Appendix C
Engineering Appendix

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APPENDIX C- ENGINEERING APPENDIX

1 General

This appendix documents the engineering analysis and follows the format of Engineering Regulation 1110-2-1150. Included with this appendix are the following reports; the Hydrology and Hydraulics Report (Jordan Creek Feasibility Study H&H Report, Attachment A), the MCACES cost estimate and construction schedule (included in Attachment B). Also attached is the Cost and Schedule Risk Analysis (Attachment C) followed by the engineering plates.

2 Hydrology and Hydraulics (H&H)

A hydraulic and hydrologic study of Jordan Creek and a portion of Wilsons Creek was performed for this study; information obtained from the model was used in developing channel dimensions. The evaluation included water surface profiles for the 1/500, 1/100, 1/50, 1/25, 1/10, 1/5, and 1/1 Annual Chance Exceedence (ACE) storm events for without-project (existing) conditions, without-project (future) conditions, and for several respective with-project alternatives. ACE is defined as the chance of that particular flood happening during any given year, for example; a 1/100 ACE storm event has a 1-percent chance of occurring during any given year. Refer to the Hydrology and Hydraulics report (Attachment A) for in-depth analysis of existing conditions and details of each of the alternative plans.

3 Surveying, Mapping, and Other Geospatial Data Requirements

The City of Springfield hired a surveying and consulting firm to perform a detailed survey at each identified channel cross section along the study reaches. This data was imported directly into GIS as a series of points with elevation attributes. This information was combined with 2-foot elevation data based on a photogrammetric flight from 1999 to create a TIN file. This information combined with aerial photography was utilized in ArcMap to layout, analyze, and compute quantities for the channel and associated work. LiDAR data from 2011 is available and is a useful resource during the design phase.

A more recent and comprehensive topographic survey will be required in order to develop plans and specifications. Due to the abundance of commercial properties affected, it is recommended that an American Land Title Association (ALTA) Land Survey be performed prior to proceeding into PED. This survey will provide topographic features, boundary lines, easements, structures, utilities, streets and railways, etc.

4 Geotechnical

4.1 General - This section presents general criteria based on limited subsurface investigations, analysis methods and assumptions for the geotechnical design of project features. Geotechnical design considerations for permanent structures are provided herein. The considerations consist of design of the structural foundations (bridges and culverts), excavation, backfill and scour protection.

4.2 Design Criteria - The following documents will be used in the geotechnical design of the project.

Engineer Manuals

- EM 1110-1-1905, "Bearing Capacity Analysis", 30 Oct 92
- EM 1110-2-1906, "Laboratory Soils Testing", 20 Aug 86

Other Publications

- *Foundation Analysis and Design*, Bowles, 1968
- *Foundation Engineering Handbook*, Fang, 2nd ed., 1991
- *Fundamentals of Geotechnical Analysis*, Dunn, Anderson, Kiefer, 1980
- *Soil Engineering*, 4th, ed., Spangler, Handy, 1982
- *Soil Mechanics in Engineering*, Terzaghi, Peck, 1967

4.3 Regional Geology - The proposed site is located in the Springfield Plateau geologic region. The Springfield Plateau, mainly an undulating to rolling plain, is on Mississippian and Ordovician age bedrock in this area and is part of the Ozark Uplift. The topography of this region is characterized by plateaus, steep valleys and hills. The immediate area is underlain by limestone of the Mississippian Age. This limestone generally consists of coarse grained gray limestone which is nearly pure calcium carbonate and highly susceptible to solutioning. Isolated chert nodules and discontinuous chert layers are present throughout the formations in this area. The upper surface of this bedrock is generally irregular due to the effects of differential weathering and solutioning activity as can be seen in road cuts along interstate 44, therefore, the depth to bedrock in any given area can vary dramatically. The overburden is residual soil having formed by the weathering of the rock through chemical action of infiltration through the rock formation. Less resistant rock formed the present soil matrix; more resistant rock is still present as weathered and intact gravel, cobbles and boulders. Due to the karst topography of this region, sinkholes and caves are in all stages of development and new sinkholes can appear at the ground surface at any time. The formation of sinkholes is a never ending process as groundwater finds new paths and soil is carried away from an area leaving a cavity. The cavity propagates upward through a continuing process of erosion of the overlying soil by piping and resulting deposition of the eroded material in the voids below. At some point the overlying undermined soil mass collapses because it can no longer support its own weight over the underground cavity. In this respect, it is virtually impossible to determine if sinkhole activity is present at a given location from a boring unless a void or channel is intercepted in an exploratory boring or unless there is some evidence of sinkhole activity at the particular site.

4.4 Seismological Evaluation - The site is located approximately 250 miles west/northwest of the New Madrid Fault Zone in southeast Missouri. In past years (1811-1812) this fault produced large magnitude earthquakes (Richter Magnitude 5+). Numerous small earthquakes (Richter Magnitude 2 to 4) occur along the new Madrid Fault each year. Springfield, Missouri is located in the Uniform Building

Code seismic risk Zone 1. Zone 1 is typified by Mercalli Intensity Scale intensities of V and VI out of a possible intensity rating I to X. The 2009 International Building Code Site Class for the area of the investigation would be Site Class “D”. The liquefaction potential for soils on this site would be minimal due to the amount of clays found in the soils.

4.5 Subsurface Investigations and In Situ Tests

Subsurface data was collected in two Phases. A total of 64 borings were drilled in the two phases. Only those borings which lie within the vicinity of the selected plan were presented in the Plates (See Plates G-1 through G-10).

Phase I consisted of 45 borings. These borings were drilled to obtain top of rock depths which would be used to aid in the design and construction of detention ponds. The borings were advanced using 4 inch solid-stem continuous flight augers. An all terrain mounted CME 550X was used to drill the borings. Representative samples were taken of the different soils encountered for visual classification purposes. The termination depth of the borings in Phase I was at the top of rock or to a maximum depth of 10 feet. Generally, the soils were classified based on auger cuttings with minimal split-spoon samples taken.

Phase II consisted of 19 borings that were drilled along the proposed alignment of the new channel and at areas of potential bridges. The borings were drilled with 4-inch diameter solid-stem augers with a truck-mounted CME-75. These borings were terminated at the top of rock or to a maximum depth of 20 feet. Samples were obtained using a split spoon sampler and the number and types of test are indicated in Table 1: Soil Tests.

Table 1: Soil Tests

Test	Number of Samples
Gradation	38
Classification (Lab)	32
Atterberg Limits	37
Moisture Content	100
Unconfined Compressive Strength (Penetrometer)	54
Splitspoons	98

The subsurface conditions encountered at the boring locations are shown on the boring logs. The near surface soil in several of the borings was classified as fill consisting of various mixtures of lean (CL) and fat (CH) clays with chert rock and some debris, base rock and crushed stone. The thickness of the fill varied from 1 foot to approximately 10.5 feet. Below the fill material were in situ soft to stiff clays (CL and CH) varying in thickness from 2 to 13 feet. In situ clays were underlain by cemented limestone bedrock. The top of rock varies through the site from 5.5 ft below the ground surface to greater than 20 feet. The top of rock in most of the drilled holes were located between 10 to 15 feet below the ground surface. The maximum depth of the drilled holes was 20 feet.

4.6 Excavation, Fill, and Slope Stability

As noted in the drilling logs, limestone can be expected as shallow as 5.5 feet below the ground surface., Due to the possibility of rock pinnacles, in some areas the rock may be shallower. Because the work is within the city limits with businesses and homes encompassing the project area, blasting will not be allowed. The rock will likely be removed by using continuous systematic chiseling, edging or other appropriate rock excavation methods. Based on the given soil types in the area, the excavated slopes for the detention ponds and channel should be 1V:4H. The channel side slopes will be covered with turf reinforcement mats, except where vertical walls or concrete paved slopes are to be constructed. Some riprap stone protection for erosion protection may be needed in bends or at transitions. In areas of the detention ponds where rock has been exposed, the rock will need to be over excavated to a minimum depth of 12 inches below planned grade and replaced with compacted impervious material. The following table (Table 2: Boring Depths to Bedrock) presents depths to bedrock based on the exploration information on the boring logs.

Table 2: Boring Depths to Bedrock

Boring	Depth to Bedrock (ft)
GSP-2, JC-14, JC-18, JC-23	Bedrock not encountered. Drilling terminated at 20
WBP-3	Bedrock not encountered. Drilling terminated at 18
JC-9	18
JC-8	17
JC-20	16.3
BESP-1	15.5
CNP-4	Bedrock not encountered. Drilling terminated at 15
JC-2	15
JC-3, JC-19	14.3
CNP-1	14
JC-7	13.5
CNP-3, JC-11	13
JC-1	12.8
JC-12, JC-15	12.5
JC-6	11.5
JC-4	10.5
JC-24	10.3
BESP-3, BUSP-1, BUSP-2, CBSP-1, CBSP-2, CNP-2, CSP-3, FREP-2, FSP-1, FSP-2, FSP-3, FSP-4, FSP-5, GSB-1, GSB-2, GSB-3, GSP-3, GSP-4, HCP-1, HCP-2, NAP-1, NAP-2, PEP-1, PEP-2, PWP-1, PWP-2, SEP-1, WBP-1, WBP-2, NEW-1	Bedrock not encountered. Drilling terminated at 10
GSP-1, BSP-1,JC-13	10
CSP-1, NEW-2	Bedrock not encountered. Drilling terminated at 8.5
JC-16	7.5
SEP-3	7
WSP-3	6
FREP-1, SEP-2	5.5

4.7 Design Parameters – The table below (Table 3: Soil Parameters) presents preliminary design values used in the design of the box culvert foundations and retaining walls. The values presented are generalized and additional studies are necessary to confirm the subsurface conditions. The allowable bearing capacity presented includes a factor of safety of 3 and skin friction capacity values include a factor of safety of 2. The following table assumes a groundwater depth of 5 feet.

Table 3: Soil Parameters

DESCRIPTION	SOIL PARAMETERS
	IMPERVIOUS SOILS
Angle of Internal Friction (φ)	$\varphi=0^o$
Moist Unit Weight (γ_m)	105 pcf
Saturated Unit Weight (γ_s)	115 pcf
Cohesion (c)	400 psf
At-Rest Coefficient (K_o)	0.8
Bearing Capacity (Q_a)	1,200 psf

If bridges are replaced or modified, the design of those bridges should be based on current Missouri Department of Transportation or Union Pacific Railway design practices. Deep foundations could be considered to support the bridges. Deep foundation alternatives types could include, but are not limited to drilled piers, driven piles and auger-cast-in-place piles.

Based on a preliminary review of the subsurface conditions, it appears that the most cost effective deep foundation alternative would be drilled piers. The soft native overburden soils and the existing fill that was generally encountered in the borings would not significantly contribute to supporting the structures through skin friction.

The table below (Table 4: Design Values for Drilled Piers) provides preliminary design values for drilled piers. The below values are generalized and additional studies are necessary to confirm the subsurface conditions. The below allowable bearing capacity includes a factor of safety of 3, skin friction capacity values include a factor of safety of 2 and assumes groundwater at a depth of 5 feet below ground surface.

Table 4: Design Values for Drilled Piers

Depth (ft)	Soil/Rock Type and Effective Unit Weight (pcf)	Allowable End Bearing Capacity (psf)	Allowable Skin Friction (psf)	Cohesion (psf)	Allowable Passive Pressure (psf)	Internal Angle of Friction (Degrees)
0 - 5	Fill – 110	N/A	N/A	250	250	0
5 – 18	Lean and Fat Clay - 60	N/A	200	500	500	0
18	Limestone – 85	10,000	1,000	0	6,000	42

4.8 Potential disposal sites.

No potential disposal areas have been identified at this time. The sponsor indicated that they are always able to find close disposal sites when doing similar projects. During the design phase disposal sites will be located and included in the plans and specifications, or made the responsibility of the contractor subject to government approval of the disposal site.

5 Environmental Engineering

5.1 Use of environmentally renewable materials.

There is little opportunity to incorporate renewable materials in this project. The majority of the work will consist of excavation for the channel and detention ponds. One of the major construction materials will be concrete which will be used for bridges, bridge shoring, channel walls, culverts, and outlet structures for detention ponds. Concrete while not considered to be renewable, could be composed of recycled concrete.

5.2 Design of positive environmental attributes into the project.

The channel side slopes will be mostly vegetated utilizing a grass and wildflower seed mix. The addition of detention basins will add more opportunity for infiltration, sedimentation, and filtration. A low flow channel will be considered during the final design, in an attempt to aid habitat improvement and channel maintenance/sediment removal.

5.3 Inclusion of environmentally beneficial operations and management for the project.

The intent is to promote a more natural channel using a wildflower and grass seed mix. This will reduce the amount of mowing as is typical on a conventional grass swale. This approach should reduce emissions from mowing equipment and the use of oil and gas.

5.4 Beneficial uses of spoil or other project refuse during construction and operation.

It is anticipated that a majority of the spoil material will be reused as fill material on other projects within and around the city. If necessary the material will be deposited in disposal areas not yet identified. The plan for disposal of spoil material will avoid and minimize adverse impact to the maximum extent practicable.

5.5 Energy savings features of the design.

Due to the scope and nature of this flood risk management project, there are no feasibly obtainable energy saving features available.

5.6 Maintenance of the ecological continuity in the project with the surrounding area and within the region.

The landscape of the project site will be altered by the excavation for the channel and detention ponds. However, the long term change in ecology of the area will be minimized as the areas will be returned to a vegetated condition to promote the habitat and minimize erosion.

5.7 Consideration of indirect environmental costs and benefits.

There are no significant indirect impacts anticipated.

5.8 Integration of environmental sensitivity into all aspects of the project.

Environmental sensitivity will be incorporated into the design and construction of the project to the maximum extent practicable.

5.9 Consideration of environmental problems on similar projects with respect to the Environmental Review Guide for Operations (ERGO).

The perusal of the Environmental Review Guide for Operations (ERGO) with respect to environmental problems that have become evident at similar existing projects and, through foresight during this design stage, have been mitigated/addressed in the project design. There are minimal environmental impacts, requiring no mitigation, from the proposed project. The construction of the project will not proceed until the Sponsor has provided a clean corridor free of any HTRW contamination.

5.10 Incorporation of environmental compliance measures into the project design.

A Storm-Water Pollution Prevention Plan (SWPPP) will be prepared by the construction contractor and implemented for the project. The Sponsor will be required by the partnering agreement to provide land free and clear of HTRW contamination. Acquisition of required state and Federal permits will be completed prior to any construction activity.

6 Civil Design

6.1 Site selection and project development

In order to find a solution for flood risk management, various channel alignments and detention basins were evaluated to determine the available alternatives. The Project Delivery Team (PDT) conducted site visits, considered existing improvements via aerial photography, and prepared preliminary cost comparisons in order to help facilitate selection of the most feasible channel alignment.

The Federal interest limit of the proposed channel includes approximately 1.8 miles on Wilsons Creek, 3.2 miles on Lower Jordan Creek, 2.2 miles on North Branch of Jordan, and 2.1 miles on South Branch of Jordan Creek (see Figure 1.1 of the main report for a map of the study area). Jordan Creek flows through the City of Springfield, Missouri into Wilsons Creek and eventually drains into the James River. The channel has varying depths and a portion of it is located along an old railroad easement. The proposed channel was designed to have a trapezoidal cross-section with a benched maintenance trail approximately 2’ higher than the flow line elevation, and gentle side slopes (typically 4H:1V) covered with turf reinforcement mats and hydro seeding. Reach E1 did not include the benched maintenance trail. Toe stones were included in areas where work occurs to stabilize the low flow portion of the channel. The channel was laid out in a manner that was hydraulically functional while minimizing the need to remove or relocate existing homes, businesses and other structures. Where it was not feasible to construct a trapezoidal channel due to real estate limitations, vertical concrete walls were incorporated.

6.2 Project Alternatives

As stated in the main report, the study area was divided into six economic reaches (E1-E6). During the formulation process, the team looked at different types of plans for the study area. The first structural measure to be considered was regional detention basins.

6.2.1 Detention Basins

The City of Springfield, serving as the H&H team member, initially looked at 24 different sites for potential regional detention ponds. These were narrowed down to 5 sites through analysis performed within the HEC-1 model. For a thorough explanation of the detention basin selection; see the H&H Report (Attachment A to this appendix). The five selected basins were: Basin B6, Basin B7, Basin B9B, Basin B11, and Basin B11C.

Basin B6

This proposed basin is located just upstream of Chestnut Expressway along the South Branch of Jordan Creek (see Plate C-3). The stream valley would be excavated to a depth of approximately 9 feet and expanded to the northeast. There are at least three property owners who would be impacted by this project and the City would need to acquire the land or obtain an easement from each. A detailed outlet structure was not designed for this basin. Instead, the rating curve was adjusted to optimize the storage capacity. For estimation purposes, a cast in place concrete outlet structure consisting of a 20’ wide sharp crested weir at elevation 1309’ was assumed with the downstream box controlling flows during large events. The weir would have end contractions with a small slot in the bottom for very low flows.

Basin B7

Located in Glenwood Park (see Plate C-4), this existing regional basin would be expanded to control peak flows and reduce flooding along Rockhurst Street. The existing basin would be excavated an additional 5-feet and the park area would be excavated an additional 2-feet. The lower portion of the basin would overtop into the park area at about the 5 to 10-yr event. The cast in place concrete outlet structure would consist of two 42-inch diameter openings that would tie into twin 42” diameter RCPs with a flow line at elevation 1331’ that would travel along Rockhurst Street and discharge downstream of Patterson Avenue. The outlet structure would also include a 5-foot wide, 6’ tall high flow weir above the 42” diameter outlets that would discharge into the existing ditch system along Rockhurst.

Basin B9B

This proposed basin is located north of Pythian Street and just west of Cedarbrook Avenue (see Plate C-5) and will be part of a two basin system when combined with an existing basin (B9C). The existing valley would be excavated to a depth of 8-feet and a berm constructed on the downstream end. The cast in place concrete control structure would consist of two 36-inch diameter openings connecting to 36” diameter RCPs and a 20’ overflow weir at elevation 1351’ that would discharge into basin B9C. This basin encroaches on parts of 4 different privately owned properties and land acquisitions or storm-water easements would be necessary. This basin will be located next to a small privately owned, public-use airport. This pond is designed to drain quickly, therefore not exceeding the maximum 48-hour detention period specified in FAA Advisory Circular 150/5200-33B. The necessary measures will be incorporated during design to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions.

Basin B11

An existing regional detention basin is currently located upstream of Glenstone Avenue (see Plate C-6). The proposed basin would expand the existing basin to the east. Additional land acquisition and/or storm-water easements wound need to be pursued from adjacent property owners. The cast in place concrete outlet structure for this basin would consist of a 15-foot sharp crested weir at elevation 1325’ just above the flow line. This weir would have two contractions and would look like a large “H” structure with the weir submerged by about 7’ during the 100-yr event. There is an existing weir in place that would likely be modified to meet the proposed storage requirements.

Basin B11C

This proposed basin is located south of Blaine Street at Link Avenue (see Plate C-6) and is currently a vacant wooded area. This area would be excavated and a control structure added. This basin attempts to minimize the impact to vegetation by only including excavation on the south side of the stream. This area would be excavated to the depth of the existing channel and a control structure would be added downstream. This would leave the north portion of the lot available for development and should make land acquisition more palatable to the owner. Side slope of basin would be 6:1. Area could be planted with wetland vegetation to provide additional water quality benefits. The cast in place concrete outlet structure was assumed to be an 18-ft wide, sharp crested weir at elevation 1333’ with two end contractions.

6.2.2 Channelization

Channelization was the next structural measure that the team analyzed. Consideration was given to existing bridges, buildings, utilities, roads and railroads that would be impacted by the selected plan. Due to these constraints, there was only one feasible route available for the proposed channel alignment. The other routes considered but not included as alternates presented obstacles such as excavating through a landfill, removing high value buildings, and/or relocating long sections of railroad. The alternates that the PDT chose consisted of channels with varying levels of protection along the same channel alignment.

Plan A

Plan A consisted of the five regional detention basins on the North and South Branches. Also, the channels, Reaches (E1-E6) were designed to provide property protection against the 1/100 ACE storm. Optimization of Plan A through HEC-FDA analysis and preliminary cost estimates resulted in a more economically efficient Plan B.

Plan B

Plan B was also designed to provide building protection to about the 1/100 ACE through channelization and the same 5 detention basins. Plan B had components that were eliminated as they were not cost effective. The major variances from Plan A include:

- In Reach E2, Sta: 36+56 to 43+14, planned improvements to Grand Street Bridge and channelization work were omitted.
- In Reach E3, Sta: 149+41 to 170+00, a planned box culvert under Phelps Street from Jefferson Street to Washington St is exchanged for an open channel to the south of Phelps Street. This would require RR line relocation or commercial buyouts.
- In Reach E5, Sta: 75+00 to 81+45, all planned bridge replacements and associated channel work in the Smith Park area of the North Branch were omitted.
- In Reach E6, all planned work to the east of Fremont Street on the South Branch was omitted. This included two RR bridges at Sta: 76+80 and Sta: 77+18, and a RR culvert at Sta: 91+41.

Plan C

Plan C utilized essentially the same structural measures as Plan B, however it was designed to offer protection against the 1/50 ACE storm. Other than channel geometry revisions to reduce the channel size, the variances between Plan C and Plan B include:

- In Reach E2, all proposed channel work between Sta: 73+13 to 81+28 and from 91+76 to 98+36 was omitted. Also the planned RR bridge just upstream of College St. was omitted.
- In Reach E4, the planned bridge reconstruction for the Central Street crossing was omitted.

Plan D

Plan D utilized essentially the same structural measures as Plan B; however it was designed to offer protection against the 1/500 ACE storm. Other than channel geometry revisions to increase the channel size, the only variance between Plan D and Plan B was an extension of the channel work at the downstream end of Reach E1. This work added channelization underneath Scenic Bridge requiring foundation modification.

Plan E

Plan E also utilized the essentially the same structural measures as Plan B, however it was designed to offer protection against the 1/25 ACE storm. Other than channel geometry revisions to reduce the channel size, the variances between Plan E and Plan B included:

- In Reach E1, all planned channel work upstream of Sta: 2+14 on Jordan creek is omitted.
- In Reach E2, all planned channel work from Sta: 72+55 to 81+28 and from 91+76 to 98+36 is omitted. This plan also omits the planned RR bridge just upstream of College St.
- In Reach E3, all planned channel work downstream of Sta: 128+00 is omitted.
- In Reach E4, all planned channel work upstream of Sta: 18+36 is omitted including the bridge for Central Street.
- In Reach E6, all planned channel work upstream of Sta: 45+09 is omitted including the culvert for Freemont Street.

The PDT, attempting to optimize the performance of the plans, performed a reach by reach analysis with the varying levels of protection to form additional plans. Plan F and Plan G were created by combining the reaches from Plans B-E to optimize for both performance and for efficiency.

Plan F

Plan F offers protection against property damage for a 1/500 ACE in Reach E1 (from Plan D) and a 1/100 ACE (from Plan B) in Reaches E3 and E6. This plan also contains the five regional detention basins on the North and South Branches. There were no structural improvements considered for Reaches E2 and E4 for this plan.

Plan G

Plan G provided protection against property damage for a 1/500 ACE in Reach E1 (from Plan D) and a 1/25 ACE (from Plan E) in Reaches E3 and E6. This plan also contains the five detention basins on the North and South Branches. There were no structural improvements considered for Reaches E2 and E4 for this plan.

The PDT then attempted to optimize Plan G. Plans G2- J are variations of Plan G. This analysis was also used to gain a better understanding of how the different components in Plan G performed.

Plan G2

Plan G2 provided protection against property damage for a 1/500 ACE in Reach E1 (from Plan D) and a 1/25 ACE (from Plan E) in Reaches E3 and E6. This plan also contained the five detention basins on the North and South Branches. There were no structural improvements considered for Reaches E2 and E4 for this plan. Unlike Plan G, this plan did not contain the proposed Main Street or Booneville Street Bridges.

Plan H

Plan H is essentially Plan G, but the culvert along Phelps Street was omitted.

Plan I

Plan I is a copy of Plan G, however the detention basins were omitted.

Plan J

Plan J contains only an excavated channel on Reach E1 providing the 1/500 ACE protection (from Plan D) and the 5 regional detention basins on the North and South Branches. This plan was determined to be the National Economic Development (NED) plan and was chosen as the selected plan. Plan J is presented on plates C1-C-7.

On Wilsons Creek, approximately 2,100 feet of channel widening will occur. The widening will start at Sta: 310+00, approximately 100 feet west of the Scenic bridge and end at the confluence of Wilsons Creek and Jordan Creek. Bridge modification to Scenic Bridge is likely required as a result of channel excavation beneath the bridge. The modification was assumed to be shoring up of the piers of the bridge by installing new piers and a mat foundation. The railroad bridge over Wilsons Creek at the southeast corner of the ball fields is a construction and is therefore replaced, see Table 5: Railroad Bridge Data, for more information.

Table 5: Railroad Bridge Data

RR X-ing	Bridge/Culvert	RR Company	Channel Reach	Station
Wilsons Creek Bridge	Bridge	Missouri and Northern Arkansas Railroad (MNA RR)	E1	322+90

Based on discussions with MNA RR, the construction of the crossing can be executed such that the work can occur within an acceptable outage window. This will prevent the need to build a shoofly to maintain RR traffic during construction. A shoofly is a temporary stretch of track that takes trains around construction.

One of MNA RR's proposed solutions for the Wilsons Creek Bridge is to utilize a "Saddlecap" method. This would involve the end bents being designed to where all shaft (pier or abutment columns) installations were constructed on each side of the existing bridge deck. Then a concrete cap would be formed and constructed under the existing bridge between the bents to complete the substructure (all while rail traffic is active on the existing track and structure). After this phase is finished, the superstructure spans would be assembled onsite (in an off-line area) and prepared for being erected during a track outage window. Once a span is set and rails reconnected, traffic is resumed until time to erect the next span (if additional spans are required). Thus any disruption to the rail traffic is minimized due to most work being performed off-line and with short outages during the switchover. MNA RR has stated that a 3 day outage window could be accommodated, which would allow this type of construction method to be a feasible option.

A formal agreement with all involved RR entities will be established upon project approval.

On Jordan Creek, widening will occur from its confluence with Wilsons Creek upstream to Sta. 11+17 on Jordan Creek which is about 350 feet North of the Bennett Street bridge. Two pedestrian walkways crossing over the channel will be removed by the Sponsor and the channel is widened from approximately 45' to 100'. No modifications will be made to the bridge on Bennett Street crossing over the channel. The street leading to the bridge from the West side acts as a flood diversion structure which provides some protection for the Archimica plant on the North side. However, the street has a sag in it which allows water to flow over it starting at the 1/10 ACE flood event. The flood water after overtopping the street is then on the protected side of the Archimica plant facility's floodwall. A flood diversion structure is planned and has been estimated at Bennett Street to prevent water from overtopping the street. The planned barrier consists of raising the road surface in the feasibility study; however, there are various options that are possible solutions to provide a flood diversion structure at this location. This approach is considered an effective higher cost option. Other options such as building a levee or flood wall shall be analyzed further during PED. The actual design will depend upon factors such as cost, constructability, and minimization of disruptions to vehicular traffic and the operations of the Archimica plant.

The Archimica plant sits on the confluence of Fassnight and Jordan Creeks protected by a floodwall on the East and South sides. A structural analysis was completed on the floodwall, and it was determined to be structurally sound. No work is planned for the floodwall. Should the floodwall need to be raised at some point in the future substantial excavation and rebuilding would be required.

The proposed construction will affect several existing streets thereby creating the need for culverts, bridges, and bridge modifications. Traffic at each bridge or culvert location will be rerouted until it is deemed safe and appropriate to use the newly constructed crossing. For a list of road and railroad structure types, dimensions and locations see Plate S-1.

6.3 Quantity Computations

The channel quantities were computed by the Average End Area Method. Cross sections depicting existing geometry channel compared with the proposed geometry were exported out of HEC-RAS into CAD software. Cut and fill areas were measured in CAD and transferred into a spreadsheet which totaled the quantities for each alternative by economic reach. Based upon the soil borings, we estimated that 5percent of the cut quantities will be rock, which will affect the amount of effort, type of machinery, and cost to remove the material.

The site quantities (vegetation, stabilization, tree clearing, demolition, roads, railroads, walls, etc.) were determined by extracting and estimating quantities from HEC-RAS cross sections and from aerial photography. The aerial photography data utilized was accessed through Google Earth and from imagery received from the sponsor which was incorporated into ArcMap with the proposed improvements.

Utility quantities were calculated by inserting GIS data received from Springfield City Utilities into ArcMap to identify potential utility conflicts. Aerial imagery was also utilized to identify utility conflicts. Quantities for utility relocation were estimated for areas where conflicts were suspected.

6.4 Assumptions For All Plans Considered

There are two pedestrian walkways bridging across the creek located in Reach E1- located on the east side of the Archimica Plant. These walkways will need to be removed for construction in the channel. The sponsor stated that they will coordinate and be responsible for removal of the bridges and replacement, if needed.

The RR contacts have indicated that bridges can be replaced without having to build shooflys. Therefore no quantities have been included for constructing an alternate/temporary bypass for the RR.

We assumed utilities crossing the channel where channelization was occurring would require lowering or relocation, unless the channel was not being lowered at that location.

In general, a proposed right of way width of 20’ beyond the top bank of the proposed channel was assumed. Staging/lay down areas were selected to be in close proximity to the reaches.

6.5 Real Estate

This project will require the acquisition of real estate in order to construct the detention basins and the right of way to construct the flood reduction channel. In general, the required right of way for the channel was determined by utilizing the proposed channel top-of-bank to top-of-bank dimension plus 20’ feet on each side for construction, access, and maintenance. The right of way was increased in areas where street and railroad reconstruction is required. Also, real estate acquisition will be required for staging/lay down areas.

6.6 Relocations.

Utilities located in the vicinity of the project were identified by using GIS files provided by Springfield City Utilities. For the selected plan sanitary sewer, potable water, gas, electric and telephone lines will have to be removed and relocated in order to construct the channel and detention basins. In general, quantities reflect a like for like replacement, meaning that the same size and type of material would be utilized in the relocation of a utility to accommodate the proposed channel work. The Corps of Engineers was required to sign a confidentiality agreement to obtain the fore mentioned utility information. For this reason, utilities will not be depicted in the plates of this appendix.

There are no planned railroad relocations in the selected plan. Regarding road relocations, Rockhurst Street will be excavated to install the twin 42” RCP culverts coming out of detention basin B7 and the sanitary sewer will be relocated under the street to accommodate the culverts. After that work is completed, the road will be replaced. Also, a portion of Bennett Street will be relocated, vertically, if that is the chosen solution to providing a flood diversion to prevent water from overtopping Bennett Street.

6.7 Risk for Cost Overruns in Civil Design

6.7.1 Utilities

Utilities are always a challenge when constructing a project of this type. It is difficult to determine where underground utilities are located. Record files have been utilized in the design of this project, but it is quite common for utility lines to be present when not indicated on the drawings. This is especially true regarding abandoned utility lines. The depth of the utilities is also hard to predict, hence knowing whether or not a utility crossing the channel needs to be relocated is challenging. It is reasonable to believe that there are more utilities in the ground than what we have record of.

6.7.2 Unknown Site Conditions

Unknown site conditions are always a potential risk on a project. This project area contains many locations where HTRW is being cleaned up. There is a possibility that more HTRW could be discovered during construction. Also, there are a couple of identified cultural resource sites that were within the project area of some of the alternatives. Any new sites found could affect cost and schedule. Other possible unknown site conditions include utilities, rock formations, and artificial subsurface obstructions.

6.8 Design Criteria and Standards.

The following documents and standards, as a minimum, will be incorporated in the design of this flood risk management project.

- "Design Standards for Public Improvements" City of Springfield, Missouri
- "Manual on Uniform Traffic Control Devices (MUTCD)", Federal Highway Administration
- "Americans with Disabilities Act and the Architectural Barriers Act Guidelines" (ADAAG)
- "International Building Code"
- Architectural and Engineering Instruction Manual (AEIM), Southwestern Division
- Unified Facilities Criteria (UFC)
- ASTM International Standards
- SpecsIntact will be utilized to develop the project specifications

7 Structural Requirements

7.1 General -

This section provides the criteria, design planning and analysis for which the design decisions were made and the structural requirements that are presented and assumed in the cost estimate.

7.2 Design Criteria –

The current edition of the following documents will be used in the structural design of this flood control project.

- AASHTO LRFD Bridge Design Specifications; Design Load shall be based on the HL-93 Design Loading
- Missouri Standard Specifications for Highway Construction
- Manual For Railway Engineering (AREMA)
- American Concrete Institute Standards (ACI 318)
- American Institute of Steel Construction (AISC – Manual of Steel Construction

7.3 Structural Systems

Railroad Bridge

There is an existing railroad bridge crossing over Wilsons Creek in Reach E1. This bridge is planned as a 90' long bridge to replace the existing 54' long bridge. The cost estimate included additional length beyond 90' to account for necessary excavation required to construct the 90' long structure. For this railroad bridge, a precast concrete box beam system was assumed based on Union Pacific Railroad 3 span Precast Channel Bridge (PCB) 90' length. Plate S-1 provides an example of the type of bridge system that would be designed for this project. During the initial stages of the design, Union Pacific (UP) Railroad was contacted for guidance and coordination. During the discussions UP recommended that we use their replacement bridge design for several reasons. First of all, it is readily available. Next, the design system is already approved. And, bridges can be replaced with a minimum amount of design time. Based on the geotechnical information, rock formations are sporadic and it is not possible to predict whether or not rock will be encountered during construction. The geotechnical engineer recommended assuming drilled pier foundations for most, if not all, of the structures. Therefore, the railroad design will have to be modified to have the steel HP piles embedded in concrete to achieve the required design capacity of the railroad and hydraulic loading.

Foundation System

The geotechnical information indicated that the in situ clays were underlain by cemented limestone bedrock. The top of rock varies through the site from 5.5 feet below the ground surface to greater than 20 feet. The top of rock found in most of the soil borings was around 10 to 15 feet below the ground surface. Based on conversations with the local engineers, the possibility for rock pinnacles is very high. A drilled pier foundation system was recommended for these structures. The quantities are based on 20 feet deep drilled piers. This is conservative based on the current information. However, the current cost estimates are based on square foot estimates for these structures.

Foundation Modifications

There were about five structures in the study that would require foundation modifications based on the hydraulic requirements and the existing structural conditions. Little or no information was known about many of the existing structural foundation systems. Therefore some piers/and mat foundation quantities were provided for estimating purposes. Sheet piling wall foundation modifications may be required when the existing structural foundation information is known or discovered. In the selected plan foundation modification will only be required on the Scenic Bridge in Reach E1. The plan and estimate included drilling 3 cast in place concrete piers 2 ft diameter around each of the columns on the 2 column open bridge bents. A pier cap was also included around the concrete piers. The purpose was to protect the existing foundation from scour.   This was a reasonable design assumption to make at the feasibility level. Additional analysis will be conducted during PED to determine the appropriate design for this structure.

Retaining Wall at Archimica Plant

The floodwall along Archimica is a reinforced CMU block retaining wall that was constructed to protect against flood waters and to protect the stream bank or slope failure that would take away from the plant parking areas. The CMU block wall has been designed and constructed to elevation 1222.0. See Plate S-3 for the floodwall section. The wall appears to be structurally sound, based on preliminary calculations and a visual inspection. The largest risk seems to be from scour or undermining of the footing during an extreme event.

Vertical Concrete Walls in the Channel

In Reach E1, it was necessary to include vertical concrete walls to provide sufficient flow area within the available channel area which was restricted due to real estate limitations. These walls were designed and estimated as cast in place concrete walls. During design, differing wall options will be considered during further analysis to determine the most cost effective and suitable wall system once we have the soil conditions and final geometry of the channel.

7.4 Structural System Chart -

As the feasibility study continued, a chart was developed in order to track what changes were being made to each channel crossing structure in each of the subsequent plans. This chart was modified after an Agency Technical Review (ATR) comment recommended that this chart be used to communicate more fully the type of structure, bridge type, foundation type and number of spans if the structure was a bridge. This chart is located on Plate S-2.

7.5 Risk for Cost Overruns in the Structural Design

7.5.1 Railroad Bridge crossing

Coordination with the railroad bridges has some inherit unknowns based on who owns the line, who operates on the line, and the individual entities that are involved with the design approval and coordination. Every effort was made to coordinate with the railroads involved, in order to use a typical design system that would alleviate as many problems as possible.

7.5.2 Structural modifications to existing bridges

Very little information was known about the existing structures and what could be done to modify the existing structure to pass the water flow or channel volume required. When a channel and a plan has been chosen, additional work will be required to find the existing construction information and detailed site inspections will be required to provide a more detailed design for these modifications.

7.5.3 Foundation Design

Rock pinnacles and soft areas are always potential risks that are associated with any feasibility design.

8 Electrical and Mechanical Requirements

The feasibility study includes functional design requirements, technical design criteria and quantity takeoff for relocation of all electric and telecom utilities above ground and underground within the project boundary that will interfere with the new channel system. Also for future reference we have included the “Springfield City Utility POC Information.pdf” which lists names and phone numbers for electric and telecom utility points of contact. Quantities were obtained using the GIS data in ARCMAP provided by City Utilities of Springfield, MO, and Google Earth Pro along with photos it generates.

Technical design criteria for relocating the electric and telecom utilities and for providing under bridge lighting at bridge structures shall, at a minimum comply, with the requirements of the following criteria, latest edition.

- **NFPA 70: National Electrical Code** – this will apply to electrical work associated with the under bridge lighting. Examples would be conduit, conductors, controls and enclosures.
- **City of Springfield Electric Utilities Standards Book and ANSI C2: National Electrical Safety Codes –** these will apply to electrical work associated with electric and telecom utility poles, conductors, clearances, separation, trenches, and manholes.

9 Hazardous and Toxic Materials

Currently, the upper branches of Jordan Creek are located in mostly residential and light commercial areas. The lower branch, within the downtown area of Springfield, is more industrialized with heavy commercial activity. Industrial development of the downtown area began in the late 1800s with a number of businesses including print shops, materials yards, foundries, and the city owned manufactured gas plant. By the 1930s, the downtown area experienced an increase in oil and gasoline facilities along with auto repair and salvage businesses. By the 1970s, the downtown area was characterized as more light industrial with increasing residential and light commercial development along the upper branches. Two historic city landfills are located along the lower portion of the lower branch.

In 1999, the City of Springfield received a USEPA Brownfields Assessment Demonstration Pilot grant for a 0.8 square mile area surrounding Jordan Valley in the historic downtown area of Springfield. Since then, the City of Springfield has expanded its assessment area and conducted environmental assessments throughout the Jordan Creek corridor. Through the USEPA Brownfields Program, along with other state related programs, the City of Springfield has received over $3,000,000 from Federal and State partners towards assessment and cleanup of properties within the city. A large portion of these funds have been used in the assessment and cleanup of properties along the Jordan Creek corridor. Plate H-1 represents environmental assessments and screenings completed as of April 2012.

In April 2012, an environmental review was prepared by Seagull Environmental Technologies under contract with the City of Springfield. The environmental review evaluated all available information on 70 properties along the Jordan Creek corridor with potential HTRW impacts to channel and associated structure modifications. The review summarizes previous environmental investigations and recommends additional assessment activities where needed. The review also provides a range of cost estimates for remedial activities. For properties without completed assessments, environmental conditions for surrounding properties along with available historic documents were used to determine potential site conditions and remedial costs. See Plate H-2 for detailed estimates for each individual site. The environmental review identified 3 sites with documented or suspected HTRW contamination within the areas impacting Plan J. The low range cost estimate for the 3 sites combined was estimated at $67,500 and the high range estimated cost for these sites was estimated at $1,340,000. Plate H-3 provides the remediation cost estimate for Plan J. While Plate H-4 depicts the indentified contaminated areas at the Archimica Plant, this site is designed to be protected by the floodwall, therefore actual remedial cost is estimated to be from $32,500 up to $340,000.

The Missouri Department of Natural Resources is currently reviewing completed environmental assessments and other documentation for these same properties to determine if or where additional action is needed.

10 Construction Procedures and Water Control Plan

The construction of the culverts and bridges will be sequenced in order to minimize the impact on the local traffic patterns. Some streets will be required to be temporarily closed during construction, specifically Rockhurst Street. Where possible, the work will be installed in sections allowing traffic to be detoured around construction. Otherwise, sequencing the installation of the structures will be necessary to allow vehicular traffic to be rerouted around the local collector streets during construction.

Barriers will be installed near the edge of the excavated channel at locations where the channel intersects an existing road.

It is anticipated that the bridges, railroad crossings and the culverts will be constructed by using the adjacent in-place soil as a natural cofferdam. Groundwater and rainwater will have to be considered during construction of these features. A combination of ditches, well points, sumps or pumps will need to be used for removal of water from the excavations for satisfactory completion of the work.

Erosion control measures will also be put in place to minimize the erosion on the excavated slopes and all adjacent land that may have been stripped of vegetation.

11 Initial Reservoir Filling and Surveillance Plan - Not applicable

12 Flood Emergency Plans for Areas Downstream of Corps Dams – Not Applicable

13 Environmental Objective and Requirements

This information is provided in the main body of the report.

14 Reservoir Clearing - Not applicable

15 Operation and Maintenance

The sponsor will be responsible for annually traversing the entire length of the channel and looking at the condition of the channel bottom and side slopes and concrete structures. The sponsor will ensure that the earthen side slopes are mowed appropriately; and that undesirable weeds and woody growth will be removed by herbicides or cutting. The concrete structures will also need to be inspected annually for damage and deterioration and repaired immediately to prevent further damage to the structure. The sponsor will be responsible for repair to any damaged sections of the riprap as well as removal of plant growth within the riprap.

16 Access Roads

This project is located within the city of Springfield and in most cases it will be feasible to use the existing public city streets for transportation miscellaneous construction equipment and hauling of excavated material, debris and construction materials. A maintenance path was included in many sections of the trail for the initial alternatives, but the path was not a part of Reach E1. Since the selected plan only includes Reach E1, there will be no sections of the channel with a maintenance path. The project site will have construction easements along the top banks of the excavated channel. The easements will provide sufficient right of way for the sponsor to go back in the future and perform maintenance as required.

17 Corrosion Mitigation

Coatings and/or cathodic protection will be included in the design as required for materials which are installed in the soil.

18 Project Security

This project, consisting only of channelization and detention ponds, is not anticipated to require a security plan.

19 Cost Estimates

The baseline cost estimate for the selected plan (Plan J) representing the scope of work was developed using MCACES in the Civil Works Work Breakdown Structure format. The estimate reflected the recent material and petroleum products price increases to the month of December 2012. Quantities were calculated and provided by the Designers in the District. The cost estimate for each feature was escalated to the midpoint of construction using the most current indices for Civil Works Construction Cost Index System (CWCCIS) EM 1110-2-1304. Contingencies were developed using input from the PDT and the abbreviated cost risk spreadsheet provided by the Civil Works Center of Expertise for Cost Estimates they ranged about 23 percent (22.85 percent to 23.15 percent). For specific cost information refer to the MCACES cost estimate located in Attachment B. The Cost and Schedule Risk Analysis is located in Attachment C.

20 Schedule for Design and Construction

The schedule for the tentatively selected plan, Plan J, is located within Attachment B.

21 Special Studies – Not Applicable

22 Plates, Figures, and Drawings

Plates included in the engineering appendix include: the plan view of the selected channel, typical cross section of the channel, plan of borings and boring logs, HTRW assessments and cleanup costs, and structural system chart.

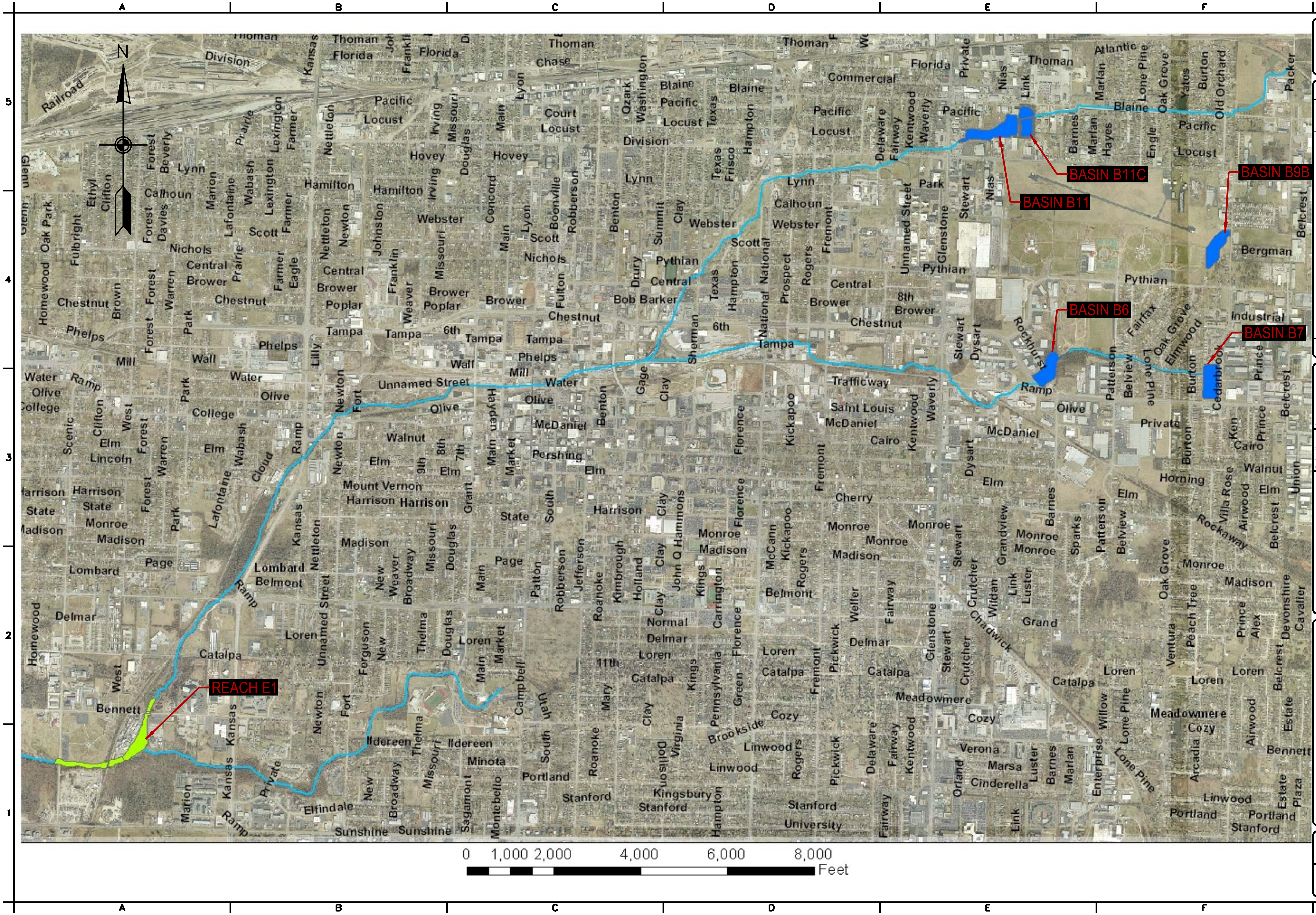
23 Data Management

During the feasibility study, electronic data was compiled and maintained in project folders for each discipline involved on the server. This data is backed up regularly by USACE's data manager (ACE-IT). The project information will be available for the next phase of the project.

24 Use of Metric System Measurements

The Sponsor specifically requested that the project be designed in English units. They have stated that the English system is consistent with their current standards, specifications and bidding practices. The City of Springfield uses data from their projects to compare trending of quantity costs; therefore, conflicting unit systems would complicate this process. With English units being the locally familiar system in this area, the material testing companies would likely be forced to work with unfamiliar units. The surveys used to produce the H&H models were all done in English units. Converting these survey drawings from English to Metric would have created additional work effort for the design team resulting in slips in the schedule and additional costs.

Engineering Plates



US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB
Drawn by: NHB
Reviewed by: NPG
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

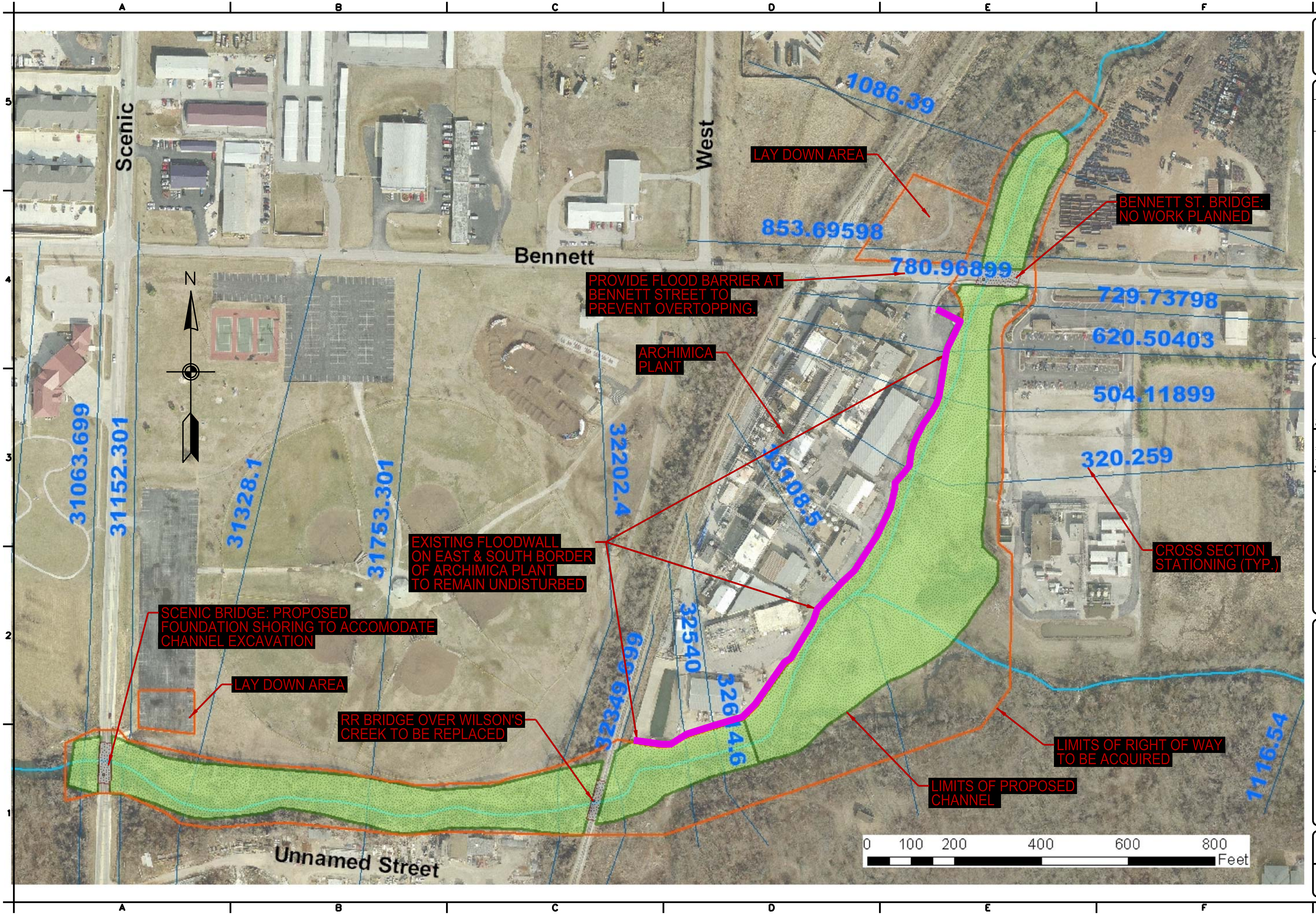
CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

PROJECT SITE MAP

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE C-1



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Little Rock District

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Reviewed by: NPG
Date: MARCH 2013
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Contract No.:

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LITTLE ROCK, ARKANSAS

Submitted by:

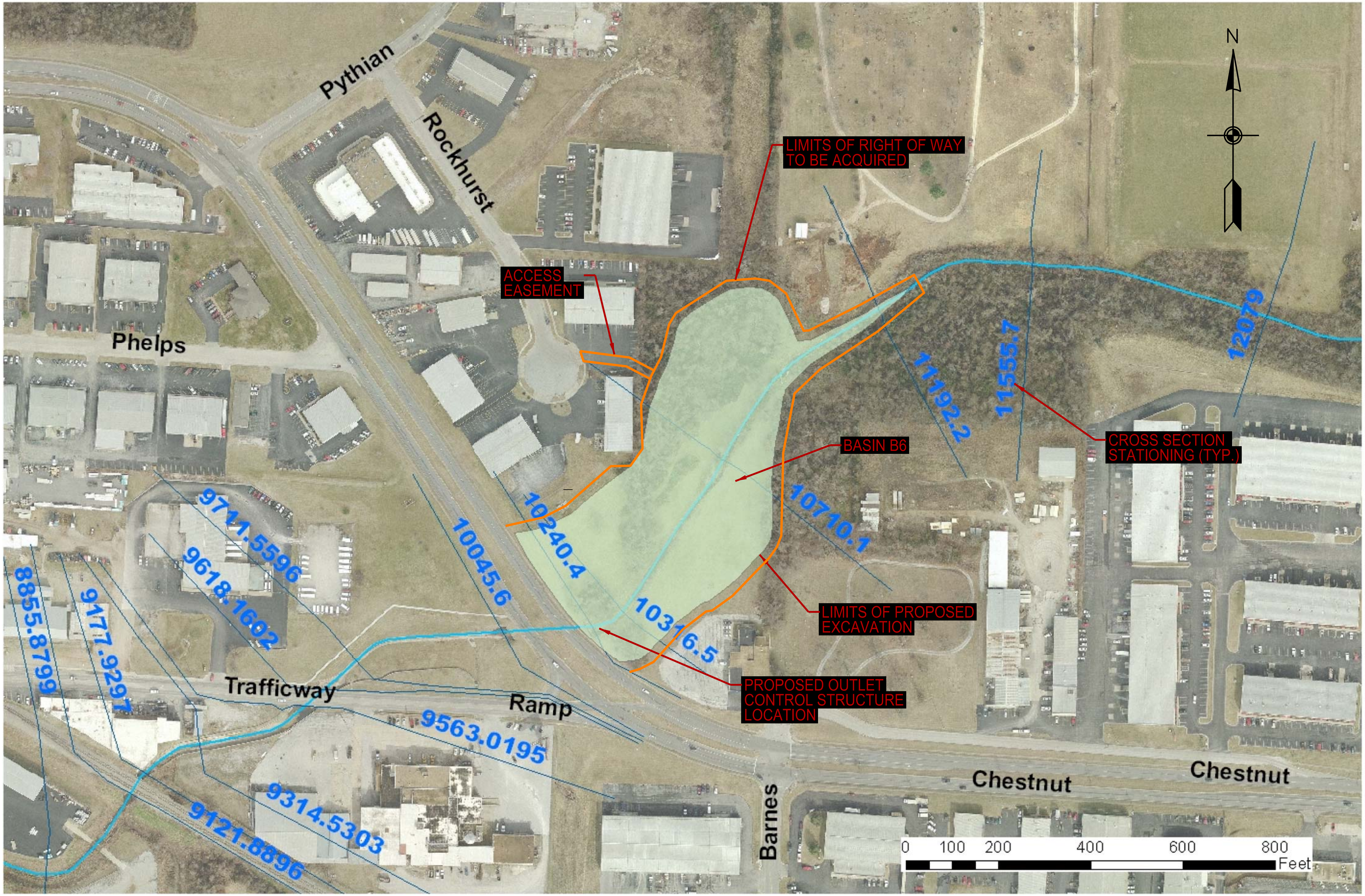
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

REACH E-1 PLAN

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE C-2



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Reviewed by: NPG
Date: MARCH 2013
Solicitation No.: N/A
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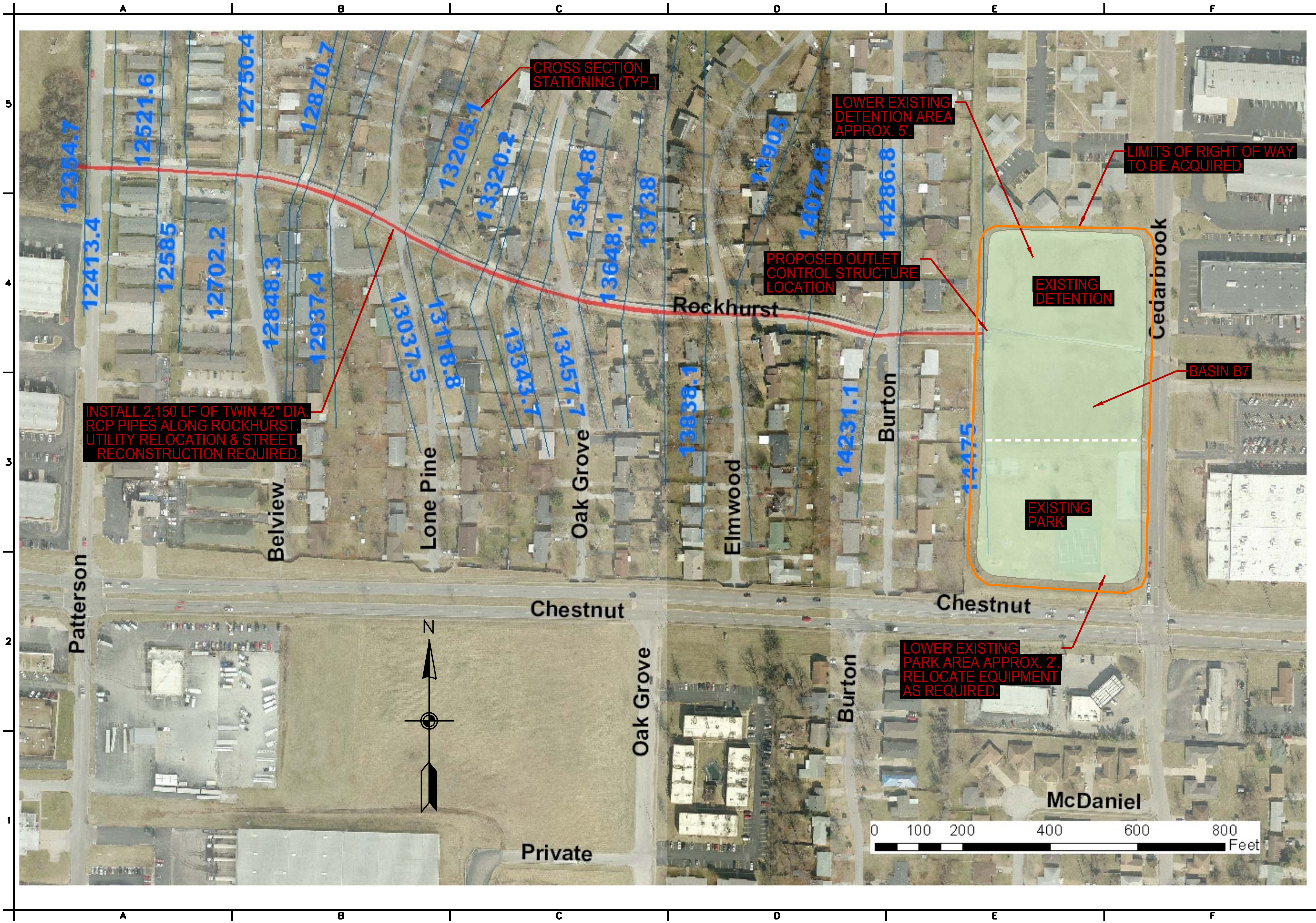
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BASIN 6 PLAN

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE C-3



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Drawn by: NHB	Solicitation No.: N/A	
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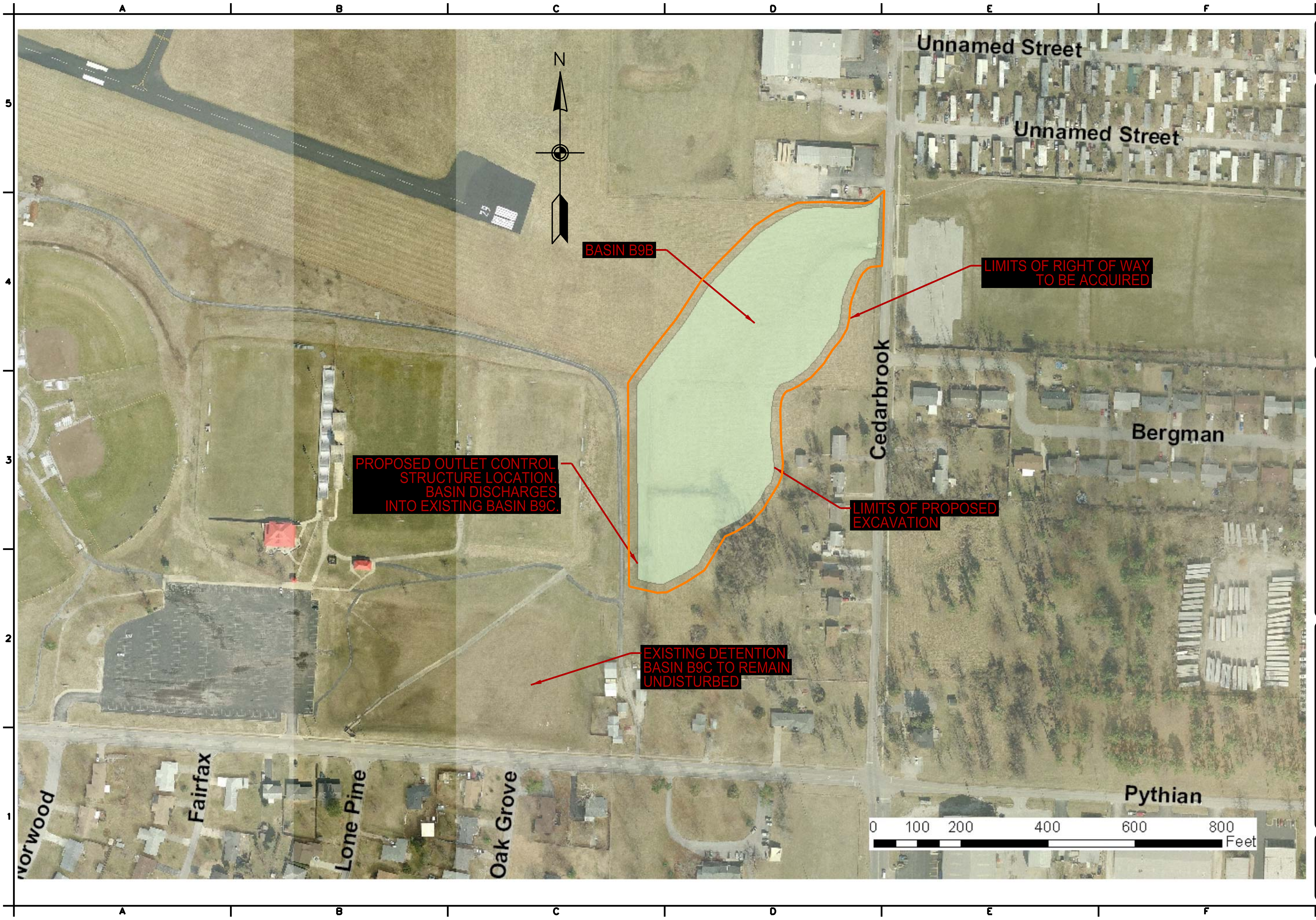
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BASIN 7 PLAN

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE C-4



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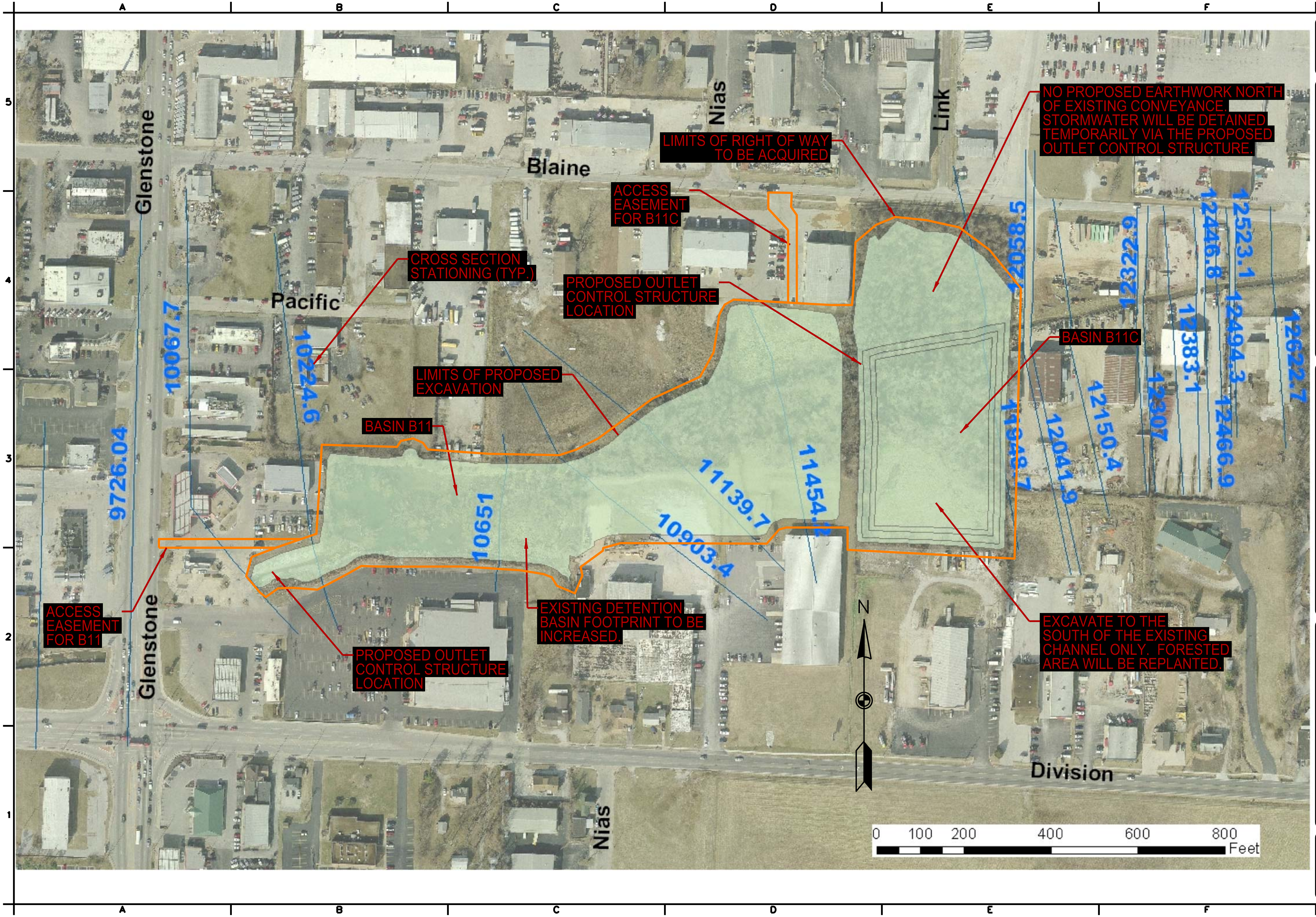
BASIN 9B PLAN

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE C-5



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Solicitation No.: N/A
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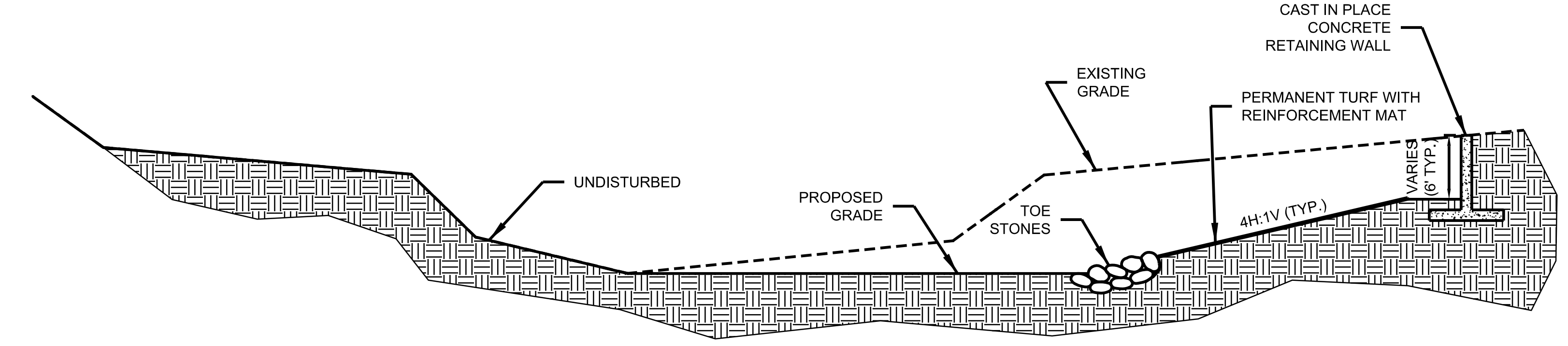
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

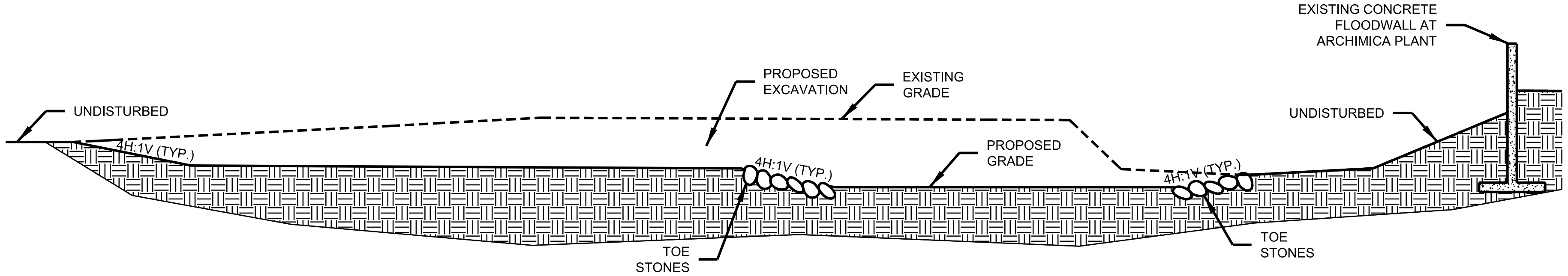
BASINS 11 & 11C PLAN

Drawing Code/ Serial No.

Drawing Ref. No.
PLATE C-6



TYPICAL SECTION
SCENIC TO WILSON RR
STA: 317+53



TYPICAL SECTION
WILSON RR TO BENNETT ST.
STA: 3+20

NOTE:
ACTUAL STRUCTURE CONFIGURATION WILL VARY FOR EACH OF THE DETENTION BASINS.

TYPICAL DETENTION BASIN
OUTLET CONTROL STRUCTURE

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

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Drawn by: NHB
Reviewed by: NPG
Date: MARCH 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

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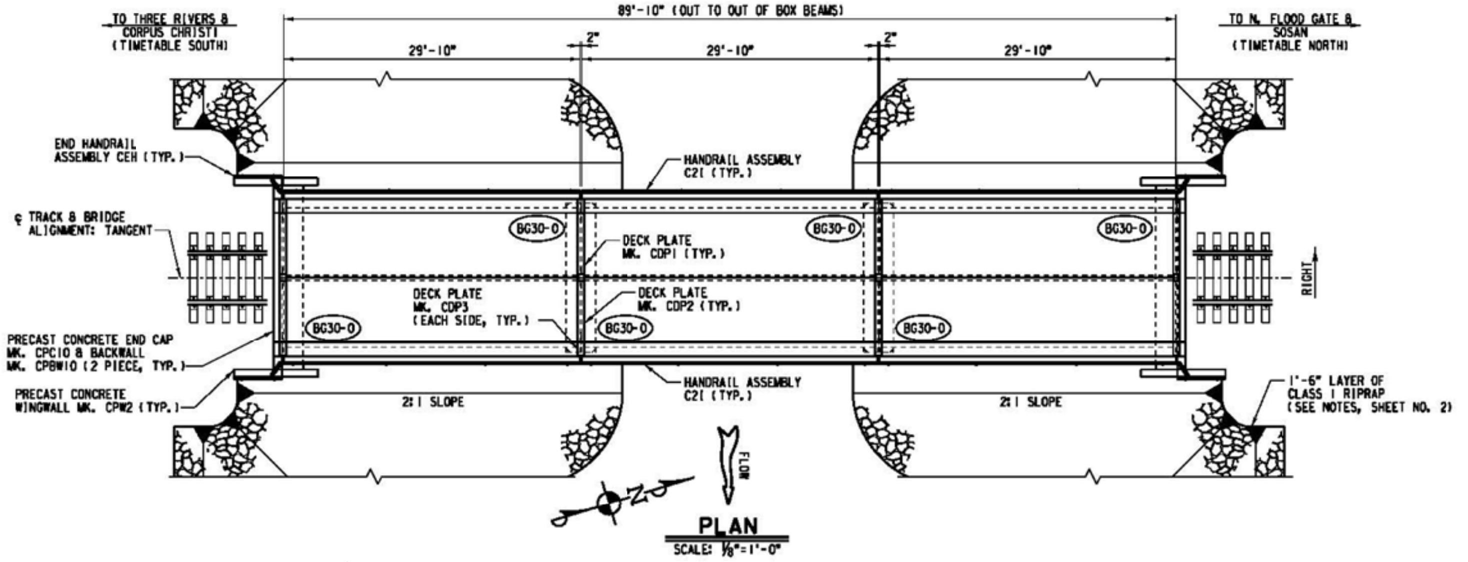
CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

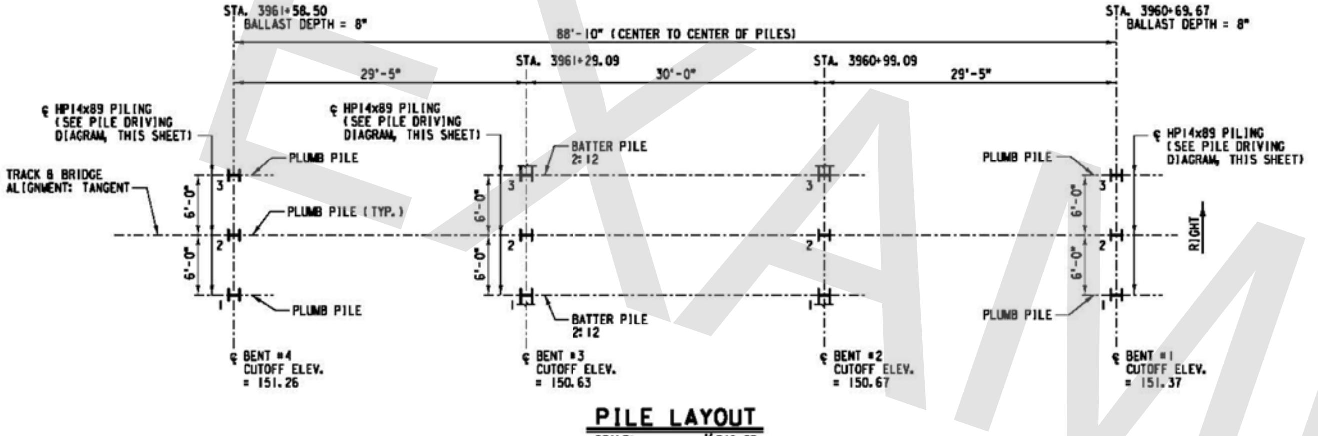
TYPICAL DETAILS

Drawing Code/
Serial No.

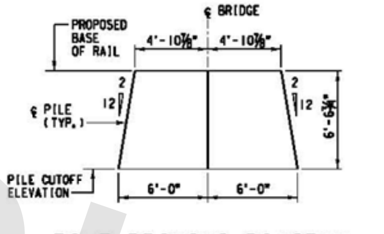
Drawing Ref. No.
PLATE C-7



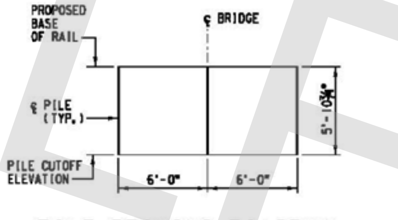
PLAN
SCALE: 1/8"=1'-0"



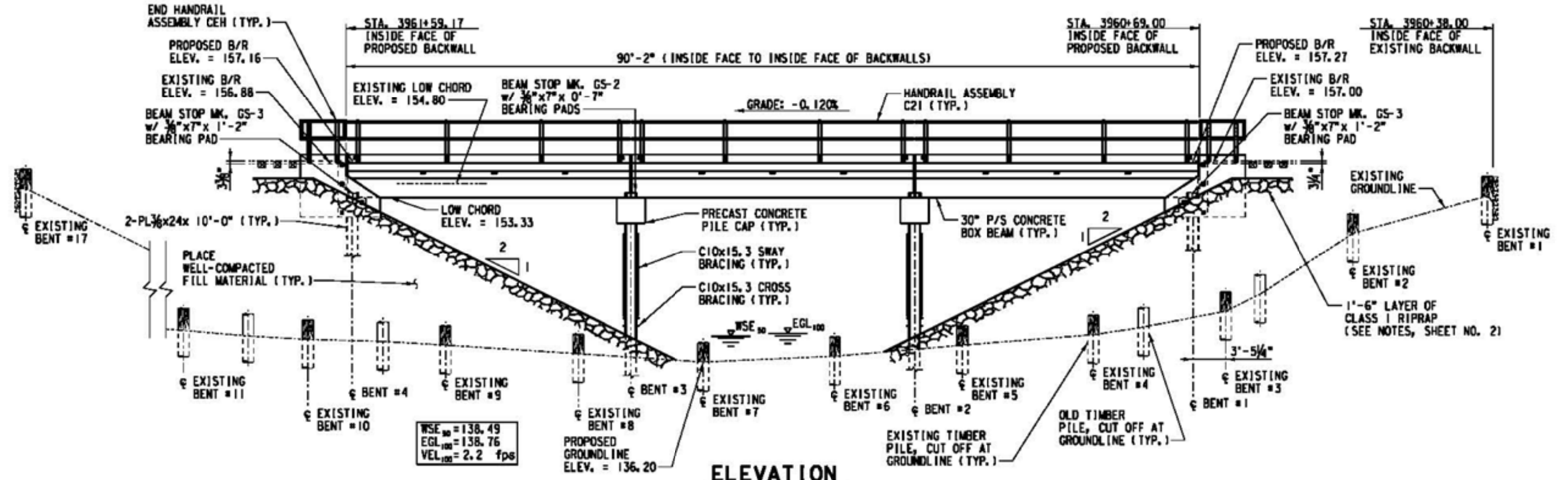
PILE LAYOUT
SCALE: 1/8"1'-0" AT PILE CUTOFF



PILE DRIVING DIAGRAM
SCALE: NO SCALE
@ BENTS #2 AND #3



PILE DRIVING DIAGRAM
SCALE: NO SCALE
@ BENTS #1 AND #4



$WSE_{50} = 138.49$
$EGL_{100} = 138.76$
$VEL_{100} = 2.2$ fps

ELEVATION
SCALE: 1/8"=1'-0"

BILL OF MATERIAL

REQ'D.	UNIT	DESCRIPTION	STORE ITEM NO.	ORDERED BY
6	EA.	30" x 29'-10" PRESTRESSED CONCRETE BOX BEAM MK. BG30-0, TYPE I w/ SLOPED CURB (REF. 3)	511-7828	MANAGER TRACK PROJECT
2	EA.	PRECAST CONCRETE END CAP MK. CPC10 FOR 30" CONCRETE BOX BEAM (REF. 6 AND 8)	511-0480	
2	EA.	PRECAST CONCRETE BACKWALL MK. CPBW10 FOR 30" CONCRETE BOX BEAM (REF. 6 AND 8)	511-7854	
4	EA.	PRECAST CONCRETE WINGWALL MK. CPW2 FOR 30" CONCRETE BOX BEAM (REF. 4)	511-0036	
2	EA.	15'-0" PRECAST CONCRETE PILE CAP w/ BEARING PADS FOR BOX BEAMS (REF. 5 AND 6)	511-0350	
12	EA.	HP14x89x 40'-0" STEEL PILE (ASTM A572 GRADE 50, PLAIN)	510-7557	
12	EA.	HP14x89x 60'-0" STEEL PILE (ASTM A572 GRADE 50, PLAIN)	510-7593	
12	EA.	PILE SPLICER FOR HP14x89 STEEL PILE	510-8065	
12	EA.	HP14x89 STEEL POINTS	510-8063	
8	EA.	C10x15.3x 20'-0" BRACE (ASTM A572 GRADE 50, PLAIN) (FIELD CUT TO LENGTH)	247-6649	
4	EA.	BEAM STOP MK. GS-2 (REF. 7)	510-0595	
4	EA.	BEAM STOP MK. GS-3 (REF. 7)	510-0596	
6	EA.	HANDRAIL ASSEMBLY C2I FOR 29'-10" CONCRETE INTERIOR SPAN (REF. 7)	510-0472	
4	EA.	END HANDRAIL ASSEMBLY CEH FOR CONCRETE SPAN (REF. 7)	513-3020	
4	EA.	DECK PLATE MK. CDP1, GALVANIZED (REF. 7)	510-0590	
4	EA.	DECK PLATE MK. CDP2, GALVANIZED (REF. 7)	510-0591	
8	EA.	DECK PLATE MK. CDP3, GALVANIZED (REF. 7)	510-0592	
8	EA.	3/8"x7"x 0'-7" ELASTOMERIC BEARING PAD	510-3635	
4	EA.	3/8"x7"x 1'-2" ELASTOMERIC BEARING PAD	510-3637	
4	EA.	PL3/8x24x 10'-0" (A36, PLAIN)	510-7650	
34	EA.	1/2"x28"x 6'-4" PREMOLDED EXPANSION JOINT FILLER PER ASTM D1751	511-8213	
380	TON	RIPRAP, CLASS I	562-2764	
2	EA.	BRIDGE MARKER SIGN PER ENGINEERING STANDARDS DRAWING NO. 0507	P00-2616	MANAGER BRIDGE CONST.
2	EA.	PRIVATE PROPERTY/NO TRESPASSING SIGN	393-3651	
2	EA.	9 FT. STEEL MOUNTING POST	393-7510	
2	EA.	SIGN MOUNTING HARDWARE KIT	393-7314	
27	TON	WELL-GRADED 1 1/2" MINUS CRUSHED ROCK		
4750	CU. YD.	FILL MATERIAL		
1	LOT	PL-400 HEAVY DUTY CONSTRUCTION ADHESIVE		

EST. WT. OF STEEL PILING = 85,440 LB.
EST. WT. OF STEEL CROSS AND SWAY BRACING = 2,450 LB.
EST. WT. OF MISC. STEEL (NOT INCL. BOLTS) = 4,620 LB.

DRAWING SCHEDULE

THIS SET	SHEET NO.	DESCRIPTION
	1	GENERAL ARRANGEMENT AND BILL OF MATERIAL
	2	NOTES AND TOP OF RAIL PROFILE

REF.	NO.	DWG. NO.	SHEET NO.	REV. NO.	DESCRIPTION
	1	530000	A1-A7	A	BOX AND SLAB BEAM, CONSTRUCTION PLANS
	2	530000	B1-B5	A	30" BOX BEAM, CONSTRUCTION DETAILS
	3	500000	BG1, BG2	F	30" DOUBLE BOX BEAM, FABRICATION PLANS
	4	501000	A1	-	PRECAST END CAP FOR 30" BOX BEAM
	5	501000	C1, C2	-	PRECAST CONCRETE PILE CAP
	6	531010	1	-	PRECAST CONCRETE PILE CAP BEARING PADS
	7	502000	1-4	A	STEEL HARDWARE AND HANDRAIL ASSEMBLIES
	8	531200	1-7	-	SINGLE TRACK TWO PIECE END CAP

EST. WT. OF PRECAST CONCRETE

BOX BEAM MK. BG30-0 = 49,500 LB. EA. (24.8 TON)
15'-0' PILE CAP = 19,700 LB. EA. (9.9 TON)
END CAP MK. CPC10 = 17,650 LB. EA. (9.8 TON)
BACKWALL MK. CPBW10 = 7,280 LB. EA. (3.7 TON)
WINGWALL MK. CPW2 = 4,900 LB. EA. (2.5 TON)

NO.	DATE	REVISIONS
	/ /	
	/ /	
	/ /	
	/ /	

FORMER MOPAC BRIDGE NO. 76.2

UNION PACIFIC RAILROAD
Office of AVP Engineering Design/Construction

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: UP RR
Date: JANUARY 2012
Drawn by: UP RR
Solicitation No.: N/A
Reviewed by: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

EXAMPLE RR BRIDGE DESIGN

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE S-1

- 🟨 New - New structure where one does not currently exist or new structure in different location than original structure
- 🟥 Replaced = Replaced structure being built
- 🟩 Modified = the structure/foundation is modified
- 🟪 removed - the structure is removed
- 🟦 Unchanged = No changes to existing structure
- 🟧 Indicates RR Structure

structure	station	location	reach	action	plan_a	plan_d	plan_b	plan_c	plan_e	plan_f	plan_g	plan_h	Plan_i	Plan_j
Scenic Bridge	311+18	Wilson's	E1	Bridge	Unchanged	Modified	Unchanged	Unchanged	Unchanged	Modified	Modified	Modified	Modified	Modified
Bridge Type						Found. Mod.				Found. Mod.	Found. Mod.	Found. Mod.	Found. Mod.	Found. Mod.
Foundation Type						Drilled Piers				Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers
Wilson's Rail Road Bridge	322+94	Wilson's	E1	Bridge	Replaced	Replaced	Replaced	Modified	Modified	Replaced	Replaced	Replaced	Replaced	Replaced
Bridge Type					Pre. Conc. Girder	Pre. Conc. Girder	Pre. Conc. Girder	Found. Mod.	Found. Mod.	Pre. Conc. Girder	Pre. Conc. Girder	Pre. Conc. Girder	Pre. Conc. Girder	Pre. Conc. Girder
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers			Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers
No. of Spans					3 Span	3 Span	3 Span			3 Span	3 Span	3 Span	3 Span	3 Span
Bennett Street Bridge	8+03	Jordan - Lower Branch 3	E1	Bridge	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Catalpa Bridge	23+93	Jordan - Lower Branch 3	E1	Bridge	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Grand Street Bridge	40+94	Jordan - Lower Branch 3	E2	Bridge	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Conc. Box Bm									
Foundation Type					Drilled Piers									
No. of Spans					3 Span									
Mount Vernon Street Bridge	71+13	Jordan - Lower Branch 3	E2	Bridge	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm					
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers					
No. of Spans					3 Span	3 Span	3 Span	2 Span	2 Span					
Kansas Expressway	79+84	Jordan - Lower Branch 3	E2	Bridge	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Walnut Street Bridge	85+26	Jordan - Lower Branch 3	E2	Bridge	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm					
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers					
No. of Spans					3 Span	3 Span	3 Span	2 Span	2 Span					
College Street Bridge	91+10	Jordan - Lower Branch 3	E2	Bridge	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm					
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers					
No. of Spans					3 Span	3 Span	3 Span	2 Span	2 Span					
College Street RR Bridge	91+85	Jordan - Lower Branch 3	E2	Bridge	Replaced	Replaced	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Pre. Conc. Girder	Pre. Conc. Girder	Pre. Conc. Girder							
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers							
No. of Spans					4 Span	4 Span	4 Span							
Fort Street Bridge	98+51	Jordan - Lower Branch 3	E2	Bridge	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
RR Bridge DS of Grant	120+82	Jordan - Lower Branch 3	E3	Bridge	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Building Over the Channel	125+24	Jordan - Lower Branch 3	E3	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Unchanged
Grant Street Bridge	126+83	Jordan - Lower Branch 3	E3	Existing Bridge to Remain	Modified	Modified	Modified	Modified	Unchanged	Modified	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Found. Mod.	Found. Mod.	Found. Mod.	Found. Mod.		Found. Mod.				
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers		Drilled Piers				
Main Street Bridge	133+28	Jordan - Lower Branch 3	E3	Bridge	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged
Bridge Type					Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	
No. of Spans					3 Span	3 Span	3 Span	2 Span	2 Span	3 Span	2 Span	3 Span	3 Span	
Campbell Street	139+85	Jordan - Lower Branch 2	E3	Bridge	New	New	New	New	New	New	New	New	New	Unchanged
Bridge Type					Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	Conc. Box Bm	
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	
No. of Spans					2 Span	3 Span	2 Span	2 Span	2 Span	2 Span	2 Span	2 Span	2 Span	
Boonville Street Box Culvert	145+57	Jordan - Lower Branch 2	E3	Box Culverts	New	New	New	New	New	New	New	New	New	Unchanged
Phelps Street	151+48	Jordan - Lower Branch 2	E3	Box Culverts	New	New	New	New	New	New	New	Unchanged	New	Unchanged
Benton Street	159+67	Jordan - Lower Branch 2	E3	Exisiting Bridge to Remain	Modified	Modified	Modified	Modified	Modified	Modified	Modified	Unchanged	Modified	Unchanged
Phelps Street (under RR)	165+63	Jordan - Lower Branch 2	E3	Box Culverts	New	New	New	New	New	New	New	Unchanged	New	Unchanged
North Branch RR Culvert	7+43	Jordan - North Branch	E4	Box Culverts	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Chestnut Expressway Overpass	10+64	Jordan - North Branch	E4	Existing Bridge to Remain	Modified	Modified	Modified	Modified	Modified	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Found. Mod.	Found. Mod.	Found. Mod.	Found. Mod.	Found. Mod.					
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers	Drilled Piers					
Lower Chestnut	11+35	Jordan - North Branch	E4	Bridge	New	New	New	New	New	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bob Barker Box Culvert	15+99	Jordan - North Branch	E4	Removed	Removed	Removed	Removed	Removed	Removed	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Central Street Culvert	20+34	Jordan - North Branch	E4	Bridge	Replaced	Replaced	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Conc. Box Bm	Conc. Box Bm	Conc. Box Bm							
Foundation Type					Drilled Piers	Drilled Piers	Drilled Piers							
No. of Spans					1 Span	1 Span	1 Span							
Smith Park#1 Bridge	75+30	Jordan - North Branch	E5	Bridge	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Prefab. Steel Brdge									
Foundation Type					Conc. Abutments									
No. of Spans					1 Span									
Smith Park#2 Bridge	79+98	Jordan - North Branch	E5	Bridge	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Prefab. Steel Brdge									
Foundation Type					Conc. Abutments									
No. of Spans					1 Span									
Bridge over Channel 1	1+14	Jordan - South Branch	E6	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Unchanged	Removed	Unchanged
Bridge over Channel 2	7+48	Jordan - South Branch	E6	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Unchanged	Removed	Unchanged
RR Culvert DS of Sherman Street	9+77	Jordan - South Branch	E6	Box Culverts	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged	Replaced	Unchanged
Sherman Street Box Culvert	12+02	Jordan - South Branch	E6	Box Culverts	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged
Bridge at Conco	14+84	Jordan - South Branch	E6	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Unchanged	Removed	Unchanged
National Box Culvert	28+60	Jordan - South Branch	E6	Box Culverts	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged
Prospect Culvert (added Oct. 2012)	33+37	Jordan - South Branch	E6	Box Culverts	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Replaced	Unchanged
Star Wholesale Box Culvert	44+31	Jordan - South Branch	E6	Box Culverts	New	New	New	New	New	New	New	New	New	Unchanged
Fremont Street Box Culvert	46+18	Jordan - South Branch	E6	Box Culverts	Replaced	Replaced	Replaced	Replaced	Unchanged	Replaced	Unchanged	Unchanged	Unchanged	Unchanged
RR Bridge DS of Trafficway #1	76+81	Jordan - South Branch	E6	Bridge	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Pre. Conc. Girder									
Foundation Type					Drilled Piers									
No. of Spans					2 Span									
RR Bridge DS of Trafficway #2A	77+30	Jordan - South Branch	E6	Bridge	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Pre. Conc. Girder									
Foundation Type					Drilled Piers									
No. of Spans					2 Span									
Trafficway Culvert	83+58	Jordan - South Branch	E6	Box Culverts	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
RR Bridge DS of Trafficway #2B	91+39	Jordan - South Branch	E6	Bridge	Replaced	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Bridge Type					Pre. Conc. Girder									
Foundation Type					Drilled Piers									
No. of Spans					2 Span									

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Date: JANUARY 2012
Solicitation No.: N/A
Contract No.:
Designed by: DCE
Drawn by: NHB
Reviewed by: NPG

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

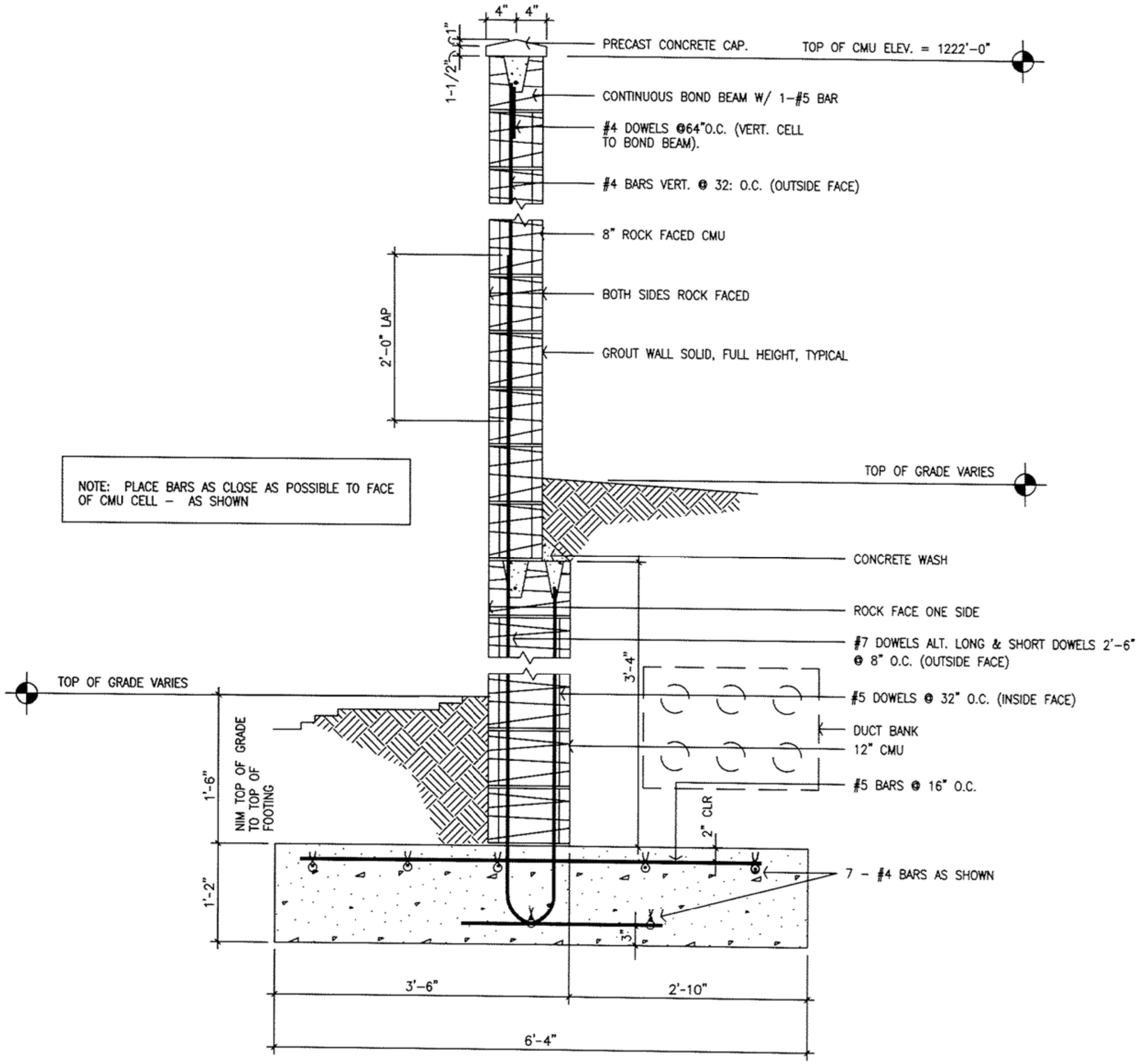
CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

STRUCTURAL SYSTEM CHART

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE S-2



NOTE: PLACE BARS AS CLOSE AS POSSIBLE TO FACE OF CMU CELL - AS SHOWN

② FLOODWALL SECTION

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: DCE
Drawn by: NHB
Reviewed by: NPG
Date: JANUARY 2012
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

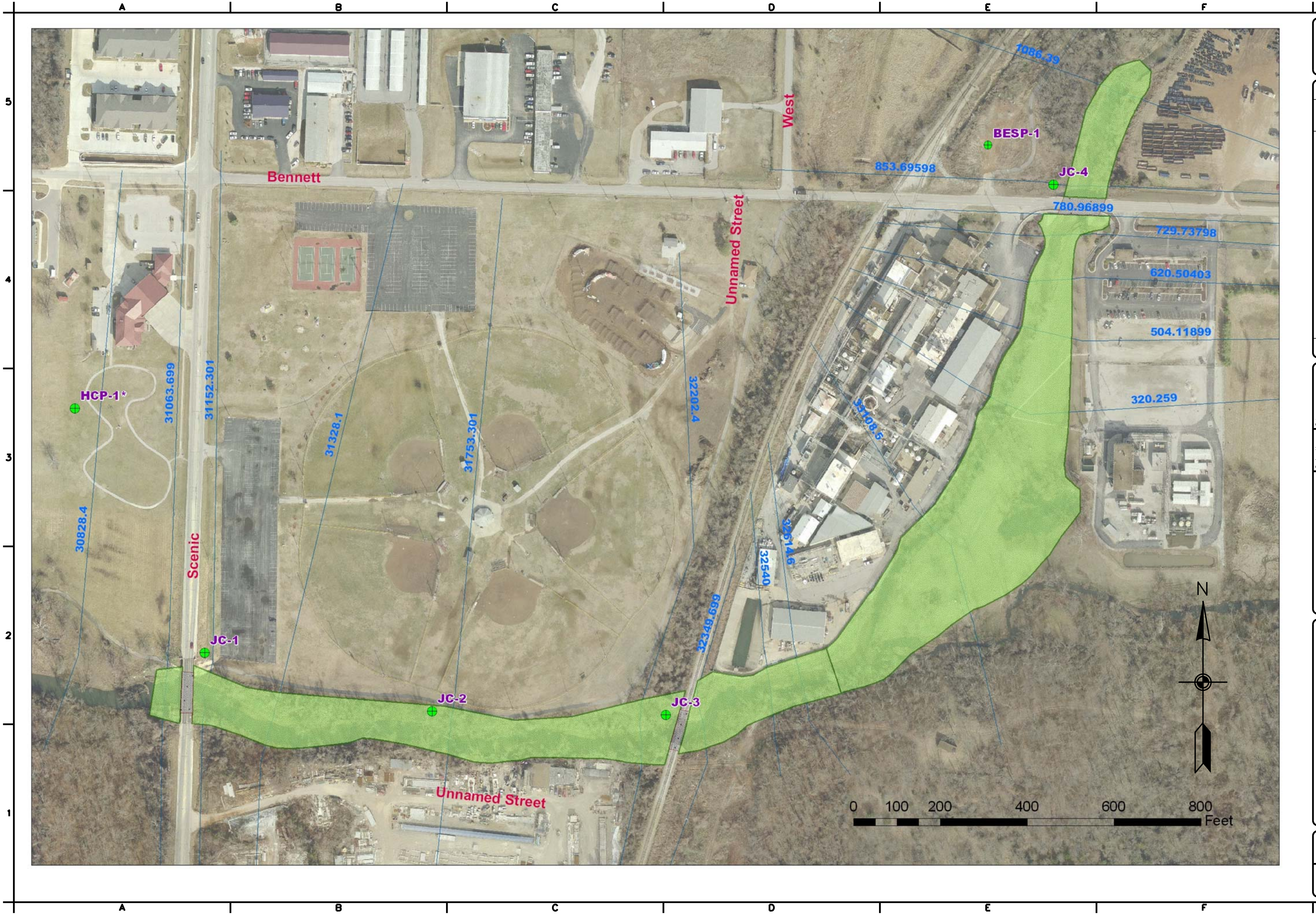
Submitted by:

Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY
EXISTING FLOODWALL
AT ARCHIMICA PLANT

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE S-3



US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB
Drawn by: NHB
Reviewed by: NPG
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

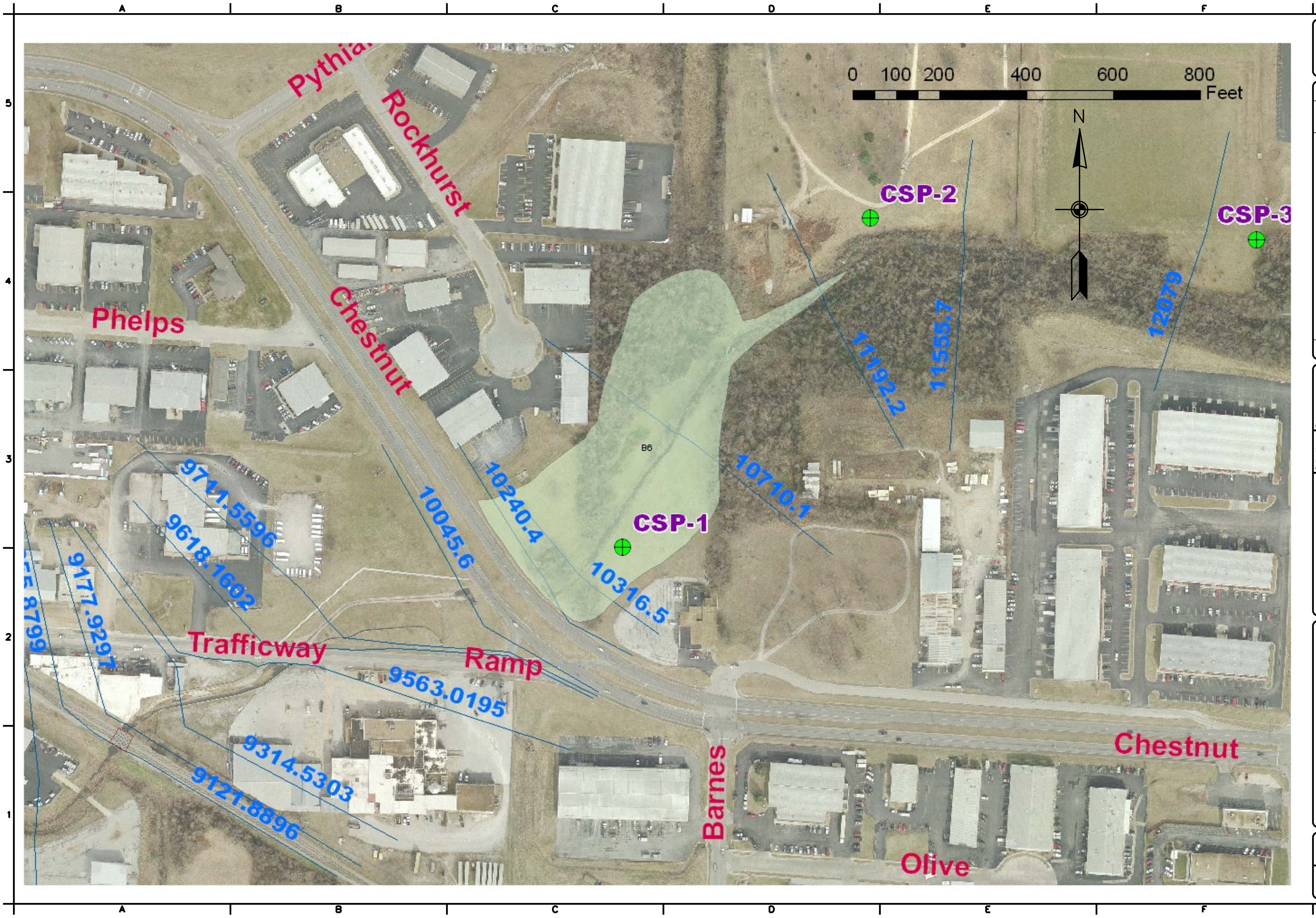
CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PLAN 1

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-1



US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB

Date: JANUARY 2013

Drawn by: NHB

Solicitation No.: N/A

Reviewed by: NPG

Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

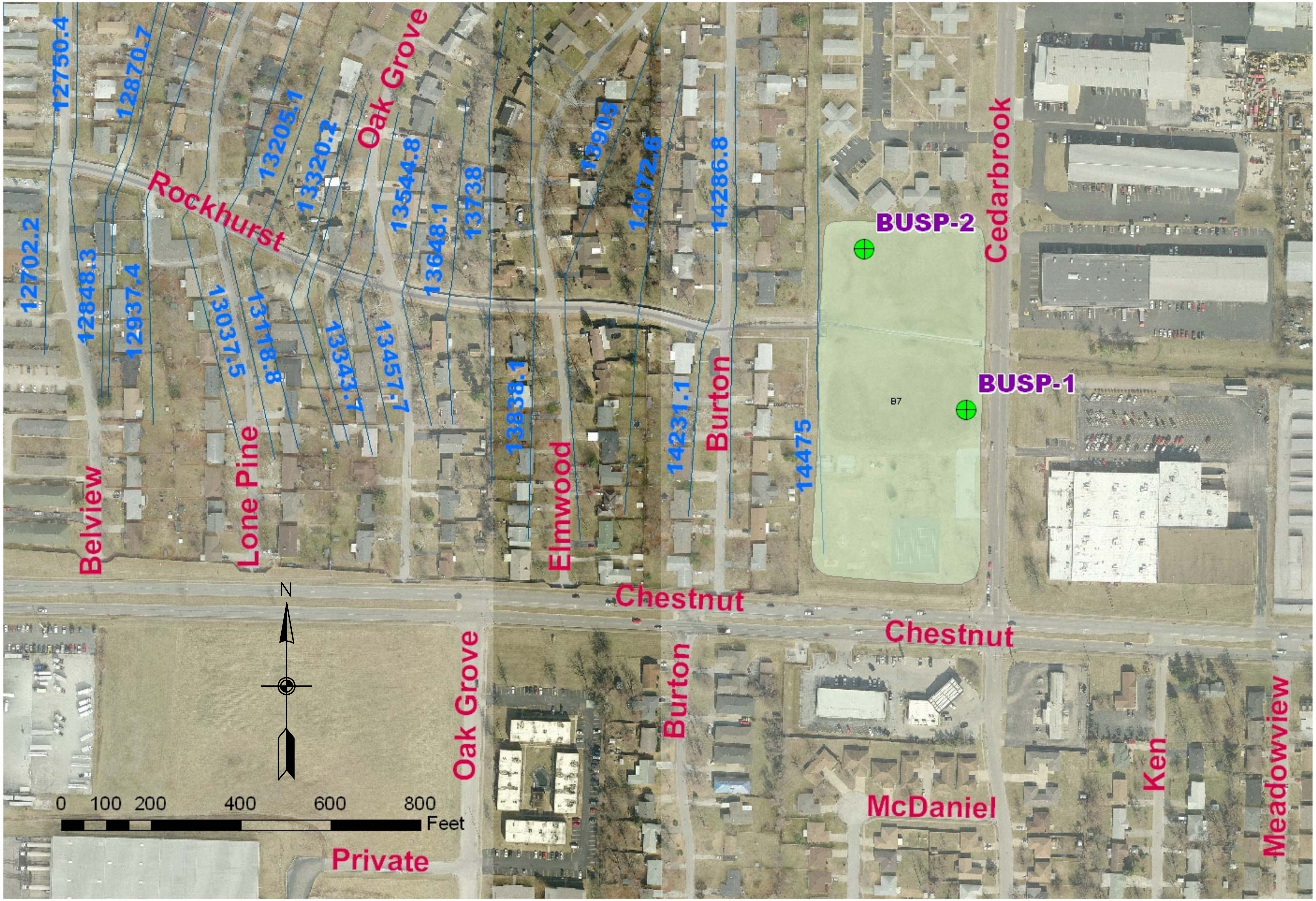
CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PLAN 2

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-2



US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB
Date: JANUARY 2013
Drawn by: NHB
Solicitation No.: N/A
Reviewed by: NPG
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

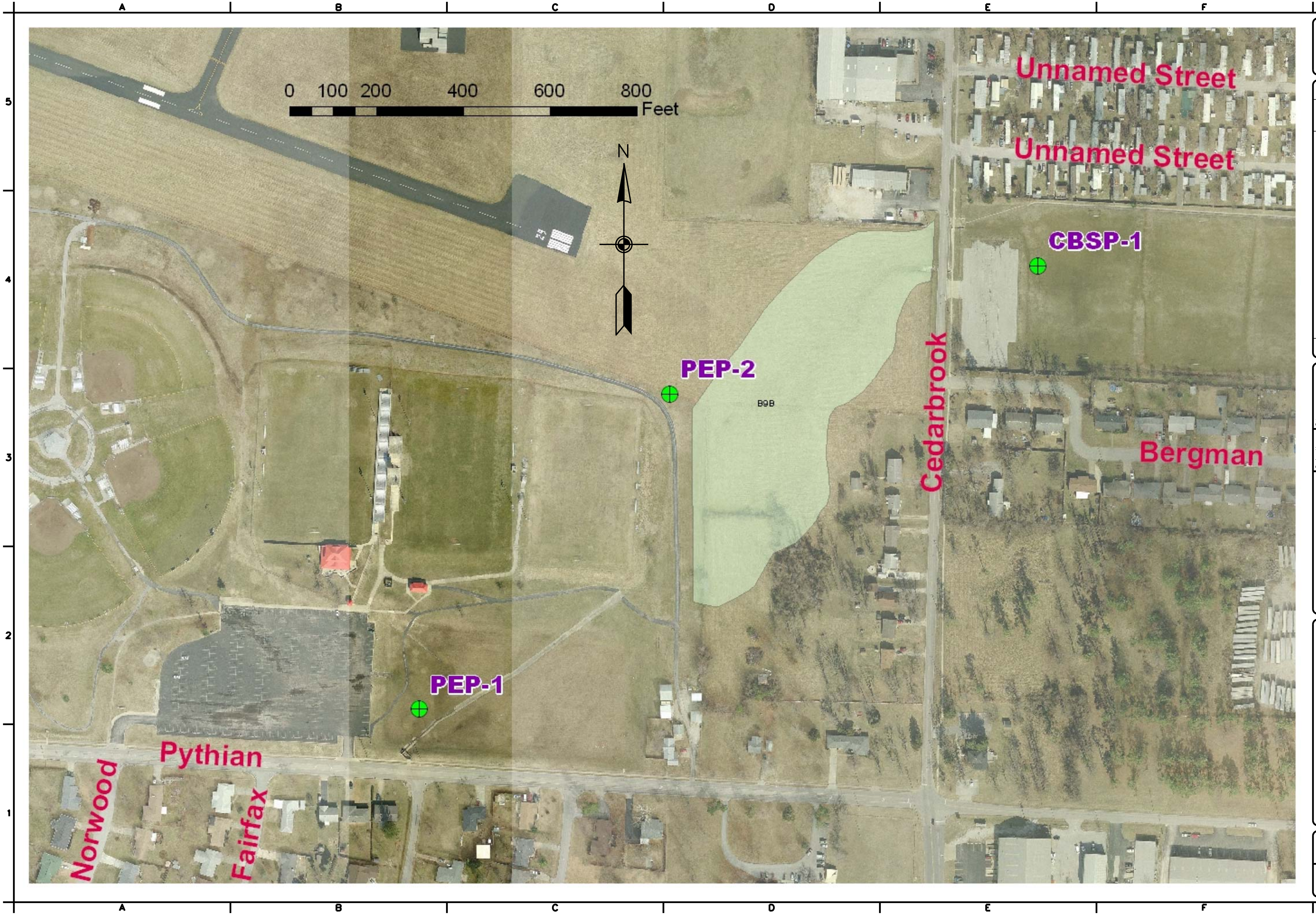
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PLAN 3

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-3



US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB
Drawn by: NHB
Reviewed by: NPG
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

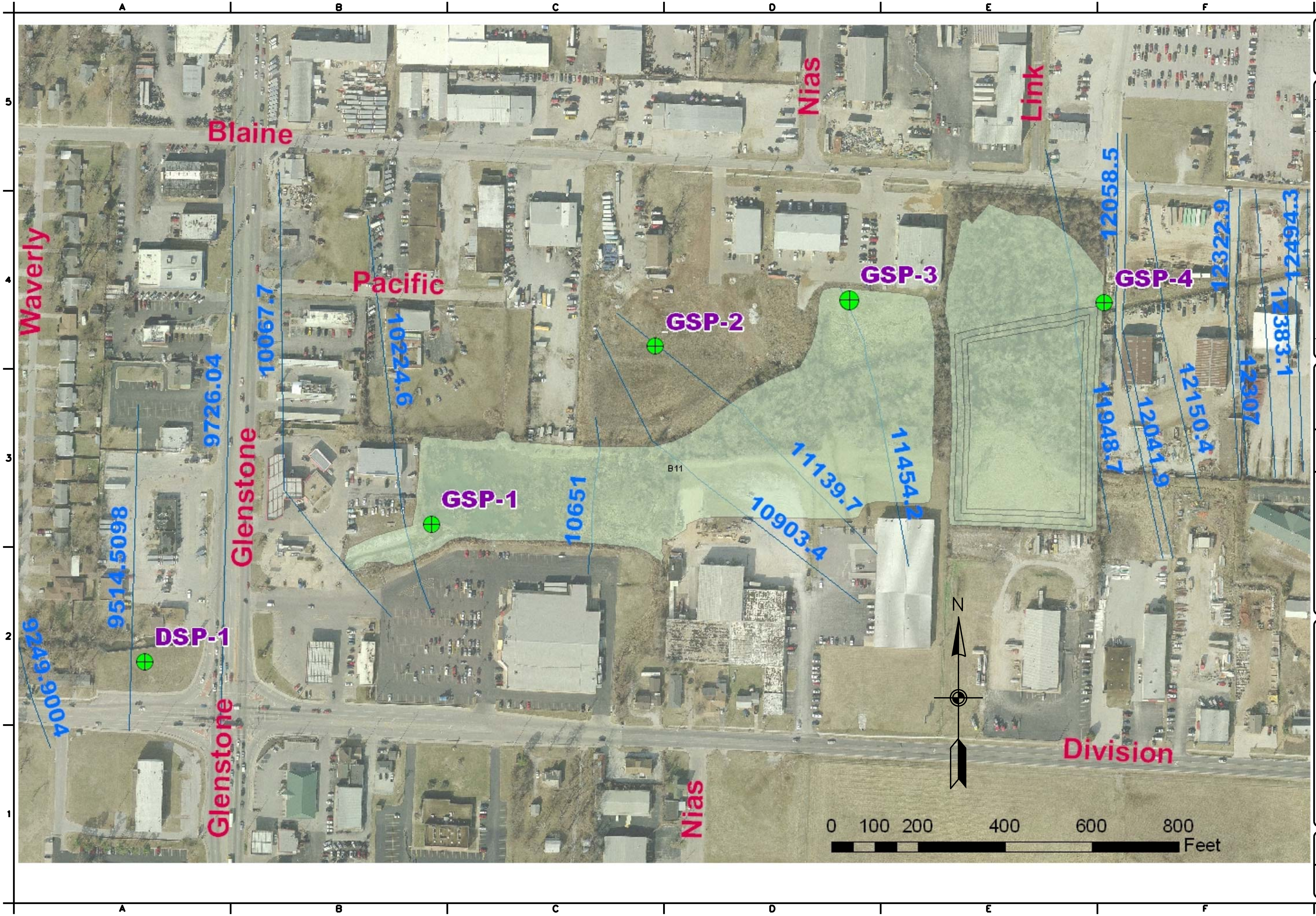
Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PLAN 4

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-4



US Army Corps of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB	Date: JANUARY 2013	
Drawn by: NHB	Solicitation No.: N/A	
Reviewed by: NPG	Contract No.:	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PLAN 5

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-5

US Army Corps of Engineers
Little Rock District

Symbol	Description	Date	Appr.

A/E ANDERSON ENGINEERING, INC.

ENGINEERS • SURVEYORS • LABORATORIES • GEOTECHNICAL

SPRINGFIELD OFFICE: 2045 W. Woodland Street, Springfield, Mo. 65807 (417) 866-2741
JOPLIN OFFICE: 501 E. 15th Street Joplin, Mo. 64804, (417) 782-7399
FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek – New Channel Alignment
Springfield, Missouri

BORING NO. JC-1
CLIENT NO. 69515
DATE DRILLED: 06/15/07
DRILL RIG: 03 DRILLER: G.W.

TOTAL DEPTH DRILLED: 15.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 3.0 FT.
AT COMPLETION 3.0 FT.

DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH–LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
Grass covered dark gray, gray, brown and yellowish brown lean clay with 10–20% chert and some glass and wood debris, moist and medium stiff (possible fill)		Solid Stem Augers	3 3 5		23.8	37	21	16	CL
			3 3 4		28.3				
Dark gray lean clay with 0–10% chert, moist and medium stiff	▨								
Gray lean clay with yellowish brown mottles and 0–10% chert, moist and medium to soft	▨		1 1 1	500*	32.9	43	22	21	CL
Gray lean clay with yellowish brown mottles and 0–10% chert, moist and stiff	▨		3 7 6	4000*	28.6				
			5 8 50/2"		32.6				
Limestone, weathered	▦								
Limestone, moderately hard	▦								
Discontinued drilling									

NOTE: * Penetrometer
0' to 1.5': Hue 10YR: 3/1, 5/1

A/E ANDERSON ENGINEERING, INC.

ENGINEERS • SURVEYORS • LABORATORIES • GEOTECHNICAL

SPRINGFIELD OFFICE: 2045 W. Woodland Street, Springfield, Mo. 65807 (417) 866-2741
JOPLIN OFFICE: 501 E. 15th Street Joplin, Mo. 64804, (417) 782-7399
FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek – New Channel Alignment
Springfield, Missouri

BORING NO. JC-2
CLIENT NO. 69515
DATE DRILLED: 06/15/07
DRILL RIG: 03 DRILLER: G.W.

TOTAL DEPTH DRILLED: 16.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 12.0 FT.
AT COMPLETION 10.0 FT.

DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH–LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
Grass covered dark brown, dark gray, and yellowish brown lean clay and red fat clay with 10–30% chert, moist and medium to stiff (possible fill)		Solid Stem Augers	4 3 3		17.6				
			5 3 7	3000*	24.7	41	33	8	CL
			3 3 6	3000*	23.8				
Gray lean clay with yellowish brown mottles and 0–10% chert, moist and stiff	▨		4 5 7	7000*	23.9				
Yellowish brown and gray mottled lean clay with 20–40% chert, moist and very stiff	▨		15 15 14		29.8	48	21	27	CL
Limestone, weathered	▦		50/5"		23.4				
Limestone, moderately hard	▦								
Discontinued drilling									

NOTE: * Penetrometer
0' to 1.5': Hue 7.5YR: 3/2, Hue 2.5YR: 4/6, 3/0

A/E ANDERSON ENGINEERING, INC.

ENGINEERS • SURVEYORS • LABORATORIES • GEOTECHNICAL

SPRINGFIELD OFFICE: 2045 W. Woodland Street, Springfield, Mo. 65807 (417) 866-2741
JOPLIN OFFICE: 501 E. 15th Street Joplin, Mo. 64804, (417) 782-7399
FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek – New Channel Alignment
Springfield, Missouri

BORING NO. JC-3
CLIENT NO. 69515
DATE DRILLED: 06/15/07
DRILL RIG: 03 DRILLER: G.W.

TOTAL DEPTH DRILLED: 15.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 12.0 FT.
AT COMPLETION 14.0 FT.

DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH–LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
Crushed stone		Solid Stem Augers	12 5 4		7.4				
Brown, reddish brown and gray lean clay with 20–40% chert, moist and stiff to medium (possible fill)									
			3 2 2	1000*	24.4 39.4				
Gray lean clay with yellowish brown mottles and 0–10% chert, moist and medium to soft	▨		5 3 3	2000* 500*	19.3 24.6	35	17	18	CL
			0 0 0	500*	37.2	43	22	21	CL
Gray lean clay with 20–40% chert, moist and stiff	▨		4 6 9		29.3				
Limestone, moderately hard	▦								
Discontinued drilling									

NOTE: * Penetrometer
0' to 1.5': Crushed stone recovered

Date: JANUARY 2013	Solicitation No.: N/A	Contract No.:
Designed by: NHB	Drawn by: NHB	Reviewed by: NPG

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

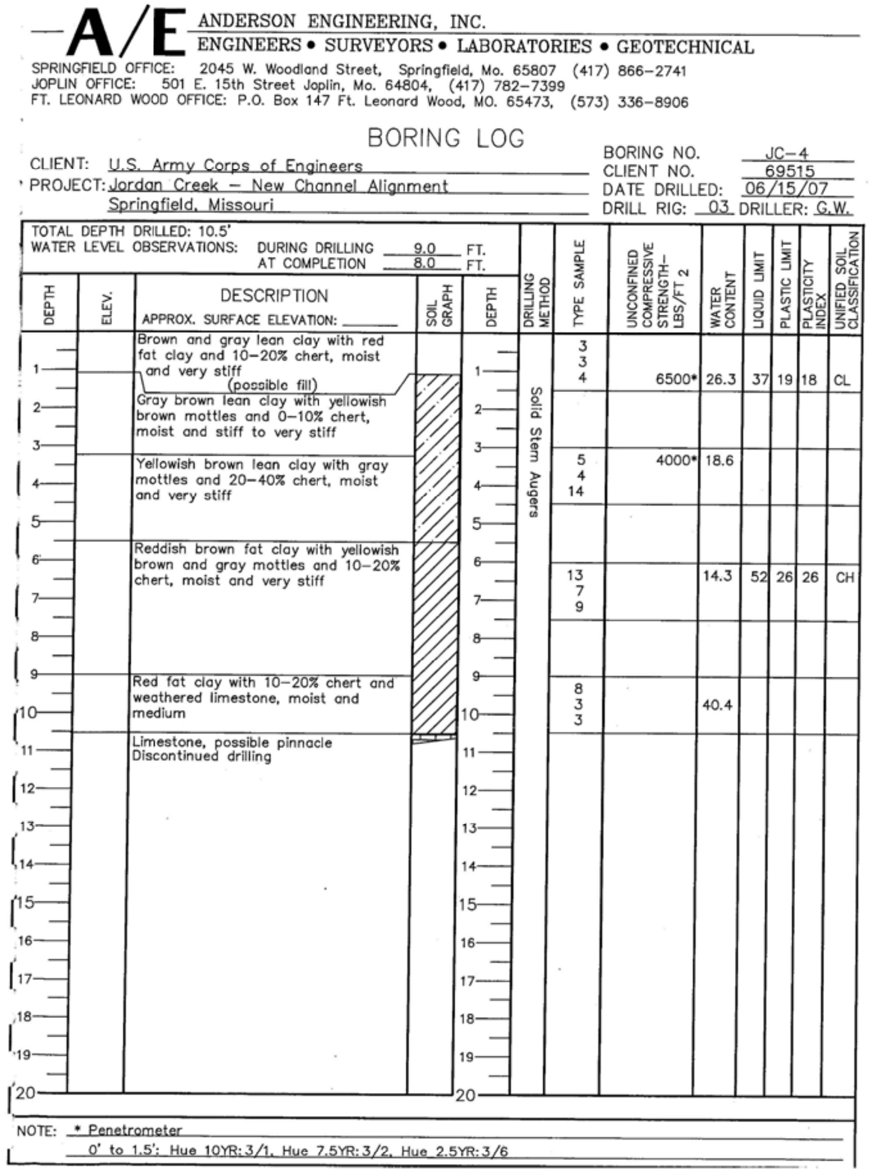
Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PROFILES 1

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-6



A/E ANDERSON ENGINEERING, INC.
ENGINEERS • SURVEYORS • LABORATORIES • GEOTECHNICAL
SPRINGFIELD OFFICE: 2045 W. Woodland Street, Springfield, Mo. 65807 (417) 866-2741
JOPLIN OFFICE: 501 E. 15th Street Joplin, Mo. 64804, (417) 782-7399
FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

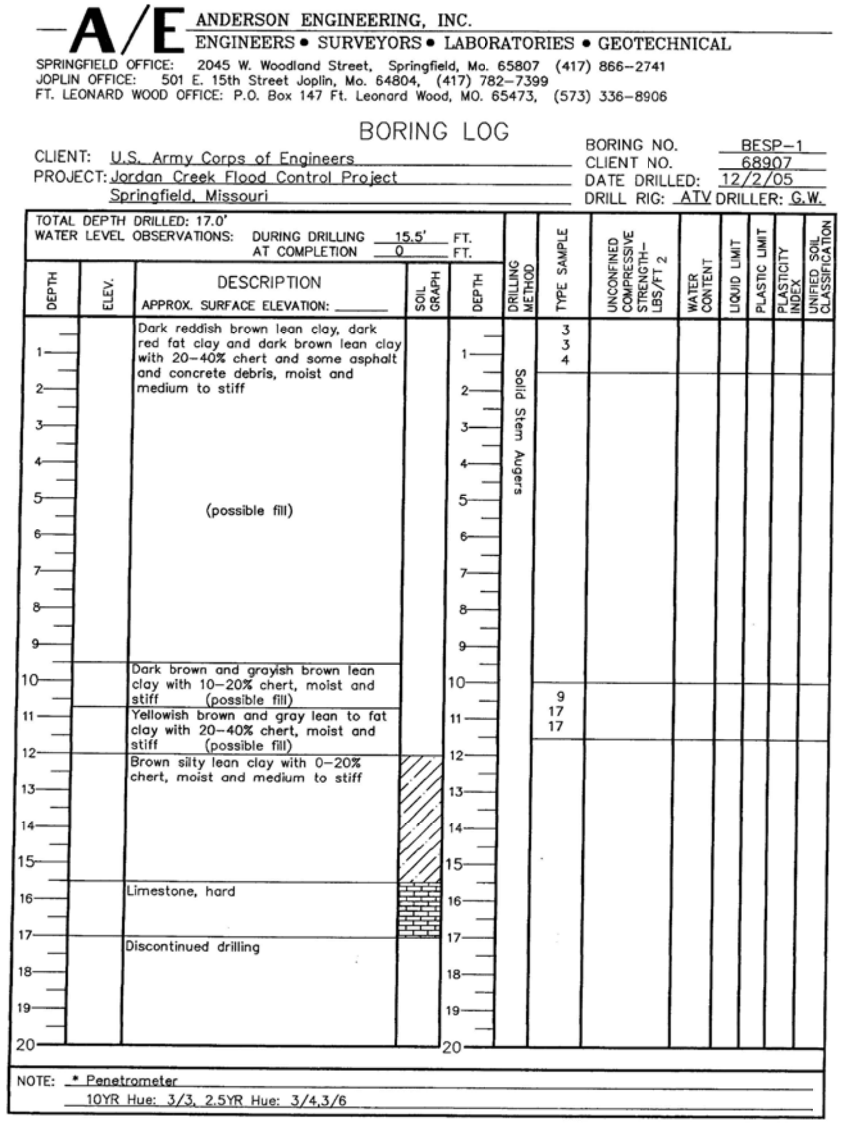
BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek – New Channel Alignment
Springfield, Missouri
BORING NO. JC-4
CLIENT NO. 69515
DATE DRILLED: 06/15/07
DRILL RIG: 03 DRILLER: G.W.

TOTAL DEPTH DRILLED: 10.5'
WATER LEVEL OBSERVATIONS: DURING DRILLING 9.0 FT.
AT COMPLETION 8.0 FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH–LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Brown and gray lean clay with red fat clay and 10–20% chert, moist and very stiff (possible fill)			Solid Stem Augers	3 3 4	6500*	26.3	37	19	18	CL
		Gray brown lean clay with yellowish brown mottles and 0–10% chert, moist and stiff to very stiff	▨									
		Yellowish brown lean clay with gray mottles and 20–40% chert, moist and very stiff	▨			5 4 14	4000*	18.6				
		Reddish brown fat clay with yellowish brown and gray mottles and 10–20% chert, moist and very stiff	▨			13 7 9		14.3	52	26	26	CH
		Red fat clay with 10–20% chert and weathered limestone, moist and medium	▨			8 3 3		40.4				
		Limestone, possible pinnacle Discontinued drilling										

NOTE: * Penetrometer
0' to 1.5': Hue 10YR:3/1, Hue 7.5YR:3/2, Hue 2.5YR:3/6



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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

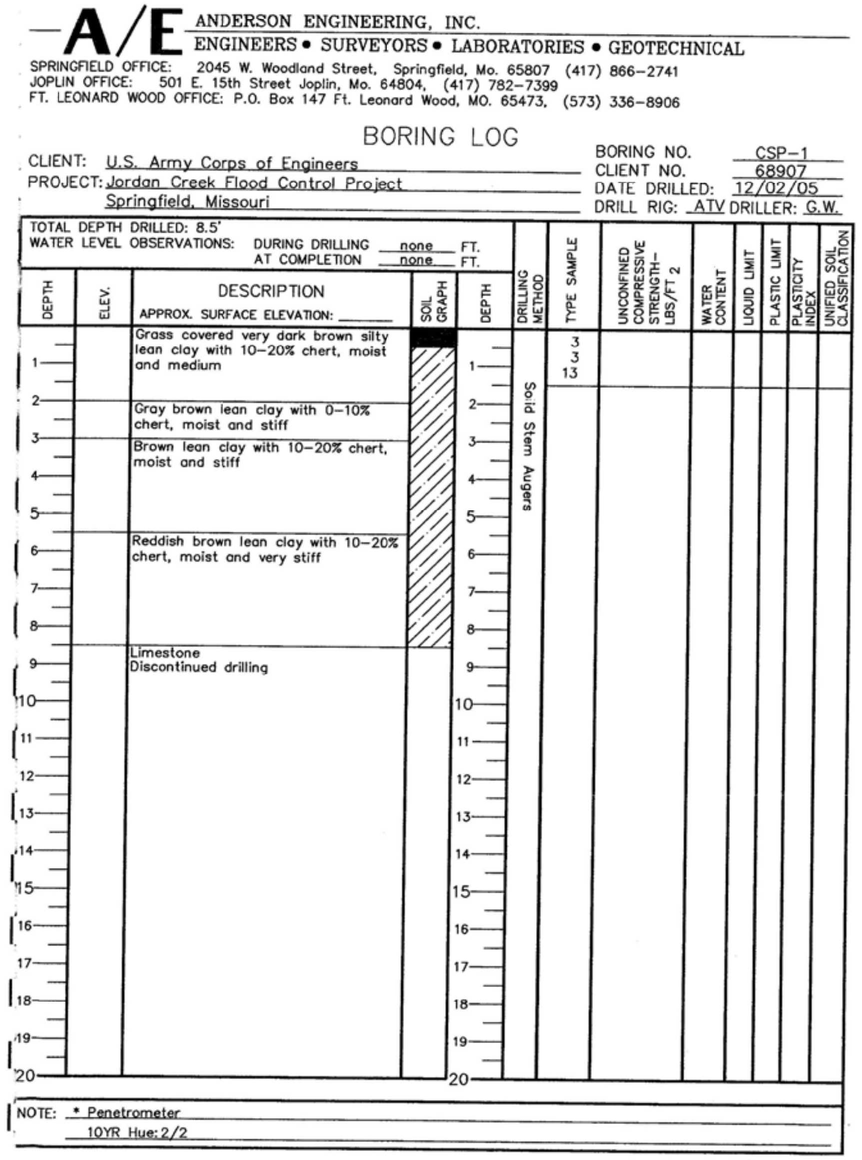
BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. BESP-1
CLIENT NO. 68907
DATE DRILLED: 12/2/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 17.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 15.5' FT.
AT COMPLETION 0 FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH–LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Dark reddish brown lean clay, dark red fat clay and dark brown lean clay with 20–40% chert and some asphalt and concrete debris, moist and medium to stiff (possible fill)			Solid Stem Augers	3 3 4						
		Dark brown and grayish brown lean clay with 10–20% chert, moist and stiff (possible fill)				9 17 17						
		Yellowish brown and gray lean to fat clay with 20–40% chert, moist and stiff (possible fill)										
		Brown silty lean clay with 0–20% chert, moist and medium to stiff	▨									
		Limestone, hard	▦									
		Discontinued drilling										

NOTE: * Penetrometer
10YR Hue: 3/3, 2.5YR Hue: 3/4,3/6



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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. CSP-1
CLIENT NO. 68907
DATE DRILLED: 12/02/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 8.5'
WATER LEVEL OBSERVATIONS: DURING DRILLING none FT.
AT COMPLETION none FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH–LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass covered very dark brown silty lean clay with 10–20% chert, moist and medium	■ ▨		Soid Stem Augers	3 3 13						
		Gray brown lean clay with 0–10% chert, moist and stiff	▨									
		Brown lean clay with 10–20% chert, moist and stiff	▨									
		Reddish brown lean clay with 10–20% chert, moist and very stiff	▨									
		Limestone Discontinued drilling										

NOTE: * Penetrometer
10YR Hue: 2/2

US Army Corps of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB
Drawn by: NHB
Reviewed by: NPG
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PROFILES 2

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-7

A/E ANDERSON ENGINEERING, INC.
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SPRINGFIELD OFFICE: 2045 W. Woodland Street, Springfield, Mo. 65807 (417) 866-2741
JOPLIN OFFICE: 501 E. 15th Street Joplin, Mo. 64804, (417) 782-7399
FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. BUSP-1
CLIENT NO. 68907
DATE DRILLED: 12/02/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 10.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING none FT.
AT COMPLETION none FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass covered gray lean clay, moist and stiff	■		Solid Stem Augers	4 13 22						
1		Gray to light gray lean clay with 20-40% chert, moist and very stiff	▨	1								
2		Reddish brown lean clay with 20-40% chert, moist and stiff	▨	2								
3			▨	3								
4		Dark red fat clay with 0-20% chert and occasional chert cobble, moist and very stiff	▨	4								
5			▨	5								
6			▨	6								
7			▨	7								
8			▨	8								
9			▨	9								
10		Discontinued drilling		10								
11				11								
12				12								
13				13								
14				14								
15				15								
16				16								
17				17								
18				18								
19				19								
20				20								

NOTE: * Penetrometer
10YR Hue:5/1, Hue:6/1

A/E ANDERSON ENGINEERING, INC.
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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. BUSP-2
CLIENT NO. 68907
DATE DRILLED: 12/02/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 10.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING none FT.
AT COMPLETION none FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass covered very dark gray silty lean clay with 0-10% chert, moist and stiff	■		Solid Stem Augers	3 9 13						
1		Dark red fat clay with 0-20% chert and occasional chert cobble, moist and very stiff	▨	1								
2			▨	2								
3			▨	3								
4			▨	4								
5			▨	5								
6			▨	6								
7			▨	7								
8			▨	8								
9			▨	9								
10		Discontinued drilling		10								
11				11								
12				12								
13				13								
14				14								
15				15								
16				16								
17				17								
18				18								
19				19								
20				20								

NOTE: * Penetrometer
10YR Hue:3/1

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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. PEP-2
CLIENT NO. 68907
DATE DRILLED: 12/01/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 10.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING none FT.
AT COMPLETION none FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass covered dark brown silty lean clay, moist and medium	■		Solid Stem Augers	3 9 9						
1		Brown lean clay with 40-60% chert, moist and very stiff	▨	1								
2			▨	2								
3		Reddish brown lean clay with 20-40% chert, moist and very stiff	▨	3								
4		Dark red fat clay with 0-10% chert and occasional chert cobble, moist and very stiff	▨	4								
5			▨	5								
6			▨	6								
7			▨	7								
8			▨	8								
9			▨	9								
10		Discontinued drilling		10								
11				11								
12				12								
13				13								
14				14								
15				15								
16				16								
17				17								
18				18								
19				19								
20				20								

NOTE: * Penetrometer
10YR Hue:3/3

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:
Designed by: NHB
Drawn by: NHB
Reviewed by: NPG

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

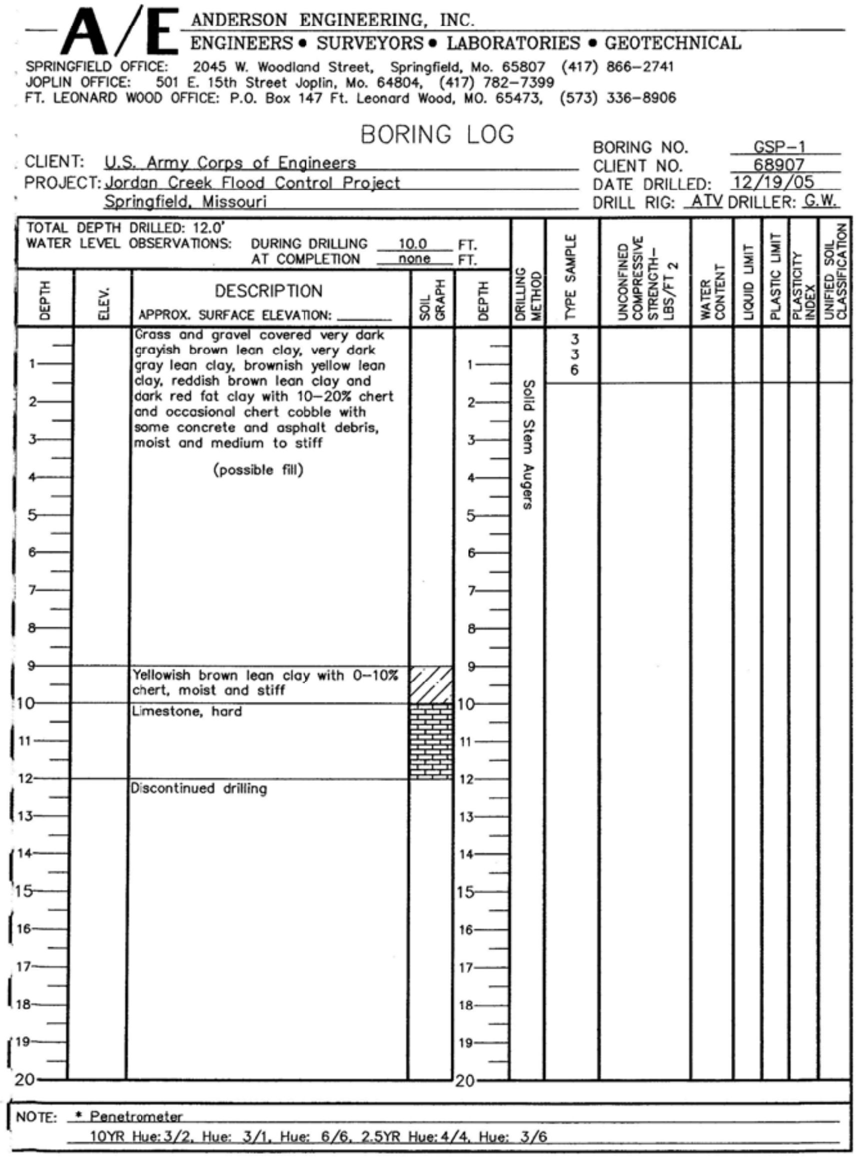
CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PROFILES 3

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-8



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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

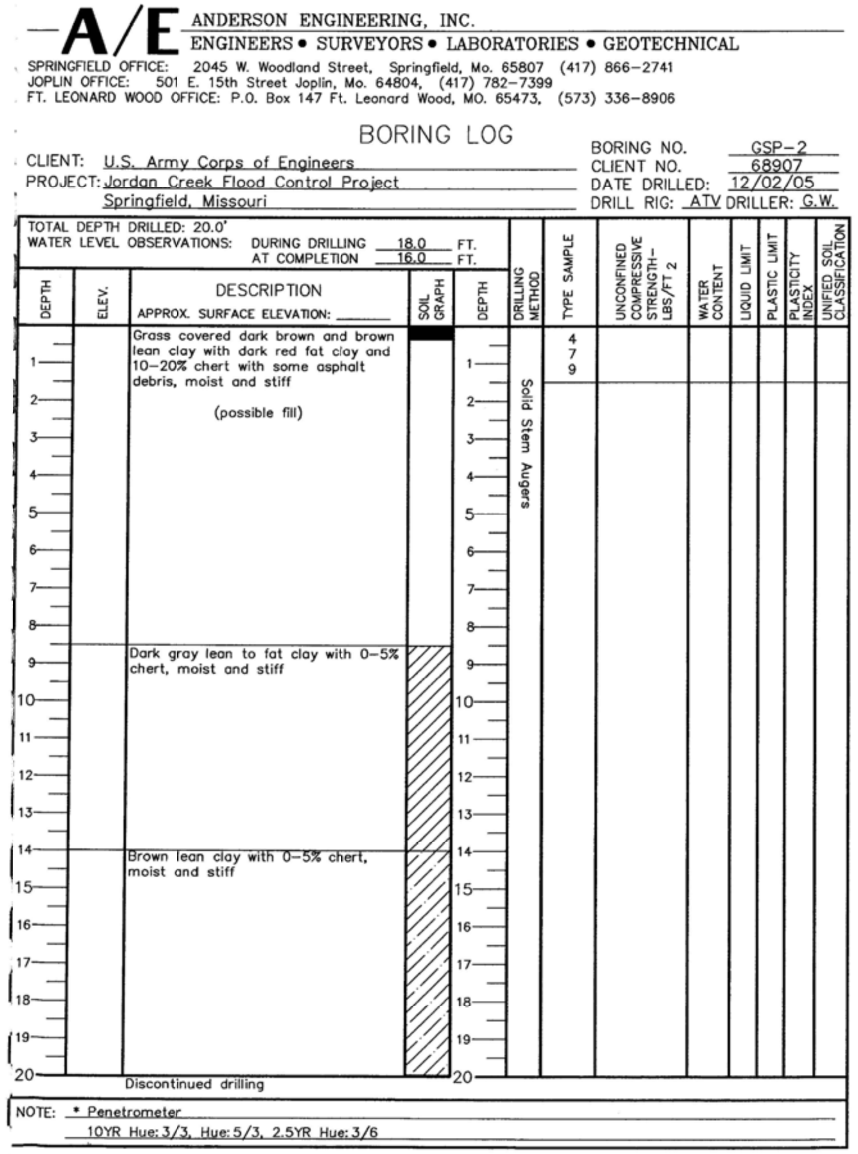
BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. GSP-1
CLIENT NO. 68907
DATE DRILLED: 12/19/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 12.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 10.0 FT.
AT COMPLETION none FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: _______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass and gravel covered very dark grayish brown lean clay, very dark gray lean clay, brownish yellow lean clay, reddish brown lean clay and dark red fat clay with 10-20% chert and occasional chert cobble with some concrete and asphalt debris, moist and medium to stiff (possible fill)			Solid Stem Augers	3 3 6						
		Yellowish brown lean clay with 0-10% chert, moist and stiff	▨									
		Limestone, hard	▦									
		Discontinued drilling										

NOTE: * Penetrometer
10YR Hue: 3/2, Hue: 3/1, Hue: 6/6, 2.5YR Hue: 4/4, Hue: 3/6



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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

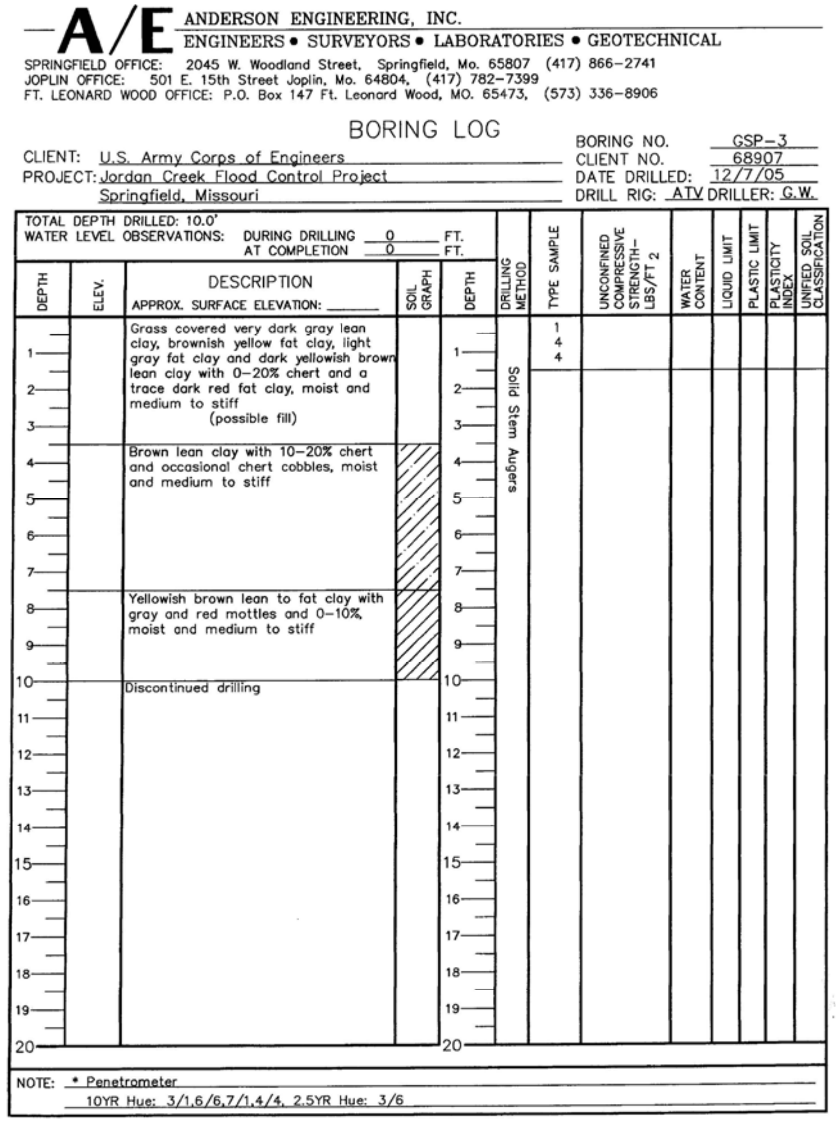
BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. GSP-2
CLIENT NO. 68907
DATE DRILLED: 12/02/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 20.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 18.0 FT.
AT COMPLETION 16.0 FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: _______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass covered dark brown and brown lean clay with dark red fat clay and 10-20% chert with some asphalt debris, moist and stiff (possible fill)			Solid Stem Augers	4 7 9						
		Dark gray lean to fat clay with 0-5% chert, moist and stiff	▨									
		Brown lean clay with 0-5% chert, moist and stiff	▨									
		Discontinued drilling										

NOTE: * Penetrometer
10YR Hue: 3/3, Hue: 5/3, 2.5YR Hue: 3/6



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FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri
BORING NO. GSP-3
CLIENT NO. 68907
DATE DRILLED: 12/7/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 10.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 0 FT.
AT COMPLETION 0 FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: _______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
		Grass covered very dark gray lean clay, brownish yellow fat clay, light gray fat clay and dark yellowish brown lean clay with 0-20% chert and a trace dark red fat clay, moist and medium to stiff (possible fill)			Solid Stem Augers	1 4 4						
		Brown lean clay with 10-20% chert and occasional chert cobbles, moist and medium to stiff	▨									
		Yellowish brown lean to fat clay with gray and red mottles and 0-10%, moist and medium to stiff	▨									
		Discontinued drilling										

NOTE: * Penetrometer
10YR Hue: 3/1,6/6,7/1,4/4, 2.5YR Hue: 3/6

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: NHB
Drawn by: NHB
Reviewed by: NPG
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

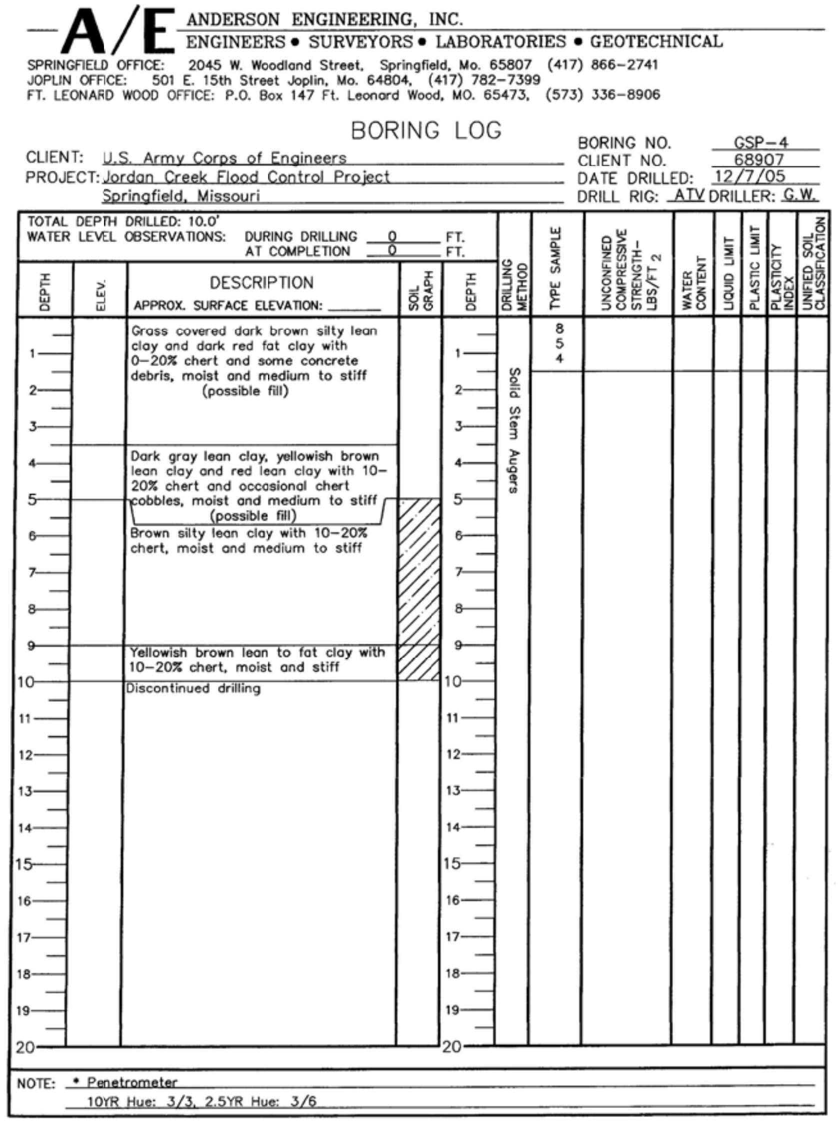
Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PROFILES 4

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-9



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SPRINGFIELD OFFICE: 2045 W. Woodland Street, Springfield, Mo. 65807 (417) 866-2741
JOPLIN OFFICE: 501 E. 15th Street Joplin, Mo. 64804, (417) 782-7399
FT. LEONARD WOOD OFFICE: P.O. Box 147 Ft. Leonard Wood, MO. 65473, (573) 336-8906

BORING LOG

CLIENT: U.S. Army Corps of Engineers
PROJECT: Jordan Creek Flood Control Project
Springfield, Missouri

BORING NO. GSP-4
CLIENT NO. 68907
DATE DRILLED: 12/7/05
DRILL RIG: ATV DRILLER: G.W.

TOTAL DEPTH DRILLED: 10.0'
WATER LEVEL OBSERVATIONS: DURING DRILLING 0 FT.
AT COMPLETION 0 FT.

DEPTH	ELEV.	DESCRIPTION APPROX. SURFACE ELEVATION: ______	SOIL GRAPH	DEPTH	DRILLING METHOD	TYPE SAMPLE	UNCONFINED COMPRESSIVE STRENGTH-LBS/FT 2	WATER CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNIFIED SOIL CLASSIFICATION
0–3.5		Grass covered dark brown silty lean clay and dark red fat clay with 0-20% chert and some concrete debris, moist and medium to stiff (possible fill)		0–3.5	Solid Stem Augers	8 5 4						
3.5–5.5		Dark gray lean clay, yellowish brown lean clay and red lean clay with 10-20% chert and occasional chert cobbles, moist and medium to stiff (possible fill)		3.5–5.5								
5.5–9		Brown silty lean clay with 10-20% chert, moist and medium to stiff	▨	5.5–9								
9–10		Yellowish brown lean to fat clay with 10-20% chert, moist and stiff	▨	9–10								
10		Discontinued drilling		10								

NOTE: * Penetrometer
10YR Hue: 3/3, 2.5YR Hue: 3/6

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:
Designed by: NHB
Drawn by: NHB
Reviewed by: NPG

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

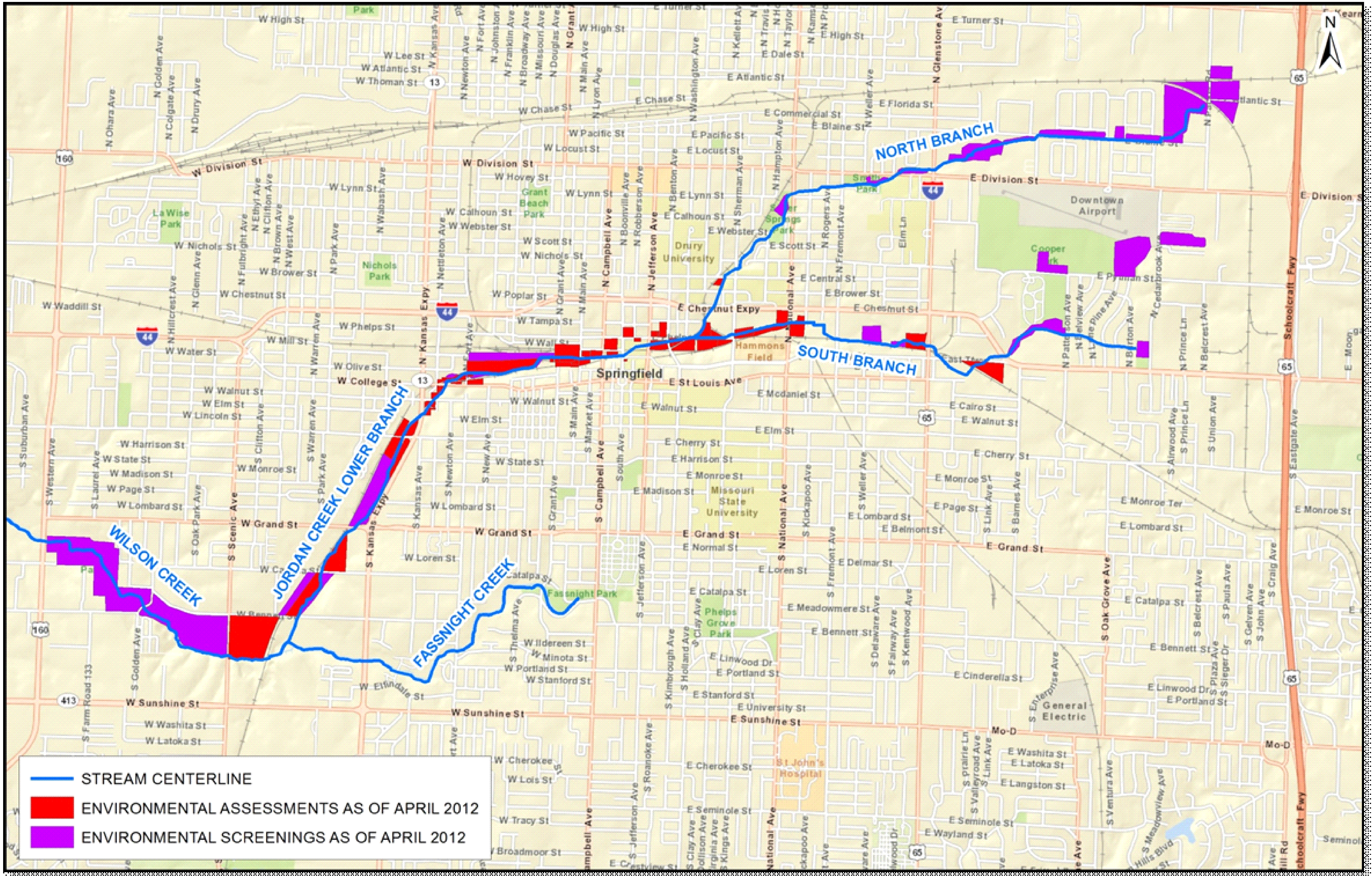
Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

BORING LOGS PROFILES 5

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE G-10



STREAM CENTERLINE

🟥 ENVIRONMENTAL ASSESSMENTS AS OF APRIL 2012

🟪 ENVIRONMENTAL SCREENINGS AS OF APRIL 2012

US Army Corps of Engineers
Little Rock District

Symbol | Description | Date | Appr.

Designed by: WJP

Drawn by: WJP

Reviewed by: RS

Date: JANUARY 2013

Solicitation No.: N/A

Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI

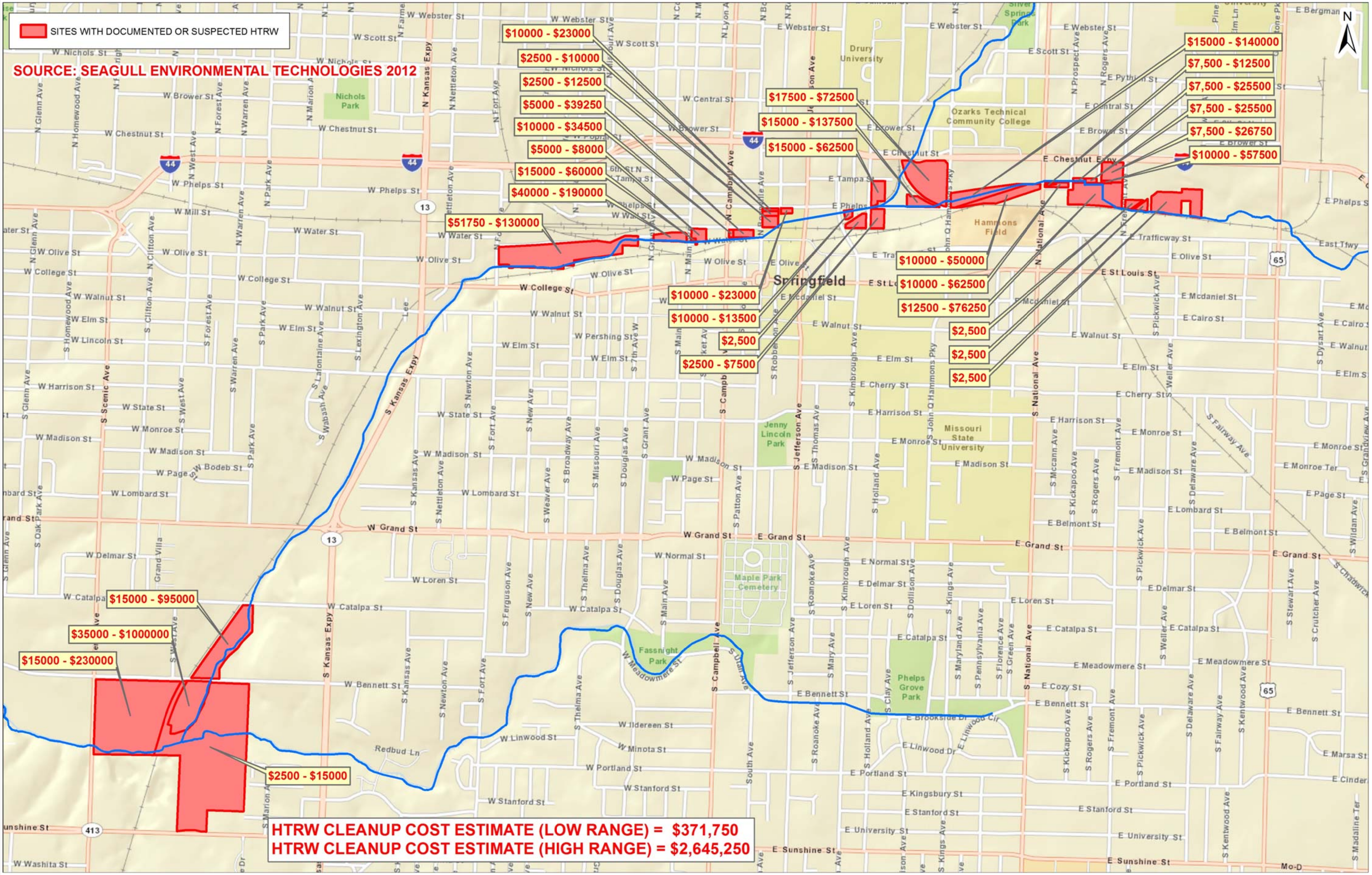
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

ENVIRONMENTAL ASSESSMENTS &
SCREENINGS AS OF APRIL 2012

Drawing Code/
Serial No.

Drawing Ref. No.

PLATE H-1



HTRW CLEANUP COST ESTIMATE (LOW RANGE) = $371,750
HTRW CLEANUP COST ESTIMATE (HIGH RANGE) = $2,645,250

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: WJP
Date: JANUARY 2013
Drawn by: WJP
Solicitation No.: N/A
Reviewed by: RS
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

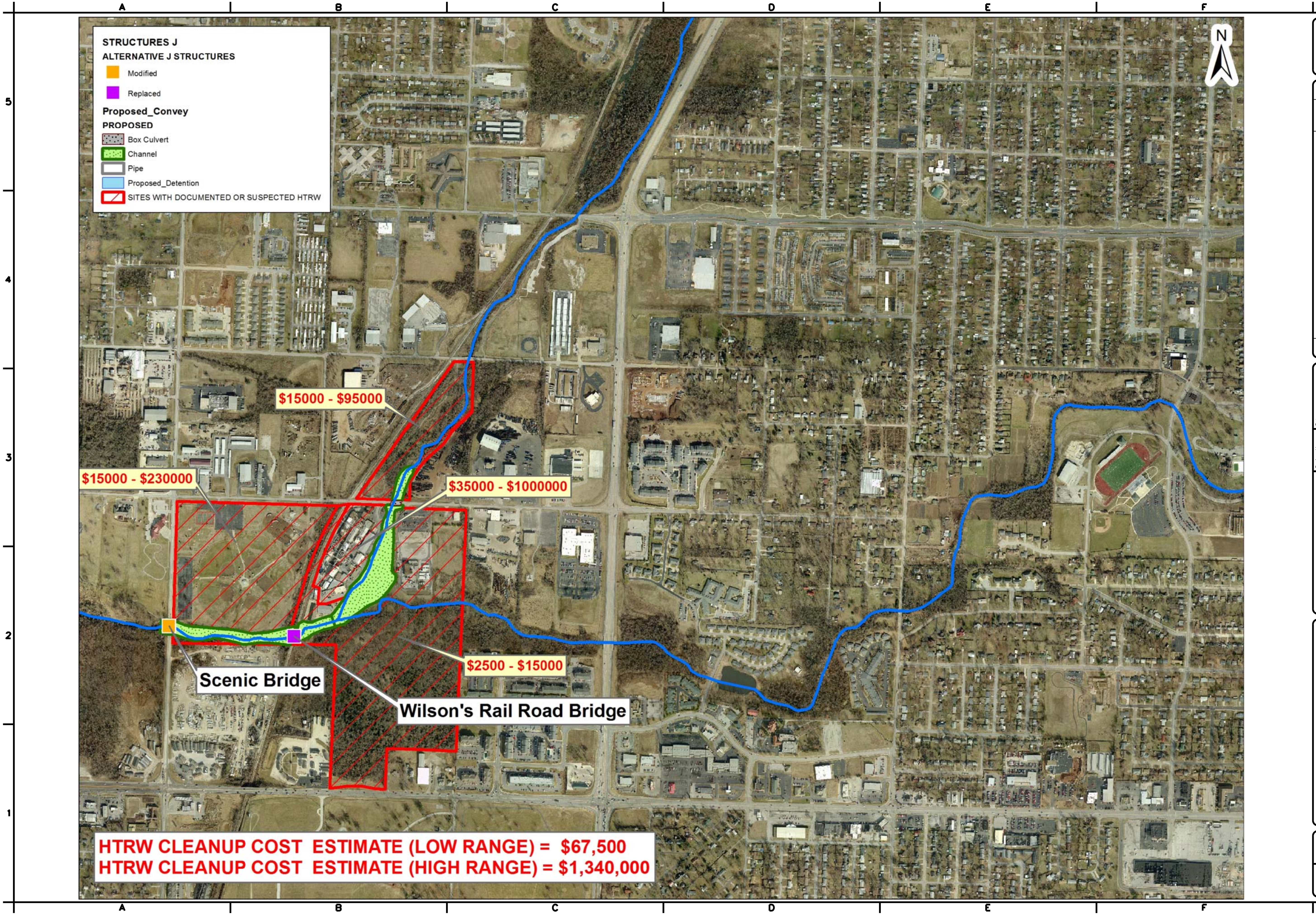
Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY

HTRW CLEANUP COST ESTIMATES

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE H-2



HTRW CLEANUP COST ESTIMATE (LOW RANGE) = $67,500
HTRW CLEANUP COST ESTIMATE (HIGH RANGE) = $1,340,000

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: WJP
Drawn by: WJP
Reviewed by: RS
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

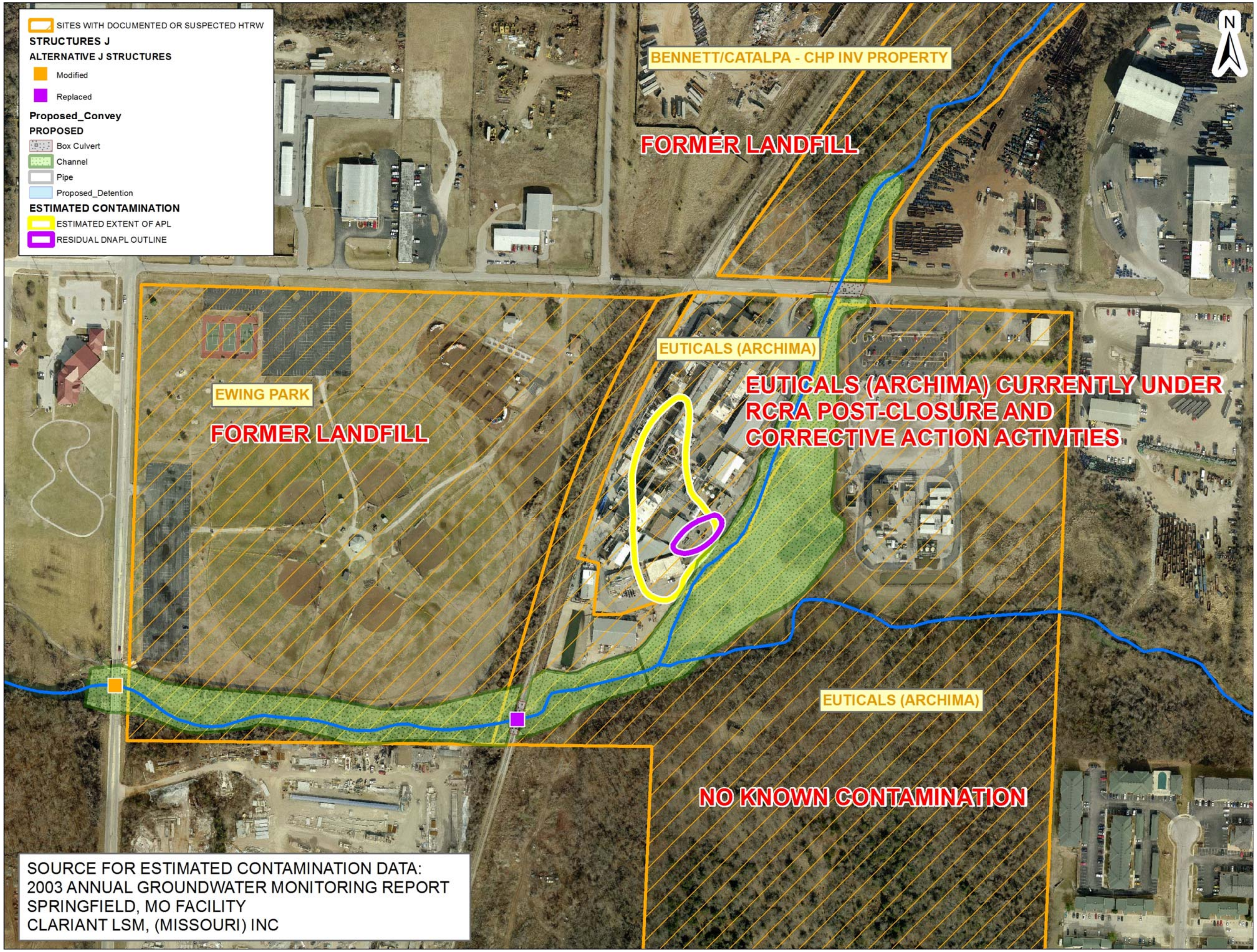
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY
HTRW REMEDIATION COST
ESTIMATE FOR PLAN J

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE H-3



SOURCE FOR ESTIMATED CONTAMINATION DATA:
2003 ANNUAL GROUNDWATER MONITORING REPORT
SPRINGFIELD, MO FACILITY
CLARIANT LSM, (MISSOURI) INC

US Army Corps
of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: WJP
Drawn by: WJP
Reviewed by: RS
Date: JANUARY 2013
Solicitation No.: N/A
Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

CITY OF SPRINGFIELD
GREENE COUNTY, MISSOURI
JORDAN CREEK
FLOOD RISK MANAGEMENT
FEASIBILITY STUDY
IDENTIFIED CONTAMINATION AREAS
AT ARCHIMICA PLANT

Drawing Code/
Serial No.

Drawing Ref. No.
PLATE H-4

Attachment A

Jordan Creek Feasibility Study

H&H Report

This report can be downloaded from the following website:

http://www.swl.usace.army.mil/Missions/Planning/SpringfieldMissouriFeasibilityStudy.aspx

Attachment B

Cost Analysis,
Construction Schedule,
& MCACES Cost Estimate

This attachment can be downloaded from the following website:

http://www.swl.usace.army.mil/Missions/Planning/SpringfieldMissouriFeasibilityStudy.aspx

Attachment C

Cost and Schedule

Risk Analysis

This attachment can be downloaded from the following website:

http://www.swl.usace.army.mil/Missions/Planning/SpringfieldMissouriFeasibilityStudy.aspx