Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, Secretary & CEO
Jonathan L. Gulliver, Highway Administrator

MassDOT
Massachusetts Department of Transportation
Highway Division

August 14, 2020

604123-111717

ADDENDUM NO. 3

To Prospective Bidders and Others on:

ASHLAND
Federal Aid Project Nos. CMQ-003S(390), STP-003S(390) & TAP-003S(390)
Roadway Reconstruction and Related Work along Route 126 (Pond Street)

BIDS TO BE OPENED AND READ ON: TUESDAY, AUGUST 25, 2020 AT 2:00 P.M.

Transmitting revisions to the Contract Documents as follows:

RESPONSES TO CONTRACTORS' QUESTIONS:	13 Pages
DOCUMENT 00010:	Revised pages 2 and 3
DOCUMENT 00104:	Revised page 3
DOCUMENT 00880:	Revised pages 3 through 11
DOCUMENT A00801:	Revised pages 105, 151, 199, 205, 206, 208, 212, and 214
DOCUMENT A00803:	Inserted new document (4 pages)
DOCUMENT A00891:	Inserted new document (72 pages)
DOCUMENT A00892:	Inserted new document (20 pages)

Take note of the above, substitute revised pages for the originals, insert new documents in proper order, and acknowledge Addendum No. 3 in your Expedite Proposal file before submitting your bid.

Sincerely,

Eric M. Cardone Digitally signed by Eric M. Cardone Date: 2020.08.14 13:09:03 -04'00'

Eric M. Cardone, P.E.
Construction Contracts Engineer

Cc: Lawrence Cash, Project Manager
EMC/jmr

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

Mass Bay Electrical Corp. email dated July 27, 2020 (from Addendum No. 1)**:**

Question #3: We cannot find any of bid item 813.30 - WIRE TYPE 7 NO. 10 GENERAL PURPOSE – 45,500 FEET. The No. 10 wire from handholes to light fixtures and receptacles is paid for under item 813.399 – SPLICE AND EXTENSION FRON HANDHOLE TO LIGHTING FIXTURES. Should bid item 813.30 be eliminated?

Response #3: See revised page A00801-151.

Question #4: Are both lighting and pole mounted receptacles to be controlled by contactors? If so, load center details on drawing 180 do not show enough contactors. Our understanding is that there should be two 10-pole contactors in load center 1, and two 8-pole contactors in load center 2. Please advise.

Response #4: No, the pole mounted receptacles are controlled by the contactors, the lighting is controlled by a photocell.

J. H. Lynch email dated July 28, 2020 (from Addendum No. 1)**:**

Question #6: Sheet 192 Roundabout Apron Detail
Please provide a detail of the expansion and contraction joints, including smooth dowels bars and preformed joint filler.
Please provide clarification of the 12"x12" slate stone, 12" wide patterned accent strips.
Are the accent strips to be colored concrete (gray?) or slate stone?

Response #6: See new Document A00803 and revised page A00801-105.

Mass Bay Electrical Corp. email dated August 4, 2020:

Question #7: In regards to vehicle detection, will the project be open to replacing the proposed loop detectors with video detection?

Response #7: The Contractor shall bid the work as specified in the Contract Documents. Alternative construction methods and materials may be submitted by the Contractor during shop drawings review process. Any alternatives must be approved by the Engineer prior construction.

Question #8: A section in the mast arm foundation specification states "Construction of PIER foundations shall be performed in accordance with MassDOT's "Overhead Signal Structure & Foundation Standard Drawings" dated December 2015. In the event that soil conditions or ledge prevent the use of MassDOT standard foundation type, shaft foundation design by Lamson Engineering Corporation shall be followed. The design is detailed in memo titled "Mast Arm Foundation Design" dated June 10, 2020.

Could you please indicate where in the specification is the "Mast Arm Foundation Design" dated June 10, 2020?

Response #8: See new Document A00891.

J.H. Lynch & Sons, Inc., email dated August 4, 2020:

Question #9: Item 183.1-Treatment of contaminated groundwater, page A00801-86 states "Groundwater stored and tested but not requiring treatment or off-site disposal shall be discharged to a location subject to the approval of MASSDOT without payment to the contractor." Please provide pre-construction sampling and testing data of groundwater so the contractor can make this determination.

Response #9: No additional pre-construction sampling and testing has been done. Per the Spec under "Establishment of Treatment Procedure", the Contractor is responsible to perform pre-construction sampling as noted.

Question #10: Item 183.1-If groundwater testing reveals it does not require treatment or off-site disposal, under what item will the contractor be paid to compensate for the pumping water, storage tanks, testing, and labor and effort to comply with the specification?

Response #10: See revised page A00801-199.

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #11: The special provisions for Item 183.1 on Page A00801-83 states it is LIKELY that treatment using carbon will be required. Page A00801-85 states to establish a basis for the bid it is ANTICIPATED that carbon will be required. Page A00801-86 states "for the purposes of bidding process, it is ANTICIPATED that sedimentation tanks and carbon filtering will be used. MASSDOT clearly desires bids based on water requiring carbon filtration. However, if the water does not require it, MASSOT does not want to pay any costs for handling water. Please establish a pay item for Treatment of NON-Contaminated groundwater to compensate contractors for handling water in case it turns out to not require carbon filtration.

Response #11: See Response #10.

Question #12: Item 953.31-953.34-Special provision on page A00801-196 states the maximum depth of excavation is 15'. The next paragraph states the excavation support system shall be designed to allow for a 2 foot depth of over excavation. Is this in addition to the 15' or, does the 15' take into account this 2 foot potential over-excavation depth?

Response #12: The 15 foot depth considers the 2 foot potential over-excavation depth.

Question #13: Confirm that item 183.1 and 183.2 will be used as compensation for treatment of groundwater generated during dewatering in addition to Items 991.11-991.14 Control of Water-Drain Structures 1-4.

Response #13: Items 183.1 and 183.2 shall be used as compensation for treatment of contaminated groundwater. Items 991.11 through 991.14 shall be used for control of water for non-contaminated water.

Question #14: Confirm that item 183.1 and 183.2 will be used as compensation for handling surface water runoff during construction in addition to Items 991.11-991.14 Control of Water-Drain Structures 1-4.

Response #14: Items 183.1 and 183.2 shall not be used as compensation for handling surface water runoff. Items 991.11 through 991.14 shall be used for handling of surface water and groundwater.

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #15: Items 991.11 through 991.14-Control of Water require the contractor to control flow of existing surface water and groundwater. By reviewing the WQC, it seems there will not be a requirement for any bypass pumping as they are intermittent streams and work is to be done during low flow periods. If there are certain flow rates that are to be maintained at each Drainage Structure, please provide them.

Response #15: Flow rates are not to be maintained at any of the four drainage areas.

Question #16: If flow data can not be provided, what flow rate (gpm), if any, will the submittal reviewing engineer check the contractor submittal against to make sure the contractor meets the required capacity?

Response #16: There is no required capacity for flow rates since these are intermittent streams and work is required to be performed during low flow periods.

Question #17: Page A00801-199 under Basis of Payment for items 991.11-991.14 states that the control of water items shall include "all labor, equipment, transportation, ***additional site testing***, maintenance, removal and disposal of materials and structures, and incidentals necessary to complete the work." What is required or what it the intent for the requirement of "***additional site testing***"?

Response #17: Testing for groundwater contamination is covered under Item 183.1. See revised page A00801-199.

Question #18: Plan Sheets 159 and 160 show traffic management plans for Drain Structure No. 4 at Pond St. Sta. 90+14. In stage 1 there is 1 lane in each direction. Then stage 2 calls for 1 lane NB and 2 lanes SB. Can stage 2 be allowed to put 1 lane in each direction and allow a larger work zone to accommodate the work in the middle of the road?

Response #18: The traffic management plans were designed based on the existing signal layout and minimizing the impact to traffic operation and have been approved by MassDOT. The work in the middle of the road involves installing drainage pipeline, which can be covered by typical traffic management applications in Sheet 147. As indicated in temporary traffic control notes, the contractor shall coordinate approval of any changes to the temporary traffic control plan with the Engineer prior to construction activities.

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #19: Regarding traffic management plans the note on plan sheet 155 states it is recommended that the wall is to be constructed prior to any utility pole relocation. Please provide a temporary traffic control plan for the construction of the Eliot St. wall.

Response #19: *This question will be addressed in a later addendum.*

Question #20: The Parking lot behind the retaining wall at Sta. 32+15 – 34+90 Left will likely need to be patched/paved as a result of excavation impacts with the wall, under what item will this HMA be paid for? Confirm it will be constructed as an HMA driveway-2.5" SIC 19.0 & 1.75" of SSC-12.5 and paid under Item 702. Confirm fine grading of the area prior to driveway repair will be paid for under Item 170.

Response #20: *This question will be addressed in a later addendum.*

Question #21: Are tiebacks or any portions of support of excavation systems allowed to remain permanently in the ground within the temporary easement area located at the Eliot St. wall?

Response #21: Portions of the support of excavation systems or tiebacks are not allowed to remain permanently in the grown within the temporary easement area located at the Eliot Street wall.

Question #22: Can the parking lot behind the wall within the Temp. Easement shown on plan sheet 19 and 20 be closed during construction to not allow traffic on top of the support of excavation area?

Response #22: *This question will be addressed in a later addendum.*

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #23: Please provide a traffic management plan for the Spyglass retaining wall.

Response #23: *This question will be addressed in a later addendum.*

Question #24: Please provide a phased traffic management plan for Drainage Structure No. 1 at Pond St. Sta. 37+48.

Response #24: The two-lane road one lane alternating traffic application and the two-lane road shoulder and travel lane closure traffic application on Sheet 147 can be used as traffic management setup for construction of Drainage Structure No. 1.

Question #25: Please provide a phase traffic management plan for Drainage Structure No. 2 at Pond St. Sta. 41+98.

Response #25: The two-lane road shoulder and travel lane closure traffic application on Sheet 147 can be used as traffic management setup for construction of Drainage Structure No. 2. Drainage structure No. 2 is a culvert extension that would be cast in place, temporary concrete barriers can be deployed in place of the guardrail for a period of time.

Question #26: Please provide a phased traffic management plan for Drainage Structure No. 3 at Pond St. Sta. 80+41.

Response #26: The two-lane road, one lane alternating traffic application, the two-lane road shoulder, and travel lane closure application on sheet 147 can be used as traffic management setup for construction of Drainage Structure No. 3.

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #27: Plan Sheets 159 and 160 show traffic management plan for the drainage structure at Sta. 90+00 to 91+00. In stage 1 there is 1 lane in each direction. Then stage 2 calls for 1 lane NB and 2 lanes SB. This is in conflict with the minimum lane requirements shown on the detail on plan sheet 148 "Typical Application-Two Lane Road Shoulder and Travel Lane Closure" showing 2 each 11' wide lanes. Can stage 2 be allowed to put 2 each 11' lanes and allow a larger work zone to accommodate the work in the middle of the road?

Response #27: Traffic management plans in plan sheets 159 and 160 are designed for proposed construction in the vicinity of a signalized intersection, and it is not in conflict with the minimum lane requirements shown on the detail on plan sheet 147 "Typical Application-Two Lane Road Shoulder and Travel Lane Closure" showing two 11' wide lanes.

The traffic management plans were designed based on the existing signal layout and minimizing the impact to traffic operation and have been approved by MassDOT. The work in the middle of the road involves installing drainage pipeline, which can be covered by typical traffic management applications on Sheet 147. As indicated in the temporary traffic control notes, the contractor shall coordinate approval of any changes to the temporary traffic control plan with the Engineer prior to construction activities.

Question #28: At the start and end of Eliot St. retaining wall, the exposed heights are +/-7' +/-10' respectively. Can the wall ends be extended or grading plans be provided for the Eliot St. wall ends as this seems extremely high to have the retaining walls end at those heights.

Response #28: *This question will be addressed in a later addendum.*

Question #29: Would extending the wall be considered incidental to the lump sum wall item or will the contractor be paid if the walls need to be lengthened to adjust for field conditions.

Response #29: *This question will be addressed in a later addendum.*

Question #30: Confirm that no mock-ups are required for the Wall Structure No. 1 and 2 to evaluator color, texture, appearance of the concrete walls.

Response #30: Confirmed. No mock-ups are required for the Wall Structures No. 1 and No. 2 to evaluate color, texture, appearance of the concrete walls.

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #31: Confirm that no color staining, stone patterns, or any other architectural feature other than striation is required for Wall Structure No. 1 and 2.

Response #31: Confirmed. No color staining, stone patterns, or any other architectural feature other than striation is required for Wall Structures No. 1 and No. 2.

Question #32: Regarding the Lump Sum drainage structures, Page A00801-204 states that existing utility locations shall be verified in the field prior to starting this work. Special Provision on page A00801-205 states the contractor shall dig test pits to verify the existing culvert dimensions prior to ordering the material and all costs shall be incidental and paid for under the lump sum price. These special provisions are repeated for all 4 wall item No.'s 997.1 through 997.4. Are test pits at the special drainage structures incidental or, will they be paid under Item 141.1-Test Pit for Exploration?

Response #32: See revised pages A00801-205, A00801-206, A00801-208, A00801-212, and A00801-214.

Question #33: Confirm excavation for culverts will be paid for under Item 141.and is not considered incidental to Item No's 997.1-997.4.

Response #33: No. The excavation for the culverts will be paid for under Item 140.

Question #34: Confirm crushed stone for bridge foundation will be paid for under Item 156.1 and is not considered incidental to Item No's 997.1-997.4.

Response #34: Confirmed. Crushed stone for the bridge foundation will be paid for under Item 156.1.

Question #35: Confirm Gravel Borrow for backfilling structures and pipes will be paid for under Item 151.2 and is not considered incidental to Item No's 997.1-997.4.

Response #35: Confirmed. Gravel borrow for backfilling structures and pipes will be paid for under Item 151.2.

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #36: Item 997.2 Special Drainage Structure No. 2 states that it is for the work required to cast-in-place the culvert extension. It then states the "The manufacturer shall submit evidence at the request of the Engineer showing that he has successfully completed work of similar magnitude prior to being approved as the source of the material for this work. The manufacturing process shall be closely supervised by experienced plant personnel and records of plastic and concrete strength shall be kept and submitted to the Engineer for control." If this work is Cast-in-Place, what is this requirement referring to? The last 4 paragraphs on Page A00801-207 go on describing precast requirements. Is the culvert extension Cast-In-Place or Precast?

Response #36: *This question will be addressed in a later addendum.*

Question #37: Item 997.2 special provision also references that the work includes the Headwalls and rip rap. Confirm that rip rap shall be paid under Item 983.1 and not as part of the Lump Sum.

Response #37: *This question will be addressed in a later addendum.*

Question #38: The Boring Log Location Plans indicates six Pavement Core locations and forty six Test Pits locations. Please provide the results of the pavement cores and test pits.

Response #38: See new Documents A00891 and A00892.

Question #39: Regarding Item 945.011-30 Inch Utility Pole Caisson-please provide the loads and pole height that the special provisions state will be provided by Eversource so that contractors can design the caisson.

Response #39: *This question will be addressed in a later addendum.*

J.H. Lynch & Sons, Inc., email dated August 4, 2020 (Continued)**:**

Question #40: Regarding Item 945.011-special provisions state the contractor is responsible for soil type determination-can MassDOT provide a soil type so all bidders are bidding on the same soil conditions similar to what is done for mast arm foundations?

Response #40: See new Documents A00891 and A00892.

Question #41: The plans for the Eliot Street retaining wall include footing elevations that differ from the elevations shown in the cross section. At station 32+50, the cross section shows the bottom of the footing for the wall slightly below 232'. The Plans show the footing to be placed at 234'. Please clarify which drawing will govern.

Response #41: *This question will be addressed in a later addendum.*

Question #42: Were any precast wall systems considered as a more cost effective option to the cast-in-place retaining walls? If so, can you provide the design information as to the reasoning that the CIP option was chosen?

Response #42: The Contractor shall bid the work as specified in the Contract Documents.

Highway Tech Signal Equipment Sales, Inc., email dated August 5, 2020:

Question #43: In regards to the light poles for Items 821.50, 821.51, 821.52,821.53. On page 173 of the special provisions it stats under "material" that "a. Pole shaft: shall be ASTM A240 201L Stainless Steel," and "c. Base Plate: ASTM A240 stainless steel with circumferential welding top and bottom, to pole." Then its states further on in the specification to paint them gloss black. Do these light poles need to be stainless steel? Would galvanized steel be considered an approved equal, how the final finish will be powder coat gloss black?

Response #43: As part of the submittal process, the Contractor may propose alternative materials.

McCourt Construction email dated August 6, 2020:

Question #44: What are the work area restrictions and allowable work hours for the full depth pavement construction work?

Response #44: *This question will be addressed in a later addendum.*

Question #45: Will existing traffic be allowed to travel on unpaved sections of the roadway?

Response #45: *This question will be addressed in a later addendum.*

Question #46: What is the length of the work zone that existing traffic can travel on unpaved sections of the roadway?

Response #46: *This question will be addressed in a later addendum.*

Question #47: Is the Contractor responsible for installing the support system for the temporary gas bypass?

Response #47: The Contractor is responsible for installing the support system for the temporary gas bypass and coordination with the gas company.

Question #48: Per the COVID 19 Guidelines and Procedures included within Article A00801, please provide the number of field stall that MassDOT will assign to the project so that the PPE that the Contractor supplies to department field personnel can be determined.

Response #48: *This question will be addressed in a later addendum.*

Question #49: Sheet No. 5, Boring Location Plan, shows Pavement Core and Test Pits. Please provide the logs and information for these subsurface investigations.

Response #49: See new Documents A00891 and A00892.

Question #50: Typical Sections shown on Sheet 13 show either 8" of existing subbase meeting Specification M1.03.0 or 8" of gravel borrow below the sidewalks, multi-use path/sidewalk, ect. Will payment of the use of the existing subbase material be paid under Item 151.2, Gravel Borrow, once it meets Specification M1.03.0?

Response #50: *This question will be addressed in a later addendum.*

Question #51: Under what bid item shall the Proposed Cement Concrete Bike Ramps be paid under?

Response #51: *This question will be addressed in a later addendum.*

Question #52: On Sheet No. 19, Construction Plans (4 of 17), proposed cement concrete curb is shown. Please add pay item for this work.

Response #52: *This question will be addressed in a later addendum.*

E.T.& L. Corp. email dated August 6, 2020:

Question #53: 6"x6" tapping sleeves are proposed at relocate hydrant locations on Rte. 126, Sta.'s 78+68 & 96+58. There is no bid item for 6"x6" tapping sleeves.

Response #53: *This question will be addressed in a later addendum.*

P. Gioioso & Sons, Inc. email dated August 10, 2020:

Question: #54: Regarding Item 120 Earth Excavation, would it be possible to add a Bid Item for excavation of existing HMA and Concrete Pavements ?

Response #54: *This question will be addressed in a later addendum.*

J.H. Lynch & Sons, Inc., email dated August 12, 2020:

Question #55: The Special Provisions for Item 755.35 state that monitoring wells shall include data loggers.
Please provide a detail of the monitoring well
Please provide information regarding the data loggers such as acceptable brands and model numbers.

Response #55: *This question will be addressed in a later addendum.*

J.H. Lynch & Sons, Inc., email dated August 13, 2020:

Question #56: The Special Provisions state "All trees, stumps, or brush not specified to remain shall be removed and shall not be stockpiled in the wetland resource areas while awaiting disposal. Work shall be coordinated with the Clearing or Tree Removal item and compensated under that Item."
Please confirm that 'that Item' refers to the Clearing and/or Tree Removal items and not Item 755.35.

The Basis of Payment states "Excavation in access of 12 needed for wetland soil will be paid under Item 120.1"
Should this read 'Excavation in access of 12 inches needed for wetland soil will be paid under Item 120.'?

Response #56: *This question will be addressed in a later addendum.*

❶ ADDENDUM NO. 1, JULY 31, 2020

DOCUMENT 00010

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❸ ADDENDUM NO. 3, AUGUST 14, 2020

❸ ADDENDUM NO. 3, AUGUST 13, 2020

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❸ ADDENDUM NO. 3, AUGUST 14, 2020

NOTICE TO CONTRACTORS (Continued)

❸ PRICE ADJUSTMENTS

This Contract contains price adjustments for hot mix asphalt and Portland cement mixtures, diesel fuel, and gasoline. For this project the base prices are as follows: liquid asphalt $485.00 per ton, Portland cement $135.98 per ton, diesel fuel $1.669 per gallon, and gasoline $1.625 per gallon. MassDOT posts the **Price Adjustments** on their Highway Division's website at https://www.mass.gov/topics/highway-construction-resources

This Contract contains Price Adjustments for steel. See Document 00813 - PRICE ADJUSTMENT FOR STRUCTURAL STEEL AND REINFORCING STEEL for their application and base prices.

MassDOT projects are subject to the rules and regulations of the Architectural Access Board (521 CMR 1.00 et seq.)

Prospective bidders and interested parties can access this information and more via the internet at WWW.COMMBUYS.COM.

BY: Stephanie Pollack, Secretary and CEO, MassDOT
Jonathan L. Gulliver, Administrator, MassDOT Highway Division
SATURDAY, JUNE 27, 2020

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General Decision Number: MA20200025 08/07/2020

Superseded General Decision Number: MA20190025

State: Massachusetts

Construction Type: Highway

County: Worcester County in Massachusetts.

HIGHWAY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage
of $10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR
5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available
at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	02/14/2020
2	08/07/2020

CARP0336-004 09/01/2019

	Rates	Fringes
CARPENTER (Includes Form Work)...	$ 41.90	29.00

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* ELEC0103-007 03/01/2020

	Rates	Fringes
ELECTRICIAN.....	$ 53.50	38.00

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* ENGI0004-030 06/01/2020

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
Group 1.....	$ 48.73	29.25+A
GROUP 1.....	$ 49.33	29.75+a
Group 2.....	$ 48.23	29.25+A
GROUP 2.....	$ 48.81	29.75+a

FOOTNOTE FOR POWER EQUIPMENT OPERATORS:
A. PAID HOLIDAYS: New Year's Day, Washington's Birthday,
Labor Day, Memorial Day, Independence Day, Patriot's Day,
Columbus Day, Veteran's Day, Thanksgiving Day, Christmas Day

POWER EQUIPMENT OPERATORS CLASSIFICATIONS
Group 1: Backhoe/Excavator/Trackhoe; Bobcat/Skid Steer/Skid
Loader; Broom/Sweeper; Gradall; Loader; Paver (Asphalt,
Aggregate, and Concrete); Post Driver (Guardrail/Fences)
Group 2: Bulldozer; Grader/Blade; Roller

ENGI0004-031 12/01/2017

	Rates	Fringes
POWER EQUIPMENT OPERATOR:		

(Milling Machine).....$ 29.80 26.66+A

FOOTNOTE FOR POWER EQUIPMENT OPERATORS:
A. PAID HOLIDAYS: New Year's Day, Washington's Birthday,
Labor Day, Memorial Day, Independence Day, Patriot's Day,
Columbus Day, Veteran's Day, Thanksgiving Day, Christmas Day

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* IRON0007-028 09/16/2019

	Rates	Fringes
IRONWORKER, STRUCTURAL	$ 47.09	32.81

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* IRON0007-029 09/16/2019

	Rates	Fringes
IRONWORKER, ORNAMENTAL	$ 47.39	32.81

LABO0039-003 06/01/2018

	Rates	Fringes
LABORER		
Asphalt, Includes Raker, Shoveler, Spreader and Distributor	$ 33.50	22.92
Common or General	$ 33.25	22.92
Guardrail Installation	$ 33.50	22.92

PAIN0035-023 07/01/2019

	Rates	Fringes
PAINTER (Steel)	$ 50.66	30.90

SUMA2014-015 01/11/2017

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 56.70	21.08
IRONWORKER, REINFORCING	$ 56.48	20.62
LABORER: Concrete Saw (Hand Held/Walk Behind)	$ 41.78	18.37
LABORER: Landscape	$ 40.39	17.68
OPERATOR: Crane	$ 52.14	21.08
OPERATOR: Forklift	$ 64.67	0.00
OPERATOR: Mechanic	$ 48.14	17.02
OPERATOR: Piledriver	$ 44.46	16.94
PAINTER: Spray (Linestriping)	$ 48.00	0.00
PILEDRIVERMAN	$ 45.65	23.33
TRAFFIC CONTROL: Flagger	$ 23.00	20.44
TRAFFIC CONTROL: Laborer-Cones/ Barricades/Barrels - Setter/Mover/Sweeper	$ 44.49	12.41
TRUCK DRIVER: Concrete Truck	$ 33.69	15.79
TRUCK DRIVER: Dump Truck	$ 30.38	7.20
TRUCK DRIVER: Flatbed Truck	$ 48.53	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave
for Federal Contractors applies to all contracts subject to the
Davis-Bacon Act for which the contract is awarded (and any
solicitation was issued) on or after January 1, 2017. If this
contract is covered by the EO, the contractor must provide
employees with 1 hour of paid sick leave for every 30 hours
they work, up to 56 hours of paid sick leave each year.
Employees must be permitted to use paid sick leave for their
own illness, injury or other health-related needs, including
preventive care; to assist a family member (or person who is
like family to the employee) who is ill, injured, or has other
health-related needs, including preventive care; or for reasons
resulting from, or to assist a family member (or person who is
like family to the employee) who is a victim of, domestic
violence, sexual assault, or stalking. Additional information
on contractor requirements and worker protections under the EO
is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within
the scope of the classifications listed may be added after
award only as provided in the labor standards contract clauses
(29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification
and wage rates that have been found to be prevailing for the
cited type(s) of construction in the area covered by the wage

determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that

no one rate prevailed for this classification in the survey and
the published rate is derived by computing a weighted average
rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates
the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates
the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007
in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion
date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a
new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union
average rate. OH indicates the state. The next number, 0010 in
the example, is an internal number used in producing the wage
determination. 08/29/2014 indicates the survey completion date
for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of
each year, to reflect a weighted average of the current

negotiated/CBA rate of the union locals from which the rate is
based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can
be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on
  a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests
for summaries of surveys, should be with the Wage and Hour
Regional Office for the area in which the survey was conducted
because those Regional Offices have responsibility for the
Davis-Bacon survey program. If the response from this initial
contact is not satisfactory, then the process described in 2.)
and 3.) should be followed.

With regard to any other matter not yet ripe for the formal
process described here, initial contact should be with the
Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an
interested party (those affected by the action) can request

review and reconsideration from the Wage and Hour Administrator
(See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the
interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an
interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

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❸ ADDENDUM NO. 3, AUGUST 14, 2020

ITEM 701.31 STAMPED CEMENT CONCRETE PAVEMENT SQUARE YARD

The work under this item shall conform to the relevant provisions of Subsection 476 of the Standard Specifications and the following:

Stamped cement concrete pavement shall consist of red colored stamped cement concrete around the central island and perimeter of the roundabout as shown on the plans. The cement concrete shall be 9 inches in thickness. A stamped brick pattern shall be utilized.

❸ Cement concrete shall be reinforced with 6”x6”x10” gauge welded steel fabric. Reinforcement shall be placed approximately 4” from the bottom of the concrete.

❸ The 12”x12” slate stone band is a band with a different stamp pattern that is comprised of 12”x12” squares textured to look like stone. The field will be a running bond brick stamp pattern as stated in the special provision. The 12” by 12” slate stone band shall be placed at one edge of all visible joints as shown on the drawing. Note that all colored stamped concrete will be red brick color. The slate stone band is part of the same pour as the adjacent brick pattern.

The cement concrete shall be an integrally colored cast in place concrete admixture formulated by L. M. Scofield (201-672-9050), Davis Colors (800-638-4444), Butterfield Color (1-800-282-3388), or an approved equal. The color shall be a red brick color and a sample color shall be sumitted for approval by the Engineer.

The Contractor shall submit for approval, the complete technical data sheets for the colored admixture, curing compound, design mixes, color sample, and stamped brick pattern.

The Installer shall have a minimum of 5 years of experience installing colorized cast in place concrete in similar applications.

The Contractor shall install in place, an integrally colored concrete mockup for the cement concrete truck apron. The mockup shall be a minimum of 3 square yards. For accurate color, the quantity of concrete mixed to produce the sample should not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. The constructed mockup shall use processes and techniques intended for use on the permanent work, including curing procedures.

The Contractor shall include samples of control, construction, stamped brick pattern, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work. The accepted mockup provides the visual standard for work and shall remain through completion of the work for use as a quality standard for the finished work.

Concrete materials and design shall be per Manufacturer’s recommendations. Admixture shall be added per Manufacturer’s recommendations.

Concrete mockup shall be allowed to cure for one month prior to review for color acceptance. Construct as many mockups as required by the Engineer until satisfactory colors and patterns are provided. The mockup will not be part of the finished work.

ITEM 701.31 (Continued)

Method of Measurement
Item 701.31 will be measured per Square Yard of stamped concrete pavement installed, complete in place.

Basis of Payment
Item 701.31 will be paid for at the contract unit price per Square Yard. This price shall include all labor, materials, preformed joint filler, smooth dowels bars, equipment, and incidentals necessary to complete the work.

ITEM 703.9 IMPRINT CROSSWALK SYSTEM SQUARE FOOT

This work under this item shall consist of furnishing and installing a colored imprint crosswalk system as detailed on the plans in accordance with these specifications, and as required by the Engineer.

The imprint crosswalk system shall be constructed to the lines and grades shown on the plans.

Also included under this item are all materials, labor, sawcuts, milling and base preparation.

The imprint crosswalk system shall consist of a hot applied, polymer modified, synthetic asphalt compound incorporating graded sand and granite aggregates, reinforced with two types of fibers. The system shall be applied over the pavement substrates to create a functional and decorative mid-block textured pavement as shown on the Drawings.

All materials shall be produced under a quality system in accordance with ISO 9002 series, and designed to provide durability, load carrying capacity and architectural compatibility with the environment. All raw materials shall be carefully graded for consistency and quality.

The imprint crosswalk system shall be installed flush and level with the pavement surface.

Only installers authorized by the manufacturers of the imprint concrete system product may perform this work.

❸ ADDENDUM NO. 3, AUGUST 14, 2020

ITEM 813.30	**WIRE TYPE 7 NO. 10 GENERAL PURPOSE**	**FOOT**
ITEM 813.33	**WIRE TYPE 7 NO. 4 GENERAL PURPOSE**	**FOOT**
ITEM 813.34	**WIRE TYPE 7 NO. 2 GENERAL PURPOSE**	**FOOT**
ITEM 813.35	**WIRE TYPE 7 NO. 1 GENERAL PURPOSE**	**FOOT**

The work under these items shall conform to the relevant provisions of Subsections 813 and 820 of the Standard Specifications and the following:

The work shall include furnishing and installing the electrical wire having XHHW insulation for the street lighting system as shown on the plans and as required by the Engineer.

ITEM 813.399 **SPLICE AND EXTENSION FROM HANDHOLE TO LIGHTING FIXTURES** **EACH**

The work under this item shall conform to the relevant provisions of Subsection 813 of the Standard Specifications and the following:

The work shall include the splicing of branch circuits for the luminaries and pole mounted receptacles from the adjacent handholes to the pole base access.

The work under this item shall include all splicing and wiring extension from the handhole to the lighting fixture for branch circuitry and also the supplemental equipment grounding from pole ground bar to the handhole grounding rod. See plans for details.

❸ All wire for light fixtures and receptacles shall be Wire Type 7 No. 10 General Purpose.

Method of Measurement
Item 813.399 will be measured by the unit Each, complete, in place, and approved.

Basis of Payment
Item 813.399 will be paid for at the contract unit price, per Each, whichce price shall include all labor, materials, equipment, and incidentals necessary to complete the work.

❸ All No. 10 wire used for lighting fixtures and receptacles will be paid for under Item 813.30..

ITEM 815.1	**TRAFFIC CONTROL SIGNAL LOCATION NO. 1**	**LUMP SUM**
ITEM 815.2	**TRAFFIC CONTROL SIGNAL LOCATION NO. 2**	**LUMP SUM**
ITEM 815.3	**TRAFFIC CONTROL SIGNAL LOCATION NO. 3**	**LUMP SUM**
ITEM 816.80	**TRAFFIC CONTROL SIGNAL REMOVED AND STACKED**	**LUMP SUM**
ITEM 816.801	**TRAFFIC CONTROL SIGNAL REMOVED AND STACKED**	**LUMP SUM**

The work under these items shall conform to the relevant provisions of Subsection 800, "Traffic Control Devices" of the MassDOT Standard Specifications for Highway and Bridges, the 2009 Manual on Uniform Traffic Control Devices (MUTCD), and the following:

The traffic control signal work shall consist of furnishing and installation of part or all of the following items: traffic signal controller, cabinet and foundation, signal posts and bases, mast arm assemblies with anchor bolts and foundations, signal housing, retroreflective backplates, loop vehicle and bicycle detectors, pedestrian signals with countdown timers and audible warning devices, pedestrian push buttons with signage, emergency vehicle preemption, wires, cables, ground rods, equipment grounding and bonding, and traffic control equipment, also making all electrical connections, tying in electrical service connections and providing all incidental equipment, materials and incidental costs necessary for fully operation and controlling the traffic control signals as specified herein and as shown on the plans at the following locations:

Traffic Control Signal Locations
Loc. No. 1: Route 126 at Eliot Street

Loc. No. 2: Route 126 at Algonquin Trail / Harvard Street

Loc. No. 3: Route 126 at Market Basket Driveway

Removing and stockpiling of existing traffic control signal installations is shown on the applicable signal plans at the following locations:

Traffic Control Signal Removed and Stacked Locations
Loc. No. 1: Route 126 at Eliot Street

Loc. No. 2: Route 126 at Market Basket Driveway

General Requirements
A list of the major traffic signal items required is included on the traffic signal plans.

All traffic signal equipment shall comply with the MassDOT Qualified Traffic Control Equipment (QTCE) List unless otherwise approved by the Engineer.

Within 30 days following Notice to Proceed, the Contractor shall submit a list of equipment and manufacturer's equipment specifications he proposes to install to the Engineer in accordance with the relevant provisions of Section 815.20. No equipment or accessories will be accepted unless type tested and approved by the MassDOT - Highway Division prior to the date of proposal.

❸ ADDENDUM NO. 3, AUGUST 14, 2020

ITEM 991.11 through **ITEM 991.14** (Continued)

The Contractor shall prepare working drawings in which the materials and methods of control of water are shown for approval by the Engineer. The working drawings shall be submitted for the proposed type of dewatering systems, arrangement, location and depths of system components, the method of disposal of pumped water, and a description of equipment and instrumentation to be used. Design computations shall be submitted for all parts of the dewatering system as applicable. The working drawings shall be certified by a Professional Engineer registered in the Commonwealth of Massachusetts. Approval of the working drawing does not relieve the Contractor of the responsibility of providing for the safety of the work and the successful completion of the project.

The Contractor shall submit a plan for management of surface and groundwater flow and potential sedimentation thereof during the installation period to the Engineer and Ashland Conservation Commission for approval prior to any work. Contractor to control surface and groundwater through the duration of the project including the stabilization period after completion of construction activities and as per the Ashland Conservation Commission.

The dewatering system shall reduce the hydrostatic pressure and lower the groundwater levels a minimum of 12 inches below the bottom of excavation elevations indicated on the Plans. All concrete work shall be done in the dry. The dewatering system shall prevent heaving of the bottom of the excavation, and shall not result in damage to adjacent properties, structures, utilities, and other work. Acceptable dewatering methods include sump pumping, single or multiple stage well point systems, eductor, and ejector type systems, deep wells or combinations thereof. Temporary surface water control measures shall be provided to prevent surface water from entering the excavation. A sufficient number of pumps with adequate capacity shall be provided at the site. Provisions shall be made for having backup power generation and groundwater control system components available for maintaining continuous operations should failure of the primary equipment occur.

Dewatering procedures that cause or threaten to cause damage to new or existing construction shall be modified by the Contractor at no additional expense to the Department.

The dewatering system shall be installed, maintained, and removed in such a manner as to prevent movement, settlement, loss of ground or damage to new and existing structures.

Collection and disposal of groundwater discharge shall be performed, in accordance with all Federal, State, and local codes, rules and regulations. Sedimentation control shall be used to segregate silt from the groundwater that is recharged into the brook outside of the limits of excavation. Pumped groundwater shall not be discharged into the roadway Right-of-Way.

Basis of Payment

❸ Items 991.11 through 991.14 shall be paid for at the respective contract unit price, Lump Sum. This price shall be full compensation for the design of the water control systems, all labor, materials, equipment, transportation, maintenance, removal and disposal of materials and structures, and incidentals necessary to complete the work.

❸ For non-contaminate water, payment for pumping water, storage tanks, testing, labor, equipment, materials, and incidentals necessary to perform the work will be paid for under the pertinent items, Items 991.11 through 991.14.

ITEM 992.33 COORDINATION AND SUPPORT OF GAS MAINS AT CULVERTS LUMP SUM

The work under this item shall conform to the relevant provisions of Subsection 900 of the MassDOT Standard Specifications and the following:

Work included under this item shall include the installation of temporary support systems for the active 12-inch and 16-inch gas mains, and the temporary by-pass for the 8-inch gas main at the various culvert replacement locations. This work shall be performed at the locations identified on the plans and per the direction and plan details provided by Eversource Engineering. Eversource shall be given a minimum of 72 hours' notice prior to any work at these locations, as well as any construction occurring within 50 feet of the Eversource Station near Butterfield Drive.

8-INCH GAS BYPASS LOCATIONS

Work included under this heading includes coordination with the gas company and the installation of support systems to carry the temporary bypass relocation of the newly installed 8-inch plastic intermediate pressure gas line at the locations shown on the plans and per the details and direction provided by Eversource Gas. The Contractor shall coordinate the exact layout of the bypass with Eversource Gas. The support systems shall be provided at the culvert replacements located at approximate stations 37+50, 80+40, and 90+15 with minimal disturbance to adjacent wetlands. Once Eversource installs the bypass onto the supports, and cuts and caps the 8-inch main, the Contractor shall remove the cut section of the 8-inch main. Once the Contractor installs the culverts, Eversource will re-install the 8-inch main and remove the by-pass piping prior to final backfilling, restoration, and paving by the Contractor. The Contractor shall remove and dispose all support systems and restore the area disturbed by the temporary support system back to its original condition.

SUPPORT OF 12-INCH AND 16-INCH HIGH PRESSURE GAS

Work under this heading includes coordination with the gas company and installation of support systems to carry the existing 12-inch and 16-inch high pressure gas mains at the locations shown on the plans and per the details and direction provided by Eversource Gas. The support systems shall be provided at the culvert replacements located at approximate stations 80+40 and 90+15.

Basis of Payment:
Item 992.33 will be paid for at the contract unit price, Lump Sum. This price shall include, labor, materials, equipment, coordination with Eversource Gas, site preparation, excavation, installing support systems, backfilling, removal of recently installed 8-inch gas line in the vicinity of the culverts, removal of temporary supports, site restoration, and incidentals necessary to complete the work..

❸ ADDENDUM NO. 3, AUGUST 14, 2020

ITEM 997.1 (Continued)

The Contractor shall dig test pits to verify the dimensions of the existing culvert prior to ordering the material and all costs shall be incidental and be paid for under the lump sum price.

NATURAL STREAMBED MATERIAL

The work under this heading shall consist of installation of natural streambed material within the bottom of the culvert to provide a natural streambed for aquatic organisms. The natural streambed construction material is to be placed within the bottom 6" of the culvert with baffles on each end, as depicted on the plans.

The intent of this work is to ensure a natural streambed within the culvert, to provide fisheries and wildlife habitat enhancement as part of the wetland replication area and natural wetlands. The natural streambed material shall be comprised of the stones 4 inches and under, that shall meet the following gradation:

Sieve opening	Percent by Mass Passing Through
4"	95
2"	55 – 65
¾"	30 – 45
#4	0 – 5

Partially angular rock is preferred over round and shall be able to lock together to prevent movement during high flows. Crushed Stone will not be accepted for any components. The inlet/outlet elevations of the proposed culvert shall match the proposed plans.

Construction of Special Drainage Structure
Work shall include removal and disposal of the existing 2'Wx2'H box culvert and existing headwalls and installing the new box culvert and new cast-in-place headwalls.

The precast concrete box culvert shall be constructed as shown on the Plans.

All precast units shall be carefully loaded, hauled, stored and erected to prevent damage. They shall be erected by experienced workmen, true to the lines and grades as shown on the Plans or directed by the Engineer. Any members superficially damaged during shipment or erection shall be rejected and shall be repaired by experienced workmen. Units badly damaged shall be rejected and shall be replaced with new units at no additional cost to the Owner. The Engineer shall be the sole judge of this damage. No holes shall be cut or drilled in the field without written approval of the Engineer.

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❸ ADDENDUM NO. 3, AUGUST 14, 2020
❶ ADDENDUM NO. 1, JULY 31, 2020

ITEM 997.1 (Continued)

❸ **Basis of Payment**

This Item will be paid for at the contract unit price per lump sum installed and completed in place. The Special Drainage Structure lump sum price shall include full compensation for all labor, materials, tools and equipment, test pits, removal, delivery and disposal at an approved landfill, the cost for approvals, testing, transportation, and other incidental expenses necessary to complete this Item.

Schedule of Basis for Partial Payments

Within ten days after the Notice to Proceed, the Contractor shall submit a schedule of unit prices for the major component Sub-Items that make up Item 997.1 as well as his/her total drainage structure Lump Sum cost for the Special Drainage Structure No. 1. The drainage structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual drainage components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 997.1 and no further compensation will be allowed.

The schedule on the proposal form applies only to Special Drainage Structure No. 1. Payment for similar materials and construction at locations other than at this drainage structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

Sub-Item	Description	Quantity	Unit	Unit Price	Total
901.	4000 PSI, 1.5 IN., 565 CEMENT CONCRETE	80	CY		
904.3	5000 PSI, ¾ IN., 685 HP CEMENT CONCRETE	10	CY		
910.2	Steel Reinforcement for Structures – Coated	2000	LB		
❶ 970.	Damp-Proofing	1305	SF		
983.52.	Natural Streambed Material	5	CY		
				Total Cost of Item 997.1=	

ITEM 997.2 SPECIAL DRAINAGE STRUCTURE NO.2 LUMP SUM

The work under this Item shall conform to the relevant provisions of Subections 901, 904, 910, 967, 970 and 983 of the Standard Specifications, and the following:

The work under this Item shall consist of furnishing all labor, materials, tools and equipment and the performance of all work required to furnish and install the 5'Wx3'H cast-in-place concrete box culvert extension at Sta. 41+98.85, the cast-in-place Headwalls, and riprap as shown on the plans.

The manufacturer shall submit evidence at the request of the Engineer showing that he has successfully completed work of similar magnitude prior to being approved as the source of the material for this work. The manufacturing process shall be closely supervised by experienced plant personnel and records of plastic and concrete strength shall be kept and submitted to the Engineer for control.

Materials
Materials shall meet the requirements specified in the following subsections of Division III, Materials Specifications of the Standard Specifications:

Cement Concrete	M4.02
Epoxy Coated Reinforcing Bars	M8.01.7
Stone for Pipe Ends	M2.02.3
Crushed Stone	M2.01.3
Geotextile Fabric	M9.50.0

The payment for Stone for Pipe Ends, Crushed Stone and Geotextile Fabric shall be paid under their respective items.

The precast box culvert (5'x3') shall be reinforced concrete and shall be manufactured in accordance with ASTM C76 standard specifications for reinforced concrete culvert. The culvert shall be designed to support an HS-20 (32,000 lbs.) truck axle load and dead load from earth cover over the top of the culvert as shown on the plans, and shall conform to all applicable 2017 AASHTO LRFD Bridge Design Specifications with current interim Specifications .

The Contractor shall submit shop drawings and structural calculations stamped by an Engineer registered in the Commonwealth of Massachusetts for approval as specified in Section 5.02 of the Standard Specifications. The shop drawings shall show the size and location of all inserts and openings as shown on the Plans.

Existing utility locations shall be verified in the field prior to starting this work. The Contractor shall provide the Engineer with a plan showing existing utility locations and elevations prior to undertaking this work.

The Contractor shall dig test pits to verify the dimensions of the existing culvert prior to ordering the material. All costs shall be incidental and be paid for under the lump sum price.

❸ ADDENDUM NO. 3, AUGUST 14, 2020

ITEM 997.2 (Continued)

Construction of Special Drainage Structure
Work shall include removal and disposal of existing headwalls and installing new culvert connecting to existing culvert and installation of new cast-in-place headwalls.

The cast-in-place concrete box culvert shall be constructed as shown on the Plans.

Repair of Existing Culvert
The work to be performed shall include the repair of the existing Culvert. The culvert has a clear opening of approximately 5' wide x 3' high. The repairs shall be done within the limits of the culvert in accordance with these specifications and as shown on the plans and all the repair areas of the culvert shall be identified and located by the Engineer in the field. Below is the summary of the repairs based on inspection finding memo dated 10/9/2019.

1. Clean the stone masonry, as necessary.
2. Fill the voids in masonry walls and roof slab with MassDOT approved material or material from MassDOT QCML or grout bags.
3. Clear all the vegetation growing from stone masonry.
4. Clear all debris and vegetation from the channel.
5. Replace all chinking stones and fill voids with grout bags.

For the repair methods, material manufacturer's recommendations shall be utilized. All materials, labor and equipment necessary for the repair shall be incidental to Item 997.2.

❸ **Basis of Payment**
Item 997.2 will be paid for at the contract unit price, Lump Sum, installed and completed in place. This price shall include full compensation for all labor, materials, tools, equipment, test pits, removal, delivery and disposal at an approved landfill, the cost for approvals, testing, transportation, the removal and disposal of existing headwalls, installing new culvert connecting to existing culvert, control of water, installing new cast-in-place headwalls, and incidentals necessary to complete this Item.

Schedule of Basis for Partial Payments
Within 10 days of the Notice to Proceed, the Contractor shall submit their proposal form a schedule of unit prices for the major component Sub-Items that make up Item 997.2 as well as their total drainage structure Lump Sum cost for the Special Drainage Structure No. 2. The drainage structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual drainage components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 997.2 and no further compensation will be allowed.

ITEM 997.3 (Continued)

The Contractor shall dig test pits to verify the dimensions of the existing culvert prior to ordering the material. All costs shall be incidental and be paid for under the lump sum price.

The work under this item shall consist of installation of natural streambed material within the bottom of the culvert to provide a natural streambed for aquatic organisms. The natural streambed construction material is to be placed within the bottom 6" of the culvert with baffles on each end, as depicted on the plans.

The intent of this item is to ensure a natural streambed within the culvert, to provide fisheries and wildlife habitat enhancement as part of the wetland replication area and natural wetlands. The natural streambed material shall be comprised of the stones 4 inches and under, that shall meet the following gradation:

Sieve opening	Percent by Mass Passing Through
4"	95
2"	55 – 65
¾"	30 – 45
#4	0 – 5

Partially angular rock is preferred over round and shall be able to lock together to prevent movement during high flows. Crushed Stone will not be accepted for any components. The inlet/outlet elevations of the proposed culvert shall match the proposed plans.

Construction of Special Drainage Structure
Work shall include removal and disposal of the existing 3'Wx2'H box culvert and existing headwalls and installing the new box culvert and new cast-in-place headwalls.

The precast concrete box culvert shall be constructed as shown on the Plans.

All precast units shall be carefully loaded, hauled, stored and erected to prevent damage. They shall be erected by experienced workmen, true to the lines and grades as shown on the Plans or directed by the Engineer. Any members superficially damaged during shipment or erection shall be rejected and shall be repaired by experienced workmen. Units badly damaged shall be rejected and shall be replaced with new units at no additional cost to the Owner. The Engineer shall be the sole judge of this damage. No holes shall be cut or drilled in the field without written approval of the Engineer.

❸ ADDENDUM NO. 3, AUGUST 14, 2020
❶ ADDENDUM NO. 1, JULY 31, 2020

ITEM 997.3 (Continued)

❸ **Basis of Payment**

Item 997.3 will be paid for at the contract unit price, Lump Sum. This price shall include all labor, materials, tools, test pits, the removal and disposal of existing headwalls, installing new culvert connecting to existing culvert, control of water, installing new cast-in-place headwalls, equipment, removal, delivery and disposal at an approved landfill, the cost for approvals, testing, transportation, and incidentals necessary to complete the work.

SCHEDULE OF BASIS FOR PARTIAL PAYMENTS

Within 10 days of the Notice to Proceed, the Contractor shall submit their proposal form a schedule of unit prices for the major component Sub-Items that make up Item 997.3 as well as their total drainage structure Lump Sum cost for the Special Drainage Structure No. 3. The drainage structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual drainage components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 997.3 and no further compensation will be allowed.

The schedule on the proposal form applies only to Special Drainage Structure No. 3. Payment for similar materials and construction at locations other than at this drainage structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

Special Drainage Structure No. 3

Sub-Item	Description	Quantity	Unit	Unit Price	Total
901	4000 PSI, 1.5 IN., 565 CEMENT CONCRETE	30	CY		
904.3	5000 PSI, ¾ IN., 685 HP CEMENT CONCRETE	10	CY		
910.2	Steel Reinforcement for Structures – Coated	900	LB		
❶ 970.	Damp-Proofing	1575	SF		
983.521.	Natural Streambed Material	10	CY		

Total Cost of Item 997.3= _____

ITEM 997.4 SPECIAL DRAINAGE STRUCTURE NO.4 LUMP SUM

The work under this Item shall conform to the relevant provisions of Subsections 901, 904, 910, 967, 970 and 983 of the Standard Specifications, and the following:

The work under this Item shall consist of furnishing all labor, materials, tools and equipment and the performance of all work required to furnish and install the 4'Wx2'H precast concrete box culvert at Sta. 90+14.32, the cast-in-place Headwalls, and riprap as shown on the plans.

The manufacturer shall submit evidence at the request of the Engineer showing that he has successfully completed work of similar magnitude prior to being approved as the source of the material for this work. The manufacturing process shall be closely supervised by experienced plant personnel and records of plastic and concrete strength shall be kept and submitted to the Engineer for control.

Materials
Materials shall meet the requirements specified in the following subsections of Division III, Materials Specifications of the Standard Specifications:

Cement Concrete	M4.02
Epoxy Coated Reinforcing Bars	M8.01.7
Stone for Pipe Ends	M2.02.3
Crushed Stone	M2.01.3
Geotextile Fabric	M9.50.0

The payment for Stone for Pipe Ends, Crushed Stone and Geotextile Fabric shall be paid under their respective items.

The precast box culvert (4'x2') shall be reinforced concrete and shall be manufactured in accordance with ASTM C76 standard specifications for reinforced concrete culvert. The culvert shall be designed to support an HS-20 (32,000 lbs.) truck axle load and dead load from earth cover over the top of the culvert as shown on the plans, and shall conform to all applicable 2017 AASHTO LRFD Bridge Design Specifications with current interim Specifications .

The Contractor shall submit shop drawings and structural calculations stamped by an Engineer registered in the Commonwealth of Massachusetts for approval as specified in Section 5.02 of the Standard Specifications. The shop drawings shall show the size and location of all inserts and openings as shown on the Plans.

Existing utility locations shall be verified in the field prior to starting this work. The Contractor shall provide the Engineer with a plan showing existing utility locations and elevations prior to undertaking this work.

The Contractor shall dig test pits to verify the dimensions of the existing culvert prior to ordering the material. All costs shall be incidental and be paid for under the lump sum price.

❸ ADDENDUM NO. 3, AUGUST 14, 2020

ITEM 997.4 (Continued)

Construction of Special Drainage Structure
Work shall include abandonment of existing culverts and removal and disposal of headwalls, installing new culvert connecting to the new special drainage manholes and new headwall, and installation of new cast-in-place headwalls.

The precast concrete box culvert shall be constructed as shown on the Plans.

All precast units shall be carefully loaded, hauled, stored and erected to prevent damage. They shall be erected by experienced workmen, true to the lines and grades as shown on the Plans or directed by the Engineer. Any members superficially damaged during shipment or erection shall be rejected and shall be repaired by experienced workmen. Units badly damaged shall be rejected and shall be replaced with new units at no additional cost to the Owner. The Engineer shall be the sole judge of this damage. No holes shall be cut or drilled in the field without written approval of the Engineer.

❸ **Basis of Payment**
Item 997.4 will be paid for at the contract unit price, Lump Sum, installed and completed in place. This price shall include full compensation for all labor, materials, tools, equipment, test pits, the removal and disposal of existing headwalls and installing new culvert connecting to existing culvert, control of water, and installing new cast-in-place headwalls, delivery and disposal at an approved landfill, the cost for approvals, testing, transportation, and incidentals necessary to complete the work.

SCHEDULE OF BASIS FOR PARTIAL PAYMENTS

Within 10 days of the Notice to Proceed, the Contractor shall submit their proposal form a schedule of unit prices for the major component Sub-Items that make up Item 997.4 as well as their total drainage structure Lump Sum cost for the Special Drainage Structure No. 4. The drainage structure Lump Sum breakdown quantities provided in the proposal form are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual drainage components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 997.4 and no further compensation will be allowed.

The schedule on the proposal form applies only to Special Drainage Structure No. 4. Payment for similar materials and construction at locations other than at this drainage structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

DRAWINGS AND SKETCHES

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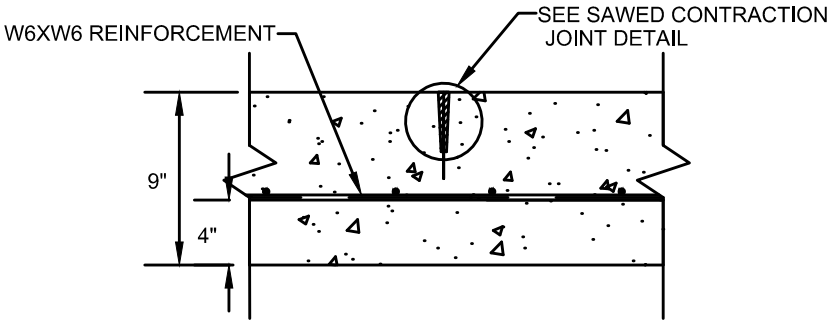

TYPICAL SECTION THRU CONTRACTION JOINT
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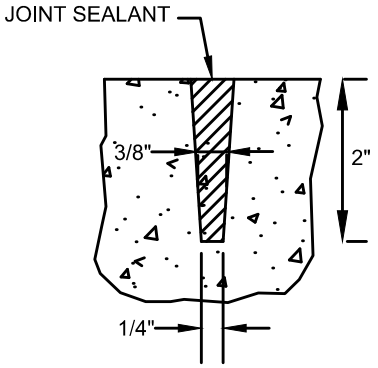

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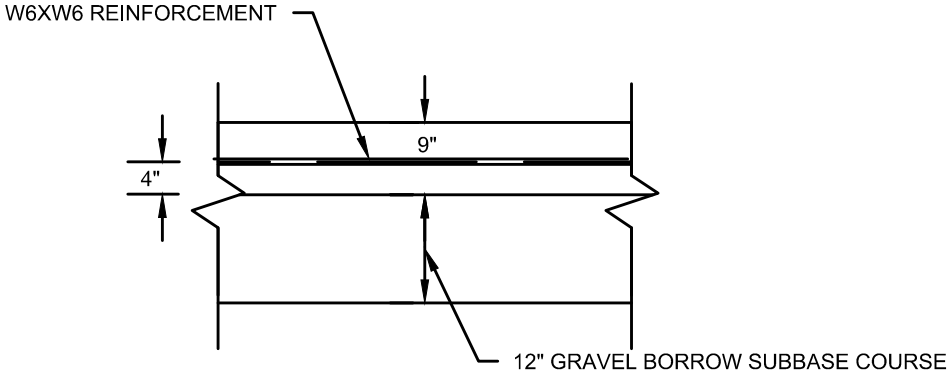

TYPICAL STAMPED CONCRETE SECTION
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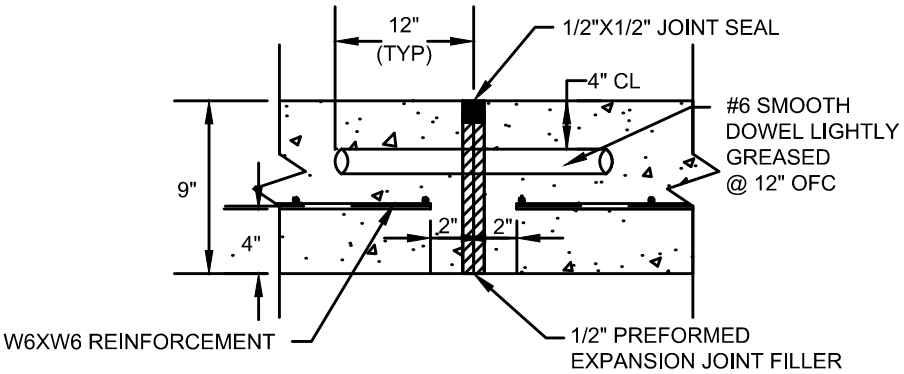

TYPICAL SECTION THRU EXPANSION JOINT
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MAST ARM
FOUNDATION DESIGN

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Mast Arm Foundation Design

for

Massachusetts Department of Transportation – Highway Division

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Project File No. 604123

Proposed Mast Arms MA-1 to MA-6

for

Route 126 (Pond Street)

Ashland, Massachusetts

Date: 04/15/2020

Prepared for:
Green International Affiliates, Inc.
239 Littleton Road, Suite 3
Westford, Massachusetts 01886
Phone: 978-923-0400

Prepared by:
Lamson Engineering Corporation
437 Cherry Street, Room # 109
Newton, Massachusetts 02465
Phone: 617-558-0101

LAMSON ENGINEERING CORPORATION
437 Cherry Street, Room # 109, Newton, Massachusetts 02465
Phone: 617-558-0101

April 15, 2020

Memorandum

Subject: MassDOT Project File Number: 604123
Mast Arm Foundation Design for Mast Arms MA-1 to MA-6
Route 126 (Pond Street), Ashland, MA

We have performed mast arm foundation design for Mast Arm No. MA-1 to MA-6 for the referenced project along Route 126 (Pond Street), Ashland, Massachusetts.

Based on the information obtained from Borings B-1, B-3, B-4, and B-7; Mast Arm No. MA-1 to MA-5 can be supported by 3'-6" diameter drilled shaft socketed 3'-0" into bedrock. If bedrock is encountered above 12' below the top of the drilled shaft, the total embedment depth (soil + rock) need not exceed 12'-0". If bedrock is not encountered 12' below the top of the drilled shaft, drilled shaft should be embedded 12'-0" into soil.

Based on the information obtained from Boring B-9, Mast Arm No. MA-6 can be supported by 3'-6" diameter drilled shaft embedded 12'-0" into soil.

For detail summary of each mast arm type, see Summary on Page 1 of the calculations.

TABLE OF CONTENT

LAMSON ENGINEERING CORPORATION			Final Page No.: 1
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 4/2020
Detail:	Summary	Checked by: WD	Date: 4/2020

Summary of Drilled Shaft Resistance

For 3.5' diameter drilled shaft:

Mast Arm Foundation - Drilled Shaft Resistance							
Mast Arm	Foundation Type	Reference Boring Number	Nominal Vertical Resistance (kips)	Factored Vertical Resistance (kips)	Factored Vertical Load (kips)	Design Drilled Shaft Soil Embedment Depth, L_s (ft)	Design Drilled Shaft Rock Socket Length, L_R (ft)
MA-1	Drilled Shaft socketed into bedrock or embeded into soil (Note 2)	B-1	3289 (Note 3)	1702 (Note 3)	21.1	12.0	3.0
MA-2	Drilled Shaft socketed into bedrock or embeded into soil (Note 2)	B-3	3289 (Note 3)	1702 (Note 3)	21.5	12.0	3.0
MA-3	Drilled Shaft socketed into bedrock or embeded into soil (Note 2)	B-3	3289 (Note 3)	1702 (Note 3)	23.1	12.0	3.0
MA-4	Drilled Shaft socketed into bedrock or embeded into soil (Note 2)	B-7	3289 (Note 3)	1702 (Note 3)	11.7	12.0	3.0
MA-5	Drilled Shaft socketed into bedrock or embeded into soil (Note 2)	B-4	3289 (Note 3)	1702 (Note 3)	19.7	12.0	3.0
MA-6	Drilled Shaft embeded into soil	B-9	163.3	83.5	24.2	12.0	-

Notes:

1. Water table was assumed to be at the top of drilled shaft for each mast arm foundation.

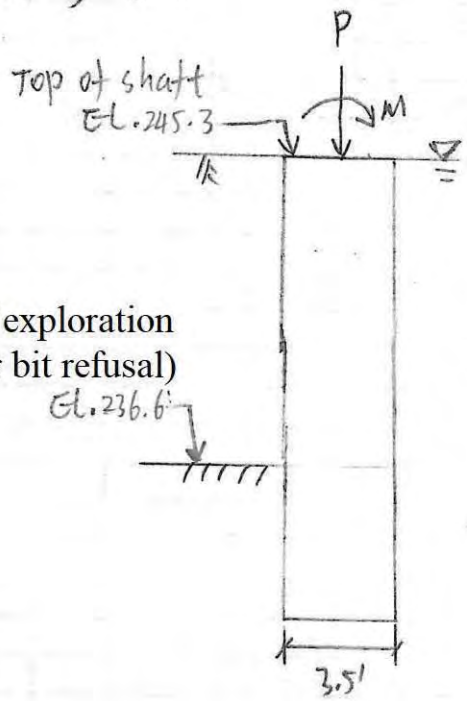
2. If bedrock is encountered above 12' below the top of the drilled shaft, 3'-0" sock socket is required for the drilled shaft but the total embedment depth (soil + rock) shall not exceed 12'-0". If bedrock is not encountered above 12' below the top of the drilled shaft, drilled shaft can be embeded 12'-0" into soil.

3. The nominal and factored vertical resistance is based on drilled shaft socketed 3'-0" into bedrock. Uniaxial compressive strength of rock is assumed to be 4000 psi (concrete) for conservative.

LAMSON ENGINEERING CORPORATION			Final Page No: 2	
Project: Route 126, Ashland		Job No:	Preliminary Sheet No:	
Subject: Mast Arm Foundation		Prepared by: JJL	Date:	10/2019
Detail: MA-1		Checked by: WD	Date:	10/2019

MA-1 Foundation

Based on Boring B-1



Medium Dense Sand

$\phi = 32°$

$\gamma = 120$ pcf

LAMSON ENGINEERING CORPORATION				Final Page No.:	3
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-1	Checked by:	WD	Date:	10/2019

Determine Unfactored Horizontal Loads

Effective angle of internal friction ϕ'_f	=	32	degree
Friction angle between fill and wall, δ	=	17	degree
Angle of fill to the horizontal, β	=	0	degree
Angle of back of wall to the horizontal, θ	=	90	degree

Lateral Earth Pressure (EH)

Active pressure coefficient, K_a

$$= \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta)\left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2}$$

$$= 0.277$$

LAMSON ENGINEERING CORPORATION			Final Page No.: 4	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-1	Checked by: WD		Date: 10/2019

Drilled Shaft Vertical Resistance

Based on B-1

φ_s = side resistance factor
= 0.55

φ_p = tip resistance factor
= 0.50 (2017 AASHTO Table 10.5.5.2.4-1)

D = Diameter of Shaft
= 3.5 ft

L_R = Rock socket length
= 3 ft

Side Resistance

q_s = unit shaft side resistance

$$= Cp_a\sqrt{\frac{q_u}{p_a}}$$

where,

P_a = Atmospheric pressure
= 2.12 ksf

q_u = uniaxial compressive strength of rock
= 576 ksf (use f'c = 4000 psi)

C = Regression coefficient
= 1.0 for normal conditions

q_s = 34.9 ksf

A_s = Drilled shaft side area
= 33.0 ft^2

R_s = $q_s A_s$
= 1152.7 kips

LAMSON ENGINEERING CORPORATION			Final Page No.: 5	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-1	Checked by: WD		Date: 10/2019

Tip Resistance

For conservative, assume random joint condition

q_p = unit shaft tip resistance

$$= A + q_u \left[m_b \left(\frac{A}{q_u} \right) + S \right]^a$$

in which,

$$A = \sigma'_{vb} + q_u \left[m_b \left(\frac{\sigma'_{vb}}{q_u} \right) + S \right]^a$$

σ'_{vb} = vertical effective stress at the socket bearing elevation
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

$$s = e^{\left(\frac{GSI-100}{9-3D}\right)}$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{\frac{-GSI}{15}} - e^{\frac{-20}{3}}\right)$$

$$m_b = m_i e^{\left(\frac{GSI-100}{28-14D}\right)}$$

Where,

GSI = Geological strength index (2017 AASHTO Figure 10.4.6.4-1)
= 25 (For conservative, based on seamy, fractured granite)

e = 2.718 (natural log base)

D = disturbance factor
= 0 (for rock coring method)

m_i = 32 (for granite) (2017 AASHTO Table 10.4.6.4-1)

Thus,

LAMSON ENGINEERING CORPORATION			Final Page No.: 6	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-1	Checked by: WD		Date: 10/2019

s = 0.00024

a = 0.531

m_b = 2.198

Then,

A = 32.3

Therefore,

q_p = 222.1 ksf

A_p = Drilled shaft tip area
= 9.6 ft^2

R_p = $q_p A_p$
= 2136.6 kips

Nominal Drilled Shaft Resistance

R_n = $R_p + R_s$
= 3289 kips

Factored Drilled Shaft Resistance

R_R = $\varphi_p R_p + \varphi_s R_s$
= 1702 kips

From Green, Group Load III

Factored vertical Load = 2281 lb
= 2 kips < 1702.3 kips
OK

Weight of Drilled Shaft = 0.15 x (π 3.5^2) / 4 x (3 + 8.7)
= 16.9 kips

Total Factored Vertical Load = 2 + 1.25 x 16.9
= 21.1 kips < 1702.3 kips
OK

LAMSON ENGINEERING CORPORATION			Final Page No.: 7	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-1	Checked by: WD		Date: 10/2019

Drilled Shaft Lateral Resistance

From Green, Group Load II, Load Case 1

Max. moment = 56591 lb-ft
at shaft top, M_u = 56.6 k-ft

φ_{ave} = Average angle of internal friction of soil, degree
= 32

K_a = Active earth pressure coefficient
= 0.277

D = Diameter of Shaft
= 3.5 ft

H = Distance from finish grade to design grade, ft
= 8.7 ft

γ_{ave} = Average unit weight of soil above top of shaft (kcf)
= 0.12

γ'_{ave} = Average effective unit weight of soil below top of shaft (kcf)
= 0.0576

P_{a1} = $0.5\, K_a\, \gamma'_{ave}\, D\, (H)^2$
= 2.11 kips

Earth Load F.S. = 1.5

Factored horizontal earth load = 1.5 x 2.11
= 3.17 kips

Factored Active earth moment = 3.17 x (8.7/3 + 3)
at shaft tip, M_a = 18.70 k-ft

$\phi_i^{'}$ = the instantaneous friction angle of the rock mass (degrees)

$$\phi_i^{'} = \tan^{-1}\left\{4h\cos^2\left[30 + 0.33\sin^{-1}\left(h^{\frac{-3}{2}}\right)\right] - 1\right\}^{\frac{-1}{2}}$$

LAMSON ENGINEERING CORPORATION				Final Page No.:	8
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-1	Checked by:	WD	Date:	10/2019

ϕ_i = 59.00 degrees

$$h = 1 + \frac{16(m\sigma_n^{'} + sq_u)}{(3m^2 q_u)}$$

h = 1.0231

q_u = Unconfined compressive strength of rock core (ksf)
= 576 ksf (For conservative, use concrete f'c = 4000 psi)

σ'_n = effective normal stress (ksf)
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

s,m = fractured rock mass parameters, for granite (assume fair rock)
s = 0.00009
m = 0.458 (AASHTO 2012 Table 10.4.6.4-4)

S_m = Shear strength of rock mass (ksf)

$$= (\cot\phi_i^{'} - \cos\phi_i^{'})m\frac{q_u}{8}$$

= 2.83 ksf

L_R = Design Rock Socket Length
= 3.0 ft

D = Drilled shaft diameter
= 3.5 ft

β' = Angle of the bedrock (degrees)
= 0

$$P_p = \frac{S_m L_R(L_R + \sqrt{2}D)}{(1 - Tan\beta')}$$

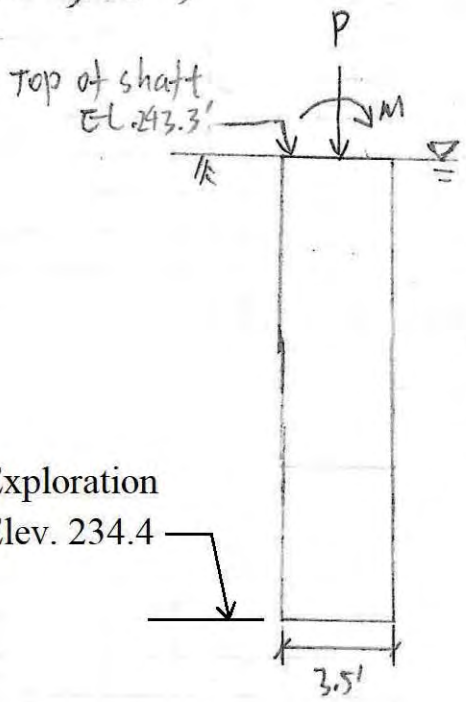
= 67.49 kips

Resistance Moment of the rock at shaft tip, M_p = 67.49 x 1.0 = 101.2 k-ft > $M_u + M_a$ = 75.3 k-ft OK

LAMSON ENGINEERING CORPORATION			Final Page No: 9	
Project: Route 126, Ashland	Job No:		Preliminary Sheet No:	
Subject: Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail: MA-2	Checked by:	WD	Date:	10/2019

MA-2 Foundation

Based on Boring B-3



Very Dense Sand & Boulder

$\phi = 38°$

$\gamma = 130$ pcf (lowered the ϕ & γ due to loose layer at the top)

LAMSON ENGINEERING CORPORATION				Final Page No.:	10
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-2	Checked by:	WD	Date:	10/2019

Determine Unfactored Horizontal Loads

Effective angle of internal friction ϕ'_f	=	38	degree
Friction angle between fill and wall, δ	=	17	degree
Angle of fill to the horizontal, β	=	0	degree
Angle of back of wall to the horizontal, θ	=	90	degree

Lateral Earth Pressure (EH)

Active pressure coefficient, K_a

$$= \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta)\left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2}$$

$$= 0.218$$

LAMSON ENGINEERING CORPORATION			Final Page No.: 11	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-2	Checked by: WD		Date: 10/2019

Drilled Shaft Vertical Resistance

Based on B-3

φ_s = side resistance factor
= 0.55

φ_p = tip resistance factor
= 0.50 (2017 AASHTO Table 10.5.5.2.4-1)

D = Diameter of Shaft
= 3.5 ft

L_R = Rock socket length
= 3 ft

Side Resistance

q_s = unit shaft side resistance

$$= Cp_a\sqrt{\frac{q_u}{p_a}}$$

where,

P_a = Atmospheric pressure
= 2.12 ksf

q_u = uniaxial compressive strength of rock
= 576 ksf (use f'c = 4000 psi)

C = Regression coefficient
= 1.0 for normal conditions

q_s = 34.9 ksf

A_s = Drilled shaft side area
= 33.0 ft^2

R_s = $q_s A_s$
= 1152.7 kips

LAMSON ENGINEERING CORPORATION			Final Page No.: 12	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-2	Checked by: WD		Date: 10/2019

Tip Resistance

For conservative, assume random joint condition

q_p = unit shaft tip resistance

$$= A + q_u \left[m_b \left(\frac{A}{q_u} \right) + S \right]^a$$

in which,

$$A = \sigma'_{vb} + q_u \left[m_b \left(\frac{\sigma'_{vb}}{q_u} \right) + S \right]^a$$

σ'_{vb} = vertical effective stress at the socket bearing elevation
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

$$s = e^{\left(\frac{GSI-100}{9-3D}\right)}$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{\frac{-GSI}{15}} - e^{\frac{-20}{3}}\right)$$

$$m_b = m_i e^{\left(\frac{GSI-100}{28-14D}\right)}$$

Where,

GSI = Geological strength index (2017 AASHTO Figure 10.4.6.4-1)
= 25 (For conservative, based on seamy, fractured granite)

e = 2.718 (natural log base)

D = disturbance factor
= 0 (for rock coring method)

m_i = 32 (for granite) (2017 AASHTO Table 10.4.6.4-1)

Thus,

LAMSON ENGINEERING CORPORATION			Final Page No.: 13
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 10/2019
Detail:	MA-2	Checked by: WD	Date: 10/2019

s = 0.00024

a = 0.531

m_b = 2.198

Then,

A = 32.3

Therefore,

q_p = 222.1 ksf

A_p = Drilled shaft tip area
= 9.6 ft^2

R_p = $q_p A_p$
= 2136.6 kips

Nominal Drilled Shaft Resistance

R_n = $R_p + R_s$
= 3289 kips

Factored Drilled Shaft Resistance

R_R = $\varphi_p R_p + \varphi_s R_s$
= 1702 kips

From Green, Group Load III

Factored vertical Load = 2730 lb
= 3 kips < 1702.3 kips
OK

Weight of Drilled Shaft = 0.15 x (π 3.5^2) / 4 x (3 + 8.9)
= 17.2 kips

Total Factored Vertical Load = 3 + 1.25 x 17.2
= 21.5 kips < 1702.3 kips
OK

LAMSON ENGINEERING CORPORATION			Final Page No.: 14
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 10/2019
Detail:	MA-2	Checked by: WD	Date: 10/2019

Drilled Shaft Lateral Resistance

From Green, Group Load II, Load Case 1

Max. moment = 59032 lb-ft
at shaft top, M_u = 59.0 k-ft

φ_{ave} = Average angle of internal friction of soil, degree
= 38

K_a = Active earth pressure coefficient
= 0.218

D = Diameter of Shaft
= 3.5 ft

H = Distance from finish grade to design grade, ft
= 8.9 ft

γ_{ave} = Average unit weight of soil above top of shaft (kcf)
= 0.13

γ'_{ave} = Average effective unit weight of soil below top of shaft (kcf)
= 0.0676

P_{a1} = $0.5\, K_a\, \gamma'_{ave}\, D\, (H)^2$
= 2.04 kips

Earth Load F.S. = 1.5

Factored horizontal earth load = 1.5 x 2.04
= 3.06 kips

Factored Active earth moment = 3.06 x (8.9/3 + 3)
at shaft tip, M_a = 18.28 k-ft

ϕ_i' = the instantaneous friction angle of the rock mass (degrees)

$$\phi_i' = \tan^{-1}\left\{4h\cos^2\left[30 + 0.33\sin^{-1}\left(h^{\frac{-3}{2}}\right)\right] - 1\right\}^{\frac{-1}{2}}$$

LAMSON ENGINEERING CORPORATION				Final Page No.:	15
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-2	Checked by:	WD	Date:	10/2019

ϕ_i = 59.00 degrees

$$h = 1 + \frac{16(m\sigma_n^{'} + sq_u)}{(3m^2 q_u)}$$

h = 1.0231

q_u = Unconfined compressive strength of rock core (ksf)
= 576 ksf (For conservative, use concrete f'c = 4000 psi)

σ'_n = effective normal stress (ksf)
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

s,m = fractured rock mass parameters, for granite (assume fair rock)
s = 0.00009
m = 0.458 (AASHTO 2012 Table 10.4.6.4-4)

S_m = Shear strength of rock mass (ksf)

$$= (\cot\phi_i^{'} - \cos\phi_i^{'})m\frac{q_u}{8}$$

= 2.83 ksf

L_R = Design Rock Socket Length
= 3.0 ft

D = Drilled shaft diameter
= 3.5 ft

$\beta^{'}$ = Angle of the bedrock (degrees)
= 0

$$P_p = \frac{S_m L_R(L_R + \sqrt{2}D)}{(1 - Tan\beta')}$$

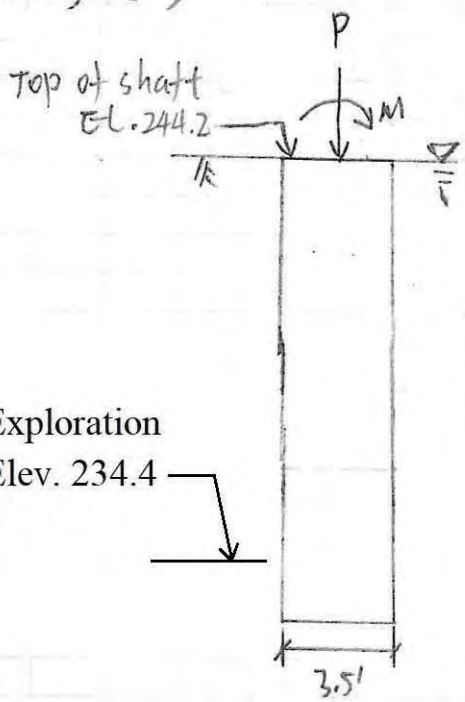
= 67.49 kips

Resistance Moment of the rock = 67.49 x 1.0 $M_u + M_a$
at shaft tip, M_p = 101.2 k-ft > 77.3 k-ft OK

LAMSON ENGINEERING CORPORATION			Final Page No: 16	
Project: Route 126, Ashland	Job No:		Preliminary Sheet No:	
Subject: Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail: MA-3	Checked by:	WD	Date:	10/2019

MA-3 Foundation

Based on Boring B-3



Very Dense Sand & Boulder

$\phi = 38°$

$\gamma = 130$ pcf (lower ϕ & γ due to loose layer at the top)

LAMSON ENGINEERING CORPORATION				Final Page No.:	17
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-3	Checked by:	WD	Date:	10/2019

Determine Unfactored Horizontal Loads

Effective angle of internal friction ϕ'_f	=	38	degree
Friction angle between fill and wall, δ	=	17	degree
Angle of fill to the horizontal, β	=	0	degree
Angle of back of wall to the horizontal, θ	=	90	degree

Lateral Earth Pressure (EH)

Active pressure coefficient, K_a

$$= \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta)\left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2}$$

$$= 0.218$$

LAMSON ENGINEERING CORPORATION			Final Page No.: 18	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-3	Checked by: WD		Date: 10/2019

Drilled Shaft Vertical Resistance

Based on B-3

φ_s = side resistance factor
= 0.55

φ_p = tip resistance factor
= 0.50 (2017 AASHTO Table 10.5.5.2.4-1)

D = Diameter of Shaft
= 3.5 ft

L_R = Rock socket length
= 3 ft

Side Resistance

q_s = unit shaft side resistance

$$= Cp_a\sqrt{\frac{q_u}{p_a}}$$

where,

P_a = Atmospheric pressure
= 2.12 ksf

q_u = uniaxial compressive strength of rock
= 576 ksf (use f'c = 4000 psi)

C = Regression coefficient
= 1.0 for normal conditions

q_s = 34.9 ksf

A_s = Drilled shaft side area
= 33.0 ft^2

R_s = $q_s A_s$
= 1152.7 kips

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Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-3	Checked by: WD		Date: 10/2019

Tip Resistance

For conservative, assume random joint condition

q_p = unit shaft tip resistance

$$= A + q_u \left[m_b \left(\frac{A}{q_u} \right) + S \right]^a$$

in which,

$$A = \sigma'_{vb} + q_u \left[m_b \left(\frac{\sigma'_{vb}}{q_u} \right) + S \right]^a$$

σ'_{vb} = vertical effective stress at the socket bearing elevation
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

$$s = e^{\left(\frac{GSI-100}{9-3D}\right)}$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{\frac{-GSI}{15}} - e^{\frac{-20}{3}}\right)$$

$$m_b = m_i e^{\left(\frac{GSI-100}{28-14D}\right)}$$

Where,

GSI = Geological strength index (2017 AASHTO Figure 10.4.6.4-1)
= 25 (For conservative, based on seamy, fractured granite)

e = 2.718 (natural log base)

D = disturbance factor
= 0 (for rock coring method)

m_i = 32 (for granite) (2017 AASHTO Table 10.4.6.4-1)

Thus,

LAMSON ENGINEERING CORPORATION			Final Page No.: 20	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-3	Checked by: WD		Date: 10/2019

s = 0.00024

a = 0.531

m_b = 2.198

Then,

A = 32.3

Therefore,

q_p = 222.1 ksf

A_p = Drilled shaft tip area
= 9.6 ft^2

R_p = $q_p A_p$
= 2136.6 kips

Nominal Drilled Shaft Resistance

R_n = $R_p + R_s$
= 3289 kips

Factored Drilled Shaft Resistance

R_R = $\varphi_p R_p + \varphi_s R_s$
= 1702 kips

From Green, Group Load III

Factored vertical Load = 2235 lb
= 2 kips < 1702.3 kips
OK

Weight of Drilled Shaft = 0.15 x (π 3.5^2) / 4 x (3 + 9.8)
= 18.5 kips

Total Factored Vertical Load = 2 + 1.25 x 18.5
= 23.1 kips < 1702.3 kips
OK

LAMSON ENGINEERING CORPORATION			Final Page No.: 21	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-3	Checked by: WD		Date: 10/2019

Drilled Shaft Lateral Resistance

From Green, Group Load II, Load Case 1

Max. moment = 56860 lb-ft
at shaft top, M_u = 56.9 k-ft

φ_{ave} = Average angle of internal friction of soil, degree
= 38

K_a = Active earth pressure coefficient
= 0.218

D = Diameter of Shaft
= 3.5 ft

H = Distance from finish grade to design grade, ft
= 9.8 ft

γ_{ave} = Average unit weight of soil above top of shaft (kcf)
= 0.13

γ'_{ave} = Average effective unit weight of soil below top of shaft (kcf)
= 0.0676

$P_{a1} = 0.5\, K_a\, \gamma'_{ave}\, D\, (H)^2$
= 2.48 kips

Earth Load F.S. = 1.5

Factored horizontal earth load = 1.5 x 2.48
= 3.72 kips

Factored Active earth moment = 3.72 x (9.8/3 + 3)
at shaft tip, M_a = 23.28 k-ft

ϕ_i' = the instantaneous friction angle of the rock mass (degrees)

$$\phi_i' = \tan^{-1}\left\{4h\cos^2\left[30 + 0.33\sin^{-1}\left(h^{\frac{-3}{2}}\right)\right] - 1\right\}^{\frac{-1}{2}}$$

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Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-3	Checked by:	WD	Date:	10/2019

ϕ_i = 59.00 degrees

$$h = 1 + \frac{16(m\sigma_n^{'} + sq_u)}{(3m^2 q_u)}$$

h = 1.0231

q_u = Unconfined compressive strength of rock core (ksf)
= 576 ksf (For conservative, use concrete f'c = 4000 psi)

σ'_n = effective normal stress (ksf)
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

s,m = fractured rock mass parameters, for granite (assume fair rock)
s = 0.00009
m = 0.458 (AASHTO 2012 Table 10.4.6.4-4)

S_m = Shear strength of rock mass (ksf)

$$= (\cot\phi_i^{'} - \cos\phi_i^{'}) m \frac{q_u}{8}$$

= 2.83 ksf

L_R = Design Rock Socket Length
= 3.0 ft

D = Drilled shaft diameter
= 3.5 ft

$\beta^{'}$ = Angle of the bedrock (degrees)
= 0

$$P_p = \frac{S_m L_R (L_R + \sqrt{2}D)}{(1 - Tan\beta')}$$

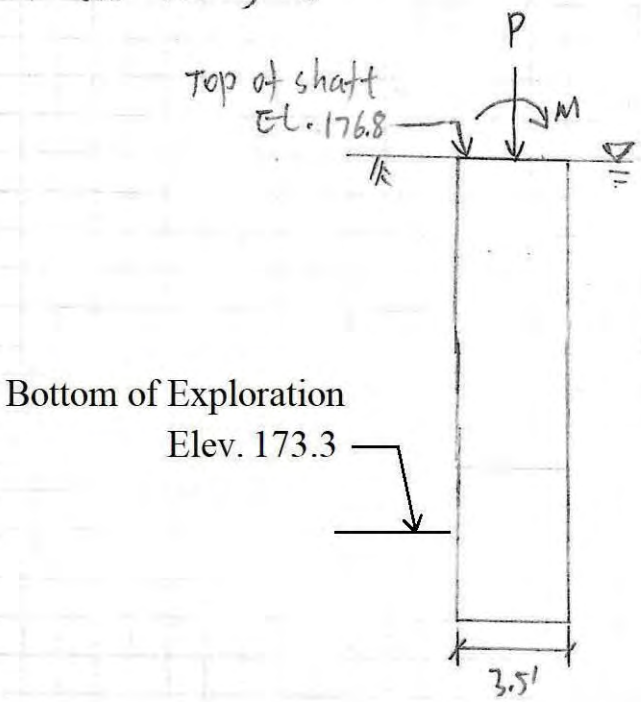
= 67.49 kips

Resistance Moment of the rock = 67.49 x 1.0 $M_u + M_a$
at shaft tip, M_p = 101.2 k-ft > 80.1 k-ft OK

LAMSON ENGINEERING CORPORATION			Final Page No: 23	
Project: Route 126, Ashland	Job No:		Preliminary Sheet No:	
Subject: Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail: MA-4	Checked by:	WD	Date:	10/2019

MA-4 Foundation

Based on Boring B-7



Very Dense Sand & Gravel

$\phi = 41°$

$\gamma = 135$ pcf

LAMSON ENGINEERING CORPORATION				Final Page No.:	24
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-4	Checked by:	WD	Date:	10/2019

Determine Unfactored Horizontal Loads

Effective angle of internal friction ϕ'_f	=	41	degree
Friction angle between fill and wall, δ	=	17	degree
Angle of fill to the horizontal, β	=	0	degree
Angle of back of wall to the horizontal, θ	=	90	degree

Lateral Earth Pressure (EH)

Active pressure coefficient, K_a

$$= \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta)\left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2}$$

$$= 0.192$$

LAMSON ENGINEERING CORPORATION			Final Page No.: 25
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 10/2019
Detail:	MA-4	Checked by: WD	Date: 10/2019

Drilled Shaft Vertical Resistance

Based on B-7

φ_s = side resistance factor
= 0.55

φ_p = tip resistance factor
= 0.50 (2017 AASHTO Table 10.5.5.2.4-1)

D = Diameter of Shaft
= 3.5 ft

L_R = Rock socket length
= 3 ft

Side Resistance

q_s = unit shaft side resistance

$$= Cp_a\sqrt{\frac{q_u}{p_a}}$$

where,

P_a = Atmospheric pressure
= 2.12 ksf

q_u = uniaxial compressive strength of rock
= 576 ksf (use f'c = 4000 psi)

C = Regression coefficient
= 1.0 for normal conditions

q_s = 34.9 ksf

A_s = Drilled shaft side area
= 33.0 ft^2

R_s = $q_s A_s$
= 1152.7 kips

LAMSON ENGINEERING CORPORATION			Final Page No.: 26	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-4	Checked by: WD		Date: 10/2019

Tip Resistance

For conservative, assume random joint condition

q_p = unit shaft tip resistance

$$= A + q_u \left[m_b \left(\frac{A}{q_u} \right) + S \right]^a$$

in which,

$$A = \sigma'_{vb} + q_u \left[m_b \left(\frac{\sigma'_{vb}}{q_u} \right) + S \right]^a$$

σ'_{vb} = vertical effective stress at the socket bearing elevation
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

$$s = e^{\left(\frac{GSI-100}{9-3D}\right)}$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{\frac{-GSI}{15}} - e^{\frac{-20}{3}}\right)$$

$$m_b = m_i e^{\left(\frac{GSI-100}{28-14D}\right)}$$

Where,

GSI = Geological strength index (2017 AASHTO Figure 10.4.6.4-1)
= 25 (For conservative, based on seamy, fractured granite)

e = 2.718 (natural log base)

D = disturbance factor
= 0 (for rock coring method)

m_i = 32 (for granite) (2017 AASHTO Table 10.4.6.4-1)

Thus,

LAMSON ENGINEERING CORPORATION			Final Page No.: 27	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-4	Checked by: WD		Date: 10/2019

s = 0.00024

a = 0.531

m_b = 2.198

Then,

A = 32.3

Therefore,

q_p = 222.1 ksf

A_p = Drilled shaft tip area
= 9.6 ft^2

R_p = $q_p A_p$
= 2136.6 kips

Nominal Drilled Shaft Resistance

R_n = $R_p + R_s$
= 3289 kips

Factored Drilled Shaft Resistance

R_R = $\varphi_p R_p + \varphi_s R_s$
= 1702 kips

From Green, Group Load III

Factored vertical Load = 2217 lb
= 2 kips

Weight of Drilled Shaft = 0.15 x (π 3.5^2) / 4 x (3 + 3.5)
= 9.4 kips

Total Factored Vertical Load = 2 + 1.25 x 9.4
= 11.7 kips < 1702.3 kips
OK

LAMSON ENGINEERING CORPORATION			Final Page No.: 28	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-4	Checked by: WD		Date: 10/2019

Drilled Shaft Lateral Resistance

From Green, Group Load II, Load Case 1

Max. moment = 45840 lb-ft
at shaft top, M_u = 45.8 k-ft

φ_{ave} = Average angle of internal friction of soil, degree
= 41

K_a = Active earth pressure coefficient
= 0.192

D = Diameter of Shaft
= 3.5 ft

H = Distance from finish grade to design grade, ft
= 3.5 ft

γ_{ave} = Average unit weight of soil above top of shaft (kcf)
= 0.135

γ'_{ave} = Average effective unit weight of soil below top of shaft (kcf)
= 0.0726

P_{a1} = $0.5\, K_a\, \gamma'_{ave}\, D\, (H)^2$
= 0.30 kips

Earth Load F.S. = 1.5

Factored horizontal earth load = 1.5 x 0.3
= 0.45 kips

Factored Active earth moment = 0.45 x (3.5/3 + 3)
at shaft tip, M_a = 1.87 k-ft

$\phi_i^{'}$ = the instantaneous friction angle of the rock mass (degrees)

$$\phi_i^{'} = \tan^{-1}\left\{4h\cos^2\left[30 + 0.33\sin^{-1}\left(h^{\frac{-3}{2}}\right)\right] - 1\right\}^{\frac{-1}{2}}$$

LAMSON ENGINEERING CORPORATION				Final Page No.:	29
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-4	Checked by:	WD	Date:	10/2019

ϕ_i = 59.00 degrees

$$h = 1 + \frac{16(m\sigma_n^{'} + sq_u)}{(3m^2 q_u)}$$

h = 1.0231

q_u = Unconfined compressive strength of rock core (ksf)
= 576 ksf (For conservative, use concrete f'c = 4000 psi)

σ'_n = effective normal stress (ksf)
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

s,m = fractured rock mass parameters, for granite (assume fair rock)
s = 0.00009
m = 0.458 (AASHTO 2012 Table 10.4.6.4-4)

S_m = Shear strength of rock mass (ksf)

$$= (\cot\phi_i^{'} - \cos\phi_i^{'})m\frac{q_u}{8}$$

= 2.83 ksf

L_R = Design Rock Socket Length
= 3.0 ft

D = Drilled shaft diameter
= 3.5 ft

β' = Angle of the bedrock (degrees)
= 0

$$P_p = \frac{S_m L_R(L_R + \sqrt{2}D)}{(1 - Tan\beta')}$$

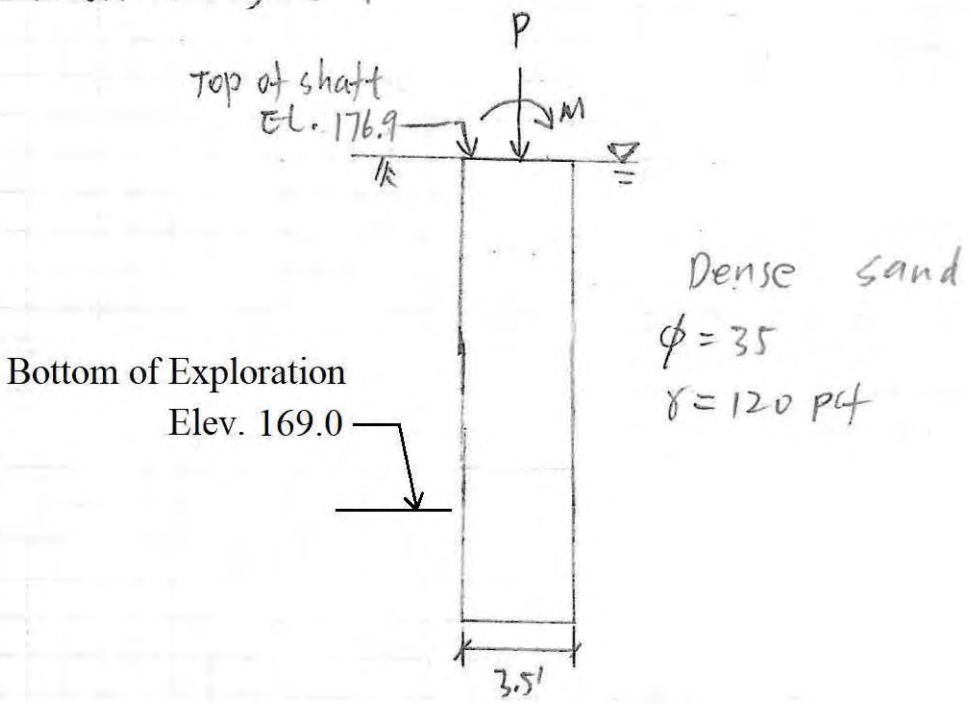
= 67.49 kips

Resistance Moment of the rock at shaft tip, M_p = 67.49 x 1.0 = 101.2 k-ft > $M_u + M_a$ = 47.7 k-ft OK

LAMSON ENGINEERING CORPORATION			Final Page No: 30	
Project: Route 126, Ashland	Job No:		Preliminary Sheet No:	
Subject: Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail: MA-5	Checked by:	WD	Date:	10/2019

MA-5 Foundation

Based on Boring B-4



Dense sand

$\phi = 35$

$\gamma = 120$ pcf

LAMSON ENGINEERING CORPORATION				Final Page No.:	31
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-5	Checked by:	WD	Date:	10/2019

Determine Unfactored Horizontal Loads

Effective angle of internal friction ϕ'_f	=	35	degree
Friction angle between fill and wall, δ	=	17	degree
Angle of fill to the horizontal, β	=	0	degree
Angle of back of wall to the horizontal, θ	=	90	degree

Lateral Earth Pressure (EH)

Active pressure coefficient, K_a

$$= \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta)\left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2}$$

$$= 0.246$$

LAMSON ENGINEERING CORPORATION			Final Page No.: 32	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-5	Checked by: WD		Date: 10/2019

Drilled Shaft Vertical Resistance

Based on B-4

φ_s = side resistance factor
= 0.55

φ_p = tip resistance factor
= 0.50 (2017 AASHTO Table 10.5.5.2.4-1)

D = Diameter of Shaft
= 3.5 ft

L_R = Rock socket length
= 3 ft

Side Resistance

q_s = unit shaft side resistance

$$= Cp_a\sqrt{\frac{q_u}{p_a}}$$

where,

P_a = Atmospheric pressure
= 2.12 ksf

q_u = uniaxial compressive strength of rock
= 576 ksf (use f'c = 4000 psi)

C = Regression coefficient
= 1.0 for normal conditions

q_s = 34.9 ksf

A_s = Drilled shaft side area
= 33.0 ft^2

R_s = $q_s A_s$
= 1152.7 kips

LAMSON ENGINEERING CORPORATION			Final Page No.: 33	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-5	Checked by: WD		Date: 10/2019

Tip Resistance

For conservative, assume random joint condition

q_p = unit shaft tip resistance

$$= A + q_u \left[m_b \left(\frac{A}{q_u} \right) + S \right]^a$$

in which,

$$A = \sigma'_{vb} + q_u \left[m_b \left(\frac{\sigma'_{vb}}{q_u} \right) + S \right]^a$$

σ'_{vb} = vertical effective stress at the socket bearing elevation
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

$$s = e^{\left(\frac{GSI-100}{9-3D}\right)}$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{\frac{-GSI}{15}} - e^{\frac{-20}{3}}\right)$$

$$m_b = m_i e^{\left(\frac{GSI-100}{28-14D}\right)}$$

Where,

GSI = Geological strength index (2017 AASHTO Figure 10.4.6.4-1)
= 25 (For conservative, based on seamy, fractured granite)

e = 2.718 (natural log base)

D = disturbance factor
= 0 (for rock coring method)

m_i = 32 (for granite) (2017 AASHTO Table 10.4.6.4-1)

Thus,

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Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-5	Checked by: WD		Date: 10/2019

s = 0.00024

a = 0.531

m_b = 2.198

Then,

A = 32.3

Therefore,

q_p = 222.1 ksf

A_p = Drilled shaft tip area
= 9.6 ft^2

R_p = $q_p A_p$
= 2136.6 kips

Nominal Drilled Shaft Resistance

R_n = $R_p + R_s$
= 3289 kips

Factored Drilled Shaft Resistance

R_R = $\varphi_p R_p + \varphi_s R_s$
= 1702 kips

From Green, Group Load III

Factored vertical Load = 3017 lb
= 3 kips

Weight of Drilled Shaft = 0.15 x (π 3.5^2) / 4 x (3 + 7.9)
= 15.7 kips

Total Factored Vertical Load = 3 + 1.25 x 15.7
= 19.7 kips < 1702.3 kips
OK

LAMSON ENGINEERING CORPORATION			Final Page No.: 35	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-5	Checked by: WD		Date: 10/2019

Drilled Shaft Lateral Resistance

From Green, Group Load II, Load Case 1

Max. moment = 61491 lb-ft
at shaft top, M_u = 61.5 k-ft

φ_{ave} = Average angle of internal friction of soil, degree
= 35

K_a = Active earth pressure coefficient
= 0.246

D = Diameter of Shaft
= 3.5 ft

H = Distance from finish grade to design grade, ft
= 7.9 ft

γ_{ave} = Average unit weight of soil above top of shaft (kcf)
= 0.125

γ'_{ave} = Average effective unit weight of soil below top of shaft (kcf)
= 0.0626

P_{a1} = $0.5\, K_a\, \gamma'_{ave}\, D\, (H)^2$
= 1.68 kips

Earth Load F.S. = 1.5

Factored horizontal earth load = 1.5 x 1.68
= 2.52 kips

Factored Active earth moment = 2.52 x (7.9/3 + 3)
at shaft tip, M_a = 14.21 k-ft

$\phi_i^{'}$ = the instantaneous friction angle of the rock mass (degrees)

$$\phi_i^{'} = \tan^{-1}\left\{4h\cos^2\left[30 + 0.33\sin^{-1}\left(h^{\frac{-3}{2}}\right)\right] - 1\right\}^{\frac{-1}{2}}$$

LAMSON ENGINEERING CORPORATION				Final Page No.:	36
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-5	Checked by:	WD	Date:	10/2019

ϕ_i = 59.00 degrees

$$h = 1 + \frac{16(m\sigma_n^{'} + sq_u)}{(3m^2 q_u)}$$

h = 1.0231

q_u = Unconfined compressive strength of rock core (ksf)
= 576 ksf (For conservative, use concrete f'c = 4000 psi)

σ'_n = effective normal stress (ksf)
= (0.12 - 0.0624) x 9 + 0.170 x 3
= 1.028 ksf

s,m = fractured rock mass parameters, for granite (assume fair rock)
s = 0.00009
m = 0.458 (AASHTO 2012 Table 10.4.6.4-4)

S_m = Shear strength of rock mass (ksf)

$$= (\cot\phi_i^{'} - \cos\phi_i^{'})m\frac{q_u}{8}$$

= 2.83 ksf

L_R = Design Rock Socket Length
= 3.0 ft

D = Drilled shaft diameter
= 3.5 ft

$\beta^{'}$ = Angle of the bedrock (degrees)
= 0

$$P_p = \frac{S_m L_R(L_R + \sqrt{2}D)}{(1 - Tan\beta')}$$

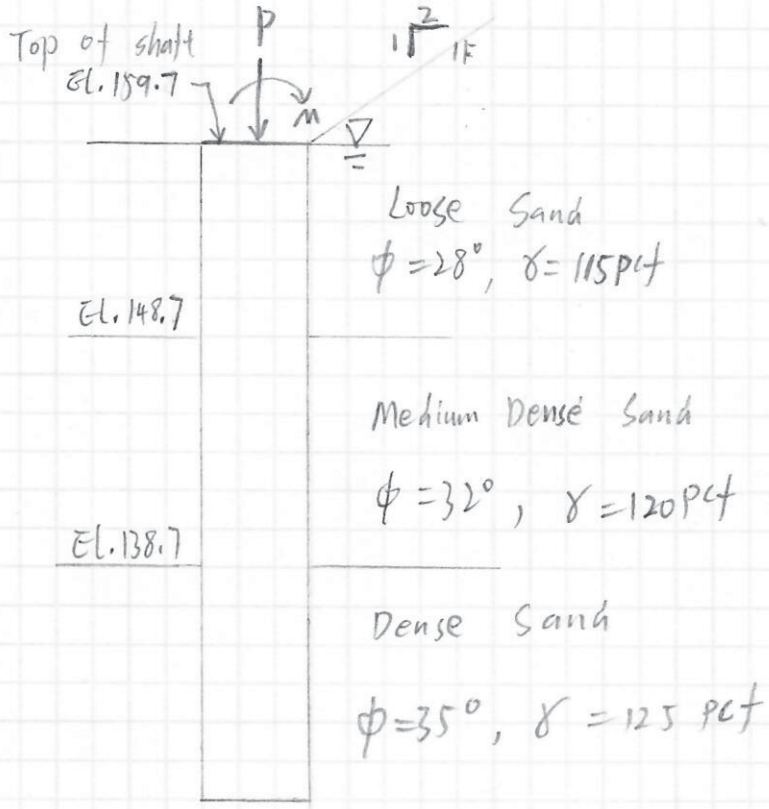
= 67.49 kips

Resistance Moment of the rock = 67.49 x 1.0 $M_u + M_a$
at shaft tip, M_p = 101.2 k-ft > 75.7 k-ft OK

LAMSON ENGINEERING CORPORATION			Final Page No: 37
Project: Route 126, Ashland	Job No:	Preliminary Sheet No:	
Subject: Mast Arm Foundation	Prepared by: JJL	Date:	10/2019
Detail: MA-6	Checked by: WD	Date:	10/2019

MA-6 Foundation

Based on Boring B-9



Average $N1 = 23$

$\Rightarrow$

use $\phi_{ave} = 32°$

$\gamma_{ave} = 120$ pcf

LAMSON ENGINEERING CORPORATION			Final Page No.: 38
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 10/2019
Detail:	Corrected *SPT* blow count	Checked by: WD	Date: 10/2019

B-9

Water table = 0.0 ft γ_w 0.0624 kcf

γ_{avg} 0.12 kcf

Depth ft	σ'_v ksf	C_N	N blows/ft	$N1 = C_N N$ blows/ft	Remark
1	0.058	2.000	4	8	Average N_{60} = 10
5	0.288	1.650	4	7	
10	0.576	1.418	11	16	
15	0.864	1.282	19	24	
20	1.152	1.186	37	44	
25	1.440	1.112	35	39	
			Average N1	23	

For example

Depth = 20 ft

C_N = $0.77 \log_{10} (40 / \sigma'_v)$ < 2 (AASHTO 10.4.6.2.4-1)

σ'_v = vertical effective stress (ksf)

= 30 ft x (0.12 - 0.0624) kcf

= 1.440 ksf

C_N = $0.77 \log_{10} (40 / 1.44)$

= 1.112 < 2

N = uncorrected *SPT* blow count (blows/ft.)

= 35 blows /ft

$N1$ = $C_N N$

= 1.051 x 120 ≤ 100 blows/ft

= 39 blows/ft < 100 blows/ft

$N1$ = 39 blows/ft

LAMSON ENGINEERING CORPORATION				Final Page No.:	39
Project:	Route 126, Ashland	Job No.:		Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by:	JJL	Date:	10/2019
Detail:	MA-6	Checked by:	WD	Date:	10/2019

Determine Unfactored Horizontal Loads

Effective angle of internal friction ϕ'_f	=	32	degree
Friction angle between fill and wall, δ	=	17	degree
Angle of fill to the horizontal, β	=	27	degree
Angle of back of wall to the horizontal, θ	=	90	degree

Lateral Earth Pressure (EH)

Active pressure coefficient, K_a

$$= \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta)\left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}}\right]^2}$$

$$= 0.453$$

LAMSON ENGINEERING CORPORATION			Final Page No.: 40
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 10/2019
Detail:	MA-6	Checked by: WD	Date: 10/2019

Drilled Shaft Vertical Resistance

Based on Boring B-9

φ_s = side resistance factor
= 0.55

φ_p = tip resistance factor
= 0.50 (AASHTO Table 10.5.5.2.4-1)

Side Resistance

q_s = shaft resistance
= $\beta\sigma_v'$

$$\beta = \left(1-\sin\varphi_f'\right)\left(\frac{\sigma_p'}{\sigma_v'}\right)^{\sin\varphi_f'}\tan\varphi_f'$$

φ_f' = friction angle of soil layer
= 32 degree

σ'_v = vertical effective stress at soil layer mid-depth

σ'_p = effective vertical preconsolidation stress
= $0.47P_a(N_{60})^m$ for sands

where,

P_a = 2.12 ksf

m = 0.8 for silty sand to sandy silts

D = Drilled shaft diameter
= 3.5 ft

L = Length of soil contributing to side resistance, (ft)

A_s = area of shaft side surface

L_S = Length of Drilled Shaft
= 12 ft

LAMSON ENGINEERING CORPORATION			Final Page No.: 41
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:
Subject:	Mast Arm Foundation	Prepared by: JJL	Date: 10/2019
Detail:	MA-6	Checked by: WD	Date: 10/2019

z (ft)	σ'_v (ksf)	N_{60}	σ'_p (ksf)	β	q_s (ksf)	L (ft)	A_s (ft^2)	R_s (kips)
6	0.3	10	6.29	1.37	0.5	7.0	76.97	36.3
							Total	36.3

Note:
The top 5 feet of the drilled shaft for soil side resistance was not considered in the vertical resistance calculations. Per AASHTO 10.8.3.5.1b

Tip Resistance

- for $N_{60} \le 50$

$$q_p = 1.2N_{60} \quad \le \quad 60 \text{ ksf}$$

- for $N_{60} > 50$

$$q_p = 0.59\left[N_{60}\left(\frac{p_a}{\sigma'_v}\right)\right]^{0.8}\sigma'_v \quad \le \quad 60 \text{ ksf}$$

Since the tip of drilled shaft is on the layer of medium dense fine sand material, N_{60} = 11

q_p = 13.20 ksf

D = Drilled shaft diameter
= 3.5 ft

A_p = area of shaft tip
= 3.14159 x 3.0 ^ 2 / 4 = 9.62 ft^2

R_p = q_p x A_p
= 127.0 kips

R_R = $\varphi_p R_p + \varphi_s R_s$
= 83.5 kips

From Green, Group Load III

Factored vertical Load = 2547 lb
= 3 kips

Weight of Drilled Shaft = 0.15 x (π 3.5^2) / 4 x 12
= 17.3 kips

LAMSON ENGINEERING CORPORATION			Final Page No.: 42	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-6	Checked by: WD		Date: 10/2019

Total Factored Vertical Load = 3 + 1.25 x 17.3

= 24.2 kips < 83.5 kips

OK

Drilled Shaft Lateral Resistance

From Green, Group Load II, Load Case 1

Max. moment = 59032 lb-ft

at shaft top, M_u = 59.0 k-ft

Required Drilled Shaft Length, L_s = 12.00 ft D = 3.5 ft

φ_{ave} = Average angle of internal friction of soil, degree

= 32

β = Maximum angle of the sloping backfill, degree

= 27 (2H:1V))

Per AASHTO Table 3.11.5.3-1:

δ = friction angle between wall and backfill, degree

= 17

Per AASHTO Fig. 3.11.5.4-2:

K_p = Coefficient of passive earth pressure

= 5.67

K_a = Design lateral earth coefficient

= 0.453

D = Drilled shaft diameter

= 3.5 ft

H = Distance from finish grade to design grade, ft

= 0.00 ft

γ_{ave} = Average unit weight of soil (kcf)

= 0.120

γ'_{ave} = Average effective unit weight of soil (kcf)

= 0.0576

LAMSON ENGINEERING CORPORATION			Final Page No.: 43	
Project:	Route 126, Ashland	Job No.:	Preliminary Sheet No.:	
Subject:	Mast Arm Foundation	Prepared by: JJL		Date: 10/2019
Detail:	MA-6	Checked by: WD		Date: 10/2019

P_{a1} = $0.5\, K_a\, \gamma'_{ave}\, D\, (H)^2$

= 0.00 k

P_{a2} = $0.5K_aL_sD(2\gamma_{ave}H + \gamma'_{ave}L_s)$

= 6.58 k

L_{a2} = Distance between design grade and P_{a2}, (ft)

= $\dfrac{L_s\left[\gamma'_{ave}H + (2/3)\gamma'_{ave}L_s\right]}{\left(2\gamma'_{ave}H + \gamma'_{ave}L_s\right)}$

= 8.0 ft

Factored Active earth moment at shaft tip, M_a = $1.5 \times [\, P_{a1} \times (\, L_s - 2H/3) + P_{a2} \times (L_s - L_{a2}\,)]$

= 39.45 k-ft (Strength I)

P_p = $1.5\, K_p\, \gamma'_{ave}\, L_s^2\, D$

= 246.90 k

Resistance Moment of the soil at shaft tip, M_p = $P_p \times L_s/3$ > $M_a + M_u$

= 987.6 k-ft > 98.5 k-ft OK

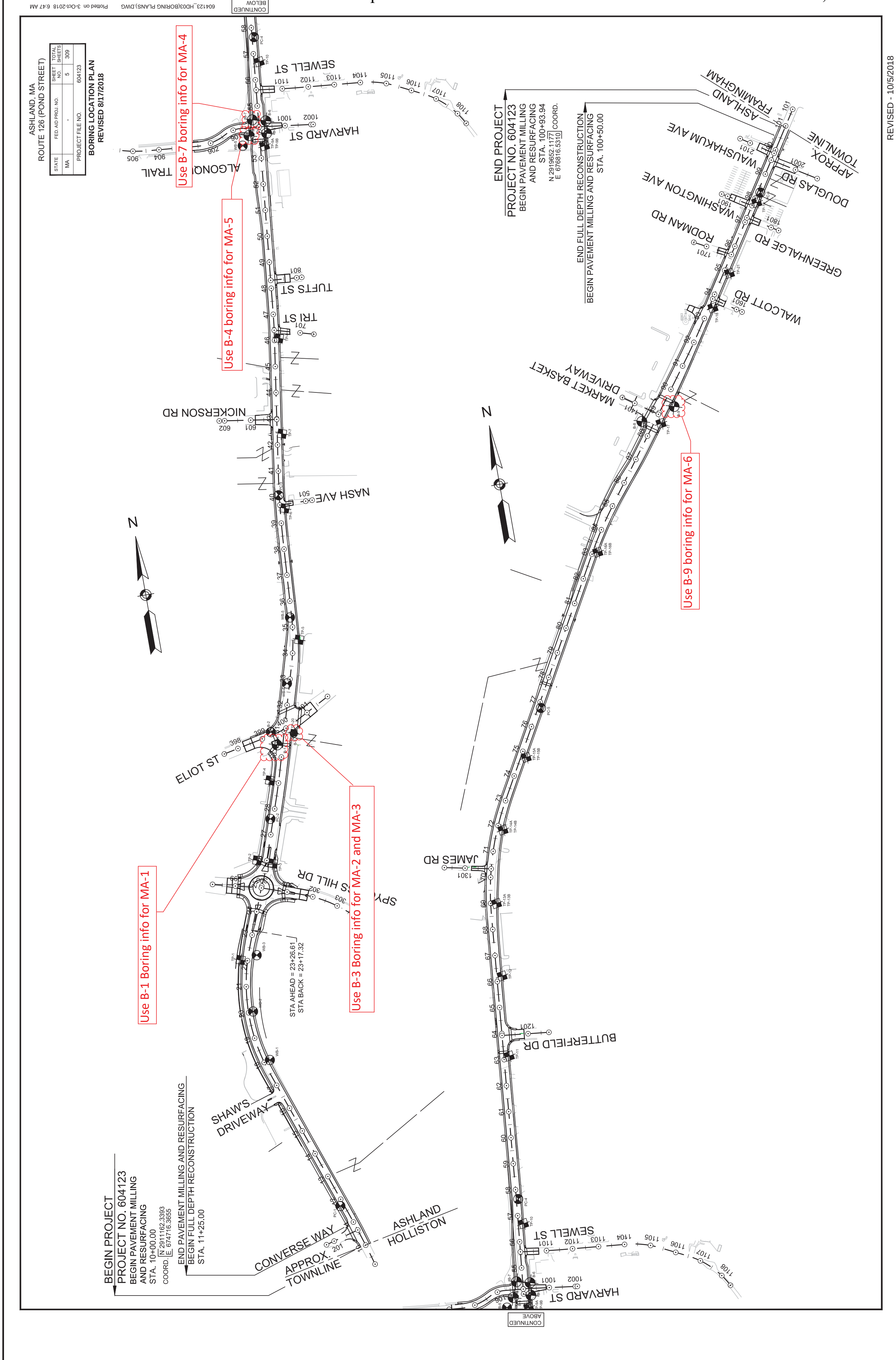
Appendix 1

Applicable Boring Information

Index

- Boring Location Plan
- Applicable Boring Logs for Borings B-1, B-3, B-4, B-7, and B-9.

Note: Lamson Engineering was not involved in the monitoring of these borings.


ASHLAND, MA
ROUTE 126 (POND STREET)
BORING LOCATION PLAN
REVISED 8/17/2018
REVISED - 10/5/2018
Use B-7 boring info for MA-4
Use B-4 boring info for MA-5
Use B-9 boring info for MA-6
Use B-1 Boring info for MA-1
Use B-3 Boring info for MA-2 and MA-3
BEGIN PROJECT
PROJECT NO. 604123
BEGIN PAVEMENT MILLING
AND RESURFACING
STA. 10+00.00
END PAVEMENT MILLING AND RESURFACING
BEGIN FULL DEPTH RECONSTRUCTION
STA. 11+25.00
END PROJECT
PROJECT NO. 604123
BEGIN PAVEMENT MILLING
AND RESURFACING
STA. 100+93.94
END FULL DEPTH RECONSTRUCTION
BEGIN PAVEMENT MILLING AND RESURFACING
STA. 100+50.00
STA AHEAD = 23+26.61
STA BACK = 23+17.32
CONVERSE WAY
SHAW'S DRIVEWAY
ELIOT ST
NICKERSON RD
NASH AVE
TRI ST
TUFTS ST
HARVARD ST
SEWELL ST
JAMES RD
BUTTERFIELD DR
MARKET BASKET DRIVEWAY
WALCOTT RD
GREENHALGE RD
RODMAN RD
WASHINGTON AVE
DOUGLAS RD
WAUSHAKUM AVE
ASHLAND
HOLLISTON
FRAMINGHAM
APPROX. TOWNLINE

Geologic - Earth Exploration, Inc.

7 Sherwood Drive
TEL 508 384 4434
Norfolk, MA 02056
FAX 508 384 4452

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA

BORING #: B-1
PAGE 1 OF 1

		CASING	SAMPLER	CORE BARREL
File #:	17171			
Date Started:	10/19/17	TYPE	HW	SS	
Date Completed:	10/20/17	SIZE	3"	24"	
Driller:	D.Jacobs	HAMMER	140#	140#	---
Site Rep.:		FALL	30"	30"	---

Surface Elevation:
Station:
Groundwater level readings
Date Depth
Date Depth

Depth ft	Sample No.	Depth ft	Pen. in	Rec. in	Blows/6"	Sample Description
	S-1	0.0-2.0	24	6	3-7-5-4	S-1 Wet loose gray fine SAND, some Gravel
5	S-2	4.0-6.0	24	5	7-9-9-14	S-2 Wet loose gray fine SAND, large Gravel
10	S-3	9.0-9.0	0	0	120/0"	S-3 Rock at 9.0', Roller bit refusal Bottom of exploration at 9.0'
15						
20						
25						
30						

Ground Surface to _____ used _____ then _____

Proportions Used		Cohesive Consistency Blows/ft				Cohesionless Density Blows/ft		Sample Type
Trace	0 to 10%	0-2	Very Soft	9-15	Stiff	0-10	Loose	UP = Fixed Piston
Little	10 to 20%	3-4	Soft	16-30	V-Stiff	10-30	M-Dense	UT = Shelby Tube
Some	20 to 35%	5-8	M-Stiff	31+	Hard	30-50	Dense	OE = Open End Rod
And	35 to 50%					50+	V-Dense	* = 300# hammer

Notes:
1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks: NOTE: All soil descriptions are made in the field by the Drilling Foreman. No laboratory analyses were performed for this purpose.

BL ALL 17171 GIA_ASHLAND_MA.GPJ GEOLOGIC.GDT 11/29/17

Geologic - Earth Exploration, Inc.

7 Sherwood Drive
Norfolk, MA 02056
TEL 508 384 4434
FAX 508 384 4452

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA

BORING #: B-3
PAGE 1 OF 1

File #: 17171
Date Started: 10/19/17
Date Completed: 10/19/17
Driller: D.Jacobs
Site Rep.:

	CASING	SAMPLER	CORE BARREL
TYPE	HW	SS	
SIZE	3"	24"	
HAMMER	140#	140#	---
FALL	30"	30"	---

Surface Elevation:
Station:
Groundwater level readings
Date Depth
Date Depth

Depth ft	Sample No.	Sample Depth ft	Pen. in	Rec. in	Blows/6"	Sample Description
	S-1	0.0-2.0	24	4	1-2-2-3	S-1 Moist loose brown MULCH and coarse SAND
5	S-2	4.0-4.2	2	2	120/2"	S-2 Moist very dense tan coarse SAND and STONE Roller bit refusal at 4.5' Cored 5 feet of different size boulders to 9.5'
10						Bottom of exploration at 9.5'
15						
20						
25						
30						

Ground Surface to _____ used _____ then _____

Proportions Used		Cohesive Consistency Blows/ft				Cohesionless Density Blows/ft		Sample Type
Trace	0 to 10%	0-2	Very Soft	9-15	Stiff	0-10	Loose	UP = Fixed Piston
Little	10 to 20%	3-4	Soft	16-30	V-Stiff	10-30	M-Dense	UT = Shelby Tube
Some	20 to 35%	5-8	M-Stiff	31+	Hard	30-50	Dense	OE = Open End Rod
And	35 to 50%					50+	V-Dense	* = 300# hammer

Notes:
1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks: NOTE: All soil descriptions are made in the field by the Drilling Foreman. No laboratory analyses were performed for this purpose.

BL ALL 17171 GIA_ASHLAND_MA.GPJ GEOLOGIC.GDT 11/29/17

Geologic - Earth Exploration, Inc.
7 Sherwood Drive
TEL 508 384 4434
Norfolk, MA 02056
FAX 508 384 4452

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA

BORING #: B-4
PAGE 1 OF 1

		CASING	SAMPLER	CORE BARREL
File #:	17171			
Date Started:	10/23/17	TYPE	HW	SS	
Date Completed:	10/23/17	SIZE	3"	24"	
Driller:	D.Jacobs	HAMMER	140#	140#	---
Site Rep.:		FALL	30"	30"	---

Surface Elevation:
Station:
Groundwater level readings
Date Depth
Date Depth

Depth ft	Sample No.	Depth ft	Pen. in	Rec. in	Blows/6"	Sample Description
	S-1	0.0-2.0	24	12	9-15-14-10	S-1 Dry medium dense brown fine TOP SOIL, trace Gravel
5	S-2	4.0-6.0	24	8	13-14-18-36	S-2 Moist dense brown fine SAND, little Silt Drilled down from 6.5' - 7.5' confirmed Rock
						Bottom of exploration at 7.5'
10						
15						
20						
25						
30						

Ground Surface to _____ used _____ then _____

Proportions Used		Cohesive Consistency Blows/ft				Cohesionless Density Blows/ft		Sample Type
Trace	0 to 10%	0-2	Very Soft	9-15	Stiff	0-10	Loose	UP = Fixed Piston
Little	10 to 20%	3-4	Soft	16-30	V-Stiff	10-30	M-Dense	UT = Shelby Tube
Some	20 to 35%	5-8	M-Stiff	31+	Hard	30-50	Dense	OE = Open End Rod
And	35 to 50%					50+	V-Dense	* = 300# hammer

Notes:
1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the crill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks: NOTE: All soil descriptions are made in the field by the Drilling Foreman. No laboratory analyses were performed for this purpose.

BL ALL 17171 GIA_ASHLAND_MA.GPJ GEOLOGIC.GDT 11/29/17

Geologic - Earth Exploration, Inc.
7 Sherwood Drive
TEL 508 384 4434
Norfolk, MA 02056
FAX 508 384 4452

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA

BORING #: B-7
PAGE 1 OF 1

		CASING	SAMPLER	CORE BARREL
File #:	17171			
Date Started:	10/25/17	TYPE	HW	SS	
Date Completed:	10/25/17	SIZE	3"	24"	
Driller:	D.Jacobs	HAMMER	140#	140#	---
Site Rep.:		FALL	30"	30"	---

Surface Elevation:
Station:
Groundwater level readings
Date Depth
Date Depth

Depth ft	Sample No.	Depth ft	Pen. in	Rec. in	Blows/6"	Sample Description
0	S-1	0.0-2.0	24	4	120/4"	S-1 Dry very dense gray coarse SAND and GRAVEL Weathered Rock from 4.0' to 5.0', Roller bit to 5.5'
5						Bottom of exploration at 5.5'
10						
15						
20						
25						
30						

Ground Surface to _____ used _____ then _____

Proportions Used		Cohesive Consistency Blows/ft				Cohesionless Density Blows/ft		Sample Type
Trace	0 to 10%	0-2	Very Soft	9-15	Stiff	0-10	Loose	UP = Fixed Piston
Little	10 to 20%	3-4	Soft	16-30	V-Stiff	10-30	M-Dense	UT = Shelby Tube
Some	20 to 35%	5-8	M-Stiff	31+	Hard	30-50	Dense	OE = Open End Rod
And	35 to 50%					50+	V-Dense	* = 300# hammer

Notes:
1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

BL ALL 17171 GIA_ASHLAND_MA.GPJ GEOLOGIC.GDT 11/29/17

Geologic - Earth Exploration, Inc.

7 Sherwood Drive
TEL 508 384 4434
Norfolk, MA 02056
FAX 508 384 4452

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA

BORING #: B-9
PAGE 1 OF 1

		CASING	SAMPLER	CORE BARREL
File #:	17171			
Date Started:	10/23/17	TYPE	HW	SS	
Date Completed:	10/23/17	SIZE	3"	24"	
Driller:	D.Jacobs	HAMMER	140#	140#	---
Site Rep.:		FALL	30"	30"	---

Surface Elevation:
Station:
Groundwater level readings
Date Depth
Date Depth

Depth ft	Sample No.	Depth ft	Pen. in	Rec. in	Blows/6"	Sample Description
	S-1	0.0-2.0	24	5	2-1-3-3	S-1 Dry loose dark brown fine TOP SOIL
5	S-2	4.0-6.0	24	2	1-2-2-2	S-2 Wet loose dark brown fine SOIL, some Gravel
10	S-3	9.0-11.0	24	4	1-4-7-9	S-3 Wet medium dense gray coarse and fine SAND
15	S-4	14.0-16.0	24	0	11-10-9-10	S-4 No Recovery
20	S-5	19.0-21.0	24	24	12-17-20-17	S-5 Wet dense gray fine SAND, some Gravel
25	S-6	24.0-26.0	24	16	13-15-20-17	S-6 Wet dense gray fine SAND, some Gravel
30						Bottom of exploration at 26.0'

Ground Surface to _____ used _____ then _____

Proportions Used		Cohesive Consistency Blows/ft				Cohesionless Density Blows/ft		Sample Type
Trace	0 to 10%	0-2	Very Soft	9-15	Stiff	0-10	Loose	UP = Fixed Piston
Little	10 to 20%	3-4	Soft	16-30	V-Stiff	10-30	M-Dense	UT = Shelby Tube
Some	20 to 35%	5-8	M-Stiff	31+	Hard	30-50	Dense	OE = Open End Rod
And	35 to 50%					50+	V-Dense	* = 300# hammer

Notes:
1. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
2. Water level readings were made in the drill hole during or at the completion of drilling. The water level may fluctuate over time.

Remarks:

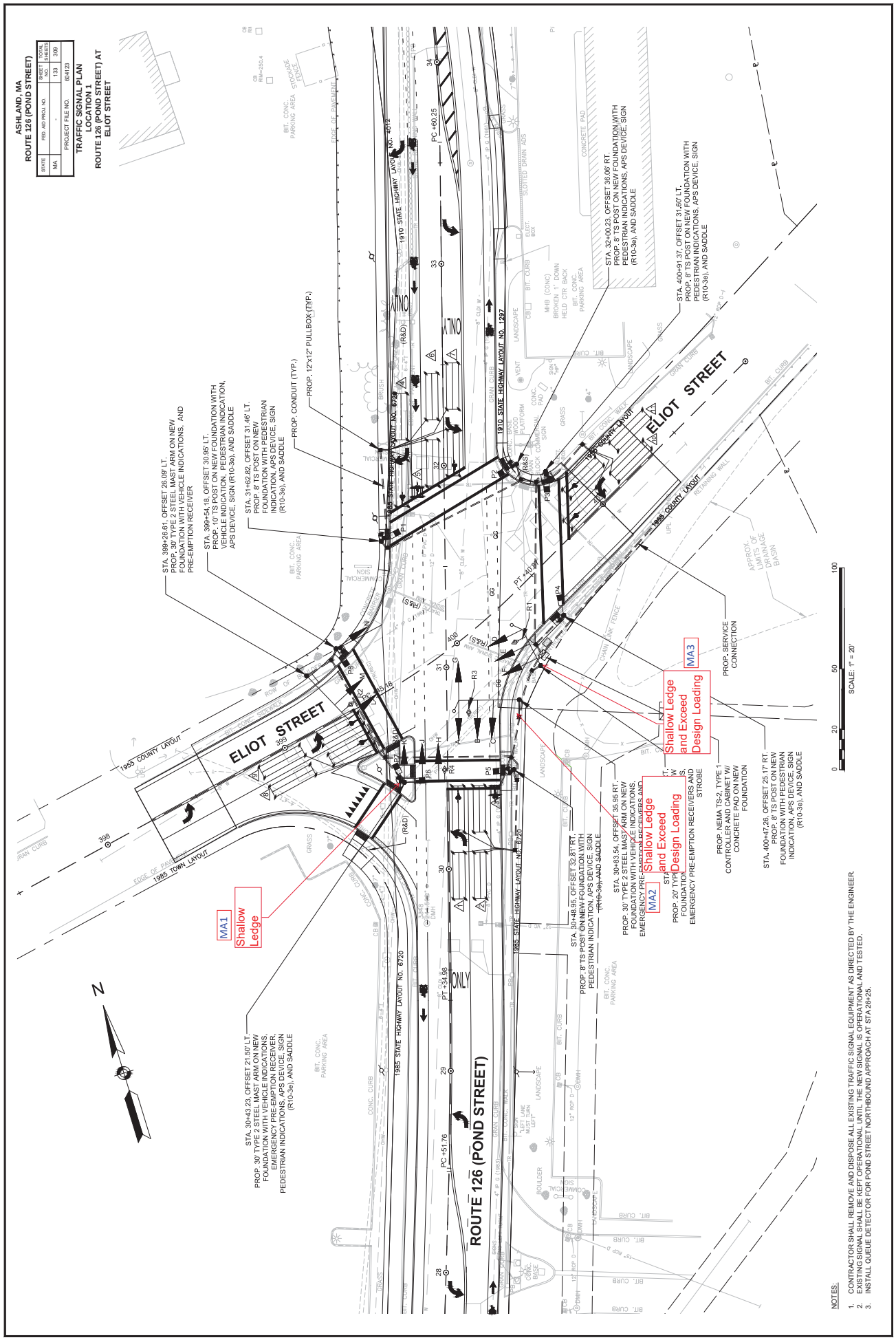
BL ALL 17171 GIA ASHLAND MA.GPJ GEOLOGIC.GDT 11/29/17

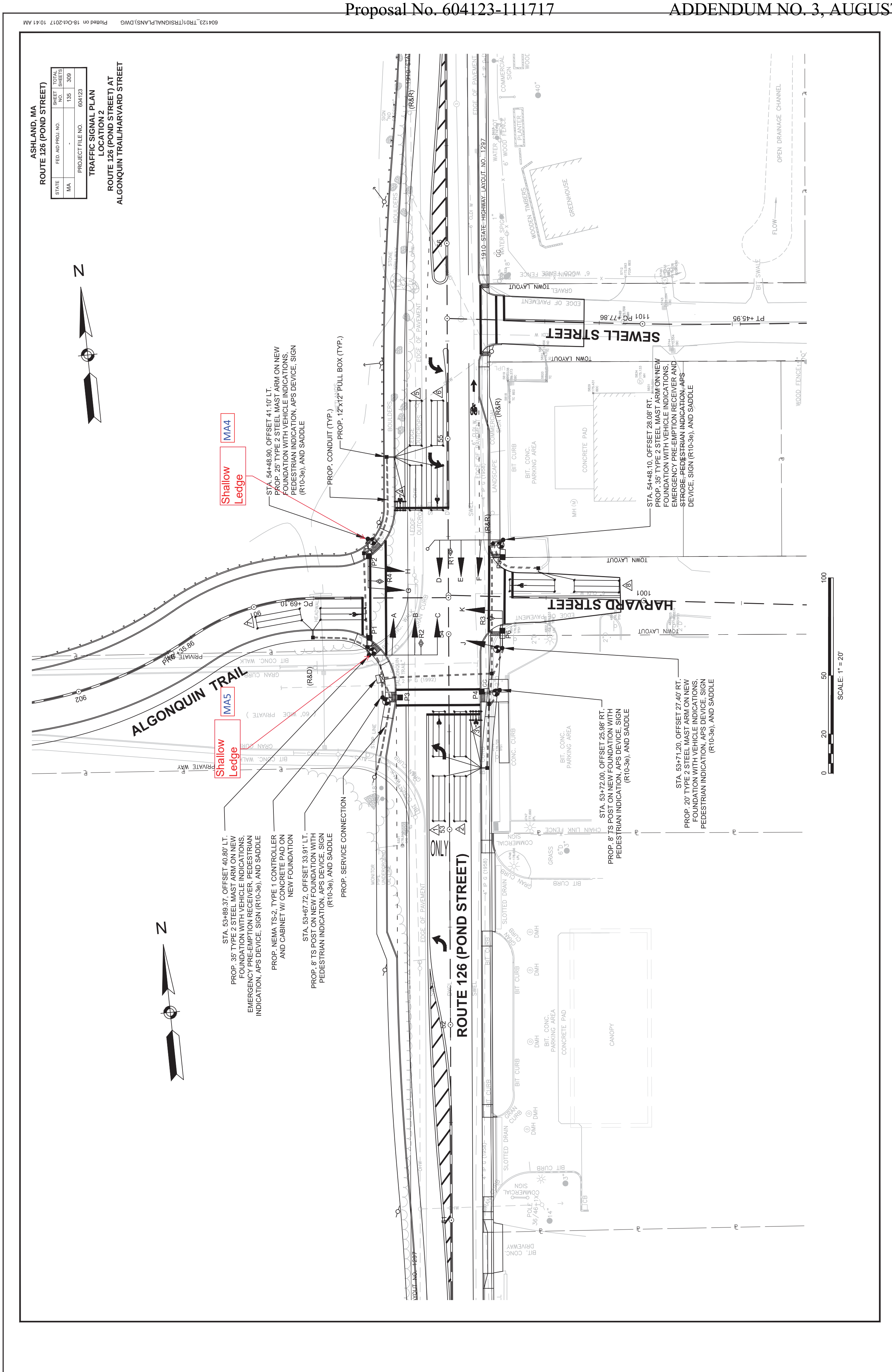
Appendix 2

Reference Information from Green International Affiliates, Inc

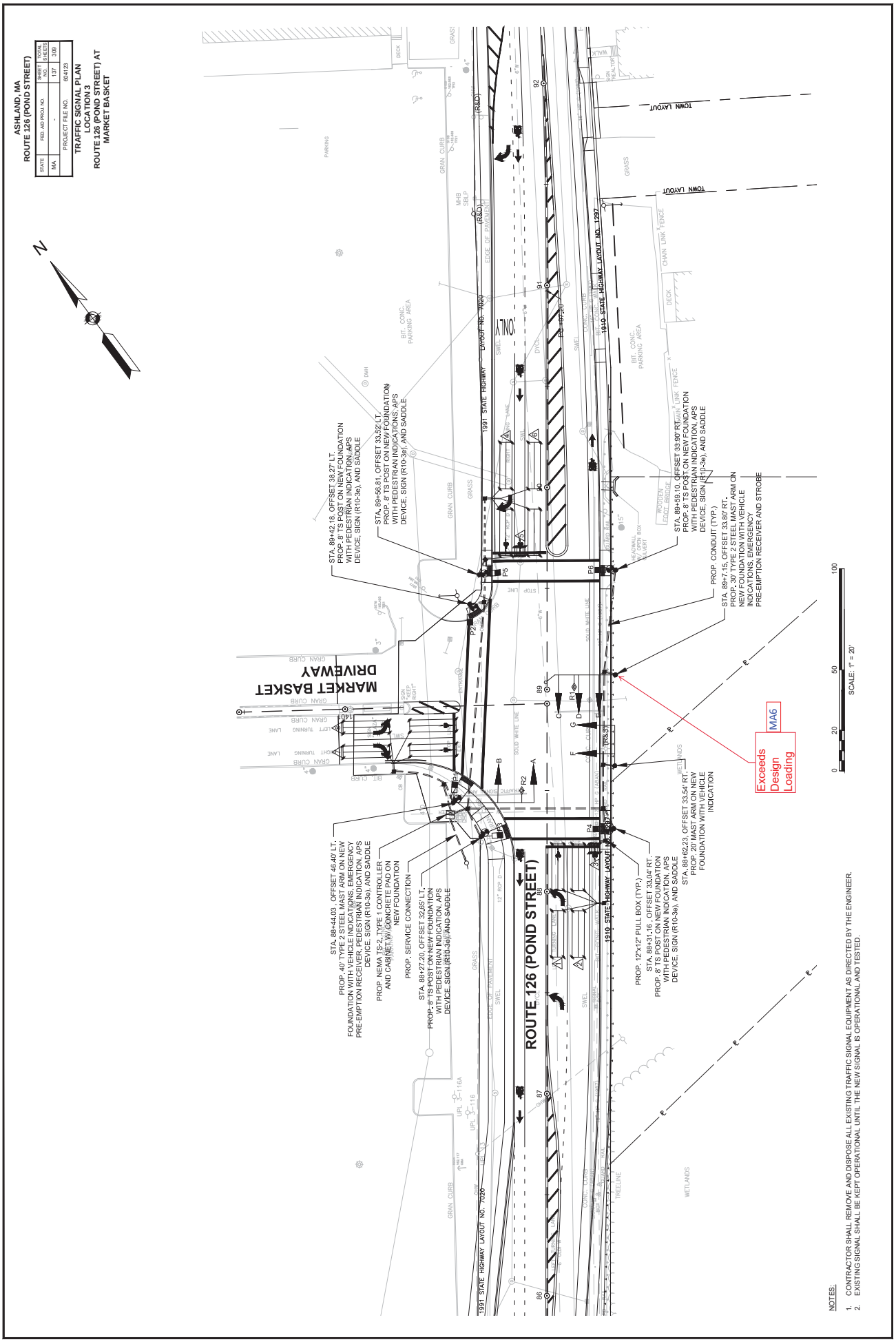
Index

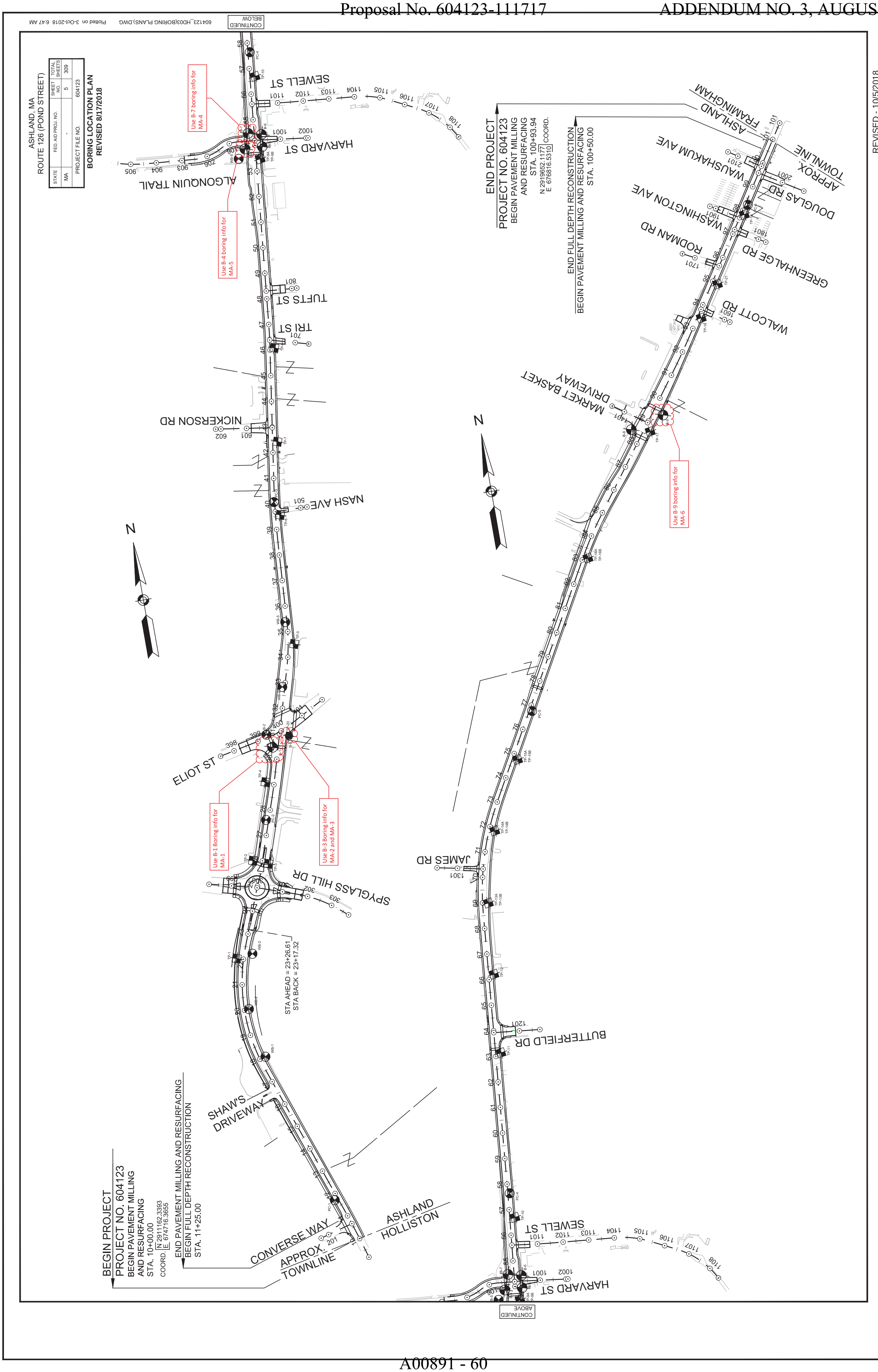
- Plan sheets (4 sheets)
- Boring Logs (5 sheets)
- Boring Elevation and Coordinates (1 sheet)
- Mast Arm Loads (6 sheets)


ASHLAND, MA
ROUTE 126 (POND STREET)
TRAFFIC SIGNAL PLAN
LOCATION 1
ROUTE 126 (POND STREET) AT
ELIOT STREET
STATE | FED. AID PROJ. NO. | SHEET NO. | TOTAL SHEETS
MA | - | 1.33 | 309
PROJECT FILE NO. 604123
ROUTE 126 (POND STREET)
ELIOT STREET
1985 COUNTY LAYOUT
1985 TOWN LAYOUT
1985 STATE HIGHWAY LAYOUT NO. 8720
1910 STATE HIGHWAY LAYOUT NO. 4018
1910 STATE HIGHWAY LAYOUT NO. 8738
1910 STATE HIGHWAY LAYOUT NO. 1297
STA. 399+26.61, OFFSET 26.09' LT, PROP. 30' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, AND PRE-EMPTION RECEIVER
STA. 399+54.18, OFFSET 30.95' LT, PROP. 10' HDD CONDUIT ON NEW FOUNDATION WITH VEHICLE, PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 31+62.82, OFFSET 31.46' LT, PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
PROP. CONDUIT (TYP.)
PROP. 12'x12' PULLBOX (TYP.)
STA. 32+00.23, OFFSET 36.06' RT, PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATIONS, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 400+91.37, OFFSET 31.60' LT, PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATIONS, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 30+43.23, OFFSET 21.50' LT, PROP. 30' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, EMERGENCY PRE-EMPTION RECEIVER, PEDESTRIAN INDICATIONS, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 30+48.95, OFFSET 32.81' RT, PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 30+83.54, OFFSET 35.95' RT, PROP. 30' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, EMERGENCY PRE-EMPTION RECEIVERS AND STROBE
PROP. 20' TYP. FOUNDATION
PROP. NEMA TS-2, TYPE 1 CONTROLLER AND CABINET W/ CONCRETE PAD ON NEW FOUNDATION
STA. 400+47.26, OFFSET 26.17' RT, PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
PROP. SERVICE CONNECTION
MA1 Shallow Ledge
MA2 Shallow Ledge and Exceed Design Loading
MA3 Shallow Ledge and Exceed Design Loading
PC +51.76
PT +34.98
PC +60.25
PT +40.98
SCALE: 1" = 20'
NOTES:
1. CONTRACTOR SHALL REMOVE AND DISPOSE ALL EXISTING TRAFFIC SIGNAL EQUIPMENT AS DIRECTED BY THE ENGINEER.
2. EXISTING SIGNAL SHALL BE OPERATIONAL UNTIL NEW SIGNAL IS INSTALLED, OPERATIONAL AND TESTED.
3. INSTALL QUEUE DETECTOR FOR POND STREET NORTHBOUND APPROACH AT STA 29+25.



ASHLAND, MA
ROUTE 126 (POND STREET)
STATE
MA
FED. AID PROJ. NO.
-
SHEET NO.
135
TOTAL SHEETS
309
PROJECT FILE NO.
604123
TRAFFIC SIGNAL PLAN
LOCATION 2
ROUTE 126 (POND STREET) AT
ALGONQUIN TRAIL/HARVARD STREET
N
ALGONQUIN TRAIL
SEWELL STREET
HARVARD STREET
ROUTE 126 (POND STREET)
Shallow Ledge
MA4
Shallow Ledge
MA5
STA. 54+48.90, OFFSET 41.10' LT.
PROP. 25' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
PROP. CONDUIT (TYP.)
PROP. 12"x12" PULL BOX (TYP.)
STA. 54+48.10, OFFSET 28.08' RT.
PROP. 35' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, EMERGENCY PRE-EMPTION RECEIVER AND STROBE, PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 53+89.37, OFFSET 40.80' LT.
PROP. 35' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, EMERGENCY PRE-EMPTION RECEIVER, PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
PROP. NEMA TS-2, TYPE 1 CONTROLLER AND CABINET W/ CONCRETE PAD ON NEW FOUNDATION
STA. 53+67.72, OFFSET 33.91' LT.
PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
PROP. SERVICE CONNECTION
STA. 53+72.00, OFFSET 25.98' RT.
PROP. 8' TS POST ON NEW FOUNDATION WITH PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
STA. 53+71.20, OFFSET 27.40' RT.
PROP. 20' TYPE 2 STEEL MAST ARM ON NEW FOUNDATION WITH VEHICLE INDICATIONS, PEDESTRIAN INDICATION, APS DEVICE, SIGN (R10-3e), AND SADDLE
SCALE: 1" = 20'
0
20
50
100


ASHLAND, MA
ROUTE 126 (POND STREET)
STATE | FED. AID PROJ. NO. | SHEET NO. | TOTAL SHEETS
MA | - | 1.37 | 309
PROJECT FILE NO. 604123
TRAFFIC SIGNAL PLAN
LOCATION 3
ROUTE 126 (POND STREET) AT
MARKET BASKET
604123_TR01(TRSIGNALPLANS).DWG Plotted on 18-Oct-2017 10:41 AM
N
ROUTE 126 (POND STREET)
MARKET BASKET DRIVEWAY
1991 STATE HIGHWAY LAYOUT NO. 7026
1910 STATE HIGHWAY LAYOUT NO. 1297
TOWN LAYOUT
STA. 89+42.18, OFFSET 38.27' LT.
PROP. 8' TS POST ON NEW FOUNDATION
WITH PEDESTRIAN INDICATION, APS
DEVICE, SIGN (R10-3e), AND SADDLE
STA. 89+56.91, OFFSET 33.59' LT.
PROP. 8' TS POST ON NEW FOUNDATION
WITH PEDESTRIAN INDICATION, APS
DEVICE, SIGN (R10-3e), AND SADDLE
STA. 89+59.10, OFFSET 93.99' RT.
PROP. 8' TS POST ON NEW FOUNDATION
WITH PEDESTRIAN INDICATION, APS
DEVICE, SIGN (R10-3e), AND SADDLE
PROP. CONDUIT (TYP.)
STA. 89+7.15, OFFSET 33.80' RT.
PROP. 30' TYPE 2 STEEL MAST ARM ON
NEW FOUNDATION WITH VEHICLE
INDICATIONS, EMERGENCY
PRE-EMPTION RECEIVER AND STROBE
STA. 88+44.03 , OFFSET 46.40' LT.
PROP. 40' TYPE 2 STEEL MAST ARM ON NEW
FOUNDATION WITH VEHICLE INDICATIONS, EMERGENCY
PRE-EMPTION RECEIVER, PEDESTRIAN INDICATION, APS
DEVICE, SIGN (R10-3e), AND SADDLE
PROP. NEMA TS-2, TYPE 1 CONTROLLER
AND CABINET W/ CONCRETE PAD ON
NEW FOUNDATION
PROP. SERVICE CONNECTION
STA. 88+27.20, OFFSET 32.65' LT.
PROP. 8' TS POST ON NEW FOUNDATION
WITH PEDESTRIAN INDICATION, APS
DEVICE, SIGN (R10-3e), AND SADDLE
PROP. 12"x12" PULL BOX (TYP.)
STA. 88+31.16 , OFFSET 33.04' RT.
PROP. 8' TS POST ON NEW FOUNDATION
WITH PEDESTRIAN INDICATION, APS
DEVICE, SIGN (R10-3e), AND SADDLE
STA. 88+62.23, OFFSET 33.54' RT.
PROP. 20' MAST ARM ON NEW
FOUNDATION WITH VEHICLE
INDICATION
Exceeds Design Loading
MA6
SCALE: 1" = 20'
NOTES:
1. CONTRACTOR SHALL REMOVE AND DISPOSE ALL EXISTING TRAFFIC SIGNAL EQUIPMENT AS DIRECTED BY THE ENGINEER.
2. EXISTING SIGNAL SHALL BE KEPT OPERATIONAL UNTIL THE NEW SIGNAL IS OPERATIONAL AND TESTED.


ASHLAND, MA
ROUTE 126 (POND STREET)
BORING LOCATION PLAN
REVISED 8/17/2018
STATE
FED. AID PROJ. NO.
SHEET NO.
TOTAL SHEETS
MA
5
309
PROJECT FILE NO.
604123
REVISED - 10/5/2018
604123_HD03(BORING PLANS).DWG
Plotted on 3-Oct-2018 6:47 AM
CONTINUED BELOW
CONTINUED ABOVE
BEGIN PROJECT
PROJECT NO. 604123
BEGIN PAVEMENT MILLING
AND RESURFACING
STA. 10+00.00
COORD. N 2911162.3393
E 674716.3655
END PAVEMENT MILLING AND RESURFACING
BEGIN FULL DEPTH RECONSTRUCTION
STA. 11+25.00
END PROJECT
PROJECT NO. 604123
BEGIN PAVEMENT MILLING
AND RESURFACING
STA. 100+93.94
N 2919652.1177
E 676816.5310
COORD.
END FULL DEPTH RECONSTRUCTION
BEGIN PAVEMENT MILLING AND RESURFACING
STA. 100+50.00
STA AHEAD = 23+26.61
STA BACK = 23+17.32
CONVERSE WAY
APPROX. TOWNLINE
ASHLAND
HOLLISTON
SHAW'S DRIVEWAY
SPYGLASS HILL DR
ELIOT ST
NASH AVE
NICKERSON RD
TRI ST
TUFTS ST
ALGONQUIN TRAIL
HARVARD ST
SEWELL ST
JAMES RD
BUTTERFIELD DR
MARKET BASKET DRIVEWAY
WALCOTT RD
GREENHALGE RD
RODMAN RD
WASHINGTON AVE
DOUGLAS RD
WAUSHAKUM AVE
APPROX. TOWNLINE
ASHLAND
FRAMINGHAM
N
Use B-1 Boring info for MA-1
Use B-3 Boring info for MA-2 and MA-3
Use B-4 boring info for MA-5
Use B-7 boring info for MA-4
Use B-9 boring info for MA-6

Boring Log — LAMSON ENGINEERING CORPORATION, 437 Cherry Street, #109, Newton, Massachusetts 02465, Phone: (617) 558-0101, E-Mail: Lamsoneng@msn.com

Boring No. WB-1 (Wall Boring)	Page 1/1	Scale: 1" = 5'	
City/Town: Ashland	Bridge No.: -	Project File No.: 604123	Contract No.: -
Location: Route 126 (Pond Street)		Date & Time Started: 10/11/17 9:30 pm	Total Hours:
Groundwater Depth (Feet): -	Date & Time: -	Date & Time Completed: 10/12/17 4:00 am	6.5
Coordinates: N 2,911,924	E 674,478	Ground Elevation (Feet): 263.5'	Inspector's Name: Weijie Dong
Drilling Company: Geologic Exploration, Inc.	Driller's Name: Damien Jacobs	Helper's Name: Keith Eastwood / John Boyd	

Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches / Coring Times Minute Per Foot	Recovery (Inches)	Field Description	Strata Changes
				Asphalt	10"
S-1	1' - 3'	14 48 57 69	15"	Dry, very dense, brown, FINE SAND, some fine gravel, trace coarse sand.	
S-2	4' - 4'5"	120/5"	4"	Dry, very dense, brown, FINE TO COARSE SAND, trace inorganic silt.	4'5"
				Cobbles 4'5"	5'7"
				Sand & Gravel from Wash. Top of Bedrock	
				Rollerbit to 8' and begin coring	
C-1	8' - 13'	6 8 8 7 8	21"	Hard, pinkish/gray, moderately fractured, GRANITE. Recovery = 35%, RQD = 7"/60" = 12% - Jammed at 13', poor recovery.	
C-2	13' - 18'	15 19 25 50 45	35"	Hard, pinkish/gray, GRANITE. Recovery = 58%, RQD = 35"/60" = 58% - Lost rest of bedrock down the hole.	
				Bottom of Exploration at 18'	18'

Notes: — Light Tower: 1; Signs: 4; Cones: 25 — Protective Device: Stand: - Box: -; Well Depth: - Solid Pipe: -; Stick Up Pipe: - Screen Pipe: -

Penetration Resistance (N) Guide:

Cohesionless Soils (Sands, Gravels)		Cohesive Soils (Silts, Clays)	
Relative Density	Penetration Resistance	Consistency	Penetration Resistance
Very Loose	0 - 4	Very Soft	0 - 2
Loose	4 - 10	Soft	2 - 4
Medium Dense	10 - 30	Medium Stiff	4 - 8
Dense	30 - 50	Stiff	8 - 15
Very Dense	Over 50	Very Stiff	15 - 30
		Hard	Over 30

N=Sum of Second and Third 6" Blow Counts

Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less

Type of Drill Rig: Scout — Hammer Weight: 300lb Fall: 24" — Casing Types: HW NW — Size: 4" 3" — Depth: 4' 8' — Sampler Type: S/S Size: 1⅜" ID — Automatic Hammer Weight: — Safety Hammer Weight: Fall: 30" — Donut Hammer Weight: 140lb — Core Barrel Type: NX Size: 2.15" ID

WB–1
SCALE: 1/8" = 1'–0"

Boring Log — LAMSON ENGINEERING CORPORATION, 437 Cherry Street, #109, Newton, Massachusetts 02465, Phone: (617) 558-0101, E-Mail: Lamsoneng@msn.com

Boring No. WB-2 (Wall Boring)	Page 1/1	Scale: 1" = 5'	
City/Town: Ashland	Bridge No.: -	Project File No.: 604123	Contract No.: -
Location: Route 126 (Pond Street)		Date & Time Started: 10/12/17 9:30 pm	Total Hours:
Groundwater Depth (Feet): -	Date & Time: -	Date & Time Completed: 10/13/17 2:00 am	4.5
Coordinates: N 2,912,118	E 674,447	Ground Elevation (Feet): 265.3'	Inspector's Name: Weijie Dong
Drilling Company: Geologic Exploration, Inc.	Driller's Name: Damien Jacobs	Helper's Name: Keith Eastwood / John Boyd	

Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches / Coring Times Minute Per Foot	Recovery (Inches)	Field Description	Strata Changes
				Asphalt	10"
S-1	1' - 2'	61 75	12"	Dry, very dense, brown, FINE SAND, some fine gravel, trace coarse sand.	
				Top of Bedrock	3'6"
				Rollerbit to 4' and begin coring	
C-1	4' - 9'	7 9 13 15 15	60"	Hard, pinkish/gray, GRANITE. Recovery = 100%, RQD = 60"/60" = 100%	
C-2	9' - 14'	12 15 15 16 16	60"	Hard, pinkish/gray, GRANITE. Recovery = 100%, RQD = 60"/60" = 100%	
				Bottom of Exploration at 14'	14'

Notes: — Light Tower: 1; Signs: 4; Cones: 25 — Protective Device: Stand: - Box: -; Well Depth: - Solid Pipe: -; Stick Up Pipe: - Screen Pipe: -

Penetration Resistance (N) Guide:

Cohesionless Soils (Sands, Gravels)		Cohesive Soils (Silts, Clays)	
Relative Density	Penetration Resistance	Consistency	Penetration Resistance
Very Loose	0 - 4	Very Soft	0 - 2
Loose	4 - 10	Soft	2 - 4
Medium Dense	10 - 30	Medium Stiff	4 - 8
Dense	30 - 50	Stiff	8 - 15
Very Dense	Over 50	Very Stiff	15 - 30
		Hard	Over 30

N=Sum of Second and Third 6" Blow Counts

Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less

Type of Drill Rig: Scout — Hammer Weight: 300lb Fall: 24" — Casing Types: NW — Size: 3" — Depth: 4' — Sampler Type: S/S Size: 1⅜" ID — Automatic Hammer Weight: — Safety Hammer Weight: Fall: 30" — Donut Hammer Weight: 140 lb — Core Barrel Type: NX Size: 2.15" ID

WB–2
SCALE: 1/8" = 1'–0"

Boring Log — LAMSON ENGINEERING CORPORATION, 437 Cherry Street, #109, Newton, Massachusetts 02465, Phone: (617) 558-0101, E-Mail: Lamsoneng@msn.com

Boring No. WB-3 (Wall Boring)	Page 1/1	Scale: 1" = 5'	
City/Town: Ashland	Bridge No.: -	Project File No.: 604123	Contract No.: -
Location: Route 126 (Pond Street)		Date & Time Started: 10/13/17 9:30 pm	Total Hours:
Groundwater Depth (Feet): -	Date & Time: -	Date & Time Completed: 10/14/17 3:00 am	5.5
Coordinates: N 2,912,328	E 674,498	Ground Elevation (Feet): 263.2'	Inspector's Name: Weijie Dong
Drilling Company: Geologic Exploration, Inc.	Driller's Name: Damien Jacobs	Helper's Name: Keith Eastwood / John Boyd	

Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches / Coring Times Minute Per Foot	Recovery (Inches)	Field Description	Strata Changes
				Asphalt	10"
S-1	1' - 3'	34 37 40 47	17"	Dry, very dense, brown, FINE SAND, trace fine gravel.	
S-2	4' - 6'	42 63 54 72	10"	Dry, very dense, brown, FINE SAND, trace fine gravel.	
S-3	9' -9'4"	120/4"	4"	Dry, very dense, brown, FINE SAND, some fine gravel, trace inorganic silt.	9'4"
				Top of Bedrock	
				Rollerbit to 11' and begin coring	
C-1	11' - 16'	15 15 25 12 15	60"	Hard, pinkish/gray, slightly fractured, GRANITE. Recovery = 100%, RQD = 40"/60" = 67%	
C-2	16' - 21'	16 16 17 20 32	60"	Hard, pinkish/gray, slightly fractured, GRANITE. Recovery = 100%, RQD = 48"/60" = 80%	
				Bottom of Exploration at 21'	21'

Notes: — Light Tower: 1; Signs: 4; Cones: 25 — Protective Device: Stand: - Box: -; Well Depth: - Solid Pipe: -; Stick Up Pipe: - Screen Pipe: -

Penetration Resistance (N) Guide:

Cohesionless Soils (Sands, Gravels)		Cohesive Soils (Silts, Clays)	
Relative Density	Penetration Resistance	Consistency	Penetration Resistance
Very Loose	0 - 4	Very Soft	0 - 2
Loose	4 - 10	Soft	2 - 4
Medium Dense	10 - 30	Medium Stiff	4 - 8
Dense	30 - 50	Stiff	8 - 15
Very Dense	Over 50	Very Stiff	15 - 30
		Hard	Over 30

N=Sum of Second and Third 6" Blow Counts

Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less

Type of Drill Rig: Scout — Hammer Weight: 300lb Fall: 24" — Casing Types: NW — Size: 3" — Depth: 11' — Sampler Type: S/S Size: 1⅜" ID — Automatic Hammer Weight: — Safety Hammer Weight: Fall: 30" — Donut Hammer Weight: 140 lbs — Core Barrel Type: NX Size: 2.15" ID

WB–3
SCALE: 1/8" = 1'–0"

BORING NOTES:

1. LOCATION OF BORINGS SHOWN ON THE PLANS THUS: WB–#, B–#.
2. BORINGS ARE TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORINGS POINTS ONLY, BUT DO NOT NECESSARILY SHOW THE NATURE OF THE MATERIALS TO BE ENCOUNTERED DURING CONSTRUCTION.
3. WATER LEVELS SHOWN ON THE BORING LOGS WERE OBSERVED AT THE TIME OF TAKING BORINGS AND DO NOT NECESSARILY SHOW THE TRUE GROUND WATER LEVEL.
4. FIGURES IN COLUMNS INDICATE NUMBER OF BLOWS REQUIRED TO DRIVE A 1⅜" I.D. SPLIT SPOON SAMPLER 6" USING A 140 POUND WEIGHT FALLING 30".
5. BORING SAMPLES ARE STORED AT A STORAGE FACILITY LOCATED ON ROUTE 114 (219 WINTHROP AVE.) IN LAWRENCE, MA. THE CONTRACTOR MAY EXAMINE THE SOIL AND ROCK SAMPLES BY CONTACTING THE MASSDOT GEOTECHNICAL SECTION AT 10 PARK PLAZA, BOSTON, MA.
6. ALL BORINGS WERE MADE IN OCTOBER 2017.
7. BORINGS WERE MADE BY GEOLOGIC EARTH EXPLORATION, INC., 7 SHERWOOD DRIVE, NORFOLK, MA 02056 AT 508–384–4434.
8. THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

ASHLAND
ROUTE 126 (POND STREET)

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	7	309
PROJECT FILE NO.	604123		

BORING LOGS 2 OF 5

MassDOT — Boring Log

LAMSON ENGINEERING CORPORATION
437 Cherry Street, #109, Newton, Massachusetts 02465
Phone: (617) 558-0101 E-Mail: Lamsoneng@msn.com

Boring No. WB-4 (Wall Boring) Page 1/1
Scale: 1" = 5'

City/Town: Ashland | Bridge No.: - | Project File No.: 604123 | Contract No.: -
Location: Route 126 (Pond Street) | Date & Time Started: 10/16/17 9:30 pm | Total Hours:
Groundwater Depth (Feet): - Date & Time: - | Date & Time Completed: 10/17/17 4:00 am | 6.5
Coordinates: *N 2,913,332 *E 674,793 | Ground Elevation (Feet): *237.2 | Inspector's Name: Weijie Dong
Drilling Company: Geologic Exploration, Inc. | Driller's Name: Damien Jacobs | Helper's Name: Keith Eastwood / Will Betts

Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches / Coring Times Minute Per Foot	Recovery (inches)	Field Description	Strata Changes
				Asphalt	10"
S-1	1' - 2'2"	5 98 50/2"	5"	Dry, very dense, dark brown, FINE SAND, trace fine gravel, trace inorganic silt.	
S-2	4' - 6'	21 21 25 86	9"	Dry, dense, brown, FINE SAND, trace fine to medium gravel, trace inorganic silt.	6'
				Top of Bedrock Rollerbit to 8' and begin coring	
C-1	8' - 13'	8 7 12 18 25	50"	Hard, gray, moderately fractured, GRANITE. Recovery = 83%, RQD = 35"/60" = 58%	
C-2	13' - 15'6"	15 18 15/6"	30"	Hard, gray, highly fractured, GRANITE. Recovery = 100%, RQD = 10"/30" = 33%	
					15'6"
				Bottom of Exploration at 15'6"	
				- Terminated at 15'6" due to machine malfunction, could not advance any further.	

Notes:
* Move boring approximately 11' East of original location due to underground utilities. Coordinates and elevation are estimated.

Light Tower: 1 | Signs: 4 | Cones: 25
Protective Device Stand: - Box: - | Well Depth: - Solid Pipe: - | Stick Up Pipe: - Screen Pipe: -

Penetration Resistance (N) Guide: | Type of Drill Rig: Scout

Cohesionless Soils (Sands, Gravels)		Cohesive Soils (Silts, Clays)		Hammer Weight: 300lb Fall: 24"
Relative Density	Penetration Resistance	Consistency	Penetration Resistance	Casing Types: NW
Very Loose	0 - 4	Very Soft	0 - 2	Size: 3"
Loose	4 - 10	Soft	2 - 4	Depth: 8'
Medium Dense	10 - 30	Medium Stiff	4 - 8	Sampler Type: S/S Size: 1⅜" ID
Dense	30 - 50	Stiff	8 - 15	Automatic Hammer Weight:
Very Dense	Over 50	Very Stiff	15 - 30	Safety Hammer Weight: Fall: 30"
N=Sum of Second and Third 6" Blow Counts		Hard	Over 30	Donut Hammer Weight: 140 lb

Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less | Core Barrel Type: NX Size: 2.15" ID

WB–4
SCALE: ⅜" = 1'–0"

213.8
(10/19/17)

MassDOT — Boring Log

LAMSON ENGINEERING CORPORATION
437 Cherry Street, #109, Newton, Massachusetts 02465
Phone: (617) 558-0101 E-Mail: Lamsoneng@msn.com

Boring No. WB-5 (Wall Boring) Page 1/1
Scale: 1" = 5'

City/Town: Ashland | Bridge No.: - | Project File No.: 604123 | Contract No.: -
Location: Route 126 (Pond Street) | Date & Time Started: 10/18/17 9:30 pm | Total Hours:
Groundwater Depth (Feet): 6'5" Date & Time: 10/19/17 12:25 am | Date & Time Completed: 10/19/17 12:45 am | 2.25
Coordinates: N 2,913,579 E 674,848 | Ground Elevation (Feet): 220.2' | Inspector's Name: Weijie Dong
Drilling Company: Geologic Exploration, Inc. | Driller's Name: Damien Jacobs | Helper's Name: Keith Eastwood / Will Betts

Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches / Coring Times Minute Per Foot	Recovery (inches)	Field Description	Strata Changes
				Asphalt	10"
S-1	1' - 1'8"	48 72/2"	6"	Dry, very dense, dark brown, FINE SAND, trace fine gravel, trace inorganic silt.	
S-2	4' - 5'7"	14 34 103 40/1"	10"	Dry, very dense, brown, FINE SAND, some inorganic silt, trace fine to medium gravel.	
S-3	9' - 11'	32 55 45 6"	10"	Moist, very dense, brown, FINE SAND, some inorganic silt, trace fine to medium gravel.	
S-4	14' - 14'3"	120/3"	0"	No Recovery	14'3"
				Cobbles & Boulders	17'
S-5	19' - 19'5"	120/5"	3"	Wet, very dense, brown, FINE SAND AND FINE TO MEDIUM GRAVEL, some inorganic silt.	21'
				Possible Top of Bedrock Rollerbit to 22' and terminate.	22'
				Bottom of Exploration at 22'	

Notes:

Light Tower: 1 | Signs: 4 | Cones: 25
Protective Device Stand: - Box: - | Well Depth: - Solid Pipe: - | Stick Up Pipe: - Screen Pipe: -

Penetration Resistance (N) Guide: | Type of Drill Rig: Scout

Cohesionless Soils (Sands, Gravels)		Cohesive Soils (Silts, Clays)		Hammer Weight: 300lb Fall: 24"
Relative Density	Penetration Resistance	Consistency	Penetration Resistance	Casing Types: NW
Very Loose	0 - 4	Very Soft	0 - 2	Size: 3"
Loose	4 - 10	Soft	2 - 4	Depth: 19'
Medium Dense	10 - 30	Medium Stiff	4 - 8	Sampler Type: S/S Size: 1⅜" ID
Dense	30 - 50	Stiff	8 - 15	Automatic Hammer Weight:
Very Dense	Over 50	Very Stiff	15 - 30	Safety Hammer Weight: Fall: 30"
N=Sum of Second and Third 6" Blow Counts		Hard	Over 30	Donut Hammer Weight: 140 lb

Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less | Core Barrel Type: - Size: -

WB–5
SCALE: ⅜" = 1'–0"

MassDOT — Boring Log

LAMSON ENGINEERING CORPORATION
437 Cherry Street, #109, Newton, Massachusetts 02465
Phone: (617) 558-0101 E-Mail: Lamsoneng@msn.com

Boring No. B-2 (Wall Boring) Page 1/1
Scale: 1" = 5'

City/Town: Ashland | Bridge No.: - | Project File No.: 604123 | Contract No.: -
Location: Route 126 (Pond Street) | Date & Time Started: 10/17/17 9:30 pm | Total Hours:
Groundwater Depth (Feet): - Date & Time: - | Date & Time Completed: 10/18/17 3:45 am | 6.25
Coordinates: N 2,913,170 E 674,690 | Ground Elevation (Feet): 247.2' | Inspector's Name: Weijie Dong
Drilling Company: Geologic Exploration, Inc. | Driller's Name: Damien Jacobs | Helper's Name: Keith Eastwood / Will Betts

Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches / Coring Times Minute Per Foot	Recovery (inches)	Field Description	Strata Changes
				Asphalt	10"
S-1	1' - 3'	27 28 27 23	14"	Dry, very dense, brown, FINE SAND, trace fine gravel, trace inorganic silt.	
				Boulder	3'10"
					5'8"
S-2	6' - 6'9"	56 64/5"	9"	Dry, very dense, brown, FINE TO COARSE SAND, some fine gravel, trace inorganic silt.	
S-3	9' - 9'5"	120/5"	3"	Moist, very dense, brown, FINE SAND AND FINE TO MEDIUM GRAVEL, some inorganic silt.	9'5"
				Cobbles	9'11"
S-4	14' - 14'4"	120/4"	4"	Moist, very dense, brown, FINE SAND AND FINE TO MEDIUM GRAVEL, some inorganic silt.	
				Top of Bedrock Rollerbit to 17' and begin coring	16'9"
C-1	17' - 22'	8 10 12 11 12	60"	Hard, gray, slightly fractured, GRANITE. Recovery = 100%, RQD = 47"/60" = 78%	
C-2	22' - 27'	11 12 11 15 12	58"	Hard, gray, slightly fractured, GRANITE. Recovery = 93%, RQD = 44"/60" = 73%	
					27'
				Bottom of Exploration at 27'	

Notes:

Light Tower: 1 | Signs: 4 | Cones: 25
Protective Device Stand: - Box: - | Well Depth: - Solid Pipe: - | Stick Up Pipe: - Screen Pipe: -

Penetration Resistance (N) Guide: | Type of Drill Rig: Scout

Cohesionless Soils (Sands, Gravels)		Cohesive Soils (Silts, Clays)		Hammer Weight: 300lb Fall: 24"
Relative Density	Penetration Resistance	Consistency	Penetration Resistance	Casing Types: NW
Very Loose	0 - 4	Very Soft	0 - 2	Size: 3"
Loose	4 - 10	Soft	2 - 4	Depth: 17'
Medium Dense	10 - 30	Medium Stiff	4 - 8	Sampler Type: S/S Size: 1⅜" ID
Dense	30 - 50	Stiff	8 - 15	Automatic Hammer Weight:
Very Dense	Over 50	Very Stiff	15 - 30	Safety Hammer Weight: Fall: 30"
N=Sum of Second and Third 6" Blow Counts		Hard	Over 30	Donut Hammer Weight: 140 lb

Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less | Core Barrel Type: NX Size: 2.15" ID

B–2
SCALE: ⅜" = 1'–0"

BORING NOTES:

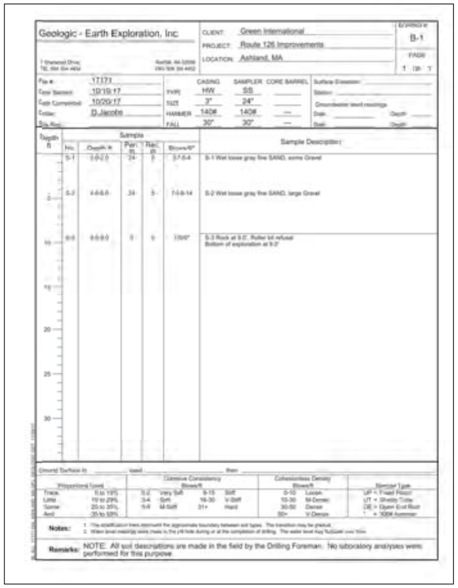
SEE SHEET 6 FOR BORING NOTES.

604123_HD03(BORING LOGS).DWG 6-Dec-2017

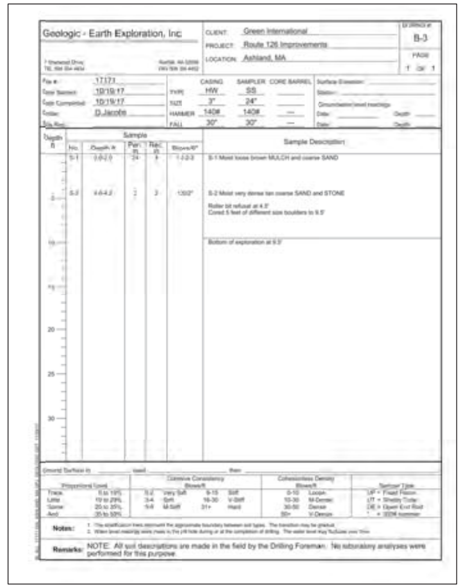
ASHLAND
ROUTE 126 (POND STREET)

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	8	309
	PROJECT FILE NO. 604123		

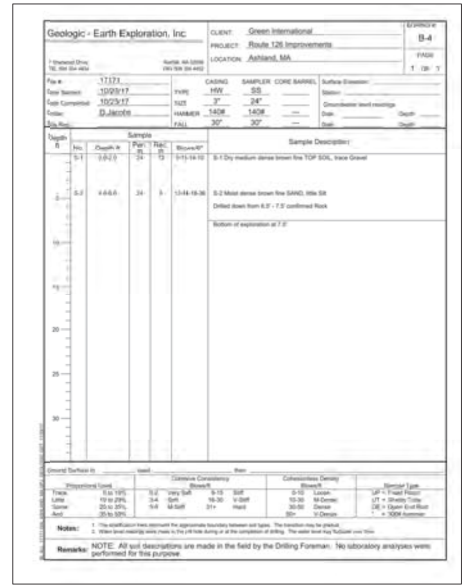
BORING LOGS 3 OF 5



B–1
SCALE: N.T.S.



B–3
SCALE: N.T.S.



B–4
SCALE: N.T.S.

BORING NOTES:

SEE SHEET 6 FOR BORING NOTES.

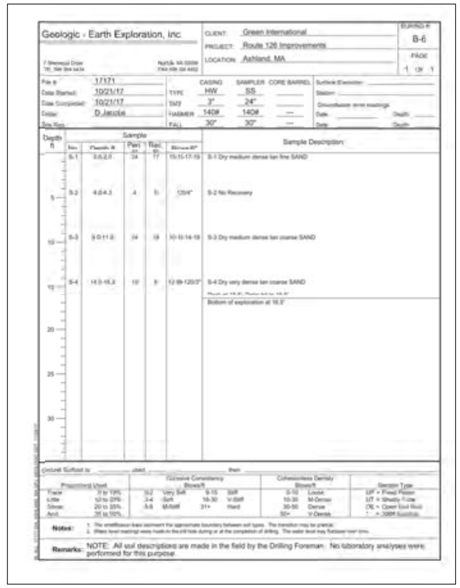
604123_HD03(BORING LOGS).DWG 6-Dec-2017

ASHLAND
ROUTE 126 (POND STREET)

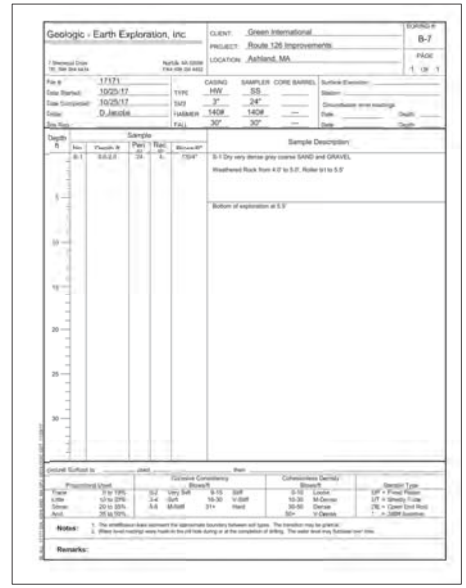
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	9	309
	PROJECT FILE NO.	604123	

BORING LOGS 4 OF 5

B–5
SCALE: N.T.S.



B–6
SCALE: N.T.S.



B–7
SCALE: N.T.S.

BORING NOTES:

SEE SHEET 6 FOR BORING NOTES.

604123_HD03(BORING LOGS).DWG 6-Dec-2017

ASHLAND
ROUTE 126 (POND STREET)

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	10	309
	PROJECT FILE NO.	604123	

BORING LOGS 5 OF 5

Geologic - Earth Exploration, Inc

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA
BORING #: B-8
PAGE 1 OF 1

File #: 17171
Date Started: 10/24/17
Date Completed: 10/24/17
Driller: D.Jacobs

	CASING	SAMPLER	CORE BARREL
TYPE	HW	SS	
SIZE	3"	24"	
HAMMER	140#	140#	—
FALL	30"	30"	—

No.	Depth ft	Pen in	Rec in	Blows/6"	Sample Description
S-1	0.0-2.0	24	13	3-1-8-13	S-1 Dry medium dense brown fine TOP SOIL, some Gravel
S-2	4.0-6.0	24	3	11-8-6-6	S-2 Wet medium dense gray coarse SAND and GRAVEL
S-3	9.0-11.0	24	6	4-4-6-8	S-3 Wet medium dense gray coarse SAND, little Gravel, trace Silt
S-4	14.0-16.0	24	18	8-11-17-12	S-4 Wet medium dense gray fine SAND, little Silt
S-5	19.0-21.0	24	12	23-20-17-19	S-5 Wet dense gray fine SAND
S-6	24.0-26.0	24	5	7-8-12-18	S-6 Wet medium dense gray fine SAND
					Bottom of exploration at 26.0'

Notes:
Remarks:

B-8
SCALE: N.T.S.

Geologic - Earth Exploration, Inc

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA
BORING #: B-9
PAGE 1 OF 1

File #: 17171
Date Started: 10/23/17
Date Completed: 10/23/17
Driller: D.Jacobs

	CASING	SAMPLER	CORE BARREL
TYPE	HW	SS	
SIZE	3"	24"	
HAMMER	140#	140#	—
FALL	30"	30"	—

No.	Depth ft	Pen in	Rec in	Blows/6"	Sample Description
S-1	0.0-2.0	24	5	2-1-3-3	S-1 Dry loose dark brown fine TOP SOIL
S-2	4.0-6.0	24	3	1-1-2-2	S-2 Wet loose dark brown fine SOIL, some Gravel
S-3	9.0-11.0	24	8	4-4-7-8	S-3 Wet medium dense gray coarse and fine SAND
S-4	14.0-16.0	24	0	11-10-9-10	S-4 No Recovery
S-5	19.0-21.0	24	24	22-17-20-17	S-5 Wet dense gray fine SAND, some Gravel
S-6	24.0-26.0	24	18	11-11-20-17	S-6 Wet dense gray fine SAND, some Gravel
					Bottom of exploration at 26.0'

Notes:
Remarks:

B-9
SCALE: N.T.S.

Geologic - Earth Exploration, Inc

CLIENT: Green International
PROJECT: Route 126 Improvements
LOCATION: Ashland, MA
BORING #: B-10
PAGE 1 OF 1

File #: 17171
Date Started: 10/26/17
Date Completed: 10/26/17
Driller: D.Jacobs

	CASING	SAMPLER	CORE BARREL
TYPE	HW	SS	
SIZE	3"	24"	
HAMMER	140#	140#	—
FALL	30"	30"	—

No.	Depth ft	Pen in	Rec in	Blows/6"	Sample Description
S-1	0.0-2.0	24	14	16-24-24-53	S-1 Dry medium dense coarse SAND and small Gravel
S-2	4.0-6.0	24	8	75-100-120/2"	S-2 Moist very dense tan fine SAND and GRAVEL
S-3	9.0-11.0	24	7	15-120/4"	S-3 Moist very dense coarse SAND and GRAVEL
S-4	14.0-16.0	24	2	120/2"	S-4 Wet very dense coarse SAND and GRAVEL
					Bottom of exploration at 16.0'

Notes:
Remarks:

B-10
SCALE: N.T.S.

BORING NOTES:

SEE SHEET 6 FOR BORING NOTES.

	Mast Arm Coordinate		
Mast Arm	**x**	**y**	**Proposed elevation of mast arm**
MA-1	674714.362	2913105.673	245.34'
MA-2	674780.810	2913128.251	243.25'
MA-3	674795.871	2913141.349	244.22'
MA-5	675013.517	2915422.445	176.86'
MA-4	675019.074	2915481.719	176.81'
MA-6	676183.912	2918646.335	159.65'

	Boring Coordinate		
Boring #	**x**	**y**	**Existing elevation of boring location**
B1	674712.047	2913105.416	245.57'
B3	674783.517	2913137.133	243.88'
B4	675015.466	2915420.100	176.54'
B7	675038.430	2915477.548	178.26'
B9	676209.643	2918673.574	157.65'

GREEN INTERNATIONAL AFFILIATES, INC.
Civil & Structural Engineers
239 Littleton Road, Suite 3
WESTFORD, MA 01886
(978) 923-0400 (978) 399-0033 (Fax)

JOB	13033.04X - ASHLAND, ROUTE 126		
SHEET NO.		OF	
CALCULATED BY	HD	DATE	07/19
CHECKED BY	BK	DATE	10/19
SCALE	MAST ARM 1 LOADS		

8.0 LOAD COMBINATIONS

FORCE	GROUP LOAD I	GROUP LOAD II		GROUP LOAD III	
	D	D + W		D + ICE + 0.5W	
		LOAD CASE 1	LOAD CASE 2	LOAD CASE 1	LOAD CASE 2
SHEAR ABOUT X, V_X (LB)	0.00	678.71	610.84	205.57	185.01
SHEAR ABOUT Z, V_Z (LB)	0.00	3393.56	2036.13	1027.86	616.71
AXIAL FORCE, P_Y (LB)	1573.11	1573.11	1573.11	2280.65	2280.65
MOMENT ABOUT X, M_X (FT-LB)	9.45	56590.92	33958.33	16626.00	10000.64
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	27536.26	16521.76	7250.82	4350.49
MOMENT ABOUT Z, M_Z (FT-LB)	6795.51	18111.80	16980.17	14663.78	14332.51

FORCE	GROUP LOAD IV - FATIQUE			
	GALLOPING	NATURAL WIND GUST		TRUCK INDUCED GUST
		LOAD CASE 1	LOAD CASE 2	
SHEAR ABOUT X, V_X (LB)	0.00	97.96	88.16	0.00
SHEAR ABOUT Z, V_Z (LB)	0.00	489.80	293.88	0.00
AXIAL FORCE, P_Y (LB)	797.34	0.00	0.00	462.92
MOMENT ABOUT X, M_X (FT-LB)	148.84	7910.27	4746.16	8577.83
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	3464.91	2078.95	0.00
MOMENT ABOUT Z, M_Z (FT-LB)	8051.81	1582.05	1423.85	3595.25

Note: Loads shown include 5% increase to account for miscellaneous connections, pre-emp devices, and strobes light.

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JOB	13033.04X - ASHLAND, ROUTE 126		
SHEET NO.		OF	
CALCULATED BY	HD	DATE	07/19
CHECKED BY	BK	DATE	10/19
SCALE	MAST ARM 2 LOADS		

8.0 LOAD COMBINATIONS

FORCE	GROUP LOAD I	GROUP LOAD II		GROUP LOAD III	
	D	D + W		D + ICE + 0.5W	
		LOAD CASE 1	LOAD CASE 2	LOAD CASE 1	LOAD CASE 2
SHEAR ABOUT X, V_X (LB)	0.00	641.03	576.93	208.75	187.88
SHEAR ABOUT Z, V_Z (LB)	0.00	3205.14	1923.08	1043.75	626.25
AXIAL FORCE, P_Y (LB)	1907.36	1907.36	1907.36	2729.82	2729.82
MOMENT ABOUT X, M_X (FT-LB)	9.00	59031.69	35422.62	18394.65	11060.64
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	54501.83	32701.10	14468.23	8680.94
MOMENT ABOUT Z, M_Z (FT-LB)	18628.50	30433.04	29252.59	34564.43	34197.73

FORCE	GROUP LOAD IV - FATIQUE			
	GALLOPING	NATURAL WIND GUST		TRUCK INDUCED GUST
		LOAD CASE 1	LOAD CASE 2	
SHEAR ABOUT X, V_X (LB)	0.00	98.68	88.81	0.00
SHEAR ABOUT Z, V_Z (LB)	0.00	493.39	296.03	0.00
AXIAL FORCE, P_Y (LB)	670.12	0.00	0.00	489.81
MOMENT ABOUT X, M_X (FT-LB)	141.75	8705.47	5223.28	9876.41
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	6972.94	4183.76	0.00
MOMENT ABOUT Z, M_Z (FT-LB)	15322.58	1741.09	1566.99	7052.14

Note: Loads shown include 5% increase to account for miscellaneous connections, pre-emp devices, and strobes light.

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JOB	13033.04X - ASHLAND, ROUTE 126		
SHEET NO.		OF	
CALCULATED BY	HD	DATE	07/19
CHECKED BY	BK	DATE	10/19
SCALE	MAST ARM 3 LOADS		

8.0 LOAD COMBINATIONS

FORCE	GROUP LOAD I	GROUP LOAD II		GROUP LOAD III	
	D	D + W		D + ICE + 0.5W	
		LOAD CASE 1	LOAD CASE 2	LOAD CASE 1	LOAD CASE 2
SHEAR ABOUT X, V_X (LB)	0.00	620.07	558.06	190.98	171.88
SHEAR ABOUT Z, V_Z (LB)	0.00	3100.35	1860.21	954.90	572.94
AXIAL FORCE, P_Y (LB)	1462.05	1462.05	1462.05	2234.82	2234.82
MOMENT ABOUT X, M_X (FT-LB)	9.00	56859.98	34119.59	16579.66	9971.64
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	29497.21	17698.33	7619.10	4571.46
MOMENT ABOUT Z, M_Z (FT-LB)	7539.44	18909.64	17772.62	16513.07	16182.67

FORCE	GROUP LOAD IV - FATIQUE			
	GALLOPING	NATURAL WIND GUST		TRUCK INDUCED GUST
		LOAD CASE 1	LOAD CASE 2	
SHEAR ABOUT X, V_X (LB)	0.00	90.80	81.72	0.00
SHEAR ABOUT Z, V_Z (LB)	0.00	454.02	272.41	0.00
AXIAL FORCE, P_Y (LB)	750.08	0.00	0.00	406.97
MOMENT ABOUT X, M_X (FT-LB)	141.75	7900.67	4740.40	8179.24
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	3674.84	2204.90	0.00
MOMENT ABOUT Z, M_Z (FT-LB)	9423.42	1580.13	1422.12	3826.95

Note: Loads shown include 5% increase to account for miscellaneous connections, pre-emp devices, and strobes light.

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JOB	13033.04X - ASHLAND, ROUTE 126		
SHEET NO.		OF	
CALCULATED BY	HD	DATE	07/19
CHECKED BY	BK	DATE	10/19
SCALE	MAST ARM 4 LOADS		

8.0 LOAD COMBINATIONS

FORCE	GROUP LOAD I	GROUP LOAD II		GROUP LOAD III	
	D	D + W		D + ICE + 0.5W	
		LOAD CASE 1	LOAD CASE 2	LOAD CASE 1	LOAD CASE 2
SHEAR ABOUT X, V_X (LB)	0.00	521.15	459.85	173.15	153.73
SHEAR ABOUT Z, V_Z (LB)	0.00	2605.76	1563.46	865.75	519.45
AXIAL FORCE, P_Y (LB)	1588.54	1588.54	1588.54	2216.79	2216.79
MOMENT ABOUT X, M_X (FT-LB)	9.00	45840.42	28181.79	14605.60	8941.90
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	31603.96	19030.13	8548.51	5144.66
MOMENT ABOUT Z, M_Z (FT-LB)	10478.36	19644.64	18761.71	19491.30	19208.12

FORCE	GROUP LOAD IV - FATIQUE			
	GALLOPING	NATURAL WIND GUST		TRUCK INDUCED GUST
		LOAD CASE 1	LOAD CASE 2	
SHEAR ABOUT X, V_X (LB)	0.00	81.53	73.38	0.00
SHEAR ABOUT Z, V_Z (LB)	0.00	407.64	244.58	0.00
AXIAL FORCE, P_Y (LB)	569.71	0.00	0.00	430.68
MOMENT ABOUT X, M_X (FT-LB)	141.75	6872.53	4123.52	8367.84
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	4104.52	2462.71	0.00
MOMENT ABOUT Z, M_Z (FT-LB)	9789.89	1374.51	1237.05	4841.08

Note: Loads shown include 5% increase to account for miscellaneous connections, pre-emp devices, and strobes light.

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JOB	13033.04X - ASHLAND, ROUTE 126		
SHEET NO.		OF	
CALCULATED BY	HD	DATE	07/19
CHECKED BY	BK	DATE	10/19
SCALE	MAST ARM 5 LOADS		

8.0 LOAD COMBINATIONS

FORCE	GROUP LOAD I	GROUP LOAD II		GROUP LOAD III	
	D	D + W		D + ICE + 0.5W	
		LOAD CASE 1	LOAD CASE 2	LOAD CASE 1	LOAD CASE 2
SHEAR ABOUT X, V_X (LB)	0.00	685.40	607.67	230.23	185.98
SHEAR ABOUT Z, V_Z (LB)	0.00	3427.00	2056.20	1151.17	626.95
AXIAL FORCE, P_Y (LB)	2194.82	2194.82	2194.82	3017.37	3017.37
MOMENT ABOUT X, M_X (FT-LB)	9.00	61491.03	37572.16	19926.80	10859.62
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	56915.04	34221.88	15762.38	7242.90
MOMENT ABOUT Z, M_Z (FT-LB)	20409.46	32705.87	31509.93	34974.24	34202.13

FORCE	GROUP LOAD IV - FATIQUE			
	GALLOPING	NATURAL WIND GUST		TRUCK INDUCED GUST
		LOAD CASE 1	LOAD CASE 2	
SHEAR ABOUT X, V_X (LB)	0.00	108.53	97.68	0.00
SHEAR ABOUT Z, V_Z (LB)	0.00	542.67	325.60	0.00
AXIAL FORCE, P_Y (LB)	531.34	0.00	0.00	573.43
MOMENT ABOUT X, M_X (FT-LB)	141.75	9395.91	5637.54	11268.12
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	7556.11	4533.67	0.00
MOMENT ABOUT Z, M_Z (FT-LB)	10265.60	1879.18	1691.26	8564.59

Note: Loads shown include 5% increase to account for miscellaneous connections, pre-emp devices, and strobes light.

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JOB	13033.04X - ASHLAND, ROUTE 126		
SHEET NO.		OF	
CALCULATED BY	HD	DATE	07/19
CHECKED BY	BK	DATE	10/19
SCALE	MAST ARM 6 LOADS		

8.0 LOAD COMBINATIONS

FORCE	GROUP LOAD I	GROUP LOAD II		GROUP LOAD III	
	D	D + W		D + ICE + 0.5W	
		LOAD CASE 1	LOAD CASE 2	LOAD CASE 1	LOAD CASE 2
SHEAR ABOUT X, V_X (LB)	0.00	641.03	576.93	208.75	187.88
SHEAR ABOUT Z, V_Z (LB)	0.00	3205.14	1923.08	1043.75	626.25
AXIAL FORCE, P_Y (LB)	1817.36	1817.36	1817.36	2546.67	2546.67
MOMENT ABOUT X, M_X (FT-LB)	9.00	59031.69	35422.62	18394.65	11060.64
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	47019.17	28211.50	12708.58	7625.15
MOMENT ABOUT Z, M_Z (FT-LB)	15102.50	26907.04	25726.59	27144.69	26777.99

FORCE	GROUP LOAD IV - FATIQUE			
	GALLOPING	NATURAL WIND GUST		TRUCK INDUCED GUST
		LOAD CASE 1	LOAD CASE 2	
SHEAR ABOUT X, V_X (LB)	0.00	98.68	88.81	0.00
SHEAR ABOUT Z, V_Z (LB)	0.00	493.39	296.03	0.00
AXIAL FORCE, P_Y (LB)	670.12	0.00	0.00	489.81
MOMENT ABOUT X, M_X (FT-LB)	141.75	8705.47	5223.28	9876.41
MOMENT ABOUT Y, M_Y (FT-LB)	0.00	6115.58	3669.35	0.00
MOMENT ABOUT Z, M_Z (FT-LB)	12919.66	1741.09	1566.99	6567.55

Note: Loads shown include 5% increase to account for miscellaneous connections, pre-emp devices, and strobes light.

PAVEMENT CORES

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"The Construction Testing People"

-Page 1

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date 12-11-2014
Report No. 1
Job Number 18014
Project Road Improvements, Ashland, MA

Contractor Green International Affiliates, Inc.

Sample Submitted By

Sample No. 728

- ☐ **Our Representative:**
- ☒ **Other:** Wing C. Wong P.E. of Green International

Date Submitted: 12/03/2014

Source of Sample

- ☒ **On-Site Existing @ location:** Pavement core #2
- ☐ **Off-Site Borrow from:**

Proposed Use: Pavement base

Material Submitted As:

- ☐ **Structural/Granular Fill:**
- ☐ **Ordinary Borrow:** MHD M1.01.0 (Shall be approved by the Architect)
- ☒ **Gravel Borrow:** MHD M1.03.0 Type: B
- ☐ **Processed Gravel For Base Course:** MHD M1.03.1
- ☐ **Sand Borrow:** MHD M1.04.0 Type:
- ☐ **Reclaimed Pavement Borrow for Base Course:** MHD M1.11.0
- ☐ **Crushed Stone:** MHD M2.01.0
- ☐ **Dense Graded Crushed Stone for Base Course:** MHD M2.01.7
- ☐ **Common Borrow:**
- ☐ **Drainage Fill:**
- ☐ **Other:**

Requested Testing

- ☐ **Atterberg Limits**
- ☒ **Gradation Analysis**
- ☐ **Hydrometer**
- ☐ **Modified Proctor**
- ☐ **Permeability**
- ☒ **Wash Sieve Analysis**
- ☐ **Other:**

Material Classification: Silty sand with gravel

Project Specification Conformance Results

- ☐ **Does conform:**
- ☒ **Does NOT conform:** MHD M1.03.0 gravel borroe type B.
- ☐ **Marginally does not* conform...Basis:**
- ☐ **No Specifications provided to our office.**
- ☐ **Specifications provided to our office but sample not submitted to a specific use.**
- ☐ **Sample submitted without indication of intended use and without specifications.**

GENERAL REMARKS:

REVIEWED BY: Geotechnical Department

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date	12-11-2014
Report No.	1
Job Number	18014
Project	Road Improvements, Ashland, MA
Contractor	Green International Affiliates, Inc.

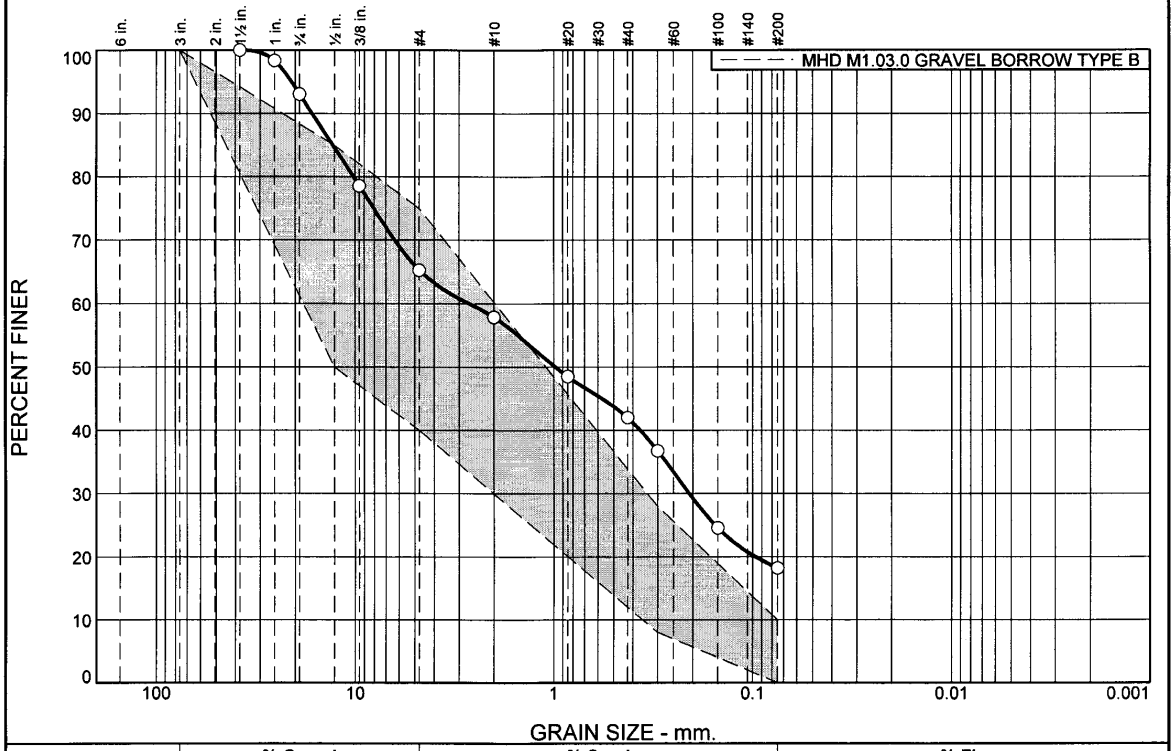
cc: Green Internationl Affiliates Wing Wong

UTS of Massachusetts, Inc.
5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Report Date 12-11-2014
Report No. 1
Job Number 18014
Project Road Improvements, Ashland, MA

Attachment

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.9	27.8	7.4	15.9	23.8	18.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	98.3		
3/4"	93.1		
3/8"	78.6		
#4	65.3	40.0 - 75.0	
#10	57.9		
#20	48.5		
#40	42.0		
#50	36.8	8.0 - 28.0	X
#100	24.6		
#200	18.2	0.0 - 10.0	X

* MHD M1.03.0 GRAVEL BORROW TYPE B

Material Description
F-M SAND, AND GRAVEL, LITTLE SILT

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 16.4629 D_{85}= 12.9394 D_{60}= 2.6359
D_{50}= 0.9804 D_{30}= 0.2080 D_{15}=
D_{10}= C_u= C_c=

Classification
USCS= SM AASHTO= A-1-b

Remarks

Source of Sample: PAVEMENT CORE #2
Sample Number: 728

Date:

UTS OF MASSACHUSETTS, INC.
5 Richardson Lane
Stoneham, MA 02180

Client: GREEN INTERNATIONAL AFFILIATES, INC.
Project: ASHLAND ROAD IMPROVEMENTS, ASHLAND, MA

Project No: **Figure**

Of Massachusetts
"The Construction Testing People"

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date 12-11-2014
Report No. 2
Job Number 18014
Project Road Improvements, Ashland, MA

Contractor Green International Affiliates, Inc.

Sample Submitted By

Sample No. 730

☐ **Our Representative:**

Date Submitted: 12/03/2014

☒ **Other:** Wing C. Wong, P.E. of Green international

Source of Sample

☒ **On-Site Existing @ location:** Pavement core #4
☐ **Off-Site Borrow from:**

Proposed Use: Pavement base

Material Submitted As:

☐ **Structural/Granular Fill:**
☐ **Ordinary Borrow:** MHD M1.01.0 (Shall be approved by the Architect)
☒ **Gravel Borrow:** MHD M1.03.0 Type: B
☐ **Processed Gravel For Base Course:** MHD M1.03.1
☐ **Sand Borrow:** MHD M1.04.0 Type:
☐ **Reclaimed Pavement Borrow for Base Course:** MHD M1.11.0
☐ **Crushed Stone:** MHD M2.01.0
☐ **Dense Graded Crushed Stone for Base Course:** MHD M2.01.7
☐ **Common Borrow:**
☐ **Drainage Fill:**
☐ **Other:**

Requested Testing

☐ **Atterberg Limits** ☒ **Gradation Analysis** ☐ **Hydrometer**
☐ **Modified Proctor** ☐ **Permeability** ☒ **Wash Sieve Analysis**
☐ **Other:**

Material Classification: Silty sand with gravel

Project Specification Conformance Results

☐ **Does conform:**
☒ **Does NOT conform:** MHD M1.03.0 gravel borrow type B.
☐ **Marginally does not* conform...Basis:**

☐ **No Specifications provided to our office.**
☐ **Specifications provided to our office but sample not submitted to a specific use.**
☐ **Sample submitted without indication of intended use and without specifications.**

GENERAL REMARKS:

REVIEWED BY: Geotechnical Department

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date	12-11-2014
Report No.	2
Job Number	18014
Project	Road Improvements, Ashland, MA
Contractor	Green International Affiliates, Inc.

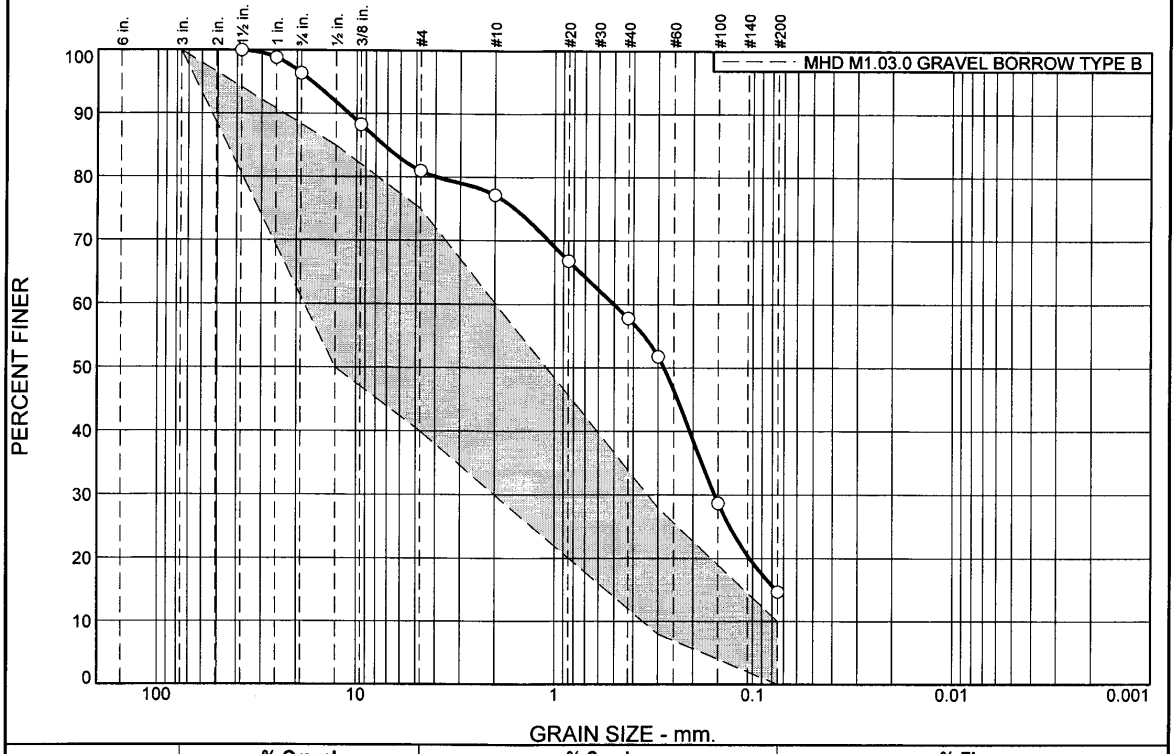
cc: Green Internationl Affiliates Wing Wong

UTS of Massachusetts, Inc.
5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Report Date 12-11-2014
Report No. 2
Job Number 18014
Project Road Improvements, Ashland, MA

Attachment

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.6	15.4	3.8	19.3	43.2	14.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	98.8		
3/4"	96.4		
3/8"	88.3		
#4	81.0	40.0 - 75.0	X
#10	77.2		
#20	66.8		
#40	57.9		
#50	51.8	8.0 - 28.0	X
#100	28.7		
#200	14.7	0.0 - 10.0	X

* MHD M1.03.0 GRAVEL BORROW TYPE B

Material Description
F-M SAND, LITTLE GRAVEL, LITTLE SILT

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 10.9190 D_{85}= 7.2501 D_{60}= 0.4999
D_{50}= 0.2807 D_{30}= 0.1565 D_{15}= 0.0764
D_{10}= C_u= C_c=

Classification
USCS= SM AASHTO= A-2-4(0)

Remarks

Source of Sample: PAVEMENT CORE #4
Sample Number: 730

Date: 12/11/2014

UTS OF MASSACHUSETTS, INC.
5 Richardson Lane
Stoneham, MA 02180

Client: GREEN INTERNATIONAL AFFILIATES, INC.
Project: ASHLAND ROAD IMPROVEMENTS, ASHLAND, MA
Project No: **Figure**

Of Massachusetts
"The Construction Testing People"

5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Soil Testing Results - Transmittal Report

Distribution Copy

Report Date 12-11-2014
Report No. 3
Job Number 18014
Project Road Improvements, Ashland, MA

Contractor Green International Affiliates, Inc.

Sample Submitted By

Sample No. 729

☐ **Our Representative:**

Date Submitted: 12/03/2014

☒ **Other:** Wing C. Wong, P.E. of Green International

Source of Sample

☒ **On-Site Existing @ location:** Pavement core #3
☐ **Off-Site Borrow from:**

Proposed Use: Pavement base

Material Submitted As:

☐ **Structural/Granular Fill:**
☐ **Ordinary Borrow:** MHD M1.01.0 (Shall be approved by the Architect)
☒ **Gravel Borrow:** MHD M1.03.0 Type: B
☐ **Processed Gravel For Base Course:** MHD M1.03.1
☐ **Sand Borrow:** MHD M1.04.0 Type:
☐ **Reclaimed Pavement Borrow for Base Course:** MHD M1.11.0
☐ **Crushed Stone:** MHD M2.01.0
☐ **Dense Graded Crushed Stone for Base Course:** MHD M2.01.7
☐ **Common Borrow:**
☐ **Drainage Fill:**
☐ **Other:**

Requested Testing

☐ **Atterberg Limits** ☒ **Gradation Analysis** ☐ **Hydrometer**
☐ **Modified Proctor** ☐ **Permeability** ☒ **Wash Sieve Analysis**
☐ **Other:**

Material Classification: Silty sand with gravel

Project Specification Conformance Results

☐ **Does conform:**
☒ **Does NOT conform:** MHD M1.03.0 gravel borrow type B.
☐ **Marginally does not* conform...Basis:**

☐ **No Specifications provided to our office.**
☐ **Specifications provided to our office but sample not submitted to a specific use.**
☐ **Sample submitted without indication of intended use and without specifications.**

GENERAL REMARKS:

REVIEWED BY: Geotechnical Department

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date	12-11-2014
Report No.	3
Job Number	18014
Project	Road Improvements, Ashland, MA
Contractor	Green International Affiliates, Inc.

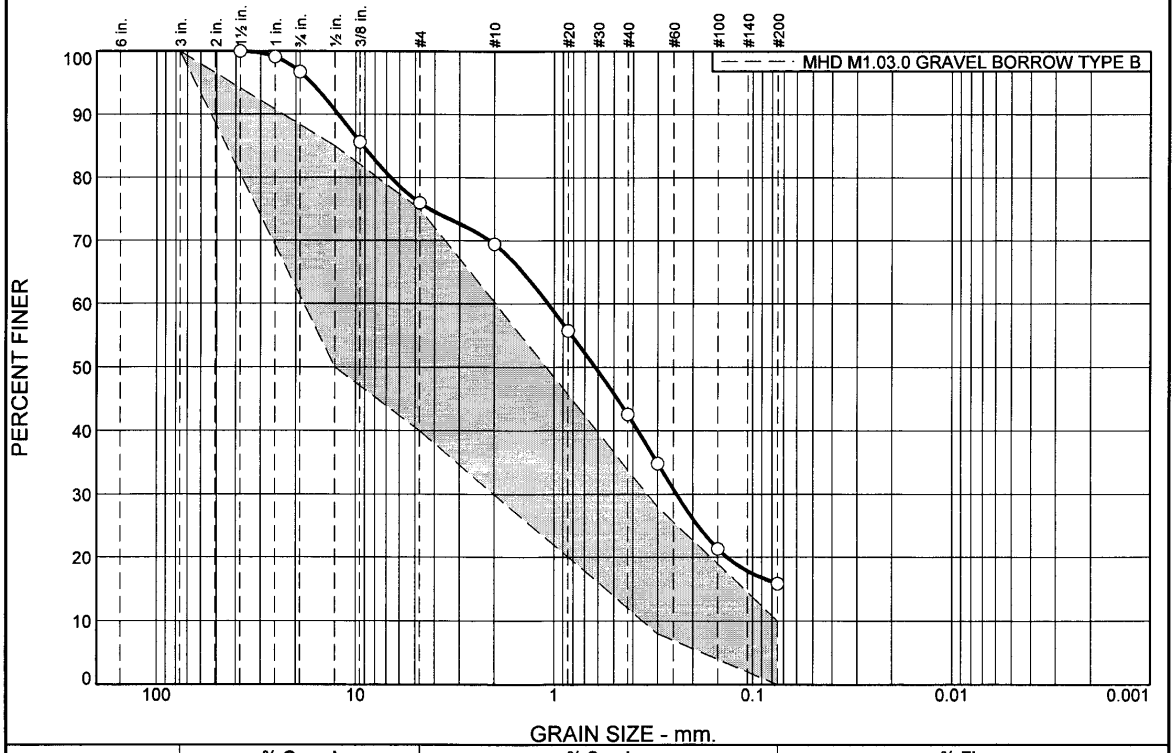
cc: Green Internationl Affiliates Wing Wong

UTS of Massachusetts, Inc.
5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Report Date 12-11-2014
Report No. 3
Job Number 18014
Project Road Improvements, Ashland, MA

Attachment

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.3	20.7	6.5	26.9	26.7	15.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	99.1		
3/4"	96.7		
3/8"	85.6		
#4	76.0	40.0 - 75.0	X
#10	69.5		
#20	55.8		
#40	42.6		
#50	34.9	8.0 - 28.0	X
#100	21.3		
#200	15.9	0.0 - 10.0	X

* MHD M1.03.0 GRAVEL BORROW TYPE B

Material Description
F-M SAND, SOME GRAVEL, LITTLE SILT

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 12.2271 D_{85}= 9.1770 D_{60}= 1.0710
D_{50}= 0.6200 D_{30}= 0.2410 D_{15}=
D_{10}= C_u= C_c=

Classification
USCS= SM AASHTO= A-1-b

Remarks

Source of Sample: PAVEMENT CORE #3
Sample Number: 729

Date:

UTS OF MASSACHUSETTS, INC.
5 Richardson Lane
Stoneham, MA 02180

Client: GREEN INTERNATIONAL AFFILIATES, INC.
Project: ASHLAND ROAD IMPROVEMENTS, ASHLAND, MA

Project No: **Figure**

Of Massachusetts
"The Construction Testing People"

-Page 1

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date 12-23-2014
Report No. 4
Job Number 18014
Project Road Improvements, Ashland, MA

Contractor Green International Affiliates, Inc.

Sample Submitted By

Sample No. 787

- ☐ **Our Representative:**
- ☒ **Other:** Wing Wong of Green International

Date Submitted: 12/17/2014

Source of Sample

- ☒ **On-Site Existing @ location:** Pavement core #1
- ☐ **Off-Site Borrow from:**

Proposed Use: Pavement base

Material Submitted As:

- ☐ **Structural/Granular Fill:**
- ☐ **Ordinary Borrow:** MHD M1.01.0 (Shall be approved by the Architect)
- ☒ **Gravel Borrow:** MHD M1.03.0 Type: B
- ☐ **Processed Gravel For Base Course:** MHD M1.03.1
- ☐ **Sand Borrow:** MHD M1.04.0 Type:
- ☐ **Reclaimed Pavement Borrow for Base Course:** MHD M1.11.0
- ☐ **Crushed Stone:** MHD M2.01.0
- ☐ **Dense Graded Crushed Stone for Base Course:** MHD M2.01.7
- ☐ **Common Borrow:**
- ☐ **Drainage Fill:**
- ☐ **Other:**

Requested Testing

- ☐ **Atterberg Limits**
- ☒ **Gradation Analysis**
- ☐ **Hydrometer**
- ☐ **Modified Proctor**
- ☐ **Permeability**
- ☒ **Wash Sieve Analysis**
- ☐ **Other:**

Material Classification: Silty sand with gravel

Project Specification Conformance Results

- ☐ **Does conform:**
- ☒ **Does NOT conform:** MHD M1.03.0 gravel borrow type B.
- ☐ **Marginally does not* conform...Basis:**
- ☐ **No Specifications provided to our office.**
- ☐ **Specifications provided to our office but sample not submitted to a specific use.**
- ☐ **Sample submitted without indication of intended use and without specifications.**

GENERAL REMARKS:

REVIEWED BY: Geotechnical Department

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date	12-23-2014
Report No.	4
Job Number	18014
Project	Road Improvements, Ashland, MA
Contractor	Green International Affiliates, Inc.

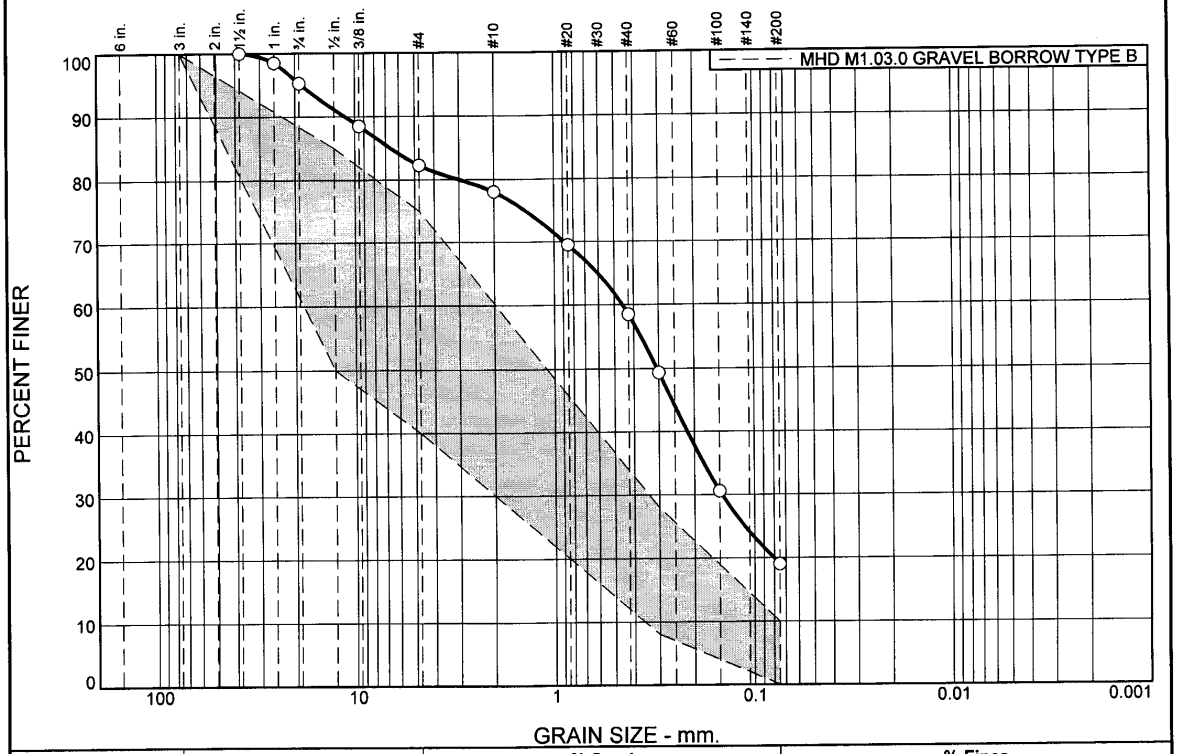
cc: Green Internationl Affiliates Wing Wong

UTS of Massachusetts, Inc.
5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Report Date 12-23-2014
Report No. 4
Job Number 18014
Project Road Improvements, Ashland, MA

Attachment

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.7	13.0	4.3	19.5	39.4	19.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	98.5		
3/4"	95.3		
3/8"	88.5		
#4	82.3	40.0 - 75.0	X
#10	78.0		
#20	69.5		
#40	58.5		
#50	49.3	8.0 - 28.0	X
#100	30.6		
#200	19.1	0.0 - 10.0	X

* MHD M1.03.0 GRAVEL BORROW TYPE B

Material Description
F-M SAND, LITTLE SILT, LITTLE GRAVEL

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 11.1792 D_{85}= 6.6082 D_{60}= 0.4545
D_{50}= 0.3070 D_{30}= 0.1461 D_{15}=
D_{10}= C_u= C_c=

Classification
USCS= SM AASHTO= A-2-4(0)

Remarks

Source of Sample: PAVEMENT CORE #1
Sample Number: 787

Date: 12/23/2014

UTS OF MASSACHUSETTS, INC.
5 Richardson Lane
Stoneham, MA 02180

Client: GREEN INTERNATIONAL AFFILIATES, INC.
Project: ASHLAND ROAD IMPROVEMENTS, ASHLAND, MA
Project No: 18014 **Figure**

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date 12-23-2014
Report No. 5
Job Number 18014
Project Road Improvements, Ashland, MA

Contractor Green International Affiliates, Inc.

Sample Submitted By

Sample No. 788

- ☐ **Our Representative:**
- ☒ **Other:** Wing Wong of Green International

Date Submitted: 12/17/2014

Source of Sample

- ☒ **On-Site Existing @ location:** Pavement core #5
- ☐ **Off-Site Borrow from:**

Proposed Use: Pavement base

Material Submitted As:

- ☐ **Structural/Granular Fill:**
- ☐ **Ordinary Borrow:** MHD M1.01.0 (Shall be approved by the Architect)
- ☒ **Gravel Borrow:** MHD M1.03.0 Type: B
- ☐ **Processed Gravel For Base Course:** MHD M1.03.1
- ☐ **Sand Borrow:** MHD M1.04.0 Type:
- ☐ **Reclaimed Pavement Borrow for Base Course:** MHD M1.11.0
- ☐ **Crushed Stone:** MHD M2.01.0
- ☐ **Dense Graded Crushed Stone for Base Course:** MHD M2.01.7
- ☐ **Common Borrow:**
- ☐ **Drainage Fill:**
- ☐ **Other:**

Requested Testing

- ☐ **Atterberg Limits**
- ☒ **Gradation Analysis**
- ☐ **Hydrometer**
- ☐ **Modified Proctor**
- ☐ **Permeability**
- ☒ **Wash Sieve Analysis**
- ☐ **Other:**

Material Classification: Silty sand with gravel

Project Specification Conformance Results

- ☐ **Does conform:**
- ☒ **Does NOT conform:** MHD M1.03.0 gravel borrow type B.
- ☐ **Marginally does not* conform...Basis:**
- ☐ **No Specifications provided to our office.**
- ☐ **Specifications provided to our office but sample not submitted to a specific use.**
- ☐ **Sample submitted without indication of intended use and without specifications.**

GENERAL REMARKS:

REVIEWED BY: Geotechnical Department

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date	12-23-2014
Report No.	5
Job Number	18014
Project	Road Improvements, Ashland, MA
Contractor	Green International Affiliates, Inc.

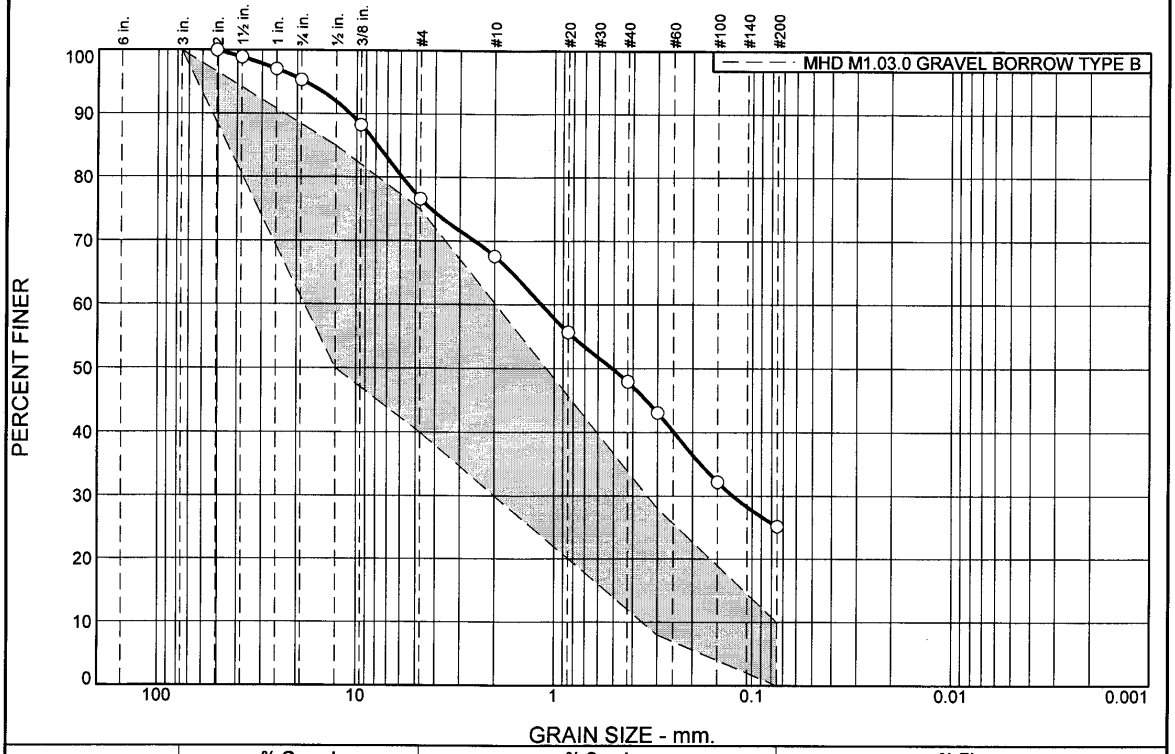
cc: Green Internationl Affiliates Wing Wong

UTS of Massachusetts, Inc.
5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Report Date 12-23-2014
Report No. 5
Job Number 18014
Project Road Improvements, Ashland, MA

Attachment

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.7	18.7	8.9	19.8	22.7	25.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5"	98.9		
1"	97.1		
3/4"	95.3		
3/8"	88.3		
#4	76.6	40.0 - 75.0	X
#10	67.7		
#20	55.7		
#40	47.9		
#50	43.1	8.0 - 28.0	X
#100	32.2		
#200	25.2	0.0 - 10.0	X

* MHD M1.03.0 GRAVEL BORROW TYPE B

Material Description
F-M SAND, SOME SILT, SOME GRAVEL

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 10.7844 D_{85}= 7.8008 D_{60}= 1.1576
D_{50}= 0.5091 D_{30}= 0.1255 D_{15}=
D_{10}= C_u= C_c=

Classification
USCS= SM AASHTO= A-1-b

Remarks

Source of Sample: PAVEMENT CORE #5
Sample Number: 788

Date: 12/23/2014

UTS OF MASSACHUSETTS, INC.
5 Richardson Lane
Stoneham, MA 02180

Client: GREEN INTERNATIONAL AFFILIATES, INC.
Project: ASHLAND ROAD IMPROVEMENTS, ASHLAND, MA

Project No: 18014 **Figure**

Of Massachusetts
"The Construction Testing People"

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date 12-23-2014
Report No. 6
Job Number 18014
Project Road Improvements, Ashland, MA

Contractor Green International Affiliates, Inc.

Sample Submitted By

Sample No. 789

☐ **Our Representative:**

Date Submitted: 12/17/2014

☒ **Other:** Wing Wong of Green International

Source of Sample

☒ **On-Site Existing @ location:** Pavement core #6
☐ **Off-Site Borrow from:**

Proposed Use: Pavement base

Material Submitted As:

☐ **Structural/Granular Fill:**
☐ **Ordinary Borrow:** MHD M1.01.0 (Shall be approved by the Architect)
☒ **Gravel Borrow:** MHD M1.03.0 Type: B
☐ **Processed Gravel For Base Course:** MHD M1.03.1
☐ **Sand Borrow:** MHD M1.04.0 Type:
☐ **Reclaimed Pavement Borrow for Base Course:** MHD M1.11.0
☐ **Crushed Stone:** MHD M2.01.0
☐ **Dense Graded Crushed Stone for Base Course:** MHD M2.01.7
☐ **Common Borrow:**
☐ **Drainage Fill:**
☐ **Other:**

Requested Testing

☐ **Atterberg Limits** ☒ **Gradation Analysis** ☐ **Hydrometer**
☐ **Modified Proctor** ☐ **Permeability** ☒ **Wash Sieve Analysis**
☐ **Other:**

Material Classification: Silty sand with gravel

Project Specification Conformance Results

☐ **Does conform:**
☒ **Does NOT conform:** MHD M1.03.0 gravel borrow type B.
☐ **Marginally does not* conform...Basis:**

☐ **No Specifications provided to our office.**
☐ **Specifications provided to our office but sample not submitted to a specific use.**
☐ **Sample submitted without indication of intended use and without specifications.**

GENERAL REMARKS:

REVIEWED BY: Geotechnical Department

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Soil Testing Results - Transmittal Report

Distribution Copy

Report Date	12-23-2014
Report No.	6
Job Number	18014
Project	Road Improvements, Ashland, MA
Contractor	Green International Affiliates, Inc.

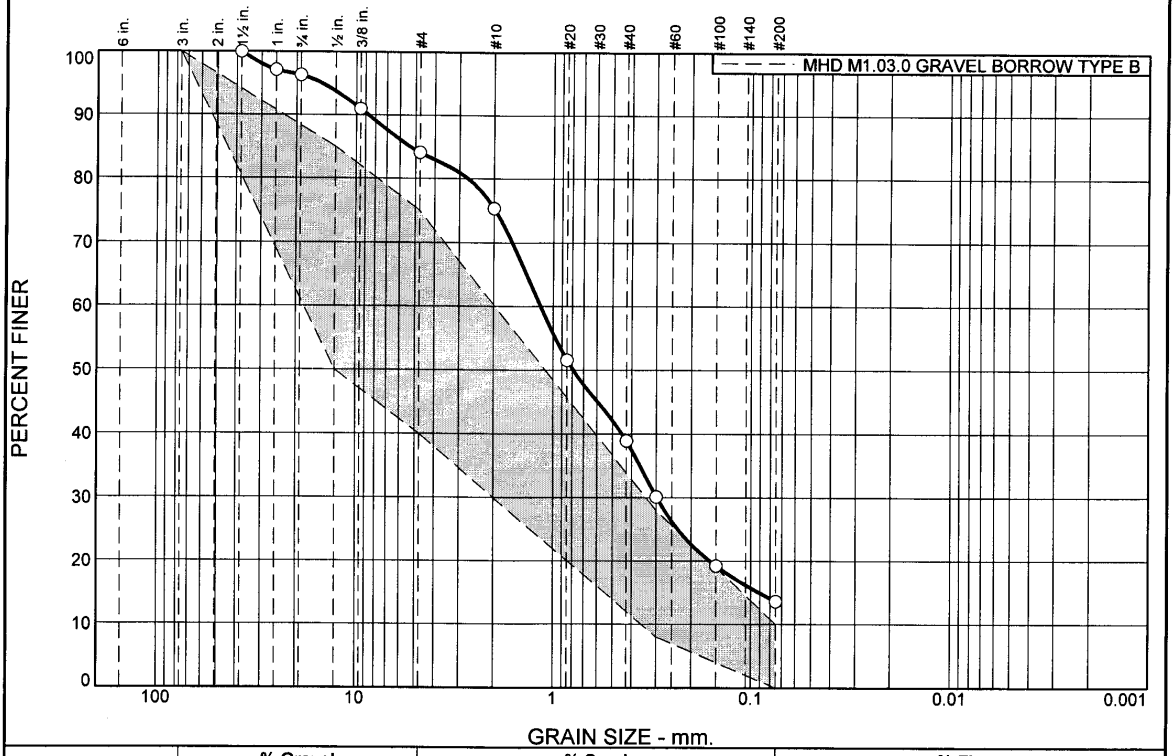
cc: Green Internationl Affiliates Wing Wong

UTS of Massachusetts, Inc.
5 Richardson Lane, Stoneham, MA 02180 781-438-7755 (Voice) 781-438-6216 (Fax)

Report Date 12-23-2014
Report No. 6
Job Number 18014
Project Road Improvements, Ashland, MA

Attachment

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.7	12.2	8.7	36.5	25.3	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	97.1		
3/4"	96.3		
3/8"	91.0		
#4	84.1	40.0 - 75.0	X
#10	75.4		
#20	51.5		
#40	38.9		
#50	30.1	8.0 - 28.0	X
#100	19.3		
#200	13.6	0.0 - 10.0	X

* MHD M1.03.0 GRAVEL BORROW TYPE B

Material Description
F-M SAND, LITTLE GRAVEL, LITTLE SILT

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 8.6756 D_{85}= 5.3126 D_{60}= 1.1576
D_{50}= 0.7917 D_{30}= 0.2986 D_{15}= 0.0910
D_{10}= C_u= C_c=

Classification
USCS= SM AASHTO= A-1-b

Remarks

Source of Sample: PAVEMENT CORE #6
Sample Number: 789

Date: 12/23/2014

UTS OF MASSACHUSETTS, INC.
5 Richardson Lane
Stoneham, MA 02180

Client: GREEN INTERNATIONAL AFFILIATES, INC.
Project: ASHLAND ROAD IMPROVEMENTS, ASHLAND, MA

Project No: 18014 **Figure**