North Carolina Wetland Mitigation Evaluation Pilot Survey

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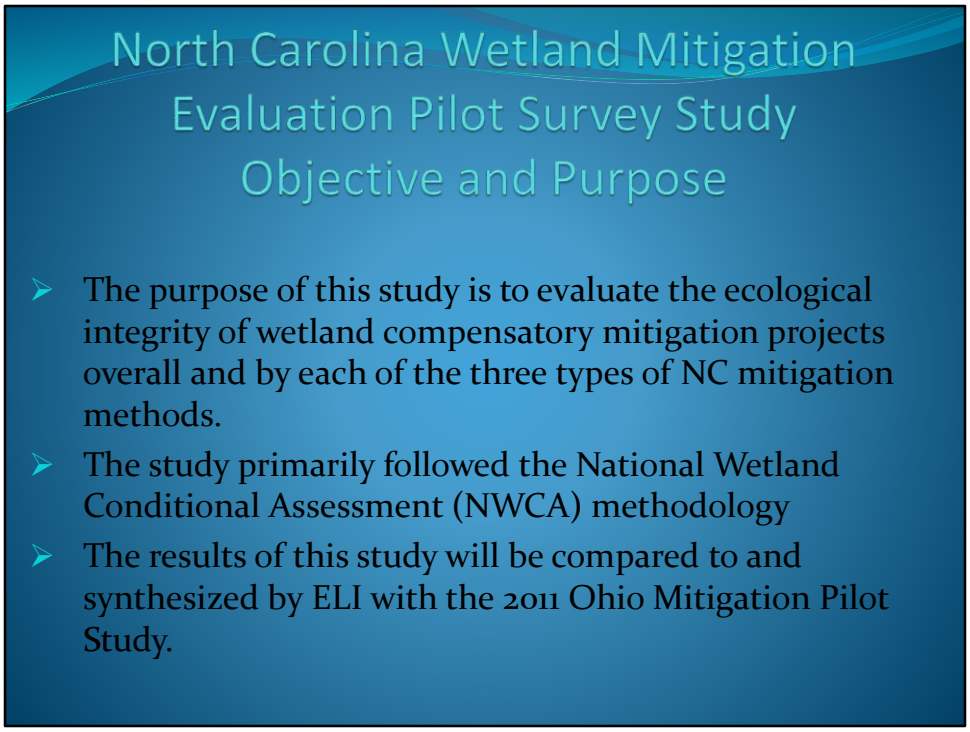
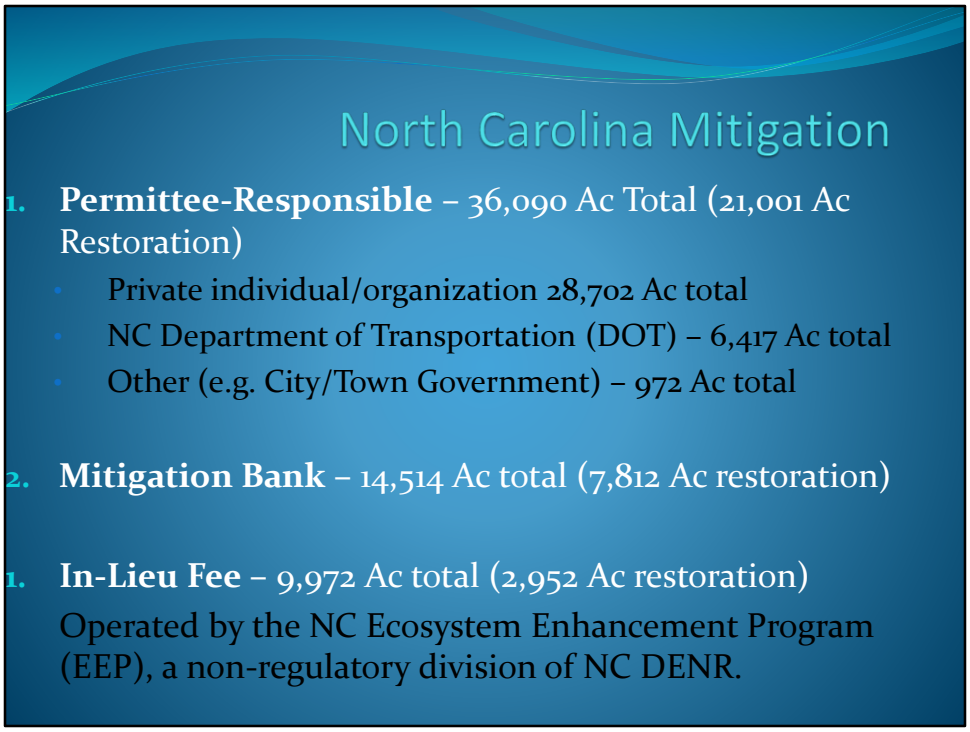


3 types of mitigation – Permittee-Responsibe, Mitigation Bank, and In-Lieu Fee. PG Environmental conducted the Ohio study.



Data as of beginning of project, September 2011. In the 1990s most NC compensatory mitigation was "permittee responsible" – 50% failure rate. So in 1997 state legislation founded the "Wetlands Restoration Program – run under DENR – wetland oriented mitigation program – this gave permittees an alternative mitigation option. In 1999, DOT started using WRP for some of their rapidly growing mitigation needs, but the situation was not working appropriately. State and federal review process recommended that Mitigation should be started years in advance for NCDOT projects. This lead to the creation of the NC EEP which ultimately absorbed WRP. Sometimes sites that are built by dot are transferred to eep for management.

Target Population for NC Mitigation Pilot Study

- Mitigation Type – Restoration.
- Wetland Type – Riverine or Riparian.
- Permitted – 2002-2006.
- Built ≥ 4 years ago.
- Deemed "successful" in most recent monitoring year for both hydrology and vegetation.
- Located in areas where trees were planted.
- Appropriate Size (≥ 0.10 ha) and width (≥ 20 m) for NWCA methodology.

Successful not closed out as in National Design, not enough sites for 2002-2006 Successful for vegetation – 260 stems per acre at year five monitoring, Hydrology depended on goals of Mitigation Monitoring Plan, ranged from 5-12.5% consecutive days of growing season within 12 inches of surface. Some restoration sites just have hydrology returned, we stayed in areas where vegetation was also planted to be consistent.

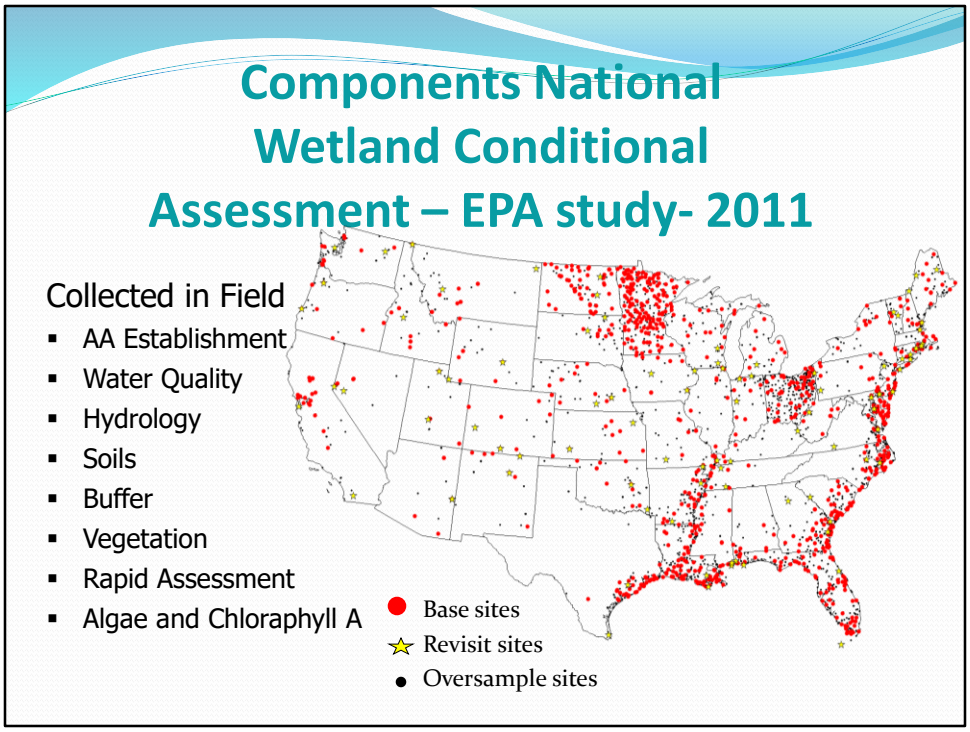
Mitigation Site Selection Methods

Target Population of Riparian/Riverine Restored Wetlands

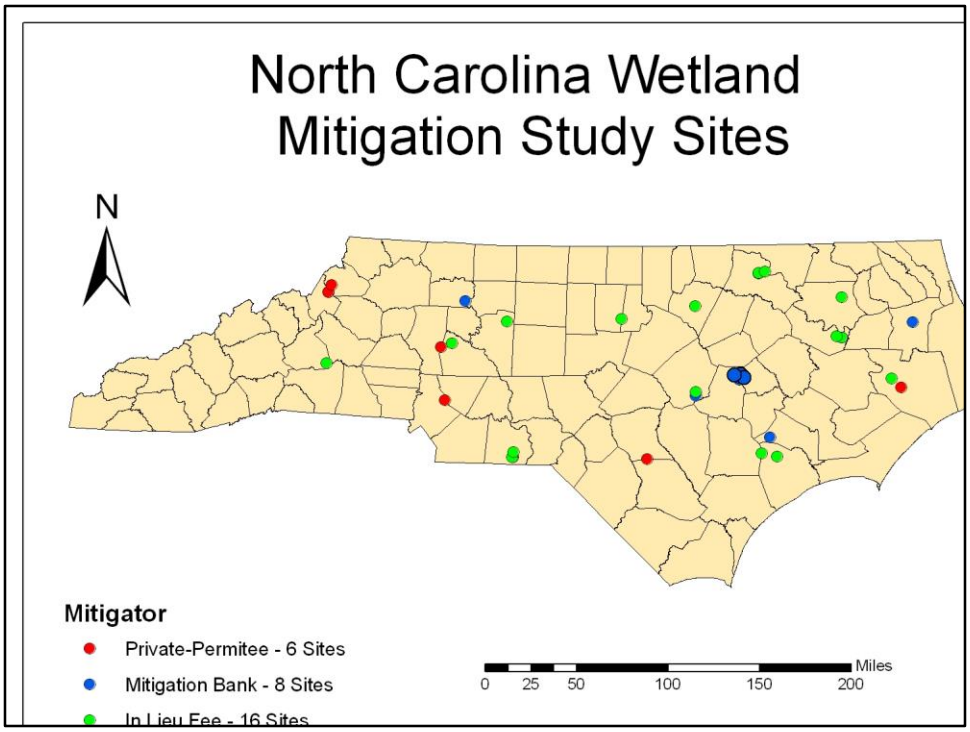
Mitigator	Number of Components	Acres
In-Lieu Fee (EEP)	42	667
Mitigation Bank	11	541
Permittee-Responsible	11	487
total	64	1695

Results of Target Population prior to desktop review for success (minimal time for recon)

Study used two approaches for choosing study sites due varying size of target population due to fewer permittee responsible and mitigation
For In-Lieu Fee - GRTS – done by Tony Olsen of the EPA. Sites are spatially balanced state wide. Design is to ensure results are within a 95% confidence interval. GRTS design includes a reverse hierarchical ordering. List of base sites provided (10) and over 100% over sample sites (32). Sites used in provided site order, if a site drops the first oversample is then evaluated and used.
If <10 sites of the mitigation / permittee responsible were deemed unusable then next oversample In-Lieu fee site would be selected. * we did not have more AA in larger sites as in national design.



5 10x10 meter plots were set up along plot placement lines, water quality collected- DO, pH, conductivity, nutrients, sediment/silt clay content, TOC, Soils – Soil chemistry, Soil isotypes, bulk density, soil enzymes, - Hydrology – observable wetland features that affect hydrology – inflow/out flow, impacts -ditching, berms, roads, culverts, etc, evidence –water marks, sediment depotsits, , surface water etc, Vegetation – vegetation cover, structure, height class / dbh for trees, gound cover

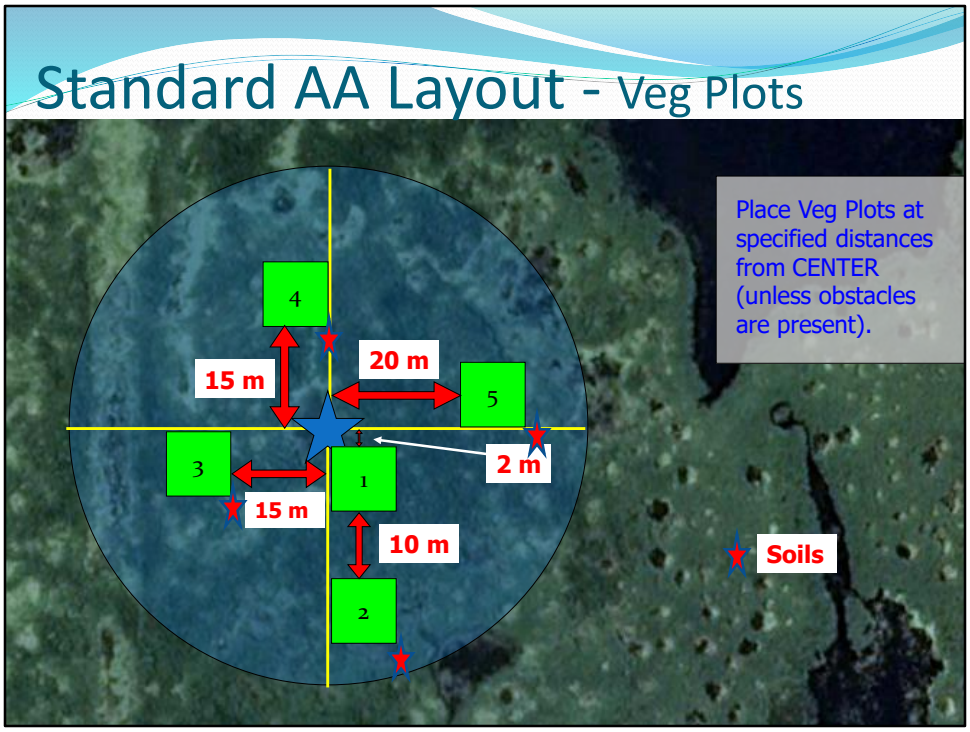


Permitee-responsible sites – 6, mitigation bank 8, In lieu fee – 16, Sites dropped for various reasons – Desk top review identified some that were not successful (most common) or were not Riverine, some were not 4 years old, were denied access to one private site.

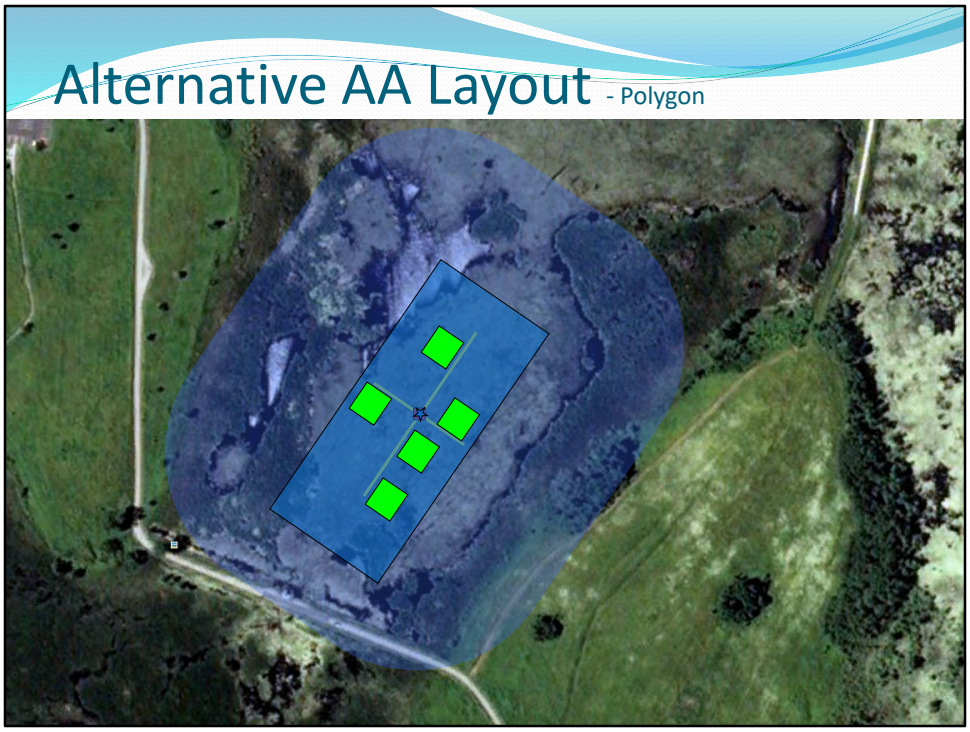
NC Mitigation Pilot Study Methods compared to NWCA

- Assessment Area – Component boundaries used rather then wetland boundary to locate AA Point.
- Water Quality – Only nutrients analyzed at lab.
- Hydrology – Hydrology success criteria and other parameters
- Soils – Soil field indicators -10 cm, 20 cm, and 30 cm. Only bulk and chemical samples collected.
- Buffer– Same as the NWCA, also calculated a Land Development Index (LDI) for 100 m buffer of AA.
- Vegetation – Added finer dbh size classes for live trees, standing dead <5cm dbh, and shrub clump count by species.
- Rapid Assessment – Added NC Wetland Assessment Method (NCWAM) and Ohio Rapid Assessment Method (ORAM).
- Algae and Chlorophyll a– Samples not collected.

The ELI study methods were finalized before the National Study Design was finalized. In a number of cases we mimicked methods used in Ohio since the two studies will be compared.
Hydrology – field sheet metrics that looked at whether the design of the site provided / controlled hydrology- NWCA did not collect info on.
WQ – used DWQ lab, so they were unable process Sediment Silt Clay content, Sediment TOC and some of methods different. pH also taken in field along with DO and conductivity.
Soils – Midwest laboratories which was used in the Ohio study. Soil Isotope and sediment enzymes not collected. Chemistry methods and some parameters dropped. Bulk density collected at 15cm middle of profile (100 ml). Second hole dug and 0-30 cm collect – composite (kg needed). We dug pits (auger used in ohio).
Buffer – Same Buffer methods also did LDI for 100m buffer
Some preliminary results to be discussed.



Standard AA used at

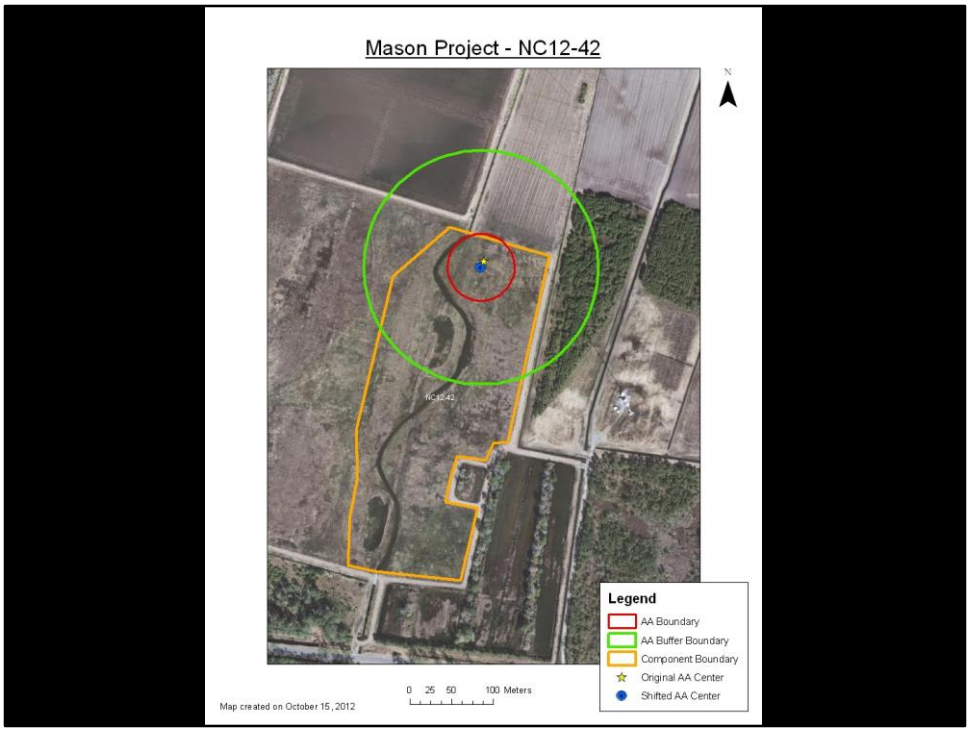


IMPORTANT NOTE: For buffer **plot** layout, a set max distance is always used. For **BUFFER ZONE** as defined by RAM, the buffer extends 100 meters from the AA perimeter in all directions. Due to this difference in definitions, the Buffer Plots may not lay evenly across the buffer zone, or may lay outside of it in some cases.

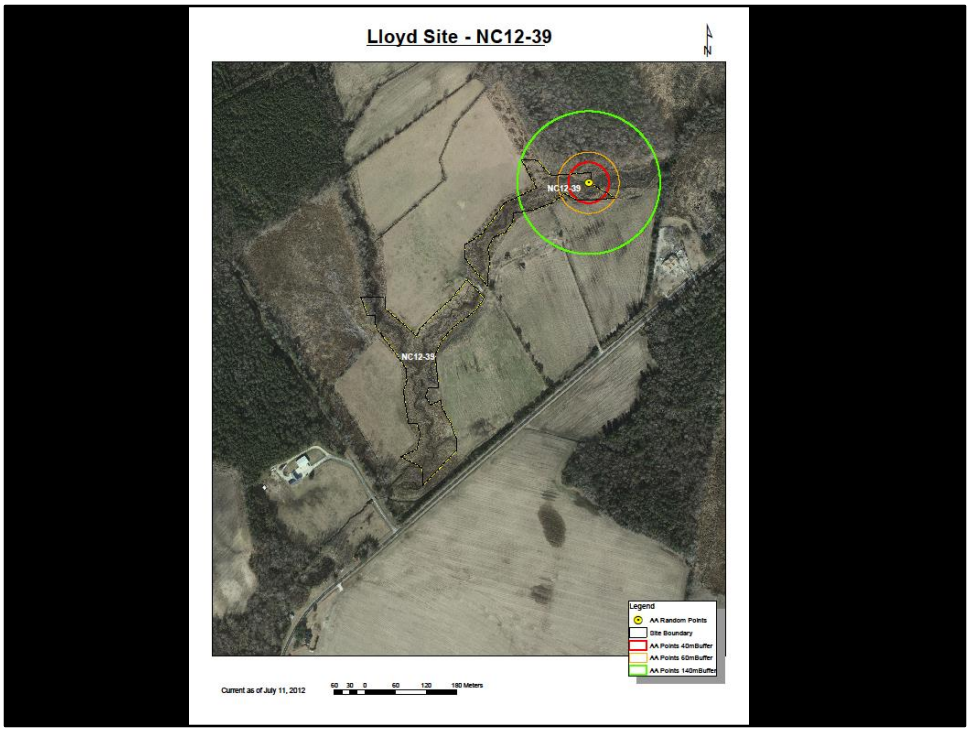
80 m circle did not fit in this area, but a wide rectangle of 0.5 hectares did. Short axis is between 40 and 80 meters wide
Notice that the plot placement lines are perpendicular to each other, but need not be along cardinal headings (though teams will quickly figure out that it is easier if they do).
Veg plots are laid out as closely to standard as possible (same as standard in the case of the very wide polygon)
Buffer plot lines are still along cardinal headings
Plot distances for each set of buffer plots needs to be calculated independently.
Buffer plots are:

#1 at edge of AA (Slight overlap is acceptable)
#3 is centered at 135 meters from CENTER
#2 is halfway between 1 and 3

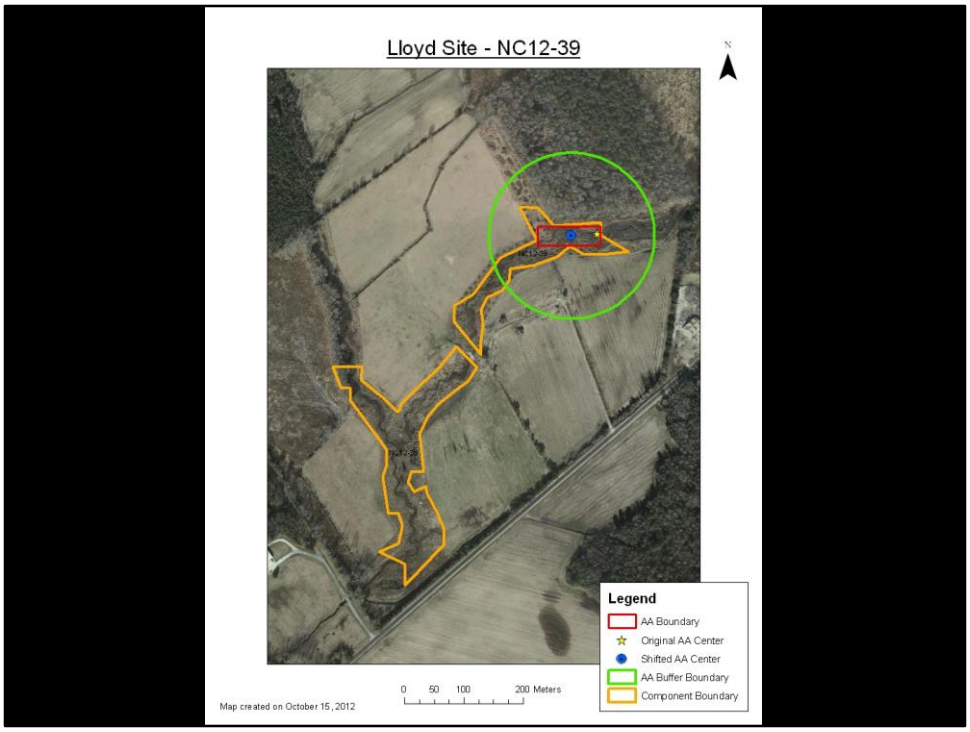
If buffer plot end up less than 10 meters apart, the short plot lines can be lengthened as necessary



Used the plan sheets to draw. Mason (In Lieu Fee) Component part of larger project. Point generated in random location. This point we had to shift just a little bit, standard 40 m radius survey area. Component that was considered riverine. Keyed as non-tidal freshwater marsh. 2006 site, small trees.



Lloyd (In Lieu Fee), shifted. Did not consider areas that were too narrow.



Lloyd survey results, point moved west. Narrow Polygon survey set up.

Water Quality Field Results

Calculation	Parameter	In-Lieu Fee	Mitigation Bank	Permittee Responsible
Sample Size		9	4	2
Min	Conductivity µS	21.6	85.8	71.6
Max		395	201.8	2719
Range		373.4	116	2647.4
Mean		139.5	138.6	1395.3
Median		112	133.4	1395.3
Min	Dissolved Oxygen mg/L	0.6	0.4	0.2
Max		8.1	5.5	6.1
Range		7.5	5.1	5.9
Mean		4.6	2.725	3.15
Median		5.3	2.5	3.15
Min	pH	4.2	3.75	4.11
Max		6.4	6.16	5.39
Range		2.2	2.41	1.28
Mean		5.7	5.235	4.75
Median		5.7	5.515	4.75
Min	Temp C°	16.4	22.2	18.3
Max		29.3	27.4	30.6
Range		12.9	5.2	12.3
Mean		22.2	25.25	24.45
Median		21.2	25.7	24.45

Preliminary wq field results presented here. Only really obvious differences were the high levels conductivity at some of the permittee responsible sites that had brackish water.

Soils

- Approximately 60% of the sites had soil horizons that appeared to be natural and fairly undisturbed.
- Three sites (two Permittee-Responsible and one In-Lieu fee) had highly disturbed soils from site construction and/or previous land use. Two of the sites (the Permittee-Responsible) did not have apparent soil horizons.
- Hydric characteristics were very weak and field indicators were completely missing in some soil pits at the same three sites.
- We would recommend using horizons for the soil survey rather than 10cm, 20cm, and 30cm for future mitigation studies.

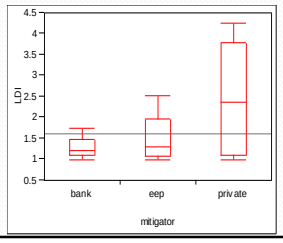
Hydric characteristics – wet influence-more general all soils. Field indicators matched with specific soil types. – NRCS list that show hydric processes, field indicators are more rigorous detailed explanation of wetland soil condition.

GIS Land Development Index (LDI)

$$LDI_{Total} = \sum \%Lu_i * LDI_i$$

LDI_{Total} = LDI Ranking for landscape unit
$\%Lu_i$= percent of the total area of influence in the land use i
LDI_i=landscape development intensity coefficient for land use

Sites	N	Min	Max	Range	Mean	Median
private	6	1	4.25	3.25	2.46	2.37
bank	9	1	1.74	0.74	1.28	1.22
eep	15	1	2.52	1.52	1.49	1.29
All	30	1	4.25	3.25	1.62	1.27



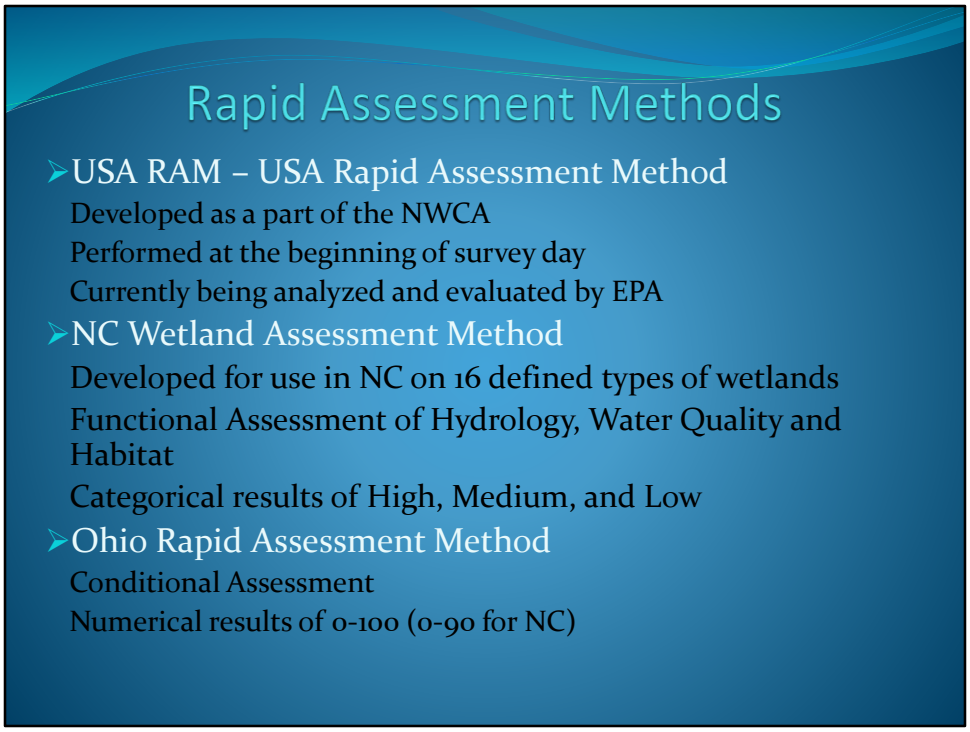
Back Creek Wetland Mitigation Site 100m Buffer LDI

LDI is a land cover analysis (Brown and Vivas) that is applied to a given area (100 m buffer) that incorporates the intensity of the land cover type weighted by the area of that land cover type. The more intense the land use – the higher the LDI value. Some of the permittee responsible sites that were private owned had higher (although probably not significantly higher) when built on-site , e.g. banner elk lowes.

Vegetation

- Cowardin used to classify veg structure – 17 Emergent, 7 Scrub-Shrub, and 6 Forested sites
- The Ohio EPA's Vegetation Index of Biotic Integrity (VIBI) was used to analyze data.
- VIBI had 10 metrics for emergent, 9 metrics for scrub shrub and 8 metrics for forested sites.
- Emergent IBIs 26-94 (high score 100) mean=70.5, med=73
- Scrub-Shrub IBIs 33-46 (high score 90) mean=39.1, med=40
- Forest IBIs 43-67 (high score 80) mean/med=55
- Weighted IBIs scores showed that the mean In-Lieu Fee and Private Permittee IBI scores were ~53 and mitigation bank IBI score was 44.3

Prelim Veg results similar for 3 types of mitigation. Mean varied from 50-62.



USA Ram – read slide**, NC WAM –** Developed by interagency federal and state team from 2003-2008. **ORAM** Also developed by an interagency team for use on Ohio wetlands

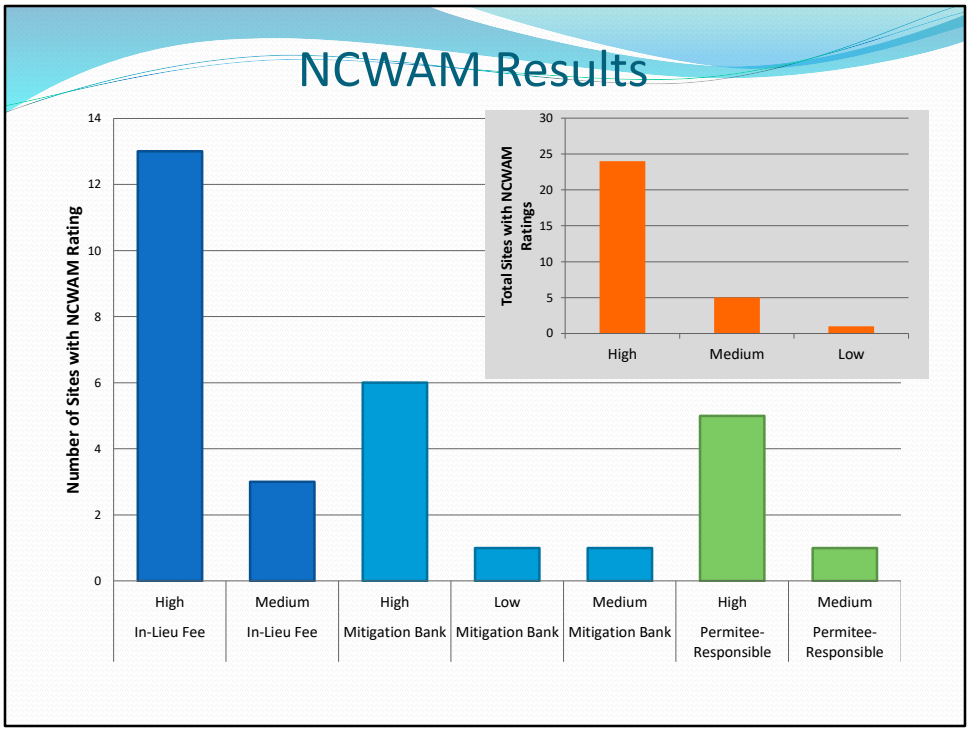
NCWAM Classification and FWS Status and Trends Vegetation Structure

FWS Status and Trends Vegetation Structure	Bottom Land Hardwood	Headwater Forest	Non-Tidal Freshwater Marsh	Riverine Swamp Forest	Riverine / Riparian	Estuarine Woody Wetland	Non-Riverine Swamp Forest	Pine Flat	Non-Riverine/Riparian	Total
Emergent	1	1	4	1	**7**	0	1	1	**2**	**9**
Shrub/Scrub	4	2	0	5	**11**	1	1	1	**3**	**14**
Forested	2	2	0	2	**6**	0	0	1	**1**	**7**
Total	7	5	4	8	**24**	1	2	3	**6**	**30**

24 of the 30 sites were considered Riverine / Riparian by NCWAM, 6 were not- due to the fact that our database reflected what was in the report and that NCWAM keys wetlands with USGS maps crenulations, at some mitigation sites streams built in flats and not recognized on USGS maps.

NCWAM classifications and FWS Status and Trends lumped by veg structure - Emergent –herbaceous, schrub shrub – woody saplings/shrubs <6m, forested – trees ≥6m

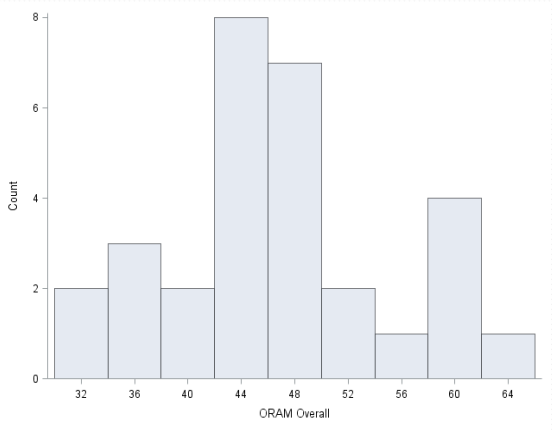
Examples of three different vegetation structured sites, Mitigation Bank Forested Deep Creek (NCWAM – riverine swamp forest), In-Lieu Fee Scrub shrub Floogie (NCWAM – riverine swamp forest), and Emergent Permitee –Responsible Banner Lowes (NCWAM – Non-tidal Freshwater marsh)



24 High, 5 medium and 1 low overall, by mitigator also primarily high with 13 high In lieu fee, 6 high mitigation bank, and 5 high permittee responsible

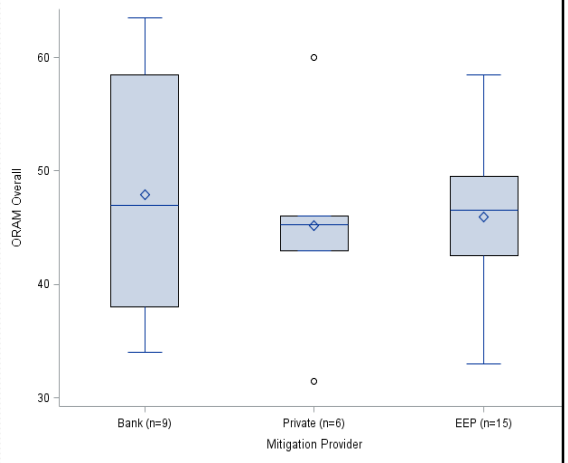
ORAM Overall Results

- Sites ranged from 31.5 to 63.5
- Mean Score – 46.38
- Median Score – 45.75

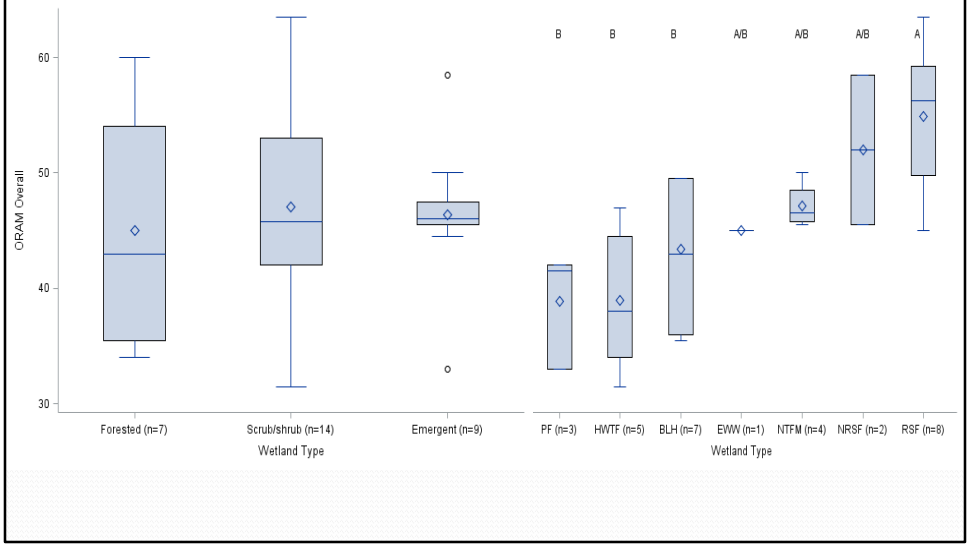


ORAM Results by Mitigator

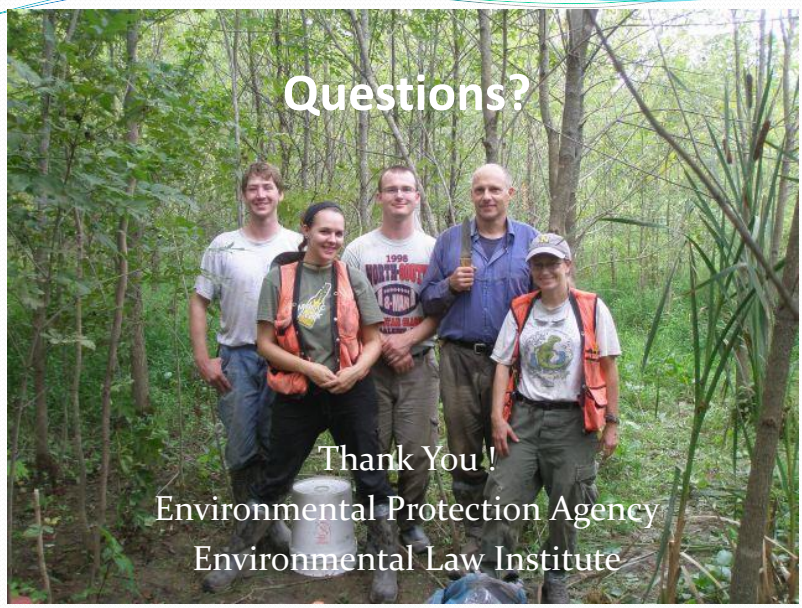
- Permittee-Responsible Ranged from 6 to 31.5, Mean 45.2, Median 45.3
- Mitigation Bank- Ranged from 36 to 63.5, Mean 49.6, Median 50.5
- In Lieu Fee- Ranged from 33 to 58.5, Mean 45.2 and Median 46



ORAM Results by Wetland Type



First three box plots are all the sites by vegetation structure, Next 7 are NCWAM types, For the NCWAM sites, A and B had significant difference with each other but not with A/B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