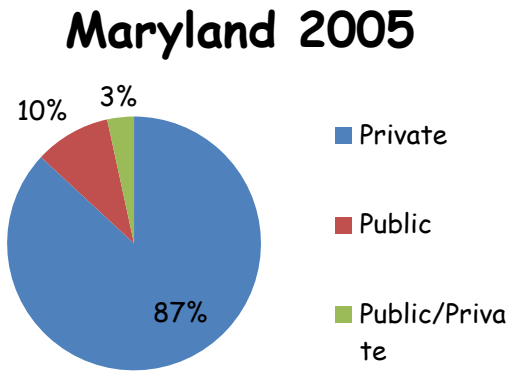
The Expert Panel
Review of the Science of
Urban Nutrient Management

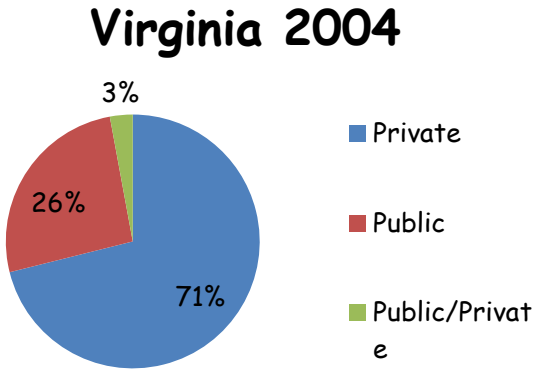
STAC WORKSHOP

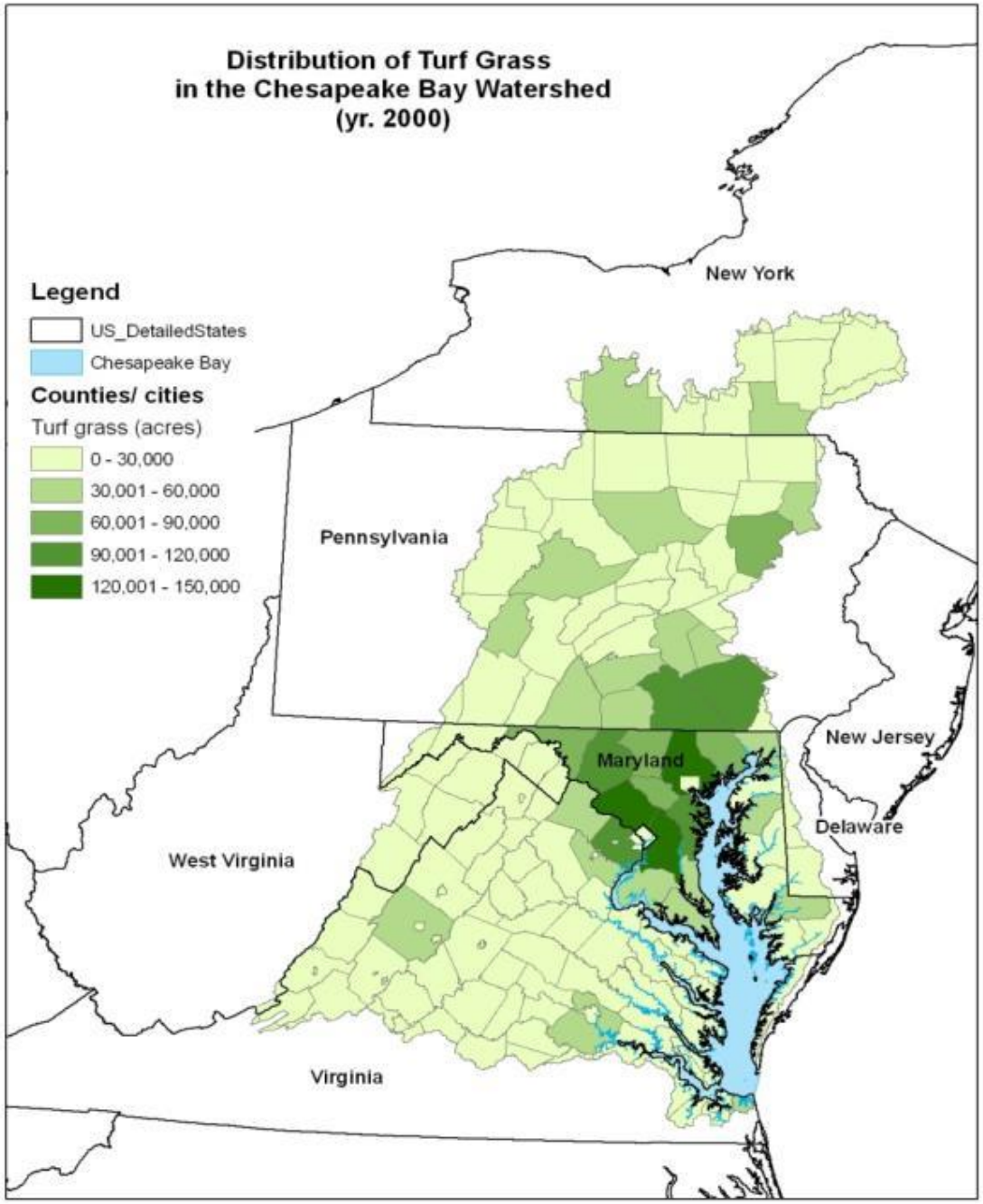
Chesapeake Bay Program
A Watershed Partnership

Pervious land has grown steadily in the last 3 decades

Most recent estimates by P. Claggett indicate pervious land is about 10% of entire Bay watershed






Distribution of Turf Grass
in the Chesapeake Bay Watershed
(yr. 2000)
Legend
US_DetailedStates
Chesapeake Bay
Counties/ cities
Turf grass (acres)
0 - 30,000
30,001 - 60,000
60,001 - 90,000
90,001 - 120,000
120,001 - 150,000
New York
Pennsylvania
New Jersey
Maryland
Delaware
West Virginia
Virginia

State P fertilizer legislation

- 3 States have done so (MD,NY, VA)
- Each legislation is different, and is not equivalent to a P-ban in fertilizer products
- States that not passed laws still benefit from industry phase-out of fertilizer products

Review of Available Science

1. P Dynamics on Urban Lawns
2. N Dynamics on Urban Lawns
3. High Risk Factors for Nutrient Export
4. Justification for Core UNM Practices
5. Impact of P Fertilizer Restrictions
6. Homeowner Fertilizer Behavior
7. Effect of Outreach on Fertilizer Behavior
8. Pervious Land and the Bay Watershed Model

Panel reviewed more than 150 papers and met 7 times

P Dynamics on Urban Lawns

1. Leaching to groundwater (minimal)
2. Soluble P loss in surface runoff
3. Sediment-bound P in surface runoff
4. Organic P (clippings/leaves) in runoff

P losses range from less than 1% of fertilizer input up to 18%, depending on timing, turf conditions

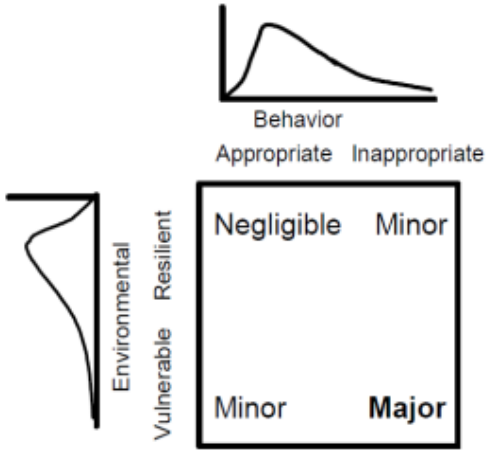
P losses strongly related to lawn runoff volume (e.g., steep slope, compacted soils, frozen ground, low turf density)

Significant P loss occurs independent of fertilization (clippings and soil erosion

N Dynamics on Urban Lawns

- Nitrate Leaching
- Nitrate/Ammonia in Overland Flow
- Washoff of Organic Nitrogen (clippings, leaves, eroded soil)
- Atmospheric Volatilization
- Denitrification

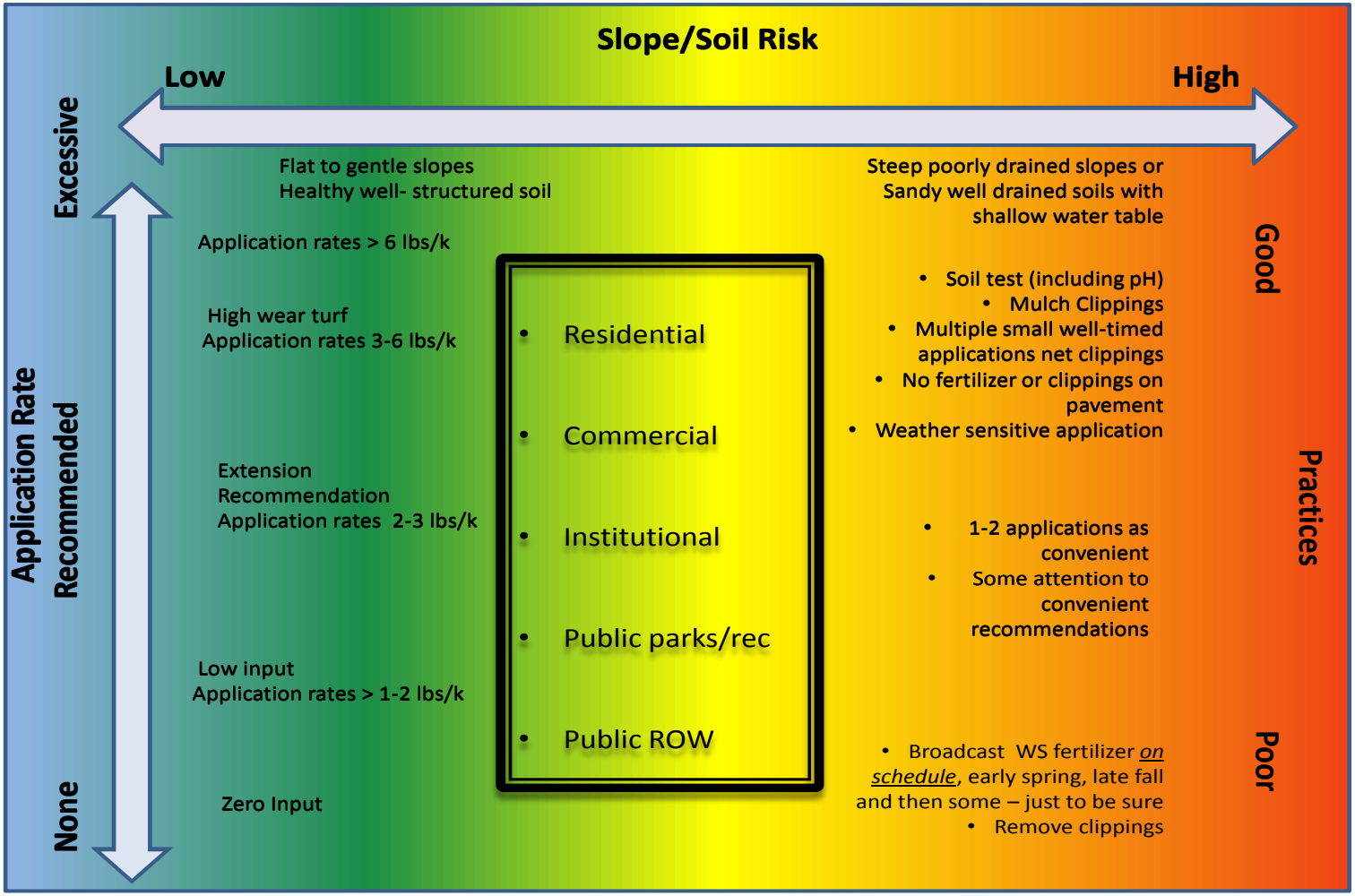
Most lawns are highly retentive of low doses fertilizer inputs, and more evidence of lawn de-nit



N Losses from Turf Grass as a Function of Fertilizer Application Rate				
N Load Exported (lb/ac)	N Fertilizer Input (lb/ac)	% of Fertilizer Exported	Reference	Notes
0.17	85	**0.20%**	Mancino & Troll, 1990	In 10 weekly apps
0.28	87.5	**0.32%**	Namcino & Troll, 1990	In 5 biweekly apps
0.06	93.7	**0.06%**	Spence et al. 2012	High Maintenance Fescue lawn
0.13	76.75	**0.17%**	Spence et al 2012	Low Maintenance Fescue Lawn
0.87	87.45	**1%**	Frank et al. 2006	Lo input *leaching losses*
1.78	131	**1.36%**	Guillard & Kopp 2004	Organic fertilizer
1.8	43.6	**4.13%**	Mancino & Troll, 1990	Single application
3.3	131	**2.52%**	Guillard & Kopp, 2004	PCSCU slow release
2.68	268	**1%**	Quiroga-Garza et al. 2001	Semi-arid, Warm season Bermuda grass
3.66	268	**1.37%**	Erickson 2001	*Leaching loss*
6.25	79	**7.91%**	King et al. 2001	**Hi Risk**: Watered to maintain 85% FC with tile drains
10.7	1071	**1%**	Quiroga-Garza et al 2001.	**Hi Risk**: Hi Input semi-arid Bermuda grass
23.02	131	**17.55%**	Guillard & Kopp 2004	**Hi Risk**: Highly soluble ammonium nitrate
24.05	219	**11%**	Frank et al. 2006	**Hi Risk**: Hi Input
68.02	412.3	**16.5%**	Roy et al 2000	**Hi Risk:** 3x sod grower practice overwhelms turf, fall *leaching losses*.
87-222	312	**28%-71%**	Pare et al 2006	**Hi Risk**: 80:20 sand peat media, applied 25kg/ha biweekly over 7 month growing season. Multiple cultivars.

Export is calculated as % fertilizer inputs. This overestimates turf *system* exports for field studies with atmospheric inputs in precipitation

High Risk Nutrient Export Factors



High Risk Factors Defined

- Owners are currently over-fertilizing beyond state or extension recommendations
- P-saturated soils as determined by a soil P test
- Newly established turf
- Steep slopes (more than 15%)
- Exposed soil (more than 5 % for managed turf and 15% for unmanaged turf)
- High water table (within three feet of surface)
- Over-irrigated lawns
- Soils that are shallow, compacted or have low water holding capacity)
- High use areas (e.g., athletic fields, golf courses)
- Sandy soils (infiltration rate more than 2 inches per hour)
- Adjacent to stream, river or Bay (within 300 feet)
- Karst terrain

High Risk Factors

- Karl will talk about whether we have the requisite mapping data to collectively estimate the high risk acreage in the RB segments in CBWM

- The Panel used best professional judgment to define a 20/80 split between low risk and high risk turf in he Bay watershed, and would sleep better at nite if a better estimate could be made with available mapping data

- Also, the science was not there to deal with the effects on multiple risk factor present on the same acre (e,g 1 to 3 risk factors vs. 7-10 factors)

Justification of Core UNM Practices

- More than 40 studies support reduced risk of N export associated w/ individual lawn care practices
- Practices include both fertilization AND management of "lawn biomass"

Core UNM Practices for the Chesapeake Bay

1. Get *technical assistance* to develop an effective UNM plan for the property
2. Maintain a **dense** vegetative cover of grass
3. Choose not to fertilize, **OR** adopt a reduce rate/monitor approach **OR** the use the small fertilizer dose approach
4. Retain clippings and mulched leaves on the yard and keep them out of streets and storm drains
5. Do not apply fertilizer before spring green up or after Halloween *

Core UNM Practices for the Chesapeake Bay

6. Maximize use of slow release N fertilizer during the active growing season
7. Set mower height at 3 inches or taller
8. Immediately sweep off any fertilizer that lands on a paved surface
9. Do not apply fertilizer within 15 to 20 feet of a water feature and manage this zone as a perennial planting, meadow or a forested buffer
10. Employ lawn practices to increase soil porosity and infiltration capability especially on portions of the lawn that can treat stormwater runoff.

The "Choose not to fertilize" option only applies to mature, flat lawns with dense ground cover

Norm goulet's house does not qualify

Impact of P Fertilizer Restrictions

- Limited number of research studies in upper Mid-west have measured reductions in ambient P concentrations in water bodies where P-fertilizer bans had been enacted

- TP concentrations reduced by 12-16% in two studies, especially for storms greater than 0.5 inch
- Might have been a bigger impact, but 28% of residents ignored the P ban
- The reported TP reductions are generally consistent with reductions for a zero P input CBWM run

Homeowner Fertilizer Behavior

Summary of Research on Homeowner Fertilization Behavior				
Study [1]	Location	% Fertilize	% DIY [2]	% Lawn Care [3]
Aveni, 1996	Northern VA	79	--	--
Swann, 1999	Ches Bay	50	91	9
Law et al, 2004	Glyndon MD	68	71	29
	Baisman Run	56	44	56
Osmond and Hardy 2004 North Carolina	Cary	83	48	52
	Goldsboro	66	76	24
	Kingston	54	70	30
	New Bern	72	75	25
	Greenville	73	65	35
Varlamof et al 2001	Georgia	76	--	--
Schueler, 2000	Non-Bay States	54-82	--	--
SMC (2001)	National	56	90	10

[1] Each of the studies utilized different survey methods and sample sizes so the studies are not strictly comparable
[2] Do-it-yourselfers
[3] Employ a lawn care company that applies fertilizer on their behalf.

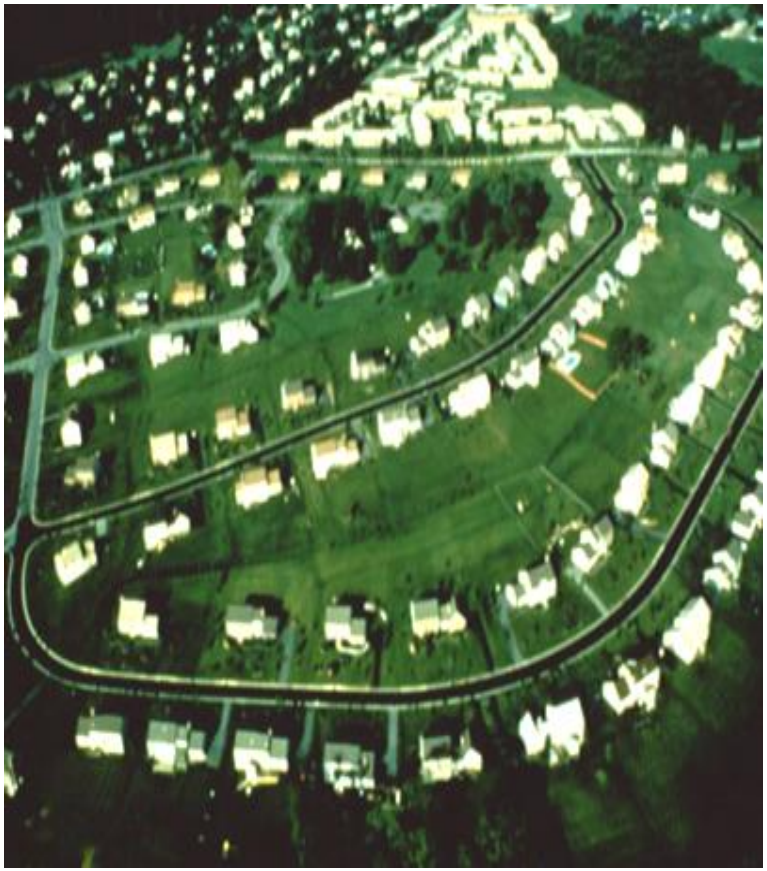
1 .7 to 2.0 fertilizer applications per year for do it yourselfers
4 - 5 fertilizer applications per year for lawn care companies

Effect of Outreach on Fertilizer Behaviors

- Recent sociological research indicated fertilization and lawn care behaviors are deeply rooted and hard to change
- Strong neighborhood pressures and norms often outweigh environmental or water quality considerations

UNM Capacity Issues

- Writing UNM plans for 1.6 million acres could outstrip capacity of existing UNM delivery system
- Several panel recommendations to increase cadre of qualified plan writers



Research Recommendations

- Monitoring of loads, concentrations and sources of nutrients from lawns w/ and w/o UNM plans
- Surveys of homeowner fertilizer behavior & norms in urban, suburban and exurban locales

Pervious Land: Model as a Load Dumpster or simulate as a turf ecosystem

- Norm has some ideas to get feedback on some options for simulating pervious land in Phase 6 CBWM
- Important to keep in mind that many other sessions will lay a claim to pervious load at this workshop, so the target unit nutrient load from turf may well need to drop in next version of model
- Need to do a conservative mass balance to assign sub-allocations to each pervious nutrient loading source (streambank erosion, inappropriate discharges, fertilizer, applications, detritus, sewage exfiltration, etc).
- Keep the pie the same size, but slice it differently