SECTION 31 22 00
SITE PREPARATION AND EARTHWORK

PART 1 - GENERAL

1.01 Section Includes

A. Clearing site of debris, grass, trees and other plant life in preparation for construction.

B. Protection of existing structures, trees or vegetation to remain.

C. Stripping of topsoil from areas to be incorporated into the work.

D. Excavation, filling and compaction for site grading and paved surface subgrade preparation.

1.02 Related Sections

A. Section 01 45 16 – Testing Requirements.

1.03 References

A. ASTM D 1557 - Standard Test Methods Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

B. ASTM D2487 - Classification of Soils for Engineering Purposes.

C. ASTM D2922 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D. ASTM D3017 - Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.04 Submittals

A. Submit compaction test reports.

PART 2 - PRODUCTS

2.01 Materials

A. Common Fill: On-site or off-site natural soil free from organic matter, debris, vegetation, stones larger than 6” and frozen material and classified in ASTM D2487 as follows:

GW - Well-graded gravels, gravel-sand mixtures, little or no fines.
GP - Poorly-graded gravels, gravel-sand mixtures, little or no fines.
GM - Silty gravels, gravel-sand-silt mixtures.
GC - Clayey gravels, gravel-sand-clay mixtures.
SW - Well-graded sands, gravelly sands, little or no fines.
SP - Poorly-graded sands, gravelly sands, little or no fines.
SM - Silty sands, sand-silt mixture.
SC - Clayey sands, sand-clay mixtures.
ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.

PART 3 - EXECUTION

3.01 Protection

A. Locate and identify existing utilities that are to remain and protect them from damage.

B. Protect trees, plants, structures, site improvements and features designated to remain.

C. Protect bench marks, property corners and other survey monuments from damage or displacement.

3.02 Clearing

A. Clear area within the PROPERTY LINES shown on the Drawings. If no clearing limits are shown, clear five feet outside of the grading limits, but not beyond project property boundaries.

B. Remove concrete & debris remaining on existing site and haul away to an appropriate landfill .off-site

3.04 Topsoil Excavation

A. Cut heavy growths of grass from areas to be stripped.

B. Strip topsoil from all areas to be excavated, regraded or landscaped to a depth that prevents the intermingling of the topsoil with the subsoil.

C. Topsoil is defined as surficial soil containing organic matter that sustains plant life.

D. Stockpile the stripped topsoil on the site for reuse, if it is clean of salvage use. If topsoil is full of debris, haul to dispose of in an appropriate landfill off-site.

E. Provide erosion protection for all stockpiled topsoil and / or around entire project property line.

3.05 Pavement Removal

A. Remove existing pavement and dispose of off-site. Removal of pavement will be considered incidental to the work unless indicated otherwise.

B. Provide a straight, clean, vertical saw cut joint between pavement being removed and pavement to remain. Use power saw for cutting. Steel disk cutters mounted on power shovel bucket are not acceptable.

3.06 Lines and Grade

A. Streets
   1. Construct the finish subgrade to the line, grade, and cross section as shown on the Drawings.
   2. The Engineer will provide grade stakes at a minimum distance of 50 feet along the centerline. Provide Engineer with a minimum of 48 hours notice of the need for grade stakes.
   3. Contractor may use slope meters or GPS type controls on machines for grade control. However, the contractor is responsible for verifying the finish grade elevations with a level at a minimum of every 50 feet along the centerline.

B. Site Grading
   1. Construct the finish subgrade to contours shown on the Drawings.
   2. The Engineer will provide grade stakes as appropriate for the Work.
   3. Contractor may use slope meters or GPS type controls on machines for grade control.

However, the contractor is responsible for verifying the finish grade elevations.

3.07 Grading and Subgrade Preparation

A. Cut and fill to the required grades and cross section and contours.

B. Scarify surface of cut areas and compact to the degree required for subsequent backfill.

C. Place fill material in continuous layers not exceeding 8” compacted thickness.

D. For proposed streets and parking lots, roll the surface with a steel drum roller to provide a relatively impervious surface where additional filling or excavation is necessary or placement of base course will be delayed.

E. Maintain surface drainage during construction.

F. Remove excess material from site. If borrow is needed, provide material meeting requirements for common fill.

G. Grading contractor shall grade roads and other surfaces to be paved to rough subgrade elevation prior to installation of utilities. After utility installation, the grading contractor shall grade to finish subgrade elevation.

H. Prior to placement of topsoil, areas that have been compacted by construction traffic shall be scarified to a minimum depth of 12 inches using a chisel plow or ripper arms on a dozer. Scarifying shall be performed along the contour.

3.08 Compaction

A. Adjust moisture content of fill material to accomplish the required degree of compaction.

B. Use a sheepsfoot roller for cohesive soils and a smooth drum vibratory roller for granular soils.

C. Compact to the percent of maximum dry density as listed below in accordance with ASTM D1557.

Compaction Requirements		
Area	Cohesive Soils	Granular Soils
Beneath Turf	85%	85%
Beneath Walks & Curbs	90%	95%
Beneath Paving	90%	95%
Building Pad Area	90%	95%
Storm Water/Treatment Pond Berms	90%	95%

3.09 Proof Rolling

A. Proof roll the finished pavement subgrade in the presence of the Engineer. Provide 24-hour notice to the Engineer as to when the proof-rolling will be performed.

B. Prior to proof rolling, the entire roadway subgrade shall have a relatively smooth surface, suitable for observing soil reaction during proof rolling.

C. Provide a loaded tri-axle dump truck with a minimum gross weight of 30 tons.

D. Proof rolling shall be accomplished in a series of traverses parallel to the centerline of the street or parking area. The truck shall traverse the length of the street or parking area once for each 12 feet

of width. Additional passes may be directed by the Engineer.

E. Soft areas, yielding areas, cracked areas, or areas where rolling or wave action is observed shall be considered indicative of unsatisfactory subgrade. Such areas shall be undercut, replaced with suitable fill material, and recompacted.

F. Once the subgrade has been proof rolled and approved, protect the soils from becoming saturated, frozen, or adversely affected.

3.10 Subgrade Stabilization

A. If ordered by the Engineer or if indicated in the Contract Documents, subgrade material that cannot be adequately compacted shall be removed and replaced with breaker run material and/or geotextile.

B. The depth of the undercut, breaker run size, and/or geotextile requirement will be at the discretion of the Engineer.

C. Unless otherwise indicated within the contract documents, subgrade stabilization with breaker run material will be paid for by the in-place cubic yard including excavation, furnishing and placement of breaker run material, and disposal of undercut material.

3.11 Geotextile Placement

A. Clear area of sharp objects, stumps, and large stones that would puncture geotextile.

B. Roll geotextile onto the subgrade by hand in the longitudinal direction. Overlap adjacent strips two feet.

C. Back-dump aggregate onto the geotextile beginning at a point just before the fabric and on firm soil. No vehicular traffic will be allowed directly on the geotextile. Spread the aggregate with a bulldozer. The first lift shall be as thick as possible to prevent over-stressing of the subgrade.

D. Take care during aggregate placement to prevent damage to the geotextile. Repair damages or tears by placing a piece of geotextile over the damaged area. Overlap the repair piece onto the undamaged area a minimum of three feet.

E. Compaction: Perform initial compaction with bulldozers while spreading. Perform final compaction with a vibratory compactor, first without vibration for several passes, followed with vibration. Do not grade down ruts; fill with additional aggregate and compact.

3.12 Tolerances

A. Top Surface of Road Subgrade:
   1. Rough Grade: Plus or minus 0.25 ft.
   2. Finish Subgrade: Plus or minus 0.05 ft.

B. Top Surface of General Grading: Plus or minus 0.1 ft.

3.13 Field Quality Control

A. Field inspection will be performed by an authorized representative of the Owner.

B. Contractor is responsible for meeting the compaction requirements. The Contractor shall hire and pay for an independent testing firm to perform compaction tests to confirm the in-place density.

C. For general grading, perform one test per 9,000 square yards or part thereof of fill placed per lift. In addition, perform one test per building lot where fill is placed. For streets perform one test per 1,000 square yards or part thereof of fill placed per lift. Engineer or Owner's Representative will direct location of tests.

D. Additional tests may be required if compaction requirements are not being met. The cost of these additional tests are the responsibility of the Contractor.

E. Determination of moisture content shall be in accordance with ASTM D3017. Determination of density shall be in accordance with ASTM D2922.

3.14 Disposal

A. Dispose of all plant material off-site at a location meeting state landfill requirements.

B. Burning at the site will not be permitted.

C. Dispose of excess soil materials or unsuitable material off-site unless on-site disposal is indicated, or approved by Owner.

END OF SECTION

SECTION 31 23 00

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

PART 1 - GENERAL

1.01 Section Includes

A. Excavation for structures.

B. Backfill and compaction for structures.

1.02 Related Sections

A. Section 01 45 16 – Testing Requirements.

1.03 References

A. ASTM D 1557 - Standard Test Methods Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

B. ASTM D2487 - Classification of Soils for Engineering Purposes.

C. ASTM D2922 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D. ASTM D3017 - Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.04 Submittals

A. Submit compaction test reports.

PART 2 - PRODUCTS

2.01 Materials

A. Structural Fill: On-site or off-site natural soil free from organic matter, debris, vegetation, stones larger than 6” and frozen material and described in ASTM D2487 as follows:

GW - Well-graded gravels, gravel-sand mixtures, little or no fines.
GP - Poorly-graded gravels, gravel-sand mixtures, little or no fines.
GM - Silty gravels, gravel-sand-silt mixtures.
GC - Clayey gravels, gravel-sand-clay mixtures.
SW - Well-graded sands, gravelly sands, little or no fines.
SP - Poorly-graded sands, gravelly sands, little or no fines.
SM - Silty sands, sand-silt mixture.
SC - Clayey sands, sand-clay mixtures.

B. Common Fill: Same as structural fill plus soils classified in ASTM D2487 as follows:

ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.

C. Sand: Clean, granular material meeting the following gradation:

Sieve Size	Percent Passing by Weight
3/8 Inch	100
No. 4	90 - 100
No. 16	45 - 80
No. 50	10 - 30
No. 100	2 - 10
No. 200	0 - 5

PART 3 - EXECUTION

3.01 Preparation

A. Identify required lines, elevations and grades.

B. Protect benchmarks, property corners and grade stakes.

C. Locate and identify utilities that are to remain and protect them from damage.

D. Protect plant life, turf, fences, structures and other site improvements from damage.

3.02 Excavation

A. Excavate structure area to line and grade. Do not excavate below indicated depth except to remove unsuitable material.

B. Dispose of unsuitable material. Stockpile suitable material for reuse as backfill.

C. Scarify surface of excavated areas and compact to the degree required for subsequent backfill.

D. Excavation walls more than five feet in depth shall be shored or cut back to a stable slope. Meet requirements of Department of Labor, Occupational Safety and Health Administration (OSHA).

E. Provide necessary equipment to remove water from excavation.

3.03 Backfilling and Compaction

A. Place fill in continuous layers not exceeding 8” compacted thickness.

B. Maintain optimum moisture content of fill material to accomplish the required degree of compaction.

C. Do not place frozen material and do not place fill on frozen ground.

D. Backfill interior and exterior of walls simultaneously.

E. Do not backfill against walls prior to completion of curing period.

F. Provide fill material as indicated in the schedule.

G. Compact to the percent of maximum dry density as listed in the schedule in accordance with ASTM D1557.

H. Schedule

Area	Fill Material	Percent Compaction
Beneath Floor Slabs		
Top 6 Inches	Sand	95
Below 6 Inches	Structural Fill	95
Foundation Walls		
Interior	Structural Fill	92
Exterior	Structural Fill	92
Walks & Pavement	Structural Fill	95
Beyond 10 Ft. from Structure	Common Fill	85

3.04 Tolerances

A. Under Paved Areas: Plus or minus 0.1 ft.

B. Under Slabs-On-Grade: Plus or minus 0.1 ft.

3.05 Field Quality Control

A. Field inspection will be performed by an authorized representative of the Owner.

B. Contractor is responsible for meeting the compaction requirements. The Contractor shall hire an independent testing firm to perform compaction tests to confirm the in-place density.

C. Determination of moisture content shall be in accordance with ASTM D3017. Determination of density shall be in accordance with ASTM D2922.

END OF SECTION

SECTION 31 23 33

UTILITY EXCAVATION, BACKFILLING AND COMPACTION

PART 1 – GENERAL

1.01 Section Includes

A. Excavation of trenches for below grade piping and conduit.

B. Backfilling and compaction.

1.02 Related Sections

A. Section 01 45 16 – Testing Requirements.

1.03 References

A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregate.

B. ASTM D1557 - Standard Test Methods Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

C. ASTM D2487 - Classification of Soils for Engineering Purposes.

1.04 Submittals

A. Submit 50 lb. sample of off-site backfill materials.

B. Submit gradation of select granular backfill.

PART 2 – PRODUCTS

2.01 Materials

A. Crushed Stone: Hard, durable particles of crushed stone or gravel substantially free from shale or lumps of clay or loam meeting the following gradation:

Crushed Stone Gradation	
Sieve Size	% Passing By Weight
2 Inch	100
1-1/2 Inch	90 - 100
1 Inch	35 - 70
3/4 Inch	0 - 15
1/2 Inch	0 - 5

B. Trench Backfill: Natural soils, free of organic matter, trash, deleterious materials, stones larger than eight inches and frozen material and classified in ASTM D2487 as follows:

GW - Well-graded gravels, gravel-sand mixtures, little or no fines.
GP - Poorly-graded gravels, gravel-sand mixtures, little or no fines.
GM - Silty gravels, gravel-sand-silt mixtures.
GC - Clayey gravels, gravel-sand-clay mixtures.
SW - Well-graded sands, gravelly sands, little or no fines.
SP - Poorly-graded sands, gravelly sands, little or no fines.
SM - Silty sands, sand-silt mixture.
SC - Clayey sands, sand-clay mixtures.
ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.

Soils classified in ASTM D2487 as follows are not acceptable:

OL - Organic silts and organic silty clays of low plasticity.
MH - Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
CH - Inorganic clays of high plasticity, fat clays.
OH - Organic clays of medium to high plasticity, organic silts.
Pt - Peat and other highly organic soils.

C. Select Granular Backfill: Durable particles ranging from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids of the coarse material. Some fine clay or loam particles are desirable, but they shall not be present in the form of lumps. Granular backfill shall conform to the following gradation:

Granular Backfill Gradation	
Sieve Size	% Passing By Weight
3 Inch	100
2 Inch	95 - 100
No. 4	35 - 60
Finer than No. 200	5 - 15

D. Bedding: See individual specification sections.

PART 3 – EXECUTION

3.01 Examination

A. Verify fill materials to be used are acceptable.

3.02 Preparation

A. Identify required lines, levels, contours, and datum.

B. Maintain and protect existing utilities remaining which pass through work area.

C. Protect plant life, lawns, and other features remaining as a portion of the final landscaping.

D. Protect benchmarks and existing features from excavation equipment and vehicular traffic.

E. Protect above and below grade utilities which are to remain.

F. Strip topsoil and stockpile on–site for reuse.

G. When excavating across or within existing pavement, saw cut in neat, straight, vertical lines.

3.03 Minor Trench Water

A. Do not allow water to accumulate in the trench.

B. Provide all equipment needed to accomplish the Work. Unless indicated otherwise, no additional compensation will be made for removing trench water.

C. No additional compensation will be made for crushed stone used for trench drainage.

D. Dispose of water in a suitable manner, and in accordance with regulations of the Wisconsin Department of Natural Resources, without damage to property.

3.04 Excavation

A. Excavate subsoil to required depth and grade.

B. Cut trenches sufficiently wide to enable installation of the utilities and allow inspection. Normal trench width below the top of the pipe shall be the nominal pipe diameter plus 24 inches.

C. Do not undercut trench walls.

D. Trench walls more than five feet in depth shall be shored, cut back to stable slope or provided with equivalent means of protection in accordance with the applicable rules of the Department of Labor, Occupational Safety and Health Administration (OSHA). Provide a ladder for trench exit in trenches over four feet deep.

E. Excess excavation below the required level shall be backfilled with crushed stone at the Contractor's expense.

F. If the trench bottom is unstable due to soil material or groundwater conditions, an additional 3 inches shall be excavated and backfilled with crushed stone as specified in Part 2. There will be no extra payment for the additional excavation and stone. If it is necessary to excavate to a greater depth to provide a stable trench, the Contractor will be paid for the additional excavation and stone, if the extra excavation was ordered by the Engineer or approved by the Engineer prior to the work being performed.

G. Remove ledge rock, boulders or large stones to provide a minimum clearance of 6 inches between the pipe and the rock. See Section on Rock Excavation, if included.

H. Not more than 100 feet of trench shall be open ahead or behind the pipe laying. Additional trenching will not be allowed if earlier trenches have not been backfilled or if the trench surfaces are unsatisfactory.

I. Utility contractor is responsible for the disposition of excess material resulting from the utility construction. Stockpile excess excavated material in areas designated on the Drawings. If stockpile areas are not designated on the Drawings, dispose of the material offsite.

3.05 Backfilling

A. Backfill trenches with excavated material meeting the requirements for backfill specified in Part 2 above. Use select granular backfill only when indicated on the Drawings or elsewhere in the Project Manual.

B. Backfill trenches to the rough subgrade elevation, plus or minus 0.25 ft.

C. Place material in continuous layers not exceeding 8 inches compacted thickness. Compact each layer to the percent of maximum dry density as listed below in accordance with ASTM D1557.

D. Compaction Requirements: Meet the following compaction requirements:

Compaction Requirements		
Area	Cohesive Soil	Granular Soil
Beneath Structures	90%	95%
Beneath Paving	90%	95%

E. Maintain moisture content of backfill materials to attain required compaction density.

3.06 Restoration

A. Remove excess excavation immediately after completion of backfilling.

B. If site restoration is required, commence immediately after backfilling is completed.

C. Maintain roadways in a driveable condition, acceptable to the Engineer, prior to pavement restoration.

3.07 Field Quality Control

A. Field inspection will be performed by an authorized representative of the Owner.

B. Contractor is responsible for meeting the compaction requirements. The Contractor shall hire an independent testing firm to perform compaction tests to confirm the in-place density.

C. Testing Requirements: Four tests at various depths per 400 feet of trench. Engineer or Owner’s

Representative will direct the location of the tests.

D. Additional tests may be required if compaction requirements are not being met. The cost of these additional tests are the responsibility of the Contractor.

E. Determination of moisture content shall be in accordance with ASTM D3017. Determination of density shall be in accordance with ASTM D2922.

END OF SECTION