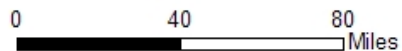


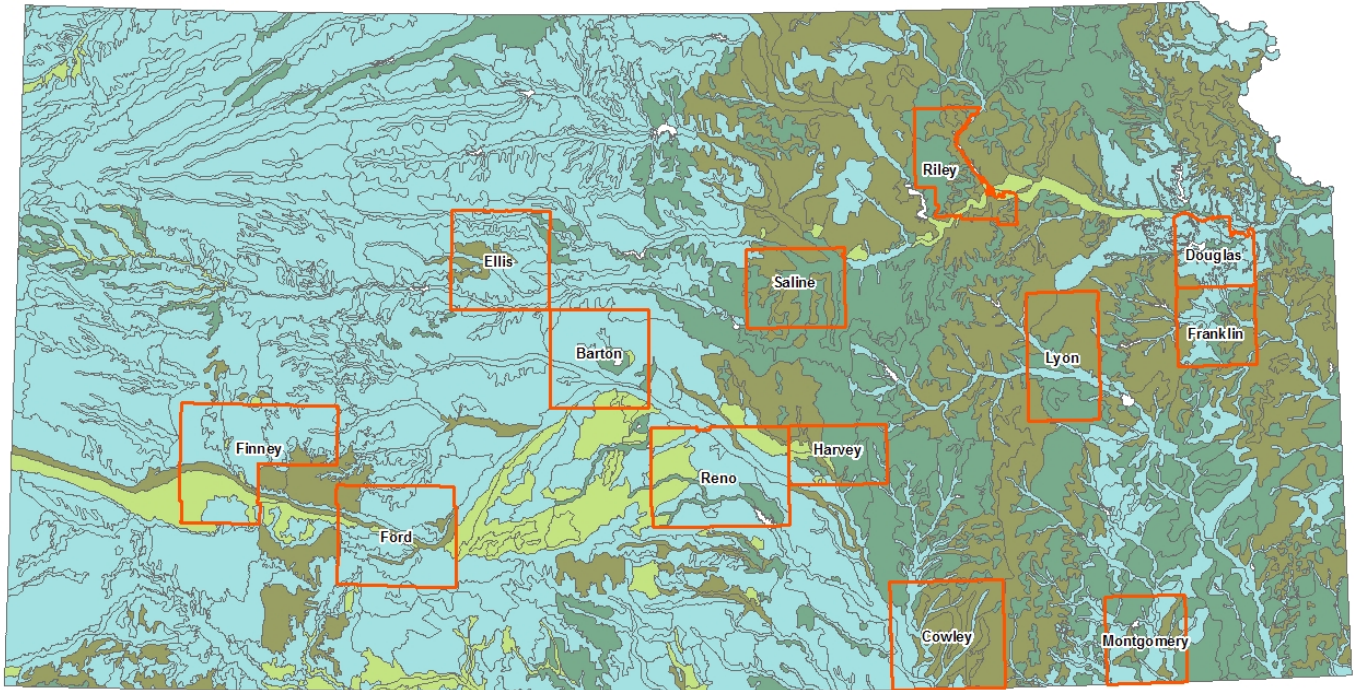
**Soil Texture**



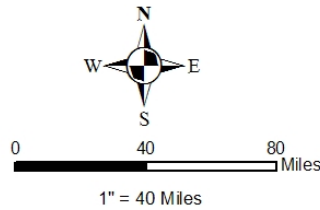
1" = 40 Miles

- |   |   |   |                |
|---|---|---|----------------|
|  | Study County                            |  | fine-silty     |
|  | clayey                                  |  | loamy          |
|  | coarse-loamy                            |  | loamy-skeletal |
|  | coarse-silty                            |  | not used       |
|  | fine                                    |  | sandy          |
|  | fine-loamy                              |  | very-fine      |
|  | fine-loamy over sandy or sandy-skeletal |   |                |





**Soil Types**



**Hydrologic Group**

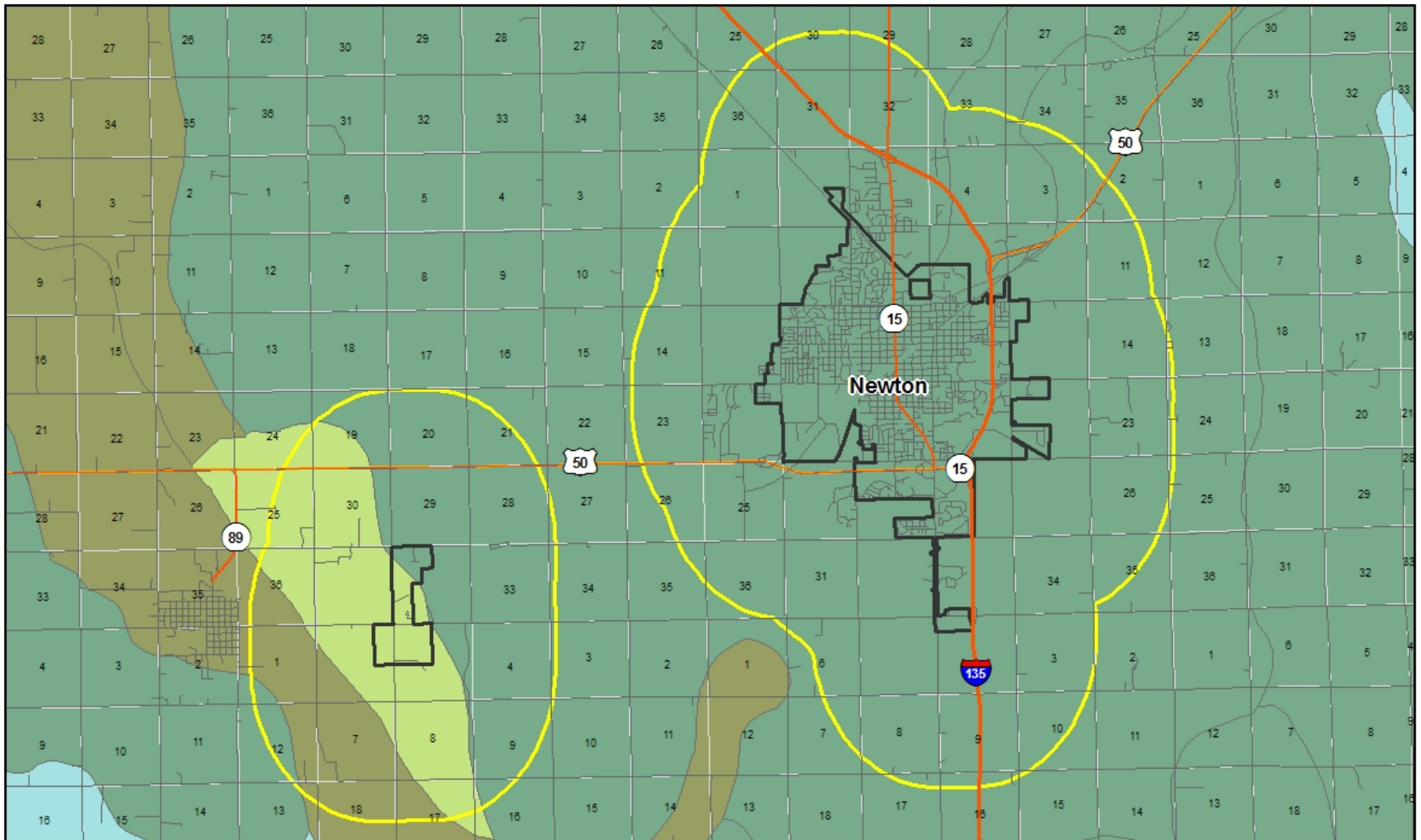


Study County

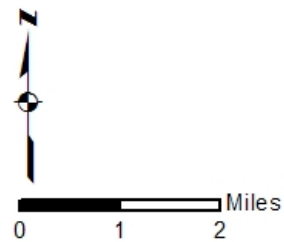


Soil Group	Description	Infiltration Rate (in hr <sup>-1</sup> )
A	Deep sands with very little silt and clay, also deep rapidly permeable loess	0.3-0.5
B	Mostly sand soils less deep than A, and loess less deep or less aggregated than A, but the group as a whole has high infiltration rate after wetting	0.16-0.3
C	Shallow soils and soils containing considerable clay and colloids, though less than those of group D. The group has a below-average infiltration after presaturation	0.04-0.16
D	Mostly clays of high swelling potential, but the group also includes some shallow soils with nearly impermeable subhorizons near the surface	0-0.04

Source: SCS (1972)



**Soil Types**  
Newton



**Hydrologic Group**

- A
- B
- C
- D

- Study City
- 2 Mile Buffer
- Sections
- Water Body
- Highways
- Roads

2. Before redistribution of the material removed under paragraph C and D of this section the regraded land shall be scarified to reduce potential slippage of the redistributed material and to promote root penetration. Such treatment may be conducted after the material is replaced if no harm will be caused to the redistributed material and reestablished vegetation.
  3. The Engineer may choose not to require the redistribution of topsoil or topsoil substitutes on the final embankments if it determines that--
    - a. Placement of topsoil or topsoil substitutes on such embankments will result in greater sedimentation than would otherwise occur, or
    - b. Such embankments will be stabilized by other approved means.
- G. Vegetation: Vegetation shall be established on all exposed surfaces. Plantings shall be as shown in the plans and as specified in Section 2314 – Best Management Practice Planting.

**A1-3. BIORETENTION FACILITY:**

- 1.1 Description: Bioretention facilities are small landscaped basins intended to provide water quality management by filtering stormwater runoff before release into stormdrain systems. This work shall consist of installing bioretention facilities as specified in the Contract Documents, including all materials, equipment, labor and services required to perform the work.
- 1.2 Materials:

**Bioretention Soil Mixture.** The Bioretention Soil Mixture (BSM) is a mixture of planting soil, mulch, and sand consisting of the following:

ITEM	COMPOSITION BY VOLUME	REFERENCE
Planting Soil	30%	See below.
Organic Compost	20%	See below.
Sand	50%	ASTM C33 Fine Aggregate

Planting Soil: The USDA textural classification of the Planting Soil for the BSM shall be LOAMY SAND OR SANDY LOAM. The Planting Soil shall be the best available on site material or furnished. Additionally, the Planting Soil shall be tested and meet the following criteria or as approved by the engineer:

ITEM	PERCENT BY WEIGHT	TEST METHOD
Sand (2.0 – 0.050 mm)	50 – 85%	AASHTO T88
Silt (0.050 – 0.002 mm)	0 – 50%	AASHTO T88
Clay (less than 0.002 mm)	2 – 5%	AASHTO T88
Organic Matter	3 – 10%	AASHTO T194

The textural analysis for the Planting Soil shall be as follows:

ASTM E11 SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
2 in.	100
No. 4	90
No. 10	80

At least 45 days prior to the start of construction of bioretention facilities, the Contractor shall submit the source and testing results of the Planting Soil for the BSM to the Engineer for approval. No time extensions will be granted should the proposed Planting Soil fail to meet the minimum requirements stated above. Once a stockpile of the Planting Soil has been sampled, no material shall be added to the stockpile.

*Organic Compost: Compost is a homogeneous and friable mixture of partially decomposed organic matter, with or without soil, resulting from composting, which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase.*

*Compost is deemed acceptable if it meets 2 of the following requirements:*

- *C/N ratio  $\leq$  25;*
- *Oxygen uptake rate  $\leq$  150 mg O<sub>2</sub>/kg volatile solids per hour; and*
- *Compost must not contain more than 1 percent foreign matter. Foreign matter is defined as:*

*“Any matter over a 2 mm dimension that results from human intervention and having organic or inorganic constituents such as metal, glass and synthetic polymers (e.g. plastic and rubber) that may be present in the compost but excluding mineral soils, woody material and rocks.”*

*Foreign matter less than 1 percent by weight must not exceed 12.5 mm in any dimension.*

The Bioretention Soil Mixture (BSM) shall be a uniform mix, free of plant residue, stones, stumps, roots or other similar objects larger than two inches excluding mulch. No other materials or substances shall be mixed or dumped within the bioretention area that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.

The Bioretention Soil Mixture shall be tested and meet the following criteria:

Item	Criteria	Test Method
Corrected pH	5.5 – 7.5	ASTM D4972
Magnesium	Minimum 32 ppm	*
Phosphorus (Phosphate - P <sub>2</sub> O <sub>5</sub> )	not to exceed 60 ppm plant available phosphorus	*
Potassium (K <sub>2</sub> O)	Minimum 78 ppm	*
Soluble Salts	Not to exceed 500 ppm	*

\*

Use authorized soil test procedures.

Should the pH fall outside of the acceptable range, it may be modified with lime (to raise) or ammonium sulfate (to lower). The lime or ammonium sulfate must be mixed uniformly into the BSM prior to use in bioretention facilities.

Should the BSM not meet the minimum requirement for magnesium, it may be modified with magnesium sulfate. Likewise, should the BSM not meet the minimum requirement for potassium, it may be modified with potash. Magnesium sulfate and potash must be mixed uniformly into the BSM prior to use in bioretention facilities.

Planting soil and/or BSM that fails to meet the minimum requirements shall be replaced at the Contractor's expense. Mixing of the corrective additives to the BSM is incidental and shall be at the Contractor's expense.

Mixing of the BSM to a homogeneous consistency shall be done to the satisfaction of the Engineer. Upon approval of all requirements and testing above, the BSM shall be stockpiled, and no material shall be added to the BSM in the stockpile or during transport to the bioretention facility.

**Other materials:**

<b>MATERIAL</b>	<b>SPECIFICATION</b>
No. 57 Aggregate	ASTM D448
No. 7 Aggregate	ASTM D448
4-inch HDPE Plastic Pipe Underdrain	AASHTO M252
Geotextile Fabric	AASHTO M288
Mulch, 2x Shredded Hardwood Bark	See below
Water	See below.
Lime	ASTM C25
Ammonium Sulfate	See below.
Magnesium Sulfate	See below.
Potash	See below.

**Shredded Hardwood Mulch:** Shredded hardwood mulch shall be aged a minimum of 6 months and consist of the bark and wood (50/50) from hardwood trees which has been milled and screened to a maximum 4 in. particle size and provide a uniform texture free from sawdust, clay, soil, foreign materials, and any artificially introduced chemical compounds that would be detrimental to plant or animal life.

No. 7 and No. 57 Aggregate shall be double-washed to reduce suspended solids and potential for clogging. The aggregate shall be placed as shown in the Contract Drawings.

**Water.** Water used in the planting, establishing, or caring for vegetation shall be free from any substance that is injurious to plant life.

**Lime.** Lime shall contain not less than 85 percent calcium and magnesium carbonates. Dolomitic (magnesium) lime shall contain at least 10 percent magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates.

Lime shall conform to the following gradation:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
No. 10	100
No. 20	98
No. 100	50

**Ammonium sulfate.** Ammonium sulfate shall be a constituent of an approved horticultural product produced as a fertilizer for supplying nitrogen and as a soil acidifier.

**Magnesium Sulfate.** Magnesium sulfate shall be a constituent of an approved horticultural product produced as a fertilizer.

**Potash.** Potash (potassium oxide) shall be a constituent of an approved horticultural product produced as a fertilizer.

- 1.3 **Construction:** Bioretention facilities shall not be constructed until all contributing drainage areas are permanently stabilized against erosion and sedimentation as shown on the Contract Plans and to the satisfaction of the Engineer. Any discharge of sediment that affects the performance of the cell will require reconstruction of the cell to restore its defined performance. No heavy equipment shall operate within the perimeter of a bioretention facility during underdrain placement, backfilling, planting, or mulching of the facility.

**Excavation.** If the bioretention facility is to be used as a sediment basin the bioretention facility shall be excavated to the dimensions, side slopes, and **1 foot above** the bottom of the Bioretention Soil Mixture elevations shown on the Contract Plans. Any sediment from construction operations deposited in the bioretention facility shall be completely removed from the facility after all vegetation, including landscaping within the drainage area of the bioretention facility, has been established. The excavation limits shall then be final graded to the dimensions, side slopes, and **final** elevations shown on the Contract Plans. Excavators and backhoes, operating on the ground adjacent to the bioretention facility, shall be used to excavate the facility if possible. low ground-contact pressure equipment or, if approved by the engineer, by excavators and/or backhoes operating on the ground adjacent to the bioretention facility. Low ground-contact pressure equipment is preferred on bioretention facilities to minimize disturbance to established areas around perimeter of cell. No heavy equipment shall be used within the perimeter of the bioretention facility before, during, or after the placement of the BSM.

Excavated materials shall be removed from the bioretention facility site. Excavated materials shall be used or disposed of in conformance with the project specifications.

After placing the underdrain and aggregate and before the BSM, the bottom of the excavation shall be roto-tilled to a minimum depth of 6 inches to alleviate any compaction of the facility bottom. Any substitute method for roto-tilling must be approved by the Engineer prior to use. Any ponded water shall be removed from the bottom of the facility and the soil shall be friable