

# James River Watershed Modeling

Supporting Virginia DEQ's Chlorophyll Study



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# Scenario Assessment

Four management scenarios evaluated 3 of which were developed as part of the original Chesapeake Bay TMDLs:

1. 2010 TMDL Scenario
2. DO TMDL Scenario
3. 2009 Progress Scenario
4. HRSD WWTP Scenario

# Scenario Descriptions

- 2010 TMDL (TMDL): nutrient and sediment load reductions required to meet the applicable seasonal chlorophyll-*a* criteria
- DO TMDL (DO): nutrient and sediment load reductions in the James River watershed required as part of the total load reductions needed to meet DO criteria in the Chesapeake Bay (190/12.7 load allocation)
- 2009 Progress (2009P): the nutrient and sediment load reductions estimated as part of the development of the Chesapeake Bay TMDLs to be realized considering 2009 land uses, NPS loadings, animal numbers, atmos. deposition, and point source loads, as well as the BMPs tracked and reported by watershed jurisdictions through 2009.
- HRSD WWTP (HRSD): point source nutrient load reductions agreed to by HRSD to be applied to applicable WWTPs as part of the state of Virginia's WIP. Reductions applied to the existing 2008 Bubble Permits that became applicable in 2011.

# Scenario Descriptions

- 2009 Progress TMDL (2009P TMDL):
  - Represents the percent difference between the 2009P and 2010 TMDL nutrient and sediment loads
  - Necessary due to concerns that the application of the TMDL load reductions to the later model time period (2007-2013) was not appropriate
    - 2010 TMDL based on load reduction for the Bay Watershed Model calibration time period (1990-2000)
    - No Bay Watershed Model output for post 2005
    - 2009P Scenario can be thought of as representative of the later James River Modeling time period baseline
    - 2009P Scenario acts as a surrogate baseline for this time period from which to calculate TMDL load reduction %

# Scenario Descriptions

## HRSD WWTP

NPDES ID	Facility Name	2011 Bubble Permit					
		Flow (MGD)	Flow (cfs)	TN (mg/L)	TP (mg/L)	TN (lb/d)	TP (lb/d)
VA0081230	HRSD - Army Base Sewage Treatment Plant	12.07	18.7	5.0	1.0	183,801	36,760
VA0081256	HRSD - Boat Harbor Sewage Treatment Plant	15.08	23.3	24.0	1.0	1,102,256	45,927
VA0081264	HRSD - Chesapeake-Elizabeth Sewage Treatment Plant	13.31	20.6	25.0	1.5	1,013,416	60,805
VA0081272	HRSD - James River Sewage Treatment Plant	14.98	23.2	12.0	1.0	547,473	45,623
VA0081299	HRSD - Nansemond Sewage Treatment Plant	19.79	30.6	8.0	1.0	482,176	60,272
VA0081281	HRSD - Virginia Initiative Sewage Treatment Plant	33.02	51.1	9.0	0.5	905,085	50,282
VA0081302	HRSD - Williamsburg Sewage Treatment Plant	16.63	25.7	14.0	1.0	709,071	50,648
<b>Total</b>						<b>4,943,278</b>	<b>350,318</b>
<b>JR Basis Reg Limit</b>						<b>6,000,000</b>	<b>582,258</b>

\*Note that VA0081264 discharges directly to the Bay and was not considered in the James Model

# Scenario Configuration

The watershed loads for the non-HRSD scenarios were provided by the CBP as either:

- Output summaries available in the Chesapeake Bay TMDL Report (EPA 2010)
- Discrete model output from the Phase 5.3 Bay Watershed Model

Scenario	% Load Reduction		
	TN	TP	TSS
2009 Progress	13.9%	8.6%	19.0%
DO TMDL	27.9%	38.1%	39.4%
2009P TMDL	29.1%	29.7%	27.7%
2010 TMDL	38.9%	35.7%	41.4%
HRSD*	17.6%	39.8%	-

\*HRSD load reductions are calculated as the difference between the 2011 Bubble Permit load limits and 2008 Bubble Permit load limits

# Scenario Configuration

- Discrete model output by source (land use, point source, atmospheric deposition) were available for the 2009P and 2010 TMDL scenarios
- Model output were not available for the DO scenario
- HRSD scenario represents the applicable 2011 permitted flow and load limits for the WWTP facilities as a constant condition over the simulation period (1990–2013).
- Initial application of the scenario load reductions for which discrete Bay Model output were available:
  1. Calculated the load differences between the scenario and baseline loads for land uses, point sources, and atmospheric deposition at the Bay Watershed Model River-Seg level
  2. Load reductions were mapped to their SWS analogues in the James River model as a percent reduction with the goal of replicating the scenario at the source level

# Scenario Configuration

- Differences in loading by source resulted in load reductions that were different than those reported for the Bay Watershed Model
  - Primarily driven by land loads
  - Non-sediment associated phosphorus loading in the Bay Model
- Bay Watershed Model scenarios included load increases for certain source categories
  - Had the effect of increasing simulated loads to the James River estuary when applied to the James River model (2009P)

Scenario	% Load Reduction		
	TN	TP	TSS
2009 Progress	63.6%*	62.9%*	120.9%*
2010 TMDL	33.8%	16.3%	11.3%

# Scenario Configuration

- To maintain consistency with the reported scenario load reductions a simpler approach was used to apply the scenario load reductions
- Load reductions were applied across each source category as a single percent reduction
- The simple approach had the benefits of:
  - Closely replicating the desired load reductions
  - Consistent methodology across all scenarios (source level load reductions not available for the DO TMDL scenario)
  - Model still considers instream transport and processes

# Scenario Results

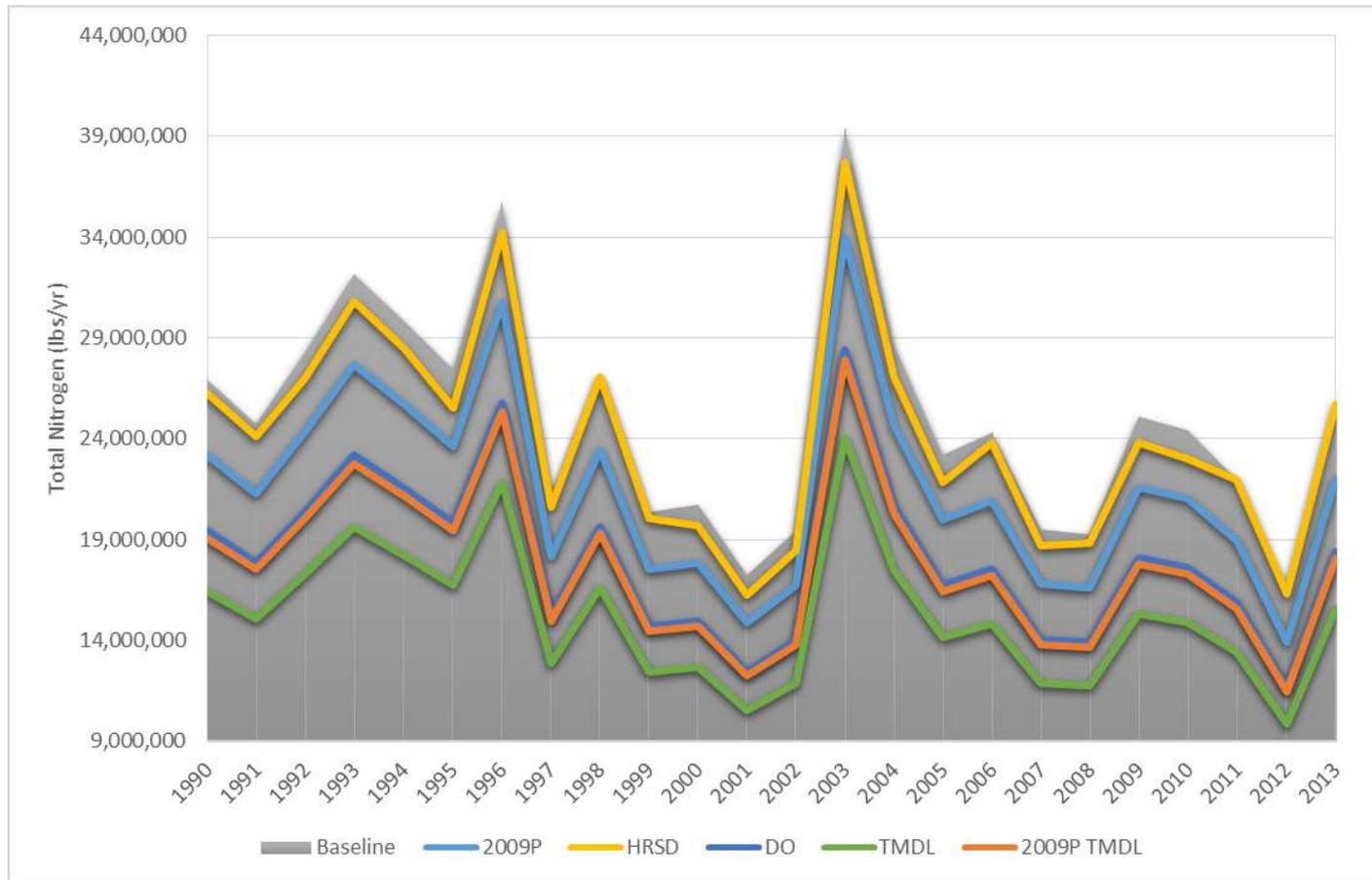
## Watershed Model Scenario Results

Scenario	TN (lbs/yr)	TN %Reduction	TP (lbs/yr)	TP %Reduction	Sediment (tons/yr)	Sediment %Reduction
Baseline	24,936,878	0.0%	3,403,228	0.0%	394,368	0.0%
HRSD 2011 Bubble Permit	24,048,064	3.6%	3,327,845	2.2%	394,380	0.0%
2009 Progress	21,480,867	13.9%	3,113,839	8.5%	320,274	18.8%
DO TMDL	17,984,690	27.9%	2,111,912	37.9%	240,584	39.0%
2009 Progress TMDL	17,677,924	29.1%	2,397,973	29.5%	286,321	27.4%
2010 TMDL	15,229,386	38.9%	2,194,648	35.5%	232,740	41.0%

## Scenario Target Load Reductions

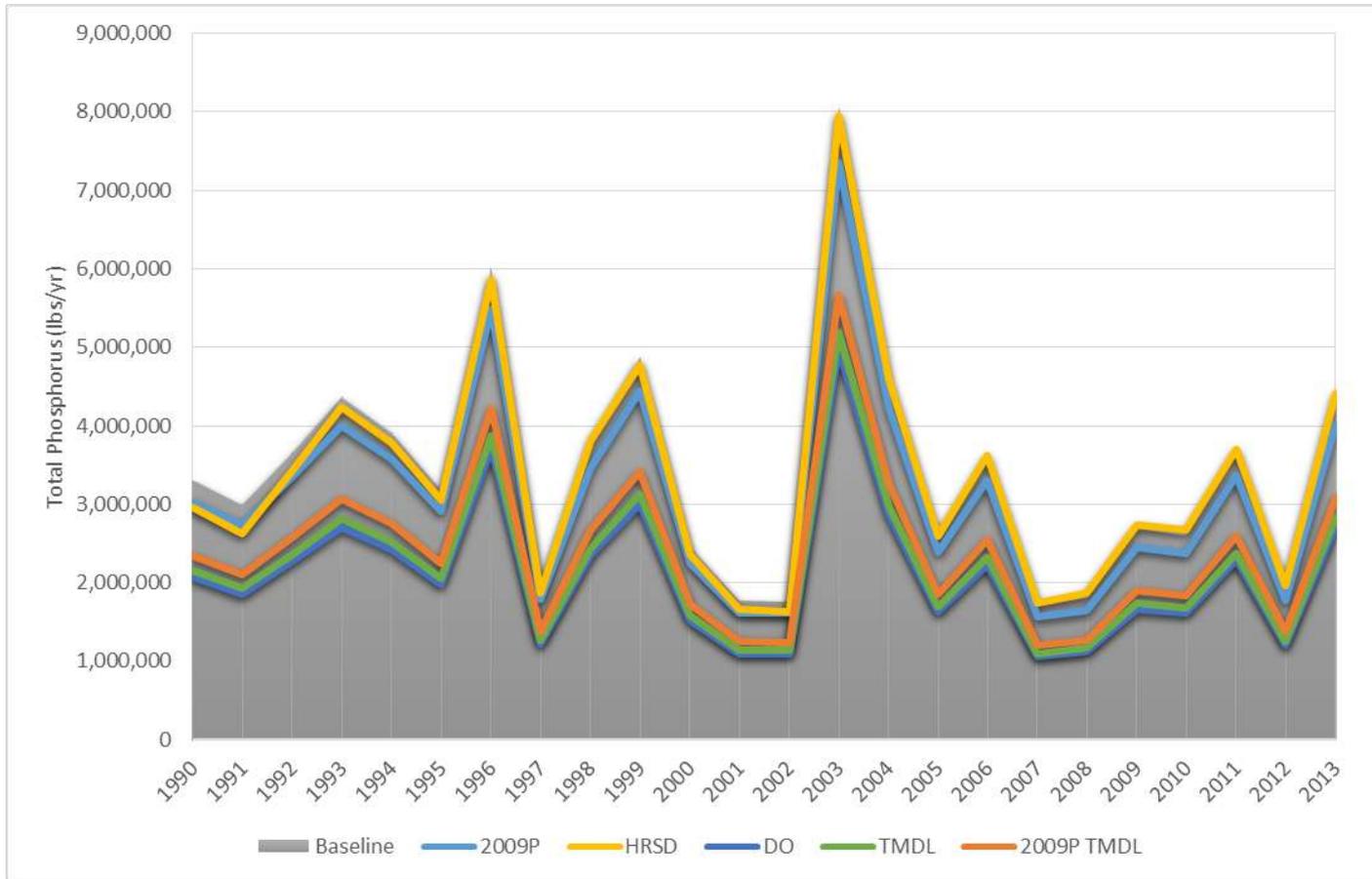
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# Scenario Results



\*HRSD > Baseline 2012-2013

# Scenario Results



\*HRSD > Baseline 2006-2013

# Scenario Results

