# DELAWARE RIVER D24
# STREAMBNAK STABILIZATION PROJECT

**ATCHISON COUNTY, KANSAS**

**Prepared for:**

**State of Kansas**
**Department of Agriculture Division of Conservation**

**Prepared by:**

**1200 SW EXECUTIVE DRIVE**
**TOPEKA, KANSAS 66615**

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Delaware River – Site D24 Photo Log
Atchison County, Kansas
Watershed Land Trust, Inc.

| | |
|---|---|
| **Photo Number:** 1 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Looking downstream from left bank. | |
| **Direction:** South | |
| **Photographer:** Brock Emmert | |
| **Date:** August 14, 2019 | |
| **Photo Number:** 2 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Looking upstream from left bank. | |
| **Direction:** North | |
| **Photographer:** Brock Emmert | |
| **Date:** August 14, 2019 | |

Delaware River – Site D24 Photo Log
Atchison County, Kansas
Watershed Land Trust, Inc.

| | |
|---|---|
| **Photo Number:** 3 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Gully confluence at right streambank. | |
| **Direction:** West | |
| **Photographer:** Brock Emmert | |
| **Date:** August 14, 2019 | |
| **Photo Number:** 4 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Site looking downstream from left bank. | |
| **Direction:** South | |
| **Photographer:** Brock Emmert | |
| **Date:** August 14, 2019 | |

Delaware River – Site D24 Photo Log
Atchison County, Kansas
Watershed Land Trust, Inc.

| | |
|---|---|
| **Photo Number:** 5 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Exposed roots of wooded riparian trees at right top of bank. | |
| **Direction:** Southwest | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |
| **Photo Number:** 6 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Right bank looking upstream from downstream end of survey. | |
| **Direction:** North | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |

Delaware River – Site D24 Photo Log
Atchison County, Kansas
Watershed Land Trust, Inc.

| | |
|---|---|
| **Photo Number:** 7 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Right bank looking upstream from left bank. | |
| **Direction:** North | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |
| **Photo Number:** 8 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Right bank looking downstream from gully confluence. | |
| **Direction:** South | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |

Delaware River – Site D24 Photo Log
Atchison County, Kansas
Watershed Land Trust, Inc.

| | |
|---|---|
| **Photo Number:** 9 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Right bank looking downstream from bar on left bank. | |
| **Direction:** Southwest | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |
| **Photo Number:** 10 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Looking upstream from right bank at downstream end of survey. | |
| **Direction:** North | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |

Delaware River – Site D24 Photo Log
Atchison County, Kansas
Watershed Land Trust, Inc.

| | |
|---|---|
| **Photo Number:** 11 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Gully confluence along eroded right bank. | |
| **Direction:** West | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |
| **Photo Number:** 12 | |
| **Client:** Kansas Department of Conservation | |
| **Description:** Slumping right bank looking downstream. | |
| **Direction:** South | |
| **Photographer:** Brock Emmert | |
| **Date:** October 16, 2019 | |

THE WATERSHED INSTITUTE

Figure 1
Drainage Area Map

**DOC Streambank Stabilization Project**
**Delaware River Site D24**

Date: January 2020

Source: https://kansasgis.org/

THE WATERSHED INSTITUTE

Figure 2
Gully Drainage Area Map

**DOC Streambank Stabilization Project**
**Cottonwood River Site D24**

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E
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Date: January 2020

Source: https://kansasgis.org/

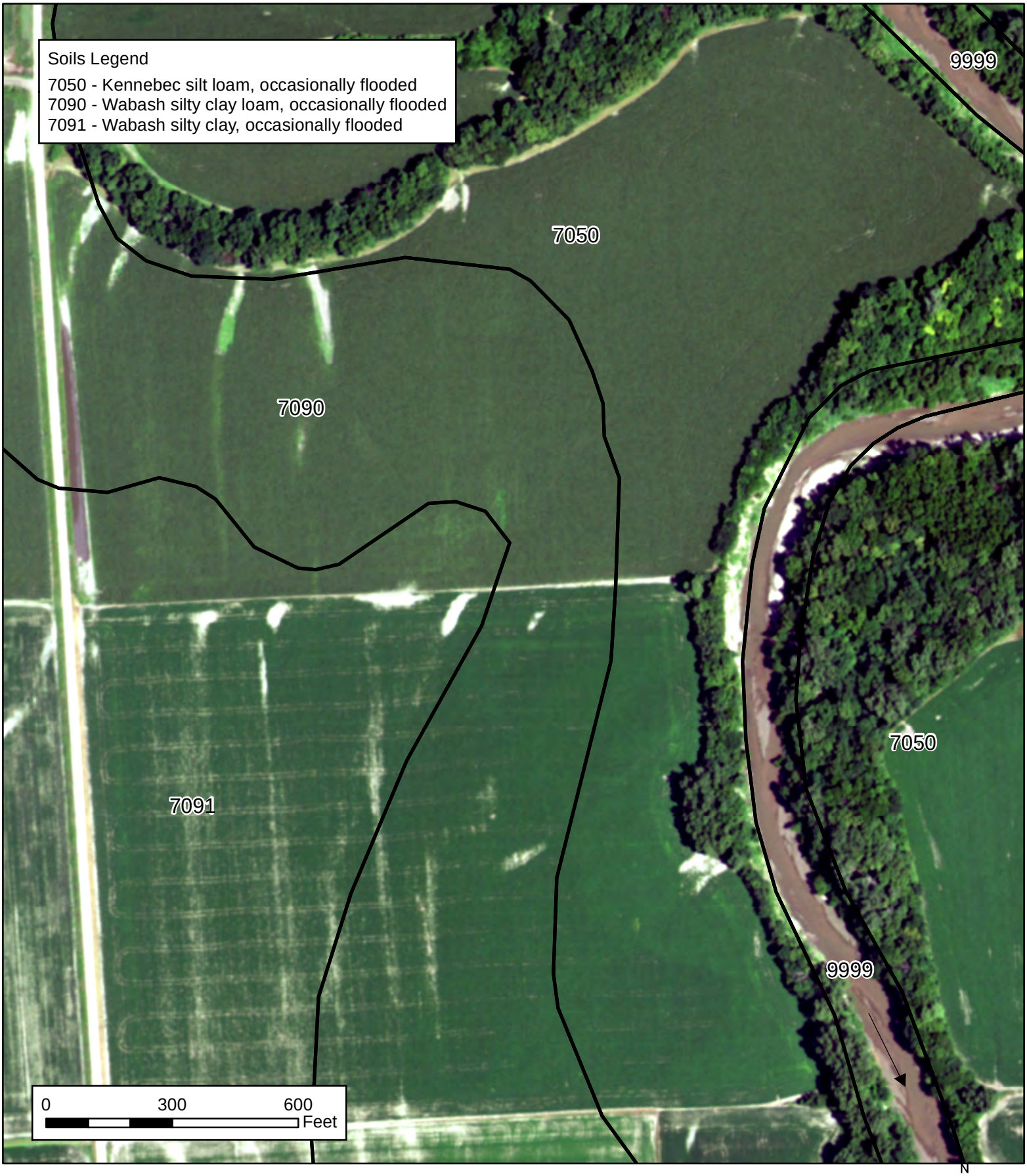
THE WATERSHED INSTITUTE

Figure 3
Field Drainage Map

**DOC Streambank Stabilization Project**
**Delaware River D24**

Date: January 2020

Source: http://www.kansasgis.org/




THE WATERSHED INSTITUTE

Figure 4
Soils Map

**DOC Streambank Stabilization Project**
**Delaware River D24**

Date: January 2020

Source: http://www.kansasgis.org/

THE WATERSHED INSTITUTE

Figure 5
Streambank Erosion Map

**DOC Streambank Stabilization Project**
**Delaware River D24**

Date: January 2020

Source: http://www.kansasgis.org/

# CONSTRUCTION SPECIFICATIONS

**Prepare for:**

**Kansas Department of Agriculture**
**Division of Conservation**

# DELAWARE RIVER D24
# STREAMBANK STABILZATION

**July 22, 2020**

**Prepared by:**

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SECTION 01001 – GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL

A. These General Requirements are incorporated herein to clarify and expand the provisions previously set forth in the Contract Documents which these specifications and drawings are a part thereof.

B. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

1. The Agreement
2. Addenda, with those of later date having precedence over those of earlier date
3. The Supplemental General Conditions
4. The General Conditions of the Contract for Construction
5. Drawings and Specifications
6. Latest version of the NRCS Specifications

C. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the more stringent condition shall be provided in accordance with the Engineer's interpretation.

D. The quality of workmanship shall be an important consideration in acceptance or rejection of work. It is expected that the Contractor shall provide qualified workmen who can produce a first quality project, as defined by approved samples. Work that fails to achieve a first quality standard may be considered defective and rejected. Such work shall be removed and replaced with new work of first quality, as defined by approved samples.

E. The Contractor, being experienced in his/her trade, prior to submitting his/her bid, having made an inspection of the existing facilities and conditions; a thorough review of the Contract Documents; understanding that all systems are new; acknowledges that the installation of these systems must be complete and operational. Accordingly, all necessary parts, equipment, accessories and components must be supplied and installed, and must pass all final testing and operations. If a system component is missing in the Contract Documents, notify Engineer for clarification.

1.2 DRAWINGS AND SPECIFICATIONS

A. Do not scale drawings for dimensions. Accurately layout such work from dimensions indicated on engineering drawings or by use of field verified dimensions. Consult the Engineer for interpretations concerning locations of equipment.

B. Where drawings indicate a portion of the work and the remainder is shown in outline, the parts drawn out apply to other like portions of the work. Where detail is indicated by starting only, such detail shall continue to apply throughout the courses or parts in which it occurs and apply to similar parts of work unless otherwise indicated.

C. Unless otherwise indicated, a detail indicates the general application of work at all locations where it logically applies, and other related work incident thereto shall be provided as

required to fully complete the work in a manner consistent in the detail and other related details, and as approved by Engineer.

1.3 ENGINEER'S SELECTION AND APPROVAL OF MATERIALS

A. Where approval of Engineer for material or equipment is required, secure such approval prior to bidding in a written request.

B. The aesthetic values of every material and installation, such as shape, proportion, texture, finish and color, will be an important consideration to the Engineer and his/her decisions concerning same shall be final, within the scope of the Contract Documents.

1.4 APPROPRIATE MATERIALS AND INSTALLATIONS

A. Furnish materials and equipment that have been properly inspected and tested in accordance with accepted industry standards. Make field laboratory test where specified herein, the cost of such being paid for by the Contractor, unless otherwise specified.

B. Before submitting any bids, the Contractor, and the Contractor's subcontractors and material suppliers shall observe the drawings and project manual and should any material and/or its installation be indicated or specified in a manner not approved by the material manufacturer, notify the Engineer and receive his/her instructions.

1.5 SITE ACCESS

A. Contractor shall provide adequate access to the site at the locations shown on the attached map, or other access routes that may be negotiated with individual homeowners by the contractor with approval of the Department of Agriculture Division of Conservation (hereinafter, the "Sponsor") or Contracting Officer.

1.6 USE OF SITE

A. Site storage shall be confined to areas indicated on the site plan or as directed by Sponsor.

B. The Contractor shall obtain and pay for any additional storage or work areas needed for construction operations.

C. The Contractor shall be responsible for site maintenance within the construction area. Site maintenance includes trash pickup, and other actions that are required to maintain a neat and orderly site.

D. The Contractor shall be responsible for maintenance beyond the construction area for areas affected by construction operations. Maintenance includes removal of trash, mud, gravel, and other debris.

E. The Contractor is responsible for the security of the work area and for any building materials and equipment stored on the site. Maintain security of existing buildings where affected by work of this Contract.

1.7 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall take charge of and assume full responsibility for proper protection of the construction areas.

B. Protect existing buildings and previously placed work by suitable coverings or other protections during installation of subsequent work. Clean off any foreign materials accidentally deposited on finish surfaces and, where such would stain, corrode or otherwise disfigure, clean it immediately with material that will not damage finished work.

C. Protect work in place requiring job finishing until such finishing has been completed. In cold weather, protect work form damage from frost and freezing. In hot weather, protect work from rapid drying.

D. Dumping on site of any liquid wastes including oils, fuels, concrete or mortar cleaning activities, paint, etc., is prohibited.

1.8 INSTALLATION

The Contractor shall:

A. Furnish, apply, install, connect, erect, clean and condition manufactured articles, materials and equipment per manufacturer's printed directions, unless otherwise indicated or specified.

B. The manufacturer's printed directions must be on job prior to and during installation of materials and equipment.

C. Make field check of actual dimensions before fabricating products.

D. Install materials only when conditions of temperature, moisture, humidity, and condition of adjacent components are conducive to achieving best installation results.

E. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking or other disfigurement.

F. Fabricate and install materials true to line, plumb and level, unless indicated otherwise. Leave finished surfaces smooth and flat or of smooth contour where indicated, free from wrinkles, warps, scratches, dents and other imperfections.

G. Conduct work in a manner to avoid injury to previously placed work.

1.9 CLOSING-IN WORK

A. Notify the Engineer to inspect any work when placing of subsequent work would prevent observation of previous work.

1.10 DEFECTIVE WORK

A. Unless the Engineer grants permission to repair any defective work, remove defective work from project and replace with new work in accordance with Contract Documents. If permission is granted, repair according to Engineer's direction. Permission to repair any such work shall not constitute a waiver of Engineer's right to require complete replacement of

defective work if repair operation does not restore quality and appearance of member or surface to Engineer's satisfaction.

1.11 UNSUITABLE CONSTRUCTION CONDITIONS

A. During unfavorable weather, wet ground, or other unsuitable construction conditions, the Contractor shall confine operations to work which will not be affected adversely thereby. No portion of the work shall be constructed under conditions which would adversely affect the quality of efficiency thereof, unless special means of precautions are taken by the Contractor to perform the work in a proper and satisfactory manner.

1.12 PERFORMANCE

A. Where Drawings and/or Specifications designate a standard of performance, the completed installation shall perform at least to the designated standard.

1.13 TESTS OF MATERIALS

A. Furnish materials and equipment that have been properly inspected and tested in accordance with accepted industry standards. Make field or laboratory tests where specified herein, the costs of such being paid for by Contractor, unless otherwise specified.

B. Should such tests or visual observation indicate failure of materials or construction to meet requirements of the Drawings and/or Specifications, Contractor shall make and pay for additional tests, as directed by Engineer until compliance has been proven, and should such work fail to comply, Contractor shall replace it at his/her expense.

1.14 RECEIVING AND STORING MATERIALS

A. On receipt of materials, check for in-transit damage in ample time to replace any damaged materials prior to installation time.

B. Store materials in a manner to prevent deterioration, staining, soiling, and intrusion of foreign materials. Provide waterproof, well-ventilated enclosures for materials subject to deteriorating by dampness. Adequately protect those materials subject to damage by freezing and frost.

C. Remove from premises and replace with new, any materials showing deterioration or damage.

1.15 EXISTING UNDERGROUND INSTALLATIONS

A. Existing underground installations such as water mains, gas mains, oil pipelines, sewers, telephone lines, power lines, and buried structures in the vicinity of the work to be done hereunder are indicated on the drawings only to the extent such information has been made available to or discovered by the Engineer in preparing the Drawings. There is no guarantee as to the accuracy or completeness of such information, and all responsibility for the accuracy or completeness thereof is expressly disclaimed. Generally, service connections are not indicated on the Drawings.

B. It is the Contractor's responsibility to contact 1-800-DIG-SAFE. The Contractor shall be solely responsible for contacting all utility companies and locating all existing underground installations, including service connections, in advance of excavating or trenching, by contacting the owners thereof and prospecting. The Contractor shall use his/her own information and shall not rely upon any information shown on the drawings concerning existing underground installations.

C. Any delay, additional work, or extra cost to the Contractor caused by existing underground installations shall not constitute a claim for extra work, additional payment, or damages.

1.16 PRESERVATION OF MONUMENTS AND STAKES

A. The Contractor shall carefully preserve all monuments, benchmarks, property markers, reference points, and stakes. In case of his/her destruction thereof, the Contractor will be charged with the expense of replacement and shall be responsible for any mistake or loss of time that may be caused. In the cases of permanent monuments or benchmarks which must be removed or disturbed, the Contractor shall furnish material and assistance for the proper replacement of such monuments or benchmarks.

1.17 APPROPRIATE MATERIALS AND INSTALLATIONS

A. Before submitting bid, Contractor, his/her subcontractors, and material suppliers shall observe existing conditions, Specifications, Drawings, and Addenda thereto and should any material and/or its installation be indicated or specified in a manner not approved by the material manufacturer, notify Engineer and receive his/her instructions. Failing to do so, Contractor shall provide other equivalent materials, suitable for the installation, as selected by Engineer or if not discovered until after installation, Contractor shall replace materials with such other equivalent suitable materials as approved by Engineer, and in either event at no added cost. If additional or other types of work are required for desired satisfactory results and specified guarantee, the additional or other work shall be included in bid amount and shall not constitute a basis of claim for "extra work" during or upon completion of this project.

1.18 CONSTRUCTION REQUIREMENTS

A. Staking: A survey with benchmarks located is included in the Drawings for Contractor's use. All other surveying and staking will be the responsibility of the Contractor at his/her own expense unless otherwise stated in the Drawings.

B. Geotechnical Reports: Subsurface data has not been obtained for design purposes. The bidder shall make his/her own interpretations of existing conditions and shall be expected to obtain additional data at his/her own expense if required to satisfy himself/herself as to the conditions to be encountered.

C. Storage: All equipment and materials to be incorporated into the work shall be stored in a manner to prevent damage from the elements, work, or handling. The Engineer will not accept damaged or deteriorated materials. All storage, to include Owner-provided items, will be at the expense of the Contractor.

1.19 ADMINISTRATIVE REQUIREMENTS

A. Coordination: The Contractor shall perform the activities necessary to properly coordinate the material and equipment procurement and the work provided by him/her and his/her subcontractors. The Contractor also shall coordinate his/her work with the Sponsor when required for the best overall coordination of the project.

B. Progress Meetings: The Contractor shall hold on-site progress meetings with the Sponsor and Engineer, to discuss job-related problems. Persons designated by the Contractor to attend and participate in the meetings shall have all required authority to commit the Contractor to solutions agreed upon in the project meeting.

C. Progress Schedule: The Contractor shall submit to the Sponsor, prior to construction, a progress schedule. The schedule shall be detailed enough to reasonably allow the Sponsor to follow the progress of the work. The schedule shall be updated periodically as required by the work and as requested by the Sponsor.

D. All materials resulting from clearing and grubbing activities shall be removed and disposed of in an acceptable manner at an acceptable facility conforming to all applicable regulations.

END OF SECTION 01001

SECTION 01002 – SPECIAL CONDITIONS

PART 1 – GENERAL

1.1 RELATIONSHIP TO GENERAL CONDITIONS

A. Should conflict occur between these Special Conditions and the General Requirements, these Special Conditions shall take precedence. When these Special Conditions modify a portion of the General Conditions, the unaltered portions of the General Conditions shall remain in effect.

1.2 LOCATIONS, LINES AND LEVELS

A. Contractor shall establish location of new work on property and establish and maintain all other grades, lines, levels, and benchmarks; check and compare all drawings, verifying grades, lines, levels, and dimensions indicated thereon, and report all inconsistencies to Engineer and receive Engineer's instructions before commencing work.

1.3 DOCUMENTS FURNISHED

A. Contractor will be responsible for obtaining all necessary Drawings and Project Manuals, including all modifications thereof, as required, including distribution to subcontractors and suppliers.

B. Contractor shall pay the actual cost of reproduction for all additional sets requested by him/her.

1.4 LAWS TO BE OBSERVED

A. The Contractor shall at all times observe and comply with all federal and state laws, local laws, ordinances, orders, decrees and regulations existing or enacted subsequent to the execution of the Contract, which in any manner affect the prosecution of the work. The Contractor and his/her Surety shall indemnify and save harmless the Department of Agriculture Division of Conservation (hereinafter, the "Sponsor"), the Sponsor's Architects, Engineers, and their representatives, agents, and employees against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by himself/herself, his/her employees, or his/her subcontractors.

1.5 CONSTRUCTION OBSERVATION

A. The undertaking of periodic site visits by the Engineer or representative shall not be construed as supervision of actual construction nor make him/her responsible for providing a safe place for the performance of work by contractors or contractor's employees, or those of suppliers or subcontractors, or for access, visits, use, work, travel, or occupancy by any person.

1.6 CONSTRUCTION COORDINATION

A. Before starting any construction, a meeting shall be held with Sponsor, Contractor, Subcontractors, and Engineer to plan and coordinate the schedule of construction and to

review intent of Contract Documents. Contractor and Subcontractor shall follow instructions received at this meeting in prosecuting the work.

END OF SECTION 01002

SECTION 01003 – SUMMARY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents
2. Type of Contract
3. Use of premises
4. Owner's occupancy requirements
5. Work restrictions
6. Specification formats and conventions

B. Related Sections include the following:

1. Division1 Section "General Requirements" for limitations and procedures governing temporary use of Department of Agriculture Division of Conservation's (hereinafter, the "Sponsor") facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work consists of the following:

1. The site work including addition of wooden, soil bioengineering, and rock structures, reconfiguration of existing streambank, planting of cover crop, mulching, and native plantings.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings.

B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.6 OWNER'S OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Homeowners will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Homeowners during

construction operations to minimize conflicts and facilitate homeowner's usage. Perform the Work so as not to interfere with Homeowners' operations.

1. Provide not less than 72 hours' notice to homeowner of activities that will affect Homeowner's operations.

1.7 WORK RESTRICTIONS

A. On-Site Work Hours: Contractor's normal working hours are acceptable. Any work expected during evenings or weekends should be coordinated with Homeowner's schedule.

1. Provide not less than 72 hours' notice to Homeowners of activities outside normal working hours.

B. Existing Utility Interruptions:

1. Notify Engineer and Sponsor not less than three days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer's written permission.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

3. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

END OF SECTION 01003

SECTION 02102 – CLEARING AND GRUBBING

PART 1 – GENERAL

1.1 WORK INCLUDED IN THIS SECTION:

A. Clearing and grubbing required for this work includes, but is not necessarily limited to:

1 Removal of trees, stumps, debris, and brush.
2 Trimming and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal.
3 Removal and disposal of miscellaneous abandoned subsurface structures and debris that may be discovered during the work.

1.2 RELATED WORK IN OTHER SECTIONS:

A. Excavating, Filling and Grading Section 02200

1.3 JOB CONDITIONS:

A. Dust Control:

1. Use all means necessary to control dust on and near the work and on and near all borrow areas.

1.4 LINES AND GRADES:

A. All clearing and grubbing shall be done within the lines and grades shown on the drawings.

PART 2 – INSTALLATION

2.1 CLEARING:

A. Contractor shall only clear trees, stumps, brush, snags and other vegetation when necessary for the installation of the overall project. All other trees and vegetation shall be left standing. Trees and vegetation to be left standing shall be protected from damage during the completion of the work.

2.2 GRUBBING:

A. In areas requiring excavation, Contractor shall grub and remove material to a depth necessary to complete excavation to the limits indicated and complete required work. Material to be grubbed shall include stumps, roots larger than one inch in diameter, matted roots, and any miscellaneous subsurface structures and debris that may be encountered. Trees shall be Trees and plants to be relocated: Any tree or plants moved shall be done in a timely manner so as not to delay construction progress. The Contractor shall take extra measures to protect trees during the relocation by erecting barricades, staking, trimming, etc. as required. Trees shall be completely removed with stump ground down to a minimum depth below the grade of six (6) inches.

2.3 PROTECTION:

A. Contractor shall take precautions to protect any trees, vegetation, structures, benchmarks and survey stakes, and utilities not intended to be removed. Prior to beginning work, Contractor shall be responsible for field verifying that there are no utilities within the work area. Contractor shall be responsible for repairing and/or replacing, at no additional cost to the Department of Agriculture Division of Conservation (hereinafter, the "Sponsor"), items that are damaged during construction that were not intended to be removed.

2.4 DISPOSAL OF MATERIAL:

A. All materials resulting from clearing and grubbing activities shall be removed and disposed of in an acceptable manner at an acceptable facility conforming to all applicable regulations. Materials suitable for use as aquatic habitat enhancement (stumps, logs, etc.) shall be stockpiled as directed by the Engineer.

PART 3 – MEASUREMENT AND PAYMENT

3.1 METHOD OF MEASUREMENT:

A. The quantity of Clearing and Grubbing will not be measured for payment unless the construction limits are changed. Clearing and Grubbing shall be considered subsidiary to Excavating, Filling, and Grading. No adjustment will be made for changes involving less than 0.1 acre (0.04 ha).

3.2 BASIS OF PAYMENT:

A. The amount of work completed and approved, as stated above, shall be paid for as part of the contract lump sum price. Such payment shall constitute full compensation for all labor, equipment, tools and all other items necessary and incidental to completion of the work.

B. In the event of a change in construction limits, the Contractor shall submit a unit price for Clearing and Grubbing to be approved by the Engineer.

END OF SECTION 02102

SECTION 02200 – EXCAVATING, FILLING AND GRADING

PART 1 – GENERAL

A.1 WORK INCLUDED IN THIS SECTION:

A. Excavating, filling and grading required for this work includes, but is not necessarily limited to:

1. Excavating, filling and backfilling for streambank stabilization.

2. Rough and finish grading of streambank.

3. Preparation of sub-grade for areas to be seeded, planted with trees and shrubs, and/or mulched.

1.2 RELATED WORK IN OTHER SECTIONS:

A. Clearing and Grubbing: Section 02101

1.3 JOB CONDITIONS:

A. Dust Control:

1. Use all means necessary to control dust on and near the work and on and near all offsite borrow areas, if such dust is caused by the Contractor's operations during performance of the work, or if resulting from the condition in which the Contractor leaves the site.

B. Protection: Use all means necessary to protect all materials of this section before, during, and after installation, and to protect all objects designated to remain. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Department of Agriculture Division of Conservation (hereinafter, the "Sponsor"). Protect tops, trunks and roots of existing trees on project site which are to remain.

C. Notification: The Contractor shall notify the Engineer prior to installation of specified portions of the work to allow the inspector sufficient time to inspect the work and shall obtain approval of all material prior to commencing construction. Any portion of the work installed without inspection may be removed to allow for inspection. Any eventual difficulty or loss of time caused by the Contractor failing to meet permit requirements shall be borne solely by the Contractor.

1.4 LINES AND GRADES:

A. All excavation, filling and backfill shall be done to the lines and grades shown on the drawings.

1.5 BENCH MARKS AND MONUMENTS:

A. Maintain carefully all bench marks and reference points, which are shown on the drawings. The Contractor shall pay for the replacement of such reference points if disturbed by the Contractor during construction.

1.6 REFERENCES:

A. The publications listed below form a part of this specification. The latest revision of the following standards shall apply to work hereunder:

Associated General Contractors of America, Inc.
"Manual of Accident Prevention in Construction"

PART 2 – PRODUCTS

2.1 FILL MATERIAL, GENERAL:

A. All fill material for embankment construction shall come from onsite unless otherwise specified by the Engineer. All fill material shall be subject to approval of the Engineer.

2.2 IMPORTED FILL MATERIAL:

A. If imported fill material is required to finish embankments or sub-grade. The Contractor shall be responsible for providing a borrow area for imported fill.

2.3 TOPSOIL:

A. All areas disturbed by construction operations, which are not to be paved or rocked under this contract, shall be provided with a 12-inch uncompacted layer of topsoil approved by the Engineer. Topsoil from areas within the project limits may be stockpiled and used where such topsoil is considered satisfactory to sustain plant growth. Additional materials, if required, shall be brought to final grade, as shown on the drawings, and shall be lightly compacted.

2.4 OTHER MATERIAL:

A. All other materials not specifically described, but required for proper completion of the work of this section, shall be as selected by the Contractor, subject to the approval of the Engineer.

PART 3 – INSTALLATION

3.1 GENERAL:

A. Familiarization: Prior to all work in this section, become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this section.

B. Backfilling Prior to Approval

1. Do not allow or cause any of the work installed to be covered up or enclosed by work of this section prior to all required inspections, tests, and approval.

2. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Sponsor.

C. Site Drainage: During construction, excavation and fill shall be performed in a manner and sequence that will provide drainage at all times.

3.2 EXCAVATION AND FILLING:

A. General: Excavation, as hereinafter specified, shall comprise the satisfactory removal and disposition of all material. After topsoil removal has been done, excavation of every description and of whatever substances encountered, shall be performed to the lines and grades indicated on the drawings. After backfilling of key trenches has been completed, any surplus of excavated material shall be known as "waste" and shall be disposed of at the location approved by the Engineer. Any additional fill material required, that is not available from excavation within the immediate project area, shall be obtained from borrow area locations approved by the Engineer. During construction, excavation, key trenching, and backfilling shall be performed in a manner and sequence that will provide drainage at all times.

1. Classification of Excavation: Excavation shall be unclassified.

2. Earth and Rock Excavation shall be unclassified. Earth and Rock Excavation shall include earth, clay, silt, sand, gravel, hard pan, loose shale, loose stone masses, boulders, rock material in ledges, bedded deposits, unstratified masses, and conglomerate deposits so firmly cemented that they possess the characteristics of solid rock, which cannot be removed without systematic drilling.

B. Depressions Resulting from Removal of Obstructions: Where depressions result from, or have resulted from, the removal of surface or subsurface obstructions, open the depression to equipment working width and remove all debris and soft material, as directed by the Engineer.

C. Sloped Surfaces: Sloped ground surfaces steeper than 1 vertical to 4 horizontal, on which fill is to be placed, shall be plowed, stepped (benched) or broken up, in such manner that the fill material will bond with the existing surface.

D. Fill and Backfill: All fill or backfill material shall consist of earth or other approved material with all undesirable material removed. Unless otherwise specified, all fill shall be uniformly placed uniform layers to achieve a 3H:1V slope or as specified by the Drawings and then compacted in 9-inch lifts by equipment.

E. Over-excavation: Backfill and compact all over-excavation areas, as specified for fill, at no additional cost to the Sponsor.

F. Unfavorable Weather: Ground frozen or too wet - do not place, spread, or roll any fill material during unfavorable weather conditions. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.

G. Overbank flow: To prevent erosion of finished slopes from overland flow, provide berms and rock chutes or slope drain devices along sections of disturbed bank where drainage is towards the disturbed bank.

H. Soften Sub-grade: Where soil has been softened or eroded by flooding or placement during unfavorable weather, remove all damaged areas and re-compact as specified for fill and compaction below.

I. Dewatering: Provide and maintain at all times during construction, ample means and devices with which to promptly remove and dispose of all water from every source entering the excavations or other parts of the work. Dewater by means, which will insure dry excavation and the preservation of the final lines and grades of bottoms of excavation.

3.3 BACKFILLING:

A. General Backfill: Unless otherwise specified by the Drawings, all channel slopes shall be shaped to a 1-foot vertical to 3-foot horizontal slope which smoothly transitions into the existing slope at each end of the project.

B. Responsibility of Contractor for Backfill Settlement:

1. The Contractor shall be responsible for the satisfactory compaction and maintenance of all backfill of any description required under this contract. If, prior to the final acceptance of this entire contract, any backfilled areas are found to have settled, they shall immediately be reworked by the Contractor and restored to the specified grades.

3.4 FINISH GRADING

A. The finishing of side slopes, cuts and fills shall be to reasonably smooth uniform surfaces that will merge with the adjacent terrain without noticeable break. Finishing shall be done in accordance with grades shown on the drawings, and without variations that are readily discernible.

B. Finish grading shall be performed to the lines and grades shown on the drawings. All areas disturbed by the Contractor during construction operations shall be bladed smooth, shaped, and compacted, as specified herein before. The finished grade shall provide for topsoil that is free from perennial vegetation and is loosened to depth of twelve (12) inches for areas disturbed under this contract.

C. Newly graded areas shall be protected from traffic, erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades reestablished to the required elevations and slopes. Damaged areas shall be re-vegetated, if necessary.

D. Haul roads into the work sites shall be ripped to loosen compacted soils prior to removing equipment from the project site.

3.5 BORROW AND SPOIL AREAS:

A. Borrow and spoil areas shall be graded to promote positive drainage at the completion of the work. No borrow or spoil slopes shall be greater than 1-foot vertical to 3-foot horizontal.

B. Erosion controls shall be implemented to prevent erosion into waterways.

C. Borrow and spoil areas shall be seeded and mulching shall be applied at the completion of construction.

3.6 CLEANING UP:

A. Upon completion of the work of this section, immediately remove all debris and excess earth materials from the site.

PART 4 – MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT:

A. Work will be measured by bid quantity of cubic yards of soil. Contractor shall maintain weight tickets for soil trucked to the site. Material moved on site by earth moving equipment will be paid at the contract unit price and units indicated.

4.2 Basis of Payment:

A. The amount of work completed and approved, as stated above, shall be paid for at the contract unit price. Such payment shall constitute full compensation for all labor, equipment, tools and all other items necessary and incidental for the completion of the work.

END OF SECTION 02200

SECTION 02900 – PROTECTION OF SOIL AND VEGETATION

PART 1 – GENERAL

1.1 WORK INCLUDED IN THIS SECTION:

A. This section governs measures and sets environmental protection performance, restoration, and design standards for protecting and restoring native soils and vegetation that are impacted by heavy construction equipment and other site construction activities.

1.2 RELATED WORK IN OTHER SECTIONS:

A. Excavating, Filling and Grading Section 02200

1.3 REFERENCES:

A. The following standards are referenced directly in this section. The latest version of these standards shall be used.

1. NRCS Planning and Design Manual, NRCS, 1998

2. Home Landscapes, Planting, Design and Management, E.C. Martin, Jr., and Pete Melby, Timber Press

3. American Standard for Nursery Stock

PART 2 – PRODUCTS:

2.1 STANDARDS

A. All materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations. The use of any herbicide shall follow directions given on the herbicide label. In the case of a discrepancy between these specifications and the herbicide label, the label shall prevail.

2.2 MATERIALS

A. Prior to delivery of any materials to the site, submit to the Engineer a complete list of all materials to be used during this portion of the work. Include complete data on source, amount and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the Engineer.

PART 3 – INSTALLATION

3.1 GENERAL

A. Selective Clearing is removal of undesirable trees and underbrush around specimen trees and brush as designated on the drawings and/or instructed by the Engineer.

B. Soil and specimen trees as shown on the drawings and/or instructed by the Engineer to save, shall be protected from damage incident to clearing, grubbing, and construction operations.

3.2 PLANT PRESERVATION

A. The Engineer shall mark all plant materials on the site to be saved and/or relocated. No plant material may be removed from the site prior to the Engineer's inspection. All plant material to be saved/or relocated will be protected from injury to the roots and to the branches, to a distance five feet beyond the drip-line. No grading, trenching, pruning, or storage of materials may go in this area, except as approved by the Engineer.

B. Trees and plants to be relocated: Any tree or plants moved shall be done in a timely manner so as not to delay construction progress. The Contractor shall take extra measures to protect the tree during the relocation by erecting barricades, staking, trimming, etc. as required.

3.3 FIELD QUALITY CONTROL

A. Qualifications of workmen: provide at least one person who shall be present at all times during execution of this portion of the work, who shall be thoroughly familiar with this type of work and the type of materials being used. Said person shall be competent at identification of soils and plant materials to be removed and to be preserved during the season (summer, winter) work is to be completed. Said person shall also direct all work performed under this section.

END OF SECTION 02900

SECTION 02901 – CHANNEL BANK VEGETATION

SUMMARY: The work described herein consists of furnishing, transporting, and installing seeds, trees, and other materials as required for the rehabilitation and establishment of stream side vegetation. It is the Contractor's responsibility to perform soil preparation, cover crop planting, native grass planting, bare root seedling planting, management, and such additional extra and incidental work as may be necessary to complete the work in accordance with the specification and plans. The Contractor shall furnish required materials, equipment, tools, labor, and incidentals, unless otherwise provided in the specifications or Drawings.

PART 1 – GENERAL

1.1 DESCRIPTION:

A. Planting required—cover crop, native grass, and trees—is indicated as plantings. Plantings on the Drawings and, in general, include, but are not limited to:

1. Procurement, storage and protection of listed grass seed.

2. Preparation of planting sites.

3. Planting areas.

4. Maintenance of plantings installed by Contractor.

B. Related Work in Other Sections:

1. Clearing and Grubbing: Section 02102

2. Excavating, Filling and Grading : Section 02200

1.2 QUALITY ASSURANCE–NATIVE GRASS SEEDING

A. Qualification of Workmen: Provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct work performed under this Section.

B. Standards:

1. Seeds shall meet or exceed the specification of Federal, State, and County laws requiring inspection for plant disease and insect control.

2. All seeds shall be true to species and shall be tagged with the name and percent pure live seed in accordance with accepted industry standards for grass seed.

3. Seed shall meet or exceed specifications of Federal, State and County laws requiring inspection for plant disease and insect control and shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

1.3 QUALITY ASSURANCE–TREE PLANTING

A Qualification of Workmen: Provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct work performed under this Section.

B Standards:

1. Bare root seedlings and cuttings must be grown from locally adapted seed or cuttings of known origin and meet height and caliper standards listed in the NRCS Kansas Forestry Technical Note KS-9.

1.4 JOB CONDITIONS:

A. Time of Planting:

1. The Contractor shall complete cover crop seeding immediately following construction during favorable weather conditions.

2. The Contractor shall complete native grass seeding during normal and accepted planting seasons listed in the NRCS Critical Area Planting – Practice 342. And during favorable weather conditions.

3. The Contractor shall complete tree plantings during normal and accepted planting seasons listed in the NRCS Kansas Forestry Technical Note KS-9 and during favorable weather conditions.

1.5 SUBMITTALS:

A. Materials list include, but not limited to, the following:

1. Quantities, Signed and Dated by Supplier(s).

1.6 DELIVERY, STORAGE AND HANDLING:

A. Delivery, Storage and Handling:

1. The Contractor shall deliver seed, bare root seedlings, and cuttings to the project site in good condition.

2. The Contractor shall use all means necessary to protect the seed, bare root seedlings, and cuttings before, during, and after installation and to protect the installed work and materials of other trades.

B. Replacement: In the event of damage during construction, the Contractor shall immediately make repairs and replant necessary to the approval of the Engineer and at no additional cost to the Department of Agriculture Division of Conservation (hereinafter, the “Sponsor”).

1.7 SITE DISTURBANCES:

A. It is the Contractor's responsibility to take precautions insuring that equipment and vehicles do not disturb or damage existing grading, seeding, or other site improvements.

B. The Contractor shall repair and/or return to original condition any damage at no cost to Sponsor.

PART 2 – MATERIALS

2.1 PLANT MATERIALS:

A. General: Furnish seed that is true to name and type representative of the species or variety.

B. Plant materials

1. Native grass seeding shall follow recommendations in NRCS Critical Area Planting – Practice 342.

2. Bare Root seedlings and tree cuttings shall follow recommendations in Kansas Forestry Technical Note No. KS-9.

3. Cover crop seeding shall follow recommendations in NRCS Cover Crop – Practice 340.

C. Mulching: Other materials not specifically described but required for a complete and proper planting installation shall be as selected by the Contractor, subject to the approval of the Engineer

2.2 WATER:

A. Water, hose, and other watering equipment required for the work shall be furnished by the Contractor.

2.3 HERBICIDE:

A. Herbicides shall be applied according to manufactures label instructions and adhere to State, Federal, and local laws.

PART 3 – INSTALLATION

3.1 SURFACE CONDITIONS:

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where these installations may properly commence.

2. Verify that planting, seeding and related construction work may be completed in accordance with the original design and the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Engineer.

2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.2 SPREADING OF TOP SOIL:

A. Finish Grading: Finish grading will be performed according to Section 02002 of these Specifications, in graded areas.

3.3 PLANTING NATIVE GRASS SEED:

A. Preparation:

1. Roughly grade seed beds with equipment, leave few ridges and depressions and making areas into a continuous, firm plane that ensures proper drainage.

B. Planting:

1. Native grass seed shall be planted by hand broadcast method as approved by the Engineer. Seeding of native grass should follow recommendation in NRCS Critical Area Planting – Practice 342.

2. For site-specific native grass mix, reference the design drawings.

3.4 PLANTING BARE ROOT SEEDLINGS

A. Preparation

1. Roughly grade channel bank slope with equipment, leave few ridges and depressions and making areas into a continuous, firm plane that ensures proper drainage. The planting area must be free of living sod and perennial weeds before planting. Vegetation from native grass seeding is acceptable.

B. Planting

1. Cuttings and bare root seedlings should follow recommendations in Kansas Forestry Technical Note KS-9.

2. For site-specific information on cutting and bare root seedlings, reference the design drawings.

3.5 MULCHING:

A. Mulching shall immediately follow native grass seed planting.

B. Mulch shall be an organic substance capable of eventual complete decay. The mulch shall be native prairie hay, brome hay, or straw and shall be applied at a rate of 4,000 pounds per acre. Native prairie hay is the preferred mulch.

C. Mulch shall be evenly distributed over the entire seeding area.

3.6 INSPECTION:

A. In addition to normal progress inspections, the Sponsor shall schedule and conduct the following formal inspections, giving the Engineer at least 24-hours prior notice of readiness for inspection:

1. Inspection of plant locations, to verify compliance with the Drawings.

2. Final inspection after completion of native grass seeding and final inspection after completion of cuttings and bare root seedling plantings; schedule these inspections sufficiently in advance, and in cooperation with the Engineer, so that final inspections may be conducted within 24 hours after completion of native grass seeding and tree planting.

3. Final inspection at the end of the maintenance period provided that previous deficiencies have been corrected. The maintenance period consists of the first three years following native grass seeding and tree planting.

3.7 CLEAN-UP:

A. During the progress of this work, and upon completion, the Contractor shall thoroughly clean the project area and remove and properly dispose of resultant dirt, debris and other waste materials.

PART 4 – MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT:

A. The quantity of seeding and mulching will be measured in pounds of pure live seed and mulch applied. Seeding and Mulching shall be considered subsidiary to grass planting and the overall construction project.

4.2 BASIS OF PAYMENT:

A. The amount of work completed and approved, as stated above, shall be paid in lump sum as part of the contract unit price. Such payment shall constitute full compensation for all labor, equipment, tools and all other items necessary and incidental for the completion of the work. Two payment requests should be made based on native grass seeding and tree planting complete. The first payment request shall follow native grass seeding and mulching. A separate payment request shall be made after the cuttings and bare root seedlings are planted.

END OF SECTION 02901

SECTION 02906 – MULCHING

PART 1 – GENERAL

1.1 DESCRIPTION:

A. Mulching is the application of organic material to the soil to protect it from raindrop and sheet flow erosion. Mulching shall be used on native grass and tree planting areas when so directed by the engineer. In general, mulching shall include, but is not limited to:

1. Procurement, storage and protection of all listed material

2. Maintaining plantings installed by Contractor.

B. Related Work in Other Sections:

1. Excavating, Filling and Grading : Section 02200

2. Channel Bank Vegetation: Section 02901

C. Purpose:

1. This practice shall be used to reduce soil erosion, aid in seed germination and establishment of plant cover, and conserve soil moisture.

1.2 QUALITY ASSURANCE:

A. Qualification of Workmen: Provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct work performed under this Section.

B. Standards:

1. Mulch materials shall be native prairie hay, brome hay, wheat straw, or hydromulch. Materials should be of good quality and free from mold or decay.

1.3 JOB CONDITIONS:

A. Site preparations: Soil surface shall be prepared prior to the application of mulch in order to achieve optimum contact between soil and mulch. Areas to be mulched should be reasonably free from rills and gullies.

B. Time of mulching: Mulching shall be performed during favorable weather conditions immediately following final grading.

1.4 SUBMITTALS:

A. Materials list shall include, but not limited to, the following:

1. Hay or straw quantities by weight with scale ticket, Signed and Dated by Supplier(s).

2. Hydromulch bag labels.

3. As-Installed Plan: During course of the installation, carefully record in red outline on a print of the planting drawings actual mulching location.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Pick up materials in accordance with any special handling instructions and deliver to project site in good condition.

B. Use means necessary to protect plant materials before, during, and after installation and to protect the installed work and materials of other trades.

1.6 SITE DISTURBANCES:

A. Take precautions to insure that equipment and vehicles do not disturb or damage existing grading, seeding, plantings or other site improvements.

B. Repair and/or return to original condition damage at no cost to Owner.

PART 2 – MATERIALS

2.1 MULCH MATERIALS.

A. General: Materials shall consist of natural, biodegradable material such as plant residue to include, but not limited to, the following:

1. Native Prairie Hay

2. Brome Hay

3. Wheat Straw

B. Materials shall be free from diseased plant residue and noxious weed seed.

C. Hydromulch shall be Flexterra HP FGM, manufactured by Profile Products, LLC. or approved equal.

D. Miscellaneous Materials: Materials not specifically described but required for a complete and proper planting installation shall be as selected by the Contractor, subject to the approval of the Engineer

PART 3 – INSTALLATION

3.1 SURFACE CONDITIONS:

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where these installations may properly commence.

2. Verify that planting, seeding and related construction work is completed in accordance with the original design and referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Engineer.

2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.2 GRADE SURFACE:

A. Finish Grading: Finish grading will be performed according to Section 02200 of these Specifications, in areas that are graded.

B. Fine Grading: Fine mechanical grading shall be conducted on areas where it can be done without posing a danger or hazard to the equipment and operator.

3.3 APPLICATION TIMING:

A. Mulch shall be applied upon completion or within 24 hours of native grass seeding.

B. Hydromulch shall be applied with both cover crop and native grass seeding following construction

3.4 APPLICATION RATE:

A. Mulch shall be applied at the rate of 4,000 pounds per surface acre.

B. Hydromulch shall be applied at the rate specified on the Drawings, or bag label for slopes greater than 1:1.

3.5 CRIMPING:

A. If required by the Engineer, mulch shall be crimped immediately after spreading with a mulch crimper or equivalent devise consisting of a series of dull flat blades with notched edges spaced approximately 8 inches apart. The mulch shall be crimped into the soil to a depth of 1 to 3 inches. Crimping shall be performed in areas where it can be done safely, without posing a danger or hazard to the operator or equipment.

3.6 INSPECTION:

A. In addition to normal progress inspections, schedule and conduct the following formal inspections, giving the Engineer at least 24-hours prior notice of readiness for inspection:

1. Final inspection after completion of seeding, planting and mulching; schedule this inspection sufficiently in advance, and in cooperation with the Engineer, so that final inspection may be conducted within 48-hours after completion of mulching.

2. Final inspection at the end of the maintenance period provided that previous deficiencies have been corrected.

3.7 MAINTENANCE:

A. General: The Contractor shall inspect the site within 48 hours of precipitation event that produces 0.5 inches or more of rain in a 24-hour period. Mulch that is displaced shall be reapplied and anchored. Maintenance shall be completed as soon as possible with consideration of site conditions.

B. Maintain seeding, planting, and mulching starting with the planting operations and continuing for 30 calendar days after mulching is complete and approved by the Engineer.

C. Work Included:

1. Protect planted areas against damage, including erosion, and drought by providing and maintaining proper safeguards such as periodic watering.

D. Extension of Maintenance Period: Continue the maintenance period at no additional cost to the Owner until all previously noted deficiencies have been corrected, at which time the final inspection shall be made.

3.8 CLEAN-UP:

A. During the progress of this work, and upon completion, thoroughly clean the project area and remove and properly dispose of resultant dirt, debris and other waste materials.

END OF SECTION 02906

SECTION 02945 – WOOD TOE REVETMENT

SUMMARY: The work described herein consists of harvesting and installing tree revetments for bank toe stabilization. The Contractor shall perform all soil preparation, placement, and such additional extra and incidental work as may be necessary to complete the work in accordance with the specification and plans. The Contractor shall furnish all required materials, equipment, tools, labor, and incidentals, unless otherwise provided in the specifications or Drawings.

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Tree revetments are structures constructed from interlocking tree materials. Located along the outside meander bend, tree revetments are designed to withstand water velocities and reduce hydraulic shear stress. These structures are intended to mimic natural systems and may improve aquatic habitat. This method should only be considered if the natural materials are found on-site. This work shall consist of furnishing and installing the necessary materials as specified in the Drawings. This section includes but is not limited to:

1. Harvesting of wood

2. Preparation of placement sites

3. Installing tree revetments

B. Related Work in Other Sections:

1. Clearing and Grubbing: Section 02102

2. Excavating, Filling and Grading: Section 02200

1.2 QUALITY ASSURANCE:

A. Qualification of Workmen: Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct all work performed under this Section.

B. Wood Requirements: Trees are to be provided by the landowner and harvested by the contractor. Trees shall be sound and free of excessive decay. Preferred, decay resistant tree include red cedar (*Juniperus virginiana*), red mulberry (*Morus rubra*), osage orange (*Maclura pomifera*), or honey locust (*Gleditsia triacanthos*). Trees shall have a minimum diameter at breast height (DBH) as specified in the drawings. The minimum effective length of tree with root wad is 30 feet unless otherwise shown in the drawings. Contractor shall keep branches intact as much as possible. Contractor may trim branches as needed to facilitate transportation to installation site. The footer log should have a DBH of at least the revetment trunk.

PART 2 - MATERIALS

2.1 PLANT MATERIALS:

A. General: Existing wood materials should be located on-site. Care should be taken to select trees that are free of physical damage and excessive decay.

2.2 HARVESTING WOOD:

A. Trees

1. Trees should be removed by machinery so that the root mass and trunk are intact. The trunk then must be cut to the appropriate length.

B. Transportation, Storage, and Handling:

1. All wood materials are located on-site and should be removed by machinery provided by contractor.

C. Site Disturbances:

1. Take precautions to ensure that equipment and vehicles do not disturb or damage existing grading, seeding, or other site improvements.

2. Repair and/or return to original condition any damage at no cost to Sponsor.

PART 3 - INSTALLATION

3.1 SURFACE CONDITIONS:

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where these installations may properly commence.

2. Verify that planting, seeding and related construction work may be completed in accordance with the Drawings and the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PLACEMENT

A. Wood

1. The first layer of revetment tree should be oriented parallel to stream flow. These logs shall be spaced along the entire structure width. Once the first layer of trees is placed, voids shall

be filled using soil and small limbs, logs, and brush. Repeat this layer per design specifications

2. The second layer of wood toe revetment should be oriented upstream to stream flow. Logs shall not extend out from the first layer, so woody debris does not catch the wood revetment material and cause it to dislodge. Once the second layer of trees is placed, voids shall be filled using soil and small limbs, logs, and brush. Repeat the layer per design specifications.

3. If specified, the contractor shall anchor the footer log into the streambank using a commercially manufactured earth anchoring system specified elsewhere in the contract documents. The engineer shall approve use of other materials or methods prior to installation. Each footer log shall be secured to the streambank by galvanized cable and two anchors. The cables will be clamped together by three galvanized clamps at each connection. Each cable and anchor shall be approximately 1-foot from each end of the foot log. Anchors should be installed at a 45-degree angle into the streambank and far enough so that the cable is tight, and the footer log will not move.

3.3 SPREADING OF TOPSOIL:

A. Finish Grading: All finish grading will be performed according to Section 02002 of these Specifications, in all graded areas.

3.4 INSPECTION:

A. In addition to normal progress inspections, schedule and conduct the following formal inspections, giving the Engineer at least 24 hours prior notice of readiness for inspection:

1. Final inspection after completion of planting; schedule this inspection sufficiently in advance, and in cooperation with the Engineer, so that final inspection may be conducted within 24 hours after completion of placement.

2. Clean-up: During the progress of this work, and upon completion, thoroughly clean the project area and remove and properly dispose of all resultant dirt, debris and other waste materials.

PART 4 - MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT:

A. Work shall be measured by linear feet.

4.2 BASIS OF PAYMENT:

A. The amount of work completed and approved, as stated above, shall be paid as a lump sum price.

END OF SECTION 02935

SECTION 03162 – CONCRETE AND ROCK STABILIZATION STRUCTURES

PART 1 – GENERAL

1.1 DESCRIPTION:

A. This section covers concrete and rock stabilization structure to be used at various locations within the project area as shown on the project design sheet. Items include, but are not limited to:

1. Rock gradation, procurement, storage, and handling.

2. Sub-grade preparation prior to rock installation.

3. Rock installation.

B. Types of structures covered by this specification:

1. Rock Vanes

2. Rock Bendway Weirs

3. Longitudinal Peaked Stone Toe Protection (LPSTP)

4. Rock Chutes

5. Stream Barbs

6. Rock Blankets

7. Rootwad Revetments

8. Cross Vanes

9. Rock Check Dams

10. Rock Berm

C. Related Work in Other Sections:

1. Excavating, Filling, and Grading: Section 02200

1.2 REFERENCES:

A. The publications listed below form a part of this specification to the extent referenced. The latest revision of the following standards shall apply to work hereunder:

1. ASTM C 88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

2. ASTM C 127-88: Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate

3. ASTM D 5312-92: Standard Test Method for Evaluation of Durability of Rock for Erosion Control under Freezing and Thawing Conditions

1.3 LINES AND GRADES:

A. Rock placement shall conform to the lines and grades shown on the technical drawings.

PART 2 – PRODUCTS

2.1 MATERIALS:

A. Material shall be reasonably free from dirt, clay, sand, rock fines and other materials not meeting the required gradation limits.

B. Except as otherwise specified, the rock shall be angular to sub rounded in shape. The rock shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The least dimension of an individual rock fragment shall not be less than one-third the greatest dimension of the fragment. Except as otherwise provided, the rock shall be tested and shall have the following properties:

1. Bulk Specific Gravity (saturated surface-dry basis) shall not be less than 2.4 when tested in accordance with ASTM C 127.

2. Absorption shall not be more than 4 percent when tested in accordance with ASTM C 127.

3. The weight loss in 5 cycles shall not be more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used when tested in accordance with ASTM C 88 for soundness

4. Rock that fails to meet the requirements stated above in 1, 2, or 3 may be accepted if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

C. Poorly sorted rock materials shall be reasonably well graded by weight and poorly sorted by size. Shot rock is stone resulting from drilling and blasting or other various methods of excavation. Shot rock may be subsequently sized using heavy equipment or other suitable methods. Shot rock shall be quarry run with no more than 10 percent passing the 1-inch sieve as determined by visual inspection. Poorly sorted rock materials shall be within the limits in the tables below or as stated on the Drawings.

**Aggregate Gradation A ($D_{50}$ = 24 in.)**

| Size (lbs) | Percent Heavier |
|---|---|
| 10 | 90 |
| 450 | 50 |

| | |
|---|---|
| 1000 | 0-10 |

**Aggregate Gradation A ($D_{50}$ = 18 in.)**

| Size (lbs) | Percent Heavier |
|---|---|
| 10 | 85-100 |
| 100 | 60-80 |
| 250 | 30-60 |
| 600 | 0-10 |

**Aggregate Gradation A ($D_{50}$ = 12 in.)**

| Size (lbs) | Percent Heavier |
|---|---|
| 5 | 85-100 |
| 50 | 50-70 |
| 100 | 5-15 |
| 400 | 0 |

D. Sorted riprap rock material shall be well graded by weight and size; within the limits stated below or on the Drawings to meet the following requirement. Riprap shall be free from earth, soapstone, shale, shalelike or other easily disintegrated material that decreases material durability after placement.

**Aggregate Gradation B ($D_{50}$ = 18 in.)**

| Size (lbs) | Percent Heavier |
|---|---|
| 5 | 90 |
| 100 | 50 |
| 250 | 0-10 |

**Aggregate Gradation B ($D_{50}$ = 12 in.)**

| Size (lbs) | Percent Heavier |
|---|---|
| 5 | 90 |
| 75 | 50 |
| 200 | 0-10 |

E. Crushed rock for filter course material shall be within the limits stated blow or on the Drawings to meet the following requirement.

**Aggregate gradation C (Crushed Rock)**

| Size (In.) | Percent Retained on Sieve Size |
|---|---|
| No. 4 | 70-95 |
| 3/8 | 55-85 |
| 1 | 25-60 |

| | |
|---|---|
| 2 | 10-40 |
| 4 | 0-5 |

PART 3 – INSTALLATION

3.1 INSTALLING ROCK STRUCTURES:

A. The sub-grade surfaces on which the rock, filter, bedding, or geotextile is to be placed shall be cut and graded to the lines and grades shown on technical drawings. The surface to which the rock is to be placed shall be reasonably smooth and free of mounds, dips, or windrows.

B. The rock shall be placed by equipment on the surfaces and to the depths specified. The rock shall be installed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying material. The rock shall be delivered and placed in a manner that will ensure the rock shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Rock shall be placed in a manner to prevent damage to existing structures. Hand placing will be required as necessary to prevent damage to new and existing structures.

C. Side slopes should be the natural angle of repose, which approximates 1.5-foot. horizontal to 1-foot. vertical.

3.2 MAINTENANCE:

A. If, before 12 months after the completion and acceptance of the work, there shall be settlement requiring repairs to be made along the line of work, or should any defect appear in the work due to neglect, carelessness or improper construction on the part of the Contractor, the Contracting Officer will notify the Contactor to make such repairs and remedy defects. The Contractor shall, within 5 days after such notice, begin and carry out such repairs at no additional cost to the owner.

PART 4 – MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT:

A. Work will be measured by tons of rock placed.

4.2 BASIS OF PAYMENT:

A. The amount of work completed and approved, as stated above, shall be paid for at the contract unit price.

END OF SECTION 03162

**NATURAL RESOURCES CONSERVATION SERVICE**

**CONSTRUCTION SPECIFICATIONS**

# CRITICAL AREA PLANTING

## 1. Scope

The work shall consist of establishing vegetation on sites with existing or expected high erosion rates or degraded sites that usually cannot be stabilized by ordinary conservation treatment and/or management. This specification (including references made within to other conservation practice standards and technical notes), Form KS-ECS-4, Grass Seeding, and/or Form KS-ECS-5, Tree/Shrub Planting, shall be used to design the practice. Practice application will be documented on Forms KS-ECS-4 and/or KS-ECS-5 and in the conservation plan. See also Critical Area Planting Statement of Work (SOW) for additional information on design, installation, and certification requirements.

## 2. Site Preparation

Necessary shaping and smoothing shall be made before seedbed preparations are started. Where practical, the area should be shaped and graded to allow the use of conventional equipment for seedbed preparation, seeding, and mulching.

Where needed to aid with revegetation, topsoil shall be salvaged from borrow areas and re-spread onto shaped and graded areas. Topsoil may be replaced in lifts no greater than six inches. Prior to topsoil application, the re-graded area will be deep chiseled or ripped to reduce soil movement and to promote root penetration.

## 3. Seedbed Preparation

Seedbed preparation is to take place immediately after final shaping and grading. All tillage operations should be performed across the general slope of the land. The seedbed should be tilled to a depth of three inches. All loose soil will be smoothed and packed to a degree that results in a firm seedbed. A seedbed is considered sufficiently firm when a person walking across the field leaves a footprint no deeper than 1/8 of an inch. All debris, such as wood, stones, and other objects that will interfere with seeding and/or maintenance will be removed.

Soil fertility and pH level will be amended to meet the needs of the planned plant species and to support the intended purpose. Soil amendments when applied should be based on results of a soil test. However, at the discretion of the responsible technician, fertilizer application rates may be based on the general recommendations provided in Table 1 in lieu of using results from the soils test. If native species are to be used, nitrogen is not recommended to be applied until plants are established.

Manure may be substituted for commercial fertilizer on the basis of one ton of manure being equivalent to ten pounds of nitrogen, five pounds of phosphate, and ten pounds of potassium, or according to material analysis test results. Manure shall be incorporated within 24 hours of application to retain nutrient value and reduce potential nutrient losses.

**Table 1. Fertilizer Application Rates**

| Seeding Zone | Pounds Per Acre | | | |
|---|---|---|---|---|
| | Nitrogen | Phosphate | Potassium | Lime |
| Western | 20-30 | * | * | |
| Central | 30-40 | 40-60 | * | |
| Eastern | 40-50 | 60-80 | * | * |

* In areas of known phosphate, potassium, and lime deficiencies, apply the amount recommended locally for ag production or the amount recommended by a soils test.

On sites where suitable topsoil exists, do not apply nitrogen fertilizer in the establishment year where native plant species are to be seeded.

**4. Vegetation Seeding**

- **Seedbed**

Seeding of permanent vegetation may be made into the following types of seedbeds:

**Standing cover** – Drill or broadcast (depending on slope) a suitable, non–competitive cover crop such as sorghum or hybrid sudangrass. See Conservation Practice Standard 340, Cover Crop, for a listing of suitable species and seeding rates.

**Surface mulch** – Crop stubble, non-growing weeds, or other plant residue (dead litter cover) that is left on the surface through chemical or non inversion-type of tillage operations. Various mulching material may also be applied before or after the permanent seeding takes place. For mulching materials and amounts, see Conservation Practice 484, Mulching.

**Clean tilled** – Prior to planting, the seedbed shall be prepared by using tillage equipment which will penetrate 2 to 3 inches and leave a firm but friable seedbed. This may not be an option where erosion is a concern unless proper amounts of mulching material are applied after seeding.

- **Seeding Method**

A grass drill is preferred. The drill should be equipped with double–disk openers, depth-control device for proper seed placement, and press wheels or drag chains. The drill should be operated across slope. The seed should be planted to a depth of ¼ to ¾ of an inch. On areas too steep for equipment operation, seed mixtures may be broadcast or hydroseeded. For broadcasting, the seed will be incorporated by harrowing, packing, raking by hand, or other suitable operation. For hydroseeding, the selected seed mixture and mulching material shall be applied according to manufacturers' recommendations.

- **Seeding Dates**

Seeding periods will be as follows:

- Cool-season species: Aug 15 – Oct 1; Dec 1 – Apr 15
- Warm-season species: Dec 1 – May 15
- Bermuda grass sprigs: Mar 1 – May 15

An extension of two weeks to the cut-off seeding date may be given by the district conservationist, based on favorable moisture and temperature conditions.

When it is not practical to wait for the seeding periods as noted above and at the discretion of the responsible technical, permanent seeding may be completed as soon as construction work is completed. Where soil erosion is a concern or at the discretion of the responsible technician, mulch will be applied according to Conservation Practice 484, Mulching, immediately following completion of the permanent seeding.

- **Plant Species Selection**

For approved plant species varieties, refer to Kansas Plant Materials Technical Note KS-1 (Rev 6), Grass and Forb/Legume Varieties Approved for Use in Kansas. For seeding zone delineation, see Figure 1. Where varieties are not available or are not adapted to the site, common (native harvest) seed from a source location as near to the area being seeded as possible may be utilized. For mileage restriction, native grass seed will not be used more than 250 to 400 miles north of or 100 to 150 miles south of its point of origin. An increase of elevation of 1500 feet is equivalent to a move of roughly 150 miles to the north. Seed from a southern source will be given preference over seed from a northern source. Seed source must be identified to the state and county level in order to certify mileage and elevation adequacy.

Seed labeling, quality, and seed testing shall be in accordance with Kansas Seed Law. For Kansas Seed Law, the germination test is valid for nine months after the end of the month the test was made so long as the seed remains in Kansas. Federal Seed Law pertains to seed shipped across state lines and the germination test is valid for five months after the end of the month the test was made.

For seed purchased during the valid period of the germination test, the analysis report may be considered current for the full seeding period in effect at the time of purchase. For example, if seed is purchased March 1 and the germination test date expires March 31, the analysis report may be considered current if the seed is planted by May 15. If the seed is to be planted during a later seeding season, a new germination test shall be performed.

A cooperator who raises and/or harvests seed for personal use must have a seed analysis performed. A copy of the report must be furnished to certify that quality and mileage restrictions are met.

**5. Vegetation Sprigging**

Vegetation may be established through the use of sprigs. Bermuda grass is typically established in this method, although seed type varieties of Bermuda grass are currently available.

- **Seedbed**

Sprigs should be planted into a firm, moist seedbed.

- **Sprigging Method**

It is desirable to plant Bermuda grass sprigs that are still dormant. Use freshly dug sprigs from areas where the top growth has been removed. Sprigs should be planted within 24 hours after they are dug. Keep sprigs moist until planted. Plant the sprigs with a mechanical sprigger or hand plant at a rate of 16 to 24 bushels per acre in 36 to 42 inch row spacing. Sprigs should be covered with 1 to 3 inches of soil and be well packed after planting. Subsequent fertilizer application shall be based on soil test, Table 1, or local extension recommendations.

Sprigging is also used as a method to establish vegetation on upstream berms of earth dams. Prairie cordgrass and common reed are typically planted as sprigs and are used to provide vegetative wave protection to the embankment. A row of sprigs shall be planted at the normal pool elevation along with a minimum of three rows planted below and three above the normal pool elevation. Rows should parallel the centerline of the dam and be spaced no greater than three feet apart. Sprigs within the rows should be placed every foot at a depth of 2 to 4 inches. Care should be taken to place prairie cordgrass sprigs with the growing point up. Sprigs should be planted while they are still dormant. Sprigs should not be permitted to dry out.

It may be necessary to control the water level of a structure to facilitate the establishment of the sprigs on the berm. Once prairie cordgrass and common reed become well established, both can tolerate extended periods of inundation. However, during the establishment period, seedlings of both species may be damaged by extended inundation periods.

- **Sprigging Date**

Sprigging should take place when soil moisture conditions are optimum during the period March 1 to May 15.

- **Plant Species Selection**

For approved plant species varieties, refer to Kansas Plant Materials Technical Note KS-1 (Rev 6).

**6. Vegetation Planting Trees/Shrubs**

Refer to Kansas Forestry Technical Note KS-9, Tree/Shrub Establishment and Maintenance Guidelines, for planting information and the electronic Field Office Technical Guide (eFOTG), Section II, Windbreaks and Environmental Plantings Interpretations for species suitability. It will be more than likely necessary to

complement the woody planting with a seeding of herbaceous species to aid with erosion control during the woody establishment period.

**7. Maintenance**

Maintenance will be carried out during establishment to aid in survival of the plant species. To manage weed competition, mow the weeds when they reach a height of 6 to 8 inches. If chemicals are used in lieu of mowing, they must be federally and locally registered and must be applied in strict accordance with authorized registered uses, directions on label, and other federal and state polices and requirements.

Livestock grazing will be excluded from the area during establishment. Flash-grazing for weed control is permissible during plant establishment if the grazing level is closely monitored. Once the plants are established, grazing may take place within the limits of proper management.

Where introduced perennial herbaceous species are used, maintenance will require periodic soil testing to determine fertilizer needs of the species.

**8. Specific Treatment for Critical Areas**

- **Dunes and Blowouts**

  Blowouts will be enclosed with a permanent fence when they are larger than approximately 2 acres and the area is grazed during the growing season. The fence will be established away from the edges of the blowout.

  Fencing of the blowout is not needed where the adjacent area is not grazed by livestock or is used only during the winter, except in areas of heavy livestock concentrations. Fencing is not necessary if the grassland that contains the blowout is used only occasionally for partial summer use, such as with a planned grazing system.

  Natural recovery (no seeding) by protection is permissible where desirable species are present in sufficient amounts and the character of the blowout will permit stabilization in the desired period of time. A temporary fence is needed to prevent livestock use of the area.

  Seedbed preparation shall consist of establishing a cover crop according to Conservation Practice Standard 340, Cover Crop or in lieu of a cover crop, apply a natural mulch or manure according to Conservation Practice Standard 484, Mulching.

For species selection and seeding rates, see Table 2. For plant species varieties, refer to Kansas Plant Materials Technical Note KS-1 (Rev. 6). Adapted native forbs and/or legumes may be added in addition to the full grass seeding mixture at a rate not to exceed 1 lb. pls/ac. See Table 7 for a listing of forb/legume species.

**Table 2. Dunes / Blowout Areas**

| SPECIES | FULL SEEDING RATE (#PLS/AC) | % OF MIXTURE | REMARKS |
|---|---|---|---|
| Native | | | |
| Big bluestem | 12 | 0-10 | Use as second choice to sand bluestem |
| Blue grama | 3 | 0-10 | |
| Indiangrass | 12 | 0-10 | |
| Little bluestem | 8 | 10-20 | |
| Prairie sandreed | 8 | 20-30 | |
| Sand bluestem | 12 | 10-30 | |
| Sand lovegrass | 2 | 10-20 | |
| Sideoats grama | 12 | 0-10 | |
| Switchgrass | 6 | 10-30 | |

- **Earth Dams**

All construction areas not covered by permanent water and any related area expected to produce sediment shall be seeded to a permanent mixture.

**Topsoiling -** Topsoil will be placed at a minimum depth of one foot and a maximum depth of three feet on all areas designated for topsoiling. To aid with vegetation establishment, topsoil will be applied as follows:

**Frontslope -** Where riprap is used, topsoil will be placed from the upper elevation of the riprap to the top of the dam. Where riprap is not used, topsoil placement will begin at the lower elevation of the vegetative berm and extend to the top of the dam.

**Emergency Spillway, Principal Spillway Outlet Channel, Dikes, Spoil Areas -** For unconsolidated or consolidated material that is determined to be adequate for erosion control and for plant establishment, no topsoiling is needed. Where the material is questionable for plant establishment, but suitable for erosion control, topsoil will be considered when aesthetic and wildlife needs have been identified and are considered important. If the material is not suitable for either erosion control or plant establishment, topsoil will be applied.

**Vegetative Treatment of Upstream Berms -** Vegetative treatment of the upstream berm for embankment protection (for the flatter designed front slopes) will consist of seeding and/or sprigging. See previous Section 5b on sprigging upstream berms. Vegetative wave protection for the dam embankment will not work well where there is an extreme water level fluctuation for extended periods of time. Under these conditions, it is difficult to get the right type and amount of vegetation established to dissipate wave energy before it reaches the embankment. Procedures for determining the need for special wave protection measures including vegetated berms are included in Technical Release No. 56 and the Engineering Field Handbook. Water level fluctuation, if not too large or too prolonged, may be accommodated by dividing the berm into two different vegetative establishment zones. Each zone would be planted or seeded to species suited to those particular growing conditions. See Table 3 for species selection and seeding rates for Zones 1 and 2. For plant species varieties, refer to Kansas Plant Materials Technical Note KS-1 (Rev. 6).

- Zone 1 will typically be saturated and/or inundated for extended periods of time. This zone is usually six inches in elevation above and 1.5 foot in elevation below the normal pool elevation. The vegetation selected for this zone should be able to tolerate these moisture conditions as well as providing a dense, upright, heavy, and flexible stem that will aid in the dissipation of wave energy.
- Zone 2 typically covers the area from just above the normal pool elevation to the base of the dam embankment. This zone may be inundated for short periods of time, but will mostly be in dryer soil conditions. Species should be able to tolerate these conditions.

**Seeding of Earth Dam Components -** Seeding of earth dam components will be completed as shown in Table 3. However, for small farm type ponds (two acres or less total disturbance), one seed mixture developed from the Borrow, Waste, and Dam Fill Component Column may be used to seed the entire disturbed area. Adapted native forbs and/or legumes may be added in addition to the full grass seeding mixture at a rate not to exceed 1 lb. pls/ac. See Table 7 for a listing of forb/legume species.

Table 3 Earth Dam

| SPECIES | | MAXIMUM PERCENT IN MIXTURE | | | REMARKS |
|---|---|---|---|---|---|
| | FULL SEEDING RATE (#PLS/AC) | BORROW AREA WASTE AREA DAM FILL | STILLING BASIN OUTLET, SHORELINE, UPSTREAM BERM | SPILLWAY | |
| Native | | | | | |
| Big bluestem | 12 | 10 | 10 | | Berm Zone 2 adapted |
| Blue grama | 3 | 20 | | 20 | |
| Buffalograss | 10 | 30 | 30 | 30 | Berm Zone 2 adapted |
| Indiangrass | 12 | 10 | 10 | | Berm Zone 2 adapted |
| Little bluestem | 8 | 20 | 10 | 20 | Berm Zone 2 adapted |
| Prairie cordgrass | | | Sprigs | | Berm Zone 1, 2 adapted. |
| Sideoats grama | 12 | 100 | 10 | 30 | Berm Zone 2 adapted |
| Switchgrass (Kanlow) | 6 | | 40 | | Berm Zone 1, 2 adapted |
| Switchgrass | 6 | 100 | 10 | | Berm Zone 2 adapted |
| Virginia wildrye | 25 | | 40 | | Berm Zone 2 adapted |
| Western wheatgrass | 20 | 100 | 30 | 100 | Berm Zone 2 adapted |
| Introduced | | | | | |
| Bermudagrass | 5 | 100 | | 100 | |
| Common reed | | | Sprigs | | Berm Zone 1, 2 adapted |
| Intermediate Wheatgrass | 18 | 100 | | 100 | |
| Pubescent Wheatgrass | 18 | 100 | | 100 | |
| Smooth bromegrass* | 16 | 100 | | 100 | |
| Tall fescue* | 12 | 100 | | 10 | |

*Brome and fescue are limited to 50 percent if seeded in conjunction with native specie(s).
For the western seeding zone, brome is limited to 50 percent and fescue is not approved.
Native or introduced forbs/legumes may be added in addition to the grass mixture at a rate not to exceed 1 lb. pls./ac.
See Table 6 for a listing of species.

- **Grassed Waterway**

A mixture of species is preferred over a single species seeding. Native species are in general more tolerant to cropland chemicals than are cool-season introduced grasses.

When a waterway is constructed to meet design criteria for an annually vegetated waterway, the following management and planting recommendations should be taken into account:

- Close grown crops are usually planted in annually vegetated waterways.
- Planting equipment that leaves a ridge less than two inches high should be used.
- Crops may be planted either parallel or perpendicular to the flow of water.
- The bottom should be left relatively flat after all seedbed and seeding operations.

For perennially vegetated waterways, see Table 4 for species selection and seeding rates. Adapted native forbs and/or legumes may be added in addition to the full grass seeding mixture at a rate not to exceed 1 lb. pls/ac. For plant species varieties, refer to Kansas Plant Materials Technical Note KS-1 (Rev. 6).

Table 4. Grassed Waterway, Ephemeral/Classic Gully, and Other Critical Treatment Areas

| SPECIES | FULL SEEDING RATE (#PLS/AC) | MAXIMUM PERCENT IN MIXTURE | | | REMARKS |
|---|---|---|---|---|---|
| | | WESTERN ZONE | CENTRAL ZONE | EASTERN ZONE | |
| Native | | | | | |
| Big bluestem | 12 | 10 | 30 | 30 | If sandy, recommend sand bluestem. |
| Blue grama | 3 | 20 | 10 | 10 | |
| Buffalograss | 8 | 30 | 10 | 10 | |
| Indiangrass | 12 | 10 | 30 | 30 | |
| Little bluestem | 8 | 20 | 20 | 20 | |
| Prairie cordgrass | 13 | | 20 | 20 | Adapted to wet sites. |
| Sideoats grama | 12 | 100 | 100 | 100 | |
| Switchgrass | 6 | 100 | 100 | 100 | Use 'Kanlow' for wet sites |
| Virginia Wildrye | 25 | 10 | 30 | 30 | Adapted to wet sites |
| Western wheatgrass | 20 | 100 | 100 | 100 | |
| Introduced | | | | | |
| Bermudagrass | 5 | | 100 | 100 | May be sprigged at 16-24 bu /ac |
| Intermediate Wheatgrass | 18 | 100 | 100 | 100 | |
| Pubescent Wheatgrass | 18 | 100 | 100 | 100 | |
| Smooth brome* | 16 | 50 | 100 | 100 | |
| Tall fescue* | 12 | | 100 | 100 | |
| Tall wheatgrass | 20 | 100 | 100 | 100 | Adapted to saline areas |

* Brome and fescue limited to 50 percent if seeded in conjunction with native specie(s).
Native or introduced forbs/legumes may be added in addition to the grass mixture at a rate not to exceed 1 lb pls./ac.
See Table 6 for a listing of species.

- **Reconstructed mined land.**

Suitable annual cover crops will be established until a suitable seedbed is prepared for the permanent mix. See Conservation Practice Standard 340, Cover Crop. On acid sites, it may require cover crops to be established for a period of 1 to 3 years so that proper soil amendments may be applied. Liming rates to amend soil pH shall be based on results of soil test.

See Table 4 for species selection and seeding rates. For plant species varieties, refer to Kansas Plant Materials Technical Note KS-1 (Rev. 6).

In addition to herbaceous species, woody species may also be planted on reconstructed mined land. See Kansas Forestry Technical Note KS-9 for planting information and the electronic Field Office Technical Guide (eFOTG), Section II, Windbreaks and Environmental Plantings Interpretations for Species Suitability.

- **Urban and developing areas.**

For short, intermediate, and long-term cover crops, see Conservation Practice Standard 340, Cover Crop.

- **Ephemeral and classic gullies.**

Remove excess organic material and other trash from the area to be shaped. Fill existing gullies. All fill material shall be thoroughly compacted.

Where gullies have depths greater than three feet, it may be necessary to slope the sides of the gully prior to filling in order to obtain sufficient compaction. Gully side slopes prior to filling shall not be steeper than 1:1. Gullies deeper than three feet shall be overfilled by 10 percent.

Gully areas shall be shaped to either a trapezoidal or parabolic cross section. A parabolic cross section can be approximated by shaping a nearly level bottom width that is approximately equal to half the finished top width. Minimum construction depth shall be 0.5 foot. The standard dimensions that may be used are provided in Table 5, Kansas Form KS-ECS-20, Critical Area Planting Ephemeral Gully, shall be used for design documentation.

Table 5. Standard Dimensions for Shaping of Ephemeral Gully

| CROSS SECTION DIMENSIONS * FEET | | | MAXIMUM CONTRIBUTING DRAINAGE AREA ACRES | | |
|---|---|---|---|---|---|
| TOP WIDTH | DEPTH | BOTTOM WIDTH | WESTERN ZONE | CENTRAL ZONE | EASTERN ZONE |
| | | | | | |
| 8 | 0.5 | 2 | 4 | 1 | 1 |
| 16 | 0.5 | 8 | 20 | 3 | 2 |

* Table dimensions may be adjusted by 10 percent to accomodate farm machinery.

Grass strips may be individually designed. Each strip must have the capacity to contain runoff from a 5-year, 24-hour storm assuming C retardence. Velocities shall not exceed 4 feet/sec, assuming D retardence. When strip width exceeds 20 feet, they shall be designed and constructed according to Conservation Practice Standard 412, Grassed Waterway.

See Table 4 for species selection and seeding rates. For plant species varieties information, refer to Kansas Plant Materials Technical Note KS-1 (Rev. 6).

- **Other areas needing critical treatment planting (diversions, dikes, or back slopes of push-up terraces, filter strips, field borders, contour buffer strips, wastewater treatment strips).**

See Table 4 for species selection and seeding rates. For plant species varieties information, refer to Kansas Plant Materials Technical Note KS-1(Rev. 6).

Table 6. Listing of Native, Introduced Forbs / Legumes

| Native Forbs / Legumes | LEGUME | GROWTH HABIT | AREA OF ADAPTATION | | |
|---|---|---|---|---|---|
| | | | EAST | CENTRAL | WEST |
| Black sampson - Echinacea angustifolia | | PERENNIAL | x | x | x |
| Blackeyed susan - Rudbeckia hirta | | PERENNIAL | x | x | |
| Butterfly milkweed - Asclepias tuberosa | | PERENNIAL | x | x | |
| Clasping coneflower - Rudbeckia amplexicaulis | | ANNUAL | x | | |
| Dotted gayfeather - Liatris punctata | | PERENNIAL | x | x | x |
| Englemann's daisy - Engelmannia pinnatifida | | PERENNIAL | x | x | x |
| False sunflower - Heliopsis helianthoides | | PERENNIAL | x | x | |
| Grayhead prairieconeflower - Ratibida pinnata | | PERENNIAL | x | | |
| Illinois bundleflower - Desmanthus illioensis | x | PERENNIAL | x | x | x |
| Indian blanket - Gaillardia pulchella | | ANNUAL | x | x | x |
| Lance-leaf coreopsis - Coreopsis lanceolata | | PERENNIAL | x | | |
| Leadplant - Amorpha canescens | x | PERENNIAL | x | x | x |
| Maximilian sunflower - Helianthus maximiliani | | PERENNIAL | x | x | x |
| Missouri primose - Oenothera missouriensis | | PERENNIAL | x | x | |
| New England aster - Aster novae angliae | | PERENNIAL | x | | |
| Pale echinacea - Echinacea pallida | | PERENNIAL | x | | |
| Pitcher sage - Salvia azurea | | PERENNIAL | x | x | x |
| Plains coreopsis - Coreopsis tinctoria | | ANNUAL | x | x | x |
| Prairie aster - Aster patens | | PERENNIAL | x | | |
| Purple prairieclover - Dalea purpurea | x | PERENNIAL | x | x | x |
| Roundhead lespedeza - Lespedeza capitata | x | PERENNIAL | x | x | |
| Shellleaf beardtongue - Penstemon grandiflorus | | PERENNIAL | x | x | |
| Showy partridge pea - Chamaecrista fasiculata | x | ANNUAL | x | x | |
| Thickspike gayfeather - Liatris pycnostachya | | PERENNIAL | x | | |
| Upright coneflower - Ratibida columnifera | | PERENNIAL | x | x | x |
| White prairieclover - Dalea candidum | x | PERENNIAL | x | x | |

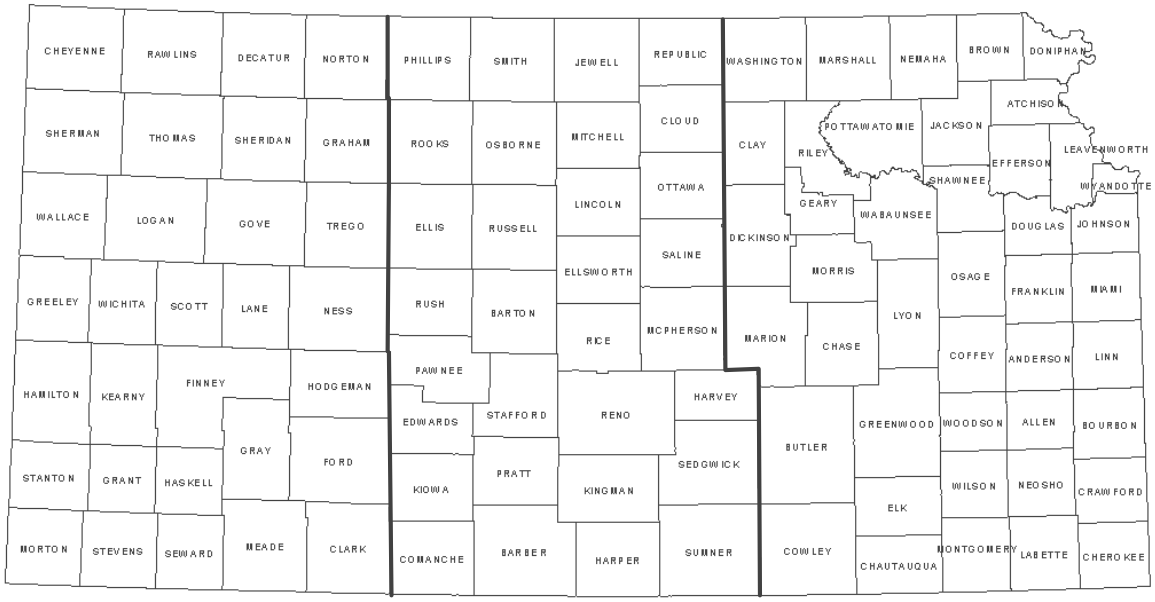
Introduced Legumes

| | | | | | |
|---|---|---|---|---|---|
| Alfalfa | x | PERENNIAL | x | x | x |
| Birdsfoot trefoil | x | PERENNIAL | x | | |
| Red Clover | x | PERENNIAL | x | | |

* Forb/legume species and varieties must be adapted to the site. For guidance on the suitability of species not listed, refer to eFOTG Section II, Rangeland Interpetations (Range Site Description) and Pasture Hayland Suitability Descriptions

**Adapted native forbs and/or legumes may be added in addition to the full grass seeding mixture at a rate not to exceed 1 lb. pls/ac.

Figure 1. Kansas Seeding Zone Delineation



**NATURAL RESOURCES CONSERVATION SERVICE**

**CONSTRUCTION SPECIFICATIONS**

# COVER CROP

## 1. Scope

The work shall consist of furnishing all materials and performing cultural operations necessary to grow and maintain the cover crop to protect soil, improve soil conditions, conserve moisture, provide temporary protection for permanent vegetative cover, add biomass to the soil, improve infiltration and tilth, reduce compaction, manage pests and nutrients, and/or provide supplemental forage.

## 2. Materials

**Seed.** Seed used in this specification will meet the requirements as stated in Kansas Noxious Weed Law (Kansas Statues Annotated [K.S.A]. 2-1314) and the Kansas Agriculture Seed Law (K.S.A. 2-1415).

When seed is purchased, the seed tags will be evidence of the purity and germination of the seed. Time since date of seed test shall not exceed 9 months.

Seed shall be of a quality that weed seed shall not exceed 0.5 percent of the aggregate of pure live seed (PLS) (percent germination x percent purity) and other material.

**Fertilizer.** All fertilizer shall be labeled in accordance with applicable state regulations and bear the warranty of the producer for the grade furnished.

**Inoculants.** The inoculants for treating legume seeds shall be a pure culture of Nitrogen fixing bacteria prepared specifically for the plant species and shall not be used later than the date indicated on the container. A mixing medium, as recommended by the manufacturer or approved substitute shall be used to bond the inoculant to the seed. For non-sandy soils with a pH greater than 6.0 and that have previously grown well-nodulated crops of the same species within the last 5 years inoculation is usually not necessary. When planting legumes in sandy soil, inoculant treatment shall be applied if the species has not been grown within the last 3 years.

**Chemicals.** All pesticides used in performing this practice shall be federally, state, and locally registered and shall be applied strictly in accordance with authorized and registered uses, directions on the label, and other federal or state policies and requirements. Chemical containers shall be properly stored and disposed of in a safe manner.

## 3. Seeding Mixture and Planting Date

The seed(s) and rate(s) specified on Form KS-ECS-4, Grass Seeding, shall be used.

The seeding rate(s) shall be the weight exclusive of any coating material. Any legume seed used shall be inoculated. Based on bag tags, seeding rates shall be adjusted to ensure the required amounts of pure live seed.

Planting shall be performed during the period that is specified on Form KS-ECS-4.

## 4. Seedbed Preparation

The area to be planted shall be weed free and have a firm seedbed which has previously been roughened by scarifying, disking, harrowing, chiseling, or otherwise worked to a depth of 2 to 4 inches, except when planting no-till or otherwise specified on Form KS-ECS-4.

Seedbed preparation shall be suspended when soil moisture conditions are not suitable for obtaining a satisfactory seedbed.

When planting legumes requiring inoculation in soils with a pH lower than 6.0, amend the soil pH by liming according to soil test recommendations, prior to planting the legume.

## 5. Fertilizing and Seeding

**Fertilizing.** Fertilizer shall be distributed uniformly over the seedbed and applied according to a soil test within the criteria of Conservation Practice Standard 590, Nutrient Management, and as specified on Form KS-ECS-4.

Fertilizer shall be applied in any way that will result in uniform distribution. The fertilizer shall be incorporated into the soil. Incorporation may be as part of the seedbed preparation or as part of the seeding operation unless otherwise specified on Form KS-ECS-4.

**Seeding.** Seed shall be drilled or broadcast by hand, mechanical hand seeder, or power operated seeder. Seed shall be incorporated into the soil, but not more than one-inch deep unless otherwise specified on Form KS-ECS-4. Drilling is preferred, but the use of row crop equipment may be used for row widths between 20 and 40 inches. Seed may be broadcast if covered with a drag or harrow.

When seeding in standing or growing row crops by air or during the last cultivation, increase seeding rate 1.5 times.

Where wind erosion is a consideration, cover and temporary cover crops planted in rows greater than 20 inches will be planted perpendicular to the prevailing wind during the critical wind erosion management period.

Seeding shall be performed as nearly as practical across the slope unless otherwise specified on Form KS-ECS-4.

## 6. Irrigation

When specified, irrigation water shall be applied during the establishment period at the times and rates listed on Form KS-ECS-4.

## 7. Additional Cultural Operations

**Managing cover crops.**

a. Suppression may be necessary to maintain the practice objectives during the period critical to the practices intended purpose and may be accomplished by mowing, light tillage and chemical applications.

b. Management of the cover crop will be necessary and should be planned for prior to planting the covers.

   (1) Natural termination will be when climatic or growing conditions naturally terminate the cover crop.

   Whenever possible, cover crop plantings will be planned to take advantage of natural termination by way of freezing. Time the plantings to obtain the desired plant height or physiological development prior to the normally occurring killing frost date.

   (2) Mechanical controls will be mowing, tillage, rolling, or grazing.

      (i) Mowing should be done prior to seed development, unless cover crop reseeding is a planned purpose. Height may be determined by other practices being implemented in a conservation plan.

      (ii) Tillage may not provide complete control without repeating the application and may need to be used in a combination with other controls. Consideration should be given to timing and effects of tillage on moisture conservation and the rest of the crop rotation.

      (iii) Rolling will be conducted in a way that will terminate the vascular transport functions of the cover crop. Rollers will be outfitted with horizontal knives or angle irons that are no more than 12 inches apart on the circumference of the roller. Knives or angle irons should not be sharp enough to chop the cover crop but the intended design is to lie over and crimp the plant stalks.

(iv) Grazing should be conducted at rates to allow adequate re-growth to provide the necessary cover for the intended purpose of the practice. Termination may require the application of herbicides or other treatment to control additional growth of the grazed cover crop.

(3) Chemical termination will be through the lethal application of herbicides. Herbicides used to terminate growth shall be applied according to the herbicide label and/or the KSU Extension Bulletin "Chemical Weed Control for Field Crops, Pastures, Rangeland and Non-cropland" prior to seed development or when the cover has accomplished the planned objective and will not create detrimental effects to the crop following, unless required for control of noxious weeds. Follow herbicide labels to determine crop compatibility for the crop following the cover crop.

(4) Grazing should be conducted at rates to allow re-growth to provide the necessary cover for the intended purpose of the cover crop. Refer to Conservation Practice 528, Prescribed Grazing, for grazing of cover crops to ensure adequate forage balance is achieved for the intended purpose of the cover crop and the nutritional needs of the livestock are met (refer to Table 1, Performance and Roles, Good Grazing). Grazing of cover crops used for sole purpose to establish permanent herbaceous cover is not recommended unless managed to meet minimum height and cover requirements.

**8. Other Requirements**

Other details for the establishment and maintenance of the plants including, but not limited to, the need for livestock and traffic control shall be applied as specified on Form KS-ECS-4.

Measures and methods that enhance fish and wildlife values, protect visual resources, and maintain or establish key habitats shall be performed when specified on Form KS-ECS-4.

For critical or highly erodible areas, increase seeding rates 1.5 times the recommended rate to obtain an effective stand that will control erosion.

**For temporary cover for acid sites.** For a period of 1 to 3 years after land shaping, a temporary cover of a winter annual is to be used. Wheat, rye, oats, or barley may be seeded at the rate of 80 pounds per acre. Apply needed nutrients as indicated by a soil test.

Prior to planting the second year temporary cover crop, soil tests will be taken as needed to determine lime requirements. Refer to Table 2 for liming rates. Apply nutrients as indicated by the soil test for the second year cover.

Specific soil tests should be conducted on areas of poor establishment of the first year cover to obtain a representative sample of problem areas. Retreat with recommended soil amendments as needed.

A third year temporary cover, nutrient, and soil amendment application may be used if need to obtain an adequate seedbed for permanent vegetation.

The owner, operator, contractor, or other persons shall conduct all work and operations in accordance with proper safety codes for the type of equipment and operations being performed with due regards to safety of all persons and property.

Crop substitutions. Sorghum-sudan grass may be substituted with pearl, proso, or foxtail millet or grain sorghum.

Rows shall not exceed 20 inches except grain sorghum rows can be 30 inches. In Major Land Resource Areas (MLRAs) 72, 73, 77, 78, and 79 where conditions do not permit the establishment of narrow row spacing, forage and grain sorghum in 40-inch rows may be used on sandy soils.

Seeding specifications will be documented with Form KS-ECS-4.

The following charts are reprinted from *Managing Cover Crops Profitably*, 3rd Edition, with permission from the Sustainable Agriculture Network (SAN). SAN is the national outreach arm of the USDA Cooperative State Research, Education, and Extension Service (CSREES) Sustainable Agriculture Research and Education (SARE) program. For more information, see www.sare.org.

**9. Cover Crop requirements for seedbed preparation with permanent vegetative cover establishment**

A standing cover or surface mulch is important for the success of any seeding in Central and Western Zones. Cover crop residue helps maintain surface soil moisture that is critical to seed germination and permanent root system development.

A standing cover crop or surface mulch is required for any seeding on soils where erosion or moisture conservation is a concern.

A standing cover crop or surface mulch is required for MLRAs 72, 73, 74, 75, 77, 78, 79, and 80A.

**a. Standing cover crop.** The cover crop should be managed to prevent the production of viable seed.

Maintain a minimum of 12-inch stubble height. A cover crop with growth exceeding 12 inches may be removed by mowing, haying, or grazing.

Small grains are excluded as a standing cover crop option on soils with an "I" value greater than 86.

**b. Sorghums.** Sorghums may be planted as late as August 1 where sufficient moisture exists to establish a quick stand. Sorghum seed formation can be limited or controlled by use of male sterile (non self-pollinating) hybrids and by planting late so that sorghums are not able to mature and form seed.

**(1) Forage sorghum** - Seed forage sorghum (includes Sudan grass) during the summer prior to the planting of the range planting mix. Row spacing shall not exceed 20 inches. The seeding rate will be 3 to 12 pounds per acre.

**(2) Grain sorghum** – Seed grain sorghum the summer prior to planting the range planting mix. Row spacing will not exceed 30 inches. The seeding rate will be 3 to 8 pounds per acre.

**(3) Exception**: Forage and grain sorghum in 40-inch rows may be used on sandy soils in MLRAs 72, 73, 77, 78, and 79 where conditions do not permit the establishment of narrower row spacing. To have adequate cover of forage and grain sorghums, the following actual residue amounts are required at seeding time. The "I" factor from the Wind Erodibility Index is used to determine minimum residue levels.

| | **Minimum Lbs. Residue/Acre** |
|---|---|
| **"I" Soil Factor** | **at Seeding Time** |
| 56 or lower | 1,750 |
| 86 | 2,000 |
| 134 | 2,250 |
| 220 and higher | 2,250* |

*If adequate sorghum residue cannot be produced or maintained, additional mulch will be applied until the listed minimum amounts are achieved.

**c. Small grain.** A minimum residue amount of 1,500 pounds per acre of flat small grain equivalent will be present at range planting time. If adequate flat small grain equivalent residue cannot be produced or maintained, additional mulch will be applied until the 1,500 pounds is achieved.

**(1) Oats** - Oats may be planted until September 15 in the fall prior to planting the range planting mix. Row spacing will not exceed 20 inches. The seeding rate will be 40 to 60 pounds per acre.

Cover crops of oats will be killed, using the Surface Mulch, chemical method, from the fifth or sixth leaf stage until boot stage and prior to the emergence of the seeded range planting mix.

**(2) Winter wheat** - Seed winter wheat in the fall prior to planting the range planting mix. Row spacing will not exceed 20 inches. The seeding rate will be 40 to 60 pounds per acre.

Wheat cover crops will be killed, using the Surface Mulch, chemical method, from the fifth or sixth leaf stage until the boot stage and prior to the emergence of the seeded range planting mix.

Seeding into growing wheat that will be grazed-out by May 1 is an acceptable method. Do not graze when fields are wet and subject to compaction.

**(3) Rye** - Rye or rye hybrids are not approved for use as a cover crop due to the potential allelopathic effects.

**d. Surface mulch.**

**(1) Tillage -** Prepare a seedbed by use of tillage operations that leaves a seedbed free of growing vegetation with crop stubble, weeds, or other vegetative material left on the surface. No inversion type of tillage operation is allowed. It may be necessary to repack the soil surface after this tillage operation to provide a firm seedbed.

**(2) Chemical -** Prepare a seedbed by use of herbicides that suppress existing vegetation and leave mulch which will be seeded into without additional tillage. (Chemicals used must be federally and locally registered and must be applied strictly in accordance with registered uses, directions on label, and other federal or state policies and requirements.)

**(3) Clean tilled -** Just prior to planting, the seedbed shall be prepared by using tillage implements, which penetrate the soil surface 2 to 3 inches and leave a firm but friable seedbed. It may be necessary to repack the soil surface after this tillage operation to provide a firm seedbed.

**Chart 1 - PERFORMANCE AND ROLES**

| Species | Legume N Source | Total N (lb./A)[1] | Dry Matter (lb./A/yr.) | N Scavenger[2] | Soil Builder[3] | Erosion Fighter[4] | Weed Fighter | Good Grazing[5] | Quick Growth |
|---|---|---|---|---|---|---|---|---|---|
| Annual ryegrass | | | 2,000–9,000 | ◕ | ◕ | ◕ | ◕ | ◕ | ◕ |
| Barley | | | 2,000–10,000 | ◕ | ◕ | ● | ◕ | ◕ | ◕ |
| Oats | | | 2,000–10,000 | ◕ | ◑ | ◕ | ● | ◑ | ● |
| Rye | | | 3,000–10,000 | ● | ● | ● | ● | ◑ | ● |
| Wheat | | | 3,000–8,000 | ◕ | ◕ | ◕ | ◕ | ◕ | ◕ |
| Buckwheat | | | 2,000–4,000 | ○ | ◑ | ◔ | ● | ○ | ● |
| Sorghum–sudan | | | 8,000–10,000 | ● | ● | ● | ◕ | ◕ | ● |
| Mustards | | 30-120 | 3,000-9,000 | ◑ | ◕ | ◕ | ◕ | ◑ | ◕ |
| Radish | | 50-200 | 4,000-7,000 | ● | ◕ | ◕ | ● | ◑ | ◕ |
| Rapeseed | | 40-160 | 2,000-5,000 | ◕ | ◑ | ◕ | ◕ | ◑ | ◕ |
| Berseem clover | ● | 75–220 | 6,000–10,000 | ◕ | ◕ | ◕ | ● | ● | ● |
| Cowpeas | ● | 100–150 | 2,500–4,500 | ◔ | ◑ | ● | ● | ◑ | ◕ |
| Crimson clover | ◕ | 70–130 | 3,500–5,500 | ◑ | ◕ | ◕ | ◕ | ● | ◑ |
| Field peas | ● | 90–150 | 4,000–5,000 | ◔ | ◑ | ◕ | ◑ | ◕ | ◕ |
| Hairy vetch | ● | 90–200 | 2,300–5,000 | ◔ | ◕ | ◑ | ◑ | ◑ | ◔ |
| Medics | ◑ | 50–120 | 1,500–4,000 | ◔ | ◑ | ◑ | ◕ | ◕ | ● |
| Red clover | ◕ | 70–150 | 2,000–5,000 | ◑ | ◕ | ◑ | ◕ | ● | ◔ |
| Subterranean clover | ● | 75–200 | 3,000–8,500 | ◔ | ◕ | ◕ | ● | ◕ | ◑ |
| Sweetclovers | ● | 90–170 | 3,000–5,000 | ◔ | ● | ◕ | ◕ | ◕ | ◑ |
| White clover | ● | 80–200 | 2,000–6,000 | ◔ | ◑ | ◕ | ◕ | ● | ◔ |
| Woollypod vetch | ● | 100–250 | 4,000–8,000 | ◑ | ● | ◑ | ● | ◑ | ◕ |

[1]**Total N**—Total N from all plant. [2]**N Scavenger**—Ability to take up/store excess nitrogen. [3]**Soil Builder**—Organic matter yield and soil structure improvement. [4]**Erosion Fighter**—Soil-holding ability of roots and total plant. [5]**Good Grazing**—Production, nutritional quality and palatability.

○=Poor; ◔=Fair; ◑=Good; ◕=Very Good; ●=Excellent

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**Chart 1 - PERFORMANCE AND ROLES** (continued)

| Species | Lasting Residue[1] | Duration[2] | Harvest Value[3] | | Cash Crop Interseed[4] | Comments |
|---|---|---|---|---|---|---|
| | | | F* | S* | | |
| Annual ryegrass | ◕ | ◕ | ◑ | ◔ | ● | Heavy N and H20 user; cutting boosts dry matter significantly. |
| Barley | ● | ◑ | ◕ | ◑ | ◕ | Tolerates moderately alkaline conditions but does poorly in acid soil < pH 6.0. |
| Oats | ◑ | ◔ | ◑ | ◑ | ● | Prone to lodging in N-rich soil. |
| Rye | ● | ◕ | ◔ | ◔ | ◕ | Tolerates triazine herbicides. |
| Wheat | ◕ | ◕ | ◑ | ◕ | ◔ | Heavy N and $H_2O$ user in spring. |
| Buckwheat | ○ | ◔ | ○ | ◔ | ◕ | Summer smother crop; breaks down quickly. |
| Sorghum–sudangrass | ◕ | ● | ● | ○ | ○ | Mid-season cutting increases yield and root penetration. |
| Mustards | ◔ | ◑ | ○ | ◔ | ○ | Suppresses nematodes and weeds. |
| Radish | ◔ | ◑ | ◕ | ◔ | ◔ | Good N scavenging and weed control; N released rapidly. |
| Rapeseed | ◑ | ◕ | ◔ | ● | ○ | Suppresses *Rhizoctonia.* |
| Berseem clover | ◑ | ● | ● | ◕ | ◑ | Very flexible cover crop, green manure, forage. |
| Cowpeas | ◔ | ● | ◑ | ◑ | ◑ | Season length, habits vary by cultivar. |
| Crimson clover | ◑ | ◔ | ● | ◕ | ● | Established easily, grows quickly if planted early in fall; matures early in spring. |
| Field peas | ◔ | ◑ | ● | ◕ | ● | Biomass breaks down quickly. |
| Hairy vetch | ◔ | ◕ | ◔ | ◕ | ◑ | Bi-culture with small grain expands seasonal adaptability. |
| Medics | ◑ | ◕ | ◑ | ◑ | ◑ | Use annual medics for interseeding. |
| Red clover | ◔ | ◑ | ● | ◕ | ● | Excellent forage, easily established, widely adapted. |
| Subterranean clover | ◕ | ◕ | ◕ | ○ | ● | Strong seedlings, quick to nodulate. |
| Sweetclovers | ◕ | ◕ | ◕ | ◑ | ◑ | Tall stalks, deep roots in second year. |
| White clover | ◔ | ● | ◕ | ◑ | ◕ | Persistent after first year. |
| Woollypod vetch | ◔ | ◕ | ◔ | ◕ | ◑ | Reseeds poorly if mowed within 2 months of seed drop; overgrazing can be toxic. |

[1]**Lasting Residue**—Rates how long the killed residue remains on the surface. [2]**Duration**—Length of vegetative stage. [3]**Harvest Value**—Economic value as a forage (F) or as seed (S) or grain. [4]**Cash Crop Interseed**—Rates how well the cover crop will perform with an appropriate companion crop.

○=Poor; ◔=Fair; ◑=Good; ◕=Very Good; ●=Excellent

**Chart 2 - Cultural Traits**

| Species | Aliases | Type[1] | Hardy thru Zone[2] | Tolerances | | | | | Habit[3] | pH (pref.) | Best Estab. | Min. Germ. Temp. (F) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Heat | Drought | Shade | Flood | Low fert. | | | | |
| Annual ryegrass | Italian ryegrass | WA | 6 | | | | | | U | 6.0-7.0 | ESp, LSu, EF, F | 40 |
| Barley | | WA | 7 | | | | | | U | 6.0-8.5 | F, W, SP | 38 |
| Oats | Spring oats | CSA | 8 | | | | | | U | 4.5-7.5 | LSu, ESp, W in 8+ | 38 |
| Rye | winter, cereal, or grain rye | CSA | 3 | | | | | | U | 5.0-7.0 | LSu, F | 34 |
| Wheat | | WA | 4 | | | | | | U | 6.0-7.5 | LSu, F | 38 |
| Buckwheat | | SA | NFT | | | | | | U/SU SU | 5.0-7.0 | Sp to LSu | 50 |
| Sorghum–sudan | Sudax | SA | NFT | | | | | | U | 6.0-7.0 | LSp, ES | 65 |
| Mustards | Brown, oriental, white, yellow | WA, CSA | 7 | | | | | | U | 5.5-7.5 | Sp, LSu | 40 |
| Radish | Oilseed, Daikon, forage radish | CSA | 6 | | | | | | U | 6.0-7.5 | SP, LSu, EF | 45 |
| Rapeseed | Rape, canola | WA | 7 | | | | | | U | 5.5-8.0 | F, Sp | 41 |
| Berseem clover | Bigbee, multicut | SA, WA | 7 | | | | | | U/SU SU | 6.2-7.0 | ESp, EF | 42 |
| Cowpeas | Crowder peas, southern peas | SA | NFT | | | | | | SU/C | 5.5-6.5 | ESu | 58 |
| Crimson clover | | WA, SA | 7 | | | | | | U/SU | 5.5-7.0 | LSu, ESu | |
| Field peas | Winter peas, black peas | WA | 7 | | | | | | C | 6.0-7.0 | F, ESp | 41 |
| Hairy vetch | Winter vetch | WA, CSA | 4 | | | | | | C | 5.5-7.5 | EF, ESp | 60 |
| Medics | | SP, SA | 4/7 | | | | | | P/SU | 6.0-7.0 | EF, ESp, ES | 45 |
| Red clover | | SP, B | 4 | | | | | | U | 6.2-7.0 | LSu, ESp | 41 |
| Subterranean clover | Sub clover | CSA | 7 | | | | | | P/SP | 5.5-7.0 | LSu, ESp | 38 |
| Sweetclovers | | B, SA | 4 | | | | | | U | 6.5-7.5 | Sp/S | 42 |
| White clover | White dutch, ladino | LP, WA | 4 | | | | | | P/SU | 6.0-7.0 | LW, E/LSp, EF | 40 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Woollypod vetch | Lana | CSA | 7 | ◕ | ◕ | ◑ | ◑ | ◕ | SP/C | 6.0-8.0 | F | |

[1]B=Biennial; CSA=Cool season annual; LP=Long-lived perennial; SA=Summer annual; SP=Short-lived perennial; WA=Winter annual. [2]See USDA Hardiness Zone Map, inside front cover, NFT=Not frost tolerant. [3]C=Climbing; U-Upright; P=Prostrate; SP=Semi-prostrate; SU=Semi-upright.. [4]E=Early; M=Mid; L=Late; F=Fall; Sp=Spring; Su=Summer; W=Winter.

◯=Poor; ◔=Fair; ◑=Good; ◕=Very Good; ●=Excellent

| Esp | Sp | Lsp | Esu | Su | Lsu | Ef | F | Lf |
|---|---|---|---|---|---|---|---|---|
| 2/15-5/15 | 4/15-5/20 | 5/10-6/10 | 6/1-7/1 | 6/15-8/15 | 8/1-9/15 | 9/1-10-15 | 10/1-11/15 | 11/1-12/1 |

## Chart 3 - Planting

| Species | Depth (in) | Seeding Rate | | | | | Inoculant Type | Reseeds[1] |
|---|---|---|---|---|---|---|---|---|
| | | Drilled | | Broadcast | | | | |
| | | lb/A | bu/A | lb/A | bu/A | oz/100 ft$^2$ | | |
| Annual ryegrass | 0–0.5 | 10-20 | .4-.8 | 20–30 | .8–1.25 | 1 | | R |
| Barley | 0.75–2 | 50–100 | 1–2 | 80–125 | 1.6–2.5 | 3-5 | | S |
| Oats | 0.5–1.5 | 80–110 | 2.5–3.5 | 110–140 | 3.5–4.5 | 4–6 | | R |
| Rye | 0.75–2 | 60–120 | 1-2 | 90–160 | 1.5–3.0 | 4–6 | | R |
| Wheat | 0.5–1.5 | 60–120 | 1–2 | 60–150 | 1–2.5 | 3–6 | | S |
| Buckwheat | 0.5–1.5 | 48–70 | 1–1.4 | 50–90 | 1.2–1.5 | 3–4 | | R |
| Sorghum-sudangrass | 0.5-1.5 | 35 | 1 | 40–50 | 1–1.25 | 2 | | S |
| Mustards | 0.25-0.75 | 5-12 | | 10-15 | | 1 | | U |
| Radish | 0.25-0.5 | 8-13 | | 10-20 | | 1 | | S |
| Rapeseed | 0.25-0.75 | 5-10 | | 8-14 | | 1 | | S |
| Berseem clover | 0.25–0.5 | 8–12 | | 15–20 | | 2 | crimson, berseem | N |
| Cowpeas | 1–1.5 | 30–90 | | 70–120 | | 5 | cowpeas, lespedeza | S |
| Crimson clover | 0.25–0.5 | 15-20 | | 22–30 | | 2–3 | crimson, berseem | U |
| Field peas | 1.5–3 | 50–80 | | 90–100 | | 4 | pea, vetch | S |
| Hairy vetch | 0.5-1.5 | 15–20 | | 25–40 | | 2 | pea, vetch | S |
| Medics | 0.25–0.5 | 8–22 | | 12–26 | | 2/3 | annual medics | R |
| Red clover | 0.25–0.5 | 8–10 | | 10–12 | | 3 | red clover, white clover | S |
| Subterranean clover | 0.25-0.5 | 10–20 | | 20–30 | | 3 | clovers, sub, rose | U |
| Sweet clovers | 0.25–1.0 | 6–10 | | 10–20 | | 1.5 | alfalfa, sweet clover | U |
| White clover | 0.25–0.5 | 3–9 | | 5–14 | | 1.5 | red clover, white clover | R |
| Woollypod vetch | 0.5–1 | 10–30 | | 30–60 | | 2-3 | pea, vetch | S |

[1]**R**=Reliably; **U**=Usually; **S**=Sometimes; **N**=Never (reseeds)

## Chart 3 - Potential Advantages

| Species | Soil Impact | | | Soil Ecology | | | | Other | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sub-soiler | Free P&K | Loosen topsoil | Nema-todes | Dis-ease | Allelo-pathic | Choke weeds | Attract bene. | Bears traffic | Short windows |
| Annual ryegrass | ◑ | ◑ | ● | ◑ | ◑ | ◑ | ● | ◔ | ● | ● |
| Barley | ◑ | ◑ | ◕ | ◔ | ◑ | ◕ | ◕ | ◑ | ◑ | ● |
| Oats | ○ | ◔ | ◕ | ○ | ◑ | ◕ | ● | ○ | ◑ | ● |
| Rye | ◔ | ◕ | ● | ◑ | ◕ | ● | ● | ◔ | ◕ | ● |
| Wheat | ◑ | ◕ | ◕ | ◔ | ◔ | ◔ | ◕ | ◔ | ◑ | ◑ |
| Buckwheat | ○ | ● | ◕ | ◔ | ○ | ◕ | ● | ● | ○ | ● |
| Sorghum–sudangrass | ● | ◑ | ◑ | ◕ | ◕ | ● | ● | ◑ | ◑ | ● |
| Mustards | ◔ | ◑ | ◕ | ◕ | ◕ | ◕ | ◕ | ◑ | ◑ | ◕ |
| Radish | ● | ◕ | ◑ | ◕ | ◑ | ◕ | ● | ◔ | ◔ | ◕ |
| Rapeseed | ◑ | ◔ | ◑ | ◕ | ◑ | ◕ | ◑ | ◑ | ◔ | ◑ |
| Berseem clover | ◔ | ◕ | ◕ | ○ | ○ | ◔ | ◕ | ◑ | ◔ | ◕ |
| Cowpeas | ◑ | ◑ | ◕ | ○ | ○ | ○ | ● | ◕ | ○ | ● |
| Crimson clover | ◔ | ◑ | ◑ | ◔ | ◑ | ◔ | ◑ | ◕ | ◔ | ◑ |
| Field peas | ◔ | ◔ | ◕ | ◑ | ◕ | ◔ | ◕ | ◕ | ◔ | ◕ |
| Hairy vetch | ◑ | ◑ | ◕ | ◔ | ◑ | ◑ | ◕ | ● | ○ | ○ |
| Medics | ◑ | ◔ | ◔ | ◑ | ◑ | ◔ | ◕ | ◔ | ◔ | ● |
| Red clover | ◕ | ◕ | ◑ | ◔ | ◔ | ◑ | ◑ | ◕ | ◑ | ◑ |
| Subterranean clover | ○ | ◔ | ◑ | ◔ | ◔ | ◕ | ● | ◕ | ◕ | ◕ |
| Sweetclovers | ● | ● | ● | ◔ | ◔ | ◔ | ◑ | ◕ | ◑ | ○ |
| White clover | ◔ | ◔ | ◕ | ○ | ○ | ◑ | ◕ | ◑ | ● | ◑ |
| Woollypod vetch | ◕ | ◑ | ◕ | ◔ | ◔ | ◑ | ● | ◕ | ◔ | ◑ |

○=Poor; ◔=Fair; ◑=Good; ◕=Very Good; ●=Excellent

**Chart 4 - Potential Disadvantages**

| Species | Increased Pest Risk | | | Management Challenges | | | | | Comments Pro/Con |
|---|---|---|---|---|---|---|---|---|---|
| | Weed potential | Insects/nematodes | Crop disease | Hinder crops | Establish | Till-kill | Mon-kill | Mature incorporate | |
| Annual ryegrass | ○ | ◕ | ◕ | ◑ | ● | ● | ● | ◑ | If mowing, leave 3-4" to ensure regrowth. |
| Barley | ◔ | ◔ | ◔ | ◑ | ● | ● | ● | ○ | Can be harder than rye to incorporate when mature. |
| Oats | ● | ◑ | ◕ | ◑ | ● | ● | ◔ | ◑ | Cleaned, bin-run seed will suffice. |
| Rye | ◔ | ◑ | ◕ | ◔ | ◕ | ◕ | ● | ○ | Can become a weed if tilled at wrong stage. |
| Wheat | ◑ | ◔ | ◔ | ◑ | ● | ● | ◕ | ◑ | Absorbs N and H20 heavily during stem growth, so kill before then. |
| Buckwheat | ○ | ◕ | ● | ● | ● | ● | ● | ● | Buckwheat sets seed quickly |
| Sorghum–sudangrass | ◑ | ◕ | ● | ◔ | ● | ◕ | ◕ | ◔ | Mature, frost-killed plants become quite woody. |
| Mustards | ◔ | ◕ | ● | ◑ | ● | ● | ◔ | ● | Great biofumigation potential; winterkills at 25° F. |
| Radish | ◑ | ◕ | ● | ● | ● | ● | ● | ● | Winter kills at 25° F; cultivars vary widely. |
| Rapeseed | ◔ | ◔ | ● | ◑ | ● | ◑ | ◔ | ◕ | Canola has less biotoxic activity than rape. |
| Berseem clover | ● | ◑ | ◕ | ● | ● | ◔ | ◔ | ◕ | Multiple cuttings needed to achieve maximum N. |
| Cowpeas | ● | ◑ | ◕ | ● | ● | ● | ● | ● | Some cultivars, nematode resistant. |
| Crimson clover | ◑ | ○ | ◕ | ● | ◕ | ◕ | ◕ | ◕ | Good for under-seeding, easy to kill by tillage or mowing. |
| Field peas | ● | ◑ | ◔ | ● | ● | ● | ● | ◕ | Susceptible to *sclerotinia* in East. |
| Hairy vetch | ◑ | ◑ | ● | ● | ◑ | ◔ | ● | ◑ | Tolerates low fertility, wide pH range, cold or fluctuating winters. |
| Medics | ◑ | ◔ | ● | ◕ | ◕ | ◔ | ◕ | ◕ | Perennials easily become weedy |
| Red clover | ◑ | ◔ | ◕ | ● | ◕ | ◑ | ◔ | ◕ | Grows best where corn grows well. |
| Subterranean clover | ◑ | ○ | ◑ | ◑ | ● | ◔ | ○ | ◕ | Cultivars vary greatly. |
| Sweetclovers | ◔ | ◔ | ● | ◑ | ● | ◑ | ◕ | ◔ | Hard seed possible problem; does not tolerate seeding year mowing |
| White clover | ◑ | ◑ | ◕ | ◔ | ◕ | ○ | ◑ | ◕ | Can be invasive; survives tillage. |
| Woollypod vetch | ◑ | ◑ | ◔ | ◑ | ◑ | ◕ | ● | ◔ | Hard seed can be problematic; resident vegetation eventually displaces. |

○=Problem; ◔=Could be a moderate problem; ◑=Could be a minor problem; ◕=Occasionally a minor problem; ●=Not a problem

# Tree/Shrub Establishment and Maintenance Guidelines

This technical note provides guidance for establishing trees and shrubs as part of the following Natural Resources Conservation Service (NRCS) Field Office Technical Guide (FOTG) Conservation Practices:

Windbreak/Shelterbelt Establishment (practice code 380)
Tree/Shrub Establishment (practice code 612)
Riparian Forest Buffer (practice code 391)
Upland Wildlife Habitat Management (practice code 645)
Hedgerow Planting (practice code 422)
Alley Cropping (practice code 311)
Recreation Area Improvement (practice code 562)

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**NRCS, KS**
**June 2002**

## CONSERVATION TREE AND SHRUB PLANTING SUITABILITY GROUPS

Refer to the Windbreak Suitability Groups in Section II of the Field Office Technical Guide (FOTG) to determine adaptation and performance of trees and shrubs for the soils of each windbreak suitability group.

## PLANT STOCK REQUIREMENTS

Planting stock must be grown from locally adapted seed or cuttings of known origin and meet height and caliper standards listed below. For species that are not native, the seedlings should be produced from seed collected from localities having climate, latitude, and altitude similar to that of Kansas or from seed sources that have been selected and tested in tree improvement programs. Planting stock from out-of-state sources must be certified disease and insect free.

**Bare Root Deciduous Seedlings** shall not be less than 3/16-inch caliper at 1 inch above the root collar. Bare root deciduous seedlings shall have a shoot (top growth) of at least 12 inches. Rooted planting stock must not exceed a 2:1 shoot-to-root ratio (see Figure 1)**.**

**Bare Root Coniferous Stock** shall have a minimum stem diameter of 5/32 inch at 1 inch above the root collar. Rooted planting stock should have a well-developed fibrous root system and should not exceed a 2:1 shoot-to-root ratio (see Figure 1).

**Vegetative Deciduous Cuttings** shall be no less than 1inch diameter at the base (recommend 2 to 3 inch diameter for better survival), have the apical bud and all lateral side branches removed, and produced in lengths long enough to reach a soil depth that remains saturated throughout the growing season, or the site must be irrigated.

Vegetative material should be collected while dormant. Dormancy means no bud swell, no green showing on buds, and no separation of bud scales. Actively growing materials can be used, but survival will usually be lower. Avoid cutting current years growth. The best material is 4 to 5 years old. A horizontal cut at the top and a 45-degree cut at the bottom will aid in planting. The ends of the cuttings may be treated with latex paint. Vegetative material works best if planted within 2 to 3 weeks of harvest. Material may be stored if dormant for a short period of if kept at a temperature of 34 to 38 degrees F. Do not allow stock to dry out for even short periods of time, as survival will be greatly reduced.

**Container-grown Stock** shall have a seedling height of at least 6 inches. Container-grown stock must be produced in containers that minimize girdling roots or J-roots.

**Seeds** should be collected as close to the planting site as possible, or purchased from nurseries or other sources that are known to be using locally adapted seed. Seed from walnut and oaks should be collected within a 200-mile radius of the planting site.

Not all seed is viable or sound. The percent of sound seed in a batch can be determined by simply cutting or cracking open a sample of the nuts. Viable nuts have white, sound-looking nut meat; nonviable seeds have darkened or shriveled kernels that may be watery or give off a foul or rancid odor. Floating seed has also been used to determine viability of some species; however, it is not as reliable as a cut test.

There is a large variation in seed quality between species. Some species of trees and shrubs have a high percentage of viable seeds that will easily germinate the first season after planting. Other species have seed that is very difficult to germinate. Even with proper scarification and/or stratification, some species will only show 2 to 3 percent germination 2 years after planting.

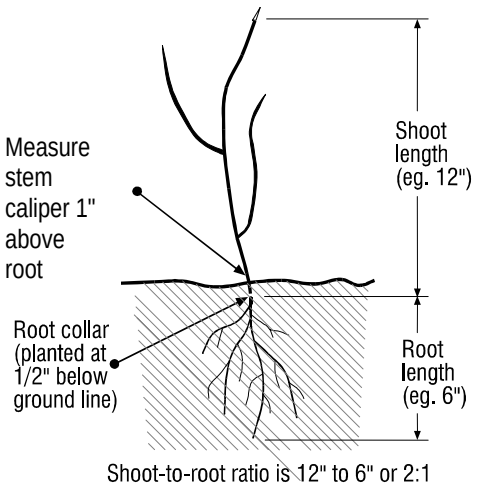



**Figure 1:** Shoot / Root Ratio

## Storage, Care, and Handling Requirements

Rooted planting stock and cuttings will be stored in a cool, moist environment (34 to 38°F) or heeled into the soil. During all stages of handling and storage, keep stock free of mold and roots moist and cool. Keep roots covered at all times. Live cuttings that are not immediately planted after harvest shall be promptly placed in controlled storage conditions (34 to 38°F) and protected until planting time.

Seeds shall be stored in a cool (35 to 40°F), dark area. Depending upon the species, seed storage may require moist or dry conditions. Become knowledgeable of the duration of seed viability. Some species of seeds lose viability within months after maturity. Others, with proper storage, remain viable for years.

Acorns should be collected in breathable sacks as soon as seed falls (late August-November) and soaked in water (running water is best) for 12 to 24 hours, drained for 30 minutes, and stored in a cool dark area. When collecting black walnut, leave husks on for fall planting and store in piles less than 10 inches deep to avoid heat buildup. Removing husks is unnecessary work that can cause seeds to dry out.

Landowners may keep stock for up to one week before planting by storing it in a shaded, cool, moist place. An unheated basement or fruit cellar works very well. Plant bundles should be turned every day when temporarily stored to avoid mold and/or drying problems within the bundle. Ensure roots are moist and not exposed to the air. Do not store in a bucket of water. Trees will commonly break dormancy (begin to leaf out) with this type of storage, resulting in poorer survival.

For longer storage periods, stock may be heeled in. This can be described as high-density planting in a furrow. Locate the heel-in bed in good soil in a protected location. See Figure 2 for details.

Thoroughly soak the trench with water after planting to remove air spaces and improve root/soil contact.

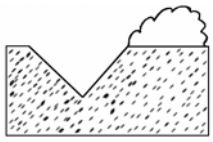


**Figure 2A:** Dig a trench deep enough for proper root placement.

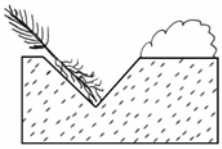


**Figure 2B:** Break bundles and spread along the trench wall with 2 to 3 inches between each plant.

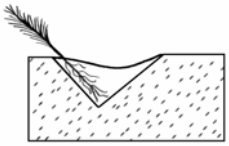


**Figure 2C:** Immediately cover roots with soil and lightly pack.

Cover roots quickly to minimize exposure to sun and air. Short periods of exposure can greatly reduce survival and establishment. Leaving plants in a heel-in bed for longer than one season increases the difficulty of transplanting and decreases survivability. Moving the transplants to their permanent location should be performed while the material is still dormant.

Roots of bare root stock shall be kept moist at <u>all times</u> during planting operations by placing in a water-soil (mud) slurry, super-absorbent (e.g., polyacrylamide) slurry, or covering with wet peat moss, wet shingletow, or other equivalent material. Do not cover with dry shingle tow, peat moss, etc. and expect to thoroughly wet it afterwards. No matter the amount of water applied, some roots will remain dry.

The rooting medium of container or potted stock shall be kept moist at all times by periodic watering.

Pre-treat stored unrooted cuttings prior to planting by soaking in water for 24-48 hours. Note: There is some debate as to the effectiveness of soaking stored, unrooted cuttings prior to planting. However, soaking will not harm cuttings and <u>may</u> increase survivability.

Keep roots moist and covered throughout the entire planting operation. To further reduce planting shock, stock could be carried during the planting process in buckets of water or slurry. Do not allow rooted conifer stock to be immersed for longer than one hour.

Stock shall not be planted when soil is frozen or dry. Do not handle trees or shrubs when temperatures are freezing or below.

Reduce exposure of bare root seedlings to air and sunshine while loading the planter and during the planting operation. Do not plant on hot, dry, windy days.

## PLANTING SITE PREPARATION

Planting sites shall be properly prepared based on soil and vegetative conditions listed below. Avoid sites that have had recent application of pesticides that may be harmful to woody species.

Prior to initiating tree planting, check waiting period restrictions and carryover characteristics of pesticides applied to the planting site in the previous one to two years.

If pesticides are used, apply only as needed within federal, state, and local regulations. Follow label directions and heed all precautions listed on the container.

On sites treated with pesticides, especially tilled sites, be alert to health risks that may result from handling the chemically treated soil or breathing the chemically impregnated dust.

Site preparation may include the whole field, strips, or patches. Individual site preparation for each tree/shrub should provide a minimum 4-foot diameter circle, or a minimum 4-foot x 4-foot square, or a 4-foot-wide strip at each planting spot (2 feet on each side of the planted stock).

The planting area must be free of living sod and perennial weeds before planting.

### Tillage Site Preparation

Tillage Site Preparation on Sod-covered Sites (or Sites With Perennial Herbaceous Cover)

Perform sufficient tillage to kill the sod and maintain the entire site in a reasonably weed free condition prior to tree and shrub planting.

Plow or chisel the sod to a minimum 12-inch depth at least one year prior to spring planting. Disc the site through the preplant growing season and immediately before planting to control any species that have resprouted.

Nonselective herbicides may be used to kill sod grasses and other herbaceous species prior to tillage. Follow guidelines under Chemical Site Preparation and instructions found on the herbicide label.

Avoid tilling soils that are wet, to minimize compaction.

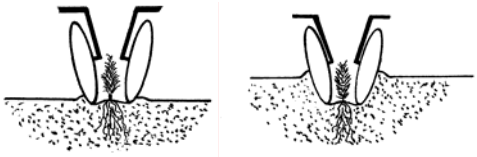
Be alert to potential wind and water erosion risks during the fallow period. Seed an annual cover crop of oats or spring grains to control erosion while minimizing water usage. Oats and spring grains will die over winter, but must be seeded early enough to attain 4- to 6-inch height prior to freeze-up to provide soil protection.

For very erosive sites and no plans for cover crops, till only 5- to 8-foot-wide strips (10 foot strips, if weed control fabric is to be installed after planting) where the trees/shrubs will be planted while leaving and maintaining the existing vegetation between the rows. This will reduce wind and water erosion, sandblasting, provide easier site access, and provide wildlife benefits. If the existing vegetation is fescue or smooth brome, tilled strips are not an option. The entire planting area will be tilled. If the site is very erosive, a cover crop will be established.

Orient tree and shrub plantings on the contour, when possible, to minimize water erosion risks during the fallow period and subsequent planting and maintenance operations.

Avoid deep tillage (greater than 2 inches deep) immediately prior to planting to prevent drying the seedbed.

Firm the seedbed prior to planting by cultipacking, if needed, to reduce soil moisture loss and aid in proper plant placement. A firm seedbed for tree planting should be similar to a firm seedbed for grass seeding where adult human footprints are barely visible and planting equipment leaves a minimal trench. See Figure 3.



**This**
Firm soil, plants at proper depth.

**Not This**
Soil too loose, plants pressed too deep.

**Figure 3:** Effects of Seedbed Firmness

Tillage Site Preparation on Cropland Sites

Shallow tillage immediately prior to planting to remove sprouted annual weeds and grasses is appropriate. Shallow tillage between harvest and freeze-up the year before planting is permitted, if needed. If a compacted plow layer exists, chisel or plow to break up the restrictive layer prior to planting. Be alert to potential wind and water erosion risks during the fallow period. If needed, seed an annual cover crop of oats or small grains to control erosion while minimizing water usage. Oats or small grains will die over winter but must be seeded early enough to attain a 4- to 6-inch height prior to freeze-up to provide soil protection.

Avoid excessive tillage prior to planting. Tillage is not needed or effective if there are no weeds present and may deplete soil moisture as well as to bring up a fresh supply of weed seed to the surface.

Prior to planting, firm the seedbed, if needed, to reduce drying and to aid in proper depth placement of the plant and natural moisture movement within the soil. A firm seedbed for tree planting should be similar to a firm seedbed for grass seeding where adult human footprints are barely visible and planting equipment leaves a minimal trench (see Figure 3).

All precautions concerning erosion and sand blasting on sod-covered sites apply on cropland sites.

Consider tilling only 4- to 5-foot strips where the tree/shrubs will be planted (10 foot strips, if weed control fabric is to be installed after planting), thereby allowing the standing stubble between the rows to act as temporary wind protection for new seedlings.

Scalp Planting Site Preparation

Scalp planting is a method that places plant material in an area cleared of competing vegetation. The area cleared is usually a foot or more wide on each side of the planted row. This operation is usually performed by attachments to the planting machine. It can also be done by other machines in a separate operation, or by hand immediately prior to planting.

Scalp planting into aggressive sods such as smooth brome or fescue is not recommended.

Scalping tends to encourage a rapid flush of annual weeds on the freshly exposed soil that will require a post-plant weed control effort.

When scalping on native range sites, orient plantings in locations that are most conducive to tree/shrub growth. Best tree growing sites are often found in toeslope positions, north facing slopes, or in swales and draws.

When possible, orient rows on a true contour to harvest runoff moisture and reduce erosion.

**Chemical Site Preparation**

Chemical Site Preparation on Sod-covered Sites (or Sites With Perennial Herbaceous Cover)

Site preparation by herbicides on sod sites should be initiated the growing season before planting.

Follow label instructions so that application technique and timing of herbicide application will lead to a complete control of the vegetation. Repeated applications throughout the fallow year may be necessary.

For sites with rhizomatous and or other competitive grasses such as smooth brome or fescue, completely spray the entire area where the trees/shrubs will be planted, including a 10-foot-wide band around the outside of the planting area.

Spraying of 5- to 8-foot-wide strips where the trees/shrubs will be planted while leaving existing vegetation between rows untreated is an option. This will reduce potential erosion, sandblasting, provide easier access, and provide wildlife benefits. If the existing vegetation is fescue or smooth brome, strip spraying is not an option. The entire planting area will be treated.

Undisturbed dead sod will often provide a season's weed control or suppression after the trees or shrubs have been planted.

Herbicides vary as to their risk of leaching or runoff. Avoid using herbicides with high leach or runoff potential on sites where there is increased risk of polluting surface or ground water sources.

Chemical Site Preparation on Cropland Sites

Apply appropriate burndown chemicals according to label directions prior to planting trees and shrubs, if needed.

Native Grass Cover

Warm season native grass species of blue grama, buffalograss, little bluestem and/or sideoats grama may be seeded between tree/shrub rows to reduce erosion and runoff, prevent sandblasting, and improve wildlife cover.

When using native grasses between rows, it is essential a weed-free zone of at least 4 feet be maintained around each tree or shrub for the first 3 years after planting.

Warm season native grass species initiate growth after trees and shrubs have leafed out, reducing early season competition for water. These warm season grass species are shade intolerant and will be suppressed as growing tree and shrub canopies shade the ground. In no case should a sod-forming and/or an aggressive cool season grass such as smooth brome or fescue be substituted for these species.

Short, warm season grasses are particularly effective between fabric strips. Without tillage between fabric strips, there is no risk of the fabric being hooked by a tillage implement and torn out.

The following pure stand seeding rates are to be used for designing the between-row grass seedings. Reduce rates by the appropriate percentage when using a mix of these grasses.

Blue grama 2# PLS (Pure Live Seed) per acre

Buffalograss 5# PLS per acre

Sideoats grama 6# PLS per acre

Little bluestem 4# PLS per acre

## ESTABLISHMENT METHODS

Plant only in the spring of the year after frost is out of the ground. Plant bareroot stock and containerized no later than May 1.

Containerized stock may be planted in the fall (September 15-Octtober 30) if soil moisture is sufficient. Extensions of these planting dates by 10 days may be made by the district conservationist, if local soil moisture and temperature conditions justify it and are documented. Before granting an extension, consider the cooperator's ability and willingness to address the greater need for supplemental watering, wind protection, and/or shade that may be necessary in the weeks immediately following a later planting.

Immediately after, or during planting of all stock, whether by hand or machine, pack soil firmly around each plant to eliminate air pockets. Proper adjustment and operation of the tree-planting machine will eliminate the need to pack the edges of tree rows with tractor tires or feet.

**Planting - Bare Root Stock (Seedlings, Transplants, Rooted Cuttings)**

Before planting, examine seedlings and discard any with poorly developed root systems and those that do not meet planting stock requirements. Rooted stock will be planted in a vertical position with the root collars approximately ½-inch below the soil surface. (See Figure 4.) The planting trench or hole must be deep and wide enough to permit roots to spread out and down without J-rooting or L-rooting. Trim straggly roots of bare-root stock as needed to prevent J-roots, L-roots, broken roots, or wadded roots that may result from "stuffing" too many roots into the planting shoe. Do not over-trim roots.

**Planting – Unrooted Cuttings (Willow, Cottonwood)**

Base ends of longer cuttings, or the entire cutting if smaller, should be soaked for 10 to 24 hours before planting.

If cuttings have been stored for more than one week, re-cut the base end at a 45-degree angle to maximize water uptake. Cut dead wood back without damaging the green tissue.

Insert cuttings to the depth required to reach adequate soil moisture with at least one to two buds sticking above the soil surface. Longer cuttings may be planted so that 2 to 3 inches of stem are aboveground to allow for more branching.

Depth to growing season water table must be determined before obtaining cuttings to ensure cuttings are sufficiently long enough to reach the water table.

**Planting – Container-grown Stock**

Container-grown stock should be planted so the top of the root crown is covered with ½ to 1 inch of soil.

**Planting – Direct Seeding**

Understand the requirements of each species to know the best time to seed. Most species, however, used for direct seeding should be planted in the fall. Some species need a warm-cold-warm stratification period while others need a cold-warm stratification period. Some species such as bur or chinquapin oak begin sprouting within days after falling from the tree. In other words, some species germinate in the fall and some, like silver maple, germinate in the spring.

For this reason, white oaks (white, bur, swamp white, chinquapin, and post oak) must be planted in the fall because that is when they germinate. White oaks do not require stratification; their acorns germinate soon after they fall to the ground.

Walnut, the red oaks (red, black, pin, and shingle oaks), and most other tree species produce dormant seed that will not germinate unless exposed to a period of moist cold. This period of "stratification" can be satisfied by planting in the fall, storing the seed over winter in a moist stratification pit, or with moist cold storage over the winter. It is important to recognize that seed purchased from vendors is not stratified seed, unless otherwise stated.

Fall planting of nuts is preferred and recommended to take advantage of the natural stratification of dormant seeds. In the fall, plant as soon as the seed has been collected so that seeds can germinate as soon as conditions are favorable. It is important to maintain moisture in the majority of seed used for direct seeding.

Seed can be planted by hand or mechanically. Tree seeds are very particular with respect to depth of planting. Tree seeds generally respond best when seeded to a depth of 1 to 3 times the diameter of the seed. For example, ash and maple seed should be planted ¼ to ½ inch deep, while acorns, walnuts, and hickory, should be planted ½ to 2 inches deep.

Large seeds, such as walnut or acorn, can be broadcast seeded using a fertilizer or lime spreader followed by a light discing operation. Small seeds, such as sycamore or ash, can be broadcast seeded followed by a light harrowing operation. Following the planting operation, the area should be rolled or cultipacked.

To calculate the amount of seed needed:

- Determine the desired number of trees per acre.
- Determine the percent composition of the desired stand.
- Estimate the percent of sound seed, percent germination (can be derived from woody production manuals), and percent survival (predation may be significant) during the first year.

For example, the goal is to have 1,600 trees of a particular species per acre. The seed used is estimated to be 50 percent sound, the average germination is 30 percent, and the initial survival is estimated to be 50 percent. To meet the desired goal, 21,333 seeds per acre would be required [1,600 / (.50 x .30 x .50)]. To estimate the number of seeds per pound, make several seed counts to arrive at this figure.

**Planting – Natural Regeneration**

It is important to understand the reproductive requirements and characteristics of the species before considering using natural regeneration as an establishment technique. Upstream or adjacent plant sources should be examined during the planning process to determine if desirable species are present. With the exception of species like cottonwood, most species do not produce a good seed crop every year. All nut or mast bearing trees should be observed early in the season to predict the type of seed crop to be expected.

To determine suitability of the site for natural regeneration, refer to Exhibit A.

## ESTABLISHMENT CRITERIA

Where natural regeneration is used as the establishment technique, the site shall be monitored for a minimum of three years to document species composition and establishment.

Documentation of establishment should be performed no earlier than August of the third growing season after the initial planting. Table 5 provides establishment criteria. A random sampling method may be used to arrive at percent survival by sampling 10 percent of the planted trees/shrubs or as a minimum for smaller plantings, 100 trees/shrubs should be sampled.

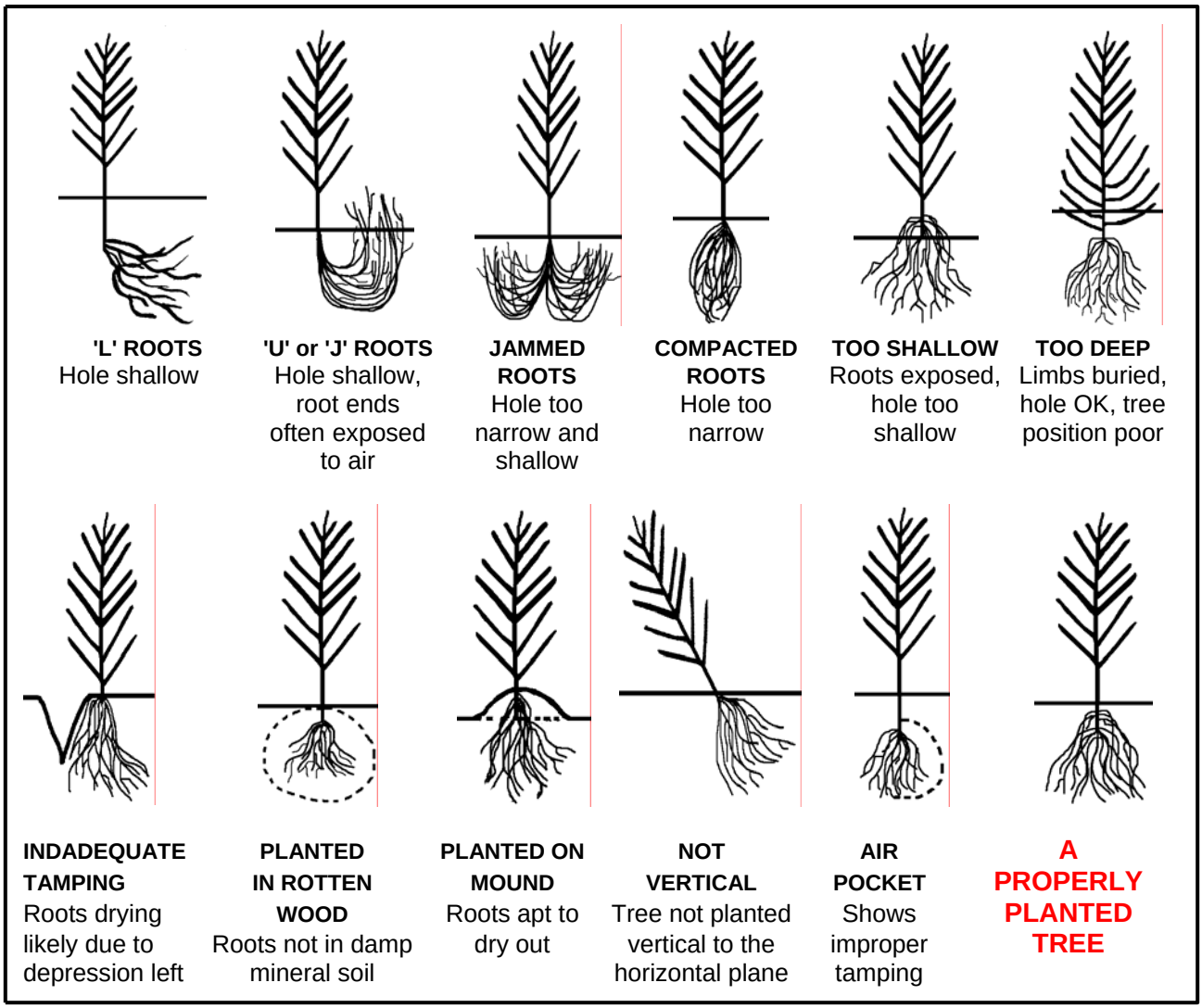



**Figure 4:** Examples of improperly planted trees.

**USDA, KS**
**June 2002**

| PRACTICE | ESTABLISHMENT CRITERIA |
|---|---|
| 380 WINDBREAK/SHELTERBELT ESTABLISHMENT | One or two row planting - 90 percent survival |
| 391 RIPARIAN FOREST BUFFER (ZONE 1) | Three or more row planting - 80 percent survival |
| 311 ALLEY CROPPING<br>391 RIPARIN FOREST BUFFER (ZONE 2)<br>422 HEDGE ROW PLANTING<br>612 TREE/SHRUB ESTABLISHMENT<br>645 UPLAND WILDLIFE HABITAT MANAGEMENT | 70 percent survival required on all trees/shrubs planted |
| DIRECT SEEDING ESTALISHMENT METHOD<br>NATURAL REGENERATION ESTABLISHMENT METHOD | Minimum of 300 trees/shrubs established per acre |

**Figure 5**: Survival rates for woody practices

**Replanting**

Any tree or shrub that fails within the first three years should be replaced with a similar plant. Replanting is essential to maintain the intended function of the planting and should be compatible with soils and climate. Growth rates of most replants (when replanted within 3 years of the original planting date) are usually such that little if any size difference is noted, across the planting, after 10 years. Dead trees should be flagged late summer before leaf drop. Delays in replanting of longer than 3 years will allow adjacent established tree roots to create greater competition to the replants, resulting in slower growth. On some sites with older established plantings (over 15 years old), replants rarely put on substantive growth nor function as desired.

## MAINTENANCE AFTER PLANTING

Competitive vegetation will be controlled for at least 3 years after planting. Specific recommendations for vegetative control should be listed in all tree planting plans for the first 3 years.

Livestock shall be excluded from the planting area.

**Mechanical Weed Control**

Use caution when tilling around trees and shrubs. Poor tillage techniques (too deep, too close to the trunk) can damage trunks, limbs, and roots. Erosion that may result from indiscriminate tillage may remove several inches of soil exposing roots to severe damage by future tillage operations.

Use tillage only when needed to maintain or improve the health and vigor of the planting. Tillage, when weeds are not growing, wastes moisture and fuel and increases the risk of mechanical injury to trees.

**Chemical Weed Control**

Specific herbicides, application rates, and timing of application should be listed in tree planting plans for the first 3 years. Plantings should be scouted annually to identify specific vegetation needing control to aid in herbicide selection. Follow label directions when applying the appropriate chemical to control weeds. Adhere to state or local rules that apply to chemical applications on tree and shrub plantings.

Some approved herbicides are nonselective and will kill most weeds but must not come in contact with any part of the tree or shrub. Other approved chemicals prevent weeds from germinating or kill newly germinated weed sprouts but will not kill emerged weeds.

Effectiveness of most herbicides used to control weeds in tree and shrub plantings is very sensitive to different application rates, considerably more so than the common herbicides used to kill weeds in lawns. Too little chemical applied will not provide adequate weed control. Applying too much of some chemicals may damage or kill trees and shrubs.

Use chemicals only when needed to maintain or improve the health and vigor of the windbreak.

**Organic Mulches**

Organic mulches may include straw, wood chips, chopped corncobs, or other organic byproducts. Mulches are most effective when maintained to the dripline of the tree or beyond. For newly planted stock, they should be placed in a 3- to 4-foot diameter circle around each plant to a depth of about 4 inches. When mulching shrub rows, mulch can be applied in a contiguous 4-foot-wide band (2 feet each side of the plants).

In situations of higher precipitation, frequent irrigation, or on tighter wetter soils, it may be appropriate to maintain a 4-inch mulch-free circle around each trunk to minimize potential trunk problems. In high moisture situations, mulch against the trunk may hold moisture and encourage bacterial growth resulting in bark injury, which could shorten the life of the tree.

If organic mulch is used, a post-emergent herbicide application is sometimes necessary to control unwanted vegetation.

**Synthetic Mulch (Fabric) Weed Control**

Synthetic Mulch (Fabric)

Fabric shall be of such quality that the manufacturer guarantees the product for at least 3 to 5 years.

Fabric must be black or capable of preventing underlying plant growth.

Fabric may be pin-punched plastic, solid polyethylene, woven polypropylene, or some other rot-resistant material. It must prevent plant shoots from pushing through from below.

The minimum width for continuous rolls of fabric applied by machine will be 6 feet, nominal 4-foot weed control width after installation. Individual fabric squares may be as small as 4 feet square since the full 4-feet, when stapled or pinned, effectively prevents weed growth. In certain planting designs a profusion of root suckers is desired. For these applications, 4- foot-wide rolls of fabric, yielding a nominal 2-foot weed free zone (1-foot each side), are appropriate. This narrow fabric is only appropriate on shrubs capable of profuse suckering. Some shrubs, such as plum, that sucker close to the trunk still may not sucker to any great degree outside the fabric edges . Consider not using fabric on suckering shrubs where a dense thicket is desired.

| Improper Weed Control Fabric Installation | Proper Weed Control Fabric Installation |
|---|---|
| Tree planted in furrow. Fabric bridged over limbs Creates an "oven." Plants can be killed by heat. | Fabric flush to ground surface. All limbs above fabric. Soil around tree is cool and moist. |

**Figure 6**: Improper & Proper Fabric Installation

Fabric Installation

Tilled sites should be firmed and leveled in such a way that the fabric will lie flat against the ground across the entire area covered by fabric. (Sites should be firmed to barely show an adult foot print, prior to planting.) (See Figure 6.)

Fabric should not be bridged over ridges or valleys left by planting operations. Fabric not flush to the ground around the tree can provide a runway for rodents and trap summer heat sufficient to damage or kill the young plant.

If fabric is installed under a no-till situation, excessive vegetation should be removed from the area where fabric will be placed, to reduce rodent habitat and to allow fabric to lie flat against the soil surface.

Openings shall be +, X, C, L or J-shaped. Length of slit should not exceed 12 inches. Do not use I-shaped (straight) slits as abrasion of tree bark can occur. “l”-shaped cuts may also constrict the tree trunk as the diameter increases.

When fabric is placed over plants before openings are made, use care to avoid cutting the plant when making the opening. Trees and shrubs must be pulled through the fabric within minutes after installation to avoid damaging temperatures created by the fabric "oven."

Fabric is not recommended within flood plains. One flooding event could cover the fabric with silt, eliminating its effectiveness, or flood flows could tear out the fabric.

Do not cover weed control fabrics or plastics with organic mulches or gravel. These materials will delay the breakdown of the fabric or plastic, possibly causing damage to the plant, and providing a medium in which weeds can flourish.

Installation of Continuous Fabric Strips.

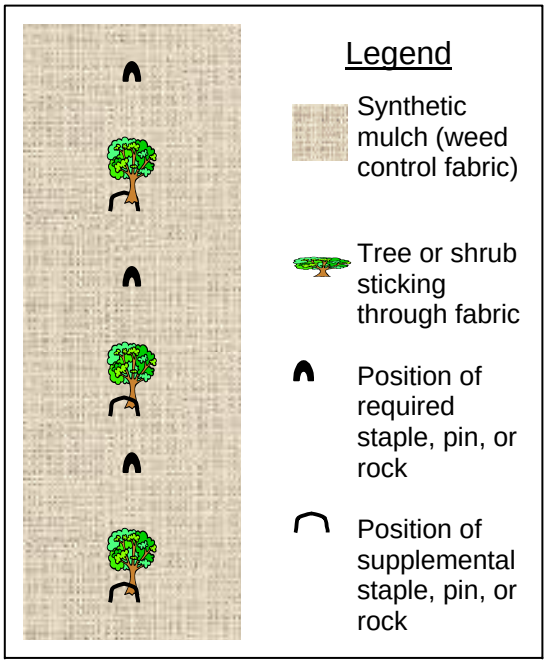



**Figure 7:** Positions of staples, pins, or rocks for continuous fabric strips.

Site preparation, if tilled, shall be at least 10 feet wide to allow enough loose soil to proper anchor fabric.

Fabric strip splices shall be anchored with staples, pins, or rocks. Staples and pins shall be of a length recommended by the manufacturer for the particular soil texture. Rocks must weigh at least 5 pounds. Do not anchor splices with soil.

About every 10 feet, or between each tree, whichever is greater, the fabric should be anchored with pins, staples, or rocks. In lighter soils, or in high wind areas, an additional pin, staple, or rock may be needed near each opening in the fabric. (See Figure 7.)

Machines must be adjusted to ensure 10 to12 inches of fabric edge are firmly anchored in the soil. After installation, it is often necessary to run a tractor wheel over the edge of the fabric to get a firm seal.

Check-dams across the furrow or slight grading of the site may be necessary on sloping land to prevent water from running along the edge of and uncovering the fabric.

Where fabric crosses larger waterways or areas of concentrated flows, the fabric shall be spliced on either side of the waterway. This is to prevent heavy runoff events from washing out an entire strip of fabric and potentially damaging 300 to 500 feet of tree row. The smaller spliced section may still wash out, but only a small amount will have to be repaired or replaced.

Pins or staples, instead of soil, may be used to anchor fabric edges. The fabric must lay flat against the soil and the pins or staples must be placed every 3 feet along the fabric edge. On sites exposed to extremely high winds or on loose soil, pins or staples may need to be closer than 3 feet.

When installing fabric on curves, use extra care to ensure that 10 to 12 inches along each edge get covered and packed with soil. Ensure the fabric is not so tight that temperature changes pull the fabric loose. Use pins, staples, or rocks to tack excessively large "puckers" to prevent wind damage.

Where fabric is desired on a curved planting with a short radius, it may be better to break the curve into short, straighter segments to ensure better quality and easier fabric installation.

Most fabric mulch will last beyond 5 years. Plantings should be checked annually to make sure that the fabric does not girdle trees as their diameter increases.

**Annual Inspection**

Inspect plantings annually to spot weather and animal damage needing repair, plants needing replacement, fabric or mulches needing repair, weeds needing treatment, or insect and disease threats that may be developing. Time of the inspection will depend upon the particular threat, but early spring is a good time to spot most problems.

**Insects and Diseases**

Inspect plantings at least annually to determine if insects or diseases are threatening the planting. If insects or diseases are observed, contact your local county extension agent to determine if control is possible or warranted.

**Protective Tree Shelters**

A wide assortment of tree shelters exists in the market place. They range from 1 foot tall to 5 feet tall, from solid tubes, to flat sheets that fold into tubes, to plastic meshes. All are effective in preventing certain kinds of damage.

One of the more common tree shelters consist of tubes, or flat sheets that fold into tubes, that range from 2 to 5 feet in height and form a 3 to 5 inch cylinder around the tree. These shelters protect the tree from wind, sun, small mammals, rodents, and deer; encourage faster initial growth; and provide an opportunity for much easier herbicide applications. Once trees grow out of shorter tubes, deer may browse the tops. For this reason, 5-foot shelters are best to prevent deer damage.

Tubes are usually tied to wood stakes with plastic ties. Tubes should not be removed for several years after the tree has emerged from the top of the tube. This period of time is needed for the tree to develop adequate stem diameter to withstand wind. Removal of the tree shelter just as the tree reaches the top of the tube will often result in a tree that "lays on the ground" or is broken off at the first strong wind.

There may or may not be merit in raising the tubes a few inches off the ground in the fall to help the tree "harden off." There is no conclusive evidence to indicate one way or the other. However, some shelters are perforated to aid in this process.

**Supplemental Watering**

Supplemental watering may be by hand, drip systems, sprinkler, furrow, flood, or other methods. The minimum water requirements discussed below will apply regardless of the watering method.

A common form of providing supplemental water is through drip systems.

The inclusion of a drip watering system as a component part of a tree/shrub conservation practice should be considered a temporary part of the planting. It will help ensure survival of new plantings and provide supplemental water during periods of drought and promote faster growth for more protection and wildlife cover.

Drip watering is based on the concept that prevention of moisture stress (as opposed to correcting moisture stress) will be realized by maintaining favorable soil moisture conditions on only a portion of the root system. Water is applied at slow rates (1 to 2 gallons per hour) for a sufficient period of time to maintain part of the soil at or near field capacity.

Special Considerations:

Usually the installation of a drip watering system is for establishment purposes and is normally limited to new plantings 3 years or less in age.

An adequate water supply shall be required before the system is installed.

Preference should be given to those woody species which are both deep rooted and long lived.

Preference should be given to those plantings which can produce multiple benefits.

Design and Installation:

For design procedure and sample problem, refer to Kansas Irrigation Guide, Procedure for Drip Watering Design for Tree Plantings.

Watering Requirements:

If practical, trees should be watered in at the time of planting. It is impractical to give a standard recommendation on watering rates or water requirements following planting because of varied soil types and variations in weather conditions. The following general guidelines should be followed:

Soak the soil profile thoroughly to a depth of 18 inches to 2 feet when watering and do not water again until the profile has dried. Thorough watering at less frequent intervals is more desirable for root development than frequent, light watering.

Watering two to three times per week will probably be needed for newly planted trees.

The first watering in the spring after the last frost and the last watering in the fall before the first frost are most important to maintain plant vigor.

## ADDITIONAL INFORMATION

“Common Insect Pests of the Trees of the Great Plains,” Great Plains Agricultural Publication No. 119.

“Diseases of Trees of the Great Plains,” Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-129.

"Tree Planting Guide"
http://www.kansasforests.org/publications/conservation.htms

"Tips on Planting Trees and Shrubs"
http://www.kansasforests.org/publications/conservation.htms

"Weed Control Options in Tree Plantings"
http://www.kansasforests.org/publications/conservation.htm

"Chemical Weed Control in Tree Plantings"
http://www.kansasforests.org/publications/conservation.htm

"Tips on Installing Weed Barrier Fabric"
http://www.kansasforests.org/publications/conservation.htm

"Weed Barrier Fabric Mulch"
http://www.kansasforests.org/publications/conservation.htm

"Wick Application of Herbicides for Weed Control"
http://www.kansasforests.org/publications/conservation.htm

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General Resource Reference, Tree Care and Management, Craig Stange, North Dakota NRCS FOTG, Sec 1, Jan 2002.

USDA Forest Service, Seeds of Woody Plants In the United States, 1974. USDA Agriculture Handbook 450.

## Exhibit A

## NATURAL REGENERATION SUITABILITY KEY

**This key is to be used by planners to determine if natural regeneration is feasible as an establishment technique. Natural regeneration may only be used on a wetland site or sites within a riparian zone where hydric soils or frequently flooded soils exist.**

| | |
|---|---|
| **1. Hydrology and soil condition marginally altered.** | **Go to 2** |
| **1. Hydrology and soil condition significantly altered.** | **Go to A** |
| **2. Propagules already exist on site.** | **Go to 3** |
| **2. Propagules do not exist on site.** | **Go to 5** |
| **3. Desirable species occur on site.** | **Go to 4** |
| **3. Desirable species do not occur on site.** | **Go to 5** |
| **4. Seed source and crop is adequate to meet planning objectives.** | **Go to B** |
| **4. Seed source and crop is inadequate to meet planning objectives.** | **Go to 5** |
| **5. Restoration site is adjacent to surrounding seed wall.** | **Go to 6** |
| **5. Restoration site is not adjacent to surrounding seed wall.** | **Go to A** |
| **6. Seed wall contains desirable species.** | **Go to C** |
| **6. Seed wall does not contain desirable species.** | **Go to A** |

**A. Natural regeneration not recommended. Another establishment technique should be considered.**
**B. Natural regeneration may be recommended for the entire area.**
**C. Natural regeneration should be considered for the area no greater than 200 feet from the surrounding seed wall.**

**Seed wall** is defined as desirable wetland/riparian plants on adjacent lands that have a good seed crop capable of dispersing to the restoration site by natural drop, wind, water, and or animals.

**Propagule** is defined as any piece of plant material that will develop into a new plant (i.e. seeds, nuts, rhizomes, or other vegetative material).

# LIVE CUTTING INSTRUCTIONS FOR VEGETATING STREAMBANKS

## INTRODUCTION

Live cuttings are leafless stem cuttings of woody plant species. These cuttings can be planted in various configurations to achieve certain vegetative and streambank stabilization goals. The planting method(s) will be specified in the project or planting design. These methods may include live siltation, brush layering, branch packing, brush mattress, live stakes, live poles, vegetated geo-grids, live crib-walls, joint planting, live fascines, and many others.

Willow and cottonwood cuttings are commonly used for riparian rehabilitation because they are easily established from cuttings. Although this document is primarily intended for willow species, the occasional inclusion of cottonwoods, sycamores, or other species as cuttings is acceptable. For additional species suitability, see the USDA, NRCS, publication National Engineering Handbook (NEH) Part 650. *Chapter 16: Streambank and Shoreline Protection*.

Cuttings can be obtained from commercial nurseries or cut from native stands located near project sites. When buying cuttings from commercial sources, the source and species shall be compatible with the planting area, (i.e. native to the area and suitable for the local climate).

## CUTTINGS FROM NATIVE STANDS

Native willow stands located near the project site are the best source of cuttings. On large stream systems, native willow stands are normally found on point bars directly across the river from project areas. Native stands of willow and cottonwood may have insect and disease infestations which can stress the plants. Extremely dry years or long periods of drought may also cause plant stress. This stress may reduce plant energy reserves resulting in decreased plant survival. When planning the number of cuttings to harvest, take stress indicators into account and harvest extra plants if needed.

Permission to harvest from the landowner, private or public, must be obtained prior to harvesting live cuttings.

## CUTTINGS

Establishment success is significantly increased if cuttings are taken from live willows during the dormant season. This is the period between the fall leaf drop and the plant leaf budding in the spring.

See "Storage" section for procedures when harvesting well before the projected planting date.

*Cutting Diameter*

Cuttings shall be 1-inch diameter or larger depending upon the species. Ideal trees for cuttings should be from 1- to 3-inches in base diameter. Larger diameter cuttings have more energy and stored reserves than smaller diameter cuttings but are often more difficult to place into the ground. Cuttings from 2- to 3-inches in diameter typically have the highest survival rates. Cuttings as large as 8 inches can be used as poles instead of live stakes. Live poles provide more resistance to higher velocity flows and create roughness which reduces water velocity. However, larger diameter cuttings require longer cutting lengths and should be planted deeper in the soil. Deciding factors for selecting the cutting diameter are stand density, size of the selected native species, and the selected planting method. When planting, cuttings should be large enough that they will not bend or break while being driven during installation. Smaller diameter cuttings, or limbs removed from larger cuttings are more suitable for brush mattresses, brush layering, branch packing, live fascines, or vegetated geo-grids.

*Cutting Length*

Cuttings shall have at least two leaf nodes, or bud scars, above the ground as illustrated on page 6. Cutting length is largely determined by the depth to the mid-summer vadose zone, or the area of moist soil at the lower bank. For ease of handling and transportation, cuttings should be harvested and stored at full length and then cut into shorter lengths prior to planting. Plantings should be placed on the lower portion of the streambank slope. Cuttings shall be long enough so the stem base reaches into the vadose zone. This zone extends slightly above the water surface elevation in most situations (See illustration on page 6).

- Several inches of the bottom of each cutting should be in the vadose zone.
- Each cutting should have a minimum of 2-4 buds above the ground.
- Observe the 2/3 or 3/4 rule: 2/3 to 3/4 of the cutting length should be placed below the soil surface.

*Harvest of Cuttings*

Once cutting size, source location is determined—and permission obtained—the actual cutting process can begin. Lopping shears, pruning shears, a small wood saw, brush cutters, or a chain saw are appropriate tools for harvesting cuttings. Desired cutting size will determine the appropriate tool(s).

- Make clean cuts. Ensure all equipment is sharp.
- Use live wood at least 1 year old or older. Do not use very old or dry wood.

- Larger wood is difficult to root. The best wood is 2-5 years old with smooth bark which is not deeply furrowed.

- Avoid current year's growth. It lacks the stored energy reserves necessary to consistently sprout when planted.

- When harvesting from native stands, make sure the stand will not be denuded or destroyed by your cutting activity.

- Trim off all side branches so only the main stem remains.

- The side branches can be used in live fascines, branch packing, brush layering, etc.

- Harvested plant material shall be 1- to 3-inches in diameter at the base. Willow cutting lengths will be determined by project conditions.

- A processing alternative, when cutting limbs into live stakes, is to cut the top of cutting with a horizontal cut and bottom of cutting with a 45-degree cut, (See illustration on page 6). This allows quick recognition of the cutting top (see Caring for Harvested Cuttings).

- Care should be taken to select plant materials that are free of physical damage, disease, and insect damage.

*Caring for Harvested Cuttings*

One of the most important steps in this process is the identification of **TOP** of cutting. If cuttings are planted upside down, mortality will occur. Leaf scars are the most reliable indicator to identify the cutting top. Buds emerging from leaf scar always point up. Another key is the stem. Usually, the smaller diameter end is the top of cutting; however, this is not always obvious.

*Transportation and Storage*

After being harvested, the cuttings should be tied into bundles small enough to be easily carried by 1 or 2 people. Each bundle may contain 25- to 50-trees, depending on their size. Placing the same number of cuttings in each bundle makes it easier to count the number of harvested cuttings.

During harvesting, transportation, and storage, willow bundles should be kept moist and protected from sunlight and wind by covering or wrapping the bundles with wet burlap or a reflective moisture barrier to protect cuttings from becoming desiccated.

To minimize storage time, harvest cuttings in early spring within two to three weeks of the

planned planting date. If this is not possible, cuttings can be harvested in late fall or winter and stored in a large cooler at 34-38°F until immediately prior to planting. Cuttings can be stored for several months in this manner. If cuttings are kept in a cooler, root cellar, garage, or shop floor, make sure the storage area is dark, moist, and cool always. Maintain a storage temperature slightly above freezing. Cuttings may be wrapped in a black tarp or plastic to be kept dark, if stored in an out-building. Cuttings should be checked periodically for signs of frost damage and/or to ensure that mold is not forming.

*Pre-plant Soaking of Cuttings*

Soaking plant material, prior to planting, significantly increases the survival rate. Prior to planting, all cuttings should be soaked for a minimum of 36-hours, regardless whether they are stored or harvested for immediate planting. Research shows that soaking the cuttings for 7- to 10-days can double the survival rate. Cuttings should be removed from water prior to root emergence from the bark. This normally takes 7-to 10-days. Soaking initiates the root growth processes within the inner layer of bark in willows and cottonwoods.

Only the bottom 1/3 of the cuttings needs to be soaked. However, soaking the entire cutting is not detrimental. Soaking can be accomplished in any container that will hold enough water to the required depth. Cuttings can also be soaked in streams, ponds, lakes, or other bodies of water. Avoid soaking cuttings in areas that are susceptible to flooding or where beavers are present.

**PLANTING LIVE CUTTINGS**

*Spacing Considerations*

Plant the cuttings about 3- to 4-feet apart. This spacing is suitable for both within and between rows. Normally, only the lower slope should be planted with willows. Live cuttings should be planted on the first and/or second row above the edge of water. The first row is normally planted approximately 4-feet from the water's edge at low flow. Subsequent rows should be planted an additional 3- to 4-feet up-slope from the previous row. Each row should be planted on an off-set pattern from the previous row (See attached design details on page 6).

*When to Plant*

Cuttings should be planted in early spring after frost has left the soil, but no later than June 1. Avoid planting cuttings or rooted stock in summer because of heat stress and a shortened growing period.

*Planting Methods and Planting Cuttings:*

One or two-person posthole power augers, hand soil augers, planting bars, shovels, soil probes,

or simply pushing or driving the cutting into moist soil are appropriate tools to plant cuttings. When planting, keep several things in mind:

- Push the cutting into the soil when possible.
- If the soil is too firm to push the cutting into the soil, the cutting can be driven into the soil using a hammer. A 2- to 3-pound "dead blow hammer" or shot filled mallet. This type of hammer reduces the chance of splitting the cutting the stake.
- If a cutting is split while driving, trim the cutting to below the split to prevent desiccation and plant mortality.
- It is essential to have firm contact between the cutting and soil. Avoid creating air pockets around the cutting that can prevent roots from developing. Holding on to the cutting with one hand while driving reduces air pocket formation.
- Avoid damaging buds when inserting the cutting into the hole or when driving the cutting.
- If the soil is too compacted to drive the cutting, a hole can be formed by driving a rebar or other metal rod into the soil first and then placing the cutting into the hole. The hole diameter shall be smaller than the cutting diameter to prevent air pocket formation.
- Holes can be created with any of the tools mentioned at the start of this section.
- The planting depth will determine the planting method. Deeper holes will be made easier by using a power auger.
- If the hole dug is larger than the cutting, additional soil will be required to form a good soil to stem contact. Preference should be given to local topsoil to encourage mycorrhizal formation and/or nodule formation by nitrogen-fixing organisms. Do not backfill with clay.
- Carefully tamp the soil around the cutting firmly several times as you fill any drilled or augured hole.
- "Water In" the back-filled soil around large cutting holes to settle soil and provide good soil to cutting contact.

*Management and Maintenance*

Proper management is necessary to maintain healthy, competitive plants that perform the desired

function. This is as important as the initial planting to ensure rehabilitation of the riparian area. Some maintenance is expected on-site for several years after planting. For the first few years after planting, vegetation should be evaluated and monitored annually, or after any flood event. Some replanting may be needed in succeeding years in order to insure the establishment of a functioning riparian corridor.

Monitoring of the site is necessary to detect any in-stream dead organic material (i.e. old logs, dead root masses, branches, etc.). In-channel organic material may cause erosive cross currents that can erode a planted streambank. If this condition develops, the organic material should be removed or repositioned. Any trimming of cuttings should be done in the dormant season so growth will not be slowed during the growing season. During the establishment period, leave standing dead branches within the plantings to reduce stream flow velocities, thus protecting the established plantings.

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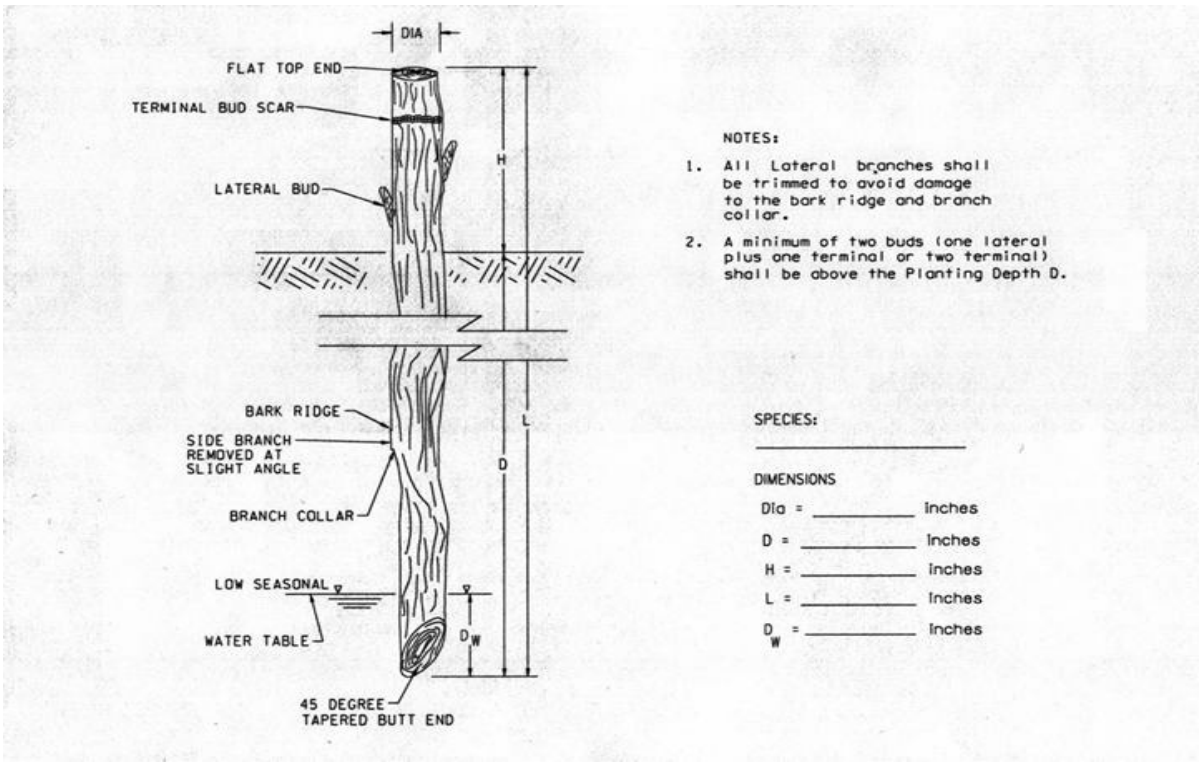
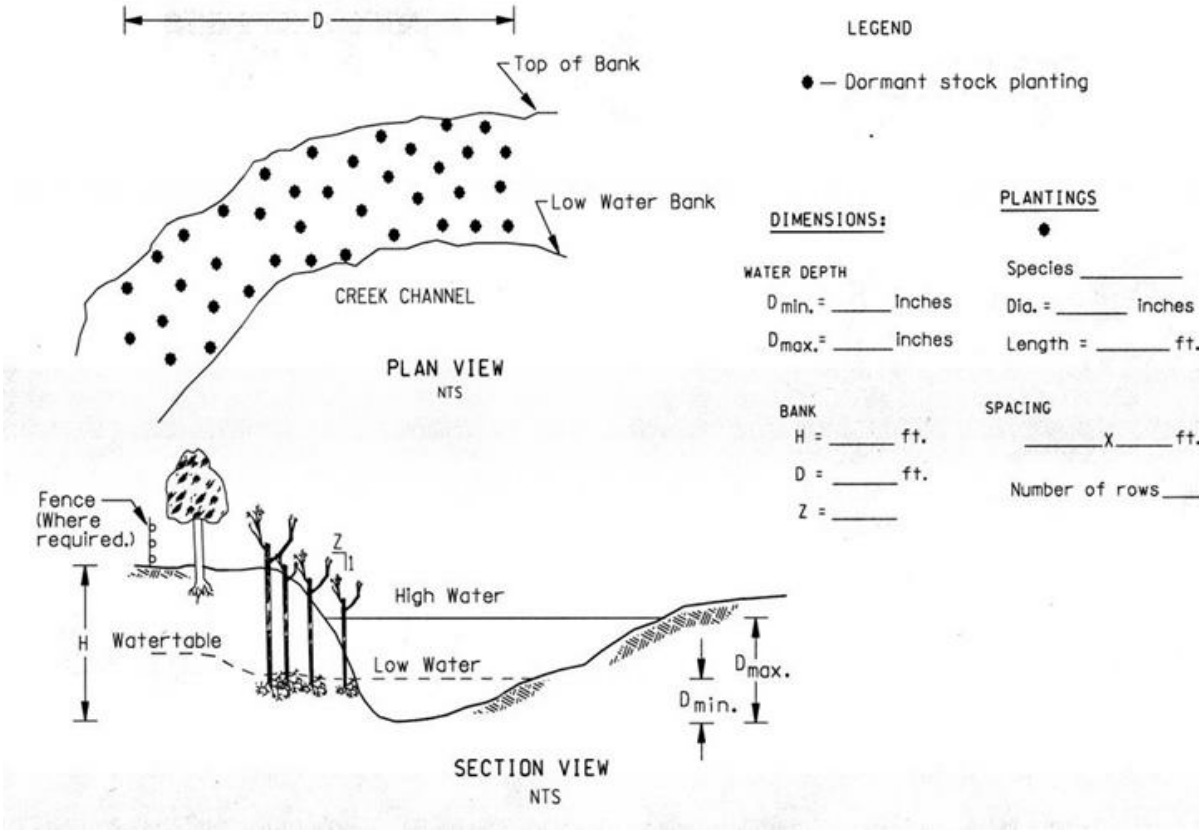



Source – USDA – Soil Conservation Service




Source – USDA – Soil Conservation Service

# Survey Notes, Abbreviations, and Definitions
# Delaware River D24

| Abbreviation | Definition |
|---|---|
| BAR | Point Bar |
| BKF | Bankfull Indicator |
| CP | Control Point |
| FE | Field Edge |
| FL | Field Drainage Flow Line |
| FLD | Field |
| GLY | Gully |
| LB | Left Bank |
| LTB | Left Top of Bank |
| LW | Left Edge of Water |
| LWD | Large Woody Debris |
| RB | Right Bank |
| RTB | Right Top of Bank |
| RW | Right Edge of Water |
| SB | Streambed |
| SEEP | Seep |
| TRIB | Tributary Confluence |
| TS | Total Station |
| WP | Work Point |

**Delaware River Site D24**
**Geomorphoric/Topographic Survey**

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 1 | 10102.908 | 10223.039 | 936.690 | CP1 |
| 2 | 10220.772 | 10179.772 | 936.680 | CP2 |
| 3 | 9805.288 | 10005.240 | 921.271 | TS |
| 4 | 9653.658 | 9497.203 | 915.304 | WP1 |
| 5 | 9707.929 | 9302.269 | 920.201 | WP2 |
| 6 | 9629.498 | 9417.441 | 917.187 | TS |
| 7 | 9529.280 | 9158.603 | 919.120 | WP3 |
| 8 | 9524.344 | 9262.831 | 917.182 | TS |
| 9 | 9392.896 | 9058.830 | 937.135 | CP3 |
| 10 | 9324.550 | 9200.140 | 917.782 | TS |
| 11 | 9250.671 | 9025.027 | 937.131 | CP4 |
| 12 | 9226.783 | 9089.237 | 914.477 | WP4 |
| 13 | 9362.422 | 9093.302 | 919.698 | WP13 |
| 14 | 9240.115 | 9082.340 | 919.899 | WP14 |
| 15 | 9180.957 | 9098.086 | 914.681 | RB |
| 16 | 9169.006 | 9099.906 | 914.665 | RB |
| 17 | 9153.909 | 9102.321 | 914.720 | RB |
| 18 | 9153.852 | 9097.893 | 916.985 | RB |
| 19 | 9154.651 | 9086.690 | 923.665 | RB |
| 20 | 9142.639 | 9100.470 | 916.956 | RB |
| 21 | 9128.849 | 9101.799 | 917.846 | RB |
| 22 | 9122.389 | 9105.718 | 916.698 | RB |
| 23 | 9176.436 | 9108.571 | 912.858 | RW |
| 24 | 9176.748 | 9114.459 | 911.584 | SB |
| 25 | 9177.209 | 9115.930 | 911.033 | SB |
| 26 | 9177.349 | 9125.692 | 910.199 | SB |
| 27 | 9179.498 | 9133.729 | 911.413 | SB |
| 28 | 9180.728 | 9145.241 | 911.803 | SB |
| 29 | 9181.149 | 9157.494 | 911.565 | SB |
| 30 | 9181.633 | 9169.648 | 911.420 | SB |
| 31 | 9180.032 | 9182.108 | 912.937 | LW |
| 32 | 9181.116 | 9192.755 | 913.650 | BAR |
| 33 | 9182.274 | 9211.746 | 914.091 | BAR |
| 34 | 9155.551 | 9210.952 | 913.745 | BAR |
| 35 | 9155.683 | 9195.450 | 913.401 | BAR |
| 36 | 9154.042 | 9184.678 | 912.929 | LW |
| 37 | 9153.181 | 9172.185 | 911.577 | SB |
| 38 | 9151.660 | 9156.785 | 911.473 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 39 | 9151.700 | 9142.217 | 911.389 | SB |
| 40 | 9150.854 | 9133.904 | 910.882 | SB |
| 41 | 9148.470 | 9123.146 | 910.337 | SB |
| 42 | 9148.024 | 9116.297 | 910.686 | SB |
| 43 | 9146.236 | 9111.324 | 912.863 | RW |
| 44 | 9047.498 | 9205.228 | 913.696 | WP44 |
| 45 | 8788.023 | 9136.695 | 916.873 | WP45 |
| 46 | 8903.889 | 9051.861 | 937.013 | CP5 |
| 100 | 9669.557 | 9514.443 | 912.908 | LW |
| 101 | 9680.718 | 9512.656 | 912.025 | SB |
| 102 | 9694.922 | 9511.423 | 911.929 | SB |
| 103 | 9705.066 | 9509.416 | 911.587 | SB |
| 104 | 9712.787 | 9507.621 | 911.328 | SB |
| 105 | 9722.328 | 9505.529 | 911.668 | SB |
| 106 | 9725.214 | 9504.939 | 912.714 | SB |
| 107 | 9735.742 | 9502.380 | 912.184 | SB |
| 108 | 9744.347 | 9499.955 | 911.954 | SB |
| 109 | 9750.790 | 9498.779 | 912.928 | RW |
| 110 | 9745.679 | 9483.299 | 912.906 | RW |
| 111 | 9739.562 | 9484.076 | 911.796 | SB |
| 112 | 9729.927 | 9487.388 | 912.296 | SB |
| 113 | 9722.708 | 9488.816 | 912.427 | SB |
| 114 | 9713.664 | 9489.966 | 911.295 | SB |
| 115 | 9704.033 | 9492.033 | 911.558 | SB |
| 116 | 9694.584 | 9494.422 | 911.834 | SB |
| 117 | 9684.304 | 9494.627 | 911.980 | SB |
| 118 | 9675.279 | 9496.425 | 911.609 | SB |
| 119 | 9668.074 | 9497.686 | 912.936 | LW |
| 120 | 9666.703 | 9478.246 | 912.859 | LW |
| 121 | 9670.359 | 9476.805 | 911.524 | SB |
| 122 | 9679.104 | 9474.472 | 911.788 | SB |
| 123 | 9689.832 | 9470.635 | 911.962 | SB |
| 124 | 9697.586 | 9467.162 | 911.566 | SB |
| 125 | 9708.046 | 9463.927 | 911.526 | SB |
| 126 | 9716.159 | 9462.106 | 911.769 | SB |
| 127 | 9720.348 | 9461.101 | 912.451 | SB |
| 128 | 9730.958 | 9458.507 | 911.903 | SB |
| 129 | 9738.362 | 9457.016 | 912.908 | RW |
| 130 | 9732.834 | 9435.277 | 912.806 | RW |
| 131 | 9724.610 | 9437.681 | 912.059 | SB |
| 132 | 9715.858 | 9439.748 | 912.141 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 133 | 9707.555 | 9441.102 | 911.703 | SB |
| 134 | 9698.649 | 9444.802 | 911.565 | SB |
| 135 | 9689.995 | 9446.585 | 911.822 | SB |
| 136 | 9680.531 | 9450.333 | 911.819 | SB |
| 137 | 9668.005 | 9452.698 | 911.647 | SB |
| 138 | 9661.013 | 9456.007 | 912.859 | LW |
| 139 | 9652.679 | 9433.836 | 912.866 | LW |
| 140 | 9662.997 | 9430.247 | 911.543 | SB |
| 141 | 9676.806 | 9425.346 | 911.814 | SB |
| 142 | 9691.927 | 9420.077 | 911.727 | SB |
| 143 | 9706.341 | 9415.797 | 911.783 | SB |
| 144 | 9715.693 | 9413.420 | 912.198 | SB |
| 145 | 9723.244 | 9411.403 | 912.043 | SB |
| 146 | 9727.402 | 9409.205 | 912.824 | RW |
| 147 | 9723.171 | 9386.305 | 912.847 | RW |
| 148 | 9714.333 | 9388.624 | 912.216 | SB |
| 149 | 9696.189 | 9392.774 | 911.851 | SB |
| 150 | 9680.087 | 9396.408 | 912.030 | SB |
| 151 | 9661.074 | 9401.409 | 911.705 | SB |
| 152 | 9644.371 | 9406.416 | 912.830 | LW |
| 153 | 9642.557 | 9384.153 | 912.815 | LW |
| 154 | 9653.640 | 9380.435 | 911.764 | SB |
| 155 | 9666.791 | 9377.126 | 911.674 | SB |
| 156 | 9678.142 | 9373.266 | 911.745 | SB |
| 157 | 9691.667 | 9369.328 | 911.673 | SB |
| 158 | 9702.562 | 9365.423 | 911.992 | SB |
| 159 | 9723.131 | 9362.295 | 912.844 | RW |
| 160 | 9713.698 | 9333.484 | 912.750 | RW |
| 161 | 9701.085 | 9337.397 | 912.179 | SB |
| 162 | 9689.856 | 9341.751 | 911.787 | SB |
| 163 | 9679.831 | 9345.166 | 911.908 | SB |
| 164 | 9669.060 | 9348.892 | 911.800 | SB |
| 165 | 9658.904 | 9352.219 | 911.512 | SB |
| 166 | 9647.292 | 9356.488 | 911.468 | SB |
| 167 | 9634.759 | 9359.884 | 912.782 | LW |
| 168 | 9630.220 | 9334.803 | 912.756 | LW |
| 169 | 9640.054 | 9330.697 | 911.554 | SB |
| 170 | 9649.166 | 9325.652 | 910.992 | SB |
| 171 | 9656.747 | 9322.478 | 911.289 | SB |
| 172 | 9665.903 | 9316.771 | 911.651 | SB |
| 173 | 9675.992 | 9312.697 | 911.929 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 174 | 9685.917 | 9305.418 | 911.787 | SB |
| 175 | 9692.541 | 9301.080 | 911.431 | SB |
| 176 | 9695.029 | 9299.655 | 912.725 | RW |
| 177 | 9678.612 | 9280.904 | 912.689 | RW |
| 178 | 9676.578 | 9283.083 | 911.030 | SB |
| 179 | 9669.440 | 9287.189 | 911.989 | SB |
| 180 | 9659.625 | 9293.759 | 911.575 | SB |
| 181 | 9652.004 | 9297.915 | 911.040 | SB |
| 182 | 9643.442 | 9301.663 | 910.969 | SB |
| 183 | 9636.820 | 9305.427 | 911.802 | SB |
| 184 | 9628.052 | 9310.458 | 912.069 | SB |
| 185 | 9621.299 | 9313.791 | 912.707 | LW |
| 186 | 9605.999 | 9288.848 | 912.591 | LW |
| 187 | 9611.884 | 9283.655 | 912.027 | SB |
| 188 | 9620.218 | 9277.126 | 911.684 | SB |
| 189 | 9628.839 | 9272.425 | 911.411 | SB |
| 190 | 9637.871 | 9264.126 | 910.712 | SB |
| 191 | 9644.825 | 9259.374 | 910.864 | SB |
| 192 | 9651.907 | 9252.866 | 910.975 | SB |
| 193 | 9653.755 | 9251.213 | 912.602 | RW |
| 194 | 9638.902 | 9237.734 | 912.742 | RW |
| 195 | 9636.901 | 9241.077 | 910.103 | SB |
| 196 | 9632.978 | 9246.900 | 910.733 | SB |
| 197 | 9626.620 | 9252.631 | 910.747 | SB |
| 198 | 9619.351 | 9259.483 | 911.320 | SB |
| 199 | 9609.175 | 9268.255 | 911.726 | SB |
| 200 | 9600.050 | 9275.315 | 912.572 | LW |
| 201 | 9586.638 | 9265.758 | 912.622 | LW |
| 202 | 9594.756 | 9258.273 | 911.511 | SB |
| 203 | 9602.306 | 9249.585 | 911.447 | SB |
| 204 | 9603.873 | 9246.105 | 911.218 | SB |
| 205 | 9607.574 | 9239.642 | 910.238 | SB |
| 206 | 9611.115 | 9235.956 | 909.813 | SB |
| 207 | 9613.136 | 9232.916 | 912.558 | RW |
| 208 | 9595.679 | 9219.077 | 912.613 | RW |
| 209 | 9591.986 | 9223.034 | 910.554 | SB |
| 210 | 9589.840 | 9227.570 | 910.294 | SB |
| 211 | 9584.127 | 9234.758 | 910.713 | SB |
| 212 | 9575.807 | 9246.639 | 911.627 | SB |
| 213 | 9568.650 | 9253.926 | 910.801 | SB |
| 214 | 9564.061 | 9261.193 | 912.604 | LW |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 215 | 9542.966 | 9245.217 | 912.581 | LW |
| 216 | 9546.734 | 9239.517 | 911.124 | SB |
| 217 | 9553.132 | 9232.738 | 911.194 | SB |
| 218 | 9561.846 | 9222.872 | 911.168 | SB |
| 219 | 9569.482 | 9215.751 | 910.783 | SB |
| 220 | 9577.416 | 9206.774 | 911.169 | SB |
| 221 | 9580.350 | 9202.474 | 912.552 | RW |
| 222 | 9556.482 | 9189.555 | 912.630 | RW |
| 223 | 9555.579 | 9191.753 | 910.648 | SB |
| 224 | 9550.793 | 9201.483 | 911.085 | SB |
| 225 | 9552.701 | 9197.103 | 911.306 | SB |
| 226 | 9544.627 | 9210.493 | 910.964 | SB |
| 227 | 9539.675 | 9216.917 | 909.549 | SB |
| 228 | 9534.189 | 9223.252 | 910.419 | SB |
| 229 | 9528.891 | 9230.128 | 910.988 | SB |
| 230 | 9525.635 | 9234.374 | 912.604 | LW |
| 231 | 9521.391 | 9240.557 | 914.117 | BAR |
| 232 | 9514.600 | 9251.389 | 916.786 | BAR |
| 233 | 9536.096 | 9271.097 | 916.911 | BAR |
| 234 | 9543.589 | 9262.662 | 914.379 | BAR |
| 235 | 9550.437 | 9295.661 | 916.809 | BAR |
| 236 | 9564.145 | 9286.334 | 914.527 | BAR |
| 237 | 9565.146 | 9317.975 | 916.526 | BAR |
| 238 | 9579.118 | 9306.780 | 914.746 | BAR |
| 239 | 9578.088 | 9346.998 | 916.546 | BAR |
| 240 | 9595.232 | 9332.887 | 914.805 | BAR |
| 241 | 9589.463 | 9373.047 | 917.540 | BAR |
| 242 | 9614.194 | 9356.555 | 915.613 | BAR |
| 243 | 9606.094 | 9393.993 | 917.456 | BAR |
| 244 | 9624.944 | 9382.495 | 916.220 | BAR |
| 245 | 9617.138 | 9424.911 | 917.372 | BAR |
| 246 | 9636.522 | 9414.823 | 915.902 | BAR |
| 247 | 9637.049 | 9455.659 | 916.676 | BAR |
| 248 | 9648.491 | 9450.593 | 915.368 | BAR |
| 249 | 9648.978 | 9487.147 | 915.481 | BAR |
| 250 | 9660.328 | 9482.830 | 914.059 | BAR |
| 251 | 9662.262 | 9518.856 | 914.764 | BAR |
| 252 | 9648.844 | 9447.732 | 915.180 | BAR |
| 253 | 9637.594 | 9485.916 | 920.044 | LB |
| 254 | 9643.389 | 9431.184 | 915.469 | BAR |
| 255 | 9618.874 | 9453.406 | 922.332 | LB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 256 | 9636.247 | 9405.386 | 914.949 | BAR |
| 257 | 9597.776 | 9412.536 | 924.831 | LB |
| 258 | 9634.252 | 9389.228 | 913.398 | BAR |
| 259 | 9630.077 | 9372.714 | 913.441 | BAR |
| 260 | 9614.689 | 9344.639 | 913.895 | BAR |
| 261 | 9604.453 | 9324.211 | 913.672 | BAR |
| 262 | 9635.270 | 9529.807 | 937.344 | LTB |
| 263 | 9635.634 | 9516.044 | 937.224 | LTB |
| 264 | 9629.360 | 9502.521 | 937.141 | LTB |
| 265 | 9620.580 | 9488.432 | 937.131 | LTB |
| 266 | 9613.095 | 9467.852 | 937.318 | LTB |
| 267 | 9604.924 | 9453.006 | 937.623 | LTB |
| 268 | 9598.539 | 9433.769 | 937.269 | LTB |
| 269 | 9590.835 | 9417.268 | 937.563 | LTB |
| 270 | 9582.172 | 9400.703 | 936.812 | LTB |
| 271 | 9760.514 | 9503.220 | 916.286 | RB |
| 272 | 9781.149 | 9509.782 | 924.882 | BKF |
| 273 | 9799.490 | 9514.085 | 929.851 | RTB |
| 274 | 9767.714 | 9498.509 | 921.108 | RB |
| 275 | 9775.035 | 9482.284 | 924.780 | BKF |
| 276 | 9791.241 | 9483.982 | 928.446 | RTB |
| 277 | 9773.485 | 9459.696 | 925.285 | BKF |
| 278 | 9788.584 | 9464.698 | 928.390 | RTB |
| 279 | 9778.993 | 9412.020 | 928.705 | RTB |
| 280 | 9755.992 | 9412.105 | 924.843 | BKF |
| 281 | 9756.791 | 9394.323 | 925.494 | BKF |
| 282 | 9770.099 | 9389.498 | 928.784 | RTB |
| 283 | 9749.863 | 9374.554 | 925.579 | BKF |
| 284 | 9762.857 | 9367.199 | 929.310 | RTB |
| 285 | 9749.269 | 9358.094 | 926.663 | BKF |
| 286 | 9737.054 | 9316.580 | 927.872 | BKF |
| 287 | 9753.117 | 9298.102 | 933.426 | RTB |
| 288 | 9725.480 | 9300.542 | 927.386 | BKF |
| 289 | 9733.826 | 9294.008 | 931.244 | RTB |
| 290 | 9715.469 | 9281.403 | 925.953 | RB |
| 291 | 9727.502 | 9259.057 | 931.717 | RTB |
| 292 | 9710.008 | 9292.138 | 923.027 | RB |
| 293 | 9702.398 | 9275.986 | 925.675 | RB |
| 294 | 9719.067 | 9248.400 | 932.448 | RTB |
| 295 | 9709.872 | 9271.665 | 928.354 | RB |
| 296 | 9705.543 | 9234.551 | 932.595 | RTB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 297 | 9693.132 | 9267.172 | 925.587 | RB |
| 298 | 9677.576 | 9258.930 | 921.461 | RB |
| 299 | 9668.392 | 9261.664 | 916.890 | RB |
| 300 | 9665.621 | 9252.162 | 917.391 | RB |
| 301 | 9675.326 | 9243.369 | 922.033 | RB |
| 302 | 9679.370 | 9232.245 | 926.645 | RB |
| 303 | 9673.594 | 9215.616 | 929.742 | RB |
| 304 | 9666.251 | 9228.696 | 925.294 | RB |
| 305 | 9661.025 | 9235.932 | 921.100 | RB |
| 306 | 9682.694 | 9210.251 | 937.797 | RTB |
| 307 | 9647.426 | 9228.646 | 918.934 | RB |
| 308 | 9670.118 | 9203.253 | 937.782 | RTB |
| 309 | 9649.268 | 9220.274 | 921.889 | RB |
| 310 | 9651.590 | 9209.085 | 926.230 | RB |
| 311 | 9642.414 | 9215.414 | 920.312 | RB |
| 312 | 9638.318 | 9190.543 | 937.765 | RTB |
| 313 | 9641.857 | 9216.952 | 917.231 | SEEP |
| 314 | 9638.569 | 9202.474 | 926.278 | RB |
| 315 | 9627.000 | 9177.397 | 936.660 | RTB |
| 316 | 9630.597 | 9217.434 | 919.599 | RB |
| 317 | 9615.428 | 9169.057 | 937.371 | RTB |
| 318 | 9631.350 | 9219.414 | 915.278 | RB |
| 319 | 9617.662 | 9226.834 | 915.341 | RB |
| 320 | 9604.335 | 9157.976 | 937.712 | RTB |
| 321 | 9607.827 | 9221.683 | 916.621 | RB |
| 322 | 9600.514 | 9215.484 | 916.831 | RB |
| 323 | 9589.487 | 9154.956 | 937.682 | RTB |
| 324 | 9594.453 | 9202.626 | 915.866 | RB |
| 325 | 9584.658 | 9149.860 | 937.660 | RTB |
| 326 | 9591.440 | 9206.842 | 913.471 | SEEP |
| 327 | 9588.558 | 9195.717 | 916.366 | RB |
| 328 | 9561.835 | 9140.291 | 937.426 | RTB |
| 329 | 9588.442 | 9195.662 | 916.366 | RB |
| 330 | 9547.114 | 9132.772 | 937.185 | RTB |
| 331 | 9580.084 | 9188.604 | 914.412 | SEEP |
| 332 | 9571.700 | 9184.527 | 915.854 | RB |
| 333 | 9558.109 | 9182.354 | 915.374 | RB |
| 334 | 9538.569 | 9129.738 | 937.969 | RTB |
| 335 | 9562.560 | 9174.132 | 918.200 | RB |
| 336 | 9576.082 | 9176.561 | 918.163 | RB |
| 337 | 9572.387 | 9169.663 | 926.665 | RB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 338 | 9584.579 | 9161.688 | 925.159 | RB |
| 339 | 9601.492 | 9164.404 | 928.545 | RB |
| 340 | 9592.181 | 9178.580 | 921.062 | RB |
| 341 | 9606.337 | 9188.833 | 922.312 | RB |
| 342 | 9606.949 | 9176.353 | 924.412 | RB |
| 343 | 9519.960 | 9119.374 | 936.378 | RTB |
| 344 | 9617.915 | 9172.238 | 928.530 | RB |
| 345 | 9628.064 | 9183.919 | 928.926 | RB |
| 346 | 9619.367 | 9193.887 | 925.038 | RB |
| 347 | 9608.650 | 9206.145 | 918.805 | RB |
| 348 | 9622.208 | 9207.994 | 921.399 | RB |
| 349 | 9633.729 | 9198.409 | 925.901 | RB |
| 350 | 9505.966 | 9108.856 | 936.880 | RTB |
| 351 | 9593.750 | 9188.627 | 917.643 | RB |
| 352 | 9628.249 | 9228.843 | 914.786 | RB |
| 353 | 9637.424 | 9230.028 | 914.749 | RB |
| 354 | 9641.881 | 9228.695 | 914.800 | RB |
| 355 | 9644.368 | 9228.952 | 917.349 | RB |
| 356 | 9656.031 | 9233.022 | 920.699 | RB |
| 357 | 9668.383 | 9239.216 | 921.845 | RB |
| 358 | 9661.886 | 9246.071 | 917.426 | RB |
| 359 | 9689.119 | 9277.894 | 920.201 | RB |
| 360 | 9700.374 | 9295.689 | 919.099 | RB |
| 361 | 9709.218 | 9311.112 | 918.587 | RB |
| 362 | 9720.999 | 9332.457 | 918.374 | RB |
| 363 | 9716.638 | 9324.514 | 918.296 | RB |
| 364 | 9723.866 | 9340.791 | 916.972 | RB |
| 365 | 9726.100 | 9354.202 | 918.616 | RB |
| 366 | 9726.812 | 9367.594 | 916.808 | RB |
| 367 | 9728.596 | 9380.569 | 916.344 | RB |
| 368 | 9733.350 | 9395.166 | 916.574 | RB |
| 369 | 9737.890 | 9412.768 | 916.188 | RB |
| 370 | 9741.073 | 9426.466 | 916.433 | RB |
| 371 | 9741.759 | 9432.566 | 916.012 | RB |
| 372 | 9749.637 | 9453.674 | 917.621 | RB |
| 373 | 9751.475 | 9462.844 | 916.592 | RB |
| 374 | 9754.021 | 9472.257 | 916.360 | RB |
| 375 | 9538.594 | 9164.668 | 918.217 | RB |
| 376 | 9534.332 | 9173.414 | 914.589 | RB |
| 377 | 9532.932 | 9177.048 | 912.608 | RW |
| 378 | 9530.216 | 9180.749 | 909.807 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 379 | 9530.213 | 9180.788 | 909.818 | SB |
| 380 | 9526.728 | 9190.010 | 909.506 | SB |
| 381 | 9523.077 | 9199.842 | 909.850 | SB |
| 382 | 9516.912 | 9212.846 | 910.393 | SB |
| 383 | 9512.178 | 9221.513 | 910.811 | SB |
| 384 | 9508.704 | 9227.244 | 912.616 | LW |
| 385 | 9488.412 | 9213.488 | 912.554 | LW |
| 386 | 9491.829 | 9207.008 | 910.587 | SB |
| 387 | 9495.214 | 9202.141 | 910.018 | SB |
| 388 | 9501.708 | 9189.271 | 909.425 | SB |
| 389 | 9506.026 | 9182.894 | 909.409 | SB |
| 390 | 9510.395 | 9174.839 | 909.367 | SB |
| 391 | 9514.387 | 9168.909 | 912.560 | RW |
| 392 | 9501.803 | 9164.759 | 912.552 | RW |
| 393 | 9499.261 | 9167.494 | 907.570 | SB |
| 394 | 9495.325 | 9173.564 | 908.339 | SB |
| 395 | 9488.700 | 9183.648 | 909.050 | SB |
| 396 | 9484.373 | 9191.502 | 909.396 | SB |
| 397 | 9478.599 | 9200.319 | 910.726 | SB |
| 398 | 9474.854 | 9205.160 | 912.580 | LW |
| 399 | 9453.116 | 9195.777 | 912.623 | LW |
| 400 | 9457.452 | 9185.944 | 910.278 | SB |
| 401 | 9461.992 | 9174.599 | 908.710 | SB |
| 402 | 9466.764 | 9166.005 | 907.405 | SB |
| 403 | 9472.053 | 9162.629 | 906.075 | SB |
| 404 | 9472.741 | 9154.669 | 906.895 | SB |
| 405 | 9474.595 | 9146.616 | 912.570 | RW |
| 406 | 9458.199 | 9143.957 | 912.576 | RW |
| 407 | 9455.031 | 9151.912 | 908.795 | SB |
| 408 | 9453.329 | 9160.299 | 908.240 | SB |
| 409 | 9448.184 | 9171.343 | 908.500 | SB |
| 410 | 9445.789 | 9180.343 | 909.982 | SB |
| 411 | 9441.263 | 9190.191 | 912.603 | LW |
| 412 | 9418.438 | 9179.561 | 912.545 | LW |
| 413 | 9422.164 | 9168.683 | 910.042 | SB |
| 414 | 9425.589 | 9159.011 | 908.300 | SB |
| 415 | 9428.593 | 9149.050 | 907.967 | SB |
| 416 | 9431.682 | 9141.187 | 909.164 | SB |
| 417 | 9435.998 | 9133.185 | 912.585 | RW |
| 418 | 9411.549 | 9127.229 | 912.648 | RW |
| 419 | 9407.886 | 9138.670 | 906.978 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 420 | 9410.032 | 9135.216 | 909.139 | SB |
| 421 | 9407.137 | 9149.315 | 907.732 | SB |
| 422 | 9403.858 | 9158.472 | 909.458 | SB |
| 423 | 9401.295 | 9166.535 | 910.770 | SB |
| 424 | 9396.732 | 9174.445 | 912.623 | LW |
| 425 | 9372.314 | 9168.373 | 912.608 | LW |
| 426 | 9374.201 | 9157.161 | 910.673 | SB |
| 427 | 9376.749 | 9147.003 | 908.784 | SB |
| 428 | 9378.475 | 9139.234 | 907.395 | SB |
| 429 | 9379.796 | 9133.166 | 908.175 | SB |
| 430 | 9380.067 | 9128.067 | 909.330 | SB |
| 431 | 9379.609 | 9124.095 | 912.576 | RW |
| 432 | 9352.933 | 9114.995 | 912.586 | RW |
| 433 | 9350.464 | 9125.200 | 909.016 | SB |
| 434 | 9348.568 | 9135.161 | 908.489 | SB |
| 435 | 9347.081 | 9143.015 | 909.337 | SB |
| 436 | 9345.791 | 9154.985 | 910.573 | SB |
| 437 | 9343.904 | 9163.205 | 912.608 | LW |
| 438 | 9315.369 | 9159.800 | 912.577 | LW |
| 439 | 9314.537 | 9146.240 | 910.466 | SB |
| 440 | 9315.523 | 9135.573 | 909.608 | SB |
| 441 | 9316.507 | 9123.505 | 908.731 | SB |
| 442 | 9317.698 | 9114.340 | 910.158 | SB |
| 443 | 9319.780 | 9106.453 | 912.598 | RW |
| 444 | 9296.057 | 9104.224 | 912.525 | RW |
| 445 | 9294.541 | 9114.393 | 909.763 | SB |
| 446 | 9297.466 | 9125.833 | 909.569 | SB |
| 447 | 9296.960 | 9140.283 | 910.106 | SB |
| 448 | 9296.420 | 9150.307 | 911.223 | SB |
| 449 | 9297.851 | 9160.862 | 912.555 | LW |
| 450 | 9271.615 | 9166.217 | 912.517 | LW |
| 451 | 9270.012 | 9154.457 | 910.840 | SB |
| 452 | 9270.336 | 9141.062 | 909.651 | SB |
| 453 | 9271.301 | 9129.212 | 910.956 | SB |
| 454 | 9274.319 | 9116.507 | 909.648 | SB |
| 455 | 9276.386 | 9122.677 | 915.083 | LWD |
| 456 | 9274.266 | 9108.889 | 910.266 | SB |
| 457 | 9274.087 | 9103.228 | 912.581 | RW |
| 458 | 9246.767 | 9099.452 | 912.578 | RW |
| 459 | 9246.194 | 9106.331 | 910.684 | SB |
| 460 | 9245.046 | 9118.382 | 910.946 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 461 | 9242.741 | 9106.118 | 914.327 | LWD |
| 462 | 9246.749 | 9129.224 | 911.136 | SB |
| 463 | 9248.799 | 9139.035 | 911.069 | SB |
| 464 | 9250.773 | 9151.830 | 910.559 | SB |
| 465 | 9253.425 | 9162.278 | 911.153 | SB |
| 466 | 9252.699 | 9168.772 | 912.508 | LW |
| 467 | 9254.990 | 9183.406 | 913.554 | BAR |
| 468 | 9256.735 | 9192.153 | 915.989 | BAR |
| 469 | 9292.238 | 9199.478 | 916.803 | BAR |
| 470 | 9289.696 | 9185.240 | 916.130 | BAR |
| 471 | 9320.277 | 9212.770 | 918.257 | BAR |
| 472 | 9288.971 | 9181.593 | 914.108 | BAR |
| 473 | 9321.560 | 9181.437 | 916.189 | BAR |
| 474 | 9320.845 | 9174.376 | 914.102 | BAR |
| 475 | 9348.455 | 9214.589 | 918.480 | BAR |
| 476 | 9349.741 | 9173.599 | 913.853 | BAR |
| 477 | 9348.953 | 9191.914 | 916.722 | BAR |
| 478 | 9384.760 | 9183.580 | 914.293 | BAR |
| 479 | 9381.467 | 9202.080 | 917.599 | BAR |
| 480 | 9376.785 | 9221.176 | 918.430 | BAR |
| 481 | 9409.915 | 9237.177 | 919.652 | BAR |
| 482 | 9416.566 | 9222.111 | 918.722 | BAR |
| 483 | 9426.951 | 9202.467 | 915.396 | BAR |
| 484 | 9453.790 | 9237.752 | 918.988 | BAR |
| 485 | 9465.228 | 9220.558 | 916.117 | BAR |
| 486 | 9444.986 | 9253.442 | 920.003 | BAR |
| 487 | 9495.204 | 9239.914 | 916.735 | BAR |
| 488 | 9486.218 | 9253.488 | 919.579 | BAR |
| 489 | 9478.428 | 9271.554 | 920.930 | BAR |
| 490 | 9535.939 | 9271.354 | 916.839 | BAR |
| 491 | 9514.206 | 9293.239 | 920.401 | BAR |
| 492 | 9554.640 | 9297.242 | 916.020 | BAR |
| 493 | 9537.699 | 9311.021 | 919.057 | BAR |
| 494 | 9574.387 | 9322.930 | 915.631 | BAR |
| 495 | 9562.533 | 9331.314 | 916.906 | BAR |
| 496 | 9508.054 | 9313.925 | 929.489 | LB |
| 497 | 9507.201 | 9329.962 | 933.807 | LTB |
| 498 | 9521.264 | 9325.673 | 930.473 | LB |
| 499 | 9503.107 | 9311.663 | 929.525 | LB |
| 500 | 9488.465 | 9314.259 | 932.362 | LTB |
| 501 | 9474.190 | 9298.884 | 932.942 | BKF |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 502 | 9483.334 | 9295.101 | 929.070 | LB |
| 503 | 9454.396 | 9283.957 | 931.904 | BKF |
| 504 | 9451.542 | 9268.216 | 924.436 | LB |
| 505 | 9435.025 | 9279.885 | 931.515 | BKF |
| 506 | 9425.037 | 9260.671 | 927.404 | LB |
| 507 | 9420.299 | 9273.177 | 931.369 | BKF |
| 508 | 9407.188 | 9255.608 | 928.102 | LB |
| 509 | 9390.483 | 9250.570 | 928.314 | LB |
| 510 | 9374.344 | 9246.370 | 928.461 | LB |
| 511 | 9360.853 | 9243.689 | 928.103 | LB |
| 512 | 9545.402 | 9173.049 | 916.282 | RB |
| 513 | 9554.921 | 9158.435 | 923.630 | RB |
| 514 | 9562.351 | 9146.529 | 928.832 | RB |
| 515 | 9546.742 | 9142.714 | 925.604 | RB |
| 516 | 9542.396 | 9150.198 | 923.065 | RB |
| 517 | 9538.040 | 9158.842 | 918.837 | RB |
| 518 | 9532.928 | 9166.940 | 916.858 | RB |
| 519 | 9517.059 | 9157.508 | 916.419 | RB |
| 520 | 9519.879 | 9150.358 | 919.492 | RB |
| 521 | 9522.492 | 9143.463 | 921.172 | RB |
| 522 | 9509.166 | 9129.838 | 923.122 | RB |
| 523 | 9505.697 | 9136.676 | 920.766 | RB |
| 524 | 9497.456 | 9152.891 | 916.342 | RB |
| 525 | 9495.261 | 9118.013 | 924.083 | RB |
| 526 | 9490.768 | 9126.146 | 920.881 | RB |
| 527 | 9486.067 | 9137.978 | 920.291 | RB |
| 528 | 9468.631 | 9128.942 | 919.047 | RB |
| 529 | 9471.568 | 9120.982 | 920.338 | RB |
| 530 | 9472.595 | 9102.571 | 925.892 | RB |
| 531 | 9449.569 | 9102.707 | 926.689 | RB |
| 532 | 9508.022 | 9111.519 | 937.337 | RTB |
| 533 | 9446.618 | 9113.766 | 921.637 | RB |
| 534 | 9443.594 | 9121.339 | 919.177 | RB |
| 535 | 9417.803 | 9119.945 | 916.003 | RB |
| 536 | 9421.294 | 9108.215 | 921.615 | RB |
| 537 | 9423.181 | 9104.019 | 922.895 | RB |
| 538 | 9493.358 | 9102.777 | 937.396 | RTB |
| 539 | 9424.922 | 9098.916 | 926.378 | RB |
| 540 | 9403.254 | 9085.161 | 926.331 | RB |
| 541 | 9487.370 | 9097.362 | 937.387 | RTB |
| 542 | 9400.374 | 9093.644 | 922.280 | RB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 543 | 9395.825 | 9102.707 | 920.106 | RB |
| 544 | 9394.995 | 9119.208 | 914.465 | RB |
| 545 | 9369.393 | 9113.710 | 915.024 | RB |
| 546 | 9471.318 | 9095.078 | 937.492 | RTB |
| 547 | 9370.648 | 9107.690 | 917.156 | RB |
| 548 | 9375.091 | 9094.903 | 919.459 | RB |
| 549 | 9461.519 | 9095.834 | 937.513 | RTB |
| 550 | 9379.907 | 9083.124 | 924.470 | RB |
| 551 | 9349.649 | 9077.485 | 925.934 | RB |
| 552 | 9446.635 | 9095.907 | 937.241 | RTB |
| 553 | 9347.498 | 9089.052 | 919.968 | RB |
| 554 | 9349.396 | 9105.652 | 916.253 | RB |
| 555 | 9431.128 | 9093.076 | 937.358 | RTB |
| 556 | 9338.516 | 9102.750 | 916.547 | RB |
| 557 | 9329.141 | 9101.177 | 916.618 | RB |
| 558 | 9415.337 | 9083.418 | 937.180 | RTB |
| 559 | 9332.867 | 9090.767 | 917.295 | RB |
| 560 | 9330.359 | 9081.672 | 920.493 | RB |
| 561 | 9323.160 | 9074.657 | 925.323 | RB |
| 562 | 9406.417 | 9075.907 | 937.241 | RTB |
| 563 | 9319.491 | 9085.841 | 920.344 | RB |
| 564 | 9318.584 | 9090.593 | 918.117 | RB |
| 565 | 9381.522 | 9069.357 | 937.145 | RTB |
| 566 | 9317.536 | 9099.340 | 915.890 | RB |
| 567 | 9290.890 | 9094.682 | 915.699 | RB |
| 568 | 9290.901 | 9083.658 | 920.447 | RB |
| 569 | 9370.868 | 9072.304 | 937.534 | RTB |
| 570 | 9258.262 | 9075.854 | 924.621 | RB |
| 571 | 9257.749 | 9085.453 | 918.245 | RB |
| 572 | 9256.333 | 9094.281 | 914.357 | RB |
| 573 | 9231.256 | 9086.648 | 916.477 | RB |
| 574 | 9210.830 | 9091.759 | 914.002 | RB |
| 575 | 9186.071 | 9096.908 | 914.589 | RB |
| 576 | 9167.095 | 9101.067 | 914.389 | RB |
| 577 | 9138.355 | 9105.921 | 914.270 | RB |
| 578 | 9334.245 | 9100.596 | 915.889 | GLY |
| 579 | 9337.411 | 9100.879 | 916.669 | GLY |
| 580 | 9332.970 | 9099.996 | 916.677 | GLY |
| 581 | 9340.240 | 9092.669 | 917.544 | GLY |
| 582 | 9334.139 | 9091.934 | 917.304 | GLY |
| 583 | 9336.686 | 9092.542 | 916.194 | GLY |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 584 | 9337.150 | 9083.450 | 917.533 | GLY |
| 585 | 9341.776 | 9084.132 | 919.421 | GLY |
| 586 | 9338.821 | 9083.264 | 916.615 | GLY |
| 587 | 9342.864 | 9073.491 | 923.352 | GLY |
| 588 | 9330.643 | 9072.469 | 920.837 | GLY |
| 589 | 9343.924 | 9073.432 | 923.324 | GLY |
| 590 | 9334.057 | 9072.637 | 917.602 | GLY |
| 591 | 9339.885 | 9074.224 | 918.832 | GLY |
| 592 | 9324.805 | 9070.820 | 924.287 | GLY |
| 593 | 9342.590 | 9069.721 | 925.368 | GLY |
| 594 | 9323.332 | 9067.793 | 934.909 | GLY |
| 595 | 9346.716 | 9070.978 | 924.903 | GLY |
| 596 | 9323.841 | 9067.038 | 925.972 | GLY |
| 597 | 9339.145 | 9069.112 | 921.094 | GLY |
| 598 | 9328.806 | 9067.620 | 922.461 | GLY |
| 599 | 9330.532 | 9067.786 | 919.747 | GLY |
| 600 | 9341.491 | 9066.849 | 924.443 | GLY |
| 601 | 9332.309 | 9068.694 | 921.738 | GLY |
| 602 | 9347.403 | 9066.141 | 926.294 | GLY |
| 603 | 9335.162 | 9065.482 | 924.147 | GLY |
| 604 | 9345.084 | 9059.940 | 926.815 | GLY |
| 605 | 9331.283 | 9065.113 | 920.516 | GLY |
| 606 | 9338.980 | 9062.829 | 925.451 | GLY |
| 607 | 9331.013 | 9057.535 | 920.934 | GLY |
| 608 | 9329.008 | 9057.662 | 925.173 | GLY |
| 609 | 9334.982 | 9056.811 | 922.535 | GLY |
| 610 | 9332.449 | 9051.780 | 921.513 | GLY |
| 611 | 9329.869 | 9050.764 | 925.706 | GLY |
| 612 | 9335.347 | 9046.878 | 922.684 | GLY |
| 613 | 9334.646 | 9051.534 | 924.355 | GLY |
| 614 | 9336.200 | 9044.204 | 925.751 | GLY |
| 615 | 9331.107 | 9045.337 | 922.986 | GLY |
| 616 | 9334.242 | 9040.868 | 926.817 | GLY |
| 617 | 9329.806 | 9045.477 | 926.815 | GLY |
| 618 | 9335.656 | 9039.599 | 927.987 | GLY |
| 619 | 9330.774 | 9040.490 | 923.967 | GLY |
| 620 | 9334.776 | 9038.755 | 925.785 | GLY |
| 621 | 9332.215 | 9037.626 | 924.118 | GLY |
| 622 | 9329.457 | 9037.125 | 927.100 | GLY |
| 623 | 9334.394 | 9034.397 | 926.841 | GLY |
| 624 | 9330.663 | 9031.350 | 925.689 | GLY |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 625 | 9328.701 | 9031.207 | 930.518 | GLY |
| 626 | 9331.082 | 9027.073 | 930.270 | GLY |
| 627 | 9334.268 | 9026.731 | 927.917 | GLY |
| 628 | 9334.701 | 9027.686 | 929.883 | GLY |
| 629 | 9332.673 | 9027.035 | 926.489 | GLY |
| 630 | 9335.605 | 9020.213 | 928.246 | GLY |
| 631 | 9332.764 | 9019.386 | 931.240 | GLY |
| 632 | 9334.684 | 9015.372 | 929.313 | GLY |
| 633 | 9338.393 | 9020.875 | 931.740 | GLY |
| 634 | 9332.078 | 9014.330 | 931.815 | GLY |
| 635 | 9337.511 | 9016.030 | 930.920 | GLY |
| 636 | 9336.083 | 9005.411 | 930.398 | GLY |
| 637 | 9331.077 | 9005.011 | 933.875 | GLY |
| 638 | 9336.620 | 8997.337 | 930.943 | GLY |
| 639 | 9343.098 | 8999.155 | 933.550 | GLY |
| 640 | 9341.635 | 9012.676 | 933.215 | GLY |
| 641 | 9340.053 | 9019.329 | 932.517 | GLY |
| 642 | 9362.859 | 9069.301 | 937.586 | RTB |
| 643 | 9356.071 | 9068.780 | 936.651 | RTB |
| 644 | 9350.470 | 9057.833 | 937.312 | RTB |
| 645 | 9214.741 | 9096.749 | 912.534 | RW |
| 646 | 9282.027 | 9068.309 | 939.683 | RTB |
| 647 | 9215.433 | 9104.192 | 911.416 | SB |
| 648 | 9214.552 | 9117.228 | 911.274 | SB |
| 649 | 9274.304 | 9067.660 | 939.661 | RTB |
| 650 | 9214.733 | 9122.468 | 910.009 | SB |
| 651 | 9216.045 | 9126.809 | 909.506 | SB |
| 652 | 9216.735 | 9135.907 | 912.299 | SB |
| 653 | 9218.534 | 9150.176 | 911.665 | SB |
| 654 | 9256.906 | 9064.965 | 939.643 | RTB |
| 655 | 9222.931 | 9163.345 | 910.875 | SB |
| 656 | 9224.898 | 9173.678 | 912.555 | LW |
| 657 | 9245.858 | 9068.790 | 939.377 | RTB |
| 658 | 9195.882 | 9181.935 | 912.546 | LW |
| 659 | 9191.199 | 9169.328 | 911.003 | SB |
| 660 | 9188.037 | 9157.162 | 911.455 | SB |
| 661 | 9187.410 | 9141.632 | 912.128 | SB |
| 662 | 9184.355 | 9126.560 | 910.185 | SB |
| 663 | 9183.190 | 9116.806 | 910.143 | SB |
| 664 | 9237.968 | 9070.531 | 938.722 | RTB |
| 665 | 9181.552 | 9110.392 | 912.499 | RW |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 666 | 9226.954 | 9069.869 | 938.729 | RTB |
| 667 | 9216.502 | 9071.561 | 938.704 | RTB |
| 668 | 9205.513 | 9071.614 | 938.597 | RTB |
| 669 | 9188.268 | 9076.817 | 937.863 | RTB |
| 670 | 9176.118 | 9078.389 | 937.312 | RTB |
| 671 | 9170.755 | 9082.576 | 937.114 | RTB |
| 672 | 9159.152 | 9080.873 | 937.555 | RTB |
| 673 | 9312.099 | 8800.028 | 935.119 | TS |
| 674 | 9721.944 | 9166.660 | 936.892 | FE |
| 675 | 9706.302 | 9157.932 | 936.829 | FE |
| 676 | 9679.260 | 9145.511 | 936.829 | FE |
| 677 | 9657.684 | 9133.942 | 936.592 | FE |
| 678 | 9657.540 | 9133.916 | 936.592 | FE |
| 679 | 9631.053 | 9123.585 | 936.347 | FE |
| 680 | 9610.420 | 9115.578 | 936.930 | FE |
| 681 | 9589.174 | 9108.826 | 937.124 | FE |
| 682 | 9568.213 | 9099.378 | 937.117 | FE |
| 683 | 9546.629 | 9093.141 | 936.585 | FE |
| 684 | 9532.632 | 9086.906 | 936.133 | FE |
| 685 | 9515.721 | 9081.055 | 936.580 | FE |
| 686 | 9499.193 | 9074.176 | 936.957 | FE |
| 687 | 9481.204 | 9066.160 | 936.957 | FE |
| 688 | 9462.178 | 9059.588 | 936.954 | FE |
| 689 | 9445.015 | 9054.747 | 936.852 | FE |
| 690 | 9424.819 | 9051.615 | 936.851 | FE |
| 691 | 9406.533 | 9051.089 | 936.951 | FE |
| 692 | 9389.997 | 9050.955 | 937.009 | FE |
| 693 | 9372.755 | 9042.891 | 937.286 | FE |
| 694 | 9363.865 | 9030.289 | 937.108 | FE |
| 695 | 9360.192 | 9013.349 | 936.997 | FE |
| 696 | 9355.736 | 8990.545 | 936.115 | FE |
| 697 | 9352.267 | 8970.511 | 934.814 | FE |
| 698 | 9348.361 | 8946.457 | 933.879 | FE |
| 699 | 9345.996 | 8926.798 | 933.594 | FE |
| 700 | 9342.361 | 8898.296 | 933.528 | FE |
| 701 | 9342.174 | 8879.534 | 933.444 | FE |
| 702 | 9340.392 | 8843.852 | 933.405 | FE |
| 703 | 9338.517 | 8820.717 | 933.524 | FE |
| 704 | 9336.883 | 8799.030 | 933.697 | FE |
| 705 | 9335.725 | 8782.674 | 933.919 | FE |
| 706 | 9330.110 | 8784.294 | 933.435 | FL |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 707 | 9332.611 | 8806.990 | 933.344 | FL |
| 708 | 9334.089 | 8822.875 | 933.274 | FL |
| 709 | 9336.839 | 8841.716 | 933.171 | FL |
| 710 | 9337.854 | 8857.774 | 933.132 | FL |
| 711 | 9336.549 | 8876.905 | 932.979 | FL |
| 712 | 9337.503 | 8889.642 | 932.783 | FL |
| 713 | 9336.213 | 8907.914 | 932.752 | FL |
| 714 | 9337.959 | 8918.708 | 932.604 | FL |
| 715 | 9338.777 | 8939.778 | 932.553 | FL |
| 716 | 9338.786 | 8939.732 | 932.533 | FL |
| 717 | 9337.613 | 8953.760 | 932.304 | FL |
| 718 | 9337.304 | 8963.246 | 932.123 | FL |
| 719 | 9336.668 | 8975.259 | 931.644 | FL |
| 720 | 9336.977 | 8986.977 | 931.166 | FL |
| 721 | 9337.567 | 8998.623 | 930.825 | GLY |
| 722 | 9336.390 | 9006.654 | 930.254 | GLY |
| 723 | 9328.953 | 8974.201 | 935.981 | FE |
| 724 | 9326.935 | 8986.192 | 936.707 | FE |
| 725 | 9335.138 | 9014.651 | 928.808 | GLY |
| 726 | 9336.178 | 9018.253 | 928.342 | GLY |
| 727 | 9323.364 | 8996.100 | 936.961 | GLY |
| 728 | 9322.167 | 9007.690 | 936.787 | GLY |
| 729 | 9321.952 | 9017.878 | 937.157 | GLY |
| 730 | 9352.992 | 9008.262 | 936.705 | GLY |
| 731 | 9351.581 | 8999.540 | 935.919 | GLY |
| 732 | 9347.762 | 8986.083 | 934.680 | GLY |
| 733 | 9344.153 | 8974.948 | 933.834 | GLY |
| 734 | 9347.200 | 9028.100 | 936.661 | GLY |
| 735 | 9345.289 | 9038.938 | 936.729 | GLY |
| 736 | 9321.227 | 9026.278 | 937.329 | GLY |
| 737 | 9317.316 | 8774.109 | 934.004 | FE |
| 738 | 9316.826 | 8794.217 | 934.025 | FE |
| 739 | 9316.654 | 8814.831 | 934.635 | FE |
| 740 | 9317.323 | 8831.435 | 934.928 | FE |
| 741 | 9318.053 | 8845.847 | 935.083 | FE |
| 742 | 9320.795 | 8864.929 | 935.090 | FE |
| 743 | 9322.576 | 8879.154 | 934.869 | FE |
| 744 | 9325.815 | 8899.895 | 934.309 | FE |
| 745 | 9327.462 | 8914.206 | 934.555 | FE |
| 746 | 9329.055 | 8935.422 | 934.631 | FE |
| 747 | 9328.714 | 8949.347 | 935.094 | FE |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 748 | 9325.471 | 8969.964 | 935.816 | FE |
| 749 | 9317.400 | 8984.603 | 936.820 | FE |
| 750 | 9301.811 | 8995.566 | 937.168 | FE |
| 751 | 9285.221 | 8998.697 | 936.949 | FE |
| 752 | 9259.966 | 9003.883 | 936.707 | FE |
| 753 | 9238.500 | 9004.652 | 936.348 | FE |
| 754 | 9216.768 | 9007.563 | 936.628 | FE |
| 755 | 9195.474 | 9009.352 | 936.593 | FE |
| 756 | 9172.221 | 9011.868 | 936.636 | FE |
| 757 | 9152.825 | 9014.267 | 936.557 | FE |
| 758 | 9130.961 | 9016.917 | 936.533 | FE |
| 759 | 9111.018 | 9019.667 | 936.620 | FE |
| 760 | 9092.739 | 9022.165 | 936.751 | FE |
| 761 | 9074.118 | 9024.512 | 936.525 | FE |
| 762 | 9051.864 | 9026.695 | 935.958 | FE |
| 763 | 9035.033 | 9028.869 | 935.939 | FE |
| 764 | 9010.249 | 9031.477 | 936.345 | FE |
| 765 | 8988.734 | 9032.489 | 936.421 | FE |
| 766 | 8964.792 | 9033.059 | 936.364 | FE |
| 767 | 8943.556 | 9030.735 | 936.416 | FE |
| 768 | 8914.036 | 9021.769 | 936.496 | FE |
| 769 | 8896.168 | 9012.088 | 936.330 | FE |
| 770 | 8881.355 | 9002.152 | 936.018 | FE |
| 771 | 8869.355 | 8996.218 | 935.529 | FE |
| 772 | 8864.328 | 8972.514 | 935.473 | FLD |
| 773 | 8870.956 | 8941.987 | 935.642 | FLD |
| 774 | 8895.738 | 8991.012 | 936.285 | FLD |
| 775 | 8909.346 | 8961.406 | 936.423 | FLD |
| 776 | 8918.397 | 9004.957 | 936.542 | FLD |
| 777 | 8937.190 | 8977.440 | 936.480 | FLD |
| 778 | 8943.977 | 9013.760 | 936.407 | FLD |
| 779 | 8953.570 | 8984.072 | 936.229 | FLD |
| 780 | 8969.834 | 9016.067 | 936.373 | FLD |
| 781 | 8972.028 | 8986.441 | 936.277 | FLD |
| 782 | 8995.848 | 9015.416 | 936.439 | FLD |
| 783 | 8996.886 | 8987.141 | 936.314 | FLD |
| 784 | 9024.067 | 9012.982 | 936.212 | FLD |
| 785 | 9025.424 | 8984.772 | 936.239 | FLD |
| 786 | 9042.980 | 9011.059 | 935.862 | FLD |
| 787 | 9041.119 | 8983.117 | 936.231 | FLD |
| 788 | 9063.925 | 9008.542 | 936.507 | FLD |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 789 | 9064.034 | 8979.940 | 936.539 | FLD |
| 790 | 9092.755 | 9005.111 | 936.499 | FLD |
| 791 | 9092.501 | 8976.567 | 936.418 | FLD |
| 792 | 9122.623 | 9000.982 | 936.467 | FLD |
| 793 | 9121.556 | 8972.443 | 936.332 | FLD |
| 794 | 9153.078 | 8997.071 | 936.502 | FLD |
| 795 | 9153.357 | 8968.886 | 936.457 | FLD |
| 796 | 9181.149 | 8993.961 | 936.504 | FLD |
| 797 | 9179.764 | 8965.664 | 936.379 | FLD |
| 798 | 9216.163 | 8990.046 | 936.537 | FLD |
| 799 | 9215.049 | 8962.074 | 936.369 | FLD |
| 800 | 9249.635 | 8986.389 | 936.549 | FLD |
| 801 | 9250.284 | 8958.026 | 936.464 | FLD |
| 802 | 9281.309 | 8982.543 | 936.960 | FLD |
| 803 | 9277.639 | 8954.572 | 936.645 | FLD |
| 804 | 9300.309 | 8974.504 | 937.219 | FLD |
| 805 | 9285.273 | 8952.094 | 936.799 | FLD |
| 806 | 9309.205 | 8953.781 | 936.998 | FLD |
| 807 | 9286.024 | 8927.191 | 936.574 | FLD |
| 808 | 9308.821 | 8921.330 | 936.331 | FLD |
| 809 | 9283.725 | 8897.361 | 936.330 | FLD |
| 810 | 9306.303 | 8891.404 | 936.299 | FLD |
| 811 | 9282.302 | 8869.261 | 936.367 | FLD |
| 812 | 9301.781 | 8862.152 | 936.234 | FLD |
| 813 | 9281.444 | 8840.903 | 936.273 | FLD |
| 814 | 9299.263 | 8837.031 | 936.138 | FLD |
| 815 | 9281.027 | 8819.485 | 936.369 | FLD |
| 816 | 9298.318 | 8816.852 | 936.018 | FLD |
| 817 | 9266.783 | 8907.557 | 936.355 | FLD |
| 818 | 9263.833 | 8874.860 | 936.155 | FLD |
| 819 | 9221.036 | 8911.762 | 936.189 | FLD |
| 820 | 9218.329 | 8878.607 | 936.118 | FLD |
| 821 | 9187.790 | 8914.338 | 936.140 | FLD |
| 822 | 9183.861 | 8881.068 | 935.891 | FLD |
| 823 | 9140.935 | 8918.164 | 936.273 | FLD |
| 824 | 9136.081 | 8884.910 | 936.006 | FLD |
| 825 | 9099.950 | 8921.345 | 936.219 | FLD |
| 826 | 9094.115 | 8888.403 | 936.001 | FLD |
| 827 | 9051.151 | 8925.088 | 936.266 | FLD |
| 828 | 9046.466 | 8891.712 | 936.127 | FLD |
| 829 | 9007.029 | 8928.549 | 936.316 | FLD |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 830 | 9004.384 | 8895.162 | 936.034 | FLD |
| 831 | 8974.237 | 8932.231 | 936.049 | FLD |
| 832 | 8970.974 | 8897.651 | 935.904 | FLD |
| 833 | 8939.561 | 8933.624 | 936.236 | FLD |
| 834 | 8936.376 | 8900.199 | 936.027 | FLD |
| 835 | 8903.340 | 8935.657 | 936.189 | FLD |
| 836 | 8900.451 | 8902.933 | 936.021 | FLD |
| 837 | 8866.829 | 8936.236 | 935.569 | FLD |
| 838 | 8863.753 | 8905.845 | 935.647 | FLD |
| 839 | 9364.543 | 8811.512 | 935.421 | FLD |
| 840 | 9396.657 | 8809.700 | 935.974 | FLD |
| 841 | 9362.376 | 8769.447 | 935.588 | FLD |
| 842 | 9392.352 | 8767.397 | 936.046 | FLD |
| 843 | 9369.796 | 8851.684 | 935.751 | FLD |
| 844 | 9397.666 | 8854.819 | 936.147 | FLD |
| 845 | 9372.739 | 8897.647 | 935.976 | FLD |
| 846 | 9400.870 | 8896.001 | 936.215 | FLD |
| 847 | 9377.546 | 8941.527 | 936.125 | FLD |
| 848 | 9405.635 | 8938.827 | 936.333 | FLD |
| 849 | 9383.595 | 8984.321 | 936.656 | FLD |
| 850 | 9410.532 | 8984.758 | 936.579 | FLD |
| 851 | 9392.989 | 9014.073 | 936.804 | FLD |
| 852 | 9415.498 | 9009.066 | 936.543 | FLD |
| 853 | 9417.622 | 9031.109 | 936.576 | FLD |
| 854 | 9430.409 | 9010.131 | 936.536 | FLD |
| 855 | 9462.580 | 9041.010 | 936.750 | FLD |
| 856 | 9471.175 | 9013.127 | 936.672 | FLD |
| 857 | 9501.590 | 9055.896 | 936.912 | FLD |
| 858 | 9516.984 | 9025.561 | 936.498 | FLD |
| 859 | 9524.799 | 9065.726 | 936.359 | FLD |
| 860 | 9538.441 | 9033.963 | 936.223 | FLD |
| 861 | 9537.730 | 9069.687 | 936.079 | FLD |
| 862 | 9552.729 | 9038.782 | 936.475 | FLD |
| 863 | 9564.958 | 9079.566 | 936.840 | FLD |
| 864 | 9579.176 | 9048.748 | 936.872 | FLD |
| 865 | 9595.667 | 9091.210 | 937.031 | FLD |
| 866 | 9608.009 | 9057.996 | 936.679 | FLD |
| 867 | 9628.164 | 9103.469 | 936.410 | FLD |
| 868 | 9643.125 | 9070.387 | 936.208 | FLD |
| 869 | 9657.055 | 9114.519 | 936.533 | FLD |
| 870 | 9672.621 | 9082.340 | 936.606 | FLD |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 871 | 9693.236 | 9132.214 | 936.762 | FLD |
| 872 | 9708.533 | 9098.966 | 936.709 | FLD |
| 873 | 9730.032 | 9151.105 | 936.768 | FLD |
| 874 | 9750.455 | 9120.751 | 936.454 | FLD |
| 875 | 9764.223 | 9175.139 | 936.584 | FLD |
| 876 | 9786.652 | 9146.634 | 936.414 | FLD |
| 877 | 9804.398 | 9120.198 | 936.213 | FLD |
| 878 | 9820.836 | 9092.492 | 935.998 | FLD |
| 879 | 9768.308 | 9098.966 | 936.383 | FLD |
| 880 | 9776.223 | 9063.071 | 936.110 | FLD |
| 881 | 9741.665 | 9076.725 | 936.203 | FLD |
| 882 | 9738.833 | 9034.971 | 936.089 | FLD |
| 883 | 9693.305 | 9044.387 | 936.319 | FLD |
| 884 | 9695.415 | 9003.728 | 936.139 | FLD |
| 885 | 9640.154 | 9011.136 | 936.306 | FLD |
| 886 | 9640.714 | 8977.313 | 936.275 | FLD |
| 887 | 9590.380 | 9003.001 | 936.715 | FLD |
| 888 | 9593.970 | 8963.720 | 936.297 | FLD |
| 889 | 9540.176 | 8989.227 | 936.423 | FLD |
| 890 | 9538.842 | 8958.709 | 936.324 | FLD |
| 891 | 9450.818 | 8961.015 | 936.394 | FLD |
| 892 | 9455.775 | 8928.856 | 936.315 | FLD |
| 893 | 9290.823 | 9190.241 | 914.471 | TS |
| 894 | 9260.776 | 9064.647 | 940.163 | RTB |
| 895 | 9277.311 | 9067.778 | 940.446 | RTB |
| 896 | 9289.653 | 9069.694 | 939.728 | RTB |
| 897 | 9299.539 | 9069.132 | 939.681 | RTB |
| 898 | 9305.382 | 9071.449 | 939.137 | RTB |
| 899 | 9313.533 | 9068.266 | 939.348 | RTB |
| 900 | 9146.293 | 9111.446 | 912.744 | RW |
| 901 | 9123.320 | 9113.440 | 912.881 | RW |
| 902 | 9123.466 | 9119.323 | 910.267 | SB |
| 903 | 9124.605 | 9131.748 | 910.341 | SB |
| 904 | 9126.243 | 9140.178 | 910.915 | SB |
| 905 | 9126.429 | 9154.085 | 911.476 | SB |
| 906 | 9127.850 | 9163.234 | 911.607 | SB |
| 907 | 9128.073 | 9173.870 | 911.720 | SB |
| 908 | 9129.108 | 9187.176 | 912.923 | LW |
| 909 | 9129.227 | 9197.172 | 913.280 | BAR |
| 910 | 9128.024 | 9210.788 | 913.789 | BAR |
| 911 | 9096.510 | 9209.971 | 913.068 | BAR |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 912 | 9096.073 | 9199.625 | 913.031 | BAR |
| 913 | 9096.565 | 9188.528 | 912.855 | LW |
| 914 | 9097.311 | 9174.814 | 911.872 | SB |
| 915 | 9096.660 | 9163.051 | 911.596 | SB |
| 916 | 9097.002 | 9154.125 | 911.493 | SB |
| 917 | 9095.604 | 9143.680 | 911.130 | SB |
| 918 | 9095.579 | 9138.576 | 910.281 | SB |
| 919 | 9095.908 | 9129.113 | 910.048 | SB |
| 920 | 9094.902 | 9121.077 | 910.553 | SB |
| 921 | 9094.433 | 9114.145 | 912.836 | RW |
| 922 | 9075.128 | 9115.265 | 912.827 | RW |
| 923 | 9076.467 | 9127.278 | 910.330 | SB |
| 924 | 9077.847 | 9136.110 | 910.195 | SB |
| 925 | 9078.357 | 9146.710 | 911.262 | SB |
| 926 | 9080.668 | 9159.267 | 911.639 | SB |
| 927 | 9078.504 | 9172.305 | 912.143 | SB |
| 928 | 9078.509 | 9187.906 | 912.860 | LW |
| 929 | 9077.821 | 9211.050 | 912.800 | BAR |
| 930 | 9052.820 | 9210.385 | 913.049 | BAR |
| 931 | 9052.799 | 9186.711 | 912.826 | LW |
| 932 | 9052.845 | 9167.066 | 911.709 | SB |
| 933 | 9052.753 | 9156.496 | 911.429 | SB |
| 934 | 9051.797 | 9149.803 | 911.004 | SB |
| 935 | 9051.309 | 9137.814 | 910.312 | SB |
| 936 | 9052.271 | 9128.907 | 910.177 | SB |
| 937 | 9051.064 | 9122.718 | 910.142 | SB |
| 938 | 9050.975 | 9119.450 | 912.759 | RW |
| 939 | 9030.249 | 9118.211 | 912.799 | RW |
| 940 | 9030.201 | 9123.576 | 910.612 | SB |
| 941 | 9030.467 | 9127.977 | 910.453 | SB |
| 942 | 9032.678 | 9140.967 | 910.125 | SB |
| 943 | 9033.231 | 9150.353 | 910.699 | SB |
| 944 | 9033.777 | 9162.552 | 911.671 | SB |
| 945 | 9031.136 | 9183.518 | 912.813 | LW |
| 946 | 9029.723 | 9210.073 | 912.985 | BAR |
| 947 | 9008.732 | 9179.502 | 912.768 | LW |
| 948 | 9007.634 | 9170.475 | 911.771 | SB |
| 949 | 9006.873 | 9159.327 | 911.163 | SB |
| 950 | 9007.419 | 9150.652 | 910.569 | SB |
| 951 | 9005.907 | 9140.952 | 910.668 | SB |
| 952 | 9005.489 | 9130.374 | 910.635 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 953 | 9005.754 | 9123.629 | 911.531 | SB |
| 954 | 9005.666 | 9118.756 | 912.747 | RW |
| 955 | 8983.961 | 9120.917 | 912.818 | RW |
| 956 | 8982.722 | 9130.828 | 910.759 | SB |
| 957 | 8984.572 | 9140.383 | 910.853 | SB |
| 958 | 8984.581 | 9150.613 | 910.613 | SB |
| 959 | 8986.523 | 9159.490 | 910.747 | SB |
| 960 | 8987.390 | 9170.385 | 911.457 | SB |
| 961 | 8990.289 | 9186.710 | 912.818 | LW |
| 962 | 8992.763 | 9194.210 | 912.190 | TRIB |
| 963 | 8976.860 | 9213.269 | 912.748 | LW |
| 964 | 8977.668 | 9200.845 | 910.837 | SB |
| 965 | 8975.307 | 9191.834 | 912.115 | SB |
| 966 | 8973.105 | 9181.531 | 911.670 | SB |
| 967 | 8971.368 | 9166.465 | 910.971 | SB |
| 968 | 8971.054 | 9155.215 | 910.780 | SB |
| 969 | 8970.578 | 9143.580 | 910.962 | SB |
| 970 | 8971.463 | 9133.205 | 911.117 | SB |
| 971 | 8970.842 | 9125.199 | 911.334 | SB |
| 972 | 8969.826 | 9119.831 | 912.781 | RW |
| 973 | 8946.158 | 9125.214 | 912.864 | RW |
| 974 | 8948.225 | 9131.221 | 910.765 | SB |
| 975 | 8948.424 | 9137.773 | 910.903 | SB |
| 976 | 8948.862 | 9148.669 | 911.016 | SB |
| 977 | 8950.511 | 9163.652 | 911.148 | SB |
| 978 | 8951.671 | 9175.173 | 911.258 | SB |
| 979 | 8952.251 | 9188.143 | 911.506 | SB |
| 980 | 8952.335 | 9199.107 | 911.826 | SB |
| 981 | 8951.389 | 9205.014 | 910.566 | SB |
| 982 | 8950.831 | 9215.443 | 912.752 | LW |
| 983 | 8926.531 | 9217.191 | 912.696 | LW |
| 984 | 8927.238 | 9207.797 | 909.745 | SB |
| 985 | 8927.000 | 9200.936 | 911.475 | SB |
| 986 | 8925.177 | 9186.326 | 911.013 | SB |
| 987 | 8924.206 | 9177.682 | 911.161 | SB |
| 988 | 8923.610 | 9162.168 | 911.114 | SB |
| 989 | 8921.411 | 9150.367 | 911.036 | SB |
| 990 | 8920.468 | 9139.914 | 911.303 | SB |
| 991 | 8918.758 | 9132.581 | 911.309 | SB |
| 992 | 8918.306 | 9125.537 | 912.755 | RW |
| 993 | 8896.442 | 9129.406 | 912.711 | RW |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 994 | 8899.054 | 9137.836 | 910.853 | SB |
| 995 | 8899.945 | 9151.076 | 911.392 | SB |
| 996 | 8903.208 | 9162.384 | 911.387 | SB |
| 997 | 8903.493 | 9175.656 | 911.087 | SB |
| 998 | 8905.349 | 9185.507 | 911.334 | SB |
| 999 | 8906.362 | 9199.519 | 911.335 | SB |
| 1000 | 8907.193 | 9209.342 | 910.330 | SB |
| 1001 | 8898.841 | 9210.359 | 910.251 | SB |
| 1002 | 8897.464 | 9199.801 | 911.420 | SB |
| 1003 | 8891.082 | 9186.795 | 911.133 | SB |
| 1004 | 8889.863 | 9177.021 | 911.364 | SB |
| 1005 | 8885.875 | 9161.878 | 911.546 | SB |
| 1006 | 8883.606 | 9152.647 | 911.236 | SB |
| 1007 | 8882.855 | 9141.347 | 911.224 | SB |
| 1008 | 8882.072 | 9134.353 | 912.261 | SB |
| 1009 | 8882.393 | 9129.913 | 912.722 | RW |
| 1010 | 8850.310 | 9136.991 | 912.748 | RW |
| 1011 | 8850.990 | 9144.329 | 911.330 | SB |
| 1012 | 8854.091 | 9157.109 | 911.260 | SB |
| 1013 | 8856.705 | 9168.011 | 911.433 | SB |
| 1014 | 8859.871 | 9180.298 | 911.394 | SB |
| 1015 | 8861.905 | 9191.118 | 911.386 | SB |
| 1016 | 8864.048 | 9202.621 | 911.543 | SB |
| 1017 | 8866.080 | 9213.682 | 910.884 | SB |
| 1018 | 9152.944 | 9222.370 | 920.567 | LB |
| 1019 | 9178.657 | 9228.445 | 923.541 | LB |
| 1020 | 9168.748 | 9249.790 | 932.394 | LB |
| 1021 | 9201.338 | 9219.339 | 920.033 | LB |
| 1022 | 9219.568 | 9220.986 | 922.143 | LB |
| 1023 | 9182.506 | 9245.383 | 930.019 | LB |
| 1024 | 9226.166 | 9229.937 | 925.126 | BKF |
| 1025 | 9202.779 | 9239.400 | 929.069 | LB |
| 1026 | 9257.372 | 9227.972 | 925.577 | LB |
| 1027 | 9284.323 | 9227.769 | 925.136 | LB |
| 1028 | 9238.015 | 9251.836 | 932.773 | LB |
| 1029 | 9224.590 | 9250.463 | 932.743 | LB |
| 1030 | 9304.905 | 9230.863 | 926.553 | BKF |
| 1031 | 9268.184 | 9249.828 | 932.944 | LB |
| 1032 | 9321.209 | 9235.267 | 928.416 | LB |
| 1033 | 9291.950 | 9254.560 | 932.354 | LB |
| 1034 | 9321.700 | 9255.184 | 931.291 | LB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 1035 | 9083.021 | 9207.162 | 913.470 | TS |
| 1036 | 9188.692 | 9219.947 | 919.308 | LB |
| 1037 | 9176.261 | 9245.855 | 931.444 | LB |
| 1038 | 9156.469 | 9244.799 | 932.096 | LB |
| 1039 | 9152.301 | 9235.802 | 924.853 | LB |
| 1040 | 9147.467 | 9226.167 | 922.568 | LB |
| 1041 | 9119.195 | 9223.339 | 920.789 | LB |
| 1042 | 9114.607 | 9247.688 | 931.744 | LB |
| 1043 | 9084.484 | 9245.448 | 930.515 | LB |
| 1044 | 9062.438 | 9247.126 | 929.739 | LB |
| 1045 | 9084.617 | 9232.647 | 925.352 | LB |
| 1046 | 9060.878 | 9225.391 | 921.763 | LB |
| 1047 | 9027.553 | 9227.488 | 920.736 | LB |
| 1048 | 9159.319 | 9081.925 | 937.015 | RTB |
| 1049 | 9151.510 | 9082.501 | 936.924 | RTB |
| 1050 | 9031.124 | 9217.821 | 913.008 | BAR |
| 1051 | 9129.250 | 9083.735 | 937.216 | RTB |
| 1052 | 9118.532 | 9090.574 | 930.078 | RB |
| 1053 | 9126.900 | 9093.397 | 928.110 | RB |
| 1054 | 9090.362 | 9065.835 | 937.109 | RTB |
| 1055 | 9072.315 | 9074.867 | 937.097 | RTB |
| 1056 | 9060.495 | 9083.808 | 934.671 | RB |
| 1057 | 9040.234 | 9085.258 | 933.349 | RB |
| 1058 | 9024.234 | 9101.556 | 926.800 | RB |
| 1059 | 9056.363 | 9071.828 | 937.223 | RTB |
| 1060 | 9025.794 | 9074.258 | 936.951 | RTB |
| 1061 | 9012.347 | 9076.014 | 937.232 | RTB |
| 1062 | 9001.092 | 9091.194 | 936.670 | RTB |
| 1063 | 8958.446 | 9083.094 | 937.138 | RTB |
| 1064 | 8967.932 | 9099.845 | 928.949 | RB |
| 1065 | 8988.781 | 9100.456 | 928.280 | RB |
| 1066 | 9001.195 | 9105.710 | 924.255 | RB |
| 1067 | 9014.643 | 9107.527 | 924.507 | RB |
| 1068 | 9026.363 | 9103.508 | 925.881 | RB |
| 1069 | 9039.838 | 9103.628 | 923.924 | RB |
| 1070 | 9059.859 | 9096.669 | 927.763 | RB |
| 1071 | 9078.657 | 9104.003 | 921.727 | RB |
| 1072 | 9097.607 | 9096.592 | 926.448 | RB |
| 1073 | 9126.504 | 9093.710 | 928.020 | RB |
| 1074 | 8926.081 | 9090.726 | 932.630 | RB |
| 1075 | 8936.919 | 9111.358 | 923.485 | RB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 1076 | 8924.780 | 9114.699 | 922.160 | RB |
| 1077 | 8913.432 | 9116.177 | 922.358 | RB |
| 1078 | 8890.487 | 9107.587 | 927.853 | RB |
| 1079 | 8906.686 | 9082.349 | 937.272 | RTB |
| 1080 | 8916.182 | 9078.705 | 936.424 | RTB |
| 1081 | 8933.067 | 9076.150 | 936.874 | RTB |
| 1082 | 8826.831 | 9119.373 | 919.339 | TS |
| 1083 | 8905.919 | 9216.157 | 912.726 | LW |
| 1084 | 8868.470 | 9101.099 | 933.256 | RTB |
| 1085 | 8882.561 | 9091.942 | 935.511 | RTB |
| 1086 | 8884.812 | 9223.757 | 912.712 | LW |
| 1087 | 8891.483 | 9088.042 | 937.100 | RTB |
| 1088 | 8868.782 | 9227.769 | 912.709 | LW |
| 1089 | 8899.901 | 9086.600 | 938.293 | RTB |
| 1090 | 8862.222 | 9239.565 | 918.189 | LB |
| 1091 | 8857.521 | 9256.732 | 927.542 | LB |
| 1092 | 8881.499 | 9102.194 | 930.029 | RB |
| 1093 | 8861.626 | 9270.570 | 932.699 | LB |
| 1094 | 8882.044 | 9276.411 | 934.016 | LB |
| 1095 | 8879.807 | 9259.229 | 928.786 | LB |
| 1096 | 8878.467 | 9250.560 | 926.237 | LB |
| 1097 | 8895.389 | 9249.687 | 927.524 | LB |
| 1098 | 8898.727 | 9262.823 | 931.347 | LB |
| 1099 | 8783.901 | 9100.043 | 936.004 | RTB |
| 1100 | 8922.034 | 9247.952 | 928.671 | LB |
| 1101 | 8797.311 | 9082.765 | 935.754 | RTB |
| 1102 | 8972.765 | 9244.999 | 926.213 | LB |
| 1103 | 8813.550 | 9092.878 | 933.463 | RTB |
| 1104 | 8980.206 | 9245.767 | 928.760 | LB |
| 1105 | 8833.571 | 9093.520 | 931.797 | RTB |
| 1106 | 8988.504 | 9238.235 | 926.843 | LB |
| 1107 | 8825.326 | 9096.274 | 932.478 | RTB |
| 1108 | 8967.761 | 9232.088 | 919.526 | LB |
| 1109 | 8845.520 | 9090.315 | 932.423 | RTB |
| 1110 | 8951.179 | 9231.510 | 921.103 | LB |
| 1111 | 8855.071 | 9089.060 | 932.493 | RTB |
| 1112 | 8909.945 | 9236.529 | 920.437 | LB |
| 1113 | 8789.025 | 9110.946 | 927.532 | RB |
| 1114 | 8852.016 | 9225.980 | 910.276 | SB |
| 1115 | 8849.135 | 9210.347 | 911.356 | SB |
| 1116 | 8844.934 | 9195.647 | 911.462 | SB |

| Point | Northing | Easting | Elevation | Description |
|---|---|---|---|---|
| 1117 | 8840.818 | 9179.096 | 911.588 | SB |
| 1118 | 8836.979 | 9162.264 | 911.326 | SB |
| 1119 | 8833.655 | 9146.051 | 911.319 | SB |
| 1120 | 8830.980 | 9138.938 | 912.664 | RW |
| 1121 | 8799.437 | 9102.076 | 932.745 | RB |
| 1122 | 8808.038 | 9090.749 | 933.616 | RB |
| 1123 | 8812.025 | 9130.715 | 916.568 | RB |
| 1124 | 8808.088 | 9116.632 | 921.827 | RB |
| 1125 | 8835.502 | 9106.905 | 921.273 | RB |
| 1126 | 8809.970 | 9103.935 | 924.172 | RB |
| 1127 | 8841.235 | 9121.819 | 918.357 | RB |
| 1128 | 8820.271 | 9118.203 | 919.609 | RB |
| 1129 | 8849.717 | 9096.782 | 925.492 | RB |
| 1130 | 8825.070 | 9130.226 | 916.482 | RB |
| 1131 | 8849.636 | 9107.015 | 921.564 | RB |
| 1132 | 8852.646 | 9125.484 | 917.740 | RB |
| 1133 | 8856.522 | 9099.401 | 924.380 | RB |
| 1134 | 8875.311 | 9116.557 | 917.507 | RB |
| 1135 | 8860.530 | 9092.900 | 927.240 | RB |
| 1136 | 8859.574 | 9090.297 | 927.937 | RB |
| 1137 | 8860.283 | 9089.626 | 929.403 | RB |
| 1138 | 8860.715 | 9084.958 | 930.321 | RB |
| 1139 | 8860.747 | 9084.442 | 931.643 | RB |
| 1140 | 8869.876 | 9085.127 | 934.284 | RB |

## Delaware River D24 Soil Moving Summary

CADD Surface Cut/Fill Summary

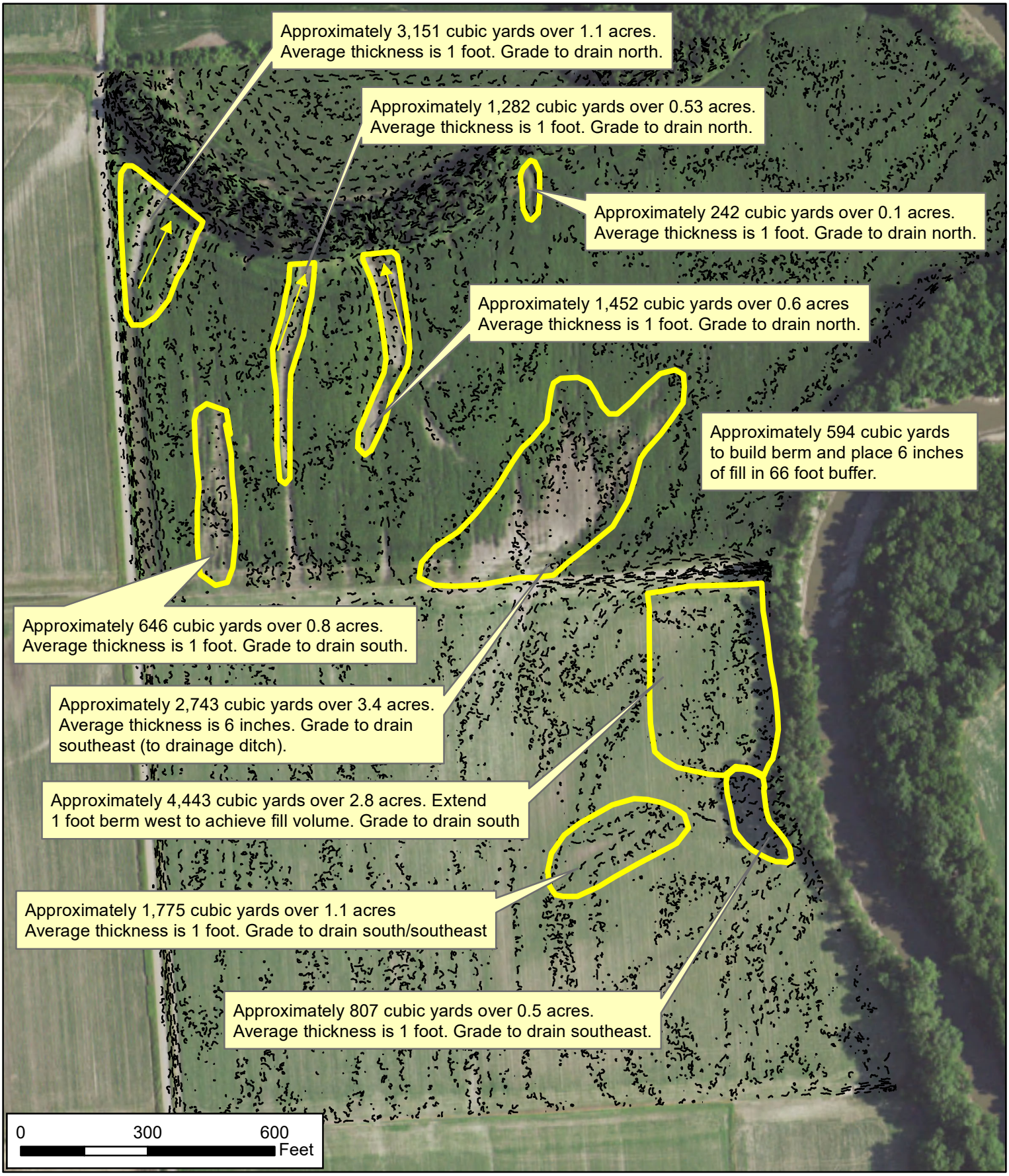
| Volume Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Name** | **Type** | **Cut Factor** | **Fill Factor** | **2d Area** (Sq. Ft.) | **Cut** (Cu. Yd.) | **Fill** (Cu. Yd.) | **Net** (Cu. Yd.) |
| Surface1 | full | 1.00 | 1.00 | 99110.06 | 15210.54 | 558.16 | 14652.38<Cut> |

| Totals | | | | |
|---|---|---|---|---|
| | **2d Area** (Sq. Ft.) | **Cut** (Cu. Yd.) | **Fill** (Cu. Yd.) | **Net** (Cu. Yd.) |
| Total | 99110.06 | 15210.54 | 558.16 | 14652.38<Cut> |

* Value adjusted by cut or fill factor other than 1.0

D24 Soil Moving Summary (cubic yards)

| | |
|---|---|
| CADD streambank soil moving volume | 15,211 |
| LPSTP soil moving volume | 729 |
| Rock Vane Key soil moving Summary | 517 |
| | **16,457** |




THE WATERSHED INSTITUTE

# Soil Placement Map

**Delaware River Site D24**
**Atchison County, Kansas**

N
W E
S

Date: July 2020

Source: http://www.kansasgis.org/

U.S. Army Corps of Engineers (USACE)

# APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

***Form Approved - OMB No. 0710-0003 Expires: 01-08-2018***

The public reporting burden for this collection of information, OMB Control Number 0710-0003, is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or burden reduction suggestions to the Department of Defense, Washington Headquarters Services, at whs.mc-alex.esd.mbx.dd-dod-information-collections@mail.mil. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR APPLICATION TO THE ABOVE EMAIL.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned. System of Record Notice (SORN). The information received is entered into our permit tracking database and a SORN has been completed (SORN #A1145b) and may be accessed at the following website: http://dpcld.defense.gov/Privacy/SORNsIndex/DOD-wide-SORN-Article-View/Article/570115/a1145b-ce.aspx

**(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)**

| 1. APPLICATION NO. | 2. FIELD OFFICE CODE | 3. DATE RECEIVED | 4. DATE APPLICATION COMPLETE |
|---|---|---|---|
| | | | |

***(ITEMS BELOW TO BE FILLED BY APPLICANT)***

| 5. APPLICANT'S NAME | 8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required) |
|---|---|
| First - Robert and Tonya Middle - Last - Hudson | First - Brock Middle - Last - Emmert |
| Company - | Company - Watershed Institute, Inc. |
| E-mail Address - | E-mail Address - brock@watershedinstitute.biz |
| 6. APPLICANT'S ADDRESS: | 9. AGENT'S ADDRESS: |
| Address- 2833 Allen Road | Address- 1200 SW Executive Dr. |
| City - Holton State - KS Zip - 66436 Country - U.S. | City - Topeka State - KS Zip - 66615 Country - U.S. |
| 7. APPLICANT'S PHONE NOs. w/AREA CODE | 10. AGENTS PHONE NOs. w/AREA CODE |
| a. Residence b. Business c. Fax | a. Residence b. Business c. Fax |
| 785-872-3455 | 785-213-3515 |

**STATEMENT OF AUTHORIZATION**

11. I hereby authorize, Brock Emmert to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

SIGNATURE OF APPLICANT DATE

**NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY**

12. PROJECT NAME OR TITLE (see instructions)
Delaware River Site D24

| 13. NAME OF WATERBODY, IF KNOWN (if applicable) | 14. PROJECT STREET ADDRESS (if applicable) |
|---|---|
| Delaware River | Address |
| 15. LOCATION OF PROJECT | City - State- Zip- |
| Latitude: ◦N 39.4743638 Longitude: ◦W 95.5474472 | |

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - 5 Township - 7S Range - 17E

17. DIRECTIONS TO THE SITE

From the intersection of Highway 116 and Anderson Rd in Arrington, KS, travel 1.5 miles north on Anderson Rd. Take the field entrance to the east and travel approximately 1/3 mile east before reaching site location.

18. Nature of Activity (Description of project, include all features)

Streambank stabilization and riparian restoration

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

Streambank stabilization and riparian restoration.

**USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED**

20. Reason(s) for Discharge

Streambank stabilization and restoration.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

| Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards |
|---|---|---|
| 1,462 cubic yards limestone shot rock | 1,764 cubic yards wood toe revetment | |

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres 0.3 acres surface area rock and wood

or

Linear Feet 1,171 linear feet of Delaware River

23. Description of Avoidance, Minimization, and Compensation (see instructions)

The rock and wood structures are designed (based on channel geomorphology)to have minimal negative affect on surrounding aquatic habitats. The design incorporates a bankfull bench to help reduce shear stress along the near bank region. Also, 850 bare root seedings and willow poles will be planted to help provide long-term stabilization.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address-

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

| AGENCY | TYPE APPROVAL* | IDENTIFICATION NUMBER | DATE APPLIED | DATE APPROVED | DATE DENIED |
|---|---|---|---|---|---|
| DWR | Stream Obstruction | | | | |
| KDHE | NOI | | | | |
| | | | | | |
| | | | | | |

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT | DATE | SIGNATURE OF AGENT | DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

U.S. Army Corps of Engineers (USACE)

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|---|---|
| First - Robert and Tonya Middle - Last - Hudson | First - Brock Middle - Last - Emmert |
| Company - | Company - Watershed Institute, Inc. |
| E-mail Address - | E-mail Address - brock@watershedinstitute.biz |
| 6. APPLICANT'S ADDRESS: | 9. AGENT'S ADDRESS: |
| Address- 2833 Allen Road | Address- 1200 SW Executive Dr. |
| City - Holton State - KS Zip - 66436 Country - U.S. | City - Topeka State - KS Zip - 66615 Country - U.S. |
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| a. Residence b. Business c. Fax | a. Residence b. Business c. Fax |
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12. PROJECT NAME OR TITLE (see instructions)
Delaware River Site D24

| 13. NAME OF WATERBODY, IF KNOWN (if applicable) | 14. PROJECT STREET ADDRESS (if applicable) |
|---|---|
| Delaware River | Address |
| 15. LOCATION OF PROJECT | City - State- Zip- |
| Latitude: ◦N 39.4743638 Longitude: ◦W 95.5474472 | |

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - 5 Township - 7S Range - 17E

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| Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards |
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or

Linear Feet 1,171 linear feet of Delaware River

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24. Is Any Portion of the Work Already Complete? ☐ Yes ☐ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address-

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

| AGENCY | TYPE APPROVAL* | IDENTIFICATION NUMBER | DATE APPLIED | DATE APPROVED | DATE DENIED |
|---|---|---|---|---|---|
| DWR | Stream Obstruction | | | | |
| KDHE | NOI | | | | |
| | | | | | |
| | | | | | |

* Would include but is not restricted to zoning, building, and flood plain permits

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# Application for Permit

K.S.A. 82a-301-305a Dams, Stream Obstructions and Channel Changes
K.S.A. 24-126 Levees and Floodplain Fills

Use this form to apply for a Division of Water Resources permit to construct or modify a dam, stream obstruction, channel change, levee or floodplain fill. Refer to K.A.R. 5-40 through 5-46 for requirements and definitions.
Send the completed application, worksheet (if applicable), required fees and plans and other materials listed in K.A.R. 5-40-1 through 5-43-5 or K.A.R 5-45-1 through 5-45-18 to:

**Kansas Department of Agriculture**
**Division of Water Resources – Water Structures**
**1320 Research Park Drive**
**Manhattan, KS 66502**

| **Land Owner Information** | |
|---|---|
| Owner Name: Robert and Tonya Hudson / Judith Moore Trust | Contact name: |
| Mailing Address: 2833 Allen Road / 5826 Lee Way | |
| City/State: Holton, KS / Milford, OH | Zip Code: 66436 / 45150 |
| Telephone: 785-872-3455 / | Email **(required):** |
| Is the project or activity located entirely on property owned by the permit applicant? ■ Yes ☐ No<br>If no, attach a document listing the names and mailing addresses for all landowners located within the project. | |
| **Applicant Information (if different than owner)** | |
| Applicant Name: | Title: |
| Mailing Address: | |
| City/State: | Zip Code: |
| Telephone: | Email **(required):** |
| **Designer Information** | |
| Firm/Agency: Watershed Institute, Inc. | |
| Contact Name: Brock Emmert | Title: Project Manager |
| Mailing Address: 1200 SW Executive Dr. | |
| City/State: Topeka, KS | Zip Code: 66615 |
| Telephone: 785-213-3515 | Email **(required):** brock@watershedinstitute.biz |
| **Project Location and Description** | |
| County: Atchison | Stream Name: Delaware |
| Legal: NW Qtr of the Qtr of the Qtr | Section: 5 Township(S): 7 Range(E/W): 17E |
| Project or site name: Delaware River Site D24 | |
| Project description and purpose: | |
| Streambank stabilization and riparian restoration | |
| | |
| Drainage area above the project: acres | 576.4 square miles |
| Area of disturbance (trees and/or vegetation) 3.4 acres | square miles |

| **For office use only** | WSN: | | ECA: | |
|---|---|---|---|---|
| Code | Fee $ | TR# | Rcpt Date | Check # |

| **Schedule** | | |
|---|---|---|
| Planned or actual **start** date (start of construction, clearing, excavation or fill) | Fall 2020 | |
| Planned or actual **completion** date (end of construction, stabilization of site) | Fall/Winter 2020 | |
| Construction, excavation and fill will be halted and the Kansas State Historical Society will be contacted when historical sites or artifacts are encountered. | ■ Yes ☐ No | |
| **Project Activities and Fee Determination** | | |
| Project Activity (check all that apply) | Permit Fee | |
| ☐ Construct, modify or repair a dam | $200 | |
| ☐ Construct, modify or repair a stream obstruction | | |
| ☐ Construct or repair a channel change | | |
| ■ Excavate or dredge within the banklines of a stream | | |
| Drainage area ≤ 5 square miles ☐ | $100 | |
| Drainage area between 5 and 50 square miles ☐ | $200 | |
| Drainage area ≥ 50 square miles ■ | $500 | |
| | Pre-construction | Post-construction |
| ☐ Construct, modify or repair a class A levee (see K.A.R. 5-45-8 for definition) | $100 | $200 |
| ☐ Construct, modify or repair a class B levee | $300 | $600 |
| ☐ Construct, modify or repair a class C levee | $500 | $1,000 |
| ☐ Place fill in a mapped floodway fringe (Zone AE with defined floodway) | $100 | $200 |
| ☐ Place fill in a mapped floodplain with no defined floodway (e.g. Zone A, AE, AH, AO) | $300 | $600 |
| ☐ Place fill in an unmapped floodplain (see K.A.R. 5-45-1(i)) | $300 | $600 |
| ☐ Place fill in a mapped floodway (Zone AE floodway) | $500 | $1,000 |
| ☐ This project qualifies for a General Permit (attach worksheet DWR 2-190) (pipeline/cable crossing, or bridge/culvert replacement) | $100 | |
| The total permit fee required will be the general permit fee if applicable, OR the highest individual fee for the project activities checked above.<br>Make checks payable to **Kansas Department of Agriculture** | Amount enclosed: | |

| **Signature** | |
|---|---|
| Application is hereby made for written consent or permit of the Chief Engineer, Division of Water Resources, for the project described above. By signing below, I certify that the information contained in this application is true, correct and complete, and that I am the owner or I am authorized by the owner to make this application for permit. | |
| Signature: | Name (print or type):<br>Date: |

NOTICE OF INTENT (NOI)

For Authorization to Discharge Stormwater Runoff from Construction Activities
In accordance with the Kansas Water Pollution Control General Permit
Under the National Pollutant Discharge Elimination System (NPDES)

Submission of this Notice of Intent constitutes notice that the party identified in Section I of this form requests authorization for coverage under the Kansas Water Pollution Control general permit, or KDHE issued successor permits, issued for stormwater runoff from construction activities in the State of Kansas. Becoming a permittee obligates the discharger to comply with the terms and conditions of the general permit. **Completion of this NOI does not provide automatic coverage under the general permit. Coverage is provided and discharge permitted when the Kansas Department of Health and Environment (KDHE) authorizes the discharge of stormwater runoff from the construction activities identified on the NOI and supporting documentation. A signed and dated copy of the first page of the NOI indicating the Authorization will be provided to the owner or operator, or all three pages for Conditional Authorizations.** Upon authorization of the construction activity discharge, a Kansas permit number and a Federal permit number will be assigned to the construction project. **A complete request for Authorization for coverage under the general permit must be submitted or the request will not be processed (see listing on Page 3 of this NOI).** KDHE will notify owners or operators whose Notice of Intent (NOI) and supporting documentation for Authorization of stormwater runoff associated with construction activities are incomplete, deficient, or denied.
**Please Print or Type**.

## I. OWNER OR OPERATOR ADDRESS, BILLING, CONTACT & RECORDS LOCATION INFORMATION

**A.** Owner or Operator's Name: Robert and Tonya Hudson / Judith Moore Trust
Company Name: _____
Owner or Operator's Phone: 785-872-3455 /
Mailing Address: 2833 Allen Road / 5826 Lee Way
City: Holton / Milford State: KS / OH Zip: 66436 / 45150

**B.** Billing Contact Name: _____
Billing Contact Address (if different): _____
City: _____ State: ____ Zip: _____

**C.** Contact Name: Brock Emmert
Company Name: Watershed Institute, Inc.
Contact Phone: 785-213-3515
Mailing Address: _____
City: Topeka State: KS Zip: 66615
E-mail Address (optional): brock@watershedinstitu

**D.** Address where records will be kept (if not on-site):
Records Address: 1200 SW Executive Dr.
City: Topeka State: KS Zip: 66615

## II. SITE INFORMATION

**A.** Project Name: Delaware River Site D24
Site Address: _____
City: Holton State: KS Zip: 66436
(Nearest City to Project)
County: Atchison

**B.** LEGAL SITE DESCRIPTION:
_____ QTR of _____ QTR of NW QTR Section: 5
Township: 7 South; Range: 17E ■ E ☐ W
Latitude: 39 28 27.71, Longitude: -95 32 50.81
Deg. Min. Sec. Deg. Min. Sec.

**For Official Use Only:**

| | | |
|---|---|---|
| Received | Amount Paid: | Authorized: ☐ Y; ☐ N |
| | Date: | Is Authorization Conditional? ☐ Y; ☐ N (if yes, see page 3 of NOI for conditions) |
| | Initials: | |
| | Check No.: | |
| Secretary, Kansas Department of Health and Environment | | Reviewer<br>Date |

KS Permit No.: _____ Federal Permit No.: _____

**Send completed 3 page NOI form with original signature and all appropriate submittals (see page 3 of NOI) to:**

Kansas Department of Health and Environment
Bureau of Water, Industrial Programs Section
1000 SW Jackson, Suite 420
Topeka, KS 66612-1367

Note: A copy of the permit can be obtained at: www.kdheks.gov/stormwater or by submitting a written request to KDHE.

**KDHE Contact Information:**
Phone: (785) 296-5545
E-mail: stormwater@kdheks.gov

**C. EXISTING CONDITIONS/USES**

1) Is any part of the project located on Indian Country land? ☐ Y; ■ N
**If yes**: Contact EPA regarding discharging stormwater runoff from industrial activities on Indian Country land.

2) If stormwater runoff drains to or through a Municipal Separate Storm Sewer System (MS4): MS4 Name: _____

3) Name of the first receiving water, stream, or lake: Delaware River, River Basin: Delaware

4) Are contaminated soils present on the site or is there groundwater contamination located within the site boundary? ☐ Y; ■ N
**If yes:** On separate paper please explain in detail the locations, contaminants and concentrations.

5) Are there any contaminated soils that will be disturbed or any contaminated groundwater that will be pumped by the proposed construction activity? ☐ Y; ■ N
**If yes:** On separate paper provide a description of the special erosion and sediment control measures to be utilized.

6) Are there any surface water intakes for public drinking water supplies located within ½ mile of the site discharge points? ☐ Y; ■ N

7) Are there any known historical or archeological sites present within the site boundary or any historic structures located within 1000 feet of the project site? ☐ Y; ■ N
**Note:** Include documentation of project-specific coordination with the Kansas Historical Society in making this determination.

8) Is any threatened or endangered species habitat located within the site boundary or in the receiving water body? ☐ Y; ■ N
**Note**: Include documentation of project-specific coordination with the Kansas Department of Wildlife, Parks & Tourism in making this determination.

9) Will the project impact the line or grade of a stream or does it include dredge or fill of a potential jurisdictional water body or wetlands? ■ Y; ☐ N
**If yes:** Include documentation of project-specific coordination with the US Army Corps of Engineers and/or the Kansas Department of Agriculture, Division of Water Resources in making this determination.

10) Are any Critical Water Quality Management Areas, Special Aquatic Life Use Waters, or Outstanding National Resource Waters located within ½ mile of the facility boundary? ☐ Y; ■ N

**If yes,** list the names of all such areas and waters: _____

**D. PROJECT DESCRIPTION**

1) Project Description: Streambank stabilization and riparian restoration along 1,171-feet of Delaware River.

2) Does this NOI include all proposed soil disturbing activities associated with the entire common plan of development? ■ Y; ☐ N

**If no,** explain what development areas of the site are not included in this NOI and provide contact information, if available, for the party or parties that own or have operational control of these areas:

_____

_____

3) Anticipated project Start Date: Fall 2020, and Completion Date: Fall/Winter 2020

4) Estimated total area to be disturbed: 3.4 Acres Total area of the site: 3.4 Acres

5) Do you plan to disturb ten or more acres that are within a common drainage area? ☐ Y; ■ N

**If yes,** will a sedimentation basin be installed in that drainage area? (Attach design calculations for each sedimentation basin.) If a sediment basin is not feasible, on a separate sheet explain what similarly effective erosion and sediment control measures will be implemented in lieu of a sedimentation basin. ☐ Y; ☐ N

**E. Maps**

Include an area map showing the outline of the construction site and the general topographic features of the area at least one mile beyond the project site boundary.

**F. EROSION CONTROL PLAN AND BEST MANAGEMENT PRACTICES**

1) Provide a site plan showing the existing contour, proposed contour, the erosion control measures and the locations of stormwater management or pollution control features including BMPs. Incorporate details and notes as necessary to describe the erosion control plans and BMPs.

2) Provide a description of the best management practices which will be utilized to control erosion, sedimentation and other pollutants in stormwater runoff during construction.

3) Provide a summary of the sequence of major soil disturbing activities and the corresponding erosion control measures or BMPs.

4) Provide the name and License or Certification Number of the engineer, geologist, architect, landscape architect, or Certified Professional in Erosion and Sediment Control (CPESC) under which the construction stormwater pollution prevention plan has been developed.

| John Browning | 10599 | Engineer |
|---|---|---|
| Name | License or Certification Number | Profession or Field (Engineer, Architect, etc.) |

**III. ANNUAL FEE**

**Enclose a check for the first year of the annual permit fee specified in K.A.R. 28-16-56 et seq. as amended. Make the check payable to "KDHE". Per K.A.R. 28-16-56, as amended, the current annual permit fee for this general permit is $60.** An invoice for the annual permit fee will be sent to the contact person requesting a permit until such time as the permittee submits a Notice of Termination (NOT).

Failure to pay the annual fee will result in termination of the construction stormwater discharge Authorization.

**IV. OWNER OR OPERATOR CERTIFICATIONS**

I, the undersigned, certify that a Stormwater Pollution Prevention Plan (SWP2 Plan) will be or has been developed for the construction site described in this NOI and supporting documentation. I further certify that the plan will be implemented at the time construction begins, and, as required by the NPDES general permit for Stormwater Runoff from Construction Activity, will revise the SWP2 plan if necessary.

I understand that continued coverage under the NPDES general permit for Stormwater Runoff from Construction Activities is contingent upon maintaining eligibility as provided for in the requirements and conditions of the general permit, and paying the annual fee.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

_____ _____

**Signature (owner or operator)** **Date**

_____

Name and Official Title (Please print or type. **Form with original signature must be sent to KDHE.**)

**Conditions of Authorization - For Official Use Only:**

When indicated, Conditions of Authorization are as follows:

_____

_____

_____

_____

_____

_____

_____

**A complete request for Authorization for coverage under the general permit must be submitted or the request will not be processed. A complete request for Authorization includes:**

- **An NOI form (construction stormwater) with an original authorized signature;**
- **The annual permit fee for the first year; ($60.)**
- **An area map showing the outline of the construction site and the general topographic features of the area at least one mile beyond the project site boundary;**
- **A detailed site plan showing the existing contours, proposed contours, erosion and sediment control features, locations where stormwater runoff leaves the construction site;**
- **A narrative summary of the additional erosion and sediment control and other best management practices that will be utilized to prevent or reduce contamination of stormwater runoff from the construction activities;**
- **Total drainage area, storage capacity and design calculations for each sedimentation basin; and**
- **Copies of letters or e-mails documenting coordination with appropriate local, state or federal agencies.**

# DELEWARE RIVER D24
# STREAMBANK STABILIZATION PROJECT

**STORM WATER POLLUTION PREVENTION PLAN FOR**
**STORM WATER DISCHARGES ASSOCIATED WITH**
**CONSTRUCTION ACTIVITY**

**January 2020**

## Certification Statement

"I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signed: _____
Brock Emmert, Project Manager
Watershed Institute, Inc.

Date: _____

# RECORD OF PLAN AMENDMENTS

| Amendment Number | Amendment Date | Authorized By/Title | Description |
|---|---|---|---|
| | | | |

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## 1.0 Purpose of Plan

The purpose of this Storm Water Pollution Prevention Plan (Plan) is to demonstrate compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) in consideration for issuance of a General Permit for storm water discharges associated with construction activity. The General Permit requires the preparation and implementation of such a plan to prevent, as much as practicable, the release of pollutants in storm water runoff from the construction site to waters of the United States.

This Plan provides information concerning the Delaware River D24 Streambank Stabilization Project. Stabilization activities include streambank reshaping, construction of rock vanes, longitudinal peaked stone toe protection (LPSTP), pipe letdown, rock blanket, and wood toe revetment, and riparian buffer restoration along the Delaware River. Administrative requirements and potential storm water and non-storm water pollutant sources are identified. Best management practices to prevent the discharge of non-storm water materials in storm water runoff are also described.

The project site is 1,171 feet long, along an outside meander bend of the Delaware River, Atchison County, Kansas. Located in the NW ¼ of Section 5, T7S, R17E and all activity is confined to the right descending bank. The adjacent land use is row crop agriculture.

## 2.0 Site Evaluation

The following sections describe existing conditions at the site.

### Topography and Drainage

The project site is a 24.5-foot high streambank along the right descending bank of the Delaware River. Storm drainage is difficult to define throughout most of the project area due to the flat topography of the Delaware River floodplain. Most of this runoff is captured before the project site and little to no overland flow reaches the streambank.

### Soils

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) web soil survey map (NRCS 2020) identifies soils within the proposed construction limits as Kennebec silt loam, occasionally flooded. Kennebec silt loam, occasionally flooded soils are typically found on floodplain terraces and consist of well drained alluvium.

### Climate

The climate of Atchison County is sub-humid with an average rainfall of 36.8-inches, conditions typical of the Glaciated ecoregion (Chapman e al. 2000). Climate patterns are characterized by wide daily and annual temperature ranges. Precipitation is heaviest in the spring and early summer with approximately 70% of the annual rainfall occurring during the growing season. The prevailing winds are southerly.

### Hydrology

The project lies within hydrologic unit 10270103 – the Delaware Basin. The Delaware River enters the project site from the east and bends towards the south creating excessive erosion on the right streambank. About 35- acres drain to the project by way of a gully channel.

### Sediments

At the project site, sediments are contributed to the Delaware River from streambank erosion.

## 3.0 Site Construction Plan

The following sections describe the proposed site construction plan.

### Construction Activities

The proposed project will stabilize the right descending bank to reduce streambank sedimentation of the Delaware River. Streambank grading will require earthwork to provide stabilization. Soil disturbing activities will include grubbing, rough grading, bank shaping, filling, and final grading. After construction, the contractor will seed a cover crop and grass mix at critical area seeding rates. Native grass seeding and mulching will also be done during recommended seeding dates. For slopes greater than 2.5:1, turf reinforced matting (TRM) or hydro-mulching will be used for extra erosion control following construction. There will be two rows of sycamore planted on the slope. The stock will be bare root seedlings and planted the first spring following construction. Tree planting will also follow design guidelines. Long-term protection will accrue through re-vegetation of the streambank with native trees. There are no off-site borrow or stockpile areas needed for this project. A record of the site construction activities, to be maintained as part of this Plan, is provided in Appendix A.

## 4.0 Storm Water Management Plan

This storm water management system was designed following EPA guidelines. Control of site runoff will be the main means of storm water management. Storm water controls will be installed prior to construction.

### General Description of Storm Water Management System

The potential for storm water runoff pollution will be present during project construction. This risk will be minimized through the use of several control measures implemented during the construction sequence.

The storm water management system was designed in accordance with the EPA's guidance document entitled *Storm Water Management for Construction Activities - Developing Pollution Prevention Plans And Best Management Practices* (EPA 832-R-92-005, September 1992). Detention is the main means of storm water management. **It will be the responsibility of the Construction Manager to revise the Erosion and Sediment Control plan sheets, if the location or types of control measures indicated are changed in the field. These documents will supersede the figures shown in this plan.**

**Peak Flows**

This project will not impact peak flows for existing and future developed conditions for the watershed. All facilities will convey the future developed condition flows.

**Stabilization Practices**

Temporary and permanent stabilization methods will be used within the project area. Major practices include preserving existing vegetation where possible and disturbing only the area needed to reshape streambanks. Disturbed portions will be stabilized within 14 days after construction activity has temporarily or permanently ceased. For steep slope areas (greater than 2.5:1 slope), disturbed portions will be stabilized within 7 days after construction activity has temporarily or permanently ceased. Stabilization practices include temporary seeding and mulching, hydro seeding and mulching, permanent vegetation—native trees and shrubs—and rock structures to redirect erosive flow.

## 5.0 Potential Storm Water Pollutant Sources and Control Measures

Pollutants from various sources have the potential to enter the Cottonwood River during project construction. A description of these potential pollutants and control measures to reduce the risk of storm water contamination is provided below.

**Construction Dust**

Fugitive dust may be generated during dry weather conditions. Dust control will be directed by the Construction Manager and implemented by the Contractor. Water sprays will be used for dust control.

**Offsite Sediment Tracking**

Access to the project area is by county gravel roads and a dirt private road. Additionally, the project lies in an area dominated by agricultural land use where offsite tracking of mud, dirt, and rock commonly occurs. As the project will be constructed during dry periods, offsite sediment tracking will not increase over current levels.

**Petroleum Products**

Construction equipment will require diesel fuel and oil on a regular basis. The potential exists for spills or leaks. All onsite vehicles will be monitored for leaks and receive regular preventative maintenance to ensure proper operation and reduce the chance of leaks. No "topping off" of gas tanks will be allowed to reduce the possibility of spills. Vehicle refueling and maintenance will occur in a designated, contained area.

Petroleum products will be stored in clearly labeled and tightly sealed containers or tanks. Any soil contaminated by fuel or oil spills will be removed and disposed of by the Contractor to an approved disposal site.

**Sanitary Wastes**

Due to the short time frame for construction, sanitary wastes will not be generated.

**Hazardous Materials**

No hazardous materials will be used or stored onsite.

**Fertilizers**

No fertilizers will be used or stored onsite.

**Paints**

No paints will be used or stored onsite.

**Waste Materials**

All trash and construction waste material will be collected and transferred to an appropriate solid waste storage facility. No construction waste will be buried onsite. No open burning will be allowed. All site personnel will be instructed by the Construction Manager of the proper waste disposal procedures.

**Allowable Non-Storm Water Discharges**

The following sources of non-storm water discharges may be combined with storm water discharges from project construction activities.

- Waters used to wash vehicles or to control dust
- Uncontaminated dewatering discharges
- Firefighting waters
- Vegetation watering
- Potable or spring water discharges

## 6.0 Best Management Practices

Petroleum products and other materials will be used and stored at the construction site. Best Management Practices, such as good housekeeping measures, inspections, containment, and spill prevention practices will be used to limit contact between storm water and potential pollutants.

**Good Housekeeping**

The good housekeeping practices listed below will be followed to reduce the risk of potential pollutants entering storm water discharges. All construction personnel will be responsible for monitoring and maintaining housekeeping tasks or notifying the appropriate person of a problem.

- Store only enough product required to do the job
- Store all materials in a neat and orderly manner in the appropriate containers and, if possible, under a roof or within an enclosure
- Keep products in the original container with the original manufacturer's label
- Do not mix products unless recommended by the manufacturer.

- Use all of a product before disposing of the container
- Use and dispose of products according to the Construction Manager's direction or manufacturer's recommendations
- Perform regular inspections of the storm water system and the material storage areas
- When and where appropriate, use posters, bulletin boards, or meetings to remind and inform construction personnel of required procedures.

**Hazardous Products**

Storage areas for fuels must be provided with secondary containment to ensure that spills in these areas do not reach wetlands or waters of the State. Contingencies for the proper disposal of contaminated soils shall be established (use of licensed hauler, approved landfill) early in the construction period.

**Spill Prevention and Response**

In addition to the housekeeping and hazardous materials storage procedures described above, spill prevention and cleanup practices will be as follows.

- Construction personnel will be informed of the manufacturer's recommended spill cleanup methods, and the location of that information and cleanup supplies.
- Materials and equipment for the cleanup of small spills (<100 gal) will be kept in the materials storage area. These facilities may include brooms, rags, gloves, shovels, goggles, sand, sawdust, plastic or metal trash containers, and protective clothing.
- All containers will be labeled, tightly sealed, and stacked or stored neatly and securely.

Spill response procedures will be as follows.

Step 1: Upon discovery of a spill; stop the source of the spill, if safe.
Step 2: Cease all spill material transfer until the release is stopped and waste removed from the spill site.
Step 3: Initiate containment to prevent spill from reaching State waters.
Step 4: Notify a Supervisor or the Construction Manager of the spill.
Step 5: The Construction Manager will coordinate further cleanup activities.
Step 6: Any significant spill of toxic or hazardous material will be reported to the appropriate state and/or local agencies at the following numbers:

| | |
|---|---|
| National Response Center | 1-800-424-8802 |
| State Contacts: | |
| KDHE | 785-296-1679 (Days) |
| | 785-296-0614 (Nights/Weekends) |
| Adjutant General | 785-296-3176 |
| Local Contacts: | |
| Atchison County Emergency Management | 913-273-6976 |
| Police or Fire Departments | 911 |

Step 7: Review the storm water pollution prevention plan and amend if needed. Record a description of the spill, cause, and cleanup measures taken.

## 8.0 Inspection, Maintenance and Record Keeping Procedures

Site inspection and facility maintenance are important features of an effective storm water management system. Qualified personnel will inspect disturbed areas of the site not finally stabilized, storage areas exposed to precipitation, all control measures, and site access areas to determine if the control measures and storm water management system is effective in preventing significant impacts to receiving waters.

**Erosion and Sediment Controls**

The following procedures will be used to maintain erosion and sedimentation controls.

- All control measures will be inspected at least once a week and after any storm event of ½-inch or more.
- All measures will be maintained in good working order; if a repair is necessary, that repair will be initiated within 24-hours of the report.
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.
- Inspect riprap and aggregate covered areas for bare spots and washouts.
- The Construction Manager will select individuals to be responsible for inspections, maintenance, repairs, and reporting. The designated inspectors will receive the necessary training from the Construction Manager to properly inspect and maintain the controls in good working order.
- An Inspection Form (Form 1) will be completed after each inspection.
- The completed Inspection Forms will be kept with this Plan in Appendix B.

**Non-Storm Water Controls**

The following procedures will be used to maintain the non-storm water controls.

- All control measures will be inspected at least once a week and after any storm event of ½-inch or more.
- All measures will be maintained in good working order; if a repair is necessary, that repair will be initiated within 24-hours of the report.
- The Construction Manager will select individuals to be responsible for inspections, maintenance, repairs, and reporting. The designated inspectors will receive the necessary training from the Construction Manager to properly inspect and maintain the controls in good working order.
- An Inspection Form (Form 2) will be completed after each inspection.
- The completed Inspection Forms will be kept with this Plan in Appendix B.

**Record Keeping**

Two inspection forms are provided on the following pages for recording inspections and maintenance of the control measures: Erosion and Sedimentation Controls (Form 1), and Non-Storm Water Source Controls (Form 2). All disturbed areas and materials storage areas require inspection at least every 7 days and within 24-hours of a ½-inch or more rainfall. After each inspection, the inspector completes an inspection report and inserts that report in Appendix C of this Plan. Any maintenance required is initiated within 24 hours of the inspection.

A fully signed copy of this Plan and any supporting materials must be maintained at the construction site from the date of project initiation to the date of final stabilization. All records and supporting documents will be compiled in an orderly manner and maintained for a period of three years following final site stabilization.

The generation of reports, as part of the construction process and inspection or amendment procedures, provides accurate records, which can be used to evaluate the effectiveness of this Plan and document compliance. Changes in design or construction of the storm water management system are documented and included with the Plan to facilitate Plan review or evaluation. Four forms have been developed to assist the Construction Manager with record keeping activities.

- Record of Plan Amendments
- Construction Activity Record
- Erosion and Sedimentation Controls Inspection Form
- Non-Storm Water Source Controls Inspection Form

Plan amendments are documented on the form in the front of this Plan and on the drawings. A record of construction activities is maintained in Appendix A of this Plan. Completed inspection and maintenance forms are kept in Appendix B of this Plan.

# INSPECTION FORM 1
# EROSION AND SEDIMENTATION CONTROLS

Visually inspect disturbed areas of the construction site that have not been finally stabilized. Inspections are to be completed every 7 days and within 24-hours of a rainfall event of ½-inch or more. Maintenance is to be performed within 24-hours of inspection.

Inspector:

Inspection Date:

Date of last rainfall:

Amount of last rainfall: inches

Report on the condition of the erosion and sedimentation controls installed at the construction site. Check for tears in silt barriers, for securely attached fabric to fence posts, and for depth of sediment in front of the silt barriers. The depth of sediment should not exceed one-third of the barrier height. Seeding/planting areas and rip-rap/aggregate areas should be inspected for bare spots and washouts.

| Area | Condition of Control | Maintenance Required/Completion Date |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Inspector Signature: _____

# INSPECTION FORM 2
# NON-STORM WATER SOURCE CONTROLS

Visually inspect material storage and construction areas. Inspections are to be completed every 7 days and within 24 hours of a rainfall event of 1/2 inch or more. Maintenance is to be performed within 24 hours of inspection.

Inspector: Inspection Date:

Date of last rainfall:

Amount of last rainfall: _____inches

Construction Dust - Is there excessive dust at the site that requires watering?

Sediment Tracking - Are the County roads mostly free from mud, dirt, or rock?

Petroleum/Chemical Products - Are spill containment structures secured? Product containers securely sealed?

Construction Waste - Are all construction waste materials collected and secured?

Material Storage Areas Exposed to Precipitation - Are materials handled and stored in a manner to prevent leakage and prevent pollutants from entering the storm water system?

Other Non-Storm Water Discharges - Are waters from line flushing, pavement wash down, and dewatering directed to the storm water system prior to discharge?

Maintenance Required Maintenance Completed Date

Inspector Signature: _____

## Certification of Compliance

This Storm Water Pollution Prevention Plan reflects best management practices and erosion and sedimentation control measures for storm water management as recommended by the Environmental Protection Agency.

**Contractor Certifications**

The Contractor Certification forms provided in this section indicate that each contractor working on the project site understands the terms, conditions, and intent of this NPDES General Permit for Storm Water Discharges Associated with Construction Activity and will implement the measures described in this Plan appropriate to his area of work.

# CONTRACTOR/SUBCONTRACTOR CERTIFICATION

I certify, under penalty of law, that I understand the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) General Permit that authorizes storm water discharges associated with construction activity from the site identified as part of this certification.

_____ Date

_____ Name/Title

_____ Firm

_____ Address

_____ Phone

_____ Nature of Contracted Service

_____ Construction Area(s)

## Project Completion

Construction is considered complete when the site is 70-percent (density) stabilized. The NPDES may be terminated at this time. A Notice of Termination should be submitted to KDHE requesting termination of the General Permit. The Notice of Termination form is included in this section.

## References

Chapman, S.S, J.M. Omernik, J.A. Freeouf, D.G. Huggins, J.R. McCauley, C.C. Freeman, G. Steinauer, R. Angelo, and R.L. Schlepp. 2000. Ecoregions of Nebraska and Kansas (color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey (USGS). Reston, Virginia.

U.S. Department of Agriculture Natural Resource Conservation Service (USDA NRCS) 2020. Websoil survey. Accessed on-line at: http://websoilsurvey.nrcs.usda.gov/app/. August.

U.S. Environmental Protection Agency. 1992. Storm Water Management for Construction Activities - Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005). September.

# APPENDIX A

# CONSTRUCTION ACTIVITY RECORD

# CONSTRUCTION ACTIVITY RECORD

An accurate and up-to-date record of construction activity must be maintained as a part of this Plan. Record the information below on an ongoing basis.

- Dates when major soil disturbing activities occur.
- Dates when construction activities temporarily cease on a portion of the site.
- Dates when construction activities permanently cease on a portion of the site.
- Dates when stabilization measures are initiated.

| Date | Activity |
| --- | --- |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

# APPENDIX B

# COMPLETED INSPECTION FORMS