Chesapeake Bay Program
Scenario Purpose and Description for
E3 (Everything, Everywhere by Everyone)

May 17, 2010

- The E3 scenario is a "what-if" scenario of watershed conditions with theoretical maximum levels of managed controls on load sources.
  - There are no cost and few physical limitations to implementing BMPs for point and non-point sources in E3.
- It is used with the No-Action scenario to define "controllable" loads, the difference between No-Action and E3 loads.
  - "Controllable" loads is a component of the methodology to allocate target loads needed to meet water quality standards to different regions of the Chesapeake Bay watershed.
  - Load allocations of target caps 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 assumptions of point source controls and nonpoint source practice and program implementation levels for both scenarios 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 types and areas, urban land areas, atmospheric deposition, etc.
- Generally, E3 implementation levels and their associated reductions in nutrients and sediment could not be achieved for many practices, programs and control technologies when considering physical limitations and participation levels.
- E3 includes most technologies, practices and programs that have been reported by jurisdictions as part of annual model assessments, Tributary Strategies, and Milestones.
  - For most non-point source BMPs, it is assumed that the load from every available acre of the relevant land area is being controlled by a suite of existing or innovative practices. In addition, management programs convert landuses from those with high-yielding nutrient and sediment loads to those with lower.
  - E3 does not include the entire suite of practices due to the goal of achieving maximum load reductions. BMPs that are fully implemented in the E3 scenario 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.
- No-Action and E3 scenario conditions can be determined for historic years (beginning around 1985), current year, or projected future years.
- Relevant comments about the definition of the E3 scenario through 5/14/10 have been considered in the details that follow:

E3 Point Sources

- E3 Significant municipal wastewater treatment facilities
  - Flow = Tributary Strategy flows where most are at design flows
  - Nitrogen effluent concentration = 3 mg TN/l
  - Phosphorus effluent concentration = 0.1 mg TP/l
  - BOD = 3 mg/l, DO = 6 mg/l and TSS = 5 mg/l
- E3 Significant industrial dischargers
  - Applies the percentage of equivalent load reduction from Tributary Strategy to E3 level by state.
  - 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 TN/l or Tributary Strategy concentration if less
  - Phosphorus effluent concentration = 2 mg TP/l or Tributary Strategy concentration if less
  - BOD = 5 mg/l, DO = 5 mg/l and TSS = 8 mg/l
- E3 Non-significant industrial wastewater treatment facilities
  - Applies the percentage of equivalent reduction from No-Action (18 mg/l TN) to Tributary Strategy (8 mg/l TN) by state.

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 Septic Practices

- E3 Septic connections
  - 10% of septic systems 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 Bay Program's air scenario that shows the maximum reductions in deposition – a projection to 2020.
- WQGIT decided to use the same atmospheric deposition for both the E3 and No-Action scenarios in the allocation methodology.
- The 2020 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.
  - 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); Coastal Plain Lowlands (high groundwater)
    - 50% of area – 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 SED by 95% from a pre-BMP condition.
  - Ultra-urban regions – defined as high- and medium-intensity land cover
    - 50% of area – 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, dry wells.
    - 20% of area – infiltration practices, e.g., infiltration trenches and basins.
  - Other urban/suburban regions
    - 10% of area – impervious cover reduction.
    - 30% of area – filtering practices, e.g. sand filters, bio-retention.
    - 60% of area – infiltration practices.
- E3 Erosion & sediment controls
  - Nutrient and sediment runoff from all bare-construction landuse is reduced: TN = 25%, TP = 40%, SED = 40%.
- E3 Nutrient management on urban
  - All pervious urban acres are under nutrient management.
- E3 Urban stream restoration
  - The length of urban streams restored is proportional to the urban area at a ratio of 0.2 feet/acre.
- E3 Street sweeping
  - The mass of SED removed from high-intensity impervious cover through street sweeping is proportional to the urban area at a ratio of 25 lbs. SED/acre high-intensity impervious.
- E3 Controls on extractive (active and abandoned mines)
  - Extractive landuse is assumed to be protected through benefits associated with stormwater filtering practices.

E3 Agricultural Practices

- E3 Conservation tillage
  - All row crops are conservation-tilled.
- E3 Enhanced nutrient management applications
  - All agricultural land 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.
  - The area and location 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.
- E3 Carbon sequestration / alternative crops
  - 5% of the available row crop acres.
  - 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.
  - Early-planting wheat commodity cover crops with drilled seeding on remaining row crops (associated with small-grain production).
- 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
  - All model AFO land use acres assumed to utilize "treatment trains" consisting of Animal Waste Management Systems: Livestock/Poultry, Barnyard Runoff Controls and Loafing Lot Management, and Mortality Composters.
  - 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.
  - See attached "Recommendations on Revising the Animal Feeding Operation (AFO) Loads Definition for the E-3 Scenarios" from the Bay Program Agriculture Workgroup.
- 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.
  - The overall benefit is assumed to yield the same reductions associated with the model's Decision Agriculture practice (Advanced Nutrient Management).
- E3 Non-urban stream restoration
  - The length of agricultural streams restored is proportional to the agricultural area at a ratio of 0.02 feet/acre of agricultural land.

E3 Forest Harvest Practices

- E3 Forest harvesting practices
  - All model acres designated as "harvested forest" receive benefits of Forest Harvesting Practices. 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 nutrient and sediment discharge.

Recommendations on Revising the Animal Feeding Operation (AFO) Loads Definition for the E-3 Scenarios
Agriculture Workgroup (AgWG)

May 11, 2010

Issue:
The Water Quality Goal Implementation Team (WQGIT) recently submitted a request to the sector workgroups that any new modeling concerns with the Phase 5.3 modeling suite be brought to the attention of the WQGIT by May 10, 2010. In response to the request, the Agriculture Workgroup (AgWG) reviewed a draft list of nominated modeling concerns on Tuesday, April 27th which had been developed by Chairman Frank Coal and Coordinator Mark Dubin. After discussion, the AgWG approved the nomination list as presented on April 27th.

Of the items included on the approved nomination list, the current definition of nutrient and sediment loads for the Animal Feeding Operation (AFO) land use under the E-3 scenarios was identified. The current definition of AFO with the E-3 scenarios does not include a specific load associated with the land use, but instead equates this load to a hay w/o nutrients land use. Consequently, it appears in the scenario that no acreage is associated with an AFO land use. This definition provides a potentially false impression to the agricultural community that no acreage has been set aside in the E-3 scenario for AFO. It also provides a nutrient and sediment load estimate that is likely beyond the load reduction expectations of AFO operations required to operate with an NPDES permit under the EPA Concentrated Animal Feeding Operation (CAFO) program.

EPA's definition of the production area (40CFR 412.2(h) under the CAFO program appears to correlate with the AFO land use area defined in the Phase 5.3 models.

"The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms and diversions which separate uncontaminated storm water. Also included in the definition of production area is any egg washing or egg processing facility, and any area used in the storage, handling, treatment, or disposal of mortalities." [40 CFR 412.2(h)]

EPA has also defined the control of nutrient and sediment losses from the production area, or AFO land use as in the Phase 5.3 models.

"When developing effluent limitations for NPDES permits for CAFOs, EPA recommends that applicable technology-based effluent limits be properly evaluated for their water quality protection benefits in the course of deciding whether to establish water quality-based limitations. The permit writer must ensure that the permit includes effluent limitations based on applicable technology-based requirements and any more stringent effluent limitations necessary to meet water quality standards. A water quality-based effluent limitation is designed to protect the quality of the receiving water by ensuring that State or Tribal water quality standards are met. Federal regulations [40 CFR 122.44(d)] require permit limitations to control all pollutants that may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard."

Although the NPDES permits for the CAFO program are known as a "zero discharge" permit, the production area program guidance calls for controlling all pollutants to the maximum extent

possible by installing a number of technical conservation practices. This acknowledgement is also incorporated into the intent by EPA to develop a Waste Load Allocation (WLA) within the Chesapeake Bay TMDLs that will not only address Point Sources (PS) such as waste water treatment plans, but also for animal production areas under a NPDES permit with the CAFO program.

"In the production area there will be designed a number of management practices to keep clean water clean, maintain proper manure storage, manage mortality, and other practices that are required by the CAFO rule. Federal regulations [40 CFR 122.44(d)] require permit limitations to control all pollutants that may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard."

Recommendations:
In consultation with EPA Region 3 and the Chesapeake Bay Program Office, it is the recommendation of the Agriculture Workgroup (AgWG) that the present definition of AFO land uses under the E-3 scenarios be revised in the following manner:

- To utilize the EPA definition of nutrient and sediment controls for NPDES permitted production areas under the CAFO program. This will further support the development of WLA associated with the CAFO subset of AFO land uses under the Phase 5.3 TMDLs.

- To utilize a "treatment train" approach of applying existing appropriate BMPs in the Phase 5.3 models for the AFO land use. The EPA CAFO definition describes the application of a number of management practices to keep clean water clean, to properly address mortality management, to incorporate manure storage and handling, and other required practices.

- The following existing appropriate agricultural BMPs should be considered in the E-3 scenarios for AFO land uses:

    - Ammonia Emission Reduction
    - Animal Waste Management Systems: Livestock/Poultry
    - Barnyard Runoff Controls
    - Dairy Precision Feeding
    - Grass/Forest Buffers
    - Loafing Lot Management
    - Manure Transport
    - Mortality Composters
    - Poultry Phytase
    - Swine Phytase

- The EPA CAFO permit guidance includes additional conservation practices that are not readily discernable in the above BMP list for Phase 5.3 models. These additional practices may be implied in the definition of the included BMP, or have application in the models for other land uses. Information may be required from the partnership to enable the application of additional BMPs in the models. The following are examples of BMPs which are not currently available to be directly included in an E-3 scenario at this time for this land use:

- Conservation Plan: cropland, hay land and pasture
- Dry Detention Ponds and Hydrodynamic Structures: urban/suburban land uses only
- Dry Extended Detention Ponds: urban/suburban land uses only
- Erosion & Sediment Control: urban/suburban land use only
- Nutrient Management: land use change associated with cropland, hay land and pasture nutrient applications
- Riparian Grass/Forest Buffer: land use change for pasture or urban land uses
- Stream Access Control w/ Fencing: land use change for pasture land use only
- Wet Ponds and Wetlands: urban/suburban land uses only

Conclusions:
The AgWG recognizes that E-3 scenarios should be reflective of the limit of technology creating the highest level of nutrient and sediment load reductions possible based on existing BMPs available within the Phase 5.3 models. The BMPs currently available in the modeling suite are limited in scope for implementation due to current model structure and incomplete information from the partnership for including additional practices. Through implementation of the enclosed recommendations, the AgWG believes that the following results will be obtained:

- The "restoration" of appropriate acreage under the AFO land use for E-3 scenarios, preventing the false impression to the agricultural community that no acreage has been set aside for AFOs.

- The full utilization of existing BMPs that will reflect the load reduction expectations of AFO operations required to operate under a CAFO permit.

- Consistency with the development of a WLA in association with CAFO permitted operations as a subset of the AFO land use.

- Future consideration should be given towards expanding the adaptively of existing BMPs, including urban practices, for more fully addressing the needs of the AFO land use through increased partnership engagement and information.