PRIME HOOK NATIONAL WILDLIFE REFUGE – WETLAND MANAGEMENT OPPORTUNITIES

(Notes prepared by Susan Guiteras, Coastal Delaware NWR Complex, June 2012)

Problem Summary

Prime Hook National Wildlife Refuge (NWR) faces tremendous challenges in the future management of coastal wetlands on the refuge. The U.S. Fish and Wildlife Service is poised to release the draft Comprehensive Conservation Plan (CCP) for the refuge, which will guide long-term management of the refuge, including its wetlands. The CCP is being released as an Environmental Impact Statement (EIS), representing the most rigorous level of environmental review possible for evaluation of refuge management options. The CCP-EIS will propose, as the Service's preferred alternative, to pursue comprehensive wetland restoration in the impounded wetland complex on the refuge. Meanwhile, significant public opposition exists to each action that the refuge proposes to take, or to not take, creating a backdrop of controversy for planning and restoration discussions.

In late May of 2011, the refuge convened a group of respected wetland restoration experts, state agency partners, and USFWS staff, to discuss these challenges and begin exploring future steps in wetland management. That meeting was just the first step in what continues to be a challenging and ongoing process. The notes from those meetings are summarized in a separate document. In April 2012, the refuge partnered with the Delaware Coastal Program (DNREC & DNERR) to sponsor a new workshop to further discuss wetland restoration strategies and challenges at the refuge.

May 2012 Meeting Overview

A full list of meeting attendees is found at the end of this summary, as Appendix 1. The meeting agenda followed, for the most part, is provided as Appendix 2.

The May 2012 meeting began with a field trip to Prime Hook NWR to visit several key locations on the refuge. Highlighted stops along the route included Fowler Beach, refuge water control structures and water monitoring sites, degraded wetlands in Unit II and Unit III visible from the roads, Prime Hook Road, Primehook Beach community, and Broadkill Road. Staff from the USFWS and DNREC described management challenges and recent changes in the refuge wetland ecosystems. Following the field trip, participants gathered at the St. Jones Reserve (Delaware National Estuarine Research Reserve). Refuge Project Leader, Michael Stroeh, gave a presentation outlining the history of refuge management and storm-induced changes along the refuge coastline. He outlined the broad options that the refuge faces: do nothing, do what is necessary to re-establish freshwater impoundments, or proactive salt/brackish marsh restoration. The draft CCP addresses those three options in more detail.

Bob Scarborough, of the Delaware Coastal Program, then gave a presentation on the monitoring and research data compiled thus far for the refuge wetlands. This data is summarized to some extent in the full notes included below this summary, and in his slide show presentation given at the meeting and available for review. Noteworthy findings include:

- Utilizing aerial imager for a GIS evaluation of shoreline position over the past 80+ years, the rate of shoreline erosion has been increasing in recent decades.

- The water control structures used for water management sit 5 – 11 inches below their intended design elevations. This is believed to be the result of errors in the benchmarks referenced during construction, though may be partly due to sinking.
- Radiometric isotope analysis of sediment cores throughout the refuge wetland complex reveals historic accretion rates in Unit II and Unit III that are the lowest in the state, and are approximately half of the current rate of sea level rise, creating an accretion deficit over recent decades.
- The elevation throughout Unit II and Unit III is approximately 7”-10” below the optimal growth range for *Spartina alterniflora*, which will make natural revegetation of most of the wetland complex unlikely.
- Higher elevations, and higher historic accretion rates (keeping pace with or exceeding sea level rise) in Unit I may be a result of periodic breaching and nourishing of marshes from bay sediments
- Best water quality is found near the breach by Fowler Beach Rd., and the worst is at Thirteen Curves Rd near the chicken waste composting operation. Most sites in the wetland complex exceed EPA guidance limits for Phosphorus in the summer.
- Based on just one tide cycle measurement, approximately 40% of the suspended sediment entering the wetlands through the breaches is settling inside the impoundments

Details regarding the specific ecological and geophysical challenges and obstacles the Refuge faces in management and restoration of the wetlands are also summarized in detail in the May 2011 meeting notes, and within Chapter 3 of the draft CCP-EIS. Questions and comments were encouraged throughout the presentations, and are captured in the full meeting notes below.

At the end of the second day, the outcome from the first meeting (April 2011) was described and the overall goals for the second day were presented. On the morning of the second day, Jeff Taber of Atkins Global described the hydrological modeling work being proposed in partnership with the USFWS, pending full funding. The modeling would include evaluation of various restoration scenarios, as identified by the USFWS in cooperation with other experts. The group then discussed the overarching management options faced by the refuge (e.g., doing nothing, returning to freshwater impoundments, restoring salt marsh, or some combination).

The group was divided into work groups for breakout sessions based generally on the expertise , experience, and/or interests of each individual. The group topics were SocioEconomic, Logistical, Physical, and Biological. Each work group was tasked with discussing the overall management options and ranking them with regard specifically to their assigned topic. For example, the Logistical group discussed how logistically feasible is each option. The SocioEconomic group discussed how each alternative would benefit or be perceived by members of neighboring communities, regardless of how feasibly it may be. The Biological group discussed which would be most beneficial for biological resources, regardless of scocioeconomic considerations. And so on. Groups were also asked to identify specific “no regrets” strategies which could be implemented fairly quickly and with limited additional resources, until (or instead of) the pursuit of large-scale restoration that would be 1-3 years away. Discussions during breakout groups and later in the afternoon focused on restoration strategies, both big (e.g., dredge material placement to restore elevation) and small (“no regrets” options), that could be pursued and should be included into the modeling evaluation.

The groups reconvened to compare rankings and discuss differences. It was determined that the interpretation of the overall management options, and of the instructions, was not quite identical among work groups, making direct comparisons difficult. However, it was found that there was still a surprising amount of agreement

regarding the overall management options considered, with all groups favoring the alternative to restore both units, or at least Unit II, to salt marsh. All the groups ranked a return to freshwater impoundments as the least desirable alternative, other than the option to do nothing. The consolidation of their rankings is provided below in the full notes, and the notes taken by each work group during their discussions are provided as Appendix 3.

For the final part of the day, the group discussed "no regrets" actions that each work group had identified and compiled a list, included in the full notes below. These actions can be pursued as soon as the CCP is finalized, or in some cases before then. Examples included living shoreline techniques adjacent to the road and/or the community, developing a small pilot project utilizing dredge material (truck hauled) to evaluate the technique locally, preparing materials necessary for permitting work that may be required for restoration actions, etc.

Finally, the group revisited the list of significant potential restoration and management actions that should be evaluated during the proposed hydrological modeling exercise and compiled a list, included in the notes below. Examples include closure of one or both breaches, deepening one breach to improve drainage, altering road dimensions and/or culverts, altering the flow through Slaughter Canal, etc. This is not a finalized list, but will be used as the USFWS works with Atkins Global to move forward with the modeling effort.

Overall, the ideas and discussions stemming from this meeting will be used to further develop restoration strategies and options, and incorporate possible changes into the CCP as it is finalized following the public comment period. In addition, the discussion will be important for outlining the restoration and management scenarios to be evaluated through hydrological modeling.

It is likely that an interested subset of the meeting participants will be reconvened in the future, perhaps as the modeling effort is finalized and before any large scale restoration project is pursued. However, no specific plans have been made to identify an ongoing restoration team or plan a follow-up meeting at this time.

Full May 2012 Meeting Notes

What follows is a compilation of all the notes taken during the workshop, provided by several different notetakers (L. Mitchell, S.C. Adamowicz, K. Valencik, C. Pinkerton, J. McAndrews). This lengthy inclusion of notes is provided for the sake of complete documentation of the meeting.

04/24/2012

Prime Hook NWR Wetlands Restoration Workshop – St. Jones Reserve Training Center
(notes taken by LRM)

Day One

Afternoon – Following morning site visits to Prime Hook Refuge Coastal locations

Kelly V. – Welcome from Reserve

Summary – Michael Stroeh, Refuge Manager

Important timeline events

- 1911; storm closed outlets of PH Creek and Slaughter Creek, Slaughter Canal was extended to Unit II and deepened (used to flow to DE Bay)
- Decades of ditching, grazing, haying
- Prime Hook Road, Fowlers Beach Road, and other roads to beach were just cow paths
- Fowlers Beach Unit II Water Control structure installed in 1988, in conjunction with dune restoration, Environmental Assessment stated there would still be saltwater intrusion into the impoundment
- Minor dune reinforcement work every few years for next few decades
- *Phragmites* herbicide applications by Refuge, resulted in increased annual waterbird food sources in impoundments (millet, etc.), 80,000 waterfowl annually (1996-2005)
- 2006, Ernesto opened overwash in Unit I
- 2008, "Mother's Day Storm", overwash in Unit II, repairs to dune made that fall; Unit I overwash enlarged, inlet formed
- 2009, "Veterans' Day storm" – Unit II overwashes again, forms 2 large breaches
- Since then, impoundment vegetation largely begins converting to open water, equals loss of waterfowl and shorebird habitat
- Refuge uplands adjacent to impoundment contain dead, dying trees (salt killed) – equals loss of neotropical migratory bird habitat (lost ~ 150 acres of trees)
- Invasive plants were also set back by salinity – Hydrilla, *Phragmites*, Nepalese browntop
- FWS considering values of open water vs. freshwater impoundments vs. salt marsh (carbon sequestration, habitats of different guilds, buffering values)

Prime Hook Refuge's Comprehensive Conservation Plan (in progress) requires comparing management/restoration alternatives – e.g. re-establish freshwater impoundments (high cost, water control structures are currently too low, spring tides over top them); undertake salt/brackish marsh restoration in impoundments (needs drainage, need to alleviate hypersalinity or water logging issues, reestablish tidal

channels, units are tidally restricted, cost unknown); or passive management (likely will result in major conversion to open water)

Must address this as an entire system – not piecemeal (i.e., can't approach the issue as "just" a breach, a road, a single Water Control structure)

Purpose of this meeting is to generate additional information and specific strategies for further consideration, evaluation, and potentially modeling

Question – what are the FWS policy conflicts to restore freshwater marshes in the impoundments?

Answer (Michael) – closing breaches and compromising tidal marshes that are becoming re-established, especially in Unit I, would be in conflict with FWS biological integrity policy – emphasizes "natural" hydrology, not manipulated hydrology

Dave Carter – what could be done under EA of current CCP? Small, piecemeal projects?

Michael – small, short term actions could be undertaken if they are listed in the CCP, bigger projects like large scale dredge material would not fly, would require a separate EA or Environmental Impact Statement

Sarah – does cost analysis have to be part of CCP?

Michael – yes

Laura (DNREC) – we envision trying to issue some kind of permit that is overarching, describes current state and future state, and have it be covered, don't want to see USFWS applying for a separate permit for every little action, should just be notification process at each juncture, referencing an already approved restoration vision/project

Michael – Slaughter Canal is free flowing

Question – does it bring significant sediment?

Michael – no, and Prime Hook Creek is dammed off; Slaughter Creek is not a big watershed

Court S. – Does CCP have Water Control (WC) structure function restoration as part of it

Michael – We will need to look at WC structures as "can we use them during the course of restoration" or do we need to yank them out? In an ideal, perfect system, strictly following biological integrity policy, they would come out

Dave C. – if replacing a WC structure were integral to marsh restoration, is that an option

Michael – yes

Question – is bottom of impoundments lower than current sea level [mean tides]?

Answer – yes. Our [USFWS] preferred alternative is to re-establish functional salt or brackish marsh in the impoundments

Court S. – Across the bay, there is an impoundment restoration project in NJ, they just keep overwashes open, why not do that here?

Tony – The breach to north of Fowler Road is a sink, robbing sand from littoral distribution to the south, each longshore system has different sediment transport processes, site specific sediment transport may make this area different that that project

Question – how can we discuss wetland restoration without a solid understanding of water flows, sediment movement/budgets in this system?

Cindy Miller – Prime Hook Beach Organization

- We are at ground zero, we take the hit from Unit II. We are a part of the Alliance of Bay Communities - Farming Community, Maritime Community, Pickering Beach, Kitts Hummock, Bowers Beach, South Bowers Beach, Slaughter Beach, PH Beach, Broadkill Beach (long list of communities impacted, don't forget them, too); http://delawareabc.weebly.com/
- We are communities that border PH NWR
- I am presenting comments from the community – reflect on marsh restoration
- If I had to summarize their comments into one sentences: fix the breaches, we don't have much more to say than that, it may not be realistic, but it's the communities' comments
- Realize we are not just talking about water and salt, but people who have lived here for a long time, our houses have no value, we live and will die together
- We count horseshoe crabs, have tent parties on the beach
- Story of woman who purchased home in 2005, after re-occurring flooding/damages; in 2011 it had to be demolished
- Picture of breaches in vicinity of Fowler Beach Road, water flows in, backs up, floods Prime Hook Beach Road
- Picture of homeowner who lost structures in yards (fences, air conditioning, etc) "We're not looking for a handout here, just someone to do the right thing"); we are repairing/putting up berms and dikes "with money that was earmarked for our college expenses"
- "Tell them how devastating this is" – flooded 5 times in 2 years, $80,000 damages for 5 floods in 4 years (was meant for retirement living expenses); septic tanks destroyed and removed, "we are old, we don't have time to recover"
- This is emotionally devastating, folks are old, this is their retirement
- Water not just coming up to the steps in houses, it's coming into the houses
- "Alice and I knew we built our home in harm's way here on the beach. Little did we even dream that the biggest danger we would face was from the Refuge"; homeowner does not live on Refuge impoundment side, lives on bayside, says "my heart bleeds for those who have invested so much of your hearts and money to be here and now have to see the destruction that has taken place"; "I have spent many nights sitting in the dark crying about leaving what was once our dream home"; says that he is going back to PA, has lost his life savings, the home will go to the mortgage company; the harm comes from a manmade structure to the west; sent picture of hibiscus in the freshwater marsh that has been lost
- Community perspective – deep sadness of what has been lost, frustration about how long the process takes to find a solution, over the passing of time, loss of faith, fear for our safety and life savings
- What we need – near term help to stop the damage, to be heard and to be made whole, ability to substantively contribute to the process, clarity of a path forward

- We understand it's a biological system, things take time to recover, you are talking about small, incremental changes that might help
- We are happy to be included and want to contribute, we have studied what is going on, too

Rob McCleary – DelDOT

- Worked on many capital projects, roadway system , worked at DNREC in the past
- Hears loud and clear what Prime Hook Community is facing
- DelDOTs mission is not protection of a National Wildlife Refuge; we are charged with maintaining a network of permanent roads and the safety of individuals who use those roads
- The filling of the breaches – yes, if they are filled, we believe that our road protection job will be easier, breaches have increased the overtopping and lost pavement issue
- What can we do with the breaches open?
- We have to deal with many tiny little roads in this state – it is part of our responsibility, unlike the situation in many other states
- We have an intermittently flooded road, it is getting flooded more often, that is scaring folks, our management plans rely on predictability of flooding, we have to make decisions on where to spend public dollars
- We have obligation to provide access to fastland that is occupied; but we have to decide "what is access"? Is it 24/7 ability to drive, or not? Perhaps not access during high-high tides
- We have to decide if a lower service level can be accepted – perhaps we need a better advance warning system, better evacuation planning, a defined point at which emergency responders say we can't get there, as sea levels rise, roads will become more frequently flooded
- DelDOT looking at adaptation options, a structural solution would be 10s of millions of dollars (this would be deep foundation, problematic to build, it's a brick on jello); there may be floating structure solutions (hot mix causes settlement over a road over a marsh that results in lower final elevation!)
- We don't have a policy handed down to us from the Governor right now, DelDOT has lots of competing interests for our limited resources, the safety issues here are being weighed against other safety issues in the state

Q – Is DelDOT going to make substantive comments/contributions to the CCP? The roads are operating as levees and dikes, and DelDOT should be experts in coming up with engineering solutions

A – DelDOT is here, participating, will continue to do that

Jan T. – Why didn't you have to go through an environmental process, and develop alternatives, an EA, when you placed culverts under Prime Hook Beach Road?

DelDOT – They were not new, they were replacing existing/collapsed culverts in our ROW; People had the sense they were new because they had limited functioning for so long, but they were not new. If we do improvements to the road, then yes, an EA will be required (because we will use Federal funding).

Court S. – Adaptation to climate changes are quite the buzz word, we should start thinking of ways to get federal sources to explore alternative materials, open structure bridges, blocks of lighter weight material, we should be able to come up with ways to get a road over a marsh, we sent men to the moon

Rob – Yes, there are pontoon bridges in Seattle, floatable structures, geoweb materials – but this hasn't been done in Delaware, I agree we need to start looking at alternatives that are used across the globe

Bob Scarborough , DNREC coastal scientist

- During past century or more, numerous creeks re-routed, canals dug, drainages altered
- Slide of Delaware bayshore, changes at Fowler's Beach Road – dune rollover, coastal erosion, 350 feet to the east between 1937-2007
- Rate of erosion is increasing (demonstrated graphically)
- Slaughter Canal WC – currently 5 inches below design, Petersfield WC 10 inches below, PH Creek WCS 11 inches below design
- We surveyed beach roads, mapped out most vulnerable, low spots (Fowlers, Prime Hook Beach, Broadkill Beach)
- Unit 1 marsh survey transects, marsh elev. Mean 0.51m, MHW = .60 m in the bay
- Unit 2 mean marsh elev. =0.41m, MHW= 0.60m
- Unit 3 mean marsh elev. =0.3m, MHW= 0.60m
- *Spartina alterniflora* is what we should be shooting for in restorations; DNREC surveyed PH to Blackbird Creek, took *Sp. alterniflora* biomass samples for health, and did marsh elevation surveys, relative to MHW at each site, used belowground biomass (e.g. 150 g/unit belowground biomass) as health indicator; developed optimal growth range estimates -0.1 m to +0.2m relative to MHW (setting MHW as zero); typical tidal range for these sites are about 2 m

Court S. – It's not just a belowground material thing, you need sediment to make it sustainable also, I don't see 150 g total belowground biomass as very sustainable, not very good

- Now look at the units, Unit 1 deficit = 0.04 m, Unit 2 = 0.18m, Unit 3 = 0.25 m, compared to MHW
- Slaughter Creek tidal datum – always flooded, never drains
- Freshwater impoundments – managed for organic deposition only, they are sediment starved, overwashes occasionally happen, causing hypersaline accumulates in sediment, and mass vegetation die offs – Units II and have the lowest sediment accumulation changes recorded in coastal marshes in the state
- The higher elevations in the marshes to the north, more intact marshes, may be a result of intermittent breaching and nourishing of marshes from bay sediments, in overwashes
- Looking at chlorophyll numbers, best water quality numbers are near the breach in Unit 2, DE Bay, worst is "13 curves" near chicken waste composting operation; most sites exceed phosphorous EPA guidance limits in the summer (system is P limited in cool months, N limited in warmer months)
- Higher suspended solids in bay waters than units, getting it to settle out would be helpful in impoundments
- Water levels – in general PH North is higher than PH South
- PH Road – floods every spring tide
- DNREC has mapped salinity levels/changes in Units II and III, over the course of the year (freshwater inputs from Prime Hook Creek, Slaughter Creek, salt water inputs from over washes)
- Did ebb tide/flood tide TSS measurements for just one tide cycle, approximately 40% deposition of TSS inside the impoundment

Bill Merideth – Net accretion of TSS, you are hoping to build the marsh – is there a scenario to close the breaches? This speaks to leaving the breaches open as a source of sediment

Bob – There would have to be artificial means to build marsh, we would need to add sediment, if we closed the breaches; we need to break the fetch in the impoundments, the sediments aren't settling due to the wind, do we "throttle" the inflows at the breaches?

Susan – We can also estimate that the amount of sediment coming in naturally is ultimately not nearly enough, would take a long, long time to make up the deficit with natural sediment influx alone. Using just a very rough calculation from the one measurement we have, it would take 30-40 years. Obviously that's a ballpark estimate.

Court – The biggest movements in may be during storm events, but that might also be tearing up the marsh and exporting material

Tony – We have multiple objectives: protect people, stop flooding, can we keep Unit II in an ebb and flow situation, will have to include a port of entry for sediments into that system, needs to be diurnal flooding for sedimentation, models will be critical here

Discussion of why is the bottom of the impoundment is now lower – you still have the "historic" elevation of the salt marshes below the freshwater marsh platform – sea level has risen, overwash events caused hypersaline conditions and mass freshwater plant die offs, peat collapse led to even more loss of marsh elevation

Court – We need more sediments and water level data collection points

Susan Guiteras

- Brainstormed last cooperative meeting – possible restoration options, next steps, data still needed
- Strategies suggested last time have been worked into CCP – these are specific tools, potential strategies
- One of the suggestions was to pursue a hydrodynamic model – Atkins will discuss this option tomorrow, their capabilities and limitations, the planned approach, we don't expect it to solve all our problems, but it will be an important step
- Tomorrow – we need to identify the restoration options that we think are worthy of consideration (that will be the focus of the morning and early afternoon)
- Some options or strategies may require substantial resources – we also need to take advantage of the brain power in the room to identify the short term, lower cost, steps the refuge should take right away; we call these "no regrets" strategies.
- As the CCP goes out for public comment, this can be part of the public comment process; we can start listing the what and where in the CCP (it will be officially and legally fleshed out and included in the CCP), we should identify the big and small

<u>04/25/2012</u>

Prime Hook NWR Wetlands Restoration Workshop – St. Jones Reserve Training Center

Day Two

Bob Scarborough

- Shows slides of Prime Hook Refuge watershed, and subwatersheds; Cedar Creek is 40 sq miles; Slaughter Creek small 6 sq miles; Unit II 7 sq miles (very little freshwater); Unit III 40 sq miles; 53 sq miles to Unit IV
- Flow maps feeding to impoundments – inflows, outflows to WC structures then change to tidal, minor leaking of tidal into impoundments, breaches as major tidal inflows

Q – Does culvert under Unit II and Unit III flow both ways

A – Yes, generally it is from north to south, with inflows from the breaches dominating

Jeff Tabar – Atkins Global (Environmental Consulting Firm, possible contractor for flow model at PMH)

- Tasked with helping FWS understand water circulation on refuge, to help inform restoration work
- Powerpoint presented, including proposed scope of work, physical data collection
- Propose hydrodynamic modeling, to inform alternatives, then establish restoration and management plan
- What if's – what if we fill this in, what if we breach this – water and sediment flow model is necessary
- Discussion of Bay Beach Management Plan – Delaware 2010 (Pickering down to Broadkill Beach); beach nourishment, storm protection (Atkins product)
- Atkins evaluated historic fill events in coastal DE, historical demand of volume of beach re-nourishment material, historically the volume of demanded material increased from north to south along beaches (higher energy, more "beachlike" to the south, more "riverlike to the north"); developed a circulation model of the Delaware Bay (using tidal, wind, and wave data); mapped historic circulation patterns - such as during Mother's Day Storm of 2008 – their model shows concentration of energy at breach areas along beach
- Scope of Work - analysis of existing data/DNREC data, to understand how system functions; set up terrain/bathymetry/topography model, then incorporate circulation patterns info on top of this
- Data to be collected – velocity measurements, continuous tidal studies of one lunar cycle, velocities at specific locations throughout the refuge, volume exchange and direction through the breaches, water level differences and tidal phase lag between breach locations and refuge, how far and how fast does the water in the breaches go over time
- Map of proposed velocity measurement locations – WC structures on Fowlers, Prime Hook Beach Road, in breaches, WC structure under Slaughter Beach Road
- Geotechnical Data – sediment sampling near breaches, cores/substrate, grain size analysis, organic content, sediment transport analysis (what would be the fate of any fill, for example)
- Shows inlet breach Project, Sandwich, MA – hydrodynamic modeling, flooding analysis, inlet stability analysis, 10 foot tidal range; inlet was moved and stabilized to increase volume of flow outward and alleviate flooding
- Modeling approach – 1. Determine marsh structure and function, 2. Establish target elevations, sedimentary and hydrodynamics characteristics (required hydro period), 3. Numerical model development
- Model – set boundary conditions, calibration with existing data, normal tide conditions, storm event conditions (not easy to select an appropriate storm)

- Need to map diked marsh cross section vs. natural tidal marsh cross section, and where different marsh platforms fall in the tidal range
- Develop topographic grid of the refuge, can make trouble spots/high priority spots a higher density of smaller grid squares – refined, more data, more spatially accurate data in these areas
- Hydro-circulation is generally the most accurate, most important tier in a model; then comes sediment transport/morphology, then water quality, most important to develop circulation patterns first
- Preferred alternative should factor community concerns, regulatory approval, environmental benefits, constructability and maintenance requirements, and cost
- Anticipate 8 month to fulfill SOW, data collection, post processing, QA/QC, delivery of data

Karen McKennah (DNREC) – what kind of restoration do you think you are aiming for?

Jeff – salt water marsh is what we are moving toward; leaving it as is, is not satisfactory; we are probably looking for what is the appropriate volume of exchange in a stable inlet, to allow for stable marsh development

Karen - Should you be looking at sedimentation – how much is coming in the inlets?

Jeff – we are focusing on the water movement first and foremost

Q – what instrumentation could be used to capture suspended material transport, and extrapolate that to the water velocity model; might we be able to use turbidity data, to yield TSS information?

Tony – not much info on the sand distribution on the beach, seems to be sediment starved; part of this project might be to determine how to develop a stable beach, this analysis should include expected return frequency of sand augmentation

Jeff(DelDOT)– have a disagreement with slide showing southern lateral drift movements in Slaughter Beach area; I disagree with direction Jeff showed based on anecdotal information, also sand is deeper

Jeff T – some of the data was not as a result of direct measurements, it came from reports; it's not gospel, but was accurate in terms of predicting larger trends/breach areas; for this exercise we would have to do a local analysis, seasonal work, to refine data on transport

Tony – the model uses vectors based on wind analysis, the model converts wind velocity and direction into wave direction, doesn't include nuances of tidal circulation in the bay, eddies, eddy effect in Slaughter Creek component; we do feed Slaughter Creek Beach at southern end and it drifts north

Cindy – Prime Hook Beach – timeline; can you do this in time to save the north end of Prime Hook Beach; if you can't do the study in this timeframe to save those homes, is there an incremental step that won't destroy your data collection?

Jeff – that is something that needs to be discussed in alternatives, fed into machine of decision making, it is a tough call

Dave – need more monitoring, more data collection, concerned about where we are on budget, how much we do or don't have to move forward with this; we need to come together and get adequate funding to collect necessary data, or this won't be very useful; this will have implications for entire mid-Atlantic

Jeff T – proponent of getting data and understanding it; the data that has been collected by DNREC is very valuable and phenomenal, should take a week just to analyze that information

Jeff Taber - Intro to Next Exercise

- Determine marsh structure and function – what is the target
- Establish target elevations, sedimentary and hydrodynamics characteristics
- System wide solution
- Develop manageable solutions
- Salt vs. fresh systems, vegetation (work in LA, FL, has shown that Phragmites will roll up on itself under heavy wave action, whereas Spartina alterniflora can handle wave action better)
- Sustainability – he thinks that smart innovative people can come up with practical ideas/solutions, not just 'walking away'

Other Atkins rep – has seen LA coastal restoration grind to a halt; if you think that sustainability is important, you can't come up with an option that has to be repaired every few years; needs new resources every few year; there will be no $ for this, budgets are not going up; we need to think in terms of 10s or 50s of years; when you have storm events, salt marsh vegetation is more resilient than freshwater vegetation; don't make this too complicated in terms of a model and don't put too much biology into it

Susan Guiteras (facilitating restoration discussion)

Susan – We envision we would now start putting ideas up there, specific ideas, big ideas of what will have enough of an impact that it might warrant modeling; then we'll break into workgroups to evaluate these options in terms of logistical, biological, physical, socio-economic-political constraints

Karen/DNREC – you need to know where you want to be, before you can discuss what to do

Susan – The objective for Unit II is "self sustaining salt marsh", in the CCP

Bill – There is still a sentiment for a freshwater component to Unit III, opportunity of the gift of freshwater from Prime Hook Creek, might involve a WC structure

Bart – Need to bring in dredge material to Unit II, can develop a salt marsh, slow movement from II to III; take Slaugher Creek flow back to Bay; remove Fowlers Beach Rd (prev 3 in combination, ideally)

Rob H - Is there a way to isolate Unit III from II, and protect the road?

Jeff T– Another thought is to open them up to each other

Virgil – Have we looked at in particular cells where we have marshes being drowned out, can we move material around within a cell; create shallow open water areas, and balance that with deeper channels? Maybe dredge from Unit III to nourish Unit II

Bill – Are you talking about removing the WC structure at Fowlers Beach Road

Laura M – Can we put up the preferred alternative on the board, I am having difficulty figuring out what the sideboards are, to guide our discussion

Greg – Having trouble figuring out how this fits into scenarios – budgets aren't growing, a scenario that captures these and minimizes maintenance over time would be valuable; not sure how to capture that, we need at some phase to recognize the value of minimizing maintenance, then perhaps have a scenario that maximizes flexibility in water control, having trouble seeing what to add to just a bunch of details

Sue A - Once we have a model, then we should reconvene this group, thinks making decision prior to understanding how the system works is premature

Laura M – Until we agree on what we are trying to achieve, what our "vision" is, we will continue to chase our tails and can't reasonably list actions

Bart – Are we looking at larger scale options, or smaller scale options?

Susan – We were envisioning how to move the preferred alternative forward – not doing nothing, also not trying to make both Units II and III freshwater impoundments again

Bart – We should put up the preferred option, then we can start looking at restoration options that will maximize sustainability, or minimize cost

Jan – lets think about what we want to have at the end of the day; we want "no regrets" restoration strategies, wants to walk away with "what should we be doing now" while we are developing a model, instead of just watching the marsh die

Annie – For the exercise today, need to decide what's at stake here, need to decide in a very simple way what objectives are for the impoundment

Charlie R. – Add a large scenario – to restore Unit II to salt marsh, and Unit III will have a gradient of habitat types, this would be more of a system wide restoration; trying to "maintain" a freshwater habitat is going to be expensive

Susan – We don't want to start the conversation as if we are focusing on freshwater in Unit II for example – that is definitely not in our preferred alternative, but has been evaluated as one option

Dave – They wants some scenarios to run, what happens if we temporarily close the breach, can we begin to gradually transition to a salt marsh, knowing that the breaches will happen again, and how to start integrating a strategic, compassionate retreat for the community; we need to start looking at flushing structures, now, how to ease the community out rather than just leaving them, these questions are not externalities, they are critical to the system, we have to evaluate closing and not closing the dune

Bill – The CCP will look a lot different than what you write now

Dave (Atkins) – one option is to allow it to be a marsh, but allow storm surges to come into a system – engineering the system to allow for tidal exchange without surges

Greg – As we come up with these things – "engineer" without storm surge scenario, then list what objectives they satisfy, we realize how different scenarios balance objectives

Pam – I need to hear the words for the preferred alternative

Susan – It is “restoration of the impounded wetland system to a natural and sustainable state”

Pam – I am involved in Everglades restoration work, 82 million dollars spent and still not figured it out; it is now “the semi-glades” instead of the Everglades; breaching berms to restore flows and hydrology, but diverting the flows to avoid communities; breaching small dams and redirecting flows may be your best options – it took many people and a lot of money to come to that idea in FL

Bill – Shouldn’t we be using the model to evaluate focused alternatives

Jeff – What are the scenarios, jumping off points we want to explore

Michael – Understand some of the frustration, in a normal structured planning process, it can take 9 years to remove a dike to restore tidal function; we are trying to speed this up, converge model, scenarios, CCP alternatives and approvals, all at once – we don’t have that much time, we are trying to step this up, we might be able to capitalize on some dredge material in the near future, for example

Break, then the group develops practicable restoration alternatives and over arching objectives for all to evaluate:

Overarching objectives:

- Maximize community protection
- Minimize up front cost
- Minimize maintenance costs; maximize sustainability
- Maximize trust resources habitat
- Maximize recreational use

Restoration Alternatives:

1. **Re-establish freshwater impoundment management capability in both Units**
    1. How do we meet our objectives through this scenario?
        a. Extensive dune line, possibly rolling, possibly static
        b. Re-engineer water control structures
        c. Add sediment to the system
        d. Raise roads/dikes
        e. Engineer extra storm surge protection
        f. Address nonpoint source nutrient loading
        g. Flushing regime to remove interstitial salinity

2. **Restore Both Units to salt marsh (a gradient within Unit III)**
    1. How do we meet our objectives through this scenario?
        a. Direct tidal flow to Unit II (bring Slaughter Creek back to the bay)
        b. Remove WCS at Slaughter Canal
        c. Raise marsh elevation in Unit II and III
            - Initial dune system reestablishment for sediment containment, dewatering; then natural dynamics, overwashes, inlets

d. Remove/alter Fowler Beach Road to maximize flow
e. Remove/alter Prime Hook Road to maximize flow
    - Perhaps series of bridges, elevated portions
    - "Fair weather" road solutions;
f. Remove WCS from Petersfield and PMH Creek, may enhance overall drainage
g. Fill in Slaughter Canal
h. Engineered storm surge solution

3. Unit II restoration to salt marsh & maintain impoundment management capability, to some extent, in Unit III

1. How do we meet our objectives through this scenario?
    - Direct tidal flow to Unit II (bring Slaughter Creek back to the bay)
    - Remove WCS at Slaughter Canal
    - Raise marsh elevation in Unit II and III
        i. Initial dune system reestablishment for sediment containment, dewatering; then natural dynamics, overwashes, inlets
    - Remove/alter Fowler Beach Road to maximize flow
    - Remove WCS from Petersfield and PMH Creek, may enhance overall drainage
    - Fill in Slaughter Canal
        i. Reestablish watershed divide between Units I and II
    - Engineered storm surge solution
    - WCS along PMH Rd, control flow between I and II
    - Raise/improve/relocate road to serve as dike
        i. Possibly remove culverts
    - Build separate dike on on north side of PHM Rd
    - Build dike along west side of community
    - Subdivide Unit III to manage portions separately

4. Brackish Impoundment with tidal exchang (may be transitional, toward long-term conversion; more resilient)

1. How do we meet our objectives through this scenario?
    a. Keep structures in place, have uni-directional tide gate
    b. Lower level dune repair that allows some overwash
    c. Conversely…may need substantial dune for max control
    d. Elevation restoration with sediment
    e. Encourage natural deposition of sediment through use of living shoreline techniques or similar strategies
    f. Lessons to be learned from state impoundment mgmt

5. Do nothing

Discussion Prior to Assigning Break-out Groups

Dave – Unsure of what "sustainable habitat" mean; much of the functionality of a salt marsh you might get with leaky structures, do we need an alternative as brackish with tidal exchange, transitioning to salt marsh some day

Fred – Are any options off the table?

Mr. Rick Allen – Is this important to Secretary Salazar's initiative on ecotourism, preserving coastline habitat, to possibly attracting resources for this system, much is at risk, not just communities, not just impoundments

Laura (DNREC) – we should capture sustainability in 3rd bullet

Breakout Groups: Logistics, Biology, Physical, Socio-Economic-Political

(Notes from these individual groups are included below as Appendix 3)

Each group meets for 2 hours to discuss:

1. Evaluate each broad alternative (#1 - #5) as it applies to your work group
    a. What is most feasible or valuable? Least feasible or valuable?
    b. What are the beneficial and adverse implications of each?
2. Is the list of associated strategies complete?
    a. Can we elaborate on any?
    b. Did we miss any?
3. Are there any strategies that can be pursued with "no regrets" and/or potentially with fewer resources?
    a. Strategies which may have incremental benefit
    b. Strategies envisioned for a large area, which could be pursued /tested in a small area
    c. Strategies not likely to further impair the system

Post-exercise discussion of why/ how groups rated alternatives, justification/reasons they rated the way they did (moderated by Susan G)

Alternative	**Biological**	**Physical**	**Logistical**	**Socio-Economic**	**OVERALL**
1	Low-Med	Low-Med	Med (11)	Low	8
2	High	Med-High	Med (13)	High	17
3	Med-Low	Med	High (18)	Med-Low	12
4*	Med-High	Med-High	Low (9)	Med-High	13
5	Low	Low	Low	Low	4

* Each group interpreted #4 a little bit differently:

Physical: To get to #2, you have to go through #4
Biological: Incremental "Slow #2"
Socio-Econ: Temporary, move toward #2
Logistical: Big dunes, water mgmt altered but still conducted, raise roads, etc

After Exercise Discussion (Susan moderator)

Laura/Susan/Greg – We apparently did not follow exactly the same rules when debating the merits of each proposal; the matrix makes us perhaps remove alternatives 1 and 2, and we should re-visit alternatives 2-4, in making sure that we are all following the same procedures, applying the same rules

Therefore, scoring and matrix must be taken with a grain of salt, given different interpretations of the alternatives and the instructions; Still provides helpful summary of the conclusions of work groups.

Discussion of "No Regrets"

"No Regrets" – defined as an action unlikely to impair things further, takes fewer resources (small grants, one year budget items), actions to take while waiting for sediment/dredge material (or to take instead, since sediment/dredge material may not be made available to Prime Hook NWR at all)

- Employ now
- "Low" cost, access funds easily ($10-50K+)
- Make some measurable improvement/do no harm
- Move system to preferred status
- Buy time, slow the degradation
- Describe sufficiently to incorporate into CCP or avoid EIS trigger

Priorities:

- Reduce loss of existing wetlands
- Build elevation wherever possible
    - Increase system resilience to storms, breaches, SLR
- Protect from flooding
- Protect high quality areas from conversion to open water
- Assist areas to transition to salt marshes
- Protect Prime Hook Beach community
    - Reduce shoreline erosion

Other considerations:

- Decrease nutrient input
- Decrease salinity shock
- Provide some level of management control

Jan T – Are there things we can do to slow down or stop the impacts to the habitat, or to the community

Dave Carter – We have a grant out to living shoreline folks, could give you some sound recommendations on where it might or might not work, to help the community

Bob – Dike around the community to protect from spring tides; start with small cell for marsh restoration, perhaps to help protect community (possibly truck hauled material, or sacrifice a portion of the impoundment)

Jan T – From the socioeconomic group; develop a community resiliency plan; bring stability to the system to close breaches right now; start process to re-nourish the beach – applying for $ now; work more cooperatively, with COE, NOAA, FEMA, EPAS, USGS to come up with ideas and funding; improve the early warning system

Sue A. – Consider the concept of making Prime Hook Road a ”fair weather road” that can withstand flooding events; also have to attack alternate route/access for community to Broadkill Beach, at the same time

Charlie - May want to come up with a plan of where to put sediment on the marsh, and create a cell, should sediment suddenly become available

Susan – Probably adjacent to the community or the road, biologically this would be fine and might reduce some of the other problems

Bob – Do we need to do some coring, now, to understand strata in places we might place sheet piling/engineering, profiles of the inlet, deep geotech cores to find firmer surfaces

Matt – For small scale, within impoundment construction, need to evaluate methods for containing the material (tubes, haybales, clay materials)

Dave – There is going to be major competition for material if a big dredge project goes through; we need to quickly be up front, open and honest about what we would want

Jan – Who would do that?

Dave – The state is doing it now, we need to get the State at the table, to show the reasons and plan for using the material; we need RFQs for qualified consultants or contractors – put them in place now, begin putting together permitting documents, for when money or materials suddenly become available

Annie – Can “no regrets” actions be incorporated into a CCP

Susan - Yes, “no regrets” actions can be worked into the CCP. If they are evaluated sufficiently, then we have the clearance to move forward on them once the CCP is approved. Regarding bigger projects that may still need a step-down EA, the idea is to start collecting the background info for a permit – like going to a pre-permit planning meeting, and finding out what data is required – before the sediment becomes available.

Summary List of “No Regrets” actions:

- Living shoreline
- Sheetpile Prime Hook Road, install water control structures
- Contact DENREC regarding compost pile/nutrient source
- Dike around the community to protect from spring tides….but not to set a precedent for other beach communities
- Wave attenuation in impoundments to reduce fetch (trees)
- Pilot study to increase elevation on a few acres in key location (thin layer deposition) (truck haul, dredge from within impoundment & determine how to contain it)
- Develop community resiliency plan
- Close breaches to bring stability to system (but by what means?)
- Proceed with design permitting & funding of beach nourishment or other restoration actions
- Create a working partnership btw Refuge, agencies & Communities (FEMA, EPA, USGS, FHWA)
    - Use that partnership to find resources to fund partnership (Bayshore Partnership)
- Living shoreline along W-side of community
- Collect the data we need for EA, NEPA
- Improved Early Warning System

    - Have DEOS give presentation
- Make Prime Hook Rd a "fair" weather road, pursue storm condition access through gated-community, improve early warning system
- Access through gated-community
- Develop plan for where to put sediment should it become available (identify priority areas and amounts)
- Additional data collection
    - Inlet cross section
    - Deep geotech cores to determine sheetpile depth
- Main Channel dredge spoil…determine where state stands on use of sediment on federal lands (state is doing it within DNREC)
- RFQ for consultants and contractors
- Identify sources for plantings/seeds
- Go to permitting agencies to determine type of information required for different permit applications
    - Assemble appropriate documents in advance
    - Hold public meetings in advance of permit applications (hearings required only when there's meritorious request)

Susan wants to move along to Bigger Items

Bob – We discussed deepening the breach, evaluating what would happen if we completely removed WC structures to alleviate outflow problems, filling Slaughter Canal – what about blocking it further up?; if we want salt marsh in Unit III, why not just open up to tidal flows, remove WC entirely and model effects

Sue A – Thought there was support to fill in Slaughter Canal, what are thoughts

Michael – There are deed restrictions, there are legal implications that it might not be an immediate option; Draper-Bennett Tax ditch is just as big an issue

Sue A – Not just fill the canal, but re-establish a watershed break, so it drains north, and south, to alleviate flooding/marsh stress on Unit I

Bob – Perhaps model where to plug it, maintain drainage through tax ditches, and alleviate flooding stress

- To model
    - More culverts and mini-bridges on Prime Hook Rd.
    - Fill Slaughter Canal & re-establish natural watershed divide btw Unit 1 & 2, redirect Slaughter Creek to discharge to ocean (need clarification of historic flow patterns….was there a watershed divide btw Units 1 and 2)
    - Deepen breaches
    - Effect of WCS and enlarging them
    - Unit 3: remove WCS and convert to salt marsh

Meeting evaluation form distributed, end of notes

APPENDIX 1 – MEETING ATTENDEES LIST

Name	**Agency / Group**
Rick Allan	Alliance of Bay Communities (ABC)
David Tomasko	Atkins Global
Jeff Tabar	Atkins Global
John Hefner	Atkins Global
Pam Latham	Atkins Global
Bart Wilson	Center for the Inland Bays
Chris Bason	Center for the Inland Bays
Lisa Jones	Community member (Agriculture)
Ron McArthur	Delaware State News
Jeff Reed	DelDOT
Rob McCleary	DelDOT
Sarah Cooksey	DNREC – Coastal Program
Bob Scarborough	DNREC - Coastal Program
Christina Pinkerton	DNREC - Coastal Program
Kelly Valencik	DNREC - Coastal Program
Dave Carter	DNREC - Coastal Program
Rob Gano	DNREC - F&W
Karen Bennett	DNREC - F&W
Kevin Kalasz	DNREC - F&W
Rob Hossler	DNREC - F&W
Dave Sevakis	DNREC - F&W
Bill Meredith	DNREC – MCS
Kim McKenna	DNREC – Shoreline
Tony Pratt	DNREC - Shoreline
Laura Herr	DNREC - Wetlands
Virgil Holmes	DNREC - Wetlands
Jacob McPherson	Ducks Unlimited
Charlie Roman	National Park Service
Cindy Miller	Prime Hook Beach Organization
Norb Psuty	Rutgers University
Charlie Myers	U.S. Army Corp of Engineers
Scott Evans	U.S. Army Corp of Engineers
Brandon Boyd	University of Delaware
Court Stevenson	University of MD - Horn Point Lab
Lorie Staver	University of MD - Horn Point Lab
Larry McGowan	USFWS – Blackwater NWR
Matt Whitbeck	USFWS – Blackwater NWR
George Ruddy	USFWS – Chesapeake Bay Field Office

Name	Agency / Group
Peter McGowan	USFWS – Chesapeake Bay Field Office
Kim Halpin	USFWS – Chincoteague NWR
Annie Larsen	USFWS – Coastal DE NWR Complex
Art Coppola	USFWS – Coastal DE NWR Complex
Bill Jones	USFWS – Coastal DE NWR Complex
Jennifer McAndrews	USFWS – Coastal DE NWR Complex
Michael Stroeh	USFWS – Coastal DE NWR Complex
Susan Guiteras	USFWS – Coastal DE NWR Complex
Greg Breese	USFWS – DE Bay Coastal Program
William (Bill) Crouch	USFWS – E.B. Forsythe NWR
Sue Adamovicz	USFWS – LMRD Biologist (Saltmarsh specialist)
Jan Taylor	USFWS – Northeast Regional Office
Rick Bennett	USFWS – Northeast Regional Office
Ann Sittauer	USFWS – Northeast Regional Office
Laura Mitchell	USFWS – Regional Fire Wildlife Biologist
Fred Wurster	USFWS – Regional Hydrologist
Ross Alliston	USFWS – Washington Office (Planning)

APPENDIX 2 - MEETING AGENDA

Tuesday April 24, 2012

ST. JONES RESERVE COASTAL TRAINING CENTER

8:00 **Check in and Coffee**

8:30 **Welcome and Introductions**
Michael Stroeh, Project Leader, Coastal Del. Refuge Complex, Bombay & Prime Hook NWRs

8:45 **Split into groups for tours, Load Vans and Depart St. Jones Reserve for Prime Hook NWR**

PRIME HOOK NATIONAL WILDLIFE REFUGE

9:30 **Begin Tour**

11:45 **LUNCH – PICNIC AT PRIME HOOK (PROVIDED)**

12:30 **Load Vans and Depart Prime Hook NWR for St. Jones Reserve**

ST. JONES RESERVE COASTAL TRAINING CENTER

Overall Summary of Refuge Wetland Management and History
Michael Stroeh, Project Leader, Coastal Del. Refuge Complex, Bombay & Prime Hook NWRs

Local Community Perspective
Cindy Miller and possibly others

BREAK

Summary of Current Data and Ongoing Research by Delaware Coastal Programs
Bob Scarborough, DNREC, Delaware Coastal Programs

Introduction to Discussion Topics for Wednesday
Susan Guiteras, Wildlife Biologist, Coastal Del. Refuge Complex, Bombay & Prime Hook NWRs

4:30 **END**

Possible group dinner at area restaurant, if there is interest

Wednesday, April 25, 2012

ST. JONES RESERVE COASTAL TRAINING CENTER

8:00 **Check in and Coffee**

8:30 **Welcome and Introductions**
Michael Stroeh, Project Leader, Coastal Del. Refuge Complex, Bombay & Prime Hook NWRs

Introduction of Atkins' Scope of Work, Capabilities & Limitations, Information Needs
Jeff Tabar – Atkins Global
Selection of Potential Restoration Scenarios (Facilitator: Jeff Tabar)
Session Goal: Identify scenarios (strategies or combinations) for potential further modeling

BREAK

Split into Break-out groups:

- **Logistical** Facilitator: Bart Wilson Note Taker: Laura Mitchell
- **Biological** Facilitator: Susan Guiteras Note taker: Jen McAndrews
- **Physical** Facilitator: Bob Scarborough Note taker: Christina Pinkerton
- **Socio-Economic-Political** Facilitator: Jan Taylor Note take: Kelly Valencik

Session Goals:
- Have workgroups discuss and record considerations for each of the identified scenarios on flip chart – determine positives and negatives associated w/each
- Have groups rank each scenario relative to their group topic – high/med/low

12:00 **Lunch**

1:00 **Resume Work in Break-out groups**
Session Goals:
- Have work groups finalize analysis and ranking of each scenario, if needed
- Have groups develop "No Regrets" actions that can be implemented on a smaller scale with low costs and/or shorter time frame

Groups Report their Analysis/Ranking of Restoration Scenarios
Facilitators will give highlights of group results

BREAK

Overall Evaluation of Restoration Scenarios (Facilitator: Jan Taylor, U.S. Fish and Wildlife)
Session Goals:
- Have entire group discuss and clarify ranking of each scenario

Discuss No Regret Restoration Options (Facilitator: Jan Taylor, U.S. Fish and Wildlife)
Session Goals:
- Have entire group discuss "no regret" restoration strategies for short-term implementation, pending CCP final approval

Next Steps and Wrap Up
Michael Stroeh, Project Leader, Coastal Del. Refuge Complex, Bombay & Prime Hook NWRs

5:00 **END**

APPENDIX 3 - WORKGROUP DISCUSSION NOTES

Physical Breakout Group notes

Extensive Dune Line

- Where to find sediment?
- How much sediment do we need?
- How often is sediment needed?
- How long does the dune line need to be?
- Main channel dredging could be possible sediment options
    - When will this sediment be available?
    - Sand will maintain dune
- Length of dune
    - Stop at Fowlers road or go past?
    - Raise Fowlers beach road
        - High cost associated with this
        - Will not need to be maintained as a road
        - Possible problem is that this road will be needed for recreational purposes

Water Control Structures

- Is Fowlers WCS design enough

Sediment to Raise Marsh Elevation

- Water levels need to remain low for vegetation growth
- Sediment is needed un Unit II
    - Unit III water levels can be controlled
- Can sediment be transferred into Unit II without destroying nearby lake

Limit Nutrient Loading

- Point source – chicken compost
    - Create a buffer around the area
    - This is a regulation issue
- Possible no regrets option

Salinity – flushing

- Unit II: Physically impossible to return to fresh (?)
    - Divert freshwater from Unit III into Unit II
    - Is there enough freshwater sources for this to happen?
    - This scenario might be difficult

Restore Both Units to Salt marsh

- Raise the elevation for a healthy salt marsh
    - There is a need for sediment
    - Hemi-marsh

        - Create shallow ponds
        - Divert sediment to upland areas of the marsh
        - Can this be maintained?
        - There is history at Blackwater NWR
- Modify/reevaluate water control structures at Slaughter Creek

Roads

- Feed Unit III from Broadkill (creating a transitional marsh)
- Are there any advantages to leaving it completely open?
    - Create a model with this scenario

Fill in Slaughter Canal

- What is the advantage?
- Maintain this as a drain for an inlet
- Filling in may not be necessary

Short-term Solutions

- Will it do any good for trapping sediment?
- Short term to fill in possible areas
    - Off road/flooding areas
    - Near the community
- Create a living shoreline with trees and logs to break wave fetch
    - Possible no regrets option

Storm surge solutions (engineered)

- High cost

Modeling Systems

- Create a model without any water control structures
- Create scenarios without roads
- Supersized culverts
- Create a model with Slaughter canal filled
- The breach also needs to be modeled

Building a Dike along the Community

- Cost?
- The community will need to maintain the dike
- Create a partnership between the refuge and the community

Subdivide Unit III

- This is physically possible
- Turn the road into a dike?

- Build a cell with sediment (long term process)
    - Is this a possible no regrets option?
- Keeping Unit II as fresh: WCS and improve roads

What other information do we need?

- Water flow data
- Sediment transport/loads
- Sediment sources
- Weather sequences – generate additional sediment core information
- Environmental dynamics

Option #4 needs to be accomplished before options #2

Restoration Options

- Create a transitional marsh/brackish marsh
- Regulate tidal exchange
- Move impoundment inland?

Dike

- Physically feasible
- This could create a partnership with the community
- This would only protect against spring tides, not storms

Ranking (High, Medium, Low)

- Option 1: Low-medium
- Option 2: Medium high
    - Still some flooding, but not as extreme
- Option 3: Medium
    - High cost
- Option 4: Medium (to low)
    - Transition, make this decision later
- Option 5: Low

No Regrets Options:

- Limit Nutrient Loading
- Create a living shoreline with trees and logs to break wave fetch

Logistics Group Notes

Alternative One

- Dune line – will require dredging material from offshore site, ½ mile away, pumping sand in (trucking not feasible); must buy out Mr. Draper along the beach front before doing this or he will demand Fowler Road access (5-7 year reworking)
- Engineering storm protection probably very cost prohibitive; if you want to engineer storm prevention, such as placing geotube in the heart of dune construction or amour the shoreline (upfront cost higher, might make re-dredging less frequent) (high cost, high feasibility)
- Re-engineer WCs - Redo entirely all 3 WC structures – raise and re-engineer
- Raise roads – turn Fowler's into a dike to be maintained by FWS, this will require closing all inlets, upper and lower inlets; this will reduce tidal exchange in Unit I, but since we will stop flows from Unit II to I, that will probably balance out
- Adding sediment to increase elevation – we cannot think of another source other than dredging – bad source for freshwater project; re-engineer bathymetry – very expensive, deep channels, would need to build deep channels to elevate material a significant amount; truck material – too expensive; to flush out the existing salinity – route Prime Hook Creek through Unit III, into II, and into I, likely will take years

Considerations – Beach permits feasible and rapid, EA after the fact will be required

Likelihood of success – several years to never to have a freshwater system, how long will it last **LOW**

Storm surge part – highly feasible and highly expensive (depending on source of material)
Flushing regime – very low feasibility
Maximize community protection – Yes
Minimize up front cost – depends on source of material
Minimize maintenance costs – depends on how constructed
Maximize trust resource habitat – No

Alternative Two:

- Raise marsh elevation - dredge it technically feasible, pump into cells; expensive; also may re-distribute material to marsh islands and create tidal flow channels (won't be stagnant)
- Remove/alter Fowler Beach Road
- Will need to engineer the appropriate size or shape of inlet to minimize storm tide inflows to the impoundment, and maximize major precipitation events out of the impoundment (feasible)
- Remove Fowler Beach road – high feasibility to remove or create inlets and improve water movement
- Prime Hook Beach road – feasibility is low – more feasibility to create small bridged sections to increase connectivity but that will probably still fail, sink; will increase connectivity ; we have no feasible/successful solution at the moment
- Considerations – Beach permits feasible and rapid, EA after the fact will be required

Likelihood of success – immediately have a tidal flushing system, how long will it last **HIGH**
Inlet re-engineering may be a no regrets strategy

Alternative Three:

- Have to reconstruct Prime Hook Road, first build a dike/road, then remove old road (medium feasible); alternative is geotubes or sheet piling along the road to keep back storm tides, possibly sheet pile both sides
- Have to have one-way valves under road (modeling needed to determine if this exacerbates flooding to western side of town (feasibility high, success high)
- Will need to engineer the appropriate size or shape of inlet to minimize storm tide inflows to the impoundment, and maximize major precipitation events out of the impoundment (feasible)
- All three WC structures re engineered, fixed
- Will likely have to extend dike/sheet piling/dike along PMH road along the back side of PMH community-model to find acceptable and successful elevation
- **Likelihood of success** – reduces area to control snow geese, alleviates drainage out of Unit II, these are small projects , can learn from this, can start to learn about marsh restoration, can be re-visited, and possibly re-fit **HIGH**

Alternative Four: Brackish Impoundment with tidal exchange:

This is like alternative One, but managing salt water levels – will still have issues with big beach face establishment, maintenance; could build a marsh platform with dredged material would work

Likelihood of success – rapidly have a brackish system, how long will it last, beaches will breach, high maintenance, high management **LOW**

Biological Workgroup Notes

Overall Concerns:

Engineering works?!
Biological community returns
Need to have clear vision of what needs to be built and what is best alternative
Massive die-off from nutrient rich sediments after 3rd growing season
Role of uncertainty in obtaining desired outcome? Type of dredged material makes a critical importance in restoration success (fine-grained nutrient rich sediments are problematic)

Alternative 1: Re-establish freshwater impoundment management capabilities in Units 2, 3

Rank: High: 0 Med: 5 Low: 9

- Maximize native wetland vegetation
- Have rare freshwater communities developed because of man-made hydrology
- Invasive spp concern (hydrilla, Phragmites, Typha)
- Sustain large numbers of migrating waterfowl, shorebirds
- Increases greenhouse gasses
- Increases biodiversity and wetland function with salt and freshwater juxtaposition
- Decreases resilience to climate change SLR
- Stopover value for forested wetland species decreased
- Least bittern habitat created
- Protect Delmarva Fox Squirrel, decrease of salt water intrusion
- Amphibians will benefit, some are S1 level of concern
- Native freshwater fish will benefit (as long as waterlevels are high enough)
- Reduce historical fish runs due to WCS
- Reduce saltwater fish nursery habitat
- Nutrient inputs increased due to concentrations of large amount of birds (may be dwarfed by agricultural inputs? Unknown)
- Eliminate horseshoe crab spawning

Alternative 2: Restore both Units 2, 3 to salt marsh (as a gradient within Unit 3)

Please replace strategy of "restore natural watershed divide between units 1 & 2" to strategy list. It gets tied to Fill Slaughter Canal

Rank: High: 13 Med: 1 Low: 0

Need drawing and more complete list of strategies as go forward (sand washovers)

- More sustainable native vegetation community, more resilient to climate change/SLR
- Increase biodiversity by gradient of salt to fresh in Unit 3
- More resilient to storm surge
- Increased habitat for salt marsh obligate nesters
- Decreased waterfowl numbers & diversity (impoundment bird densities may have been artificially high)

- Increase shorebird diversity, but perhaps not numbers
- Accommodate horseshoe crab spawning
- Reduce unnatural short-stopping on migration
- Increase critical habitat for red knots
- Phragmites in certain areas
- Increased nursery habitat for fish, crabs, eels, anadromous fish runs, trophic transfer
- Increased terrapin habitat
- Increased carbon sequestration ("blue carbon")
- Increased deep peat bogs & surrounding forests to salt water intrusion
- Migration of salt marsh habitat landward
- Impacts to songbird migration habitat and DFS habitat
- Consider excavating sediment from within units or bringing fill in to create islands

Alternative 3: Unit 2 restored to salt marsh; maintain Unit 3 as impoundment

Skipped but not excluded

Rank: High: 0 Med: 10 Low: 4

Alternative 4: Incremental transition to salt marsh (not have brackish as final goal for Unit 2 but gradient for Unit 3)

Rank: High: 6.5 Med: 7.5 Low:0

Need WCS to promote sedimentation, protect roads

- Water levels could promote salt marsh veg growth and allow sediment to accumulate
- Lacks sediment input to build elevations

Alternative 5. Status Quo: Do nothing in terms of restoration.

Don't restore elevation or boost accretion by human intervention. Leave breaches alone. Leave WCS open in Units 1, 2; manage in Unit 3 as per deed restrictions (2.8m AMSL). Maintain roads ad hoc.

Rank: High: 0 Med: 0 Low: 14

- System is sediment starved and will result in all open water eventually (gigantic inland bay)
- Shift to more marine fish habitat
-

<u>Rankings</u>

High value for trust resources, sustainable over long-term, more winners than losers:
Medium, lots of winners, losers:
Low, lots of losers:

Socio-Economic Workgroup Notes

Task: Evaluate each broad alternative as it applies to the Socio/Econ/Political considerations

Alternative #1 – Re-establish freshwater impoundment management capability in both Units as a temporary solution to buy time **RANK LOW**

- Positive for waterfowl response
- Nirvana for community residents
- Farming: waterfowl would leave property and return to Refuge
    - Bird watchers would leave too
- Birders: positive
- Farmers: positive because salt water intrusion would decrease and less salt water would flood fields
- Political: flooding impacts eliminated
    - Road and community not flooded
- Community:
    - Bad: would the dune line be more susceptible to flooding or collapse?
    - Good: wouldn't have to worry during high winds about flooding
        - Would reduce flooding rates in the near term
- Economic: least sustainable option
    - High costs to maintain
    - $17 million for repairs each time
    - Has failed in the past – gives false hope
- Politically: difficult to go back to the original state

Alternative #2 – Restore both units to salt marsh **RANK HIGH**

- Community: would give system integrity
    - Would provide ecological asset to community (Fowlers removal)
- If doing Alternative #1 first, it would buy time for Alternative #2
- Would give protection to farmers from storms
- Birders: removal of Fowlers Rd. would create different species of birds there
    - Would limit access by road and car
        - Could add a bike route/trails instead
- Alternative #2 would satisfy most of the objectives
- Feasibility – there are legal issues of filling in tax ditches
- Adding bridges may not be as doable, culverts could also work
- Fisheries/crabs: access impacted

Alternative #3 **RANK MEDIUM-LOW**

- Economic: very expensive to do
- Hunters: middle ground between salt and fresh marsh
- Birders: middle ground between salt and fresh marsh, and there could be more varieties
- Community: Bad for evacuation, could lose the road during storms catastrophically

- Economics: 800 feet of dike would cost $1.65 million, built to a 10 year storm event
    - Feasibility is low
    - Pipe culverts would be a no regrets action

Alternative #4 **RANK HIGH** (if temporary)

- Farming: system would be more resilient to salt water intrusion

Do Nothing Alternative **RANK LOW**

(refuge specific, other agencies and organizations would still take action but still more doable if everyone partners on solution, make the work more feasible, gives political and social buy-in)

- Farming: bad
- Political: bad

Is the list of associated strategies complete?

- USDA conservation programs/incentives to compensate landowners
- Make #1 temporary solution – just to buy time (15 years to adapt)
- Armoring marsh side of community
- Elevating structures
- Find road through Broadkill

No Regrets

- Develop community resiliency plan
- Stability to system
- Proceeding with design permitting and funding for beach nourishment assistance
- Create working partnerships and increase communication between Refuge, agencies, and community
    - Use this as a resource to find additional help, funding, resources, example: Bayshore initiative
- Improve partnerships with the federal government
- Partner with other organizations/agencies including DNREC, the Army Corps of Engineers, FEMA, EPA, NOAA, USGS, FHWA
- Build living shorelines along the west side of the Prime Hook community
- Collect data for EA, NEPA permits, so we can be ready to go forward with projects
- Improve the early warning system for Prime Hook residents
    - Have DEOS provide presentations to community on how to use it