6-201 CLEARING AND GRUBBING

6-201.1 GENERAL

Clearing and grubbing consists of removing objectionable material from the construction areas and right-of-way. On environmentally sensitive projects, the specifications may require the contractor to stockpile material from the clearing and grubbing operation for reuse on the project. A thorough and organized clearing operation can directly affect the project's final appearance. Debris and excess materials left on jobsites can affect maintenance costs. Debris from the clearing and grubbing operation can clog drains or create additional maintenance activities.

6-201.2 BEFORE CONSTRUCTION

The contractor should protect existing roadway improvements, utility facilities, adjacent buildings, fences, and landscaping. The plans and specifications describe the elements to protect during the clearing and grubbing operation. The Resident Engineer should mark improvements or items that the contractor must protect.

The inspector should do the following before clearing and grubbing begins:

- Confirm the appropriate authority has approved the contractor's water pollution control plan. Review the plan to make sure that clearing and grubbing is consistent with the approved plan. Confirm that the contractor has all required environmental permits before work begins.
- Discuss with the contractor the marking of special locations such as environmentally sensitive areas and other specified avoidance areas.
- Before the contractor disposes of material outside of the right-of-way, review Section 107.14 of the specifications to determine the contractor's responsibilities.
- Before the contractor handles any hazardous waste materials, the contractor must contact the Nevada Department of Conservation and Natural Resources, Division of Environmental Protection for specific information and assistance.
- Confirm that the contractor has installed Best Management Practices (BMP) measures before activities begin, and complete NDOT form 040-054, "Weekly NDOT Construction Site Discharge Inspection Checklist."

6-201.3 DURING CONSTRUCTION

Slope staking is completed before clearing and grubbing operations begin on a project. Slope stakes guide clearing operations. The Resident Engineer ensures that the clearing operation limits are sufficiently marked, including areas near drainage structures or other appurtenances.

During construction operations, the contractor is responsible for protecting existing property or areas. To prevent damage to certain property or areas on the project, the contractor may erect protective fencing or other barriers. The contractor can place timbers around existing trees and shrubs to protect the bark from equipment or falling rocks. Unless specifications state that the protective measures are to be paid for, as pay items, the cost of providing protective measures is included in other items of work, and not paid for directly.

For clearing and grubbing operations, contractors may use a variety of equipment. The contractor selects the appropriate types of equipment for each operation. The contractor's equipment must have the required safety devices to protect personnel, and spark arresters to reduce fire hazards.

The inspector should consider the following when monitoring the contractor's clearing and grubbing operations:

- Observe that the contractor's operations do not create hazards. If necessary, require traffic control to provide for safety.
- Monitor adjacent property and environmentally sensitive areas to observe that the contractor's operations do not damage the areas.
- Monitor the contractor's compliance with to permits and agreements. Document any deviations, and inform the Resident Engineer and the contractor of required corrective action.
- Review the specifications to determine if fallen timber or salvaged items are the property of others.
- If the specifications allow burying debris within the right-of-way, confirm the following:
    - Debris will not act as an impermeable layer
    - Debris does not block drainage
    - Debris will not interfere with maintenance
    - Material is not buried within the roadway prism
    - Organic material is not buried within the right-of-way
- Keep accurate records when disposing of solid wastes adjacent to the roadway. Also, show this information on the as-built plans.
- Do not dispose of debris by burning it.
- If necessary, provide a list of incomplete clearing locations in the final project stages.

6-201.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the Construction Division *Documentation Manual*. Keep accurate records of cleared and grubbed areas in the form of sketches and measurements. Make payments only for those areas shown in the plans. If the contractor does not complete the work within one pay period, determine a method of partial payment that provides for payment based on a percentage of work completed.

6-202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

6-202.1 GENERAL

This section provides information about removing structures and other materials within the construction limits. Examples of structures to be removed include buildings, foundations, fences, guardrails, pavements, culverts, curbs, sidewalks, masonry, monuments, manhole and valve covers, and bridges. Some structures may include hazardous materials with specific handling requirements. Removed structures and materials may be disposed or salvaged, depending on the specifications.

Coldmilling is a technique for removing a portion of the asphalt or concrete pavement. Coldmilling (also called rotomilling) involves specialized equipment that removes the material to a desired depth to restore the surface to the grade and slope shown in the plans. Pavement material picked up during the coldmilling process can be recycled for use on the same job or on future projects. When removing surface materials using methods other than coldmilling, the inspector should give attention to the removal method and removal limits identified in the plans and specifications.

6-202.2 BEFORE CONSTRUCTION

Before work begins, the Resident Engineer, inspectors, and the contractor should discuss the work to be performed. These personnel should discuss special situations or details and resolve issues regarding limits of removal, salvage, storage, and disposal of obstructions and materials.

The inspector or survey crew should stake or mark structures and obstructions designated for removal. Structure removal may include coldmilling of concrete and asphalt pavements. The Resident Engineer should coordinate with the contractor for disposal or reuse of the milled materials.

When blasting is necessary to remove obstructions, the contractor prepares a safety plan in accordance with the specifications. Everyone involved with the blasting operation must understand the plan. Although the contractor is liable for damage incurred by the blasting operations, the Resident Engineer and inspectors should point out to the contractor any unsafe or hazardous conditions that might exist.

6-202.3 DURING CONSTRUCTION

Follow these guidelines for disposing of objectionable material during construction:

- Refer to Section 107 of the specifications for procedures when disposing of material outside the right-of-way.
- When disposal areas are within the right-of-way, the specifications will describe the disposal requirements. In addition to the specifications, the material should appear finished and be covered with soil.
- In mountainous areas, be aware that disposal sites above the roadway grade may present sliding or maintenance problems. Before approving disposal sites above roadways, the Resident Engineer should evaluate the potential for slides and maintenance problems.
- Avoid disposing of material in a manner that alters existing drainage patterns.

- When removing concrete pavements, curb, and sidewalk, existing joints are sawcut to provide a clean separation between remaining and removed concrete. The plans and specifications require the contractor to sawcut existing bituminous surface at the limits of removal. The Resident Engineer may modify removal limits based on field conditions.

When removing asphalt by coldmilling, refer to Section 202 of the specifications. The inspector should observe the following additional guidelines:

- Monitor the coldmilling depth to confirm compliance with plans.
- Verify that stockpiles of milled material do not become contaminated.
- Confirm that the contractor disposes of milled materials as stated in the specifications.
- The Resident Engineer may request the contractor to perform additional coldmilling as required by the specifications to remove delaminated areas.
- Discuss coldmilling texture, depth uniformity, delaminations, grade control, cross-slope, transitions, and sawcuts at intersections with the contractor.

Removal of a bituminous pavement from a bridge deck involves removing the bituminous surface while protecting the remainder of the bridge deck. The Resident Engineer confers with the contractor to determine the procedures that the contractor will use. The inspector observes that the contractor exercises care and does not damage the bridge deck.

When removing materials or obstructions for salvage, the plans describe the removal and storage conditions. Store salvaged materials in designated areas.

6-202.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the Construction Division *Documentation Manual*. Sawcuts are typically not measured or paid for, as they are included in other items of work. Painted line removal is measured and paid by the linear foot. Gaps in painted lines are included in the linear foot measurement.

6-203 EXCAVATION AND EMBANKMENT

6-203.1 GENERAL

Excavation and embankment consists of excavating soil or similar material and constructing embankments. More specifically, it may include furnishing, hauling, stockpiling, placing, disposing, sloping, shaping, compacting, and finishing embankment material. This work may also consist of performing slope scaling and placing geotextile fabric as required in the specifications.

6-203.2 BEFORE CONSTRUCTION

Inspection of embankment and excavation operations requires monitoring of several concurrent activities. Effectively monitoring these activities requires the inspector to become familiar with the following:

- Slope staking
- Profile sheets, ditch sheets, and cross sections
- Material sources
- Drainage improvements
- Testing requirements

Before the contractor begins work, the survey crew typically takes cross sections every 1,000 feet to verify the original ground elevations used for the design. In variable terrain, field checks are performed at closer intervals. Cross sections taken before the contractor begins work are useful in resolving disputes relating to excavation quantity.

During the design phase, the Design Division may identify a need for embankment material. When material is excavated, the volume increases because the material is loose or uncompacted. The difference in volume, expressed as a percentage, is called the swell factor. When material is compacted, the volume decreases. This difference in volume is called the shrink factor. Shrink and swell factors are calculated based on soil type.

Shrink and swell factors are listed in the plans. Typically, excavation quantities are calculated based on the amount of embankment required. The amount of excavation is estimated by determining the amount of embankment required, then dividing the embankment amount by the difference of one hundred percent and the shrinkage factor.

When conditions such as unsuitable material are within the project limits, placement of a geotextile or a geogrid may be required. Geogrids and geotextiles are made of synthetic (manmade) material, typically polypropylene. Geogrids are synthetic materials with uniform openings that look like netting. Geotextiles are permeable fabrics manufactured using one of following methods: woven (looks like burlap), non-woven (looks like felt), and heat bonded (looks like ironed felt). A geogrid is used to reinforce soil. Geotextiles are used as follows:

- Separation – the geotextile separates and prevents mixing of two layers of soil having different particle sizes or properties
- Drainage – the geotextile collects water and drains it
- Filtration – the geotextile acts as a filter between soil and a drain material, allowing water and small soil particles to pass through the filter
- Reinforcement – the geotextile provides strength to reinforce soil

Geotextiles and geogrids must conform to the requirements contained in the specifications. The specifications describe the physical characteristics such as tensile strength, stretch or elongation, puncture strength, average opening size, weight, and ultraviolet resistance.

During construction, unsuitable and unexpected material may be encountered. Review the specifications to determine what options are available. If the specifications do not describe options, the Resident Engineer discusses the material type and conditions with the Materials Division.

the contractor intends to use over-sized vehicles, the Resident Engineer can find information regarding over-sized vehicles and permit information at www.nevadadot.com/business/trucker/overdimensional/. Use NDOT form 040-000, "Vehicle Weight Limit," to record dimensions of the contractor's vehicles to verify that they do not exceed legal limits.

Contractors typically use scrapers and motor graders to excavate roadways and large ditches. On projects with significant excavation, dozers may push scrapers to increase the scraping depth. Scrapers are particularly adapted to granular materials, softer grades of rock, and long hauls with flat to mild grades. Scrapers are also used on new alignments where accommodation of existing traffic is not an issue. Trucks loaded by shovels or loaders are used when material must be hauled on existing roads or streets, or when haul distances are very long and are regulated by weight restrictions.

Many types of compacting equipment are available. Common roller types include sheepsfoot, rubber-tired, vibrating, oscillating, grid, segmented, and steel wheel. Some types of equipment handle certain types of material better than other types of equipment. Specifications typically describe acceptable equipment that the contractor may use for compaction.

For various soil types, the contractor selects the appropriate equipment, such as the following:

- Steel wheel roller (vibratory or non-vibratory) – For granular materials, the contractor may use vibratory steel wheel rollers. The vibratory roller effectively compacts clean, granular soils containing little or no clay particles. The vibratory roller can vibrate a uniform, granular soil to high density. The vibratory roller becomes less effective, however, as the amount of clay particles increases.
- Sheepsfoot roller – These most effectively compact clays and silts. They work well in cohesive soils, but will compact most soils containing granular material if the soil contains a reasonable proportion of cohesive material. Tamping foot and sheepsfoot rollers can operate in only about a 6-inch lift because of the length of their feet (protrusion) from the drum. In thicker lifts, the drum will ride on the surface of the loose soil and the feet will not reach into and compact the lower portion of the lifts. Tamping foot and the sheepsfoot rollers are not effective in compacting clean sands and gravels.
- Pneumatic tired roller – This is capable of effectively compacting soils that contain fine materials with clay particles. Pneumatic rollers apply a kneading action on the material, which can increase the compactive effort.

Figure 6-203.1. Steel Wheel Vibratory Roller.

Figure 6-203.2. Sheepsfoot Roller.

Figure 6-203.3. Pneumatic Tired Roller.

Slopes are usually finished with motorized equipment. The type of equipment varies depending on slope steepness, access, type of material, and availability of equipment. Although the type of equipment used is the contractor's decision, it must produce acceptable results.

The success of constructing an embankment depends on the proper preparation of the foundation. Specifications may describe requirements, such as benching, related to constructing embankments. The inspector should monitor construction of embankment to confirm that slippage planes, areas of soft materials, and water in the form of springs or seeps are addressed. Identifying possible problems and discussing them with the contractor before work begins can reduce disruption during construction.

Blasting, which loosens solid rock outside of the planned slopes, requires strict adherence to safety measures because of the potential for flying debris and slides. Before blasting takes place, the contractor must comply with the requirements of the specifications. If a blasting plan is required, the Resident Engineer reviews and accepts the plan.

On projects that require shaping slopes or removing rock debris, review the requirements described in the specifications. Depending on the complexity of the slope scaling, a contractor may be required to submit qualifications to perform the work. In addition to providing qualifications, a contractor may be required to submit a work plan or fulfill other requirements as described in the specifications. Review ingress and egress to work areas, haul routes, and traffic control requirements with the contractor.

6-203.3 DURING CONSTRUCTION

6-203.3.1 ROADWAY EXCAVATION

During roadway excavation, periodically check for proper elevations, depth of excavations, and conformance to the typical sections shown in the plans. The inspector should compare the actual construction and the grade stakes with information contained in the plans, especially at intersecting roads, approaches, and driveways. Monitoring the amount of completed excavation provides for scheduling of surveying.

6-203.3.1.1 UNSUITABLE MATERIAL

During roadway excavation, unforeseen conditions, such as unsuitable materials, may be encountered. Unsuitable material is any material that adversely affects roadbed stability. Preliminary investigations may identify materials as being unsuitable for roadway construction. The plans and specifications identify these areas and the measures that the contractor should take. The Resident Engineer should contact the Materials Division Geotechnical Section for direction when the specifications do not address unsuitable materials. The Resident Engineer directs the contractor to remove and dispose of unsuitable material encountered, even though not originally planned or anticipated. After consulting with the Materials Division, the Resident Engineer directs the contractor on the limits of removal.

Material that is unsuitable because of high moisture content may be satisfactory for use in embankments after it has dried. When backfilling areas that contained saturated material, the contractor may be required to install a seepage outlet or to place perforated drains.

Before removing unsuitable material that is not shown on the plans or described in the specifications, determine the payment method for excavation and disposal.

6-203.3.2 DRAINAGE AND CHANNELS

When a drainage channel is modified, maintaining alignments of existing channels inside and outside of the NDOT right-of-way is important. New or modified channels may increase the potential for erosion, either by changes in flow direction or by increasing flow velocities because of increased grades. After ditch construction, assess the ditch's ability to pass runoff without causing erosion or other damage. If the Resident Engineer determines that a ditch may cause erosion, the Resident Engineer should confer with the Roadway Design Division Hydraulics Section.

6-203.3.3 BORROW

If the material excavated from a roadway is insufficient to construct an embankment, the additional material is called borrow. Borrow material can be either excavated from a location on the jobsite outside of the roadway prism or from an off-site material source. If the excavated material is unsuitable for use as embankment, the material is disposed of and borrow material is placed in the embankment. Typically, the specifications designate a borrow material source.

When the excavation is substantially complete, the need for borrow material is confirmed. If additional borrow material is needed, the location where the borrow is to be obtained is cleared and grubbed, and then cross sectioned. Borrow measured in this manner is called borrow excavation. In urban areas, borrow may be obtained from a variety of locations and is measured in-place. Borrow measured in this manner is called borrow embankment.

If final measurements are necessary, the site is cross sectioned again to determine the volume of material excavated. Although quantities shown in the plans may be used for payment, the Resident Engineer may use or the contractor may request payment based on quantities calculated from initial and final cross sections.

6-203.3.4 SURPLUS MATERIAL

If a project requires excavation of more material than can be used in the embankment, the excess is called surplus material. As soon as possible, the Resident Engineer should reconcile preliminary quantity calculations, including shrinkage and swell factors, with actual quantities and factors. Deviations may require wasting of material, adjustments in haul, or adjustments in grade or alignment. When wasting surplus material, the Resident Engineer should consider flattening slopes to provide additional recovery areas for vehicles.

Plans typically direct the contractor to place surplus material alongside an embankment, between embankment and right-of-way lines, or in interchange areas, if such areas are available. The contractor should dispose of surplus materials in areas that will not interfere with drainage, will benefit future improvements, or will improve the appearance or stability of the roadway. Surplus material placed adjacent to an embankment should be compacted. If the plans and specifications do not address the disposal of surplus material, the contractor must dispose of the surplus material at no cost to NDOT.

6-203.3.5 SELECTED MATERIAL

Selected material is typically used for structure backfill, topsoil, or for other purposes shown on the plans. Selected material must meet requirements of the specifications. The contractor must not use selected material for any purpose other than that designated in the plans and specifications unless approved by the Resident Engineer.

6-203.3.6 SLIDES AND SLIPOUTS

Slides and slipouts are unplanned earth movements. When these movements occur, the Resident Engineer may require the contractor to excavate and remove material. Potential slides may be stabilized by installing horizontal drains or underdrains, or, in the case of small slides, by constructing bulkheads or retaining walls. Benches may be constructed in the slide area to reduce the potential of falling material.

When a slide or slipout has occurred, corrective action or resloping a slide area may be required. To determine corrective actions, the Resident Engineer should confer with the Materials Division Geotechnical Section for guidance. Resloping normally occurs incrementally during slide removal. During resloping, the Resident Engineer should determine if minor slippages appear probable. If slippages appear probable, then resloping should be discontinued until the slope is stabilized.

6-203.3.7 FOUNDATION FOR EMBANKMENT

The inspector should monitor construction of the embankment foundation to verify proper preparation. Following are conditions that may require corrective measures for a proper foundation:

- Proper compaction of the original ground
- Drainage seepage
- Springs
- Lush growth of vegetation in local areas, indicating ground water
- Trees and brush leaning downhill, indicating slippage of the surface mantle
- Rolling terrain
- Twisted trees or lack of vegetation in otherwise timbered areas, indicating a large slide

Following are common causes of embankment failure and possible corrective measures:

- The weight of the embankment displaces or consolidates material in the foundation. Possible solutions are as follows:
    - If economically feasible, remove plastic material in the foundation.
    - Construct fills adjacent to the embankment as a counterweight that would resist upward movement of foundation material next to the embankment.
    - Construct embankment at a controlled rate so that settlement occurs over an extended period, allowing hydrostatic pressures to dissipate.
    - Construct a surcharge, such as additional embankment, on the completed embankment to accelerate settlement.
    - Construct vertical sand drains to facilitate drainage of water from the foundation.

- The embankment traps water in the foundation which forces the water to escape at the edges of the embankment, causing sloughing of the embankment. Possible solutions are as follows:
  - Install a filter material over the embankment area to allow drainage.
  - Construct a ditch or underdrain on the high side (up-gradient) of the embankment to intercept water.
- The embankment moves on a slippage plane in the underlying foundation. Possible solutions are as follows:
  - Construct a stabilization trench through the slippage plane.
  - Install horizontal drains to drain water from the slippage plane.
  - Construct buttress fills to support the embankment.

The Resident Engineer should confer with the Materials Division Geotechnical Section for guidance on embankment failures.

When embankment material contains scattered boulders, the contractor should distribute the boulders throughout the fill. Rock fills are constructed with a bulldozer to manipulate the rock into a compact mass. The contractor should water boulders and rock fills to wash fine material into the voids. In swampy or marshy areas, uncompacted thick layers of rock are placed across the area to act as a bridge over the marshy area. Typically, the contractor installs settlement-measuring devices in large embankments or surcharge areas and the Resident Engineer's survey crew monitors the settlement. The Materials Division usually directs the placement of settlement measuring devices.

If embankment settlement is anticipated, the survey crew should offset slope stakes to allow for the anticipated settlement. After settlement occurs, the offset slope stakes remain valid for the settled embankment. .

6-203.3.8 COMPACTION

Compaction directly affects the ability of soil to support vertical forces such as soil, water-bearing soil, and traffic loadings. Insufficient compaction reduces the supporting strength needed for subsequent layers. The contractor can use a variety of methods to achieve the required compaction. The inspector should not direct the contractor's compaction operation. However, the inspector should monitor the thickness of the material layer placed by the contractor to verify that the contractor does not exceed thicknesses allowed by the specifications. Refer to Table 5.1 in Section 5, Sampling and Testing, of this *Construction Manual* for testing requirements.

Successful compaction depends on uniform moisture content in the material. The contractor may do the following when working with soil and moisture:

- Some soil materials do not mix with moisture as easily as others do. The contractor may mix or manipulate the soil and water with a bulldozer, disk, or motor grader.
- The contractor may use chemical wetting agents. Because wetting agents are expensive, contractors do not use them extensively.
- Contractors may apply water during excavation to improve the mixing of water and soil. Applying water during excavation provides additional mixing time during excavating, loading, unloading, and placing of the material.
- When experiencing soil moisture difficulties, the contractor mixes soil and moisture and then compacts the mixed material in thinner layers.

In confined areas, the contractor obtains compaction by watering and using small manual or motorized compaction equipment such as hand tampers, vibrating hand compactors, small hand-operated motorized rollers, or impact-type compactors. For rock fills, the contractor may use the proof rolling method for compaction. Proof rolling is repeatedly driving over the fill with a loaded truck, heavy equipment, or roller until no deflection is observed in the surface of the material being compacted. The specifications describe acceptable methods of proof rolling. The Resident Engineer should not allow proof rolling unless the material has a significant quantity of rock greater than four inches.

When haul vehicles travel over the embankment material, the contractor should stagger the vehicle paths so that as much of the fill area as possible is compacted. .

6-203.3.9 SLOPE SCALING

Slope scaling is the process of removing loose rock debris from a slope. Slope scaling can be the first step in stabilizing a slope from further rock debris accumulation. Rock debris can create an unsafe condition for traveling motorists due to the potential for falling rocks. Scaling is performed with hand tools or power tools such as jackhammers, hydraulic splitters, drills, crowbars, pry bars, jacks, and shovels. Heavy equipment is used when hand tools are inadequate. Blasting removes larger wedges of fractured material and overhanging cemented soils, but may be used only with prior approval. Caution is taken to prevent over steepening of the slope face, which may make the slope unstable.

The specifications require the contractor to provide the Resident Engineer qualifications and submittals at least 30 days before slope scaling operations begin. Review the specifications for qualification and submittal requirements. The Resident Engineer should consult with the Materials Division Geotechnical Section to understand the intent of the slope scaling project. Additionally, the Resident Engineer invites a representative from the Materials Division Geotechnical Section to the preconstruction meeting.

Slope scaling begins at the top of the slope and proceeds down slope, removing rock. The contractor removes or stabilizes material on the slope face that is loose, hanging, or creating a dangerous situation. Qualified scalers perform slope scaling. Scalers are workers that traverse the face of a slope while attached to ropes.

If the potential exists for damage to the roadway during scaling operations, the contractor must use protective mats or a soil cover on the roadway for protection. Before work begins, the contractor must obtain approval to place a temporary protective barrier at the near edge or center of the roadway. This barrier prevents the slope material from reaching the travel lane that is open to traffic. The contractor must maintain this barrier during slope scaling operations. The contractor bears the costs for repairing any damage to the roadway. The contractor reshapes ditches after work is complete so all water drains freely. The contractor must clean debris from the roadway before traffic is returned to the roadway.

6-203.3.10 GEOTEXTILE

When geotextiles are specified to address unsuitable soil conditions, the inspector must verify that the material delivered to the project conforms to the requirements of the specifications. Verify that the certificate of compliance that accompanies the geotextile delivered to the site complies with the specifications requirements. The contractor must stockpile geotextile fabric in a manner that protects it from moisture and sun exposure. If the fabric is stored outdoors, the geotextile rolls must be stored off the ground.

Prior to placing geotextiles, the inspector should confirm that the surface that receives the geotextile has been properly prepared. The surface should be smooth and free from cavities, large stones, or other irregularities that could puncture or damage the geotextile.

Geotextiles are placed by unrolling the fabric onto the surface. Adjacent pieces of geotextile may be joined by sewing or by overlapping. Contractors typically overlap geotextiles. The inspector should review the specifications to identify seam or overlap requirements. Prior to placing material over the geotextile, confirm that the geotextile is smooth and without gaps, tears, folds, wrinkles, or stretching. Do not operate equipment on the exposed geotextile.

Overlying material is placed on the geotextile by dumping from the edge of the geotextile or from previously placed lifts. The contractor must exercise care during placement of overlying material to ensure that the geotextile is not damaged. To protect the geotextile from damage, the contractor may reduce the size of the equipment used to place the overlying material or reduce the size of the loads being placed on the geotextile. Damaged geotextile must be repaired or replaced before material is placed on it.

6-203.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*. Following is additional measurement and payment guidance:

- Removal of unsuitable material – For unsuitable material that is not shown in the plans or specifications, determine the method of payment for excavation and disposal:
  - If payment will be at contract prices, record measurements for calculating quantities.
  - If the contractor requests payment to be made as extra work, obtain the request in writing. Prepare and process a contract change order or a Letter of Authorization (LOA), and keep the necessary records relating to extra work.
- Extra work – Section 104.03 of the specifications provides guidance for payment as extra work for such operations as disposal of unsuitable materials or widening cuts by special equipment or other unusual operations.
- Drainage and channels – Channels are ditches with a width of 12 feet or more and are located outside the roadway prism. Excavation of channels is measured as channel excavation because they can be excavated with common earth-moving equipment. Excavation of ditches with bottom widths of less than 12 feet is measured as drainage excavation.
- Slides and slipouts – Payment as force account for slide removal may be the equitable solution and may help to avoid controversy with respect to excavation, pioneering, and resloping. Payment for resloping is made when the slide occurs in a cut that was previously sloped. The removal process is similar to other roadway excavation procedures. Payment for slipout removal is the same as payment for slide removal, typically either by load counts or by volume balance amounts.
- Borrow embankment – The quantity for payment is the quantity shown in the plans plus or minus any authorized changes. If the contractor disputes the quantity and requests final measurement, cross sections are taken to determine the actual borrow embankment quantity. If the final quantity is less than the quantity shown in the plans, the contractor reimburses NDOT for the cost of the final measurement.
- Borrow excavation – The quantity for payment is measured at the source of the excavation. Cross sections are taken before and after the excavation to determine the quantity.
- Slope scaling – Slope scaling is measured and paid by the cubic yard of material removed. To establish a method of measurement for the quantity of material removed by slope scaling, the inspector determines the capacity of the hauling vehicles. The inspector should coordinate with the contractor to reach an agreement on the hauling vehicles capacities. The inspector monitors the loading of the hauling vehicles to confirm that the vehicles are filled to the same level for each load. Any safety measures, protective barriers, blasting, drilling, material haul, and disposal costs are considered incidental to the payment for material removed and are not paid for separately.
- Geotextile – Geotextile fabric can be either measured and paid by the square yard of placed geotextile fabric or may be considered incidental to other items of work. When measured by the square yard, only the coverage area is measured. Material that overlaps is not measured for payment. When considered incidental to other items of work, there is no additional payment for geotextile fabric.

6-206 STRUCTURE EXCAVATION

6-206.1 GENERAL

Structure excavation is the removal of materials to accommodate the construction of structures such as culverts, drainage structures, abutments, and footings.

6-206.2 BEFORE CONSTRUCTION

Before excavation begins, the contractor must submit a safety plan to the Resident Engineer that includes detailed shop drawings of any shoring, cribbing, sloping, or other protective systems that conform to the Occupational Safety and Health Administration (OSHA) regulations.

At least two weeks before excavation begins, coordinate with the contractor to reduce possible problems regarding measurements for payment. The contractor may excavate outside of the excavation limits shown in the plans, at no cost to NDOT, but the contractor cannot excavate to less than the prescribed limits because of possible interference with backfill or testing operations.

6-206.3 DURING CONSTRUCTION

Observe excavation operations as they progress so alterations or changes can be made without causing delays. Observe safety procedures during excavation and throughout the installation process. Payment for additional excavation is allowed only with prior approval of the Resident Engineer.

Inspect excavation depth and verify that the compaction of the excavation floor meets the requirements of the specifications before the contractor constructs or installs the structures.

6-206.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*.

6-207 BACKFILL

6-207.1 GENERAL

Backfill includes placing and compacting material in excavations for bridges, retaining walls, headwalls, culverts, and other structures. Requirements for backfill materials are listed in the specifications. Improper backfilling can cause future failures of culverts or structures. .

6-207.2 BEFORE CONSTRUCTION

Before backfill activities begin, the inspector should review the locations where culverts and other structures require backfill. The inspector should be aware of the different types of backfill, such as backfill from the excavation, granular backfill, or slurry cement backfill, and review the specifications to determine which one the contractor is to use. The use of “pea gravel” is prohibited. The contractor may stockpile approved backfill material near the structure site where the backfill material is to be used.

The inspector should coordinate with the contractor for efficient inspection and testing activities. The inspector should confer with the testers to verify that the backfill material meets specifications before it is used. The inspector should confirm the source for backfill material has received source acceptance from the Materials Division.

6-207.3 DURING CONSTRUCTION

Place backfill uniformly on all sides of the structure. Unequal backfilling may push the structure out of line or subject it to stresses. The inspector should be aware of the maximum allowable placement depth of each layer, typically eight inches, and observe that the contractor adheres to the specification requirement. The inspector should closely monitor the compaction operations. Although it is difficult for the contractor to compact backfill under the pipe haunches, compacted material under the haunches is necessary to support the pipe. Additionally, the contractor should not over-compact the backfill, which can lift the pipe out of position. Compaction testing is performed consistent with requirements of Table 5.1 in Section 5, Sampling and Testing, of this *Construction Manual*.

6-207.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*.

6-208 FOUNDATION FILL

6-208.1 GENERAL

Foundation fill is placed in excavated areas to establish a stable foundation for culverts, bridges, and other structures. Foundation fill replaces material that is unsuitable as foundation material. The specifications contain requirements for foundation fill material.

6-208.2 BEFORE CONSTRUCTION

Review the plans and specifications to determine requirements and locations for foundation fill. Coordinate with the contractor to establish a clear understanding of the foundation fill requirements. Coordination with the contractor can make inspection and testing duties more efficient.

6-208.3 DURING CONSTRUCTION

If the plans do not provide for the use of foundation fill and the Resident Engineer determines that foundation fill is required, the Resident Engineer should consult with the Materials Division. The inspector monitors excavation activities for necessary corrective actions. Occasionally, the floor of an excavated area that is to receive foundation fill is soft or spongy. The contractor should remove the unsuitable soil and place foundation fill in the excavated area. The contractor then compacts the foundation fill to the density stated in the specifications.

6-208.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*.

6-209 DRAIN BACKFILL

6-209.1 GENERAL

When water is encountered below grade, trenches are constructed to intercept and remove water from the embankments or excavated areas. Typically, these trenches contain perforated pipes that allow groundwater to enter the pipe and flow from the area. The gradation of drain backfill allows water to pass through the backfill and enter the pipe. These trenches often involve considerable quantities of excavation, drain backfill, geotextile, and perforated underdrain pipe.

6-209.2 BEFORE CONSTRUCTION

Review the plans and specifications to determine locations and requirements for drain backfill. A thorough understanding of the trenching and backfill requirements helps to reduce problems during construction. Refer to Section 6-607, Underdrains, for additional information regarding trench construction and materials placement.

6-209.3 DURING CONSTRUCTION

Drain backfill allows water to drain from the surrounding soil and enter the underdrain pipe. Therefore, to ensure a fully functioning underdrain, the backfill requires a specified gradation, adequate compaction, and proper trench bedding. The contractor may need to remove water from the trench during construction to allow equipment and laborers to construct the drainage system properly.

6-209.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*.

6-210 WATERING

6-210.1 GENERAL

Watering consists of furnishing and applying water for all of the project needs. Developing a water supply can include arranging for obtaining water from a fire hydrant, digging a well, or constructing a reservoir. Developing a water supply can also include constructing a pumping station, installing pipelines throughout the project, and installing or constructing storage facilities, such as tanks or ponds. The water supply must be capable of supplying sufficient water during high demand periods and remain functional for the duration of the project.

6-210.2 BEFORE CONSTRUCTION

For the supply of water, the contractor must negotiate with the owner of the supply and provide the Resident Engineer with a copy of the agreement. When the contractor drills a well or uses an existing well for roadway construction purposes, the contractor must complete a request for waiver as described in the specifications. The waiver request is submitted to the Nevada Division of Water Resources using forms found at the Division's website, http://water.nv.gov. The Resident Engineer confirms that an approved request for a water well waiver is on-site during drilling operations. If the water source is surface water, such as a lake, pond, or river, and has a current permit from the Nevada Division of Water Resources, the contractor must submit an application to change the place of diversion, manner of use, or place of use with the Nevada Division of Water Resources. If the surface water has not been permitted, the contractor must make application to appropriate the water through the Nevada Division of Water Resources.

Regardless of the water source, water samples are necessary to confirm that the water quality meets requirements for its intended use as described in Section 722 of the specifications.

6-210.3 DURING CONSTRUCTION

Water supplied by the contractor is used for compacting or processing material, and controlling dust. Based on how the water is used, the specifications will describe requirements.

When a waiver is issued by the Nevada Division of Water Resources, the contractor must comply with the conditions contained in the approved waiver, such as monitoring water usage, limitations on water pumping, and plugging and abandoning the well upon completion of the use of the well. The Resident Engineer must monitor the contractor's compliance with the specifications and the conditions of the approved waiver.

6-210.4 MEASUREMENT AND PAYMENT

The cost of developing a water source and supplying water is included in payment for other items of work. No separate payment is made.

6-211 EROSION CONTROL

6-211.1 GENERAL

Erosion control consists of construction or installation of permanent pollution and erosion control measures. These measures reduce air pollution, erosion, sedimentation, and pollution of water and wetlands that a completed roadway project can cause. Pollution control measures related to construction activities are contained in Section 6-637, Pollution Control.

Erosion control measures properly applied are key elements in preventing water and air pollution. Erosion control measures can also reduce sedimentation. The success of erosion control measures often depends on the time of year that they are applied.

6-211.2 BEFORE CONSTRUCTION

The contractor obtains topsoil from sources listed in the specifications. If the specifications do not designate a source, the topsoil must conform to the requirements in the specifications. If required, top soil is sampled by the Resident Engineer's tester and submitted to the Department of Agriculture for testing. The Resident Engineer reviews the test results to confirm that the top soil conforms to the requirements of the specifications. The contractor must use seeds and fertilizers that are packaged and show content analysis. The contents on the packaging, or certification of the seed or fertilizer, must conform to the requirements in the specifications.

6-211.3 DURING CONSTRUCTION

The specifications explain how to prepare for and apply products. Uniformly spread topsoil or compost at the specified rate or depth.

During seeding, the contractor must follow the manufacturer's recommendations.

Refer to Section 6-212, Landscaping, for additional information about planting and fertilizing.

6-211.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*.

6-212 LANDSCAPING

6-212.1 GENERAL

Landscaping consists of preparing areas for planting; applying pesticides and fertilizers; and furnishing, planting, and maintaining plants. The Resident Engineer should adjust the locations of shrubs and trees to avoid obstacles whenever possible. Generally, mature trees are placed more than 30 feet from the traveled way if they will grow to or have a diameter of four inches or more. Landscaping is placed to meet the intended look and purpose, as planned by the landscape designer. The inspector should be aware of the appearance and purpose of the landscape design. The landscape designer should be contacted to determine what changes may be acceptable, if changes are needed.

6-212.2 BEFORE CONSTRUCTION

The Resident Engineer must determine if container grown plants furnished by the contractor are acceptable and meet the requirements of the plans and specifications. They can make this determination by visual inspection after removing the plants from the containers. The inspector should consider the following information when evaluating container grown plants:

- Accept small plants if they have developed roots sufficient to hold a ball of earth together when removed from the container.
- Reject plants that are damaged or pot-bound.
- Reject plants that have not been properly cared for.
- Confirm that the contractor stores containerized plants in a protected and shaded area.
- Monitor plants to confirm the contractor keeps plants moist at all times. The ball of earth around the plant roots must be wet at all times. Plants in containers are more exposed to wind and heat and dry out more readily.
- The contractor should only remove plants from the container when planting.
- The contractor should cut back container grown plants as necessary to encourage plant growth while being stored in the storage area.

Refer to the specifications and the planting details in the plans for additional information on how to protect potted plants. Contact the landscape designer regarding questions related to planting.

6-212.3 DURING CONSTRUCTION

6-212.3.1 PREPARATION

Planting success depends largely on the preparation of the planting areas. Planting is easier if the contractor eliminates weeds and noxious grasses while the planting areas are easily accessible and before any planting begins. After planting, the contractor should control weed growth during the plant establishment period.

Except on slopes, follow this common planting process:

- Dig the planting holes for container grown plants. Dig to the required depth below the bottom of the completed basin.
- Mix the fertilizer with the backfill material in the planting hole. Thoroughly mix the fertilizer with the backfill material to the full depth of the planting hole.
- Saturate the mixture before constructing the basin and basin walls to the specified size. Thoroughly saturate the backfill mixture to the depth of the drilled hole. Occasionally, when planting slope areas, the basin is formed first.

The Resident Engineer determines which rocks to remove. Typically, only large rocks that will interfere with planting operations are removed from the planting area.

6-212.3.2 PLANTING

Construct basins and basin walls to the planned dimensions before planting. After the backfill material is saturated in the planting holes, the inspector should observes that the material has settled and that it retains sufficient moisture before the contractor places the plant in the basin.

Do not allow clods, rocks, or lumpy materials in the backfill. The contractor should not tamp or compact the backfill around the plant roots. Tamping or compacting around the plant root inhibits the natural penetration of water around the plant.

The contractor must plant trees and shrubs before ground cover plants and turf. To prevent unnecessary compaction of the soil, the contractor must keep foot traffic to a minimum after planting ground cover plants.

The contractor should follow these guidelines when planting trees:

- Securely stake and tie trees as soon as possible after planting. If trees are not staked immediately after planting, the wind tends to shift and move the trees and damage them.
- Place ties sufficiently high on the tree to contain the major portion of the top growth.
- Do not damage the plant ball when driving stakes.
- Place the mulch, if required, as soon as possible after planting to retain moisture and discourage weed growth. An exception is during extremely wet weather when trampling the areas while placing the mulch would compact the soil and the mulch would hold excessive moisture around the plant.

6-212.3.3 WATERING

With the initial watering, the inspector should closely monitor the amount of water applied, and the manner in which it is applied. The contractor waters most plants immediately after planting them. Following the initial watering, the contractor must water all plants and planted areas as often as conditions require. Ultimately, the contractor should keep the plants in good growing condition through the time of final acceptance. This time is referred to as the “plant establishment” period, which is a one year period. During the plant establishment period, the inspector completes NDOT form 040-046, “Monthly Summary of Plant Establishment”. Refer to the specifications for additional requirements related to the plant establishment period. The Resident Engineer should not direct the contractor on watering activities. However, the Resident Engineer should advise the contractor if the plant conditions deteriorate and watering might correct the condition.

6-212.3.4 INSPECTION

The inspector should inspect planted and stored plants weekly. Mark unhealthy plants for removal, and inspect replacement plants before planting. Coordinate final inspection with the contractor. The Resident Engineer should coordinate attendance of the landscape designer and the District landscape maintenance supervisor.

The inspector should be aware of any requirements for plant establishment and document timeframes to verify specification conformance.

6-212.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*. for landscaping.

6-213 IRRIGATION SYSTEMS

6-213.1 GENERAL

Irrigation systems are installed to apply water to roadway landscaping. The specifications provide detailed requirements for irrigation systems. After installation and acceptance by NDOT, the Resident Engineer should provide NDOT maintenance personnel or the entity responsible for operations of the system with operating manuals, brochures, and “as-built” drawings from the contractor.

6-213.2 BEFORE CONSTRUCTION

The inspector and the contractor should review the irrigation system details. This review provides the inspector with the ability to schedule inspection and testing, and to collect samples or material certificates. The inspector obtains representative samples of pipes and fittings proposed for use in the watering system. In most cases, sprinklers and valves are clearly marked with the manufacturer’s name and model number and are not tested for compliance with specifications. The specifications describe water pipe installation. The plans provide a diagram layout of the watering system. The inspector can adjust the installation as needed to avoid conflicts.

The Resident Engineer coordinates with the District utility inspector who works with the utility companies to obtain power and water for the irrigation system. If water and electrical services have not been completed, coordinate service points and meter locations with the District utility representative. Verify the availability of water in the quantities and the pressure required for the irrigation system.

6-213.3 DURING CONSTRUCTION

The contractor may make adjustments to the irrigation to obtain complete and uniform coverage. These adjustments are made because of variations in water pressure, slope, or size of the coverage area. The inspector should do the following:

- Inspect the installation and location of backflow preventers to verify conformance to the requirements of local codes and to the specifications.
- Inspect the installation of gate valves and unions on each side of the backflow preventer.
- Observe trenching and the placement of conduit and pipe.
- Measure the depths and setbacks of irrigation lines to verify conformance with the plans and specifications.
- Do not allow backfilling until all piping has been inspected, pressure tested, and accepted.

The contractor must locate and repair leaks and repeat the test as many times as necessary to obtain satisfactory test results. The contractor must also refill trenches that have settled below the level of the surrounding area.

6-213.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*. ..

6-214 MAILBOX SYSTEMS

6-214.1 GENERAL

This section includes removal of existing mailboxes, relocation of mailboxes, and installation of new mailboxes. Close coordination with the United States Postal Service and the mailbox owner is important to ensure no disruption of mail delivery service occurs, and to reduce owner complaints.

6-214.2 BEFORE CONSTRUCTION

Before the contractor begins construction activities, the inspector must document the condition of existing mailboxes, including taking photographs. Mailboxes may need to be moved several times during construction. If possible, mailboxes should be set once, at their final location. The contractor, the Resident Engineer, the United States Postal Service, and the owner should coordinate and plan mailbox placement before construction begins.

6-214.3 DURING CONSTRUCTION

Any mailbox relocation for contractor convenience is the contractor's responsibility. The contractor must maintain proper position and access to mailboxes for postal deliveries and owner pick-up. The contractor must coordinate with the United States Postal Service five working days before any mailbox installation or relocation. The contractor should also inform the owner of scheduled removal or installation.

6-214.4 MEASUREMENT AND PAYMENT

Measurement and payment are described in the specifications and the *Documentation Manual*.