Science and Technical Advisory Committee
Winter Meeting
Albemarle-Pamlico National Estuary Partnership
March 2, 2018

STAC Members: Jud Kenworthy, Burrell Montz, Bo Dame, Robin Dennis, Doug Wakeman, Jess Whitehead, Rua Mordecai, Michelle Moorman, Peter Kalla, Lee Bodkin, Don Field, Erin Fleckenstein, Randall Etheridge, Hans Paerl (remote), Tim Goodale (remote)
Guests: Joel McCormick (Chowan University), Donna Schwede (USEPA), Rick Savage (Carolina Wetlands)
APNEP Staff: Bill Crowell, Dean Carpenter, Tim Ellis, Kelsey Ellis, Jimmy Johnson, Coley Cordeiro (remote), Stacey Feken (remote)

Call to Order, Welcome & Introductions, Approval of Fall (November) 2017 meeting notes, Meeting objectives, Public comments (Jud Kenworthy, STAC Co-Chair)
Jud Kenworthy – Welcomed everyone, this is his and Burrell Montz's last meeting as STAC co-chairs. Appreciate the hard work the STAC is doing. A lot of work happening now with the Monitoring and Assessment Teams (MATs), a lot happening outside of these brief meetings.

Kenworthy – This is great that we have a meeting webinar for STAC members who cannot be here today. Next item to think about is where we all stand, anyone who is interested in taking over as STAC Co-chair, best thing is to talk to Dean, you can talk to us as well. Burrell Montz – Not an onerous commitment. Dean Carpenter – Two-year term, will start on July 1. Two elected co-chairs who will nominate three additional members for the STAC executive board.

Kenworthy – Next week, members should expect to receive a Doodle poll from Dean to plan for the next meeting. Carpenter – Target is September. Kenworthy – Agenda today is typical, opportunity for a lot of interaction and to hear about progress the MATs are making. Feel free to speak up and interact with all the speakers today. After these presentations we'll spend time in the afternoons doing evaluations of the teams and self-evaluations. All these teams involve people who aren't on the STAC.

Kenworthy – Next step is to approve the fall meeting notes. Anyone make a motion to approve these notes? [motion, motion seconded. No comments.] Notes approved.

Kenworthy – Objective today is to move forward with these MAT short reports, get feedback from APNEP staff about what they might need for this imminent deadline in preparation for EPA's program evaluation. Is there anyone here that isn't on the STAC, that is with us and from the public?

Joel McCormick – I'm here, professor from Chowan University. Bo Dame was my mentor, interested in developing some courses about coastal tourism. Teaches recreation. Interested in

meeting people, making connections. Prepare students to work at state parks, local parks, ecotourism, etc.

[STAC member and participant introductions]

APNEP Staff Update and Member Reports (Dr. Dean Carpenter, APNEP)
Carpenter – Thanks all for attending the meeting. Staff generally provides an overview of what's been happening in the APNEP science & technology world. Dean has provided members beforehand a document highlighting what's transpired from December through February. There have been a number of APNEP-sponsored workshops, webinars, etc. In parentheses are the members of staff who were involved in each particular activity. Opens up to questions. No questions.

APNEP Planning, Monitoring, and Assessment (Dean Carpenter)
Carpenter – Gives adaptive management/update presentation.

Carpenter – APNEP is undergoing its programmatic review by EPA this spring. The last EPA review was in 2013, they give APNEP challenges no matter how well you do, they told us to make progress on indicator development. In 2018 we're going full guns here on this process. We had all seven teams do work on this, they took the lists from Phase One (pre-2011) and made some improvements. We'd like the STAC to weigh on the teams' progress with the recognition that some teams have been working months longer than others. Comments from this meeting will be relayed back to monitoring and assessment teams. This will give the teams feedback to consider, each of the team's charge in the spring will be – these are the comments from the STAC, then they'll identify a handful or so of metrics that they're fairly comfortable with – Tier I are the metrics a MAT is most comfortable with, Tier II needs more research. APNEP staff are here to facilitate this process, but it's really up to the partners on each team. We're not going to wait for all assessments to be completed to roll out a report (as was the case in 2012), we're going to publish them as they're ready.

Carpenter – All clear on what is happening in 2018? Ideally by December of 2018, we would like each team to produce at least five assessments.

Bo Dame – Is that going to incorporate the feasibility of those indicators to be measured?
Carpenter – In 2018, will be based on the data we have available. For 2018, we're going to rely on the high quality, regional data that is available right now. If data isn't available for whole region, we can focus on a sub-region.

Michelle Moorman – As part of our prioritization process, should we give more priority to metrics that don't already have a regional assessment? Carpenter – There are only 24 featured in the 2012 APNEP ecosystem assessment…personally I would like more metrics evaluated. If choosing is between those metrics we assessed in 2012 and those we haven't assessed I'd prefer the latter. Think about the five metrics we're starting with first. Moorman – Thinking from a team perspective. The water team had a lot of indicators so we're going to have to pare

down. Should we take that as a factor? Some things we might be able to assess easily but the state or EPA already has these regional assessments. There are some things like cyanotoxins that don't have an assessment. Carpenter – misunderstood Michelle's question (thought she was referring to APNEP assessments rather than partner assessments)…I don't have a preference one way or another. Way to get things rolling, we're going to have to do the remainder of the geography. Taking what our partners have done and determining what the value added is.

Rua Mordecai – Originally talking about three to five indicators, now five assessments. Thinking about quantity over quality. Bill Crowell – Need something you're comfortable standing behind. Mordecai – Could have less than five, depending. Bill Crowell – More than one. Mordecai – Asking about it in the context of paring down, we may have five to spread our efforts out on but we may not get as far with them as if we were doing three. Carpenter – What we're trying to convey is that within APNEP's decision support system, we would like to have multiple assessments from each of our MATs by the end of the calendar year.

Moorman – Are we as a STAC really going to come together, are we going to have a unified product? Assessments from different indicators will look different or the same? Carpenter – Staff will be working on that, making things transparent for someone to visit. Staff will propose a first vision of that.

Moorman – Will we get a copy of that vision? If we're going to start working on indicators, we'll need a copy of that outline. Crowell – You'll be getting that soon, will be similar from 2012 framework. Tim Ellis – What does this indicator report? Why can't we say more about it? Potential gaps in data. 2012 assessment.

Robin Dennis – Same as 2012 assessment? Would be important to have this guidance. Carpenter – Yes, will be out hopefully in April.

Moorman – Some of these indicators, we have technology now, we could bring someone on to help these teams, if we have this online indicator assessment, it would be really slick if we had some code written for indicators that could go and pull data from portals and teams could focus on what do we want this indicator to look like so indicator is generated and constantly updated online. Don't know if resources are available, there are students who could work on that.

Carpenter – Yes, staff is thinking along the same lines. Bill Crowell – We can make APNEP resources/money available to build these kinds of things. Time/personnel contracting issue. Going back to Rua's question, there are indicators for which we don't have data and those aren't helpful to start with. Want to see – do we have data and will they be helpful in implementing CCMP actions.

Rick Savage – Wish to tout EPA's assessments of wetlands. Five assessments – when they came up with indicators, I was involved with the wetlands indicators for the 2011 surveys. Reports show how they used multimetric techniques to come up with the state of the wetlands. APNEP

staff should look at those to see how we could integrate. Don't want a hodgepodge of indicators, want to be able to roll them up.

Moorman – I'm in support of rolling up and automating the process.

Ellis – As we review these indicators, think about what can be automated and what can't. Don't have routine monitoring. Think about that, we're going to be developing a monitoring strategy for teams.

Kenworthy – Situation is, the team could think this is a very good indicator but we don't have the data in place to process it. Carpenter – If team thinks it's an important metric and it's not being collected by our partners at all then that metric should be championed. While a major criterion is whether data are available to make it a core metric, we're trying to address core metrics, and should target missing pieces as well. I think team should state such. Could do a pilot study on part of our geography or something to state its utility.

Ellis – For some indicators, data are available but is local/regional. Could fill in spatial gap by monitoring throughout A-P region.

Erin Fleckenstein – Unfamiliar with APNEP's Leadership Council, is that Executive Committee? Carpenter – With new administration, APNEP has a new executive order. APNEP has a new executive order laying out state's cooperation with our partnership. One of the things that did change, Policy Board became Leadership Council. Any other changes? Crowell – In the new Executive Order, the Leadership Council replaces the Policy Board. Same membership, expanded a bit. Deputy Secretary of the NC Department of Natural and Cultural Resources (DNCR) and Department of Environmental Quality (DEQ) will be on the Council. Will have an at-large position from Virginia in addition to the two seats we had previously. Everyone has received their appointments to the council, we are only waiting on the EPA person to be identified. STAC has all accepted their new appointments. Implementation Advisory Committee (IAC) still needs to be set up, will be comprised of members of the Action Teams and a few other engaged stakeholders. IAC will take projects from Action Teams and sort out resources for those. Leadership Council budgets money for implementation projects and IAC will decide which activities of the action teams will get funding.

Kenworthy – When will those be up and running? Crowell – all but three action teams are active, currently figuring out who will represent the action teams on the IAC. Each team will send a person.

Kalla – Wanted to elaborate. EPA already has scripts written in R to analyze probabilistically. If you do that, you're good to go. True for all the MATs. Carpenter – Reminder that the difference between this and future assessments, if data isn't probabilistic…we need to make sure the data we collect is truly representative of target population.

Kalla – For wetlands, let us assume data from EPA assessment isn't available for this year, would be assessing from data from previous survey. Many indicators will come from national wetland condition assessment. Will date assessment considerably.

Carpenter – Working with the National Aquatic Resources Survey (NARS), including the National Coastal Condition Assessment (NCCA), talking to them about not holding up all parameters, APNEP is one of those partners that is waiting for 2015 survey data. NCCA staff has been providing us drafts. I'm hopeful that we can make some inquiries about the 2016 wetlands information, maybe through you, to see when we can release it. Maybe not holding it all up for four years as it is developed. Savage – I can link you up with the right person. Kalla – Good that the request comes from the state, comes from you all. Savage – Would be the raw data. Kalla – Wouldn't release anything until it's quality assured.

Kenworthy – Let's start with the indicator reports.

Indicator Reports by APNEP Monitoring and Assessment Teams (MATs)
Wetlands Indicators (Rick Savage)
Carpenter – Each team has about 30 minutes, don't have to take all the time. Would take us days to do a deep dive. Evaluation of what you see, what is missing, what are overlaps.

Savage – I'll preface, we had good people on the team. One difficult aspect of wetland ecosystems is their uniqueness – no two wetlands are the same. Interesting process. [Shows list of indicators] A lot of vegetation data, fair to say these indicators have been used a lot, mostly in EPAs assessment and our own for the state, we adopted the vegetation survey protocols adopted by the Carolina vegetation surveys. Allows plant data to be compared which is nice. Any comments or questions?

Carpenter – Note that asterisks in the indicator list means Tier II, we're less committed to these and more research is needed.

Kenworthy – Relative to previous discussion, this dependency on existing metrics and evaluations that have been done by others. Have you discovered that strength of indicators can be improved because you can tie them to historical datasets? More info means and more powerful indicator? Savage – Fair to say, can't say it is true for every indicator. EPA took metrics and indicators and rolled them up in a multimeric technique. Combination of indicators is what told you whether the wetlands were in a good state or not. This vegetation data have been collected for years. Carolina vegetation survey has been conducted for 30 years or more. They have a ton of data themselves. Our research for the state, used the same vegetation methods and the EPA adopted it. A lot of historical precedence for it. Mostly documenting what is available, what they had. We were mostly in the baseline stage, just was getting to that when the program ended. EPA is also monitoring trends over time.

Kalla – Another feature, data are compared to reference site data to provide a standard. Rick – in 2011, had almost 1,000 sites nationally and almost 100 reference sites.

Mordecai – To me that wetland condition index, all that work that went into all of it – great indicator for APNEP to use without having to do all those calculations themselves. Maybe focus is on intensification of monitoring to make it better. APNEP wouldn't have to develop all reference, multimeric index, etc. Savage – Good point, methods are based on probabilistic sampling technique. If you want to collect more data, will want to do that as well.

Kenworthy – Has anyone taken the time to critically evaluate the benefit of straight probabilistic, random? Savage – Some probabilistic…Carpenter – do you know about the benefits of the intensification? What can you say when you added all the intensification? Savage – Did that in 2012, worked with four states on it. Twenty additional sites in each state and combined that with data from the NWCA and did our own assessment of the region. Never went back and rolled it up.

Moorman – You said maybe 2016 data will be unavailable by year's end, this could be a place to grab publicly available data from the 2014 data and you provide the analysis. Could be easily updated when 2016 data becomes available. Savage – Yes, think that makes sense. Any other questions about vegetation?

Savage – Next, Tier II indicators. Wetland Fauna. One problem with these assessments is that they must be done early in the year. Salamanders are a good indicator, in our research we sampled salamanders. North Carolina has more salamander species than any other state in the country and they depend on wetlands. Colonial waterbirds, well done survey and has generated a lot of data we can access. Macroinvertebrates needs more work, butterflies are there…more work to do on that.

Savage – Wetland Landscape indicator. Wetland hydrology, alterations that would affect wetlands function. Wetland buffers, good to get that data because it gives some indication of what's happening around the wetland. Been a fair amount of work in the Carolinas that indicates marshes will move backwards in response to sea-level rise unless there's development, that's where barriers to saltmarsh migration originate.

Dennis – How would you measure that? Savage – Would have to look at development, like idea of looking at development in buffer areas, from a GIS perspective, add density score to land area and get a score. There are techniques to do that.

Kalla – I'm working on these hydrology metrics, idea was that you could intersect map of metrics with linear features. Low lying areas are already mapped next to roads, easy. Hardened shorelines, more difficult. Carpenter – Do they have a database about permitted hardened shorelines? Group – Yes. Fleckenstein – Assessment in 2012. Tim– New one should be coming out soon. Mordecai – Can incorporate barriers on a larger scale.

Savage – Wetland permits, wetland protection. Any questions?

Kenworthy – One thought on barriers to saltmarsh migration, beyond infrastructure, what seems to me to be a big deal is the slope. Ultimately elevation. Kalla – Hard to detect that from a satellite eye view. Jud – Many LIDAR missions right now. Don, Carpenter know about them. Mordecai – NOAA sea level rise model uses LIDAR stuff. Does take into account that slope aspect. Kenworthy – We know how sensitive marshes are to elevation, slope. Mordecai – There's also a small action connection. Work further north, looking to facilitate marsh migration, noticed that people were mowing into the salt marsh. Marsh was trying to migrate and they were trying to mow down the marsh grass. Education need. Could be some citizen-scale things that people could do to help as well. Kalla – No escarpment? Savage – No. Kenworthy – Setback rules only affect structure.

Moorman – On a metric, what about surface elevation? Whitney Jenkins coordinating that. Effort to compile that information in the region. Savage – Covered in here because in coastal plain, six inches is a mountain. Going to get information about elevation through plant species data. Dame – Structure follows function.

SAV Indicators (Jud Kenworthy)
Kenworthy – What I aim to do is introduce you to complexity and challenges in developing monitoring methods.

[Notes were not taken for a few minutes, did not take detailed notes on content on Jud's talk – only on comments/questions]

Kalla – How do you define shore normal distance? Kenworthy – Site specific. Track movement of deepwater edge.

Kenworthy – SAV species composition. Metric we haven't addressed yet, could be really important, issues with nonnative species.

Kenworthy – To give perspective, we're living near the largest coastal lagoon in the country. Addressing three factors we know affect SAV growth/distribution. Salinity, water depth, water clarity. Starting with salinity, slide was developed by Joe Luczkovich from dataset. Harvested available salinity data from North Carolina. Sharpest difference between Albemarle sound and southern area. Important because this defines species composition. This is list of all SAV in North Carolina. Talking about differences between SAV species, growing at different times of year and in different salinity, that changes how you monitor them. All flowering plants, produce seeds, reproduce sexually/asexually. Most weedy is *Ruppia maritima*. Very important, ephemeral, dynamic plant. Next factor is water depth. Behind barrier islands, clear shallow water. Most seagrass is in water less than two meters. Waters of the sound too deep/dark for SAV to grow. In clear water, high salinity environment, we can remotely sense this resource. Aerial photography.

Kalla – So seagrass bed is dark? Jud Kenworthy – Yes. Kalla – What is light green? Kenworthy – Deepwater slope, finer sediments. Grass beds don't necessarily go all the way up to the marsh.

Kenworthy – Dealing with water clarity. We have never been able to get aerial data for rivers. Mixed results, aren't going to be able to use the same methods to monitor this resource comprehensively. You can imagine how much shoreline we have with these systems. Impractical to look at it all. Used established technique, SONAR. Joe Luczkovich (ECU professor) working on this, starting to map and develop monitoring protocols in Albemarle, Pamlico, Neuse. Underwater video too time consuming. Used to groundtruth acoustic data however. Another form of remote sensing. Metrics also include accuracy assessments. Solution for low salinity areas – sentinel monitoring sites. Ten sites in Albemarle, ten sites in Pamlico. Smaller areas we can monitor more frequently at higher intensity. A problem – plants all have different seasonal pulses. Discussion of monitoring protocol. Dynamics are interannual. Extremely dynamic places, vegetation comes and goes really fast. Have to develop rapid technique.

McCormick – Are data collected on same dates? Kenworthy – We're trying to determine the optimum sampling window to collect these data.

Kenworthy – Showing data from Kitty Hawk Bay. Problem with technique is that it can only be conducted in no less than 0.5-meter water depth. Developing a technique for change analysis in the monitoring program – haven't proposed yet to do change analysis, but think it could be done. Can determine gain/loss of SAV.

Kenworthy – Turning it over to Don for a minute. What we're doing, where we've gone. Green on the map is 130,000-plus acres of SAV.

Don Field – Thanks to Dean and Bill and the SAV Team, we've flown the entire coast. 2006-2008 and 2013-2014. It's between Bogue inlet to Manteo. In process now of finishing up change detection for those two time periods. Been very challenging, this is one of the largest seagrass resources in the world and only Florida and Texas have more in the country. Difficult task, large area to deal with. Another issue – more patchy seagrass beyond deep-water edge. Yellow shoal in photo is shallow, doesn't have to be perfect water quality conditions. Can identify the deep-water edge of SAV in nonperfect historical imagery. What we're afraid of is retreat of the deep-water edge, berm is one of the biggest protection those marshes have from large waves. When reviewing photographs from the 1950s, noticed that the deep-water edge in certain areas have been reduced/pushed back. No indication that this is an anomaly. That's the second metric to areal extent, slightly easier to deal with because you don't have to have perfect water quality.

Kenworthy – Questions? Fleckenstein – Can you differentiate species with aerial imagery? Field – Only sentinel sites will have data collected with quadrates/cores, will include species composition. Dame – difference in intensity – more quadrats – up north vs down south? Kenworthy – Yes, takes more effort.

Mordecai – SAV captures so many components of the ecosystem. So much great work here already. Why isn't this the core indicator that isn't above everything else and other indicators aren't complementary to that? Why isn't held up, lead with SAV?

Kenworthy – You can back out of SAV to a lot of other metrics in the system. Mordecai – Curious why it is very explicitly listed in other partnerships, here there is a lot of effort but it is implicit and not as front-facing. Kenworthy – Very complex. High salinity work, most originated in Carteret County. No one in the rest of the state except for Mark Brinson were working on low salinity SAV. Very difficult for us to work in those regions. One of the challenges of that past ten years is to find someone at an institution who is more capable and that's been Joe Luczkovich. As long as we can maintain funding, we've gotten grants from Coastal Recreation Fishing License (CRFL), Coastal Habitat Protection Plan (CHPP), we know a lot about high salinity species because we had five marine labs in Carteret county working on it. Canary in the coal mine resource.

Mordecai – Are we at a point where APNEP as an organization – part of why I ask this is related to the monitoring stuff, if there's going to be a core indicator and others that tell a story, that's going to change how we write up a report and tell a story. Carpenter – I'd like to provide some pushback on SAV not being a core metric. If I limited to one measure, SAV would be the one metric. Although many NEPs do not have as comprehensive an effort in indicator development, they do have SAV as an indicator. In developing our effort, we facilitated the SAV partnership, seemed like partners were willing to contribute bits and pieces, then APNEP's Policy Board agreed to allocate significant resources to do baseline map, released in 2011 map. It's always been a priority for our efforts, APNEP has tried to do a lot.

Mordecai – I was saying, it seems clear this is a big priority, but it hasn't been held up/communicated that…others have one big indicator and others complement it. Carpenter – You can have SAV in excellent condition, but fish communities might be in poor condition…as a coastal habitat measure it is important. Bill Crowell – For us the issue was important, but we didn't know what was there, my impression is that we still don't have a good handle on what we could/should have. Would like to develop key indicators. What you're asking is how do we relate water clarity back to SAV for example?

Mordecai – Thinking it's going to be like, tell me the story in a sentence, paragraph, etc.? Difference between 1 among 50, 30, and setting things up to present SAV as a showcase. Don't know if we aren't at a point of doing that yet for the …

Crowell – Deciding how we want to organize things is up to the STAC. Carpenter – Tampa Bay in the 1950s was fortunate in having aerial photography missions done. We were starting a little more behind the curve, we've had more challenges in developing that, tracking, teasing out the anthropogenic signal. There's a lot of complexity in the system.

Kalla – Deep blue area in the sound. Did you say there's never going to be seagrass there, no light? You wouldn't want it to be the only indicator then, because it would leave out a huge part of the estuarine area. Mordecai – You wouldn't assume seagrass has to be everywhere, idea would be if you had to pick one indicator to pull them together, if you saw you were losing it, water quality and other threats would be manifested in SAV change. It's not …in the

Chesapeake, they hold it up but they have complementary measures that look at how you get there, what are the problems.

Kenworthy – Any other comments, questions?

Human Dimensions Indicators (Dr. Burrell Montz)
Montz – Human Dimensions team met a few weeks ago, fortunate to have had an East Carolina University report that was done in 2011 where a group got together to develop a social science observatory. While the indicator list now is really long, we wanted to be as comprehensive as possible because there are so many factors out there, things that are available from the census. Resource extraction and productivity. Economics, I won't go through every item on here. We want to know what's most important to the other MATs if we're going to prioritize. We want Tier I to be the indicators that are of importance to other teams. We can set a baseline, easy to do that for most things. It's time that's the problem, the expense that goes with that time. We see ourselves as the input to the other teams. Looking to you for input, we came up with what the team thought was an important list of human dimensions. Our report is looking to you all to help us decide what are the most important indicators.

Moorman – This is maybe where that idea, if we had a couple core indicators – elevator indicators. When we say what does APNEP do? APNEP monitors SAV in the A-P system and it's getting better, not changing, etc. Could be oysters, etc. If we could come up with those, that might help us to narrow down the larger list of indicators. I support Rua's suggestion, maybe more than just SAV.

Kalla – Everything that is in black font is a potential metric? Carpenter – Yes, blue is indicator and black are the supporting metrics.

Carpenter – Please scroll down to the model diagram. This group is talking about the drivers of a lot of the impacts. Resource extraction, biological harvest, that sort of thing. Tradeoff between human activities, economy, environment. You've got to be able to track that, if we're going to tell the story – degradation down here, working up through the stressors, we've got to be able to track them as well. We're talking about a socioecological system, having a social science component equal to the traditional ecology.

Montz – Want to compile data to set a baseline. We can track past trends, get a baseline, track current trends. In some cases, correlation isn't always causation – have to be careful about that. We don't have Tier I and II because I think we should and can collect all of it, key is prioritizing what will help other MATs most.

McCormick – Please scroll up to recreational metrics. Recreational, commercial fishing licenses. Is there data on where the access points are, how many people are using them? Montz – Varies. Carpenter – APNEP has an action team that focuses on public access, this will feed into that and inform what they're doing.

Mordecai – The South Atlantic Landscape Conservation Cooperative (SALCC) has a greenway indicator that's very similar, could fit very well. Simple summaries could be one of the assessments that could be done and that's one that is a pain to get across the whole geography. Volunteer to help with that. Looking at greenway per capita.

McCormick – Blue trails? Canoe trails? Mordecai – Would be a good collaborative thing to work on.

Carpenter – Ultimately all these ecological endpoints are supporting a human wellbeing index. Savage – A lot of the efforts we would be making in other areas would be benefitting human needs. Carpenter – As other MATs develop their models, will be talking about how human drivers influence the stressors, so to speak. Mordecai – Way to merge those in a way that is complementary, you have income, nature-based income, way to merge those…if it's up, we're happy. I think there are ways to lump those together in a way that would resonate. Montz – Ways to pull that together, how exactly I'm not sure but I'm sure it can be done. Mordecai – Other assessments have done that before, could look to their example.

Montz – Could look at these indicators and metrics for baseline, past trends, then could look to other teams to prioritize. Carpenter – Social observatory, that's what we're trying to do for our geography.

Kalla – Census is major source, for others… Montz – Local, county, property, tax information. Kalla – How many of the metrics are not already sitting on a shelf somewhere. Montz – Not on one shelf. Ellis – Team didn't dive that deep yet, discussion of other indicators we didn't put on list. Montz – Tried to pick indicators where info was reasonably/readily available.

Fleckenstein – Can you define coastal region? Is that APNEP region only? Carpenter – That's part of the discussion, what do we want to assess? Kalla – There are some indicators and metrics that are going to be pretty difficult if you don't limit yourself to the coastal zone. Fleckenstein – State parks will keep great records, etc., picking key locations would help. Montz – Yes exactly. Was in original language but doesn't need to just be that.

Kenworthy – In early 2000's NOAA pushed to work on human dimensions – did that go anywhere? Montz – not that I am aware. Kenworthy – Seemed to be bigger than NOAA, in terms of what government agencies were thinking about. Integrative assessments (IAs), human dimensions was a part of that. Don't know where it went. Carpenter – I'll look into that.

Montz – We really are looking to the other teams to help us. Looking to get a baseline, historic data, then focus on not everything but what would be most helpful to the other teams.

Moorman – The census data, this seems like a great thing, if we could streamline getting the report out. No matter what you work on, human population change, income change, everyone uses to couch and provide background on their system and reports. Would be a great service if

APNEP was constantly updating these indicators as new information came out. Carpenter – Just a reminder that the 2012 assessment included that information.

Kenworthy – Another thing that comes to mind: in ecology we get fooled by averages, what drives the systems is at times extreme events or outliers. For human dimensions, would it be worth it to look at extreme events and how they affect the ecosystem instead of this whole cadre of potential averages? Montz – Reason to get historic data, see when those pulses were and document what they are. Kenworthy – First thing that comes to mind, ecological anthropology. Sometimes statistical averages don't mean anything.

Kalla – Can you provide an example in human dimensions? Kenworthy – When did all those chicken farms move into the watershed in North Carolina? Came in one big pulse from Iowa. Joel – Also thinking about environmental education, changes in people's perceptions, have we made gains in getting people to be more environmentally conscious? Mordecai – That could really color the model, how has the indicator changed in the past and how are they pulsed? And many of our efforts are also pulsed, in response to events. Good want to think about what pressures and things should APNEP be focused on to make things better?

Kenworthy – Future example – aquaculture.

Air Resources Indicators (Dr. Robin Dennis)

Dennis – Overview of air resources indicators. First three would be based on data, last would be based on remote sensing. Any questions?

Donna Schwede – Any other information that would be of interest in terms of ambient air monitoring?

Moorman – We use ambient air temperature sometimes, idea is some kind of interactive map. Climate Voyager example. Robin – We'll be working with North Carolina State.

Dame – Are there stations in the APNEP region? Dennis – There are stations, there aren't any ozone stations in Virginia. Dame – Connecting air data back to herps, salamanders.

Moorman – Some of these indicators, storm frequency/severity, nice to be able to understand why years are wet/dry, etc. Groundwater index. Wet years, normal years, dry years. Dame – Yes, could help you understand why you're seeing trends.

Kenworthy – Atmospheric deposition, no interest in pH? Schwede – Part of the dataset. Dennis – Haven't run across anyone who uses pH of rainwater, because dynamics once it enters the water is determined so much by the dynamics of the water it enters that it doesn't matter.

Schwede – We do have wet mercury deposition, few sites for dry deposition. Relatively new effort, would be an area for expansion. Kalla – Isn't there an APNEP site now? Donna – Limited coverage now.

Carpenter – Learned at Air Resources MAT kickoff meeting that we're soon going to lose many stations. In terms of spatial/temporal resolution, that's for teams to decide for their individual metrics/indicators.

Water Resources Indicators (Dr. Michelle Moorman)
Moorman – The Water Resources Monitoring & Assessment Team met in June, came up with cadre of core things and revisited them last month. Core – harmful algal blooms (HABs), microbiota, water column pathogens. Metrics had a lot of overlap between different indicators.

Carpenter – Reminder – Water Resource MAT has the lead on microbiota. Moorman – Yes, all Tier I indicators.

Moorman – Phytoplankton, thinking about phytoplankton that can actually produce toxins. For toxins, we are talking about toxins specific to HABs. Focus on the type of algae that are harmful in the system.

Moorman – Idea that we should also think about sea level rise, physical stressors, chemical components of water quality.

Kalla – Point source discharge rates – for NPDES rates? Moorman – Discussion there was related to ecological flows, how much water was being put into a stream. Kalla – Effluent dominated or not? Moorman – Idea was, in some of our streams, especially headwater streams, point source discharge can be a big component in the water. Kalla – Is there pressure to abandon stream gauges in the region? Carpenter – There have been threats of dropping gauges, APNEP has helped fund. Moorman – when I used to work for USGS, ones that were partially locally funded usually stayed and those that were part of a national program were more likely to be cut. There's always a question of not having enough gauges. Carpenter – Hopefully now APNEP will be in a better position when asked to fund gauges, how relevant that is to APNEP information needs.

Moorman – Big hole for project in Albemarle Sound – small coastal streams/ditches and very few gauges that were even measuring streams coming into the Albemarle sound. So we don't know a lot about what's happening out in the outer Coastal Plain system in terms of water flow. Forgotten area, no man's land.

Paerl – First gauge downstream on the Neuse River is Fort Barnwell.

Dame – Where do you want to get relative sea level data? Moorman – Tide gauges, Division of Emergency Management runs tide gauges all over eastern NC. Moorman – Most people work on water quality in this group, haven't talked as much about quantity.

Whitehead – Don't know how long that data goes back though, need a certain amount of data to be certain that there is a sea level rise trend.

Moorman – In a nutshell, we're focused on issues related to eutrophication, emerging contaminants, water clarity and turbidity, and we kept coming back to the EPA's idea of is it fishable, swimmable, drinkable. Our next piece is deciding what is our first three-to-five indicators we want to tackle.

Kenworthy – Might suggest one more, when Deepwater Horizon oil spill happened, there was very little baseline hydrocarbon data, hard to make recommendations about extent of issue. Given drilling issue and Atlantic Coast Pipeline, without baseline data it's going to be difficult to understand what has happened.

Paerl – Don't think hydrocarbons are routinely measured. Kenworthy – In the Gulf, had to scramble to get reference numbers. Paerl – Closest thing would be DOC. ECU is monitoring on the Pamlico…

Moorman – Could be added as a Tier II indicator to the list. Peter – Do you anticipate getting data from National Coastal Condition Assessment (NCCA), other monitoring, all of the above? Moorman – Anticipate narrowing this down and choosing a few. In many of our discussions as a team, a lot of people were interested in HABs and cyanotoxins. As team lead, I may suggest that as one of the core metrics, indicators. Returning to Rua's idea, one of those things people want to know about. Maybe team would support using HABs as a core indicator. All other indicators could help us understand if/why they're occurring.

Paerl – Total nitrogen and total phosphorus, those are two parameters the state doesn't measure. Under soluble fractions, should put orthophosphate and ammonium. The state doesn't measure phosphate. Getting phosphate and ammonium numbers would be important too, from a water quality and fish health standpoint. Kalla – Orthophosphate is another can of worms because it has such a short hold (48 hours). Paerl – Samples usually get through within an hour or so of collection.

McCormick – What about recreational boaters, fuel spills, oil spills, sewage, bilges, etc. Would it be a big enough issue to address? Moorman – There is an oil spill reporting database. When oil spills happen in the region where I work, I get an email. I know that exists, Mike Mallin (UNC-W) does interesting work at marinas. McCormick – Worthwhile to look at them? Moorman – Don't know if we want to add that to the list… Carpenter – oil spills and sewage for boats…we do have pathogens so sewage is covered. We're not going to be able to diagnose individual marinas, response depends on severity of problems.

Mordecai – Seems like this is a Tier II issue, interesting to explore and something that people can directly see in the water. Good just in the sense that you have that connection with people – they can see them so they care about them.

Paerl – Sometimes people get oil and algae mixed up when they call and report something.

Moorman – We recognize if there are data gaps, maybe we target the water quality portal now. If we got assistance to hire some slick college students, could generate reports that would be updated annually. That would be a wonderful outcome that all kinds of people would use.

Kalla – Suspended sediment is floc layer? Moorman – People were concerned about water clarity, talking about total suspended sediment in the water column. Kalla – would have thought that would be in the water column part. Carpenter – Should be moved.

Moorman – Sediment condition was added at end of team's last discussion, could get into all kinds of sediment samples. Kalla – Nutrients, recommend that if it's already being collected in the NCCA. Carpenter – NRCS is doing an effort in our region on subaqueous soils. Moorman – For indicator, NCCA data would be good to use.

Moorman – Are we best off focusing our results on synthesizing, because many people are already collecting data, are we better off synthesizing this for the region? Kalla – Should be utilizing existing data sets, trick is to take ambient/fixed station data and treat them as if they're probabilistic. NCCA has virtue of being probabilistic but should also use ambient data because its already there.

Paerl – One of the other reasons why suspended sediments is in there is it being one of the components of turbidity, important component that will ultimately go into other measurements. Seagrasses for example. I think it's okay to have suspended sediments in this particular group.

Terrestrial Resources Indicators (Dr. Rua Mordecai)
Mordecai – Team met last month for first meeting, had really long list of ideas. Spent meeting combing through long list. Main overview, one challenge was wanting to spill into the Wetlands Team component. Other thing was agreeing to consider everything but consider everything in terms of connections to the water and the estuary. We combed through a number of them, didn't think about how easy they are to monitor. Terrestrial vegetation, extent versus structure. Good approaches from Heritage Program. Rua listed indicators and metrics.

Mordecai – Questions about vegetation? Dame – Glad to see you have ephemeral pools/ponds, what do you have in mind? Mordecai – That's a core component of the system, where terrestrial and aquatic intersect. Where does the wetlands group begin, there's a lot of connection between the two. Key rare species along the gradient, wanted to make sure that was captured.

Kalla – What's the metric for that one? Mordecai – Had challenges in how we capture it, needs more work and collaboration with the wetlands group. Need to dig a little more into it.

Mordecai – Terrestrial fauna. Have team members assigned to follow up on various things. Dame – Any discussion on coyote? Mordecai – Yes, about what pervasiveness is telling us. Insects/arachnids – do we know enough about them to incorporate them into monitoring? Important for further investigation, Tier II.

Kalla – You're talking about things that are already being studied by someone that is not dependent on continued grant funding. Mordecai – Weren't looking through that particular window but can get that for many of these. Some would fall out if you looked at it through that lens.

Mordecai – Non-native invasive terrestrial fauna. Fire ants jumped out, affect land and people. Feral hogs were a big invasive mammal. Didn't discuss invasive birds' issues. Few for further looking, most will probably be cut out. Carpenter – We'll be talking with invasive action teams about this. Ellis – The Invasives Action Team will weigh in on all MAT metrics except those for Water and Air.

Mordecai – Faunal diseases, mostly Tier II.

Carpenter – I know STAC member Robert Miller, he's been active on our Invasives Team, mentioned some diseases/pathogens that he has in mind.

Mordecai – Coastal margin, soil condition indicators. Measure of potential runoff from land use/slope would be easy to do – but didn't make it onto this terrestrial indicators list.

Kenworthy – How do you intend to prioritize? Mordecai – Next meeting, first thing will do which are doable with current info. That will greatly reduce this list. We'll also have to have discussion as a team, spent time going through really long list and didn't have time to talk about our core three-to-five indicators – finding a complementary set, capturing components of the ecosystem. Taking that step back and finding a few really high-level ones that can complement each other.

Fleckenstein – Many indicators being discussed, great ideas. But thinking about a volunteer group helping to write assessments on an annual or semiannual basis, it's a lot to bite off. We should think about what the public cares about. Is there an effort, intermediate step, where we go to the public and see what resonates with them? Check in? I think all of these ideas are fabulous and I'm not saying we shouldn't try to understand them all, but next steps need to have some parameters. Chesapeake Bay report card – 13 indicators annually by water body. Can show trends over time. A caution – taking on more than we can manage as a volunteer group, all have other tasks. What is most relevant to the people of APNEP's region, the people of North Carolina. Caring about swimming, catching crabs, etc. What are indicators that are going to capture the public's interest but will also tell us about the health of the system.

Savage – There may be certain things we want to highlight to the public, that doesn't mean that's all we do. Carpenter – Public focused effort will be the APNEP report card. For this

assessment, part at the front says why we're doing it. Assessments are linked to outcomes, human communities, native species, water quality.

Crowell – We do have to be mindful that we can't measure everything. There is the behind the scenes monitoring and assessment, but we do have to get to where it is manageable.

Kalla – All the groups have measurements that are more static, things that won't change often. Maybe that means it won't be a good metric after all.

Savage – I trust the MATs to look at what is actually doable.

Fleckenstein – Could Education Team conduct this survey to see what the public values?

Crowell – Would be more supportive of contracting that out, we've worked with ECU staff before, we've also conducted two surveys of the things that people value in the system, maybe going back and looking at that is the first thing we should do.

Aquatic Fauna Indicators (Dr. Tim Ellis)
Ellis – Aquatic Herptofauna. American alligator, Neuse River Waterdog – likely to be listed. Restricted to Tar and Neuse. All macroinvertebrates except for insects are monitored by NC-DWR. Data collected regularly and for the long term.

Ellis – Diadromous fishes. Atlantic Sturgeon and American Shad. With all fish indicators, still need to determine specific metrics. Overview of remaining indicators/metrics.

Ellis – Want to look at Fish Habitat and Habitat Condition in light of Freshwater Habitat and Fish Passage Team, want to see how this is changing. Will meet with team and do Tier I/II and pick top three-to-five, ones that are important and have good data.

McCormick – Used to work with Virginia marine science museum. Contacted them for dolphin stranding data? Ellis – Yes, coordinator for NC as well. Biased because data is only collected for dead or stranded animals. Fleckenstein – Outer Banks Center for Dolphin Research? Active monitoring of dolphin population. Ellis – Yes, they do their genetic assessments, keeping track of residency. Those conversations were very short with that team, didn't have the experts available. Same with sea turtles and expert Matthew Godfrey (NC-WRC).

Kalla – What's the metric for freshwater hardbottom? Ellis – That's just a habitat type we knew was important, because it's limited. This is from team kickoff, we haven't had chance to follow up yet.

Kalla – Does anyone have shellfish bed closures on the list? Fleckenstein – Water Resources MAT had pathogens, would include that?

2:45 – Evaluation of APNEP Monitoring and Assessment Team Processes (Jud Kenworthy)

Members will propose improvements on intra-MAT processes and suggest protocols for inter-MAT processes (technical integration)

Kenworthy – There was another item on the agenda that staff felt was important, we're not going to get through all of this, some discussion/evaluation of this process that we're going through. Any thoughts and opinions about this process so staff can get some feedback?

Kenworthy – Report card is a different thing, but I think the idea that we could choose some indicators for the report card, seems like a good one. Seems like all the teams should be thinking about that – what's your silver bullet that could be represented in the report card. Would stimulate some thinking about how to prioritize too. Not to suggest taking things off the table.

Fleckenstein – It could be a full time job for everyone to perform this assessment, if you chose all of these indicators, so I would want to encourage everyone to prioritize. Kenworthy – I'm working on some other projects around the country developing a community of practice. It's huge, going through steps of interviewing people, doing surveys, similar type exercise. And it's really driven our approach to – we could have come up a list with SAV like all these others, but in reality, those data aren't available and I don't suspect they will be anytime in the future. What you saw today is what we think we can do.

Dame – One of my questions is overlap between Wetlands and Terrestrial Fauna – where does that come in?

Carpenter – How do we ensure, short of having an in-person STAC meeting, how do we ensure that we're communicating and there isn't overlap?

Kalla – Overlap of indicators, but separation at level of metrics.

Carpenter – Tim Ellis and I are going to be working on this regional model. Have to start somewhere, will put pieces together at some point.

McCormick – Something in a similar vein, outreach/education and this group. Carpenter – Getting the word out to the public? Bolstered staff, new newsletter out. How to effectively use technologies to get the word out, large region, we have a communications plan, getting our word out.

[Discussion of integration of implementation of CCMP actions and monitoring]

Crowell – Returning to all of you with an overview of other NEP's report cards and monitoring and assessment programs.

Ellis – Asking for feedback from team members, ways that we can make this process better. Dame – Positive feedback on Wetland MAT teleconference. Savage – Agreed. Carpenter – Reminder that capacity issue, working at a technical level right now, working with senior

management and getting them to understand the goals/objectives, getting their staff to work with us. A lot of these assessments could be useful for our partnership.

2:45 – Action Items (Jud Kenworthy)

Kenworthy – Goal here is to keep the team moving forward, with staff involvement from APNEP. Hopefully all of you will take back to your teams the encouragement to keep moving forward. Teams are in different places.

3:00pm - Adjourn