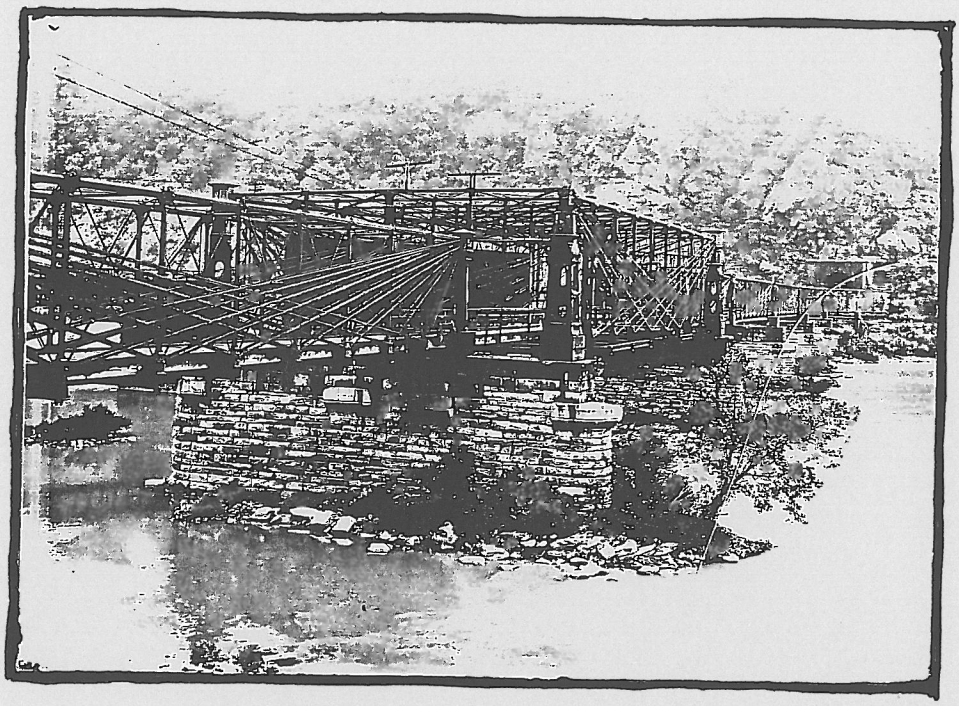
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B & O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

ASSESSMENT DATA and TREATMENT RECOMMENDATIONS REPORT

HAFE PACKAGE 212
IDLCS NO.45497 - STRUCTURE NO. PT02

FINAL REPORT

06 May 1994
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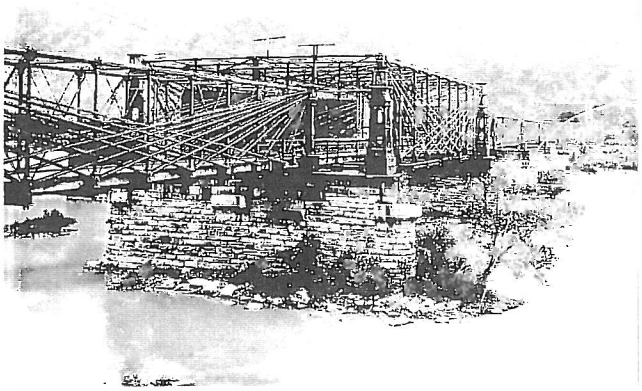
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HISTORIC DATA

Bridging the Potomac River at the confluence of the Shenandoah and Potomac Rivers for railroad use was accomplished through construction of two phases of bridge superstructures, one replacing the other ,upon the same masonry piers.
The design of the first, timber frame bridge superstructure supported by limestone masonry piers is attributed to architect Benjamin Latrobe, Jr Construction was completed in 1836.
The contracts for the construction of the bridge were let in two sections. Masonry work was carried out by Charles Wilson. Lewis Wernwag implemented the construction of the wooden superstructure.[1]



PHOTOGRAPH: CAST IRON BOLLMAN TRUSS SYSTEM, C.1860, HAFE-LIBRARY.

Later, in April of 1837 alarmed engineers discovered that the masonry work on the piers was so defective that reconstruction of the foundations was required. The historic record does not indicate which piers received repair or the extent of the damage. Supposed inferior work by Wilson had caused the problem. Latrobe was faced with the task of keeping the bridge in operation while the repairs were made. William Lester was contracted to administer the repair work to the masonry.[2]

The wooden truss designed by Latrobe placed a considerable amount of lateral thrust to the abutments and piers, requiring heavy masonry to accept the load. This excessive lateral dead load may have contributed to the failure of the pier foundations, associated masonry, and damage to the wood superstructure.
Repair work on the piers continued through summer of 1837 while trains cautiously made their way across the bridge. By the fall of 1837 the repair work was completed along with the weather boarding and roofing of the span over the C&O Canal.[3]

The construction of the wye span began in 1840 with the alteration of Pier A. An additional section of masonry was added onto the upstream end of the existing pier. This may explain the current appearance and condition of Pier A - the upstream end of the structure has settled.
The B&O abutment was in-situ as a previous abutment for the earlier Wager bridge. This abutment probably received alteration at the time that the wye span was added. A tin roof and weather boarding of the bridge was implemented in 1842. [4]

During the rush to complete the timber wye span a cheaper grade of timber was used. This timber rotted more quickly with the weather boarding concealing the damage. The timber wye span between Pier A and Pier B gave way on September 4, 1844 while a train was crossing the bridge - plunging men and equipment

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1 Stinson, Dwight K. First Railroad Bridge at Harpers Ferry, Engineer Report, Harpers Ferry Park Library, 10 March 1970.

2 Ibid

3 Ibid

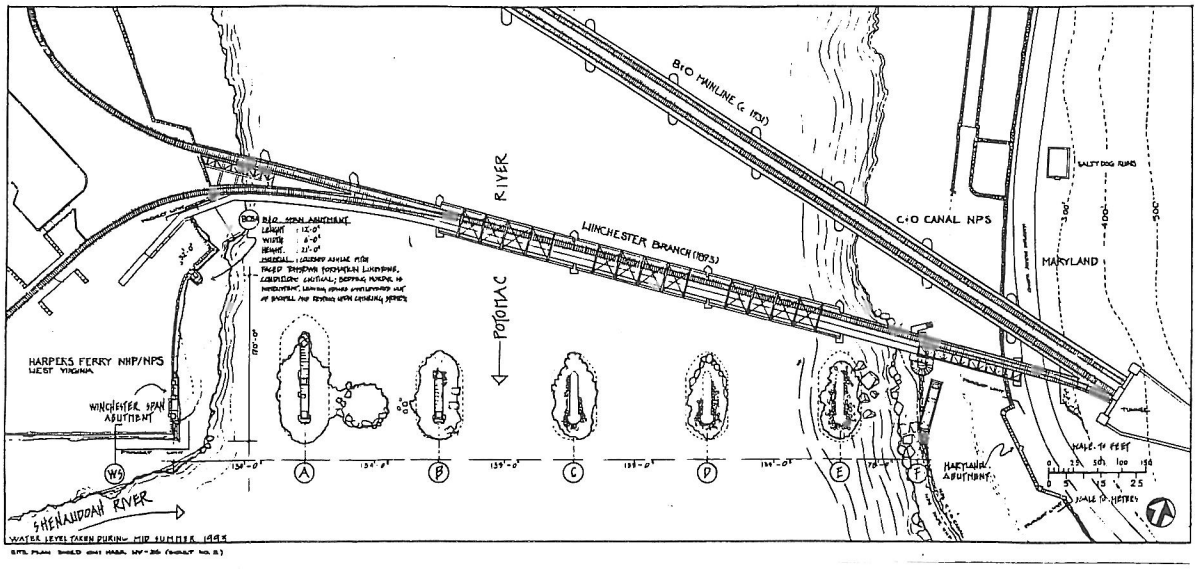
4 Ibid

into the river below.[5]

Bollman was granted permission to construct the Wye Span in cast iron in 1851 giving the bridge a composite appearence until 1862. The wooden span was repaired extensively until the entire superstructure was replaced with the cast iron Bollman Truss system by 1862. The new superstructure was the first use of Bollman type span in the world; used by John Brown to enter Harpers Ferry during his raid. During the Civil War repetitive destruction of the bridge began with the Confederates on June 14, 1861. Through out the Civil War the bridge was destroyed and rebuilt nine times retrieving and resetting cast iron elements from the Potomac River. The structure was finally rebuilt as a complete Bollman span. Following the war, the bridge was used as a wagon/ pedestrian bridge following completion of new railroad bridge upstream in 1893. Automobile traffic was routed over the Bollman superstructure serving as the primary entrance into Harpers Ferry from Maryland until the catastrophic flood of 1936. Pier E may have received the concrete repair during its use as an automobile bridge. Final destruction of superstructure came in the 1936 flood. Pier E (total failure), Pier F, and associated stone work along the Maryland bank was impacted by the flood of 1985.

The types of stone used in construction of piers A, B, C, D, and E are limestone of the Tomstown Formation, and Harpers Formation phyllite rubble. Pier F is constructed of granite. The abutments on the West Virginia bank were constructed with Tomstown limestone, harpers phyllite, and granite.

All of the limestone masonry piers have been surmounted with coursed ashlar granite reflecting the changing technology of railroad bridge construction at Harpers Ferry.



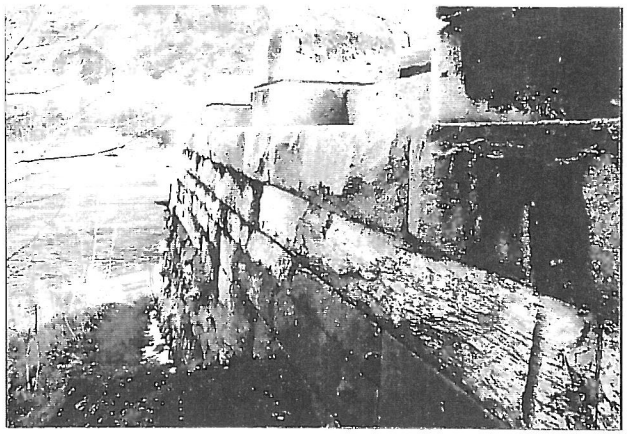
SITE PLAN: WPTC-NPS, 1994, BASED ON HAER WV-36

5 Stinson, Dwight K. First Railroad Bridge at Harpers Ferry, Engineer Report, Harpers Ferry Park Library, 10 March 1970.

WINCHESTER SPAN ABUTMENT

GENERAL DESCRIPTION

The Winchester span abutment located on the West Virginia bank of the Potomac River has functioned as the anchoring abutment for two separate bridge superstructures; the earlier Latrobe timber bridge superstructure, and the later ,named for its function, cast iron Bollman bridge superstructure.

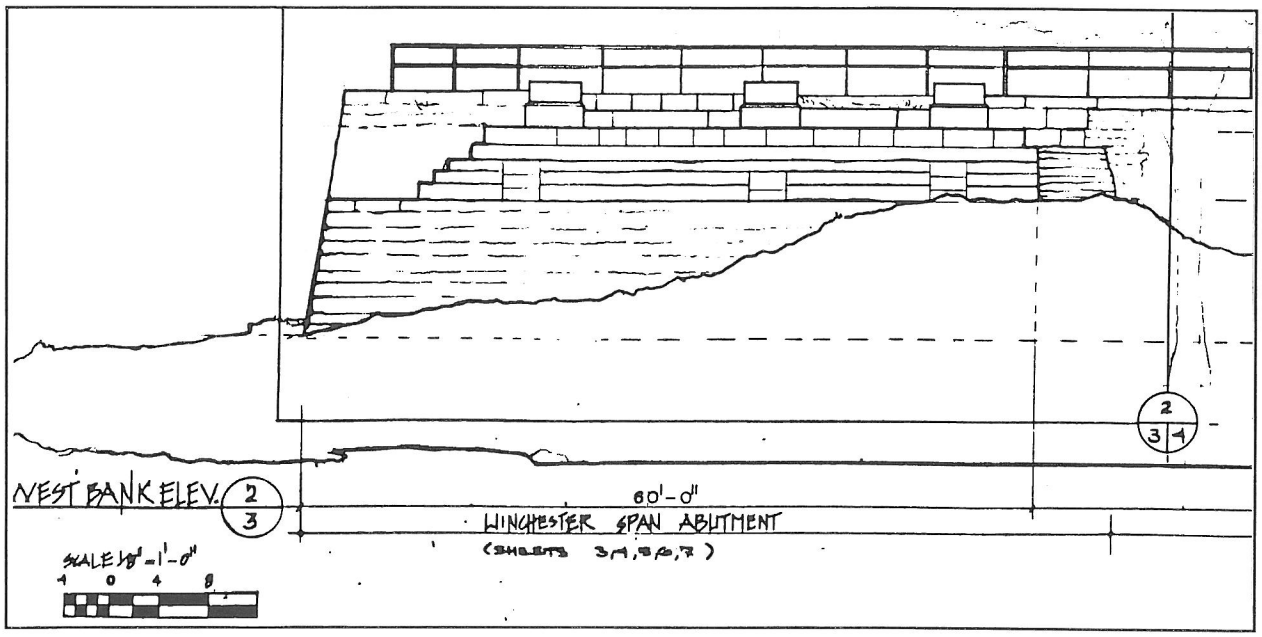


PHOTOGRAPH: SITE CONDITIONS, OBLIQUE VIEWING SOUTH, WPTC-NPS 1993.

Construction of the Winchester span abutment is contemporaneous with the completion of the piers for the Latrobe timber bridge c. 1836. The base of the abutment forms the corner of the embankment wall protecting the lower town of Harpers Ferry from catastrophic flood water impacts.

Stone utilized in the construction of the abutment includes Tomstown Formation limestone, granite, some Harpers Formation phyllite, and red sandstone. The base of the structure is constructed of the limestone and phyllite. The granite addition was placed as a coping and plinth for the cast iron superstructure. Sandstone placed at the coping may not be associated with the cast iron bridge (this is the only occurrence of use of sandstone in all elements of the bridge).

The abutment stones are of Tomstown Formation limestone placed as pitched-face coursed ashlar. Upper courses of this limestone were altered with the addition of granite-bearing surface. The coursed ashlar granite addition was placed to accept the 1851 cast iron Bollman truss Winchester Span. The granite coping was created to accept the plinth stones for the cast iron truss pillars.



DRAWING: WINCHESTER SPAN - EAST ELEVATION, WPTC-NPS 1993.

The structure remains protected from catastrophic flood waters and mean river levels through the siting of the abutment, natural deposition of silt, and subsequent establishment of hardwood vegetation at the base of the structure.

The condition of the base courses of the abutment beneath the deposition embankment is unknown. Masonry above the sloping grade line shows no indication of major settlement or displacement. Local hydraulic impacts include flood waters and water-borne debris from the Shenandoah and the Potomac Rivers. The two rivers flooding at different times and stages combined with the direction of the currents has caused the deposition of silt at the base of the wall to be higher at its center. This siltation encourages vegetation growth with root systems that may impact the base of the abutment. Stone utilized in the construction of the abutment includes Tomstown Formation limestone, granite, some Harpers Formation phyllite, and red sandstone. The base of the structure is constructed of the limestone and phyllite. The granite addition was placed as a coping and plinth for the cast iron superstructure. Sandstone placed at the coping may not be associated with the cast iron bridge (this is the only occurrence of use of sandstone in all elements of the bridge).

SITE CONDITIONS

Site conditions include seasonal flooding that impacts the lower courses of the abutment. The structure has the potential of becoming severely impacted by high flood waters breaching the banks of the Shenandoah. The south end of the abutment is most vulnerable to impacts from the Shenandoah flood waters. Aggressive currents from the west and northeast have aided in the displacement of some of the lower coursework. The Potomac River currents impact the face of the abutment at times of high flood waters. The currents strike the face of the abutment at a diagonal eroding the mortar from the masonry joints.



PHOTOGRAPH: WINCHESTER SPAN ABUTMENT , WPTC-NPS 1993.

The berm at the base of the abutment, a resultant of confluent river currents deposition, serves to protect the lower courses from erosive impacts, but also encourage tree growth that may subsequently impact the abutment through root action.

CONDITION ASSESSMENT

MASONRY: The abutment serves as an anchoring corner for the Shenandoah River and the Potomac River retaining walls of lower town Harpers Ferry. The structural condition of the wall exhibits no sign of displacement or potential wallfall. All stones remain in good condition on original bedding mortar.
Masonry of the abutment was placed in a manner that integrated each of the stones with the back-fill rubble. The back-fill stone rubble is not exposed in any place along the wall or from above. Coping and plinth stones remain in-situ as originally placed.
Deposition of river silt at the base of the abutment has covered nearly half of the structure.
Coursed rubble masonry at the base of the abutment remains in-situ with little displacement of bedding stones.

WINCHESTER SPAN ABUTMENT

The exposed section of the structure is in good condition. There is no severe damage to individual units.Deposition of silt at the base of the abutment has aided in stabilizing the masonry of the structure. Trees at the base of the wall retain the deposited silt.

The granite addition placed on top of the limestone abutment has three courses of stone. The lowest course of granite is a coping on which two courses of plinth stones and secondary points of bearing stones are placed.

Plinth stones are bush hammered stones with a weathered chamfer on the top of the bottom course. The stones retain tool marks. Granite coping stones of the addition are placed directly on top of the limestone abutment wall. The coping stones are pitched faced stones providing a drip edge for the wall below.

Major structural displacement or failure of stone coursework is not present.

CRITICAL ELEMENTS

Critical elements of the Winchester Span include the deteriorated and displaced mortar of the east elevation, and impacting vegetation growing at the base of the structure.
The condition of the masonry beneath the deposition on the east elevation is unknown. Additional investigation will be required at the time of removal of siltation to determine the condition and appropriate treatment of the masonry.

TREATMENT RECOMMENDATIONS

GENERAL

Winchester Span critical elements shall be addressed first. The removal of herbaceous and woody vegetation from the base of the abutment will prevent damage to the extant masonry. Root action from the trees at the base of the structure (determined through the placement of the trunk, drip line, and the present level of deposition at the base) are impacting the masonry. Roots grow into masonry joints damaging the mortar and associated stones. This is not desirable, however, the larger trees serve to retain the embankment and level of deposition that in turn serves to protect the abutment from impacts from flood waters and water-borne debris. Therefore large healthy hardwoods shall be managed in place through selective removal of roots and overhanging branches. Required removal of small hardwoods will protect the masonry from further impacts on the masonry.
Further tree growth at the base of the abutment shall be arrested through hand removal of root systems, trunks, and canopies.

MASONRY

Prepare mortar joints for repointing through removal of only deteriorated mortar. Rake joints utilizing hand tools removing deteriorated mortar, vegetation, organic debris, and deposition from flood waters.
Re-establishment of bed and head joint mortar may be necessary. This may be implemented through a specified grout injection process and/ or tamp pointing.

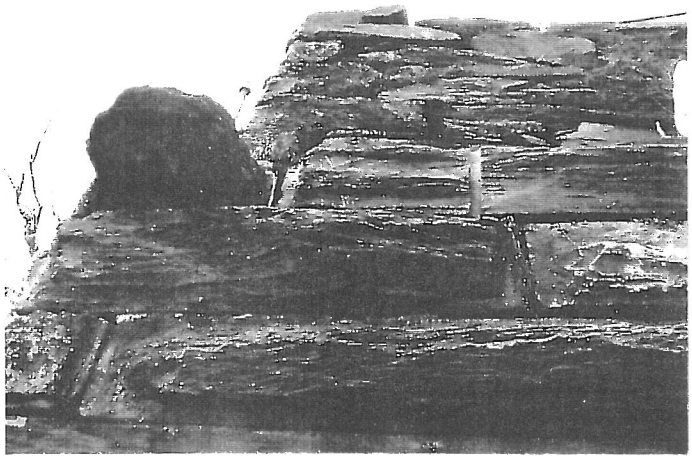
RECOMMENDATIONS for FURTHER STUDY

Determine condition of base stones concealed by deposition of silt at the base of the wall.
Determine bedding mortar and pointing mortar mixes.
Determine grout mixes.

WINCHESTER SPAN ABUTMENT

TREATMENT RECOMMENDATION:
WSA-01
TAMP - POINTING
Tamp pointing utilizes the placement of mortar in a series of lifts in masonry that has total loss of mortar.

SCOPE
Masonry joints that no longer retain mortar material require tamp pointing to re-establish proper bedding mortar.
Tamp pointing of the masonry joints of the Winchester Span abutment will be necessary in areas where the mortar has been washed from a limited area. Deteriorated mortar ranges from loss of pointing mortar to total loss of bed and head joint mortar (4 - 12 inches in depth).



PHOTOGRAPH: WINCHESTER SPAN ABUTMENT OBLIQUE, WPTC-NPS 1993.

METHODOLOGY
Mortar mix for tamp pointing shall be of an approved and appropriate mix matching the historic bed and head joint material in color, and texture.
Mortar mix shall be designed for use as bed mortar - relying on the pointing mortar to act as the sacrificial material for the masonry joint. Tamp - pointing shall fill the full depth of the joint leaving 4 inches in depth from the face of the joint to accept an approved and appropriate pointing mortar. Once newly implemented tamp pointing mortar has cured the final pointing mortar shall be implemented.

Where grout injection is not applicable, or feasible, tamp pointing shall be implemented. Prepare mortar joints for repointing through removal of only deteriorated mortar leaving sound mortar in place.
Rake joints utilizing hand tools removing deteriorated mortar, vegetation, organic debris, and deposition from flood waters.

Tamp appropriate and approved mortar into joints with hand tools matching the dimension of the mortar joints. Tamp until joint material reaches sound mortar. Tamp pointing shall be continued until immediate area of work has been completed. Do not allow mortar to set and form cold joints between lifts.

Mortar mixes shall be developed for approval through field and material testing prior to implementation of pointing.

WINCHESTER SPAN ABUTMENT

TREATMENT RECOMMENDATION :
WSA-02
POINTING

SCOPE
A comprehensive total removal of mortar from masonry joints is not necessary. Spot tamp pointing shall be implemented in areas where the mortar has deteriorated or has been washed-out.

METHODOLOGY
Preparation of mortar joints to accept an approved and appropriate mortar shall involve removal of only deteriorated mortar. Sound mortar shall be left in-situ.
Remove deteriorated mortar using hand tools. Rake out joints removing deteriorated mortar, organic matter, and flood deposition.
Repoint utilizing an approved and appropriate mortar mix matching associated historic mortar in color, texture, and joint profile.



PHOTOGRAPH: WSA SOUTH ELEVATION, WPTC-NPS 1994

B&O SPAN ABUTMENT

GENERAL DESCRIPTION:

The B&O Railroad Company completed construction on the West Virginia B&O Span abutment in the summer of 1836. Other bridge piers also received major repairs in April of 1837. The masonry construction is the same as that of the repaired piers. There is no available record indicating historic repairs to the abutment immediately following its construction.



PHOTOGRAPH: B&O SPAN ,OBLIQUE EAST ELEVATION, WPTC-NPS 1993

The later addition and increase in height of the bridge foundation system significantly altered the appearance of the B&O Abutment. A major granite addition to the abutment on the upstream face of the pilaster increased the form and size of the structure. This same type of granite masonry was utilized to construct Pier F (c. 1836) on the Maryland side of the river. The historical record indicates that Pier A had several feet of limestone masonry added to the upstream end in 1840 to accept the placement of the WYE Span. The granite addition to the B&O Span must have occurred at this time.



PHOTOGRAPH: B&O SPAN PILASTER, VIEWING NORTH WEST, WPTC-NPS 1993



PHOTOGRAPH: B&O SPAN ABUTMENT NORTH ELEVATION, WPTC-NPS, 1993

The B&O Span Abutment granite addition does not appear to be integrated with the preexisting limestone structure. The granite stones have been rough cut to the exterior face of the limestone masonry. Course work appears abrupt at the junctures of the two types of masonry.
Constructed of pitch-faced Tomstown Formation limestone, the abutment is integrated into the stone embankment wall protecting the lower town area from high waters of the Potomac River. The stone embankment wall associated with the abutment was laid as coursed ashlar Harpers Formation phyllite. The masonry of the limestone pilaster of the abutment is integrated into the stone embankment wall . A radial wall makes the south elevation of the pilaster. The north face of the pilaster has been partially encapsulated with the addition of the granite section of the abutment. Contemporaneous with the placement of the Bollman cast iron B&O span the granite addition has not been keyed into the limestone pilaster. Vertical height of the pilaster measures twenty-one feet. This addition increased the height of the wall by approximately five feet.

B&O SPAN ABUTMENT

SITE CONDITIONS

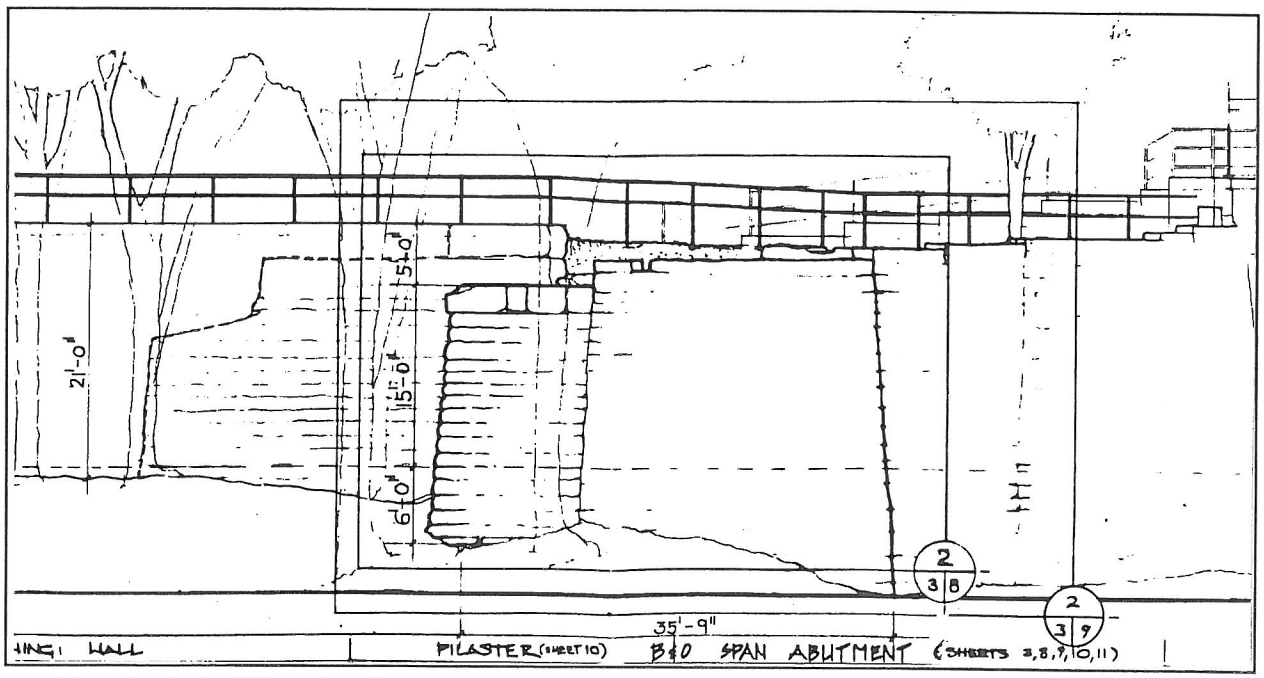
The B&O Span Abutment is susceptible to periodic flooding. Total submersion of the resource does not occur during seasonal flooding. The lower masonry courses and the pilaster of the abutment are subject to the flood water and water-borne debris of the Potomac River. The structure has few impacts from the west / back-filled side. Most critical impacts come from the north striking the north face of the limestone pilaster and the granite addition. The abutment is protected from lateral working live loads from log jambs through the siting of the structure. The river currents are directed into the upstream face of the granite addition yet this element deflects water borne debris rather than retaining it. The upstream face of the limestone pilaster is protected by the placement of the granite addition.

Tree roots from hardwoods living within the deposition area along the river bank have grown into the masonry joints of the limestone pilaster. Roots have aided in the deterioration and spalling of mortar. The stones have suffered from tangential and lateral cracking from roots growing within mortar joints placing undue stress and strain on the stone.



PHOTOGRAPH: DETAIL ROOTS IMPACTING JUNCTURE OF PILASTER AND RETAINING WALL

Impacting vegetation is evident through the exposed root action of associated trees on the limestone pilaster of the abutment. The root systems have aided in retaining the deposition at the base of the abutment, however, detrimental root action continues to work on the lower courses of the wall. This deposition protects the abutment somewhat through buttressing the lower courses of the wall and eliminates the erosive action on the face of the masonry. Additional tree and root growth at the base of the wall will continue to negatively impact the structure.



DRAWING: B&O SPAN EAST ELEVATION, WPTC-NPS 1993.

B&O SPAN ABUTMENT

CONDITION ASSESSMENT

MASONRY:

Critical areas endangering the overall structural integrity of the abutment are at the junctures of the limestone and granite masonry. Head and bed joints at junctures of masonry walls have lost all mortar through deterioration and erosion. There are serious gaps in the masonry enabling water to infiltrate into the core of the structure.

The two junctures face upstream. The loss of mortar from the full depth of all masonry joints combined with aggressive flood water currents on the face of the abutment has encouraged the deterioration of the mortar. This leaves the back-fill material subject to water infiltration, saturation, and subsequent freeze-thaw cycles. Results may be the deterioration of extant mortar within the back-fill stone work. Wash-out of earth from the back-fill masonry may be endangering the integrity of the exposed stone work. This point of weakness is most critical on this structure.

RECOMMENDATIONS for FURTHER STUDY

Develop specifications for low pressure grouting and mix. Determine bedding mortar and pointing mortar mixes.

Develop and determine field testing schedule.

TREATMENT RECOMMENDATION:

BOSA-01 GROUT INJECTION

SCOPE:

Masonry joints of the B&O Span abutment have been totally washed out leaving individual stones resting upon each other, upon chinking stones, or left in a cantilevered condition.

Quantitatively ninety per cent of the limestone course work of the structure requires re-establishment of mortar material within the masonry joints (repointing). Preservation treatment recommendations are to re-establish the structural integrity of the masonry.

METHODOLOGY: GROUTING

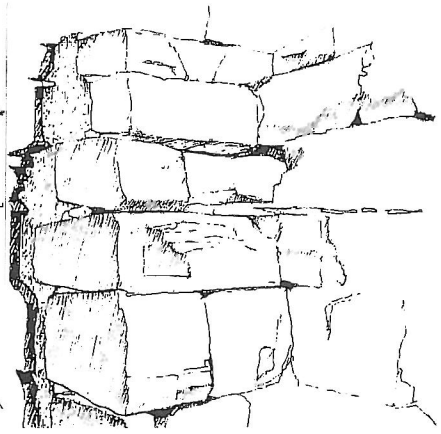
Reintegration of the masonry through placement of new mortar in bed joints and head joints must be implemented in a manner that re-establishes the mortar material within the mortar joint.

MATERIALS: MIX PROPORTIONS COMPATIBILITY

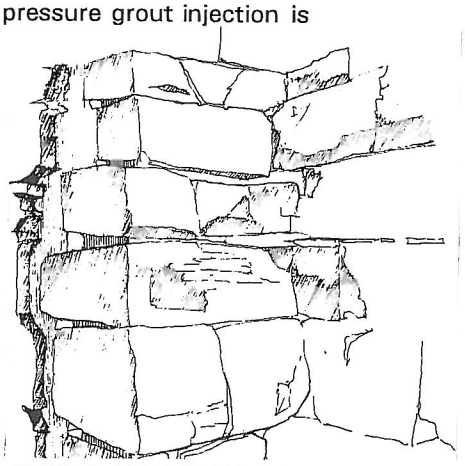
Mix proportions of the grout must be compatible with the thermal and moisture properties of the stone of the abutment. The section of the core to be consolidated through low pressure grout injection is



DETAIL: MASONRY JOINT EXTANT CONDITIONS, WPTC-NPS 1994



DETAIL: GROUT INJECTION WPTC-NPS 1994



DRAWING: DETAIL POST POINTING WPTC-NPS 1994

constructed of Tomstown formation limestone. The properties of the grout to be injected must retain after setting a similar moisture uptake relative to the stone. Thermal expansion properties of the grout material must be as close as possible to that of the stone without exceeding them.
NOTE:
Formulations should be premixed dry and then well mixed with water to the consistency of heavy cream. Cavities to be grouted are first cleaned of debris with compressed air. Cracks and fissures are dammed with nonstaining potters clay and the grout injected by low pressure grout pumps or syringes. After voids are completely filled, the work is covered with wet burlap for a slow cure.
All masonry work should be executed under optimum weather conditions to ensure the success of the repairs.
No work shall be executed nor cured during freezing weather (below 40 F). Prevent rapid dehydration of masonry work. Repeat misting w/ water and protect from the sun with damp burlap sacking.

BOSA 02 POST GROUTING POINTING
Pointing of the masonry following the grouting procedure will permit the injected grout to cure properly and provide for a final mortar joint profile. Appearance will be matching the historic mortar in color, texture, and joint profile.

PIER A

GENERAL DESCRIPTION:

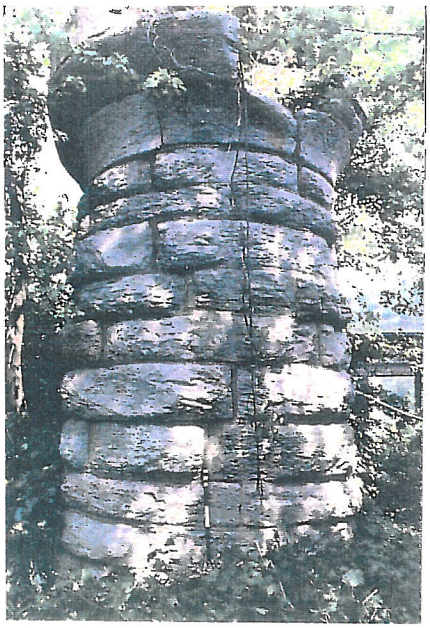
First of the river-bound bridge piers from the West Virginia bank of the Potomac, the pier now measures 32'-6" in height, 8'-6" in width, and 90'-0" in length. Rip-rap at the base of the structure creates an island on which the pier appears to rest - increasing the footprint of the structure by 30' in width and 30' in length. The overall measurements of the island are 50' in width and 130' in length. Constructed of Tomstown formation limestone, the pitch-faced, coursed ashlar masonry pier has been tapered on the upstream end and rounded on the downstream end. This design reduces impact forces from flooding and water-borne debris.



PHOTOGRAPH:PIER A WEST ELEVATION, WPTC-NPS 1993

Changes in the superstructure of the bridge required the altering of Pier A. The structure received two additions. The first alteration occurred in 1840 through the lengthening of the structure from its original 52' length to the current length 90'. The northern/ upstream end of the pier was increased by 42' feet during the addition of the Wye and B&O spans. Present length of the pier measures 90'-0" from north to south. It previously functioned as bearing for two tangentially intersecting spans of the original Latrobe timber B&O Railroad Bridge. The B&O span and Winchester span were independently placed on this pier.

Later, with the placement of the 1851 cast iron Bollman truss, the Pier was increased in height by from 17 feet to 32 feet with four courses of pitch-faced coursed ashlar granite and two courses of granite plinth stones.



SOUTH ELEVATION, WPTC-NPS 1993

SITE CONDITIONS :

LOCAL HYDROLOGY

Located at the confluence of the Shenandoah and Potomac Rivers, Pier A survives as the largest and most intact, protected through its proximity to the Harpers Ferry bank and bypassing confluent river currents. Main channels of the meeting rivers flow past the base of the pier. The Shenandoah River provides lateral impacts to the west, and south face of the structure. Back-eddying currents occur at times when the Shenandoah river floods before the Potomac. The shallow depth of the water around the base of the Pier is the result of deposition and lack of strong current to discharge sand, silt, and stones downstream.

PIER A

Seasonally impacted by high water the rip-rap of the structure submerses. Lower coursing of the masonry pier remains in contact with the water without the protection of rip rap on the north end of the structure.



PHOTOGRAPH: PIER-A SOUTH ELEVATION, WPTC-NPS, 1994

CONDITION ASSESSMENT:

MASONRY

The pier is constructed of Tomstown Formation limestone. This material was shaped and laid as pitch-faced coursed ashlar with a rubble masonry core. It is highly probable that the core of the structure has been keyed and placed using a combination of Harpers Formation phyllite and Tomstown Formation limestone laid in a cementitious based mortar. The exposed cores of Pier B, C, D, and E clearly shows this type of construction. Extant fabric of the exposed core of the failed piers exhibits a methodology of construction that allowed for the keying of each course of the finished masonry with the core of the structure. The core construction utilized tie stones of a dimension that stretched across the full width of the core.

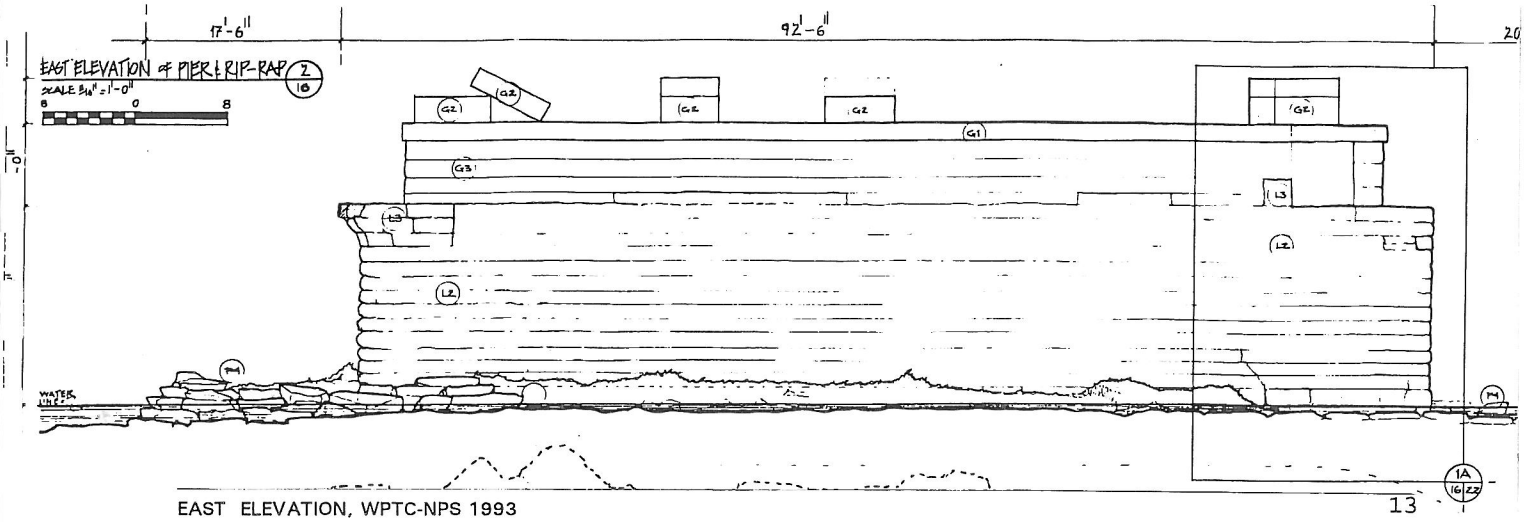
RIP-RAP

Historic photograph of Pier A with the Winchester span in-situ shows that there had been displacement of the rip-rap on the north (upstream) end of the pier early in the structure's history. Rip-rap utilizing slabs of Harpers Formation phyllite had been dry-laid in a fish scale pattern - one stone buttressing the other against the prevailing current of the Potomac River. One third of the rip-rap has been displaced from the pier and discharged into the river. .

CONDITION ASSESSMENT

NORTH ELEVATION :

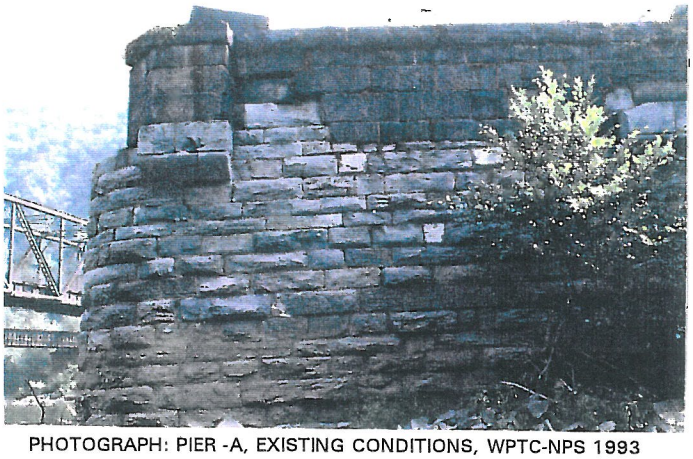
The north end of the structure has been subject to catastrophic impacts from flood waters and water-borne debris. Through referencing historic photographs taken prior to the catastrophic cultural impacts of the civil war the north (upstream) rip - rap was noted to have been totally displaced. This indicates that the pier has been without rip - rap for at least 12 decades.



EAST ELEVATION, WPTC-NPS 1993

PIER A

The placement of the Wager Bridge pier foundation ruins just upstream from Pier A has provided protection from detrimental currents and water-borne debris. Without the presence of the Wager bridge foundation Pier A may have suffered further damage. Masonry of the north end of the wall remains in sound condition. Lateral and transverse cracks associated with the wye span addition on the east and west elevations do not appear on the north elevation.



PHOTOGRAPH: PIER -A, EXISTING CONDITIONS, WPTC-NPS 1993

RIP RAP

Most critical of lost elements of Pier A is the absence of rip-rap once placed on the north end of the pier island. Displaced and discharged downstream the rip-rap may have been scaled-off through flooding of the Shenandoah prior to flooding of the Potomac (an unusual occurrence). Combined later with high flood waters working on the shallow bedrock of Harpers Formation - the rip-rap of Pier A received less stone than the other piers. More courses of rip-rap had been placed on the deeper bedrock of piers B,C,D.

CONDITION ASSESSMENT

SOUTH ELEVATION:

Character defining features on this elevation include the semicircular limestone plinth(point-of-bearing). The limestone courses associated with the granite addition have been slightly damaged on the outer edge , but have remained in-situ. Three courses of limestone creating the plinth suffered damage to the top course through impacts from the failed superstructure.

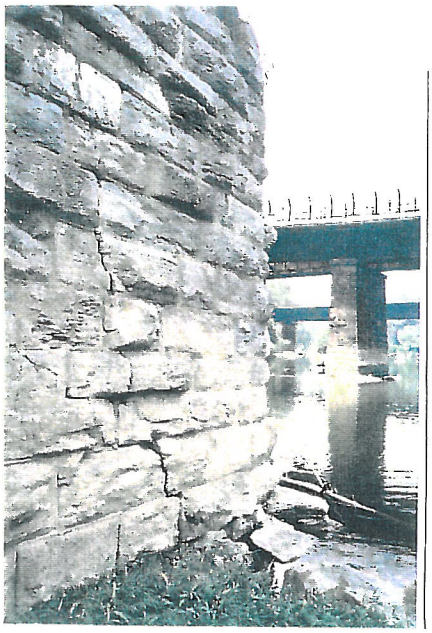
RIP-RAP

The base of the pier is protected by rip-rap slabs of Harpers phyllite. The rip-rap has been placed in a fish scale pattern laid to take on the currents of the Potomac River. Flood waters currents from the Shenandoah have impacted these stones through displacement. The stones have been flipped over and now rest on top of remaining associated rip-rap.

CONDITION ASSESSMENT

EAST ELEVATION

The east face of Pier A has a transverse and lateral crack that angles down and across the masonry. This crack is associated with a similar crack on the west face of the pier. This may indicate that impacts from flood water and water-borne debris are destabilizing the north (upstream) addition of the pier that was placed to accept the wye span of the bridge. It is possible that water has infiltrated through this crack to the core of the pier. Structurally the pier appears in sound condition, however, repeated saturation and

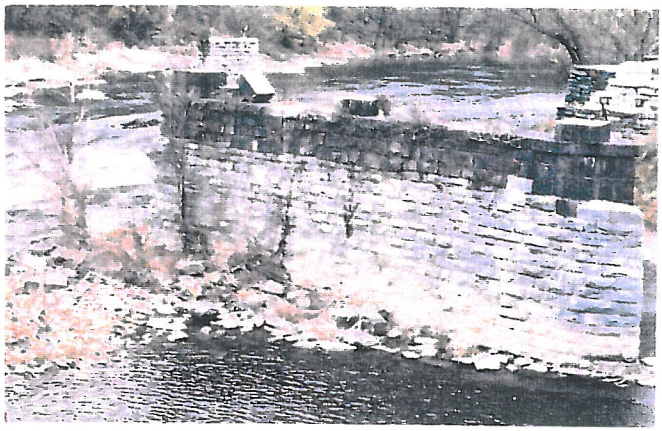


PHOTOGRAPH: PIER-A EAST ELEVATION, WPTC-NPS 1994

freeze - thaw cycles may have damaged the core of the pier by destabilizing the masonry.

RIP-RAP

Rip-rap of the east elevation has been displaced and discharged downstream as a result of the flood waters from the Shenandoah and Potomac Rivers. The bedrock in area of the pier island rises high creating a shallow area at the confluence. Material was spared when implementing the rip-rap slabs. Fewer courses were placed without integration with the bedrock. The loss of fabric is evident when referencing the plan.



PHOTOGRAPH: PIER -A OBLIQUE,WPTC-NPS 1994

CONDITION ASSESSMENT

WEST ELEVATION

Pier A shows settlement in the upstream portion of the structure. This settlement appears to have occurred early in the construction. It may be associated with the upstream addition placed to accept the wye span of the bridge. The limestone coursing of the upstream end of the pier is not level. The top course of limestone has been sized to provide a level point-of-bearing for the granite addition. The top of the Pier retains the plinth stones of the cast iron bridge. Though displaced, the remaining stones in-situ are not in danger of falling.

MORTAR

Later campaigns of repointing with a cementitious based mortar mix have removed all signs of original pointing. Similar masonry on the abutments received less care. Extant mortar in the masonry of the abutments indicates that the earlier pointing mortar had a low proportion of cementitious material in the mix. The latest campaign of portland based pointing mortar has obliterated all original pointing mortar.
Raised joints of the latest campaign of pointing are in sound condition with few areas of spalling. The existing mortar has a high content of portland cement.
The Harpers Formation phyllite rip-rap placed on the upstream end of the pier no longer remains intact. This creates potentially destabling erosion.

SUMMARY OF PIER CONDITION

Overall condition indicates that Pier A is in stable condition requiring further measures to protect existing fabric from displacement and potential failure of the structure.

RECOMMENDATION for FURTHER STUDY

Determine methodology for rip-rap placement and stabilization.
Determine specification for low pressure grout injection and mix.

TREATMENT RECOMMENDATION PA-01

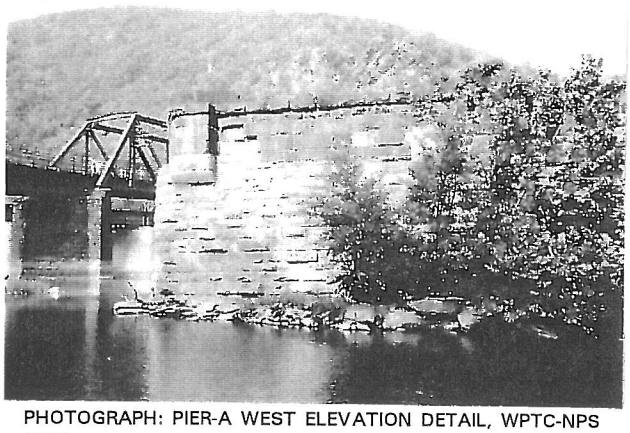
SITE CONDITIONS:

Site location: The pier islands of Harpers Formation phyllite rubble and rip-rap are located within the Potomac River subject to seasonal flooding, and total submersion of the resources.
All work must be prepared, implemented, and completed during times of low water.
Dangerous river currents to the east of Pier B are present during times of high and low water levels.

River Hazards:

Include the submerged cast iron debris of the bridge superstructure located downstream from Pier B.

SCOPE:
Reset rip-rap at base of the pier where historic rip-rap has been displaced.
Replicate associated historic rip-rap masonry in type of stone, methodology of placement, and level of historic craftsmanship.
MATERIAL:
Stone rip-rap of Harpers Formation phyllite rubble (in slab form) with units weighing 300 lbs to 800 lbs (170 #/cf) placed as three courses of rip-rap fanning out to a single course around the perimeter of the structure.



PHOTOGRAPH: PIER-A WEST ELEVATION DETAIL, WPTC-NPS 1994

METHODOLOGY:
Placement of the rip-rap shall include the preparation of the river bottom in areas where the historic rip rap has been displaced (removal of deposition of silt and debris). Cuts shall be made into the bedrock at designated angles to provide points of bearing for diagonally placed stones. Bed stones shall be anchored. The methodology of anchoring the base stones of the rip-rap may be accomplished through drilling a counter sunk hole on the top face of the stone followed by a drill hole through each unit into the bedrock. A stainless steel epoxy coated reinforcing bar shall be grouted in the bedrock. Stainless steel anchoring nut / washer / and whaler shall be torqued prior to grouting in place.
Placement of upper coursing shall be dry-laid. Following preparation of bedrock (sculpting) in designated areas.

<u>TREATMENT RECOMMENDATION PA-02</u>
GROUT INJECTION
CONDITION:
Masonry joints of that have been totally washed out leaving individual units resting upon each other, upon chinking stones, or left in a cantilevered condition.

SCOPE: GROUTING
Reintegration of the masonry through placement of new mortar in bed joints and head joints.
Lower strength and more vapor permeable formulations can be formulated.

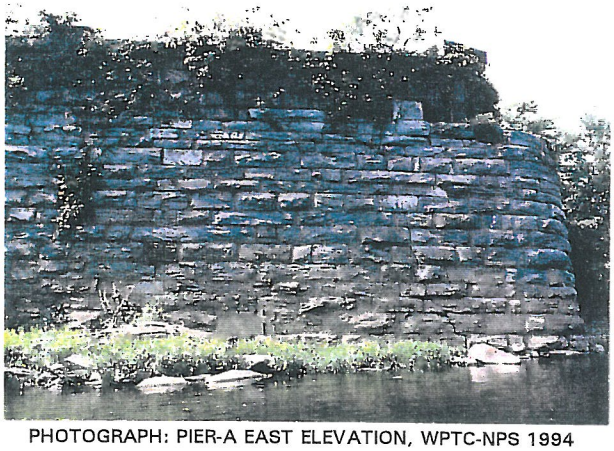
MATERIALS: MIX PROPORTIONS:
COMPATIBILITY:
Mix proportions of the grout must be compatible with the thermal and moisture properties of the stone of the piers. The section of the core to be consolidated through low pressure grout injection is constructed of Tomstown formation limestone. The properties of the grout to be injected must retain a similar moisture uptake relative to the stone after setting. Thermal expansion properties of the grout material must be as close as possible to that of the stone without exceeding them. Material tests can be carried out at the time of construction.

NOTE: PRELIMINARY SPECIFICATIONS

Formulations should be premixed dry and then well mixed with water to the consistency of heavy cream or according to manufacturers specifications.

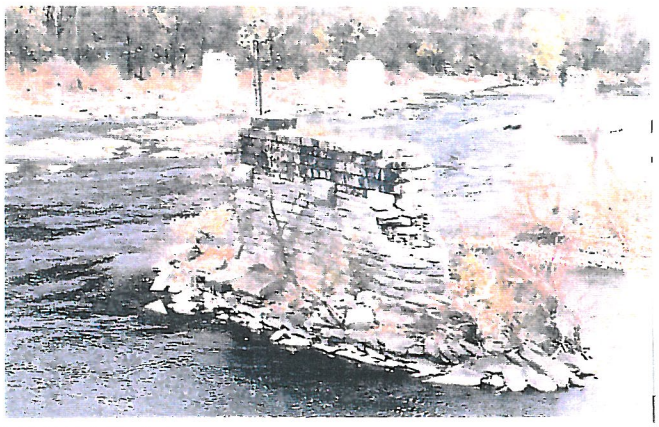
Cavities to be grouted are first cleaned of debris with compressed air then water flushed at low pressure. Cracks and fissures are dammed with nonstaining potters clay and the grout injected by low pressure grout pumps or syringes. After voids are completely filled, the work is covered with wet burlap or plastic for a slow cure. All masonry work should be executed under optimum weather conditions to ensure the success of the repairs.

No work shall be executed nor cured during freezing weather (below 40F). Prevent rapid dehydration of masonry work repeat misting and protect from the sun with damp burlap sacking.



PHOTOGRAPH: PIER-A EAST ELEVATION, WPTC-NPS 1994

PIER B



PHOTOGRAPH: PIER-B, WPTC-NPS, 1994

GENERAL DESCRIPTION

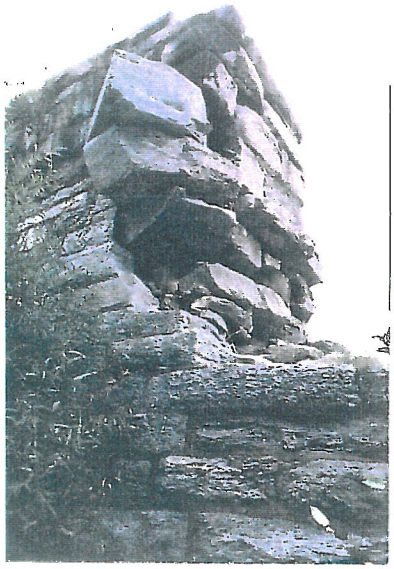
Pier B is the second pier from the West Virginia bank of the Potomac. It exhibits the same detailing and material in its construction as that of Pier A. The structure's length measures fifty-two feet ,some thirty-nine feet shorter in length than Pier A. Pier B has a width of 8'-6" and retains an overall height of 31'. This pier is constructed of coursed ashlar Tomstown Formation limestone. The stone is dressed out to a pitched face with marginated edges. The upper ten feet is constructed of coursed ashlar granite. The granite has weathered to a dark gray. This may be attributed to discharges from locomotives and ferrous deposits from the nonexistent bridge superstructure. Pier B follows the same design as Piers, C, D, E. The north end of the pier is tapered while the south end of the pier is rounded. The shape assists in protecting the structure from flood waters and water-borne debris.

Pier B carried the load of the adjoining wye-span superstructure.

Pier B is in the most critical condition of all the extant elements of the bridge. Lateral and dynamic live load impacts from floating debris and log jambs have severely damaged the upstream end of the structure. Stones have been displaced through log jambs placing lateral and vertical live loads to the masonry elements. This action causes stones to uplift from their proper bedding. Limestone facing stones on the upstream end of the structure have been displaced. The stones have come to rest on the east side of the structure. Some of the stones have shattered upon impact while other cut stones have been left undamaged.

SITE CONDITIONS:

Sited within the river the structure remains subject to the varying levels of the Potomac and Shenandoah Rivers. The local hydrology of the area permits the seasonal submersion of the structure through rising water levels of the Potomac and Shenandoah Rivers.



PHOTOGRAPH: PIER-B, DETAIL NORTH ELEVATION, WPTC-NPS 1994

CONDITION ASSESSMENT

NORTH ELEVATION

The north end of the structure retains the lower seven courses of cut stone. These stones have been shaped to form an edge on the center line of the upstream elevation. This edge permits the pier to take impacts from flood waters and divert water-borne debris. The upstream stones are solid across the full width of the wall. There are no head joints in the masonry that coincide with the center line of the north elevation.

The remaining masonry exhibits signs of erosion. The upper granite addition was set back from the upstream edge of the pier with squared faced ashlar to the upstream end. This granite appears eroded and has been subject to freeze-thaw cycles. Cracks and discoloration of the granite shows the results of the hydraulic impacts and scouring.

The displacement of stones from the top seven courses of the piers north end has exposed the core of the structure. The pier is vulnerable without the proper placement of the lower coursing associated with the original construction of the bridge c. 1837.
The cantilevered point-of-bearing stones (Tomstown Formation limestone) on the upstream end of the structure have been shifted off of their original bedding. Two of the stones on the east side remain in place supported by cantilevered elements of the core. Wall fall to the east and the south clearly shows a pattern of failure attributed to the presence of log jambs resting against the upstream face of the pier during high-water. Severely undercut the point-of-bearing stones are in most critical of condition. Further wallfall here is inevitable without stabilization.

The exposed core allows for flood waters to impact the stones in-situ. Saturation of the core of the structure has aided in the deterioration of the extant mortar. Erosion causes the most dramatic impact. Combined with repeated saturation and dehydration, erosion has leached out the lime within the mortar over and has caused degradation of the material through freeze-thaw cycles and erosion.

The exposed core exhibits Harpers Formation phyllite rubble masonry keyed across each course and into the limestone facing stone of the pier. Stones have been placed across the full width of the pier as distinct slabs. The core of the structure was designed to take the impacts of floating debris encouraging incremental failure of elements reducing the possibility of monolithic failure. Core elements were placed using a mortar with a high lime content or no mortar at all. The internal core was permitted to move through repeated impacts and saturation. Without this flexibility the pier may have experienced total failure.

RIP-RAP
Slabs of Harpers Formation phyllite function as rip-rap on the upstream end of the structure. Placed in a fish scale pattern the stones remain in place with slight displacement on the northern most end of the island. Distribution of the displacement of the rip-rap remains concentrated on the southeast side of the structure. Rip-rap on the north and west side of the structure remains in shallow water where the Harpers Formation bed of the river rises connecting Pier A and Pier B during periods of low water.

CONDITION ASSESSMENT
SOUTH ELEVATION
The plinth (point-of-bearing) stone masonry for the c.1837 bridge superstructure is semicircular in plan and is placed at the top of the southern end of the pier. The plinth has a shaped profile for each of the three courses of Tomstown Formation limestone. The coping stones have been shaped in plan to fit the curvature of the plinth with a straight face in profile. Coping stones are bedded upon two lower courses of the plinth. Two courses below the coping have a convex and concave face. The concave faced lower course makes the transition to the pitched-faced Tomstown Formation limestone of the pier. A section of the limestone plinth has been displaced and damaged . This may have occurred with the loss of the bridge superstructure.


PHOTOGRAPH: PIER-B SOUTH ELEVATION, WPTC-NPS 1994

The addition of granite coursing above the limestone increases the height of the pier 7'-6". From this coursing the pier is increased in height by an additional 4'-0" with squared granite plinth stones making the total height of the pier 31'-03". The granite remains from the c.1840 cast iron superstructure. This portion of the pier is sound without major displacement or potential of wallfall. The coursed ashlar

granite contrasts with the limestone in color. There remains a darkened patina from the rail operations. Scouring of the stones from water and water-borne debris is minimal on the south elevation.

RIP-RAP
Rip-rap at the base of the south elevation remains in sound condition with little displacement. The rip-rap has been placed utilizing Harpers Formation phyllite slabs surrounding the base of the pier in a fish scale pattern.

CONDITION ASSESSMENT
EAST ELEVATION
Facing the Maryland bank of the Potomac River the east elevation of Pier B has been subject to less of a direct impact than that of the north and west elevations. However, the main channel of the river begins at the base of the east face of the structure. This depth and the action of the river increases at the edge of the remaining rip-rap. Here there has been displacement of perimeter rip-rap leaving two courses of rip-rap exposed in section. The upstream end of the rip-rap has been displaced with some of the harpers phyllite slabs discharged towards the north end of the pier and the east side of the pier.

The masonry on the east face of the pier has damage concentrated on the north end where seven courses of Tomstown formation limestone have been displaced by lateral impacts from floating debris and log jambs. The point-of bearing stone described in the north elevation condition remains as the most critical element subject to wall fall. The east face has some transverse and lateral cracking, but not as severe as Pier A. Wall fall from Pier B has been discharged by flood water currents to the east and south.
Wall fall from the limestone masonry has concentrated at the base of the northeast side of the pier. Some of the shaped stones remain intact while others have shattered on impact.

The upper portion of the pier having a dark patina had three granite plinth stones. Two of the plinths have been displaced from the top of the pier and now rest at the base of the east face of the wall, towards the south end. This displacement must have occurred during major flooding, and may be associated with the failure of the superstructure. Projecting from the east face of the wall is a limestone plinth stone associated with the c.1837 bridge superstructure. Shaped stones match the profile of the downstream plinth with three stones having profiles flat, convex, and concave, respectively.

CONDITION ASSESSMENT
WEST ELEVATION
The base of the west elevation of the structure is a shallow area that adjoins the island of Pier A and the island of Pier B. During dry periods the water of the Potomac does not pass between these two structures. Deposition of material - silt, sand, and stone has concentrated on this side of the Pier due to the confluent currents of the Shenandoah and the Potomac.
The west face of Pier B remains in good condition with damage concentrated on the north end of the structure. A distinct feature on the west face of the pier just south of the damaged upstream end is a brick pilaster with pargetting that is attached or integrated with the west face of the wall. Water infiltration with subsequent freeze-thaw cycles is evident through the spalling of the brick and pargetting. This pilaster may have been placed as a non-structural crack repair



PHOTOGRAPH: DETAIL WEST ELEVATION, WPTC-NPS 1994

measure.

RIP-RAP
The rip-rap at the base of the west elevation remains in sound condition. Rip-rap and the Harpers Formation river bed on the west side of the pier integrates with the rip-rap at the base of the east elevation of Pier A. During periods of low water the two pier islands join.

RECOMMENDED TREATMENT - PB 01
RESETTING of DISPLACED MASONRY
SCOPE
Stabilization of Pier B must be implemented in order to save remaining historic fabric. The north (upstream) end of the bridge pier must be stabilized through replacing displaced masonry elements and reestablishing washed out mortar of the core of the structure.

METHODOLOGY
Tomstown Formation limestone and Harpers Formation phyllite elements that have been displaced through lateral live loads and hydraulic impacts may be retrieved from wall fall concentrated at the base of the east elevation. Some of the elements upon displacement have shattered, have become irreparable, or have been discharged downstream. Missing elements must be replicated through referencing extant associated fabric to match type of stone, dimension, shape, tool marks, and methodology of placement.
Preparation of the extant bed stones for placement of newly placed stones must involve the stabilizing of masonry below the plane of placement.

MATERIALS
Utilize Tomstown Formation limestone wall fall at the base of the south and east elevations for the exterior finish coursing.
Utilize Harpers Formation phyllite wall fall at the base of the south and east elevations for the core of the structure.
Additional stone if required must match extant stone in type, hardness, absorption, color, texture, and design.

RECOMMENDED TREATMENT - PB 02
POINTING
A comprehensive total removal of mortar from masonry joints is not necessary.
Prior to reestablishing the integrity of the core of the structure through placement of displaced stones and grout injection the repointing of the exterior of the structure must be implemented.

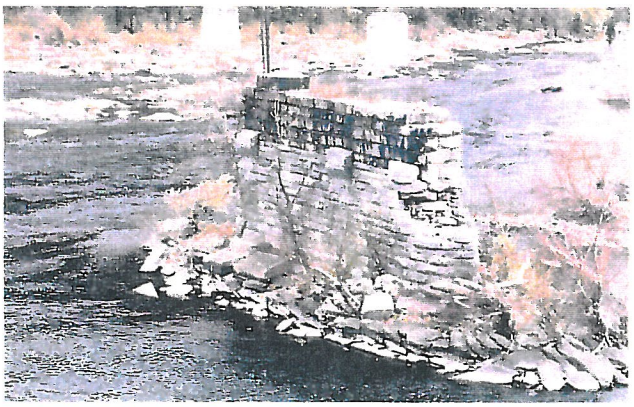
METHODOLOGY
Preparation of mortar joints to accept an approved and appropriate mortar shall involve removal of only deteriorated mortar. Sound mortar shall be left in-situ.
Remove deteriorated mortar using hand tools. Rake out joints removing deteriorated mortar, organic matter, and flood deposition.
Repoint utilizing an approved and appropriate mortar mix matching the historic mortar in color, texture, and joint profile.

RECOMMENDED TREATMENT - PB 03
GROUT INJECTION
SCOPE
Masonry joints of that have been totally washed out leaving individual units resting upon each other, upon

chinking stones, or left in a cantilevered condition or cores elements of the pier no longer retaining mortar from original placement.
Grout injection shall be implemented to re-establish the structural integrity of the core of the pier.
Reintegration of the masonry through placement of new mortar in bed joints and head joints.
Lower strength and more vapor permeable formulations can be formulated.

MATERIALS
MIX PROPORTIONS COMPATIBILITY
Mix proportions of the grout must be compatible with the thermal and moisture properties of the stone of the piers. The section of the core to be consolidated through low pressure grout injection is constructed of Tomstown formation limestone. The properties of the grout to be injected must retain a similar moisture uptake relative to the stone after setting. Thermal expansion properties of the grout material must be as close as possible to that of the stone without exceeding them. Material tests can be carried out at the time of construction.

NOTE:
Formulations should be premixed dry and then well mixed with water to the consistency of heavy cream or according to manufacturers specifications.
Cavities to be grouted are first cleaned of debris with compressed air then water flushed at low pressure. Cracks and fissures are dammed with nonstaining potters clay and the grout injected by low pressure grout pumps or syringes. After voids are completely filled, the work is covered with wet burlap or plastic for a slow cure.
All masonry work should be executed under optimum weather conditions to ensure the success of the repairs.
No work shall be executed nor cured during freezing weather (below 40F). Prevent rapid dehydration of masonry work repeat misting and protect from the
sun with damp burlap sacking.



PHOTOGRAPH: OBLIQUE PIER B, WPTC-NPS 1994

PIER C



PHOTOGRAPH: PIER C, WPTC-NPS 1994

GENERAL DESCRIPTION

Third bridge pier from the West Virginia bank of the Potomac River, Pier C remains as a ruin measuring 98 feet in length and 70 feet in width. The masonry structure and associated rip-rap of the island is sited in the center of the Potomac River. It has been subject to catastrophic impacts from flood waters and water-borne debris. The footprint of the pier remains intact with lower courses of the masonry on original bedding measuring 52'-0" in length and 8'-6" in width. Failure of the structure has displaced stones creating a ruin now retaining six courses of Tomstown formation pitched faced limestone on an island of Harpers phyllite rip-rap. The extant masonry of the pier at the south end tapers from six courses down to two courses at the upstream end in response to the aggressive river currents. From the east side of the pier the extant masonry has been buttressed by the displaced upper courses of masonry. Displaced masonry of the pier has been concentrated on the east and south faces of the pier indicating the direction that the structure failed.

SITE CONDITIONS

Submersible, Pier C is sited within the main current of the Potomac River. The extant masonry of the ruin remains as more vulnerable than that of Pier D

CONDITION ASSESSMENT

MASONRY:

Much of the rip-rap remains in place protected and weighted down with the masonry of the failed pier dispersed over the west and southern end of the pier island. Rip-rap Harpers Formation phyllite slabs average five hundred pounds placed in a fish scale pattern. Perimeter courses on the east side of the island have been displaced by aggressive currents of one of the main channels of the river providing a lateral live load to the structure.

The extant masonry of the pier is most recognizable on the east elevation. Exposed and free of displaced masonry from the failed section six courses of Tomstown formation limestone take lateral live loads from river currents. These courses are composed of pitched-faced and marginated coursed ashlar. The upstream end of coursing has been incremental displaced leaving two base courses of limestone. Stones of the north end have been shaped tapered to a point in plan.

Extant course work becomes totally submerged during times of high water. Hydraulic pressure on the standing coursework remains terrific as shown with slight displacement of the upstream end base stones shifted slightly off of their bedding. Hydraulic impacts combined with floating debris and gathering of log jambs have had a detrimental impact on the structure. The core of the structure remaining in built with Harpers Formation phyllite and has been displaced from the interior of the pier. This leaves the extant outer coursework more vulnerable to displacement without proper buttressing.

Pointing mortar of the exposed masonry is a raised joint utilizing a mortar mix with a high content of portland cement. Mortar associated with the core of the structure is limited. Most of the core has been subject to erosive action of flood waters with subsequent freeze-thaw cycles leaving little original mortar used in placement of the core.

PIER C

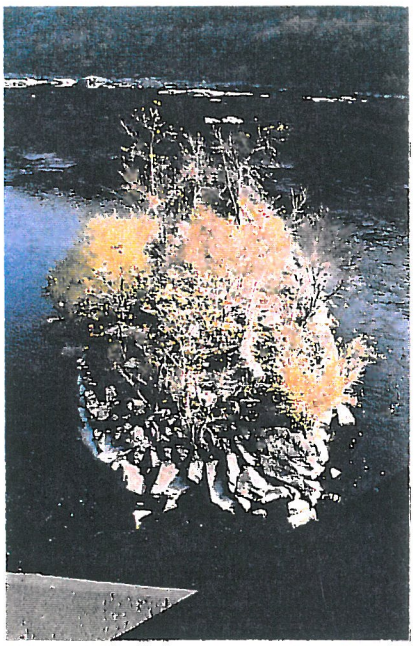
RECOMMENDED TREATMENT

Extant masonry elements shall be left in-situ. Harpers phyllite rip-rap of the pier shall be left in-situ. Displacement of the elements of the structure through lateral live loads and hydraulic impacts is unavoidable. The pier island trees shall be left intact. Though the trees have some impact on the remaining masonry the vegetation shall be left in place. Helping to retain some of the elements of the structures the trees periodically are thrashed by flood waters and water-borne debris that will naturally limit the size and health of the vegetation. Removal of log jams from the structure will not be necessary - the structures low elevation and submersible character shall encourage the natural discharging of water-borne debris.

PIER D

GENERAL DESCRIPTION:

This site is the fourth pier from the West Virginia bank of the Potomac River measuring 95 feet in length and 52 feet in width. Pier D remains as the pier with the largest loss of limestone coursing. Unlike the associated piers, Pier D has fully retained all Harpers phyllite stone rip-rap ,however, the pier elements have been displaced and discharged into the main channels of the Potomac River. Lower coursing of the structure remains in-situ with three courses of coursed ashlar pitched-faced Tomstown Formation limestone measuring 52 feet in length and 8'-6" in width. Most of the material has been discharged to the south and the east leaving the north and west elevations of Tomstown Formation limestone exposed and scoured. River deposition of silt and sand is concentrated on the east and south sides of the structure.



PHOTOGRAPH: PIER-D, WPTC-NPS,1993

SITE CONDITIONS:

LOCAL HYDROLOGY: Pier D sited near the east bank of the Potomac lies within the main current of the river. Lateral impacts are encouraged on the west elevation as indicated by the lack of erosion on the south and east sides of the pier. These lateral impacts combined with working live loads from gathered water-borne debris attributed to the failure of the pier. Aggressive water currents breach over the top of the extant masonry. These strong currents increase the level of displacement of remaining stones. Presently the stones of the core of the structure have been displaced from the upstream portion of the pier leaving the extant limestone outer coursing without buttressing. The shaped limestone of the upper end of the pier remaining have been shifted off of their bedding mortar by lateral live loads impacting the structure.

The placement of this pier island within the main current of the Potomac River has allowed for the tremendous loss of historic fabric. At times of high water the Potomac River totally submerges the remains of Pier D. Stones that remain in-situ are subject to hydraulic lateral live loads and impacts from water-borne debris. The level of displacement remains unavoidable. Extant vegetation on the pier shall remain in place. Sizes of the vegetation are limited by the natural impacts of the wave action and impacts from water-borne debris.

CONDITION ASSESSMENT

Masonry of the pier has totally collapsed and is covered with debris and vegetation. Pier D no longer exhibits distinct features as a structural element of the bridge system. However, lower courses of the wall remain in-situ defining the footprint of the pier. This course work is the same manner of construction as the other river-bound piers, utilizing pitched-faced ashlar Tomstown Formation limestone.

RECOMMENDED TREATMENT

Extant masonry elements shall be left in-situ. Harpers phyllite rip-rap of the pier shall be left in-situ. Displacement of the elements of the structure through lateral live loads and hydraulic impacts is unavoidable. No reconstruction or repair work is recommended. The pier island trees shall be left intact. Though the trees have some impact on the remaining masonry the vegetation shall be left in place. Helping to retain some of the elements of the structures the trees periodically are thrashed by flood waters and water-borne debris that will naturally limit the size and health of the vegetation. Removal of log jams from the structure will not be necessary. The structures low elevation and submersible character of the remaining pier structure shall encourage the natural discharging of water-borne debris.

PIER E

GENERAL DESCRIPTION:

Fifth pier from the West Virginia bank and first from the Maryland bank of the Potomac River, Pier E remains as a ruin measuring more than 130 feet in length and 72 feet in width. The extant coursing of the pier measures 53 feet in length and 8'-0" in width with a rounded downstream end and tapered upstream end. Early attempts at stabilization include a poured in place concrete repair on the upstream face of the pier. This concrete repair resulted in the consolidation of the remaining coursed ashlar Tomstown Formation limestone into a rigid, monolithic structure. This repaired pier was unable to respond to the impacts of water-borne debris and flood waters. Pier E experienced a monolithic failure in 1985 attributed to the consolidation of the masonry.

The core of the structure was left exposed following the failure of the upstream end of the pier . This exposed core allowed water infiltration and erosion of the extant mortar followed by incremental failure of the remaining courses. Further failure of the structure discharged the stones of the south end to the southwest. This is evident by the placement of dressed stones of the granite addition (c. 1840).



PHOTOGRAPH: PIER E VIEWING SOUTH, WPTC-NPS, 1993

The section of the pier consolidated by the concrete repair toppled to the east coming to rest in the shallows of the Maryland bank approximately fifteen feet from the original placement. The failure appears to have occurred in the following manner. The limestone masonry and associated granite coping stones were displaced first. This left the remaining granite addition of the center section of the pier to collapse to the west.
The southern downstream end of the pier failed to the southwest. Toppled granite stones remain in place southwest of the base of the structure.

Pier E retains distinct character defining features of a complete failure of the structure with the stones of the pier within close proximity. This differs from the failures of Pier D and Pier C where a substantial number of elements have been discharged downstream. Stones of Pier E are jumbled along the Maryland bank of the river, yet they retain each element without significant damage. Most of the granite stones retain the original sizes, tool markings, and shaped profiles. The granite stones have been subject to more scouring than the granite of Pier A, and Pier B which remains intact.

PIER E

SITE CONDITIONS

Located close to the Maryland bank of the Potomac River and within the shallows where bedrock is exposed, the pier has been subject to very aggressive flood water currents. The Maryland bank of the Potomac river experiences a major turn at the confluence with the Shenandoah. Water volume and impacting currents from both rivers at the confluence have displaced a tremendous amount of material from the adjacent C&O Canal berm. Some ten vertical feet of fill has clearly been displaced.

Tomstown Formation limestone was utilized as rip-rap at the base of the 1890 bridge connecting to the island of Pier E rip-rap of Harpers Formation phyllite. This rip-rap aids in protecting the remains of Pier E and the associated retaining walls of Pier F.
During times of high water the remains of Pier E become totally submerged. Aggressive river currents within the eddies around the structure have displaced the stones of the pier at the base of the retaining wall associated with Pier F.



PHOTOGRAPH: PIER E, WPTC-NPS,1993

CONDITION ASSESSMENT:

MASONRY:
Extant masonry of the footprint of the pier remains buttressed against incoming flood waters by wall fall displaced and distributed to the south and east of the ruin. Large elements of the monolithic failure including the concrete repair, and granite addition resting northwest and east of the tapered end of the pier footprint are partially protected from flood waters by the placement of the c. 1890 bridge pier and associated rip-rap.
Pointing mortar remaining in masonry joints has a raised profile with a composition that has a high content of portland cement. The mortar of the core of the structure remaining in place is much softer, though cementitious, it appears to have a high content of lime. Much of the mortar of the core has deteriorated.

Concrete used to consolidated the north end of the pier used no structural reinforcing. Natural sand and large sharp aggregate was utilized in the mix. Upon failure of the pier there was no damage to the concrete repair, though toppled the concrete, shows no signs of cracking or spalling. Associated granite plinth stones cleanly separated from the concrete/ consolidated masonry.

Rip rap at the base of the c.1890 Railroad bridge has been placed to take the lateral live loads of the hydraulic action from flood waters. The Tomstown formation rip-rap adjoins with the Harpers phyllite rip-rap of Pier E.

RECOMMENDED TREATMENT

Preservation treatment recommendations for the ruins of Pier E include limiting impact on the pier by railroad operations and repair of C&O Canal Pier F retaining walls and foundation. Stones of the failed pier shall be left in-situ. No reconstruction or repair of existing masonry is recommended.

Tree growth in this area is limited by the returning flood waters and wave action upon the vegetation. Recommend monitoring change in vegetation growth and further displacement of the structures elements.

S U M M A R Y o f T R E A T M E N T R E C O M M E N D A T I O N S

RESOURCE	GENERAL TREATMENT
B&O SPAN ABUTMENT	Re-establish masonry / mortar joints through specified grout injection. Remove soil deposition from base of the abutment. Remove tree roots impacting the masonry. Repair exposed masonry followed by replacement of the soil deposition.
WINCHESTER SPAN ABUTMENT	Re-establish masonry / mortar joints through specified grout injection. Remove soil deposition from the base of the abutment. Repair newly exposed masonry followed by replacement of the soil deposition.
PIER A	Remove tree roots, trunks, and canopies. Re-establish the rip-rap around the north (upstream) end of the structure. Repoint masonry where mortar has become displaced or is non-existent. Consolidate / fill crack in the masonry through specified grout injection.
PIER B	Remove tree root systems, trunks, and canopies. Reset displaced masonry of the north (upstream) end of the structure. Consolidate the weakened core of the pier through specified grout injection. Repoint masonry where mortar has deteriorated or has been washed - out. Re-establish displaced rip-rap around the structure.
PIER C	Leave vegetation in-situ. Leave displaced masonry in-situ.
PIER D	Leave vegetation in-situ. Leave displaced masonry in-situ.
PIER E	Leave vegetation in-situ. Leave displaced masonry in-situ.

Summary of Recommendations for Further Study

OBJECTIVES

In order to resolve construction planning issues in advance of day labor stabilization crews, several issues must be resolved.

Construction planning is recommended as it would resolve logistical challenges associated with work on the bridge abutments , the bridge piers, and their associated rip-rap island bases.

Other objectives for construction planning include the issues such as access technology and equipment, investigation of construction methods and technology, field testing of selected construction technologies, development of construction details and specifications for the day labor crew - development of construction details and specifications is dependent upon additional fabric investigation, also to be conducted during the construction planning phase. Other technical information concerning materials, ie., grouts, backing material, pointing mortars and stone would be developed as part of this further study.

Other project planning issues which require further study well prior to construction start-up are:

Compliance procedures (both cultural and natural) ownership issues, state jurisdiction issues, construction staging, tools and equipment issue. As an example - determination of options for stabilization of rip-rap island bases would be investigated and cost estimates would be prepared for park and regional consideration. Systems and options for rip-rap would be developed.

PRIORITIZED LIST

(Most critical to least critical)

IIB PIER B
1. PIER MASONRY
2. RIP-RAP

IIA PIER A
1. RIP-RAP
2. PIER MASONRY

IA B&O SPAN ABUTMENT
1. PILASTER - PILASTER WALL
2. GRANITE ADDITION
3. ABUTMENT WALL

IB WINCHESTER SPAN ABUTMENT
1. SOUTH ELEVATION
2. EAST ELEVATION
3. ABUTMENT RETAINING WALL

PIER B IIB1: Treatment Recommendation PB-01 Reset displaced rip-rap on the north end of the pier. IIB2: Treatment Recommendation PB-02 Reset displaced masonry on the north end of the pier. Consolidate the core of the pier through backing and grout injection. IIB3: Treatment Recommendation PB-02 Remove and replace mortar that has deteriorated on all elevations of the structure.	1 - Achieve compliance to remove siltation and vegetation to allow structural investigation of rip-rap base and base of pier 2 - Determine alternate methodologies for replacement of rip-rap function pier base. ie. Repair historic rip-rap, install gabions to act as rip-rap etc. 3 - Determine construction technologies to implement proposed methodologies. 4 - Determine cultural and natural issues which will set the compliance agenda and approval process in motion to achieve project compliance(ie. ownership and state jurisdiction issues - work with the NCR Lands Office for accurate information. 5 - Determine sources of material, material quantity needs and Class "A" cost estimates for construction. 6 - Produce project specifications for materials, etc. 7 - Determine alternate proposals for access to the pier for construction purposes (see compliance issues Pier A) 8 - Determine procurement process to acquire project access and materials. 9 - Establish construction planning, compliance and day labor construction time line for project and 10 - Establish project costs...

FURTHER STUDY

PIER A	
IIA1: TREATMENT RECOMMENDATION PA-02: Reset displaced rip-rap of the north (upstream) end of the pier. IIA2: TREATMENT RECOMMENDATION PA-01: Grout inject major crack in masonry. IIA3: TREATMENT RECOMMENDATION PA-03: Remove and replace only deteriorated mortar on all elevations of the pier.	1 - Achieve compliance to remove siltation and vegetation to allow structural investigation of rip-rap base and base of pier 2 - Determine alternate methodologies for replacement of rip-rap function pier base. ie. Repair historic rip-rap, install gabions to act as rip-rap etc. 3 - Determine construction technologies to implement proposed methodologies. 4 - Determine cultural and natural issues which will set the compliance agenda and approval process in motion to achieve project compliance(ie. ownership and state jurisdiction issues - work with the NCR Lands Office for accurate information. 5 - Determine sources of material, material quantity needs and Class "A" cost estimates for construction. 6 - Produce project specifications for materials, etc. 7 - Determine alternate proposals for access to the pier for construction purposes (see compliance issues Pier A) 8 - Determine procurement process to acquire project access and materials. 9 - Establish construction planning, compliance and day labor construction time line for project and 10 - Establish project costs...

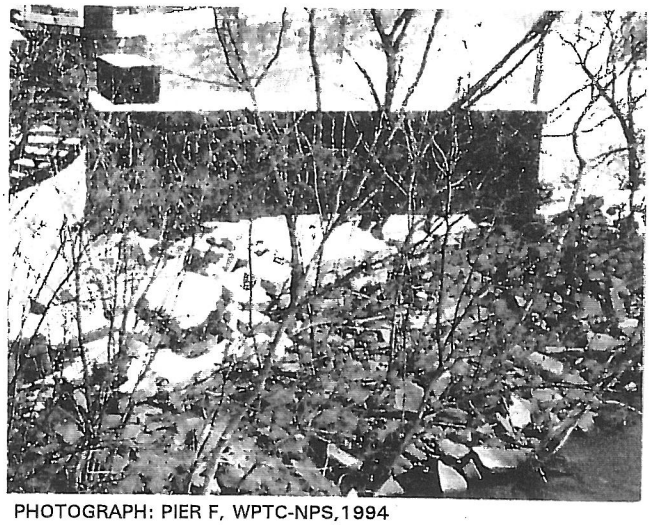
BOSA IA1. PILASTER IA2. GRANITE ADDITION IA3. ABUTMENT (RETAINING) WALL	1 - Achieve compliance for the removal of silt at the base of WSA. 2 - Conduct field investigations to determine condition of the base stones. 3 - Achieve compliance to remove existing vegetation in order to inspect concealed masonry. 4 - Conduct field investigations to determine extent of voids in the masonry back-fill material. 5 - Determine field mix for grouting and mortar - develop field test for and sample panels for approval. 6 - Develop field testing schedule 7 - Develop specifications for low pressure grouting and methods for grout mix. 8 - Develop mixes for bedding mortar.
WSA IB1 South Elevation IB2 East Elevation IB3 Abutment Retaining Wall	IB 1 - Achieve compliance for silt removal in order to inspect masonry for damage and displacement. 2 - Remove existing vegetation in order to inspect masonry for damage and displacement. (see BOSA IA)

APPENDIX A

APPENDIX A
PIER F

GENERAL DESCRIPTION:

Located on the Maryland bank of the Potomac River Pier F remains as the only land based pier of the B&O Railroad Bridge. The structure is contemporaneous with the construction of the Latrobe Timber Frame truss bridge as noted in the original specifications for the bridge.



PHOTOGRAPH: PIER F, WPTC-NPS,1994

The pier remains as the only granite pier of the bridge. It is rectilinear in plan which differs from the other piers which have a tapered upstream end and a rounded downstream end. The squared upstream end of the pier has sustained damage through the impacts of flood waters and water-borne debris. As sited the structure is subject to impacts from catastrophic flooding. Lateral live loads from flood waters impact the base and west face of the pier. The Maryland bank of the river has been subject to tremendous flood waters as the erosion in the area of the C&O Canal lock and Pier F exhibits.

The exposed rubble core of the coursed ashlar pitch-faced granite pier is of harpers phyllite rubble masonry. Coping stones of the pier are pitch-faced coursed ashlar granite.

CONDITION

MASONRY

Critical elements of the pier are the two associated retaining walls at the foot of the west river side elevation. The two retaining walls begin as low walls following the contour of the river bank. The walls taper and join together as one wall at the south end of the pier where there lies the most damage. Sections of the retaining walls have been damaged through terrific hydraulic impacts. Stones of the embankment walls have been jumbled with upper coursing displaced to the base of the wall within the river. Combined with undercutting of the base of the wall this has endangered the foundation stones of the pier. Further displacement of upper coursing of the supporting retaining wall will expose the underside of the foundation stones.

The piers upstream/ north end has been damaged through impacts from flood waters and water-borne debris shifting the base granite course stones exposing the core of the structure. Subsequent saturation and freeze thaw cycles have damaged the core of the pier.

The associated stone retaining walls on the Maryland bank of the Potomac River are in poor condition. Paralleling the bank of the river are two retaining walls with the base of the pier resting upon the upper stone retaining wall. Partially cantilevered the southwest corner of the structure overhangs the remains of the retaining wall below.

The base of the east elevation of the pier (along the tow path) has the most critical damage. Lower courses at grade have been displaced through rodent and water impacts. The core of the structure has been severely undermined beyond the opening having a cavernous space approximately ten feet in length beneath the core of the pier. Further water infiltration and subsequent erosion will further impact the strucutral stability of the pier.

RECOMMENDED TREATMENT:

CRITICAL

Excavate at the base of the east elevation to reveal the extent of the damage to the core. Stabilize the pier through the use of traditional masonry techniques. Infill the eroded area beneath the core with stone matching the core of the structure in type (harpers phyllite or a stone of same hardness and absorption rate).

Refrain from using concrete to make repairs to the base of the structure.

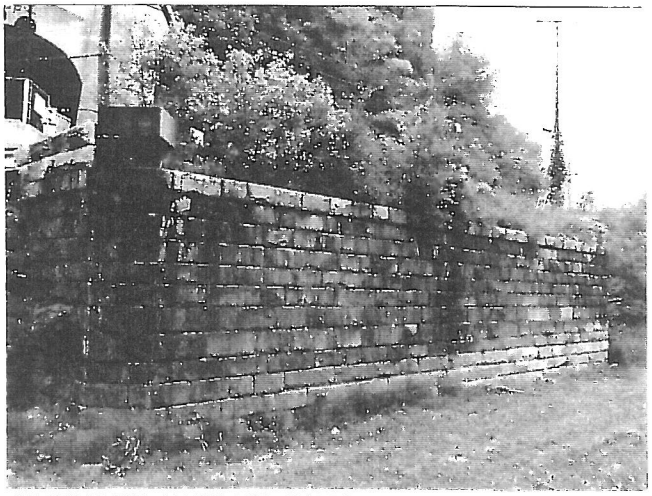
Partial stabilization of the pier through placement of concrete may induce unequal stresses on the masonry above encouraging the displacement of masonry or unequal settlement of the pier as a whole. Reset the displaced coursing at the north end of the pier and at the base of the east wall.

Remove the root systems, trunks, and canopies of the trees that are damaging the masonry at the base of the west elevation. The base of the west elevation has displaced masonry associated with the two retaining walls supporting the above pier foundation. Dismantling of displaced masonry will be necessary in order to reset the stones to original placement.

APPENDIX A
MARYLAND ABUTMENT

GENERAL DESCRIPTION

Located above the Maryland bank of the Potomac River on the east side of the C&O Canal is the Maryland Abutment. It remains as a retaining wall supporting Harpers Ferry Road in Washington County, Maryland. Constructed of coursed ashlar granite the masonry of the abutment is of the same type as that of Pier F. Two courses of Tomstown formation limestone finishes off the coping of the north and south wing walls of the abutment tieing the structure into the west retaining wall of the canal and roadway. Extant granite plinth stones each of two courses have a pecked face finish dressed as square plinths for the now gone cast iron superstructure towers. Ferrous stains remain on the plinth stones and sections of the abutment. The lower courses of the abutment have been scoured by clean flood waters that breach the tow path berm and inundate the remaining depression of the canal. Vegetation has impacted the abutment along the coping within the back-fill and at the base of the north and south wing walls.



PHOTOGRAPH: MARYLAND ABUTMENT, WPTC-NPS,1994

CONDITION

MASONRY:

Masonry of the abutment remains structurally sound with few elements showing displacement. Courses have been pointed with a cement based mortar much of it remaining in sound condition.

RECOMMENDED TREATMENT:

Hardwood vegetation within the back-fill area at the coping line and at the base of the abutment should be managed through removal of the root systems, trunks, and canopies. Vines should be kept free from the face of the structure.

Implement general pointing through removal of only deteriorated mortar. Replace mortar with an approved and appropriate mortar mix matching the historic mortar in color, texture, and joint profile.

APPENDIX B

ITEMIZED CLASS "C" COST ESTIMATE for PHASED CONSTRUCTION

INTRODUCTION: This Class "C" construction cost estimate has been organized in two phases as per direction from the park. Phase I work consists of preservation treatment of the B&O Span Abutment and the Winchester Span Abutment on the West Virginia shore. Phase II work consists of preservation treatment of bridge Piers A and B. In each of these two phases work has been itemized to further reflect the realities of the construction sequence. Work has also been prioritized according to the 80 % Draft Review Assessment Data and Treatment Recommendations report.

The Class "C" estimate is a conceptual estimate based on square foot (or unit) costs of similar construction or identifiable unit costs of similar construction items. These estimates are prepared without a fully defined scope of work. Class "C" costs may appear high; however, these figures have been compiled from historic contract data and have been adjusted to compensate for undefined related costs that will typically be needed for historic structures such as the B&O Railroad Bridge Abutments and Piers.

Per square foot costs include labor and material only. WPTC overhead is included as outlined on the summary page of this document to reflect true project totals.

PHASE I: WEST VIRGINIA ABUTMENTS

IA: B&O SPAN ABUTMENT

IA1: B&O SPAN LIMESTONE PILASTER (East Elevation)

DESCRIPTION: Pilaster projects from the face of the embankment retaining wall measuring twenty-one feet in height. Its construction utilized pitched faced ashlar Tomstown Formation limestone with radially shaped stones placed in mortar.

TREATMENT RECOMMENDATION: Preparatory work: removal of vegetation, power cleaning, raking out mortar. Repointing and grout injection of 100% of structure.

IA1 Class C Construction Cost Estimate

Pilaster:		
Raking and pointing	1200 sqft x $12/ sqft =	$14400
Backing and grout Injection	430 cuft x $36.50/cuft =	$15695
Pilaster wall:		
Raking and pointing	750 sqft x $12/sqft =	$09000
Backing and grout injection	177cuft x $36.50/cuft =	$06488
SUB TOTAL		**$45583**

IA2: B&O SPAN GRANITE ADDITION

DESCRIPTION: Granite addition placed as an appendage onto the face of the limestone abutment measuring 25 feet in height. The masonry addition was constructed utilizing pitched faced and marginated coursed ashlar granite stones set in mortar.

TREATMENT RECOMMENDATION: Preparatory work (including tree and stump removal) followed by pointing 100% of the wall and grout injection at the junctures with the limestone masonry.

IA2 Class C Construction Cost

Raking and Pointing:	1600 sqft x $12/ sqft =	$19200
Backing and grout injection	88cuft x $36.50/cuft =	$03212
SUB TOTAL		**$22412**

IA3: B&O SPAN LIMESTONE ABUTMENT WALL

DESCRIPTION: Placed between the granite addition and the c.1890 Bridge Abutment the limestone abutment wall constructed of pitched faced coursed ashlar tomstown formation limestone racked back from the base course approximately five feet to a height of 25 feet.

RECOMMENDED TREATMENT: Preparatory work followed by pointing and grout injection 100% of the wall section.

IA3 Class C Construction Cost

Raking and pointing	750 sqft x $12/ sqft =	$09000
Backing and grout injection	668 cuft x $36.50/cuft =	$24382
SUB TOTAL		**$33382**

IB: WINCHESTER SPAN ABUTMENT

IB1: WINCHESTER SPAN ABUTMENT - SOUTH ELEVATION

DESCRIPTION: Section of the south elevation of the Winchester Span Abutment located along the north bank of the Shenandoah River is integrated into the massive railroad bed retaining wall along the Shenandoah River. This section of the abutment is constructed of mortared pitched-faced coursed ashlar masonry integrated into dry-laid Harpers Formation phyllite rubble. A small dry-laid rubble wing wall (running north-south) is integrated into the abutment elevation marking the western most section of the abutment to be considered. Work will focus only on the mortared sections of wall. Dry-laid sections of wall are not included in this project.

TREATMENT RECOMMENDATION: Repoint, and tamp point areas of deteriorated mortar retaining dry-laid sections.

IB1 Class C Construction Cost

Raking and pointing	1200 sqft x $ 12/ sqft =	$14400
SUB TOTAL		**$14400**

IB2 : WINCHESTER SPAN ABUTMENT - EAST ELEVATION

DESCRIPTION: The east elevation of the Winchester Span anchors the southeast corner of the town of Harpers Ferry. The abutment stones are of Tomstown Formation limestone placed as pitched-faced coursed ashlar. Upper courses of this limestone were altered with the addition of granite-bearing surface. The coursed ashlar granite addition was placed to accept the 1851 cast iron Bollman truss Winchester Span. The granite coping was created to accept the plinth stones for the cast iron superstructure.

TREATMENT RECOMMENDATION: Remove extensive silt build-up along base of walls to expose lowest course evident at southeast corner. Repoint, and tamp point removing only deteriorated mortar.

IB2 Class C Construction Cost

Raking and pointing	1700 sqft x $ 12/ sqft =	$20400
SUB TOTAL		**$20400**

IB3: ABUTMENT RETAINING WALL

DESCRIPTION: Located between B&O Span Abutment and the Winchester Span Abutment the retaining wall constructed of coursed and random Harpers Formation phyllite rubble was mortared in place measuring 21' in height and 103 feet in length racking back from the base course to the coping eight feet.

TREATMENT RECOMMENDATION: Remove extensive silt build-up along base of walls to expose lowest course evident at southeast corner. Repoint , tamp point, and grout inject - 100% of the wall surface.

IB3 Class C Construction Cost

Raking and pointing	1760 sqft x $12/ sqft =	$21120
Backing and grout injection	1043 cuft x $36.50/cuft =	$38061
SUB TOTAL		**$59190**

PHASE II: BRIDGE PIERS

Phase II construction shall concentrate on the two extant piers in the Potomac River (Piers A and B).

IIA: PIER A

DESCRIPTION: First of the river-bound bridge piers from the West Virginia bank of the Potomac, the pier now measures 32'-6" in height and 90'-0" in length. Rip-rap at the base of the structure creates an island on which the pier appears to rest - increasing the footprint of the structure by 30' in width and 30' in length. Constructed of Tomstown formation limestone, the pitched-face, coursed ashlar masonry pier has been tapered on the upstream end and rounded on the downstream end.

IIA1: TREATMENT RECOMMENDATION PA-02:
Reset displaced rip-rap of the north (upstream) end of the pier.

IIA2: TREATMENT RECOMMENDATION PA-01:
Grout inject major crack in masonry.

IIA3: TREATMENT RECOMMENDATION PA-03:
Remove and replace only deteriorated mortar on all elevations of the pier.

IIA Class C Construction Cost

Rip Rap:
10000 cubic feet
(10000) (170#/ cuft) = 850 tons
850 tons x $300/ ton = $255000

STONE PLACEMENT NOTE: Harpers Formation phyllite delivered, shaped and sized by masons to match extant rubble slabs and placed in a pattern in marine conditions. (incl. 21 days equipment rental @ 3500 dollars per day = $73500)

Backing and grout injection	249 cuft x $36.50/cuft =	$009088
Raking and pointing	1890 sqft x $12/ sqft =	$022680
SUB TOTAL PHASE IIA		**$ 286680**

SUMMARY PHASE I: WEST VIRGINIA ABUTMENTS

B & O SPAN ABUTMENT MATERIALS AND LABOR

IA1	$45583
IA2	$22412
IA3	$33382
SUB TOTAL	**$101377**

WINCHESTER SPAN ABUTMENT MATERIALS AND LABOR

IB1	$14400
IB2	$20400
IB3	$59190
SUB TOTAL	**$93990**

$195367 TOTAL for MATERIALS and LABOR

FIXED COST ITEMS		
Transportation (vehicle charges)	$005000	(28 weeks at $180/ week)
Equipment (scaffolding, grout pump,etc.)	$016000	
Tools (replacement)	$003000	
SUBTOTAL FIXED COST ITEMS	$024000	

TOTAL PHASE I	$195367	for materials & labor
	$024000	for fixed cost items
	$219367	Subtotal
	$073122	WPTC overhead

CLASS C ESTIMATE (not including optional items)

TOTAL PHASE I **$292489**

SUMMARY PHASE II: BRIDGE PIER A, BRIDGE PIER B

Materials and Labor:
(includes rental of marine equipment, crane, and operators)

IIA	$286680	Pier A
IIB	$167242	Pier B
SUB TOTAL	$453922	

Total for Materials and Labor	$453922
FIXED COST ITEMS	
Transportation (vehicle charges)	$001440
Equipment (scaffolding, boats)	$003000
Tools (replacement)	$004549
SUB TOTAL PHASE II	$462911
WPTC OVERHEAD	$154304

CLASS C ESTIMATE (not including optional items)

TOTAL PHASE II **$617214**

OPTIONAL ITEMS

Note that optional items as outlined for Phase I and Phase II construction may be carried out by HAFE park. Should HAFE consider WPTC to implement the optional items, costs will be as follows.

PHASE I		
IA1	OPTIONAL ITEM: (Vegetation and soil removal)	@ $3000
IA2	OPTIONAL ITEM: (Tree, stump, and soil removal)	@ $5560
IA3	OPTIONAL ITEM: (Vegetation and soil removal)	@ $0000
IB1	OPTIONAL ITEM: (Vegetation and soil removal)	@ $3000
IB2	OPTIONAL ITEM: (Vegetation and soil removal)	@ $5560
IB3	OPTIONAL ITEM: (Vegetation and soil removal)	@ $5560
SUBTOTAL		$22680
WPTC OVERHEAD (COST SAVINGS IF IMPLEMENTED BY HAFE)		$07560
PHASE I OPTIONAL ITEMS TOTAL:		**$30240**

PHASE II		
IIA	OPTIONAL ITEM: (Vegetation and debris removal)	@ $6000
IIB	OPTIONAL ITEM: (Vegetation and debris removal)	@ $6000
SUBTOTAL		$12000
WPTC OVERHEAD (COST SAVINGS IF IMPLEMENTED BY HAFE)		$04000
PHASE II OPTIONAL ITEMS TOTAL:		**$16000**

FINAL COST

TOTAL PROJECT COST INCLUDING OPTIONAL ITEMS

PHASE I OPTIONAL ITEMS TOTAL	$030240
CLASS C ESTIMATE PHASE I	$292489
TOTAL PHASE I CLASS C ESTIMATE (w/ optional items)	**$322729**
PHASE II OPTIONAL ITEMS TOTAL	$016000
CLASS C ESTIMATE PHASE II	$617214
TOTAL PHASE II CLASS C ESTIMATE (w/ optional items)	**$633214**

TOTAL PHASE I and PHASE II CLASS "C" CONSTRUCTION COST

TOTAL PHASE I CLASS C ESTIMATE (w/ optional items)	**$322729**
TOTAL PHASE II CLASS C ESTIMATE (w/ optional items)	**$633214**
TOTAL PHASE I and PHASE II CLASS "C" CONSTRUCTION COST	**$955943**

CONSTRUCTION PLANNING TEAM COST ESTIMATE for PKG 212

The purpose of the construction planning team is to resolve the logistical challenges of completing stabilization work on the bridge abutments, the bridge piers and the associated rip rap island bases.

Goals and objectives for the construction planning team will be further developed but include the following general issue topics: access technology and equipment, construction methodology, compliance (both cultural and natural), staging equipment, and tools and materials issues.

Proposed Team Members from WPTC and associated cost

Doug Hicks, Supervisory Exhibit Specialist
1 PP x $3290 / PP = $ 3290

Earl Gillespie, Exhibit Specialist
1 PP x $2564 / PP = $ 2564

Chris McGuigan, Exhibit Specialist
1 PP x $2042 / PP = $ 2042

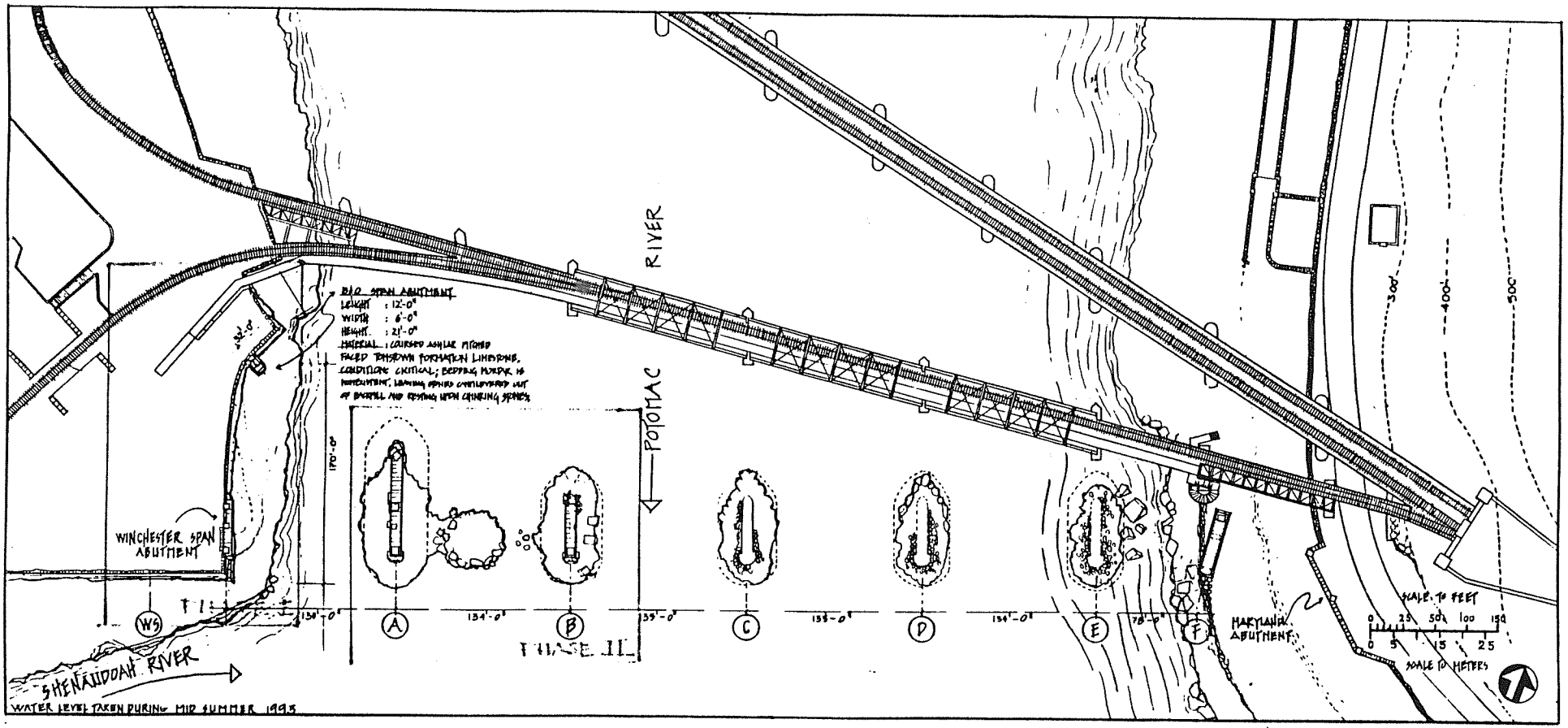
Tom Vitanza, Historical Architect
2 PP x $2600 / PP = $ 5200

Paul Neidinger, Historical Architect
2 PP x $2170 / PP =m $ 4340

Barry Welton, Structural Engineer
1 PP x $4000 / PP = $ 4000

SUB TOTAL SALARIES	$21436	
TRAVEL COSTS		$ 2000
SUPPLIES		$ 1200
SUB TOTAL ESTIMATE		$24636
WPTC OVERHEAD	$ 8212	

CONSTRUCTION PLANNING TEAM ESTIMATE TOTAL $32848



WINCHESTER SPAN ABUTMENT
LENGHT : 44'-3"
WIDTH : 8'-8"
HEIGHT : 19'-4"
MATERIAL - COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE W/
- COURSED ASHLAR PITCHED FACED GRANITE ADDITIONS.
- HARPERS PHYLITE RUBBLE

NOTE - LEVEL OF MASONRY AT BASE OF MONUMENT.

PIER A
LENGHT : 40'-0"
WIDTH : 8'-0"
HEIGHT : 32'-6"
MATERIAL - COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION
- COURSED ASHLAR GRANITE ADDITION
- RIP RAP (135'x 85')
HARPERS PHYLITE PLACED IN A FISH SCALE PATTERN.

CRITICAL CONDITION - DISPLACED HARPERS PHYLITE RIP RAP ON UPSTREAM (NORTH) END.

PIER B
LENGHT : 52'-0"
WIDTH : 8'-6"
HEIGHT : 31'-3"
MATERIAL - COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE W/
- COURSED ASHLAR GRANITE ADDITION
- RIP RAP (85'x12')
HARPERS PHYLITE PLACED IN A FISH SCALE PATTERN

CRITICAL CONDITION - DISPLACED STONES OF UPPER COURSES OF THE UPSTREAM (NORTH) END

PIER C
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 8'-0"
MATERIAL - COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE
- RIP RAP (85'x12')
HARPERS PHYLITE PLACED IN A FISH SCALE PATTERN.

CONDITION: SIX COURSES OF MASONRY REMAIN IN-SITU. UPPER COURSES DISCHARGED INTO RIVER INCLUDING ASHLAR GRANITE ADDITION

PIER D
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 3'-9"
MATERIAL - COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE
- RIP RAP (85'x12')
HARPERS PHYLITE PLACED IN A FISH SCALE PATTERN.

CONDITION : THREE COURSES OF MASONRY REMAIN IN-SITU. DEBRIS FROM UPPER COURSES IS CONCENTRATED AROUND EXTANT COURSE WORK.

PIER E
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 4'-0"
MATERIAL - COURSED ASHLAR PITCHED FACE TOMSTOWN FORMATION LIMESTONE
- RIP RAP (85'x12')
HARPERS PHYLITE PLACED IN A FISH SCALE PATTERN.

CONDITION : BASE COURSES OF MASONRY REMAIN IN-SITU. DEBRIS FROM UPPER COURSES IS CONCENTRATED AROUND EXTANT COURSE WORK. EARLY REPAIR AT UPSTREAM (NORTH) END CONSOLIDATED THE MASONRY CONTRIBUTING TO MONOLITHIC FAILURE.

PIER F
LENGTH : 58'-0"
WIDTH : 10'-0"
HEIGHT : 14'-0"
MATERIAL : COURSED ASHLAR PITCHED FACED GRANITE WITH MARGINS. FOUNDATION STONES ARE HARPERS PHYLITE COURSED RUBBLE MASONRY.

CRITICAL CONDITION : DISPLACED GRANITE COURSEWORK AT NORTH END. SEVERE UNDERMINING ALONG EAST SIDE OF FOUNDATION. SEVERE DISPLACEMENT OF RUBBLE MASONRY OF ASSOCIATED FOUNDATION RETAINING WALL AT SOUTHWEST CORNER.

MARYLAND ABUTMENT
LENGHT : 90'-0"
WIDTH : 15'-0"
HEIGHT : 50'-0"
MATERIAL : COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE.

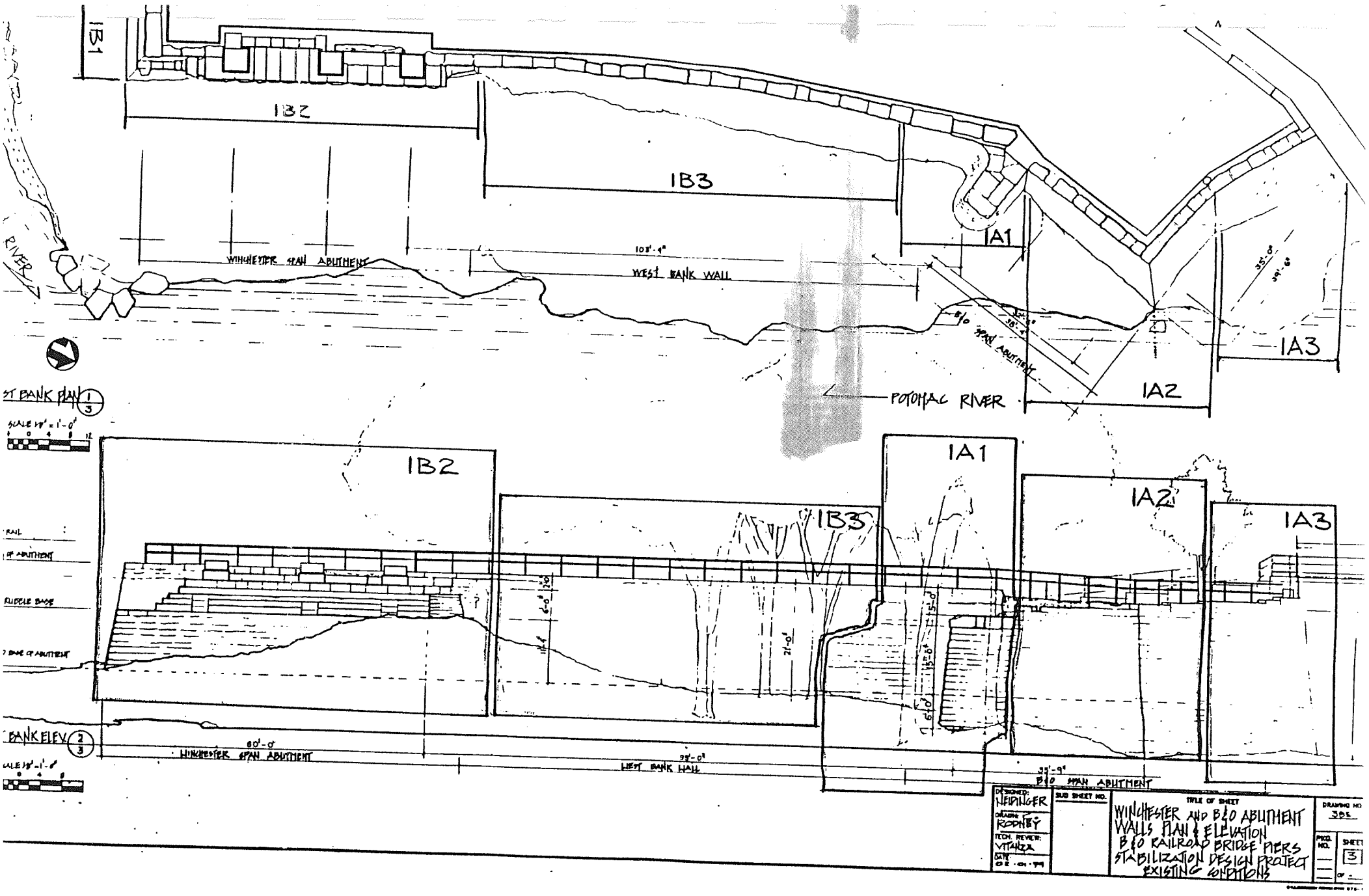
CONDITION: REPAIRS TO EMBANKMENT OF C&O CANAL AND MARYLAND HARPERS FERRY ROAD, WASHINGTON COUNTY.

DESIGNED: HEDINGER
DRAWN: C. RODNEY
TECH. REVIEW: T. VITANZA
DATE: OCT. '93
SUB SHEET NO.

TITLE OF SHEET
SITE-PLAN
B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 3DE
PKG. NO.
SHEET 2 OF

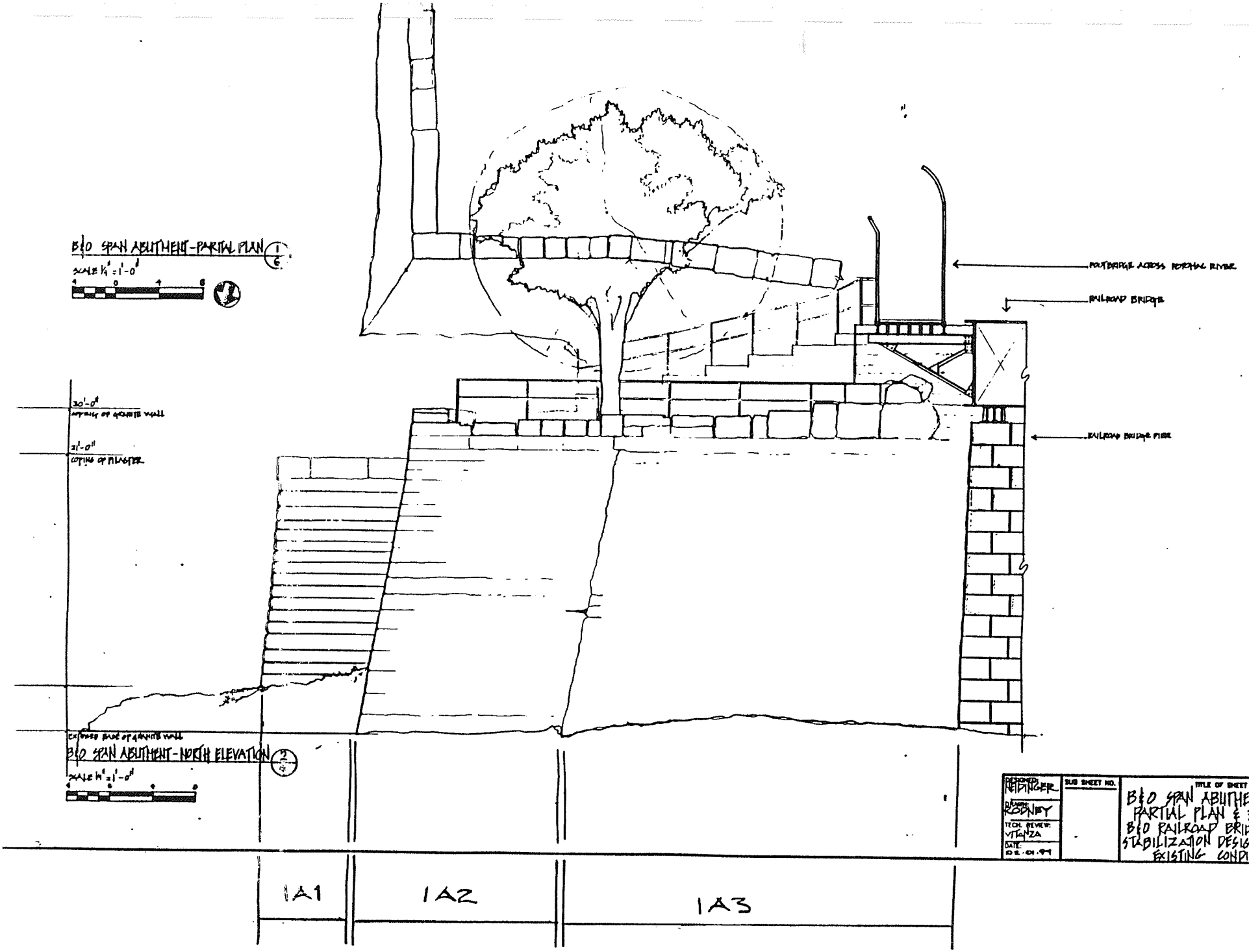
PHASE I and PHASE II
CLASS "C" CONSTRUCTION COST
ESTIMATE



□ - PHASE I - CONSTRUCTION

B&O SPAN ABUTMENT-PARTIAL PLAN (1/6)

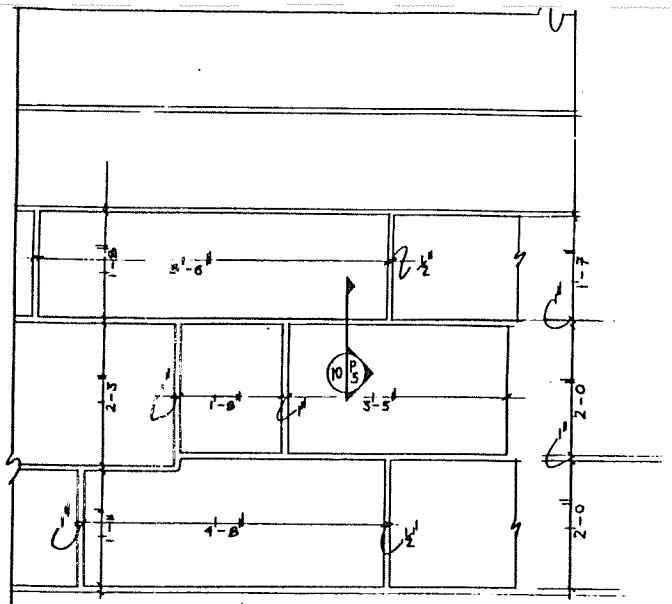
SCALE 1/4" = 1'-0"



B&O SPAN ABUTMENT-NORTH ELEVATION (2/6)

SCALE 1/4" = 1'-0"

DESIGNED: RETTINGER	SUB SHEET NO.	TITLE OF SHEET: B&O SPAN ABUTMENT WALL PARTIAL PLAN & ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS
DRAWN: RODNEY		DRAWING 328
TECH. REVIEW: VITANZA		PKG. NO.
DATE: 10-31-91		

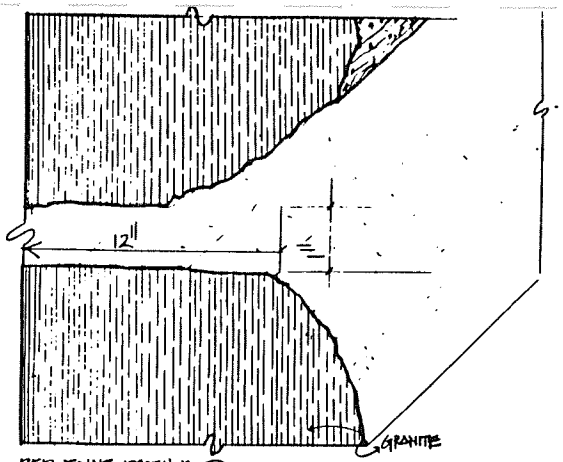


ASHLAR MASONRY DETAIL OF B&O SPAN ABUTMENT (EAST ELEVATION) 1/10

SCALE: 1"=1'-0"

EXISTING CONDITIONS:

MORTAR HAS COMPLETELY DETERIORATED AND WASHED OUT THROUGH EROSIVE ACTION OF FLOOD WATERS, SATURATION, AND SUBSEQUENT FREEZE-THAW CYCLES.



BED JOINT PROFILE P5/10

FULL SCALE

3 0 3

EXISTING CONDITIONS:

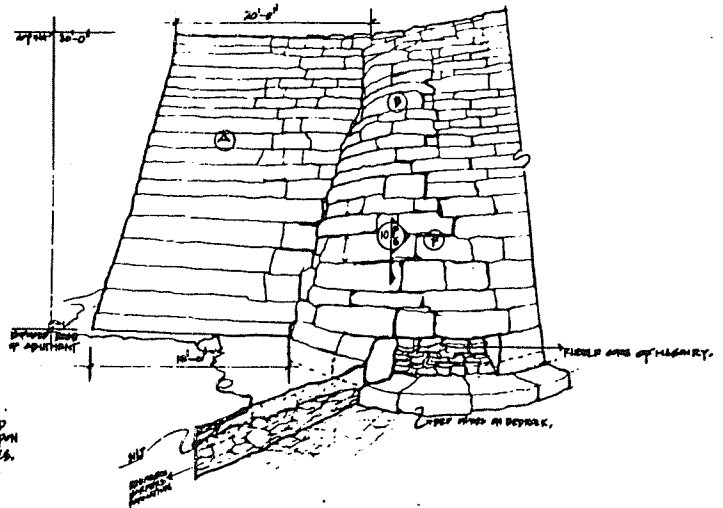
GRANITE – COURSED ASHLAR. PITCHED FACED.

LIMESTONE- TONOWDEN FORMATION PITCHED FACED COURSED ASHLAR REPLACED STONE.

DRESSED STONE.

CONVERSE CRACK IN MASONRY.

VERTICAL CRACK IN MASONRY.

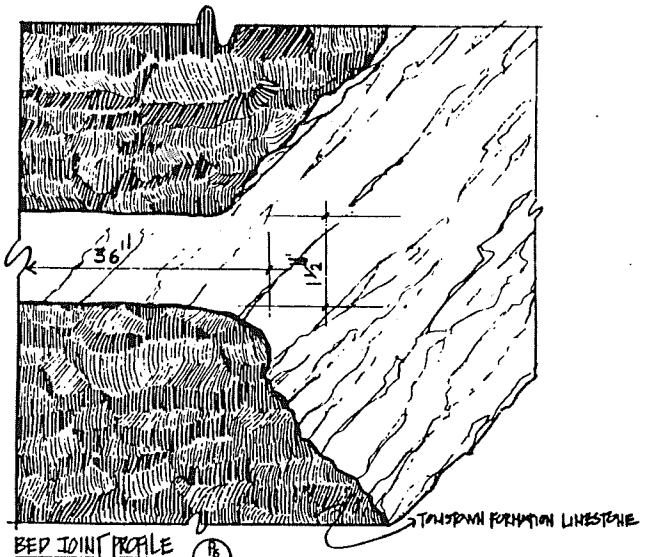


EXISTING CONDITIONS:

STONE MASONRY WAS ADDED C.1891 FOR PLACEMENT OF LIFE SPAN B&O SPAN ABUTMENT ADDITION. STONE IN THE ABUTMENT IS PITCHED TO RANDOM ASHLAR.

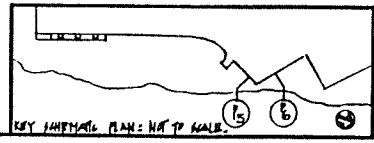
TOP OF THE HEAD AND BED JOINTS HAS WASHED COMPLETELY LEAVING STONES RESTING UPON KING STONES AND RUBBLE CORE STONES. SEGMENT TRANSVERSED AND LATERAL CRACKING OF MASONRY.

NORTH (UPSTREAM) ELEVATION DETAIL OF B&O SPAN ABUTMENT 2/10



BED JOINT PROFILE P6/10

FULL SCALE



KEY SHEET PLAN: NOT TO SCALE.

DESIGNED: NEIDINGER
DRAWN: RODNEY
TECH. REVIEW: VIGNZA
DATE: 02.01.94

SUB SHEET NO.

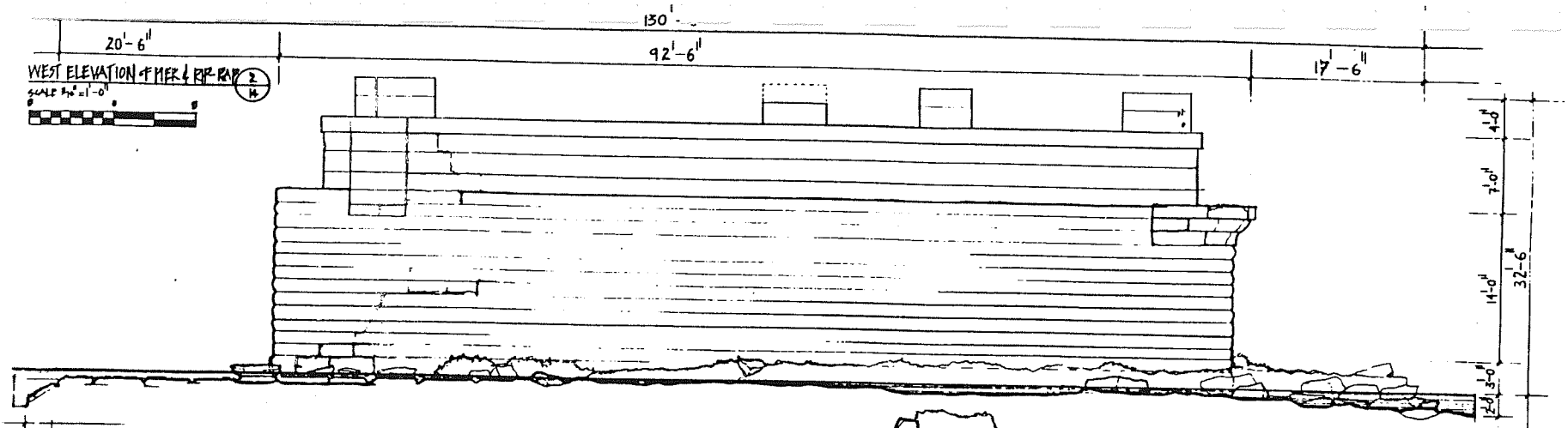
TITLE OF SHEET
B&O SPAN ABUTMENT WALL MASONRY DETAIL & JOINTS PROFILES B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS

DRAWING NO. 358

PKG. NO.

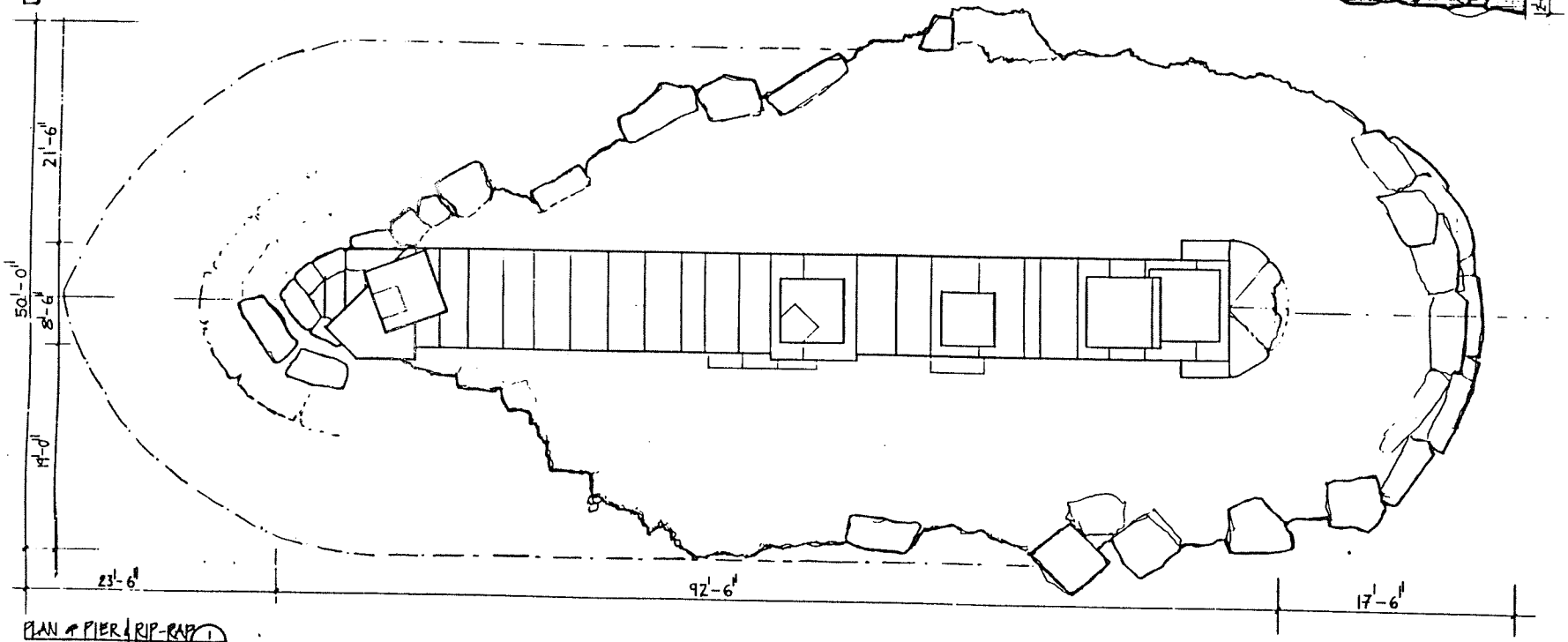
SHEET 10 OF

1.2-7 1.2-3



WEST ELEVATION of PIER & RIP-RAP 2/14

SCALE 1/8" = 1'-0"

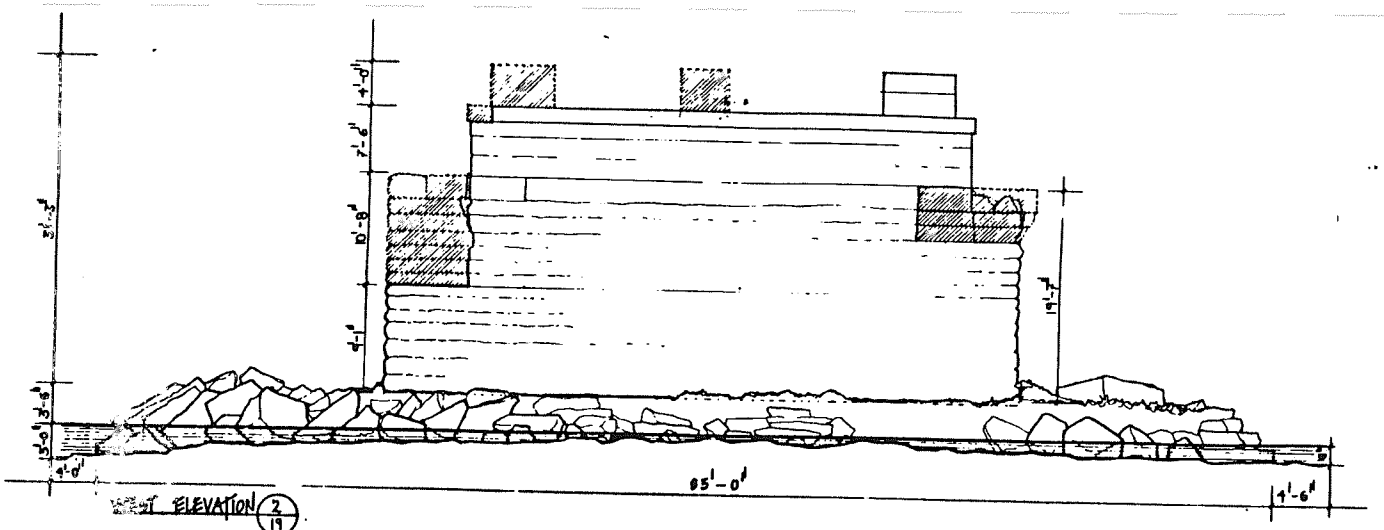


PLAN of PIER & RIP-RAP 1/14

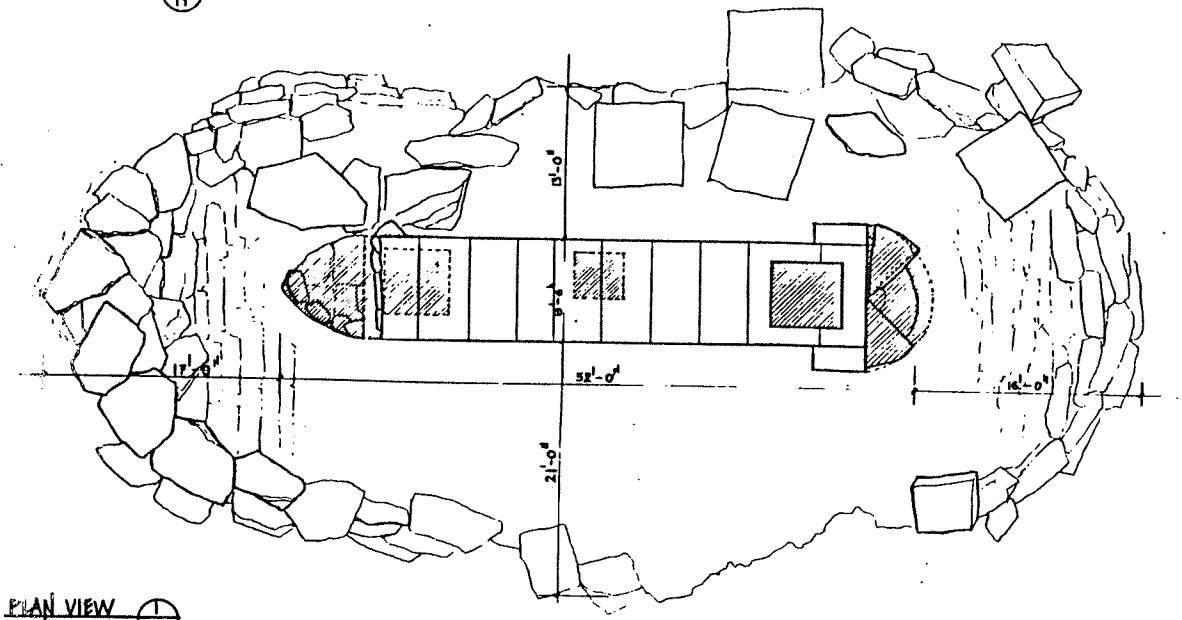
SCALE 1/8

DESIGNED: MEFINGER	SUB SHEET NO.	TITLE OF SHEET: PIER A RIP RAP PLAN & WEST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. SBS
DRAWN: RODNEY			PKG. NO. —
TECH. REVIEW: VIVANZA			SHEET 14
DATE: 02.01.99			OF —

PHASE II



WEST ELEVATION (2/19)



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

PLAN VIEW (1/19)

DESIGNED: NADINGER	SUB SHEET NO.	TITLE OF SHEET: PIER-B RIP RAP PLAN & WEST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. 385
DRAWN: RODNEY			PROJ. NO.
TECH. REVIEW: VIGANZA			SHEET 19
DATE: OCT-01-94			OF

PHASE II

APPENDIX C

01618000 POTOMAC RIVER AT SHEPHERDSTOWN, WV

LOCATION.--Lat 39°26'04", long 77°48'07", Jefferson County, Hydrologic Unit 02070004, on right bank, 0.1 mi downstream from Rumsey Bridge at Shepherdstown, 3.3 mi upstream from Antietam Creek, and at mile 184.

DRAINAGE AREA.--5,936 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--August 1928 to September 1953. Annual maximums, water years 1954-64. July 1964 to current year. Gage-height record and estimated discharges October 1953 to June 1964 available in files of the Maryland/Delaware/DC district office.

REVISED RECORDS.--WSP 756: Drainage area. WSP 781: 1929(M).

GAGE.--Water-stage recorder. Datum of gage is 281.00 ft above National Geodetic Vertical Datum of 1929.

REMARKS.--Water-discharge records good except those for estimated daily discharges (doubtful or missing record), which are fair. Some regulation at low flow by power plants upstream from station, prior to July 1981 by Stony River Reservoir, since December 1950 by Savage River Reservoir (see station 01597500), and since July 1981 by Jennings Randolph Lake. National Weather Service gage height telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Floods in June 1889 and May 1924 reached stages of 39.2 ft and 29.8 ft respectively, from floodmarks, discharges, about 290,000 ft^3/s and 168,000 ft^3/s respectively, from rating curve extended as explained above.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 23,000 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 23	1500	*39,900	*12.46	No other peak greater than base discharge.			

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN DAILY VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	865	1020	1320	e5400	2210	11600	9910	7460	4440	3630	5050	e2100
2	731	921	2160	e4400	2010	9860	8800	7430	4370	3490	4110	e1950
3	710	943	3850	3750	2230	8280	7940	6910	3720	3880	3470	e1900
4	684	958	7490	3470	2290	6760	7240	5620	3270	4440	3610	e1850
5	728	1090	7890	3680	2260	5920	6550	5080	3370	6070	3430	e1800
6	1010	921	5250	5260	2360	5260	5810	4880	9770	4410	2720	e1800
7	1270	772	3790	8930	2150	6290	5280	4660	12800	3480	2340	e2100
8	938	661	2960	6660	2060	11300	4850	4460	10700	2960	2090	e3000
9	998	824	2780	5210	1970	10600	4430	5780	8350	2560	1960	e3500
10	939	929	2990	4360	1940	9190	4080	13500	7220	2290	1930	e3300
11	731	1220	3260	3790	1880	8830	3870	17600	6220	2120	1980	e3200
12	804	1130	3030	3430	1810	11500	3880	13900	5330	2210	2040	e3100
13	696	1070	2660	3060	1770	16800	3900	10900	4630	2430	2320	e3000
14	776	1140	2600	2860	1830	14100	3930	9100	4190	2380	2190	e2800
15	1090	1060	2500	3030	2060	11500	3600	8540	3790	2580	e2200	e2500
16	1170	1120	2250	3200	1880	9490	3340	9420	3370	2420	e2200	e2300
17	1020	987	1960	2970	e2500	8050	3190	11600	3100	2070	e2200	e2100
18	840	1010	1620	2750	e3800	7020	3120	10200	3110	1890	e2200	e2000
19	881	1080	1710	2350	e4300	6790	3000	9280	3080	1760	e2200	e1900
20	596	925	1880	2000	e4600	8080	2990	7990	3150	1670	e2200	e1800
21	743	969	1810	1640	e5000	13900	3420	7200	3460	1640	e2150	e1750
22	726	1520	1690	2340	e4800	15500	15200	6160	3640	1570	e2100	e2000
23	653	2010	1690	2610	e4500	13600	35600	5450	3230	1450	e2000	e2500
24	650	2150	1550	2550	e4000	11900	27000	4920	2860	1740	e1900	e2100
25	659	2250	1620	2260	e4200	10400	18300	4630	2670	4100	e1800	e1800
26	673	2000	1860	2150	e5000	9250	14700	4580	2620	8430	e1750	e1750
27	669	1880	2400	2240	15800	15600	12300	4410	2750	7200	e1700	e1750
28	971	1540	3740	2280	20000	20300	10000	3980	2630	7310	e1650	e1750
29	960	1430	4290	2260	15000	15800	8620	3630	2300	9360	e1600	e1800
30	868	1180	e4600	2290	---	13000	7680	3370	2260	9120	e1900	e2000
31	944	---	e5000	2330	---	10900	---	3640	---	6400	e2900	---
TOTAL	25993	36710	94200	105510	126210	337370	252530	226280	136400	117060	73890	67200
MEAN	838	1224	3039	3404	4352	10880	8418	7299	4547	3776	2384	2240
MAX	1270	2250	7890	8930	20000	20300	35600	17600	12800	9360	5050	3500
MIN	596	661	1320	1640	1770	5260	2990	3370	2260	1450	1600	1750
CFSM	.14	.21	.51	.57	.73	1.83	1.42	1.23	.77	.64	.40	.38
IN.	.16	.23	.59	.66	.79	2.11	1.58	1.42	.85	.73	.46	.42

e Estimated

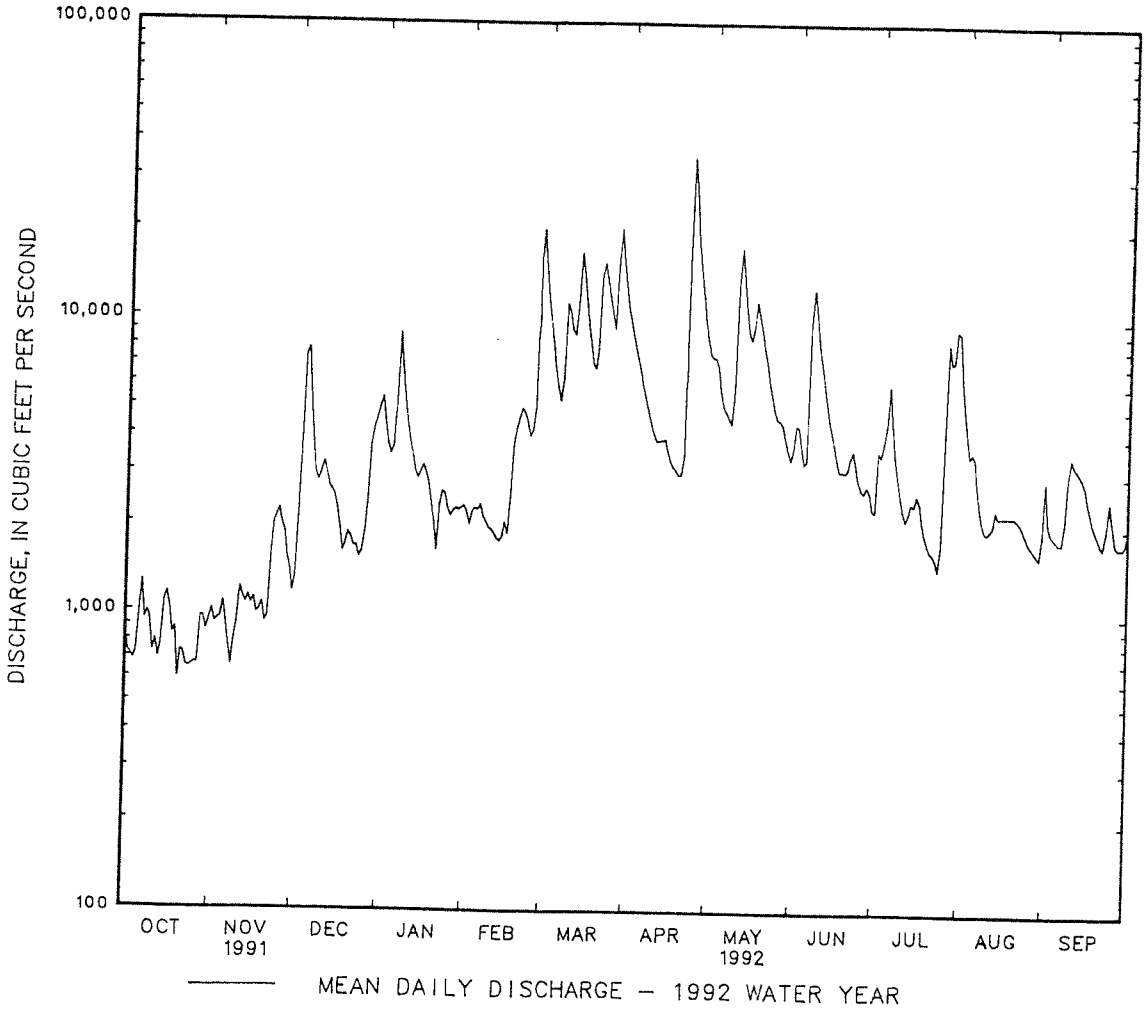
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1928 - 1992, BY WATER YEAR (WY)

MEAN	3186	3666	5618	6866	9068	12670	11100	8086	4586	2478	2247	1973
MAX	20080	24780	22070	20480	23770	45990	25020	20450	22600	9529	12140	11750
(WY)	1977	1986	1973	1937	1971	1936	1984	1988	1972	1949	1955	1975
MIN	351	395	621	1009	1580	3081	4010	2049	970	556	429	378
(WY)	1931	1931	1931	1981	1934	1990	1969	1930	1969	1966	1930	1930

01618000 POTOMAC RIVER AT SHEPHERDSTOWN, WV--Continued

SUMMARY STATISTICS	FOR 1991 CALENDAR YEAR		FOR 1992 WATER YEAR		WATER YEARS 1928 - 1992	
ANNUAL TOTAL	1856108		1599353			
ANNUAL MEAN	5085		4370		5944	
HIGHEST ANNUAL MEAN					9988	1972
LOWEST ANNUAL MEAN					2607	1969
HIGHEST DAILY MEAN	54000	Jan 18	35600	Apr 23	287000	Mar 19 1936
LOWEST DAILY MEAN	596	Oct 20	596	Oct 20	185	Jul 31 1966
ANNUAL SEVEN-DAY MINIMUM	671	Oct 20	671	Oct 20	294	Sep 4 1966
INSTANTANEOUS PEAK FLOW	59600	Jan 18	39900	Apr 23	a335000	Mar 19 1936
INSTANTANEOUS PEAK STAGE	16.12	Jan 12	12.46	Apr 23	b42.10	Mar 19 1936
INSTANTANEOUS LOW FLOW	493	Oct 11	493	Oct 11	170	Aug 1 1966
ANNUAL RUNOFF (CFSM)	.86		.74		1.00	
ANNUAL RUNOFF (INCHES)	11.63		10.02		13.61	
10 PERCENT EXCEEDS	11400		9870		13400	
50 PERCENT EXCEEDS	1880		2880		3200	
90 PERCENT EXCEEDS	909		995		862	

a From rating curve extended above 200,000 ft^3/s on basis of slope-area measurement of peak flow.
b From floodmarks.



UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01618000 POTOMAC R AT SHEPHERDSTOWN, WV STREAM SOURCE AGENCY USGS
LATITUDE 392604 LONGITUDE 0774807 DRAINAGE AREA 5936.00 DATUM 281.00 STATE 54 COUNTY 037

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1740	5470	2560	45900	6630	5470	10600	5140	2060	1200	1190	933
2	1670	5290	2530	30700	6300	5270	9610	4790	1810	1270	1220	770
3	1180	4930	2820	21700	6090	5060	8870	4480	1860	1140	1370	770
4	1230	4660	5440	17300	5940	6350	8000	4060	1780	1070	1550	815
5	1310	4460	15500	14200	5780	24700	7360	3730	1780	1020	1490	1240
6	1210	4270	10900	11600	5770	27500	6990	3650	1910	1140	1430	1040
7	1260	4160	8060	10600	6480	19100	6650	3980	1860	1410	1340	924
8	1250	4040	6730	10900	9810	16400	6370	4300	1570	2150	1400	942
9	1360	3850	5750	10500	11200	13800	6050	3890	1420	1830	1580	967
10	1360	4060	5150	9760	10000	11600	5840	3600	1280	1660	1450	934
11	1880	4840	4700	9780	8940	10000	5820	3440	1530	1220	1390	791
12	3270	5280	4320	11900	7980	8890	5680	3340	1700	1320	1390	915
13	10500	5010	3970	14600	7290	7970	5380	3330	1810	1690	1350	903
14	25700	4800	3730	18600	6970	7490	5450	3570	1770	1410	1350	888
15	13700	4320	3700	16800	7360	7230	9730	4060	1750	1260	1480	906
16	9180	4190	4490	15600	7690	6880	20600	3580	1550	997	1500	897
17	6920	3990	6050	42700	6850	6480	20800	3300	1730	985	1480	907
18	5680	3840	6570	54000	6350	6370	16500	3050	1910	1070	1300	988
19	6750	3650	9830	36100	6310	6850	12600	2770	1450	1010	1560	3260
20	7980	3360	13800	25800	6440	8270	10500	2670	1260	949	1370	2540
21	6940	3170	11700	21200	6610	9280	9510	2640	1140	904	1070	1460
22	6130	3080	10900	18800	6870	8830	9340	2570	1290	829	1530	1250
23	9160	3330	10600	15600	7100	9700	8860	2560	1240	938	1520	1100
24	45100	3300	13100	12600	6810	39600	7820	2310	1070	919	1330	973
25	31700	3250	17800	11100	6440	48600	7040	2120	1140	920	1350	1320
26	18400	3160	15700	9540	6140	27400	6470	2100	1190	999	1410	1320
27	13000	2960	13100	8350	5900	19000	6020	2110	1180	911	1420	1000
28	9760	2810	11100	7910	5660	16100	5640	2240	1220	908	1590	1100
29	7790	2700	9690	7570	---	13600	5550	2230	1180	962	1140	913
30	6600	2630	8950	7130	---	11700	5490	2360	1200	1170	809	909
31	5870	---	18900	6700	---	11100	---	2330	---	1040	950	---
TOTAL	265580	118860	268140	555540	197710	426590	261140	100300	45640	36301	42309	33675
MEAN	8567	3962	8650	17920	7061	13760	8705	3235	1521	1171	1365	1122
MAX	45100	5470	18900	54000	11200	48600	20800	5140	2060	2150	1590	3260
MIN	1180	2630	2530	6700	5660	5060	5380	2100	1070	829	809	770
CFSM	1.44	.67	1.46	3.02	1.19	2.32	1.47	.55	.26	.20	.23	.19
IN.	1.66	.74	1.68	3.48	1.24	2.67	1.64	.63	.29	.23	.27	.21

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1928 - 1991, BY WATER YEAR (WY)

MEAN	3223	3705	5659	6921	9145	12700	11140	8099	4587	2458	2245	1969
MAX	20080	24780	22070	20480	23770	45990	25020	20450	22600	9529	12140	11750
(WY)	1977	1986	1973	1937	1971	1936	1984	1988	1972	1949	1955	1975
MIN	351	395	621	1009	1580	3081	4010	2049	970	556	429	378
(WY)	1931	1931	1931	1981	1934	1990	1969	1930	1969	1966	1930	1930

SUMMARY STATISTICS	FOR 1990 CALENDAR YEAR		FOR 1991 WATER YEAR		WATER YEARS 1928 - 1991	
ANNUAL TOTAL	2014930		2351785			
ANNUAL MEAN	5520		6443		5969	
HIGHEST ANNUAL MEAN					9988	1972
LOWEST ANNUAL MEAN					2607	1969
HIGHEST DAILY MEAN	45100	Oct 24	54000	Jan 18	287000	Mar 19 1936
LOWEST DAILY MEAN	1160	Aug 12	770	Sep 2	185	Jul 31 1966
ANNUAL SEVEN-DAY MINIMUM	1260	Oct 3	884	Aug 29	294	Sep 4 1966
INSTANTANEOUS PEAK FLOW			59600	Jan 18	335000	Mar 19 1936
INSTANTANEOUS PEAK STAGE			16.12	Jan 18	42.10	Mar 19 1936
INSTANTANEOUS LOW FLOW			679	Jul 22	170	Aug 1 1966
ANNUAL RUNOFF (CFSM)	.93		1.09		1.01	
ANNUAL RUNOFF (INCHES)	12.63		14.74		13.66	
10 PERCENT EXCEEDS	10900		14000		13400	
50 PERCENT EXCEEDS	3880		4060		3200	
90 PERCENT EXCEEDS	1670		1030		860	

STATISTICS COMPUTED BY: RWJAMES DATE: 03/11/1992 AT: 09:29:52

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01618000 POTOMAC R AT SHEPHERDSTOWN, WV STREAM SOURCE AGENCY USGS
LATITUDE 392604 LONGITUDE 0774807 DRAINAGE AREA 5936.00 DATUM 281.00 STATE 54 COUNTY 037

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2940	2790	4160	2690	18200	3640	3590	3340	20600	1840	1550	2120
2	3140	2970	3970	2970	14300	3630	4260	3430	14000	1830	1360	1910
3	3970	2900	3890	9190	12200	3620	6060	3340	10900	2130	1320	1830
4	4930	2740	3530	9190	11700	3560	7770	3160	10100	3470	1250	1670
5	5290	2600	3400	7820	12300	3500	7160	3440	8790	2620	1250	1550
6	4760	2400	3360	8270	12300	3420	6420	5200	7320	2260	1540	1480
7	4240	2250	3250	11100	11700	3300	5960	7620	6150	1920	1790	1510
8	3760	2350	3300	10000	10700	3180	5790	6780	5440	1890	1600	1520
9	3440	2360	3170	8490	9820	3070	5620	5650	4890	1740	1680	1510
10	3160	2650	2810	7160	8890	3050	5440	5180	4690	2050	1540	1530
11	3010	3050	2730	7040	10500	3000	5430	6760	4380	2080	1390	1520
12	2820	3200	2900	7560	11500	2960	6100	7980	4070	2190	1160	1650
13	2700	3180	e2850	7810	11100	2890	6420	6930	4150	2870	1360	1820
14	2610	2900	e2750	7120	10200	2850	6130	6310	3730	3290	1280	1940
15	2520	2760	e2600	6280	9230	2890	5620	5680	3360	10900	1380	2900
16	2410	2960	e2200	5780	8400	2780	5250	4960	2910	9860	1160	2700
17	2260	11700	e1950	5640	7800	2710	4830	4760	2950	10200	1180	2540
18	1920	17200	e1850	5570	7230	2680	4630	4420	2780	8280	1310	2810
19	2210	12500	e1750	5620	6700	2770	4250	4480	3050	6400	1210	2740
20	4660	8970	e1700	5810	6120	2850	3880	3920	2890	4790	2020	2220
21	14500	7370	e1700	6180	5810	2980	3660	3640	2650	4030	4100	2020
22	11800	6420	e1700	6560	5400	3200	3500	3590	2360	3900	3080	2490
23	8580	5530	e1700	7430	4990	3090	3440	3580	2240	3750	3700	2400
24	6680	5020	e1700	7150	5060	2960	3440	3090	2150	3360	5720	2180
25	5430	4530	e1700	6590	4980	2860	3520	2770	2120	3190	8620	2280
26	4620	4160	e1700	6680	4420	2810	3370	3080	2090	2960	e5200	2170
27	4120	3970	e1700	7490	3980	2880	3120	7460	2050	2490	e4400	1960
28	3730	3990	e1800	7400	3720	2970	3080	17900	1820	2100	e3900	1910
29	3400	4160	e2000	6920	---	3020	3060	20500	1590	1930	3320	1940
30	3180	4310	e2100	15800	---	3070	3090	31100	1690	1720	2810	1890
31	2950	---	2450	24700	---	3310	---	31700	---	1660	2450	---
TOTAL	135740	143890	78370	244010	249250	95500	143890	231750	147910	113700	75630	60710
MEAN	4379	4796	2528	7871	8902	3081	4796	7476	4930	3668	2440	2024
MAX	14500	17200	4160	24700	18200	3640	7770	31700	20600	10900	8620	2900
MIN	1920	2250	1700	2690	3720	2680	3060	2770	1590	1660	1160	1480
CFSM	.74	.81	.43	1.33	1.50	.52	.81	1.26	.83	.62	.41	.34
IN.	.85	.90	.49	1.53	1.56	.60	.90	1.45	.93	.71	.47	.38

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1929 - 1990, BY WATER YEAR (WY)

MEAN	3137	3701	5610	6743	9178	12680	11180	8177	4637	2478	2248	1973
MAX	20080	24780	22070	20480	23770	45990	25020	20450	22600	9529	12140	11750
(WY)	1977	1986	1973	1937	1971	1936	1984	1988	1972	1949	1955	1975
MIN	351	395	621	1009	1580	3081	4010	2049	970	556	429	378
(WY)	1931	1931	1931	1981	1934	1990	1969	1930	1969	1966	1930	1930

SUMMARY STATISTICS	FOR 1989 CALENDAR YEAR		FOR 1990 WATER YEAR		WATER YEARS 1929 - 1990	
ANNUAL TOTAL	2466840		1720350			
ANNUAL MEAN	6758		4713		5961	
HIGHEST ANNUAL MEAN					9988	1972
LOWEST ANNUAL MEAN					2607	1969
HIGHEST DAILY MEAN	55300	May 17	31700	May 31	287000	Mar 19 1936
LOWEST DAILY MEAN	1640	Sep 16	1160	Aug 12	185	Jul 31 1966
ANNUAL SEVEN-DAY MINIMUM	1700	Dec 20	1260	Aug 12	294	Sep 4 1966
ANNUAL RUNOFF (CFSM)	1.14		.79		1.00	
ANNUAL RUNOFF (INCHES)	15.46		10.78		13.64	
10 PERCENT EXCEEDS	13700		9060		13400	
50 PERCENT EXCEEDS	4160		3360		3200	
90 PERCENT EXCEEDS	2330		1700		860	

STATISTICS COMPUTED BY: RWJAMES DATE: 09/19/1991 AT: 13:23:32

e Estimated

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DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1700	1350	2650	2970	2940	4960	16200	4350	5010	4490	7650	3120
2	1750	1070	2240	3050	2820	4420	15400	5820	4620	3840	6540	2840
3	1580	1350	2220	2620	3050	4100	12600	11500	4070	3570	5300	2520
4	1600	1120	2270	2560	3340	3790	10800	17900	3820	3120	4600	2320
5	2160	1360	2380	2410	3460	3840	9460	13100	3870	3980	4350	2520
6	1710	1510	2340	2290	3360	4540	8510	16000	4020	7350	3760	2480
7	1280	2090	2430	2180	3300	16200	7800	35100	3810	7650	3400	2070
8	1320	2790	2310	2620	3250	28900	7010	32100	4090	8880	2870	1800
9	1250	2440	2190	3040	3000	18500	6530	22300	4110	8480	2770	1690
10	1260	2500	2190	4130	2660	13500	6200	19900	4290	6310	2500	1740
11	1240	2370	2110	5280	2500	12200	5870	39900	4520	5080	2340	1760
12	1280	2120	1970	5500	2510	13800	5500	39200	4230	4990	2310	1820
13	1220	2030	1770	6850	2420	15800	5250	28100	3920	4840	2180	1730
14	1250	2180	1510	10300	2930	15400	5080	21400	3690	4770	2320	1750
15	1300	2390	1570	9450	3130	13600	4860	18200	3670	5420	2520	1810
16	1270	2500	e1500	10300	4060	13300	4340	24500	3660	6480	2490	1640
17	1270	2240	e1450	11300	7950	12700	4200	55300	4940	10100	2490	2020
18	1290	2090	e1400	9950	9490	10500	4250	43400	10200	11200	2480	2430
19	1350	2150	1470	8400	8270	9180	3910	27200	9440	8950	2500	4050
20	1370	2300	1420	7000	7240	8650	3780	19400	7800	10200	2440	3880
21	1340	6330	1670	5770	6270	7900	3690	15200	9620	19800	2690	3080
22	1260	10300	1680	4720	6180	7890	3540	12700	21900	15900	3250	2740
23	1370	7920	1730	3760	7220	9080	3330	10700	13600	15100	3300	2590
24	1300	6080	2230	3510	7140	9890	3150	11300	15700	12300	4040	2410
25	1250	4890	2600	3460	6650	21400	3110	13000	13700	9510	6100	2720
26	1270	4080	3980	3210	5940	28500	3090	10300	10500	7640	6750	4570
27	1280	3620	4880	3010	5550	21200	2840	8850	8140	7370	7220	4050
28	1110	3320	4690	2880	5650	16500	2750	7790	6910	10100	5790	3510
29	1080	3120	4210	2850	---	13300	4020	6710	6250	8400	4520	3390
30	1150	2940	3680	2610	---	11200	4370	6010	5290	6600	3790	3200
31	1090	---	3240	2900	---	12300	---	5520	---	5780	3350	---
TOTAL	41950	92550	73980	150880	132280	387040	181440	602750	209390	248200	118610	78250
MEAN	1353	3085	2386	4867	4724	12490	6048	19440	6980	8006	3826	2608
MAX	2160	10300	4880	11300	9490	28900	16200	55300	21900	19800	7650	4570
MIN	1080	1070	1400	2180	2420	3790	2750	4350	3660	3120	2180	1640
CFSM	.23	.52	.40	.82	.80	2.10	1.02	3.28	1.18	1.35	.64	.44
IN.	.26	.58	.46	.95	.83	2.43	1.14	3.78	1.31	1.56	.74	.49

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DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1800	1620	15500	8130	5160	3560	3640	2970	6970	e1650	1150	2830
2	1770	1570	13100	7180	6330	3460	3530	2920	6420	e1500	1500	2110
3	2050	1530	8980	6530	7720	3330	3450	2990	6060	e1400	1410	1930
4	2280	1460	6650	5700	9370	3440	3360	3190	5420	e1300	1440	2050
5	1890	1510	5440	4820	12000	5140	3280	3380	4960	e1300	1250	2650
6	1860	1420	4750	3650	12100	10400	3270	7240	5010	e1250	1370	4400
7	1860	1470	4090	e3200	10100	9740	3760	53100	4510	e1200	1630	4100
8	1750	1380	3700	e2800	9030	8330	25800	50500	4030	e1200	1590	3020
9	1780	1320	3390	e2750	8480	7150	30300	30300	4300	e1200	1330	2390
10	1760	1500	3160	e2700	7180	6430	20800	20900	4590	e1200	1200	2340
11	1690	2070	3070	e2650	5780	5900	14700	14000	4480	e1200	1360	2210
12	1540	2550	3020	e2600	5270	5400	11400	11000	3950	e1250	1270	2320
13	1460	2590	3230	e2550	4930	5010	9330	9300	3400	e1400	1230	2160
14	1520	2680	3140	e2500	4110	4750	7940	7620	3300	e1300	1230	1910
15	1510	3120	3160	e2400	4050	4460	6960	7050	2960	e1250	1230	1550
16	1470	3610	3220	e2350	4240	4250	6200	6470	2780	e1200	1230	1810
17	1360	3880	3510	e2300	4310	4120	5540	6650	2640	e1250	1160	1460
18	1400	3600	3820	2310	4080	3840	4980	9520	2700	e1300	852	1350
19	1350	3830	4100	2640	4010	3610	4770	50500	2850	e1250	1020	1700
20	1560	3790	4130	6210	4120	3400	4600	67300	e2600	e1400	1230	2820
21	1960	3370	4850	38600	4730	3440	4340	61600	e2400	e1500	1490	2620
22	1380	3080	6990	27300	5280	3230	3960	43100	e2300	1400	1540	2060
23	1350	2950	6960	17900	5070	3070	3680	28800	e2100	1410	2080	1480
24	1320	2690	6070	12900	4830	3050	3570	25000	e2400	1540	2650	1350
25	1330	2640	5330	10300	4600	2970	3480	28900	e2400	1450	2870	1570
26	1210	2490	5510	9020	4350	3040	3520	21900	e2100	1380	3280	1510
27	1260	2390	6740	8000	4070	3300	3370	16700	e2100	1300	2490	1540
28	1590	2310	7790	6510	3920	3840	3260	13200	e2000	1260	2020	2100
29	1730	2950	8180	5410	3760	4150	3150	10800	e1850	1140	2090	2370
30	1770	7270	8600	5330	---	4030	3060	9160	e1700	1140	2250	2010
31	1700	---	9530	5270	---	3780	---	7840	---	1150	3020	---
TOTAL	50260	78640	179710	222510	172980	143620	213000	633900	105280	40670	51462	65720
MEAN	1621	2621	5797	7178	5965	4633	7100	20450	3509	1312	1660	2191
MAX	2280	7270	15500	38600	12100	10400	30300	67300	6970	1650	3280	4400
MIN	1210	1320	3020	2300	3760	2970	3060	2920	1700	1140	852	1350
CFSM	.27	.44	.98	1.21	1.00	.78	1.20	3.44	.59	.22	.28	.37
IN.	.31	.49	1.13	1.39	1.08	.90	1.33	3.97	.66	.25	.32	.41

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DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1470	1180	4550	6050	5550	7180	9200	8920	4120	1830	1210	943
2	1450	1340	4140	5520	5460	17400	16200	8370	3820	1960	1130	851
3	1160	1310	4900	5160	6740	28400	13700	7660	3980	2300	983	915
4	993	1370	8420	4830	14600	21900	15300	7770	4610	2590	948	867
5	1110	1490	9380	4490	16200	15500	53900	14800	4920	2180	1010	900
6	1080	1790	7750	4080	13500	12100	40700	20400	4240	1930	1190	1060
7	1260	1880	5900	3670	11200	10000	39200	16100	3640	1820	1180	1140
8	1100	2420	5010	3600	9840	8630	35700	13600	3220	2050	1090	1400
9	1080	2860	4610	3740	8730	8020	30300	10900	2930	2150	1140	2740
10	967	3140	4940	3630	7200	8440	27900	8960	2780	2050	1020	3190
11	925	3950	6120	3710	5650	9030	22600	7790	2570	2040	958	4610
12	839	4540	6120	3740	5050	9030	18100	6940	2420	2030	921	3650
13	1000	4910	5770	3680	5050	7850	15800	6170	2360	2090	963	3560
14	1150	4310	5340	3640	5760	6780	13600	5680	2380	2340	908	6360
15	1080	2970	4890	3590	5620	5910	11100	5330	2580	3560	875	5700
16	1050	2350	4580	3580	5470	5330	10200	4980	2410	2900	887	4060
17	1060	2320	4350	3660	5140	4980	28900	4630	2220	2510	845	3150
18	1050	2100	4260	3650	4870	4730	80700	4430	2070	2200	802	2760
19	1040	2130	4480	4050	4600	4620	54200	4720	1970	2040	753	3010
20	1010	2270	4770	10300	4300	4420	35700	5220	1900	1910	784	3030
21	994	3140	4390	22500	4080	4550	26100	5840	2110	1760	731	3600
22	1030	4370	3960	17700	3790	4410	20600	10600	2970	2200	768	5150
23	1020	4570	3650	13000	3860	4270	16200	8310	3300	1650	919	5220
24	943	3940	3440	9830	4090	4120	12600	6840	3130	1540	930	4110
25	925	3410	8140	7100	4460	4000	11600	5820	2490	1410	1130	3380
26	1110	3090	17900	5750	4610	3930	15100	5270	2210	1300	1160	2740
27	1180	3050	17500	4950	4820	3910	16200	4860	2370	1260	1160	2490
28	1220	4370	13400	4350	5150	4010	13900	4700	2310	1310	1080	1990
29	1740	5160	10500	4400	---	3970	11800	4520	2150	1300	1070	1870
30	1100	4790	8400	4600	---	3940	9890	4760	2140	1250	1080	1790
31	1130	---	6930	5750	---	4350	---	4550	---	1220	954	---
TOTAL	34266	90520	208490	188300	185390	245710	726990	239440	86320	60680	30579	86236
MEAN	1105	3017	6725	6074	6621	7926	24230	7724	2877	1957	986	2875
MAX	1740	5160	17900	22500	16200	28400	80700	20400	4920	3560	1210	6360
MIN	839	1180	3440	3580	3790	3910	9200	4430	1900	1220	731	851
CFSM	.19	.51	1.13	1.02	1.12	1.34	4.08	1.30	.48	.33	.17	.48
IN.	.21	.57	1.31	1.18	1.16	1.54	4.56	1.50	.54	.38	.19	.54

01638500 POTOMAC RIVER AT POINT OF ROCKS, MD

LOCATION.--Lat 39°16'25", long 77°32'35", Frederick County, Hydrologic Unit 02070008, on left bank at downstream side of bridge on U.S. Highway 15 at Point of Rocks, 0.3 mi downstream from Catoctin Creek (Virginia), 6 mi upstream from Monocacy River, and at mile 159.5.

DRAINAGE AREA.--9,651 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--February 1895 to current year.

REVISED RECORDS.--WSP 192: 1895-1905. WSP 1432: 1899, 1901-2, 1904-5, 1912, 1914(M), 1915, 1917(M), 1918, 1919(M), 1920, 1921-23(M), 1924, 1925-28(M), 1930(M).

GAGE.--Water-stage recorder. Datum of gage is 200.63 ft above National Geodetic Vertical Datum of 1929. Prior to Oct. 28, 1929, nonrecording gage at same site. Prior to Sept. 2, 1902, at datum about 0.45 ft higher.

REMARKS.--Water-discharge records good except those for estimated daily discharges (backwater from grass), which are fair. Low flow affected slightly from 1913 to July 1981 by Stony River Reservoir; since December 1950 by Savage River Reservoir (see station 01597500); and since July 1981 by Jennings Randolph Lake. Low flow affected extensively at times by run-of-the-river hydroelectric plants. National Weather Service gage height telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of June 2, 1889, reached a stage of 40.2 ft, from floodmarks, discharge, about 460,000 ft^3/s from rating curve extended as explained in footnotes.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 35,000 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 23	1700	*90,000	*16.25	No other peak greater than base discharge.			

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN DAILY VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e1400	e1200	1920	7330	3810	18100	13400	11000	6580	4040	7180	3680
2	e1350	e1100	2060	7610	3510	14900	12200	10000	6780	4300	6140	3160
3	e1300	e1100	3770	6640	3470	12800	11100	9270	6160	4740	5040	3030
4	e1300	e1100	6810	6020	3560	10600	10100	8540	5510	4950	5200	2880
5	e1300	e1200	13200	7480	3410	8970	9360	8010	5680	7320	4860	2740
6	e1500	e1300	11300	13800	3430	8220	8400	7650	13800	6320	4210	2860
7	e1800	e1100	7980	17600	3270	9810	7770	7130	27300	5070	3640	9660
8	e1900	e1100	6050	14100	3060	16300	7210	6970	21300	4450	3370	6660
9	e1500	e1000	4920	10800	3120	17500	6640	8540	16000	4000	3160	6420
10	e1700	e1100	4720	8780	3110	15800	6210	17700	12900	3640	3140	6940
11	e1500	e1300	4880	7480	2980	15400	5930	24900	10900	3470	3250	7050
12	e1400	e1300	5060	6580	2850	16400	5850	21200	9320	3250	3600	7350
13	e1400	e1400	4990	5910	2890	23600	5730	16900	8050	3480	3590	6130
14	e1300	e1400	4590	5390	2800	21700	5770	14000	7030	3350	3800	5240
15	e1300	e1600	4290	5340	3060	17800	5400	12500	6340	3560	3440	4610
16	e1600	e1600	3930	5360	3110	14800	5060	13100	5720	3540	3430	4140
17	e2200	e1500	3720	5180	3500	12600	4810	16300	5160	3370	3450	3760
18	e2000	e1400	3380	4810	4690	10900	4720	15900	4900	2910	3420	3530
19	e1700	e1400	3250	4750	5780	10300	4630	14400	4950	2740	3380	3330
20	e1500	e1400	3350	4000	6510	10700	4640	12700	5090	2650	3320	3190
21	e1300	e1300	2430	3560	6980	15500	5700	11800	5270	2460	3170	3070
22	e1400	e1800	2820	3620	6930	19100	38400	10700	5550	2620	2990	3030
23	e1400	2440	2840	4310	6700	18000	82300	9430	5350	2550	2820	3800
24	e1300	2740	2730	4310	6290	15900	58200	8340	4800	2740	2760	3700
25	e1300	2930	2630	4220	6130	14200	34700	7700	4490	5070	2680	3220
26	e1200	3210	2600	3630	6930	12700	26400	7370	4430	9380	2600	3350
27	e1200	2700	2520	3840	15100	16500	21100	7280	4400	9710	2540	4380
28	e1200	2790	2530	3850	28400	24200	17000	6680	4380	9070	2460	4890
29	e1200	2380	3210	3820	23200	21100	14300	6200	3870	10700	2610	4430
30	e1200	2230	4110	3780	---	17400	12300	5870	3580	11600	2890	3850
31	e1100	---	6030	3800	---	15000	---	6490	---	8950	3490	---
TOTAL	44750	50120	138620	197700	178580	476800	455330	344570	235590	156000	111630	134080
MEAN	1444	1671	4472	6377	6158	15380	15180	11120	7853	5032	3601	4469
MAX	2200	3210	13200	17600	28400	24200	82300	24900	27300	11600	7180	9660
MIN	1100	1000	1920	3560	2800	8220	4630	5870	3580	2460	2460	2740
CFSM	.15	.17	.46	.66	.64	1.59	1.57	1.15	.81	.52	.37	.46
IN.	.17	.19	.53	.76	.69	1.84	1.76	1.33	.91	.60	.43	.52

e Estimated

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1895 - 1992, BY WATER YEAR (WY)

MEAN	5094	5485	8341	11080	14210	19160	16360	12320	8016	4518	4192	3496
MAX	37030	39000	32610	31350	42640	68360	39840	41970	40400	16000	23580	17820
(WY)	1943	1986	1973	1937	1897	1936	1918	1924	1972	1949	1955	1975
MIN	706	840	1253	1703	2661	5400	4368	3276	1932	1056	771	834
(WY)	1931	1931	1966	1981	1934	1931	1915	1930	1969	1966	1930	1930

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01638500 POTOMAC R AT POINT OF ROCKS, MD STREAM SOURCE AGENCY USGS
LATITUDE 391625 LONGITUDE 0773235 DRAINAGE AREA 9651.00 DATUM 200.54 STATE 24 COUNTY 021

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2080	8420	3540	61400	10200	7620	18900	8270	3260	2060	e5600	e1500
2	2240	7680	3270	46300	9700	7380	16900	7680	2940	1970	e4100	e1400
3	2100	7180	3520	32600	9120	6940	15300	7120	2950	1920	e3400	e1400
4	1810	6560	4440	25700	8790	8330	13800	6630	3280	2020	e3000	e1400
5	1960	6080	16000	21300	8540	26200	12600	6170	3030	2310	e2600	e1600
6	1940	6010	15300	17600	8420	43700	11800	6000	3040	2780	e2400	e1700
7	1800	5770	12700	16000	8920	30500	11200	6200	3010	3680	e2200	e1700
8	1830	5470	10600	16000	11500	24600	10600	6540	2880	4830	e2000	e1700
9	1870	5270	8980	16400	14200	20700	10000	6280	2580	4190	e2000	e1600
10	2060	5620	7870	15900	13500	17300	9430	5790	2360	3490	e1900	e1400
11	2340	6140	7110	15600	12200	15000	9020	5610	2310	2940	e1700	e1400
12	3200	6710	6520	19100	11000	13400	8720	5450	2440	2300	e1700	e1400
13	12300	7040	6020	27600	10200	12100	8230	5250	2160	2740	e1800	e1300
14	25300	6540	5600	34500	9800	11300	8250	5320	1990	2670	e1700	e1300
15	24000	6330	5540	31400	9970	10900	10600	5650	2160	2300	e1700	e1200
16	18000	5730	5990	28000	10400	10500	23000	5780	1920	2450	e1700	e1100
17	12900	5530	7360	51500	9730	9990	25800	5270	1880	2370	e1600	e1200
18	10300	5350	8700	78100	8840	9740	21900	5150	2240	2210	e1600	e1200
19	10400	4950	10600	54700	8690	10000	17700	4790	2350	2080	e1500	e2900
20	15000	4810	15700	38900	8780	11200	15000	4440	2190	1980	e1800	e5000
21	14500	4740	14700	31600	9020	12900	13500	4580	2250	1940	e2400	e2800
22	11600	4480	13400	27700	9130	12700	13300	4470	2340	1830	e2200	e2200
23	13200	4350	13300	23700	9510	15600	12800	4210	2260	1880	e2300	e2000
24	60000	4350	15000	19500	9210	49300	11700	4060	2200	1970	e2100	e1800
25	57900	4300	21500	16900	8710	74900	10600	4020	2170	1920	e1900	e1700
26	32900	4010	21000	15000	8370	43700	9720	3610	2530	2030	e1800	e2100
27	22600	4070	19000	13300	8080	30500	9080	3570	2790	1980	e1700	e1700
28	17000	3940	16300	12400	7820	24900	8560	3490	2580	1680	e1900	e1500
29	13200	3790	14300	11800	---	21300	8320	3620	2360	2270	e2200	e1500
30	11100	3860	13900	11300	---	18400	8650	3780	2340	e3500	e1700	e1400
31	9520	---	24700	10600	---	18000	---	3380	---	e3800	e1500	---
TOTAL	416950	165080	352460	842400	272350	629600	384980	162180	74790	78090	67700	52100
MEAN	13450	5503	11370	27170	9727	20310	12830	5232	2493	2519	2184	1737
MAX	60000	8420	24700	78100	14200	74900	25800	8270	3280	4830	5600	5000
MIN	1800	3790	3270	10600	7820	6940	8230	3380	1880	1680	1500	1100
CFSM	1.39	.57	1.18	2.82	1.01	2.10	1.33	.54	.26	.26	.23	.18
IN.	1.61	.64	1.36	3.25	1.05	2.43	1.48	.63	.29	.30	.26	.20

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1895 - 1991, BY WATER YEAR (WY)

MEAN	5132	5524	8382	11130	14300	19200	16370	12330	8018	4513	4198	3486
MAX	37030	39000	32610	31350	42640	68360	39840	41970	40400	16000	23580	17820
(WY)	1943	1986	1973	1937	1897	1936	1918	1924	1972	1949	1955	1975
MIN	706	840	1253	1703	2661	5400	4368	3276	1932	1056	771	834
(WY)	1931	1931	1966	1981	1934	1931	1915	1930	1969	1966	1930	1930

SUMMARY STATISTICS	FOR 1990 CALENDAR YEAR		FOR 1991 WATER YEAR		WATER YEARS 1895 - 1991	
ANNUAL TOTAL	2964160		3498680			
ANNUAL MEAN	8121		9585		9366	
HIGHEST ANNUAL MEAN					15840	1972
LOWEST ANNUAL MEAN					4366	1969
HIGHEST DAILY MEAN	60000	Oct 24	78100	Jan 18	434000	Mar 19 1936
LOWEST DAILY MEAN	1740	Aug 17	1100	Sep 16	540	Sep 10 1914
ANNUAL SEVEN-DAY MINIMUM	1900	Oct 4	1240	Sep 12	593	Sep 6 1966
INSTANTANEOUS PEAK FLOW			85000	Mar 25	480000	Mar 19 1936
INSTANTANEOUS PEAK STAGE			15.63	Mar 25	41.03	Mar 19 1936
INSTANTANEOUS LOW FLOW					530	Sep 11 1966
ANNUAL RUNOFF (CFSM)	.84		.99		.97	
ANNUAL RUNOFF (INCHES)	11.43		13.49		13.19	
10 PERCENT EXCEEDS	15400		21300		20400	
50 PERCENT EXCEEDS	6140		6000		5380	
90 PERCENT EXCEEDS	2440		1800		1650	

STATISTICS COMPUTED BY: JFHORNLEIN DATE: 11/12/1991 AT: 16:06:52

e Estimated

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01638500 POTOMAC R AT POINT OF ROCKS, MD STREAM SOURCE AGENCY USGS
LATITUDE 391625 LONGITUDE 0773235 DRAINAGE AREA 9651.00 DATUM 200.54 STATE 24 COUNTY 021

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5730	5060	5990	e4000	25400	6830	7000	5380	33100	2540	2490	3480
2	5720	4980	5700	e6500	20400	6720	8040	5540	23200	2450	2460	3070
3	5780	5010	5450	e16000	17300	6610	10600	5380	17200	2520	2120	2630
4	10300	4720	5140	16300	16100	6450	12200	5130	14800	4000	2280	2590
5	11500	4480	4890	13700	16400	6240	12100	5200	12800	3930	2110	2400
6	9390	4260	4820	12700	18000	6060	10900	5860	11000	3330	2700	2210
7	7740	4070	4750	14800	16900	5770	10400	9270	9230	2840	2820	2420
8	6540	4050	4600	14000	15600	5560	10500	9300	7970	2570	2800	2190
9	5760	4160	4640	12400	14300	5270	11300	7910	7210	2530	2690	2160
10	5150	4240	4400	10600	13400	5200	11400	7580	7020	2400	2610	2090
11	4730	4800	3990	10100	14100	5100	11200	8470	6350	2790	2230	2110
12	4320	4870	4180	10400	16200	5010	11600	10800	5790	3060	2180	2190
13	4150	4930	4320	10800	16300	4930	11800	10300	5770	3470	1940	2550
14	3910	4530	4140	10100	15000	4770	11100	9740	5410	5520	2070	2580
15	3650	4380	3940	9050	13800	4690	10300	8810	4940	11300	2290	4040
16	3520	4450	3540	8370	12600	4690	9550	7930	4440	13400	1870	4470
17	3460	9130	e2600	7920	11800	4950	8940	7490	4260	13700	1740	3920
18	3460	22800	e2400	7910	11000	4920	8340	7070	4010	12400	1780	3830
19	4780	20200	e2200	7730	10200	4860	7670	6900	4160	9240	1810	3720
20	10200	14800	e2200	7960	9340	6150	7050	6420	4190	7140	2100	3390
21	24200	11600	e2100	8190	8730	6320	6690	5850	3940	6000	3630	2850
22	21700	10100	e2100	8230	8230	6310	6430	5490	3510	5820	3710	2890
23	15900	8770	e2200	9140	7720	6270	6270	5350	3360	6090	3610	2730
24	12400	7740	e2200	9110	8120	6060	6270	5160	3100	5430	5770	2620
25	10000	7100	e2200	8660	8740	5910	6140	4680	3010	5420	9450	2890
26	8450	6530	e2200	9020	8740	5870	5890	5470	3010	4790	10100	2680
27	7370	6100	e2100	9850	7780	5930	5460	7340	3190	4150	8030	2620
28	6670	5960	e2300	10400	7100	5990	5230	17100	2960	3410	7050	2410
29	6110	6090	e2500	10200	---	6050	5170	25900	2590	3200	5700	2390
30	5650	6210	e2800	16100	---	6080	5200	30200	2740	2820	4680	2260
31	5280	---	e3200	e30000	---	6630	---	37700	---	2660	4090	---
TOTAL	243520	216120	109790	340240	369300	178200	260740	300720	224260	160920	110910	84380
MEAN	7855	7204	3542	10980	13190	5748	8691	9701	7475	5191	3578	2813
MAX	24200	22800	5990	30000	25400	6830	12200	37700	33100	13700	10100	4470
MIN	3460	4050	2100	4000	7100	4690	5170	4680	2590	2400	1740	2090
CFSM	.81	.75	.37	1.14	1.37	.60	.90	1.01	.77	.54	.37	.29
IN.	.94	.83	.42	1.31	1.42	.69	1.01	1.16	.86	.62	.43	.33

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01638500 POTOMAC R AT POINT OF ROCKS, MD STREAM SOURCE AGENCY USGS
LATITUDE 391625 LONGITUDE 0773235 DRAINAGE AREA 9651.00 DATUM 200.54 STATE 24 COUNTY 021

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2260	1520	3500	3440	3920	6720	19400	7350	7320	6770	8880	6130
2	2050	1550	3190	3230	3790	6060	19200	11300	6770	5910	9160	5350
3	1910	1510	2910	3180	3730	5500	16100	28600	6200	5250	7720	4720
4	1730	1550	2750	3050	4050	5110	13900	33100	5800	4860	6780	4200
5	2270	1740	2560	2970	4100	4910	12400	24800	5590	5810	6020	3860
6	2190	2100	2400	2870	4300	6360	11200	27100	5950	8870	5230	4010
7	1660	2320	2370	2850	4230	13500	10400	54000	6110	10100	4760	3420
8	1520	3000	2320	2840	4200	29600	9300	57400	5950	10300	4410	3180
9	1490	2980	2230	3250	4060	25700	8670	40100	6790	11800	4070	3070
10	1510	3000	2110	3920	3740	19600	8090	32100	8070	8720	3810	2950
11	1470	2870	2160	5580	3390	16800	7700	49200	8540	6970	3490	2950
12	1470	2490	2140	6730	3310	17300	7240	56400	8790	6440	3480	3030
13	1380	2340	2060	7140	3350	19200	6750	41600	7870	6380	3450	2870
14	1380	2360	1790	11100	3400	19000	6430	31900	6980	6690	3620	2790
15	1380	2390	1440	11400	3570	17000	6130	27300	6860	7690	4390	3040
16	1320	2500	1970	11500	4230	15900	5860	36000	7060	10100	4260	3200
17	1360	2570	2160	12900	7500	15500	5910	71200	8090	10700	3810	3050
18	1390	2390	1890	12000	10900	13500	5890	63100	11800	14900	3700	4340
19	1410	2320	1850	10900	9850	11800	5760	40200	13600	12300	3740	8960
20	1430	2920	1700	9360	8760	10900	6310	29300	11400	12100	4090	8260
21	1480	4490	1880	8070	7960	10200	6110	23500	10500	20800	4820	6730
22	1770	11600	2080	6990	7680	9910	5900	19000	23500	20400	5530	5620
23	1740	9590	2040	5870	8970	10600	5490	16300	19400	20600	5850	5070
24	1700	7580	2130	5290	9270	13600	5020	15600	20900	17600	7300	5270
25	1720	6140	2420	5010	8470	22100	4830	17400	19000	13200	8910	7430
26	1720	5110	3180	4560	7980	35600	4680	14800	14900	10700	11800	8560
27	1760	4510	5090	4440	7480	29700	4520	12700	12200	9280	14600	7870
28	1680	4250	4960	4160	7740	23500	4320	11400	10100	11200	11700	7740
29	1630	4010	4620	4000	---	19000	5600	9800	9300	11300	9010	7230
30	1550	3820	4130	3950	---	16000	7310	8620	7810	9540	7560	6450
31	1530	---	3760	3960	---	15600	---	7830	---	8210	6630	---
TOTAL	50860	107520	81790	186510	163930	485770	246420	919000	303150	325490	192580	151350
MEAN	1641	3584	2638	6016	5855	15670	8214	29650	10100	10500	6212	5045
MAX	2270	11600	5090	12900	10900	35600	19400	71200	23500	20800	14600	8960
MIN	1320	1510	1440	2840	3310	4910	4320	7350	5590	4860	3450	2790
CFSM	.17	.37	.27	.62	.61	1.62	.85	3.07	1.05	1.09	.64	.52
IN.	.20	.41	.32	.72	.63	1.87	.95	3.54	1.17	1.25	.74	.58

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01638500 POTOMAC R AT POINT OF ROCKS, MD STREAM SOURCE AGENCY USGS
LATITUDE 391625 LONGITUDE 0773235 DRAINAGE AREA 9651.00 DATUM 200.54 STATE 24 COUNTY 021
PROVISIONAL DATA SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3360	2610	22000	13800	8650	5700	5710	4410	11100	2360	1880	3390
2	3210	2450	21800	12000	9470	5510	5490	4330	9940	2120	1980	2660
3	3290	2350	16400	10900	11700	5330	5310	4290	9050	2060	1920	2410
4	3520	2260	12200	9860	14000	5460	5080	4390	8470	2020	1720	2260
5	3300	2150	9870	e9000	16400	6760	5070	4820	8060	2010	1620	2390
6	3120	2000	8400	e7030	17300	12300	4970	8540	7790	1980	1580	3720
7	2970	2000	7310	e5260	14900	13400	6220	54900	7160	1930	1740	4670
8	2890	1960	6580	e4760	13400	11700	21200	78300	6480	1880	1740	3740
9	2780	1940	5660	e4650	12600	10200	37000	46600	6120	1830	1710	2990
10	2700	2140	5290	e4600	11500	9200	28700	32100	6210	1860	1760	2580
11	2660	2680	5060	e4550	9900	8540	21000	23300	6360	1800	1630	2260
12	2500	2870	4830	e4500	9230	8030	16400	17500	6280	1850	1530	2100
13	2420	3210	4880	e4450	8610	7420	13700	14700	5480	1990	1590	1910
14	2370	3690	5060	e4450	8010	6890	11700	12100	5050	2010	1340	1810
15	2320	4350	5300	e4400	7080	6590	10400	10700	4610	1890	1420	1820
16	2060	4850	5240	e4500	7450	6280	9310	9970	4350	1820	1430	1680
17	2140	5350	5740	e4600	7280	5980	8400	10300	4150	1900	1230	1720
18	2120	5330	6250	4790	7010	5690	7640	16000	4010	1880	1280	1780
19	2140	5180	6960	5030	6910	5420	7220	58500	3970	2050	1350	1760
20	2080	5400	6900	10300	6950	5090	6920	93400	3740	2150	1400	2300
21	2820	4840	7100	e28600	7330	5130	6510	84000	3520	3800	1720	2840
22	2430	4590	9420	31400	7960	4860	6050	63000	3390	2500	1740	2660
23	2080	4300	10100	27300	8020	4700	5670	43100	3320	3110	2070	2190
24	2020	3970	9350	20600	7590	4550	5460	41600	3390	2700	2530	1560
25	1970	3780	8420	16300	7200	4470	5220	45900	3320	2600	2370	1750
26	1930	3570	8210	14300	6740	4830	5170	36500	3200	2660	3610	1870
27	1970	3460	9400	12700	6370	4880	5010	27900	2890	2630	3150	1930
28	2650	3480	11000	10900	6150	5510	4980	22000	2760	2650	2300	2070
29	2650	7260	11900	9180	5950	6180	4730	17800	2820	2340	2120	2350
30	2720	10600	13200	8500	---	6410	4420	14800	2660	2040	2150	2370
31	2710	---	15800	8500	---	6050	---	12700	---	2240	2450	---
TOTAL	79900	114620	285630	321710	271660	209060	290660	918450	159650	68660	58060	71540
MEAN	2577	3821	9214	10380	9368	6744	9689	29630	5322	2215	1873	2385
MAX	3520	10600	22000	31400	17300	13400	37000	93400	11100	3800	3610	4670
MIN	1930	1940	4830	4400	5950	4470	4420	4290	2660	1800	1230	1560
CFSM	.27	.40	.95	1.08	.97	.70	1.00	3.07	.55	.23	.19	.25
IN.	.31	.44	1.10	1.24	1.05	.81	1.12	3.54	.62	.26	.22	.28

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TOWSON PRIME 07/20/93

STATION NUMBER 01638500 POTOMAC R AT POINT OF ROCKS, MD STREAM SOURCE AGENCY USGS
LATITUDE 391625 LONGITUDE 0773235 DRAINAGE AREA 9651.00 DATUM 200.54 STATE 24 COUNTY 021
PROVISIONAL DATA SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1780	1500	5600	9200	9730	12600	10100	16500	7330	9860	1680	1510
2	1930	1700	5500	8300	8670	24000	19600	15200	6710	5520	1650	1430
3	1820	1660	6560	7600	10000	42600	21200	13700	6520	13700	1640	1380
4	1520	1750	9900	6960	17400	37900	24400	13800	7850	5040	1630	1320
5	1470	1780	12500	6370	23800	27100	59200	19600	8670	3970	1620	1300
6	1480	2040	11700	5870	21300	21000	62400	31300	8090	3600	1820	1410
7	1500	2290	8750	5310	18100	17300	52300	26500	7170	3390	1830	1600
8	1540	2860	7150	4960	15900	14900	51900	21900	6180	3630	1770	2490
9	1480	3290	6370	5030	14400	13500	42900	18200	5510	3740	1790	4330
10	1410	3630	6310	5160	13100	13500	39500	15200	4880	3380	1900	15200
11	1340	4710	7450	5280	11800	14200	34000	13200	4530	3090	1720	10300
12	1230	5290	8130	5220	10700	15000	27300	11900	4230	2830	1610	10800
13	1280	6020	7650	5050	9880	13800	23700	10700	4140	3270	1490	8930
14	1440	5780	7200	5050	9290	12000	20600	9680	4180	3540	1480	13700
15	1380	4350	6640	4890	8840	10800	17400	9010	4440	4480	1440	12200
16	1410	3450	6250	4680	8640	9840	16000	8390	4030	4610	1410	8890
17	1450	3080	5870	4890	7930	9260	41000	7930	3790	3700	1400	6580
18	1480	2970	5820	4880	7520	8710	136000	7390	3550	3150	1380	6180
19	1430	2720	5910	5810	7070	8330	119000	7410	3360	2790	1340	5850
20	1410	2830	6140	11800	6710	7810	64500	8100	3190	2600	1290	5490
21	1380	3400	5850	27500	6440	7520	45600	9450	3780	2360	1350	6200
22	1380	4440	5250	27600	6110	7260	35700	16200	4600	2570	1320	8100
23	1400	5230	4900	20400	6250	7040	28400	15200	4660	2440	1330	11200
24	1380	4960	5470	16000	6430	6840	23100	12500	4710	2040	1410	8410
25	1310	4380	9840	12300	6620	6590	21000	10900	4140	2130	1480	6830
26	1340	4020	23000	9740	7010	6460	26300	10600	3530	1840	1650	5610
27	1410	3810	26500	8430	7410	6380	32200	9330	3470	1800	1710	4800
28	1490	4380	20900	7100	7950	6380	27000	8600	4260	1770	1750	4100
29	1780	6060	16100	7290	---	6380	22400	8350	3650	1740	1630	3740
30	1790	5850	13100	7690	---	6380	18900	8340	4300	1680	1580	3550
31	1390	---	10700	8720	---	6730	---	8150	---	1630	1540	---
TOTAL	45830	110230	289010	275080	295000	408110	1163600	403230	149450	111890	48640	183430
MEAN	1478	3674	9323	8874	10540	13160	38790	13010	4982	3609	1569	6114
MAX	1930	6060	26500	27600	23800	42600	136000	31300	8670	13700	1900	15200
MIN	1230	1500	4900	4680	6110	6380	10100	7390	3190	1630	1290	1300
CFSM	.15	.38	.97	.92	1.09	1.36	4.02	1.35	.52	.37	.16	.63
IN.	.18	.42	1.11	1.06	1.14	1.57	4.49	1.55	.58	.43	.19	.71

APPENDIX D

APPENDIX D
PROJECT TEAM

PROJECT TEAM:

Williamsport Preservation Training Center:

Thomas Vitanza, Project Historical Architect
Paul Neidinger, Historical Architect
Carlisle A. Rodney, Student Trainee - Architecture

Harpers Ferry National Historical Park:

Peter Dessauer, Park Historical Architect

National Capital Region:

Rebecca Stevens, Regional Historical Architect
Stephen Ziegenfuss, Assistant Regional Historical Architect
Maureen Joseph, Landscape Architect

PROJECT CONSULTANTS:

Barbara Zook, Acting Harpers Ferry Program Coordinator, NCR

Douglas Hicks, Deputy Chief, WPTC

Earl Gillespie, Masonry Section Chief, WPTC

Donald Campbell, Superintendent, HAFE

Dennis Frye, Chief of Interpretation and Cultural Resources, HAFE

Tim Fox, Chief of Maintenance, HAFE

Paul Shackel, Park Archaeologist, HAFE

PROFESSIONAL SUPPORT

CHIEF Ron Skurkis under LT. Henson
w/ Underwater Construction Team 01
NORFOLK, VA.
804-464-7704
804-464-7447

Bureau of Reclamation (Responsible for the design for Dam No. 05 at C&O Canal)

BM1 Dwight Price under LT. Martins
BEACHMASTER UNIT 02
804-464-7722

APPENDIX E

LEGEND

- PARK BOUNDARY
- STATE BOUNDARY
- TRAIL
- RIVER
- VISITOR CENTER — VC
- CEMETERY — †
- ARMORY SITE — (1)
- MATHER EMPLOYEE DEVELOPMENT CTR. — (2)
- INFORMATION CENTER — (3)
- ST. PETERS CATHOLIC CHURCH — (4)
- JOHN BROWNS FORT — (5)

DELINEATION & KEY NOTES

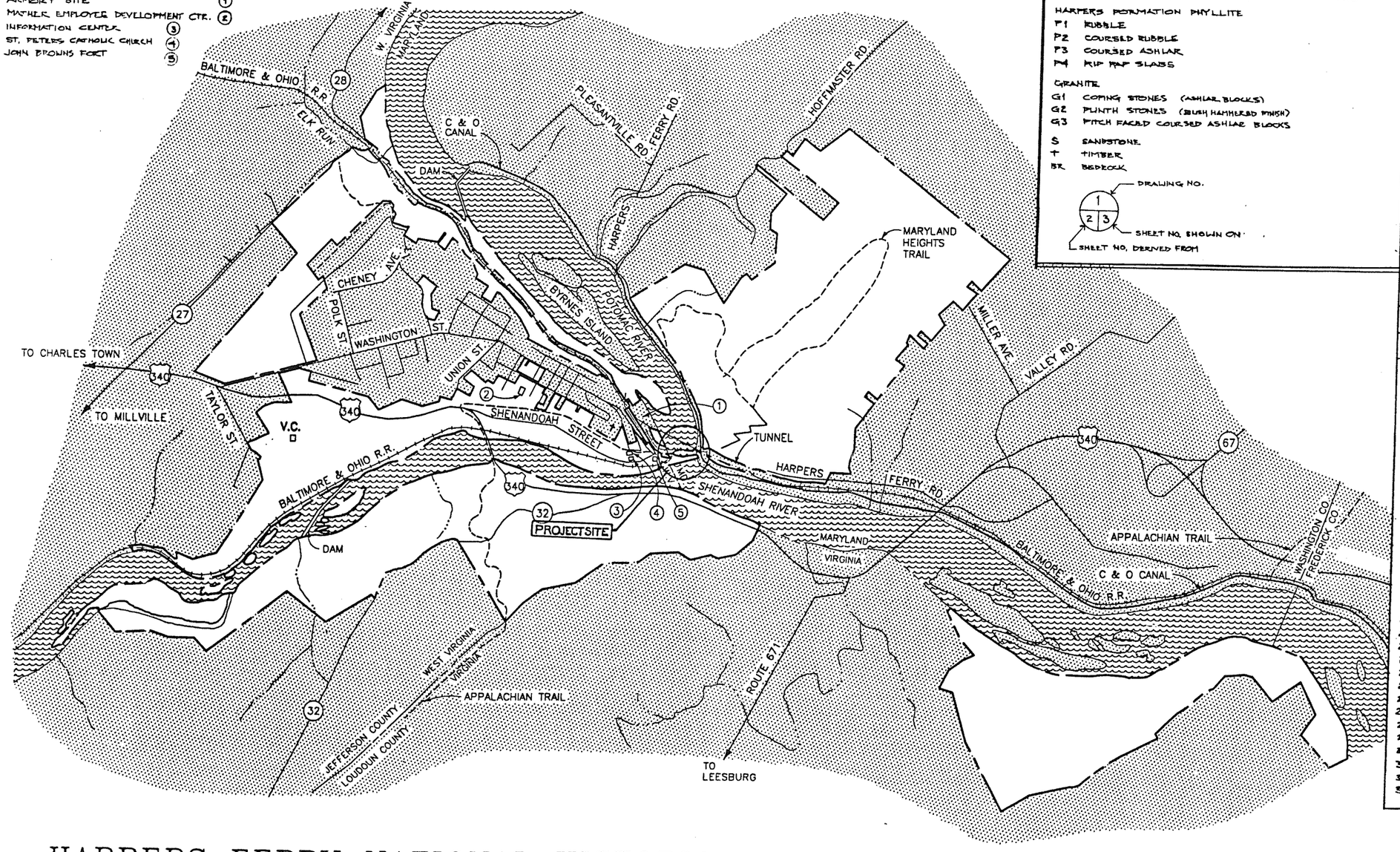
TOMSTOWN FORMATION LIMESTONE
- L1 COURSED RUBBLE
- L2 PITCH FACED COURSED ASHLAR
- L3 PLINTH STONES
- L4 RUBBLE CORE, LIMESTONE and HARPERS PHYLLITE

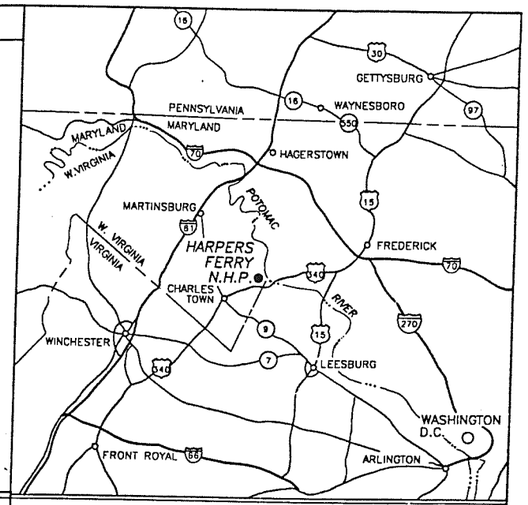
HARPERS FORMATION PHYLLITE
- P1 RUBBLE
- P2 COURSED RUBBLE
- P3 COURSED ASHLAR
- P4 RIP RAP STONES

GRANITE
- G1 COPING STONES (ASHLAR BLOCKS)
- G2 PLINTH STONES (BUSH HAMMERED FINISH)
- G3 PITCH FACED COURSED ASHLAR BLOCKS

- S SANDSTONE
- † TIMBER
- BR BEDROCK

DRAWING NO. / SHEET NO. SHOWN ON / SHEET NO. DERIVED FROM





WEST VIRGINIA

SCALE OF MILES 10 0 10

DRAWING INDEX

DWG NO.	SUBSHEET NO	SHEET TITLE
1 –	S1	COVER SHEET
2 –	S2	SITE MAP
3 –	S3	WINCHESTER AND B&O SPAN ABUTMENTS, ELEV. & PLAN
4 –	WSA1	WINCHESTER SPAN ABUTMENT, PARTIAL PLAN, EAST ELEV.
5 –	WSA2	WINCHESTER SPAN ABUTMENT, PLAN & SOUTH & WEST ELEV.
6 –	WSA3	WINCHESTER SPAN ABUTMENT, EAST WALL & DETAIL
7 –	WSA4	WINCHESTER SPAN ABUTMENT, EAST WALL & DETAIL
8 –	BOSA1	B&O SPAN ABUTMENT, PARTIAL PLAN & EAST ELEV.
9 –	BOSA2	B&O SPAN ABUTMENT, PARTIAL PLAN & NORTH ELEV.
10 –	BOSA3	B&O SPAN ABUTMENT, EAST PILASTER ELEV. & DETAIL
11 –	BOSA4	B&O SPAN ABUTMENT, NORTH & EAST WALL ELEV. & DETAILS
12 –	PA1	PIER "A" PLAN, NORTH & WEST ELEV.
13 –	PA2	PIER "A" PLAN, SOUTH & EAST ELEV.
14 –	PA3	PIER "A" RIP RAP, NORTH & SOUTH ELEV. W/ PLANS
15 –	PA4	PIER "A" RIP RAP, PLAN & WEST ELEV.
16 –	PA5	PIER "A" RIP RAP, PLAN & EAST ELEV.
17 –	PB1	PIER "B", PLAN, NORTH AND WEST ELEV.
18 –	PB2	PIER "B", PLAN, SOUTH & EAST ELEV.
19 –	PB3	PIER "B", RIP RAP, NORTH & SOUTH ELEV. & PLANS
20 –	PB4	PIER "B", RIP RAP PLAN, WEST ELEV.
21 –	PB5	PIER "B", RIP RAP PLAN, EAST ELEV.
22 –	PAB1	PIERS 'A' & 'B', DETAIL VIEWS OF EXISTING CONDITIONS
23 –	PC1	PIER "C" RIP RAP, PLAN
24 –	PC2	PIER "C" ELEVATIONS (N,S,E,W)
25 –	PD1	PIER "D" RIP RAP, PLAN
26 –	PD2	PIER "D" ELEVATIONS (N,S,E,W)
27 –	PE1	PIER "E" RIP RAP, PLAN
28 –	PE2	PIER "E" ELEVATIONS (N,S,E,W)
29 –	PE3	PIER "E" DETAILS
30 –	PF1	PIER "F" AREA SHE PLAN VIEW
31 –	PF2	PIER "F" ELEVATIONS (N,S,E,W)
32 –	MDA1	MARYLAND ABUTMENT, PLAN & ELEVATION
33 –	PFMDA1	PIER "F" & MD. ABUTMENT DETAIL & EXISTING COND.

SCALE OF FEET
1200 0 1200 2400
200 0 200 400 600
SCALE OF METERS

HARPERS FERRY NATIONAL HISTORICAL PARK

BASIC DATA: LAND STATUS MAP(S) 395-92,002/NPS MINI FOLDER DTD 1988

/PROJ/COVERS/APPROVED/HAFE_COVER.DG

SUB SHEET NO.	Mark	Sheet	REVISION	Date	Initial
S1					

RECOMMENDED
- Regional Historical Architect, MCR — 5/6/94 Date
- Chief, Mid-Atlantic Historic Preservation Training Center — 5/5/94 Date
- Superintendent, HAFE — 5-5-94 Date

APPROVED — Regional Director, MCR — 5/5/94 Date

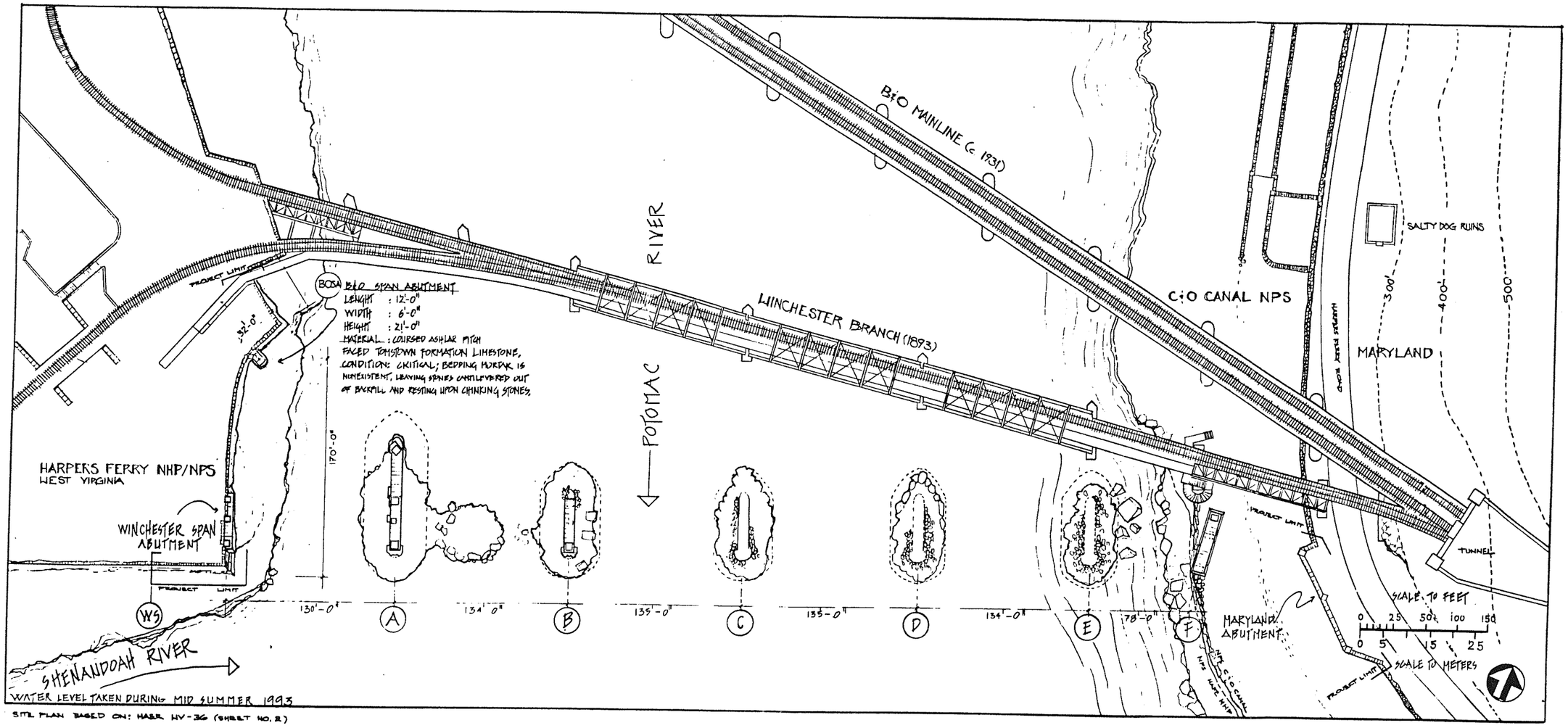
WILLIAMSPORT HISTORIC PRESERVATION TRAINING CENTER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

DESIGNED: WPTC
DRAWN: ROBNEY / NEIDINGER
TECH REVIEW: VITANZA
DATE: 03/23/94

TITLE OF DRAWING
EXISTING CONDITIONS
LOCATION WITHIN PARK
B&O RAILROAD BRIDGE PIERS & ABUTMENTS
NAME OF PARK
HARPERS FERRY
NATIONAL HISTORICAL PARK
REGION: MID-ATLANTIC | COUNTY: JEFFERSON | STATE: WEST VIRGINIA

DRAWING NO. 385 60070
PKG. NO. 212
SHEET 1 OF 33



SITE PLAN BASED ON: HABR HV-36 (SHEET NO. 2)

WINCHESTER SPAN ABUTMENT
LENGHT : 44'-3"
WIDTH : 6'-6"
HEIGHT : 19'-4"
MATERIAL - COURSED ASHLAR PITCH - FACED TOMSTOWN FORMATION LIMESTONE W/
- COURSED ASHLAR PITCH - FACED GRANITE ADDITIONS.
- HARPERS PHYLLITE RUBBLE

NOTE - LEVEL OF SILTATION AT BASE OF MONUMENT.

PIER A
LENGTH : 90'-0"
WIDTH : 8'-0"
HEIGHT : 32'-6"
MATERIAL - COURSED ASHLAR PITCH - FACED TOMSTOWN FORMATION
- COURSED ASHLAR GRANITE ADDITION
- RIP RAP (135'x50') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CRITICAL CONDITION - DISPLACED HARPERS PHYLLITE RIP RAP ON UPSTREAM (NORTH) END.

PIER B
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 31'-3"
MATERIAL - COURSED ASHLAR PITCH - FACED TOMSTOWN FORMATION LIMESTONE W/
- COURSED ASHLAR GRANITE ADDITION
- RIP RAP (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN

CRITICAL CONDITION - DISPLACED STONES OF UPPER COURSES OF THE UPSTREAM (NORTH) END.

PIER C
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 8'-6"
MATERIAL - COURSED ASHLAR PITCH - FACED TOMSTOWN FORMATION LIMESTONE
- RIP RAP (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CONDITION: SIX COURSES OF MASONRY REMAIN IN-SITU. UPPER COURSES DISCHARGED INTO RIVER INCLUDING ASHLAR GRANITE ADDITION

PIER D
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 3'-9"
MATERIAL - COURSED ASHLAR PITCH - FACED TOMSTOWN FORMATION LIMESTONE
- RIP RAP (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CONDITION : THREE COURSES OF MASONRY REMAIN IN-SITU. DEBRIS FROM UPPER COURSES IS CONCENTRATED AROUND THE EXTANT COURSE WORK.

PIER E
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 4'-0"
MATERIAL - COURSED ASHLAR PITCH - FACE TOMSTOWN FORMATION LIMESTONE
- RIP RAP (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CONDITION : BASE COURSES OF MASONRY REMAIN IN-SITU. DEBRIS FROM UPPER COURSES IS CONCENTRATED AROUND EXTANT COURSE WORK. EARLY REPAIR OF UPSTREAM (NORTH) END CONSOLIDATED THE MASONRY CONTRIBUTING TO MONOLITHIC FAILURE.

PIER F
LENGTH : 58'-0"
WIDTH : 10'-0"
HEIGHT : 19'-0"
MATERIAL : COURSED ASHLAR PITCH - FACED GRANITE WITH MARGINS. FOUNDATION STONES ARE HARPERS PHYLLITE COURSED RUBBLE MASONRY.
CRITICAL CONDITION : DISPLACED GRANITE COURSEWORK AT NORTH END. SEVERE UNDERMINING ALONG EAST SIDE OF FOUNDATION. SEVERE DISPLACEMENT OF RUBBLE MASONRY OF ASSOCIATED FOUNDATION RETAINING WALL AT SOUTHWEST CORNER

MARYLAND ABUTMENT
LENGHT : 90'-0"
WIDTH : 15'-0"
HEIGHT : 30'-0"
MATERIAL : COURSED ASHLAR PITCH FACED TOMSTOWN FORMATION LIMESTONE.
CONDITION: REPAINS EMBANKMENT OF C&O CANAL AND MARYLAND HARPERS FERRY ROAD, WASHINGTON COUNTY.

DESIGNED: WPTC	SUB SHEET NO. S2	TITLE OF SHEET: SITE-PLAN
DRAWN: RODNEY		B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT
TECH. REVIEW: VITANZA		EXISTING CONDITIONS
DATE: 03/25/94		DRAWING NO. 385 80070
		PKG. NO. 212
		SHEET 2 OF 33

SHENANDOAH RIVER

MATCH LINE - PARTIAL PLAN (1/3)

EXISTING TREES & CANOPIES

REMOVE TREE

17'-0" 18'-0" 16'-0" WINCHESTER SPAN ABUTMENT

103'-4"

89'-0" WEST BANK ABUTMENT RETAINING WALL

32'-6"

38'-4" B&O SPAN ABUTMENT

COPING 35'-0"

BASE 39'-6"

POTOMAC RIVER

N

WEST BANK PLAN (1/3)

SCALE 1/8" = 1'-0"

4 0 4 8 12

24'-8" TOP OF RAIL

20'-4" COPING OF ABUTMENT

11'-4" TOP OF RUBBLE BASE

0'-0" EXPOSED BASE OF ABUTMENT

AREA OF SILT DEPOSITS TO BE REMOVED TO EXPOSE MASONRY

6'-0" 20'-0"

11'-4"

21'-0"

15'-0"

6'-0"

NOTE: EXISTING TREES RANGE IN DIAMETER from 8" to 18" WITH GROUPINGS OF SMALLER TRUNK DIAMETERS AVERAGING 3 FT to 5 FT IN WIDTH.

WEST BANK ELEV. (2/3)

SCALE 1/8" = 1'-0"

4 0 4 8

60'-0" WINCHESTER SPAN ABUTMENT (SHEETS 3,4,5,6,7)

99'-0" WEST BANK ABUTMENT RETAINING WALL

PILASTER (SHEET 10)

35'-9" B&O SPAN ABUTMENT (SHEETS 8,9,10,11)

HAFE, WVA

S3

POTOMAC RIVER

LOCATION PLAN

CHOH, MD

DESIGNED: WPTC

DRAWN: RODNEY

TECH. REVIEW: YYTANZA

DATE: 03/29/94

SUB SHEET NO. S3

TITLE OF SHEET

WINCHESTER AND B&O ABUTMENT WALLS: PLAN & ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

PKG. NO. 212

SHEET 3 OF 33

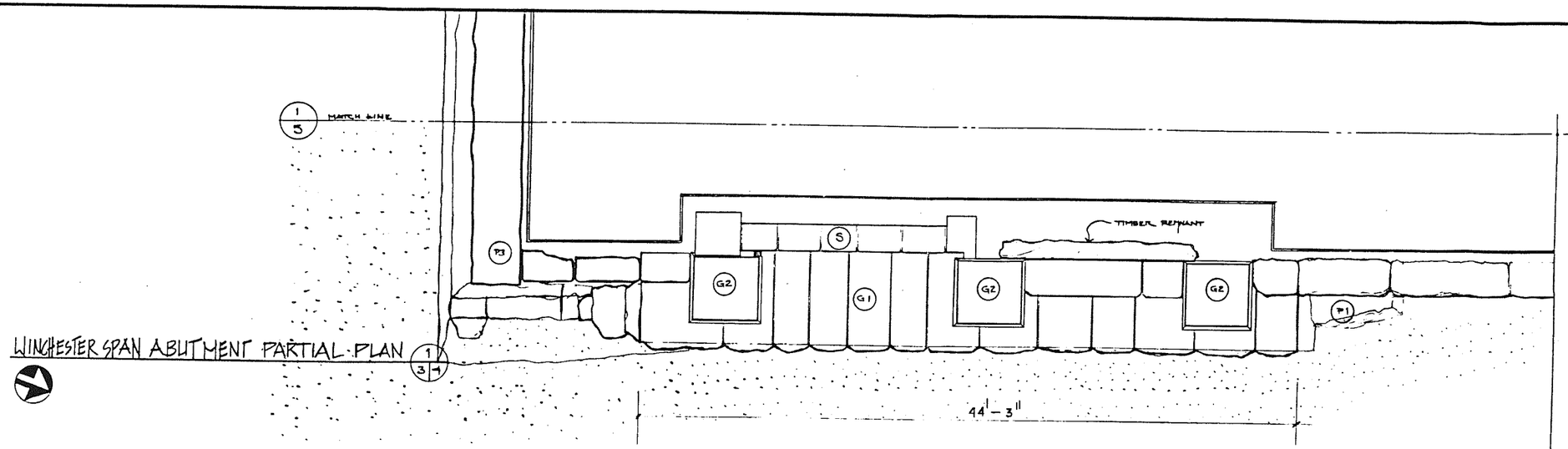
DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L1 – COURSED RUBBLE BASE
- L2 – PITCH-FACED COURSED ASHLAR
- L3 – PLINTH STONES

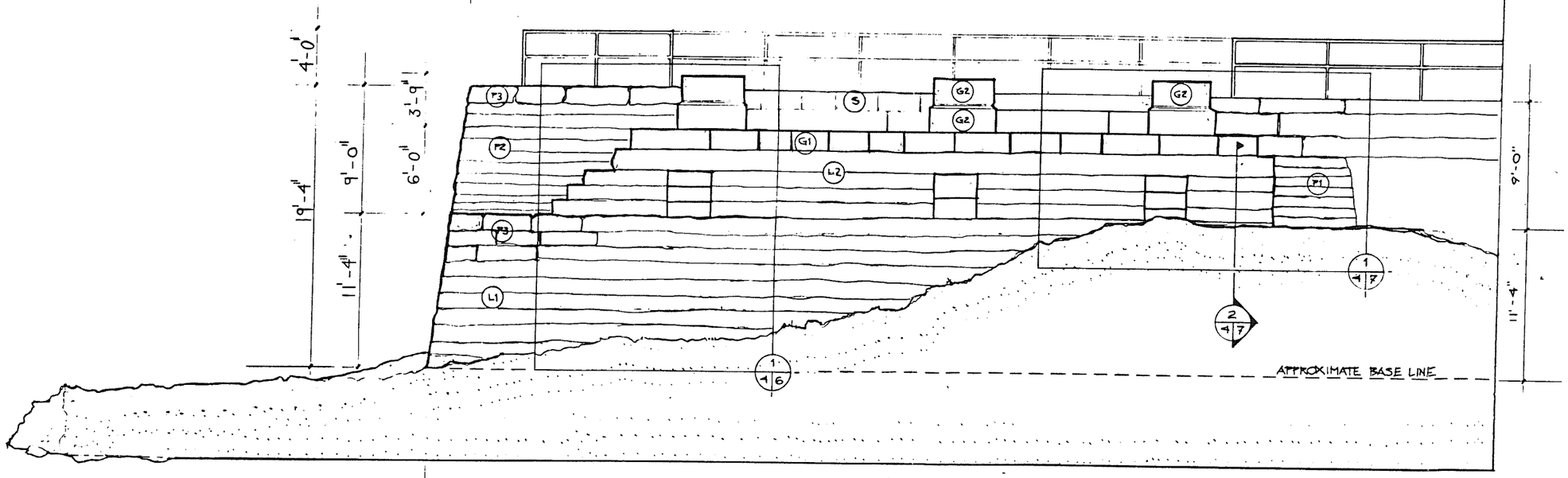
HARPERS FORMATION PHYLLITE
- P1 – RUBBLE
- P2 – COURSED RUBBLE
- P3 – COURSED ASHLAR
- P4 – RIP RAP SLABS

GRANITE
- G1 – COPING STONES
- G2 – PLINTH STONES
- G3 – PITCH-FACED COURSED ASHLAR BLOCKS

(S) – SANDSTONE

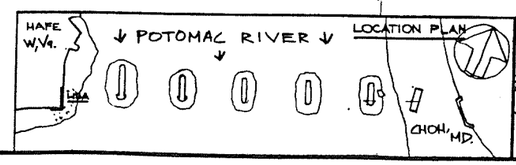


WINCHESTER SPAN ABUTMENT PARTIAL PLAN 1/3-1



WINCHESTER SPAN ABUTMENT-EAST ELEVATION 2/3-1

SCALE 1/4"=1'-0"
4 0 4 8



DESIGNED: WPTC	SUB SHEET NO. WSA 1
DRAWN: RODNEY	
TECH. REVIEW: MTANZA	
DATE: 03/20/74	

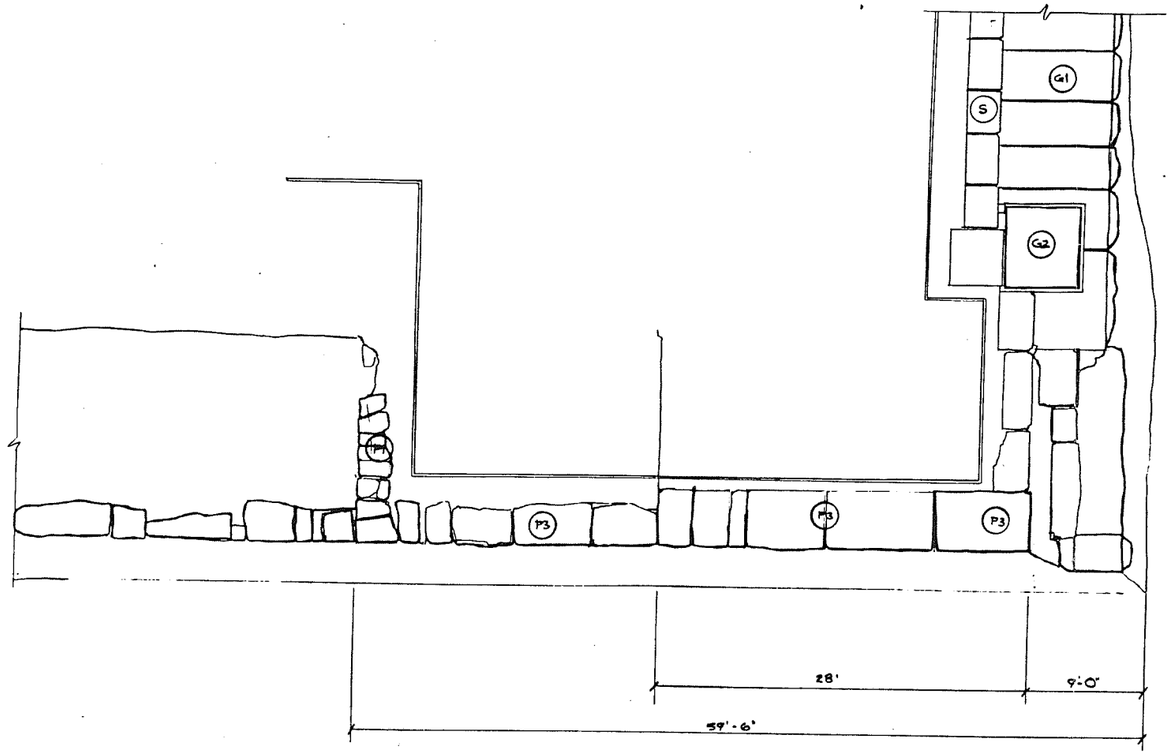
TITLE OF SHEET
WINCHESTER SPAN ABUTMENT WALL
PARTIAL PLAN & EAST ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 325 80070

PKG. NO. 212

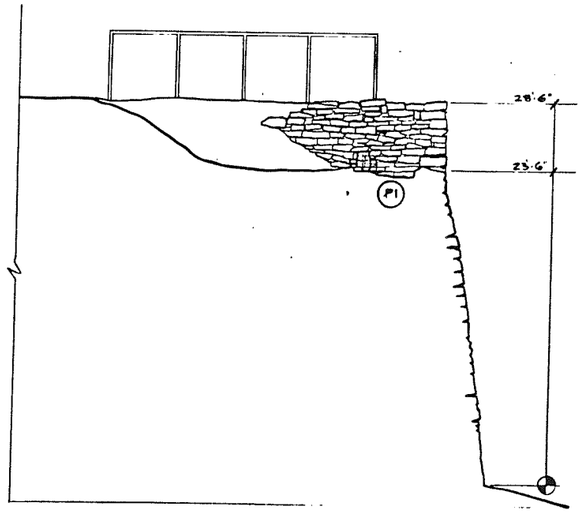
SHEET 4 OF 33

U.S. GOVERNMENT PRINTING OFFICE: 878-100

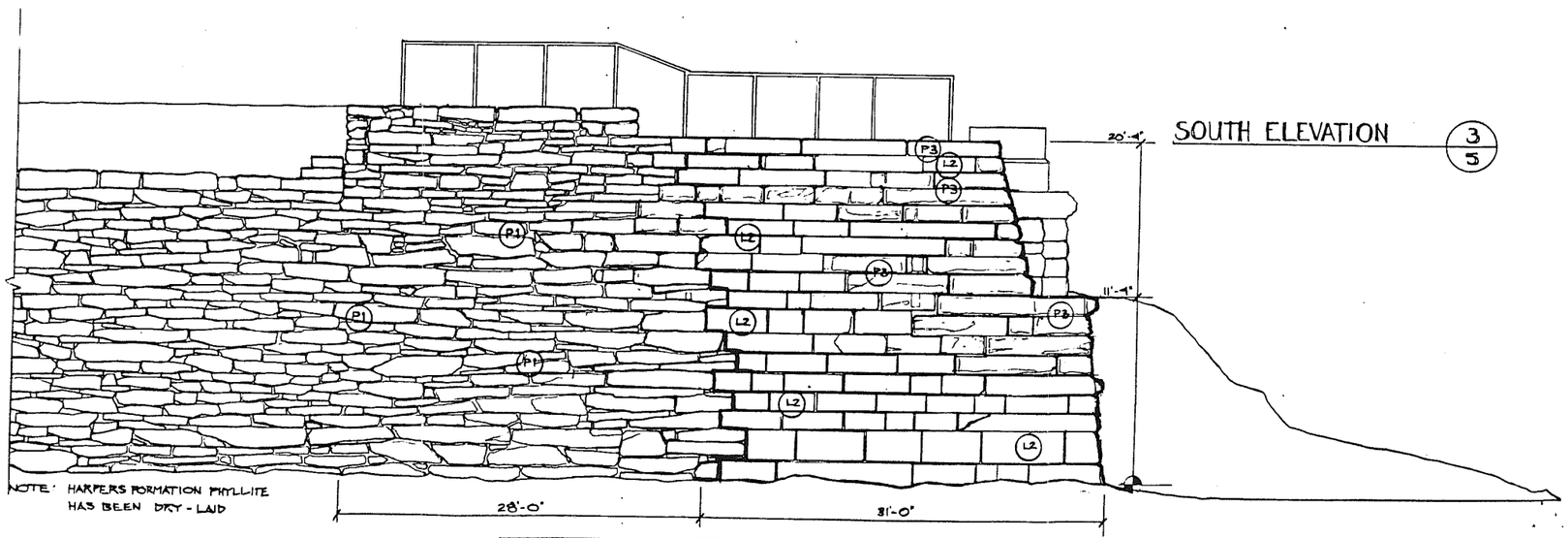


PARTIAL PLAN 1/5

SCALE: 3/16" = 1'-0"

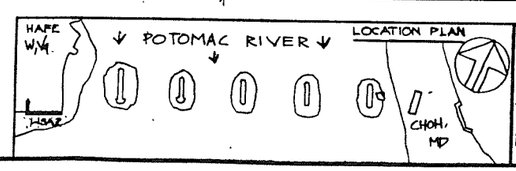


WEST ELEVATION 2/5



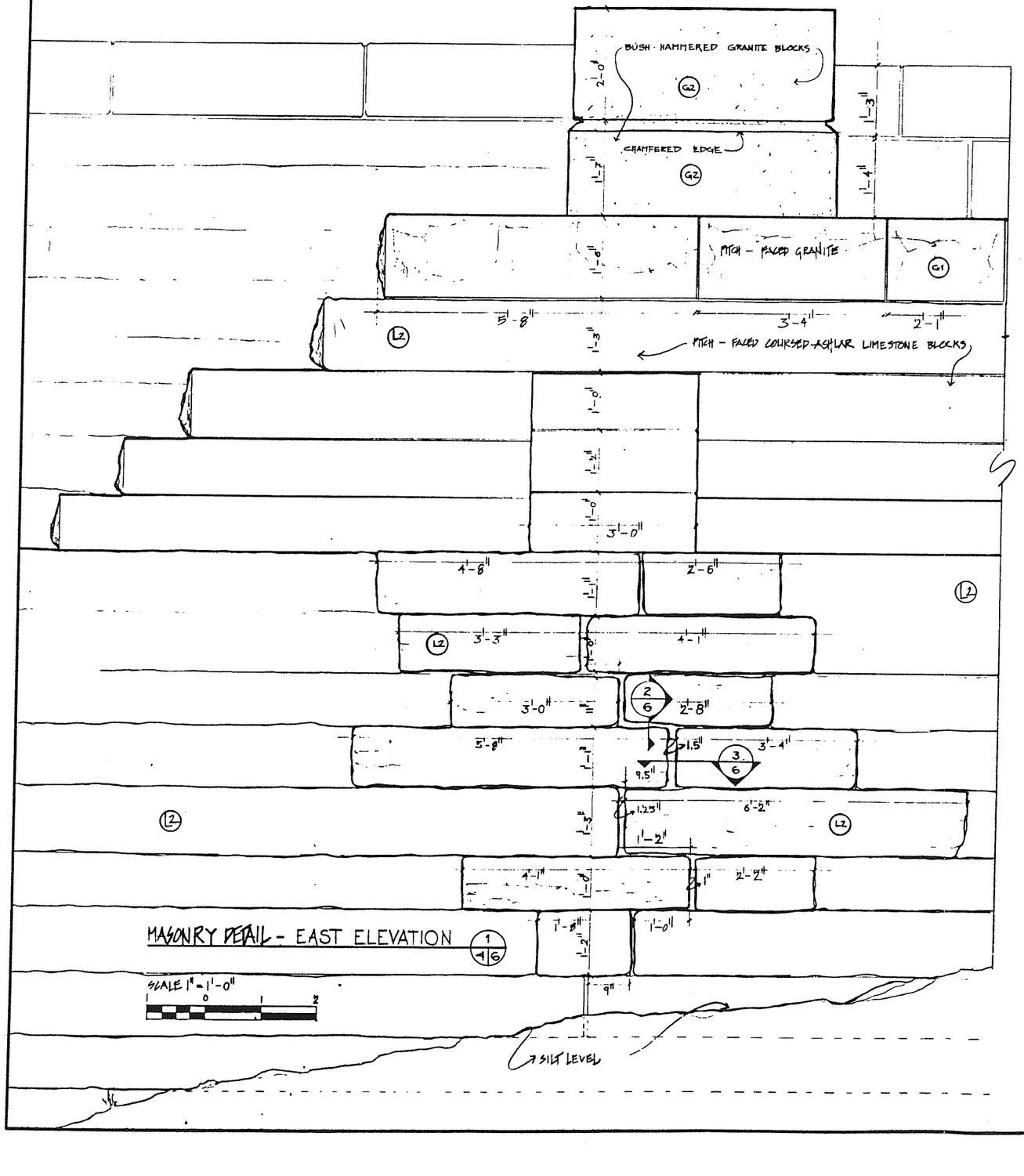
NOTE: HARPERS FORMATION PHYLLITE HAS BEEN DRY-LAID

SOUTH ELEVATION 3/5



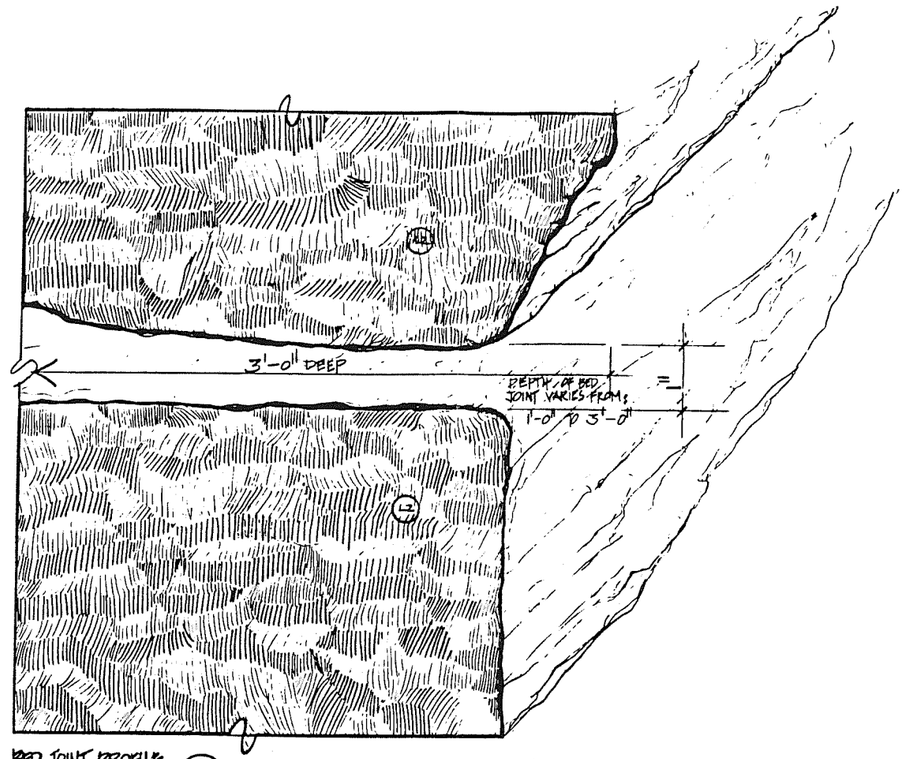
DESIGNED: WPTC	SUB SHEET NO. WSA2	TITLE OF SHEET: WINCHESTER SPAN ABUTMENT PLAN & ELEVATIONS B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. 385 80070
DRAWN: NEUSINGER			PKG. NO. 212
TECH. REVIEW: MANEA			SHEET 5 OF 33
DATE: 03/25/99			

U.S. GOVERNMENT PRINTING OFFICE: 878-100



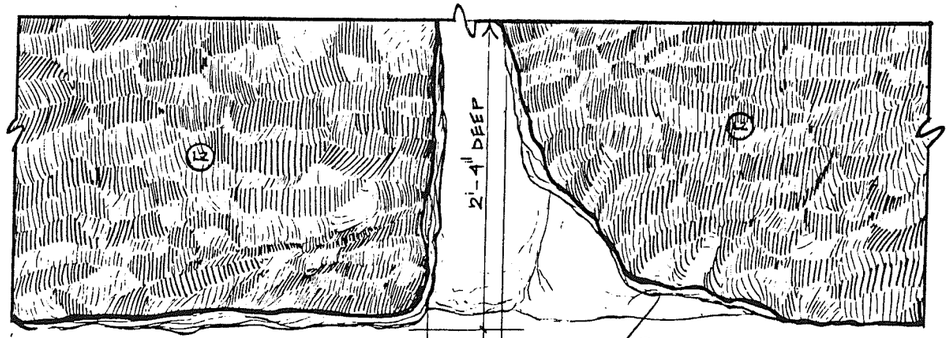
MASONRY DETAIL - EAST ELEVATION (1/6)

SCALE 1" = 1'-0"



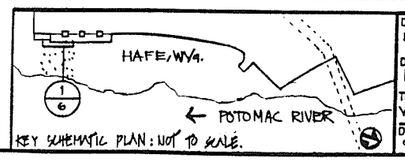
BED JOINT PROFILE (2/6)

FULL SCALE



HEAD JOINT PROFILE (PLAN VIEW) (3/6)

FULL SCALE



DESIGNED: WPTC
DRAWN: RDONBY
TECH. REVIEW: VIVANZA
DATE: 03/23/71

SUB SHEET NO. WSA3

TITLE OF SHEET
WINCHESTER SPAN ABUTMENT
MASONRY DETAIL & JOINT PROFILE
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 383 70070

PKG. NO. 212

SHEET 6 OF 33

★U.S. GOVERNMENT PRINTING OFFICE: 675-100

TIMBER REMANT RETAINS BACKFILL of COPING STONES

GRANITE G2 4'-6" 2'-0"

GRANITE G2 4'-9" 1'-6"

PITCH-FACED GRANITE BLOCKS

HARPERS PHYLLITE RUBBLE MASONRY P1

LIMESTONE L2 3'-0"

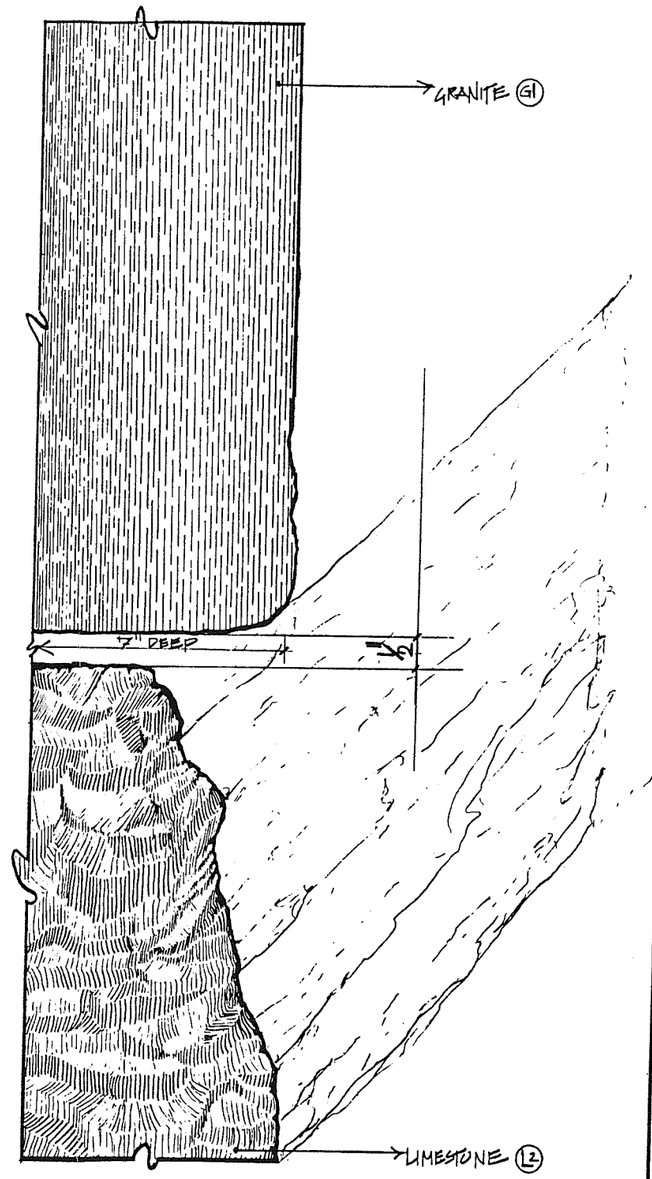
HARPERS PHYLLITE COURSED RUBBLE MASONRY P2

1'-0" 1'-6" 1'-10" 1'-6" 1'-4" 1'-2" 1'-1" 1'-1" 1'-2"

MASONRY DETAIL-EAST ELEVATION 1/7

SCALE 1" = 1'-0"

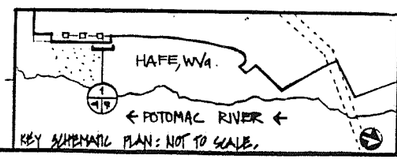
0 1 2



GRANITE AND LIMESTONE MASONRY-BED JOINT PROFILE 2/7

FULL SCALE

3 0 3



KEY SCHEMATIC PLAN: NOT TO SCALE.

DESIGNED: WPTC
DRAWN: RODNEY
TECH REVIEW: VIANZA
DATE: 03/25/79

SUB SHEET NO. WSA 4

TITLE OF SHEET
WINCHESTER SPAN ABUTMENT MASONRY DETAIL & JOINT PROFILE
B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

PKG. NO. 212

SHEET 7 OF 33

U.S. GOVERNMENT PRINTING OFFICE: 979-100

NOTE:
- FLOOD WATERS PERIODICALLY SUBMERGE THE STRUCTURE IMPACTING THE MASONRY THROUGH EROSION, AND FLOATING DEBRIS.
- PILASTER MORTAR IS NONEXISTENT

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L-1 COURSED RUBBLE BASE
- L-2 PITCH-FACED COURSED ASHLAR BLOCKS
- L-3 PLINTH STONES
- L-4 RUBBLE CORE LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
- P-1 RUBBLE
- P-2 COURSED RUBBLE
- P-3 COURSED ASHLAR
- P-4 RIP-RAP SLABS

GRANITE
- G1 COPING STONES (ASHLAR BLOCKS)
- G2 PLINTH STONES (BUSH HAMMERED)
- G3 PITCH-FACED COURSED ASHLAR BLOCKS

6'-0" 30'-0"

2'-9"

12'-6"

30'-0"

34'-0" TOP OF RAIL

30'-6" TOP COPING STONES

26'-0" TOP OF COPING OF PILASTER

4'-6" RAISED PILASTER

TRANSITION TO HARPERS PHYLLITE ABUTMENT REMAINING WALL

NOTE: DEPOSITION FROM POTOMAC RIVER REMAINS INSITU THROUGH ROOT ACTION OF NEARBY TREES.

NOTE: SEE SUB SHEET BOSA-4 FOR FURTHER DETAILS

B&O LIMESTONE PILASTER WALL | PILASTER | GRANITE ADDITION | LIMESTONE WALL B&O SPAN ABUTMENT | WINCHESTER BRANCH ABUTMENT c. 1893

B&O SPAN ABUTMENT PLAN (PARTIAL VIEW) 1 / 3 8

SCALE 1/4" = 1'-0"

B&O SPAN ABUTMENT EAST ELEVATION 2 / 3 8

SCALE 1/4" = 1'-0"

LOCATION PLAN

HAFE WV4 BOSA 1 ↓ POTOMAC RIVER ↓ CHOH, MD

DESIGNED: WPTC	SUB SHEET NO. BOSA-1
DRAWN: RODNEY	
TECH. REVIEW: VTANZA	
DATE: 03/25/94	

TITLE OF SHEET
B&O SPAN ABUTMENT WALL PLAN & EAST ELEVATION
B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

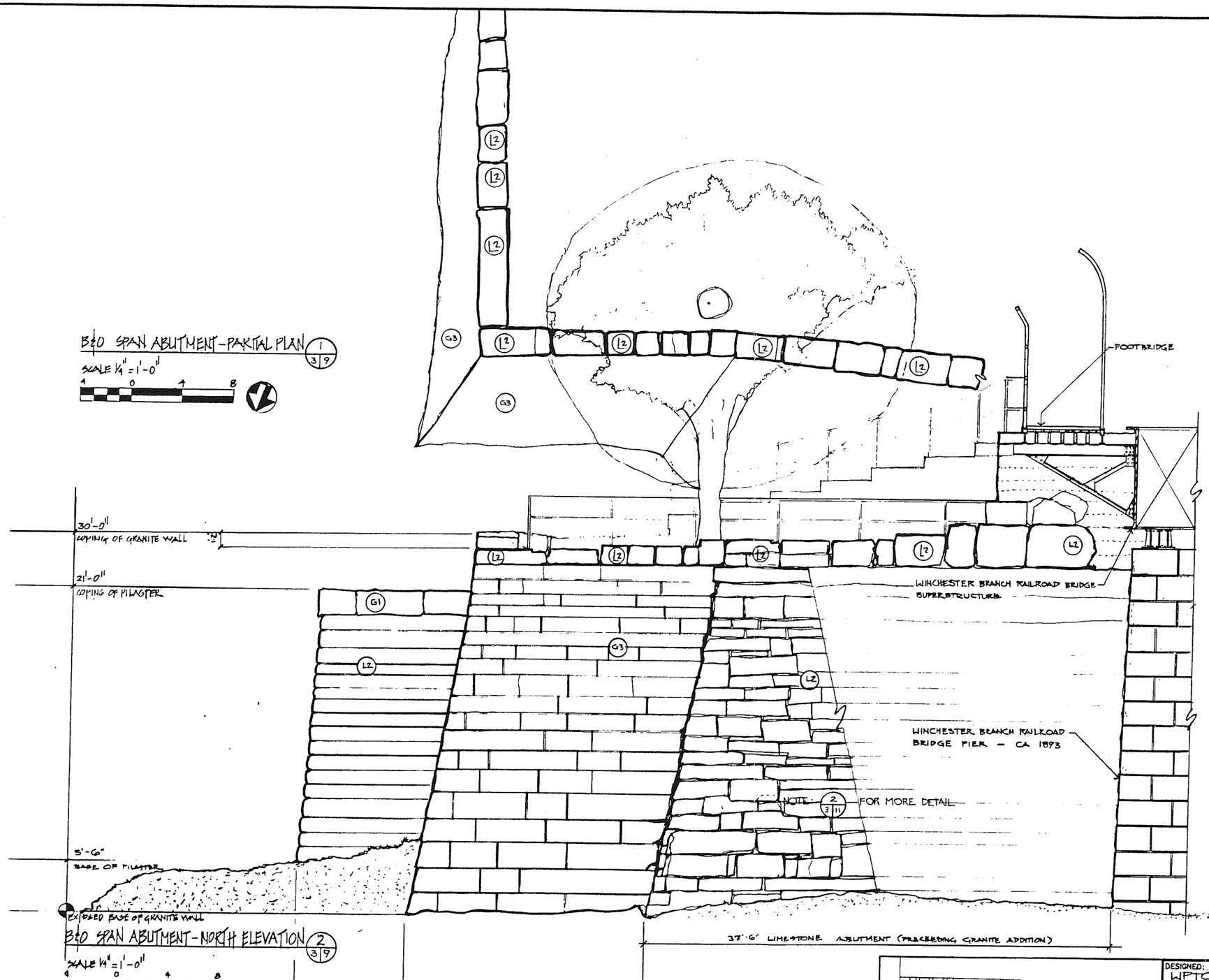
PKG. NO. 212

SHEET 8 OF 33

B&O SPAN ABUTMENT - PARTIAL PLAN (1/3|9)

SCALE 1/4" = 1'-0"

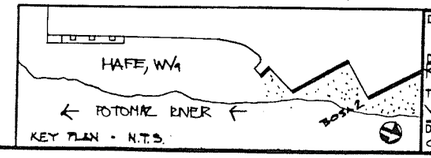
4 0 4 8



B&O SPAN ABUTMENT - NORTH ELEVATION (2/3|9)

SCALE 1/4" = 1'-0"

4 0 4 8



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VTANZA
DATE:	03/25/94

SUB SHEET NO. B0SA2

TITLE OF SHEET
B&O SPAN ABUTMENT
PARTIAL PLAN & NORTH ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

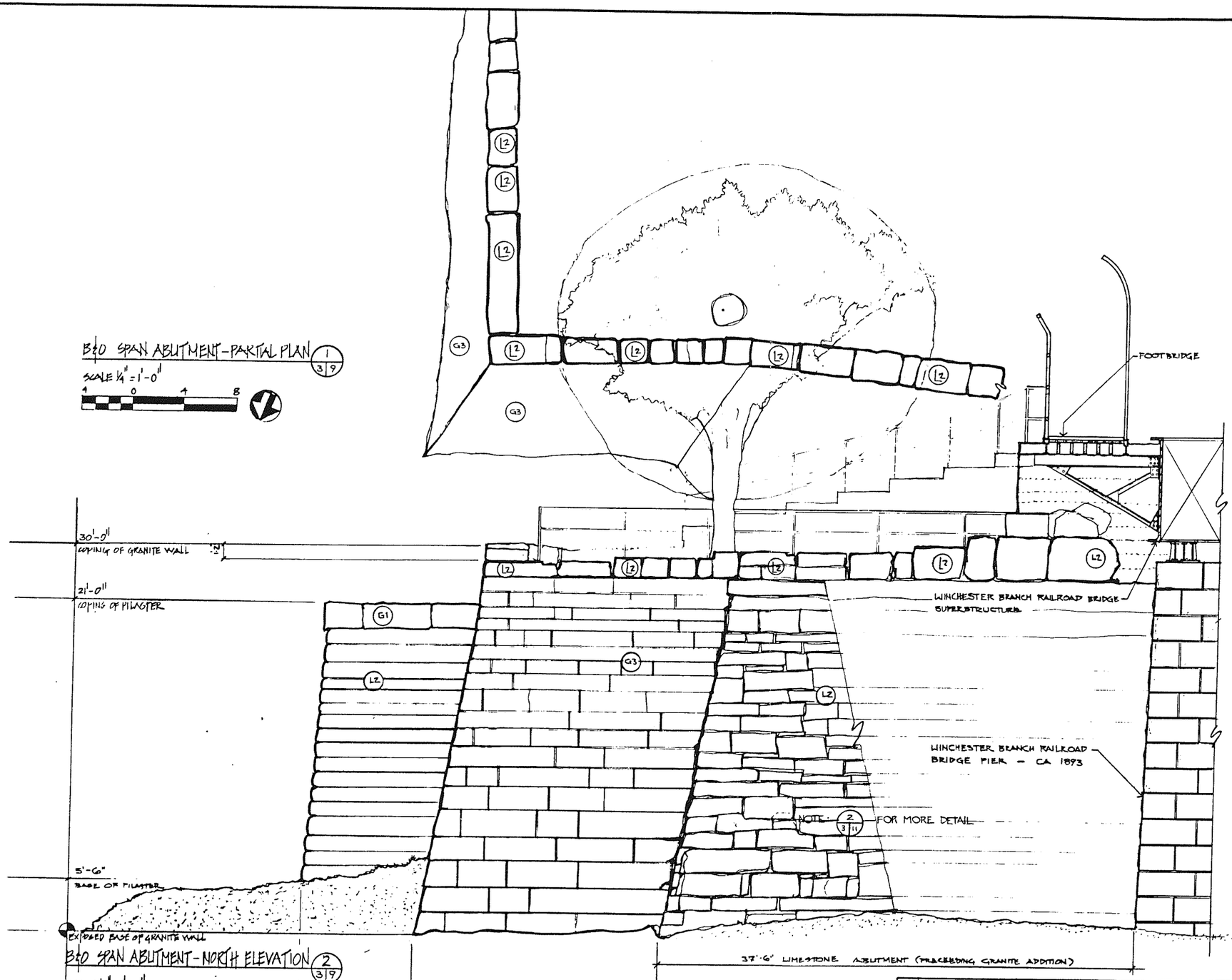
PKG. NO. 212

SHEET 9 OF 33

B&O SPAN ABUTMENT - PARTIAL PLAN (1 / 3 / 9)

SCALE 1/4" = 1'-0"

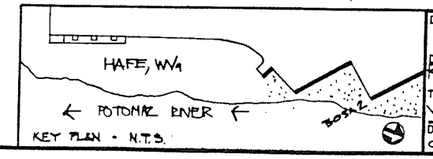
4 0 4 8



B&O SPAN ABUTMENT - NORTH ELEVATION (2 / 3 / 9)

SCALE 1/4" = 1'-0"

4 0 4 8



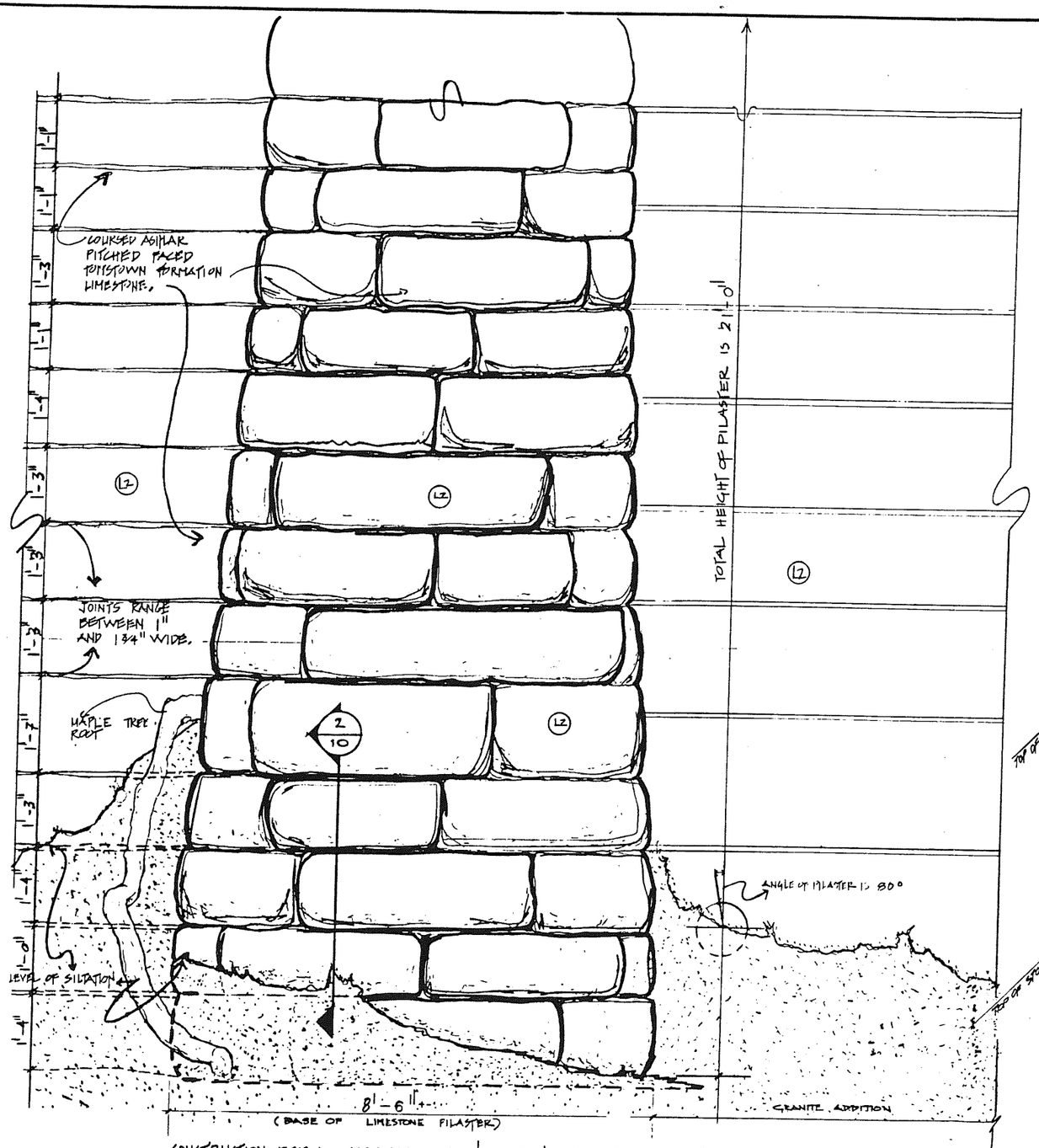
DESIGNED: WPTC	SUB SHEET NO. BOSA2
DRAWN: RODNEY	
TECH. REVIEW: VITANZA	
DATE: 03/25/94	

TITLE OF SHEET
B&O SPAN ABUTMENT
PARTIAL PLAN & NORTH ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

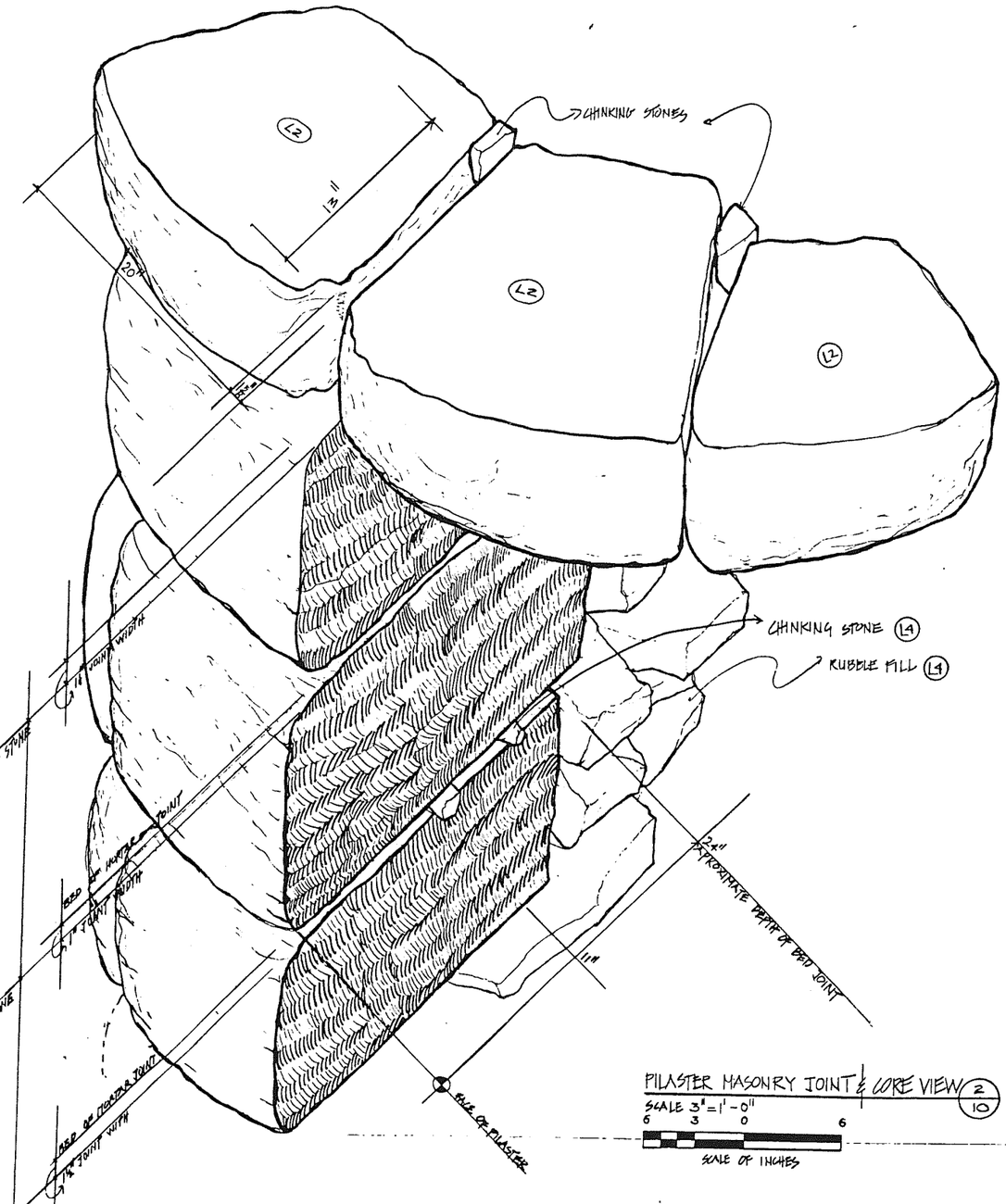
PKG. NO. 212

SHEET 9 OF 33



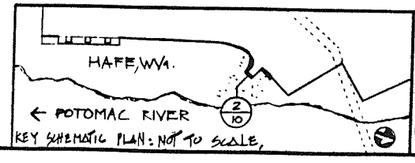
CONSTRUCTION DETAIL – MASONRY OF B&O SPAN PILASTER • EAST ELEVATION 1/8|10

SCALE 1" = 1'-0"
1 0 1 2
SCALE OF FEET



PILASTER MASONRY JOINT & CORE VIEW 2/10

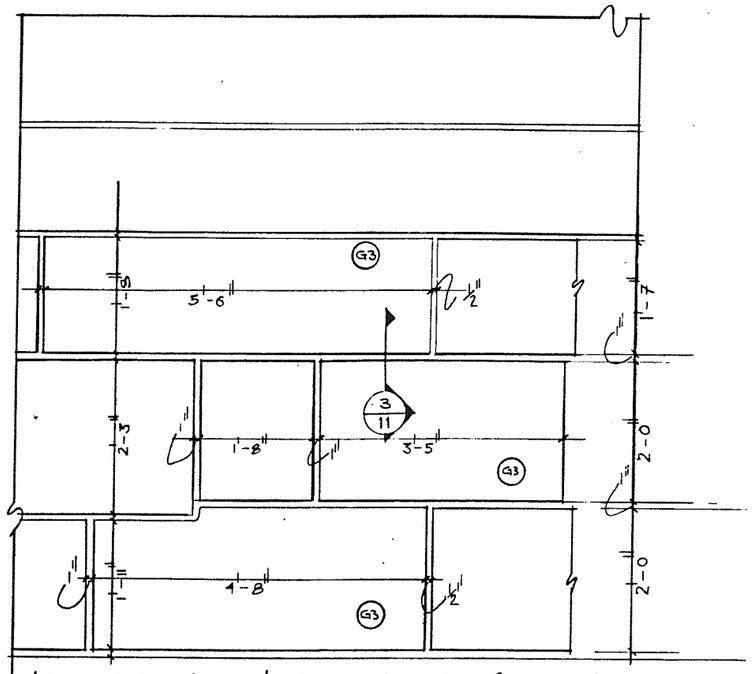
SCALE 3" = 1'-0"
6 3 0 6
SCALE OF INCHES



KEY SCHEMATIC PLAN: NOT TO SCALE.

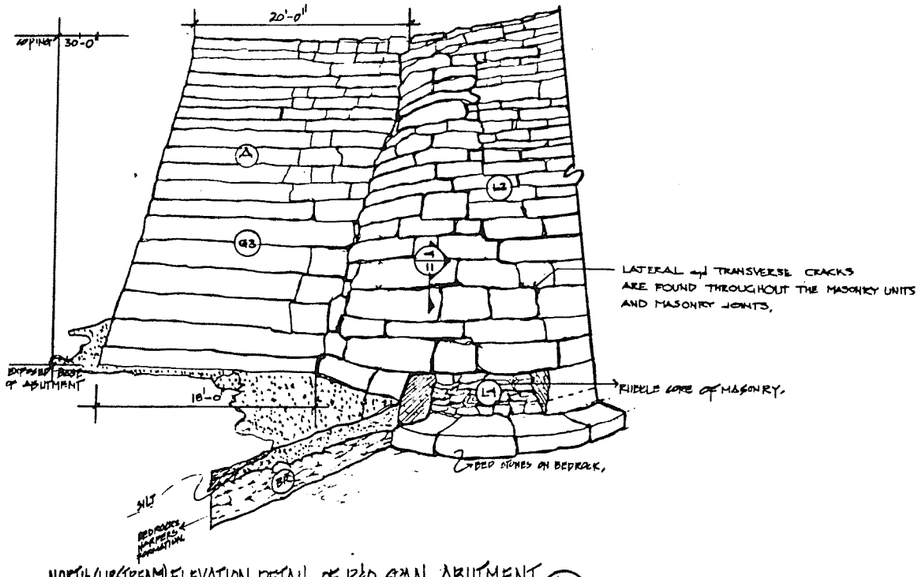
DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VIVANZA
DATE:	03/23/94
SUB SHEET NO.	BOSA-3
TITLE OF SHEET	B&O SPAN ABUTMENT CONSTRUCTION DETAILS & PROFILES B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS
DRAWING NO.	385 80070
PKG. NO.	212
SHEET	10 OF 33

☆ U.S. GOVERNMENT PRINTING OFFICE: 873-100

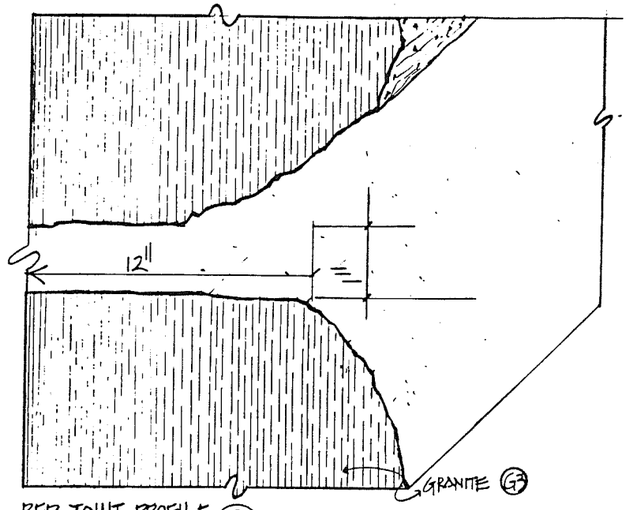


ASHLAR MASONRY DETAIL OF B&O SPAN ABUTMENT (EAST ELEVATION) (1 / 8 11)

SCALE: 1"=1'-0



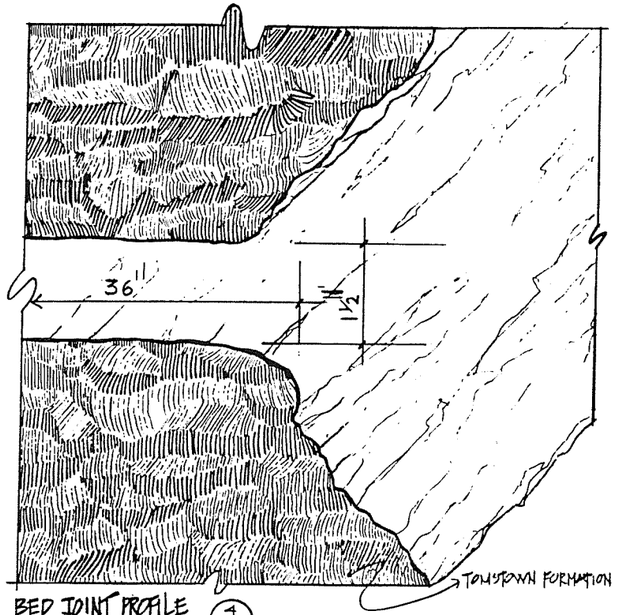
NORTH (UPSTREAM) ELEVATION DETAIL OF B&O SPAN ABUTMENT (2 / 3 11)



BED JOINT PROFILE (3 / 11)

FULL SCALE

3 0 3



BED JOINT PROFILE (4 / 11)

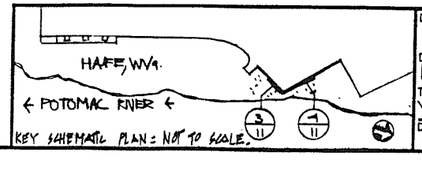
FULL SCALE

EXISTING CONDITIONS

GRANITE MASONRY WAS ADDED C. 1851 WITH THE CONSTRUCTION OF THE WYE SPAN and B&O ABUTMENT ADDITION.

MORTAR JOINTS HAVE ERODED LEAVING STONES SUPPORTED ONLY by the CHINKING STONES. THIS HAD LED to SUBSEQUENT CRACKING of MASONRY.

(SEE CONDITION ASSESSMENT NOTES @ 305/80071 DWGS.)



KEY SCHEMATIC PLAN: NOT TO SCALE.

DESIGNED: WPTE
DRAWN: RODNEY
TECH. REVIEW: VIGNZA
DATE: 03/23/71

SUB SHEET NO. BOSA4

TITLE OF SHEET
B&O SPAN ABUTMENT WALL MASONRY DETAIL & JOINTS PROFILES B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS

DRAWING NO. 358 80070

PKG. NO. 212

SHEET 11 OF 32

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

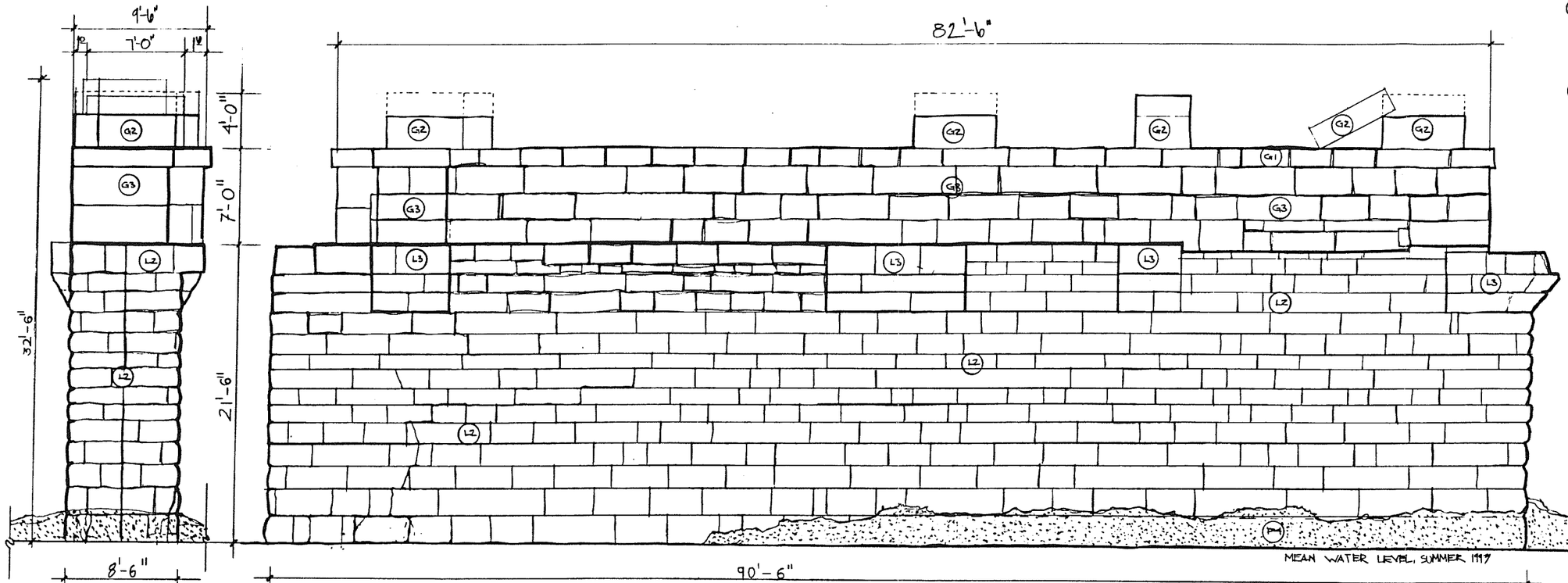
- L1 – COURSED RUBBLE BASE
- L2 – PITCH-FACED COURSED ASHLAR BLOCKS
- L3 – PLINTH STONES
- L4 – RUBBLE CORE LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE

- P1 – RUBBLE
- P2 – COURSED RUBBLE
- P3 – COURSED ASHLAR
- P4 – RIP-RAP SLABS

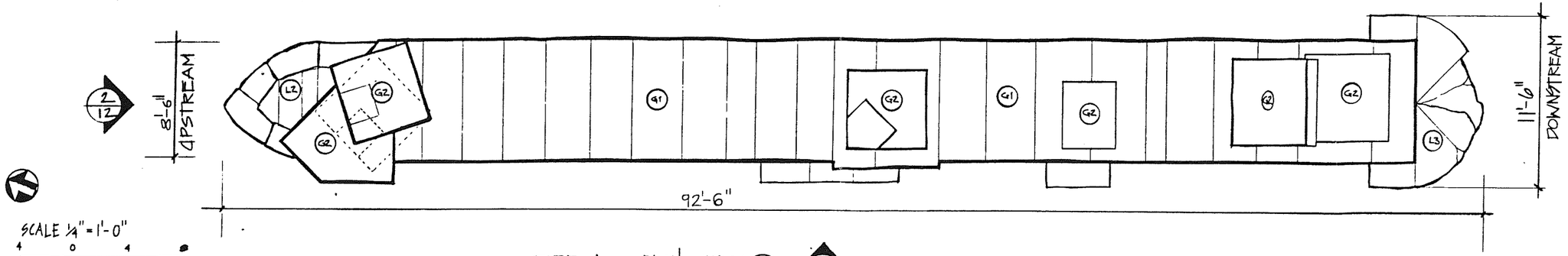
GRANITE

- G1 – COPING STONES (ASHLAR BLOCKS)
- G2 – PLINTH STONES (BUSH HAMMERED FINISH)
- G3 – PITCH-FACED COURSED ASHLAR BLOCKS
- BR – BEDROCK – HARPERS FORMATION PHYLLITE



NORTH ELEVATION (UPSTREAM) 2/12

WEST ELEVATION 3/12

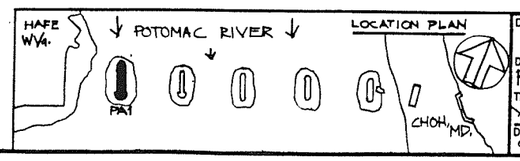


SCALE 1/4" = 1'-0"

4 0 4 8

PIER-A PLAN VIEW (TOP VIEW of PIER) 1/12 3/12

DIRECTION of RIVER FLOW →



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	YITANZA
DATE:	03/25/97

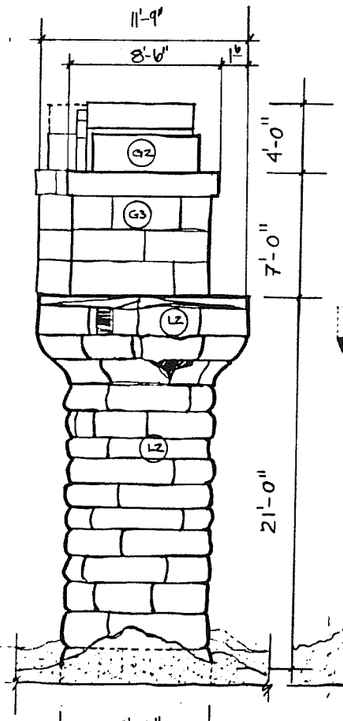
SUB SHEET NO. PA-1

TITLE OF SHEET
PIER-A
PLAN, NORTH & WEST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

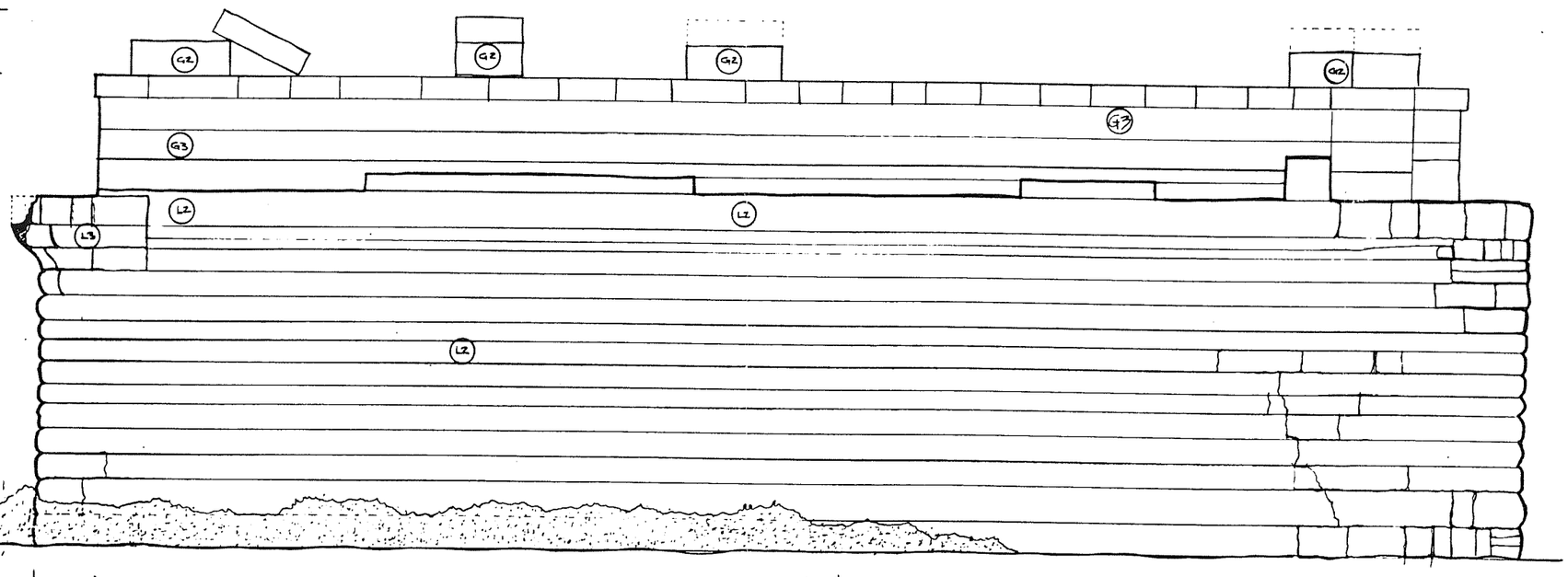
DRAWING NO. 385 80070

PKG. NO. 2/2

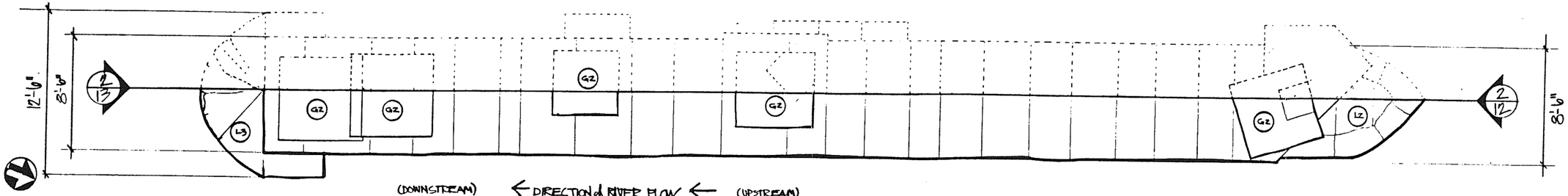
SHEET 12 OF 33



SOUTH ELEVATION (2/13)
DOWNSTREAM



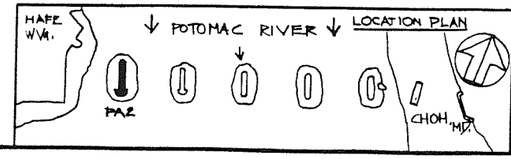
EAST ELEVATION (3/13)



(DOWNSTREAM) ← DIRECTION of RIVER FLOW ← (UPSTREAM)

PIER - A PLAN VIEW (1/13) (3/13)
(PARTIAL)

SCALE 1/4" = 1'-0"
4 0 4 8



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VITANZA
DATE:	03/25/99

SUB SHEET NO. PA-2

TITLE OF SHEET
PIER-A
PLAN w/ SOUTH & EAST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

PKG. NO. 212

SHEET 13 OF 33

NORTH ELEVATION (1/14)

SCALE 1/4"=1'-0"

4 0 4 8

DELINEATION & KEY NOTES

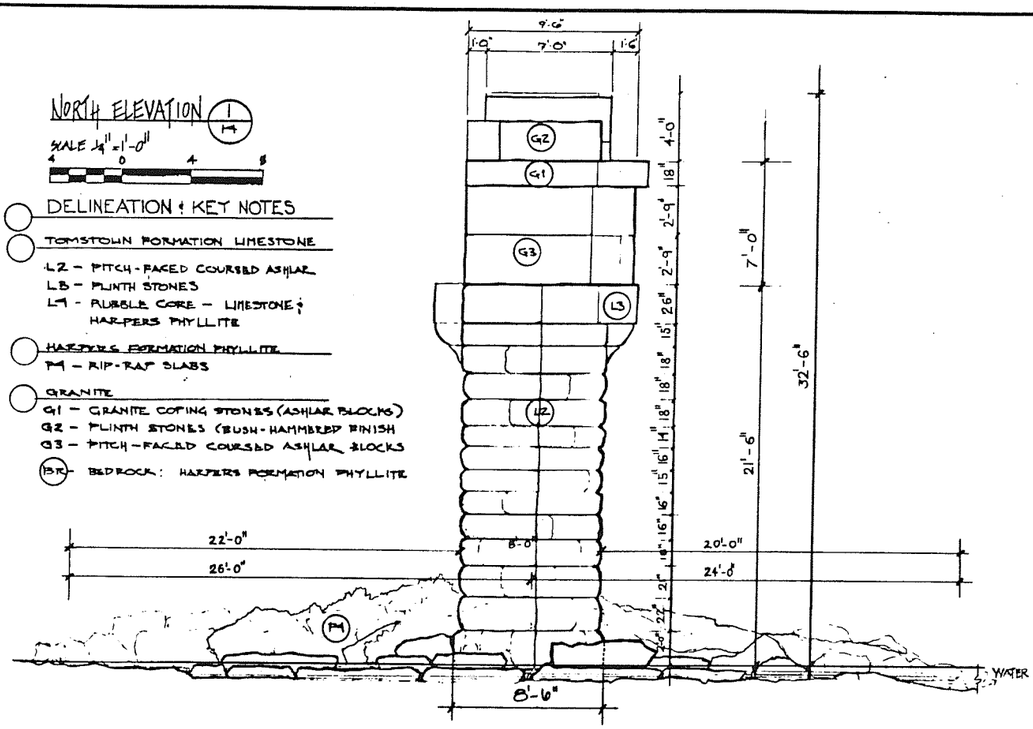
TOMSTOWN FORMATION LIMESTONE

L2 - PITCH-FACED COURSED ASHLAR
L3 - PLINTH STONES
L4 - RUBBLE CORE - LIMESTONE & HARPERS PHYLLITE

HARPERS FORMATION PHYLLITE
P4 - RIP-RAP SLABS

GRANITE
G1 - GRANITE COPING STONES (ASHLAR BLOCKS)
G2 - PLINTH STONES (BUSH-HAMMERED FINISH
G3 - PITCH-FACED COURSED ASHLAR BLOCKS

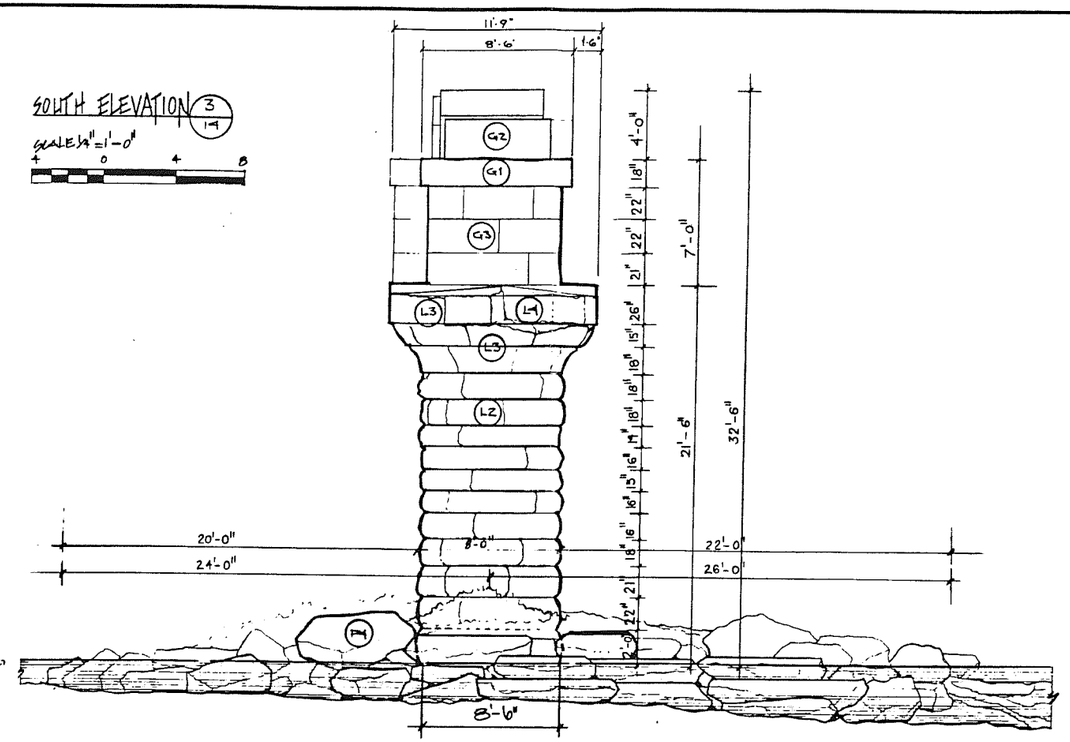
BR - BEDROCK: HARPERS FORMATION PHYLLITE

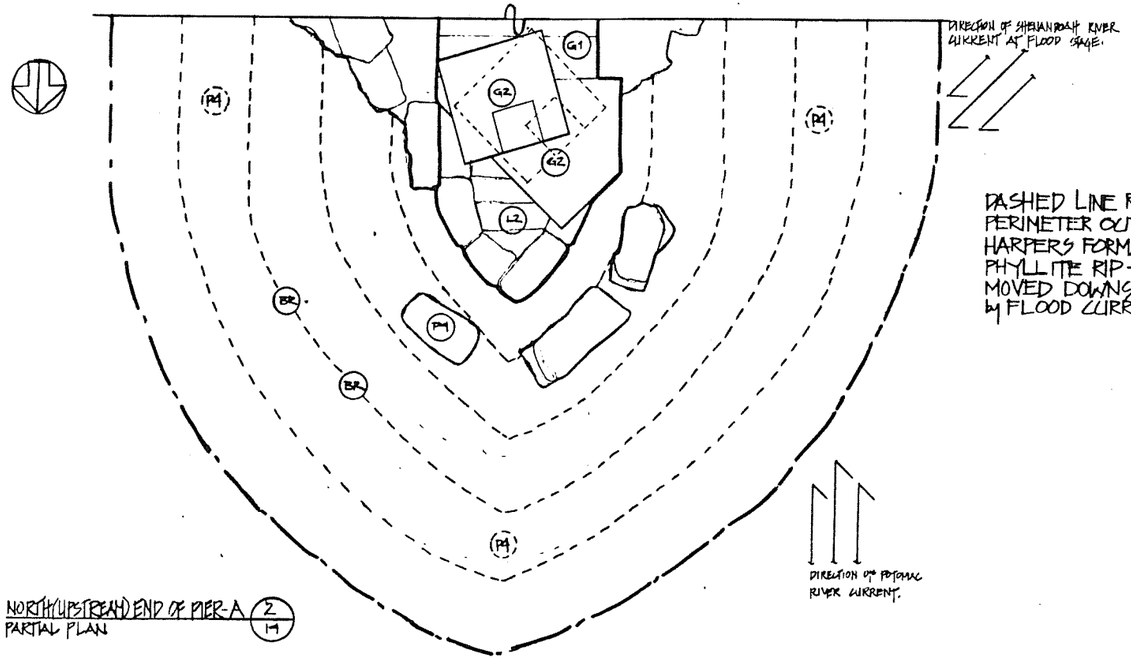


SOUTH ELEVATION (3/14)

SCALE 1/4"=1'-0"

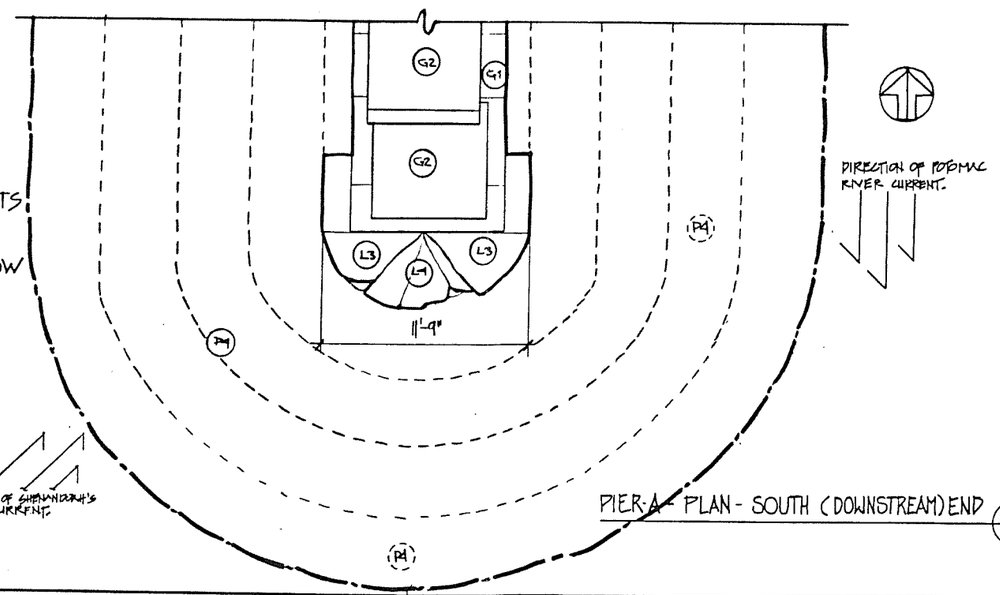
4 0 4 8





NORTH (UPSTREAM) END OF PIER-A (2/14)
PARTIAL PLAN

DASHED LINE REPRESENTS PERIMETER OUTLINE OF HARPERS FORMATION PHYLLITE RIP-RAP - NOW MOVED DOWNSTREAM by FLOOD CURRENTS.



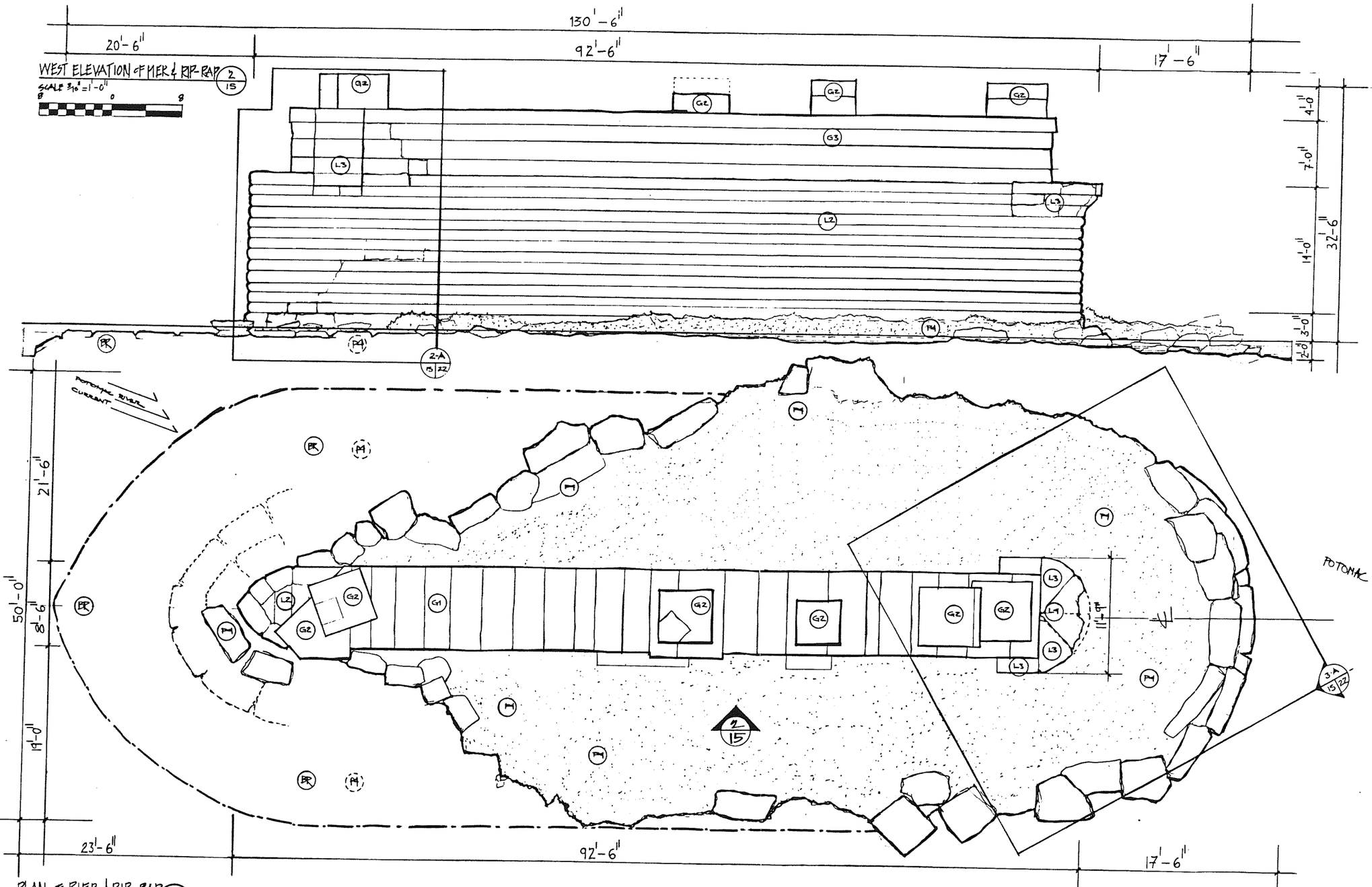
PIER-A - PLAN - SOUTH (DOWNSTREAM) END (4/14)

HAFE, WVa.
POTOMAC RIVER
LOCATION PLAN
PA3
CHCH, MD.

DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	YITANZA
DATE:	03/25/94
SUB SHEET NO.	PA3

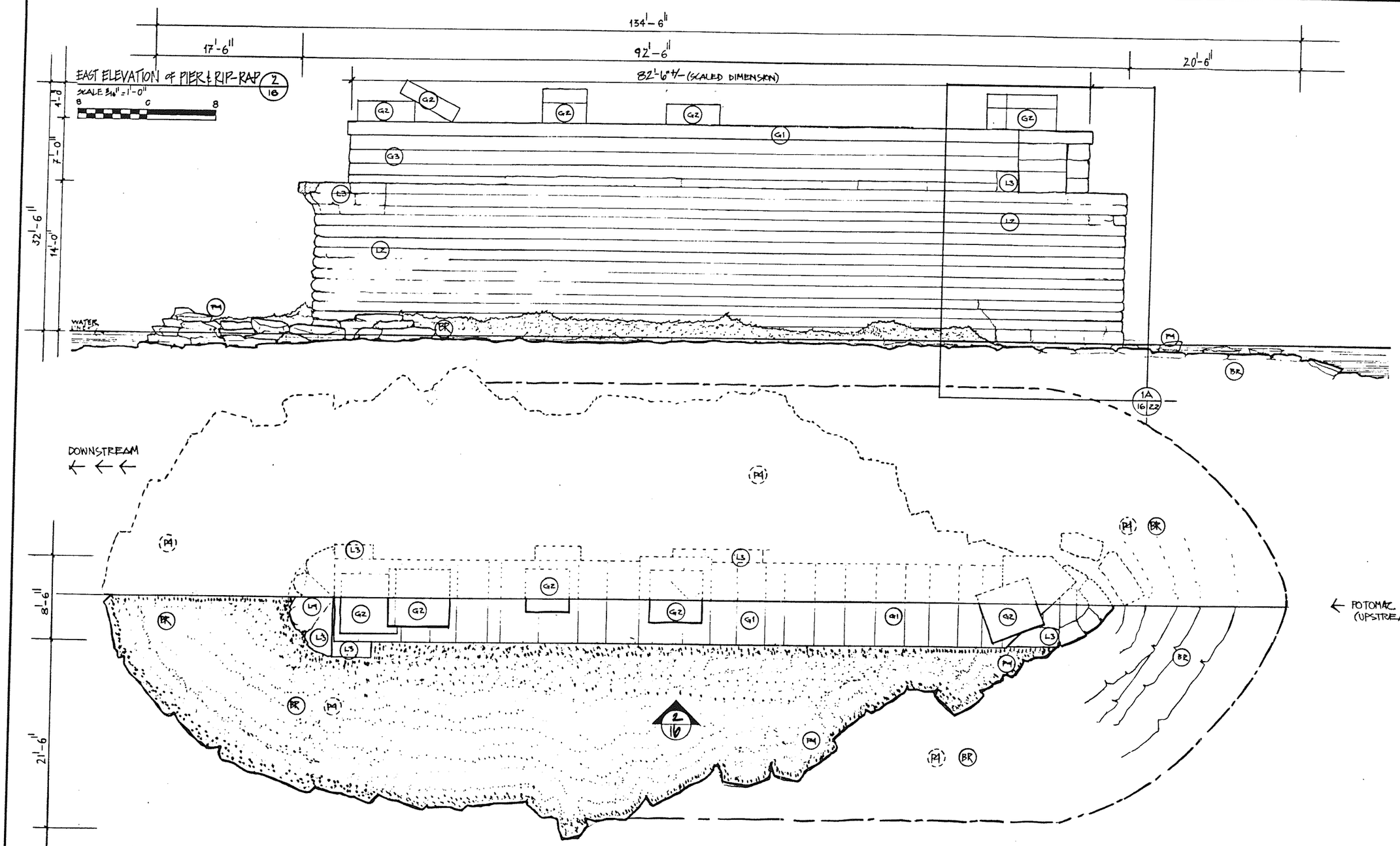
TITLE OF SHEET
PIER-A RIP RAP
NORTH & SOUTH ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO.	385 80070
PKG. NO.	212
SHEET	14 of 33



DESIGNED: WPTC	SUB SHEET NO. PA4	TITLE OF SHEET: PIER A RIP RAP PLAN & WEST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. 325 80070
DRAWN: RODNEY			PKG. NO. 212
TECH. REVIEW: VIANZA			SHEET 15 OF 33
DATE: 03/23/94			

U.S. GOVERNMENT PRINTING OFFICE: 878-100


134'-6"
17'-6"
92'-6"
20'-6"
82'-6"+/- (SCALED DIMENSION)
EAST ELEVATION OF PIER & RIP-RAP 2/16
SCALE 3/16" = 1'-0"
8 0 8
4'-0"
7'-0"
32'-6"
14'-0"
WATER LINE
G1
G2
G3
L3
L7
PM
BR
1A 16/22
DOWNSTREAM
P4
8'-6"
21'-6"
2/16
← POTOMAC RIVER FLOW (UPSTREAM)
PARTIAL PLAN OF PIER & RIP-RAP 1/16
SCALE 3/16" = 1'-0"
8 0 8
HAFE/ WV4
POTOMAC RIVER
PA5
LOCATION PLAN
CHOH, MD
DESIGNED: WPTC
DRAWN: RDPNET
TECH. REVIEW: VITANZA
DATE: 03/25/94
SUB SHEET NO. PA 5
TITLE OF SHEET
PIER-A RIP RAP PLAN & EAST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS
DRAWING NO. 395 80070
PKG. NO. 212
SHEET 16 OF 33

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

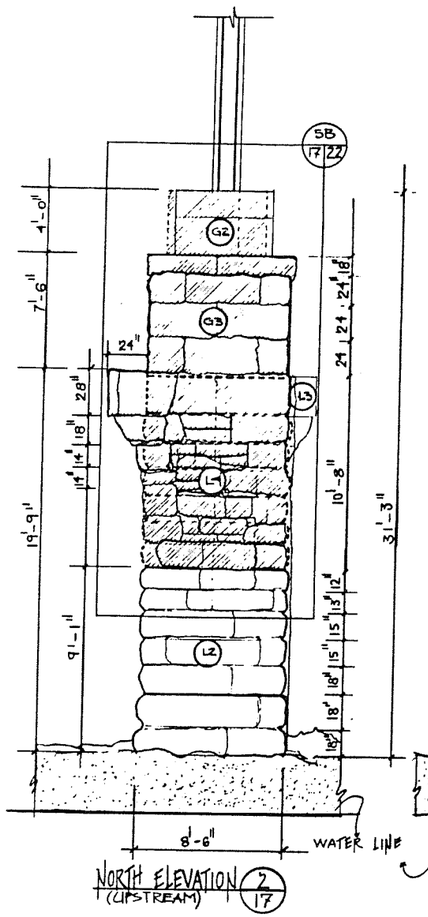
- L2 – PITCH FACED COURSED ASHLAR BLOCKS
- L3 – PLINTH STONES
- L4 – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE

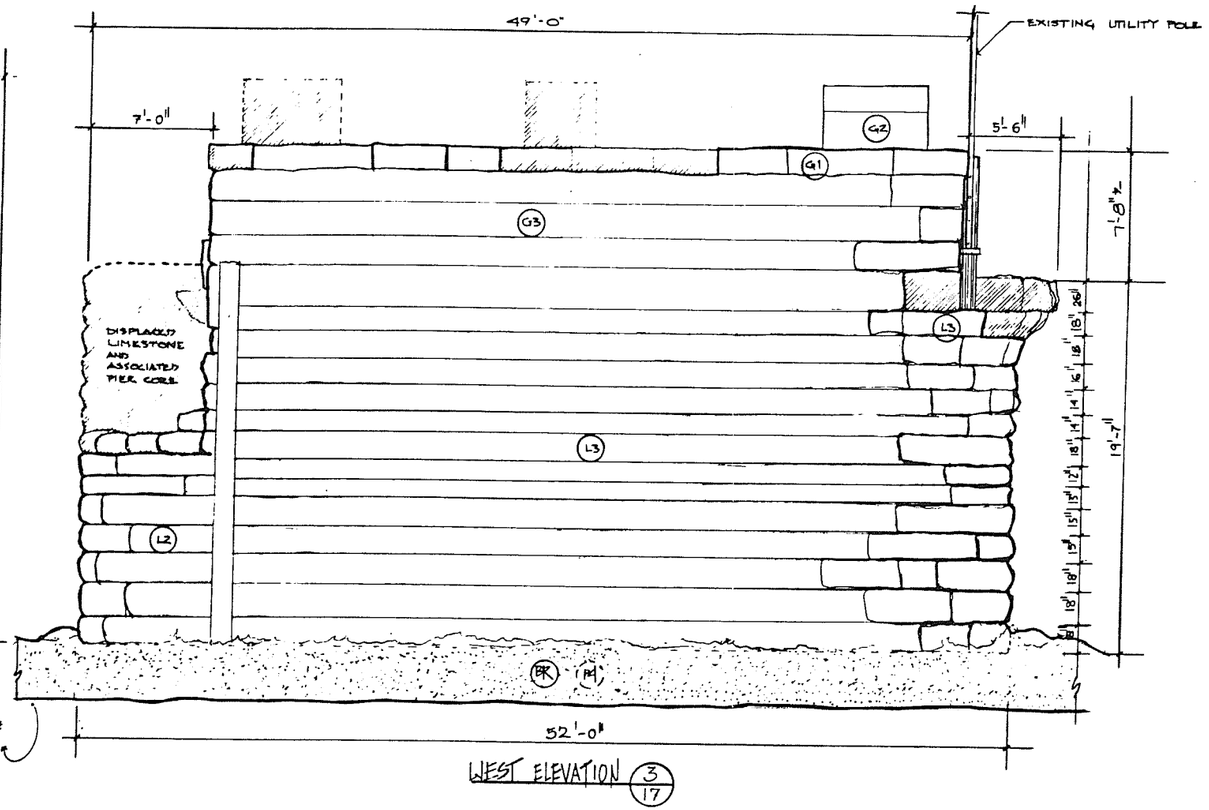
- P4 – RIP-RAP SLABS

GRANITE

- G1 – COPING STONES
- G2 – PLINTH STONES
- G3 – PITCH-FACED COURSED ASHLAR BLOCKS
- BR – BED ROCK

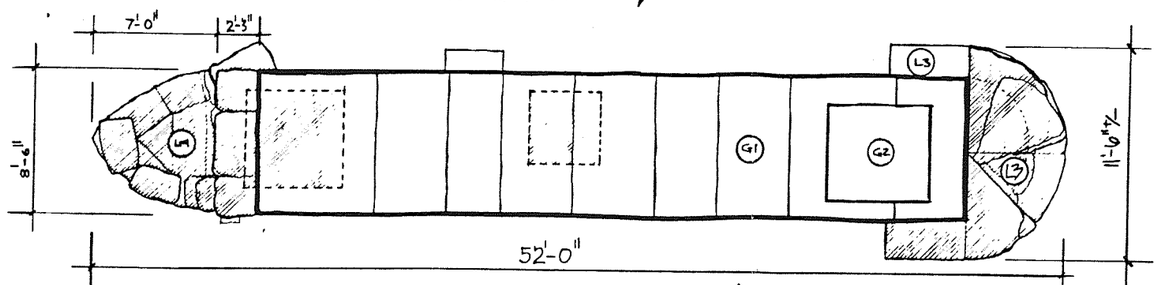


NORTH ELEVATION (UPSTREAM) 2/17



WEST ELEVATION 3/17

POTOMAC RIVER FLOW →

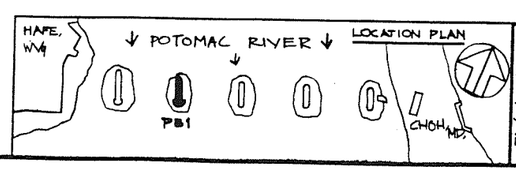


(UPSTREAM) PLAN VIEW 1/17 (DOWNSTREAM)

2/17

3/17

SCALE: 1/4" = 1'-0"
4 0 4 8



DESIGNED:	LPTC.
DRAWN:	ROONEY
TECH. REVIEW:	VIYANZA.
DATE:	03/25/99

SUB SHEET NO. PB1

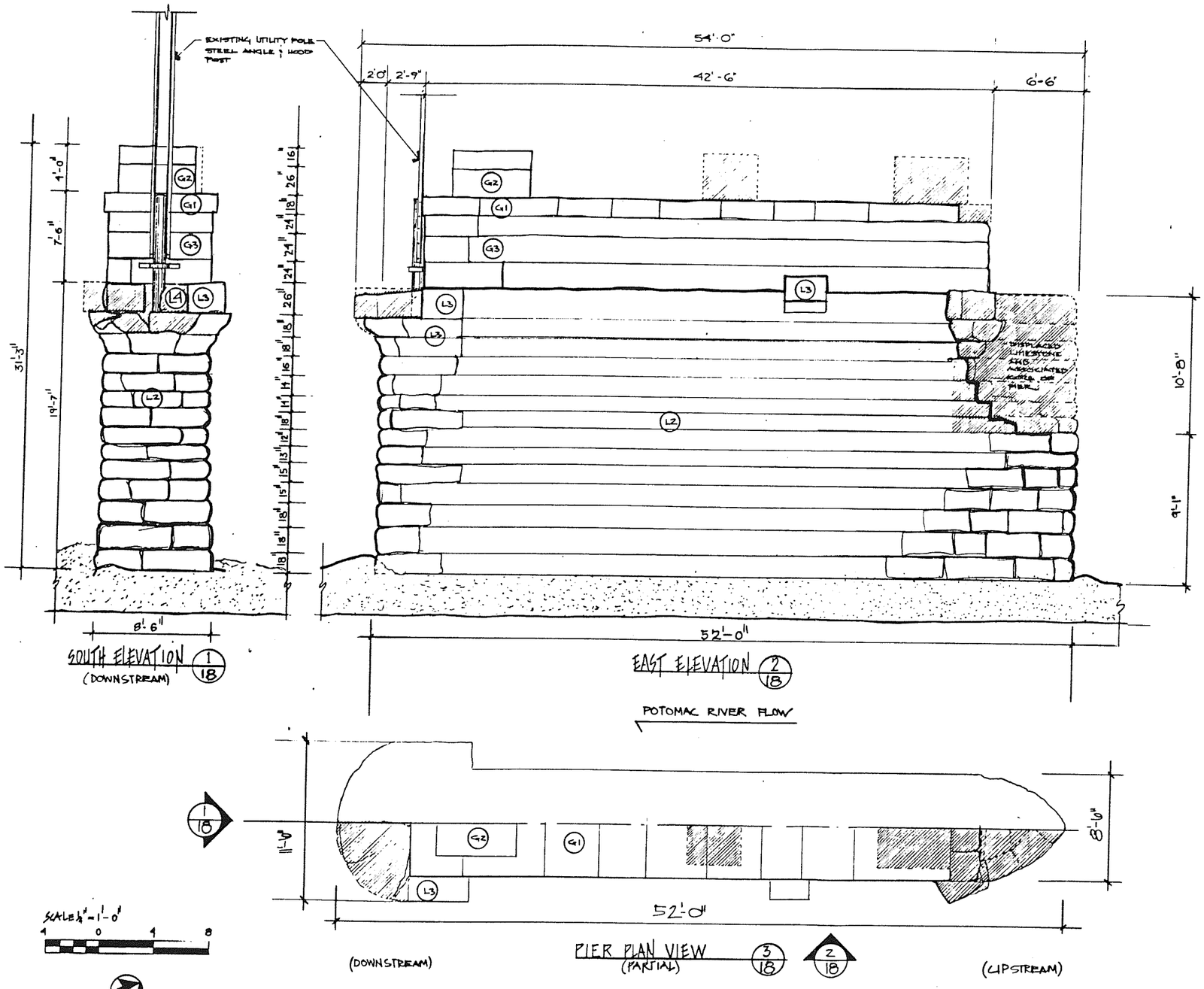
TITLE OF SHEET
PIER-B
NORTH & WEST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

PKG. NO. 212

SHEET 17 OF 33

U.S. GOVERNMENT PRINTING OFFICE: 676-106



DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

- L2 - PITCH-FACED COURSED ASHLAR BLOCKS
- L3 - PLINTH STONES
- L4 - RUBBLE CORE, LIMESTONE AND HARPERS PHYLLITE

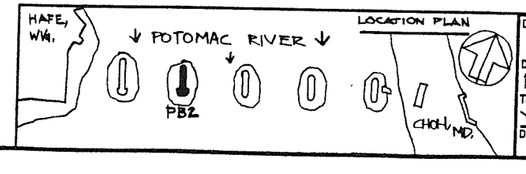
HARPERS FORMATION PHYLLITE

- P4 - RIP-RAP

GRANITE

- G-1 - COPING STONES (ASHLAR BLOCKS)
- G-2 - PLINTH STONES (BUSH-HAMMERED FINISH)
- G-3 - PITCH FACED COURSED ASHLAR BLOC

AREA OF DISPLACED AND DAMAGED STONE.



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	YITANZA
DATE:	03/25/99

SUB SHEET NO. PB2

TITLE OF SHEET
PIER-B
SOUTH & EAST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

PKG. NO. 212

SHEET 18 OF 33

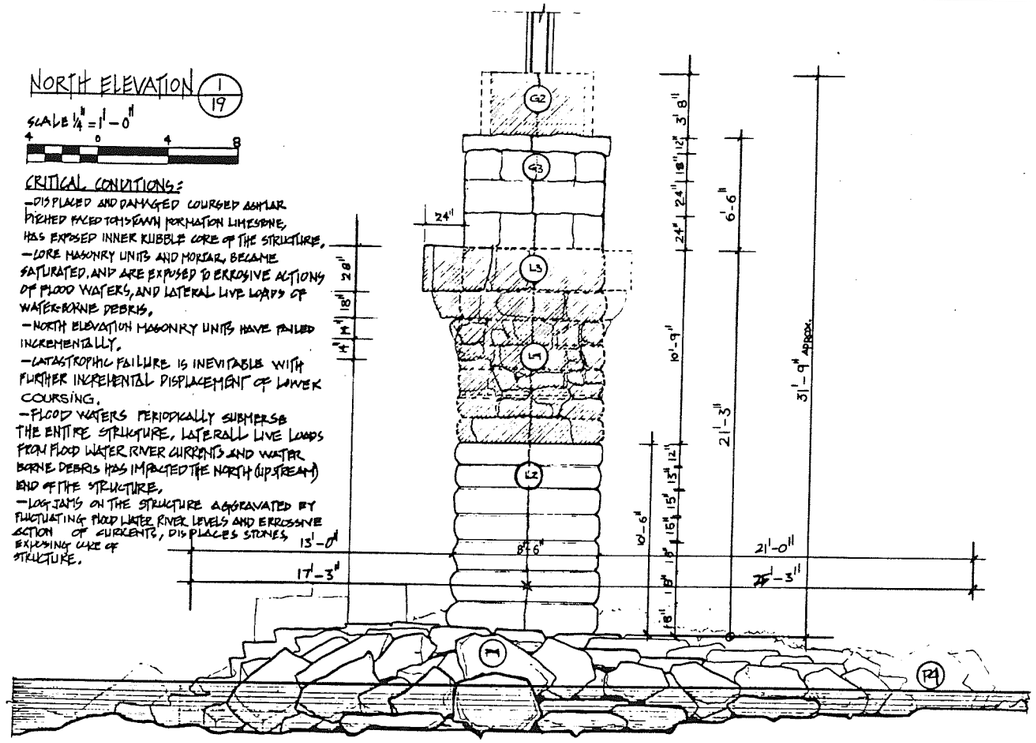
NORTH ELEVATION (1/19)

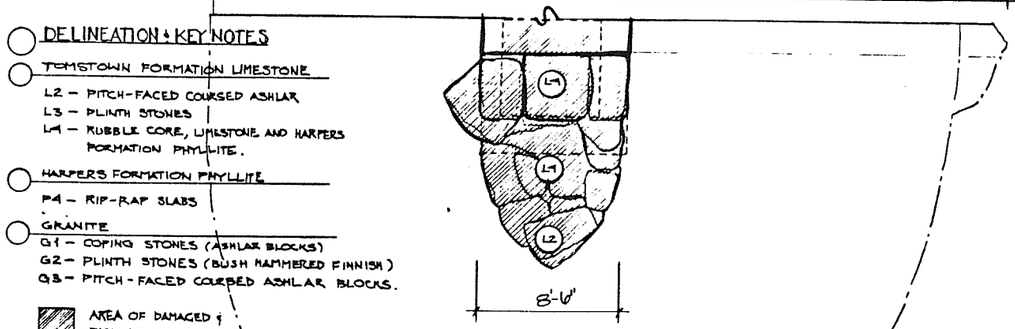
SCALE 1/4" = 1'-0"

4 0 4 8

CRITICAL CONDITIONS:

- DISPLACED AND DAMAGED COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE, HAS EXPOSED INNER RUBBLE CORE OF THE STRUCTURE,
- CORE MASONRY UNITS AND MORTAR, BECAME SATURATED, AND ARE EXPOSED TO EROSIVE ACTIONS OF FLOOD WATERS, AND LATERAL LIVE LOADS OF WATER-BORNE DEBRIS,
- NORTH ELEVATION MASONRY UNITS HAVE FAILED INCREMENTALLY,
- CATASTROPHIC FAILURE IS INEVITABLE WITH FURTHER INCREMENTAL DISPLACEMENT OF LOWER COURSING.
- FLOOD WATERS PERIODICALLY SUBMERSE THE ENTIRE STRUCTURE, LATERALL LIVE LOADS FROM FLOOD WATER, RIVER CURRENTS AND WATER BORNE DEBRIS HAS IMPACTED THE NORTH (UPSTREAM) END OF THE STRUCTURE,
- LOG JAMS ON THE STRUCTURE AGGRAVATED BY FLUCTUATING FLOOD WATER RIVER LEVELS AND EROSIVE ACTION OF CURRENTS, DISPLACES STONES EXPOSING CORE OF STRUCTURE.



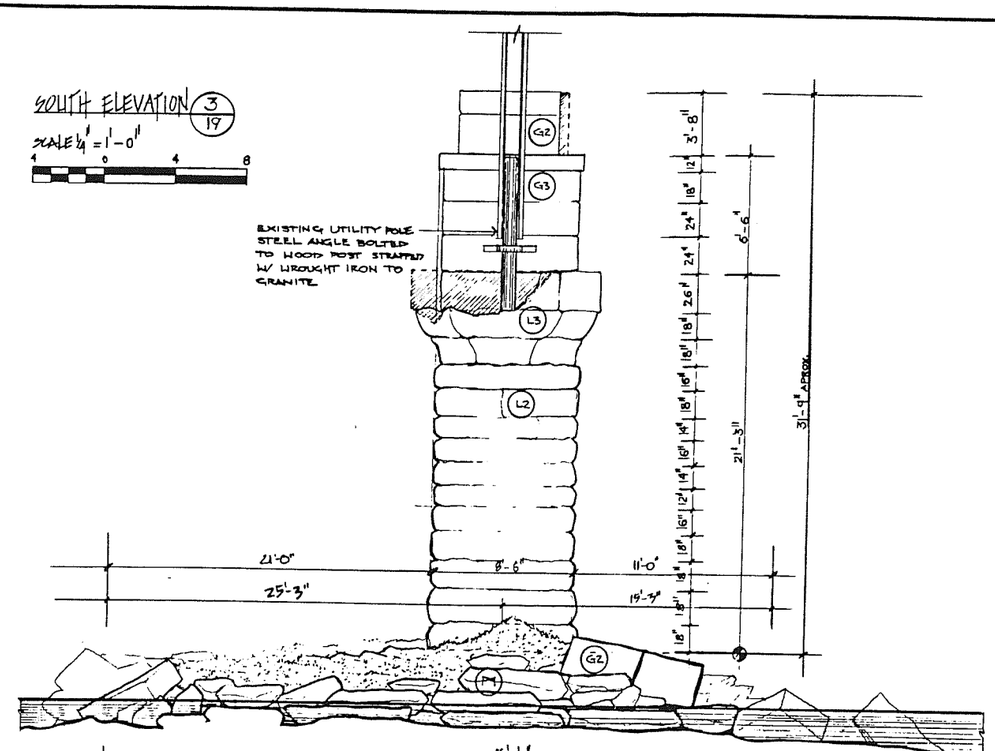


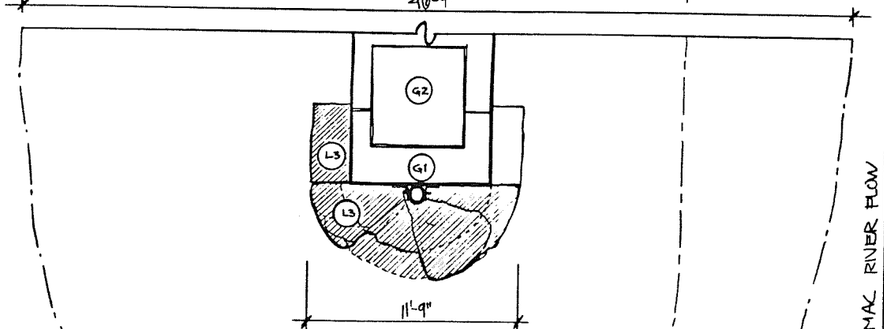
SOUTH ELEVATION (3/19)

SCALE 1/4" = 1'-0"

1 0 4 8

EXISTING UTILITY POLE STEEL ANGLE BOLTED TO WOOD POST STRAPPED W/ WROUGHT IRON TO GRANITE





DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

- L2 – PITCH-FACED COURSED ASHLAR
- L3 – PLINTH STONES
- L4 – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE.

HARPERS FORMATION PHYLLITE

- P1 – RIP-RAP SLABS

GRANITE

- G1 – COPING STONES (ASHLAR BLOCKS)
- G2 – PLINTH STONES (BUSH HAMMERED FINNISH)
- G3 – PITCH-FACED COURSED ASHLAR BLOCKS.

▨ AREA OF DAMAGED & DISPLACED MASONRY

(BR) – BEDROCK

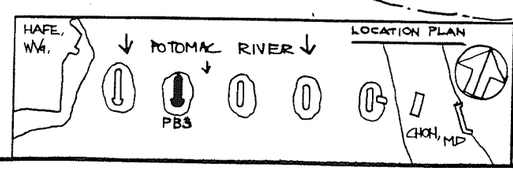
POTOMAC RIVER FLOW

SHENANDOAH RIVER FLOW

POTOMAC RIVER FLOW

NORTH (UPSTREAM) END OF PIER-B (2/19) (PARTIAL PLAN)

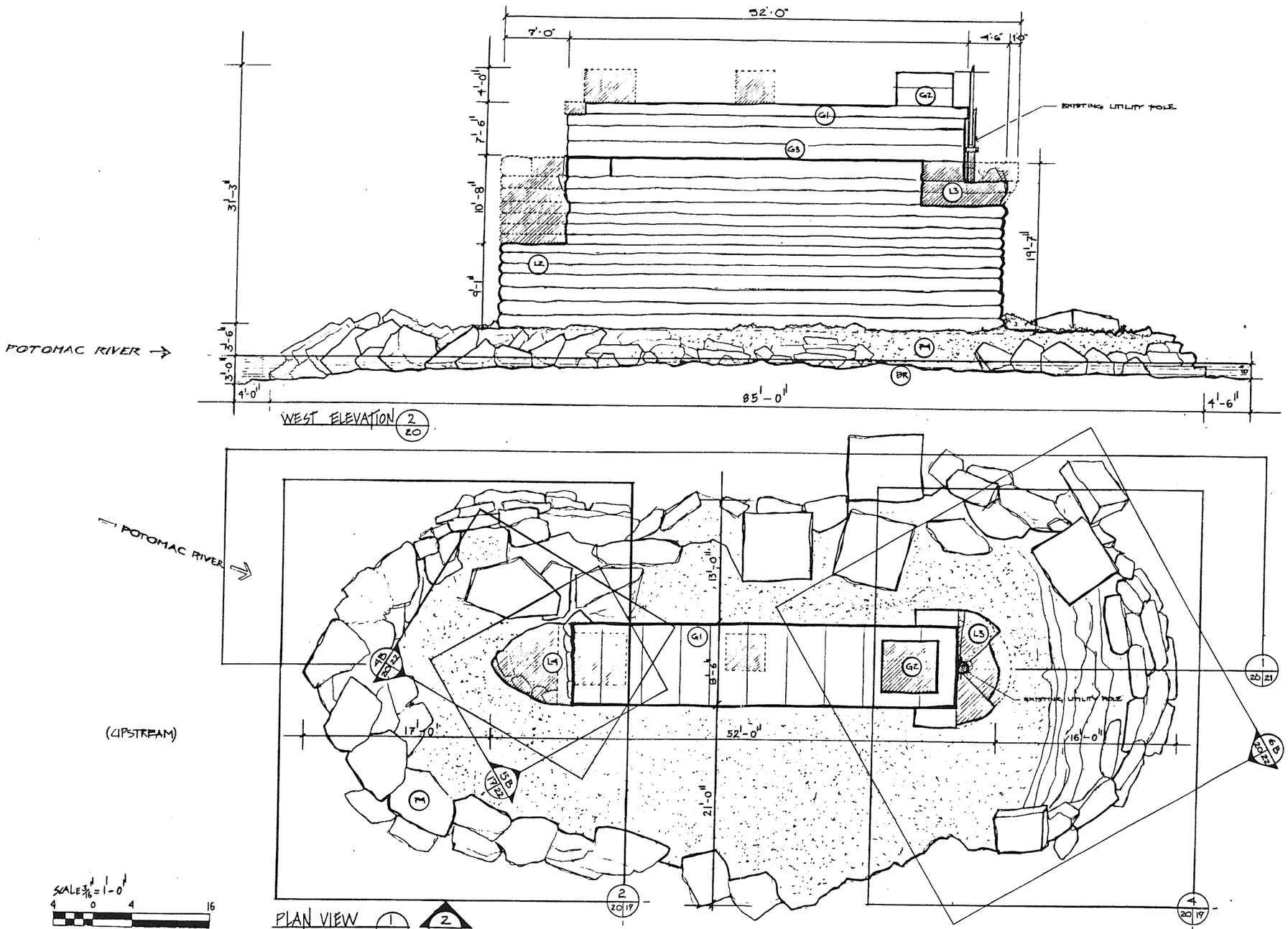
SOUTH (DOWNSTREAM) END PIERA (4/19) (PARTIAL PLAN)



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VITANZA
DATE:	03/23/79
SUB SHEET NO.	PB3

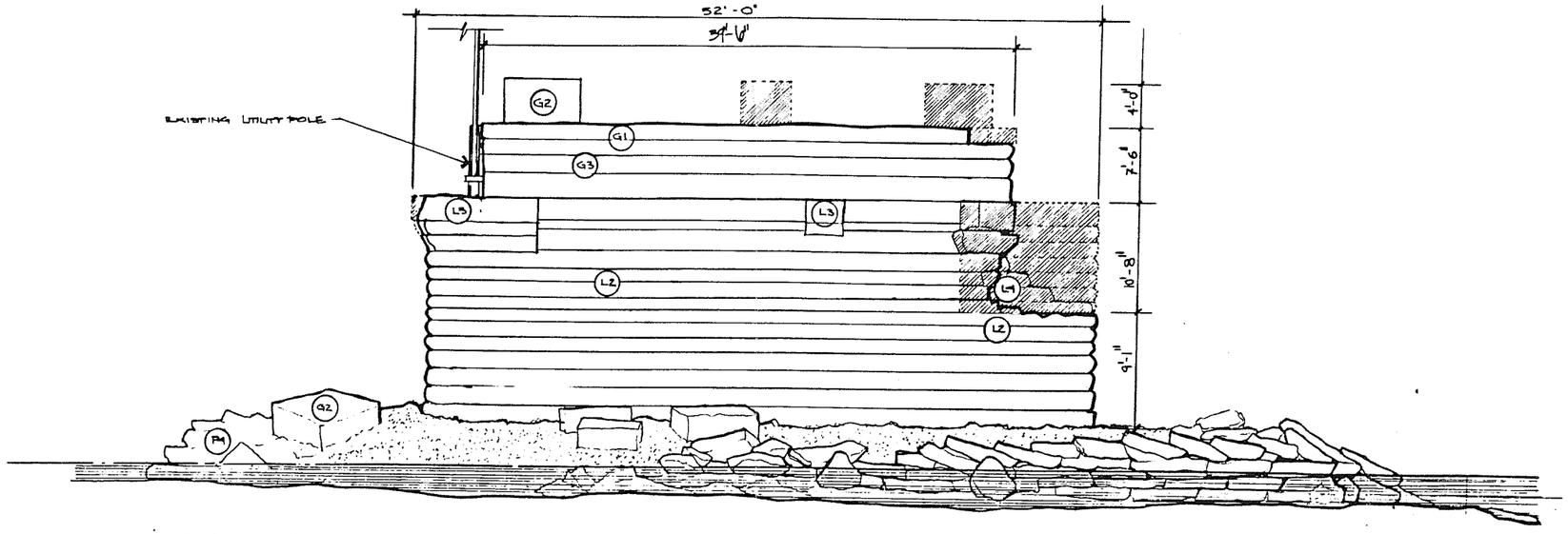
TITLE OF SHEET
PIER-B RIP RAP
NORTH & SOUTH ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO.	285 80070
PKG. NO.	212
SHEET	19 OF 33

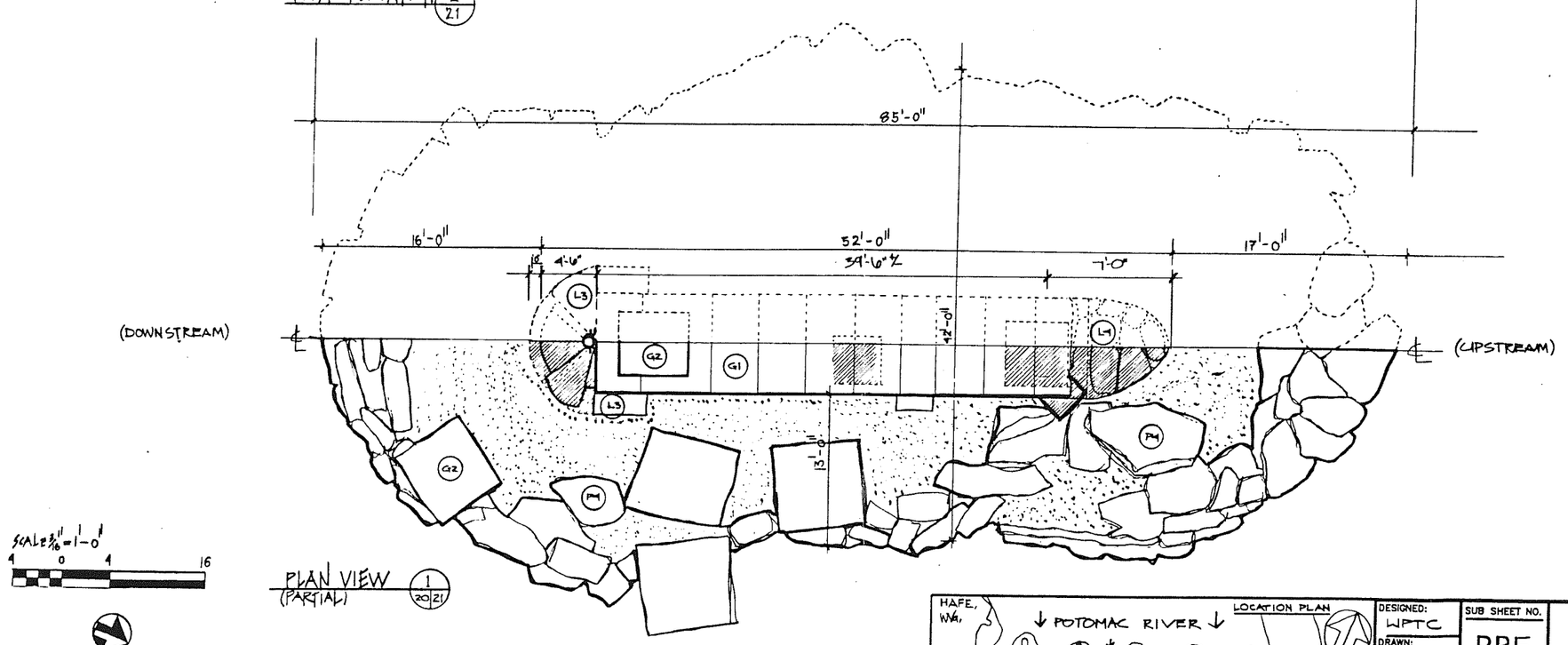


DESIGNED:	LIPTC
DRAWN:	RODNEY
TECH. REVIEW:	YIENZA
DATE:	03/29/74
SUB SHEET NO.	PB4
TITLE OF SHEET	PIER-B RIP RAP PLAN & WEST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS
DRAWING NO.	385 80070
PKG. NO.	212
SHEET	20 OF 33

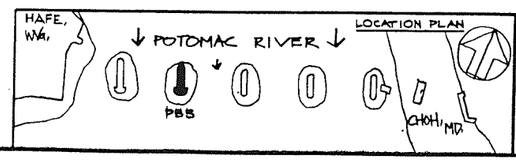
U.S. GOVERNMENT PRINTING OFFICE: 878-100



EAST ELEVATION 2/21

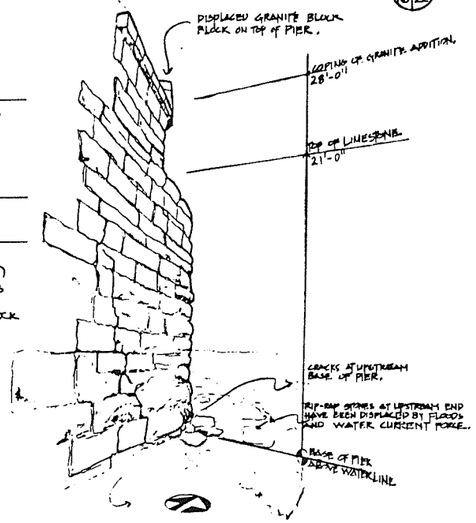


PLAN VIEW (PARTIAL) 1/20/21



DESIGNED: WPTC	SUB SHEET NO. PB5	TITLE OF SHEET: PIER-B RIP RAP PLAN & EAST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. 385 / 80070
DRAWN: RODNEY			PKG. NO. 212
TECH. REVIEW: VITANZA			SHEET 21 OF 33
DATE: 03/25/94			

DETAIL OF PIER A LOOKING AT NORTH (UPSTREAM) END FROM EASTWARD SIDE OF PIER (1-A 16/22)
(NOT TO SCALE)



DELINEATION & KEY NOTES

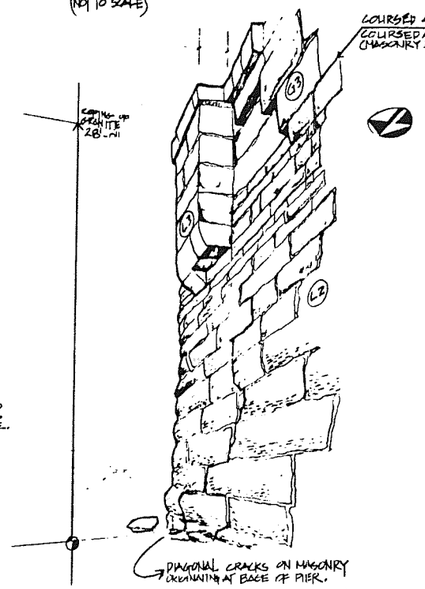
TOMSTOWN FORMATION LIMESTONE
- L2 – PITCH-FACED COURSED ASHLAR BLOCKS
- L3 – PLINTH STONES
- L4 – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
- M – RIP-RAP SLABS

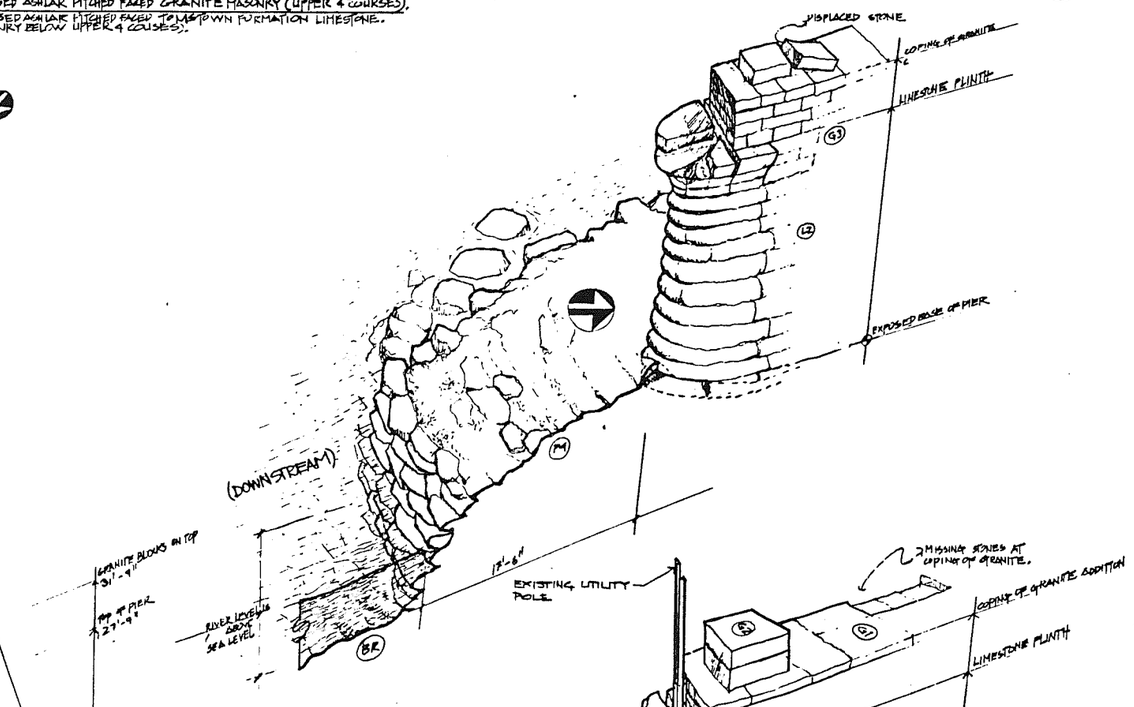
GRANITE
- G1 – COPING (ASHLAR BLOCKS)
- G2 – PLINTH STONES (BUSH-HAMMERED FINISH)
- G3 – PITCH-FACED COURSED ASHLAR BLOCKS

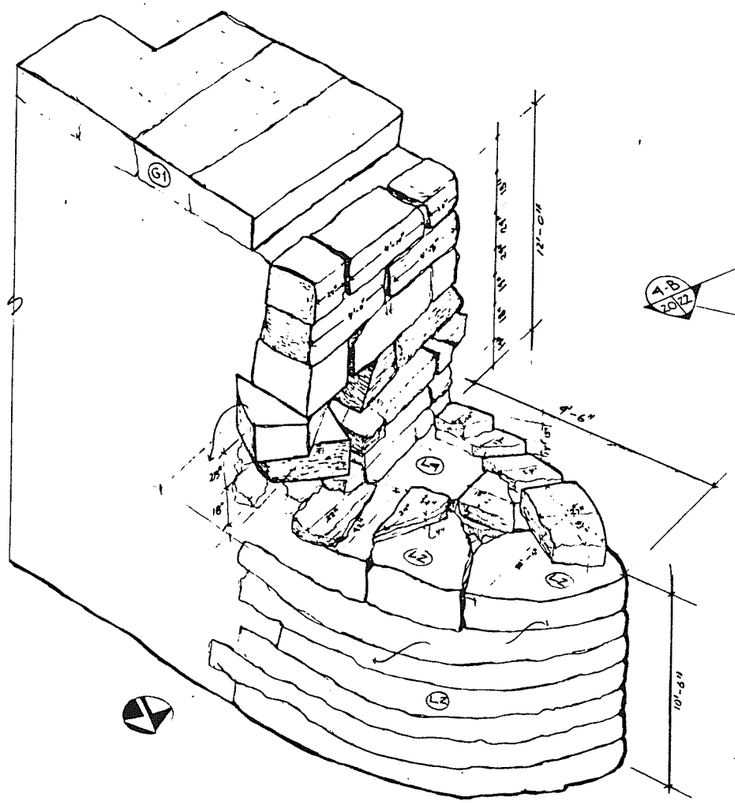
BR – HARPERS FORMATION PHYLLITE BED-ROCK

VIEW OF PIER A LOOKING AT NORTH (UPSTREAM) END FROM WESTWARD SIDE OF PIER (2-A 15/22)
(NOT TO SCALE)

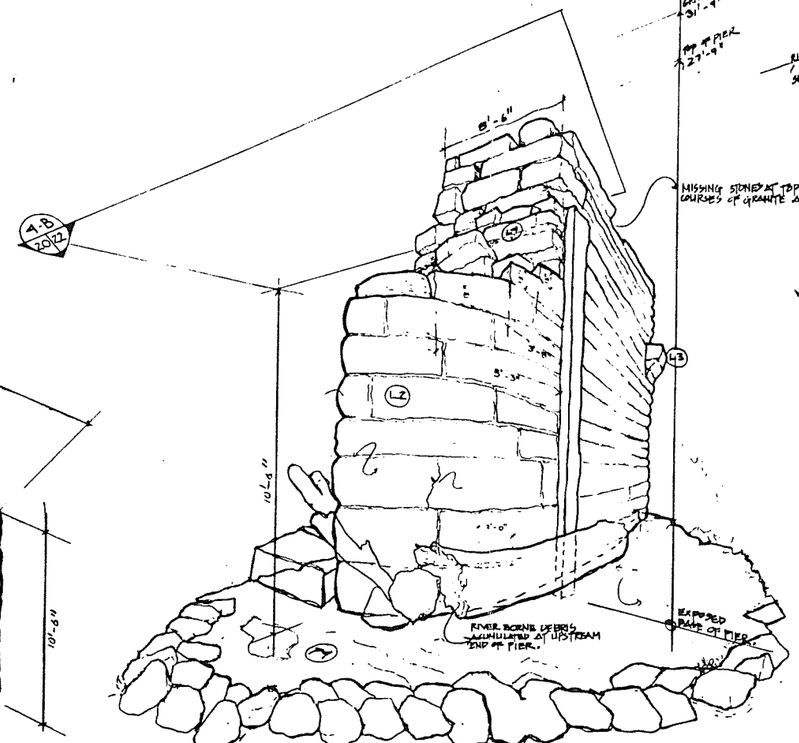


PIER A: DETAIL SHOWING SOUTH (DOWNSTREAM) END OF PIER & RIP-RAP (3-A 15/22)
(NOT TO SCALE)

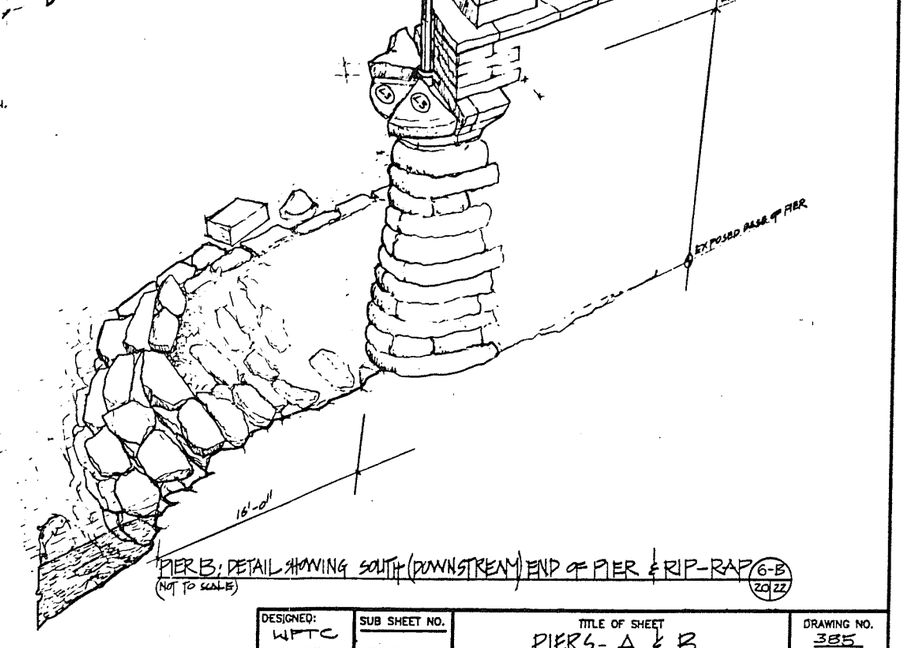




DETAIL OF PIER B NORTH (UPSTREAM) END (4-B 20/22)
(NOT TO SCALE)



VIEW OF PIER B LOOKING SOUTH FROM NORTH (UPSTREAM) END (5-B 17/22)
(NOT TO SCALE)



PIER B: DETAIL SHOWING SOUTH (DOWNSTREAM) END OF PIER & RIP-RAP (6-B 20/22)
(NOT TO SCALE)

NOTE: ALL DRAWINGS WERE MADE FREEHAND; THUS, (ALTHOUGH ACCURATE IN PROPORTIONS) THEY DO NOT CONFORM TO ANY GRAPHICAL SCALE.

DESIGNED: WPTC	SUB SHEET NO. PAB1	TITLE OF SHEET: PIERS-A & B VIEWS OF EXISTING CONDITIONS B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. 385 80070
DRAWN: RODNEY			PKG. NO. 213
TECH. REVIEW: VITALIZA			SHEET 22
DATE: 03/23/99			OF 33

U.S. GOVERNMENT PRINTING OFFICE: 678-100

DELINEATION : KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L2 – PITCH FACED COURSED ASHLAR BLOCKS
- L3 – PLINTH STONES
- L4 – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
- M – RIP-RAP SLABS

GRANITE
- G1 – COPING STONES (ASHLAR BLOCKS)
- G2 – PLINTH STONES (BUSH-HAMMERED FINISH)
- G3 – PITCH FACED COURSED ASHLAR BLOCKS
- (BR) – BEDROCK

MATERIAL NOTES
PIER – TOMSTOWN FORMATION LIMESTONE PITCHED FACE COURSED ASHLAR. RUINS RETAIN SEVEN COURSES

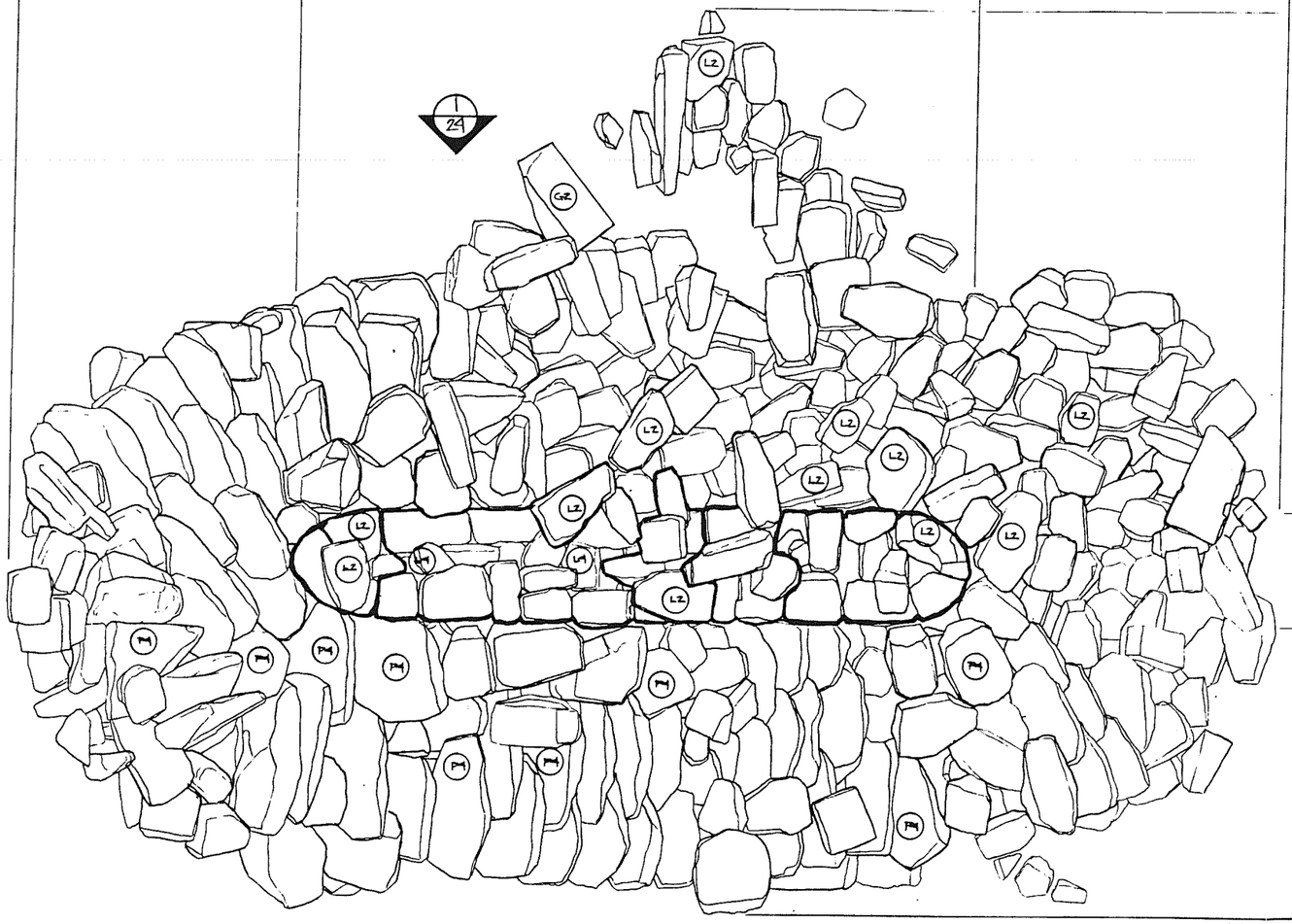
GRANITE ADDITION – DISPLACED INTO THE RIVER DOWN CURRENT TO THE SOUTHEAST OF THE PIER ISLAND.

MORTARED MASONRY RECEIVED LATER CAMPAIGNS OF POINTING W/ PORTLAND CEMENT BASED MORTAR.

DIRECTION of FLOW

98'-0" LENGTH of RUIN

52'-0" LENGTH of PIER FOUNDATION



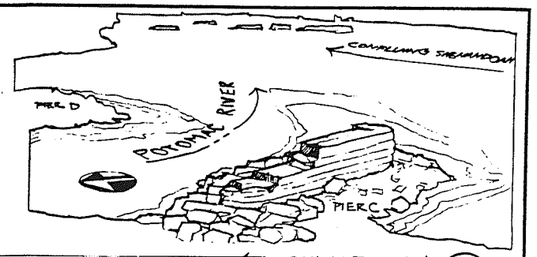
1/24

3/24 (UPSTREAM)

4/24 (DOWNSTREAM)

8'-6"

20'-0" HEIGHT of RUIN

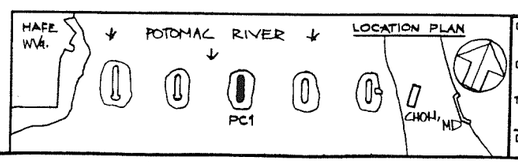


SCHEMATIC VIEW 2/23

PLAN VIEW 1/23

2/24

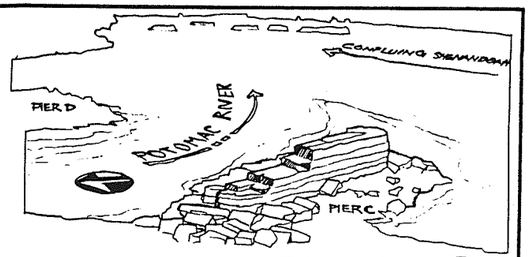
SCALE: 3/16" = 1'-0"



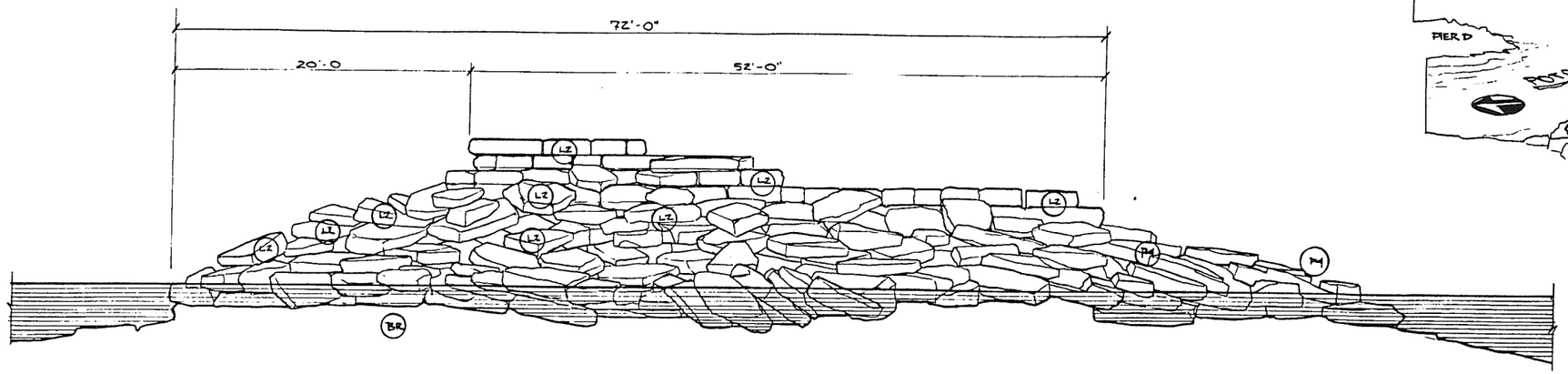
DESIGNED:	WPTC
DRAWN:	HEIDINGER
TECH. REVIEW:	VITANZA
DATE:	03/25/94
SUB SHEET NO.	PC1

TITLE OF SHEET
PIER - C RIP-RAP PLAN
B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS

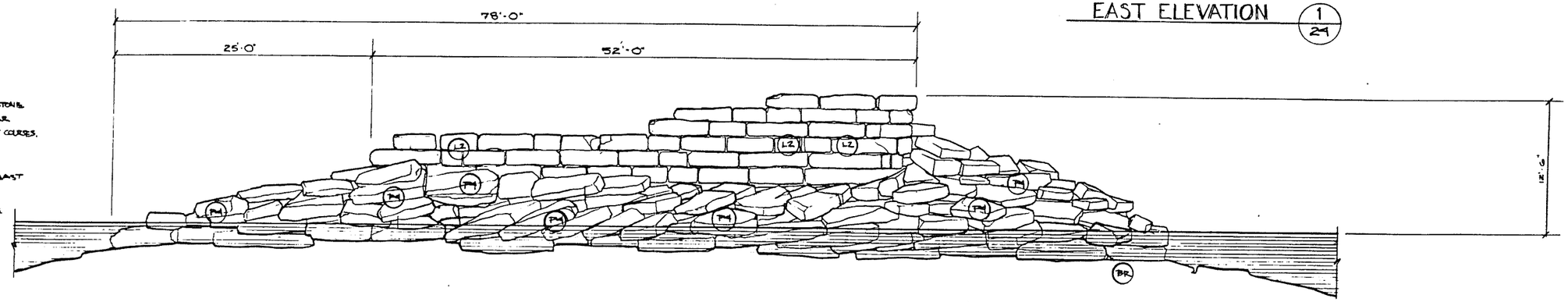
DRAWING NO.	385 80070
PKG. NO.	212
SHEET	23 OF 33



SCHEMATIC VIEW 5/24



EAST ELEVATION 1/24



WEST ELEVATION 2/24

MATERIAL NOTES

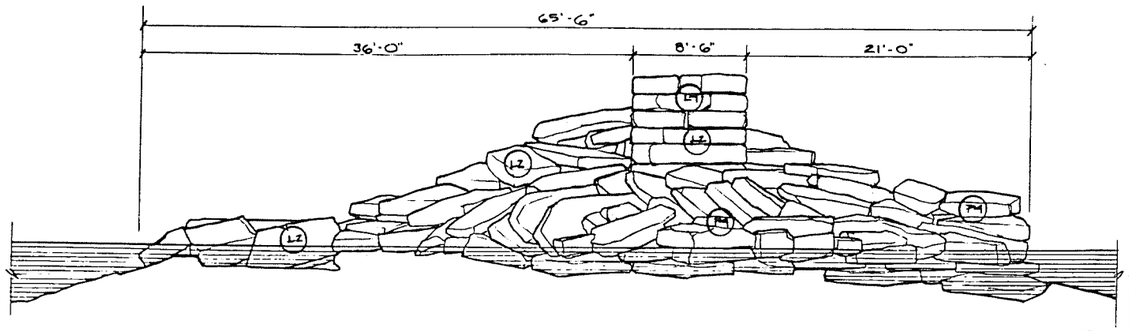
PIER – TOMSTOWN FORMATION LIMESTONE. PITCHED FACE COURSED ASHLAR. RUINS REMAIN W/ SEVEN EXTANT COURSES.

GRANITE ADDITION – DISPLACED INTO THE RIVER DOWN CURRENT TO THE SOUTHEAST OF THE PIER ISLAND

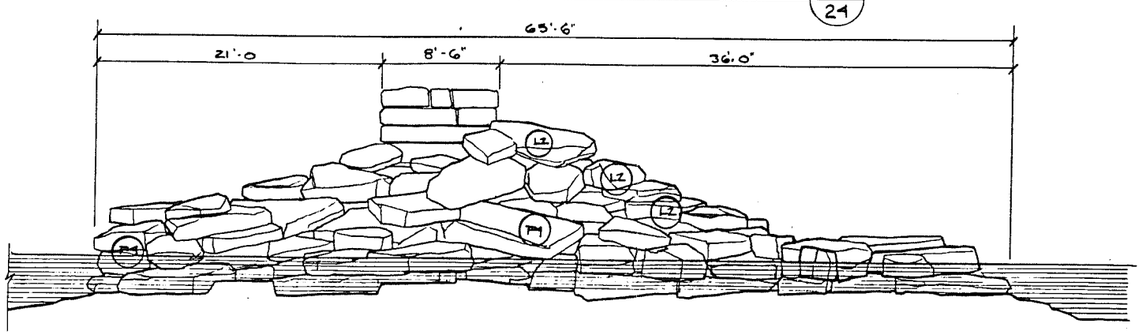
RIP RAP- HARPERS FORMATION PHYLLITE

MASONRY PLACED AS MORTARED W/ LATER CAMPAIGNS OF POINTING W/ PORTLAND CEMENT BASED MORTAR.

VEGETATION NOT SHOWN FOR CLARITY.



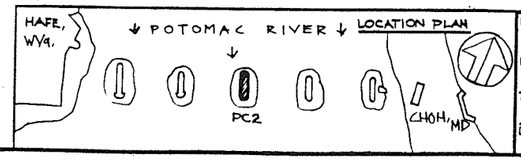
NORTH ELEVATION UPSTREAM 3/24



SOUTH ELEVATION DOWNSTREAM 4/24

0 2 4 6 8 10 12 14 16

SCALE: 3/16"=1'-0"



DESIGNED:	WPTG
DRAWN:	NEIDINGER
TECH. REVIEW:	VITANZA
DATE:	03/25/99
SUB SHEET NO.	PC2

TITLE OF SHEET
PIER-C ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070

PKG. NO. 212

SHEET 24 OF 33

☆U.S. GOVERNMENT PRINTING OFFICE: 878-100

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L2 - PITCH-FACED COURSED ASHLAR
- L3 - PLINTH STONES
- L4 - RUBBLE CORE LIMESTONE & HARPERS PHYLLITE

HARPERS FORMATION PHYLLITE
- P4 - RIP-RAP SLABS

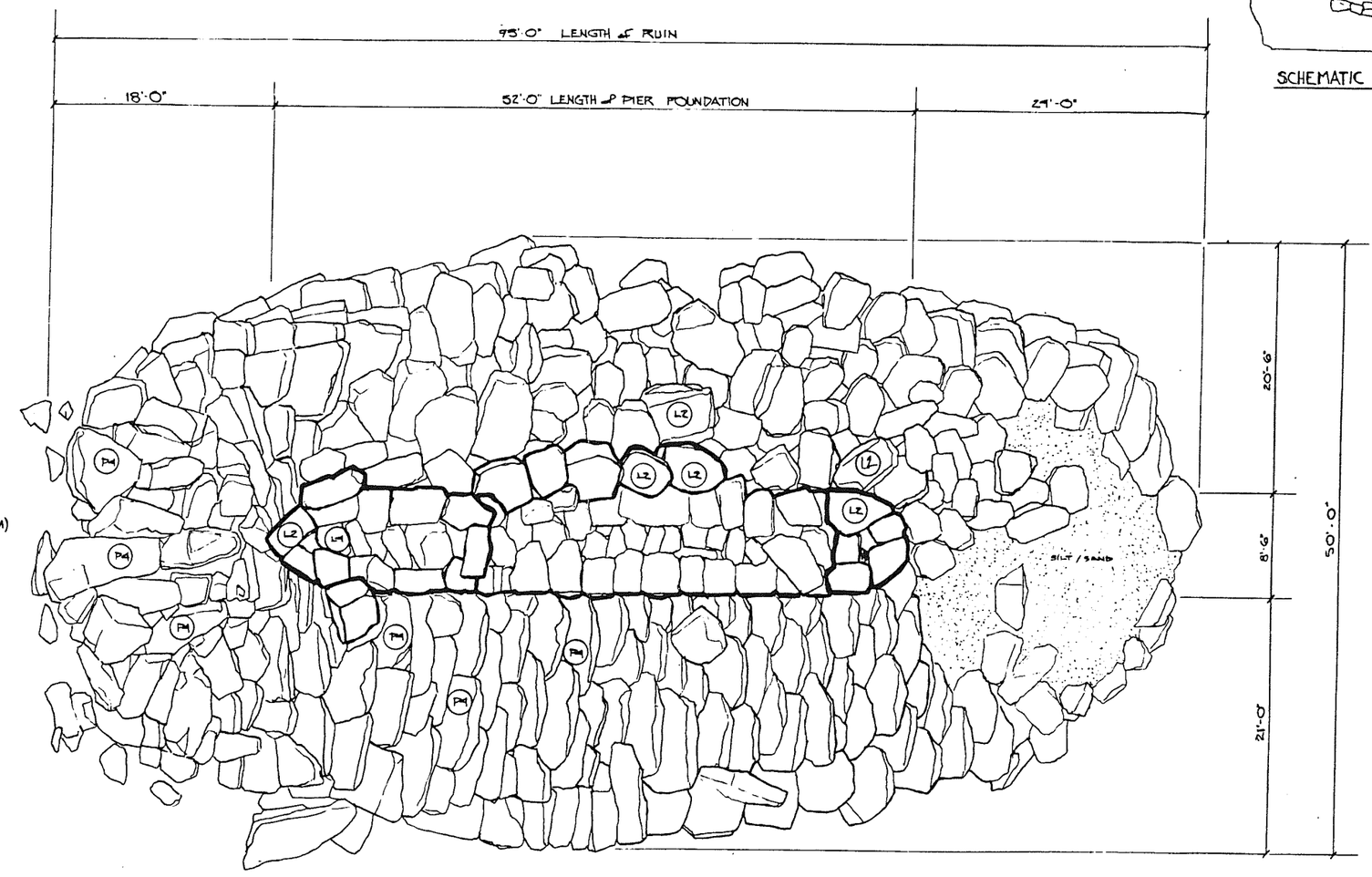
GRANITE
- G1 - COPING STONES (ASHLAR BLOCKS)
- G2 - PLINTH STONES (BUSH-HAMMERED FINISH)
- G3 - PITCH-FACED COURSED ASHLAR BLOCKS
- (BR) - BEDROCK HARPERS FORMATION PHYLLITE

MD. BANK

PIER E

POTOMAC RIVER

SCHEMATIC VIEW - PIER D (2/25)



MATERIAL NOTES:

PIER - TOMSTOWN FORMATION LIMESTONE PITCHED FACED COURSED ASHLAR. RUIN RETAINS FOUR EXTANT COURSES. MORTARED W/ LIMER CAMPAIGNS OR POINTING W/ POTELAND BASED MORTAR.

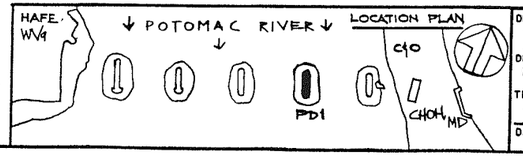
GRANITE ADDITION - DISPLACED AND DISCHARGED INTO THE RIVER DOWN CURRENT TO THE SOUTHEAST

RIP-RAP - HARPERS FORMATION PHYLLITE. PLACED IN A FISH SCALE PATTERN.

PLAN VIEW (1/25)

0' 2 4 6 8 10 12 14 16

SCALE 3/16" = 1'-0"



DESIGNED: WPTC
DRAWN: NEIDINGER
TECH. REVIEW: VITANZA
DATE: 03/29/94

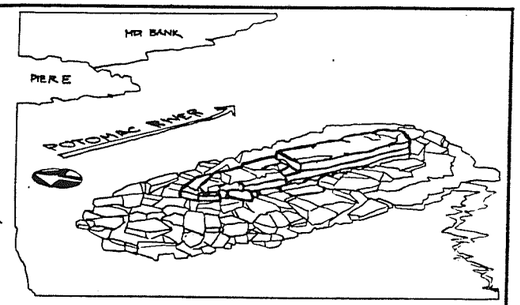
SUB SHEET NO. PD1

TITLE OF SHEET
PIER-D RIP-RAP
PLAN OF RIP-RAP BASE
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

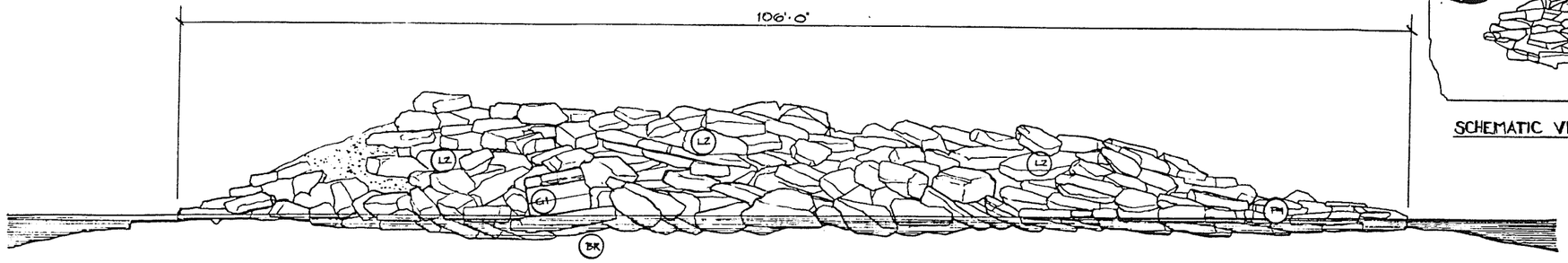
DRAWING NO. 385 80070

PKG. NO. 212

SHEET 25 OF 33



SCHEMATIC VIEW - PIER D 5/26



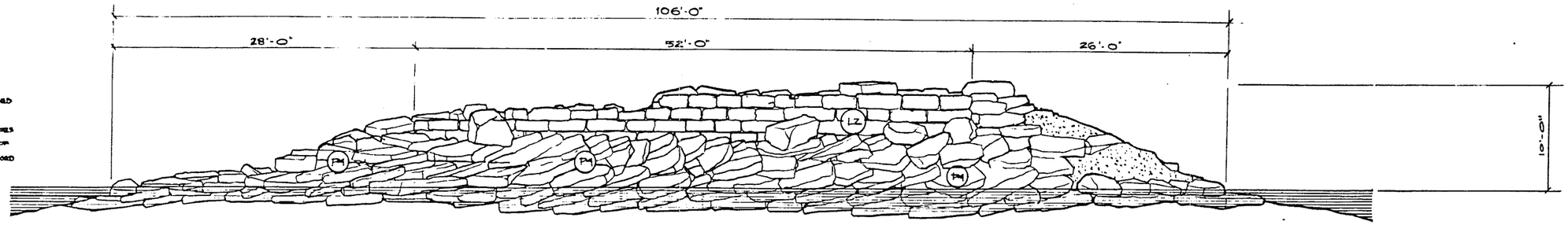
EAST ELEVATION 1/26

MATERIAL NOTES:

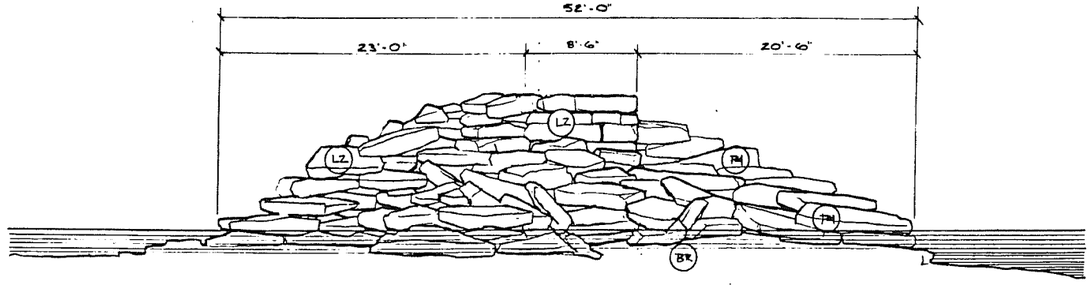
PIER: TOMSTOWN FORMATION LIMESTONE - PITCHED FACED COURSED ASHLAR.
RUIN RETAINS FOUR EXTANT COURSES MORTARED W/ LATER CAMPAIGNS OF POINTING W/ PORTLAND CEMENT BASED MORTAR.

GRANITE ADDITION:
DISPLACED AND DISCHARGED INTO THE RIVER DOWN CURRENT TO THE SOUTHEAST.

RIP-RAP -
HARPERS FORMATION PHYLLITE PLACED IN A FISH SCALE PATTERN.

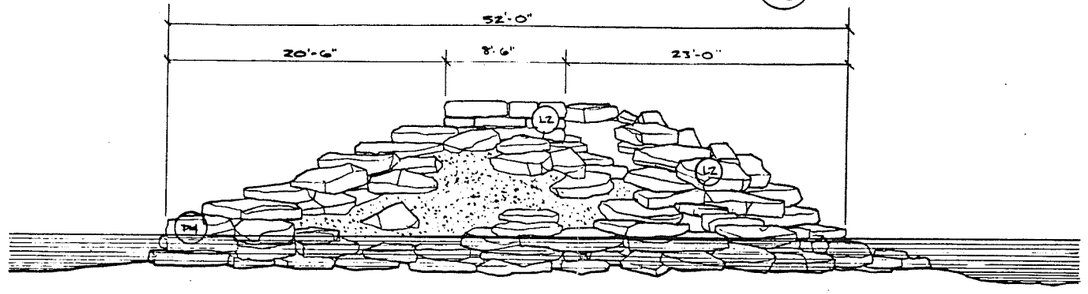


WEST ELEVATION 2/26

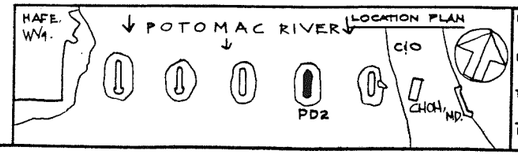


0 2 4 6 8 10 12 14 16 SCALE: 3/16" = 1'-0"

NORTH ELEVATION 3/26
UPSTREAM



SOUTH ELEVATION 4/26
DOWNSTREAM



DESIGNED: WPTC	SUB SHEET NO. PD2	TITLE OF SHEET: PIER-D ELEVATIONS B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS	DRAWING NO. 385 80070
DRAWN: NEIDINGER			PKG. NO. 212
TECH. REVIEW: VITANZA			SHEET 26 OF 33
DATE: 03/25/91			

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L2 - PITCH-FACED COURSED ASHLAR BLOCKS
- L3 - PLINTH STONES
- L4 - RUBBLE CORE LIMESTONE & HARPERS FORMATION PHYLLITE
- L5 - LIMESTONE RIP RAP SLABS

HARPERS FORMATION PHYLLITE
- P4 - RUBBLE SLABS

GRANITE
- G-1 COPING STONES (ASHLAR BLOCKS)
- G-2 PLINTH STONES (BUSH HAMMERED FINISH)
- G-3 PITCH-FACED COURSED ASHLAR BLOCKS

MATERIAL NOTES:

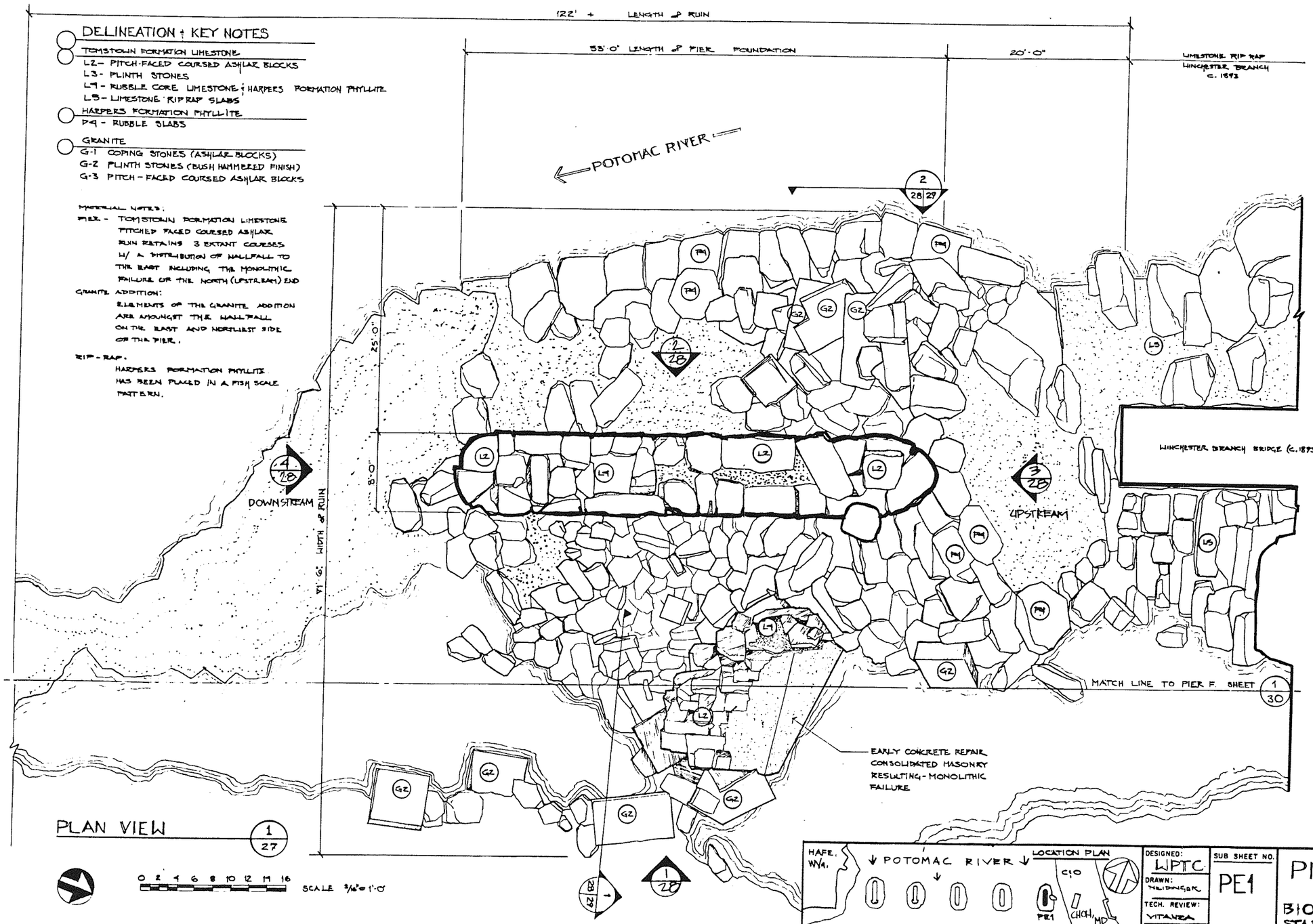
PIER - TOMSTOWN FORMATION LIMESTONE PITCHED FACED COURSED ASHLAR. RUIN RETAINS 3 EXTANT COURSES W/ A DISTRIBUTION OF RUBBLE TO THE EAST INCLUDING THE MONOLITHIC FAILURE OF THE NORTH (UPSTREAM) END

GRANITE ADDITION:

ELEMENTS OF THE GRANITE ADDITION ARE AMONGST THE RUBBLE ON THE EAST AND NORTHEAST SIDE OF THE PIER.

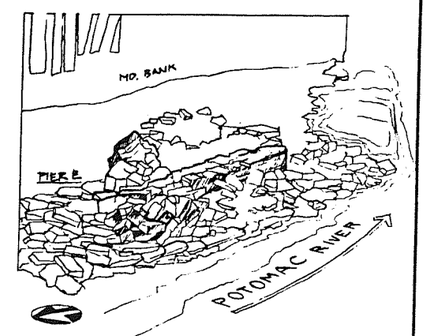
RIP-RAP:

HARPERS FORMATION PHYLLITE HAS BEEN PLACED IN A FISH SCALE PATTERN.



PLAN VIEW 1 27

0 2 4 6 8 10 12 14 16 SCALE 3/16" = 1'-0"



SCHEMATIC VIEW PIER-E 2 27

DESIGNED:	WPTC
DRAWN:	HELDINGER
TECH. REVIEW:	VITANZA
DATE:	03/25/94
SUB SHEET NO.	PE1

TITLE OF SHEET
PIER-E RIP-RAP PLAN
B10 RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO.	385 80070
PKG. NO.	212
SHEET	27
	OF 33

MATERIAL NOTES:

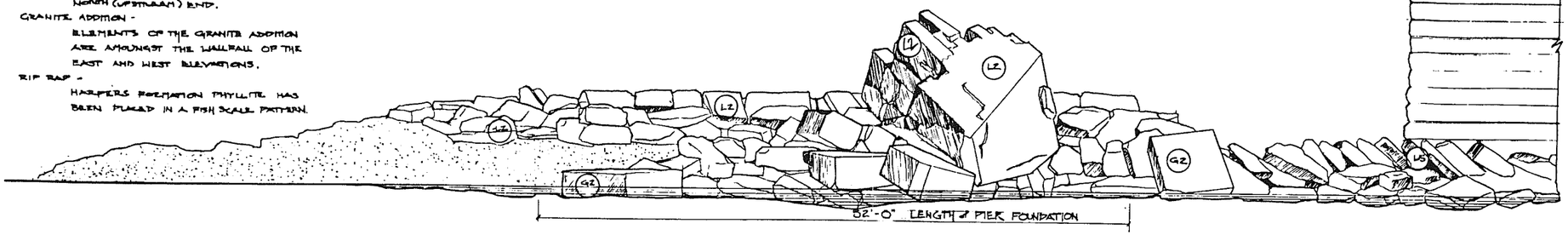
PIER - TOMSTOWN FORMATION LIMESTONE PITCHED FACED COURSED ASHLAR RUIN RETAINS 3 EXTANT COURSES W/ A DISTRIBUTION OF WALLFALL TO THE EAST INCLUDING THE MONOLITHIC FAILURE OF THE NORTH (UPSTREAM) END.

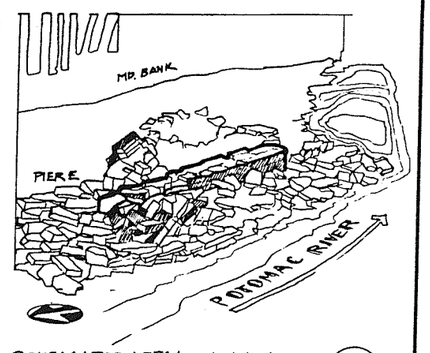
GRANITE ADDITION -

ELEMENTS OF THE GRANITE ADDITION ARE AMOUNGST THE WALLFALL OF THE EAST AND WEST ELEVATIONS.

RIP RAP -

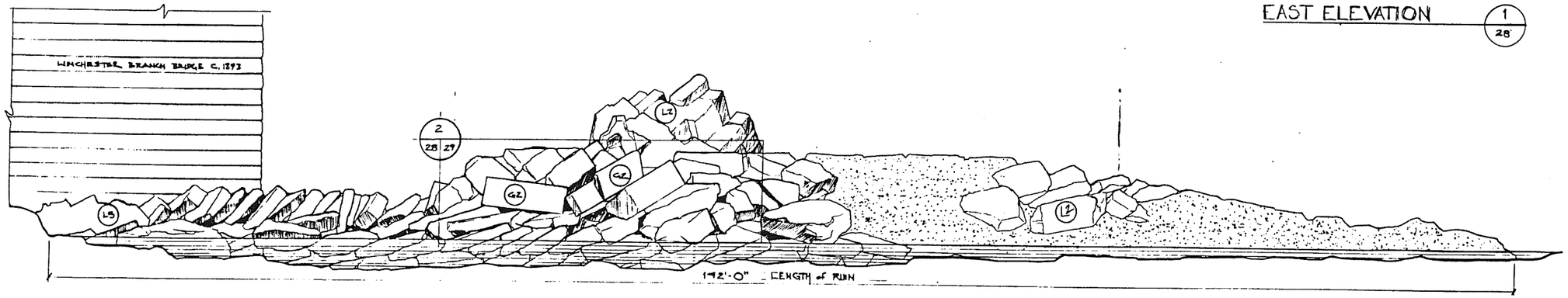
HARPERS FORMATION PHYLLITE HAS BEEN PLACED IN A FISH SCALE PATTERN.



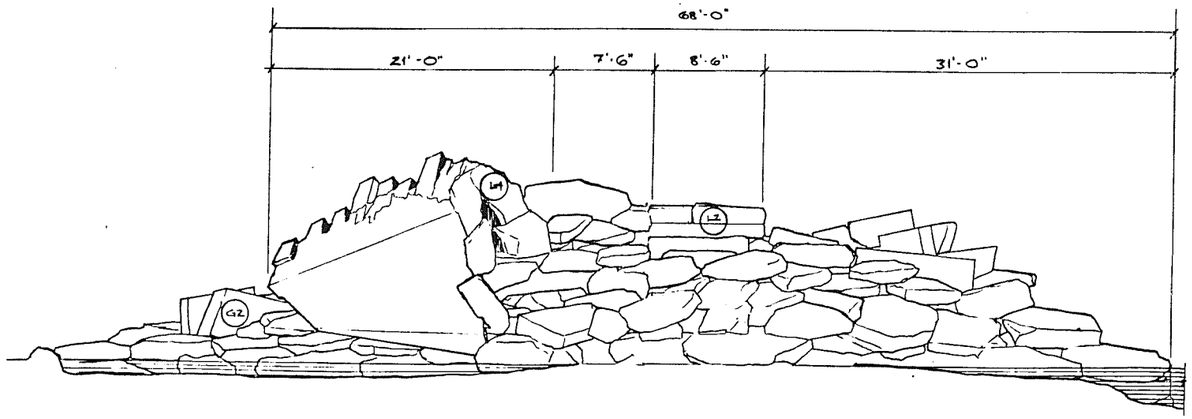


SCHEMATIC VIEW PIER-E 5/28

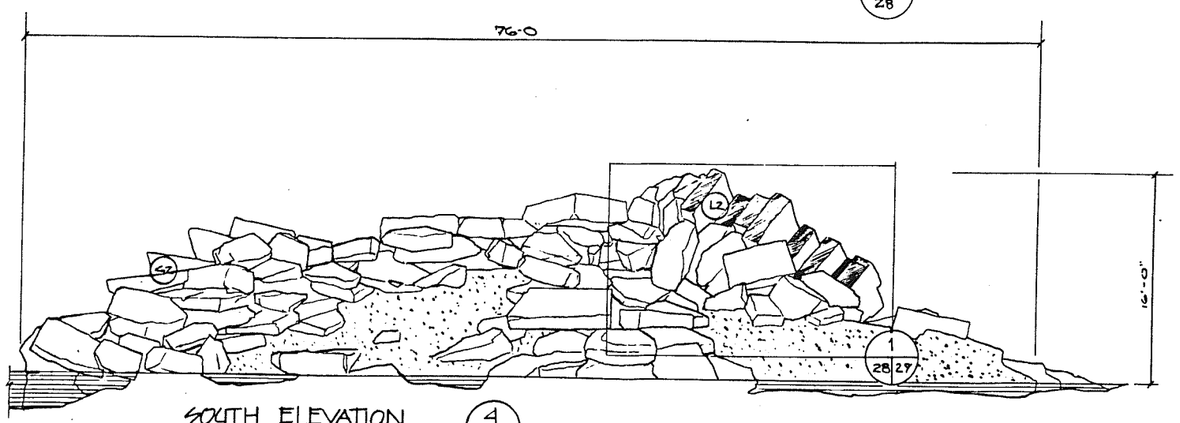
EAST ELEVATION 1/28



WEST ELEVATION 2/28

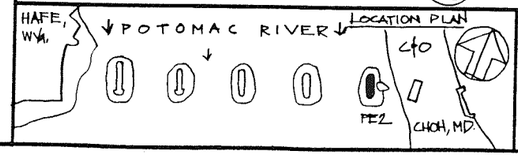


NORTH ELEVATION 3/28
UPSTREAM



SOUTH ELEVATION 4/28
DOWNSTREAM

0 2 4 6 8 12 16
SCALE: 3/16" = 1'-0"

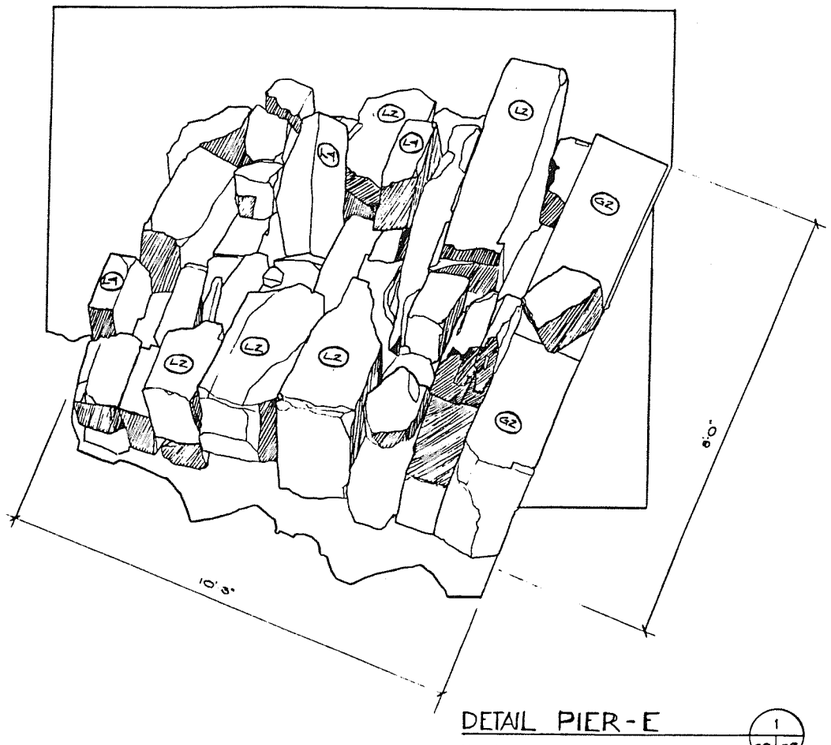


DESIGNED: WPTC
DRAWN: HEIDINGER
TECH. REVIEW: YITANZA
DATE: 03/23/99

SUB SHEET NO. PE2

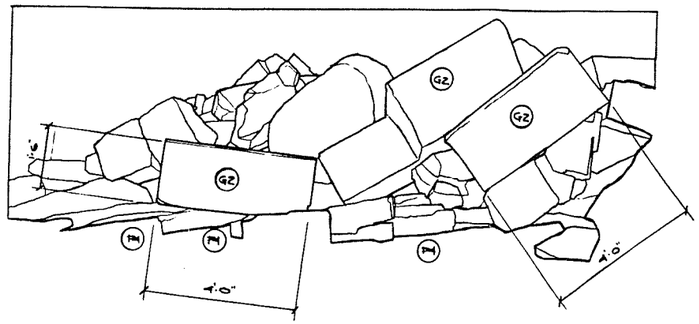
TITLE OF SHEET
PIER - E ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 80070
PKG. NO. 212
SHEET 28 OF 33



DETAIL PIER-E (1) — 28 | 29

NOTE:
DETAIL OF SOUTH ELEVATION OF FAILED SECTION OF PIER E EXHIBITING THE RUBBLE CORE-KEYED ACROSS THE FULL WIDTH OF THE PIER WITH PLACEMENT OF EACH COURSE.



DETAIL PIER-E (2) — 28 | 29

NOTE:
DETAIL OF WEST ELEVATION OF FAILED SECTION OF PIER E.
STONES OF THE GRANITE ADDITION THAT HAVE BEEN DISPLACED NOW REST UPON THE HARPERS PHYLLITE RIP-RAP.
HALF-FALL OF THE COURSED ASHLAR GRANITE ADDITION RETAINS SHAPE AND TOOTH-CHISELED FINISHING OF ORIGINAL PLACEMENT.

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

- L2 – PITCH-FACED COURSED ASHLAR BLOCKS
- L3 – PLINTH STONES
- L4 – RUBBLE CORE, LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE

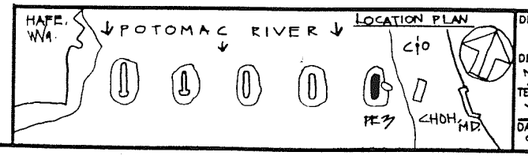
- RM – RIP-RAP SLABS

GRANITE

- G1 – COPING STONES (ANGULAR BLOCKS)
- G2 – PLINTH STONES (BUSH HAMMERED)
- G3 – PITCH-FACED COURSED ASHLAR BLOCKS.

HARPERS FORMATION (PHYLLITE)
BROWN TO DARK BLUE-GRAY OR GREEN-GRAY BANDED SHALE TO LUSTROUS DARK GRAY LAMINATED PHYLLITE.

TOMSTOWN FORMATION (LIMESTONE)
GRAY TO DARK BLUE-GRAY LAMINATED LIMESTONE W/ BLACK BANDED CHERT THROUGHOUT — DOLOMITIC LIMESTONE - RECRYSTALLIZED TO MARBLE.



DESIGNED: WPTC.
DRAWN: [illegible]
TECH. REVIEW: VITANZA
DATE: 03/25/94

SUB SHEET NO. PE3

TITLE OF SHEET
PIER "E"
DETAILS OF MASONRY CONSTRUCTION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 / 80070
PKG. NO. 212
SHEET 29 OF 33

MATCH LINE TO PLAN VIEW PIER E

1/27

LOW WATER PONDING ALONG MD. BANK of POTOMAC

PIER E

L2

G2

L1

RIVER LEVEL - SUMMER 1993

DASHED LINE INDICATES LOCATION of FOOTBRIDGE

LOWER RIVER-BANK RETAINING WALL

P1

WINCHESTER BRANCH RAILROAD BRIDGE c. 1893

3/30/33

UPPER RIVER-BANK RETAINING WALL

PIER F

G1

G3

1/30/33

N 9/30/33

49.6

9.0

CANAL TOWPATH

PLAN VIEW 1/30

SCALE: 3/16" = 1'-0"

C & O CANAL

NOTE: MEAN RIVER LEVELS IMPACT ALL ELEMENTS OF THIS SITE PLAN.

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L-2 PITCH-FACED COURSED ASHLAR BLOCKS
- L-3 PLINTH STONES
- L-4 RUBBLE CORE, LIMESTONE & HARPERS PHYLLITE

HARPERS FORMATION PHYLLITE
- P-1 RUBBLE
- P-2 COURSED RUBBLE
- P-3 COURSED ASHLAR
- P-4 RIP-RAP SLABS

GRANITE
- G-1 COPING STONES (ASHLAR BLOCKS)
- G-2 PLINTH STONES (RUSH-HAMMERED FINISH)
- G-3 PITCH-FACED COURSED ASHLAR BLOCKS

HAFE., WVA.

POTOMAC RIVER

LOCATION PLAN

C&O

PF1

CLIO, MD.

DESIGNED:	LIPTC
DRAWN:	NBLIPINGER
TECH. REVIEW:	VITANZA
DATE:	03/25/99

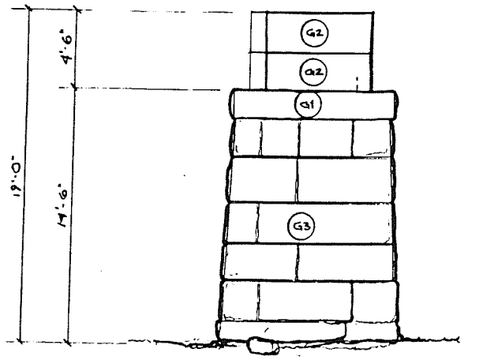
SUB SHEET NO. PF1

TITLE OF SHEET
PIER - F
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

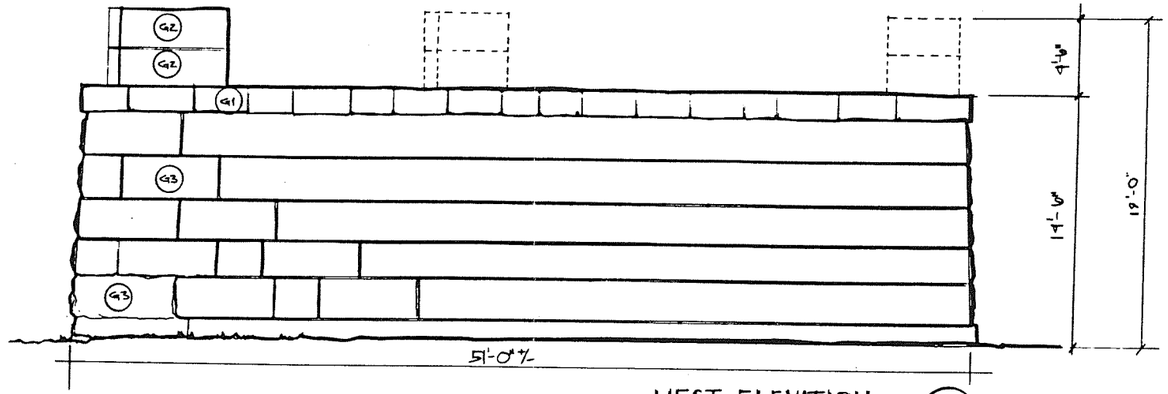
DRAWING NO. 385 / 80070

PKG. NO. 212

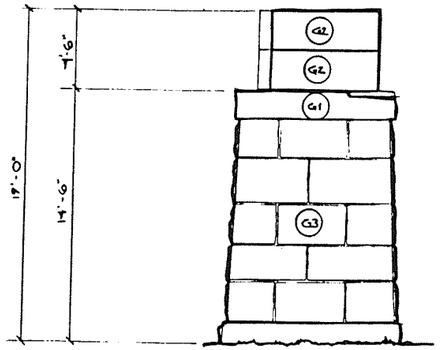
SHEET 30 OF 33



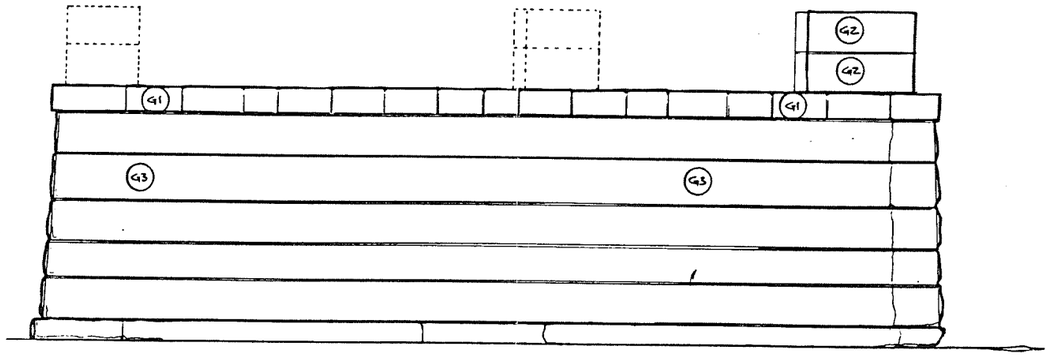
NORTH ELEVATION 1/31



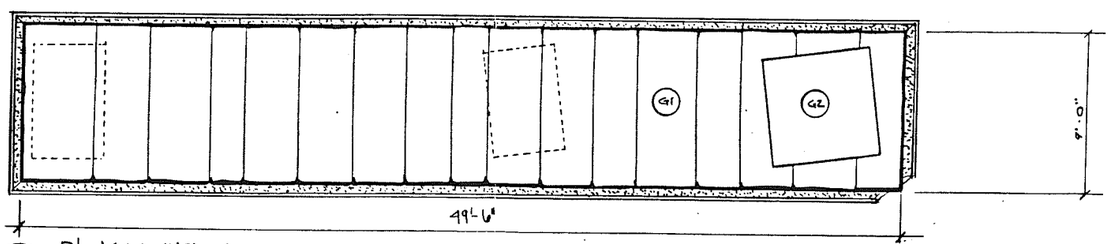
WEST ELEVATION 2/31



SOUTH ELEVATION 3/31



EAST ELEVATION 4/31



5/31 PLAN VIEW

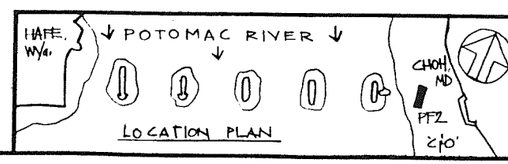
MATERIAL NOTES:

PIER - PITCH - FACED COURSED ASHLAR GRANITE W/ A CORE OF HARPERS FORMATION PHYLLITE AND TOMSTOWN FORMATION LIMESTONE IN A SLURRY LIME - BASED MORTAR.

DISPLACEMENT OF FIRST AND SECOND COURSE ON NORTH ELEVATION.

0 2 4 6 8 10 12

SCALE 1/4"=1'-0"



DESIGNED:	WPTC
DRAWN:	J. RODNEY
TECH. REVIEW:	VITANZA
DATE:	03/25/99

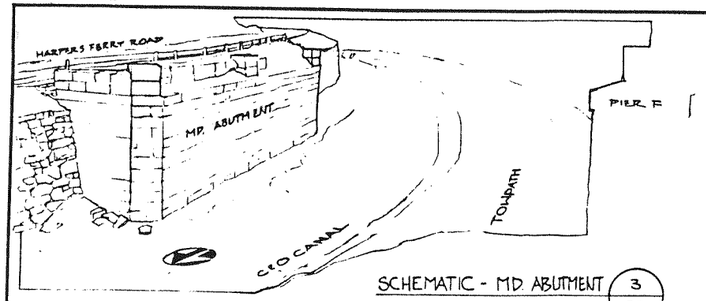
SUB SHEET NO. PF2

TITLE OF SHEET
PIER-F ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 / 80070

PKG. NO. 212

SHEET 31 OF 33



SCHEMATIC - MD. ABUTMENT (3/32)

PLAN (1/32)

0 2 4 6 8 10 12 14 16
SCALE: 3/16" = 1'-0"

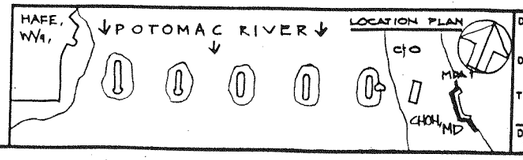
WEST ELEVATION (2/32)

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L-2 PITCH-FACED COURSED ASHLAR
- L-3 PLINTH STONES
- L-4 RUBBLE CORE, LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
- P-1 RUBBLE
- P-2 COURSED RUBBLE
- P-3 COURSED ASHLAR

GRANITE
- G-1 COPING STONES (ASHLAR BLOCKS)
- G-2 PLINTH STONES (BUSH HAMMERED)
- G-3 PITCH FACED COURSED ASHLAR BLOCKS

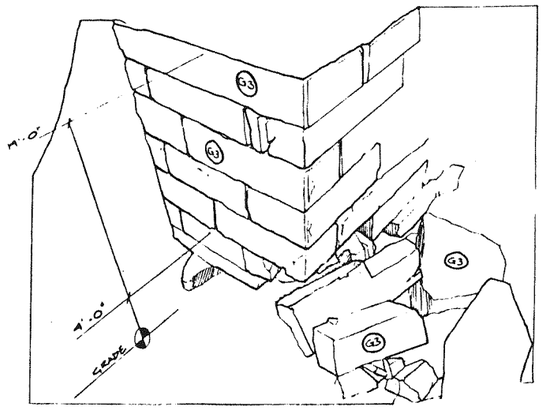


DESIGNED: WPTC
DRAWN: NEIDINGER
TECH. REVIEW: VMANZA
DATE: 03/28/94

SUB SHEET NO. MDA1

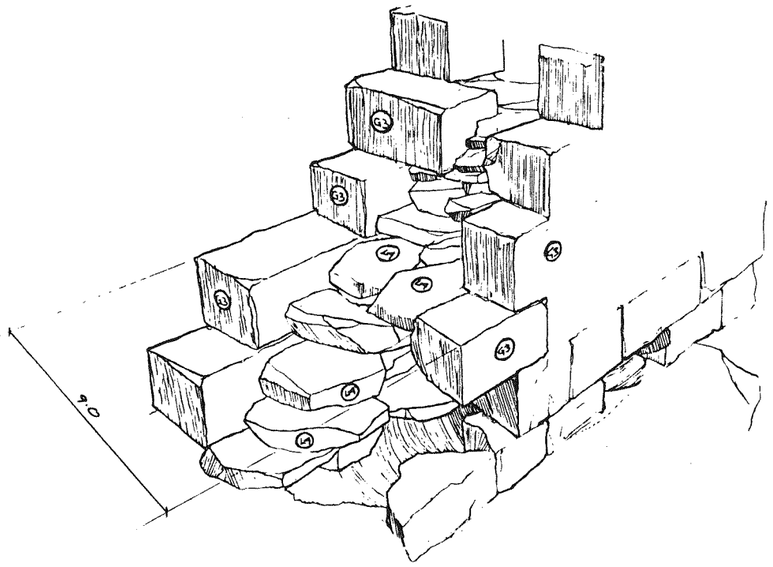
TITLE OF SHEET
MARYLAND ABUTMENT
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
EXISTING CONDITIONS

DRAWING NO. 385 / 80070
PKG. NO. 212
SHEET 32 OF 33



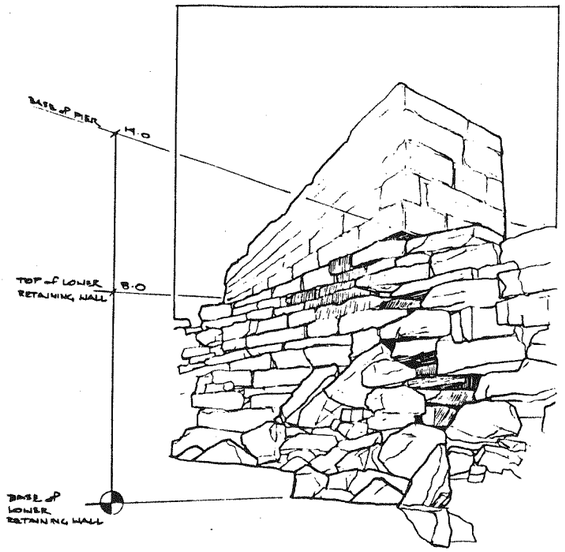
PIER - F - DETAIL NORTH ELEVATION (1 / 30 | 33)

NOTE: BASE STONES OF NORTH ELEVATION HAVE BEEN DISPLACED. VIEW FROM ABOVE EXHIBITS DISTRIBUTION OF WALLFALL AND POSITION OF THE THIRD COURSE OF STONE CANTILEVERED AT 4.0' ABOVE GRADE.



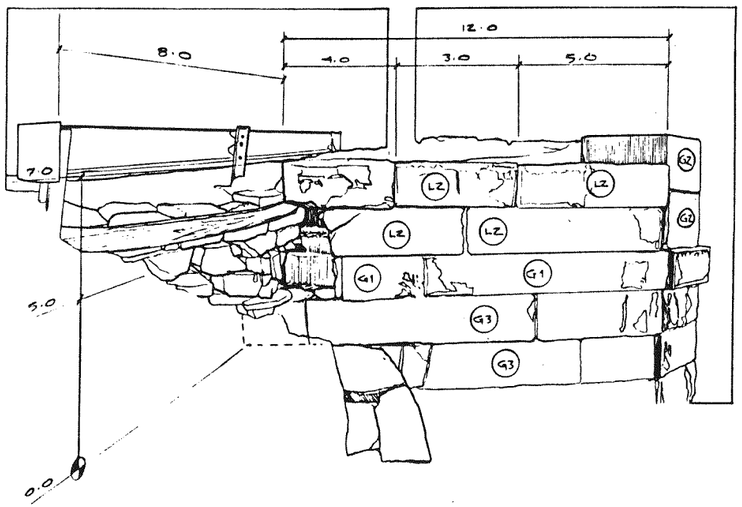
PIER - F - DETAIL of construction and foundation damage (2 / 30 | 33)

NOTE: CUT-AWAY DRAWING REVEALS METHOD of CONSTRUCTION of CORE of PIER and EROSION DAMAGE TO PIER FOUNDATION. EARTH FILL AT BASE of CORE of PIER EXTENSIVELY ERODED.



PIER - F - SOUTHWEST RETAINING WALL (3 / 30 | 33)

NOTE: OBLIQUE: VIEWING NORTHEAST AT CONDITION OF FOUNDATION STONE RETAINING WALL. SEVERELY IMPACTED BY VEGETATION (REMOVED FROM THIS VIEW TO SHOW STONE DISPLACEMENT) AND FLOOD WATERS — THE SOUTH WEST CORNER OF THE PIER HAS BEEN LEFT UNSUPPORTED.



MARYLAND ABUTMENT - DETAIL NORTH ELEVATION (4 / 32 | 33)

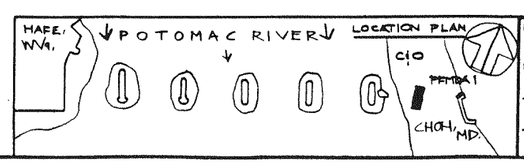
NOTE: JUNCTURE of NORTH ELEVATION of MARYLAND ABUTMENT AND C!O CANAL RETAINING WALL HAS BEEN TEMPORARILY BRACED W/ WOOD FRAMING MEMBER THAT RETAINS RUBBLE FILL. TOP TWO COURSES OF LIMESTONE HAVE SHIFTED OUT OF PLUMB FROM SOIL PRESSURE AND INCREASED LATERAL LOAD. ASSOCIATED STONES HAVE BEEN DISPLACED AT WALL JUNCTURE.

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L-1 COURSED RUBBLE
- L-2 PITCH-FACED COURSED ASHLAR
- L-3 PLINTH STONES
- L-4 RUBBLE CORE, LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
- P-1 RUBBLE
- P-2 COURSED RUBBLE
- P-3 COURSED ASHLAR

GRANITE
- G-1 COPING STONES (ASHLAR BLOCKS)
- G-2 PLINTH STONES (BUSH HAMMERED)
- G-3 PITCH-FACED COURSED ASHLAR BLOCKS



DESIGNED: WPTC.
DRAWN: HEIDINGER
TECH. REVIEW: VITANZA
DATE: 03/25/99

SUB SHEET NO. PFMDA 1

TITLE OF SHEET: PIER F & MARYLAND ABUTMENT B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT EXISTING CONDITIONS

DRAWING NO. 385 / 80070

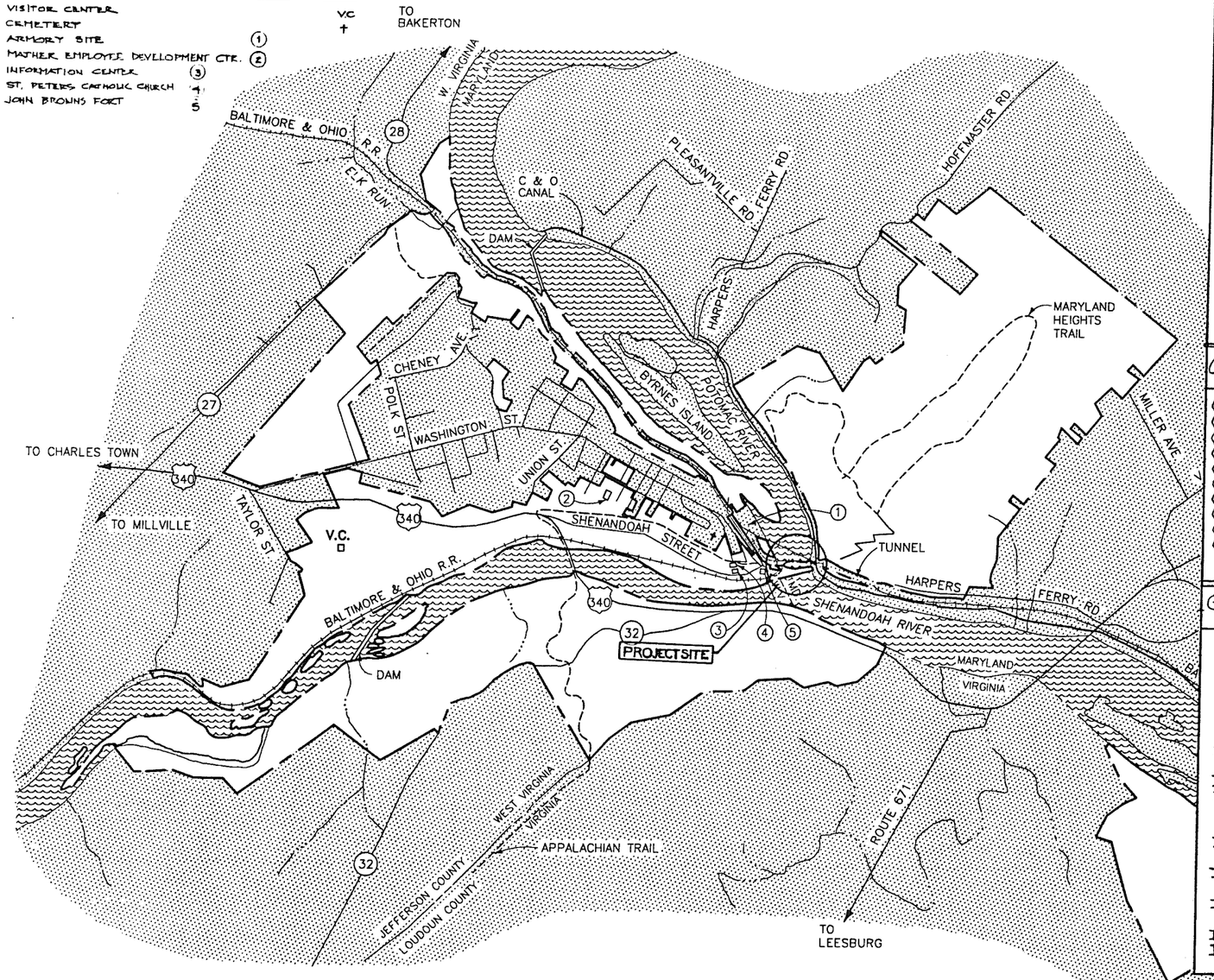
PKG. NO. 212

SHEET 33 OF 33

APPENDIX F

LEGEND

- PARK BOUNDARY
- STATE BOUNDARY
- TRAIL
- RIVER
- VISITOR CENTER — VC
- CEMETERY — †
- ARMORY SITE — (1)
- MASTER EMPLOYEE DEVELOPMENT CTR. — (2)
- INFORMATION CENTER — (3)
- ST. PETERS CATHOLIC CHURCH — 4
- JOHN BROWNS FORT — 5



DELINEATION & KEY NOTES

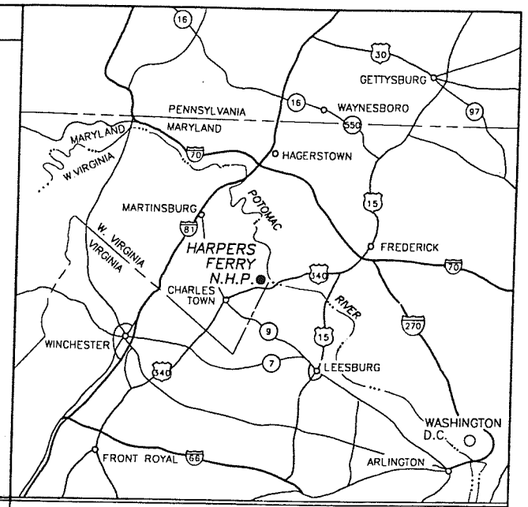
TOMSTOWN FORMATION LIMESTONE
- L1 COURSED RUBBLE
- L2 PITCH FACED COURSED ASHLAR
- L3 PLINTH STONES
- L4 RUBBLE CORE, LIMESTONE and HARPERS PHYLLITE

HARPERS FORMATION PHYLLITE
- P1 RUBBLE
- P2 COURSED RUBBLE
- P3 COURSED ASHLAR
- P4 RIP RAP SLABS

GRANITE
- G1 COPING STONES (ASHLAR BLOCKS)
- G2 PLINTH STONES (BRUSH HAMMERED FINISH)
- G3 PITCH FACED COURSED ASHLAR BLOCKS

- (S) SANDSTONE
- (T) TIMBER
- (BR) BEDROCK

DRAWING NO. / SHEET NO. SHOWN ON / SHEET NO. DERIVED FROM



GENERAL CONDITION ASSESSMENT NOTES
(USED THROUGHOUT THESE DRAWINGS)

- (1) DISPLACED STONE
- (2) DAMAGED STONE
- (3) TRANSVERSE CRACK IN MASONRY
- (4) LATERAL CRACK IN MASONRY
- (5) CONCENTRATED OPEN MORTAR JOINTS THIS AREA
- (6) POTENTIAL VOIDS IN RUBBLE CORE MATERIAL
- (7) EXPOSED RUBBLE CORE MATERIAL
- (8) SILTATION BUILD-UP THIS AREA (OBSCURES MASONRY)
- (9) DISPLACED RIP-RAP
- (10) FLOOD IMPACT ZONE

ADDITIONAL SHEET NOTES AS NEEDED

GENERAL TREATMENT RECOMMENDATIONS
(USED THROUGHOUT THESE DRAWINGS)

I. REMOVE VEGETATION AS INDICATED!
- IA. REMOVE EXISTING STUMPS and ROOTS by HAND METHOD, REPAIR ANY DAMAGED MASONRY, FILL STUMP VOID w/RUBBLE
- IB. REMOVE EXISTING TREE, REMOVE ROOTS by HAND, REPAIR ANY DAMAGED MASONRY, FILL STUMP VOID w/RUBBLE
- IC. PRUNE EXISTING TREE & REMOVE OVERHANGING BRANCHES AS TAGGED in FIELD by PROJECT ARCHITECT

II. REMOVE SILTATION BUILD-UP in SELECTED LOCATIONS to EXTENT INDICATED by DRAWINGS

III. REPAIR MASONRY:
- IIIA. RAKE OUT and REPOINT JOINTS; REFILL VERTICAL HEAD JOINTS and HORIZONTAL BED JOINTS to MAXIMUM DEPTH of JOINT, NOT TO EXCEED 12 INCHES (AREAS INDICATED on DRAWINGS)
- IIIB. RAKE OUT JOINTS; USING TAMP POINTING METHOD & REPOINT VERTICAL and HORIZONTAL JOINTS in SELECTED AREAS
- IIIC. TAMP POINT and INSTALL BACKING and GROUT INJECTION to FILL VOIDS and CONSOLIDATE CORE in RUBBLE AREAS
- IIID. RETAIN ALL DRY-LAID MASONRY - DO NOT INSTALL MORTAR in THESE AREAS
- IIIE. PRESERVE EXISTING MORTAR - NO REPOINTING REQUIRED

IV. INDIVIDUAL SHEET NOTATIONS: WSA, BOSA, PA & PB.

WEST VIRGINIA

SCALE OF MILES: 10 0 10

DRAWING INDEX

DWG NO.	SUBSHEET NO	SHEET TITLE
1	S1	COVER SHEET
2	S2	SITE MAP
3	S3	WINCHESTER AND B&O SPAN ABUTMENTS, ELEV. & PLAN
4	WSA1	WINCHESTER SPAN ABUTMENT, PARTIAL PLAN, EAST ELEV.
5	WSA2	WINCHESTER SPAN ABUTMENT, PLAN & SOUTH & WEST ELEV.
6	WSA3	WINCHESTER SPAN ABUTMENT, EAST WALL & DETAIL
7	WSA4	WINCHESTER SPAN ABUTMENT, EAST WALL & DETAIL
8	BOSA1	B&O SPAN ABUTMENT, PARTIAL PLAN & EAST ELEV.
9	BOSA2	B&O SPAN ABUTMENT, PARTIAL PLAN & NORTH ELEV.
10	BOSA3	B&O SPAN ABUTMENT, EAST PILASTER ELEV. & DETAIL
11	BOSA4	B&O SPAN ABUTMENT, NORTH & EAST WALL ELEV. & DETAILS
12	PA1	PIER "A" PLAN, NORTH & WEST ELEV.
13	PA2	PIER "A" PLAN, SOUTH & EAST ELEV.
14	PA3	PIER "A" RIP RAP, NORTH & SOUTH ELEV. W/ PLANS
15	PA4	PIER "A" RIP RAP, PLAN & WEST ELEV.
16	PA5	PIER "A" RIP RAP, PLAN & EAST ELEV.
17	PB1	PIER "B", PLAN, NORTH AND WEST ELEV.
18	PB2	PIER "B", PLAN, SOUTH & EAST ELEV.
19	PB3	PIER "B", RIP RAP, NORTH & SOUTH ELEV. & PLANS
20	PB4	PIER "B", RIP RAP PLAN, WEST ELEV.
21	PB5	PIER "B", RIP RAP PLAN, EAST ELEV.
22	PAB1	PIERS "A" & "B", DETAIL VIEWS OF EXISTING CONDITIONS
23	PC1	PIER "C" RIP RAP, PLAN
24	PC2	PIER "C" ELEVATIONS (N,S,E,W)
25	PD1	PIER "D" RIP RAP, PLAN
26	PD2	PIER "D" ELEVATIONS (N,SE,W)
27	PE1	PIER "E" RIP RAP, PLAN
28	PE2	PIER "E" ELEVATIONS (N,S,E,W)
29	PE3	PIER "E" DETAILS
30	PF1	PIER "F" AREA SITE PLAN VIEW
31	PF2	PIER "F" ELEVATIONS (N,S,E,W)
32	MDA1	MARYLAND ABUTMENT, PLAN & ELEVATION
33	PFMDA1	PIER "F" & MD. ABUTMENT DETAIL & EXISTING COND.

SCALE OF FEET: 1200 0 1200 2400
SCALE OF METERS: 200 0 200 400 600

HARPERS FERRY NATIONAL HISTORICAL PARK ~ WPTC STABILIZATION DESIGN DRAWINGS for DAY-LABOR CONSTRUCTION

BASIC DATA: LAND STATUS MAP(S) 395-92,002/NPS MINI FOLDER DTD 1988

/PROJ/COVERS/APPROVED/HAFE_COVER.DG

SUB SHEET NO.	Mark	Sheet	REVISION	Date	Initial
S1					

RECOMMENDED
- Rebecca J. Stoltzfus, Regional Historical Analyst, NCR — 5/6/94
- A. Ted Mackintosh, Chief, Williamsport Historic Preservation Training Center — 2/15/94
- Daniel T. Campbell, Superintendent, HAFE — 5-5-94

APPROVED: Kent Lee, Regional Director, NCR — 5/9/94

NATIONAL PARK SERVICE — DEPARTMENT OF THE INTERIOR

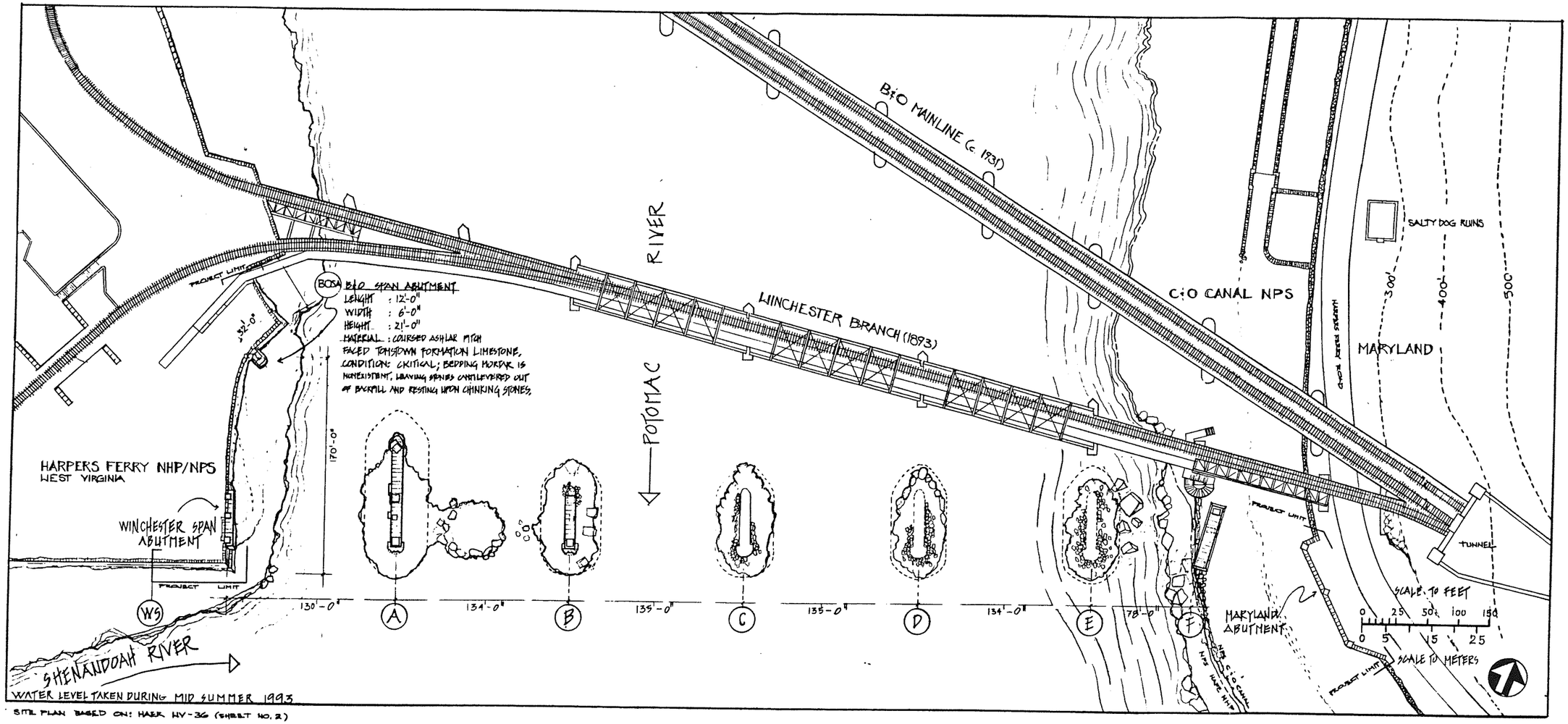
WILLIAMSPORT HISTORIC PRESERVATION TRAINING..... CENTER

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HARPERS FERRY CENTER

DESIGNED: WPTC
DRAWN: RODWELL / NELDING/BR
TECH REVIEW: VITANZA
DATE: 05.01.94

TITLE OF DRAWING: DAY LABOR CONSTRUCTION
LOCATION WITHIN PARK: B&O RAILROAD BRIDGE PIERS & ABUTMENTS
NAME OF PARK: HARPERS FERRY NATIONAL HISTORICAL PARK
REGION: MID-ATLANTIC | COUNTY: JEFFERSON | STATE: WEST VIRGINIA

DRAWING NO. 385 80071
PKG. NO. 212
SHEET 1 OF 22



SITE PLAN BASED ON: HAER WV-36 (SHEET NO. 2)

WINCHESTER SPAN ABUTMENT
LENGHT : 44'-3"
WIDTH : 6'-6"
HEIGHT : 19'-4"
MATERIAL – COURSED ASHLAR PITCH – FACED TOMSTOWN FORMATION LIMESTONE W/
– COURSED ASHLAR PITCH – FACED GRANITE ADDITIONS.
– HARPERS PHYLITE RUBBLE

NOTE: – LEVEL OF SILTATION AT BASE OF MONUMENT.

PIER A
LENGTH : 90'-0"
WIDTH : 8'-0"
HEIGHT : 32'-6"
MATERIAL – COURSED ASHLAR PITCH – FACED TOMSTOWN FORMATION
– COURSED ASHLAR GRANITE ADDITION
– RIP RAP (133'X50') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CRITICAL CONDITION – DISPLACED HARPERS PHYLITE RIP RAP ON UPSTREAM (NORTH) END.

PIER B
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 31'-3"
MATERIAL – COURSED ASHLAR PITCH – FACED TOMSTOWN FORMATION LIMESTONE W/
– COURSED ASHLAR GRANITE ADDITION
– RIP RAP: (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN

CRITICAL CONDITION – DISPLACED STONES OF UPPER COURSES OF THE UPSTREAM (NORTH) END.

PIER C
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 8'-6"
MATERIAL – COURSED ASHLAR PITCH – FACED TOMSTOWN FORMATION LIMESTONE
– RIP RAP: (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CONDITION: SIX COURSES OF MASONRY REMAIN IN-SITU. UPPER COURSES DISCHARGED INTO RIVER INCLUDING ASHLAR GRANITE ADDITION

PIER D
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 3'-9"
MATERIAL – COURSED ASHLAR PITCH – FACED TOMSTOWN FORMATION LIMESTONE
– RIP RAP: (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CONDITION: THREE COURSES OF MASONRY REMAIN IN-SITU. DEBRIS FROM UPPER COURSES IS CONCENTRATED AROUND THE EXTANT COURSE WORK.

PIER E
LENGTH : 52'-0"
WIDTH : 8'-6"
HEIGHT : 4'-0"
MATERIAL – COURSED ASHLAR PITCH – FACE TOMSTOWN FORMATION LIMESTONE
– RIP RAP (85'X42') HARPERS PHYLLITE PLACED IN A FISH SCALE PATTERN.

CONDITION: BASE COURSES OF MASONRY REMAIN IN-SITU. DEBRIS FROM UPPER COURSES IS CONCENTRATED AROUND EXTANT COURSE WORK. EARLY REPAIR OF UPSTREAM (NORTH) END CONSOLIDATED THE MASONRY CONTRIBUTING TO MONOLITHIC FAILURE.

PIER F
LENGTH : 58'-0"
WIDTH : 10'-0"
HEIGHT : 19'-0"
MATERIAL: COURSED ASHLAR PITCH – FACED GRANITE WITH MARGINS. FOUNDATION STONES ARE HARPERS PHYLLITE COURSED RUBBLE MASONRY.
CRITICAL CONDITION: DISPLACED GRANITE COURSEWORK AT NORTH END. SEVERE UNDERMINING ALONG EAST SIDE OF FOUNDATION. SEVERE DISPLACEMENT OF RUBBLE MASONRY OF ASSOCIATED FOUNDATION RETAINING WALL AT SOUTHWEST CORNER.

MARYLAND ABUTMENT
LENGHT : 90'-0"
WIDTH : 15'-0"
HEIGHT : 30'-0"
MATERIAL: COURSED ASHLAR PITCH FACED TOMSTOWN FORMATION LIMESTONE.
CONDITION: RETAINS EMBANKMENT OF C&O CANAL AND MARYLAND HARPERS FERRY ROAD, WASHINGTON COUNTY.

DESIGNED: WPTC	SUB SHEET NO. S2	TITLE OF SHEET: SITE PLAN B&O RAILROAD BRIDGE PIERS and ABUTMENTS STABILIZATION DESIGN PROJECT DAY-LABOR CONSTRUCTION SET
DRAWN: RODNEY		DRAWING NO. 385 80077
TECH. REVIEW: VITANZA		PKG. NO. 212 —
DATE: 05.02.99		SHEET 2 of 22

★U.S. GOVERNMENT PRINTING OFFICE: 676-196

MATCH LINE - PARTIAL PLAN 1/5

SHENANDOAH RIVER

EXISTING TREES and CANOPIES SELECT VEGETATION REMOVAL THIS AREA

REMOVE TREES

17'-0" | 18'-0" | 18'-0" | 103'-4" | 84'-0"

WINCHESTER - SPAN ABUTMENT

WEST BANK ABUTMENT RETAINING WALL

B&O SPAN ABUTMENT

32'-6"

38'-4"

COPING 355'-0"

BASE 391'-6"

POTOMAC RIVER

N

1/3 | 1/3 | 2/3 | 2/11 | 1/3 | 1/3 | 1/3

WEST BANK PLAN 1/3

SCALE 1/8" = 1'-0"

4 0 4 8 12

24'-8" TOP OF RAIL

20'-4" COPING OF ABUTMENT

11'-4" TOP OF RUBBLE BASE

0'-0" EXPOSED BASE OF ABUTMENT

6'-0" | 21'-0" | 15'-0" | 6'-0"

NOTE: EXISTING TREES RANGE in DIAMETER from 8" to 18" WITH GROUPINGS of SMALLER TRUNK DIAMETERS AVERAGING 3FT. to 5FT. in WIDTH (TOTAL)

2/3 | 2/3 | 2/3

WEST BANK ELEV. 2/3

SCALE 1/8" = 1'-0"

4 0 4 8

60'-0" WINCHESTER SPAN ABUTMENT (SHEETS 3/1, 3/6, 3/7)

99'-0" WEST BANK ABUTMENT RETAINING WALL

35'-9" PILASTER (SHEET 10) B&O SPAN ABUTMENT (SHEETS 3/8, 3/9, 3/10, 3/11)

HAFE WM. SS

POTOMAC RIVER

LOCATION PLAN

CHOH, MD.

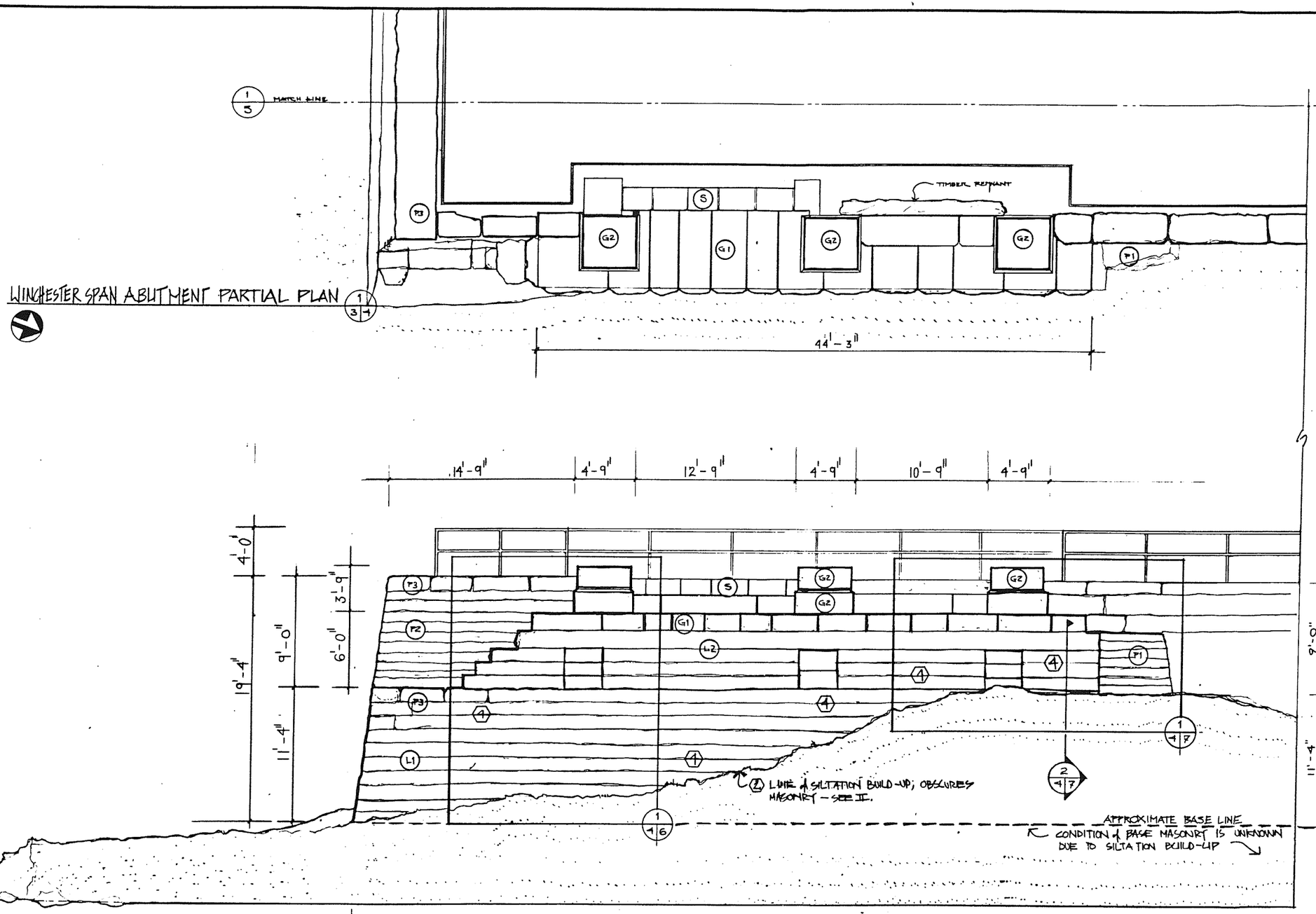
DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VITANZA
DATE:	05.02.94
SUB SHEET NO.	S3

TITLE OF SHEET

WINCHESTER and B&O SPANS and ABUTMENTS PLAN VIEWS and RIVER ELEVATIONS

B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT DAY-LABOR CONSTRUCTION SET

DRAWING NO.	385 80071
PKG. NO.	212
SHEET	3 of 22



WINCHESTER SPAN ABUTMENT PARTIAL PLAN 1/3-4

WINCHESTER SPAN ABUTMENT-EAST ELEVATION 2/3-4

SCALE 1/8"=1'-0"
4 0 4 8

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

- L1 - COURSED RUBBLE BASE
- L2 - PITCH-FACED COURSED ASHLAR
- L3 - PLINTH STONES

HARPERS FORMATION PHYLLITE

- P1 - RUBBLE
- P2 - COURSED RUBBLE
- P3 - COURSED ASHLAR
- P4 - RIP RAP SLABS

GRANITE

- G1 - COPING STONES
- G2 - PLINTH STONES
- G3 - PITCH-FACED COURSED ASHLAR BLOCKS
- (S) - SANDSTONE

CONDITION ASSESSMENT NOTES "WSA"

(1) VEGETATION IMPACTING CONDITION of MASONRY

(2) SILTATION BUILD-UP (OBSCURES MASONRY) FRTHER INVESTIGATION REQUIRED

(3) SEVERE FLOOD IMPACT ZONE

(4) DETERIORATED and DISPLACED MORTAR - OPEN MORTAR JOINTS

TREATMENT RECOMMENDATION NOTES

IA. REMOVE EXISTING STUMP & ROOTS BY HAND REPAIR ANY DAMAGED MASONRY, FILL VOID W/ STONE MATCHING ORIGINAL IN STONE TYPE SIZE, SHAPE, & DESIGN.

IB. REMOVE EXISTING TREE, REMOVE ROOTS BY HAND, REPAIR ANY DAMAGED MASONRY, FILL VOID W/ STONE MATCHING ORIGINAL IN STONE TYPE SIZE, SHAPE, & DESIGN.

IC. PRUNE EXISTING TREE., REMOVE OVERHANGING BRANCHES AS TAGGED IN THE FIELD BY PROJECT LEADER.

II. REMOVE EXTENSIVE SILT BUILD-UP ALONG BASE OF WALLS TO EXPOSE OBSCURED COURSEWORK EVIDENT @ S.E. CORNER

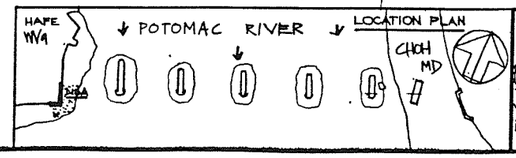
III. MORTAR AND GROUT MIXES SHALL BE DETERMINED THROUGH FURTHER MATERIAL TESTING (TESTING SHALL DETERMINE THERMAL & MOISTURE PROPERTIES OF THE STONE, CONDITION OF THE EXTANT BACKFILL, A COMPATIBLE BACKING MATERIAL, AND FEASIBLE METHODOLOGY OF IMPLEMENTATION.

IIIA. RAKE-OUT JOINTS, REPOINT & TAMP POINT IN INDICATED AREAS, RETAIN DRY LAID SECTIONS APPROX. 1200 SFT SOUTH ELEVATION
EAST ELEVATION

IIIB. RAKE-OUT AND REPOINT JOINTS
RE POINT HEAD & BED JOINTS
TAMP POINT IN SELECTED LOCATIONS AS INDICATED
GROUT INJECTION IN SELECTED AREAS AS INDICATED.

IIIC. RETAIN MORTAR WHERE IT IS IN GOOD and SOUND CONDITION

LOCATION PLAN



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	MTANZA
DATE:	05.02.99

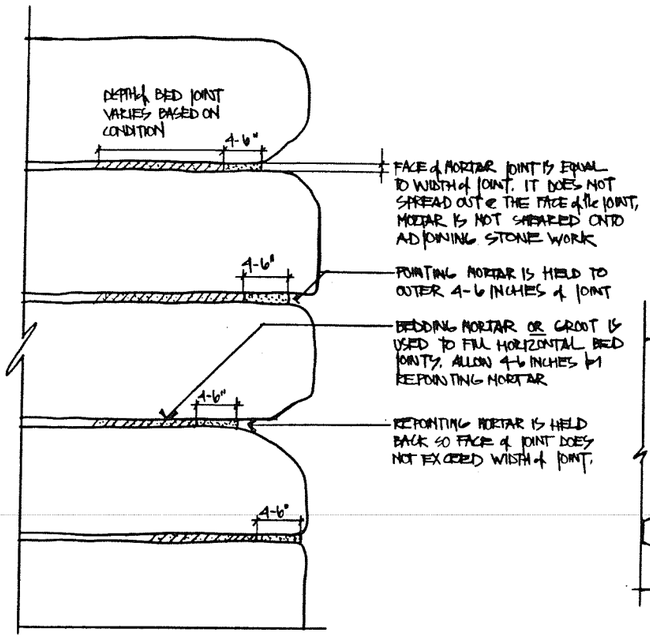
SUB SHEET NO. WSA 1

TITLE OF SHEET
WINCHESTER SPAN ABUTMENT
PARTIAL PLAN and EAST ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY-LABOR CONSTRUCTION SET

DRAWING NO. 385 80071

PKG. NO. 216

SHEET 4 OF 22



REPOINTING TECHNIQUES 4/5

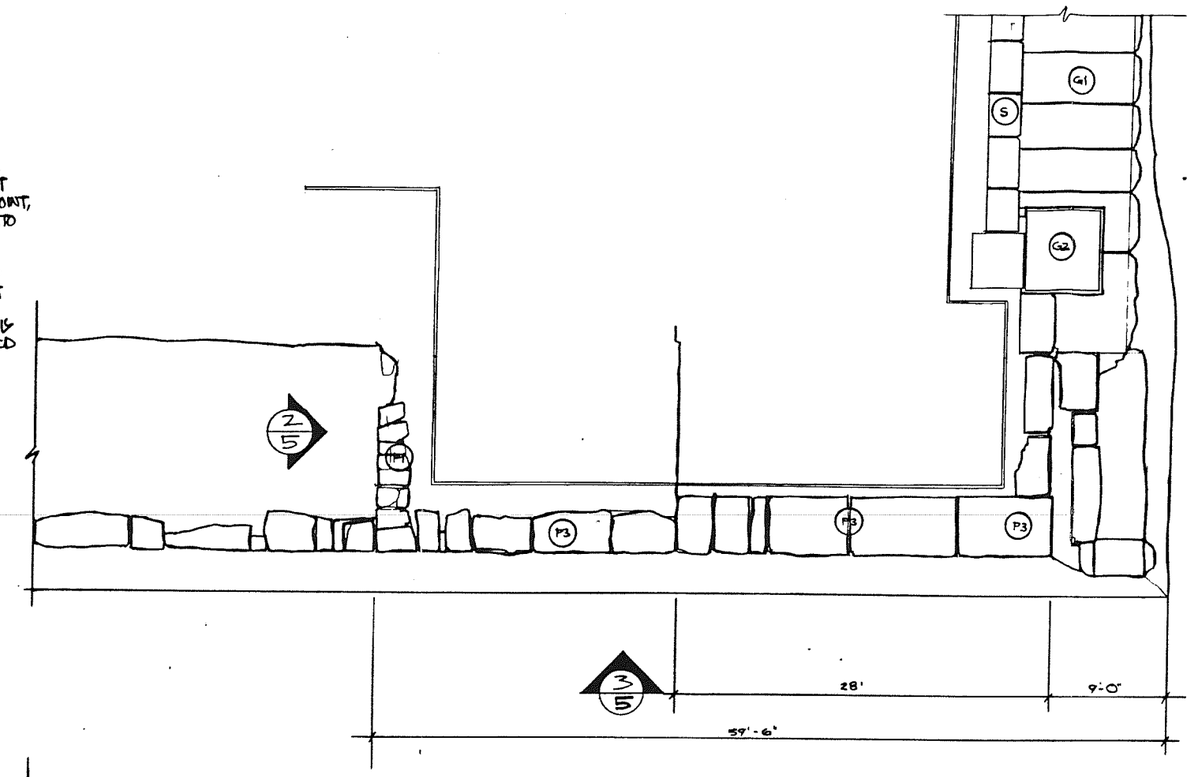
SCALE: 1/8 INCH = 1 INCH

TREATMENT RECOMMENDATIONS

WSA-01 : TAMP POINTING – UTILIZES the PLACEMENT of MORTAR in a SERIES of LIFTS WHERE MASONRY HAS HAD TOTAL LOSS of JOINT MORTAR. (4-12 INCHES in DEPTH) TAMP POINTING SHALL BE HELD BACK FROM FACE of MASONRY TO ALLOW MINIMUM of 4 INCHES of POINTING MORTAR.

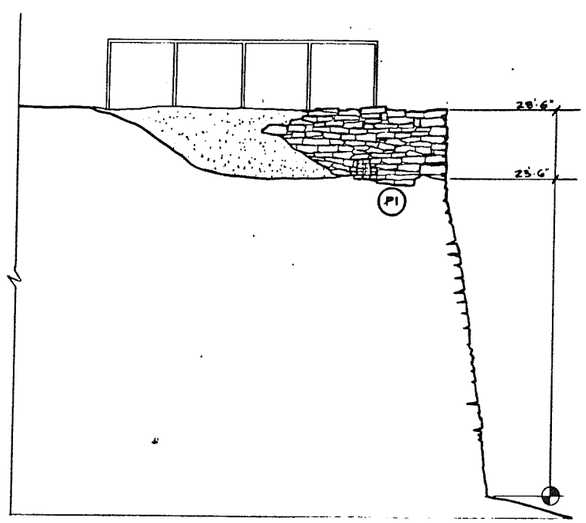
WSA-02 : REPOINTING – LEAVE SOUND MORTAR in PLACE; SPOT TAMP-POINTING SHALL BE USED in AREAS WHERE MORTAR HAS BEEN LOST.

SEE 4/5 FOR REPOINTING DETAILS



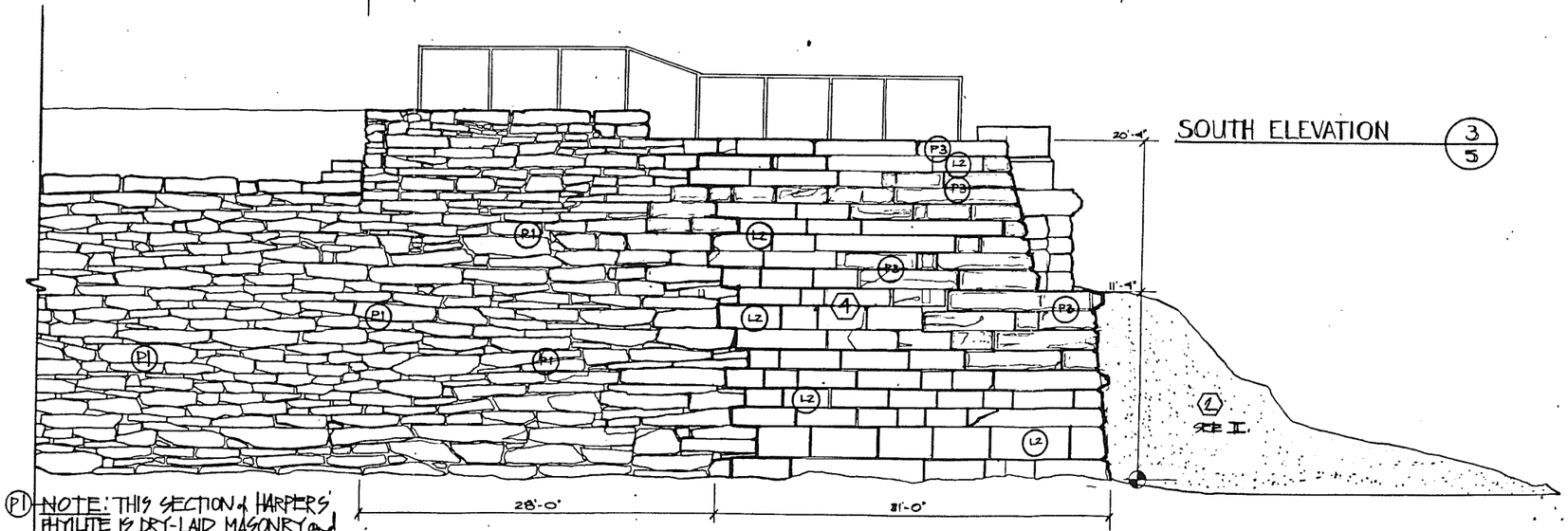
PARTIAL PLAN 1/5

SCALE: 3/16" = 1'-0"

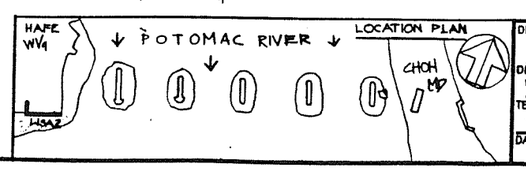


'WEST ELEVATION 2/5

P1 NOTE: THIS SECTION of HARPERS' PHYLLITE IS DRY-LAID MASONRY and DOES NOT REQUIRE MORTAR and/or REPOINTING



SOUTH ELEVATION 3/5



DESIGNED: WPTC
DRAWN: NEUSINGER
TECH. REVIEW: VMANEA
DATE: 05.02.94

SUB SHEET NO. WSA2

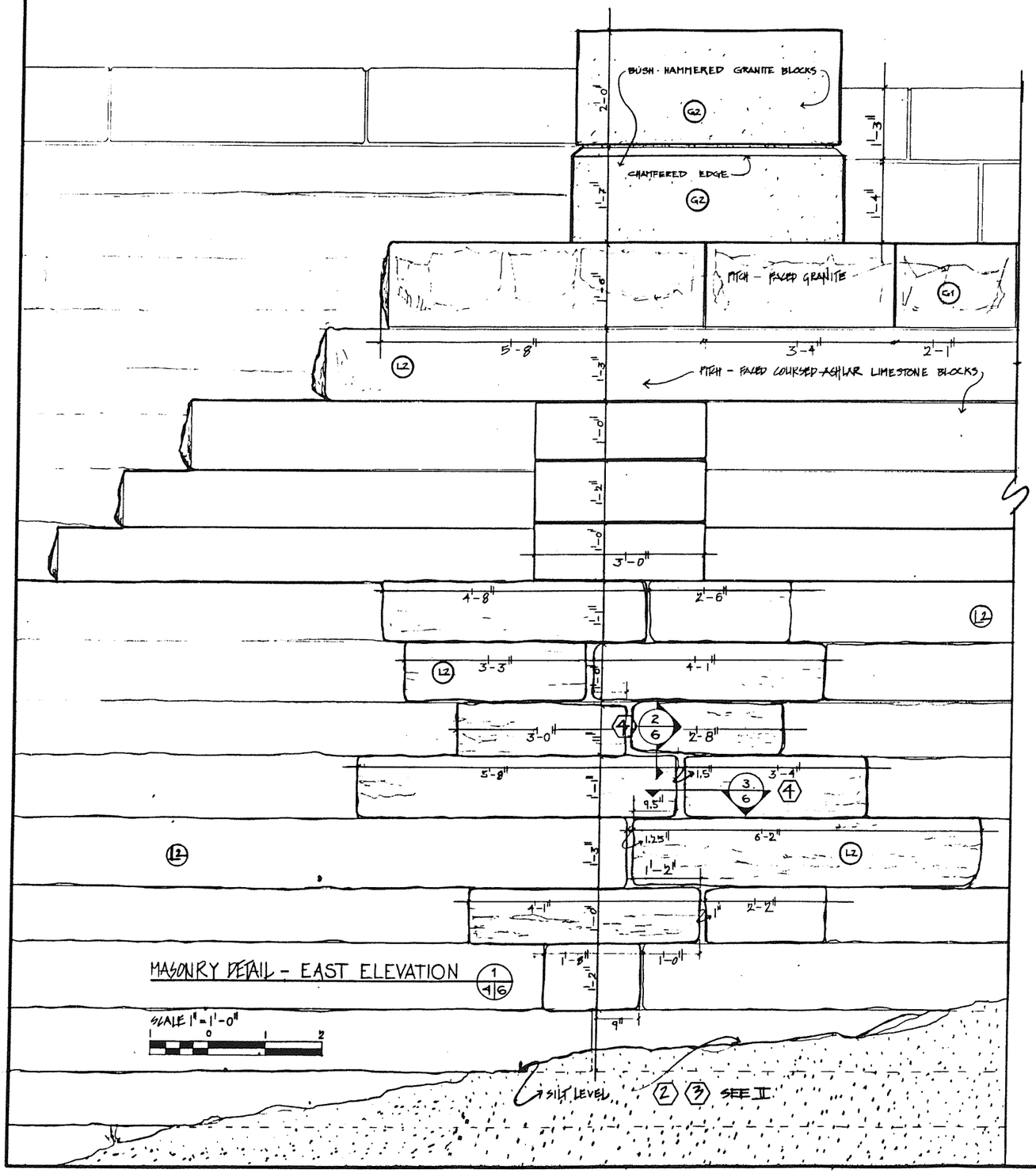
TITLE OF SHEET
WINCHESTER SPAN ABUTMENT PLAN & ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY-LABOR CONSTRUCTION SET

DRAWING NO. 385 / 80071

PKG. NO. 212

SHEET 5 OF 22

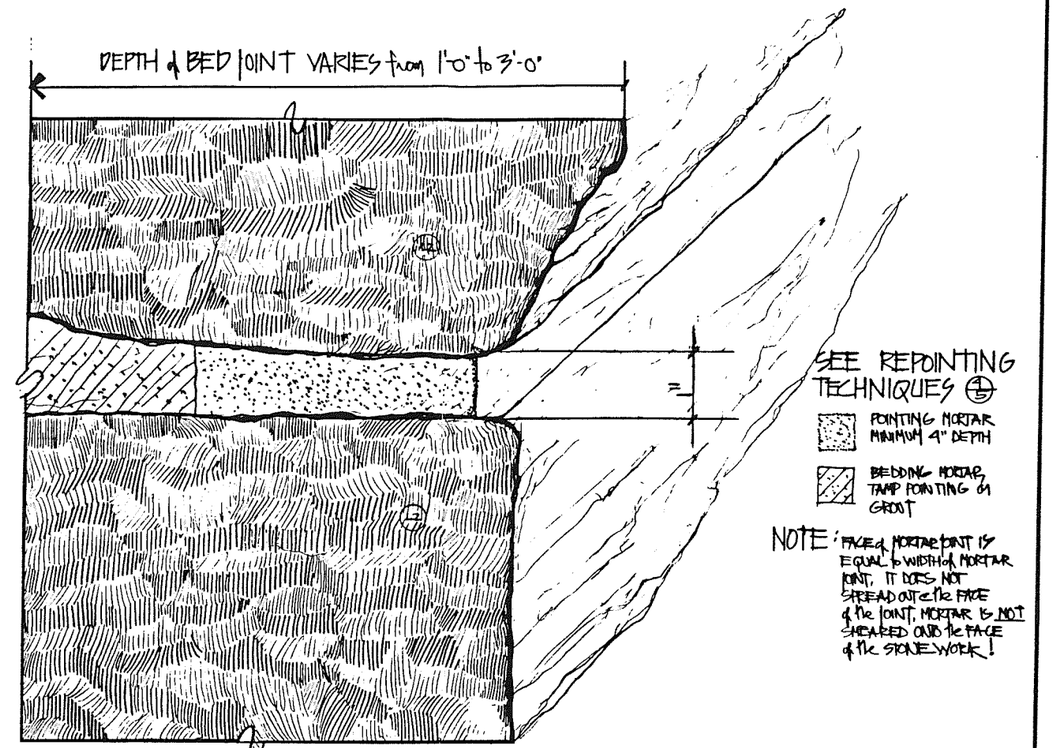
U.S. GOVERNMENT PRINTING OFFICE: 878-100



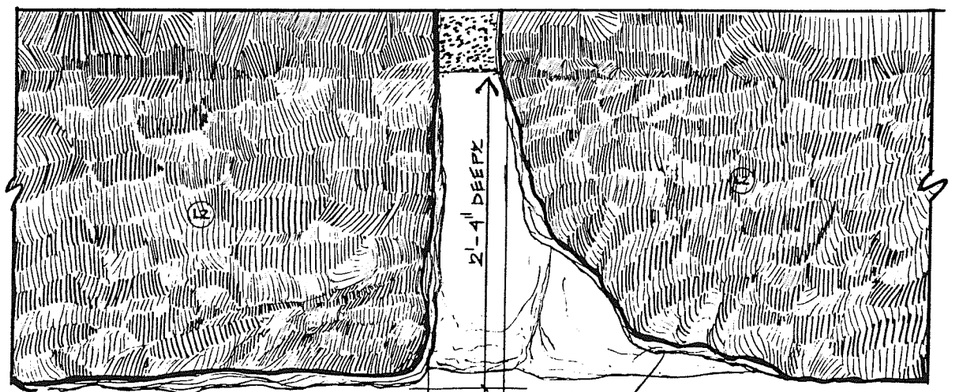
MASONRY DETAIL - EAST ELEVATION (1/6)

SCALE 1" = 1'-0"

1 0 1 2



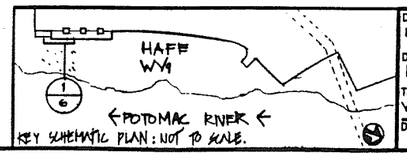
BED JOINT PROFILE EXAMPLE (2/6)



HEAD JOINT PROFILE (PLAN VIEW) (3/6)

FULL SCALE

3 0 3



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VYANZA
DATE:	05.02.94
SUB SHEET NO.	WSA3
TITLE OF SHEET	WINCHESTER SPAN ABUTMENT MASONRY DETAIL & JOINT PROFILE B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT DAY-LABOR CONSTRUCTION SET
DRAWING NO.	383 80071
PKG. NO.	212
SHEET	6 OF 22

EXISTING PIPE RAIL

TIMBER REMANT RETAINS BACKFILL of COPING STONES

GRANITE (G2) 4'-6" 2'-0"

GRANITE (G2) 4'-9" 1'-6"

PITCH - FACED GRANITE BLOCKS (G1)

HARPER'S PHYLLITE RUBBLE MASONRY (P1)

LIMESTONE (L2) 3'-0"

HARPERS PHYLLITE COURSED RUBBLE MASONRY (P2)

(2) (3) SEE II

1'-0" 1'-6" 1'-16" 1'-6" 1'-4" 1'-2" 1'-1" 1'-1" 1'-2"

MASONRY DETAIL - EAST ELEVATION (1/7)
SCALE 1" = 1'-0"
1 0 1 2

GRANITE (G1)

DEPTH of BED JOINTS VARIES UP TO 12" THIS LOCATION

LIMESTONE (L2)

GRANITE AND LIMESTONE MASONRY - BED JOINT PROFILE (2/7)
FULL SCALE
3 0 3

HAFE WV4. (1/7)
POTOMAC RIVER
KEY SCHEMATIC PLAN: NOT TO SCALE.

DESIGNED: WPTC	SUB SHEET NO. WSA4	TITLE OF SHEET: WINCHESTER SPAN ABUTMENT MASONRY DETAIL & JOINT PROFILE B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT DAY-LABOR CONSTRUCTION SET	DRAWING NO. 385 8007I
DRAWN: RODNEY			PKG. NO. 212
TECH REVIEW: VIVANZA			SHEET 7 OF 22
DATE: 05.02.94			

U.S. GOVERNMENT PRINTING OFFICE: 676-100

NOTE:
- FLOOD WATERS PERIODICALLY SUBMERGE THE STRUCTURE IMPACTING THE MASONRY THROUGH EROSION, AND FLOATING DEBRIS.
- PILASTER MORTAR IS NONEXISTENT

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
- L-1 COURSED RUBBLE BASE
- L-2 PITCH-FACED COURSED ASHLAR BLOCKS
- L-3 PLINTH STONES
- L-4 RUBBLE CORE LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
- P-1 RUBBLE
- P-2 COURSED RUBBLE
- P-3 COURSED ASHLAR
- P-4 RIP-RAP SLABS

GRANITE
- G1 COPING STONES (ASHLAR BLOCKS)
- G2 PLINTH STONES (BUSH HAMMERED)
- G3 PITCH-FACED COURSED ASHLAR BLOCKS

TREATMENT RECOMMENDATION NOTES for B&O SPAN ABUTMENT

BOSA-01 GROUT INJECTION

IMPLEMENT GROUT INJECTION W/ AN APPROVED MIX in DESIGNATED AREAS. RE-ESTABLISH STRUCTURAL INTEGRITY & ABUTMENT CORE THROUGH GROUT INJECTION, SEE NOTES on SHEET BOSA-2.

BOSA-02 REPOINTING - POST GROUT REPOINTING

SEE NOTES on SHEET BOSA-2;

BOSA-03 PREPARATION - SILT REMOVAL

REMOVE SILT BUILD-UP in TARGET AREAS, FOLLOWED by MASONRY INSPECTION and EVALUATION. VEGETATION REMOVAL AS PER SPECIFIC SITE RECOMMENDATIONS. PREPARATION for EITHER GROUTING OR REPOINTING WORK

6'-0" 30'-0"

2'-0"

12'-6"

B&O SPAN ABUTMENT PLAN (PARTIAL VIEW) 1 / 3|8

SCALE 1/4" = 1'-0"

34'-0" TOP OF RAIL

30'-8" TOP COPING STONES

26'-0" TOP OF COPING OF PILASTER

4'-6" BASE OF PILASTER

TRANSITION TO HARPERS PHYLLITE ABUTMENT REMAINING WALL

SEE NOTE III

SEE NOTES I and II

NOTE: DEPOSITION FROM POTOMAC RIVER REMAINS INTACT THROUGH ROOT ACTION OF NEARBY TREES.

NOTE: SEE SUB SHEET "BOSA-1" FOR FURTHER DETAILS

30'-0"

B&O SPAN ABUTMENT EAST ELEVATION 2 / 3|8

SCALE 1/4" = 1'-0"

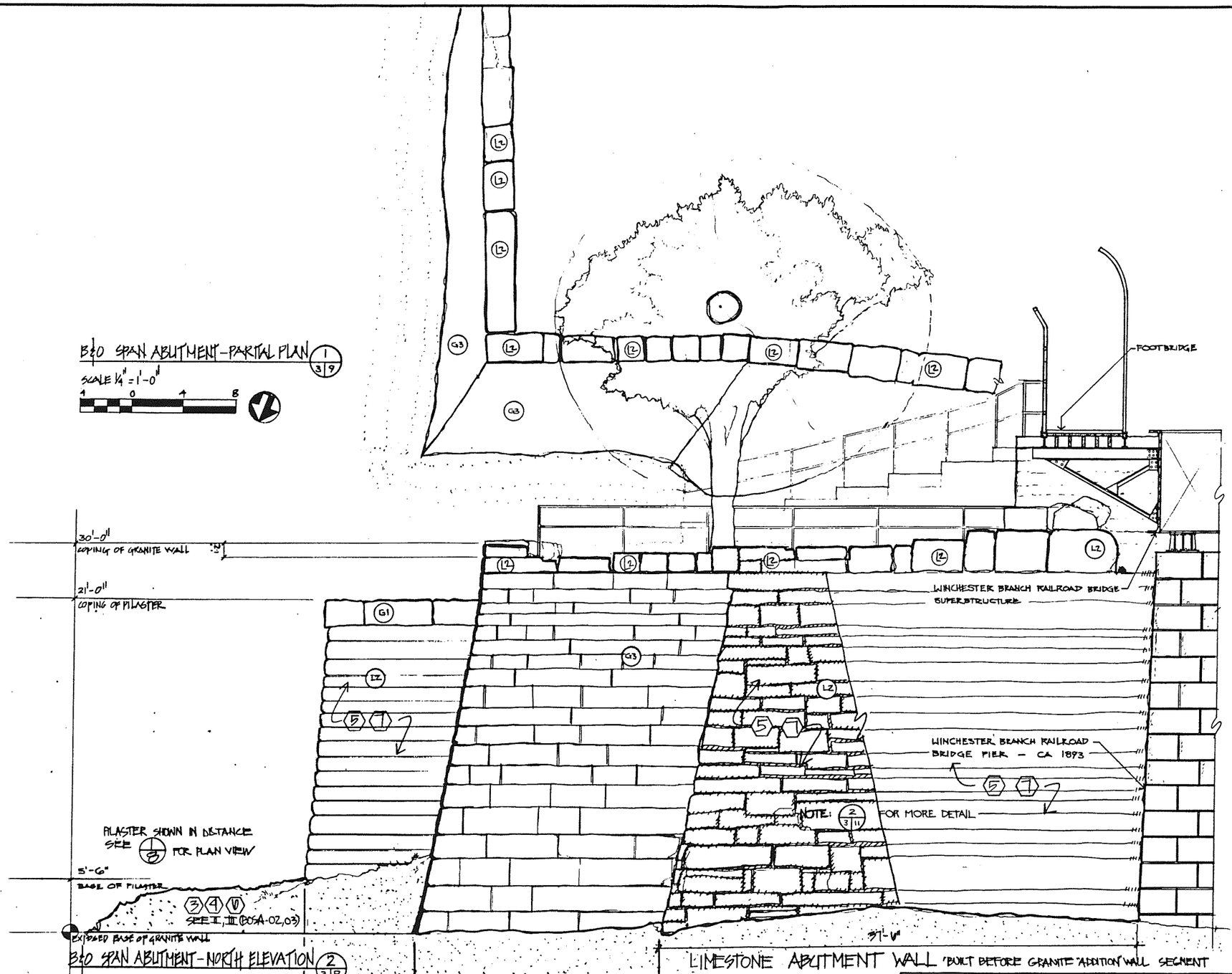
B&O LIMESTONE PILASTER WALL | PILASTER | GRANITE ADDITION | LIMESTONE WALL | WINCHESTER SPAN

B&O SPAN ABUTMENT | C. 1897

LOCATION PLAN

HARPERS FERRY WVA — BOSA1 — POTOMAC RIVER — CHOH MD

DESIGNED: WPTC	SUB SHEET NO. BOSA-1	TITLE OF SHEET: B&O SPAN ABUTMENT PARTIAL PLAN & EAST ELEVATION B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT DAY-LABOR CONSTRUCTION SET	DRAWING NO. 385 80071
DRAWN: RODNEY			PKG. NO. 21E
TECH. REVIEW: VTANZA			SHEET 8 OF 22
DATE: 05.02.94			



B&O SPAN ABUTMENT - PARTIAL PLAN 1/3/9

SCALE 1/4" = 1'-0"

B&O SPAN ABUTMENT - NORTH ELEVATION 2/3/9

SCALE 1/4" = 1'-0"

DELINEATION and KEY NOTES: 'BOSA'

TOMSTOWN FORMATION LIMESTONE

- L1 COURSED RUBBLE LIMESTONE BASE
- L2 PITCH-FACED COURSED ASHLAR BLOCKS
- L3 PLINTH STONES - CUT and FINISHED
- L4 RUBBLE CORE LIMESTONE & HARPERS FORMATION PHYLLITE

HARPERS' FORMATION PHYLLITE

- P1 RUBBLE
- P2 COURSED RUBBLE
- P3 COURSED ASHLAR BLOCKS
- P4 RIP-RAP SLABS

GRANITE

- G1 COPING STONES: ASHLAR BLOCKS
- G2 PLINTH STONES: BUSH HAMMERED
- G3 PITCH-FACED COURSED ASHLAR BLOCKS

CONDITION ASSESSMENT NOTES: 'BOSA'

- 1 DISPLACED STONE
- 2 DAMAGED STONE
- 3 TRANSVERSE CRACK IN MASONRY
- 4 LATERAL CRACK IN MASONRY
- 5 CONCENTRATION of OPEN MORTAR JOINTS
- 6 SILTATION BUILD-UP THIS AREA (OBSCURES MASONRY)
- 7 POTENTIAL VOIDS in CORE MATERIAL DUE to WASHED OUT MORTAR JOINTS

TREATMENT RECOMMENDATION NOTES

I. REMOVE VEGETATION AS INDICATED:

IA. REMOVE EXISTING TREE, REMOVE STUMP and ROOTS by HAND METHODS, REPAIR DAMAGED MASONRY, FILL STUMP and ROOT VOID WITH RUBBLE

II. REMOVE EXTENSIVE SILT BUILD-UP AT BASE of NORTH and EAST ELEVATIONS TO EXPOSE BASE COURSES of CONCEALED MASONRY WALLS

III. REPAIR MASONRY:

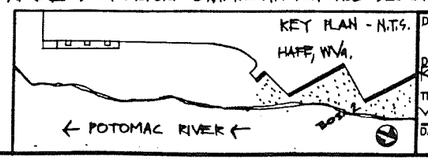
BOSA-01: GROUT INJECTION - MASONRY JOINTS HAVE BEEN WASHED OUT, 90% of COURSEWORK REQUIRES REPOINTING - GROUTING WILL RE-ESTABLISH STRUCTURAL INTEGRITY of MASONRY BY REPLACING DEEPLY RECESSED WASHED OUT MORTAR and PROVIDING NEW BEDDING and SUPPORT for MASONRY

BOSA-02: POST GROUT REPOINTING - ALL MORTAR JOINTS REQUIRE REPOINTING after GROUT INJECTION IS COMPLETED. POINTING MORTAR WILL PROVIDE FINAL MORTAR JOINT PROFILE

BOSA-03: PREPARATION - REMOVAL of VEGETATION, REMOVAL of SILT BUILD-UP, CLEANING of MORTAR JOINTS

SUMMARY of WORK:

PILASTER: EAST ELEVATION		
PILASTER	RAKING and POINTING	1200 SQFT
	BACKING and GROUT INJECTION	430 CUFT
PILASTER WALL		
	RAKING and POINTING	150 SQFT
	BACKING and GROUT INJECTION	171 CUFT
GRANITE WALL ADDITION		
	RAKING and POINTING	1900 SQFT
	BACKING and GROUT INJECTION	880 CUFT
LIMESTONE ABUTMENT WALL		
	RAKING and POINTING	150 SQFT
	BACKING and GROUT INJECTION	1408 CUFT



DESIGNED: WPTC
DRAWN: RODNEY
TECH. REVIEW: VITANZA
DATE: 05.02.94

SUB SHEET NO. BOSA2

TITLE OF SHEET
B&O SPAN ABUTMENT
PARTIAL PLAN and NORTH ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
PAY-LABOR CONSTRUCTION SET

DRAWING NO. 385 8007T

PKG. NO. 12E

SHEET 9 OF 22

COURSED ASHLAR PITCHED FACED TUSCARORA FORMATION LIMESTONE.

JOINTS RANGE BETWEEN 1" AND 1 3/4" WIDE.

MAPLE TREE ROOT, REMOVE USING HAND METHODS, TYP.

TOTAL HEIGHT OF PILASTER IS 21'-0"

ANGLE OF PILASTER IS 80°

LEVEL OF SILTATION

SEE BOSA TREATMENT RECOMMENDATIONS

8'-6"+- (BASE OF LIMESTONE PILASTER)

GRANITE ADDITION

CONSTRUCTION DETAIL – MASONRY OF B&O SPAN PILASTER • EAST ELEVATION (1/8|10)

SCALE 1"=1'-0"

1 0 1 2

SCALE OF FEET

CHINKING STONES

13"

20"

18"

CHINKING STONE (14)

RUBBLE FILL (14)

TOP OF STONE

BED OF HORIZONTAL JOINT

CENTERLINE WIDTH OF JOINT

BED OF HORIZONTAL JOINT WITH THE JOINT WIDTH

TOP OF STONE

2"+/- APPROXIMATE DEPTH OF BED JOINT

FACE OF PILASTER

PILASTER MASONRY JOINT & CORE VIEW (2/10)

SCALE 3"=1'-0"

6 3 0 6

SCALE OF INCHES

HAFE, WV4.

POTOMAC RIVER

(2/10)

KEY SCHEMATIC PLAN: NOT TO SCALE,

DESIGNED: WPTC

DRAWN: RODNEY

TECH. REVIEW: VIANZA

DATE: 050394

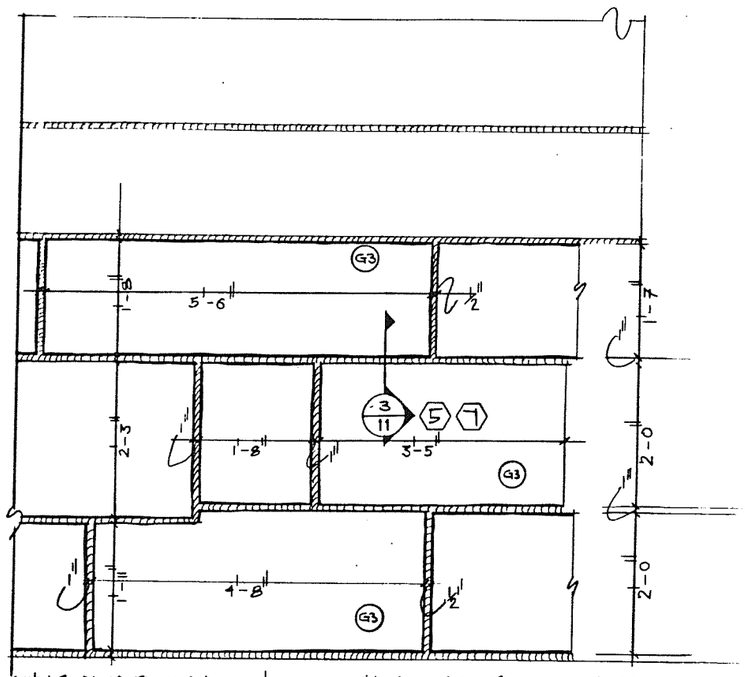
SUB SHEET NO. BOSA-3

TITLE OF SHEET: B&O SPAN ABUTMENT EAST PILASTER ELEVATION & DETAILS B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT DAY LABOR CONSTRUCTION SET

DRAWING NO. 385 80071

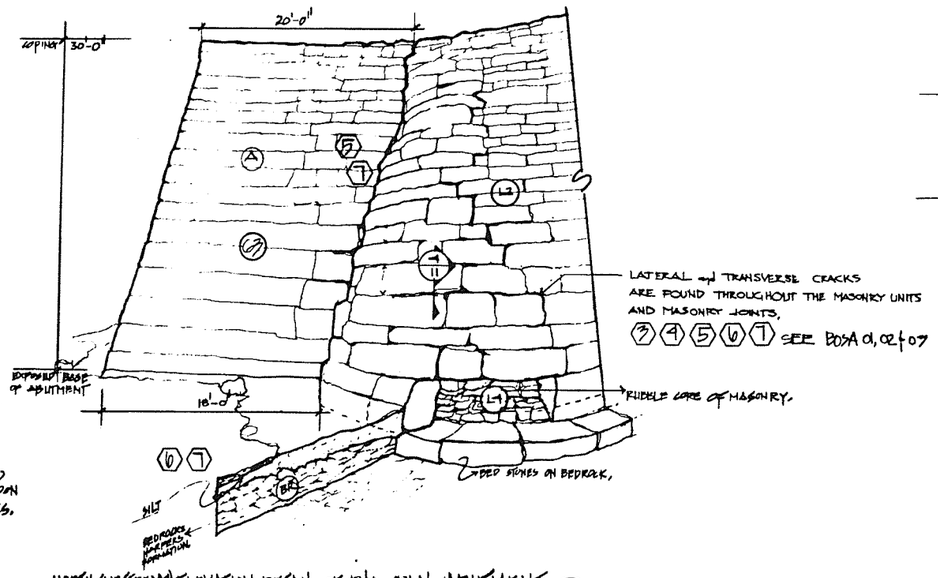
PKG. NO. 212

SHEET 10 OF 22



ASHLAR MASONRY DETAIL OF B&O SPAN ABUTMENT (EAST ELEVATION) 1/8/11

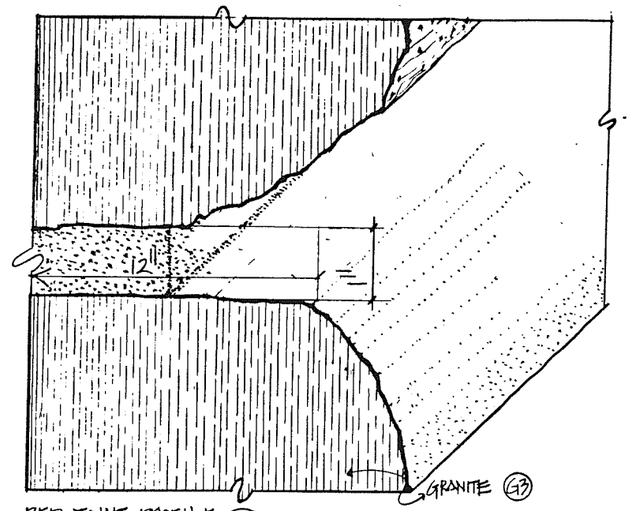
SCALE: 1"=1'-0"



NORTH (UPSTREAM) ELEVATION DETAIL OF B&O SPAN ABUTMENT 2/3/11

EXISTING CONDITIONS:

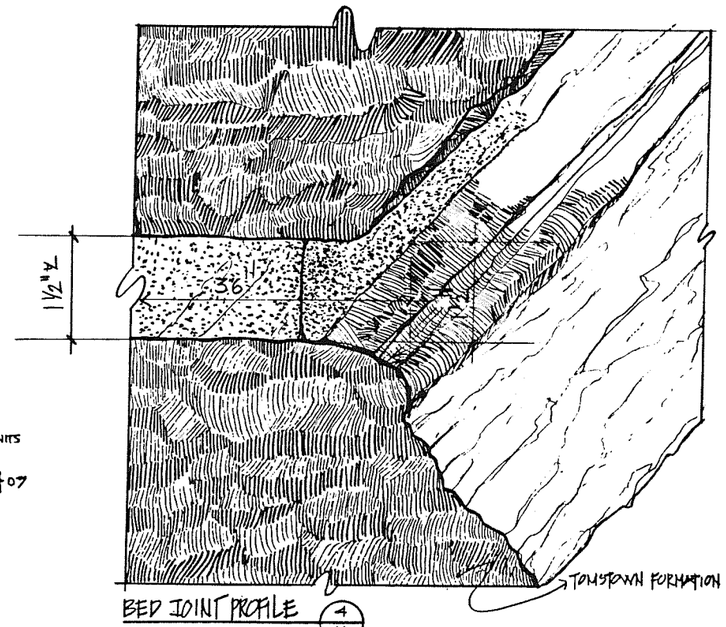
- GRANITE MASONRY WAS ADDED C. 1851 WITH THE PLACEMENT OF LIVE SPAN AND B&O SPAN ABUTMENT ADDITION.
- LIMESTONE ON THE ABUTMENT IS PITCHED FACED RANDOM ASHLAR.
- MORTAR OF THE HEAD AND BED JOINTS HAS WASHED OUT COMPLETELY LEAVING STONES RESTING UPON CHINKING STONES AND RUBBLE CORE STONES.
- SUBSEQUENT TRANSVERSE AND LATERAL CRACKING OF MASONRY.
- MORTAR HAS COMPLETELY DETERIORATED AND WASHED OUT THROUGH WEEPS DUE ACTION OF FLOOD WATERS AND SUBSEQUENT FREEZE THAW CYCLES.



BED JOINT PROFILE 3/11

FULL SCALE

3" 0 3"



BED JOINT PROFILE 4/11

FULL SCALE

SEE REPOINTING TECHNIQUES 4/5

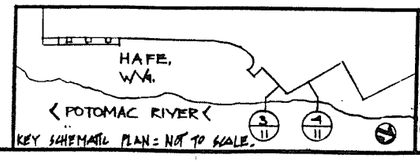
POINTING MORTAR MINIMUM 4 INCH DEPTH

BEDDING MORTAR, TAMP POINTING and BACKING for GROUT

NOTE: FACE of MORTAR JOINT IS EQUAL to WIDTH of MORTAR JOINT. IT DOES NOT SPREAD OUT @ THE FACE of the JOINT. MORTAR IS NOT SMEARED ONTO the FACE of the ADJOINING STONE WORK!

TREATMENT RECOMMENDATION

LIMESTONE PILASTER: REMOVAL of VEGETATION, POWER CLEANING and HAND RAKING OUT of MORTAR JOINTS, REPOINTING of BEDDING and POINTING MORTARS, GROUT INJECTION of 100 PERCENT of STRUCTURE.



KEY SCHEMATIC PLAN: NOT TO SCALE.

DESIGNED: WPTC
DRAWN: RODNEY
TECH. REVIEW: VIGNZA
DATE: 05.03.99

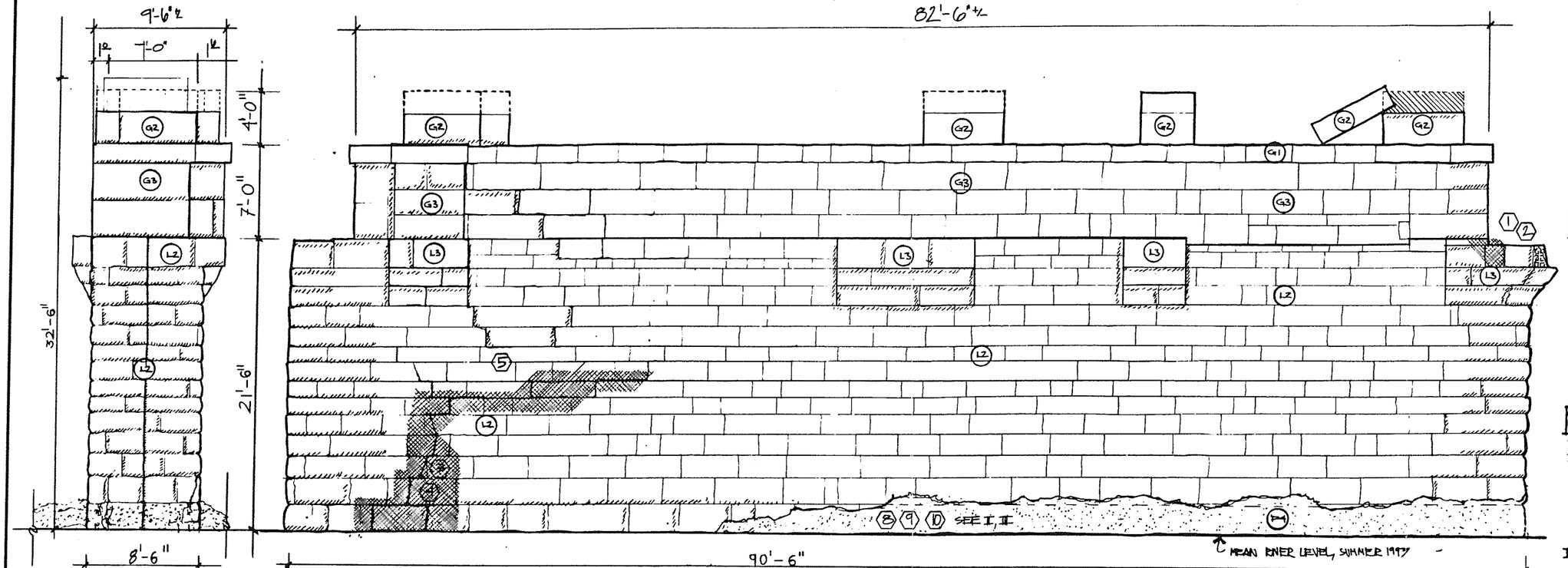
SUB SHEET NO. BOSA4

TITLE OF SHEET
B&O SPAN ABUTMENT
MASONRY DETAIL & JOINT PROFILES
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
PAY-LABOR CONSTRUCTION SET

DRAWING NO. 365 8007T

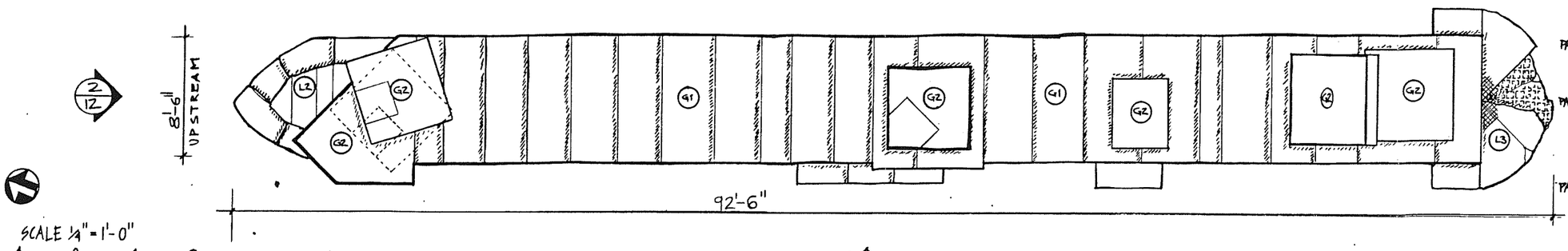
PKG. NO. 2/2

SHEET 11 OF 22



NORTH ELEVATION (UPSTREAM) 2/12

WEST ELEVATION 3/12



SCALE 1/4" = 1'-0"

PIER-A PLAN VIEW (TOP of PIER) 1/12 3/12

DIRECTION of RIVER FLOW →

DELINEATION and KEY NOTES: PA

TOMSTOWN FORMATION LIMESTONE

- (L1) COURSED RUBBLE BASE
- (L2) PITCH-FACED COURSED ASHLAR BLOCKS
- (L3) PLINTH STONES
- (L4) RUBBLE CORE MIXED W/ HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE

- (H1) RUBBLE
- (H2) COURSED RUBBLE
- (H3) COURSED ASHLAR
- (H4) RIP-RAP SLABS

GRANITE

- (G1) COPING STONES (ASHLAR BLOCKS)
- (G2) PLINTH STONES (BUSH HAMMERED FINISH)
- (G3) PITCH-FACED COURSED ASHLAR BLOCKS

OTHER

- (BR) BEDROCK - HARPERS FORMATION PHYLLITE

CONDITION ASSESSMENT: PA

- (1) DISPLACED STONE
- (2) DAMAGED STONE
- (3) TRANSVERSE CRACK in MASONRY
- (4) LATERAL CRACK in MASONRY
- (5) CONCENTRATION of OPEN MORTAR JOINTS
- (6) POTENTIAL VOIDS in RUBBLE CORE
- (7) EXPOSED RUBBLE CORE
- (8) SILTATION BUILD-UP (OBSCURES MASONRY)
- (9) DISPLACED RIP-RAP
- (10) SEVERE FLOOD IMPACT ZONE

TREATMENT RECOMMENDATIONS

I. REMOVE VEGETATION AS INDICATED:

IA. REMOVE VEGETATION WHOSE ROOT SYSTEMS DIRECTLY IMPACT THE MASONRY STRUCTURE (PIER and ISLAND BASE) ROOT SYSTEMS ARE TO BE REMOVED USING HAND METHODS - DO NOT PULL AT ROOT SYSTEMS AS THIS WILL DISLODGE UNSTABLE MASONRY, REPAIR DAMAGED MASONRY, FILL ROOT and STUMP VOIDS w/ RUBBLE

II. REMOVE SILTATION BUILD-UP AT BASE of MASONRY STRUCTURE TO EXPOSE BASE COURSES of MASONRY STRUCTURE.

III. REPAIR MASONRY AS INDICATED:

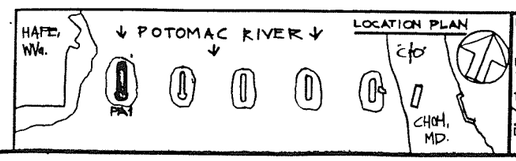
PA1: RESET RIP-RAP AT BASE of PIER WHERE HISTORIC RIP-RAP HAS BEEN DISPLACED. REPLACEMENT RIP-RAP SLABS WILL MATCH HISTORIC RIP-RAP in TYPE of STONE, LEVEL of CRAFTSMANSHIP and METHODOLOGY of PLACEMENT.

PA2: GROUT INJECTION - REINTEGRATION of EXISTING MASONRY THROUGH PLACEMENT of NEW MORTAR in BED JOINTS and HEAD JOINTS. CONSOLIDATION of RUBBLE CORE and FILLING of VOIDS.

PA3: POST GROUT REPOINTING - ALL MORTAR JOINTS REQUIRE REPOINTING after GROUT INJECTION IS COMPLETED. POINTING MORTAR WILL PROVIDE FINAL JOINT PROFILE in PIER MASONRY. REMOVE and REPLACE ONLY DETERIORATED MORTAR AS INDICATED by PROJECT ARCHITECT

PA4: REPLACE DAMAGED STONES AS INDICATED OR AS DETERMINED in the FIELD by PC PROJECT ARCHITECT

CONTINUED SHT. PA2



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	YTENZA
DATE:	OCT. 07, 99

SUB SHEET NO. PA-1

TITLE OF SHEET
PIER-A
PLAN, NORTH & WEST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
PAY-LABOR CONSTRUCTION SET

DRAWING NO. 385 80071

PKG. NO. 212

SHEET 12 OF 22

TREATMENT RECOMMENDATIONS

PA-01 RESET DISPLACED MASONRY

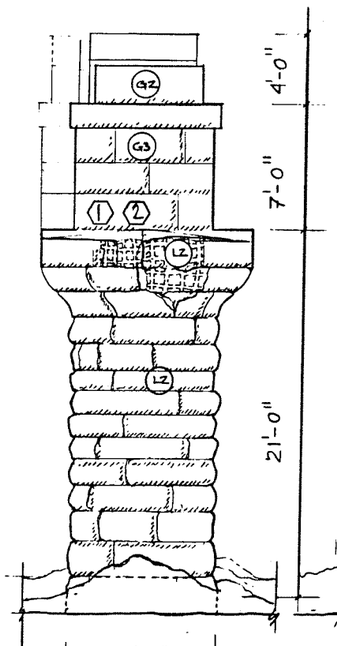
PA-02 GROUT INJECTION

PA-03 POST GROUT REPOINTING

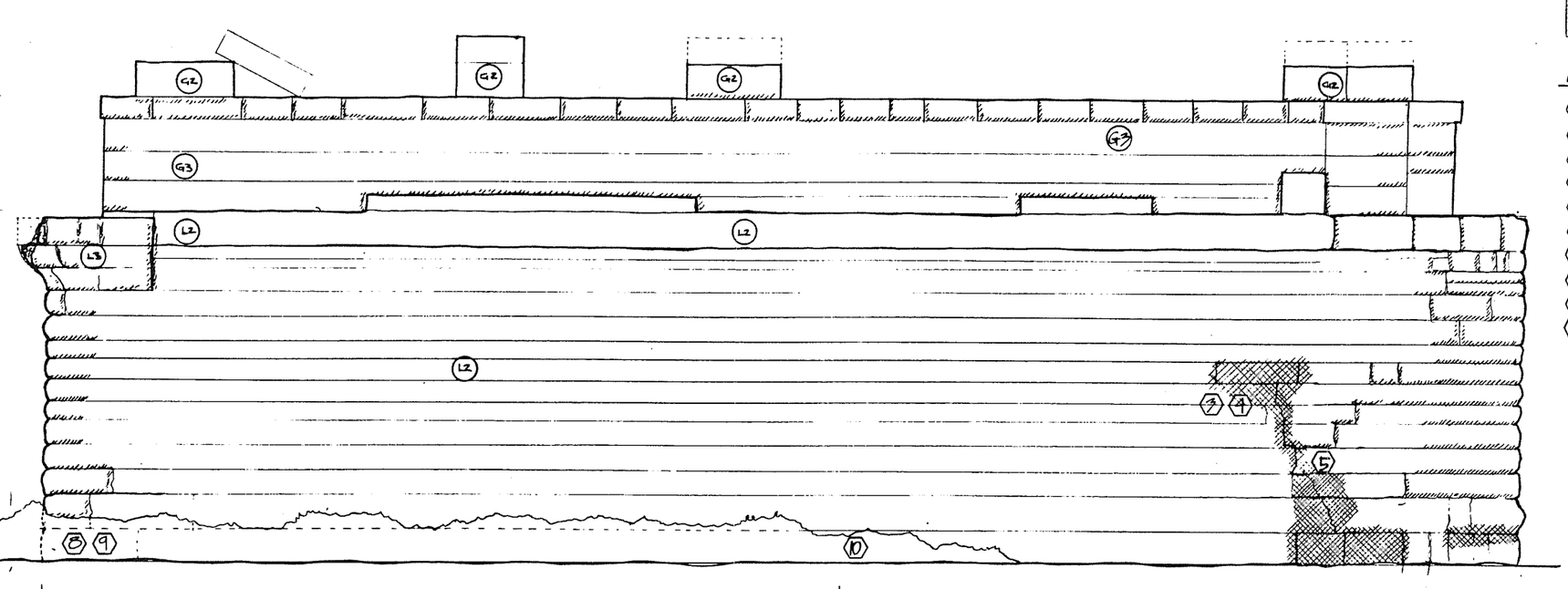
PA-04 REPLACEMENT or TREATMENT of DAMAGED STONES.

CONDITION ASSESSMENT

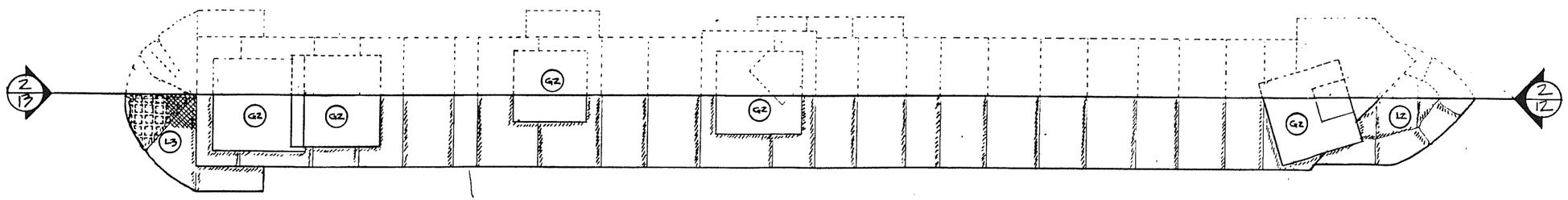
1. DISPLACED STONE
2. DAMAGED STONE
3. TRANSVERSE CRACK in MASONRY
4. LATERAL CRACK in MASONRY
5. CONCENTRATION of OPEN MORTAR JOINTS
6. POTENTIAL VOIDS in RUBBLE CORE
7. EXPOSED RUBBLE CORE
8. SILTATION BUILD-UP
9. DISPLACED RIP-RAP
10. SEVERE FLOOD IMPACT ZONE



SOUTH ELEVATION (2/13)



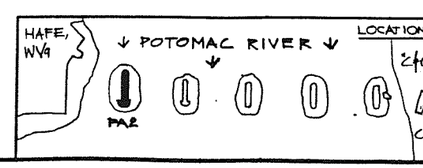
EAST ELEVATION (3/13)



PIER - A PLAN VIEW (PARTIAL) (1/13) (3/13)

SCALE 1/4" = 1'-0"

4 0 4 8



DESIGNED: WPTC
DRAWN: RODNEY
TECH. REVIEW: VITANZA
DATE: 05/94

SUB SHEET NO. PA-2

TITLE OF SHEET
PIER-A
PLAN w/ SOUTH & EAST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAT-LABOR CONSTRUCTION SET

DRAWING NO. 385 80071

PKG. NO. 212

SHEET 13 OF 27

U.S. GOVERNMENT PRINTING OFFICE: 878-100

NORTH ELEVATION (1/14)

SCALE 1/4"=1'-0"

4 0 4 8

DELINEATION & KEY NOTES

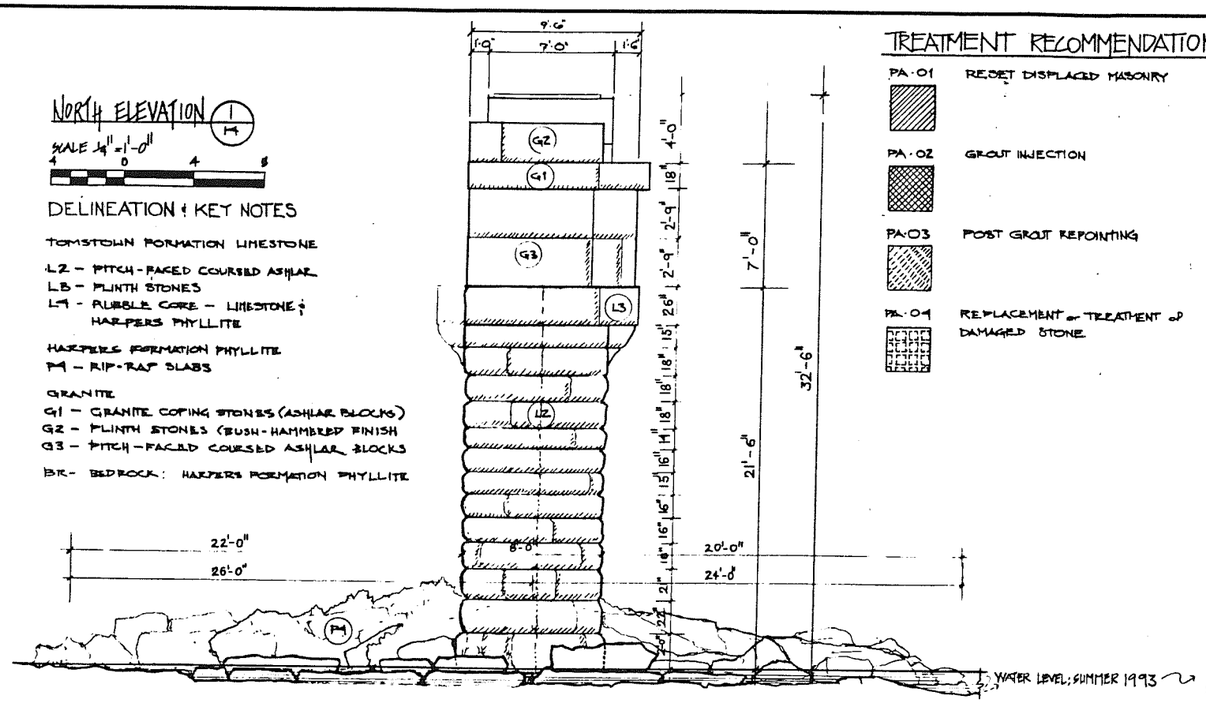
TOMSTOWN FORMATION LIMESTONE

L2 – PITCH-FACED COURSED ASHLAR
L3 – PLINTH STONES
L4 – RUBBLE CORE – LIMESTONE & HARPERS PHYLLITE

HARPERS FORMATION PHYLLITE
P4 – RIP-RAP SLABS

GRANITE
G1 – GRANITE COPING STONES (ASHLAR BLOCKS)
G2 – PLINTH STONES (BUSH-HAMMERED FINISH)
G3 – PITCH-FACED COURSED ASHLAR BLOCKS

BR – BEDROCK: HARPERS FORMATION PHYLLITE



TREATMENT RECOMMENDATIONS

PA-01 RESET DISPLACED MASONRY

PA-02 GROUT INJECTION

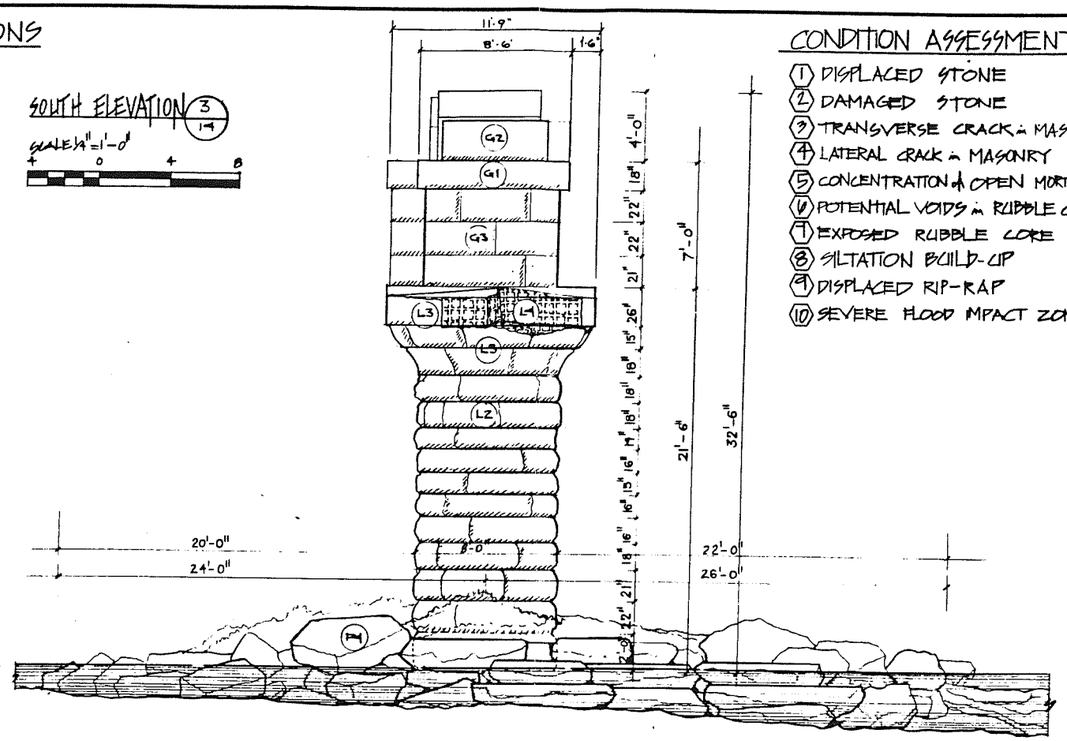
PA-03 POST GROUT REPOINTING

PA-04 REPLACEMENT or TREATMENT of DAMAGED STONE

SOUTH ELEVATION (3/14)

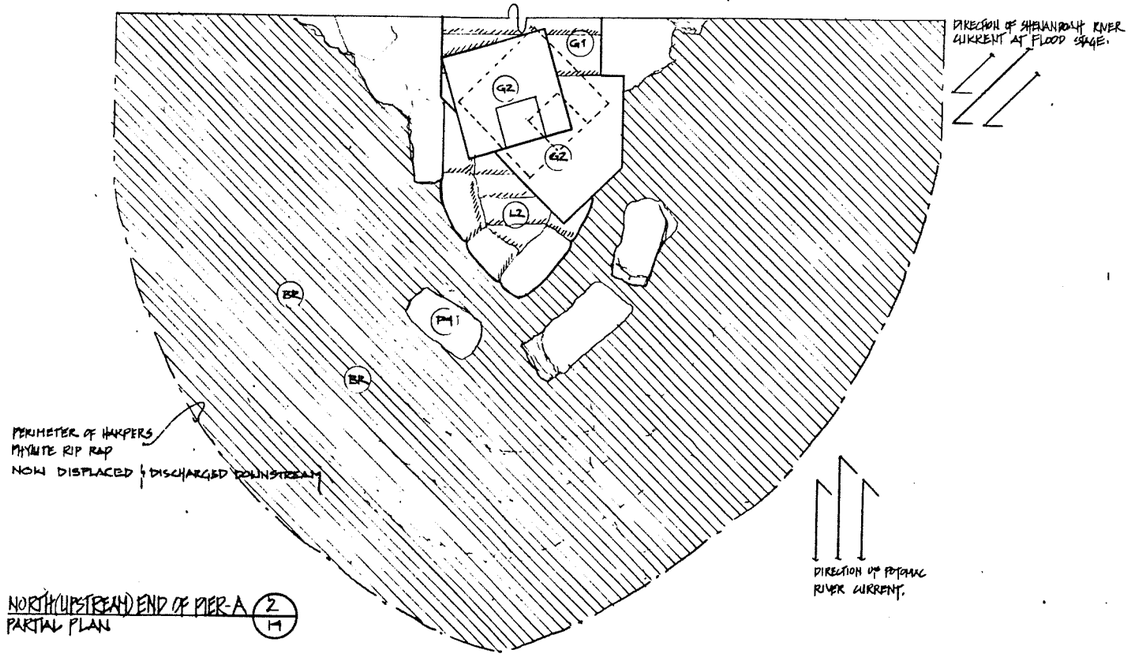
SCALE 1/4"=1'-0"

4 0 4 8

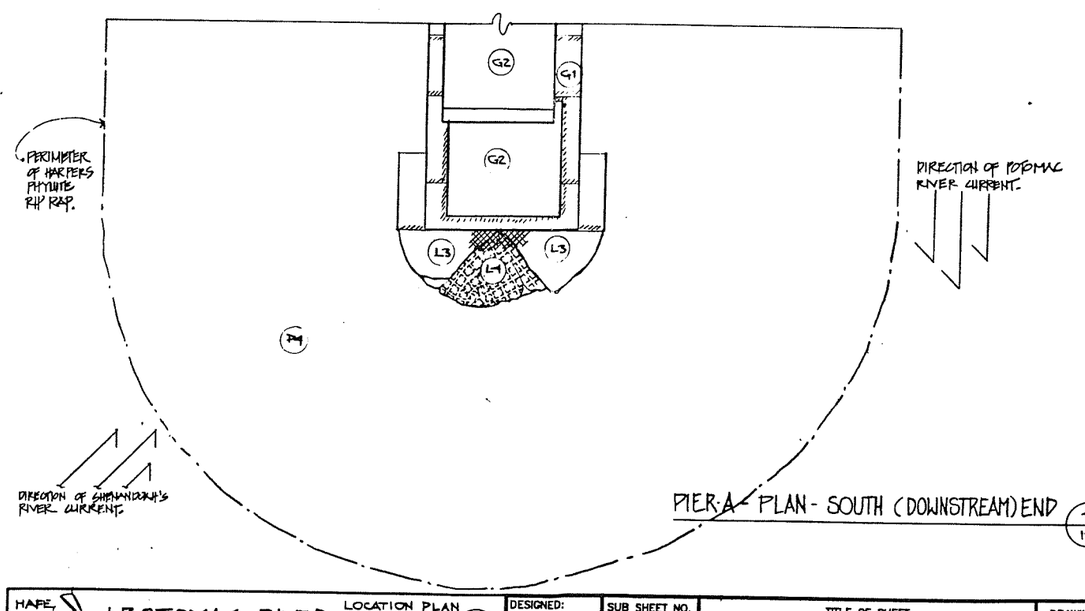


CONDITION ASSESSMENT

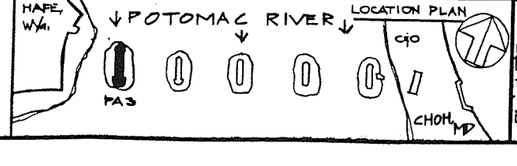
1. DISPLACED STONE
2. DAMAGED STONE
3. TRANSVERSE CRACK in MASONRY
4. LATERAL CRACK in MASONRY
5. CONCENTRATION of OPEN MORTAR JOINTS
6. POTENTIAL VOIDS in RUBBLE CORE
7. EXPOSED RUBBLE CORE
8. SILTATION BUILD-UP
9. DISPLACED RIP-RAP
10. SEVERE FLOOD IMPACT ZONE



NORTH (UPSTREAM) END OF PIER-A (2/14)
PARTIAL PLAN



PIER-A PLAN - SOUTH (DOWNSTREAM) END (4/14)



DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	YITANZA
DATE:	06.02.04

SUB SHEET NO. PA3

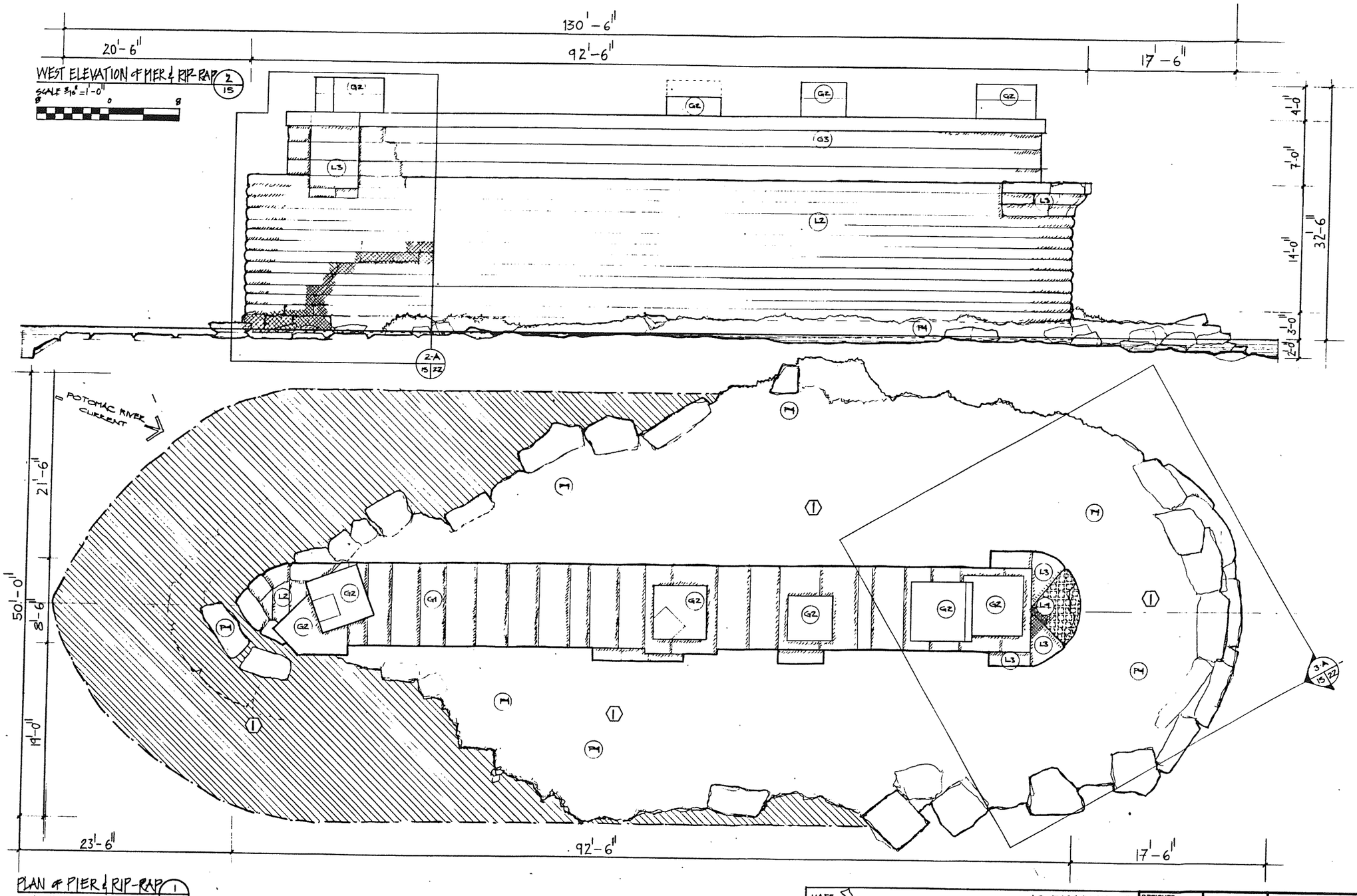
TITLE OF SHEET
PIER-A RIP RAP
NORTH & SOUTH ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY LABOR CONSTRUCTION SET

DRAWING NO. 385 E0071

PKG. NO. 213

SHEET 14 OF 22

U.S. GOVERNMENT PRINTING OFFICE: 679-100



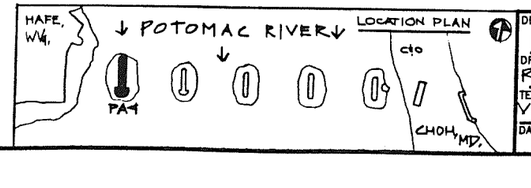
PLAN of PIER & RIP-RAP 1/15
SCALE 3/16

TREATMENT RECOMMENDATIONS

- PA-01 RESETTING of DISPLACED MASONRY
- PA-02 GROUT INJECTION
- PA-03 POST GROUT POINTING
- PA-04 REPLACEMENT or TREATMENT of DAMAGED STONE

CONDITION ASSESSMENT

1. DISPLACED STONE
2. DAMAGED STONE
3. TRANSVERSE CRACK in MASONRY
4. LATERAL CRACK in MASONRY
5. CONCENTRATION of OPEN JOINTS
6. POTENTIAL VOIDS in RUBBLE CORE
7. EXPOSED RUBBLE CORE
8. SILTATION BUILD-UP
9. DISPLACED RIP-RAP
10. SEVERE FLOOD IMPACT ZONE



DESIGNED: WPTC
DRAWN: RODNEY
TECH. REVIEW: VIVANZO
DATE: 05.04.94

SUB SHEET NO. PA4

TITLE OF SHEET
PIER A RIP RAP
PLAN & WEST ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY-LABOR CONSTRUCTION SET

DRAWING NO. 525 80071
PKG. NO. 212
SHEET 15 OF 22

U.S. GOVERNMENT PRINTING OFFICE: 675-100

EAST ELEVATION of PIER & RIP-RAP (2/16)

SCALE 3/16" = 1'-0"

8 0 8

134'-6"

17'-6" | 92'-6" | 20'-6"

32'-6" | 4'-8" | 7'-0" | 14'-0"

WATER LINE

PARTIAL PLAN of PIER & RIP-RAP (1/16)

SCALE 3/16" = 1'-0"

8 0 8

21'-6" | 8'-6"

PA-01 RESETTING DISPLACED MASONRY

PA02 GROUT INJECTION

PA03 POST GROUT POINTING

PA04 REPLACEMENT or TREATMENT of DAMAGED STONES

CONDITION ASSESSMENT PA

1. DISPLACED STONE
2. DAMAGED STONE
3. TRANSVERSE CRACK IN MASONRY
4. LATERAL CRACK IN MASONRY
5. CONCENTRATION of OPEN MORTAR JOINTS
6. POTENTIAL VOIDS IN RUBBLE CORE
7. EXPOSED RUBBLE CORE
8. SILTATION BUILD-UP (OBSCURES MASONRY)
9. DISPLACED RIP-RAP
10. SEVERE FLOOD IMPACT ZONE

HAFE — PA5 — POTOMAC RIVER — LOCATION PLAN — C&O

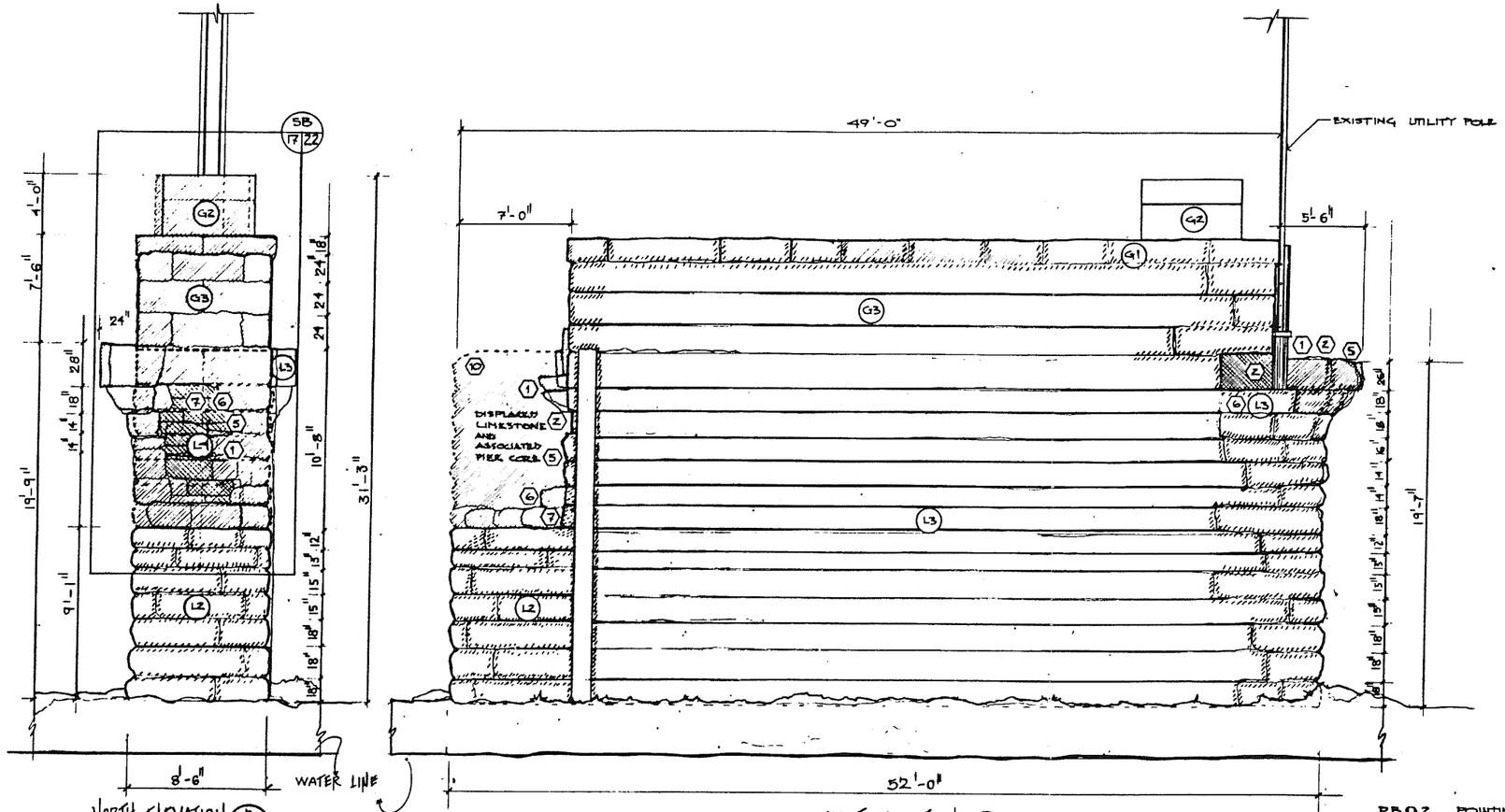
DESIGNED: WPTC	SUB SHEET NO. PA 5
DRAWN: ROPNEY	
TECH. REVIEW: VIANZA	
DATE: 04.21.94	

TITLE OF SHEET
PIER-A RIP RAP
PLAN & EAST ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY-LABOR CONSTRUCTION SET

DRAWING NO. 395 80071

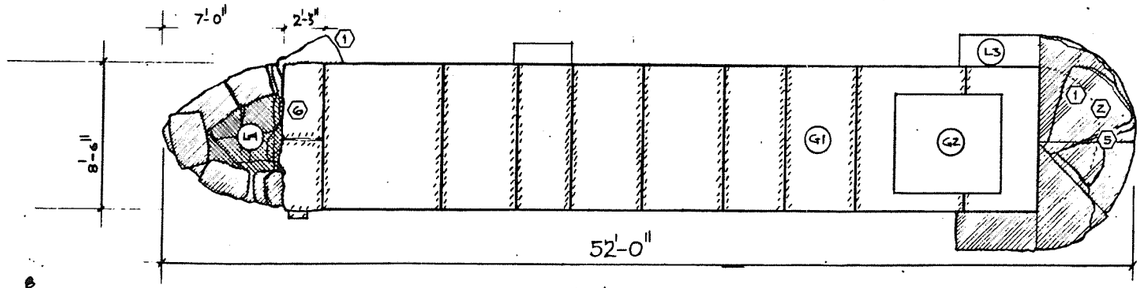
PKG. NO. 212

SHEET 16 OF 22



NORTH ELEVATION (2/17)

WEST ELEVATION (3/17)



PLAN VIEW (1/17)

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

4 0 4 8

DELINEATION : KEY NOTES

TOMSTOWN FORMATION LIMESTONE

(L2) – PITCH FACED COURSED ASHLAR BLOCKS
(L3) – PLINTH STONES
(L4) – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE
PR – RIP-RAP SLABS

GRANITE

(G1) – COPING STONES
(G2) – PLINTH STONES
(G3) – PITCH-FACED COURSED ASHLAR BLOCKS

BR – BED ROCK HARPERS FORMATION PHYLLITE

CONDITION ASSESSMENT "PB"

(1) DISPLACED STONE
(2) DAMAGED STONE
(3) TRANSVERSE CRACK IN MASONRY
(4) LATERAL CRACK IN MASONRY
(5) CONCENTRATION OF OPEN MORTAR JOINTS
(6) POTENTIAL VOIDS IN RUBBLE CORE
(7) EXPOSED RUBBLE CORE
(8) SILTATION BUILD-UP (OBSCURES MASONRY)
(9) DISPLACED RIP-RAP
(10) SEVERE FLOOD IMPACT ZONE

TREATMENT RECOMMENDATIONS 'PB'

I REMOVE VEGETATION AS INDICATED

IA REMOVE VEGETATION WHOSE ROOT SYSTEMS DIRECTLY IMPACT THE MASONRY STRUCTURE (PIER & ISLAND BASE) ROOT SYSTEMS ARE TO BE REMOVED USING HAND METHODS – DO NOT PULL AT ROOT SYSTEMS AS THIS WILL DISLODGE UNSTABLE MASONRY – REPAIR DAMAGED MASONRY, FILL ROOT AND STUMP VOIDS W/ RUBBLE

II REMOVE SILTATION BUILD-UP AT BASE OF MASONRY STRUCTURE TO EXPOSE BASE COURSE OF MASONRY STRUCTURE.

III REPAIR MASONRY AS INDICATED

PB 02 POINTING

REPOINT MORTAR JOINTS WHERE MORTAR HAS DETERIORATED OR HAS COMPLETELY WASHED-OUT REMOVE DETERIORATED MORTAR USING HAND TOOLS. RAKE-OUT JOINTS REMOVING DETERIORATED MORTAR, ORGANIC MATTER, AND FLOOD DEPOSITION.
REPOINT UTILIZING AN APPROVED AND APPROPRIATE MORTAR MIX MATCHING THE HISTORIC MORTAR IN COLOR, TEXTURE, AND JOINT PROFILE.
SOUND MORTAR SHALL BE LEFT IN-SITU

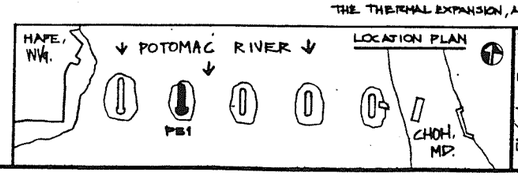
PB 03 GROUT INJECTION

IMPLEMENT GROUT INJECTION W/ AN APPROVED AND APPROPRIATE GROUT MIX IN DESIGNATED AREAS RE-ESTABLISH STRUCTURAL INTEGRITY OF THE CORE OF THE PIER THROUGH PLACEMENT OF GROUT
MATERIAL TESTS SHALL BE CARRIED OUT AT TIME OF CONSTRUCTION DETERMINING A COMPATIBLE GROUT MIX TAKING INTO ACCOUNT THE THERMAL EXPANSION, ABSORPTION, AND COMPRESSIVE STRENGTH OF THE EXTANT CORE MASONRY.

PB 01 RESETTING of DISPLACED MASONRY –

RESET OR REPLACE DISPLACED MASONRY ON THE NORTH (UPSTREAM) END OF THE BRIDGE PIER RETRIEVING ASSOCIATED WALL FALL FROM THE BASE OF THE NORTH END OF THE PIER. MISSING ELEMENTS SHALL REPLICATE EXTANT MASONRY MATCHING IN TYPE OF STONE, DIMENSION, SHAPE, TOOL MARKS, AND METHODOLOGY OF PLACEMENT.
PREPARE EXTANT BED STONES THROUGH RESETTING ON PROPER BEDDING PLUMB AND LEVEL TO ACCEPT REPLACEMENT AND RESET STONES IN THE DESIGNATED DAMAGED AREA.

MATERIALS:
EXTERIOR FINISH COURSING – TOMSTOWN FORMATION LIMESTONE WALLFALL
CORE – WALL FALL – HARPERS FORMATION PHYLLITE
ADDITIONAL REPLACEMENT STONE – MATCH EXTANT MASONRY IN TYPE, HARDNESS, ABSORBTION, COLOR, TEXTURE AND DESIGN.

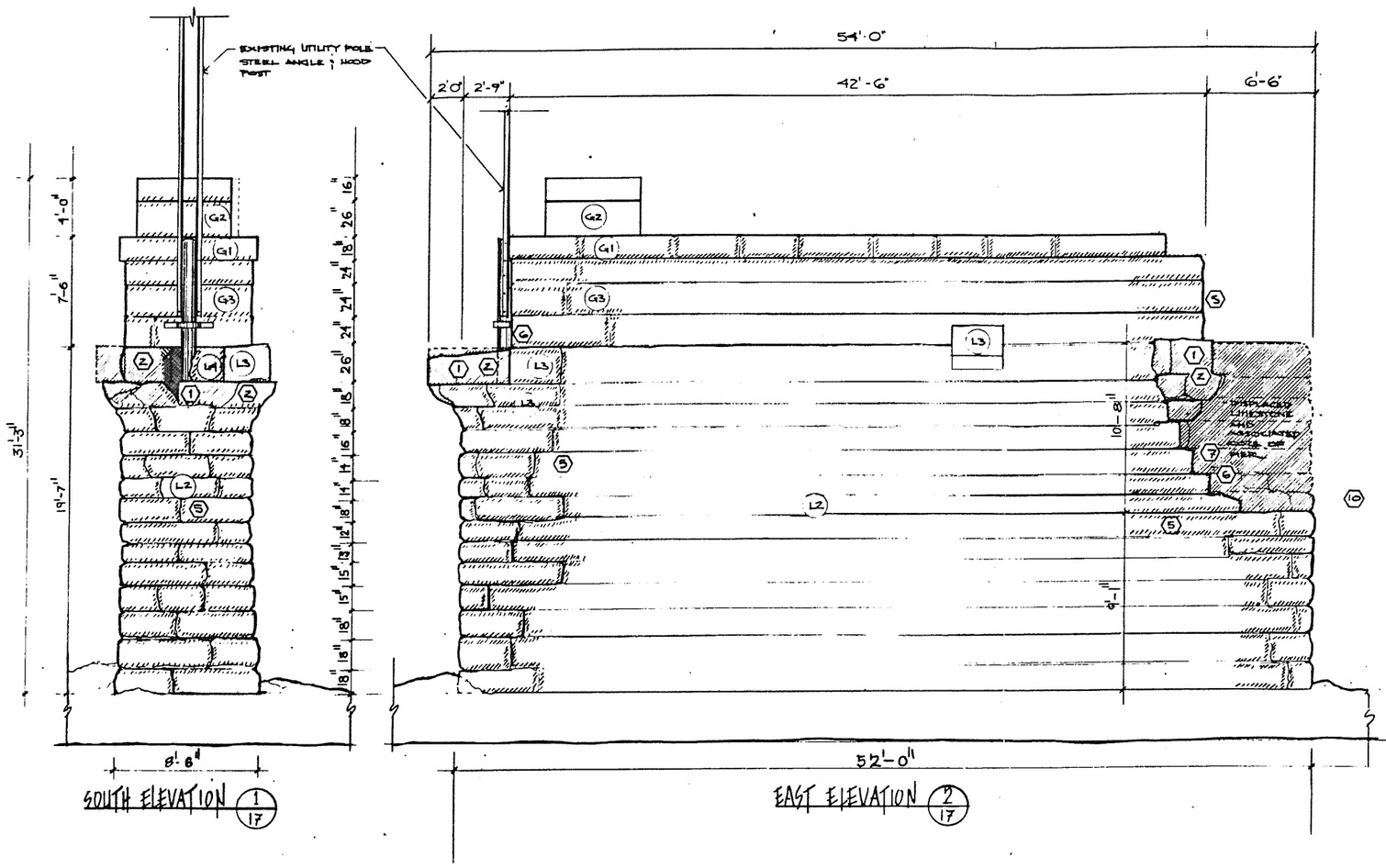


DESIGNED: LJPTC.
DRAWN: RODNEY
TECH. REVIEW: VITANZA.
DATE: MAY 02 94

SUB SHEET NO. PB1

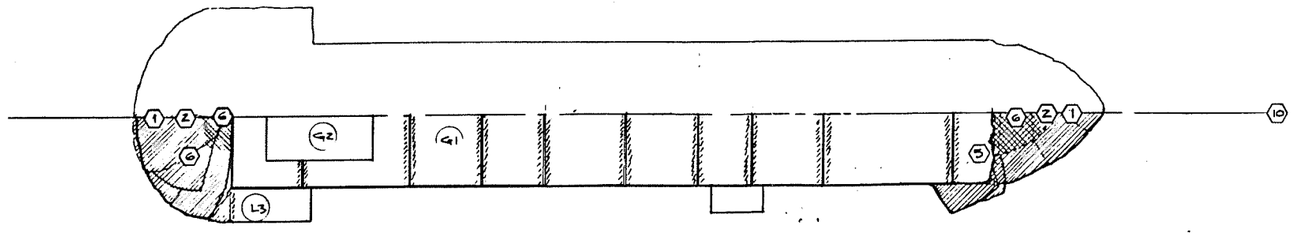
TITLE OF SHEET
PIER-B
NORTH & WEST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY LABOR CONSTRUCTION

DRAWING NO. 385 80071
PKG. NO. 212
SHEET 17 OF 22



SOUTH ELEVATION (1/17)

EAST ELEVATION (2/17)



PIER PLAN VIEW (PARTIAL) (3/17)

SCALE 3/4" = 1'-0"

4 0 1 8

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

(L2) – PITCH-FACED COURSED ASHLAR BLOCKS
(L3) – PLINTH STONES
(L4) – RUBBLE CORE, LIMESTONE AND HARPERS PHYLLITE

HARPERS FORMATION PHYLLITE

(R) – RIP-RAP

GRANITE

(G1) – COPING STONES (ASHLAR BLOCKS)
(G2) – PLINTH STONES (BUSH-HAMMERED FINISH)
(G3) – PITCH FACED COURSED ASHLAR BLOC

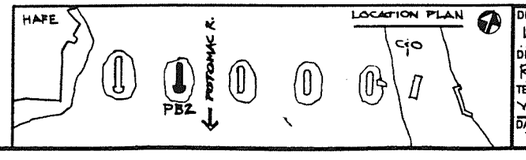
PB 01 RESETTING OF DISPLACED MASONRY

PB 02 POINTING

PB03 GROUT INJECTION

CONDITION ASSESSMENT NOTES

1. DISPLACED STONE
2. DAMAGED STONE
3. TRANSVERSE CRACK IN MASONRY
4. LATERAL CRACK IN MASONRY
5. CONCENTRATION OF OPEN MORTAR JOINTS
6. POTENTIAL VOIDS IN RUBBLE CORE
7. EXPOSED RUBBLE CORE
8. SILTATION BUILD-UP (OBSCURES MASONRY)
9. DISPLACED RIP-RAP
10. SEVERE FLOOD IMPACT ZONE



DESIGNED: WPTC
DRAWN: RODNEY
TECH. REVIEW: YITWZA
DATE: MAY 02, 91

SUB SHEET NO. PB2

TITLE OF SHEET
PIER-B
SOUTH & EAST ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY LABOR CONSTRUCTION

DRAWING NO. 385 / 80071

PKG. NO. 212

SHEET 18 OF 22

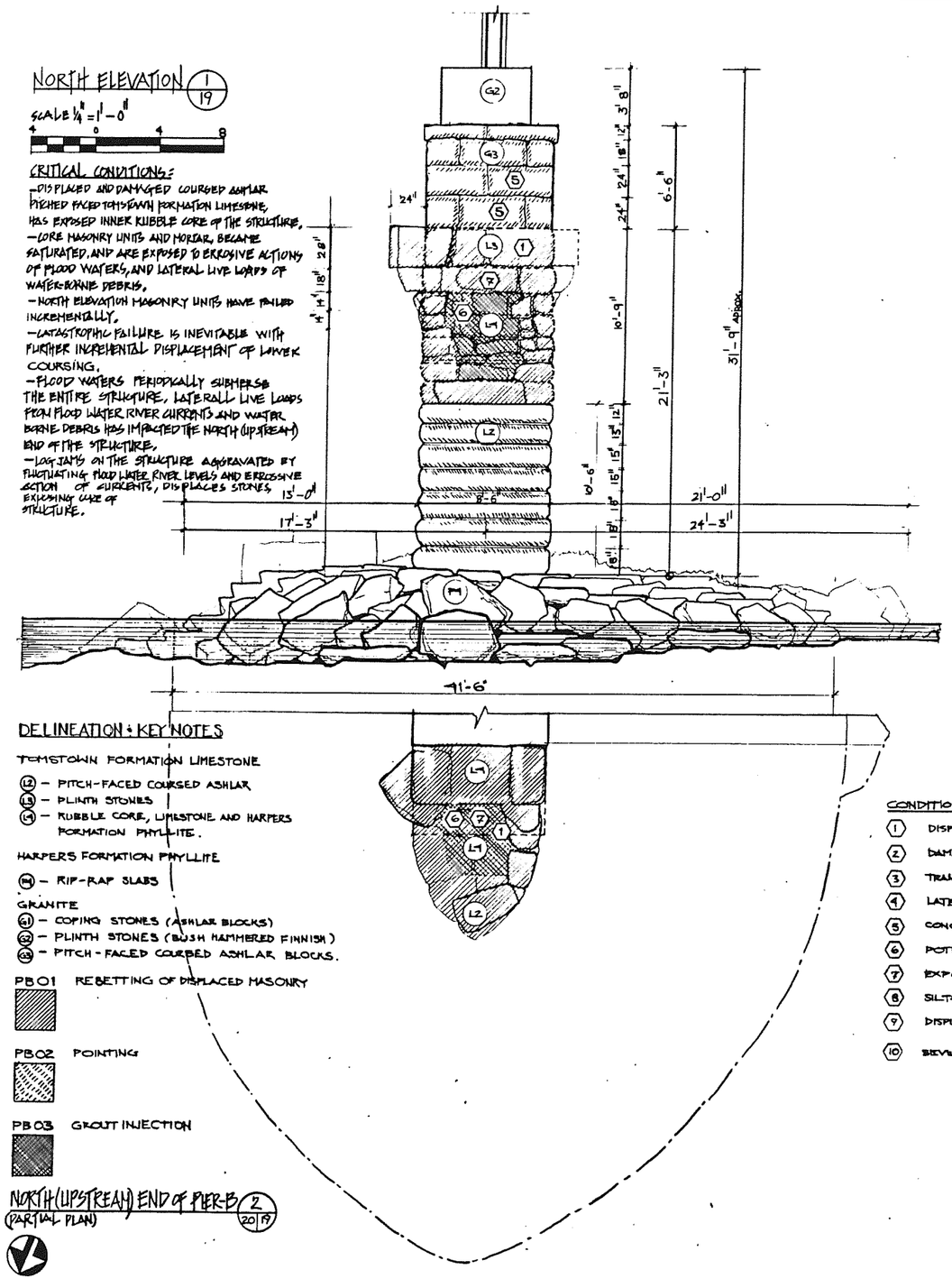
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NORTH ELEVATION (1/19)

SCALE 1/4" = 1'-0"

CRITICAL CONDITIONS:

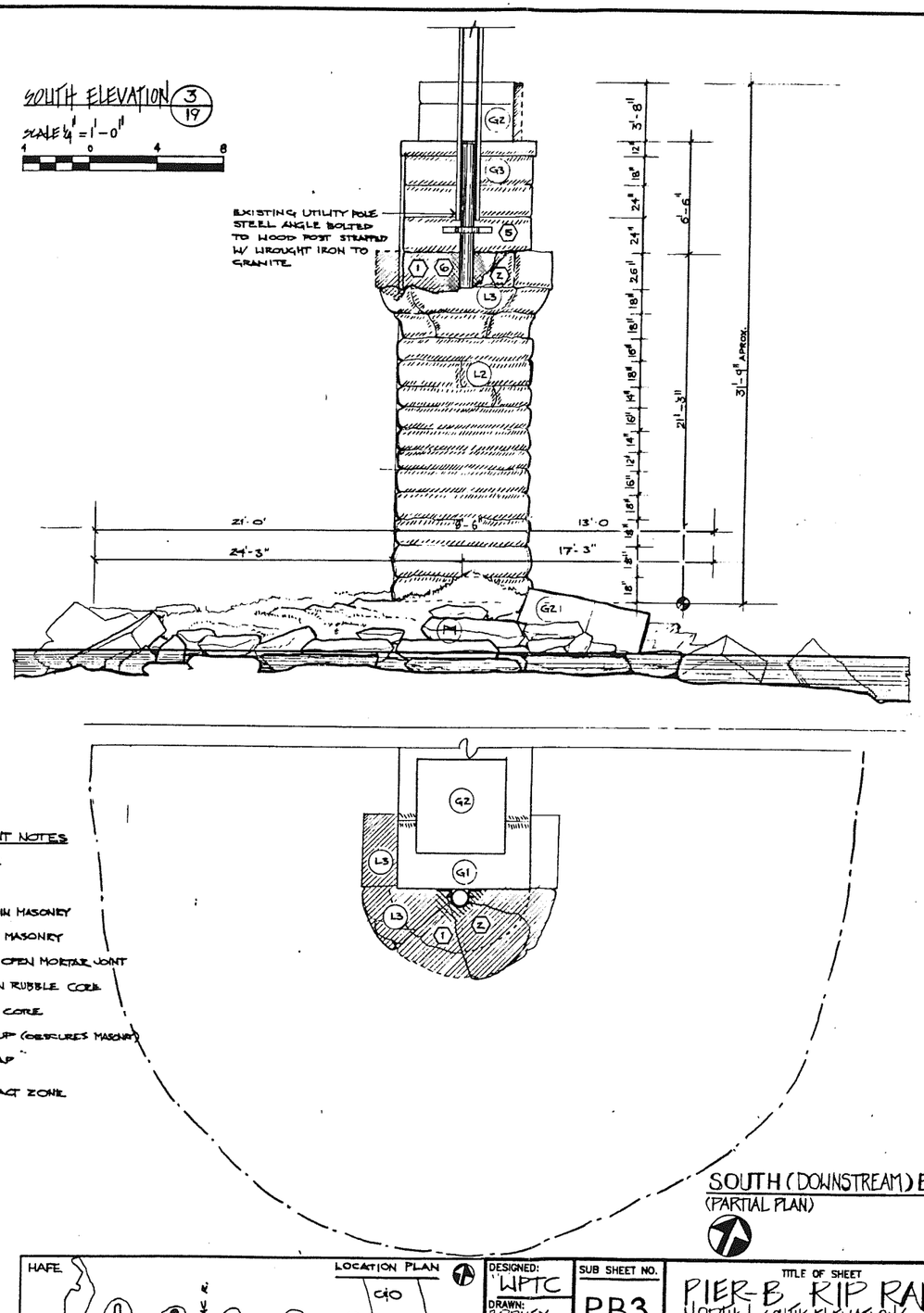
- DISPLACED AND DAMAGED COURSED ASHLAR PITCHED FACED TOMSTOWN FORMATION LIMESTONE HAS EXPOSED INNER RUBBLE CORE OF THE STRUCTURE.
- CORE MASONRY UNITS AND MORTAR, BECAME SATURATED, AND ARE EXPOSED TO ERROSIVE ACTIONS OF FLOOD WATERS, AND LATERAL LIVE LOADS OF WATER-BORNE DEBRIS.
- NORTH ELEVATION MASONRY UNITS HAVE FAILED INCREMENTALLY.
- CATASTROPHIC FAILURE IS INEVITABLE WITH FURTHER INCREMENTAL DISPLACEMENT OF LOWER COURSING.
- FLOOD WATERS PERIODICALLY SUBMERSE THE ENTIRE STRUCTURE, LATERALL LIVE LOADS FROM FLOOD WATER, RIVER CURRENTS AND WATER BORNE DEBRIS HAS IMPACTED THE NORTH (UPSTREAM) END OF THE STRUCTURE.
- LOG JAMS ON THE STRUCTURE AGGRAVATED BY FLUCTUATING FLOOD WATER, RIVER LEVELS AND ERROSIVE ACTION OF CURRENTS, DISPLACES STONES EXPOSING CORE OF STRUCTURE.



SOUTH ELEVATION (3/19)

SCALE 1/4" = 1'-0"

EXISTING UTILITY POLE STEEL ANGLE BOLTED TO WOOD POST STRAPPED W/ WROUGHT IRON TO GRANITE.



DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

- (L2) – PITCH-FACED COURSED ASHLAR
- (L3) – PLINTH STONES
- (L4) – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE.

HARPERS FORMATION PHYLLITE

- (M4) – RIP-RAP SLABS

GRANITE

- (G1) – COPING STONES (ASHLAR BLOCKS)
- (G2) – PLINTH STONES (BUSH HAMMERED FINNISH)
- (G2.1) – PITCH-FACED COURSED ASHLAR BLOCKS.

PB01 REBETTING OF DISPLACED MASONRY

PB02 POINTING

PB03 GROUT INJECTION

CONDITION ASSESSMENT NOTES

1. DISPLACED STONE
2. DAMAGED STONE
3. TRANSVERSE CRACK IN MASONRY
4. LATERAL CRACK IN MASONRY
5. CONCENTRATION OF OPEN MORTAR JOINT
6. POTENTIAL VOIDS IN RUBBLE CORE
7. EXPOSED RUBBLE CORE
8. SILTATION BUILD-UP (OBSCURES MASONRY)
9. DISPLACED RIP-RAP
10. SEVERE FLOOD IMPACT ZONE

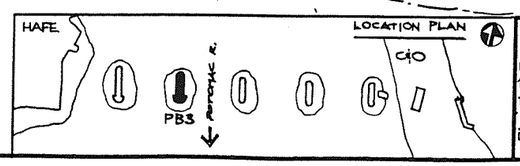
NORTH (UPSTREAM) END OF PIER-B (2/19)

(PARTIAL PLAN)

SOUTH (DOWNSTREAM) END PIERA (4/19)

(PARTIAL PLAN)

HAER



LOCATION PLAN

DESIGNED: WPTC	SUB SHEET NO. PB3
DRAWN: RODNEY	
TECH. REVIEW: VITANZA	
DATE: MAY 02, 94	

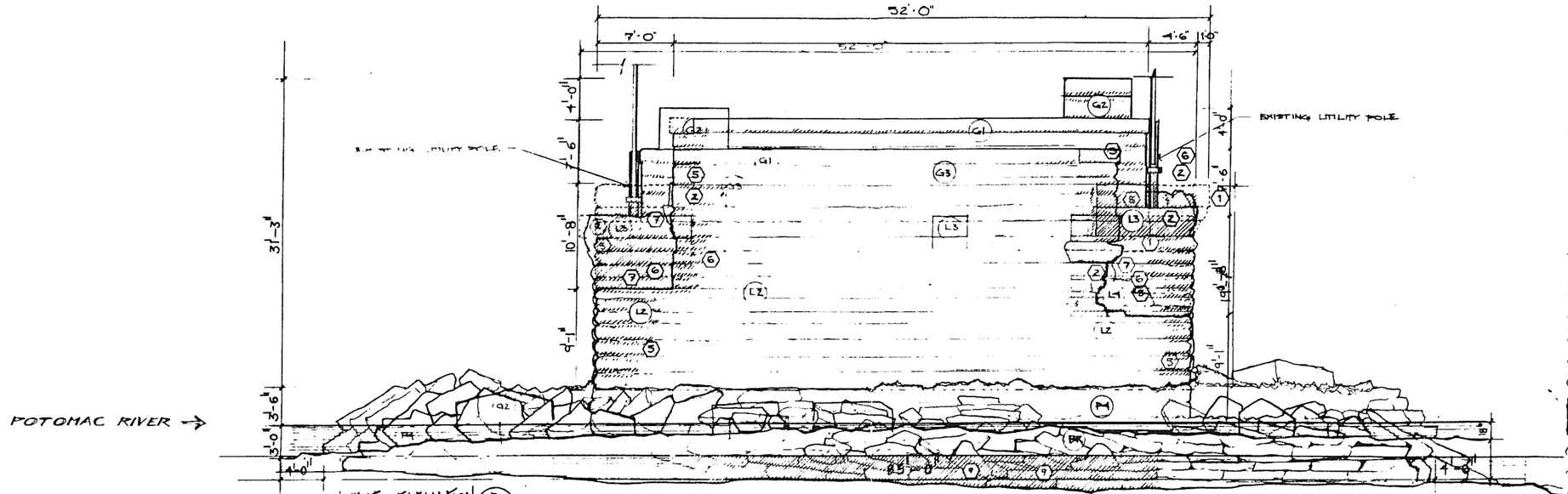
TITLE OF SHEET
PIER-B RIP RAP
NORTH & SOUTH ELEVATIONS
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY LABOR CONSTRUCTION

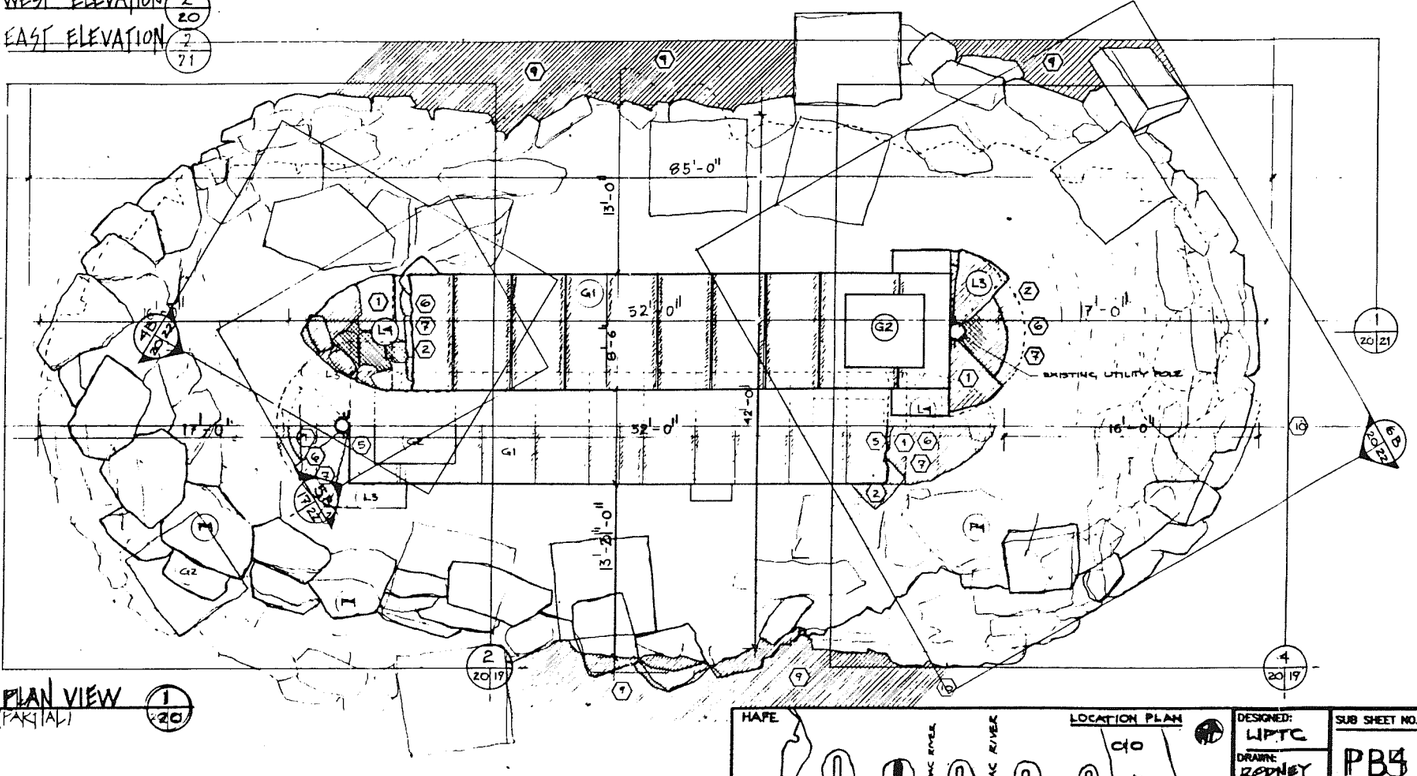
DRAWING NO. 385 80071

PKG. NO. 212

SHEET 19 OF 22

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DELINEATION & KEY NOTES

DELINEATION & KEY NOTES

LIMESTONE FORMATION OR LIMESTONE

(LS) LIMESTONE FORMATION UNDRESSED ASHLAR BLOCKS

(G2) PITCH-FACED COURSED ASHLAR BLOCKS RUBBLE CORE, LIMESTONE AND HARPERS

(G3) FLINTY STONES PHYLLITE

(H) RUBBLE CORE, LIMESTONE & HARPERS

(H) FORMATION PHYLLITE

GRANITE

(G1) COPING STONES
– COPING STONES

(G2) PLINTH STONES
– PITCH-FACED COURSED ASHLAR BLOCKS

(G3) PITCH-FACED COURSED ASHLAR BLOCKS BED ROCK HARPERS FORMATION PHYLLITE

(BR) BED ROCK HARPERS FORMATION PHYLLITE

CONDITION ASSESSMENT PB

PB 01 DISPLACED MASONRY

DAMAGED STONE

TRANSVERSE CRACK IN MASONRY

PB 02 POINTING
LATERAL CRACK IN MASONRY

CONCENTRATION OF OPEN MORTAR JOINTS

PB 03 GROUT INJECTION
POTENTIAL VOIDS IN RUBBLE CORE

EXPOSED RUBBLE CORE

SILTATION BUILD-UP (OBSCURES MASONRY)

(7) – DISPLACED RIP-RAP

CONDITION ASSESSMENT HATCH ZONE

(1) DISPLACED STONE
PB 01 RESETTING of DISPLACED MASONRY

(2) DAMAGED STONE

(3) TRANSVERSE CRACK IN MASONRY

(4) LATERAL CRACK IN MASONRY

(5) CONCENTRATION OF OPEN MORTAR JOINTS

(6) POTENTIAL VOIDS IN RUBBLE CORE

(7) EXPOSED RUBBLE CORE

(8) SILTATION BUILD-UP (OBSCURES MASONRY)

PB 03 GROUT INJECTION
(7) DISPLACED RIP-RAP

(10) SEVERE FLOOD IMPACT ZONE

SCALE: 1/16" = 1'-0"

4 0 4 16

HAER

LOCATION PLAN

PB4

POTOMAC RIVER

POTOMAC RIVER

C10

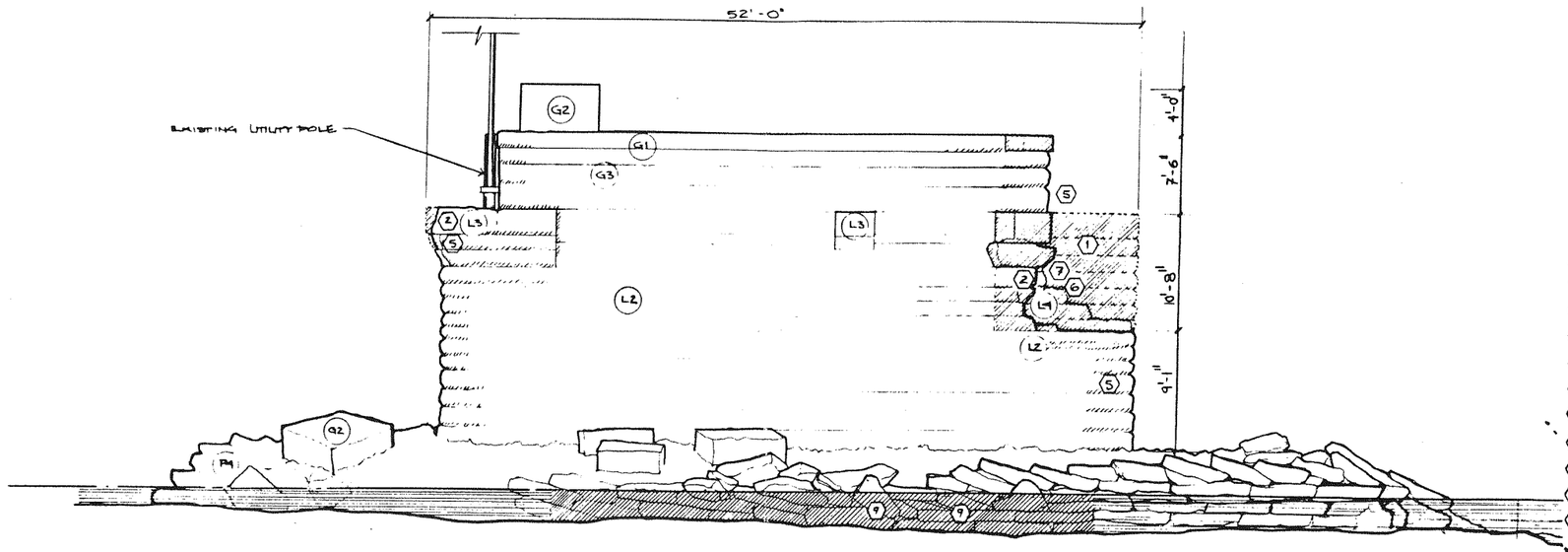
DESIGNED: LIPTC	SUB SHEET NO. PB4
DRAWN: RODNEY	
TECH. REVIEW: VIVANZA	
DATE: MARCH 2004	

TITLE OF SHEET
PIER-B RIP RAP
PLAN & EAST ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DATA | LABOR | CONSTRUCTION

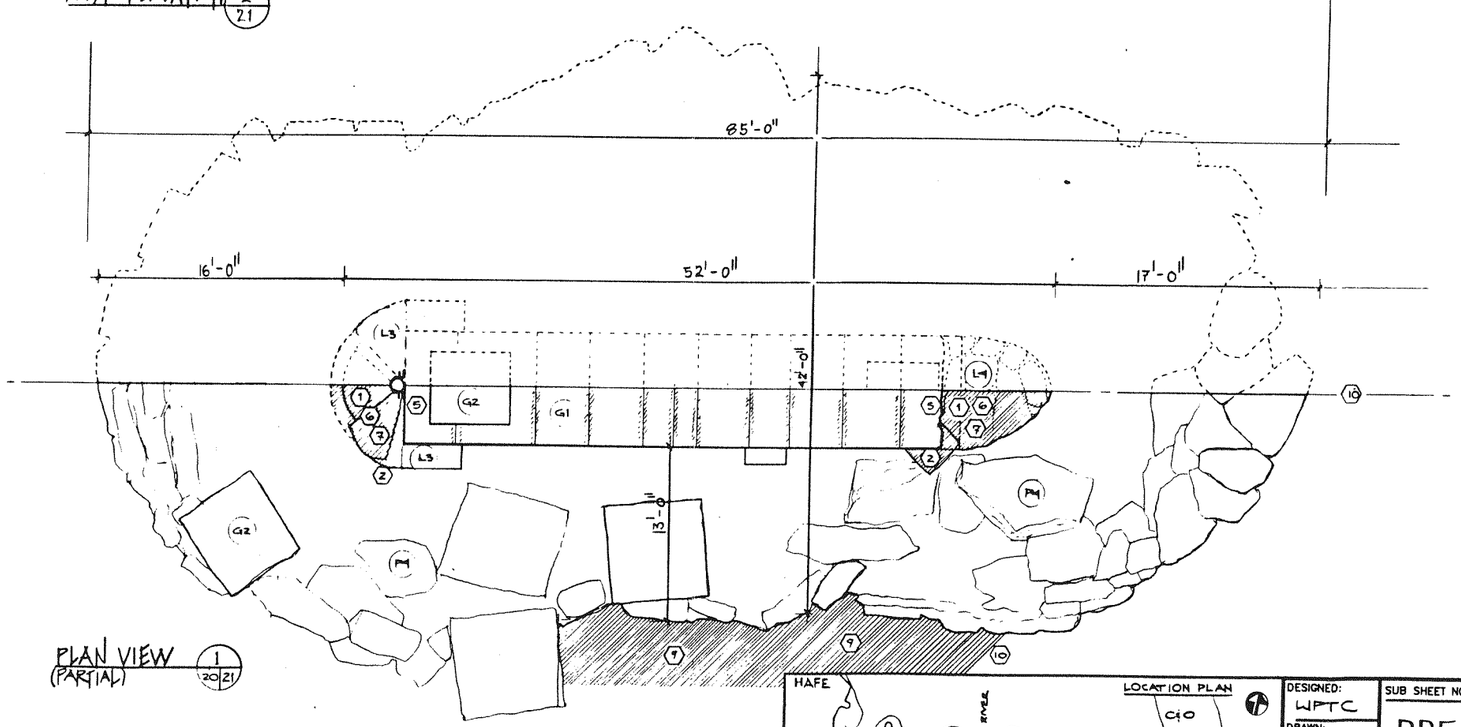
DRAWING NO. 385 80071

PROJ. NO. 212

SHEET 20 OF 22



EAST ELEVATION (2/21)



PLAN VIEW (PARTIAL) (1/20/21)

SCALE: 3/16" = 1'-0"

4 0 4 16

DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE

- (L2) PITCH-FACED COURSED ASHLAR BLOCKS
- (L3) PLINTH STONES
- (L4) RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE

HARPERS FORMATION PHYLLITE

- (PM) RIP-RAP SLABS

GRANITE

- (G1) – COPING STONES
- (G1') – PLINTH STONES
- (G2) – PITCH-FACED COURSED ASHLAR BLOCKS
- (BR) BED ROCK HARPERS FORMATION PHYLLITE

CONDITION ASSESSMENT PB

- (1) – DISPLACED STONE
- (2) – DAMAGED STONE
- (3) – TRANSVERSE CRACK IN MASONRY
- (4) – LATERAL CRACK IN MASONRY
- (5) – CONCENTRATION OF OPEN MORTAR JOINTS
- (6) – POTENTIAL VOIDS IN RUBBLE CORE
- (7) – EXPOSED RUBBLE CORE
- (8) – SILTATION BUILD-UP (OBSCURES MASONRY)
- (9) – DISPLACED RIP-RAP
- (10) – SEVERE FLOOD IMPACT ZONE

PB 01 RESETTING of DISPLACED MASONRY

PB 02 POINTING

PB 03 GROUT INJECTION

HAFE

LOCATION PLAN

PB5 ← POTOMAC RIVER

C&O

DESIGNED:	WPTC
DRAWN:	RODNEY
TECH. REVIEW:	VITANZA
DATE:	MAY 02, 99

SUB SHEET NO. PB5

TITLE OF SHEET
PIER-B RIP RAP
PLAN & EAST ELEVATION
B&O RAILROAD BRIDGE PIERS
STABILIZATION DESIGN PROJECT
DAY LABOR CONSTRUCTION

DRAWING NO. 385 80071

PKG. NO. 212

SHEET 21 OF 22

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DETAIL OF PIER A LOOKING AT NORTH (UPSTREAM) END FROM EASTWARD SIDE OF PIER (1-A 16/22)
(NOT TO SCALE)

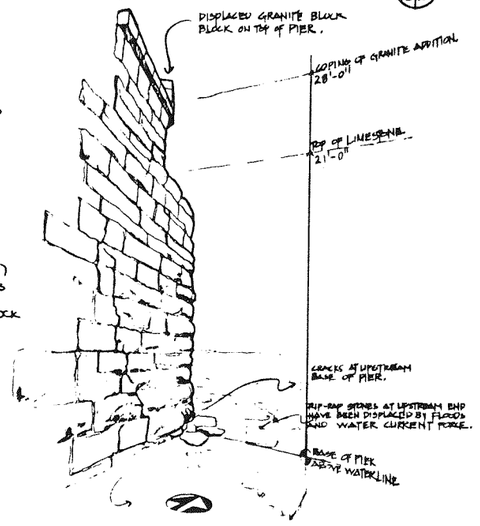
DELINEATION & KEY NOTES

TOMSTOWN FORMATION LIMESTONE
L2 – PITCH-FACED COURSED ASHLAR BLOCKS
L3 – PLINTH STONES
L4 – RUBBLE CORE, LIMESTONE AND HARPERS FORMATION PHYLLITE

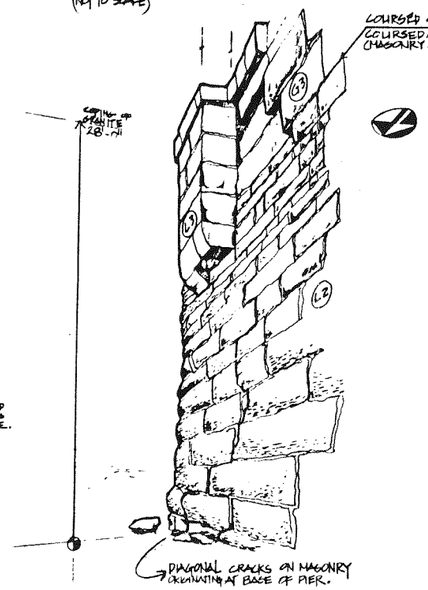
HARPERS FORMATION PHYLLITE
R4 – RIP-RAP SLABS

GRANITE
G1 – COPING (ASHLAR BLOCKS)
G2 – PLINTH STONES (BUSH-HAMMERED FINISH)
G3 – PITCH-FACED COURSED ASHLAR BLOCKS

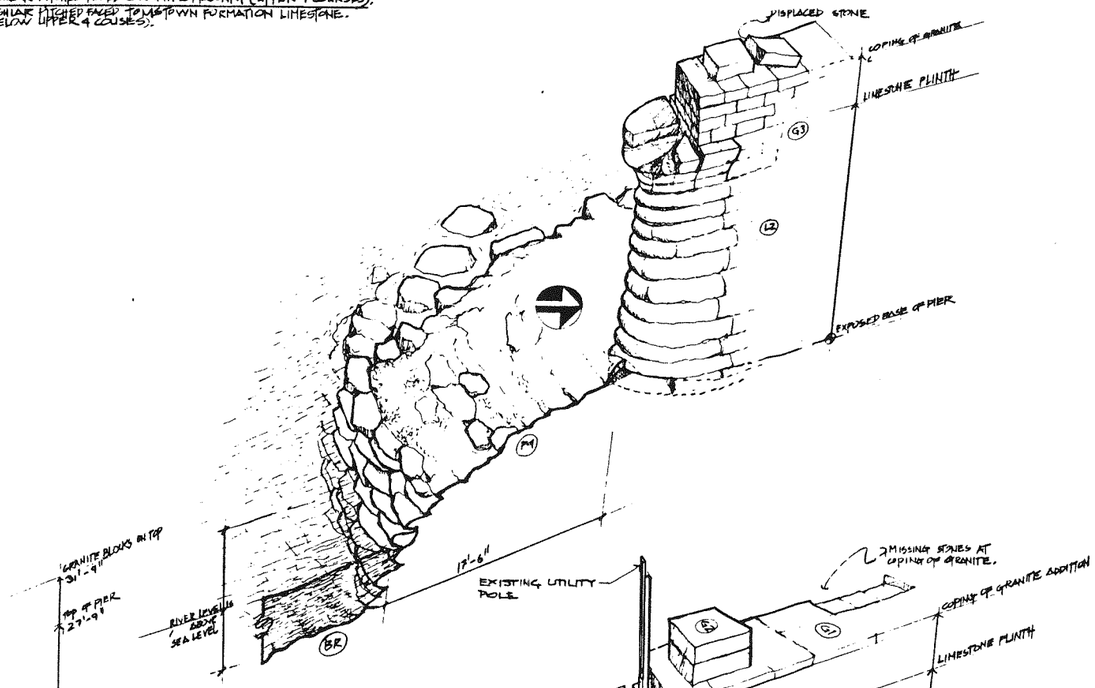
BR – HARPERS FORMATION PHYLLITE BED-ROCK



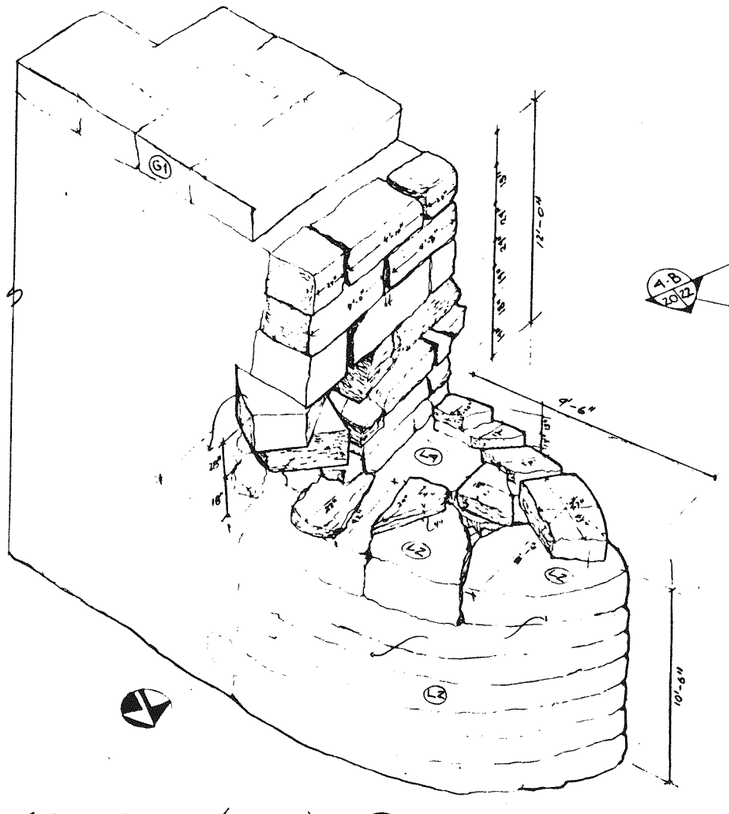
VIEW OF PIER A LOOKING AT NORTH (UPSTREAM) END FROM WESTWARD SIDE OF PIER (2-A 15/22)
(NOT TO SCALE)



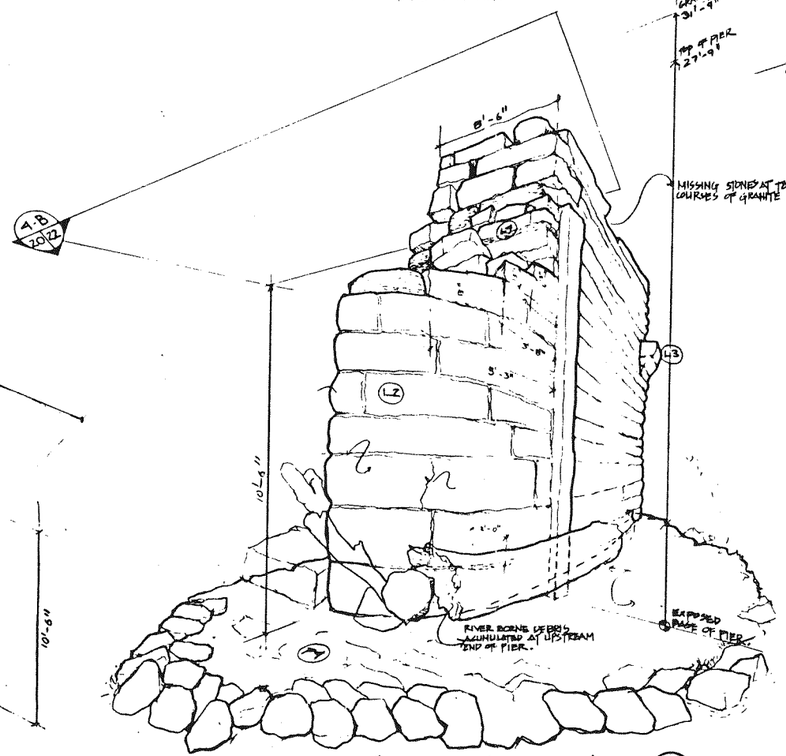
PIER A: DETAIL SHOWING SOUTH (DOWNSTREAM) END OF PIER & RIP-RAP (3-A 15/22)
(NOT TO SCALE)



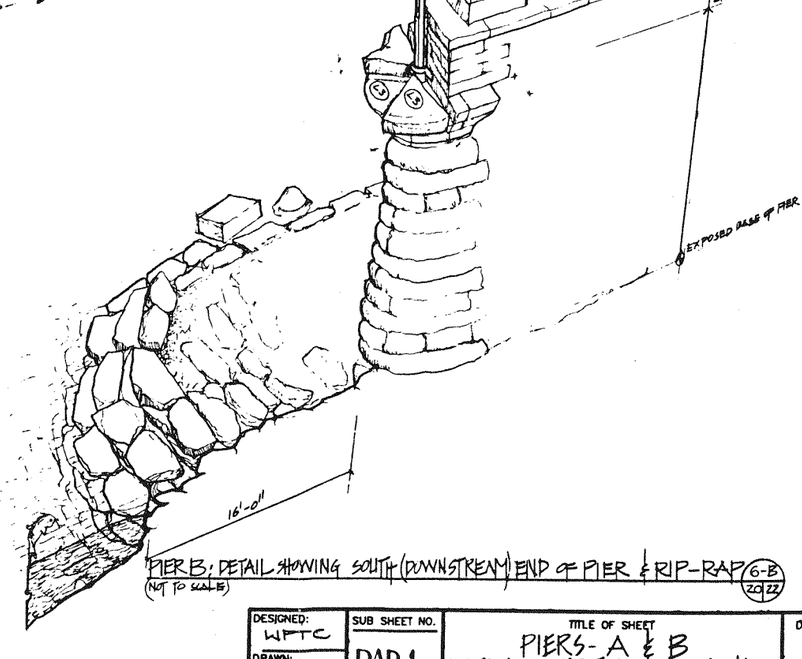
DETAIL OF PIER B NORTH (UPSTREAM) END (4-B 20/22)
(NOT TO SCALE)



VIEW OF PIER B LOOKING SOUTH FROM NORTH (UPSTREAM) END (5-B 17/22)
(NOT TO SCALE)



PIER B: DETAIL SHOWING SOUTH (DOWNSTREAM) END OF PIER & RIP-RAP (6-B 20/22)
(NOT TO SCALE)



NOTE: ALL DRAWINGS WERE MADE FREEHAND; THUS (ALTHOUGH ACCURATE IN PROPORTIONS) THEY DO NOT CONFORM TO ANY GRAPHICAL SCALE.

DESIGNED: WPTC	SUB SHEET NO. PAB1	TITLE OF SHEET: PIERS-A & B VIEWS OF EXISTING CONDITIONS B&O RAILROAD BRIDGE PIERS STABILIZATION DESIGN PROJECT DAY LABOR CONSTRUCTION	DRAWING NO. 385 80071
DRAWN: RODNEY			PKG. NO. 213
TECH. REVIEW: VITANZA			SHEET 22 OF 22
DATE: MAY 02, 94			

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