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Technical Memorandum

Date: **January 10, 2012 DRAFT**
By: AECOM Engineering Staff
Subject: **Chesapeake Connector Project, Third Track on Northeast Corridor Between Bacon and Prince Interlockings: Cost Estimate**

This technical memorandum describes the process followed, and logic for development of an engineers estimate for the Chesapeake Connector Project. The memorandum defines the work items, and what work they encompass. It also attempts to identify unknown elements and explain how those costs were captured in the estimate. The estimate is based a conceptual level, approximately 5%, engineering design. It is recommended that this estimate not be used for application for funds, but instead as starting point for the next level of design. Costs included herein, which were identified as not having a high level of accuracy should be researched first during the next level of design.

The cost estimate was based on existing resources available at the time that the conceptual level engineering task was performed. Data used to develop the estimate included aerial photos, Amtrak track chart data, which included mileage, and location of overhead and undergrade bridges, field reconnaissance which was limited to viewing the right of way at public areas, off of Amtrak right of way, and commercially available video footage taken from the head end of an Amtrak train in 1986. Unit prices used in the estimate are based on previous project experience, and off-line discussion with contractors, railroads and agencies, and fabricators, as well as industry recognized estimating tools such as RS Means.

An engineer's cost estimate was developed for each option progressed. These include Option A, and Option B. Option A adds the third main track and crosses the North East Corridor (NEC) tracks 2 and 3 by grade separated structure, in that the third track crosses over the NEC. The conceptual cost estimate for Option A is **\$349.5 million**. Option B adds the third main track and crosses the NEC at grade, via use of special trackwork at Bacon and Prince Interlockings. The conceptual cost estimate for Option B is **\$162.2 million**.

The estimate was organized in the Federal Transit Administration (FTA) Standard Cost Category (SCC) system, in a modified version. While this project will probably not fall within the FTA's jurisdiction, the FTA SCC system was used as it provides an established organization for work elements.

An attempt was made to capture as many costs as possible, however, with the limited availability of existing information, the cost estimate does include inaccuracies. Items which are known to include inaccuracies are labeled in the table using the word "ALLOWANCE". ALLOWANCE, indicates an item which is identified as potentially requiring work, but it is unknown what level of work is required. For these items, engineering best guesses were used to determine the unit cost.

The cost estimate contains two levels of contingency; Allocated, and Unallocated. Both forms of contingency are defined in forms of a percentage applied to a cost. Allocated contingency is added to each individual work item. This allows the contingency to be item specific. Items for which it is felt are well understood, and that existing cost data experience is deemed sufficient, are assigned a low contingency percentage. Items which are not fully understood, or which existing cost data experience is not complete or varies widely are assigned a high contingency percentage. For these items, there is a high level of risk involved, and cost could increase greatly, as the level of detailed knowledge increases. Unallocated contingency is added at the final stage of the estimate, as line item 90.1. This contingency adds a percentage to the total sum of all elements, and serves as a project reserve.

An explanation of work elements is as follows:

Category 10, Guideway and Track Elements:



Item 10.1: Trackway Preparation, at grade; This item includes the removal of 12 inches topsoil, over an average 50 feet wide section. This equates to 1.9 cubic yards (cy) of removal per track foot. The unit price of this item assumes that the top soil will be re-spread along railroad right of way at the end of the project to establish a surface for seeding.

Item 10.2: Concrete Tie Track, Single Track; This item includes furnishing and installing all track material, including rail, ties, OTM, ballast, and subballast. It is for a single track, and in accordance with the typical sections. Ballast and tie track will be used throughout the project, including on bridge decks and tunnel inverts.

Items 10.3, 10.4, 10.5; These items include furnishing and installing turnouts and cross-overs, as identified in the table. Cost includes special trackwork, ballast, subballast, switch machine and switch heaters. Note that item 10.5 is a placeholder for a No. 10 turnout. Mason Dixon Co. Sand and Gravel is an industry which locates on the west side of the railroad at MP 55.870. At one time this industry was served by rail, via a trailing point turnout, in the south direction, from track 3. At the time of this writing, the turnout has been removed. This cost estimate does not include any cost for replacing the turnout, however, a placeholder (without cost) is included in the estimate to remind the reader of the industry's existence should there be a possibility of restoration of service.

Item 10.6: Remove No. 20 Concrete Tie Cross-over; This item includes all labor and material required to remove existing No. 20 concrete tie cross-over and restoring track at Bacon Interlocking. This item applies to Option B only, and is necessary to accommodate the proposed turnout on the west side to access proposed track 4. There is no cost added for this item. It is assumed that Amtrak will remove the turnout at its own cost, recovering this cost through the salvage cost of the material.

Item 10.7: Remove No. 20 Concrete Tie Turnout; This item includes all labor and material required to remove existing No. 20 concrete tie turnout and restoring track at Bacon Interlocking. This item applies to Option B only, and is necessary to accommodate the proposed turnout on the west side to access proposed track 4. There is no cost added for this item. It is assumed that Amtrak will remove the turnout at its own cost, recovering this cost through the salvage cost of the material.

Item 10.8: Shift Existing Track (Up to 8 feet); This item includes work required to cut and throw existing track, up to 8 feet. Item includes nominal ballast, cutting and re-welding rail, and labor to perform the work. This is work required to shift tracks to new alignments for the at grade option.

Item 10.9: Not Used

Item 10.10: UG 51.030 North East Creek; This appears to be a stone arch structure about 130 feet long. The structure deck appears to be sufficiently wide to accommodate a new track 14 foot offset from existing track 2, on the east side. While the structure is probably homogeneous throughout, given the size and age of the structure, an allowance was incorporated to make potential repairs to the structure.

Item 10.11: UG 51.120 Culvert; This appears to be either a box or stone arch culvert structure, about 25 feet in length. The culvert drains from the west to a basin or small lake to the east. The top of the culvert appears to be about 15 feet below the top of tie elevation. The trackbed above the culvert appears to be sufficiently wide to accommodate a new track 14 foot offset from existing track 2, on the east side. It was assumed that the existing structure is sufficient to support the proposed track. No cost was included to modify the bridge, however, a cost was included for rating the structure during the design phase.

Item 10.12: UG 51.140 McCullough Dr. / Railroad Ln.; This appears to be a box type structure, about 25 feet in length. The roadway surface below the structure is about 15 feet wide, and is not paved. The top of structure appears to be about 10 feet below the top of tie elevation. The trackbed above the culvert appears not to be sufficient to accommodate a track on the east side. Costs are added to construct a new culvert at 25 feet long by 20 feet wide.

Item 10.13: UG 51.330 Pedestrian Underpass / North Main St.; This structure appears very similar to UG 51.140. Costs are added to construct a new culvert at 25 feet long by 20 feet wide.



Item 10.14: OH 51.430 Northeast Rd. / Maudlin Ave. – (MD RT 272); This is an overhead bridge structure which includes two piers adjacent to tracks 2 and 3. There appears to be sufficient space to accommodate a new track 14 foot offset from existing track 2, on the east side, and not move the east bridge pier. However, the east bridge pier crash protection appears to be only 6 feet high. As the new track would locate about 12' adjacent to the pier, the crash wall would need to be increased to 12 feet high. A cost was included to increase the crash wall from 6 feet high, to 12 feet high.

Item 10.15: UG 51.880 Post Road - (MD RT 7); This is a stone arch structure which accommodates two traffic lanes under the railroad. The track alignment on the bridge is within curve 343. The roadway alignment under the bridge is within a reverse curve. The bridge does not appear wide enough to accommodate a new track. Costs are included to construct a new 75 feet long by 20 feet wide structure for purposes of locating the proposed third track.

Item 10.16: BA 51.940 Stoney Run; This is a tall stone arch structure carrying the railroad over Stoney Run. At the water level, the structure appears to be about 25 feet wide. The top of structure appears to be less than 5 feet from top of tie. While the structure is probably homogeneous throughout, given the size and age of the structure, an allowance was incorporated to make potential repairs to the structure.

Item 10.17: UG 52.640 Pedler's Run; This structure appears to be very similar to that of Item 10.16, with the exception that the width at water level appears to be 40 feet. As such, an allowance was incorporated to make potential repairs to the structure.

Item 10.18: UG 52.960 Broad Creek; This appears to be a box culvert type structure about 30 feet wide. The top of box appears to be less than 5 feet from top of tie. The width of structure is not sufficient to accommodate a new track. Costs are included to construct a new 50 feet long by 20 feet wide structure for purposes of locating the proposed third track. Note that the length of structure is greater than length of existing structure. This structure locates very close to the North East River. Understanding the sensitivity of the area the additional length should ensure that the bridge abutments can be constructed outside of the limits of the existing river.

Item 10.19: OH 53.510 Heisler's Road / Bladen St. - (MD RT 267); This is an overhead structure which appears to be very similar to that of Item 10.14. Costs are included to construct / increase the crash wall from 6 feet to 12 feet high.

Item 10.20: UG 54.290 Stream; This is a tall stone arch structure carrying the railroad over a stream. At the water level, the structure appears to be about 15 feet wide. The top of structure appears to be less than 10 feet from top of tie. The structure does not appear to provide sufficient roadbed width to accommodate a third track. Costs are added to provide a 40 foot long by 20 foot wide structure. The additional length, 40 feet vs. 15 feet, is an attempt to locate proposed bridge abutments outside of the stream limits.

Item 10.21: OH 54.750 Weaver's RD / Ogle Rd. (MD RT 267); This structure appears to be very similar to that of Items 10.14 and 10.19. Costs are included to construct / increase the crash wall from 6 feet to 12 feet high.

Item 10.22: UG 56.260 Long Hollow Creek; Based on reference information, this structure was not located. Aerial information indicates sufficient right of way width between OH 54.750, and UG 56.510. Therefore, it was assumed no work would be required, and only a cost for rating the structure was included in the estimate. No cost for this work was included in Option A, as the proposed alignment would locate on structure at this location, and that cost is captured in the "Bridge Structure adjacent to NEC" cost item.

Item 10.23: UG 56.510 Carpenter Rd./ Mountain Hill Rd.; This structure appears to be about 30 feet in length, and about 30 feet wide. It is not sufficiently wide to accommodate a proposed third track. Costs are included to construct a new 50 feet long by 20 feet wide structure for the additional track. The additional length, 50 feet vs. 30 feet, is an attempt to avoid conflict between the proposed and existing bridge abutments. No cost for this work was included in Option A, as the proposed alignment would locate on structure at this location, and that cost is captured in the "Bridge Structure adjacent to NEC" cost item.

Item 10.24: UG 56.920 Principo Creek; Based on reference information, it is not possible to tell what type of structure this is. However, it appears to be at least 60 feet wide at the base, and, on the side slope on the east side appears to be insufficient to provide track bed for a proposed track. Additionally, this is the area where the proposed track shift would be occurring to re-align the tracks to the west. Because so much is unknown about



this structure, an allowance was added for a proposed 80 feet long by 20 feet wide structure. The additional length, 80 feet vs. 60 feet, is an attempt to locate the bridge abutments outside of the creek limits. It is understood that during design, sufficient track bed might be available at this location to accommodate all three tracks, however, some form of mitigation with respect to parapets would be required. Given the unknowns, it was decided to be conservative, and include costs for a new structure.

Item 10.25: Retaining Wall Soldier Pile and Lagging; This item is a retaining wall used to maintain a railroad embankment. This item is only used where proposed track locates at or very near existing top of rail. Generally, the existing alignment locates on embankment with steep slopes on either side of the right of way. To minimize impacts associated with constructing new track on fill, an ALLOWANCE of 8 feet high wall for 1 mile in length was included in the estimate.

Item 10.26: Retaining Wall Soldier Pile and Lagging at North East River; This item is a retaining wall used to maintain a railroad embankment specifically at the North East River. This item is very similar in nature to Item 10.25, however, the unit price is greater than Item 10.25, to reflect the complications required to construct the wall. Those complications include a sensitive environmental location, minimal access for construction, and what would appear to be challenging sub-surface conditions.

Item 10.27: Retained Fill Structure - for grade separated option; This item is a T-Wall type retained fill concrete retaining wall structure as manufactured by The Neel Company or equal. This item is used in Option A, for purposes of retaining the railroad roadbed as the alignment ascends and descends to achieve grade separation. This item is used to achieve up to 12 feet in vertical separation from the existing ground.

Item 10.28: Bridge Structure Adjacent to NEC; This item is a steel through girder or deck girder ballasted deck bridge. This item is used in Option A, for purposes of ascending and descending from retained fill structure to the Bridge structure over NEC, Item 10.29. This item consists of steel through girder or deck girder ballasted deck bridges of no greater than 75 feet span length.

Item 10.29: Bridge Structure Over NEC; This item is for a complex, multiple span, long bridge structure, on a flat skew angle over the NEC. This item is used in Option A. At the time of this report, the engineering for this bridge had not been fully developed. However, at the area where the grade separated alignment crosses over the NEC, the skew angle to the NEC will be rather flat. Therefore, it is anticipated that a series of varying size structures would be necessary to bridge over the NEC.

Category 20, Stations, Shops, Terminal, Intermodal:

This category was not used in the estimate.

Category 30, Support Facilities: Yards, Shops, Admin. Bldgs:

This category was not used in the estimate.

Category 40, Sitework & Special Conditions:

Item 40.1: Utility Relocation – FOU; This item includes cost to re-locate the Fiber Optic Utility located on the west side of the right of way. The cost is in route miles, and is based on a similar utility relocation project. The size for the FOU is unknown.

Item 40.2: Utility Relocation ALLOWANCE; This item attempts to capture the cost associated with relocation of utilities other than FOU, which may be impacted by construction of additional track. Because of the limited knowledge a cost per rail foot was developed to quantify potential utility relocations. A research of utilities was not performed as part of this study.

Item 40.3: Clearing and Grubbing; This item includes clearing and grubbing of existing vegetation which locates within the work limits as established by the typical sections. For estimating purposes, a nominal 25 foot wide section was assumed to require clearing and grubbing for the length of the project. While item 10.01 assumed a 50 foot wide section for top soil removal, observation indicates that vegetation along the right of way is cleared to a point about 25 feet from existing tracks.

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Items 40.4 - 40.6: Embankment Construction General Excavation and Ditch Excavation; field observation indicates that the alignment locates within existing cuts, on embankments, and on nominally flat area. The cut sections appear to be as high as 15 feet, and the embankment sections achieve at least 15' as well. For purposes of estimating, three typical sections were developed to quantify earthwork; these include a typical cut section, typical embankment section, and typical ditch section. For cut and fill, the height or depth was set at 10 feet. For the general ditch section, the ground elevation was set level, with ditch excavation being the only work assumed. These sections were used to develop an earthwork quantity per track foot, per section. The sections were then applied to the alignment, as appropriate, based off available information. It is assumed that any excess excavated material will be stockpiled on Amtrak right of way.

Item 40.7: Drainage ALLOWANCE (Perforated Pipe); This item quantifies an underdrain / perforated pipe system, which would be necessary were the right of way drainage cannot be achieved using ditches, but where a conventional storm sewer would not be appropriate. As stated in Item 40.7, drainage design was not included at this level of engineering, but it is anticipated that it will be necessary to include this item in the final design effort. It is anticipated that this item would be essential for Option A, however, an ALLOWANCE of one mile was included for Option B as well. The item includes an allowance for 18" perforated corrugated metal pipe.

Item 40.8: Drainage ALLOWANCE (Storm Sewer); This item quantifies a storm sewer system, which would be necessary at locations where right of way drainage cannot be achieved by employing ditches. This level of engineering did not include a drainage design, but it is anticipated that during subsequent design efforts, storm sewer needs will be identified. As such, an ALLOWANCE of one mile for this item was included in the estimate. The item includes allowance for 24" reinforced concrete pipe, and drop inlets spaced on 500' centers.

Item 40.9: Environmental (E&S); This item includes all temporary and permanent erosion and sedimentation control devices including but not limited to silt fence, hay bales – check dams, rock construction entrances and seeding.

Item 40.10: Mobilization; This item includes cost associated with Contractor's mobilization and demobilization of staff and equipment. It also covers material the Contractor will need to purchase up front to begin work. The cost for this item is a percentage of the Construction Subtotals – Categories 10 – 50, as indicated in the table.

Item 40.11: Temporary Maintenance of Traffic; This item includes temporary maintenance of traffic at the 5 existing undergrade bridges during construction activities.

Item 40.12: Environmental Mitigation ALLOWANCE @ \$100k / mi; This item includes an allowance for mitigation of unknown elements discovered during earthwork activities. Generally, such items uncovered on railroad right of way would be moved and stored on railroad right of way, however, it is unknown what Amtrak's wishes are with respect to this item. Therefore, this allowance was included in the estimate.

Item 40.13: Environmental Mitigation at North East River – ALLOWANCE; This item is an ALLOWANCE for environmental mitigation and permitting which will be required for construction activities adjacent to the North East River. This measurement is in units of Acres. Acreage area includes from east limits of work activities, to the edge of river for the length of alignment adjacent to the river. Note that the horizontal offset from work limit to river was measured in Google Earth, and it is unknown if the river was at high or low tide when the area was photographed. As well, this assumes that no work will be performed in the river.

Category 50. Systems:

Item 50.1: Traction Power Substation Modifications - ALLOWANCE; This item is an ALLOWANCE for upgrades to the traction power substation which provides power to the section of catenary between Bacon and Prince Interlockings. Adding a track in this section will introduce additional power requirements from the substation. Offline conversations with Amtrak staff indicate that the existing substation should be sufficient to handle the additional power requirements, however, without an engineered study, this is still an unknown element. As such, an ALLOWANCE was added to attempt to capture unknown costs associated with this item.

Item 50.2: Electrification - OCS Using Existing Structure (Wire and Hardware Only); This item includes costs for furnishing and installing new catenary wire, hardware and appurtenances for the proposed track. The catenary wire would utilize existing catenary structures.



Item 50.3: OCS Using Proposed Cantilever Structure - Single Track; This item includes costs for furnishing and installing new catenary wire, hardware and appurtenances, new catenary pole, cantilever, foundation and guy wires. This item applies to areas where the proposed track locates outside of the limits of the existing catenary structures.

Item 50.4: Remove and Install Catenary Structure (Cantilever Structure); This item is very similar to Item 50.5, however this item includes costs for furnishing and installing a new cantilever catenary structure.

Item 50.5: Remove and Install Catenary Portal Structure (3 - 4 Track Structure); This item includes costs for furnishing and installing a new 4 track catenary structure, foundations, and appurtenances adjacent to an existing catenary structure, attaching the existing catenary, signal and high voltage lines to the new structure and demolishing / removing the existing catenary structure. This item applies to areas where the proposed track will locate nominally 14 feet adjacent to the existing track, and the existing catenary structure width does not provide sufficient clearance to the existing track.

Item 50.5: Remove and Install Catenary Structure (Cantilever Structure); This item is very similar to Item 50.4, however this item includes costs for furnishing and installing a new 4 cantilever catenary structure.

Item 50.6: TCS for New Track; This item includes furnishing and installing all equipment / material required to provide a Train Control System for the proposed track.

Item 50.7: Signal Modifications at Bacon Interlocking; This item includes furnishing and installing all equipment / material required to modify the signal system at Bacon Interlocking and distant signals to support the proposed schematic changes at the interlocking.

Item 50.8: Signal Modifications at Prince Interlocking; This item includes furnishing and installing all equipment / material required to modify the signal system at Prince Interlocking and distant signals to support the proposed schematic changes at the interlocking.

Category 60, Right of Way:

Item 60.: Right-of-Way; Right-of-way includes property, other than that which is currently owned by Amtrak, which would require purchase for construction of the project. Property lines / limits were established by GIS data provided by Cecil County MD. Right-of-way limits are based on the needs of the typical section, that is to say that only areas of property required for construction and future operation was considered necessary to acquire; purchase of entire lots was not included in the estimate. A detailed analysis of individual properties was not performed at this time. Instead, an average property value was established for Cecil County, and that cost per area was applied. The cost per area was doubled to include legal costs and other unknown elements which would present themselves at the time of purchase.

Item 60.2: Temporary Construction Easement; This item provides an ALLOWANCE for costs associated with acquiring temporary easements for purpose of constructing the project. The intent is that upon completion of the project, all property is returned to the existing owner, and in the same condition prior to construction.

Category 70, Vehicles:

This category was not used in the estimate.

Category 80, Professional Services:

Items 80.1 – 80.7; These categories itemize costs for what is typically referred to as soft costs. Soft costs include items such as surveying and engineering, construction monitoring, insurance and bid bonds associated with construction, permitting, and testing. All elements in category 80 calculated based on a percent of the construction subtotal. Overall, category 80 includes about 35% of the construction costs. This is a typical percentage based on experience with other large publicly funded railroad / transit projects.

Category 90, Unallocated Contingency:



Item 90.1: Project Reserve; This item represents project reserve, or what is commonly referred to as unallocated contingency. It represents a contingency factor applied to the sum of all cost categories, except category 60, right of way, and category 80, professional services.

ATTACHMENTS:

ATTACHMENT A: ORDER OF MAGNITUDE CAPITAL COST ESTIMATE, Dated 10-25-2011

ATTACHMENT B: EXHIBITS:

Sheet 1 of 10: Schematic Option A, Dated 10-07-2011

Sheet 2 of 10: Schematic Option A, At Bridge Over NEC, Dated 10-07-2011

Sheet 3 and 4 of 10: Typical Sections Option A, Dated 10-07-2011

Sheet 5 of 10: Schematic Option B, Dated 10-07-2011

Sheet 7 and 7 of 10: Typical Sections Option B, Dated 10-07-2011

Sheets 8 – 10 of 10: Typical Sections – All Options, Dated 10-07-2011

CHESAPEAKE CONNECTOR FREIGHT AND PASSENGER RAIL BENEFITS STUDY
 DATE: 01-10-11 DRAFT
 ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
 NOTE: COST IN 2011 DOLLARS

SUMMARY TABLE: DRAFT

Cat. No.	Description	OPTION A	OPTION B
		GRADE SEPARATED OPTION	AT GRADE OPTION
		TOTAL COST INCLUDING ALLOCATED AND UNALLOCATED CONTINGENCY: 2011 Dollars	TOTAL COST INCLUDING ALLOCATED AND UNALLOCATED CONTINGENCY: 2011 Dollars
10	GUIDEWAY & TRACK ELEMENTS		
	TOTAL CATEGORY 10	\$167,257,175	\$49,885,500
20	STATIONS, STOPS, TERMINALS, INTERMODAL		
	TOTAL CATEGORY 20	\$0	\$0
30	SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS		
	TOTAL CATEGORY 30	\$0	\$0
40	SITWORK & SPECIAL CONDITIONS		
	TOTAL CATEGORY 40	\$33,032,574	\$29,582,574
50	SYSTEMS		
	TOTAL CATEGORY 50	\$24,828,636	\$23,981,136
CONSTRUCTION SUBTOTAL (Sum Categories 10 - 50)		\$225,118,385	\$103,449,210
60	ROW, LAND, EXISTING IMPROVEMENTS		
	TOTAL CATEGORY 60	\$7,950,000	\$5,460,000
70	VEHICLES		
	TOTAL CATEGORY 70	\$0	\$0
80	PROFESSIONAL SERVICES (Calc. on Subtotal 10 - 50)		
	TOTAL CATEGORY 80	\$78,443,359	\$36,267,665
90	UNALLOCATED CONTINGENCY (Calculated on Subtotal Cat. 10 - 80)		
	TOTAL CATEGORY 90	\$37,955,514	\$17,023,614
Total Project		\$349,467,258	\$162,200,489

Total Route Miles	6.34	6.34
Cost Per Mile	\$ 55,080,213	\$ 25,564,734