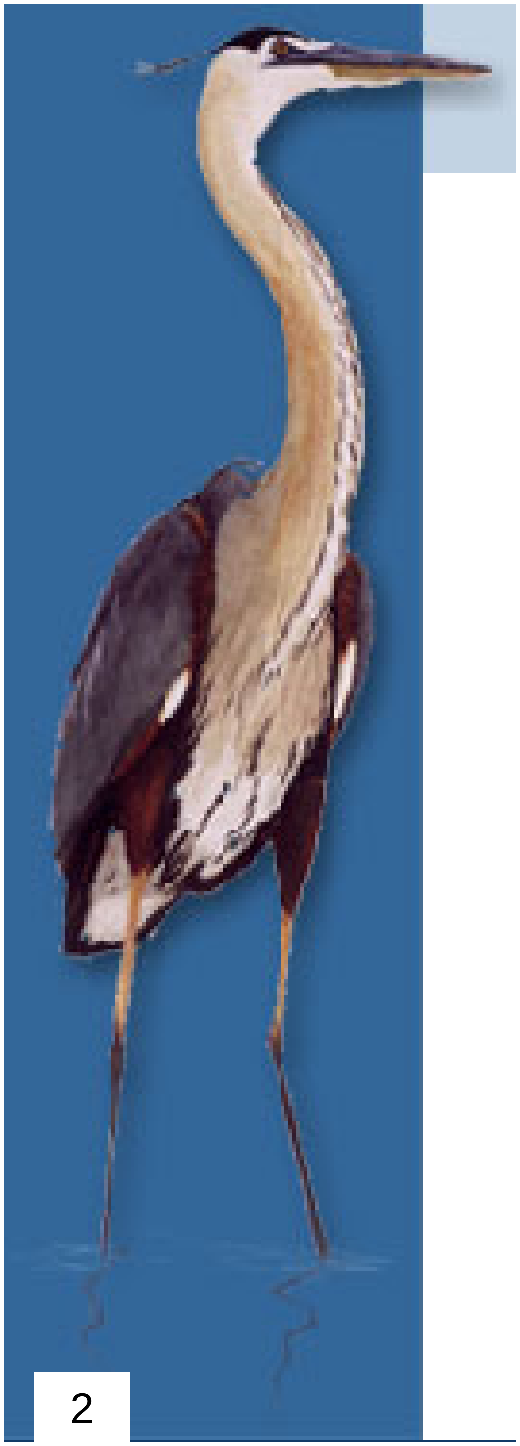
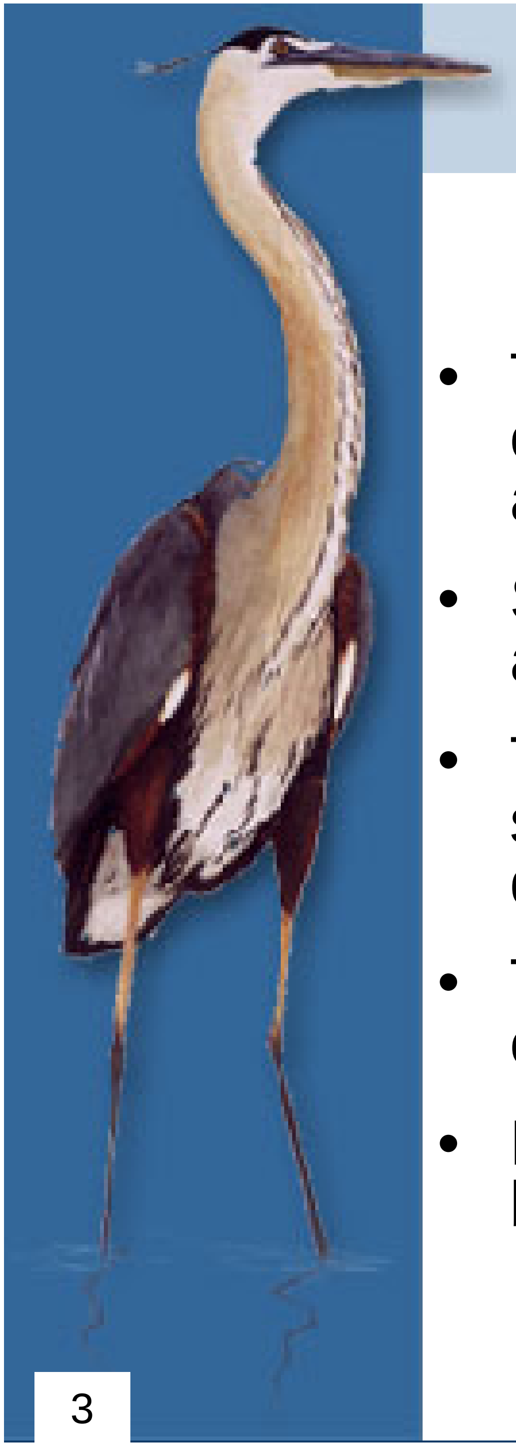
Chesapeake Bay
Maryland Phase I WIP Strategy
Key Concepts: Septics and Stormwater

June 13th, 2011



Topics Covered

- Purpose of Reviewing Phase I WIP
- Context of our WIP Planning
- Urban Stormwater
- Septic Systems



Purposes for Reviewing Phase I WIP Strategies

- The State's "default strategy" will use elements of the Phase I WIP Strategy, which you might also want to consider using.
- Some of the Phase I WIP Strategy elements are occurring in your jurisdiction.
- To help team members be conversant in the subject, which will improve communications during the strategy development process.
- To provide "rules of thumb" to help teams with conceptual planning of strategies.
- Provide insights about Phase II WIP and beyond.

Context of Developing WIP Strategies

- Phase II WIP is a coarse-level of planning.
  - For comparison: NPDES Stormwater permits require additional planning, which itself is fairly coarse.
- EPA promotes adaptive management; therefore, the strategies and milestones can change after the WIP is completed.
- EPA's expectation of the Phase II WIP recognizes that we have limited time and tools.
- The following focuses on strategies for the 2017 Interim Target, but also considers Final Targets.

Urban Stormwater
Phase I WIP

Category	Key 2017 WIP Strategies
Non-MS4	• Urban Nutrient Management • Rural Residential Tree Planting
Phase I MS4	• Urban Nutrient Management • 30% Impervious Retrofit
Phase II MS4	• Urban Nutrient Management • 20% Impervious Retrofit

Other Urban Practices:
- Stream Restoration (not by name in Phase I WIP)
- Regenerative Stormwater Conveyances
- Urban Tree Canopy

Rural Residential Tree Planting

- Increase rural resident tree planting, including conversion of turf grass to tree covers. May also consider mandatory stream and waterway buffers
- 600 acres by 2017 (100 ac/yr)
- 8.6 lbs/acre/yr Reduction in Nitrogen.
- 18,000 lb Reduction by 2017

Urban Nutrient Management

- MDA regulates approximately 700 commercial lawn fertilizer applicators who manage parcels of 10 or more acres of non-agricultural land, including private lawns, golf courses, public parks, airports, athletic fields and state owned land such as restoration areas and highway right-of-ways.
- Accounting for non-compliance, an estimated 220,000 acres/year are managed.
- Annual Load Reduction (delivered)
  - 385,000 lbs/yr N
  - 59,400 lbs/yr P
- Note it is an annual practice. That is, it must be redone each year or there is no reduction.
- Although not directly comparable, new stormwater retrofits each year achieve about 16,600 lbs/yr additional nitrogen reduction, adding up over a a five-year period to 249,000 lbs N. {NOTE: Not 16,600 x 5 … See Next Slide}
- UNM results in urban reductions for non-MS4 jurisdictions in Phase I WIP.

Retrofit Cumulative Reduction Calculation

(Pounds of Nitrogen)

						Sub-Totals
Year 1	16,600					**16,600**
Year 2	Year 1 16,600	16,600				**33,200**
Year 3	Year 1 16,600	Year 2 16,600	16,600			**49,800**
Year 4	Year 1 16,600	Year 2 16,600	Year 3 16,600	16,600		**66,400**
Year 5	Year 1 16,600	Year 2 16,600	Year 3 16,600	Year 4 16,600	16,600	**83,000**
5-year Cumulative Total						**249,000**

About 6,600 acres per year retrofitted.

UNM Annual Reduction Calculation

(Pounds of Nitrogen Delivered)

						Sub-Totals
Year 1	385,000					**385,000**
Year 2		385,000				**385,000**
Year 3			385,000			**385,000**
Year 4				385,000		**385,000**
Year 5					385,000	**385,000**
5-year Cumulative Total						**1,925,000**

Note: This is also a “preventive” activity. That is, it is assumed that without this program, about 385,000 additional pounds of nitrogen would go into the Bay each year due to over fertilization of large lawns.

Phase I WIP
Stormwater Retrofit Strategies

- **Phase I MS4s:** Nutrient and Sediment reductions equivalent to stormwater treatment on 30% of the impervious surface that does not have adequate stormwater controls*. (10% from previous permit commitments plus 20% more by 2017).

- **Phase II MS4s:** Nutrient and Sediment reductions equivalent to stormwater treatment on 20% of the impervious surface that does not have adequate stormwater controls.

* Rule-of-thumb: Land developed before 1985 State stormwater law.

Note: State Highway Administration (SHA) will retrofit 20% or 30% depending on the jurisdiction.

Stormwater Retrofits
Untreated Urban Nutrient Load*

Land without stormwater controls (untreated):

- Unit Load:
  - Pounds/acre/Year:
- Typical Unit Load for Untreated Urban (Nitrogen):
  - 10 lbs/ac/yr
- Urban Load for a particular area:

	Land Area (acres)	x	Unit Load (lbs/ac/yr)	=	Load (lbs/yr)
Example:	200 (acres)	x	10 (lbs/ac/yr)	=	2,000 (lbs/yr)

* Land developed before the 1985 State Stormwater Law usually has no stormwater controls.

Urban Load with Stormwater Retrofits

- Reduction due to Retrofit:

Unit Load (lbs/ac/yr) x Reduction Efficiency = Reduction

Example: 10 (lbs/ac/yr) x 0.25 = 2.5 (lb/ac/yr)

- Remaining Load:

Original unit load – Reduction = Remaining Load

Example: 10 (lbs/ac/yr) – 2.5 (lbs/ac/yr) = 7.5 (lbs/ac/yr)

- Urban Load for a particular area of 200 acres:

Multiply by the acres involved, for Example:

REDUCTION: 200 (acres) x 10 (lbs/ac/yr) x 0.25 = 500 (lbs/yr)

REMAINING: 2,000 (lbs/yr) – 500 (lbs/yr) = 1,500 (lbs/yr)

Estimated Reduction from Phase I WIP Urban Retrofit Strategy*

Case: Small Phase 2 MS4 Municipality with total area of about 2 mi^2 , which is equal to 1,250 acres.

Strategy: Retrofit 20% of Untreated Urban Land*

Untreated Urban Land: Land developed before 1985 (estimate)

- Step 1: Determine Area of Untreated Land, e.g., 80% developed before 1985
  - E.g., 80% of 1,250 acres is 1,000 acres
- Step 2: Determine 20% of Untreated Land:
  - E.g., 1,000 acres x 0.2 = 200 acres
- Step 3: Calculate Load Reduction (Assume 25% efficiency of BMPs for nitrogen)
  - 200 acres x 10 (lbs/ac/yr) x 0.25 = 500 lbs/yr reduced

* This is simplified example that equates total area to impervious area.

Some Stormwater BMP Efficiencies

BMP Type	Nitrogen	Phosphorus
Dry Extended Detention Ponds	20%	20%
Wet Ponds and Wetlands	20%	45%
Infiltration Practices	80%	85%
Filtering Practices	40%	60%
Vegetated Open Channels	45%	45%

Alternative to 25% Efficiency Estimate

Example: Weighted Average of Future BMPs:

20% Infiltration at 80% Efficiency

30% Wet Ponds at 20% Efficiency

25% Filtering Practices at 40% Efficiency

25% Vegetated Open Swales at 45% Efficiency

$0.2*0.8 + 0.3*0.2 + 0.25*0.4 + 0.25*0.45 = 0.43$ (43% Efficiency)

Reduction Calculations:

Previous: 200 acres x 10 (lbs/ac/yr) x 0.25 = 500 lbs/yr

Alternative: 200 acres x 10 (lbs/ac/yr) x 0.43 = 860 lbs/yr

Putting it Together for a Phase I MS4 Urban Retrofit Strategy for 2017

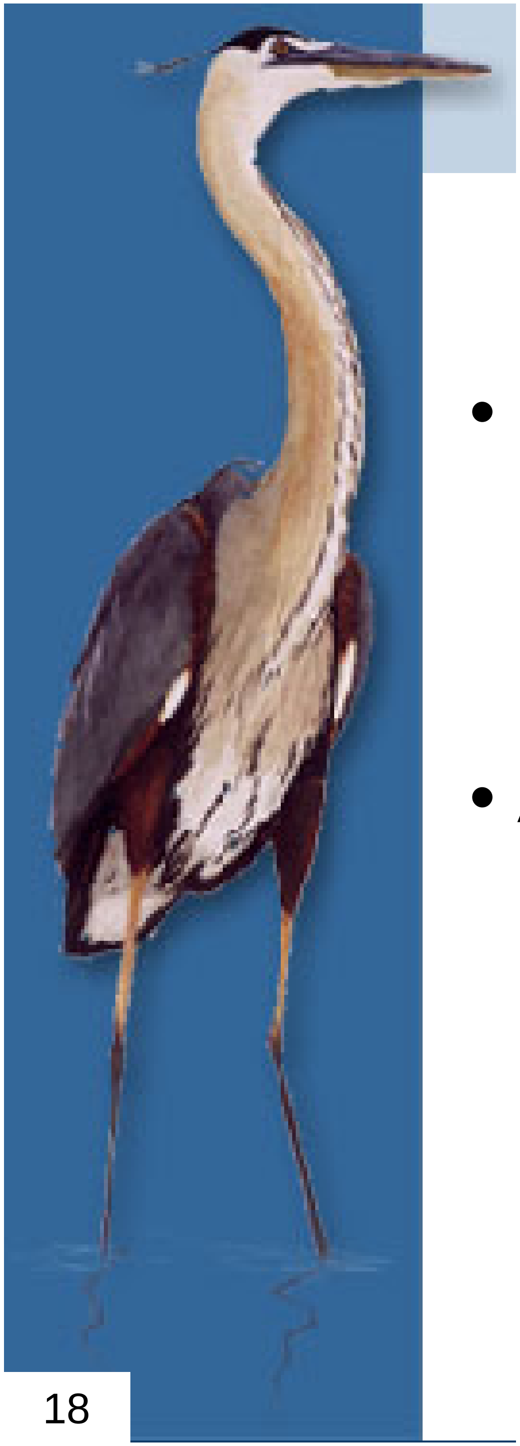
The strategy development process can be very simple:

- **Step 0: It is assumed you have an estimate of the Area to be treated (Range is about 3,000 – 40,000 acres).**
- **Step 1: It is assumed you know the Remaining Percentage to treat from past permit cycles:**
  - E.g., 4% remaining from past 10% treatment permit requirement.
- **Step 2: Total percentage of untreated area to be treated by 2017**
  - E.g., 4% + 20% = 24%
- **Step 3: Estimate percentage of all urban area,**
  - E.g., If untreated area is 70% of total urban area, and you will be treating 24% of that, then: (Total Urban Area) x 0.7 x 0.24 = (Urban Area Treated)
  - % Total Urban Treated area is: (Urban Area Treated)/(Total Urban Area)
- **Step 4: Estimate aggregate retrofit efficiency: e.g., 33%**
- **Step 5: Enter percentage of area treated & efficiency.**

Putting it Together for a Phase 1 MS4 Urban Retrofit Strategy for 2017 (con't)

Refinement Issues to Consider:

1. Pervious vs Impervious.
2. Local Land Area Estimates vs EPA Bay Program Estimates
3. Geographic Location of Treatment:
   – Beware of varying delivery factors within your county, e.g., above/below a reservoir, between major basins.
4. More Explicit BMPs
   – Although we advocate using a simple approach for BMP analyses, some might wish to mimic more complex local plan elements in MAST.
   – Recommend: You have simplified approach as a fall-back.



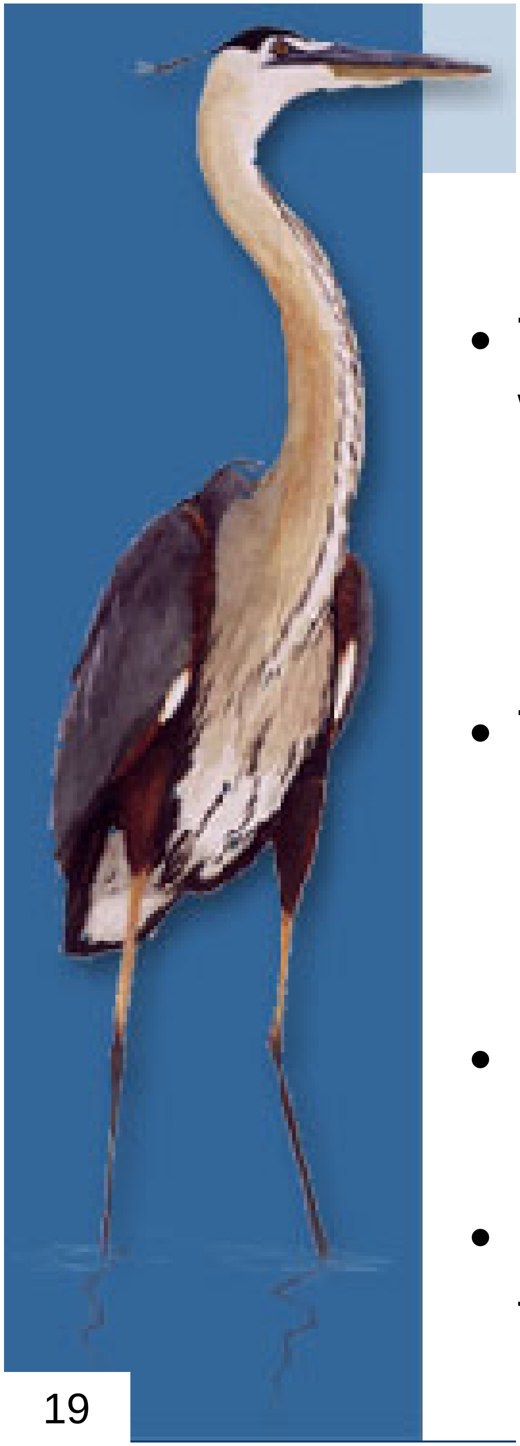
Septic System Nitrogen Loads

- Basic Loading Calculation for a System:

  X people/system x **Y** lbs/person/year = lbs/system/year
  - Load to the septic system drain field
  - People/system 2.6 – 3.2
  - Load/person 8.6 – 9.5

- Accounting for losses:

  X people/system x **Y** lbs/person/yr x <u>Delivery Factor</u>
  - Deliver Factor ≤ 1
  - Load to the nearest surface water
  - Does NOT account for transport to the Bay

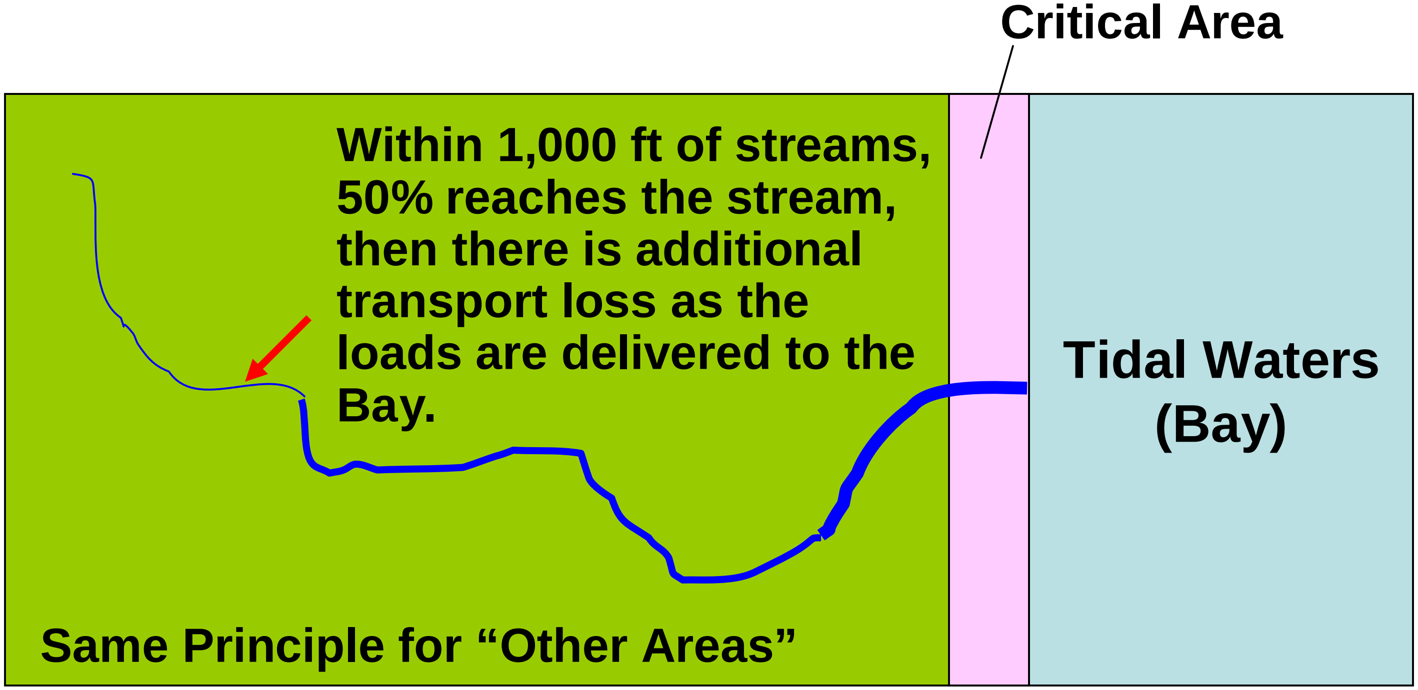


Septic System
Nitrogen Loads by Zone

- Three Zones for Load Estimates to Surface Waters:
  1. Critical Area: Within 1,000 ft of tidal waters
  2. Near Streams: Within 1,000 ft of a perennial stream
  3. Other Areas
- Transport of Load to Nearest Surface Waters:
  1. Critical Area: 80% reaches the water
  2. Near Streams: 50% reaches the water
  3. Other Areas: 30% reaches the nearest water
- E.g., Calculation in Critical Area:
  – 2.6 people/system x 8.6 lbs/person/yr x 0.8 = 17.9 lbs/yr
- Except for the Critical Area, these do not include transport loss to the Bay: {See Next Slide}

Septic System Nitrogen Transport Losses to Bay

- Transport Losses to Tidal Waters (Bay):
  - Critical Area: Entire 80% is delivered to the Bay
  - Near Streams: 50% reaches the stream - loss to Bay
  - Other Areas: 30% reaches the stream - loss to Bay



Septic System Nitrogen Transport Losses to Bay

- Sample Calculations:
  - Critical Area: Entire 80% is delivered to the Bay

    2.6 x 8.9 x 0.8 x 1 = Annual Load to Bay
  - Near Streams: 50% reaches the stream - loss to Bay*

    2.6 x 8.9 x 0.5 x DF* = Annual Load to Bay
  - Other Areas: 30% reaches the stream - loss to Bay*

    2.6 x 8.9 x 0.3 x DF* = Annual Load to Bay

* DF - The additional loss during transport to the Bay varies across the State. DF was about 0.75 as a statewide average in the Phase I WIP model.

Numbers of Maryland Septic Systems in the Bay Watershed

Zone	Number of Septic Systems
Critical Area	46,255
1000 feet of Stream	134,807
Other	237,473
Total	**418,535**

Septic Systems Strategies Overview

- Two General Strategy Options:
  - Upgrade to Nutrient Removal Technology, also called "best available technology" (BAT)
  - Connect to Advanced Wastewater Plant
- Both Reduce the Nitrogen Load by about Half (50%)

Septic Systems
Phase I WIP 2017 Strategy

Category	Key 2017 WIP Strategies
Critical Area	• Upgrade 33,252 systems (60%) to BAT – 27,522 Septic Owners to upgrade* – 5,700 New or Failing to be upgraded
Near Streams	• No explicit strategy
Other	• No explicit strategy

* In 2011, assess options to phase in requirement to retrofit all septic systems in the Critical Area using best available technology beginning in 2012. Assessment to include viability of tax credits, income-based criteria for grant eligibility and other means to facilitate upgrades.

Other Septic Reductions:

• 930 Septic Connections

Phase I WIP Short on Upgrades

- Final Allocation calls for 39% Reduction:
  - 39% reduction implies upgrading 78% of systems*
- 2017 Plan calls for upgrading about 8% of systems
  - Implies upgrading remaining 70% between 2017 and 2020
- Implications:
  - Phase II WIP needs greater pace of upgrades than 8%.
  - Phase II WIP 2017 strategy needs upgrades outside of Critical Area.
  - If only 78% systems upgrade, which ones do and which ones don’t upgrade? What are the funding implications?
  - Phase II WIP needs to commit to a *process* for resolving these issues.

* 50% reduction per system necessitates upgrading 2 x 39%, or 78% as a ball-park estimate

END