PROJECT MANUAL

Mulberry Avenue & East 2nd Street Roundabout
City of Muscatine
Muscatine, IA

BOLTON & MENK

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CERTIFICATION
PROJECT MANUAL

for

Mulberry Avenue & East 2nd Street Roundabout

City of Muscatine

Muscatine, IA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

_____ Date: 6/13/2019

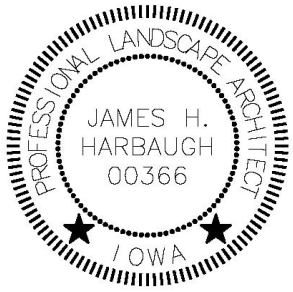
Adrian L. Holmes

License No. 17935

My renewal date is December 31, 2019

Pages or sheets covered by this seal:

C 1 - C 2, TOC 1, NB 1 – NB 4, IB 1 - IB8, FP 1 - FP11, FC 1 - FC 3, PPB 1 - PPB 2, SC 1 - SC 11



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Landscape Architect under the laws of the State of Iowa.

_____ Date: 6/13/2019

James H. Harbaugh

License No. 00366

My renewal date is June 30, 2020

Pages or sheets covered by this seal:

SP 1 – SP 6, TS 1 – TS 27

This project is based on
SUDAS STANDARD SPECIFICATIONS, 2019 EDITION
unless modified herein.

MULBERRY AVENUE & EAST 2ND STREET ROUNDABOUT PROJECT

CITY OF MUSCATINE
MUSCATINE, IOWA

PUBLIC NOTICE

NOTICE OF TIME AND PLACE OF PUBLIC HEARING ON THE MULBERRY AVENUE & EAST 2ND STREET ROUNDABOUT PROJECT

Public Notice is hereby given that the City Council of the City of Muscatine, Iowa will hold a Public Hearing to hear objections to the plans, specifications, form of contract, and cost estimate for the proposed Mulberry Avenue & East 2nd Street Roundabout Project. Said hearing will be held in the City Council Chambers, City Hall, Muscatine, Iowa on July 3, 2019 at 7:00 p.m. All interested persons are invited to attend and will be given an opportunity to be heard relative to this matter.

_____

Gregg Mandsager, City Administrator

NOTICE TO BIDDERS
Mulberry Avenue & East 2nd Street Roundabout Project

Notice is hereby given that the City of Muscatine, Iowa, will receive sealed proposals in the office of the City Clerk, City Hall, (215 Sycamore Street, Muscatine, IA 52761) until 3:00 p.m., July 25, 2019, for the Mulberry Avenue & East 2nd Street Roundabout Project for the City of Muscatine. At 3:10 p.m. on the same day the City's Purchasing Agent shall open the bids received and announce the results in the City Hall Council Chambers.

Time and Place for Pre-Bid Meeting. A Pre-Bid Meeting will be held at 10:00 AM. on July 9, 2019 for the Mulberry Avenue & East 2nd Street Roundabout Project at City Hall, Lower Conference Room, City of Muscatine, 215 Sycamore Street, Muscatine, IA 52761.

Bids will be reported to the City Council at their meeting to be held at 7:00 p.m., August 1, 2019. Said proposals shall be acted on at that time or at such later time and place as may then be fixed.

Description of the Type and Location of the Project

The project consists of the reconstruction of the intersection of Mulberry Avenue and East 2nd Street intersection as a roundabout. Construction primarily includes pavement removal, excavation, concrete paving, subdrains, granular subbase, underground utility improvements, concrete pavers, and streetscape amenities. All works is within the corporate city limits of Muscatine, Iowa.

Proposals shall be submitted on a form furnished by the City and accompanied by a bid security in an amount equal to five (5) percent of the bid and shall stand as security that the successful bidder will enter into a contract for the work bid upon within ten (10) days after acceptance of his proposal by the City.

The City reserves the right to defer acceptance of any proposal for a period not to exceed thirty (30) calendar days and to reject any and all bids, to waive technicalities and to enter into such contract as it shall deem for the best interest of said City.

The Contractor must ensure that employees and applicants for employment are not discriminated against because of their race, color, religion, sex or national origin.

Payment to the Contractor will be made from funds legally available for that purpose. Payment will be made on the basis of monthly estimates equal to ninety-five (95) percent of the contract price. The balance of the five (5) percent due to the contractor will not be made earlier than thirty (30) days from the final acceptance of said work by the City, subject to the conditions and in accordance with the provisions of Chapter 573 of the Code of Iowa. Before final payment will be made, the Contractor shall certify that all materials, labor and services have been paid for.

All work is to be performed and completed under the guidelines of OSHA and in strict compliance with plans and specifications prepared by the City of Muscatine Public Works Department, which have heretofore been approved by the City Council and are now on file for public examination.

Contract Documents

Proposed plans, specifications, and contract documents may be available for review at the Department of Finance, City Hall, City of Muscatine, 215 Sycamore St, Muscatine, Iowa 52761, between the hours of 8:00 a.m. and 5:00 p.m., Monday thru Friday.

You may view and download the digital plan documents for free by entering Quest project # 6404661 on the website's Project Search page at www.questcdn.com. Please contact QuestCDN.com at 952-233-1632 or info@questcdn.com for assistance in free membership registration, viewing, downloading, and working with this digital project information.

This Notice is published by order of the City Council of the City of Muscatine, Iowa.

_____

Gregg Mandsager, City Administrator

INSTRUCTIONS TO BIDDERS

TABLE OF CONTENTS

IB-01 BIDDER'S KNOWLEDGE

The proposed Mulberry Avenue & East 2nd Street Roundabout Project is located in the City of Muscatine, Iowa. Bidders shall familiarize themselves with the specifications and conditions, which will affect the construction. Specific items relating to the preparation of bids and the submission thereof are listed elsewhere in the Contract Documents. It will be the responsibility of the Bidder to examine all Contract Documents and to make a personal examination of the job site and the physical conditions, which may affect his bidding and performance under the contract.

IB-02 BIDDER'S QUALIFICATIONS

The Bidder may be required to satisfy the Owner as to his integrity, experience, equipment, personnel and financial ability to perform the work.

If the successful Bidder is a non-Iowa corporation, he shall submit proof to the Owner, prior to the execution of the contract, of authorization by the Secretary of State to do business in Iowa.

IB-03 METHOD OF BIDDING

Bidder shall submit unit price bids as required for the work covered by the specifications. Prices shall cover complete work and include all costs incidental thereto, unless otherwise indicated.

The Engineer may change location, quantities, and combination of units as required during the progress of construction.

Bids will be computed using quantities shown in the proposal. The unit price quantities are approximate and only for comparison of bids.

In the event of discrepancies between unit prices and unit price extensions listed in Bidder's proposal, unit prices shall govern.

IB-04 SUBMISSION OF BIDS

The bids shall be submitted in duplicate on the proposal form included herewith. The proposal shall be submitted in a sealed envelope separate from the bid security. The envelope shall bear the return address of the Bidder and shall be addressed as follows:

TO: City Clerk
City Hall
215 Sycamore
Muscatine, Iowa 52761

Proposal for
Mulberry Avenue & East 2nd Street Roundabout Project

The bid shall be signed by a legally authorized representative of the Bidder.

The bid security shall be placed in a separate envelope attached to the envelope containing the bid.

Only the proposal form shall be included in the envelope with the bid. Do not submit plans and/or specifications with the bid.

IB-05 WITHDRAWAL OF BIDS

Bids may be withdrawn any time prior to the scheduled closing time for receipt of bids; but no bids may be withdrawn for a period of thirty (30) calendar days thereafter.

IB-06 EVALUATION OF BIDS

The Owner may consider such factors as bid price, experience and responsibility of Bidder, and similar factors in determining which bid deems to be the best interest of the Owner for the project.

The Owner may make such investigations as he deems necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the agreement and to complete the work contemplated therein.

The Owner may reject any or all bids, waive informalities or technicalities in any bid, and accept that bid which it deems to be in its best interest.

IB-07 SALES TAX EXEMPTION

The City of Muscatine will provide each contractor and subcontractor for this project with a certificate of exemption and an authorization letter which can be presented to material suppliers which will allow the contractor/subcontractor to purchase building materials used in this contract exempt from Iowa sales tax and any applicable local option sales tax and school infrastructure local option tax except for such items noted in the Estimate Reference notes which are not tax exempt. Complete information on qualifying materials and supplies can be found at www.state.ia.us/tax, the Iowa Department of Revenue and Finance (IDRF) web site. Links can be found in the Business Taxes and Local Government categories. Bids submitted for this project should be submitted on this basis.

IB-08 EXECUTION OF CONTRACT

The party to whom the contract is awarded will be required to execute the Agreement and obtain the performance bond and payment bond within ten (10) calendar days from the date when Notice of Award is delivered to the Bidder. The Notice to Award shall be accompanied by the necessary Agreement and bond forms. In case of failure of the Bidder to execute the Agreement, the Owner may at his option consider the Bidder in default, in which case the bid bond accompanying the proposal shall become the property of the Owner.

The Owner, within thirty-one (31) days of receipt of acceptable performance bond, payment bond and Agreement signed by the party to whom the Agreement was awarded shall sign the Agreement and return to such party and executed copy of the Agreement. Should the Owner not execute the Agreement within such period, the Bidder may, by written notice, withdraw his signed Agreement. Such notice of withdrawal shall be effective upon receipt of the notice by the Owner.

The Notice to Proceed shall be issued, in writing, following execution of the contract, by the Owner. The Contractor will acknowledge receipt of Notice to Proceed and work shall proceed within ten (10) days.

The contract, when executed, shall be deemed to include the entire agreement between the parties; the Contractor shall not claim any modification resulting from representation or promise made by representatives of the Owner or other persons.

IB-09 DISQUALIFICATION OF BIDDERS

Attention of bidders is directed to Section 553.23 of the current Code of Iowa, regarding unlawful combination in making public contracts.

IB-10 QUANTITIES

Estimated quantities shown on the proposal form are provided solely for the Contractor's information and shall not be construed as being necessarily accurate or complete.

Bidders must satisfy themselves of the accuracy of the estimated quantities in the bid tabulation included in the Form of Proposal by examination of the site and a review of the drawings and specifications including addenda. After bids have been submitted, the Bidder shall not assert that there was a misunderstanding concerning the quantities of work or of the nature of the work to be done.

IB-11 COMPLETION DATE

All work must be completed by Late Start 8/19/2019; 70 Working Days.

Contractor shall pay liquidated damages for noncompliance with said completion provisions at the rate of Six Hundred dollars ($600.00) for each calendar day thereafter that the work remains incomplete beyond the late start 8/19/2019; 70 working days completion date. Liquidated damages for failing to timely attain substantial completion and final completion are not additive and will not be imposed concurrently.

Should the Contractor fail to complete the construction work within the time specified, he shall reimburse the Owner for any extra engineering and inspection costs deemed necessary by the Owner necessitated by the continuance of the work beyond the time herein specified for completion. Such extra engineering costs, not included in the liquidated damages, charged to the Contractor as hereby agreed to in no way constitute a penalty, but said costs represent additional expense to the Owner caused by delayed prosecution of the work by the Contractor. Such additional expense will be deducted from the monies due the Contractor at the time of final payment, recognizing any extensions of time granted by the Owner.

IB-12 GUARANTEE

The Contractor shall furnish a maintenance bond, subject to the Owner's approval, guaranteeing to keep all work constructed under this contract in good repair for a period of two (2) years from date of final acceptance. Good repair shall be construed to mean free from any functional or structural deterioration, except that caused from ordinarily reasonable use and acts of God, which appreciably reduces the effectiveness of the improvement for the purpose intended or any serious departure from the standards or original construction.

If, in the opinion of the Owner, such deterioration takes place, they shall so notify the Contractor by registered letter to the address given in the Contractor's proposal and send a copy of such notice to the bonding company, which notice is mutually agreed to be sufficient and adequate. If the Contractor shall not proceed to remedy such defects as are called to his attention in the notice within ten (10) days, the City shall cause the repairs to be made as it deems best, and the entire cost thereof shall be paid by the Contractor or his sureties.

IB-13 QUESTIONS AND ADDENDA

If any person contemplating submitting a bid for the proposed work, material or equipment is in doubt as to the true meaning of any part of the plans, specifications or other Contract Documents, he may request an interpretation thereof. The person submitting the request will be responsible for its prompt delivery.

Questions concerning interpretation or intent of the Contract Documents should be directed to:

James Edgmond, P.E.
Public Works Building
1459 Washington Street
Muscatine, IA 52761
Phone 563-263-8933
Fax 563-263-2127

Any oral interpretation given will be valid only if confirmed by written addendum. Information obtained from an officer, agent, or employee of the Owner shall not affect the risks or obligations assumed by the Contractor or relieve him from fulfilling any of the conditions of the contract.

The Owner reserves the right to revise or amend the Contract Documents, prior to the date set for receipt of bids. Such revisions and amendments, if any, will be announced by an addendum or addenda to the Contract Documents.

Copies of such addenda as may be issued will be furnished to all holders of specifications.

Bidders are required to acknowledge receipt of all addenda by listing such addenda in the Form of Proposal.

IB-14 PRECONSTRUCTION CONFERENCE

Following the award of contract, the Contractor and his subcontractors will be required to attend a preconstruction meeting at a time and place designated by the Owner.

IB-15 SUB-CONTRACTORS

The prime contractor shall submit to the Owner, in writing, the names of all sub-contractors along with the items and amounts to be sublet. The prime contractor shall not sublet more than 60% of the dollar amount of the contract. All sub-contractors shall be approved by the Owner before work is begun.

IB-16 BUY AMERICA

On all contracts, all products of iron, steel, or a coating of steel which are incorporated into the work shall be of domestic origin and shall be melted and manufactured in the United States. The Engineer may allow minimal amounts of these materials from foreign sources, provided the cost does not exceed 0.1% of the contract sum or $2,500, whichever is greater. This amount shall include transportation, assembly, and testing as delivered cost of foreign products to the project. Per Materials Iowa DOT I.M. 107, miscellaneous steel or iron components, subcomponents, and hardware, as defined by FHWA, will not be subject to Buy America requirements.

MULBERRY AVENUE & EAST 2ND STREET ROUNDABOUT

CITY OF MUSCATINE - MUSCATINE, IOWA

FORM OF PROPOSAL

Name of Bidder _____

Address of Bidder _____

TO: The Honorable Mayor
and City Council
City Hall
Muscatine, Iowa 52761

GENTLEMEN:

A. The undersigned Bidder submits herewith bid security in the amount of $_____ in accordance with the terms set forth in the Instructions to Bidders.

B. The undersigned Bidder, having examined the plans, specifications, Notice to Bidders, the location and sites of the proposed work, the nature of the work to be done, extent and condition of existing structures affecting, or affected by the proposed work, and being fully advised as to the extent and character of the work and all existing local conditions, relative to construction difficulties, hazards, labor transportation, hauling, trucking, plant sites, and other factors affected by or affecting the work covered by this proposal as outlined in the specifications and plans, including Addenda _____ and _____.

HEREBY PROPOSES to furnish all materials, tools, appliances, plant and equipment; and to perform all necessary labor required for the complete construction of the Mulberry Avenue & East 2nd Street Roundabout Project for the City of Muscatine, Iowa and all items incidental thereto and to perform all work in accordance with the plans and specifications for said project, including all items to expense and profit, as follows:

PROPOSAL FORM
MULBERRY AVENUE & EAST 2ND STREET ROUNDABOUT PROJECT

BID ITEMS AND QUANTITIES					
ITEM NO.	**DESCRIPTION**	**UNIT**	**APPROX. QUANTITY**	**UNIT PRICE**	**AMOUNT**
1	TRAFFIC CONTROL	LS	1		
2	CLEARING AND GRUBBING	LS	1		
3	TOPSOIL, OFF SITE	CY	200		
4	TOPSOIL, OFF SITE, LOAD & SPREAD	CY	800		
5	EXCAVATION, CLASS 13	CY	2500		
6	SUBGRADE PREPARATION	SY	5850		
7	SUBGRADE STABILIZATION, 12-INCH	CY	500		
8	SUBGRADE TREATMENT, GEOTEXTILE	SY	400		
9	SUBBASE, MODIFIED SUBBASE, 6-INCH	SY	5850		
10	REMOVAL, HYDRANT	EA	3		
11	REMOVAL, TRAFFIC SIGNAL FOUNDATION	EA	3		
12	REMOVAL, STREET LIGHT POLES AND FOUNDATIONS	EA	13		
13	EXPLORATORY EXCAVATION	LF	100		
14	TRENCH FOUNDATION	TON	200		
15	REPLACEMENT OF UNSUITABLE BACKFILL MATERIAL	CY	2600		
16	REPLACEMENT OF UNSUITABLE BACKFILL MATERIAL, COHESIVE BACKFILL	CY	320		
17	RAVINE FILL AREA EARTHWORK MANAGEMENT	CY	2920		
18	TRENCH COMPACTION TESTING	LS	1		
19	SANITARY SEWER GRAVITY MAIN, TRENCHED, PVC, 8 INCH	LF	680		
20	SANITARY SEWER SERVICE STUB, PVC, 6"	LF	40		
21	REMOVAL OF SANITARY SEWER, LESS THAN 36"	LF	690		

ITEM NO.	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT
22	SANITARY SEWER ABANDONMENT, 8" DIA.	LF	205		
23	STORM SEWER, TRENCHED, RCP, 15 INCH	LF	950		
24	STORM SEWER, TRENCHED, RCP, 18 INCH	LF	180		
25	REMOVAL OF STORM SEWER, LESS THAN 36 INCH	LF	422		
26	SUBDRAIN, HPDE, 6 INCH	LF	1490		
27	SUBDRAIN CLEANOUT	EA	5		
28	SUBDRAIN OUTLETS AND CONNECTIONS	EA	7		
29	WATER MAIN, TRENCHED, FUSED HDPE, 12"	LF	477		
30	WATER MAIN, TRENCHED, FUSED HDPE, 10"	LF	26		
31	WATER MAIN, TRENCHED, FUSED HDPE, 6"	LF	238		
32	CUT AND CAP, 10"	EA	1		
33	CUT AND CAP, 12"	EA	2		
34	WATER SERVICE STUB, COPPER, 1-INCH	LF	470		
35	TAPPING SLEEVE AND VALVE, 12"x12"	EA	2		
36	TAPPING SLEEVE AND VALVE, 10"x10"	EA	1		
37	HYDRANT, ASSEMBLY	EA	1		
38	MANHOLE TYPE SW-301, 60 INCH	EA	2		
39	MANHOLE TYPE SW-401, 60 INCH	EA	1		
40	INTAKE TYPE SW-501	EA	14		
41	INTAKE TYPE SW-503	EA	1		
42	MANHOLE ADJUSTMENT, MAJOR	EA	1		
43	REMOVE MANHOLE	EA	4		
44	REMOVE INTAKE	EA	6		
45	PAVEMENT, PCC, 10 INCH	SY	4055		
46	PAVEMENT, PCC, 10 INCH, COLORED	SY	413		

ITEM NO.	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT
47	CURB AND GUTTER, 36 INCH, 10 INCH THICK	LF	206		
48	BEAM CURB	LF	40		
49	PCC PAVEMENT SAMPLES AND TESTING	LS	1		
50	HMA PAVEMENT, 8 INCH	SY	360		
51	REMOVAL OF SIDEWALK	SY	1486		
52	REMOVAL OF DRIVEWAY	SY	268		
53	SIDEWALK, PCC, 5 IN.	SY	1390		
54	SIDEWALK, PCC, 10 IN. (RAMP)	SY	110		
55	CONCRETE MEDIANS, APRON, BANDING, PCC, 10 IN.	SY	301		
56	CONCRETE UNIT PAVERS TYPE B & C WITH SAND SETTING BED & PCC SUBBASE	SF	1300		
57	HISTORIC PAVERS, TYPE A WITH SAND SETTING BED & PCC SUBBASE (PAVERS FURNISHED BY CITY)	SF	550		
58	CROSSWALK PAVERS WITH 3/4" ASPHALT SETTING BED	SF	720		
59	DETECTABLE WARNING	SF	300		
60	DRIVEWAY, PAVED, PCC, 7 INCH	SY	600		
61	DRIVEWAY, PAVED, PCC, 10 INCH	SY	505		
62	PAVEMENT REMOVAL	SY	4225		
63	PAINTED PAVEMENT MARKINGS, SOLVENT/WATERBORNE	STA	27		
64	SEEDING, FERTILIZING & HYDROMULCHING	AC	0.5		
65	SOD	SQ	150		
66	DECIDUOUS SHRUBS	EA	19		
67	ORNAMENTAL TREE	EA	8		
68	PERENNIAL GROUND COVER (1 GAL)	EA	558		
69	DECIDUOUS TREE	EA	18		
70	SWPPP MANAGEMENT	LS	1		
71	FILTER SOCKS, 12 INCH	LF	1800		
72	SILT FENCE OR SILT FENCE DITCH CHECK	LF	200		

ITEM NO.	DESCRIPTION	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT
73	INLET PROTECTION DEVICE, DROP IN PROTECTION	EA	21		
74	CONSTRUCTION SURVEY	LS	1		
75	MOBILIZATION	LS	1		
76	CONCRETE WASHOUT	LS	1		
77	LIMESTONE EDGER	LF	310		
78	BOULDER SEATWALLS	LF	25		
79	DUCT BANK, 3x2 CONFIGURATION	LF	381		
80	ELECTRICAL CONDUIT, OPEN CUT, HDPE OR PVC, 6-INCH	LF	321		
81	ELECTRICAL CONDUIT, OPEN CUT, HDPE OR PVC, 2-INCH	LF	1341		
82	JUNCTION BOX, ELECTRICAL, 13"x24"	EA	2		
83	JUNCTION BOX, ELECTRICAL, 10" DIAMETER	EA	1		
84	FOUNDATION, STREET LIGHT	EA	10		
85	COMMUNICATION CONDUIT, OPEN CUT, HDPE, QUAD DUCT (4x1.5-INCH)	LF	647		
86	HAND HOLE, COMMUNICATIONS, 30"x48"	EA	2		
				TOTAL AMOUNT BID	

Company Name: _____

By: _____

Title:_____ Date:_____

C. We further propose:

1. To do all extra work which may be required to complete the work contemplated at unit price or lump sum, to be agreed upon prior to starting such work.

2. To execute the form of contract with ten (10) days after Notice of Award is received and to complete all work by Late Start 8/19/2019; 70 Working Days.

Contractor shall pay liquidated damages for noncompliance with said completion provisions at the rate of Six Hundred dollars ($600.00) for each calendar day thereafter that the work remains incomplete beyond the late start 8/19/2019; 70 working days completion date. Liquidated damages for failing to timely attain substantial completion and final completion are not additive and will not be imposed concurrently.

D. Attached, hereto, is an affidavit in proof that the undersigned Bidder has not colluded with any person in respect to this Bid or any other Bids or the submitting of Bids for the contract for which this Bid is submitted. A Non-collusion Affidavit of Sub-Contractors will be required for submission in the Form of Contract.

E. The undersigned Bidder states that this proposal is made in conformity with the Contract Documents and agrees that, in the event of any discrepancies or differences between any conditions of his proposal and the Contract Documents prepared by the Owner, the provisions of the latter shall prevail.

F. The total bid is based on estimated quantities, and the actual amount will be adjusted in accordance with the final determination of quantities involved, as explained in the Detailed Specifications. In case of error in the item totals as quoted, the proper figure based on the estimated quantities and the unit prices as quoted shall govern.

G. The undersigned Bidder is prepared to submit the Bidders' Qualifications statement upon request.

Firm: _____

By: _____

_____
(Title)

_____
(Business Address)

(Seal - if bid is by a corporation)

All bidders must submit the following completed form to the governmental body requesting bids per 875 Iowa Administrative Code Chapter 156.

Bidder Status Form

To be completed by all bidders — Part A

Please answer "Yes" or "No" for each of the following:

☐ Yes ☐ No My company is authorized to transact business in Iowa.
(To help you determine if your company is authorized, please review the worksheet on the next page).

☐ Yes ☐ No My company has an office to transact business in Iowa.

☐ Yes ☐ No My company's office in Iowa is suitable for more than receiving mail, telephone calls, and e-mail.

☐ Yes ☐ No My company has been conducting business in Iowa for at least 3 years prior to the first request for bids on this project.

☐ Yes ☐ No My company is not a subsidiary of another business entity or my company is a subsidiary of another business entity that would qualify as a resident bidder in Iowa.

If you answered "Yes" for each question above, your company qualifies as a resident bidder. Please complete Parts B and D of this form.

If you answered "No" to one or more questions above, your company is a non-resident bidder. Please complete Parts C and D of this form.

To be completed by resident bidders — Part B

My company has maintained offices in Iowa during the past 3 years at the following addresses:

Dates: _____ to _____ Address: _____

(mm/dd/yyy) City, State, Zip: _____

Dates: _____ to _____ Address: _____

(mm/dd/yyy) City, State, Zip: _____

Dates: _____ to _____ Address: _____

(mm/dd/yyy) City, State, Zip: _____

You may attach additional sheet(s) if needed.

To be completed by non-resident bidders — Part C

1. Name of home state or foreign country reported to the Iowa Secretary of State: _____
2. Does your company's home state or foreign country offer preferences to bidders who are residents? ☐ Yes ☐ No
3. If you answered "Yes" to question 2, identify each preference offered by your company's home state or foreign country and the appropriate legal citation.

_____

_____

You may attach additional sheet(s) if needed.

To be completed by all bidders — Part D

I certify that the statements made on this document are true and complete to the best of my knowledge and I know that my failure to provide accurate and truthful information may be reason to reject my bid.

Firm Name: _____

Signature: _____ Date: _____

Worksheet: Authorization to Transact Business

This worksheet may be used to help complete Part A of the Resident Bidder Status form. If at least one of the following describes your business, you are authorized to transact business in Iowa.

☐ Yes ☐ No My business is currently registered as a contractor with the Iowa Division of Labor.

☐ Yes ☐ No My business is a sole proprietorship and I am an Iowa resident for Iowa income tax purposes.

☐ Yes ☐ No My business is a general partnership or joint venture. More than 50 percent of the general partners or joint venture parties are residents of Iowa for Iowa income tax purposes

☐ Yes ☐ No My business is an active corporation with the Iowa Secretary of State and has paid all fees required by the Secretary of State, has filed its most recent biennial report, and has not filed articles of dissolution.

☐ Yes ☐ No My business is a corporation whose articles of incorporation are filed in a state other than Iowa, the corporation has received a certificate of authority from the Iowa Secretary of State, has filed its most recent biennial report with the Secretary of State, and has neither received a certificate of withdrawal from the Secretary of state nor had its authority revoked.

☐ Yes ☐ No My business is a limited liability partnership which has filed a statement of qualification in this state and the statement has not been canceled.

☐ Yes ☐ No My business is a limited liability partnership which has filed a statement of qualification in a state other than Iowa, has filed a statement of foreign qualification in Iowa and a statement of cancellation has not been filed.

☐ Yes ☐ No My business is a limited partnership or limited liability limited partnership which has filed a certificate of limited partnership in this state, and has not filed a statement of termination.

☐ Yes ☐ No My business is a limited partnership or a limited liability limited partnership whose certificate of limited partnership is filed in a state other than Iowa, the limited partnership or limited liability limited partnership has received notification from the Iowa Secretary of state that the application for certificate of authority has been approved and no notice of cancellation has been filed by the limited partnership or the limited liability limited partnership.

☐ Yes ☐ No My business is a limited liability company whose certificate of organization is filed in Iowa and has not filed a statement of termination.

☐ Yes ☐ No My business is a limited liability company whose certificate of organization is filed in a state other than Iowa, has received a certificate of authority to transact business in Iowa and the certificate has not been revoked or canceled.

NONCOLLUSION AFFIDAVIT OF PRIME BIDDER

EXHIBIT A

State of _____)
) ss.
County of _____)

(1) He is the _____ of _____, the Bidder that has submitted the attached Bid:

(2) He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

(3) Such Bid is genuine and is not a collusive or sham bid;

(4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement, or collusion or communication or conference with any other Bidder, firm, or person to fix the price or prices in the attached Bid or of any Bidder, or, to fix any, overhead, profit, or cost element of the bid price or the bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against the City of Muscatine or any person interested in the proposed Contract; and

(5) The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant (Signed)

(Signed) _____

_____
Title

Subscribed and sworn to before me
this _____ day of _____, 2019.

_____

_____
Title

My commission expires _____

STATEMENT OF BIDDER'S QUALIFICATIONS

EXHIBIT B

All questions must be answered and the data given must be clear and comprehensive. The statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information he desires.

1. Name of Bidder.

2. Permanent main office address, including City, State & Zip Code.

3. When organized.

4. If a corporation, where incorporated.

5. How many years have you engaged in construction work under your present firm or trade name?

6. Contracts on Hand: Schedule these, showing gross amount of each contract and the appropriate anticipated dates of completion.

7. General character of work performed by your company.

8. Have you ever failed to complete any work awarded to you? If so, where and why?

9. Have you ever defaulted on a contract? If so, where and why?

10. List the more important contracts recently completed by you, stating the approximate gross cost for each, and the month and year completed.

11. List your major equipment <u>available for this contract</u>.

12. Experience in construction work similar in importance to this project.

13. Background and experience of the principal members of your organization including the officers.

14. Credit available: $_____.

15. Give bank reference.

16. Will you upon request, fill out a detailed financial statement and furnish any other information that may be required by the City of Muscatine?

17. (a) Have you ever been a party to or otherwise involved in any action or legal proceeding involving matters related to race, color, nationality or religion? If so, give full details.

    (b) Have you ever been accused of discrimination based upon race, color, nationality, or religion in any action or legal proceeding, including any proceeding related to any Federal Agency? If so, give full details.

18. The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by the City of Muscatine in verification of the recitals comprising this Statement of Bidder's Qualifications.

Dated at _____ this _____ of _____
_____, 2019.

_____
(Name of Bidder)

By _____

Title _____

State of _____)
) ss
County of _____)

_____ being duly sworn, deposes and says that he is the _____ of _____ and that the answers to the foregoing questions and all statements therein contained are true and correct.

Subscribed and sworn to before me this _____ day of _____, 2019.

_____
Notary Public

My Commission expires _____

FORM OF CONTRACT

THIS AGREEMENT, made and entered into this ____ day of _____, 2019, by and between the City of Muscatine, Iowa, party of the first part, hereinafter referred to as the "City" and _____, party of the second part, hereinafter referred to as the "Contractor".

WITNESSETH

That the Contractor and the City for the consideration stated herein mutually agree as follows:

ARTICLE 1: Statement of work. The Contractor shall furnish all supervision, technical, personnel, labor, materials, machinery, tools, equipment, and services, including utility and transportation services and perform all work required for the construction of the Mulberry Avenue & East 2nd Street Roundabout Project, Muscatine, Iowa, all in strict accordance with the Contract Documents prepared by the City of Muscatine, Department of Public Works.

ARTICLE 2. The City will pay the Contractor for the performance of the contract, from funds legally available for that purpose. Payment will be made on the basis of an estimate equal to ninety-five (95) percent of the contract price, including materials, subject to approval of the City. The balance of the five (5) percent due to the Contractor will be made no earlier than thirty (30) days from the final acceptance of said work by the City.

The Contractor shall provide surety bond in the amount of 100% of the contract and shall guarantee the maintenance of the improvement for a period of two (2) years after its completion and acceptance by the City.

Completion Dates: All work shall be completed by Late Start 8/19/2019; 70 Working Days.

The contract amount is $_____.

ARTICLE 3. Contract: The executed contract documents shall consist of the following:

a. This Agreement
b. Addenda Numbers_____
c. Plans
d. Notice to Bidders
e. Instruction to Bidders
f. Signed Copy of Proposal
g. Non-Collusion Affidavit of Subcontractors
h. Special Conditions
i. Detailed Specifications
j. Standard Specifications
k. General Conditions

THIS AGREEMENT, together with other documents enumerated in this ARTICLE 3, with said other documents are as fully a part of the contract as if hereto attached or herein repeated, forms the contract between the parties hereto. In the event that any provision in any component part of this contract conflicts with any provision of any other component part, the provision of the component part first enumerated in this ARTICLE 3 shall govern, except as otherwise specifically stated.

IN WITNESS WHEREOF, the parties thereto have caused this AGREEMENT to be executed in triplicate original copies on the date and year first above written.

CITY OF MUSCATINE, IOWA

By: Diana Broderson, Mayor

ATTEST: _____
By: Gregg Mandsager, City Administrator

_____
CONTRACTOR

_____
By:

_____
TITLE

ATTEST: _____

_____
TITLE

NONCOLLUSION AFFIDAVIT OF SUBCONTRACTOR
EXHIBIT A

State of _____)
) ss.
County of _____)

_____, being first duly sworn, deposes and says that:

(1) He is the _____ of _____ _____, hereinafter referred to as the "Subcontractor";

(2) He is fully informed respecting the preparation and contents of the Subcontractor's Proposal submitted by the Subcontractor to _____, the Contractor for certain work in connection with the _____ Contract pertaining to the Mulberry Avenue & East 2nd Street Roundabout Project in Muscatine, Iowa;

(3) Such Subcontractor's Proposal is genuine and is not a collusive or sham bid;

(4) Neither the Subcontractor nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement, or collusion or communication or conference with any other Bidder, firm, or person to fix the price or prices in the attached Bid or of any Bidder, or, to fix any overhead, profit, or cost element of the bid price or the bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against the City of Muscatine or any person interested in the proposed Contract; and

(5) The price or prices quoted in the Subcontractor's Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed) _____

_____
Title

Subscribed and sworn to before me
this _____ day of _____, 2019.

_____

_____
Title
My commission expires _____

PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS THAT, a Principal, hereinafter called the Contractor and

_____

(Here insert the legal title of Surety)

as Surety, hereinafter called the Surety, are held and firmly bound unto City of Muscatine, Muscatine County, Iowa as obligee, hereinafter called the Owner, in the amount of

_____

DOLLARS ($) for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 2019, entered into a Contract with Owner for the

MULBERRY AVENUE & EAST 2ND STREET ROUNDABOUT PROJECT

in accordance with drawings and specifications prepared by the Department of Public Works, City of Muscatine, Iowa, which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly and faithfully perform said Contract, then the obligation of this bond shall be null and void; otherwise it shall remain in full force and effect.

A. The Surety hereby waives notice of any alteration by Owner to be, in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

1. Complete the Contract in accordance with its terms and conditions, or
2. Obtain a bid or bids for submission to Owner for completing the Contract in accordance with its terms and conditions, and upon determination by Owner and Surety of the lowest responsible Bidder, arrange for a contract between such Bidder and Owner, and make available as work progresses (even though there should be a default or a succession or defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract Price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "Balance of the Contract Price", as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

B. The Contractor and his surety shall be obligated to remedy any defects in workmanship or materials that may develop in the improvements covered by this bond for a period of two (2) years from the date of acceptance of the improvements by the owner.

C. Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the contract falls due.

D. D. No right of action shall accrue to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of Owner.

IT IS A FURTHER CONDITION OF THIS OBLIGATION that the principal and surety shall, in accordance with the provisions of Chapter 573 of the Code of Iowa, pay to all persons, firms or corporations having contracts directly with the principal or with subcontractors all just claims due them for labor performed or materials furnished in the performance of the contract on account of which this bond is given.

The provisions of Chapter 573, Code of Iowa, are a part of this bond to the same extent as if they were expressly set out herein.

SIGNED AND SEALED THIS _____ DAY OF _____, A.D. 2019.

IN THE PRESENCE OF:

_____
PRINCIPAL

_____ _____
WITNESS TITLE

_____
SURETY

SPECIAL CONDITIONS
Table of Contents

SC-01 FORM OF DETAILED SPECIFICATIONS

The Detailed Specifications are of the abbreviated or outline type and the Contractor must supply omitted words or phrases by interference. Omissions of words or phrases such as "the contractor shall", "in conformance with", "shall be", "as noted on the plans", "according to the plans", "a", "an", "the", and "all" are intentional.

SC-02 DEFINITIONS

OWNER:	City of Muscatine, Iowa which is the Party of the First Part in the accompanying contract, acting through its authorized representatives, and referred to in these proceedings as "City" or "Owner".
ENGINEER:	A city Engineer of Muscatine, Iowa, or his authorized representative.
INSPECTOR:	The authorized representative of the Owner, assigned to the detailed inspection of the work or materials therefore, and to such other duties as may be delegated to him in these specifications.
CONTRACTOR:	The Party of the Second Part in the accompanying contract for the improvement covered by these specifications or his authorized representative.
SUBCONTRACTOR:	Any person, firm, or corporation who has, with the approval of the Owner, contracted with the Contractor to execute and perform in his stead all, or any part, of the contract.
SPECIFICATIONS:	The documents that set forth manner in which the proposed work is to be accomplished, which have been prepared by the Department of Public Works and their Consultants and approved by the Owner, official copies of which are now on file with the City Clerk.
WORK OR PROJECT:	The improvement that is to be made, the approximate quantities for which, and the location of, as set out in the NOTICE TO BIDDERS.

PLANS:	Drawings that may indicate manner, materials, or requirements of this contract and are made a part of the Contract as if bound into the specifications.

SC-03 NOTICE TO PROCEED

The Contractor shall not commence work before receiving written notice to proceed and must begin within ten (10) days after such notice.

SC-04 MAINTENANCE AND CONTROL OF TRAFFIC

The Contractor shall conduct his work as to assure the least possible obstruction to access by the residents along the project. Suitable access shall mean a roadway of sufficient width, free from ruts, potholes and mud holes, and capable of carrying a passenger car without damage to the car. When access must be denied due to construction, the Contractor shall provide suitable access within 24 hours after responsible construction is completed. Whenever construction is stopped due to inclement weather, weekends, holidays or other reasons, suitable access shall be provided for all property owners.

Emergency vehicles shall be provided reasonable access at all times.

The Contractor shall maintain all equipment within the gross weight limits as licensed by the State of Iowa. Damage to existing sealcoat or concrete streets as a result of excessive loads shall be the Contractor's responsibility to repair. Damage to existing sealcoat or concrete streets as a result of construction equipment that maintains the licensed weight limit shall be the responsibility of the city.

All open excavations, machinery, material or other items on the project that could constitute a hazard shall be marked by lighted barricades to ensure the safety of the public. (See DS-01.03)

The Contractor shall furnish the name and telephone number of at least one individual who shall be responsible for maintaining project signs and barricades at night, weekends and any time workers are not present.

Existing traffic and street name signs which will interfere with construction will be removed and

relocated by the Contractor at a location designated by the Engineer. Any signs damaged by the Contractor shall be repaired or replaced at no expense to the Owner.

SC-05 COPIES OF PLANS & SPECIFICATIONS

After award of contract, the Owner will furnish the Contractor three (3) sets of plans and specifications. Additional sets will be available upon request.

SC-06 RIGHT-OF-WAY

All construction activity will be on rights-of-way provided by Owner.

SC-07 CONSTRUCTION FACILITIES

Limited storage space for materials and equipment will be available within portions of the right-of-way provided for construction.

All storage areas will be subject to approval.

The Contractor will arrange for any utilities required for construction facilities, and all expense will be borne by the Contractor.

SC-08 SALVAGE

All asphalt millings belong to the City and shall be delivered to the City maintenance yards located at 1459 Washington Street. Any items to be salvaged by the Contractor will be so noted on the plans or in the Detailed Specifications.

SC-09 WASTE SITE

A waste site for rubble and miscellaneous non-asphalt material will be provided and specified by the Engineer.

SC-10 INSURANCE

The Contractor shall purchase and maintain throughout the construction period, insurance in the following minimum requirements, and the coverage must be written in a company that has a Best's rating of B+ or better:

(1) Worker's compensation insurance including Employer's Liability and Occupation disease covering all Iowa employees for statutory Iowa benefits who perform any of the obligations assumed by the Contractor under the contract. The policy will contain broad form all states endorsement.
(2) Comprehensive General Liability, including independent contractors, completed operations and products, contractual liability, broad form property damage, personal injury, and X, C, and U coverage; coverages must meet the following limits. Deductibles on bodily injury are not acceptable:

COVERAGE	MINIMUM LIMITS
Bodily Injury or Death	$1,000,000 each occurrence $5,000,000 aggregate
Property Damage	$1,000,000 each occurrence
Combined Single Limit	$1,000,000 each occurrence
Umbrella Liability Coverage	$2,000,000 Total

(3) Comprehensive General Automobile liability insurance on all self-propelled vehicles not covered under general liability and used in connection with the Contract, whether owner, non-owner, or hired:

COVERAGE	MINIMUM LIMITS
Bodily Injury or Death	$1,000,000 each occurrence
Property Damage	$1,000,000 each occurrence
Option: Combined Single Limit	$1,000,000 each occurrence

The Owner shall have the right at any time to require public liability insurance and property damage liability insurance greater than those required in the above paragraphs. In any such event, the additional premium or premiums payable solely as the result of such additional insurance shall be added to the bid price.

Any reductions in limits or coverages or exceptions to the insurance requirements can be made if requested in writing and mutually agreed to.

The Contractor shall furnish to the Owner, Certificates of Insurance evidencing compliance with the foregoing requirements before commencing any operations under this contract. (These Certificates shall contain a provision that the coverage afforded under the policies will not be canceled or materially changed until at least thirty (30) days prior written notice has been given to the Owner and Engineer).

SC-11 CONTRACT TERMINATION

Provisions contained in Chapter 573A Code of Iowa providing for the termination of contracts in construction of public improvements when construction is stopped because of national emergency shall apply to and be a part of this contract and binding on all parties including subcontractors and sureties upon any bond given or filed in connection therewith.

SC-12 CODES AND STANDARDS

a. Perform work in accordance with best present day installation and manufacturing practices; conform to "Manual of Accident Prevention in Construction" by the Associated General Contractors of America, Inc., and Iowa Employment Safety Commission requirements.

b. Comply with all applicable laws, building and construction codes, and requirements of governmental agencies under those jurisdiction work is being performed; fees for permits and licenses shall be paid by Contractor.

c. Unless specifically noted to the contrary, conform with and test in accordance with applicable sections of latest revisions of codes and standards listed in Detailed Specifications.

d. Conflicts:

   1. Between referenced codes and standards: code or standard establishing more stringent requirements shall be followed.

   2. Between referenced codes and standards and specifications and/or plans: one establishing more stringent requirements shall be followed.

   3. Between specifications and plans: plans shall govern.

e. All work included under this Contract shall be done in accordance with the Occupational Safety and Health Act of 1970 (Williams-Steiger Act) as amended and enforced by the governmental authority responsible for the local enforcement of the Act. Enforcement and responsibility for fulfilling this provision of the specifications shall rest solely with the contractor, his superintendents, and his foreman, and in no way shall rest with the Owner or the Engineer.

f. All work included under this contract shall be done in accordance with the Secretary of Labor's Safety and Health Standards established under PL 31-54.

SC-13 SURVEYS AND STAKING (Applicable Only When Construction Survey is not a Bid Item)

The Contractor will be responsible for any survey and/or staking required and will be incidental to the project.

SC-14 MATERIAL TEST AND CERTIFICATION

Material tests or certification will be required on all materials (pre-cast concrete structures included) incorporated in the project. Such testing and certification costs shall be paid for by the Contractor. Two (2) copies of the test results or certification should be filed with the Engineer prior to the material usage.

The class, date of manufacture, and trademark shall be plainly marked or stenciled on the inside of each segment of reinforced concrete pipe not later than 24 hours after the pipe is made.

SC-15 PAYMENT

Separate payment will be made for only those items specifically listed in the proposal. Payment will be made for the quantities of work completed in accordance with Item DS-05 included in the Detailed Specifications.

Payment will also be made in accordance with the Notice to Bidders.

SC-16 COORDINATION OF CONSTRUCTION BY THE CONTRACTOR

Coordination work with other contractors, Owner and Engineer to assure orderly and expeditious progress of work.

Select order of work and establish schedule of working hours for construction, subject to approval of Owner and Engineer.

Maintain existing water systems, sewer systems, gas systems, electrical utilities, highways and railroads in substantially continuous operation during construction, unless specifically permitted otherwise by Engineer or other authority.

Perform work hazardous to operation of existing water systems, sewer systems, gas systems, electrical utilities, railroads and highways, or which will require interruption of service, at times specifically approved by Owner and Engineer, or authority in charge of specific utility or service involved.

The Contractor shall be responsible for giving advance notice to all public and private utility

companies of his work and use all necessary precautions to prevent damage to all utilities. The Contractor shall be held responsible for all damages and will bear the cost of any repairs or damages caused by his neglect.

Make any temporary connections necessary for maintaining service during course of work and continued operation of sewer system at Contractor's expense.

Make temporary connections in workmanlike manner; avoid hazards to personnel or service.

Remove temporary connections after permanent connections are made.

Schedule construction to minimize interruptions to utility service or use of street barricades and detours.

SC-17 SANITARY FACILITIES

Sanitary facilities shall be provided by Contractor for use of all construction personnel, including those of other contractors, for the duration of the project, as follows:

Facilities shall consist of chemical units, complete with weather-tight enclosure adequately ventilated, and equipped with latching door.

Chemical units shall be maintained weekly or at lesser periods if determined necessary. Chemical units shall be in accordance with the rules and regulations of the locality of the project (state, county or city).

Contractor shall furnish toilet paper for the chemical units and shall replenish supply whenever required.

Sanitary facilities remain property of the Contractor and, upon completion of the work, shall be removed from the site.

SC-18 MINOR WORK

Any minor work not specifically mentioned in the specifications or shown on the plans but obviously necessary for the proper completion of the work shall be considered as being a part of and included in the contract and shall be executed in the proper manner and the contractor shall not be entitled to extra or additional compensation for same.

SC-19 SITE CLEANUP

The Contractor shall be responsible for removal of all debris remaining at the project site, which is the result of the various construction operations. The final cleanup of the project site must be completed to the satisfaction of the Owner and Engineer before final payment will be made.

SC-20 FINAL INSPECTION AND ACCEPTANCE

The Contractor shall notify the Engineer when work is considered to be complete and ready for final inspection.

The Engineer, after determining that the work is ready for final inspection and giving ten (10) days notice to the Contractor, will make final inspection and tests he deems necessary to determine that

provisions of the specifications are satisfied.

The Owner will not accept work or make final payment to the Contractor until the Engineer has certified that the work of the Contractor is complete and in conformance with the specifications.

SC-21 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

The Contractor assumes full responsibility for the safekeeping of all materials and equipment and for all unfinished work until final acceptance by the Owner, and if any of it be damaged or be destroyed from any cause, he shall replace it at his own expense.

The Contractor shall indemnify and save harmless the Owner against any liens for nonpayment of his bills in connection with the contract work. The Contractor shall furnish the Owner satisfactory evidence that all persons who have done work or furnished materials, equipment, or service of any type under this contract have been fully paid prior to the acceptance of the work by the Owner.

Contractor will indemnify, defend, keep and save harmless, Owner, its agents, officials and employees against all suits or claims that may be based on bodily injury to persons or damage to property of others, or personal injury including libel and slander that is the result of an error, omission or negligent act of Contractor or any person employed by the Contractor, sub-contractor or any person employed by the Contractor, sub-contractor or agent of either.

If the contract involved construction of a structure that would normally be the subject of builders risk insurance, Contractor will purchase such a policy for the full-completed value of the structure, with allowable exclusions. This policy will be written on an "all risk" basis. The named insured will include the owner, general contractor, and any subcontractors as their interest may appear. A deductible of 2% of the completed value with a maximum of $5,000 will be permitted.

SPECIAL PROVISIONS
Table of Contents

SP-01 SECTION 7030 – SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS SPECIAL PROVISIONS

*This special provision amends Section 7030 as it pertains to the following bid items:

- Concrete unit pavers, Type B & C, with sand setting bed and PCC subbase
- Historic pavers, Type A, with sand setting bed and PCC subbase (pavers furnished by City)
- Crosswalk concrete unit pavers, Type D, on concrete base with 3/4" asphalt setting bed
- Detectable warnings

1.03 Submittals: Add the following to item C.

C. Concrete unit paver types and source, manufacturer specifications, HMA setting bed mix design and gradation reports, samples of each type of paver showing color and texture, and polymeric sand joint filler.

1.08 Measurement and Payment: Item F covers the measurement and payment for all concrete unit pavers with concrete subbase. Delete item 1. Revise item 2 per the following.

F. Concrete Unit Pavers

1. Delete.

2. Concrete Unit Pavers with Concrete Base:

a. Measurement: Measurement will be in square foot (SF) for the area of concrete unit pavers placed on a concrete base. The area of the concrete base will not be measured separately.

b. Payment: Payment will be at the unit price per square foot (SF) for the area of concrete unit pavers placed on concrete base.

c. Includes: Unit price includes, but is not limited to, Subgrade preparation, concrete base, rebar, HMA setting bed (if required by specified installation), neoprene asphalt mastic (if required by specified installation), concrete unit pavers and polymeric sand joint filler.

2.03 Brick Pavers: Replace text with the following.

A. Refer to Sheet T.01 of the contract documents for list of concrete unit paver types, color and manufacturer information.

B. Contractor shall furnish an additional 5% of each paver type to Owner at completion of project, palletized and delivered to City yard. Cost is incidental to paver unit bid price.

2.06 Brick Joint Filler: Replace text with the following.

A. Joint filler for concrete unit pavers shall consist of polymeric sand. Acceptable products are Alliance – Gator Maxx or Techniseal NextGel, color to be approved by Engineer.

B. Contractor shall furnish two (2) additional bags of joint filler to Owner at completion of project, delivered to City yard. Cost is incidental to paver unit bid price.

2.07 Detectable Warnings: Replace text with the following.

Refer to contract documents for a description of detectable warning panel, size and location.

3.06 Brick Sidewalks: This section shall apply to concrete unit pavers set on concrete base. Refer to contract documents for installation details and manufacturer standard specifications.

SP-02 SECTION 9030 – PLANT MATERIAL AND PLANTING SPECIAL PROVISIONS

*This special provision amends Section 9030 as it pertains to the following bid items:

- Deciduous Shrubs
- Ornamental Trees
- Perennial Ground Cover (1 Gal.)
- Deciduous Trees

1.08 Measurement and Payment: Replace with the following.

1. Measurement: Each tree, shrub, groundcover or perennial plant accepted in place will be counted. Amended planting soil shall be considered incidental to plant bid items.

2. Payment: Payment will be at the unit price for each tree, shrub, or groundcover perennial plant. Payment will be made according to the following:

a. 100% of unit price at initial acceptance (less retainage). Initial acceptance will be determined by Engineer. Plant material shall be thriving, fully maintained and show no signs of stress. Upon substantial completion of entire project, a one-year warranty period will commence. Contractor shall provide one-year warranty certificate with start and finish dates as directed by Engineer. Contractor shall maintain all plant material as necessary, including watering, to ensure healthy, vigorous plant material throughout warranty period.

b. At end of one-year warranty period, the Contractor and Engineer will conduct a thorough review of all plant material. Any plant material not thriving shall be replaced with same size, species and quality as originally planted, per contract documents, at no additional cost to the Owner. A one-year warranty period will apply to all replacement plant material.

3. Includes: Unit price includes, but is not limited to, delivery, excavation, installation, watering, placing amended planting soil, backfill, mulching, wrapping, staking or guying, herbicide, maintenance during establishment and warranty periods, and replacements.

2.02 Mulch: Replace with the following.

A. Finely shredded, hardwood mulch.

B. Particle sizes ranging from 0.25-0.5 inch diameter and maximum 3 inches in length.

C. Green or freshly chipped or shredded mulch shall be rejected.

D. Mulch shall be free of weeds, weed seed, chaff, diseases, or other foreign material.

2.03 Backfill Material: Replace with the following.

A. Planting backfill shall consist of amended planting soil as indicated on contract documents. See 'T' Sheet Series for amended soil mix design.

B. Excavated soil from planting pits may be amended with compost and sand to the ratios described in amended planting soil notes. Existing soil must be approved for use.

C. Ensure backfill material is loose, friable, and free of clods and rocks 2 inches in diameter or larger. Do not use frozen or muddy soil as backfill material.

TECHNICAL SPECIFICATIONS
Table of Contents

TS-01 SECTION 02220 – STRUCTURAL PLANTING SOIL

PART 1 -- GENERAL

1.1 Summary

A. Section Includes:

1. All labor, materials, equipment, and supervision required to furnish and install the structural soil to finished grade for designated tree plantings, as shown on the Plan Sheets or directed by the Engineer.

1.2 Measurement and Payment

A. Structural Planting Soil:

1. Payment shall be per cubic yard and shall include all costs to supply, mix, haul, place and compact the structural soil material. All costs associated with subgrade preparation shall be included in this bid item. Excavation for structural soil will be paid separate, under common excavation bid item.

1.3 Submittals

A. Product labels and data sheets

B. Chemical analysis of structural soil

C. 1 Gallon sample of structural soil mix

PART 2 -- MATERIALS

2.1 Clay Loam

A. Clay Loam shall be a "loam" based on the "USDA classification system" as determined by mechanical analysis (ASTM D-422) and it shall be of uniform composition, without admixture of subsoil. It shall be free of stones greater than one-half inch, lumps, plants and their roots, debris and other extraneous matter over one inch in diameter or excess of smaller pieces of the same materials. It shall not contain toxic substances harmful to plant growth. It shall be obtained from naturally well-drained areas, which have never been stripped of topsoil before and have a history of satisfactory vegetative growth. Clay loam shall contain not less than 2% or more than 5% organic matter as determined by the loss on ignition of over-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F., plus or minus 9 degrees.

B. Mechanical analysis for a Loam/Clay Loam shall be as follows:

Textural Class	% of Total Weight
Gravel	less than 5%
Sand	20-45%
Silt	20-50%
Clay	20-40%

C. Chemical analysis: Meet or be amended to meet the following criteria:

1. pH between 5.5 to 6.5.
2. Percent organic matter 2% - 6% by dry weight.
3. Nutrient levels as required by the testing laboratory recommendations for the type of plants to be grown in the soil.
4. Soluble salt less than 1.0 Millimho per cm.
5. Cation Exchange Capacity (CEC) greater than 10.
6. Carbon/Nitrogen Ratio less than 33:1.

D. No topsoil shall come from USDA - classified prime farmland.

2.2 Crushed Stone

A. Crushed Stone shall be either granite or limestone. The size of the crushed stone shall be 0.75 inches to 1.5 inches allowing for 5% to 10% to be greater than 1.5 inches, and 5% to 10% less than 0.75 inches.

B. Acceptable aggregate dimensions will not exceed 2.5:1.0 for any two dimensions chosen.

C. Minimum 90% with one fractured face, minimum 75% with two or more fractured faces.

D. Results of Aggregate Soundness Loss test shall not exceed 18%.

E. Losses from LA Abrasion tests shall not exceed 40%.

2.3 Fertilizer

A. Commercial fertilizer shall comply with State and United States fertilizer laws. Fertilizer shall be formulated for mixing into the soil and be certified by the manufacturer to provide controlled release of nitrogen continuously for a period of no less than nine months and no more than 12 months.

B. Fertilizer percentages of weight of ingredients and application rates shall be as recommended by the soil testing results. Contractor tor to coordinate any required testing and action required.

2.4 Sulfur

A. Sulfur shall be commercial granular, 96% pure sulfur, delivered in containers with the name of the manufacturer, material and analysis appearing on the container.

B. Sulfur used to lower soil pH above 6.5 shall be ferrous sulfate formulation.

2.5 Lime

A. Agricultural limestone containing a minimum of 85% carbonates. Minimum gradation: 100% passing 10 mesh sieve; 98% passing 20 mesh sieve; 55% passing 60 mesh sieve and 40% passing 100 mesh sieve.

2.6 Hydrogel

A. Hydrogel shall be a potassium propenoate-propenamide copolymer Hydrogel (Gelscape® Hydrogel Tackifier) as manufactured by Amereq Corp. (800) 832-8788, or approved equal.

2.7 Water

A. The installing contractor shall be responsible to furnish his own supply of water (as needed)

2.8 Structural Soil Blend

A. A uniformly blended mixture of crushed stone, clay loam and hydrogel mixed in the following proportions:

Material	Unit of Weight
Specified Crushed Stone	100 units dry weight
Specified clay loam	20-25 units (to achieve minimum CBR of 50)
Hydrogel	0.035 units dry weight

Moisture	ASTM D698/AASHTO T-99 optimum moisture

PART 3 -- EXECUTION

3.1 Mixing and Quality Control

A. All structural soil mixing shall be performed at the producer's yard using appropriate soil measuring, mixing and shredding equipment of sufficient capacity and capability to assure proper quality control and consistent mix ratios. No mixing of Structural Soil at the project site shall be permitted.

B. Should the independent laboratory test results of the clay loam reveal a need to amend it, to meet specifications, the amending materials should be added to the clay loam following the rates and recommendations provided by the licensed producer of the structural soil.

3.2 Underground Utilities and Subsurface Conditions

A. The installing contractor shall notify the engineer of any subsurface conditions which will affect the contractors ability to install the structural soil

B. The installing contractor shall locate and confirm all underground utility lines and structures prior to the start of any excavation

C. The installing contractor shall repair any underground utilities or foundations damaged during the progress of the is work

3.3 Site Preparation

A. Do not proceed with the installation of structural soil material until all walls, curbs, footings and utility work in the area have been installed. For site elements dependent on structural soil for foundation support, postpone installation of such elements until immediately after the installation of structural soil.

B. Excavate and compact the proposed subgrade to depths, slopes and widths as shown on the drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted subgrades of adjacent pavement or structures.

C. Do not proceed with the installation of structural soil until the confirmation of the subgrade elevation and compaction and all utility work in the area has been installed. All subsurface drainage systems shall be operational prior to installation of structural soil.

3.4 Installation of Structural Soil

A. Install structural soil in 6 inch lifts and compact each lift.

B. Compact all materials to at least 95% Proctor Density from a standard compaction curve AASHTO T 99 (ASTM D 698). No compaction shall occur when moisture content exceeds maximum as listed herein. Delay compaction if moisture content exceeds maximum allowable as directed by the engineer.

C. Bring structural soil to finished grades as shown on the drawings and protect from contamination as directed by the engineer.

D. The engineer may periodically check the material being delivered, prior to installation for color and texture consistency with the approved sample provided by the installing contractor as part of the submittal for structural soil. If the engineer determines that the delivered structural soil varies significantly from the approved samples, the engineer shall contact the licensed producer.

E. Structural soil should not be stockpiled long-term. Any structural soil not installed immediately should be protected by a tarp or other waterproof covering.

3.5 Clean-Up

A. Upon completion of the structural soil installation operations, clean areas within the contract limits. Remove all excess fills, soils and mix stockpiles and legally dispose of all waste materials, trash and debris. Remove all tools and equipment and provide a clean, clear site. Sweep, do not wash, all paving and other exposed surfaces of dirt and mud until the paving has been installed over the structural soil material. Do no washing until finished materials covering structural soil material are in place.

1. ***END OF SECTION***

PART 4 -- GENERAL

4.1 Summary

A. SECTION INCLUDES

1. Requirements for furnishing and installing site furnishings.

B. MEASUREMENT AND PAYMENT

1. Measurement and payment for site amenities shall be per unit quantity and shall include all equipment, materials, and labor to install site furnishings complete. Footings and/or attachment hardware are incidental to the unit price.

4.2 Submittals

A. Shop Drawings: Shop drawings to be submitted for each item, including color chips of the same material as the site furniture item.

B. Product Data: Submit manufacturer's assembly and installation drawings.

C. Color Samples: Submit color samples for approval prior ordering

4.3 Ordering, Delivery, Handling, and Storage

A. Contractor shall be responsible for execution of all phases of site furnishings work, including ordering, shipping, storage, and installation, and shall protect furnishing from damage by construction and clean-up activities following installation until acceptance of project by Owner.

PART 5 -- PRODUCTS

5.1 Benches

A. Victor Stanley

RBF-28 Steel Bench, 6’ Length, Black
Andrew Hosmer
P.O. Drawer 330
Dunkirk, MD 20754
Tel: 301.855.8300 ext. 323

B. SiteScapes, Inc

WestPort Steel Loop Ends
Model: WP1-1060, Six Foot Backed Bench
Powder Coat Finish: Black

C. Approved Equal

5.2 Litter Receptacle

A. Victor Stanley

SDC-36 (SteelSites Side Door Receptacle, Convex Lid, Keyed Lock, Black)
Andrew Hosmer
P.O. Drawer 330
Dunkirk, MD 20754
Tel: 301.855.8300 ext. 323

B. Approved Equal

5.3 Bike Racks

A. Victor Stanley

BFRE-161 (Freesia Bike Rack, with crossbar, surface mount, Black)
Andrew Hosmer
P.O. Drawer 330
Dunkirk, MD 20754
Tel: 301.855.8300 ext. 323

B. Approved Equal

PART 6 -- EXECUTION

6.1 General

A. Install all site furnishings at locations described on the Drawings.

6.2 Installation

A. Install all site furnishings as per manufacturer's recommendations.

1. ***END OF SECTION***

2.

PART 7 -- GENERAL

7.1 Section Includes

A. Quarried limestone products for outcropping boulders and boulder seatwalls.

7.2 Measurement and Payment

A. Limestone Outcropping Boulders as indicated on the plans, complete-in-place will be measured and paid as per Each (EA) of outcropping boulder installed complete. Unit bid price shall include, but not limited to, furnish and install all items necessary to complete including outcropping boulder and aggregate base.

B. Limestone Boulder Seatwall as indicated on the plans, complete-in-place will be measured and paid as per Linear Foot (LF) of outcropping boulder seatwall. Unit bid price shall include, but not limited to, fabricating, furnish and install all items necessary to complete including outcropping boulder, and aggregate pins per contract documents.

1. Concrete base beneath outcropping seatwall will be paid at per Square Foot (SF) unit of 12” and 18” Concrete Band, see plan drawings for locations.

7.3 Submittals

A. Product Data: Provide data on stone units including source and description of type, finish, and size.

B. Shop Drawings:

1. Submit cutting and setting drawings indicating sizes, dimensions, sections, and profiles of stones; arrangement and provisions for jointing and anchoring.

C. Submit 3 samples showing, color range, vein direction, markings, surface finish of each product specified.

D. Submit stone fabricator's installation instructions

PART 8 -- PRODUCTS

8.1 Stone Supplier

A. Weber Stone Company

12791 Stone City Rd X28
Anamosa, Iowa 52205

Chad Foley: 319-462-3581

B. Or approved Equal

8.2 Stone

A. Boulder Seatwall

1. Anamosa Limestone Custom Block
2. Color: Buff/Natural
3. Splitface front/back, natural top/bottom, w/ sawn/mitered jointing
4. Minimum width 18”, max. width 30”, varies as needed to maintain consistent radius on face of wall
5. See Boulder Seatwall details for face of wall radius and length for each wall.
6. Boulder seatwalls shall be tagged by each location by supplier prior to delivery to site. Stone supplier shall provide shop drawings indicating location of each section of each wall for installation.

B. Outcropping Boulders

1. Anamosa Limestone Outcropping
2. Color: Buff/natural
3. Natural surface, all sides
4. Size varies, 18”-24” depth x 24”-36” width x 18-24” height
5. See plans for locations, see outcropping details for installation

8.3 Anchoring Pins

A. STAINLESS STEEL PINS

1. 1/2” X 6” Stainless steel pins, two (2) per block, see contract documents for locations.

PART 9 -- EXECUTION

9.1 Preparation

A. Stone shall be brushed free of dust and foreign matter.

B. Wet stone sufficiently to take up surface absorption

9.2 Setting

A. Boulder Seatwall

1. Dry fit boulder seatwall sections together prior to pinning in place.
2. Review mockup of each wall in place with Engineer prior to pinning.
3. Install boulder seatwalls per installation details in contract documents.
4. Mitered joints shall fit tight and be free of voids and gaps.
5. Upon completion, remove any jagged or sharp stone edges.

B. Outcropping Boulders

1. Engineer to approve boulder selection prior to installation. Any boulders not meeting the specified description, shall be rejected at Contractor's expense.
2. Upon placement of boulders, review final orientation with Engineer for any required field adjustments.

9.3 Cleaning

A. Keep stone work as clean as possible as work progresses. Upon completion clean stone thoroughly with water or detergent and water and fiber brushes. Thoroughly rinse when complete with clean water. Do NOT use acids or wire brushes.

B. Special consideration and protection shall be provided when brickwork is cleaned above the limestone. Strong acid compounds used for cleaning brick will burn and discolor the limestone.

1. ***END OF SECTION***

TS–04 04850 - STONE MASONRY

PART 1 - GENERAL

9.4 Section Includes

A. This section includes all labor, materials, equipment, supervision and items of pertinence required to furnish and install stone masonry work for the Intersection Marker, District Marker, and Kiosk.

B. This section includes specifications for unit masonry, stone veneer masonry and pre-cast stone caps.

9.5 Measurement and Payment

A. Stone Masonry shall be considered as an incidental to the associated bid items including: Intersection Marker, District Marker, and Kiosk. Refer to details shown on plans and the following.

9.6 Submittals

A. Shop Drawings

1. Stone masonry details shall be included in the shop drawings for each feature. Information shall include material type, finish, size, attachment, etc. necessary for complete installation.
2. All masonry work including unit masonry, veneer masonry and cap installation shall be covered by shop drawings.

B. Product Data: For the following products:

1. Stone Veneer manufacturer's data
2. CMU block manufacturer's data
3. Pre-cast stone caps manufacturer's data
4. Grout Mix design and data
5. Mortar Mix design and data
6. Waterproofing Membrane product data

C. Samples for Verification:

1. Pointing mortar/grout samples for color selection
2. Joint sealant for color selection

3. Pre-cast stone cap for color and finish selection
4. Stone Veneer Mockups
   (a) 24”x24” mock-up for each feature showing typical joint connections, veneer sizing and finish
   (b) Sample to be approved and available on site during construction.
   (c) Mockups will be used for quality control and will not be a part of permanent construction.

D. Qualification Data

1. Submit data verifying qualifications and five (5) years of experience for manufacturer and installer of similar stone product. Include list of three (3) completed projects having similar scope with water feature work identified by name, location, date, reference names, and phone numbers.

9.7 Quality Assurance

A. Minimum 5 years of documented experience with work of similar scope and complexity required by this Project involving water feature design.

B. Single Source Responsibility for Pre-Cast Caps: Obtain pre-cast cap units of uniform texture and color, from one manufacturer for each different product required for each continuous surface of visually related surfaces.

C. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

D. Single Source Responsibility for Stone Veneer Materials: Obtain stone veneer of uniform quality, including color variations and surface texture, from one manufacturer for each component.

9.8 Delivery and Storage

A. Deliver materials to project site in undamaged condition.

B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, or other causes. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained.

E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

F. Precast concrete to be stored insecure area in original packaging. Protect from damage by other trades.

9.9 Field Conditions

A. Cold-Weather Requirements

1. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
2. Cold-weather procedures when ambient temperature falls below 40°F (4°C) or the temperature of masonry units is below 40°F (4°C).

B. Hot-Weather Requirements

1. Implement hot-weather construction procedures in accordance with ACI 530.1/ASCE 6/TMS 602.
2. Hot-weather procedures when ambient temperature exceeds 100°F (38°C), or exceeds 90°F(32°C) with a wind velocity greater than 8 mph.

PART 10 -- PRODUCTS

10.1 Precast Concrete Cap

A. Materials:

1. Portland Cement: ASTM C-150 specifications for Portland Cement.
2. Aggregates: All aggregates to meet ASTM C-33 specifications, cleaned, and properly graded to size. Aggregates shall be blended to meet individual project requirements.
3. Coloring: Pigments used shall be inorganic, resistant to alkalinity, and used per manufacturer's recommendations. Color and texture to be approved by Landscape Architect.
4. Reinforcement and Hardware: To conform to ACI and manufacturer's design.
   (a) Reinforce precast with deformed rods or wire or both as recommended by precast concrete manufacturer.
5. Caulks and Sealants: Urethane or polyurethane sealant, with color selected by Engineer from standard color palette.

6. Sealer: Colorless, pure acrylic water-repellent penetrating sealer, to maintain natural look of concrete surface with no glue or gloss, darkening or color change.

B. Manufactured Units:

1. Sizing Tolerances: All units to conform to shop drawings, with 1/16” tolerance in dimensions.
2. Precast Surfaces and Edges:
   (a) All exposed edges to have minimum 1/8” chamfer, except where otherwise noted, to prevent chipping.
   (b) Finished surfaces to match approved color sample.
   (c) All precast concrete finished surfaces to be sealed with a sealer approved by manufacturer.

C. Manufacturers:

1. Wausau Tile, Inc., Terra-Form Division, Wausau, WI (800) 388-8728
2. Midwest Cast Stone (913) 371-3300
3. Edwards Cast Stone (563) 556-0535
4. Approved Equal.

10.2 Concrete Masonry Units

A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

B. Concrete Masonry Pilaster Block: Provide units complying with characteristics indicated below for grade, type, face size, exposed face, and weight classification.

1. Grade N.
2. Size: Manufacturer’s standard units with nominal face dimensions per shop drawings.
3. Type 1, moisture-controlled units. Cure units by ASTM Type 1 method.
4. Hollow Load-Bearing Block: Materials shall comply to ASTM C 90 for material and strength, and as follows:
   (a) Weight Classification: Normal weight.

10.3 Limestone Veneer

A. Splitface Limestone Veneer

1. Weber Stone Company

12791 Stone City Rd X28
Anamosa, Iowa 52205
Chad Foley: 319-462-3581

2. See construction documents for type, size and finish.

10.4 Mortar and Grout Materials

A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate for Mortar: ASTM C 144, except for joints less than ¼" use aggregate graded with 100% passing the No. 16 sieve.

D. Aggregate for Grout: ASTM C 404

E. Water: Clean and potable

F. Mortar color: Submit samples to Engineer for Approval.

10.5 Masonry Cleaners

A. Manufacturer's standard strength general purpose cleaner designed for new masonry surfaces of type indicated; composed of blended organic and inorganic acids combined with special wetting systems and inhibitors, expressly approved for intended use by manufacturer of masonry units being cleaned.

1. Products: Subject to compliance with requirements, provide "Sure Klean" No. 600 Detergent; ProSoCo, Inc.

10.6 Mortar and Grout Mixes

A. Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.

B. Mixing: Combine and thoroughly mix cementitious, water, and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types or mortar required, unless otherwise indicated.

1. Limit cementitious materials in mortar to Portland cement-lime
2. Use Type S mortar for all masonry.

D. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of reinforced and non-reinforced unit masonry. Use grout of consistency indicated or, if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Grout to have 3000 psi ultimate compressive strength.

10.7 Steel

A. Steel shall comply with ASTM 615 and be Grade 60.

B. Shop bends only

PART 11 -- EXECUTION

11.1 Installation

A. Cleaning Reinforcing: Before placing, remove loose rust, ice, and other coatings from reinforcing.

B. No stone veneer shall be installed until supporting structure is approved by owner's representative.

C. Install stone veneer with vertical end joints staggered randomly to form an offset pattern.

11.2 Construction Tolerances

A. Variation in Cross-Sectional Dimension: For all elements, from dimensions shown, do not exceed minus 1/4" nor plus 1/2"

B. Variation in Mortar joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

C. Setting cap:

1. Set accurately as shown on approved shop drawings.
2. Alignment of cap should be straight and true to all dimensions, not to vary more than 1/8" in length, height, or width.
3. Install anchors as shown on details.
4. Fill joints between with manufacturer-approved joint sealant as specified in shop drawings.

11.3 Laying Stone Veneer

A. Lay out veneer in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns, and offsets. Avoid the use of less than half-size units at corners.

B. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units or courses above and below.

C. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

11.4 Mortar Bedding And Jointing

A. Lay solid brick size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Set stone caps in full bed or mortar. Fill dowel, anchor, and similar holes solid. Wet stone joint surface thoroughly before setting; for stone surfaces which are soiled, clean bedding, and exposed surfaces with fiber brush and soap powder followed by thorough rinsing with clear water.

D. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8” joints.

E. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials, unless otherwise indicated.

F. All mortar joints in stone veneer to be per shop drawings.

G. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units that have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

11.5 Repair, Pointing, And Cleaning

A. Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.

C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
2. Test cleaning methods on sample column; leave 1/2 column unclean for comparison purposes. Obtain approval of sample cleaning by Owner's Representative prior to proceeding with cleaning of masonry.
3. Protect adjacent stone and on-masonry surfaces from contact with cleaner by waterproof masking tape.
4. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.
5. Use bucket and brush hand cleaning method described in BIA "Technical note No. 20 Revised" to clean brick masonry made from clay or shale using job mixed detergent solution.
6. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

D. Protection: Provide final protection and maintain conditions in a manner acceptable to installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

E. WARNING Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION

1. TS–05 SECTION 05500 – CUSTOM METAL FABRICATIONS

PART 12 -- GENERAL

12.1 Work Included

A. This section covers the fabrication, furnishing, materials, tools, equipment, labor, and performances of all work and services necessary or incidental for the fabrication of metal elements as indicated on the drawings or as specified herein.

12.2 Method of Measurement and Payment

A. Measurement and compensation for all metal fabricated elements shall be at the contract bid price for each contract item installed complete, per UNIT as noted in the contract documents. The bid amount shall be full compensation for all costs of shop drawings, structural engineering, furnishing, and installing all items as specified and shown on the construction documents plans and details, including, but not limited to the following:

B. Furnish and installation of Intersection Marker, per EACH. Including all items necessary for fabrication and installation, including but not limited to: Concrete footing, split face limestone veneer, aluminum metal work and framing, internal wiring internal LED light, LED Driver, extruded push through acrylic letters, mounting hardware, fit and finish etc.

C. Furnish and installation of District Monument, per EACH. Including all items necessary for fabrication and installation, including but not limited to: Concrete footing, structural core, limestone veneer, pre-cast concrete cap, ornamental lettering and metal work, mounting hardware, fit and finish etc.

D. Furnish and installation of KIOSK, per EACH. Including all items necessary for fabrication and installation, including but not limited to: Concrete footing, split face limestone veneer, steel framing, weather proof display cabinet, internal LED light, LED Driver, high pressure laminate graphic panel, mounting hardware, fit and finish etc.

12.3 Quality Assurance

A. Fabricator shall have Minimum of 5 years of experience with similar elements for all fabrication elements that are required to be UL Approved.

B. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

12.4 References

A. ASTM A653/A 653-M-00 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized)-or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process).

B. ASTM A123/A122M-00- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM B117 Test Method – Salt Spray (Fog) Testing.

D. ASTM A787-96 Standard Specifications for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing

E. ASTM B209–10 Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate

F. ASTM B221 Standard Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

G. ASTM B308 / B308M Standard Specifications for Aluminum-Alloy 6061-T6 Standard Structural Profiles

H. ASTM B429 Standard Specifications for Aluminum-Alloy Extruded Structural Pipe and Tube

I. Aluminum Association – Aluminum Design Manual

J. TT-P-645 – Paint, Aluminum, Heat Resisting

12.5 Submittal

A. Submit data verifying qualifications and min five (5) years of experience for fabricator and installer of similar fabrications and components. Include list, min three (3) of completed projects having similar scope of work identified by name, location, date, reference names, and phone numbers.

B. Manufacturer's literature

C. Manufacturer's documentation with min of 5 year experience (as required)

D. Warranty information for all components and finishes

E. Certified shop drawings detailing dimensions, materials, structural engineering, footings, anchor bolts, and finishes shall be submitted prior to fabrication.

F. Actual color chips of selected color from requested color palettes shall be selected by Owners Representative.

12.6 Product Handling And Storage

A. Upon receipt at the job site, all materials shall be checked to ensure that no damages

occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

PART 13 -- MATERIALS

13.1 Materials

A. Materials for all signage features and structures shall be as detailed on drawings. Fabrication and finishing of structures and elements shall be completed as per shop drawings. Onsite fabrication and finishing of structure is not allowed.

B. Stainless steel as detailed to be: Stainless Steel Grade 316

C. Aluminum Tubing as detailed to be: Alloy and temper 6016-T6

D. All hardware, anchor bolts, washers, lock washers and nuts shall be stainless steel. Stud anchors shall have a minimum pullout strength of 8000 pounds based on 4000 psi concrete unless otherwise noted.

PART 14 -- EXECUTION

14.1 Preparation

A. All new installation shall be laid out by the contractor in accordance with the construction plans. Verify areas to receive structures or elements are completed to final grades, elevations, and materials.

B. Coordinate installation with work of other sections of these specifications.

14.2 Installation

A. Install all elements and structures in accordance with the Drawings, Specifications, and manufacturer's instructions.

B. Field cutting, drilling, or welding of prefinished metal components will not be allowed without prior approval of the Engineer.

14.3 Cleaning

A. The contractor shall clean any dirt or protective wrap following installation and remove all excess materials and trash from the jobsite.

END OF SECTION

TS–06 SECTION 12020 - HIGH PERFORMANCE COATINGS

PART 15 -- GENERAL

15.1 Section Includes:

A. High performance coatings as identified in plans and specs as Powder Coat Finish for Handrails, District Monument, Kiosk and Intersection Marker.

15.2 References

A. FS TT-P-28 - Paint, Aluminum, Heat Resisting (1200 degrees F.); Federal Specifications and Standards; Revision G, 1985.

B. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

C. SSPC-SP 3 - Power Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

D. SSPC-SP 5 - White Metal Blast Cleaning; Society for Protective Coatings; 2000 (Ed. 2004).

E. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2000 (Ed. 2004).

F. SSPC-SP 7 - Brush-Off Blast Cleaning; Society for Protective Coatings; 2000 (Ed. 2004).

G. SSPC-SP 10 - Near-White Blast Cleaning; Society for Protective Coatings; 2000 (Ed. 2004).

H. SSPC-SP 11 - Power Tool Cleaning to Bare Metal; Society for Protective Coatings; 1987 (Ed. 2004).

15.3 Submittals

A. Samples: Submit two samples 6 x 6 inch in size illustrating colors available for selection.

B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Maintenance Data: Include cleaning procedures and repair and patching techniques.

15.4 Quality Assurance

A. Maintain one copy of each referenced document that applies to application on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience.

15.5 Mock-Up

A. Provide mock-up, 2 feet long by 2 feet wide, illustrating coating, color, and surface sheen, for each specified coating.

B. Mock-up may remain as part of the Work.

15.6 Warranty

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for bond to substrate.

15.7 Maintenance Products

A. Provide 1 gallon of color matched exterior grade polyurethane paint for each color specified, for Contracting Authority's maintenance use.

B. Label each container with manufacturer's name, product number, and color number.

PART 16 -- PART 2 PRODUCTS

16.1 Manufacturers

A. High-Performance Coatings:

1. H.B. Fuller Company; Product Omega Caliber Weatherable Powder Coat
2. PPG Architectural Finishes, Inc; Product Environchron Powder Coat
3. Tiger Dry-Lac; Product Series 49 Polyester TGIC Powder Coating
4. Approved Equal

16.2 Materials

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, number of coats specified does not include primer or filler coat.

1. Colors: Selected from manufacturer's standard colors and as approved by owner.

B. Primers: As recommended by coating manufacturer for specific substrate.

PART 17 -- PART 3 EXECUTION

17.1 Examination

A. Verify existing conditions before starting work.

B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

17.2 Preparation

A. Clean surfaces of loose foreign matter.

B. Remove finish hardware, fixture covers, and accessories and store.

C. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent.

D. Ferrous Metal:

1. Solvent clean.
2. Remove loose rust, loose mill scale, and other foreign substances using power tools according to SSPC-SP 3.

E. Protect adjacent surfaces and materials not receiving coating from overspray; mask if necessary to provide adequate protection. Repair damage.

17.3 Priming

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

17.4 Coating Application

A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified by manufacturer.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

17.5 Cleaning

A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

17.6 Protection Of Finished Work

A. Protect elements adjacent to the work of this section from damage and disfigurement.

1.

2. ***END OF SECTION***

MUSCATINE POWER AND WATER

MISSISSIPPI DIRVE CORRIDOR RECONSTRUCTION

STANDARD SPECIFICATIONS FOR WATER DISTRIBUTION SYSTEM IMPROVEMENTS

I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

(SIGNATURE) _____ (DATE) 1/20/2017

RICHARD H. TEED

LICENSE NUMBER: 23299
MY LICENSE RENEWAL DATE IS DECEMBER 31, 2016.

PAGES OR SHEETS COVERED BY THIS SEAL ARE:

i-24, AWD0212A – AWD0212E

MUSCATINE POWER AND WATER
3205 CEDAR STREET
MUSCATINE, IA 52761
JANUARY 2017

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1.1 GENERAL REQUIREMENTS

A. Standard Specification covers construction, connections to, and repairs made on Muscatine Power and Water's (MP&W or Owner) water distribution system.

B. Standard Specification is intended to cover installations by both MP&W in-house personnel and outside contractors and serve as a guide for design of water main improvements for MP&W's water system.

C. Questions regarding interpretation or changes to the Standard Specifications should be directed to Manager, Water and Utility Services or Owner's Project Leader at Muscatine Power and Water, 3205 Cedar Street, Muscatine, Iowa 52761.

D. Standard Specification is on file at the offices of the Iowa Department of Natural Resources (IDNR) in Des Moines, Iowa.

E. Any exceptions or modifications to Standard Specifications for specific projects shall be made in writing. Should these specifications contained herein conflict with SUDAS 2016, then these standard specifications shall be the prevailing standard/specification.

F. Unforeseen circumstances or conditions encountered during construction must be reported to MP&W Manager, Water and Utility Services or Owner's Project Leader immediately.

G. No water main extensions or services tapped from MP&W owned facilities will be permitted without prior approval by MP&W.

1.2 DESIGN STANDARDS

A. Fire Protection: Water distribution system shall be designed in accordance with the grading schedule for Municipal Fire Protection recommended fire flows by the Insurance Service Offices and 10 States Standards.

B. Hydrant Location: Hydrants shall be spaced not more than 400 feet apart in single family residential districts and no more than 300 feet or about one city block apart in other districts. Spacing may vary slightly to allow placement of fire hydrants on extensions of property lines.

C. Valve Spacing: Valves shall be installed so that not over 800 feet of water main, with services, will be shut off at any time. Transmission mains with no services shall have valves located so that not over 1200 feet of main will be shut off at any time.

D. Bury Depth: All waterlines shall be buried with a 5'-0" bury depth to the top of pipe unless otherwise designed and approved by MP&W. Where conflicts occur with other utilities not identified on the plans Contractor shall obtain approval from MP&W for recommended bury depth.

1.3 PERMITS

A. Plans for water main extensions or modifications prepared by engineering personnel other than MP&W's shall be submitted to MP&W for design review, approval, and IDNR permitting before the work is bid.

B. Permits for utilizing or crossing IDOT, County, Railroad, and other utilities' right of way/easements will be acquired by Owner unless otherwise noted in the Water Main Extension Agreement or the Detailed Specifications for the Project.

C. Contractor shall obtain Street Excavation Permits and Street Closure Permits from the City of Muscatine's Building and Zoning Department at Muscatine's City Hall located at 215 Sycamore Street, Muscatine, Iowa 52761.

D. Storm water permitting will be acquired by contractor unless otherwise noted in the Water Main Extension Agreement or the Detailed Specifications for the Project. Costs of compliance with requirements of storm water permit will be handled by contractor unless otherwise outlined in the Water Main Extension Agreement or in the Detailed Specifications for the Project.

1.4 CODES AND STANDARDS

A. In the event of a conflict between codes and standards, the one establishing the more stringent requirements shall be followed (10 States, AWWA, or SUDAS 2016).

B. The following standards and specifications are used in or referred to in this Standard Specification:

1. American Water Works Association (AWWA).
2. 10 States Standards (above all for fire flow and design).
3. SUDAS 2016
4. Occupational Safety and Health Act of 1970, as amended (OSHA).
5. American National Standards Institute (ANSI).
6. Iowa Department of Health.
7. Iowa Department of Transportation (IDOT).
8. Iowa Department of Natural Resources (IDNR).
9. American Society for Testing and Materials (ASTM).
10. City of Muscatine, Iowa, Codes and Standards.
11. Muscatine Power and Water's rules and regulations as outlined in WATER CUSTOMER SERVICE HANDBOOK.

12. Muscatine Power and Water's current "Backflow Prevention Policy".

13. Steel Structures Painting Council (SSPC).

C. The most current versions or updates of the above specifications are to be used unless otherwise noted in the Detailed Specifications for the Project.

D. Copies of all codes and standards referenced in these Standard Specifications are on file for review at the offices of Muscatine Power and Water, 3205 Cedar Street, Muscatine, Iowa 52761.

1.5 MATERIALS

A. Pipe Types: Pipe, joints and couplings (as applicable) shall be legibly and permanently marked with critical information including: nominal pipe size, pressure class, dimensions ration, applicable conformance standards (e.g. ANSI / AWWA / ASTM), manufacturer's name, production record code, seal or mark of testing agency verifying suitability of pipe material for potable water service and for use in fire protection systems (e.g. UL / FM / NSF, as applicable.

All water main distribution pipe shall be 6 inches in diameter or larger. Where the distribution system is significantly looped then 6-inch diameter pipe is the minimum standard in residential areas. For dead end water mains 8-inch diameter is the minimum acceptable pipe diameter in residential areas. Where fire flows larger than 1,500 gpm then larger pipe diameter will be required and shall be specified on the plans.

1. Ductile iron water main pipe (DIP). DIP pipe shall be used for all pipes larger than 12 inches in diameter unless alternate materials are shown on the Drawings, and may be used for pipe 12-inches in diameter and smaller. DIP shall conform to ANSI/AWWA C151/A21.51. Pipe shall be cement-mortar lined in accordance with ANSI/AWWA C104/A21.4.53. Thickness design of pipe shall conform to ANSI/AWWA C150/A21.51. Pipe shall be manufactured with a bituminous coal tar base exterior coating system not less than 1 mil thick in accordance with AWWA C-151/ANSI A-21.4.

Nitrile gaskets shall be provided for water main construction unless noted and approved by MP&W. No exceptions are allowed where it is determined that hydrocarbon contamination is present

All pipe and pipe joints shall be push-on, restrained or mechanical as required by the design and shall conform to ANSI/AWWA C111/A21.11 unless otherwise designed and approved by MP&W. Pipe shall be minimum Class 52 unless specified otherwise on the Plans or in the Detailed Specifications for the Project.

2. Polyvinyl Chloride Pipe (PVC): PVC may be used for all pipe 12-inches in diameter and smaller, in accordance with the Project Documents. All pipe shall be manufactured in accordance with AWWA C900. Pipe joints shall be bell-and-spigot, push-on type with integral elastomeric gasket, in conformance with ASTM D3139 and ASTM F477.

Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign material blisters, and other visible deleterious faults. Pipe shall be manufactured from rigid polyvinyl chloride compound with cell classification 12454-B as defined in ASTM D-1784. Normal laying length is 20 feet.

PVC pipe shall not be permitted in identified LUST sites where possible hydrocarbon contamination may occur.

3. Restrained Joint Polyvinyl Chloride Pipe (RJ-PVC). RJ-PVC may be used for pipe 12-inches in diameter and smaller, in accordance with the Project Documents and as approved by the Engineer. All pipe shall be manufactured in accordance with AWWA C900. Pipe joints shall be non-metallic mechanically restrained elastomeric bell-and-spigot joints of either coupled or integral bell type in conformance with ASTM F-477 and AWWA C-900.

Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign material blisters, and other visible deleterious faults. Pipe shall be manufactured from rigid polyvinyl chloride compound with cell classification 12454-B as defined in ASTM D-1784. Normal laying length is 20 feet.

RJ-PVC pipe shall not be permitted in identified LUST sites where possible hydrocarbon contamination may occur.

4. High Density Polyethylene water main pipe (HDPE): High density polyethylene (HDPE) pipe and fittings shall conform to ANSI/AWWA C906.99. Follow the AWWA standard for Polyethylene Pressure Pipe and Fittings for Water Distribution and Transmission which is C906-07. Any deviations in material or workmanship including fusing shall be rejected if it does not conform with C906-07.

HDPE pipe shall be ductile iron pipe size with black with two blue stripes. Wall thickness shall be DR11 unless specified differently on the plans. HPDE pipe will be permitted on a case-by-case basis as shown as approved by MP&W. HDPE shall not be permitted in identified LUST sites where possible hydrocarbon contamination may occur.

5. Mechanical Joint Restrained Joints: Full body style, ductile iron radial type bolt retainer glands for mechanical joint applications design for respective pipe material being used and for MJ fittings and valves. Split-ring retainer glands will not be permitted on new construction except under special circumstances. All glands shall be of uniform thickness and utilize a standard MJ gasket and match standard MJ bold circle, using 304/316 SS bolts and nuts (Teflon coated) required for installation.

Acceptable mechanical joint restraint styles include EBAA IRON INC. 1100, 1100SD, or 1100HD Series MEGALUG Mechanical Joint Restraints and shall meet oversize requirements

6. Other Restraints: Tie rod system or assembly is subject to Owner's approval. Tie rods shall be no less than 3/4-inch diameter threaded steel coated with two coats of coal tar epoxy paint or approved spray on bituminous automotive undercoating material.

7. Casing Pipe: Steel casing for bored and jacked steel casings shall be smooth wall, welded steel pipe of diameter and minimum wall thickness shown on Plans, with a minimum 3/8" thickness. Defined by IDOT.

a) Casing Spacers: Casing spacers shall be specifically manufactured for installation of ductile iron water main in steel casings. Spacers shall be able to remain securely fastened to the water main during installation of water main in the casing. Choice of casing spacers is subject to Owner's approval. Powerseal Model 4810.

b) End Seals: End seals for steel casings shall be rubber, HDPE or neoprene wrap around type with stainless steel bands manufactured for that specific purpose and sized accordingly. Choice of end seals is subject to Owner's approval. Powerseal end seals.

B. Pipe Fittings: Ductile iron fittings shall conform to ANSI/AWWA C110/A21.10 (full-body) and ANSI/AWWA C153/A21.53 (compacts). Fittings shall be cement-mortar lined in accordance with ANSI/AWWA C104/A21.4.95. For pipes smaller than 4-inches fittings shall be push-on. For pipes with a nominal diameter 4 inches and larger fittings shall be mechanical joint or as specified by the specific Plans for the Project. Bolts, nuts and washers shall be stainless steel or high strength low alloy Corten Blue.

HDPE pipe fittings for new construction shall conform to ANSI/AWWA C906.99 and be heat fused. When restrained mechanical joints are specified for HDPE pipe Mueller AquaGrip or Engineer approved equal shall be provided.

C. Tapping Sleeves: Tapping sleeves for ductile iron or PVC water main pipe taps shall be all stainless steel per ASTM A-240, fully enclosed tapping sleeve, full wrap gasket, full flange, and stainless steel bolts and nuts with 3/4 inch NPT test plug with stainless plug. Approved tapping sleeve styles include JCM-432, Ford-FTSS, Mueller-H-304 or approved equal with nitrile gasket.

D. Valves and Valve Boxes:

1. Gate Valves: All gate valves shall conform to AWWA C509. Acceptable manufacturer is Mueller. Gate valves shall meet the following specific requirements: Resilient seated wedge type. Manufacturer Tested to 500 psig, 250 psig working pressure, turn clockwise (right) to open, epoxy coated (triple dipped). Stainless steel bolts in the bonnet, bi-directional flows and flat bottom for handling, brass trim, triple O-ring seal on stem and O-ring seal on bonnet with the top two replacements with valve open, non-rising stem with 2-inch square wrench nut with notification washers made from polymer, all bolts to be stainless steel.

2. Butterfly Valves: Butterfly valves shall only be used in special circumstances and shall conform to AWWA C504. Butterfly valves shall meet the following specific requirements: Steel adjusting packing, stainless shaft. stem with 2-inch square wrench nut, turn clockwise (right) to open, epoxy coated, all bolts to be stainless steel, domestic preferred.

3. Tapping Valves: Tapping valves shall be fully open style to accommodate Owner's Hydra-Stop tapping and hydra-stopping machine (flange to mechanical joint). Tapping valves can be MJ x MJ if using the Ford FTSS sleeve with MJ outlet. All tapping valves shall conform to the applicable flange only tapping sleeve requirements for gate valves. Approved application is MJ x MJ gate valve with the Ford FTSS sleeve with MJ outlet.

4. Valve Boxes: Valve Boxes shall be domestic only, heavy duty, like Tyler 664S or East Jordan with centering ring or approved equal. Cover shall have the word "WATER" cast into the cover. Provide 5'-0" standard length unless specified otherwise. Bury depths greater than 5' need a valve nut extender.

5. Extension Stems: Extension stems shall be provided for buried valves when the operating nut is more than 5'-6" below finished grade. Each extension stem for a buried valve shall extend to between 5'-0" and 5'-6" of the ground surface, no exceptions will be allowed, and shall be provided with spacers, which will center the stem in the valve box, and shall be equipped with a 2-inch wrench nut painted red.

E. Fire Hydrants: Fire hydrants shall conform to AWWA C502. All hydrants shall be Mueller Centurion meeting the following specific requirements: 6-inch mechanical joint connection, direction to OPEN shall be clockwise (right), nozzles: two 2-1/2-inch hose nozzles, one 4-1/2-inch pumper nozzle, nozzles to be National Standard Thread (NST) style, O-ring packing nitrile, suitable for 5'-0" depth of cover unless specified otherwise on Plans. Valve opening of 4-1/2 inch, automatic drain valve to drain hydrant barrel when main valve is closed. Operating nut shall be National Standard 1 inch square, oversized mechanical joint shoe, epoxy coated bowl. All underground parts shall be constructed of ductile iron with Stainless steel bolts. Shall include 1" washed rock around the drips in the hydrant.

Exposed hydrant body shall be factory primed painted white and buried portion shall have top coats black.

F. Tracer Wire: All tracer wire components for water main pipe shall be Copperhead brand, blue polyethylene jacketed direct bury type.

1. Open-Cut Installation: use number 12 superflex part number\1230B-SF-500', 1,000', 2,500' with a 45 mil coating.

2. Horizontal Directional Drill Installation: #12 ccs Extra high strength – Blue – "Soloshot" – for HDD, part number 1245B-EHS-500', 1,000', 2,500' with a 45 mil coating.

Tracer wire splices shall be Copperhead Industries LLC tracer wire. Dry-con connectors – 3WB-01-Blue, 3-way direct bury lug connector. Snake Pit Trace Wire Boxes – RP14*TP for roadway, LD14*TP – Adjustable for light duty. Copperhead 1 lb. magnesium anode used on dead-end trace wires. Cobra Test Station for service ends, T3-B75, Blue.

G. Gravel Backfill: Gravel for drainage shall be clean washed gravel 3/4 inch to 1-inch size without fines or standard washed pea gravel.

H. Corrosion Protection: All ductile iron pipe, fittings and buried hydrant barrels shall be protected from corrosive soils by wrapping with NLT 10-mil thick polyethylene tubing or sheeting conforming to ANSI/AWWA C105/A21.5. The ploy-wrap shall be secured around the pipe with 2-inch wide by 10-mil thick tape supplied by the poly-wrap manufacturer.

I. Insulation: Insulation shall be required where water main pipe is above the ground elevation. Insulation shall be Pittsburg Corning Foamglas with Pitwrap. Insulation thickness shall be as shown on the Plans, no less than 5 inches thick. Bells will be covered.

J. Services: All new water service piping shall have a minimum 1" nominal diameter from the main to the service meter. During water main replacement projects all services shall be replaced to the meter setter with approved pipe material if the existing service line is not approved service line material.

Service lines 2 inches in diameter and smaller, but no less than 1" shall be Type K (heavy), soft annealed, seamless copper. Connections to existing service lines (where required) shall be 3 piece compression type, Mueller 110 Conductive Compression Connection. If the main is wrapped with poly-wrap, so should service for 3-4 feet.

Tapping pipe saddles shall be as follows:

1. Service Saddle for DIP: Tapping ductile iron or cast iron pipe for 1-1/2 inch and 2 inch sizes shall be JCM 406, ROMAC Style 202NS, Smith Blair 317, Mueller DR2S or Ford FC202 service saddles, nylon or thick epoxy coated with stainless steel straps for use on ductile iron or cast iron pipe. Torque to manufacturer's specifications.

2. Service Saddle for HDPE: Tapping HDPE pipe for 1-1/2 inch or 2 inch sizes shall be JCM 406 or ROMAC 202N-H, nylon or plastic coated with stainless steel straps for use on HDPE pipe and should be supplied with concave or spring washers. Fused saddles can be Integrity of Fischer Brand electrofusion branch saddles.

Corporation and curb stops shall be as follows:

3. Corporation: Mueller No. B-25008, 1" brass. Corporations are provided by Owner unless otherwise specified in Detailed Specifications for Project. Lead free brass.

4. Curb Stops: Lead free brass Mueller H-10314 curb stop box and valve with 5' long curb box, extension type – arch pattern base, one piece lid with rod, upper section lid to be two hole.

K. Backflow Prevention: Backflow prevention devices shall conform to requirements of MP&W's current "Backflow Prevention Policy" and MP&W's current "Customer Service Handbook". Check with MP&W's Metering Department for latest updates of both documents.

L. Concrete: Concrete shall be air entrained with a minimum 28 day compressive strength of 4000 psi. In instances where high early strength is desirable as in cases where it is desirable to open roadways sooner to traffic or to shorten maintenance time for traffic control signage and barricades for street cuts, IDOT M-4 mix shall be used. For kickers, a minimum of 24 hours for cure time on M-4 is required.

M. Seeding, Fertilizer and Mulch: The rates of seed, fertilizer, and water applications required by this Subsection M are minimums, and the Contractor shall be solely responsible for the establishment of 70% grass coverage of all unpaved or otherwise uncovered areas of soil within the limits of the Project or disturbed soil by the Contractor. Additional labor, materials, equipment and incidentals to establish the 70% coverage shall be subsidiary to the pay items

"Seeding and Fertilizing".

All areas which have been disturbed by the Contractor during construction shall be graded and shaped to the grades shown on the Drawings, and shall be finished with 6 inches of topsoil provided by the Contractor and approved by the Engineer. Topsoil may be either material selected from the site or imported material. shall be the following:

1. Fertilizer: Fertilizer to be seed starter 13-13-13 or 15-15-15. Fertilizer is to be applied at a rate of 50 pounds per 4000 square feet.

2. Seed: Seed mix to be equal parts Kentucky Bluegrass, Fescue and perennial rye. Seed mix is to be applied at rate of 5 pounds per 1000 square feet.

3. Mulch: Mulch to be clean straw pinned in place over all seeded areas. Straw mulch is to be applied at rate of one 40 pound bale per 600 square feet.

An equivalent hydro seeding application may also be considered.

1.6 SUBMITTALS

A. All shop drawing submittals shall include a standard transmittal form.

B. Shop drawing submittals shall include one electronic in PDF and one hard copy of all submittal items required in the Detailed Specifications for the Project.

C. Contractor shall submit manufacturer's catalog data for all items to be used in constructing the Project, one electronic Adobe .pdf file and one hard copy

D. Contractor shall submit certificates from manufacturers evidencing compliance with standards listed in this Standard Specification and as listed in the Detailed Specifications for the Project.

1.7 TRAFFIC CONTROL

A. Traffic control shall be coordinated with City of Muscatine Police and Engineering Departments or the Iowa Department of Transportation as appropriate.

B. Traffic control shall meet the requirements of IDOT "Work Zone Safety Guidelines for Utilities", current edition and MUTCD.

1.8 INSPECTION AND TESTING

A. Construction Inspection: Construction will be inspected by Owner's Project Leader or other designated representative. No pipe or appurtenances shall be buried prior to final approval by Owner or Owner Representative. All change orders must be processed in writing through the Project Leader.

B. Compaction Testing: In place density testing for compaction shall be conducted for water main installation under a roadway. If the water main installation is installed during a road improvement project the compaction testing may be completed by another Contractor. Compaction testing is not required when the water main is installed 10' or more outside of the roadway unless stated otherwise on the Plans or in the Detailed Specifications for the Project. In the event of a disagreement as to whether the compaction requirements have been met when no testing is required, the Contractor shall enlist the services of an Owner-approved independent soil testing company to make field tests as necessary to establish compliance with this Standard Specification. Contractor shall pay costs of all failing tests and Owner shall pay costs of all passing tests. Costs of laboratory determinations will be divided between Contractor and Owner based on percentage of field tests each is responsible to pay for. Moisture density testing shall conform to ASTM D1557. Field density tests, when required, shall be performed as directed by Owner's Project Superintendent. A minimum of one test shall be taken every 300 feet along the trench for each 8-inch lift or layer of backfill material. Field density tests shall conform to ASTM D1556.

C. Concrete Testing: One set of four concrete test cylinders shall be taken for each concrete pour. Cylinders will be retained by Owner and broken if a question arises as to the strength of the concrete provided. Each cylinder shall be provided with a tag giving the date, time, location and strength requirements specified for the Project. Tag to be taped to each cylinder with several wraps of fiber packing tape.

D. Material Inspection: All pipe and appurtenances are subject to inspection by the Owner at the point of delivery. Material found to be defective due to manufacture or damaged in shipment shall be rejected or recorded on the bill of lading and removed from the job site. The Owner may perform tests as specified in the applicable AWWA standard to ensure conformance with the standard. In case of failure of the pipe or appurtenance to comply with such Specifications, responsibility for replacement of the defective materials becomes that of the Contractor.

E. Filling and Flushing: Pipe and appurtenances to be tested shall be filled slowly with potable water. After filling, lines shall be flushed at blow-offs and dead-ends at a minimum velocity of 3.0 feet per second in the pipeline to be tested (refer to AWWA C651-14 Table 3 for required flow and openings). Flushing shall be carried out until turbidity-free (< 5 NTU or system ambient values) water is obtained from all points along the main. Certain contaminants resist flushing at any feasible velocity and pigging of the main may be required. A special pipeline pig may be required when the required flushing velocity cannot be achieved or when needed to conserve water during water use restriction period or to remove cake deposits or to prevent erosion damage, nuisance or traffic interruption, as directed by the Engineer.

F. Pressure and Leakage Testing: Pressure test after initial flushing of line and before bacteriological testing has commenced. An Owner's Representative shall be present at the beginning and end of each pressure test. The owner shall be notified of the time of the test a minimum of 24 hours prior to the test. The Owner's Representative shall record the test pressure at 30 minute intervals. The duration of the pressure test shall be a minimum of two hours and cannot commence until the Owner's Representative records the initial test pressure. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test.

1. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. After all the air has been expelled, all corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place as directed by the Owner.

2. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered during the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until line passes test to Owner's satisfaction.

3. All make up water and make up water containers and pumps shall be cleaned and disinfected with a 6 to 8% chlorine bleach solution.

4. When hydrants are in the test section, the test shall be made against the auxiliary valves of the hydrant.

5. The contractor may be responsible for disinfection of the water main on a case by case basis.

Pressure testing shall be conducted through Owner installed corporations and not through fire hydrants.

The pressure test shall consist of holding a minimum hydrostatic pressure of 150 pounds per square inch for a period of two hours at the lowest elevation of the test section. Test pressure shall not exceed pipe, thrust-restraint, or appurtenances' design pressure at the lowest section of pipeline being tested.

Water mains shall be pressure tested at valved sections, not exceeding 1200 feet in total length. Valves shall not be operated in either direction at differential pressures exceeding the rated valve working pressure.

A two pound test gauge with a minimum capacity of 160 pounds will be required. The test shall conform to the applicable sections of AWWA C-600, AWWA C-605 or AWWA C-906. The hydrostatic test pressure shall not vary by more than +/- 5.0 psig for the duration of the test period. The test pressure shall be maintained within this tolerance by adding make-up water through a metered pressure test pump into the pipeline test segment. The meter on the pressure test pump shall be capable of reading to the nearest 0.10 gallon increment. All make-up water added shall be accurately measured in gallons (and fractions thereof) by suitable methods. The total make-up water added during and at the conclusion of the test period to reach the required test pressure shall not exceed the calculated leakage allowance for the pipeline segment being hydrostatically test as outlined in sections AWWA C-600, AWWA C-605 or ASTM F2164.

CAUTION: Pressurize HDPE pipe in accordance with manufacturer's recommendations. Pressurizing HDPE pipe for testing or placing into service requires additional precautions: Leaks at pressurized fusion joints may immediately precede catastrophic and sudden pipe separation and result in violent and dangerous movement of piping or attached parts and cause a sudden release of piping contents under pressure. Never approach or attempt to repair or stop leaks while pipe is pressurized. Always depressurize pipe before making corrections. Faulty fusion joints cannot be repaired. They must be cut out and rejoined using proper heat fusion procedures.

G. Tracer Wire Inspection: Tracer wires will be tested by Owner for continuity shortly after pressure testing has been completed.

H. Disinfection: At a minimum the standards set forth in AWWA C651 shall be followed excluding the use of calcium hypochlorite granular tablets. Preferred disinfection method is the continuous-feed method for new waterline construction.

A more specific description of the process follows:

Once the pipe section has been slowly filled, the bacterial/disinfection test will be officially started. The test requires the pipe to stand for 24 hours undisturbed after the initial chlorination testing confirms that a minimum of 25 ppm available chlorine is present when using the continuous-feed method. If less than 25 ppm of chlorine is available at initial filling, the test will be considered invalid and pipe must be rechlorinated. After 24 hours the residual will be checked to confirm that not less than 10 ppm of chlorine is available. If confirmed, the pipe can be flushed until the available chlorine is equal to the normal distribution levels and a sample for analysis will be drawn. The pipe shall be isolated again for 24 hours. After 24 hours, the water will be tested a second time to confirm not less than 0.3 ppm of chlorine remains in the main. If confirmed a second sample will be drawn for bacteriological analysis. Failure of any of the above test results will require re-chlorination to the minimum 25 ppm and repeat bacteria testing. All chlorinated water needs to be de-chlorinated by an approved method before it is released to the environment.

The contractor may be responsible for de-chlorination of the water main from high test chlorination on a case by case basis.

I. Bacteriological Testing: Owner will take two bacteriological samples 24-hours apart for in-house analysis after disinfection for each sample location as required in AWWA C651. Contractor shall assist Owner in collecting samples as required. Owner will not place installation into operation until test results from water samples taken test out satisfactory. One set of bacteriological tests shall be collected from every 1,200 foot section of new water main, plus one set from the end of the line and at least one set from each branch.

For any failed bac-t test, the IDNR must be notified by MP&W lab staff.

All pressure testing and bacteriological tests shall be completed prior to the installation of service lines.

1.9 LOCATING BURIED UTILITIES

A. Contractor shall contact the Iowa One-Call system at 1-800-292-8989 for locations prior to doing any excavating (48 hour notice required).

B. All utility crossing shall be exposed by pot-holing or day-lighting prior to crossing with underground drilling equipment, HDD, moles, etc.

1.10 PROTECTION OF EXISTING FACILITIES

A. Contractor shall exercise care to assure that all private and publicly owned facilities, buildings, poles, wires, walkways, roadways, and other items near the construction area and not shown as removal items on the Plans are protected so they are not damaged or destroyed.

B. Contractor shall repair or replace all damaged items.

1.11 WORK BY OWNER AND COORDINATION WITH OWNER

A. Contractor shall coordinate activities with Owner so that disturbances to normal utility water system operations are minimized. Contractor shall provide a minimum 24 hour notice to Owner to allow adequate scheduling of men and equipment. Contractor shall assume all responsibilities for costs incurred due to the lack of 24 hour notice to Owner. MP&W must be notified at least 3 working days before a scheduled water outage to allow time for customer notification.

B. Operation of all valves and hydrants during charging of main, pressure testing, disinfection and bacteria testing shall be by Owner unless Owner specifically directs otherwise.

C. Owner will provide tapping and corporations up to 2-inch size required for blowing off air and making pressure tests to line segments installed. On contracts for developers, costs for this work are to be paid by the developer. On in house contracts let by MP&W, costs for this work will be paid by MP&W and not billed to contractor.

D. Tapping of existing water mains with taps of up to 12-inch size will be done by Owner unless otherwise noted in Detailed Specifications for the Project. On contracts for developers, costs for this work are to be paid by the developer. On in house contracts let by MP&W, costs for this work will be paid by MP&W and not billed to contractor.

E. Owner will hold electrical poles where necessary for construction if construction is within the Owner's electrical service area. Contractor shall provide a minimum 24 hour notice to Owner to allow adequate scheduling of men and equipment. On projects contracted by Muscatine Power and Water there will be no charge to Contractor for this service. On all other projects, Contractor will be billed for this service. Contractor will be responsible for the coordination and fees charged by utilities for this service outside MP&W's electrical service area.

1.12 TRENCH EXCAVATION

A. Trench excavations shall be in compliance with 29 CFR Part 1926 OCCUPATIONAL SAFETY AND HEALTH STANDARDS-EXCAVATIONS.

B. Sheeting, shoring, bracing, and trench boxes shall be of an OSHA approved design and certified in accordance with current OSHA rules and regulations. Sheeting and shoring materials shall be removed in a manner that avoids damage or disturbance to the work completed or adjacent structures or pavements. Trench boxes shall be lifted prior to moving forward to prevent displacement of pipe in place.

C. Compact light weight trench boxes or shoring shall be required in front yard stop box replacements for contractor's safety and to minimize disturbances to lawn, sidewalk and parking areas.

D. Excavation depth to provide a minimum 5'-0" cover over top of pipe.

E. Trench width shall be ample to permit the pipe to be laid and joined properly but should be no more than 12 inches on either side of the pipe. Keep walls of trench vertical below top of pipe.

F. Level trench bottom to provide uniform bearing and support for full length of the pipe barrel. Provide bell holes for each pipe joint. Stones found in the trench shall be removed for a depth of at least 6 inches below bottom of pipe.

G. If soft, spongy, or otherwise unsuitable materials are encountered which do not provide suitable bedding or support for the pipe, Contractor shall notify Owner's Project Leader or designated representative immediately.

If removal of unsuitable material is authorized, contractor is responsible for removal of material.

Contractor shall replace unsuitable materials with Owner approved crushed stone, sand or manufactured sand as appropriate. New materials shall be placed and compacted in accordance with backfill portion of this Standard Specification.

H. All pipe installations shall be conducted only in dry materials. Contractor shall take such steps as are necessary to prevent surface and ground water from flowing into the excavation. Remove all accumulated water by pumping or dipping with equipment bucket.

I. Dewatering systems, if required, shall be subject to Owner's approval and shall remain in place until construction work and testing have been completed.

J. Removal of pavement and road surfaces shall be a part of the trench excavation. Pavement removal shall conform to City of Muscatine Public Works requirements. The dimensions of pavement removed shall not exceed the dimensions of the opening required for installation of pipe, valves, hydrants, fittings, and other structures by more than 12 inches in any direction, unless otherwise directed by Owner's Project Superintendent or required by City of Muscatine "Guidelines for Repairs in Streets". Pavements shall be sawed to ensure the breakage, removal and replacement of pavement along straight lines.

1.13 BACKFILL AND COMPACTION

A. Backfill shall not proceed until water main installation, thrust blocking or thrust restraints have been inspected and approved by Owner's Project Leader or designated representative.

B. Backfill materials shall be suitable soils from trench excavation or from a borrow area approved by Owner's Project Leader. Suitable materials shall be free of debris, small stones, rock, roots, lumps, frozen materials or any other items that will prevent placing and compacting the material to the density required.

C. Backfill under or within 10 feet of the edge of roadways or parking areas shall be manufactured sand compacted in accordance with this Standard Specification.

D. Backfill materials shall be approved by Owner's Project Leader prior to placement.

E. Backfill shall be placed on both sides of pipe simultaneously to prevent displacement. Place backfill in successive horizontal lifts of not more than 8 inches loose depth. This depth may be adjusted if it can be shown that required compaction can be achieved utilizing a different layer thickness. Backfill shall be placed and compacted using hand equipment up to 18 inches above top of pipe. Refer to Attachment 5 for more details.

F. Place material at proper moisture content for obtaining specified density.

G. Compaction requirements are as follows:

1. Areas beneath or within 10 feet of edge of roadways or parking areas shall be compacted to 95 percent of maximum dry density as determined by ASTM D1557.

2. All other areas shall be compacted to 90 percent of maximum dry density as determined by ASTM D1557.

3. Method of compaction is subject to Owner's approval.

H. "Flooding" or "jetting" of backfill trench is not an acceptable compaction method or process and will not be approved.

1.14 PIPE AND MATERIAL HANDLING AND STORAGE

A. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skid ways shall not be rolled or skidded against pipe on the ground.

B. Slings, hooks, or pipe tongs shall be used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.

C. Stored materials shall be kept safe from damage. The interior of all stored and placed pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times by use of tight fitting end plugs or sturdy durable plastic bags or other Owner approved means. Pipe and fittings contaminated with mud and surface water shall be removed from the site and not used in construction unless thoroughly cleaned by the Contractor and inspected and approved by Owner. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

D. Gaskets for mechanical and push-on joints shall be stored in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

E. Mechanical-joint bolts shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

F. Staging will not occur prior to one week of construction and placed in a neat and orderly fashion.

1.15 PIPE INSTALLATION

A. Ductile iron pipe installation shall conform to the requirements of ANSI/AWWA C600. PVC pipe installation shall conform to the requirement of AWWA C605. HDPE installation shall conform to the requirement of AWWA M55.

B. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be lowered carefully into the trench by means of suitable tools, rigging and equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. The trench shall be dewatered prior to installation of the pipe.

C. All pipe, fittings, valves, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Owner, who may prescribe corrective repairs or reject the materials.

D. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign materials before the pipe is laid.

E. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing, or other materials shall be placed in the pipe at any time.

F. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material. Lay pipe in dry bedding material.

G. At all times when pipe-laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Owner. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation, should the trench fill with water.

H. Cutting pipe for insertion of valves, fittings, or closure pieces shall be done in conformance with all safety recommendations of the manufacturer of the cutting equipment. Cutting shall be done in a safe, workmanlike manner without creating damage to the pipe or cement-mortar lining. All PPE shall be used while cutting, including safety glasses and a shield. Pipe may be cut using a hydraulic squeeze cutter, abrasive pipe saw, rotary wheel cutter or guillotine pipe saw. Cut ends and rough edges shall be ground smooth, and for push-on joint connections, the cut end shall be beveled by methods recommended by the manufacturer and approved by the Owner.

I. For installations requiring polyethylene encasement for ductile-iron pipe, the encasement shall be installed in accordance with ANSI/AWWA C105/A21.5 and recommendations of DUCTILE IRON PIPE RESEARCH ASSOCIATION INSTALLATION GUIDE FOR DUCTILE IRON PIPE. This includes overlapping and the correct tape to be used on the joints. Use 10 mil blue or black polywrap pipe sleeve from AA Thread or equivalent. Use 10 mil PVC tape to bind ends with 1 ½' overlap. On mechanical or open joints with couplings, use cross laminated HDPE joint wrap, 10 mil XLAM HDPE joint wrap.

J. Restraining glands shall be used when pressure testing against a dead-end section of pipe. Engineer shall determine the required length of pipe to be restrained. Under typical installation methods, which included a bury depth of 5'-0" then 20 LF of restrained joint pipe is acceptable for 6-inch pipe or smaller and 40 LF of restrained joint pipe is acceptable for 8-inch, 10-inch, or 12-inch pipe. For larger pipe sizes refer to project plan or Engineer.

K. Pipe which is damaged or unsound will be rejected and marked. Sound pipe before installation to detect cracks.

L. Use suitable fittings where grades or alignments require offsets greater than manufacturer's recommended joint deflections.

M. Follow manufacturer's recommended installation and assembly practices.

N. CAUTION: Pressurizing HDPE pipe for testing or placing into service requires additional precautions: Leaks at pressurized fusion joints may immediately precede catastrophic and sudden pipe separation and result in violent and dangerous movement of piping or attached parts and cause a sudden release of piping contents under pressure. Never approach or attempt to repair or stop leaks while pipe is pressurized. Always depressurize pipe before making corrections. Faulty fusion joints cannot be repaired. They must be cut out and rejoined using proper heat fusion procedures.

O. TRENCHLESS INSTALLATION

1. General: Select a method of installation that is appropriate for the soil conditions anticipated and will 1) allow the pipe to be installed to the desired line and grade within the specified tolerances; 2) prevent heaving or settlement of the ground surface or damage to nearby facilities; and 3) prevent damage to the carrier pipe and any lining materials within the carrier pipe.

2. Installation Method: Horizontal directional drilling (HDD) shall be the primary method for installing pipe with trenchless technology. HDD installs pipe from a surface-launched drilling rig. A pilot bore is formed and then enlarged by back reaming and removing the spoil material. The pipe is then pulled in place. Other methods may be allowed with the Engineer's approval.

3. Line and Grade: Install pipe at line and grade that will allow the carrier pipe to be installed at its true starting elevation and grade within the specified maximum alignment deviation of the pipe centerline. When no deviation tolerances are specified in the contract documents, apply the following maximum deviations to the carrier pipe.

4. Pressurized Pipe: Tolerances for installation of pressurized water main pipe shall include horizontally accuracy of ± 2.0 feet, vertical accuracy ± 1.0 foot, while maintaining the minimum depth specified in the contract documents. Greater deviation or interference with other identified facilities may be cause for rejection.

5. Deviation from Line and Grade: Installations deviating from the specified tolerances that cannot be adjusted to conform to the specified tolerances may be rejected by the Engineer. If nonconforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no additional cost to the Owner. Abandon rejected installation and place special fill materials, at no additional cost to the Owner. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.

6. Casing Pipe or Un-cased Carrier Pipe Installation: Install pipe by approved methods. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage. Do not exceed the compressive or tensile strength capacity of the pipe during pushing or pulling operations. Fully support bore hole at all times to prevent collapse. Insert pipe as soil is removed, or support bore with drilling fluid. Fully weld all casing pipe joints. Use an interlocking connection system when approved by the Engineer. Fill space between the inside of the bore hole and the outside of the pipe with special fill material if the space is greater than 1 inch.

7. Pit Restoration: Remove installation equipment and unused materials from the launching and receiving pits. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to this Section. Place suitable backfill material in the pit. Apply the testing requirements of this Section. Restore the site to original condition or better.

1.16 TRACER WIRE INSTALLATION

A. Copperhead tracer wire shall be installed on top of water main once backfill has been brought up to top of pipe.

B. Tracer wires will be tested for continuity before final acceptance of the Project. Wires without continuity shall be repaired or reinstalled by Contractor.

C. Tracer wire shall be brought up to ground level at all valve boxes and installed in a separate tracer wire box. At all dead ends and valve/hydrants, a tracer wire anode will be installed. See the tracer wire specification drawings in Attachment 4 for more detail.

D. Tracer wire access boxes will be placed at a maximum distance of 500'.

1.17 HORIZONTAL AND VERTICAL SEPARATIONS

A. Horizontal Separation of Gravity Sewers from Water Mains:

1. Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless: (a) the top of a sewer main is at least 18 inches below the bottom of the water main, and (b) the sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

2. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of SUDAS Section 5010, 2.01. However, provide a linear separation of at least 2 feet.

B. Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

1. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of SUDAS Section 5010, 2.01 and,

2. The sewer force main is laid at least 4 linear feet from the water main.

C. Separation of Sewer and Water Main Crossovers: Comply with SUDAS section 3.07.C.3 for all sewer separation requirements at sewer crossings.

1. Vertical separation of sanitary and storm sewers crossing under any water main should be at least 18 inches when measured from the top of the sewerto the bottom of the water main. If physical conditions prohibit the separation, the sewer maybe placed not closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. The sewer and water pipes must be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

2. Where the sanitary sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main.

3. Where the storm sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material or reinforced concrete pipe (RCP)with flexible O-ring gasket joints so both joints are as far as possible from the water main.

D. Surface Water Crossings: Comply with the Recommended Standards for Water Works, 2007 Edition, section 3.07 CONFLICTS (Section from SUDAS)

1. Above-water Crossings: Ensure the pipe is adequately supported and anchored; protected from vandalism, damage, and freezing; and accessible for repair or replacement.

2. Underwater Crossings: Provide a minimum cover of 5 feet over the pipe unless otherwise specified in the contract documents. When crossing water courses that are greater than 15 feet in width, provide the following: (a) pipe with flexible, restrained, or welded watertight joints, (b) valves at both ends of water crossings so the section can be isolated for testing or repair; ensure the valves are easily accessible and not subject to flooding, and (c) permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

E. No water pipe shall pass through or come in contact with any part of a sewer manhole, sewer, or other appurtenance. A minimum horizontal separation of 3 feet shall be maintained.

F. Should physical conditions exist such that exceptions to above separations are required, Contractor shall obtain Owner's Project Superintendent's assistance for details which will provide protection equal to that provided by above items. When it is impossible to obtain the minimum specified separation distances, the IDNR must specifically approve any variance from the requirements from Section 10.17.

1.18 CONNECTIONS TO EXISTING WATER MAINS

A. Existing water mains shall remain in service during installation of new water main. Length of time for tie-in shall be kept to a minimum. Coordinate tie-in with Owner.

B. Uncover existing mains, to which connections are to be made, a sufficient time ahead of pipe laying operations to verify fittings required.

C. Clean and disinfect existing main and inside of fittings and valves in accordance with Disinfection and De-chlorination section of this Standard Specification.

D. In general, a 6' by 8' hole will be required for MP&W to make a safe tapping connection. If a tap larger than 4" is being made, 6' of clearance is needed from the face of the tapping valve. The side of the pipe that is being tapped needs to be excavated lower so water does not come up on to the pipe or contaminate the tapping machine. Any excavation over 5' deep requires trench protection.

1.19 GATE VALVES AND FITTINGS

A. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure-containing bolting and test plugs, cleanliness of valve ports and seating surfaces, handling damage, and cracks. Defective valves shall be corrected or held for inspection by the Owner. Valves shall be closed before being installed.

Valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner specified for all valves for cleaning, laying, and joining pipe. Valves 12 inches and larger should be provided with special support, such as crushed stone or concrete blocks so that the pipe will not be required to support the weight of the valve. Valves shall be installed in the closed position.

B. Install valves with stems vertical, except where shown otherwise on plans.

C. Tighten valve glands on new and existing valves as work is installed; replace O-rings if required and retighten glands after valves are placed in operation and brought up to operating pressure. Replace any O-rings which are deteriorated or in unsatisfactory condition.

D. A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve. Valve box shall be centered over the operating nut of the valve using one standard centering ring manufactured for that purpose. The box cover shall be flush with the surface of the finished area unless otherwise directed by the Owner.

E. All valves shall be restrained to the pipe and/or fittings.

F. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

G. If valves are going to be deeper than 5' from ground surface, MP&W requires an valve nut extension. If deeper than 8', a solid valve box will be required.

1.20 TAPPING VALVES AND SLEEVES

A. Conform to requirements for gate valves and fittings listed above.

B. Follow manufacturer's recommended assembly and installation practices.

C. All valves and sleeves will be blocked for support.

1.21 FIRE HYDRANTS

A. Prior to installation, all hydrants shall be inspected for direction of opening, nozzle threading, operating-nut and cap-nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow, handling damage, and cracks. Defective hydrants shall be replaced or held for inspection by the Owner.

B. All hydrants shall be set plumb and shall have their nozzles parallel with or at right angles to the curb, with steamer (largest) nozzle facing the curb.

C. Hydrants shall be set to the established grade and set to the bury line marked on the hydrant so the breakaway will work correctly.

D. Hydrant drains shall not be connected to, or located within 10 feet of, sanitary sewers and storm drains.

E. All fire hydrants shall be independently valved. Refer to Attachment 2 for plan layout of valving and pipe.

F. Flush hydrants will be used at the discretion of the Utility.

G. Hydrants must meet new specifications for lead free brass.

H. Hydrants need to be blocked with hard blocks and shims. Pour concrete only if poor soils are in the area. Refer to Attachment 1 for more details.

1.22 THRUST RESTRAINT/BLOCKING

A. Thrust blocking: Provide cast-in-placed concrete thrust blocks where buried piping changes direction, changes size, and at dead ends, unless otherwise noted on the Plans or approved by the Engineer. Concrete shall have a minimum compressive strength of 4000 psi in 28 days. Allow concrete adequate time to reach a compressive strength of 3000 psi prior to pressure testing. Concrete thrust blocks shall be cast against undisturbed vertical edge of trench for bearing, the bearing surface of thrust block shall be symmetrical vertically and horizontally with respect to line of force of pipe or joint, thrust blocks at dead ends, at plugs and at caps shall be removable so that lines may be easily extended after testing and a period of normal service, and thrust blocks at fittings shall be placed in such a manner as to permit tightening of mechanical joint bolts after placement of trust block.

Thrust blocks shall be subject to inspection and approval of the Owner's Project Superintendent prior to water main testing.

B. Tie rods: Tie rods and fittings shall be suitable for use with mechanical joint fittings. Coat tie rods and fittings with 2 coats of coal tar paint or spray on bituminous automotive undercoating material after installation. Tie-rod assemblies and systems are subject to Owner's approval.

C. Thrust restraint: Mechanical joint restraints for push on or mechanical joints may be used instead of concrete blocking when indicated on the Plans or in the Detailed Specifications for the Project. The preferred method is to use joint restraints (i.e. Megalugs) in addition to concrete blocking or poured kickers.

D. A detail drawing showing typical thrust block installations is found in Attachment 3 at the end of these specifications. Thrust blocking from pipe sizes greater than 20-inches will be as shown on the Plans or in Detailed Specifications for the Project.

Sizes of thrust blocks in square feet of bearing area for water mains based on soil bearing capacity of 2000 pounds per square foot are listed in the table below:

Table 2 - Bearing Area of thrust Blocks in Square Feet

Pipe Size (Inches)	90° Bend	45° Bend	22-1/2° Bend	11-1/4° Bend	Dead End or Tee
4	3	2	2	1	2
6	6	3	2	1	4
8	10	5	3	2	7
10	14	8	4	2	10
12	20	11	6	3	14
14	26	14	8	4	19
16	34	19	10	5	24
18	40	22	11	6	28
20	52	28	15	7	37

1.23 SURFACE RESTORATION

A. Reopen backfilled areas to traffic or former use as soon as possible. Refer to Attachment 6 and 7 for typical trench and roadway repairs.

B. Fill all depressions and grade disturbed areas to provide smooth uniformly sloping surfaces with positive drainage.

C. Seeding details are noted in Section 1.5.M

D. Agricultural areas shall have topsoil stripped back to a depth of 12 inches. Topsoil shall be kept separate from other excavated materials and spread back over disturbed areas after water main installation and backfill operations have been completed.

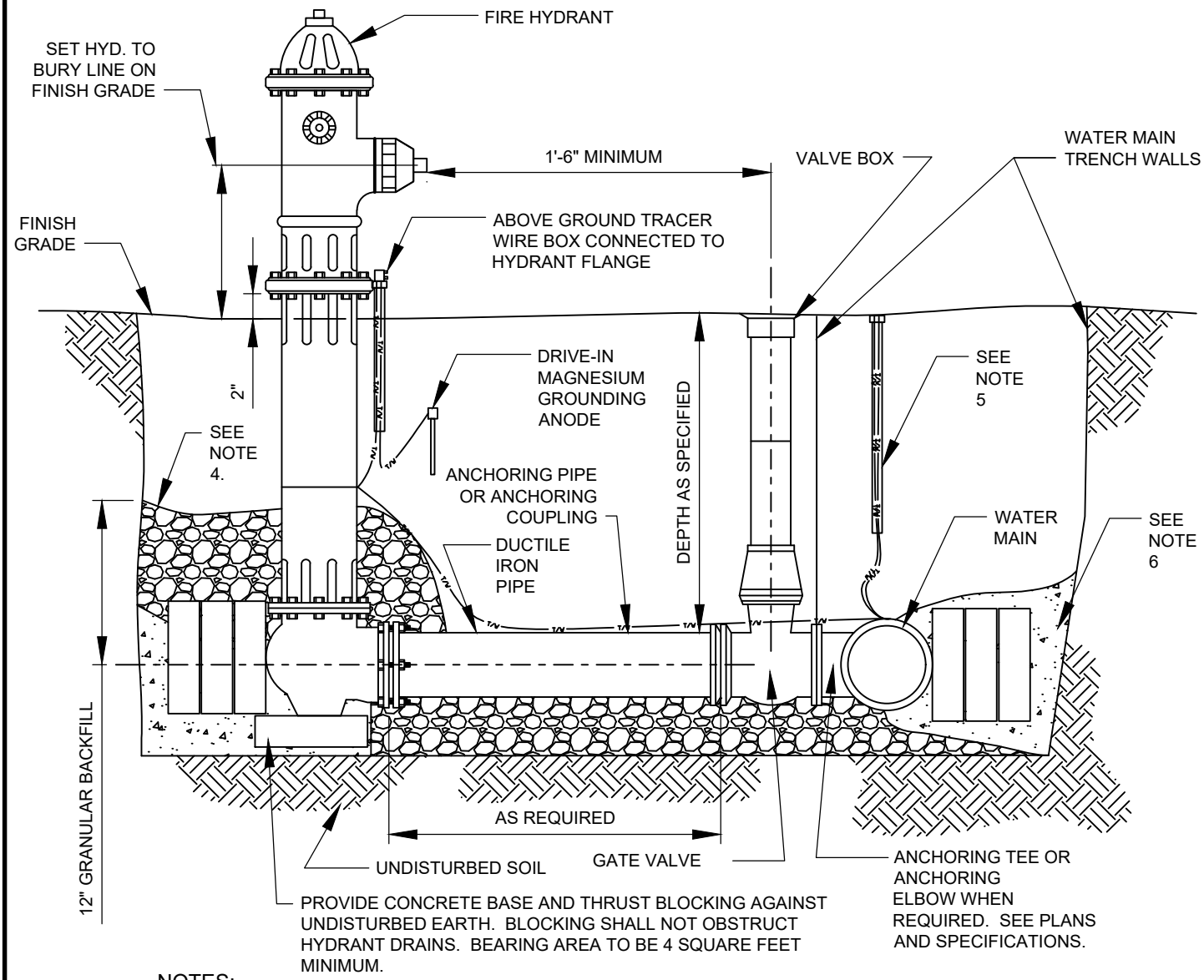
E. Apply fertilizer, seeding and mulch at rates provided for in Materials portion of this Standard Specification.

1.24 CLEAN UP

A. Contractor shall keep site clean and orderly. Contractor shall remove all brush, rubbish, rocks, spoil and other waste materials off site for disposal. Owner reserves the right to instruct the contractor on clean up time lines. Excess materials from all demolitions and excavations shall be disposed of offsite by Contractor, at Contractor's expense, unless otherwise shown on Plans or described in Detailed Specifications for the Project. Leave site generally as it was prior to construction. Site shall be picked up, raked and left in a finished, smooth, clean, seeded and mulched condition.

ATTACHMENTS

1. Hydrant Installation Detail Elevation – AWD0212A
2. Hydrant Installation Detail Plan – AWD0212B
3. Thrust Block Details – AWD0212C
4. Tracer Wire Installation Plan – AWD0212D
5. Trench Detail – AWD0212E
6. City Guidelines for Repairs in Streets, City of Muscatine, Iowa
7. Typical Trench and Street Repairs, City of Muscatine, Iowa
8. Full Depth Hot Mix Asphalt Finish Patches



NOTES:

1. ALTERNATE MECHANICAL JOINT RESTRAINT SYSTEMS ARE SUBJECT TO OWNER'S APPROVAL.
2. APPLY POLYETHYLENE ENCASEMENT ON PIPE, VALVE, VALVE BOX FIRE HYDRANT AND FITTINGS AS SPECIFIED.
3. HYDRANT STEAMER NOZZLE TO BE TURNED TOWARDS STREET UNLESS SPECIFIED OTHERWISE.
4. INSTALL LAYER OF FILTER FABRIC OR 4 MIL PLASTIC FILM BARRIER OVER DRAIN FIELD. DRAIN FIELD COMPRISED OF 1/2 CU. YD. MINIMUM OF 1" WASHED GRAVEL.
5. USE SNAKEPIT TRACER WIRE BOXES ON WATERMAIN AS SPECIFIED IN PLANS.
6. USE CONCRETE BLOCKS IF SOIL IS LOAD BEARING, OTHERWISE, USE POURED CONCRETE THRUST BLOCK AS SPECIFIED IN PLANS.

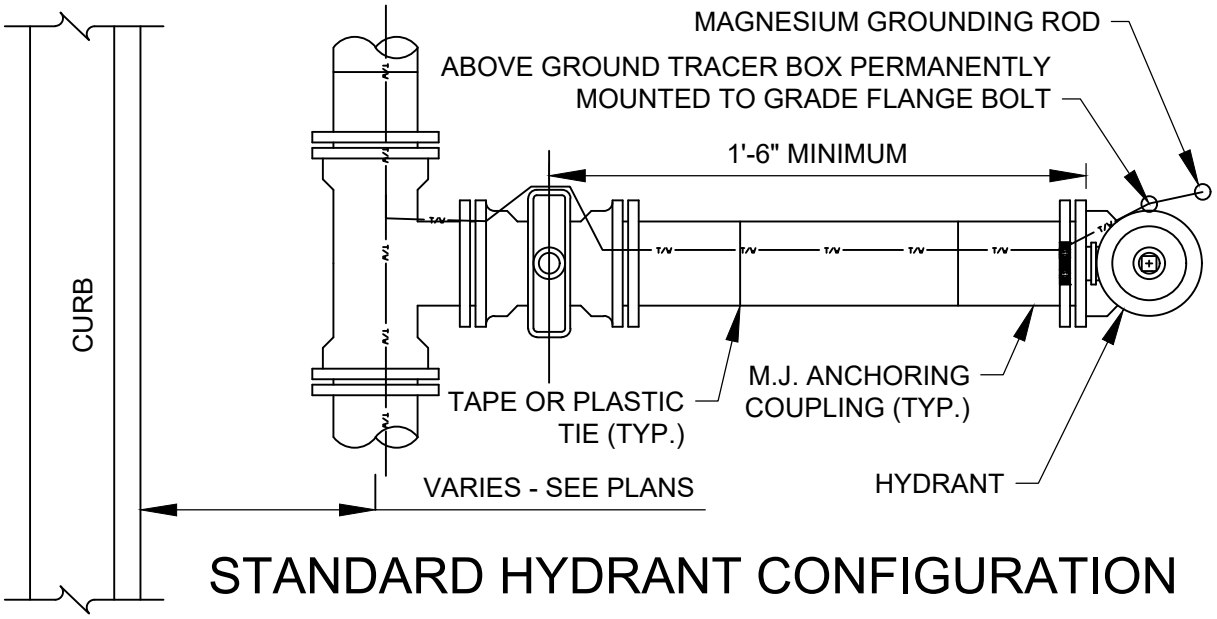
DRAWN BY: S. WIESKAMP	DATE: 11/30/04
APPROVED BY: A. GROSS	DATE: 2-18-15
REVISED BY: A. HANEY	DATE: 2-12-15
SCALE: NONE	

HYDRANT INSTALLATION DETAIL ELEVATION

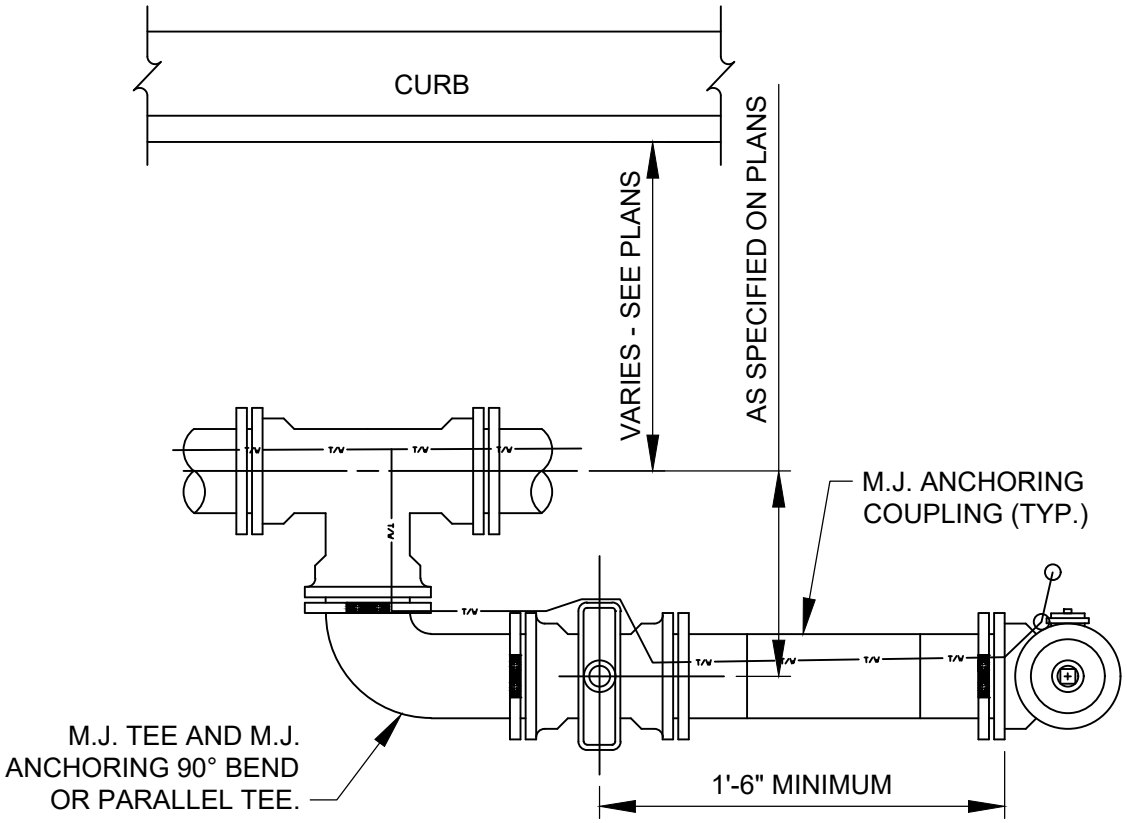
MUSCATINE POWER & WATER

FILE No. 142

DRAWING No. AWD0212A



STANDARD HYDRANT CONFIGURATION



PARALLEL HYDRANT CONFIGURATION

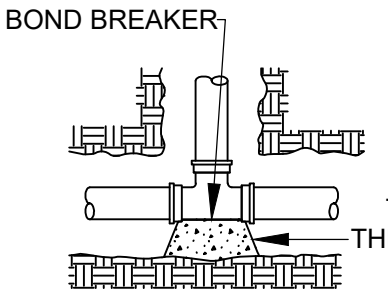
DRAWN BY: S. WIESKAMP	DATE: 11/30/04
APPROVED BY: A. GROSS	DATE: 2/17/15
REVISED BY: A. HANEY	DATE: 2/17/15
SCALE: NONE	

HYDRANT INSTALLATION DETAIL PLAN

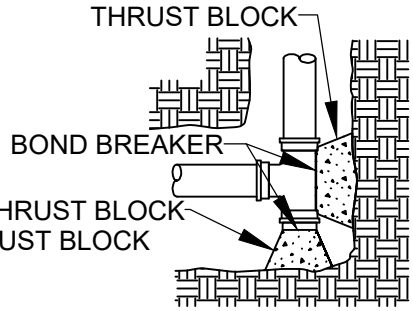
MUSCATINE POWER & WATER

FILE No. 142

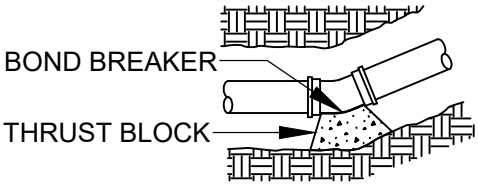
DRAWING No. AWD0212B



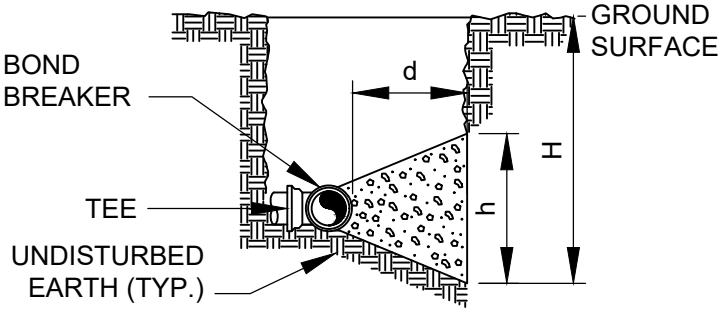
TEE (PLAN)



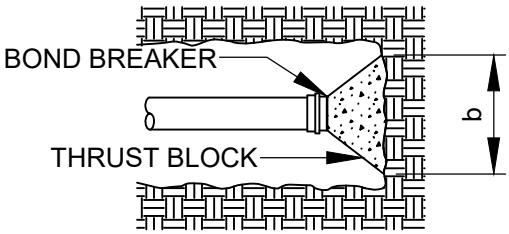
PLUGGED TEE (PLAN)



BEND (PLAN)



ELEVATION



DEAD END (PLAN)

NOTES:

1) BEARING SURFACE SHOULD, WHERE POSSIBLE, BE PLACED AGAINST UNDISTURBED SOIL. WHERE IT IS NOT POSSIBLE, THE FILL BETWEEN THE BEARING SURFACE AND UNDISTURBED SOIL MUST BE COMPACTED TO AT LEAST 90% STANDARD PROCTOR DENSITY, VERIFIED BY IN PLACE DENSITY TESTING.

2) BLOCK HEIGHT (h) SHOULD BE EQUAL TO OR LESS THAN ONE-HALF THE TOTAL DEPTH TO THE BOTTOM OF THE BLOCK, (H), BUT NOT LESS THAN THE PIPE DIAMETER.

3) BLOCK HEIGHT (h) SHOULD BE CHOSEN SUCH THAT THE CALCULATED BLOCK WIDTH (b) VARIES BETWEEN ONE AND TWO TIMES THE HEIGHT.

4) DO NOT ALLOW CONCRETE TO DIRECTLY CONTACT JOINTS OR FITTING BOLTS, PROTECT JOINTS AND BOLTS WITH POLYETHYLENE ENCASEMENT.

5) BLOCK DEPTH (d) SHALL BE AT LEAST $\frac{1}{2}$ BLOCK HEIGHT (H).

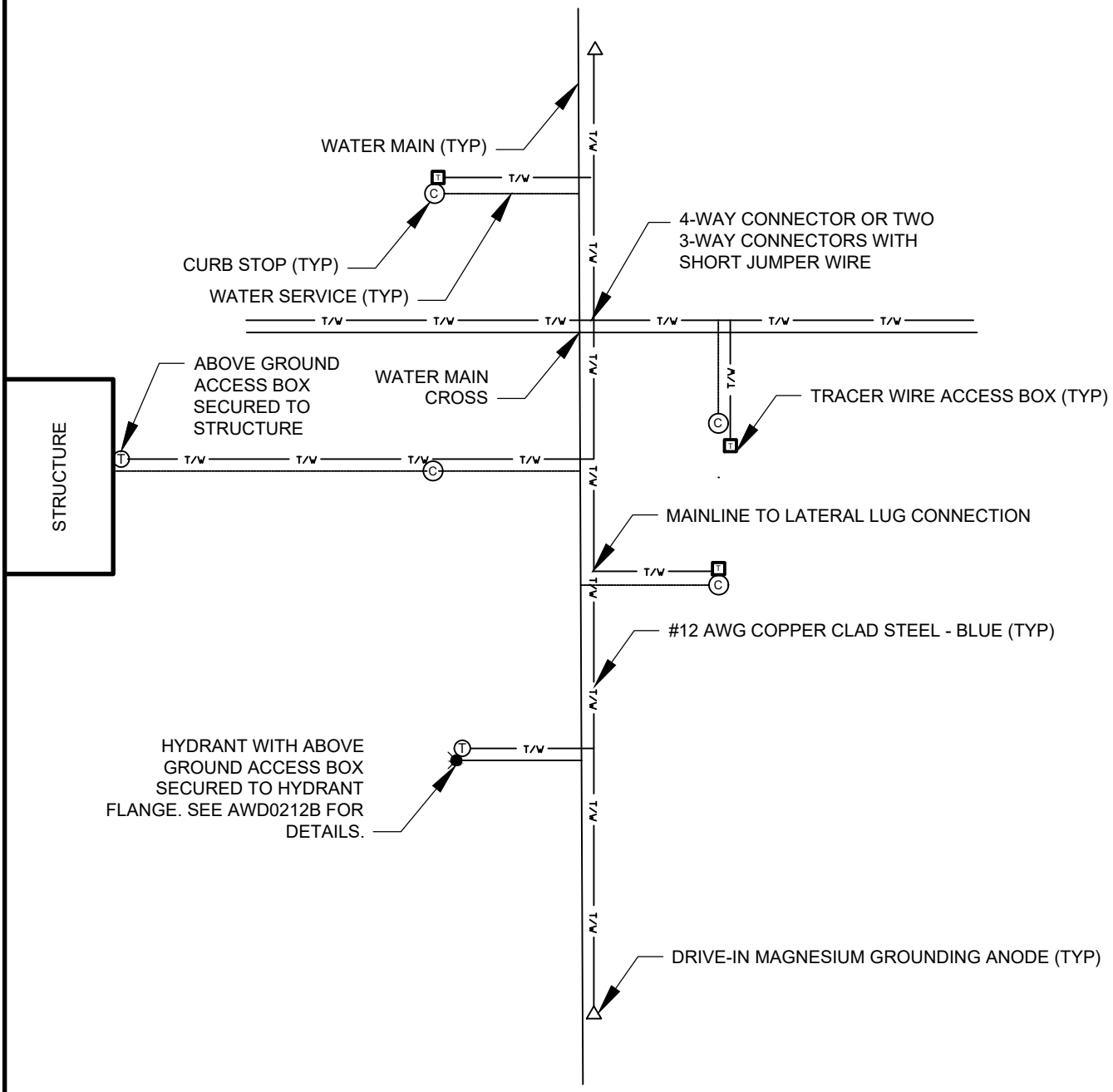
DRAWN BY: S. WIESKAMP	DATE: 12/02/04
APPROVED BY: Gerald R. Peterson	DATE: 01/13/05
REVISED BY: E.B.GLENNEY	DATE: 3-28-08
SCALE: NONE	

THRUST BLOCK DETAILS

MUSCATINE POWER & WATER

FILE No. 142

DRAWING No. AWD0212C



NOTES

1. TRACER WIRE SHOWN OFFSET FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON TOP OF PIPE AND FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

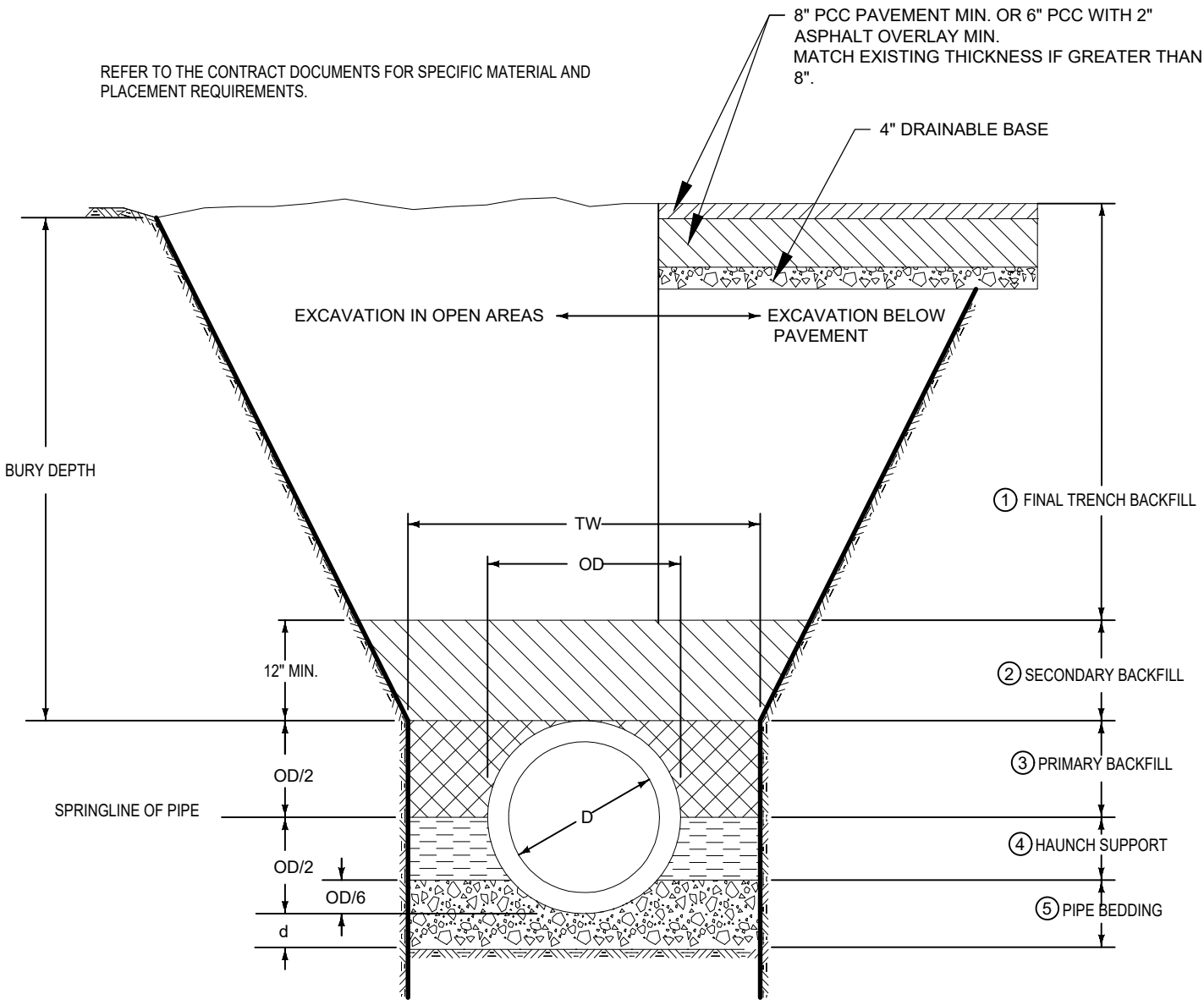
DRAWN BY: A. HANEY	DATE: 2/10/15
APPROVED BY: A. GROSS	DATE: 2/18/15
REVISED BY: A. HANEY	DATE: 2/10/15
SCALE: NONE	

TRACER WIRE INSTALLATION PLAN

MUSCATINE POWER & WATER

FILE No. 142

DRAWING No. AWD0212D



① BACKFILL SHALL BE CLEAN SAND OR MANUFACTURED SAND WITHIN 10 FT. OF PAVEMENT.

②③④ BACKFILL SHALL BE CLEAN SAND OR MANUFACTURED SAND REGARDLESS OF LOCATION.

⑤ IF ROCKS OR UNSUITABLE SOILS ARE ENCOUNTERED, OVER EXCAVATE AND REPLACE WITH COMPACTED ROCK OR MANUFACTURED SAND; OTHERWISE PIPE CAN BE BEDDED ON NATIVE MATERIALS.

Key

OD = OUTSIDE DIAMETER OF PIPE

D = INSIDE DIAMETER OF PIPE

TW = TRENCH WIDTH AT TOP OF PIPE, MAX IS OD + 12" EACH SIDE

d = DEPTH OF BEDDING MATERIAL BELOW PIPE, 6"

DRAWN BY: A. HANEY	DATE: 5-22-15
APPROVED BY: AHREN GROSS	DATE: 5-28-15
REVISED BY:	DATE:
SCALE: NONE	

TRENCH DETAIL

MUSCATINE POWER & WATER

FILE No. 142

DRAWING No. AWD0212E

CITY GUIDELINES FOR REPAIRS IN STREETS

City of Muscatine, Iowa

1. Dimensions for a Utility Patch:

   A. Minimum dimensions for a utility patch bounding a joint or pavement edge shall be six (6) feet.

   B. A patch inside a pavement panel (interior patch) not bounded by a joint or an edge shall have minimum dimensions of four (4) feet.

   C. All sides of an interior patch shall be at least four (4) feet from a pavement joint.

   D. Patches should be eight (8) inch thickness minimum.

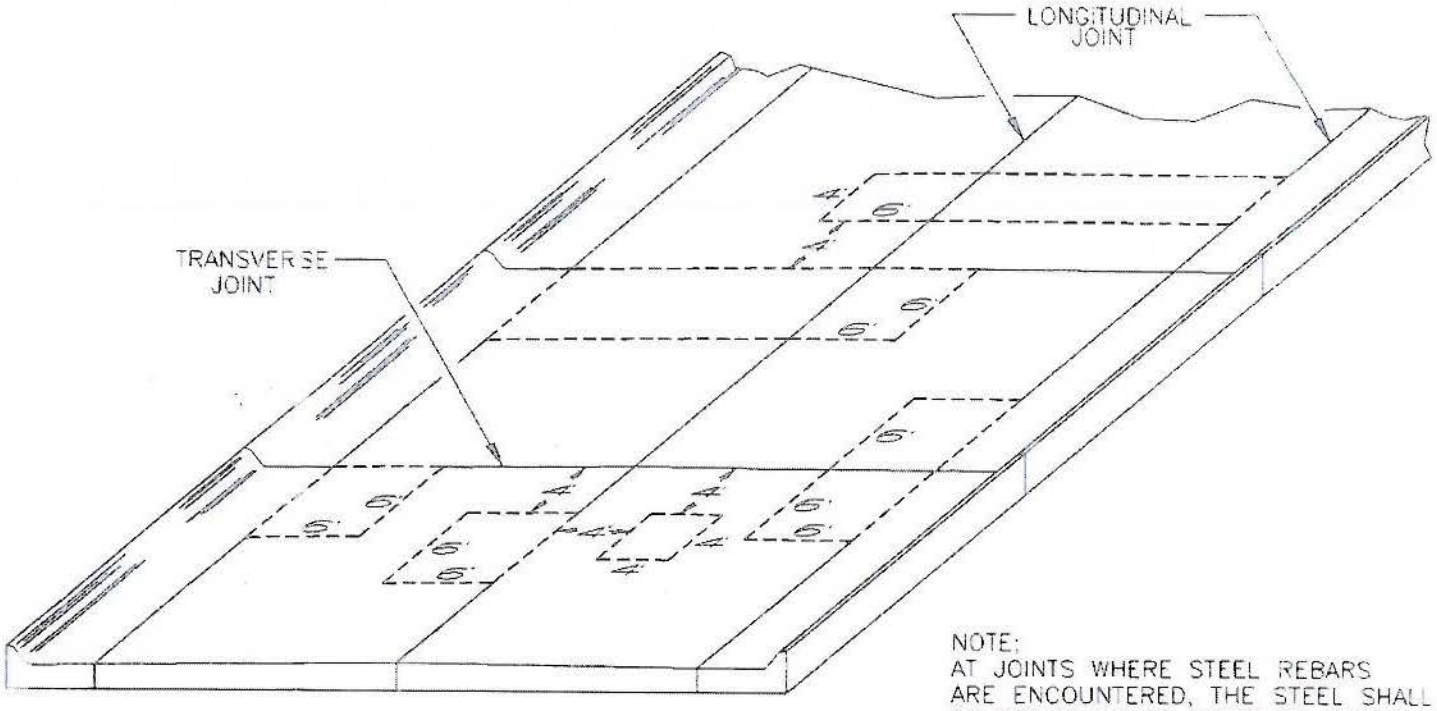
2. Untreated granular material shall not be placed within eighteen (18) inches of the slab, unless otherwise authorized.

3. Saw cuts shall be a minimum of four (4) inches deep, preferably full depth.

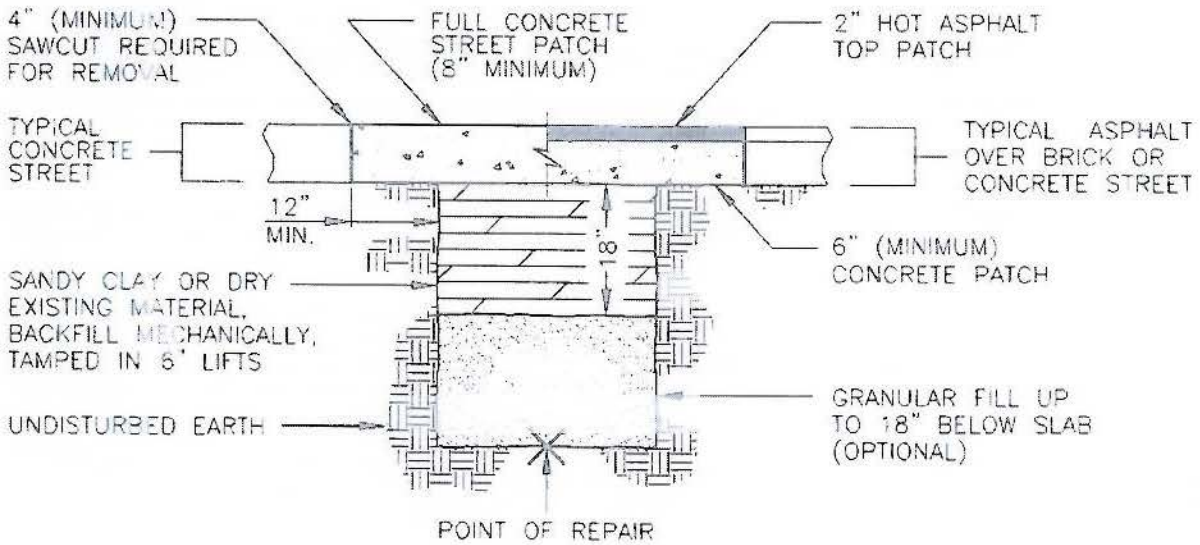
4. Asphalt streets and sealcoated streets shall be patched with a minimum of three (3) inches of hot mix asphalt.

5. No frozen material may be placed in the fill.

6. Contractors are required to obtain excavation permits, and to have all utilities located prior to excavation.



MINIMUM SIZE PATCHES
FOR STREET REPAIR



TYPICAL TRENCH AND
STREET REPAIR

FULL DEPTH HOT MIX ASPHALT FINISH PATCHES

TRAFFIC CONTROL: Furnishing, placing and removal of all signs, barricades, and flag man shall be the responsibility of the contractor and shall be in compliance with the current manual on uniform traffic control devices.

PAVEMENT REMOVAL: When repairing A.C. or P.C.C. pavement, the pavements shall be sawed full depth of the existing pavement and removed. If the base material is unstable, it shall also be removed.

Except where an existing transverse or longitudinal joint forms the edge of the patch, the edge shall be constructed by sawing full depth of the pavement resulting in a reasonably vertical edge when removing the material. The work shall be done in such a manner that the edges and remaining pavement are not damaged.

CLEANING AND PREPARATION: All loose material and debris shall be removed with hand tools and air blast. The entire area shall be free of foreign material and moisture. All removal material shall remain the property of the Contractor and shall be removed from the job site and disposed of at the Contractor's disposal area.

The base shall be dry and tamped with a mechanical tamper until the desired compaction is achieved.

TACK COAT: Tack coat may be SS-1, SS-1H. RC-70 and MC-70 may be used after 1 October. Tack Coat shall only be applied when the surface temperature exceeds 35 degrees Fahrenheit.

HOT MIX ASPHALT MIXTURE: The existing surface and the surface of each layer shall be free of moisture and foreign material before placing mixture. The hot mix asphalt temperature range shall be 245 to 330 degrees Fahrenheit when placed. The hot mix asphalt mixture shall use a ½" Type "A" aggregate and shall meet or exceed 300,000 ESAL H.M.A. criteria.

The contractor shall furnish a plant certification specifying the H.M.A. is in compliance with specifications along with a job mix formula for each 100 ton of mix or as required by the Engineer.

EQUIPMENT: Hand tools, mechanical tamper and a vibratory roller suitable for the work. All equipment shall be approved by the Engineer.

PROCEDURE: Tack coat shall be applied to all vertical surfaces that will come in contact with the hot mixture.

The application rate of the tack coat material shall not exceed 0.15 gal per square yards. The H.M.A. mix shall not be placed when the surface temperature is below 35 degrees Fahrenheit.

The hot mix asphalt mixture shall be placed in lifts not exceeding 3" after compaction. Each lift shall be compacted with a mechanical tamper. The final lift shall be compacted with a vibratory roller and placed so that after compaction the surface of the patch is flush with the existing pavement.

The patch may be open to traffic when the patch temperature is cool to the touch and all excess material and debris have been cleaned and removed by the Contractor.

GEOTECHNICAL REPORT

Mississippi Drive Corridor
City of Muscatine
Muscatine, IA

Geotechnical Engineering Report

Mississippi Drive Corridor Reconstruction

Muscatine, Iowa

February 2017

Prepared for:

February 7, 2017

Mr. Jim Harbaugh, PLA, ASLA
Bolton & Menk, Inc.
309 E 5th Street Address, Suite 202
Des Moines, IA 50309

RE: Geotechnical Engineering Report
Mississippi Drive Corridor Reconstruction
Muscatine, Iowa

Dear Mr. Harbaugh,

HDR, Inc. is pleased to provide the accompanying geotechnical engineering report for the proposed reconstruction of the Mississippi Drive corridor in Muscatine, Iowa. This report presents our findings, conclusions and final recommendations for the geotechnical aspects of the project, as well as the results of field exploration and laboratory testing completed by Braun Intertec.

Please contact us if you have any questions or comments concerning this information.

Sincerely,
HDR ENGINEERING, INC.

Brian T. Havens, P.E.
Senior Geotechnical Engineer

Patrick H. Poepsel, P.E.
Geotechnical Section Manager

Enclosure

LICENSED PROFESSIONAL ENGINEER
BRIAN T. HAVENS
13863
IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Brian T. Havens, P.E. **Date** 2/7/17
My license renewal date is December 31, 2018.

Pages covered by this seal: Pages 1 through 8, Figures 1 through 16, and Appendices A through D.

hdrinc.com

8404 Indian Hills Drive, Omaha, NE 68114
T 402.399.1123 F 402.399.4979

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List of Tables

List of Figures

Appendices

Geotechnical Engineering Report
Mississippi Drive Corridor Reconstruction
Muscatine, Iowa

1.0 Introduction

This report presents the results of the Geotechnical Engineering study performed for the proposed Mississippi Drive Corridor Reconstruction in Muscatine, Iowa. The purpose of this study is to perform geotechnical investigations and engineering analyses so that the contract documents for the project can be prepared and finalized.

This report presents findings, conclusions and recommendations regarding:

- Geologic setting;
- Subsurface soil and groundwater conditions;
- Evaluation of the engineering characteristics of the foundation and embankment soils;
- Evaluation of stability of existing and proposed embankments and foundation soils;
- Design of the pavement section; and
- Recommendations for construction.

This report was prepared by a licensed professional civil engineer specializing in geotechnical engineering and licensed in the State of Iowa. The recommendations presented herein are based on the applicable standards of the profession at the time of this report within this geographic area. This report has been prepared for the exclusive use of Bolton & Menk and the City of Muscatine for specific application to the proposed project, in accordance with generally accepted soil and foundation engineering practices.

2.0 Project Description

The project includes reconstruction of the Mississippi Drive Corridor as follows:

- Hershey Avenue/East Mississippi Drive from Station 20+21.49 (approximately 350 feet west of Green Street) to Station 35+55.40 (approximately Broadway Street). Surface reconstruction includes new parking lanes, sidewalks and medians. Existing mainline pavements will be used as previously constructed.
- Hershey Avenue/East Mississippi Drive from Station 35+55.40 (approximately Broadway Street to approximately Station 73+24 (approximately 100 feet northwest of Mississippi Drive on Mulberry Avenue). The full roadway section will be reconstructed.
- East 2nd Street from Station 84+72.11 (approximately 100 feet southwest of intersection with Orange Street) to Station 95+56.88 (approximately 630 feet northeast of intersection with Orange Street). The full roadway section will be reconstructed.
- Reconstruction of short segments (50 feet to150 feet) of intersecting streets, including the following streets:
    - Pine Street
    - Chestnut Street
    - Iowa Avenue
    - Sycamore Street
    - Cedar Street

  - Walnut Street
  - Orange Street
  - Oak Street
- Future reconstruction of Grandview Avenue from Main Street to Mill Street
- Future reconstruction of Green Street from Mill Street to Hershey Avenue

Cuts up to 1 foot deep and fills up to 2 feet in thickness are anticipated to reconstruct the proposed roadways. The new pavement section will include Portland Cement Concrete (PCC) over an aggregate base. Stormwater drainage improvements are planned.

3.0 Geotechnical Investigations

3.1 Historical Information

The available geotechnical information for this project consists of a Geotechnical Engineering Report prepared by Terracon dated February 14, 2011. This report is reproduced in Appendix C and includes 27 soil borings and associated laboratory test data.

3.2 Drilling, Sampling and In-Situ Testing

The current geotechnical investigation for the roadway improvements consisted of 23 exploratory test borings. The borings were completed between October 26 and October 27, 2016. The approximate locations of the borings are shown on Figures 2 through 16.

The borings were advanced with an ATV (rubber tire) mounted CME rotary drill rig using 4-inch OD continuous flight augers. The depths of the borings ranged from 4 to 10 feet below the existing ground surface.

The sample numbers, types, recovery lengths, and sampling intervals are shown on the logs of the borings, which are provided in Appendix A.

3.3 Laboratory Materials Testing

Following completion of the borings, the field logs were reviewed to estimate the approximate depths, thicknesses, and lateral extent of the various soil strata. A laboratory testing program was developed to evaluate the engineering properties of selected samples and to substantiate the soil classifications made in the field. All tests were conducted in general accordance with current ASTM or state-of-the-practice test procedures.

The foundation soils were tested to determine moisture content, dry density, gradation, plasticity indices, Standard Proctor, unconfined compressive strength and California Bearing Ratio (CBR). Laboratory test results are presented in Appendix B.

4.0 Site Conditions

4.1 Geologic Setting

The project site is situated within the Mississippi River Alluvial Plain physiographic province of eastern Iowa. The site is located along the right (west) bank of the Mississippi River and on the west side of its relatively broad river valley.

The predominant soil type within the project area is fine and coarse grained alluvium of Late Wisconsinan and Holocene age which extends to depths of over 80 feet. The recent, fine alluvium overlies the older, thicker, coarse alluvium. The present configuration of the various soils has resulted from a complex series of depositional and erosional events from action of a changing river, blowing wind and glacial advances and retreats.

The uplands adjacent to the river valley are typically mantled with loess and glacial till. The project site is situated in the Mississippi River alluvium, but glacial till is expected to underlie the alluvium at some locations.

The local bedrock is of the Pennsylvanian period and consists of limestone and shale. The top surface of the bedrock appears to be eroded and weathered in some instances.

The U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) describes the soil in this area of Muscatine County using the following soil units:

- *Richwood soils*. These soils were formed in well-drained alluvium and are located on stream terraces.
- *Radford soils*. These soils were formed in poorly-drained, moderately permeable alluvium on bottom lands or uplands.
- *Shaffton soils*. These soils were formed in somewhat poorly-drained alluvium on high bottom lands.

4.2 Subsurface Conditions

The primary geologic strata encountered in this investigation include the following:

- Topsoil;
- Existing fill soils;
- Fine alluvium;
- Coarse alluvium;
- Glacial till; and
- Bedrock.

A brief description of these units and their engineering characteristics is presented below.

4.3.1 Topsoil

Topsoil was not encountered at the boring locations as the borings were drilled through existing pavement areas, but topsoil is expected to be present in landscape areas adjacent to the existing pavements.

4.3.2 Existing Fill

Existing fill soils were encountered at various locations and at variable depths along the project alignment. The existing fill soils, where encountered in this study, generally consisted of brown to gray, lean clay (CL), sandy lean clay (CL), silty sand (SM), poorly graded sand (SP) and wood fragments. Thickness of the existing fills varied from 2.5 to more than 8.5 feet at the boring locations. SPT blowcounts (uncorrected) in the existing fill ranged from 2 to 21 blows per foot (bpf).

Pocket penetrometer measurements in the fill samples were 0.5 to 4 tons per square foot (tsf). Water contents from tested samples ranged from 13 to 44 percent and dry unit weights ranged from 109 to 123 pounds per cubic foot (pcf). Liquid limits and plasticity indices ranged from 24 to 34 and 7 to 19, respectively. The unconfined compressive strength of one sample was 2050 pounds per square foot (psf). The fines content of tested samples ranged from 28 to 87 percent. California Bearing Ratio (CBR) values ranged from 1.3 to 2.1 (four samples tested).

4.3.3 Fine Alluvium

Fine-grained (cohesive) alluvium was generally found to consist of firm to stiff, gray and dark gray, silty clay (CL-ML) and lean clay (CL). Pocket penetrometer measurements in 2 samples of

the fine alluvium were 1 ton per square foot (tsf). Where encountered in this study, the fine alluvium extended to the maximum depth explored of 10 feet. Information provided in a previous geotechnical report prepared by Terracon (2011) indicates that the cohesive alluvium ranged from 3 feet to more than 17 feet thick, with water contents from tested samples ranging from 15 to 37 percent, dry unit weights ranging from 83 to 103 pounds per cubic foot (pcf) and unconfined compressive strengths ranging from 310 to 2820 psf.

4.3.4 Alluvial Sands

The alluvial sands were generally encountered below the cohesive alluvium and were found to consist of brown poorly graded sand (SP) and poorly graded sand with silt (SP-SM). Where encountered, the alluvial sands extended to the bottom of the borings. The relative density of the granular alluvium was described as very loose to loose. SPT blowcounts (uncorrected) in the alluvium ranged from 4 to 8 blows per foot (bpf). Where encountered, the alluvial sands extended to the maximum depth explored of 10 feet. Information provided in a previous geotechnical report prepared by Terracon (2011) indicates that the alluvial sand ranged from 2.5 to 8 feet thick at the boring locations.

4.3.5 Glacial Till

The glacial till generally consisted of brown and gray, lean clay with sand (CL). Where encountered, the glacial till extended to the maximum depth explored of 10 feet. Pocket penetrometer measurements in the till were 1 to 1.5 tons per square foot (tsf).

4.3.6 Bedrock

Bedrock (highly weathered limestone) was encountered in the Boring RB-11 at a depth of 3.5 feet, corresponding to approximate elevation 563 feet. SPT blowcounts (uncorrected) in the limestone ranged from 50 blows per 3 inches to 50 blows with no penetration. Weathered shale bedrock was also noted in several borings drilled by Terracon (RW3, RW5, RW6, RW7, RW8 and RW9) at depths ranging from 10 to 18.5 feet, corresponding to elevations ranging from 539.5 to 554 feet.

4.3.7 Groundwater

Field measurements from this investigation indicate that the groundwater was not encountered while drilling the relatively shallow borings for this study. However, groundwater was encountered by Terracon in 2010 at depths ranging from 2 to 18 feet below existing grade while drilling and at depths of 1 to 15 feet below existing grade after drilling.

Fluctuations in groundwater levels should be expected with variations in the local and regional precipitation and with variations in the Mississippi River level.

5.0 Engineering Analyses and Recommendations

5.1 Stability Evaluation of Existing Roadway Embankment

HDR evaluated stability of the existing 10-foot high embankment foreslope extending from Hershey Avenue/Mississippi Street down to the existing railroad tracks between Stations 27+00 (approximately 100 feet southwest of Ash Street) and 46+00 (approximately Linn Street Intersection) since roadway improvements will be made in this area. The present foreslope inclination is noticeably steeper (up to 1.4H:1V) than typical permanent slopes. HDR recommends flattening this sideslope to reduce the risk of future instability that could undermine the roadway and drainage improvements and existing features such as the power poles.

A 2.5H:1V permanent slope was evaluated, resulting in extending the toe of the existing slope closer to the existing railroad tracks and existing drainage swale. This evaluation was made using SLOPE/W software, soil properties based on experience with similar soils and the proposed

slope configuration at Station 41+00. HDR did consider potential impacts from a flood on the Mississippi River, but Flood Insurance Study maps provided by FEMA suggest that a 500-year flood would only reach the toe of the slope, so this does not appear to be a factor in selection of the slope inclination. The results of the analyses indicated that the 2.5H:1V slope inclination will provide a Factor of Safety (FOS) of at least 1.5 under long-term conditions which is considered to be reasonable.

Following discussion with Bolton & Menk and the City of Muscatine, we understand that the City of Muscatine prefers that the existing foreslope not be flattened between Stations 27+00 and 35+75 as there is no earthwork and no pavement reconstruction planned in this area. The existing foreslope will be flattened from Station 35+75 to 46+00.

Since the slope flattening will involve placement of narrow "sliver fills" in some instances, special requirements will be needed to mesh the new fill with the existing slope, so that the flattened slope does not include a zone of weakness. Specifically, the new fill should be constructed with a step or series of steps (benches) cut on approximately horizontal planes with vertical slope cut dimensions of no less than 3 feet. The contractor may need to temporarily overbuild the slope for proper compaction and then cut the temporary slope back to the 2.5H:1V permanent slope.

5.2 Earthwork and Embankment Construction

Earthwork and embankment construction should be completed in accordance with SUDAS Standard Specifications (Section 2010, 3.04). As noted in Section 5.1 of this report, the contractor will need to "bench" the new fill into the existing foreslope fill where the existing foreslope is steeper than 3H:1V.

5.3 Pavement Subgrade Preparation

Pavement subgrade preparation should be completed in general accordance with SUDAS Standard Specifications (Section 2010, 3.06). In addition, the following recommendations should be applied to this project:

- Select subgrade materials (Section 2010, 3.06.A) will not be required since the pavement section will include subbase material.
- Subgrade compaction in fill sections (Section 2010, 3.06.A.1) should include removal and stockpiling of existing subbase material, placement/compaction of suitable soil fill and placement/compaction of subbase material.
- Subgrade compaction in cut sections or sections with no cut/fill (Section 2010, 3.06.A.2) will be dependent on the condition of the existing subgrade. The existing subgrades are expected to be fill that was previously placed and compacted, so the primary consideration is whether the subgrade has become weakened since the time that the existing pavements were constructed. Subgrade preparation should include proofrolling to determine if the subgrade is sufficiently stable as described in Section 2010, 3.06.B. Unstable subgrade should be removed and replaced as described in Section 2010, 3.06.B or modified to meet the stability requirements. The extent of modification will depend on the depth of unstable soil and may involve in-place discing, drying and recompaction or removal of unstable soil followed by in-place discing, drying and recompaction. Care should be taken to avoid proofrolling directly over shallow existing utility lines that are designated to remain in place.

5.4 Pavement Section Design

HDR completed a design for the PCC pavement section between Station 35+55.40 (approximately Mississippi Drive at Broadway Street) and Station 95+56.88 (East 2nd Street approximately 630 feet northeast of the intersection with Orange Street). In order to evaluate and design the pavement thickness, it was necessary to have a means of judging and categorizing

the support characteristics of the subgrade soil following pavement subgrade preparation. The Statewide Urban Design and Specifications (SUDAS) design manual provides correlations to soil resilient modulus, M_R, and modulus of subgrade reaction, k, using an estimate of the California Bearing Ratio (CBR) for design of rigid pavements.

The lab CBR testing was performed by Braun Intertec. Bulk samples were obtained of the subgrade soils below existing pavements at depths of 2 to 8 feet at 4 boring locations. The CBR samples were compacted to 95% of the maximum dry density (ASTM D 698) at a water content between 3% and 4% above optimum as determined by the Standard Proctor test. CBR test results are provided in Appendix B. A CBR value of 2 was selected for design.

SUDAS recommends the value of the modulus of subgrade reaction be corrected for the presence of a subbase layer, seasonal effects and loss of support. Table 1 provides the recommended modulus of subgrade reaction values for pavement design.

Table 1: Recommended Subgrade Soil Properties for Pavement Design

Subgrade	*k*, corrected (psi / in)
6-Inch Granular Subbase	140

Pavement design was completed in accordance with the SUDAS design manual (SUDAS, 2016). Table 2 provides the traffic design information that was obtained from the Iowa DOT Traffic Data (online) to calculate the equivalent single axle loading (ESAL).

Table 2: Traffic Design Information

2014 Average Annual Daily Traffic (AADT) (both directions combined)	9200
Percent Trucks	7%
Average Annual Growth Rate	1%

Table 3 provides the parameters that were used to complete the pavement design for rigid pavements.

Table 3: Rigid Pavement Design Parameters

ESAL (50-year design life)	8,900,000
Initial Serviceability Index	4.5
Terminal Serviceability Index (minor arterial)	2.5
Reliability (minor arterial)	95%
Overall Standard Deviation	0.35
Concrete Modulus of Rupture (ksi)	580
Concrete Elastic Modulus (ksi)	3915
Load Transfer Coefficient (with dowels)	2.7 for D* ≥ 8”
Drainage Coefficient (with subbase)	1.0

*D=pavement depth/thickness

Table 4 provides the recommended pavement thickness determined in accordance with the AASHTO Pavement Design Manual (AASHTO, 1993) and SUDAS design manual (SUDAS, 2016a). Pavement design calculations are provided in Attachment E.

Table 4: Recommended Pavement Thicknesses

Subgrade	Thickness (in)
6-Inch Granular Subbase	10

The granular subbase material should consist of Special Backfill in accordance with Iowa Department of Transportation (Iowa DOT) Specifications Section 4123 (Iowa DOT, 2016).

The recommended pavement section shown in Table 4 is consistent with pavement sections used previously by the City of Muscatine on routes with a higher percentage of truck traffic. Longitudinal subdrains were considered in combination with a drainable subbase to improve the pavement section drainage and reduce the PCC thickness, but we understand that the City of Muscatine prefers that longitudinal drains not be used for this project.

5.5 Sidewalk Subgrade Preparation

Subgrade preparation for sidewalks should follow requirements shown in the SUDAS Standard Specifications, Section 7030.

5.6 Utility Trench Backfill

Utility trench backfill should be placed and compacted as described in the SUDAS Standard Specifications, Section 3010, with the following modifications:

- Class I and II (clean granular) backfill materials should be compacted to at least 70% relative density within the right-of-way, regardless of depth or position relative to the utility line.
- Class III and IVA (granular with fines and cohesive) backfill materials should be compacted to at least 95% within the right-of-way, regardless of depth or position relative to the utility line.

5.7 Traffic Signal Foundations

Recommendations for traffic signal foundations were not included in HDR's work scope. We understand that the traffic signal foundations will be designed by others.

6.0 Limitations

This geotechnical engineering report presents the findings, conclusions and final recommendations for the geotechnical aspects of the interchange improvements and related features. It has been prepared in accordance with generally accepted engineering practice and in a manner consistent with the level of care and skill for this type of project within this geographical area. No warranty, expressed or implied, is made.

The conclusions and recommendations presented herein are based on field reconnaissance, research and available literature, the results of field exploration and laboratory materials testing, and the results of preliminary engineering analyses.

Geotechnical engineering and the geologic sciences are characterized by uncertainty. Professional judgments presented herein are based partly on our understanding of the proposed construction, partly on our general experience and the state-of-the-practice at the time of this evaluation.

7.0 References

American Association of State Highway and Transportation Officials (AASHTO) (1993), AASHTO Guide for Design of Pavement Structures.

Braun Intertec (2016), "Geotechnical Data Report, Proposed Mississippi Drive Improvements, Muscatine, Iowa", December 2, 2016.

Iowa Department of Transportation (2016). Traffic Data in Iowa. Available online at http://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=0cce99afb78e4d3b9b24f8263717f910. Accessed December 2016.

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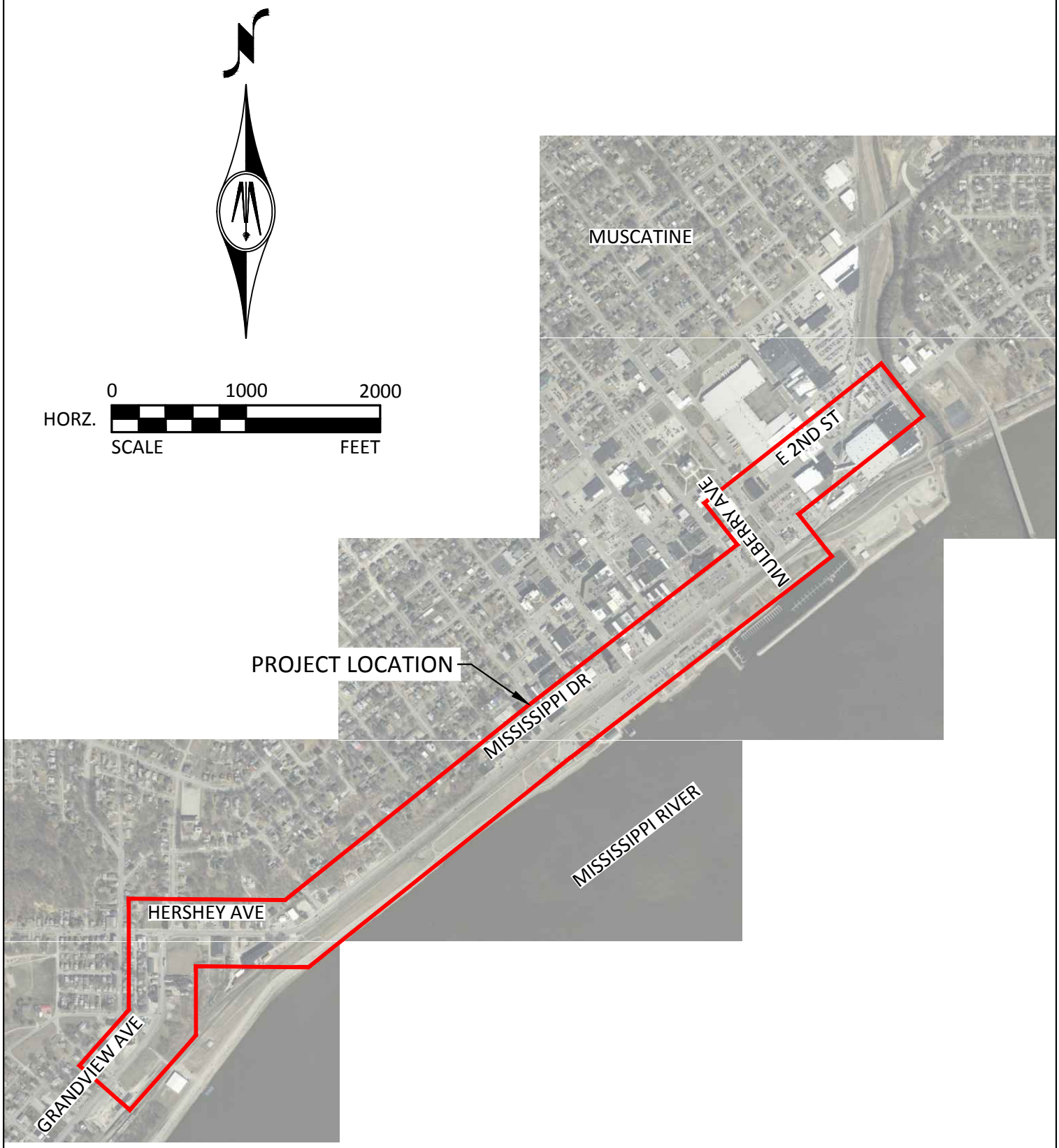
SLOPE/W (2012), GeoStudio 2012, August 2015 Release, Version 8.15.4.11512, created by Geo-Slope International (www.geo-slope.com).

Statewide Urban Design and Specifications (SUDAS) (2016), Design Manual, Chapter 5 – Roadway Design, Section 5F-1 Pavement Thickness Design, 2016 Edition.

Terracon Consultants, Inc. (2010), "Geotechnical Engineering Report, Proposed Mississippi Drive Improvements, Muscatine, Iowa", February 14, 2011.



HDR	MUSCATINE	SITE LOCATION PLAN MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION	Date December 2016 Figure 1

LEGEND

EXISTING BORING

BORING DRILLED FOR THIS STUDY

MILL ST

GREEN ST

MAIN ST

GRANDVIEW AVE

8" SAN

GRASS

GRAVEL

105+00

106+00

107+00

108+00

109+00

110+00

111+00

B-1

RB-1

HORZ. SCALE 0 20 40 FEET

C:\Users\gregbr\AppData\Local\Temp\dcclpdata.dwg 12/23/15 1:05 pm

MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

BOLTON & MENK, INC.
Consulting Engineers & Surveyors
2730 FORD ST, P.O. BOX 668
AMES, IOWA 50010
(515)-233-1600

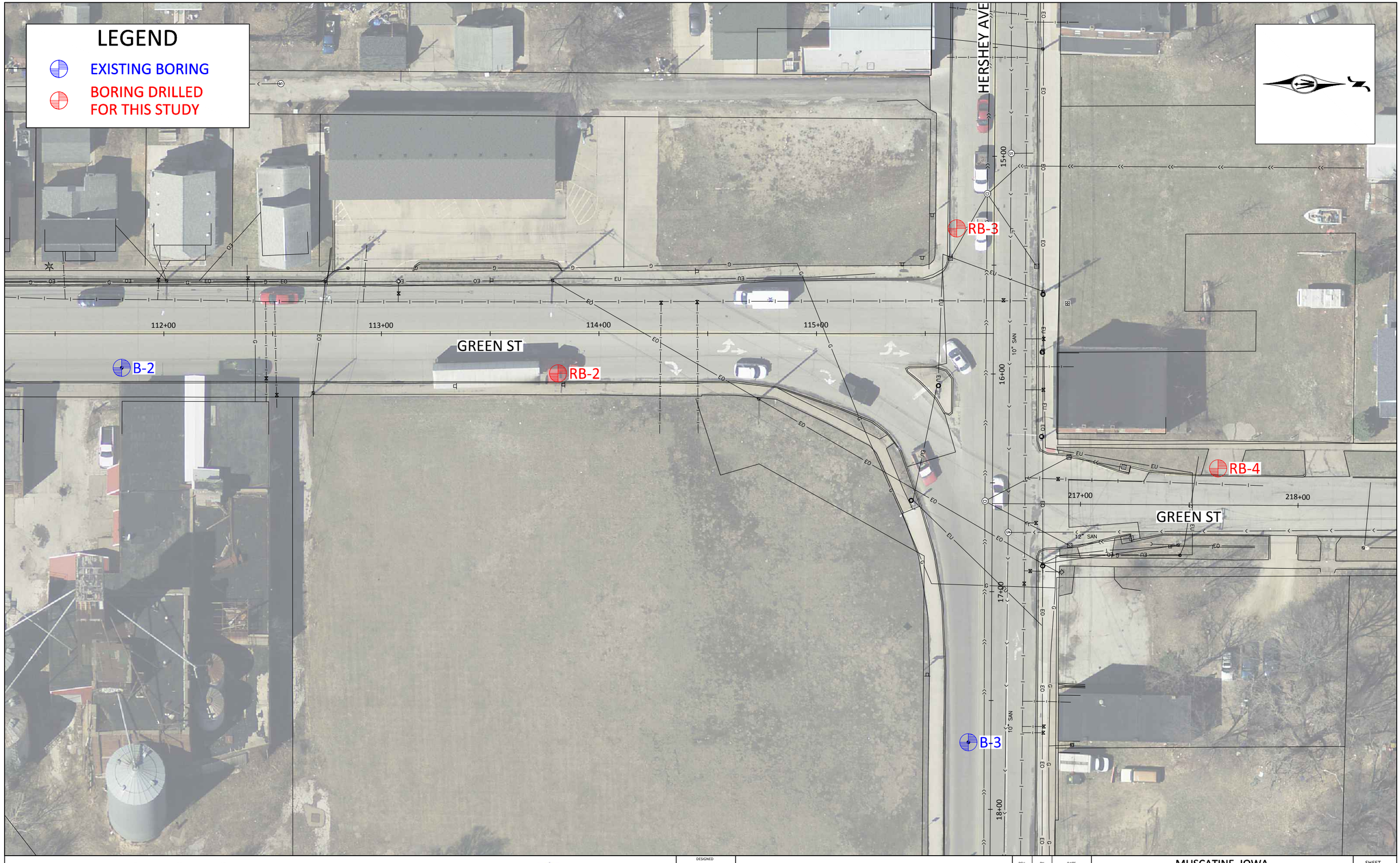
REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 2



HORZ. 0 20 40
SCALE FEET

C:\Users\gregbr\AppData\Local\Temp\dcclpdata.dwg 12/23/15 1:05 pm

MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

BOLTON & MENK, INC.
Consulting Engineers & Surveyors
2730 FORD ST, P.O. BOX 668
AMES, IOWA 50010
(515)-233-1600

REV.	BY	DATE

MUSCATINE, IOWA
MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION
BORING LOCATION PLAN

SHEET 3

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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AMES, IOWA 50010
(515)-233-1600

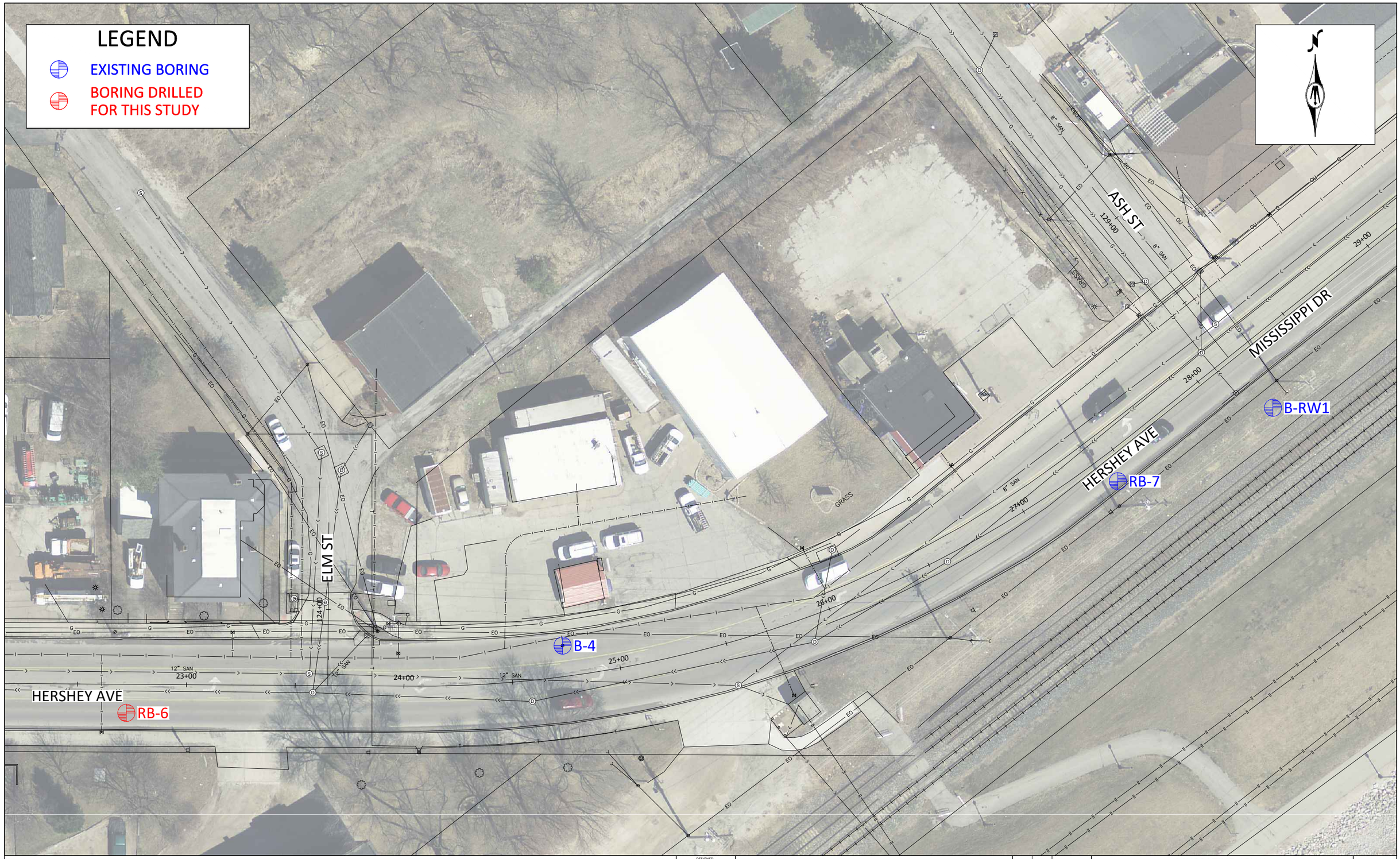
REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 4



HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 5

LEGEND

EXISTING BORING

BORING DRILLED FOR THIS STUDY

ASH ST

MISSISSIPPI DR

B-5

B-RW1

RB-8

B-RW2

B-RW3

RB-9

GRASS

CONCRETE

GRASS

INTAKE RIM = 561.88
IE S- 12" CONC. = 558.03

28+00 29+00 30+00 31+00 32+00 33+00 34+00

129+00

8" SAN

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	DRAWN	CHECKED
BTH	TJB	KDM

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REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 6

LEGEND

EXISTING BORING

BORING DRILLED FOR THIS STUDY

BROADWAY ST

MISSISSIPPI DR

RB-10

RB-9

RB-11

B-1 (APRIL 2010)

B-2 (APRIL 2010)

B-RW4

B-RW5

B-RW6

34+00 35+00 36+00 37+00 38+00 39+00

8" SAN

12" SAN

CONCRETE PAVEMENT

EO

STORM M.H. / INTAKE M.H. RIM = 556.10
INTAKE F.E. IN = 555.54
F.E. S.W. 6" METAL = 552.60
F.E. S.E. 24" CONC. = 550.80

E 24" CLAY PIPE = 557.79

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	DRAWN	CHECKED
BTH	TJB	KDM

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REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 7

HORZ. 0 20 40
SCALE FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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AMES, IOWA 50010
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REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 8

LEGEND

EXISTING BORING

BORING DRILLED FOR THIS STUDY

LINN ST

PINE ST

MISSISSIPPI DR

STORM M.H. RIM = 559.97
E. S.W. 12" CONC. = 556.17
E. S.E. 24" CONC. = 555.97

12' X 3' INTAKE RIM = 558.37
E. S.W. 12" CMP = 556.47
E. N.W. 24" CONC. = 554.37
E. S.E. 24" CONC. = 554.47

STORM M.H. RIM = 560.01
ABANDONED M.H. FULL OF SILT

CURB INTAKE M.H.
GUTTER = 556.27
E. S.W. 18" CLAY = 552.31
RIM = 556.51

B-6

B-RW9

B-RW10

RB-12

RB-13

6" SAN

10" SAN

45+00
46+00
47+00
48+00
49+00
50+00
51+00
147+00
146+00
2+00
3+00
4+00
5+00

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	DRAWN	CHECKED
BTH	TJB	KDM

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AMES, IOWA 50010
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REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 9

LEGEND

- EXISTING BORING
- BORING DRILLED FOR THIS STUDY

PINE ST

CHESTNUT ST

MISSISSIPPI DR

RB-13

B-7

RB-1

2+00 3+00 5+00 8+00 9+00 10+00

49+00 50+00 51+00 52+00 53+00 54+00 55+00

10" SAN 6" SAN 8" SAN

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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Consulting Engineers & Surveyors
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AMES, IOWA 50010
(515)-233-1600

REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 10

LEGEND

- EXISTING BORING
- BORING DRILLED FOR THIS STUDY

IOWA ST

SYCAMORE ST

MISSISSIPPI DR

RB-14

RB-15

B-8

GRAVEL

11+00

12+00

13+00

14+00

16+00

17+00

18+00

56+00

57+00

58+00

59+00

60+00

61+00

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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AMES, IOWA 50010
(515)-233-1600

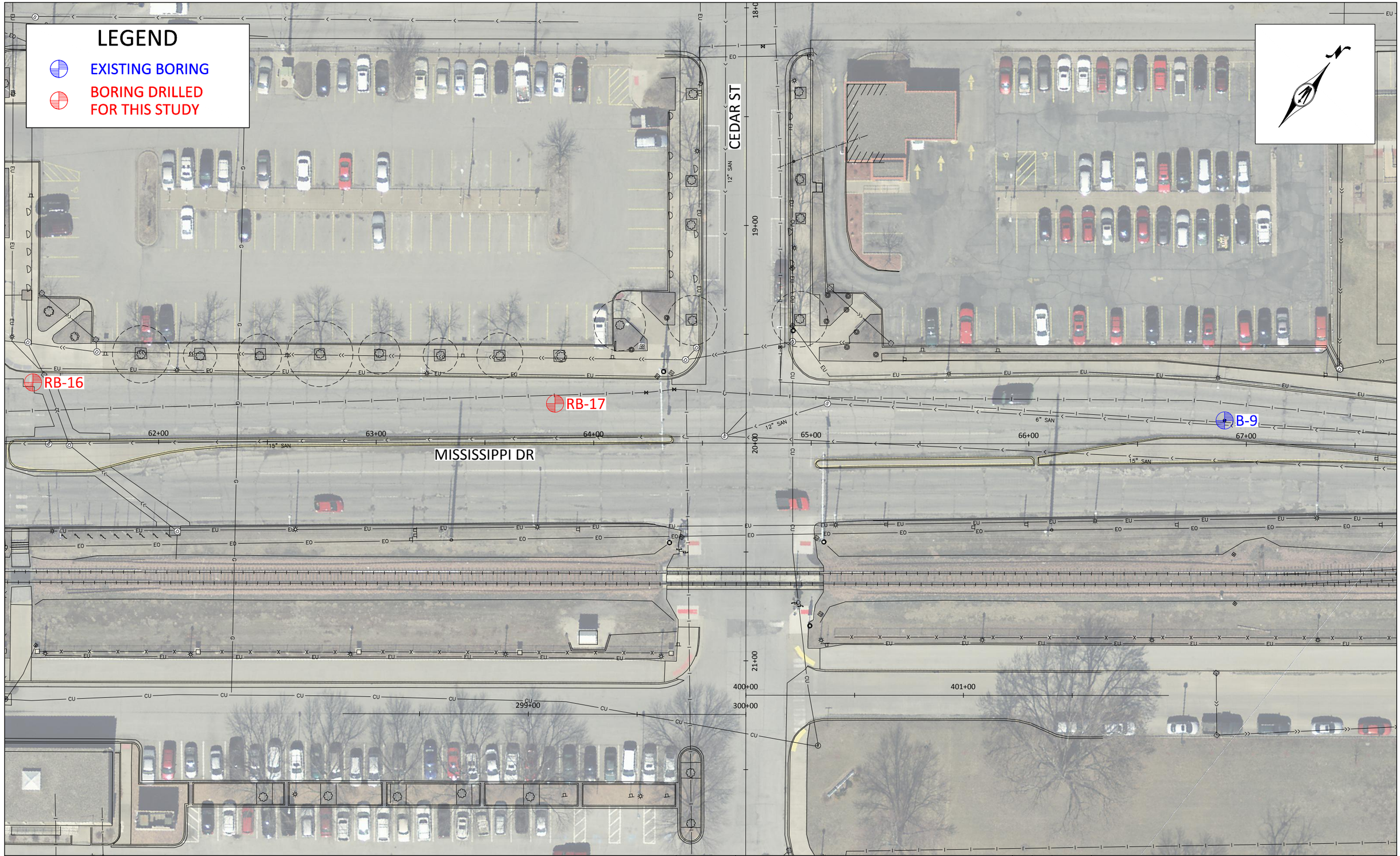
REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 11



HORZ. SCALE 0 20 40 FEET

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MUSCATINE

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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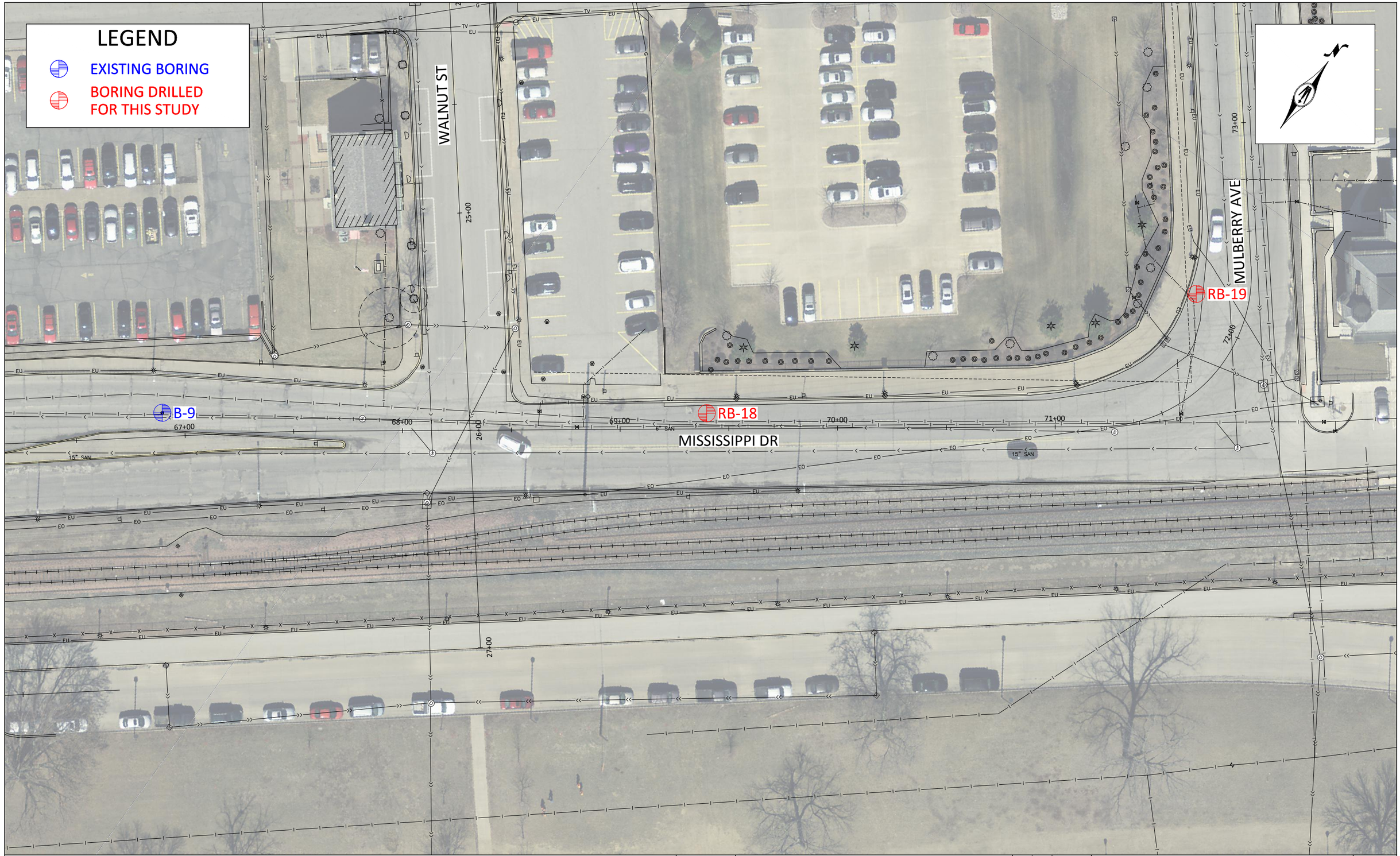
AMES, IOWA 50010
(515)-233-1600

REV.	BY	DATE

MUSCATINE, IOWA
MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION
BORING LOCATION PLAN

SHEET 12



HORZ. SCALE 0 20 40 FEET

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MUSCATINE

DESIGNED	DRAWN	CHECKED
BTH	TJB	KDM

BOLTON & MENK, INC.
Consulting Engineers & Surveyors
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AMES, IOWA 50010
(515)-233-1600

REV.	BY	DATE

MUSCATINE, IOWA
MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION
BORING LOCATION PLAN

SHEET 13

LEGEND

- EXISTING BORING
- BORING DRILLED FOR THIS STUDY

RB-20
RB-21
B-10
B-

E 2ND ST
MULBERRY AVE
ORANGE ST

76+00
75+00
74+00
73+00
82+00
83+00
84+00
85+00
86+00
87+00
27+00
28+00
29+00

6" SAN
8" SAN
12" SAN
18" SAN

HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

BOLTON & MENK, INC.
Consulting Engineers & Surveyors
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AMES, IOWA 50010
(515)-233-1600

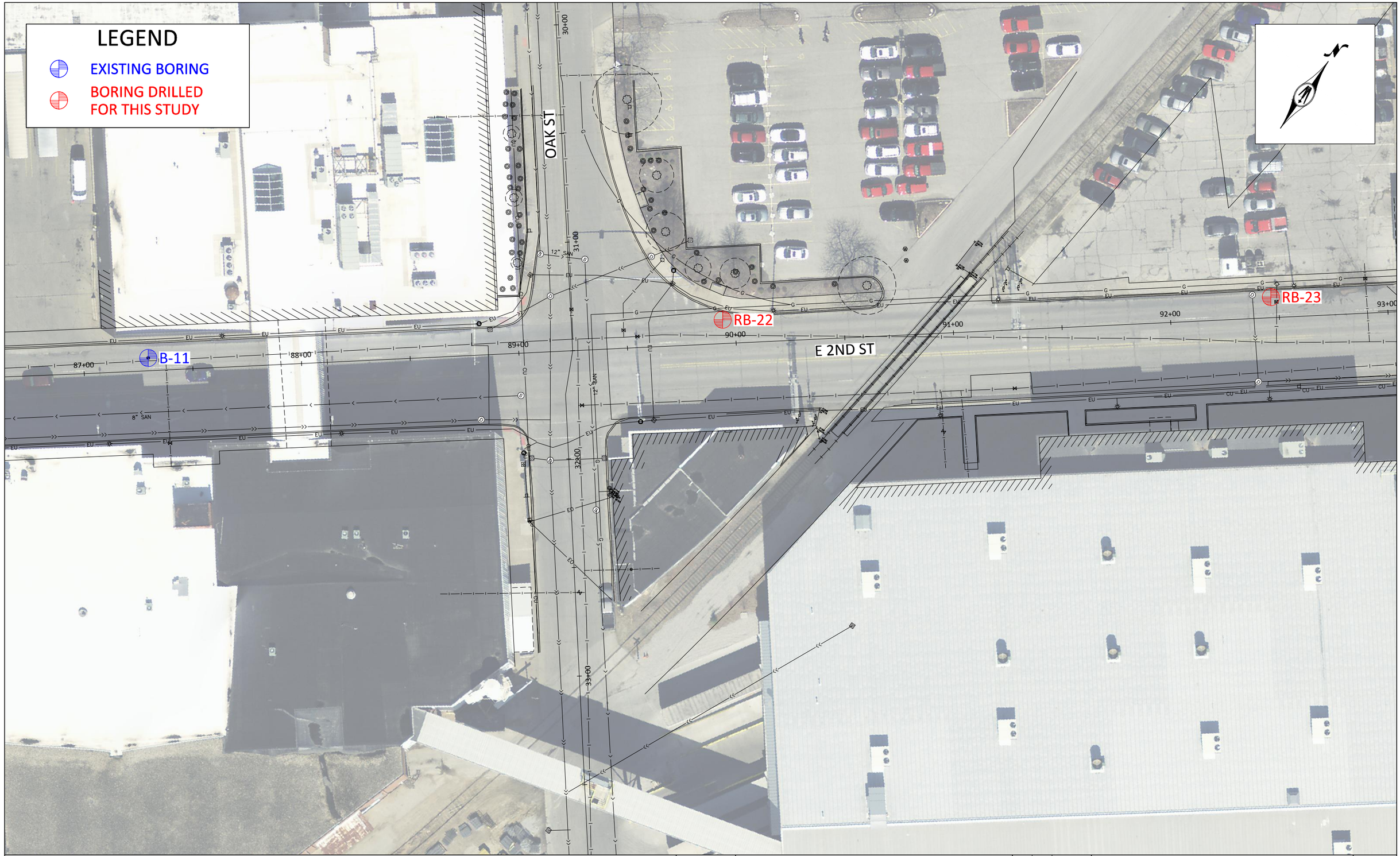
REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 14



HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

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AMES, IOWA 50010
(515)-233-1600

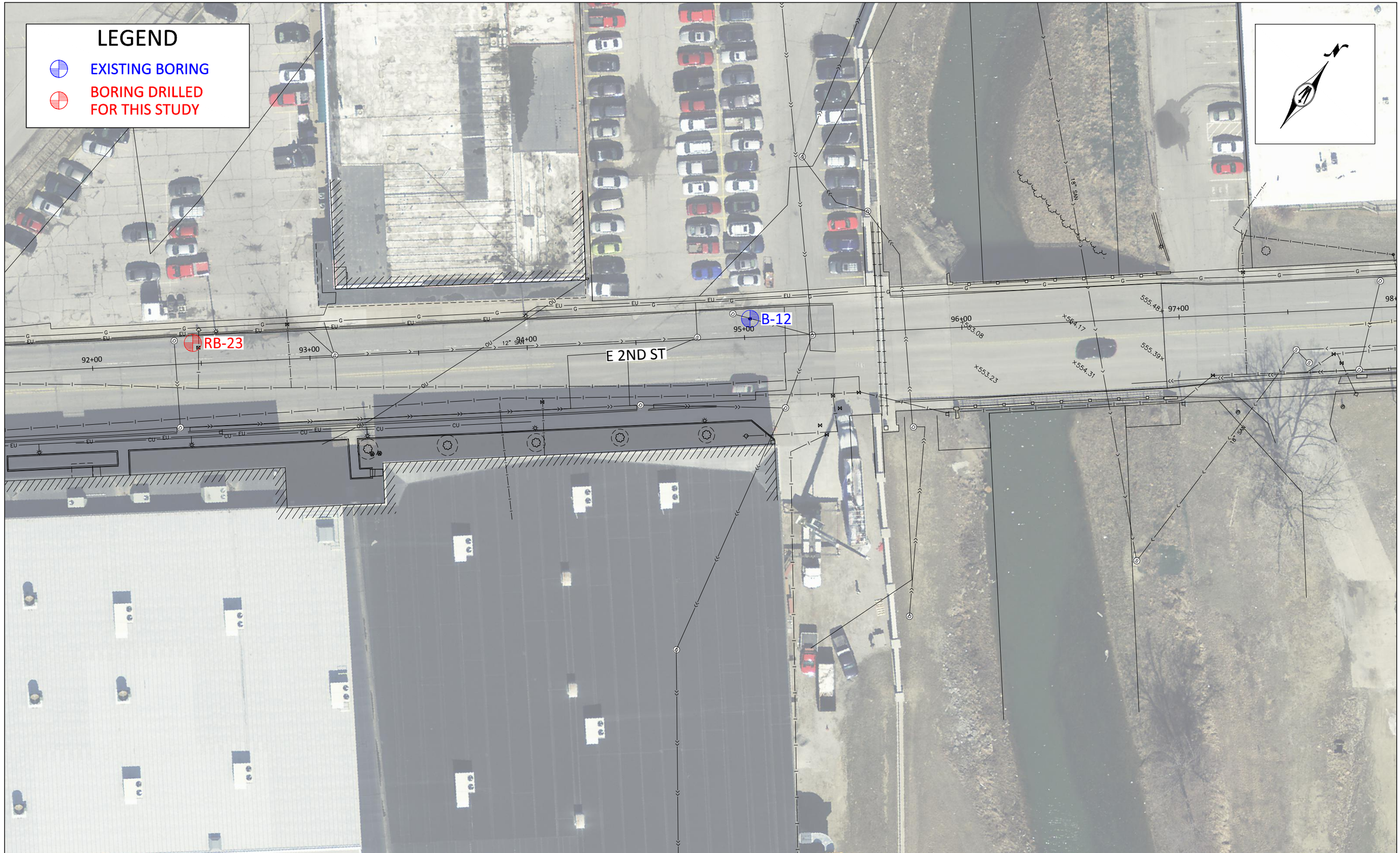
REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 15



HORZ. SCALE 0 20 40 FEET

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MUSCATINE

HDR

DESIGNED	BTH
DRAWN	TJB
CHECKED	KDM

BOLTON & MENK, INC.
Consulting Engineers & Surveyors
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AMES, IOWA 50010
(515)-233-1600

REV.	BY	DATE

MUSCATINE, IOWA

MISSISSIPPI DRIVE CORRIDOR RECONSTRUCTION

BORING LOCATION PLAN

SHEET 16

HDR Engineering, Inc.

8408 Indian Hills Drive
Omaha, NE 68114

Phone (402) 399-1000
Fax (402) 399-4979
www.hdrinc.com

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-01**

LOCATION: Latitude: 41.413585
Longitude: -91.057882

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
546.1	0.0						
545.8	0.3	PAV	Asphalt Pavement				
545.0	1.1	PAV	PCC Pavement				
544.6	1.5	AGG	Aggregate Base	15		13	LL= N/A, PL= NP, PI= NP P200= 28% q_p= 1.0 tsf
543.1	3.0	FILL	FILL: Silty Sand with Gravel, dark brown, dry				
540.1	6.0	FILL	FILL: Sandy Lean Clay with wood fragments, brown and gray, moist				
538.6	7.5	FILL	FILL: Lean Clay, trace Sand and Gravel, gray, moist	8			
536.1	10.0	CL-ML	SILTY CLAY, trace Gravel and Organics, gray, moist (Alluvium)				q_p= 1.0 tsf
			END OF BORING. Water not observed while drilling. Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-02**

LOCATION: Latitude: 41.414800
Longitude: -91.057731

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
555.2	0.0						
555.0	0.3	PAV	Asphalt Pavement				
554.1	1.1	PAV	PCC Pavement				
553.7	1.5	AGG	Aggregate Base				
		FILL	FILL: Sandy Lean Clay, trace Gravel, dark brown, dry	15		14	
552.2	3.0	FILL	FILL: Sandy Lean Clay with wood fragments, gray, moist				Bulk sample from 2 to 8 feet. q_p= 1.0 tsf
549.2	6.0	FILL	FILL: Sandy Lean Clay, trace Gravel and roots, light brown and gray, moist to wet				q_p= 1.0 tsf
545.2	10.0			3			
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-03**

LOCATION: Latitude: 41.415308
Longitude: -91.057955

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	DD pcf	Tests or Notes
559.7	0.0							
558.7	1.0	PAV	PCC Pavement					
558.2	1.5	AGG	Aggregate Base					
		FILL	FILL: Lean Clay, trace Sand and Gravel, brown and gray, moist	9				*No recovery
						19	109	q_p= 1.0 tsf
								q_p= 1.0 tsf
								q_p= .05 tsf
549.7	10.0		END OF BORING.					
			Water not observed while drilling.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-04**

LOCATION: Latitude: 41.415629
Longitude: -91.057541

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
568.5	0.0						
568.3	0.3	PAV	PCC Pavement				
567.0	1.5	AGG	Aggregate Base				Bulk sample from 1 to 10 feet.
566.0	2.5	FILL	FILL: Sandy Lean Clay, brown, moist				
565.5	3.0	FILL	FILL: Poorly Graded Sand with Silt, fine- to medium-grained, orange brown, moist				q_p= 0.5 tsf
		FILL	FILL: Lean Clay with Sand, brown and gray, moist to wet	11		18	q_p= 2.0 tsf
							q_p= 2.5 tsf
558.5	10.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-05**

LOCATION: Latitude: 41.415268
Longitude: -91.056191

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
555.6	0.0					
554.9	0.8	PAV	PCC Pavement			
554.1	1.5	AGG	Aggregate Base			
552.6	3.0	FILL	FILL: Silty Sand, trace Gravel and Organics, fine- to medium-grained, brown and gray, dry	12		
547.6	8.0	FILL	FILL: Sandy Lean Clay, trace Gravel, brown and gray, moist			q_p= 1.5 tsf q_p= 1.0 tsf
545.6	10.0	CL	LEAN CLAY, trace Organics, dark gray, moist (Alluvium)			q_p= 1.0 tsf
			END OF BORING. Water not observed while drilling. Boring then backfilled.			Bulk sample from 3 to 8 feet. LL= 28, PL=15, PI=13 P200= 58%

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-06**

LOCATION: Latitude: 41.415249
Longitude: -91.055261

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
556.7	0.0					
556.0	0.8	PAV	PCC Pavement			
555.2	1.5	AGG	Aggregate Base			
		FILL	FILL: Sandy Lean Clay, trace Organics, brown and gray, dry	13		q_p= 4.0 tsf
						q_p= 3.0 tsf
				11		
546.7	10.0		END OF BORING.			
			Water not observed while drilling.			
			Boring then backfilled.			

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-07**

LOCATION: Latitude: 41.415506
Longitude: -91.053589

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
556.0	0.0						
555.2	0.8	PAV	PCC Pavement				
554.5	1.5	AGG	Aggregate Base				
553.0	3.0	FILL	FILL: Silty Sand, trace Gravel, fine- to medium-grained, brown, dry	15			
550.0	6.0	FILL	FILL: Lean Clay with Gravel, trace Organics, brown, dry	7		27	
548.0	8.0	FILL	FILL: Wood fragments	6			
546.0	10.0	FILL	FILL: Lean Clay, trace Organics, gray	3		44	
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-08**

LOCATION: Latitude: 41.415802
Longitude: -91.053070

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
558.0	0.0						
557.1	0.9	PAV	PCC Pavement				
556.5	1.5	AGG	Aggregate Base				
		FILL	FILL: Silty Sand with brick fragments, trace Gravel, fine- to medium-grained, brown and dark gray, dry	21		12	P200= 23%
555.0	3.0						
		FILL	FILL: Lean Clay, trace Gravel, dark gray, dry	5		18	
552.0	6.0						
		FILL	FILL: Wood fragments				
550.0	8.0						
		FILL	FILL: Lean Clay with debris (PVC fragments), trace Gravel, gray, moist	5		39	
548.0	10.0						
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-09**

LOCATION: Latitude: 41.416489
Longitude: -91.051845

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/26/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	DD pcf	Tests or Notes
563.7	0.0							
562.8	0.9	PAV	PCC Pavement					
562.2	1.5	AGG	Aggregate Base					
		FILL	FILL: Sandy Lean Clay with brick fragments, brown and gray, dry to moist	10		15		
						13	123	q_u= 2050 psi
				12		15		
				7				*No Recovery
553.7	10.0		END OF BORING.					
			Water not observed while drilling.					
			Boring then backfilled.					

LOG OF BORING N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 12/2/16 16:14

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-10**

LOCATION: Latitude: 41.416882
Longitude: -91.051382

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
566.0	0.0						
565.2	0.8	PAV	PCC Pavement				
564.5	1.5	AGG	Aggregate Base				
		FILL	FILL: Sandy Lean Clay, trace Gravel, orange brown and gray, dry to moist	9		15	LL= 32, PL= 13, PI= 19 P200= 53% q_p= 1.5 tsf
562.0	4.0		AUGER REFUSAL at 4 feet. Water not observed while drilling. Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-11**

LOCATION: Latitude: 41.417127
Longitude: -91.050719

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
566.7	0.0					
566.4	0.3	PAV	Asphalt Pavement			
565.8	0.9	PAV	PCC Pavement			
		FILL	FILL: Lean Clay, trace Sand and Gravel, brown and gray, dry	8		
563.2	3.5					
		LS	Highly weathered LIMESTONE	50/3"		*No Recovery
				50/0"		*No Recovery
558.7	8.0					
			AUGER REFUSAL AT 8 FEET.			
			Water not observed while drilling.			
			Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-12**

LOCATION: Latitude: 41.419020
Longitude: -91.047665

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
557.4	0.0						
557.1	0.3	PAV	Asphalt Pavement				
556.6	0.8	PAV	PCC Pavement				
555.9	1.5	AGG	Aggregate Base				
		FILL	FILL: Lean Clay, trace Sand and Organics, dark gray and brown, dry to wet	9		19	
				5			Bulk sample from 3 to 8 feet.
552.4	5.0						
		CL	LEAN CLAY with SAND, trace Gravel, brown, moist, rather stiff (Glacial Till)				q_p= 1.5 tsf
				11			
547.4	10.0						
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
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Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-13**

LOCATION: Latitude: 41.419404
Longitude: -91.046906

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
556.0	0.0						
555.2	0.8	PAV	PCC Pavement				
554.5	1.5	AGG	Aggregate Base				
		FILL	FILL: Silty Gravel with Sand, trace Organics, brown and gray, dry	16		11	LL= N/A, PL= NP, PI= NP P200= 30%
				5			
550.0	6.0						q_p= 1.0 tsf
		CL	LEAN CLAY with SAND, trace Gravel, brown, moist, rather stiff (Glacial Till)				
				9			
546.0	10.0						
			END OF BORING. Water not observed while drilling. Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-14**

LOCATION: Latitude: 41.420102
Longitude: -91.045558

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
554.5	0.0						
553.7	0.8	PAV	PCC Pavement				
553.0	1.5	AGG	Aggregate Base				
		FILL	FILL: Lean Clay, trace Sand and wood fragments, dark gray, dry	11		14	
				7			
549.0	5.5						
		FILL	FILL: Lean Clay, trace Sand and Organics, brown and gray, moist				q_p= 3.0 tsf
				7			
544.5	10.0						
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-15**

LOCATION: Latitude: 41.420494
Longitude: -91.045047

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
554.9	0.0					
554.7	0.3	PAV	Asphalt Pavement			
553.8	1.1	PAV	PCC Pavement			
553.4	1.5	AGG	Aggregate Base			
		SP	POORLY GRADED SAND, fine- to medium-grained, brown, dry to moist, very loose to loose (Alluvium)	6		
				6		
				5		
				4		
544.9	10.0		END OF BORING.			
			Water not observed while drilling.			
			Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-16**

LOCATION: Latitude: 41.421196
Longitude: -91.043766

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
550.8	0.0						
550.7	0.1	PAV	Asphalt Pavement				
549.9	0.9	PAV	PCC Pavement				
549.4	1.4	AGG	Aggregate Base				
		FILL	FILL: Sandy Lean Clay with brick fragments, trace Gravel, brown, moist	9		17	
				5			
							q_p= 2.5 tsf
542.8	8.0						
			Boring terminated due to obstruction.				Bulk sample from 3 to 8 feet.
			Water not observed while drilling.				LL= 27, PL= 16, PI= 11
			Boring then backfilled.				P200= 50%

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-17**

LOCATION: Latitude: 41.421568
Longitude: -91.043043

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
552.9	0.0					
552.7	0.3	PAV	Asphalt Pavement			
552.2	0.8	PAV	PCC Pavement			
551.7	1.3	AGG	Aggregate Base	9		Bulk sample from 2 to 8 feet.
		FILL	FILL: Poorly Graded Sand with Silt and Clay pockets, orange brown, dry	5		
546.9	6.0					
		FILL	FILL: Lean Clay with Sand, trace Gravel, brown and gray, moist	6		q_p= 3.5 tsf
542.9	10.0					
			END OF BORING.			
			Water not observed while drilling.			
			Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-18**

LOCATION: Latitude: 41.422439
Longitude: -91.041369

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
551.3	0.0						
551.2	0.1	PAV	Asphalt Pavement				
550.6	0.7	PAV	PCC Pavement				
549.8	1.5	AGG	Aggregate Base				
		FILL	FILL: Sandy Silty Clay, trace Gravel, brown to dark brown, moist	6		17	LL= 24, PL= 17, PI= 7 P200= 63%
				6			
							q_p= 2.5 tsf
				9			
541.3	10.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-19**

LOCATION: Latitude: 41.422909
Longitude: -91.040800

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
552.5	0.0						
551.8	0.8	PAV	PCC Pavement				
551.0	1.5	AGG	Aggregate Base				
		FILL	FILL: Lean Clay, trace Sand, brown, moist	6		26	
548.5	4.0						q_p= 1.0 tsf
		SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist to wet, loose (Alluvium)	5			
				8			
542.5	10.0						
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-20**

LOCATION: Latitude: 41.423895
Longitude: -91.041223

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
557.0	0.0						
556.2	0.8	PAV	PCC Pavement				
555.5	1.5	AGG	Aggregate Base				
554.0	3.0	FILL	FILL: Silty Sand with Clay pockets, brown, dry	12			
552.0	5.0	FILL	FILL: Sandy Silt, trace Gravel, brown to dark brown, dry	8		16	LL= N/A, PL= NP, PI=NP P200= 50% Bulk sample from 3 to 8 feet. q_p= 2.0 tsf
549.0	8.0	FILL	FILL: Poorly Graded Sand with Silt, orange brown, moist				
547.0	10.0	FILL	FILL: Lean Clay with Sand, brown, moist	5			
			END OF BORING. Water not observed while drilling. Boring then backfilled.				

BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-21**

LOCATION: Latitude: 41.424161
Longitude: -91.040483

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
551.0	0.0						
550.8	0.2	PAV	Asphalt Pavement				
550.0	1.0	PAV	PCC Pavement				
549.5	1.5	AGG	Aggregate Base				
		FILL	FILL: Lean Clay, trace Sand and Gravel, brown and gray, moist	12		17	q_p= 1.5 tsf
				7			
				10			
541.0	10.0		END OF BORING.				
			Water not observed while drilling.				Bulk sample from 3 to 8 feet. LL= 34, PL=15, PI=19 P200= 87%
			Boring then backfilled.				

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BRAUN INTERTEC

LOG OF BORING

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-22**

LOCATION: Latitude: 41.425027
Longitude: -91.039175

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
548.7	0.0						
547.7	1.0	PAV	PCC Pavement				
547.2	1.5	AGG	Aggregate Base				
		FILL	FILL: Lean Clay with Sand, brown and gray, dry to wet	10		14	Bulk sample from 2 to 8 feet. q_p= 2.0 tsf
				14			
				2			
538.7	10.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

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Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: **RB-23**

LOCATION: Latitude: 41.425437
Longitude: -91.038434

DRILLER: R.Hunt/C.Gracey | METHOD: Power Auger | DATE: **10/27/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
548.9	0.0						
548.7	0.2	PAV	Aspahlt Pavement				
548.2	0.8	PAV	PCC Pavement				
547.4	1.5	AGG	Aggregate Base				
		FILL	FILL: Lean Clay, trace Sand, brown and gray, dry to wet	15		14	
				4			q_p= 1.0 tsf
				4			
538.9	10.0		END OF BORING.				
			Water not observed while drilling.				Bulk sample from 2 to 8 feet.
			Boring then backfilled.				LL=26, PL= 13, PI=13 P200= 65%

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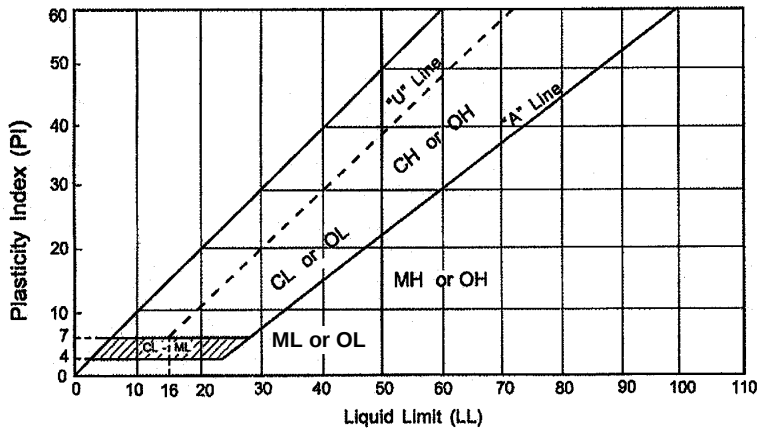
BRAUN INTERTEC

Descriptive Terminology of Soil

Standard D 2487
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils	Primarily organic matter, dark in color and organic odor			PT	Peat

a. Based on the material passing the 3-inch (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60}/D_{10}$ $C_c = \frac{(D30)^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines: to group name.
h. If soil contains ≥15% gravel, add "with gravel" to group name.
i. Sand with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" lines.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %
WD	Wet density, pcg	**S**	Percent of saturation, %
MC	Natural moisture content, %	**SG**	Specific gravity
LL	Liquid limit, %	**C**	Cohesion, psf
PL	Plastic limits, %	**Ø**	Angle of internal friction
PI	Plasticity index, %	**qu**	Unconfined compressive strength, psf
P200	% passing 200 sieve	**qp**	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders..... over 12"
Cobbles ..... 3" to 12"
Gravel
  Coarse ..... 3/4" to 3"
  Fine..... No. 4 to 3/4"
Sand
  Coarse ..... No. 4 to No. 10
  Medium..... No. 10 to No. 40
  Fine..... No. 40 to No. 200
Silt ..... <No. 200, PI< 4 or below "A" line
Clay ..... <No. 200, PI ≥ 4 and on or about "A" line

Relative Density of Cohesionless Soils

Very Loose..... 0 to 4 BPF
Loose..... 5 to 10 BPF
Medium dense ..... 11 to 30 PPF
Dense ..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils

Very soft..... 0 to 1 BPF
Soft..... 2 to 3 BPF
Rather soft ..... 4 to 5 BPF
Medium..... 6 to 8 BPF
Rather stiff ..... 9 to 12 BPF
Stiff ..... 13 to 16 BPF
Very stiff..... 17 to 30 BPF
Hard..... over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers, unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. All samples were taken with the standard 2" OD split-tube samples, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous flight, solid-stern augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface, and are therefore, somewhat approximate.

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn.

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments, and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight, and driving not required.

TW: TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.

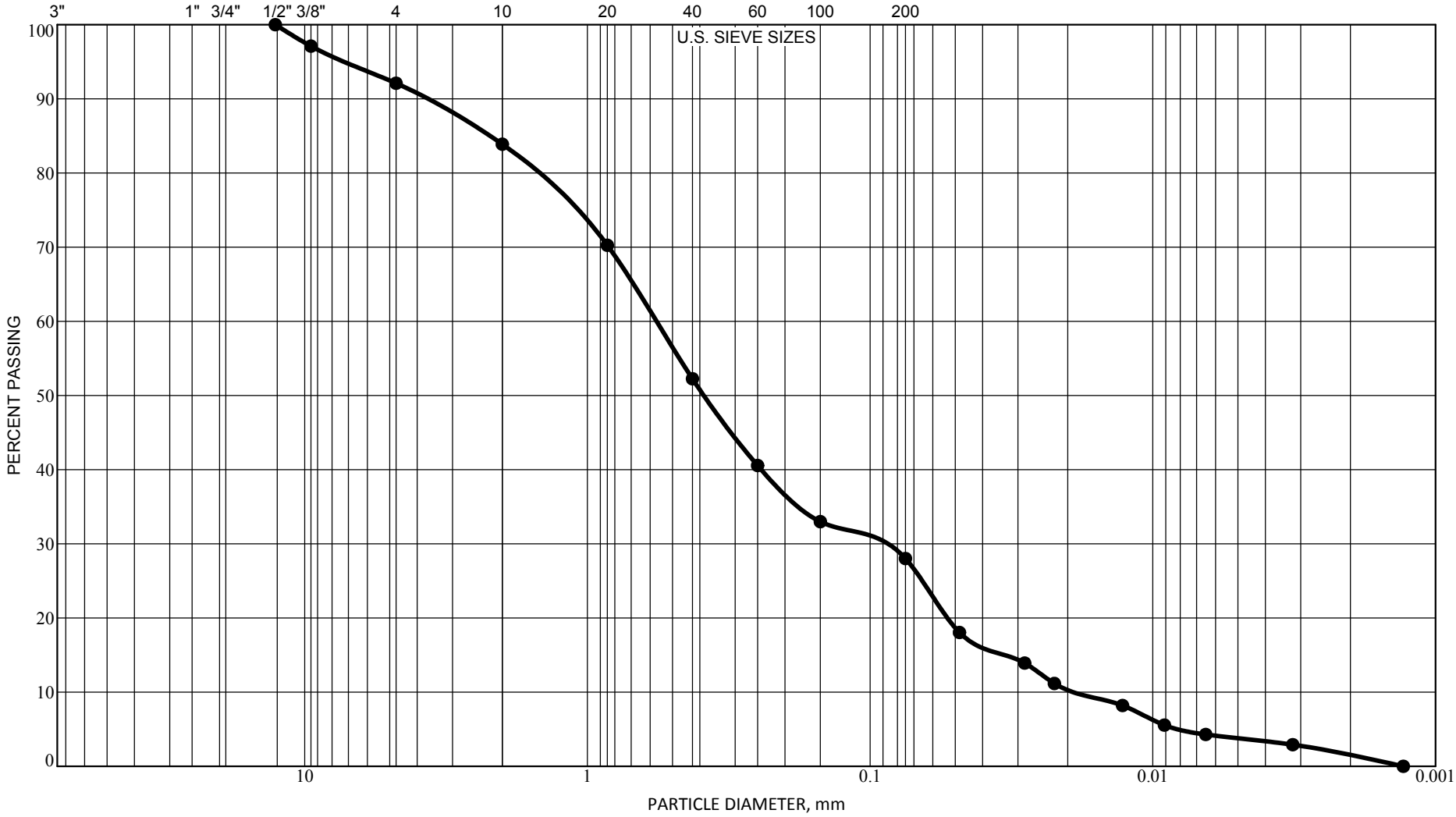
HDR Engineering, Inc.

8408 Indian Hills Drive
Omaha, NE 68114

Phone (402) 399-1000
Fax (402) 399-4979
www.hdrinc.com

GRAIN SIZE ACCUMULATION CURVE (AASHTO)

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY



BRAUN INTERTEC

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: RB-01 DEPTH: 1.5'-3.0'

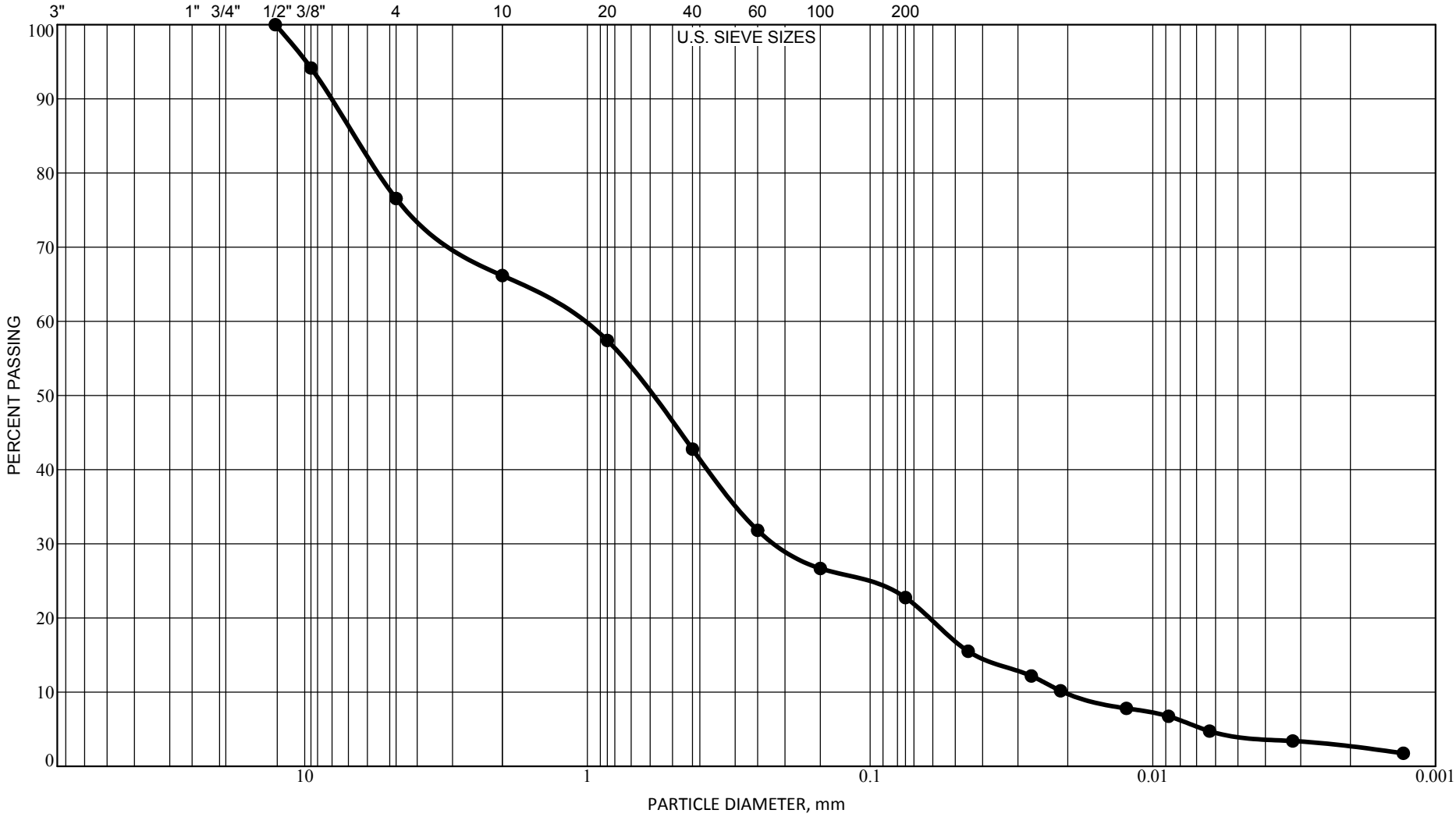
GRAVEL	16.1%
SAND	55.9%
SILT	26.6%
CLAY	1.4%

CLASSIFICATION:

GS AASHTO N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 11/17/16 14:34

GRAIN SIZE ACCUMULATION CURVE (AASHTO)

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY



BRAUN INTERTEC

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: RB-08 DEPTH: 1.5'-3.0'

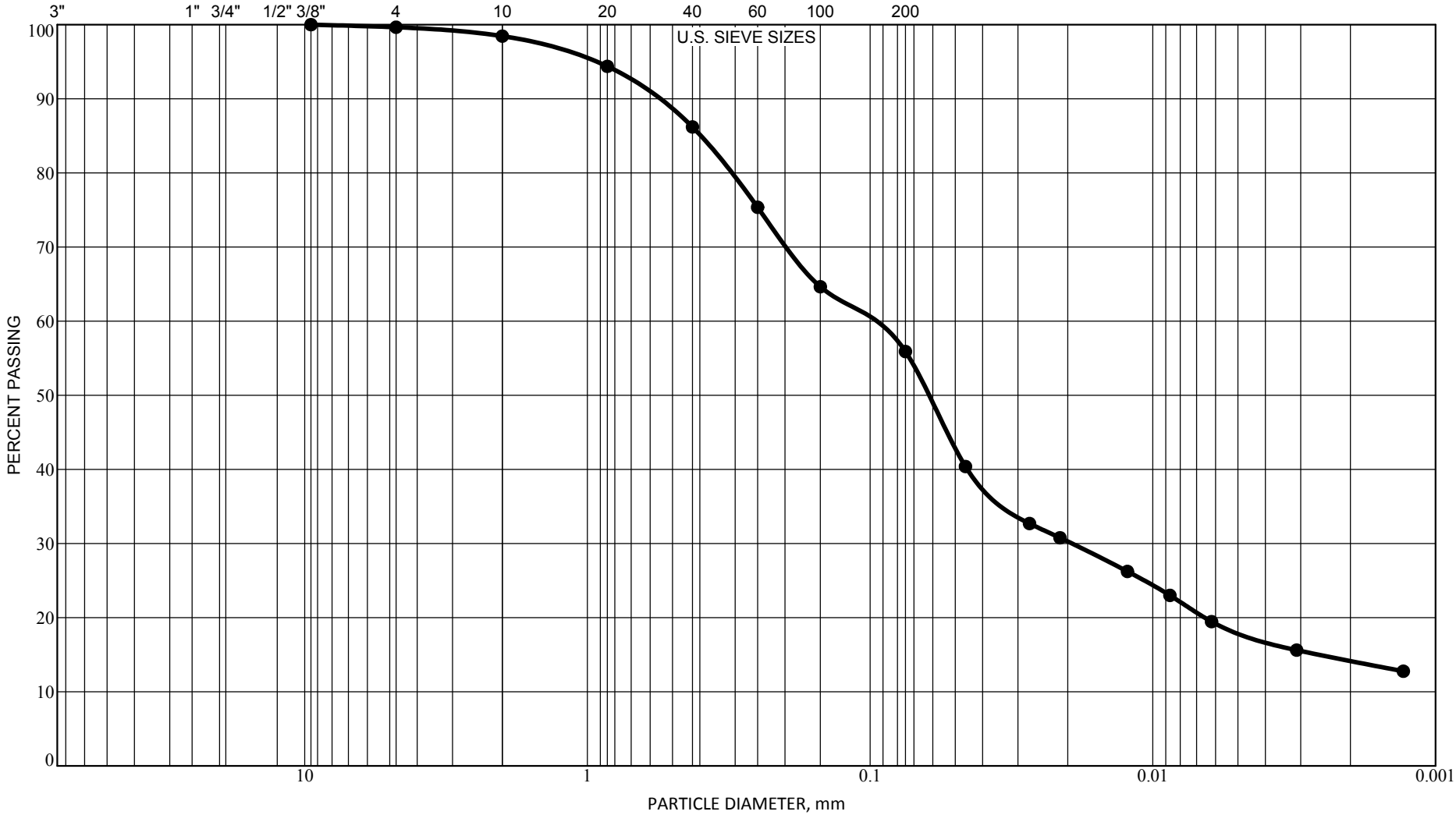
GRAVEL	33.8%
SAND	43.4%
SILT	20.2%
CLAY	2.5%

CLASSIFICATION:

GS AASHTO N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 11/17/16 14:34

GRAIN SIZE ACCUMULATION CURVE (AASHTO)

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY



BRAUN INTERTEC

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: RB-10 DEPTH: 1.5'-3.0'

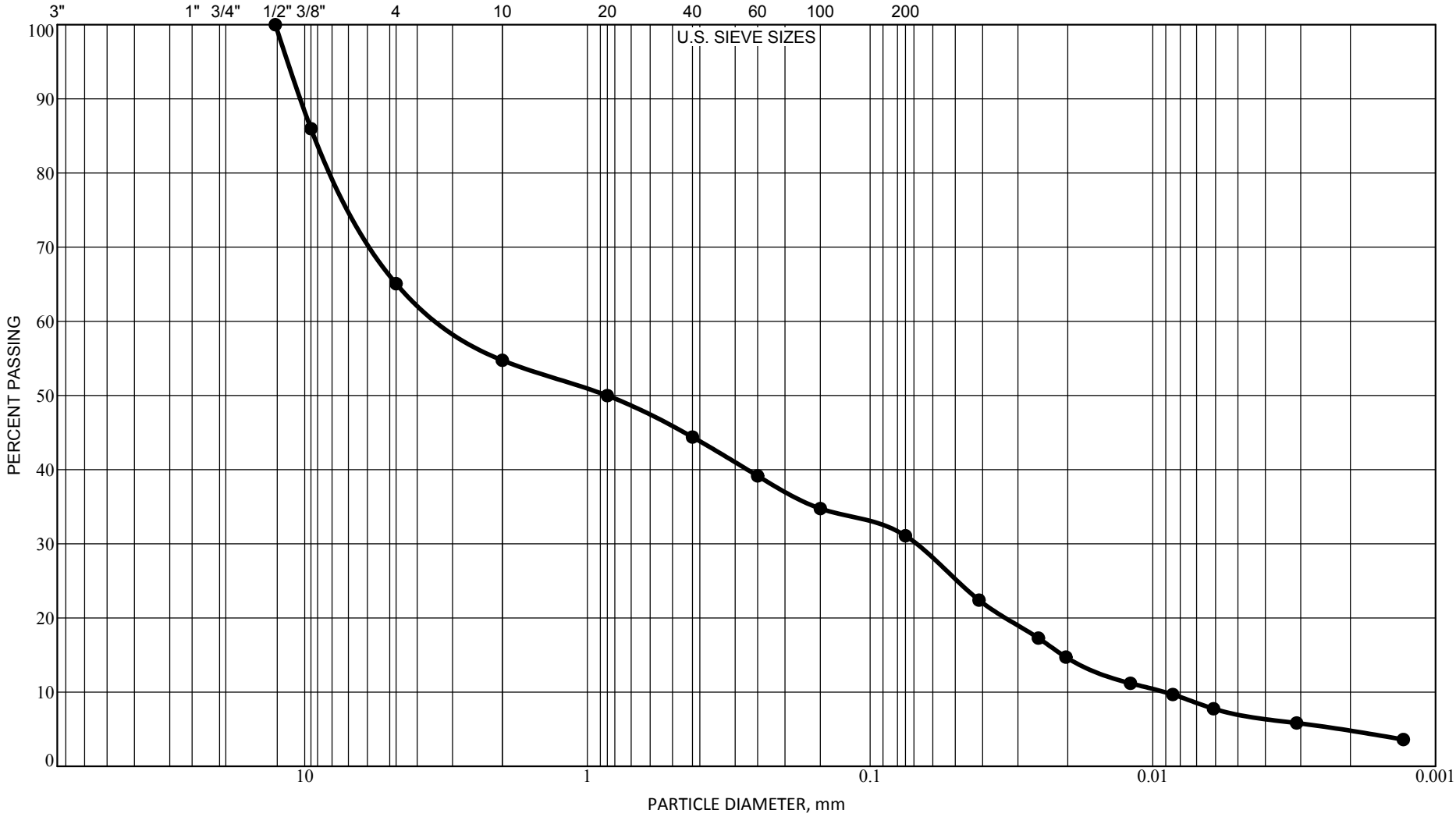
GRAVEL	1.5%
SAND	42.6%
SILT	41.7%
CLAY	14.2%

CLASSIFICATION:

GS AASHTO N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 11/17/16 14:34

GRAIN SIZE ACCUMULATION CURVE (AASHTO)

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY



BRAUN INTERTEC

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

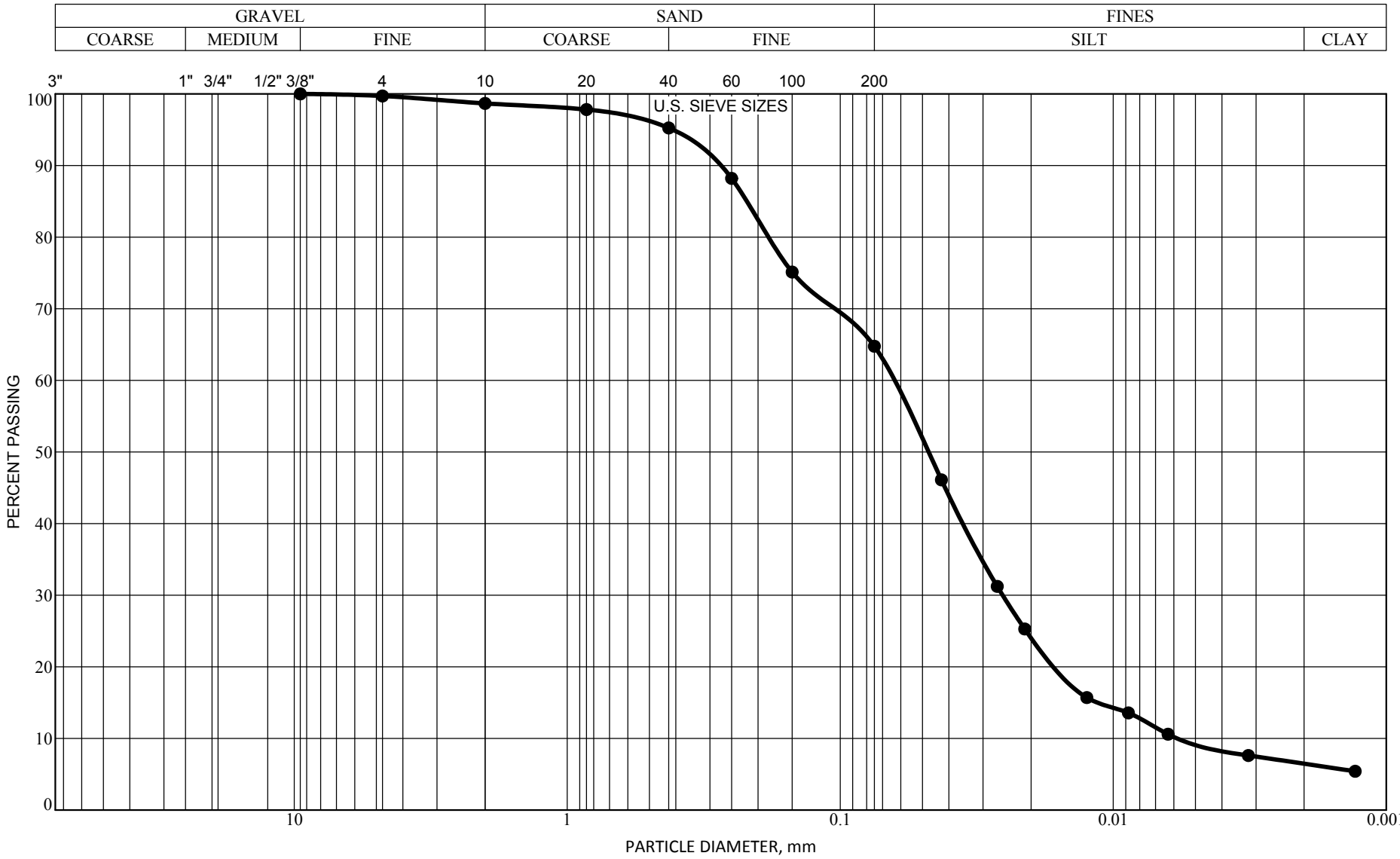
BORING: RB-13 DEPTH: 1.5'-3.0'

GRAVEL	45.3%
SAND	23.7%
SILT	26.4%
CLAY	4.7%

CLASSIFICATION:

GS AASHTO N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 11/17/16 14:34

GRAIN SIZE ACCUMULATION CURVE (AASHTO)



BRAUN INTERTEC

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

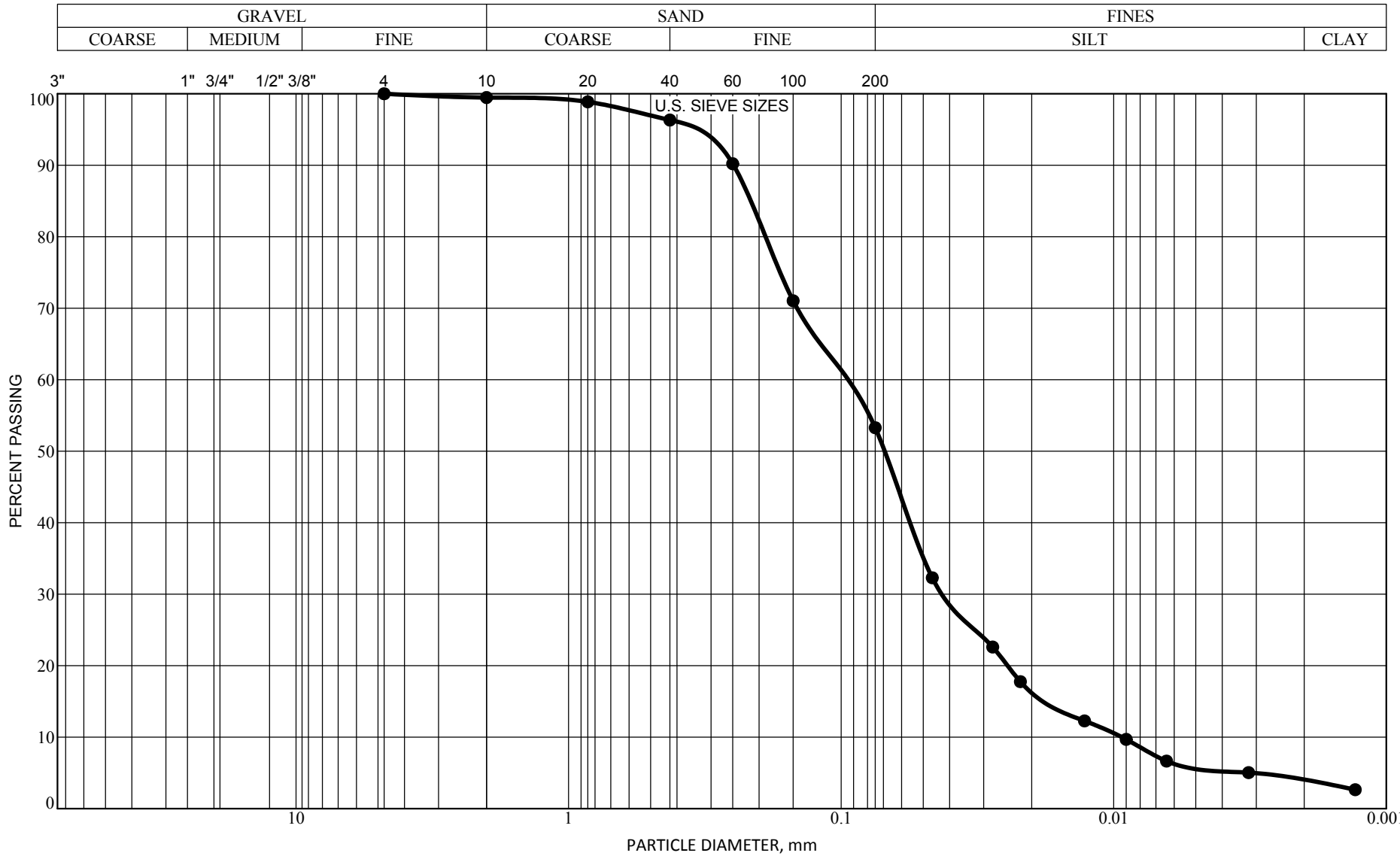
BORING: RB-18 DEPTH: 1.5'-3.0'

GRAVEL	1.3%
SAND	33.9%
SILT	58.3%
CLAY	6.5%

CLASSIFICATION:

GS AASHTO N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 11/17/16 14:34

GRAIN SIZE ACCUMULATION CURVE (AASHTO)



BRAUN INTERTEC

Braun Project B16-10125
Geotechnical Evaluation
Mississippi Drive Improvements
Muscatine, Iowa

BORING: RB-20 DEPTH: 3.5'-5.0'

GRAVEL	0.5%
SAND	46.2%
SILT	49.5%
CLAY	3.8%

CLASSIFICATION:

GS AASHTO N:\GINT\PROJECTS\CEDARRAPIDS\2016\B1610125.GPJ BRAUN_V8_CURRENT.GDT 11/17/16 14:34

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S1
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761
Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761
TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

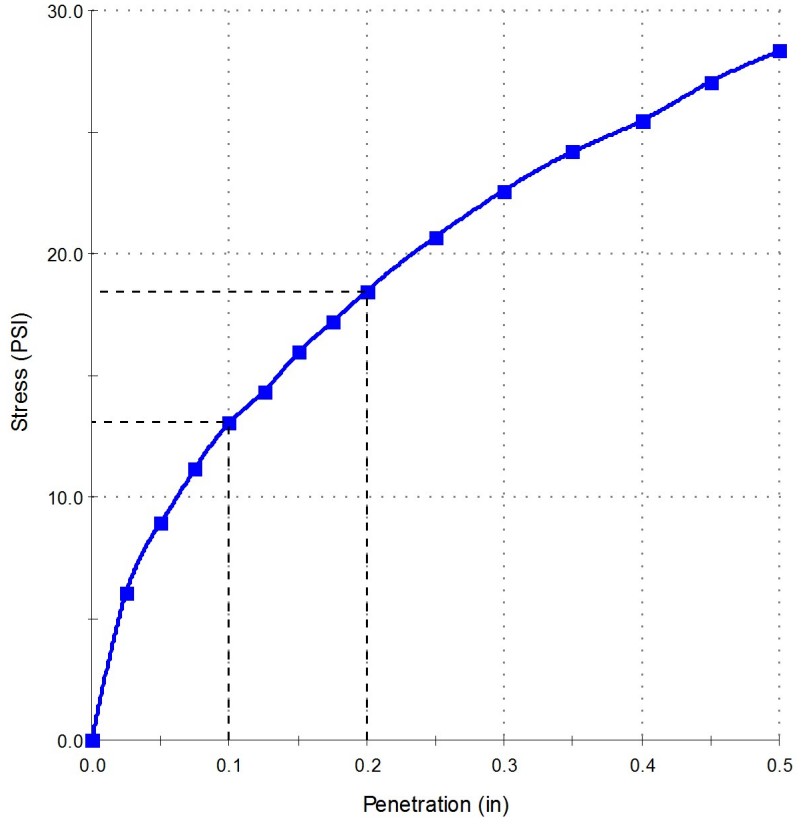
ISO/IEC 17025

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S1	Alternate Sample ID:	P-01
Sampled By:	Drill Crew	Date Sampled:	
Sampling Method:	Soil Boring	Source:	Onsite material
Material:	Sandy Lean Clay	Specification:	
Sample Location:	B-5, 3'-10'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	1.3
CBR At 0.2in (%):	1.2
Compactive Effort:	ASTM D 698
Number of Blows:	25
% of Maximum Dry Density:	94.6
Dry Density Before Soaking (lb/ft³):	111.9
MC Before Compaction (%):	16.9
MC After Compaction (%):	16.5
Moisture Content of Top 1in (%):	17.1
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	118.3
Optimum Moisture Content (%):	12.9
Sample Condition:	soaked
Swell (%):	0.1
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S2
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761
Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761
TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

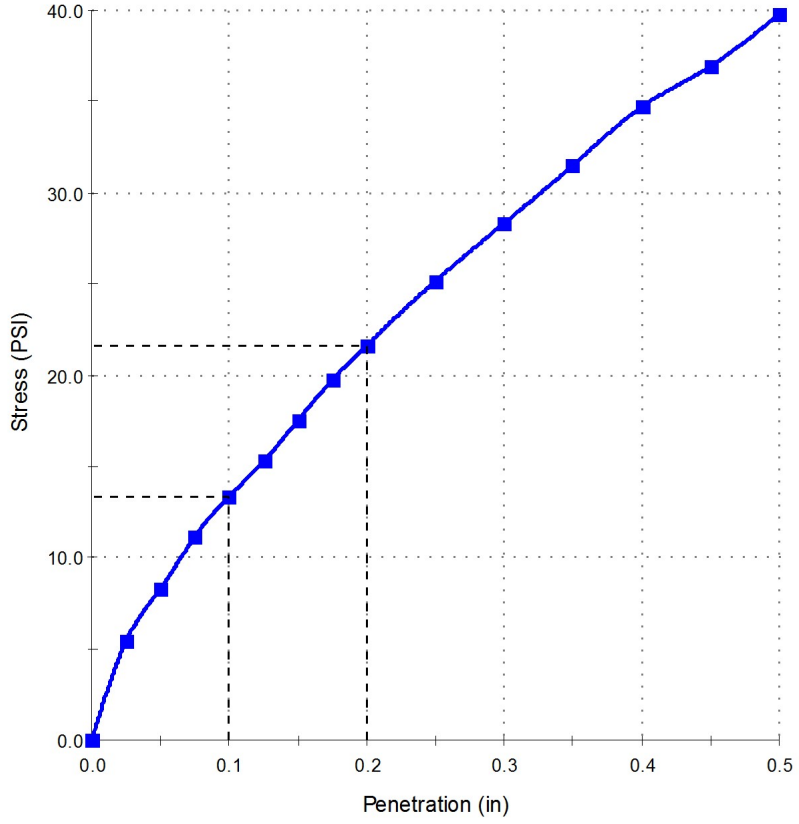
ISO/IEC 17025

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S2	Alternate Sample ID:	P-02
Sampled By:	Drill Crew	Date Sampled:	
Sampling Method:	Soil Boring	Source:	Onsite material
Material:	Clayey Sand	Specification:	
Sample Location:	B-16, 3'-8'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	1.3
CBR At 0.2in (%):	1.4
Compactive Effort:	ASTM D 698
Number of Blows:	22
% of Maximum Dry Density:	94.9
Dry Density Before Soaking (lb/ft³):	113.5
MC Before Compaction (%):	16.6
MC After Compaction (%):	16.0
Moisture Content of Top 1in (%):	16.3
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	119.6
Optimum Moisture Content (%):	12.8
Sample Condition:	soaked
Swell (%):	0.2
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S3
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761
Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761
TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

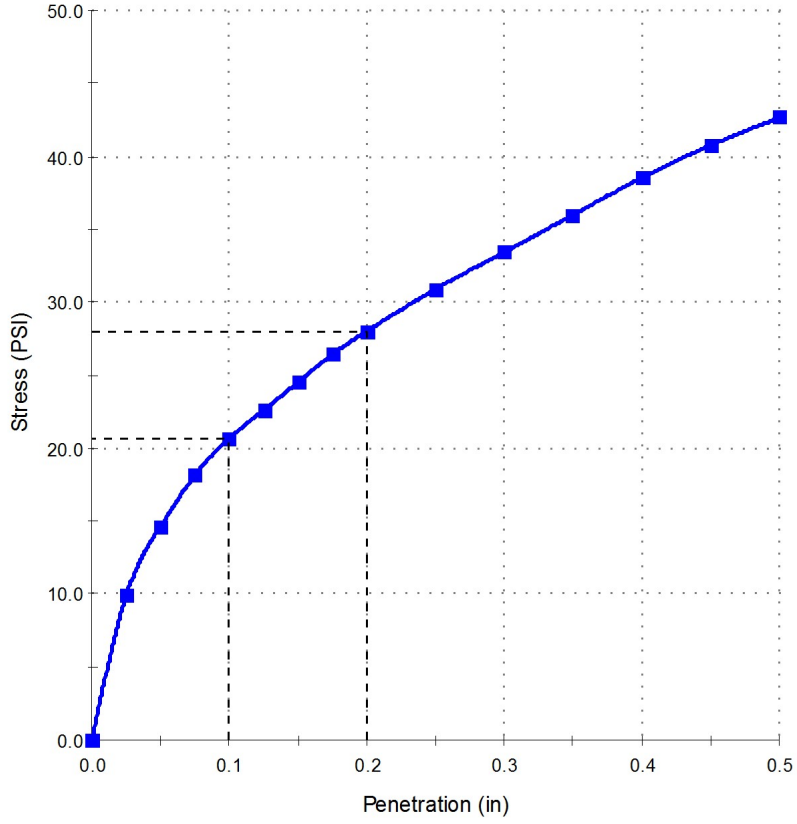
ISO/IEC 17025

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S3	Alternate Sample ID:	P-03
Sampled By:	Drill Crew	Date Sampled:	
Sampling Method:	Soil Boring	Source:	Onsite material
Material:	Lean Clay with Sand	Specification:	
Sample Location:	B-21, 3'-8'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	2.1
CBR At 0.2in (%):	1.9
Compactive Effort:	ASTM D 698
Number of Blows:	19
% of Maximum Dry Density:	95.0
Dry Density Before Soaking (lb/ft³):	105.5
MC Before Compaction (%):	19.1
MC After Compaction (%):	18.6
Moisture Content of Top 1in (%):	19.3
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	111.0
Optimum Moisture Content (%):	15.0
Sample Condition:	soaked
Swell (%):	0.1
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S4
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761
Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761
TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

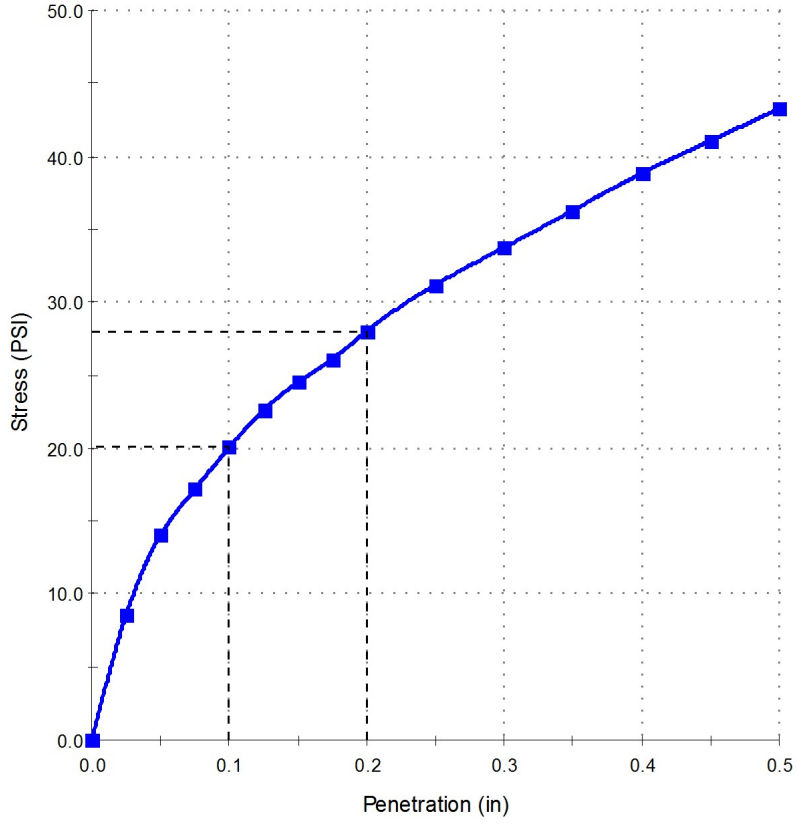
ISO/IEC 17025

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S4	Alternate Sample ID:	P-04
Sampled By:	Drill Crew	Date Sampled:	
Sampling Method:	Soil Boring	Source:	Onsite material
Material:	Sandy Lean Clay	Specification:	
Sample Location:	B-23, 2'-8'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	2.0
CBR At 0.2in (%):	1.9
Compactive Effort:	ASTM D 698
Number of Blows:	27
% of Maximum Dry Density:	94.8
Dry Density Before Soaking (lb/ft³):	114.3
MC Before Compaction (%):	15.6
MC After Compaction (%):	15.1
Moisture Content of Top 1in (%):	15.5
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	120.6
Optimum Moisture Content (%):	11.6
Sample Condition:	soaked
Swell (%):	0.0
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Geotechnical Engineering Report

Proposed Mississippi Drive Improvements

Muscatine, Iowa

February 14, 2011

Terracon Project No. 07105080

Prepared for:

Stanley Consultants, Inc.
Muscatine, Iowa

Prepared by:

Terracon Consultants, Inc.
Bettendorf, Iowa

TABLE OF CONTENTS

Terracon

February 14, 2011

Stanley Consultants, Inc.
225 Iowa Avenue
Muscatine, Iowa 52761

Attention: Mr. Michael R. Helms, P.E.

Re: Geotechnical Engineering Report
Proposed Mississippi River Drive Improvements
Muscatine, Iowa
Terracon Project No. 07105080

Dear Mr. Helms:

Terracon Consultants, Inc. has completed the subsurface exploration for the proposed Mississippi Drive Improvements planned in Muscatine, Iowa. These services were performed in general accordance with the Task Order of the Master Agreement for Geotechnical Services between Stanley Consultants, Inc. and Terracon Consultants, Inc. and Terracon's Proposal (Proposal No. P07100023r3) dated May 27, 2010. This report describes the subsurface conditions encountered at the boring locations, presents the test data, and provides geotechnical engineering recommendations regarding earthwork including fill materials, placement, and compaction; subgrade preparation, drainage and an estimated pavement support value (k) for rigid pavement design, and lateral earth pressures, allowable bearing pressures, and drainage for reinforced concrete cantilever retaining walls for the proposed project.

We appreciate the opportunity to be of service to you on this project, and we look forward to providing the recommended construction observation/testing services. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Vaughn Rupnow, P.E.
Iowa No. 19259

W. Ken Beck, P.E.
Iowa No. 10684

VER/WKB/N:/Projects/2010/07105080/07105080 Report.doc

Attachments

EXECUTIVE SUMMARY

Thirteen (13) borings extending to depths of approximately 10 to 10½ feet below existing grades were performed to evaluate subgrade soil conditions for design of the new pavement. Ten (10) retaining wall borings extending to depths of approximately 13 to 28 feet below existing grades were also performed for the project. Four (4) borings were previously conducted within the roadway in April, 2010 under Terracon Project No. 07105037 and were used in our analysis for this report. The purposes of this report are to describe the subsurface conditions encountered at the boring locations, present the test data, and provide geotechnical engineering recommendations regarding earthwork including fill materials, placement, and compaction; subgrade preparation, drainage and an estimated pavement support value (k) for rigid pavement design; lateral earth pressures, allowable bearing pressures, and drainage for reinforced concrete cantilever retaining walls for the proposed project.

Based on the information obtained from our subsurface exploration, the following geotechnical considerations were identified:

- Existing fill was encountered at the current and previous boring locations to depths ranging from about 2 to 12 feet below existing grades. Documentation regarding placement and compaction of the existing fill was not available for our review. It is our opinion that the existing fill should be removed and replaced with engineered fill for pavement and foundation support. Provided the City accepts the risk of larger than normal settlements, support of pavements and the retaining walls over a portion of the existing fill could be considered.

- Improvements to the in-place subgrade soils should be expected in some areas to support the construction equipment required to construct the pavements. Subgrade support can be improved by overexcavating and backfilling with a crushed limestone aggregate or by modifying the soil using Class "C" fly ash and/or lime.

- Limestone and weathered shale were encountered at variable depths along the reconstruction route. The upper weathered portion of the rock could likely be excavated with conventional equipment; however, if excavations into the less weathered portions of the rock are required, additional effort should be expected.

- This summary must be used in conjunction with the entire report since some recommendations were not included or fully discussed in this section. This report must be read in its entirety for a comprehensive understanding of our recommendations for this project. The section titled **GENERAL COMMENTS** must be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED MISSISSIPPI DRIVE IMPROVEMENTS
MUSCATINE, IOWA

Terracon Project No. 07105080
February 14, 2011

1.0 INTRODUCTION

Thirteen (13) borings extending to depths of approximately 10 to 10½ feet below existing grades were performed to evaluate subgrade soil conditions for design of the new pavement. Ten (10) retaining wall borings extending to depths of approximately 13 to 28 feet below existing grades were also performed for the project. Four (4) borings were previously conducted within the roadway in April, 2010 under Terracon Project No. 07105037 and are in Appendix D. The approximate boring locations are provided on the Boring Location Sketch (Exhibits A-1 and A-2) in Appendix A. Boring logs (Exhibits A-3 through A-25) are in Appendix A. The purposes of this report are to describe the subsurface conditions encountered at the boring locations, present the test data, and provide geotechnical engineering recommendations regarding:

- earthwork including fill materials, placement, and compaction
- pavement subgrade preparation
- lateral earth pressures for reinforced concrete retaining walls
- foundation support for cantilever retaining walls
- pavement subsurface drainage
- modulus of subgrade reaction value (k) for pavement design

2.0 PROJECT INFORMATION

The following information was provided by Stanley Consultants, Inc. (SCI). If any of the referenced information changes or does not accurately describe the proposed construction, Terracon should be contacted to review, and as necessary, revise the recommendations provided in this report.

ITEM	DESCRIPTION
Location	East 2nd Street from Lombard Street to Mulberry Avenue Mississippi Drive from Mulberry Avenue to Green Street/Hershey Avenue Green Street from Hershey Avenue/Mississippi Drive to Pearl Street
Existing Improvements	Existing paved city streets
Existing Topography	Elevations along the proposed reconstruction route range between approximately 545 and 580 feet where the retaining wall is planned. Mississippi Drive extends up to about 10 feet above the adjacent railroad tracks to the south. Relative steep slopes are present along a portion of the north side of Mississippi Drive.

ITEM	DESCRIPTION
Proposed Improvements	The referenced pavements will be reconstructed as a part of this project. In particular, Mississippi Drive will be reconstructed as a two-lane road with a center turn lane. The total length of pavement to be reconstructed is on the order of 4,500 linear feet. A retaining wall may be constructed between Mississippi Drive and the adjacent railroad tracks between about Linn and Ash Streets (approximately 1,900 linear feet). The maximum wall height will be about 10 feet. Where the projected wall height will be relatively small, the wall may be eliminated, and the ground surface will be sloped.
Grading	No appreciable change in the profile grade is expected.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Subsurface conditions at each boring location are described on the individual boring logs. The stratification boundaries shown on the boring logs represent the approximate depths where changes in material types occur. In-situ, the transitions between native materials are usually gradual. Based on the conditions observed at the boring locations, the stratigraphy can generally be described as follows. Please refer to the attached boring logs for further information.

Mississippi Drive (Borings 1 through 13)			
Description	**Approximate Depth to Bottom of Stratum[1]**	**Material Encountered**	**Consistency/ Density**
Surface	2 to 3½ inches 3 to 18 inches 3 to 12 inches	asphaltic cement concrete[2] portland cement concrete crushed limestone[3]	NA
Stratum1 (fill)[4]	3 to 10 feet	clayey sand and silty clay with varying amounts of sand	NA
Stratum 1 (alluvium)[5]	10 feet	silty clay, lean clay, fat clay with varying amounts of sand(CL/ML, CL, CH)	soft to stiff
Stratum2 (glacial deposit)[6]	10 feet	sandy lean clay (CL)	medium stiff to stiff

[2] Approximate thickness for surface materials
[2] Borings 1, 2, 6, 9, 10, 11, 12, and 13
[3] Borings 1, 2, 3, 4, 5, 7, 9, 12, and 13
[4] Extended to a termination depth of about 10 feet at Boring 8
[5] Extended to a termination depth of about 10 feet at Borings 1, 2, 3, 4, 5, 6, 10, 11, 12, and 13
[6] Extended to a termination depth of about 10 feet at Borings 7 and 9

Retaining Wall (Borings RW1 through RW10)			
Description	**Approximate Depth to Bottom of Stratum**	**Material Encountered**	**Consistency/ Density**
Stratum 1 (fill)	5 to 12 feet	sandy lean clay, sand with varying amounts of clay	NA
Stratum 2 (alluvium) [1]	10 to 26 feet	silty clay and lean clay with varying amounts of sand (CL/ML, CL)	very soft to stiff
		sand with gravel (SP)	NA
Stratum 3 (glacial deposit) [2]	28 feet	sandy lean clay (CL)	medium stiff to stiff
		fine to medium sand (SP)	loose
Stratum 4 (rock) [3]	12.9 to 26 feet	weathered clay shale	NA

[1] Borings RW1, RW2, RW3, RW5 through RW10; extended to respective termination depths of 15 to 26 feet at Borings RW1, RW2 and RW10
[2] Extended to a termination depth of 28 feet at Boring RW4.
[3] Borings RW3, RW5, RW6, RW7, RW8, and RW9. Extended to termination depths ranging from 13 to 26 feet.

3.2 Water Level Observations

The borings were observed during and after the completion of drilling for the presence and level of water. The subsurface water levels observed at these times are provided on the boring logs in Appendix A (Exhibits A-3 through A-25) and are summarized in the following table. The absence of water at a boring location does not necessarily mean that boring terminated above the subsurface water level. Longer term readings in cased holes or piezometers would be required to better define the subsurface water levels along the proposed project limits.

	Observed Depth To Water (ft) [1]	
Boring Number	**While Drilling**	**After Drilling**
3, 4, 5, 7, 8, 9, 10, 12, 13, RW6, RW8	none	NA [2]
1, 6	8	NA [2]
2	4	NA [2]
11	8½	NA [2]
RW1	12	8½
RW2	15½	15
RW3	18	15
RW4, RW7	13	NA [2]
RW5	11	5
RW9	9	NA [2]
RW10	14½	NA [2]

[1] Below existing grade
[2] Water levels were not recorded.

Water levels may fluctuate due to seasonal variations in the amount of rainfall, runoff, Mississippi River stage, and other factors not evident at the time the borings were performed. Subsurface water levels during construction or at other times in the future may be different from the levels indicated on the boring logs. Trapped or "perched" water could occur above lower permeability soil or rock layers. Water level fluctuations and perched water should be considered when developing design and construction plans and specifications for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Existing fill was encountered at all of the boring locations to depths ranging from about 3 to 12 feet. Documentation regarding placement and compaction of the existing fill was not available for our review. Although the fill has likely been in place for a long time, pavements and the proposed retaining walls supported over undocumented fills may not perform predictably. To reduce the potential for unpredictable performance and potential damage to the pavements and retaining wall, it is our opinion that the existing fill should be removed and replaced with engineered fill for pavement and foundation support. However, removal and replacement of the fill may not be practical for the project. Provided the City of Muscatine (City) accepts the risk of unpredictable performance and potential damage, leaving a portion of the existing fill in place beneath pavements and retaining wall foundations could be considered. In this case, the existing fill should be removed to a depth of at least 12 inches below final subgrade elevation, and the underlying soils should be scarified and recompacted. Grade should be established with engineered fill. Where the existing grade is below the final subgrade elevation, the existing fill should be scarified and recompacted to a depth of 12 inches prior to placing new engineered fill. Existing fill should be removed to a depth of about 1 footing width beneath retaining wall foundations and should be replaced with new engineered fill. For fill placement beneath footings, the excavations should be widened at least 8 inches beyond each footing edge for every foot of new fill placed below the design footing base elevation. If the City is not willing to accept the risks of constructing over existing fill, then the existing fill should be removed and replaced as previously discussed.

In lieu of overexcavation and replacement, a ground improvement system such as Geopiers® or Vibro Piers® could be considered to support the retaining wall foundations. Ground improvement systems are generally proprietary, with design and installation performed by a specialty contractor. Terracon can provide contact information for specialty design-build contractors if this option is considered. Due to the proprietary nature of these ground improvement procedures, we recommend that a performance specification be used.

The existing fill soils encountered at most of the boring locations at the proposed subgrade elevations consist of sandy lean clay, clayey sand, and silty clay that classify as CL, SC, and CL/ML in accordance with the Unified Soil Classification System. These soils classify as A-4

and A-6 and in accordance with the AASHTO Classification System and are considered poor subgrade materials due to their susceptibility to frost action. Frost action is particularly a concern in the presence of free moisture. However, due to the cost of treating these soils or removing and replacing them with select material as defined by the Iowa Department of Transportation (IDOT), these soil types are commonly used in eastern Iowa for pavement support with the knowledge that additional maintenance and/or a shorter pavement life are likely.

To improvement pavement performance with the use of select subgrade material, in our opinion, at least 12 inches of low plasticity select material should be placed and compacted below the top of the subgrade elevation. Cohesive select material should have a maximum of 45% silt, a minimum standard Proctor maximum dry density of 110 pcf, a plasticity index greater than 10, classify as A-4, A-6, or A-7-6, and be of glacial origin. Granular select material should have a maximum of 15% silt and clay, a minimum standard Proctor maximum dry density of 110 pcf, a maximum plasticity index of 3, and classify as A-1, A-2, or A-3. Off-site sources will be required to obtain these materials. Upon request, we are available to discuss the use of select material with you.

The recommendations presented in this report consider that the retaining walls will be cast-in-place reinforced concrete cantilever walls. The design information presented in this report for cantilever walls is not applicable to other retaining wall systems such as mechanically stabilized earth (MSE) or segmental retaining walls (SRW). Design of MSE/segmental retaining walls requires geotechnical parameters different than those presented in this report. Since MSE/segmental retaining walls are often procured on a design-build basis, and the design is manufacturer specific, the selection of design parameters is the responsibility of the designer. Upon request, Terracon is available to design or review the design of these walls.

Limestone was encountered at Borings 1 through 4 performed earlier this year (Terracon Project No. 07105037) at depths ranging from about 2 to 2 to 7½ feet. Weathered shale was encountered near depths ranging from 10 to 18½ feet at Borings RW3 and RW5 through RW9. Rock could be present at shallower depths in other unexplored areas along the reconstruction route. The upper weathered portion of the rock could likely be excavated with conventional equipment; however, excavations into rock could require heavy duty excavation equipment such as track-mounted excavators equipped with rock teeth or bulldozers equipped with ripping attachments where rock materials were penetrated with flight augers in the exploratory borings. Excavation of rock formations that cannot be penetrated with flight augers is usually much more difficult and often requires the use of pneumatic breakers or other rock excavation techniques. Excavation of rock in confined excavations is generally difficult, even above the level of auger refusal.

Our scope of services for this project did not include stability analyses of the existing and final slopes. A steep slope is located on the north side along portions of Mississippi Drive. Care

must be taken during and after construction to avoid disturbing the slope toe or increasing the water contents of the slope soils, which could result in a subsequent increase in hydrostatic pressure, loss of strength, and slope movement. Upon request, stability analyses can be provided for an additional fee.

4.2 Earthwork

Recommendations for site preparation, excavation, subgrade preparation and placement of engineered fill for the project are provided in the following sections.

4.2.1 Site Preparation

Organic materials, existing fill, existing pavements, and loose, soft, or otherwise unsuitable materials should be removed from proposed pavement/retaining wall areas where fill will be placed or pavements will be constructed. Based on the information obtained at the boring locations, removal depths on the order of 12 feet should be expected to remove most of the surface materials and existing fill, but greater depths may be required in areas not explored. Crushed limestone should be stockpiled for future use. Organic and other unsuitable soils removed during site preparation could be utilized areas of the project where engineered fill is not required.

After removing surface materials and existing fill as recommended, but before placing engineered fill, the exposed soils should be observed and tested by Terracon. Where recommended by Terracon, the subgrade soils should be scarified to a depth of about 9 inches and be compacted as recommended in this report. Scarification and compaction of subgrades will help provide a firmer base for the compaction of new fill sections and in delineating soft or disturbed materials that may exist at shallow depths below grade. If unsuitable materials are observed that cannot be satisfactorily compacted in place, they should be removed and replaced with engineered fill as discussed in the **Earthwork Construction Considerations** section (Section 4.2.4) of this report.

4.2.2 Engineered Fill Material Requirements

Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Cohesive	CL, CL/ML, ML, ML/CL (LL ≤ 45 and PI ≤ 20)	below/adjacent to retaining walls and pavements
Granular	GW, GP, GM, GC SW, SP, SM, SC	below/adjacent to retaining walls and pavements
Unsuitable	CL/CH, CH, MH, OL, OH, PT	non-structural locations

Fill Type [1]	USCS Classification	Acceptable Location for Placement
On-site fill and native soils[2, 3]	CL, CL/ML, SP, SC, CH	Low plasticity on-site native and existing fill soils (CL, CL/ML, SP, SC) and crushed limestone encountered at the boring locations may be suitable for use as engineered fill

[1] Engineered fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this site.

[2] Lean clay and silty clay native and fill soils encountered in the borings should meet the criteria for engineered fill. Any organic materials, rock fragments larger than 3 inches, and other unsuitable materials should be removed prior to use of the existing fill.

[3] The fat clay soil (CH) encountered below a depth of 8 feet at Boring 4 is not expected to meet the criteria for engineered fill. Further testing would be required to evaluate this material for use as engineered fill.

4.2.3 Fill Placement and Compaction Requirements

Item	Description
Fill lift thickness	9 inches or less in loose thickness; thinner lifts will be required when using hand equipment (e.g., jumping jack, vibratory plate compactor, etc.)
Compaction of granular material and cohesive soil [1, 2]	At least 95% of the material's standard Proctor maximum dry density (ASTM D 698). The compaction effort should be increased to 98% of the material's standard Proctor maximum dry density (ASTM D 698) for subgrade soils with 12 inches of the final pavement subgrade elevation and for fill placed beneath retaining wall foundations. The recommended compaction effort should extend laterally from the pavement edges at least 8 inches for every foot of fill placed beneath the final subgrade elevation.
Moisture content of cohesive soil	Within 2% below to 3% above the material's standard Proctor optimum moisture content at the time of placement and compaction.
Moisture content of granular material [3]	Workable moisture levels.

[1] We recommend that each lift of fill be tested by Terracon for moisture content and compaction prior to the placement of additional fill or concrete. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

[2] If granular material is coarse sand, gravel, or crushed limestone, is of a uniform size, or has low fines content, compaction comparison to relative density (ASTM D 4253/4254) may be more appropriate.

[3] The gradation of a granular material affects its stability and the moisture content required for proper compaction. Moisture levels should be maintained to achieve compaction without bulking during placement or pumping when proofrolled.

4.2.4 Earthwork Construction Considerations

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of engineered fill, backfilling of excavations, and just prior to construction of pavements.

The water contents of the on-site soils were generally above their optimum water contents as determined by the standard Proctor test method. For this reason, adjustments to the on-site soils' water contents should be expected to obtain the degree of compaction recommended in this report.

Improvements to the in-place subgrade soils should be expected in some areas to support the construction equipment required to construct the pavements, and the equipment needed to place and compact new engineered fill. Subgrade support can be improved by overexcavating and backfilling with a crushed limestone aggregate containing less than 6% passing the No. 200 sieve and/or by modifying the soil using Class "C" fly ash and/or lime. The required crushed limestone aggregate layer thickness will depend upon the time of year subgrade improvement is needed and the intended use of the subgrade after construction. A geosynthetic could also be used beneath the crushed limestone aggregate to assist in improving subgrade strength, but should only be placed after below grade construction is completed to avoid damaging the geosynthetic. Soil modification using Class "C" fly ash and/or lime can be procured using a "performance specification" and should only be performed by pre-qualified contractors having successful experience with similar-sized projects in the region.

Care should be taken to avoid disturbance of prepared subgrades. Although the exposed subgrade may be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. New fill compacted above optimum moisture content or that accumulates water during construction can also become disturbed under construction equipment. Construction traffic over the completed pavement subgrades should be avoided to the extent practical. If the subgrade becomes saturated, desiccated, or disturbed, the affected materials should either be scarified and compacted, modified or be removed and replaced. Subgrades should be observed and tested by Terracon prior to construction of pavements.

Although subsurface water was not observed at shallow depths at most boring locations, water could be present at shallow depths in other areas of the alignment during construction. Although dewatering is the responsibility of the contractor, it is expected any seepage entering shallow excavations in clay soils could likely be managed using sump pits and pumps. More extensive dewatering methods may be necessary depending on depths of excavations, soil types and seasonal/weather conditions.

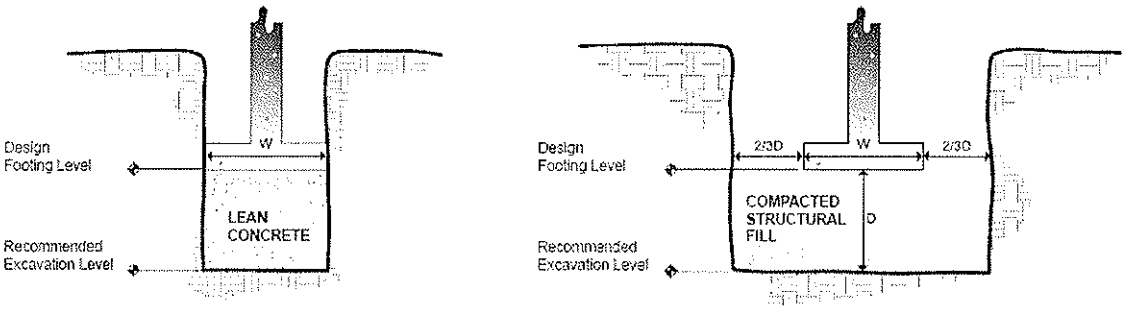
As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those specified by these safety regulations. Flatter slopes than those dictated by these regulations may be required depending upon the soil conditions encountered and other external factors. These regulations are strictly enforced and if they are not followed, contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties. Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

4.2.5 Grading and Drainage

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so saturation of subgrades is avoided. Surface water should not be permitted to accumulate on the site.

4.3 Retaining Wall Foundations

In our opinion, the proposed retaining walls can be supported using conventional spread footing foundations bearing on approved native soils and/or rock. However, the soils at expected bearing depths for retaining wall foundations may consist of existing fill and/or soft native soils. Provided the City accepts the risk previously discussed regarding constructing over the existing fill, consideration could be given to supporting the wall using conventional spread footing foundations bearing over a portion of the existing fill. It is our opinion that the existing fill and soft natural soils should be removed and replaced with engineered fill or lean concrete to a depth of at least 1 footing width below the design bearing depth. The footing excavations for both removal of the fill and unsuitable native soils should extend laterally at least 8 inches beyond the edges of the footing for each foot of overexcavation depth below the footing base elevation. The overexcavated depth should then be backfilled up to the foundation base elevation with lean concrete or crushed limestone placed in lifts and compacted to at least 98% of the material's standard Proctor maximum dry density or at least 60% of the material's maximum relative density (ASTM D 4253/4254). Each lift of new engineered fill should be observed and tested by Terracon. The overexcavation and backfill procedure is illustrated in the following figure.



Lean Concrete Backfill **Overexcavation / Backfill**

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.3.1 Foundation Design Recommendations

DESCRIPTION	VALUE
Maximum net allowable bearing pressure [1]	1,500 psf
Minimum embedment below finished grade for frost protection	4½ feet
Approximate total settlement[2]	NA
Minimum footing width	16 inches

[1] The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.

[2] Settlement of foundations supported over undocumented fill cannot be accurately predicted, but could be larger than normal. In particular, abrupt differential settlements can occur between foundations supported on native soils and those supported over the existing fill. Construction joints should be provided to help accommodate larger than normal total and differential settlement.

4.3.2 Foundation Construction Considerations

The soils at the base of each footing excavation should be observed and tested by Terracon. The excavation should be probed or otherwise sampled at regular intervals along continuous footings.

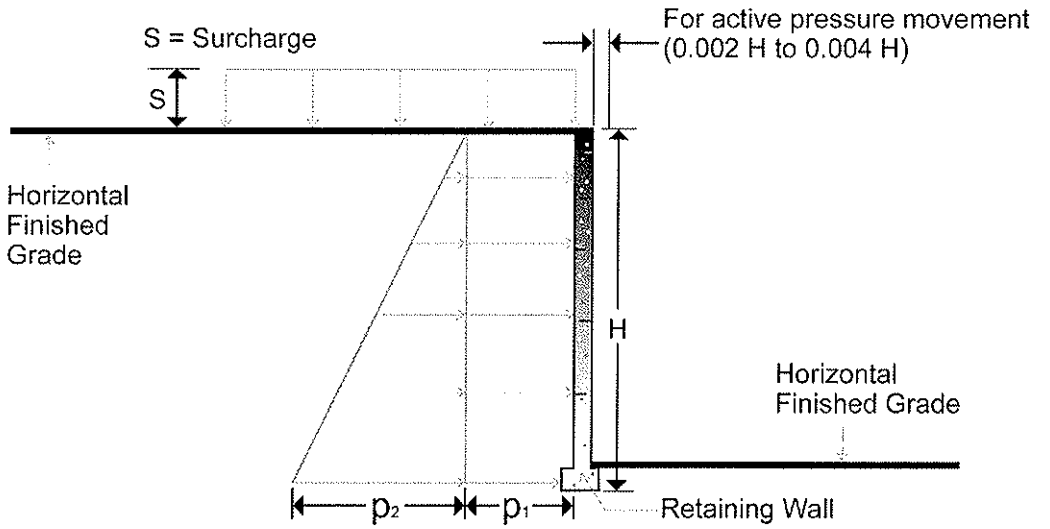
The base of foundation excavations should be free of water and loose soil prior to placement of concrete or reinforcing steel. The native soils encountered at the site are easily disturbed by construction activity and water seepage. Care should be taken during foundation construction to avoid disturbance of the bearing soils. Should bearing soils become disturbed, excessively dry, or saturated, the affected soil should be removed and replaced with engineered fill. A lean concrete or crushed limestone aggregate working mat could be needed to reduce disturbance of the native bearing soils. Only minimal foot traffic should be permitted on the bearing soils.

4.4 Lateral Earth Pressures for Concrete Cantilever Retaining Walls

The recommendations presented in this section of this report are for cast-in-place reinforced concrete cantilever walls, and are not applicable to other retaining wall systems, such as mechanically stabilized earth (MSE) or segmental retaining walls (SRW).

4.4.1 Retaining Wall Design Considerations

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained will influence earth pressures. "Active" earth pressure is commonly used for design of freestanding cantilever retaining walls and is based on some wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Lateral Earth Pressures

Pressure Conditions	Coefficient For Backfill Type	Equivalent Fluid Unit Weight (pcf)	Surcharge Pressure, P_1 (psf)	Earth Pressure, P_2 (psf)
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
	Cohesive - 0.42	50	(0.42)S	(50)H
Passive (Kp)	Granular – 3.0	360	---	---
	Cohesive – 2.4	290	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted between 95 and 100 percent of standard Proctor maximum dry density

- Loading from heavy compaction equipment not included
- No dynamic loading
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.30 should be used as the ultimate coefficient of friction between the bottom of footings and the underlying soil.

4.4.2 Subsurface Drainage

Subdrains should be constructed at the base of retaining walls to reduce hydrostatic loading. The drainpipe should be located with its invert at least 6 inches below the foundation bottom elevation and should be surrounded with free-draining granular material graded to prevent the intrusion of fines. A 2-foot wide layer of free-draining granular material should be placed adjacent to the wall. The granular material should extend from the drainage pipe to within 18 inches of final grade and be capped with a cohesive fill material placed and compacted as recommended in **Earthwork** section (Section 4.2) of this report. As an alternative to filter graded gravel, free-draining 3/4-inch nominal size gravel could be used for the drain if the entire system, including the gravel is encapsulated with an appropriate filter fabric. Pipes should be designed to discharge to a suitable outlet.

A prefabricated drainage structure placed against retaining walls may also be used as an alternative to free-draining granular fill above the pipe. A prefabricated drainage structure consists of a plastic drainage core or mesh that is covered with filter fabric to prevent soil intrusion. The drainage structure is fastened to the wall after the wall has been waterproofed.

As an alternative to installation of a subdrain, cantilever retaining walls can be designed to resist hydrostatic pressure. For the "active" condition, combined hydrostatic and lateral earth pressures should be calculated using equivalent fluid unit weights of 90 pcf and 85 pcf for lean clay and granular backfill soils, respectively.

4.5 Pavement Subgrades

The recommendations provided in this section of the report are based on the subsurface conditions observed at the boring locations and for subgrades prepared as discussed in this report.

4.5.1 Pavement Design Recommendations

The following estimated parameters can be used in designing rigid pavements supported on approved subgrades prepared as recommended in this report.

Pavement Type	Approximate Modulus of Subgrade Reaction (k) (pci)
Rigid	100[1]

[1] If a 6-inch thick granular base is placed beneath the pavement and compacted as recommended in this report, the modulus of subgrade reaction value could be increased to about 150 pci.

The soils encountered along the proposed alignment are considered frost susceptible. Although water was not encountered at depths within 4 feet of final grade at the boring locations, subsurface water fluctuations may occur and a perched water condition could develop. Even in the absence of shallow groundwater, drainable base and shoulder (edge) drains can substantially increase pavement life, especially if a granular base is used. We recommend that shoulder drains be installed in accordance with Iowa DOT requirements where a granular base is used. The drainable base should be constructed with at least 6 inches of clean, well-graded crushed limestone with less than 6% passing the No. 200 sieve. The drainable base should hydraulically connect to the shoulder drains to allow for proper drainage.

Pavements should be sloped to provide rapid drainage of surface water. Water should not be allowed to accumulate on or adjacent to the pavements, since this could saturate the subgrade and contribute to premature pavement deterioration. Periodic maintenance of the pavements will be required. Cracks should be sealed, and areas exhibiting distress should be repaired promptly to help prevent further deterioration. Even with periodic maintenance, some movement and related cracking may still occur and repairs may be required.

4.5.2 Pavement Construction Considerations

Subgrades can become disturbed by construction traffic after the completion of grading. Non-uniform subgrades often result in poor pavement performance and local failures relatively soon after pavements are constructed. Depending on the paving equipment used by the contractor, measures may be required to improve subgrade strength to greater depths for support of heavily loaded concrete trucks. Improvements should be made as recommended in the **Earthwork** section (Section 4.2) of this report.

Before paving, and where recommended by Terracon, pavement subgrades should be proofrolled in the presence of a Terracon representative. Proofrolling of the subgrade should help locate soft, yielding, or otherwise unsuitable soil at or just below the exposed subgrade level. Unsuitable areas observed at this time should be improved by scarification and compaction or be removed and replaced with engineered fill. Proofrolling of clay subgrade materials should be accomplished with a fully loaded, tandem-axle dump truck with a minimum gross weight of 25 tons or other equipment providing an equivalent subgrade loading. Where crushed limestone or other granular material is present at subgrade elevation, a vibratory smooth drum roller should be used to prepare the subgrade.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

Support of pavements and foundations above existing fill is discussed in this report. Even with the construction observation/testing recommended in this report, a risk remains for the owner that unsuitable materials within or buried by the fill will not be discovered. This may result in larger than normal settlement and damage to pavements and foundations supported above existing fill. This risk cannot be eliminated without removing the existing fill from below the foundations and pavements.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the sites, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

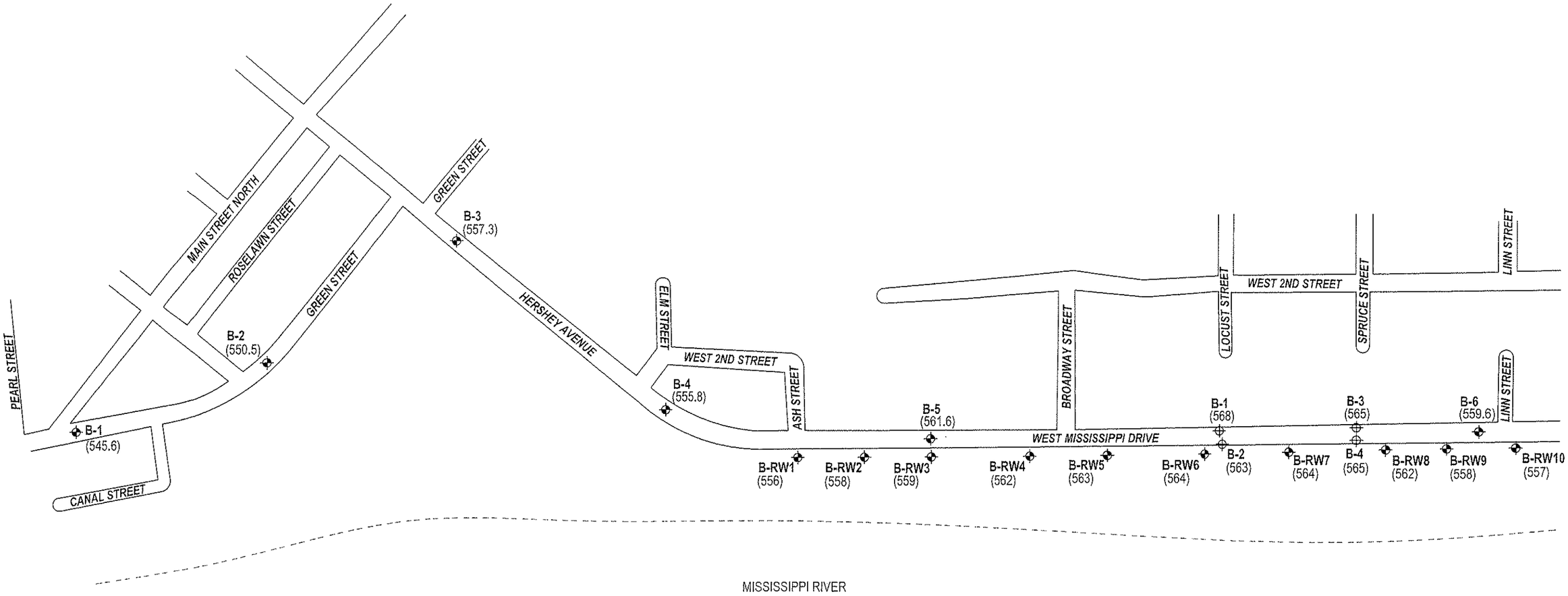
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

LICENSED PROFESSIONAL ENGINEER VAUGHN RUPNOW 19259 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Vaughn Rupnow, P.E. — Date: 2/14/2011 My license renewal date is December 31, 2012.

APPENDIX A

FIELD EXPLORATION



N

NOT TO SCALE

LEGEND

- APPROXIMATE BORING LOCATION
- APPROXIMATE BORING LOCATION (TERRACON PROJECT NO. 07105037)
- (X) APPROXIMATE SURFACE ELEVATION (FEET)

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr:	VER
Drawn By:	TLY
Checked By:	VER/MRF
Approved By:	VER
Project No.	07105080
Scale:	AS SHOWN
File No.	GEO07105080-1
Date:	JANUARY 2011

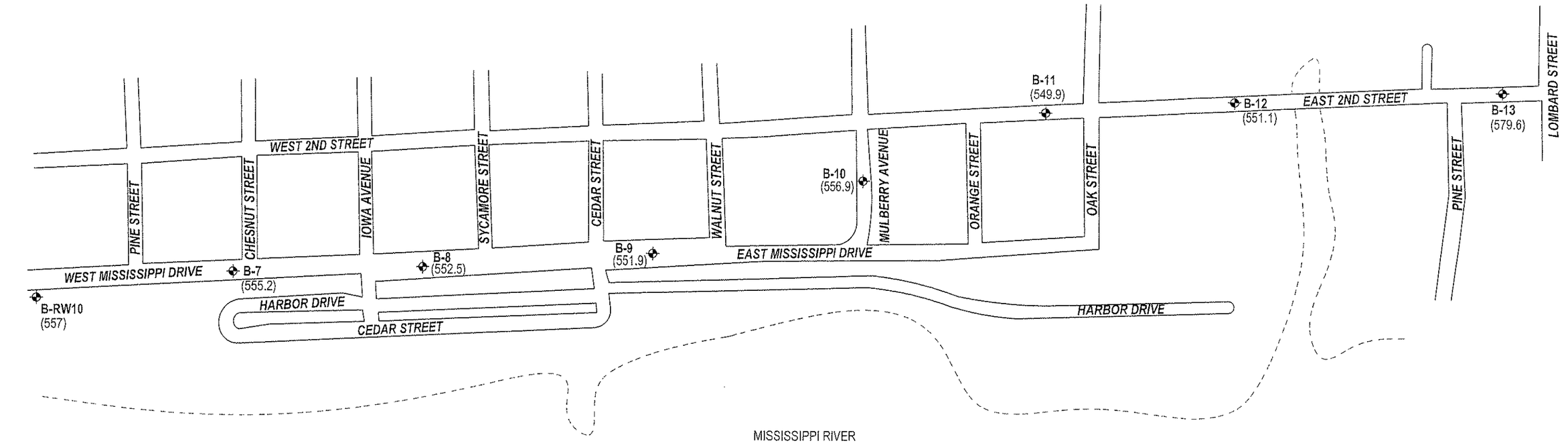
Terracon
Consulting Engineers and Scientists
870 49th Avenue, Bettendorf, Iowa 52722
(563) 355-6702 (563) 355-4765

BORING LOCATION PLAN

PROPOSED MISSISSIPPI DRIVE RECONSTRUCTION
MISSISSIPPI DRIVE
MUSCATINE, IOWA

EXHIBIT

A-1



LEGEND

NOT TO SCALE

- APPROXIMATE BORING LOCATION
- (X) APPROXIMATE SURFACE ELEVATION (FEET)

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr:	VER
Drawn By:	TLY
Checked By:	VER/MRF
Approved By:	VER
Project No.	07105080
Scale:	AS SHOWN
File No.	GEC07105C02-2
Date:	JANUARY 2011

Terracon
Consulting Engineers and Scientists
370 John Avenue Bettendorf, Iowa 52722
(563) 355-0702 (563) 355-4785

BORING LOCATION PLAN

PROPOSED MISSISSIPPI DRIVE RECONSTRUCTION
MISSISSIPPI DRIVE
MUSCATINE, IOWA

EXHIBIT

A-2

BORING NO. 1

CLIENT: **Stanley Consultants, Inc.**

ENGINEER: **Stanley Consultants, Inc.**

SITE: **Muscatine, Iowa**

PROJECT: **Proposed Mississippi Drive Reconstruction**

Boring Location: 524102.3N, 2309943.0E

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS
	Approx. Surface Elev.: 545.6 ft										
	Approx. 3" Asphaltic Cement Concrete				HS						
	Approx. 8" Portland Cement Concrete										
	Approx. 3" Crushed Limestone			1	SS	10	6	25			
	FILL, LEAN CLAY			2	SS	16	5	50			LL=32
	Gray-Brown										PI=15
	5 540.6	5			HS						
	SANDY LEAN CLAY (ALLUVIUM)		CL	3	SS	18	3	21			
	Gray-Brown				HS						
	Soft		CL	4	SS	16	3	20			
	▽										
	10 535.6	10									
	BOTTOM OF BORING										
	Sample 2 - 57% passing #200 sieve										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 8	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-3

BORING NO. 2

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 524663.6N, 2310200.2E

Approx. Surface Elev.: 550.5 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 3" Asphaltic Cement Concrete				HS					
	Approx. 8" Portland Cement Concrete			1	SS	8	5	39		
	Approx. 2" Crushed Limestone									
	3 547.5 **FILL, SANDY LEAN CLAY** Gray-Brown ▽		CL ML	2	SS	11		61	68	670
	SILTY CLAY (ALLUVIUM) Gray Soft	5			HS					
			CL ML	3	SS	16	4	43		
					HS					
			CL ML	4	ST	23		32	80	840
	10 540.5 BOTTOM OF BORING	10								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ. the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 4	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 3

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 525052.9N, 2310372.1E

DESCRIPTION

Approx. Surface Elev.: 557.3 ft

Approx. 8" Portland Cement Concrete

Approx. 4" Crushed Limestone

FILL, CLAYEY SAND

Gray-Brown

7 — 550.3

SANDY LEAN CLAY (ALLUVIUM)

Dark Gray-Brown

Medium Stiff

10 — 547.3

BOTTOM OF BORING

Sample 2 - 44% passing #200 sieve

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
			HS						
		1	SS	8	11	15			
		2	SS	10		13	110	1210	LL=33 PI=14
5			HS						
		3	SS	9	12	14			
			HS						
	CL	4	SS	11	6	21			
10									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer

**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 4

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 525077.7N, 2311075.8E

Approx. Surface Elev.: 555.8 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 12" Portland Cement Concrete				HS					
	Approx. 18" Crushed Limestone			1	SS	12	12	10		
	FILL, SANDY LEAN CLAY Gray				HS					
				2	SS	10	8	18		
		5			HS					
				3	SS	16	15	17		
	8 547.8				HS					
	SANDY FAT CLAY WITH SAND SEAMS (ALLUVIUM) Gray Medium Stiff			4	SS	14	7			
	10 545.8		CH					33		
	BOTTOM OF BORING	10								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-1-10		
BORING COMPLETED	12-1-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-6

BORING NO. 5

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 525420.6N, 2311621.6E

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 561.6 ft									
	Approx. 9" Portland Cement Concrete				HS					
	Approx. 15" Crushed Limestone			1	SS	10	15	10		
	FILL, SANDY LEAN CLAY				HS					
	Dark Brown			2	SS	8	7	19		
		5			HS					
				3	SS	10	18	16		
					HS					
	SANDY LEAN CLAY (ALLUVIUM)		CL	4	SS	12	5	15		
	Dark Brown									
	8 553.6									
	Medium Stiff	10								
	10 551.6									
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▽
WL	▽		▽
WL			

Terracon

BORING STARTED	12-1-10		
BORING COMPLETED	12-1-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-7

BORING NO. 6

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 526316.6N, 2312727.7E

DESCRIPTION

Approx. Surface Elev.: 559.6 ft

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
			HS						
		1	SS	6	3	23			
			HS						
5		2	ST	12		23	98	960	LL=34 PI=11
			HS						
	CL ML	3	ST	10		26	96	1430	
			HS						
10	CL ML	4	SS	12	5	24			

Approx. 2" Asphaltic Cement Concrete
Approx. 3" Portland Cement Concrete
FILL, LEAN CLAY WITH SAND
Gray-Brown

7 — 552.6

SILTY CLAY (ALLUVIUM) ▽
Gray-Brown
Medium Stiff

10.5 — 549.1

BOTTOM OF BORING

Sample 2 - 78% passing #200 sieve

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 8	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-1-10		
BORING COMPLETED	12-1-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-8

BORING NO. 7

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 526738.7N, 2313304.0E

Approx. Surface Elev.: 555.2 ft

DEPTH, ft.	GRAPHIC LOG	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
		Approx. 18" Portland Cement Concrete			HS						
		Approx. 12" Crushed Limestone		1	SS	14	20	19			
		FILL, CLAYEY SAND Dark Brown			HS						
5				2	SS	18	6	24			LL=28 PI=10
					HS						
				3	SS	18	12	19			
8		547.2									
		SANDY LEAN CLAY (GLACIAL TILL) Brown-Gray Medium Stiff to Stiff			HS						
10			CL	4	SS	18	8	19			
10.5		544.7									
		BOTTOM OF BORING									
		Sample 2 - 44% passing #200 sieve									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft

WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-1-10		
BORING COMPLETED	12-1-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 8

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 527153.7N, 2313816.9E

Approx. Surface Elev.: 552.5 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 9" Portland Cement Concrete				HS					
	FILL, SANDY LEAN CLAY Brown-Gray			1	ST	18		15	114	2840
				2	ST	13		13	112	2140
		5			HS					
				3	SS	15	5	18		
					HS					
				4	ST	10		15	111	*2500
	10 542.5	10								
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-10

BORING NO. 9

CLIENT: **Stanley Consultants, Inc.**

ENGINEER: **Stanley Consultants, Inc.**

SITE: **Muscatine, Iowa**

PROJECT: **Proposed Mississippi Drive Reconstruction**

Boring Location: 527627.4N, 2314406.4E

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 551.9 ft									
	Approx. 3½" Asphaltic Cement Concrete				HS					
	Approx. 7" Portland Cement Concrete			1	ST	8		18	98	1050
	FILL, SANDY LEAN CLAY Gray-Brown				HS					
				2	SS	12	4	20		
		5			HS					
				3	ST	13		19	104	1920
	8.5 543.4				HS					
	SANDY LEAN CLAY (GLACIAL DEPOSIT)		CL	4	SS	15	7	18		
	10 Brown-Gray 541.9	10								
	Medium Stiff									
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE_99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-11

BORING NO. 10

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 528110.3N, 2314678.5E

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
	Approx. Surface Elev.: 556.9 ft										
	Approx. 2" Asphaltic Cement Concrete Approx. 7" Portland Cement Concrete **FILL, CLAYEY SAND** Brown-Gray				HS						
				1	ST	14		19	96	1620	
					HS						
				2	SS	16	4	19			LL=22 PI=6
	5 551.9	5									
	SILTY CLAY WITH SAND (ALLUVIUM) Brown Medium Stiff		CL ML	3	ST	22		24	97	1130	
					HS						
			CL ML	4	ST	19		28	91	1140	
	10 546.9	10									
	BOTTOM OF BORING										
	Sample 2 - 41% passing #200 sieve										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 11

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 528564.5N, 2314980.4E

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 549.7 ft									
	Approx. 2" Asphaltic Cement Concrete				HS					
	Approx. 8" Portland Cement Concrete			1	ST	18		23	97	2460
	FILL, SILTY CLAY WITH SAND				HS					
	Gray			2	SS	15	4	26		
		5			HS					
				3	ST	21		26	99	1290
	8.5 ▽ 541.2				HS					
	SILTY CLAY (ALLUVIUM)		CL	4	SS	12	4	23		
	10 Gray-Brown 539.7	10	ML							
	Soft to Medium Stiff									
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 8.5	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-13

BORING NO. 12

CLIENT	ENGINEER
Stanley Consultants, Inc.	Stanley Consultants, Inc.
SITE	**PROJECT**
Muscatine, Iowa	Proposed Mississippi Drive Reconstruction

Boring Location: 529045.6N, 2315585.7E

Approx. Surface Elev.: 551.1 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
Approx. 2" Asphaltic Cement Concrete				HS						
Approx. 8" Portland Cement Concrete										
Approx. 2" Crushed Limestone			1	SS	11	4	15			
FILL, SANDY LEAN CLAY				HS						
Brown-Gray			2	SS	8	5	25			LL=36
5 546.1	5									PI=20
LEAN CLAY WITH SAND (ALLUVIUM)				HS						
Gray-Brown		CL	3	ST	23		25	96	1440	
Medium Stiff				HS						
Soft at Sample 4		CL	4	SS	15	3	25			
10 541.1	10									
BOTTOM OF BORING										
Sample 2 - 64% passing #200 sieve										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 13

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

Boring Location: 529488.8N, 2316198.7E

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 579.6 ft									
	Approx. 3" Asphaltic Cement Concrete				HS					
	Approx. 8" Portland Cement Concrete									
	Approx. 3" Crushed Limestone			1	SS	14	5	20		
	3 576.6 **FILL, SILTY CLAY** Brown-Gray		CL ML	2	ST	24		25	93	2820
	SILTY CLAY (ALLUVIUM) Gray-Brown Stiff Medium stiff at Sample 3	5			HS					
			CL ML	3	ST	20		25	92	1450
					HS					
	10 569.6		CL ML	4	SS	13	10	22		
	BOTTOM OF BORING	10								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	12-2-10		
BORING COMPLETED	12-2-10		
RIG	928	FOREMAN	MW
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. RW1

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 556 ft									
	FILL, SANDY LEAN CLAY Dark Brown and Brown				HS					
		5		1	SS	3	2	20		
					HS					
				2	SS	10	7	24		
					HS					
	9 ▼ 547									
	SILTY CLAY WITH SAND (ALLUVIUM) Dark Gray Very Soft to Medium Stiff	10	CL ML	3	ST	16		37	83	310
					HS					
			CL ML	4	SS	8	5	27		
					HS					
	14 ▽ 542	15	CL	5	SS	14	14	18		
	SANDY LEAN CLAY (ALLUVIUM) Gray-Brown Stiff				HS					
	Soft below about 19 feet	20	CL	6	SS	16	3	22		
					HS					
		25	CL	7	ST	14		25	95	960
	26 530									
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL ▽	12	WD ▼ 8.5	AB
WL ▼		▼	
WL			

Terracon

BORING STARTED	12-1-10		
BORING COMPLETED	12-1-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. RW2

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 558 ft									
	FILL, SANDY LEAN CLAY Dark Brown and Brown				HS					
				1	SS	4	9	17		
		5			HS					
				2	SS	5	4	25		
					HS					
				3	ST	7	5	21		
		10			HS					
	11.5 546.5		CL	4	ST	6	9	22		
	LEAN CLAY WITH SAND (ALLUVIUM) Gray-Brown Stiff				HS					
			CL	5	ST	10	9	20		
		15			HS					
	Medium stiff below about 16 feet		CL	6	SS	14	5	26		
			CL	7	ST	18		25	100	1370
	19.5 538.5									
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 15.5	WD	▼ 15	AB
WL	▽		▼	
WL				

Terracon

BORING STARTED	11-30-10		
BORING COMPLETED	11-30-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-17

BORING NO. RW3

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 559 ft									
	FILL, SANDY LEAN CLAY Dark Brown and Brown				HS					
				1	SS	8	4	22		
		5			HS					
				2	SS	18	4	23		
	9.5 549.5									
	SANDY LEAN CLAY (ALLUVIUM) Brown Stiff	10			HS					
				3	ST	16		19	108	2190
				4	HS ST	18		17	112	2220
		15			HS					
	17 542			5	ST	22		12	119	2400
	WEATHERED CLAY SHALE Gray-Brown				HS					
				6	SS	18	45	9		
		20			HS					
				7	SS	11	9	17		
	26 533	25		8	SS	16	42	14		
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 18	WD ▽ 15	AB
WL	▽	▽	
WL			

Terracon

BORING STARTED	11-30-10		
BORING COMPLETED	11-30-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-18

BORING NO. RW4

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 562 ft									
	FILL, SANDY LEAN CLAY Brown and Dark Brown				HS					
				1	SS	4	1	17		
		5			HS					
				2	SS	14	5	16		
	8.5 553.5				HS					
	SANDY LEAN CLAY (GLACIAL DEPOSIT) Brown-Gray Medium Stiff to Stiff	10	CL	3	ST	18		16	107	2010
	13 ▽ 549				HS					
	FINE TO MEDIUM SAND (GLACIAL DEPOSIT) Brown Loose		SP	4	SS	16	4	18		
					HS					
		15	SP	5	SS	18	5	16		
					HS					
			SP	6	SS	14	4	20		
		20			HS					
	SANDY LEAN CLAY (GLACIAL DEPOSIT) Gray-Brown Stiff		CL	7	SS	16	10	19		
		25			HS					
	28 534		CL	8	SS	12	11	28		
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 13	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-30-10		
BORING COMPLETED	11-30-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-19

BORING NO. RW5

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 563 ft									
	FILL, SANDY LEAN CLAY Dark Brown and Gray				HS					
				1	SS	12	5			
		5			HS					
				2	SS	14	2			
		10			HS					
	12 551									
	12.9 **WEATHERED CLAY SHALE** 550.1 Gray			3	SS	8	12 50/3"			
	BOTTOM OF BORING									
	Auger refusal at about 12.9 feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 11	WD	▼ 5	AB
WL	▼		▼	
WL				

Terracon

BORING STARTED	11-30-10		
BORING COMPLETED	11-30-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-20

BORING NO. RW6

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N → BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 564 ft									
	FILL, SANDY LEAN CLAY Brown and Dark Brown				HS					
		5		1	SS	10	9	11		
	559									
	SANDY LEAN CLAY (ALLUVIUM) Gray-Brown Stiff				HS					
		10	CL	2	SS	8	9	15		
	554									
	WEATHERED CLAY SHALE Gray				HS					
		15		3	SS	10	60	14		
	549									
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft

WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-30-10		
BORING COMPLETED	11-30-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. RW7

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 564 ft									
	FILL, SANDY LEAN CLAY Dark Brown				HS					
	6 — 558	5								
	SANDY LEAN CLAY (ALLUVIUM) Gray-Brown Stiff		CL	1	SS	6	9	26		
	9.5 — 554.5	10			HS					
	SAND WITH GRAVEL (ALLUVIUM) Brown Dense			2	SS	16	30	21		
	12 — 552				HS					
	WEATHERED CLAY SHALE ▽ Gray			3	SS	12	50/5"	18		
		15			HS					
	16.5 — 547.5			4	SS	10	50/5"	20		
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 13	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-29-10		
BORING COMPLETED	11-29-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. RW8

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 562 ft									
	FILL, SANDY LEAN CLAY Brown-Gray				HS					
	8 / 554	5		1	SS	3	5	16		
					HS					
	SANDY LEAN CLAY (ALLUVIUM) Gray-Brown Soft		CL	2	SS	10	3	22		
	11 / 551	10			HS					
	WEATHERED CLAY SHALE Gray			3	SS	8	14	25		
					HS					
				4	SS	14	48	15		
		15			HS					
	20 / 542			5	SS	13	110	13		
	BOTTOM OF BORING	20								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-29-10		
BORING COMPLETED	11-29-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

SOREHOLE_99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. RW9

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 558 ft									
	FILL, CLAYEY SAND, TRACE GRAVEL Brown				HS					
				1	SS	3	5	16		
		5			HS					
				2	SS	6	3	15		
	7.5 550.5				HS					
	SILTY CLAY (ALLUVIUM) Gray ▽ Medium Stiff		CL ML	3	ST	24		26	94	1270
		10			HS					
	Sandy and soft at Sample 4		CL ML	4	ST	14		24	103	810
					HS					
	Very soft at Sample 5		CL ML	5	SS	13	WOH	31		
		15			HS					
	18.5 539.5									
	WEATHERED CLAY SHALE Gray			6	SS	10	70	17		
	20 538	20								
	BOTTOM OF BORING									
	WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-29-10		
BORING COMPLETED	11-29-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit A-24

BORING NO. RW10

CLIENT: Stanley Consultants, Inc.

ENGINEER: Stanley Consultants, Inc.

SITE: Muscatine, Iowa

PROJECT: Proposed Mississippi Drive Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 557 ft									
	FILL, FINE TO MEDIUM SAND WITH CLAY Dark Brown and Brown				HS					
				1	SS	4	32	13		
					HS					
				2	SS	8	4	6		
	5 552	5								
	SILTY CLAY (ALLUVIUM) Gray Very Soft				HS					
			CL ML	3	SS	14	WOH	34		
	8.5 548.5				HS					
	SANDY LEAN CLAY (ALLUVIUM) Gray Stiff		CL	4	SS	10	10	20		
		10			HS					
	Medium stiff at Sample 5 ▽		CL	5	SS	4	6	18		
	15 542	15								
	BOTTOM OF BORING									
	WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 14.5	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-29-10		
BORING COMPLETED	11-29-10		
RIG	961	FOREMAN	JC
APPROVED	VER	JOB #	07105080

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Field Exploration Description

The approximate borings locations are shown on the Boring Location Plans (Exhibits A-1 and A-2) in this appendix (Appendix A). SCI provided surface elevations at Borings 1 through 13, and the surface elevations at Borings RW1 through RW 10 were estimated to the nearest foot from a topographic plan of the site provided by SCI. Actual surface elevations could differ due to interpolation, and other differences could occur from superposing approximate boring locations on the topographic plan. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were performed with both track (Geoprobe®) and truck-mounted rotary drill rigs equipped with hydraulic heads used for drilling and sampling operations. The borings were advanced using continuous-flight, hollow stem augers. Samples were obtained using both thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled seamless steel tube with a sharp cutting edge is hydraulically pushed into the ground to obtain samples of cohesive and moderately cohesive soils. In the split-barrel sampling procedure, a standard 2-inch (outside diameter) split-barrel sampling spoon is driven into the ground with a Central Mine Equipment (CME) 140-pound automatic standard penetration test (SPT) hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches (or less) of a normal 18-inch penetration is recorded as the standard penetration resistance value (N) and is used to help estimate the relative density of granular soils, the consistency of cohesive soils and to a lesser extent, the hardness of weathered rock. These "N" values are indicated on the boring logs at their depths of occurrence. The samples were transported to our laboratory for testing and classification.

The drill crew prepared a field log of each boring. The boring logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and testing of the samples.

APPENDIX B

LABORATORY TESTING

Laboratory Testing

The samples obtained from the borings were tested in our laboratory to determine their water contents. Dry densities were obtained and unconfined compression tests were performed on selected tube samples. A pocket penetrometer was used to help estimate the approximate unconfined compressive strength of some cohesive samples. The pocket penetrometer provides a better estimate of soil consistency than visual examination alone. Atterberg limits and the percent passing a No. 200 sieve tests were performed on selected samples from the roadway borings to better evaluate their engineering properties. The laboratory test results are presented on the boring logs in Appendix A.

The soil samples were classified in the laboratory based on visual observation, texture and plasticity. The soil descriptions and estimated group symbols presented on the boring logs are in general accordance with the Unified Soil Classification System (USCS) (Exhibit C-3) and the attached General Notes (Exhibit C-1). A summary of the USCS is also attached.

Rock sample classifications and descriptions are in accordance with the enclosed General Notes - Sedimentary Rock Classification (Exhibit C-2), and are based on tactile and visual observations of the disturbed samples. Core samples and petrographic analysis may reveal other rock types.

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0-1	Very Soft
500 – 1,000	2-4	Soft
1,001 – 2,000	4-8	Medium Stiff
2,001 – 4,000	8-15	Stiff
4,001 – 8,000	15-30	Very Stiff
8,000+	>30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
50+	99+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	>30

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz, ($Si0_2$), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

DEGREE OF WEATHERING:

SLIGHT	Slight decomposition of parent material on joints. May be color change.
MODERATE	Some decomposition and color change throughout.
HIGH	Rock highly decomposed, may be extremely broken.

Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

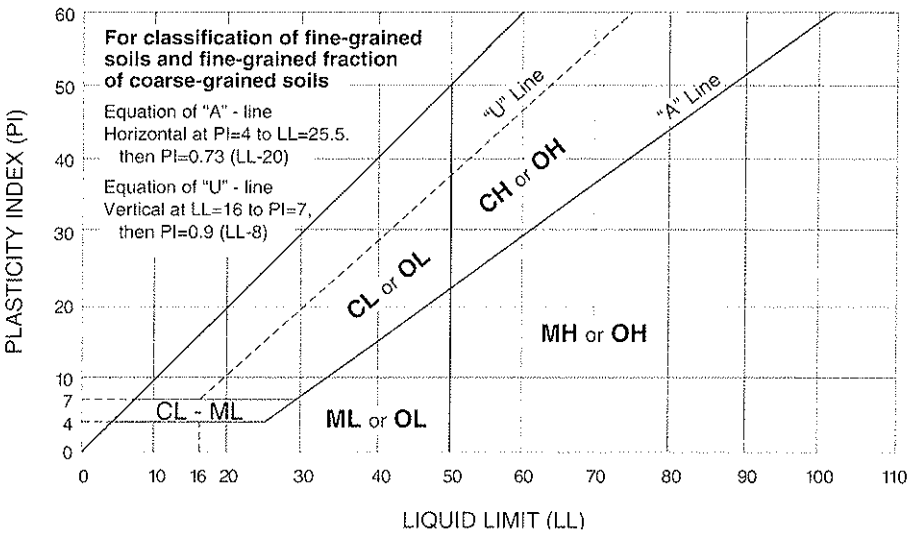
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



APPENDIX D

ADDITIONAL INFORMATION

BORING NO. 1

CLIENT: City of Muscatine

ENGINEER: Stanley Consultants, Inc.

SITE: Mississippi Drive, Muscatine, Iowa

PROJECT: Proposed Mississippi River Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 1" Asphaltic Cement Concrete Approx. 9" Portland Cement Concrete				PA					
	FILL, SANDY LEAN CLAY, TRACE LIMESTONE AGGREGATE Brown-Gray			1	SS	15	9	15		
					PA					
	4			2	SS	14	40/6" 50/2"	13		
	WEATHERED SANDSTONE*** Brown				PA					
	5	5		3	SS	0	50/2"			
	BOTTOM OF BORING									

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ None	WD	▼ None	AB
WL	▼		▼	
WL				

Terracon

BORING STARTED	4-27-10		
BORING COMPLETED	4-27-10		
RIG	35E	FOREMAN	RP
APPROVED	WKB	JOB #	07105037

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 2

CLIENT: City of Muscatine

ENGINEER: Stanley Consultants, Inc.

SITE: Mississippi Drive, Muscatine, Iowa

PROJECT: Proposed Mississippi River Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 1" Asphaltic Cement Concrete Approx. 9" Portland Cement Concrete				PA					
	FILL, SANDY LEAN CLAY, TRACE LIMESTONE AGGREGATE Brown-Gray			1	SS	10	9	13		
					PA					
				2	SS	10	10	12		
		5			PA					
				3	SS	10	4	16		
					PA					
	7.5 ▽									
	WEATHERED SANDSTONE*** Brown ▼									
	8.5			4	SS	0	50/0"			
	BOTTOM OF BORING									

***Classification of rock materials has been estimated by the drill crew from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 7	WD	▼ 8	AB
WL	▽		▼	
WL				

Terracon

BORING STARTED	4-27-10		
BORING COMPLETED	4-27-10		
RIG	35E	FOREMAN	RP
APPROVED	WKB	JOB #	07105037

SOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit D-2

BORING NO. 3

CLIENT: City of Muscatine

ENGINEER: Stanley Consultants, Inc.

SITE: Mississippi Drive, Muscatine, Iowa

PROJECT: Proposed Mississippi River Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 1" Asphaltic Cement Concrete Approx. 9" Portland Cement Concrete				PA					
	FILL, SANDY LEAN CLAY ▼ Brown-Gray			1	SS	13	12/6" 50/4"	13		
	2 ▽				PA					
	WEATHERED SANDSTONE*** Gray			2	SS	3	50/3"			
					PA					
		5		3	SS	4	40/4"	14		
	Light brown at Sample 3				PA					
	8.5			4	SS	2	50/2"	14		
	BOTTOM OF BORING									

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL ▽ 2	WD ▼ 1	AB	
WL ▼	▼		
WL			

Terracon

BORING STARTED	4-27-10		
BORING COMPLETED	4-27-10		
RIG	35E	FOREMAN	RP
APPROVED	WKB	JOB #	07105037

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

BORING NO. 4

CLIENT: City of Muscatine

ENGINEER: Stanley Consultants, Inc.

SITE: Mississippi Drive, Muscatine, Iowa

PROJECT: Proposed Mississippi River Reconstruction

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. 1" Asphaltic Cement Concrete Approx. 9" Portland Cement Concrete				PA					
	FILL, SANDY LEAN CLAY, TRACE LIMESTONE AGGREGATE AND SHELLS Brown-Gray			1	SS	14	8	15		
	3 ▽				PA					
	WEATHERED SANDSTONE*** Gray			2	SS	3	50/3"			
		5			PA					
				3	SS PA	2	50/2"	19		
	8.5									
	BOTTOM OF BORING			4	SS	0	50/1"			

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 3	3	▼ None	AB
WL	▼		▼	
WL				

Terracon

BORING STARTED	4-27-10		
BORING COMPLETED	4-27-10		
RIG	35E	FOREMAN	RP
APPROVED	WKB	JOB #	07105037

BOREHOLE 99 BORING LOGS.GPJ TERRACON.GDT 1/14/11

Exhibit D-4

HDR Engineering, Inc.

8408 Indian Hills Drive
Omaha, NE 68114

Phone (402) 399-1000
Fax (402) 399-4979
www.hdrinc.com

Project: Muscatine - Miss. St.	Computed: BTH	Date: 11/18/16
Subject: Pavement Design	Checked: BJK	Date: 12/12/16
Task:	Page: 1	of: 16
Job #: 10025173	No:	

Design Pavement Section

- Per Kevin and Joe, PCC pavement is preferred
- 30% plans from B-M ⇒ PCC pavement (8" assumed thickness) over modified subbase

- Existing pavement is PCC with an ACC overlay at some locations and aggregate subbase at some locations
- PCC varies from 3"-18" thick, with typical thickness of 7"-12"
- Agg. subbase varies from 2"-18" thick, with typical thickness of 5"-8"

- Use SUDAS (2016) Design Manual, Section 5F
- SUDAS uses the AASHTO Guide for the Design of Pavement Structures

- P_i (Initial Serviceability) = 4.5 per AASHTO for rigid pavement ✓
- P_t (Terminal Serviceability) = 2.5 per SUDAS for major collectors and arterials

- Analysis period = 50 yrs per SUDAS ✓
- AADT for base year (2014) = 9200 based on Iowa DOT Traffic Data (online)
- For proposed 2-lane sections, AADT = 4600 per lane
- Assume 7% trucks per Joe/Kevin
- Use 1% growth rate per B-M report
- From Table 5F-1.07, ESAL = 138,000 for 7% trucks and AADT = 9200 (see attached)
- From Table 5F-1.11, Growth Factor = 64.5 for 50 yrs and 1% annual growth (See attached) ✓

- $ESAL_{(50yrs)} = (138{,}000)(64.5) = 8.9 \times 10^6$

- Reliability = 95% for arterial streets per SUDAS

- Overall Standard Dev. = 0.35 for PCC per AASHTO for rigid pavement ✓

Table 5F-1.07: Base Year Design ESALs for Two Lane *Rigid Pavement*

For AADT=9200, interpolate to get ESAL= 138,000 ✓

% Trucks	Two Way, Base Year AADT							
	1,000	*2,000*	*3,000*	*4,000*	*5,000*	*10,000*	*15,000*	*20,000*
1	1,000	3,000	4,000	9,000	11,000	21,000	32,000	43,000
2	3,000	6,000	8,000	17,000	21,000	43,000	64,000	86,000
3	4,000	8,000	13,000	26,000	32,000	64,000	96,000	129,000
4	9,000	17,000	26,000	34,000	43,000	86,000	129,000	171,000
5	11,000	21,000	32,000	43,000	54,000	107,000	161,000	214,000
6	13,000	26,000	39,000	51,000	64,000	129,000	193,000	257,000
7	15,000	30,000	45,000	60,000	75,000	150,000	225,000	300,000
8	17,000	34,000	51,000	69,000	86,000	171,000	257,000	343,000
9	19,000	39,000	58,000	77,000	96,000	193,000	289,000	386,000
10	21,000	43,000	64,000	86,000	107,000	214,000	322,000	429,000
12	26,000	51,000	77,000	103,000	129,000	257,000	386,000	514,000
14	30,000	60,000	90,000	120,000	150,000	300,000	450,000	600,000
16	34,000	69,000	103,000	137,000	171,000	343,000	514,000	686,000
18	39,000	77,000	116,000	154,000	193,000	386,000	579,000	772,000
20	43,000	86,000	129,000	171,000	214,000	429,000	643,000	857,000
22	47,000	94,000	141,000	189,000	236,000	472,000	707,000	943,000
24	51,000	103,000	154,000	206,000	257,000	514,000	772,000	1,029,000
26	56,000	111,000	167,000	223,000	279,000	557,000	836,000	1,115,000
28	60,000	120,000	180,000	240,000	300,000	600,000	900,000	1,200,000
30	64,000	129,000	193,000	257,000	322,000	643,000	965,000	1,286,000

Assume two lane roadway with 50/50 directional split of base year AADT
Values within "box" assume a low volume mix of trucks

Table 5F-1.08: Base Year Design ESALs for Two Lane *Flexible Pavement*

% Trucks	Two Way, Base Year AADT							
	1,000	*2,000*	*3,000*	*4,000*	*5,000*	*10,000*	*15,000*	*20,000*
1	1,000	2,000	4,000	7,000	8,000	17,000	25,000	33,000
2	2,000	5,000	7,000	13,000	17,000	33,000	50,000	66,000
3	4,000	7,000	11,000	20,000	25,000	50,000	75,000	99,000
4	7,000	13,000	20,000	27,000	33,000	66,000	99,000	133,000
5	8,000	17,000	25,000	33,000	41,000	83,000	124,000	166,000
6	10,000	20,000	30,000	40,000	50,000	99,000	149,000	199,000
7	12,000	23,000	35,000	46,000	58,000	116,000	174,000	232,000
8	13,000	27,000	40,000	53,000	66,000	133,000	199,000	265,000
9	15,000	30,000	45,000	60,000	75,000	149,000	224,000	298,000
10	17,000	33,000	50,000	66,000	83,000	166,000	249,000	332,000
12	20,000	40,000	60,000	80,000	99,000	199,000	298,000	398,000
14	23,000	46,000	70,000	93,000	116,000	232,000	348,000	464,000
16	27,000	53,000	80,000	106,000	133,000	265,000	398,000	531,000
18	30,000	60,000	90,000	119,000	149,000	298,000	448,000	597,000
20	33,000	66,000	99,000	133,000	166,000	332,000	497,000	663,000
22	36,000	73,000	109,000	146,000	182,000	365,000	547,000	730,000
24	40,000	80,000	119,000	159,000	199,000	398,000	597,000	796,000
26	43,000	86,000	129,000	172,000	216,000	431,000	647,000	862,000
28	46,000	93,000	139,000	186,000	232,000	464,000	696,000	929,000
30	50,000	99,000	149,000	199,000	249,000	497,000	746,000	995,000

Assume two lane roadway with 50/50 directional split of base year AADT
Values within "box" assume a low volume mix of trucks

Table 5F-1.11: Growth Factor

Design Period Years (n)	Average Annual Traffic Growth Rate, Percent (r)					
	No Growth	*1%*	*2%*	*3%*	*4%*	*5%*
1	1.0	1.0	1.0	1.0	1.0	1.0
2	2.0	2.0	2.0	2.0	2.0	2.1
3	3.0	3.0	3.1	3.1	3.1	3.2
4	4.0	4.1	4.1	4.2	4.2	4.3
5	5.0	5.1	5.2	5.3	5.4	5.5
6	6.0	6.2	6.3	6.5	6.6	6.8
7	7.0	7.2	7.4	7.7	7.9	8.1
8	8.0	8.3	8.6	8.9	9.2	9.5
9	9.0	9.4	9.8	10.2	10.6	11.0
10	10.0	10.5	10.9	11.5	12.0	12.6
11	11.0	11.6	12.2	12.8	13.5	14.2
12	12.0	12.7	13.4	14.2	15.0	15.9
13	13.0	13.8	14.7	15.6	16.6	17.7
14	14.0	14.9	16.0	17.1	18.3	19.6
15	15.0	16.1	17.3	18.6	20.0	21.6
16	16.0	17.3	18.6	20.2	21.8	23.7
17	17.0	18.4	20.0	21.8	23.7	25.8
18	18.0	19.6	21.4	23.4	25.6	28.1
19	19.0	20.8	22.8	25.1	27.7	30.5
20	20.0	22.0	24.3	26.9	29.8	33.1
21	21.0	23.2	25.8	28.7	32.0	35.7
22	22.0	24.5	27.3	30.5	34.2	38.5
23	23.0	25.7	28.8	32.5	36.6	41.4
24	24.0	27.0	30.4	34.4	39.1	44.5
25	25.0	28.2	32.0	36.5	41.6	47.7
26	26.0	29.5	33.7	38.6	44.3	51.1
27	27.0	30.8	35.3	40.7	47.1	54.7
28	28.0	32.1	37.1	42.9	50.0	58.4
29	29.0	33.5	38.8	45.2	53.0	62.3
30	30.0	34.8	40.6	47.6	56.1	66.4
31	31.0	36.1	42.4	50.0	59.3	70.8
32	32.0	37.5	44.2	52.5	62.7	75.3
33	33.0	38.9	46.1	55.1	66.2	80.1
34	34.0	40.3	48.0	57.7	69.9	85.1
35	35.0	41.7	50.0	60.5	73.7	90.3
36	36.0	43.1	52.0	63.3	77.6	95.8
37	37.0	44.5	54.0	66.2	81.7	101.6
38	38.0	46.0	56.1	69.2	86.0	107.7
39	39.0	47.4	58.2	72.2	90.4	114.1
40	40.0	48.9	60.4	75.4	95.0	120.8
41	41.0	50.4	62.6	78.7	99.8	127.8
42	42.0	51.9	64.9	82.0	104.8	135.2
43	43.0	53.4	67.2	85.5	110.0	143.0
44	44.0	54.9	69.5	89.0	115.4	151.1
45	45.0	56.5	71.9	92.7	121.0	159.7
46	46.0	58.0	74.3	96.5	126.9	168.7
47	47.0	59.6	76.8	100.4	132.9	178.1
48	48.0	61.2	79.4	104.4	139.3	188.0
49	49.0	62.8	81.9	108.5	145.8	198.4
50	50.0	64.5	84.6	112.8	152.7	209.3

Growth Factor = $\frac{[(1+r)^n]-1}{r}$ for values of n > 0

Project: Muscatine - Miss. St.	Computed: BHH	Date: 11/21/16
Subject: Pavement Design	Checked: BPK	Date: 12/12/16
Task:	Page: 4	of: 16
Job #: 10025173	No:	

- Subgrade Support

- Test results are 1.4, 2.1, 2.0 and 1.3 for CBR (see attached results)
- Test results seem low, but SUDAS indicates that in-situ CBR values of 1 to 3 are typical for Iowa; Samples compacted at 3% to 4% above optimum
- Per NCHRP Project 1-28,

$$M_R = 1941.488 \times CBR^{0.6844709}$$

- Assume CBR = 2 for design

$$M_R = 1941.488 \times (2)^{0.6844709}$$

$$M_R = 3120 \text{ psi}$$ ✓

- From AASHTO, $k = M_R / 19.4$

$$k = \frac{3120}{19.4} = 160 \text{ psi/in} = 160 \text{ pci}$$ ✓

- Assume 6" aggregate base to match Hershey Avenue paving
- See attached Table 3.2 and Figures 3.3, 3.5 and 3.6 and Table 2.7

- $k_c = 245$ pci from Table 3.2 → Seems too high
- Use $k_c = 140$ pci based on experience and published values

- Concrete properties

$$S_c' = 2.3 f_c^{0.667}$$

Assume $f_c' = 3000$ psi

$$S_c' = 2.3(4000)^{0.667} = 580 \text{ psi}$$

$$E_c = 6750(S_c') = 6750(580) = 3.915 \times 10^6 \text{ psi}$$

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S2
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761

Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761

TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

ISO/IEC 17025

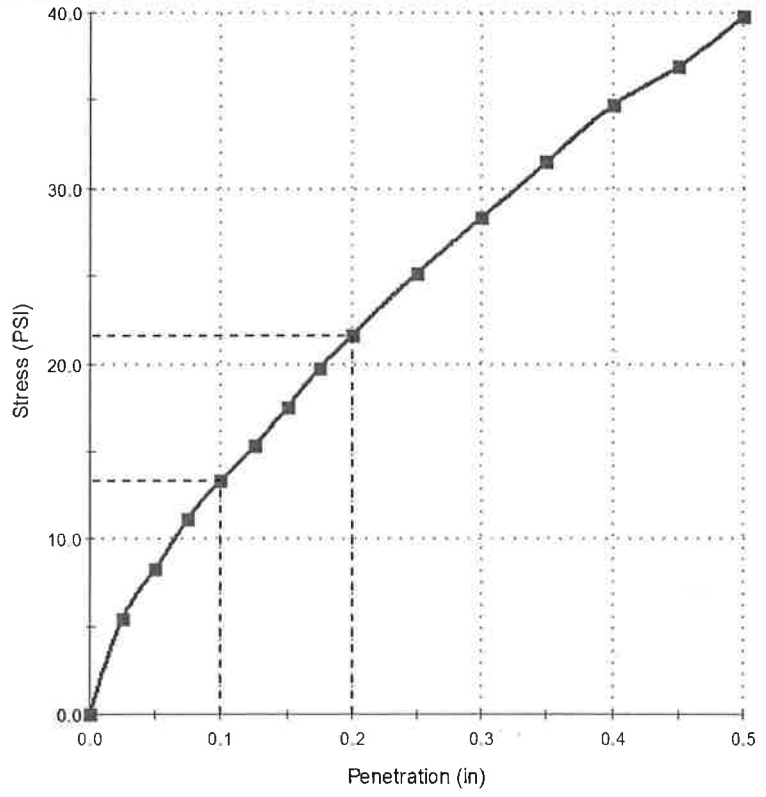
Jason Limley

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S2	**Alternate Sample ID:**	P-02
Sampled By:	Drill Crew	**Date Sampled:**	
Sampling Method:	Soil Boring	**Source:**	Onsite material
Material:	Clayey Sand	**Specification:**	
Sample Location:	B-16, 3'-8'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	1.3
CBR At 0.2in (%):	1.4
Compactive Effort:	ASTM D 698
Number of Blows:	22
% of Maximum Dry Density:	94.9
Dry Density Before Soaking (lb/ft³):	113.5
MC Before Compaction (%):	16.6
MC After Compaction (%):	16.0
Moisture Content of Top 1in (%):	16.3
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	119.6
Optimum Moisture Content (%):	12.8
Sample Condition:	soaked
Swell (%):	0.2
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S3
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761

Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761

TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

ISO/IEC 17025

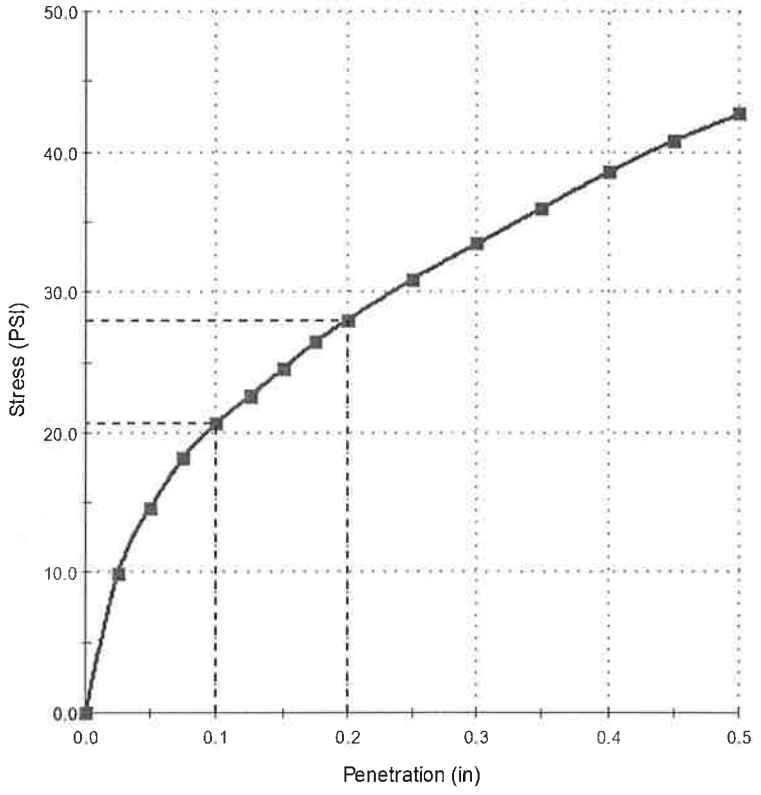
Jason Limley

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S3	**Alternate Sample ID:**	P-03
Sampled By:	Drill Crew	**Date Sampled:**	
Sampling Method:	Soil Boring	**Source:**	Onsite material
Material:	Lean Clay with Sand	**Specification:**	
Sample Location:	B-21, 3'-8'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	2.1
CBR At 0.2in (%):	1.9
Compactive Effort:	ASTM D 698
Number of Blows:	19
% of Maximum Dry Density:	95.0
Dry Density Before Soaking (lb/ft³):	105.5
MC Before Compaction (%):	19.1
MC After Compaction (%):	18.6
Moisture Content of Top 1in (%):	19.3
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	111.0
Optimum Moisture Content (%):	15.0
Sample Condition:	soaked
Swell (%):	0.1
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S4
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761

Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761

TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

ISO/IEC 17025

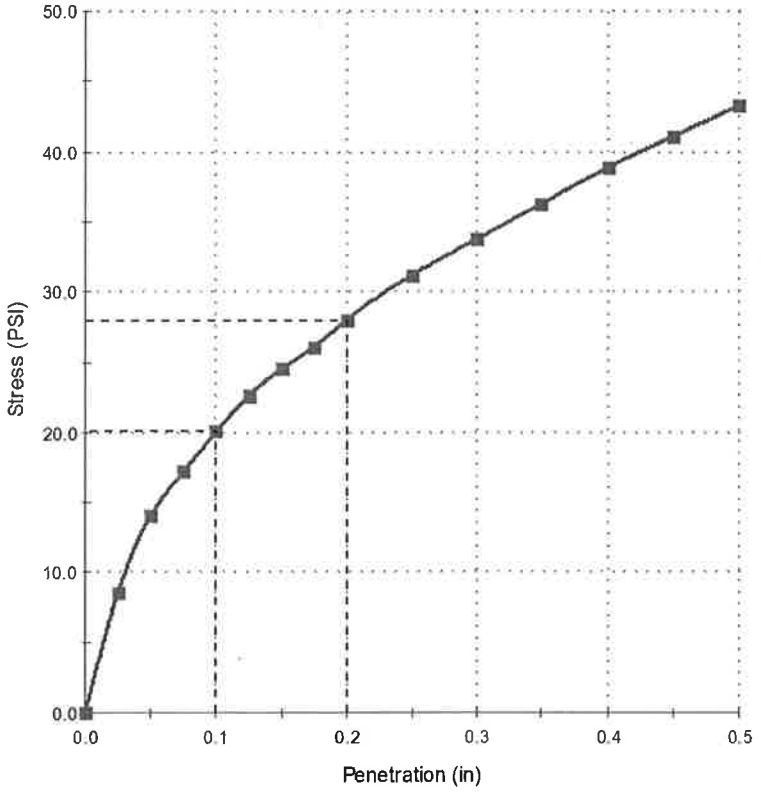
Jason Limley

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S4	**Alternate Sample ID:**	P-04
Sampled By:	Drill Crew	**Date Sampled:**	
Sampling Method:	Soil Boring	**Source:**	Onsite material
Material:	Sandy Lean Clay	**Specification:**	
Sample Location:	B-23, 2'-8'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	2.0
CBR At 0.2in (%):	1.9
Compactive Effort:	ASTM D 698
Number of Blows:	27
% of Maximum Dry Density:	94.8
Dry Density Before Soaking (lb/ft³):	114.3
MC Before Compaction (%):	15.6
MC After Compaction (%):	15.1
Moisture Content of Top 1in (%):	15.5
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	120.6
Optimum Moisture Content (%):	11.6
Sample Condition:	soaked
Swell (%):	0.0
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W16-010531-S1
Issue No: 1

Client: Jim Edgmond
City of Muscatine
1459 Washington Street
Muscatine, IA, 52761

Project: B1610125
Mississippi Drive Improvements, Muscatine, Iowa
Mississippi Drive
Muscatine, IA, 52761

TR: Jeremy Elkin, jelkin@braunintertec.com

Laboratory Results Reviewed by:

ISO/IEC 17025

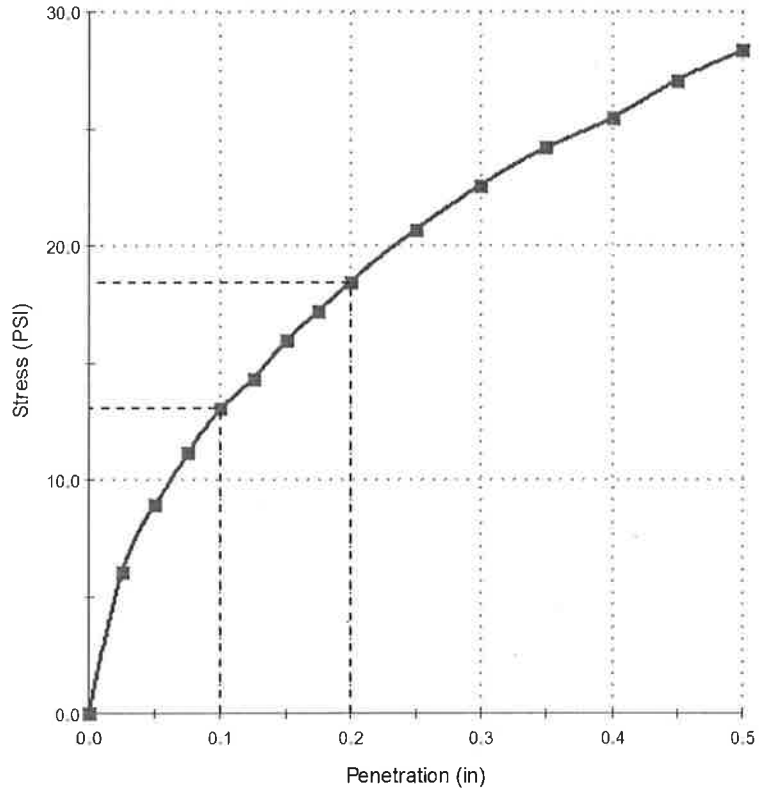
Jason Limley

Jason Limley
Engineering Technician III
Date of Issue: 11/16/2016

Sample Details

Sample ID:	W16-010531-S1	**Alternate Sample ID:**	P-01
Sampled By:	Drill Crew	**Date Sampled:**	
Sampling Method:	Soil Boring	**Source:**	Onsite material
Material:	Sandy Lean Clay	**Specification:**	
Sample Location:	B-5, 3'-10'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	1.3
CBR At 0.2in (%):	1.2
Compactive Effort:	ASTM D 698
Number of Blows:	25
% of Maximum Dry Density:	94.6
Dry Density Before Soaking (lb/ft³):	111.9
MC Before Compaction (%):	16.9
MC After Compaction (%):	16.5
Moisture Content of Top 1in (%):	17.1
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	118.3
Optimum Moisture Content (%):	12.9
Sample Condition:	soaked
Swell (%):	0.1
Surcharge Mass (lb):	10.00
Oversize Material (%):	0.0
Date Tested:	11/16/2016

Comments

✓ BDK 12/12/16

Table 3.2. Table for Estimating Effective Modulus of Subgrade Reaction

Trial Subbase: Type Agg. Subbase **Depth to Rigid Foundation (feet)** 10+
Thickness (inches) 6 **Projected Slab Thickness (inches)** 10
Loss of Support, LS 0

(1) Month	(2) Roadbed Modulus, M_R (psi)	(3) Subbase Modulus, E_{SB} (psi)	(4) Composite k-Value (pci) (Fig. 3.3)	(5) k-Value (pci) on Rigid Foundation (Fig. 3.4)	(6) Relative Damage, u_r (Fig. 3.5)
Jan	20k	50k	1100		0.65
Feb	20k	50k	1100		0.65
Mar	930	15k	65		1.75
Apr	930	15k	65		1.75
May	3100	20k	195		1.35
June	3100	20k	195		1.35
July	3100	20k	195		1.35
Aug	3100	20k	195		1.35
Sept	3100	20k	195		1.35
Oct	3100	20k	195		1.35
Nov	3100	20k	195		1.35
Dec	20k	50k	1100		0.65
				Summation Σu_r =	14.81

Average: $\bar{u}_r = \frac{\Sigma u_r}{n} = \frac{14.9}{12} = 1.24$ Say 1.22

Effective Modulus of Subgrade Reaction, k (pci) = 245 ✓

Corrected for Loss of Support k (pci) = 245

Example:

D_{SB} = 6 inches

E_{SB} = 20,000 psi

M_R = 7,000 psi

Solution: k_∞ = 400 pci

✓ BPL 12/12/16

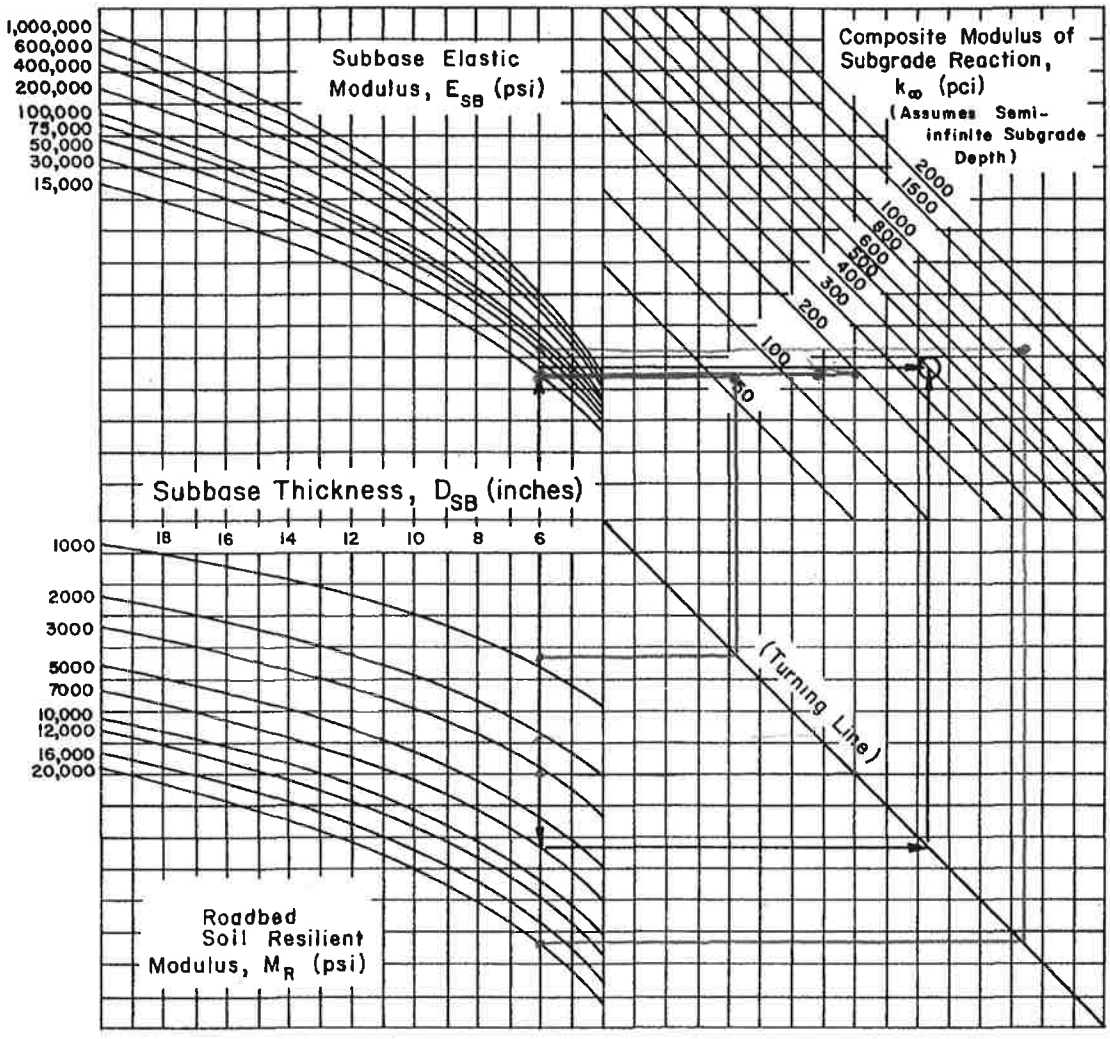


Figure 3.3. Chart for Estimating Composite Modulus of Subgrade Reaction, k_∞, Assuming a Semi-Infinite Subgrade Depth. (For practical purposes, a semi-infinite depth is considered to be greater than 10 feet below the surface of the subgrade.)

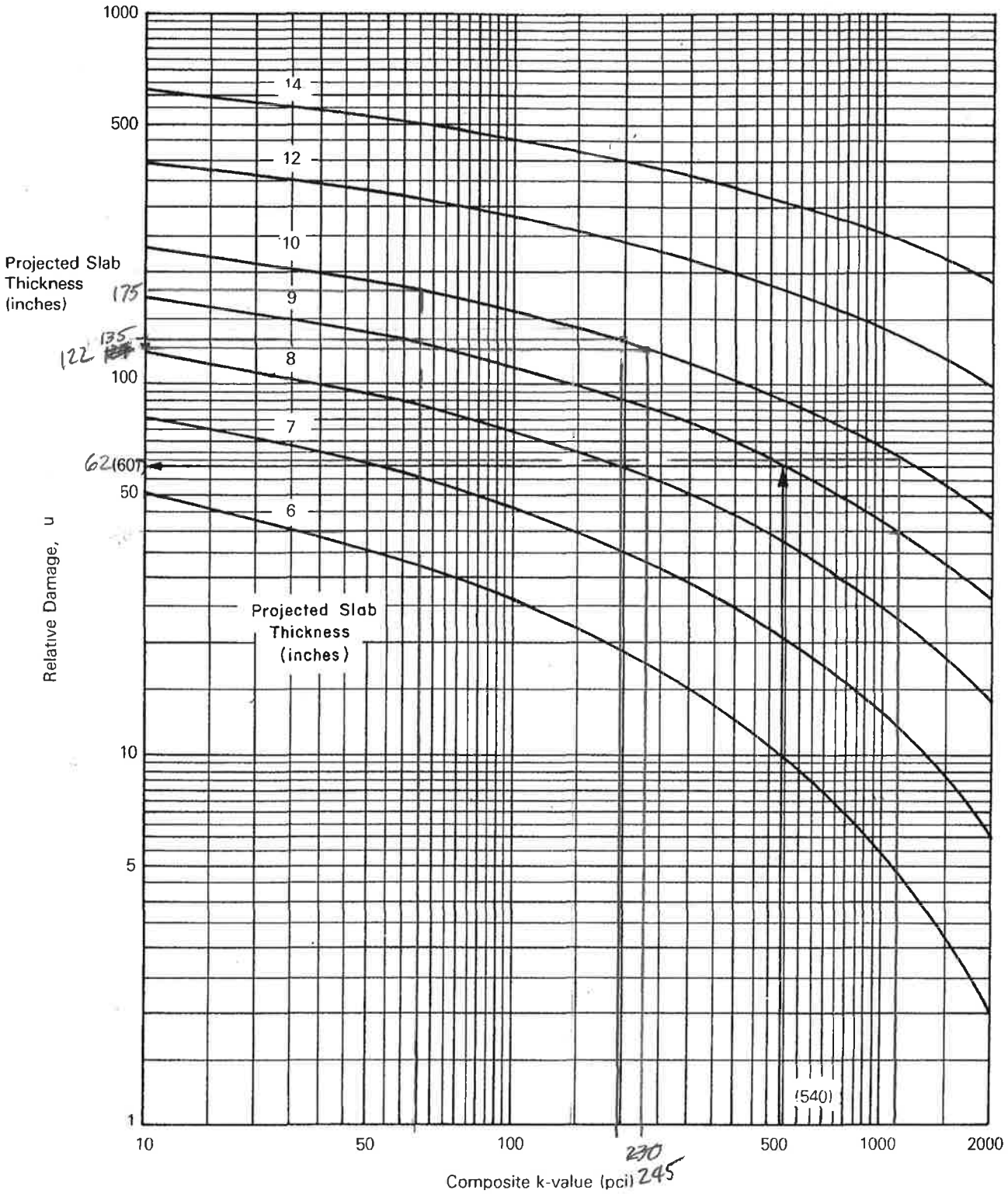


Figure 3.5. Chart for Estimating Relative Damage to Rigid Pavements Based on Slab Thickness and Underlying Support

Table 5F-1.12: Parameter Assumptions Used for Pavement Thickness Design Tables

Subbase:	Natural			4" Granular			6" Granular			8" Granular			10" Granular			12" Granular		
CBR Value:	3	5	10	3	5	10	3	5	10	3	5	10	3	5	10	3	5	10
Rigid Pavement Parameters																		
Initial Serviceability Index, P_o	4.5																	
Terminal Serviceability Index, P_t	Local Roads = 2.00 Collector Roads = 2.25 Arterials = 2.50																	
Reliability, R	Local Roads = 80% Collector Roads = 88% Arterial Roads = 95%																	
Overall Standard Deviation, S_o	0.35																	
Loss of Support, LS	1			0														
Soil Resilient Modulus, M_R Per NCHRP Project 128 $M_R = 1941.488 \times CBR^{0.6844709}$	4120	5840	9400	4120	5840	9400	4120	5840	9400	4120	5840	9400	4120	5840	9400	4120	5840	9400
Subbase Resilient Modulus, E_{SB} * Assumed	Not Applicable			30,000														
Modulus of Subgrade Reaction, k, and Composite Modulus of Subgrade Reaction, k_c Use AASHTO Chapter 3, Table 3.2 and Figures 3.3 - 3.6 to determine	252	327	469	263	332	455	284	354	477	308	379	504	332	406	535	356	433	566
Adjusted k or k_c for Loss of Support Use AASHTO Part 2, Figure 3.6	85	105	160	263	332	455	284	354	477	308	379	504	332	406	535	356	433	566
Coefficient of Drainage, C_d	1.00			1.10														
Modulus of Rupture, S'_c $S'_c = 2.3 \times f_c^{0.667}$ * Assumed 4,000 psi concrete	580																	
Modulus of Elasticity, E_c $E_c = 6,750 \times S'_c$ * Assumed 4,000 psi concrete	3,915,000																	
Load Transfer, J	J = 3.1 (Pavement Thickness < 8") J = 2.7 (Pavement Thickness ≥ 8")																	
Flexible Pavement Parameters																		
Initial Serviceability Index, P_o	4.2																	
Terminal Serviceability Index, P_t	Local Roads = 2.00 Collector Roads = 2.25 Arterials = 2.50																	
Reliability, R	Local Roads = 80% Collector Roads = 88% Arterial Roads = 95%																	
Overall Standard Deviation, S_o	0.45																	
Layer Coefficients	Surface/Intermediate Course = 0.44 Base Course = 0.40 Granular Subbase = 0.14																	
Soil Resilient Modulus, M_R Per NCHRP Project 128 $M_R = 1941.488 \times CBR^{0.6844709}$	4120	5840	9400	4120	5840	9400	4120	5840	9400	4120	5840	9400	4120	5840	9400	4120	5840	9400
Effective Soil Reslient Modulus, MR Use AASHTO Chapter 2, Figure 2.3 to determine	2460	3480	5580	2460	3480	5580	2460	3480	5580	2460	3480	5580	2460	3480	5580	2460	3480	5580
Coefficient of Drainage, M_i	1.00			1.15														

Project: Muscatine - Miss. St.	Computed: BTG	Date: 11/18/16
Subject: Pavement Design	Checked: BPK	Date: 12/12/16
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- Coefficient of drainage

  Will have storm sewers
  - Assume that aggregate subbase will be used, but no longitudinal drains
  - Result is "Fair drainage" where material is drained to 50% saturation in 1 Week
  - Assume that pavements are exposed to saturation during 25% of time
  - C_d = 1.0 per Table 2.5 (attached)

- Load transfer coefficient
  - Table 2.6 provides range of J values for various conditions (see attached)
  - Assume plain jointed or jointed reinforced without load transfer devices based on review of Hershey Avenue plans and IDOT Type C transverse joints
  - Say J = 2.7 for design based on SUDAS example for t ≥ 8" (assume)
  - Based on SUDAS guidance, use CD joint w/dowels for t ≥ 8" (attached)

- thickness

From attached spreadsheet,

t = 10 inches

Table 2.5. Recommended Values of Drainage Coefficient, C_d, for Rigid Pavement Design

Quality of Drainage	Percent of Time Pavement Structure is Exposed to Moisture Levels Approaching Saturation			
	Less Than 1%	1–5%	5–25%	Greater Than 25%
Excellent	1 25–1 20	1 20–1 15	1 15–1 10	1 10
Good	1 20–1 15	1 15–1 10	1 10–1 00	1 00
Fair	1 15–1 10	1 10–1 00	1 00–0 90	0 90
Poor	1 10–1 00	1 00–0 90	0 90–0 80	0 80
Very poor	1 00–0 90	0 90–0 80	0 80–0 70	0 70

Use 1.0 ✓

coefficient, then the value of J should be increased On the other hand, if few heavy trucks are anticipated such as a low-volume road, the J-value may be lowered since the loss of aggregate interlock will be less Part I of this Guide provides some other general criteria for the consideration and/or design of expansion joints, contraction joints, longitudinal joints, load transfer devices, and tie bars in jointed pavements

Continuously Reinforced Pavements. The value of J recommended for continuously reinforced concrete pavements (CRCP) without tied concrete shoulders is between 2 9 to 3 2, depending on the capability of aggregate interlock (at future transverse cracks) to transfer load In the past, a commonly used J-value for CRCP was 3 2, but with better design for crack width control each agency should develop criteria based on local aggregates and temperature ranges

Tied Shoulders or Widened Outside Lanes. One of the major advantages of using tied PCC shoulders (or widened outside lanes) is the reduction of slab stress and increased service life they provide To account for this, significantly lower J-values may be used for the design of both jointed and continuous pavements

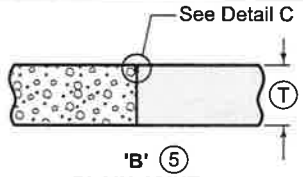
For continuously reinforced concrete pavements with tied concrete shoulders (the minimum bar size and maximum tie bar spacing should be the same as that for tie bars between lanes), the range of J is between 2 3 and 2 9, with a recommended value of 2 6 This value is considerably lower than that for the design of concrete pavements without tied shoulders because of the significantly increased load distribution capability of concrete pavements with tied shoulders

For jointed concrete pavements with dowels and tied shoulders, the value of J should be between 2 5 and 3 1 based on the agency's experience The lower J-value for tied shoulders assumes traffic is not permitted to run on the shoulder

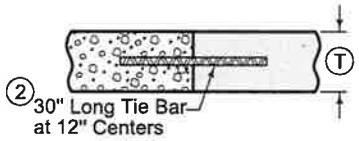
NOTE Experience has shown that a concrete shoulder of 3 feet or greater may be considered a tied shoulder Pavements with monolithic or tied curb and gutter that provides additional stiffness and keeps

Table 2.6. Recommended Load Transfer Coefficient for Various Pavement Types and Design Conditions

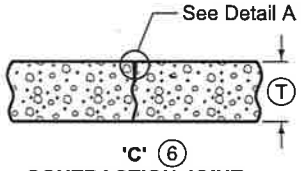
Shoulder	Asphalt		Tied P.C.C.	
Load Transfer Devices	Yes	No	Yes	No
Pavement Type				
1 Plain jointed and jointed reinforced	3 2	3 8–4 4	2 5–3 1	3 6–4 2
2 CRCP	2 9–3 2	N/A	2 3–2 9	N/A



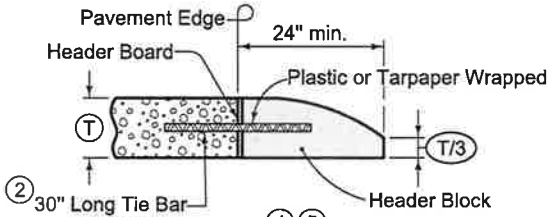
'B' (5)
PLAIN JOINT
(Abutting Pavement Slabs)



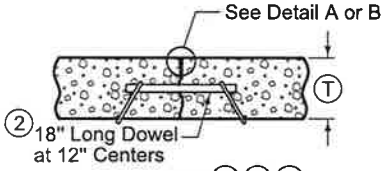
'DW' (3)(4)(7)
DAY'S WORK JOINT(Non-working)



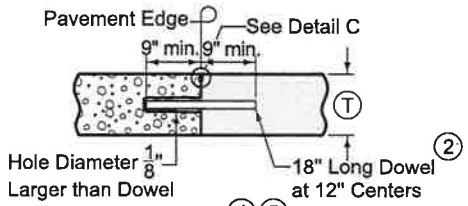
'C' (6)
CONTRACTION JOINT



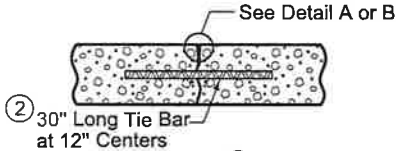
'HT' (4)(5)
HEADER JOINT
(End Rigid Pavement)



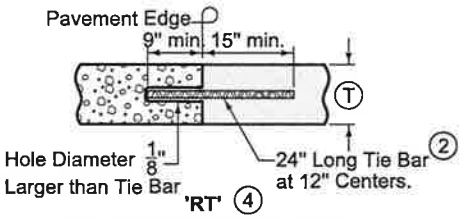
'CD' (1)(4)(6)
DOWELED CONTRACTION JOINT



'RD' (4)(5)
ABUTTING PAVEMENT JOINT



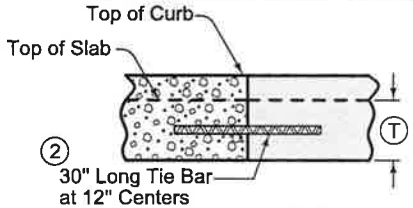
'CT' (4)
TIED CONTRACTION JOINT



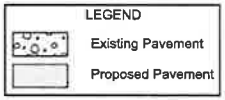
'RT' (4)
ABUTTING PAVEMENT JOINT
RIGID TIE

TRANSVERSE CONTRACTION

1. See dowel assemblies for fabrication details.
2. See Bar Size Table.
3. Locate 'DW' joint at a mid-panel location between future 'C' or 'CD' joints. Place no closer than 5 feet to a 'C' or 'CD' joint.
4. Place bars within the limits shown under dowel assemblies.
5. Edge with 1/8 inch tool for length of joint. For HT joint, remove header block and board when second slab is placed.
6. Unless otherwise specified, use 'CD' transverse contraction joints in mainline pavement when (T) is greater or equal to 8 inches. Use 'C' joints when (T) is less than 8 inches.
7. 'RT' joint may be used in lieu of 'DW' joint at the end of the days work. Remove any pavement damaged due to the drilling at no additional cost to the Contracting Authority.



'DW - CG' (3)(4)
DAY'S WORK JOINT
CURB AND GUTTER UNIT



SUDAS | IOWA DOT | REVISION 6 04-19-16
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101
SHEET 1 of 8

REVISIONS: Revised note 5 on page 1. Revised notes 19, 22, and 23 on pages 6, 7, and 8. Added shading and a Legend to define existing and proposed pavement.

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 | SHEET 1 OF 8

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AASHTO RIGID PAVEMENT DESIGN

Design Inputs

W18 =	8,900,000	*ESALs Applications Over Design Period*	Typ. Range 0.5 to 100 million
PCC MR =	580 psi	*Concrete Modulus of Rupture*	Typ. Range 550 to 750 psi
E =	3,915,000 psi	*Concrete Elastic Modulus*	Typ. Range 3 to 6 million psi
k-value =	140 psi/in	*Modulus of Subgrade Reaction*	Typ. Range 100 to 500 psi/in
R =	95 %	*Reliability*	Typ. Range 80 to 95%
So =	0.35	*Standard Deviation*	Typ. Range 0.3 to 0.5
J =	2.7	*Load Transfer Coefficient*	Typ. Range 2.2 to 4.4
Cd =	1	*Drainage Coefficient*	Typ. Range 0.9 to 1.1
Pi =	4.5	*Initial Serviceability*	Typ. Range 4.5 to 4.8
Pt =	2.5	*Terminal Serviceability*	Typ. Range 2.0 to 3.0

DESIGN D, inches, = 10.03 ✓

BPK 12/12/16

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