Appendix J
Key Chesapeake Bay TMDL Reference and Management Modeling Scenarios: Definitions and Descriptions

1985 Scenario

The 1985 scenario uses the estimated 1985 land uses, NPS loadings, animal numbers, atmospheric deposition, and point source loads. This scenario estimates the highest loads of nitrogen, phosphorus, and sediment to the Bay in recent time (using a constant 1991-2000 hydrology). The Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

2009 Scenario

The 2009 scenario uses the estimated 2009 land uses, NPS loadings, animal numbers, atmospheric deposition, and point source loads as well as the best management practices tracked and reported by the seven watershed jurisdictions through 2009. The 2009 year was chosen as the baseline for the TMDL, as it was the most recent year for which complete implementation data (BMPs, waster loads, etc.) was available during the Bay TMDL development process. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

Tributary Strategy Scenario

The Tributary Strategy scenario estimates the nitrogen, phosphorus, and sediment loads through model simulations of full implementation of the seven jurisdictions' 2004-2005 tributary strategies throughout the Chesapeake Bay watershed. This scenario included an accounting for all the tributary strategy BMPs on a 2010 land use, and the 2010 estimated permitted loads for all the significant and non-significant wastewater dischargers, as described in Table J-1. Adjustments to the jurisdictions' tributary strategies developed in 2004 and 2005 to reflect changes in State laws or policies (e.g., permitting of significant wastewater discharge facilities) since development of the initial set of jurisdictional tributary strategies were also included in this scenario's input decks. Atmospheric deposition inputs were from the Community Multi-scale Air Quality Model's 12 km grid with an estimated 2010 deposition and included simulations of the State Implementation Plans to reach the 2010 Air Quality Standards. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

Table J-1. Wastewater discharge facilities and combined sewer overflows (CSO) assumptions for the Tributary Strategy, Everything by Everyone Everywhere (E3) and the 2010 No Action scenarios

Scenario		Tributary Strategy	E3	2010 No Action
Definition		Latest jurisdiction tributary strategy	Level of Technology Everywhere Tier 4 Level	No management action. Secondary Treatment at the same level everywhere with tributary strategy flows
Concentration	Significant Municipal Plants	Latest jurisdiction tributary strategy BOD=5 mg/l, DO=5 mg/l and TSS=5 mg/l	TN=3 and TP=0.1 BOD=3 mg/l, DO=6 mg/l and TSS=5 mg/l	TN=18 mg/l and TP =3 mg/l BOD=30 mg/l, DO=4.5 mg/l and TSS=15 mg/l
	Significant Industrial Plants	Latest jurisdiction tributary strategy BOD=5 mg/l, DO=5 mg/l and TSS=5 mg/l	TN=3 and TP=0.1 or tributary strategy level if less for industrial facilities BOD=3 mg/l, DO=6 mg/l and TSS=5 mg/l	Highest Loads on record, or tributary strategy loads if greater BOD=30 mg/l, DO=4.5 mg/l and TSS=15 mg/l
	Non-significant Municipal Plants	2006 data or more recently submitted non-significant facility data BOD=30 mg/l, DO=4.5 mg/l and TSS=25 or 45 mg/l	TN=8 mg/L and TP=2 mg/L for municipal plants Current level adjusted by the same rates used for sig industrial plants BOD =5 mg/l, DO=5 mg/l and TSS= 8 mg/l	TN=18 mg/l and TP =3 mg/l BOD=30 mg/l, DO=4.5 mg/l and TSS=15 mg/l
	Non-significant Industrial Plants	Tetra Tech estimated non-significant industrial data BOD=30 mg/l, DO=4.5 mg/l and TSS=25 or 45 mg/l	Tetra Tech estimated non-significant industrial data adjusted by the percentage of equivalent reduction from No-Action (18 mg/l TN, 3mg/l TP) to E3 (3 mg/l TN, 0.1 mg/l TP) BOD =5 mg/l, DO=5 mg/l and TSS= 8 mg/l	Tetra Tech estimated non-significant industrial data. BOD=30 mg/l, DO=4.5 mg/l and TSS=25 or 45 mg/l
Flow		Tributary strategy flows for significant facilities. 2006 data or more recently submitted data for non-significant facilities	Same as tributary strategy scenario	Same as tributary strategy scenario
CSO		Long Term Control Plan--full implementation	100% CSO overflow reduction	2003 Estimates

Notes: E3 - everyone, everything, everywhere, TN - total nitrogen, TP - total phosphorus, BOD - biological oxygen demand, DO - dissolved oxygen, TSS - total suspended solids, CSO- combined sewer overflow

1985 No Action Scenario

The No Action scenario estimates nitrogen, phosphorus, and sediment loads under the conditions of minimal to no pollution reduction controls on sources and nonpoint sources using a 1985 land use and human and agricultural animal populations. Major widespread management practices that would not already be in place such as nutrient management and conservation tillage were eliminated in this scenario. Wastewater treatment/discharging facilities were set at primary treatment with no nutrient removal and with no phosphate detergent ban. Atmospheric deposition loads were set to 1985 levels of emissions and controls. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

The No Action scenario is used with the E3 scenario to define “controllable” loads, the difference between No Action and E3 loads. No Action and E3 scenario conditions can be determined for historic years (beginning 1985), current year, or projected future (through 2030) by changing the underlying land use, associated pollutant loadings and population estimates. All past practices, programs, and treatment upgrades that currently exist are credited toward the needed reductions from the No Action “baseline”.

1985 No Action Wastewater Treatment/Discharging Facilities

- No Action Significant municipal wastewater treatment facilities
  - Flow = Tributary Strategy flows where most are at design flows
  - Nitrogen effluent concentration = 18 mg/l TN
  - Phosphorus effluent concentration = 6 mg/l TP
  - BOD = 30 mg/l, DO = 4.5 mg/l and TSS = 15 mg/l
- No Action Significant industrial dischargers
  - Flow = Tributary Strategy flows where most are at design flows
  - Highest Loads on record or Tributary Strategy loads if greater
  - BOD = 30 mg/l, DO = 4.5 mg/l and TSS = 15 mg/l
- No Action Nonsignificant municipal wastewater treatment facilities
  - Flow = Tributary Strategy flows
  - Nitrogen effluent concentration = 18 mg/l TN
  - Phosphorus effluent concentration = 6 mg/l TP
  - BOD = 30 mg/l, DO = 4.5 mg/l and TSS = 15 mg/l

1985 No Action Combined Sewer Overflows

- Flow = current base condition flow
- Nitrogen effluent concentration = 18 mg/l TN
- Phosphorus effluent concentration = 6 mg/l TP
- BOD = 200 mg/l, DO = 4.5 mg/l and TSS = 45 mg/l.

1985 No Action On-site Waste Treatment Systems

There are no nitrogen and phosphorus control practices and programs in the No Action scenario throughout the Chesapeake Bay watershed for on-site waste treatment systems.

1985 No Action Atmospheric Deposition

The 2020 CMAQ Scenario is used for atmospheric deposition in both the E3 and No-Action scenarios in determining the “controllable” load (see Appendix L). This approach allows for the agreed to Bay TMDL air reductions to be already considered in the nitrogen load reductions needed to achieve the Bay water quality standards.

1985 No Action Urban Practices

There are no nitrogen, phosphorus, and sediment control practices and programs in the No Action scenario throughout the Chesapeake Bay watershed for the urban sector.

1985 No Action Agricultural Practices

There are no nitrogen, phosphorus, and sediment control practices and programs in the No Action scenario throughout the Chesapeake Bay watershed for agricultural lands and operations.

1985 No Action Forestry Practices

There are no nitrogen, phosphorus, and sediment control practices and programs in the No Action scenario throughout the Chesapeake Bay watershed on forest lands where there could be environmental impacts from timber harvesting and dirt and gravel roads.

2010 No Action Scenario

This scenario estimates nutrient and sediment loads under the conditions of minimal to no pollution reduction controls on point sources and nonpoint sources using a 2010 land use and population. Major widespread management practices such as nutrient management and conservation tillage were eliminated in this scenario. Wastewater treatment facilities were set at primary treatment (no nutrient removal) with no phosphate detergent ban. Atmospheric deposition loads were set to 1985 levels of emissions and controls. See the above description of the 1985 No Action Scenario for further details. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

Everyone, Everything, Everywhere (E3) Scenario

The E3 Scenario is an estimate of the application of management actions to the fullest possible extent practicable (this is not Limit of Technology). The E3 scenario is a “what-if” scenario of watershed conditions with the theoretical maximum practicable levels of managed controls on all pollutant load sources. There are no cost and few physical limitations to implementing BMPs for point and nonpoint sources in the E3 scenario. This scenario is used with the No Action scenario to define "controllable" loads, the difference between No Action and E3 loads. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

"Controllable" loads are considered when allocating the target loads needed to meet water quality standards to different regions of the Chesapeake Bay watershed. Target cap allocations also take into consideration the relative impacts of load reductions from regions throughout the watershed on water quality standards. Differences between No Action and E3 scenario loads provide equity among regions of the Chesapeake Bay watershed in that the assumptions for point source controls and nonpoint source practice and program implementation levels for each scenario are spatially universal. Differences among regions occur because of more "inherent" differences in, for example, animal and human populations, the number and types of point source facilities, agricultural land uses and areas, urban land areas, atmospheric deposition, etc.

Generally, E3 implementation levels and their associated reductions in nitrogen, phosphorus, and sediment could not be achieved for many practices, programs, and control technologies when considering physical limitations and required participation levels. E3 includes most technologies, practices and programs that have been reported by jurisdictions as part of annual model assessments, Tributary Strategies, and two-year milestones.

For most non-point source BMPs, it was assumed that the load from every available acre of the relevant land area was being controlled by a suite of existing or innovative practices. In addition, management programs converted land uses from those with high yielding nitrogen, phosphorus, and sediment loads to those with lower. E3 does not include the entire suite of practices, but rather, fully implements only those practices that have been estimated to produce greater reductions than alternative practices that could be applied to the same land base.

The current definition of E3 includes a greater number of types of practices than historic E3 scenarios. E3 load reductions could be exceeded through greater effectiveness of practices and technologies in the future because of, for example, employment of new technologies and greater efforts on operation and maintenance. For point sources, nutrient control technologies are assumed to apply to all dischargers.

E3 Wastewater Discharging Facilities

- E3 Significant municipal wastewater treatment facilities
  - Flow = Tributary Strategy flows where most are at design flows
  - Nitrogen effluent concentration = 3 mg/l TN
  - Phosphorus effluent concentration = 0.1 mg/l TP
  - BOD = 3 mg/l, DO = 6 mg/l and TSS = 5 mg/l
- E3 Significant industrial dischargers
  - Flow = Tributary Strategy flows where most are at design flows
  - Nitrogen effluent concentration = 3 mg/l TN or Tributary Strategy concentration if less
  - Phosphorus effluent concentration = 0.1 mg/l TP or Tributary Strategy concentration if less
  - BOD = 3 mg/l, DO = 6 mg/l and TSS = 5 mg/l

- E3 Non-significant municipal wastewater treatment facilities
  - Flow = Design or 2006 flow if design is not available
  - Nitrogen effluent concentration = 8 mg/l TN or Tributary Strategy concentration if less
  - Phosphorus effluent concentration = 2 mg/l TP or Tributary Strategy concentration if less
  - BOD = 5 mg/l, DO = 5 mg/l and TSS = 8 mg/l
- E3 Nonsignificant industrial wastewater treatment facilities
  - Applies the percentage of equivalent reduction from No Action (18 mg/l TN, 3mg/l TP) to E3 (3 mg/l TN, 0.1 mg/l TP) to the 2010 load estimates.

E3 Combined Sewer Overflows

- 100% overflow reduction through storage and treatment, separation or other practices. Storage and treatment is assumed in current model scenarios.

E3 On-site Wastewater Treatment Systems

- E3 Septic system connections
  - 10% of septic systems retired and connected to wastewater treatment facilities.
- E3 Septic denitrification and maintenance
  - Remaining septic systems after connections employ denitrification technologies and are maintained through regular pumping to achieve a 55% TN load reduction at the edge-of-septic-field.
  - Septic systems are maintained by a responsible management entity or in perpetuity through a maintenance contract.

E3 Atmospheric Deposition

- E3 atmospheric deposition uses the Chesapeake Bay Program's air scenario that shows the maximum reductions in deposition – a projection to 2020 called the Maximum Feasible Scenario (see Appendix L).
- The Chesapeake Bay Program's Water Quality Goal Implementation Team decided to use the same atmospheric deposition for both the E3 and No Action scenarios in the allocation methodology.
- The 2020 Maximum Feasible Scenario represents incremental improvements and control options (beyond 2020 CAIR) that might be available to states for application by 2020 to meet a more stringent ozone standard, stricter than 0.08 ppm – such as the proposed 0.070 ppm ozone standard of January 2010.
- Emissions projections for the 2020 E3 scenario assume the following:
  - National/regional and available State Implementation Plans (SIP) for NOx reductions – with lower ozone season nested emission caps in OTC states; targeting use of maximum controls for coal fired power plants in or near non-attainment areas.
  - Electric Generating Units (EGU):
    - CAIR second phase in place, in coordination with earlier NOx SIP call.

    - NOx Budget Trading Program (NBP).
    - Regional Haze Rule and guidelines for Best Available retrofit Technology (BART) for reducing regional haze.
    - Clean Air Mercury Rule (CAMR) in place.
  - Non-EGU point sources:
    - New supplemental controls, such as low NOx burners, plus increased control measure efficiencies on planned controls and step up of controls to maximum efficiency measures, e.g., replacing SNCRs (Selective Non-Catalytic Reduction) with SCRs (Selective Catalytic Reduction) control technology.
    - Solid Waste Rules – Hospital/Medical Waste Incinerator Regulations
  - On-Road mobile sources:
    - On-Road Light Duty Mobile Sources – Tier 2 vehicle emissions standards and the Gasoline Sulfur Program which affects SUV's, pickups and vans which are subject to same national emission standards as cars.
    - On-Road Heavy Duty Diesel Rule – Tier 4: New emission standards on diesel engines starting with the 2010 model year for NOx, plus increased penetration of diesel retrofits and continuous inspection and maintenance using remote onboard diagnostic systems.
  - Clean Air Non-Road Diesel Rule:
    - Off-road diesel engine vehicle rule, reduced NOx emissions from marine vessels in coastal shipping lanes, and locomotive diesels (phased in by 2014) require controls on new engines.
    - Off-road large spark ignition engine rules affect recreational vehicles (marine and land based).
  - Area (nonpoint area) sources: switching to natural gas and low sulfur fuel.

- E3 Agricultural Ammonia Emissions Reductions
  - Assumes rapid incorporation of fertilizers in soils at the time of application, litter treatment, bio-filters on housing ventilation systems, and covers on animal waste storage or treatment facilities.
  - The overall benefit of reduced emissions from confined animal housing and waste storage as well as lower emissions from fertilized soils is a 15% reduction of ammonia deposition.

E3 Urban Practices

- E3 Forest conservation & urban growth reduction
  - All projected loss of forest from development is retained or planted in forest.

- E3 Riparian forest buffers on urban
  - 10% of pervious riparian areas without natural vegetation (forests and wetlands) associated with urban lands are buffered as forest for each modeled hydrologic segment in the Chesapeake Bay watershed.
  - The area of un-buffered riparian land is determined using the best available data: 1) 1:24K National Hydrography Dataset; and 2) 2001 land cover.

- E3 Tree planting on urban
  - Forest conservation and urban riparian forest buffers account for tree plantings in the urban sector.
- E3 Stormwater Management
  - Regions with karst topography (low permeability) and Coastal Plain Lowlands (high groundwater)
    - 50% of areas – impervious cover reduction.
    - 30% of area – filtering practices designed to reduce TN by 40%, TP by 60% and SED by 80% from a pre-BMP condition.
    - 20% of area – infiltration practices designed to reduce TN by 85%, TP by 85% and sediment by 95% from a pre-BMP condition.
  - Ultra-urban regions – defined as high- and medium-intensity land cover
    - 50% of areas – impervious cover reductions, e.g. cisterns and collections systems to capture rainwater for reuse.
    - 30% of area – filtering practices, e.g., sand filters, bio-retention, and dry wells.
    - 20% of area – infiltration practices, e.g., infiltration trenches and basins.
  - Other urban/suburban regions
    - 10% of areas – impervious cover reduction.
    - 30% of area – filtering practices, e.g. sand filters, bio-retention.
    - 60% of area – infiltration practices.
- E3 Erosion & sediment controls
  - Controls of the runoff from all bare-construction land use areas are assumed to be at a level so that the construction loads are equal to the nutrient and sediment edge-of-stream loads from pervious urban under E3 conditions.
- E3 Nutrient management on urban
  - All pervious urban acres are under nutrient management.
- E3 Controls on extractive (active and abandoned mines)
  - Controls of the runoff from all extractive land use areas are assumed to be to a degree so that the loads are equal to the nutrient and sediment edge-of-stream loads from pervious urban under E3 conditions.

E3 Agricultural Practices

- E3 Conservation tillage
  - All row crops are conservation-tilled.
- E3 Enhanced nutrient management applications
  - All cropland is under enhanced nutrient management – the hybrid of reduced application rate and decision agriculture.
  - Long-term, adaptive management approach with continuous improvement.

- E3 Riparian forest buffers on agriculture
  - Riparian areas without natural vegetation (forests and wetlands) associated with agricultural lands are buffered as forest.
  - This equates to 15% of cropland and 10% of pasture land including the pasture stream corridor for each modeled hydrologic segment in the Chesapeake Bay watershed.
  - The area of un-buffered riparian land is determined using the best available data: 1) 1:24K National Hydrography Dataset; and 2) 2001 land cover.
  - Current implementation of riparian grass buffers is considered converted to riparian forest buffers.
- E3 Wetland restoration
  - 5% of available agricultural acres in crops and grazed for each modeled hydrologic segment in the Chesapeake Bay watershed.
- E3 Carbon sequestration / alternative crops
  - 5% of the available row crop acres for each modeled hydrologic segment in the Chesapeake Bay watershed.
  - Program is replacement of row crops with long-term grasses that serve as a carbon bank.
- E3 Agricultural land retirement
  - Retirement of highly erodible land is considered in the E3 practices of riparian forest buffers, wetland restoration, and carbon sequestration practices which typically have equal or greater environmental benefits.
- E3 Tree planting on agriculture
  - Tree planting is considered in the E3 practice of riparian forest buffers which typically have equal or greater environmental benefits.
- E3 Conservation Plans (non-nutrient management)
  - Conservation Plans are fully implemented on all agricultural land (row crops, hay, alfalfa, and pasture).
- E3 Cover crops and commodity cover crops
  - Early-planting rye cover crops with drilled seeding on all relevant row crops.
  - The watershed-wide average of 81% of row crops are not associated with small-grain production is applied to each modeled hydrologic segment in the Chesapeake Bay watershed.
  - Early-planting wheat commodity cover crops with drilled seeding on remaining row crops (associated with small-grain production).
    - The watershed-wide average of 19% of row crops associated with small-grain production is applied to each modeled hydrologic segment in the Chesapeake Bay watershed.
- E3 Pasture Management
  - Stream Access Control with Fencing – Exclusion fencing is assumed to protect the stream corridor area designated as the degraded landuse and the area between the

stream bank and fence is converted to (and is part of) the agricultural forest buffer determination.
  - Prescribed grazing – All upland pasture area is assumed to be under prescribed grazing.
  - Dairy Precision Feeding and Forage Management (also listed under E3 Dairy Precision Feeding) – All dairy heifers have reduced nutrient concentrations in excreted manure of TN = 24% and TP = 28% from a pre-feed management condition.
    - Management approaches may include increased productivity and use of on-farm grass forage.
  - Horse pasture management benefits are the same as those for fencing and prescribed grazing practices for livestock in general.

- E3 Animal waste management/runoff control
  - Controls of runoff of manure nutrients from the production area of animal feeding operations is assumed to be at a level so that loads are equal to the nutrient and sediment edge-of-stream loads associated with hay that does not receive fertilizer applications.
  - Other practices typically associated with animal waste management and runoff control, that may affect runoff from the production area, are addressed separately in the E3 scenario. These include Poultry and Swine Phytase, Dairy Precision Feeding, Manure Transport, and Ammonia Emissions Reductions.

- E3 Poultry phytase
  - The phosphorus content in the manure of all poultry is reduced by 32% from a pre-feed management condition.

- E3 Swine phytase
  - The phosphorus content in excreted manure of all swine is reduced from a pre-feed management condition by 17%.

- E3 Dairy Precision Feeding
  - All dairy heifers have reduced nutrient concentrations in excreted manure of TN = 24% and TP = 28% from a pre-feed management condition.

- E3 Ammonia emissions reductions
  - Also under E3 Atmospheric Deposition – Agricultural Ammonia Emissions Reductions
  - Assumes rapid incorporation of fertilizers in soils at the time of application, litter treatment, bio-filters on housing ventilation systems, and covers on animal waste storage or treatment facilities.
  - The overall benefit of reduced emissions from confined animal housing and waste storage as well as lower emissions from fertilized soils is a 15% reduction of ammonia deposition.

- E3 Nursery Management
  - All nursery operations are managed through a number of practices to protect water quality including properly addressing nutrient management and incorporating erosion and sedimentation controls.

- Controls are to a degree so that runoff from nursery areas is equal to the nitrogen, phosphorus, and sediment edge-of-stream loads from hay that does not receive fertilizer applications.

E3 Forest Harvest Practices

- E3 Forest harvesting practices
  - Controls of runoff from the disturbed area of timber harvest operations is assumed to be at a level so that the nitrogen, phosphorus, and sediment loads are equal to edge-of-stream loads associated with the forest/woody landuse.
  - It's assumed these BMPs, designed to minimize the environmental impacts from timber harvesting (such as road building and cutting/thinning operations), are properly installed on all harvested lands with no measurable increase in nitrogen, phosphorus, and sediment discharge.

All Forest with Current Air Scenario

This scenario uses an all forest land use and estimated atmospheric deposition loads for the 1991 – 2000 period, and represents estimated loads with maximum reductions on the land including the elimination of fertilizer, point source, and manure loads. However, this scenario has loads greater than a pristine scenario which would have reduced input atmospheric deposition loads by about an order of magnitude. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Tables J-3, J-5, and J-7, respectively.

Base Calibration Scenario

The Base Calibration Scenario is used in data correction procedures and represents the calibration of the time series of land uses, loads, and hydrology over the ten year simulation period (1991-2001) used for TMDL scenarios. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Tables J-2, J-4, and J-6, respectively.

Allocation Scenario

The Allocation Scenario characterizes the nitrogen, phosphorus and sediment loads necessary to achieve the Bay jurisdictions' Chesapeake Bay water quality standards. This scenario, ultimately replaced by the final Bay TMDL allocations listed in Section 9, is provided for documentation purposes. The Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Table J-8.

190/12.7 Loading Scenario

This scenario of 190 million pounds nitrogen and 12.7 million pounds phosphorus delivered to the Bay is one of several scoping scenarios that were run to explore the region of nutrient loads that were close to achieving all water quality standards in the Chesapeake. Phase 5.3 Chesapeake

Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-3, J-5, and J-7, respectively.

179/12 Loading Scenario

This scenario of 179 million pounds nitrogen and 12 million pounds phosphorus delivered to the Bay is one of several scoping scenarios that were run to explore the region of nutrient loads that were close to achieving all water quality standards in the Chesapeake Bay. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Tables J-3, J-5 and J-7, respectively.

170/11.3 Loading Scenario

This scenario of 170 million pounds nitrogen and 11.3 million pounds phosphorus delivered to the Bay is one of several scoping scenarios that were run to explore the region of nutrient loads that were close to achieving all water quality standards in the Chesapeake Bay. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-3, J-5, and J-7, respectively.

James Level of Effort Potomac Scenario

This scenario was one of several scoping scenarios examining achievement of the tidal James River's chlorophyll *a* water quality standards. The 190/12.7 Loading Scenario was used as a base for this scenario and all other basins but the James River basin received the nitrogen and phosphorus loadings that were allocated as part of the 190/12.7 Loading Scenario. In the James River basin, the nitrogen and phosphorus loads were equivalent to the same level of effort as Virginia's portion of the Potomac for the 190/12.7 Loading Scenario. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus, and sediment loads for this scenario are listed in Tables J-3, J-5, and J-7, respectively.

James ½ Level of Effort Potomac Scenario

This scenario was one of several scoping scenarios examining achievement of the tidal James River's chlorophyll *a* water quality standards. The 190/12.7 Loading Scenario was used as a base for this scenario and all other basins but the James received the nitrogen and phosphorus loadings that were allocated as part of the 190/12.7 Loading Scenario. In the James River basin, the nitrogen and phosphorus loads are equivalent to the level of effort ***half way*** between Virginia's portion of the Potomac River basin and the James River basin for the 190/12.7 Loading Scenario. Phase 5.3 Chesapeake Bay Watershed Model simulated nitrogen, phosphorus and sediment loads for this scenario are listed in Tables J-3, J-5 and J-7, respectively.

Please note that in some cases the scenario loads reported in this Appendix may differ slightly from loads reported in other documentation, such as in the stoplight plots in Appendix M. This is because the scenario loads in this Appendix have the latest updated input load information but the stoplight plots in Appendix M contain scenarios that were dated and in some cases corrected with new information. For example, the scoping scenarios of the 190/12.7 Loading Scenario, 179/12 Loading Scenario, and 170/11 Loading Scenario were developed with appropriate factors of an early Tributary Strategy Scenario which has been updated since the stoplight assessments were run.

Table J-2. Delivered Total Nitrogen Loads (millions lbs/year) by State Basin and Scenario

Scenario		1985	Base Calibration	2009	2010 No-Action	Tributary Strategy	2010 E3
Eastern Shore (EAS)							
	DE	4.59	4.77	4.15	4.98	3.16	2.22
	MD	16.55	16.35	12.42	17.70	9.84	7.18
	PA	0.57	0.54	0.44	0.49	0.31	0.20
	VA	2.15	2.20	2.00	2.41	1.03	0.79
James River Basin (JAM)							
	VA	42.47	36.82	31.52	49.11	27.51	16.45
	WV	0.02	0.02	0.02	0.02	0.02	0.02
Potomac River Basin (POT)							
	DC	6.22	5.41	2.86	9.78	2.26	1.47
	MD	29.56	26.96	18.77	32.96	16.10	11.42
	PA	7.23	6.95	6.23	6.69	4.24	3.50
	VA	30.14	28.36	20.31	33.53	16.38	13.31
	WV	8.08	7.79	5.91	6.37	4.78	3.61
Rappahannock River Basin (RAP)							
	VA	8.92	8.35	6.94	9.33	5.62	4.39
Susquehanna River Basin (SUS)							
	MD	2.29	2.02	1.54	1.75	1.26	0.87
	NY	16.87	15.02	10.95	11.03	9.56	6.39
	PA	127.49	118.86	101.65	119.29	71.09	56.89
Western Shore (WES)							
	MD	27.00	17.75	14.00	36.64	9.84	5.99
	PA	0.04	0.04	0.03	0.04	0.01	0.01
Patuxent River Basin (PAT)							
	MD	4.16	3.86	3.09	6.01	2.78	2.03
York River Basin (YOR)							
	VA	7.60	7.37	6.44	8.49	5.09	3.83
Totals(millions lbs/year)							
State	DC	6.22	5.41	2.86	9.78	2.26	1.47
	DE	4.59	4.77	4.15	4.98	3.16	2.22
	MD	79.56	66.95	49.81	95.05	39.82	27.49
	NY	16.87	15.02	10.95	11.03	9.56	6.39
	PA	135.34	126.39	108.35	126.51	75.66	60.59
	VA	91.27	83.10	67.21	102.86	55.65	38.78
	WV	8.11	7.81	5.93	6.39	4.80	3.63
Basin	EAS	23.85	23.85	19.01	25.58	14.34	10.39
	JAM	42.49	36.84	31.54	49.12	27.53	16.47
	POT	81.23	75.47	54.07	89.33	43.76	33.31
	RAP	8.92	8.35	6.94	9.33	5.62	4.39
	SUS	146.65	135.90	114.14	132.07	81.92	64.15
	WES	27.04	17.79	14.03	36.68	9.85	6.00
	PAT	4.16	3.86	3.09	6.01	2.78	2.03
	YOR	7.60	7.37	6.44	8.49	5.09	3.83
Chesapeake Bay Total(millions lbs/year)							
Total		341.95	309.44	249.26	356.61	190.90	140.57

Table J-3. Delivered Total Nitrogen Loads (millions lbs/year) by State Basin and Scenario

		190/12.7	179/12	170/11.3	James L.O.E. 1/2 Potomac	James L.O.E. Potomac	All Forest
Eastern Shore							
	DE	3.14	2.85	2.57	3.14	3.14	0.58
	MD	9.76	8.88	8.00	9.76	9.76	2.65
	PA	0.31	0.28	0.25	0.31	0.31	0.09
	VA	1.02	0.93	0.84	1.02	1.02	0.22
James River Basin							
	VA	26.55	25.99	25.43	23.47	21.51	7.26
	WV	0.02	0.02	0.02	0.02	0.02	0.01
Potomac River Basin							
	DC	2.31	2.21	2.10	2.31	2.31	0.06
	MD	16.48	15.72	14.96	16.48	16.48	4.66
	PA	4.34	4.14	3.94	4.34	4.34	1.03
	VA	16.77	16.00	15.23	16.77	16.77	5.22
	WV	4.89	4.67	4.44	4.89	4.89	1.84
Rappahannock River Basin							
	VA	5.87	5.54	5.22	5.87	5.87	2.20
Susquehanna River Basin							
	MD	1.25	1.17	1.09	1.25	1.25	0.50
	NY	9.44	8.85	8.27	9.44	9.44	2.88
	PA	70.20	65.87	61.54	70.20	70.20	23.52
Western Shore							
	MD	9.45	9.08	8.71	9.45	9.45	2.29
	PA	0.01	0.01	0.01	0.01	0.01	0.00
Patuxent River Basin							
	MD	2.77	2.63	2.49	2.77	2.77	0.88
York River Basin							
	VA	5.37	5.10	4.83	5.37	5.37	1.85
Totals(millions lbs/year)							
State	DC	2.31	2.21	2.10	2.31	2.31	0.06
	DE	3.14	2.85	2.57	3.14	3.14	0.58
	MD	39.70	37.48	35.26	39.70	39.70	10.98
	NY	9.44	8.85	8.27	9.44	9.44	2.88
	PA	74.86	70.30	65.74	74.86	74.86	24.63
	VA	55.58	53.56	51.54	52.51	50.55	16.74
	WV	4.91	4.69	4.46	4.91	4.91	1.85
Basin	EAS	14.23	12.94	11.66	14.23	14.23	3.54
	JAM	26.57	26.01	25.45	23.49	21.53	7.27
	POT	44.79	42.73	40.67	44.79	44.79	12.80
	RAP	5.87	5.54	5.22	5.87	5.87	2.20
	SUS	80.88	75.89	70.90	80.88	80.88	26.90
	WES	9.46	9.09	8.72	9.46	9.46	2.30
	PAT	2.77	2.63	2.49	2.77	2.77	0.88
	YOR	5.37	5.10	4.83	5.37	5.37	1.85
Chesapeake Bay Total(millions lbs/year)							
		189.94	179.94	169.95	186.86	184.90	57.72

Table J-4. Delivered Total Phosphorus Loads (millions lbs/year) by State Basin and Scenario

		1985	Base Calibration	2009	2010 No-Action	Tributary Strategy	2010 E3
Eastern Shore							
	DE	0.37	0.38	0.32	0.45	0.27	0.19
	MD	1.70	1.59	1.17	2.00	1.04	0.83
	PA	0.02	0.02	0.02	0.02	0.01	0.01
	VA	0.26	0.25	0.19	0.30	0.13	0.12
James River Basin							
	VA	6.47	4.32	3.25	7.52	3.28	1.55
	WV	0.01	0.01	0.01	0.01	0.01	0.01
Potomac River Basin							
	DC	0.10	0.10	0.09	1.58	0.11	0.05
	MD	1.48	1.24	1.01	3.56	1.03	0.63
	PA	0.57	0.54	0.54	0.61	0.38	0.33
	VA	2.18	2.09	2.01	4.97	1.70	0.98
	WV	0.85	0.91	0.82	0.92	0.54	0.37
Rappahannock River Basin							
	VA	1.29	1.24	1.08	1.65	0.94	0.60
Susquehanna River Basin							
	MD	0.09	0.07	0.06	0.07	0.06	0.04
	NY	1.07	0.98	0.80	0.97	0.65	0.43
	PA	4.48	3.79	3.41	5.25	2.65	1.76
Western Shore							
	MD	1.62	0.87	0.77	3.63	0.68	0.25
	PA	0.00	0.00	0.00	0.00	0.00	0.00
Patuxent River Basin							
	MD	0.48	0.36	0.29	0.83	0.29	0.13
York River Basin							
	VA	1.02	0.76	0.62	1.16	0.59	0.35
Totals(millions lbs/year)							
State	DC	0.10	0.10	0.09	1.58	0.11	0.05
	DE	0.37	0.38	0.32	0.45	0.27	0.19
	MD	5.37	4.13	3.31	10.10	3.10	1.88
	NY	1.07	0.98	0.80	0.97	0.65	0.43
	PA	5.07	4.36	3.97	5.89	3.04	2.10
	VA	11.24	8.67	7.15	15.60	6.64	3.60
	WV	0.86	0.93	0.83	0.93	0.55	0.38
Basin	EAS	2.36	2.23	1.70	2.77	1.45	1.15
	JAM	6.49	4.34	3.26	7.53	3.29	1.55
	POT	5.19	4.90	4.46	11.64	3.76	2.36
	RAP	1.29	1.24	1.08	1.65	0.94	0.60
	SUS	5.64	4.84	4.27	6.29	3.36	2.24
	WES	1.62	0.87	0.77	3.63	0.68	0.25
	PAT	0.48	0.36	0.29	0.83	0.29	0.13
	YOR	1.02	0.76	0.62	1.16	0.59	0.35
Chesapeake Bay Total(millions lbs/year)							
		24.10	19.54	16.46	35.51	14.36	8.63

Table J-5. Delivered Total Phosphorus Loads (millions lbs/year) by State Basin and Scenario

		190/12.7	179/12	170/11.3	James L.O.E.	James L.O.E.	All Forest
					1/2 Potomac	Potomac	
Eastern Shore(EAS)							
	DE	0.29	0.27	0.25	0.29	0.29	0.05
	MD	1.10	1.02	0.94	1.10	1.10	0.22
	PA	0.01	0.01	0.01	0.01	0.01	0.00
	VA	0.14	0.13	0.12	0.14	0.14	0.02
James River Basin(JAM)							
	VA	2.67	2.57	2.47	2.34	2.21	0.90
	WV	0.01	0.01	0.01	0.01	0.01	0.01
Potomac River Basin(POT)							
	DC	0.10	0.09	0.09	0.10	0.10	0.00
	MD	0.95	0.90	0.85	0.95	0.95	0.25
	PA	0.35	0.33	0.31	0.35	0.35	0.13
	VA	1.56	1.48	1.39	1.56	1.56	0.40
	WV	0.50	0.47	0.45	0.50	0.50	0.27
Rappahannock River Basin(RAP)							
	VA	0.91	0.85	0.78	0.91	0.91	0.30
Susquehanna River Basin(SUS)							
	MD	0.05	0.05	0.04	0.05	0.05	0.01
	NY	0.56	0.53	0.51	0.56	0.56	0.31
	PA	2.28	2.17	2.06	2.28	2.28	1.04
Western Shore(WES)							
	MD	0.45	0.42	0.40	0.45	0.45	0.15
	PA	0.00	0.00	0.00	0.00	0.00	0.00
Patuxent River Basin(PAT)							
	MD	0.21	0.20	0.18	0.21	0.21	0.07
York River Basin(YOR)							
	VA	0.54	0.51	0.48	0.54	0.54	0.21
Totals(millions lbs/year)							
State	DC	0.10	0.09	0.09	0.10	0.10	0.00
	DE	0.29	0.27	0.25	0.29	0.29	0.05
	MD	2.75	2.58	2.41	2.75	2.75	0.71
	NY	0.56	0.53	0.51	0.56	0.56	0.31
	PA	2.64	2.52	2.39	2.64	2.64	1.17
	VA	5.82	5.53	5.24	5.48	5.36	1.84
	WV	0.51	0.48	0.45	0.51	0.51	0.28
Basin	EAS	1.53	1.42	1.31	1.53	1.53	0.30
	JAM	2.68	2.58	2.47	2.35	2.22	0.91
	POT	3.46	3.27	3.09	3.46	3.46	1.06
	RAP	0.91	0.85	0.78	0.91	0.91	0.30
	SUS	2.89	2.75	2.62	2.89	2.89	1.36
	WES	0.45	0.42	0.40	0.45	0.45	0.15
	PAT	0.21	0.20	0.18	0.21	0.21	0.07
	YOR	0.54	0.51	0.48	0.54	0.54	0.21
Chesapeake Bay Total(millions lbs/year)							
		12.67	12.00	11.33	12.33	12.20	4.36

Table J-6. Delivered Total Suspended Solids Loads (millions lbs/year) by State Basin and Scenario

		1985	Base Calibration	2009	2010 No-Action	Tributary Strategy	2010 E3
Eastern Shore							
	DE	76.68	76.96	64.78	93.67	54.75	31.13
	MD	260.20	243.41	185.80	294.98	156.99	126.05
	PA	38.73	37.04	31.66	40.47	20.12	19.52
	VA	22.16	20.21	16.38	21.99	10.30	8.83
James River Basin							
	VA	1562.90	1473.21	1247.04	1506.04	1004.70	691.16
	WV	29.45	28.81	28.52	28.59	18.21	14.62
Potomac River Basin							
	DC	22.54	29.86	32.00	100.95	10.31	4.12
	MD	923.43	866.58	781.47	1036.36	665.62	471.50
	PA	323.32	303.02	309.61	391.39	226.28	225.46
	VA	1296.91	1204.65	1092.77	1346.84	823.32	607.61
	WV	426.22	384.14	349.86	418.46	230.02	166.15
Rappahannock River Basin							
	VA	890.56	840.71	754.27	852.79	688.86	634.32
Susquehanna River Basin							
	MD	106.49	96.35	73.29	100.82	63.55	53.72
	NY	400.98	336.60	337.27	344.28	310.74	212.05
	PA	2718.95	2386.77	2286.39	2899.89	1756.33	1589.07
Western Shore							
	MD	311.80	266.86	239.00	325.15	204.99	105.10
	PA	0.93	0.89	0.77	1.11	0.49	0.56
Patuxent River Basin							
	MD	182.30	171.33	114.46	158.87	103.34	60.57
York River Basin							
	VA	208.88	179.78	145.18	201.47	114.12	83.19
Totals(millions lbs/year)							
State	DC	22.54	29.86	32.00	100.95	10.31	4.12
	DE	76.68	76.96	64.78	93.67	54.75	31.13
	MD	1784.21	1644.53	1394.02	1916.18	1194.48	816.94
	NY	400.98	336.60	337.27	344.28	310.74	212.05
	PA	3081.93	2727.72	2628.42	3332.86	2003.23	1834.60
	VA	3981.40	3718.57	3255.65	3929.11	2641.31	2025.11
	WV	455.67	412.96	378.38	447.04	248.23	180.77
Basin	EAS	397.76	377.62	298.62	451.11	242.17	185.53
	JAM	1592.34	1502.02	1275.56	1534.62	1022.91	705.78
	POT	2992.42	2788.26	2565.72	3293.99	1955.55	1474.84
	RAP	890.56	840.71	754.27	852.79	688.86	634.32
	SUS	3226.43	2819.72	2696.94	3345.00	2130.62	1854.84
	WES	312.73	267.75	239.76	326.26	205.48	105.65
	PAT	182.30	171.33	114.46	158.87	103.34	60.57
	YOR	208.88	179.78	145.18	201.47	114.12	83.19
Chesapeake Bay Total(millions lbs/year)							
		9803.41	8947.19	8090.52	10164.10	6463.06	5104.72

Table J-7. Delivered Total Suspended Solids Loads (millions lbs/year) by State Basin and Scenario

		190/12.7	179/12	170/11.3	James L.O.E. 1/2 Potomac	James L.O.E. Potomac	All Forest
Eastern Shore(EAS)							
	DE	59.35	53.25	47.15	59.35	59.35	43.17
	MD	170.16	152.68	135.20	170.16	170.16	51.17
	PA	21.81	19.57	17.33	21.81	21.81	7.11
	VA	11.17	10.02	8.87	11.17	11.17	2.63
James River Basin(JAM)							
	VA	893.92	875.04	856.15	833.04	809.93	388.49
	WV	16.20	15.86	15.52	15.10	14.68	11.68
Potomac River Basin(POT)							
	DC	9.73	9.36	9.00	9.73	9.73	2.44
	MD	627.64	604.39	581.13	627.64	627.64	263.33
	PA	213.37	205.46	197.56	213.37	213.37	99.70
	VA	776.35	747.58	718.82	776.35	776.35	274.89
	WV	216.90	208.86	200.83	216.90	216.90	120.38
Rappahannock River Basin(RAP)							
	VA	678.31	657.13	635.96	678.31	678.31	506.66
Susquehanna River Basin(SUS)							
	MD	59.65	58.51	57.37	59.65	59.65	24.85
	NY	291.65	286.08	280.51	291.65	291.65	186.12
	PA	1648.48	1616.97	1585.46	1648.48	1648.48	1044.88
Western Shore(WES)							
	MD	150.73	144.46	138.20	150.73	150.73	84.11
	PA	0.36	0.35	0.33	0.36	0.36	0.06
Patuxent River Basin(PAT)							
	MD	81.84	78.75	75.67	81.84	81.84	64.89
York River Basin(YOR)							
	VA	105.98	101.56	97.13	105.98	105.98	61.29
Totals(millions lbs/year)							
State	DC	9.73	9.36	9.00	9.73	9.73	2.44
	DE	59.35	53.25	47.15	59.35	59.35	43.17
	MD	1090.01	1038.79	987.56	1090.01	1090.01	488.34
	NY	291.65	286.08	280.51	291.65	291.65	186.12
	PA	1884.03	1842.36	1800.68	1884.03	1884.03	1151.75
	VA	2465.72	2391.33	2316.94	2404.84	2381.73	1233.96
	WV	233.10	224.72	216.34	231.99	231.58	132.06
Basin	EAS	262.48	235.52	208.55	262.48	262.48	104.08
	JAM	910.12	890.90	871.67	848.14	824.61	400.16
	POT	1843.98	1775.66	1707.35	1843.98	1843.98	760.74
	RAP	678.31	657.13	635.96	678.31	678.31	506.66
	SUS	1999.78	1961.56	1923.33	1999.78	1999.78	1255.85
	WES	151.09	144.81	138.53	151.09	151.09	84.17
	PAT	81.84	78.75	75.67	81.84	81.84	64.89
	YOR	105.98	101.56	97.13	105.98	105.98	61.29
Chesapeake Bay Total(millions lbs/year)							
		6033.58	5845.89	5658.19	5971.60	5948.07	3237.84

Table J-8. Delivered Total Allocation Scenario Loads (millions lbs/year) by State Basin

		Allocation Scenario (Nitrogen)	Allocation Scenario (Phosphorus)	Allocation Scenario (TSS) (range)
Eastern Shore(EAS)				
	DE	2.95	0.26	58-64
	MD	9.71	1.09	166-182
	PA	0.28	0.01	21-23
	VA	1.21	0.16	11-12
James River Basin(JAM)				
	VA	23.48	2.34	837-920
	WV	0.02	0.01	15-17
Potomac River Basin(POT)				
	DC	2.32	0.12	10-11
	MD	15.70	0.90	654-719
	PA	4.72	0.42	221-243
	VA	17.46	1.47	810-891
	WV	4.67	0.74	226-248
Rappahannock River Basin(RAP)				
	VA	5.84	0.90	681-750
Susquehanna River Basin(SUS)				
	MD	1.08	0.05	60-66
	NY	8.23	0.52	293-322
	PA	71.74	2.31	1660-1826
Western Shore(WES)				
	MD	9.74	0.46	155-170
	PA	0.02	0.001	0.37-0.41
Patuxent River Basin(PAT)				
	MD	2.85	0.21	82-90
York River Basin(YOR)				
	VA	5.41	0.54	107-118
Totals(millions lbs/year)				
State	DC	2.32	0.12	10-11
	DE	2.95	0.26	58-64
	MD	39.09	2.72	1,116-1,228
	NY	8.23	0.52	293-322
	PA	76.77	2.74	1,903-2,093
	VA	53.40	5.41	2,446-2,691
	WV	4.68	0.75	241-265
Basin	EAS	14.15	1.53	256 -281
	JAM	23.50	2.35	852-937
	POT	44.88	3.66	1,920-2,113
	RAP	5.84	0.90	681-750
	SUS	81.06	2.88	2,013-2,214
	WES	9.76	0.46	155-171
	PAT	2.85	0.21	82-90
	YOR	5.41	0.54	107-118
Bay Total(millions lbs/yr)				
		187.44	12.52	6,066-6,673