INFRASTRUCTURE COMMITTEE
Tuesday, November 24, 2015 at 5:15 p.m.
City Hall Council Chambers

Agenda

1. **Infrastructure Committee Orientation Materials**
   (Presented by John Theriault, City Engineer)

2. **Street Acceptance: Telcom Drive, Bangor International Airport Commercial Industrial Park**
   (Council Order, Council Action, Location Map Attached)

3. **Street Acceptance: Corporate Drive, from Venture Way to Maine Avenue – Maine Business Enterprise Park**
   (Council Order, Council Action, Location Map Attached)

4. **Grant Application: Project Canopy Grant Application**
   (Memo by Dana Wardwell, Public Work Director & Presentation by John Theriault, City Engineer)

5. **Report: City of Bangor Retaining Wall**
   (Report Attached)

6. **Discussion: Diverging Diamond Traffic Patterns**
   (Materials Attached & Presentation by John Theriault, City Engineer)

Office of the City Engineer
John M. Theriault, P.E., P.T.O.E
73 Harlow Street Phone: 207.992.4249
Bangor, Maine 04401 Fax: 207-992-4194
www.bangormaine.gov

To: **Infrastructure Members**
From: **John M. Theriault, P.E., P.T.O.E., City Engineer**
Date: **November 17, 2015**
Subject: **Infrastructure Overview**

Welcome to the Infrastructure Committee! As newly appointed members of the Committee, I wanted to provide you with some background information.

I serve as the designated Staff contact for the Infrastructure Committee. The Committee meets every second and fourth Tuesday of the month at 5:15 p.m. On rare occasion the Committee may be cancelled upon concurrence from the Chair and the City Manager if there is no pending business. The Agenda is prepared prior to noon on Wednesday prior the week prior to the Committee Meeting. Public Works Department, Waste Water Treatment Plant, Legal, and Stormwater submit items relative to matters concerning the City's Infrastructure for review. If any Committee Member wishes to include an item on the agenda, please feel free to contact the City Manager, Committee Chair or myself so we may assist and prepare placing it on the agenda which includes preparation of back-up material.

Some items that may be presented for Committee consideration and discussion include but not limited to:

- Review and approval of City capital projects to include stormwater, sanitary sewer, streets, intersection improvements, pedestrian/bicycle improvements, and trails.
- Review and approval to execute contracts with Maine Department of Transportation for state roadways, pedestrian safety, intersection improvements.
- Review and modification of streets and roadways such as acceptances and discontinuances, and changes in circulation patterns and access.
- Sewer Abatements
- Stormwater utility Ordinance modifications.
- Review and approval of grants offered through State and Federal agencies, such as Federal Highway Administration, Maine Department of Transportation, and Department of Environmental Protection Agency.
- The Committee also serves as a venue to provide information for several City issues, such as, watershed management plans, stormwater utility program, and other studies completed by City Staff and City Consultants, and or MaineDOT.

Should you have any questions or concerns, please feel free to contact me at 207-992-4249 or john.theriault@bangormaine.gov.

_____**COUNCIL ACTION**_____

Item No.

Date: December 14, 2015

Item/Subject: ORDER, Acceptance of a Telcom Drive as a Public Street and Adding it to the Official City Map

Responsible Department: Engineering

Commentary:

This Order will accept an 80 foot wide and 142.28 foot with a 60 foot radius of Telcom Drive (map attached) as a public street and will add it to the Official City Map.

Telcom Drive is located in the Bangor International Airport Commercial Industrial Park and is extends southwesterly of Union Street, Telcom Drive includes a 10" sanitary sewer and a 12" storm drain lines. Reviewed by the Infrastructure Committee on November 24, 2015.

John M. Theriault, PE, PTOE
Department Head

Manager's Comments:

City Manager

Associated Information: Order & Location Map

Budget Approval:

Finance Director

Legal Approval:

City Solicitor

Introduced for
____ Passage
___ First Reading
___ Referral

Page __ of ___

Assigned to Councilor

CITY OF BANGOR

(TITLE.) ORDER, Acceptance Corporate Drive as a Public Street and Adding it to the Official City Map

WHEREAS, the City is owner of property known as the Maine Business Enterprise Park and property abutting the Maine Business Enterprise Park; and

WHEREAS, access to the Maine Business Enterprise Park and abutting property is via Venture Way Maine Avenue; and

WHEREAS, Corporate Drive from Venture Way to Maine Avenue is 80 foot wide and is located between Venture Way and Maine Avenue

WHEREAS, Corporate Drive that has not been accepted as a public street; and

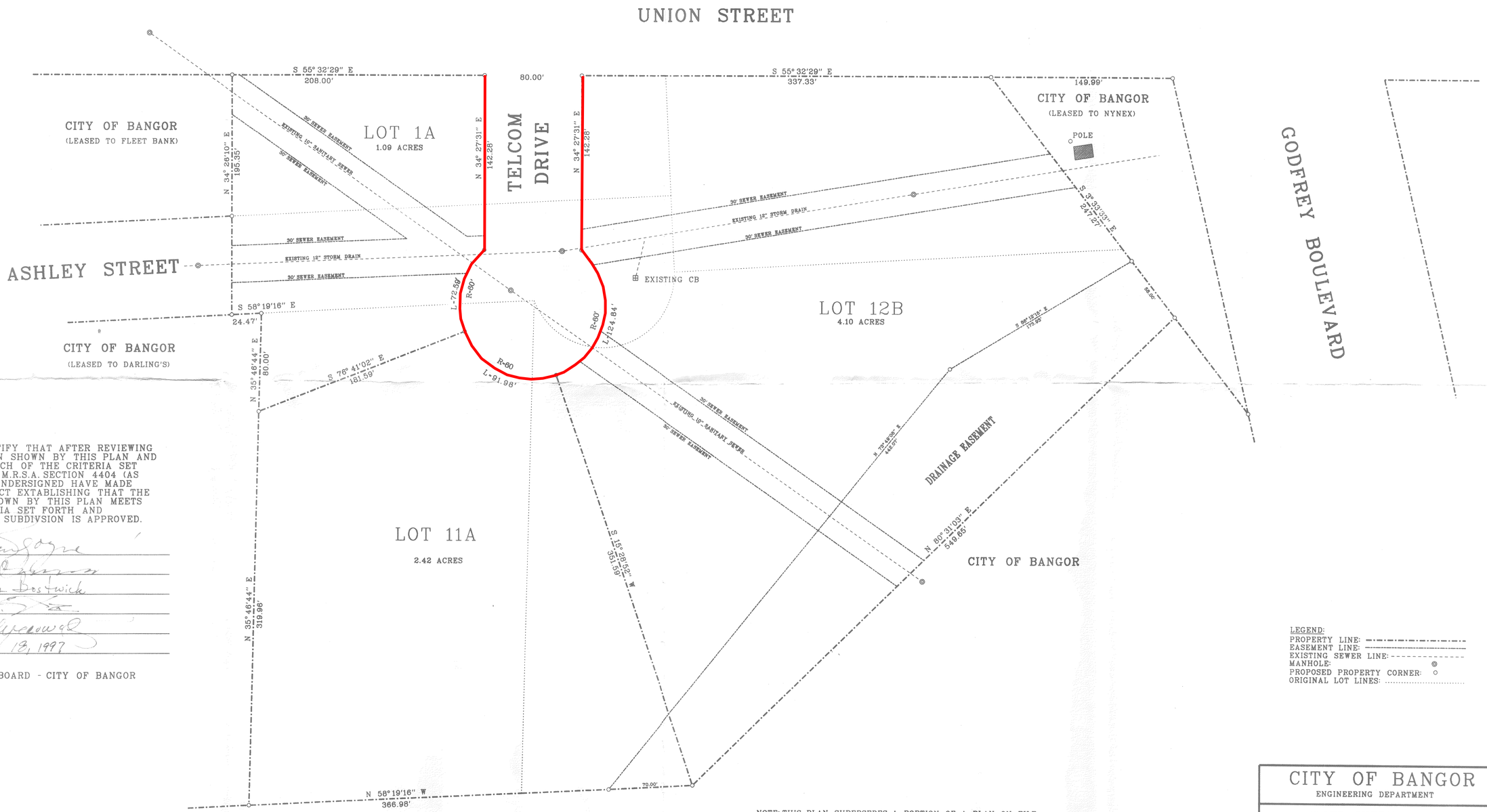
WHEREAS, it is in the interest of the City of Bangor to accept Cleveland Street as a public street.

By the City Council of the City of Bangor:

ORDERED,

That pursuant to 23 M.R.S.A. §3022 and 23 M.R.S.A. §3025 Corporate Drive is hereby accepted as a public way and street by the City of Bangor and is hereby added to the Official City Map.

THIS SUBDIVISION IS ORIENTED TO GRID NORTH
MAINE STATE COORDINATE SYSTEM (EAST ZONE NAD 1927)



THIS IS TO CERTIFY THAT AFTER REVIEWING THE SUBDIVISION SHOWN BY THIS PLAN AND CONSIDERING EACH OF THE CRITERIA SET FORTH IN 30-A M.R.S.A. SECTION 4404 (AS AMENDED) THE UNDERSIGNED HAVE MADE FINDINGS OF FACT EXTABLISHING THAT THE SUBDIVISION SHOWN BY THIS PLAN MEETS ALL THE CRITERIA SET FORTH AND THEREFORE THE SUBDIVSION IS APPROVED.

Gorgel Fengoyne
Ray Robinson
Mary Ann Bostwick
[illegible]
Nicole Rippeon
DATE: November 18, 1997

THE PLANNING BOARD - CITY OF BANGOR

LEGEND:
PROPERTY LINE:
EASEMENT LINE:
EXISTING SEWER LINE:
MANHOLE:
PROPOSED PROPERTY CORNER:
ORIGINAL LOT LINES:

NOTE: THIS PLAN SUPERSEDES A PORTION OF A PLAN ON FILE IN THE CITY ENGINEER'S OFFICE NUMBERED SD-133.

CERTIFICATION
THIS SURVEY CONFORMS TO STANDARDS SET FORTH BY THE STATE BOARD OF REGISTRATION FOR LAND SURVEYORS, CATEGORY I, CONDITION III, WITH THE FOLLOWING EXCEPTIONS:
1. NO WRITTEN REPORT WAS ISSUED AS A RESULT OF THIS SURVEY.
2. LOT CORNERS ARE NOT MARKED

SCALE: 1"=40'
0' 20' 40' 100' 200'

SURVEYED BY:
JAMES M. GREER
73 HARLOW ST.
BANGOR, ME. 04401

James M. Greer

CITY OF BANGOR
ENGINEERING DEPARTMENT

AMENDED SUBDIVISION PLAN
B.I.A. COMMERCIAL INDUSTRIAL PARK
UNION ST. - BANGOR, ME.
RECORD OWNER: CITY OF BANGOR
73 HARLOW ST.
BANGOR, ME. 04401

DRAWN BY: J. GREER	DATE: NOV. 4, 1997
SCALE: 1"=40'	PLAN NO:

_____COUNCIL ACTION_____

Item No.

Date: December 14, 2015

Item/Subject: ORDER, Acceptance of a Corporate Drive as a Public Street and Adding it to the Official City Map

Responsible Department: Engineering

Commentary:

This Order will accept an 80 foot wide and approximately 1,061.447 foot section of Corporate Drive, extending Easterly from Venture Way to Maine Avenue (map attached) as a public street and will add it to the Official City Map.

The City is owner of property known as the Maine Business Enterprise Park and additional property abutting the Maine Business Enterprise Park. Means of access to Maine Business Enterprise Park and the abutting property includes Corporate Drive.

Reviewed by the Infrastructure Committee November 24, 2015.

John M. Theriault, PE, PTOE
Department Head

Manager's Comments:

City Manager

Associated Information: Order & Location Map

Budget Approval:

Finance Director

Legal Approval:

City Solicitor

Introduced for
____ Passage
___ First Reading
___ Referral

Page __ of ___

Assigned to Councilor

CITY OF BANGOR

(TITLE.) ORDER, Acceptance Telcom Drive as a Public Street and Adding it to the Official City Map

WHEREAS, Telcom Drive is located in the Bangor International Airport Commercial Industrial Park; and

WHEREAS, Telcom Drive extends southwesterly of Union Street with a length of 142.28' with a 60' radius and

WHEREAS, Telcom Drive includes a 10" Sanitary Sewer Line and a 12" Storm Drain line

WHEREAS, Telcom Drive that has not been accepted as a public street; and

WHEREAS, it is in the interest of the City of Bangor to accept Telcom Drive as a public street.

By the City Council of the City of Bangor:

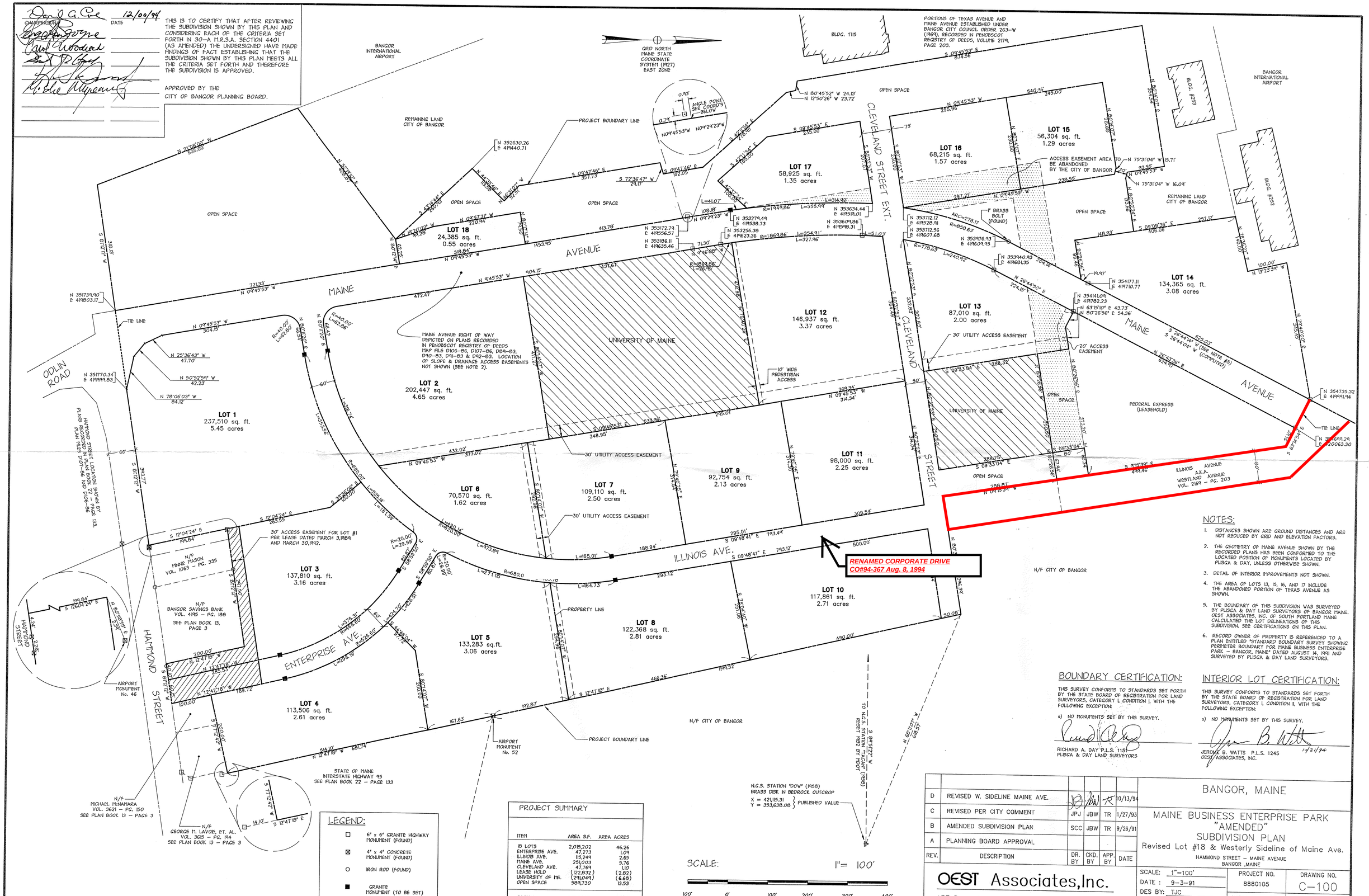
ORDERED,

That pursuant to 23 M.R.S.A. §3022 and 23 M.R.S.A. §3025 Telcom Drive is hereby accepted as a public way and street by the City of Bangor and is hereby added to the Official City Map.

CHAIRPERSON — DATE 12/06/94

THIS IS TO CERTIFY THAT AFTER REVIEWING THE SUBDIVISION SHOWN BY THIS PLAN AND CONSIDERING EACH OF THE CRITERIA SET FORTH IN 30-A M.R.S.A. SECTION 4401 (AS AMENDED) THE UNDERSIGNED HAVE MADE FINDINGS OF FACT ESTABLISHING THAT THE SUBDIVISION SHOWN BY THIS PLAN MEETS ALL THE CRITERIA SET FORTH AND THEREFORE THE SUBDIVISION IS APPROVED.

APPROVED BY THE CITY OF BANGOR PLANNING BOARD.



NOTES:

1. DISTANCES SHOWN ARE GROUND DISTANCES AND ARE NOT REDUCED BY GRID AND ELEVATION FACTORS.
2. THE GEOMETRY OF MAINE AVENUE SHOWN BY THE RECORDED PLANS HAS BEEN CONFORMED TO THE LOCATED POSITION OF MONUMENTS LOCATED BY PLISGA & DAY, UNLESS OTHERWISE SHOWN.
3. DETAIL OF INTERIOR IMPROVEMENTS NOT SHOWN.
4. THE AREA OF LOTS 13, 15, 16, AND 17 INCLUDE THE ABANDONED PORTION OF TEXAS AVENUE AS SHOWN.
5. THE BOUNDARY OF THIS SUBDIVISION WAS SURVEYED BY PLISGA & DAY LAND SURVEYORS OF BANGOR MAINE. OEST ASSOCIATES, INC. OF SOUTH PORTLAND MAINE CALCULATED THE LOT DELINEATIONS OF THIS SUBDIVISION. SEE CERTIFICATIONS ON THIS PLAN.
6. RECORD OWNER OF PROPERTY IS REFERENCED TO A PLAN ENTITLED "STANDARD BOUNDARY SURVEY SHOWING PERIMETER BOUNDARY FOR MAINE BUSINESS ENTERPRISE PARK - BANGOR, MAINE" DATED AUGUST 14, 1991 AND SURVEYED BY PLISGA & DAY LAND SURVEYORS.

BOUNDARY CERTIFICATION:

THIS SURVEY CONFORMS TO STANDARDS SET FORTH BY THE STATE BOARD OF REGISTRATION FOR LAND SURVEYORS, CATEGORY I, CONDITION I, WITH THE FOLLOWING EXCEPTION:

a) NO MONUMENTS SET BY THIS SURVEY.

RICHARD A. DAY P.L.S. 1151
PLISGA & DAY LAND SURVEYORS

INTERIOR LOT CERTIFICATION:

THIS SURVEY CONFORMS TO STANDARDS SET FORTH BY THE STATE BOARD OF REGISTRATION FOR LAND SURVEYORS, CATEGORY I, CONDITION I, WITH THE FOLLOWING EXCEPTION:

a) NO MONUMENTS SET BY THIS SURVEY.

JEROME B. WATTS P.L.S. 1245
OEST ASSOCIATES, INC. 12/2/94

LEGEND:

- 6" x 6" GRANITE HIGHWAY MONUMENT (FOUND)
- 4" x 4" CONCRETE MONUMENT (FOUND)
- IRON ROD (FOUND)
- GRANITE MONUMENT (TO BE SET)

PROJECT SUMMARY

ITEM	AREA S.F.	AREA ACRES
18 LOTS	2,015,202	46.26
ENTERPRISE AVE.	47,273	1.09
ILLINOIS AVE.	115,249	2.65
MAINE AVE.	251,003	5.76
CLEVELAND AVE.	47,769	1.10
LEASE HOLD	(122,832)	(2.82)
UNIVERSITY OF ME.	(291,049)	(6.68)
OPEN SPACE	589,730	13.53
TOTALS ----	3,066,226	70.39

REV.	DESCRIPTION	DR. BY	CKD. BY	APP. BY	DATE
D	REVISED W. SIDELINE MAINE AVE.		JBW	TR	10/13/94
C	REVISED PER CITY COMMENT	JPJ	JBW	TR	1/27/93
B	AMENDED SUBDIVISION PLAN	SCC	JBW	TR	9/26/91
A	PLANNING BOARD APPROVAL				

BANGOR, MAINE

MAINE BUSINESS ENTERPRISE PARK "AMENDED" SUBDIVISION PLAN

Revised Lot #18 & Westerly Sideline of Maine Ave.

HAMMOND STREET - MAINE AVENUE
BANGOR, MAINE

OEST Associates, Inc.
133 Pope Avenue · South Portland, ME 04106

SCALE: 1"=100'
DATE: 9-3-91
DES BY: TJC
DWN BY: SCC
CHK BY: JBW

PROJECT NO. 8880105
DRAWING NO. C-100
SHEET 1 OF 1
FIELD BOOK NO.

530 MAINE AVE.
BANGOR, MAINE 04401
TEL: 207/992-4501

PUBLIC SERVICES DEPARTMENT – OPERATION and MAINTENANCE
Dana R.Wardwell, Director

To: Infrastructure Committee
From: Dana Wardwell
Subject: Project canopy grants
Date: November 24, 2015

Project Canopy is a division of the Maine Forest Service that provides assistance to local municipalities. At this time they have two grants available.

1. A planting/ maintenance grant for a maximum of $8,000. I am proposing applying for this grant to prune city trees with a private contractor. These grants require a 50/50 match and I propose matching the $8,000 with money budgeted for private contracting in my FY 16 budget
2. A planning grant for a maximum of $10,000. I am proposing to match this amount with in kind services utilizing city staff and equipment. With this grant we would hire an intern to perform an inventory of city street trees utilizing our GIS system. Having an accurate inventory will allow us to form a maintenance plan as well as be prepared to take prompt remedial action should invasive pests or disease enter the city.

   We will be eligible for only one of these grants. If we are successful on both applications I will choose the planning grant to perform the street tree inventory. I request permission to apply for these grants.

Assigned to Councilor

CITY OF BANGOR

(TITLE.) Order, Authorizing the City manager to apply for a Project Canopy maintenance grant in the amount 0f $8,000

By the City Council of the City of Bangor: **The City manager may apply for a Project Canopy grant in the amount of $8,000 to prune trees in the City of Bangor**

ORDERED, THAT

Assigned to Councilor

CITY OF BANGOR

(TITLE.) Order, Authorizing the City manager to apply for a Project Canopy planning grant in the amount 0f $8,000

By the City Council of the City of Bangor: **The City manager may apply for a Project Canopy grant in the amount of $8,000 to perform a street tree inventory in the City of Bangor**

ORDERED, THAT

Office of the City Engineer
John M. Theriault, P.E., P.T.O.E
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Bangor, Maine 04401 Fax: 207-992-4194
www.bangormaine.gov

To: **Infrastructure Members**
From: **John M. Theriault, P.E., P.T.O.E., City Engineer**
Date: **November 17, 2015**
Subject: **Retaining Wall**

This past summer, the City of Bangor retained Fessenden Geo-Environmental Services Construction Materials Testing (FGS-CMT) to conduct a geotechnical evaluation of the existing retaining wall that surrounds City Hall and provides support for Park Street.

The wall surrounds City Hall on three sides and has a total length of about 400 feet. The maximum exposed height of the wall is 24'. The wall shows signs of significant cracking and shifting and the intent of FGS-CMT work was to provide an assessment of the stability of the wall as well as reviewing options for repair and/or replacement of the wall. FGS-CMT conducted corings through the concrete of the retaining wall as well as soil borings in front of and behind the wall.

Based on the information provided within the report it was concluded that the integrity of the wall is compromised and that repair and/or replacement of the wall, in the immediate future, is recommended.

Factors leading up to the current poor condition of the wall include freeze thaw cycles of trapped water behind the wall, as well as unsuitable material behind the wall.

Preliminary estimates provided within the report show a range of 1.3 - 1.4 million to repair the wall and 2.2 - 2.5 million to replace the wall.

The Engineering Department has recently had a full survey of the wall completed such that initial design can begin for a future improvement project to the wall.

FGS/CMT.inc.

Fessenden Geo-Environmental Services
Construction Materials Testing

SUBSURFACE EXPLORATION AND GEOTECHNICAL EVALUATION

Concrete Retaining Wall at Bangor City Hall

73 Harlow St., Bangor, Maine

Conducted for the City of Bangor
Engineering Department
Bangor, ME

October 23, 2015

FGS/CMT inc.

Fessenden Geo-Environmental Services
Construction Materials Testing

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APPENDICES

Appendix A: Limitations

Appendix B: Figures

Appendix C: Test Boring Logs

Appendix D: Plans

Appendix E: About the Design-Build Method

FGS/CMT inc.

Fessenden Geo-Environmental Services
Construction Materials Testing

October 23, 2015

Mr. John Theriault, PE, City Engineer
City of Bangor Engineering Department
73 Harlow Street,
Bangor, ME 04401

Ref: Concrete Retaining Wall Evaluation at City Hall Bangor
73 Harlow St., Bangor, Maine

1. INTRODUCTION

1.1 General

Following our proposal, a geotechnical exploration program was carried out at the subject site. The purpose of the exploration was to:

(1) obtain information about the ground and water conditions in front and behind the wall as well as below the existing wall foundation level,

(2) conduct concrete coring for determining the quality/conditions of the existing concrete of the wall, and

(3) make an appraisal of the wall stability conditions and provide potential alternative solutions, at a preliminary stage, for the wall.

Details of our findings and their evaluation, and our assessments and recommendations are provided in this report and should be carefully reviewed.

This report is subject to the limitations outlined in Appendix A. Important information about the report is included in the same appendix.

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1.2 Site Description

The general layout of the project location is shown on Figure 1 of Appendix B. The existing retaining wall, approximately 405 ft long, has three sections, surrounding the City Hall from north, east and south. Along Park Street its maximum height (above the finished pavement in front of the wall) is about 24 ft at its northeastern corner and about 10 ft at its southeastern corner. On the north wall its height tapers down to about 2 feet at its west end, and the southern wall tapers down to about 3 feet at its west end.

Based on available information by the City of Bangor- Department of Engineering the wall is almost 100 years old and was most recently repaired in 1978.
The SE part of the east section of the wall is very close to the Old Boiler Room and Loading Dock structure.

The Department of Engineering of the City of Bangor provided FGS/CMT, inc. with "Retaining Wall Repair at Bangor City Hall" drawings (dated 14 Oct. 1977) titled as: Site Plan, North Wall, East Wall, South Wall, Miscellaneous Details and Wall Details. In the last drawing there is no note as to where these wall sections refer and there is no scale.

During our site visit we observed that the retaining wall has sustained considerable strain (cracking, spalling and tilting) and surface weathering.

2. EXPLORATIONS AND TESTING

2.1 General

The exploration program consisted of drilling eight test borings, B1 to B8 and three core drillings of the retaining wall concrete, C1 to C3.

Two of the borings, B2 and B3 were drilled from the sidewalk pavement at the top of the north section of the retaining wall.
Two borings, B1 and B8, were drilled in the 'parking lot' in front of the east and north sections of the retaining wall in respectively.
Four borings B4, B5, B6, and B7 were drilled on the sloped sideway behind the crest of the north section of the retaining wall.

Core drilling C1 was drilled in the east section of the retaining wall while core drillings C2 and C3 in the north section of the retaining wall.

The approximate boring and core drilling locations is shown on Figure 1 of Appendix B.

2.2 Explorations

2.2.1 Test borings - Test borings were drilled by Northern Boring Contractors, of Hermon Maine on May 8th and May 11th, 2015, under the direction and supervision of FGS/CMT, inc. personnel.

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The borings were drilled using either 1-3/8” or 2-1/2” hollow stem augers (HSA) and soil samples were obtained by driving a standard split-spoon sampler two feet into the soil with a 140 lb weight that was dropped 30 inches. The blow counts per six inches were recorded and the six-inch to eighteen-inch interval blows were used to determine the standard penetration resistance of the soil. Split spoon samples were taken at five (5) foot intervals when possible.

Borings were stopped when spoon or auger refusal was met due to the presence of cobbles/boulders or presumably bedrock. Auger refusal due to large rock pieces (cobbles/boulders) or possible bedrock was encountered in all borings.

Borings B-2 and B-3 were drilled to a depth of 30.05 ft, and 20.0 ft., respectively, below pavement surface (bgs) while the rest of the borings were drilled 2.4 ft to 3.8 ft below pavement surface. The upper 6.0-7.0 ft of borings B2 and B3 were water jet-vacuum excavated to avoid damage of the natural gas pipeline that is running along the pavement close to boring locations.

Borings B4, B5, B6, and B7 were drilled closed to each other (about 1.5 ft) to check the ground conditions due to shallow auger refusal and presence of ledge (presumably) in boring B4; boring B4 was cored from 4.3 ft to 6.2 ft below the pavement surface.

Borings drilled fill of varying composition: pavement material, sand and gravel, clayey silt, cobbles and boulders and rock fragments. The lower part of boring B4 was drilled into ledge.

For detailed information regarding borings, refer to boring logs in Appendix C.

2.2.2 Concrete Core drilling

Core drillings was conducted using a hand held core drill equipped with a 2-inch core bit. The core length for each drilling was about 12 inches. Rock was drilled at the end of the length of core of drilling C2. The same core drilling cut a piece of the wall’s steel reinforcement; the steel was found in good condition.

3. SUBSURFACE CONDITIONS

This section summarizes the surface and subsurface soil and groundwater conditions at the boring locations.

3.1 Soil conditions at boring locations

Boring B2

Below the pavement and up to 6.0 ft the boring was water-jet vacuum excavated. Starting from the ground surface and moving downwards, to the end of the boring (30.05 ft), the boring encountered materials consisted of cobbles and rock fragments with sandy gravel and silt at places. Most of the cobbles and gravel pieces were angular, presumably products of rock excavations conducted in the area. The spoon sampler for the standard penetration test (SPT) met refusal in these materials. The auger met refusal at the depth of 30.05 ft below the pavement surface possibly due to the presence of ledge.

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Boring B3

Starting from the pavement base and moving downwards:

- The materials below the pavement and up to 7.0 ft (where the boring was water-jet vacuum excavated) as were observed on the walls of the hole, consisted of sandy gravel, with cobbles (mostly angular), and some silt.
- From 7.0 ft to 17.0 ft the drilled material consisted of layers of clayey silt, sandy silt and cobbles. The SPT values increase with depth in these materials, namely N= 3, N= 15 and N=49.
- From 17.0 ft to 20.0 ft the boring encountered cobble like material (after the drillers report). The boring stopped at 20.0 ft because of difficulty in auger drilling possibly due to the presence of ledge.

Boring B4

Below a thin layer of pavement and up to 3.7 ft (spoon sample refusal) the boring encountered fill material consisted of sandy gravel, piece of brick, angular stone pieces. The auger drilled up to 4.3 ft with difficulty; then up to 6.2 ft the boring was cored (presumably ledge).

Borings B5, B6, and B7

In these borings were drilled close to each other and to B4. They all met auger refusal, presumably on ledge, at about 4.3 ft.

Borings B1 and B8

In the upper 0.5 ft - 1.0 ft, in both borings the auger drilled through concrete. Below the concrete and up to 2.8 ft-2.9 ft (auger refusal) the borings met a 1-2 inches layer of gravel/crushed stone followed by sandy gravel and pieces of stone.

3.2 Groundwater Conditions

No groundwater was observed in the borings during drilling operations, as well as removal of the the auger from the borehole. Our observations refer only to the time and location of borings mentioned above.

During the water-jet vacuum excavation of the upper part of boring B3, we observed that west of the boring location water was seeping through the base of the wall. During subsequent visits to the site with contractors and a random site visit in September after several weeks without precipitation, we observed that water was still seeping through the same point (there was a continuous water flow) draining towards the corner of the loading dock and along the south wall, where the pavement was undercut and the ground eroded. From the presence of staining and odor, we assumed that the seepage water was from a sewage/storm drain pipe leakage. In October, the Bangor Public Works Department checked the sewage pipe, found extensive leaking north of boring B3and started repairing works.

During drilling of boring B4, it was observed that water was seeping through a crack of the wall located in the area where the boring was located.

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3.3 Ground Conditions in the Wall Area

Based on the results of borings B2, B3 and B4 it appears that:

- At boring locations B2 and B3, it is likely that the depth of ledge is about 8-10 ft below the paved parking area between the retaining wall and the City Hall building as well as the generator room and loading dock structure.
- At boring location B4 it appears that the ledge is probably 3.7-4.0 ft below surface.
- The wall backfill material may vary along the wall. The backfill is more granular at the location of borings B2 and B4 compared to that of B3. In the latter, the backfill contains clayey silt, sandy silt and cobbles (from 7 ft to 17 ft below pavement), which in general may entail increased lateral pressure on the back of the wall. The wall north and south of boring B3 is bulged.

Based on the topography of the site and the existence of a basement in the City Hall we assume that:

(a) excavations in the area included most likely rock blasting and

(b) products of blasting were most likely used as fill material for the walls and their foundation

The topography of the rock surface at different distances behind the wall is unknown; it requires additional drilling for its mapping. The rock surface elevation may vary considerably over short distance. It seems that, close to the wall it is below 7 ft from the road pavement, based on information from the depth of embedment of the utility lines.

4. WALL CONDITIONS

During our site visit we observed that the retaining wall has sustained considerable strain (cracking, spalling and tilting) and surface weathering- see Figures 2, 3a and 3b.

As it was mentioned in paragraph 1.2, based on available information by the City of Bangor-Department of Engineering the wall is almost 100 years old and some sections were repaired in 1978.

The wall repairs included removal and replacement/reconstruction of parts of the east section of the wall (see Plan No: B-55, sheet 3/5- Appendix D) and almost half of the total length of the north section of the wall (see Plan No: B-55, sheet 2/5- Appendix D). Also many joints/cracks were cleaned and filled with epoxy grout. We observed that the grout at present is not in full contact with the crack walls or detached from the crack walls.

The concrete surface at many locations is porous and suffered extensive weathering. From the above and examination of the concrete cores it may be deducted that at places the concrete below the surface is good and the steel not corroded. In one location, close to the northeast corner of the east

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section of the wall, at a badly weathered joint we observed that the exposed steel reinforcement appears rusted with reduced actual working diameter.

During our site visit we observed that:

- Many of the drainage holes at the bottom of the wall had no signs of water draining through them.

- There were no obvious signs or water running through the cracks of the wall with the exception of the water running at the base of the wall, west of boring B3 (see paragraph 3.3). Nevertheless, after rain, many drainage holes and crack walls along the wall were wet.

- The cracks are mainly developed along horizontal and vertical construction joints or separation surfaces when pouring concrete (see Figs. 2 and 3a and 3b).

- Many joints/cracks along the wall were widened considerably and their wall surfaces were shifted. Widened cracks could be attributed to water and frost action. We observed that, in some cracks, particularly on the east section of the wall, water from the sidewalk was entering into the crack opening.

- Close to the eastern corner of the north section of wall (north wall) some cracks are considerable widened, with weathered crack wall surfaces.

The crest of the wall, at the west part of the northern section of the wall shows signs of slight deformation - outward movement.

The largest wall deformations were observed at the southern end of the eastern section of the wall (100-120 ft long), where the old generator room and loading dock building are located. Our observations southern end of the eastern section of the wall can be summarized as follows:

- The wall crack opening ranged between 0.5 and 2.0 inches.

- Cracks on concrete capping are at places sheared-displaced at by almost 1.0 -1.5 inches.

- The concrete at places is weathered, crumbled and caved (along some joints/cracks) up to almost 10.0 inches.

- The upper part/crest area of the wall shows considerable tilting, up to 4inches outwards.

- Vertical cracks along construction joints are widened and sheared (in the normal to wall direction).

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- As was mentioned in paragraph 3.3 there is water seeping though the base of the wall in the area close to the location of boring B3. The water is draining towards the corner of the loading dock and along the south wall, where the pavement was undercut and the ground eroded. From the presence of a light stain in the water and the smell of the water, we assume that it is from sewage/storm water pipe leakage.

- The wall appears to be in marginally stable condition, i.e. it can easily turn into an actively unstable condition.

With reference to the south wall, we observed that at its eastern corner there is a 0.5-2.5 inches wide crack running from top to bottom of the wall. At the crack the wall we observed that the wall has moved about 1.0 inch outwards (northwards).

5. DISCUSSION AND RECOMMENDATIONS

From the results of the site exploration and site observations, it can be concluded that the integrity of the wall is compromised (cracking, spalling, and tilting).

It is suggested that the factors contributing to the wall deformations, which eventually may lead to its loss of functionality and failure, are most likely:

- Water and frost-thaw action in the wall joints/cracks; it can cause deterioration of crack conditions and concrete fragmentation

- Presence of poor quality backfill and soils behind the wall as observed in the area of boring B3 at the southern part of the east section of the wall.

- random dynamic or seismic events.

The presence of cracks creates a fragmented concrete mass and can increase gradually the mobility-deformability of the wall leading towards less stable wall conditions.

The southern part of the east section of the wall appears to be in marginally stable condition at best, i.e. it can easily turn into an actively unstable condition

In general, the remedial measures available for tackling the problem can be classified into the following groups: (1) corrective measures/improvements of the existing retaining wall and (2) alternative earth retaining wall schemes.

(1) <u>Corrective measures/improvements of the existing retaining wall</u>

Solutions in this group deal with the strengthening/reinforcement of the existing wall by utilizing reinforced shotcrete and anchoring/nailing of the wall. The wall should be adequately drained. Solutions of this kind entail use of specialized equipment (strong scaffolding, special drilling rigs,

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etc.) for the construction and require a specialized contractor (at present not available in the State) with great experience in similar works. The contractor shall provide shotcrete resistant to freeze-thaw cycles.
The solution shall not be implemented in the southern part of the east wall section. In that section solutions of type 2a or 2b will be implemented i.e. dismantling the existing wall and construction of new concrete or MSE retaining wall section.

(2) Alternative earth retaining schemes- They include the following two options:

(a) Dismantling the existing wall sections and construction of new concrete retaining wall sections

(b) Dismantling the existing wall sections and construction of MSE Walls

Option 2a- This solution requires excavations behind the existing wall; due to these excavation the east section of the wall will be closed for the traffic. In addition the contractor has to support existing utilities and keep them in service, relocate them or have them turned off during the wall construction period.
Usually the foundation base width, behind the wall face, may be 0.5H, where H is the height of the wall. Slope excavation lines and required stabilization measures would be dictated from the introduction of an acceptable safe setback distance from properties and buildings.

Option 2b- Like the previous solution (i.e. option 2a) requires excavations behind the existing wall and will result in closing the east section of the wall for traffic. In addition, the contractor has to support existing utilities and keep them in service, relocate them or have them turned off during the wall construction period.
The solution of an MSE Wall is characterized by simple and rapid construction without the use of specialized labor or equipment, conformance to almost any alignment and grade and environmentally friendly final appearance.
The MSE wall can be constructed by local contractors using available construction equipment and may be cost effective. For engineered MSE Walls the minimum width of the reinforced fill is usually around 0.7H, where H is the height of the wall. Slope excavation lines and required stabilization measures would be dictated from the introduction of an acceptable safe setback distance from properties and buildings.

The approximate cost of each solution has as follows:

Option 1:
Application of shotcrete and anchors for the north and northern part of east wall; remove south wall and southern part of east wall and built MSE or concrete retaining wall: $1.3 to $1.4 Million

Option 2a:
Remove the entire existing wall and replace it with a new concrete retaining wall: $2.5 Million

Option 2b:
Remove the entire existing wall and replace it with MSE Wall: $2.25 Million

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Remarks:
Implementation of any of the above solutions might require dismantling of the old generator room and loading dock structure. Also any construction along Park Street will require closing the road and shutdown gas and possibly sewer line. Taken into consideration that the latter one is very old and made of bricks, therefore susceptible to damages even with small soil movements, we propose replacement of the old pipe with a new one. The cost of replacement is not included in the approximate cost estimate of the above options/solutions.

We understand that the project will commence next year, 2016; therefore we recommend sealing the joint between the road curb and the side pavement along Park Street to reduce infiltration of storm water behind the wall and reduce potential adverse impacts from frost-thaw cycles.

For better assessing the ground conditions at some distance behind the wall face for dimensioning free and fix lengths of the anchors as well as for analyzing slope stability issues of excavations and shoring/bracing requirements of slopes a supplemental drilling program of 3-4 test borings is required.

Due to the nature of the project, it seems that implementation of the Design-Build, (D-B), procedure for the project delivery might be helpful. D-B is a method of project delivery in which one entity, the design-build team, works under a single contract with the project owner to provide design and construction services. More information about the method is given in Appendix E.
In the case this method is implemented, the Bangor City Hall Department of Engineering can contact the Maine DOT for advice, if necessary, since DOT has implemented the method in many projects.

6. CLOSING

It has been a pleasure to assist you in this phase of the project. If you have any questions, please call us.

Sincerely
FGS/CMT, inc.

Miltiades Zacas, Ph.D, P.E.
Geotechnical Engineer

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Appendices

Appendix A : Limitations – Important information about your Geotechnical Engineering Report

Appendix B : Figures

Appendix C : Test Boring Logs

Appendix D : Plans

Appendix E : About the Design-Build Method

Appendix A

Limitations – Important information about your Geotechnical Engineering Report

Limitations

This report has been prepared for the exclusive use of the City of Bangor – Department of Engineering for the specific application to the City Hall Concrete Retaining Wall Evaluation project. Copies of the report may be given to contractor(s), with the contract documents, to disclose information relative to the project. Nevertheless, the report has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project architect, structural engineer, and/or civil engineer. Reproduction and distribution of this report must be authorized by the client and FGS/CMT, inc.

This work was done in accordance with generally accepted geotechnical principles and practices, with the level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions for the period in which this work was accomplished. No other warranty, expressed or implied, is made.

The analyses and recommendations contained in this report are preliminary and are based in part upon the data obtained from the referenced subsurface explorations and information provided by others. It is recommended that the architect, civil engineer and structural engineer along with any other design professionals involved in the project carefully review the conditions and characteristics of the proposed construction assumed in this report to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein have been correctly interpreted.

The results of the investigation indicate subsurface conditions only at the specific locations and times, and only at the depths observed. They do not reflect the actual environmental or stratigraphic variations that may exist between such locations. The validity of the recommendations is based in part on assumptions about the stratigraphy made by FGS/CMT, Inc. If subsurface conditions different from those described are observed during construction, it will be necessary to reevaluate the findings and recommendations of this report.

It must be noted that the findings presented do not represent scientific certainties and are based on professional judgment. The conclusions regarding the condition of the site do not represent a warranty that all areas within the site and beneath structures are of the same quality as those observed, or that the site contains no hazardous substances or latent conditions beyond those detected or observed during the investigation.

FGS/CMT, Inc. is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or the reuse of the subsurface data for engineering analysis by others.

No attempt has been made to verify the findings and recommendations of others, or to verify the compliance of the past or present owners and/or occupants of the property with local, state, or federal laws and regulations.

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES

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Appendix B

Figures

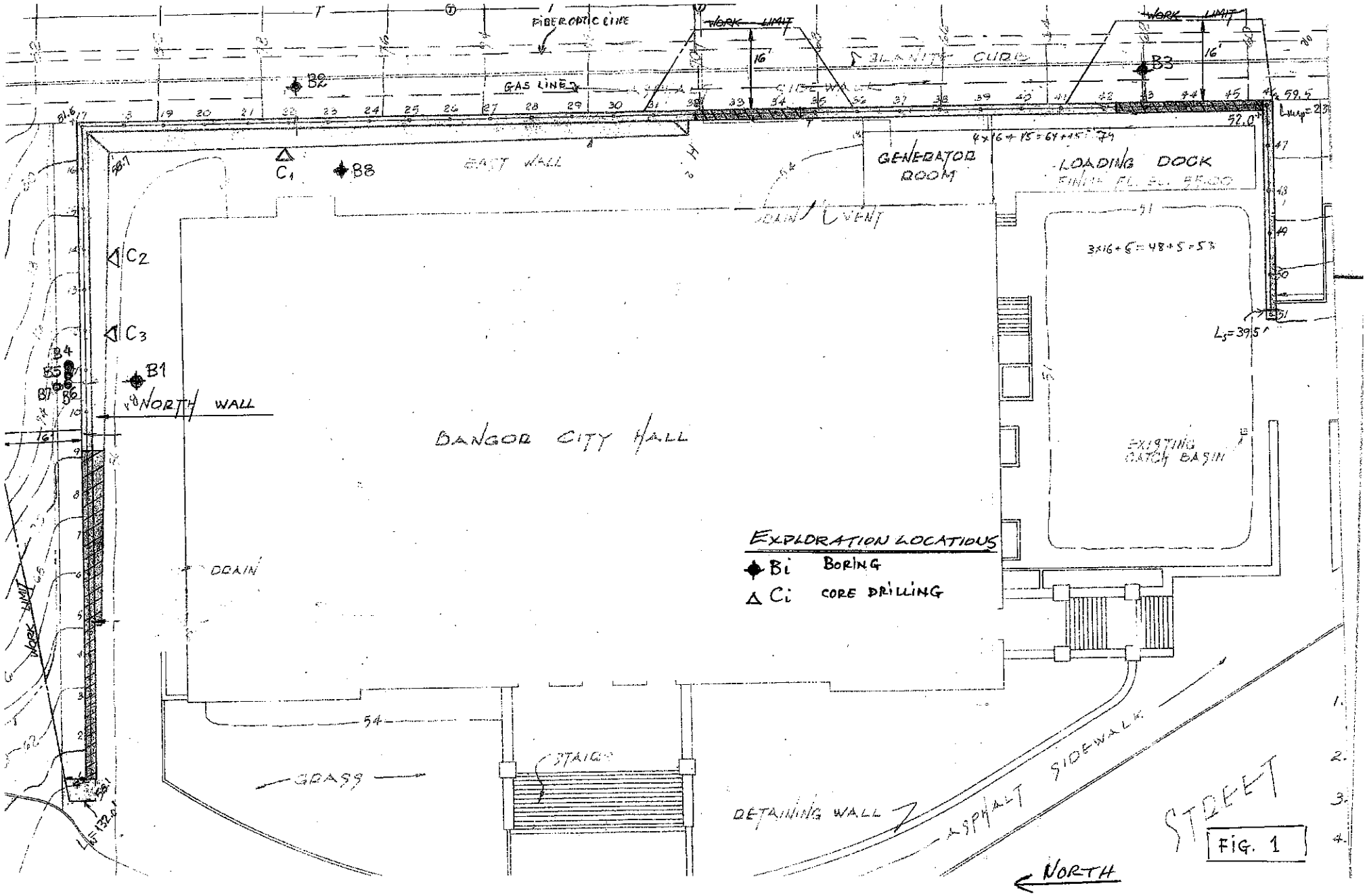
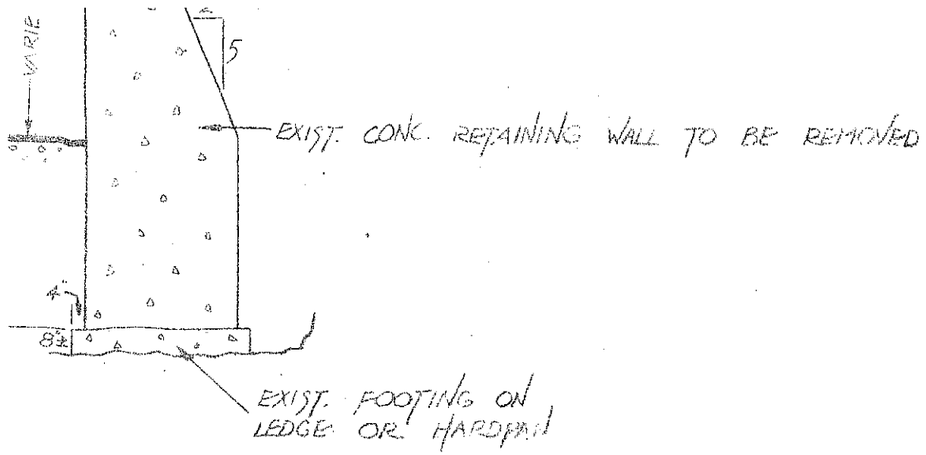

FIBEROPTIC LINE
WORK LIMIT
GAS LINE
GRANITE CURB
SIDEWALK
B2
B3
B8
B1
B4
B5
B6
B7
C1
C2
C3
EAST WALL
GENERATOR ROOM
LOADING DOCK
DRAIN
VENT
NORTH WALL
BANGOR CITY HALL
EXISTING CATCH BASIN
DRAIN
EXPLORATION LOCATIONS
Bi BORING
Ci CORE DRILLING
GRASS
STAIRS
RETAINING WALL
ASPHALT SIDEWALK
STREET
NORTH

FIG. 1



SCALE: 1/4" = 1'-0"

SECTION A-A

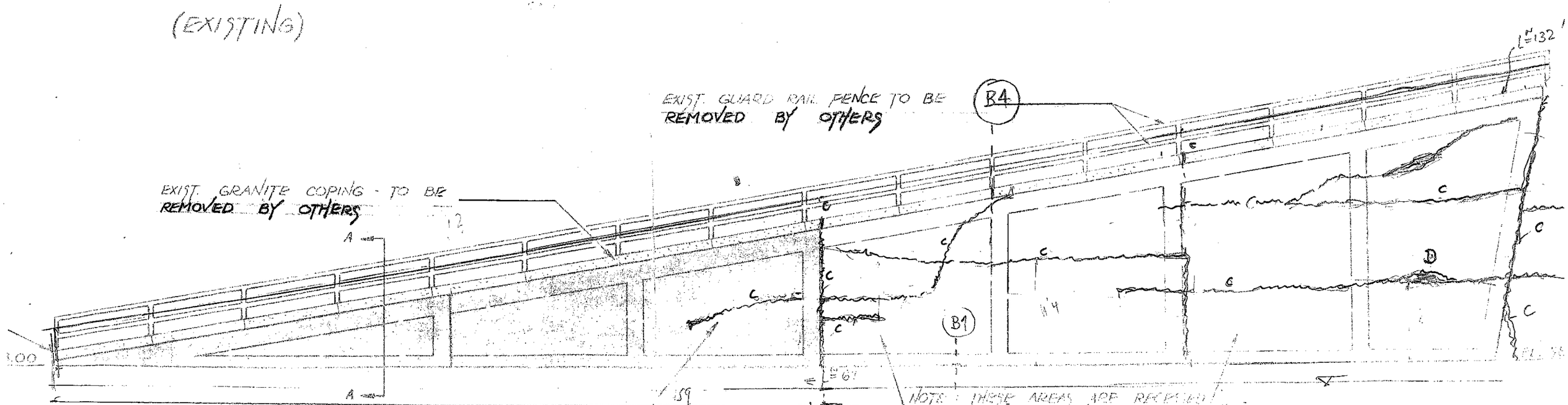
(EXISTING)

NORTH WALL

VIEW OF CRACKS

c: cracks

(NOT TO SCALE)



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

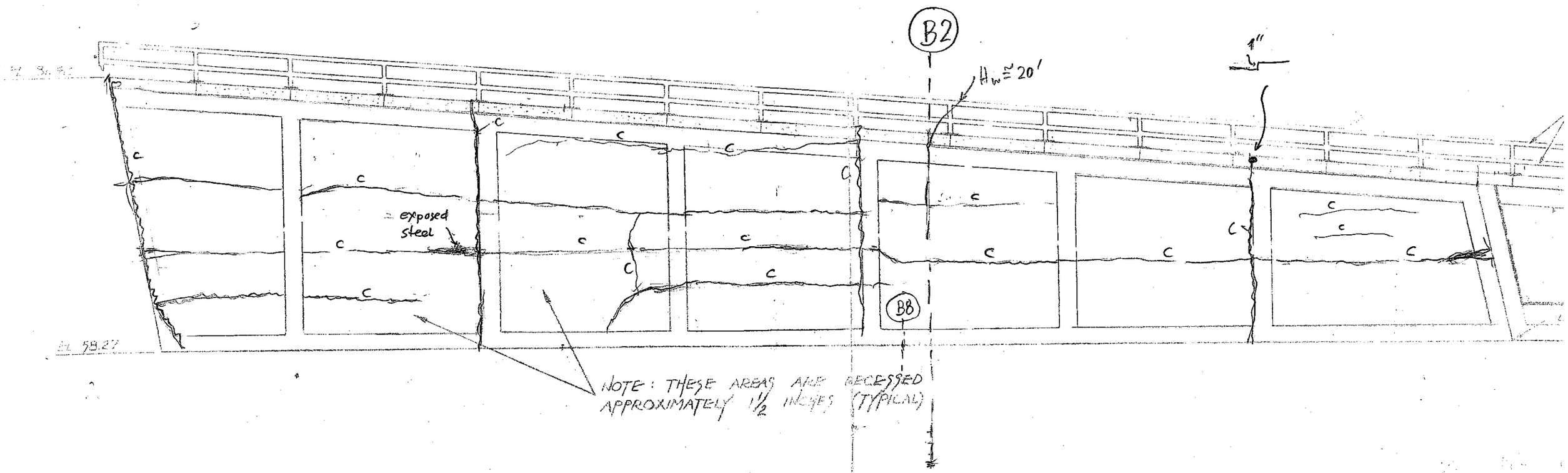
(EXISTING)

FIG. 2

NORTH PART OF THE EAST WALL

VIEW OF CRACKS

C; crack



SKETCH

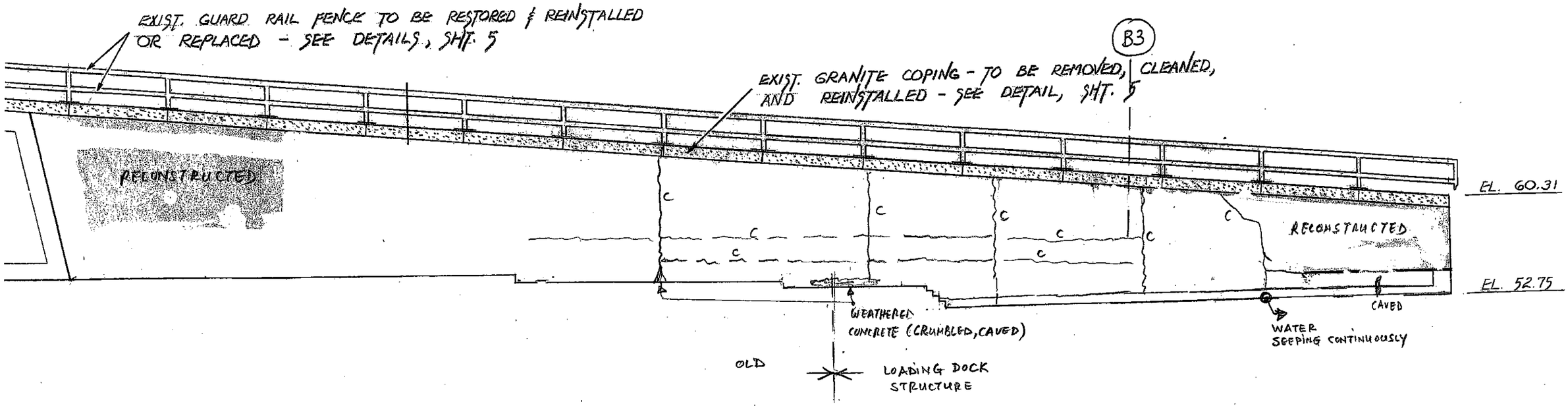
(NOT TO SCALE)

FIG. 3A

SOUTH PART OF EAST WALL

VIEW OF CRACKS

c: crack



EVATION

SKETCH
(NOT TO SCALE)

FIG. 3B

Appendix C

Test Boring Logs

Fessenden GeoEnvironmental Serv. P.O. Box 2097 Bangor, ME 04402-2097	CLIENT: City of Bangor	SHEET 1 OF 1 HOLE NO. B1
DRILLER: NE Boring Contractors	PROJECT NAME: Retaining Wall	LINE & STATION: North side of building
JOB NUMBER:	LOCATION: Park St. Bangor, ME	OFFSET: Base of Wall

GROUNDWATER OBSERVATONS		CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
None	TYPE		D		5/8/15	5/8/15
	SIZE I.D.		1 3/8"			
	HAMMER WT.		140 lbs		SURFACE ELEV:	
	HAMMER FALL		30"			

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading	DEPTH	STRATUM DESCRIPTION
											1.0'	Concrete + subgrade
	B1S1	2"	1.5'	9"	2.5'	–	14	24	NP		2.5'	Top 2" crushed stone Rest: Sand, gravel
												Refusal at 2.5', drilled into uniform like rock for 0.4'. Assumed Ledge End of B1

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
✓ SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B1

Fessenden GeoEnvironmental Serv.
P.O. Box 2097
Bangor, ME 04402-2097

CLIENT: City of Bangor

SHEET 1 OF 1
HOLE NO. B2

DRILLER: NE Boring Contractors
PROJECT NAME: Retaining Wall
LINE & STATION: Park St. Sidewalk
JOB NUMBER:
LOCATION: Park St. Bangor, ME
OFFSET: Top of Hill

GROUNDWATER OBSERVATONS: None

	CASING	SAMPLER
TYPE		D
SIZE I.D.		1 3/8"
HAMMER WT.		140 lbs
HAMMER FALL		30"

CORE BARREL	Start Date	Finish Date
	5/8/15	5/8/15
	SURFACE ELEV:	

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading	DEPTH	STRATUM DESCRIPTION
												Water-Jet, Vacuum Excavated
											6.0'	Sandy gravel with cobbles
	B2S1	2"	1.1'	12"	7.1'	24	39	40/0.1			7.1'	2" sandy gravel, 10" sand + silt
												Cobble
											10'	
	B2S2	2"	0.2'	3/4"	10.2'	50/0.2'					10.2'	Fine gravel with silt
												Cobble
											15'	
	B2S3	2"	0.1'	0	15.1'	50/0.1'					15.1'	Cobble
											16.0'	Easy Drilling
											18.7'	
											20'	
	B2S4	2"	0	0	20'	NP						
											25'	
	B2S5	2"	0.1	0	25.1'	50/0.1'					25.1'	Cobble
											30.0'	
	B2S6	2"	0	0	30.5'	NP					30.05'	Drilled into uniform like Rock for 0.5' Assumed ledge
												End B2

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
✓ SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B2

Fessenden GeoEnvironmental Serv.
P.O. Box 2097
Bangor, ME 04402-2097

CLIENT: City of Bangor

SHEET 1 OF 1
HOLE NO. B3

DRILLER: NE Boring Contractors
PROJECT NAME: Retaining Wall
LINE & STATION: Park St. Sidewalk
JOB NUMBER:
LOCATION: Park st. Bangor, ME
OFFSET: Bottom of Hill

GROUNDWATER OBSERVATONS: None

	CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
TYPE		D		5/8/15	5/8/15
SIZE I.D.		1 3/8"			
HAMMER WT.		140 lbs		SURFACE ELEV:	
HAMMER FALL		30"			

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading	DEPTH	STRATUM DESCRIPTION
												Water-Jet, Vacuum Excavated Sandy Gravel with Cobbles
											7.0'	
	B3S1	2"	2.0'	14"	9.0'	2	2	1	3		9.0'	Clayey Silt: qp: 1.25 TSF 0.75 TSF
											10.0'	
	B3S2	2"	2.0'	3"	12.0'	6	6	9	11		17.0'	Clayey Silt, broken Stone Tube blocked by stone
												Cobble
											15.0'	
	B3S3	2"	2.0'	10"	17.0'	14	25	24	75		17.0'	Top 8" Clayey Silt Bottom 2" Dry Sandy Gravel
												Cobble
											20.0'	Drilling in Uniform Bedrock
	B3S4	2"	0	0	20.0'	NP						Assumed Ledge
												End of B3

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
✓ SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B3

Fessenden GeoEnvironmental Serv. P.O. Box 2097 Bangor, ME 04402-2097	CLIENT: City of Bangor	SHEET 1 OF 1 HOLE NO. B4
DRILLER: NE Boring Contractors	PROJECT NAME: Retaining Wall	LINE & STATION: North side of Building
JOB NUMBER:	LOCATION: Park St. Bangor, ME	OFFSET: Top of Wall

GROUNDWATER OBSERVATONS		CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
None	TYPE		D		5/11/15	5/11/15
	SIZE I.D.		1 3/8"		SURFACE ELEV:	
	HAMMER WT.		140 lbs			
	HAMMER FALL		30"			

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading
	B4S1	2"	1.7'	8"	3.7'	6	6	4	50/0.2'	
	B4 R									

DEPTH	STRATUM DESCRIPTION
2.0'	Augered
3.7'	Fill: Sandy gravel, brick, broken stone
4.3'	Hard drilling / Uniform Rock
6.2'	Rock Core

Broke at 5.1'
Redrilled to 5.2'
Coring Bit broke at 6.2'

100% Recovery
RQD = 64%
Fine grained, Blue/Grey metamorphic rock
Thinly bedded at ~50° from horizontal
Soft - Moderately Soft
Moderate - Intensly fractured
Slight weathering between fractured bedding planes

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
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✓ SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B4

Fessenden GeoEnvironmental Serv. P.O. Box 2097 Bangor, ME 04402-2097	CLIENT: City of Bangor	SHEET 1 OF 1 HOLE NO. B5
DRILLER: NE Boring Contractor	PROJECT NAME: Retaining Wall	LINE & STATION: North of Building, Top of Wall
JOB NUMBER:	LOCATION: Park St. Bangor, ME	OFFSET: 2' West, 0.5' North of BH

GROUNDWATER OBSERVATONS		CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
None	TYPE				5/11/15	5/11/15
	SIZE I.D.				SURFACE ELEV:	
	HAMMER WT.					
	HAMMER FALL					

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading	DEPTH	STRATUM DESCRIPTION
												Refusal at 3.8'
												Drilled to 4.3'
												Assumed ledge
												End B5

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B5

Fessenden GeoEnvironmental Serv. P.O. Box 2097 Bangor, ME 04402-2097	CLIENT: City of Bangor	SHEET 1 OF 1 HOLE NO. B6
DRILLER: NE Boring Contractors	PROJECT NAME: Retaining Wall	LINE & STATION: North of Building, Top of Wall
JOB NUMBER:	LOCATION: Park St Bangor, ME	OFFSET: 3' West, 4' North of B5

GROUNDWATER OBSERVATONS		CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
None	TYPE				5/11/15	5/11/15
	SIZE I.D.				SURFACE ELEV:	
	HAMMER WT.					
	HAMMER FALL					

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading	DEPTH	STRATUM DESCRIPTION
												Refusal at 3.8'
												Drilled to 4.3' Assumed ledge End B6

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B6

Fessenden GeoEnvironmental Serv. P.O. Box 2097 Bangor, ME 04402-2097	CLIENT: City of Bangor	SHEET OF HOLE NO. B7
DRILLER: NE Boring Contractors	PROJECT NAME: Retaining Wall	LINE & STATION: North of Building, Top of Wall
JOB NUMBER:	LOCATION: Park St. Bangor, ME	OFFSET: 1' North of B6

GROUNDWATER OBSERVATONS		CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
None	TYPE				5/11/15	5/11/15
	SIZE I.D.				SURFACE ELEV:	
	HAMMER WT.					
	HAMMER FALL					

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading	DEPTH	STRATUM DESCRIPTION
												Refusal at 3.8'
												Drilled to 4.3'
												Assumed Ledge
												End B7

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

REMARKS:

HOLE NO. B7

Fessenden GeoEnvironmental Serv.
P.O. Box 2097
Bangor, ME 04402-2097

CLIENT: City of Bangor

SHEET 1 OF 1
HOLE NO. B8

DRILLER: NE Boring Contractors
PROJECT NAME: Retaining Wall
LINE & STATION: East Side of Building
JOB NUMBER:
LOCATION: Park St. Bangor, ME
OFFSET: Bottom of Wall

GROUNDWATER OBSERVATONS: None

	CASING	SAMPLER	CORE BARREL	Start Date	Finish Date
TYPE		D		5/11/15	5/11/15
SIZE I.D.		1 3/8"			
HAMMER WT.		140 lbs		SURFACE ELEV:	
HAMMER FALL		30"			

CASING BLOWS PER FOOT	SAMPLE NO.	O.D.	PEN.	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER 0-6	6-12	12-18	18-24	Vane Reading
	B8S1	2"								

DEPTH	STRATUM DESCRIPTION
0.5'	Augered / Concrete
1.7'	Top 1": gravel Rest: Broken Stone
	2.4' Drilled through Uniform Rock to 2.4' Assumed Ledge
	End B8

SAMPLES
D = SPLIT SPOON
C = 2" SHELBY TUBE
S = 3" SHELBY TUBE
U = 3 1/2" SHELBY TUBE
R = ROCK CORE
V = VANE TEST

SOIL CLASSIFIED BY:
XX DRILLER-VISUALLY
✓ SOIL TECHNICIAN-VISUALLY
LABORATORY TESTS

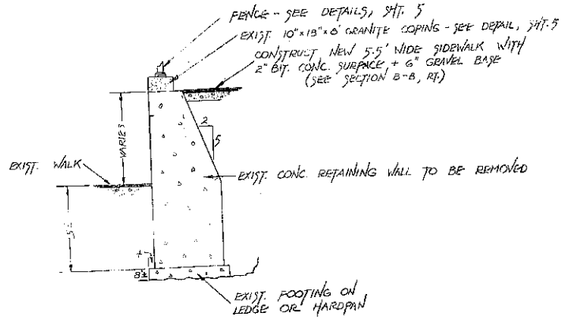
REMARKS:

HOLE NO. B8

Appendix D

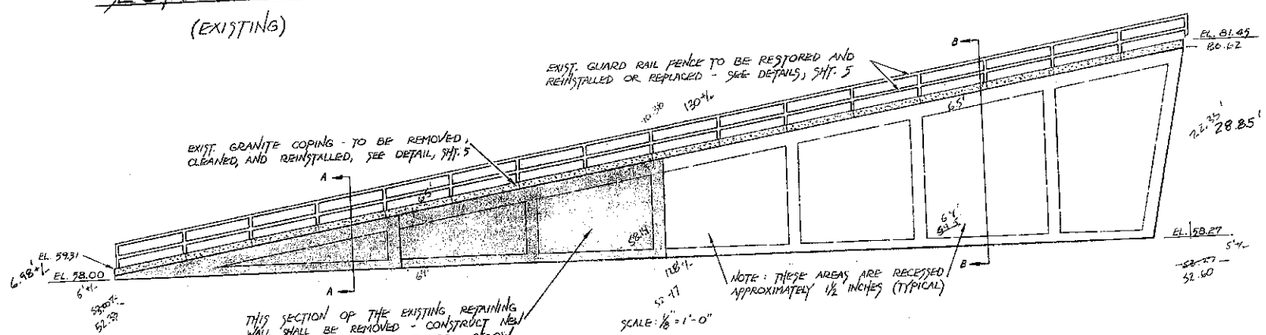
Plans

(Plan B-55/sheet 2/5 & Plan B-55/sheet 3/5)



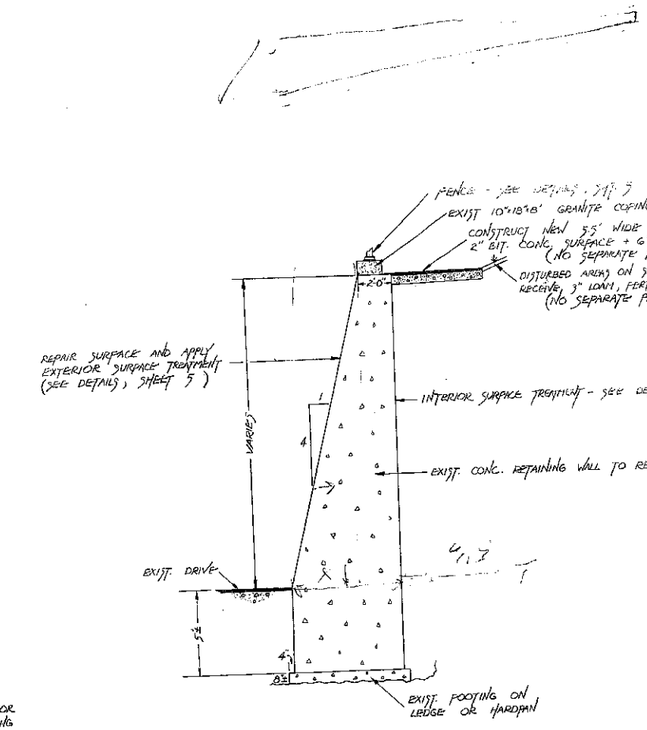
SCALE: 1/4" = 1'-0"

SECTION A-A
(EXISTING)



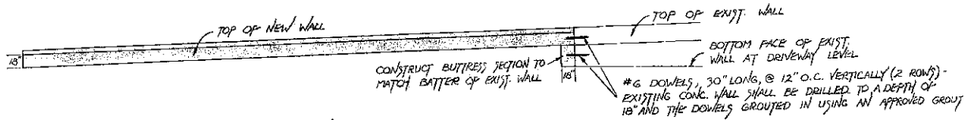
SCALE: 1/8" = 1'-0"

(EXISTING)
ELEVATION

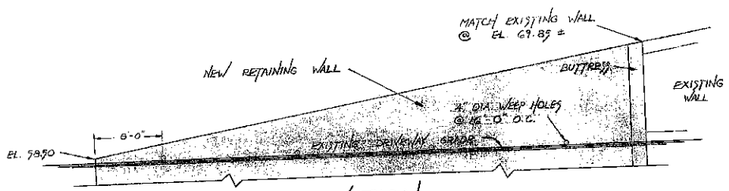


SCALE: 1/4" = 1'-0"

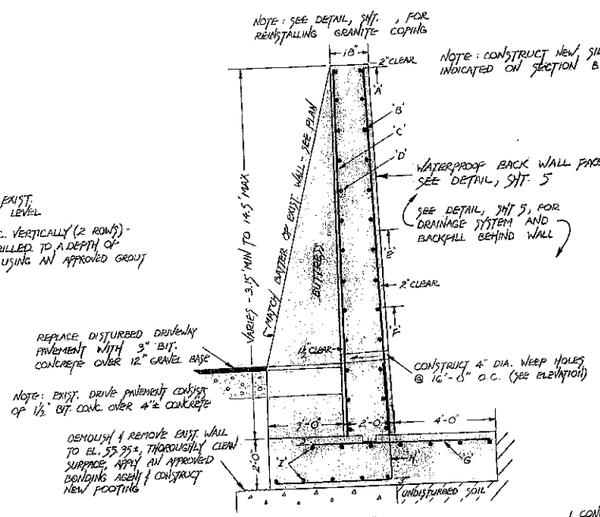
SECTION B-B
(EXISTING)



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



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



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

SECTION

NEW WALL SECTION REINFORCING STEEL SCHEDULE					
MARK	SIZE	SPACING	LENGTH	SHAPE	LOCATION
'A'	#5	15" O.C.	14'-4"	STRAIGHT	BACK OF WALL - VERTICAL
'B'	#4	14" O.C.	CONTINUOUS - PIECES CUT TO FIT WALL TAPER	STRAIGHT	BACK OF WALL - HORIZONTAL
'C'	#4	18" O.C.	14'-4"	STRAIGHT	FRONT OF WALL - VERTICAL
'D'	#5	14" O.C.	CONTINUOUS - FIELD CUT TO FIT WALL TAPER	STRAIGHT	FRONT OF WALL - HORIZONTAL
'E'	#6	15" O.C.	8'-0"	STRAIGHT	BACK OF WALL - VERTICAL
'F'	#6	15" O.C.	5'-0"	STRAIGHT	BACK OF WALL - VERTICAL
'G'	#8	10" O.C.	7'-0"	STRAIGHT	TOP OF FOOTING
'H'	#6	5" O.C.	9'-0"	BENT	BOTTOM OF FTG. & BACK OF WALL
'I'	#4	14" O.C.	CONTINUOUS	STRAIGHT	TOP & BOTTOM OF FOOTING

NOTES

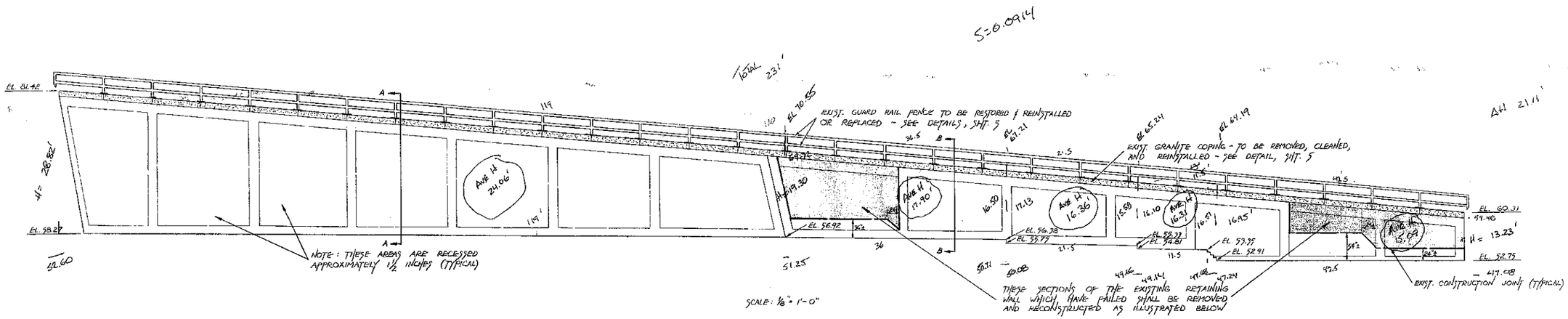
1. CONCRETE FOR THE NEW SECTION OF THE RETAINING WALL SHALL HAVE A 28 DAY COMPRESSIVE STRENGTH OF 4,000 P.S.I. MINIMUM.
2. REINFORCING STEEL SHALL HAVE A MINIMUM YIELD STRENGTH OF 50 K.S.I..
3. ALTERNATE VERTICAL BARS IN THE BACK OF THE WALL AS FOLLOWS: 'A', 'F', 'E', 'A' ETC..
4. ALL BARS, VERTICAL AND HORIZONTAL, IN THE WALL, SHALL BE FIELD CUT TO PROVIDE 2" CLEARANCE FROM THE TOP OF THE WALL.

CITY OF BANGOR
ENGINEERING DEPARTMENT

RETAINING WALL REPAIR AT BANGOR CITY HALL NORTH WALL

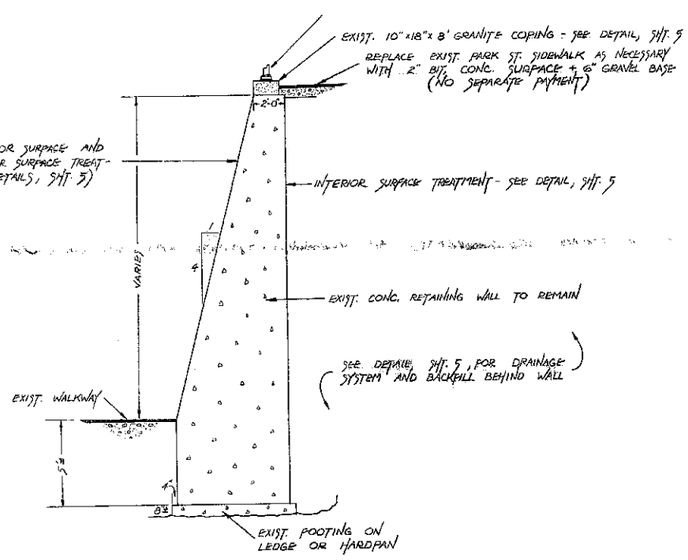
DRAWN BY J. D. RING	APPROVED CITY ENGINEER
CHECKED BY	SHEET 2 OF 5 SHEETS
SCALE AS NOTED	
DATE APRIL 5, 1978	PLAN NO. B-55

NEW SECTION OF RETAINING WALL



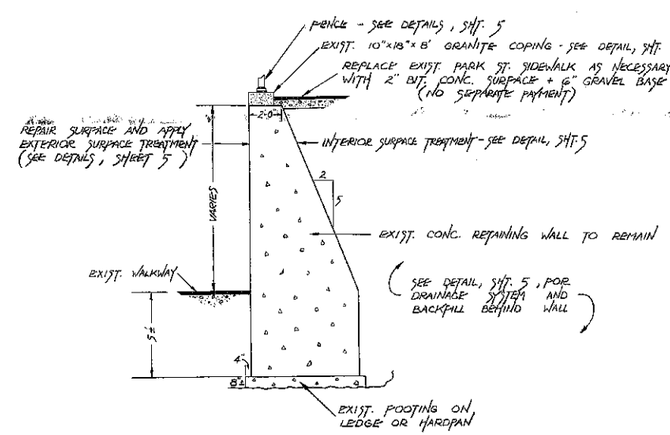
SCALE: 1/8" = 1'-0"

ELEVATION



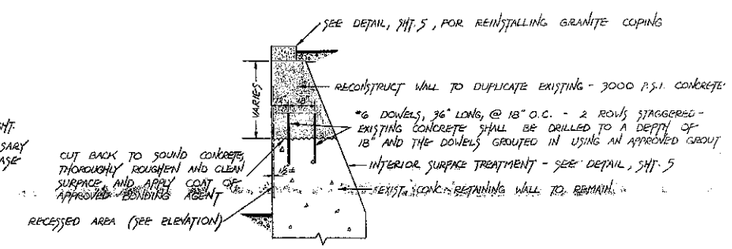
SCALE: 1/4" = 1'-0"

SECTION A-A



SCALE: 1/4" = 1'-0"

SECTION B-B



SCALE: 1/4" = 1'-0"

RETAINING WALL REPLACEMENT DETAIL

CITY OF BANGOR
ENGINEERING DEPARTMENT

RETAINING WALL REPAIR AT BANGOR CITY HALL EAST WALL

DRAWN BY J. P. RING	APPROVED CITY ENGINEER
CHECKED BY	SHEET 3 OF 5 SHEETS
SCALE AS NOTED	PLAN NO. B-55
DATE APRIL 5, 1978	

Appendix E

About the Design-Build Method

INFORMATION ABOUT THE DESIGN-BUILD APPROACH

In conventional construction, there are three phases: design, bidding process and selection of contractor. In the D-B process, the owner identifies what it wants to be constructed, accepts proposals and selects a D-B team to assume the risk and responsibility for the design and construction phases. With D-B, the owner generally has the option of selecting a D-B team based on a best-value basis, allowing the owner to consider other factors beyond lowest price. The selection process under design-build contracting can be in the form of a negotiated process involving one or more contracts, or a competitive process based on some combination of price, duration, and proposer qualifications. Portions of the overall design or construction work can be performed by the design-build entity or subcontracted out to other companies that may or may not be part of the design-build team.

The D-B method accelerates project delivery, or shortens the project duration, in several ways. The contractor has flexibility in selecting: the design team that will design the project, materials and construction methods based on the available equipment, work force and resources. The contractor also works closely with the designer, sharing his or her expertise, to reduce the risk of design errors and the need for redesigns, which can add to project costs and project delays. Allowing the contractor to tailor the project design and apply appropriate innovations provides flexibility for the contractor to manage and compensate for cost increases in one area through efficiencies in another. This does not include changes to environmental commitments, but control of the means and methods. But there are also certain disadvantages: With design-build, the owner will lose some control of the design process. While some design elements may be specified, typically the contractor is given flexibility in design. Contract management is more challenging as well. Contract administration overall requires more collaboration; absence of effective collaboration may create problems.