STRUCTURE EVALUATION REPORT

Southborough Rural Cemetery

Retaining Wall Evaluation

PREPARED FOR

Town of Southborough
17 Common Street
Southborough, MA, 01772
508.485.0710

PREPARED BY

101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

February 2021

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1

Project Description

The Town of Southborough has concerns related to the condition of the existing retaining wall in the southwest corner of the Southborough Rural Cemetery. The Town has received complaints from residents that the wall appears to be leaning and could potentially collapse. VHB were engaged by the town to evaluate the condition of the existing wall and recommend measures to correct any deficiencies and mitigate against the reoccurrence of similar issues in the future.

Existing Structure

A plan of the existing retaining wall is attached as Appendix A.

The wall is approximately 262 ft. long with a maximum retained height of approximately 8 ft 6 in. It comprises three distinct sections. From south to north the wall consists of approximately 70 ft. of stone masonry, 148 ft. of precast concrete, and a second section of stone masonry approximately 44 ft. long. There is also a short return at the north end and a flight of steps in similar stone masonry construction.

There are graves located at the lower level, directly in front of the face of the wall, and at the upper level directly behind the wall.

The two stone masonry sections of wall are of similar construction. The date of construction is unknown, but they are assumed to be the same age. Most of the graves adjacent to the stone wall sections are from the 1980s. The earliest is dated 1974.

The central precast concrete section of wall was constructed in 1982. It is not known whether this replaced an earlier wall.

Stone Masonry Wall Details

The photos below show the north and south stone masonry sections of the wall. The wall faces are of uncoursed rubble masonry construction – large irregular shaped stones with smaller stone infill. Most of the joints between stones contain mortar, although in many places it is highly weathered, and the joints appear open at the surface. It is not clear

whether the stones were bedded on mortar during construction or is of dry construction and was subsequently pointed with mortar.

North Wall

The north wall is approximately 44 ft. long and 8 ft. 6 in. high. The face contains a course of large flat stones running through it, which may be the top level of earlier construction which was subsequently built up to the present height of the wall. This possibility is supported by the fact that the construction above the line is noticeably different from that below. However, this remains speculation as there is no documentary evidence regarding the age and construction history of the masonry sections of wall.

South Wall

The south wall is approximately 70 ft. long and 5 ft. 6 in. high.

Both north and south stone walls exhibit a visible lean, particularly noticeable towards the north end of the south wall and at the north end of the north wall where the wall meets a set of stone steps and cracks in the end of the wall are visible. The lean of the walls is discussed further in Section 2 of this report.

Precast Concrete Wall Details

The photos below show typical panels of the center precast concrete section of the wall. There are 29 panels in total, all identical. Each panel is 5′-1″ long and 8′-6″ high. Fortunately, the town was able to provide from their records, the original accepted bid for the precasting and construction of the wall.

The wall was constructed in Nov 1982 by Chase Precast Corporation of North Brookfield MA for a total price of $7,000. The Chase proposal is attached to this report as Appendix B. It includes three drawings by Chase Precast, a sketch showing the concrete reinforcement and two pages of design calculations by Cullinan Engineering Co. Inc. of Auburn MA. The drawings show that the walls are L-shape in cross-section with a stem that tapers from 10 in. thick at the base to 4½ in. at the top of the wall. The base of the wall is 4′-0″ wide, including a 2′-4″ heel extending into the retained earth behind the wall. The heel slab tapers in thickness from 6 in. to 4 in.

North End of Precast Wall

Intermediate Wall Panel

The dimensions and details shown on the bid drawings were confirmed by measurement as far is what is visible without excavation. The only difference appears to be that there are in fact 29 panels rather than the 32 detailed on the precasters plans. The total length is

therefore somewhat shorter at approximately 148 ft. rather than the 162'-8" shown on the Chase drawings.

Most of the precast concrete panels exhibit significant cracking and spalling, particularly at the ribs. The deterioration of the concrete is discussed further in Section 2 of this report – Condition Evaluation.

Scope of Investigation

VHB performed the following tasks within the scope of this investigation:

- Performed a field survey and wetlands delineation of the site of the wall. This survey is attached as Appendix C.
- Reviewed existing documentation provided by the Town. This consisted of the original proposal and drawings for the precast concrete wall by Chase Precast. No information regarding the stone walls was available.
- Visited the site on two occasions, taking photos, confirming dimensions and performing a verticality survey of the existing stone walls.
- Analyzed the verticality survey results, preparing charts of the results. These show the current condition and may be used as baseline data for future monitoring.
- Performed calculations to determine the strength of the precast wall and evaluate the walls safety in its current condition.
- Evaluated viable concepts for repair or replacement of each section of wall and provided conceptual construction cost estimates for comparison purposes.

Recommendations for future monitoring, repair and/or reconstruction are provided at the end of this report.

2

Condition Evaluation

The condition of the stone wall sections was reviewed by visual inspection. The lean of the walls was measured and recorded, and the risk of collapse assessed. No subsurface investigation was carried out therefore the thickness and depth of the wall can only be guessed at. The concrete wall was also inspected and a panel by panel review of condition made, including a comprehensive photo record.

Wall Condition and Potential for Failure

Stone Masonry Walls

The most obvious sign of movement of the stone masonry walls is at the north end of the north wall where cracks are visible at the end of the wall adjacent to the stone steps. The south wall is also clearly leaning, particularly towards the north end.

North End of North Wall

North End of South Wall

In order to provide an objective measure of the lean of the walls, measurements were taken using a plumb line at approximately 6 ft. intervals along the length of each wall. The results of this verticality survey are plotted in Figure 1 below.

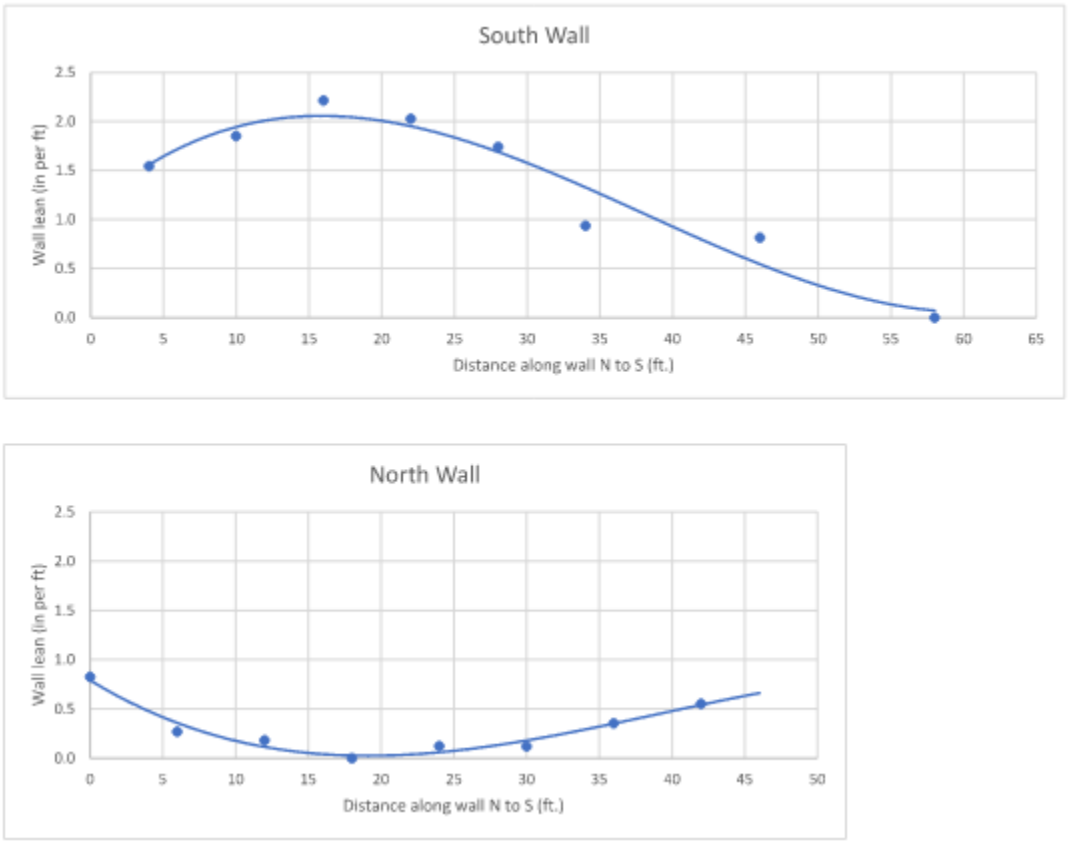
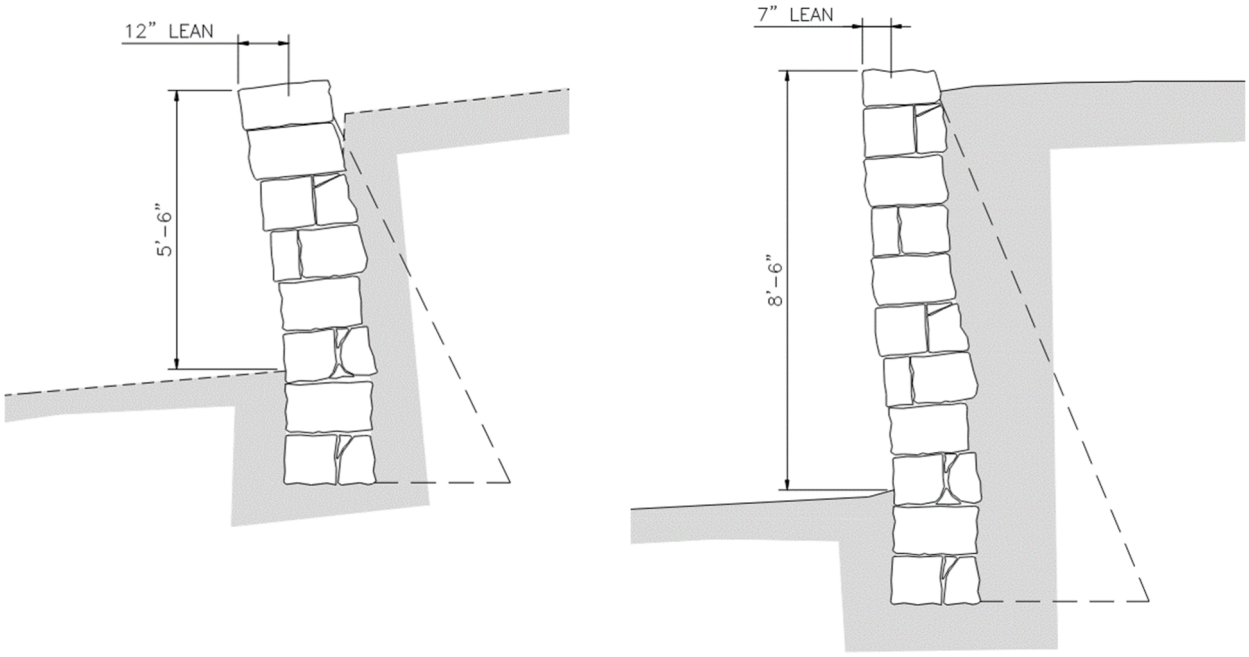


Figure 1 Verticality Survey

Looking first at the south wall, the survey shows the lean of the wall varies from zero at the south end to a maximum of approximately 2 in/ft (2 in 12) towards the north end of the wall.

The north wall is also leaning but to a lesser degree. It can be seen from Figure 1 that this wall has a lean at each end but is vertical in the center. The maximum lean is approximately 1 in/ft (1 in 12).

The maximum lean of each wall is shown in the sketches of Figures 2. The dashed outline behind each wall indicates where the back of the wall may be. Typically, walls of this type have a sloping back and are significantly thicker at the base than at the top. This helps the wall remain stable under the lateral pressure of earth and water behind. However, without construction records or excavating a trial pit behind the wall, the profile is not known and can only be guessed at.



South Wall *North Wall*

Figure 2 Existing Wall Cross-sections

Wall Stability and Potential Causes of Failure

Stone masonry walls such as these are gravity retaining walls. As the name suggests, they rely on gravity and the weight of the wall material acting downward to resist the lateral forces trying to push the wall over. These lateral forces include the pressure of the retained earth behind the wall, water pressure when this retained material becomes saturated, and also the pressure of any surcharge – materials stacked above the wall, vehicles or crowds of people. In this case there is typically little or no surcharge, so the primary loads acting on the wall are the backfill material and any water pressure that may build up.

The most likely causes for the leaning that is visible in the cemetery walls are as follows:

1. It's possible that the wall construction is narrower than is necessary to maintain stability. A gravity wall typically has a sloped back and is much thicker at the base than the top (see the standard wall design in Section 3). This creates the weight needed for stability and ensures that weight acts towards the back of the wall, resisting overturning.

2. Poor drainage may also be a primary cause of the wall movement or at least a contributing factor. Water pressure, if allowed to build up, dramatically increases the lateral pressure on the wall. Typically, this buildup of water pressure is mitigated by backfilling directly behind the wall with free-draining granular material – crushed stone or well graded aggregate, something with minimal silt or clay. This is used in

combination with either a perforated drain pipe laid the full length of the wall, carrying excess water away at the ends, or weep holes through the wall at intervals, allowing the water to drain away through the front face.

The thickness of the wall and the profile of the back face could be determined by excavating a trial pit behind the wall. This would also determine how deep the wall extends below the lower ground surface.

The walls do not appear to have any weep holes. The nature of the backfill material and whether there is a drain behind the wall could be investigated by trial pit. The concrete wall panels do have weep holes and several of these had a quantity of sand and silt which had washed out from behind the wall. This is evidence that the backfill material may contain a significant quantity of fines and not be free draining.

Without knowing the properties of the backfill material and the profile of the back face of the walls, it is not possible to determine the stability of the walls by calculation. The walls do have a visible and measurable lean and without mitigation measures it is expected that there will be continued movement. Experience with other walls of this type has shown that movement tends to continue slowly, and that sudden failure is unlikely to occur. However, it is recommended that measures to stabilize the wall be put in place sooner rather than later and that in the meantime, the lean of the wall should be monitored at regular intervals.

Precast Concrete Walls

The concrete walls show no signs of instability, either in terms of leaning of the wall stem or uplift of the base. However, there is considerable cracking of the panel faces and in particular at the vertical thickening ribs. In many cases this cracking is severe - concrete has spalled and the reinforcing bars have been exposed. Typical examples are shown in the photos below.

Typical Cracked Rib at Panel Joint

Typical Cracked Center Rib

The cracking of these thickening ribs does not appear to be structural in nature. It is likely that the cracking is caused by a combination of factors:

- The as-cast durability of the concrete may be less than that of a modern precast component and has probably deteriorated over its 40-year life.
- The repeated action of freeze-thaw on the relatively thin ribs may have contributed to the deterioration of the concrete and initiated cracking.
- The reinforcing bars in the ribs that have failed are often very close to the surface. Adequate concrete cover to the reinforcing bars is probably the most important factor in a long-lasting concrete element.

Twenty-one out of the twenty-nine wall panels exhibit some visible cracking of the vertical ribs. In many cases this cracking is extensive with large cracks or spalls. However, preliminary calculations indicate that the walls have sufficient strength. The damage is therefore mostly cosmetic at this stage, although if allowed to progress, sooner or later panels will begin to fail.

3

Repair Options

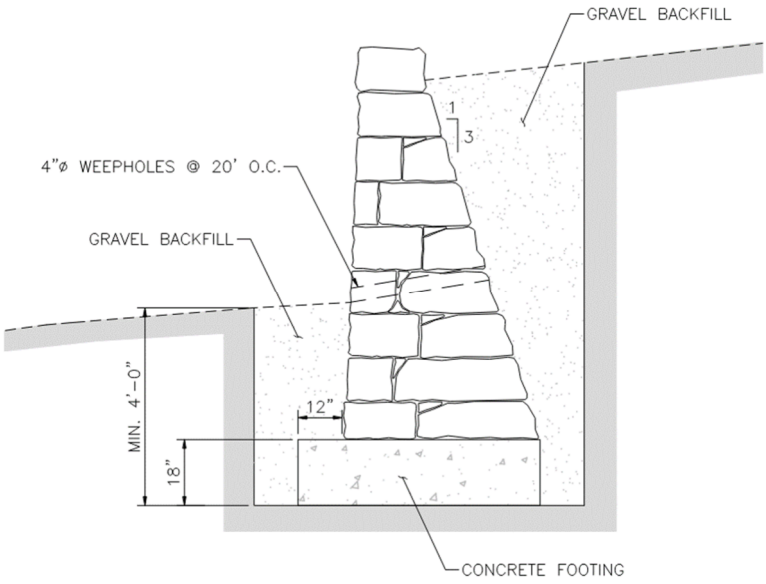
The stone masonry wall could be taken down and rebuilt. The precast concrete wall panels could be repaired or replaced. Alternatively, the whole length of wall could be removed and replaced with new.

Stone Masonry Walls

Take down and Re-build

Seemingly the simplest option for the stone masonry wall is to take down the wall, or at least those parts that are leaning, and rebuild using the same stone, supplementing where necessary with new. There are however still some significant unknowns with these walls.

It is not known how thick the walls are and whether the back faces have an adequate batter. It is also not known whether the walls have free draining backfill. Either of these items could be contributory factors in the leaning of the walls and not correcting them would simply lead to similar problems in the future.



Typical Stone Masonry Wall to MassDOT Standards

The re-built walls would need to have a stable cross-section, possibly requiring a significant amount of new material. They would also require free-draining gravel backfill and adequate drainage weepholes. The cross-section of a typical stone masonry wall following MassDOT standards is shown above.

The estimated cost of rebuilding both the north and south wall sections in stone is $75,000.

Replace with Modular Block Wall

Given the extent of the wall that would need to be taken down and replaced and the additional excavation and materials that may be needed, it may be a better option to replace the stone walls in their entirety with a new modular block wall. There are many proprietary modular block walls with a wide variety of finishes. However, they all rely on the same basic form, using interlocking precast blocks. They have proved to be economical and long-lasting solution for retaining walls of the height required here. The cost would be approximately $85,000.

Precast Concrete Wall

Repair Option

The wall panels have suffered significant deterioration, particularly to the vertical ribs which in many cases require removal in part or entirely and re-casting. This will be a slow and costly process. There are also other smaller spalls and cracks in need of repair. Work of this type is notoriously difficult to estimate, but for comparison purposes, the cost is estimated to be in the region of $90,000. It should be recognized that even if all the current cracking is repaired, the wall remains in a deteriorated state and further cracking and spalling is likely to develop over the next few years.

Replace with New Concrete Wall

The wall could be replaced with a similar precast concrete cantilever wall. This could perhaps be done panel by panel, reducing the need for temporary support of the retained earth if the whole existing wall were removed prior to replacement. Cost of a new concrete wall is estimated to be approximately $205,000.

Replace with Modular Block Wall

The concrete panel wall could be replaced with a new modular block wall similar to the option for the stone walls. This would be more economical than a new concrete cantilever wall, with a cost estimate of approximately $140,000.

4

Recommendations

Neither the stone masonry wall nor the precast concrete panels are considered at risk of sudden failure. However, the stone wall is expected to continue moving and the concrete will continue to deteriorate. Replacement should be planned for, and in the short-term, the lean of the masonry walls should be monitored.

Movement Monitoring

As shown in Section 2 of this report, a verticality survey was carried out, measuring the variation in the lean of the stone walls along their length. It is recommended that similar surveys be carried out at regular intervals (say 6 months) and compared with previous results in order to monitor the rate of movement of the wall.

Reconstruction

Re-building of the stone masonry walls in kind may require a significant amount of additional material and backfill. If work of this extent were being carried out, it is recommended that instead the wall be replaced with a new modular block wall of a design and finish chosen by the town to be sympathetic to the surrounding landscape of the cemetery.

Repairing the concrete wall will be difficult and costly and even if all currently visible cracks and spalls are repaired, this will still be a 40-year-old wall which will soon be subject to further deterioration and cracking. Replacement is the recommended option.

Using a suitable modular block wall, it is recommended that the whole wall, both stone and concrete sections, be replaced. The cost of reconstruction is estimated to be approximately $225,000.

Note regarding Cost Estimates

It should be noted that although cost estimates given in this report include materials and labor for the repair, demolition, construction and backfilling of walls, they are preliminary in nature and are for comparison purposes only. They do not include any engineering or design costs nor do they include mobilization or other ancillary costs associated with a construction contract.

A

Retaining Wall Plan

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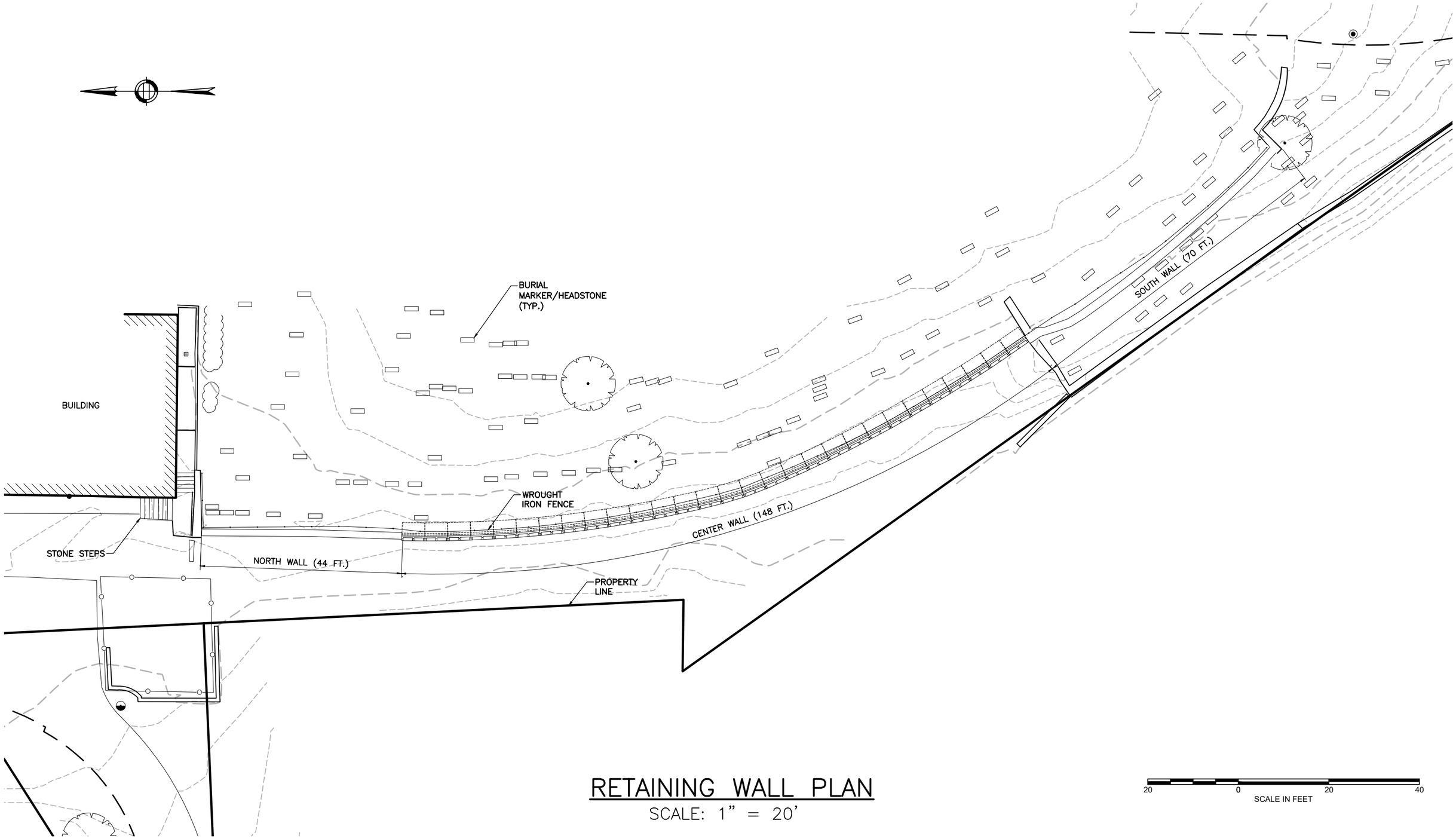

RETAINING WALL PLAN

SCALE: 1" = 20'

20 0 20 40
SCALE IN FEET

RETAINING WALL PLAN
SOUTHBOROUGH RURAL CEMETERY
SOUTHBOROUGH MA

12/9/2020
REV 0

B

Precast Wall Original Documents

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OFFICE OF

The Cemetery Commissioners

SOUTHBOROUGH, MASSACHUSETTS

November 1,1982

Chase Precast Corporation
East Brookfield Road
North Brookfield,Ma.01536

Gentlemen:

The Board of Cemetery Commissioners of the Town of Southborough is pleased to inform you that your bid of$7,000.00 for construction of a retaining wall as described in your specifications of October 28,1982 has been accepted.

Sincerely yours,

Fred J.Quinn, Chairman

Fred J. Quinn

OFFICE OF

The Cemetery Commissioners

SOUTHBOROUGH, MASSACHUSETTS

Town of Southborough Board of Cemetery Commissioners precast retaining wall.

It is the intent of this proposal to provide the Town of Southborough Cemetery Commissioners with approximately 160 linear feet of precast retaining wall. Complete in place.

Said wall shall be approximately 8'6" in height and shall be adequately designed to retain embankments existing on the site.

The contractor shall thoroughly appraise himself of all conditions existing at the site. Site inspections can be arranged with the Cemetery Superintendent Monday thru Friday 8:00 A.M. to 4:00 P.M.

As part of this proposal it shall be the responsibility of the contractor to supply the Cemetery Commissioners with long hand design calculations, erection plans and shop drawings pertaining to this project.

The contractor shall state an approximate date of commencement after the awarding of the contract and elapsed time until completion.

OFFICE OF

The Cemetery Commissioners

SOUTHBOROUGH, MASSACHUSETTS

The undersigned as contractor hereby agrees to provide the Town of Southborough Cemetery Commissioners with a precast retaining wall erected in place as herein specified for the sum of

Forty-Three---------- dollars

seventy-five---------- cents PER LINEAR FOOT

COMPANY: Chase Precast Corp.

ADDRESS: P.O. Box 484, East Brookfield Road

North Brookfield, MA 01535

By: Tom Long

Title: Sales

DATE: October 26, 1982

MEMBER

CHASE PRECAST CORP.

EAST BROOKFIELD ROAD — P.O. BOX 484 — NORTH BROOKFIELD, MASS. 01535

TELEPHONE (617) 867-8312 (617) 885-4531

October 26, 1982

Mr. Leo Bertonazzi, Superintendent
Town of Southborough
Cemetery Commissioners
Southborough, MA 01772

Re: 8'6" Retaining Wall
Location: Southborough Rural Cemetery

Enclosure #1: Bid Form
Enclosure #2: Long-hand design calculations
Enclosure #3: Chase Precast Drawings SC1, SC2, SC3
Enclosure #4: Proposal

Dear Commissioners:

Enclosures 1 through #4 are forwarded for your imformation and action. As indicated on enclosure #1, Chase Precast will provide 8'6" retaining wall at $43.75 per lineal foot, approximately 160 lineal feet. Above quoted price includes delivery and installation on your prepared site.

Upon notification of award, Chase Precast will require fifteen (15) working days for fabrication of wall and two (2) working days for installation. Notification on November 1, 1982, will give expected completion date of November 23, 1982.

Thank you for the opportunity to quote.

Sincerely,

Tom Long
Sales

TL:jm
Enclosures

Proposal

(Specifications and Estimate)

Proposal No._____

CHASE PRECAST CORPORATION

EAST BROOKFIELD ROAD–NORTH BROOKFIELD, MASS. 01535

TELEPHONES: (617)867–8312 (617)885–4531

PROPOSAL SUBMITTED TO	PHONE	DATE
Town of Southborough Cemetery Commissioners		10-28-82
STREET	**JOB NAME**	
Mr. Leo Bertonazzi, Superintendent	8'6" Retaining Wall	
CITY, STATE AND ZIP CODE	**JOB LOCATION**	
Southboro, MA 01772	Southborough Rural Cemetery	
ARCHITECT / **DATE OF PLANS**		**JOB PHONE**

We hereby propose to furnish materials and labor necessary for the completion of:

ITEM:	QUANTITY:	PRICE:
8'6" Retaining Wall	160 Lineal Feet @ $43.75 per L.F.	$7,000.00

Price per lineal foot will remain firm on 160 lineal feet ± 10% footage.

Delivery date: On or before November 23, 1982.

We Propose hereby to furnish material and labor – complete in accordance with above specifications, for the sum of:

_____dollars ($_____)

Payment to be made as follows:

Net 30 days

CONDITIONS: The prices and terms on this quotation are not subject to verbal changes or other agreements unless approved in writing by the Home Office of the Seller. All quotations and agreements are contingent upon strikes, accidents, fires, availability of materials and all other causes beyond our control. Prices are based on costs and conditions existing on date of quotation and are subject to change by the Seller before final acceptance.

Typographical and stenographic errors subject to correction. Purchaser assumes liability for patent and copyright infringement when goods are made to Purchaser's specifications. When quotation specifies material to be furnished by the purchaser, ample allowance must be made for reasonable delivery of raw materials which must be of suitable quality to facilitate efficient production.

Conditions not specifically stated herein shall be governed by established trade customs. Terms inconsistent with those stated herein which may appear on Purchaser's formal order will not be binding on the Seller.

Final acceptance by Buyer shall be deemed to have taken place upon any of the following events: (a) fourteen (14) days after delivery by Seller; (b) incorporation by Seller of articles described hereunder into construction project; (c) failure to give written notice to Seller within seven (7) days of date when Buyer knew or should have known of any defect.

In the event payment is not made within 30 days, interest charges of 1½% on balances under $500 and 1% over $500 will be assessed; annual rates of 12% and 18%.

In the event that it becomes necessary for Seller to employ legal counsel in order to enforce its rights hereunder, Buyer agrees that it will be responsible for Seller's reasonable attorney fees and expenses.

Authorized Signature Tom Long

Tom Long

Note: This proposal may be withdrawn by us if not accepted within_____days.

Acceptance of Proposal – The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified. Payment will be made as outlined above.

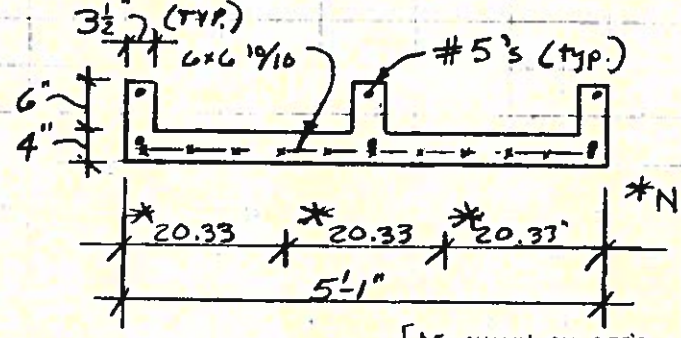
Signature_____

Date of Acceptance: _____

Signature_____

Flexural Strength of Retaining Walls

8' Wall Provided by Chase Precast



$b = \frac{3.5''}{1in^2}$ $d = \frac{8.5''}{1in^2}$ [AS SHOWN ON ATT'D. CALC. & AS ALLOWED BY A.C.I.]

$A_s = 0.31'' + 0.042'' = 0.352\ in^2$
(3-10 GAGE WIRES @ 0.014 in² EA) ℄ 1 #5

* $\rho = \frac{A_s}{bd} = \frac{0.352}{3.5 \times 8.5} = 0.012$

$f_c' = 5000\ psi$ - $f_y = 60{,}000\ psi$

* $K_u = \phi f_c' \left(\rho \frac{f_y}{f_c'}\right)\left[1 - .59\left(\rho \frac{f_y}{f_c'}\right)\right]$

$= .90 \times 5000 (.144)[1 - .59(.144)]$

$= 593$

* $F = \frac{bd^2}{12000} = \frac{3.5''(8.5)^2}{12000} = 0.0211$

* $M_u = F K_u = .0211 \times 593 = 12.5^{1K}$ (FOR 20.33" WIDTH)

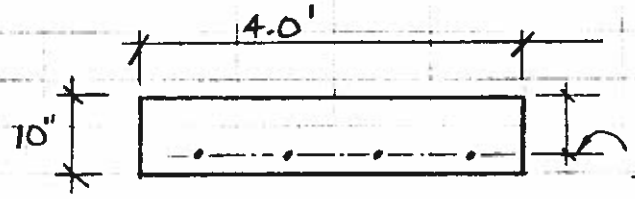
$= \frac{12.5^{1K}\ 12''/1}{20.33''} = \underline{7.38^{1K}/ft \text{ OF WIDTH}}$

*NOTE: SINCE AT THE BASE, DEFLECTION OF EACH WEB = 0, ∴ BY THE LAW OF COMPATIBILITY, THE STRESSES WILL DISTRIBUTE THEMSELVES EVENLY. — THIS IS ANALOGOUS TO THE CASE DESCRIBED IN PARAGRAPH 13.3.4.1 OF ACI 318-71: I.E. "*Where the exterior support (OF A TWO-WAY SLAB) consists of a wall extending for a distance equal to or greater than three quarters of l_2 (LENGTH OF SLAB TRANSVERSE TO THE SPAN), "the exterior negative moment shall be considered to be uniformly distributed.*"

* [REFERENCE: AMERICAN CONCRETE INSTITUTE SP-17(73)
AND AMERICAN CONCRETE INSTITUTE 318-71]

FLEXURAL STRENGTH

8' WALL SHOWN ON CONTRACT DRAWINGS:



$d = 10" - (2" + \frac{.625}{2}) = 7.69$

$b = 12"$ $\quad d = 7.69"$

$F = \frac{bd^2}{12000} = .0591$

$A_s = 0.31 \text{ in}^2/\text{ft}$

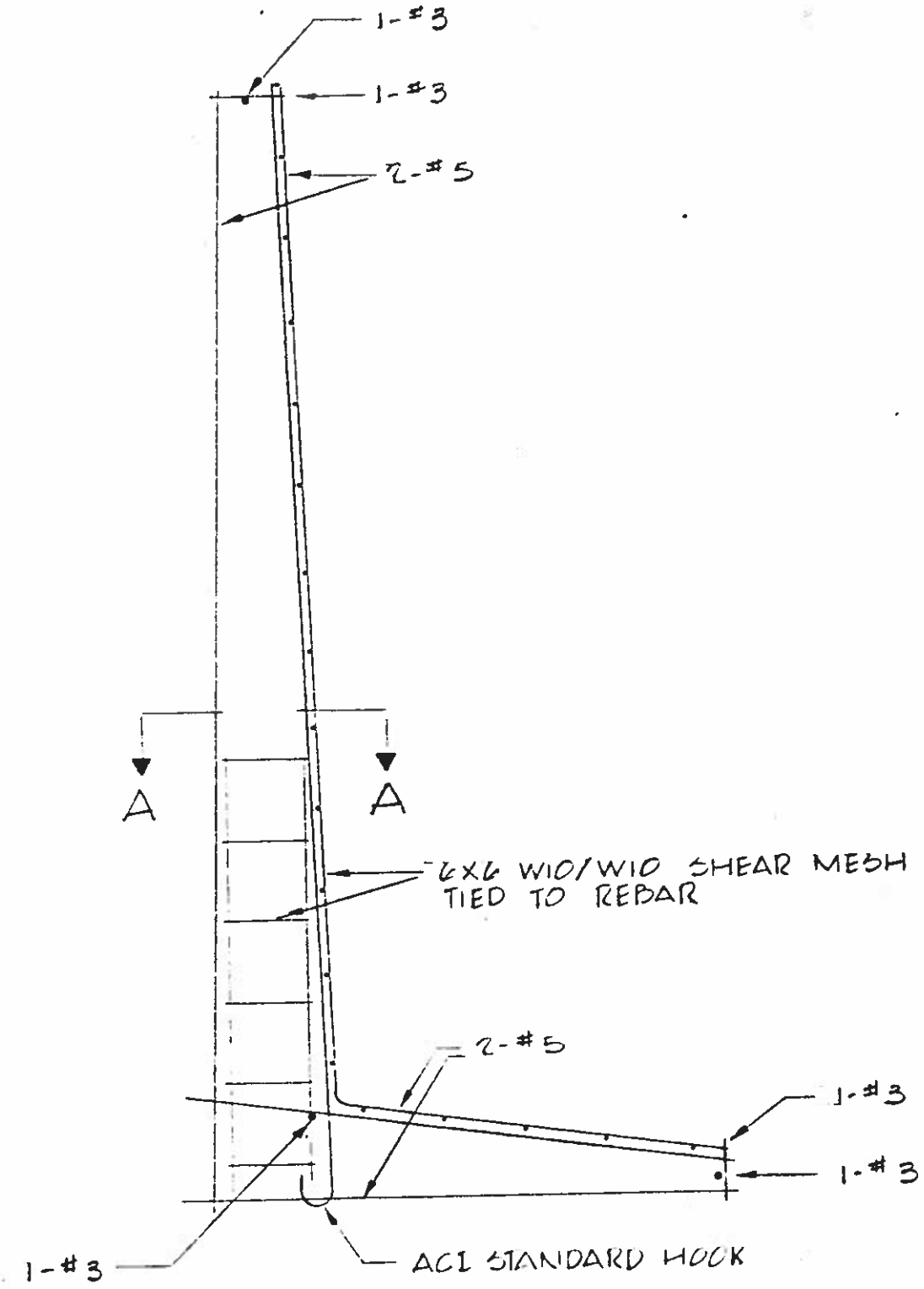
$\rho = \frac{A_s}{b\,d} = \frac{.31}{12" \times 7.69} = 0.0034$

$f'_c = 5000 \text{ psi}$ $\quad f_y = 40{,}000 \text{ psi}$

$K_u = \phi f'_c \left(\rho \frac{f_y}{f'_c}\right)\left[1 - .59\left(\rho \frac{f_y}{f'_c}\right)\right]$

$= .90 \times 5000 \,(0.0272)\left[1 - (.59 \times .0272)\right] = 120$

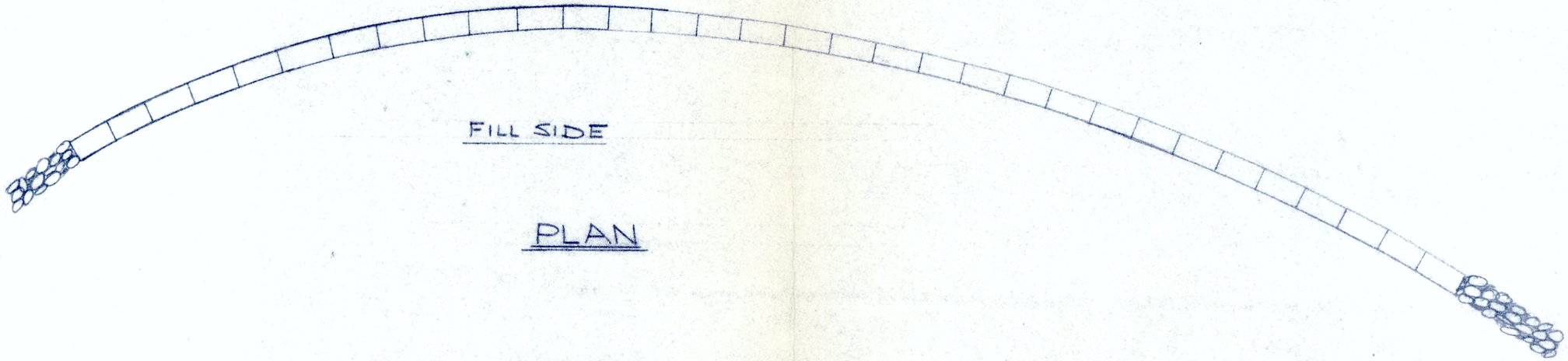
$M_u = FK_u = 0.0591 \times 120 = 7.09 \text{ k/ft of width}$



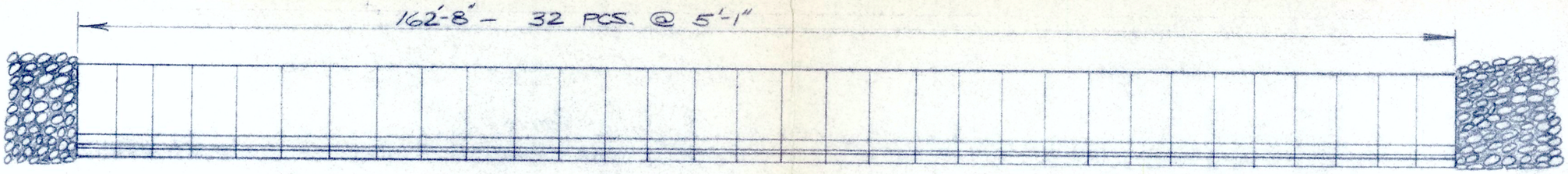
8'-0" SECTION

TYPICAL RIB

NO SCALE

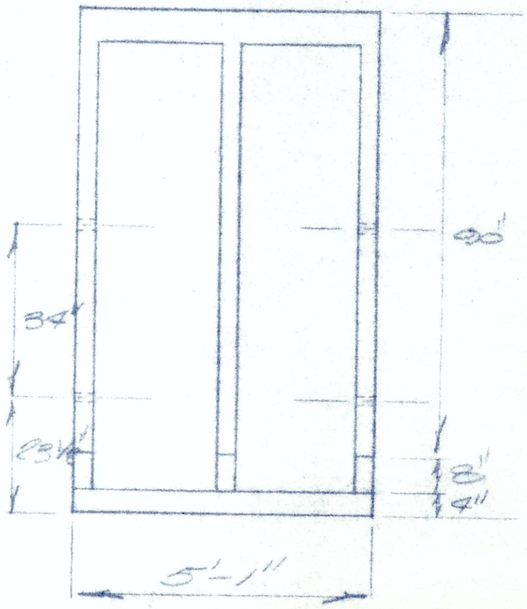


PLAN



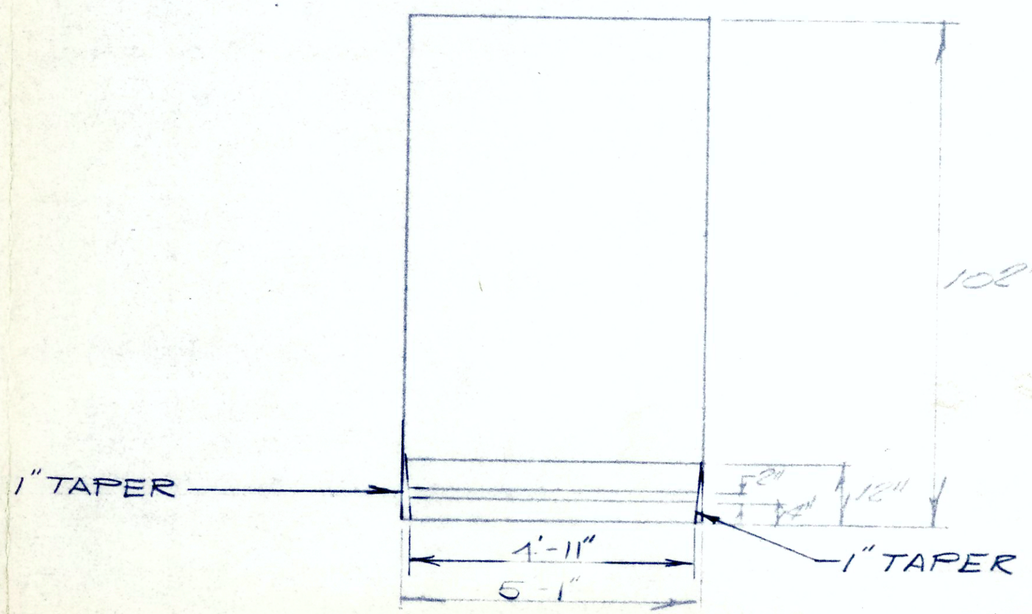
ELEVATION

CHASE PRECAST CORPORATION	
NORTH BROOKFIELD	MA.
ITEM 8'-6" RETAINING WALL	
JOB SOUTHBOROUGH RURAL CEMETERY	
CONTRACTOR	
SCALE NONE	DATE 10-26-82
DWN. M.J.Q.	REV.
DRAWING NO.	SC-3



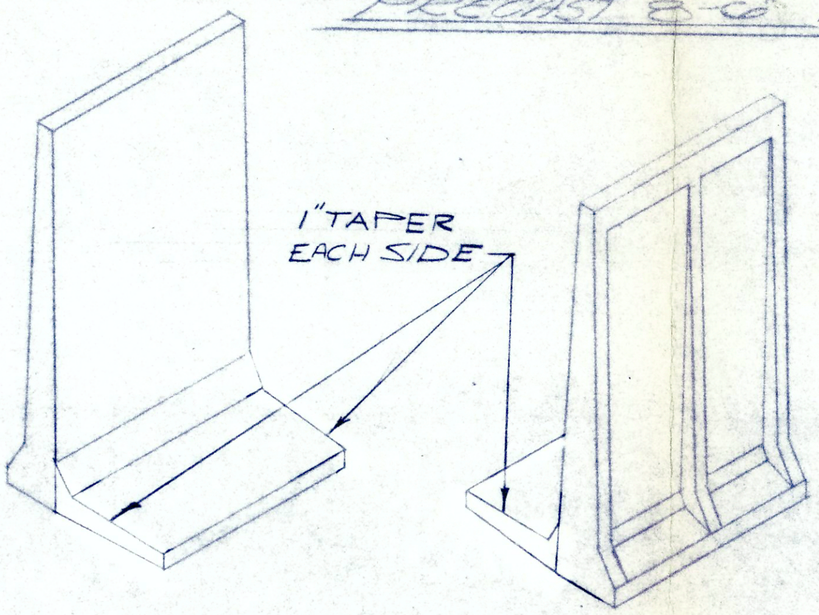
BACK

SIDE



FRONT

PRECAST 8'-6" RET. WALL



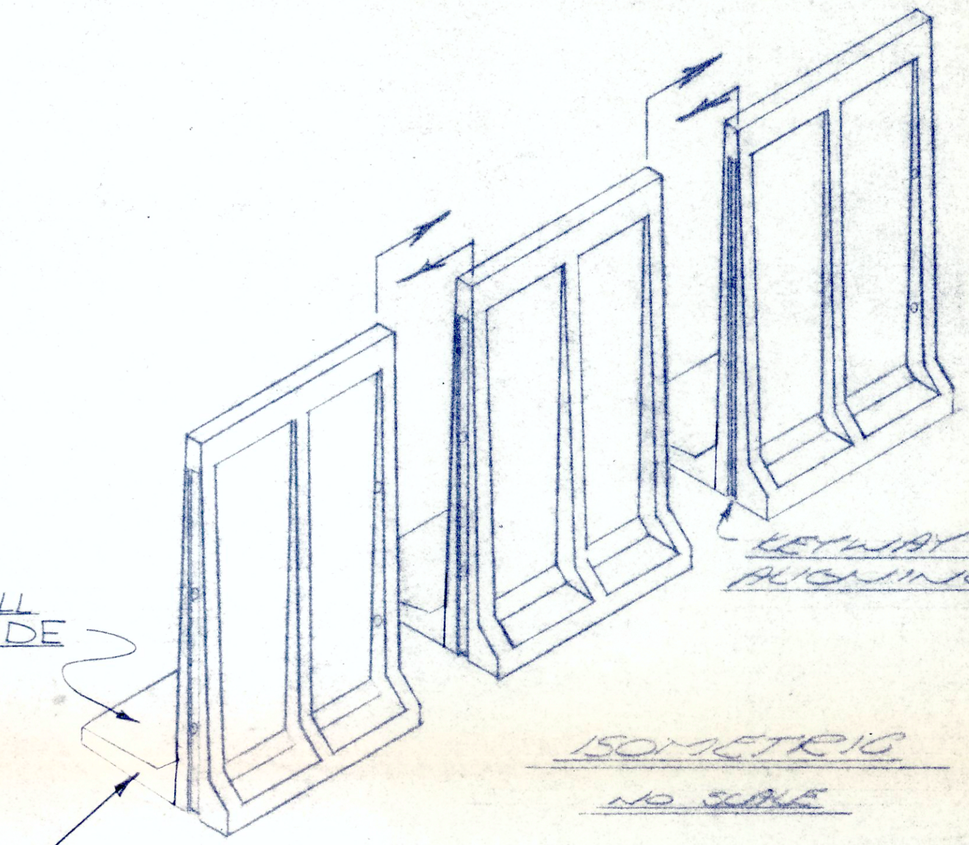
ISOMETRIC
8'-6" RET. WALL

NOTE

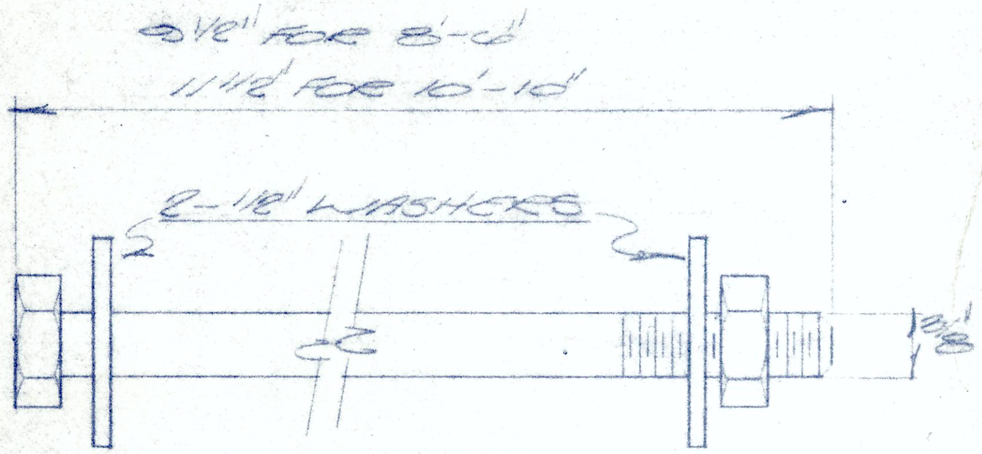
1. CONCRETE MIN. STRENGTH 4000 PSI AT 28 DAYS.
2. REINFORCING ROD TO BE GRADE 60.
3. CALCULATIONS PROVIDED UPON REQUEST.

CHASE PRECAST CORP. NORTH BROOKFIELD MA.	
ITEM: 8'-6" RETAINING WALL	
JOB:	
SCALE: NO	DATE: 6/28
DWN: E.W.	REV: 10-8-82 10-26-82

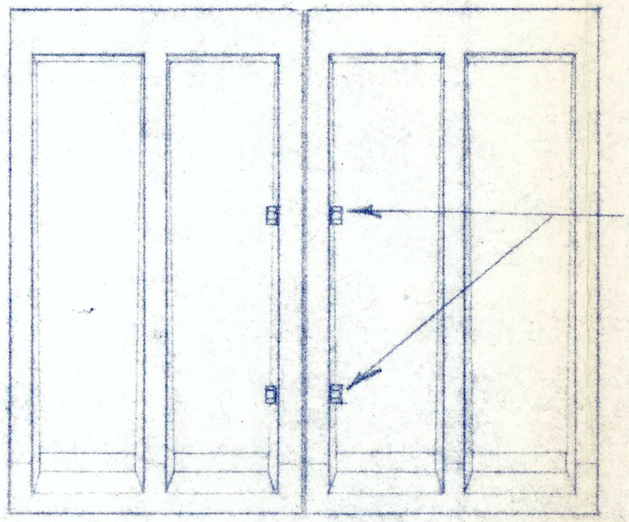
DWG. NO. SC-2



ISOMETRIC
NO SCALE



BOLTS FOR CONNECTING WALL SECTIONS
2 REQ'D.
NO SCALE



REAR ELEVATION

CHASE PRECAST CORP.
NORTH BROOKFIELD MA.
ITEM: CONNECTING DETAIL
JOB:
SCALE: NO
DRAWN: E.M.
DATE: 7-82
REV. 10-8-82
10-26-82
DRAWING SC-1

C

Survey Plan and Wetlands Delineation

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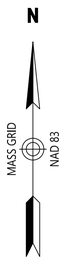

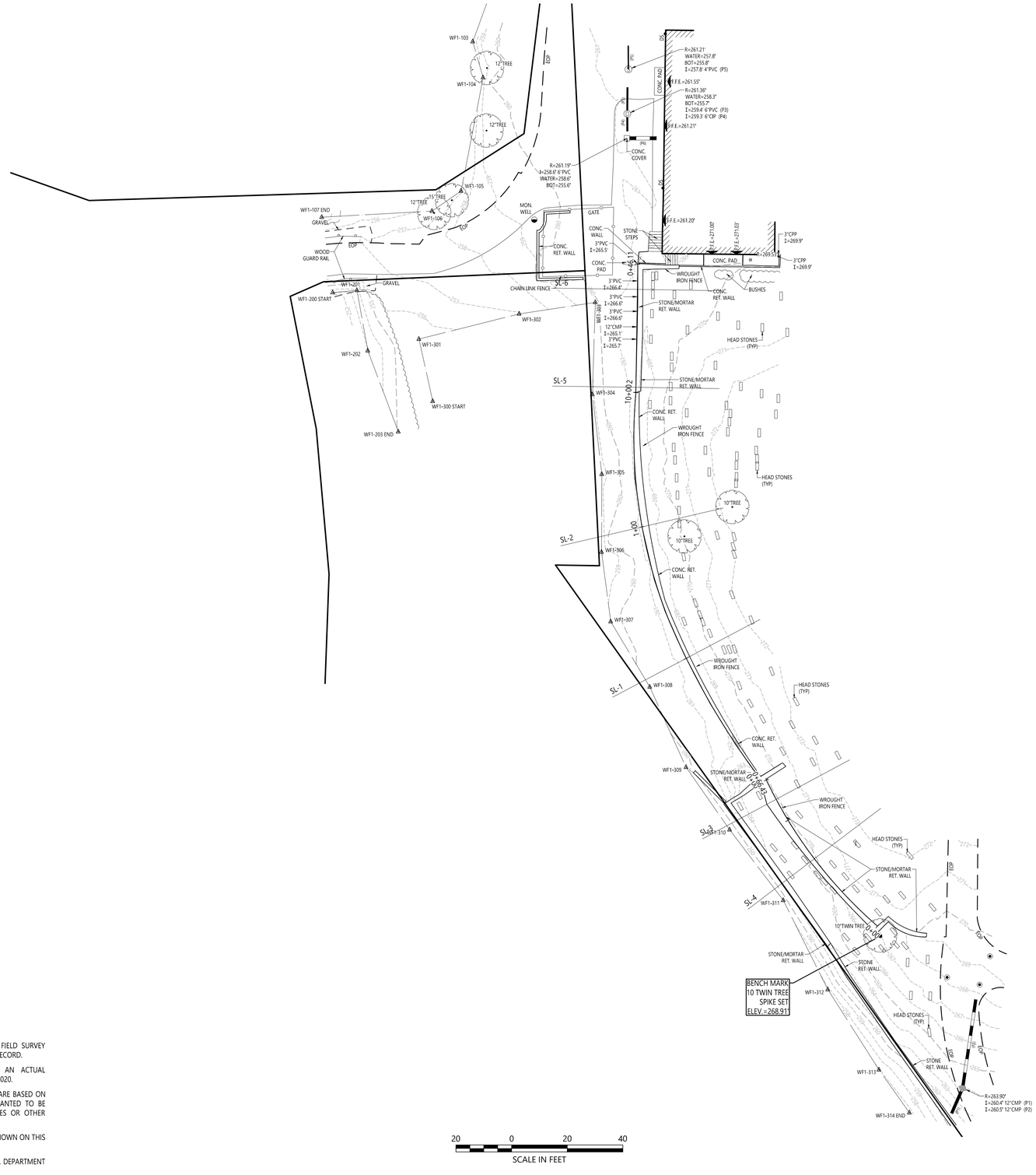

20 0 20 40
SCALE IN FEET

General Notes

1) THE PROPERTY LINES SHOWN ON THIS PLAN ARE BASED UPON AN ACTUAL FIELD SURVEY CONDUCTED BY VHB, INC. IN SEPTEMBER, 2020 AND FROM DEEDS AND PLANS OF RECORD.
2) THE EXISTING CONDITIONS SHOWN ON THIS PLAN ARE BASED UPON AN ACTUAL ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY VHB, INC. IN SEPTEMBER, 2020.
3) THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHOWN ON THIS PLAN ARE BASED ON FIELD OBSERVATIONS AND INFORMATION OF RECORD. THEY ARE NOT WARRANTED TO BE EXACTLY LOCATED NOR IS IT WARRANTED THAT ALL UNDERGROUND UTILITIES OR OTHER STRUCTURES ARE SHOWN ON THIS PLAN.
4) HORIZONTAL DATUM IS BASED ON MASS. GRID SYSTEM, NAD 1983. ELEVATIONS SHOWN ON THIS PLAN REFER TO NAVD OF 1988.
5) THE WETLANDS SHOWN ON THIS PLAN WERE FLAGGED BY VHB ENVIRONMENTAL DEPARTMENT AND FIELD SURVEYED BY VHB IN SEPTEMBER, 2020.
6) THE TREE SYMBOL OUTLINE SHOWN ON THIS PLAN DOES NOT REPRESENT THE ACTUAL TREE CANOPY.
7) THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A CURRENT TITLE REPORT AND MAY BE SUBJECT TO ADDITIONAL INFORMATION DISCLOSED IN SUCH.

vhb.com
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PO Box 9151
Watertown, MA 02471
617.924.1770

Legend

- DRAIN MANHOLE
- CATCH BASIN
- SEWER MANHOLE
- ELECTRIC MANHOLE
- TELEPHONE MANHOLE
- MANHOLE
- HH HAND HOLE
- WATER GATE
- FIRE HYDRANT
- GAS GATE
- BOLLARD w/LIGHT
- STREET SIGN
- LIGHT POLE
- UTILITY POLE
- GUY POLE
- GUY WIRE
- MONITORING WELL
- FLOOD LIGHT
- W WELL
- MARSH
- F.F.E.=45.27' FINISHED FLOOR ELEVATION
- CNO COULD NOT OPEN
- NPV NO PIPES VISIBLE
- DYL DOUBLE YELLOW LINE
- DWL DASHED WHITE LINE
- SYL SINGLE YELLOW LINE
- LSA LANDSCAPED AREA
- EOP EDGE OF PAVEMENT
- CC CONCRETE CURB
- VGC VERTICAL GRANITE CURB
- SGE SLOPED GRANITE EDGE
- BB BITUMINOUS BERM
- BC BITUMINOUS CURB
- GUARD RAIL
- CHAIN LINK FENCE
- DRAINAGE LINE
- SEWER LINE
- OHW OVERHEAD WIRE
- E UNDERGROUND ELECTRIC
- T TELEPHONE LINE
- G GAS LINE
- W WATER LINE
- STONE WALL
- TREE LINE
- 100'BZ 100-FT BUFFER ZONE
- 100'RA 100-FT RIVER FRONT AREA
- 200'RA 200-FT RIVER FRONT AREA
- BF1-100 LIMIT MEAN ANNUAL HIGH WATER
- BF1-100 LIMIT OF BANK
- WF1-100 VEGETATED WETLAND BOUNDARY

Southborough Rural Cemetery

Southborough, Massachusetts

No.	Revision	Date	Appvd.

Designed by | Checked by

Issued for | Date

September 16, 2020

Drawing Title

Existing Conditions Plan of Land

Drawing Number

Sv-1

Sheet 1 of 1

Project Number

15009.00