Manual on Uniform Traffic Control Devices (MUTCD) as the legal standard as required by RCW 47.36.030. **It is mandatory that traffic control measures on maintenance projects comply with the MUTCD requirements.** The MUTCD outlines basic principles and prescribes standards for the design, application, installation, and maintenance of traffic control devices. The MUTCD details requirements for color, size, shape, location and need for traffic control devices.

In some cases WSDOT and the Washington State Department of Labor and Industries has standards exceeding those established in the MUTCD (e.g., see *Traffic Manual*, M 51-02, Chapter 5 and the *Work Zone Traffic Control Guidelines Book*, M 54-44). In these situations the more stringent standard is followed (see WAC 296-0155-305). Review all applicable standards before determining the traffic control plan.

When standard layouts are not applicable consult the Kitsap County Traffic Engineer.

The employee in charge at a work zone is responsible to ensure all established standards are followed. The person in charge also ensures temporary signs, warning devices, and flag persons are placed appropriately to protect both motorists and workers. **Safety is always the primary consideration in a work zone.** Safety takes precedence over any efforts to maintain roadway or structure integrity, or to preserve traffic flows.

Fundamental Principles

The following lists fundamental principles that enhance motorist and worker safety in work zones.

- Implement a comprehensive traffic control strategy. Consider the type of work being done, the area of the work zone, and traffic patterns to determine which traffic control devices to use.
- Maintain normal traffic flows in the work zone as much as possible.
- Do not surprise motorists. Provide adequate sight distance for motorists to recognize and react to traffic control devices. Place traffic control devices on straight highway sections when feasible.
- Prepare and implement effective traffic control plans in work zones. Minimum standards may not meet the need in every work zone. Evaluate work operations, consider work zone and traffic conditions and determine an appropriate level of traffic control measures for each work zone established.
- Avoid frequent and abrupt changes in traffic alignment.
- Minimize worker exposure time to traffic.
- Provide adequate warning, delineation, and channelization.
- Remove inappropriate pavement markings on long-term (work in a zone for more than three days) projects.
- Use flagging staff to direct traffic only when other methods of traffic control are inadequate.
- Inspect traffic set-up control devices prior to work.
- Monitor traffic control strategies. Modify your strategy when traffic conditions change.
- Remove, cover, or turn traffic control devices away from traffic when not in use.
- Channel traffic in the work zone with pavement markings, signs, cones, plastic barrels, water filled barriers, or lightweight devices.
- Use sand bags for sign ballast. Do not use heavy, solid weights, (e.g., concrete blocks) to stabilize portable sign supports.

- Keep the drivers' perspective in mind when selecting and implementing traffic control devices. Credible messages must be conveyed to motorists so they can comply as expected.
- Use cones and barrels to define any closed portion of the roadway within a work zone. Even short term operations realize safety benefits when traffic control devices are placed to send an obvious message that a portion of the road is closed and motorists must divert around the work zone.

Traffic Control Zones

The traffic control zone is the work area between the first advance warning sign and the point beyond where traffic is no longer affected. Traffic control zones are divided into the following areas:

- Advance Warning Area
- Transition area (for lane or shoulder closures)
- Buffer space
- Work area
- Termination area

Advance Warning Area — Warning signs are located before the transition area to let motorists know what you want them to do. When no lane or shoulder closure is needed, as in mowing operations, one sign is sufficient. When multiple signs are needed in a work zone they should follow the MIA (Message, Information & Action) plan for signs. The first sign should convey a message, the second should provide more information, and the third should convey the action you want the motorists to take. The first sign provides a general message to motorists. This advance warning sign tells motorists they are approaching a work zone (e.g., ROAD WORK AHEAD). The next sign provides additional information about the upcoming cautions (e.g., ONE LANE ROAD AHEAD). The third sign tells motorists what action to take (e.g., BE PREPARED TO STOP, MERGE LEFT).

Transition Area — A transition area is where the lane and/or shoulder is closed by channelizing devices. Traffic is moved out of the closed lane or shoulder by tapering the traffic. The rate of taper is determined by guidelines in the "*Work Zone Traffic Control Guidelines Book*". If sight distance is restricted (e.g., by a sharp vertical or horizontal curve), be sure the lane closure begins well in advance of the restriction.

Buffer Space — The unoccupied space between the transition and work areas is referred to as buffer space. Buffer space provides a margin of safety for vehicle traffic as well as employees. When work requires a moving traffic control zone the buffer space is that space between the attenuator or buffer truck and the work vehicle.

Work Area — The work area is where the equipment and workers actively engaged in maintenance activities.

Termination Area — The termination area provide space for traffic to return to the normal configuration after leaving the work area.

Traffic Control Devices

Traffic control devices warn, regulate, and guide traffic. They include signs, signals, lighting devices, pavement markings, delineators, channeling devices, hand signaling devices, and temporary barriers. **Traffic control devices must conform to WSDOT and MUTCD standards.**

Sign supports — Sign supports can be portable or fixed, depending on the duration of work. Only use small sand bags to stabilize portable sign supports. Do not use heavy or large objects that could become a projectile upon impact (e.g., concrete, chain, etc.). Sign supports should be lightweight, yielding and breakaway in a collision with a motor vehicle.

Signs on portable supports must be at least one (1) foot above the roadway. Supports mounted on fixed posts must be five (5) feet above the roadway in rural areas and seven (7) feet above the roadway in urban areas.

Sign intervals are prescribed in Table 2–1 on the next page. Consider in-place existing signs when developing and implementing traffic control plans.

Table 2.1 — Advance Warning Sign Spacing⁽¹⁾

Road Type	Speed	Road Type
		A ⁽²⁾
Freeways and Expressways	70 55	1,500 feet +/- or per MUTCD
Rural highways	65 60	800 feet +/-
Rural roads	55 45	500 feet +/-
Rural roads and urban arterials	40 35	350 feet +/-
Rural roads, urban streets, residential business districts	30 25	200 feet ⁽³⁾
Urban streets	25 or less	100 feet ⁽³⁾
<p>(1) All spacing may be adjusted to accommodate interchange ramps, at-grade intersections, and driveways</p> <p>(2) This refers to the distance between advance warning signs.</p> <p>(3) This spacing may be reduced in urban areas to fit roadway conditions</p>		

Regulatory signs — Regulatory signs (e.g., KEEP RIGHT, DO NOT PASS) impose legal restrictions, and are placed where regulations apply. Most regulatory signs have black text on a white background. Only use regulatory signs where needed.

Reduced legal speed limits — When other traffic control efforts do not work you may consider reducing the legal speed limit. Follow speed reduction guidelines outlined in RCW 47.48.020, the WSDOT *Construction Manual* (M 41-01), and WSDOT Directive D 55-20, Reduced Speed in Maintenance and Construction Work Zones when reduced speed limits are needed. Requests to reduce speed limits on County-maintained roads are submitted to the Kitsap County Traffic Engineer.

Warning signs — Warning signs give motorists advance notification of hazardous conditions for traffic. Use warning signs as needed, particularly when the hazard is not obvious or cannot be seen by approaching motorists. Be cautious of how many warning signs are used. When warning signs are overused they lose their attention-getting value.

All warning signs have black text on orange backgrounds (except the round railroad advance sign, which is black text on a yellow background). **Do not use double faced (back-to-back) signs as warning signs.**

Variable message signs — Variable message signs are recommended for high speed, high volume roadways, and for work zones that require highly visible messages. Variable message signs supplement or enhance work zone safety and are not used to replace required signs. No more than two message panels are permitted in work zones. When the work requires a moving work zone consider truck mounted Portable Changeable Message Signs (PCMS) for shadow or buffer vehicle(s). Typical work zone application for variable message signs includes:

- Locations where speed of traffic drops substantially
- Locations where significant delays are expected
- Accident or incident management

Variable messages should be brief, clear and concise. When special messages are needed follow

conventional signs standards. It is best to use the pre-programmed stored messages provided with PCMS equipment. Do not display a message with an arrow from a PCMS located on the same shoulder as the arrow direction. Use the right shoulder for left arrows and the left shoulder for right arrows.

Channelizing Devices – Channelizing devices are used to direct traffic away from or around the work zone, or to separate two-way traffic. Use reflective devices in night-time work zones. Traffic cones are the most common channelization devices. Cones must be at least 18 inches tall in most situations. When cones are used in high-speed or high-volume operations they must be at least 28 inches tall.

Place channelizing devices closes in zones is recommended. Allow room for large work vehicle access. Route larger vehicle access off the existing shoulder or through a staggered placement of channelization devices. Place barrels or cones diagonally across closed lanes to indicate the lanes are closed.

Refer to the *Work Zone Traffic Control Guidelines* for more information on channelization devices, when to apply them and how to effectively place them. All interested parties should meet before cones are placed. The following procedures need to be discussed:

- Which technique (e.g., a whistle or voice actuated headset) is going to be used to signal between the cone handler and truck operator?
- Are cone tapers placed across closed lanes done by hand?
- The driver is responsible for safe operation of the vehicle, maintaining the vehicle at a safe speed, watching the cone side and the front of the vehicle, and watching the cone handler.
- The cone handler is responsible for setting and removing cones, and signaling the driver in case of any obstruction or emergency.
- The driver and cone handler decide if a shadow vehicle with a truck mounted attenuator is required to protect the cone handler while exposed to traffic.

Traffic Safety — Use drums on freeways. They provide greater target value and their imposing size increases visibility.

Barricades — Barricades protect spot hazards and closed roadways and sidewalks. Barricades are placed along with appropriate signing. Barricades can also provide additional protection to work areas. Lights used to channel traffic must be steady burning, “Type C”. Do not use flashing, “Type A”, warning lights on barricades when barricades are used to channel traffic.

Temporary pavement markings — Temporary markings are used to delineate lanes and tapers on long-term projects. Before applying temporary markings you need to remove existing markings so motorists are not confused. When temporary markings are used in short-term maintenance operations it may not be practical to remove and then restore pavement markings. If it is necessary to divert traffic across existing pavement markings in a short-term application the channelizing device used must be so dominant that a motorist’s attention is drawn completely away from the existing marking. Reducing the spacing between devices is recommended. The use of removable black mask tape (see QPL–*Qualified Products List*) may also be considered to temporarily cover existing markings.

High-level warning devices — High-level warning devices are tall, portable stands with flags or flashing lights visible above traffic. These devices can be used with flags only, or they may have a sign or flashing light attached. In some applications high-level warning devices are attached to vehicles used in moving or mobile work zones. (See MUTCD, Part VI).

Temporary Barriers - There are several different types of temporary barrier protection used in work zones. These include concrete barriers, portable concrete barriers, steel barriers and water-filled barriers. Temporary barriers are effective and do provide protection in work zones, but may result in more damage to vehicles that collide with them.

- **Concrete barriers** are rigid barriers designed to prevent errant vehicles from entering work zones. They are considered the best type of barrier to enhance worker safety. Kitsap County’s Traffic Engineer can provide direction for site-specific placement. Consider using concrete barriers in these situations:
 - High-speed roadways and work zones with high potential for worker injuries.
 - Work zones in “no escape” areas (e.g., tunnels, bridges, and lane expansion work).
 - Long term, stationary jobs where a work zone is established in one location for more

- than three (3) days.
 - Work zones in close proximity to traffic (e.g., concrete slab repair on freeways).
- **Movable barriers** are specialty barriers and require a Transfer/Transport Vehicle (TVV) to physically move the barrier. Use movable barriers in high-volume traffic conditions when the work zone produces very short-term lane closures. Movable barriers can also be used in continuous operations over an extended period of time. This is particularly effective when the closed lane reverts to normal operations at a different time of day. Protect the ends of concrete barriers with approved crash cushions, unless flared outside the clear Zone. Consult with Kitsap County's Traffic Engineer to determine appropriate end treatments.
- **Steel barriers** are rigid portable barriers designed to prevent errant vehicles from entering work zones. Steel barriers are best in work zones where concrete barrier are also used. The benefits of steel barriers include their light-weight stackable design which reduces transport costs when compared to traditional barriers. Optional casters can also be installed to simplify deployment and movement and allows barriers to be pushed and pulled into position.
- **Water-filled barriers** are portable traffic barriers that prevent errant vehicles from entering work zones. They are most effective in stationary work zones with exposure to high-speed traffic. They are also effective in work zones where concrete barriers are not practical, but more protection than channelization devices is desired. When placing water-filled barriers always consider that lateral deflections of up to 23 feet can occur when water-filled barriers are impacted at high speed. Consider these factors when you use water-filled barriers:
 - Do use them in short-term work zones (less than three (3) days) with minimum lengths of 100 feet.
 - Do not use them in lane transitions unless they meet all manufacturers' specifications for that use.
 - Always consider risk and work zone conditions.
 - Always follow manufacturer's guidelines and specifications when using water-filled barrels. Consult with Kitsap County's Traffic Engineer before using water-filled barrels in the work zone.

Hand Signaling Devices — When other methods of traffic control are not effective for warning and directing motorists consider hand signaling device. When you use flagger traffic control only approved hand signals may be used. The stop/slow paddle must be at least 18 inches in diameter. If paddles are used in night-time work zones they must be reflective. When used in high-speed, high-volume work zones, or when used in work zones where more advance driver attention is desired, use 24 inch stop/ slow paddles or Flashing Stop/ Slow Paddles (FSSP).

Lighting Devices — Lighting devices are used to call attention to hazardous situations, especially at night. They can include warning lights, flashing vehicle lights, floodlights, and flashing arrow boards. A brief description of these devices is shown below.

- **Warning lights** either flash or burn steady. They are referred to as Type A, Type B, Type C or strobe lights. Warning lights are generally mounted on channelizing devices, barriers and signs. Always ensure that warning lights are secured to the channelizing device or sign so they do not come loose, unsecured warning lights can become dangerous flying objects when struck by a vehicle. The MUTCD, Part VI provides additional information regarding warning lights.
- **Steady burning lights (Type C)** are normally used in a series of channelizing devices or barriers and delineate a taper or separate the work zone from travel lanes. Never use flashing lights in sequence for transitions or continuous channelization.
- **Flashing vehicle lights** alert motorists to potential hazards presented by maintenance vehicles and workers near travel lanes. Flashing lights are an effective warning for isolated hazards and signs. Snow-removal and other roadway maintenance equipment use flashing lights for safety while working. You should always use flashing lights when operating over-width equipment on highways (see WAC 468-38-390.)
- **Floodlights** are used to illuminate nighttime work zones. Floodlights provide lighting for

work operations, and increase crew visibility for motorists. Most night work zones require flaggers. Flaggers must be illuminated by flood lighting to increase visibility. Shield the light source to protect motorists from glare.

- **Flashing arrow boards and variable message signs** are **required** for day and nighttime tapered lane closures and moving work zones. A photocell that automatically dims at least 50% must be used in night-time work zones. This helps prevent motorists from being temporarily blinded by variable message signs. When using variable message signs for lane closures tapers locate them in the lane, or partially on the shoulder, being closed. Place them behind the taper of channelizing devices, usually within the first one third of the taper. Do not use arrow boards or arrow displays on variable message signs under these conditions.
 - When the work zone does not include lane closures, unless it is a moving work zone on multi-lane roads.
 - When the work zone is on or outside the shoulder and no closure of the adjacent travel lane is required.
 - When the work zone is on a two-lane, two-way roadway.
 - When only a shoulder closure is required.

Do not use more than one arrow display for each lane being closed. An arrow display with a shadow vehicle is permitted in moving lane closures. The caution mode (flashing four corner lights only) may be used as supplemental warning in work zones that do not require a lane closure.

Arrow displays used on PCMS's must meet the same performance standards for flashing arrow boards as described in the MUTCD, Part VI.

Traffic Control Procedures

A myriad of factors contribute when choosing the best way to control traffic in work zones. You must consider the maintenance activity being performed in the work zone, the estimated duration of the work, type of highway where the work zone is established, traffic speeds and traffic volume through the work zone. Appropriate safety clothing is required for Kitsap County employees in work zones.

Providing advance warning to drivers approaching work zones is required. Specific requirements depend on the variables mentioned above. Advance warning could be as simple as the flashing beacon on a work vehicle or may require a series of portable signs and a PCMS. Refer to the "*Work Zone Traffic Control Guidelines M54-44*" Book and the MUTCD, Part VI for specific advance warning requirements. Using advance warning signs can be effective when:

- Activity in the work zone may distract motorists or require them to react beyond normal driving behaviors encountered on that section of road.
- Work is performed on, or immediately adjacent to, the roadway. This usually is defined as work within 15 feet of the edge of the roadway.
- Equipment is moved along or across the highway.
- The shoulder is occupied or closed.
- There is encroachment into travel lanes.

You can find examples of typical traffic control plans, as well as guidance for work zone traffic control in the MUTCD, Part VI and in the "*Work Zone Traffic Control Guidelines M54-44*" book. Traffic control plans are flexible. Even the best developed plan may need to be modified due to changing conditions. Always evaluate the effectiveness of your plan and be willing to modify it when needed.

Once a traffic control plan is set-up the maintenance employee in charge drives through the work area as motorists are expected to transit through the work zone. This helps determine the plan's effectiveness. Continued monitoring ensures traffic control devices remain in place.

Changing conditions can include traffic volumes, the type of work being performed, or the time of day. These factors may require adjustments to your traffic control plan. When an accident or near accident occurs after traffic controls are established you may need to make adjustments immediately. Once adjustments are made, continue to monitor traffic patterns to see if additional changes are needed. Always remove, cover or turn traffic control away from traffic when devices are not in use.

Refer to the "*Work Zone Traffic Control Guidelines*" Book and the MUTCD, Part VI for guidance on

specific work operations, duration of work requirements and flagging operations.

Off-Road Activities

When maintenance work is being done off roadways and shoulders, but within the rights-of-way hazards are usually minimal. An appropriate advance warning sign (e.g., MOWER) is recommended for these activities to increase motorist awareness.

Nighttime Activities

Some maintenance activities are scheduled during the night. This allows crews to take advantage of lower traffic volumes and reduced traffic disruption. Nighttime work is also required when responding to emergencies including fallen trees, mud slides, and storm response.

Working at night presents additional safety challenges. Signs used at night must be reflective as specified in the MUTCD. The normal street or highway lighting does not meet requirements for traffic control device illumination.

Floodlights may be necessary to provide work area illumination and help crews and flaggers to be visible to motorists. See the section above on floodlights for more information.

The effectiveness of flagging is diminished at night. It may be difficult for motorists to see the flagger. Whenever possible, control traffic using other means. If you use flaggers be sure they are positioned within a coned area. This is usually on the shoulder or in an other relatively safe location, but not within the taper itself. Be sure flaggers, as well as all other crews in work zones, wear traffic vests made with highly visible materials. The vests can be supplemented with reflective material visible on all sides of the wearer. Be sure crew hard hats are very visible and use reflective qualities in their construction.

Temporary and Portable Signal Systems

Temporary traffic control signals are commonly found in work zones with temporary one-way operations including bridges and intersections. Kitsap County's Traffic Engineer can provide specific guidance and advice on the use of these systems. A traffic control plan is required when using temporary or portable signal systems.

- Temporary signal system typically modifies a permanent signal system with a temporary configuration that can include temporary pole locations during intersection construction, span wire systems, or adjusting signal heads to accommodate a construction stage.
- Portable traffic signal systems are usually trailer-mounted traffic signals used in work zones to control traffic. These versatile, portable units allow for alternative power sources such as solar power, generator and deep cycle marine batteries in addition to AC power.

Non-motorized Traffic Control

Do consider pedestrian and bicycle traffic that may transit your work zone. Provide alternate routes when designated walkways or bicycle routes are restricted by the work zone. Be sure alternate routes are free of obstructions and hazards including holes, debris, mud, construction and stored materials. Clearly mark all hazards near or adjacent to the path including ditches, trenches, and excavations. Bicycles are required to observe the same flagging procedures as motor vehicles. Be careful when placing signs. Do not place signs and other traffic control devices in a way that poses hazards to pedestrians or cyclists.

Pedestrian Control

Provide an alternate pedestrian walkway when:

- Walkways are in the work zone.
- A designated school route runs through the work zone.
- Significant evidence of pedestrian activity exists (a worn path, school yard, ball field, etc.).

Consider the following when you design or construct alternate pedestrian facilities:

- Separate pedestrians and vehicles by barrier or channelizing devices. Use barriers in high-

- speed work-zones. Use channelizing devices in low speed (35 mph or less) work zones.
- If the alternate walkway is used at night ensure temporary lighting is provided.
 - Use warning lights to mark pathways and identify hazards.
 - Make every effort for alternate pathways to be reasonable routes when compared to the route they replace. Pedestrians will not go far out of their way, and may disregard alternates if they drastically alter the normal path they take.

Bicycle Control

Bicycles have legal rights to access to most road. Provisions for their safe transit through work zones are necessary. Provide and sign an appropriate alternate route when the work zone prevents cyclists from using designated (signed) bicycle paths or shoulder bikeways. If horizontal separation for cyclists and pedestrians existed prior to establishing the work zone, consider maintaining that separation on alternate routes. When planning alternate bicycle routes, be sure overhead obstructions do not present a hazard for cyclists.

Safety

Protecting employees in work zones is the goal of these activities. Injuries are costly, both in terms of toll on workers, and the costs associated with accidents..

Employee safety guidelines for work zones are contained in the Kitsap County Public Works safety manual. Questions regarding safety in work zones are to be brought to the employee's supervisor attention or to the Road Department Safety Coordinator as soon as they are identified. Avoiding accidents including injuries from equipment, falls, and other trauma is the end result of effective safety management. As materials and chemicals used in maintenance activities become more complex, safety risk also increases. Promoting safe work zones involves training employees to know and observe the rules, policies and techniques that reduce the risk.

Safety always pays dividends on every job. A pro-active and positive attitude toward safety helps to protect employees and promotes continued job satisfaction. Each employee must develop a habit of thinking safety at all times, especially in work zones along roads.

Work Zone Operations

Employees must stay alert and "think safety" to protect themselves, their crew, and motorists in work zones. The basic guide for staff responsible for safety in work zones is the "*Manual on Uniform Traffic Control Devices*" (MUTCD), Part VI.

Work zone safety requires balancing two aspects of the work request, which can present very real challenges. Production pressure can create an environment where safety is weighted against efficiency. The very real concern of liability resulting from a traffic accident also impacts safety decisions. Employees and motorists alike are entitled to reasonably safe work zones. Because of that implementing the most effective traffic control strategy is critical in work zones. An effective strategy addresses the needs and requirements of employees and motorists. Developing and implementing comprehensive traffic control strategies help balance these aspects.

Don't overlook employee input. Many times employees have innovative ideas that can improve traffic flow through a work zone or enhance safety protection for the crew. Be sure to get formal approval from Kitsap County's Traffic Engineer to test and evaluate ideas in the field when the idea deviates from the Maintenance Manual or MUTCD. This limits Kitsap County's liability if a motor vehicle accident occurs during the testing.

Enforcement

Maintenance supervisors should work with local and regional law enforcement agencies and ask them to patrol work zones frequently as possible. A law enforcement presence near work zones increases safety and improves motorist compliance with traffic control strategies.

Using contracted law enforcement staff may be needed in some work zones. Consider local

knowledge of the road and traffic pattern, sound judgment, and the advice from Kitsap County's Traffic Engineer to determine if contracted law enforcement presence is needed. Additional factors to consider include the type of work being done, complexity of the traffic control plan, possible speed reduction needs, traffic volumes, nighttime work activity, the cost benefit analysis, and any actual traffic concerns as work progresses.

Pavement Patching & Repair

A roadway is defined as the paved or otherwise improved portion of a public right-of-way used for vehicle travel. Roadway surfaces are classified as rigid (consisting of Portland Cement Concrete) or flexible (consisting of asphaltic materials). Characteristics of a good roadway include a smooth surface, good skid resistance, free of alligator cracks, pumping, pushing, wheel rutting, raveling, frost heaving, and potholes.

Roadway maintenance must include a program to preserve these characteristics. Maintaining pavement effectively includes minimizing expenses and traffic disruptions. Maintaining pavement is an investment that protects road surfaces from costly renovation or reconstruction.

Preventive maintenance is more cost-effective than major repair work. Maintenance staff inspects each section of roadway annually to detect and schedule repairs.

All maintenance activities should consider impact to drainage along roadways. Poor drainage can lead to premature aging of the roadway surface and sub-grade, resulting in significant damage.

Maintenance of Flexible Pavements

Flexible pavement is referred to as asphaltic concrete pavement (ACP) or bituminous surface treatment (BST). Flexible pavement develops strength from the tight interlocking of crushed rocks with an asphalt material that binds the rock together. This mixture deflects when loaded by traffic and exerts pressure on the sub grade. Because of this both the pavement and the sub grade must be in good condition to avoid maintenance problems.

Load & Speed Restrictions

Maintenance staff regularly monitors roadway conditions during inclement weather. If the sub grade lacks strength to carry prescribed loads due to excess moisture and/or thawing, weight and speed restrictions can be imposed. The County Engineer is responsible to direct emergency restrictions based on reports from maintenance staff. Temporary restrictions can avoid unnecessary stress, and help prevent permanent damage.

Restrictions should be no more severe or of longer duration than needed to protect the roadway. The County Engineers always considers economic impact for road users before implementing temporary restrictions. Damage caused by not using temporary restrictions on soft roadways can severely impact maintenance budgets, and limit the ability to meet LOS targets.

Pavement Deficiencies

Damage and deterioration of pavements becomes apparent in a variety of ways. An overlay with excess asphalt or poorly graded or inadequately fractured paving material may not have adequate particle interlock, resulting in pushing, rutting, & humps. Poor sub grade drainage, heavy tonnage, and accelerating or decelerating traffic can produce surface irregularities. Types of pavement deficiencies are explained in detail below.

- **Rutting** is a surface depression within the wheel path. Rutting is usually a result of permanent deformation of the pavement or sub grade. Rutting is caused by heavy loads on roads that lack sufficient strength to support loads. In some cases, rutting is also caused by studded tire use. Wheel ruts can trap water and cause hydroplaning.
- **Alligator cracking** refers to the condition attained when isolated longitudinal cracks interconnect to form a series of small polygons resembling alligator skin. Alligator cracking is usually caused by poor drainage; poor mix design, or sub grade failure. Roadway surfaces should be treated with a seal coat or overlaid with suitable material before water has an opportunity to penetrate the surface and lead to alligator cracking. If it is neglected and

alligator cracks appear, heavy traffic can push the surfacing rock into the wet soil beneath it. This forces mud up through the asphalt surface (pumping) and causes permanent damage that cannot be repaired by a seal or overlay. Spots where severe pumping has occurred often need dug out, and the base rock, surfacing rock, and asphalt often need replaced.

- **Longitudinal cracking** follows a course that runs parallel to the center line. Longitudinal cracks usually are created by natural causes or traffic loads.
- **Transverse cracking** follows a course that runs perpendicular to the center line. Transverse cracks are created by surface shrinkage due to low temperatures, hardening of the asphalt, or cracks in underlying pavement layers such as Portland Concrete slabs. Cracks may extend partially or fully across the roadway.
- **Potholes** are voids in the roadway surface where pieces of the pavement have come loose. When many potholes occur at the same location it may indicate fundamental problems including inadequate drainage, pavement strength, or base/sub grade problems. When potholes occur in isolated areas, no other treatment beyond repairing the individual pothole is usually required. Keep records of pothole locations which receive a temporary fix. Records should be reviewed periodically to see if the area should be included in your annual permanent fix program. The number of potholes appearing in wet or winter weather can often indicate the effectiveness of permanent repairs.
- **Raveling and pitting** is characterized by the loss or loosening of surface aggregate particles. Oxidized asphalt binder can cause raveling and pitting. In addition to oxidized binder's poor compaction, letting the mix get cold when paving, dirty aggregate, not enough asphalt in the mix, overheating the mix during manufacture, or aging can also cause raveling and pitting. Routine maintenance repairs should be made as soon as conditions permit and/or materials are available. Repairs must be completed quickly to prevent a more serious condition and prior to the onset of inclement weather.

Properly constructed open-grade pavements that allow water to drain through and out the side don't need to be sealed. Any pavement that is raveling must be sealed. Unsealed pavements with raveling continue to ravel and ages and hardens faster than normal. This condition can encourage loss or stripping of asphalt within the pavement. Timely sealing can add significantly to the life of the pavement. Open-grade pavements should be fog-sealed on a regular schedule developed by the area supervisor. Not sealing on a regular schedule leads to premature failure of the open grade mat, and can create difficult maintenance challenges.

- **Flushing** (or bleeding) is free asphalt on the surface of the pavement. Flushing is caused by too many fines in the mix, too few voids, too much asphalt in patches, or a chip seal that has lost its rock. This type of distress often shows as a shiny, glass-like reflective surface. It is inherent to unstable mixes and often results in other roadway surface distresses if not corrected.

Removing and replacing flushed or bleeding pavement areas is expensive, but can be the most cost-effective method of repair. Thin overlays of flushed or bleeding areas frequently has the "fat spot" show through in hot weather and exhibits the same characteristics as in the "before" condition.

- **Sags and humps** are localized depressions or elevated areas of the pavement resulting from settlement, pavement shoving, displacement due to sub-grade swelling, or displacement due to tree roots. Sags and humps usually occur in isolated areas on the roadway surface.
- **Edge raveling** occurs when the pavement edge breaks. It is found mostly on roadways that were constructed without curbs or paved shoulders.

Pavement Maintenance Techniques

- **Patching** — All flexible pavements require patching during its service life. Surface patching should be performed to a standard established that considers resource availability and the objective of retaining a smooth ride as long as possible. There are two principal methods of repairing asphalt pavements:
 1. Remove and replace the defective pavement and surfacing or base material.

2. Cover the defective area with an overlay of a suitable material to renew the surface, seal the defective area, and stabilize the affected pavement.

These repairs can be called 'dig-outs' or 'overlays' according to the method used.

- **Patching with Base Repair** — "Full-depth" patches are used to make permanent repairs to pavement. Defective pavement and unstable surfacing materials are removed down to a stable base. This can include removing some of the sub grade material. The excavated area should extend 12 inches into the good pavement around the defective area.. Cut the edges of the patch vertically and in straight lines to provide a good line for compaction. A pavement saw provides a fast, neat cut in pavement patching.

After the cut is made and the defective pavement and/or base material is removed, level and compact the base material. This makes an adequate foundation for the new asphalt concrete material. Surfacing materials (gravel base, crushed surfacing) and pavement must always be replaced in depths at least equal to the original design, or by additional depth of ACP compacted in lifts of one to three inches. Applying a tack coat of asphalt to the vertical sides of the hole assures a good bond and seal between old and new pavements.

Back-filling the hole with a hot plant-mix material such as HMA or cold patch provides the best results for this type of repair. The asphalt should be compacted in lifts of no more than three (3) inches thick to obtain optimum patch life. Small patch projects can be compacted with a vibrating plate compactor. A roller works best on large patches. During hot weather keep water on hand to help cool the mix between lifts. Standing water should not be allowed on the mix between lifts.

After the completing the intermediate lifts of the patch, the surface lift can be completed. Be sure the lift is compacted to be even and flush with the surrounding surface. This provides a good riding surface. Some compaction occurs by traffic as the mix is further kneaded into place. The patch should be cool to not leave surface marks before traffic is allowed on it. Deeper patches require more cooling time. Plan accordingly to ensure proper cooling times.

- **Potholes** — All localized failures, including potholes, should be repaired as soon as possible. Asphalt pre-mix (cold mix) should be available throughout the year to provide for quick pothole repair. Fiber reinforced, and other specialized 'winter mix' have proven effective during the winter. Using a propane torch to dry the holes and heat the mix can provide for good compaction.

The use of asphalt 'tack' is highly recommended. A higher success rate can be achieved when repairs are squared up and tack is added to the edge of the pothole.

Don't use sand, clay, or other temporary patching material to patch or "pad" potholes or frost boils. These methods usually cost more in the long run, and often leave unsafe conditions for motorists. Asphalt pre-mix is the preferred method, even if it has to be replaced when final repairs are made.

For permanent pothole patching proceed as follows:

- Remove the defective material down to a stable base
- Square off the edge of the hole vertically
- Dry the hole as much as possible (fiber reinforced mix often does well in wet holes).
- Tack the hole if possible
- Place and compact the mix

Compaction is important to make the repair permanent. Heat applied to the mix helps to provide good compaction. If traffic picks fresh mix out of the hole, dust the finished patch with roadside dirt. Permanent repairs are normally made with hot mix when available.

- **Overlay Patches** — When an area is too large to be economically repaired by hand with a small crew an overlay patch is applied. The overlay patch is made with hot plant-mix asphalt and sets quickly. Overlay patching requires a considerable investment in labor, equipment, and materials.

Most overlay patches are applied where pavement failure or wear problems exist, rather than

areas with base or sub-grade problems. Ruts, raveling, pitting, minor cracking, and oxidation are typical failures where overlays are effective in quickly and permanently restoring surfaces. To correct pavement rutting the mix should be placed in lifts to get uniform compaction. This method of compaction helps prevent the rut from reflecting into the finished patch. A rubber-tired roller is recommended to obtain proper compaction in wheel ruts. Steel wheel rollers bridge the rut and very little compaction occurs. After ruts are filled, and it is decided to overlay the entire lane, use a steel-wheel roller for compaction.

Applying overlay patches requires a considerable degree of skill, coordination, and planning. All loose, broken asphalt must be removed and replaced. Deep ruts, depressions, or humps should be repaired or pre-leveled in advance. Repairing these areas prior to the overlay provides an even platform for new pavement. This helps ensure proper compaction. If wheel path ruts are overlaid without pre leveling, the ruts are not compacted the same as the thinner high spots are. Traffic wheel loads eventually compact the deeper new sections and cause ruts to reappear. All areas should be tacked before patching to ensure a good bond and minimize raveling in thin areas. The tack rate is 0.4 to 1.4 gallon per square yard of applied tack (0.2 to 0.8 residual).

Be careful when repairing the roadway surface along unpaved shoulders. Widening over thin gravel or dirt shoulders usually leads to cracking and failure, due to the lack of sufficient top course material. If the paved roadway needs widened, be sure the shoulder is prepared properly to support the anticipated loading.

- **Spreader Box Patching** — On small paving jobs it is often convenient and economical to use a tow-behind paver, or spreader box. These pavers hook to the rear of the trucks hauling the mix. Asphalt is dumped directly in the hopper of the paver.

As the towing vehicle moves ahead, the mix is struck off by an adjustable height blade (cutter bar or screed) and is surface-finished by the screed. Starting the paving at full depth requires setting the screed on blocks before filling the hopper. Keep the hopper uniformly full during paving to ensure an even spread. Maintain an even towing speed to ensure a uniform spread thickness.

Cleaning equipment and tools daily helps ensure good patches. Clean-up is critical to keep the spreader box operating efficiently. It is important that cold asphalt be prevented from accumulating on the spreader. Asphalt release agent is the most common and effective material used to clean tools and equipment.

The advantage of spreader box patching with hot plant-mix material is a smooth finished surface. Several people are needed to operate a spreader box efficiently. Careful planning is critical to make spreader box patching economical and cost-effective. The spreader boxes work best when surface irregularities are pre-leveled, and when the equipment used is appropriate for conditions. The entire surface should be tacked before pre-leveling and before starting the spreader box patch.

Roll the hot plant-mix immediately after placing it. When the mix is allowed to cool below 180 degrees adequate compaction is not possible.

- **Grader Patching** — Road graders are a useful pavement-patching tool. Graders vary in size, model, and capabilities.

One efficient way of blade patching is using two graders that face each other. This method is quicker than the single blade method, and can help in getting the patch laid before the mix gets cold. It keeps coarse mix away from the ends of the patches, makes smoother approaches, and helps keep edges straight. Two-grader operations offer a good opportunity to train inexperienced grader operators.

When it is not practical or economical to use other means hot plant-mix patching with graders provides a good solution. Graders are for a good choice when leveling to eliminate sharp depressions or sags and to lay a leveling course of pavement prior to placing finish courses with asphalt spreader boxes. They are also good when placing a leveling course to restore the roadway grade and shape when it cannot be done with a paver or spreader box.

Tack all areas to be blade patched. Road graders with a long wheelbase and smooth-tread tires are often used for spreading hot plant-mix asphalt in leveling operations. The roller must follow the grader immediately after the mix is spread and while it is still hot.

Graders are not efficient at carrying large quantities of material over long distances. This requires asphalt dumping to be carefully controlled for efficient operations. Make as few passes as possible with the grader to reduce segregation of the material.

- **Full Depth Patching or Milling** — This method is commonly done prior to maintenance overlays or used as a permanent patch. Failures are identified by our Pavement Management System or by Road Maintenance staff, and are placed on an overlay program or a full depth-patching list.

Typical defect identified include rutting, alligator cracking, longitudinal cracking, transverse cracking, raveling and poor patchwork.

Failures happen because of heavy volumes of traffic, water entering the sub base, movement in the earth or poor workmanship during renovation of a road surface. They also occur as a result of poor mix design.

Full-depth patching requires traffic control, mix appropriate for different depths and widths and for different plant locations, and trucks to haul away from the site and return with asphalt. You also need a grader with an adjustable paving box on its blade or a Layton box. This allows you to control your width and gives the job a smooth finish. You also need a five-ton asphalt roller, a sweeper and your grinding or milling machine.

The grinding or milling machine requires a high level of maintenance. There are many moving parts and they must be cleaned after every use. Water is an important factor while operating a grinding or milling machine. Water serves as a lubricant for the drum and teeth during the process of grinding. Water also is important to help control dust.

Be sure to level the drum prior to the start of grinding or milling operations. This allows the operator to set his depth of cut and grind-out, and allows for adjustments as you proceed. The current machine has a 40-inch wide cut and depth can be adjusted up to 10 inches in one pass. You can remove whatever width you desire, depending on the width of the failure in the pavement.

- **Rolling Hot Mix Patches** — In any job you should use the most effective tools for the job at hand, including asphalt work. The use of a finish lute person on the patching crew is recommended. The quality and ride of the patch is often much better due to their expertise. To ensure quality product consider borrowing people from another road shop if necessary. Patching is one of the most expensive operations done. It is essential to develop work schedules that include the following:
 - Desirable weather conditions
 - Adequate staffing and
 - Proper equipment

A ten ton or larger steel-wheeled roller is important to efficient asphalt patching operations. A lighter vibratory roller is a poor substitute, and slows operations considerably. On larger paving projects, use one roller for the breakdown rolling or initial compaction, and another to finish rolling.

Patching operations should match the speed of the roller. When patching crews outpaces the roller, it forces the rolling of mix that has cooled resulting in a poor quality patch that can include cracking. Do not compact hot mix asphalt concrete at a temperature below 180° F. Use care to ensure the mix is not hotter than 320° F. Rolling mix hotter than that causes pushing.

Compaction is an important phases of the operation. All asphalt concrete patches, small and large, are compacted to consolidate materials. Properly compacted asphalt patches are tough and dense and stand up to traffic and weather wear better than poorly compacted patches.

Rolling for compaction begins as soon as paving material is laid. Initial rolling, or breakdown, provides the highest percentage of compaction of any rolling phase. It also offers the most potential for material displacement at the edges. Make the initial breakdown pass at least four

inches away from the edges of the mat. A subsequent pass will level the edge.

Do not stop the roller or reverse direction on a hot mat. Do not turn on the mat while moving, as this affects the ride of the patch.

Intermediate rolling further compacts and seals the surface. Finish rolling removes any roller marks and other blemishes left by prior rolling.

Various roller types are used in asphalt compaction, including steel-wheeled, vibratory, and pneumatic-tired rollers. Steel wheeled and vibratory rollers are used for all three phases of asphalt rolling. Vibratory and rubber-tired rollers are not effective on thin lifts and are not generally used in maintenance patching operations.

All rollers used in asphalt paving or patching operations should be:

- In good operating condition.
- Operated according to the manufacturer's recommendations.
- Capable of reversing direction without backlash.
- Able to operate at speeds low enough to avoid displacement of the hot asphalt.

Do not use rollers producing pickup, washboard, uneven compaction, or other undesirable effects. Do not go faster than three MPH while using vibratory rollers under vibration. Limit speed to four MPH with steel-wheeled rollers, and five MPH with pneumatic tired rollers The drive wheel of the roller should always be pulling the roller to prevent displacement and pushing of the material. This is particularly important on steeper grades and in breakdown rolling passes.

Effects of Traffic on a Patching Operation

Timing is critical while doing hot asphalt mix patching. Cold asphalt mix yields inferior patches. Flaggers must avoid delaying asphalt trucks and paving equipment while hot mix patching. Don't let traffic drive on unrolled mix. A finished patch should be cool enough to hold your hand on before traffic is allowed to drive normal speeds on it. A pilot car offers a big advantage for multiple patches over an extended section of roadway by keeping traffic off of the new patch and ensuring traffic safety. Use a third flagger to keep traffic off the unfinished mix and away from the maintenance equipment is desirable. Traffic striping that is blacked out or covered should be remarked the same day.

Crack Sealing (or Pouring)

There are significant costs involved in filling cracks, both for materials and labor, the supervisor needs to be aware of the nature, extent, and severity of the cracking problem and also of the next scheduled contract for resurfacing. Crack sealing areas scheduled for reconstruction or resurfacing is not recommended unless it is a part of those projects. Sealing minor cracks in when these types of projects are not planned can extend the useful pavement life by several years.

Crack sealing prevents water from entering the sub grade and causing damage. Hot pour and cold pour are the most common crack pouring materials used in highway maintenance. Each type uses different techniques and equipment.

Over-poured crack sealing, especially on longitudinal cracks, can create safety hazards for motorcycles. This is especially true on curves, or on wet surfaces.

- **A Hot Pour Method** uses blocks of material heated in specialized machines. These machines are usually trailer mounted, oil jacketed units. Hot pours are used to repair distressed areas that are not going to be removed and repaired prior to an overlay. It is the method most often used to seal the joint between the edge of a concrete road surface and asphalt shoulders. It is effective in large areas with large cracks. Cracks are usually routed out first. If they are not routed clean and dry the area using compressed air prior to pouring. Hot pour sealing requires a large crew and specialized equipment. Hot pour materials are extremely hot and can cause severe burns. Use common sense and extreme care when loading machines or applying material.
- **A Cold Pour Method** — uses a liquid material that does not require specialized equipment.

Cold pour is available in five to fifty-gallon containers. Once applied it requires only light sanding before opening the road to traffic. Cold pours can be applied by one person. Cold pour prevents water entry into the sub grade as well as hot pour material. It also resists build up on bumps better than the hot material. Cold pour is excellent as tack for small asphalt patches and pothole repairs. It greatly simplifies the problems of tack storage, transporting, and application. Pothole patching crews should carry sealed five-gallon buckets to use in their operation.

Cold pour is effective for hand pouring cracks around an isolated bridge drain or catch basin. Use a piece of foam 'backer rod' poked into the crack before pouring. This serves as a bottom for the material. Cold pour material can be poured against rubber expansion joints without melting them.

Maintenance of Rigid Pavements – Bridge Decks

Rigid pavements are referred to as Portland Cement Concrete (PCC) pavement . PCC pavement should be patched with Portland Cement Concrete or any other Washington State Department of Transportation approved patching material. Prepare and apply patching materials according to the manufacturer instructions. If recommended by the patching material manufacturer, use a bonding agent.

Remove all loose material down to solid material of full-depth when repairing PCC surfaces. Use a jackhammer or similar equipment, if needed. Square the repair area by concrete sawing. The area should be sand blasted, cleaned and dried before repair operations begin.

Delaminating occurs when a thin layer of surface concrete loses its bond with the underlying concrete. Always check areas around the patch for delaminating. Tap the surface with a hammer and listen for a hollow sound to identify delaminated areas.

Be sure to remove or neutralize rust when you encounter reinforcing steel. Coat exposed reinforcing steel with a WSDOT approved product to inhibit rust and corrosion before applying a patch. Keep traffic off newly patched areas as specified by the manufacturer until it gains sufficient strength to support traffic.

Maintenance Overlay Paving

This operation is guided by the Pavement Management System (PMS) and does not replace or substitute for proper road maintenance. Pavement management systems are useful tools that help rate county roads and assist Maintenance Divisions develop budgets.

Prior to overlay paving the road section is prepared for the one-inch maintenance overlay by grader patching, spreader box patching, pre-level patching, full depth patching, crack sealing or chip sealing. Preparation improves the ride smoothness and extends the life of the road. Prep work can eliminate about 90% of imperfections in the travel way mat. Maintenance overlays without proper preparation do not accomplish this.

Planning is one of the most important elements of maintenance overlay operations. The supervisor is responsible for developing a traffic control plan. The supervisor orders asphalt for one-inch average compacted depth. To compute the amount needed multiply the road width by the length by the depth. Be sure to consider plant location and mix design, trucks required for transporting materials, as well as rollers, paving machine, oil distributor or other specialized equipment needed. Take in account the amount of tack coat to bond the new pavement to the prepared road.

Paving machines are high-maintenance pieces of equipment with many moving parts. These parts require careful cleaning after every use. The machine has two major components, the tractor and the screed. Settings need to be checked frequently, prior to and during the season, to ensure optimum performance. The screed unit strikes off the mix to meet the thickness and smoothness specifications and provides initial compaction to the mix. The screed unit connects to the tractor unit by pivoting screed pull arms so the entire screed is permitted to float.

During operation different factors affect the performance of the tractor and the screed. These factors include the trucks hauling the asphalt, proper loading at the plant, segregation during

loading, checking the mix before leaving the plant, retention of heat / tarp load if needed, backing into paver or leaving, bumping the paver, holding truck brakes, leaving piles of mix on the grade or pulling away from the paver and leaving the load on the grade. Without proper operation, these factors can cause cold spots in the mat that show up in the final rolling or other deficiencies that decrease the life of the overlay. Overuse of the release agent in the truck box can shorten mat life.

Other factors to consider while running the tractor and screed include the ability to maintain speed of the paving machine and keeping the hopper full of product, as well as flow gate adjustment with the head of material. Most (95 to 98%) paving deficiencies are created by improperly controlling the head of material. Hold the volume size of the head of material +/- one inch.

Screed operation is an important operation around the paver. Look ahead to see how many trucks are in front of the paver, and set paving speed accordingly. Always try to achieve non-stop paving. Check and maintain "head of material". Check asphalt yields to determine an average distance per load. This helps you figure out the speed of the paver.

Read your mat. Your goal is for a blemish free mat. The mat should be free of lines, streaks, dragging (tearing), segregation and or texture differential like crushing aggregate or having large voids.

Compaction of Hot-mix asphalt is extremely important. There are 2 primary objectives for roller compaction; obtain desired density for maximum strength and durability and provide a smooth, sealed impermeable riding surface. Compaction variables in a 1-inch overlay versus a 2-inch construction overlay are not the same product. Most large paving contractors and the Asphalt Institute do not recognize a thin overlay. Generally, a thin lift is when the asphalt is being placed at 1¼-inch non-compacted material. To avoid over-compacting or damaging the aggregate on a thin overlay, less compacting force is used on thin lifts. Vibration can be used on thin lifts providing the operator maintains the number of passes and rolling patterns established. Be careful not to turn the drum when the compactor is stopped on a thin mat. This applies to mats of all thicknesses, but it is especially important on thin mats because they tear or distort more easily. Remember, thin mats loose heat rapidly. Be sure to consider weather factors during a thin overlay.

Breakdown compaction is the first step in the compaction process and should produce the majority of target density in the mat. Breakdown compaction should begin at the highest possible mix temperature without distorting the mat, and stay as close to the paving machine as possible. Depending on mix design and mat thickness, this could be as high as 300 degrees. Once the mix begins to cool, the viscosity of the asphalt cement rises and density may be harder to achieve.

Finish compaction improves the surface smoothness and should be done while the mix is still warm enough to allow the removal of drum marks. Mix design plus temperatures and mat thickness is an issue here. Depending on the mix design you could be doing your finish work between 180 to 210 degrees. Make sure you have some way to measure your mix temperature during finish rolling. Shaded areas are also a concern during finish rolling.

Asphalt Emulsion Surface Treatment

Service life is greatly improved when preventive maintenance programs start early in life of a pavement (1 to 3 years). Surface treatments can delay the costs of major reconstruction on aged pavement. Asphalt emulsion surface treatments are excellent for preventing the development of early pavement damage or distress. The surface treatment seals the pavement, retards the aging process and prevents the old pavement from further hardening. Bituminous Surface Treatment (BST) is one way to seal minor cracks and provide a renewed roadway surface. BST is also effective to repair a dry raveling surface and provides a skid resistant surface.

- **Fog seals** may adequately seal pavement and prevent further raveling in instances with very minor raveling.. Fog Seals are very light applications of diluted, quick breaking asphalt emulsions. Asphalt materials used for fog seals include CSS-1 and STE-1 which are cationic (positively charged) emulsions,, or HFE-100S-50% diluted which is an anionic (negatively charged) emulsion. These products may require cover material (1/4 - 0) depending on the surface and application rate. The decision whether to use a cationic or anionic formulation

is based on knowledge of the charge of the existing materials used as part of the pavement. Like charged materials repel each other and opposites charged materials attract. Use materials that attract each other to make a tight bond.

Asphalt emulsions used for fog seals are usually diluted 50% with water or other types of cutbacks as prescribed by the manufacturer. The Fog Seals are applied at the rate of 0.1 to 0.2 gallons (of diluted material) per square yard, depending on the texture and porosity of the old pavement. The application rate is determined by the amount of emulsion the old pavement surface can absorb without becoming slippery. Traffic control may be required for up to two hours, depending on location and volume of traffic.

- **Sand seal** — In instances of major raveling a sand seal may be needed to adequately seal the surface and provide a quality surface. A sand seal is an application of liquid or emulsified asphalt covered with fine aggregate. It is used to seal against air and water infiltration, or improve skid resistance. Applications are 0.1 to 0.2 gallons of CRS-2 or CMS-2 per square yard covered with ten pounds of 3/8 minus aggregate. Some regions have found 1/4 minus better suited for sand seals.
- **Aggregate (Chip) seal** — When raveling is more advanced, an aggregate or chip seal may be needed. In cases where raveling is allowed to progress to the point where the ride is affected, a thin overlay, or pre-leveling followed by a chip seal, might be needed. An aggregate seal is a single spray application, usually of a liquid or emulsified asphalt. Immediately following is a single layer of aggregate of as uniform a gradation (size) as practicable. This type of seal reduces the infiltration of air and water into the mat and may be used to improve skid resistance of slippery pavements.

Chip seals are useful and can be applied in many different ways including full lane width, partial lane width, short longitudinal sections or long sections.

A typical example of a BST uses application rates for CRS-2 or CRS-2P. Refer to the Standard Specification Manual, section 5-02, 9-02, and 9-03.4 for additional information on Bituminous Surface Treatment and materials.

Pavement Conditions for a Successful Project

Always examine the roadway surface prior to sealing. Use that examination to determine which repair type is needed. Because a chip seal does not add to the structural integrity of pavement, existing pavement must be structurally sound for long performance life. Existing pavements may have to be repaired; patched, crack sealed and allowed to cure before a chip seal can be applied. Always clean the existing roadway surface before starting the chip seal process.

Chip sealing does not correct surface irregularities since it follows the original profile of the pavement. Chip seals cannot be used on pavements with more than 3/8" to 9/16" of rutting. Aggregates in the ruts cannot be fully compacted. Cleaning loose aggregate from the rut with a power broom dislodges aggregate from the non-rutted area. If the surface has light-to-moderate bleeding, reduce the binder application rate. Don't use a chip seal on pavements with a high severity of bleeding.

Material Selection

- **Asphalts and Emulsions** — The two general types of asphalt for seal coating are liquid asphalt and emulsified asphalt. Liquid asphalts are graded by viscosity. SC-Slow Cure-70, MC-Medium Cure-70, RC-Rapid Cure-70, have the lowest viscosity. SC, MC, RC 3000 has the highest viscosity. The type of solvent used to thin them also grades liquid asphalts: SC with light oil, MC with kerosene, and RC with naphtha cutback. MC 3000, RC 3000, or RC 800 is the liquid asphalts used for chip sealing. Emulsified asphalts are manufactured by suspending asphalt particles in water with the aid of an emulsifying agent. Asphalts for Bituminous Surface Treatment are listed in the Standard Specification Manual. (9-02)
- **Common Types of Emulsions Used for Chip Seals** — CRS-2 (Cationic Rapid Set Emulsion) and CRS-2P are the most widely used emulsions. This emulsion runs into wheel ruts and

down super elevated roadways if applied at rates above 0.4 gallons per square yard. CRS-2 and CRS-2P provides a good seal on low volume highways.

- **Aggregate** for bituminous surface treatment must conform to the requirements in the Standard Specifications Manual 9.03.4 for grading and quality. The material must meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway. The County Engineer or Road Superintendent determines the exact point of acceptance. The finished product must be clean, uniform in quality, and free from wood, bark, roots, and other contaminants. Crushed screenings must be substantially free from adherent coatings.
- **Weather** — The best time of year for a seal coat is during hot and dry weather before, and for some weeks after, treatment. Specifications require air temperature in the shade to be at least 60° Fahrenheit before work begins. Asphalt cools to the temperature of the pavement surface within one minute after application. Best results are achieved when BST treatments are placed between May 15th and August 15th. Do not apply BST treatments when road surfaces are wet, or when rain is forecast. When fresh seal gets wet, the combination of water and traffic will result in loss of the cover aggregate.

Roadway Preparation

Road surfaces should be thoroughly cleaned prior to application of asphalt. Sweep roadway surfaces before starting the job. Sweeping allows dust to be flushed with water or blown off the roadway surface by traffic.

If patching is needed, allow time for the patch material to cure prior to sealing. Two weeks is recommended for hot mix to cure. Allow six weeks at temperatures of 50° to 60° F for cold mix to cure. To preserve the centerline location place flexible reflective markers prior to the seal. These can also be used to indicate the beginning and end of no passing zones. Flexible reflective markers have a removable cover so that they retain their reflectivity after the seal. They also function as guides for the striper truck.

Equipment

Before beginning work examine all equipment and ensure it is in good working condition. Check spreader boxes or aggregate spreaders to see they work properly. The roller operator should make sure that each tire on the roller is equally inflated to correct pressure and that controls for steering, starting, and stopping operate smoothly. All tires should be the same size. Check the water spray and scraper system to ensure material does not bond to the tires.

- **Distributor** — Newer distributors use a ground speed control sensor and computer to regulate material application rates. Set the computer to the desired rate and the application will be correct even if the vehicle speed varies.
- **Nozzle Size** — The spray bar and nozzles are an important part of the distributor. The proper quantity of asphalt must be spread uniformly on the road surface through the spray nozzles. Correctly sized nozzles must be selected for the job conditions to achieve the best results. If nozzles are too large for the desired application pulsation of the spray may occur, resulting in uneven longitudinal spreading of the asphalt.

Each equipment manufacturer has specific recommendations for the size of spray nozzles to be used for different applications. Use the manufacturer's recommendation when choosing the correct nozzle size. All nozzles selected for use at any one time should have the same size opening.

- **Proper Pressure** — The spray bar must have a constant, uniform pressure along its entire length for equal output from all nozzles. Be sure the spray bar and nozzles are CLEAN.

Although several methods are used to maintain pressure, distributors use gear-type pumps to deliver asphalt to the spray bar. Variable pump speed on some distributors and by constant pump speed and a pressure relief valve on others governs pressure. Each application should be checked, as recommended by the manufacturer.

The correct pump speed or pressure is critical to the proper application of the asphalt. Low pressure results in a non-uniform discharge/streaking of material from the individual nozzles.

High pressure, in addition to atomizing the asphalt, will distort the spray fan.

When a metering system is used, the manufacturer supplies the distributor with charts for finding the proper pump speed for each application rate.

When a pressure relief valve is used, the pump runs at a constant speed and the pressure is automatically held in the spray bar. The manufacturer supplies charts for determining the discharge in gallons per minute for each size nozzle, the proper truck speeds for various application rates, and the corrections for temperature-viscosity variations.

- **Spray Bar Height** — The most important adjustment that ensures uniformity of the asphalt spread is the height of the spray bar above the pavement surface. Correct height must be maintained during the entire application. Streaking results when the spray bar is too low or too high.

The preset height above the pavement surface should not vary more than 1/2-inch. The bar will not stay within this tolerance, however, unless the manufacturer or the operator takes steps to ensure that it does. As the asphalt leaves the spray bar, the load lightens and the springs raise the distributor. If there is an appreciable amount of deflection in the springs, the spray bar can rise as much as 4 inches, resulting in an uneven application.

- Triple coverage is where any point on the roadway surface will receive overlapping spray from the two adjoining nozzles.
 - Double coverage involves the same procedure as above except that every other nozzle is left open; the remaining ones are shut off. If the distributor has already been checked for double coverage, increasing the spray bar height by 50 percent will give triple coverage.
- **Proper Nozzle Angle** — Adjust nozzle-opening angles so the spray fans will not interfere with each other. The nozzle angle will vary according to the make of the distributor. The angle recommended by the Asphalt Institute, measured from the spray bar axis, is 15–30 degrees.

Manufacturers furnish special wrenches for setting nozzle angles. Using these wrenches is recommended over visually set nozzles. It is extremely difficult to obtain a uniform spread with visually set nozzles. All nozzles should be set at the same angle except for the cut-off (end) nozzle. Manufacturers make a nozzle with ½ spray pattern for this purpose.

Inspect the edges of the nozzle openings for damage at the time the angle of the nozzle is set. A nicked or otherwise damaged edge will produce a distorted fan of asphalt. Streaking occurs:

- When the asphalt is too cold.
- When the viscosity of the asphalt is too high.
- When the snivvies are not at the same angle.
- When the bar is too high.
- When the bar is too low.
- When the bar pressure is too high it cuts furrows because the snivves are too small and/or there is too much pump pressure.
- When the bar varies in height from a full to an empty distributor, blocking or locking against the overload springs will reduce or eliminate this variance in height.
- When the bar is too long and/or the snivy openings are too large for the pump capacity, this results in narrow and fluttering fans. Smaller snivies and/or higher pump capacity will correct this.
- If the pump pressure is too low it will create narrower spray fans and fluttering.
- If the distributor tank is allowed to run completely empty, an irregular pattern of misses and fluttering will occur across the bar. For this reason, the shot should be terminated while approximately 100 gallons are left in the distributor.

Cleaning the Distributor

Clean the distributor in an area determined by its characteristics that protect the environment. Areas near waterways or with high seasonal water tables are not good locations for distributor

cleaning. Cleaning areas may require all fluids to flow through an oil water separator and all tank and bar cleaning agents to be barreled and labeled for disposal. Do not discharge or blow your distributor bars in the ditch line, on rights-of-way, or on private property. Improper discharge could result in a serious violation.

Traffic Control

Traffic control must be maintained throughout the work area. High-speed traffic over a fresh seal coat displaces aggregate, causing bleeding of asphalt. Traffic should be allowed only in the lane not being sealed. When work is completed, traffic speed should be maintained at less than 35 MPH until the asphalt sets. Use warning signs, flag persons, and pilot cars as needed for traffic control. Route trucks hauling aggregate to the aggregate spreader in a direction opposite of the seal coat operation. This prevents loaded trucks being turned on freshly placed seal coat.

Some emulsions, such as High Floats, may require up to 24 hours of traffic control, or may need traffic control until the first sweeping occurs. This usually occurs in areas of high volume traffic or in areas where vehicle weight exceeds the normal load range.

Spreading Aggregate

Be sure all aggregate required for the planned spread is on-hand before starting. Dampen the material, if needed, as described in the section on Material Selection. When the distributor moves forward to spray asphalt, the aggregate spreader should follow immediately behind it. The asphalt must be covered as soon as possible; otherwise the cooling of the asphalt will prevent good adhesion between asphalt and aggregate. It is important that the aggregate be spread uniformly and at the proper rate of one rock thickness. Marking the length that each truckload of aggregate should cover aids in controlling distribution.

Chip spreader Calibration

The following is a step-by-step procedure on how to calibrate your chip spreader and calculate the application rate.

1. Construct a one square yard shallow box or tarp, with shallow and narrow sides.
2. Place the box/tarp in the middle of the roadway a minimum of 50' in front of the chip spreader.
3. Get the chip spreader up to speed and apply chips over the top of the box/tarp.
4. Remove the box/tarp with the chips from the road.
5. Find an accurate materials scale. If in the field, the scale must be leveled and checked.
6. Place the chips from the box/tarp in a small bucket and weigh the bucket with the chips.
7. Empty the chips out and weigh the empty bucket.
8. Subtract the weight of the empty bucket from the weight of the bucket with the chips.
9. Since you had a one-square yard box/tarp, the weight from Step 8 is your pounds per square yard of chips.
10. Repeat the process at two to three gears and two to three RPM or speeds. You can then develop a chart.

NOTE — *The aggregate weight may vary a couple of pounds if the chips are wet.*

Chip Spreader

Chip spreaders kick the aggregate backward or drop the aggregate straight down to reduce aggregate rollover and reduce the degree to which the aggregate picks up on vehicle tires after the section has been opened to traffic. The spreader is a variable width machine and calibrated on pounds per square yard. Dump trucks work in combination with the chip spreader to achieve a uniform application of aggregate.

Rolling

Rolling seats the aggregate in the asphalt and promotes the bond necessary to resist traffic stresses. Pneumatic tired rollers should be used on all seal coat jobs to give uniform ground pressure over the entire area to achieve proper embedment of the aggregate in the asphalt binder. Steel

wheeled rollers tend to compact only high spots and can fracture soft aggregates.

Rolling should begin immediately after the aggregate has been distributed and should continue until the aggregate is properly seated in the binder. Rolling should begin at the outer edge of the treatment and proceed in a longitudinal direction, working toward the center of the road. Each trip should overlap the previous trip by about one-half the width of the front wheels. Stop rolling as soon as the asphalt has a definite set or hardening. This prevents the bond between the surface and aggregate from being broken by the roller.

Operate rollers at slow speeds (4 to 6 mph) to set the rock, rather than displace it. The number of rollers required for a seal coat project depends on the length of the operation. It takes two to four passes of the roller to set the rock. Keep tire pressure at 45 psi or more.

Loose aggregate should be swept along the longitudinal joint and from the uncovered lane prior to application of asphalt. Broom loose aggregate on a completed sealed surface as soon as practicable, preferably during the cool part of the day. This can minimize flying rock problems.

Relying on traffic to seat the aggregate has been successful, if speed is controlled, but using rollers gives better control and improves the chances for success.

Spreading of Fines or Choking—Optional

The need for applying fines will vary with the types of emulsions used and application rates. Closely monitor application rates. The most common material used for choking is 3/8" to #10 or 1/4" minus maintenance sand. In urban areas clean masonry sand can be used. Spreading these fines on a seal helps fill the voids, key the stone, reduces the chances of bleeding, and stops the squeezing and tracking of asphalt. The application of these fines, prior to or after the roller, depends on the types of emulsions used and the location of the project. Fines application should not cover the coarse aggregate but merely fill the voids. The spreading of fines could be achieved by using a Hopper Sander with a mid mount spinner. Depending on the type of operation the vehicle may be placed before or after the rollers.

Post-Seal Inspection

Check how the aggregate embedded into the asphalt a day or so after the construction of the seal coat. Remove several of the largest stones and determine if the 50 percent to 70 percent embedment has been obtained.

If an inadequate application of asphalt was applied, a fog seal can enrich and tie down the seal rock. A diluted CSS-1 (usually 50/50) is applied at the rate of .1 to .2 gallons per square yard of the dilution. (Application varies depending on pavement texture, local conditions, and traffic). No cover aggregate is required. If a tighter seal is desired a sand or 1/4" 0 cover may follow. Traffic should be controlled until the CSS-1 has cured.

The "Do" and "Do not" of Seal Coating

- **Do** turn spray nozzles so that fans are at proper angle to spray bar, so sprays do not touch or merge.
- **Do** check bar height at start of each shot to determine ground-to-nozzle distance over the entire bar length.
- **Do** check spraying pressure so as to give constant uniform spray. Pressure too high cause spray to fog and distort, pressure too low causes spray to sag with heavy edges and pronounced longitudinal streaking.
- **Do** heat asphalt to upper part of spraying temperature range to eliminate heavy edge that is characteristic of all fan type sprays.
- **Do** keep spray bars in proper working order by regular cleaning and inspecting of strainers. Clean spray bars after each day's operation.
- **Do** keep aggregate stockpiles clean and free of contaminants.
- **Do** clean out tank thoroughly when changing asphalts from emulsified to cutback asphalts or

from cationic to anionic emulsions.

- **Do** keep equipment on the same side of the roadway that the sealing operation is on, so traffic flow is not impeded.
- **Do** cover shot as soon as possible and roll immediately to ensure a good bond.
- **Do not** use worn nozzles or ones that have mechanical imperfections.
- **Do not** heat asphalt material above maximum temperature range. This can cause fan spray patterns to be uneven.
- **Do not** use asphalts that are too cold. Material will be too viscous and cause narrow spray fan. Materials will not flow together.
- **Do not** try to seal a wet or dirty road surface.
- **Do not** try to seal coat if air or road surface is too cold.
- **Do not** seal when windy.
- **Do not** make shots too long before applying aggregate.
- **Do not** turn equipment on a fresh patch.

Stockpiled mixes made with MC or SC cutback asphalts should be allowed to cure out for a period of time before the mix is used. Cure time varies depending on weather conditions but will normally be approximately two weeks.

The “Do” and “Do not” Tips for Handling Emulsified Asphalts

- **Do** agitate emulsified asphalt when heating to eliminate or reduce skin formation. Agitation also prevents the asphalt lying next to the heating chamber from becoming overheated and boiling.
- **Do** protect pumps, valves, and lines from freezing in winter. Drain pumps or fill them with anti-freeze according to the manufacturer’s recommendations.
- **Do** blow out lines and leave plugs open when they are not in service.
- **Do** use pumps with proper clearances for handling emulsified asphalt. Tightly fitting pumps can cause binding and seizing.
- **Do** use a mild heating method to apply heat to the pump packing or casing to free a seized pump. Discourage the use of propane torches.
- **Do** warm the pump to about 150° F (65° C) to ease start-up.
- **Do** fill it with No. 1 fuel oil to ensure a free start-up when a pump is out of service, even for a short period of time.
- **Do** check the compatibility of the water with the emulsion by testing in a flask before diluting grades of emulsified asphalt, .
- **Do** use warm water, when possible, for diluting and always add the water slowly to the emulsion (not the emulsion to the water).
- **Do** avoid repeated pumping and recycling. The viscosity may drop and air may become entrained, causing the emulsion to be unstable.
- **Do** guard against mixing different classes, types and grades of emulsified asphalt in storage tanks, transports, and distributors. If cationic and anionic emulsified asphalts are mixed, the blend will break and separate into water and coagulated asphalt that is difficult to remove. Always make a trial blend of the newly delivered emulsion and stored emulsions before pumping off. It is hard to determine visually the difference between various emulsified asphalts. Check the trial blend for compatibility.
- **Do** place inlet pipes and return lines at the bottom of tanks to prevent foaming.
- **Do** pump from the bottom of the tank to minimize contamination from skinning that may have formed.
- **Do** remember that emulsions with the same grade designation can be very different

chemically and in performance.

- **Do** haul emulsion in truck transports with baffle plates to prevent sloshing.
- **Do** mix emulsions that have been in prolonged storage. They may not be the proper consistency, as emulsions tend to separate when stored for extended periods.
- **Do not** use tight-fitting pumps for pumping emulsified asphalt; they may “freeze”.
- **Do not** apply severe heat to pump packing glands or pump casings. The pump may be damaged and the asphalt may become even harder.
- **Do not** dilute rapid-setting grades of emulsified asphalt with water. Medium and slow setting grades may be diluted, but always add water slowly to the asphalt emulsion. Never add the asphalt emulsion to a tank of water when diluting.
- **Do not** recirculate emulsified asphalts for too many cycles. They tend to lose viscosity when subjected to pumping. Air bubbles may become entrained rendering the emulsion unstable.

Drainage

Water is the greatest natural destructive element that affects roadways. Controlling water on the right of way requires a drainage system that effectively responds to the immediate environment. A typical roadway drainage system includes ditches, gutters, drains, culverts, storm sewers, and other drainage structures.

A drainage system is designed and constructed to collect and remove water from the highway right of way. It must be properly maintained to:

- Permit the maximum use of the roadway
- Prevent damage to the highway structure
- Protect natural resources
- Protect abutting property from physical damage.

Drainage facilities should be maintained in the condition, and at the capacity, for which they were designed and constructed. Inspections may be required during heavy storms and periods of high runoff. Observe and record high water marks. Look for conditions that threaten damage to the drainage facility or the roadway. Maintenance personnel must be alert to ensure all natural watercourse channels crossing the right of way remain open. Always follow the Regional Road Maintenance Program (RRMP) guidelines and Hydraulics Project Approval (HPA) requirements.

Drainage from Abutting Properties

Storm water is the only effluent allowed to be discharged on road rights of way. Population growth, urban sprawl, and new regulations restrict how surface and subsurface drainage systems are maintained. Regulations that affect drainage maintenance include:

- Endangered Species Act
- Storm water management guidelines
- Wetlands preservation
- Growth management
- Shorelines
- Irrigation limitations

Maintenance personnel who routinely patrol roadway sections must be trained and be able to identify the types of direct drainage and sheet flow that may require a permit. These include new:

- Commercial developments such as shopping centers
- Subdivisions
- Industrial development
- Illicit discharge identification

Maintenance personnel report land use changes they observe to their supervisor. The supervisor will forward this information to the appropriate department.

Ditches and Gutters

Open ditches should be routinely checked and maintained to the line, grade, depth and cross section to which they were constructed. Where practical, non-standard ditches should be modified to produce a relatively flat, shallow ditch to enhance motorist safety.

Vegetation in ditches often helps prevent erosion and treats storm water. Remove vegetation only when flow is blocked or excess sediments have accumulated. Remove vegetation using "best management practices" that minimize erosion and sediment escape to water bodies.

Excessive erosion of drainage ditches must be controlled and repaired. To control erosion use ditch linings of loose or grouted rock and concrete or other energy dissipation methods. Check ditch linings frequently and repaired when needed. Keep ditches and gutters free of litter and debris. Repair cracks and breaks as needed.

Use extra care when using chemicals for brush and grass control in open ditches. Herbicide application is carefully controlled to prevent contamination to water or to adjacent areas where environmental damage may result. Always follow product application instructions.

Watch for diversion ditches on top of cut slopes. These ditches prevent slope erosion by intercepting surface drainage. Diversion ditches must be maintained to retain their diversion shape and capability.

Material placed into the adjacent portions of the highway or disposal areas must not obstruct or impair other roadside drainage areas. Do not use material that can cause sedimentation problems to water bodies. Avoid causing erosion problems or loose unstable fills. Don't use non-porous materials such as clay. Non-porous materials become unstable when wet and trap water in the existing fill. Any concerns about using surplus materials are directed to the area Road Supervisor.

Don't blade ditch cleanings across roadway surfaces. Dirt and debris remaining on the pavement after ditch cleaning operations must be swept from the pavement.

Avoid undercutting the roadway back slope or in slope. Undercutting weakens the slope and will cause damaging slip-outs and other forms of slope erosion.

Rock Lined Ditches and Slope Benches

Keep rock lined ditches and slope benches clean. Remove large amounts of slough or rock fall, or other slide material that effectively block the ditch or bench, as soon as possible.

Culverts

A culvert is a conduit or pipe used as an artificial channel under a roadway or embankment to maintain flow from a natural channel or drainage ditch. Keep culverts clean for maximum operation efficiency.

Water runoff, sedimentation and debris can increase when logging, land development activities, farming practices, forest fires, or other changes occur upstream. Inspect culverts more frequently, particularly after periods of high runoff, so corrective measures can be started if damage occurs. Always inspect critical areas and the culvert inlets during major storms and flooding.

Proper maintenance to badly worn or broken culverts can minimize saturation damage to the roadbed.

Clean or flush culverts, with 50 percent or more constriction, to restore the culvert's original capacity. Use established BMP's to minimize impact to fish during maintenance. Many of the larger culverts in flowing streams are designed to accommodate fish life. Be sure to clear culverts of obstructions that may be detrimental to fish passage.

Check culverts for scour around the inlet and outlet. Repair scoured areas with riprap or other protection as needed. In some cases standing water is desirable at the inlet end of the culvert to settle out sediment. Vegetation at culvert ends can be controlled by residual herbicides or mechanical means. Be sure that vegetation control methods are accompanied by erosion and sediment control features and practices. Be sure RRMP guidelines and HPA requirements are followed.

Renew pavement markings that show the location of culverts annually. These markings are critical for quickly locating culverts for both emergency and routine maintenance. Use permanent pavement markings, such as thermoplastics, whenever possible..

Storm Sewers

Tight line storm sewer systems are maintained by SSWM. Pipe systems are used to convey storm runoff normally handled by ditches. Storm sewers are often used in long, depressed roadways or along curbed sections on urban roads. Water is collected through inlets, or catch basins and carried by pipe to an outfall on a natural waterway.

Clean clogged pipes with high-pressure water jets. Additional service is required when tree roots or broken pipes cause the clogging. Use flexible rotary cutters to remove roots intruding into a pipe.

An insert liner at the location of a failure may repair a broken pipe. If a liner does not work the failed pipe may have to be excavated for repairs. Always use methods that prevent erosion and control sediment when cleaning lines. Debris or sediment can not be allowed to enter a water body.

Manholes are generally used where there is a change in profile or alignment and also at strategic points in long, straight sections in order to provide access for cleaning the conduit. Use a vacuum truck to inspect and clean inlets, catch basins, and manholes. Inspect systems during storms to prevent grates from getting clogged with water-born debris. Regular sweeping operations help limit the accumulation of leaves, paper, or other clogging debris that can get washed into the system.

Always make sure that the manhole and catch basin covers are flush with the finished pavement elevations after paving operations.

Bank Protection

Many conditions may cause scour, undermining, or washout of roadway embankments or drainage structures including storms, floods, or wave action. Most roadways are protected by damage due to high water using a variety of methods. Methods include barbs, stone rip-rap, pile revetments, retaining walls and cribs, rock and wire mesh (gabions), and vegetation.

Protective features should be inspected each spring. Additional inspections are advised during major storms or extended periods of high water. Make repairs, when needed, with materials similar to those in place. If possible take corrective measures to eliminate the direct cause of the damage. Be sure to follow RRMP guidelines and HPA requirements.

Snow & Ice Control Procedures

Removing snow and ice from roads is a priority and takes precedence over other road work. Roadways are plowed, sanded or de-iced as needed. Snow and ice removal operations are conducted in accordance with KCPW Policy 26.01.100. This policy establishes a priority method to accomplish snow and ice removal tasks.

Snow and ice removal operations provide motorists with a reasonably safe traveling surface. These operations take time, and often require crews to return to primary routes before moving to secondary priorities. There roads that have not been treated and motorist may need to limit travel, or install chains or other traction devices to safely drive on them.

Preparing for Winter Operations

Effective winter operations begin well before winter. By November 1st of each year all equipment should be ready for snow and ice operations. Equipment inspections are documented on the Snow Removal Equipment Checklist (KCPW 2064) shown in Appendix B. The following items are visually inspected and operationally tested as part of our annual inspection program for snow removal equipment:

- Brine trucks
- Snow plows, mooring pins and brackets
- Hydraulic fittings and hoses
- Internal controls in the cab of each vehicle
- Sander mounts and brackets
- Sander chains, conveyors and spinners
- Sander lights, hydraulic hoses and fittings

During the summer and fall you can prepare roads for effective winter operations by:

- Cleaning side ditches so they are free of obstruction or debris.
- Ensuring shoulders are smooth and flush with the pavement.
- Cleaning sand out from under guardrail.

Each Kitsap County Road Shop has maps showing priority routes for snow and ice operations. Equipment operators need to become thoroughly familiar with these routes. Priority 1 routes are marked in red, priority 2 routes are marked in blue. These maps are available at each road shop before winter begins. Road Supervisors are responsible for ensuring employees know what is expected of them. They must keep records documenting work directions given to crews and ensure operators are adequately trained to operate equipment.

Each year all road crew staff are required to navigate an obstacle course designed to test their driving skills. The test helps train them in safe operating techniques for loaders, trucks, plows, sanders and salt brine application equipment.

Each sand and salt brine spreader is calibrated to make the spreads required at a reasonable speed. Different drivers operate the same piece of sanding equipment. Drivers need to be familiar with the unique specifications, or quirks, of each vehicle. A card, showing the truck speed or tachometer reading and adjustment to the spreader to deliver specified spreads, is posted in each vehicle. Variations from this calibrated rate may be necessary based on actual field conditions. Salt brine spreaders are calibrated per manufacturer's specifications contained in the operator's manual for each vehicle. Appendix B provides procedures for snow and ice operations.

Stockpile sand and salt before winter. Locate stockpiles on smooth surfaces. Stockpiles should be set-up to allow work from the south side which provides maximum exposure to sunlight. Loaders should be staged near the stockpiles and ready for operation.

Road Categories

County routes are assigned priority status in the Snow and Ice policy.

Special Criteria

Several criteria are used to assign priority to routes. The following list are some of the criteria considered as priority routes are developed:

- Access to commercial areas and truck routes
- Commuter routes
- School bus routes
- Hospitals and other emergency services
- Proximity to population densities
- Curvature and grade of highway alignment
- Alignment with Kitsap Transit snow routes

Work on Kitsap County Roadways

This section provides general guidelines for snow and ice operations on County-maintained roads.

- **Area of Responsibility**—Snow and ice control is restricted to the County-maintained road rights-of-way, including intersection with roads within County-maintained rights-of-way that are maintained by other agencies
- **Snow Control Operations**—Snow control removes accumulated snow from the traveled way, shoulders, and widened areas with plows. If snow removal is not possible because the snow is compacted the accumulation is treated as an ice control operation.
- **Ice Control Operations**—Ice control consist of pretreating the road surface with anti-icing chemicals or sand. Until compact snow and ice can be removed anti-icing chemicals or sand is applied at bridges, curves, intersections, railroad crossings, steep grades, and isolated shaded areas. Once thawing begins compact snow and ice is removed with plows.
- **Operations Timing**—Temperatures are usually at their highest between 11:00 a.m. and 3:00 p.m. making compact snow and ice removal operations more effective. This is the best time to clear surfaces of melting snow and ice, and to remove as much slush as possible prior to lower evening temperatures. Road graders used to remove compact snow and ice are most effective during the day. Using the warmer temperature window can make cleanup operations more efficient.

Anti-icing & Deicing Chemicals

Salt brine, at a ratio of 23.3% salt to water, is effective as an anti-icing application. Salt brine is applied to locations where the Road Supervisor has determined will most benefit from the application. Equipment used to spread salt brine is inspected, calibrated and field-tested prior to November 1st of each year.

Effective winter storm operations are coordinated with weather forecasts. Forecasts help determine the best time to apply anti-icing chemicals and assist in determining staffing needs. Kitsap County uses an Accu-Weather forecast to estimate the onset of road surface ice. Maintenance crews apply anti-icing treatments before the storm which helps make snow and ice removal more effective after the storm passes. Appendix A contains Figures 5–1 through 5–5 which describe the different winter weather events and appropriate snow and ice controls for each.

Each action is defined for a range of pavement temperatures and an associated air temperature trend. For some events, the operation is dependent not only on the pavement temperature and trend, but also upon the pavement surface or traffic condition at the time of the anti-icing action. Most maintenance actions involve Sodium Chloride applications in a dry solid, liquid, or pre-wetted solid form. Application rates or “spread rates” are given for Sodium Chloride (NaCl) and are to be used appropriately. These are suggested values and should be adjusted, when warranted, to increase effectiveness or efficiency. Application rates in volumetric units (gal/lane/mi) are calculated from dry chemical rates. Comments and notes are given in each table where appropriate to further guide the field maintenance personnel in their anti-icing operations. Procedures related to salt brine mixing and production are listed in Appendix C.

Anti-icing Terms

The information below defines common terms used in anti-icing operations

- **Black Ice**—Popular term for a thin coating of clear, bubble-free, homogeneous ice that forms on pavement at temperatures at or slightly above 32° F. When the temperature is below the freezing-point of water and road surfaces are sufficiently cool, small slightly super cooled water droplets deposit on the surface and coalesce (flow together) before freezing
- **Level of Service Coordination.** Effective snow and ice operations require coordination between adjacent areas. This ensures changes in level of service on continuous sections of roadway are avoided.
- **Tandem Plowing**—Tandem plowing can be used to remove snow from multilane roadways. Be careful and ensure snow is not thrown into the path of oncoming vehicles or onto a roadway below the roadway being plowed.
- **Spinner Shut-off**—In most cases spinner assemblies are used to distribute sand. Operator's should turn the spinner off temporarily when meeting oncoming traffic. It may be necessary to temporarily stop sanding to allow traffic backed up behind equipment to pass.
- **Railroad Crossings**—Do not leave snow windrows on a railroad grade crossing. Raise, or otherwise adjust the blade, before reaching the crossing to prevent damage to the crossing and/or equipment. Avoid conflicts between snow removal operations and approaching railway traffic. Do not sand railroad crossings.
- **Widening**—Shoulders are often plowed along with the traffic lanes, or immediately after the storm is over. Clear shoulders provides storage space for additional snow, makes the road safer for motorists, helps prevent drifting, decreases the likelihood of damage to the roadbed from moisture infiltration, and minimizes excessive runoff onto the pavement. Perform shoulder plowing in the direction of travel. Always establish proper traffic control if plowing against traffic is necessary.

Work on Roads Not Maintained by Kitsap County

Snow and ice control operations for other governmental agencies may be authorized as long as costs are reimbursed by the requesting agency. The Road Superintendent or an authorized representative develops working agreements that show the work to be performed and ensure reimbursement for associated costs. Work of this type is secondary to snow and ice removal from County-maintained roads.

Maintenance on private approaches, including any portion located within the road right-of-way, is the responsibility of the property owner. Kitsap County does not remove snow or ice from private driveways.

Snow and ice control activities may deposit windrows on private approaches. Kitsap County does not assume responsibility for the removal or clearance of such material. Employees involved in snow control operations are expected to be sensitive, considerate, and courteous to the impact that snow and ice control operations may cause to private property. Mailbox turnouts on the shoulders may be plowed as a part of shoulder widening operation.

Abandoned or Illegally Parked Vehicles

Kitsap County Public Works Policy 25.13.01 does not restrict parking during snow and ice removal operations. It does allow, in accordance with RCW 46.55.085, local law enforcement to impound abandoned or illegally parked vehicles after documented attempts to notify the owner. This process usually requires several days. If a vehicle is determined to be a hazard to snow and ice control operations, law enforcement agencies can arrange for immediate removal.

Closures

Winter storms can create conditions so severe that snow and ice control operations are ineffective. Temporary road restrictions or closures may be the only safe alternative when this happens. The County Engineer or his designated representative may temporarily prohibit or restrict traffic on any county roadway during snow and ice removal operations.

When a road is closed or restricted:

- The area Supervisor, Assistant Supervisor, Road Superintendent or the County Engineer

notifies the Public Communications Manager (PCM) and/or designee. The PCM or designee notifies CENCOM, the media, and other pertinent agencies. Maintenance crews set traffic control devices warning motorists of the closure.

- Advance warning should be placed in locations that prevent motorists from entering and becoming stranded in the closed section.
- When the closure or restriction is removed notify The PCM or designee. The PCM or designee will notify the appropriate agencies that the closure or restriction has been removed.

Emergency Assistance

Emergency roadside assistance is limited to actions that safeguard life and property. Employees may render emergency assistance to motorists when requested. Vehicles that slid off the road may be pulled onto the roadway if the vehicle is drivable. The motorist must provide a tow chain or cable hookup and disconnect. This kind of assistance is typically permissible only when snow or ice conditions are reasonably under control and when private towing trucks are not available.

It may be necessary occasionally for an employee to exercise judgment as to whether a motorist is capable of driving his vehicle. Sometimes it appears that the motorist is inebriated or otherwise unsuited to drive. In these situations notify law enforcement agencies by radio or other available means as soon as possible. Employees are required to notify the Kitsap 1 and the Traffic Investigator about any accidents that occur on the roadway.

Never tow any vehicle that may be unable to proceed because of lack of power or traction, except when the vehicle blocks the traveled way. In this instance, the stalled vehicle may be towed a sufficient distance to clear the normally traveled portion of the roadway to allow the safe passage of other vehicles. Employees may not accept compensation of any kind for this or any other type of assistance.

County policy prohibits non-employees as passengers in county-owned vehicles. Any exception to this policy must be approved by the Road Superintendent, County Engineer or the Director. Helping a motorist stranded during a blizzard is an example of the type of exception to this policy that may be permitted.

Precautions

Use care to prevent damage to signs, mailbox posts, signposts, and other roadside appurtenances. Trucks must be operated at moderate speeds when removing snow, especially when slush exists. Operators must be aware of their surroundings during snow and ice control operations. Stop or slow down to allow traffic to pass when vehicles queue behind equipment. Avoid plowing slush or snow at high speeds. Plowing slush at high speeds can deposit slush on signs making them illegible. Plowing snow at high speeds causes excessive snow cloud making travel hazardous.

When plowing overpasses, passing, or being overtaken by other traffic avoid throwing snow onto windshields and obstructing the vision of other drivers.

Be aware of cars parked adjacent to the roadway. Even though they may be illegally parked take reasonable care to avoid damaging the vehicles during snow and ice control operations.

Use rubber bits on snowplows when possible to avoid destroying raised traffic buttons. Rubber bits are most effective in slushy snow or in snow that has not been compacted by traffic.

Procedures

Procedures for mounting snow and ice control equipment, loading materials, and the snow removal equipment check list (KCPW 2064) are found in Appendix B. Procedures for mixing and loading salt brine are found in Appendix C.

Street Sweeping

Purpose

Road sweeping is an important element in our maintenance program. Roads are swept to remove sediment and debris to provide a safe driving area, to maintain maximum traction, to protect the environment and to protect stormwater conveyance systems.

Procedure

Sweeping activities use the same work safety zone procedures used for any work done on or near travel lanes. Traffic control is established if needed. A mechanical or regenerative air self-loading street sweeper is used to remove sediment and debris from the pavement surface. The broom operator makes passes in the direction of normal traffic flow, working from the center line towards the edge of pavement. Proper technique is used to avoid depositing material being swept into drainage structures and drainage courses. Waste materials collected are hauled to a designated processing site, and disposed of or reused in accordance with established procedures. When visible dust is generated an on-board water system, or dust control support from a water truck is used to avoid fugitive discharges. If dust cannot be controlled sweeping operations cease and the supervisor is notified.

Request for Sweeping

Residents often call to request sweeping specific roads, particularly to remove sand after winter storms. Sweeping activities follow the same procedures outlined in PW 25.01.02 POL Snow and Ice Control. The Road Shop Supervisor deviates from that policy at their discretion.

Water-Quality Street Sweeping Operations Plan

We developed a street sweeping operational plan focused on pollutant removal and water-quality enhancement by working with our Surface and Stormwater Management Program (SSWM).

Traditionally, street sweeping has focused mainly on aesthetics and safety. Conventional street sweepers use rotating brooms as the primary methods to remove litter, street grit, organic debris and debris from accidents or vehicle wear. This type of sweeper is not designed to remove the fine sediment particles that associated with road-vehicle pollutants including metals and petroleum hydrocarbons.

Newer street sweepers are designed to collect debris and larger sediment particles, and are also capable of removing fine sediment from paved surfaces. This prevents sediments and associated pollutants from entering the stormwater system and the receiving waters downstream. These newer sweepers include regenerative-air and vacuum type sweepers. The high-efficiency sweepers still use brooms for collecting larger debris, but use high-pressure air to loosen very fine sediment from pavement surfaces. A vacuum-assisted filter system collects the fine material and attached pollutants. Kitsap County Department of Public Works has two high-efficiency sweepers.

Developing and implementing a water-quality (WQ) focused street-sweeping program is part of a comprehensive effort to reduce pollutant loading from roads and other impervious surfaces shown to be significant source areas for urban stormwater pollution. Under the National Pollution Discharge Elimination System (NPDES) permit that governs pollution prevention, jurisdictions are required to reduce pollutant loading from streets using best management practices (BMP). SSWM operates and maintains numerous stormwater treatment facilities as part of this overall effort to reduce pollutant loading. Engineered facilities are not 100% effective and the coverage of developed areas is limited based on available space and treatment technology. Using high-efficiency street sweepers to remove pollutants from roads surfaces reducea pollution near its source and meets NPDES permit requirements. This WQ street-sweeping program is the first line of defense in protecting Kitsap streams, wetlands, lakes and Puget Sound.

Pollution Loading Potential

Current scientific research indicates that pollutant loading from roads is, in large part, due to motor-vehicle use and pollutant loading is correlated with the following factors:

- Traffic levels and type of traffic
- Surrounding land use activity
- Proximity to receiving waters

Traffic is one of the most influential factor in determining pollutant loading potential. Traffic levels are measured by the average daily traffic (ADT) counts. Higher ADT levels generally mean higher pollution loading potential. The ADT determines the priority for water quality street sweeping. Roads with an ADT greater than 10,000 are considered to be “high” priority. Roads with an ADT between 5,000 and 10,000 are considered “medium-high” priority. Roads with an ADT between 3,000 and 5,000 are considered “medium” priority. Roads with an ADT between 1,000 and 3,000 are considered “medium-low” priority. Roads with an ADT of less than 1,000 are considered “low” priority. All Kitsap roads were first ranked based on their ADT.

We also consider the surrounding land use in setting priorities. Roads in industrial and commercial areas are given a greater pollution–potential weighting than residential roads. Roads in urban areas are weighted more than rural roads for pollution potential.

The proximity of the road to natural receiving waters is also considered when setting priorities because it is more likely that road runoff will reach these water bodies without encountering treatment or the opportunity to be filtered by contact with native soil and vegetation. Therefore, roads with multiple stream crossings and shoreline roads are ranked higher for pollution potential.

Water Quality Street-Sweeping Operations

Based on the overall pollutant-loading-potential analysis, the high-efficiency sweepers are designated for service in Central Kitsap (Silverdale) and in North Kitsap area. High pollutant-loading potential roads are swept more frequently than lower ranked roads. Kitsap County Street Sweeping Route Map shows street–sweeping routes and road pollution potential classifications.

All designated street-sweeping routes are swept at least once per month during July, August, and September. Some roads are swept on a biweekly basis as indicated on the map. During the rest of the year designated water quality street sweeping roads are swept annually or semiannually or when conditions warrant additional sweeping. Water quality street-sweeping schedule is part of our overall road maintenance program. Urban roads in non–commercial and non–industrialized areas are routinely swept semiannually, or as conditions warrant. See Figure 6.1 for a representation of the street sweeping route map. A large-format map is posted at each road shops and is available in interactive format on the Public Works’ Intranet under “Shared Documents.”

Street-Sweeping Waste Management

Material collected during street sweeping operations is considered solid waste (WAC 173-350 Solid Waste Handling Standards and Kitsap County Health District #SHW 2008-01 Street Waste Management in Kitsap County). Solid waste can only be stored in approved facilities (WAC 173-350-320). Facilities used to store solid waste for more than three months must meet design standards including sealed surface (e.g. concrete or asphalt), run–on and run–off controls, and odor control. Storage facilities must have official records including engineering drawings, annual reports, operating plans, lists of sources of material, and a contaminant sampling and analysis plan.

Kitsap County treats street sweeping material as solid waste and stores the waste temporarily in designated areas at road maintenance shops. The waste is sampled in accordance with approved sampling plan and is removed to the waste transfer station monthly for disposal in an approved landfill. Street sweeping materials stored at designated sites for three months or more is stored and handled in accordance with WAC 173-350-320.

Road Maintenance staff maintains records of the cumulative weight of street waste transferred to the landfill on an annual basis and reports that quantity to SSWM for NPDES reporting.

Street-Sweeping Waste Monitoring

Staff from the SSWM water quality monitoring team collect representative samples of street sweeping waste following Kitsap County Health District requirements (KCHD 1998 and Olsen 2010). Sampling is conducted monthly at each storage facility to meet Ecology's (Ecology 2005) recommended sample frequency shown below.

Recommended Sampling Frequency for Street Waste Solids

<u>Cubic Yards of Solids</u>	<u>Minimum Number of Samples</u>
0 – 100	3
101 – 500	5
501 – 1000.....	7
1001 – 2000	10
>2000.....	10 + 1 for each additional 500 cubic yards

Subsequent sampling is conducted quarterly at each storage area. Data is submitted to both Waste Management and Ecology to meet disposal permit and NPDES permit requirements respectively. Street-sweeping waste is analyzed for the chemical constituents listed below:

Recommended Street Waste Solids Chemical Analyses







<u>Chemical Constituent</u>	<u>Analytical Method</u>
NWTPH-DX.....	Ecology (1997)
PAHs	EPA 8270C
Total Metals RCRA 8 +Cu, Ni, Zn.....	EPA 6010B
Mercury.....	EPA 7471A
TOC	EPA 9060
PSD	ASTM D422

SSWM staff calculates pollutant load removal from street-sweeping operations based on tons of material disposed and the average of sampling outlined above. This is reported to WA-DOE annually.

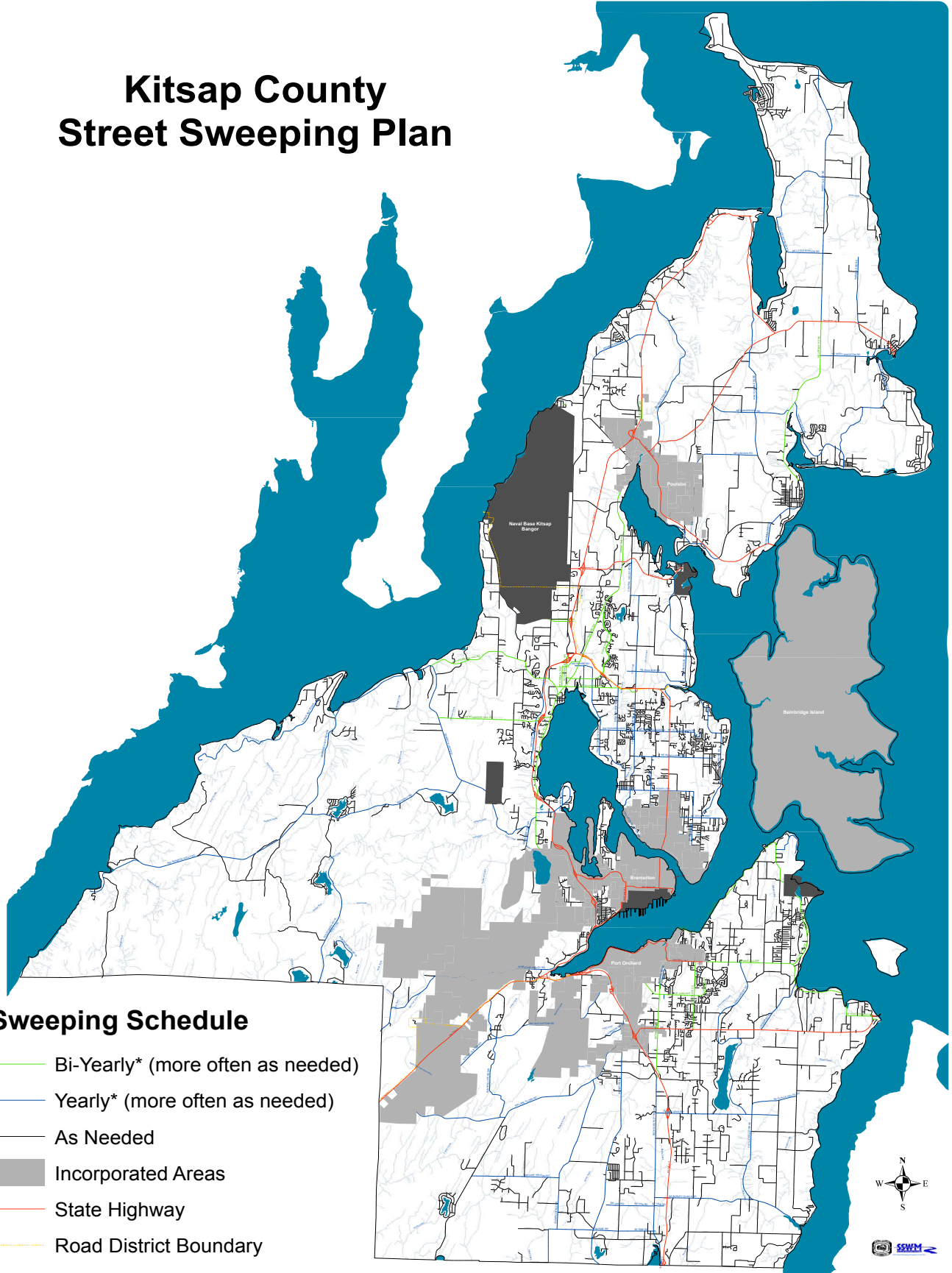
Figure 6.1 — Kitsap County Street Sweeping Plan

Kitsap County Street Sweeping Plan

Sweeping Schedule

-  Bi-Yearly* (more often as needed)
-  Yearly* (more often as needed)
-  As Needed
-  Incorporated Areas
-  State Highway
-  Road District Boundary

* Project Green Sweep (monthly July – September)



Road Side Maintenance

This chapter also addresses vegetation and litter management on County-maintained roadsides.

Definitions

The following terms are commonly used in road side maintenance operations.

Roadside—The roadside is the area maintained by Kitsap County outside established travel lanes. It includes unpaved median strips, pedestrian and bicycle facilities and wetlands.

Roadside Management encompasses the planning, design, construction, and maintenance of the roadside. Efficient roadside management meets these goals:

- Provides roadway functional and operational objectives.
- Protects the environment.
- Creates and/or maintain desirable aesthetic qualities.

Apply consistent, long term strategies throughout the management process to achieve lowest life-cycle costs. Always use appropriate site specific Best Management Practices (BMPs) in roadside areas. Integrated Vegetation Management (IVM) techniques are used to control roadside vegetation.

Integrated Vegetation Management is a coordinated decision making process using the most appropriate vegetation management strategy on a site specific basis. A monitoring and evaluation system is used to ensure roadside maintenance program goals and objectives are met. IVM practices are environmentally responsible and economically sound. The type of site-specific vegetation chosen is designed to require the least possible attention over the long term.

Best Management Practices (BMPs) are physical, structural, and/or managerial practices that reduce impacts of stormwater draining from roads. Typical BMPs include bio-filtration swales, wet ponds vegetated filter strips, and wet vault/tanks. BMP details can be found in the Local Implementation Manual and the Regional Road Maintenance Program.

Roadside Functions

The roadside is managed to four functional categories: operational, environmental, visual, and auxiliary functions. By managing roadway needs in these four categories, the roadside contributes to Kitsap County's delivery of transportation services. Table 7.1 explains the functions and gives examples.

Roadside Maintenance

Roadside maintenance operations include these elements:

- Litter pick-up
- Noxious weed control
- Nuisance vegetation control
- Controlling vegetation obstructions
- Drainage
- Shoulder maintenance
- Landscape maintenance

Roadside Management Zones

Roadsides are divided into three major zones.

- Zone 1—Vegetation Free
- Zone 2—Operational
- Zone 3—Transition/Buffer.

Roadside maintenance priorities within zones are established with activities relating to the safe roadway operations, maintenance and preservation of the roadway.

Table 7.1 — Roadside Functions

Function	Examples
Operational	Functions providing safe and multi-use roadsides. Operational functions include access control, vehicle recovery areas and sight distances that accommodate signs and utilities.
Environmental	Functions that protect and enhance natural and built surroundings. Environmental functions mitigate the roadway's impact on surrounding ecosystems. Major environmental functions include: <ul style="list-style-type: none"> • Water quality preservation, protection, and improvement • Storm water detention and retention • Wetland and sensitive area protection • Noxious weed control • Litter Control • Habitat protection and connectivity • Air quality improvement • Erosion control
Visual	Functions that are designed and experienced primarily from a visual perspective. Visual functions promote aesthetics and are integral to operational, environmental, and auxiliary functions. Visual functions include enhancing guidance and navigation, distraction screening, corridor continuity, roadway, and adjacent property buffering, and scenic view preservation.
Auxiliary	Functions that provide additional operational, environmental, and visual functions that support or supplement the transportation system. Examples of auxiliary facilities include community enhancement areas, bicycle and pedestrian facilities, and stockpile sites.

Most “high priority” and routine roadside maintenance activities occur in Zones 1 and 2 roadsides. Activities in these zones are designed and maintained to facilitate operational roadway functions, including surface and subsurface drainage, traffic operations visibility and site distance. Zones 1 and 2 also allow unobstructed vehicle recovery where traffic may accidentally leave the roadway.

Zone 3 roadsides are where adequate right-of-way area exists beyond what is necessary to deliver operational functions of the roadway. Zone 3 is managed for safety functions including hazard trees and trees shading the roadway. Other operational functions addressed within Zone 3 roadsides include drainage, noise and visual attenuation, and storm water management needs. Zone 3 areas are primarily developed and maintained for the visual, auxiliary, and non-regulated environmental functional needs of the roadway. Zone 3 roadsides offer the greatest opportunity to create and maintain self-sustaining, low maintenance plant communities.

Roadside maintenance program objectives are established and prioritized to deliver the functional needs of the roadway within these three zones.

Maintaining Zone 1

Zone 1 roadsides are maintained to remain free of vegetation. This zone begins at the edge of the pavement and extends outward to Zone 2. Zone 1 is no wider than necessary to achieve the functional objective.

The ideal maximum width is two feet beyond the pavement, or beyond any roadside hardware (guide posts/guardrail) if present. In some instances Zone 1 may be less than two feet or unnecessary.

These include:

- Roadsides and medians with adequate profile and ditch to provide surface runoff.
- Smaller areas required by environmental commitment.
- Areas immediately adjacent to flowing or standing water.
- Any abutting curb and sidewalk sections.
- Areas adjacent to full depth pavement (where shoulder pavement functions as Zone 1).
- By agreement or permit when maintenance is done by others.

Areas where Zone 1 may be wider than two feet include areas:

- Where visibility and maintenance of hardware such as guardrail or fencing must be facilitated.
- Where there is a high risk of fire.
- Where natural rock and gravel ditches make maintaining desirable vegetation impractical.
- Where drifting sand or snow accumulates on roadway as a result of vegetation growth at the edge of the pavement.
- Needed for sight visibility at selected intersections or approaches when mowing isn't practical.

Methods—Zone 1 areas require more regular and routine maintenance attention than any other zone. The primary tool used in Zone 1 is non-selective herbicide products. These products bind within the soil profile and suppress seed germination throughout the growing season. Non-selective herbicides, which eliminate existing living plant material through contact with the leaves or stem, may also be used to control emergent vegetation in this zone. Using non-selective post-emergent products alone may require more than one treatment during a single growing season. Labor intensive non-herbicide controls are available for special situations.

Maintaining Zone 2

Zone 2 is maintained to provide safety and operational functions of the roadside. Maintenance within Zone 2 impacts the visual functions due to human perceptions of roadside neatness and degree of care. Avoid creating negative visual impacts including brown outs from herbicide applications.

Zone 2 maintenance begins at the shoulder or the outside edge of Zone 1. It extends outward to the right of way line or the edge of Zone 3 (where present).

Variations from the optimum minimum width is justified based on the following:

Areas where Zone 2 may be less than the minimum width specified in the *Design Manual*:

- Where compromises exist on older roadways and adequate widths were not established during previous construction and maintenance funding levels do not provide for improvement.

Areas where Zone 2 may be wider than the minimum width specified in the *Design Manual*:

- Where the edge between Zone 2 and 3 has been set through the Design and Construction process and maintenance has adequate resources to sustain Zone 2 beyond the minimum required width.
- Where visual access is desirable across the right of way either from the road out or from lands adjacent to the right of way.

Methods— Maintenance activities applied in Zone 2 are intended to keep vegetation from encroaching on the roadway's safety and operational functions. The maintenance focus is to selectively cut back or remove vegetation. Use selective methods when possible to control unwanted vegetation. Using a broad leaf controlling herbicide to remove noxious weeds or nuisance vegetation from a grass stand is an example of a selective method. Other methods may be non-selective, such as mowing of a grass stand as needed to prevent undesirable vegetation from maturing or setting seed.

Maintenance work in Zone 2 provides the most visible evidence of roadside management. Methods selected have a significant impact on visual quality. Visual quality creates an impression to motorists of the overall maintenance service level.

Service level commitments and funding do not always allow for visual impact consideration. Time herbicide applications for tree and brush control to minimize "brown-outs." Avoid using flail or rotary type side arm mowers when trimming native vegetation when there are alternate ways to

accomplish the same goal.

Maintaining Zone 3

Zone 3 exists when there is adequate right of way beyond the requirements for Zone 2. It is managed to be self-sustaining, and allows for naturally evolving blending with the surrounding vegetation.

Zone 3 begins at the outside edge of Zone 2, or behind guardrail or concrete barrier. It extends to the right of way boundaries on the outside shoulder or an opposing edge of Zone 2, such as in a wide median strip or the interior of an interchange configuration. Zone 3 may also include a managed strip along the outside edge of the right-of-way managed to allow for maintenance access if needed.

Methods—When Zone 3 is properly designed and developed, very little maintenance is needed. Zone 3 maintenance activities are usually selective. Removing noxious or nuisance weeds, hazard trees, or thinning shading trees that increase frost or ice on the roadway are all examples of selective maintenance. The majority of this work is done by hand. Chippers can mulch vegetation waste for on-site disposal. Felled trees should be dropped in place and left to decompose when possible.

When removing nuisance vegetation, including Himalayan blackberry or Scotch broom, preserve desirable vegetation as much as possible.

Integrated Vegetation Management

Integrated Vegetation Management (IVM) is a coordinated decision making process that uses the most appropriate vegetation management methods and strategies. IVM includes a monitoring and evaluation system to ensure roadside maintenance goals, both economic and environmental, are met.

Roadside management work focuses on controlling undesirable vegetation, as well as promoting desirable vegetation growth. Public Works, as required under RCW 17.15 utilizes Integrated Pest Management (IPM) principles to help reach these goals.

Methods

There are four basic methods used in vegetation management. The goal is to use the most effective method, or combination of methods, that provides the highest roadside service levels at the lowest life-cycle costs. Each of the methods is described below.

- **Biological:** Using living organisms to inhibit a host plant's ability to survive or reproduce is considered biological control. Insects, diseases, and foraging animals are examples of biological control organisms. Biological methods are used when weed infestations are so well established that eradication is not practical or possible. Careful testing and screening is used before biological control organisms are applied to ensure they will not also attack native or other desirable plants.
- **Chemical:** This method uses herbicides to control weeds and undesirable vegetation. Chemical control also uses plant growth regulators to reduce pruning or mowing requirements and insecticides to control predatory insects. There are a wide variety of chemical control products available for vegetation management. The use of chemicals to manage vegetation can create controversy. Licensed applicators use proper amounts and application methods that minimize potentially adverse impact.
- **Cultural:** Developing and maintaining healthy growth of desirable plants is considered a cultural method of vegetation management.
- **Mechanical:** Mowing, cutting, pruning, and cultivating to reduce, remove or prevent undesirable plant growth is the mechanical method of vegetation management. Removing seedling trees and undesirable brush from a grass stand by mowing is an example of mechanical vegetation management.

Many factors are considered while developing and implementing an IVM program. Begin by developing roadside maintenance priorities. You may need to develop Best Management Practices (BMPs) or use existing practices to accomplish your goals. Maintenance priorities are specific to each

area's unique set of roadside configurations and are based on established service levels.

Using Herbicides

Herbicides are an effective and economical method to control roadside vegetation. Be sure herbicides are applied properly as instructed on the product labels. Herbicides can be used in combination with other vegetation management tools to effectively control roadside vegetation.

Herbicides are often the first method employed to control weed infestations. Once an infestation has been reduced or eliminated through herbicide applications, other methods can be employed for long-term management. Herbicide application should decrease and become increasingly selective over time as beneficial vegetation gets established on the roadside.

Evaluating and Using New Products

New herbicides are formally evaluated to ensure they are safe to human life and the environment. The evaluation is completed before the herbicide is added to the statewide contract for use on roadside vegetation. All herbicides must be approved by the Kitsap County Engineer or his designee prior to use. The use of new products is encouraged, and the evaluation process is meant to ensure review not to discourage their use.

Pesticide License

All pesticides, including herbicides or other pest control agents, are applied by employees or contractors licensed through the Washington State Department of Agriculture (WSDA). Licensed application staff must attend and receive credit for WSDA certified continuing education to keep licenses current. Forty (40) recertification credits are required every four years and no more than fifteen (15) credits can be counted for any one-year period.

Record Keeping

Record all pesticide application information within the computerized application database on Washington State Department of Agriculture Form AGR 640-4235, Pesticide Application Record. State law, RCW 17.21, requires that records of all pesticide applications be retained for seven years.

Product Labels

Product labels show how and where products are used. Following directions on product labels protect the environment and ensures the safety of the applicator and the public.

Posting Requirements

Posting signs immediately after applying herbicides in areas intended for public access, including rest areas and bicycle/pedestrian paths. Legal requirements for posting signs are listed in RCW 17.21.410. A placard on the spray apparatus is required for right-of-way applications made with power equipment. The posting requirements for this type of application are found in RCW 17.21.400.

Aquatic Pesticide Applications

Kitsap County Public Works does not use aquatic pesticides within roadway rights-of-way.

Pesticide Sensitive Individuals

State law requires notifying individuals medically certified as "pesticide sensitive" and live within one-half mile of the roadway application site, prior to applying pesticides. The WSDA maintains a list of individuals who have received this certification. The WSDA Office is responsible for supplying information on pesticide sensitive individuals to the maintenance areas where notification is required. The process and requirements for establish the WSDA's listing is contained in RCW 17.21.420. Notification requirements are listed in RCW 17.21.430.

Container Disposal

The Washington Administrative Code (WAC) 16-228-185(2) prohibits pesticide container disposal that can pollute water or cause damage or injury. All pesticide containers must be triple rinsed before

disposal. Use an appropriate solvent (water, diesel, oil, etc.) equal to approximately 10 percent of the container's capacity to thoroughly clean containers. Rinse containers as soon as possible after emptying. Dispose of the container according to instructions listed on the product label.

Using refillable bulk containers eliminates the need for container rinsing and disposal. Using bulk containers and metered pumps to transfer products to the spray equipment reduces human contact with pesticides. When used in conjunction with injection type spray equipment unused product is returned to the bulk container at the end of the day.

Using Mowing Equipment

Mowing produces a neat and aesthetically pleasing appearance on roadsides. Mowing is an important part of an IVM program. Mowing is used to maintain the desired service level and controls vegetative obstructions and nuisance vegetation in Zone 2. Use the minimum number of mowing cycles necessary to accomplish IVM objectives at each site. Mowing cycles can be reduced to once every two or three years in some locations without compromising service level commitments.

Multiple mowing cycles of non-irrigated erosion control grasses not regularly fertilized will cause plant population to thin. This reduces the grasses' competitive capabilities and allows undesired seedling trees, brush, and weeds to become established.

Do not remove more than 1/3 of the total grass height at a time, unless the grass has produced seed and dried. Mow grass to between six and eight inches for erosion control grasses.

Wait until erosion control grasses have matured and set seed before mowing. This allows for root growth and development and helps to establish the grass. Mow during the seasonal dry period to avoid damage to the grass stand from mower tires. Mowing when soil is wet causes tire slip and compaction. This increases the opportunity for erosion and weed invasion.

Wait until newly seeded erosion control grass stands are in place one full year before mowing. Mowing is necessary within formal landscaped areas to improve sight distance and to maintain local aesthetics. Keep roadside mowing compatible with how adjacent private property is mowed.

Other Cutting Methods

When vegetation is too large to remove by mowing use saws, axes, and other cutting implements.

After cutting plants, an herbicide may be applied that prevents re-sprouting. Cutting conifer trees below the lowest limb eliminates re-growth. When cutting occurs in summer after spring growth re-sprouting is minimized. July, August, and September are the most effective time to cut trees, brush, and shrubs.

Non-selective trimming on the sides of trees should be avoided. Do not top trees. Remove the entire tree when needed. Topping damages the tree's natural form.

Pruning trees and shrubs may be needed to remove unsightly dead stubs or other conditions that endanger the health of the plant.

Cultural Control Methods

Encourage desirable vegetation growth by meeting its moisture, light and nutrient requirements. This allows desirable vegetation to dominate the plant community and crowd out unwanted vegetation. Watering or irrigation can provide needed moisture. Removing vegetation that shades desirable vegetation provide more light and promotes growth. Applying fertilizers provides nutrients and stimulates plant growth.

After cutting and spraying eliminates undesirable plant growth, cultural control methods are essential to establish desirable vegetation.

Biological Control

Plant predators depend on a very small number of plant species for their survival. This makes them effective control agents. Host plants are not usually completely eradicated by biological

methods. When predator population is high, targeted host plant populations decrease. When host plant population dwindles predator populations also decrease.

Biological control works best when weeds dominate due to a lack of natural predators. Biological control measures are usually used to keep existing, well-established weed infestations from spreading.

When biological controls are used with cultural controls eradication of a weed species such as Tansy Ragwort can be accomplished. Cinnabar moth larvae feed on the Tansy Ragwort blooms. Seed flies reduce seed production and flea beetles reduce the plant's vigor by feeding in the crown and stems. Tansy Ragwort is a biennial plant that blooms and then dies if seed is produced in the second year. When biological predators are used the seed produced is reduced. This limits the plant's ability to establish itself, especially if surrounding soils have grass or other native vegetation thriving in the area.

The Washington State University Cooperative Extension Service provides assistance to help evaluate potential success of biological control programs.

Noxious Weed Control

Regulations and controls for noxious weed species are defined in RCW 17.10. All state agencies are required to control noxious weeds on lands they own.

Noxious weed control is important to prevent new infestations along roadway corridors. Controlling noxious weeds helps preserve the environment. Noxious weed control has priority over other vegetation management activities except where vegetation management has a direct and immediate safety implication.

When prioritizing control efforts apply the following guidelines:

- **First Priority**—Class "A" noxious weed infestations and weeds on the Class "B" list as designated by the noxious weed board or district. The highest priority is new infestations and established weed populations where adjacent neighbors are making effort to control noxious weeds.
- **Second Priority**—Areas where noxious weed control has been done in the past, adjacent to neighbors not making any effort to control noxious weeds.
- **Lowest Priority**—Areas with no potential for neighbors to comply with noxious weed regulations and no seed production onto the road rights-of-way.

Achieving compliance with noxious weed regulations on adjacent lands is enhanced by working cooperatively with local weed boards and districts. To do this:

- Share information on new infestations with weed board.
- Advise weed boards of adjacent lands not in compliance with existing regulations.
- Request "Weed Free" buffers be provided on lands adjacent to KCPW right of ways.
- Participate in joint control efforts contracted by weed board.

Danger Trees

Danger trees are defined as dead, leaning, or structurally unsound trees within the rights-of-way that pose a threat to those using the road. Danger trees can also damage pavement, structures, or other parts of the roadway. Once identified, danger trees should be removed as soon as practical.

If the tree is on private property Kitsap County Public Works consults with the property owner regarding removal. If imminent danger is present, and the owner can not be contacted, the tree is removed immediately. The Road Shop Supervisor contacts the property owner at the soonest opportunity to explain the situation.

Identifying potential danger trees is part of the job for every Road Division employee. Crews are instructed to look for potential danger trees while performing their assigned tasks and duties. All primary and secondary County arterials are inspected for danger trees bi-annually. All other county-maintained roads are inspected annually. If there is not certainty about the dangerous nature of the tree, Kitsap County Public Works consults with an arborists and follows all recommendations

provided by an arborist.

Debris and waste may be left on-site within Zone 3 boundaries. The Road Superintendent or area Road Supervisor directs off-site disposal or reuse of wood from danger trees. When possible the adjacent property owner is notified prior to removal. When imminent danger exists from a tree outside the County maintained right-of-way, remove the tree immediately and notify the property owner at the earliest opportunity.

Clear cuts adjacent to logging activities can create a fringe of unstable trees along the right-of-way. When possible danger trees should be removed prior to, or in conjunction with, adjacent logging operations. Removing and disposing, or sale, of timber from county property is outlined in RCW 47.12.140.

Removing Dangerous Objects and Structures

Do not arbitrarily remove object from the roadside unless they represent a definite danger to the road, or to roadway users. Advise the area Road Supervisor when a decision is needed, unless immediate action is required for safety reasons.

Trespass and Encroachment

All employees are required to obtain permission from property owners before entering private property, except in cases of an immediate emergency.

Encroachments—General

While field personnel are not expected to be familiar with every law and policy applicable to using public rights-of-way they should at least know this:

- No work by contractors of any kind is permitted on county rights-of-way except work authorized by law. Adopted policies, rules, and regulations govern legal encroachments. Permission to occupy the right-of-way is always granted by written permit, a franchise, or other agreement.

Encroachment—Maintenance Crew Responsibilities

Area Road Supervisors report any evidence of intended or actual encroachment on County maintained rights-of-way to the Road Superintendent. Property owners encroach on rights-of-way when they are not aware of the law or are unaware of the delineation between rights-of-way and personal property.

When an encroachment is observed the area Road Supervisor or Assistant Road Supervisor must inform the violator immediately. Do not permit unauthorized work to continue without warning the violator of the consequence of continued encroachment. Many property owners use contracted labor. The contractor's crew may not have knowledge of existing permits or franchises that affect the property they are working on.

It is safe to assume permission has not been granted to install or erect signs, sub-standard or otherwise, on the rights-of-way. Contact the Traffic Engineer to determine the legality of any sign placed in the right-of-way. Maintenance crews should be familiar with rights-of-way widths in order to detect encroachments.

Wood Debris

Wood debris is disposed as directed in established solid waste regulations.

Illegal Tree Removal

Removing or damaging desirable trees on rights-of-way is a misdemeanor and punishable by law. Removing materials without authorization often occurs when property owners feel trees are blocking visibility across the right-of-way. It is difficult to monitor all rights-of-way for illegal activity. If you know locations more prone to these issues be sure to watch for violations within the area.

Significant Roadside Activities

Major maintenance on roadsides can significantly impact adjacent property owners and motorists. Be sure to notify residents and motorists when maintenance activities create customer concerns.

Public information strategies can increase costs and take time. Effective communication and public involvement results in fewer complaints and builds public trust. Communication also enhances property owner's understanding of vegetation management techniques and how their personal habit impact roadside maintenance habits. These terms are commonly used to describe roadside activity.

Maintenance Activity is any work within or adjacent to roadway rights-of-ways that preserves, protects, and enhances safe mobility for motorists, roadway facilities and the environment.

Significant Roadside Activity describes work that alters the visual appearance of a roadside. This can include the following maintenance activities:

- Removing large stands of vegetation.
- Grading to re-contour slopes or ditches.
- Removing natural or constructed noise or visual barriers.
- Altering the appearance of more than 1,000 linear feet of roadside.

Ditch and culvert cleaning, herbicide applications, mowing, erosion and slide repairs, grass seeding, fertilizing, hardware repair, hardware installation, litter pick up, and emergency response activities are not considered significant roadside activities.

Notification

Public notification for significant roadside activities is advised at least one week before work begins. Use the most effective method listed below to notify the public.

- Telephone
- Flyer delivered to each residence
- Mailed notice
- Posted sign
- Media release
- Personal contact
- Posted notice on local bulletin boards
- Public service announcement on radio or television
- Legal notice
- Town meeting

Removing Debris and Rubbish

Debris and rubbish on or along the roadway should be removed as soon as practical. Fallen branches, rocks, or earth slides encroaching in travel lanes or shoulders should be removed immediately.

Litter Control and Partnerships for Roadside Enhancement

Litter creates a perception that maintenance service level is low. Litter control and roadside enhancement are not high maintenance priorities for road maintenance staff. Local partnerships help accomplish litter clean up at minimal cost.

Kitsap County's Solid Waste Division manages responsibility for litter control on county roads. They oversee a program with the Kitsap County Sheriff's Office that uses inmate labor to remove litter from roads. They also administer an Adopt-a-Road program. This program provides residents with the equipment and safety training needed so they can clean litter from local access roads in their neighborhoods. Both programs are effective in removing litter from roads.

Dead Animals

Dead animals fall into two general categories. Wild animals are indigenous or feral animals with no obvious private owner. This includes big game (deer, elk, bear) and small game and rodents

(opossum, raccoon, squirrel, birds.) Domesticated animals are those who have owners responsible for their well being. This includes farm animals (cows, horses, goats, pigs, fowl) and companion animals, (cats and dogs.)

Reports or observations related to domesticated animals are forwarded to the Kitsap County Humane Society. If a large domesticated animals (horse, cow, etc.) is blocking the travel lane Public Works may assist in removing the animal from the travel lane, but disposal is still the responsibility of the owner and/or the Kitsap County Humane Society.

Road crews respond and remove wild animals found or reported dead in the travel lanes of County- maintained rights-of-way. Once reported or discovered they are removed from travel lanes as soon as practical. Dead animals outside of travel lanes are removed by the end of the next business day.

Employees removing dead animals shall wear appropriate Personal Protective Equipment (PPE) including, but not limited to, non-permeable gloves with long sleeves, rubber boots, eye protection, and appropriate inclement weather gear. Employees removing dead animals ensure the carcass is covered, or otherwise not visible to motorists while transporting the remains.

Small animals may be placed in a plastic bag and transported either to an approved disposal location, or to an approved holding area at one of the Division's facilities. Large animal carcasses are returned to nature on County-owned property and allowed to follow the natural decomposition process. If natural decomposition is not possible Public Works contracts with a rendering company for disposal of the remains.

Maintaining Structures

The proper care of structures is vital to the preservation of the county road network and to the safety of the traveling public. This chapter discusses those items in which area maintenance personnel assist in this maintenance effort.

Major Structures

For maintenance purposes, all bridges shall be considered major structures. Major structures are identified as those bridges or culverts with an inside span that is greater than 20 feet. A current list of County owned bridges is maintained in the Construction Inspection office.

Bridges that are closed due to structural damage require approval from the Washington State Department of Transportation (WSDOT) before re-opening.

Minor Structures

For maintenance purposes, minor structures are identified as those drainage structures with an inside span that is less than 20 feet, retaining walls, cribbing, etc. Any defects or damage to minor structures should be referred to the Road Superintendent, Road Supervisor and the Construction Manager, who coordinate any required action.

Inspection

WSDOT requires that a crew under the supervision of the County certified Bridge Inspection Program Manager, inspect all major county road structures on a least a two year interval. The County has chosen to perform inspections on each structure every year.

The Bridge Inspection Program shall provide County maintenance personnel with an updated list of deficiencies for each bridge structure after each annual inspection.

Area maintenance crews are expected to maintain or repair minor approach settlements, approach guardrail damage, plugged bridge drains, sweeping of bridge decks, asphalt overlays and other items that are considered part of normal maintenance operations. Additionally, removal of dirt and debris accumulation on timber caps, timber stringers, steel expansion devices (bearings), lower chords of steel bridges and sign bridge bases are considered routine maintenance activity. (NOTE: no additional appurtenances or asphalt overlays shall be applied to a bridge structure without the direction of the County Engineer. Adding appurtenances or pavement overlays increase loading on the bridge and potentially compromise structural integrity)

Any maintenance activity performed on, or around, a bridge structure shall be reported to the County Bridge Inspection Program immediately upon completion of the work. This information will be added to the structure file and reported to the State.

A bridge's condition can change in much less than two years. The Bridge Inspection Program relies on area maintenance personnel to be alert for settlement, washout, collision damage, and other problems, and to notify their supervisor as appropriate.

Maintenance crews shall review bridge inspection report notes, repairs, and photos to identify items to focus on during inspections. During inspection deficiencies should be immediately repaired, or scheduled for future work.

- **Approach Fills**—Note any deficiency. Pay particular attention to the pavement seats of the structure. Look for pot holing, , sloughing of shoulders.
- **Asphalt Wearing Surface**—Note potholes, cracking, wheel rutting, and general pavement condition.
- **Concrete Deck**—Note scaling, spalling, cracks, and any exposed reinforcing steel.

- **Curbs and Railings**—Note any deterioration, cracking, spalling, or damage.
- **Paint**—Note the general condition of the paint.
- **Stringers, Caps, and Floor Beams**—Note any crushing at bearing points, and any warping, cracking, splitting in beams, piers in the water with debris accumulation.
- **Steel Truss Members**—Note bent or damaged steel, deflection, cracking, vibration, debris buildup on chord members, and deterioration due to rust. Pay particular attention to pinned joints at hinges, excessive rust, vibration, missing nuts, or loose plates. Immediately inform the designated bridge maintenance representative of any known or suspected problems.
- **Wood Truss Members**—Look for and note damaged or broken members, crushing, splitting, warping, vibration, and deterioration due to rot or boring insects.
- **Expansion Joints**—Note loose, banging, and jammed expansion joints. Also, note the presence and condition of the joint material.
- **Abutments, Bulkheads, Piers, and Intermediate Bents**—Note any type of tilting, bulging, and deterioration. Pay particular attention to the buildup of drift debris and any scouring or undermining due to high water and erosion.
- **Bridge Drains**—Note plugged bridge drains. Check pipe outfall areas to see if soil erosion is occurring. Plugged drains may result in saturation of the bridge approach fills and may explain any unusual erosion or undermining of abutments or bulkheads.
- **Waterways**—Note scour and conditions that could cause log jams or ice jams during high water stages. Look for any logs or other debris jammed against piers, bulkheads, or piling. In the winter check all bridges with piers or bulkheads in the water with a floating debris problem during and after each flooding condition.
- **General Conditions**—Look for accumulation of dirt, excessive bird droppings or debris at bearing points and on the caps or lower chords. Pay particular attention to the presence of materials that might pose a fire hazard or restrict access for maintenance activities. Note any unauthorized attachments such as private fences. Have electrical fences removed from bridge access areas or clearly mark them with warning signs.
- **Walls and Cribbing**—Inspection can be of a cursory nature according to guidelines designated by the Construction Inspection personnel. Check walls for tipping, bulging, cracking, spalling, and water runoff over or through wall. Check all weep holes to assure that they are open. If the structure is wooden, check for rot and the presence of fire hazards.

Bridge Repair Guidelines

Any major or structural repairs need to be coordinated through and approved by the County Engineer. If there is any doubt about the structural significance of a damaged or deteriorated bridge component, notify the County Engineer immediately. Generally, bridge repairs will be identified in the annual Bridge Inspection Report.

The annual Bridge Inspection Report provided by the Construction Inspection office will identify needed maintenance and modifications for each structure. Maintenance crews shall complete all routine maintenance activities identified, and any other necessary maintenance or modifications for which it feels qualified. If there are any identified deficiencies outside the area of expertise, the Road Superintendent and Construction Manager shall be notified, who will coordinate the required action.

Environmental Aspects

Before initiating bridge repair activities, the County Engineer, Road Superintendent, or Supervisor will confirm if environmental permits are required. They will also review the proposed repair method with the environmental staff to determine whether it is both appropriate and/or environmentally sound.

Utility Installations

Utility companies who wish to install their facilities on, or around, a bridge structure must first apply for a Right-of-Way Permit. Applications will be carefully evaluated with regards to the impact of the proposed work on the bridge structure, including the effects of additional loading on the structure. A load rating analysis, performed by a licensed Structural Engineer, may be necessary. All work on, or around, county owned bridges shall be performed in accordance with the most current version of the WSDOT Standard Specifications.

Traffic Services

Traffic services are maintenance functions used for safe and efficient traffic movement. Maintaining roadway signs, delineators, pavement markings, traffic islands, curbs, impact attenuators, barriers, guardrail, traffic signals, and roadway illumination are all examples of traffic services. Guardrails and curbs are repaired and maintained by Road Department personnel. The County's Traffic Engineer is responsible for maintaining all other traffic services.

When Applying, installing, or maintaining traffic service functions you must conform to the practices and standards set forth in the FHWA Manual on Uniform Traffic Control Devices (MUTCD), the WSDOT Design Manual, and the WSDOT Standard Plans for Road, Bridge, and Municipal Construction.

Reconstruction Principles

Guardrail terminals, transitions, and post spacing are example of items subject to reconstruction to meet current design standards. Send an email listing materials use to the Traffic Engineer when upgrading damaged hardware to current standards. Take photographs before and after repair and updating, and include the photos in the job file.

Signing

Roadway signs convey specific messages to motorists. They provide regulatory, warning, and guidance information.

Signing Responsibility

The Kitsap County Traffic Engineer has the authority for design, location, height, and other features associated with installing new signs, and for revisions that are needed. Traffic Division maintenance personnel are responsible for maintaining signs.

Traffic Barriers and Impact Attenuators

Traffic barriers, including beam guardrails, cable barriers, and concrete barriers, protect vehicles from hazards within the Design Clear Zone that cannot be removed or otherwise relocated. Hazards may be a single point, such as a bridge pier, or an extensive area, such as steep embankments. Elements of traffic barriers include the standard run of barrier, terminals or anchors for the treatment of the ends, and transitions for connecting to stiffer barriers. Maintain records with descriptions of observations and repairs.

Maintenance

Barriers must be properly maintained to ensure that they will perform properly when struck by errant vehicles. Keep the area under and around barriers clean and free of vegetation and debris. Do not place objects that could become projectiles on top of barriers.

Inspection

Inspect barriers periodically, either by visual drive-by or by physical inspections. Inspect for:

- The overall condition of the barrier.
- Proper interconnection of units.
- Proper installation of anchor cables and connecting pins.
- Tightness of blocks and fasteners.
- Proper overlapping of beam guardrail.
- Secure attachment of beam guardrail.

Repair

Repair damaged roadside barriers within two weeks. Repairs can include replacing or removing the damaged barrier.

Removing a barrier may be the best solution. This requires evaluating the barrier requirements. In some instances the barrier can be eliminated by flattening slopes or removing a fixed object. Contact the Kitsap County Traffic Engineer for guidance on evaluating the need for a barrier. The following guidance is provided to help evaluate the need to upgrade a barrier:

Standard Run of Barrier

The "Standard Run" of barrier is the majority of the barrier run. The standard run of the barrier includes the entire barrier except the terminals and transition sections. Because barrier standards have changed over many years there are barrier systems on Kitsap county roadways that do not meet current design standards.

Examples of non-standard barriers include:

- W-beam guardrail with 12' – 6" post spacing and no block outs.
- W-beam guardrail on concrete posts.
- Half moon or C shape rail element.

If damage to these barriers requires the reconstructing a significant portion of the run, consider upgrading the entire run to current design standards. When minor repairs are made upgrade the damaged portion of w-beam barriers to current design standards. Minor repairs to non-standard cable, half moon, or C shaped rails may be repaired in kind when upgrading is not practical.

Terminals and Anchors

A guardrail anchor is required at the ends of a standard run of guardrail to develop its tensile strength throughout its length. In addition, when the end of any barrier is subject to head-on impacts, a crash worthy terminal is required. Guardrail anchorage may be provided as part of the terminal, as a connection to a rigid structure, or by an anchor whose only purpose is to strengthen the run (Type 4 and 7 anchors).

Many different terminal designs are been used on Kitsap County roads. Upgrade damaged guardrail ends that do not have a crash worthy design.

Common features of non-crash worthy designs are as follows:

- No cable anchor.
- A cable anchored into concrete in front of the first post.
- Second post not breakaway (CRT).
- Design A end section (Design C end sections are acceptable to be left in place).
- Beam guardrail on both sides of the posts (two sided).

During an upgrade it may be possible to extend the run to a location where the end is less likely to be struck, or to where it can be buried in a back slope. If burying the end is not possible, consider a flared terminal as shown on *Standard Plan C-4b*, or a non-flared terminal as shown on *Standard Plan C-4e*. These terminals are proprietary devices and the specific details are not shown on standard plans. Manufacturer's drawings used in Washington can be obtained from the manufacturer.

Maintenance

Replace and repair impact attenuators in accordance with the manufacturer's recommendations. Check for proper restraining cable tightness, anchor bolt tightness, diaphragm and hardware condition, and that fender panels are securely in place.

Islands

Islands must be properly maintained to provide protection for motorists and pedestrians. Keep island passageways clear of debris. Displaced or missing raised curb must be repositioned or replaced.

Miscellaneous

Right-of-Way Fences

The Road Superintendent is responsible to resolve questions regarding maintenance responsibilities for fence section within, or on, County rights-of-way.

Road Approaches—General

Road approaches must be authorized by Kitsap County. Road approaches for private access require a permit. The permit stipulates conditions for the road approach. Permits are obtained through Kitsap County Department of Community Development. A fee is charged for the permit. The fee covers administrative costs associated with issuing the permit. Conditions of approval can include the allowed width; turn radii, paving and culvert requirements, and specific location information that ensures safe sight distances. The permit holder is responsible for maintaining the approach between the edge of pavement and the property line. When permit violations are observed notify the Road Superintendent or area Road Supervisor.

Maintenance Yards

Maintenance yards are maintained to present a neat, clean, and orderly appearance. Keep all buildings, both interiors and exteriors, in good repair. Paint surface when conditions warrant.

Keep truck sheds free from debris and fire hazards. Do not store gasoline or other flammable materials in buildings where trucks or equipment are stored. Keep oily rags in metal containers.

Store materials and supplies in an orderly manner. Keep an inventory of all materials and supplies on hand. Keep all buildings and yards locked when not occupied by responsible personnel.

Place any hazardous wastes (i.e. solvent contaminated rags, methyl methacrylate wastes, and paint residues) in proper containers labeled with a yellow hazardous waste label. Dispose of all hazardous waste properly within ninety (90) days.

Stockpile Sites

Clear stockpile sites of all vegetation, trees, brush, rocks, or other debris. Prepare a uniform ground surface prior to depositing stockpile material. Minimize visual impact, especially in urban areas, when selecting location for stockpiles. Construct stockpiles to occupy the smallest area possible while proving access for equipment without obstructing the road. Build stockpiles in layers. Place signs that identify the material as County-owned property at each stockpile.

Fence sites when material is stockpiled year-round. Place signs along the fence that identifies the site as county property. Keep gates locked.

Inspect stockpiles periodically and remove any vegetation growth. Look for any signs of stockpiles being removed by unauthorized persons. Record any potential storm water impacts off-site and make corrections as appropriate.

Materials from County Quarries or Pits

Materials produced or manufactured in county-owned pits or quarries may not be sold or, given to private individuals. Kitsap County may sell materials to other government agencies through inter-local agreements when feasible.

Procuring Materials

Materials needed for road maintenance are available from the inventory of materials in stockpiles. ER&R staff can purchase materials not available in stockpiles.

Material Specifications—General

All materials used by county employees to repair or reconstruct road facilities and buildings must conform to Washington State Department of Transportation specifications adopted for new construction.

Specifications are necessary to ensure that the department receives the quality of material required for the intended use. They also provide a uniform base for vendor quotes. There is logic behind specifying a particular design, mix, formula, type, or dimension. Good workmanship does not counteract the effects of the use of inferior material, or material intended for another purpose, or material that is adequate under different conditions.

Instructions for Radio Operation

Keep these points in mind for effective radio operation:

- Emergency and urgent calls have priority over routine radio traffic.
- Keep radio messages brief, professional, and simple.
- Speak into the microphone using a normal tone. Speak clearly.
- Confirm radio call numbers when receiving numbers in a transmission.
- Listen for radio messages already in progress before initiating a new conversation. Allow existing conversations to finish before you start.
- Hold the “talk switch” down for a second or two before beginning your transmission.
- You cannot receive radio traffic while the “talk switch” is down. Release it after speaking and waiting for a reply.

Work Scheduling and Reporting

This section briefly covers budget and planning and reporting activities.

- **Budget**—Planning helps determine work activities and ensures activities are funded. The actual work performed does not always match the work planned, but planning helps form the basis for changes in the number of employees, equipment, and materials to accomplish the work.
- **Scheduling**—Supervisors must consider the costs of work on each project, and the impact to their annual budget. Refine your budget frequently to ensure that the most important jobs are accomplished. Coordinate materials and equipment to ensure the most important work gets done. Along with a monthly plan, supervisors should prepare a daily plan specifying work assignments for the upcoming week. The daily plan recognizes the priority items in the monthly plan, and makes allowances for weather conditions, unexpected events, employee absences, equipment breakdowns, or other unforeseen challenges. A daily plan also helps employees prepare for the next day’s tasks and assignments.
- **Reporting**—The value of effective reporting can seem lost to field workers. While some employees consider reporting needs excessive or tedious, it is the basis used to prepare budgets and plan activities. When accurate data is not reported, it makes proper preparation difficult. When budgets are prepared without realistic data, the effective use of employees, equipment, and materials is limited.

Environmental Sensitivity

Many maintenance activities impact the environment. Painting, sanding, anti-icing, vegetation management, mowing, brush control, landscaping, and maintaining drainage can cause environmental concerns among residents. Handling these materials has environmental safety implications for our employees and the general public. Kitsap County uses an aggressive training program that educates about these hazards, and focuses on the safe and effective use of these materials.

Snow and Ice Response Tables

Service Level 1 — Light Snow
Using a 23% concentration of Sodium Chloride

Pavement Temperature Range and Trend	INITIAL OPERATION			SUBSEQUENT OPERATIONS			COMMENTS	
	Pavement surface at time of Initial operation	Maintenance action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		
			Liquid NaCl	Solid or pre-wet solid (lb)		Liquid NaCl		Solid or pre-wet solid (lb)
Above 32° F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	N/R	None, see comments	N/R	N/R=Not Recommended	
32° F or below is imminent	Dry	Apply liquid or pre-wet solid chemical	20-40	75-125	Plow as needed; reapply liquid or solid chemical when needed	20-40	75-125	
ALSO 20 to 32 °F Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	20-90	100-210		20-90	100-210	
15 to 20° F Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-240	Plow as needed; reapply pre-wet solid chemical when needed	N/R	200-240	
Below 15 °F Steady or falling	Dry or light snow cover	Plow as needed	N/R	N/R	Plow as needed	N/R	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

*Note: Verify with Road Supervisor or ASU if Application rates require an application rate higher than 25/gal/per lane mile.

Figure 5.2 — Service Level 2 (Light Snow With Periods of Moderate or Heavy Snow)

**Service Level 2 — Light Snow Storm With Period (S) Of Moderate Or Heavy Snow
Using a 23% concentration of Sodium Chloride**

Pavement Temperature Range and Trend	INITIAL OPERATION			SUBSEQUENT OPERATIONS				COMMENTS	
	Pavement surface at time of initial operation	Maintenance action	Chemical spread rate (gal/h-mi or lb/h-mi)		Chemical spread rate (gal/h-mi or lb/h-mi)				
			Liquid NaCl	Solid or pre-wet solid	Liquid NaCl	Solid or pre-wet solid	Light snow		Heavier snow
Above 32° F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	N/R	N/R	N/R	N/R	N/R=Not Recommended * Monitor pavement temperature closely * Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed	
32° F or below is imminent	Dry	Apply liquid or pre-wet solid chemical	20-40	75-150	20-40	40-65	75-125	150-200	* Application rates will depend on dilution potential
ALSO 20 to 32 °F Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	20-90	175-200	20-80	80-90	175-185	190-200	* Application rates will depend on dilution potential
15 to 25° F Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-230	N/R	N/R	200-230	200-250	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Application rates will depend on dilution potential
Below 15 °F Steady or falling	Dry or light snow cover	Plow as needed	N/R	N/R	Plow as needed	Plow as needed	N/R	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to prevent deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

*Note: Verify with Road Supervisor or ASU if Application rates require an application rate higher than 25/gal/per lane mile.

Figure 5.3 — Service Level 3 (Moderate or Heavy Snow Storm)

**Service Level 3 — Moderate Or Heavy Snow Storm
Using a 23% concentration of Sodium Chloride**

Pavement Temperature Range and Trend	INITIAL OPERATION			SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of initial operation	Maintenance action	Chemical spread rate (gal/in-mi or lb/in-mi)	Maintenance action	Chemical spread rate (gal/in-mi or lb/in-mi)	COMMENTS	
			Liquid NaCl		Liquid NaCl		
Above 32° F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	N/R=Not Recommended	
32° F or below is imminent	Dry	Apply liquid or pre-wet solid chemical	20-65	Plow accumulation and reapply liquid or pre-wet solid chemical when needed	20-65	150-200	* Do no apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 25 to 32° F Remaining in range	Wet, slush, or light snow cover	Apply solid chemical	N/R	Plow accumulation and reapply liquid or pre-wet solid chemical when needed	80-90	190-200	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Application rates will depend on dilution potential
15 to 25° F Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	Plow as needed; reapply pre-wet solid chemical when needed	N/R	200-250	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction
Below 15° F Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to prevent deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible.

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

*Note: Verify with Road Supervisor or ASU if Application rates require an application rate higher than 25/gal/per lane mile.

Figure 5.4 — Service Level 4 (Frost or Black Ice)

**Service Level 4 — Frost Or Black Ice
Using a 23% concentration of Sodium Chloride**

Pavement Temperature Range and Trend	Traffic Condition	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS	
		Maintenance action	Chemical spread rate (gal/ln-mi or lb/ln-mi) Liquid NaCl	Solid or pre-wet solid (lb)	Maintenance action		Chemical spread rate (gal/ln-mi or lb/ln-mi) Liquid NaCl
32° F, Steady or rising	Any level	None, see comments	N/R	N/R	None, see comments	N/R	N/R=Not Recommended * Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32° F or below and is at or below dew point
28 to 32° F Remaining in range or falling 32°F or below, and equal to or below dew point	Any level	Apply liquid or pre-wet solid chemical	20-60	100-130	Reapply liquid or pre-wet solid chemical when needed	20-60	100-130
20 to 28° F Remaining in range, and equal to or below dew point			20-75	100-130		20-75	100-130
15 to 20° F Remaining in range, and equal to or below dew point	Any level	Apply pre-wet solid chemical	20-80	165-200	Apply abrasives as needed	20-80	165-200
Below 15° F Steady or falling				N/R		175-225	N/R
		Apply abrasives	N/R	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to prevent deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

*Note: Verify with Road Supervisor or ASU if Application rates require an application rate higher than 25/gal/per lane mile.

Figure 5.5 — Service Level 5 (Sleet Storm)

**Service Level 5 — Sleet Storm
Using a 23% concentration of Sodium Chloride**

Pavement Temperature Range and Trend	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance action	Chemical spread rate (lb/in-mi) NaCl	Maintenance action	Chemical spread rate (lb/in-mi) NaCl	
Above 32° F, Steady or rising	None, see comments	N/R	None, see comments	N/R	N/R=Not Recommended *Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100-150 lb/lane-mi
32° F or below is imminent	Apply liquid or pre-wet solid chemical	125	Plow accumulation and reapply liquid or pre-wet solid chemical as needed	125	*Monitor pavement temperature and precipitation closely *Application rates will depend on dilution potential
28 to 32° F Remaining in range		125-325		125-325	
15 to 25° F Remaining in range		250-400		250-400	
Below 15° F Steady or falling	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to prevent deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible.

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

*Note: Verify with Road Supervisor or ASU if Application rates require an application rate higher than 25/gal/per lane mile.

Procedures for Snow and Ice Operations

Tandem (Saddle Tanks) Salt Brine Application

Into Spray Bar

- Turn sander switch on dash to “on” position
- Turn (white) toggle switch to “on” position
- Turn sander switch by tailgate switch to “on” position
- Press and hold master on/off switch on controller till lights come on
- To activate brine, push spreader on/off on controller
- To adjust spray, use flow rate up/down buttons

Into Sand

- Turn sander switch on dash to “on” position
- Turn (white) toggle switch to “spray” position
- Turn sander switch by tailgate switch to “on” position
- Press and hold master on/off switch on controller, till lights come on
- To activate brine, push spreader on/off switch on controller
- To stop sander and brine at same time, use sander switch by tailgate switch
- To adjust spray, use flow rate up/down buttons

Alternate Tandem (Saddle Tanks) Salt Brine Operation

Into Spray Bar

- Turn on sander switch by plow controls
- Turn on power to brine controller
- Turn switch on center of dash to up position (light on)
- To activate brine, push on/ off button on brine control box
- To adjust spray

Into Sand

- Turn on sander control switch next to plow controls
- Turn power on to brine controller
- Turn switch on center of dash to middle position
- To activate brine, push on/ off button on brine control box
- To set amount of brine, turn base of on/off button

Loading Sand Into Sanders

- Position truck in loading area
- Set parking brake
- Perform pre- trip walk around on loader
- Climb into loader using 3 points of contact at all times
- Put on seat belt and start loader
- Get a bucket of sand(If sand pile is frozen, take crust off pile and set aside)

- Proceed to truck, slowly dump sand into sander until full(stagger buckets front to rear for even loads)
- Park loader
- Clean any chunks off top of sander

One-Ton(4 X4) Plow Mounting

- Turn switch on inside marked plow on dash
- Place switch on light bar in up position
- Pull pins out on plow mount and be sure they are held out with wire spring
 - Not roll pin
- Drive into plow
- Plug in power cords (2)
- Move red switch on joystick to plow up position
 - Light bar will raise and pins will lock
- Ensure pin are locked completely
- Move switch on light bar to down position
 - Plow is now ready for service

One-Ton(4 X4) Sander Mounting

Offload Flatbed

- Push in clutch and pull PTO handle up on floor
- Pull left black handle in cab till stops
- Pull center red handle till bed is on ground and opening on hook is aligned with bar
- Drive away from bed

Loading Sander

- Back up to sander and align opening in hook with bar on sander
 - Be sure to be lined up straight with sander
- Push center red handle till sander stops
- Push left black handle till sander stops
- Shut off engine
- Support side spinner chute on left side of sander and pull long pin out
- Slowly lower chute and install pin and clip to hold in down position
- Hook up three hydraulic lines and one power cord on right side of sander
- Hook up one power cord on right rear of sander for salt brine applicator

One – Ton(4 X 4) Sander Operation

- Push in clutch and pull PTO knob on floor to up position
- Turn switch on dash marked “sander” to up position
- Turn power switch on sander controller to on position

- Pull far right lever towards you to detent position to activate sander
- Push far right lever away from you to stop sander
- Adjust spread and feed rate knobs as needed
- If not using sander for extended periods of time, shut off PTO

Salt Brine Operation

- Fill salt brine saddle tank
- Turn on valve on front of tank
- Turn switch on dash marked "salt" to up position to pre-wet sand
- This system is gravity feed and will only pre-wet sand on conveyor

Plow Mounting For Tandem Truck

- Have spotter on hand to guide into plow
- Be sure plow lock is in the forward (locked position)
- Pull into plow until pins are in plow slots (Use spotter to guide)
- Hook up lift chains and raise plow.(Plow should seat onto pins and lock)
- Raise and lock plow support legs
- Lower plow to ground and turn off truck engine
- Check to make sure plow is locked onto pins
- Clean hydraulic fittings and connect to truck
- Start truck and test all plow functions and check for leaks
- Check plow rubber or cutting edge for proper adjustment

Sander Mounting For Tandem Trucks

- Have spotter on hand to guide under sander
- Lift dump box to same angle as sander on rack
- Back under sander until bars are in tailgate latches and lock tailgate switch
- Put dump box down
- Use supplied ladder to get up onto sander
- Unhook rear support chains
- Lift dump box until front chains are loose
- Unhook front chains
- Lower dump box and hook up and tighten turnbuckle
- Turn off truck engine and clean all electrical and hydraulic connections
- Connect all electrical and hydraulic fittings
- Set rear door to proper opening (approximately six (6) inches)
- Start truck engine and check all sander functions
- Check for hydraulic leaks
- Load with sand and check for proper sanding pattern

Snow Removal Equipment Checklist

2064 (03-10)

Date: _____ Vehicle #: _____ Mileage: _____

Inspected by (printed name & signature) _____

Snow Plowing Equipment—Inspect each item annually before winter operations begin November 1st.

<input checked="" type="checkbox"/> Item inspected	Remarks and comments
<input type="checkbox"/> Mooring pins and brackets	_____
<input type="checkbox"/> Hydraulic fittings and hoses	_____
<input type="checkbox"/> Internal controls in vehicle cab	_____
<input type="checkbox"/> Lights	_____

Sanding & Salt Brine Equipment—Inspect each item annually before winter operations begin November 1st.

<input checked="" type="checkbox"/> Item inspected	Remarks and comments
<input type="checkbox"/> Mounts and brackets	_____
<input type="checkbox"/> Chains, conveyors and spinners	_____
<input type="checkbox"/> Hydraulic hoses and fittings	_____
<input type="checkbox"/> Lights	_____

Please use the back of this form for any additional comments or observations.

Salt Brine Mixing & Applicator Loading Operation Manual

Salt Brine Mixing & Applicator Loading Operators Manual

Making Salt Brine

1. Close all valves on salt brine machine .
2. Close valve #2 and open #1.
3. Fill salt hopper.
4. Open valve #6, 7, 10, 12 to allow water into the hopper .
5. Fill the machine to within one (1) foot of the top of the machine holding tank, checking the salt brine concentration as it fills.. Close valve #12 once you reach within one (1) foot. **Do not overfill.** You need to obtain a 23.3% salt brine mixture.
6. Once 23.3 % is reached transfer to holding tank.
7. To lower salt content follow the procedure for adding water.
8. If salt needs to be added follow the procedure for adding salt.

Lowering Salt Concentration In Brine

1. When the salt content in the brine exceeds 23.3% add water.
2. Close valves #10 and #12.
3. Open valves #6 and #8. This allows water to enter the machine holding tank.
4. Run water then close valves #6 and #8.
5. Circulate and mix the solution according the procedure below.
6. Measure concentration and repeat if needed.
7. When the concentration is 23.3% pump brine to holding tank.

Increasing Salt Concentration in Brine

1. When the salt content in the brine is less than 23.3% add salt.
2. Close valve #6.
3. Open valves #4, #5, #7, #10 and #12
4. Turn circulating pump on with switch on end of blue cord. **Do not run pump dry.**
5. Run pump for a few minutes
6. Shut pump off and check brine concentration.
7. Repeat if needed.
8. When the concentration is 23.3% pump brine to holding tank.

Circulating and Mixing Salt Brine in the Machine Tank

1. Close all valves.
2. Open valves #4, #5, #7 and #8
3. Turn circulating pump on with switch on end of blue cord. **Do not run pump dry.**
4. Shut pump off and check brine solution for proper concentrations (23.3%).
5. Adjust brine concentration as needed. Follow procedures listed above.
6. Once the proper concentration is done turn the pump off.
7. Close valves #4, #5, #7 and #8.

Transferring Brine to the Holding Tank

1. When the brine concentration is 23.3% transfer the brine to the holding tank.
2. Open valves #13, #14 and #15.
3. On the panel locate the breaker labeled "Pump". Turn it on. **Do not run pump dry.**
4. Do not try to empty the salt brine holding tank.
5. When finished transferring brine, turn the pump off.
6. Close all valves.

Transferring Salt Brine From the Holding Tank to the Truck

1. Hook up hose from valve #16 to the truck.
2. Open valves #13, #14, and #16.
3. On the panel locate the breaker labeled "Pump". Turn it on. **Do not run pump dry.**
4. Do not try to empty the salt brine holding tank.
5. When finished turn the pump off
6. Close all valves.

Circulating and Mixing Brine in the Holding Tank

1. Close all valves.
2. Open valves #14, #15 and #17.
3. On the panel locate the breaker labeled "Pump". Turn it on. **Do not run pump dry.**
4. When finished turn pump off.
5. Close all valves.

Loading Trucks With the Pump

1. Hook up hose from valve #16 to the truck.
2. Open valve #14, #16, and #17.
3. On the panel locate the breaker labeled "Pump". Turn it on. **Do not run pump dry.**
4. When truck is loaded turn pump off
5. Close all valves.

Washing Down and Shutting Down at the End of the Day

1. Close all valves.
2. Open valves #6, #7 and #9.
3. Wash down the salt brine machine and area around the machine with a garden hose.
4. Close valve #9
5. Wash out transfer pump by stretching hose on valve #16.
6. Open valve #6, #7, #10, #11, #14 and #16.
7. Run water for a couple of minutes to wash brine out of the pump.
Note — do not wash out pump and lines if temperature is going to be 32 degrees and falling.
8. Close all valves on the salt brine machine.
9. Close valve # 1 and open valves #2, #6 and #8 to drain water out of salt brine machine.

Transferring to the 5,000 Gallon Holding Tank

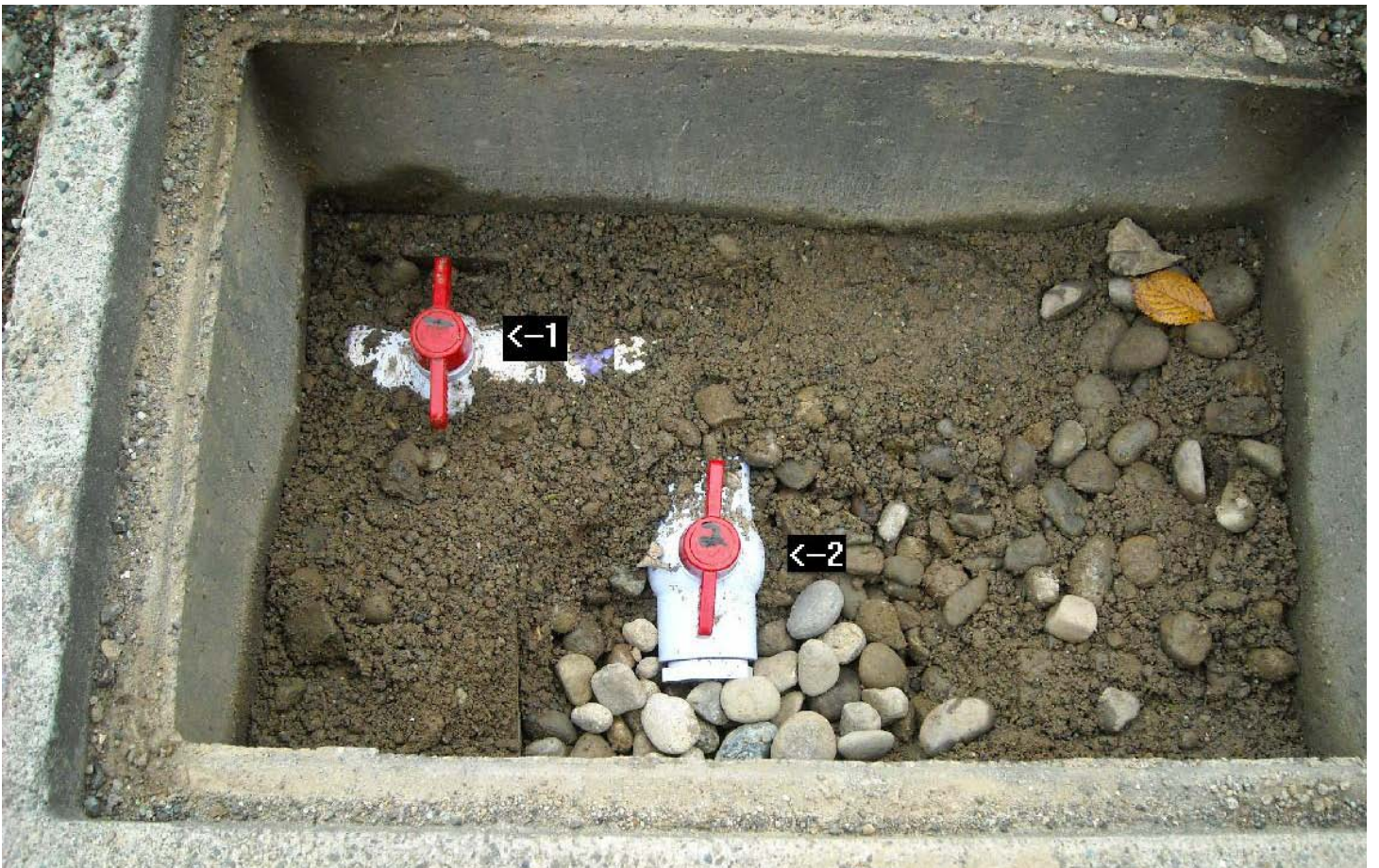
1. When the concentration is 23.3% you can transfer brine into the holding tank.
2. Open valves #13, #14, #19 and #21 .
3. On the panel locate the breaker labeled "Pump". Turn it on. **Do not run pump dry.**
4. Do not try to empty the salt brine holding tank.
5. When finished turn pump off.
6. Close all valves.

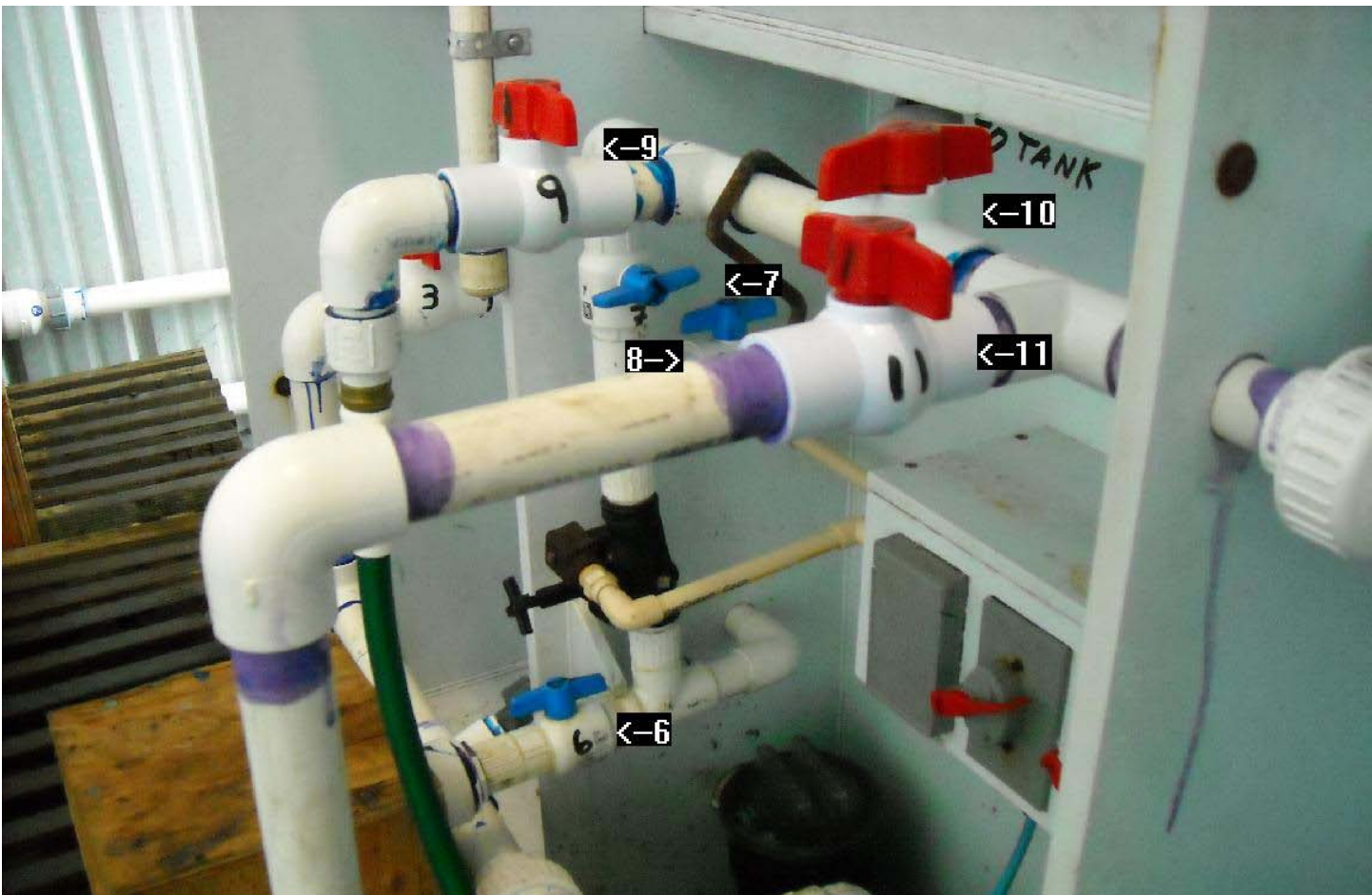
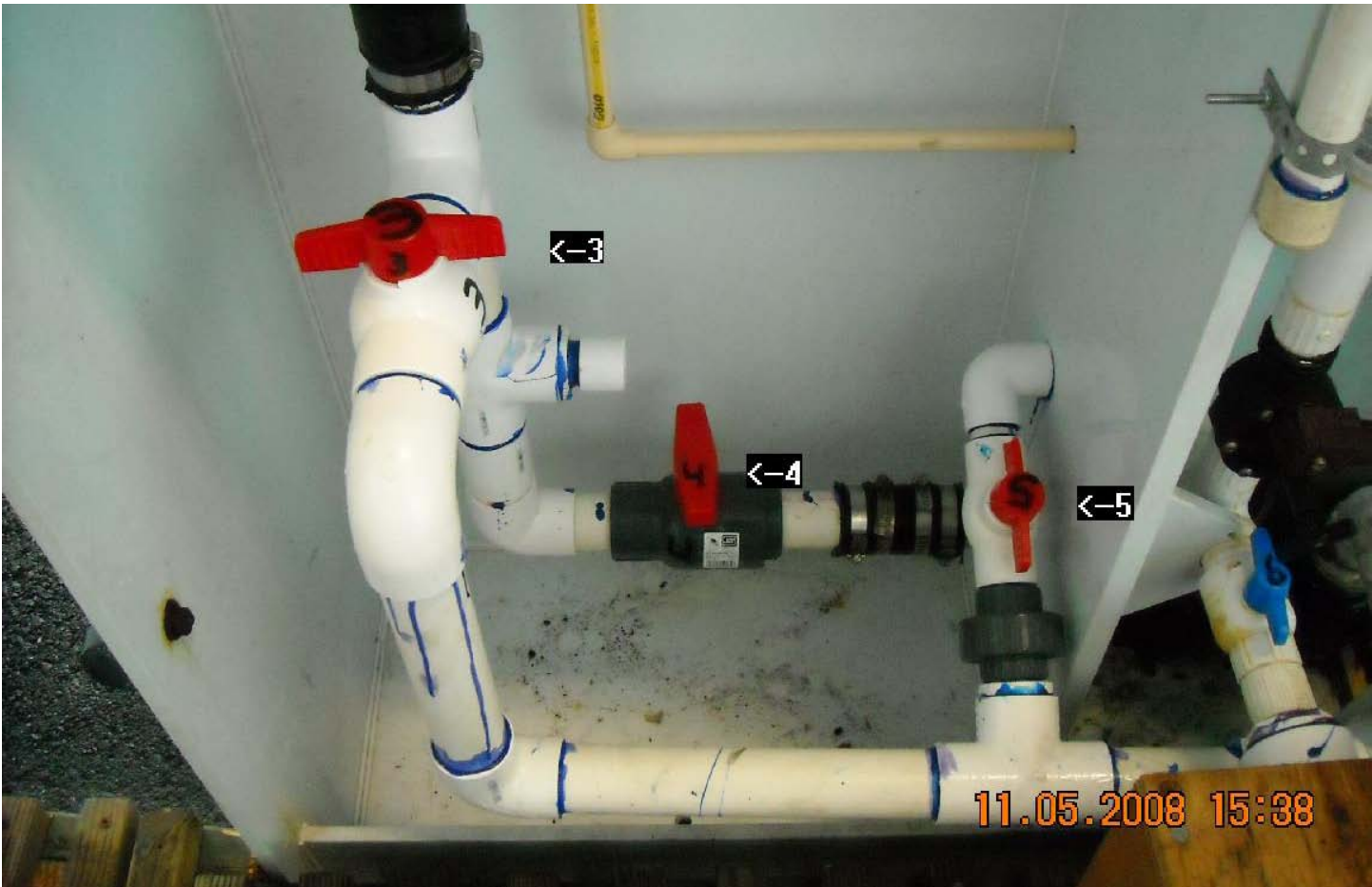
Transferring Brine from the 5,000 Holding Tank to the 10,000 Gallon Holding Tank

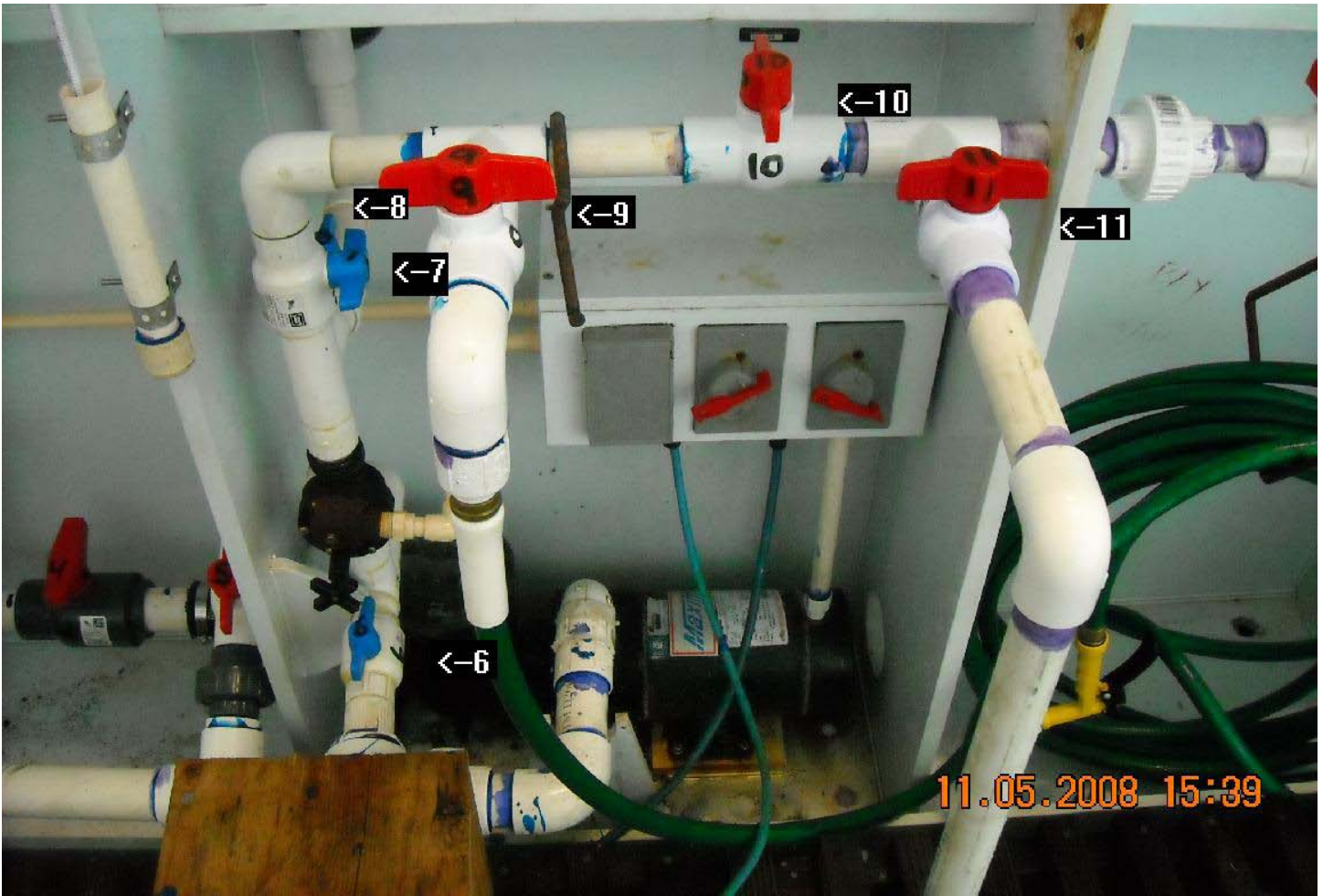
1. Open valves #14, #15, #20 and #21
2. On the panel locate the breaker labeled "Pump". Turn it on. **Do not run pump dry.**
3. Do not try to empty the salt brine holding tank.
4. When finished turn pump off.
5. Close all valves.

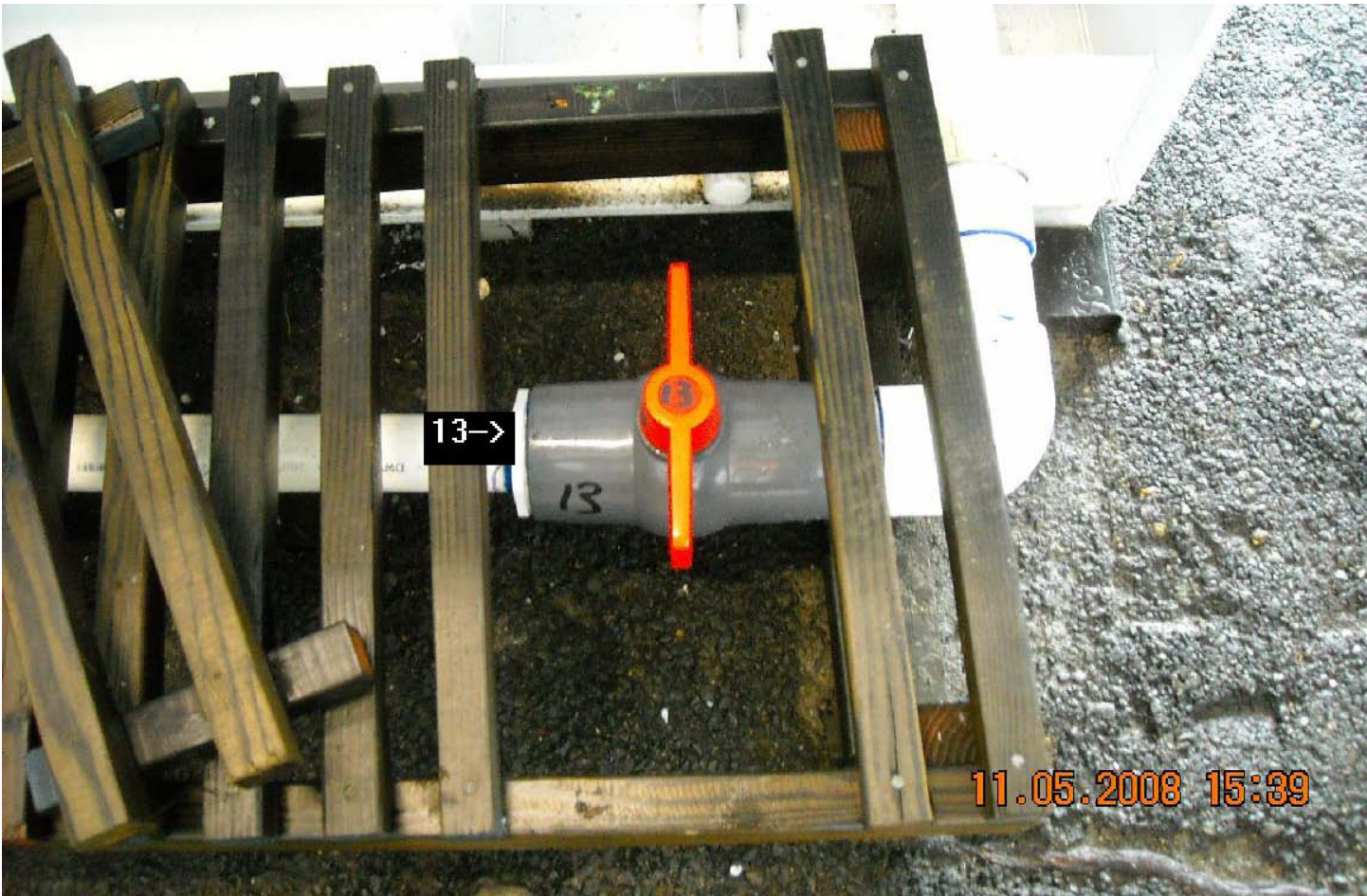
Loading The Truck From The 5,000 Gallon Holding Tank

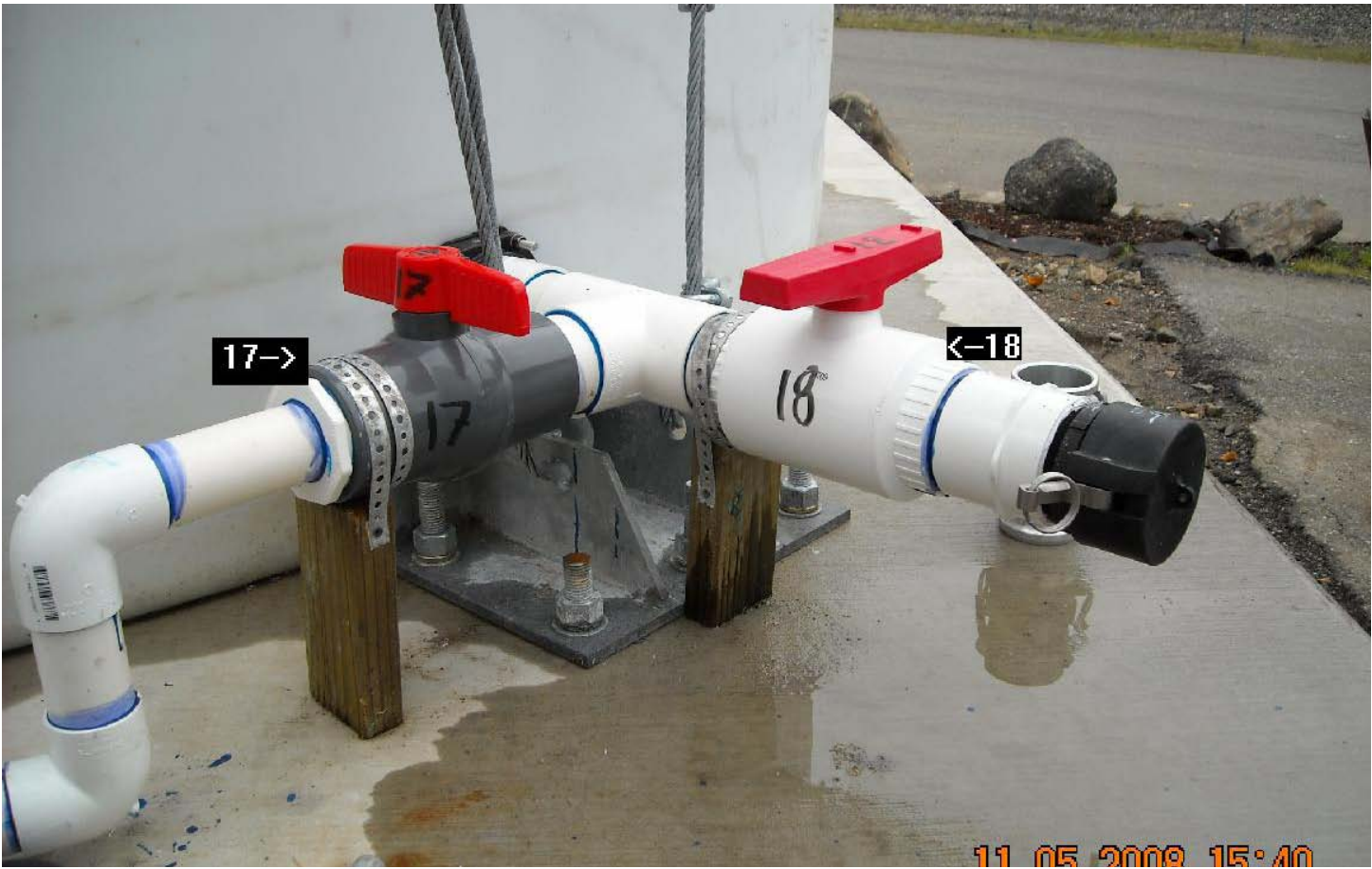
1. Hook up the hose to valve #16
2. Open valves #14, #16, #20 and #21
3. On the panel locate the breaker labeled "Pump". Turn it on. ***Do not run pump dry.***
4. Do not try to empty the salt brine holding tank.
5. When finished turn pump off.
6. Close all valves.













21 on 5000 tank^

2010/10/18