

## SECTION 3 – STORMWATER MANAGEMENT AND EARTHWORK OPERATIONS

### 3.1 STORMWATER MANAGEMENT *(Rev. 09-29-20)*

The specifications require the contractor to schedule and conduct its operations to minimize erosion of soils and to prevent sediment from reaching streams, irrigation systems, lakes, reservoirs, etc. The discussion of stormwater management must be included in all pre-construction conferences. Instead of waiting until the final stages of the project, the requirements to schedule seeding and sodding operations should be stressed when discussing these operations with the contractor during progress meetings and as construction progresses .

The Construction Stormwater General Permit or the Indiana Administrative Code Title 327 IAC 15-5 (Rule 5) defines the State's regulations governing storm water management for land-disturbing activities affecting one or more acres. These regulations are the responsibility of IDEM to enforce. Regulation compliance is the responsibility of the contractor and INDOT.

The PE/S should have a thorough understanding of good stormwater management, and the best management practices (BMP) utilized by the Department. The PE/S should also understand the processes by which the Department obtains approval from IDEM to perform construction projects under the Construction Stormwater General Permit or Rule 5 permit and the requirements placed on the contractor for stormwater management by the contract documents.

The Department's stormwater BMPs are defined within the Standard Specifications, the Standard Drawings, the contract plans, and the Department's Storm Water Management Field Guide. The PE/S should review this information to understand the purpose and scope of stormwater control established for the contract. The IDEM Storm Water Quality Manual also provides excellent reference information for review by the PE/S to ensure the project is in compliance with the Construction Stormwater General Permit or the Rule 5 permit. It is advised that the PE/S retain a copy of any permit for review and reference.

#### 3.1.1 Purpose

The purpose of stormwater management is to minimize or eliminate the potential for soil erosion and off-site sedimentation. At its core, stormwater management has two basic processes.

The first core process is erosion control. Erosion control measures are designed to maintain the soil on the ground, to keep the soil within the construction area, and to minimize its movement. Erosion control measures are more cost effective than trying to manage sediment after it has begun to move. Minimizing water or wind produced movement of soils from stockpiles, new embankments or ditch lines would fall within the erosion control category.

The second core process is sediment control. Sediment control measures are designed to slow the movement of water to allow time for sediment particles carried by the water to

settle and drop out of suspension. Sediment control measures are generally more expensive, require more maintenance, and are a less effective stormwater management tool. The management of soil particles moving with stormwater during a rain event would fall within the sediment control category.

### **3.1.2 INDOT's Stormwater Pollution Prevention Plan**

The Department's Environmental Services Section (ES) works with the designer and IDEM to obtain approval to publish the Notice of Intent (NOI) prior to letting a contract that will disturb one or more acres of land. INDOT's designer develops an initial Storm Water Pollution Prevention Plan (SWPPP) to address anticipated land-disturbing activities within the construction limits during the contract. Prior to contract letting, the plan is reviewed by ES, and occasionally by IDEM. Revisions are made as necessary to provide a workable plan that ultimately becomes part of the contract documents.

### **3.1.3 Contractor's Storm Water Quality Control Plan**

Plans are incorporated into the contract to address the anticipated needs for stormwater management during the different phases of the construction contract. However, since INDOT's designer, ES, and IDEM cannot foresee the exact methods and sequence of operations the contractor may use on a given project, the Specifications require the contractor to develop and submit for acceptance a Stormwater Quality Control Plan (SWQCP) to the PE/S describing the sequencing, prosecution, and phasing of the work for each stage of the construction contract. The SWQCP shall be prepared and stamped by a licensed engineer that holds a current certification for a Certified Professional in Erosion and Sediment Control (CPESC), or an approved equal.

INDOT's design developed SWPPP and the Contractor's developed SWQCP shall work in coordination to satisfy the requirements of the Construction Stormwater General permit or the Rule 5 permit.

The SWQCP, or any phase of the SWQCP, shall be submitted 14 days prior to the start of any land-disturbing activities for that particular phase. The SWQCP must address:

- (a) Locations of all proposed soil stockpiles.
- (b) Locations of all proposed equipment storage areas, fueling locations, construction trailers, batch plants, and designated concrete truck washouts.

The SWQCP must also include a written plan for the collection, storage, and disposal of concrete washout waste water. The capacity of the washout containers must be adequate to accommodate the size of the concrete pour. A secondary container shall also be kept on site. The container or pit shall be lined with a continuous sheet of plastic that is a minimum 10 mil thick. The material must be leak free and cannot be overlapped. Soils that are contaminated by spills shall be excavated and disposed of in accordance with 202.08. All costs for work shall be the responsibility of the Contractor.

- (c) Proposed construction sequence and phasing of the erosion control measures. The total number of proposed construction phases must also be specified.
- (d) Locations of offsite areas that drain onto the project limits. The SWQCP is required to include BMPs properly sized and placed to accommodate runoff from outside and inside the project limits.
- (e) Locations of all construction entrances where vehicles and equipment will enter and exit the site.
- (f) An updated stormwater management budget including a list of all proposed BMPs with price calculations based upon the established unit prices or contract prices.
- (g) Material handling and spill prevention plan, which includes a listing of expected materials that may be present on the site during construction and the written plan of how those materials will be handled to minimize their potential for entering the storm water runoff from the site.
- (h) Statements that the stormwater management features used shall, at a minimum, be inspected each calendar week and by the end of the next work day following every 1/2 inch rain event.
- (i) Provisions to ensure pollutants such as fuel, lubricants, asphalt, sewage, wastewater, wash water, or waste from concrete mixing operations, and other harmful materials not discharge into existing bodies of water.
- (j) Provisions to ensure all applicable regulations and statutes relating to the prevention and abatement of pollution be complied with in the performance of the contract.

Additional contractor responsibilities within the SWQCP process include:

- (a) Designating a trained employee as the Storm Water Quality Manager (SWQM) to oversee and be in responsible charge of the contractor's storm water management operations.
- (b) Ensuring that the signed and dated SWQCP is submitted 14 days prior to any earth disturbing activities.
- (c) Completing inspections of all installed BMPs at the correct frequency and documenting the inspections using the current inspection reporting process.
- (d) Amending and resubmitting their SWQCP as necessary to address changes during the construction of the project.

The SWQCP is a “living” document and is required to be amended by the contractor as new situations occur or as the plan of operation changes.

Once the SWQCP is received from the contractor, the PE/S will perform the following:

- (a) Review the SWQCP within 14 days of receipt utilizing the process outlined in ITM 803, Section 15 and the SWQCP checklist within Appendix I.
- (b) Contact their Area Engineer for clarification and utilize the ES Permit Coordinator as an information reference for the SWQCP review.
- (c) Sign and date the SWQCP to document the review of the methodology and approval of the content.

In addition to the work covered by the contract documents and the SWQCP, the contractor may also need to operate offsite borrow and disposal sites. Waterway permits for these sites are solely the responsibility of the contractor and are not covered in any part by the Department’s SWPPP, the plans, or the contract permits. A copy of the Contractor’s offsite operations, NOI for items such as offsite stockpiles, borrow sites, waste sites, or storage areas shall be submitted to the PE/S prior to operations at those sites.

#### **3.1.4 Installation, Inspection, and Maintenance**

As defined within the Standard Specifications, the contractor is responsible for the proper installation, inspection and maintenance of all stormwater management measures. In accordance with the Construction Stormwater General Permit or the Rule 5 permit, stormwater management inspections are required to occur at a minimum frequency of once per calendar week, and by the end of the next work day following each measurable storm event equal to or greater than 1/2 inch of rainfall.

On contracts operating under waterway permits and not a Construction Stormwater General Permit or a Rule 5 permit, inspections are required to occur at a minimum frequency of once per calendar week.

Inspection reports are to be submitted by the SWQM within 24 hours of the day of the inspection. The reports are to be documented and submitted electronically using the current version of the Department’s stormwater inspection process. A paper inspection form may be used in the event that the electronic inspection process is out of service or as directed.

The PE/S is responsible to make sure that the contractor’s SWQM has submitted inspection reports correctly, in a timely manner, and in accordance with the Construction Stormwater General Permit or the Rule 5 permit requirements. Any additional stormwater management features suggested by the contractor’s SWQM in the inspection report should be evaluated and either accepted or denied by the PE/S on the inspection report. Evaluations of any proposed new storm water management features should include discussions with the AE, District Stormwater Specialist, the Department’s designer, and the ES Permit Coordinator. They can help determine and ensure that the contract continues to meet the intent of the

specifications, maintains economic value, and maintains compliance with all requirements of the Construction Stormwater General Permit or the Rule 5 permit.

As with any plan, it is not uncommon for changes to be made in order for the plan to work properly. Similarly, the stormwater management measures in the contract must be used to their best advantage to accomplish the job. Therefore, some stormwater management item quantities may overrun and some may underrun. The PE/S must use their best judgment and work with the contractor, AE, the District Stormwater Specialist, the Department's designer, and the ES Permit Coordinator to adapt the best plan to fit the actual conditions of each project while still being as efficient as possible with the use of BMPs. All of the initiated changes should be documented as amendments to the SWQCP.

The processes discussed within this section can be referenced within the Department's Storm Water Management Field Guide.

### **3.2 BORROW AND DISPOSAL SITES** *(Rev. 08-10-17)*

The contractor must submit proposed borrow and disposal site locations to the PE/S for approval. Form IC 203, Request for Approval of Borrow or Disposal Site, is available on the Department's website and must be completed by the contractor for each proposed site and submitted to the PE/S for approval. The form requires the contractor's signature certifying that they have complied with all environmental laws and regulations required to perform the planned operations at the site. The PE/S will review the form and sign it if properly completed. A site must be approved before the contractor can begin operations at the site.

Requirements for different types of sites shall be in accordance with 203.08.

The primary reason for the need to review and approve borrow and disposal sites is to help prevent contractors from inadvertently dumping in a wetlands area or disturbing an archeologically sensitive site. As the owner of the project, INDOT is responsible to take measures to prevent these occurrences.

There are many different situations that can arise when determining whether a borrow or disposal site is acceptable; however, the specifications are intended to give the PE/S the tools necessary to reasonably ensure that the contractor has taken appropriate measures to prevent borrow or disposal operations from becoming a violation of environmental laws.

In some cases, such as existing commercial operations where the entire area has previously been developed, there can be consideration made as to whether the requirements for a wetlands delineation or archeological investigation are appropriate. There are areas on form IC 203 for the contractor to explain why certain permit requirements may not apply to a given situation.

The PE/S must use their best judgment to reasonably determine when a given area may or may not require all environmental work to be done. However, it is the contractor who is ultimately responsible for ensuring compliance with the laws. By contract, the Department's approval of borrow or disposal sites does not relieve the contractor of any

obligations or penalties under the law. The Department will hold the contractor responsible, not the PE/S, if an approved site turns out to be in non-compliance with any law or regulation. It is not the intent of the Department's procedures to place the PE/S in a position of responsibility for the contractor's compliance with the laws, rather only to provide a means for the PE/S and the Department to be aware of the contractor's planned sites and to obtain the contractor's certification that they are in compliance with the laws. If the PE/S has questions about a given site, they should contact the AE for further guidance.

### **3.3 GENERAL** *(Rev. 09-24-09)*

Unless advised to the contrary, no restrictions should be placed on the contractor by the PE/S as to where it shall commence work, except that where the alignment follows an old road, the road must not be in disrepair during the winter months.

A contractor must not be allowed to construct earth cofferdams, earth causeways or other earthen structures in a stream. For non-earthen cofferdam and causeways, the contractor is required to submit a drawing for approval. If the cofferdam or causeway is not included in the permits obtained by the Department for the contract, the contractor must obtain any necessary permits or addenda prior to starting the work.

Construction of drainage facilities and performance of other contract work which will contribute to the control of erosion and sedimentation must be carried out prior to, in conjunction with, or as soon thereafter as practicable with earthwork operations. The contractor may be required to construct temporary berms, dikes, slope drains, or sedimentation basins to prevent sedimentation before the permanent erosion controls are placed.

To help prevent erosion, sodding and seeding of cut and fill slopes should be accomplished as construction progresses instead of waiting until the end of a construction season. Temporary seeding should be required if areas of disturbed earth will be open for more than 7 days. Special consideration should be made to manage earth disturbing activities such that temporary/permanent seeding or sodding can occur prior to the end of the growing season, so as to prevent a winter long E&SC problem.

As provided in the SS, the contractor is responsible for the repair and restoration of any damaged sodded and seeded areas prior to final acceptance. This includes the work necessary to comply with the requirements of erosion control.

The procurement of soil samples, representative of the soil to be incorporated in embankments, should be one of the first activities of the PE/S. The samples must be sent to the District Testing Laboratory as soon as possible in order to expedite the return of the results to the PE/S. This data is necessary to perform density tests. The samples must be properly tagged and identified.

### **3.4 STAKING AND CONSTRUCTION ENGINEERING** *(Rev. 09-24-09)*

Staking is done almost exclusively by the contractor and paid for under the items and specifications for construction engineering. The following instructions apply only in cases where construction engineering by the contractor is not included in the contract or if it is

determined that additional staking is required and it will not be added to the contract by change order.

When staking is performed as part of a construction engineering pay item, the contractor will frequently use GPS surveying equipment to establish and control grades on the project. This “stakeless” surveying does not lend itself to checking of grade by the PE/S. However, it should be noted that the SS require the contractor to furnish all staking necessary for checking of the work. This is a topic that should be discussed with the contractor at the pre-construction conference.

If the contract does not have a pay item for construction engineering, the PE/S should determine, as soon as possible, at what point on the project the contractor intends to start work and start setting grade stakes at that point. The rough grade stakes should then be set for the balance of the project as rapidly as possible. This procedure will expedite the moving of utilities and fences which is a feature that quite often causes delays in grading operations.

Rough grade stakes should be of such length and type that will serve the intended purpose and will last for the duration of the work. They should be planed on two sides to facilitate marking. They should be set on each side of the road on the right-of-way line, at each station, at 50 ft intervals on all horizontal curves over four (4) degrees, and on all vertical curves where the algebraic difference of gradients is greater than six (6). Normally, grade stakes set on the right-of-way line serve to denote the limits of the right-of-way. Therefore, a stake should be set at any break in the right-of-way to facilitate the erection of fences and relocating of utilities. If Department personnel have set the grade stakes, the contractor should not be allowed to remove rough grade stakes except with PE/S permission. Negligence in preserving grading stakes should not be tolerated.

Before and after setting the stakes, the plans and cross-sections should be carefully examined to make sure that sufficient right-of-way has been shown on the plans. Particular attention should be given to special ditches, relocation of streams and ends of structures in narrow channels. Stakes should be driven at least 1 ft into the ground and station number and distance marked on them. In some locations it is advantageous to set the rough grade stakes flush with the ground and place guard laths with station and distance. Elevations should be taken on the top of stake and the ground at centerline so that grade sheets can be prepared. Grade sheets must show the vertical distance from the top of the grade stake to a specific grade at centerline. This specific grade may be to finish grade on regraded sections, subgrade of subbase, subgrade of a base or surface course, or finished surface grade; however, the grade used must be noted somewhere on the sheet.

Any change in grade or any correction made subsequent to issuing the grade sheet should be shown on a revised grade sheet with corrections or revisions noted thereon. Taking elevations of all grade stakes should START FROM A BENCHMARK AND TIE INTO A BENCHMARK EACH TIME ANY ELEVATIONS ARE RUN. Rod readings are read to hundredth of a foot (thousandth of a meter). All recorded notes must be kept.

Upon assignment to a project, the setting of stakes should be pursued until the entire project is staked. If the stakes are set during the winter months, elevations should not be taken on them until the contractor is about ready to begin grading or until the frost has gone out of the ground. Stakes set in the winter should be driven lightly again before taking elevations. Stakes on which elevations were taken during the winter must be rechecked in the spring.

Since the construction work will disturb the alignment, control points such as a P.O.T., P.C., P.T., etc. must be referenced to stakes or objects that will not be disturbed. There are a number of methods used in referencing points and consideration should be given to the availability of the reference objects after the grade has been completed. These references must be recorded in a permanent field book and not in a hub book or loose leaf book.

### **3.5 CHECKING ORIGINAL CROSS SECTIONS** *(Rev. 05-25-18)*

When there is a pay item for construction engineering in the contract, the contractor must take complete cross sections at 500 foot intervals and verify that the planned alignment and grades will match the existing conditions.

If an item for construction engineering does not exist, then the PE/S must make the cross section checks.

While setting rough grade stakes, the elevation of the original ground at the centerline of each station must be recorded. A complete cross section must be taken at every 500 feet. The centerline elevation at each station and the cross sections taken every 500 feet must be checked with those on the plans. If they do not check satisfactorily, or vary consistently more than 0.2 ft from the original sections, the reason should be found and the investigation continued to determine the correct original cross sections. It may be necessary to re-cross section the project. In case of doubt, consult the AE.

### **3.6 SLOPE STAKES** *(Rev. 05-25-18)*

This work is typically required to be done by the contractor as part of the construction engineering pay item. If a pay item is not included in the contract, the PE/S must perform the staking required.

Slope stakes should be set at each station for both cuts and fills throughout the entire length of the project including additional slope stakes for special ditches. The distances from the centerline to the slope stakes shall be shown on the grade sheets with the slope shown in the "Cross Section" column. In preparing to set slope stakes, the cross sections should be studied to note planned variations from the typical cross section and slopes.

The slope stake book should contain notes as to cut or fill, distance from centerline and elevation at which the slope stake was set. The elevation at which the slope stake was set is useful in tying final cross sections and in plotting the slope stakes on the original cross section sheets.

When rock is encountered in a cut with an overburden of earth above it, the cut shall be made by excavating the earth far enough back so that a shoulder or shelf will be left on top of the rock between the base of the earth cut and the top of the rock cut.



In cuts where it is not known or cannot be determined with certainty how far the rock is below the surface of the ground, the slope stake shall be set as if the entire cut consisted of earth. The overburden would then be excavated on the normal earth slope to the top of the rock. After the overburden has been stripped from the rock, the top of rock is slope staked for the typical rock section or to slopes designated by the PE/S. A separate or supplemental grade sheet should then be completed. The distance to the top of the rock slope and designating the cross section to be constructed should be shown. Where rock cuts are very short, construct the typical earth cross section.

### **3.7 CLEARING RIGHT-OF-WAY** *(Rev. 05-25-18)*

The PE/S upon assignment to a contract should request copies of the right-of-way grants from the DO and compare the right-of-way distances on the grants with those on the plans. The DO should be notified of any discrepancies that are discovered. All buildings, gasoline pumps, etc. shall be removed from the right-of-way. A time limit for the removal of buildings from the right-of-way is usually incorporated in the right-of-way grant. If there is difficulty in getting them removed, the matter should be taken up with the DO. It is easier to remove all encroachments at this stage of construction rather than just prior to final acceptance.

Right-of-way grants must be checked for special commitments. When shown, these commitments must be fulfilled. Right-of-way commitments may be fulfilled within the existing or future contracts, or the property owner may have been compensated during project development. For these reasons, the PE/S should not make promises to property owners to perform work or other tasks that would directly profit the property owner unless the tasks are already shown on the plans. Where commitments are noted in the parcel files and not included in the contract, the PE/S should notify the Project Manager and AE to verify.

Vegetation and trees between the construction limits and the right-of-way line must be preserved as much as possible. The waterway permits for the contract often do not cover work outside of the construction limits. The PE/S must be aware of the limits covered by the permits before allowing any clearing outside of the construction limits. Before the contractor starts clearing the right-of-way, the trees to be removed should be marked. Occasionally, right-of-way grants contain provisions for leaving certain trees on the right-of-way. These trees must not be disturbed. The contractor should be notified of the exception. The District Landscape Supervisor should be advised of any proposed tree trimming by utilities.

Before trees, stumps, rubbish, or other material can be deposited beyond the right-of-way limits by the contractor, it will be necessary for the contractor to submit a waste disposal plan as provided in the Specifications. After the contract has been completed, the contractor should obtain signed property releases (Form IC 149) for the disposal areas, borrow pits, plant sites, etc. A copy of these releases must be included in the final construction record.

On pre-graded projects, paving contractors on pre-graded projects are required to mow weeds and clean up the right-of-way without compensation in the same manner as on a grading or a grading and paving project.

### **3.7.1 Temporary Right-of-Way for Private Drives**

All right-of-way matters except temporary right-of-way for private drive extensions will be handled by authorized right-of-way agents. Where additional right-of-way is necessary for planned construction, constructing outlet channels, peat disposal, authorized grade changes, etc., sketches of the additional right-of-way with the property owner's names should be made and submitted to the DO for acquisition.

### **3.7.2 Temporary Right-of-Way for Building Removal**

Many of the road and bridge plans indicate TEMPORARY RIGHT-OF-WAY FOR BUILDING REMOVAL. In numerous instances the property owner cannot utilize the remainder of his property until the building has been removed and the temporary right-of-way formally released by INDOT. In some instances the courts have been critical of the delay in making the temporary right-of-way available to the owner. In view of the above, the Land Acquisition Division has requested that their office be promptly notified when the building or buildings, on any individual tract or parcel of temporary right-of-way that was acquired for building removal purposes, have been removed. The Division of Construction Management should be advised when such temporary right-of-way may be formally released to the property owner. Construction Management will in turn inform the Land Acquisition Division. It is suggested the removal of buildings located on temporary right-of-way be considered at the pre-construction conference or early in the life of the contract. Every reasonable effort should be made to expedite the removal of those that fall outside the permanent right-of-way. Conducting business in this manner will contribute to a more favorable public opinion.

### **3.7.3 Sign Encroachments**

The owners of outdoor advertising signs located within the right-of-way should be advised, either by personal contact or by letter, to remove their sign. If the sign is of material value and the owner does not desire to salvage or relocate it, a letter should be secured from the owner so indicating. Once the letter is received, the contractor can then proceed to remove the sign in accordance with the provisions of the SS. If the sign is of material value and the owner refuses to remove the sign, the DO must be contacted for guidance.

### **3.7.4 Archeological Artifacts and Historic Features**

If archeological artifacts or historic features are found, work must be stopped immediately in the area of the discovery. Section 3.22 provides guidance on how to proceed.

### **3.7.5 Disposal of Timber**

The following procedures apply to the disposition of merchantable timber within the construction limits:

- (1) Section 201.03 of the SS provides that "All merchantable timber in the clearing area which has not been removed from the right-of-way prior to the beginning of construction shall become the property of

the Contractor, unless otherwise provided.” This will be the procedure in most cases.

- (2) In the event the Land Acquisition Division has arranged with the property owner, as a part of the right of way settlement, for the property owner to retain and remove the timber, this information will be included in the contract special provisions.

### **3.8 CUTS** *(Rev. 09-24-09)*

The typical sections will indicate the normal slopes based on the minimum right-of-way and width of roadway. A different typical section will be used for rock cuts than that used for earth slopes. The cross section sheets should be checked for exceptions to the normal slopes. Terrain or soil conditions may also necessitate deviation from the typical slopes. Flat slopes provide additional safety, can reduce erosion, are easily maintained, and greatly improve the appearance of the road by blending in with the adjacent topography. In deep cuts, interceptor ditches should be cut at the top of slopes when right-of-way width permits.

It is standard practice to flare out the side ditches at the end of cuts to avoid spilling side ditch drainage onto a fill slope. The additional excavation required for flaring ditches is authorized excavation, and slope stakes should be set accordingly.

Special ditches shall be located as close to the right-of-way lines as possible in order to eliminate the hazard of deep ditches near the shoulder line. Special ditches should be aligned to provide a smooth alignment but not necessarily parallel to the centerline. The flow lines of special ditches with flat gradients should be staked for final finishing.

Where dirt is left in place for shoulders, transverse trenches shall be cut through the shoulders at sufficient intervals to maintain the subgrade in a well drained condition. The center of the roadway shall also be crowned to provide drainage. Cuts should be excavated so that water will not pond at the face of the cut. Dirt for shoulders shall not be left so high as to interfere with surfacing or finishing operations.

Where backslopes for cut sections are made in material which is not suitable for the growth of vegetation, the PE/S can authorize the undercutting of such slopes and the back-filling of the same with suitable material, as set out in Section 203.09 of the SS, for encasement.

No trees outside the slope-stake limits are to be disturbed, damaged or trimmed unless permission is granted by the PE/S.

Instructions pertaining to the grading of approaches are included in Section 18 of this manual.

### **3.9 EARTH CLASSIFICATION** *(Rev. 05-25-18)*

The different classes of excavation are outlined in the Specifications. It is imperative that all classes of excavation be measured in their original position and an accurate set of notes kept which will show the quantities of each class. Original cross sections for rock are taken after the overburden is removed, and are taken for each section in the plans plus any

necessary supplementary sections. Check shots for minimum depths below pavement are made after the rock is removed and before the cut is backfilled.

It is important that the field notes be complete with title, closed bench circuit and dates. The time to do this with any necessary explanatory notes is when the work is being performed.

Two copies of the Soil Report and Soil Profile are furnished to the DO. One of these sets should always be furnished to the PE/S for information and guidance during construction of the contract. This set should be kept in the project field office.

### **3.10 EMBANKMENTS** *(Rev. 05-18-20)*

The Specifications provide that after embankment areas have been cleared of all perishable materials such as trees, stumps, sod, weeds, cornstalks, etc., the upper 6 in. of the natural ground shall be well compacted with an approved compaction equipment. Dirt piles from structure excavations should be removed and if suitable, incorporated in the embankment in layers. Weeds and brush should not be placed in the toe of slope. Sound stumps and non-perishable solid objects may be left a minimum of 3 ft below subgrade or slope of embankments provided they are as nearly flush as possible, but they must not extend more than 4 in. above the ground line or low water level. Sound stumps may be cut off at ground level outside of the toe of the slope.

Earth embankments must be constructed in layers of the thickness specified, leveled, disked and thoroughly compacted. When using a three wheeled 10 t roller or pneumatic tired roller, the layer must not exceed 8 in. before compacting. When using a sheepsfoot roller, the depth of the loose dirt must not exceed the length of the tamper feet. If the material is of a granular nature, a heavy crawler type tractor may be used, but the depth of the layer must not exceed 6 in. For areas inaccessible to the above equipment, such as structure backfills, the material must be placed in 6 in. layers and compacted with mechanical tamps or vibrators. To maintain these maximum depths of lifts, it is essential that each layer or lift be leveled, preferably by a grader. It is impossible to get a uniform compaction unless the fill is reasonably level.

The base of fills shall be constructed to the full width between slope stakes. On high fills the width should be checked occasionally as the fill progresses. Side casting to bring the fill to section should be avoided since side casting usually develops a fill slough or slide.

After clearing of the embankment area and prior to embankment placement, all pronounced depressions left in the original ground shall be filled with suitable material and compacted in accordance with 203. Proofrolling of the natural ground surface shall be performed in accordance with 203.26 within all areas where new fill is to be placed. Original ground that cannot be compacted sufficiently shall either be replaced or dried with a soil modifier as described in 203.09.

The grading should be watched closely in regard to unsuitable material. Roots should be removed and disposed of properly. Frozen material must not be used in the fill and a lift of

dirt must not be placed upon a frozen layer. The frozen layer may be removed or bladed over the side of the fill.

As noted in the specifications, rock lifts or layers are variable in height depending on the amount of rock, topography, type of rock and mixtures of soil and rock. There should be a minimum of voids in rock fills. Bridging by slabs of rock should be avoided by judicious use of a bulldozer.

When aggregate is used for embankment construction and it is not possible to perform stiffness testing in accordance with ITM 508 or strength testing in accordance with ITM 509, the material should be compacted with several passes of crawler-tread equipment or with vibratory equipment, or both. Equipment weight shall be at least 10 tons. The PE/S may want to consult with the AE prior to making this determination.

For LWD testing of aggregate, if average deflection for the aggregate is greater than the maximum allowed deflection from the Specifications, a sample of the aggregate should be obtained (AASHTO T 2) and a moisture content test performed (ITM 506 or AASHTO T 255) to determine if the aggregate moisture content is within acceptable limits. If the moisture content is outside acceptable limits, wait 24 hours, retest for acceptable moisture content, and test the aggregate at the same location. The aggregate test will be acceptable if the LWD tests are equal to or less than the maximum allowed deflection.

The critical point of any grade is the junction of the cut and the fill. If not properly constructed, a weak spot in the finished grade will result. In many cases, especially where there is a quantity of topsoil, it is advisable to undercut the beginning or ending of a fill into the cut and replace with suitable material.

Attention must be given to methods of building embankments on steep side hill slopes as outlined in the specifications. Plowing is not a pay item but benching may be paid for at the classification encountered. In general, benching should be considered if the slope is steeper than 4:1, as per Section 203 of the SS.

Where an existing fill will not accommodate the full width of the new pavement, the existing fill shall be excavated and the material, if suitable, used in the new embankment. This work is authorized excavation. The handling of embankments over existing pavement is explicit in the specifications.

Broken concrete or brick pavement may be disposed of in fills, at least 24 in. below subgrade elevation. They must be spread in such a manner as to fill the voids with soil and the layers thoroughly rolled.

Embankments around the end bents of bridges must be constructed at the same time and in the same manner as the approach fills and before piling in the end bents are driven. Intermediate bents or piers which fall within the toe of the approach fill must be back-filled to the original ground line with B borrow. The fill above the original ground line at these bents shall be kept balanced on both sides of the bent and carefully compacted. Care should be exercised in order to prevent displacement of the piers or bents.

Density and moisture tests must be performed and documented as required.

Compaction tests are based on dry weights. The moisture content must be controlled as per the SS or as recommended by OGE. In actual practice, excessive moisture in the soil is obvious. A practical solution is to disc and aerate the lift of earth until it has dried sufficiently to compact satisfactorily. Soils that are too dry to compact to the minimum density can be disked, wet down and re-compacted. However, it is the contractor's responsibility to determine the methods to obtain the proper moisture content of the soil. Wetting the grade without disking has been found to slightly help density.

The specifications provide for aeration of embankment material if the material is too wet and the embankment is not satisfactory. This moisture provision was adopted to protect INDOT from having to accept fills that passed the density specification yet were obviously unsatisfactory as evidenced by excessive rutting under the construction equipment. The aeration provision is to be used when the embankment is not satisfactory but not to be used merely because the material is over optimum moisture. The contractor must keep the grade properly drained. If necessary, payment should be withheld on grade work done but not properly drained.

Section 203.23 of the SS states that "If the embankment material is too wet or too dry, either the material shall be aerated to remove excess moisture or watered and disked to increase the moisture content, until in either case the moisture content is within the specified range." The determination of whether or not a fill is satisfactory is a matter of personal judgment in addition to the required density and moisture tests. Some degree of deformation of the fill under the heavily loaded equipment can be tolerated providing the fill is dense, well compacted and not developing permanent ruts.

The definition of excessive permanent rutting involves personal judgment. As a general guide it would seem that as much as 3 in. of rutting could be tolerated under the modern, large capacity, heavily loaded equipment and still not be detrimental providing the fill meets specifications. This guide depth is relative to the original top of fill. Equipment should not be allowed to "follow the leader" in the same track.

### **3.11 GRADING OVER PEAT MARSHES** *(Rev. 09-24-09)*

Every attempt is made during the design phase to locate all peat marshes. Soils surveys normally make investigations regarding types of soil and sub-grade conditions, and from these investigations compile their findings and recommendations. The soil information is normally incorporated into the plans.

The PE/S should review the soil report to help assure that its recommendations are incorporated into the plans.

Unless otherwise instructed, peat should be excavated and treated in accordance with the methods set out in the specifications. The width of the excavation should extend to the limits shown on the typical sections as determined by the depth and to the bottom of the peat bed or firm foundation. If the bottom of the peat slopes transversely, consideration

should be given to excavating to a greater width on the deepest side in order to minimize subsequent lateral displacement and settlement. In cases of transverse slopes on the bottom or when questionable material is encountered, the PE/S should contact the AE.

Cross sections must be taken before the peat is excavated and again before the backfill is placed, or as outlined in Section 203 of the SS.

### **3.12 MEASUREMENT OF PEAT EXCAVATION** *(Rev. 09-24-09)*

The contract should provide for payment of peat excavation. The typical sections included in the plans for peat excavation should show the limits of excavation, backfill, and disposal. The embankment is to be built with a 2:1 slope from the shoulder point of the roadway down to the original ground line with compacted soil. From that point on the OG, a 1:1 slope should be constructed down to the lowest elevation of peat excavation. This established point determines the lower limit of peat excavation. The pay quantities for peat excavation will be limited to the volume of peat lying between the vertical neat lines for peat excavation from the lower limits to the OG. B borrow is to be deposited in the excavation left by the peat removal and paid for as shown in the contract.

Peat may be deposited in the side slopes of the embankment outside the 2:1 slope shown on the typical section to the finished side slope. Peat may also be placed and graded to drain outside the backslope of side ditches to the construction limits. Also temporary R/W for peat disposal will typically be shown on the plans.

When peat is removed by complete excavation, the volume will be computed from final cross sections taken after complete excavation and before placing granular backfill. Normal cross section methods and field notes should be used.

When peat removal by displacement is necessary, the volume will be computed from final cross sections derived from test holes through the completed granular treatment. A bid item for Cased Test Holes will be included in the contract for this purpose, unless otherwise specified in the SP. An external pipe of a diameter chosen by the contractor will provide the outside casing. Water pumped through a smaller diameter inner pipe will facilitate sinking of the casing and determination of the depth. Color of the wash water and material rising to the top indicates the change in material at the bottom of the casing. Therefore, the contractor should arrange the two pipes and water pressure such that the wash water rises between the pipes rather than outside of the larger pipe.

A record of the cased test holes must be kept in a project field book. An example is shown in Section 28 of these instructions. Cross sections from test holes should generally be taken at stations 50 ft apart, or more frequent if necessary; with a minimum of five test holes per cross section. The maximum spacing of test holes for cross section purposes should be 50 ft. A line of stakes should be placed on centerline and at the right and left edges of the treatment. All stakes should be graded to the same elevation, if possible. The HT can determine the elevation of the top of the B borrow by stretching a string across the three hubs and measuring down to the B borrow. As the HT observes the borings, the depth of penetration into the B borrow and trapped peat, if any, will be recorded. If there is any

trapped peat, the pay length of the boring would be the sum of the depth of B borrow and trapped peat.

### **3.13 SLIDES** *(Rev. 09-24-09)*

One cause of slides is free water. When free water is introduced into a cut bank or embankment in a quantity sufficient to reduce the angle of repose to less than the angle of cut or fill slope, a flow of soil or a slide occurs. Slides also occur when the surface of an impervious stratum is tilted to such an angle that it will not offer sufficient resistance or friction to withstand the weight or pressure of the overlying material. Another type of slide or slough that occurs in fill sections is caused by not rolling to the edges of each lift or by side casting material to bring the slopes to the proper cross section. Benching of hillside fills in potential slide areas should be checked with the AE.

A review should be made by the PE/S of cuts where the natural slope of a hillside has been intercepted by a steeper slope. The presence of terraces adjacent to the project indicates former slides. If this equilibrium is disturbed, further sliding can be anticipated. Usually, the first indication of a slide in a complete or incomplete cut section is a bulging of the backslope with cracks parallel to the roadway appearing in the original ground on top of the backslope. It is at this stage the sliding plane, if any, can be observed. The PE/S should note this sliding plane by elevations and distances as an aid in determining the correction plan.

Should a slide occur in a cut section, the PE/S will extend the original sections immediately. In the event of any slide occurring on the project, advise the DO. The OGE will propose a plan of correction. For additional information see Section 203 of the SS.

### **3.14 EXCAVATION FOR SMALL STRUCTURES AND CHANNEL CHANGES**

*(Rev. 09-24-09)*

No payment is made for any class of excavation necessary to construct pipe, box, or slab top structures up to and including 20 ft span, or miscellaneous structures unless the structure is relocated from the location shown on the plans or the flow line lowered. Notice that this refers to additional excavation and is usually determined by cross sectioning the planned site and the relocated site. Neat lines as established are to be used in this comparison.

Unsuitable material which is authorized to be excavated below the planned elevation of the bottom of footings of the structure is treated the same as above. When the undesirable material is removed in conjunction with adjacent excavation below grade, the entire volume shall be paid for at the contract unit price for the classification encountered and not considered as additional structure excavation. If selected material is used to backfill the excavated area, this material shall be paid for at the contract unit price for the material selected. No payment is to be made for material excavated below grade and backfilled for the convenience of the contractor in stabilizing a normally stable foundation.

No payment is made for excavation within the right-of-way limits to construct a new or old channel to the grade and width shown on the plans or to the width of the new structure.



Before starting channel change excavation that is a pay quantity, the cross sections should be checked for adequate coverage of the area and if necessary, additional sections taken.

### **3.15 SINKHOLES** *(Rev. 05-25-18)*

Sinkholes occur in limestone areas of the state and are the result of surface drainage through a hole or crevice in the top of the rock, a flow of water on top of the rock, or drainage through narrow, horizontal seams. The surface of the ground often appears as saucer shaped depressions that vary in size from a few feet to possibly 400 ft in diameter. The actual fault in the rock may be from zero feet to as much as 35 ft below the bottom of the depression, that is; the opening may be exposed or it may not be apparent.

Sinkholes are environmentally sensitive features and each must be addressed as a separate problem. If the excavation, capping and backfilling of a sinkhole is not directly addressed by the contract documents or if a sinkhole is discovered that isn't shown on the plans, the AE and the Office of Environmental Services must be contacted for guidance before any work is done. When excavation, capping and backfilling of a sinkhole is planned or approved, the following procedures should be followed.

Before starting the excavation of a sinkhole, original sections must be taken of the sinkhole site. If the hole or crevice is not exposed, it is suggested that the original sections cover an area beyond right-of-way to right-of-way and a comparable distance from the sinkhole each way on centerline.

The fault or crevice in the rock strata may be quite some distance laterally from the opening in the soil overburden. The additional area covered by the cross sections should anticipate this lateral drift or provide for a long crevice.

When the opening in the rock is exposed, the dirt overburden adjacent to the hole is excavated and the rock prepared for the cap. If the rock is not exposed and an opening occurs in the overburden, the opening must be followed to the rock. The following method is recommended when a sinkhole with no apparent opening is encountered. First, the low point must be determined by observing after a rain, leveling, or by observing the location of heavy vegetation. Using a scraper type of grading equipment, light parallel cuts need to be made through the area.

This will usually disclose a small area of soil that is darker than the surrounding soils and/or an accumulation of small stones. The dark soil and stones should be followed with shovel or crane type of equipment to the top of rock. If the contractor elects to use scraper type equipment after the initial cut, neat lines of excavation must be established and the contractor notified. As excavation proceeds, authorized neat lines of excavation must be noted in the project field books.

When the opening in the rock is revealed, the dirt is cleared for a distance of 2 ft to 3 ft on each side of the opening. It is often necessary to remove rock adjacent to the opening to obtain a satisfactory seal. The immediate area should be checked for secondary openings. The cap is then laid out to have a bearing of approximately 2 ft to 3 ft on the adjacent rock. It is unnecessary to have the cap in the form of a square or rectangle as indicated on the

plans, but should conform to the figure required to cover and seal the opening. If the opening is a crevice, the cap shall extend a sufficient distance to provide adequate protection to the road; as determined in the field after consultation with the AE.

Immediately after the cap is formed or not later than the morning after the cap is placed, it shall be measured, sketched in the project field books, and checked for computability. Final cross sections are then taken of the entire excavated area but payment is made only to neat lines previously established or authorized.

As soon as a flexural strength of 480 psi is obtained for the concrete cap based on beam breaks, consideration is given to the method of backfilling. When the cap is below top of rock or a drainage cap is designed, B borrow should be limited and its use discussed with the DCD. When the excavated area is within the roadway area, ramps should be excavated parallel to centerline to eliminate abrupt changes in fill depth. A 3:1 slope is recommended for the ramping. Since ramping is paid for at the contract unit price for the class of excavation encountered and sinkhole excavation at 3 times the contract unit price for the classification encountered, the cross sections must clearly indicate this separation. No payment is made for backfill except for authorized B borrow. The backfill must be placed in accordance with the specifications and thoroughly compacted.

### **3.16 BORROW** *(Rev. 05-18-20)*

Borrow is a satisfactory material obtained by the contractor from locations outside of the right-of-way to complete the planned grading section. Coal ash as well as granular tire shed mixtures (GTS) may be utilized as borrow if they meet the requirements of the Specifications.

Borrow may also consist of coal ash if it meets the requirements of 203.08.2. When used as borrow, the contractor is required to place the material in the embankment, compact, and encase the material upon delivery to the contract. If the material is stockpiled, it must stockpiled at an approved location and in an approved manner. All control measures used should be included in the contractor's submitted SWQCP and in accordance with 205. If there is no SWQCP required for the contract, control measures should be documented by the contractor in the site plan and in accordance with 108.04.

Coal ash is should not be mixed with other embankment materials within a given lift and should not be considered for placement in the following locations:

1. Below existing ground.
2. Within a 100 ft horizontal distance of a stream, river, lake, reservoir, wetland, karst feature, or any protected environmental area.
3. Within a 150 ft horizontal distance of a well, spring, pond, or other ground source of water.
4. MSE wall backfill.
5. As encasement material.
6. Within the limits of subgrade treatment.

7. Directly in contact with any permanent metallic construction materials.

Compaction procedures and moisture content will be in accordance with 203.23.1.

Material such as muck, cinders, or a soil mixture with a high organic content shall not be used. Should the material be questionable, the AE must be contacted.

When borrow is necessary, the contractor must make the arrangements for obtaining the material. The PE/S must be notified of the location of the proposed borrow pit and an IC 203 must be submitted for approval of the location prior to beginning earth disturbing activities.

If the location, planned excavation, and material comply with our specifications, the contractor may proceed with clearing the borrow pit site. Soil samples of the pit are then taken and forwarded to District Testing. Before any pay material is removed from the borrow pit, The PE/S must establish a base line and take original cross sections for the pit. The base line should be established through or near the proposed borrow pit with the extremities of the line staked and referenced outside of the area that will be excavated.

Precautions are to be taken to insure that the stakes or references are not disturbed. In establishing a base line, consideration should be given to the topography, the line of the cross sections, and the possibility of extending sections, if necessary. If the borrow pit involves a large area, it is suggested that an auxiliary line be run parallel to the base line to properly align the cross sections. Borrow pits that are adjacent to the right-of-way often involve excavation within the right-of-way. No material excavated within the right-of-way is considered as borrow. In such case, a rod reading and distance from the base line at the point each cross section intercepts the right-of-way line must be taken. This will aid in computing the separation of the borrow quantity from the Common Excavation quantity. A sketch must be made of the borrow pit layout in the permanent field notes immediately preceding the original cross section notes. A description of the location of the borrow pit is placed on the sketch, such as, the number of feet right or left of a roadway station. The name of the property owner is also placed on the sketch.

If the borrow pit is in close proximity to the project right-of-way, a benchmark should be established near the borrow pit and the elevation of it tied into the project level circuit.

Specifications must be read carefully relative to the location of borrow pits. Proximity to the right-of-way, elevation, drainage, erosion control, etc. must be evaluated.

Since the contractor selects the source of borrow material, it is responsible for compliance with all environmental regulations that may govern the borrow site. The PE/S must evaluate the submitted IC 203 to determine if the contractor has complied with the requirements.

**3.17 B BORROW** *(Rev. 04-22-14)*

B borrow consists of suitable crushed stone, sand, gravel, or other materials meeting the requirements of Section 211 of the SS. This material is used for constructing fills over peat marshes, up to the elevation of 2 ft above free water, as backfill for certain structures, or other places where settlement might seriously affect the finished work. B borrow should not be used at places other than indicated on the plans, unless approved by the AE.

The preferred method of placing B borrow is in specified lifts and compacted. At locations that are inaccessible to heavy compacting equipment such as tractors, rollers, etc., vibrators or mechanical tamps are to be used. B borrow should not be used indiscriminately. Factors to be considered in choosing locations where B borrow is to be used should include practicability of compaction and the type of pavement surface being constructed.

Should there be material within the project limits that substantially meets the specifications for B borrow and is readily available, this material must be used in lieu of the planned B borrow within the project. This material is in that event, paid for as Common Excavation.

For certain locations such as Catch Basins, Inlets, and Manholes, as defined in the specifications, no payment is made for structure backfill for these structures.

When the contract proposal contains a pay item of "B Borrow", payment will be made on the basis of limits as shown on the plans or as adjusted for authorized changes, provided the material comes from outside the permanent right-of-way. The provision for adjustment by authorized changes is included to allow for adjustments due to plan error or omissions and changes in the structures in the field, either of which are of substantial quantity. In those cases where an adjustment in the plan quantity is required, the theoretical amount should be computed for the individual structure in the normal manner and these computations kept in the project file for inclusion in the FCR. Before completion of the FCR a Change Order containing the adjustments required for B borrow should be submitted for approval.

The method of payment for B borrow should be discussed with the contractor at all pre-construction conferences.

**3.18 PLAN QUANTITY PAYMENT FOR COMMON EXCAVATION** *(Rev. 09-24-09)*

Section 203.27 of the SS states that the quantities of excavation to be paid for will be those shown in the contract, unless extra work has been performed or either party disagrees.

The following procedure will apply to all contracts or portions of contracts that involve payment for Common Excavation on the basis of plan quantity:

New original cross sections are to be taken at 500 ft intervals and plotted to check the accuracy of the original sections. (See section on Staking and Construction Engineering).

Final cross sections are to be taken at 500 ft intervals. Cross sections should be complete sections in cuts and from the shoulder break out

in fills. These final sections should indicate substantial conformance with the planned cut slopes and ditches, and will be used to determine if earthwork deductions are required.

Spot checks must be made of the cross-section areas shown in the plans. The number of spot checks should average one for each 2,000 ft with the locations concentrated in areas of the major excavation. Additional area checks should be made to determine whether the plan quantity should be adjusted if any of the areas checked varies more than 10% from the area shown on the plans. If the average deviation of all the areas checked varies from the total planned areas at the same location by more than 2%, a more detailed check will be required on those areas or balances showing the highest deviation.

Form IC 615 could be used to make the area checks as indicated above and must be included in the Final Construction Record. This form should have the heading "Comparison of Planned and Final Cut Areas for Check of Plan Quantity." The form could then be divided into five columns with headings of: Station, Planned Area, Checked Area, Percent Deviation, and Remarks. The Percent Deviation column would be totaled algebraically and the average Percent Deviation would be listed.

The computation of the volume from the planned areas of one balance should be checked. In general this should be the largest balance in the contract. Any other questionable balances should also be checked for volume computations.

Any other pertinent facts that would justify using plan quantity or indicating the need for adjustments should be considered. In addition to the above steps, the FCR should have a statement over the PE/S's signature as follows:

"Volume computations and check sections of original and final cross-sections indicate that the planned quantities are accurate enough to justify payment on the basis of plan quantity as adjusted by approved Change Orders as compiled herein."

### **3.19 DEDUCTIONS** *(Rev. 09-24-09)*

The policy concerning deductions in excavation and Borrow quantities is covered in the Final Construction Record Guide. It is important that the PE/S and contractor be familiar with such policy. It is essential that all notes and computations be accurate and complete to support any deductions made in accordance with the established policy. Should circumstances justify waiving deductions, a full explanation should be written into the notes, on the cross section sheets and signed by the PE/S.

When payment is made on the basis of plan quantity or computer facilities used for computation of pay quantities, sufficient documentation must be included in the FCR to indicate whether deductions are required. Sections plotted at 500 ft intervals should be used to verify whether deductions according to standard procedures are necessary. The completed project should be visually inspected to determine whether there are other

locations which warrant cross sections to check for deductions such as; areas bounded by interchange ramps, areas between variable median sections, etc. When deductions are indicated, additional sections must be taken at the necessary stations to compute the deductible materials. A statement should be included in the Final Construction Record over the PE/S signature that the above check has been made.

### **3.20 SETTLEMENT STAKES AND PIEZOMETERS** *(Rev. 05-25-18)*

When the geotechnical investigation indicates a large or uneven settlement of the foundation soil under a proposed embankment is expected, fill movements during and after grading must be reviewed. This review is specified mainly for three reasons:

1. To detect foundation soil failures in early stages to prevent costly reconstruction.
2. To verify predicted settlement.
3. To determine when embankment settlement has slowed to the point that paving can be done without being excessively distorted by continued uneven settlement.

The checking of fill movement can be accomplished through installation of settlement plates, lateral stakes, and shoulder stakes. When any of these are required, details of their construction and use are set out in the SP. These details should be carefully followed so that desired results will be obtained.

Settlement plates are for observation of vertical movement of the original ground beneath a fill during and following embankment construction.

The PE/S will determine the plate elevation and the elevation of the top of the first section of pipe at the time the plate is set. As additional sections of pipe are added their effective length must be carefully measured. Observations are to be made every 7 days to determine movement of the plates. These observations should start about 7 days after fill construction has started.

Results of settlement observations on the plates are to be reported weekly. This weekly report series should start with the first observations after fill construction has started. During winter months and periods of job suspension, the frequency of observations and reports may be decreased with proper approval. Observations and reports should continue until a written release from observation responsibility has been secured from the OGE.

In the event that the vertical or lateral movement indicates that material beneath the embankment is being displaced rather than consolidated, work should be suspended and the OGE should be notified.

Settlement stakes may be required for observation of movement of the original ground along side the new fill construction or movement of any given portion of finished fill. These stakes may be used to measure either, or both, horizontal and vertical movements.

Centerline stakes should be set as soon as the embankment has been constructed to approximate subgrade elevation. Observations should be made on these stakes at the same time that settlement plate observations are made. Toe stakes should be set, before embankment starts, near the toe of the slope (usually about 5 ft from the slope stake) at a location where they are least likely to suffer construction damage. Where a special ditch is to be constructed, they should be on the fill side of the ditch. Another row of stakes should be installed as far from the fill as practical (usually along the right-of-way) to be used as reference stakes. Every 7 days, measurements are made between the reference stakes and the stakes near the toe of fill to check for possible movement. These measurements are taken to the nearest 0.01 ft. If more than 8 ft of fill is placed between two consecutive observation dates, an additional set of observations should be taken. These measurements and observations should be continued until the OGE gives a release.

When stakes are specified in the contract to be placed along the shoulder of the completed embankment, they are used for the purpose of detecting both horizontal and vertical movements. Measurements are taken every 7 days to determine the amount of movement. These measurements are taken to the nearest 0.01 ft.

Prior to the embankment construction, a definite pattern should be established for obtaining settlement data. At least two permanent benchmarks should be established for each group of settlement plates. These benchmarks must be located well beyond the influence of any fill settlement but close enough to require only a minimum amount of instrument turns. When taking settlement readings, the instrument should be set up at the same location each time and readings taken in the same sequence as done in the previous period. This will reduce the possibility of instrument error. A self-leveling instrument has proven to give more reliable readings than the conventional level or transit and should be used if available.

Piezometers are specified to measure pore water pressure in saturated compressible material beneath an embankment, before, during, and following construction. Their construction and use is described in the SP. The 4 in. pipe specified is a minimum size. Larger pipe may be required if the number of piezometers in one pipe make it necessary.

A report on the construction of each piezometer is to be made. This is a graphical sketch of the piezometer and should be submitted upon completion of the installation.

Piezometers should be read daily after placement and before any embankment is constructed to determine the stabilized in-place ground water elevation at the given piezometer location.

Piezometers should be read daily during embankment construction and weekly upon completion of embankment. If the "Critical Pore Pressure" is approached, embankment construction should be halted and the data analyzed by the OGE. The "Critical Pore Pressure" is that pressure at which foundation and embankment failure may occur. This information for each Piezometer should be on the project site and is available from the Geotechnical Report or the OGE.

Piezometer reports should be submitted as soon as possible after readings are obtained.

Piezometer observations and reports, like those of settlement plates and stakes, should continue until the responsibility for reporting is released. When it appears to the PE/S that reporting responsibility should be terminated he should inform the DO. If the DO concurs they should so inform OGE by letter and request that a review of the data be made.

The Division of Construction Management should be furnished a copy of the letter.

After consulting with the Chief Geotechnical Engineer, a letter releasing the PE/S from the reporting responsibility will be written.

### **3.21 SUBGRADE TREATMENT** *(Rev. 05-18-20)*

Section 207 of the SS contains the requirements for subgrade treatment. In most cases, the contractor may choose options for subgrade treatment. The plans and Standard Drawings should be reviewed for information on the treatment specified for the contract.

### **3.22 ARCHAEOLOGICAL ARTIFACTS** *(Rev. 01-21-14)*

An archeological artifact may be a fragment of historic or prehistoric pottery, chipped stone tools or flakes, ground stone tools, prehistoric or historic housing material, or burial objects such as headstones or even human remains. Other types of historic features may be a prehistoric garbage pit or cooking pit, the remains of a prehistoric house, a privy, well, canal features, building foundations, etc. Burial objects are of particular concern, because they suggest the presence of human remains.

If any archaeological artifact or historic feature, including human remains, is found during construction, work must immediately stop within 100 feet of the site and the site must be left undisturbed.

For artifacts other than human remains, the PE/S must coordinate with IDNR to mitigate impacts to the discovery. Work at the site cannot resume until written consent is received.

If human remains are encountered, the local law enforcement agency must be contacted first, and then OES must be notified. The law enforcement agency will contact the County Coroner. Although human remains may appear archaeological or historic, they may actually represent a modern or historically recent crime scene. This is why the County Coroner always documents the remains. It is very important to leave the area of the discovery as undisturbed as possible.

### **3.23 REGULATED MATERIALS** *(Rev. 08-10-17)*

Hazardous materials are considered to be regulated materials and must be handled in accordance with applicable environmental laws, regulations, and rules. Sections 104.06 and 202 of the SS clearly address all the requirements that the contractor must deal with when working with regulated materials. However, disposal of bridge painting debris shall be in accordance with 619. The PE/S is required to see that the contractor follows those specifications.



When materials suspected of being regulated are encountered on the project site and are identified in the contract documents, the contractor must cease all operations in the immediate vicinity and the PE/S must notify the AE. If the situation warrants an immediate emergency response, the procedures as outlined in Section 104.06 of the SS must be followed.

The DCD will work with the District Environmental Scientist concerning any necessary handling, cleanup, testing, transportation, and disposal of such materials. They may contact the OES for further guidance and coordination with IDEM.

A private consulting company may be necessary for testing of suspected regulated materials. This consultant may be acquired and paid by the contractor or the state. OES and/or IDEM would review the results of any such tests. The PE/S should be advised, through the DCD, of procedures for the contractor to follow. The contractor may be advised of any required handling, storage, cleanup, additional testing, transportation, or disposal of hazardous materials.

The contractor should not resume work in any affected area until notified that conditions and the area have been rendered safe for resumption of work.

Payment for the contractor's work related to storage, cleanup, testing, transportation, or disposal of any such materials should be in accordance with Sections 104.06 and 202 of the SS.

Removal of Underground Storage Tanks (UST) shall follow Section 202 of the SS. The Contractor and PE/S must maintain accurate records of all operations. The Contractor shall submit two additional copies of the compulsory completed report distributed to IDEM UST Branch (Notification for UST & UST System Closure Site Assessment Report) to the Engineer within 30 days after closure. One copy shall be forwarded to the OES, in CO. The second copy is retained in the project file. In addition, a copy of all detailed pay item costs with justification and calculations relating to the UST removal will be submitted to the OES, in CO. This documentation is needed so INDOT may submit to IDEM for cost reimbursement from the Excess Liability Fund (ELF) for the removal of the UST's.

### **3.24 ASBESTOS CONTAINING MATERIALS** *(Rev. 01-21-14)*

The contractor is required to comply with all applicable laws and regulations concerning the inspection and testing for, and removal of, asbestos material. Asbestos containing materials are considered to be regulated materials and must be handled as such. Sections 104.06 and 202.06 of the SS explain in detail what procedures the contractor must follow when handling this type of material. Such regulations require an inspection for the presence of asbestos in buildings, bridges, and pipes to be demolished or renovated. The inspection must be done before the start of demolition or renovation operations. Renovation in this law is defined as the disturbance of any load-carrying member. In bridges this has been defined as any substructure element.

Persons who inspect for asbestos containing materials must have a current certificate of accreditation, issued by IDEM. Also, only accredited asbestos removal contractors,

supervisors, and workers can be employed on asbestos removal operations. Listings of accredited inspectors, and asbestos removal contractors and persons, can be obtained from IDEM's Office of Air Management.

IDEM requires written notification 10 working days prior to the start of renovation and demolition operations, even if no asbestos is found during the inspection. IDEM's notification form must be filled out completely and accurately. The start of work date must be as accurate as possible. If work will not start on the date shown on the form for some reason, a new notification must be made. Copies of the same form may be used to satisfy the notification requirements of the US Environmental Protection Agency, and the Indianapolis Air Pollution Control Division for such operations in Marion County. There are specified waiting periods between notification and asbestos stripping or removal that must be followed.

### **3.25 MECHANICALLY STABILIZED EARTH RETAINING WALLS**

*(Rev. 09 29-20)*

Inspection for mechanically stabilized earth walls must include field verification that the wall is being constructed in accordance with specifications and plans. It will include monitoring the foundation preparation and wall erection.

The inspection of the foundation preparation typically will verify that the foundation is level, at the correct elevation, is appropriate sized, and the foundation soils are adequate. The foundation must be graded level to a width equal to or exceeding the length of the soil reinforcement, proof rolled, and any unsuitable material removed and replaced. If a concrete leveling pad is used, then the appropriate level tolerances will be verified. Concrete must cure for 12 hours prior to the placement of any wall panels.

Structure backfill (the reinforced soil) must be tested prior to placement to ensure the 34° angle requirement. B-borrow may be used for backfill beyond a theoretical 1:1 slope behind the reinforced soil.

[The inspection of the wall erection](#) will include checking all tolerances and alignments of the wall as it is constructed, monitoring compaction of the backfill and placement of soil reinforcing, verifying that the face panel-to-soil reinforcement connections are correctly made, and monitoring the placement of soil reinforcement in and around the appurtenances. The soil reinforcement must be pulled taut during backfill placement to remove any play in the connection between the face of the panel and the soil reinforcement.

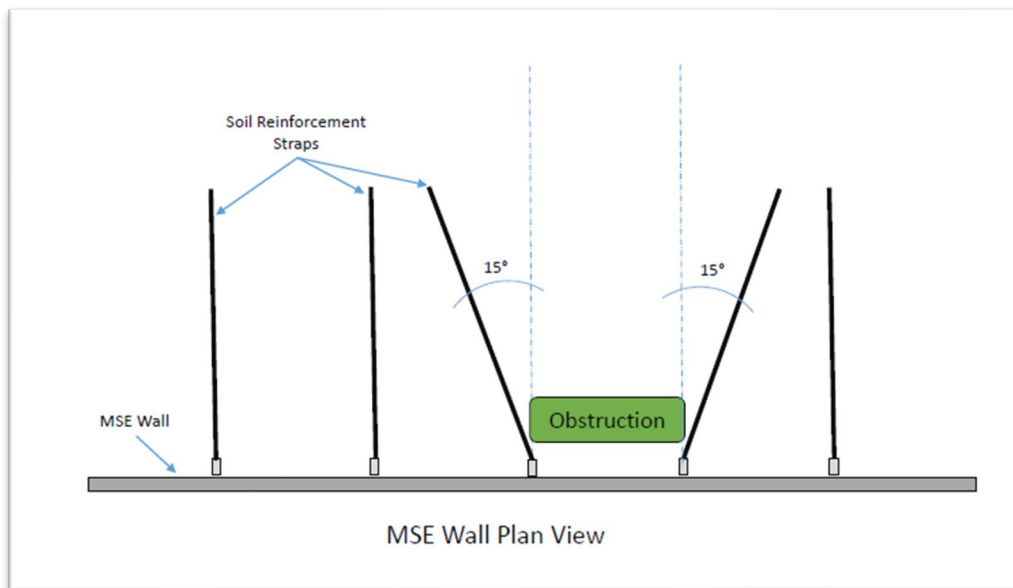
The checking of the tolerances and alignments will include verifying that the face panels are plumb within specification over the entire height of the wall. Alignments and tolerances should be checked at every layer of panels after the backfill behind the panels has been compacted, and the results recorded. Hardwood wedges used for alignment must be removed after the panels are complete and in place. The horizontal alignment of the wall and the elevations of the top and bottom of the wall will be checked against the plans and specifications. All joints between panels must be covered with geotextile on the backfill side of the face panel. Proper placement of geotextile over the panel joints is critical in preventing loss of backfill.

Proper compaction is critical to the appearance and performance of the mechanically stabilized earth wall. Compaction will start at the back of the facing panels and progress towards the reinforced soil mass. Lightweight compaction equipment is to be used with 3 ft of the face panels to minimize lateral movement. Ensure that the maximum lift thicknesses are adhered to. If a lift fails compaction requirements, no additional fill can be placed until the lift meets specifications. All compaction equipment must have smooth compaction surfaces to avoid damage to soil reinforcement. Compaction efforts that distort the soil reinforcement must not be allowed.

Grading around and backfilling of the wall should be watched closely and care should be taken to ensure the placement of level and uniform lift placement. Improper grading around the wall can cause component failures. Careless placement and improper compaction methods used in constructing the backfill can cause unwanted wall deflections and reduce overall retaining capacity.

Soil reinforcement must not be field cut, nor deviate from being placed normal to the face panels unless specifically called for in the plans.

Reinforcement straps should be straight and level when placed. There should not be vertical gaps between the wall connection and its strap end. Straps should be the correct length for the location. Check the Contractor supplied shop drawings and working drawings for information. Soil reinforcement should splay no more than 15° from a line perpendicular to the wall face. This angling of soil reinforcement is typically used to avoid obstructions, such as drainage structures, which may be located just inside the MSE wall structure. Field changes to reinforcement to avoid obstructions should not be made unless shown on the approved drawings. The figure below illustrates the concept.



If unexpected conflicts arise, the wall designer must be notified for plan revisions.

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